

2009 Sportster

SERVICE MANUAL

Part Number 99484-09

Chapter 1 Maintenance
Chapter 2 Chassis
Chapter 3 Engine
Chapter 4 Fuel System
Chapter 5 Drive/Transmission
Chapter 6 Electrical

ELECTRICAL DIAGNOSTICS

Part Number 99495-09

Chapter 1 Starting / Charging
Chapter 2 Instruments
Chapter 3 TSM/HFSM
Chapter 4 Engine Management





2009 Sportster Models Service Manual

99484-09

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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



2009 Sportster Models Service Manual

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2009 Sportster Models Service Manual (99484-09)

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Service Communications Department

Harley-Davidson Motor Company

P.O. Box 653

Milwaukee, WI USA 53201

NOTES



ABOUT THIS MANUAL

GENERAL

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

HOW TO USE YOUR SERVICE MANUAL

Refer to the table below for the content layout of this manual.

NO.	CHAPTER
1	Maintenance
2	Chassis
3	Engine
4	Fuel System
5	Drive/Transmission
6	Electrical
A	Appendix A Connector Repair
B	Appendix B Wiring
C	Appendix C Conversions
D	Appendix D Compensating Sprocket
E	Appendix E Glossary

Use the TABLE OF CONTENTS (which follows this FOREWORD) and the INDEX (at the back of this manual) to quickly locate subjects. Sections and topics in this manual are sequentially numbered for easy navigation.

For example, a cross-reference shown as **2.1 SPECIFICATIONS** refers to chapter 2 CHASSIS, heading 2.1 SPECIFICATIONS.

For quick and easy reference, all pages contain a section number followed by a page number. For example, **page 3-5** refers to page 5 in section 3.

A number of acronyms and abbreviations are used in this document. See the [E.1 GLOSSARY](#) for a list of acronyms, abbreviations and definitions.

PREPARATION FOR SERVICE

WARNING

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

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

NOTES

- To avoid unnecessary disassembly, carefully read all relative service information before repair work is started.*
- In figure legends, the number which follows the name of a part indicates the quantity necessary for one complete assembly.*
- When servicing a vehicle equipped with the Harley-Davidson Smart Security System (H-DSSS), you must first disarm the security system. Either keep the fob in close proximity to the vehicle, or use Digital Technician II to disable the security system while the vehicle is being serviced and re-enable the system after service is completed.*

SERVICE BULLETINS

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

USE GENUINE REPLACEMENT PARTS

WARNING

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

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

WARNINGS AND CAUTIONS

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

WARNING

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

CAUTION

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

CAUTION

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

NOTE

Refers to important information, and is placed in italic type. It is recommended that you take special notice of these items.

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

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

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

Kent-Moore Products

All tools mentioned in this manual with an "HD", "J" or "B" preface must be ordered through SPX Kent-Moore. For ordering

information or product returns, warranty or otherwise, visit www.spx.com.

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, please contact Loctite Corp. at www.loctite.com.

PRODUCT REGISTERED MARKS

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

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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.

MAINTENANCE

1.1 FASTENER TORQUE VALUES

Fastener Torque Values in this Chapter.....1-1

1.2 GENERAL

Servicing a New Motorcycle.....	1-4
Safe Operating Maintenance.....	1-4
Shop Practices.....	1-4
Repair Notes.....	1-4
Safety.....	1-4
Removing Parts.....	1-4
Cleaning.....	1-4
Disassembly and Assembly.....	1-5
Checking Torques on Fasteners.....	1-5
Magnetic Parts Trays.....	1-5
Repair and Replacement Procedures.....	1-5
Hardware and Threaded Parts.....	1-5
Threadlocking Agents.....	1-5
Wiring, Hoses and Lines.....	1-5
Instruments and Gauges.....	1-5
Bearings.....	1-5
Bushings.....	1-5
Gaskets.....	1-5
Lip Type Seals.....	1-5
O-Rings (Preformed Packings).....	1-6
Gears.....	1-6
Shafts.....	1-6
Part Replacement.....	1-6
Exhaust System Leakage.....	1-6
Cleaning.....	1-6
Part Protection.....	1-6
Cleaning Process.....	1-6
Rust or Corrosion Removal.....	1-6
Bearings.....	1-6
Tool Safety.....	1-6
Air Tools.....	1-6
Wrenches.....	1-6
Pliers/Cutters/Pry bars.....	1-6
Hammers.....	1-7
Punches/Chisels.....	1-7
Screwdrivers.....	1-7
Ratchets and Handles.....	1-7
Sockets.....	1-7
Storage Units.....	1-7

1.3 FUEL AND OIL

Fuel.....	1-8
Gasoline Blends.....	1-8
Engine Lubrication.....	1-8
Winter Lubrication.....	1-9

1.4 MAINTENANCE SCHEDULE

General.....1-10

1.5 BULB REQUIREMENTS

Bulb Chart.....1-14

1.6 ENGINE OIL AND FILTER

Checking and Adding Oil.....	1-15
Removing and Replacing Oil Filler Cap.....	1-15
Checking Oil with Cold Engine.....	1-15
Checking Oil with Warm Engine.....	1-15
Changing Oil and Filter.....	1-16
General.....	1-16

Draining Oil Tank.....	1-16
Removing Oil Filter.....	1-16
Installing New Oil Filter.....	1-17
Refilling Oil Tank.....	1-17

1.7 BRAKES

General.....	1-18
Inspection.....	1-18
Troubleshooting.....	1-18

1.8 BLEEDING HYDRAULIC BRAKE SYSTEM

General.....	1-20
Bleeding Front Brake: All Models.....	1-20
Bleeding Rear Brake: All Models.....	1-22

1.9 BRAKE PADS AND DISCS: XL MODELS

Inspection.....	1-24
Brake Pads.....	1-24
Brake Disc Thickness, Lateral Runout and Warpage.....	1-24
Brake Pad Replacement: Front.....	1-25
Brake Pad Replacement: Rear.....	1-27

1.10 BRAKE PADS AND DISCS: XR MODELS

Inspection.....	1-31
Brake Pads.....	1-31
Brake Disc Thickness, Lateral Runout and Warpage.....	1-31
Brake Pad Replacement: Front.....	1-31
Removal.....	1-31
Installation.....	1-32
Brake Pad Replacement: Rear.....	1-33
Removal.....	1-33
Installation.....	1-34

1.11 TIRES AND WHEELS

Tires.....	1-36
Tire Replacement.....	1-37
Inspection.....	1-37
When To Replace Tires.....	1-37
Wheel Bearings.....	1-37
Wheel Spokes.....	1-37

1.12 PRIMARY CHAIN

Inspection.....	1-39
Adjustment.....	1-39

1.13 CLUTCH

Adjustment.....	1-41
-----------------	------

1.14 TRANSMISSION LUBRICANT

Transmission Lubrication: Sportster Models.....	1-43
Check Lubricant Level.....	1-43
Changing Lubricant.....	1-44

1.15 REAR BELT AND SPROCKETS

General.....	1-45
Cleaning.....	1-45
Inspection.....	1-45
Sprockets.....	1-45
Idle Pulley: XR Models.....	1-45
Rear Belt.....	1-45

1.16 REAR BELT DEFLECTION

Rear Drive Belt: Sportster Models.....	1-47
--	------

TABLE OF CONTENTS

General.....	1-47
Gauging Deflection.....	1-47
Belt Deflection Adjustment.....	1-48
Wheel Alignment.....	1-49
Checking Wheel Alignment.....	1-49
Adjusting Wheel Alignment.....	1-50

1.17 BATTERY MAINTENANCE

General.....	1-52
Battery Disconnection and Removal.....	1-53
Cleaning and Inspection.....	1-54
Charging Battery.....	1-54
Safety Precautions.....	1-54
Using a Battery Charger.....	1-54
Battery Installation and Connection.....	1-55
Storage.....	1-56

1.18 SPARK PLUGS

General.....	1-58
Inspection.....	1-58
Spark Plug Cable Inspection.....	1-59

1.19 STEERING HEAD BEARINGS

Adjustment.....	1-60
Lubrication.....	1-60

1.20 SHOCK ABSORBER ADJUSTMENT

Shock Absorber Preload Adjustment: Sportster Models...	1-62
--	------

1.21 REAR FORK BEARINGS

Lubrication.....	1-64
Replacement.....	1-64

1.22 FRONT FORK OIL

Changing Fork Oil: XL Models.....	1-65
Draining Fork Oil.....	1-65
Filling Fork Oil: Forks Assembled, in Frame.....	1-65
Filling Fork Oil: Forks Disassembled, out of Frame.....	1-66
Changing Fork Oil: XR Models.....	1-66
Left Fork.....	1-67
Right Fork.....	1-69

1.23 CABLE AND CHASSIS LUBRICATION

General.....	1-72
Cables and Hand Levers.....	1-72
Foot Shift Lever and Rear Brake Pedal.....	1-72
Jiffy Stand.....	1-72
Steering Head Bearings.....	1-72

1.24 AIR CLEANER: XL MODELS

General.....	1-73
Removal.....	1-73
Cleaning, Inspection and Repair.....	1-73
Installation.....	1-74

1.25 AIR CLEANER: XR MODELS

General.....	1-75
Removal.....	1-75
Cleaning, Inspection and Repair.....	1-76
Installation.....	1-76

1.26 EXHAUST SYSTEM

Exhaust System Leak Check.....	1-78
--------------------------------	------

1.27 THROTTLE CONTROL

Cable Inspection and Lubrication.....	1-79
Cable Adjustment.....	1-79

1.28 IDLE SPEED AND IGNITION TIMING

Idle Speed.....	1-80
Ignition Timing.....	1-80

1.29 FUEL SUPPLY FILTER

General.....	1-81
Removal.....	1-81
Installation.....	1-81

1.30 ENGINE MOUNTS AND STABILIZER LINKS

Inspection.....	1-82
-----------------	------

1.31 HEADLAMP ALIGNMENT

Headlamp Alignment.....	1-83
Headlamp Adjustment: Sportster Models.....	1-83
Adjustment (XL 883C and XL 1200C Models).....	1-83
Adjustment (All Models Except XL 883C and XL 1200C).....	1-84

1.32 FLUID AND LUBRICANT REQUIREMENTS

Brake Fluid.....	1-85
Brake Component Grease.....	1-85
Front Fork Oil.....	1-85
Primary Drive/Transmission Lubricant.....	1-85
Engine Oil.....	1-85

1.33 CRITICAL FASTENERS

Inspection.....	1-86
Checking Torques on Fasteners.....	1-86

1.34 STORAGE

General.....	1-88
Placing in Storage.....	1-88
Removal From Storage.....	1-88

1.35 TROUBLESHOOTING

General.....	1-90
Engine.....	1-90
Starter Motor Does Not Operate or Does Not Turn Engine Over.....	1-90
Engine Turns Over But Does Not Start.....	1-90
Starts Hard.....	1-90
Starts But Runs Irregularly or Misses.....	1-90
Spark Plug Fouls Repeatedly.....	1-91
Pre-Ignition or Detonation (Knocks or Pings).....	1-91
Check Engine Light Illuminates During Operation.....	1-91
Overheating.....	1-91
Valve Train Noise.....	1-91
Excessive Vibration.....	1-91
Lubrication System.....	1-91
Oil Does Not Return To Oil Tank.....	1-91

Engine Uses Too Much Oil Or Smokes Excessively.....	1-91	2.6 WHEEL LACING: 19 INCH RIM	
Engine Leaks Oil From Cases, Push Rods, Hoses, Etc.....	1-91	Procedure.....	2-31
Low Oil Pressure.....	1-91	2.7 WHEEL LACING: 21 INCH RIM	
High Oil Pressure.....	1-92	General.....	2-35
Electrical System.....	1-92	Procedure.....	2-35
Alternator Does Not Charge.....	1-92	2.8 TRUING LACED WHEELS	
Alternator Charge Rate Is Below Normal.....	1-92	General.....	2-39
Speedometer Operates Erratically.....	1-92	Lateral Truing.....	2-39
Transmission.....	1-92	Radial Truing.....	2-40
Shifts Hard.....	1-92	2.9 CHECKING CAST WHEEL RUNOUT	
Jumps Out Of Gear.....	1-92	General.....	2-42
Clutch Slips.....	1-92	Lateral Runout.....	2-42
Clutch Drags Or Does Not Release.....	1-92	Radial Runout.....	2-42
Clutch Chatters.....	1-92	2.10 FRONT BRAKE MASTER CYLINDER	
Handling.....	1-92	General.....	2-43
Brakes.....	1-92	Inspection.....	2-43
Brake Does Not Hold Normally.....	1-92	Removal.....	2-43
CHASSIS		Disassembly.....	2-45
2.1 FASTENER TORQUE VALUES		Cleaning, Inspection and Repair.....	2-47
Fastener Torque Values in this Chapter.....	2-1	Assembly.....	2-47
2.2 SPECIFICATIONS		Installation.....	2-48
Sportster Specifications.....	2-8	2.11 FRONT BRAKE CALIPER: XL MODELS	
Chassis Specifications.....	2-8	Removal.....	2-52
Tire Specifications.....	2-9	Disassembly.....	2-53
2.3 VEHICLE IDENTIFICATION NUMBER (V.I.N.)		Cleaning, Inspection and Repair.....	2-55
Vehicle Identification Number (V.I.N.): Sportster Models.....	2-11	Assembly.....	2-56
General.....	2-11	Lubricating Front Caliper Bolt Pins and Boots.....	2-56
Abbreviated V.I.N.....	2-11	Installing Brake Pads in Caliper.....	2-57
2.4 WHEELS		Installation.....	2-58
General.....	2-13	2.12 FRONT BRAKE CALIPER: XR MODELS	
Troubleshooting.....	2-13	Removal.....	2-60
Front Wheel.....	2-14	Disassembly.....	2-61
Removal.....	2-14	Cleaning, Inspection and Repair.....	2-62
Disassembly: Cast Front Wheel.....	2-15	Assembly.....	2-63
Disassembly: Laced Front Wheel.....	2-15	Installation.....	2-64
Cleaning and Inspection.....	2-15	2.13 REAR BRAKE MASTER CYLINDER: XL MODELS	
Assembly: Cast Front Wheel.....	2-15	General.....	2-65
Assembly: Laced Front Wheel.....	2-16	Inspection.....	2-65
Installation.....	2-20	Removal.....	2-65
Rear Wheel.....	2-20	Disassembly.....	2-68
Removal.....	2-20	Cleaning, Inspection and Repair.....	2-69
Disassembly.....	2-21	Assembly.....	2-70
Cleaning and Inspection.....	2-21	Installation.....	2-72
Assembly.....	2-21	2.14 REAR BRAKE MASTER CYLINDER: XR MODELS	
Installation.....	2-24	General.....	2-73
Sealed Wheel Bearings.....	2-24	Inspection.....	2-73
Inspection.....	2-24	Removal.....	2-73
Removal.....	2-25	Disassembly.....	2-74
Installation.....	2-27	Cleaning, Inspection and Repair.....	2-75
2.5 WHEEL LACING: 16 INCH RIM		Assembly.....	2-76
General.....	2-28		
Procedure.....	2-28		

TABLE OF CONTENTS

Installation.....	2-77
-------------------	------

2.15 REAR BRAKE MASTER CYLINDER RESERVOIR

General.....	2-79
Removal: XL Models.....	2-79
Installation: XL Models.....	2-80
Removal: XR Models.....	2-80
Installation: XR Models.....	2-81

2.16 REAR BRAKE CALIPER: XL MODELS

Removal.....	2-82
Disassembly.....	2-84
Cleaning, Inspection and Repair.....	2-85
Lubricating Rear Caliper Bolt Pins and Boots.....	2-85
Assembly.....	2-86
Installation.....	2-87

2.17 REAR BRAKE CALIPER: XR MODELS

Removal.....	2-90
Disassembly.....	2-91
Cleaning, Inspection and Repair.....	2-93
Assembly.....	2-93
Installation.....	2-94

2.18 BRAKE LINES

Front Brake Line: All Models.....	2-97
Removal.....	2-97
Installation.....	2-98
Rear Brake Line: XL Models.....	2-99
Removal.....	2-100
Installation.....	2-100
Rear Brake Line: XR Models.....	2-101
Removal.....	2-101
Installation.....	2-102

2.19 TIRES

General.....	2-103
Removal.....	2-103
Cleaning, Inspection and Repair.....	2-104
Installation.....	2-104
Tube Type Tires.....	2-104
Tubeless Tires.....	2-105
Checking Tire Runout.....	2-105
Lateral Runout.....	2-105
Radial Runout.....	2-105
Wheel Balancing.....	2-106
Weights for Laced Wheels.....	2-106
Weights for Cast Wheels.....	2-106

2.20 LEFT SIDE COVER

General.....	2-107
Opening Left Side Cover.....	2-107
Closing Left Side Cover.....	2-108
Removing Left Side Cover.....	2-108
Installing Left Side Cover.....	2-109

2.21 FRONT FORK: XL MODELS

General.....	2-110
Removal.....	2-110
Disassembly.....	2-110

Cleaning, Inspection and Repair.....	2-112
Assembly.....	2-112
Installation.....	2-113

2.22 FRONT FORK: XR MODELS

General.....	2-115
Removal.....	2-115
Disassembly.....	2-115
Left Side.....	2-115
Right Side.....	2-117
Cleaning and Inspection.....	2-119
Assembly.....	2-119
Left Side.....	2-119
Right Side.....	2-122
Installation.....	2-124

2.23 FORK STEM AND BRACKET ASSEMBLY

Removal and Disassembly.....	2-126
Cleaning, Inspection and Repair.....	2-126
Assembly and Installation.....	2-127

2.24 BELT GUARD AND DEBRIS DEFLECTOR

Belt Guard: XL Models.....	2-128
Removal.....	2-128
Installation.....	2-128
Debris Deflector: XL Models.....	2-128
Removal.....	2-128
Installation.....	2-128
Belt Guard: XR Models.....	2-128
Removal.....	2-128
Installation.....	2-128
Debris Deflector: XR Models.....	2-129
Removal.....	2-129
Installation.....	2-129

2.25 REAR FORK

General.....	2-130
Removal.....	2-130
Disassembly.....	2-130
Cleaning and Inspection.....	2-131
Assembly.....	2-131
Installation.....	2-131

2.26 SHOCK ABSORBERS

General.....	2-133
Removal.....	2-133
Cleaning and Inspection.....	2-133
Installation.....	2-133

2.27 STABILIZER LINKS

General.....	2-135
Upper Front Stabilizer Link.....	2-135
Removal.....	2-135
Installation.....	2-135
Lower Front Stabilizer Link.....	2-135
Removal.....	2-135
Installation.....	2-135
Rear Stabilizer Link.....	2-136
Removal.....	2-136

Installation.....	2-136	2.36 REAR FENDER: XR MODELS	
2.28 FRONT ENGINE MOUNT/ISOLATOR		Removal.....	2-166
Removal.....	2-137	Installation.....	2-166
Installation.....	2-138	2.37 JIFFY STAND	
2.29 REAR ENGINE MOUNT/ISOLATOR		General.....	2-167
Removal.....	2-139	Jiffy Stand Interlock: International Models.....	2-167
Installation.....	2-141	Removal.....	2-167
2.30 THROTTLE CABLES: ALL MODELS		Cleaning and Lubrication.....	2-167
Removal and Disassembly.....	2-142	Installation.....	2-168
Cleaning, Inspection and Repair.....	2-144	2.38 SEAT: XL MODELS	
Assembly and Installation.....	2-144	General.....	2-169
2.31 CLUTCH CONTROL		Seat Removal: XL Models.....	2-169
General.....	2-146	Seat Installation: XL Models.....	2-169
Removal and Disassembly.....	2-146	2.39 SEAT: XR MODELS	
Clutch Cable: Lower.....	2-146	Seat Removal: XR 1200 Model.....	2-171
Clutch Lever and Clutch Cable: Upper.....	2-147	Seat Installation: XR 1200 Model.....	2-171
Clutch Hand Control.....	2-147	Passenger Pillion: XR 1200 Model.....	2-171
Assembly and Installation.....	2-148	Removal.....	2-171
Clutch Hand Control.....	2-148	Installation.....	2-171
Clutch Lever and Clutch Cable: Upper.....	2-149	2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS	
Clutch Cable: Lower.....	2-149	Right Footrest and Rear Brake Pedal Assembly.....	2-173
Finish.....	2-149	Removal.....	2-173
2.32 HANDLEBARS		Installation.....	2-173
Removal.....	2-150	Left Footrest and Shift Lever Assembly.....	2-173
All Models.....	2-150	Removal.....	2-173
XL 883C and XL 1200C.....	2-150	Installation.....	2-173
All XL Models Except XL 883C, XL 1200C.....	2-151	2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS	
XR1200.....	2-152	Right Footrest and Rear Brake Pedal Assembly.....	2-175
Installation.....	2-153	Removal.....	2-175
XL 883C and XL 1200C.....	2-153	Installation.....	2-175
All XL Models Except XL 883C, XL 1200C.....	2-154	Left Footrest and Shift Lever Assembly.....	2-176
XR1200.....	2-154	Removal.....	2-176
All Models.....	2-155	Installation.....	2-177
2.33 FRONT FENDER		Adjusting Shift Pedal.....	2-178
XL Models.....	2-156	2.42 RIDER FOOT CONTROLS: XR MODELS	
Removal.....	2-156	Right Footrest and Rear Brake Pedal Assembly.....	2-179
Installation.....	2-156	Removal.....	2-179
XR Models.....	2-156	Installation.....	2-179
Removal.....	2-156	Left Footrest and Shift Lever Assembly.....	2-179
Installation.....	2-156	Removal.....	2-179
2.34 REAR FENDER: ALL XL MODELS EXCEPT XL 1200N		Installation.....	2-180
General.....	2-157	Adjusting Shift Pedal.....	2-180
Removal.....	2-157	2.43 PASSENGER FOOTRESTS	
Installation.....	2-159	General.....	2-181
2.35 REAR FENDER AND LICENSE PLATE BRACKET: XL 1200N		XL Models.....	2-181
General.....	2-161	Removal.....	2-181
Removal and Disassembly.....	2-161	Installation.....	2-181
Assembly and Installation.....	2-163	XR Models.....	2-181
		Removal.....	2-181
		Installation.....	2-181

TABLE OF CONTENTS

2.44 FORK LOCK

Removal.....	2-183
Installation.....	2-183

ENGINE

3.1 FASTENER TORQUE VALUES

Fastener Torque Values in this Chapter.....	3-1
---	-----

3.2 SPECIFICATIONS

Specifications: 2009 Sportster Models.....	3-5
--	-----

3.3 ENGINE

General.....	3-11
--------------	------

3.4 OIL PRESSURE

General.....	3-12
Oil Pressure Indicator Lamp.....	3-12
Checking Oil Pressure.....	3-13
Connecting Gauge: XL Models.....	3-13
Connecting Gauge: XR Models.....	3-13
Testing Pressure.....	3-13
Removing Gauge: XL Models.....	3-13
Removing Gauge: XR Models.....	3-13
Finalize Test.....	3-13

3.5 CRANKCASE BREATHING SYSTEM: XL MODELS

General.....	3-15
--------------	------

3.6 CRANKCASE BREATHING SYSTEM: XR MODELS

General.....	3-16
--------------	------

3.7 TROUBLESHOOTING

Diagnosing Valve Train Noise.....	3-18
Compression Test.....	3-18
Cylinder Leakage Test.....	3-18
Diagnosing Smoking Engine or High Oil Consumption.....	3-19
Check Prior to Cylinder Head Removal.....	3-19
Check After Cylinder Head Removal.....	3-19
Adjustment and Testing.....	3-19
General.....	3-19

3.8 ENGINE LUBRICATION SYSTEM

Oil Pump Operation.....	3-20
Oil Flow: XL Models.....	3-23
Oil Flow: XR Models.....	3-23

3.9 HOW TO USE THIS SECTION

Typical Symptoms.....	3-29
Top End Repair.....	3-29
Bottom End Repair.....	3-29

3.10 TOP END SERVICE

Engine in Chassis.....	3-30
Engine Removed from Chassis.....	3-31

3.11 BOTTOM END SERVICE

Engine in Chassis.....	3-32
Engine Removed From Chassis.....	3-33

3.12 REMOVING ENGINE FROM CHASSIS

General.....	3-34
Procedure: XL Models.....	3-34
Procedure: XR Models.....	3-38

3.13 INSTALLING ENGINE IN CHASSIS

General.....	3-43
Procedure: XL Models.....	3-43
Procedure: XR Models.....	3-45

3.14 PRECISION COOLING SYSTEM: XR MODELS

General.....	3-48
Return Oil Manifold.....	3-48
Removal.....	3-48
Installation.....	3-49
Cylinder Head Oil Return Lines.....	3-49
Removal.....	3-49
Installation.....	3-50
Cylinder Head Oil Feed Assembly.....	3-50
Removal.....	3-50
Installation.....	3-50
Oil Pump Lines.....	3-51
Removal.....	3-51
Installation.....	3-52
Oil Cooler.....	3-52
Removal.....	3-52
Installation.....	3-52

3.15 TOP END OVERHAUL: DISASSEMBLY

General.....	3-53
Stripping Motorcycle for Top End Repair.....	3-53
Cylinder Heads.....	3-54
Disassembling Rocker Covers.....	3-54
Removing Cylinder Head.....	3-56
Disassembling Push Rods and Covers.....	3-59
Cylinder and Piston.....	3-60

3.16 TOP END OVERHAUL: ASSEMBLY

General.....	3-62
Piston and Cylinder.....	3-62
Push Rods, Covers, and Retainers.....	3-63
Cylinder Head.....	3-65
Rocker Covers.....	3-68
Assembling Motorcycle After Top End Repair.....	3-71

3.17 BOTTOM END OVERHAUL: DISASSEMBLY

General.....	3-73
Tappets.....	3-73
Oil Pump: XL Models.....	3-73
Gearcase Cover and Cam Gears: XL Models.....	3-73
Oil Pump Housing/Gearcase Cover and Cam Gears: XR Models.....	3-74
Crankcase.....	3-76
Removing Piston Oil Jets.....	3-77

Removing Cylinder Base Studs.....	3-77		
3.18 BOTTOM END OVERHAUL: ASSEMBLY		3.22 CYLINDER AND PISTON	
Crankcase.....	3-78	Removal and Disassembly.....	3-114
Installing Piston Oil Jets.....	3-78	Cleaning, Inspection and Repair.....	3-114
Installing Pinion Shaft Bearings.....	3-78	Checking Gasket Surface.....	3-114
Installing Left Main Bearing.....	3-80	Measuring Cylinder Bore.....	3-114
Assembling Crankcase Halves.....	3-80	Measuring Piston to Cylinder Fit.....	3-115
Installing Cylinder Base Studs.....	3-83	Boring and Honing Cylinder.....	3-116
Cam Gears and Gearcase Cover: XL Models.....	3-83	Fitting Piston Rings.....	3-116
Cam Gears and Gearcase Cover: XR Models.....	3-86	Connecting Rod Bushings.....	3-118
Tappets.....	3-89	Removing Upper Connecting Rod Bushings.....	3-118
Assembling Top End of Engine.....	3-90	Installing Upper Connecting Rod Bushings.....	3-120
		Reaming Upper Connecting Rod Bushings.....	3-120
		Honing Upper Connecting Rod Bushings.....	3-121
		Repair.....	3-121
		Assembly and Installation.....	3-121
3.19 VALVE TAPPETS		3.23 CRANKCASE	
General.....	3-91	General.....	3-122
Removal.....	3-91	Removal.....	3-122
Cleaning and Inspection.....	3-91	Disassembly.....	3-123
Installation.....	3-91	Fitting Pinion Bearings.....	3-124
		Bearing Selection.....	3-125
		Inner Bearing Finish Example.....	3-127
		Lapping Engine Main Bearing Races.....	3-128
		Assembling Crankcase Halves.....	3-129
3.20 GEARCASE COVER AND CAM GEARS		3.24 OIL PUMP: XL MODELS	
General.....	3-92	General.....	3-130
Removal and Disassembly.....	3-92	Removal.....	3-131
Cleaning, Inspection and Repair.....	3-92	Disassembly.....	3-131
Cam and Pinion Gear Identification, Inspection and Selection.....	3-92	Cleaning and Inspection.....	3-131
Bushing Inspection and Removal: XL Only.....	3-92	Assembly.....	3-131
Bushing Installation: XL Only.....	3-94	Installation.....	3-132
Cam Gear Bushings in Right Crankcase.....	3-94		
Cam Gear Bushings (Except Rear Intake Bushing) in Gearcase Cover.....	3-94	3.25 OIL PUMP: XR MODELS	
Rear Intake Cam Gear Bushing in Gearcase Cover.....	3-94	General.....	3-133
Pinion Shaft Bushing in Gearcase Cover.....	3-94	Disassembly.....	3-134
Bushing Reaming: XL Only.....	3-95	Cleaning and Inspection.....	3-135
Cam Gear Bushings in Right Crankcase.....	3-95	Assembly.....	3-136
Cam Gear Bushings (Except Rear Intake Bushing) in Gearcase Cover.....	3-96		
Rear Intake Cam Gear Bushing in Gearcase Cover.....	3-96	3.26 OIL FILTER MOUNT	
Pinion Shaft Bushing in Gearcase Cover.....	3-96	General.....	3-137
Assembly and Installation.....	3-97	Disassembly.....	3-137
		Cleaning and Inspection.....	3-137
		Assembly.....	3-137
3.21 CYLINDER HEAD		3.27 OIL TANK	
Removal.....	3-98	Oil Hose Routing: XL Models.....	3-138
Disassembly.....	3-98	Oil Line Routing: XR Models.....	3-138
Cleaning and Inspection.....	3-100	Removal.....	3-140
Cylinder Heads.....	3-100	Installation.....	3-142
Rocker Arm Assemblies.....	3-100		
Valves.....	3-102	FUEL SYSTEM	
Valve Seats.....	3-102		
Valve Guides.....	3-102	4.1 FASTENER TORQUE VALUES	
Valve Springs.....	3-102	Fastener Torque Values in this Chapter.....	4-1
Spark Plug Threads.....	3-103		
Push Rods.....	3-103	4.2 SPECIFICATIONS: FUEL SYSTEM	
Replacing Rocker Arm Bushings.....	3-103	Specifications: 2009 Sportster Models.....	4-4
Replacing Valve Guides.....	3-104		
Removal.....	3-104		
Installation.....	3-105		
Refacing Valve Seats.....	3-108		
Replacing Valve Seats.....	3-110		
Assembly.....	3-110		
Installation.....	3-113		

TABLE OF CONTENTS

4.3 ELECTRONIC FUEL INJECTION (EFI)

Troubleshooting.....	4-5
----------------------	-----

4.4 AIR CLEANER: XL MODELS

Removal.....	4-6
Cleaning, Inspection and Repair.....	4-6
Installation.....	4-7

4.5 AIRBOX: XR MODELS

Removal.....	4-8
Installation.....	4-8

4.6 FUEL TANK: XL MODELS

General.....	4-9
Purging and Disconnecting Fuel Supply Hose.....	4-10
Removing Fuel Tank.....	4-10
Cleaning and Inspection.....	4-11
Installing Fuel Tank.....	4-11
Reconnecting Fuel Hose and Filling Fuel Tank.....	4-12
Vapor Valve.....	4-12
Console Replacement.....	4-13
Removal.....	4-13
Installation.....	4-14

4.7 FUEL TANK: XR MODELS

General.....	4-16
Purging and Disconnecting Fuel Supply Hose.....	4-16
Removing Fuel Tank.....	4-16
Disassemble Fuel Tank.....	4-18
Cleaning and Inspection.....	4-18
Assemble Fuel Tank.....	4-19
Installing Fuel Tank.....	4-19
Reconnecting Fuel Hose and Filling Fuel Tank.....	4-20

4.8 THROTTLE POSITION (TP) SENSOR

General.....	4-21
Removal: XL Models.....	4-22
Installation: XL Models.....	4-22
Removal: XR Models.....	4-23
Installation: XR Models.....	4-23

4.9 ENGINE TEMPERATURE (ET) SENSOR

General.....	4-25
Removal.....	4-25
Installation.....	4-26

4.10 INDUCTION MODULE: XL MODELS

General.....	4-28
Removal.....	4-28
Disassembly.....	4-30
Assembly.....	4-31
Installation.....	4-32

4.11 INDUCTION MODULE: XR MODELS

General.....	4-34
Removal.....	4-34
Disassembly.....	4-35
Assembly.....	4-36
Installation.....	4-36

4.12 IDLE AIR CONTROL (IAC)

General.....	4-38
Removal: XL Models.....	4-39
Installation: XL Models.....	4-39
Removal: XR Models.....	4-40
Installation: XR Models.....	4-41

4.13 TEMPERATURE MANIFOLD ABSOLUTE PRESSURE (TMAP) SENSOR

General.....	4-42
Removal: XL Models.....	4-42
Installation: XL Models.....	4-43
Removal: XR Models.....	4-44
Installation: XR Models.....	4-44

4.14 OXYGEN SENSOR

General.....	4-46
Removal.....	4-46
Installation.....	4-47

4.15 EXHAUST SYSTEM: XL MODELS

General.....	4-48
Removal.....	4-49
Mufflers and Exhaust Pipes.....	4-49
Muffler Interconnect Bracket.....	4-49
Installation.....	4-50
Muffler Interconnect Bracket.....	4-50
Exhaust Pipes and Mufflers.....	4-50

4.16 EXHAUST SYSTEM: XR MODELS

General.....	4-52
Removal.....	4-52
Mufflers.....	4-52
Header Pipes.....	4-53
Installation.....	4-53
Header Pipes.....	4-53
Mufflers.....	4-53

4.17 FUEL INJECTORS

General.....	4-54
Removal.....	4-54
Installation.....	4-55

4.18 FUEL PUMP

General.....	4-57
Removal.....	4-57
Disassembly.....	4-58
Pressure Regulator and Filter Housing.....	4-58
Fuel Pump Assembly and Pump Bracket.....	4-59
Low Fuel Level Sensor Assembly.....	4-59
Fuel Pump/Sender Harness.....	4-59
Assembly.....	4-59
Fuel Pump/Sender Harness.....	4-59
Low Fuel Level Sensor Assembly.....	4-59
Fuel Pump Assembly and Pump Bracket.....	4-59
Pressure Regulator and Filter Housing.....	4-59
Installation.....	4-60

4.19 FUEL PRESSURE TEST

General.....	4-62
--------------	------

TABLE OF CONTENTS

Testing.....	4-62
--------------	------

4.20 INTAKE LEAK TEST

General.....	4-64
Leak Tester.....	4-64
Parts List.....	4-64
Tester Assembly.....	4-64
Tester Adjustment.....	4-64
Procedure.....	4-64

4.21 EVAPORATIVE EMISSIONS CONTROL (CA MODELS)

General.....	4-66
Charcoal Canister.....	4-67
Removal.....	4-67
Installation.....	4-68
Vapor Valve: XL Models.....	4-68
Removal.....	4-68
Installation.....	4-68
Hose Routing.....	4-69
Induction Module.....	4-69
Canister Hose Routings: XL Models.....	4-70
Canister Hose Routings: XR Models.....	4-70

DRIVE/TRANSMISSION

5.1 FASTENER TORQUE VALUES

Fastener Torque Values in this Chapter.....	5-1
---	-----

5.2 SPECIFICATIONS: DRIVE

2009 Sportster Specifications.....	5-3
------------------------------------	-----

5.3 PRIMARY CHAIN ADJUSTER

General.....	5-4
Removal.....	5-4
Primary Cover.....	5-4
Primary Chain Adjuster.....	5-6
Installation.....	5-6
Primary Chain Adjuster.....	5-6
Primary Cover.....	5-7

5.4 CLUTCH RELEASE MECHANISM

Removal and Disassembly.....	5-9
Cleaning, Inspection and Repair.....	5-10
Assembly and Installation.....	5-10

5.5 PRIMARY DRIVE AND CLUTCH: XL MODELS

General.....	5-12
Removal.....	5-14
Disassembly.....	5-14
Inspection and Repair.....	5-15
Assembly.....	5-16
Installation.....	5-17

5.6 PRIMARY DRIVE AND CLUTCH: XR MODELS

General.....	5-20
Removal.....	5-22
Disassembly.....	5-22

Clutch Pack Cleaning and Inspection.....	5-23
Adjusting Screw Disassembly/Assembly.....	5-24
Clutch Shell/Hub Inspection.....	5-24
Clutch Shell Bearing Replacement.....	5-25
Assembly.....	5-26
Installation.....	5-28

5.7 DRIVE BELT

Removal.....	5-30
XL Models.....	5-30
XR Models.....	5-31
Installation.....	5-31
XL Models.....	5-31
XR Models.....	5-32
Idle Pulley: XR Models Only.....	5-33
Removal.....	5-33
Installation.....	5-34

5.8 TRANSMISSION

General.....	5-35
--------------	------

5.9 CASE DISASSEMBLY FOR TRANSMISSION REMOVAL

General.....	5-37
Engine Removal and Disassembly.....	5-37

5.10 TRANSMISSION REMOVAL AND DISASSEMBLY

Transmission Removal From Left Crankcase.....	5-41
Mainshaft/Countershaft.....	5-44
Mainshaft Disassembly.....	5-45
Cleaning and Inspection.....	5-46
Countershaft Disassembly.....	5-46
Cleaning and Inspection.....	5-46

5.11 TRANSMISSION ASSEMBLY

Mainshaft Assembly.....	5-48
Countershaft Assembly.....	5-48

5.12 MAIN DRIVE GEAR AND BEARING

General.....	5-50
Removal.....	5-51
Main Drive Gear.....	5-51
Main Drive Gear Ball Bearing.....	5-52
Disassembly.....	5-52
Assembly.....	5-53
Installation.....	5-54
Main Drive Gear Bearing: XL Models.....	5-54
Main Drive Gear Bearing: XR Models.....	5-55
Main Drive Gear.....	5-55
Main Drive Gear Seal.....	5-57

5.13 TRANSMISSION RIGHT CASE BEARINGS

Removal.....	5-59
Countershaft Needle Bearing.....	5-59
Shifter Drum Bushing.....	5-59
Installation.....	5-59
Countershaft Needle Bearing.....	5-59
Shifter Drum Bushing.....	5-59

TABLE OF CONTENTS

5.14 TRANSMISSION LEFT CASE BEARINGS

Removal.....	5-60
Mainshaft and Countershaft Bearings.....	5-60
Shifter Drum Bushing.....	5-60
Installation.....	5-60
Mainshaft and Countershaft Bearings.....	5-60
Shift Drum Bushing.....	5-60

5.15 TRANSMISSION INSTALLATION

General.....	5-61
Installation.....	5-61
Shifter Forks and Drum Assembly.....	5-62
Assembling Crankcases.....	5-63
Shifter Shaft Installation.....	5-65

5.16 TRANSMISSION SPROCKET

Removal.....	5-67
All Models.....	5-67
XL Models.....	5-67
XR Models.....	5-67
All Models.....	5-68
Installation.....	5-68
All Models.....	5-68
XL Models.....	5-69
XR Models.....	5-70
All Models.....	5-70

ELECTRICAL

6.1 FASTENER TORQUE VALUES

Fastener Torque Values in this Chapter.....	6-1
---	-----

6.2 SPECIFICATIONS: ELECTRICAL

Specifications: 2009 Sportster Models.....	6-4
--	-----

6.3 VOLTAGE REGULATOR

General.....	6-5
Removal: XL Models.....	6-5
Installation: XL Models.....	6-6
Removal: XR Models.....	6-7
Installation: XR Models.....	6-8

6.4 FUSES AND RELAYS

General.....	6-10
Replacing Fuses.....	6-10
Replacing Relays.....	6-10

6.5 MAIN FUSE HOLDER

General.....	6-11
Replacement.....	6-11

6.6 SPEEDOMETER: XL SINGLE GAUGE MODELS EXCEPT XL 883C/XL 1200C

Removal.....	6-12
Installation.....	6-12

6.7 SPEEDOMETER AND TACHOMETER: XL DUAL GAUGE MODELS

Speedometer Removal.....	6-14
Speedometer Installation.....	6-14
Trip Odometer Reset Switch Replacement.....	6-15
Tachometer Removal.....	6-16
Tachometer Installation.....	6-16

6.8 SPEEDOMETER: XL 883C/XL 1200C

Removal.....	6-17
Installation.....	6-18

6.9 SPEEDOMETER AND TACHOMETER: XR MODELS

Speedometer Removal.....	6-19
Speedometer Installation.....	6-19
Trip Odometer Reset Switch Replacement.....	6-21
Tachometer Removal.....	6-21
Tachometer Installation.....	6-21

6.10 TURN SIGNAL AND SECURITY MODULE (TSM/TSSM/HFSM)

General.....	6-22
Testing.....	6-22
Removal.....	6-22
Installation.....	6-23

6.11 BATTERY CABLES

Removal.....	6-24
Installation.....	6-25

6.12 BATTERY TRAY

General.....	6-26
Removal.....	6-26
Installation.....	6-27

6.13 STARTER

General.....	6-29
Wiring Diagrams.....	6-29
Paint Touch-Up.....	6-29
Removal.....	6-29
Field Coil Assembly.....	6-29
Disassembly.....	6-29
Inspection.....	6-29
Assembly.....	6-30
Drive Assembly.....	6-31
Disassembly.....	6-31
Inspection.....	6-31
Assembly.....	6-31
Installation.....	6-32

6.14 STARTER SOLENOID

Solenoid Assembly.....	6-33
Disassembly.....	6-33
Assembly.....	6-33
Solenoid Plunger.....	6-33
Disassembly.....	6-33
Assembly.....	6-33
Solenoid Contacts.....	6-33
Disassembly.....	6-33

TABLE OF CONTENTS

Assembly.....	6-34	Disconnect Wiring: All Models Except XL 1200N.....	6-59
6.15 IGNITION SYSTEM		Disconnect Wiring: XL 1200N.....	6-60
Troubleshooting.....	6-36	Remove and Disassemble Turn Signal Assembly: All But XR 1200.....	6-61
6.16 IGNITION AND LIGHT SWITCH		Reassemble and Install Turn Signal Assembly: All But XR 1200.....	6-62
General.....	6-37	Remove and Disassemble Turn Signal Assembly: XR 1200.....	6-63
Removal.....	6-37	Reassemble and Install Turn Signal Assembly: XR 1200.....	6-64
Installation.....	6-37	Connect Wiring: All Models Except XL 1200N.....	6-64
6.17 ELECTRONIC CONTROL MODULE (ECM)		Connect Wiring: XL 1200N.....	6-64
General.....	6-39	Final Assembly: All Models.....	6-64
Removal.....	6-39	6.25 LICENSE PLATE LAMP MODULE: XL 1200N	
XL Models.....	6-39	General.....	6-65
XR Models.....	6-39	Removal (Domestic Only).....	6-65
Installation.....	6-39	Installation (Domestic Only).....	6-65
XL Models.....	6-39	Removal (HDI Only).....	6-66
XR Models.....	6-39	Installation (HDI Only).....	6-68
6.18 SPARK PLUG CABLES		6.26 REAR LIGHTING CONVERTER MODULE: XL 1200N (DOMESTIC ONLY)	
General.....	6-41	General.....	6-70
Removal.....	6-41	Removal.....	6-70
Installation.....	6-42	Installation.....	6-71
6.19 IGNITION COIL		6.27 REAR STOP LAMP SWITCH	
General.....	6-44	General.....	6-72
Troubleshooting.....	6-44	Replacement.....	6-72
Removal.....	6-44	6.28 CRANK POSITION SENSOR (CKP)	
Installation.....	6-45	General.....	6-74
6.20 CHARGING SYSTEM		Removal.....	6-74
General.....	6-47	Installation.....	6-74
Alternator.....	6-47	6.29 ALTERNATOR	
Voltage Regulator.....	6-47	Removal and Disassembly.....	6-75
6.21 HEADLAMP		Rotor.....	6-75
Replacement: XL 883C/XL 1200C.....	6-48	Stator.....	6-75
Replacement: All Models Except XL 883C/XL 1200C.....	6-50	Cleaning and Inspection.....	6-76
6.22 INDICATOR LAMP MODULE		Assembly and Installation.....	6-76
General.....	6-52	Stator.....	6-76
Preliminary Disassembly: All Models.....	6-52	Rotor.....	6-77
Replacement: XL 1200L and XL 1200N.....	6-52	Final Assembly.....	6-77
Replacement: XL 883C and XL 1200C.....	6-53	6.30 VEHICLE SPEED SENSOR (VSS)	
Replacement: All Other Models.....	6-53	General.....	6-78
Reassembling Vehicle: All Models.....	6-54	Removal.....	6-78
6.23 TAIL LAMP: ALL MODELS EXCEPT XL 1200N		Installation.....	6-78
General.....	6-55	6.31 NEUTRAL INDICATOR SWITCH	
Bulb Replacement.....	6-55	General.....	6-79
Base Replacement.....	6-55	Replacement.....	6-79
6.24 TURN SIGNALS		6.32 MAIN WIRING HARNESS	
General.....	6-58	General.....	6-81
Bulb Replacement.....	6-58	Removal.....	6-81
Front Housing Replacement.....	6-58	Installation.....	6-82
Rear Housing Replacement.....	6-59		
Preliminary Vehicle Disassembly: All Models.....	6-59		

TABLE OF CONTENTS

6.33 ELECTRICAL CADDIES

General.....	6-85
Voltage Regulator Caddy: XL Models Only.....	6-85
Removal.....	6-85
Installation.....	6-85
Wire Harness Caddy: XL Models.....	6-85
Removal.....	6-86
Installation.....	6-87
Wire Harness Caddy: XR Models.....	6-89
Removal.....	6-89
Installation.....	6-90

6.34 JIFFY STAND SWITCH: INTERNATIONAL MODELS

General.....	6-91
Removal.....	6-91
Installation.....	6-92

6.35 OPTIONAL SECURITY SIREN

General.....	6-93
Removal.....	6-93
Disassembly.....	6-93
Battery Replacement.....	6-94
Schedule.....	6-94
Battery Replacement: Early Style Siren.....	6-94
Battery Replacement: Late Style Siren.....	6-94
Assembly.....	6-95
Installation.....	6-95

6.36 OIL PRESSURE SWITCH

General.....	6-96
Removal.....	6-96
Installation.....	6-97

6.37 HORN

Troubleshooting.....	6-98
Voltage Test.....	6-98
Replacement: Models with Front Mounted Horn.....	6-98
Replacement: Models with Side Mounted Horn.....	6-98

6.38 MAIN FUSE

General.....	6-100
Removal.....	6-100
Installation.....	6-100

6.39 HANDLEBAR SWITCH ASSEMBLIES

General.....	6-101
Repair Procedures.....	6-101
Connectors.....	6-102

6.40 RIGHT HANDLEBAR SWITCHES

Removal.....	6-103
Disassembly.....	6-103
Switch Repair/Replacement.....	6-104
Upper Housing Repair.....	6-104
Lower Housing Repair.....	6-105
Turn-Right Signal Switch.....	6-105
Front Stoplight Switch.....	6-105
Assembly.....	6-105
Installation.....	6-106

6.41 LEFT HANDLEBAR SWITCHES

Removal.....	6-109
Disassembly.....	6-109
Switch Repair/Replacement.....	6-109
Upper Housing Repair.....	6-109
Lower Housing Repair.....	6-110
Turn-Left Signal Switch.....	6-110
Clutch Interlock Switch.....	6-110
Assembly.....	6-110
Installation.....	6-111

APPENDIX A CONNECTOR REPAIR

A.1 AMP MULTILOCK CONNECTORS

AMP Multilock Connector Repair.....	A-1
General.....	A-1
Separating Pin and Socket Housings.....	A-1
Mating Pin and Socket Housings.....	A-1
Removing Terminals from Housing.....	A-1
Inserting Terminals into Housing.....	A-2
Preparing Wire Leads for Crimping.....	A-2
Crimping Terminals to Leads.....	A-3
Inspecting Crimped Terminals.....	A-4

A.2 AUTOFUSE ELECTRICAL CONNECTORS

Autofuse Connector Repair.....	A-5
General.....	A-5
Disassembly.....	A-5
Assembly.....	A-5

A.3 DELPHI CONNECTORS

Delphi Connector Repair.....	A-6
General.....	A-6
Separating Pin and Socket Housings.....	A-6
Mating Pin and Socket Housings.....	A-6
Removing Socket Terminals.....	A-6
Installing Socket Terminals.....	A-6

A.4 DELPHI MAIN FUSE HOUSING

Delphi Main Fuse Housing Repair.....	A-8
General.....	A-8
Removing Main Fuse.....	A-8
Installing Main Fuse.....	A-8
Removing Socket Terminals.....	A-8
Installing Socket Terminals.....	A-8

A.5 DEUTSCH ELECTRICAL CONNECTORS

Deutsch Connector Repair.....	A-10
General.....	A-10
Separating Pin and Socket Housings.....	A-10
Mating Pin and Socket Housings.....	A-10
Removing Socket Terminals.....	A-10
Installing Socket Terminals.....	A-10
Removing Pin Terminals.....	A-12
Installing Pin Terminals.....	A-12
Crimping Terminals.....	A-13

A.6 DEUTSCH STANDARD TERMINAL REPAIR

Deutsch Standard Terminal Crimps.....	A-14
Preparing Wire Leads for Crimping.....	A-14
Crimping Terminal to Lead.....	A-14
Inspecting Crimps.....	A-14

A.7 DEUTSCH SOLID BARREL MINI TERMINAL REPAIR

Deutsch Solid Barrel Terminal Crimps.....	A-15
Preparing Wire Leads For Crimping.....	A-15
Adjusting Crimper Tool.....	A-15
Crimping a Barrel Contact To Wire Lead.....	A-15
Inspecting Crimps.....	A-15

A.8 DEUTSCH MINI TERMINAL REPAIR

Deutsch Mini Terminal Crimps.....	A-17
Preparing Wire Leads for Crimping.....	A-17
Crimping a Mini Terminal to Wire Lead.....	A-17
Inspecting Crimps.....	A-17

A.9 MOLEX CONNECTORS

Molex Connector Repair.....	A-18
Separating Pin and Socket Housings.....	A-18
Mating Pin and Socket Housings.....	A-18
Removing Terminals.....	A-18
Installing Terminals.....	A-18
Crimp Terminal to Lead.....	A-19
Prepare Lead.....	A-19
Prepare Tool.....	A-19
Position Terminal in the Punch/Die.....	A-20
Insert Stripped Lead.....	A-20
Crimp Terminal to Lead.....	A-21
Inspect Crimp.....	A-21

A.10 PACKARD 150 METRI-PACK CONNECTORS

150 Metri-Pack Connector Repair.....	A-22
General.....	A-22
Separating Pin and Socket Housings.....	A-22
Mating Pin and Socket Housings.....	A-22
Removing Socket Terminal.....	A-22
Inserting Socket Terminal.....	A-22

A.11 PACKARD 280 METRI-PACK RELAY AND FUSE BLOCK CONNECTORS

Fuse Block Repair.....	A-24
Removing Socket Terminals.....	A-24
Installing Socket Terminals.....	A-24
Crimping Terminals.....	A-24

A.12 PACKARD 480 METRI-PACK CONNECTORS

480 Metri-Pack Connector Repair.....	A-25
General.....	A-25
Separating Pin and Socket Housings.....	A-25
Mating Pin and Socket Housings.....	A-25
Removing Socket Terminals.....	A-25
Installing Socket Terminals.....	A-25

A.13 PACKARD 630 METRI-PACK CONNECTORS

630 Metri-Pack Connector Repair.....	A-26
General.....	A-26
Separating Pin and Socket Housings.....	A-26
Mating Pin and Socket Housings.....	A-26
Removing Socket Terminal.....	A-26
Installing Socket Terminal.....	A-26

A.14 PACKARD METRI-PACK TERMINALS

Metri-Pack Terminal Crimps.....	A-27
Matching Terminal To Crimper.....	A-27
Preparing Wire Lead.....	A-27
Crimping Wire Core.....	A-27
Crimping Insulation/Seal.....	A-27
Inspecting Crimps.....	A-28

A.15 PACKARD ECM CONNECTOR

Packard 100W Connector Repair.....	A-29
General.....	A-29
Separating Socket Housing From ECM.....	A-29
Mating Socket Housing To ECM.....	A-29
Removing Socket Terminal.....	A-29
Installing Socket Terminal.....	A-29
Crimping Terminals.....	A-29

A.16 PACKARD MICRO-64 CONNECTORS

Packard Micro-64 Connector Repair.....	A-31
General.....	A-31
Separating Pin and Socket Housings.....	A-31
Mating Pin and Socket Housings.....	A-31
Removing Terminal.....	A-31
Installing Terminal.....	A-32
Preparing Wire Leads for Crimping.....	A-32
Crimping Terminals.....	A-32
Inspecting Crimps.....	A-32

A.17 SEALED SPLICE CONNECTORS

Sealed Splice Connector Repair.....	A-34
General.....	A-34
Preparing Wire Leads.....	A-34
Splicing Wire Leads.....	A-34
Inspecting Seals.....	A-34

APPENDIX B WIRING

B.1 CONNECTORS

Connector Locations.....	B-1
Function/Location.....	B-1
Place and Color.....	B-1
Connector Number.....	B-1
Repair Instructions.....	B-1

B.2 WIRING DIAGRAMS

Wiring Diagram Information.....	B-3
Wire Color Codes.....	B-3
Wiring Diagram Symbols.....	B-3
2009 Sportster Wiring Diagrams.....	B-4

TABLE OF CONTENTS

APPENDIX C CONVERSIONS

C.1 METRIC CONVERSION

Conversion Table.....C-1

C.2 FLUID CONVERSIONS

United States System.....C-2

Metric System.....C-2

British Imperial System.....C-2

C.3 TORQUE CONVERSIONS

United States System.....C-3

Metric System.....C-3

APPENDIX D COMPENSATING SPROCKET

D.1 COMPENSATING SPROCKET

General.....D-1

Removal and Disassembly.....D-1

Cleaning, Inspection and Repair.....D-1

Sprocket Bearing Replacement.....D-1

 Removal.....D-1

 Installation.....D-2

Assembly and Installation.....D-2

APPENDIX E GLOSSARY

E.1 GLOSSARY

Acronyms and Abbreviations.....E-1

REFERENCE MATERIAL

TOOLS.....I

TORQUE VALUES.....IX

INDEX.....XXIX



TABLE OF CONTENTS

SUBJECT	PAGE NO.
1.1 FASTENER TORQUE VALUES.....	1-1
1.2 GENERAL.....	1-4
1.3 FUEL AND OIL.....	1-8
1.4 MAINTENANCE SCHEDULE.....	1-10
1.5 BULB REQUIREMENTS.....	1-14
1.6 ENGINE OIL AND FILTER.....	1-15
1.7 BRAKES.....	1-18
1.8 BLEEDING HYDRAULIC BRAKE SYSTEM.....	1-20
1.9 BRAKE PADS AND DISCS: XL MODELS.....	1-24
1.10 BRAKE PADS AND DISCS: XR MODELS.....	1-31
1.11 TIRES AND WHEELS.....	1-36
1.12 PRIMARY CHAIN.....	1-39
1.13 CLUTCH.....	1-41
1.14 TRANSMISSION LUBRICANT.....	1-43
1.15 REAR BELT AND SPROCKETS.....	1-45
1.16 REAR BELT DEFLECTION.....	1-47
1.17 BATTERY MAINTENANCE.....	1-52
1.18 SPARK PLUGS.....	1-58
1.19 STEERING HEAD BEARINGS.....	1-60
1.20 SHOCK ABSORBER ADJUSTMENT.....	1-62
1.21 REAR FORK BEARINGS.....	1-64
1.22 FRONT FORK OIL.....	1-65
1.23 CABLE AND CHASSIS LUBRICATION.....	1-72
1.24 AIR CLEANER: XL MODELS.....	1-73
1.25 AIR CLEANER: XR MODELS.....	1-75
1.26 EXHAUST SYSTEM.....	1-78
1.27 THROTTLE CONTROL.....	1-79
1.28 IDLE SPEED AND IGNITION TIMING.....	1-80
1.29 FUEL SUPPLY FILTER.....	1-81
1.30 ENGINE MOUNTS AND STABILIZER LINKS.....	1-82
1.31 HEADLAMP ALIGNMENT.....	1-83
1.32 FLUID AND LUBRICANT REQUIREMENTS.....	1-85
1.33 CRITICAL FASTENERS.....	1-86
1.34 STORAGE.....	1-88
1.35 TROUBLESHOOTING.....	1-90

NOTES



FASTENER TORQUE VALUES

1.1

FASTENER TORQUE VALUES IN THIS CHAPTER

The table below lists torque values for all fasteners presented in this chapter.

FASTENER	TORQUE VALUE		NOTES
Air cleaner cover screw	36-60 in-lbs	4.1-6.8 Nm	1.4 MAINTENANCE SCHEDULE, General
Air cleaner cover screw	36-60 in-lbs	4.1-6.8 Nm	1.24 AIR CLEANER: XL MODELS, Installation
Air filter element screw	40-60 in-lbs	4.5-6.8 Nm	1.4 MAINTENANCE SCHEDULE, General
Air filter element screw	40-60 in-lbs	4.5-6.8 Nm	1.24 AIR CLEANER: XL MODELS, Installation
Axle nut, rear	95-105 ft-lbs	129-142 Nm	1.16 REAR BELT DEFLECTION, Belt Deflection Adjustment
Axle nut, rear	95-105 ft-lbs	129-142 Nm	1.16 REAR BELT DEFLECTION, Wheel Alignment
Battery cable connector nut	55-75 in-lbs	6.2-8.5 Nm	1.17 BATTERY MAINTENANCE, Battery Installation and Connection
Battery negative terminal screw	60-70 in-lbs	6.8-7.9 Nm	1.4 MAINTENANCE SCHEDULE, General
Battery negative terminal screw	60-70 in-lbs	6.8-7.9 Nm	1.17 BATTERY MAINTENANCE, Battery Installation and Connection
Battery positive terminal screw	60-70 in-lbs	6.8-7.9 Nm	1.17 BATTERY MAINTENANCE, Battery Installation and Connection
Battery strap screw	36-60 in-lbs	4.1-6.8 Nm	1.17 BATTERY MAINTENANCE, Battery Installation and Connection
Bleeder valve	35-61 in-lbs	4.0-6.9 Nm	1.8 BLEEDING HYDRAULIC BRAKE SYSTEM, Bleeding Front Brake: All Models
Bleeder valve	35-61 in-lbs	4.0-6.9 Nm	1.8 BLEEDING HYDRAULIC BRAKE SYSTEM, Bleeding Rear Brake: All Models
Brake hose clamp-to-rear fork screw	30-40 in-lbs	3.4-4.5 Nm	1.16 REAR BELT DEFLECTION, Belt Deflection Adjustment
Brake pad pin	131-173 in-lbs	14.8-19.6 Nm	1.9 BRAKE PADS AND DISCS: XL MODELS, Brake Pad Replacement: Rear
Brake pad pin	131-173 in-lbs	14.8-19.6 Nm	1.10 BRAKE PADS AND DISCS: XR MODELS, Brake Pad Replacement: Rear
Brake pad pin plug	18-25 in-lbs	2.0-2.9 Nm	1.9 BRAKE PADS AND DISCS: XL MODELS, Brake Pad Replacement: Front
Brake pad pin plug	18-25 in-lbs	2.0-2.9 Nm	1.9 BRAKE PADS AND DISCS: XL MODELS, Brake Pad Replacement: Rear
Brake pad pin plug	18-25 in-lbs	2.0-2.9 Nm	1.10 BRAKE PADS AND DISCS: XR MODELS, Brake Pad Replacement: Rear
Brake pad pins, front caliper	131-173 in-lbs	14.8-19.6 Nm	1.10 BRAKE PADS AND DISCS: XR MODELS, Brake Pad Replacement: Front
Caliper pad pin	131-173 in-lbs	14.8-19.6 Nm	1.9 BRAKE PADS AND DISCS: XL MODELS, Brake Pad Replacement: Front
Captive screw	9-17 in-lbs	1.0-2.0 Nm	1.8 BLEEDING HYDRAULIC BRAKE SYSTEM, Bleeding Front Brake: All Models
Captive screw	9-17 in-lbs	1.0-2.0 Nm	1.9 BRAKE PADS AND DISCS: XL MODELS, Brake Pad Replacement: Front
Chain tensioner nut	20-25 ft-lbs	27.1-33.9 Nm	1.4 MAINTENANCE SCHEDULE, General
Clutch inspection cover screw	84-108 in-lbs	9.5-12.2 Nm	1.4 MAINTENANCE SCHEDULE, General
Clutch inspection cover screw	84-108 in-lbs	9.5-12.2 Nm	1.13 CLUTCH, Adjustment

FASTENER	TORQUE VALUE		NOTES
Clutch inspection cover screw	84-108 in-lbs	9.5-12.2 Nm	1.14 TRANSMISSION LUBRICANT, Transmission Lubrication: Sportster Models
Footrest mount fastener: XR models	45-50 ft-lb	61.0-67.8 Nm	1.13 CLUTCH, Adjustment
Footrest mount fastener: XR models	45-50 ft-lb	61.0-67.8 Nm	1.14 TRANSMISSION LUBRICANT, Transmission Lubrication: Sportster Models
Fork cap: XR models	21-29 ft-lbs	29-39 Nm	1.22 FRONT FORK OIL, Changing Fork Oil: XR Models
Fork cap: XR models	21-29 ft-lbs	29-39 Nm	1.22 FRONT FORK OIL, Changing Fork Oil: XR Models
Fork cap to retainer nut: XR models	150-195 in-lbs	17-22 Nm	1.22 FRONT FORK OIL, Changing Fork Oil: XR Models
Fork cap to retainer nut: XR models	150-195 in-lbs	17-22 Nm	1.22 FRONT FORK OIL, Changing Fork Oil: XR Models
Fork slider tube cap	22-58 ft-lbs	29.9-78.7 Nm	1.22 FRONT FORK OIL, Changing Fork Oil: XL Models
Fork slider tube cap	22-58 ft-lbs	29.9-78.7 Nm	1.22 FRONT FORK OIL, Changing Fork Oil: XL Models
Fork stem pinch screw	30-35 ft-lbs	40.7-47.5 Nm	1.19 STEERING HEAD BEARINGS, Adjustment
Front fork lower bracket pinch screw	30-35 ft-lbs	40.7-47.5 Nm	1.19 STEERING HEAD BEARINGS, Adjustment
Front fork oil drain screw	13-17 in-lbs	1.5-2.0 Nm	1.22 FRONT FORK OIL, Changing Fork Oil: XL Models
Front master cylinder cover screw	9-17 in-lbs	1.0-2.0 Nm	1.10 BRAKE PADS AND DISCS: XR MODELS, Brake Pad Replacement: Front
Front master cylinder reservoir cover screw	9-17 in-lbs	1.0-2.0 Nm	1.4 MAINTENANCE SCHEDULE, General
Fuel pump module mounting screw	40-45 in-lbs	4.5-5.1 Nm	1.4 MAINTENANCE SCHEDULE, General
Fuel pump module mounting screw	40-45 in-lbs	4.5-5.1 Nm	1.29 FUEL SUPPLY FILTER, Installation
Handlebar clamp screw	108-132 in-lbs	12.2-14.9 Nm	1.4 MAINTENANCE SCHEDULE, General
Handlebar switch housing screw	35-45 in-lbs	4.0-5.1 Nm	1.4 MAINTENANCE SCHEDULE, General
Handlebar switch housing screw	35-45 in-lbs	4.0-5.1 Nm	1.27 THROTTLE CONTROL, Cable Inspection and Lubrication
Headlamp Allen head capscrew	30-35 ft-lbs	40.7-47.5 Nm	1.31 HEADLAMP ALIGNMENT, Headlamp Adjustment: Sportster Models
Headlamp clamp nut	120-240 in-lbs	14-27 Nm	1.31 HEADLAMP ALIGNMENT, Headlamp Adjustment: Sportster Models
Inner fork nut, right: XR models	69-83 ft-lbs	93-113 Nm	1.22 FRONT FORK OIL, Changing Fork Oil: XR Models/Hand tighten. Then tighten to torque.
Primary chaincase drain plug	14-30 ft-lbs	19.0-40.7 Nm	1.4 MAINTENANCE SCHEDULE, General
Primary chaincase drain plug	14-30 ft-lbs	19.0-40.7 Nm	1.14 TRANSMISSION LUBRICANT, Transmission Lubrication: Sportster Models/Apply LOCTITE THREADLOCKER 565 (white).
Primary chain inspection cover	84-120 in-lbs	9.5-13.6 Nm	1.12 PRIMARY CHAIN, Adjustment
Primary chain inspection cover screw	84-120 in-lbs	9.5-13.6 Nm	1.4 MAINTENANCE SCHEDULE, General
Primary chain lock nut	20-25 ft-lbs	27.1-33.9 Nm	1.12 PRIMARY CHAIN, Adjustment
Rider footrest support bracket mounting screw	45-50 ft-lbs	61-68 Nm	1.13 CLUTCH, Adjustment
Rider footrest support bracket mounting screw	45-50 ft-lbs	61-68 Nm	1.14 TRANSMISSION LUBRICANT, Transmission Lubrication: Sportster Models
Shift linkage pivot bolt	10-15 ft-lbs	13.6-20.3 Nm	1.13 CLUTCH, Adjustment

FASTENER	TORQUE VALUE		NOTES
Shift linkage pivot bolt	10-15 ft-lbs	13.6-20.3 Nm	1.14 TRANSMISSION LUBRICANT, Transmission Lubrication: Sportster Models
Spark plug	12-18 ft-lbs	16.3-24.4 Nm	1.18 SPARK PLUGS, Inspection
Spark plug (XL)	12-18 ft-lbs	16.3-24.4 Nm	1.4 MAINTENANCE SCHEDULE, General
Spark plug (XL)	12-18 ft-lbs	16.3-24.4 Nm	1.4 MAINTENANCE SCHEDULE, General
Spoke nipple	55 in-lbs	6.2 Nm	1.4 MAINTENANCE SCHEDULE, General
Spoke nipple	55 in-lbs	6.2 Nm	1.11 TIRES AND WHEELS, Wheel Spokes
Vertical headlamp adjustment bolt	30-35 ft-lbs	40.7-47.5 Nm	1.31 HEADLAMP ALIGNMENT, Headlamp Adjustment: Sportster Models



GENERAL

1.2

SERVICING A NEW MOTORCYCLE

WARNING

Perform the service and maintenance operations as indicated in the regular service interval table. Lack of regular maintenance at the recommended intervals can affect the safe operation of your motorcycle, which could result in death or serious injury. (00010a)

Service operations to be performed before customer delivery are specified in the applicable model year predelivery and set-up instructions.

The performance of new motorcycle initial service is required to keep warranty in force and to verify proper emissions systems operation. See [1.4 MAINTENANCE SCHEDULE](#).

SAFE OPERATING MAINTENANCE

NOTES

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

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

Check:

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

SHOP PRACTICES

Repair Notes

General maintenance practices are given in this section.

NOTES

- Repair = Disassembly/Assembly.
- Replacement = Substitute a **new** part for existing component.

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

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

Safety

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

Removing Parts

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

WARNING

Be sure to check capacity rating and condition of hoists, slings, chains and cables before use. Exceeding capacity ratings or using lifting devices that are in poor condition can lead to an accident, which could result in death or serious injury. (00466c)

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 verify 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 guarantee satisfactory operation.

When you are instructed in a step to clean fastener threads or threaded holes, proceed as follows: Clean all LOCTITE material from fastener threads and threaded holes. Use a wire brush to clean fastener threads. Use a thread chaser or other suitable tool to clean threaded holes. Use PJ-1 cleaner or equivalent to remove all traces of oil and contaminants from threads. Blow out all threaded holes with low pressure compressed air.

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.

Always verify cleanliness of blind holes before assembly. Tightening a screw with dirt, water or oil in the hole can cause castings to crack or break.

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.

Checking Torques on Fasteners

Attempt to turn the fastener using a torque wrench set to the minimum torque specification for that fastener. If the fastener does not rotate, the fastener torque has been maintained. If the fastener rotates, remove it to determine if it is a lock-patch type.

If it has a locking agent, clean all locking material from the threaded hole. Replace the fastener with a new one or clean the original fastener threads and apply the appropriate Loctite product (see appropriate procedure). Install and tighten the fastener to specification.

If the fastener is not lock-patch type, install and tighten to specification.

Magnetic Parts Trays

Magnetic parts trays are becoming common in the service facility because they are convenient and can keep parts from becoming lost during a repair procedure.

However, hardened steel parts can become magnetized when held in magnetic parts trays. Metal fragments that would ordinarily be washed away in the oil and trapped in the oil filter or magnetic drain plug during vehicle operation could be captured by magnetized parts in the engine, potentially causing accelerated engine wear and damage.

Parts that will be returned to service inside the vehicle's powertrain such as gears, thrust washers and especially bearings should never be kept in magnetic parts trays.

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 pipe sealant or LOCTITE 565 THREAD SEALANT on pipe fitting threads.

Threadlocking Agents

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

using new or existing fasteners. Always use the recommended threadlocking agent for your specific procedure.

Wiring, Hoses and Lines

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.

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

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

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

Bushings

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

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

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

Gaskets

Always discard gaskets after removal. Replace with **new** gaskets. Never use the same gasket twice. Be sure that gasket holes match up with holes in the mating part. But be aware that sections of a gasket may be used to seal passages.

If a gasket must be made, be sure to cut holes that match up with the mating part. Serious 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.

Exhaust System Leakage

In the event of an exhaust system leak at a muffler or header pipe connection location, disassemble and clean all mating surfaces. Replace any damaged components. If leak still exists, disassemble and repair the leak by applying a bead of Harley-Davidson High-Performance Sealant (Part No. 99650-02) (or an equivalent 02 Sensor/Catalyst-safe alternative). Reassemble components, wipe off any excess sealant and allow adequate curing time following sealant product instructions before operating vehicle.

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 priming and 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.

WARNING

Using compressed air to "spin dry" bearings can cause bearing to fly apart, which could result in death or serious injury. (00505b)

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 with compressed air. Do not spin bearings while they are drying.

TOOL SAFETY

Air Tools

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

Wrenches

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

Pliers/Cutters/Pry bars

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

Hammers

- Never strike a 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

- Do not 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.
- Do not interchange POZIDRIV, PHILLIPS or REED AND PRINCE screwdrivers.
- Screwdriver handles are not intended to act as insulation. Do not use on live electrical circuits.
- Do not 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

- Do not 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.
- Do not 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 workspace.

FUEL AND OIL

1.3

FUEL

Refer to [Table 1-1](#). Always use a good quality unleaded gasoline. Octane ratings are usually found on the pump.

⚠ WARNING

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

⚠ WARNING

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

Modern service station pumps dispense a high flow of gasoline into a motorcycle fuel tank making air entrapment and pressurization a possibility.

Table 1-1. Octane Ratings

SPECIFICATION	RATING
Pump Octane (R+M)/2	91 (95 RON)

GASOLINE BLENDS

Your motorcycle was designed to get the best performance and efficiency using unleaded gasoline. Most gasoline is blended with alcohol and/or ether to create oxygenated blends. The type and amount of alcohol or ether added to the fuel is important.

CAUTION

Do not use gasoline that contains methanol. Doing so can result in fuel system component failure, engine damage and/or equipment malfunction. (00148a)

- Gasoline 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 is a mixture of 10% ethanol (Grain alcohol) and 90% unleaded gasoline. Gasoline/ethanol blends can be used in your motorcycle if the ethanol content does **not** exceed 10%.
- REFORMULATED OR OXYGENATED GASOLINES (RFG): Reformulated gasoline is a term used to describe gasoline blends that are specifically designed to burn cleaner than other types of gasoline, leaving fewer tailpipe emissions. They are also formulated to evaporate less when you are filling your tank. Reformulated gasolines use additives to oxygenate the gas. Your motorcycle will run normally using this type of gas and Harley-Davidson recommends you use it when possible, as an aid to cleaner air in our environment.
- Do not use race gas or octane boosters. Use of these fuels will damage the fuel system.

Some gasoline blends might adversely affect the starting, driveability or fuel efficiency of the motorcycle. If any of these problems are experienced, try a different brand of gasoline or gasoline with a higher octane blend.

ENGINE LUBRICATION

CAUTION

Do not switch lubricant brands indiscriminately because some lubricants interact chemically when mixed. Use of inferior lubricants can damage the engine. (00184a)

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. Refer to [Table 1-2](#). Your authorized dealer has the proper oil to suit your requirements.

If it is necessary to add oil and Harley-Davidson oil is not available, use an oil certified for diesel engines. Acceptable diesel engine oil designations include: CF-4, CG-4, CH-4 and CI-4.

The preferred viscosities for the diesel engine oils in descending order are: 20W50, 15W40 and 10W40.

At the first opportunity, see an authorized dealer to change back to 100 percent Harley-Davidson oil.

Table 1-2. Recommended Engine Oils

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

WINTER LUBRICATION

In colder climates, the engine oil should be changed often. If motorcycle is used frequently for short trips, less than 15 miles (24 kilometers), in ambient temperatures below 60° F (16° C), oil change intervals should be reduced to 1500 miles (2400 kilometers). Motorcycles used only for short runs must have a thorough tank flush-out before **new** oil is put in. The tank flush-out should be performed by an authorized dealer or qualified technician.

NOTE

The further below freezing the temperature drops, the shorter the oil change interval should be.

Water vapor is a normal by-product of combustion in any engine. During cold weather operation, some of the water vapor condenses to liquid form on the cool metal surfaces inside the engine. In freezing weather this water will become slush or ice and, if allowed to accumulate too long, may block the oil lines and cause damage to the engine.

If the engine is run frequently and allowed to thoroughly warm up, most of this water will become vapor again and will be blown out through the crankcase breather.

If the engine is not run frequently and allowed to thoroughly warm up, this water will accumulate, mix with the engine oil and form a sludge that is harmful to the engine.



MAINTENANCE SCHEDULE

1.4

GENERAL

The table below lists the periodic maintenance requirements for Sportster model motorcycles. If you are familiar with the procedures, just refer to the table for the recommended service interval. If necessary, see the quick reference table ([Table 1-4.](#)) for the required specifications.

If more detailed information is needed, turn to the sections which follow for step-by-step instructions.

Also, throughout this manual, you will be instructed to use various lubricants, greases and sealants. Refer to [Table 1-5.](#) for the correct part numbers of these items.

Table 1-3. Regular Service Intervals: 2009 Sportster Models

ITEM SERVICED	PROCEDURE	1000 MI 1600 KM	5000 MI 8000 KM	10,000 MI 16,000 KM	15,000 MI 24,000 KM	20,000 MI 32,000 KM	25,000 MI 40,000 KM	NOTES
Engine oil and filter	Replace	X	X	X	X	X	X	3
Oil lines and brake system	Inspect for leaks	X	X	X	X	X	X	1, 3
Air cleaner	Inspect, service as required	X	X	X	X	X	X	
Tires	Check pressure, inspect tread	X	X	X	X	X	X	
Wheel spokes	Check tightness	X	X			X		1, 4
Transmission lubricant	Replace	X		X		X		
Clutch	Check adjustment	X	X	X	X	X	X	1
Primary chain	Check adjustment	X	X	X	X	X	X	
Rear belt and sprockets	Inspect, adjust belt	X	X	X	X	X	X	1
Throttle, brake and clutch controls	Check, adjust and lubricate	X	X	X	X	X	X	1
Jiffy stand	Inspect and lubricate	X		X		X		1
Fuel lines and fittings	Inspect for leaks	X	X	X	X	X	X	1
Fuel tank filter screen	Replace						X	1
Brake fluid	Check levels and condition	X	X	X	X	X	X	5
Brake pads and discs	Inspect for wear	X	X	X	X	X	X	
Front brake lever pin	Inspect		X	X	X	X		1, 2
	Lubricate						X	1, 2
Brake caliper pins	Inspect		X	X	X	X		1, 2
	Lubricate						X	1, 2
Brake caliper boots and bushings	Inspect		X	X	X	X		1, 2
	Replace						X	1, 2
Rear master cylinder outer boot	Inspect		X	X	X	X	X	1, 2
Brake components	Replace brake rubber components in master cylinders and calipers						X	1, 2
	Lubricate master cylinder pistons						X	1, 2
Spark plugs	Inspect	X	X		X		X	
	Replace					X		
Electrical equipment and switches	Check operation	X	X	X	X	X	X	
Engine idle speed	Check adjustment	X	X	X	X	X	X	1
Front fork oil	Replace							1, 6
Steering head bearings	Adjust	X				X		1, 7
Rear fork bearings		Inspect every 30,000 MI (48,000 KM)						1
Shock absorbers	Inspect	X	X	X	X	X	X	1
Critical fasteners	Check tightness	X		X		X		1
Engine mounts and stabilizer links	Inspect			X		X		1
Battery	Check battery and clean connections							3
Exhaust system	Inspect for leaks, cracks, and loose or missing fasteners or heat shields	X	X	X	X	X	X	3

Table 1-3. Regular Service Intervals: 2009 Sportster Models

ITEM SERVICED	PROCEDURE	1000 MI 1600 KM	5000 MI 8000 KM	10,000 MI 16,000 KM	15,000 MI 24,000 KM	20,000 MI 32,000 KM	25,000 MI 40,000 KM	NOTES
Road test	Verify component and system functions	X	X	X	X	X	X	
NOTES:	1. Should be performed by an authorized Harley-Davidson dealer, unless you have the proper tools, service data and are mechanically qualified. 2. Replace every four (4) years. 3. Perform annually or at specified intervals, whichever comes first. 4. Not all vehicles are equipped with spoke wheels. Consult appropriate topic in service manual. 5. Replace D.O.T. 4 HYDRAULIC BRAKE FLUID and flush system every two (2) years. 6. Disassemble, lubricate and inspect every 50,000 miles (80,000 km). 7. Disassemble, lubricate and inspect every 30,000 miles (48,000 km).							

Table 1-4. Quick Reference Maintenance Chart

ITEM SERVICED	SPECIFICATION	DATA
Engine oil and filter	Oil capacity	2.8 qt (2.65 L)
	Filter	Hand tighten 1/2-3/4 turn after gasket contact
	Chrome filter (XL 1200C)	Part no. 63796-77A
	Black filter (all except XL 1200C)	Part no. 63805-80A
Primary chain tension	Deflection with hot engine	1/4-3/8 in. (6.3-9.5 mm)
	Deflection with cold engine	3/8-1/2 in. (9.5-12.7 mm)
	Chain tensioner nut torque	20-25 ft-lbs (27.1-33.9 Nm)
	Primary chain inspection cover screw torque	84-120 in-lbs (9.5-13.6 Nm)
Primary chain/transmission lubricant	Lubricant capacity	32 oz. (946 mL)
	Primary chaincase drain plug torque	14-30 ft-lbs (19.0-40.7 Nm)
	Lubricant	Genuine Harley-Davidson Formula+ Transmission and Primary Chaincase Lubricant
Clutch adjustment	Free play at adjuster screw	1/4 turn
	Free play at hand lever	1/16-1/8 in. (1.6-3.2 mm)
	Clutch inspection cover screw torque	84-108 in-lbs (9.5-12.2 Nm)
Tire condition and pressure	Pressure for solo rider: XL Models	Front: 30 psi (207 kPa), Rear: 36 psi (248 kPa)
	Pressure for rider and passenger: XL Models	Front: 30 psi (207 kPa), Rear: 40 psi (276 kPa)
	Pressure for solo rider: XR Models	Front: 36 psi (248 kPa), Rear: 38 psi (262 kPa)
	Pressure for rider and passenger: XR Models	Front: 36 psi (248 kPa), Rear: 42 psi (290 kPa)
	Wear	Replace tire if 1/32 in. (0.8 mm) or less of tread pattern remains
Wheel spokes	Spoke nipple torque	55 in-lbs (6.2 Nm)
Steering head bearings	Lubricant for neck fitting	SPECIAL PURPOSE GREASE

Table 1-4. Quick Reference Maintenance Chart

ITEM SERVICED	SPECIFICATION	DATA
Brake fluid reservoir level	Brake fluid type	D.O.T. 4 brake fluid
	Proper fluid level (front brake)	1/4 in. (6.35 mm) from the top of the reservoir
	Proper fluid level (rear brake)	Upper fluid level in reservoir
	Front master cylinder reservoir cover screw torque	9-17 in-lbs (1.0-2.0 Nm)
Brake pad linings and discs	Minimum brake pad thickness	0.04 in. (1.02 mm)
	Minimum brake disc thickness	See stamp on side of disc
Drive belt	Upward measurement force applied at midpoint of bottom belt strand	10 lb. (4.5 kg)
	Belt deflection with motorcycle on jiffy stand, belt and sprockets at ambient temperature (cold engine), without rider or luggage	XL 883C/XL 883L/XL 1200C/XL 1200L/XL 1200N: 1/4-5/16 in. (6.35-7.94 mm) XL 883/XL 883R/XL 1200R: 9/16-5/8 in. (14.3-15.9 mm)
	Belt deflection measurement taken midway between rear sprocket and idler	XR Models: 1/4-3/8 in. (6.4-9.5 mm)
	See 1.25 AIR CLEANER: XR MODELS	
Air cleaner	Air filter element screw torque: XL Models	40-60 in-lbs (4.5-6.8 Nm)
	Air cleaner cover screw torque: XL Models	36-60 in-lbs (4.1-6.8 Nm)
Engine idle speed	Idle speed	950-1050 RPM
Fuel filter	Fuel pump module mounting screw torque	40-45 in-lbs (4.5-5.1 Nm)
Clutch and throttle cables	Lubricant	SUPER OIL
	Handlebar clamp screw torque	108-132 in-lbs (12.2-14.9 Nm)
	Handlebar switch housing screw torque	35-45 in-lbs (4.0-5.1 Nm)
Spark plugs: XL models	Type	6R12
	Gap	0.038-0.043 in. (0.96-1.09 mm)
	Torque	12-18 ft-lbs (16.3-24.4 Nm)
Spark plugs: XR models	Type	10R12X
	Gap	0.032-0.038 in. (0.81-0.97 mm)
	Torque	12-18 ft-lbs (16.3-24.4 Nm)
Front fork oil	Type	HYDRAULIC FORK OIL (TYPE E)
	Amount	See 1.22 FRONT FORK OIL
Battery	Lubricant	ELECTRICAL CONTACT LUBRICANT
	Terminal screw torque	60-70 in-lbs (6.8-7.9 Nm)
Critical fasteners	See 1.33 CRITICAL FASTENERS	
Engine mounts/isolators and Stabilizers	See 2.28 FRONT ENGINE MOUNT/ISOLATOR , 2.29 REAR ENGINE MOUNT/ISOLATOR , 2.27 STABILIZER LINKS	

Table 1-5. Lubricants, Greases, Sealants

ITEM	PART NUMBER	PACKAGE
Anti-Seize Lubricant	98960-97	1 oz squeeze tube
CCI #20 Brake Grease	42830-05 (included in master cylinder rebuild kit)	squeeze packet
D.O.T. 4 Brake Fluid	99953-99A	12 oz. bottle
Electrical Contact Lubricant	99861-02	1 oz squeeze tube
Genuine Harley-Davidson Formula+ Transmission and Primary Chaincase Lubricant	99851-05	1 qt bottle
G40M Brake Grease	42820-04	squeeze packet
Gray High Performance Sealant	99650-02	1.9 oz squeeze tube
HYLOMAR Gasket and Thread Sealant	99653-85	3.5 oz tube
Loctite Pipe Sealant With Teflon 565	99818-97	6 ml squeeze tube
Loctite Prism Primer (770)		
Loctite Prism Superbonder (411)		
Loctite Superbonder 420 Adhesive		
Loctite Threadlocker 243 (blue)	99642-97	6 ml squeeze tube
Loctite Threadlocker 262 (red)	94759-99	6 ml squeeze tube
Loctite Threadlocker 272	98618-03	10 ml bottle
Special Purpose Grease	99857-97	14 oz. cartridge
Super Oil	94968-85TV	1/4 fl. oz
Type "E" Hydraulic Fork Oil	99884-80	16 oz bottle



BULB REQUIREMENTS

1.5

BULB CHART

Table 1-6. Bulb Chart: 2009 Sportster Models

LAMP	DESCRIPTION (ALL LAMPS 12 VOLT)	BULBS REQUIRED	CURRENT DRAW (AMPERAGE)	HARLEY-DAVIDSON PART NUMBER
Headlamp	high beam/low beam	1	5.0/4.58	68329-03
	position lamp international	1	0.32	53438-92
Tail and stop lamps	tail lamp	1	0.59	68167-04
	stop lamp	1	2.10	68167-04
	tail lamp international	1	0.59	68167-04
	stop lamp international	1	2.10	68167-04
Turn signal lamp	front/running	2	2.25/0.59	68168-89A
	front international	2	1.75	68163-84
	rear	2	2.25	68572-64B*
	rear international	2	1.75	68163-84**
Instrument panel	Illuminated with LEDs. Replace entire assembly upon failure.			
*Functions as turn signals, tail lamps and brake lamps on 1200N models.				
**On international and Japanese 1200N models, this is an LED assembly (replace entire assembly upon failure).				



ENGINE OIL AND FILTER

1.6

CHECKING AND ADDING OIL

Check engine oil level in oil tank and add oil if necessary. Oil tank capacity (wet) is 2.8 quarts (2.65 liters). Refer to [Table 1-2](#) for recommended engine oil viscosity.

CAUTION

Oil level cannot be accurately measured on a cold engine. For pre-ride inspection, with motorcycle leaning on jiffy stand on level ground, oil should register on dipstick between arrows when engine is cold. Do not add oil to bring the level to the FULL mark on a COLD engine. (00185a)

Removing and Replacing Oil Filler Cap

1. See [Figure 1-1](#). Position motorcycle so that it is leaning on jiffy stand on level ground. Remove filler cap from oil tank on right side of vehicle.
 - a. Press straight down on filler cap and release. Cap will pop up.
 - b. Pull up on filler cap while turning counterclockwise one-quarter turn as if removing filler cap.
2. Wipe attached dipstick clean.

NOTE

See [Figure 1-2](#). Note that dipstick has a wide slot (1) and a narrow slot (2) and can only be inserted in oil tank one way.

3. Insert dipstick into tank. Turn filler cap clockwise one-quarter turn as if screwing filler cap into tank. When filler cap stops turning, it is fully seated. Press down on filler cap until it snaps in place, flush with top of oil tank cover.



Figure 1-1. Filler Cap/Dipstick Location

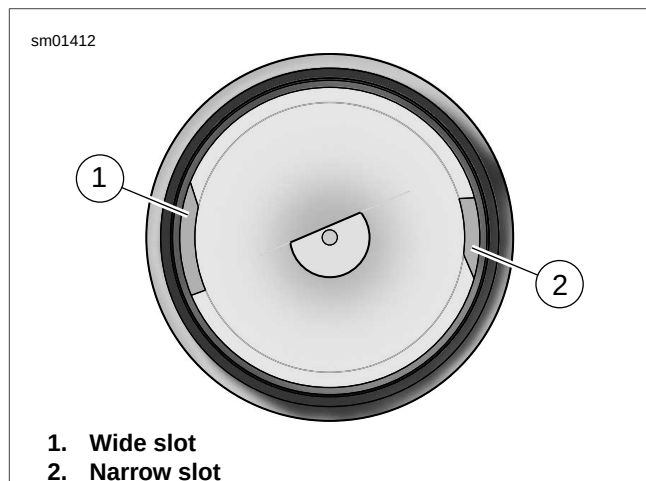


Figure 1-2. Filler Cap/Dipstick

Checking Oil with Cold Engine

1. Position motorcycle so that it is leaning on jiffy stand on level ground.
2. Remove filler cap. See Removing and Replacing Oil Filler Cap above. Wipe attached dipstick clean. Reinstall oil filler cap in tank.
3. Remove oil filler cap again and check oil level on dipstick. See [Figure 1-3](#). Dipstick has two marks. If oil level is at or below lower mark (2), add only enough oil to bring the level to a point between the two arrows on the dipstick. Replace filler cap.

Checking Oil with Warm Engine

1. Run engine until engine oil is at normal operating temperature. Turn engine off.
2. Position motorcycle so that it is leaning on jiffy stand on level ground.
3. Remove filler cap. See Removing and Replacing Oil Filler Cap above. Wipe attached dipstick clean. Reinstall oil filler cap in tank.
4. Remove filler cap again and check warm oil level on dipstick. See [Figure 1-3](#). Dipstick has two marks. If oil level in tank is at or below lower mark, add 1.0 quart (0.946 liter) of Harley-Davidson oil to tank. Replace filler cap.
5. If you added oil in step 4, remove filler cap and verify correct engine oil level in oil tank. Do not fill oil tank to a level above upper mark on dipstick. Replace filler cap.

CAUTION

Do not overfill oil tank. Doing so can result in oil carryover to the air cleaner leading to equipment damage and/or equipment malfunction. (00190a)

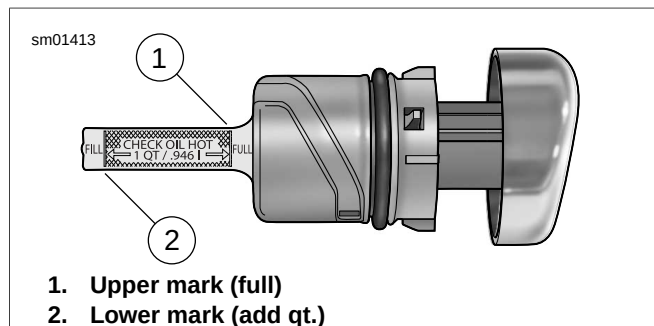


Figure 1-3. Oil Level Marks on Dipstick (typical; XL model shown)

CHANGING OIL AND FILTER

PART NUMBER	TOOL NAME
HD-42311	HARLEY-DAVIDSON OIL FILTER WRENCH
HD-44067-A	HARLEY-DAVIDSON OIL FILTER WRENCH

General

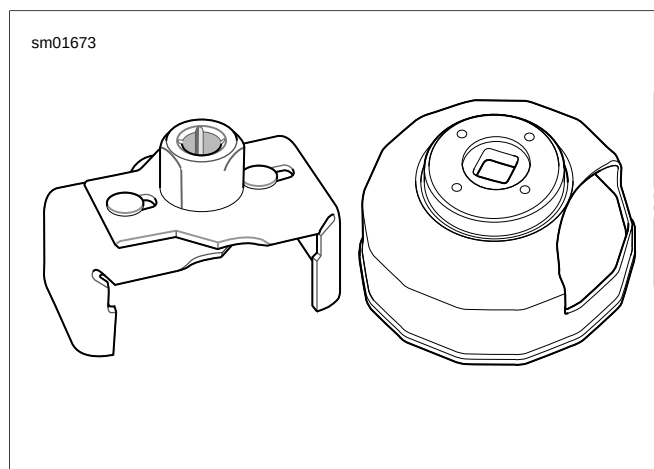


Figure 1-4. Oil Filter Wrenches

Completely drain oil tank of used oil at scheduled service intervals as specified in [1.4 MAINTENANCE SCHEDULE](#). Refer to [Table 1-3](#). Refill with fresh oil.

NOTES

- 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.

Draining Oil Tank

- Run engine until engine oil has reached normal operating temperature.

NOTE

Oil will drain more quickly if filler cap/dipstick is removed from oil tank.

- Remove oil filler cap/dipstick from oil tank.

- See [Figure 1-5](#). Place a suitable container directly under the drain hose (1) at the bottom rear of the engine crankcase. The container must be able to hold approximately 4.0 quarts (3.8 liters).
- Loosen worm drive clamp (2) and pull drain plug (3) from end of drain hose. Completely drain engine oil from oil tank. It is not necessary to drain engine crankcase.
- Replace drain plug into end of drain hose and tighten worm drive clamp securely.

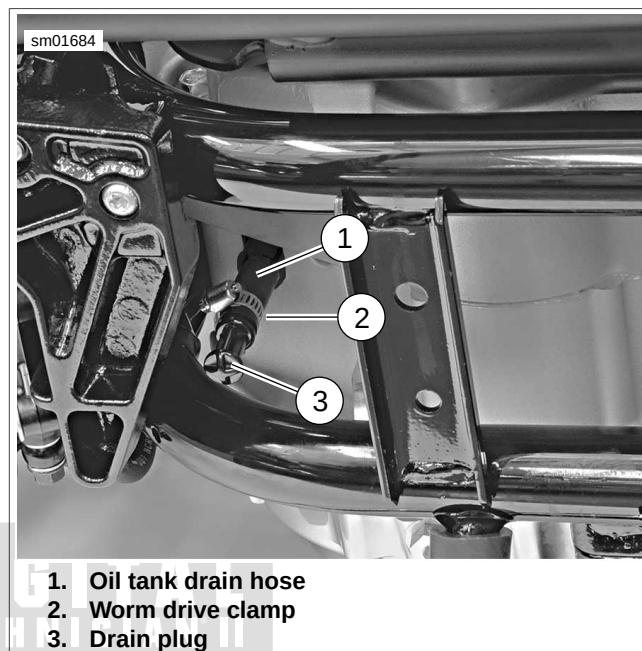


Figure 1-5. Oil Tank Drain Hose (typical; XL model shown)

Removing Oil Filter

- Place a drain pan beneath front of engine crankcase.

CAUTION

Use Harley-Davidson oil filter wrench for filter removal. This tool can prevent damage to crankshaft position sensor and/or sensor cable. (00192b)

- See [Figure 1-4](#). See [Figure 1-6](#). Remove oil filter using HARLEY-DAVIDSON OIL FILTER WRENCH (Part No. HD-42311) or HARLEY-DAVIDSON OIL FILTER WRENCH (Part No. HD-44067-A). Turn oil filter counter-clockwise to remove from filter mount.
- Drain oil filter into drain pan. Discard oil filter.
- Clean any oil spills off crankcase and frame.

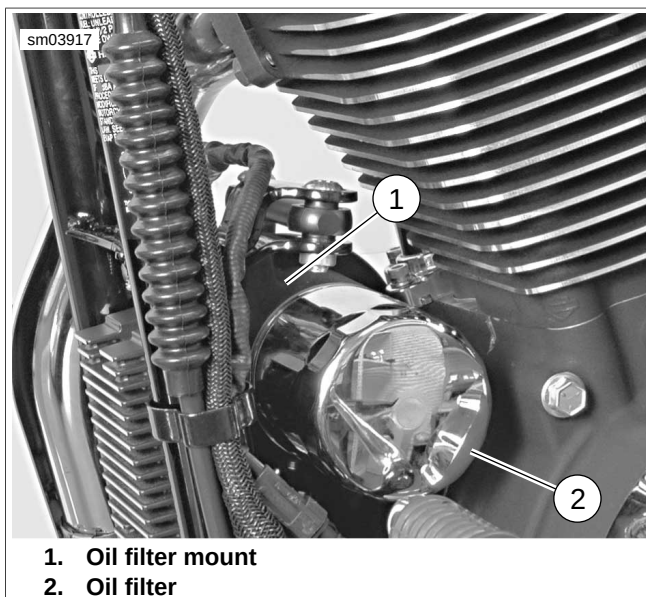


Figure 1-6. Oil Filter: All Models (XL 1200C Shown)

Installing New Oil Filter

NOTE

Partially fill oil filter before installation to minimize the time required for buildup of oil pressure when engine is first started.

1. Pour about 4 fluid ounces (120 ml) of fresh, clean engine oil into **new** oil filter. Allow time for oil to soak into filter element.
2. Wipe filter gasket contact surface of oil filter mount with a clean cloth.
3. See [Figure 1-7](#). Coat oil filter gasket with clean Harley-Davidson 20W-50 engine oil.

NOTE

Do not use oil filter wrench to install new oil filter.

4. Install **new** oil filter. Turn filter clockwise to install. Hand tighten filter 1/2 to 3/4-turn after gasket contacts filter mount surface.

Refilling Oil Tank

CAUTION

Do not overfill oil tank. Doing so can result in oil carryover to the air cleaner leading to equipment damage and/or equipment malfunction. (00190a)

1. Refer to [Table 1-2](#). Always use the proper grade of oil for the lowest expected air temperature before the next regularly scheduled oil change. Pour 2.0 quarts (1.9 liters) of oil into engine oil tank.

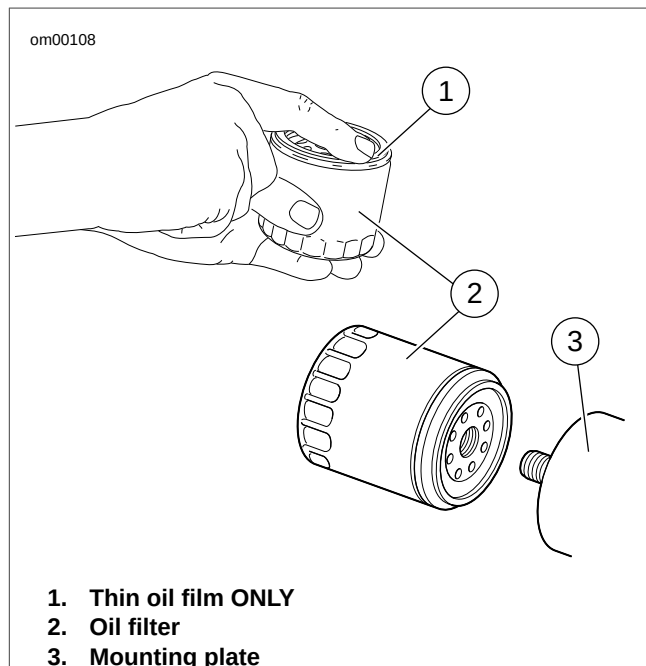


Figure 1-7. Applying Thin Oil Film

CAUTION

Loosen clamp and pull plug from end of oil tank drain hose. Allow a small amount of oil to flow from hose before reinstalling drain plug. This removes air from the drain hose and reduces the possibility of oil pump cavitation. (00560b)

2. Install filler cap onto oil tank as described on previous page. Make sure cap is fully seated.
3. Start engine. See [Figure 1-8](#). Verify that oil pressure signal lamp turns off when engine speed is 1000 RPM or above. Turn engine off.
4. Check for oil leaks at oil filter and oil tank drain hose. Check engine oil level. See [1.6 ENGINE OIL AND FILTER, Checking and Adding Oil](#) earlier in this section.

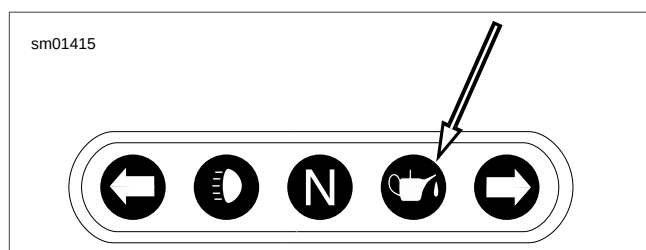


Figure 1-8. Oil Pressure Indicator Lamp

BRAKES

1.7

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 on the right handlebar. The rear brake master cylinder is located at the rear of the motorcycle's frame, beneath the rear fork pivot point and is actuated by the rear brake pedal via mechanical linkage.

WARNING

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

CAUTION

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

CAUTION

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

NOTES

- If D.O.T. 4 brake fluid contacts painted surfaces, IMMEDIATELY flush area with clear water.
- Cover handlebar switches with a shop towel before adding brake fluid to front master cylinder reservoir. Spilling brake fluid on handlebar switches may render them inoperative.

WARNING

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

INSPECTION

Check the master cylinder reservoirs for proper fluid levels. With the reservoir in a level position, add HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID from a sealed container until the fluid level is within approximately 1/4-inch (6.35 mm) below the top edge of the reservoir (front brake) or reaches the upper fluid level in the reservoir (rear brake).

Do not overfill the reservoir. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#) for procedures related to filling reservoirs.

Check brake pads and discs for wear. Replace brake pads if friction material is worn to 0.04 in. (1.02 mm) or less. Minimum brake disc thickness is stamped on side of disc. Replace any brake disc that is worn beyond this limit. Maximum brake rotor lateral runout and warp is 0.008 in. (0.2 mm) when measured near the outside diameter.

- For disc replacement procedures, see [2.4 WHEELS](#).
- For XL Models brake master cylinder service, see: [2.10 FRONT BRAKE MASTER CYLINDER](#) or [2.13 REAR BRAKE MASTER CYLINDER: XL MODELS](#).
- For XR Models brake master cylinder service, see: [2.10 FRONT BRAKE MASTER CYLINDER](#) or [2.14 REAR BRAKE MASTER CYLINDER: XR MODELS](#).
- For XL Models brake caliper service, see: [2.11 FRONT BRAKE CALIPER: XL MODELS](#) or [2.16 REAR BRAKE CALIPER: XL MODELS](#).
- For XR Models brake caliper service, see: [2.12 FRONT BRAKE CALIPER: XR MODELS](#) or [2.17 REAR BRAKE CALIPER: XR MODELS](#).
- For brake line replacement procedures, see [2.18 BRAKE LINES](#).

TROUBLESHOOTING

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

Table 1-7. Troubleshooting Brakes

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



BLEEDING HYDRAULIC BRAKE SYSTEM

1.8

GENERAL

Bleed the hydraulic brake system any time 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.

CAUTION

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

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 diaphragm in place.

BLEEDING FRONT BRAKE: ALL MODELS

CAUTION

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

NOTES

- If D.O.T. 4 brake fluid contacts painted surfaces, IMMEDIATELY flush area with clear water.
 - Cover handlebar switches with a shop towel before adding brake fluid to front master cylinder reservoir. Spilling brake fluid on handlebar switches may render them inoperative.
- See [Figure 1-9](#). Position motorcycle so that top of front master cylinder reservoir (1) is level.
 - See [Figure 1-10](#). Remove reservoir cover (4) with two captive screws (5), diaphragm plate (3) and diaphragm (2) from master cylinder reservoir (1).

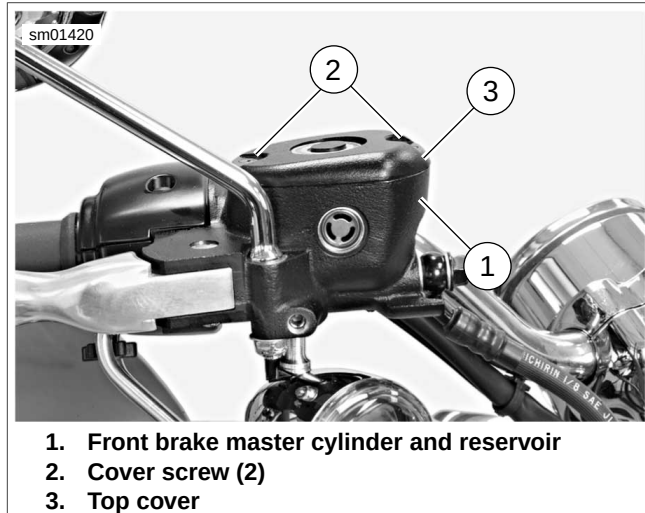


Figure 1-9. Front Brake Master Cylinder Reservoir (typical; XL model shown)

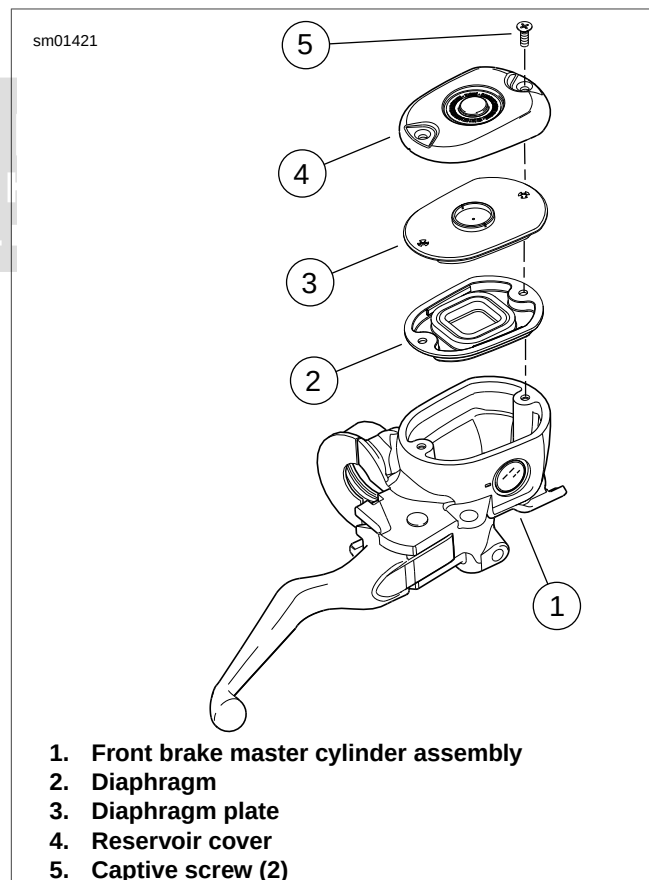


Figure 1-10. Front Brake Master Cylinder Cover Assembly (Typical)

NOTES

- See [Figure 1-11](#). Do not use sight glass (2) to determine maximum fluid level. Sight glass should only be used as a visual indicator that fluid level is low and needs attention. A ridge (1) is cast into the inside of the reservoir to assist you in determining the correct level.
- Use only HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID from a sealed container.
- Do not overfill reservoir. Do not reuse old brake fluid.



Figure 1-11. Filling Front Master Cylinder Reservoir (Typical)

3. See [Figure 1-11](#). Add enough HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID to reservoir to bring fluid level even with ridge (1) cast into inside of reservoir, about 1/4-in. (6.35 mm) below top edge.
4. See [Figure 1-12](#) or [Figure 1-13](#). Remove bleeder cap (3) from bleeder valve (2) on front caliper (1).
5. See [Figure 1-14](#). Install end of a length of 5/16 in. (7.9 mm) I.D. clear plastic tubing over caliper bleeder valve. Place free end of tube in a clean container.
6. Squeeze and hold brake lever to build up hydraulic pressure. See [Figure 1-12](#). Open bleeder valve (2) about 1/2-turn. Brake fluid will flow from bleeder valve through tubing. Observe fluid flowing through tubing. Check for air bubbles.
7. Close bleeder valve when brake lever has moved 1/2 to 3/4 of its full range of travel. Allow brake lever to return slowly to its released position.
8. Repeat two previous steps until all air bubbles are purged from system.
9. Final tighten bleeder valve to 35-61 **in-lbs** (4.0-6.9 Nm). Remove plastic tubing and install bleeder cap (3).
10. See [Figure 1-11](#). Add enough HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID to reservoir to bring fluid level even with ridge cast into inside of reservoir, about 1/4-in. (6.35 mm) below top edge.

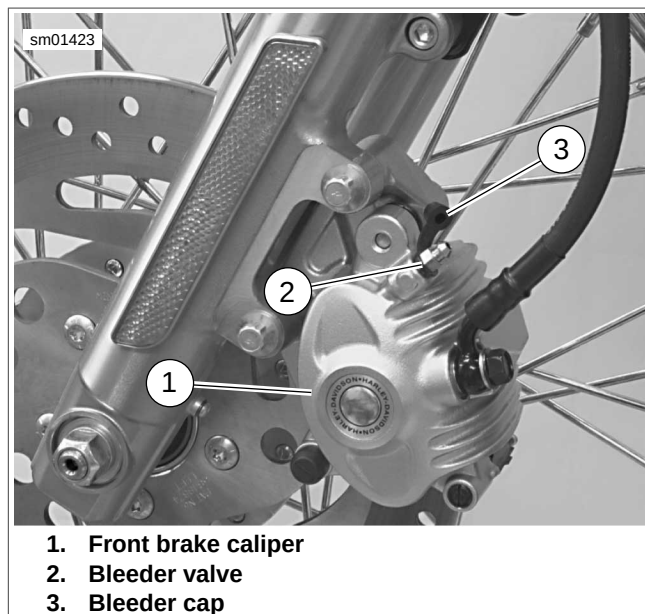


Figure 1-12. Front Brake Caliper: XL Models

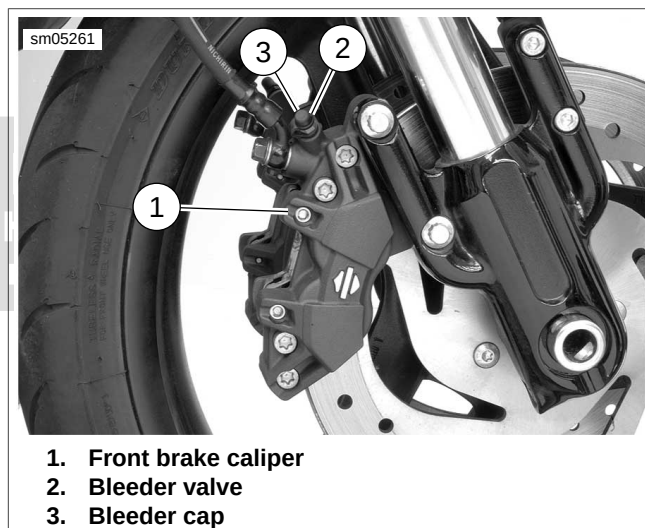


Figure 1-13. Front Caliper Assembly: XR Models

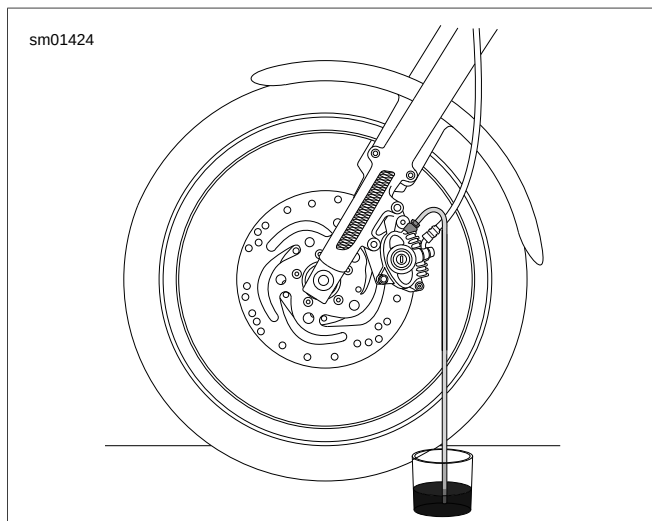


Figure 1-14. Bleeding Hydraulic System (typical; XL model shown)

11. If bleeding vehicle equipped with dual front disc brake system, repeat this procedure for other caliper.
12. See [Figure 1-10](#). Replace diaphragm (2), diaphragm plate (3) and reservoir cover (4) with captive screws (5). Tighten to 9-17 **in-lbs** (1.0-2.0 Nm).

WARNING

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

13. Test ride motorcycle at low speed. Repeat the above bleeding procedure if front brake feels spongy.

BLEEDING REAR BRAKE: ALL MODELS

CAUTION

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

NOTES

- If D.O.T. 4 brake fluid contacts painted surfaces, **IMMEDIATELY** flush area with clear water.
- See [Figure 1-15](#) or [Figure 1-16](#). Vehicle must be upright so that rear brake master cylinder reservoir (1) is in a level position when filling and checking fluid level.
- Reservoir cover (5) may be removed from rear brake master cylinder reservoir to more easily verify fluid level in reservoir.
- Use only HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID from a sealed container.
- Do not overfill reservoir. Do not reuse old brake fluid.

1. Position motorcycle upright (not resting on jiffy stand). See [Figure 1-15](#) or [Figure 1-16](#). Remove reservoir cap (2).
2. If desired, remove reservoir cover (5) by grasping cover and gently pull straight out from reservoir (1).
3. Add HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID to master cylinder reservoir (1) until the fluid reaches the upper fluid level (3).
4. See [Figure 1-17](#) or [Figure 1-18](#). Remove bleeder cap (3). Install end of a length of 5/16 in. (7.9 mm) I.D. clear plastic tubing over caliper bleeder valve (2). Place free end of tube in a clean container.
5. Depress and hold brake pedal to build up hydraulic pressure. Open bleeder valve about 1/2-turn. Brake fluid will flow from bleeder valve through tubing. Observe fluid flowing through tubing. Check for air bubbles.
6. Close bleeder valve when brake pedal has moved 1/2 to 3/4 of its full range of travel. Allow brake pedal to return slowly to its released position.
7. Repeat two previous steps until all air bubbles are purged.
8. Final tighten bleeder valve to 35-61 **in-lbs** (4.0-6.9 Nm). Remove plastic tubing and install bleeder cap.
9. See [Figure 1-15](#) or [Figure 1-16](#). Add HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID to master cylinder reservoir (1) until the fluid reaches the upper fluid level (3).
10. Replace reservoir cap (2). Replace reservoir cover (5) if removed.

WARNING

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

11. Test ride motorcycle at low speed. Repeat the above bleeding procedure if rear brake feels spongy.

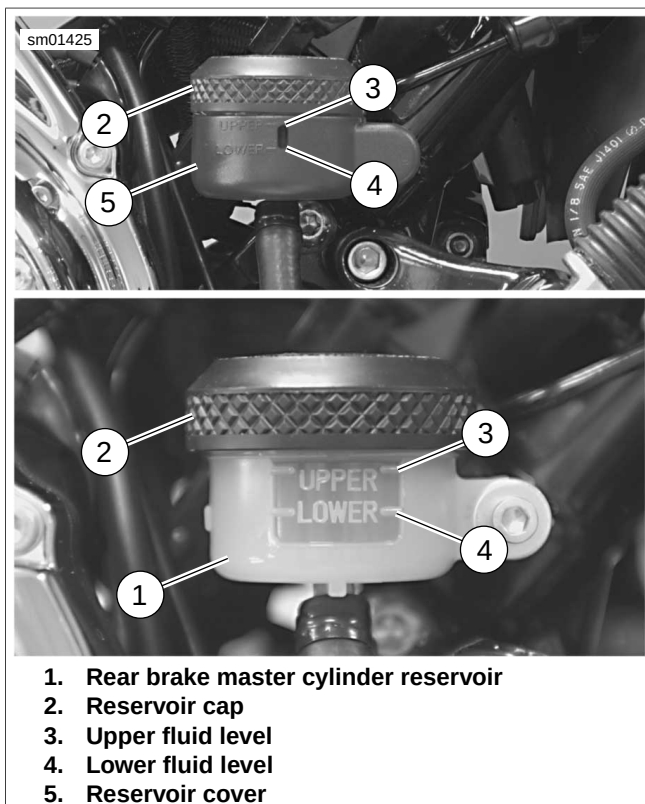


Figure 1-15. Rear Brake Master Cylinder Reservoir: XL Models

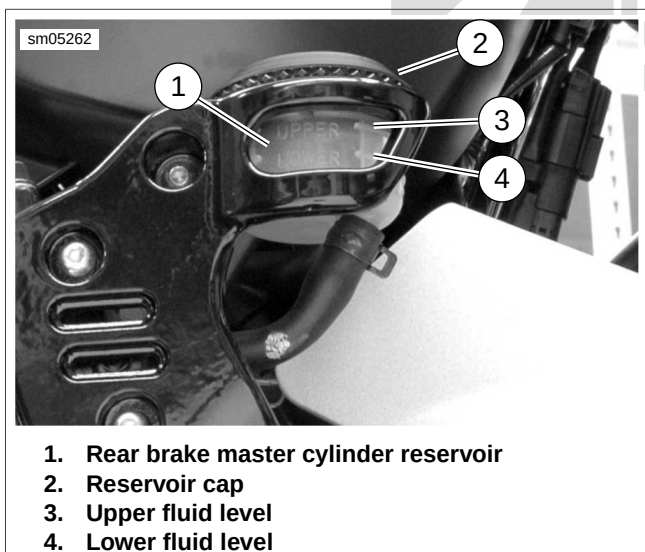


Figure 1-16. Rear Brake Master Cylinder Reservoir (XR Models)

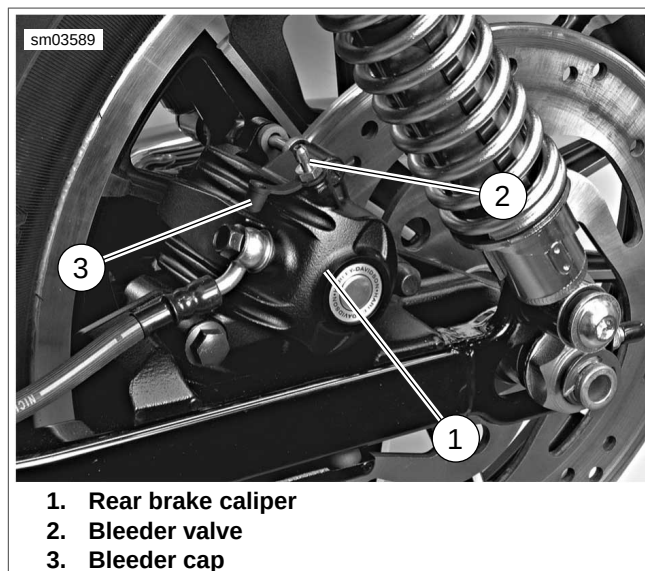


Figure 1-17. Rear Brake Caliper: XL Models

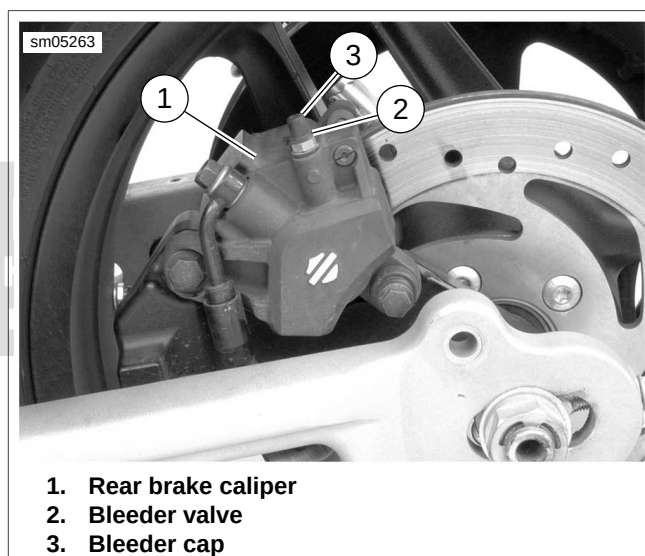


Figure 1-18. Rear Brake Caliper: XR Models

BRAKE PADS AND DISCS: XL MODELS

1.9

INSPECTION

Brake Pads

CAUTION

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

CAUTION

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

WARNING

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

See [Figure 1-19](#). Replace brake pads (3) if brake pad friction material on either the front or rear caliper is worn to 0.04 in. (1.02 mm) or less above the backing plate (4). Always replace both pads in a caliper as a set. See [1.9 BRAKE PADS AND DISCS: XL MODELS, Brake Pad Replacement: Front](#) or [1.9 BRAKE PADS AND DISCS: XL MODELS, Brake Pad Replacement: Rear](#).

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

Brake Disc Thickness, Lateral Runout and Warpage

The minimum brake disc (2) thickness is stamped on the side of the disc. Replace disc if worn past minimum thickness or badly scored.

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

- To replace front brake disc(s), see [2.4 WHEELS, Front Wheel](#).
- To replace rear brake disc, see [2.4 WHEELS, Rear Wheel](#).

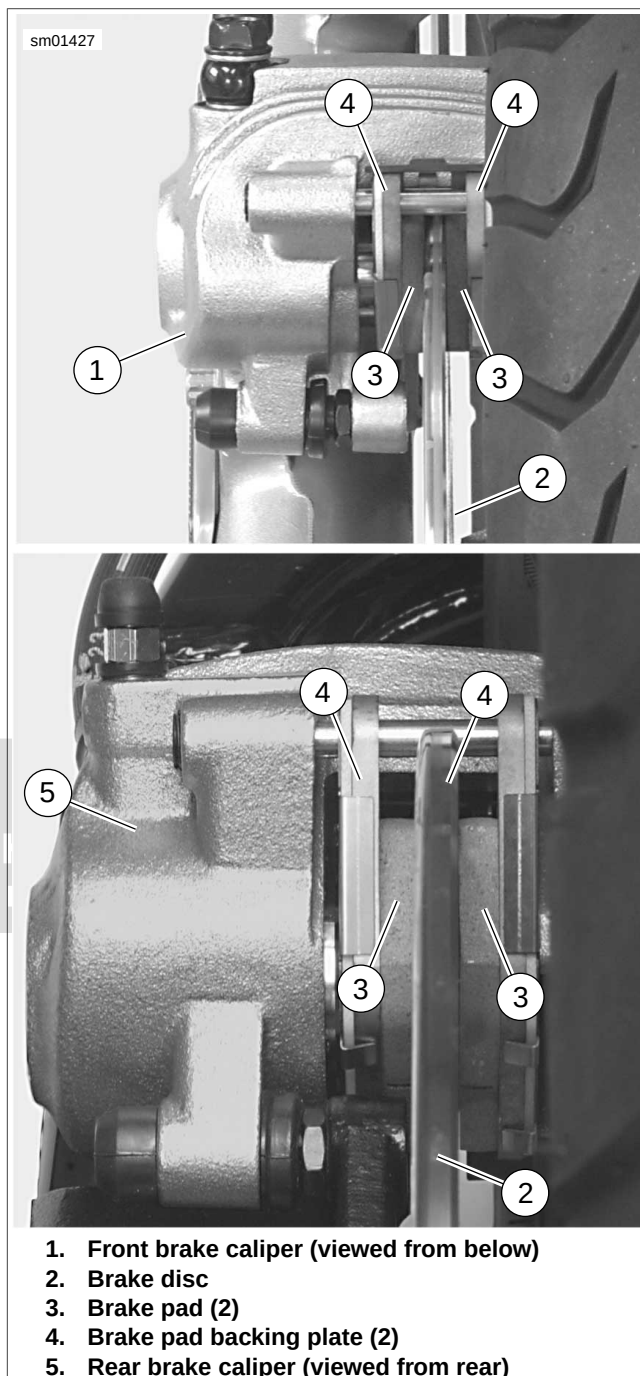


Figure 1-19. Brake Pad Inspection (Top: Front Brake, Bottom: Rear Brake)

BRAKE PAD REPLACEMENT: FRONT

CAUTION

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

NOTES

- Do not remove front caliper(s) from mounting bracket unless caliper mounting pins require service. Removing caliper from mounting bracket unnecessarily increases the risk of contaminants falling into mounting pin holes and damaging caliper during vehicle operation.
 - If D.O.T. 4 brake fluid contacts painted surfaces, IMMEDIATELY flush area with clear water.
 - Cover handlebar switches with a shop towel before adding brake fluid to front master cylinder reservoir. Spilling brake fluid on handlebar switches may render them inoperative.
- See [Figure 1-20](#). Position motorcycle so that front master cylinder reservoir (1) is level.
 - See [Figure 1-21](#). Remove two screws (5), reservoir cover (4), diaphragm plate (3) and diaphragm (2) from master cylinder reservoir (1).

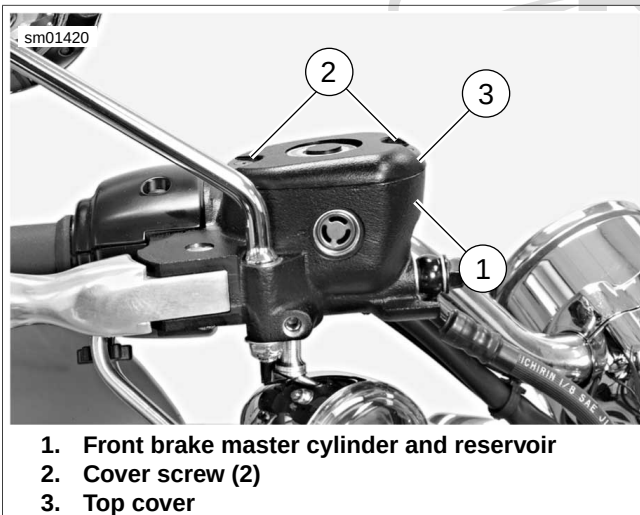


Figure 1-20. Front Brake Master Cylinder Reservoir (typical; XL model shown)

NOTE

As the pistons are pushed back into the caliper, fluid level may rise higher than fluid level mark at about 1/4-in. (6.35 mm) below top of reservoir. You may have to remove fluid to allow for this.

- Press against the side of the brake caliper body to push the outside brake pad (pad closest to caliper pistons) back. This pushes the caliper pistons back into their bores.

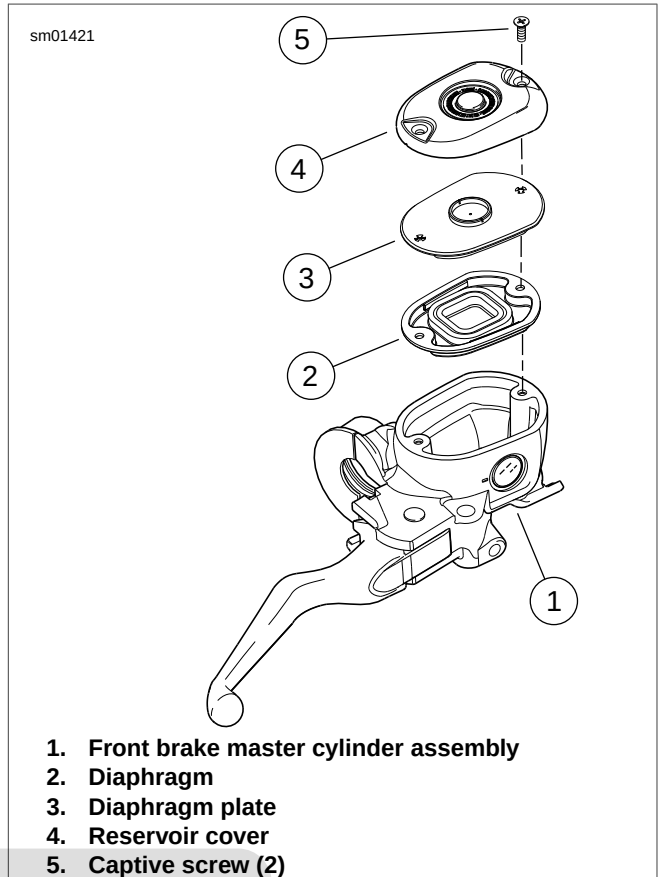


Figure 1-21. Front Brake Master Cylinder Cover Assembly (Typical)

NOTES

- See [Figure 1-22](#). When replacing front brake pads, make sure pad spring does not become dislodged and fall out. If it does, you will have to reinstall it before installing new pads.
- The front left and front right (not present on all models) calipers do NOT use the same brake pad set as the rear brake caliper.

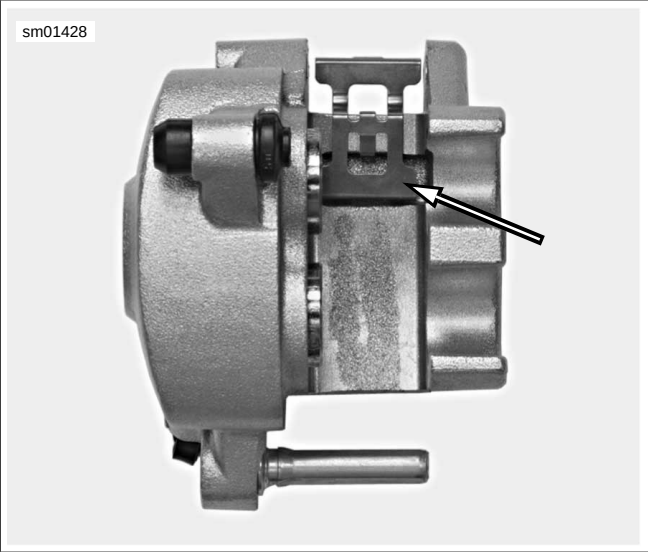


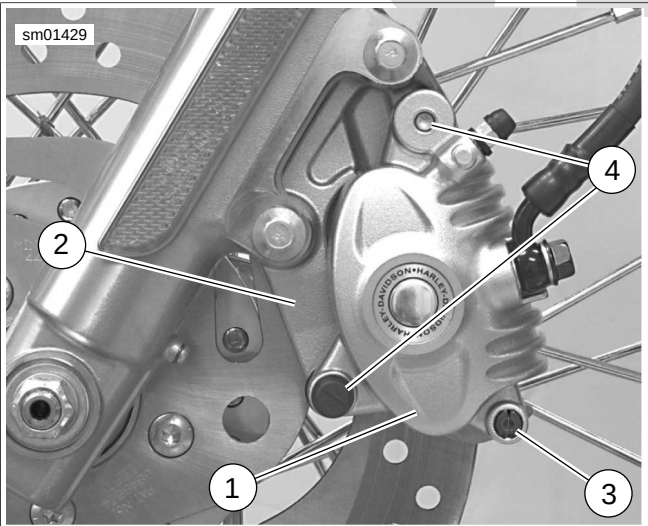
Figure 1-22. Front Caliper Pad Spring

4. See [Figure 1-23](#). Remove pad pin plug (3).
5. See [Figure 1-24](#). Loosen, but do not remove, brake pad pin.

NOTE

Do not completely remove brake pad pin from caliper during the next step. Completely removing pad pin at this time may cause difficulty during assembly.

6. Once the pistons have been fully retracted into their bores, pull pad pin part way until inside pad drops free. Note the pad's original orientation for replacement purposes.



1. Front brake caliper
2. Caliper mounting bracket
3. Pad pin plug
4. Caliper mounting pins

Figure 1-23. Front Caliper Assembly

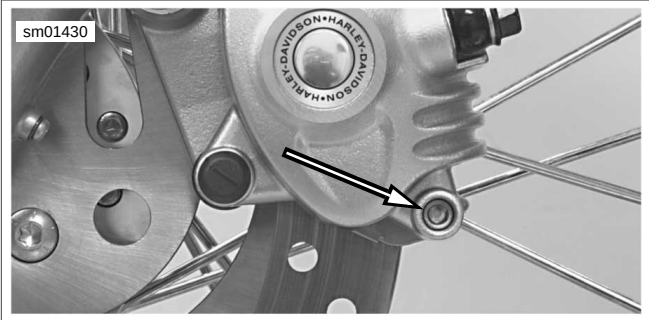
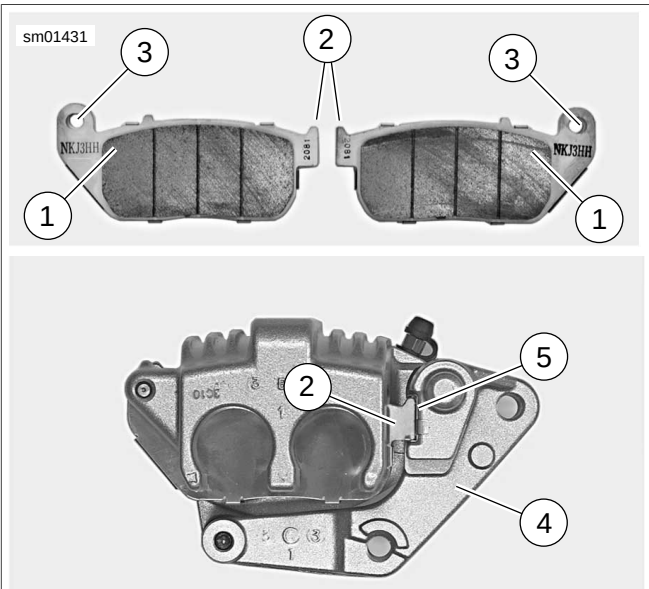


Figure 1-24. Brake Pad Pin (Plug Removed)

7. See [Figure 1-25](#). Install **new** inside brake pad (1) using same orientation as pad previously removed. Make sure front mounting tab (2) is seated in slot (5) in caliper mounting bracket (4) and pad friction material faces brake disc.
8. While holding **new** inside pad in place, pull pad pin out and remove outside brake pad. Note the pad's original orientation for replacement purposes.
9. Install **new** outside brake pad using the same orientation as pad previously removed. Make sure front mounting tab is seated in slot in caliper mounting bracket and pad friction material faces brake disc.
10. Temporarily insert a 1/8-in drill bit in caliper pad pin hole to hold both pads in place.
11. Inspect pad pin for grooving and wear. Measure pad pin diameter in an unworn area, and then in the area of any grooving or wear. If wear is more than 0.011 in. (0.28 mm), replace pin.



1. Brake pad
2. Front mounting tab
3. Pad pin hole
4. Front caliper mounting bracket
5. Slot

Figure 1-25. Front Brake Pads

12. Press brake pads firmly up against pad spring, remove drill bit and install pad pin. Tighten to 131-173 **in-lbs** (14.8-19.6 Nm).

NOTE

If pad pin does not fit, check the following:

- You are using a set of pads, not two identical pads.
 - Pad spring orientation must match [Figure 1-22](#).
 - See [Figure 1-25](#). Pad front mounting tabs (2) must be fully seated in mounting bracket slot (5).
 - Pads must be pushed tight up against pad spring before pad pin is installed.
13. See [Figure 1-23](#). Install pad pin plug (3). Tighten to 18-25 **in-lbs** (2.0-2.9 Nm).

⚠ WARNING

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

14. Pump brake lever to move pistons out until they contact outside brake pad. Verify piston location against pad.

⚠ CAUTION

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

CAUTION

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

NOTE

If D.O.T. 4 brake fluid contacts painted surfaces, IMMEDIATELY flush area with clear water.

15. See [Figure 1-26](#). Check brake fluid level in master cylinder. Add enough HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID to reservoir to bring fluid level even with ridge (1) cast into inside of reservoir, about 1/4-inch (6.35 mm) below top edge.



1. Cast-in ridge
2. Sight glass

Figure 1-26. Filling Front Master Cylinder Reservoir (Typical)

16. See [Figure 1-21](#). Install diaphragm (2), diaphragm plate (3), reservoir cover (4) and screws (5) on front brake master cylinder reservoir. Tighten screws to 9-17 **in-lbs** (1.0-2.0 Nm).

⚠ WARNING

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

17. Test brake system.
 - a. Turn ignition switch ON. Pump brake lever to verify operation of the brake lamp.
 - b. Test ride the motorcycle. If the brakes feel spongy, bleed the system. See [1.8 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.

BRAKE PAD REPLACEMENT: REAR

CAUTION

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

NOTES

- Do **not** remove rear caliper from mounting bracket unless caliper mounting pins and boots require service. Removing caliper from mounting bracket unnecessarily increases the risk of contaminants falling into caliper boots and

bushings which could damage caliper during vehicle operation.

- See [Figure 1-29](#). It is further **not** required or recommended to remove or loosen the caliper mounting pins (4).
- It is **not** necessary or recommended to remove the rear brake caliper from the caliper mounting bracket to replace pads.
- If D.O.T. 4 brake fluid contacts painted surfaces, IMMEDIATELY flush area with clear water.

1. Place motorcycle in an upright, level position.

NOTE

See [Figure 1-27](#). As the piston is pushed back into the caliper, fluid level may rise higher than the upper fluid level (3) in the reservoir (1). You may have to remove fluid to allow for this.

2. See [Figure 1-27](#). Remove rear master cylinder reservoir cap (2).

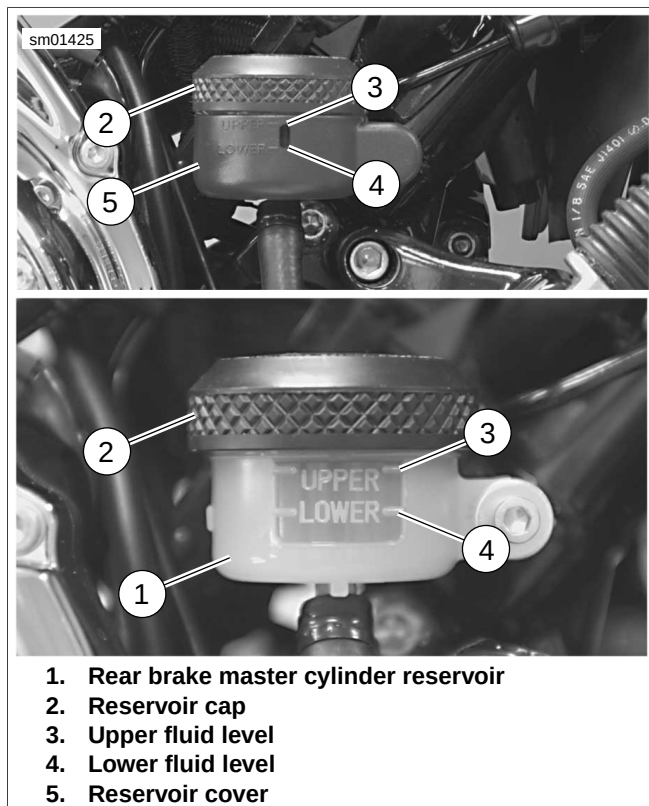


Figure 1-27. Rear Brake Master Cylinder Reservoir: XL Models

3. Press against the side of the brake caliper body to push the outside brake pad (pad closest to caliper piston) back. This pushes the caliper piston back into its bore.

NOTES

- See [Figure 1-28](#). When replacing rear brake pads, make sure pad spring does not become dislodged and fall out.

If it does, you will have to reinstall it before installing new pads.

- The rear brake caliper does NOT use the same brake pad set as the front left and front right (not present on all models) calipers.

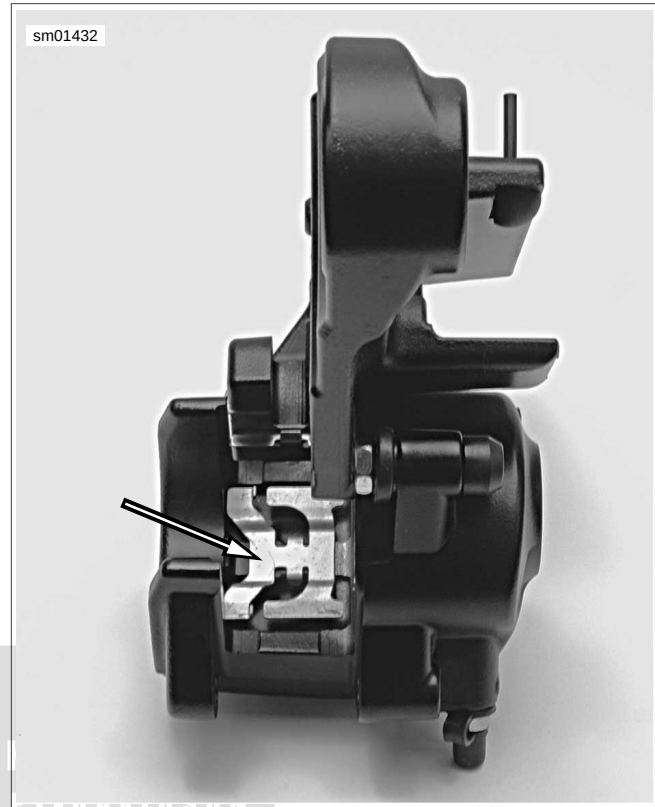


Figure 1-28. Rear Caliper Pad Spring

4. See [Figure 1-29](#). Remove pad pin plug (3).
5. See [Figure 1-30](#). Loosen, but do not remove, brake pad pin.

NOTE

Do not completely remove brake pad pin from caliper during the next step. Completely removing pad pin at this time may cause difficulty during assembly.

6. Once the piston has been fully retracted into its bore, pull pad pin part way until inside pad drops free. Note the pad's original orientation for replacement purposes.

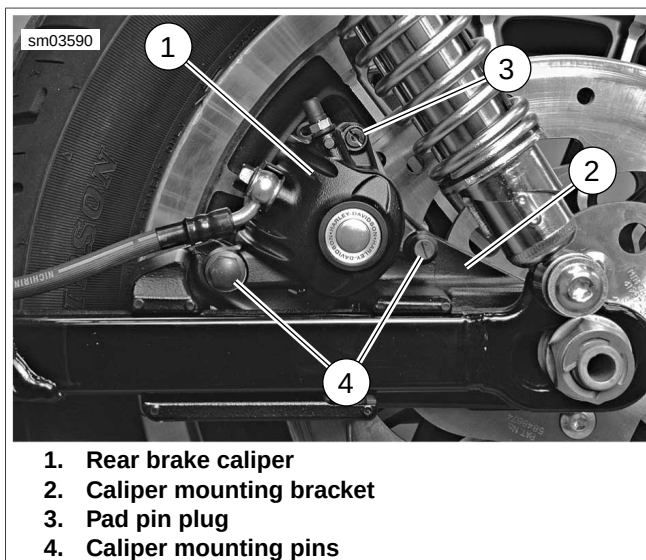


Figure 1-29. Rear Caliper Assembly



Figure 1-30. Brake Pad Pin (Plug Removed)

7. See [Figure 1-31](#). Install **new** inside brake pad (2) using same orientation as pad previously removed. Make sure front mounting tab (3) is seated in slot (6) in caliper mounting bracket (5) and pad friction material faces brake disc.
8. While holding **new** inside pad in place, pull pad pin out and remove outside brake pad (1). Note the pad's original orientation for replacement purposes.
9. Install **new** outside brake pad using the same orientation as pad previously removed. Make sure front mounting tab is seated in slot in caliper mounting bracket and pad friction material faces brake disc.
10. Temporarily insert a 1/8-in. (3.175 mm) drill bit in caliper pad pin hole to hold pads in place.
11. Inspect pad pin for grooving and wear. Measure pad pin diameter in an unworn area, and then in the area of any grooving or wear. If wear is more than 0.011 in. (0.28 mm), replace pin.
12. Press brake pads firmly up against pad spring, remove drill bit and install pad pin. Tighten to 131-173 **in-lbs** (14.8-19.6 Nm).

NOTE

If pad pin does not fit, check the following:

- You are using a set of pads, not two identical pads.
 - Pad spring orientation must match [Figure 1-28](#).
 - See [Figure 1-31](#). Pad front mounting tabs (3) must be fully seated in mounting bracket slot (6).
 - Pads must be pushed tight up against pad spring before pad pin is installed.
13. See [Figure 1-29](#). Install pad pin plug (3). Tighten to 18-25 **in-lbs** (2.0-2.9 Nm).

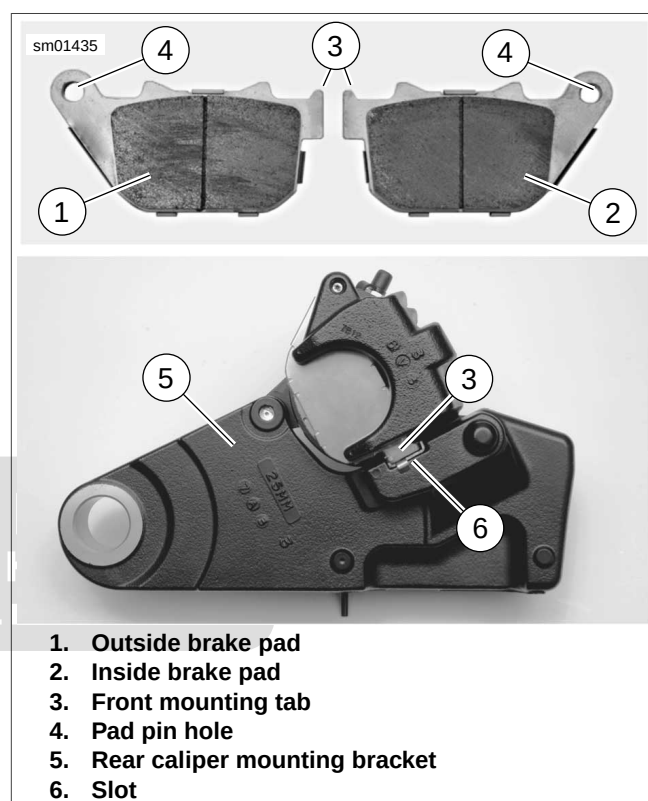


Figure 1-31. Rear Brake Pads

⚠ WARNING

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

14. Pump brake pedal to move piston out until it contacts outside brake pad. Verify piston location against pad.

⚠ CAUTION

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

CAUTION

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

NOTES

- If D.O.T. 4 brake fluid contacts painted surfaces, IMMEDIATELY flush area with clear water.
 - Rear brake master cylinder reservoir must be in a level position when filling and checking fluid level.
 - See [Figure 1-27](#). Reservoir cover (5) may be removed from rear brake master cylinder reservoir (1) to more easily verify fluid level in reservoir.
15. See [Figure 1-27](#). If desired, remove rear brake master cylinder reservoir cover (5) by grasping cover and gently pulling it straight away from reservoir (1).
16. Check brake fluid level in master cylinder reservoir. If necessary, add HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID to reservoir until fluid reaches upper fluid level (3).

17. Replace master cylinder reservoir cap (2). Replace reservoir cover (5), if removed.

WARNING

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

18. Test brake system.
- a. Turn ignition switch ON. Pump brake pedal to verify operation of the rear brake lamp.
 - b. Test ride motorcycle at low speed. If the brakes feel spongy, bleed the system. See [1.8 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.



BRAKE PADS AND DISCS: XR MODELS

1.10

INSPECTION

Brake Pads

WARNING

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

CAUTION

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

CAUTION

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

See [Figure 1-32](#). Replace brake pads if thickness (1) of brake pad friction material (3) is worn to 0.040 in. (1.02 mm) or less. Always replace both pads in a caliper as a set. See [1.10 BRAKE PADS AND DISCS: XR MODELS, Brake Pad Replacement: Front](#) or [1.10 BRAKE PADS AND DISCS: XR MODELS, Brake Pad Replacement: Rear](#).

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

Brake Disc Thickness, Lateral Runout and Warpage

The minimum brake disc (4) thickness is stamped on the side of the disc. Replace disc if worn past minimum thickness or badly scored.

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

- To replace front brake disc(s), see [2.4 WHEELS, Front Wheel](#).
- To replace rear brake disc, see [2.4 WHEELS, Rear Wheel](#).

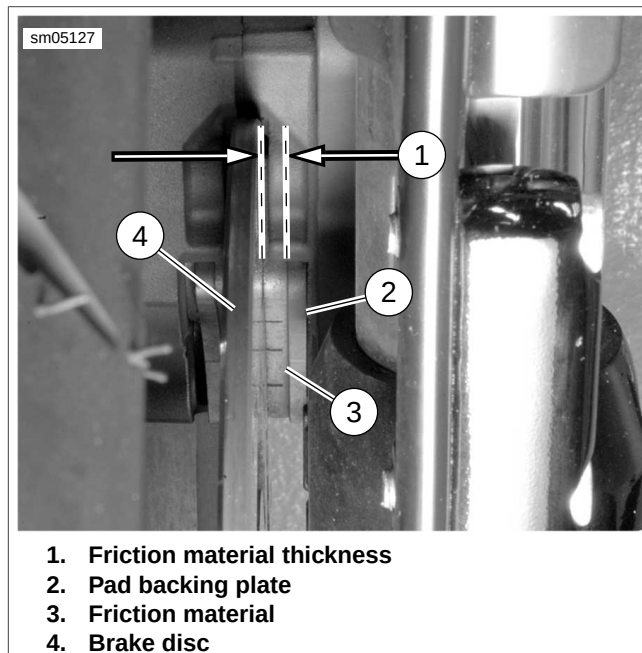


Figure 1-32. Brake Pad Inspection (front brake shown)

BRAKE PAD REPLACEMENT: FRONT

Removal

CAUTION

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

NOTES

- If D.O.T. 4 brake fluid contacts painted surfaces, IMMEDIATELY flush area with clear water.
- Cover handlebar switches with a shop towel before adding brake fluid to front master cylinder reservoir. Spilling brake fluid on handlebar switches may render them inoperative.

- Position motorcycle so that front master cylinder reservoir is level.
- See [Figure 1-33](#). Remove two screws (5), reservoir cover (4), diaphragm plate (3) and diaphragm (2) from master cylinder reservoir (1).

NOTE

As the pistons are pushed back into the caliper, fluid level may rise higher than fluid level mark at about 1/4-in. (6.35 mm) below top of reservoir. Remove fluid as necessary to prevent overflow.

- Wrap a shop towel around the master cylinder reservoir to contain any brake fluid spills.

4. Pry between the brake pads and brake disc to force all caliper pistons back into their bores. Use care not to scratch the rotor or cause warpage.

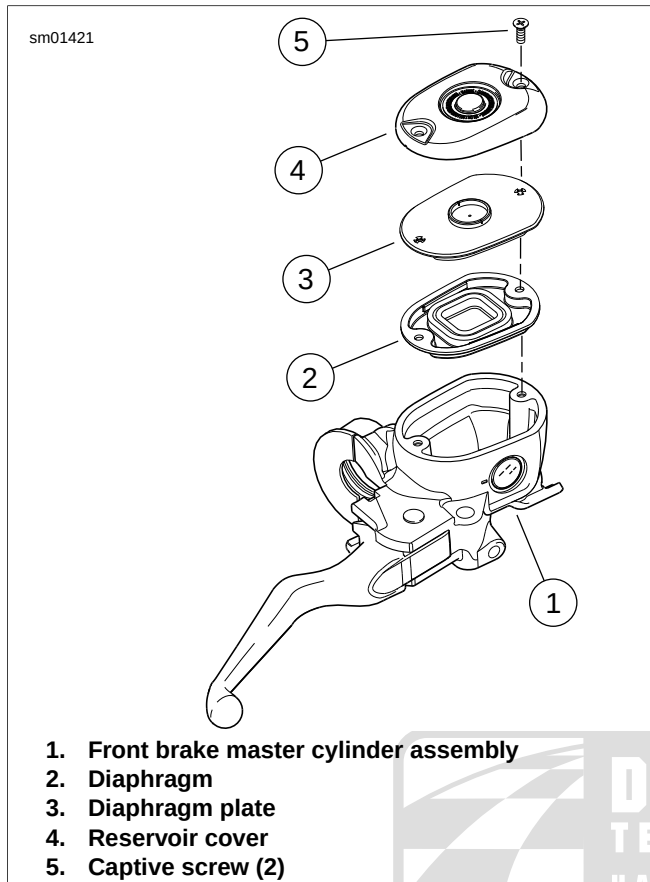


Figure 1-33. Front Brake Master Cylinder Cover Assembly (Typical)

5. See [Figure 1-34](#). Remove pad pins (1).
6. Remove pad spring (2) and brake pads through opening in caliper assembly.

NOTE

The pad pins are manufactured with a relief near the center of their length, where the pad spring touches. Do not use this area as a measurement point to determine pad pin wear.

7. Inspect pad pin for grooving and wear. Measure pad pin diameter in an unworn area, and then in the area of any grooving or wear. If wear is more than 0.011 in. (0.28 mm), replace pin.
8. Inspect pad spring for wear or cracks. If worn or damaged, replace.

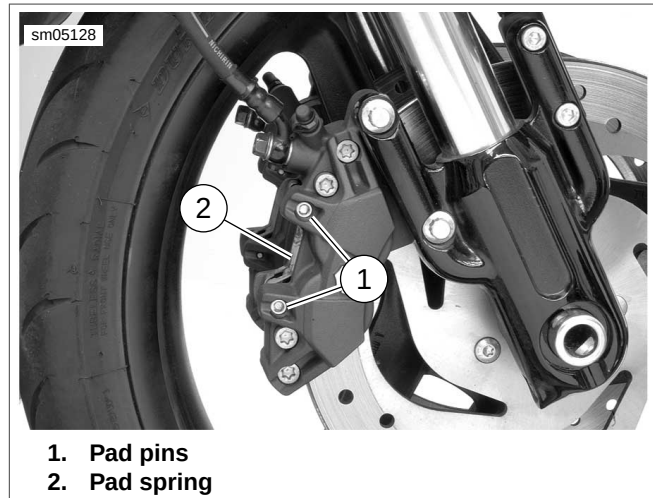


Figure 1-34. Front Caliper Assembly: XR Models

Installation

NOTE

See [Figure 1-35](#). When replacing front brake pads, make sure pad spring is installed with the arrow and word "UP" (2) pointing up, and captured by both pad pins (3).

1. See [Figure 1-34](#). Install **new** outer brake pad and pad spring. Make sure friction material faces brake disc.

NOTES

If pad pin does not fit, check the following:

- You are using the correct set of pads.
 - Pad spring orientation must match [Figure 1-35](#).
 - Pads must be pushed tight up against pad spring before pad pins are installed.
2. While holding **new** outer pad in place, insert pad pins through holes in tabs of pad and into pad spring.
 3. Install **new** inner brake pad, making sure friction material faces brake disc.
 4. Push pad pins through holes in tabs of inner pad and into holes in caliper housing.
 5. Tighten pad pins to 131-173 **in-lbs** (14.8-19.6 Nm).

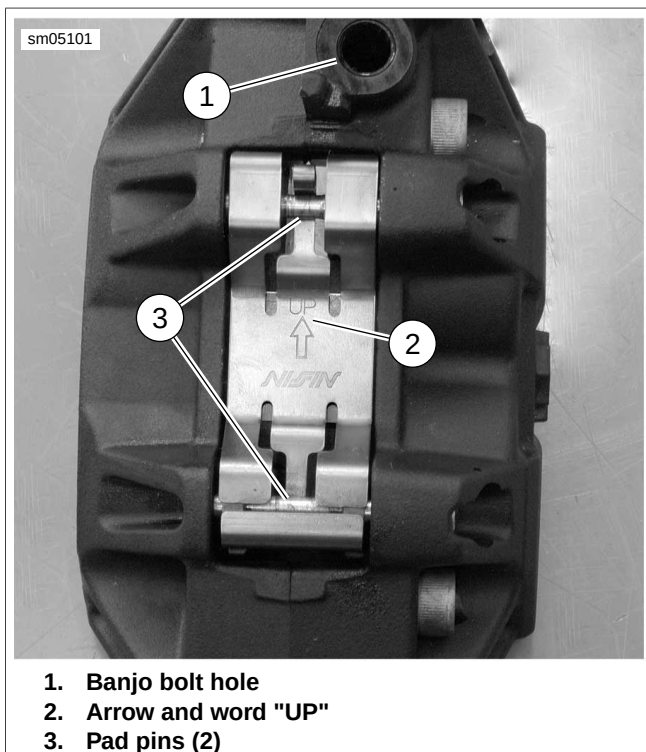


Figure 1-35. Front Caliper Pad Spring Orientation

⚠ WARNING

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

6. Pump brake lever to move pistons out until they contact outside brake pad. Verify piston location against pad.

⚠ CAUTION

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

CAUTION

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

NOTE

If D.O.T. 4 brake fluid contacts painted surfaces, IMMEDIATELY flush area with clear water.

7. See [Figure 1-36](#). Check brake fluid level in master cylinder. Add enough HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID to reservoir to bring fluid level even with ridge (1) cast into inside of reservoir, about 1/4 in. (6.35 mm) below top edge.



Figure 1-36. Filling Front Master Cylinder Reservoir (Typical)

8. See [Figure 1-33](#). Install diaphragm (2), diaphragm plate (3), reservoir cover (4) and screws (5) on front brake master cylinder reservoir. Tighten screws to 9-17 in-lbs (1.0-2.0 Nm).

⚠ WARNING

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

9. Test brake system.
 - a. Turn ignition switch ON. Pump brake lever to verify operation of the brake lamp.
 - b. Test ride the motorcycle. If the brakes feel spongy, bleed the system. See [1.8 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.

BRAKE PAD REPLACEMENT: REAR

Removal

CAUTION

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

NOTES

- Do **not** remove rear caliper from mounting bracket unless caliper mounting pins and boots require service. Removing caliper from mounting bracket unnecessarily increases the risk of contaminants falling into caliper boots and

bushings which could damage caliper during vehicle operation.

- See [Figure 1-38](#). It is **not** required or recommended to remove or loosen the caliper mounting fasteners (3).
- It is **not** necessary or recommended to remove the rear brake caliper from the caliper mounting bracket to replace pads.
- If D.O.T. 4 brake fluid contacts painted surfaces, IMMEDIATELY flush area with clear water.

1. Place motorcycle in an upright, level position.
2. Remove rear master cylinder reservoir cover.
3. Place a suitable container under the rear master cylinder to catch any fluid that may overflow.

NOTE

As the piston is pushed back into the caliper, fluid level may rise higher than the upper fluid level in the reservoir. Remove fluid as necessary to avoid fluid overflow.

4. Press against the outside of the brake caliper body to push the caliper piston back into its bore, forcing fluid back to the reservoir.

NOTE

See [Figure 1-37](#). When replacing rear brake pads, make sure pad spring does not become dislodged and fall out. If it does, reinstall it before installing new pads.

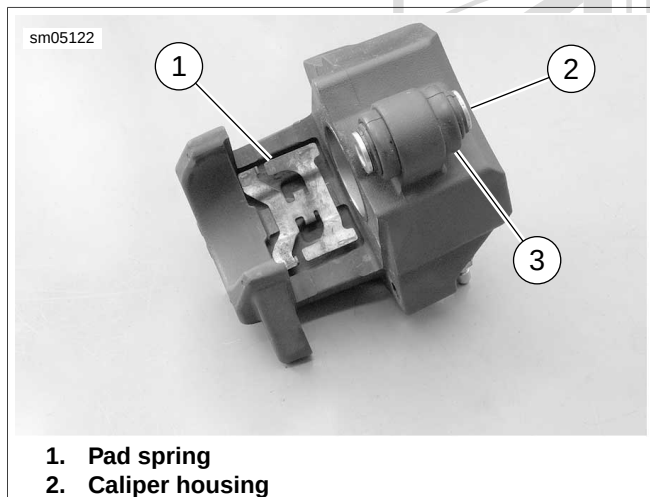


Figure 1-37. Rear Caliper Pad Spring

NOTE

Left shock absorber is disconnected from rear fork for clarity of photograph. Pad replacement does not require the shock be disconnected.

5. See [Figure 1-38](#). Remove pad pin plug (1).
6. Loosen, but do not remove, brake pad pin (2) (metric).
7. Pull pad pin part way out until inner pad drops free. Remove pad and note the pad's original orientation for replacement purposes.
8. Continue to remove pad pin until outer pad drops free.

9. Inspect pad pin for grooving and wear. Measure pad pin diameter in an unworn area, and then in the area of any grooving or wear. If wear is more than 0.011 in. (0.28 mm), replace pin.

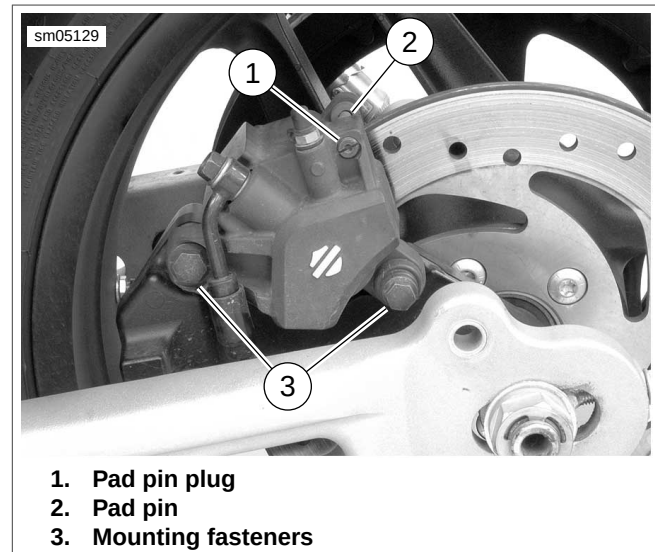


Figure 1-38. Rear Caliper Assembly

Installation

NOTE

The caliper and mounting bracket are shown removed for clarity of photograph. Removal is not required to replace brake pads.

1. See [Figure 1-39](#). Install **new** outside brake pad using the same orientation as pad previously removed. Make sure front mounting tab (3) is seated in slot (6) in caliper mounting bracket and pad friction material faces brake disc.
2. Install pad pin into caliper and through outer pad.
3. Position inner pad and continue to install pad pin while pressing brake pads firmly up against pad spring. Tighten pad pin to 131-173 **in-lbs** (14.8-19.6 Nm).

NOTE

If pad pin does not fit, check the following:

- The correct pads are being installed.
 - Pad spring orientation is correct as shown in [Figure 1-37](#).
 - See [Figure 1-39](#). Pad front mounting tabs (3) must be fully seated in mounting bracket slot (6).
 - Pads must be pushed tight up against pad spring before pad pin is installed.
4. See [Figure 1-38](#). Install pad pin plug (1). Tighten to 18-25 **in-lbs** (2.0-2.9 Nm).

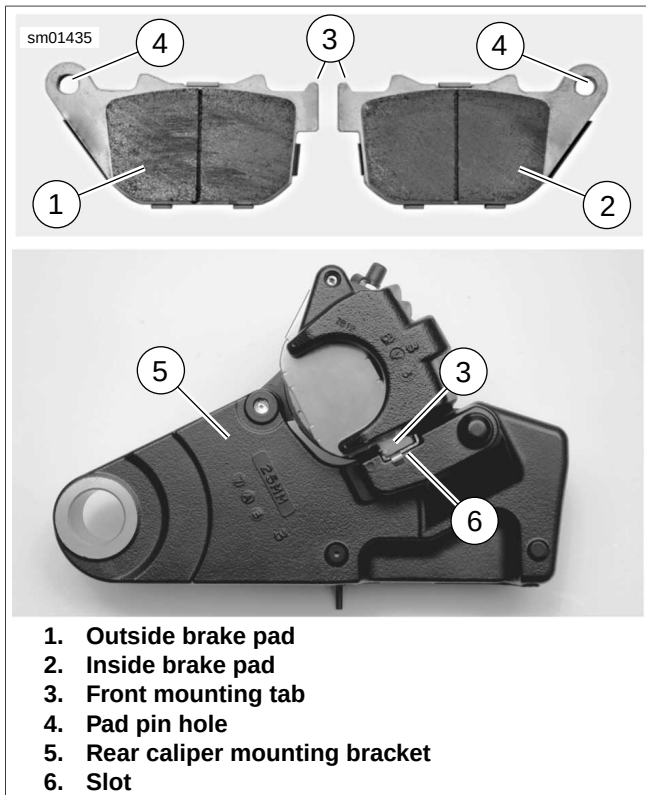


Figure 1-39. Rear Brake Pads

⚠ WARNING

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

5. Pump brake pedal to move piston out until it contacts outside brake pad. Verify piston location against pad.

⚠ CAUTION

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

NOTE

Rear brake master cylinder reservoir must be in a level position when filling and checking fluid level.

6. Remove rear brake master cylinder reservoir cover and check brake fluid level in master cylinder reservoir. If necessary, add HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID to reservoir until fluid reaches upper fluid level.
7. Replace reservoir cover.

⚠ WARNING

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

8. Test brake system.
 - a. Turn ignition switch ON. Pump brake pedal to verify operation of the rear brake lamp.
 - b. Test ride motorcycle at low speed. If the brakes feel spongy, bleed the system. See [1.8 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.

TIRES AND WHEELS

1.11

TIRES

⚠ WARNING

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

⚠ WARNING

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

⚠ WARNING

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

NOTES

- Inner tubes must not be used in radial tires and radial tires must not be used on laced (wire spoked) wheels.
- Tubeless tires are used on all Harley-Davidson cast and disc wheels.
- Tire sizes are molded on the tire sidewall. Inner tube sizes are printed on the tube.
- New tires should be stored on a horizontal tire rack. Avoid stacking new tires in a vertical stack. The weight of the stack compresses the tires and closes down the beads.

Check tire pressure and tread:

- As part of the pre-ride inspection.
 - At every scheduled service interval.
1. Inspect each tire for punctures, cuts and breaks.
 2. Inspect each tire for wear. Replace tires before they reach the tread wear indicator bars.

NOTE

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

3. Check for proper front and rear tire pressures when tires are cold. Compare results against [Table 1-9](#).

Table 1-8. Tire Sizes: 2009 Sportster Models

MODEL	MOUNT	SIZE	NUMBER
XR 1200	front	18 in.	D209 120/70 ZR 18
XR 1200	rear	17 in.	D209 180/55 ZR 17
XL 883, XL 883R, XL 883L, XL 1200R, XL 1200L, XL 1200N	front	19 in.	D401F 100/90-19
XL 883C, XL 1200C	front	21 in.	D402F MH90-21
All XL models	rear	16 in.	D401 150/80B16
2009 vehicles use Dunlop Harley-Davidson tires only.			

Table 1-9. Tire Pressures: 2009 Sportster Models

MODEL	TIRE PRESSURE (COLD)			
	FRONT		REAR	
	PSI	kPa	PSI	kPa
XL models (solo rider)	30	206	36	248
XL models (rider and passenger)	30	206	40	275
XR models (solo rider)	36	248	38	262
XR 1200 (rider and passenger)	36	248	42	290

TIRE REPLACEMENT

Inspection

⚠ WARNING

Harley-Davidson tires are equipped with wear bars that run horizontally across the tread. When wear bars become visible and only 1/32 in. (0.8 mm) tread depth remains, replace tire immediately. Using a worn tire can adversely affect stability and handling, which could result in death or serious injury. Use only Harley-Davidson approved replacement tires. (00090b)

See [Figure 1-40](#). Arrows on tire sidewalls pinpoint location of wear bar indicators.

Tread wear indicator bars will appear on tire tread surfaces when 1/32 in. (0.8 mm) or less of tire tread remains. See [Figure 1-41](#). Always replace tires before the tread wear indicator bars appear.

When To Replace Tires

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

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

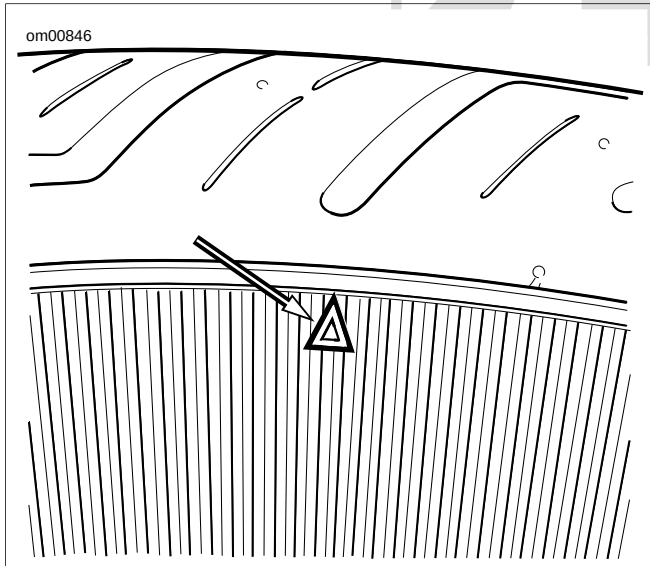


Figure 1-40. Tire Sidewall Wear Bar Locator

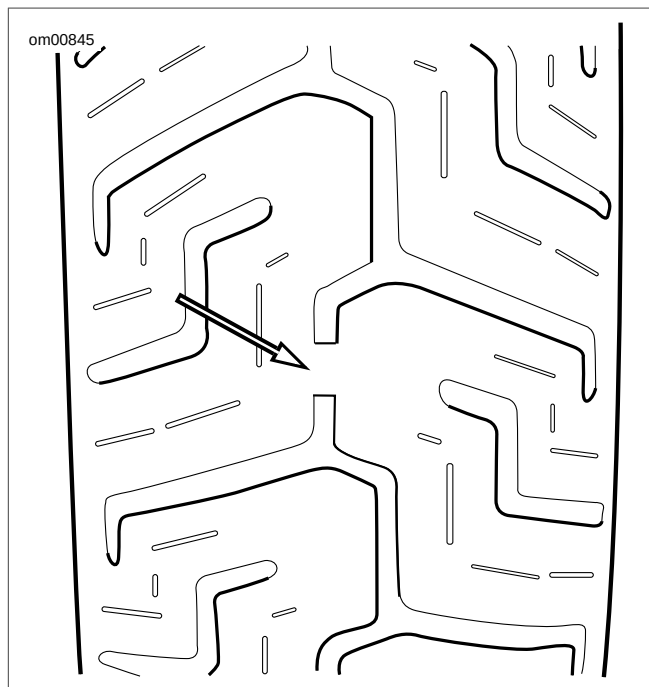


Figure 1-41. Wear Bar Appearance (Typical)

WHEEL BEARINGS

1. Replace when bearings exceed end play service wear limit of 0.002 in. (0.051 mm).
2. Inspect any time the wheels are removed.
 - a. Inspect the play of the wheel bearings by finger while they are in the wheel.
 - b. Rotate the inner bearing race and check for abnormal noise.
 - c. Make sure bearing rotates smoothly.
3. Check wheel bearings and axle spacers for wear and corrosion. Excessive play or roughness indicates worn bearings. Replace bearings in sets only. See [2.4 WHEELS, Sealed Wheel Bearings](#).

WHEEL SPOKES

⚠ WARNING

Spokes that are too tight can draw nipples through the rim or distort hub flanges. Spokes that are too loose can continue to loosen when put in service. Either condition can adversely affect stability and handling, which could result in death or serious injury. (00286a)

CAUTION

If nipples require more than one full turn to tighten spoke, remove tire to check that spoke protrusion has not damaged tube. (00526b)

1. Raise motorcycle wheel off the ground.

NOTE

Perform the entire procedure for each spoke, one at a time.

2. Mark one of the spokes with a reference mark to the rim.
3. Loosen spoke 1/4 turn.

NOTES

- *Use a spoke torque wrench to tighten spokes.*
 - *Do not tighten spoke more than 1/4 turn past reference mark. If more tension is needed, label spoke and check after completing rest of wheel.*
4. Tighten spoke to reference mark. If torque is less than the value listed in [Table 1-10](#), continue to tighten spoke until it reaches the listed torque.

5. Once the entire wheel has been checked, repeat procedure for each labeled spoke.
6. If more than a few spokes were loose, true the entire wheel following procedure under [2.8 TRUING LACED WHEELS](#).

Table 1-10. Spoke Nipple Torque Specification

RIM TYPE	MINIMUM TORQUE
All	55 in-lbs (6.2 Nm)



PRIMARY CHAIN

1.12

INSPECTION

See [Figure 1-42](#). 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).

NOTES

- See [Figure 1-43](#). Refer to [Table 1-11](#). A properly adjusted primary chain should have the specified vertical free play in its upper strand. Be sure the measurement is taken midway between engine and clutch sprockets with sprockets rotated to the tightest chain position.
- Always measure the vertical free play with the sprockets rotated to several different positions. The tightest measurement observed must be within specifications shown in [Table 1-11](#).
- The initial primary chain vertical free play specification used at the Harley-Davidson assembly plant is 1/4-3/8 in. (6.35-9.53 mm) with a cold engine. The 1/4 in. (6.35 mm) minimum is only allowed at the absolute tightest point in the drive, as measured with precision factory equipment. If a chain has less than 1/4 in. (6.35 mm) vertical free play (with a cold engine), adjust free play to the "field" specification of 3/8-1/2 in. (9.53-12.70 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 [1.14 TRANSMISSION LUBRICANT](#).
- 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 [5.5 PRIMARY DRIVE AND CLUTCH: XL MODELS](#).

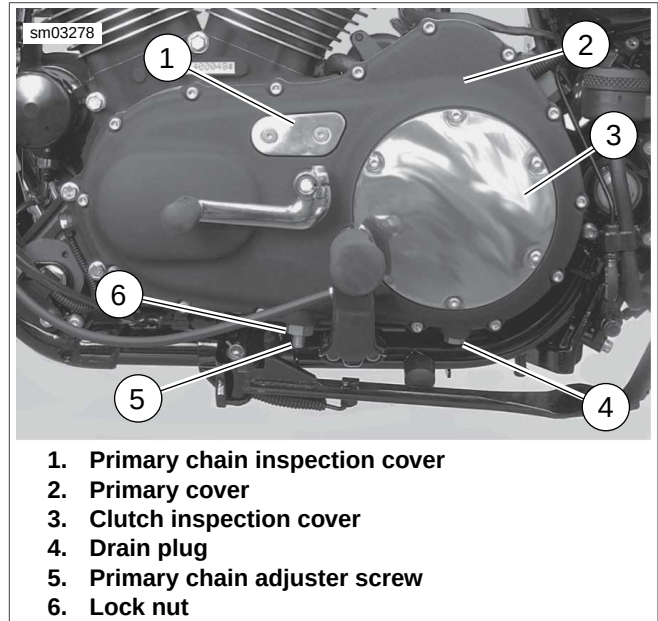


Figure 1-42. Primary Cover: All Models (XL Model Shown)

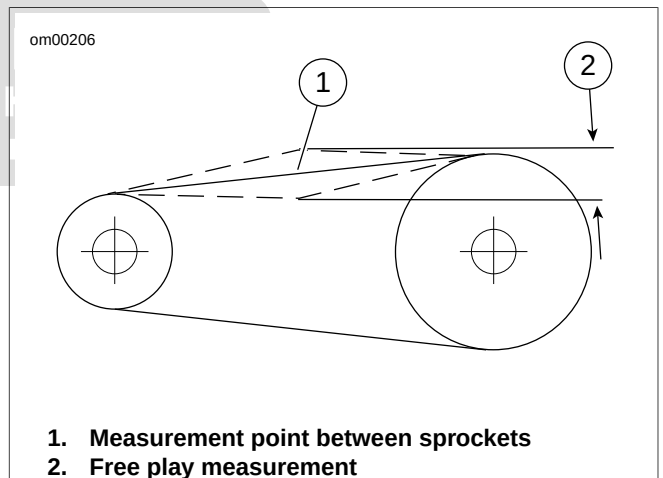


Figure 1-43. Primary Chain Vertical Free Play: Sportster Models

Table 1-11. Primary Chain Adjustment: Sportster Models

FREE PLAY	INCHES	MILLIMETERS
COLD engine	3/8-1/2	9.5-12.7
HOT engine	1/4-3/8	6.3-9.5

ADJUSTMENT

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

See [Figure 1-42](#). The primary chain can be adjusted without removing the primary cover (2). Proceed as follows:

1. Unplug main fuse. See [6.38 MAIN FUSE](#).
2. Remove two hex socket screws securing primary chain inspection cover (1).
3. Rotate sprockets to find tightest point on primary chain.

CAUTION

Do not adjust the primary chain tighter than specified. Running chain too tight will result in excessive wear. (00202a)

4. Loosen lock nut (6). Using a 1/4-inch allen wrench, turn chain adjuster screw (5) clockwise (inward) to reduce free

play or counterclockwise (outward) to increase free play. Vertical free play must fall within the limits specified in [Table 1-11](#).

NOTE

If vertical free play cannot be set within the limits specified in [Table 1-11](#), then primary chain and/or chain adjuster are worn beyond adjustment limits. Replace parts as necessary. See [5.3 PRIMARY CHAIN ADJUSTER](#).

5. See [Figure 1-42](#). When tension is set correctly, hold chain adjusting screw with allen wrench and tighten lock nut (6) to 20-25 ft-lbs (27.1-33.9 Nm).
6. Install primary chain inspection cover (1) and **new** gasket. Tighten hex socket screws to 84-120 **in-lbs** (9.5-13.6 Nm).
7. Plug in main fuse. See [6.38 MAIN FUSE](#).



CLUTCH

1.13

ADJUSTMENT

All models feature a primary cover and a quick-release clutch cable to simplify both clutch service and adjustment. See [Figure 1-44](#). Clutch cable adjuster is located in middle of cable, adjacent to left frame downtube.



Figure 1-44. Clutch Cable Adjuster Location (typical; XL model shown)

1. See [Figure 1-45](#). Slide rubber boot (1) off cable adjuster (2).
2. Holding cable adjuster with 1/2 inch wrench, loosen jam nut (3) using a 9/16 inch wrench. Back jam nut away from cable adjuster. Screw adjuster toward jam nut to introduce a large amount of free play at hand lever.
3. **XL models equipped with mid-mount foot controls:** remove left side rider footrest and mounting bracket assembly. See [2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS](#) for removal.
XR models: remove left side rider footrest, mounting bracket assembly, and shift linkage. See [2.42 RIDER FOOT CONTROLS: XR MODELS](#) for removal.
4. See [Figure 1-46](#). Remove six screws (1) and remove clutch inspection cover (2). Remove and discard quad ring (7).
5. Remove hex lockplate with attached spring (3) from flats of adjusting screw assembly (8). Turn adjusting screw counterclockwise until resistance is felt. Back off adjusting screw 1/4 turn.
6. Slide hex lockplate with spring 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.

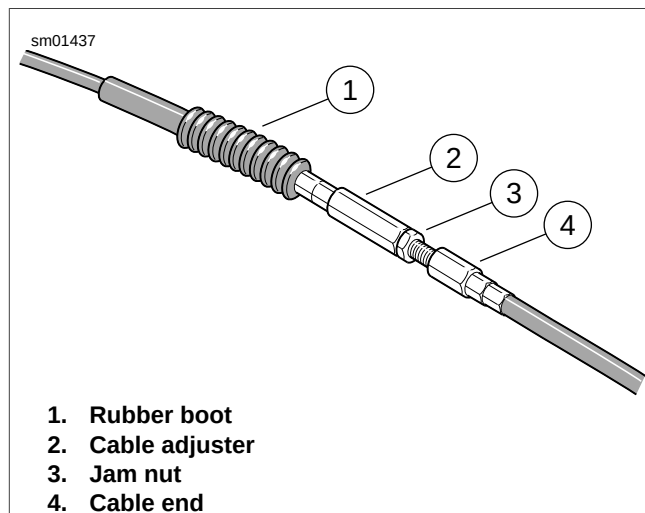
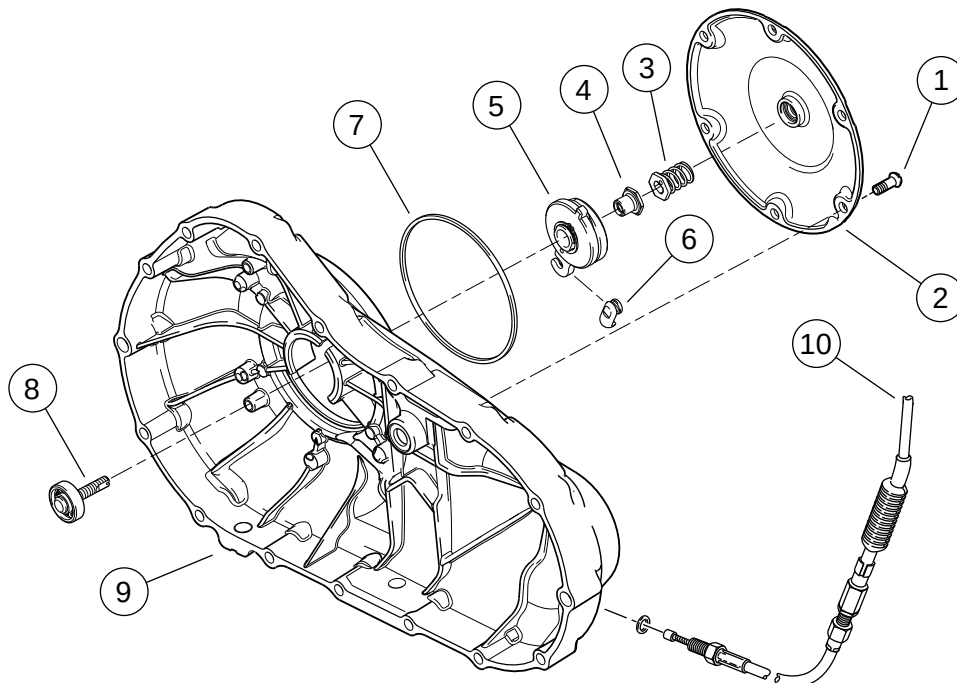


Figure 1-45. Clutch Cable Adjuster Mechanism

7. Install **new** quad ring. Verify that quad ring is fully seated in groove of primary cover. Install clutch inspection cover and secure with six screws. Tighten screws in a crosswise pattern to 84-108 **in-lbs** (9.5-12.2 Nm).
8. See [Figure 1-45](#). Turn cable adjuster (2) clockwise away from jam nut (3) until slack is eliminated.
9. See [Figure 1-47](#). Pull clutch cable ferrule away from clutch lever bracket to check free play. Turn cable adjuster as necessary to obtain 1/16-1/8 in. (1.6-3.2 mm) free play between end of cable ferrule and clutch lever bracket.
10. See [Figure 1-45](#). Hold adjuster (2) with 1/2 inch wrench. Using 9/16 inch wrench, tighten jam nut (3) against cable adjuster. Cover cable adjuster mechanism with rubber boot (1).
11. Secure cable in cable retainers attached to down tube.
12. **XL models equipped with mid-mount foot controls:** install left side rider footrest and mounting bracket assembly. Tighten footrest bracket mounting screws to 45-50 ft-lbs (61-68 Nm). See [2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS](#) for installation.
XR models: install left side rider footrest, shifter and mounting bracket assembly, and shift linkage. Tighten footrest bracket mounting screws to 45-50 ft-lb (61.0-67.8 Nm). Tighten linkage fastener to 10-15 ft-lbs (13.6-20.3 Nm). See [2.42 RIDER FOOT CONTROLS: XR MODELS](#) for installation.

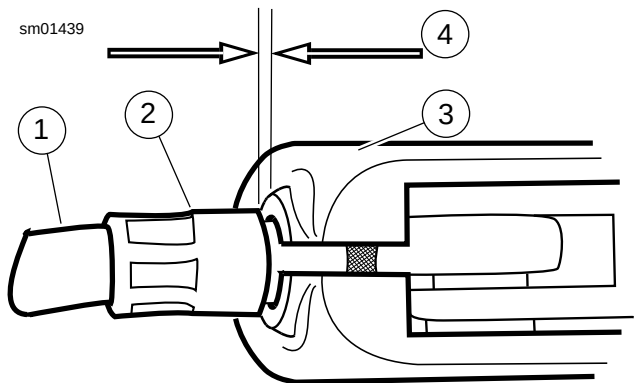
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1. Screw (6)
2. Clutch inspection cover
3. Hex lockplate and spring
4. Nut
5. Ramp assembly
6. Coupling
7. Quad ring
8. Clutch adjusting screw assembly
9. Primary cover
10. Clutch cable

Figure 1-46. Clutch Release Mechanism

sm01439



1. Clutch cable
2. Cable ferrule
3. Clutch lever bracket
4. Adjustment range

Figure 1-47. Clutch Freeplay: Adjust for 1/16-1/8 in. (1.6-3.2 mm) Gap Between Ferrule and Bracket

TRANSMISSION LUBRICANT

1.14

TRANSMISSION LUBRICATION: SPORTSTER MODELS

Refer to [Table 1-3](#). The transmission should be drained and refilled with fresh lubricant at proper intervals. For best results, drain lubricant while hot.

NOTE

When checking the transmission lubricant level, motorcycle should be standing **STRAIGHT UP**, not leaning on the jiffy stand. Keep motorcycle upright for a short period of time to equalize lubricant level in the transmission compartments.

CAUTION

When draining or adding lubricant, do not allow dirt, debris or other contaminants to enter the engine. (00198a)

WARNING

Be sure that no lubricants or fluids get on tires, wheels or brakes when changing fluid. Traction can be adversely affected, which could result in loss of control of the motorcycle and death or serious injury. (00047d)

CAUTION

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

Check Lubricant Level

1. Ride motorcycle until engine is warmed up to normal operating temperature.
2. Position motorcycle straight up.

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

3. Remove main fuse. See [6.38 MAIN FUSE, Removal](#).
4. **XL models equipped with mid-mount foot controls:** remove left side rider footrest and mounting bracket assembly. See [2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS](#) for removal.
XR models: remove left side rider footrest, mounting bracket assembly, and shift linkage. See [2.42 RIDER FOOT CONTROLS: XR MODELS](#) for removal.
5. See [Figure 1-48](#). Remove screws with washers from clutch inspection cover (1). Remove clutch inspection cover from primary cover.

NOTE

The filler access is the clutch inspection cover.

6. See [Figure 1-49](#). Verify that lubricant level is even with bottom of clutch diaphragm spring.

NOTE

Add only enough of **GENUINE Harley-Davidson FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT** (Part No. 98851-05 quart) through clutch inspection cover opening until the lubricant reaches the bottom of clutch diaphragm spring.

7. Install **new** quad ring. Verify that quad ring is fully seated in groove of primary cover. Install clutch inspection cover and secure with six screws. Tighten screws in a crosswise pattern to 84-108 **in-lbs** (9.5-12.2 Nm).
8. **XL models equipped with mid-mount foot controls:** install left side rider footrest and mounting bracket assembly. Tighten footrest bracket mounting screws to 45-50 ft-lbs (61-68 Nm). See [2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS](#) for installation.
XR models: install left side rider footrest, shifter and mounting bracket assembly, and shift linkage. Tighten footrest bracket mounting screws to 45-50 ft-lb (61.0-67.8 Nm). Tighten linkage fastener to 10-15 ft-lbs (13.6-20.3 Nm). See [2.42 RIDER FOOT CONTROLS: XR MODELS](#) for installation.

9. Install main fuse.
10. Start engine. Check for any lubricant leaks.
11. Turn engine off.

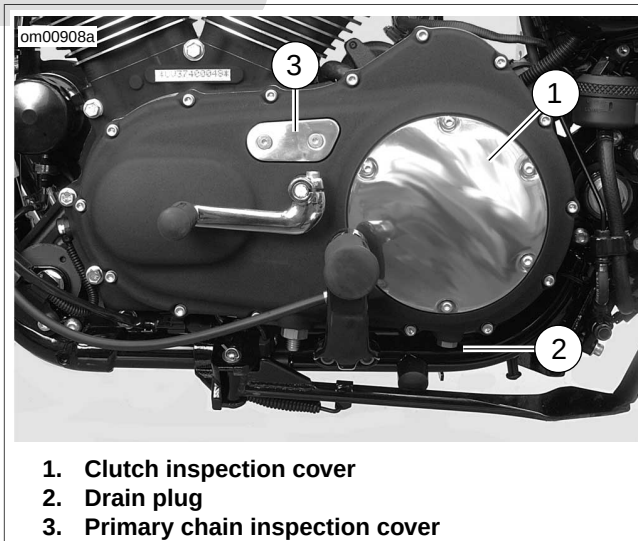


Figure 1-48. Primary Cover: Sportster Models (XL Model Shown)

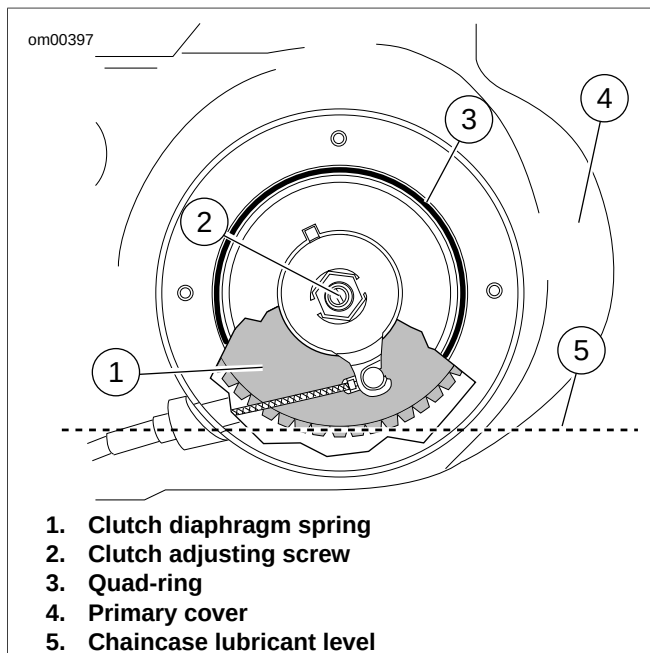


Figure 1-49. Chaincase Lubricant Level: Sportster Models

Changing Lubricant

1. Ride motorcycle until engine is warmed up to normal operating temperature.
2. When the engine reaches normal operating temperature, turn the engine off and position motorcycle on jiffy stand. This will allow the chaincase lubricant to drain out of transmission.

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

3. Remove main fuse. See [6.38 MAIN FUSE, Removal](#).

4. See [Figure 1-48](#). Position a suitable container under transmission drain plug (2).
5. The drain plug is located under the clutch, on the underside of the chaincase. Remove drain plug and drain lubricant.
6. Position the motorcycle STRAIGHT UP and LEVEL. This allows additional fluid to be drained from clutch compartment.

NOTE

Dispose of lubricant in accordance with local regulations.

CAUTION

Do not over-tighten filler or drain plug. Doing so could result in a lubricant leak. (00200b)

7. Remove foreign material from magnetic drain plug. Replace O-ring if torn or damaged. Apply LOCTITE 565 (white) to drain plug and tighten to 14-30 ft-lbs (19.0-40.7 Nm).
8. Remove inspection cover from primary cover. See [1.14 TRANSMISSION LUBRICANT, Transmission Lubrication: Sportster Models](#).

NOTE

The filler access is the clutch inspection cover.

9. Add 32 fluid ounces (946 milliliters) of GENUINE Harley-Davidson FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT (Part No. 98851-05 quart) through clutch inspection cover opening.
10. Install clutch inspection cover on primary cover. See [1.14 TRANSMISSION LUBRICANT, Transmission Lubrication: Sportster Models](#).
11. Install main fuse.
12. Start engine. Check for any lubricant leaks.
13. Turn engine off.

REAR BELT AND SPROCKETS

1.15

GENERAL

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.

⚠ WARNING

Never bend belt forward into a loop smaller than the drive sprocket diameter. Never bend belt into a reverse loop. Over bending can damage belt resulting in premature failure, which could cause loss of control and death or serious injury. (00339a)

CLEANING

Keep dirt, grease, oil, and debris off the belt and sprockets. Clean the belt with a rag slightly dampened with a light cleaning agent.

INSPECTION

Sprockets

NOTE

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

1. See [Figure 1-50](#). Inspect each tooth (1) of rear sprocket for:
 - a. Major tooth damage.
 - b. Large chrome chips with sharp edges.
 - c. Gouges caused by hard objects.
 - d. Excessive loss of chrome plating (see next step).
2. To check if chrome plating has worn off, drag a scribe or sharp knife point across the bottom of a groove (2) (between two teeth) with medium pressure.
 - a. If scribe or knife point slides across groove without digging in or leaving a visible mark, chrome plating is still good.
 - b. If scribe or knife points digs in and leaves a visible mark, it is cutting the bare aluminum. A knife point will not penetrate the chrome plating.
3. Replace rear sprocket if major tooth damage or loss of chrome exists.

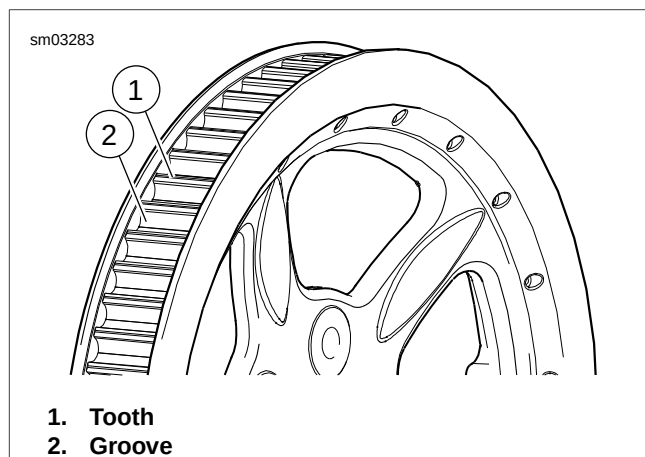


Figure 1-50. Rear Sprocket

Idler Pulley: XR Models

See [Figure 1-51](#). Inspect idler pulley for signs of uneven wear. Excessive lateral side play of 0.035 in. (0.9 mm) or roughness indicates worn bearings. Replace idler pulley as an assembly. See [5.7 DRIVE BELT](#).



Figure 1-51. Measuring Lateral Side Play on Idler Pulley

Rear Belt

See [Figure 1-52](#). Inspect drive belt for:

- Cuts or unusual wear patterns.
- Outside edge bevelling (8). Some bevelling is common, but it indicates that sprockets are misaligned.
- Outside ribbed surface for signs of stone puncture (7). If cracks/damage exists near edge of belt, replace belt immediately. Damage to center of belt will require belt replacement eventually, but when cracks extend to edge of belt, belt failure is imminent.
- Inside (toothed portion) of belt for exposed tensile cords (normally covered by nylon layer and polyethylene layer). This condition will result in belt failure and indicates worn

transmission sprocket teeth. Replace belt and transmission sprocket.

- Signs of puncture or cracking at the base of the belt teeth. Replace belt if either condition exists.
- Replace belt if conditions 2, 3, 6 or 7 (on edge of belt) exist.

NOTE

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

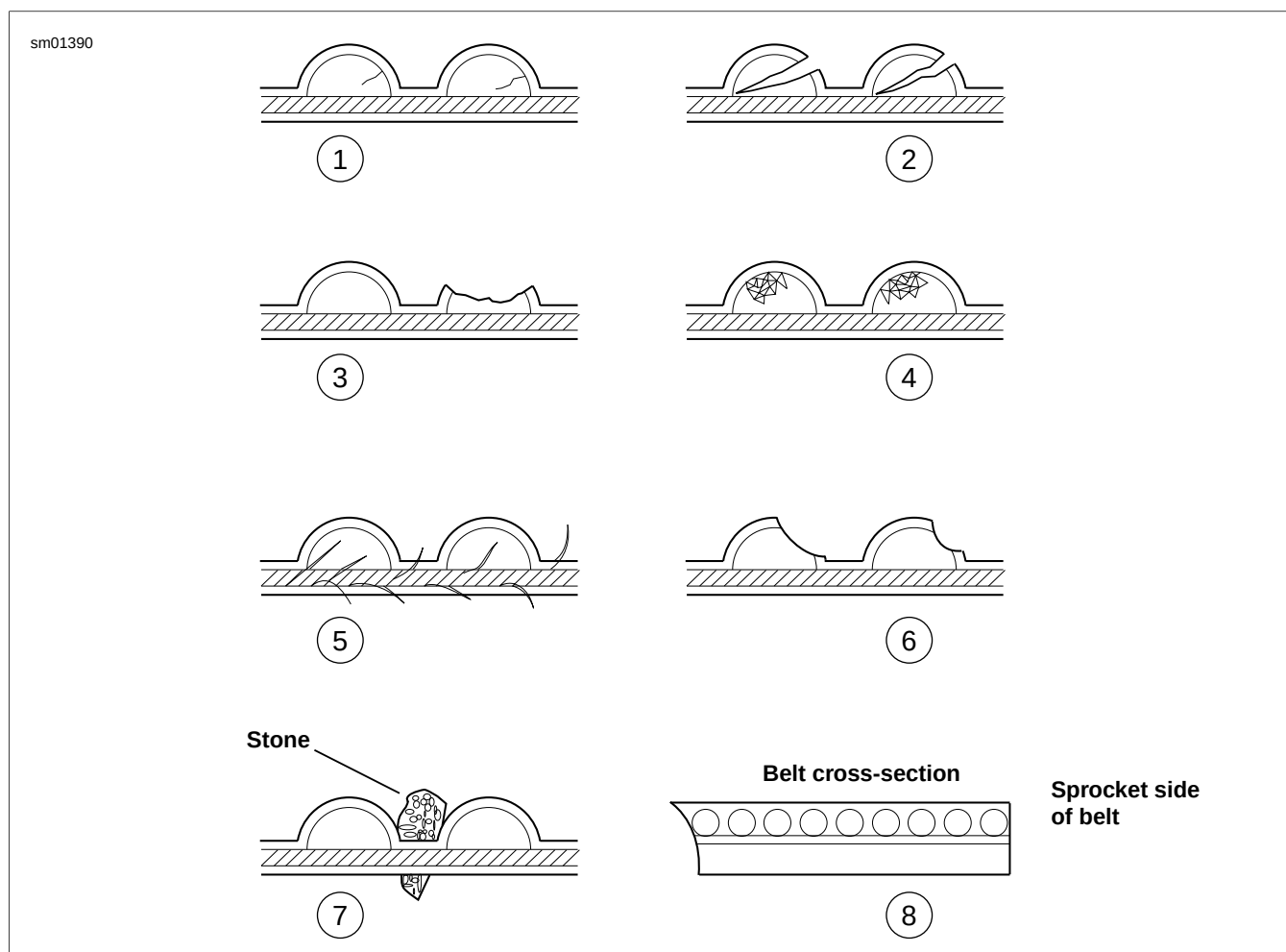


Table 1-12. Drive Belt Wear Analysis

PATTERN	CONDITION	REQUIRED ACTION
1	Internal tooth cracks (hairline)	OK to run, but monitor condition.
2	External tooth cracks	Replace belt.
3	Missing teeth	Replace belt.
4	Chipping (not serious)	OK to run, but monitor condition.
5	Fuzzy edge cord	OK to run, but monitor condition.
6	Hook wear	Replace belt and sprocket.
7	Stone damage	Replace belt if damage is on the edge.
8	Bevel wear (outboard edge only)	OK to run, but monitor condition.
XR only	Excess edge wear	Check idler bearings and bracket attachment.

REAR BELT DEFLECTION

REAR DRIVE BELT: SPORTSTER MODELS

PART NUMBER	TOOL NAME
HD-35381A	BELT TENSION GAUGE

General

The inner tooth surface of the secondary belt has a thin coating of polyethylene lubricant. During initial operation, this coating will wear off as it is burnished into the belt fabric. This is a normal condition and not an indication of belt wear.

Belt tension is set at the factory and should be checked after the first 1000 miles (1600 kilometers), at scheduled maintenance intervals, and after a hard ride.

Gauging Deflection

Check belt deflection at the loosest spot in the belt with the transmission in neutral and the motorcycle at ambient temperature.

1. With the motorcycle unladen and resting on its jiffy stand, fit the BELT TENSION GAUGE (Part No. HD-35381A) on the belt.
 - a. See [Figure 1-56](#). On XR 1200 model, fit BELT TENSION GAUGE half-way between the idler wheel and rear sprocket.
 - b. See [Figure 1-55](#). On all other models, position the gauge half-way between the transmission and rear wheel sprockets.
2. With the BELT TENSION GAUGE set to 0 lbs. (0 kg), note the current belt position.
 - a. See [Figure 1-54](#). On XR 1200 model, note the belt position according to the graduations on the front of the debris deflector.
 - b. See [Figure 1-53](#). On all other models, note the belt position according to the graduations on the belt deflection window located on the rear drive belt guard.
3. Using the BELT TENSION GAUGE, apply 10 lbs. (4.5 kg) of force to the bottom belt. Count the number of graduations between the original belt position and after applying the force. Multiply this number by 1/8 in. (3.2 mm) to determine the deflection.
4. Refer to [Table 1-13](#) for the recommended deflection. If belt tension adjustment is necessary, see a Harley-Davidson dealer or follow the belt deflection adjustment procedure in the Service Manual.

Table 1-13. Belt Deflection: Sportster Models

MODELS	INCHES	MILLIMETERS
XL 883C, XL 883L, XL 1200C, XL 1200L, XL 1200N	1/4-5/16	6.4-7.9
XL 883, XL 883R, XL 1200R	9/16-5/8	14.3-15.9
XR 1200	1/4-3/8	6.4-9.5

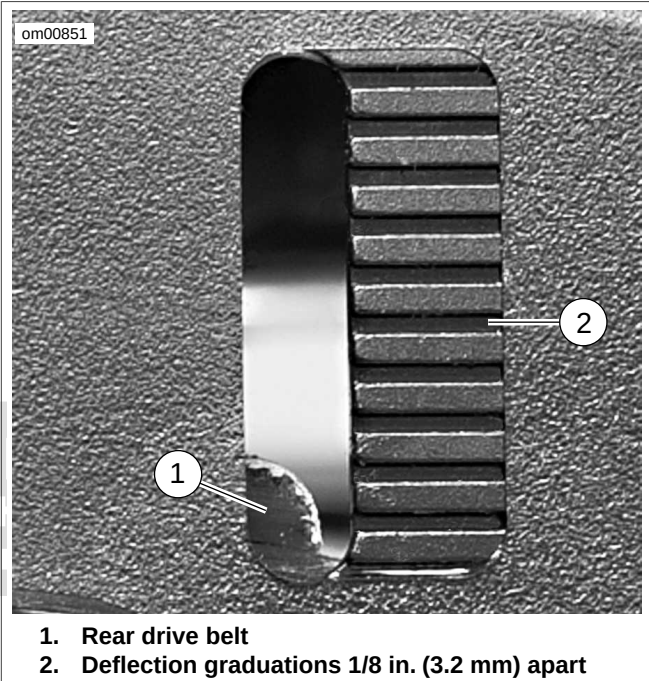


Figure 1-53. Belt Deflection Window (typical)

WARNING

Be sure wheel and brake caliper are aligned. Riding with a misaligned wheel or brake caliper can cause the brake disc to bind and lead to loss of control, which could result in death or serious injury. (00050a)

NOTE

When gauging deflection, check the rear brake caliper position on rear brake disc. Disc should run true within brake caliper.

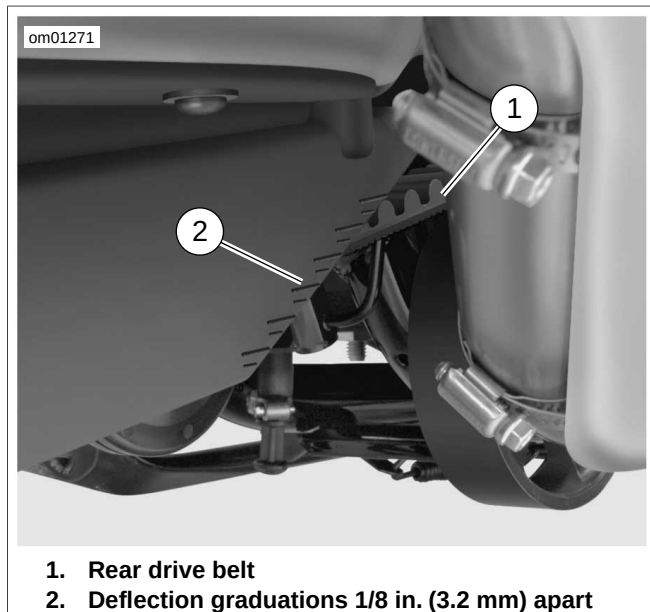


Figure 1-54. Belt Deflection: XR 1200 Model

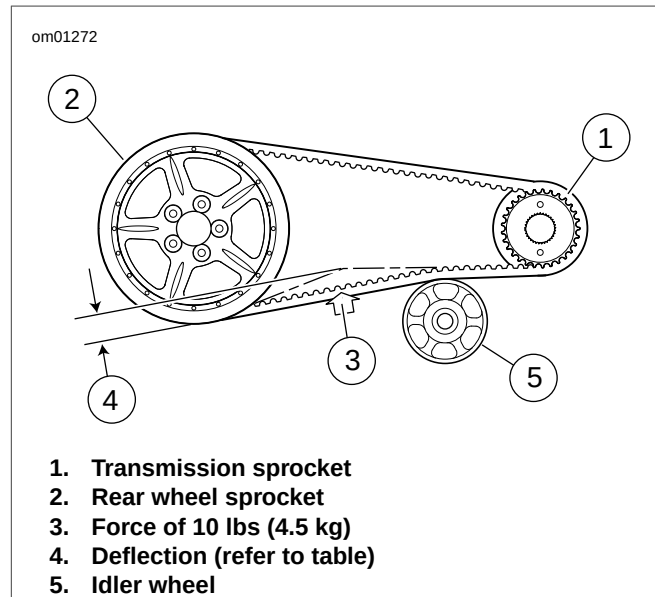


Figure 1-56. Gauging Belt Deflection: XR 1200 Model

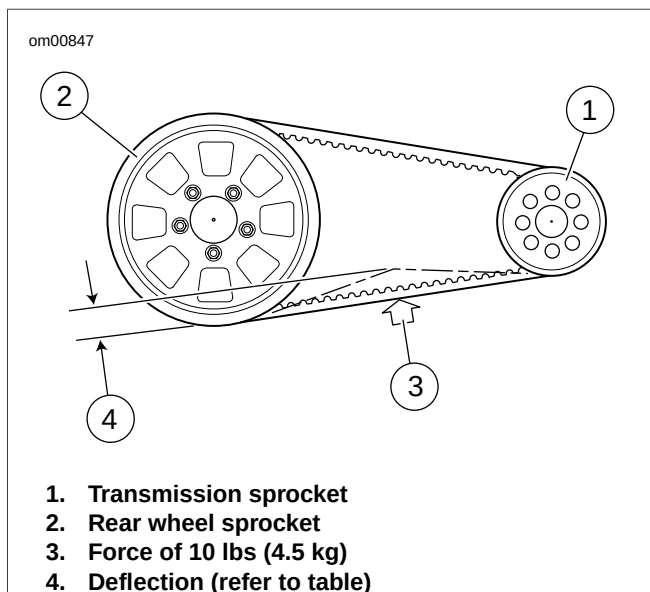


Figure 1-55. Gauging Belt Deflection: Sportster XL Models

BELT DEFLECTION ADJUSTMENT

See [Figure 1-55](#). Determine belt deflection in manner specified in [1.16 REAR BELT DEFLECTION, Rear Drive Belt: Sportster Models](#). If belt deflection is not correct, adjust per the following procedure.

NOTE

Rear brake line is clamped tightly to rear fork to avoid chafing of brake line in clamp. A small amount of slack must be maintained in rear brake line between clamp and rear caliper when rear wheel is adjusted.

1. **XL Models:** See [Figure 1-57](#). Remove screw (4) from clamp (3) on rear brake line (2).
2. See [Figure 1-58](#). Remove e-clip (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 both adjuster nuts the same number of turns in order to maintain approximate alignment of rear wheel.
3. Check rear wheel alignment. Wheel must be centered in rear fork. See [1.16 REAR BELT DEFLECTION, Wheel Alignment](#).

⚠ WARNING

Do not exceed specified torque when tightening axle nut. Exceeding torque can cause wheel bearings to seize during vehicle operation, which could result in death or serious injury. (00408e)

4. After belt deflection and wheel alignment are properly adjusted,
- a. Tighten axle nut (4) to 95-105 ft-lbs (129-142 Nm). Install e-clip (1).
 - b. **XL Models:** See [Figure 1-57](#). Reposition clamp (3) on rear brake line (2) and secure clamp to rear fork (1) with screw (4). Tighten to 30-40 **in-lbs** (3.4-4.5 Nm).

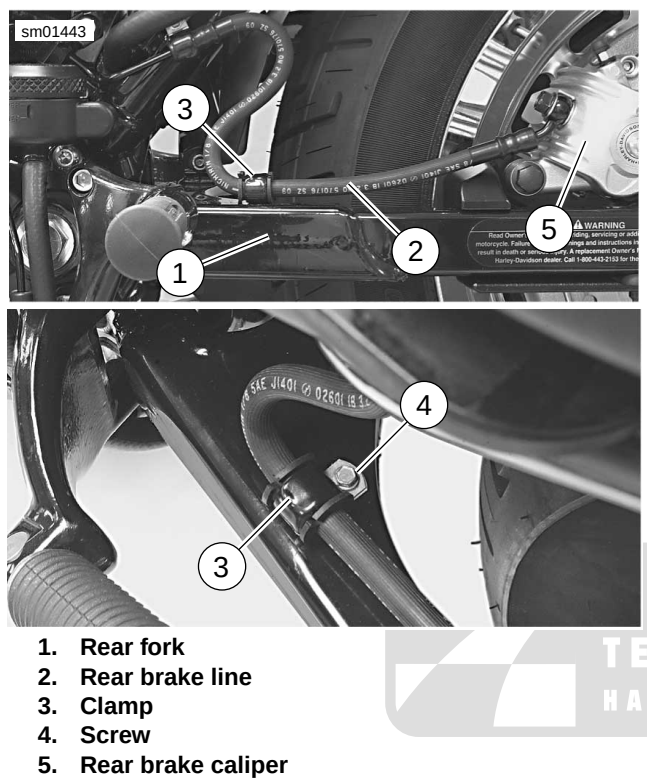


Figure 1-57. Rear Brake Line: XL Models

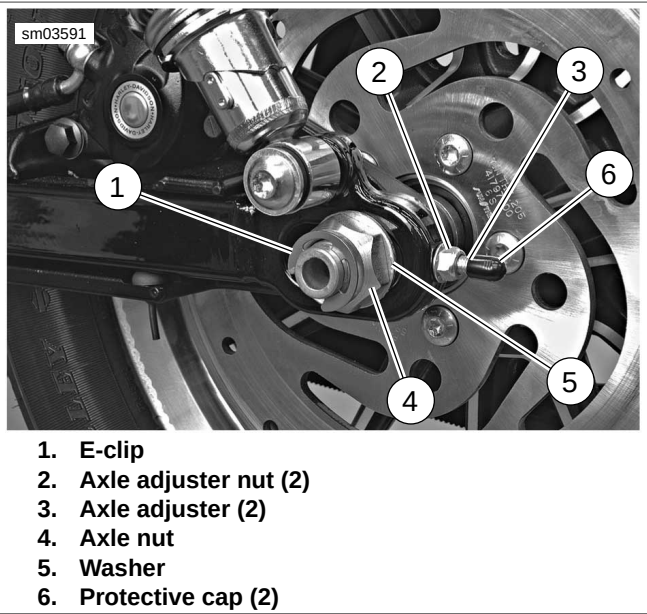


Figure 1-58. Secondary Drive Belt Adjustment (typical; XL model shown)

WHEEL ALIGNMENT

PART NUMBER	TOOL NAME
HD-48856	AXLE ALIGNMENT PLUG SET

Checking Wheel Alignment



Check vehicle alignment according to following procedures. Incorrect alignment can adversely affect stability and handling, which could result in death or serious injury. (00287a)

- 1. Obtain AXLE ALIGNMENT PLUG SET (Part No. HD-48856). See [Figure 1-59](#). Insert axle alignment plugs (1, 2) into left and right ends of rear axle.
- 2. **For XL Models:** See [Figure 1-60](#). Fabricate an alignment tool using a piece of 1/8-in. (3.175 mm) diameter aluminum welding rod 21.5 in. (546 mm) long. Grind one end down to a blunt point. Use pliers to bend rod at a 90 degree angle, 2.25 in. (57 mm) from the blunt point, as shown. Place a snug-fitting rubber grommet (2) on rod to act as a slide measurement indicator.
- 3. **For XR Models:** See [Figure 1-61](#). Fabricate an alignment tool using a piece of 1/8-in. (3.175 mm) diameter aluminum welding rod 22.375 in. (568 mm) long. Grind one end down to a blunt point. Use pliers to bend rod as shown. Place a snug-fitting rubber grommet (2) on rod to act as a slide measurement indicator.
- 4. [Figure 1-62](#). Insert blunt point of alignment tool in rear fork pivot bolt dimple (2) on right side of rear fork (3). Slide rubber grommet along tool shaft until it aligns with hole in center of alignment plug (5). Measure distance from pointed end of alignment tool to grommet. Repeat measurement for left side of rear fork.

5. If left and right side measurements are not equal, adjust rear wheel alignment.

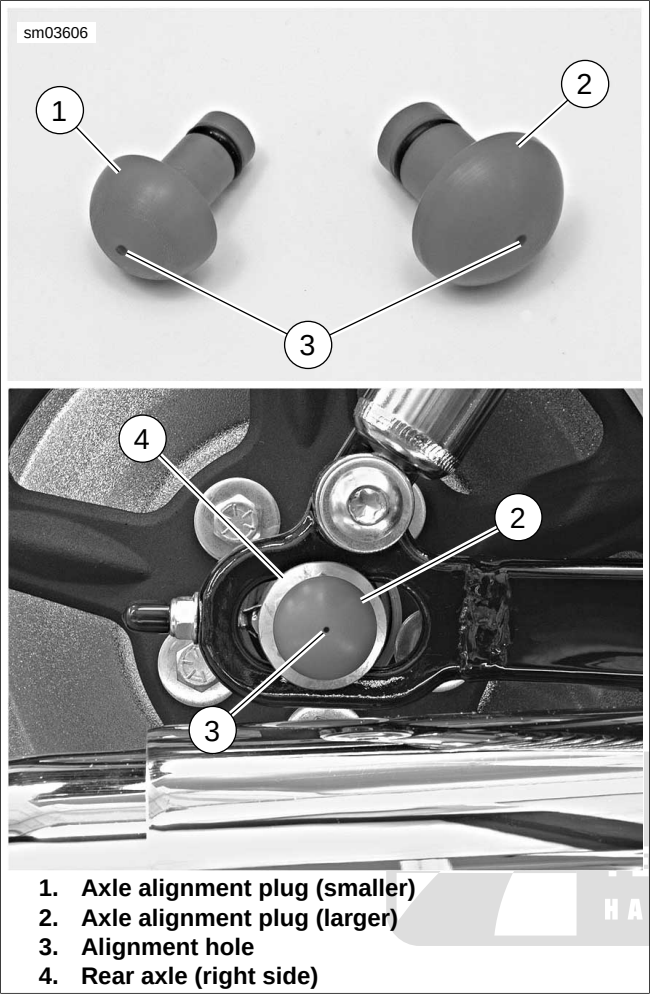


Figure 1-59. Axle Alignment Plugs

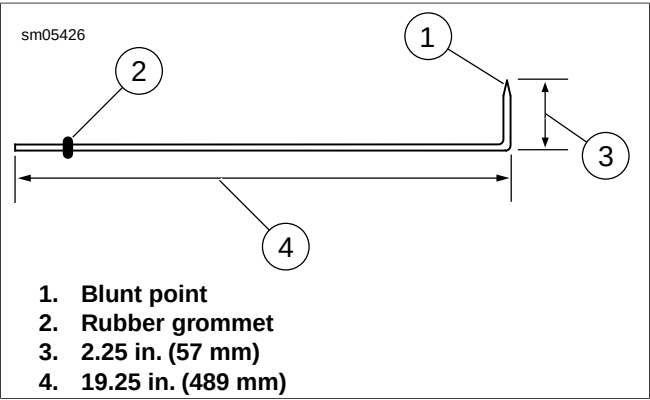


Figure 1-60. Wheel Alignment Tool: XL Models

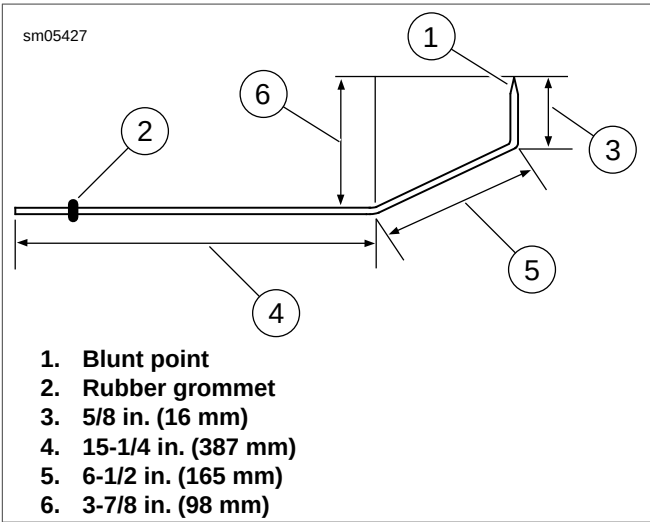


Figure 1-61. Wheel Alignment Tool: XR Models

Adjusting Wheel Alignment

1. See [Figure 1-58](#). Remove and discard e-clip (1).
2. Loosen rear axle nut (4).
3. On side of rear fork that has longer distance from pivot bolt to axle center, turn nut (2) on axle adjuster (3) 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 or install **new** e-clip until after checking rear drive belt tension.

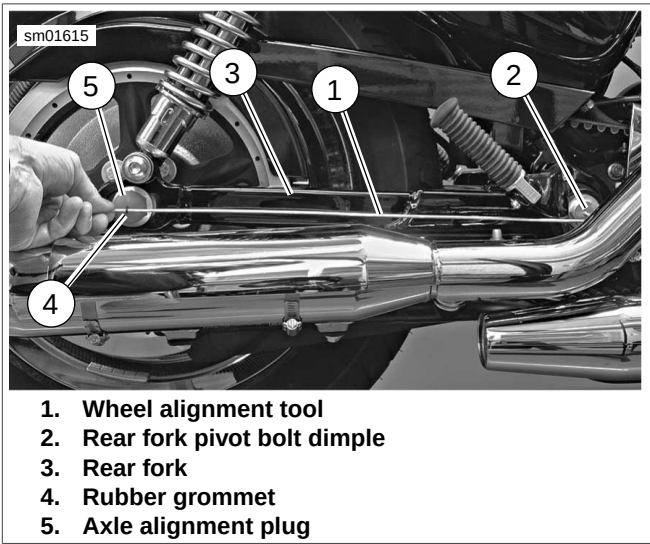


Figure 1-62. Checking Wheel Alignment Using Wheel Alignment Tool (XL Models Shown)

4. Verify rear drive belt deflection after aligning rear wheel; adjust if required. See [1.16 REAR BELT DEFLECTION, Belt Deflection Adjustment](#).

NOTE

Rear brake line is clamped tightly to rear fork to avoid chafing of brake line in clamp. If rear axle has been moved forward or back, make sure there is a small amount of slack in rear brake line between clamp and rear caliper. If necessary, loosen clamp screw, reposition brake line, then tighten screw. See [1.16 REAR BELT DEFLECTION, Belt Deflection Adjustment](#).

⚠ WARNING

Do not exceed specified torque when tightening axle nut. Exceeding torque can cause wheel bearings to seize during vehicle operation, which could result in death or serious injury. (00408e)

5. If not yet done, tighten axle nut to 95-105 ft-lbs (129-142 Nm) and install **new** e-clip.



BATTERY MAINTENANCE

GENERAL

⚠ WARNING

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

⚠ WARNING

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

⚠ WARNING

Batteries, battery posts, terminals and related accessories contain lead and lead compounds, and other chemicals known to the State of California to cause cancer, and birth defects or other reproductive harm. Wash hands after handling. (00019e)

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.

NOTE

For charging information, see [1.17 BATTERY MAINTENANCE, Charging Battery](#). For testing information, see [ELECTRICAL DIAGNOSTIC MANUAL](#).

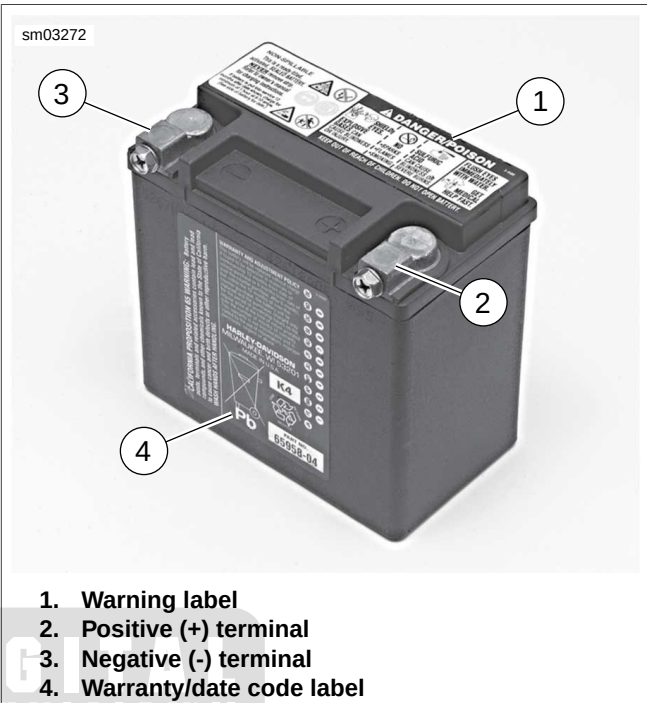


Figure 1-63. Battery



Figure 1-64. Battery Warning Label

Table 1-14. Antidotes for Battery Acid

CONTACT	TREATMENT
External	Flush with water.
Internal	Drink large quantities of milk or water, followed by milk of magnesia, vegetable oil or beaten eggs. Get immediate medical attention.
Eyes	Flush with water. Get immediate medical attention.

BATTERY DISCONNECTION AND REMOVAL

⚠ WARNING

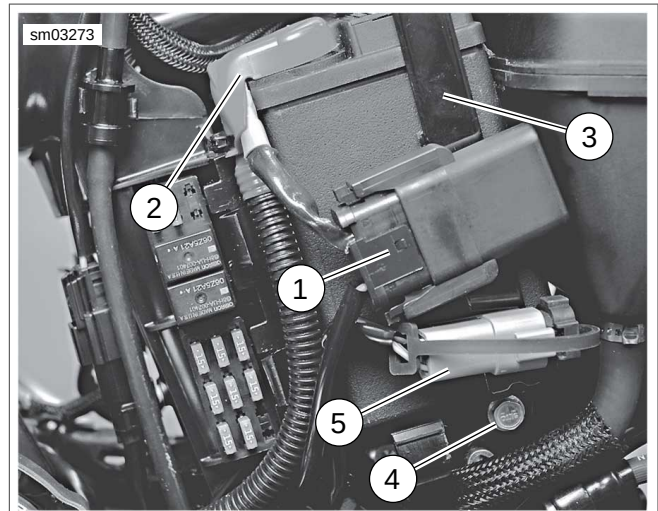
Disconnect negative (-) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00049a)

1. Open left side cover.

NOTE

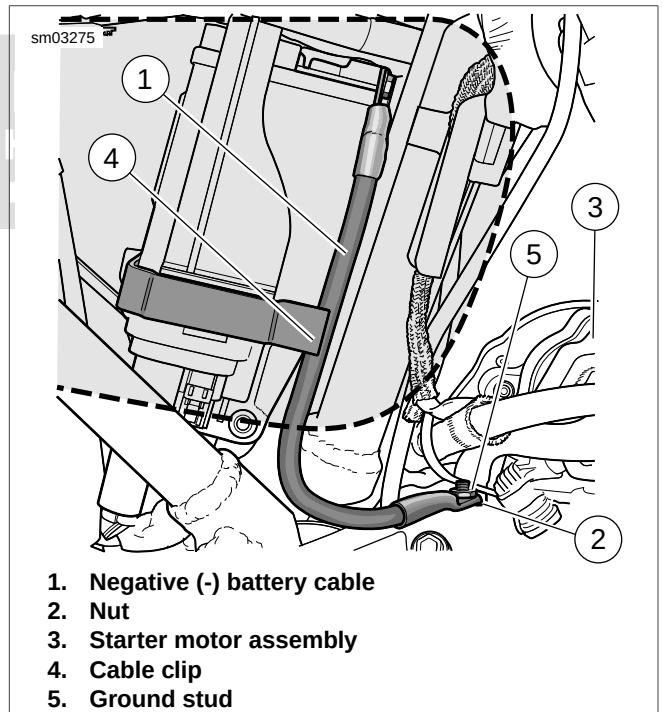
If vehicle is equipped with optional security siren, verify that fob is present and turn ignition key to IGNITION before removing main fuse or disconnecting battery.

2. See [Figure 1-65](#). Press main fuse holder (1) toward the rear of the motorcycle until it pops off its mounting pin on battery strap (3). Remove main fuse holder from battery strap.
3. Press data link connector (5) toward the rear of the motorcycle until it pops off its mounting pin on battery strap. Remove the connector from battery strap.
4. Remove battery strap screw and flat washer (4). Unhook battery strap from battery tray mount on top of battery and remove strap.
5. See [Figure 1-66](#). Remove nut (2) that secures the negative (-) battery cable (1) connector to ground stud (5) on crankcase boss behind starter motor assembly (3). Remove cable connector from stud.
6. Pull end of negative (-) cable forward gently to free it from cable clip (4).
7. See [Figure 1-65](#). Lift up protective rubber boot covering battery positive (+) terminal (2). Remove screw from battery positive (+) terminal and remove positive (+) battery cables.
8. See [Figure 1-67](#). Disconnect positive (+) battery cable (2) from cable holders (1).
9. Remove battery from battery tray. See [Figure 1-66](#). Note routing of negative (-) battery cable around frame down-tube.
10. If battery is to be left out of vehicle (i.e. winter storage), close left side cover.



1. Main fuse and holder
2. Positive (+) battery terminal (under protective rubber boot)
3. Battery strap
4. Screw and flat washer
5. Data link connector

Figure 1-65. Main Fuse and Battery Location: All Models



1. Negative (-) battery cable
2. Nut
3. Starter motor assembly
4. Cable clip
5. Ground stud

Figure 1-66. Negative (-) Battery Connection

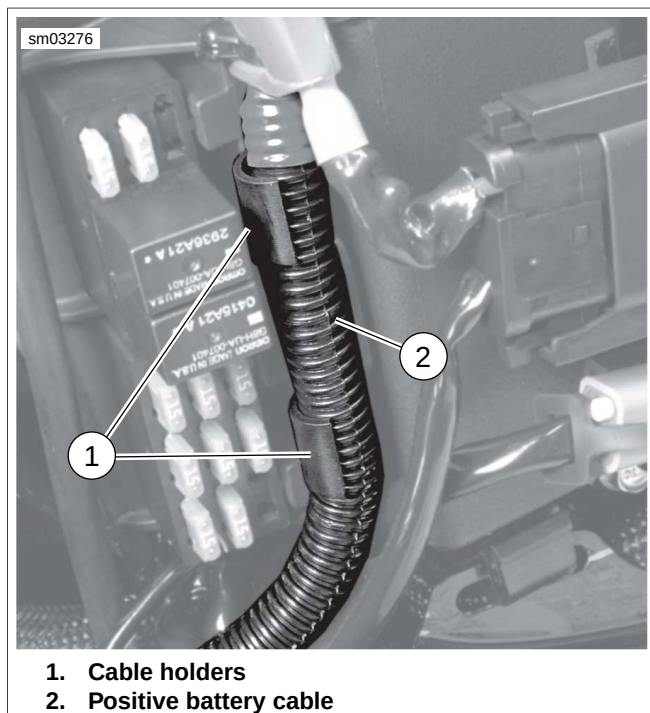


Figure 1-67. Positive (+) Battery Cable Holders

CLEANING AND 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.

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 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 separated, frayed or loose.
- If the battery gets hotter than 110° F (43° C) during charging, discontinue charger and allow the battery to cool.
- Always turn the charger off before removing charger leads from the battery to avoid dangerous sparks.

Using a Battery Charger

Charge the battery if any of the following conditions exist:

- Vehicle lights appear dim.
- Electric starter sounds weak.
- Battery has not been used for an extended period of time.

⚠ WARNING

Explosive hydrogen gas, which escapes during charging, could cause death or serious injury. Charge battery in a well-ventilated area. Keep open flames, electrical sparks and smoking materials away from battery at all times. KEEP BATTERIES AWAY FROM CHILDREN. (00065a)

CAUTION

If battery releases an excessive amount of gas during charging, decrease the charging rate. Overheating can result in plate distortion, internal shorting, drying out or damage. (00413b)

1. Perform a voltmeter test to determine the state of charge. See the ELECTRICAL DIAGNOSTIC MANUAL. If battery needs to be charged, proceed to the next step.

NOTE

The figures listed in the table assume that the battery is charging at room temperature. If warmer than room temperature, use a slightly shorter charging time. If colder, use a slightly longer charging time.

Table 1-15. 12 Amp-Hour Battery Charging Rates and Times

READING (VOLTS)	PERCENT CHARGE	3 AMP CHARGER	6 AMP CHARGER	10 AMP CHARGER	20 AMP CHARGER
12.7	100	N/A	N/A	N/A	N/A
12.6	75	1 hour 10 minutes	34 minutes	20 minutes	10 minutes
12.3	50	2 hours 20 minutes	1 hour 10 minutes	40 minutes	20 minutes
12.0	25	3 hours 20 minutes	1 hour 40 minutes	1 hour	30 minutes
11.8	0	4 hours 30 minutes	2 hours 14 minutes	1 hour 20 minutes	40 minutes

- The figures listed above assume the battery is charging at room temperature. If warmer than room temperature, use a slightly shorter charging time. If colder, use a slightly longer charging time.
- The use of constant current chargers to charge sealed maintenance-free batteries is not recommended. Any overcharge will cause dry-out and premature battery failure. If a constant current charger is the only type available, do **not** exceed the charge times listed above and do **not** continue charging the battery if it gets hot. When charging, **never** exceed 15 volts for more than 30 minutes.

NOTE

*The use of constant current chargers to charge sealed maintenance-free batteries is not recommended. Any overcharge will cause dry-out and premature battery failure. If a constant current charger is the only type available, do **not** exceed the charge times listed above and do **not** continue charging the battery if it gets hot. When charging, never exceed 15 volts for more than 30 minutes.*

WARNING

Unplug or turn OFF battery charger before connecting charge cables to battery. Connecting cables with charger ON can cause a spark and battery explosion, which could result in death or serious injury. (00066a)

CAUTION

Do not reverse the charger connections described in the following steps or the charging system of the motorcycle could be damaged. (00214a)

2. Connect red battery charger lead to the positive (+) terminal of the battery.
3. Connect 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.

4. Step away from the battery and turn on the charger. See the charging instructions in [Table 1-15](#).

WARNING

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

5. After the battery is fully charged, disconnect the black battery charger lead to the negative (-) terminal of the battery.
6. Disconnect the red battery charger lead to the positive (+) terminal of the battery.
7. Mark the charging date on the battery.
8. Perform either a conductance test or load test to determine the condition of the battery. See the ELECTRICAL DIAGNOSTIC MANUAL.
9. If charging battery because voltmeter test reading was below 12.6 V, perform voltmeter test. See the ELECTRICAL DIAGNOSTIC MANUAL.

BATTERY INSTALLATION AND CONNECTION**CAUTION**

Connect the cables to the correct battery terminals. Failure to do so could result in damage to the motorcycle electrical system. (00215a)

1. If negative (-) battery cable was removed from battery, insert screw through negative (-) battery cable and into negative (-) battery terminal. Thread screw into terminal. Position negative (-) battery cable so that it hangs straight down from negative (-) battery terminal. Tighten screw to 60-70 **in-lbs** (6.8-7.9 Nm).
2. Apply a light coat of petroleum jelly or corrosion retardant material to the negative (-) battery terminal.
3. Open left side cover.
4. Slide fully charged battery into battery tray, routing negative (-) battery cable around frame downtube.

⚠ WARNING

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

⚠ WARNING

Do not allow positive (+) battery cable to contact ground with negative (-) cable connected. Resulting sparks can cause a battery explosion, which could result in death or serious injury. (00069a)

- See [Figure 1-65](#). With negative (-) battery cable disconnected from grounding point on crankcase, insert screw through positive (+) battery cables: through main fuse cable first, then through main positive (+) battery cable, and into positive (+) battery terminal (2). Thread screw into terminal. Tighten to 60-70 **in-lbs** (6.8-7.9 Nm).
- Apply a light coat of petroleum jelly or corrosion retardant material to the positive (+) battery terminal. Place protective rubber boot over terminal.
- Hook top of battery strap (3) to battery tray mount on top of battery. Install flat washer and strap screw (4). Tighten to 36-60 **in-lbs** (4.1-6.8 Nm).
- Route main positive (+) battery cable through holders on electrical bracket.
- Hook main fuse holder (1) to top pin on battery strap and slide forward until it snaps into place.
- Hook data link connector (5) to bottom pin on battery strap and slide forward until it snaps into place.
- See [Figure 1-66](#). Press negative (-) battery cable (1) into cable clip (4).
- Place negative (-) battery cable connector onto ground stud (5) on crankcase boss behind starter motor assembly (3). Thread nut (2) onto stud.
- See [Figure 1-68](#) or [Figure 1-69](#). Press negative (-) battery cable connector (1) against cable stop (2) on crankcase and tighten nut (3) to 55-75 **in-lbs** (6.2-8.5 Nm).
- Close left side cover.

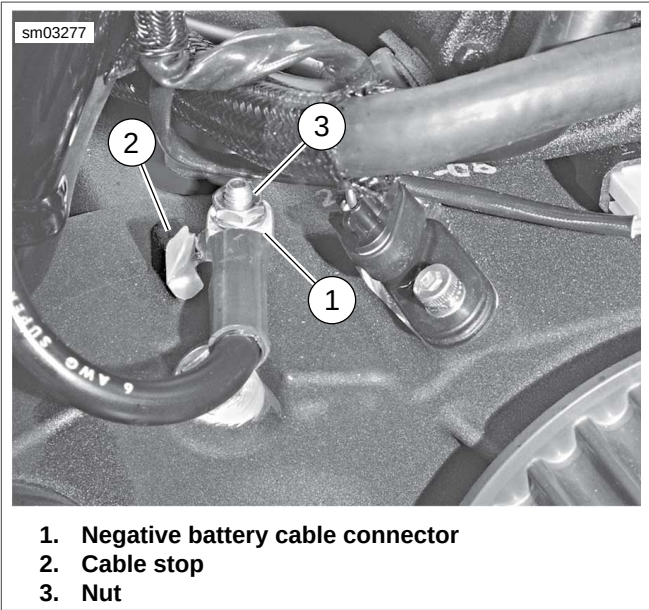


Figure 1-68. Attaching Negative (-) Battery Cable to Ground Stud Crankcase: XL Models

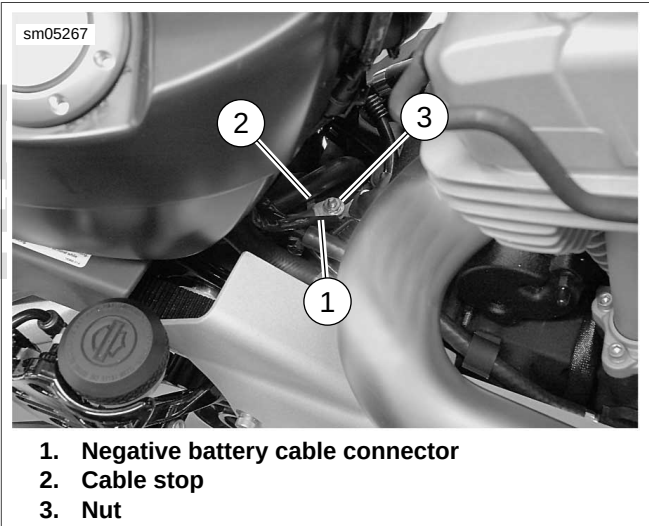


Figure 1-69. Attaching Negative (-) Battery Cable to Ground Stud Crankcase: XR Models

STORAGE

PART NUMBER	TOOL NAME
99863-01A	GLOBAL BATTERY CHARGER

⚠ WARNING

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

CAUTION

Do not allow battery to completely discharge. The electrolyte in a discharged battery will freeze. The more discharged a battery is, the more easily it can freeze and crack the battery case. (00218a)

If the motorcycle is to be stored with the security system armed, connect a GLOBAL BATTERY CHARGER (Part No. 99863-01A) to maintain battery charge.

If the motorcycle is to be stored with the battery installed, a GLOBAL BATTERY CHARGER unavailable, and with the security system **not** armed, unplug the main fuse.

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

See [Figure 1-70](#). Self-discharge is a normal condition and occurs continuously at a rate that depends on the ambient temperature and the battery's state of charge. Batteries discharge at a faster rate at higher ambient temperatures. To reduce the self-discharge rate, store battery in a cool (not freezing), dry place.

Charge the battery every month if stored at temperatures below 60° F (16° C). Charge the battery more frequently if stored in a warm area above 60° F (16° C).

NOTES

- The GLOBAL BATTERY CHARGER (Part No. 99863-01A) may be used to maintain battery charge for extended periods of time without risk of overcharging or boiling.
- When returning a battery to service after storage, see *ELECTRICAL DIAGNOSTIC MANUAL*.

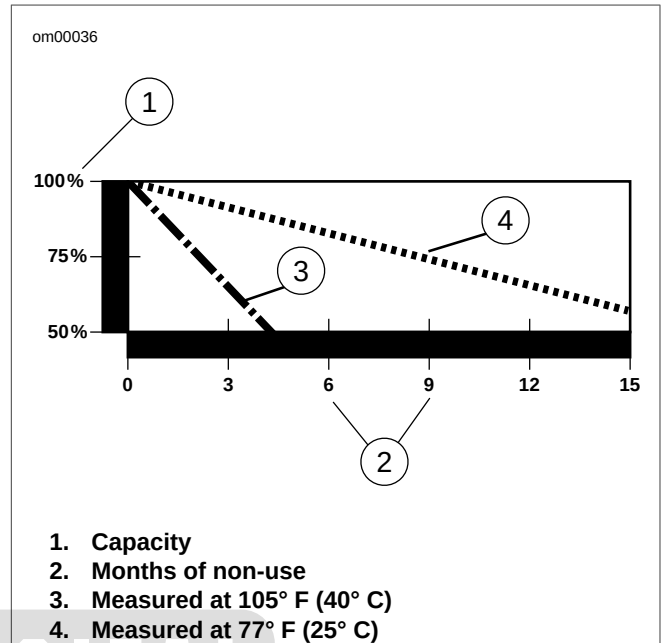


Figure 1-70. Effective Rate of Temperature on Battery Self-discharging Rate



SPARK PLUGS

1.18

GENERAL

Harley-Davidson 6R12 and 10R12X spark plugs have a resistor element to reduce the radio interference which originates in the motorcycle ignition system. Use only the resistor-type spark plugs specified.

INSPECTION

⚠ WARNING

Disconnecting spark plug cable with engine running can result in electric shock and death or serious injury. (00464b)

1. After the engine has cooled to room temperature, disconnect cables from both spark plugs.
2. Remove spark plugs. If a plug has eroded electrodes, heavy deposits or a cracked insulator, discard it.
3. See [Figure 1-71](#). Compare your observations of the plug deposits with the descriptions provided below.
 - a. A wet, black and shiny deposit on plug base, electrodes and ceramic insulator tip indicates an oil fouled plug. The condition may be caused by one or more of the following: worn pistons, worn piston rings, worn valves, worn valve guides, worn valve seals, a weak battery or a faulty ignition system.
 - b. A dry, fluffy or sooty black deposit indicates an air-fuel mixture that is too rich.
 - c. A light brown, glassy deposit indicates an overheated plug. This condition may be accompanied by cracks in the insulator or by erosion of the electrodes and is caused by an air-fuel mixture that is too lean, a hot-running engine, valves not seating or improper ignition timing. The glassy deposit on the spark plug is a conductor when hot and may cause high-speed mis-firing. 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.

⚠ WARNING

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

4. If the plugs require cleaning between tune-ups, proceed as follows:
 - a. Degrease firing end of spark plug using ELECTRICAL CONTACT CLEANER. Dry plug with compressed air.
 - b. Use a thin file to flatten spark plug electrodes. A spark plug with sharp edges on its electrodes requires 25-40% less firing voltage than one with rounded edges.
 - c. If the plugs cannot be cleaned, replace with **new** spark plugs.
5. Check electrode gap with a wire-type feeler gauge. Bend the outside of the electrode so only a slight drag on the gauge is felt when passing it between electrodes. Proper gap measurement is listed in [Table 1-16](#).
6. Check condition of threads on cylinder head and plug. If necessary to remove deposits, apply penetrating oil and clean out with a thread chaser.
7. Apply LOCTITE ANTI-SEIZE to the spark plug threads. Install and tighten to 12-18 ft-lbs (16.3-24.4 Nm).
8. Connect spark plug cables. Rear cylinder plug cable attaches to top coil terminal. Verify that cables are securely connected to coil and spark plugs.

Table 1-16. Spark Plug Gap

MODEL	TYPE	GAP (IN.)	GAP (MM)
All XL	6R12	0.038-0.043	0.96-1.09
XR	10R12X	0.032-0.038	0.81-0.97

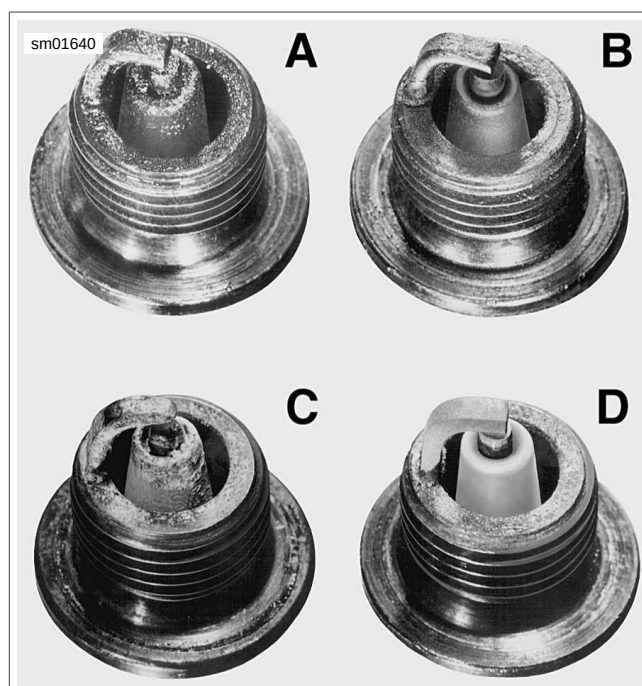


Figure 1-71. Typical Spark Plug Deposits

SPARK PLUG CABLE INSPECTION

1. Inspect spark plug cables. Replace cables that are worn or damaged.
 - a. Check for cracks or loose terminals.
 - b. Check for loose fit on ignition coil and spark plugs.
2. Check cable boots/caps for cracks or tears. Replace boots/caps that are worn or damaged.
3. See [Figure 1-72](#). Check spark plug cable resistance with an ohmmeter. Compare values from test with [Table 1-17](#). Replace cables not meeting resistance specifications.

Table 1-17. Spark Plug Cable Resistance

CABLE	RESISTANCE (OHMS)
Front	1,750-4,836
Rear	4,968-13,427

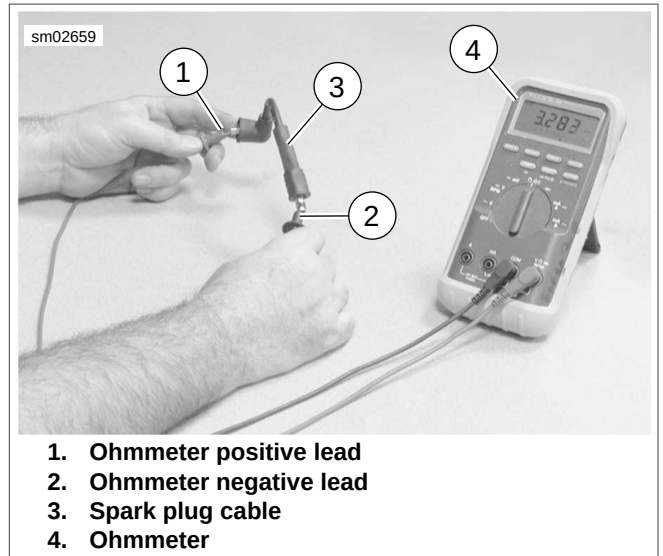


Figure 1-72. Testing Resistance



STEERING HEAD BEARINGS

1.19

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 1.0-2.0 in. (25-50 mm) for XL models and 2.0-4.0 in. (50-100 mm) for XR models for proper bearing adjustment.
7. See [Figure 1-73](#). If the distance is not correct, perform the following procedure:
 - a. Loosen the two lower bracket pinch screws (6) and the fork stem pinch screw (4).
 - b. Remove fork stem bolt cap (1) (XL 1200R and XL1200L models).
 - c. Loosen or tighten the fork stem bolt (2) until the "fall-away" distance is 1.0-2.0 in. (25-50 mm) for XL models or 2.0-4.0 in. (50-100 mm) for XR models.

NOTE

Loosen fork stem bolt if "fall-away" point is more than 2.0 in. (50 mm) for XL models or more than 4.0 in. (100 mm) for XR models. If "fall-away" point is less than 1.0 in. (25 mm) for XL models or less than 2.0 in. (50 mm) for XR models, tighten fork stem bolt.

- d. Tighten fork stem pinch screw to 30-35 ft-lbs (40.7-47.5 Nm).
- e. Tighten lower bracket pinch screws to 30-35 ft-lbs (40.7-47.5 Nm).
- f. Install fork stem bolt cap (XL 1200R and XL1200L models).
- g. Recheck "fall-away."

LUBRICATION

See [Figure 1-73](#). Disassemble the steering head assembly and lubricate the tapered roller bearings (8) with HARLEY-DAVIDSON SPECIAL PURPOSE GREASE. See [2.23 FORK STEM AND BRACKET ASSEMBLY](#) for disassembly and reassembly procedures.

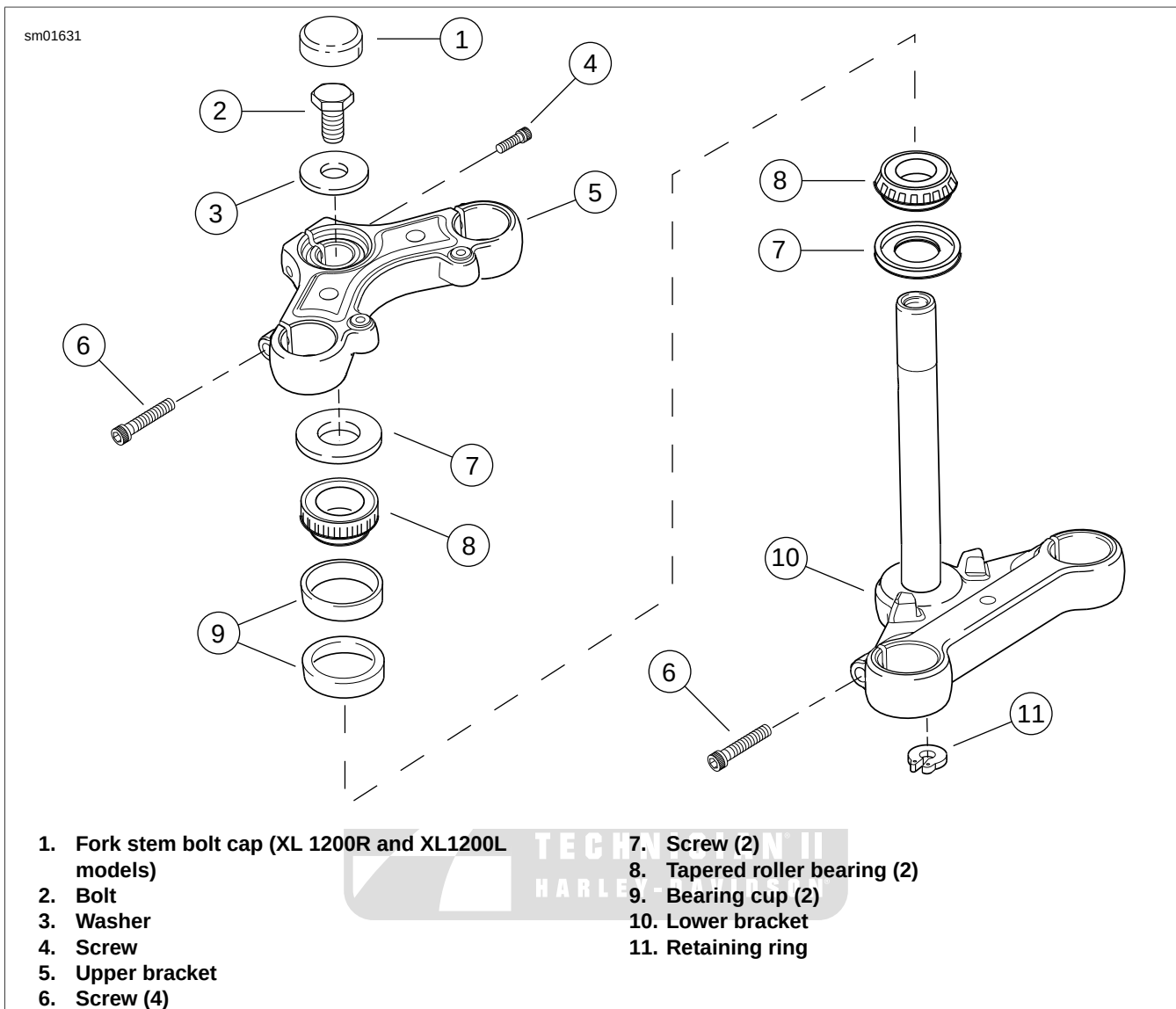


Figure 1-73. Steering Head Assembly (typical; XL model shown)

SHOCK ABSORBER ADJUSTMENT

1.20

SHOCK ABSORBER PRELOAD ADJUSTMENT: SPORTSTER MODELS

PART NUMBER	TOOL NAME
HD-48645	SPANNER WRENCH
HD-94820-75A	SPANNER WRENCH

See [Figure 1-74](#). The rear shock absorber spring preload can be adjusted for the weight the motorcycle is to carry. Increase preload to accommodate additional weight of rider, passenger and/or luggage. Reduce preload if carrying less weight.

NOTE

See [Figure 1-77](#). The shock absorber has multiple preload positions, depending on the motorcycle model.

WARNING

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

See [Figure 1-75](#). To adjust the rear shock spring preload, turn spring adjusting cam to the desired position with a SPANNER WRENCH (Part No. HD-94820-75A). When reducing preload, cam should be rotated in opposite direction.

See [Figure 1-76](#). On the XR 1200 model, use SPANNER WRENCH (Part No. HD-48645) with a 3/8-inch ratchet and extension to adjust the preload on the right side of the motorcycle.

CAUTION

The 883 Low and 1200N are designed for solo operation. If you choose to add an adult passenger and/or cargo to the vehicle, the ride quality will be compromised. See a Harley-Davidson dealer for high capacity rear suspension options. (00487e)

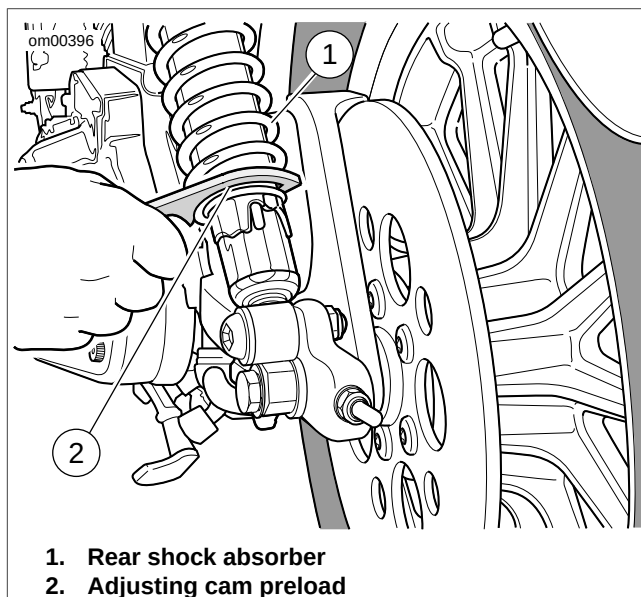


Figure 1-74. Rear Shock Absorber Adjustment: Sportster Models



Figure 1-75. Spanner Wrench (HD-94820-75A)

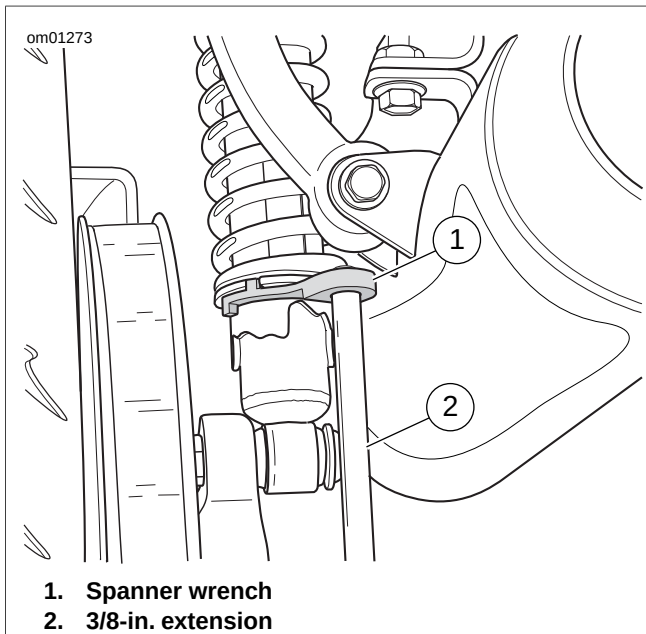


Figure 1-76. Right Side Preload Adjustment: XR 1200 Model

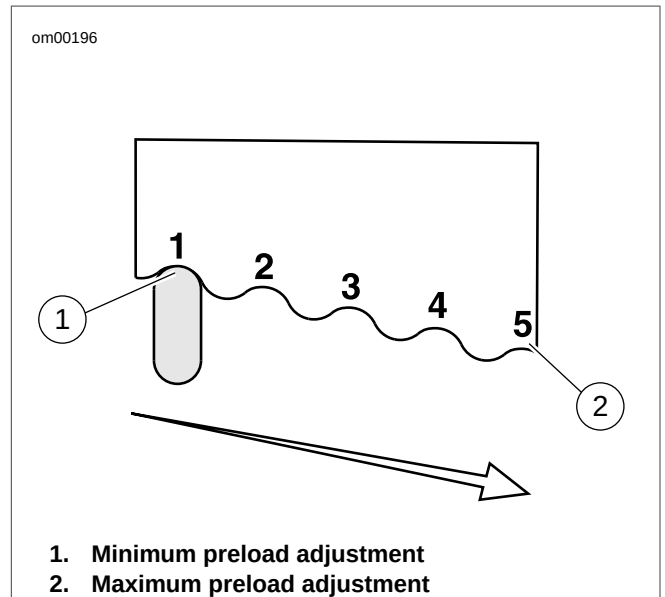


Figure 1-77. Preload Adjustment



REAR FORK BEARINGS

1.21

LUBRICATION

The rear fork bearings are sealed units and need no lubrication.

REPLACEMENT

See [2.25 REAR FORK](#) for rear fork bearing replacement procedure.



FRONT FORK OIL

1.22

CHANGING FORK OIL: XL MODELS

PART NUMBER	TOOL NAME
HD-59000-B	HARLEY-DAVIDSON PRO-LEVEL OIL GAUGE

Draining Fork Oil

1. Have an assistant hold vehicle upright (not resting on jiffy stand), with front fork pointed straight ahead.
2. Place a drain pan under bottom of right fork slider. See [Figure 1-78](#). Remove drain screw and washer (5) from bottom of one slider (4).
3. Drain fork oil by repeatedly compressing front suspension slowly.

NOTE

If fork oil is emulsified, aerated or light brown in color, it has been contaminated by water. Replace fork oil seals. See [2.21 FRONT FORK: XL MODELS](#).

4. Replace drain screw and washer. Tighten to 13-17 in-lbs (1.5-2.0 Nm).
5. Repeat previous steps for left side fork.

NOTE

Refer to [Table 1-18](#). Fork oil amounts can be measured two ways.

- Use oz/ml measurement if fork is left in frame.
- Use in/mm measurement if fork has been disassembled.

Table 1-18. Type E Fork Oil Amounts

MODEL	OZ	ML	IN	MM
XL 883L/XL 1200N	13.6	401	3.11	79
XL 1200L	12.3	364	4.80	122
All other XL models	11.6	343	5.75	146

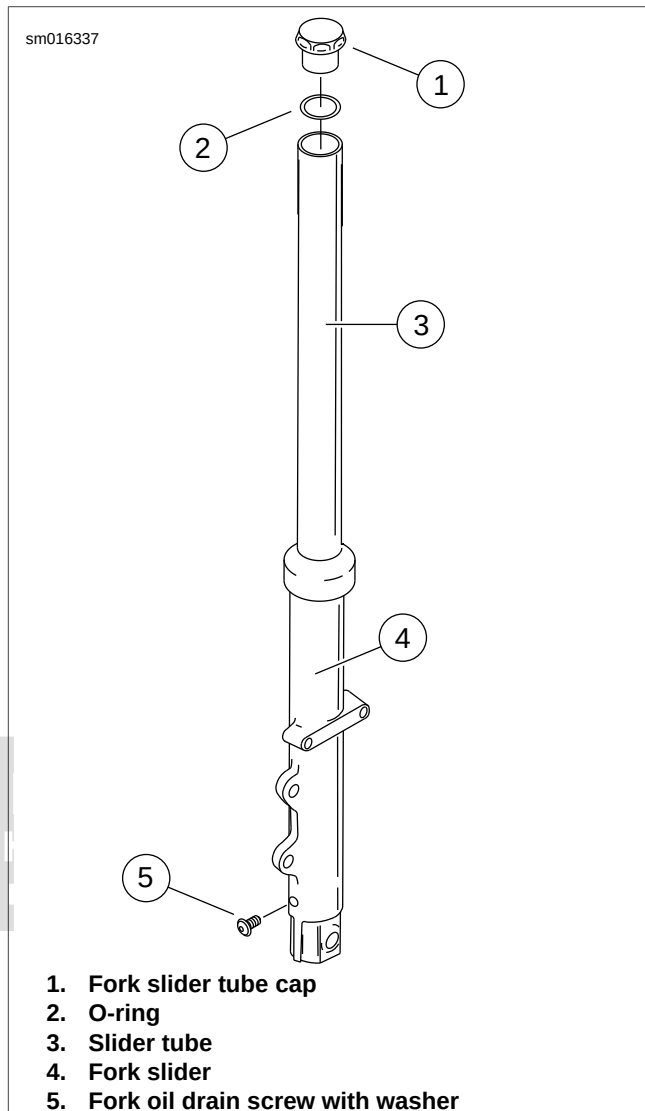


Figure 1-78. Draining Front Fork Oil

Filling Fork Oil: Forks Assembled, in Frame

1. 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 preload (compression force) to be relieved.

WARNING

Incorrect amount of fork oil can adversely affect handling and lead to loss of vehicle control, which could result in death or serious injury. (00298a)

2. See [Figure 1-78](#). Remove fork slider tube cap (1) with o-ring (2) from each slider tube (3). Replace the o-ring if damaged or worn.
3. Fill each slider tube/slider assembly with the amount of TYPE "E" HYDRAULIC FORK OIL specified in [Table 1-18](#).

4. Install each slider tube cap with o-ring. Tighten to 22-58 ft-lbs (29.9-78.7 Nm).
5. Lower motorcycle to the ground.

Filling Fork Oil: Forks Disassembled, out of Frame

1. Position fork tube assembly upright. Remove spring and compress assembly fully.
2. See [Table 1-18](#). Pour approximately 14 fl oz. (414 ml) TYPE "E" HYDRAULIC FORK OIL into fork.
3. See [Figure 1-79](#). Using HARLEY-DAVIDSON PRO-LEVEL OIL GAUGE (Part No. HD-59000-B), adjust oil level:
 - a. 3.11 in. (79 mm) for XL883L/XL1200N.
 - b. 4.80 in. (122 mm) for XL 1200L.
 - c. 5.75 in. (146 mm) for all other XL models.
4. Install spring and slider tube cap with o-ring. Tighten to 22-58 ft-lbs (29.9-78.7 Nm).
5. Assemble fork and install in frame.
6. Repeat this procedure for other fork tube assembly.

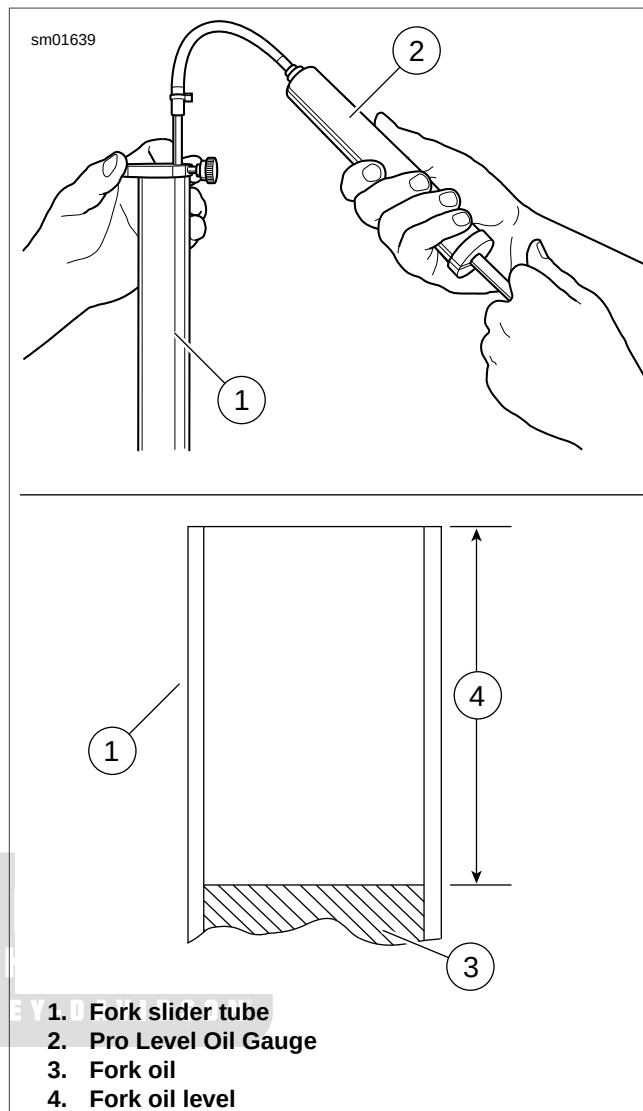


Figure 1-79. Refilling Front Fork Oil

CHANGING FORK OIL: XR MODELS

PART NUMBER	TOOL NAME
HD-41177	FORK TUBE HOLDER
HD-45966	FRONT FORK COMPRESSOR
HD-47852	INNER FORK NUT REMOVER/INSTALLER
HD-59000B	OIL LEVEL GAUGE

1. Support the motorcycle so the front end is off the floor and the forks are fully extended.
2. Remove the forks and drain the fork oil. See [2.22 FRONT FORK: XR MODELS](#).

Left Fork

WARNING

Wear safety glasses or goggles when servicing fork assembly. Do not remove slider tube caps without relieving spring preload or caps and springs can fly out, which could result in death or serious injury. (00297a)

NOTES

- When using *FRONT FORK COMPRESSOR* be sure not to bind the outer fork tube on the tool.
- *FRONT FORK COMPRESSOR* (Part No. HD-45966) comes with a cup and screw that are for FLT models only and not to be used with this fork assembly.

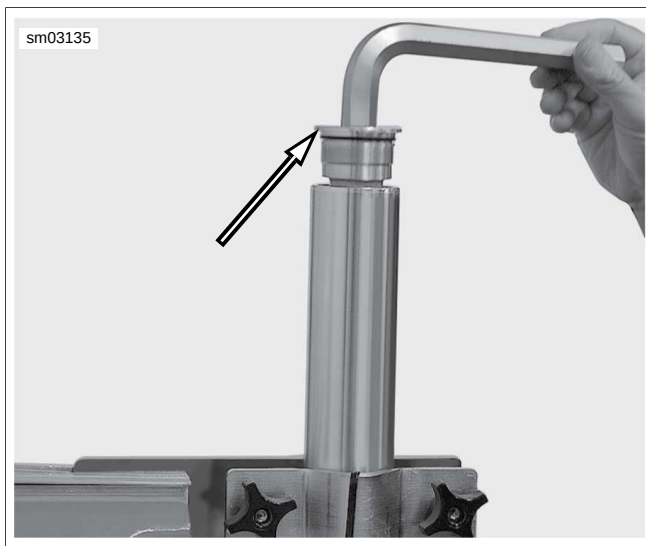


Figure 1-80. Clamp Fork and Remove Fork Cap

1. See [Figure 1-80](#). Using *FORK TUBE HOLDER* (Part No. HD-41177), mount fork assembly in vise.
2. Remove fork cap.



Figure 1-81. Compress Fork Assembly

3. See [Figure 1-81](#). Compress fork using *FRONT FORK COMPRESSOR* (Part No. HD-45966).

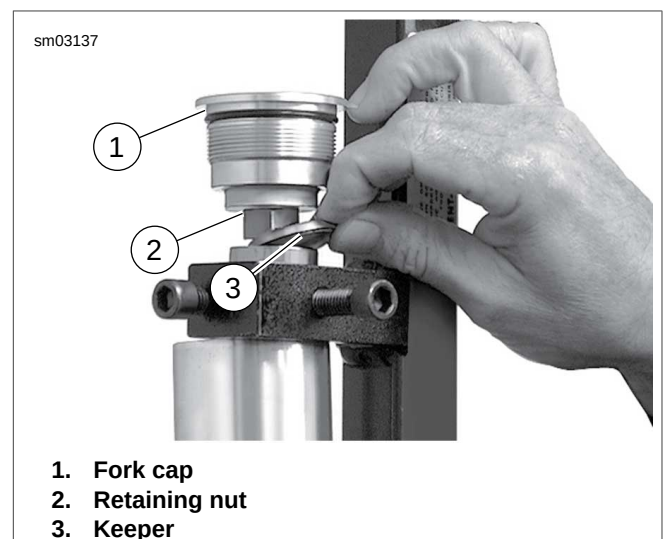


Figure 1-82. Remove Keeper

NOTE

Note position of retaining nut with shoulder of nut facing away from fork cap. Be sure to install in the same manner.

4. See [Figure 1-82](#). Remove keeper and loosen retaining nut, and fork cap from cartridge assembly.
5. Remove front fork compressor.



Figure 1-83. Remove Collar, and Spring Assembly

6. See [Figure 1-83](#). Remove collar and spring from fork assembly.
7. Remove fork from vise and drain fork oil into a suitable container by tipping fork upside down and stroke cartridge plunger to remove excess fork oil.

Table 1-19. Oil Level, Left Fork

MEASUREMENT		VOLUME	
2.8 in.	71 mm	20.7 oz	613 cc

8. Using FORK TUBE HOLDER (Part No. HD-41177), mount fork assembly in vise vertically and compress fully.
9. Fill fork with Harley-Davidson TYPE E FORK OIL (Part No. HD-99884-80) until it is approximately 2.0 in. (50.8 mm) from top of fork tube.

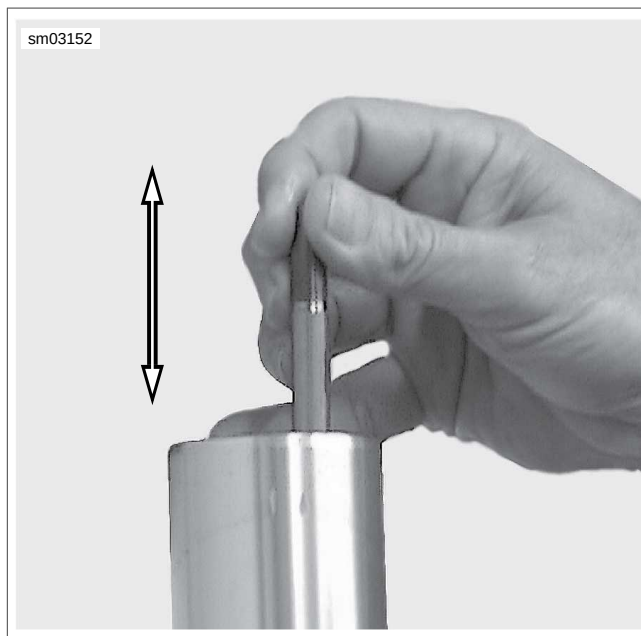


Figure 1-84. Pump Cartridge

10. See [Figure 1-84](#). Slowly pump cartridge 8 to 10 times to exhaust air from assembly.



Figure 1-85. Measure Fork Oil

NOTE

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

11. See [Figure 1-85](#). Fully compress fork and adjust the oil level to specification from top of fork tube using OIL LEVEL GAUGE (Part No. HD-59000B). Refer to [Table 1-19](#).

NOTE

Coil windings tighten at bottom of spring. Be sure to install in this manner.

12. See [Figure 1-86](#). Fully extend fork and install spring in fork tube (with tightly wound end at bottom), washer and collar.

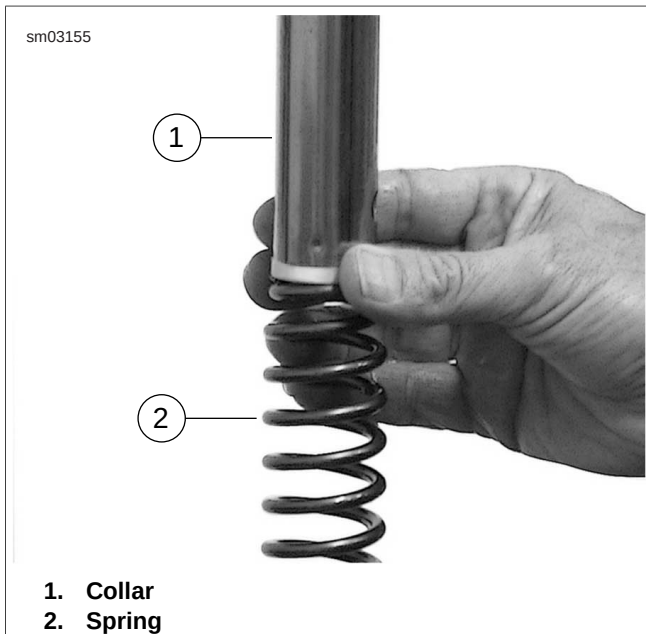


Figure 1-86. Collar and Spring Assembly

13. See [Figure 1-87](#). Compress fork using FRONT FORK COMPRESSOR (Part No. HD-45966).
14. Install keeper.



Figure 1-87. Install Keeper

15. Install retainer nut on cartridge rod 0.55 in. (14 mm) from top of rod and install fork cap onto cartridge rod.
16. Tighten cap against retainer nut to 150-195 **in-lbs** (17-22 Nm) while holding retainer nut with a wrench.
17. Release tension and remove fork compressing tool.



Figure 1-88. Install Fork Cap

18. See [Figure 1-88](#). Apply a light coat of fork oil on o-ring and thread fork cap into fork tube. Tighten to 21-29 ft-lbs (29-39 Nm).

Right Fork

⚠ WARNING

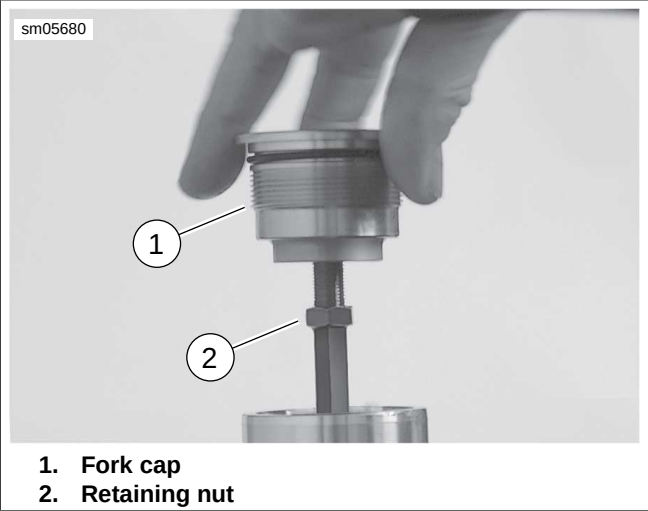
Wear safety glasses or goggles when servicing fork assembly. Do not remove slider tube caps without relieving spring preload or caps and springs can fly out, which could result in death or serious injury. (00297a)

1. See [Figure 1-89](#). Using FORK TUBE HOLDER (Part No. HD-41177), mount fork assembly in vise.



Figure 1-89. Clamp Fork and Loosen Fork Cap

2. Loosen fork cap.



- 1. Fork cap
- 2. Retaining nut

Figure 1-90. Remove/Install Fork Cap and Retaining Nut

- 3. See [Figure 1-90](#). Back retaining nut away from fork cap. Remove fork cap and retainer nut from inner fork nut threaded shaft.

NOTE

Do not fully extend fork assembly. Extending fork will cause oil to leak from bleed hole.

- 4. See [Figure 1-91](#). Using INNER FORK NUT REMOVER/INSTALLER (Part No. HD-47852), remove inner fork nut assembly from fork tube.

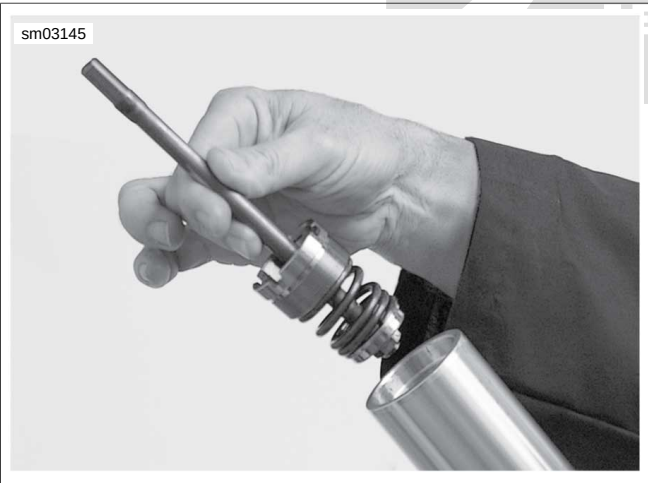


Figure 1-91. Inner Fork Nut

NOTE

Note positioning of collar, washer and spring for assembly.

- 5. See [Figure 1-92](#). Remove collar, washer and spring from fork assembly.
- 6. Remove fork from vise and drain fork oil into a suitable container by tipping fork upside down.



Figure 1-92. Remove Collar, Washer and Spring

Table 1-20. Oil Level, Right Fork

MEASUREMENT		VOLUME	
3.7 in.	93 mm	23.1 oz	684 cc

- 7. Using FORK TUBE HOLDER (Part No. HD-41177), mount fork assembly in vise vertically and fully compress fork.

NOTE

Measure fork oil level from top of fork tube using the OIL LEVEL GAUGE (Part No. HD-59000B).

- 8. Fill fork with Harley-Davidson TYPE E FORK OIL (Part No. HD-99884-80) to specification shown in [Table 1-20](#).



Figure 1-93. Measure Fork Oil

- 9. Fully extend fork.

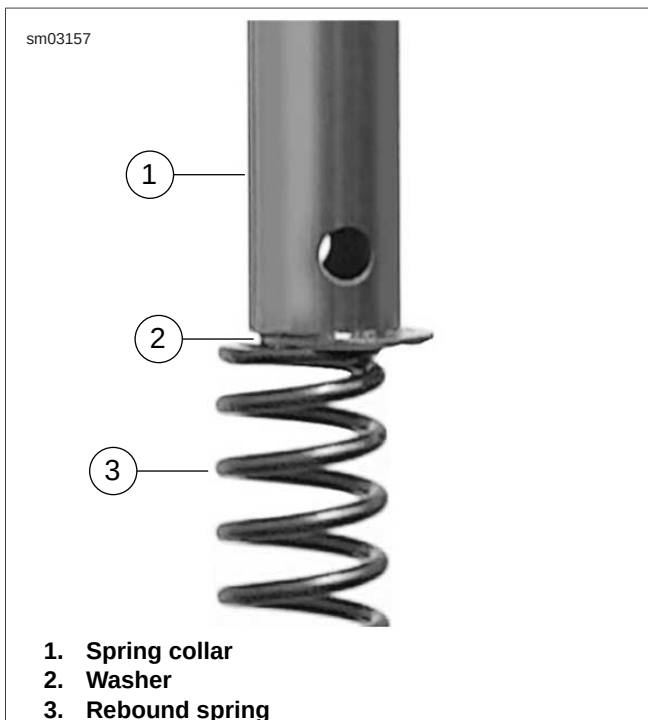


Figure 1-94. Collar, Washer and Spring Assembly

NOTE

Coil windings tighten at bottom of spring. Be sure to install in this manner.

10. See [Figure 1-94](#). Install rebound spring in fork tube (with tightly wound end at bottom), washer, and spring collar.
11. Verify that washer has properly seated on top of spring.



Figure 1-95. Inner Fork Nut

12. See [Figure 1-95](#). Insert inner fork nut and finger tighten.

NOTE

To prevent cross-threading fork tube damper cups and caps, use caution when threading in the caps with the spring com-

pressed. It may be helpful to use a palm-ratchet during this process.

13. See [Figure 1-96](#). Final tighten inner fork nut to 69-83 ft-lbs (93-113 Nm) using INNER FORK NUT REMOVER/INSTALLER (Part No. HD-47852).



Figure 1-96. Hand Tighten

14. See [Figure 1-97](#). Install retainer nut (retainer nut must be installed 0.55 in. (14 mm) from top of threaded shaft).



Figure 1-97. Remove/Install Fork Cap and Retaining Nut

15. Install fork cap on inner rod and tighten against the retainer nut to 150-195 in-lbs (17-22 Nm) while holding retainer nut with wrench.
16. Apply a light coat of fork oil on o-ring and thread cap into fork tube. Tighten fork cap to 21-29 ft-lbs (29-39 Nm).
17. Install the forks. See [2.22 FRONT FORK: XR MODELS](#).

CABLE AND CHASSIS LUBRICATION

1.23

GENERAL

Inspect and lubricate the following at scheduled service intervals as specified in [1.4 MAINTENANCE SCHEDULE](#).

- Front brake hand lever
- Clutch hand lever
- Throttle control cables
- Throttle control grip sleeve
- Clutch cable
- Foot shift lever pivot (if applicable)
- Rear brake lever pivot
- Steering head bearings
- Jiffy stand

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

CABLES AND HAND LEVERS

For throttle cables, see [2.30 THROTTLE CABLES: ALL MODELS](#).

Use SUPER OIL (Part No. HD-94968-85TV) for hand levers and cables.

FOOT SHIFT LEVER AND REAR BRAKE PEDAL

Clean and lubricate the foot shift lever pivot (XL 883C/XL 1200C) and rear brake pedal pivot with ANTI-SEIZE LUBRICANT at scheduled service intervals as specified in [1.4 MAINTENANCE SCHEDULE](#).

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

JIFFY STAND

Clean and lubricate the jiffy stand. For more information, see [2.37 JIFFY STAND](#).

STEERING HEAD BEARINGS

Lubricate the steering head bearings with HARLEY-DAVIDSON SPECIAL PURPOSE GREASE. See [1.19 STEERING HEAD BEARINGS](#) for procedure.



AIR CLEANER: XL MODELS

1.24

GENERAL

The air cleaner prevents foreign material from entering the induction module and engine, trapping airborne dust and dirt in the filter element.

REMOVAL

1. See [Figure 1-98](#). Remove two screws (1) and trim insert (2) from air cleaner cover (3).

2. Remove air cleaner cover from air cleaner backplate (9). Remove air cleaner seal (4) from cover.
3. Remove three screws (5). Remove air filter element (6) and gasket (7) from air cleaner backplate. Discard gasket.

CAUTION

Install air filter before running engine. Failure to do so can draw debris into the engine and could result in engine damage. (00207a)

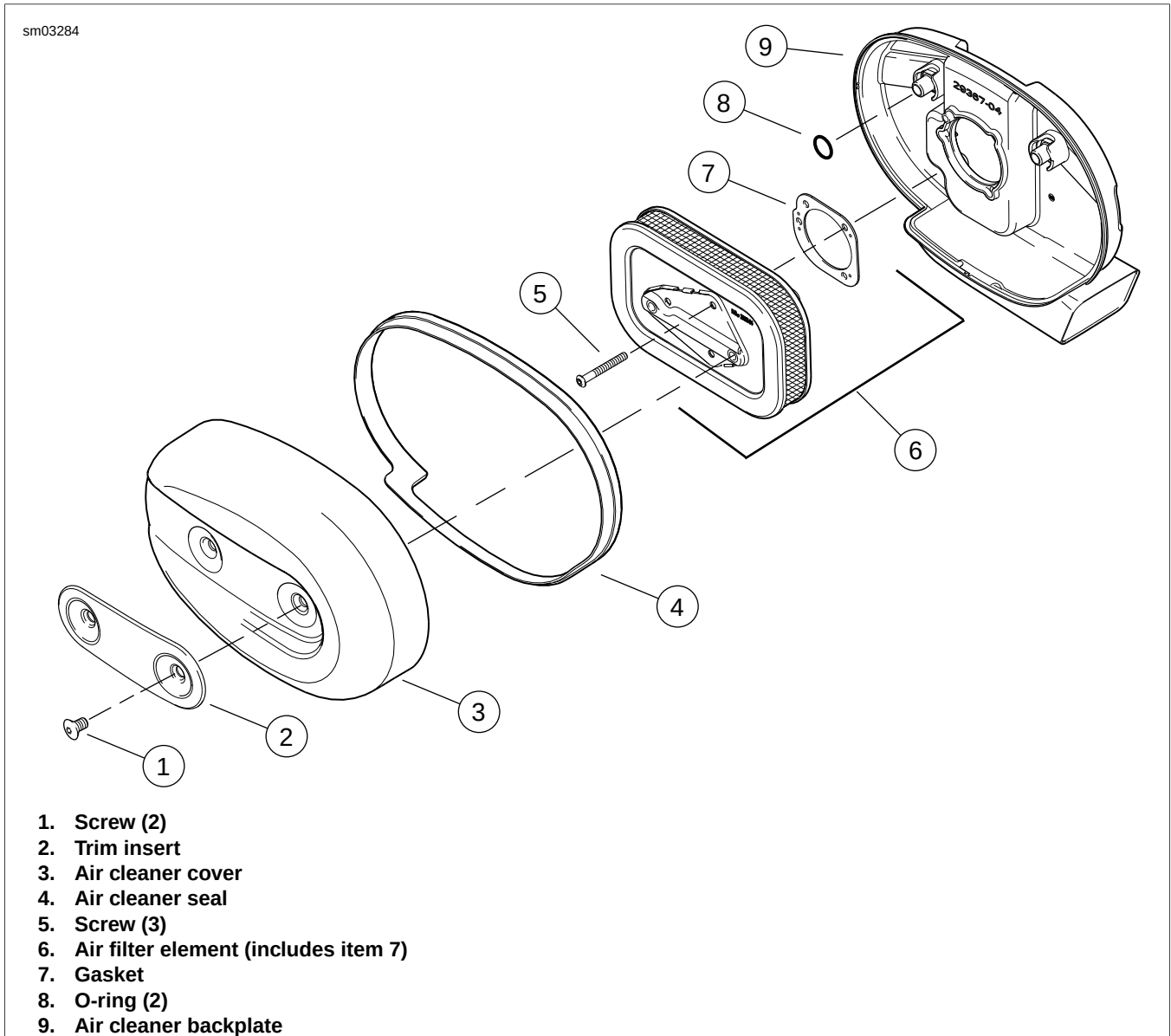


Figure 1-98. Air Cleaner Assembly: XL Models

CLEANING, INSPECTION AND REPAIR

1. See [Figure 1-98](#). Thoroughly clean air cleaner backplate (9) and inside of air cleaner cover (3).

2. If air filter element (6) is damaged or if filter media cannot be adequately cleaned, replace element and proceed to steps below to examine o-rings and air cleaner seal.

 WARNING

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

3. Wash air filter element thoroughly in warm, soapy water. To remove soot and carbon, soak air filter element for 30 minutes in warm water with mild detergent.

 WARNING

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

4. Dry air filter element using low-pressure compressed air. Rotate air filter element while moving air nozzle up and down filter element interior. Do not tap air filter element on hard surface.
5. Hold air filter element up to strong light source. Element can be considered sufficiently clean if light is uniformly visible through filter material.

NOTE

Do not use air cleaner filter oil on Harley-Davidson paper air filter elements.

6. Examine o-rings (8). If damaged, replace with **new** o-ring(s).
7. Examine air cleaner seal (4). If cracked, torn or otherwise damaged, replace with **new** seal.

INSTALLATION

1. See [Figure 1-98](#). Apply a thin coat of engine oil or light grease to o-rings (8). This will help prevent them from being damaged when air filter element is installed.
2. Position **new** gasket (7) on air cleaner backplate (9). Make sure gasket holes are lined up with backplate holes.
3. Install air filter element (6) onto backplate. The words "This Side Out" should be readable on the upper edge of the air filter element when installed. Secure with three screws (5). Tighten to 40-60 **in-lbs** (4.5-6.8 Nm).
4. Fit air cleaner seal (4) onto air cleaner cover (3). To ensure proper sealing, make sure air cleaner seal covers entire edge of air cleaner cover.
5. Install air cleaner cover onto backplate. Make sure air cleaner seal fits inside backplate and is not pinched or distorted.
6. Install trim insert (2) and secure cover assembly with two screws (1). Tighten to 36-60 **in-lbs** (4.1-6.8 Nm).



AIR CLEANER: XR MODELS

1.25

GENERAL

The air cleaner prevents foreign material from entering the induction module and engine, trapping airborne dust and dirt in the filter element.

See [Figure 1-99](#). The XR air filter element (3) is housed in the airbox assembly (1), mounted to the underside of the fuel tank on the right side of the vehicle. In order to remove the air filter element for service, the fuel tank must be removed from the vehicle.



Figure 1-99. Airbox: XR Models

REMOVAL

⚠ WARNING

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

1. Purge and disconnect fuel supply hose, and remove fuel tank. See [4.7 FUEL TANK: XR MODELS](#).

2. See [Figure 1-100](#). Using a long magnetic phillips screwdriver, remove two screws (2, 3) securing air filter cover (4) to airbox assembly (1).
3. Remove airbox assembly. See [4.5 AIRBOX: XR MODELS](#).
4. Using a small flat blade screwdriver, or other suitable tool, gently pry two button head clips (5) securing air filter cover to airbox. Discard button head clips.

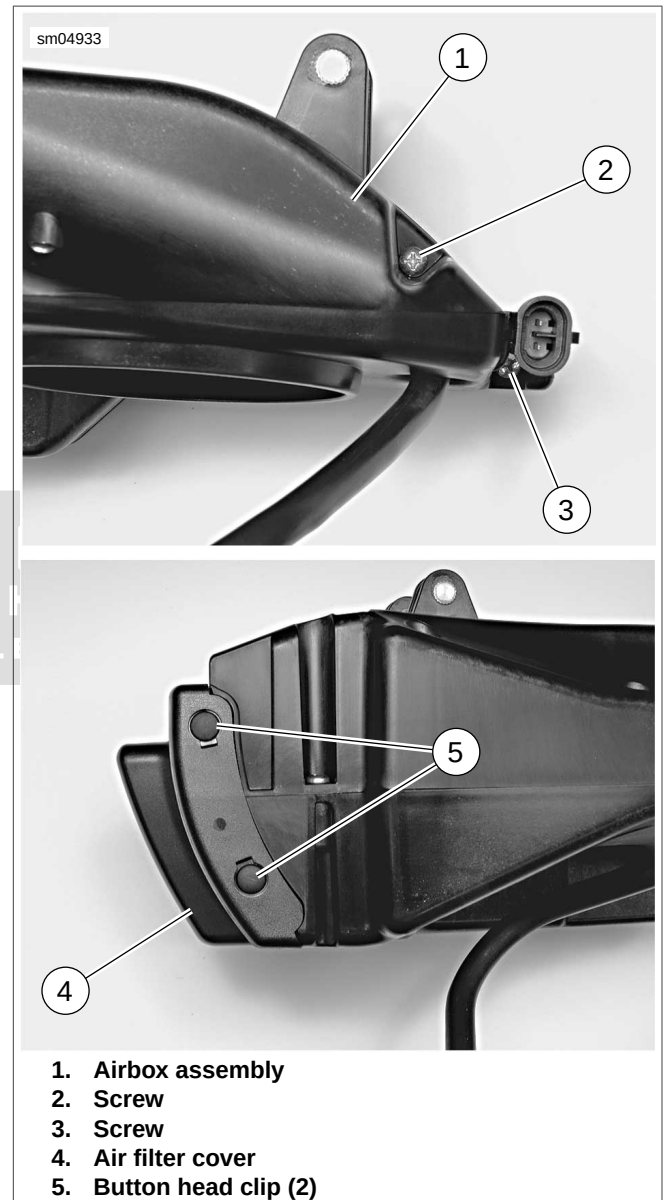


Figure 1-100. Unbolting Air Filter Cover

5. See [Figure 1-101](#). Gently pull rear end of air filter cover away from airbox assembly. Disengage front of air filter cover from airbox assembly and set cover aside.

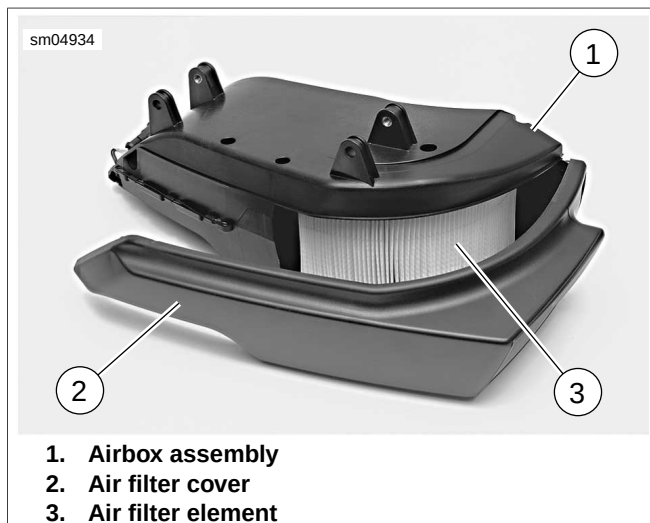


Figure 1-101. Removing Air Filter Cover

6. See [Figure 1-102](#). Using a flat blade screwdriver or other suitable tool, gently pry lower front corner of air filter element out of airbox. Work screwdriver around bottom of filter element gasket (4) until entire bottom end of filter element is free.
7. Carefully pull air filter element out of airbox.

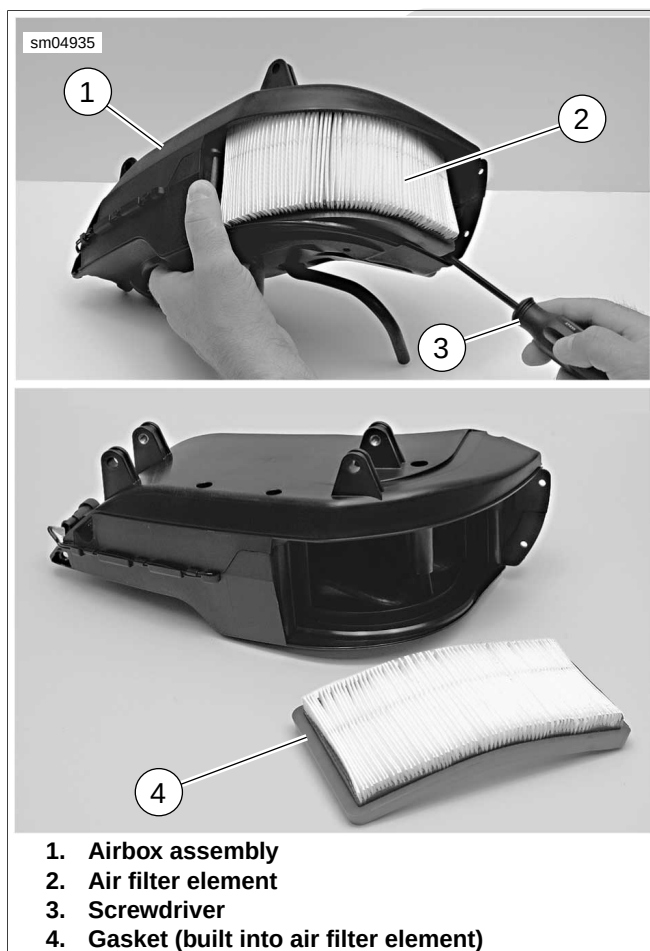


Figure 1-102. Removing Air Filter Element

CLEANING, INSPECTION AND REPAIR

1. See [Figure 1-101](#). Thoroughly clean inside of airbox housing (1) and cover (2).
2. If air filter element (3) is damaged or if filter media cannot be adequately cleaned, replace filter element.
3. See [Figure 1-102](#). Examine air filter seal (4). If cracked, torn or otherwise damaged, replace filter element.

⚠ WARNING

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

4. Wash air filter element thoroughly in warm, soapy water. To remove soot and carbon, soak air filter element for 30 minutes in warm water with mild detergent.

⚠ WARNING

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

5. Dry air filter element using low-pressure compressed air. Rotate air filter element while moving air nozzle up and down filter element interior. Do not tap air filter element on hard surface.
6. Hold air filter element up to strong light source. Element can be considered sufficiently clean if light is uniformly visible through filter material. If any holes are visible, the element must be replaced.

NOTE

Do not use air cleaner filter oil on Harley-Davidson paper air filter elements.

INSTALLATION

1. Form **new** air filter element into a curved shape. Slide top of air filter element up into opening in airbox. See [Figure 1-103](#). Top of air filter element must fully fit into channel in top of airbox.
2. Press bottom and ends of air filter element into airbox, making sure that filter element fits fully into airbox opening.
3. See [Figure 1-101](#). Position front of air filter cover (2) onto airbox. Do not secure with button head clips at this time.
4. See [Figure 1-104](#). Make sure active intake connector wiring harness (4) is in recess (5) in airbox (1) and cannot be pinched or cut when air filter cover (2) is installed.
5. See [Figure 1-100](#). Install rear of air filter cover in place onto airbox. Secure with two screws (2, 3) and tighten.
6. Install **new** button head clips (5). Press in firmly.
7. Install airbox assembly. See [4.5 AIRBOX: XR MODELS](#).
8. Install fuel tank. See [4.7 FUEL TANK: XR MODELS](#).

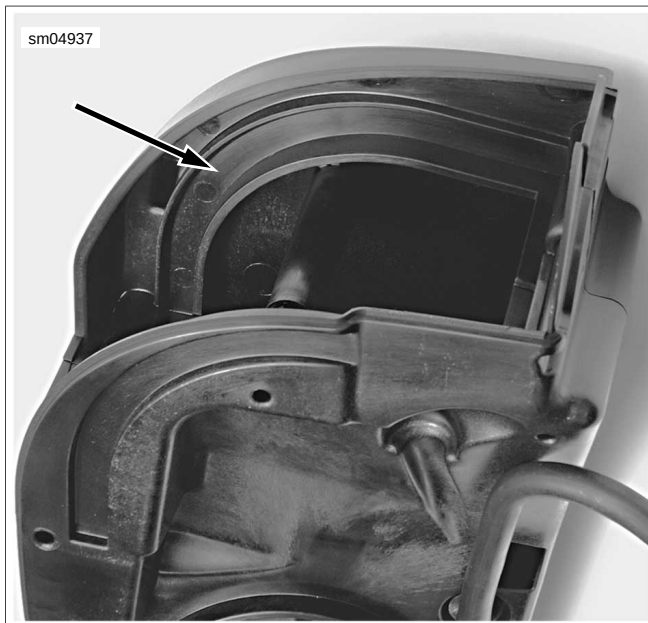


Figure 1-103. Filter Element Channel

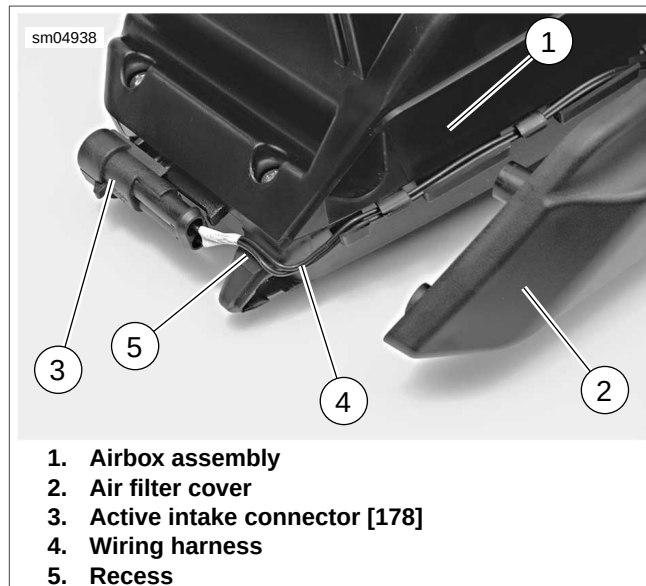


Figure 1-104. Installing Air Filter Cover



EXHAUST SYSTEM

1.26

EXHAUST SYSTEM LEAK CHECK

Check the exhaust system for leaks at every scheduled service interval as follows:

1. Check entire exhaust system for loose or missing fasteners, broken pipe clamps or brackets, and obvious signs of leakage (carbon tracks at pipe joints, etc.).
2. Check for loose or broken heat shields. Repair or replace as necessary.
3. Start engine, cover muffler ends with clean, dry shop towels and listen for audible signs of exhaust leakage.
4. Correct any leaks detected. See [4.15 EXHAUST SYSTEM: XL MODELS](#) or [4.16 EXHAUST SYSTEM: XR MODELS](#) for exhaust system removal and installation procedures.



THROTTLE CONTROL

1.27

CABLE INSPECTION AND LUBRICATION

Inspect, lubricate and adjust throttle control cables as follows.

1. See [Figure 1-105](#). Remove two screws (1) to separate the upper handlebar housing from the lower housing.
2. Unhook each ferrule and cable from the throttle grip and remove the throttle sleeve.
3. Inspect each cable. Replace cable assembly if cable is frayed or kinked.
4. Inspect entire cable outer sheath from throttle grip to induction module for damage. Replace if necessary.
5. Apply a light coat of graphite to the handlebar and replace throttle grip.
6. Pour one or two drops of SUPER OIL into the housing of each cable.
7. Assemble handlebar housing. Tighten both screws (1) to 35-45 in-lbs (4.0-5.1 Nm).

CABLE ADJUSTMENT

⚠ WARNING

Before starting engine, be sure throttle control will snap back to idle position when released. A throttle control that prevents engine from automatically returning to idle can lead to loss of control, which could result in death or serious injury. (00390a)

See [Figure 1-105](#). With throttle friction screw (3) backed off, induction module throttle wheel must return to closed (idle) position. Check control cable adjustment. With engine idling, turn handlebars through full range of travel. If engine speed changes during this maneuver, adjust control cables according to the following procedure.

1. Loosen throttle friction screw (3).
2. Slide rubber boot off each control cable adjuster (6).
3. Loosen jam nut (7) on each cable adjuster.
4. Turn cable adjusters in direction which will shorten cable housings to minimum length.
5. Point front wheel straight ahead. With engine OFF, gently turn throttle control grip (2) to fully open position (fully counterclockwise) and hold in position.
6. Gently turn adjuster (6) on throttle control cable (4) counterclockwise until throttle cam (8) touches throttle cam stop (10). Release throttle control grip and turn adjuster counterclockwise an additional 1/2-1 turn. Tighten jam nut on throttle control cable adjuster.
7. Turn handlebars fully to right. Turn adjuster (6) on idle control cable (5), lengthening sleeve until end of cable housing just touches spring (9) within cable guide (11).
8. Check adjustment. With throttle friction screw loosened, twist and release throttle control grip two or three times. Induction module throttle wheel must return to idle position

each time throttle grip is released. If throttle does not return to idle, turn idle adjuster, shortening sleeve until correct adjustment is reached. Tighten jam nut.

9. Slide rubber boot over each cable adjuster.

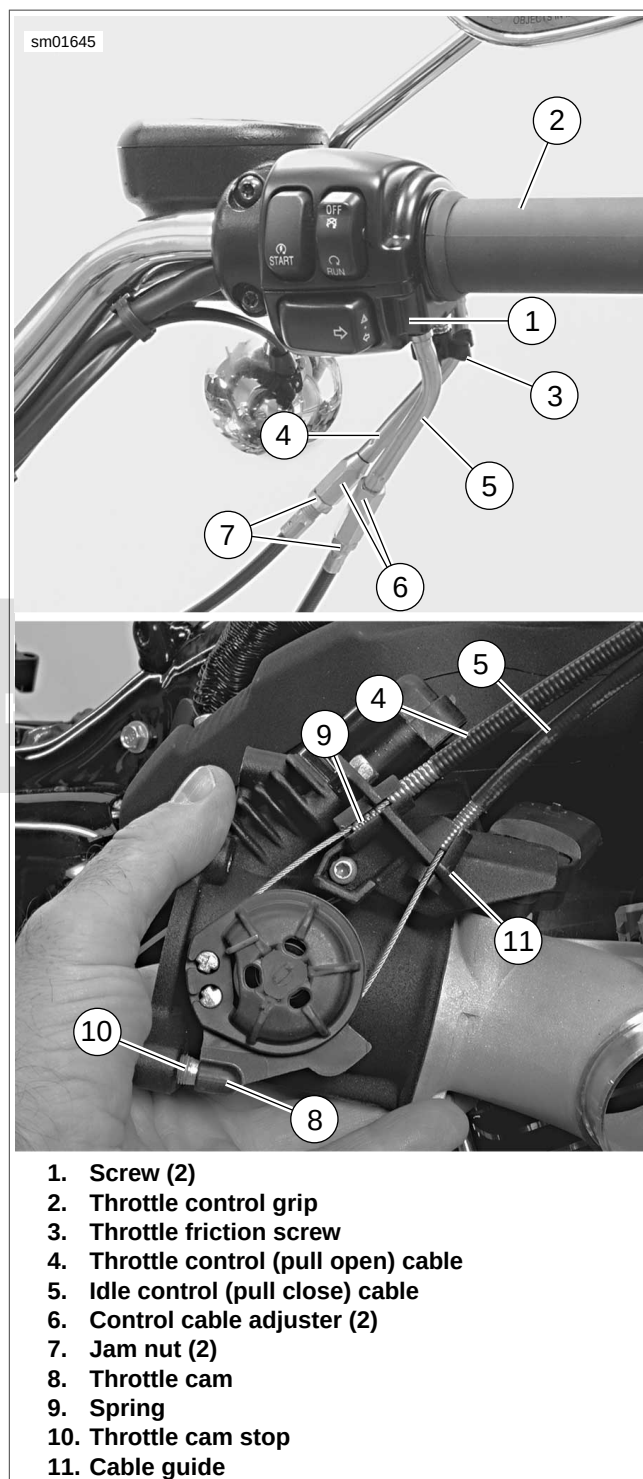


Figure 1-105. Throttle Cable Adjustment (typical; XL model shown) (Induction Module Partially Removed from Vehicle for Clarity)

IDLE SPEED AND IGNITION TIMING

IDLE SPEED

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

Idle speed can only be set using a computer based diagnostic package called DIGITAL TECHNICIAN II (Part No. HD-48650). See your Harley-Davidson dealer.

IGNITION TIMING

See [Figure 1-106](#). Ignition timing is controlled by the Electronic Control Module (ECM) based on input from:

- Temperature/Manifold Absolute Pressure (TMAP) sensor.
- Crank Position (CKP) sensor.

No ignition timing adjustment is required, or possible. Should a sensor fail, the resulting diagnostic trouble code (DTC) will identify the problem. See the ELECTRICAL DIAGNOSTIC MANUAL for more information.

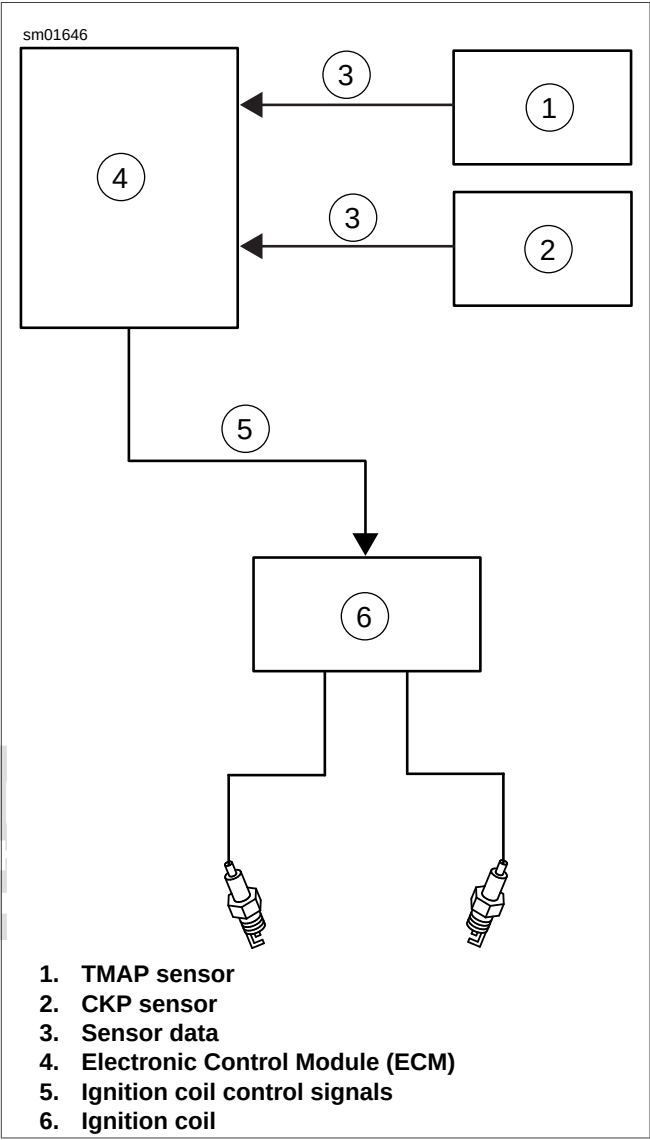


Figure 1-106. Ignition Control

FUEL SUPPLY FILTER

1.29

GENERAL

The fuel supply filter is located in the fuel pump assembly inside the fuel tank.

Check fuel system hose and fittings for leaks.

REMOVAL

⚠ WARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

1. Purge the fuel supply hose of high pressure gasoline. Disconnect fuel supply hose from fuel pump module. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).
2. Remove seat.

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

3. Unplug main fuse. See [6.38 MAIN FUSE](#).
4. Drain and remove fuel tank. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).
5. Remove fuel pump assembly from fuel tank. See [4.18 FUEL PUMP](#).
6. See [Figure 1-107](#). Remove and discard cover plate seal (6).
7. Remove retaining clip (4) and lift filter housing (5) off fuel pump assembly (1).
8. Remove and discard filter element (3).

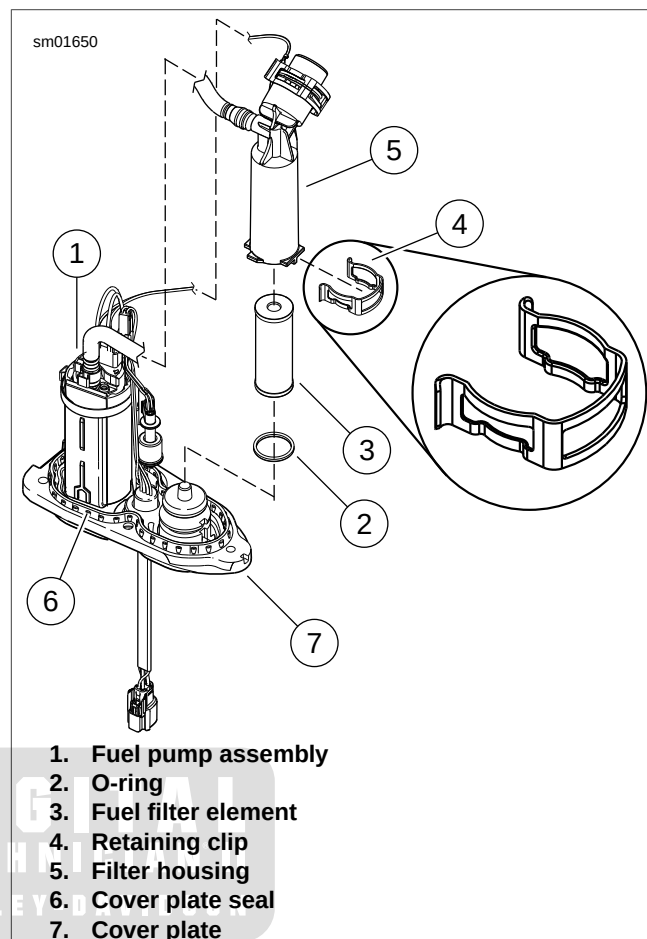


Figure 1-107. Replacing Fuel Filter Element

INSTALLATION

1. See [Figure 1-107](#). Examine o-ring (2). Replace if cracked, torn or otherwise damaged.
2. Install **new** filter element (3) into filter housing (5).
3. Install filter housing onto base of fuel pump assembly (1). Secure with retaining clip (4), making sure that clip is oriented right side up, exactly as shown in the figure.
4. Install **new** cover plate seal (6) into groove in cover plate (7).
5. Install fuel pump assembly into fuel tank. Tighten mounting screws in a cross pattern to 40-45 **in-lbs** (4.5-5.1 Nm). Plug in fuel pump wiring harness connector [141A]. See [4.18 FUEL PUMP](#).
6. Install fuel tank and reconnect fuel hose. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#). Fill fuel tank and carefully check for leaks.
7. Plug in main fuse. See [6.38 MAIN FUSE](#).
8. Install seat.
9. Turn ignition switch ON and verify operation of fuel pump.

ENGINE MOUNTS AND STABILIZER LINKS

1.30

INSPECTION

Check engine mounts and stabilizer links as follows:

1. See [Figure 1-108](#). Check for cracks or tears in engine mount isolator rubber (17, 18).
2. Check stabilizer links (8) for wear.
3. Check that all engine mount bolts and stabilizer link screws are tight. See [2.27 STABILIZER LINKS](#), [2.28 FRONT ENGINE MOUNT/ISOLATOR](#), or [2.29 REAR ENGINE MOUNT/ISOLATOR](#) for torque specifications.
4. Check that the mounts are supporting the weight of the motor.

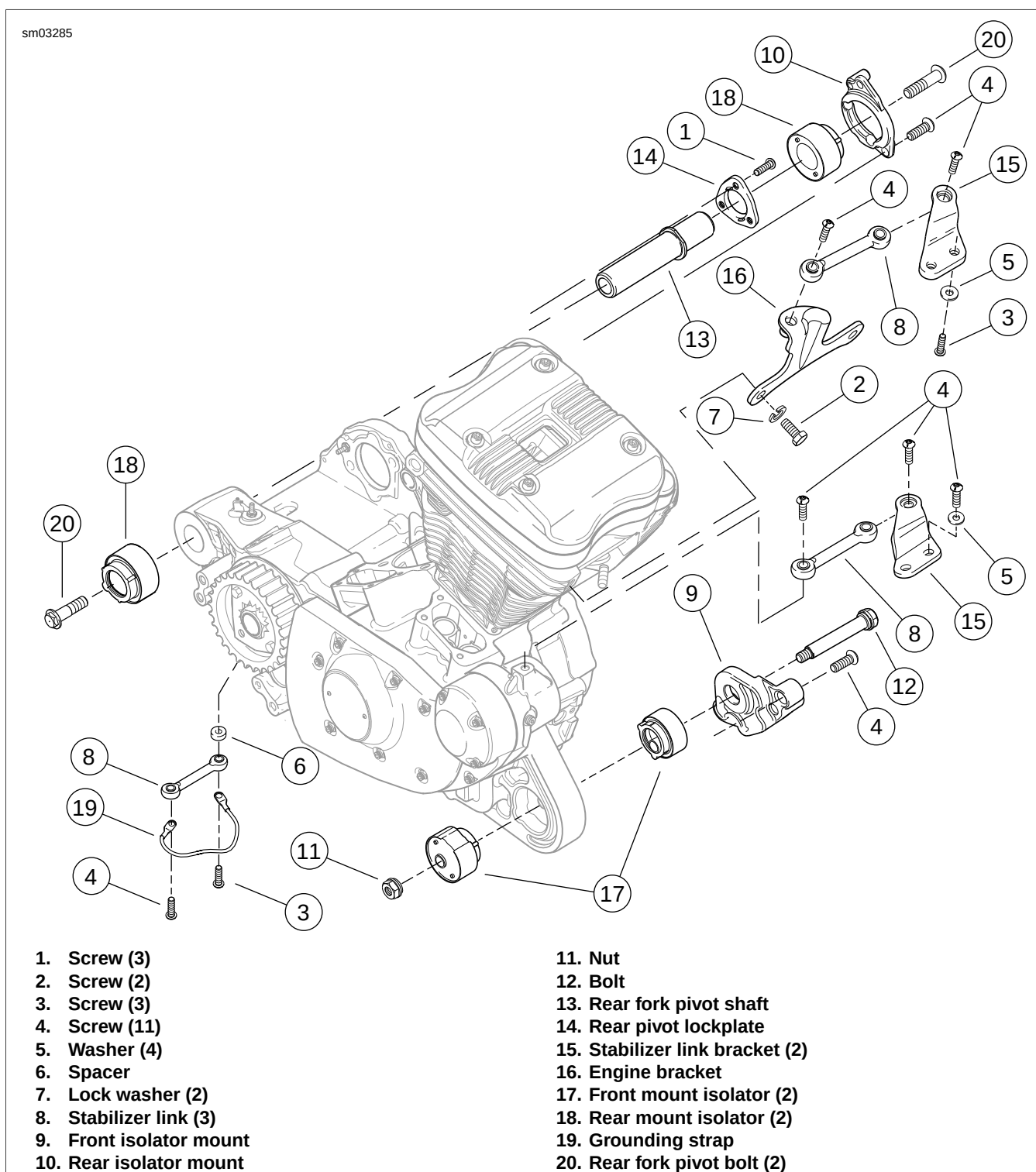


Figure 1-108. Engine Mounting Assemblies: All Models (XL Model Shown)

HEADLAMP ALIGNMENT

1.31

HEADLAMP ALIGNMENT

⚠ WARNING

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

NOTE

Vehicles with multiple beam headlamps that are individually aimed should be adjusted so both lamps converge into one pattern.

1. Verify that front and rear tire inflation pressures are correct and that suspension is adjusted to the weight of the principal rider. See [1.11 TIRES AND WHEELS](#).
2. Fill fuel tank or add ballast to equal the weight of the fuel needed.

NOTE

See [Figure 1-109](#). To aid in properly placing the motorcycle, a perpendicular line (1) can be drawn on the floor. For best results, choose an area with minimum light.

3. See [Figure 1-109](#). Draw a vertical line (2) on the wall.
4. Position motorcycle so that front axle is 25 feet (7.6 meters) from wall.

NOTE

As the weight of the rider will compress the suspension slightly, have a person whose weight is approximately the same as that of the principal rider sit on the motorcycle.

5. With the vehicle laden and upright, point the front wheel straight forward at wall and measure the distance (4) from the floor to the center of the HIGH BEAM bulb.
6. Draw a horizontal line (5) through the vertical line on the wall that is 2.1 in. (53.3 mm) lower than the measured bulb centerline.

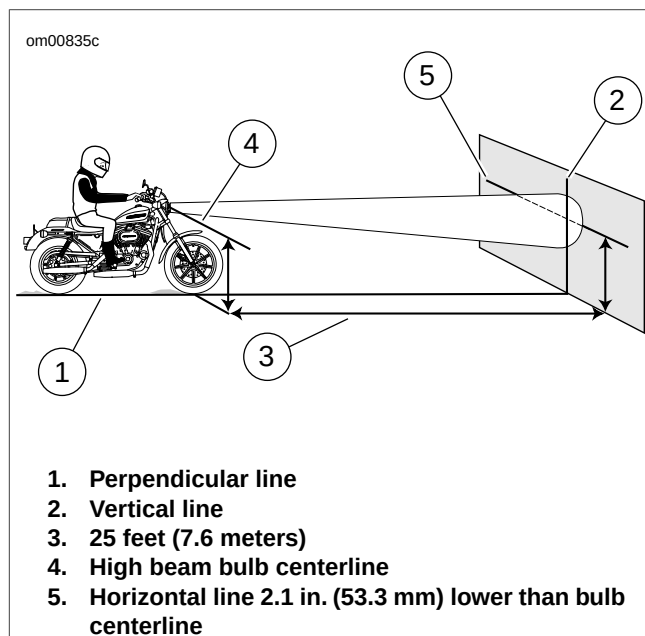


Figure 1-109. Checking Headlamp Alignment: Sportster Models

NOTE

As the weight of the rider will compress the suspension slightly, have a person whose weight is approximately the same as that of the principal rider sit on the motorcycle.

7. See [Figure 1-109](#). Verify headlamp alignment. Turn the ignition switch to IGNITION and set the headlamp switch to HIGH beam.
 - a. The center of the hot spot (brightest area of light beam) should be centered where the two lines intersect.
 - b. Adjust headlamp alignment if necessary.

HEADLAMP ADJUSTMENT: SPORTSTER MODELS

Adjustment (XL 883C and XL 1200C Models)

1. Set horizontal adjustment:
 - a. See [Figure 1-110](#). Loosen the Allen head capscrew (3).
 - b. Turn the headlamp right or left as necessary to direct the light beam straight ahead.
 - c. Tighten the Allen head capscrew to 30-35 ft-lbs (40.7-47.5 Nm).

2. Set vertical adjustment:
 - a. See [Figure 1-110](#). Loosen the locknut (1) for the vertical adjustment bolt.
 - b. Tilt headlamp up or down to properly aim it at the horizontal line on the wall.
 - c. Tighten headlamp locknut to 30-35 ft-lbs (40.7-47.5 Nm).

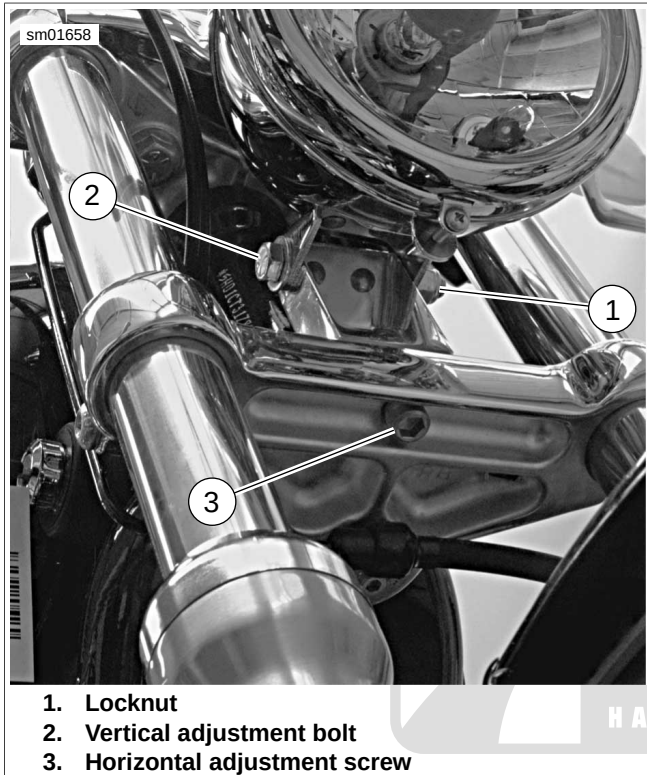


Figure 1-110. Headlamp Adjustment (XL 883C/XL 1200C)

Adjustment (All Models Except XL 883C and XL 1200C)

1. See [Figure 1-111](#). Remove snap plug (1) on top of headlamp bracket (2).
2. See [Figure 1-112](#). Loosen headlamp clamp nut.
3. 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.

4. Tighten headlamp clamp nut to 120-240 in-lbs (14-27 Nm) after lamp is properly positioned. Install snap plug in headlamp bracket.

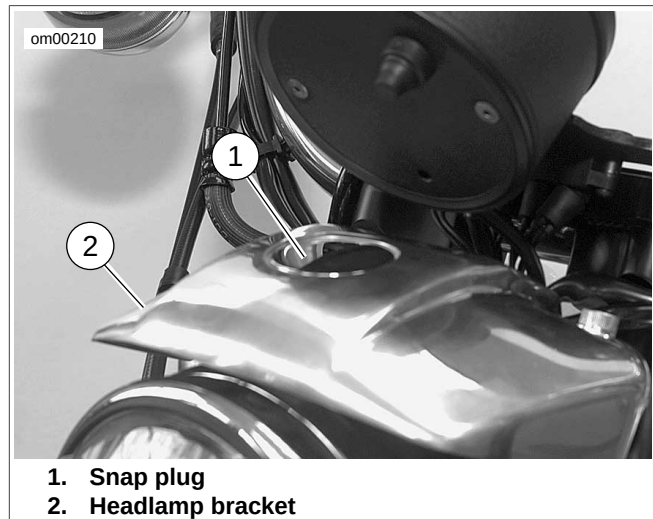


Figure 1-111. Headlamp Snap Plug: Sportster Models (XL Model Shown)

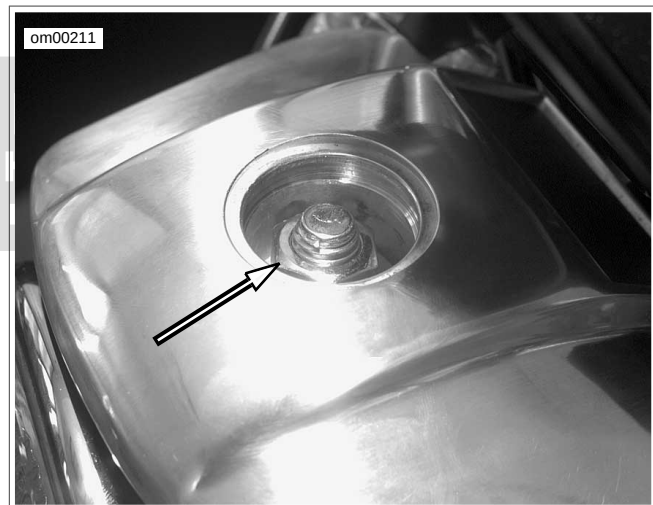


Figure 1-112. Headlamp Clamp Nut: Sportster Models (XL Model Shown)

FLUID AND LUBRICANT REQUIREMENTS

1.32

BRAKE FLUID



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

Use only Harley-Davidson brand D.O.T. 4 BRAKE FLUID.

BRAKE COMPONENT GREASE

Use only CCI #20 BRAKE GREASE to lubricate master cylinder bores, pistons, and primary and secondary cups. Use only G40M BRAKE GREASE to lubricate all other brake system components.

FRONT FORK OIL

Use only HARLEY-DAVIDSON TYPE "E" HYDRAULIC FORK OIL.

PRIMARY DRIVE/TRANSMISSION LUBRICANT

Use only GENUINE HARLEY-DAVIDSON FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT.

ENGINE OIL

Engine oil is a major factor in the performance and service life of the engine. Refer to [Table 1-21](#). 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 CF, CF-4, CG-4 and CH-4. The preferred viscosities for the diesel engine oils, in descending order, are 20W-50, 15W-40 and 10W-40. At the first opportunity, see a Harley-Davidson dealer to change back to 100 percent Harley-Davidson oil.

Table 1-21. Recommended Engine Oils

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

CRITICAL FASTENERS

1.33

INSPECTION

Inspect critical fasteners at the scheduled service intervals.

Replace any fasteners that are damaged or missing.

Checking Torques on Fasteners

Refer to [Table 1-22](#). Attempt to turn the fastener using a torque wrench set to the minimum torque specification for that fastener. If the fastener does not rotate, the fastener torque

has been maintained. If the fastener rotates, remove it to determine if it has a locking agent.

If it has a locking agent, clean all locking material from the threaded hole. Replace the fastener with a new one or clean the original fastener threads and apply the appropriate locking agent (see appropriate procedure). Install and tighten the fastener to specification.

If the fastener does not have a locking agent, install and tighten to specification.

Table 1-22. Critical Fasteners

SYSTEM	FASTENER	TORQUE	
Hand controls	Upper and lower switch housing screws	35-45 in-lbs	4.0-5.1 Nm
	Clutch lever handlebar clamp screws	108-132 in-lbs	12.2-14.9 Nm
	Master cylinder handlebar clamp screws	108-132 in-lbs	12.2-14.9 Nm
Engine	Stabilizer link screws	25-35 ft-lbs	33.9-47.5 Nm
	Upper front stabilizer link frame bracket mounting screws	25-35 ft-lbs	33.9-47.5 Nm
	Upper front stabilizer link engine bracket mounting screws	55-65 ft-lbs	74.6-88.2 Nm
	Lower front stabilizer link frame bracket mounting screws	25-35 ft-lbs	33.9-47.5 Nm
	Front isolator mounting bolt	60-70 ft-lbs	81.4-95.0 Nm
	Rear fork pivot/engine mount bolts	60-70 ft-lbs	81.4-95.0 Nm
	Front isolator mounting bracket screws (left side)	25-35 ft-lbs	33.9-47.5 Nm
	Rear isolator mounting bracket screws (left side)	25-35 ft-lbs	33.9-47.5 Nm
Brakes	Brake line banjo bolts	20-25 ft-lbs	27.1-33.9 Nm
	Front brake disc mounting screws	16-24 ft-lbs	21.7-32.6 Nm
	Rear brake disc mounting screws	30-45 ft-lbs	40.7-61.1 Nm
	Front master cylinder reservoir cover screws	9-17 in-lbs	1.0-2.0 Nm
	Rear master cylinder mounting screws: XL	17-22 ft-lbs	23.1-29.9 Nm
	Rear master cylinder mounting screws: XR	72-96 in-lbs	8.1-10.9 Nm
	Rear master cylinder bracket-to-frame mounting screws: XL	17-22 ft-lbs	23.1-29.9 Nm
	Rear master cylinder/footpeg bracket-to-frame mounting screws: XR	45-50 ft-lbs	61-67.8 Nm
	Front brake caliper mounting bolts	28-38 ft-lbs	38.0-51.6 Nm
Axle nuts	Front	60-65 ft-lbs	81-88 Nm
	Rear	95-105 ft-lbs	129-142 Nm

Table 1-22. Critical Fasteners

SYSTEM	FASTENER	TORQUE	
Front fork/handlebars	Lower bracket pinch screws	30-35 ft-lbs	40.7-47.5 Nm
	Upper bracket pinch screws	30-35 ft-lbs	40.7-47.5 Nm
	Fork stem bolt	23-27 ft-lbs, loosen, 72-96 in-lbs	31.2-36.6 Nm, loosen, 8.1-10.9 Nm
	Fork stem pinch screw	30-35 ft-lbs	40.7-47.5 Nm
	Front axle pinch screw: XL	21-27 ft-lbs	28.5-36.6 Nm
	Front axle pinch screw: XR	41-48 ft-lbs	55.6-65.1 Nm
	Handlebar clamp mounting screw	12-18 ft-lbs	16.3-24.4 Nm
	Riser mounting bolts	30-40 ft-lbs	40.7-54.3 Nm
Final drive	Rear sprocket mounting screws	60 ft-lbs, loosen 180°, 80 ft-lbs	81.3 Nm, loosen 180°, 108 Nm



STORAGE

1.34

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 fuel system.

This work should be performed following Service Manual procedures.

PLACING IN STORAGE

PART NUMBER	TOOL NAME
98716-87A	STORAGE COVER

WARNING

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

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

WARNING

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

WARNING

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

2. Prepare your fuel system by filling fuel tank and adding a gasoline stabilizer. Use one of the commercially available gasoline stabilizers following the manufacturer's instructions.
3. Remove the spark plugs, inject a few squirts of engine oil into each cylinder and crank the engine 5-6 revolutions. Reinstall spark plugs.
4. Inspect rear belt deflection. See [1.16 REAR BELT DEFLECTION](#).
5. Inspect rear belt and sprockets. See [1.15 REAR BELT AND SPROCKETS](#).
6. Inspect air cleaner filter. See [1.24 AIR CLEANER: XL MODELS](#) or [1.25 AIR CLEANER: XR MODELS](#).
7. Lubricate controls. See [1.23 CABLE AND CHASSIS LUBRICATION](#).

8. Inspect operation of all electrical equipment and switches.
9. Check tire inflation and inspect tires for wear and/or damage. See [1.11 TIRES AND WHEELS](#). If the motorcycle will be stored for an extended period of time, securely support the motorcycle under the frame so that all weight is off the tires.

WARNING

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

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

WARNING

Unplug or turn OFF battery charger before connecting charger cables to battery. Connecting cables with charger ON can cause a spark and battery explosion, which could result in death or serious injury. (00066a)

WARNING

Explosive hydrogen gas, which escapes during charging, could cause death or serious injury. Charge battery in a well-ventilated area. Keep open flames, electrical sparks and smoking materials away from battery at all times. **KEEP BATTERIES AWAY FROM CHILDREN.** (00065a)

11. Remove battery from vehicle. Charge battery until the correct voltage is obtained. Charge the battery every other month if it is stored at temperatures below 60° F (16° C). Charge battery once a month if it is stored at temperatures above 60° F (16° C). See [1.17 BATTERY MAINTENANCE](#).

WARNING

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

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

REMOVAL FROM STORAGE

WARNING

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

1. Charge and install battery. If main fuse was removed, plug it in.
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 hose was 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.



TROUBLESHOOTING

1.35

GENERAL

WARNING

The Troubleshooting section of this manual is a guide to diagnose problems. Read the appropriate sections of this manual before performing any work. Improper repair and/or maintenance could result in death or serious injury. (00528b)

The following check list of possible operating troubles and their probable causes will be helpful in keeping a motorcycle in good operating condition. More than one of these conditions may be causing the trouble and all should be carefully checked.

NOTE

For further troubleshooting information, see the *ELECTRICAL DIAGNOSTIC MANUAL*.

ENGINE

Starter Motor Does Not Operate or Does Not Turn Engine Over

1. Engine run switch in OFF position.
2. Ignition switch not in IGNITION position.
3. Discharged battery, loose or corroded connections (solenoid chatters).
4. Starter control circuit, relay, or solenoid faulty.
5. Electric starter shaft pinion gear not engaging or overrunning clutch slipping.
6. TSM/TSSM/HFSM Bank Angle Sensor tripped and ignition switch not cycled OFF then back to IGNITION position.
7. Security system activated.
8. Motorcycle in gear and clutch not pulled in.
9. Main fuse not in place.
10. Jiffy stand down and transmission in gear (HDI models).

Engine Turns Over But Does Not Start

1. Fuel tank empty.
2. Fuel filter clogged.
3. Plugged fuel injectors.
4. Discharged battery, loose or broken battery terminal connections.
5. Fouled spark plugs.
6. Spark plug cables in bad condition and shorting, cable connections loose or cables connected to incorrect cylinders.
7. Ignition timing incorrect due to faulty coil, ECM or sensors (TMAP, CKP) and/or TSM/TSSM/HFSM.
8. Bank Angle Sensor tripped and ignition/light key switch not cycled OFF then back to IGNITION.

9. Damaged wire or loose wire connection at ignition coil, battery or ECM connector.
10. Sticking or damaged valve(s) or wrong length push rod(s).
11. Engine lubricant too heavy (winter operation).

NOTE

For cold weather starts, always disengage clutch.

Starts Hard

1. Spark plugs in bad condition, have improper gap or are partially fouled.
2. Spark plug cables in bad condition.
3. Battery nearly discharged.
4. Damaged wire or loose wire connection at battery terminal, ignition coil or ECM connector.
5. Ignition not functioning properly (possible sensor failure).
6. Faulty ignition coil.
7. Fuel tank filler cap vent plugged or fuel line closed off restricting fuel flow.
8. Water or dirt in fuel system.
9. Intake air leak.
10. Partially plugged fuel injectors.
11. Valves sticking.
12. Air cleaner EVAP flapper (if equipped) stuck close or inoperative.
13. Engine lubricant too heavy (winter operation).

NOTE

For cold weather starts, always disengage clutch.

Starts But Runs Irregularly or Misses

1. Spark plugs in bad condition or partially fouled.
2. Spark plug cables in bad condition and shorting or leaking.
3. Spark plug gap too close or too wide.
4. Faulty ignition coil, ECM, or sensor (TMAP, CKP, ET or O2).
5. Battery nearly discharged.
6. Damaged wire or loose connection at battery terminals, ignition coil or ECM connector.
7. Intermittent short circuit due to damaged wire insulation.
8. Water or dirt in fuel system.
9. Fuel tank vent system plugged.
10. Air leak at intake manifold or air cleaner.
11. Partially plugged fuel injectors.
12. Damaged intake or exhaust valve(s).
13. Weak or broken valve springs.
14. Incorrect valve timing.

15. Air cleaner EVAP flapper (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.
4. Valve guides or seals badly worn or damaged.

Pre-Ignition or Detonation (Knocks or Pings)

1. Excessive carbon deposit on piston head or in combustion chamber.
2. Incorrect heat range spark plug.
3. Faulty spark plug(s).
4. Ignition timing advanced. ECM or sensors (CKP, ET or TMAP) defective.
5. Fuel octane rating too low.
6. Intake manifold vacuum leak.

Check Engine Light Illuminates During Operation

Fault detected. See the ELECTRICAL DIAGNOSTIC MANUAL for this motorcycle.

Overheating

1. Insufficient oil supply or oil not circulating.
2. Insufficient air flow over engine.
3. Leaking valve(s).
4. Heavy carbon deposits.
5. Ignition timing retarded. ECM or sensor (CKP, TMAP) defective.

Valve Train Noise

1. Low oil pressure caused by oil feed pump not functioning properly or oil passages obstructed.
2. Faulty hydraulic lifter(s).
3. Bent push rod(s).
4. Incorrect push rod length.
5. Cam(s), cam gear(s), or cam bushing(s) worn.
6. Rocker arm binding on shaft.
7. Valve sticking in guide.

Excessive Vibration

1. Stabilizer links worn or loose, or stabilizer link brackets loose or broken.
2. Isolators worn or isolator bolts loose or broken.
3. Isolator mounting brackets (left side of vehicle) loose or broken.
4. Rubber mounts loose or worn.
5. Rear fork pivot shaft fasteners loose.

6. Front engine mounting bolts loose.
7. Exhaust system binding or hitting frame.
8. Engine/transmission and rear wheel not aligned properly.
9. Broken frame.
10. Ignition timing advanced due to faulty sensor inputs (CKP, TMAP)/poorly tuned engine.
11. Primary chain badly worn or links tight as a result of insufficient lubrication or misalignment.
12. Wheels not aligned, rims bent, or tires worn or damaged.
13. Internal engine problem.

LUBRICATION SYSTEM

PART NUMBER	TOOL NAME
HD-35457	BLACK LIGHT LEAK DETECTOR

Oil Does Not Return To Oil Tank

1. Oil tank empty.
2. Oil pump gerotors damaged; oil pump not functioning.
3. Restricted oil hoses or fittings.
4. Restricted oil filter.

Engine Uses Too Much Oil Or Smokes Excessively

1. Piston rings badly worn or broken.
2. Valve guide(s) or seal(s) worn or damaged.
3. Restricted oil filter.
4. Oil tank overfilled.
5. Restricted oil return hose to tank.
6. Restricted breather operation.
7. Plugged crankcase scavenge port.
8. Oil diluted with gasoline.

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

1. Loose parts.
2. Imperfect seal at gaskets, push rod cover, washers, etc.

NOTE

To aid locating leaks, use BLACK LIGHT LEAK DETECTOR (Part No. HD-35457).

3. Restricted oil return hose to tank.
4. Restricted breather passage(s) to air cleaner.
5. Restricted oil filter.
6. Oil tank overfilled.
7. Porosity.

Low Oil Pressure

1. Oil tank underfilled.
2. Faulty low oil pressure switch.

3. Worn oil pump gerotor(s).
4. Worn pinion shaft drive gear.
5. Restricted feed hose from oil tank.
6. Restricted high-pressure feed hose to oil filter housing.
7. Oil diluted with gasoline.
8. Oil bypass plunger stuck open.

High Oil Pressure

1. Oil tank overfilled.
2. Restricted oil tank return hose.
3. Oil bypass plunger stuck closed.

ELECTRICAL SYSTEM

NOTE

For diagnostic information see the *ELECTRICAL DIAGNOSTIC MANUAL*.

Alternator Does Not Charge

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

Alternator Charge Rate Is Below Normal

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

Speedometer Operates Erratically

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

TRANSMISSION

Shifts Hard

1. Clutch dragging slightly.
2. Transmission lubricant level too high.
3. Transmission lubricant too heavy (winter operation).
4. Shifter return spring (inside primary chaincase) bent or broken.
5. Bent shifter rod.
6. Shifter forks sprung or damaged.
7. Corners worn off gear dogs and shifter dog rings.

Jumps Out Of Gear

1. Shifter engaging parts (inside transmission) badly worn and rounded.

2. Shifter forks bent.
3. Shifter drum damaged/worn.
4. Damaged gears.

Clutch Slips

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

Clutch Drags Or Does Not Release

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

Clutch Chatters

Friction plates or steel plates worn, warped or dragging.

HANDLING

1. Tires improperly inflated. See [1.11 TIRES AND WHEELS](#). Do not overinflate.
2. Loose wheel axle nuts. Tighten to recommended torque specification.
3. Improper vehicle alignment: rear wheel out of alignment with frame and front wheel.
4. Rims and tires out-of-true sideways.
5. Rims and tires out-of-round or eccentric with hub.
6. Loose spokes (models with laced wheels).
7. Irregular or peaked front tire tread wear.
8. Damaged tires or improper front-rear tire combination.
9. Tire and wheel unbalanced.
10. Steering head bearings improperly adjusted or pitted or worn bearings and races.
11. Shock absorbers damaged or worn and not functioning normally.
12. 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.
13. Engine mounts and/or stabilizer links loose, worn or damaged.
14. Rear fork pivot assembly: improperly tightened or assembled, or loose, pitted or damaged pivot bearings.

BRAKES

Brake Does Not Hold Normally

1. Master cylinder reservoir low on fluid, system leaking or pads worn.
2. Brake system contains air bubbles.

3. Master cylinder or caliper piston seals worn or parts damaged.
4. Brake pads contaminated with grease or oil.
5. Brake pads badly worn.
6. Brake disc badly worn or warped.
7. Brake drags - insufficient brake pedal or hand lever free-play, caliper piston worn or damaged, or excessive brake fluid in reservoir.
8. Brake fades due to heat build up - brake pads dragging or excessive braking.
9. Brake fluid leak when under pressure.



NOTES



TABLE OF CONTENTS

SUBJECT	PAGE NO.
2.1 FASTENER TORQUE VALUES.....	2-1
2.2 SPECIFICATIONS.....	2-8
2.3 VEHICLE IDENTIFICATION NUMBER (V.I.N.).....	2-11
2.4 WHEELS.....	2-13
2.5 WHEEL LACING: 16 INCH RIM.....	2-28
2.6 WHEEL LACING: 19 INCH RIM.....	2-31
2.7 WHEEL LACING: 21 INCH RIM.....	2-35
2.8 TRUING LACED WHEELS.....	2-39
2.9 CHECKING CAST WHEEL RUNOUT.....	2-42
2.10 FRONT BRAKE MASTER CYLINDER.....	2-43
2.11 FRONT BRAKE CALIPER: XL MODELS.....	2-52
2.12 FRONT BRAKE CALIPER: XR MODELS.....	2-60
2.13 REAR BRAKE MASTER CYLINDER: XL MODELS.....	2-65
2.14 REAR BRAKE MASTER CYLINDER: XR MODELS.....	2-73
2.15 REAR BRAKE MASTER CYLINDER RESERVOIR.....	2-79
2.16 REAR BRAKE CALIPER: XL MODELS.....	2-82
2.17 REAR BRAKE CALIPER: XR MODELS.....	2-90
2.18 BRAKE LINES.....	2-97
2.19 TIRES.....	2-103
2.20 LEFT SIDE COVER.....	2-107
2.21 FRONT FORK: XL MODELS.....	2-110
2.22 FRONT FORK: XR MODELS.....	2-115
2.23 FORK STEM AND BRACKET ASSEMBLY.....	2-126
2.24 BELT GUARD AND DEBRIS DEFLECTOR.....	2-128
2.25 REAR FORK.....	2-130
2.26 SHOCK ABSORBERS.....	2-133
2.27 STABILIZER LINKS.....	2-135
2.28 FRONT ENGINE MOUNT/ISOLATOR.....	2-137
2.29 REAR ENGINE MOUNT/ISOLATOR.....	2-139
2.30 THROTTLE CABLES: ALL MODELS.....	2-142
2.31 CLUTCH CONTROL.....	2-146
2.32 HANDLEBARS.....	2-150
2.33 FRONT FENDER.....	2-156
2.34 REAR FENDER: ALL XL MODELS EXCEPT XL 1200N.....	2-157
2.35 REAR FENDER AND LICENSE PLATE BRACKET: XL 1200N.....	2-161
2.36 REAR FENDER: XR MODELS.....	2-166
2.37 JIFFY STAND.....	2-167
2.38 SEAT: XL MODELS.....	2-169
2.39 SEAT: XR MODELS.....	2-171
2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS.....	2-173
2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS.....	2-175
2.42 RIDER FOOT CONTROLS: XR MODELS.....	2-179
2.43 PASSENGER FOOTRESTS.....	2-181
2.44 FORK LOCK.....	2-183

NOTES



FASTENER TORQUE VALUES

2.1

FASTENER TORQUE VALUES IN THIS CHAPTER

The table below lists torque values for all fasteners presented in this chapter.

FASTENER	TORQUE VALUE		NOTES
Axle (front) pinch screw	21-27 ft-lbs	28.5-36.6 Nm	2.11 FRONT BRAKE CALIPER: XL MODELS, Installation
Axle (front) pinch screw	41-48 in-lbs	55.6-65.1 Nm	2.12 FRONT BRAKE CALIPER: XR MODELS, Installation
Axle (front) pinch screw: XL Models	21-27 ft-lbs	28.5-36.6 Nm	2.4 WHEELS, Front Wheel
Axle (front) pinch screw: XR Models	41-48 ft-lbs	55.6-65.1 Nm	2.4 WHEELS, Front Wheel
Axle nut, front	60-65 ft-lbs	81-88 Nm	2.4 WHEELS, General
Axle nut, front	60-65 ft-lbs	81-88 Nm	2.4 WHEELS, Front Wheel
Axle nut, front	60-65 ft-lbs	81-88 Nm	2.11 FRONT BRAKE CALIPER: XL MODELS, Installation
Axle nut, front	60-65 ft-lbs	81-88 Nm	2.12 FRONT BRAKE CALIPER: XR MODELS, Installation
Axle nut, rear	95-105 ft-lbs	129-142 Nm	2.4 WHEELS, General
Axle nut, rear	95-105 ft-lbs	129-142 Nm	2.4 WHEELS, Rear Wheel
Battery terminal bolts	60-70 in-lbs	6.8-7.9 Nm	2.22 FRONT FORK: XR MODELS, Installation
Belt guard screw, front (XL)	120-180 in-lbs	13.6-20.4 Nm	2.24 BELT GUARD AND DEBRIS DEFLECTOR, Belt Guard: XL Models
Belt guard screw (XR), front	72-96 in-lbs	8.1-10.8 Nm	2.24 BELT GUARD AND DEBRIS DEFLECTOR, Belt Guard: XR Models
Brake (rear) disc screw	30-45 ft-lbs	40.7-61.1 Nm	2.4 WHEELS, Rear Wheel
Brake (rear) line/switch tee bracket screw	72-120 in-lbs	8.14-13.6 Nm	2.18 BRAKE LINES, Rear Brake Line: XL Models
Brake (rear) line/switch tee bracket screw	17-22 in-lbs	1.9-2.5 Nm	2.18 BRAKE LINES, Rear Brake Line: XR Models
Brake bridge bolt, front caliper	12-18 ft-lbs	16.9-24.5 Nm	2.12 FRONT BRAKE CALIPER: XR MODELS, Assembly
Brake caliper bleeder valve	35-61 in-lbs	4.0-6.9 Nm	2.10 FRONT BRAKE MASTER CYLINDER, Installation
Brake caliper bleeder valve	35-61 in-lbs	4.0-6.9 Nm	2.11 FRONT BRAKE CALIPER: XL MODELS, Assembly
Brake caliper bleeder valve	35-61 in-lbs	4.0-6.9 Nm	2.12 FRONT BRAKE CALIPER: XR MODELS, Assembly
Brake caliper bleeder valve	35-61 in-lbs	4.0-6.9 Nm	2.18 BRAKE LINES, Front Brake Line: All Models
Brake caliper bleeder valve	35-61 in-lbs	4.0-6.9 Nm	2.18 BRAKE LINES, Rear Brake Line: XL Models
Brake caliper bleeder valve	35-61 in-lbs	4.0-6.9 Nm	2.18 BRAKE LINES, Rear Brake Line: XR Models
Brake disc mounting screw	16-24 ft-lbs	21.7-32.6 Nm	2.4 WHEELS, Front Wheel/Cast front wheel
Brake disc mounting screw	16-24 ft-lbs	21.7-32.6 Nm	2.4 WHEELS, Front Wheel/Cast front wheel
Brake disc mounting screw	16-24 ft-lbs	21.7-32.6 Nm	2.4 WHEELS, Front Wheel/Laced front wheel
Brake front caliper mounting bolt	28-38 ft-lbs	38.0-51.6 Nm	2.11 FRONT BRAKE CALIPER: XL MODELS, Installation
Brake front caliper mounting bolt	28-38 ft-lbs	38.0-51.6 Nm	2.12 FRONT BRAKE CALIPER: XR MODELS, Installation

FASTENER	TORQUE VALUE		NOTES
Brake front cover master cylinder reservoir cover screw	9-17 in-lbs	1.0-2.0 Nm	2.10 FRONT BRAKE MASTER CYLINDER, Installation
Brake front master cylinder clamp screw	108-132 in-lbs	12.2-14.9 Nm	2.10 FRONT BRAKE MASTER CYLINDER, Installation
Brake front master cylinder reservoir cover screw	9-17 in-lbs	1.0-2.0 Nm	2.11 FRONT BRAKE CALIPER: XL MODELS, Installation
Brake hose clamp-to-battery tray screw	30-40 in-lbs	3.4-4.5 Nm	2.18 BRAKE LINES, Rear Brake Line: XL Models
Brake hose clamp-to-rear fork screw	30-40 in-lbs	3.4-4.5 Nm	2.18 BRAKE LINES, Rear Brake Line: XL Models
Brake lamp switch, rear	80-123 in-lbs	9.0-13.9 Nm	2.18 BRAKE LINES, Rear Brake Line: XL Models
Brake lamp switch, rear	80-123 in-lbs	9.0-13.9 Nm	2.18 BRAKE LINES, Rear Brake Line: XR Models
Brake line banjo bolt	20-25 ft-lbs	27.1-33.9 Nm	2.10 FRONT BRAKE MASTER CYLINDER, Installation
Brake line banjo bolt	20-25 ft-lbs	27.1-33.9 Nm	2.11 FRONT BRAKE CALIPER: XL MODELS, Installation
Brake line banjo bolt	20-25 ft-lbs	27.1-33.9 Nm	2.12 FRONT BRAKE CALIPER: XR MODELS, Installation
Brake line banjo bolt	20-25 ft-lbs	27.1-33.9 Nm	2.16 REAR BRAKE CALIPER: XL MODELS, Installation
Brake line banjo bolt	20-25 ft-lbs	27.1-33.9 Nm	2.17 REAR BRAKE CALIPER: XR MODELS, Installation
Brake line banjo bolt	20-25 ft-lbs	27.1-33.9 Nm	2.18 BRAKE LINES, Front Brake Line: All Models
Brake line banjo bolt	20-25 ft-lbs	27.1-33.9 Nm	2.18 BRAKE LINES, Front Brake Line: All Models
Brake line banjo bolt	20-25 ft-lbs	27.1-33.9 Nm	2.18 BRAKE LINES, Rear Brake Line: XL Models
Brake line banjo bolt	20-25 ft-lbs	27.1-33.9 Nm	2.18 BRAKE LINES, Rear Brake Line: XR Models
Brake line-to-front fork bracket clamp screw	45-65 in-lbs	5.1-7.4 Nm	2.18 BRAKE LINES, Front Brake Line: All Models
Brake line-to-front fork lower bracket clamp screw	120-168 in-lbs	13.6-19.0 Nm	2.18 BRAKE LINES, Front Brake Line: All Models
Brake pad pin	131-173 in-lbs	14.8-19.6 Nm	2.11 FRONT BRAKE CALIPER: XL MODELS, Installing Brake Pads in Caliper
Brake pad pin	131-173 in-lbs	14.8-19.6 Nm	2.16 REAR BRAKE CALIPER: XL MODELS, Installation
Brake pad pin, front caliper	11-14 ft-lbs	14.7-19.6 Nm	2.12 FRONT BRAKE CALIPER: XR MODELS, Assembly
Brake pad pin plug	18-25 in-lbs	2.0-2.9 Nm	2.11 FRONT BRAKE CALIPER: XL MODELS, Installing Brake Pads in Caliper
Brake pad pin plug	18-25 in-lbs	2.0-2.9 Nm	2.16 REAR BRAKE CALIPER: XL MODELS, Installation
Brake pedal clevis screw	96-156 in-lbs	10.9-17.6 Nm	2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS, Right Footrest and Rear Brake Pedal Assembly
Brake pedal clevis screw	96-156 in-lbs	10.9-17.6 Nm	2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS, Right Footrest and Rear Brake Pedal Assembly
Brake rear master cylinder banjo bolt; XL models	20-25 ft-lbs	27.1-33.9 Nm	2.13 REAR BRAKE MASTER CYLINDER: XL MODELS, Installation
Brake rear master cylinder banjo bolt; XR models	20-25 ft-lbs	27.1-33.9 Nm	2.14 REAR BRAKE MASTER CYLINDER: XR MODELS, Installation
Brake rear master cylinder mounting bracket screw; XL models	17-22 ft-lbs	23.1-29.9 Nm	2.13 REAR BRAKE MASTER CYLINDER: XL MODELS, Installation

FASTENER	TORQUE VALUE		NOTES
Brake rear master cylinder mounting bracket screw; XL models	17-22 ft-lbs	23.1-29.9 Nm	2.13 REAR BRAKE MASTER CYLINDER: XL MODELS, Installation
Brake rear master cylinder mounting screw; XL models	17-22 ft-lbs	23.1-29.9 Nm	2.13 REAR BRAKE MASTER CYLINDER: XL MODELS, Installation
Brake rear master cylinder mounting screw; XR models	72-96 in-lbs	8.1-10.9 Nm	2.14 REAR BRAKE MASTER CYLINDER: XR MODELS, Installation
Brake rear master cylinder pushrod nut; XR models	130-173 in-lbs	14.7-19.6 Nm	2.14 REAR BRAKE MASTER CYLINDER: XR MODELS, Assembly
Brake rear master cylinder pushrod shoulder nut	130-173 in-lbs	14.7-19.6 Nm	2.13 REAR BRAKE MASTER CYLINDER: XL MODELS, Assembly
Brake rear master cylinder reservoir mounting screw	20-25 in-lbs	2.3-2.8 Nm	2.15 REAR BRAKE MASTER CYLINDER RESERVOIR, Installation: XL Models
Brake rear master cylinder reservoir mounting screw	20-25 in-lbs	2.3-2.8 Nm	2.25 REAR FORK, Installation
Brake rear master cylinder reservoir mounting screw; XR models	36-60 in-lbs	4.1-6.8 Nm	2.15 REAR BRAKE MASTER CYLINDER RESERVOIR, Installation: XR Models
Brake rod-to-bell crank screw	120-180 in-lbs	13.6-20.4 Nm	2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS, Right Footrest and Rear Brake Pedal Assembly
Brake rod-to-bell crank screw	120-180 in-lbs	13.6-20.4 Nm	2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS, Right Footrest and Rear Brake Pedal Assembly
Brake rod-to-brake pedal screw	120-180 in-lbs	13.6-20.4 Nm	2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS, Right Footrest and Rear Brake Pedal Assembly
Brake rod-to-brake pedal screw	120-180 in-lbs	13.6-20.4 Nm	2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS, Right Footrest and Rear Brake Pedal Assembly
Clutch cable end fitting	36-108 in-lbs	4.1-12.2 Nm	2.31 CLUTCH CONTROL, Assembly and Installation
Clutch inspection cover screw	84-108 in-lbs	9.5-12.2 Nm	2.31 CLUTCH CONTROL, Assembly and Installation
Clutch lever anti-rattle spring screw	8-13 in-lbs	0.9-1.5 Nm	2.31 CLUTCH CONTROL, Assembly and Installation
Clutch lever handlebar clamp screw	108-132 in-lbs	12.2-14.9 Nm	2.31 CLUTCH CONTROL, Assembly and Installation
Clutch lever handlebar clamp screw	108-132 in-lbs	12.2-14.9 Nm	2.32 HANDLEBARS, Installation
Cylinder head exhaust port nut	96-120 in-lbs	10.9-13.6 Nm	2.10 FRONT BRAKE MASTER CYLINDER, Installation
Debris deflector screw (XL)	36-60 in-lbs	4.1-6.8 Nm	2.24 BELT GUARD AND DEBRIS DEFLECTOR, Debris Deflector: XL Models
Debris deflector screw (XR)	72-96 in-lbs	8.1-10.8 Nm	2.24 BELT GUARD AND DEBRIS DEFLECTOR, Debris Deflector: XR Models
Engine mount (front) bolt	60-70 ft-lbs	81.4-95.0 Nm	2.28 FRONT ENGINE MOUNT/ISOLATOR, Installation
Exhaust pipe clamp bracket screw	30-33 ft-lbs	40.7-44.8 Nm	2.29 REAR ENGINE MOUNT/ISOLATOR, Installation
Fender (front) mounting screw	96-156 in-lbs	10.9-17.6 Nm	2.21 FRONT FORK: XL MODELS, Installation
Fender (rear) mounting screw	132-216 in-lbs	14.9-24.4 Nm	2.34 REAR FENDER: ALL XL MODELS EXCEPT XL 1200N, Installation
Footrest bracket fastener: XR models	45-50 ft-lbs	61.0-67.8 Nm	2.42 RIDER FOOT CONTROLS: XR MODELS, Left Footrest and Shift Lever Assembly

FASTENER	TORQUE VALUE		NOTES
Footrest bracket screw (XR)	45-50 ft-lbs	61-68 Nm)	2.43 PASSENGER FOOTRESTS, XR Models
Footrest clevis fastener: XR models	20-24 ft-lbs	27.1-32.5 Nm	2.42 RIDER FOOT CONTROLS: XR MODELS, Right Footrest and Rear Brake Pedal Assembly
Footrest clevis fastener: XR models	20-24 ft-lbs	27.1-32.5 Nm	2.42 RIDER FOOT CONTROLS: XR MODELS, Left Footrest and Shift Lever Assembly
Footrest wear peg	72-108 in-lbs	8.1-12.2 Nm	2.42 RIDER FOOT CONTROLS: XR MODELS, Right Footrest and Rear Brake Pedal Assembly
Footrest wear peg	72-108 in-lbs	8.1-12.2 Nm	2.42 RIDER FOOT CONTROLS: XR MODELS, Left Footrest and Shift Lever Assembly
Fork cap: XR models	150-195 in-lbs	17-22 Nm	2.22 FRONT FORK: XR MODELS, Assembly
Fork cap: XR models	21-29 ft-lbs	29-39 Nm	2.22 FRONT FORK: XR MODELS, Assembly/Second torque. Tighten to this torque second.
Fork cap: XR models	21-29 ft-lbs	29-39 Nm	2.22 FRONT FORK: XR MODELS, Assembly
Fork cap to retainer nut: XR models	150-195 in-lbs	17-22 Nm	2.22 FRONT FORK: XR MODELS, Assembly
Fork cartridge fastener	132-216 in-lbs	14.9-24.4 Nm	2.22 FRONT FORK: XR MODELS, Assembly
Fork slider tube fastener	132-216 in-lbs	14.9-24.4 Nm	2.21 FRONT FORK: XL MODELS, Assembly
Fork stem bolt, final	72-96 in-lbs	8.1-10.9 Nm	2.23 FORK STEM AND BRACKET ASSEMBLY, Assembly and Installation
Fork stem bolt, initial	23-27 ft-lbs	31.2-36.6 Nm	2.23 FORK STEM AND BRACKET ASSEMBLY, Assembly and Installation
Fork stem pinch screw	30-35 ft-lbs	40.7-47.5 Nm	2.23 FORK STEM AND BRACKET ASSEMBLY, Assembly and Installation
Forward and lower sprocket cover screws: XR models	80-120 in-lbs	9.0-13.6 Nm	2.29 REAR ENGINE MOUNT/ISOLATOR, Installation
Front fender (XL) mounting screw	96-156 in-lbs	10.9-17.6 Nm	2.33 FRONT FENDER, XL Models
Front fender (XR) mounting screw	15-19 ft-lbs	20.4-25.8 Nm	2.33 FRONT FENDER, XR Models
Front fender bracket (XR) screw	36-60 in-lbs	4.1-6.8 Nm	2.33 FRONT FENDER, XR Models
Front fork bracket pinch screw	30-35 ft-lbs	40.7-47.5 Nm	2.21 FRONT FORK: XL MODELS, Installation
Front fork bracket pinch screw	30-35 ft-lbs	40.7-47.5 Nm	2.22 FRONT FORK: XR MODELS, Installation
Front fork slider tube cap	22-58 ft-lbs	29.9-78.7 Nm	2.21 FRONT FORK: XL MODELS, Installation
Front master cylinder cover screw	9-17 in-lbs	1.0-2.0 Nm	2.12 FRONT BRAKE CALIPER: XR MODELS, Installation
Gear shift lever pinch screw	16-20 ft-lbs	21.7-27.1 Nm	2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS, Left Footrest and Shift Lever Assembly
Gear shift lever pinch screw	16-20 ft-lbs	21.7-27.1 Nm	2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS, Left Footrest and Shift Lever Assembly
Handlebar riser cover screw (XL 883C/XL 1200C)	8-12 in-lbs	0.9-1.4 Nm	2.32 HANDLEBARS, Installation
Handlebar riser mounting bolt (XL 883C/XL 1200C)	30-40 ft-lbs	40.7-54.3 Nm	2.32 HANDLEBARS, Installation
Handlebar switch housing screw	35-45 in-lbs	4.0-5.1 Nm	2.30 THROTTLE CABLES: ALL MODELS, Assembly and Installation
Handlebar switch housing screw	35-45 in-lbs	4.0-5.1 Nm	2.31 CLUTCH CONTROL, Assembly and Installation
Handlebar switch housing screw	35-45 in-lbs	4.0-5.1 Nm	2.32 HANDLEBARS, Installation
Handlebar switch housing screw	35-45 in-lbs	4.0-5.1 Nm	2.32 HANDLEBARS, Installation

FASTENER	TORQUE VALUE		NOTES
Handlebar upper clamp/speedometer housing screw (XL 883C/XL 1200C)	12-18 ft-lbs	16.3-24.4 Nm	2.32 HANDLEBARS, Installation
Handlebar upper clamp/speedometer housing screw (XL 883C/XL 1200C)	12-18 ft-lbs	16.3-24.4 Nm	2.32 HANDLEBARS, Installation
Hub plate mounting screw	16-24 ft-lbs	21.7-32.6 Nm	2.4 WHEELS, Front Wheel/Cast front wheel
Inner fender screw: XR models	72-120 in-lbs	8.1-13.6 Nm	2.36 REAR FENDER: XR MODELS, Installation
Inner fork nut, right: XR models	69-83 ft-lbs	93-113 Nm	2.22 FRONT FORK: XR MODELS, Assembly/Hand tighten. Then tighten to torque.
Isolator (front) mounting bracket screw	25-35 ft-lbs	33.9-47.5 Nm	2.28 FRONT ENGINE MOUNT/ISOLATOR, Installation
Isolator (front) mounting bracket screw	25-35 ft-lbs	33.9-47.5 Nm	2.29 REAR ENGINE MOUNT/ISOLATOR, Installation
License plate bracket mounting screw	20-25 in-lbs	2.3-2.8 Nm	2.34 REAR FENDER: ALL XL MODELS EXCEPT XL 1200N, Installation
Lower fork bracket pinch screw	30-35 ft-lbs	40.7-47.5 Nm	2.23 FORK STEM AND BRACKET ASSEMBLY, Assembly and Installation
Lower handlebar clamp bolts	30-40 ft-lbs	40.7-54.3 Nm	2.32 HANDLEBARS, Installation
Lower shock absorber fastener	30-45 ft-lbs	40.7-61.0 Nm	2.17 REAR BRAKE CALIPER: XR MODELS, Installation
Mirror stem lock nut	96-144 in-lbs	10.9-16.3 Nm	2.10 FRONT BRAKE MASTER CYLINDER, Installation
Mirror stem lock nut	96-144 in-lbs	10.9-16.3 Nm	2.31 CLUTCH CONTROL, Assembly and Installation
Muffler bracket-to-footrest bracket screw (XR)	15-19 ft-lbs	20.4-25.8 Nm	2.43 PASSENGER FOOTRESTS, XR Models
Passenger footrest support bracket screw	45-50 ft-lbs	61-68 Nm	2.25 REAR FORK, Installation
Passenger footrest support bracket screw	45-50 ft-lbs	61-68 Nm	2.43 PASSENGER FOOTRESTS, XL Models
Passenger pillion retainer post screw: XR models	36-60 in-lbs	4.1-6.8 Nm	2.36 REAR FENDER: XR MODELS, Installation
Rear caliper mounting bolt	14-18 ft-lbs	19.6-24.5 Nm	2.17 REAR BRAKE CALIPER: XR MODELS, Installation
Rear caliper pin bolt	14-18 ft-lbs	19.6-24.5 Nm	2.17 REAR BRAKE CALIPER: XR MODELS, Installation
Rear fender brace screw	20-25 in-lbs	2.3-2.8 Nm	2.35 REAR FENDER AND LICENSE PLATE BRACKET: XL 1200N, Assembly and Installation
Rear fender support screw	132-216 in-lbs	14.9-24.4 Nm	2.35 REAR FENDER AND LICENSE PLATE BRACKET: XL 1200N, Assembly and Installation
Rear fork pivot/engine mount bolt	60-70 ft-lbs	81.4-95.0 Nm	2.25 REAR FORK, Installation
Rear fork pivot/engine mount bolt	60-70 ft-lbs	81.4-95.0 Nm	2.29 REAR ENGINE MOUNT/ISOLATOR, Installation
Rear sprocket cover screw: XR models	30-33 ft-lbs	40.7-44.7 Nm	2.29 REAR ENGINE MOUNT/ISOLATOR, Installation
Rear turn signal stalk nut	132-216 in-lbs	14.9-24.4 Nm	2.35 REAR FENDER AND LICENSE PLATE BRACKET: XL 1200N, Assembly and Installation
Rider footrest bracket mounting screw	45-50 ft-lbs	61-68 Nm	2.31 CLUTCH CONTROL, Assembly and Installation
Rider footrest support bracket mounting screw	45-50 ft-lbs	61-68 Nm	2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS, Right Footrest and Rear Brake Pedal Assembly

FASTENER	TORQUE VALUE		NOTES
Rider footrest support bracket mounting screw	45-50 ft-lbs	61-68 Nm	2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS, Left Footrest and Shift Lever Assembly
Rider footrest support bracket mounting screw	45-50 ft-lbs	61-68 Nm	2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS, Right Footrest and Rear Brake Pedal Assembly
Rider footrest support bracket mounting screw	45-50 ft-lbs	61-68 Nm	2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS, Left Footrest and Shift Lever Assembly
Seat post mounting screw	96-156 in-lbs	10.9-17.6 Nm	2.35 REAR FENDER AND LICENSE PLATE BRACKET: XL 1200N, Assembly and Installation
Seat post screw	96-156 in-lbs	10.9-17.6 Nm	2.34 REAR FENDER: ALL XL MODELS EXCEPT XL 1200N, Installation
Shifter peg: XR models	96-144 in-lbs	10.9-16.3 Nm	2.42 RIDER FOOT CONTROLS: XR MODELS, Left Footrest and Shift Lever Assembly
Shifter peg screw	96-144 in-lbs	10.9-16.3 Nm	2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS, Left Footrest and Shift Lever Assembly
Shifter peg screw	96-144 in-lbs	10.9-16.3 Nm	2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS, Left Footrest and Shift Lever Assembly
Shifter rod-to-shift lever screw	120-180 in-lbs	13.6-20.4 Nm	2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS, Left Footrest and Shift Lever Assembly
Shifter rod-to-shift lever screw	120-180 in-lbs	13.6-20.4 Nm	2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS, Left Footrest and Shift Lever Assembly
Shifter rod-to-shift lever screw	120-180 in-lbs	13.6-20.4 Nm	2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS, Adjusting Shift Pedal
Shift linkage fastener	120-180 in-lbs	13.6-20.3 Nm	2.42 RIDER FOOT CONTROLS: XR MODELS, Left Footrest and Shift Lever Assembly
Shift pedal clevis screw	18-22 ft-lbs	24.4-29.9 Nm	2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS, Left Footrest and Shift Lever Assembly
Shift rod screw (XR)	120-180 in-lbs	13.6-20.4 Nm	2.42 RIDER FOOT CONTROLS: XR MODELS, Adjusting Shift Pedal
Shock absorber mounting screw	45-50 ft-lbs	61-68 Nm	2.4 WHEELS, Rear Wheel
Shock absorber mounting screw	45-50 ft-lbs	61-68 Nm	2.24 BELT GUARD AND DEBRIS DEFLECTOR, Belt Guard: XL Models
Shock absorber mounting screw	45-50 ft-lbs	61-68 Nm	2.26 SHOCK ABSORBERS, Installation
Shock absorber mounting screw	45-50 ft-lbs	61-68 Nm	2.26 SHOCK ABSORBERS, Installation
Single caliper cast front wheel hub plate screw	16-24 ft-lbs	21.7-32.6 Nm	2.4 WHEELS, Sealed Wheel Bearings
Spoke nipple	55 in-lbs	6.2 Nm	2.5 WHEEL LACING: 16 INCH RIM, Procedure
Spoke nipple	55 in-lbs	6.2 Nm	2.6 WHEEL LACING: 19 INCH RIM, Procedure
Spoke nipple	55 in-lbs	6.2 Nm	2.7 WHEEL LACING: 21 INCH RIM, Procedure
Spoke nipple	55 in-lbs	6.2 Nm	2.8 TRUING LACED WHEELS, Radial Truing
Sprocket (rear) mounting screw - FINAL torque	80 ft-lbs	108.0 Nm	2.4 WHEELS, Rear Wheel
Sprocket (rear) mounting screw - INITIAL torque	60 ft-lbs	81.3 Nm	2.4 WHEELS, Rear Wheel

FASTENER	TORQUE VALUE		NOTES
Sprocket cover screw: XL models	80-120 in-lbs	9.0-13.6 Nm	2.29 REAR ENGINE MOUNT/ISOLATOR, Installation
Sprocket cover screw: XL models	80-120 in-lbs	9.0-13.6 Nm	2.29 REAR ENGINE MOUNT/ISOLATOR, Installation
Stabilizer link (lower front) frame bracket mounting screw	25-35 ft-lbs	33.9-47.5 Nm	2.27 STABILIZER LINKS, Lower Front Stabilizer Link
Stabilizer link (lower front) frame bracket mounting screw	25-35 ft-lbs	33.9-47.5 Nm	2.29 REAR ENGINE MOUNT/ISOLATOR, Installation
Stabilizer link (upper front) engine bracket mounting screw	55-65 ft-lbs	74.6-88.2 Nm	2.27 STABILIZER LINKS, Upper Front Stabilizer Link
Stabilizer link (upper front) frame bracket mounting screw	25-35 ft-lbs	33.9-47.5 Nm	2.27 STABILIZER LINKS, Upper Front Stabilizer Link
Stabilizer link (upper front) frame bracket mounting screw	25-35 ft-lbs	33.9-47.5 Nm	2.28 FRONT ENGINE MOUNT/ISOLATOR, Installation
Stabilizer link (upper front) frame bracket mounting screw	25-35 ft-lbs	33.9-47.5 Nm	2.29 REAR ENGINE MOUNT/ISOLATOR, Installation
Stabilizer link screw	25-35 ft-lbs	33.9-47.5 Nm	2.27 STABILIZER LINKS, Upper Front Stabilizer Link
Stabilizer link screw	25-35 ft-lbs	33.9-47.5 Nm	2.27 STABILIZER LINKS, Lower Front Stabilizer Link
Stabilizer link screw	25-35 ft-lbs	33.9-47.5 Nm	2.27 STABILIZER LINKS, Rear Stabilizer Link
Stabilizer link screw	25-35 ft-lbs	33.9-47.5 Nm	2.28 FRONT ENGINE MOUNT/ISOLATOR, Installation
Stabilizer link screw	25-35 ft-lbs	33.9-47.5 Nm	2.28 FRONT ENGINE MOUNT/ISOLATOR, Installation
Stabilizer link screw	25-35 ft-lbs	33.9-47.5 Nm	2.29 REAR ENGINE MOUNT/ISOLATOR, Installation
Tail lamp base mounting screw	45-48 in-lbs	5.1-5.4 Nm	2.34 REAR FENDER: ALL XL MODELS EXCEPT XL 1200N, Installation
Tail section bolts: XR models	72-120 in-lbs	8.1-13.6 Nm	2.36 REAR FENDER: XR MODELS, Installation
Turn signal (front) clamp screw	96-120 in-lbs	10.9-13.6 Nm	2.31 CLUTCH CONTROL, Assembly and Installation
Turn signal (rear) stalk nut	132-216 in-lbs	14.9-24.4 Nm	2.34 REAR FENDER: ALL XL MODELS EXCEPT XL 1200N, Installation
Upper handlebar clamp screw, front	12-18 ft-lbs	16.3-24.4 Nm	2.32 HANDLEBARS, Installation
Upper handlebar clamp screw, front	12-18 ft-lbs	16.3-24.4 Nm	2.32 HANDLEBARS, Installation
Upper handlebar clamp screw, rear	12-18 ft-lbs	16.3-24.4 Nm	2.32 HANDLEBARS, Installation
Upper handlebar clamp screw, rear	12-18 ft-lbs	16.3-24.4 Nm	2.32 HANDLEBARS, Installation
Valve stem nut	12-15 in-lbs	1.4-1.7 Nm	2.19 TIRES, Installation

SPECIFICATIONS

2.2

SPORTSTER SPECIFICATIONS

Chassis Specifications

Table 2-1. Dimensions: 2009 Sportster 883 Models

ITEM	XL 883 XL 883R		XL 883C CUSTOM		XL 883L LOW	
	IN.	MM	IN.	MM	IN.	MM
Wheel base	60.00	1524.00	60.40	1534.16	60.00	1524.00
Overall length	90.10	2288.54	90.30	2293.62	89.10	2263.14
Overall width	32.70	830.58	32.70	830.58	35.20	894.08
Road clearance	5.60	142.24	4.40	111.76	3.90	99.06
Overall height*	45.70	1160.78	45.70	1160.78	45.70	1160.78
Saddle height**	27.30	693.42	26.50	673.10	25.30	642.62
*XL 883R overall height is 44.8 in. (1137.9 mm).						
**With 180 lb. (81.7 kg) rider on seat.						

Table 2-2. Dimensions: 2009 Sportster 1200 Models

ITEM	XL 1200C CUSTOM		XL 1200R ROADSTER		XL 1200L LOW		XL 1200N NIGHTSTER		XR 1200	
	IN.	MM	IN.	MM	IN.	MM	IN.	MM	IN.	MM
Wheel base	60.40	1534.16	60.00	1524.00	59.70	1516.38	60.00	1524.00	59.80	1518.92
Overall length	90.30	2293.62	90.10	2288.54	89.10	2263.14	85.80	2179.32	85.40	2169.16
Overall width	32.70	830.58	36.70	932.18	35.20	894.08	36.40	924.56	36.50	927.10
Road clearance	4.40	111.76	5.60	142.24	4.40	111.76	3.90	99.06	5.80	147.32
Overall height	45.70	1160.78	49.20	1249.68	46.80	1188.72	43.60	1107.44	45.10	1145.54
Saddle height*	26.50	673.10	28.10	713.74	26.30	668.02	25.30	642.62	29.20	741.68
*With 180 lb. (81.7 kg) rider on seat.										

Table 2-3. Weights: 2009 Sportster 883 Models

ITEM	XL 883		XL 883C CUSTOM		XL 883L LOW		XL 883R	
	LB.	KG	LB.	KG	LB.	KG	LB.	KG
Weight (as shipped from factory)	563.00	255.37	565.00	256.28	563.00	255.37	568.00	257.64
GVWR	1000.00	453.59	1000.00	453.59	1000.00	453.59	1000.00	453.59
GAWR front	335.00	151.95	335.00	151.95	335.00	151.95	335.00	151.95
GAWR rear	665.00	301.64	665.00	301.64	665.00	301.64	665.00	301.64

Table 2-4. Weights: 2009 Sportster 1200 Models

ITEM	XL 1200C CUSTOM		XL 1200R ROADSTER		XL 1200L LOW		XL 1200N NIGHTSTER		XR 1200	
	LB.	KG	LB.	KG	LB.	KG	LB.	KG	LB.	KG
Weight (as shipped from factory)	562.00	254.92	565.00	256.28	557.00	252.65	545.00	247.21	562.00	254.92
GVWR	1000.00	453.59	1000.00	453.59	1000.00	453.59	1000.00	453.59	1000.00	453.59
GAWR front	335.00	151.95	335.00	151.95	335.00	151.95	335.00	151.95	350.00	158.76
GAWR rear	665.00	301.64	665.00	301.64	665.00	301.64	665.00	301.64	650.00	294.84

Table 2-5. Capacities: 2009 Sportster 883 Models

ITEM	XL 883 XL 883R		XL 883C CUSTOM		XL 883L LOW	
	U.S.	LITERS	U.S.	LITERS	U.S.	LITERS
Fuel tank (total)	3.30 gal.	12.49	4.50 gal.	17.03	3.30 gal.	12.49
Oil tank with filter	2.80 qt.	2.65	2.80 qt.	2.65	2.80 qt.	2.65
Transmission (approximate)	1.00 qt.	0.95	1.00 qt.	0.95	1.00 qt.	0.95
Low fuel warning light on	0.80 gal.	3.03	1.00 gal.	3.79	0.80 gal.	3.03


Table 2-6. Capacities: 2009 Sportster 1200 Models

ITEM	XL 1200C CUSTOM		XL 1200R ROADSTER		XL 1200L LOW		XL 1200N NIGHTSTER		XR 1200	
	U.S.	LITERS	U.S.	LITERS	U.S.	LITERS	U.S.	LITERS	U.S.	LITERS
Fuel tank (total)	4.50 gal.	17.03	4.50 gal.	17.03	4.50 gal.	17.03	3.30 gal.	12.49	3.50 gal.	13.25
Oil tank with filter	2.80 qt.	2.65	2.80 qt.	2.65	2.80 qt.	2.65	2.80 qt.	2.65	2.80 qt.	2.65
Transmission (approximate)	1.00 qt.	0.95	1.00 qt.	0.95	1.00 qt.	0.95	1.00 qt.	0.95	1.00 qt.	0.95
Low fuel warning light on	1.00 gal.	3.79	1.00 gal.	3.79	1.00 gal.	3.79	0.80 gal.	3.03	0.50 gal.	1.89

Table 2-7. Brake Disc Specifications

SPECIFICATION	IN	MM
Diameter (front and rear)	11.5	292
Minimum thickness (front)	0.200	5.08
Minimum thickness (rear)	0.230	5.84
Maximum disc runout (front and rear)	0.008	0.20

Tire Specifications

WARNING

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

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 2-8. Tire Fitment: Tubeless Cast Wheels

WHEEL SIZE AND POSITION	RIM SIZE AND CONTOUR	RIM VALVE HOLE DIA.		TIRE	
		IN	MM	TYPE	SIZE
19 in - Front (XL models)	T19 x 2.15 MT	0.33	8.46	Dunlop D401F	100/90-19 57H
16 in - Rear (XL models)	T16 x 3.00 D			Dunlop D401	150/80B16 71H
18 in - Front (XR models)	E18 x 3.5 MT			Dunlop D209F	120/70 ZR18
17 in - Rear (XR models)	E17 x 5.5 M			Dunlop D209	180/55 ZR17

Table 2-9. Tire Fitment: Tube Type Steel Laced Wheels

WHEEL SIZE AND POSITION	RIM SIZE AND CONTOUR	TUBE SIZE	TIRE	
			TYPE	SIZE
21 in - Front	T21 x 2.15 TLA	MH90-21	Dunlop D402F	MH90-21 54H
19 in - Front	T19 x 2.50 TLA	MJ90-19	Dunlop D401F	100/90-19 57H
16 in - Rear	T16 x 3.00 D	MT90-16	Dunlop D401	150/80B16 71H

Table 2-10. Tire Fitment: Tube Type Chrome Aluminum Profile Laced Wheels

WHEEL SIZE AND POSITION	RIM SIZE AND CONTOUR	TUBE SIZE	TIRE	
			TYPE	SIZE
21 in - Front	T21 x 2.15 MT	MH90-21	Dunlop D402F	MH90-21 54H
16 in - Rear	T16 x 3.00 MT	MT90-16	Dunlop D401	150/80B16 71H

Table 2-11. Tire Pressures: 2009 Sportster Models

MODEL	TIRE PRESSURE (COLD)			
	FRONT		REAR	
	PSI	kPa	PSI	kPa
XL models (solo rider)	30	206	36	248
XL models (rider and passenger)	30	206	40	275
XR models (solo rider)	36	248	38	262
XR 1200 (rider and passenger)	36	248	42	290

VEHICLE IDENTIFICATION NUMBER (V.I.N.)

2.3

VEHICLE IDENTIFICATION NUMBER (V.I.N.): SPORTSTER MODELS

General

See [Figure 2-1](#). The full 17-digit V.I.N. is stamped on the steering head and printed on a label located on the right front frame down tube.

See [Figure 2-2](#). A unique 17-digit serial or Vehicle Identification Number (V.I.N.) is found on each motorcycle. For a description of each item in the V.I.N., refer to [Table 2-12](#).

Abbreviated V.I.N.

An abbreviated V.I.N. is stamped on the left side of the crankcase between the front and rear cylinders.

Example: CV39111000

See [Figure 2-2](#) for the complete V.I.N. for the same motorcycle as it appears on the steering head.

NOTE

Always give the full 17-digit Vehicle Identification Number when ordering parts or making any inquiry about your motorcycle.

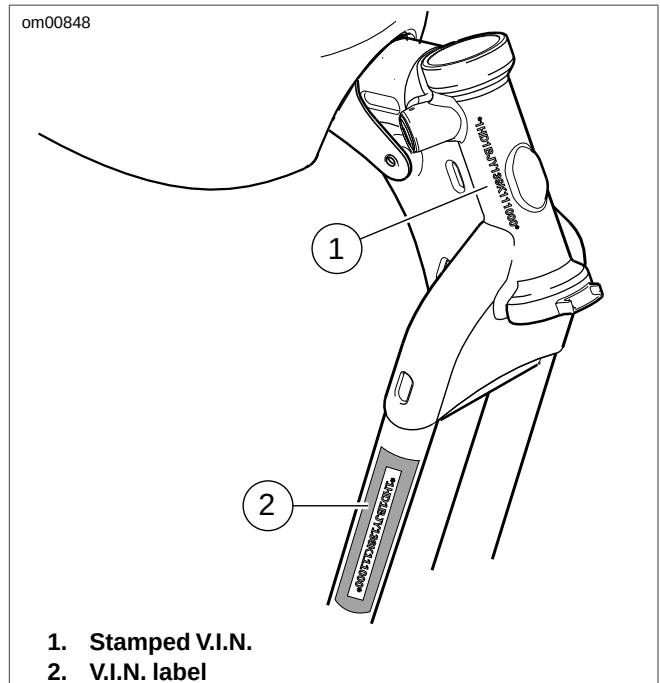


Figure 2-1. V.I.N. Locations: Sportster Models

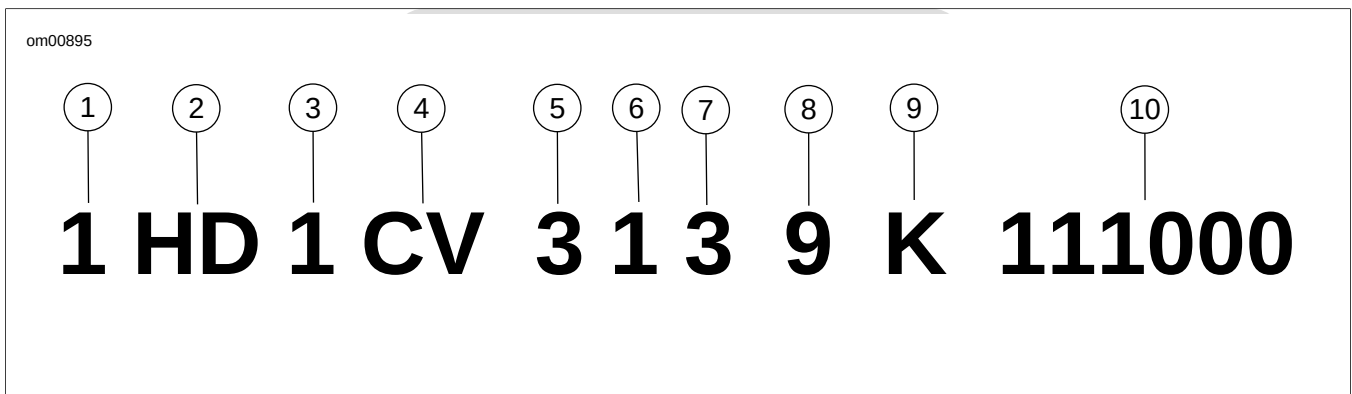


Figure 2-2. Typical Harley-Davidson V.I.N.: 2009 Sportster Models

Table 2-12. Harley-Davidson V.I.N. Breakdown: 2009 Sportster Models

POSITION	DESCRIPTION	POSSIBLE VALUES
1	Market designation	1=Originally manufactured for sale within the United States 5=Originally manufactured for sale outside of the United States
2	Manufacturer	HD=Harley-Davidson
3	Motorcycle type	1=Heavyweight motorcycle (901 cc or larger) 4=Middleweight motorcycle (351 cc to 900 cc)
4	Model	See V.I.N. model table
5	Engine type	2=Evolution® 883 cc air-cooled, fuel-injected 3=Evolution® 1200 cc air-cooled, fuel-injected 6=Evolution® 1200 cc precision-cooled, fuel-injected

Table 2-12. Harley-Davidson V.I.N. Breakdown: 2009 Sportster Models

POSITION	DESCRIPTION	POSSIBLE VALUES
6	Introduction date	1=Regular 2=Mid-year 3=California/regular 4=Cosmetic changes and/or special introductory date 5=California/cosmetic changes and/or special introductory date 6=California/mid-year
7	V.I.N. check digit	Can be 0-9 or X
8	Model year	9=2009
9	Assembly plant	K=Kansas City, MO U.S.A.
10	Sequential number	Varies

Table 2-13. V.I.N. Model Codes: 2009 Sportster Models

CODE	MODEL	CODE	MODEL
CN	XL 883 Sportster® 883	CV	XL 1200R Sportster® 1200 Roadster
CP	XL 883C Sportster® 883 Custom	CX	XL 1200L Sportster® 1200 Low
CR	XL 883L Sportster® 883 Low	CZ	XL 1200N Sportster® 1200 Nightster™
CS	XL 883R Sportster® 883R	LA	XR 1200 Sportster® 1200
CT	XL 1200C Sportster® 1200 Custom		



WHEELS

2.4

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 [1.35 TROUBLESHOOTING](#) or refer to [Table 2-14](#) 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 inflate tire beyond maximum pressure as specified on sidewall. Over inflated tires can blow out, which could result in death or serious injury. (00027a)

Table 2-14. Wheel Service Chart

CHECK FOR	REMEDY
Loose axle nuts.	Tighten front axle nut to 60-65 ft-lbs (81-88 Nm). Tighten rear axle nut to 95-105 ft-lbs (129-142 Nm).
Excessive side-play or radial (up-and-down) play in wheel hubs.	Replace wheel hub bearings. See 2.4 WHEELS, Sealed Wheel Bearings .
Loose spokes.	Tighten or replace spokes. See 2.8 TRUING LACED WHEELS and 2.5 WHEEL LACING: 16 INCH RIM , 2.6 WHEEL LACING: 19 INCH RIM or 2.7 WHEEL LACING: 21 INCH RIM .
Alignment of rear wheel in frame or with front wheel.	Check rear wheel alignment as described in this section or repair rear fork as described in 2.25 REAR FORK .
Rims and tires out-of-true sideways; should not be more than 1/32 in. (0.76 mm).	True wheels, replace rims or replace spokes. See 2.8 TRUING LACED WHEELS and 2.5 WHEEL LACING: 16 INCH RIM , 2.6 WHEEL LACING: 19 INCH RIM or 2.7 WHEEL LACING: 21 INCH RIM .
Rims and tires out-of-round or eccentric with hub; should not be more than 1/32 in. (0.76 mm).	
Irregular or peaked front tire wear.	Replace as described in 2.4 WHEELS and 2.19 TIRES .
Correct tire inflation.	Inflate tires to correct pressure. See 2.2 SPECIFICATIONS .
Correct tire and wheel balance.	Static balance may be satisfactory if dynamic balancing facilities are not available. However, dynamic balancing is strongly recommended.
Steering head bearings.	Correct adjustment and replace pitted or worn bearings. See 2.23 FORK STEM AND BRACKET ASSEMBLY .
Damper tubes.	Check for leaks. See 2.21 FRONT FORK: XL MODELS or 2.22 FRONT FORK: XR MODELS .
Shock absorbers.	Check damping action and mounting stud bushings. See 2.26 SHOCK ABSORBERS .
Rear fork bearings.	Check for looseness. See 2.25 REAR FORK .

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.

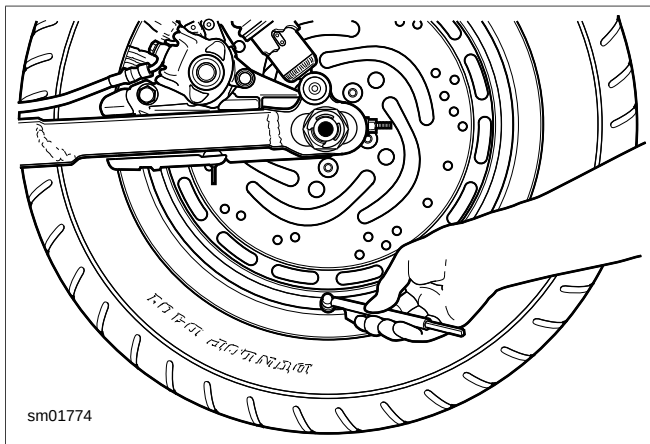


Figure 2-3. Checking Tire Pressure

⚠ WARNING

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

At regular intervals of 5000 miles (8000 km), or whenever handling irregularities are noted, see [Table 2-14](#) for the recommended service procedure.

⚠ WARNING

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

NOTES

Use the following guidelines when installing a new tire or repairing a flat.

- Always locate and eliminate the cause of the original tire failure.
- Do not patch or vulcanize a tire casing. These procedures weaken the casing and increase the risk of a blowout.
- Only patch an inner tube as an emergency measure. Replace the damaged tube as soon as possible.
- 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.
- The use of tires other than those specified can adversely affect handling resulting in death or serious injury.
- 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](#). Check wheel bearing end play.
 - a. Mount a magnetic base dial indicator on the brake disc. Set the indicator contact point on the end of the axle.
 - b. Move the wheel back as far as it will go. Holding the wheel in position, zero the dial indicator gauge.
 - c. 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. (0.05 mm). Repeat the procedure to verify the reading.
 - d. If the end play is 0.002 in. (0.05 mm) or more, replace the wheel bearings.
3. See [Figure 2-5](#). Remove brake caliper mounting screws (3). Slide caliper (4) off brake disc and secure caliper out of the way.

NOTES

- Do not operate the front brake lever with the front wheel removed or the caliper pistons may be forced out. Reseating the pistons requires disassembly of the caliper.
 - On models with dual disc brakes, remove both calipers.
4. Remove axle nut (1) and flat washer (2) from axle on left side of vehicle.
 5. See [Figure 2-6](#). On right side of vehicle, loosen nut (4) on pinch screw (1). Pull axle out of hub while supporting wheel.
 6. Remove spacer and front wheel assembly.

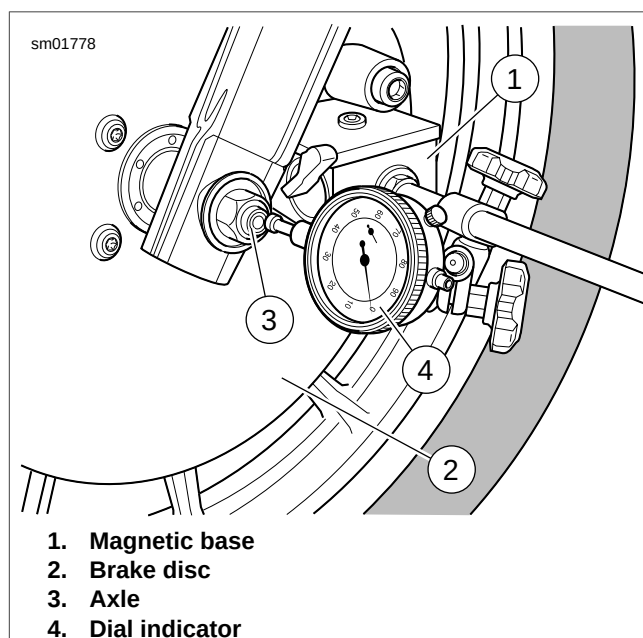


Figure 2-4. Check Wheel Bearing End Play

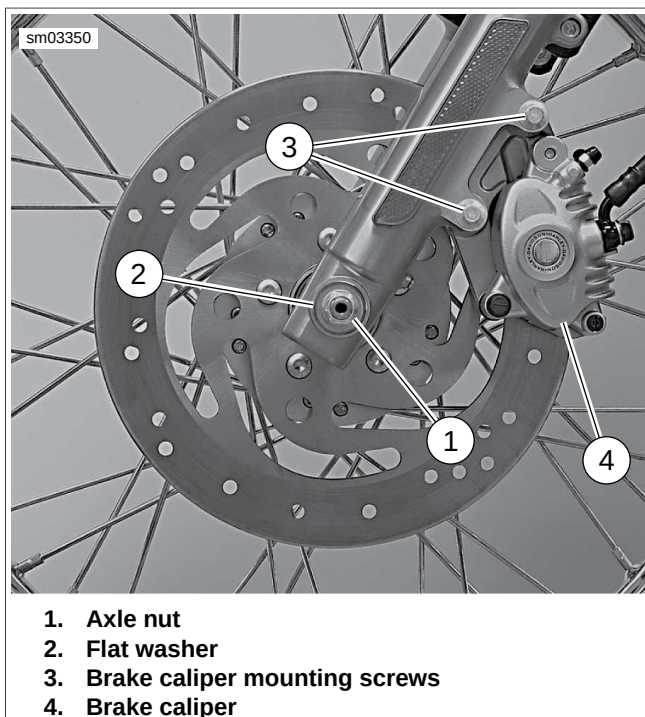


Figure 2-5. Left Side Front Wheel Mounting: (Laced Front Wheel Shown)

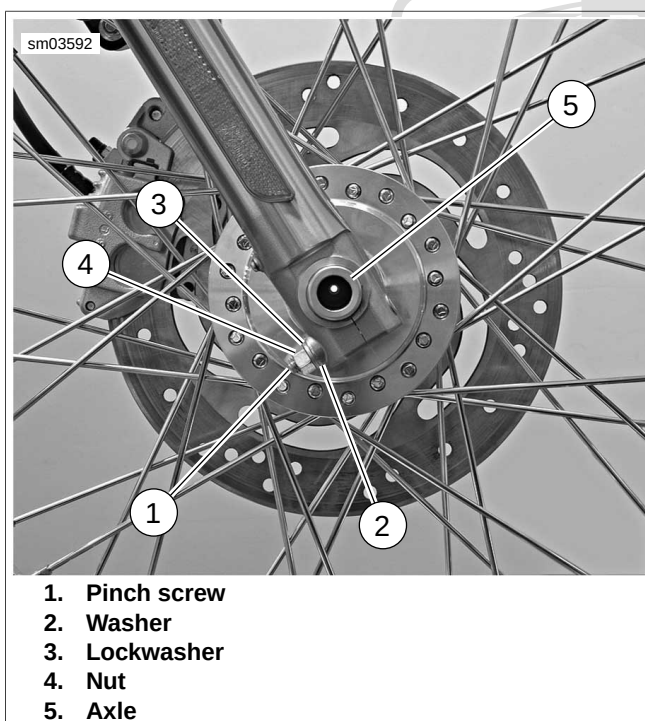


Figure 2-6. Right Side Front Wheel Mounting: Typical (Laced Front Wheel Shown)

Disassembly: Cast Front Wheel

If necessary, remove tire. See [2.19 TIRES](#).

NOTE

Label all components as they are removed so they may be returned to their original locations.

1. See [Figure 2-9](#). Remove bearing spacers (9, 11) from right and left sides of wheel.
2. If necessary, remove five screws (1) and left side brake disc (13).
3. If necessary, remove five screws and right side brake disc (14) (dual front disc models) or hub plate (8) (single front disc models).
4. If necessary, remove roller bearings (4) and hub spacer (10). See [2.4 WHEELS, Sealed Wheel Bearings](#).

Disassembly: Laced Front Wheel

1. See [Figure 2-10](#). Remove spacers (9, 11) from right and left sides of wheel.
2. If necessary, remove five screws (1) and brake disc (14).
3. If necessary, remove wheel bearings (4) and hub spacer (10). See [2.4 WHEELS, Sealed Wheel Bearings](#).

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. See [2.6 WHEEL LACING: 19 INCH RIM](#) or [2.7 WHEEL LACING: 21 INCH RIM](#). Then, see [2.8 TRUING LACED WHEELS](#).

4. If it is necessary to disassemble wheel, loosen spoke nipples and spokes (8) and slide each spoke out of hub (12).

Cleaning and Inspection

1. Inspect all parts for damage or excessive wear.

WARNING

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

2. Inspect brake pads and disc(s). See [1.9 BRAKE PADS AND DISCS: XL MODELS](#) or [1.10 BRAKE PADS AND DISCS: XR MODELS](#). Replace as necessary.

Assembly: Cast Front Wheel

WARNING

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

1. See [Figure 2-9](#). Install hub spacer (10) and wheel bearings (4) if removed. See [2.4 WHEELS, Sealed Wheel Bearings](#).

2. **Single front disc models:** If necessary, install hub plate and brake disc as follows:
 - a. Install hub plate (8) on left side of wheel. Secure with **new** screws and tighten in an alternating pattern to 16-24 ft-lbs (21.7-32.6 Nm).
 - b. Install brake disc (13). Secure with **new** screws and tighten in an alternating pattern to 16-24 ft-lbs (21.7-32.6 Nm).
3. **Dual front disc models:** If necessary, install brake discs as follows:
 - a. Hold brake discs together, inboard sides facing each other (minimum thickness and part number stampings are on outboard side of brake disc).
 - b. **XL Models:** See [Figure 2-7](#). Orient brake discs so that bulb shaped end of each slot is on the leading edge of the slot in the direction of rotation, as shown. Note that the words "LEFT" and "RIGHT" will be located on what appears to be the incorrect sides when oriented this way. This is correct per Service Bulletin M-1192A.
 - c. **XR Models:** See [Figure 2-8](#). Orient brake discs so that outer diameter of each slot is on the leading edge in the direction of rotation, as shown. Note that the words "LEFT" and "RIGHT" will be located on correct sides when oriented this way.
 - d. Rotate one brake disc as necessary, until all vent holes are aligned with those of the other brake disc.
 - e. Holding brake discs aligned, use a felt marking pen or paint pen to draw a line across the edge of both brake discs.
 - f. See [Figure 2-9](#). Keeping the paint marks on the edge of both discs aligned, install both brake discs onto hub. Secure with **new** screws and tighten in an alternating pattern to 16-24 ft-lbs (21.7-32.6 Nm).
4. Install spacers (9, 11) on right and left sides of wheel.
5. Verify that wheel is true. See [2.9 CHECKING CAST WHEEL RUNOUT](#).
6. Install tire, if removed. See [2.19 TIRES](#).

Assembly: Laced Front Wheel

1. See [Figure 2-10](#). Install hub spacer (10) and wheel bearings (4) if removed. See [2.4 WHEELS, Sealed Wheel Bearings](#).
2. If hub (12) and rim (5 or 16) were disassembled, reassemble and true wheel. See [2.6 WHEEL LACING: 19 INCH RIM](#) or [2.7 WHEEL LACING: 21 INCH RIM](#). Then see [2.8 TRUING LACED WHEELS](#).

WARNING

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

3. Install brake disc (14). Secure with **new** screws and tighten to 16-24 ft-lbs (21.7-32.6 Nm).

4. Install spacers (9, 11) on right and left sides of wheel.
5. Verify that wheel is true. See [2.8 TRUING LACED WHEELS](#).
6. Install tire, if removed. See [2.19 TIRES](#).

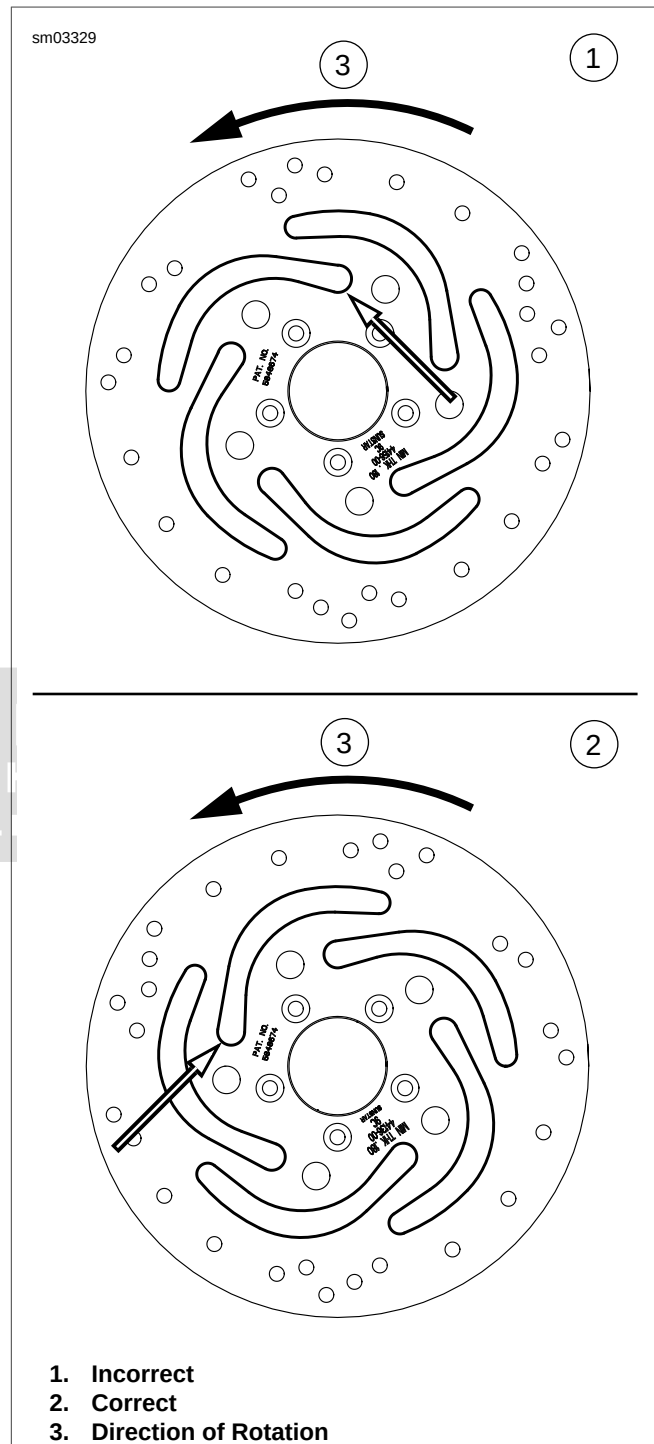


Figure 2-7. Dual Rotor Orientation: XL Models (Left Side Brake Disc Shown)

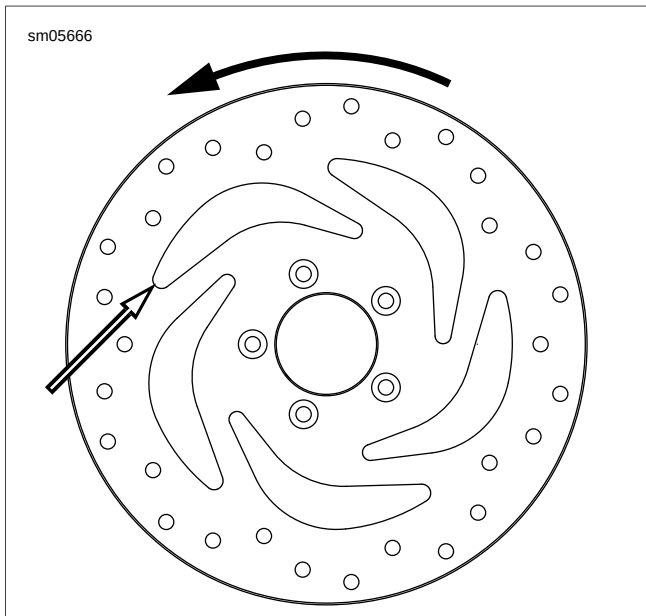
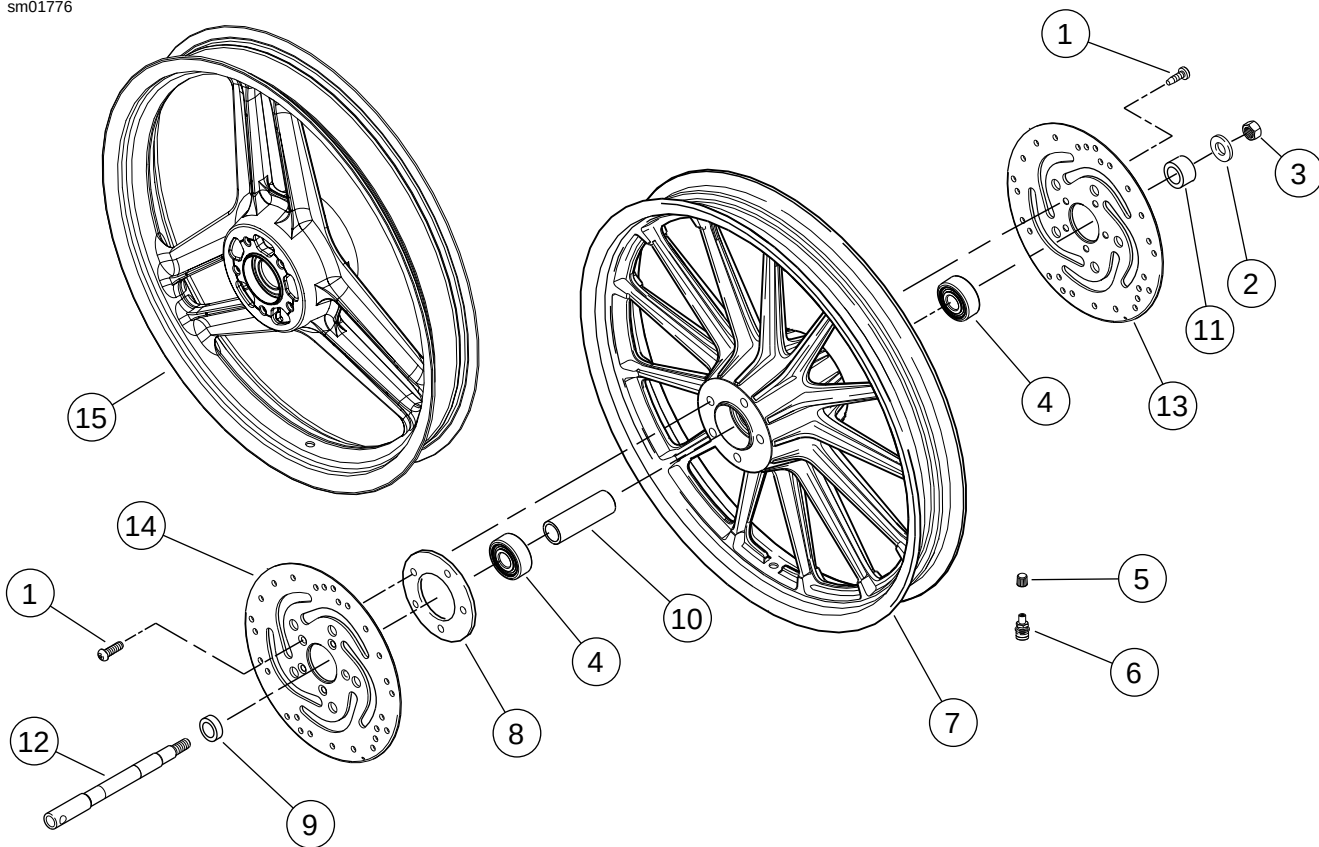


Figure 2-8. Dual Rotor Orientation: XR Models (Left Side Brake Disc Shown)



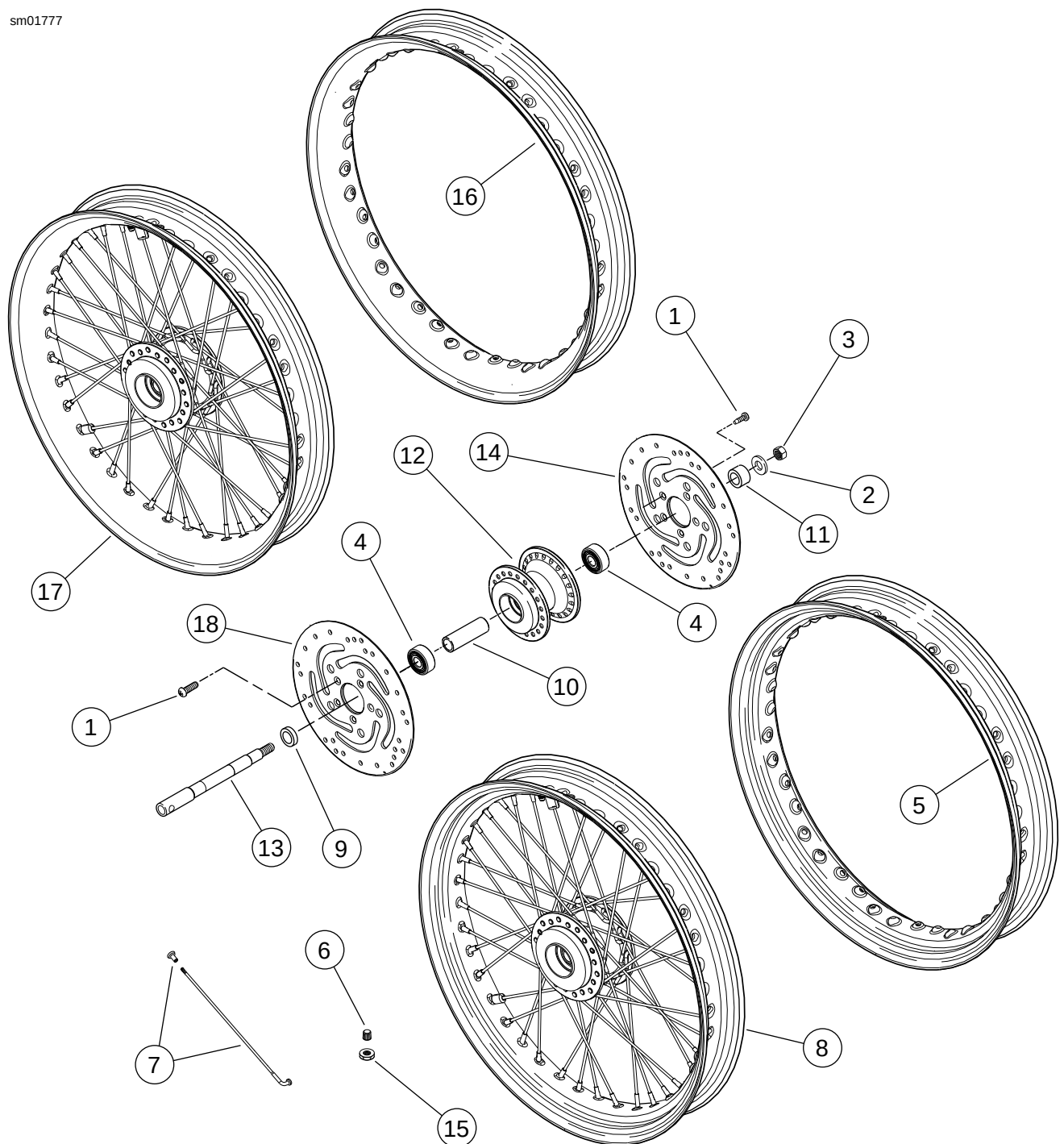
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- | | |
|--|---|
| 1. Screw (dual front disc models-10, all others-5) | 9. Bearing spacer, narrow |
| 2. Washer | 10. Hub spacer |
| 3. Nut | 11. Bearing spacer, wide |
| 4. Roller bearing (2) | 12. Front axle |
| 5. Valve cap | 13. Brake disc L.H. |
| 6. Valve stem assembly with nut | 14. Brake disc R.H. (dual front disc models only) |
| 7. Wheel assembly, 19 in., XL models | 15. Wheel assembly, XR models |
| 8. Hub plate (single front disc models only) | |

Figure 2-9. Cast Wheel Front (typical)

sm01777



1. Screw (dual front disc models-10, all others-5)
2. Washer
3. Nut
4. Roller bearing (2)
5. Rim, 19 in. or 21 in., standard
6. Valve cap
7. Spoke and nipple
8. Wheel assembly, 19 in. or 21 in., standard
9. Bearing spacer, narrow

10. Hub spacer
11. Bearing spacer, wide
12. Wheel hub
13. Front axle
14. Brake disc L.H.
15. Valve stem nut
16. Rim, 21 in., profile
17. Wheel assembly, 21 in., profile rim
18. Brake disc, R.H. (dual front disc models only)

Figure 2-10. Laced Front Wheel

Installation

1. See [Figure 2-9](#) or [Figure 2-10](#). Apply a light coat of ANTI-SEIZE LUBRICANT to the axle (12 or 13), bearing (4) bores, and hub spacer (10) bore.
2. Position wheel between forks. Verify that bearing spacers (9, 11) on right and left side of wheel bearings are in position.
3. See [Figure 2-6](#). With pinch screw (1) loose, insert threaded end of axle (5) through right side fork. Push axle through fork and wheel hub until it begins to emerge from left side of hub.
4. Push axle through left fork, until axle shoulder contacts external bearing spacer on right fork side.
5. See [Figure 2-5](#). Install flat washer (2) and axle nut (1) 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 60-65 ft-lbs (81-88 Nm).
6. If servicing a vehicle with dual front brakes, align calipers to brake discs as follows:
 - a. Make sure axle pinch screw nut is loose.
 - b. See [Figure 2-9](#) or [Figure 2-10](#). Position right fork leg against bearing spacer (9).
 - c. **XL Models:** Tighten axle pinch screw to 21-27 ft-lbs (28.5-36.6 Nm).
XR Models: Tighten axle pinch screw to 41-48 ft-lbs (55.6-65.1 Nm).
7. Install brake caliper(s). See [2.11 FRONT BRAKE CALIPER: XL MODELS](#) or [2.12 FRONT BRAKE CALIPER: XR MODELS](#).

WARNING

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

8. Check wheel bearing end play. See [2.4 WHEELS, Front Wheel](#).

WARNING

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

9. Pump brake lever to move pistons out until they contact outside brake pad(s). Verify piston location against pad.

REAR WHEEL

PART NUMBER	TOOL NAME
HD-45968	FAT JACK

Removal

1. Secure motorcycle upright on a suitable lift. Raise rear end of motorcycle high enough to permit wheel removal, using a FAT JACK (Part No. HD-45968) (or similar lifting device) underneath frame.
2. Check wheel bearing end play.
 - a. Mount a magnetic base dial indicator on the brake disc. Set the indicator contact point on the end of the axle.
 - b. Move the wheel back as far as it will go. Holding the wheel in position, zero the dial indicator gauge.
 - c. 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. (0.05 mm). Repeat the procedure to verify the reading.
 - d. If end play is 0.002 in. (0.05 mm) or more, remove wheel and replace both wheel bearings.
3. **XL Models:** Remove rear muffler. See [4.15 EXHAUST SYSTEM: XL MODELS](#).
4. **XL Models:** Remove right lower shock absorber nut and pull screw out slightly. This will help avoid damage to sprocket when rear wheel is removed.
5. See [Figure 2-11](#). Remove e-clip (2), axle nut (1) and washer (3).
6. Loosen adjuster screws several turns to relieve belt tension.
7. Gently tap end of axle (4) with a soft hammer to loosen. Pull axle free of rear fork assembly.
8. Slide wheel forward and slip belt off sprocket.

NOTE

It is not necessary to disassemble rear brake caliper in order to remove rear wheel.

9. **XR Models:** Disengage brake hose from clamps on lower side of rear fork. Carefully slide caliper and bracket assembly forward to disengage from brake disk and boss on rear fork. Support assembly from frame using rope or bungee cord.
10. Remove spacers and roll rear wheel assembly back out of fork.
11. Remove rear wheel assembly.

NOTE

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

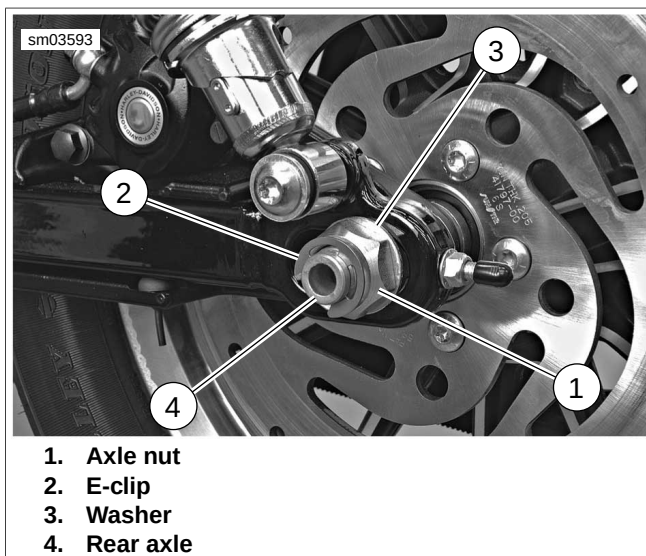


Figure 2-11. Rear Wheel Mounting (typical)

Disassembly

If necessary, remove tire. See [2.19 TIRES](#).

NOTES

- Sportster models sold in the Japanese market are equipped with rear wheel compensating sprockets. See [D.1 COMPENSATING SPROCKET](#) for the correct disassembly and repair procedures.
- Label all components as they are removed so they may be returned to their original locations.

Cast or Disc wheel: see [Figure 2-12](#). **Laced wheel:** see [Figure 2-13](#).

1. Remove spacers (8, 9) from left and right sides of wheel.
2. If necessary, remove five screws (15) to detach rear brake disc (10) from left side of wheel.
3. If necessary, remove five screws (2) and washers (4) to detach rear sprocket (7) from right side of wheel.
4. If necessary, remove wheel bearings (6) and hub spacer (14). See [2.4 WHEELS, Sealed Wheel Bearings](#).

NOTE

Laced Wheel: 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. See [2.5 WHEEL LACING: 16 INCH RIM](#), [2.6 WHEEL LACING: 19 INCH RIM](#) or [2.7 WHEEL LACING: 21 INCH RIM](#). Then true wheel. See [2.8 TRUING LACED WHEELS](#).

5. **Laced Wheel:** see [Figure 2-13](#). If it is necessary to disassemble wheel, loosen spoke nipples and spokes (19) and slide each spoke out of hub (18).

Cleaning and Inspection

1. Inspect all parts for damage or excessive wear.

! WARNING

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

2. Inspect brake pads and disc. See [1.9 BRAKE PADS AND DISCS: XL MODELS](#) OR [1.10 BRAKE PADS AND DISCS: XR MODELS](#).
3. Inspect rear belt and sprocket. See [1.15 REAR BELT AND SPROCKETS](#).

Assembly

1. **Laced Wheel:** if wheel was disassembled, reassemble hub, rim, spokes and nipples, and tighten spokes. See [2.5 WHEEL LACING: 16 INCH RIM](#), [2.6 WHEEL LACING: 19 INCH RIM](#) or [2.7 WHEEL LACING: 21 INCH RIM](#).
2. **Cast or disc wheel:** see [Figure 2-12](#). **Laced wheel:** see [Figure 2-13](#).
3. Install hub spacer (14) and wheel bearings (6), if removed. See [2.4 WHEELS, Sealed Wheel Bearings](#).
4. If brake disc (10) was removed, install brake disc on valve stem side of wheel. Secure with **new** screws and tighten to 30-45 ft-lbs (40.7-61.1 Nm).

NOTE

Sportster models sold in the Japanese market are equipped with rear wheel compensating sprockets. See [D.1 COMPENSATING SPROCKET](#) for the correct assembly/installation procedure.

5. If rear sprocket (7) was removed, install sprocket on side of wheel opposite valve stem.
 - a. Secure with **new** screws and washers (4). Tighten to 60 ft-lbs (81.3 Nm).
 - b. Loosen each screw 180° and retighten to 80 ft-lbs (108.0 Nm).
6. Verify that wheel assembly is true. See [2.8 TRUING LACED WHEELS](#) or [2.9 CHECKING CAST WHEEL RUNOUT](#).
7. Install tire, if removed. See [2.19 TIRES](#).

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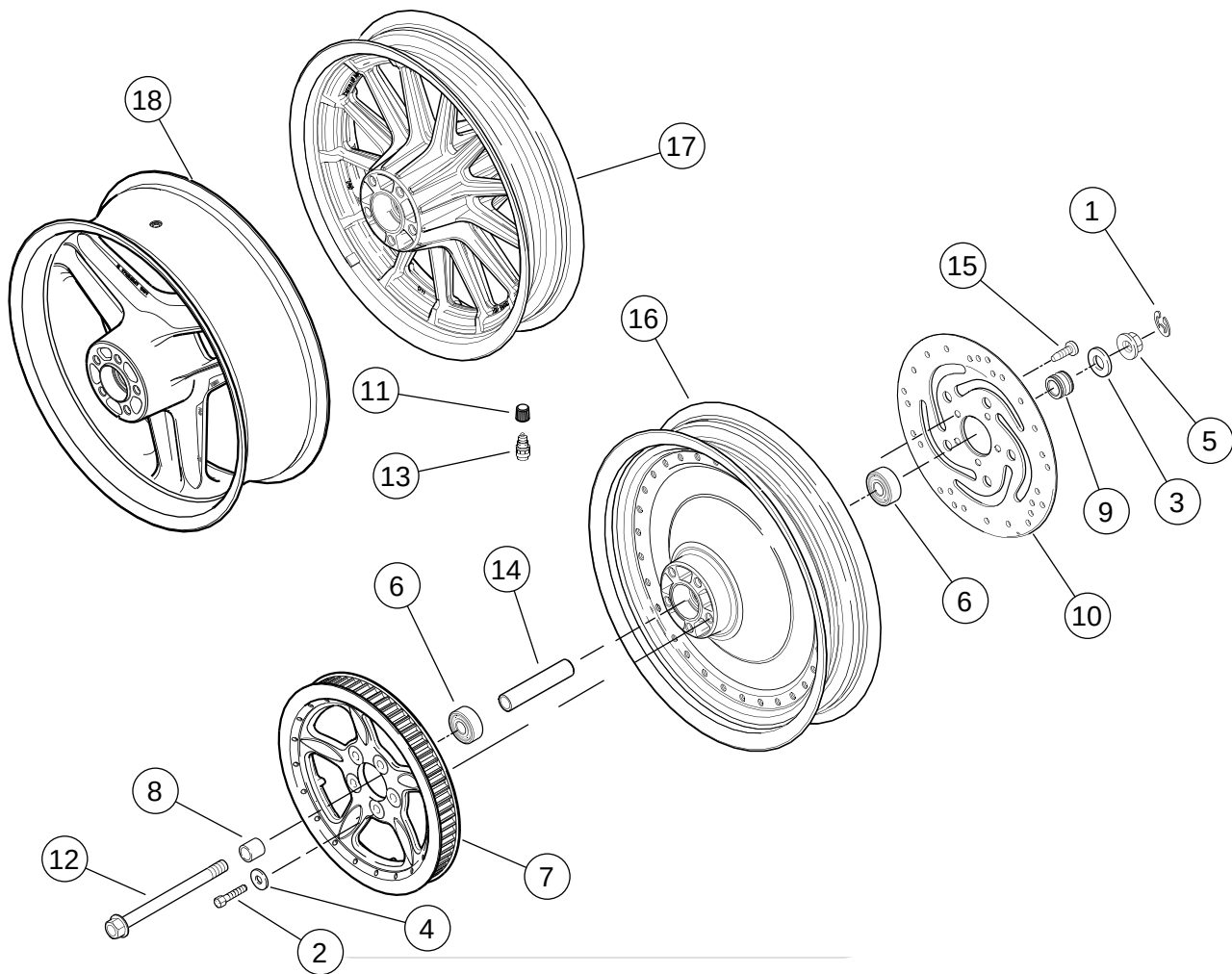
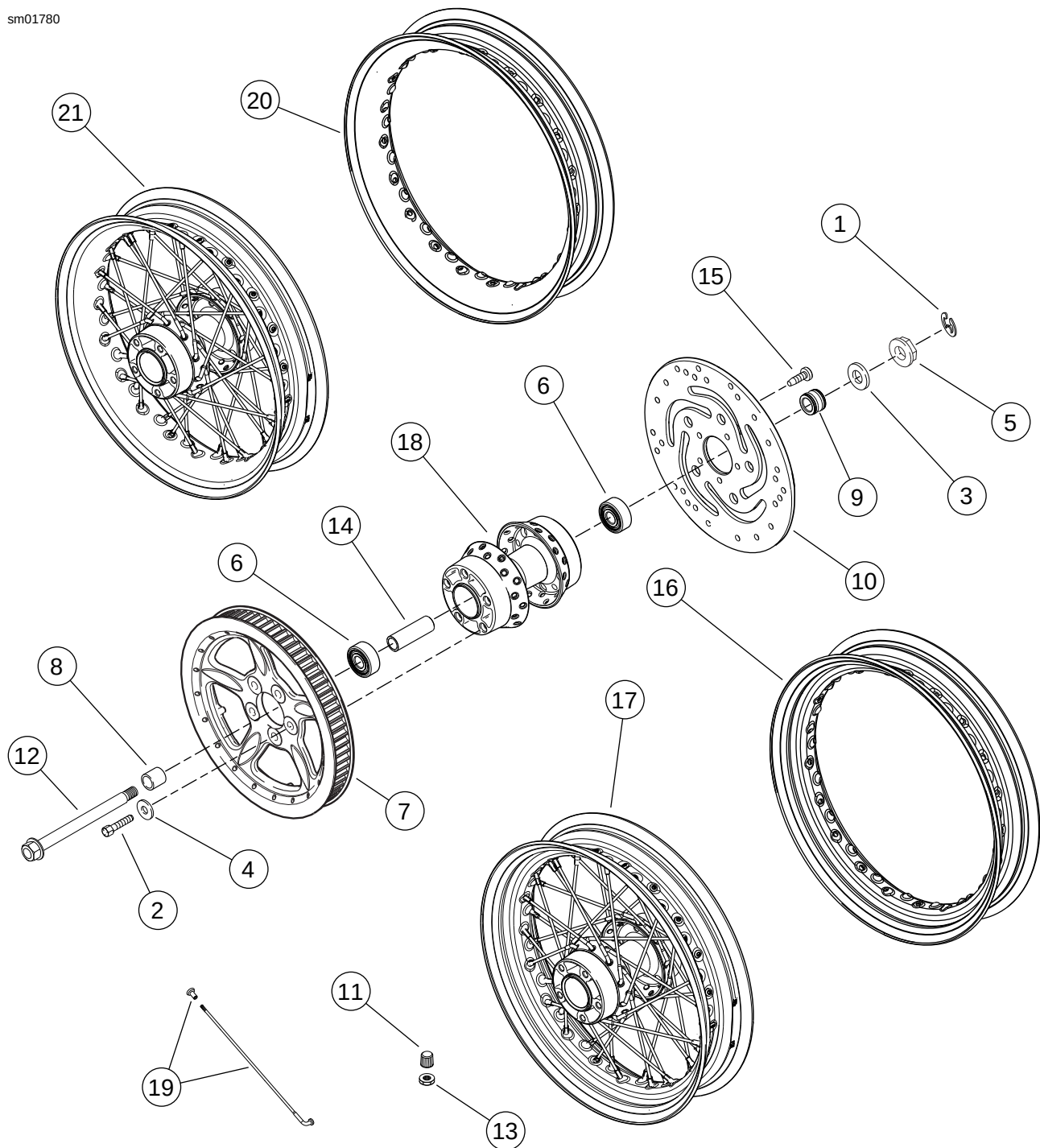


Figure 2-12. Cast or Disc Rear Wheel

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- | | |
|-----------------------|---|
| 1. E-clip | 12. Axle |
| 2. Screw (5) | 13. Valve stem nut |
| 3. Spacer | 14. Hub spacer |
| 4. Washer (5) | 15. Brake disc screw (5) |
| 5. Axle nut | 16. Rim, standard (all except XL 883C/XL 1200C) |
| 6. Roller bearing (2) | 17. Wheel assembly, 16 in., standard rim |
| 7. Sprocket | 18. Hub |
| 8. Spacer, wide | 19. Spoke and nipple (40) |
| 9. Spacer, narrow | 20. Rim, profile (XL 883C/XL 1200C only) |
| 10. Brake disc | 21. Wheel assembly, 16 in., profile rim |
| 11. Valve cap | |

Figure 2-13. Laced Rear Wheel

Installation

1. See [Figure 2-12](#) or [Figure 2-13](#). Apply a light coat of ANTI-SEIZE LUBRICANT to the axle (12), bearing (6) bores, and hub spacer (14) bore.
2. Place wheel centrally in the rear fork assembly. Engage the brake disc in the caliper on XL models.
3. **XR Models:** With the wheel as far forward as possible, install the caliper/bracket assembly in place, engaging the brake disk and the boss on the rear fork.
4. Slide wheel forward and slip belt over sprocket and then slide the wheel back.
5. Position sprocket side spacer (8) between wheel and rear fork.
6. Insert axle (12) through right side of rear fork and right side axle adjuster, sprocket side spacer (8), wheel assembly, disc side spacer (9), rear caliper bracket, and left side of rear fork and left side axle adjuster.
7. Install washer (3) and axle nut (5) on left end of axle. Do not tighten nut at this time.
8. **XL Models:** Slide right lower shock absorber screw back in place. Install nut and tighten to 45-50 ft-lbs (61-68 Nm).

NOTE

If rear brake caliper was disassembled or removed, see [2.16 REAR BRAKE CALIPER: XL MODELS](#) or [2.17 REAR BRAKE CALIPER: XR MODELS](#) for the proper assembly and installation procedure.

9. Check for proper belt tension and rear wheel alignment. See [1.16 REAR BELT DEFLECTION](#).

⚠ WARNING

Do not exceed specified torque when tightening axle nut. Exceeding torque can cause wheel bearings to seize during vehicle operation, which could result in death or serious injury. (00408e)

10. Tighten axle nut to 95-105 ft-lbs (129-142 Nm). Install e-clip.

⚠ WARNING

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

11. Check wheel bearing end play. See [2.4 WHEELS, Rear Wheel](#).
12. **XL Models:** Install rear muffler. See [4.15 EXHAUST SYSTEM: XL MODELS](#).

⚠ WARNING

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

13. Pump brake pedal to move piston out until it contacts outside brake pad. Verify piston location against pad.

SEALED WHEEL BEARINGS

PART NUMBER	TOOL NAME
HD-44060-B	WHEEL BEARING INSTALLER/REMOVER

Inspection

1. Inspect the play of the wheel bearings by finger while they are in the wheel. Rotate the inner bearing race and check for abnormal noise. Make sure bearing rotates smoothly.
2. Check wheel bearings and axle spacers for wear and corrosion. Excessive play or roughness indicates worn bearings. Replace bearings in sets only.

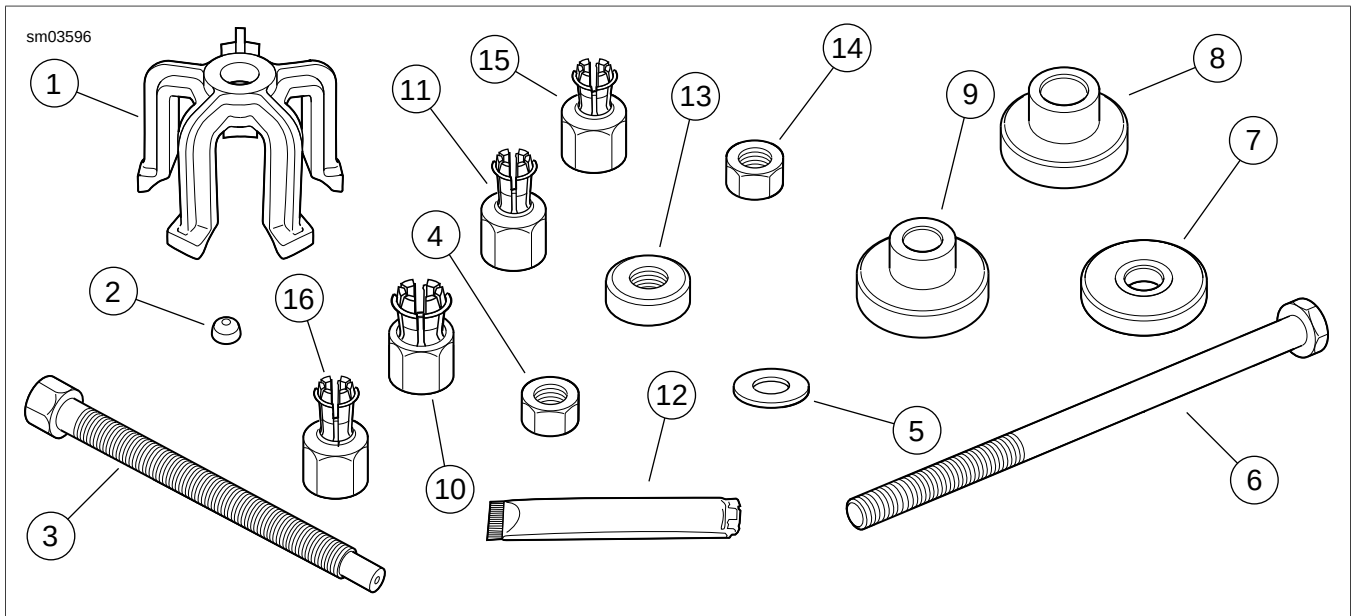


Figure 2-14. Wheel Bearing Remover/Installer (HD-44060-B) (See Table)

Table 2-15. HD-44060-B Wheel Bearing Remover/Installer

NO.	DESCRIPTION	PART NO.
1	Bridge	HD-44060-5
2	Steel ball	12547
3	6 in. forcing screw	HD-44060-4
4	1/2-20 UNF nut	222413
5	Washer	12004
6	11 in. forcing screw	280856
7	Support plate	HD-44060-1
8	Pilot, 1 in. and 25 mm	HD-44060-8
9	Pilot, 3/4 in.	HD-44060-6
10	Collet, 1 in.	HD-44060-7A
11	Collet, 3/4 in.	HD-44060-3A
12	Thread lubricant	J-23444-A
13	Bearing	217801
14	1/2-13 UNC nut	215654
15	Collet, 25 mm	HD-44060-10
16	Collet, 25 mm (ABS only)	HD-44060-11

Removal

1. If not already done, remove wheel from motorcycle. See [2.4 WHEELS](#). On models with a single front brake caliper, remove hub plate from wheel on side opposite front brake disc.

NOTE

See [Figure 2-15](#). Some wheel hubs may not provide adequate support for the puller bridge. In these cases, center a used brake disc over the hub to support the puller bridge while removing the bearing.



Figure 2-15. Brake Disk as Puller Aid

2. See [Figure 2-16](#). Obtain WHEEL BEARING INSTALLER/REMOVER (Part No. HD-44060-B) and assemble.
 - a. Sparingly apply graphite lubricant to threads of forcing screw (1) for prolonged service life and smooth operation.
 - b. Install nut (2), washer (3) and Nice bearing (4) on screw. Insert assembly through hole in bridge (5).
 - c. Drop ball bearing inside collet (6). Fasten collet and ball bearing to forcing screw.
3. Hold end of forcing screw and turn collet to expand edges of collet.

4. See [Figure 2-17](#). When expanded collet has gripped bearing edges, hold end of forcing screw (1) and turn the nut (2) to remove bearing from wheel.
5. Remove spacer from inside wheel hub.
6. Repeat procedure for opposite side bearing. Discard both bearings upon removal.

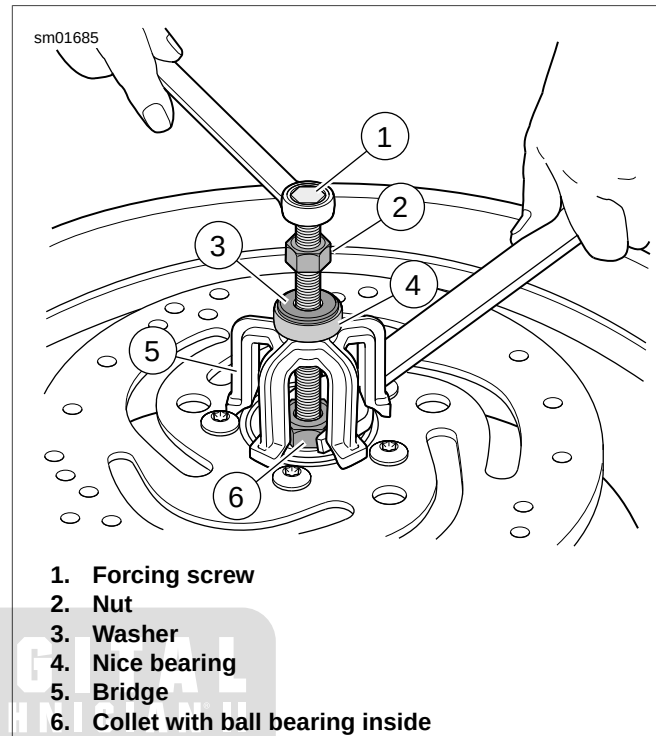


Figure 2-16. Wheel Bearing Removal Tool

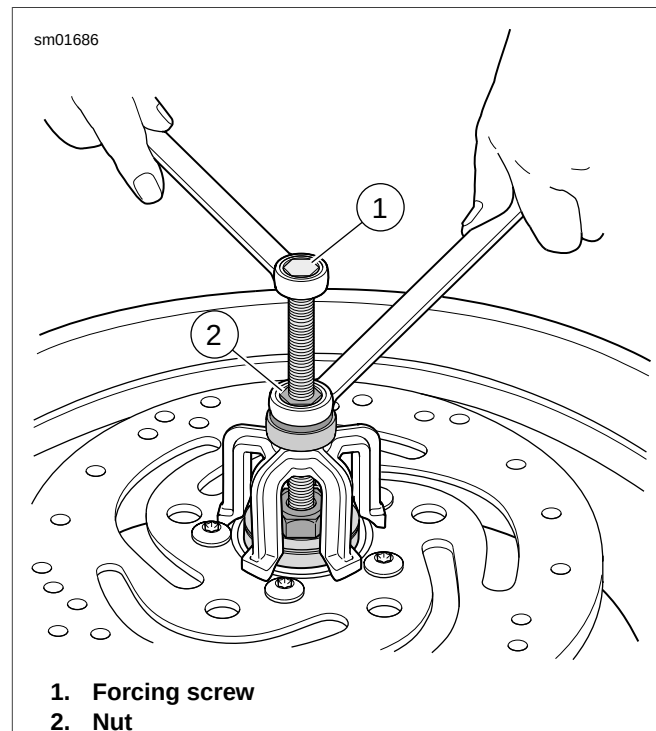


Figure 2-17. Removing Bearing

Installation

NOTES

- When installing wheel bearings, use specialty tool **WHEEL BEARING INSTALLER/REMOVER** (Part No. HD-44060-B).
 - Always install first bearing on primary brake disc side. If front wheel has two brake discs, install bearing on the left side first.
1. See [Figure 2-14](#). Obtain **WHEEL BEARING INSTALLER/REMOVER** (Part No. HD-44060-B) and assemble.
 - a. Sparingly apply graphite lubricant to threads of threaded rod (6) for prolonged service life and smooth operation.
 - b. See [Figure 2-18](#). Place threaded rod (1) through support plate (2). Insert assembly through wheel.
 - c. See [Figure 2-19](#). Place **new** bearing on rod (1) with lettered side facing out.
 - d. Install pilot (5), Nice bearing (4), washer (3) and nut (2) over rod.
 2. Hold hex end of threaded rod and turn nut to install wheel bearing. Bearing is fully seated when nut can no longer be turned. Remove tool.
 3. Install spacer inside wheel hub.
 4. Reverse tool and install opposite side wheel bearing.
 5. On cast front wheels with single brake caliper, apply two drops of **LOCTITE THREADLOCKER 243** to hub plate mounting screws. Install hub plate opposite brake disc and secure with screws. Tighten to 16-24 ft-lbs (21.7-32.6 Nm).

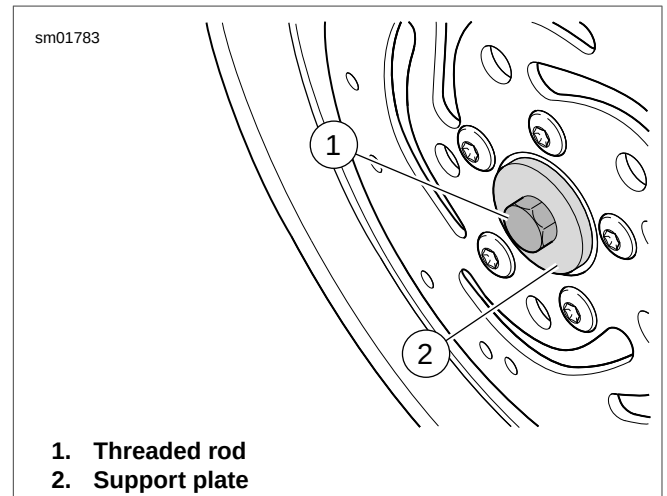


Figure 2-18. Assembling Installation Tool

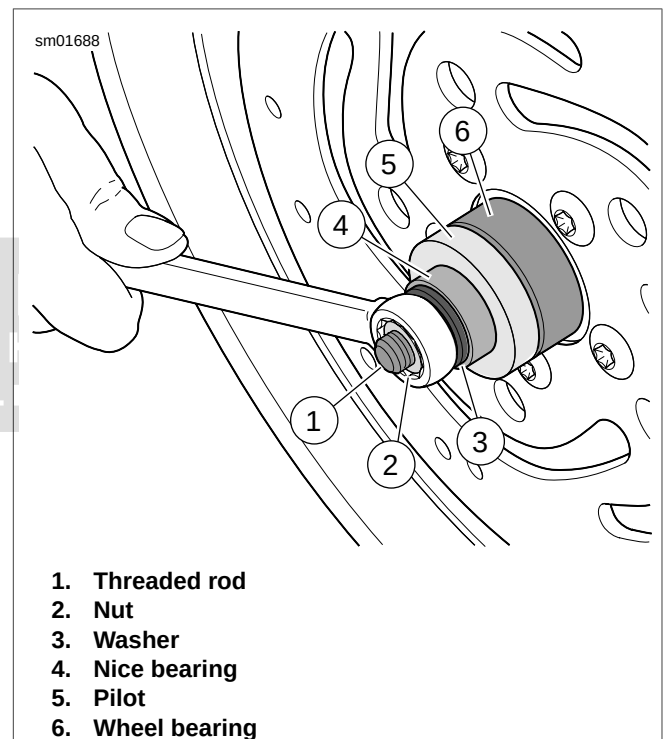


Figure 2-19. Installing Bearing

WHEEL LACING: 16 INCH RIM

2.5

GENERAL

NOTES

- 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.
- Do not install incorrect spokes or spoke nipples on rim.

See [Figure 2-20](#). Measure spoke length (distance "A"). To determine correct spoke length for type of rim used, refer to [Table 2-16](#).

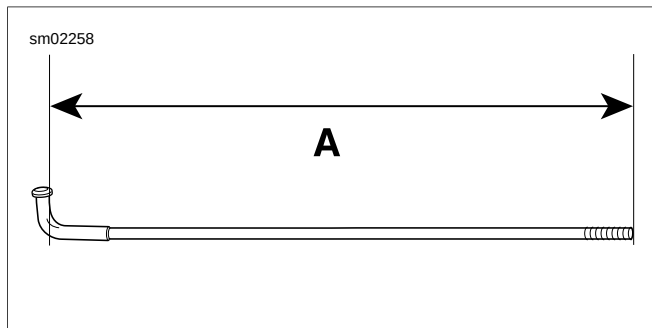


Figure 2-20. Measuring Spoke Length

Table 2-16. Rim Spoke Length

RIM	IN.	MM
Steel laced	6.71-6.75	170.4-171.5
Chrome aluminum profile laced	6.84-6.88	173.7-174.8

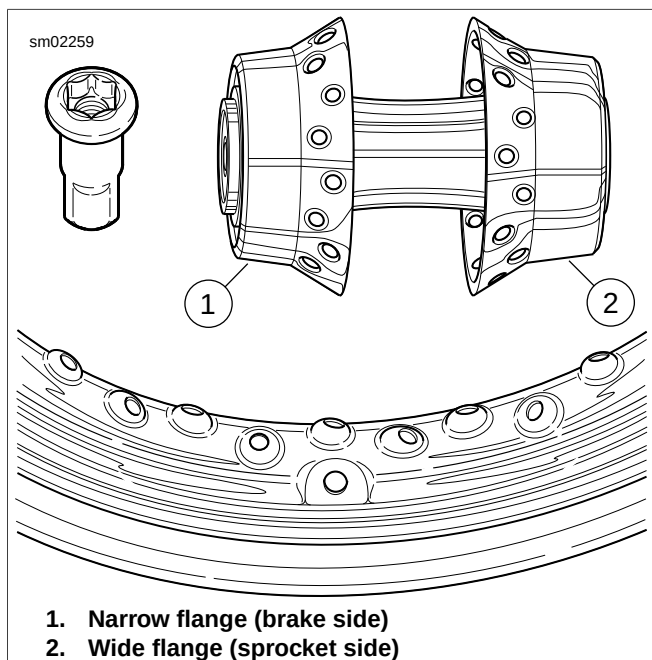


Figure 2-21. Rim, Hub and Spoke Nipple

PROCEDURE

NOTE

The primary brake disc side of the hub can be identified by having one or two grooves cut into the disc mounting surface.

- See [Figure 2-22](#). Place hub on table with primary brake disc side up. Insert a spoke in each hole of **lower** row as shown in the figure. Angle spokes clockwise.

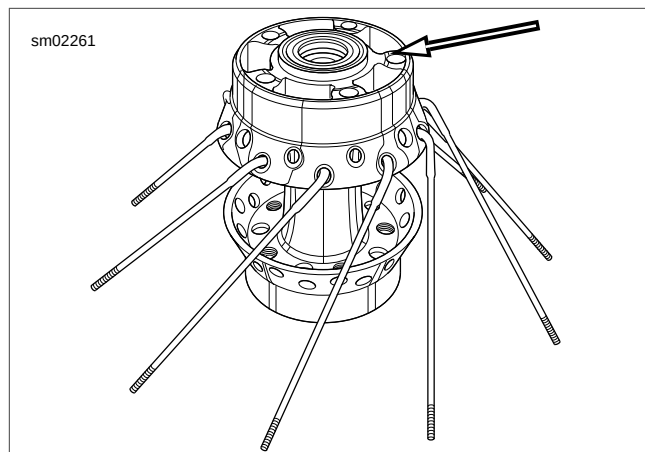


Figure 2-22. Hub: Primary Brake Disc Side Up

- See [Figure 2-23](#). Center rim over hub assembly with valve stem hole facing upward.
- Using any **lower** row spoke, place first spoke into rim hole to left of valve stem hole on upper half of rim centerline.

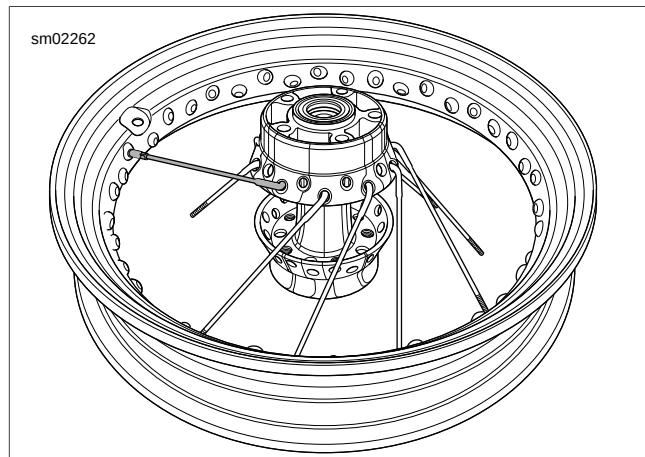


Figure 2-23. Brake Side Up: Start First Spoke of Bottom Row

- See [Figure 2-24](#). Install remaining lower row spokes, one in every fourth hole.

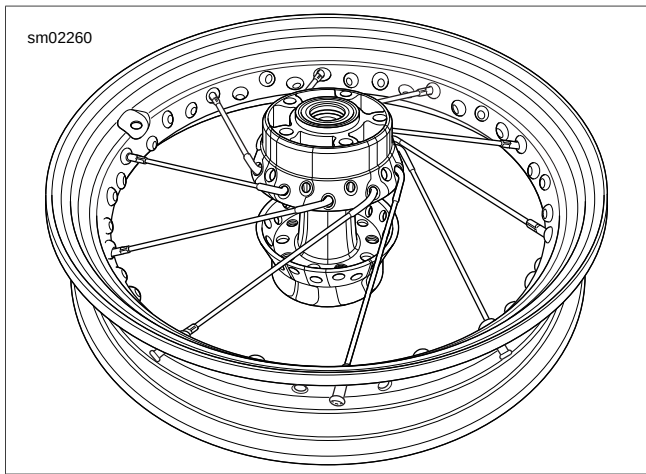


Figure 2-24. Brake Side Up: Bottom Row of Spokes Laced

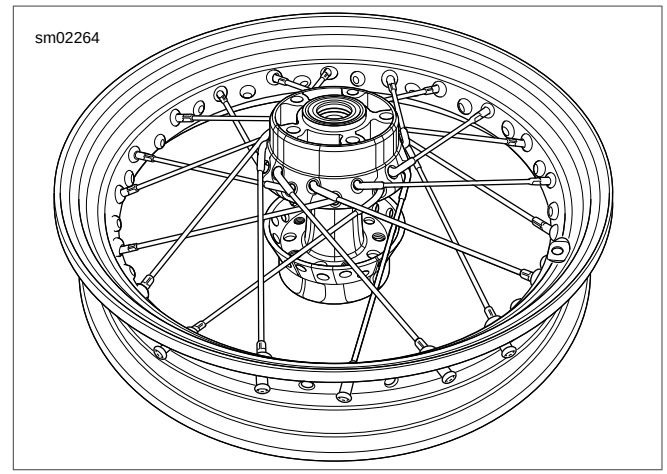


Figure 2-26. Brake Side Up: Top Row of Spokes Laced

5. See [Figure 2-25](#). Place first **upper** row spoke into hub as shown. Angle spoke counterclockwise, **crossing four lower row spokes**. Spoke must enter hole to left of valve stem hole.

7. See [Figure 2-27](#). Turn wheel assembly over so primary brake disk side faces down. Place any **lower** row spoke into hub. Angle spoke clockwise and place into rim hole angled to accept it.

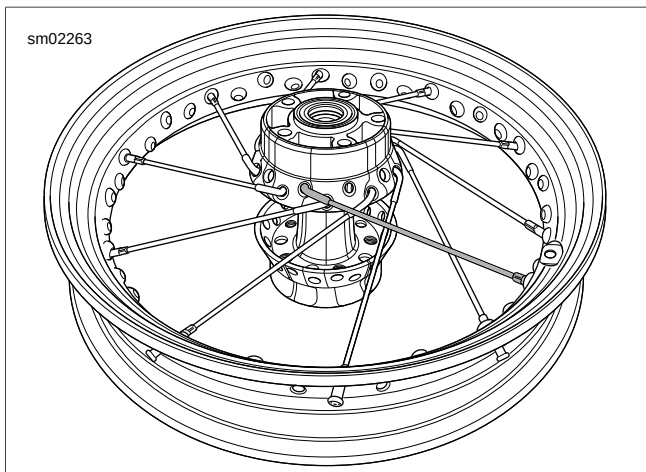


Figure 2-25. Brake Side Up: Start First Spoke of Top Row

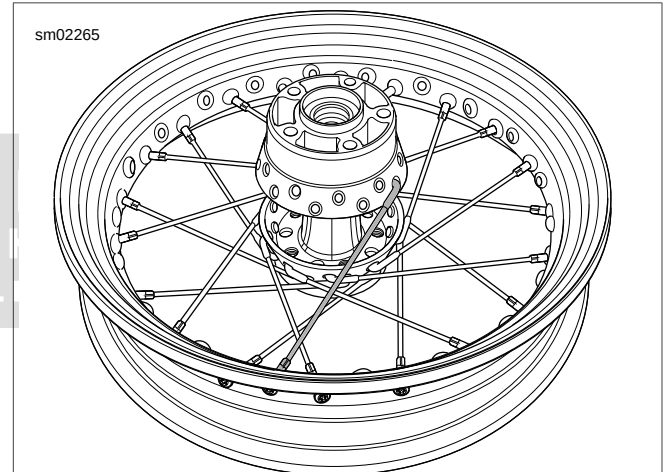


Figure 2-27. Sprocket Side Up: Start First Spoke of Bottom Row

6. See [Figure 2-26](#). Install remaining nine upper row spokes into every fourth remaining hole above rim centerline. This completes spoke installation on brake disc side.

8. See [Figure 2-28](#). Place remaining nine lower row spokes, angled clockwise, into hub and rim.

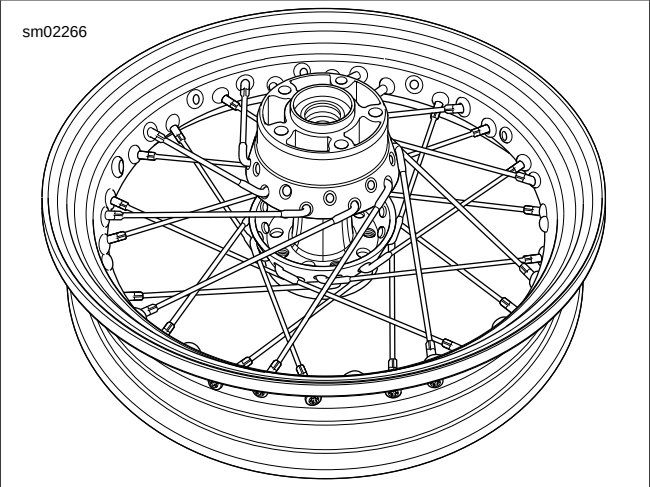


Figure 2-28. Sprocket Side Up: Bottom Row of Spokes Laced

9. See [Figure 2-29](#). Insert any **upper** row spoke into hub and angle spoke counterclockwise. Place spoke into appropriate rim hole.

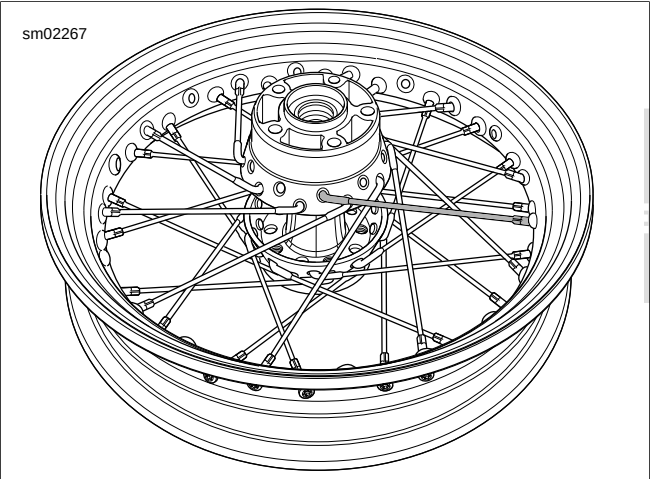


Figure 2-29. Sprocket Side Up: Start First Spoke of Top Row

10. See [Figure 2-30](#). Install remaining nine upper row spokes.

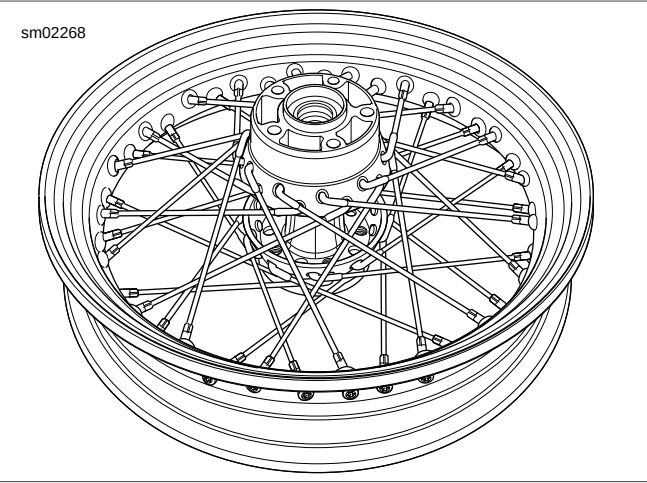


Figure 2-30. Wheel Completely Laced

11. Tighten spoke nipples to specification listed in [Table 2-17](#).
12. True wheel. See [2.8 TRUING LACED WHEELS](#).

Table 2-17. Spoke Nipple Torque Specification

RIM TYPE	MINIMUM TORQUE
All	55 in-lbs (6.2 Nm)

WHEEL LACING: 19 INCH RIM

2.6

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.
 - a. Inner spokes have long heads.
 - b. Outer spokes have short heads.
2. Lubricate spoke threads and nipple shoulders with tire mounting lubricant.

NOTE

The primary brake disc side of the hub can be identified by having one or two grooves cut into the disc mounting surface.

3. See [Figure 2-31](#). Place hub on bench with the primary 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 2-32](#). 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.

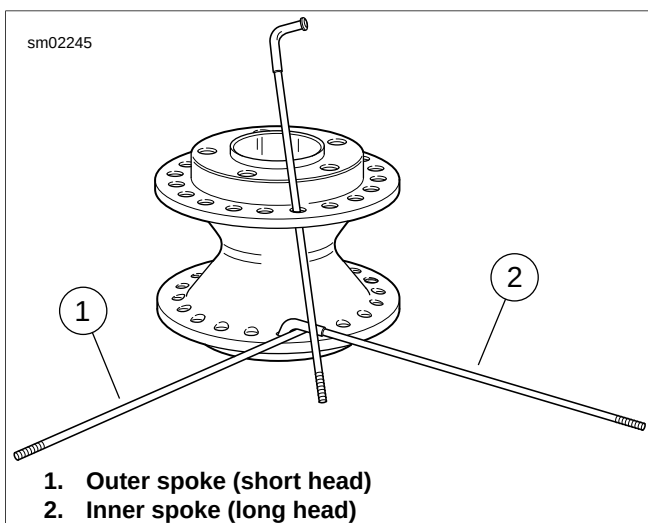


Figure 2-31. Lacing 19 Inch Wheel Hub

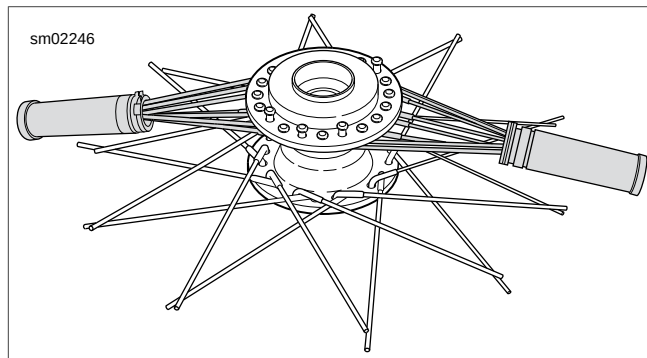


Figure 2-32. Bundling Top Spokes

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).
9. 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 2-33](#). 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.

10. 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.

11. Straighten any spokes that were accidentally bumped or moved on the bottom flange.
12. Work with the bottom flange of outer spokes (short head) first.
13. See [Figure 2-34](#). 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 2-35](#). Once you have completed lacing the bottom row of outer spokes (short head) double check for three empty holes in between each spoke.

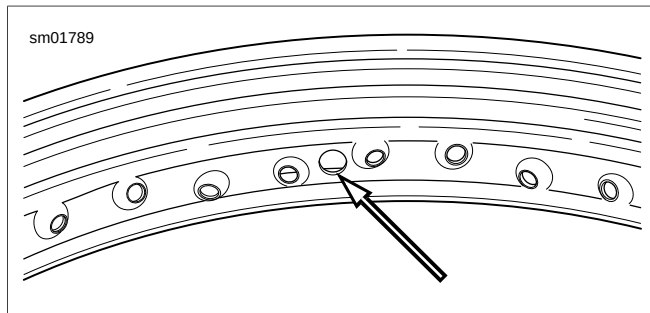


Figure 2-33. Valve Stem Hole Location

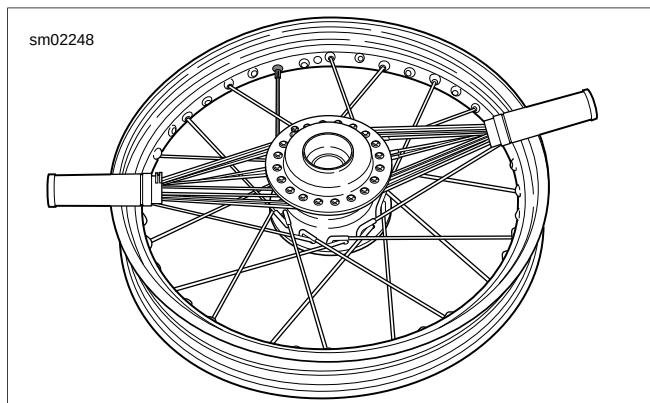


Figure 2-34. Beginning Spoke: Bottom Flange Outer

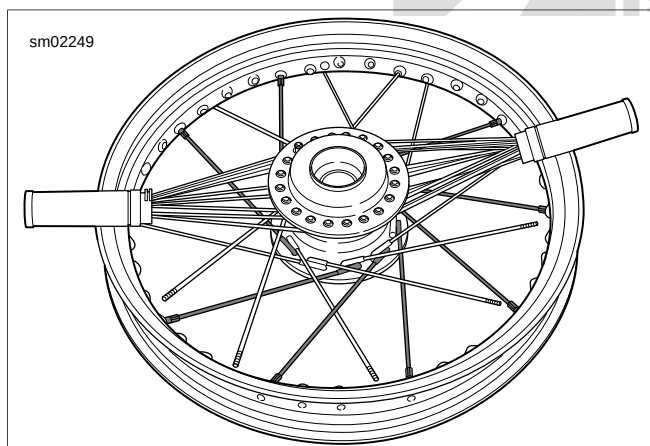


Figure 2-35. Completed Spokes: Bottom Flange Outer

14. Work with bottom flange inner spokes (long head) next. Choose a beginning spoke closest to the valve stem hole.
 - a. See [Figure 2-36](#). Each inner spoke (long head) crosses four outer spokes (short head).
 - b. See [Figure 2-37](#). 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).
15. See [Figure 2-38](#). Undo each top bundle and fan the spokes out (in a starburst pattern) around the top rim edge.

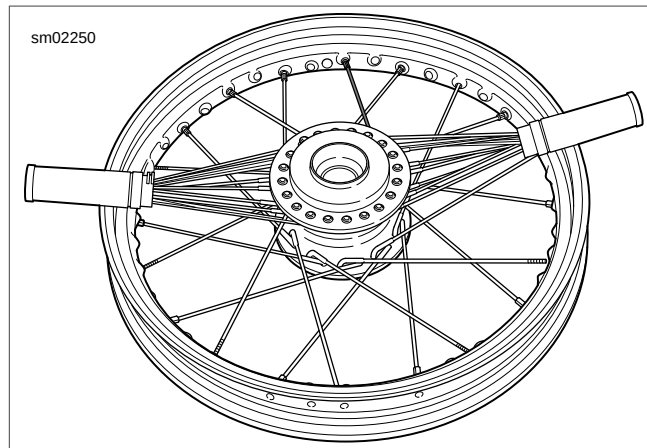


Figure 2-36. Beginning Spoke: Bottom Flange Inner

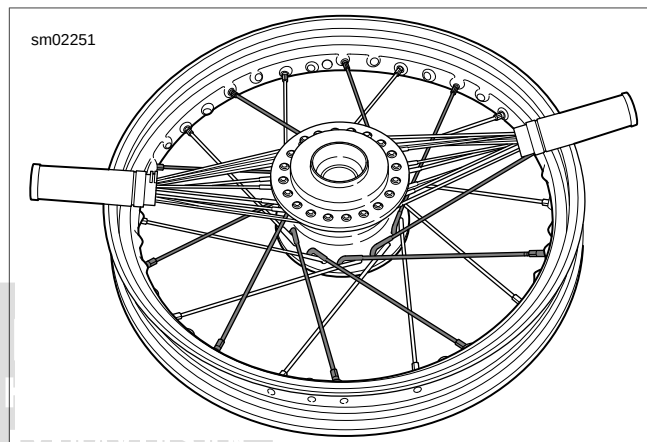


Figure 2-37. Completed Spokes: Bottom Flange Inner

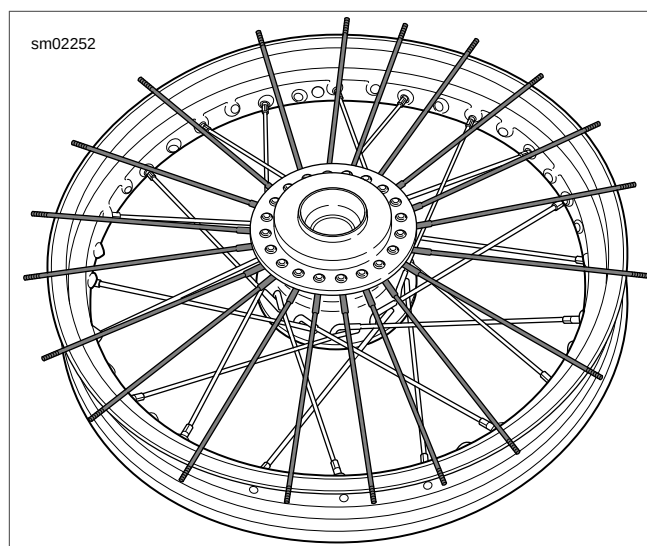


Figure 2-38. Fanning Top Flange Spokes

16. See [Figure 2-39](#). 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.

17. 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 2-40](#). Verify spoke reaches spoke nipple and secure spoke by hand. Follow pattern to complete top flange inner spokes (long head).
 - b. See [Figure 2-41](#). Once you have completed the top flange of inner spokes (long head) double check for one empty hole after every third spoke.

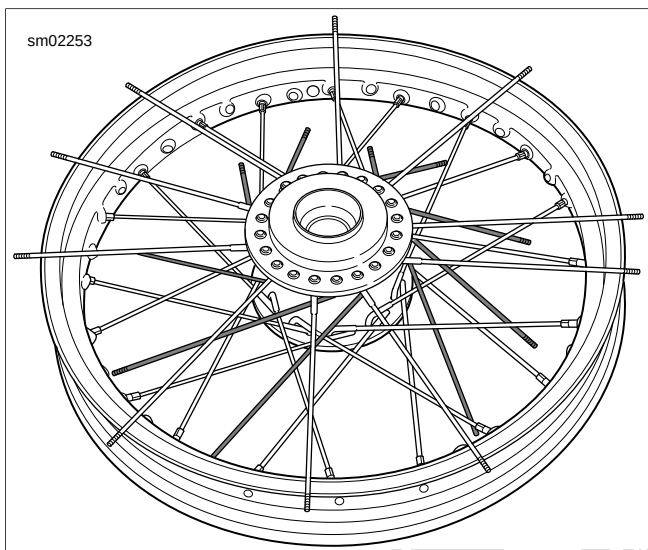


Figure 2-39. Setting Top Flange Inner Spokes

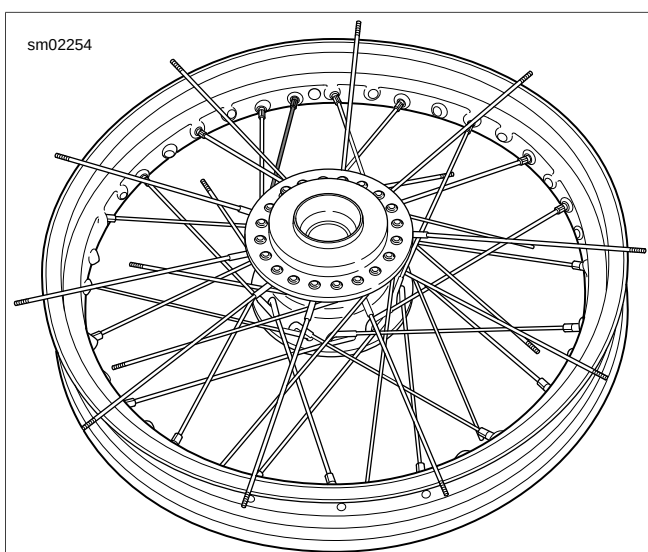


Figure 2-40. Beginning Spoke: Top Flange Inner

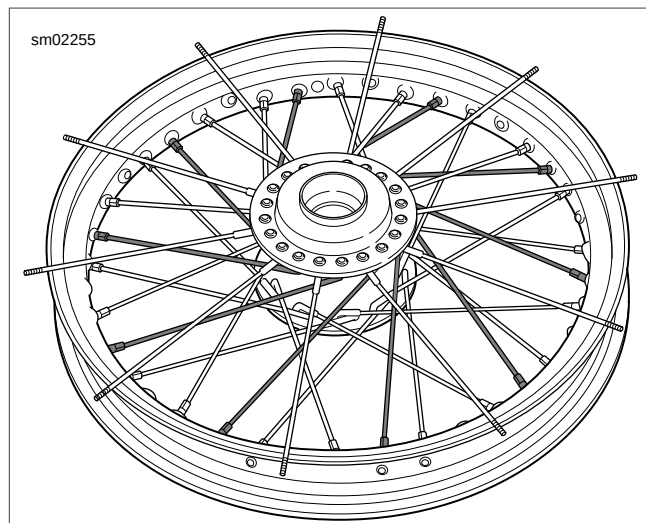


Figure 2-41. Completed Spokes: Top Flange Inner

18. See [Figure 2-42](#). 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.
19. See [Figure 2-43](#). Verify spoke reaches spoke nipple and secure spoke by hand. Follow pattern to complete top flange outer spokes (short head).
20. Tighten spoke nipples to specification listed in [Table 2-18](#).
21. True the wheel. See [2.8 TRUING LACED WHEELS](#).

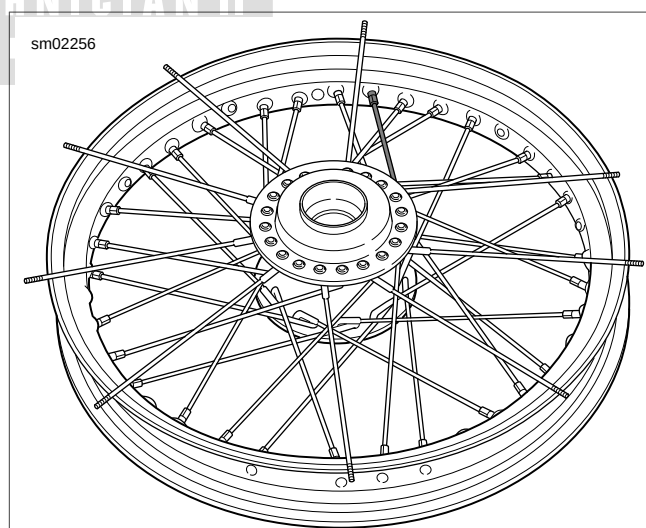


Figure 2-42. Beginning Spoke: Top Flange Outer

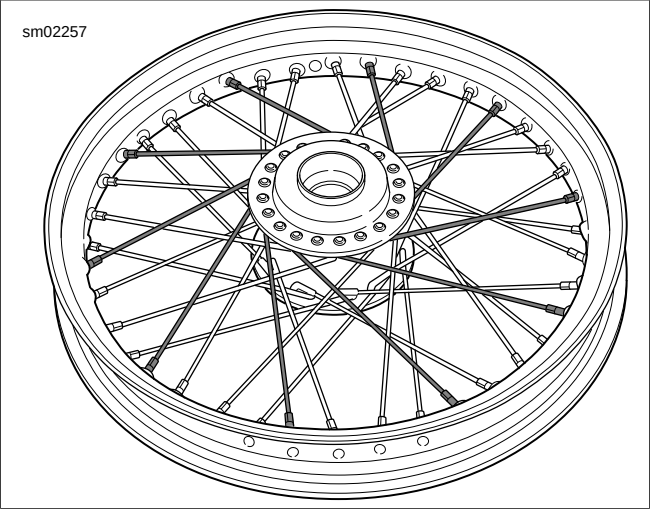


Figure 2-43. Completed Spokes: Top Flange Outer

Table 2-18. Spoke Nipple Torque Specification

RIM TYPE	MINIMUM TORQUE
All	55 in-lbs (6.2 Nm)



WHEEL LACING: 21 INCH RIM

2.7

GENERAL

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.

NOTE

Do not install incorrect spokes or spoke nipples on rim. Using incorrect spokes can result in improper thread engagement which could result in damage to rim, tubes or tire.

See [Figure 2-44](#). Measure distance "A" to determine spoke length. Refer to [Table 2-19](#) to determine correct spoke length for type of rim used.

Table 2-19. 21 Inch Rim Spoke Length

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

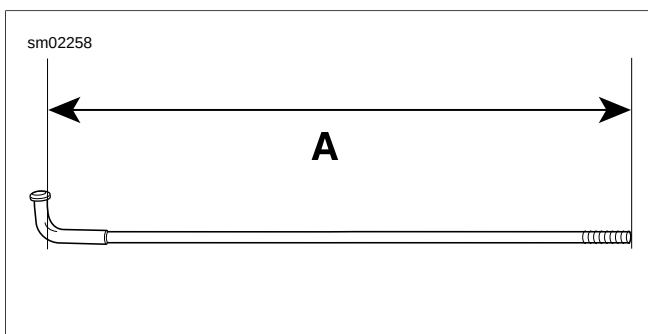


Figure 2-44. Measuring Spoke Length

PROCEDURE

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

NOTE

See [Figure 2-45](#). The spoke holes in the 21 inch wheel hub are staggered, alternating between inner holes (nearer hub center) and outer holes (nearer hub edge).

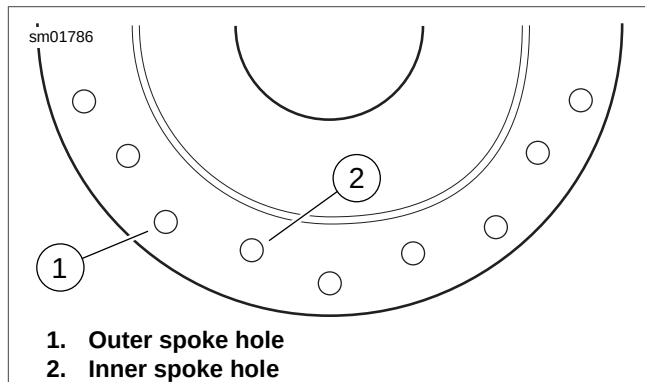


Figure 2-45. Spoke Hole Pattern

2. Lubricate spoke threads and nipple shoulders with tire mounting lubricant.
3. See [Figure 2-46](#). Place hub on bench with the brake disc side up. Insert one outer spoke (short-head) into an outer top flange hole and swing it counterclockwise. Insert an inner spoke (long-head) in the next hole to the right of the outer spoke. Swing the inner spoke clockwise under the outer spoke.
4. In the same way, insert all remaining spokes in brake-side flange alternating inner and outer spokes.
5. After brake-side flange is completed flip wheel hub over and repeat procedure on other flange.

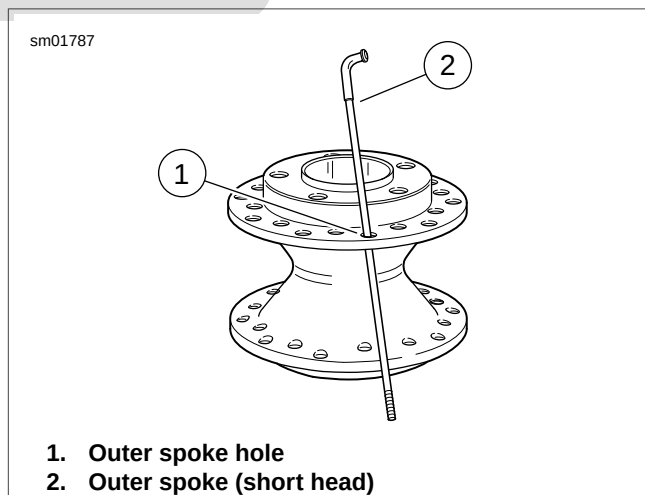


Figure 2-46. Lacing 21 Inch Wheel Hub

6. See [Figure 2-47](#). 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.

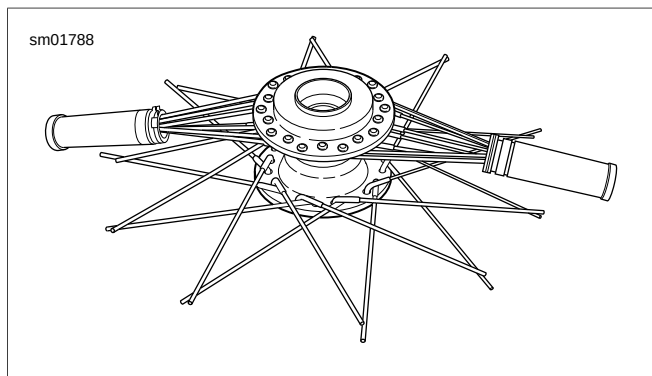


Figure 2-47. Bundling Top Spokes

7. Make sure all spokes on brake-side flange are still arranged properly and pointing in the right direction:
 - a. Swing all outer spokes (short-head) clockwise.
 - b. Swing the inner spokes (long-head) counterclockwise, crossing over the outer spokes (short-head).
 - c. Angle all spokes as far as they will go without overlapping the next LIKE spoke. For instance, swing an inner spoke (long-head) counterclockwise 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 2-48](#). The valve stem hole is centered on the rim; you do not have to worry about choosing the correct relationship between the rim and the hub.
8. Center the rim over the hub assembly.

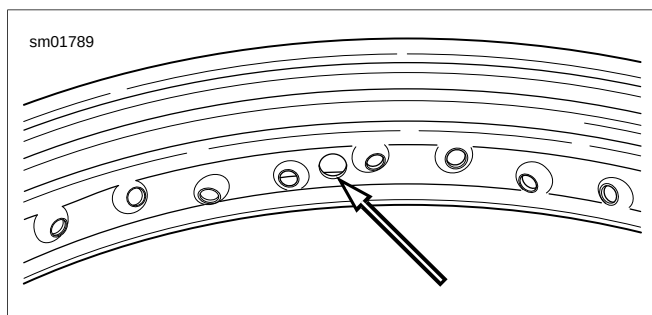


Figure 2-48. Valve Stem Hole Location

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.

9. Straighten any spokes that were accidentally bumped or moved on the bottom flange.
10. Work with the bottom flange of outer spokes (short-head) first. See [Figure 2-49](#). Using the spoke alignment method discussed previously, locate a spoke hole in the rim

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 2-50](#). Once you have completed lacing the bottom row of outer spokes (short-head) double check for three empty holes in between each spoke.

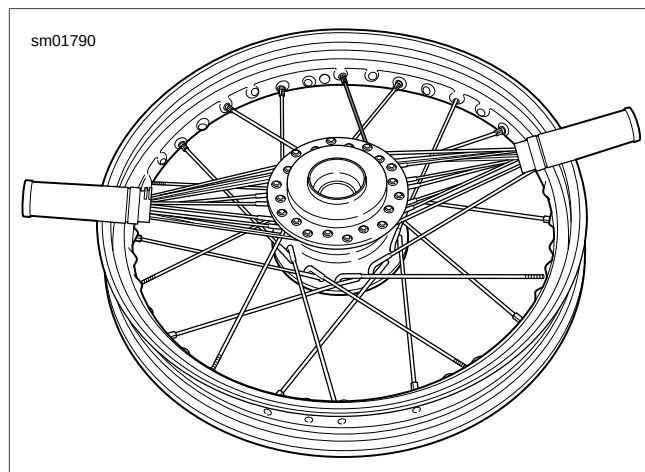


Figure 2-49. Beginning Spoke-Bottom Flange Outer

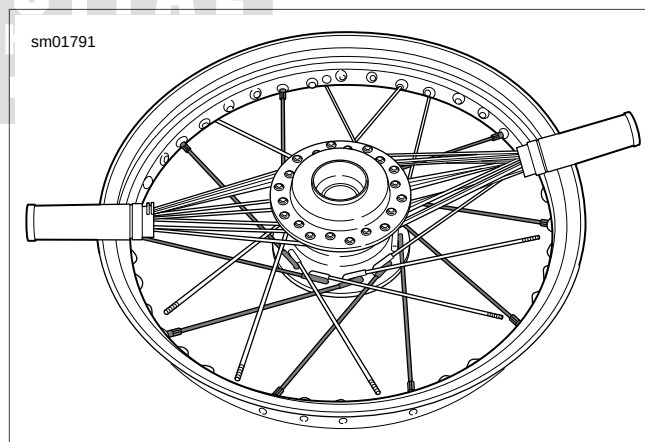


Figure 2-50. Completed Spokes-Bottom Flange Outer

11. Work with bottom flange inner spokes (long-head) next. Choose a beginning spoke closest to the valve stem hole.
 - a. See [Figure 2-51](#). Each inner spoke (long-head) crosses four outer spokes (short-head).
 - b. See [Figure 2-52](#). 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).

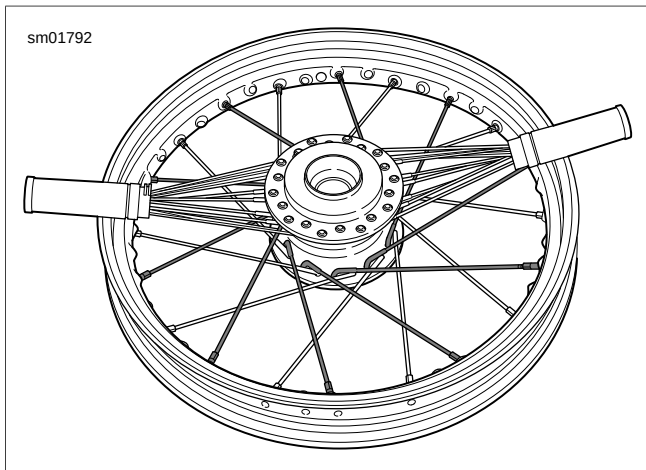


Figure 2-51. Beginning Spoke-Bottom Flange Inner

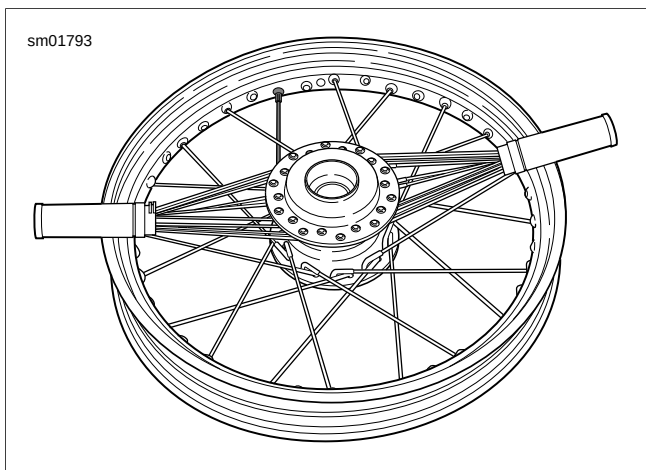


Figure 2-52. Completed Spokes-Bottom Flange Inner

12. See [Figure 2-53](#). Undo each top bundle and fan the spokes out (in a starburst pattern) around the top rim edge.

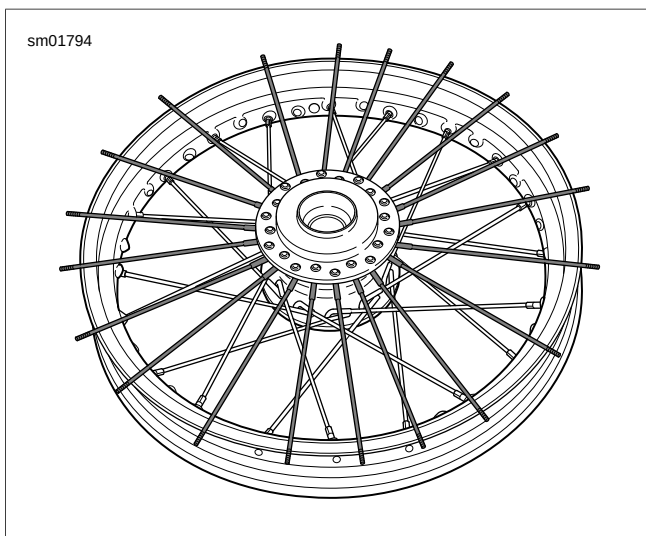


Figure 2-53. Fanning Top Flange Spokes

13. See [Figure 2-54](#). 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.

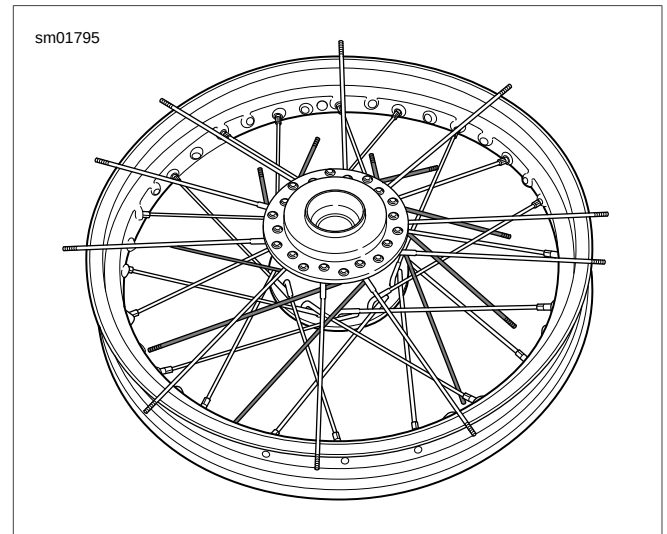


Figure 2-54. Setting Top Flange Inner Spokes

14. 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.
- See [Figure 2-55](#). Verify spoke reaches spoke nipple and secure spoke by hand. Follow pattern to complete top flange inner spokes (long-head).
 - See [Figure 2-56](#). Once you have completed the top flange of inner spokes (long-head) double check for one empty hole after every third spoke.

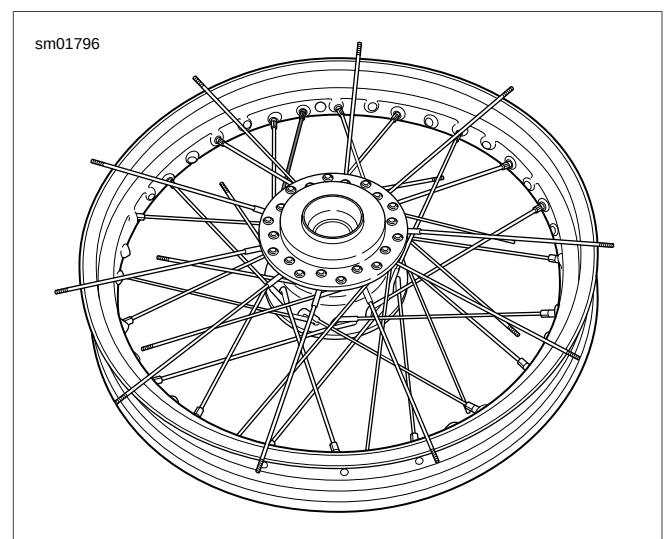


Figure 2-55. Beginning Spoke-Top Flange Inner

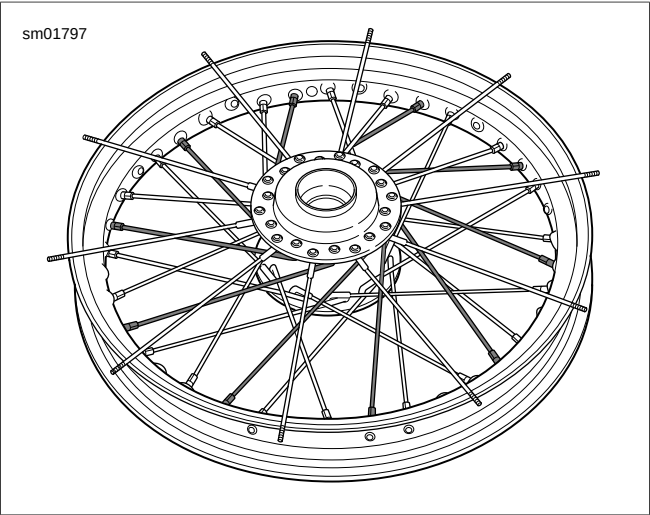


Figure 2-56. Completed Spokes-Top Flange Inner

15. See [Figure 2-55](#). 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.

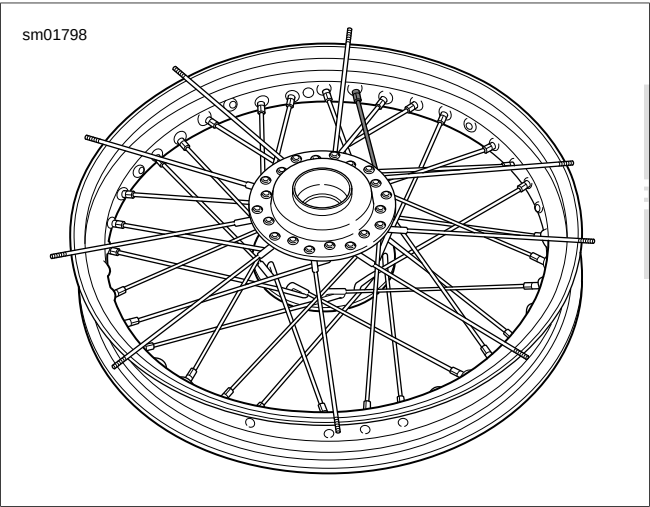


Figure 2-57. Beginning Spoke-Top Flange Outer

16. See [Figure 2-58](#). Verify spoke reaches spoke nipple and secure spoke by hand. Follow pattern to complete top flange outer spokes (short-head).

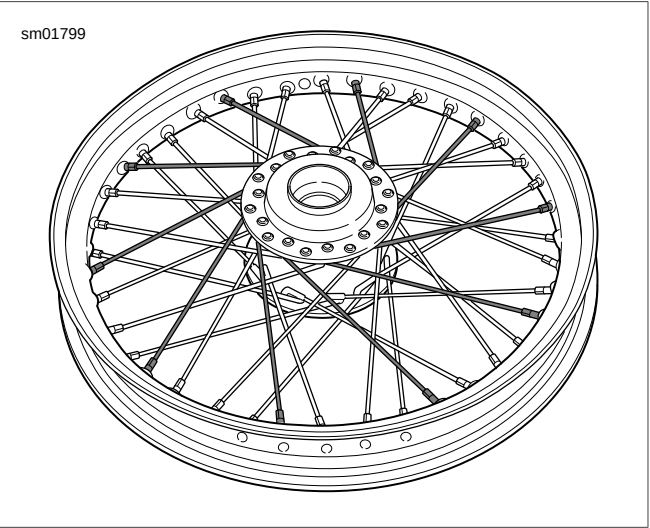


Figure 2-58. Completed Spokes-Top Flange Outer

17. Verify that all outer (short head) spokes on top flange point counterclockwise, and all outer spokes on bottom flange point clockwise. Verify that all inner (long head) spokes on top flange point clockwise, and all inner spokes on bottom flange point counterclockwise.
18. Tighten spoke nipples to specification listed in [Table 2-20](#).
19. True the wheel. See [2.8 TRUING LACED WHEELS](#).

Table 2-20. Spoke Nipple Torque Specification

RIM TYPE	MINIMUM TORQUE
All	55 in-lbs (6.2 Nm)

TRUING LACED WHEELS

2.8

GENERAL

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

LATERAL TRUING

PART NUMBER	TOOL NAME
HD-94681-80	SPOKE WRENCH
HD-99500-80	WHEEL TRUING STAND

1. See [Figure 2-59](#). 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.

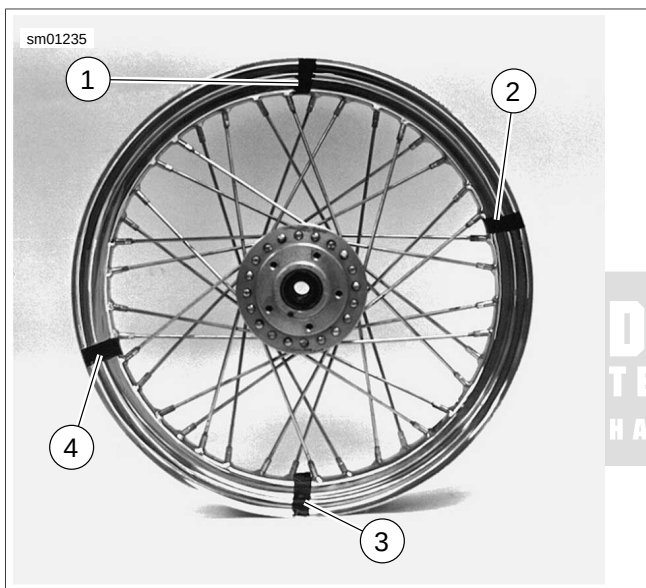


Figure 2-59. Marking Spoke Groups

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.

NOTE

16 inch (rear) and 21 inch (front) chrome aluminum profile laced wheels are optional for XL 883C and XL 1200C models. The offset measurement for positioning the profile wheel is shown in [Figure 2-60](#).

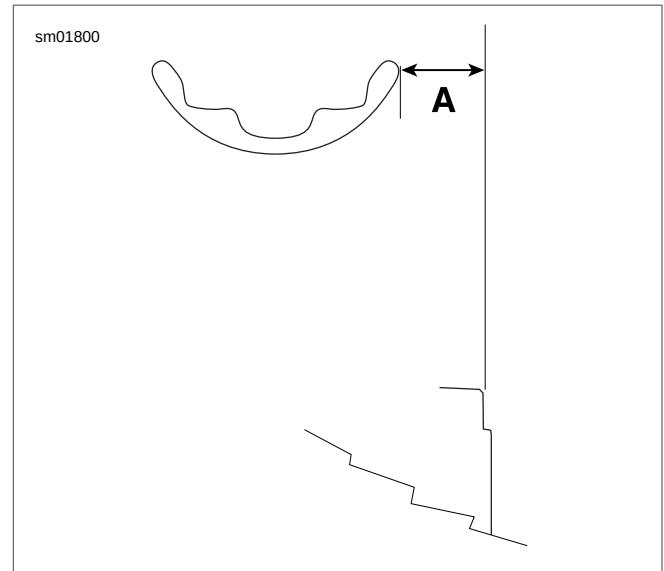


Figure 2-60. Positioning Chrome Aluminum Profile Laced Wheel Hub

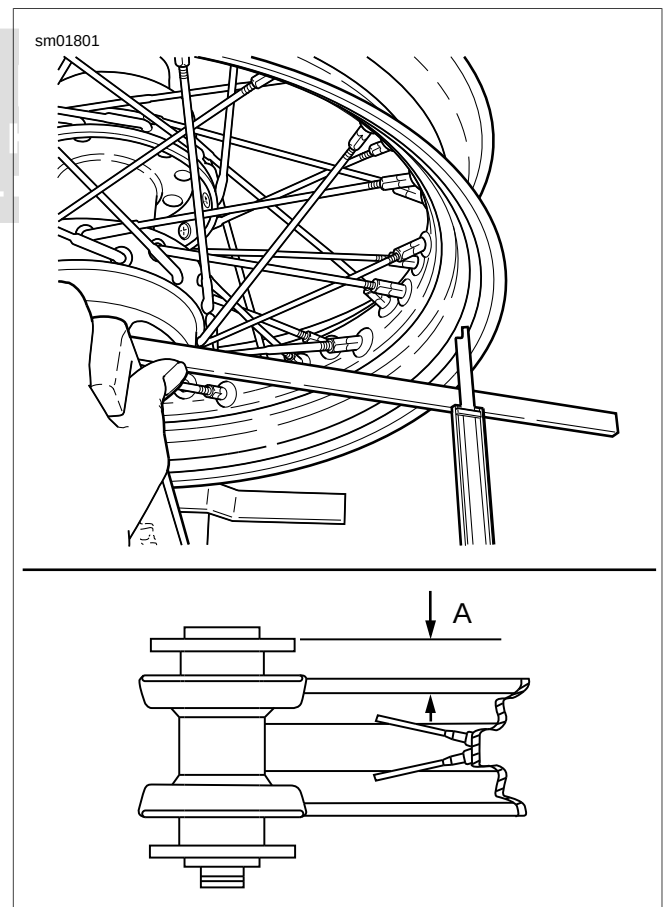


Figure 2-61. Positioning 16 Inch Wheel Hub

4. See [Figure 2-61](#). See [Figure 2-62](#). Refer to [Table 2-21](#). The hub must be positioned correctly with the rim. Lay a straightedge across the primary hub brake disc mounting face and the rim. Measure the distance from the straightedge to the rim as shown. If this dimension does not match the dimension listed in the table, loosen and tighten the four spokes accordingly. Use SPOKE WRENCH (Part No. HD-94681-80).

NOTE

See [Figure 2-61](#). See [Figure 2-62](#). Refer to [Table 2-21](#). Dimension "A" must be maintained to ensure centering of wheel on motorcycle.

EXAMPLE

If dimension A on the left side is not correct, 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.

NOTE

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

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

Table 2-21. Hub Positioning Dimensions

RIM		DIMENSION A VALUE	
TYPE	SIZE	IN.	MM
Steel laced	16 in.	1.472-1.492	37.39-37.90
	19 in.	0.837-0.857	21.26-21.77
	21 in.	0.719-0.739	18.26-18.77
Chrome aluminum profile laced	16 in.	1.188-1.207	30.17-30.67
	21 in.	0.749-0.769	19.03-19.53

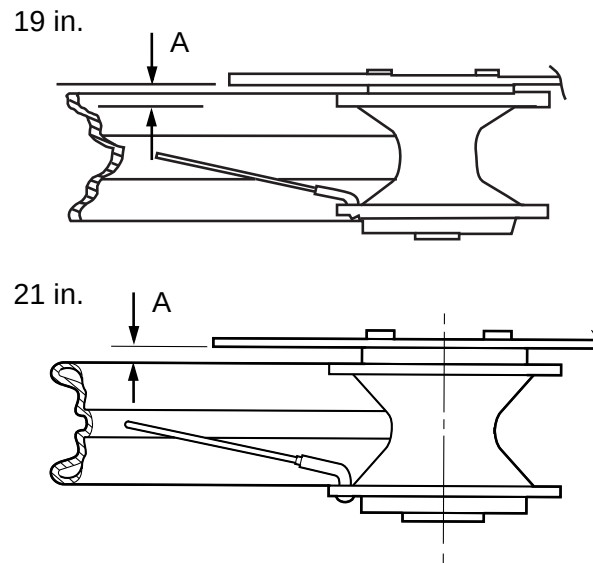


Figure 2-62. Centering 19 Inch and 21 Inch Hub

RADIAL TRUING

1. See [Figure 2-63](#). Adjust truing stand gauge to the rim's tire bead seat as shown. The rim should be trued within 0.030 in. (0.76 mm).

NOTES

- Tighten or loosen spoke one flat at a time and recheck measurement.
- Always loosen the appropriate spokes before tightening the other two. Reversing this procedure will cause the rim to become out-of-round.

2. Spin the rim slowly.
 - a. 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.
 - b. 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.
3. When the wheel is centered and trued, start at the valve hole and tighten the rest of the spoke nipples one turn at a time until they are snug.
4. Seat each spoke head in the hub flange using a flat nose punch and mallet. Then check wheel trueness again and tighten the nipples accordingly.

⚠ WARNING

Spokes that are too tight can draw nipples through the rim or distort hub flanges. Spokes that are too loose can continue to loosen when put in service. Either condition can adversely affect stability and handling, which could result in death or serious injury. (00286a)

5. Verify spokes are tightened to specification listed in [Table 2-22](#).
6. File or grind off ends of spokes protruding through nipples to prevent puncturing tube when tire is mounted.

NOTE

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

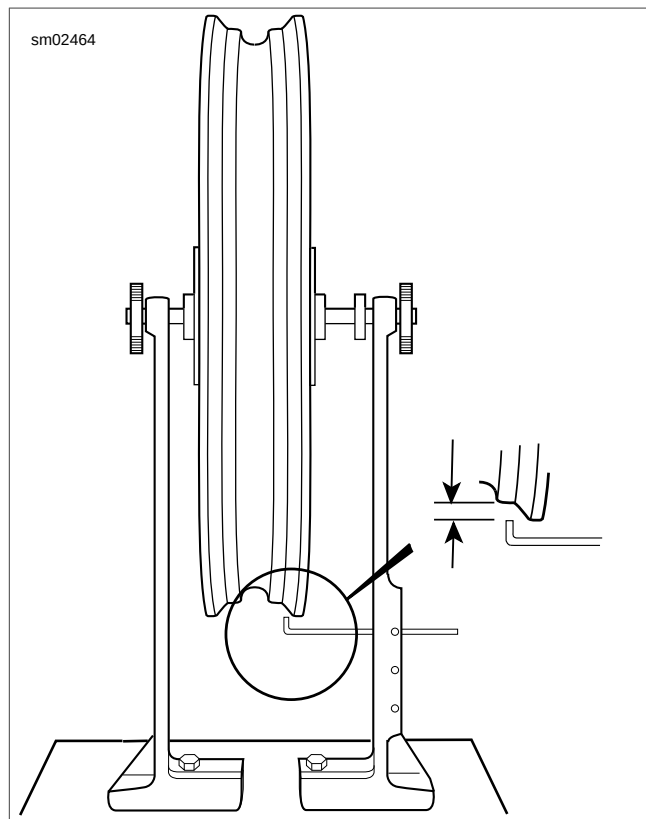


Figure 2-63. Truing Rim Radially

Table 2-22. Spoke Nipple Torque Specification

RIM TYPE	MINIMUM TORQUE
All	55 in-lbs (6.2 Nm)

CHECKING CAST WHEEL RUNOUT

2.9

GENERAL

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

LATERAL RUNOUT

See [Figure 2-64](#). Install arbor in the wheel hub and place wheel in the truing stand. To check rim lateral runout, place a gauge rod or dial indicator near the rim bead. If lateral runout exceeds 0.030 in. (0.76 mm), replace the wheel.

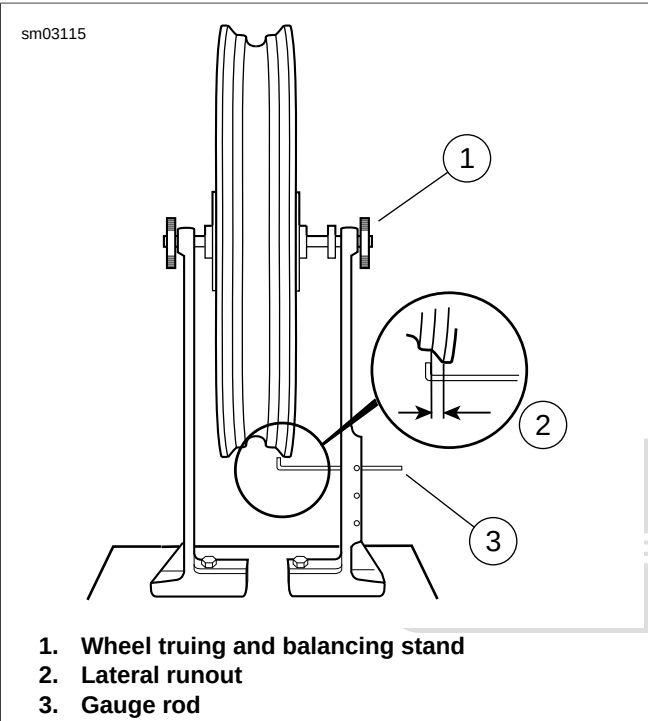


Figure 2-64. Checking Cast Wheel Lateral Runout

RADIAL RUNOUT

PART NUMBER	TOOL NAME
HD-99500-80	WHEEL TRUING AND BALANCING STAND

See [Figure 2-65](#). Using WHEEL TRUING AND BALANCING STAND (Part No. HD-99500-80), check for radial runout as shown. Replace the wheel if runout exceeds 0.030 in. (0.76 mm).

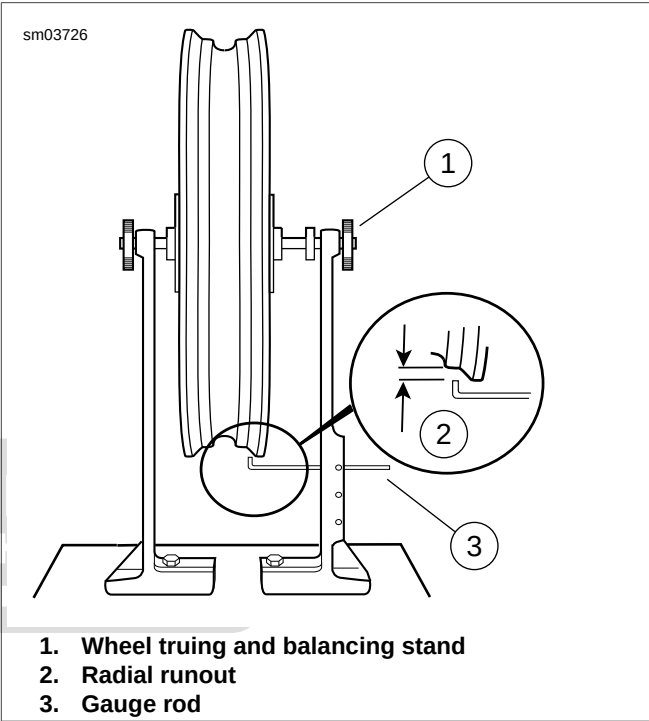


Figure 2-65. Checking Cast Wheel Radial Runout

FRONT BRAKE MASTER CYLINDER

2.10

GENERAL

The front brake master cylinder designed for dual disc (two caliper) operation has a larger bore than the master cylinder designed for single disc (one caliper) operation.

See [Figure 2-66](#). The bore size is cast into the side of the master cylinder body facing the handlebar.

- The single disc master cylinder has "11" (11 mm) cast into the body.
- The dual disc master cylinder has "1/2" (1/2 in.) cast in.

WARNING

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

CAUTION

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

NOTE

If D.O.T. 4 brake fluid contacts painted surfaces, IMMEDIATELY flush area with clear water.

INSPECTION

1. Check the level of fluid in the front brake reservoir. If it is low, refill and bleed brake system. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#).
2. Check for fluid leaks in the brake line, around banjo fittings or front brake caliper pistons or bleeder valve. Repair and bleed brake system.
 - a. For brake line replacement procedure, see [2.18 BRAKE LINES](#).
 - b. To repair front brake caliper, see procedure in [2.11 FRONT BRAKE CALIPER: XL MODELS](#) or [2.12 FRONT BRAKE CALIPER: XR MODELS](#).
 - c. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#) for hydraulic brake system bleeding procedure.
3. Check front brake friction pads and disc(s) for excessive wear or damage. Replace worn or damaged items.
 - a. See [1.9 BRAKE PADS AND DISCS: XL MODELS](#) or [1.10 BRAKE PADS AND DISCS: XR MODELS](#) for specifications and brake pad replacement procedure.
 - b. See [2.4 WHEELS](#) for brake disc replacement procedure.

4. Eliminate any air in the hydraulic brake assembly by bleeding the system. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#).

If none of these conditions exist but the front brake system does not operate properly, the front brake master cylinder is most likely defective and must be repaired or replaced.

REMOVAL

1. See [Figure 2-67](#). Loosen turn signal clamp screw (3) and remove turn signal assembly (5) from front brake master cylinder housing (1).
2. Loosen and remove lock nut and washer (4), and lift mirror (2) from master cylinder housing.

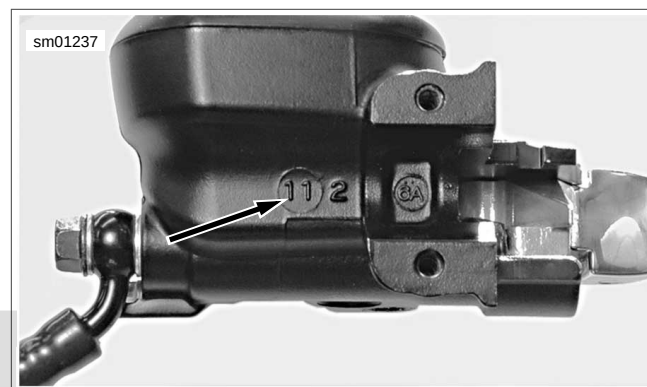


Figure 2-66. Verifying Front Brake Master Cylinder Bore Size (Single Disc Master Cylinder Shown)

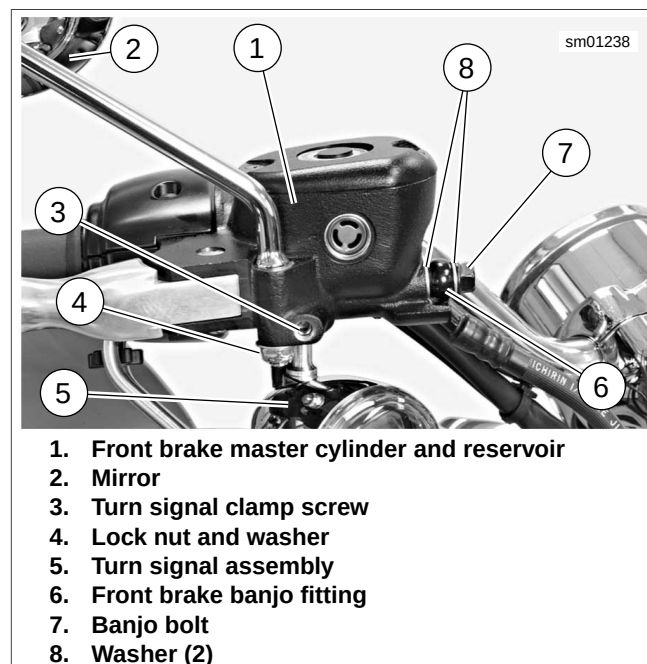
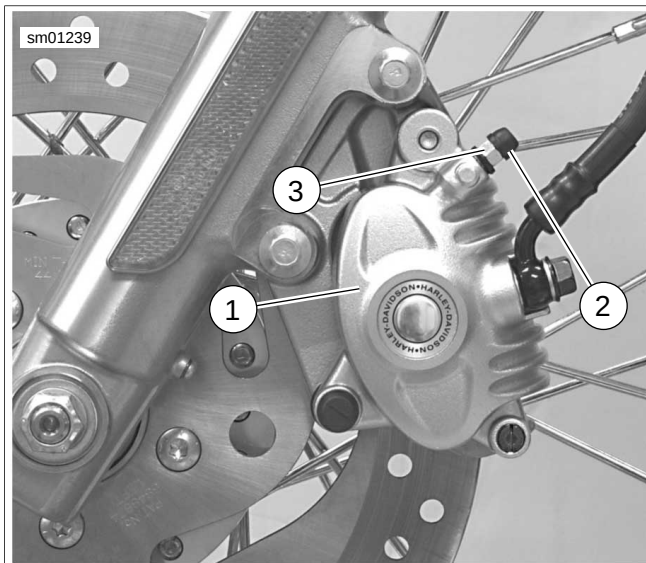


Figure 2-67. Front Brake Master Cylinder (typical: XL model shown)

CAUTION

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

3. See [Figure 2-68](#). See [Figure 2-69](#). Remove bleeder nipple cap (2) from bleeder valve (3) on front brake caliper (1). Install end of a length of 5/16 in. (7.9 mm) I.D. clear plastic tubing over caliper bleeder valve (3), while placing free end in a suitable container. Open bleeder valve about 1/2 turn. Pump brake hand lever several times to drain brake fluid. Close bleeder valve.



1. Front brake caliper
2. Bleeder nipple cap
3. Bleeder valve

Figure 2-68. Front Caliper Bleeder Valve (typical; XL shown)

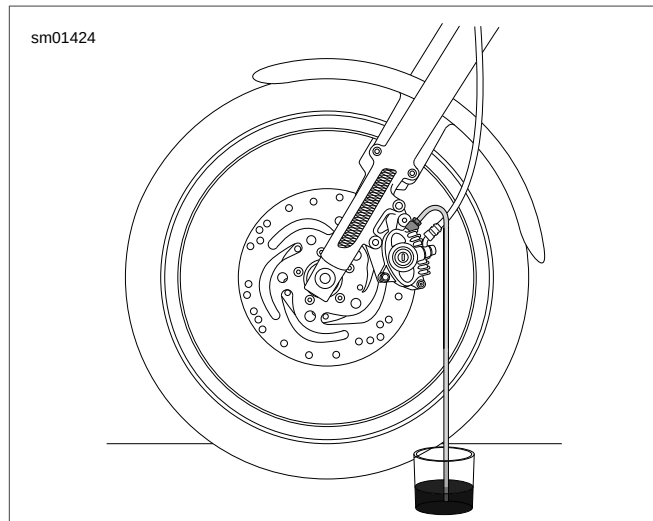


Figure 2-69. Bleeding Hydraulic System (typical; XL model shown)

4. See [Figure 2-67](#). Remove banjo bolt (7) and two washers (8) to disconnect hydraulic brake line banjo fitting (6) from master cylinder (1). Discard washers.
5. See [Figure 2-70](#). Squeeze front brake lever and place a 5/32 in. (4 mm) thick cardboard insert between brake lever and lever bracket. Release brake lever.

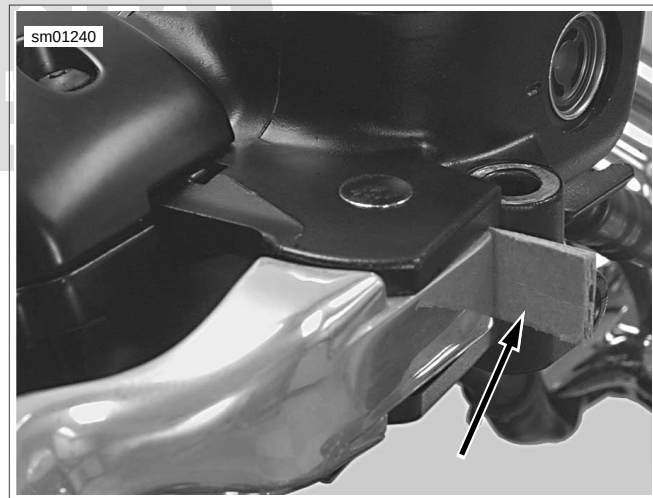


Figure 2-70. Install Cardboard Insert Before Removing Master Cylinder Assembly

CAUTION

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

NOTE

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

6. See [Figure 2-71](#). Using a T-27 TORX drive head, remove the two screws (6) and washers (7) securing the handlebar clamp (8) to the master cylinder housing (5). Remove the brake lever/master cylinder assembly and clamp from the handlebar.

DISASSEMBLY

WARNING

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

NOTE

Use correct retaining ring pliers and correct tips. Verify that tips are not excessively worn or damaged.

1. See [Figure 2-71](#). Remove retaining ring (17) from pivot pin (9) groove at bottom of master cylinder bracket. Discard retaining ring.
2. Remove pivot pin and brake hand lever (18) from master cylinder assembly.
3. Remove and discard dust boot (16).

NOTE

See [Figure 2-72](#). Clamp front brake master cylinder in a vise by the mirror mounting boss only. Use brass or aluminum jaw covers or other protective device on vise jaws to prevent damage to master cylinder.

4. See [Figure 2-72](#). Clamp master cylinder in a vise so that banjo fitting hole is pointing straight down.

WARNING

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

NOTE

Use correct retaining ring pliers and correct tips. Verify that tips are not excessively worn or damaged.

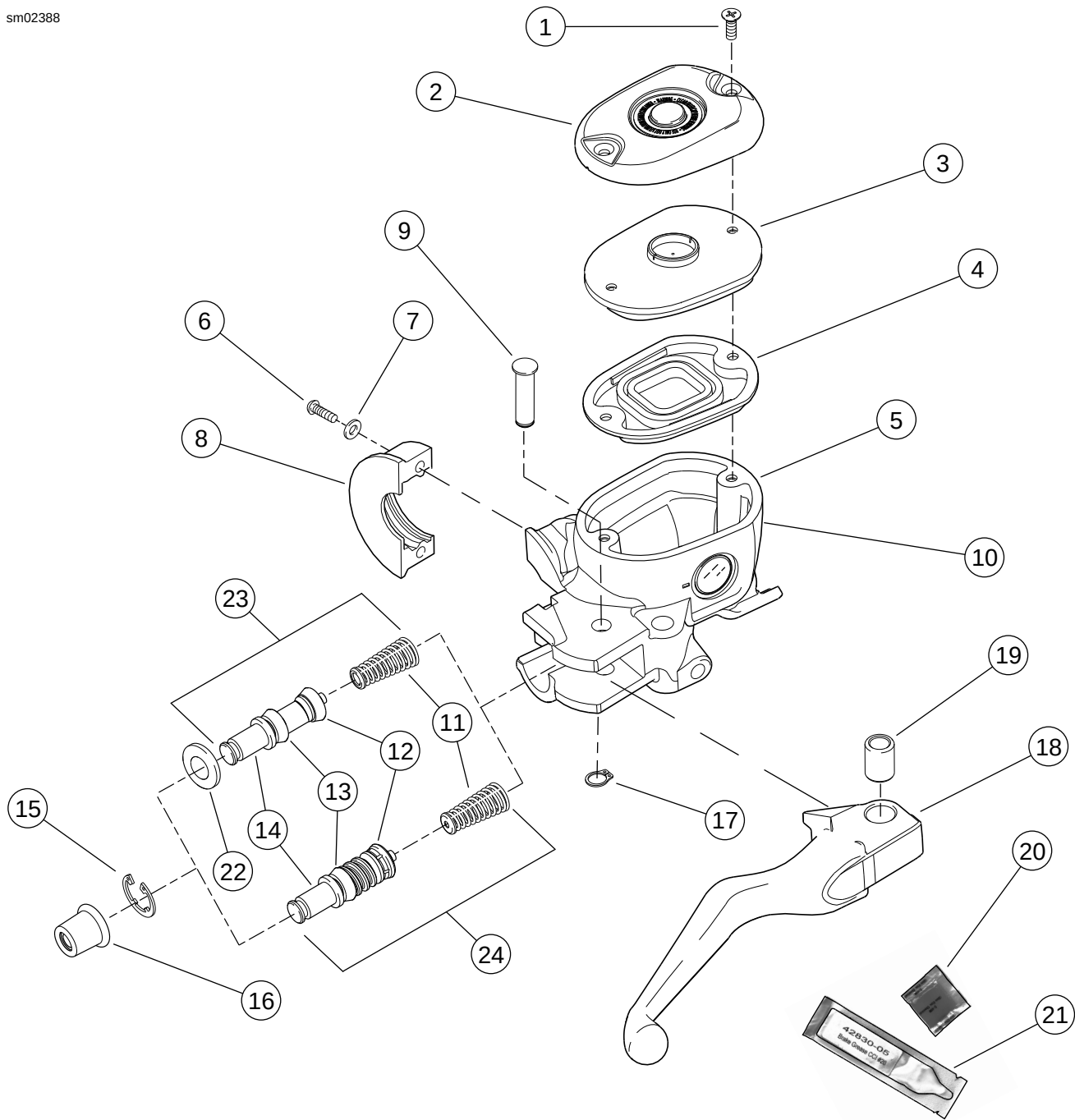
5. See [Figure 2-71](#). Press down on end of piston and remove retaining ring (15). Discard retaining ring.
6. **Single disc piston assembly:** remove stop plate (22).
7. Remove and discard piston assembly (12, 13, 14) and piston spring (11).

NOTES

- See [Figure 2-71](#). Both primary (12) and secondary (13) cups are fitted into grooves in the piston body (14). The piston spring (11) fits onto the end of the piston.
 - To prevent dirt and other contaminants from entering the master cylinder reservoir, thoroughly clean the cover before removal
8. Remove two screws (1), cover (2), diaphragm plate (3) and diaphragm (4) from the master cylinder reservoir.



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- | | |
|--|---|
| 1. Screw (2) | 13. Secondary cup* |
| 2. Reservoir cover | 14. Piston* |
| 3. Diaphragm plate | 15. Retaining ring* |
| 4. Diaphragm | 16. Dust boot* |
| 5. Master cylinder housing | 17. Retaining ring |
| 6. Screw (2) | 18. Brake hand lever |
| 7. Washer (2) | 19. Bushing |
| 8. Handlebar clamp | 20. G40M brake grease* |
| 9. Pivot pin | 21. CCI #20 brake grease* |
| 10. Brake line banjo fitting seating surface | 22. Stop plate (single disc piston only)* |
| 11. Spring* | 23. Single disc piston assembly |
| 12. Primary cup* | 24. Dual disc piston assembly |

Figure 2-71. Front Brake Master Cylinder Assembly (*Provided in Service Parts Kit)

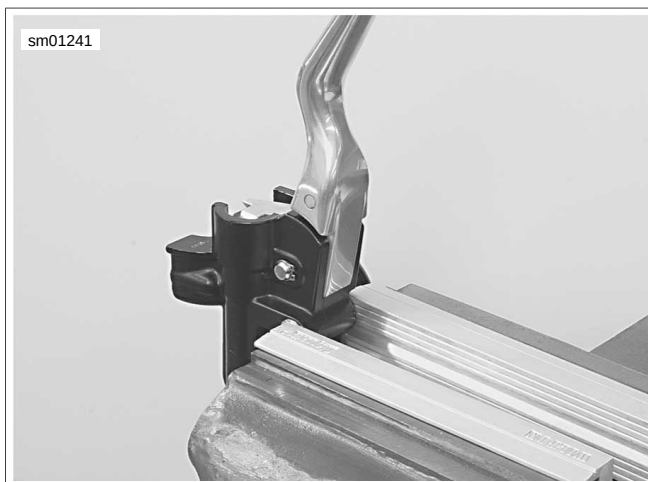


Figure 2-72. Clamping Front Master Cylinder

CLEANING, INSPECTION AND REPAIR

⚠ WARNING

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

1. Clean all brake system components with denatured alcohol. Do not contaminate with mineral oil or other solvents. Wipe dry with a clean, lint free cloth. Blow out drilled passages and piston bore with low pressure compressed air from a clean air supply. Do not use a wire or similar instrument to clean drilled passages in bottom of reservoir.

⚠ WARNING

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

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

ASSEMBLY

⚠ WARNING

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

NOTES

- Always reassemble the master cylinder using new parts from the correct service repair kit.
 - CCI #20 BRAKE GREASE is recommended for lubrication of cylinder bore, cups and seals prior to assembly.
 - See [Figure 2-72](#). Clamp front brake master cylinder in a vise by the mirror mounting boss only. Use brass or aluminum jaw covers or other protective device on vise jaws to prevent damage to master cylinder.
1. See [Figure 2-72](#). Clamp master cylinder in a vise so that banjo fitting hole is pointing straight down.
 2. See [Figure 2-71](#). Coat piston bore of master cylinder housing (5), piston (14), primary cup (12) and secondary cup (13) with CCI #20 BRAKE GREASE (21) supplied in the service parts kit.
 3. See [Figure 2-73](#). Install piston assembly into master cylinder.
 - a. Press small end of piston spring (4) onto mounting boss (6) on piston (1).
 - b. Slide piston/spring assembly, flared end of spring first, into master cylinder bore so that spring seats against counter bore (recess) at bottom of cylinder.
 - c. **Single disc piston:** Slide stop plate (7) down over end of piston.

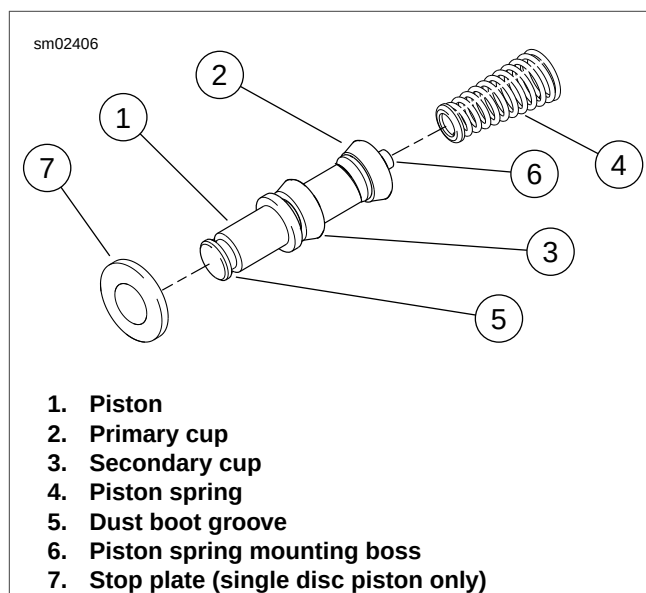


Figure 2-73. Front Brake Master Cylinder Piston (Typical-Single Disc Piston Shown)

⚠ WARNING

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

NOTE

Use correct retaining ring pliers and correct tips. Verify that tips are not excessively worn or damaged.

4. See [Figure 2-71](#).
 - a. **Dual disc master cylinder:** Press down on piston (14) and install **new** retaining ring (15). Verify that retaining ring is fully seated in groove.
 - b. **Single disc master cylinder:** Press down on piston (14) and stop plate (22), and install **new** retaining ring (15). Verify that retaining ring is fully seated in groove.
5. Install **new** dust boot (16). Large lip of dust boot fits down inside end of piston bore. Small lip of dust boot fits into groove in end of piston (item 5, [Figure 2-73](#)).
6. Apply approximately 0.1 g G40M BRAKE GREASE (from service parts kit) to each of the following two locations:
 - a. Pivot hole in brake hand lever (18).
 - b. End of piston (14).
7. Align hole in brake hand lever with hole in master cylinder bracket. From top of assembly, slide pivot pin (9) through bracket and hand lever.

⚠ WARNING

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

NOTE

Use correct retaining ring pliers and correct tips. Verify that tips are not excessively worn or damaged.

8. Install **new** retaining ring (17) in pivot pin groove. Verify that retaining ring is fully seated in groove.
9. Remove master cylinder assembly from vise. Install cover (2), diaphragm plate (3) and diaphragm (4) on master cylinder reservoir. Install two screws (1) to fasten cover to reservoir, but do not tighten at this time.
10. See [Figure 2-74](#). Squeeze front brake lever and place a 5/32 in. (4 mm) thick cardboard insert between brake lever and lever bracket. Release brake lever.



Figure 2-74. Install 5/32 in. (4 mm) Cardboard Insert Before Installing Master Cylinder Assembly

INSTALLATION

CAUTION

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

1. See [Figure 2-75](#). Position brake lever/master cylinder assembly inboard of switch housing assembly (1) engaging tab (5) on lower switch housing in slot (4) at top of brake lever bracket (3).
2. See [Figure 2-71](#). Align holes in handlebar clamp (8) with those in master cylinder housing (5) and start two screws (6) with washers (7). Beginning with top screw, tighten screws to 108-132 **in-lbs** (12.2-14.9 Nm) using a T27 TORX drive head.

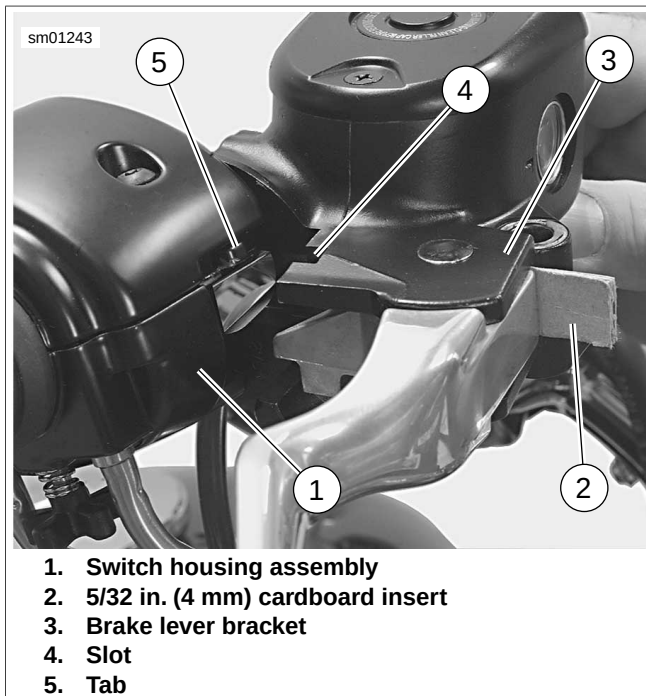


Figure 2-75. Fitting Brake Lever/Master Cylinder To Right Handlebar Switch Housing

CAUTION

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

NOTE

Master cylinder housings have various positive stops for banjo fittings, based on the model being repaired. The front brake systems as used on XR models and XL models employ different master cylinder housings as shown in [Figure 2-76](#). Never intermix system components. When tightening the banjo fitting in the next step, ensure the banjo fitting is properly oriented and contacts the positive stop.

3. See [Figure 2-77](#). Position a **new** washer (8) on each side of hydraulic brake line banjo fitting (6). Insert banjo bolt (7) through washers and fitting. Thread bolt into master cylinder housing. Tighten to 20-25 ft-lbs (27.1-33.9 Nm).

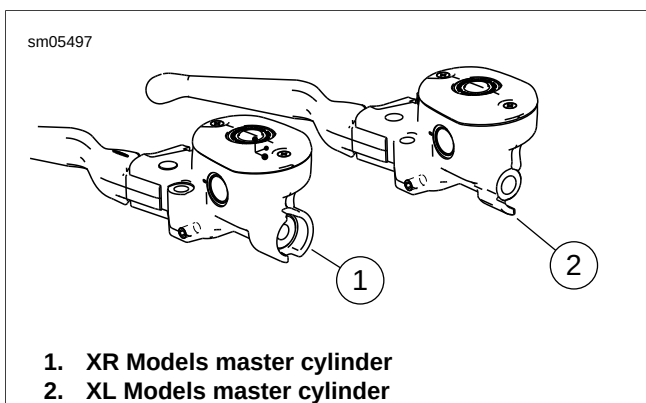


Figure 2-76. Front Brake Master Cylinder Identification

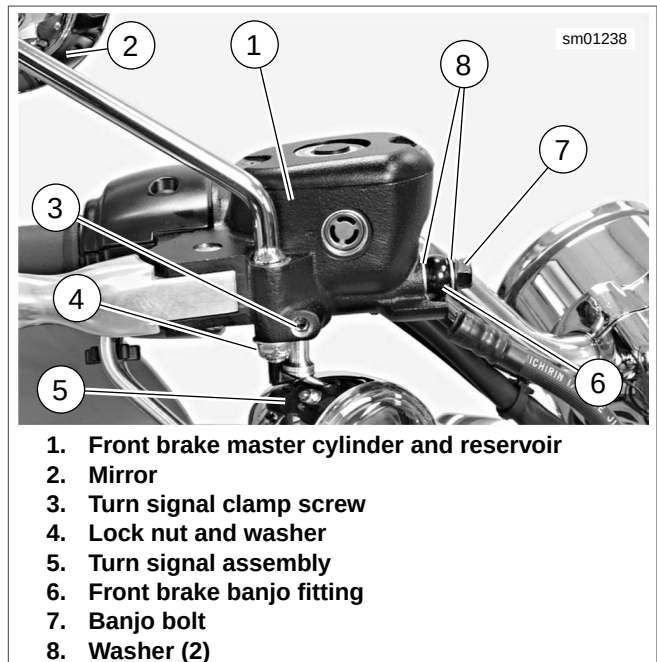


Figure 2-77. Front Brake Master Cylinder (typical: XL model shown)

4. Position motorcycle so that top of master cylinder reservoir is level. See [Figure 2-71](#). Remove two screws (1), front master cylinder reservoir cover (2), diaphragm plate (3) and diaphragm (4).

CAUTION

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

CAUTION

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

NOTES

- If D.O.T. 4 brake fluid contacts painted surfaces, IMMEDIATELY flush area with clear water.
- Cover handlebar switches with a shop towel before adding brake fluid to front master cylinder reservoir. Spilling brake fluid on handlebar switches may render them inoperative.
- See [Figure 2-78](#). Do not use sight glass (2) to determine maximum fluid level. Sight glass should only be used as a visual indicator that fluid level is low and needs attention.

A ridge (1) is cast into the inside of the reservoir to assist you in determining the correct maximum fluid level.

- Fill master cylinder only with HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID from a sealed container.
 - Do not overfill reservoir. Do not reuse old brake fluid.
5. See [Figure 2-78](#). Add enough HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID to reservoir to bring fluid level even with ridge (1) cast into inside of reservoir, about 1/4 in. (6.35 mm) below top edge.



Figure 2-78. Filling Front Master Cylinder Reservoir

⚠ WARNING

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

6. Verify proper operation of master cylinder relief port. Slowly actuate brake hand lever with reservoir cover removed. A slight spurt of fluid will break fluid surface in reservoir compartment if all internal components are working properly.
7. See [Figure 2-79](#). Install length of 5/16 in. (7.9 mm) I.D. clear plastic tubing over front brake caliper bleeder valve (3). Place free end of tube in a clean container.

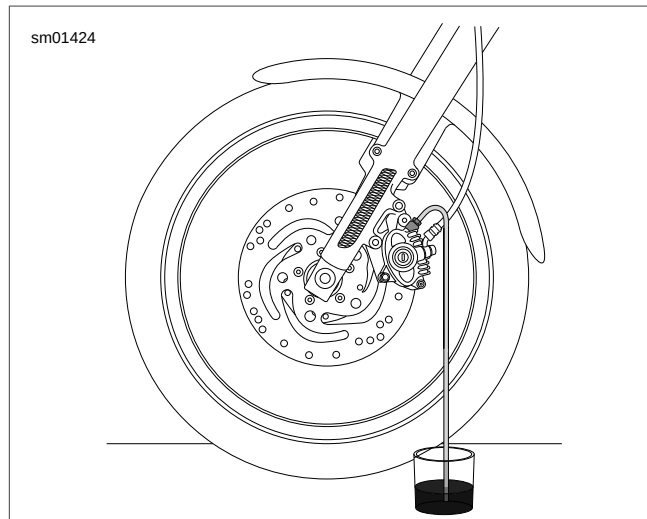


Figure 2-79. Bleeding Hydraulic System (typical; XL model shown)

8. See [Figure 2-78](#). Add enough HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID to reservoir to bring fluid level even with ridge cast into inside of reservoir, about 1/4 in. (6.35 mm) below top edge.
9. Depress and hold brake hand lever to build up hydraulic pressure.
10. Open front caliper bleeder valve about 1/2-turn. Brake fluid will flow from bleeder valve through tubing. Close bleeder valve when brake hand lever has moved approximately 1/2 to 3/4 of its full range of travel. Allow brake hand lever to return slowly to its released position.
11. Repeat three previous steps until all air bubbles are purged.
12. Final tighten bleeder valve to 35-61 **in-lbs** (4.0-6.9 Nm). Install bleeder nipple cap.

NOTE

On models with two front brake calipers, repeat steps 7-12 on second caliper.

13. See [Figure 2-78](#). Add enough HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID to reservoir to bring fluid level even with ridge (1) cast into inside of reservoir, about 1/4 in. (6.35 mm) below top edge.
14. See [Figure 2-71](#). Note that angular shape of master cylinder cover (2) makes one side thicker than the other. Install cover with diaphragm plate (3) and diaphragm (4) on master cylinder housing (5) so that thicker side is positioned above brake line banjo fitting. Fasten cover to reservoir with two screws (1). Tighten to 9-17 **in-lbs** (1.0-2.0 Nm).
15. See [Figure 2-77](#). Install mirror (2), secure with lock nut and washer (4). Position mirror for best rearward visibility. Tighten lock nut to 96-144 **in-lbs** (10.9-16.3 Nm).
16. Install turn signal assembly (5). Position so turn signal lens faces directly forward and turn signal does not strike fuel tank when handlebars are turned full right. Tighten clamp screw (3) to 96-120 **in-lbs** (10.9-13.6 Nm).

17. With Ignition/Light Key Switch turned to IGNITION, actuate front brake hand lever to verify operation of rear brake lamp.

⚠ WARNING

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

18. Test ride motorcycle at low speed. If brake feels spongy, repeat bleeding procedure.



FRONT BRAKE CALIPER: XL MODELS

2.11

REMOVAL

NOTE

If only replacing brake pads, do not remove front brake caliper(s). For brake pad replacement only, see [1.9 BRAKE PADS AND DISCS: XL MODELS](#).

CAUTION

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

NOTE

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

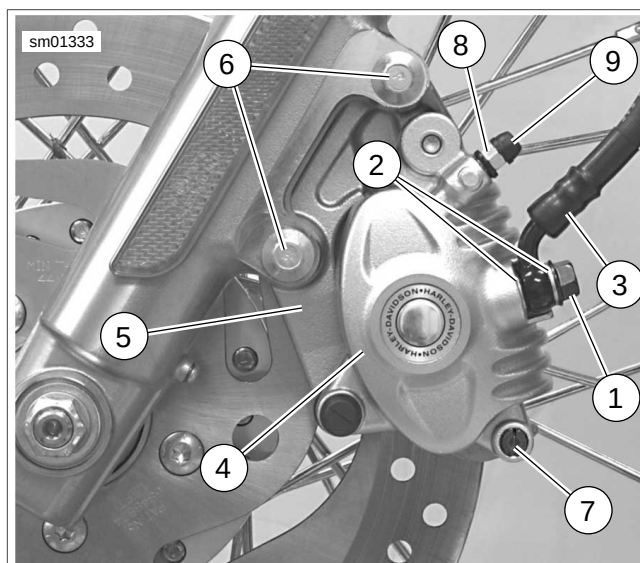
CAUTION

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

NOTE

If D.O.T. 4 brake fluid contacts painted surfaces, IMMEDIATELY flush area with clear water.

1. See [Figure 2-80](#). Remove bleeder nipple cap (9) from bleeder valve (8) on front brake caliper (4).
2. See [Figure 2-81](#). Install end of a length of 5/16 in. (7.9 mm) I.D. 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 repeatedly to drain brake fluid. Close bleeder valve.
3. See [Figure 2-80](#). Remove the banjo bolt (1) and both washers (2) to detach front brake line (3) from caliper (4). Discard washers.
4. Remove pad pin plug (7).
5. See [Figure 2-82](#). Loosen, but do not remove, brake pad pin.
6. See [Figure 2-80](#). Remove both mounting bolts (6) (12 pt/10 mm). Pull caliper and mounting bracket assembly rearward to disengage from brake disc.



1. Banjo bolt
2. Washer (2)
3. Front brake line
4. Brake caliper
5. Caliper mounting bracket
6. Mounting bolt (2) (12 pt/10 mm)
7. Pad pin plug
8. Bleeder valve
9. Bleeder nipple cap

Figure 2-80. Front Caliper Assembly

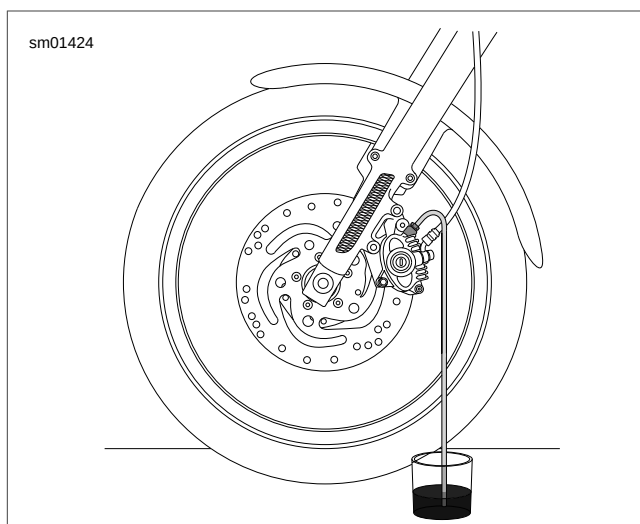


Figure 2-81. Bleeding Hydraulic System (typical; XL model shown)

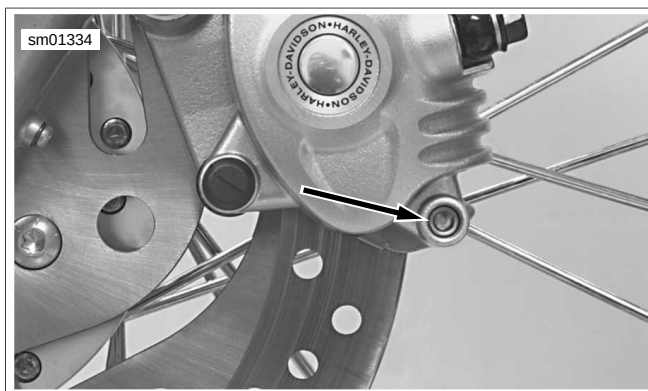


Figure 2-82. Brake Pad Pin (Plug Removed)

DISASSEMBLY

1. See [Figure 2-83](#). Remove brake pad pin (14) and brake pads (8) from caliper body (15).
2. Slide brake caliper off mounting bracket (1).
3. Remove pad spring (16). Do not remove bleeder valve (10) at this time.
4. See [Figure 2-84](#). Install a discarded brake pad in the caliper (1) with the backing plate (4) facing the pistons. Position the brake pad so the friction material (3) is against the back of the caliper, as shown.
5. Loosely install brake pad pin (2) to hold brake pad in place.

⚠ WARNING

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

NOTE

Be careful not to damage banjo bolt sealing surface or threads of banjo bolt hole in brake caliper. It is recommended that you use an air nozzle with a rubber tip to perform the next step in this procedure.

⚠ CAUTION

When removing piston with compressed air, piston can develop considerable force and fly out of caliper bore. Keep hands away from piston to avoid possible injury. (00530b)

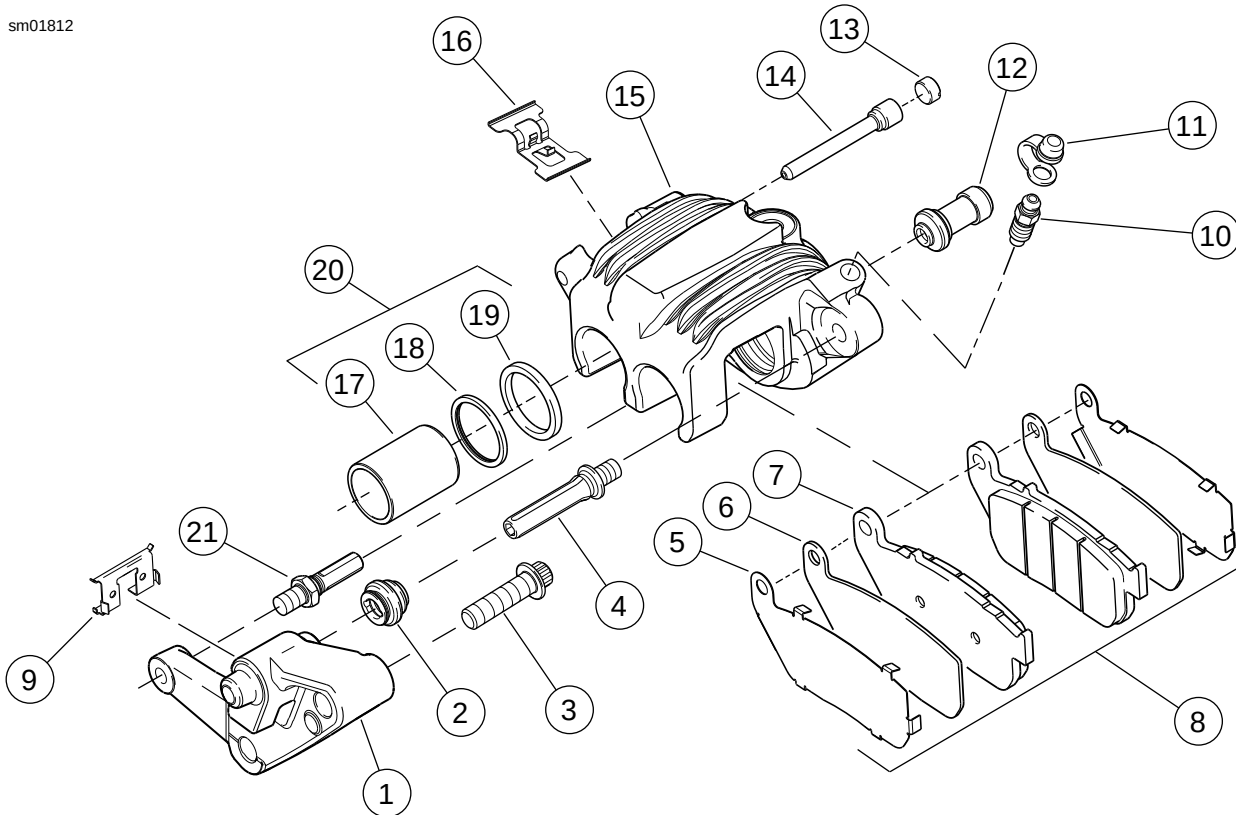
6. See [Figure 2-85](#). Gently apply low pressure compressed air to banjo bolt hole (3) to force pistons from caliper bores.
7. Remove brake pad pin and brake pad.
8. See [Figure 2-83](#). Remove both pistons (17) from caliper bores by hand. If necessary, wiggle pistons gently to completely remove.

NOTE

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

9. See [Figure 2-86](#). Using a wooden toothpick (1), remove dust seal (2) and piston seal (3) from each caliper bore. Discard seals.
10. See [Figure 2-83](#). If necessary, remove bleeder valve (10).

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- | | |
|--|---------------------------------|
| 1. Caliper bracket | 12. Caliper bushing boot |
| 2. Caliper pin boot | 13. Pad pin plug |
| 3. Screw (2) | 14. Pad pin |
| 4. Bolt pin (caliper) | 15. Caliper body |
| 5. Pad retainer (2) | 16. Pad spring |
| 6. Insulator (2) | 17. Piston (2) |
| 7. Brake pad (2) | 18. Piston seal (2) |
| 8. Brake pad set (includes item 9) | 19. Dust seal (2) |
| 9. Retainer clip (not sold separately) | 20. Piston kit |
| 10. Bleeder valve | 21. Bolt pin (mounting bracket) |
| 11. Bleeder nipple cap | |

Figure 2-83. Front Brake Caliper Assembly

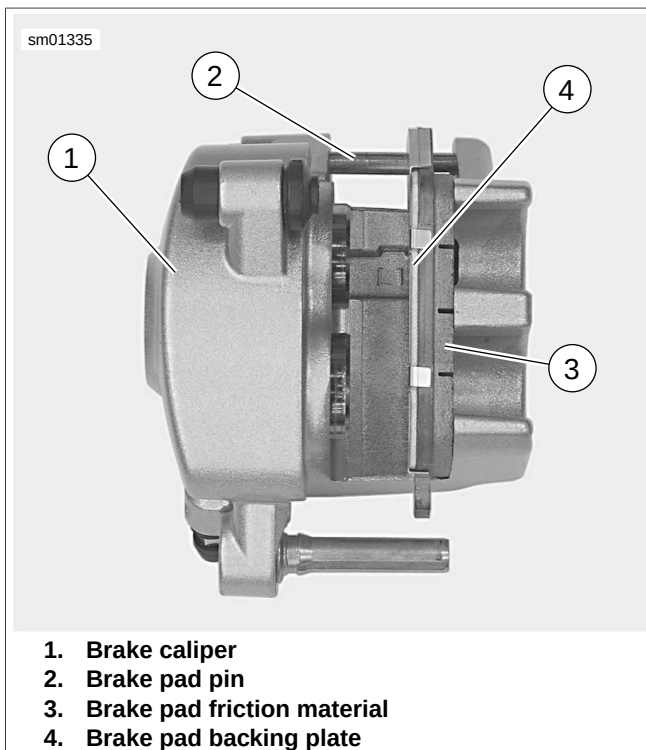


Figure 2-84. Preparing Caliper for Piston Removal

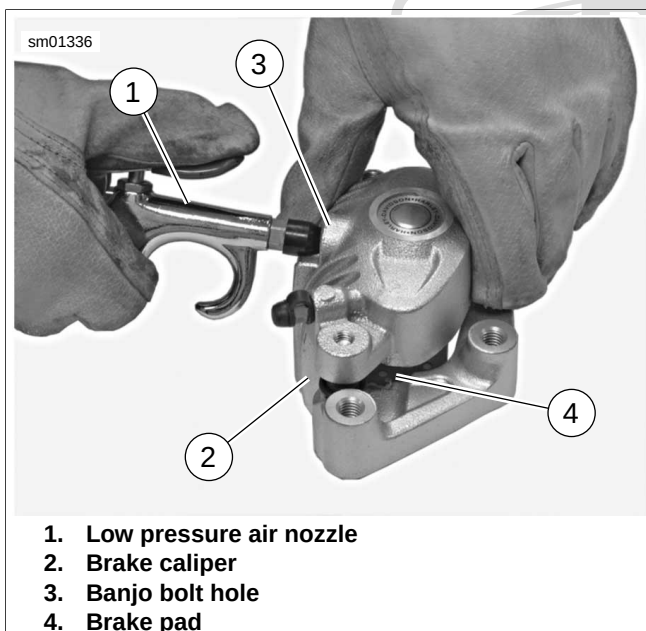


Figure 2-85. Removing Pistons

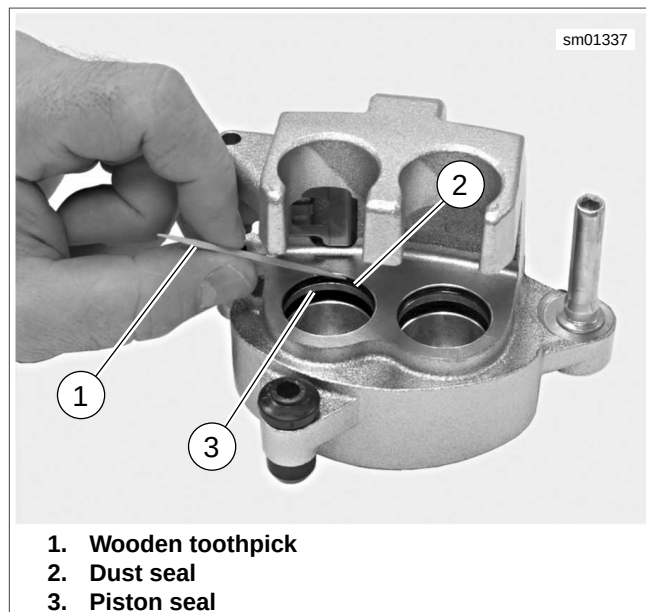


Figure 2-86. Caliper Seals

CLEANING, INSPECTION AND REPAIR

⚠ WARNING

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

1. See [Figure 2-83](#). Wipe old lubrication from inside of caliper pin boot (2) and caliper bushing boot (12) with a soft, clean cloth.
2. Clean all other rubber parts with HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID. Do not contaminate with mineral oil or other solvents. Clean all metal parts with denatured alcohol. Wipe parts dry with a clean, lint free cloth.

⚠ WARNING

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

3. Blow out drilled passages and piston bore with low pressure compressed air from a clean air supply. Do not use a wire or similar instrument to clean drilled passages.

4. Carefully inspect all components. Replace any parts that appear damaged or worn.
 - a. Check pistons (17) for pitting, scratching or corrosion on outside surfaces.
 - b. Inspect caliper piston bores. Do not hone bores. If bores show pitting or corrosion, replace caliper.
 - c. Inspect pad pin (14) for grooving and wear. Measure the pad pin diameter in an unworn area, and then in the area of any grooving or wear. If wear is more than 0.011 in. (0.28 mm), replace pad pin.
 - d. Inspect caliper bolt pin (4). If damaged or excessively worn, replace brake caliper assembly.
 - e. Inspect caliper bushing boot and caliper pin boot. If worn or damaged, replace.
 - f. Always replace all seals after disassembly.

WARNING

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

5. Inspect brake pads and brake disc. Replace if necessary.
 - a. See [1.9 BRAKE PADS AND DISCS: XL MODELS](#) for specifications.
 - b. See [2.4 WHEELS](#) for brake disc replacement procedure.

ASSEMBLY

NOTE

Use **ONLY KS62F assembly grease for lubrication**. Use of D.O.T. 4 brake fluid will result in increased brake lever travel.

1. Lubricate the following parts prior to assembly using a light coat of KS62F assembly grease from the service parts kit. All other surfaces must be dry for assembly.
 - a. Nose radius of pistons. See [Figure 2-87](#).
 - b. All surfaces of piston seals and dust seals.

NOTE

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

2. See [Figure 2-86](#). Install a **new** piston seal (3) and a **new** dust seal (2) into each piston bore.
3. Carefully insert pistons by hand, nose radius first (see [Figure 2-87](#)), into caliper bores. If installation shows resistance, remove piston(s) and check that seals are properly installed and fully seated in grooves.
4. See [Figure 2-83](#). Install bleeder valve (10) on caliper housing if removed. Tighten bleeder valve to 35-61 in-lbs (4.0-6.9 Nm).
5. See [Figure 2-88](#). Place caliper housing on workbench as shown. Install pad spring in channel. Press firmly into place.



Figure 2-87. Piston Nose Radius

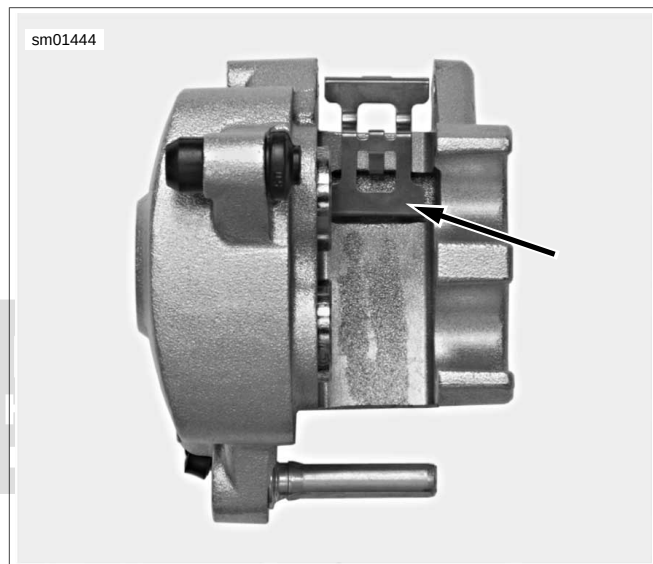


Figure 2-88. Front Caliper Pad Spring

LUBRICATING FRONT CALIPER BOLT PINS AND BOOTS

1. See [Figure 2-89](#). Apply approximately 0.4 g of G40M BRAKE GREASE inside caliper bushing boot (3) and caliper pin boot (4).
2. See [Figure 2-90](#). Apply G40M BRAKE GREASE inside boot lip (8) to prevent sticking between boots (3, 4) and bolt pins (5, 6).
3. Assemble brake caliper and mounting bracket, carefully sliding bolt pins into boots. Slide brake caliper all the way onto mounting bracket until boot lips fit over tapered shoulders (7) of bolt pins.

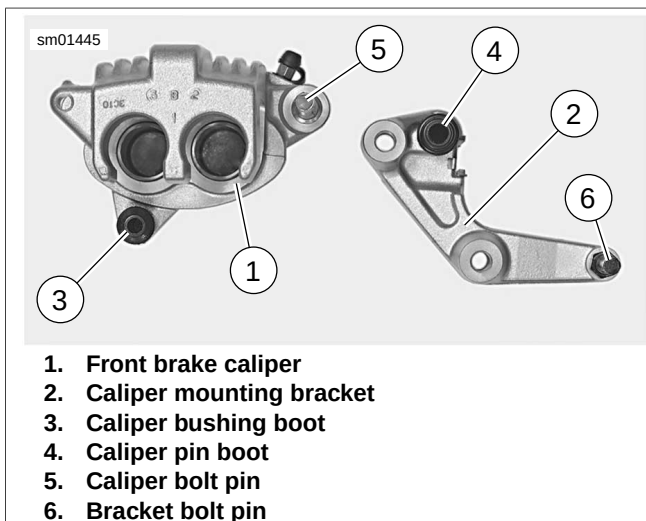


Figure 2-89. Lubricating Caliper Boots and Pins

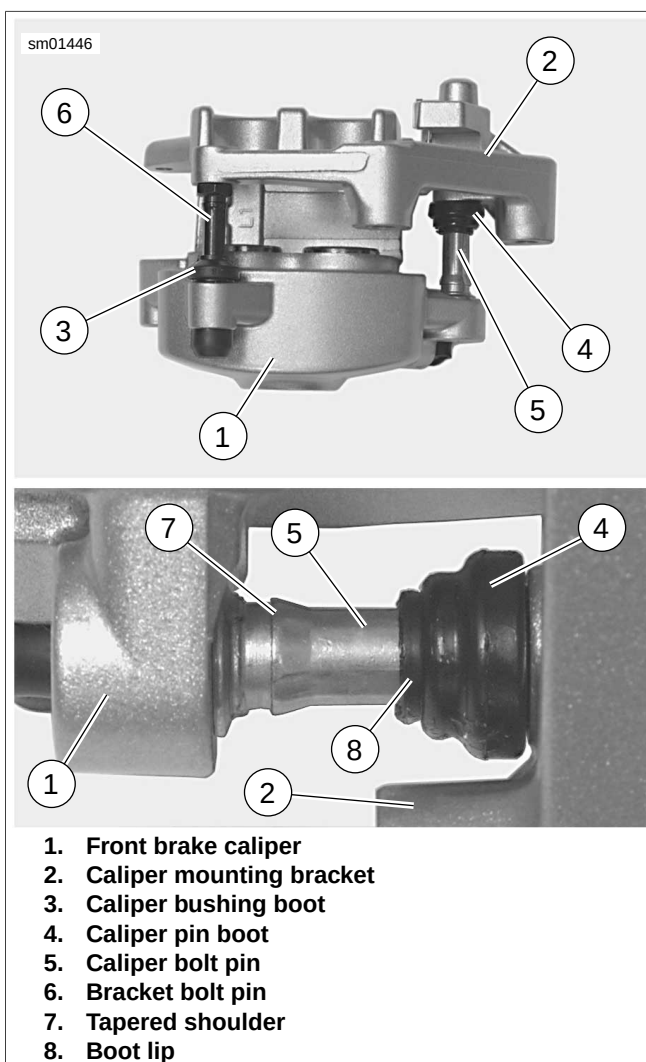


Figure 2-90. Assembling Front Brake Caliper and Mounting Bracket

INSTALLING BRAKE PADS IN CALIPER

NOTE

The front left and front right (not present on all models) calipers do NOT use the same exact brake pad set as the rear brake caliper.

1. See [Figure 2-91](#). Insert one set of brake pads (1) into caliper with friction material on pad facing opening for brake disc. Curved portion of pad fits into recessed area of caliper. Make sure brake pad front mounting tab (2) fits into slot (5) in caliper mounting bracket (4).
2. See [Figure 2-83](#). Press brake pads (8) tightly up against pad spring (16) and install pad pin (14). Tighten to 131-173 **in-lbs** (14.8-19.6 Nm).

NOTE

If pad pin does not fit, check the following:

- You are using a set of pads, not two identical pads.
- Pad spring orientation must match [Figure 2-88](#).
- See [Figure 2-91](#). Pad front mounting tabs (2) must be fully seated in mounting bracket slot (5).
- Pads must be pushed tight up against pad spring before pad pin is installed.
- 3. See [Figure 2-83](#). Install pad pin plug (13). Tighten to 18-25 **in-lbs** (2.0-2.9 Nm).

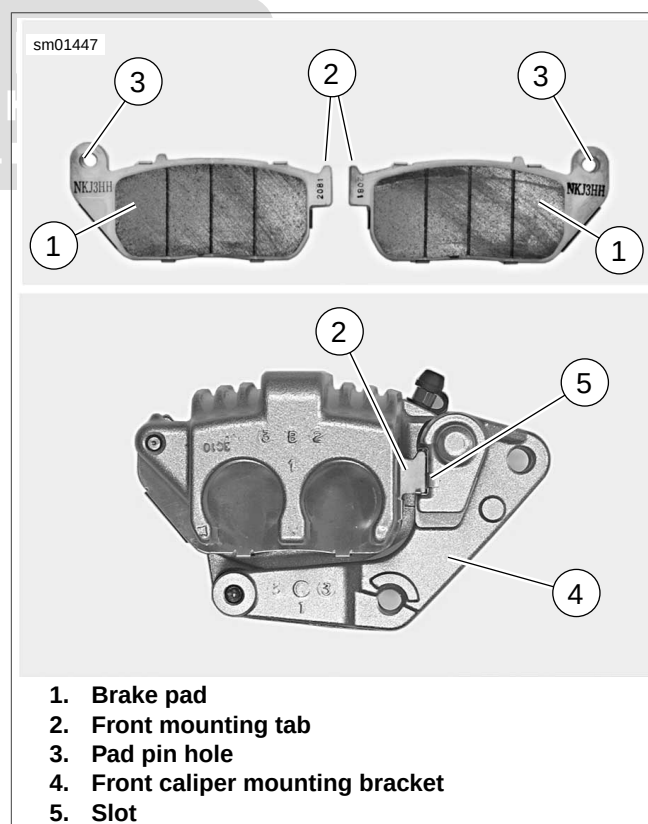


Figure 2-91. Front Brake Pads

INSTALLATION

CAUTION

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

CAUTION

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

NOTE

If D.O.T. 4 brake fluid contacts painted surfaces, **IMMEDIATELY** flush area with clear water.

1. 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 60-65 ft-lbs (81-88 Nm).
 - b. Loosen axle pinch screw nut.
 - c. Position right fork leg against bearing spacer. Tighten axle pinch screw to 21-27 ft-lbs (28.5-36.6 Nm) and withdraw drill bit.
2. See [Figure 2-92](#). Place brake caliper (4) with mounting bracket (5) over brake disc with bleeder valve (8) facing upwards. Install mounting bolts (6) into mounting holes on fork leg. Tighten to 28-38 ft-lbs (38.0-51.6 Nm).

CAUTION

Avoid leakage. Be sure gaskets, banjo bolt(s), brake line and caliper bore are clean and undamaged before assembly. (00321a)

NOTE

Brake caliper housing has a positive stop for banjo fitting. When tightening banjo bolt into brake caliper in the next step, rotate banjo fitting clockwise until it contacts positive stop.

3. Position a new washer (2) on each side of hydraulic brake line (3) banjo fitting. Insert banjo bolt (1) through washers and fitting. Thread bolt into caliper housing. Tighten to 20-25 ft-lbs (27.1-33.9 Nm).
4. **Vehicles with dual front brake calipers:** repeat previous two steps for other brake caliper.
5. See [Figure 2-93](#). Remove cover screws (3), top cover (2) and gasket from front brake master cylinder reservoir (1).

NOTES

- See [Figure 2-94](#). Do not use sight glass to determine maximum fluid level. Sight glass should only be used as a visual indicator that fluid level is low and needs attention.
 - Cover handlebar switches with a shop towel before adding brake fluid to front master cylinder reservoir. Spilling brake fluid on handlebar switches may render them inoperative.
 - Use only HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID from a sealed container.
 - Do not overfill reservoir. Do not reuse old brake fluid.
6. See [Figure 2-94](#). Add enough HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID to reservoir to bring fluid level even with ridge cast into inside of reservoir, about 1/4 in. (6.35 mm) below top edge

WARNING

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

7. Bleed brake system. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#).

NOTE

On models with dual front brake calipers, make sure to perform brake system bleeding procedure on both calipers.

WARNING

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

8. Verify proper operation of master cylinder relief port. With motorcycle positioned so that master cylinder reservoir is level, squeeze brake lever slowly with reservoir cover removed. A slight spurt of fluid will break the surface if all internal components are working properly.
9. See [Figure 2-94](#). Add enough HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID to reservoir to bring fluid level even with ridge cast into inside of reservoir, about 1/4 in. (6.35 mm) below top edge.
10. Install gasket and cover on master cylinder. Tighten cover screws to 9-17 in-lbs (1.0-2.0 Nm).
11. Tighten front axle and slider cap nuts if necessary.

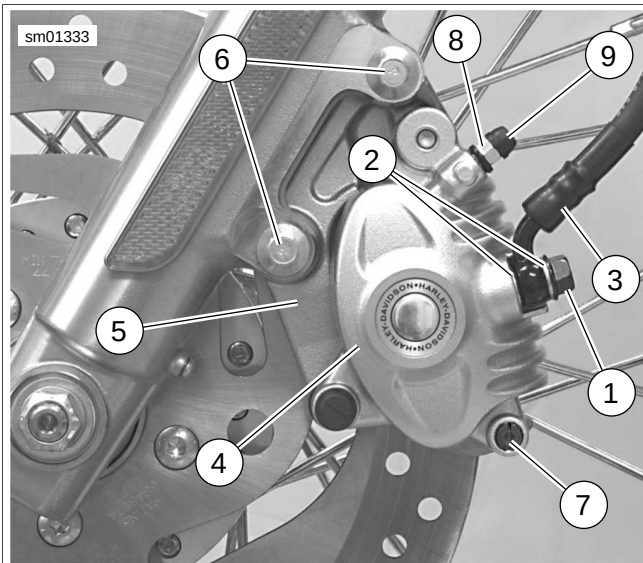
WARNING

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

12. Test brake system.
 - a. Turn ignition switch ON. Squeeze brake hand lever to verify operation of the brake lamp.
 - b. Test ride the motorcycle. If the brakes feel spongy, bleed the system again. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#).

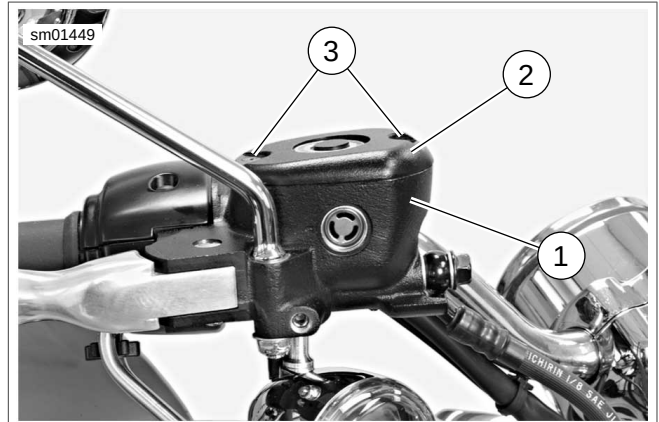
NOTE

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



1. Banjo bolt
2. Washer (2)
3. Front brake line
4. Brake caliper
5. Caliper mounting bracket
6. Mounting bolt (2) (12 pt/10 mm)
7. Pad pin plug
8. Bleeder valve
9. Bleeder nipple cap

Figure 2-92. Front Caliper Assembly



1. Front brake master cylinder and reservoir
2. Top cover
3. Cover screw (2)

Figure 2-93. Removing Master Cylinder Reservoir Cover



1. Cast-in ridge
2. Sight glass

Figure 2-94. Filling Front Master Cylinder Reservoir

FRONT BRAKE CALIPER: XR MODELS

2.12

REMOVAL

NOTE

If only replacing brake pads, do not remove front brake caliper(s). For brake pad replacement only, see [1.10 BRAKE PADS AND DISCS: XR MODELS](#).

CAUTION

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

NOTE

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

CAUTION

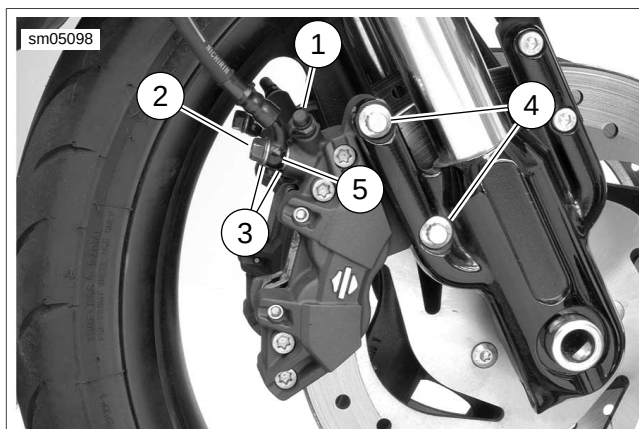
D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

NOTE

If D.O.T. 4 brake fluid contacts painted surfaces, IMMEDIATELY flush area with clear water.

1. See [Figure 2-95](#). Remove bleeder nipple cap from bleeder valve (1) on front brake caliper.
2. See [Figure 2-96](#). Install end of a length of 5/16 in. (7.9 mm) I.D. 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 repeatedly to drain brake fluid. Close bleeder valve.
3. See [Figure 2-95](#). Remove the banjo bolt (2) (metric) and both washers (3) to detach front brake line from caliper. Discard washers.

4. Remove both mounting bolts (4) (metric). Pull caliper assembly rearward to remove from brake disc.



1. Bleeder valve
2. Banjo bolt (metric)
3. Washer (2)
4. Mounting bolt (2) (metric)
5. Banjo fitting

Figure 2-95. Front Caliper Assembly: XR Models

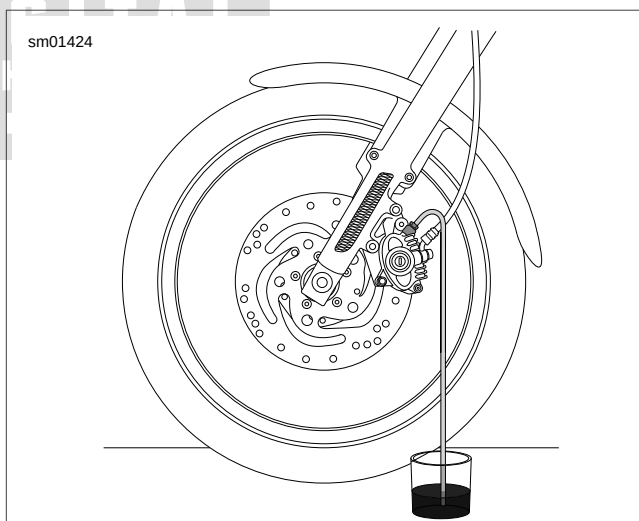


Figure 2-96. Bleeding Hydraulic System (typical; XL model shown)

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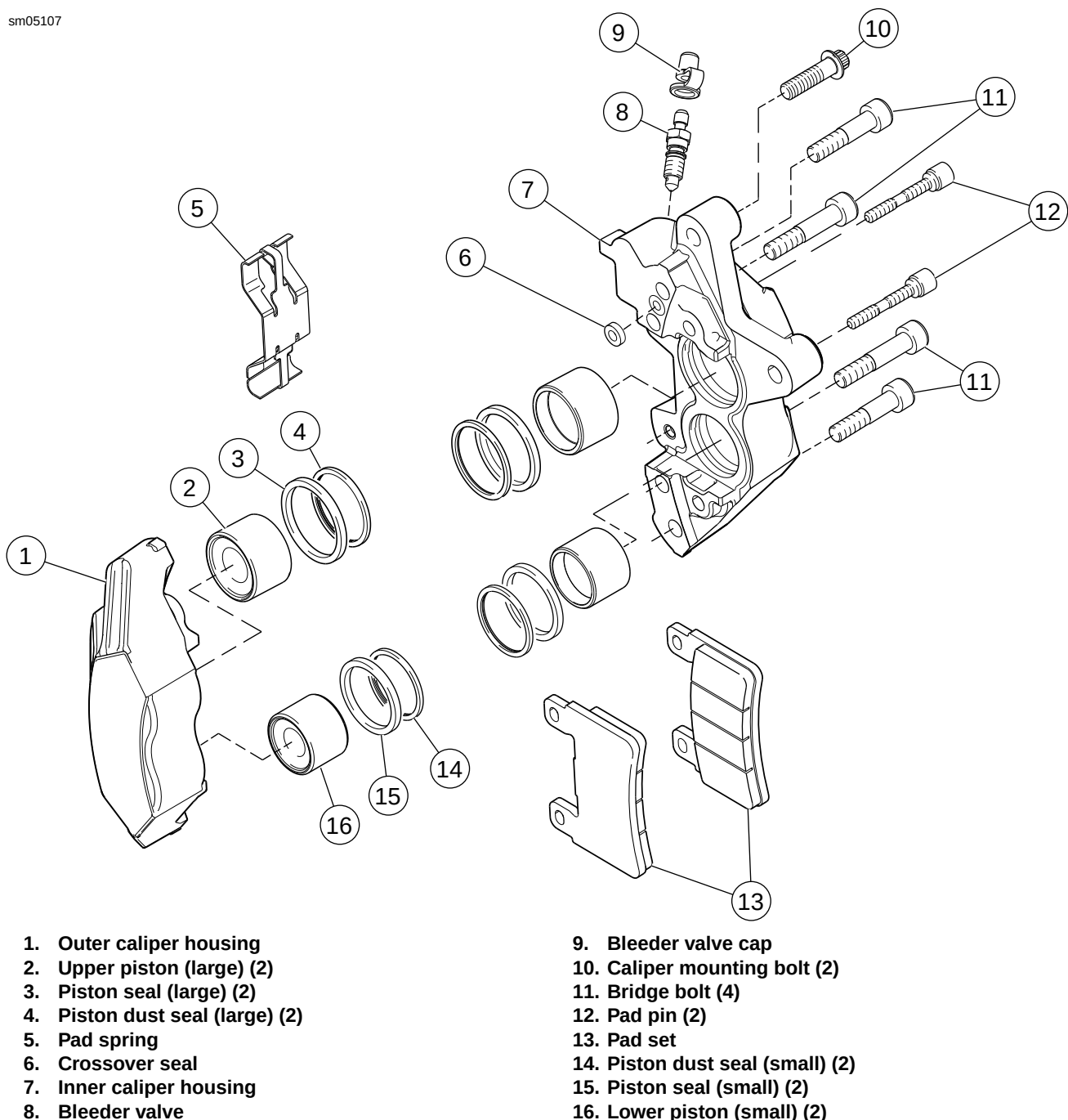


Figure 2-97. Front Brake Caliper Assembly

DISASSEMBLY

1. See [Figure 2-98](#). Remove brake pad pins (1) and anti-rattle spring (2).
2. Slide one brake pad out of caliper assembly. Do not remove bleeder valve (3) at this time.
3. With one brake pad in the caliper, loosely install brake pad pins (1) to hold brake pad in place.

WARNING

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

NOTE

Be careful not to damage banjo bolt sealing surface or threads of banjo bolt hole in brake caliper. It is recommended that you

use an air nozzle with a rubber tip to perform the next step in this procedure.

CAUTION

When removing piston with compressed air, piston can develop considerable force and fly out of caliper bore. Keep hands away from piston to avoid possible injury. (00530b)

4. See [Figure 2-98](#). Gently apply low pressure compressed air to banjo bolt hole (4) to force pistons from caliper bores.
5. Remove brake pad pins and brake pad.
6. Remove bridge bolts (5, 6) and separate caliper housings.
7. Remove pistons from each housing by hand. If necessary, wiggle pistons gently to completely remove.

NOTE

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

8. See [Figure 2-99](#). Using a wooden toothpick (1), remove dust seal (2) and piston seal (3) from each caliper bore. Discard seals.
9. See [Figure 2-98](#). If necessary, remove bleeder valve (3).

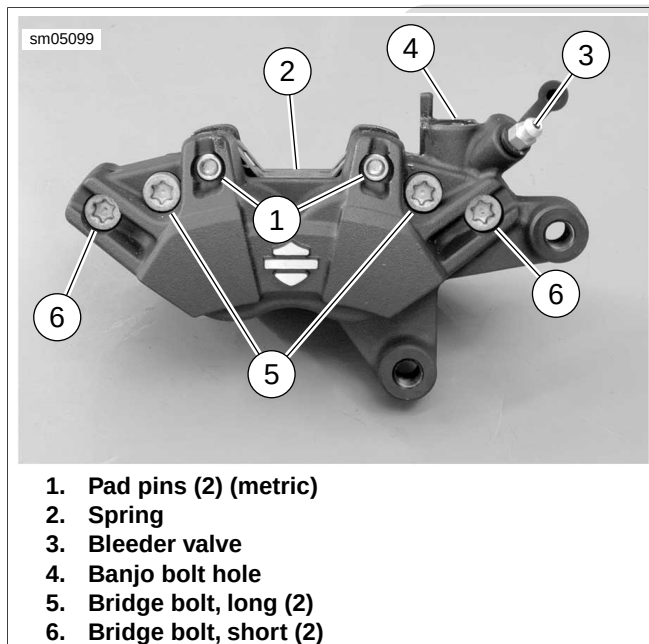


Figure 2-98. Preparing Caliper for Piston Removal

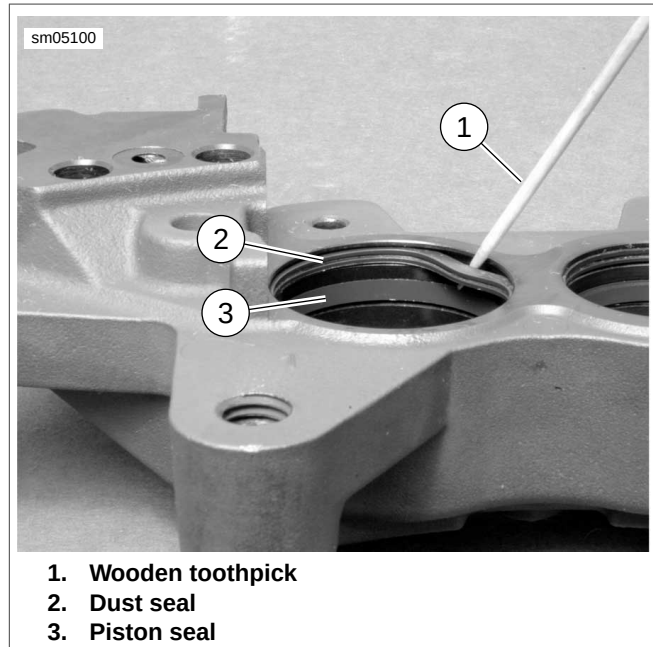


Figure 2-99. Caliper Seals

CLEANING, INSPECTION AND REPAIR

WARNING

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

1. Clean all rubber parts with HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID. Do not contaminate with mineral oil or other solvents. Clean all metal parts with denatured alcohol. Wipe parts dry with a clean, lint free cloth.

WARNING

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

2. Blow out drilled passages and piston bore with low pressure compressed air from a clean air supply. Do not use a wire or similar instrument to clean drilled passages.
3. Carefully inspect all components. Replace any parts that appear damaged or worn.
 - a. Check pistons for pitting, scratches or corrosion on outside surfaces.
 - b. Inspect piston bores. Do not hone bores. If bores show pitting or corrosion, replace caliper.

NOTE

The pad pins are manufactured with a relief near the center of their length, where the pad spring touches. Do not use

this area as a measurement point to determine pad pin wear.

- c. Inspect pad pin for grooving and wear at the pad contact points. Measure the pad pin diameter in an unworn area, and then in an area of any grooving or wear. If wear is more than 0.011 in. (0.28 mm), replace pad pin.
- d. Inspect pad spring for wear or cracks. If worn or damaged, replace.
- e. Always replace all seals after disassembly.

⚠ WARNING

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

4. Inspect brake pads and brake disc. Replace if necessary.
 - a. See [1.10 BRAKE PADS AND DISCS: XR MODELS](#) for specifications.
 - b. See [2.4 WHEELS](#) for brake disc replacement procedure.

ASSEMBLY

NOTE

Use **ONLY KS62F assembly grease for lubrication**. Use of D.O.T. 4 brake fluid will result in increased brake lever travel.

1. Lubricate the following parts prior to assembly using a light coat of KS62F assembly grease from the service parts kit. All other surfaces must be dry for assembly.
 - a. Nose radius of pistons.
 - b. All surfaces of piston seals and dust seals.

NOTES

- Damaged piston bores will leak when reassembled. Do not use metal objects to remove or install objects in piston bores. Prevent damage to bores by only using a wooden toothpick when servicing calipers.
 - Pistons and bores differ slightly in diameter; one large and one small in each housing.
2. See [Figure 2-99](#). Install a **new** piston seal (3) and a **new** dust seal (2) into each piston bore.
 3. See [Figure 2-100](#). Carefully insert pistons (2, 3) by hand, nose radius first, into caliper bores. If installation shows resistance, remove piston(s) and check that seals are properly installed and fully seated in grooves. Press pistons completely into bores.
 4. Install **new** crossover seal (1).
 5. See [Figure 2-98](#). Apply a drop of LOCTITE 569 Sealant to the threads of the bridge bolts (5, 6). Assemble caliper housings and secure with bridge bolts. Ensure the bridge bolts are in the correct locations based on length. Tighten bridge bolts to 12-18 ft-lbs (16.9-24.5 Nm).
 6. See [Figure 2-101](#). Install brake pads and pad spring. Ensure the spring is oriented as shown with the arrow and

word "UP" (2) facing the banjo bolt hole (1). Secure with pad pins (3).

7. Tighten pad pins to 11-14 ft-lbs (14.7-19.6 Nm).
8. Install bleeder valve on caliper housing if removed. Tighten bleeder valve to 35-61 **in-lbs** (4.0-6.9 Nm).

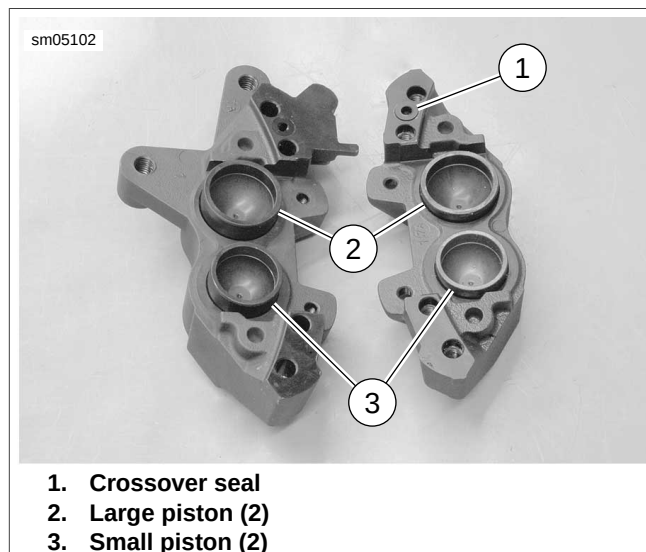


Figure 2-100. Caliper Housings and Pistons

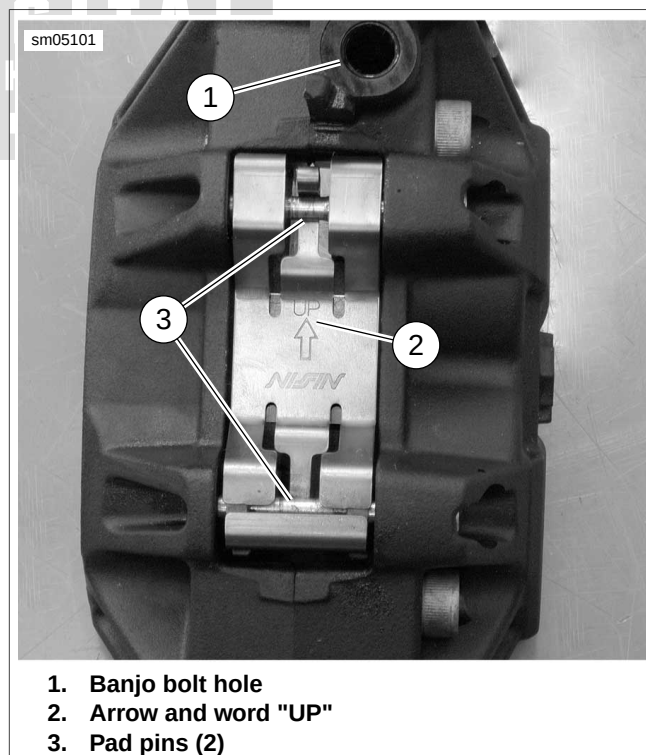


Figure 2-101. Front Caliper Pad Spring Orientation

INSTALLATION

CAUTION

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

CAUTION

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

NOTE

If D.O.T. 4 brake fluid contacts painted surfaces, **IMMEDIATELY** flush area with clear water.

1. Align calipers to brake discs.
 - a. Tighten axle nut to 60-65 ft-lbs (81-88 Nm).
 - b. Loosen axle pinch screw nut.
 - c. Position right fork leg against bearing spacer. Tighten axle pinch screw to 41-48 **in-lbs** (55.6-65.1 Nm).
2. See [Figure 2-102](#). Place brake caliper over brake disc with bleeder valve (1) facing upwards. Install mounting bolts (4) and tighten to 28-38 ft-lbs (38.0-51.6 Nm).

CAUTION

Avoid leakage. Be sure gaskets, banjo bolt(s), brake line and caliper bore are clean and undamaged before assembly. (00321a)

NOTE

Brake caliper housing has a positive stop for banjo fitting. When tightening banjo bolt into brake caliper in the next step, rotate banjo fitting clockwise until it contacts positive stop.

3. Position a **new** washer (3) on each side of hydraulic brake line banjo fitting (5). Insert banjo bolt (2) through washers and fitting. Tighten banjo bolt to 20-25 ft-lbs (27.1-33.9 Nm).
4. Fill and bleed brake system. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#).

NOTE

Make sure to perform brake system bleeding procedure on both calipers.

WARNING

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

5. Verify proper operation of master cylinder relief port. With motorcycle positioned so that master cylinder reservoir is level, squeeze brake lever slowly with reservoir 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 9-17 **in-lbs** (1.0-2.0 Nm).

WARNING

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

7. Test brake system.
 - a. Turn ignition switch ON. Squeeze brake hand lever to verify operation of the brake lamp.
 - b. Test ride the motorcycle. If the brakes feel spongy, bleed the system again. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#).

NOTE

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

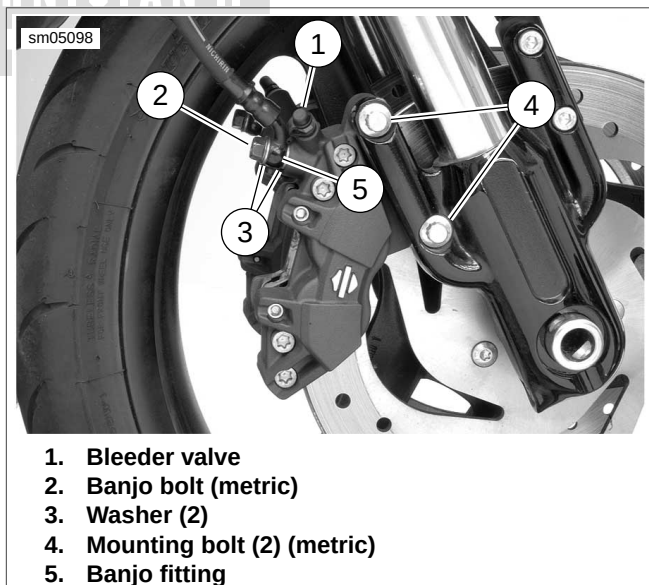


Figure 2-102. Front Caliper Assembly: XR Models

REAR BRAKE MASTER CYLINDER: XL MODELS

2.13

GENERAL

The rear brake master cylinder is mounted transverse to the centerline of the vehicle, beneath the rear fork pivot shaft assembly.

If the rear brake feels spongy or excessive pedal travel exists or the brake does not work at all, proceed with Inspection which follows.

CAUTION

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

CAUTION

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

NOTE

If D.O.T. 4 brake fluid contacts painted surfaces, IMMEDIATELY flush area with clear water.

INSPECTION

1. Check the level of fluid in the rear brake reservoir. If it is low, refill and bleed brake system. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#).
2. Check for fluid leaks in the brake line, around banjo fittings or rear brake caliper piston or bleeder valve. Repair and bleed brake system.
 - a. For brake line replacement procedure, see [2.18 BRAKE LINES](#).
 - b. To repair rear brake caliper, see procedure in [2.16 REAR BRAKE CALIPER: XL MODELS](#).
 - c. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#) for hydraulic brake system bleeding procedure.
3. Check rear brake friction pads and disc for excessive wear or damage. Replace worn or damaged items.
 - a. See [1.9 BRAKE PADS AND DISCS: XL MODELS](#) for specifications.
 - b. See [1.9 BRAKE PADS AND DISCS: XL MODELS, Brake Pad Replacement: Rear](#) for brake pad replacement procedure.
 - c. See [2.4 WHEELS](#) for brake disc replacement procedure.

4. Check mechanical brake linkage from brake pedal to master cylinder for damage. Repair or replace worn or damaged items.
 - a. **Models equipped with mid-mount foot controls:** see [2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS](#).
 - b. **Models equipped with forward foot controls:** see [2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS](#).
5. Eliminate any air in the hydraulic brake assembly by bleeding the system. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#).

If none of these conditions exist but the rear brake system does not operate properly, the rear master cylinder is most likely defective and must be repaired or replaced.

REMOVAL

CAUTION

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

1. See [Figure 2-103](#). Drain rear brake master cylinder reservoir (1) and remove hose clamp (4) and feed hose (3) from master cylinder feed hose port fitting (5). See [2.15 REAR BRAKE MASTER CYLINDER RESERVOIR](#). Discard hose clamp.
2. Remove bleeder nipple cap (21) from bleeder valve (22) on rear brake caliper (20). Install end of a length of 5/16 in. (7.9 mm) I.D. clear plastic tubing over caliper bleeder valve, while placing free end in a suitable container.
3. Open bleeder valve about 1/2-turn. Pump brake pedal to drain brake fluid. Close bleeder valve but do not tighten.

WARNING

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

NOTE

Use correct retaining ring pliers and correct tips. Verify that tips are not excessively worn or damaged.

4. Remove retaining ring (11) from clevis pin (9). Remove clevis pin and disengage master cylinder yoke (10) from bell crank (12). Discard retaining ring.

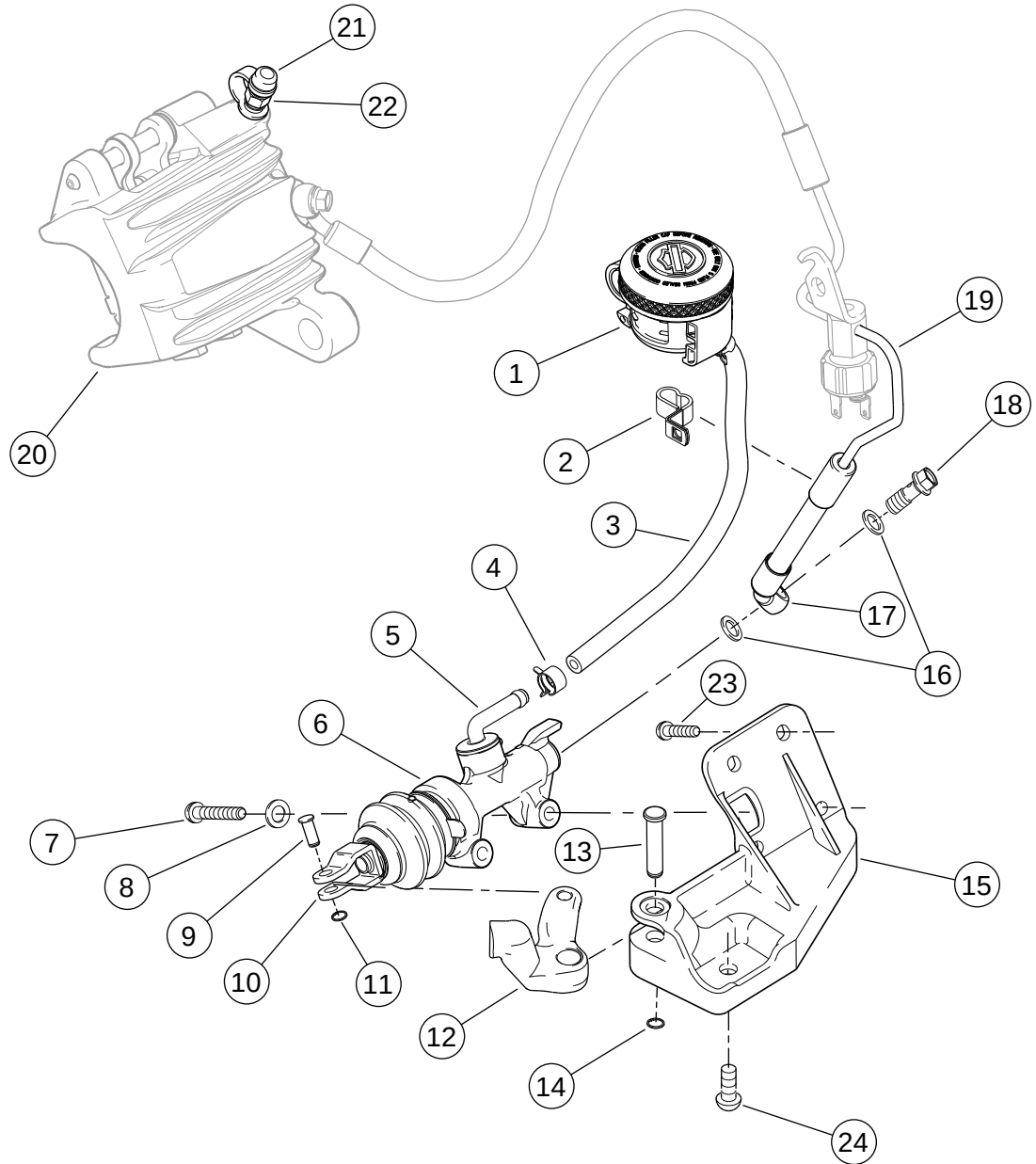
NOTE

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

5. Remove banjo bolt (18) and washers (16) from master cylinder (6). Lift banjo fitting away from master cylinder. Discard washers.
6. Remove two screws (7) and two washers (8) securing rear master cylinder to master cylinder mounting bracket (15) and remove rear master cylinder.
7. If it is necessary to remove master cylinder mounting bracket:
 - a. Remove retaining ring (14) and clevis pin (13). Disconnect bell crank (12) from mounting bracket.
 - b. Remove two screws (23).
 - c. Remove screw (24) and mounting bracket.



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- | | |
|---|--|
| 1. Rear brake master cylinder reservoir | 13. Clevis pin |
| 2. B-clamp | 14. Retaining ring |
| 3. Master cylinder feed hose | 15. Master cylinder mounting bracket |
| 4. Hose clamp | 16. Washer (2) |
| 5. Feed hose port fitting | 17. Banjo fitting |
| 6. Rear brake master cylinder | 18. Banjo bolt |
| 7. Screw (2) | 19. Rear brake line including stoplight switch |
| 8. Washer (2) | 20. Rear brake caliper |
| 9. Clevis pin | 21. Bleeder nipple cap |
| 10. Yoke | 22. Bleeder valve |
| 11. Retaining ring | 23. Screw (2) |
| 12. Bell crank | 24. Screw |

Figure 2-103. Rear Brake Master Cylinder and Reservoir

DISASSEMBLY

NOTE

- Do not disassemble the rear master cylinder unless problems are being experienced. Discard all seals during the disassembly procedure. Install a complete rebuild kit when the unit is reassembled.
 - See [Figure 2-105](#). Clamp rear brake master cylinder (19) in a vise by its mounting bosses (18) only. Use brass or aluminum jaw covers or other protective device on vise jaws to prevent damage to master cylinder.
- See [Figure 2-105](#). Clamp rear brake master cylinder (19) in a vise with yoke (3) pointing up.
 - Remove external boot (5). Remove spring pin (12) from end of push rod (13). Discard spring pin.

NOTE

See [Figure 2-104](#). Grip yoke by the edges with an adjustable wrench. Do not grip yoke by the flats or the yoke may become deformed.

- See [Figure 2-104](#). Hold yoke with an adjustable wrench. Using an open-end wrench, loosen shoulder nut. Remove yoke.

⚠ WARNING

Wear safety glasses or goggles when removing or installing spring. Spring tension can cause spring, attached components and/or hand tools to fly out which could result in death or serious injury. (00477c)

- See [Figure 2-105](#). Press down on spring retainer (6) to compress external return spring (7). While spring is compressed, remove shoulder nut from push rod. Carefully release pressure on external return spring. Remove spring retainer and external return spring.
- Remove and discard inner boot (8).

NOTE

Do not remove boot collar nut (9) and push rod retainer (11) from push rod.

⚠ WARNING

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

NOTE

Use correct retaining ring pliers and correct tips. Verify that tips are not excessively worn or damaged.

- Thread shoulder nut back onto push rod several turns, to protect push rod threads. Press down on push rod to compress piston spring (17). Remove retaining ring (10), push rod with boot collar nut (9) and push rod retainer (11), piston (15) with secondary cup (14), primary cup (16) and piston spring. Discard retaining ring, piston with secondary cup, primary cup and piston spring.
- Remove dust cover (23), retaining ring (22), feed port fitting (21) and o-ring (20). Discard retaining ring and o-ring.

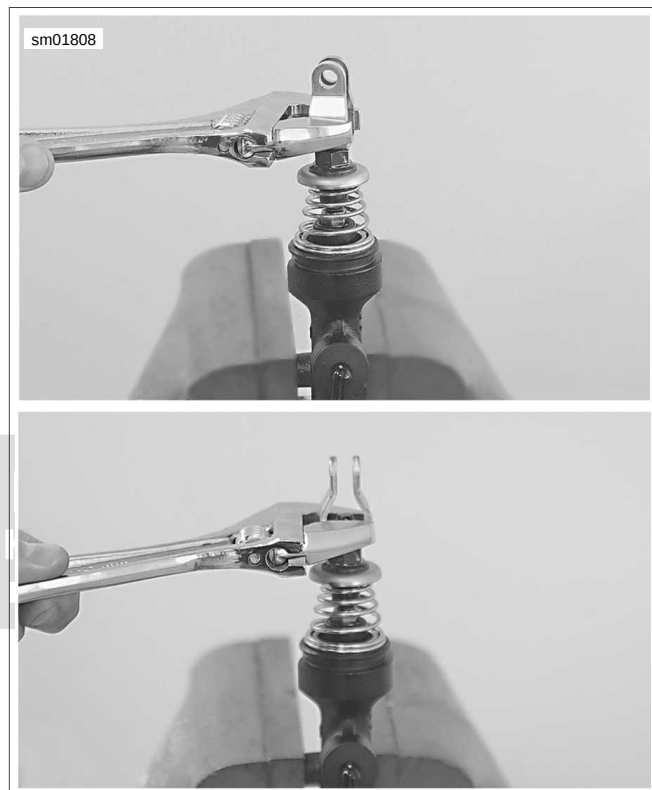


Figure 2-104. Tightening Yoke (Top: Incorrect, Bottom: Correct)

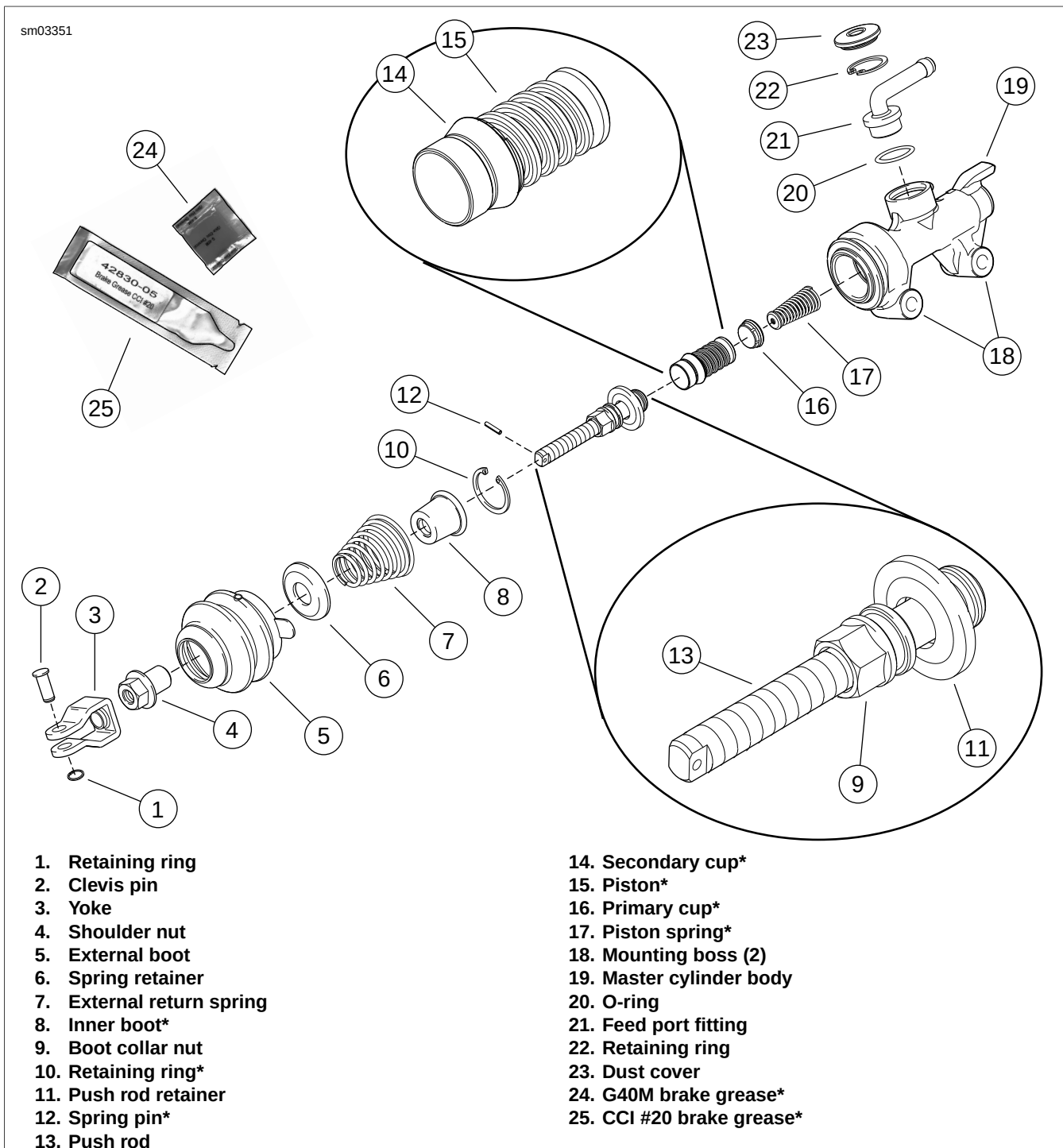


Figure 2-105. Rear Brake Master Cylinder (*Provided in Service Parts Kit)

CLEANING, INSPECTION AND REPAIR

WARNING

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

WARNING

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

1. See [Figure 2-105](#). Thoroughly clean master cylinder body (19) and all brake system components. Blow out drilled

passages and piston bore in master cylinder body with low pressure compressed air from a clean air supply. Do not use a wire or similar instrument to clean drilled passages.

2. Carefully inspect all parts for wear or damage and replace as necessary.
 - a. Inspect piston bore in master cylinder housing for scratches, grooves, scoring, pitting or corrosion. Replace housing if any of these conditions are found.
 - b. Inspect outlet port that mates with brake line banjo fitting. This is a critical sealing surface. Replace housing if any scratches, dents or other damage is found.
3. Verify that vent holes in master cylinder are completely open and free of dirt or debris.

ASSEMBLY

NOTES

- When assembling rear brake master cylinder, always use **new** parts from the service parts kit. Consult the PARTS CATALOG for the correct kit part number.
- CCI #20 BRAKE GREASE is recommended for lubrication of cylinder bore, cups and seals prior to assembly.
- Stand master cylinder on wooden block or clean, lint-free towel to protect seating surfaces.

WARNING

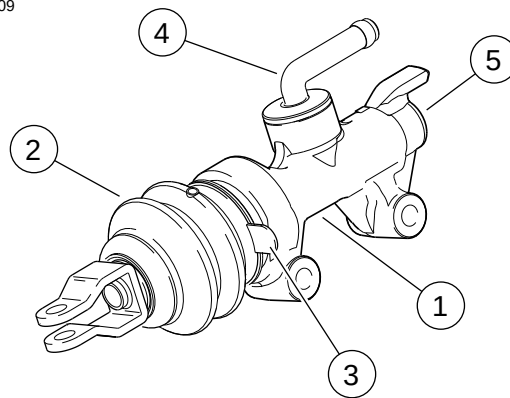
Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

NOTE

Use correct retaining ring pliers and correct tips. Verify that tips are not excessively worn or damaged.

1. See [Figure 2-105](#). Coat **new** o-ring (20) with HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID. Install o-ring and feed port fitting (21) into feed port on top of master cylinder (19). Secure with **new** retaining ring (22). Verify that retaining ring is fully seated in groove.
2. Slide dust cover (23) onto feed port fitting and press into place in master cylinder feed port. See [Figure 2-106](#). Turn feed port fitting (4) so it points toward banjo fitting (5) end of master cylinder body (1).

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1. Rear master cylinder assembly
2. External boot
3. Tabs (2)
4. Feed port fitting
5. Banjo fitting hole

Figure 2-106. Assembled Rear Master Cylinder

NOTE

See [Figure 2-105](#). Clamp rear brake master cylinder (19) in a vise by its mounting bosses (18) only. Use brass jaw covers or other protective device on vise jaws to prevent damage to master cylinder.

3. Clamp master cylinder in a vise with banjo fitting end pointing down.
4. See [Figure 2-107](#). Lubricate master cylinder bore, **new** piston (1) with **new** secondary cup (3), and **new** primary cup (2) with CCI #20 BRAKE GREASE supplied in the service parts kit.

WARNING

Wear safety glasses or goggles when removing or installing spring. Spring tension can cause spring, attached components and/or hand tools to fly out which could result in death or serious injury. (00477c)

5. Press small end of **new** piston spring (4) onto mounting boss (8) on piston (1).

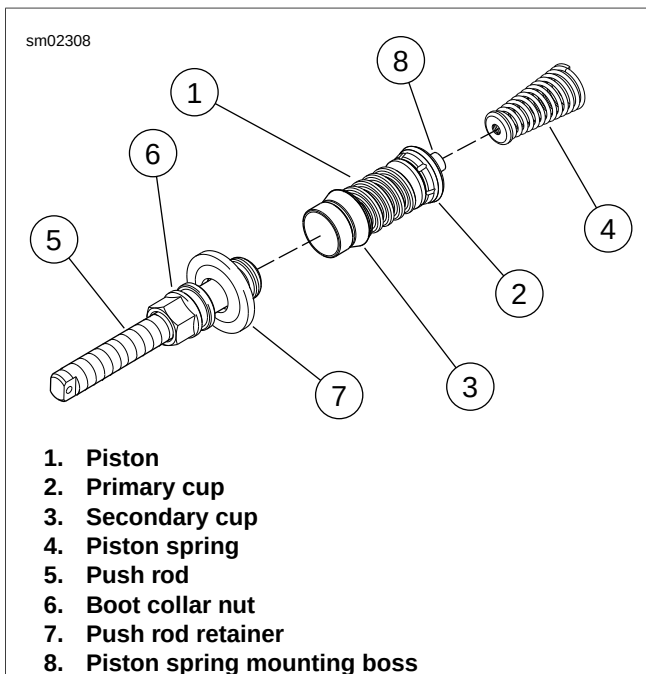


Figure 2-107. Rear Master Cylinder Piston, Push Rod and Spring Assembly

6. Slide piston/spring assembly, flared end of spring first, into cylinder bore so that spring seats against counter bore (recess) at bottom of cylinder.
7. Apply approximately 0.1 g of G40M BRAKE GREASE to ball end of push rod (5). Insert ball end of push rod into cupped end of piston.

WARNING

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

NOTE

Use correct retaining ring pliers and correct tips. Verify that tips are not excessively worn or damaged.

8. See [Figure 2-105](#). Temporarily thread shoulder nut (4) onto push rod (13) several turns to protect push rod threads. Press down on push rod to compress piston spring (17). Slide push rod retainer (11) down into master cylinder bore.
9. Secure push rod assembly with **new** retaining ring (10). Verify that retaining ring is fully seated in groove. Remove shoulder nut from push rod.
10. See [Figure 2-108](#). Apply approximately 0.1 g of G40M BRAKE GREASE around groove (4) in boot collar nut (3). Carefully slide inner boot (5) down onto push rod (2) and into end of master cylinder bore. Press lip of inner boot down around groove in boot collar nut.
11. See [Figure 2-105](#). Install external return spring (7) and spring retainer (6). Thread shoulder nut (4) shoulder-first onto push rod (13), several turns past flats.

12. Thread yoke (3) onto push rod, at least 2-3 turns past flats. Install **new** spring pin (12) into end of push rod.

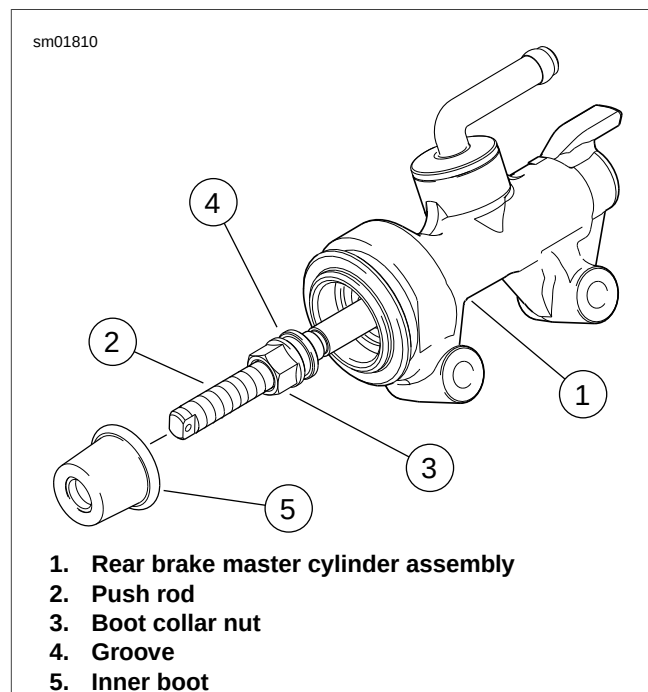


Figure 2-108. Lubricating and Installing Inner Boot

13. See [Figure 2-109](#). Measure distance from centerline of clevis pin hole (1) in yoke to centerline of master cylinder mounting boss hole (2) closest to yoke. This distance must be 3.40-3.48 in. (86.3-88.3 mm). Turn yoke on push rod in one direction or the other until this distance is obtained.

NOTE

See [Figure 2-104](#). Grip yoke by the edges with adjustable wrench. do not grip yoke by the flats of the yoke may become deformed.

14. See [Figure 2-104](#). Holding yoke with an adjustable wrench, turn shoulder nut back against yoke. Tighten to 130-173 in-lbs (14.7-19.6 Nm).
15. Remove master cylinder assembly from vise. See [Figure 2-106](#). Slide external boot (2) over yoke/push rod assembly and external return spring.
16. Position external boot so that tabs (3) are at the 3-o'clock and 9-o'clock position when master cylinder body (1) is held upright. This assures that drain hole is at bottom of boot when master cylinder is mounted on motorcycle. Make sure that lip on large end of external boot fits fully in groove in end of master cylinder. Make sure that spring retainer is fully seated in groove in small end of external boot.

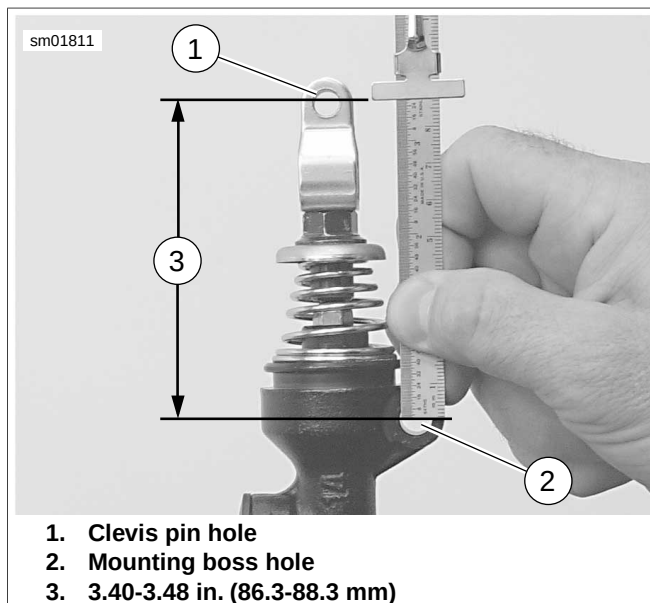


Figure 2-109. Adjusting Push Rod Length

INSTALLATION

WARNING

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

NOTE

Use correct retaining ring pliers and correct tips. Verify that tips are not excessively worn or damaged.

1. See [Figure 2-103](#). If master cylinder mounting bracket (15) was removed:
 - a. Attach mounting bracket to frame loosely with screws (23, 24). Then tighten two screws (23) to 17-22 ft-lbs (23.1-29.9 Nm). Tighten screw (24) to 17-22 ft-lbs (23.1-29.9 Nm).
 - b. Install bell crank (12) with clevis pin (13). Secure with **new** retaining ring (14).
2. Install rear master cylinder assembly (6) on mounting bracket (15) with screws (7) and washers (8). Tighten to 17-22 ft-lbs (23.1-29.9 Nm).
3. Fit yoke (10) onto bell crank (12). Install clevis pin (9) and secure with **new** retaining ring (11).

NOTE

Master cylinder housing has a positive stop for banjo fitting. When tightening banjo bolt into master cylinder in the next step, rotate banjo fitting clockwise until it contacts positive stop.

4. Position a **new** washer (16) on each side of hydraulic brake line banjo fitting (17). Insert banjo bolt (18) through washers and fitting. Thread bolt into master cylinder housing. Tighten to 20-25 ft-lbs (27.1-33.9 Nm).
5. Install rear brake master cylinder feed hose (3) on master cylinder feed hose port fitting (5). Secure with new hose

clamp (4). See [2.15 REAR BRAKE MASTER CYLINDER RESERVOIR](#).

CAUTION

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

CAUTION

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

NOTES

- If D.O.T. 4 brake fluid contacts painted surfaces, IMMEDIATELY flush area with clear water.
 - Rear brake master cylinder reservoir must be in a level position when filling and checking fluid level.
 - Reservoir cover may be removed from rear brake master cylinder reservoir to more easily verify fluid level in reservoir.
 - Use only HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID from a sealed container.
 - Do not overfill reservoir. Do not reuse old brake fluid.
6. Position motorcycle upright (not resting on jiffy stand).
 7. See [Figure 2-117](#). Remove reservoir cap (4). If desired, remove reservoir cover: grasp cover (2) and gently pull straight out from reservoir (1).
 8. Fill rear master cylinder reservoir with HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID until the fluid level reaches the UPPER mark on the reservoir.
 9. Bleed brake system. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#).
 10. Turn ignition/light switch ON. Test operation of brake lamp with the rear brake applied.

WARNING

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

WARNING

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

11. Test ride motorcycle at low speed. If brake feels spongy, repeat bleeding procedure.

REAR BRAKE MASTER CYLINDER: XR MODELS

2.14

GENERAL

The rear brake master cylinder is mounted to the right side rider footrest/rear brake pedal bracket.

If the rear brake feels spongy or excessive pedal travel exists or the brake does not work at all, proceed with Inspection which follows.

CAUTION

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

CAUTION

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

NOTE

If D.O.T. 4 brake fluid contacts painted surfaces, IMMEDIATELY flush area with clear water.

INSPECTION

1. Check the level of fluid in the rear brake reservoir. If it is low, refill and bleed brake system. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#).
2. Check for fluid leaks in the brake line, around banjo fittings or rear brake caliper piston or bleeder valve. Repair and bleed brake system.
 - a. For brake line replacement procedure, see [2.18 BRAKE LINES](#).
 - b. To repair rear brake caliper, see procedure in [2.17 REAR BRAKE CALIPER: XR MODELS](#).
 - c. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#) for hydraulic brake system bleeding procedure.
3. Check rear brake friction pads and disc for excessive wear or damage. Replace worn or damaged items.
 - a. See [1.10 BRAKE PADS AND DISCS: XR MODELS](#) for specifications.
 - b. See [1.10 BRAKE PADS AND DISCS: XR MODELS, Brake Pad Replacement: Rear](#) for brake pad replacement procedure.
 - c. See [2.4 WHEELS](#) for brake disc replacement procedure.
4. Eliminate any air in the hydraulic brake assembly by bleeding the system. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#).

If none of these conditions exist but the rear brake system does not operate properly, the rear master cylinder is most likely defective and must be repaired or replaced.

REMOVAL

CAUTION

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

1. See [Figure 2-110](#). Drain rear brake master cylinder reservoir (7) and remove feed hose (8) from master cylinder feed hose port fitting. See [2.15 REAR BRAKE MASTER CYLINDER RESERVOIR](#). Discard hose clamp.
2. Install end of a length of 5/16 in. (7.9 mm) I.D. clear plastic tubing over rear caliper bleeder valve and place free end of tubing in a suitable container.
3. Open bleeder valve about 1/2-turn. Pump brake pedal to drain brake fluid. Close bleeder valve but do not tighten.

WARNING

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

4. Remove retaining ring (1) from clevis pin (2). Remove clevis pin and disengage master cylinder yoke (3) from brake pedal. Discard retaining ring.

NOTE

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

5. Remove banjo bolt (6) and washers (5). Lift banjo fitting away from master cylinder. Discard washers.
6. Remove two screws (4) securing rear master cylinder to master cylinder mounting bracket and remove rear master cylinder.
7. If it is necessary to remove master cylinder/footpeg mounting bracket, remove fasteners (9). Refer to [2.42 RIDER FOOT CONTROLS: XR MODELS](#) for disassembly and repair procedures.

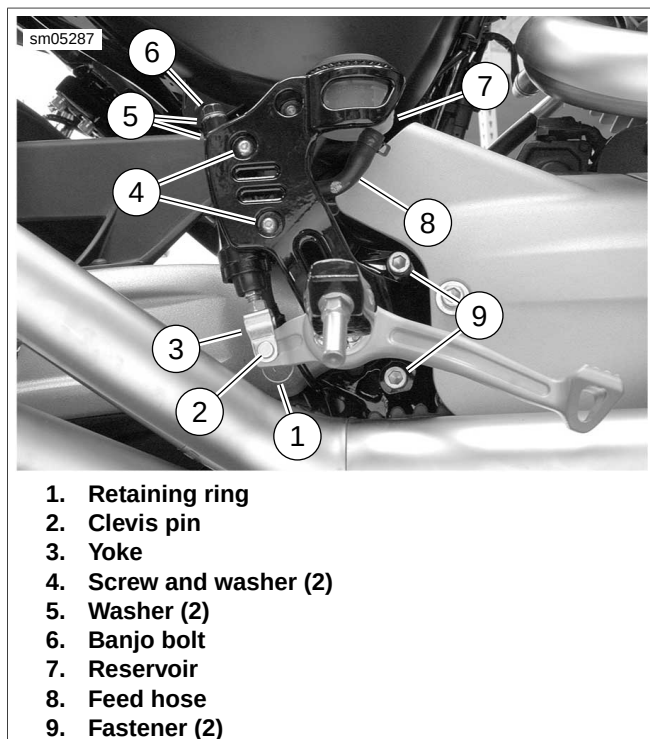


Figure 2-110. Rear Brake Master Cylinder and Reservoir

DISASSEMBLY

NOTE

- Do not disassemble the rear master cylinder unless problems are being experienced. Discard all seals during the disassembly procedure. Install a complete rebuild kit when the unit is reassembled.

- Clamp rear brake master cylinder in a vise by its mounting bosses only. Use brass or aluminum jaw covers or other protective device on vise jaws to prevent damage to master cylinder.

- See [Figure 2-112](#). Clamp rear brake master cylinder in a vise with yoke (3) pointing up.

NOTE

See [Figure 2-111](#). Grip yoke by the edges with an adjustable wrench. Do not grip yoke by the flats or the yoke may become deformed.

- See [Figure 2-111](#). Hold yoke with an adjustable wrench. Using an open-end wrench, loosen shoulder nut. Remove yoke.
- See [Figure 2-112](#). Remove nut (4) from push rod.
- Remove and discard boot (5).

NOTE

Do not remove boot collar nut (8) from push rod.

WARNING

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

NOTE

Use correct retaining ring pliers and correct tips. Verify that tips are not excessively worn or damaged.

- Thread nut (4) back onto push rod several turns, to protect push rod threads. Press down on push rod to compress piston spring (12). Remove retaining ring (6), push rod (7) with boot collar nut (8), piston (10) with secondary cup (9), primary cup (11) and piston spring (12). Discard retaining ring, piston/cup assembly and piston spring.
- Remove dust cover (16), retaining ring (15), feed port fitting (14) and o-ring (13). Discard retaining ring and o-ring.

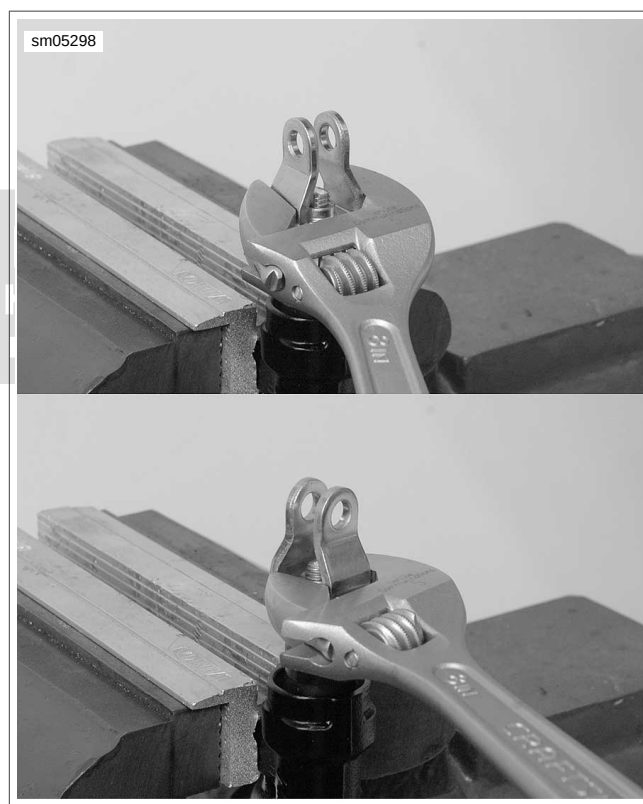


Figure 2-111. Holding Yoke (Top: Incorrect, Bottom: Correct)

sm05290

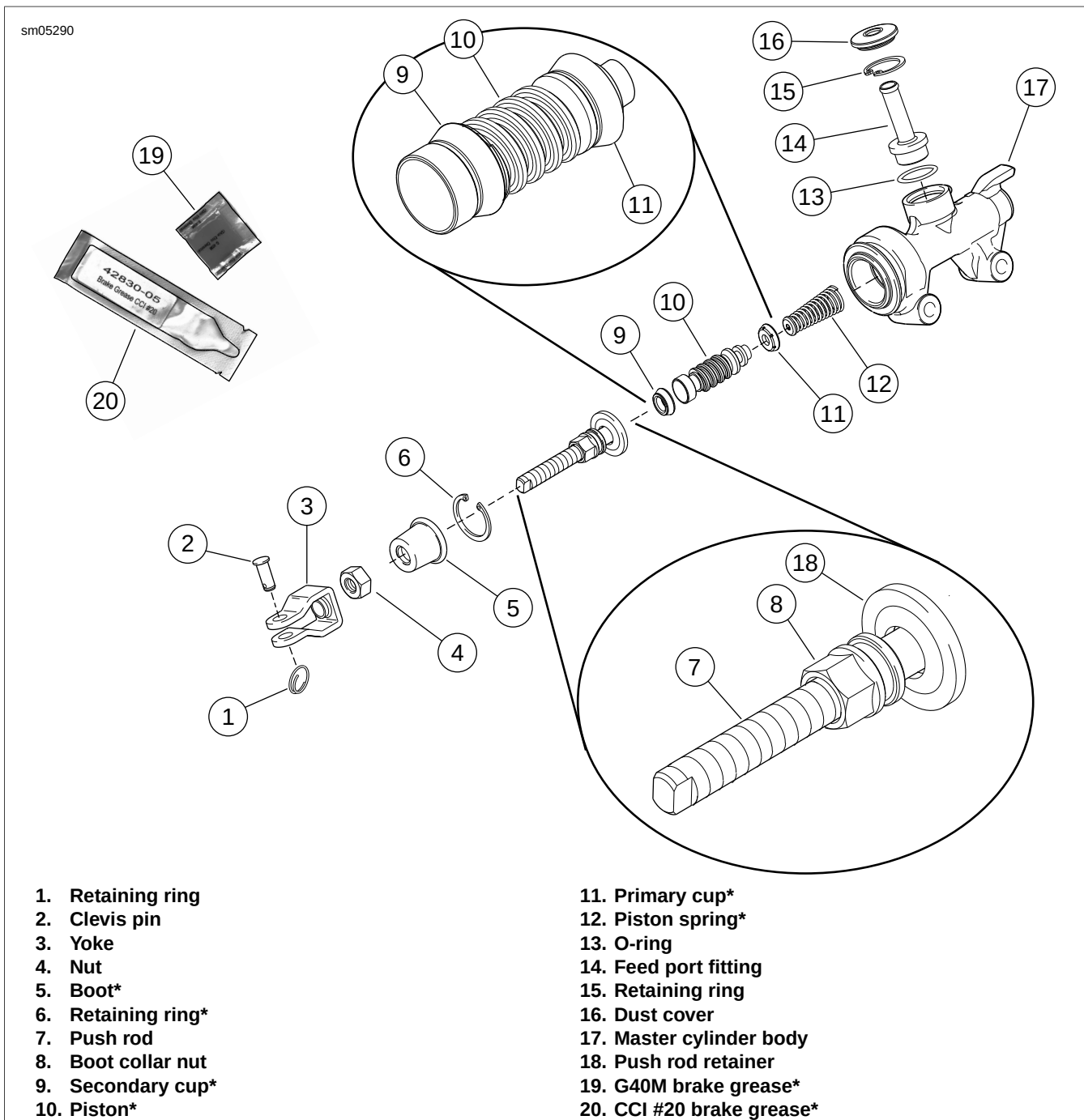


Figure 2-112. Rear Brake Master Cylinder (*Provided in Service Parts Kit)

CLEANING, INSPECTION AND REPAIR

⚠ WARNING

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

⚠ WARNING

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

1. See [Figure 2-112](#). Thoroughly clean master cylinder body (17) and all brake system components. Blow out drilled passages and piston bore in master cylinder body with low pressure compressed air from a clean air supply. Do

not use a wire or similar instrument to clean drilled passages.

2. Carefully inspect all parts for wear or damage and replace as necessary.
 - a. Inspect piston bore in master cylinder housing for scratches, grooves, scoring, pitting or corrosion. Replace housing if any of these conditions are found.
 - b. Inspect outlet port that mates with brake line banjo fitting. This is a critical sealing surface. Replace housing if any scratches, dents or other damage is found.
3. Verify that vent holes in master cylinder are completely open and free of dirt or debris.

ASSEMBLY

NOTES

- When assembling rear brake master cylinder, always use **new** parts from the service parts kit. Consult the **PARTS CATALOG** for the correct kit part number.
- CCI #20 BRAKE GREASE is recommended for lubrication of cylinder bore, cups and seals prior to assembly.
- Stand master cylinder on wooden block or clean, lint-free towel to protect seating surfaces.

⚠ WARNING

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

NOTE

Use correct retaining ring pliers and correct tips. Verify that tips are not excessively worn or damaged.

1. See [Figure 2-112](#). Coat **new** o-ring (13) with HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID. Install o-ring and feed port fitting (14) into feed port on master cylinder body (17). Secure with **new** retaining ring (15). Verify that retaining ring is fully seated in groove.
2. Slide dust cover (16) onto feed port fitting and press into place in master cylinder feed port.

NOTE

Clamp rear brake master cylinder body (17) in a vise by its mounting bosses only. Use brass jaw covers or other protective device on vise jaws to prevent damage to master cylinder.

3. Clamp master cylinder in a vise with banjo fitting end pointing down.
4. See [Figure 2-113](#). Lubricate master cylinder bore, **new** piston (1) with **new** secondary cup (3), and **new** primary cup (2) with CCI #20 BRAKE GREASE supplied in the service parts kit.

⚠ WARNING

Wear safety glasses or goggles when removing or installing spring. Spring tension can cause spring, attached components and/or hand tools to fly out which could result in death or serious injury. (00477c)

5. Press small end of **new** piston spring (4) onto mounting boss (8) on piston.

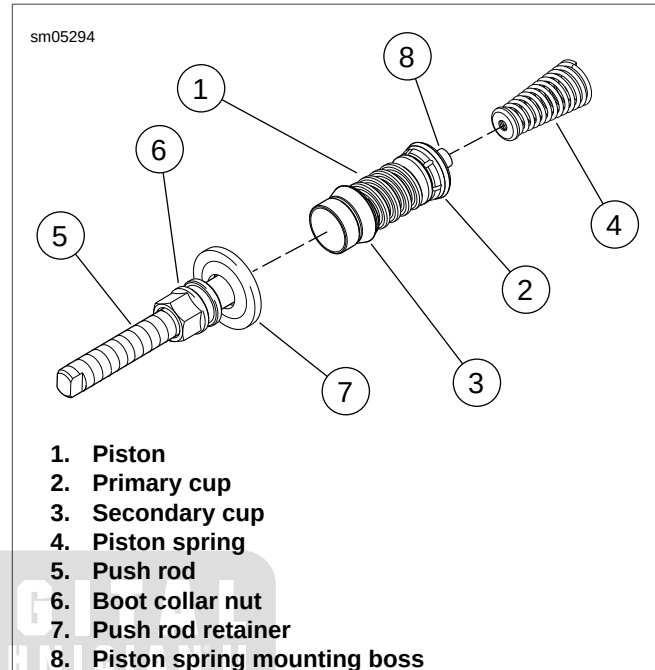


Figure 2-113. Rear Master Cylinder Piston, Push Rod and Spring Assembly

6. Slide piston/spring assembly, flared end of spring first, into cylinder bore so that spring seats against counter bore (recess) at bottom of cylinder.
7. Apply approximately 0.1 g of G40M BRAKE GREASE to ball end of push rod (5).

⚠ WARNING

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

NOTE

Use correct retaining ring pliers and correct tips. Verify that tips are not excessively worn or damaged.

8. See [Figure 2-112](#). Temporarily thread nut (4) onto push rod (7) several turns to protect push rod threads.
9. Insert push rod into master cylinder body. Press down on push rod to compress piston spring (12). Slide push rod retainer (18) down into master cylinder bore and hold in place.
10. Secure push rod assembly with **new** retaining ring (6). Verify that retaining ring is fully seated in groove. Remove nut (4) from push rod.

11. See [Figure 2-114](#). Apply approximately 0.1 g of G40M BRAKE GREASE around groove (4) in boot collar nut (3). Carefully slide inner boot (5) down onto push rod (2) and into end of master cylinder bore. Press lip of inner boot down around groove in boot collar nut.
12. See [Figure 2-112](#). Thread nut (4) onto push rod (7), several turns past flats.
13. Thread yoke (3) onto push rod, at least 2-3 turns past flats.

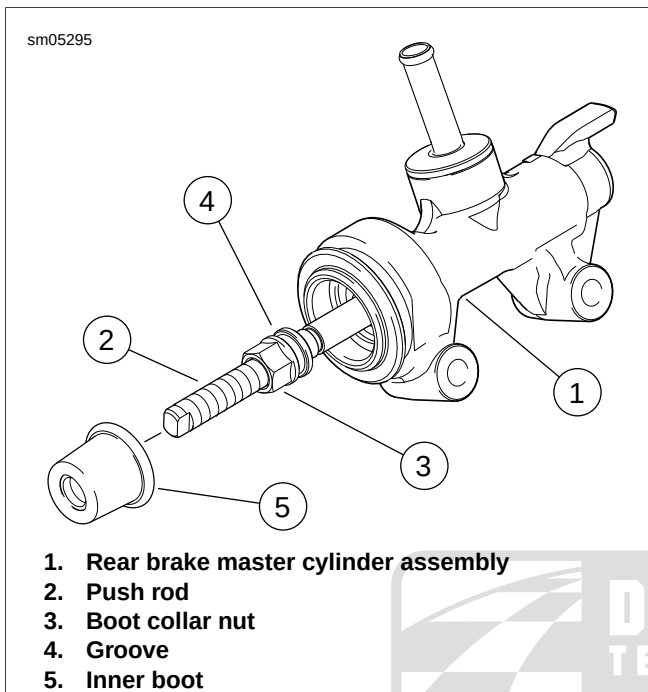


Figure 2-114. Lubricating and Installing Inner Boot

14. See [Figure 2-115](#). Measure distance (3) from centerline of clevis pin hole (1) in yoke to centerline of master cylinder mounting boss hole (2) closest to yoke. This distance must be 2.64-2.76 in. (67.1-70.1 mm). Adjust yoke until this distance is obtained.

NOTE

See [Figure 2-111](#). Grip yoke by the edges with adjustable wrench. do not grip yoke by the flats or the yoke may become deformed.

15. See [Figure 2-111](#). While holding yoke with an adjustable wrench, turn shoulder nut back against yoke. Tighten to 130-173 **in-lbs** (14.7-19.6 Nm).
16. Remove master cylinder assembly from vise.

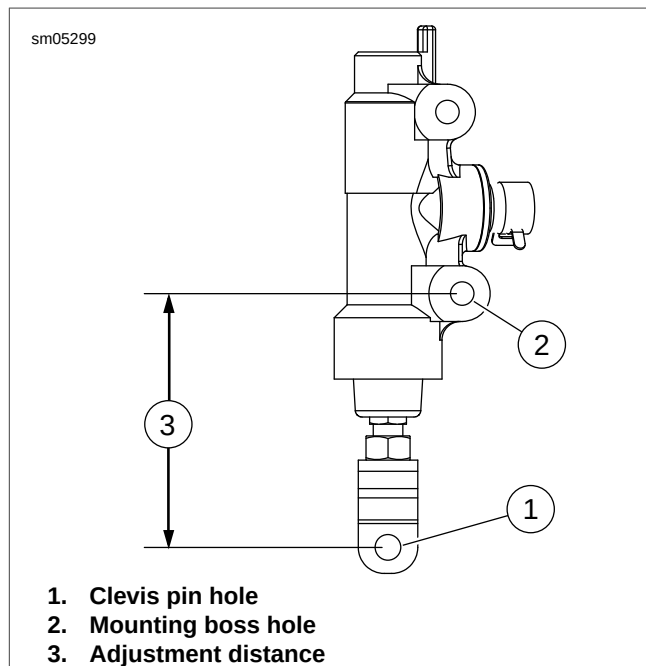


Figure 2-115. Adjusting Push Rod Length

INSTALLATION

⚠ WARNING

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

1. See [Figure 2-110](#). Assemble and install master cylinder/footpeg mounting bracket if it was removed. See [2.42 RIDER FOOT CONTROLS: XR MODELS](#).
2. Install rear master cylinder assembly to mounting bracket with screws and washers (4). Tighten to 72-96 **in-lbs** (8.1-10.9 Nm).
3. Fit yoke (3) onto foot pedal. Install clevis pin (2) and secure with **new** retaining ring (1).

NOTE

Master cylinder housing has a positive stop for banjo fitting. When tightening banjo bolt into master cylinder in the next step, rotate banjo fitting clockwise until it contacts positive stop.

4. Position a **new** washer (5) on each side of hydraulic brake line banjo fitting. Insert banjo bolt (6) through washers and fitting. Thread banjo bolt into master cylinder housing. Tighten to 20-25 ft-lbs (27.1-33.9 Nm).
5. Install rear brake master cylinder feed hose (8) on master cylinder feed hose port fitting. Secure with new hose clamp.

CAUTION

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

CAUTION

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

NOTES

- If D.O.T. 4 brake fluid contacts painted surfaces, **IMMEDIATELY** flush area with clear water.
 - Rear brake master cylinder reservoir must be in a level position when filling and checking fluid level.
 - Reservoir cover may be removed from rear brake master cylinder reservoir to more easily verify fluid level in reservoir.
 - Use only **HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID** from a sealed container.
 - Do not overfill reservoir. Do not reuse old brake fluid.
6. Position motorcycle upright (not resting on jiffy stand).
 7. See [Figure 2-116](#). Remove reservoir cap (2).
 8. Fill rear master cylinder reservoir (1) with **HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID** until the fluid level reaches the **UPPER** mark (3) on the reservoir.
 9. Bleed brake system. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#).

10. Turn ignition/light switch ON. Test operation of brake lamp with the rear brake applied.

WARNING

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

WARNING

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

11. Test ride motorcycle at low speed. If brake feels spongy, repeat bleeding procedure.

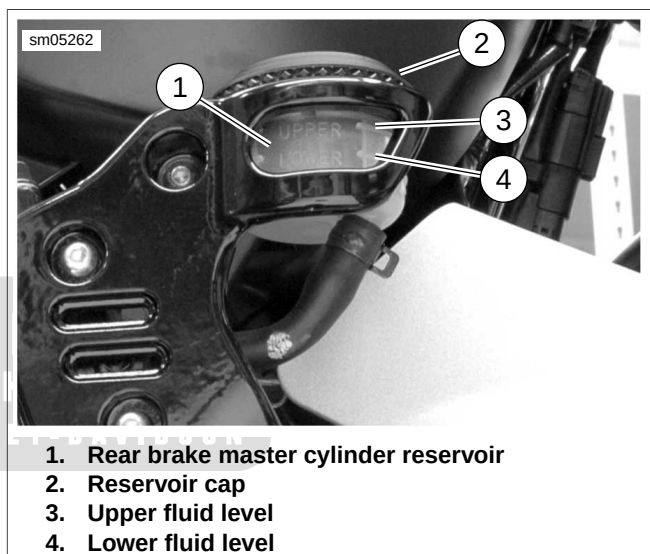


Figure 2-116. Rear Brake Master Cylinder Reservoir (XR Models)

REAR BRAKE MASTER CYLINDER RESERVOIR

2.15

GENERAL

The rear brake master cylinder is equipped with a remote fluid reservoir. On XL models, this reservoir is located to the rear of the primary cover, below the left side cover. On XR models, the reservoir is mounted on the right side rider footrest/rear brake pedal bracket.

REMOVAL: XL MODELS

CAUTION

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

CAUTION

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

NOTE

If D.O.T. 4 brake fluid contacts painted surfaces, IMMEDIATELY flush area with clear water.

1. Position motorcycle upright on suitable lift.
2. See [Figure 2-117](#). Grasp reservoir cover (2) and gently pull straight out from reservoir (1).
3. Remove screw with captive washer (3).
4. Remove reservoir cap (4). Hold reservoir upside down over a suitable container and drain brake fluid.
5. Loosen hose clamp (5) and pull feed hose (6) from reservoir. Slide hose clamp off free end of feed hose.
6. See [Figure 2-118](#). Slide feed hose (2) down through B-clamp (3). Hold free end of hose down over container and drain any brake fluid remaining in hose.
7. Loosen hose clamp (4) and pull feed hose off feed hose port (5) on master cylinder (1).
8. Cover feed hose port with a clean, lint-free cloth to keep dirt and debris out of master cylinder.

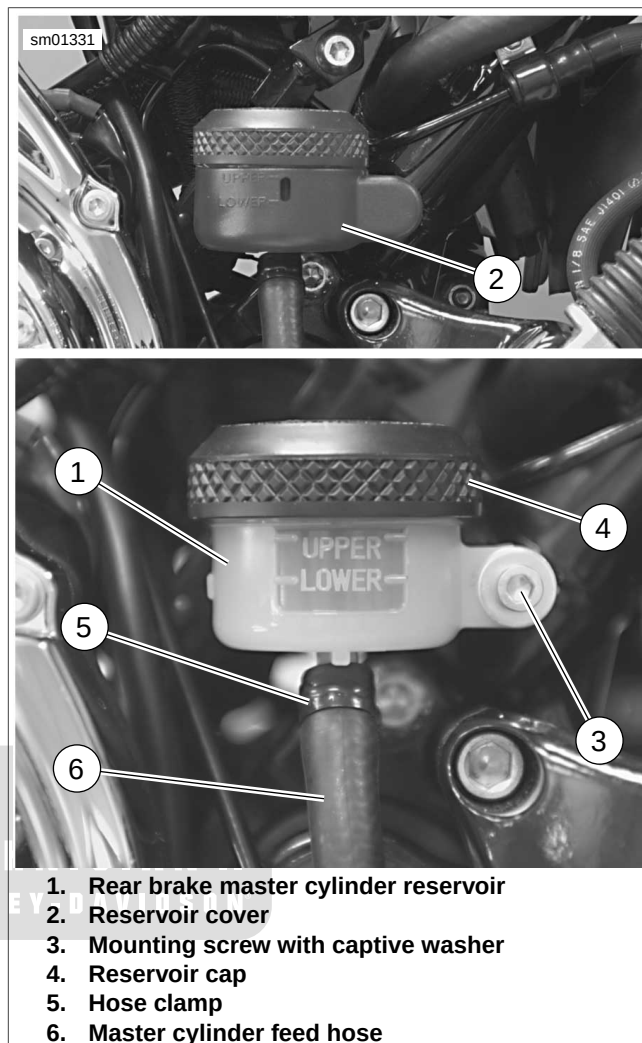
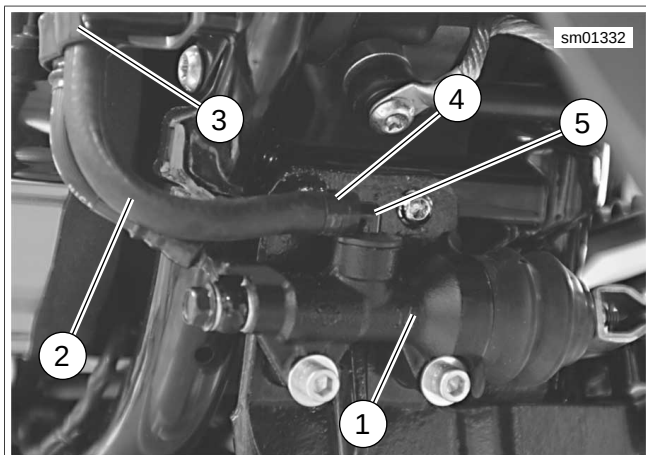


Figure 2-117. Reservoir Mount



1. Rear brake master cylinder
2. Master cylinder feed hose
3. B-clamp
4. Hose clamp
5. Feed hose port

Figure 2-118. Master Cylinder Feed Hose

INSTALLATION: XL MODELS

CAUTION

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

CAUTION

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

NOTE

If D.O.T. 4 brake fluid contacts painted surfaces, **IMMEDIATELY** flush area with clear water.

1. See [Figure 2-118](#). Slide end of feed hose (2) onto feed hose port (5) on master cylinder (1). Secure feed hose to fitting with hose clamp (4).
2. Slide free end of feed hose up through B-clamp (3).
3. See [Figure 2-117](#). Slide hose clamp (5) onto free end of feed hose (6).
4. Push feed hose onto fitting on reservoir (1) and secure with hose clamp.
5. Install reservoir using screw with captive washer (3). Tighten to 20-25 **in-lbs** (2.3-2.8 Nm).

NOTES

- Rear brake master cylinder reservoir must be in a level position when filling and checking fluid level.
 - Use only **HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID** from a sealed container.
 - Do not overfill reservoir. Do not reuse old brake fluid.
6. Position motorcycle upright (not resting on jiffy stand). Fill master cylinder reservoir with **HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID** until the fluid level reaches the **UPPER** mark on the reservoir.
 7. Bleed brake system. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#).
 8. Install reservoir cover (2).
 9. Turn ignition/light switch **ON**. Test operation of brake lamp with the rear brake applied.

WARNING

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

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

REMOVAL: XR MODELS

CAUTION

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

CAUTION

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

NOTE

If D.O.T. 4 brake fluid contacts painted surfaces, **IMMEDIATELY** flush area with clear water.

1. Position motorcycle upright on suitable lift.
2. See [Figure 2-119](#). Loosen reservoir cap (2).
3. Remove screw (6).
4. Remove reservoir cap (2). Hold reservoir upside down over a suitable container and drain brake fluid.
5. Loosen hose clamp (3) and pull feed hose (4) from reservoir. Slide hose clamp off free end of feed hose.

6. Loosen hose clamp (5) and pull feed hose off master cylinder. Cover feed hose port with a clean, lint-free cloth to keep dirt and debris out of master cylinder.

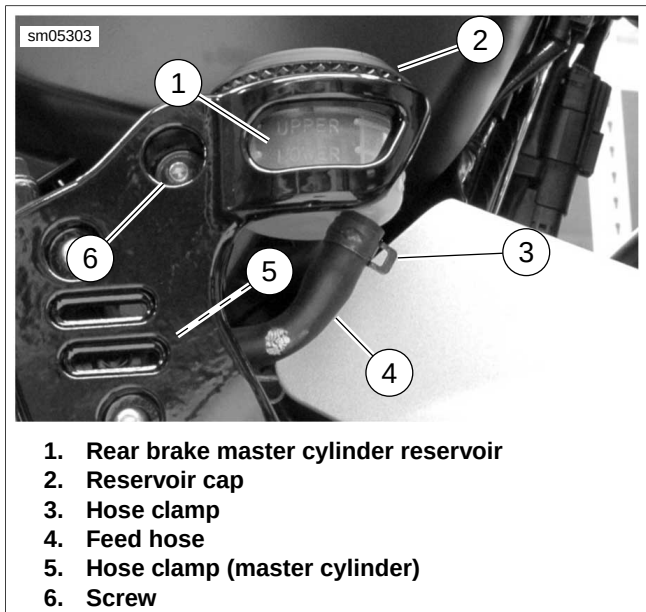


Figure 2-119. Rear Brake Master Cylinder Reservoir: XR Models

INSTALLATION: XR MODELS

CAUTION

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

CAUTION

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

NOTE

If D.O.T. 4 brake fluid contacts painted surfaces, IMMEDIATELY flush area with clear water.

1. See [Figure 2-119](#). Slide end of feed hose (4) onto feed hose port on master cylinder. Secure feed hose to fitting with hose clamp (5).
2. Slide hose clamp (3) onto free end of feed hose (4).
3. Push feed hose onto fitting on reservoir (1) and secure with hose clamp.
4. Install reservoir using screw (6). Tighten to 36-60 **in-lbs** (4.1-6.8 Nm).

NOTES

- *Rear brake master cylinder reservoir must be in a level position when filling and checking fluid level.*
 - *Use only HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID from a sealed container.*
 - *Do not overfill reservoir. Do not reuse old brake fluid.*
5. Position motorcycle upright (not resting on jiffy stand). Fill master cylinder reservoir with HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID until the fluid level reaches the UPPER mark on the reservoir.
 6. Bleed brake system. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#).
 7. Install reservoir cover (2).
 8. Turn ignition/light switch ON. Test operation of brake lamp with the rear brake applied.

WARNING

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

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

REAR BRAKE CALIPER: XL MODELS

2.16

REMOVAL

NOTE

If only replacing brake pads, do not remove rear brake caliper. For brake pad replacement only, see [1.9 BRAKE PADS AND DISCS: XL MODELS](#).

CAUTION

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

NOTE

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

CAUTION

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

NOTES

- Do **not** remove rear caliper from mounting bracket unless caliper mounting pins and boots require service. Removing caliper from mounting bracket unnecessarily increases the risk of contaminants falling into caliper boots and bushings which could damage caliper during vehicle operation.
 - It is further **not** required or recommended to remove or loosen the caliper mounting pins.
 - It is **not** necessary or recommended to remove the rear brake caliper from the caliper mounting bracket to perform caliper service.
 - If D.O.T. 4 brake fluid contacts painted surfaces, IMMEDIATELY flush area with clear water.
- Position vehicle upright on a suitable lift.
 - Place a suitable container under the rear caliper brake line banjo fitting to catch any brake fluid that may leak out. Do not reuse brake fluid.
 - See [Figure 2-120](#). Remove the banjo bolt (1) and both washers (2) to detach rear brake line (3) from brake caliper (4). Discard washers.

- Remove pad pin plug (6).
- See [Figure 2-121](#). Remove brake pad pin.
- See [Figure 2-122](#). Remove brake pads (15).
- Remove rear wheel. See [2.4 WHEELS, Rear Wheel](#).
- See [Figure 2-120](#). Remove rear brake caliper (4) and caliper mounting bracket (5) as an assembly.

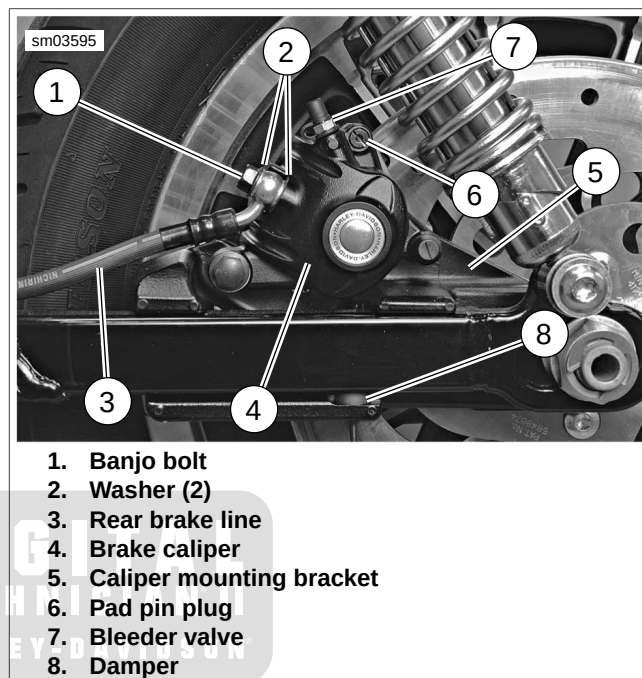


Figure 2-120. Rear Caliper Assembly

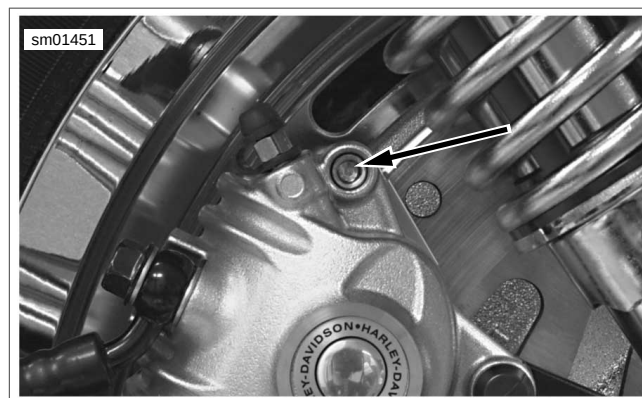
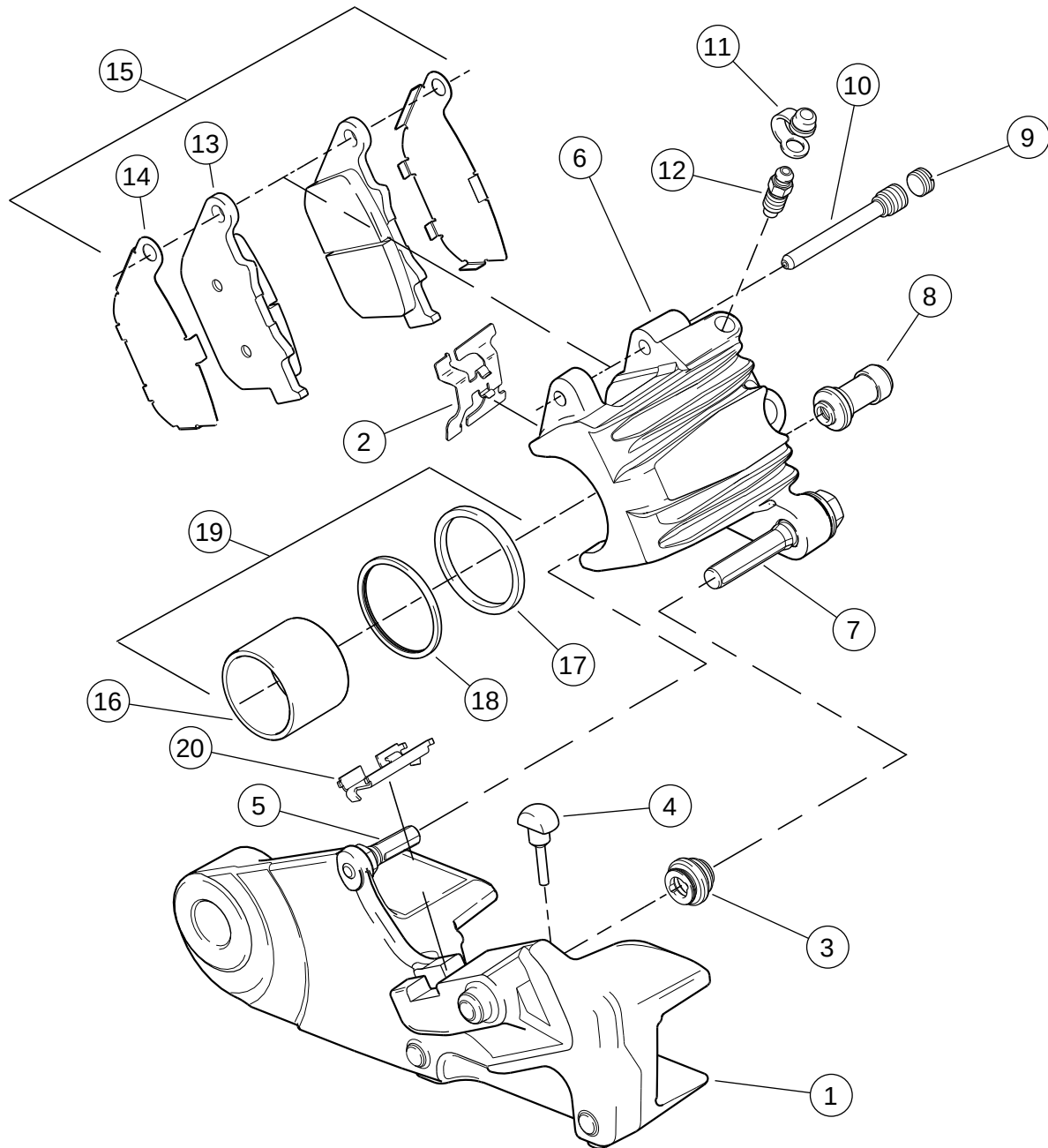


Figure 2-121. Brake Pad Pin (Plug Removed)

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- | | |
|--|---|
| 1. Caliper mounting bracket | 11. Bleeder nipple cap |
| 2. Pad spring | 12. Bleeder valve |
| 3. Caliper pin boot | 13. Brake pad (2) |
| 4. Damper | 14. Pad retainer (2) |
| 5. Mounting bracket bolt pin (do not remove) | 15. Brake pad set (includes item 20) |
| 6. Caliper body | 16. Piston |
| 7. Caliper bolt pin (do not remove) | 17. Piston seal |
| 8. Caliper bushing boot | 18. Dust seal |
| 9. Pad pin plug | 19. Piston kit |
| 10. Pad pin | 20. Retainer clip (not sold separately) |

Figure 2-122. Rear Brake Caliper Assembly

DISASSEMBLY

1. See [Figure 2-122](#). Remove pad spring (2). Do not remove bleeder valve (12) at this time.
2. See [Figure 2-123](#). Install a discarded brake pad in the caliper with the backing plate (4) facing the piston. Position the brake pad so the friction material (3) is against the back of the caliper, as shown.
3. Loosely install brake pad pin (2) to hold brake pad in place.

⚠ WARNING

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

⚠ CAUTION

When removing piston with compressed air, piston can develop considerable force and fly out of caliper bore. Keep hands away from piston to avoid possible injury. (00530b)

NOTE

Be careful not to damage banjo bolt sealing surface or threads of banjo bolt hole in brake caliper. It is recommended that you use an air nozzle with a rubber tip to perform the next step in this procedure.

4. See [Figure 2-124](#). Gently apply low pressure compressed air to banjo bolt hole (3) to force piston from caliper bore.
5. Remove brake pad pin and brake pad from caliper.
6. See [Figure 2-122](#). Remove piston (16) from caliper bore by hand. If necessary, gently wiggle piston to completely remove.

NOTE

A damaged piston bore will leak when reassembled. Do not use metal objects to remove or install components in piston bore. Prevent damage to piston, seal and bore by only using a wooden toothpick when servicing caliper.

7. See [Figure 2-125](#). Using a wooden toothpick (1), remove dust seal (2) and piston seal (3) from caliper bore. Discard seals.
8. See [Figure 2-122](#). If necessary, remove bleeder valve (12).

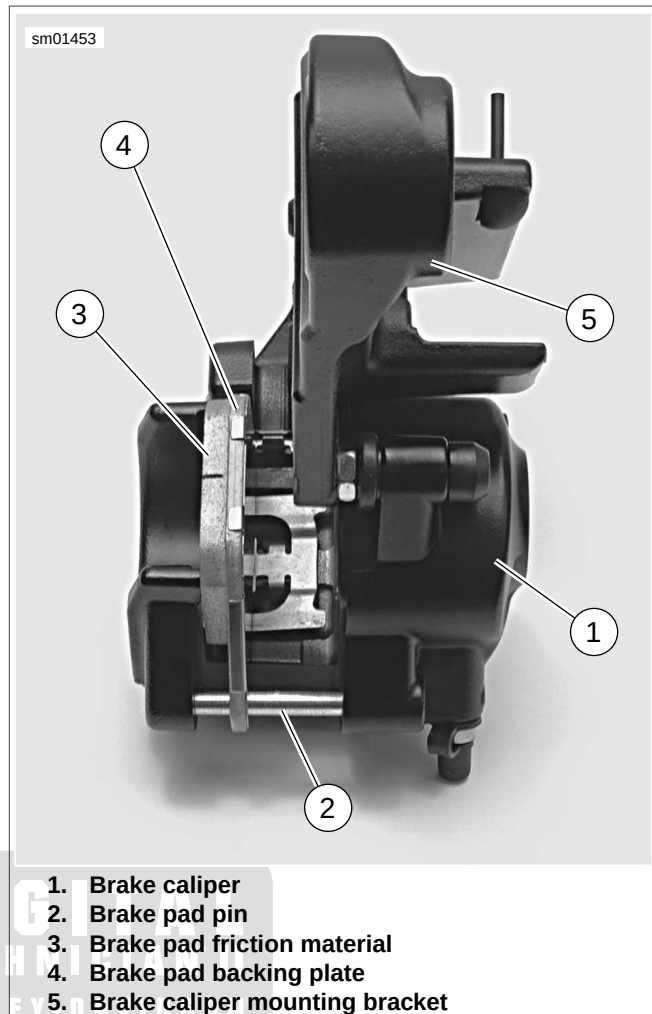


Figure 2-123. Preparing Caliper for Piston Removal

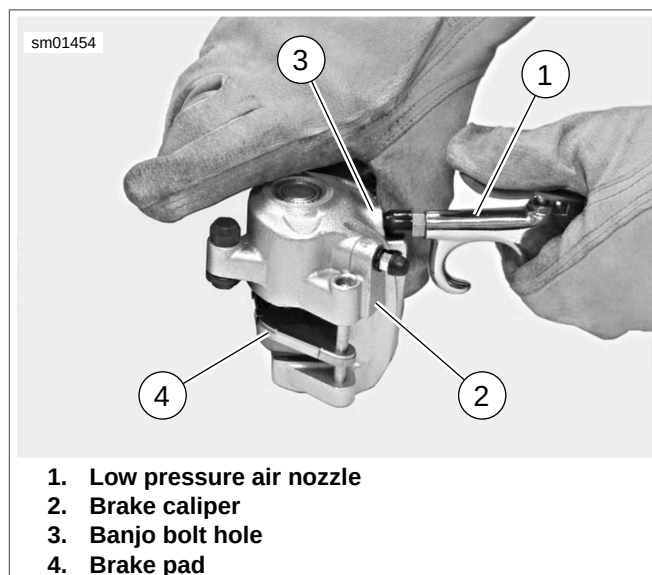


Figure 2-124. Removing Piston (Caliper Removed from Mounting Bracket for Clarity)



Figure 2-125. Caliper Seals

CLEANING, INSPECTION AND REPAIR

⚠ WARNING

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

1. Clean piston bore with denatured alcohol.
2. Clean all rubber parts with HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID. Do not contaminate with mineral oil or other solvents. Wipe parts dry with a clean, lint free cloth.

⚠ WARNING

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

3. Blow out drilled passages and piston bore with low pressure compressed air from a clean air supply. Do not use a wire or similar instrument to clean drilled passages.
4. Carefully inspect all components. Replace any parts that appear damaged or worn.
 - a. Check piston (16) for pitting, scratching or corrosion on outside surfaces.
 - b. Inspect caliper (6) piston bore. Do not hone bore. If bore shows pitting or corrosion, replace caliper.
 - c. Inspect pad pin (10) for grooving and wear. Measure the pad pin diameter in an unworn area, and then in the area of any grooving or wear. If wear is more than 0.011 in. (0.28 mm), replace pad pin.
 - d. Always replace all seals after disassembly.

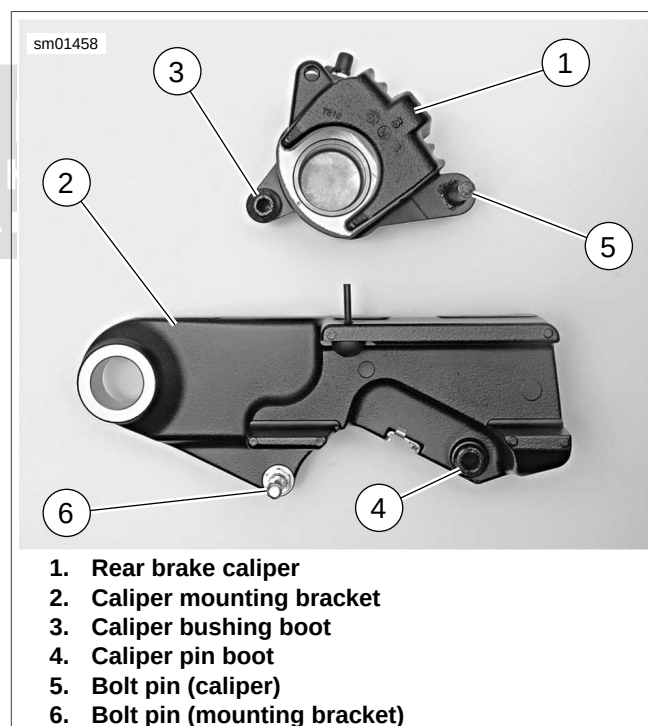
⚠ WARNING

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

5. Inspect brake pads (13) and brake disc. Replace if necessary.
 - a. See [1.9 BRAKE PADS AND DISCS: XL MODELS](#) for specifications.
 - b. See [2.4 WHEELS](#) for brake disc replacement procedure.

LUBRICATING REAR CALIPER BOLT PINS AND BOOTS

1. See [Figure 2-126](#). Apply approximately 0.4 g of G40M BRAKE GREASE inside caliper bushing boot (3) and caliper pin boot (4).
2. See [Figure 2-127](#). Apply G40M BRAKE GREASE inside boot lip (8) to prevent sticking between boots (3, 4) and bolt pins (5, 6).
3. Insert mounting bracket bolt pin (6) into caliper bushing boot (3).



1. Rear brake caliper
2. Caliper mounting bracket
3. Caliper bushing boot
4. Caliper pin boot
5. Bolt pin (caliper)
6. Bolt pin (mounting bracket)

Figure 2-126. Lubricating Caliper Boots and Pins

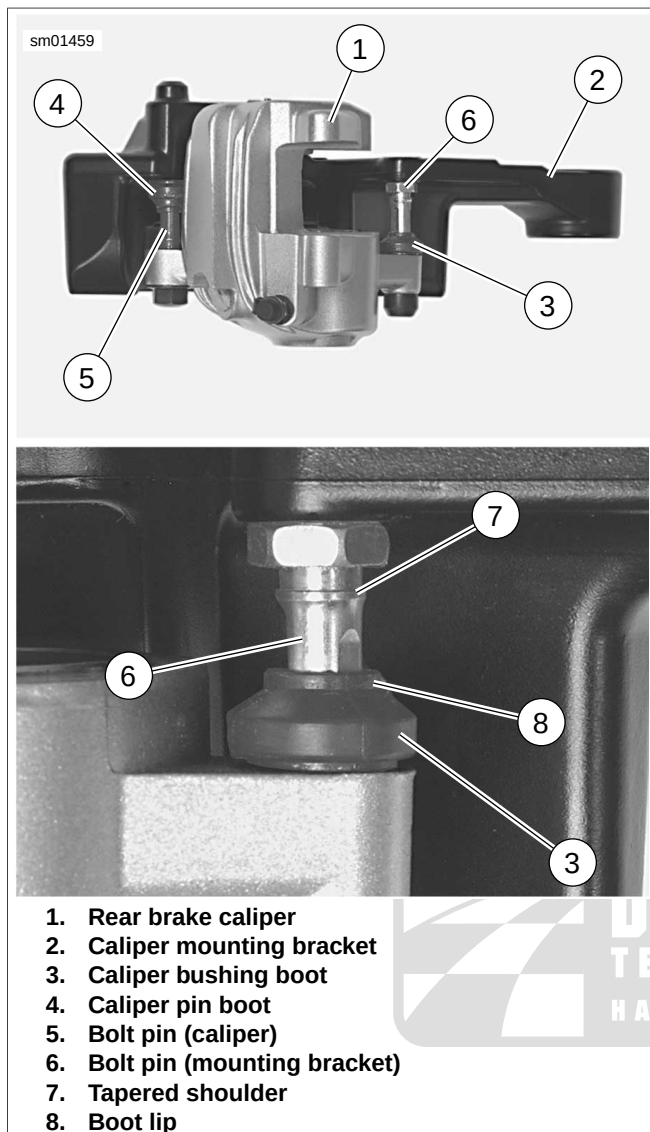


Figure 2-127. Assembling Rear Brake Caliper to Mounting Bracket

ASSEMBLY

NOTE

Use **ONLY** KS62F assembly grease for lubrication. Use of D.O.T. 4 brake fluid will result in increased brake pedal travel.

1. Lubricate the following parts prior to assembly using a light coat of KS62F assembly grease from the service parts kit. All other surfaces must be dry for assembly.
 - a. Nose radius of piston. See [Figure 2-128](#).
 - b. All surfaces of piston seal and dust seal.

NOTE

A damaged piston bore will leak when reassembled. Do not use metal objects to remove or install components in piston bore. Prevent damage to bore by only using a wooden toothpick when servicing caliper.

2. See [Figure 2-125](#). Install a **new** piston seal (3) and a **new** dust seal (2) into piston bore.

3. Carefully insert piston by hand, nose radius first (see [Figure 2-122](#)), into caliper bore. If installation shows resistance, remove piston and check that seals are properly installed and fully seated in grooves.
4. See [Figure 2-122](#). Install bleeder valve (12) on caliper housing if removed. Do not tighten bleeder valve at this time.
5. See [Figure 2-129](#). Place caliper and mounting bracket assembly on workbench as shown. Install pad spring in channel. Press firmly into place.



Figure 2-128. Piston Nose Radius

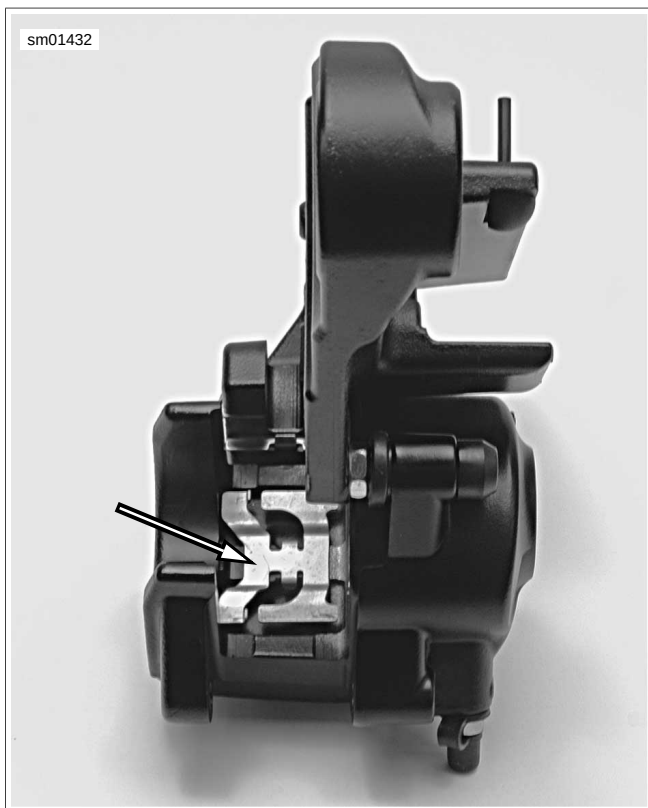


Figure 2-129. Rear Caliper Pad Spring

INSTALLATION

1. See [Figure 2-130](#). Before installing caliper, make sure that retainer clip is properly installed on mounting bracket.
2. See [Figure 2-122](#). Place rear caliper assembly (6) onto mounting bracket (1), being careful not to pinch or roll boots over.
3. Install rear brake caliper and mounting bracket assembly onto vehicle.

NOTE

Brake caliper housing has a positive stop for banjo fitting. When tightening banjo bolt into brake caliper in the next step, rotate banjo fitting clockwise until it contacts positive stop.

4. See [Figure 2-131](#). Position a **new** washer (2) on each side of hydraulic brake line (3) banjo fitting. Insert banjo bolt (1) through washers and fitting. Thread bolt into caliper housing. Tighten to 20-25 ft-lbs (27.1-33.9 Nm).

NOTE

The rear brake caliper does NOT use the same exact brake pad set as the front left and front right (not present on all models) calipers.

5. See [Figure 2-132](#). Insert brake pads (1) into caliper with friction material on pad facing brake disc. Curved portion of pad fits into recessed area of caliper. Make sure brake pad front mounting tab (2) fits into slot (5) in caliper mounting bracket (4).
6. See [Figure 2-122](#). Press brake pads (15) tightly up against pad spring (2) and install pad pin (10). Tighten to 131-173 in-lbs (14.8-19.6 Nm).

NOTES

If pad pin does not fit, check the following:

- You are using a set of pads, not two identical pads.
 - Pad spring orientation must match [Figure 2-129](#).
 - See [Figure 2-132](#). Pad front mounting tabs (2) must be fully seated in mounting bracket slot (5).
 - Pads must be pushed tight up against pad spring before pad pin is installed.
7. See [Figure 2-122](#). Install pad pin plug (9). Tighten to 18-25 in-lbs (2.0-2.9 Nm).

CAUTION

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

CAUTION

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

NOTES

- If D.O.T. 4 brake fluid contacts painted surfaces, IMMEDIATELY flush area with clear water.
 - Rear brake master cylinder reservoir must be in a level position when filling and checking fluid level.
 - See [Figure 2-133](#). Reservoir cover (2) may be removed from rear brake master cylinder reservoir (1) to more easily verify fluid level in reservoir.
8. See [Figure 2-133](#). If desired, remove reservoir cover: grasp cover (2) and gently pull straight out from reservoir (1).
 9. Remove rear brake master cylinder reservoir cap (5). Add HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID to reservoir until fluid reaches upper fluid level (3). Do not overfill reservoir. Do not reuse brake fluid.

WARNING

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

10. Bleed brake system. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#).

WARNING

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

11. Verify proper operation of master cylinder relief port.
 - a. Press against rear brake caliper to push caliper piston back into its bore. This pushes brake fluid back through master cylinder and verifies that relief port is not plugged.
 - b. Pump brake pedal until caliper piston pushes pads against disc and pressure is returned to brake system.
12. Add HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID to reservoir until fluid reaches upper fluid level.
13. If reservoir cover was removed, install cover on reservoir.

WARNING

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

14. Test brake system.
 - a. Turn ignition switch ON. Pump brake pedal to verify operation of brake lamp.
 - b. Test ride motorcycle at low speed. If brakes feel spongy, bleed system again. See [1.8 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.

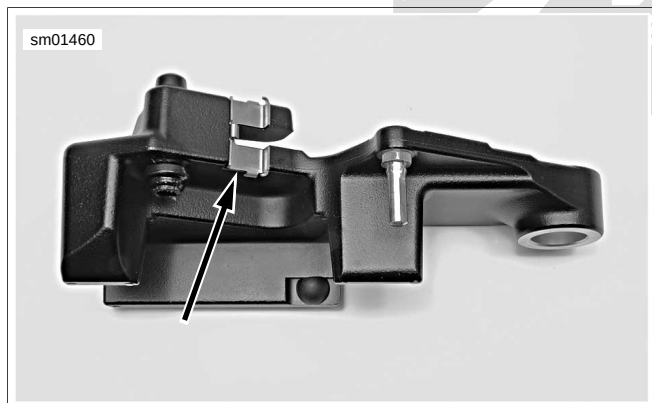


Figure 2-130. Retainer Clip

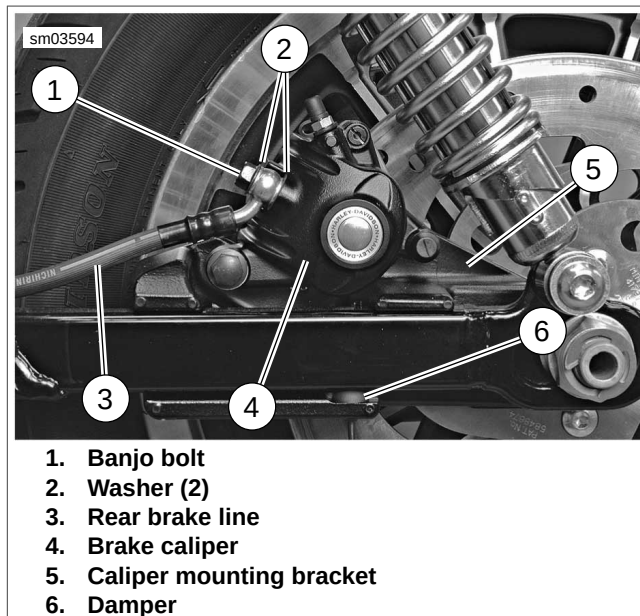


Figure 2-131. Rear Caliper Assembly

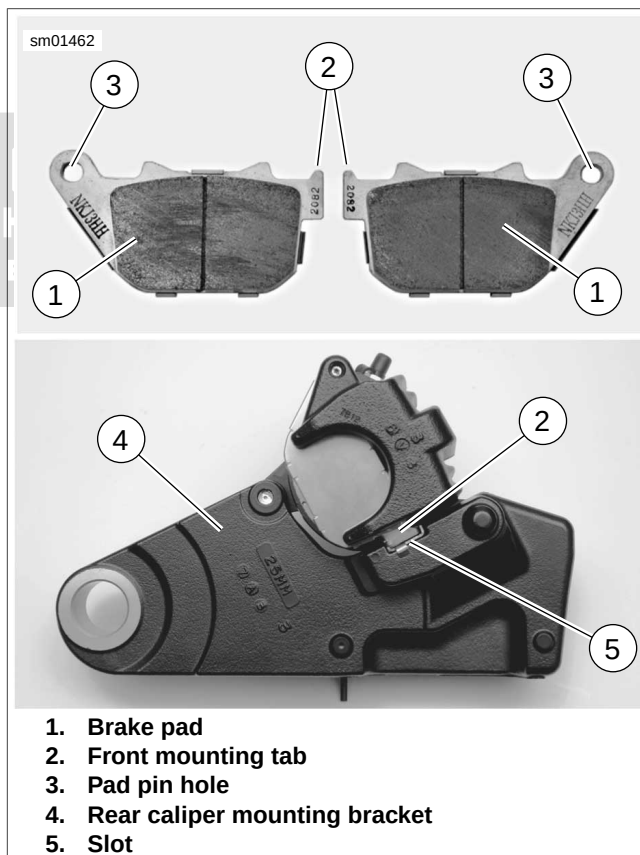


Figure 2-132. Installing Rear Brake Pads

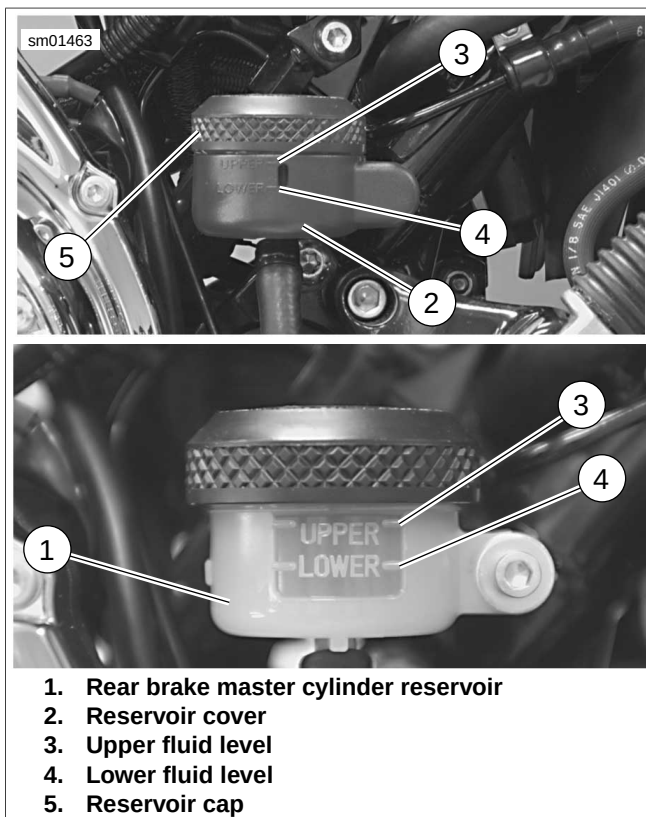


Figure 2-133. Rear Brake Master Cylinder Reservoir



REAR BRAKE CALIPER: XR MODELS

2.17

REMOVAL

NOTE

If only replacing brake pads, do not remove rear brake caliper. For brake pad replacement only, see [1.10 BRAKE PADS AND DISCS: XR MODELS](#).

CAUTION

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

NOTE

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

CAUTION

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

NOTES

If D.O.T. 4 brake fluid contacts painted surfaces, IMMEDIATELY flush area with clear water.

1. Position vehicle upright on a suitable lift.
2. Place a suitable container under the rear caliper brake line banjo fitting to catch any brake fluid that may leak out. Do not reuse brake fluid.

3. Disconnect left shock absorber from rear fork and rotate shock absorber out of the way.
4. Loosen rear axle nut and turn adjuster nuts to allow the rear wheel to move forward to the adjustment limit.
5. See [Figure 2-134](#). Remove the banjo bolt (2) and both washers (3) to detach rear brake line (1) from brake caliper. Discard washers.
6. Remove mounting bolt (5) and bolt pin (6).
7. Remove caliper assembly from motorcycle.

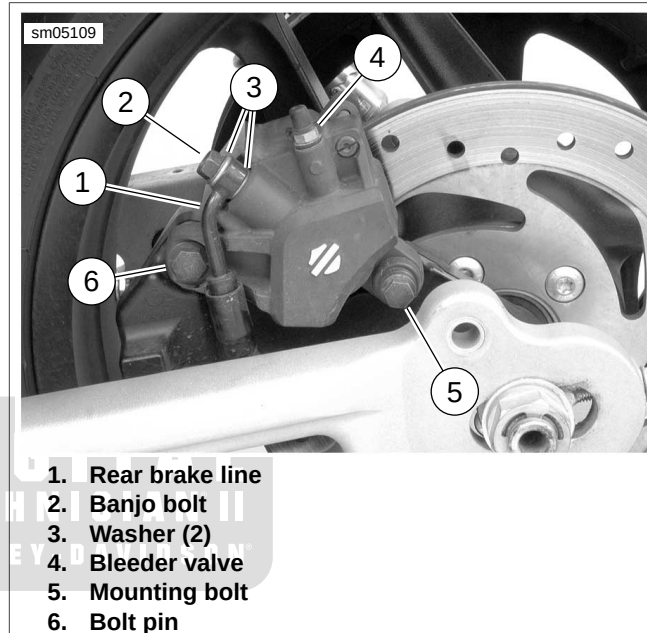
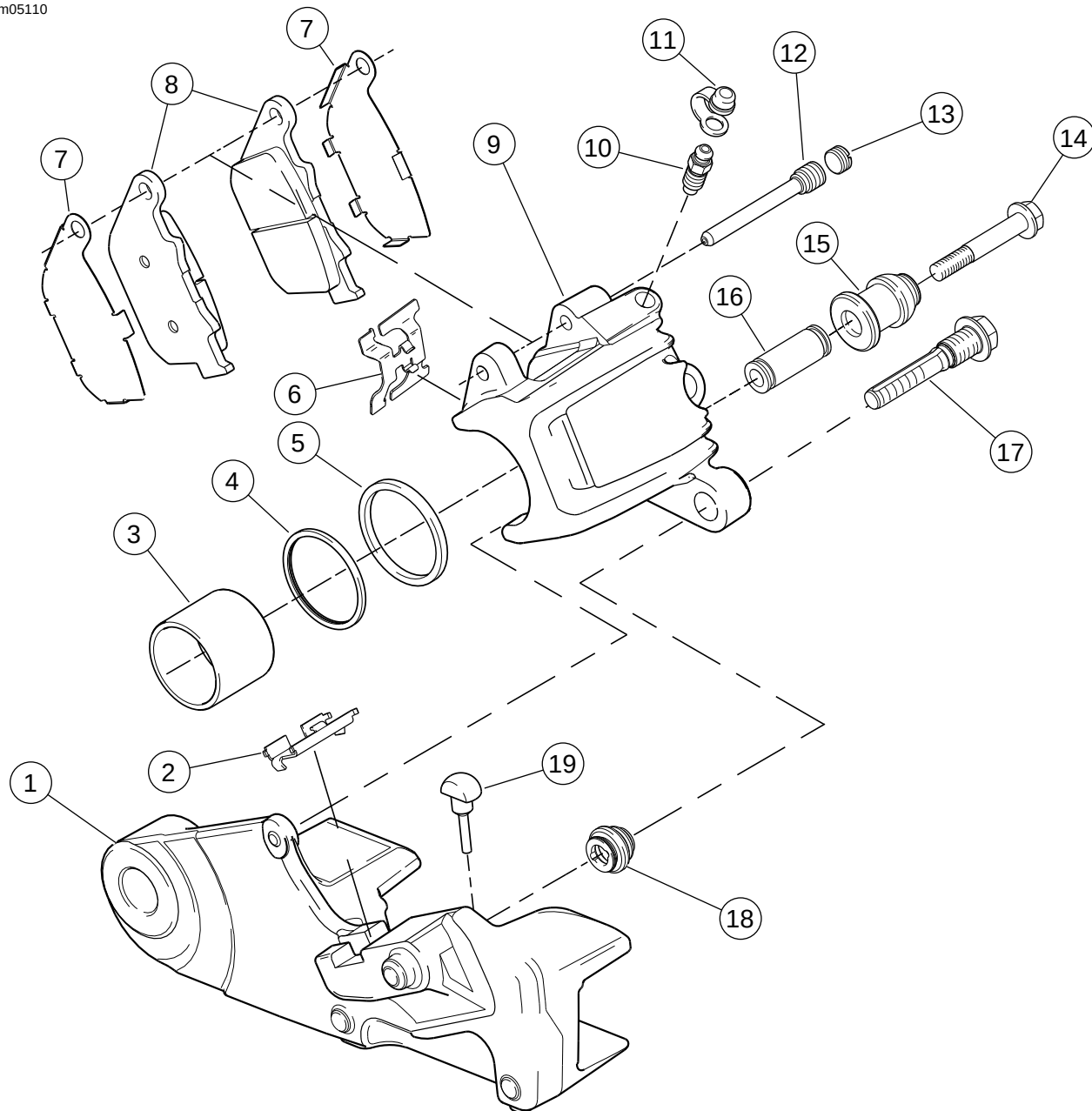


Figure 2-134. Rear Caliper Assembly

sm05110



1. Caliper mounting bracket
2. Wear plate
3. Piston
4. Dust seal
5. Piston seal
6. Pad spring
7. Pad retainer
8. Brake pad
9. Caliper housing
10. Bleeder valve

11. Bleeder nipple cap
12. Pad pin
13. Pad pin plug
14. Mounting bolt
15. Boot
16. Bushing
17. Bolt pin
18. Boot
19. Damper

Figure 2-135. Rear Brake Caliper Assembly

DISASSEMBLY

1. See [Figure 2-136](#). Remove brake pad pin plug to expose brake pad pin (1). Remove brake pad pin and pads (2).

2. See [Figure 2-137](#). Remove pad spring (1).

3. Remove bushing (2) from boot (3). Remove boot from mounting hole (4). Do not remove bleeder valve at this time.
4. See [Figure 2-138](#). Install a discarded brake pad (1) in the caliper with the backing plate facing the piston. Position the brake pad so the friction material is against the back of the caliper, as shown.
5. Loosely install brake pad pin (2) to hold brake pad in place.

WARNING

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

CAUTION

When removing piston with compressed air, piston can develop considerable force and fly out of caliper bore. Keep hands away from piston to avoid possible injury. (00530b)

NOTE

Be careful not to damage banjo bolt sealing surface or threads of banjo bolt hole in brake caliper. It is recommended that you use an air nozzle with a rubber tip to perform the next step in this procedure.

6. Gently apply low pressure compressed air to banjo bolt hole (3) to force piston from caliper bore.
7. Remove brake pad pin and brake pad from caliper.
8. Remove piston from caliper bore by hand. If necessary, gently wiggle piston to completely remove.

NOTE

A damaged piston bore will leak when reassembled. Do not use metal objects to remove or install components in piston bore. Prevent damage to piston, seal and bore by only using a wooden toothpick when servicing caliper.

9. See [Figure 2-139](#). Using a wooden toothpick (1), remove dust seal (2) and piston seal (3) from caliper bore. Discard seals.
10. If necessary, remove bleeder valve.

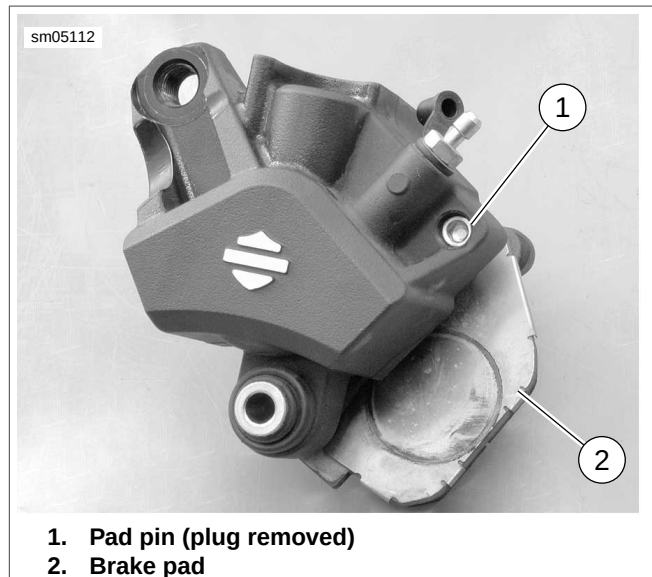


Figure 2-136. Pad Pin

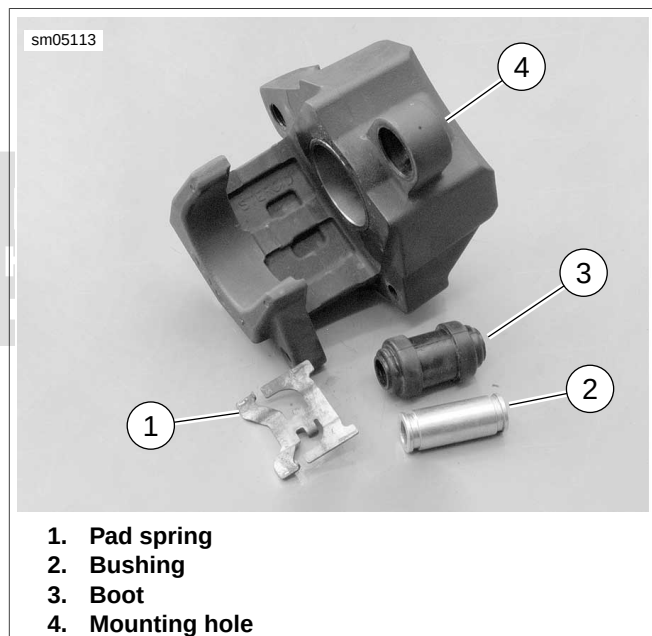


Figure 2-137. Spring, Bushing and Boot



Figure 2-138. Removing Piston: XR Models

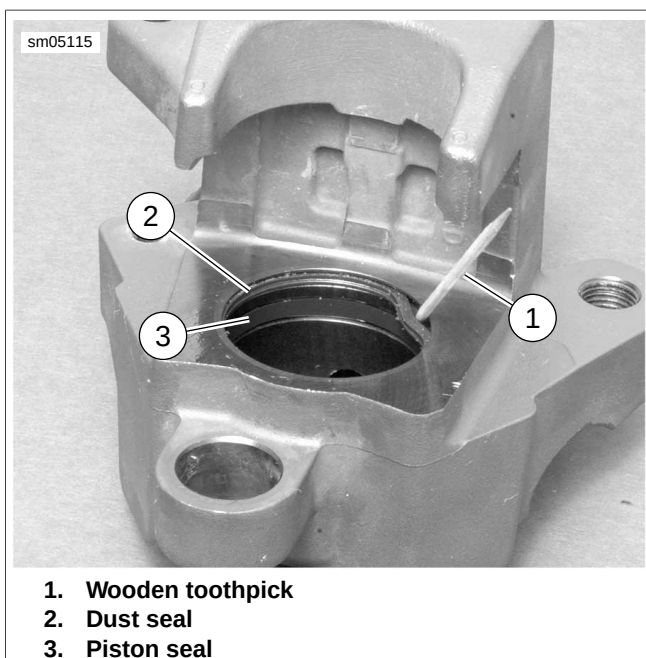


Figure 2-139. Caliper Seals

CLEANING, INSPECTION AND REPAIR

⚠ WARNING

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

1. Clean piston bore with denatured alcohol.
2. Clean all rubber parts with HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID. Do not contaminate with mineral oil or other solvents. Wipe parts dry with a clean, lint free cloth.

⚠ WARNING

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

3. Blow out drilled passages and piston bore with low pressure compressed air from a clean air supply. Do not use a wire or similar instrument to clean drilled passages.
4. Carefully inspect all components. Replace any parts that appear damaged or worn.
 - a. Check piston for pitting, scratching or corrosion on outside surfaces.
 - b. Inspect caliper piston bore. Do not hone bore. If bore shows pitting or corrosion, replace caliper.
 - c. Inspect pad pin for grooving and wear. Measure the pad pin diameter in an unworn area, and then in the area of any grooving or wear. If wear is more than 0.011 in. (0.28 mm), replace pad pin.
 - d. Always replace all seals after disassembly.
5. Inspect bushing boot and bolt pin boot for deterioration or damage. Replace as necessary.
6. Inspect wear plate on caliper mount for wear. Replace as necessary.

⚠ WARNING

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

7. Inspect brake pads and brake disc. Replace if necessary.
 - a. See [1.10 BRAKE PADS AND DISCS: XR MODELS](#) for specifications.
 - b. See [2.4 WHEELS](#) for brake disc replacement procedure.

ASSEMBLY

1. See [Figure 2-140](#). If removed, install bushing boot (3) in caliper.
2. Apply approximately 0.4 g of G40M BRAKE GREASE inside caliper bushing boot (3).
3. Insert caliper bushing (2) into boot. Ensure lips of boot are engaged in grooves at either end of bushing.
4. Install pad spring (1) in caliper housing. Ensure spring is installed in the orientation shown.

NOTE

Use ONLY KS62F assembly grease for lubrication of internal brake parts. Use of D.O.T. 4 brake fluid will result in increased brake pedal travel.

5. Lubricate the following parts prior to assembly using a light coat of KS62F assembly grease from the service parts kit. All other surfaces must be dry for assembly.
 - a. Nose radius of piston.
 - b. All surfaces of piston seal and dust seal.

NOTE

A damaged piston bore will leak when reassembled. Do not use metal objects to remove or install components in piston bore. Prevent damage to bore by only using a wooden toothpick when servicing caliper.

6. See [Figure 2-141](#). Install a **new** piston seal (3) and a **new** dust seal (2) into piston bore.
7. Carefully insert piston by hand, nose radius first, into caliper bore. If installation shows resistance, remove piston and check that seals are properly installed and fully seated in grooves.
8. Install bleeder valve if removed. Do not tighten bleeder valve at this time.

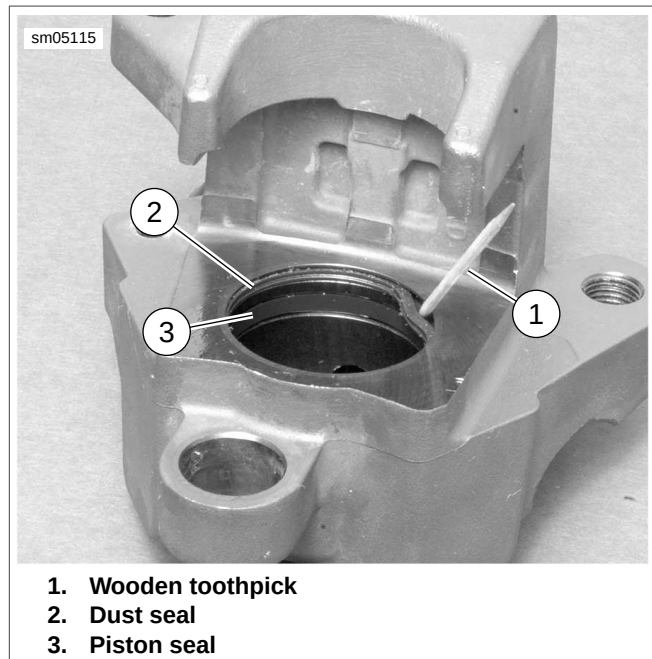


Figure 2-141. Caliper Seals

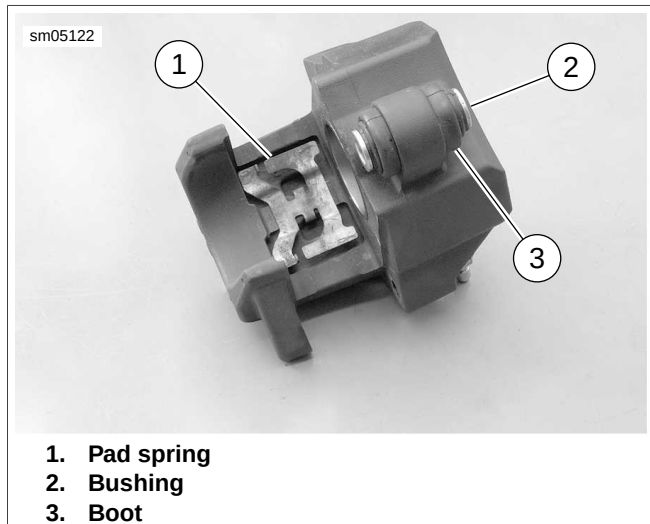


Figure 2-140. Assemble Caliper

INSTALLATION

1. See [Figure 2-142](#). If removed, install bolt pin boot (1).
2. Apply approximately 0.4 g of G40M BRAKE GREASE inside bolt pin boot.
3. If removed, install wear plate (2) on mounting bracket.
4. See [Figure 2-143](#). Apply a drop of LOCTITE 272 Thread Lock to threads of bolt pin (6).
5. Place rear caliper assembly onto mounting bracket. Install bolt pin (6), being careful not to pinch or roll boot over. Tighten bolt pin to 14-18 ft-lbs (19.6-24.5 Nm). See [Figure 2-144](#). Ensure lip of boot (1) properly engages the groove (2) in the bolt pin.
6. See [Figure 2-143](#). Install mounting bolt (5) and tighten to 14-18 ft-lbs (19.6-24.5 Nm).

NOTE

Brake caliper housing has a positive stop for banjo fitting. When tightening banjo bolt into brake caliper in the next step, rotate banjo fitting clockwise until it contacts positive stop.

7. Position a **new** washer (3) on each side of hydraulic brake line (1) banjo fitting. Insert banjo bolt (2) through washers and fitting and thread bolt into caliper housing. Tighten to 20-25 ft-lbs (27.1-33.9 Nm).
8. Install brake pads. See [1.10 BRAKE PADS AND DISCS: XR MODELS, Brake Pad Replacement: Rear](#).
9. Secure lower end of shock absorber to rear fork. Tighten to 30-45 ft-lbs (40.7-61.0 Nm)
10. Adjust drive belt and check vehicle alignment. See [1.16 REAR BELT DEFLECTION](#).

⚠ CAUTION

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

CAUTION

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

NOTES

- If D.O.T. 4 brake fluid contacts painted surfaces, IMMEDIATELY flush area with clear water.
 - Rear brake master cylinder reservoir must be in a level position when filling and checking fluid level.
11. Remove rear brake master cylinder reservoir cap. Add HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID to reservoir until fluid reaches upper fluid level (3). Do not overfill reservoir. Do not reuse brake fluid.
 12. Bleed brake system. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#).

⚠ WARNING

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

13. Verify proper operation of master cylinder relief port.
 - a. Press against rear brake caliper to push caliper piston back into its bore. This pushes brake fluid back through master cylinder and verifies that relief port is not plugged.
 - b. Pump brake pedal until caliper piston pushes pads against disc and pressure is returned to brake system.
14. Add HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID to reservoir until fluid reaches upper fluid level.

⚠ WARNING

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

⚠ WARNING

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

15. Test brake system.
 - a. Turn ignition switch ON. Pump brake pedal to verify operation of brake lamp.
 - b. Test ride motorcycle at low speed. If brakes feel spongy, bleed system again. See [1.8 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.

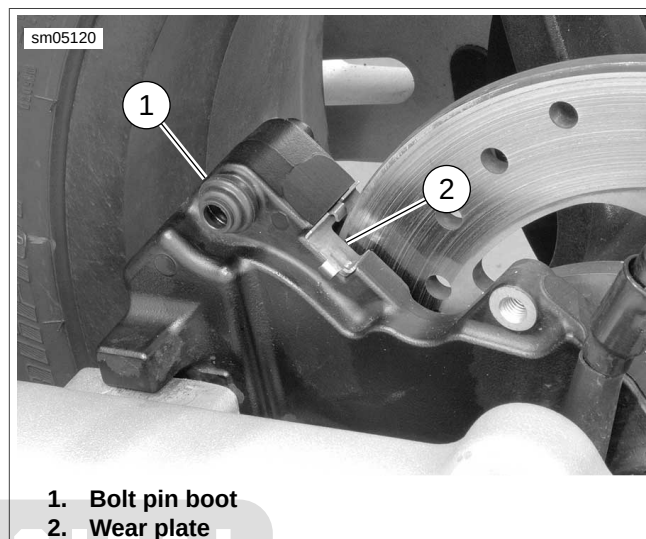


Figure 2-142. Caliper Mount

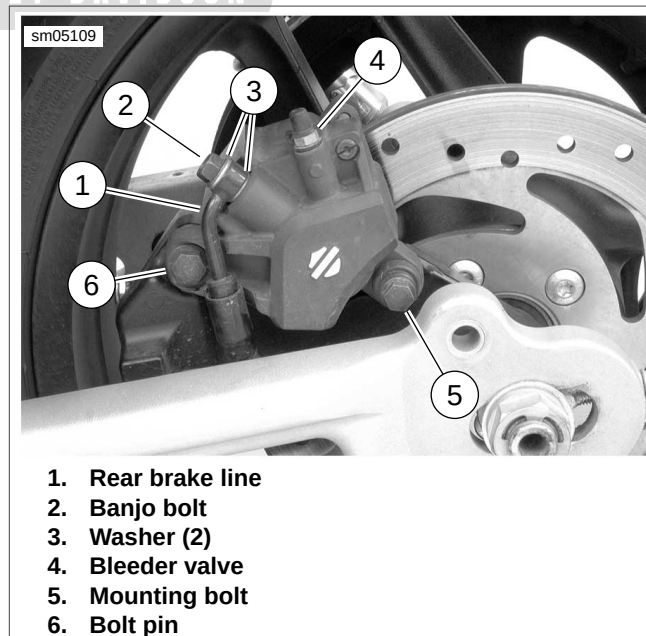


Figure 2-143. Rear Caliper Assembly

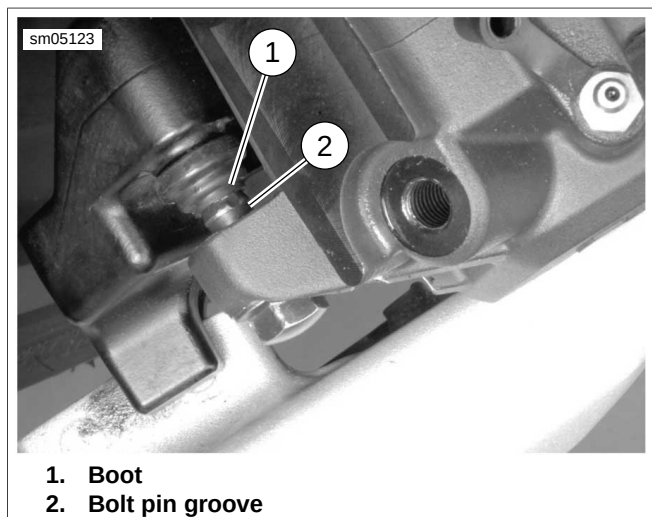


Figure 2-144. Bolt Pin and Boot



BRAKE LINES

2.18

FRONT BRAKE LINE: ALL MODELS

CAUTION

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

CAUTION

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

NOTE

If D.O.T. 4 brake fluid contacts painted surfaces, IMMEDIATELY flush area with clear water.

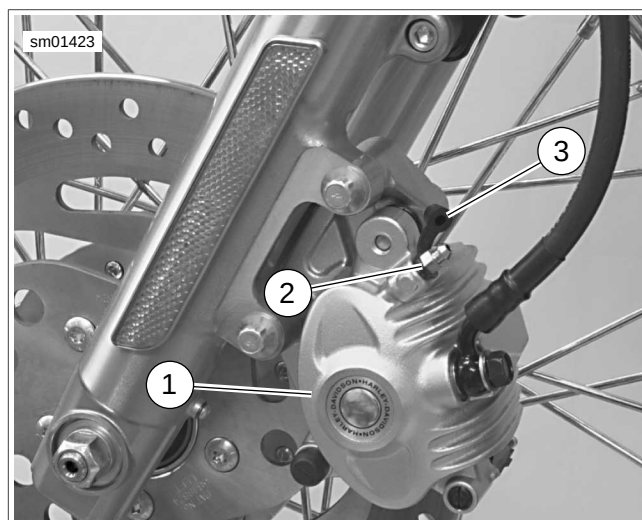
Removal

- See [Figure 2-145](#) or [Figure 2-146](#), and [Figure 2-147](#). Remove bleeder nipple cap (3) from bleeder valve (2) on front brake caliper (1). Install end of a length of 5/16 in. (7.9 mm) I.D. clear plastic tubing over caliper bleeder valve (3), 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.
- See [Figure 2-149](#). Remove screw (5) to detach brake line clamp (4) from front fork upper bracket (XL models) or lower fork bracket (XR models).
- Detach brake line from stem at bottom of front fork lower bracket.
 - Dual front disc models: Remove screw with captive washer (8) and clamp (9) to detach brake line manifold (11).
 - Single front disc models: Remove screw with captive washer (8) and clamp (7) to detach brake line.

NOTE

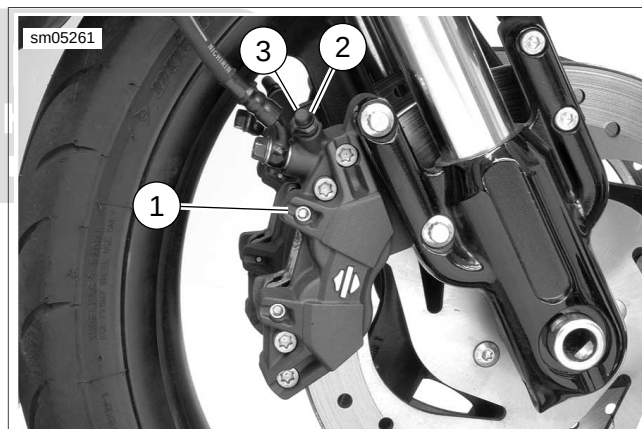
Damaged banjo bolt surfaces will leak when reassembled. Prevent damage to seating surfaces by carefully removing brake line components.

- Remove banjo bolt (2) and washers (1) to detach brake line from master cylinder body. Discard washers.
- Remove banjo bolt (2, 3) and washers (1) to detach brake line from front brake caliper(s). Discard washers.
- Carefully inspect brake line for dents, cuts or other defects. Replace brake line if any damage is found.



1. Front brake caliper
2. Bleeder valve
3. Bleeder cap

Figure 2-145. Front Brake Caliper: XL Models



1. Front brake caliper
2. Bleeder valve
3. Bleeder cap

Figure 2-146. Front Caliper Assembly: XR Models

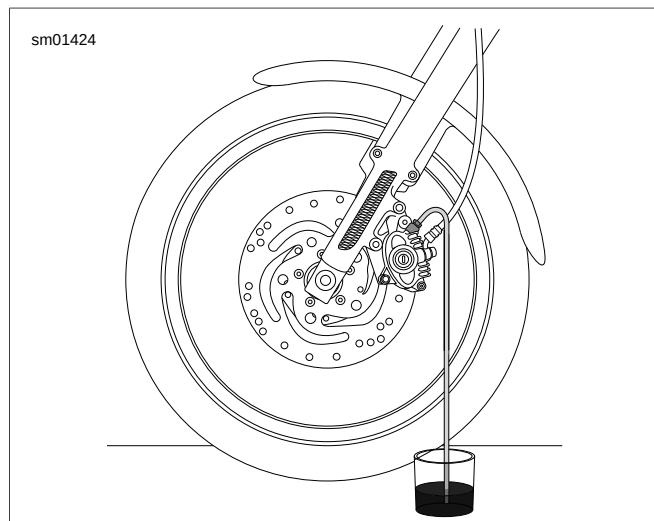


Figure 2-147. Bleeding Hydraulic System (typical; XL model shown)

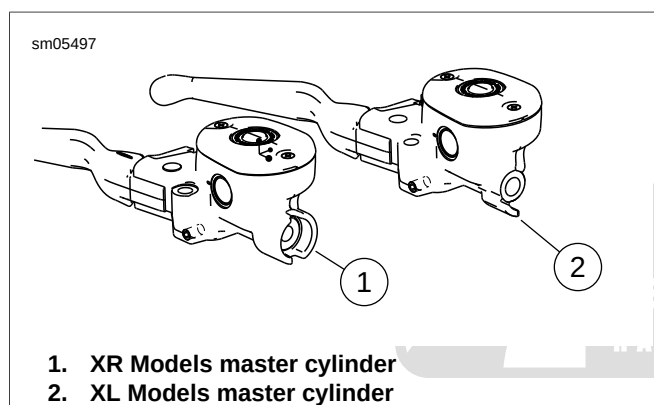
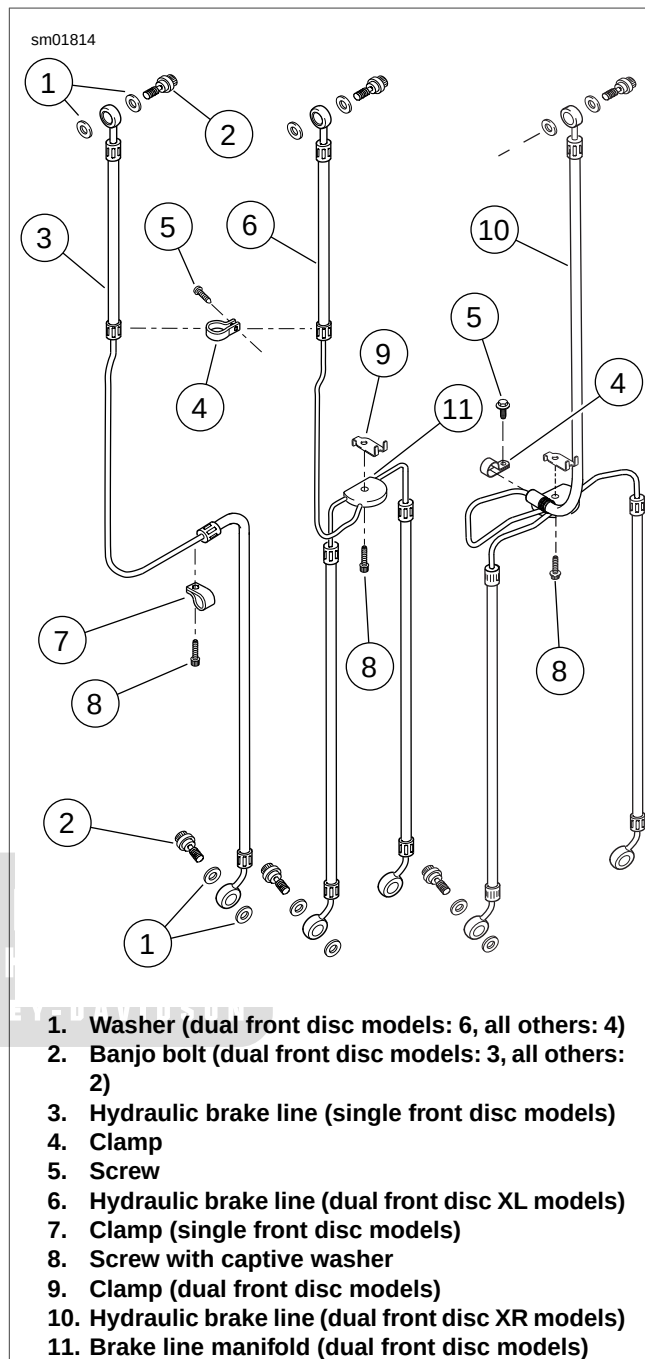


Figure 2-148. Front Brake Master Cylinder Identification



1. Washer (dual front disc models: 6, all others: 4)
2. Banjo bolt (dual front disc models: 3, all others: 2)
3. Hydraulic brake line (single front disc models)
4. Clamp
5. Screw
6. Hydraulic brake line (dual front disc XL models)
7. Clamp (single front disc models)
8. Screw with captive washer
9. Clamp (dual front disc models)
10. Hydraulic brake line (dual front disc XR models)
11. Brake line manifold (dual front disc models)

Figure 2-149. Front Brake Line (typical)

Installation

NOTE

Master cylinder housings have various positive stops for banjo fittings, based on the model being repaired. The front brake systems as used on XR models and XL models employ different master cylinder housings as shown in [Figure 2-148](#). Never intermix system components. When tightening the banjo bolt in the next step, verify the banjo fitting is properly oriented and contacts the positive stop.

1. See [Figure 2-149](#). Note that hydraulic brake line is made up of thin tube construction and flexible hose sections. Position **new** washers (1) on each side of banjo fitting on end of brake line with shortest flexible hose section. Insert

- banjo bolt (2) through washers and banjo fitting. Loosely install banjo bolt into master cylinder.
- Route brake line downward in front of right handlebar, and inward behind fork brackets. Install clamp (4) around lower fitting of upper flexible hose section. Loosely attach clamp to front fork upper bracket (XL models) or lower bracket (XR models) with screw (5).
 - Continue routing brake line downward crossing to left side of the vehicle under front fork lower bracket.
 - Clamp brake line to stem at bottom of front fork lower bracket.
 - Dual front disc models: Install screw with captive washer (8) through brake line manifold (11) and clamp (9). Loosely thread screw into front fork lower bracket stem.
 - Single front disc models: Install clamp (7) around top fitting of long flexible hose section. Loosely attach clamp to front fork lower bracket stem with screw with captive washer (8).

NOTE

Single front disc models must have line positioned to maintain a gap between line and lower fork bracket. Dual front disc models will self-align creating a gap by default, but the gap should be visually confirmed.

- Single front disc models: See [Figure 2-150](#). Measure distance between front brake line metal tubing and lower fork bracket adjacent to pinch bolt. Move brake line assembly forward or back until there is a 1/4 in. (6.35 mm) gap between brake line and lower fork bracket.

WARNING

Do not bend metal brake line. Bending brake line could cause metal fatigue and brake failure, which could result in death or serious injury. (00543b)

- See [Figure 2-149](#). While maintaining proper gap between brake line and lower fork bracket, tighten screw (8) to 120-168 **in-lbs** (13.6-19.0 Nm).
- Position **new** washers (1) on each side of banjo fitting at free end of brake line. Insert banjo bolt(s) (2, 3) through washers and banjo fitting of each caliper. Loosely install banjo bolt into each caliper.

NOTE

Master cylinder housing has a positive stop for banjo fitting. When tightening banjo bolt into master cylinder in the next step, rotate banjo fitting clockwise until it contacts positive stop.

- Tighten banjo bolt (2) into master cylinder to 20-25 ft-lbs (27.1-33.9 Nm).
- Tighten screw (5) to 45-65 **in-lbs** (5.1-7.4 Nm).

NOTE

Brake caliper housing has a positive stop for banjo fitting. When tightening banjo bolt into brake caliper in the next step, rotate banjo fitting clockwise until it contacts positive stop.

- Tighten banjo bolt into brake caliper to 20-25 ft-lbs (27.1-33.9 Nm). Dual front disc models: repeat this step for other front brake caliper.

- Fill master cylinder with **new** HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID and bleed brakes. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#). Test operation of brake lever.
- Tighten bleeder valve to 35-61 **in-lbs** (4.0-6.9 Nm). Install bleeder nipple cap. Dual front disc models: repeat this step for other front brake caliper.

WARNING

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

- Test ride motorcycle. If front brake feels spongy, bleed system again. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#).

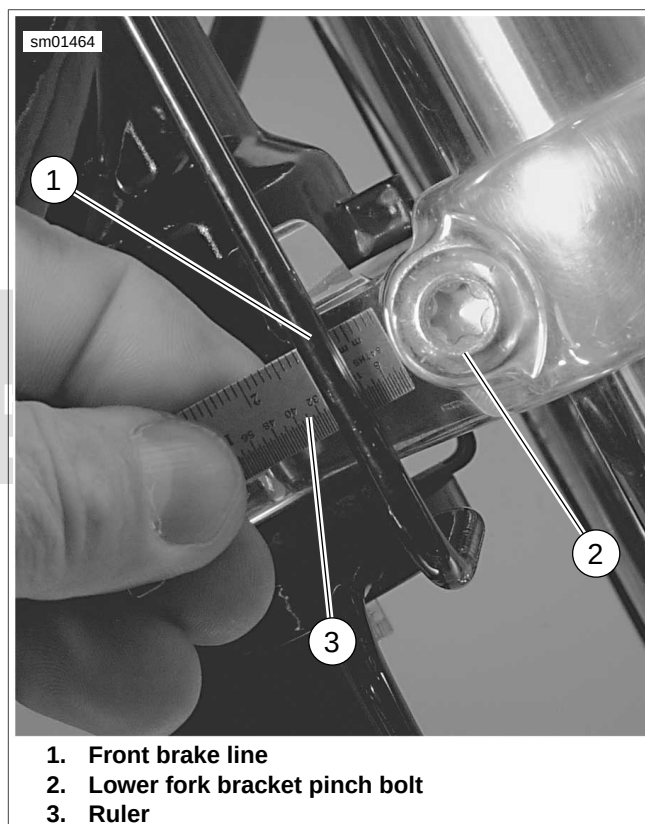


Figure 2-150. Measuring Front Brake Line Clearance

REAR BRAKE LINE: XL MODELS

CAUTION

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

CAUTION

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

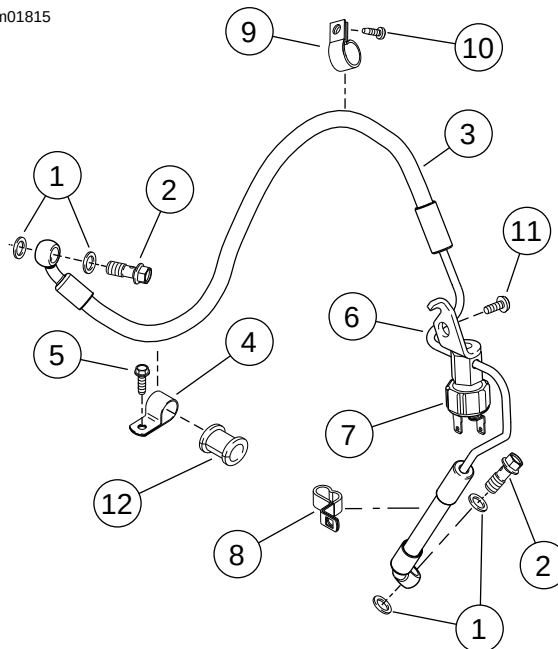
NOTE

If D.O.T. 4 brake fluid contacts painted surfaces, IMMEDIATELY flush area with clear water.

Removal

1. Drain rear brake master cylinder reservoir. See [2.15 REAR BRAKE MASTER CYLINDER RESERVOIR](#).
2. Remove bleeder nipple cap from bleeder valve on rear brake caliper. Install end of a length of 5/16 in. (7.9 mm) I.D. clear 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. Close bleeder valve.
3. See [Figure 2-151](#). Unplug harness connectors [121] from stop lamp switch (7).
4. Remove banjo bolt (2) and washers (1) to detach rear brake line (3) from master cylinder body and rear brake caliper. Discard washers.
5. Remove screw (5) to detach brake line clamp (4) with bushing (12) from rear fork.
6. Remove screw (10) to detach brake line clamp (9) from battery tray bracket.
7. Remove screw (11) securing brake line/switch tee (6) to battery tray bracket.
8. Feed brake line up through B-clamp (8).
9. Hold hex body of brake line/switch tee with an open-end wrench. Using a 1.0-in. six-point deep socket, remove stop lamp switch from brake line/switch tee.

sm01815



1. Washer (4)
2. Banjo bolt (2)
3. Rear brake line
4. Clamp
5. Screw
6. Brake line/switch tee
7. Stop lamp switch assembly
8. B-clamp
9. Clamp
10. Screw
11. Screw
12. Bushing

Figure 2-151. Rear Brake Line: XL Models

Installation

1. See [Figure 2-151](#). Thread stop lamp switch (7) into brake line/switch tee (6) on **new** rear brake line (3). Hold hex body of brake line/switch tee with an open-end wrench. Using a 1.0-in. six-point deep socket, tighten stop lamp switch assembly to 80-123 **in-lbs** (9.0-13.9 Nm).
2. Feed rear brake line down through B-clamp (8).
3. Position brake line/switch tee mounting bracket on battery tray bracket. Secure with screw (11). Tighten to 72-120 **in-lbs** (8.14-13.6 Nm).
4. Install clamp (9) and screw (10) to secure rear brake hose to battery tray bracket. Tighten screw to 30-40 **in-lbs** (3.4-4.5 Nm).

NOTE

When installing clamp (4), bushing (12) and screw (5) in the next step, make sure to adjust brake hose length between rear caliper and clamp so there is no extra length. Do not twist or stretch brake hose. Make sure bushing sits squarely in clamp and around hose.

5. Install clamp (4) with bushing (12) and screw (5), to secure rear brake hose to rear fork. Tighten screw to 30-40 **in-lbs** (3.4-4.5 Nm).

NOTE

Master cylinder and brake caliper housings have a positive stop for banjo fitting. When tightening banjo bolt into master cylinder and brake caliper in the next step, rotate banjo fitting clockwise until it contacts positive stop.

- Position **new** washers (1) on each side of banjo fittings by rear brake master cylinder and rear brake caliper. Insert banjo bolts (2) through washers and banjo fittings. Tighten to 20-25 ft-lbs (27.1-33.9 Nm).

 WARNING

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

NOTE

Rear brake master cylinder reservoir must be in a level position when filling and checking fluid level.

- Position motorcycle upright (not resting on jiffy stand). Fill rear brake master cylinder reservoir with HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID and bleed brake system. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#).
- Tighten bleeder valve to 35-61 **in-lbs** (4.0-6.9 Nm). Install bleeder nipple cap.
- Turn the ignition/light switch ON. Test operation of brake lamp with the rear brake applied.

 WARNING

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

- Test ride motorcycle. If rear brake feels spongy, bleed system again. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#).

REAR BRAKE LINE: XR MODELS

 CAUTION

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

CAUTION

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

NOTE

If D.O.T. 4 brake fluid contacts painted surfaces, IMMEDIATELY flush area with clear water.

Removal

- Drain rear brake master cylinder reservoir. See [2.15 REAR BRAKE MASTER CYLINDER RESERVOIR](#).
- Remove bleeder nipple cap from bleeder valve on rear brake caliper. Install end of a length of 5/16 in. (7.9 mm) I.D. clear 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. Close bleeder valve.
- See [Figure 2-152](#). Unplug harness connectors [121] from stop lamp switch (2).
- Remove banjo bolts (4) and washers (5) to detach rear brake line (3) from master cylinder body and rear brake caliper. Discard washers.
- Remove fasteners (7) to detach brake line clamps (6) from rear fork.
- Remove fasteners (8) securing brake line bracket/switch tee (1) to lower frame.
- Hold hex body of brake line bracket/switch tee with an open-end wrench. Using a 1.0-in. six-point deep socket, remove stop lamp switch from brake line bracket/switch tee assembly.
- If necessary, remove clamp and bushing (9).

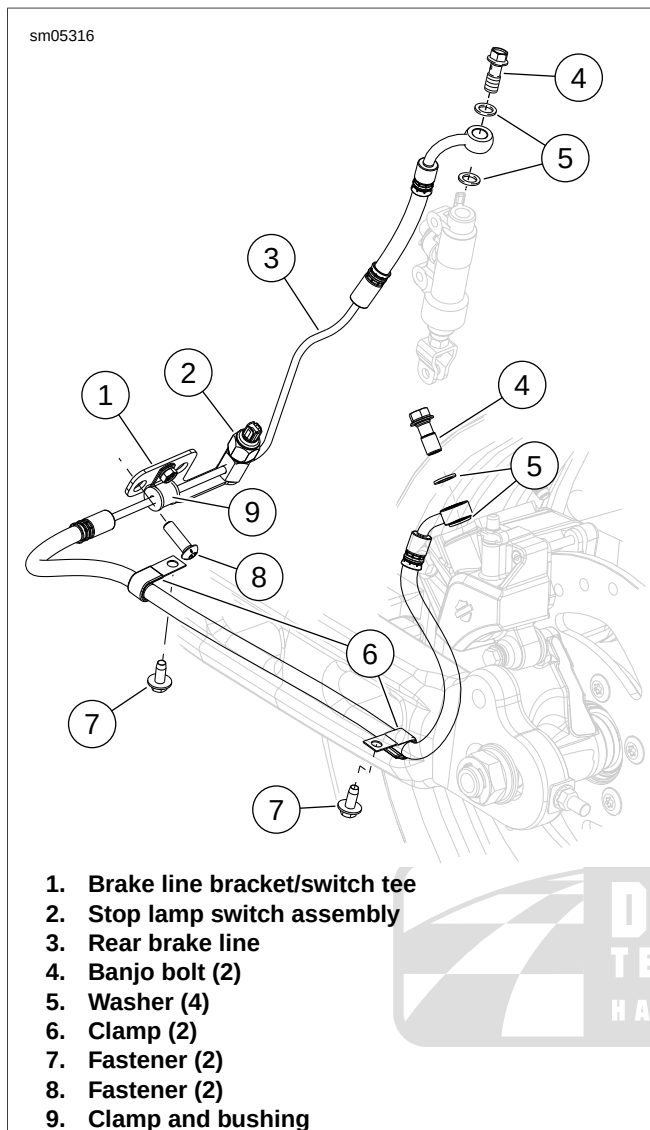


Figure 2-152. Rear Brake Line: XR Models

Installation

1. See [Figure 2-152](#). Thread stop lamp switch (2) into brake line bracket/switch tee (1) on rear brake line (3). Hold hex body of brake line bracket/switch tee with an open-end wrench. Using a 1.0-in. six-point deep socket, tighten stop lamp switch assembly to 80-123 **in-lbs** (9.0-13.9 Nm).
2. If removed, install clamp and bushing (9).

3. Route brake line assembly to master cylinder and brake caliper. Loosely install **new** washers (5) and banjo bolts (4) to hold line in place.
4. Position brake line bracket/switch tee on lower frame and secure with fasteners (8). Tighten to 17-22 **in-lbs** (1.9-2.5 Nm).
5. Connect harness connectors [121] to brake lamp switch (2).

NOTE

Master cylinder and brake caliper housings have a positive stop for banjo fitting. When tightening banjo bolt into master cylinder and brake caliper in the next step, rotate banjo fitting clockwise until it contacts positive stop.

6. With **new** washers (5) on each side of banjo fittings, tighten banjo bolts (4) to 20-25 ft-lbs (27.1-33.9 Nm).
7. Secure brake line to bottom of rear fork with clamps (6) and fasteners (7).

WARNING

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

NOTE

Rear brake master cylinder reservoir must be in a level position when filling and checking fluid level.

8. Position motorcycle upright (not resting on jiffy stand). Fill rear brake master cylinder reservoir with HARLEY-DAVIDSON D.O.T. 4 BRAKE FLUID and bleed brake system. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#).
9. Tighten bleeder valve to 35-61 **in-lbs** (4.0-6.9 Nm). Install bleeder nipple cap.
10. Turn the ignition/light switch ON. Test operation of brake lamp with the rear brake applied.

WARNING

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

11. Test ride motorcycle. If rear brake feels spongy, bleed system again. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#).

TIRES

2.19

GENERAL

⚠ WARNING

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

⚠ WARNING

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

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

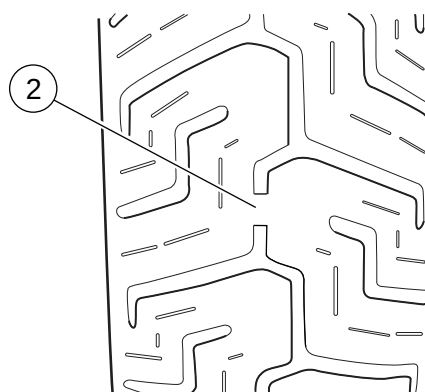
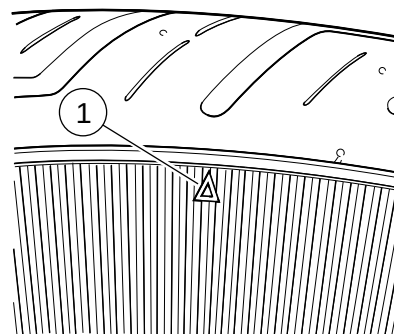
Tires should be inspected for punctures, cuts, breaks and wear at least weekly.

See [Figure 2-153](#). The tread wear indicator bars will appear on tire tread surfaces when 1/32 in. (0.8 mm) or less of tread remains. Always remove tires from service before they reach the tread wear indicator bars.

New tires are needed if any of the following conditions exist. See [1.11 TIRES AND WHEELS](#).

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

sm02177



1. Sidewall
2. Tread surface

Figure 2-153. Tread Wear Indicators (Typical)

REMOVAL

NOTE

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

1. Remove wheel from motorcycle:
 - a. **Front wheel:** see [2.4 WHEELS, Front Wheel](#).
 - b. **Rear wheel:** see [2.4 WHEELS, Rear Wheel](#).
2. Deflate tire.

NOTE

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

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

CLEANING, INSPECTION AND REPAIR

1. Clean the inside of tire and outer surface of tube.
2. If rim is dirty or rusty, clean with a stiff wire brush.
3. Check wheels for lateral and radial runout before installing a new tire.
 - a. **Models with laced wheels:** see [2.8 TRUING LACED WHEELS](#).
 - b. **Models with cast wheels:** see [2.9 CHECKING CAST WHEEL RUNOUT](#).
4. Inspect the tire and tube for wear and damage. Inspect tread depth. Replace worn tires. Replace damaged tubes.

⚠ WARNING

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

5. Tubeless tires may be repaired in the tread area only if the puncture is 1/4 in. (6.4 mm) or smaller. All repairs must be made from inside the tire.
6. Acceptable repair method involves the use of a patch and plug combination.

INSTALLATION

⚠ WARNING

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

⚠ WARNING

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

⚠ WARNING

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

For tire pressures, see [1.11 TIRES AND WHEELS, Tires](#).

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

Tube Type Tires

⚠ WARNING

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

⚠ WARNING

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

NOTES

- For correct tire and tube types, see [2.2 SPECIFICATIONS](#).
 - Whenever a tube type tire is replaced, the tube should also be replaced. Inner tubes should be patched only as an emergency measure. Replace a damaged or patched tube as soon as possible. Rim bands must be used on all laced wheels.
1. See [Figure 2-154](#). On laced wheels, install a rim strip into the rim well. Make sure no spokes protrude through nipples, and be sure to align the valve stem hole in rim strip with valve stem hole in rim.
 2. Install tube and tire.



Figure 2-154. Installing Rim Strip

Tubeless Tires

⚠ WARNING

Only install original equipment tire valves and valve caps. A valve, or valve and cap combination, that is too long or too heavy can strike adjacent components and damage the valve, causing rapid tire deflation. Rapid tire deflation can cause loss of vehicle control, which could result in death or serious injury. (00281a)

1. See [Figure 2-155](#). 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** (1.4-1.7 Nm).
5. Install tire.

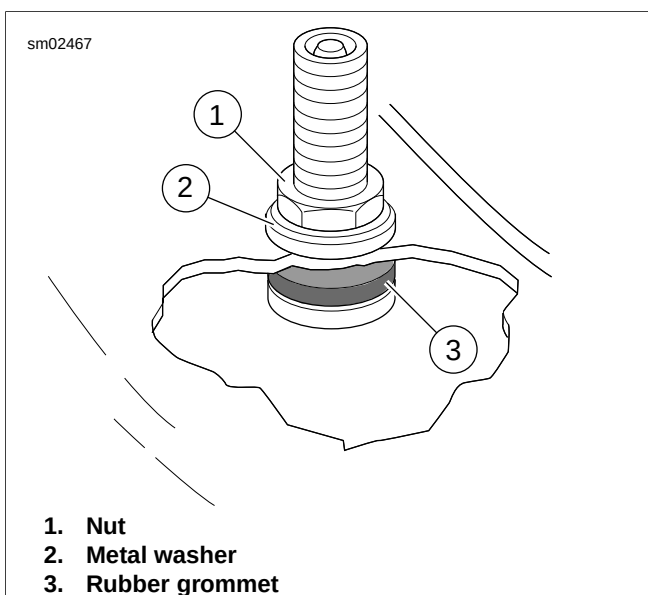


Figure 2-155. Tubeless Tire Valve Stem

CHECKING TIRE RUNOUT

Lateral Runout

1. See [Figure 2-156](#). 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 0.090 in. (2.29 mm). If runout exceeds this specification, 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.

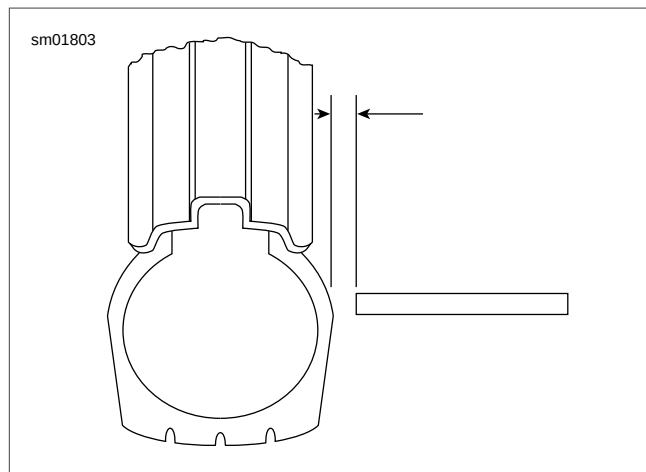


Figure 2-156. Checking Tire Lateral Runout

Radial Runout

1. See [Figure 2-157](#). 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 this 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.

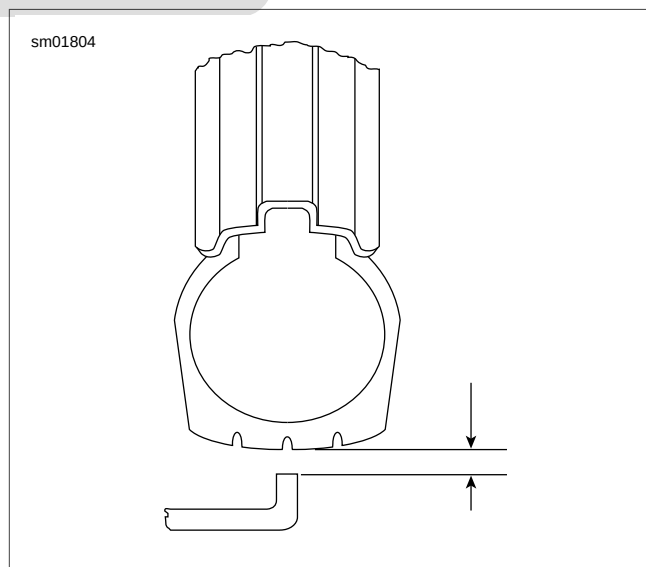


Figure 2-157. Checking Tire Radial Runout

WHEEL BALANCING

PART NUMBER	TOOL NAME
HD-99500-80	WHEEL TRUING STAND

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. (99.2 g) (total weight applied to the rim). Wheels should be balanced to within 1/2 oz. (14 g) at 60 mph (97 km/h).

Weights for Laced Wheels

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

Table 2-23. Laced Wheel Balance Weights

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

Weights for Cast Wheels

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

Table 2-24. Cast Wheel Balance Weights

WEIGHT (MASS)		FINISH	HD PART NUMBER
OZ. (U.S.)	GRAMS		
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.



LEFT SIDE COVER

2.20

GENERAL

See [Figure 2-158](#). The left side cover provides access to the battery (1), fuses (3, 4) and diagnostic electrical connector (5). No tools are required to open or close the cover.

See [Figure 2-159](#) or [Figure 2-160](#). The left side cover is secured to the motorcycle by two upper slots that fit into clips (XL models) or two molded-in posts that fit into grommets (XR models). The side cover is also secured to the vehicle by a bottom slot that fits onto a mounting tab on the battery tray.

NOTE

The left side cover does not need to be completely removed from the vehicle to access the battery or fuses.

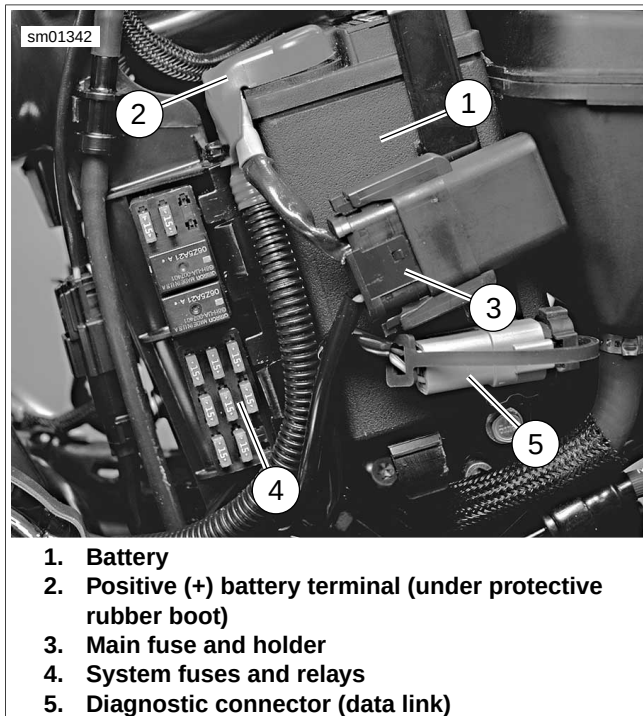


Figure 2-158. Main Fuse and Battery Location: All Models (XL Model Shown)

OPENING LEFT SIDE COVER

1. Place a clean, dry cloth over rear brake master cylinder reservoir and left passenger foot peg (if equipped). This will protect left side cover from damage.
2. See [Figure 2-159](#) or [Figure 2-160](#). Grasp left side cover at upper corners and gently pull away from plastic mounting clips (XL models) or grommets (XR models) on frame.

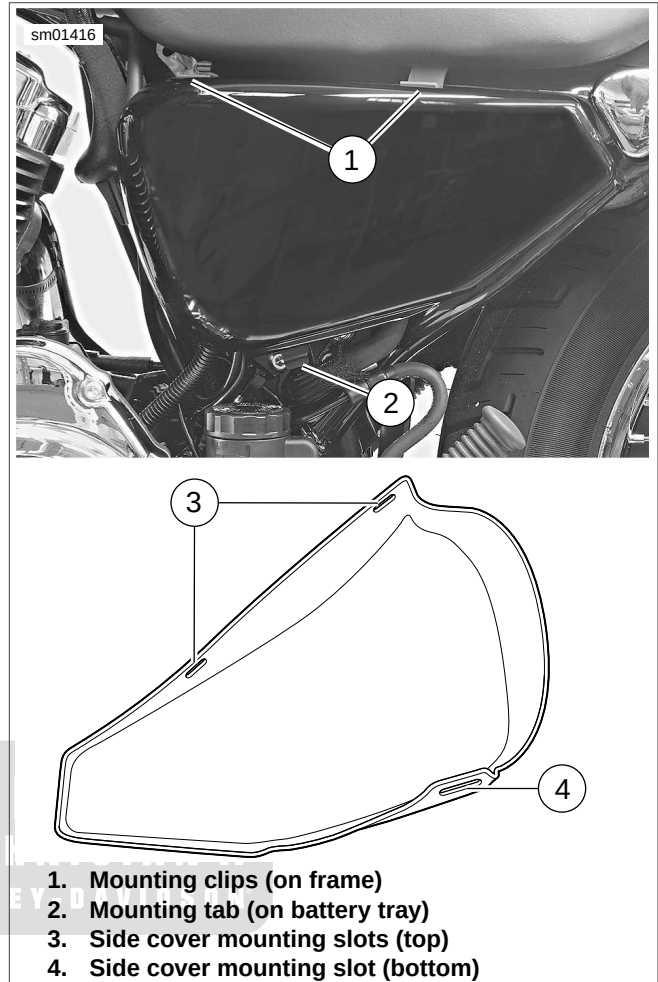


Figure 2-159. Left Side Cover: XL Models

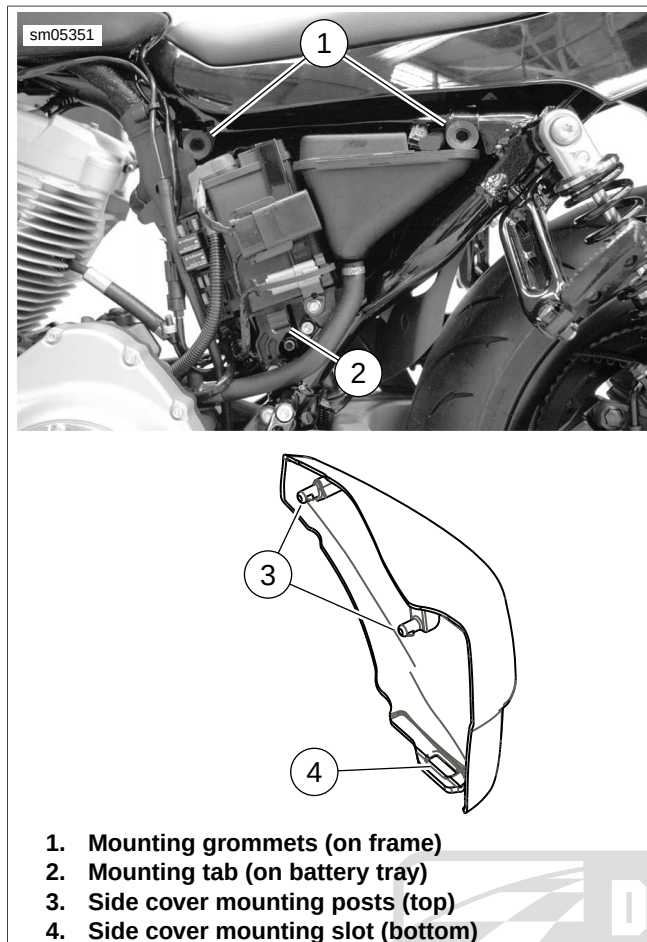


Figure 2-160. Left Side Cover: XR Models

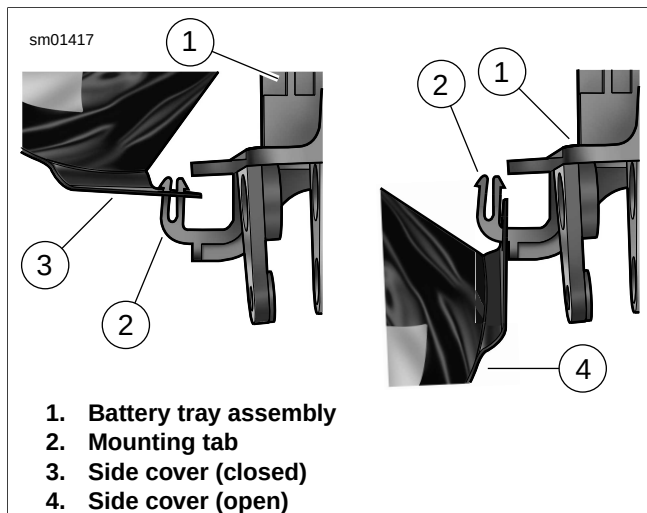


Figure 2-161. Left Side Cover Bottom Mount: All Models

3. See [Figure 2-161](#). While rotating top of cover out away from motorcycle, slide cover down slightly so mounting slot on cover slides down mounting tab (2) on battery tray assembly (1). See [Figure 2-162](#). Side cover (3) will now rest on top of rear brake master cylinder reservoir and left passenger footrest (if equipped) with slot (2) hanging off bottom of mounting tab (1).

CAUTION

Leaning or placing tools on side cover could cause damage to cover and/or mounting tab on battery tray. (00523b)

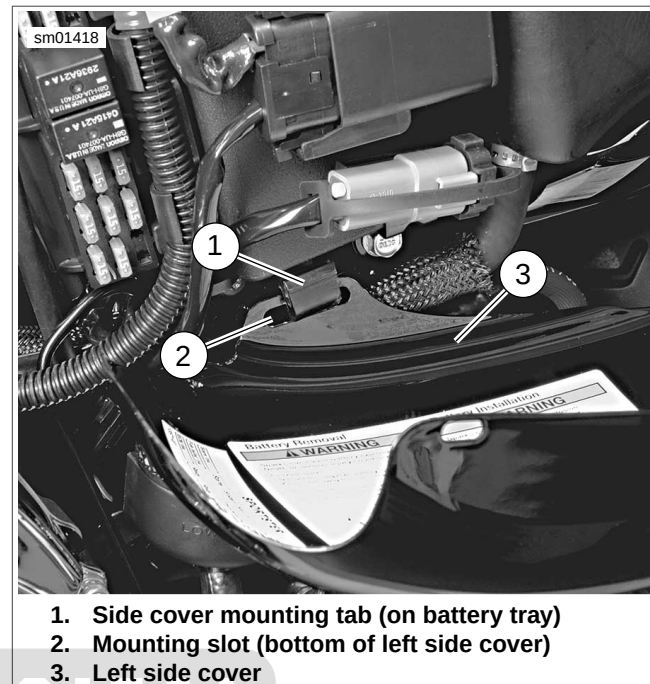


Figure 2-162. Left Side Cover in Open Position: All Models (XL Model Shown)

CLOSING LEFT SIDE COVER

1. See [Figure 2-162](#). Grasp top corners of side cover (3). While rotating top of cover up toward motorcycle, gently pull cover up so that mounting slot (2) slides up mounting tab (1).
2. Press top of side cover into place:
 - a. **XL models:** see [Figure 2-159](#). Line up top slots of side cover with mounting clips (1) on motorcycle frame, aligning with front clip first. Press top of side cover into clips until snug.
 - b. **XR models:** see [Figure 2-160](#). Line up molded-in posts in top of side cover with mounting grommets on motorcycle frame. Press posts in side cover into grommets until snug.

NOTE

Side cover should snap into place with minimal pressure. Using excessive force or striking side cover to close it can damage mounting clips (XL models) or molded-in posts (XR models).

REMOVING LEFT SIDE COVER

NOTE

It is rarely necessary to remove the left side cover completely. However, if left side cover removal is necessary, use the following procedure.

1. See [Figure 2-159](#) or [Figure 2-160](#). Grasp side cover at upper corners and gently pull away from plastic mounting clips (XL models) or grommets (XR models) on frame.
2. See [Figure 2-163](#). Lift side cover up and tilt cover to the rear of the motorcycle. With a slight back and forth rocking motion, pull up gently until cover disengages from mounting tab on battery tray.



Figure 2-163. Removing Left Side Cover: All Models (XL Model Shown)

INSTALLING LEFT SIDE COVER

NOTE

It is rarely necessary to remove the left side cover completely. However, if left side cover has been removed, reinstall cover as described in the following procedure.

1. See [Figure 2-162](#). Position side cover over battery tray assembly with slot in bottom of cover resting on mounting tab on battery tray.
2. Gently press downward on side cover until slot snaps down over mounting tab.
3. Now close left side cover. See [2.20 LEFT SIDE COVER, Closing Left Side Cover](#).



FRONT FORK: XL MODELS

2.21

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.

REMOVAL

1. Remove front brake caliper(s). See [2.11 FRONT BRAKE CALIPER: XL MODELS](#).
2. Remove front wheel assembly. See [2.4 WHEELS](#).
3. Remove front fender mounting screws and lock nuts. Remove fender. See [2.33 FRONT FENDER](#).
4. See [Figure 2-164](#). Loosen, but do not remove, slider tube caps (12).
5. Loosen front fork upper and lower bracket pinch screws (11 and 14). Remove fork assemblies (13) from fork brackets.

DISASSEMBLY

1. See [Figure 2-165](#). Remove drain screw and washer (19) from slider (16). Remove tube cap (7) from slider tube (9). Drain fork oil. Remove o-ring (6) from tube cap.
2. Remove spring (5) from slider tube.
3. **All except XL 1200L:** Remove spring collar (20) and spring washer (21) from slider tube.
4. **All except XL 1200N:** Remove cover (11).

NOTE

See [Figure 2-166](#). The XL 1200N is equipped with fork gaiters (2) instead of metal covers. The lower lip (3) of the fork gaiter fits into the groove at the upper end of the fork slider (1). The upper end of the fork gaiter fits tightly around the slider tube, just below the front fork lower bracket (4).

5. **XL 1200N:** See [Figure 2-166](#). Peel back lower lip (3) of fork gaiter (2) from slider groove and slide fork gaiter up and off end of slider tube.
6. See [Figure 2-165](#). Remove dust seal (12). Compress internal circle clip (13). Remove clip from groove in top of slider bore.
7. 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.

8. Withdraw slider tube (9) from slider 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.
9. Remove sleeve (15). Sleeve will be found within slider or on bottom end of damper tube (3).
10. Insert a small diameter rod through opening in bottom of slider tube to remove damper tube assembly.
11. Remove rebound spring (8) from damper tube.
12. Remove damper tube ring(s) (4) from damper tube.
13. Remove lower bushing from damper tube only if replacement is necessary.

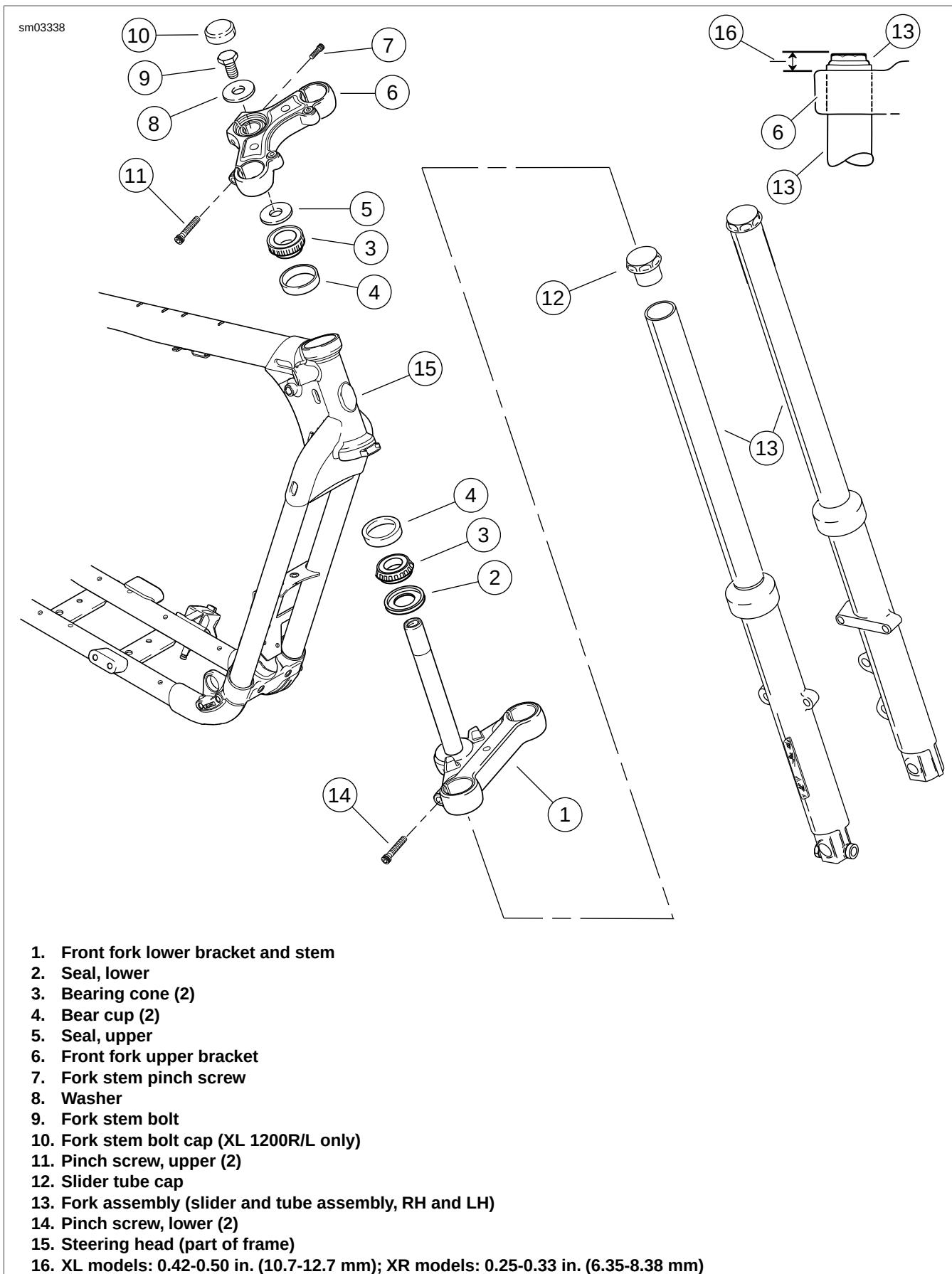


Figure 2-164. Front Fork Assembly: XL Models

CLEANING, INSPECTION AND REPAIR

1. Thoroughly clean and inspect all parts. Replace any parts that are bent or damaged.
2. See [Figure 2-165](#). 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

PART NUMBER	TOOL NAME
HD-36583	FORK SEAL AND BUSHING INSTALLATION TOOL

1. See [Figure 2-165](#). If lower bushing (10) was removed, install **new** lower bushing in groove of slider tube (9). Expand bushing only enough to fit over tube.
2. Install damper tube ring(s) (4) into groove(s) of damper tube (3).
3. Place rebound spring (8) over damper tube (3). Insert damper tube into slider tube.
4. Insert spring (5) into slider tube with the tapered end down. Push damper tube through opening at bottom of slider tube using spring. Place sleeve (15) over end of damper tube.
5. **All except XL 1200L:** Install spring washer (21) and spring collar (20) into slider tube.
6. Install slider tube 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, final tighten screw to 132-216 **in-lbs** (14.9-24.4 Nm).
7. 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. Install bushing, spacer and seal into slider bore by tapping components downward with the installation tool. Install internal circle clip (13) into groove in top of slider bore.
8. Install dust seal (12) at top of slider.
9. **All except XL 1200N:** Install cover (11).
10. **XL 1200N:** See [Figure 2-166](#). Slide a fork gaiter (2) down each slider tube. Peel back lower lip (3) and slip over end of fork slider (1), fitting lower lip down over groove in upper end of fork slider. Slide upper end of fork gaiter down as far as possible.
11. See [Figure 2-165](#). Install drain screw and washer (19) into lower end of slider.
12. Pour the proper amount of TYPE "E" HYDRAULIC FORK OIL into top end of slider tube. See [1.22 FRONT FORK OIL](#).
13. Install slider tube cap (7) with o-ring (6). Screw tube cap all the way into slider tube. Finger-tighten only at this time.

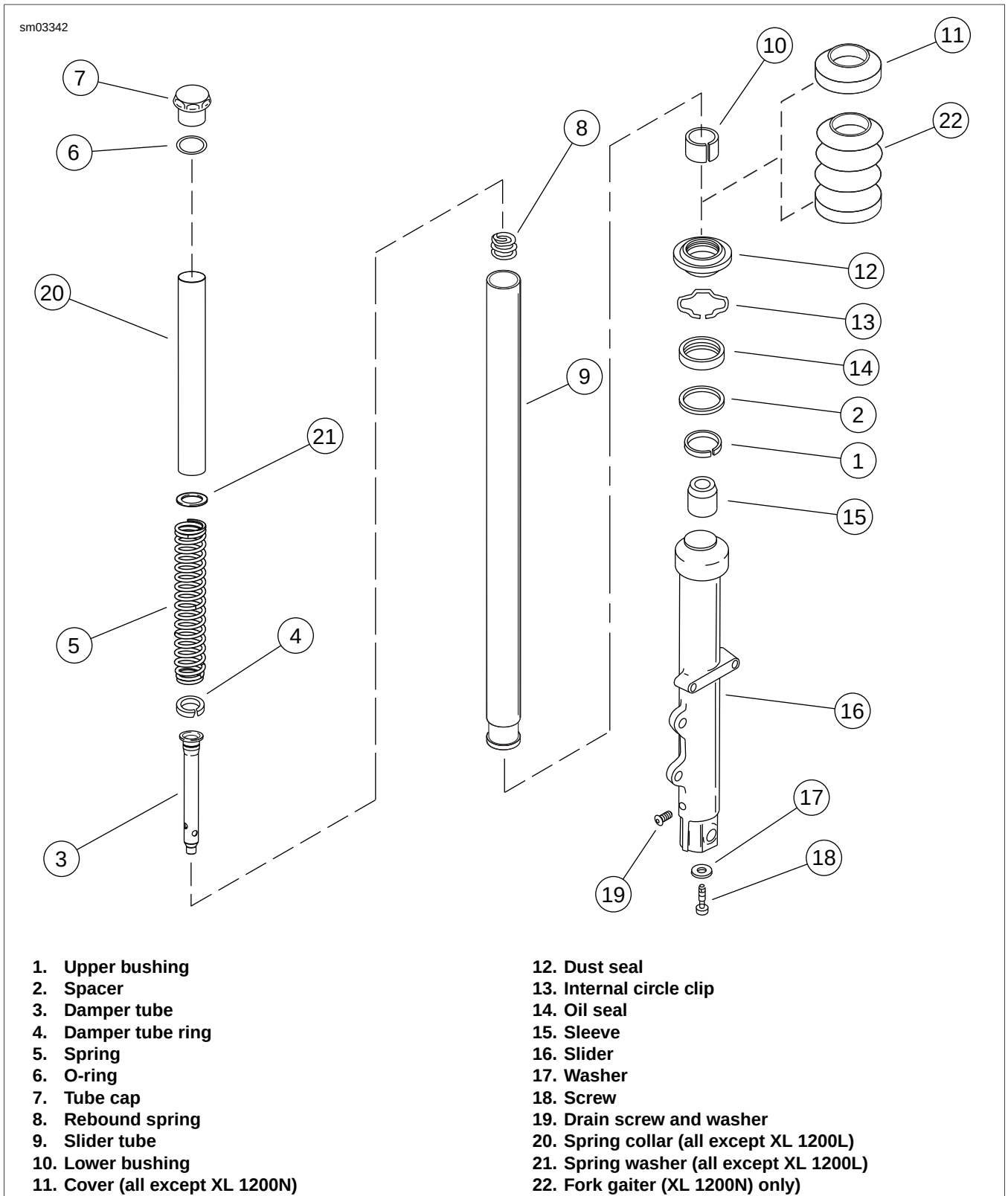


Figure 2-165. Front Slider Tube/Slider Assembly: XL Models

INSTALLATION

1. See [Figure 2-164](#). Insert each fork assembly (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. Tighten front fork upper and lower bracket pinch screws (11 and 14) to 30-35 ft-lbs (40.7-47.5 Nm).

3. Now tighten slider tube caps to 22-58 ft-lbs (29.9-78.7 Nm).
4. **XL 1200N:** See [Figure 2-166](#). Slide upper end of each fork gaiter (2) up until it contacts underside of front fork lower bracket (4).
5. Install front fender. See [2.33 FRONT FENDER](#). Tighten fasteners to 96-156 **in-lbs** (10.9-17.6 Nm).
6. Install front wheel assembly and front brake caliper. See [2.4 WHEELS](#).

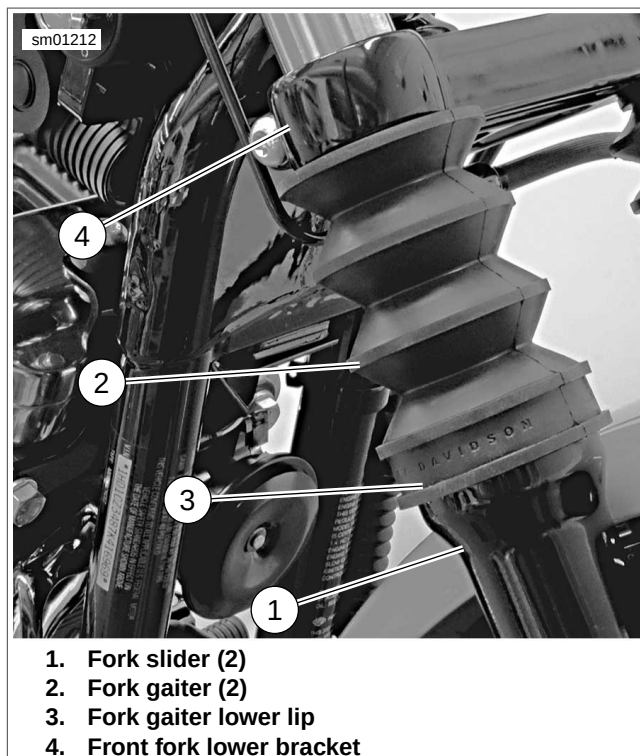


Figure 2-166. Fork Gaiter: XL 1200N Only



FRONT FORK: XR MODELS

2.22

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.

REMOVAL

PART NUMBER	TOOL NAME
HD-48287	TRIPLE TREE WEDGE TOOL

1. Remove front brake calipers. See [2.12 FRONT BRAKE CALIPER: XR MODELS](#).
2. Remove front wheel assembly. See [2.4 WHEELS](#).
3. Remove front fender and bracket assembly. See [2.33 FRONT FENDER](#).
4. See [Figure 2-167](#). Remove upper and lower fork bracket pinch bolts.
5. Using TRIPLE TREE WEDGE TOOL (Part No. HD-48287), insert wedge in fork brackets to relieve clamping pressure on fork tubes.
6. Remove fork from upper and lower fork brackets.
7. Repeat steps for other side.

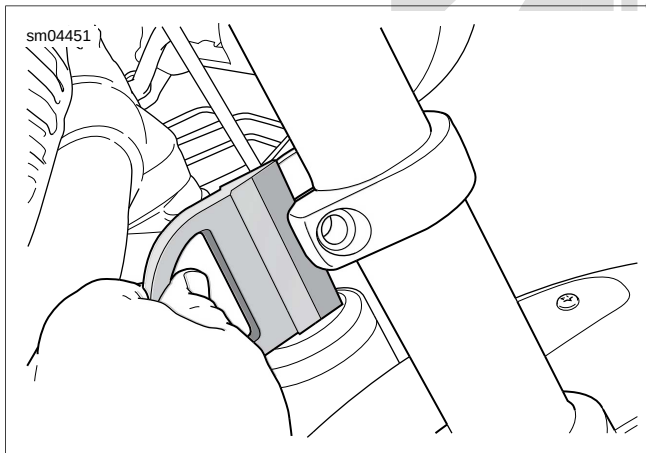


Figure 2-167. Insert Triple Tree Wedge (typical)

DISASSEMBLY

PART NUMBER	TOOL NAME
HD-41177	FORK TUBE HOLDER
HD-45966	FRONT FORK COMPRESSOR
HD-47852	INNER FORK NUT REMOVER/INSTALLER

Left Side

⚠ WARNING

Wear safety glasses or goggles when servicing fork assembly. Do not remove slider tube caps without relieving spring preload or caps and springs can fly out, which could result in death or serious injury. (00297a)

NOTES

- When using FRONT FORK COMPRESSOR be sure not to bind the outer fork tube on the tool.
- FRONT FORK COMPRESSOR (Part No. HD-45966) comes with a cup and screw that are for FLT models only and not to be used with this fork assembly.



Figure 2-168. Clamp Fork and Remove Fork Cap

1. See [Figure 2-168](#). Using FORK TUBE HOLDER (Part No. HD-41177), mount fork assembly in vise.
2. Remove fork cap.



Figure 2-169. Compress Fork Assembly

3. See [Figure 2-169](#). Compress fork using FRONT FORK COMPRESSOR (Part No. HD-45966).

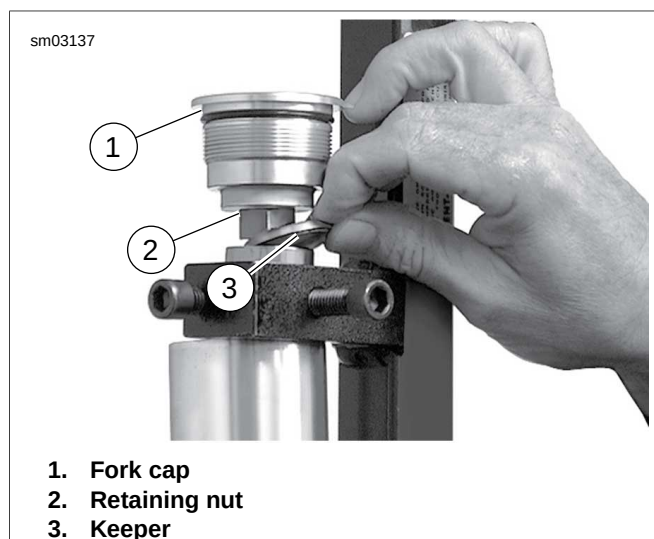


Figure 2-170. Remove Keeper

NOTE

Note position of retaining nut with shoulder of nut facing away from fork cap. Be sure to install in the same manner.

4. See [Figure 2-170](#). Remove keeper and loosen retaining nut, and fork cap from cartridge assembly.
5. Remove Front Fork Compressor.



Figure 2-171. Remove Collar, and Spring Assembly

6. See [Figure 2-171](#). Remove collar and spring from fork assembly.
7. Remove fork from vise and drain fork oil into a suitable container by tipping fork upside down and stroke cartridge plunger to remove excess fork oil.



Figure 2-172. Remove Fastener and Copper Washer

NOTE

Always use soft jaws for bench vise when placing any fork components into vise to prevent damage to components.

8. See [Figure 2-172](#). Place fork slider into bench vise with soft-jaws and remove fastener and copper washer from bottom of fork assembly.

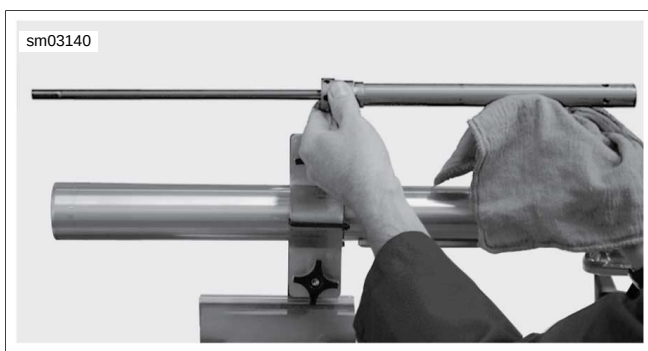


Figure 2-173. Cartridge Assembly

9. Remove fork from vise.
10. See [Figure 2-173](#). Place fork in vise using FORK TUBE HOLDER (Part No. HD-41177). Remove cartridge assembly from fork slider.

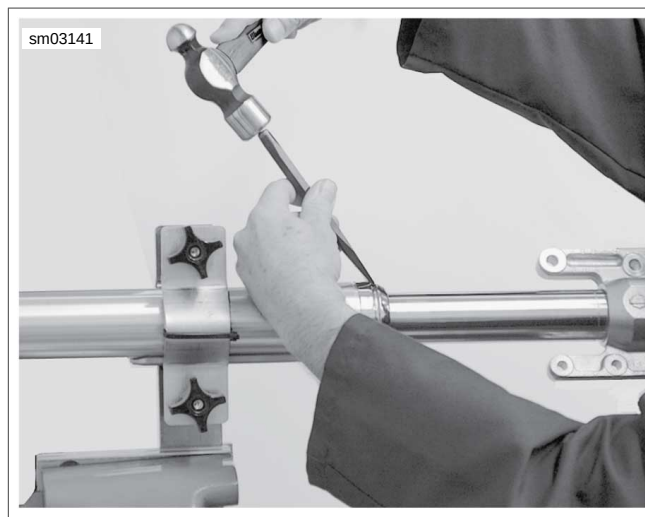


Figure 2-174. Remove Chrome Dust Cover

11. See [Figure 2-174](#). Using a blunt soft object (such as a wood dowel or chisel with duct tape), gently tap chrome dust cover away from seat, remove dust seal, lock ring, fork seal, spacer, and bushing from fork tube. Then, expand fork tube and slider against each other (in a slider-hammer effect) repeatedly to free fork slider from fork tube. Use caution not to damage components.

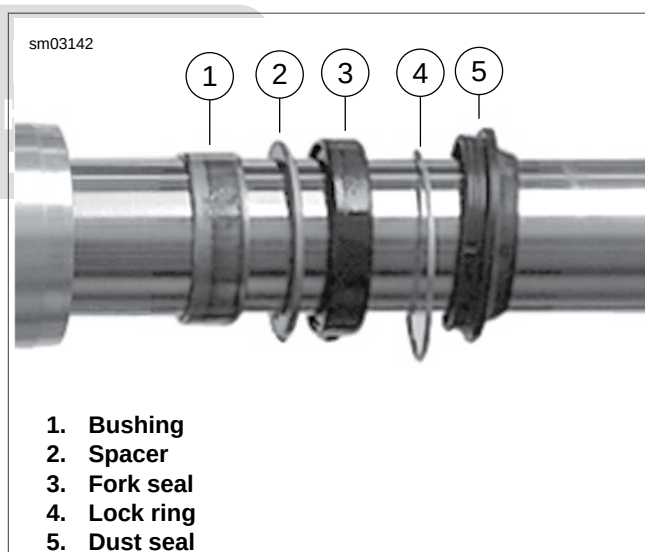


Figure 2-175. Seal Components

12. See [Figure 2-175](#). Once fork tube and slider are separated, remove dust seal, lock ring, fork seal, spacer, bushing and chrome dust cover (not shown) from fork slider.

Right Side

⚠ WARNING

Wear safety glasses or goggles when servicing fork assembly. Do not remove slider tube caps without relieving spring preload or caps and springs can fly out, which could result in death or serious injury. (00297a)

1. See [Figure 2-176](#). Using FORK TUBE HOLDER (Part No. HD-41177), mount fork assembly in vise.



Figure 2-176. Clamp Fork and Loosen Fork Cap

2. Loosen fork cap.



Figure 2-177. Remove/Install Fork Cap and Retaining Nut

3. See [Figure 2-177](#). Back retaining nut away from fork cap. Remove fork cap and retainer nut from inner fork nut threaded shaft.

NOTE

Do not fully extend fork assembly. Extending fork will cause oil to leak from bleed hole.

4. See [Figure 2-178](#). Using INNER FORK NUT REMOVER/INSTALLER (Part No. HD-47852) and remove inner fork nut assembly from fork tube.

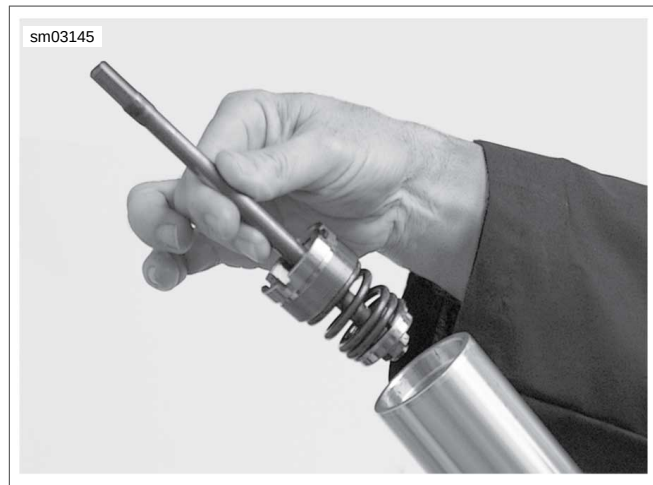


Figure 2-178. Inner Fork Nut

NOTE

Note positioning of collar, washer and spring for assembly.

5. See [Figure 2-179](#). Remove collar, washer and spring from fork assembly.
6. Remove fork from vise and drain fork oil into a suitable container by tipping fork upside down and drain excess fork oil into suitable container.



Figure 2-179. Remove Collar, Washer and Spring

7. See [Figure 2-180](#). Using FORK TUBE HOLDER (Part No. HD-41177), mount fork assembly in vise.

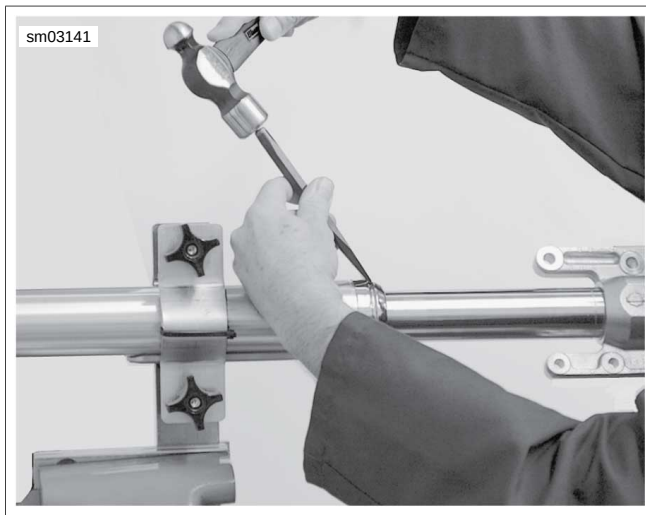


Figure 2-180. Remove Chrome Dust Cover

8. Using a blunt soft object (such as a wood dowel, or chisel with duct tape), gently tap chrome dust cover away from seat, remove dust seal, lock ring, fork seal, spacer, and bushing from fork tube. Then, by expanding fork and slider against each other (in a slider-hammer effect) repeatedly, pull slider free from fork tube. Use caution not to damage components.

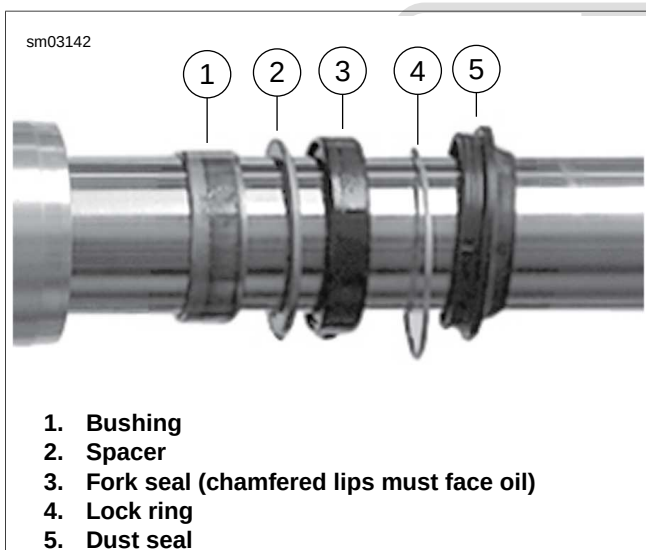


Figure 2-181. Seal Components

9. See [Figure 2-181](#). Once fork tube and slider are separated, remove dust seal, lock ring, fork seal, spacer, bushing and chrome dust cover (not shown) from fork slider.

CLEANING AND INSPECTION

1. Thoroughly clean and inspect each part. If inspection shows that any parts are bent or damaged, those parts should be repaired or replaced.
2. Inspect fork tube bushing and slider guide bushing and replace as required.
3. Always replace oil seals and o-rings.

4. Check dust cover there it rubs on fork tube. Dust cover should not show any wear.
5. If springs are damaged, replace springs.
6. If a fork tube or slider is bent or damaged, replace it.
7. Replace all other worn or damaged components as necessary.

NOTES

- Any time fork pinch bolts are loosened or removed for any reason, the following procedure must be performed. Fork tube installation process is extremely critical and must follow this procedure with no exceptions. Failure to properly clean the threads will cause improper torque readings upon assembly, causing loss of vehicle control, resulting in death or serious injury.
- **New bolts are recommended for assembly. If the original bolts are to be reused, completely clean excess lock patch from pinch bolt threads using a wire wheel. Wash bolts with solvent and dry thoroughly before installing.**

⚠ WARNING

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

- Clean bolt holes using a bottoming thread tap and blow bolt hole threads clean with compressed air.
- 8. Thoroughly clean all locking material from the fastener and bracket bolt hole threads. Fork pinch bolts must be thoroughly cleaned of all lock patch material. Fork bracket bolt holes must be tapped with a bottoming tap and blown clear with compressed air to remove excess lock patch material. If bolts can not be completely cleaned, it is required that new fork pinch bolts be installed.

ASSEMBLY

PART NUMBER	TOOL NAME
B-42571	FORK SEAL DRIVER
HD-41177	FRONT FORK TUBE HOLDER
HD-45966	FRONT FORK COMPRESSOR
HD-47852	INNER FORK NUT REMOVER/INSTALLER
HD-59000B	OIL LEVEL GAUGE

Left Side

NOTE

Chamfered lips on oil seal MUST face towards oil in fork.

1. See [Figure 2-182](#). Use sleeve from fork seal driver and install chrome dust cover (not shown) and components onto fork slider in order shown.

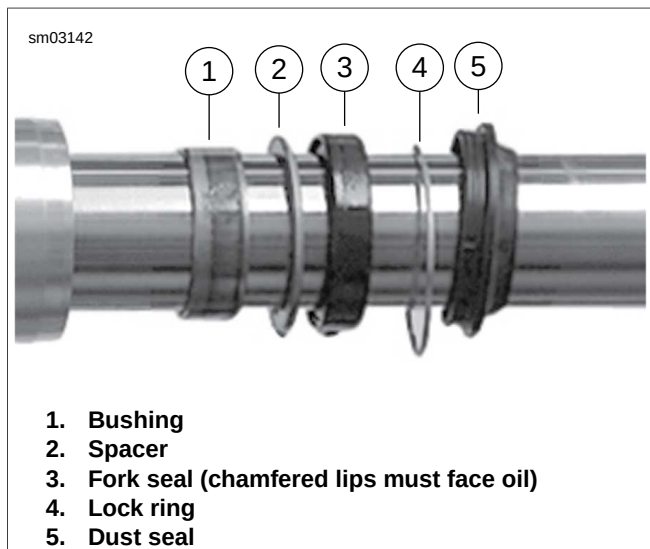


Figure 2-182. Fork Tube Shown Installed In Order of Installation

2. Lightly coat fork slider and bushing with fork oil and gently install slider into fork tube.

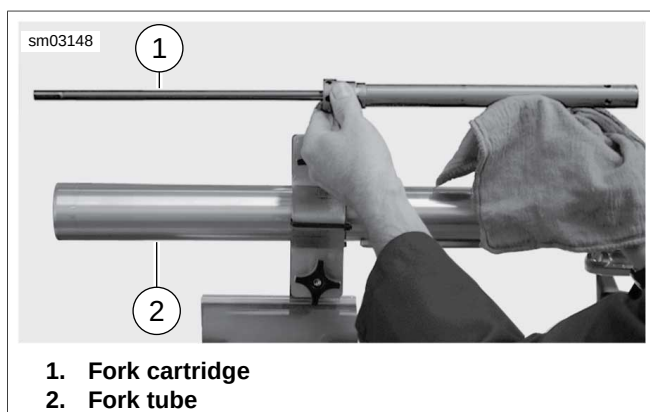


Figure 2-183. Install Fork Cartridge

3. See [Figure 2-183](#). Using FRONT FORK TUBE HOLDER (Part No. HD-41177), mount fork assembly in vise.
4. Make sure cap (centering plate) is on bottom end of fork cartridge and install fork cartridge (big end first) into fork slider.
5. Remove fork and FRONT FORK TUBE HOLDER from vise.

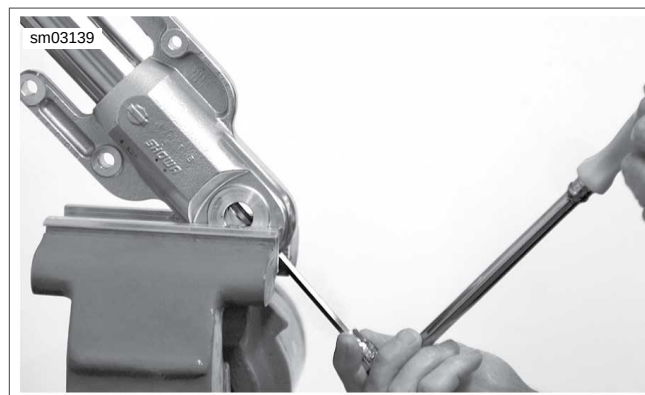


Figure 2-184. Install Fastener and Copper Washer

NOTE

Always use soft jaws for bench vise when placing any fork components into vise to prevent damage to components.

6. See [Figure 2-184](#). Using a vise with soft jaws, clamp fork slider in vise. Install **new** fastener and copper washer to hold fork cartridge in place inside fork tube. Tighten to 132-216 **in-lbs** (14.9-24.4 Nm).
7. Remove fork from vise.
8. Using FRONT FORK TUBE HOLDER (Part No. HD-41177), mount fork assembly in vise.
9. See [Figure 2-185](#). Assemble the FORK SEAL DRIVER (Part No. B-42571) over fork slider in front of oil seal with the long end of tool facing seal. Install parts in the following order: bushing, spacer, and drive fork seal into fork tube bore with tool until tool is flush with fork slider.
10. Install lock ring into groove in top of oil seal. Verify lock ring is properly seated.



Figure 2-185. Install Bushing, Spacer, and Install Fork Seal in Place with Seal Driver

11. See [Figure 2-186](#). Remove FORK SEAL DRIVER, reverse tool to short side of tool to prepare to install chrome dust cover. Rotate slider cover to match any removal burrs in slider and tap chrome dust cover into place.

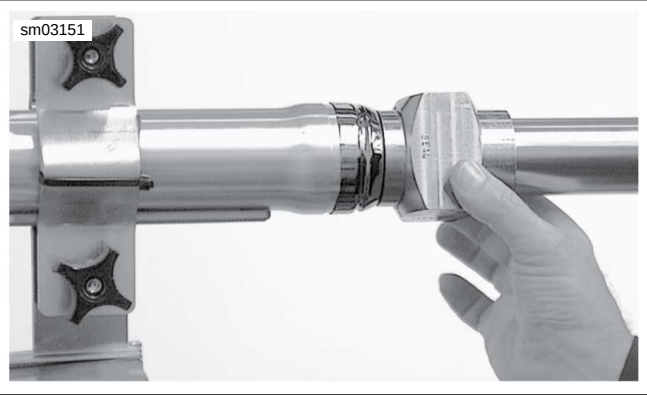


Figure 2-186. Install Chrome Dust Cover



Figure 2-188. Measure Fork Oil

Table 2-25. Oil Level, Left Fork

MEASUREMENT		VOLUME	
2.8 in.	71 mm	20.7 oz	613 cc

12. Adjust fork assembly to be vertical in vise and fully compressed.
13. Fill fork with Harley-Davidson TYPE E FORK OIL (Part No. HD-99884-80) until it is approximately 2.0 in. (50.8 mm) from top of fork tube.



Figure 2-187. Pump Cartridge

14. See [Figure 2-187](#). Slowly pump cartridge 8 to 10 times to exhaust air from assembly.

NOTE

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

15. See [Figure 2-188](#). Fully compress fork and adjust the oil level to specification from top of fork tube using OIL LEVEL GAUGE (Part No. HD-59000B). Refer to [Table 2-25](#).

NOTE

Coil windings tighten at bottom of spring. Be sure to install in this manner.

16. See [Figure 2-189](#). Fully extend fork and install spring in fork tube (with tightly wound end at bottom), washer and collar.

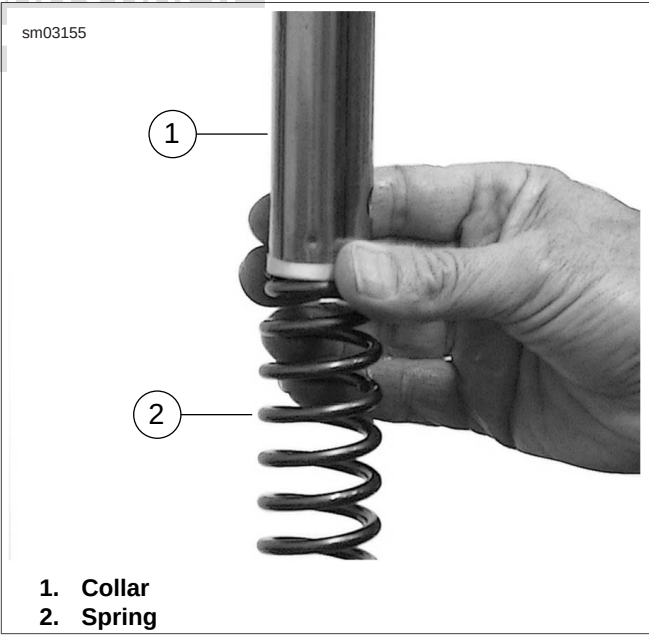


Figure 2-189. Collar and Spring Assembly

⚠ WARNING

Wear safety glasses or goggles when servicing fork assembly. Do not remove slider tube caps without relieving spring preload or caps and springs can fly out, which could result in death or serious injury. (00297a)

17. See [Figure 2-190](#). Compress fork using FRONT FORK COMPRESSOR (Part No. HD-45966).
18. Install keeper.

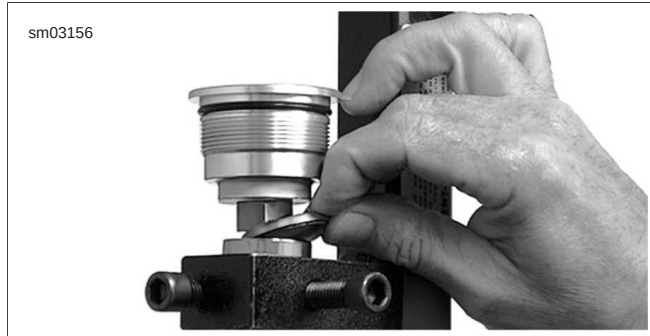


Figure 2-190. Install Keeper

19. Install retainer nut on cartridge rod 0.551 in. (14 mm) from top of rod and install fork cap onto cartridge rod.
20. Install fork cap on inner rod and tighten against the retainer nut to 150-195 **in-lbs** (17-22 Nm) while holding retainer nut with wrench.
21. Release tension and remove fork compressing tool.



Figure 2-191. Install Fork Cap

22. See [Figure 2-191](#). Install fork cap and tighten to 21-29 ft-lbs (29-39 Nm).

Right Side

1. Using FORK TUBE HOLDER (Part No. HD-41177), mount fork assembly in vise vertically and fully compress fork.

2. See [Figure 2-192](#). Install chrome dust cover (not shown) and components onto fork slider in order shown.

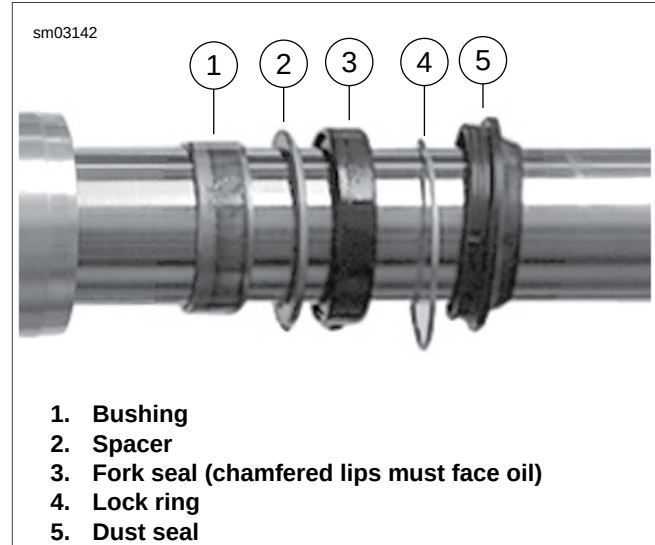


Figure 2-192. Seal Components

3. Lightly coat fork slider and bushing with fork oil and gently install slider into fork tube.

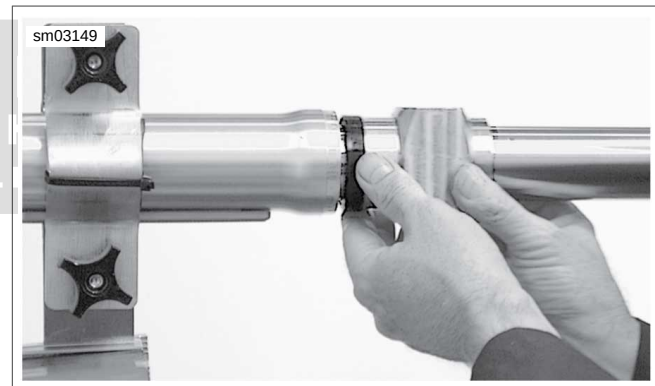


Figure 2-193. Install Seal Components

NOTE

Chamfered lips on oil seal MUST face towards oil in fork.

4. See [Figure 2-193](#). Assemble the FORK SEAL DRIVER (Part No. B-42571) over fork slider in front of oil seal with the long end of tool facing seal and assemble in the following order: Install bushing, spacer, and drive fork seal into fork tube bore with tool until tool is flush with fork slider.
5. Install lock ring into groove in top of oil seal. Verify lock ring is properly seated.
6. See [Figure 2-194](#). Remove FORK SEAL DRIVER and reverse tool to short side of tool to prepare to install chrome dust cover. Rotate slider cover to match any removal burrs in slider and tap chrome dust cover into place.

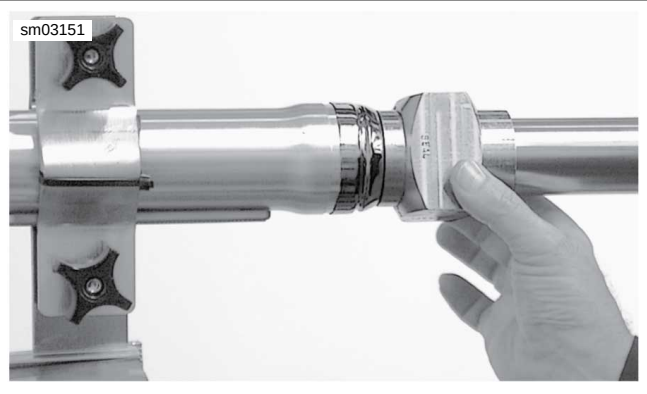


Figure 2-194. Install Chrome Dust Cover

Table 2-26. Oil Level, Right Fork

MEASUREMENT		VOLUME	
3.7 in.	93 mm	23.1 oz	684 cc

7. Using FORK TUBE HOLDER (Part No. HD-41177), mount fork assembly in vise vertically and fully compress fork.

NOTE

Measure fork oil level from top of fork tube using the OIL LEVEL GAUGE (Part No. HD-59000B).

8. Fill fork with Harley-Davidson TYPE E FORK OIL (Part No. HD-99884-80) to specification shown in [Table 2-26](#).



Figure 2-195. Measure Fork Oil

9. Fully extend fork.

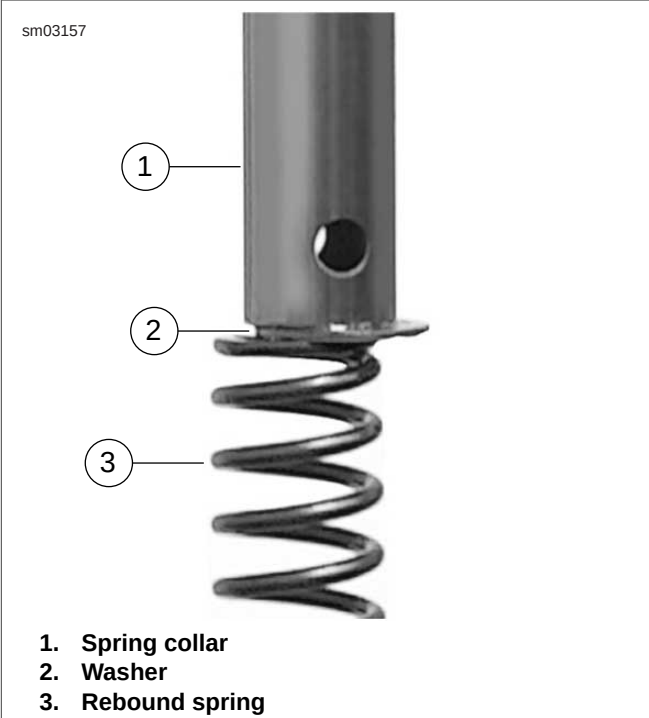


Figure 2-196. Collar, Washer and Spring Assembly

10. See [Figure 2-196](#). Install rebound spring in fork tube (with tightly wound end at bottom), washer, and spring collar.
11. Verify that washer has properly seated on top of spring.



Figure 2-197. Inner Fork Nut

12. See [Figure 2-197](#). Insert inner fork nut and finger tighten.

WARNING

Wear safety glasses or goggles when servicing fork assembly. Do not remove slider tube caps without relieving spring preload or caps and springs can fly out, which could result in death or serious injury. (00297a)

NOTE

To prevent cross threading fork tube damper cups and caps, use caution when threading in the caps with the spring compressed. It may be helpful to use a palm-ratchet during this process.

13. See [Figure 2-198](#). Final tighten inner fork nut to 69-83 ft-lbs (93-113 Nm) using INNER FORK NUT REMOVER/INSTALLER (Part No. HD-47852).



Figure 2-198. Hand Tighten

14. See [Figure 2-199](#). Install retainer nut (retainer nut must be installed 0.551 in (14 mm) from top of threaded shaft).



Figure 2-199. Remove/Install Fork Cap and Retaining Nut

15. Install fork cap on inner rod and tighten against the retainer nut to 150-195 in-lbs (17-22 Nm) while holding retainer nut with wrench.
16. Apply a light coat of fork oil on o-ring and thread cap into fork tube. Tighten fork cap to 21-29 ft-lbs (29-39 Nm).

INSTALLATION

PART NUMBER	TOOL NAME
HD-48287	TRIPLE TREE WEDGE TOOL

Any time fork pinch bolts are loosened or removed for any reason, the bolts and threaded holes must be completely clean of excess lock patch material. If the threads have not been properly cleaned, follow procedure in [2.22 FRONT FORK: XR MODELS, Cleaning and Inspection](#). Failure to properly clean these threads will cause improper torque readings upon assembly and can result in loss of vehicle control, death or serious injury.

NOTES

- It is recommended that **new** fork pinch bolts be installed. If **new** bolts are not readily available, use a wire grinder wheel to remove all remaining lock patch from original bolts, wash bolts in clean solvent and dry thoroughly.
 - Fork tube installation height is also critical and must match the opposite side exactly for proper vehicle operation, reliability and performance.
 - When installing fork leg in triple trees, do not twist fork leg to avoid damage to cosmetic finishes.
- Identify left and right side fork assemblies.
 - Insert fork assembly from the lower fork bracket upward through the upper fork bracket.
 - Remove TRIPLE TREE WEDGE TOOL (Part No. HD-48287) used during removal process.
 - See [Figure 2-200](#). Measure distance from top of upper fork bracket to top of fork assembly. Both sides must be exactly the same and measure 0.250-0.330 in (6.35-8.38 mm).

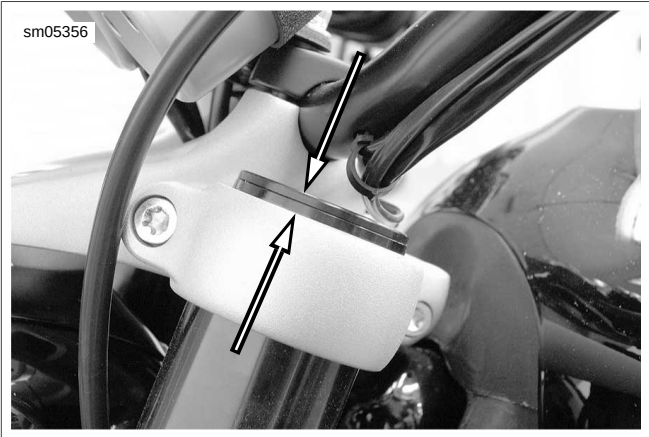


Figure 2-200. Fork Installation Height Measurement

NOTE

If **new** bolts are not readily available, use a wire grinder wheel to remove all remaining lock patch from original bolts, wash bolts in clean solvent and dry thoroughly. Apply two drops of LOCTITE® 262 to the first 1/4 in. (6.35 mm) of the end threads. Install screws in triple clamp clamps.

5. Install **new** pinch bolts with lock patch or original bolts using Loctite.
6. Verify fork tube installation measurement is 0.250-0.330 in (6.35-8.38 mm).
7. Tighten pinch bolts to 30-35 ft-lbs (40.7-47.5 Nm).
8. Install front fender and bracket. See [2.33 FRONT FENDER](#).
9. Install front brake caliper hydraulic lines and install front brake calipers. See [2.12 FRONT BRAKE CALIPER: XR MODELS](#).
10. Install front wheel and align the wheel to the forks. See [2.4 WHEELS](#).
11. Install negative battery cable. Tighten to 60-70 **in-lbs** (6.8-7.9 Nm).



FORK STEM AND BRACKET ASSEMBLY

2.23

REMOVAL AND DISASSEMBLY

1. Place a protective cover over fuel tank. Remove the fork assemblies. See [2.21 FRONT FORK: XL MODELS](#) or [2.22 FRONT FORK: XR MODELS](#).
2. See [Figure 2-201](#). Remove stem bolt cap (10) (XL 1200R only), fork stem bolt (9) and washer (8). Loosen fork stem pinch screw (7).
3. Lift handlebar assembly from steering head with fork upper bracket (6) attached. Carefully position assembly out of the way. Exercise caution to avoid damaging control cables, wiring harnesses, clutch cable or brake lines.

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.

4. Remove upper seal (5) and upper bearing cone (3). Slide fork stem and lower bracket (1) from frame.

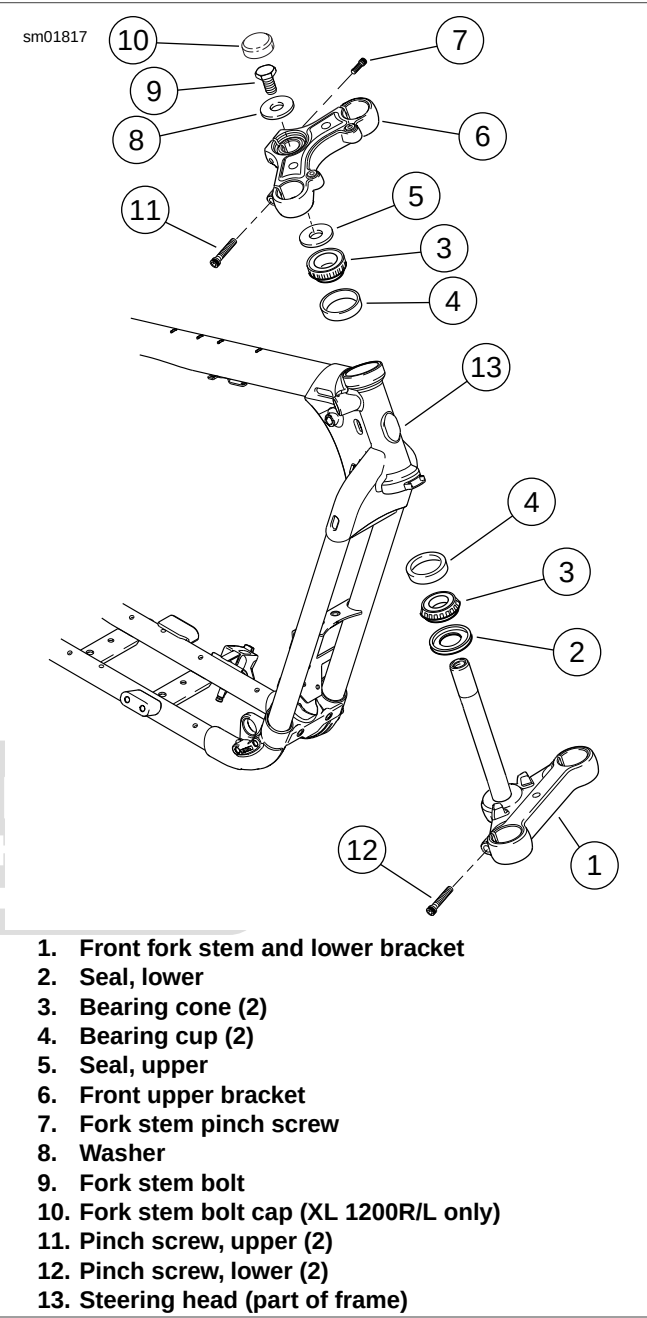


Figure 2-201. Fork Stem and Bracket Assembly: Typical

CLEANING, INSPECTION AND REPAIR

PART NUMBER	TOOL NAME
HD-33416	UNIVERSAL DRIVER HANDLE
HD-39301-A	STEERING HEAD BEARING RACE REMOVAL TOOL

1. See [Figure 2-201](#). Clean the seals (2, 5), bearing cones (3), fork stem and lower bracket (1) and steering head (13) with solvent.

2. Inspect fork stem and lower bracket (1). Replace if damaged.
3. Carefully inspect bearing races and assemblies for pitting, scoring, wear and other damage. Check for roughness of bearings by turning them in their races. Replace bearings and bearing cups if bearings do not turn freely and smoothly. Replace damaged bearings as a set.

CAUTION

Replace both bearing assemblies even if one assembly appears to be good. Mismatched bearings can lead to excessive wear and premature replacement. (00532b)

4. Replace bearings and bearing cups as follows:
 - a. The lower bearing cone is a slip fit on the fork stem. Remove lower bearing cone by sliding it up and off fork stem. If necessary, gently pry bearing cone off fork stem with a pair of flat blade screw drivers. Remove lower seal (2).
 - b. Drive bearing cups from steering head using STEERING HEAD BEARING RACE REMOVAL TOOL (Part No. HD-39301-A) and UNIVERSAL DRIVER HANDLE (Part No. HD-33416). **If bearing cups are removed, the bearings cannot be reused. They must be replaced.**

ASSEMBLY AND INSTALLATION

PART NUMBER	TOOL NAME
HD-39302	STEERING HEAD BEARING RACE INSTALLATION TOOL

1. See [Figure 2-201](#). If bearing cups (4) were removed, obtain **new** bearings and bearing cups. Install **new** bearing cups

into frame steering head using STEERING HEAD BEARING RACE INSTALLATION TOOL (Part No. HD-39302).

WARNING

Properly seat bearing cups in steering head bore. Improper seating can loosen fork stem bearings adversely affecting stability and handling, which could result in death or serious injury. (00302a)

2. Liberally coat the bearing cones (3) with HARLEY-DAVIDSON SPECIAL PURPOSE GREASE. Work the grease thoroughly into the bearing rollers.
3. Place lower bearing seal (2) over fork stem. Install lower bearing cone (3) onto fork stem and bracket (1).
4. Insert fork stem and bracket (1) through the steering head. Install bearing cone (3) and seal (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 slider and tube assemblies. See [2.21 FRONT FORK: XL MODELS](#) or [2.22 FRONT FORK: XR MODELS](#). Leave both lower fork bracket pinch screws (12) loose.
7. Tighten fork stem bolt (9) to 23-27 ft-lbs (31.2-36.6 Nm). Loosen fork stem bolt, then retighten to 72-96 **in-lbs** (8.1-10.9 Nm).
8. Tighten lower fork bracket pinch screws to 30-35 ft-lbs (40.7-47.5 Nm).
9. Tighten fork stem pinch screw (7) to 30-35 ft-lbs (40.7-47.5 Nm).

BELT GUARD AND DEBRIS DEFLECTOR

2.24

BELT GUARD: XL MODELS

Removal

1. See [Figure 2-202](#). Remove right side lower shock absorber mount lock nut (1). Pull shock absorber mounting screw (2) out slightly until it clears mounting hole in belt guard (4).
2. Remove screw (5), washer (6) and nut (7) securing front of belt guard to rear fork (10).
3. Remove belt guard from vehicle.

Installation

1. See [Figure 2-202](#). Slide belt guard (4) into place on vehicle. Tab on front of belt guard mounts outboard of mounting bracket on rear fork.
2. Secure front of belt guard to rear fork (10) with screw (5), washer (6) and nut (7). Tighten to 120-180 **in-lbs** (13.6-20.4 Nm).
3. Push lower shock absorber mounting screw (2) through rear belt guard mounting hole. Thread lock nut (1) on screw. Tighten to 45-50 ft-lbs (61-68 Nm).

DEBRIS DEFLECTOR: XL MODELS

Removal

1. See [Figure 2-202](#). Loosen, but do not remove, three screws with captive washers (9) securing debris deflector (8) to underside of rear fork (10).
2. Slide debris deflector forward until keyway slots in deflector clear screw heads. Remove debris deflector.

Installation

1. See [Figure 2-202](#). Position debris deflector (8) in place on underside of rear fork (10).
2. Fit large end of keyway slots in deflector over screw heads and captive washers (9). Slide deflector rearward to lock screws in slots. Tighten screws to 36-60 **in-lbs** (4.1-6.8 Nm).

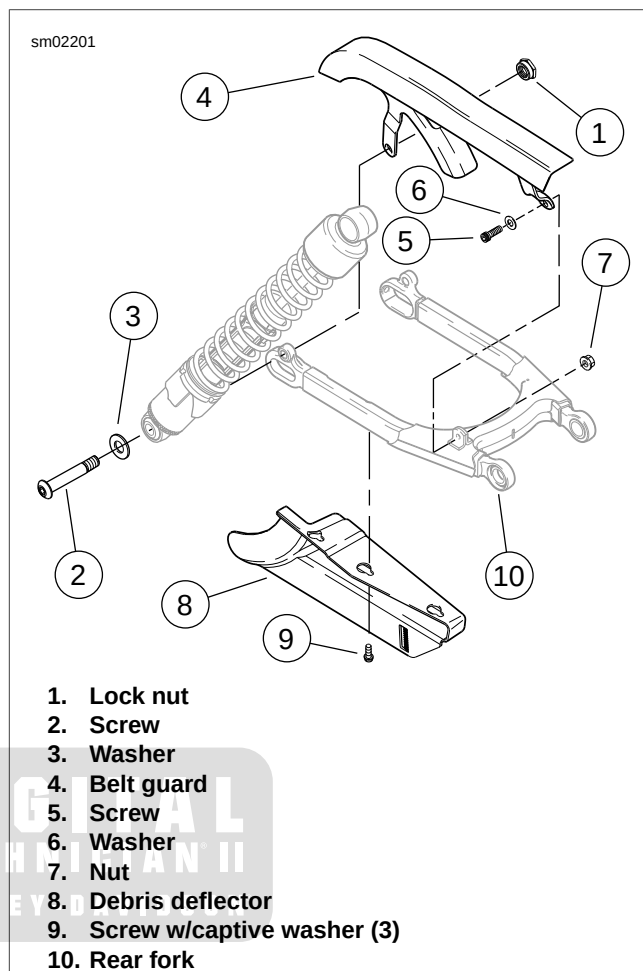


Figure 2-202. Belt Guard/Debris Deflector: XL Models

BELT GUARD: XR MODELS

Removal

NOTE

See [Figure 2-203](#). Note that exhaust system has been removed for clarity. It is **not** necessary to remove exhaust system to remove and replace belt guard and/or debris deflector.

1. See [Figure 2-203](#). Remove two screws with captive washers (2) securing belt guard to top of rear fork (5).
2. Remove belt guard from vehicle.

Installation

1. See [Figure 2-203](#). Slide belt guard (1) into place on top of rear fork (5).
2. Secure belt guard using two screws with captive washers (2). Tighten to 72-96 **in-lbs** (8.1-10.8 Nm).

DEBRIS DEFLECTOR: XR MODELS

Removal

1. See [Figure 2-203](#). Remove three screws with captive washers (4) securing debris deflector (3) to underside of rear fork (5). Note that front screw is located inboard of debris deflector.
2. Remove debris deflector from vehicle.

Installation

1. See [Figure 2-203](#). Position debris deflector (3) in place on underside of rear fork (5).
2. Secure with three screws (4). Tighten screws to 72-96 in-lbs (8.1-10.8 Nm).

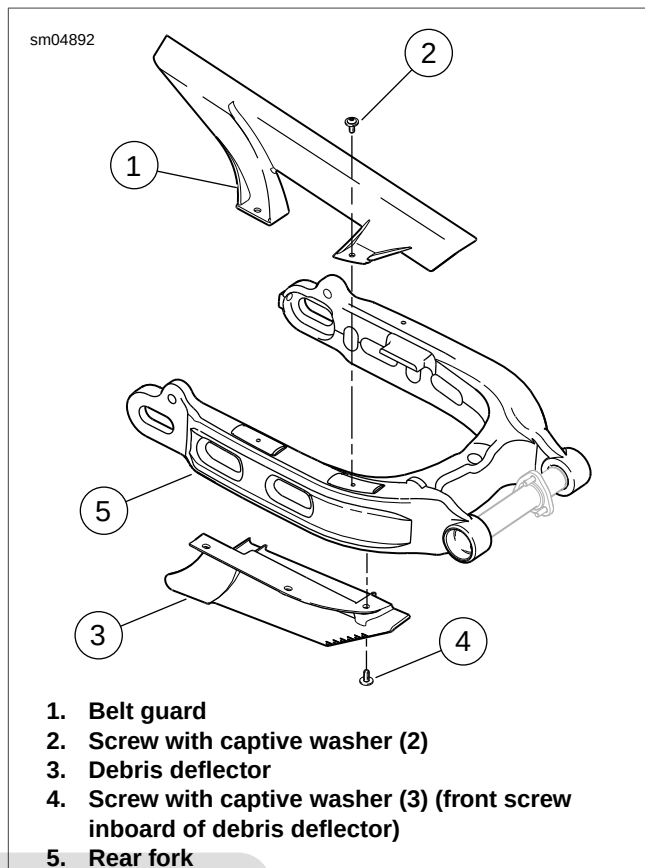
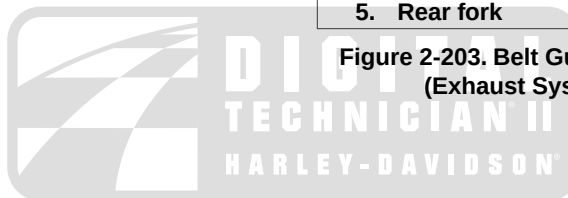


Figure 2-203. Belt Guard/Debris Deflector: XR Models
(Exhaust System Removed for Clarity)



REAR FORK

2.25

GENERAL

The rear fork used on the XR model differs in appearance from the XL model rear fork. However, the removal, servicing and installation procedures are functionally identical.

REMOVAL

NOTE

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

1. Support motorcycle under frame with suitable lifting device so that rear wheel is off the ground.
2. **XL models:** remove rear exhaust pipe and muffler. See [4.15 EXHAUST SYSTEM: XL MODELS](#).
3. **XR models:** remove exhaust system. See [4.16 EXHAUST SYSTEM: XR MODELS](#).
4. Remove rear wheel. See [2.4 WHEELS](#).
5. Remove rear brake caliper assembly from rear fork. See [2.16 REAR BRAKE CALIPER: XL MODELS](#) or [2.17 REAR BRAKE CALIPER: XR MODELS](#). Remove screw(s) securing brake line clamp(s) to rear fork.
6. **XR Models:** Remove fasteners securing brake line to left side of rear fork.
7. Remove both shock absorber screws, washers and nuts from rear fork. See [2.26 SHOCK ABSORBERS](#).
8. Remove rear belt guard and debris deflector. See [2.24 BELT GUARD AND DEBRIS DEFLECTOR](#).
9. **XL Models:** Remove rear brake reservoir cover by grasping cover and gently pulling straight out from reservoir. Remove reservoir mounting screw and pull reservoir back out of the way. See [2.15 REAR BRAKE MASTER CYLINDER RESERVOIR](#).
10. **XL Models:** Loosen, but do not remove, top mounting screw from left passenger footrest bracket. Remove bottom mounting screw. Move brake hoses and B-clamp forward slightly to gain access to left rear fork/engine mount bolt.
11. **XR Models:** Remove left and right rider footrests. See [2.42 RIDER FOOT CONTROLS: XR MODELS](#).
12. See [Figure 2-204](#). Support rear fork (3). Remove rear fork/engine mount bolts (1) and pull fork assembly from frame.

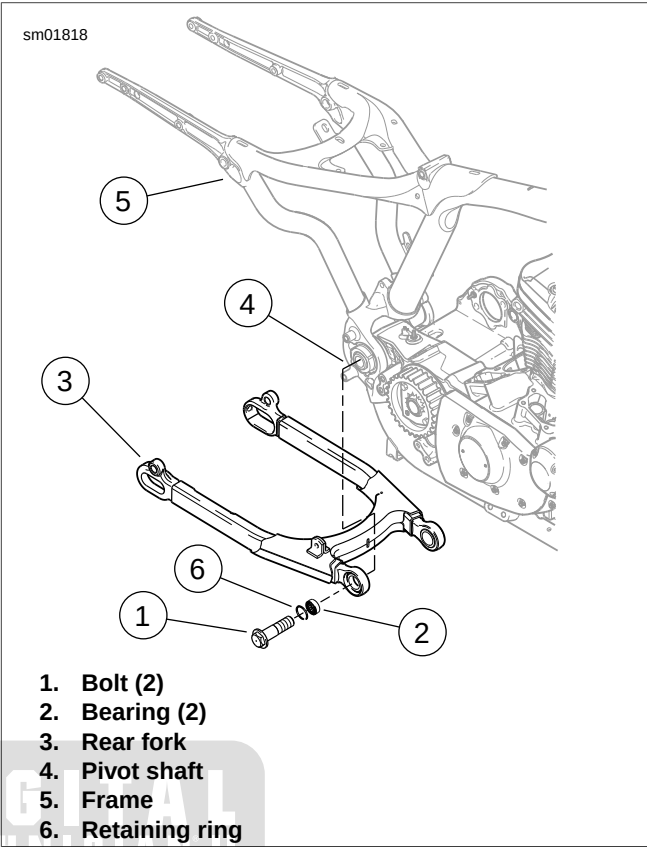


Figure 2-204. Rear Fork Assembly: All Models (XL Shown)

DISASSEMBLY

PART NUMBER	TOOL NAME
HD-46281	BEARING REMOVER/INSTALLER TOOL

NOTE

See [Figure 2-204](#). Remove pivot bearings (2) only if replacement is required.

1. See [Figure 2-205](#). Using BEARING REMOVER/INSTALLER TOOL (Part No. HD-46281) (4, 5, 6), carefully press bearing assemblies from fork bearing bosses (2):
 - a. Place receiver cup (6) on press bed, with recessed end of cup facing up.
 - b. Place rear fork pivot bearing boss (2) over cup as shown in the photo.
 - c. Slide pilot (5) through bearing and into receiver cup.
 - d. Insert handle (4) through other rear fork pivot bearing boss and bearing, down into pilot.
 - e. Engage press ram on end of handle and press bearing out.
2. Turn rear fork over and press out other pivot bearing in the same manner.

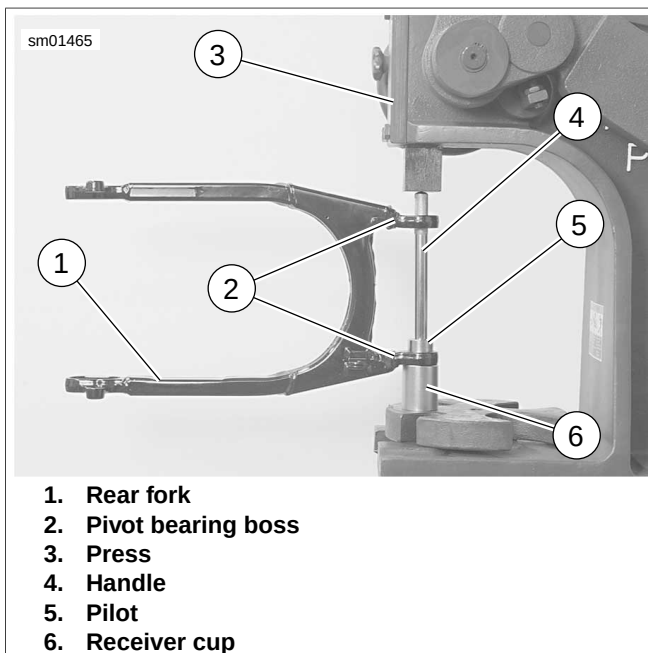


Figure 2-205. Removing Rear Fork Pivot Bearings: All Models (XL Shown)

CLEANING AND INSPECTION

WARNING

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

1. Clean all components in solvent and blow dry with low pressure compressed air. Carefully inspect bearings for wear and/or corrosion. Replace bearing assembly if damaged.
2. See [Figure 2-204](#). Make sure pivot bearing retaining ring (6) is not bent or damaged. If it is, replace it with a **new** retaining ring. Make sure retaining ring is fully seated in the groove in each bearing (2).
3. Check that rear fork (3) is not bent, twisted or cracked. Replace if damaged.

ASSEMBLY

PART NUMBER	TOOL NAME
HD-46281	BEARING REMOVER/INSTALLER TOOL

1. See [Figure 2-204](#). If necessary, press **new** bearings (2) into position in rear fork, using BEARING REMOVER/INSTALLER TOOL (Part No. HD-46281):
 - a. See [Figure 2-206](#). Place receiver cup (7) on press bed, with recessed end of cup facing up.
 - b. Place rear fork pivot bearing boss (2) over cup as shown in the photo.
 - c. Place **new** pivot bearing (6) over pivot bearing boss, with retaining ring side of bearing up.
 - d. Slide pilot (5) through **new** pivot bearing, through pivot bearing boss, and into receiver cup.
 - e. Insert handle (4) down into pilot.
 - f. Engage press ram on end of handle and press bearing down until retaining ring bottoms out in rear fork pivot bearing boss.
2. Turn rear fork over and in the same manner, press in other pivot bearing into rear fork pivot bearing boss.

INSTALLATION

1. Slide rear fork assembly into position on motorcycle.
2. See [Figure 2-204](#). Holding rear fork assembly in position, install rear fork/engine mount bolts (1). Tighten to 60-70 ft-lbs (81.4-95.0 Nm).
3. **XL models:** Position rear brake hose B-clamp and left passenger footrest bracket in place and install lower mounting screw. Tighten both mounting screws to 45-50 ft-lbs (61-68 Nm).
4. **XL models:** Install rear brake reservoir using screw with captive washer. Tighten to 20-25 **in-lbs** (2.3-2.8 Nm). Place reservoir cover over reservoir and gently press cover into place. See [2.15 REAR BRAKE MASTER CYLINDER RESERVOIR](#).
5. **XR models:** Install left and right rider footrests. See [2.42 RIDER FOOT CONTROLS: XR MODELS](#).
6. Install belt guard and debris deflector. See [2.24 BELT GUARD AND DEBRIS DEFLECTOR](#).
7. Install shock absorbers onto rear fork. See [2.26 SHOCK ABSORBERS](#).
8. Install rear brake caliper assembly. See [2.16 REAR BRAKE CALIPER: XL MODELS](#) or [2.17 REAR BRAKE CALIPER: XR MODELS](#).
9. **XR models:** Secure rear brake line to left side of fork. See [2.18 BRAKE LINES](#).
10. Install rear wheel and adjust rear belt. See [2.4 WHEELS](#).
11. **XL models:** install rear exhaust pipe and muffler. See [4.15 EXHAUST SYSTEM: XL MODELS](#).
12. **XR models:** install exhaust system. See [4.16 EXHAUST SYSTEM: XR MODELS](#).

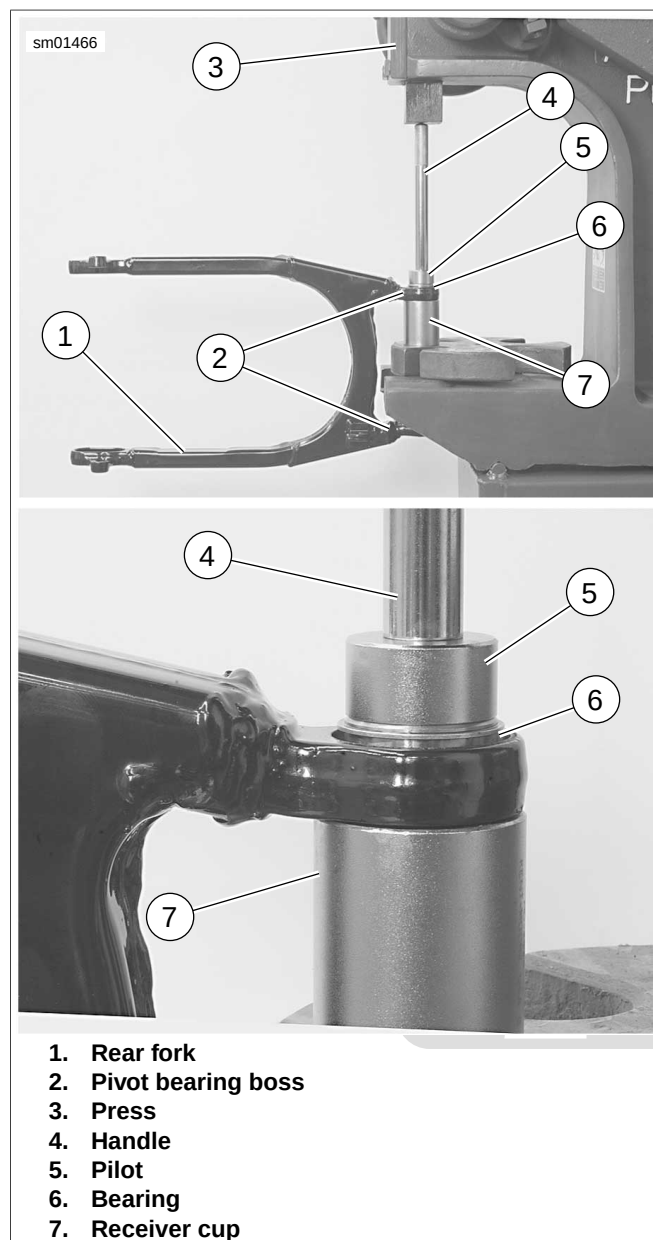


Figure 2-206. Installing Rear Fork Pivot Bearings: All Models (XL Shown)

SHOCK ABSORBERS

2.26

GENERAL

When removing shock absorbers, remove and install one shock absorber first, then the other. This will eliminate the need to raise the rear end of the motorcycle. If it is necessary to remove both shock absorbers at once, place the motorcycle on a suitable lift with the rear wheel raised off the ground.

See [1.20 SHOCK ABSORBER ADJUSTMENT](#) for information on preload adjustment and suspension settings.

NOTE

Except for rubber mounting damper bushings, shock absorbers are non-repairable items. If the shock absorber is leaking or damaged, it must be replaced as an assembly.

REMOVAL

1. If necessary, 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 2-207](#). Remove screw (1), washer (7) and lock nut (9) from bottom end of shock absorber (6) or (15).
3. Remove screw (2), washer (3) and stud cover (4) (XL models) from top end of shock absorber.
4. Remove shock absorber.
5. If shock absorber is to be replaced, take note of the position of the preload setting and adjust the replacement shock absorber to the same setting.

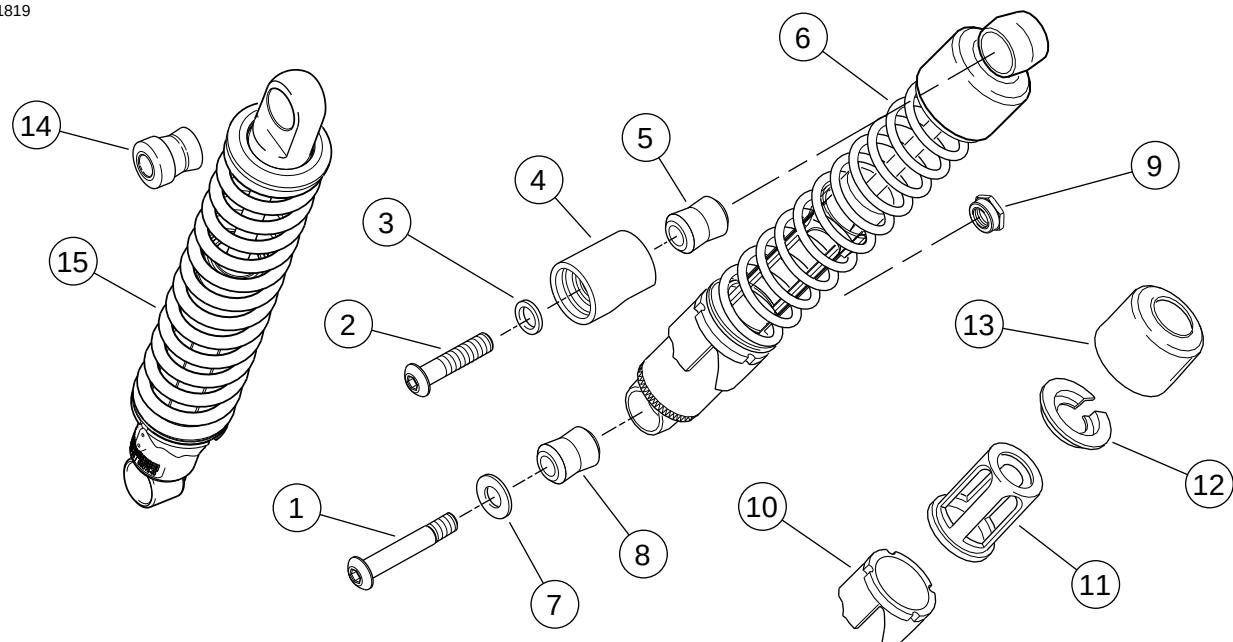
CLEANING AND INSPECTION

Clean and inspect all parts for wear and damage. Check rubber components for wear, cracking and stiffness. Examine shock assembly for signs of leakage. Replace both shock absorbers as a set if either shock absorber assembly is excessively worn, leaking or damaged.

INSTALLATION

1. See [Figure 2-207](#). Install shock absorber upper mounting screw (2), washer (3), stud cover (4) (XL models) and shock absorber (6) or (15).
2. Position bottom end of shock absorber against outboard side of rear fork mount. Insert screw (1) and washer (7) through damper bushing (8) and rear fork mount flange. Install lock nut (9) on end of bolt.
3. Remove upper mounting screw (2). Apply 2-3 drops of LOCTITE THREADLOCKER 243 (blue) to threads of upper mounting screw.
4. Install washer (3) onto upper mounting screw. Insert screw through stud cover (4), upper shock absorber damper bushing (5) and into frame boss. Tighten to 45-50 ft-lbs (61-68 Nm).
5. Tighten lower shock absorber mounting screw to 45-50 ft-lbs (61-68 Nm).
6. If the shock absorber just installed is a replacement, adjust the preload setting to the same as the original shock absorber.

sm01819



- | | |
|------------------------------|-------------------------------------|
| 1. Screw | 9. Nut |
| 2. Screw | 10. Spring adjuster: XL models |
| 3. Washer | 11. Lower spring guide: XL models |
| 4. Stud cover: XL models | 12. Upper spring seat: XL models |
| 5. Upper bushing: XL models | 13. Shock absorber cover: XL models |
| 6. Shock absorber: XL models | 14. Upper bushing: XR models |
| 7. Washer | 15. Shock absorber: XR models |
| 8. Lower bushing | |

Figure 2-207. Shock Absorber: All Models (Right Side Shown)

STABILIZER LINKS

2.27

GENERAL

The stabilizer link system allows the engine to "float" on its rubber engine mounts while maintaining engine-to-frame alignment. The stabilizer links provide a fixed alignment, and no adjustment is necessary or possible.

UPPER FRONT STABILIZER LINK

Removal

1. Position motorcycle upright on suitable lift.
2. See [Figure 2-208](#). Remove screws (4) and stabilizer link (2).
3. Remove upper frame bracket:
 - a. **Models with front mounted horn:** remove screws (5), washers (8), horn bracket (9), and upper frame bracket (3) from frame.
 - b. **Models with side mounted horn:** remove screws (5), washers (8) and upper frame bracket (3) from frame.
4. Remove screws (6), lock washers (7) and engine bracket (1) from front cylinder head.

Installation

1. See [Figure 2-208](#). Install screws (6), lock washers (7) and engine bracket (1) to front cylinder head. Tighten to 55-65 ft-lbs (74.6-88.2 Nm).
2. Install upper frame bracket:
 - a. **Models with front mounted horn:** install upper frame bracket (3), horn bracket (9), screws (5) and washers (8).
 - b. **Models with side mounted horn:** install upper frame bracket (3), screws (5) and washers (8).
 - c. Tighten screws to 25-35 ft-lbs (33.9-47.5 Nm).
3. Install stabilizer link (2). Secure with screws (4). Tighten to 25-35 ft-lbs (33.9-47.5 Nm).

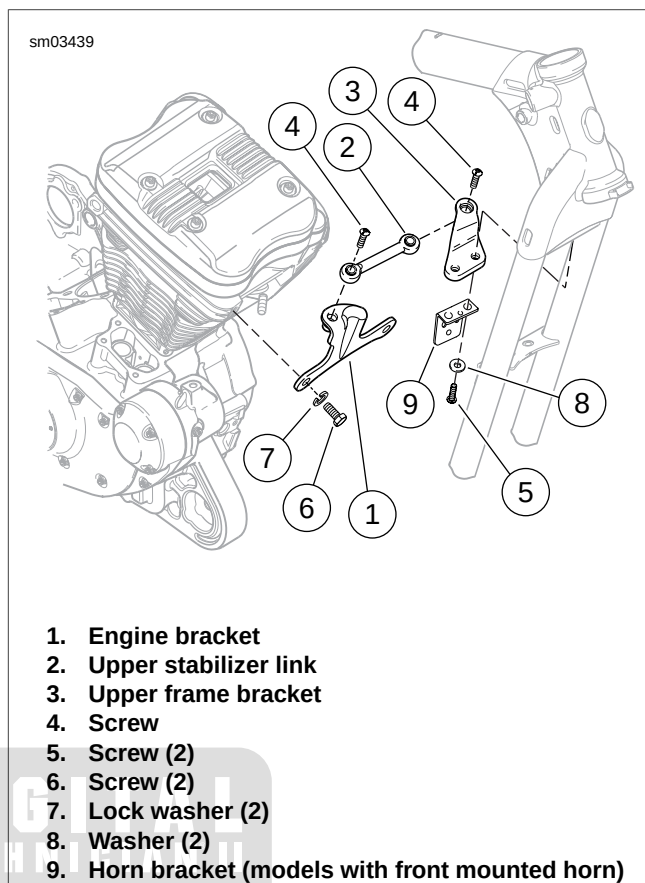


Figure 2-208. Upper Front Stabilizer Link Assembly: Typical (XL Model Shown)

LOWER FRONT STABILIZER LINK

Removal

1. Position motorcycle upright on suitable lift.
2. See [Figure 2-209](#). Remove screws (3) and stabilizer link (1).
3. Remove screws (4), washers (5) and lower frame bracket (2) from frame.

Installation

1. See [Figure 2-209](#). Install screws (4), washers (5) and lower frame bracket (2) to frame. Tighten to 25-35 ft-lbs (33.9-47.5 Nm).
2. Install stabilizer link (1). Secure with screws (3). Tighten to 25-35 ft-lbs (33.9-47.5 Nm).

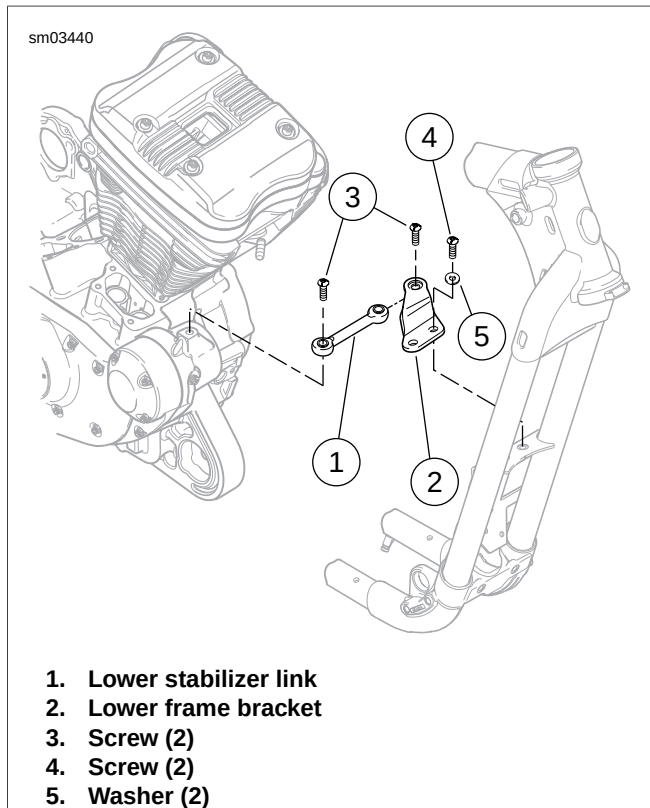


Figure 2-209. Lower Front Stabilizer Link Assembly: Typical (XL Model Shown)

REAR STABILIZER LINK

Removal

1. Position motorcycle upright on suitable lift.
2. **California vehicles:** remove EVAP canister and mounting bracket. See [4.21 EVAPORATIVE EMISSIONS CONTROL \(CA MODELS\), Charcoal Canister](#).
3. See [Figure 2-210](#). Remove short screw (3), long screw (4), ground strap (2), stabilizer link (1) and spacer (5).

Installation

1. See [Figure 2-210](#). Install short screw (3) through ground strap (2) and stabilizer link (1). Thread screw into frame on right side of motorcycle. Do not tighten at this time.
2. Install long screw (4) through ground strap, stabilizer link and spacer (5) into engine case.
3. Tighten both screws to 25-35 ft-lbs (33.9-47.5 Nm).
4. **California vehicles:** Install EVAP canister and mounting bracket. See [4.21 EVAPORATIVE EMISSIONS CONTROL \(CA MODELS\), Charcoal Canister](#).

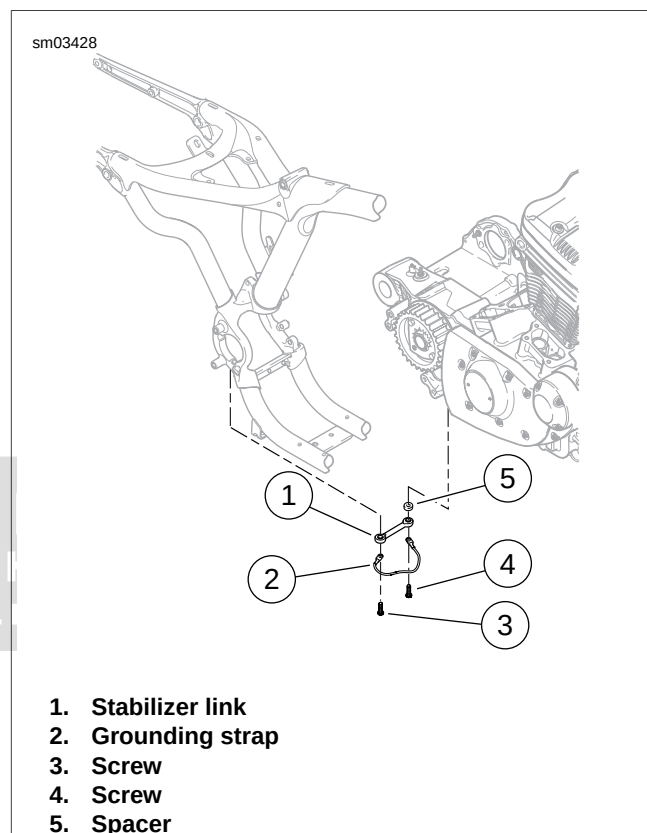


Figure 2-210. Rear Stabilizer Link Assembly: Typical (XL Model Shown)

FRONT ENGINE MOUNT/ISOLATOR

2.28

REMOVAL

PART NUMBER	TOOL NAME
HD-45968	FAT JACK

1. Position motorcycle upright on a suitable lift.
2. **XL Custom models:** Remove both forward foot control assemblies. See [2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS](#).
3. Support front of engine with FAT JACK (Part No. HD-45968) and suitable blocks.
4. See [Figure 2-208](#). Remove screw (4) securing upper front stabilizer link (2) to stabilizer link bracket (3).
5. See [Figure 2-209](#). Remove screw (3) securing lower front stabilizer link (1) to stabilizer link bracket (2).

6. See [Figure 2-210](#). Remove screw (4) from left end of rear stabilizer link (1) and ground strap (2). Remove spacer (5).

NOTE

See [Figure 2-211](#). In the next step, the engine may need to be jacked up or down slightly to aid in removing bolt (3).

7. See [Figure 2-211](#). Remove nut (4) and bolt (3) from front engine mount/isolator assembly.
8. Remove screws (5) from front isolator mount (2) on left side of motorcycle. Remove isolator mount and left front isolator (1).
9. Carefully pry front end of engine to the left approximately 1.0 in. (25.4 mm). Remove right front isolator (1) from crankcase.

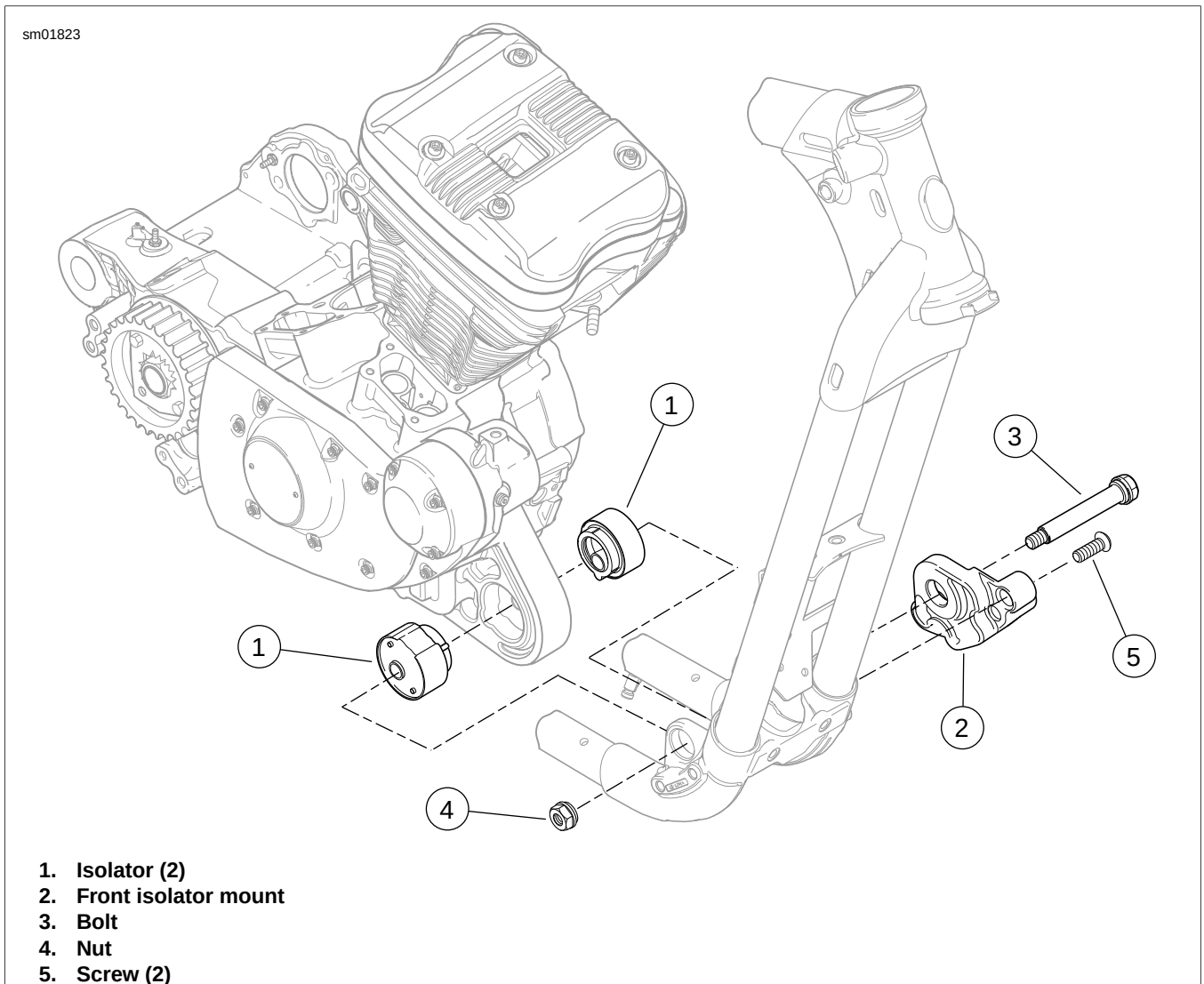


Figure 2-211. Front Engine Mount/Isolator: Typical (XL Model Shown)

INSTALLATION

PART NUMBER	TOOL NAME
HD-45968	FAT JACK

1. See [Figure 2-211](#). Install both front isolators (1) in engine mounting boss on front of crankcase. Note that each isolator has a half-moon tab and fits into engine mounting boss in only one way. Push engine to the right until right isolator contacts frame boss.
2. Install front isolator mount (2) over left front isolator.
3. Install screws (5) through front isolator mount and thread into frame. Tighten to 25-35 ft-lbs (33.9-47.5 Nm).
4. Insert bolt (3) through front isolator/engine mount assembly from left side. Thread nut (4) onto bolt. Tighten to 60-70 ft-lbs (81.4-95.0 Nm).
5. See [Figure 2-209](#). Attach lower front stabilizer link (1) to bracket (2) with screw (3). Tighten to 25-35 ft-lbs (33.9-47.5 Nm).
6. See [Figure 2-208](#). Attach upper front stabilizer link (2) to bracket (3) with screw (4). Tighten to 25-35 ft-lbs (33.9-47.5 Nm).
7. See [Figure 2-210](#). Install screw (4) through free end of ground strap (2), rear stabilizer link (1), spacer (5), and into engine crankcase. Tighten to 25-35 ft-lbs (33.9-47.5 Nm).
8. Remove FAT JACK (Part No. HD-45968) and blocks from under engine.
9. **XL Custom models:** Install both forward foot control assemblies. See [2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS](#).



REAR ENGINE MOUNT/ISOLATOR

2.29

REMOVAL

PART NUMBER	TOOL NAME
HD-45967	SHOP DOLLY
HD-45968	FAT JACK

1. Remove seat.
2. Open left side cover. See [2.20 LEFT SIDE COVER](#).

⚠ WARNING

Prevent accidental vehicle start-up, which could cause death or serious injury. First disconnect negative (-) battery cable at engine and then positive (+) cable from battery. (00280b)

3. Disconnect both battery cables, negative cable first. See [1.17 BATTERY MAINTENANCE](#).
4. Remove exhaust system. See [4.15 EXHAUST SYSTEM: XL MODELS](#) or [4.16 EXHAUST SYSTEM: XR MODELS](#).
5. With the aid of a FAT JACK (Part No. HD-45968), support motorcycle on SHOP DOLLY (Part No. HD-45967).

NOTE

Position vehicle on SHOP DOLLY so that FAT JACK may be used (with the aid of suitable blocks) to support engine when rear engine mount is removed.

6. Remove sprocket cover.
 - a. **XL models:** see [Figure 2-212](#). Remove screw (6), washer (5) and exhaust pipe clamp bracket (4). Remove two screws (2, 3). Remove sprocket cover (1).
 - b. **XR models:** see [Figure 2-213](#). Remove screw and washer (2) and screws (3, 4). Remove sprocket cover (1).
7. Loosen rear axle and remove rear drive belt. See [5.7 DRIVE BELT](#).
8. **XL models equipped with passenger footrests:** Remove left passenger footrest assembly. See [2.43 PASSENGER FOOTRESTS](#).
9. **XR models:** Remove left and right rider controls and brackets. See [2.42 RIDER FOOT CONTROLS: XR MODELS](#).
10. Unbolt rear brake master cylinder remote reservoir. Do not disconnect hose from reservoir. Secure reservoir to vehicle in an upright position, out of the way. See [2.15 REAR BRAKE MASTER CYLINDER RESERVOIR](#).
11. Support rear fork assembly using vehicle tiedown straps.
12. See [Figure 2-214](#). Remove rear fork pivot bolts (1).
13. Pull rear fork back far enough to clear rear engine mounts and isolators.
14. **California vehicles:** remove EVAP canister and mounting bracket See [4.21 EVAPORATIVE EMISSIONS CONTROL \(CA MODELS\)](#), [Charcoal Canister](#).

15. See [Figure 2-210](#). Remove screws (3, 4) securing rear stabilizer link (1). Remove stabilizer link, ground strap (2), and spacer (5).
16. See [Figure 2-208](#). Remove screw (4) securing upper front stabilizer link (2) to stabilizer link bracket (3).
17. See [Figure 2-209](#). Remove screw (3) securing lower front stabilizer link (1) to stabilizer link bracket (2).
18. Support rear of engine with FAT JACK and suitable blocks.
19. See [Figure 2-214](#). Remove two screws (7) securing rear isolator mount (2) to left side of frame. Remove isolator mount and left isolator (3).
20. Remove three screws (6) securing rear pivot lockplate (5) to rear of engine case. Remove lockplate and rear fork pivot shaft (4).

NOTE

Engine may need to be jacked up or down slightly to aid in removing pivot shaft.

21. Carefully pry rear end of engine to the left approximately 1.0 in. (25.4 mm). Remove right rear isolator (3) from frame.

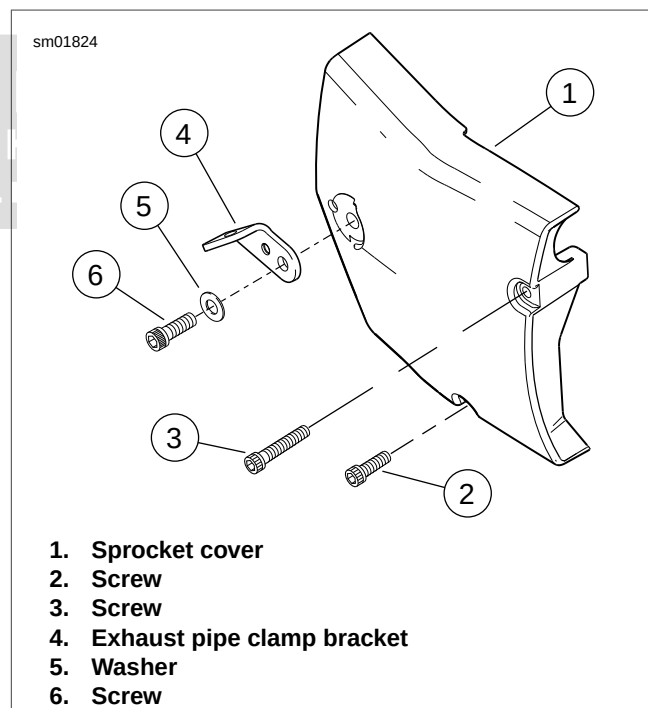


Figure 2-212. Sprocket Cover: XL Models

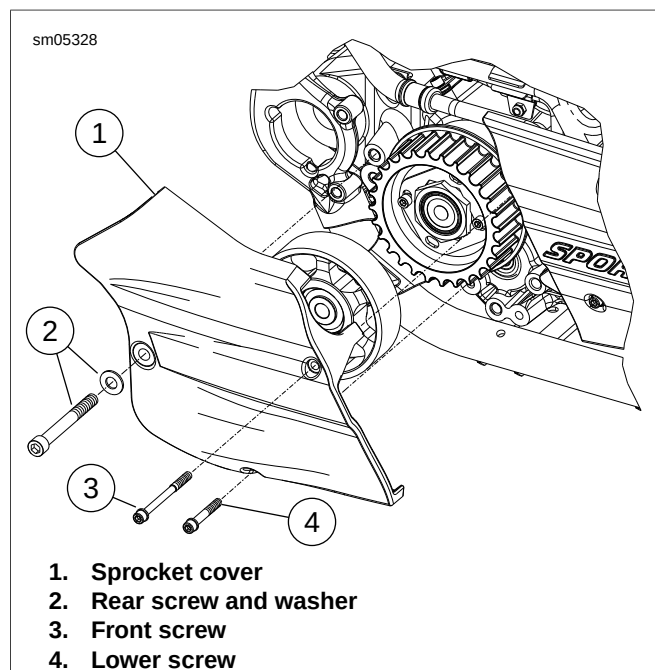


Figure 2-213. Sprocket Cover: XR Models

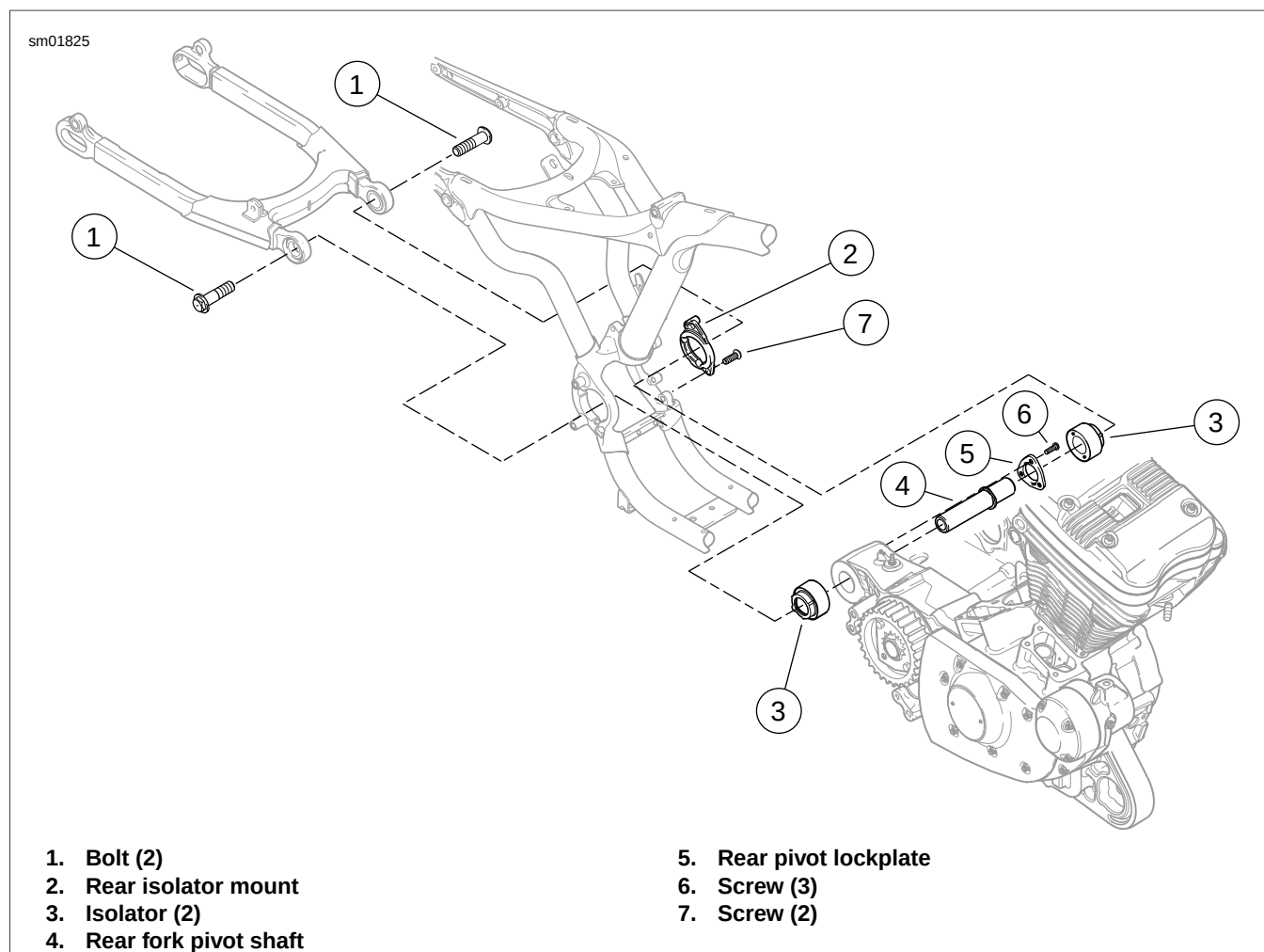


Figure 2-214. Rear Engine Mount/Isolator: Typical (XL Model Shown)

INSTALLATION

PART NUMBER	TOOL NAME
HD-45968	FAT JACK

1. See [Figure 2-214](#). Install **new** right rear isolator (3) into frame, lining up tabs on isolator with slots in frame. Slide rear end of engine to the right until engine mounting boss on rear of crankcase contacts right isolator.
2. Slide rear fork pivot shaft (4) through engine mounting boss.

NOTE

Engine may need to be moved slightly in one direction or another in order to line up pivot shaft with isolator.

3. Install rear pivot lockplate (5) over pivot shaft with ridges on lockplate engaging flats on pivot shaft flange. Secure to crankcase with three screws (6). Tighten to 80-120 **in-lbs** (9.0-13.6 Nm).
4. Install **new** left rear isolator (3) on rear fork pivot shaft.
5. Place rear isolator mount (2) over left rear isolator, lining up tabs on isolator with slots in isolator mount. Install screws (7). Tighten to 25-35 ft-lbs (33.9-47.5 Nm).
6. Remove FAT JACK (Part No. HD-45968) and blocks.
7. See [Figure 2-208](#). Attach upper front stabilizer link (2) to bracket (3) with screw (4). Tighten to 25-35 ft-lbs (33.9-47.5 Nm).
8. See [Figure 2-209](#). Attach lower front stabilizer link (1) to bracket (2) with screw (3). Tighten to 25-35 ft-lbs (33.9-47.5 Nm).
9. See [Figure 2-210](#). Install short screw (3) through ground strap (2) and rear stabilizer link (1) into frame on right side of motorcycle. Install long screw (4) through free end of ground strap, stabilizer link and spacer (5) into engine case. Tighten both screws to 25-35 ft-lbs (33.9-47.5 Nm).
10. **California vehicles:** Install EVAP canister and mounting bracket. See [4.21 EVAPORATIVE EMISSIONS CONTROL \(CA MODELS\)](#), [Charcoal Canister](#).
11. See [Figure 2-214](#). Slide rear fork forward into position. Install rear fork pivot/engine mount bolts (1). Tighten to 60-70 ft-lbs (81.4-95.0 Nm). Remove vehicle tiedown straps supporting rear fork.
12. Install rear brake master cylinder remote reservoir. See [2.15 REAR BRAKE MASTER CYLINDER RESERVOIR](#).

13. **XL models equipped with passenger footrests:** Install left passenger footrest assembly. See [2.43 PASSENGER FOOTRESTS](#).
14. **XR models:** Install left and right rider foot controls and brackets. See [2.42 RIDER FOOT CONTROLS: XR MODELS](#).
15. Install and adjust rear drive belt and tighten rear axle. See [5.7 DRIVE BELT](#).
16. **XL Models:** Install sprocket cover.
 - a. See [Figure 2-212](#). Install sprocket cover (1). Secure with two screws (2, 3). Note that long screw goes in top hole, short screw in bottom hole. Do not tighten screws at this time.
 - b. Install exhaust pipe clamp bracket (4), washer (5) and screw (6). Tighten to 30-33 ft-lbs (40.7-44.8 Nm). Now tighten screws (2, 3) to 80-120 **in-lbs** (9.0-13.6 Nm).
17. **XR Models:** Install sprocket cover.
 - a. See [Figure 2-213](#). Tighten screw (2) to 30-33 ft-lbs (40.7-44.7 Nm).
 - b. Tighten screws (3, 4) to 80-120 **in-lbs** (9.0-13.6 Nm).
18. Install exhaust system. See [4.15 EXHAUST SYSTEM: XL MODELS](#) or [4.16 EXHAUST SYSTEM: XR MODELS](#).

WARNING

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

19. Connect both battery cables, positive (+) cable first. See [1.17 BATTERY MAINTENANCE](#).
20. Close left side cover. See [2.20 LEFT SIDE COVER](#).

WARNING

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

21. Install seat.

THROTTLE CABLES: ALL MODELS

2.30

REMOVAL AND DISASSEMBLY

⚠ WARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

1. Purge the fuel supply hose of high pressure gasoline. Disconnect fuel supply hose from fuel pump module. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

2. Unplug main fuse. See [6.38 MAIN FUSE](#).
3. Remove seat.
4. Remove fuel tank. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).
5. **XL Models:**
 - a. See [Figure 2-215](#). Remove screw (3) securing left wire harness caddy (2) to right wire harness caddy (1). See [6.33 ELECTRICAL CADDIES](#). Separate left wire harness caddy from right wire harness caddy.
 - b. Cut cable straps (5) securing throttle cables (4) to right wire harness caddy. Remove and discard cable straps.
 - c. Disengage ignition coil bracket (6) uprights from frame bosses and remove throttle cables from recess in right wire harness caddy.
6. See [Figure 2-216](#). Slide rubber boot off each cable adjuster (4).
7. See [Figure 2-217](#). Loosen jam nut (5) on each adjuster (6). Turn adjusters in direction which will shorten cable housings to minimum length.
8. See [Figure 2-216](#). Remove two screws (7) and separate upper housing (9) from lower housing (11).
9. Unhook ferrules (1) and cables (2, 3) from throttle control grip (12) and lower housing (11).
10. **XR Models:** See [Figure 2-219](#). Disengage cables from retainer (2) on lower fork bracket. Disengage cables from loop retainer (3) located under fuel tank.
11. Remove air cleaner assembly. See [4.4 AIR CLEANER: XL MODELS](#) or [4.5 AIRBOX: XR MODELS](#).
12. Disconnect cables from induction module.
13. See [Figure 2-216](#). Remove friction spring (8), throttle friction screw (13) and spring (5) from lower housing.

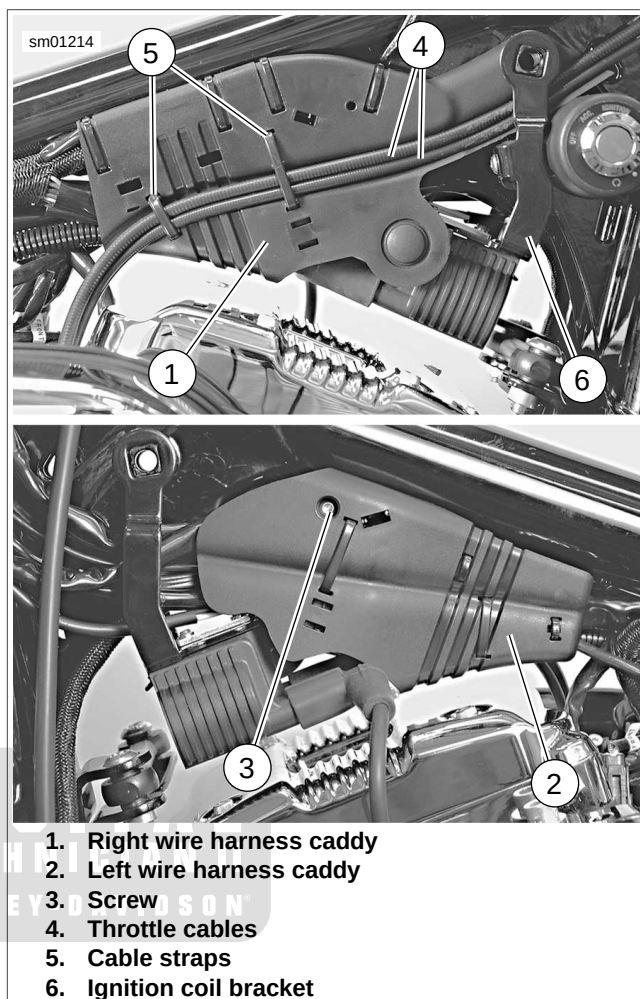


Figure 2-215. Wire Harness Caddy Assembly: XL Models

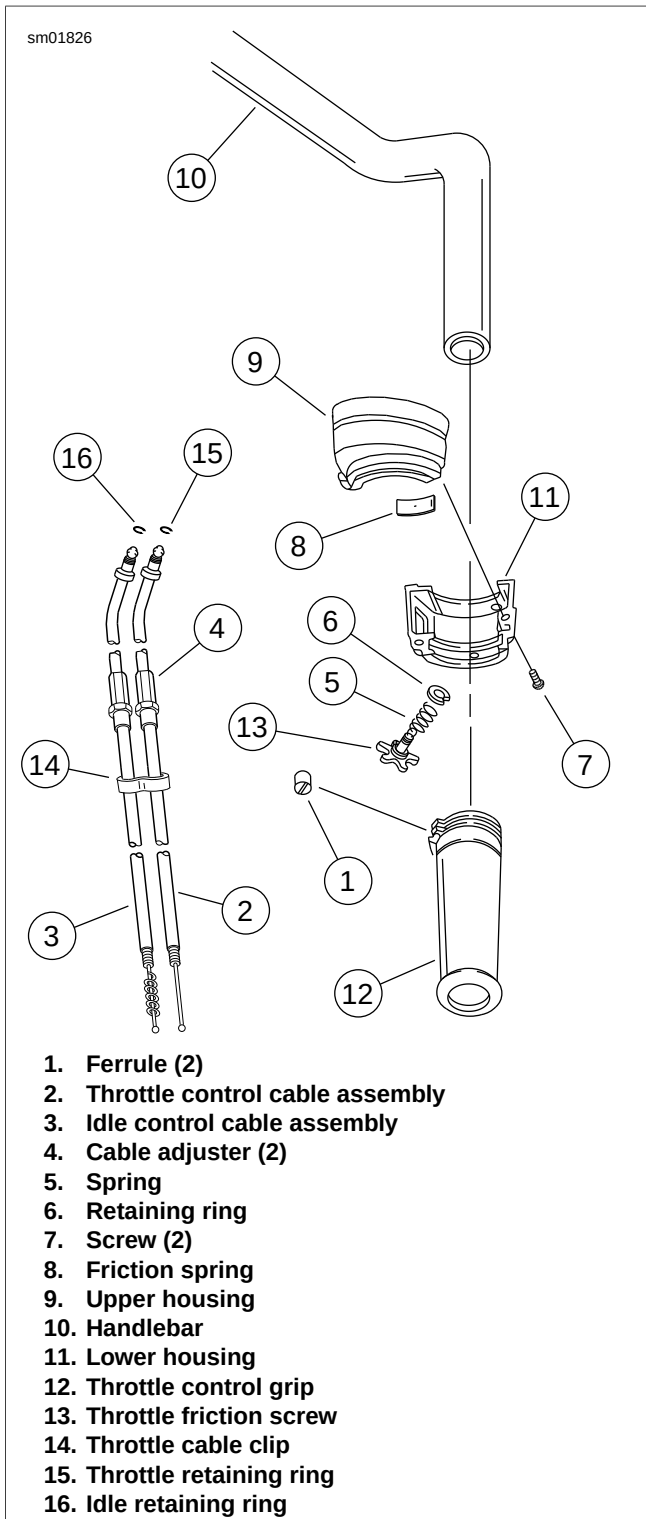


Figure 2-216. Throttle Control, Right Handlebar

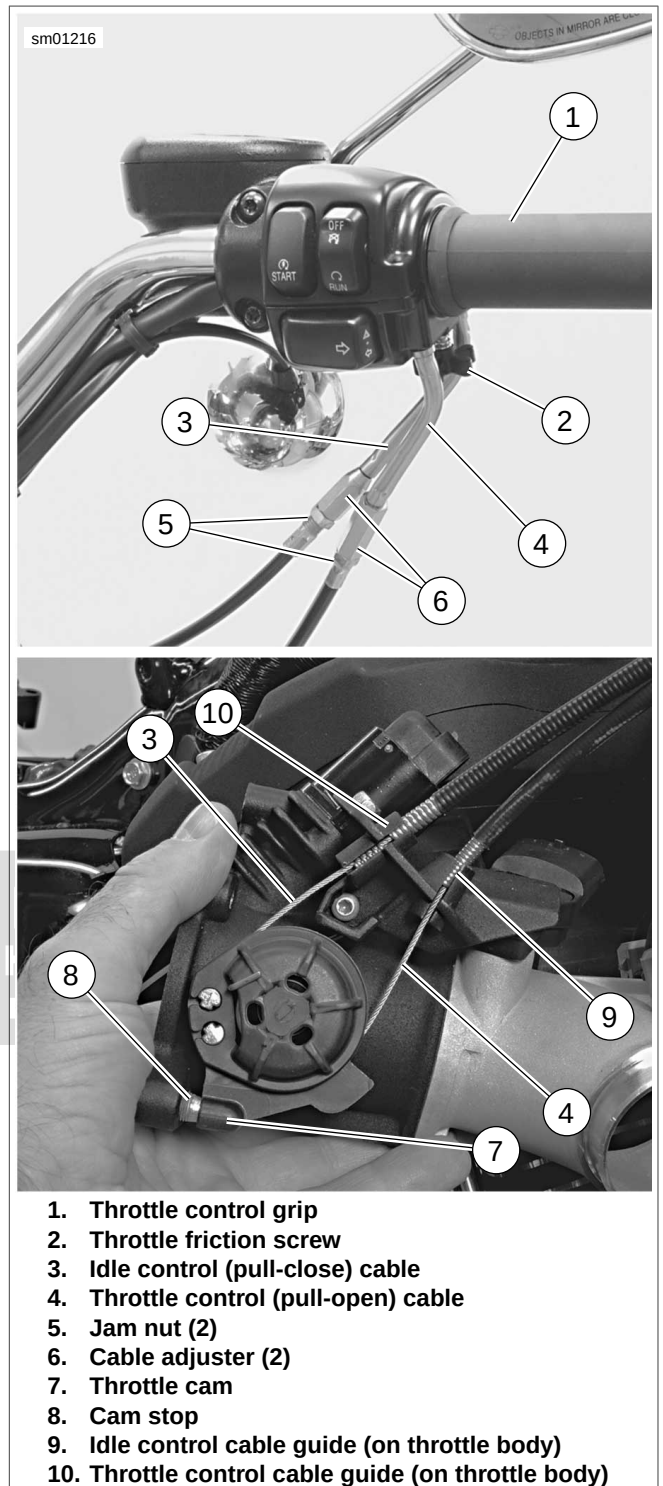


Figure 2-217. Throttle/Idle Control Cable (typical, XL model shown)

CLEANING, INSPECTION AND REPAIR

⚠ WARNING

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

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

ASSEMBLY AND INSTALLATION

1. See [Figure 2-216](#). Apply a light coating of graphite to the handlebar (10) and the inside surface of the upper and lower housings (9, 11).
2. Install spring (5), throttle friction screw (13) and friction spring (8) in lower housing (11).
3. Attach cable assemblies (2, 3) to lower housing. See [Figure 2-217](#). Throttle control cable (4) 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 2-216](#). Install throttle control grip (12) over end of right handlebar (10). Position lower housing (11) 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 (9) over right handlebar and secure to lower housing using screws (7). Tighten screws to 35-45 in-lbs (4.0-5.1 Nm).
6. **XL Models:** See [Figure 2-218](#). 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 and frame backbone, over ignition switch housing, between coil bracket and frame, and downward to induction module.
7. **XR Models:** See [Figure 2-219](#). Route cables forward between right fork and brake hose (1), then back between the forks above the lower fork bracket. Pass cables through wire retainer (2) on lower fork and continue above the front cylinder toward the induction module.
8. See [Figure 2-217](#). Install idle control cable (3) housing into inboard (idle) cable guide (9) on induction module.
9. Install throttle control cable (4) housing and spring into outboard cable guide (10) on induction module.
10. **XL Models:** See [Figure 2-215](#). Place throttle cables (4) into channel in right wire harness caddy (1) and secure with two cable straps (5). Note that forward cable strap also secures instrument connector [20] and rear cable strap secures wiring harnesses on other side of caddy wall.

⚠ WARNING

Be sure that steering is smooth and free without interference. Interference with steering could result in loss of vehicle control and death or serious injury. (00371a)

- Be sure cables are not pinched between the frame and/or forks.
 - Be sure throttle/idle control cables do not pull tight when handlebars are turned fully to left or right fork stops.
11. Adjust control cables. See [1.27 THROTTLE CONTROL, Cable Adjustment](#).
 12. **XL Models:** See [Figure 2-215](#). Mount left wire harness caddy (2) to right wire harness caddy (1). Secure with screw (3) and tighten.
 13. Install air cleaner assembly.
 14. Install fuel tank and connect fuel hose. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).
 15. **XR Models:** See [Figure 2-219](#). Secure cables in loop retainer (3) and attach retainer to the bottom of the fuel tank.

⚠ WARNING

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

16. Install seat.
17. Plug in main fuse. See [6.38 MAIN FUSE](#).

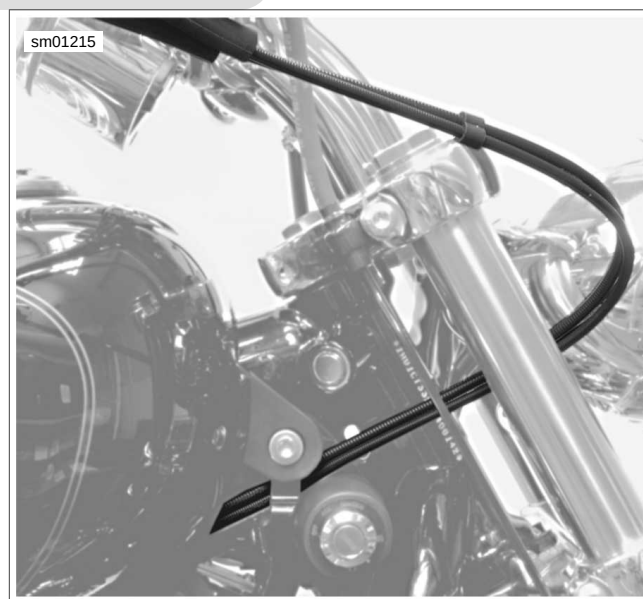


Figure 2-218. Throttle Control Cable Routing: XL Models



Figure 2-219. Throttle Control Cable Routing: XR Models



CLUTCH CONTROL

2.31

GENERAL

For clutch adjustment, see [1.13 CLUTCH](#).

For clutch replacement, see [5.5 PRIMARY DRIVE AND CLUTCH: XL MODELS](#).

REMOVAL AND DISASSEMBLY

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

Unplug main fuse. See [6.38 MAIN FUSE](#).

Clutch Cable: Lower

1. **Models equipped with mid-mount foot controls:** remove left side rider footrest and mounting bracket assembly. See [2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS](#) or [2.42 RIDER FOOT CONTROLS: XR MODELS](#) for removal procedure.
2. See [Figure 2-220](#). Slide rubber boot (1) on clutch cable adjuster (2) upward to expose adjuster mechanism. Loosen jam nut (3) from adjuster. Turn adjuster to shorten cable housing until there is a large amount of freeplay at clutch hand lever. See [1.13 CLUTCH](#).
3. See [Figure 2-221](#). Remove six screws (1) and clutch inspection cover (2). Exercise caution to avoid damaging or dislodging quad ring (7) from groove in primary cover (9).
4. Slide hex lockplate with attached spring (3) from flats of adjusting screw assembly (8).

5. Turn adjusting screw assembly clockwise to release ramp assembly (5) and coupling (6). As the adjusting screw is turned, ramp assembly moves forward. Remove nut (4) from end of adjusting screw.
6. Remove hook of ramp from cable coupling. Remove clutch cable end (11) from slot in coupling. Remove coupling and ramp assembly.
7. Remove cable end fitting (12) and remove clutch cable (13) lower section from primary cover. Remove o-ring (10) from cable end fitting. Discard o-ring.
8. Clean all metal parts in a non-volatile cleaning solution or solvent.

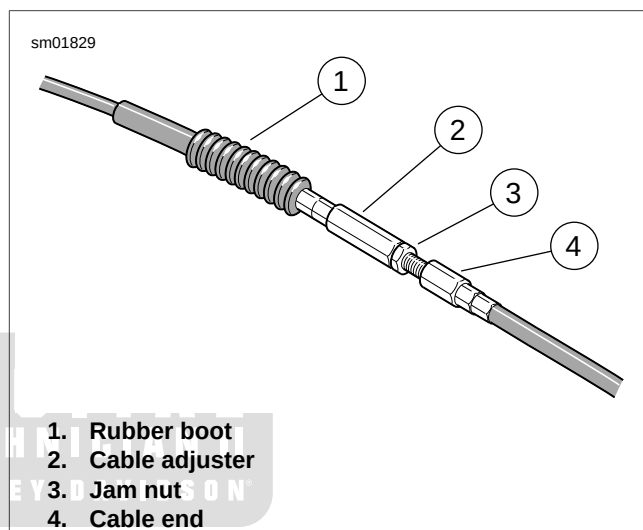
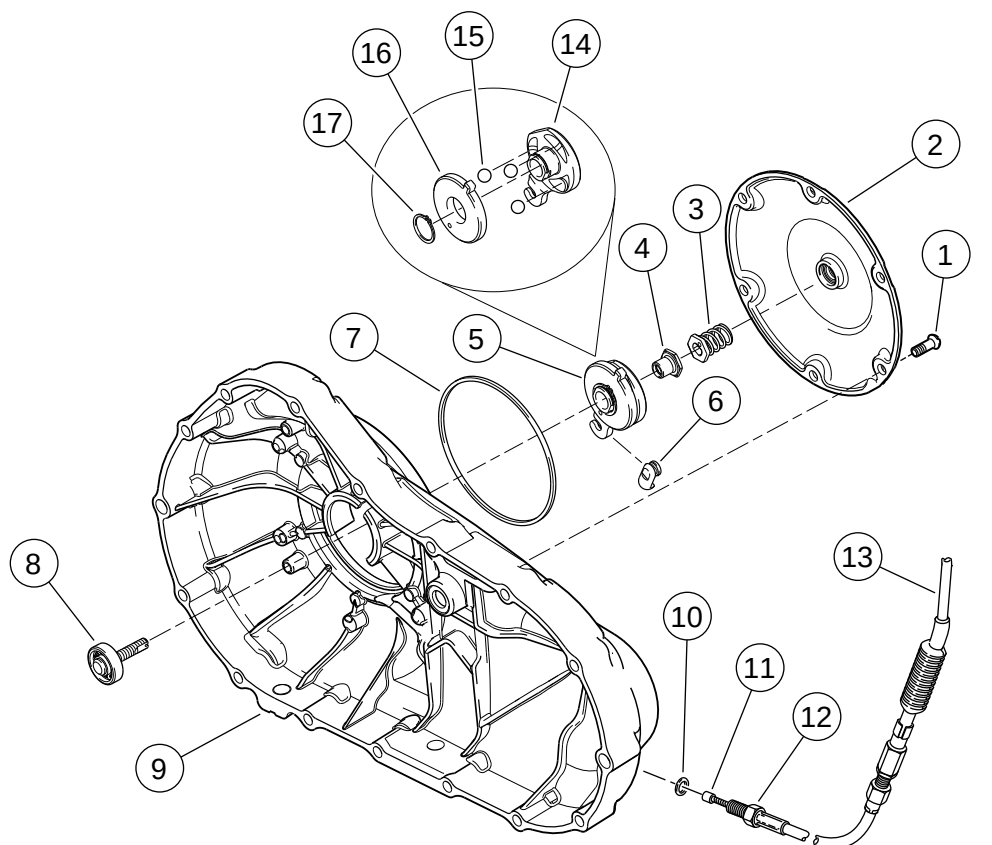


Figure 2-220. Clutch Cable Adjuster Mechanism

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- | | | |
|------------------------------------|------------------------------------|--------------------|
| 1. Screw (6) | 7. Quad ring | 13. Clutch cable |
| 2. Clutch inspection cover | 8. Clutch adjusting screw assembly | 14. Outer ramp |
| 3. Hex lockplate and spring | 9. Primary cover | 15. Ball (3) |
| 4. Nut | 10. O-ring | 16. Inner ramp |
| 5. Ramp assembly (see items 14-17) | 11. Clutch cable end | 17. Retaining ring |
| 6. Coupling | 12. Cable end fitting | |

Figure 2-221. Clutch Release Mechanism

Clutch Lever and Clutch Cable: Upper

- See [Figure 2-222](#). Remove retaining ring (3) and pivot pin (6). Discard retaining ring.
- Remove clutch lever (1) from clutch lever bracket (5).
- Remove clutch cable pin (2). Disconnect clutch cable (4) upper section from lever.
- Remove bushing (9) from clutch lever. Bushing has a collar on one end and can only be removed from top of lever.
- Remove screw (10) and anti-rattle spring (11).

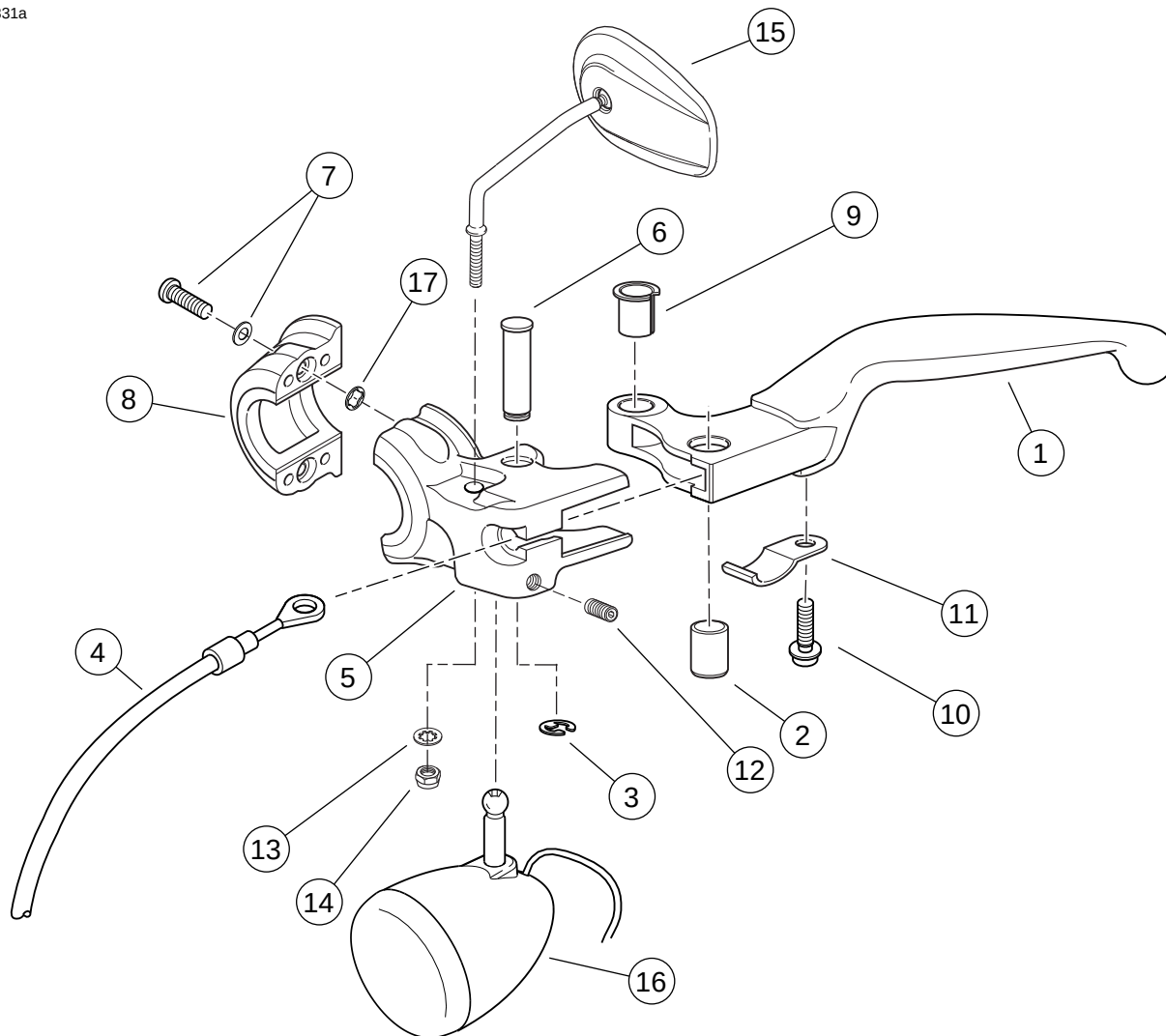
Clutch Hand Control

- See [Figure 2-222](#). Loosen set screw (12) and remove turn signal assembly (16) from clutch lever bracket (5).
- Loosen and remove lock nut (14) and lock washer (13), and lift mirror (15) from clutch lever bracket.
- Remove two screws and washers (7) and retainers (17) from clutch control clamp (8).
- Remove clutch control clamp (8) and clutch lever bracket from left handlebar.

NOTE

See [Figure 2-222](#). You may need to loosen two screws of left handlebar switch housing to remove clutch control clamp (8) and clutch lever bracket (5) from left handlebar.

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- | | |
|-------------------------|--------------------------|
| 1. Clutch lever | 10. Screw |
| 2. Clutch cable pin | 11. Anti-rattle spring |
| 3. Retaining ring | 12. Set screw |
| 4. Clutch cable | 13. Lock washer |
| 5. Clutch lever bracket | 14. Lock nut |
| 6. Pivot pin | 15. Mirror |
| 7. Screw and washer (2) | 16. Turn signal assembly |
| 8. Clutch control clamp | 17. Retainer (2) |
| 9. Bushing | |

Figure 2-222. Clutch Hand Control

ASSEMBLY AND INSTALLATION

Clutch Hand Control

- See [Figure 2-222](#). Position clutch control clamp (8) and clutch lever bracket (5) onto left handlebar. Hold clamp and bracket assembly firmly against left handlebar switch housing.
- Secure components to left handlebar using two screws and washers (7) and retainers (17). Tighten to 108-132 **in-lbs** (12.2-14.9 Nm).
- Install mirror (15), secure with lock nut (14) and lock washer (13). Position mirror for best rearward visibility. Tighten lock nut to 96-144 **in-lbs** (10.9-16.3 Nm).
- Install turn signal (16) and secure with set screw (12). Position so turn signal lens faces directly forward and turn signal does not strike fuel tank when handlebars are turned full left. Tighten set screw to 96-120 **in-lbs** (10.9-13.6 Nm).

NOTE

*If two screws of left handlebar switch housing were loosened during clutch hand control removal, tighten to 35-45 **in-lbs** (4.0-5.1 Nm).*

Clutch Lever and Clutch Cable: Upper

1. See [Figure 2-222](#). Install anti-rattle spring (11) and screw (10) onto clutch lever (1). Tighten screw to 8-13 **in-lbs** (0.9-1.5 Nm).
2. Install bushing (9) in clutch lever. Bushing has a collar on one end and must be installed from top of lever.
3. Connect end of clutch cable (4) upper section to clutch lever (1) using clutch cable pin (2).
4. Position lever within clutch lever bracket (5), install pivot pin (6) and secure with **new** retaining ring (3).

Clutch Cable: Lower

1. See [Figure 2-223](#). If not yet done, route clutch cable (3) forward from clutch lever (1), downward to outboard side of left front fork slider tube, through two clips (6) on left front frame downtube, and then rearward to primary cover (4).
2. See [Figure 2-221](#). Install **new** o-ring (10) over cable end fitting (12) of clutch cable (13) lower section. Screw fitting into primary cover (9). Tighten to 36-108 **in-lbs** (4.1-12.2 Nm).
3. Fit coupling (6) over cable end (11) with the rounded side inboard, the ramp connector button outboard. With

retaining ring side of ramp assembly (5) facing inward, place hook of ramp around coupling button and rotate assembly counterclockwise until tang on inner ramp (16) fits in slot of primary cover.

4. Thread nut (4) on adjusting screw assembly (8) until slot of screw is accessible with a screwdriver. Fit nut hex into recess of outer ramp (14). Turn adjusting screw counterclockwise until resistance is felt. Then back off adjusting screw 1/4 turn.
5. Install hex lockplate with spring (3) onto flats of adjusting screw assembly (8). If necessary, turn adjusting screw clockwise slightly so that lockplate slides onto flats while also fitting within recess of outer ramp.
6. Verify that quad ring (7) is fully seated in groove of primary cover (9). Install clutch inspection cover (2) and secure with six screws (1). Tighten screws in a crosswise pattern to 84-108 **in-lbs** (9.5-12.2 Nm).
7. **Models equipped with mid-mount foot controls:** install left side rider footrest and mounting bracket assembly. Tighten footrest bracket mounting screws to 45-50 ft-lbs (61-68 Nm). See [2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS](#) or [2.42 RIDER FOOT CONTROLS: XR MODELS](#) for installation procedure.

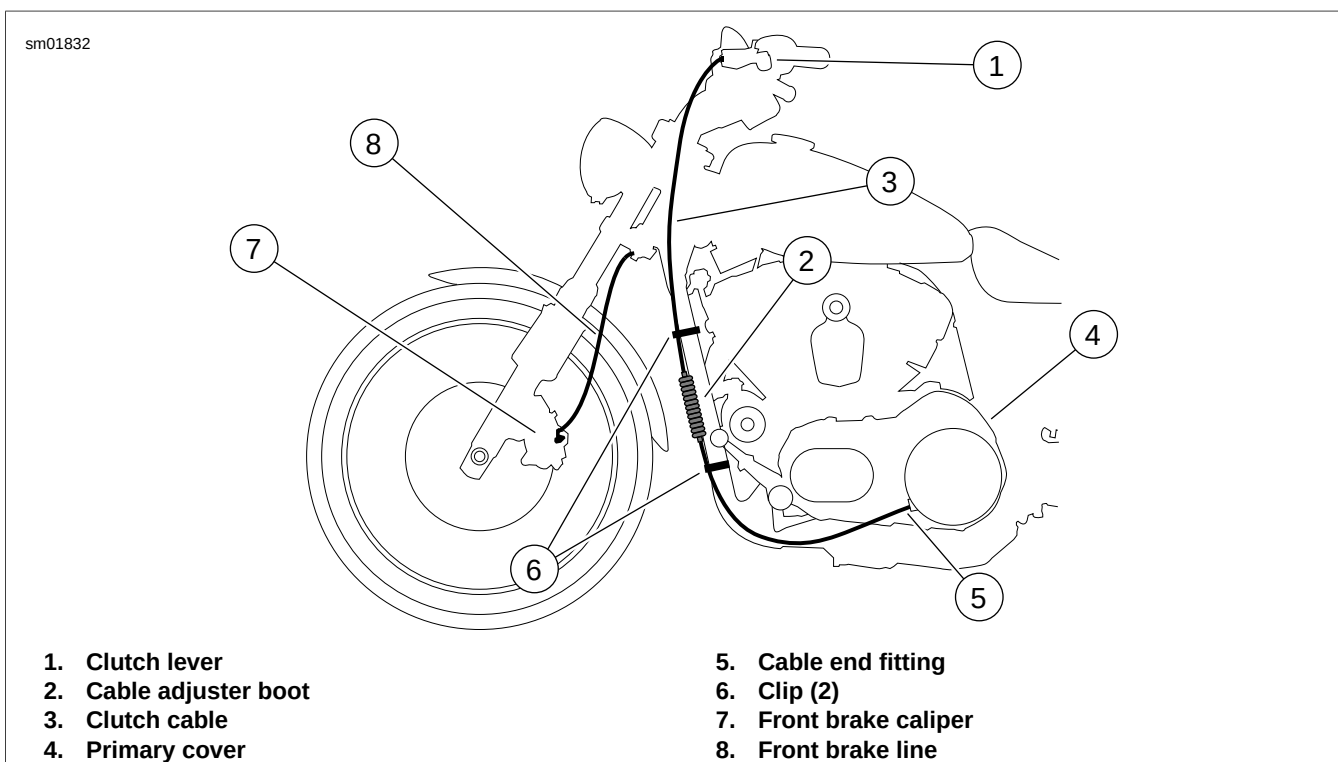


Figure 2-223. Clutch Cable and Front Brake Line Routings - Left Side

Finish

Plug in main fuse. See [6.38 MAIN FUSE](#).

HANDLEBARS

2.32

REMOVAL

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

All Models

1. Unplug main fuse. See [6.38 MAIN FUSE](#).
2. Remove two screws securing clutch control assembly to left side of handlebar. See [2.31 CLUTCH CONTROL](#).
3. Remove two screws securing left handlebar switch assembly to handlebar. See [6.41 LEFT HANDLEBAR SWITCHES](#). Let wires carefully support the switch assembly.
4. Remove left handlebar grip.

5. Remove front brake master cylinder assembly from right handlebar. See [2.10 FRONT BRAKE MASTER CYLINDER](#).

XL 883C and XL 1200C

1. See [Figure 2-224](#). Cut and remove four wiring harness retainers (10). When cutting retainers, be careful not to cut into wiring harnesses. Discard retainers.
2. Loosen, but do not remove, two control housing screws (8).
3. Remove two screws (16) and riser cover (15).
4. Remove four screws (3) and upper handlebar clamp/speedometer housing (2). Detach handlebar (5) from riser.
5. Slide right hand control and throttle assembly (4, 6, 9) off detached handlebar.
6. If removing riser (14), remove bolts (11), washers (12) and riser from upper fork bracket (13).



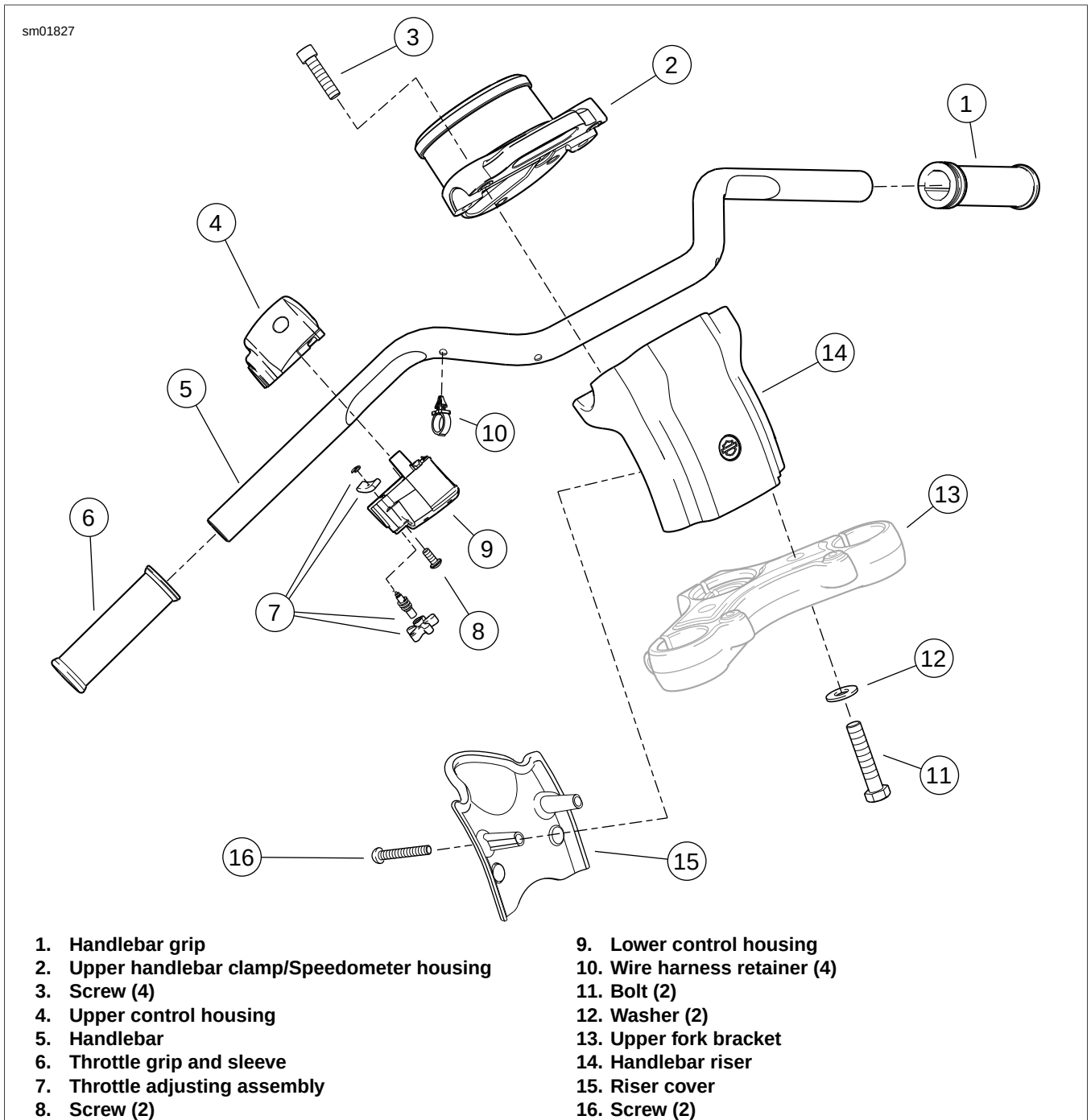
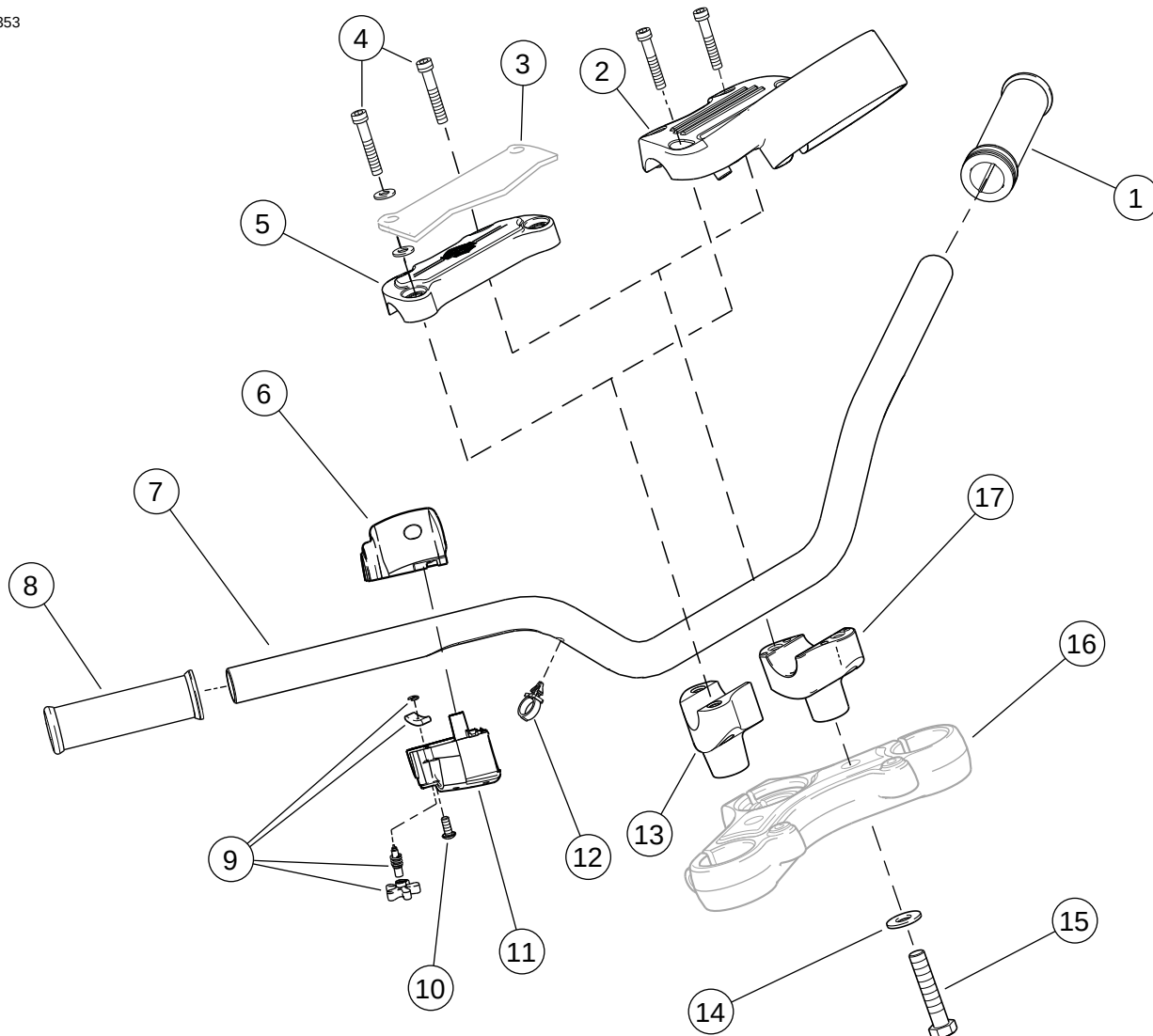


Figure 2-224. Handlebars: XL 883C; XL 1200C

All XL Models Except XL 883C, XL 1200C

- See [Figure 2-225](#). Cut and remove four wiring harness retainers (12). When cutting retainers, be careful not to cut into wiring harnesses. Discard retainers.
- Loosen, but do not remove, two control housing screws (10).
- If removing lower handlebar clamps (13, 17), loosen, but do not remove, two bolts (15) securing lower handlebar clamps to upper fork bracket (16).
- Remove screws (4) and instrument bracket (3) (if equipped), upper handlebar clamp (5) or instrument bracket (2).
- Detach handlebar (7) from lower handlebar clamps.
- Slide right hand control housing and throttle assembly (6, 8, 11) off detached handlebar.
- If removing lower handlebar clamps (13, 17), remove two bolts (15), washers (14) and lower handlebar clamps from upper fork bracket (16).

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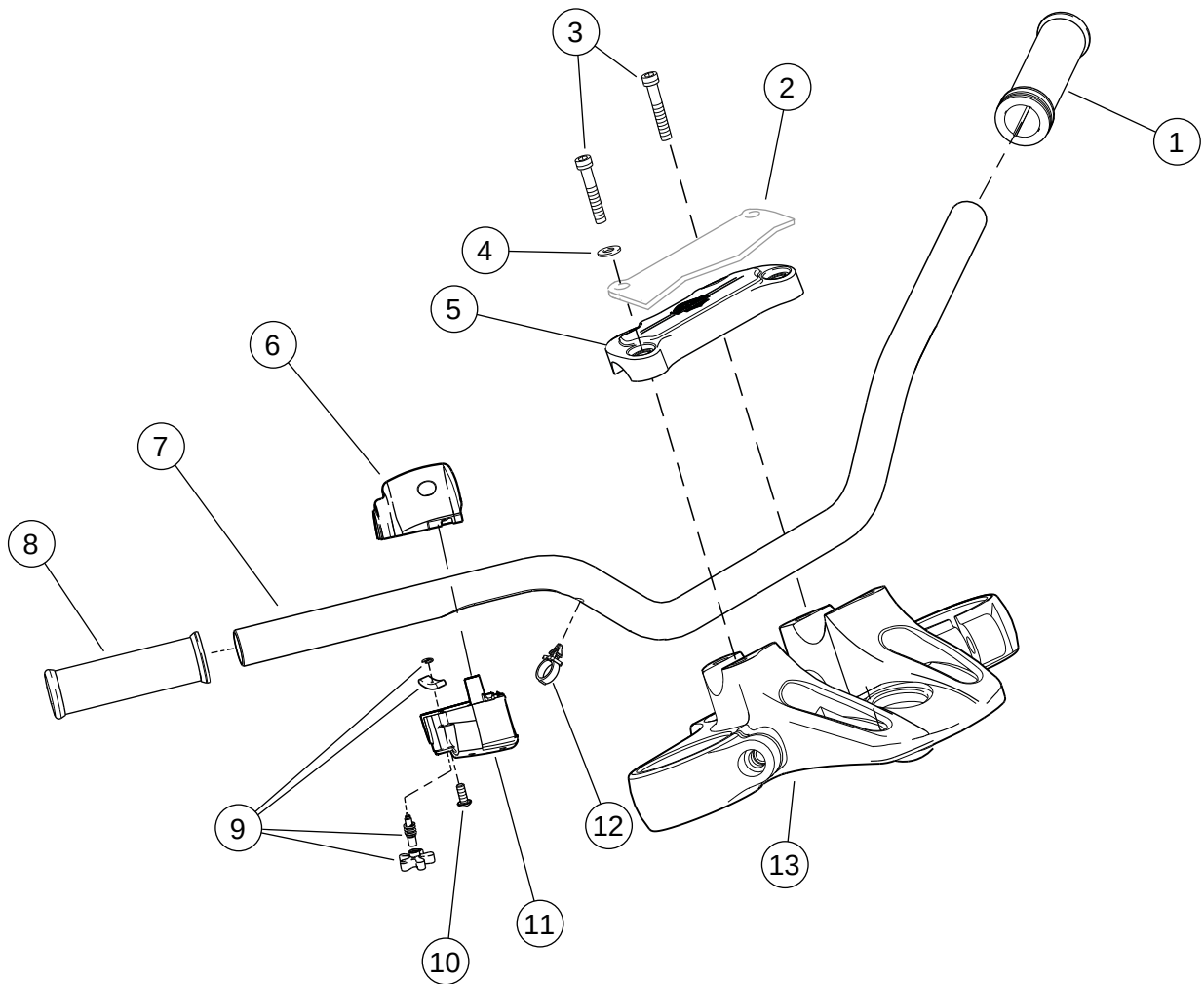
- | | |
|---|---------------------------------|
| 1. Handlebar grip | 10. Screw (2) |
| 2. Upper handlebar clamp/instrument bracket (XL1200L/N) | 11. Lower control housing |
| 3. Bolt-on instrument bracket (XL 883/L/R; XL 1200R) | 12. Wire harness retainer (4) |
| 4. Screw (4) | 13. Lower right handlebar clamp |
| 5. Upper handlebar clamp | 14. Washer (2) |
| 6. Upper control housing | 15. Bolt (2) |
| 7. Handlebar | 16. Upper fork bracket |
| 8. Throttle grip and sleeve | 17. Lower left handlebar clamp |
| 9. Throttle adjusting assembly | |

Figure 2-225. Handlebars: XL 883L/R; XL 1200L/N/R

XR1200

- See [Figure 2-226](#). Cut and remove four wiring harness retainers (12). When cutting retainers, be careful not to cut into wiring harnesses. Discard retainers.
- Loosen, but do not remove, two control housing screws (10).
- Remove two front screws (3) and washers (4). Remove instrument bracket (2).
- Remove two rear screws (3) and upper clamp (5).
- Detach handlebar (7) from upper fork bracket (13).
- Slide right hand control housing and throttle assembly (6, 8, 11) off detached handlebar.

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1. Handlebar grip
2. Instrument bracket
3. Screw (4)
4. Washer (2)
5. Upper handlebar clamp
6. Upper control housing
7. Handlebar

8. Throttle grip and sleeve
9. Throttle adjusting assembly
10. Screw (2)
11. Lower control housing
12. Wire harness retainer (4)
13. Upper fork bracket

Figure 2-226. Handlebars: XR1200

INSTALLATION

XL 883C and XL 1200C

1. See [Figure 2-224](#). If riser (14) was removed, secure riser to upper fork bracket (13) with two bolts (11) and washers (12). Make sure handlebar wiring harnesses are routed behind and inside riser. Tighten bolts to 30-40 ft-lbs (40.7-54.3 Nm).
2. Slide right handlebar control housing and throttle assembly (4, 6, 9) onto right end of handlebar (5). Position handlebar on lower handlebar clamp.
3. Place upper handlebar clamp/speedometer housing (2) in position and thread four screws (3) in place.
4. See [Figure 2-227](#). Adjust handlebars to desired position. Tighten front screws (2) first, to 12-18 ft-lbs (16.3-24.4 Nm). Then tighten rear screws (3) to 12-18 ft-lbs (16.3-24.4 Nm).
5. See [Figure 2-224](#). Be sure handlebar wiring harnesses are routed properly and are not pinched. Install riser cover (15) and screws (16). Tighten to 8-12 in-lbs (0.9-1.4 Nm).

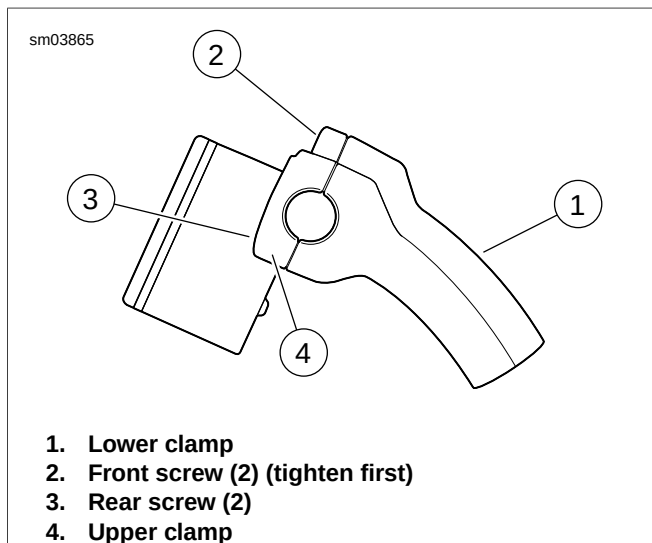


Figure 2-227. Handlebar Riser: XL 883C/XL 1200C

All XL Models Except XL 883C, XL 1200C

1. See [Figure 2-225](#). If lower handlebar clamps (13, 17) were removed, secure clamps to upper fork bracket (16) with bolts (15) and washers (14). Finger tighten bolts only at this time. Make sure wiring harnesses are routed between lower handlebar clamps.
2. Slide right handlebar control housing and throttle assembly (6, 8, 11) onto right end of handlebar (7). Position handlebar on lower handlebar clamps.
3. Place upper handlebar clamp (5) or clamp/instrument bracket (2) in position and install four screws (4).
4. **Models with bolt-on instrument bracket:**
 - a. See [Figure 2-229](#). Place spacers (6) over two front mounting holes of upper handlebar clamp.
 - b. Position instrument bracket (5) over two front holes of upper handlebar clamp and install two screws (4) and washers (8).
5. See [Figure 2-228](#). Adjust handlebars to desired position. Tighten rear screws first, to 12-18 ft-lbs (16.3-24.4 Nm). Then tighten front screws to 12-18 ft-lbs (16.3-24.4 Nm).
6. See [Figure 2-225](#). Tighten lower handlebar clamp bolts (15) to 30-40 ft-lbs (40.7-54.3 Nm).

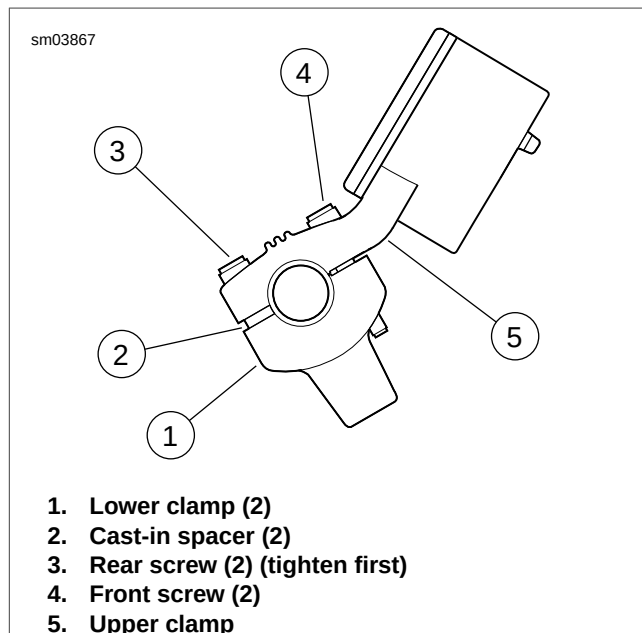


Figure 2-228. Handlebar Riser: XL 1200L/XL 1200N

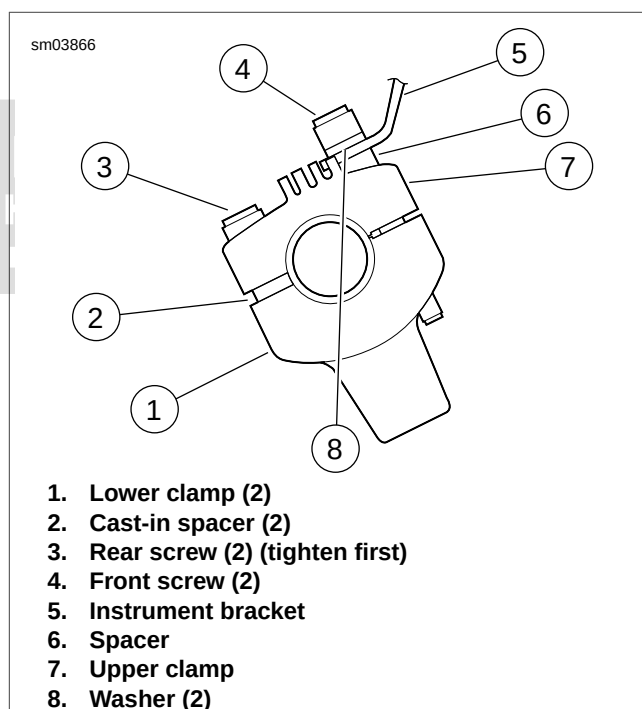


Figure 2-229. Handlebar Clamp: XL Models with Bolt-On Instrument Bracket

XR1200

1. See [Figure 2-226](#). Slide right handlebar control housing and throttle assembly (6, 8, 11) onto right end of handlebar (7). Position handlebar on upper fork bracket (13).
2. Place upper handlebar clamp (5) in position and install rear screws (3).
3. Place instrument bracket in position and install front screws (3) and washers (4).

4. Adjust handlebars to desired position. Tighten rear screws first, to 12-18 ft-lbs (16.3-24.4 Nm). Then tighten front screws to 12-18 ft-lbs (16.3-24.4 Nm).

All Models

1. Install front brake master cylinder assembly. See [2.10 FRONT BRAKE MASTER CYLINDER](#).
2. 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.

3. Position left hand control and loosely install hand control clamp screws. See [6.41 LEFT HANDLEBAR SWITCHES](#).
4. Attach clutch control assembly to left side of handlebar. Tighten screws to 108-132 **in-lbs** (12.2-14.9 Nm). See [2.31 CLUTCH CONTROL](#).
5. Tighten left hand control clamp screws to 35-45 **in-lbs** (4.0-5.1 Nm).
6. Tighten right hand control clamp screws to 35-45 **in-lbs** (4.0-5.1 Nm).
7. Wrap four **new** wiring harness retainers (item 12, [Figure 2-226](#), item 11, [Figure 2-225](#) or item 10, [Figure 2-224](#).) around handlebar wiring harnesses and push retainers into holes in handlebar.
8. Plug in main fuse. See [6.38 MAIN FUSE](#).
9. Verify the following:
 - a. Clutch cable adjustment/operation.
 - b. Proper throttle cable operation.
 - c. All electrical switch functions.
 - d. Proper brake operation and brake lamp function.



FRONT FENDER

2.33

XL MODELS

NOTE

Be careful when removing or installing fender assembly, to avoid scratching the paint. If necessary, cover the fender with a clean shop towel to prevent damage.

Removal

1. See [Figure 2-230](#). Remove four screws (1) and lock nuts (2) to detach front fender (3) from front fork sliders.
2. Carefully remove fender from between front fork sliders.

Installation

1. See [Figure 2-230](#). Carefully position front fender (3) between right and left front fork sliders.
2. Secure fender using four screws (1) and lock nuts (2). Tighten to 96-156 **in-lbs** (10.9-17.6 Nm).

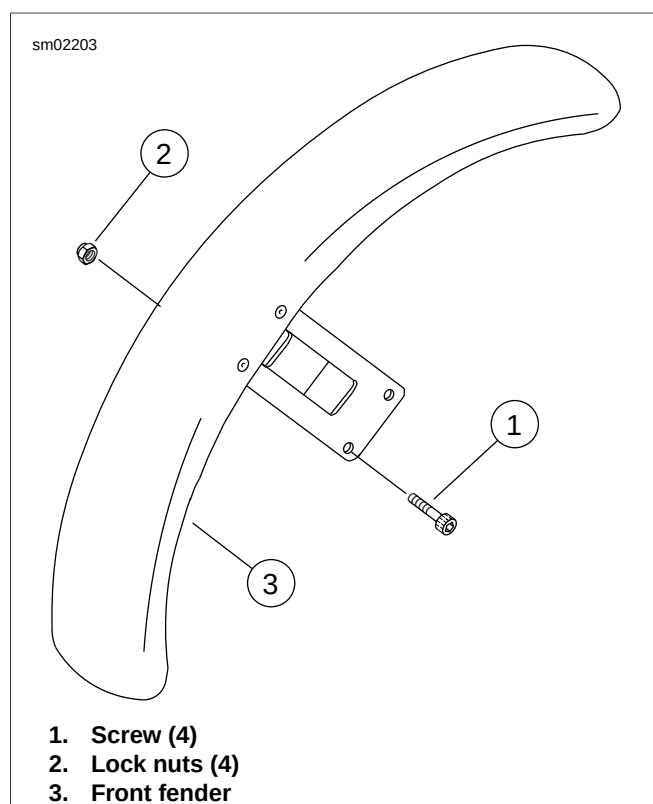


Figure 2-230. Front Fender: XL Models

XR MODELS

NOTE

Be careful when removing or installing fender assembly, to avoid scratching the paint. If necessary, cover the fender with a clean shop towel to prevent damage.

Removal

1. See [Figure 2-231](#). Remove four screws (2) to detach front fender (5) from front fork sliders.
2. Carefully remove fender and fender bracket assembly from between front fork sliders.
3. Remove four screws (1) and nuts (3) to detach front fender from fender bracket.

Installation

1. See [Figure 2-231](#). Carefully position fender bracket (4) over front fender (5). Secure with four screws (1) and nuts (3). Tighten to 36-60 **in-lbs** (4.1-6.8 Nm).
2. Carefully position front fender and fender bracket assembly between right and left front fork sliders.
3. Secure front fender assembly using four screws (2). Tighten to 15-19 **ft-lbs** (20.4-25.8 Nm).

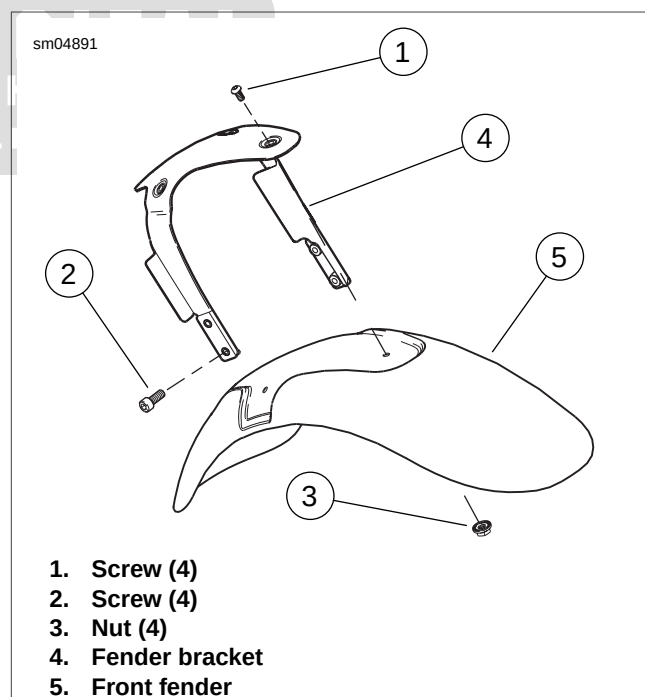


Figure 2-231. Front Fender: XR Models

REAR FENDER: ALL XL MODELS EXCEPT XL 1200N

2.34

GENERAL

For rear fender and convertible side mount license plate bracket removal and installation on XL 1200N model, see [2.35 REAR FENDER AND LICENSE PLATE BRACKET: XL 1200N](#).

REMOVAL

1. Remove seat.

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

2. Unplug main fuse. See [6.38 MAIN FUSE](#).
3. See [Figure 2-232](#). Remove two screws (6) and tail lamp lens (7) from tail lamp base assembly (11). Twist tail lamp bulb socket (9) 1/4 turn counterclockwise and remove from lens.

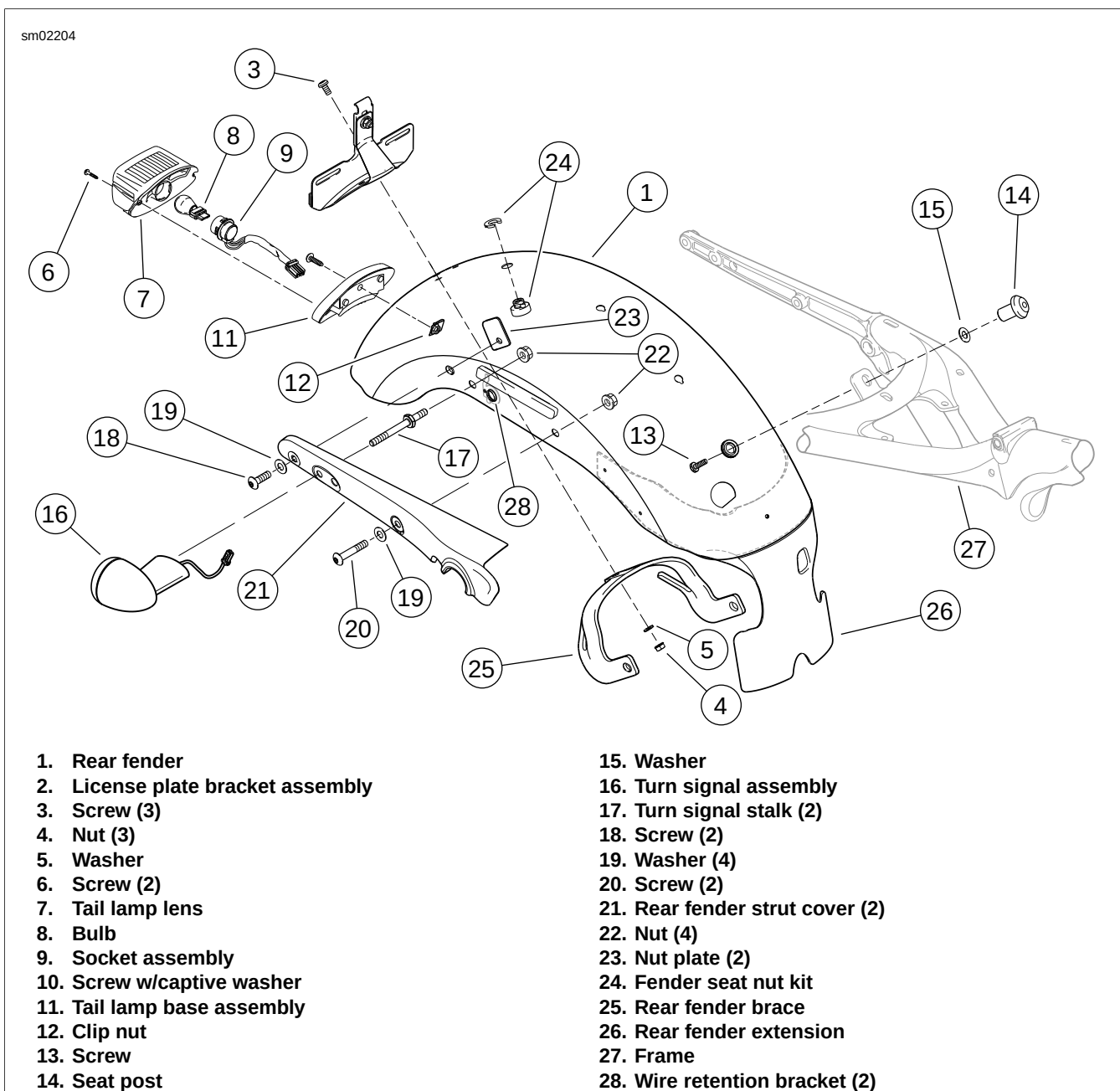


Figure 2-232. Rear Fender Assembly

4. See [Figure 2-233](#). Note location of electrical connectors on tail lamp circuit board. Depress latches on turn signal connectors (1, 2) and tail lamp connector (4). Unplug connectors from rear lighting circuit board.
5. See [Figure 2-235](#). Unplug rear lighting connector assembly [7] (2). Depress external latch and use a rocking motion to separate connector halves.
6. See [Figure 2-236](#). Depress latch (3) and unplug ECM connector [78B] (2). Place ECM harness out of the way.
7. Gently bend back ECM latches (4) and lift ECM off locating pins on ECM caddy (9).
8. **H-DSSS equipped models:** Gently bend back antenna latch (7) and lift security antenna (5) out of recess. Release antenna harness from harness retainer (8) in ECM caddy. Place antenna and harness out of the way.

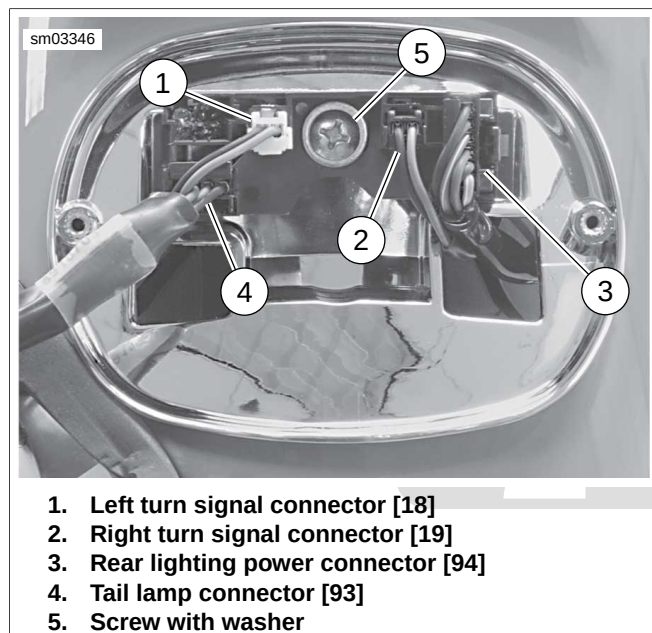


Figure 2-233. Tail Lamp Housing

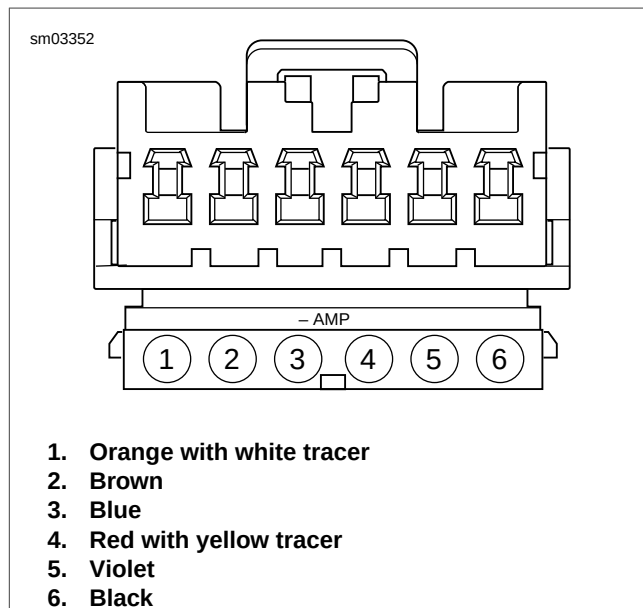


Figure 2-234. Tail Lamp Connector [94] (Secondary Lock Open)

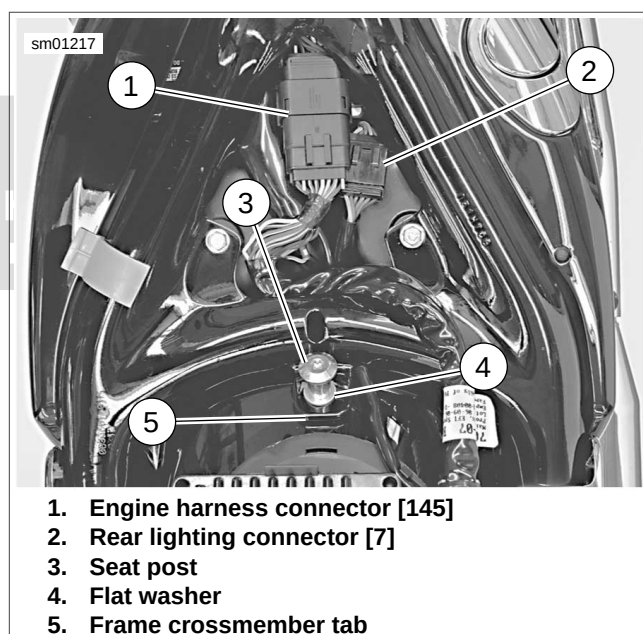


Figure 2-235. Rear Lighting Connector Location

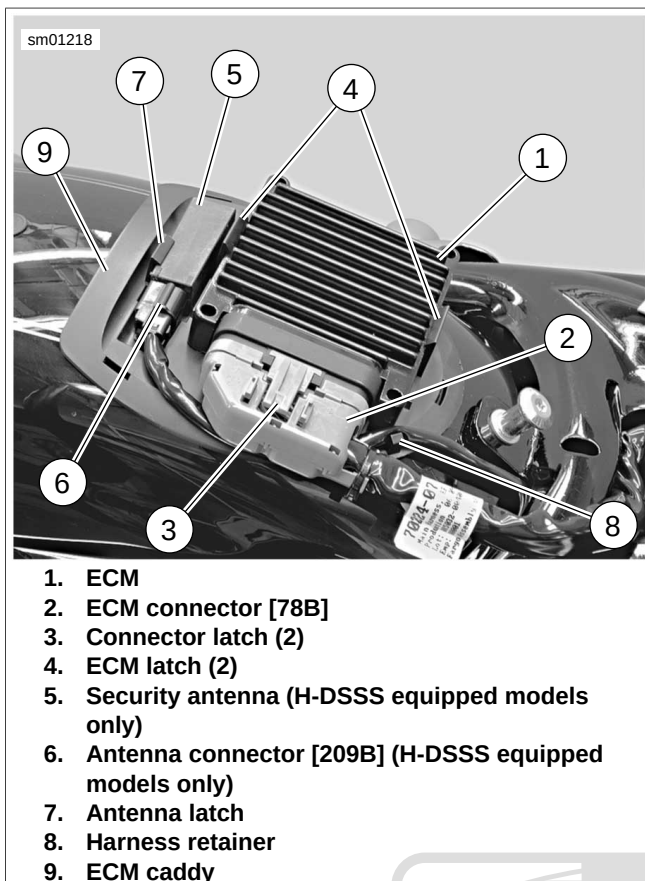


Figure 2-236. Security Antenna (H-DSSS only) and ECM Removal/Installation

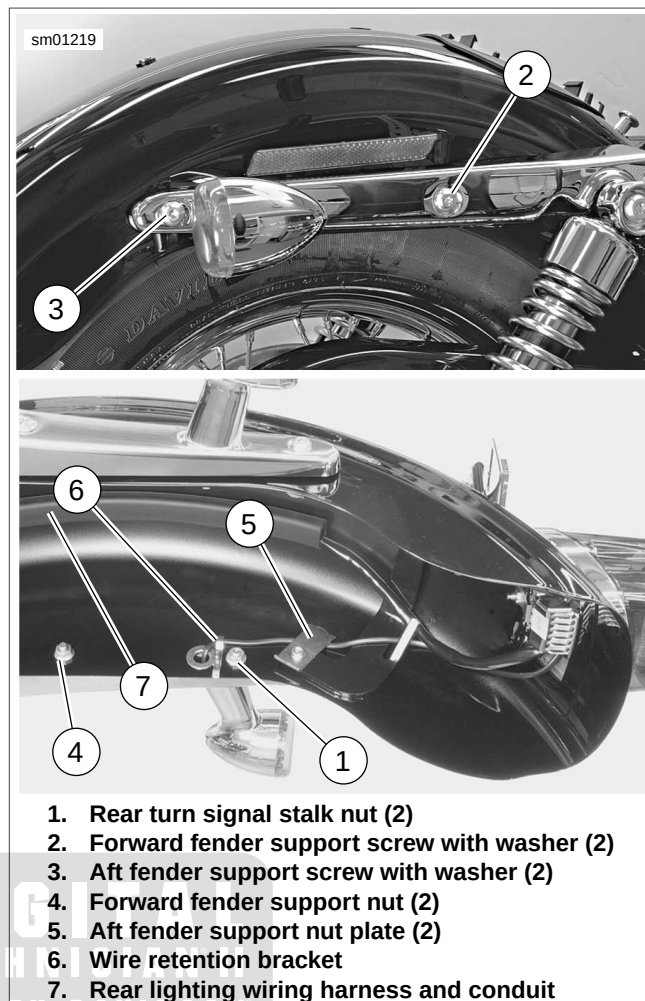


Figure 2-237. Rear Fender, Strut Cover and Turn Signal Lamp Assembly

9. See [Figure 2-237](#). Remove rear turn signal stalk nuts (1) from inside rear fender on both sides.
10. Remove forward fender support screw with washer (2) and nut (4), and aft fender support screw with washer (3) and nut plate (5) on both sides.
11. Pull turn signal wiring harnesses through holes in tail lamp base and rear fender. Disengage turn signal wiring harnesses from wire retention brackets (6).
12. See [Figure 2-232](#). Remove rear fender strut covers (21) with attached turn signal assemblies (16) from rear fender struts.
13. Remove screw (13), seat post (14) and flat washer (15) to detach top of rear fender (1) from frame cross member tab.
14. Carefully remove rear fender with attached tail/brake lamp assembly from motorcycle.
15. See [Figure 2-233](#). Depress latch on rear lighting power connector [94] (3) and unplug connector from rear lighting circuit board.
16. Remove screw with washer (5) and lift tail/brake lamp base from fender.
17. Gently bend back ECM caddy latches on underside of fender and lift caddy from top of fender.

INSTALLATION

NOTE

If a **new** fender is being installed, complete steps 1-7. Otherwise proceed directly to step 8.

1. See [Figure 2-232](#). Install license plate assembly on **new** rear fender:
 - a. Remove three screws (3), three nuts (4) and one washer (5) securing license plate bracket assembly (2) and rear fender brace (25) to old fender (1).
 - b. Position assembly on **new** fender and secure with screws, nuts and washer.
 - c. Align remaining holes in rear fender brace with aft fender support screw holes in fender.
 - d. Tighten license plate bracket mounting screws to 20-25 **in-lbs** (2.3-2.8 Nm).
2. Carefully drill out pop rivets securing rear fender extension (26) to old fender with a 1/4-in diameter drill bit. Rivet rear fender extension to **new** fender.

3. Carefully drill out pop rivets securing wire retention brackets (28) to old fender with a 1/4-in diameter drill bit. Rivet brackets to **new** fender.
 4. Remove fender seat nut kit (24) from old fender and install on **new** fender.
 5. Place fender upside down on clean, soft towel or mat to protect the finish. Clean inside area of fender where wiring harness/conduit will be placed, with a mixture of alcohol and water. Allow to air-dry thoroughly.
 6. Position **new** wire harness and conduit inside fender at the same approximate position where harness/conduit assembly is located in old fender. Insert end of wiring harness with 'D' plug through 'D' hole in front of fender. Insert plug into hole.
 7. Slide conduit toward 'D' plug as far as it will go. Insert other end of wiring harness through tail lamp housing hole in rear of fender. Remove adhesive tape backing from conduit and press conduit in place along right side curve of fender.
 8. Carefully install rear fender onto motorcycle. Align holes in fender with those in struts. Temporarily install screws (18, 20) through fender struts and fender to hold fender in place. Route rear lighting harness connector [7B] between frame cross member and top of oil tank. Plug connector into socket [7A].
 9. See [Figure 2-232](#). Secure front of fender with screw (13), washer (15) and seat post (14). Finger-tighten screw only, at this time.
 10. **H-DSSS equipped models:** Make sure antenna harness feeds up between oil tank and fender on right side of vehicle, and is not pinched between fender and frame crossmember.
 11. Remove screws from right side of fender that were temporarily installed in step 8. Install right side rear fender strut cover (21) with attached turn signal assembly to fender strut. Push turn signal wiring harness through appropriate hole in strut and fender. Install nut (22) onto turn signal stalk (17) from inside fender. Finger-tighten only at this time.
 12. Secure fender to strut with screw (20), washer (19) and nut (22) in forward mounting hole. Install screw (18), washer (19) and nut plate (23) in aft mounting hole. Finger-tighten screws only at this time.
 13. Repeat steps 11. and 12. on left side of fender.
 14. Now tighten all fender mounting hardware in the following sequence:
 - a. Tighten screw (13) and seat post (14) to 96-156 **in-lbs** (10.9-17.6 Nm).
 - b. Tighten turn signal stalk nuts to 132-216 **in-lbs** (14.9-24.4 Nm).
 - c. Tighten screws (18, 20) to 132-216 **in-lbs** (14.9-24.4 Nm).
 15. Install tail lamp base (11) to fender with screw (10) and clip nut (12). Tighten screw to 45-48 **in-lbs** (5.1-5.4 Nm).
 16. See [Figure 2-233](#). Push 6-pin Amp connector [94] (3) and left [18] (1) and right [19] (2) turn signal connectors through access holes in tail lamp base and connect as shown.
 17. See [Figure 2-236](#). Snap ECM caddy (9) into place in top of fender.
 18. **H-DSSS equipped models:** Place security antenna (5) into recess in ECM caddy with flat side of antenna facing up and connector (6) facing right side of vehicle. Press down gently on antenna until it snaps in place. Route harness around right side of caddy and through harness retainer (8).
 19. Lower ECM (1) onto locating pins in ECM caddy with ECM connector [78A] facing right side of vehicle. Press down gently on ECM until it snaps in place. **H-DSSS equipped models:** Make sure antenna harness is not pinched underneath ECM.
 20. Plug ECM connector [78B] (2) into ECM.
 21. See [Figure 2-233](#). Insert tail lamp connector [93] (4) in tail lamp base socket as shown. See [Figure 2-232](#). Screw tail lamp socket assembly (9) into lens (7). Attach tail lamp lens (7) to base (11) with two screws (6).
 22. Plug in main fuse. See [6.38 MAIN FUSE](#).
-  **WARNING**
- Be sure headlamp, tail and stop lamp and turn signals are operating properly before riding. Poor visibility of rider to other motorists can result in death or serious injury. (00478b)**
23. Turn ignition switch ON and check rear lighting.
 - a. Make sure tail lamp is lit.
 - b. Depress turn signal switches and make sure both turn signals are operating properly.
 - c. Operate front or rear brake and make sure brake lamp illuminates.
-  **WARNING**
- After installing seat, pull upward on seat to be sure it is locked in position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070b)**
24. Install seat.

REAR FENDER AND LICENSE PLATE BRACKET: XL 1200N

2.35

GENERAL

Unlike all other XL models, XL 1200N models sold in the domestic market are equipped with a convertible side-mount license plate bracket assembly. Incorporated into the bracket is a license plate lamp module.

NOTE

Due to local regulations, this side mount license plate bracket may not be offered in all markets.

The standard rear fender-mounted tail lamp and brake lamp assembly common to all other XL models is not present on the domestic XL 1200N. Instead, the rear turn signals also function as tail lamps and brake lamps and are controlled by a rear lighting converter module located under the seat.

For instructions on replacing the rear lighting converter module, see [6.26 REAR LIGHTING CONVERTER MODULE: XL 1200N \(DOMESTIC ONLY\)](#).

NOTES

- XL 1200N models sold in the international market are equipped with a center mounted license plate bracket that incorporates a license plate lamp assembly.
- XL 1200N models sold in the international market are not equipped with a rear lighting converter module. Instead, they incorporate discrete LED assemblies in the rear turn signal housings for brake lamp, tail lamp and turn signal functions.

REMOVAL AND DISASSEMBLY

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Unplug main fuse. See [6.38 MAIN FUSE](#).
2. Position motorcycle upright on suitable lift with rear wheel elevated.
3. Remove rear wheel. See [2.4 WHEELS](#).
4. Remove seat.
5. See [Figure 2-238](#). Depress latch (3) and unplug ECM connector [78B] (2). Place ECM harness out of the way.
6. Gently bend back ECM latches (4) and lift ECM off locating pins on ECM caddy (9).
7. **H-DSSS equipped vehicles:** Gently bend back antenna latch (7) and lift security antenna (5) out of recess. Release antenna harness from harness retainer (8) in ECM caddy. Position antenna and harness out of the way.
8. See [Figure 2-239](#). Unplug license plate lamp connector (1) [40]. Unplug right rear lighting harness connector (3) [19]. This connector is identified by a brown band (4) on the harness near the connector. Unplug left rear lighting harness connector (2) [18].

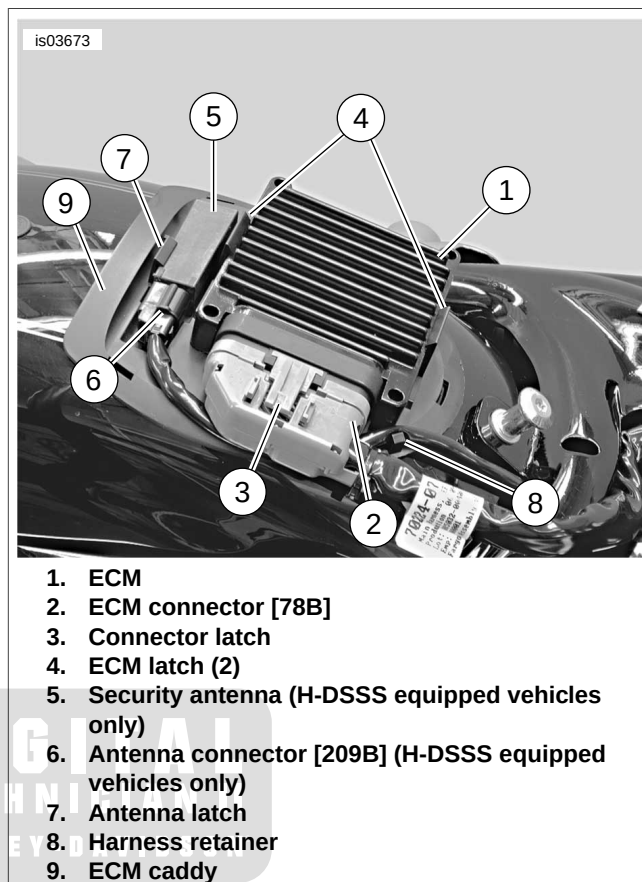


Figure 2-238. Security Antenna (H-DSSS only) and ECM Removal/Installation

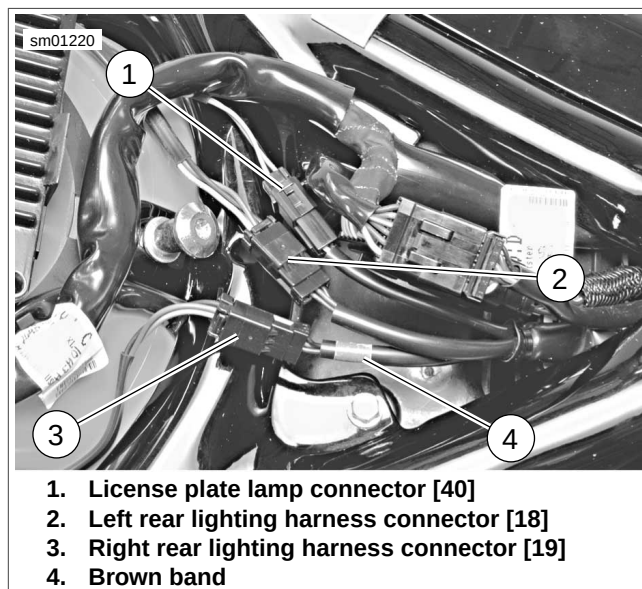


Figure 2-239. Rear Lighting Harness Connectors

9. See [Figure 2-240](#). Carefully pull both rear lighting harnesses (2, 3) and license plate lamp harness (6) through feed-through holes (4, 5) in rear fender.
10. Remove both rear lighting harnesses and license plate lamp harness from fender harness clips (1).
11. See [Figure 2-241](#). Remove left rear lighting harness (5) from harness clips (2) on lower side of bracket on left side of fender. Repeat this step for right side of fender.
12. See [Figure 2-242](#). Remove rear turn signal stalk nuts (6) from inside rear fender on both sides.
13. Remove forward fender support screw with washer (2) and nut (4), and aft fender support screw with washer (3) and nut plate (5) (domestic only) on both sides.
14. Remove screw with washer (10) and rear fender brace (7).
15. **HDI models:** Remove license plate lamp module harness from upper harness clips on bracket inside fender (left side). Separate license plate bracket from rear fender brace.
16. Remove rear fender strut covers (1) with attached turn signal assemblies from rear fender struts. Carefully pull turn signal wiring harnesses through holes in rear fender and strut as each strut cover is removed.

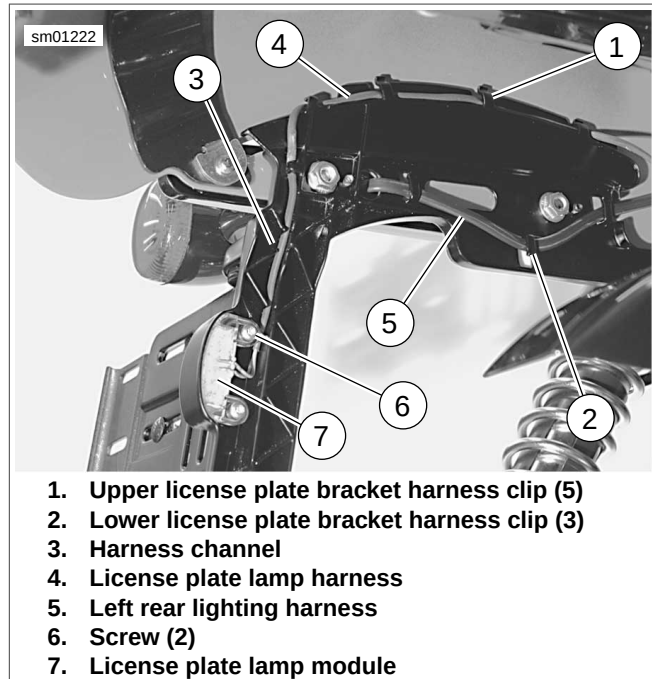


Figure 2-241. Removing/Installing License Plate Lamp Module (Domestic Only)

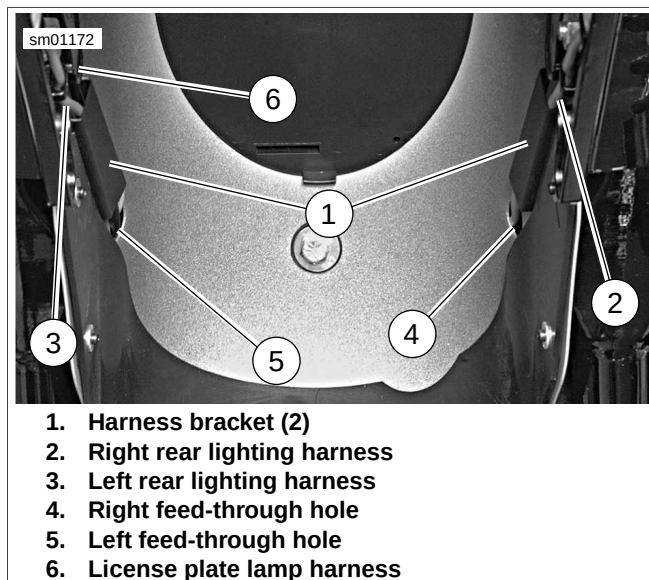


Figure 2-240. Lighting Harnesses and Harness Brackets (View from Inside Rear Fender): XL 1200N

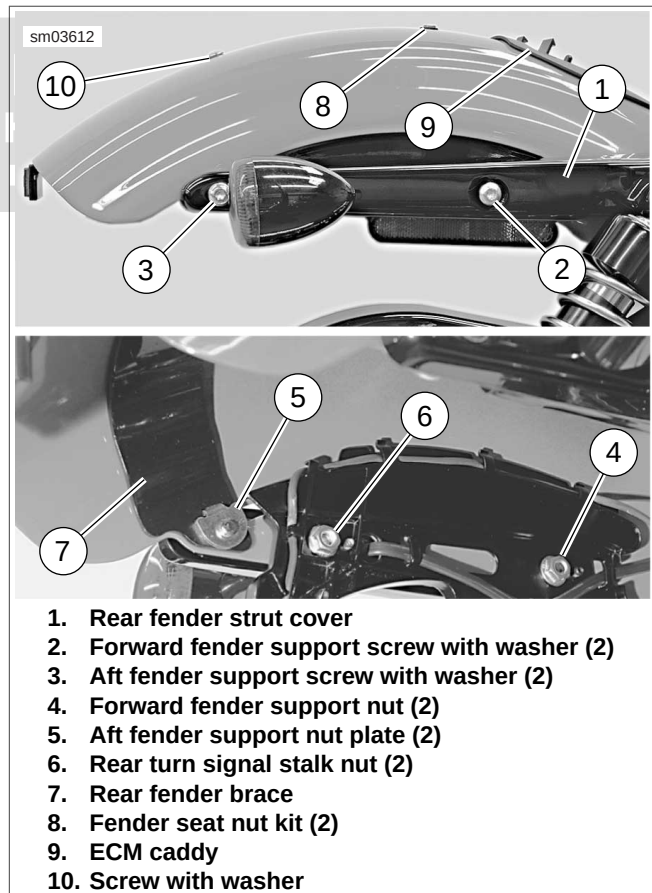


Figure 2-242. Rear Fender, Strut Cover and Turn Signal Lamp Assembly (Typical, Domestic Shown)

17. Place a clean shop towel between each fender strut and fender to protect paint.
18. Have an assistant hold rear fender in place. See [Figure 2-243](#). Remove seat post (1), washer (2) and screw (5). Remove rear fender from vehicle, being careful not to damage paint. Lay rear fender on a soft, clean surface.
19. **Domestic models:** Remove convertible side mount license plate bracket from rear fender.
 - a. See [Figure 2-241](#). Remove license plate lamp module harness from upper harness clips (1) and harness channel (3) in license plate bracket. Remove two screws (6) and license plate lamp module (7).
 - b. See [Figure 2-244](#). Carefully drill out two pop rivets (3) securing license plate bracket assembly (2) to left side of fender.
20. See [Figure 2-242](#). If rear fender is being replaced, do the following:
 - a. Remove ECM caddy (9).
 - b. Remove fender seat nut kit (8).
 - c. Carefully drill out pop rivets securing rear fender extension to old fender with a 1/4-in (6.35 mm) diameter drill bit.
 - d. Set caddy, nut kit and fender extension aside for now.

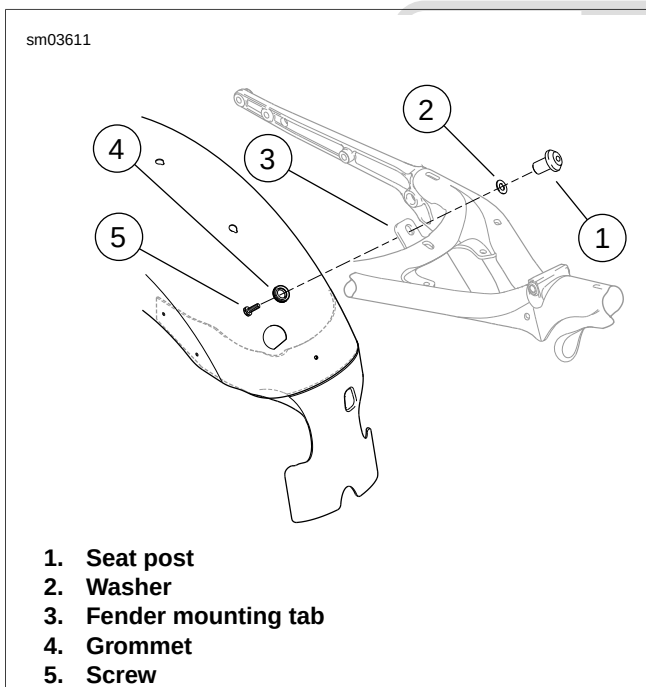


Figure 2-243. Seat Post/Rear Fender Mount Hardware

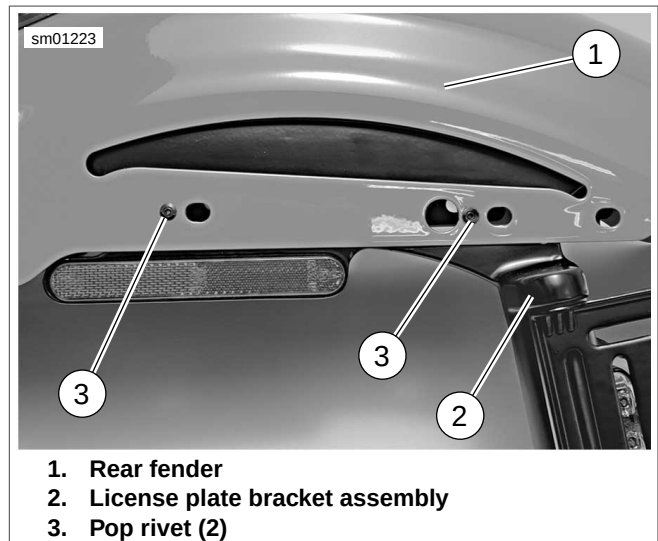


Figure 2-244. Removing/Installing License Plate Bracket Assembly (Domestic Only)

ASSEMBLY AND INSTALLATION

1. See [Figure 2-242](#). If **new** rear fender is being installed, do the following:
 - a. Install ECM caddy (9).
 - b. Install fender seat nut kit (8).
 - c. Rivet rear fender extension to fender.
2. **Domestic models:** Install convertible side mount license plate bracket on fender.
 - a. See [Figure 2-244](#). Position license plate bracket assembly (2) against inside of rear fender (1) on left side. Line up holes in bracket with holes in fender and secure bracket to fender with two **new** pop rivets (3).
 - b. See [Figure 2-241](#). Install license plate lamp module (7) on to license plate bracket. Secure with two screws (6). Feed license plate lamp harness (4) up through harness channel (3). Insert harness into upper license plate bracket harness clips (1).
3. Place clean shop towels over fender struts. With the aid of an assistant, carefully install rear fender onto vehicle.
4. See [Figure 2-243](#). With assistant holding rear fender in place, install screw (5) through fender and frame tab. Install washer (2) on screw. Thread seat post (1) onto screw. Tighten seat post only finger tight at this time.
5. **H-DSSS equipped vehicles:** Make sure antenna harness feeds up between oil tank and fender on right side of vehicle. and is not pinched between fender and frame crossmember.
6. Remove shop towels from fender struts.
7. See [Figure 2-242](#). Install fender strut covers (1) with attached turn signal lamp assemblies. Carefully feed each turn signal harness through appropriate hole in fender strut and fender as you install each strut cover.

8. Thread nut (6) onto each rear turn signal stalk finger-tight. Install two forward fender support screws with washers (2). Thread nut (4) onto each screw finger-tight.
9. **HDI models:** hook tab of license plate bracket into slot in rear fender brace.
10. Place rear fender brace (7) in position under fender and secure with screw and washer (10) finger-tight. Install two aft fender support screws with washers (3).
 - a. **HDI models:** thread each mounting screw through rear fender brace, into threaded inserts in license plate bracket. Install finger-tight. Make sure threaded inserts in license plate bracket fit into holes in rear fender brace.
 - b. **Domestic models:** see [Figure 2-245](#). Install nut plate (2) on each mounting screw (5) finger-tight.

NOTE

Domestic models: see [Figure 2-245](#). Make certain that tab (3) on each nut plate (2) fits into slot (4) in fender brace (1) when securing nut plate with rearmost fender mounting screw (5).

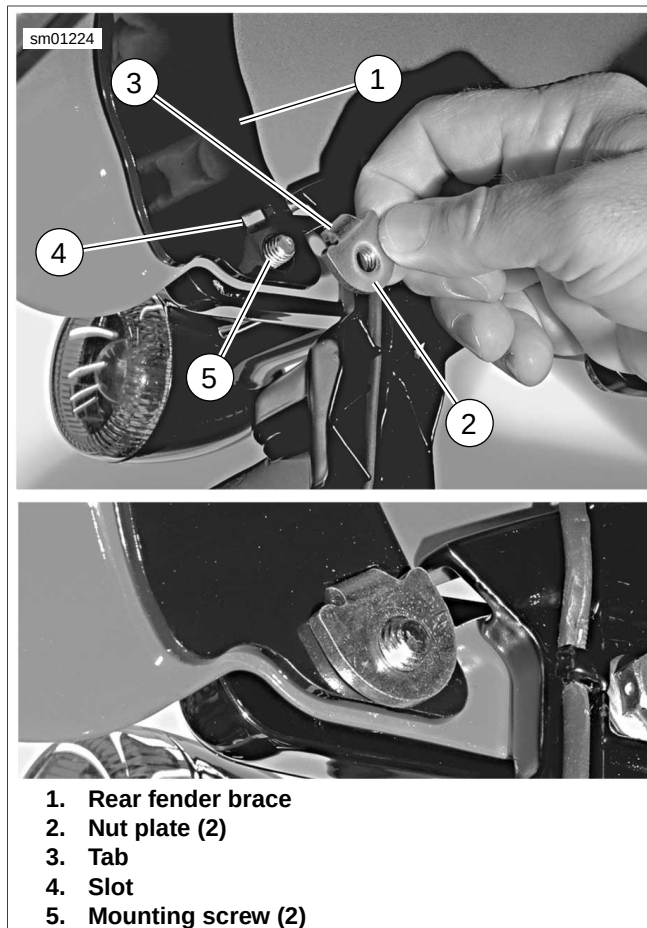


Figure 2-245. Rear Fender Nut Plate (Domestic Only)

11. Now tighten all fender mounting hardware in the following sequence:
 - a. See [Figure 2-243](#). Tighten screw (5) and seat post (1) to 96-156 **in-lbs** (10.9-17.6 Nm).
 - b. See [Figure 2-242](#). Tighten left and right turn signal stalk nuts (6) to 132-216 **in-lbs** (14.9-24.4 Nm).
 - c. Tighten forward and aft fender support screws (2, 3) on both sides of fender to 132-216 **in-lbs** (14.9-24.4 Nm).
 - d. Tighten rear fender brace screw (10) to 20-25 **in-lbs** (2.3-2.8 Nm).
12. See [Figure 2-240](#). Install left rear lighting harness (3) and license plate lamp harness (6) into fender harness clip (1) on left side of fender. Install right rear lighting harness (2) into fender harness clip on right side of fender.
13. Carefully feed both rear lighting harnesses and license plate lamp harness through feed-through holes (4, 5) in rear fender.
14. See [Figure 2-239](#). Plug in license plate lamp connector (1) [40]. Plug in left rear lighting harness connector (2) [18].
15. Plug in right rear lighting harness connector (3) [19]. This connector is identified by a brown band (4) on the harness near the connector.
16. **H-DSSS equipped vehicles:** See [Figure 2-238](#). Gently bend back antenna latch (7) and position security antenna (5) in recess in ECM caddy (9). Release latch. Position antenna harness in harness retainer (8).
17. See [Figure 2-238](#). Gently bend back ECM latches (4) and install ECM into locating pins on caddy with connector [78A] on ECM body facing right side of vehicle.
18. Plug harness connector [78B] (2) into ECM. Tug gently on connector to make sure connector latch (3) has locked in position properly and cannot come loose.

⚠ WARNING

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

19. Install seat.
20. Install rear wheel. See [2.4 WHEELS](#). Make certain rear wheel is properly aligned and rear drive belt is properly tensioned. See [1.16 REAR BELT DEFLECTION](#).
21. Plug in main fuse. See [6.38 MAIN FUSE](#).

⚠ WARNING

Be sure headlamp, tail and stop lamp and turn signals are operating properly before riding. Poor visibility of rider to other motorists can result in death or serious injury. (00478b)

22. Turn ignition switch ON. Verify all rear lighting is operating properly: license plate lamp, tail lamps, brake lamps and turn signals.

23. Start engine to verify proper ECM function. Turn ignition switch OFF.
24. Remove vehicle from lift.



REAR FENDER: XR MODELS

2.36

REMOVAL

1. Remove rider's seat and passenger pillion.

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

2. Unplug main fuse. See [6.38 MAIN FUSE](#).
3. See [Figure 2-246](#). Remove three bolts and washers (1). Remove two bolts (2) and retainers (3). Lift tail section (4) off from motorcycle.
4. Remove screw (5). Rotate inner fender (6) down and release tabs (7) from notches in frame.
5. Disconnect ECM connector and remove inner fender and ECM as an assembly. Remove ECM from inner fender if necessary.

INSTALLATION

1. See [Figure 2-246](#). If removed, install passenger pillion retainer post (9). Tighten screw (8) to 36-60 **in-lbs** (4.1-6.8 Nm).
2. If removed, install ECM on inner fender.
3. While holding inner fender/ECM assembly in place, connect ECM connector.
4. Ensure tabs (7) are located in notches in frame and secure inner fender with screw (5). Tighten to 72-120 **in-lbs** (8.1-13.6 Nm).

NOTE

Washers and retainers (3) are installed with shoulder down.

5. Install tail section (4) and secure with bolts, washers, and seat retainers. Tighten bolts to 72-120 **in-lbs** (8.1-13.6 Nm).

WARNING

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

6. Install passenger pillion and rider's seat.
7. Install main fuse.

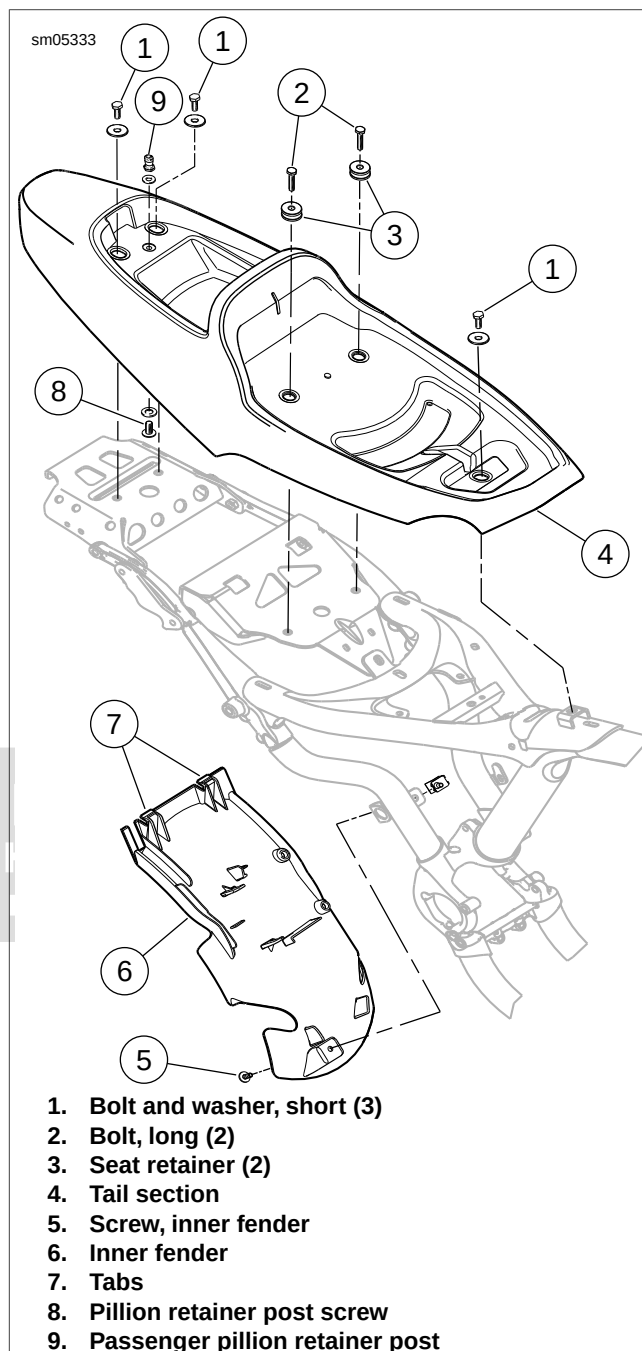


Figure 2-246. Rear Fender: XR Models

2.37

GENERAL

See [Figure 2-247](#). 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

The jiffy stand locks when placed in the full forward (down) position with vehicle weight on it. If the jiffy stand is not in the full forward (down) position with vehicle weight on it, the vehicle can fall over which could result in death or serious injury. (00006a)

⚠ WARNING

Always park motorcycle on a level, firm surface. An unbalanced motorcycle can fall over, which could result in death or serious injury. (00039a)

⚠ WARNING

Be sure jiffy stand is fully retracted before riding. If jiffy stand is not fully retracted, it can contact the road surface causing a loss of vehicle control, which could result in death or serious injury. (00007a)

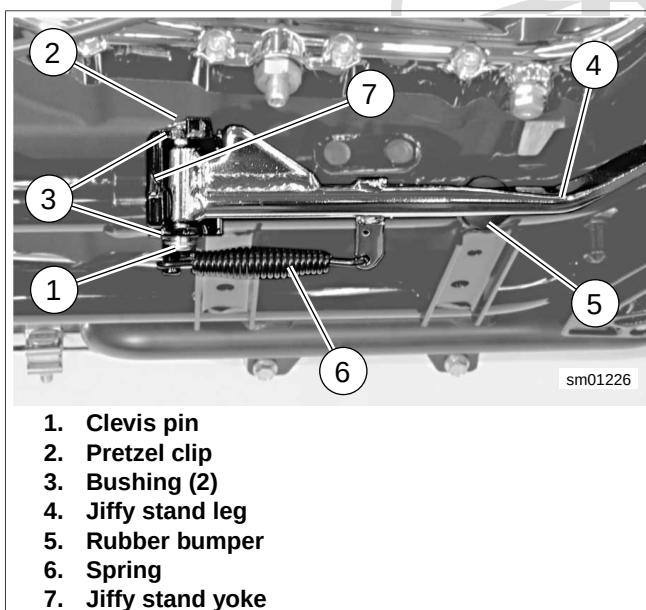


Figure 2-247. Jiffy Stand (Retracted Position) (Typical)

Some international models are equipped with a jiffy stand interlock feature.

If the rider attempts to start the engine or pushes the starter button while the transmission is in gear and the jiffy stand is down, then the jiffy stand interlock system will not permit the engine to run. The message "SidE StAnd" will scroll across

the odometer to indicate this to the rider. Raising the jiffy stand (or putting the transmission in neutral) will permit the engine to run and clear the message.

If the jiffy stand falls out of the fully retracted position while riding at speeds greater than 10 mph (15 km/h), then the jiffy stand interlock system will maintain engine operation and alert the rider about this by illuminating the indicators (flash twice) and scroll the message "SidE StAnd" across the odometer. The message will remain until the system detects the jiffy stand in the fully retracted position again. The rider may continue to operate the vehicle while in this mode.

The rider may clear the text messages at any time by pressing the function switch once while the vehicle is powered up.

NOTE

If the operation of raising the jiffy stand and putting the transmission in gear is rapidly executed, the jiffy stand bouncing off the frame could cause the jiffy stand interlock system to activate and stop the engine.

REMOVAL

1. Block motorcycle under frame so that motorcycle is securely resting upright and jiffy stand may be moved through its full range of travel.
2. See [Figure 2-247](#). 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. See [Figure 2-248](#). Place jiffy stand leg in retracted position. Remove and discard pretzel clip (3).

⚠ WARNING

Wear safety glasses or goggles when removing or installing spring. Spring tension can cause spring, attached components and/or hand tools to fly out which could result in death or serious injury. (00477c)

4. While firmly holding jiffy stand leg (5) in fully retracted position, withdraw clevis pin (1) until it disengages from upper pivot hole of jiffy stand yoke (4).
5. Detach spring (6) from anchor pin (7) using pliers. Unhook other end of spring from jiffy stand leg.
6. Remove clevis pin from lower pivot hole of jiffy stand yoke. Remove jiffy stand leg. Remove upper and lower bushings (2).

CLEANING AND LUBRICATION

Clean and lubricate jiffy stand assembly every 5000 miles (8000 km). Proceed as follows:

1. See [Figure 2-248](#). See [2.37 JIFFY STAND, Removal](#) above 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, groove of anchor pin and O.D. of clevis pin (1).

4. See [2.37 JIFFY STAND, Installation](#) to install jiffy stand to motorcycle frame.

INSTALLATION

1. Clean and lubricate jiffy stand components according to procedure listed in [2.37 JIFFY STAND, Cleaning and Lubrication](#) above.

NOTE

See [Figure 2-247](#). When installing jiffy stand spring (6), make sure open ends of spring hooks face inward toward centerline of vehicle, as shown in the figure.

⚠ WARNING

Wear safety glasses or goggles when removing or installing spring. Spring tension can cause spring, attached components and/or hand tools to fly out which could result in death or serious injury. (00477c)

2. See [Figure 2-248](#). Hook either end of spring (6) into spring mounting hole on jiffy stand leg (5). Install other end of spring over frame mounted anchor pin (7).
3. Install bushing (2) onto clevis pin (1) with shoulder of bushing facing head of clevis pin.
4. While holding end of spring in groove of anchor pin and holding jiffy stand leg in its retracted position, place pivot end of jiffy stand leg into yoke (4) on motorcycle frame (refer to [Table 2-27](#), for correct clevis pin application). Insert clevis pin (1) up through lower pivot hole of yoke and halfway into pivot hole of jiffy stand leg.
5. See [Figure 2-247](#). Lift jiffy stand leg (4) upward, aligning pivot hole of jiffy stand leg with slotted upper hole of yoke (7). Push clevis pin through upper hole in yoke. Make certain that shank of lower bushing (3) fits inside lower pivot hole in yoke.
6. Install upper bushing with shoulder facing up, over end of clevis pin and against upper surface of yoke. Insert new pretzel clip (2) through hole in end of clevis pin.

NOTE

See [Figure 2-249](#). Make sure the loop of the pretzel clip snaps over the end of the clevis pin.

7. See [Figure 2-247](#). Press rubber bumper (5) onto mounting stud on motorcycle frame.
8. 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.
9. Place jiffy stand in its full forward position (down). Carefully remove support blocking from beneath motorcycle frame. Rest motorcycle on jiffy stand.

Table 2-27. Clevis Pin Application

MODEL	PIN COLOR	OVERALL LENGTH (IN/MM)
XL 883L	Black	2.64/67.1
All except XL 883L	Silver	2.72/69.1

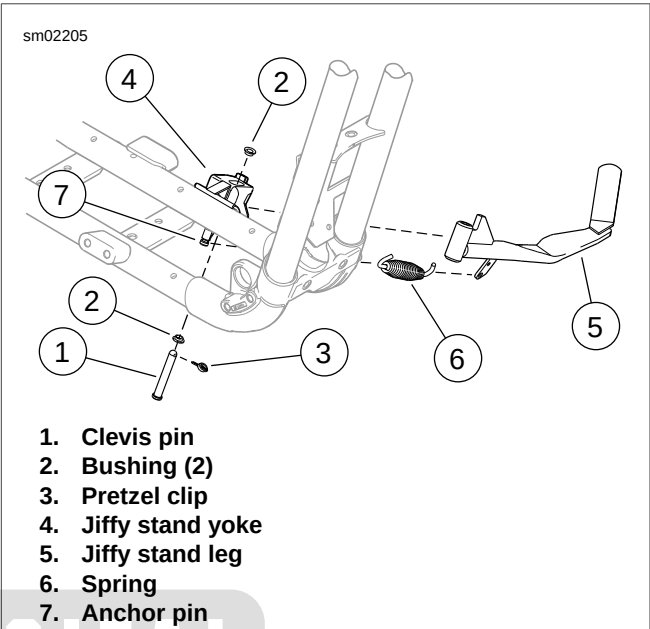


Figure 2-248. Jiffy Stand

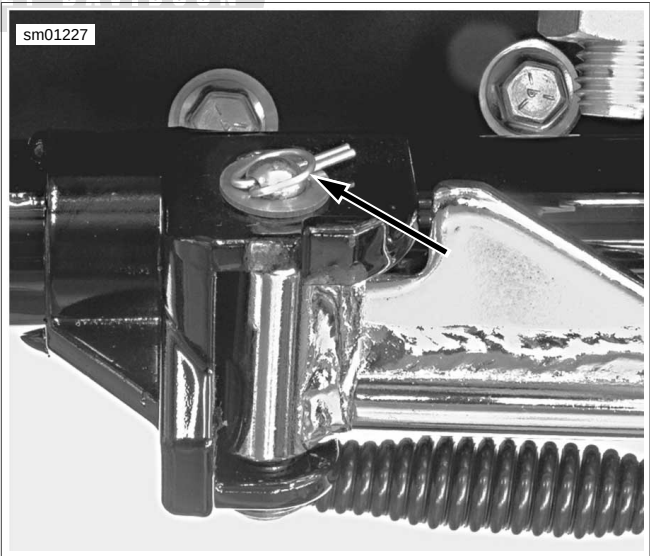


Figure 2-249. Pretzel Clip

GENERAL

The seat is attached to the vehicle at three points.

1. See [Figure 2-250](#). The tongue (1) fits under the rear fuel tank bracket.
2. The keyhole (2) locks into the seat post (See [Figure 2-251](#)).
3. See [Figure 2-252](#). The mounting bracket (2) bolts to the seat with two screws (5) and lock washers (6), and attaches to a seat nut (4) in the rear fender with a screw (1).

SEAT REMOVAL: XL MODELS

1. See [Figure 2-252](#). Remove screw (1) to detach seat from rear fender.
2. Slide seat forward and lift up slightly to detach keyhole bracket from seat post. Then slide seat rearward to detach seat tongue from rear fuel tank bracket.
3. See [Figure 2-250](#). Verify that tongue (1) and keyhole bracket (2) are tightly secured to seat bottom and that no rivets are loose or missing.
4. See [Figure 2-252](#). If two-up seat (8), inspect passenger strap (9) for damage or excessive wear.

NOTE

The passenger strap is not sold separately. If it is damaged, excessively worn or otherwise unusable, the entire seat assembly must be replaced.



1. Tongue
2. Keyhole bracket
3. Passenger strap

Figure 2-250. Seat

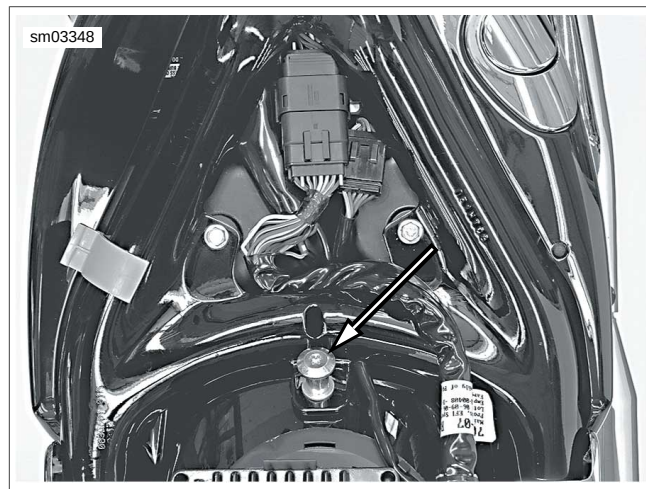


Figure 2-251. Seat Post: Sportster XL Models

SEAT INSTALLATION: XL MODELS

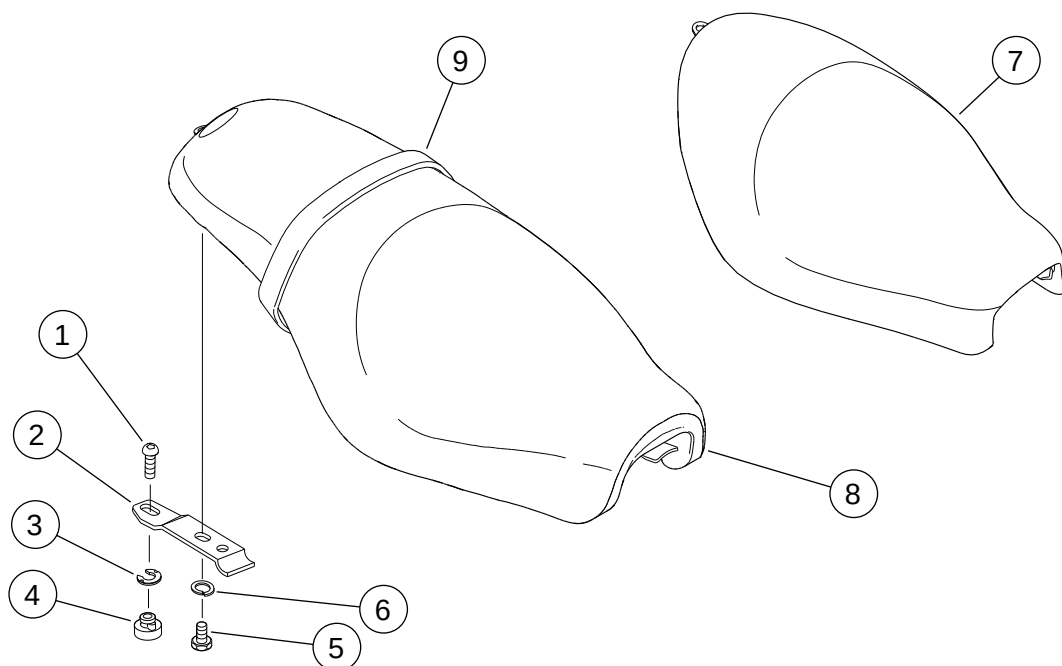
1. See [Figure 2-252](#). Position seat on frame with mounting bracket at rear.
2. Slide seat forward until the tongue fits snugly under rear fuel tank bracket.
3. See [Figure 2-251](#). Push seat forward, engage keyhole onto seat post, then pull seat back slightly.
4. See [Figure 2-252](#). Install seat mounting screw with captive washer (1) 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.
5. Pull up on seat to verify that it is locked in place.
6. Tighten seat mounting screw.

WARNING

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

7. Pull up on seat again to verify that it is properly secured at all three points.

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1. Seat mounting screw with captive washer
2. Mounting bracket
3. Retaining clip
4. Seat nut
5. Screw (2)

6. Lock washer
7. Seat assembly, solo (typical)
8. Seat assembly, two-up (typical)
9. Passenger strap (not sold separately)

Figure 2-252. Seat Assembly: Sportster XL Models



SEAT: XR MODELS

2.39

SEAT REMOVAL: XR 1200 MODEL

1. See [Figure 2-253](#). Reach under front end of tail section and press the two seat tabs inward.
2. Pull front of seat upward to disengage seat from the front end of the tail section.
3. Pull seat forward over fuel tank.

NOTES

- When removing the seat, verify that the mounting bracket under the seat is tightly secured to the seat bottom and that no rivets are loose or missing. Inspect passenger strap for damage or excessive wear.
- The passenger strap is not sold separately. If it is damaged, excessively worn, or otherwise unusable, the entire seat must be replaced.

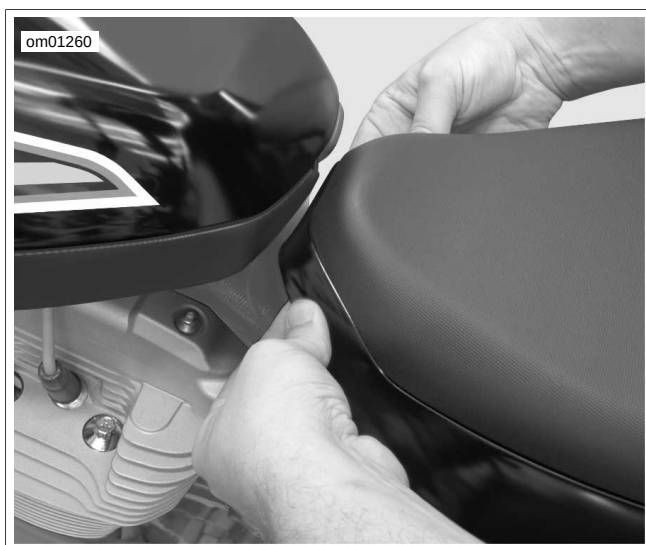


Figure 2-253. Front Seat Tabs (Under Tail Section): XR 1200 Model

SEAT INSTALLATION: XR 1200 MODEL

1. See [Figure 2-254](#). Place rear of seat into tail section, aligning the guides in the seat bracket with the two seat posts.
2. Push down on front of seat until the two tabs engage the front end of tail section.

⚠ WARNING

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

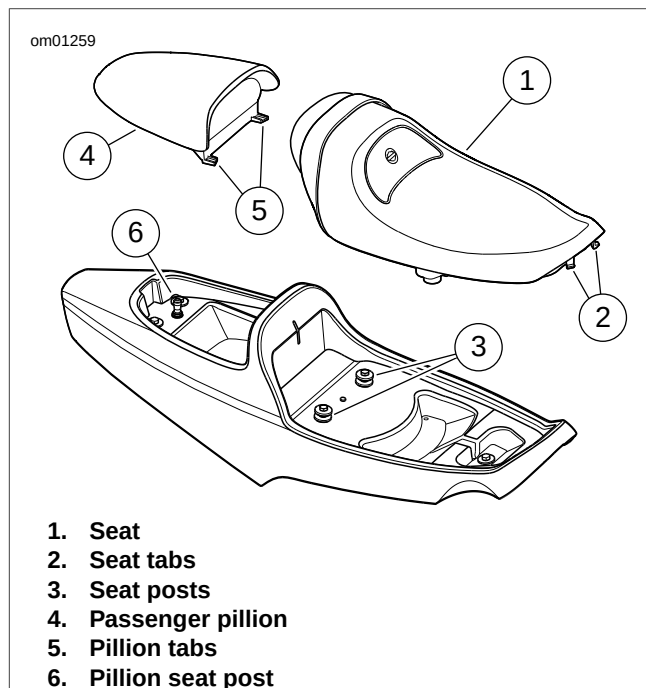


Figure 2-254. Seat and Pillion: XR 1200 Model

PASSENGER PILLION: XR 1200 MODEL

Removal

1. See [Figure 2-255](#). Lift the rear of pillion to disengage grommet from the seat post.
2. Pull pillion out from tail section.

Installation

1. See [Figure 2-255](#). Insert pillion into trunk, aligning tabs on pillion with the slots in the trunk.
2. Push down firmly on rear of pillion until grommet fully engages the seat post.

⚠ WARNING

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

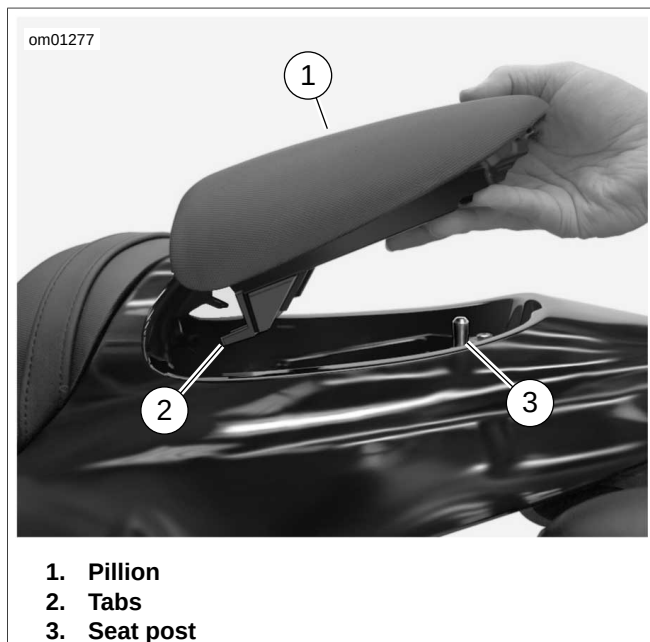


Figure 2-255. Passenger Pillion: XR 1200 Model



RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS

2.40

RIGHT FOOTREST AND REAR BRAKE PEDAL ASSEMBLY

Removal

1. Remove front muffler. See [4.15 EXHAUST SYSTEM: XL MODELS](#).
2. See [Figure 2-256](#). Remove retaining ring (3), clevis pin (5), footrest (1) and spring washer (2). Discard retaining ring.
3. Remove brake rod (7) from brake pedal (8) and master cylinder bell crank (19).
4. Remove retaining ring (26), screw (11) and clevis (4). Slide brake pedal (8) off clevis. Discard retaining ring.
5. Remove two screws (9) and right rider footrest/brake pedal support bracket (10) from frame (12).

Installation

1. See [Figure 2-256](#). Mount right rider footrest/brake pedal support bracket (10) to frame (12) with two screws (9). Tighten to 45-50 ft-lbs (61-68 Nm).
2. Slide brake pedal (8) onto clevis (4). Mount clevis on right rider footrest/brake pedal support bracket. Line up hole in clevis with hole in support bracket. Secure with screw (11). Tighten to 96-156 **in-lbs** (10.9-17.6 Nm). Install **new** retaining ring (26) on end of clevis.
3. Install footrest (1) on clevis with spring washer (2). Make sure spring washer is positioned inside clevis with the square edge toward the inside. Align holes and push clevis pin (5) from top down through hole in clevis. Secure with **new** retaining ring (3).
4. Apply two drops of LOCTITE THREADLOCKER 243 (blue) to threads of both brake rod ball stud screws.
5. Thread one end of brake rod (7) into master cylinder bell crank (19). Tighten to 120-180 **in-lbs** (13.6-20.4 Nm).
6. Thread other end of brake rod into brake pedal. Tighten to 120-180 **in-lbs** (13.6-20.4 Nm).

7. Install front muffler. See [4.15 EXHAUST SYSTEM: XL MODELS](#).

LEFT FOOTREST AND SHIFT LEVER ASSEMBLY

Removal

1. See [Figure 2-256](#). Remove retaining ring (15), clevis pin (17), footrest (18) and spring washer (16). Discard retaining ring.
2. Remove two screws (14) and left rider footrest support bracket (13) from frame (12).
3. Remove screw (27) and shifter peg (25).
4. Remove pinch screw (22) and washer (23). Remove shift lever assembly (24) and rubber washer (21).

Installation

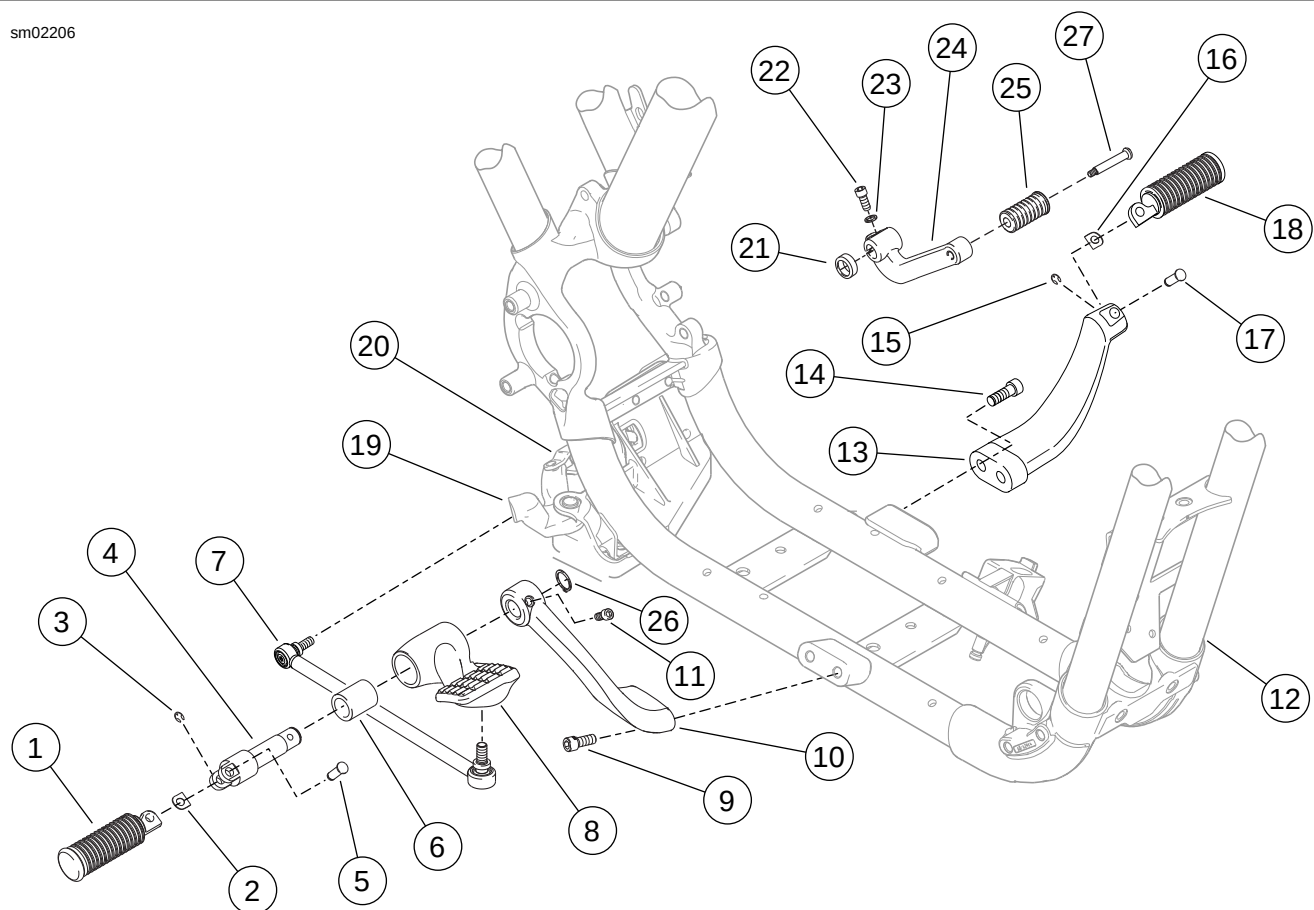
1. See [Figure 2-256](#). Install rubber washer (21) and shift lever (24) on transmission shift lever shaft. Secure with washer (23) and pinch screw (22). Tighten to 16-20 ft-lbs (21.7-27.1 Nm).
2. If re-using shifter peg screw (27), clean screw threads and apply one or two drops of LOCTITE THREADLOCKER 243 (blue) to threads.

NOTE

*The previous step is not necessary for a **new** shifter peg screw as it has a built-in lock patch.*

3. Install shifter peg (25) and secure with screw (27). Tighten screw to 96-144 **in-lbs** (10.9-16.3 Nm)
4. Attach rider footrest support bracket (13) to frame (12) with two screws (14). Tighten to 45-50 ft-lbs (61-68 Nm).
5. Install footrest (18) on footrest support bracket with spring washer (16). Make sure spring washer is positioned inside support bracket mounting boss with the square edge toward the inside. Align holes and push clevis pin (17) from top down through hole in support bracket. Secure with **new** retaining ring (15).

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- | | |
|--|---|
| 1. Footrest | 15. Retaining ring |
| 2. Spring washer | 16. Spring washer |
| 3. Retaining ring | 17. Clevis pin |
| 4. Rider footrest clevis | 18. Footrest |
| 5. Clevis pin | 19. Bell crank |
| 6. Bushing | 20. Rear brake master cylinder and bracket assembly |
| 7. Rear brake rod assembly | 21. Rubber washer |
| 8. Rear brake pedal | 22. Pinch screw |
| 9. Screw (2) | 23. Washer |
| 10. Right rider footrest/brake pedal support bracket | 24. Shift lever |
| 11. Screw | 25. Shifter peg |
| 12. Frame | 26. Retaining ring |
| 13. Left rider footrest support bracket | 27. Screw, shifter peg |
| 14. Screw (2) | |

Figure 2-256. Mid-Mount Controls: Rider Footrests/Foot Controls

RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS

2.41

RIGHT FOOTREST AND REAR BRAKE PEDAL ASSEMBLY

Removal

NOTE

*Right side access is improved by exhaust system removal.
See [4.15 EXHAUST SYSTEM: XL MODELS](#).*

1. See [Figure 2-257](#). Remove retaining ring (2), clevis pin (5), footrest (1) and spring washer (3). Discard retaining ring.
2. Remove brake rod (8) from brake pedal (7) and master cylinder bell crank (14).
3. Remove retaining ring (16), screw (11) and clevis (4). Slide brake pedal off clevis. Discard retaining ring.
4. Remove two screws (9), footrest/brake pedal support bracket (10) and j-clip (12) from frame (13).

Installation

1. See [Figure 2-257](#). Position j-clip (12) against frame as shown. Mount footrest/brake pedal support bracket (10)

and j-clip to frame (13) with screws (9). Tighten to 45-50 ft-lbs (61-68 Nm).

2. Slide brake pedal (7) onto clevis (4). Mount clevis on footrest/brake pedal support bracket. Line up hole in clevis with hole in support bracket. Secure with screw (11). Tighten to 96-156 **in-lbs** (10.9-17.6 Nm). Install **new** retaining ring (16) on end of clevis.
3. Install footrest (1) on clevis with spring washer (3). Make sure spring washer is positioned inside clevis with the square edge toward the inside. Align holes and push clevis pin (5) from top down through hole in clevis. Secure with **new** retaining ring (2).
4. Apply two drops of LOCTITE THREADLOCKER 243 (blue) to threads of both brake rod ball stud screws.
5. Thread one end of brake rod (8) into master cylinder bell crank (14). Tighten to 120-180 **in-lbs** (13.6-20.4 Nm).
6. Thread other end of brake rod into brake pedal. Tighten to 120-180 **in-lbs** (13.6-20.4 Nm).



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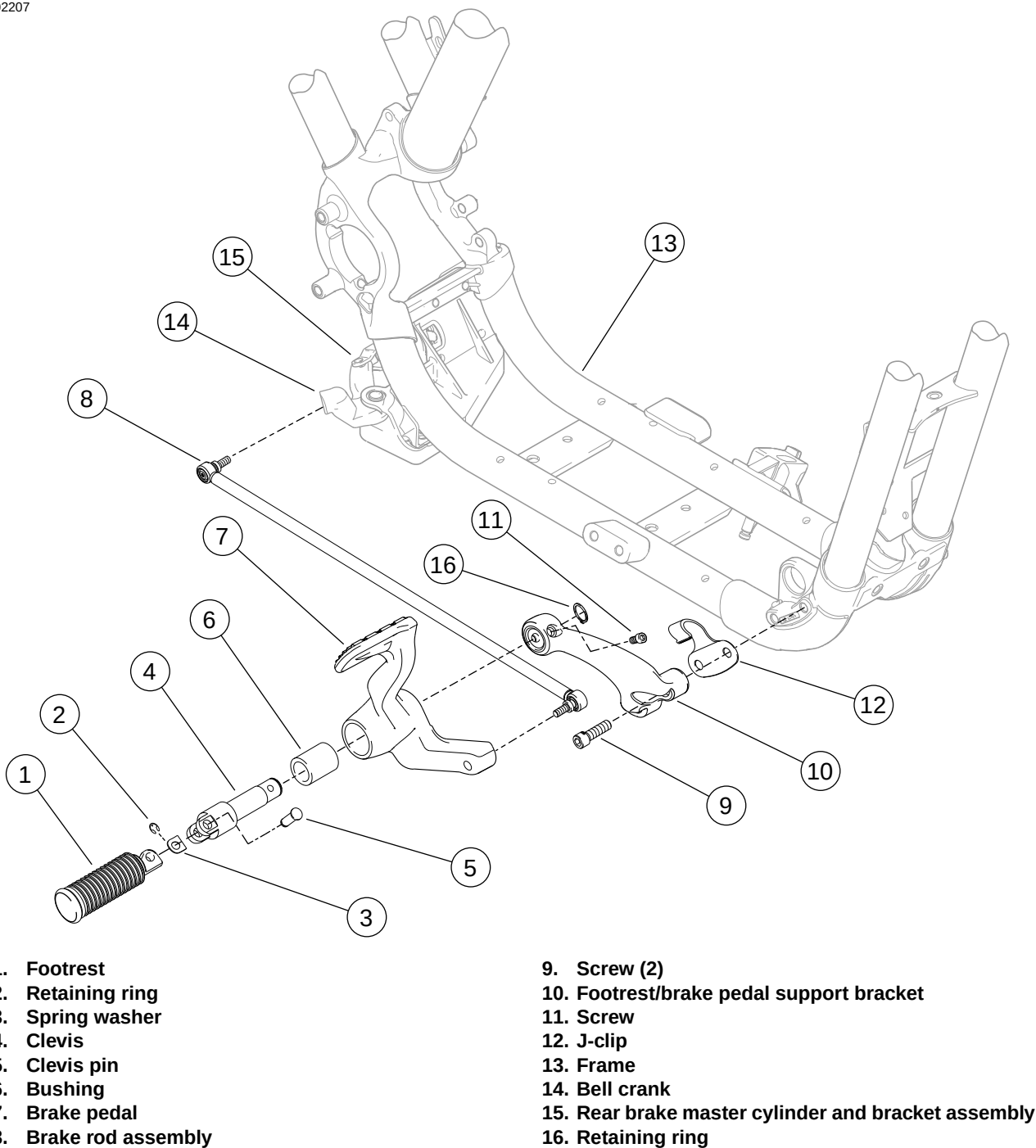


Figure 2-257. Forward Controls - Brake Side

LEFT FOOTREST AND SHIFT LEVER ASSEMBLY

Removal

- See [Figure 2-258](#). Remove retaining ring (13), clevis pin (17), footrest (16) and spring washer (15). Discard retaining ring.
- Remove screw (21) and shifter peg (18).
- Remove shifter rod assembly (4) from shifter lever assembly (12) and shift lever (3).
- Remove retaining ring (20), screw (10) and clevis (14). Slide shifter lever assembly off clevis. Discard retaining ring.
- Remove two screws (9), footrest/shifter lever support bracket (8) and j-clip (7) from frame.
- Remove pinch screw (1), washer (2), shift lever (3) and rubber washer (19) from transmission shift shaft.

Installation

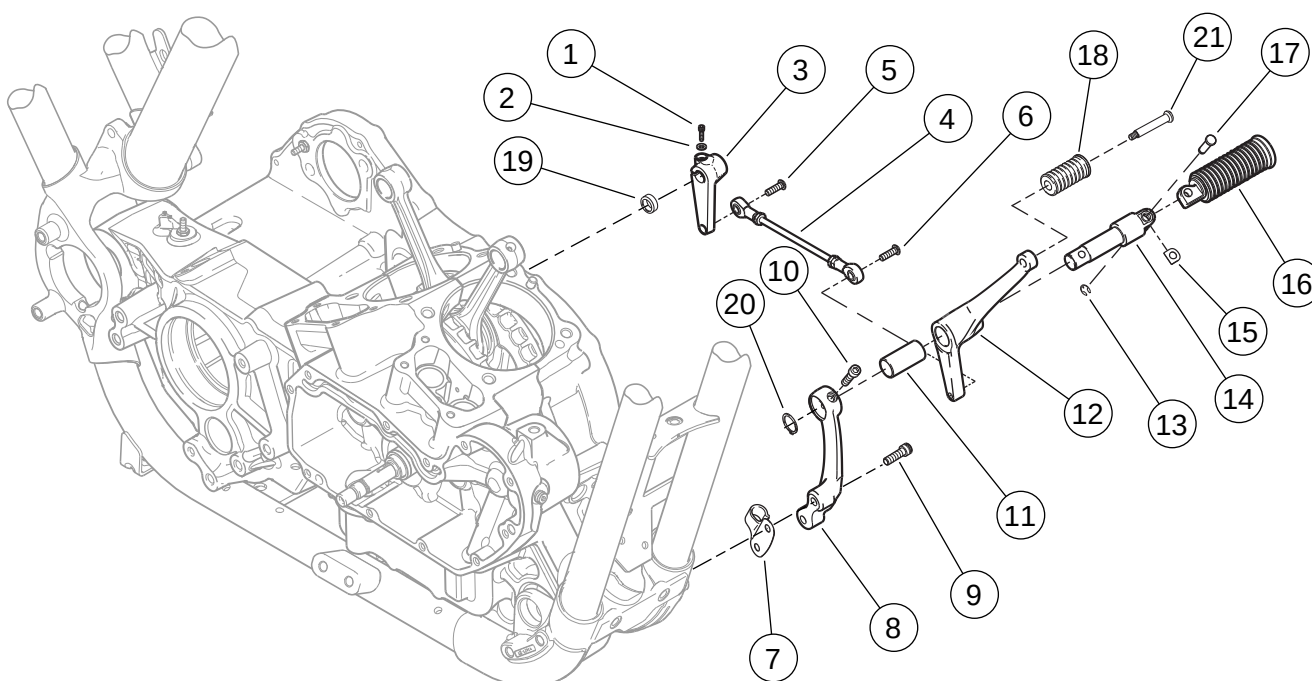
1. See [Figure 2-258](#). Install rubber washer (19) and shift lever (3) onto transmission shifter shaft, with shift lever arm pointing straight down. Secure with pinch screw (1) and washer (2). Tighten pinch screw to 16-20 ft-lbs (21.7-27.1 Nm).
2. Mount j-clip (7) and footrest/shifter lever support bracket (8) to frame with two screws (9). Tighten to 45-50 ft-lbs (61-68 Nm).
3. Slide shifter lever assembly (12) onto clevis (14). Mount clevis on footrest/shifter lever support bracket. Line up hole in clevis with hole in support bracket. Secure with screw (10). Tighten to 18-22 ft-lbs (24.4-29.9 Nm). Install retaining ring (20) on end of clevis.
4. Mount footrest (16) on clevis with spring washer (15). Make sure spring washer is positioned inside clevis with the square edge toward the inside. Align holes and push clevis pin (17) from top down through hole in clevis. Secure with **new** retaining ring (13).
5. Thread screw (5) in one end of shifter rod assembly (4) into shift lever (3). Tighten to 120-180 **in-lbs** (13.6-20.4 Nm).
6. Thread screw (6) in other end of shifter rod into shift lever assembly. Tighten to 120-180 **in-lbs** (13.6-20.4 Nm).
7. If re-using shifter peg screw (21), clean screw threads and apply one or two drops of LOCTITE THREADLOCKER 243 (blue) to threads.

NOTE

*The previous step is not necessary for a **new** shifter peg screw as it has a built-in lock patch.*

8. Install shifter peg (18) and secure with screw (21). Tighten screw to 96-144 **in-lbs** (10.9-16.3 Nm)

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- | | |
|---|----------------------------|
| 1. Pinch screw | 12. Shifter lever assembly |
| 2. Washer | 13. Retaining ring |
| 3. Shift lever | 14. Clevis |
| 4. Shifter rod assembly | 15. Spring washer |
| 5. Screw | 16. Footrest |
| 6. Screw | 17. Clevis pin |
| 7. J-clip | 18. Shifter peg |
| 8. Footrest/shifter lever support bracket | 19. Rubber washer |
| 9. Screw (2) | 20. Retaining ring |
| 10. Screw | 21. Screw, shifter peg |
| 11. Bushing | |

Figure 2-258. Forward Controls - Shifter Side

ADJUSTING SHIFT PEDAL

The foot shift linkage is set at the factory and normally should need no adjustment. However, if gears do not engage fully or toe shifter travel is incorrect, adjust linkage rod as follows.

See [Figure 2-259](#). Adjust shifter rod assembly (4) length until shifter lever assembly (5) is at 45° as shown in the figure:

1. Loosen lock nuts (3) on both ends of shifter rod.
2. Remove screw (1) securing ball joint (2) to shifter lever assembly.
3. Turn ball joint or shifter rod to adjust rod length. Temporarily attach ball joint to shifter lever assembly and check angle. Make sure an equal number of threads are visible on both ends of shifter rod.
4. When angle of shift lever assembly is at 45°, install screw (1). Tighten to 120-180 **in-lbs** (13.6-20.4 Nm).
5. Holding shifter rod so that it does not turn, tighten lock nuts on both ends.

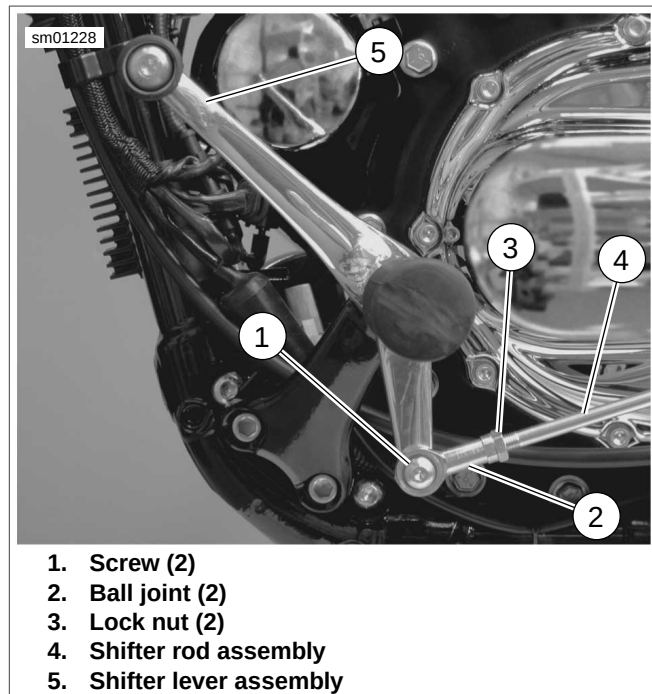


Figure 2-259. Adjusting Shift Pedal: Models with Forward Controls



RIDER FOOT CONTROLS: XR MODELS

2.42

RIGHT FOOTREST AND REAR BRAKE PEDAL ASSEMBLY

Removal

1. Remove exhaust system. See [4.16 EXHAUST SYSTEM: XR MODELS](#).
2. Remove clevis pin connecting master cylinder to brake pedal. See [2.14 REAR BRAKE MASTER CYLINDER: XR MODELS](#).
3. If necessary, remove wear peg (11).
4. See [Figure 2-260](#). Remove retaining ring (10) and washer (9). Discard retaining ring.
5. Remove clevis pin (5), spring (7), and footrest (8).
6. Remove bolt (3), footrest clevis (6), and brake pedal (4).
7. If necessary, remove bracket (1). The master cylinder must be disconnected from the bracket or brake line disconnected prior to removing the two fasteners (2). See [2.14 REAR BRAKE MASTER CYLINDER: XR MODELS](#).

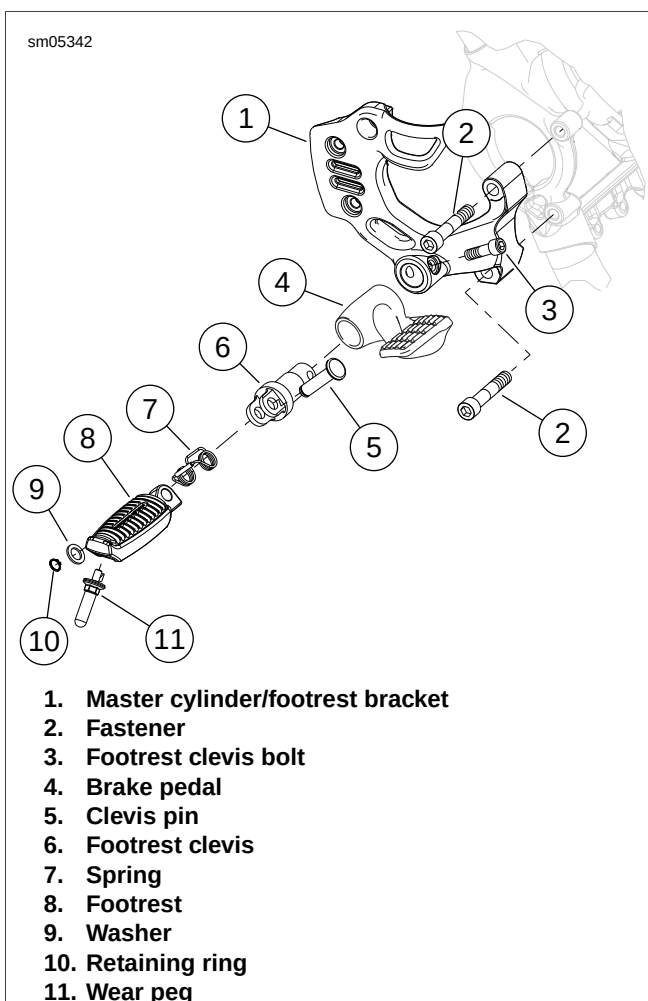


Figure 2-260. Rider Foot Control, Right Side: XR Models

Installation

1. If removed, install master cylinder/footrest bracket. See [2.14 REAR BRAKE MASTER CYLINDER: XR MODELS](#).
2. See [Figure 2-260](#). Install brake pedal on footrest clevis and install footrest clevis. Tighten bolt (3) to 20-24 ft-lbs (27.1-32.5 Nm).
3. Install footrest (8) and spring (7) on clevis and secure with clevis pin (5). Install washer (9) and **new** retaining ring (10).
4. If removed, install wear peg and tighten to 72-108 in-lbs (8.1-12.2 Nm).
5. Connect brake pedal to master cylinder. See [2.14 REAR BRAKE MASTER CYLINDER: XR MODELS](#).
6. Install exhaust system. See [4.16 EXHAUST SYSTEM: XR MODELS](#).

LEFT FOOTREST AND SHIFT LEVER ASSEMBLY

Removal

1. See [Figure 2-261](#). Remove fasteners (11) and remove linkage (12).
2. If necessary, remove wear peg (9).
3. Remove retaining ring (4) and washer (5). Discard retaining ring.
4. Remove clevis pin (10), spring (7), and footrest (8).
5. Remove bolt (3), footrest clevis (6), and foot shift lever (15).
6. Remove shifter peg (13).
7. If necessary, remove fasteners (2) and bracket (1).

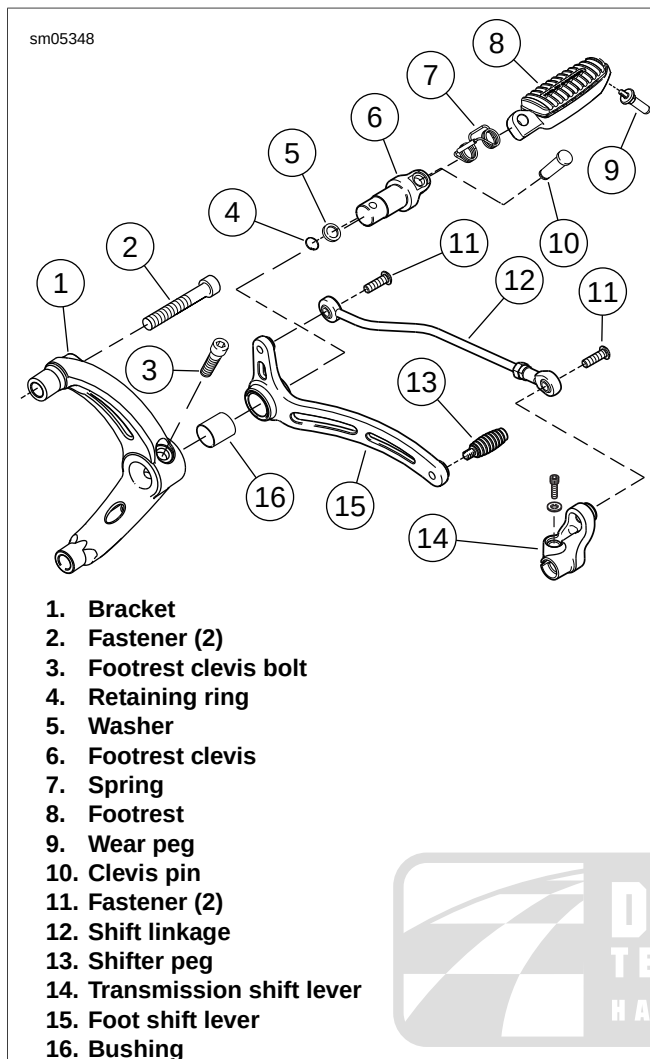


Figure 2-261. Rider Foot Control, Left Side: XR Models

Installation

1. See [Figure 2-261](#). If removed, install bracket (1). Tighten fasteners (2) to 45-50 ft-lbs (61.0-67.8 Nm).
2. Install foot shift lever on footrest clevis and install footrest clevis. Tighten bolt (3) to 20-24 ft-lbs (27.1-32.5 Nm).
3. Install footrest (8) and spring (7) on clevis and secure with clevis pin (10). Install washer (5) and **new** retaining ring (4).
4. Install shifter peg (13) and tighten to 96-144 **in-lbs** (10.9-16.3 Nm).

5. If removed, install wear peg and tighten to 72-108 **in-lbs** (8.1-12.2 Nm).
6. Connect linkage (12) between foot shift lever (15) and transmission shift lever (14) using fasteners (11). Tighten to 120-180 **in-lbs** (13.6-20.3 Nm).
7. Check shift linkage adjustment and adjust as necessary.

ADJUSTING SHIFT PEDAL

The foot shift linkage is set at the factory and normally should need no adjustment. However, if gears do not engage fully or toe shifter travel is incorrect, adjust linkage rod as follows.

See [Figure 2-262](#). Adjust shifter rod assembly (4) length until shifter lever assembly (5) is at approximately 20° from horizontal as shown in the figure.

1. Loosen jam nut (3) on front end of shifter rod.
2. Remove screw (1) securing ball joint (2) to shifter arm (6).
3. Turn ball joint in one direction or the other to adjust rod length as necessary. Temporarily attach ball joint to shifter arm and check angle.
4. when angle of shift lever assembly is at 20°, install screw (1). Tighten to 120-180 **in-lbs** (13.6-20.4 Nm).
5. Holding ball joint with a wrench on the flats, tighten jam nut.

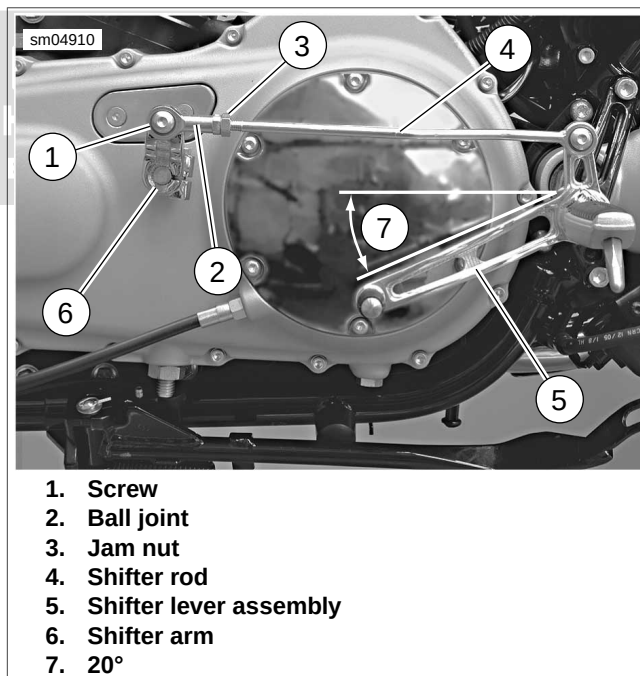


Figure 2-262. Adjusting Shift Pedal: XR Models

PASSENGER FOOTRESTS

2.43

GENERAL

Passenger footrest assemblies are standard equipment on certain models only.

XL MODELS

Removal

1. See [Figure 2-263](#). Remove retaining ring (1), clevis pin (2), footrest (3) and spring washer (4). Discard retaining ring.
2. Remove two screws (5) and footrest support bracket (6) from frame (7).

Installation

NOTE

See [Figure 2-263](#). On left side of vehicle, a B-clip (8) is positioned between footrest support bracket (6) and lower support bracket hole on frame (7). Make sure this clip is positioned between footrest support bracket and frame when attaching support bracket in the next step.

1. See [Figure 2-263](#). Attach footrest support bracket (6) to frame (7) with two screws (5). Tighten to 45-50 ft-lbs (61-68 Nm).
2. Install footrest (3) on footrest support bracket with spring washer (4). Make sure spring washer is positioned inside support bracket mounting boss with the square edge toward the inside.
3. Align holes and push clevis pin (2) from top down through hole in support bracket. Secure with **new** retaining ring (1).

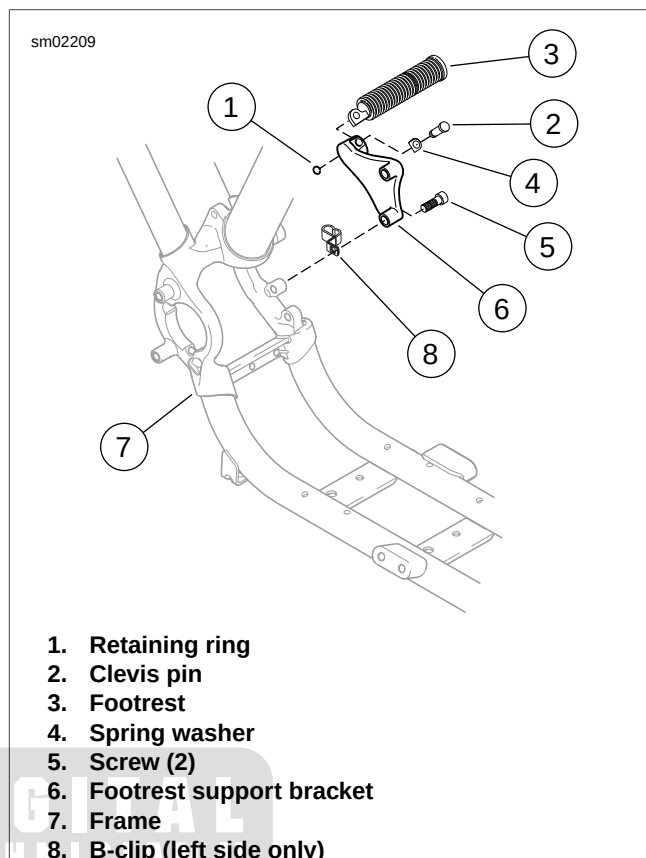


Figure 2-263. Passenger Footrest Assembly (Not Standard Equipment on Some Models)

XR MODELS

Removal

1. See [Figure 2-264](#). Remove retaining ring (1), clevis pin (2), footrest (3) and spring washer (4). Discard retaining ring.
2. On right side of vehicle, remove screw (8) securing muffler bracket (6) to footrest support bracket (7).
3. Remove two screws (5) and footrest support bracket from frame.

Installation

1. See [Figure 2-264](#). Attach footrest support bracket (7) to frame with two screws (5). Tighten to 45-50 ft-lbs (61-68 Nm)).
2. Attach muffler bracket (6) to footrest support bracket with screw (8). Tighten to 15-19 ft-lbs (20.4-25.8 Nm).
3. Install footrest (3) on footrest support bracket with spring washer (4). Make sure spring washer is positioned inside support bracket mounting boss with the square edge toward the inside.

4. Align holes in footrest and support bracket and push clevis pin (2) from top down through hole in support bracket. Secure with **new** retaining ring (1).

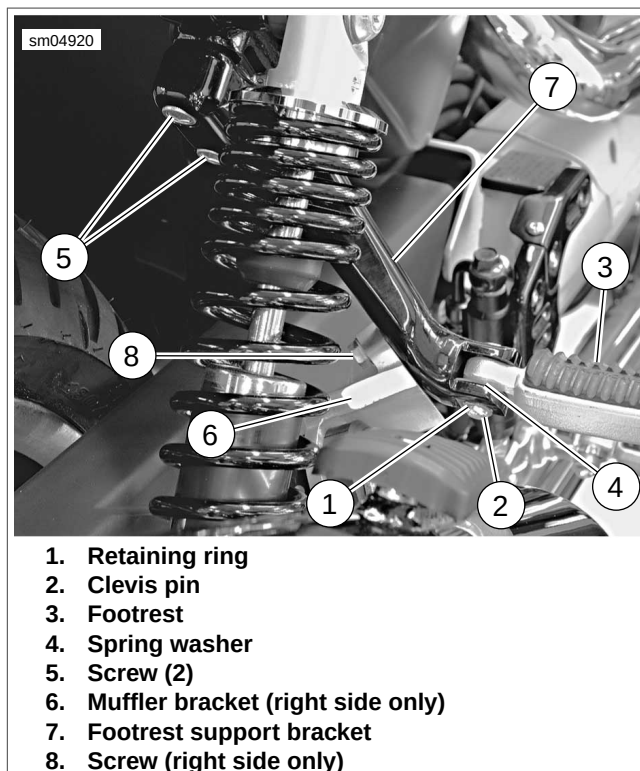


Figure 2-264. Passenger Footrest Assembly: XR Models
(Right Side Shown)



FORK LOCK

2.44

REMOVAL

⚠ WARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

1. Purge the fuel supply hose of high pressure gasoline. Disconnect fuel supply hose from fuel pump module. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

2. Unplug main fuse. See [6.38 MAIN FUSE](#).
3. Prepare vehicle for fork lock replacement.
 - a. **All models:** remove fuel tank. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#). Turn front forks fully to the left.
 - b. **XL 883C/XL 1200C models:** remove handlebar upper clamp/speedometer housing. See [2.32 HANDLEBARS](#). Secure handlebar assembly out of the way.
4. See [Figure 2-265](#). See [Figure 2-266](#). Using a 5/64 in. 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 slides off-center, removal of lock pin will be difficult.

5. See [Figure 2-267](#). To remove lock pin, insert a screw extractor into the 5/64 in. 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.
6. Remove lock assembly.



Figure 2-265. Fork Lock Pin



Figure 2-266. Drilling Lock Pin



Figure 2-267. Removing Lock Pin

INSTALLATION

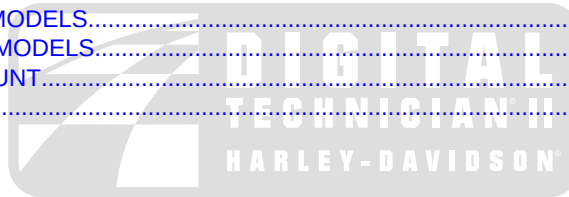
1. Insert **new** lock assembly in frame lock housing.
2. Align lock pin hole in **new** lock assembly with hole in the frame lock housing.
3. Drive **new** lock pin in position (flush with frame lock housing).

4. Reassemble motorcycle.
 - a. **XL 883C/XL 1200C models:** Install handlebar assembly and upper clamp/speedometer housing. See [2.32 HANDLEBARS](#).
 - b. **All models:** install fuel tank. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).
5. Verify proper operation of fork lock.
 - a. Turn front forks fully to the left.
 - b. Insert key into fork lock. Turn key 90 degrees clockwise.
 - c. Verify that front forks are locked and cannot be turned.
 - d. Turn key 90 degrees counterclockwise and remove from fork lock.
 - e. Verify that front forks are now free to fully turn right and left.
6. Plug in main fuse. See [6.38 MAIN FUSE](#).



TABLE OF CONTENTS

SUBJECT	PAGE NO.
3.1 FASTENER TORQUE VALUES.....	3-1
3.2 SPECIFICATIONS.....	3-5
3.3 ENGINE.....	3-11
3.4 OIL PRESSURE.....	3-12
3.5 CRANKCASE BREATHING SYSTEM: XL MODELS.....	3-15
3.6 CRANKCASE BREATHING SYSTEM: XR MODELS.....	3-16
3.7 TROUBLESHOOTING.....	3-18
3.8 ENGINE LUBRICATION SYSTEM.....	3-20
3.9 HOW TO USE THIS SECTION.....	3-29
3.10 TOP END SERVICE.....	3-30
3.11 BOTTOM END SERVICE.....	3-32
3.12 REMOVING ENGINE FROM CHASSIS.....	3-34
3.13 INSTALLING ENGINE IN CHASSIS.....	3-43
3.14 PRECISION COOLING SYSTEM: XR MODELS.....	3-48
3.15 TOP END OVERHAUL: DISASSEMBLY.....	3-53
3.16 TOP END OVERHAUL: ASSEMBLY.....	3-62
3.17 BOTTOM END OVERHAUL: DISASSEMBLY.....	3-73
3.18 BOTTOM END OVERHAUL: ASSEMBLY.....	3-78
3.19 VALVE TAPPETS.....	3-91
3.20 GEARCASE COVER AND CAM GEARS.....	3-92
3.21 CYLINDER HEAD.....	3-98
3.22 CYLINDER AND PISTON.....	3-114
3.23 CRANKCASE.....	3-122
3.24 OIL PUMP: XL MODELS.....	3-130
3.25 OIL PUMP: XR MODELS.....	3-133
3.26 OIL FILTER MOUNT.....	3-137
3.27 OIL TANK.....	3-138



NOTES



FASTENER TORQUE VALUES

3.1

FASTENER TORQUE VALUES IN THIS CHAPTER

The table below lists torque values for all fasteners presented in this chapter.

FASTENER	TORQUE VALUE		NOTES
Anti-rotation device mounting screw	80-110 in-lbs	9.0-12.4 Nm	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Tappets
Axle nut, rear	95-105 ft-lbs	129-142 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Axle nut, rear	95-105 ft-lbs	129-142 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Brake (rear) hose clamp-to-frame screw	30-40 in-lbs	3.4-4.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Brake rear master cylinder reservoir mounting screw	20-25 in-lbs	2.3-2.8 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Breather screw	35-55 in-lbs	4.0-6.2 Nm	3.16 TOP END OVERHAUL: ASSEMBLY, Rocker Covers
Crankcase fastener	15-19 ft-lbs	20.3-25.8 Nm	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Crankcase
Cylinder head bolts	96-120 in-lbs	11-14 Nm	3.16 TOP END OVERHAUL: ASSEMBLY, Cylinder Head/See procedure
Cylinder head bolts	13-15 ft-lbs	18-20 Nm	3.16 TOP END OVERHAUL: ASSEMBLY, Cylinder Head/See procedure
Cylinder head bolts	96-120 in-lbs	11-14 Nm	3.16 TOP END OVERHAUL: ASSEMBLY, Cylinder Head/See procedure
Cylinder head bolts	13-15 ft-lbs	18-20 Nm	3.16 TOP END OVERHAUL: ASSEMBLY, Cylinder Head/See procedure
Cylinder head bracket screw	17-24 ft-lbs	23.1-32.6 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Cylinder head bracket screw	17-24 ft-lbs	23.1-32.6 Nm	3.16 TOP END OVERHAUL: ASSEMBLY, Assembling Motorcycle After Top End Repair
Cylinder head oil feed flare fitting, Precision Cooling	22-26 ft-lbs	29.8-35.3 Nm	3.14 PRECISION COOLING SYSTEM: XR MODELS, Cylinder Head Oil Feed Assembly
Cylinder head oil feed line flare nut, Precision Cooling	13-17 ft-lbs	17.6-23.0 Nm	3.14 PRECISION COOLING SYSTEM: XR MODELS, Cylinder Head Oil Feed Assembly
Cylinder stud	120-240 in-lbs	13.6-27.1 Nm	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Crankcase
Exhaust pipe clamp bracket screw	30-33 ft-lbs	40.7-44.8 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Footrest bracket fastener	45-50 ft-lbs	61.0-67.8 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Footrest mount fastener	45-50 ft-lb	61.0-67.8 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Front cylinder oil line retainer nut	84-108 in-lbs	9.5-12.2 Nm	3.14 PRECISION COOLING SYSTEM: XR MODELS, Cylinder Head Oil Return Lines
Front engine mount bolt	60-70 ft-lbs	81.4-95.0 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Front engine mount bolt	60-70 ft-lbs	81.4-95.0 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models

FASTENER	TORQUE VALUE		NOTES
Fuel tank mounting screw	15-20 ft-lbs	20.4-27.1 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Fuel tank mounting screw	15-20 ft-lbs	20.4-27.1 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Fuel tank mounting screw	15-20 ft-lbs	20.4-27.1 Nm	3.16 TOP END OVERHAUL: ASSEMBLY, Assembling Motorcycle After Top End Repair
Gearcase/oil pump housing cover fastener	80-110 in-lbs	9.0-12.4 Nm	3.25 OIL PUMP: XR MODELS, Assembly
Gearcase and oil pump cover fastener	80-110 in-lbs	9.0-12.4 Nm	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Cam Gears and Gearcase Cover: XR Models
Gearcase cover fastener: XR models	80-110 in-lbs	9.0-12.4 Nm	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Cam Gears and Gearcase Cover: XR Models
Gearcase cover screw	80-110 in-lbs	9.0-12.4 Nm	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Cam Gears and Gearcase Cover: XL Models
Gearcase housing plug	108-156 in-lbs	12.2-17.6 Nm	3.25 OIL PUMP: XR MODELS, Assembly
High pressure feed hose fitting (to crankcase)	60-90 in-lbs	6.8-10.2 Nm	3.24 OIL PUMP: XL MODELS, Installation
High pressure feed hose fitting nut	85-105 in-lbs	9.6-11.8 Nm	3.24 OIL PUMP: XL MODELS, Installation
Ignition switch mounting screw	34-45 in-lbs	4.0-5.1 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Ignition switch mounting screw	34-45 in-lbs	4.0-5.1 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Induction module cover-to-cylinder head fastener	20-24 ft-lbs	27.1-32.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Induction module cover-to-induction module fastener	84-108 in-lbs	9.5-12.2 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Induction module cover-to-wire form fastener	84-108 in-lbs	9.5-12.2 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Inner rocker cover bolt, large	18-22 ft-lbs	24.4-29.8 Nm	3.16 TOP END OVERHAUL: ASSEMBLY, Rocker Covers
Inner rocker cover bolt, small	135-155 in-lbs	15.3-17.5 Nm	3.16 TOP END OVERHAUL: ASSEMBLY, Rocker Covers
Inner rocker cover screw	135-155 in-lbs	15.3-17.5 Nm	3.16 TOP END OVERHAUL: ASSEMBLY, Rocker Covers
Isolator mount screw, front	25-35 ft-lbs	33.9-47.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Isolator mount screw, front	25-35 ft-lbs	33.9-47.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Isolator mount screw, rear	25-35 ft-lbs	33.9-47.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Isolator mount screw, rear	25-35 ft-lbs	33.9-47.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Lower front retainer plate fastener	45-50 ft-lbs	61.0-67.8 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Lower shock absorber fastener	30-45 ft-lb	40.7-61.0 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Oil cooler fastener	36-60 in-lbs	4.1-6.8 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models/Apply Loctite Threadlocker 243 (blue)

FASTENER	TORQUE VALUE		NOTES
Oil cooler fastener	36-60 in-lbs	4.1-6.8 Nm	3.14 PRECISION COOLING SYSTEM: XR MODELS, Oil Cooler/Apply Loctite Threadlocker 243 (blue)
Oil deflector plate screw	25-35 in-lbs	2.8-3.9 Nm	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Crankcase
Oil filter adapter	96-144 in-lbs	10.9-16.3 Nm	3.26 OIL FILTER MOUNT, Assembly
Oil pressure indicator switch	50-70 in-lbs	5.6-7.9 Nm	3.26 OIL FILTER MOUNT, Assembly
Oil pump cover screws	70-80 in-lbs	7.9-9.0 Nm	3.24 OIL PUMP: XL MODELS, Assembly
Oil pump feed fitting	55-65 in-lbs	6.2-7.4 Nm	3.24 OIL PUMP: XL MODELS, Installation
Oil pump rotor cover screw: XR models	80-110 in-lbs	9.0-12.4 Nm	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Cam Gears and Gearcase Cover: XR Models
Oil pump rotor cover screw: XR models	80-110 in-lbs	9.0-12.4 Nm	3.25 OIL PUMP: XR MODELS, Assembly
Oil pump-to-crankcase screw	125-150 in-lbs	14.1-16.9 Nm	3.24 OIL PUMP: XL MODELS, Installation
Oil tank mounting screw	36-60 in-lbs	4.1-6.8 Nm	3.27 OIL TANK, Installation
Outer rocker cover screw	120-168 in-lbs	13.5-19.0 Nm	3.16 TOP END OVERHAUL: ASSEMBLY, Rocker Covers
Passenger footrest support bracket screw	45-50 ft-lbs	61-68 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Pinion shaft locking nut	19-21 ft-lbs	26-29 Nm	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Cam Gears and Gearcase Cover: XL Models
Pinion shaft locking nut	19-21 ft-lbs	26-29 Nm	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Cam Gears and Gearcase Cover: XR Models
Piston oil jet screw	25-35 in-lbs	2.8-4.0 Nm	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Crankcase
Precision cooling check valve housing fastener	84-108 in-lbs	9.5-12.2 Nm	3.14 PRECISION COOLING SYSTEM: XR MODELS, Cylinder Head Oil Feed Assembly
Precision cooling check valve housing fastener	84-108 in-lbs	9.5-12.2 Nm	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Cam Gears and Gearcase Cover: XR Models
Precision cooling check valve plug fitting	15-21 ft-lbs	20.3-28.5 Nm	3.14 PRECISION COOLING SYSTEM: XR MODELS, Cylinder Head Oil Feed Assembly
Push rod retainer screw	80-110 in-lbs	9.0-12.4 Nm	3.16 TOP END OVERHAUL: ASSEMBLY, Push Rods, Covers, and Retainers
Quick connect fitting	108-156 in-lbs	12.2-17.6 Nm	3.14 PRECISION COOLING SYSTEM: XR MODELS, Oil Pump Lines
Quick connect fitting, cylinder head return oil	108-156 in-lbs	12.2-17.6 Nm	3.14 PRECISION COOLING SYSTEM: XR MODELS, Cylinder Head Oil Return Lines
Rear fork pivot/engine mount bolt	60-70 ft-lbs	81.4-95.0 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Rear fork pivot/engine mount bolt	60-70 ft-lbs	81.4-95.0 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Rear rigid oil line retainer screw	84-108 in-lbs	9.5-12.2 Nm	3.14 PRECISION COOLING SYSTEM: XR MODELS, Cylinder Head Oil Return Lines
Rear rigid oil line retainer screw	84-108 in-lbs	9.5-12.2 Nm	3.14 PRECISION COOLING SYSTEM: XR MODELS, Oil Pump Lines
Rear stop light switch bracket screw	72-120 in-lbs	8.1-13.6 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Return oil manifold screw	84-108 in-lbs	9.5-12.2 Nm	3.14 PRECISION COOLING SYSTEM: XR MODELS, Return Oil Manifold

FASTENER	TORQUE VALUE		NOTES
Shift linkage pivot bolt	10-15 ft-lbs	13.6-20.3 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Siren/canister bracket; rear brake line fastener	17-22 ft-lbs	23.0-29.8 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Sprocket cover fastener, large: XR models	30-33 ft-lbs	40.7-44.8 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Sprocket cover fastener, small: XR models	80-120 in-lbs	9.0-13.6 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Sprocket cover screw	80-120 in-lbs	9.0-13.6 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Stabilizer link (lower front) frame bracket mounting screw	25-35 ft-lbs	33.9-47.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Stabilizer link (lower front) frame bracket mounting screw	25-35 ft-lbs	33.9-47.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Stabilizer link (lower front) frame bracket mounting screw	25-35 ft-lbs	33.9-47.5 Nm	3.16 TOP END OVERHAUL: ASSEMBLY, Assembling Motorcycle After Top End Repair
Stabilizer link (upper front) frame bracket mounting screw	25-35 ft-lbs	33.9-47.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Stabilizer link (upper front) frame bracket mounting screw	25-35 ft-lbs	33.9-47.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Stabilizer link (upper front) frame bracket mounting screw	25-35 ft-lbs	33.9-47.5 Nm	3.16 TOP END OVERHAUL: ASSEMBLY, Assembling Motorcycle After Top End Repair
Stabilizer link bracket to front head screws and lock washers	55-65 ft-lbs	74.6-88.2 Nm	3.21 CYLINDER HEAD, Assembly
Stabilizer link screw	25-35 ft-lbs	33.9-47.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Stabilizer link screw	25-35 ft-lbs	33.9-47.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Stabilizer link screw	25-35 ft-lbs	33.9-47.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Stabilizer link screw	25-35 ft-lbs	33.9-47.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Stabilizer link screw	25-35 ft-lbs	33.9-47.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Stabilizer link screw	25-35 ft-lbs	33.9-47.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models

SPECIFICATIONS

3.2

SPECIFICATIONS: 2009 SPORTSTER MODELS

measurements exceed values listed in the SERVICE WEAR LIMITS columns.

Service wear limits are given as a guideline for measuring components that are not new. Replace components when their

Table 3-1. Engine: 2009 Sportster Models

ITEM	XL 883 MODELS		XL 1200 MODELS		XR 1200 MODEL	
Number of cylinders	2					
Type	4-cycle, 45 degree, V-Type, air cooled					
Compression ratio	8.9-1		9.7-1		10.0-1	
Bore	3.000 in.	76.20 mm	3.500 in.	88.90 mm	3.500 in.	88.90 mm
Stroke	3.812 in.	96.82 mm	3.812 in.	96.82 mm	3.812 in.	96.82 mm
Displacement	53.89 cu. in.	883.10 cu. cm	73.40 cu. in.	1202.81 cu. cm	73.40 cu. in.	1202.81 cu. cm
Torque (North America)	55.00 ft-lbs @ 3500 RPM	74.58 Nm @ 3500 RPM	79.00 ft-lbs @ 4000 RPM	107.12 Nm @ 4000 RPM	N/A	N/A
Torque (World)	53.00 ft-lbs @ 4500 RPM	71.87 Nm @ 4500 RPM	75.00 ft-lbs @ 3500 RPM	101.70 Nm @ 3500 RPM	73.60 ft-lbs @ 4000 RPM	99.80 Nm @ 4000 RPM
Torque (Japan)	48.00 ft-lbs @ 3500 RPM	65.09 Nm @ 3500 RPM	66.00 ft-lbs @ 3500 RPM	89.50 Nm @ 3500 RPM	68.10 ft-lbs @ 3500 RPM	92.34 Nm @ 3500 RPM



Table 3-2. Cylinder Heads-883 cc/1200 cc

ITEM	NEW COMPONENTS		SERVICE WEAR LIMITS	
Valve guide in head (tight)	0.0033-0.0020 in.	0.084-0.051 mm	-	-
Valve seat in head	0.0035-0.0010 in.	0.089-0.025 mm	-	-
Head gasket surface (flatness)	0.006 in.	0.152 mm	Replace if more than 0.006 in.	Replace if more than 0.152 mm

Table 3-3. Rocker Arms and Shafts-883 cc/1200 cc

ITEM	NEW COMPONENTS		SERVICE WEAR LIMITS	
Shaft in bushing (loose)	0.0005-0.0020 in.	0.013-0.051 mm	0.0035 in.	0.0889 mm
End clearance	0.003-0.013 in.	0.08-0.33 mm	0.025 in.	0.635 mm
Bushing fit in rocker arm	0.004-0.002 in.	0.10-0.05 mm	-	-
Shaft fit in rocker cover	0.0007-0.0022 in.	0.018-0.056 mm	0.0035 in.	0.0889 mm

Table 3-4. Valves-883 cc/1200 cc

ITEM	NEW COMPONENTS		SERVICE WEAR LIMITS	
Fit in guide (intake/exhaust)	0.001-0.003 in.	0.0254-0.0762 mm	0.0038 in.	0.0965 mm
Seat width	0.040-0.062 in.	1.02-1.57 mm	0.090 in.	2.286 mm
Stem protrusion from cylinder valve pocket	2.028-2.064 in.	51.511-52.426 mm	2.082 in.	52.883 mm

Table 3-5. Valve Springs (Intake/Exhaust)-883 cc/1200 cc

ITEM	NEW COMPONENTS		SERVICE WEAR LIMITS	
Closed	135 lbs @ 1.850 in.	61.2 kg @ 47.0 mm	-	-
Open	312 lbs @ 1.300 in.	141.5 kg @ 33.0 mm	-	-
Free length	2.325 in.	59.1 mm	2.325 in. (min)	59.1 mm (min)

Table 3-6. Tappets-883 cc/1200 cc

ITEM	NEW COMPONENTS		SERVICE WEAR LIMITS	
Fit in guide	0.0008-0.0023 in.	0.020-0.058 mm	0.003 in.	0.0762 mm
Roller fit	0.0006-0.0013 in.	0.015-0.033 mm	-	-
Roller end clearance	0.008-0.022 in.	0.203-0.559 mm	0.026 in.	0.660 mm

Table 3-7. Cylinder Bore-883 cc

BORE DIAMETER	NEW COMPONENTS		SERVICE WEAR LIMITS	
Standard +/-0.0002 in. (0.0051 mm)	3.0005 in.	76.213 mm	3.0035 in.	76.289 mm
0.005 in. O.S. (oversize) +/-0.0002 in. (0.0051 mm)	3.0048 in.	76.323 mm	3.0078 in.	76.398 mm
0.010 in. O.S. +/-0.0002 in. (0.0051 mm)	3.0098 in.	76.449 mm	3.0128 in.	76.525 mm
0.020 in. O.S. +/-0.0002 in. (0.0051 mm)	3.0198 in.	76.703 mm	3.0228 in.	76.779 mm
Taper	-	-	0.002 in.	0.0508 mm
Out of round	-	-	0.003 in.	0.0762 mm
Top gasket surface warpage	-	-	0.006 in.	0.152 mm
Base gasket surface warpage	-	-	0.008 in.	0.203 mm

Table 3-8. Cylinder Bore-1200 cc

BORE DIAMETER	NEW COMPONENTS		SERVICE WEAR LIMITS	
Standard +/-0.0002 in. (0.0051 mm)	3.4978 in.	88.844 mm	3.5008 in.	88.920 mm
0.005 in. O.S. (oversize) +/-0.0002 in. (0.0051 mm)	3.502 in.	88.95 mm	3.505 in.	89.027 mm
0.010 in. O.S. +/-0.0002 in. (0.0051 mm)	3.507 in.	89.08 mm	3.510 in.	89.154 mm
0.020 in. O.S. +/-0.0002 in. (0.0051 mm)	3.517 in.	89.33 mm	3.520 in.	89.408 mm
Taper	-	-	0.002 in.	0.0508 mm
Out of round	-	-	0.003 in.	0.0762 mm
Top gasket surface warpage	-	-	0.006 in.	0.152 mm
Base gasket surface warpage	-	-	0.008 in.	0.203 mm
XR Models: Oversized pistons are not available. Replace piston and/or cylinder as needed.				

Table 3-9. Pistons-883 cc

ITEM	NEW COMPONENTS		SERVICE WEAR LIMITS	
Compression ring gap (top and 2nd)	0.010-0.023 in.	0.25-0.58 mm	0.032 in.	0.813 mm
Oil control ring rail gap	0.010-0.053 in.	0.25-1.35 mm	0.065 in.	1.651 mm
Top compression ring side clearance	0.0020-0.0045 in.	0.051-0.114 mm	0.0065 in.	0.165 mm
2nd compression ring side clearance	0.0020-0.0045 in.	0.051-0.114 mm	0.0065 in.	0.165 mm
Oil control ring side clearance	0.0014-0.0074 in.	0.036-0.188 mm	0.0094 in.	0.239 mm
Piston pin fit (loose; room temperature)	0.00005-0.00045 in.	0.0013-0.0114 mm	-	-
Piston fit in cylinder (loose; room temperature)	0.0015-0.0026 in.	0.038-0.066	0.0030 in.	0.076 mm

Table 3-10. Pistons-1200 cc

ITEM	NEW COMPONENTS		SERVICE WEAR LIMITS	
Compression ring gap (top and 2nd)	0.007-0.020 in.	0.18-0.51 mm	0.032 in.	0.813 mm
Oil control ring rail gap	0.009-0.052 in.	0.23-1.32 mm	0.065 in.	1.651 mm
Top compression ring side clearance	0.0020-0.0045 in.	0.051-0.114 mm	0.0065 in.	0.165 mm
2nd compression ring side clearance	0.0016-0.0041 in.	0.041-0.104 mm	0.0065 in.	0.165 mm

Table 3-10. Pistons-1200 cc

ITEM	NEW COMPONENTS		SERVICE WEAR LIMITS	
Oil control ring side clearance	0.0016-0.0076 in.	0.041-0.193 mm	0.0094 in.	0.239 mm
Piston pin fit (loose; room temperature)	0.00005-0.00045 in.	0.0013-0.0114 mm	-	-
Piston fit in cylinder (loose; room temperature)	0.0015-0.0026 in.	0.038-0.066	0.0030 in.	0.076 mm

Table 3-11. Connecting Rods-883 cc/1200 cc

ITEM	NEW COMPONENTS		SERVICE WEAR LIMITS	
Piston pin fit (loose)	0.00125-0.00175 in.	0.0318-0.0445 mm	0.00200 in.	0.0508 mm
Side play between flywheels	0.005-0.025 in.	0.013-0.64 mm	0.030 in.	0.762 mm
Fit on crankpin	0.0004-0.0017 in.	0.010-0.043 mm	0.0027 in.	0.0686 mm

Table 3-12. Flywheels-883 cc/1200 cc

ITEM	NEW COMPONENTS		SERVICE WEAR LIMITS	
Runout (flywheels at rim)	0.000-0.010 in.	0.00-0.254 mm	0.010 in.	0.254 mm
Runout (shaft at flywheel end)	0.000-0.002 in.	0.00-0.0508 mm	0.002 in.	0.0508 mm
End play	0.003-0.013 in.	0.076-0.330 mm	0.013 in.	0.330 mm

Table 3-13. Pinion Shaft Bearing-883 cc/1200 cc

ITEM	NEW COMPONENTS		SERVICE WEAR LIMITS	
Pinion shaft journal diameter	1.2500-1.2496 in.	31.750-31.740 mm	1.2494 in.	31.735 mm
Outer race diameter in right crankcase	1.5646-1.5652 in.	39.741-39.756 mm	1.5672 in.	39.807 mm
Bearing running clearance	0.00012-0.00088 in.	0.0030-0.0224 mm	-	-
Fit in cover bushing (loose)	0.0023-0.0043 in.	0.058-0.109 mm	0.0050 in.	0.127 mm

Table 3-14. Gearcase-883 cc/1200 cc

ITEM	NEW COMPONENTS		SERVICE WEAR LIMITS	
Cam gear shaft in bushing (loose)	0.0007-0.0022 in.	0.018-0.056 mm	0.003 in.	0.0762 mm
Cam gear shaft endplay (except rear intake) (min.)	0.005-0.024 in.	0.13-0.61 mm	0.025 in.	0.635 mm
Rear intake cam gear shaft end play (min.)	0.006-0.024 in.	0.15-0.61 mm	0.040 in.	1.016 mm

Table 3-15. Oil Pump-883 cc/1200 cc

ITEM	NEW COMPONENTS		SERVICE WEAR LIMITS	
Feed/scavenger inner/outer gerotor clearance	0.003 in.	0.08 mm	0.004 in.	0.102 mm
Shaft to pump clearance	0.0025 in.	0.064 mm	-	-

Table 3-16. Sprocket Shaft Bearing-883 cc/1200 cc

ITEM	SPECIFICATION (INTERFERENCE FIT)	
Outer race fit in crankcase (tight)	0.006 in.	0.152 mm
Inner race fit on shaft (tight)	0.006 in.	0.152 mm

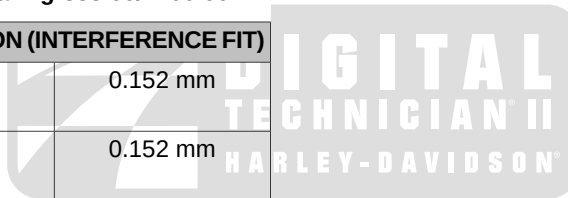


Table 3-17. Oil Pressure

ENGINE RPM	PRESSURE	
	XL Models	XR Models
1000	7-12 PSI (43.3-82.7 kPa)	16-20 PSI (110.3-137.9 kPa)
2500	10-17 PSI (68.9-117 kPa)	40-44 PSI (275.8-303.4 kPa)
XL Models: Oil pressure at normal operating temperature (pressure reading taken at oil pressure switch fitting)		
XR Models: Oil pressure at normal operating temperature (pressure reading taken at oil cooler inlet)		

Table 3-18. Ignition System: 2009 Sportster XL Models

COMPONENT	SPECIFICATION	
Ignition timing	not adjustable	
Battery	12 volt, 12 amp/hr, sealed and maintenance free	
Spark plug type	HD-6R12	
Spark plug size	12 mm	
Spark plug gap	0.038-0.043 in.	0.97-1.09 mm
Spark plug torque	12-18 ft-lbs	16.3-24.4 Nm

Table 3-19. Ignition System: 2009 Sportster XR 1200 Model

COMPONENT	SPECIFICATION	
Ignition timing	not adjustable	
Battery	12 volt, 12 amp/hr, sealed and maintenance free	
Spark plug type	10R12X	
Spark plug size	12 mm	
Spark plug gap	0.032-0.038 in.	0.81-0.97 mm
Spark plug torque	12-18 ft-lbs	16.3-24.4 Nm



ENGINE

3.3

GENERAL

The 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 Control Module (ECM), ignition coil, and spark plugs. Spark timing is determined primarily by crankshaft rotation, triggering a magnetic sensing unit.

Each spark plug fires independently at the end of that cylinder's compression stroke, igniting the air/fuel mixture in the cylinder.

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. Piston jets spray oil on the underside of the pistons to cool the piston crown and skirt area.

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 [3.8 ENGINE LUBRICATION SYSTEM](#) later in this section for further information.



OIL PRESSURE

3.4

GENERAL

XL Models: The oil pump is non regulatory and delivers its entire volume of oil under pressure to the oil filter mount.

XR Models: The feed oil pump incorporates a bypass valve that will open at approximately 50 psi (345 kPa), preventing overpressure in the oil cooler and related components. The XR Models also incorporate a thermostat in the oil cooler return path, and can have an effect on measured oil pressure.

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 pump rotors rotate faster, increasing the volume of oil circulated through the oiling system, resulting in higher oil pressure. As engine speed is reduced, the volume of oil pumped is also reduced, resulting in lower oil pressure.

Oil Pressure Indicator Lamp

See [Figure 3-1](#). The red OIL PRESSURE indicator lamp illuminates to indicate improper circulation of the engine oil.

Refer to [Table 3-20](#). The oil pressure indicator lamp 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 indicator lamp turns OFF when oil is circulating with adequate pressure through the engine running at 1000 RPM or greater.

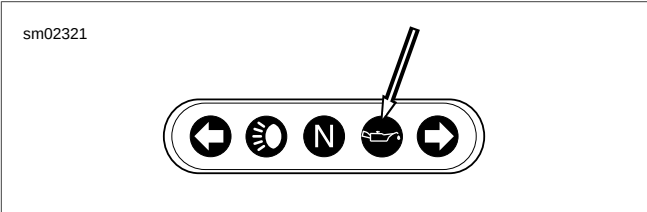


Figure 3-1. Oil Pressure Indicator Lamp

CAUTION

If the oil pressure indicator lamp remains lit, always check the oil supply first. If the oil supply is normal and the lamp is still lit, stop the engine at once and do not ride further until the trouble is located and the necessary repairs are made. Failure to do so may result in engine damage. (00157a)

NOTE

If the ignition is turned back on immediately after the engine is stopped, the oil pressure indicator lamp may not turn on right away because of oil pressure retained in the filter housing.

Table 3-20. Oil Lamp Troubleshooting

OIL PRESSURE INDICATOR LAMP	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 pressure switch wire. • Malfunctioning oil pressure switch. • Diluted oil. • Malfunctioning check valve. • See 3.26 OIL FILTER MOUNT and 3.14 PRECISION COOLING SYSTEM: XR MODELS, Cylinder Head Oil Feed Assembly • Malfunctioning or improperly installed pressure relief valve.
Flickers at idle.	• Incorrect idle speed. Malfunctioning or improperly installed check valve. • See 3.26 OIL FILTER MOUNT and 3.14 PRECISION COOLING SYSTEM: XR MODELS, Cylinder Head Oil Feed Assembly • Malfunctioning or improperly installed pressure relief valve.
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 before this table.

CHECKING OIL PRESSURE

PART NUMBER	TOOL NAME
HD-48386	OIL PRESSURE SENDING UNIT WRENCH
HD-96921-125	OIL PRESSURE GAUGE ADAPTER
HD-96921-52D	OIL PRESSURE TEST GAUGE KIT
HD-96925-58	OIL PRESSURE GAUGE ADAPTER

Check operating oil pressure as follows:

1. Fill oil tank to proper level. See [1.6 ENGINE OIL AND FILTER](#).
2. Place a container under vehicle to catch any oil that may leak out.
3. Obtain OIL PRESSURE TEST GAUGE KIT (Part No. HD-96921-52D).

Connecting Gauge: XL Models

1. Remove voltage regulator DC output connector and neutral switch wiring harness from voltage regulator caddy. Remove caddy. See [6.32 MAIN WIRING HARNESS](#).
2. See [Figure 3-2](#). Unplug connector [120] (3) from oil pressure indicator lamp switch (2) located under oil filter (1) by pulling elbow connector straight down from stud on oil pressure switch.
3. Using OIL PRESSURE SENDING UNIT WRENCH (Part No. HD-48386), remove oil pressure switch.
4. See [Figure 3-3](#). Install OIL PRESSURE GAUGE ADAPTER (Part No. HD-96925-58) (2) in oil pressure indicator lamp switch mounting hole. Tighten adapter snugly. DO NOT OVERTIGHTEN.

Connecting Gauge: XR Models

1. See [Figure 3-5](#). Disconnect the quick connect fitting from the inlet side of the oil cooler (4). See [3.14 PRECISION COOLING SYSTEM: XR MODELS, General](#).
2. Connect OIL PRESSURE GAUGE ADAPTER (Part No. HD-96921-125) (5) to the oil hose (6).
3. Connect the other end of the adapter to the oil cooler fitting (4).

Testing Pressure

1. See [Figure 3-4](#) or [Figure 3-5](#). Assemble banjo bolt (2), washer (3), OIL PRESSURE GAUGE banjo fitting (1) and second washer onto adapter and tighten snugly.

NOTE

For an accurate reading, engine oil should be at normal operating temperature: 230°F (110°C).

2. Temporarily secure oil pressure gauge and hose to motorcycle frame with cable straps. Make sure gauge and hose assembly do not interfere with normal operation of the vehicle. Start engine and ride motorcycle at least 20 miles (32 km) at or above 50 mph (80 km/h) to allow engine to reach operating temperature.
3. Check and record the pressure readings at normal idle (approximately 1000 RPM) and again at 2500 RPM.

Compare the readings with the specifications in [Table 3-21](#).

Table 3-21. Oil Pressure

ENGINE RPM	PRESSURE	
	XL Models	XR Models
1000	7-12 PSI (43.3-82.7 kPa)	16-20 PSI (110.3-137.9 kPa)
2500	10-17 PSI (68.9-117 kPa)	40-44 PSI (275.8-303.4 kPa)
XL Models: Oil pressure at normal operating temperature (pressure reading taken at oil pressure switch fitting)		
XR Models: Oil pressure at normal operating temperature (pressure reading taken at oil cooler inlet)		

Removing Gauge: XL Models

1. Stop engine. Remove OIL PRESSURE GAUGE assembly from oil pressure indicator lamp switch mounting hole in crankcase. Cut cable straps securing gauge and hose. Remove banjo bolt, gauge assembly, washers and adapter from vehicle.
2. See [Figure 3-2](#). Coat threads of oil pressure switch (2) with LOCTITE 565 HIGH PERFORMANCE PIPE SEALANT with TEFLON. Reinstall oil pressure switch. Using OIL PRESSURE SENDING UNIT WRENCH, tighten switch snugly. DO NOT OVERTIGHTEN.
3. Plug in connector [120] (3) by pushing elbow connector straight up onto stud on oil pressure switch.
4. Install voltage regulator caddy and attach DC output connector and neutral switch wiring harness to caddy. See [6.32 MAIN WIRING HARNESS](#).

Removing Gauge: XR Models

1. Stop engine. Cut cable straps securing gauge and hose. Remove banjo bolt, gauge assembly, washers and adapter from vehicle.
2. Connect oil hose to oil cooler fitting, making sure it is securely latched.

Finalize Test

NOTE

If an appreciable amount of oil leaked out when oil pressure switch was removed, it will have to be replaced with fresh oil.

1. Check oil level in oil tank. See [1.6 ENGINE OIL AND FILTER](#). Top off oil level if necessary.
2. Start engine and test oil pressure switch for proper operation. Check for oil leaks.

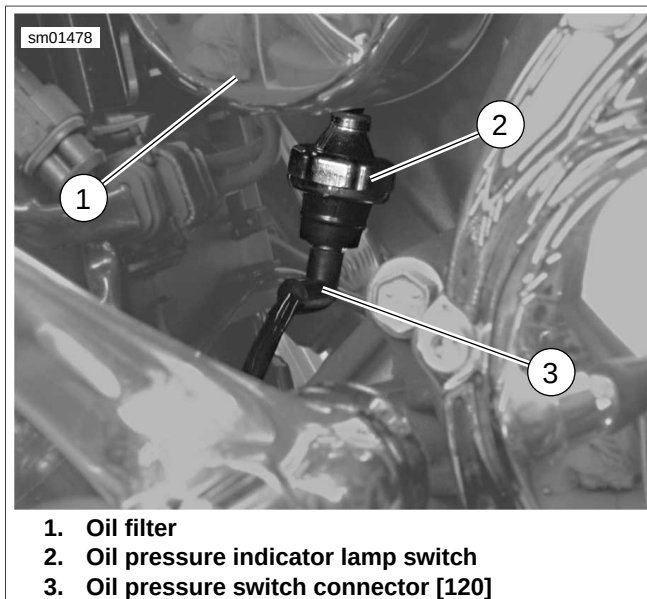


Figure 3-2. Oil Pressure Indicator Lamp Switch

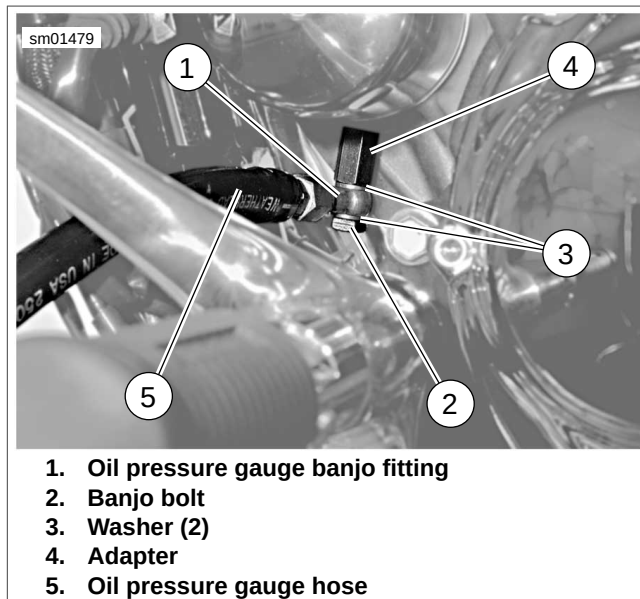


Figure 3-4. Oil Pressure Test Connections: XL Models

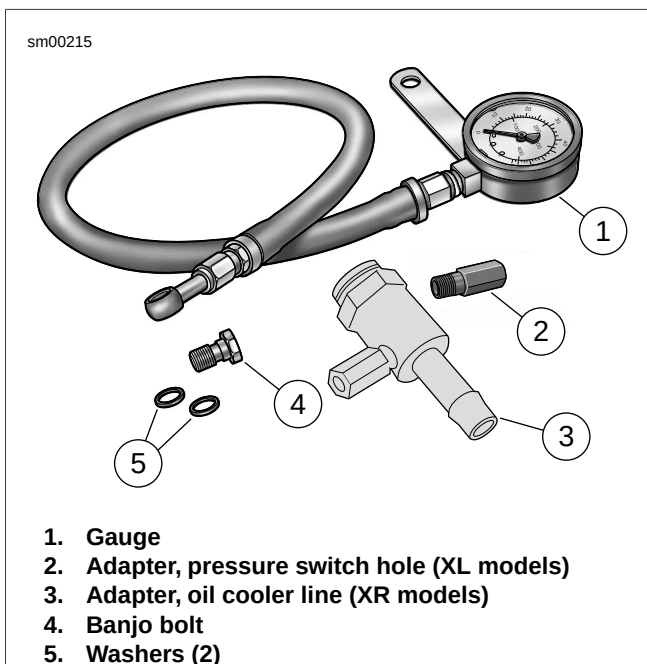


Figure 3-3. Oil Pressure Test Gauge Set

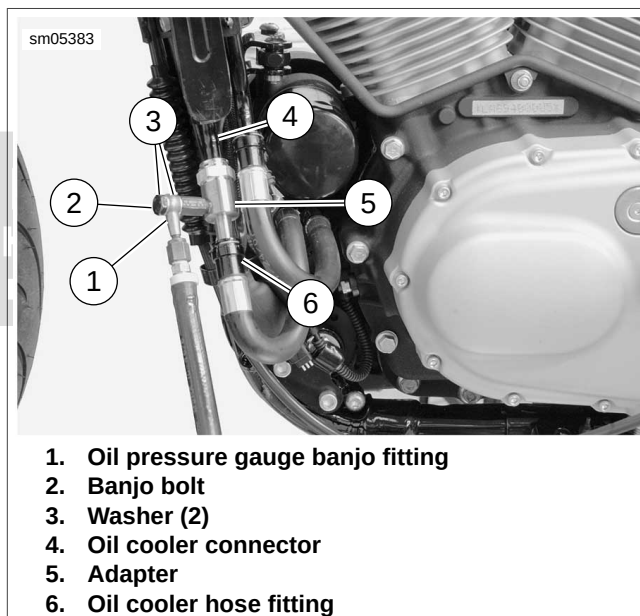


Figure 3-5. Oil Pressure Test Connections: XR Models

CRANKCASE BREATHING SYSTEM: XL MODELS

3.5

GENERAL

See [Figure 3-6](#). On the piston downstroke, a mixture of crankcase air and oil mist is vented up the push rod covers (1) through a breather valve (2) in each inner rocker box section.

The oil mist separates from the crankcase air, collects and passes through a small drain hole adjacent to the exhaust valve in the head 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 (3) into the filtered side of the air cleaner.

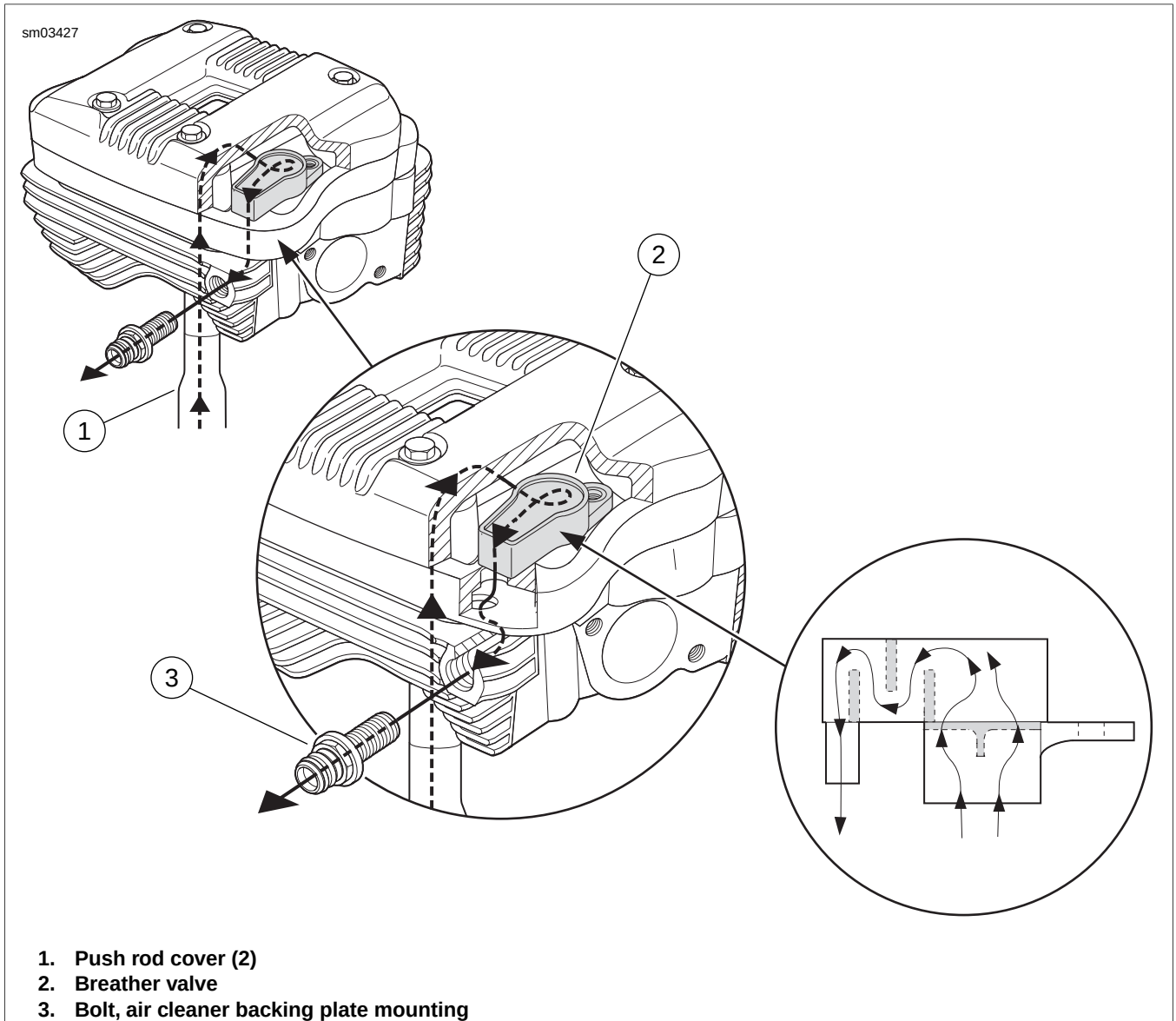


Figure 3-6. Crankcase Breathing System: XL Models

CRANKCASE BREATHING SYSTEM: XR MODELS

3.6

GENERAL

During engine operation, internal crankcase pressure increases due to the reciprocating components and also any combustion gas that passes by the piston rings. Along with increased pressures, a mixture of air and oil mist develops in the crankcase. The Crankcase Breathing System will vent the pressure and separate the air from the oil. The following description is for one cylinder however, each cylinder is equipped the same.

See [Figure 3-7](#). During the piston downstroke, internal crankcase pressure increases, forcing a vapor (9) of crankcase air and oil mist into the area around the rocker arms and valve springs. The vapor travels down through two passages (6) in the inner rocker cover into a cavity (7) between the cylinder head and inner rocker cover. The vapor then moves into the filter media (8) of the breather valve (3).

As the oil-laden vapor passes through the filter media (8) of the breather valve assembly, the oil mist separates from the crankcase air, drains back into cavity (7) where it flows toward the exhaust valve area. The oil then passes through a small drain hole adjacent to the exhaust valve in the head where it eventually returns to the crankcase.

The air pressure forces the umbrella valve (5) of the breather valve to open and air is routed through a fitting (4) in the outer rocker cover. The umbrella valve prevents the air from moving back into the crankcase during piston upstroke. The crankcase air then travels through a vapor hose (2) which is connected to a hose and tee assembly (10) in the airbox. The air eventually exits into the intake air stream above the induction module and is consumed by the engine.



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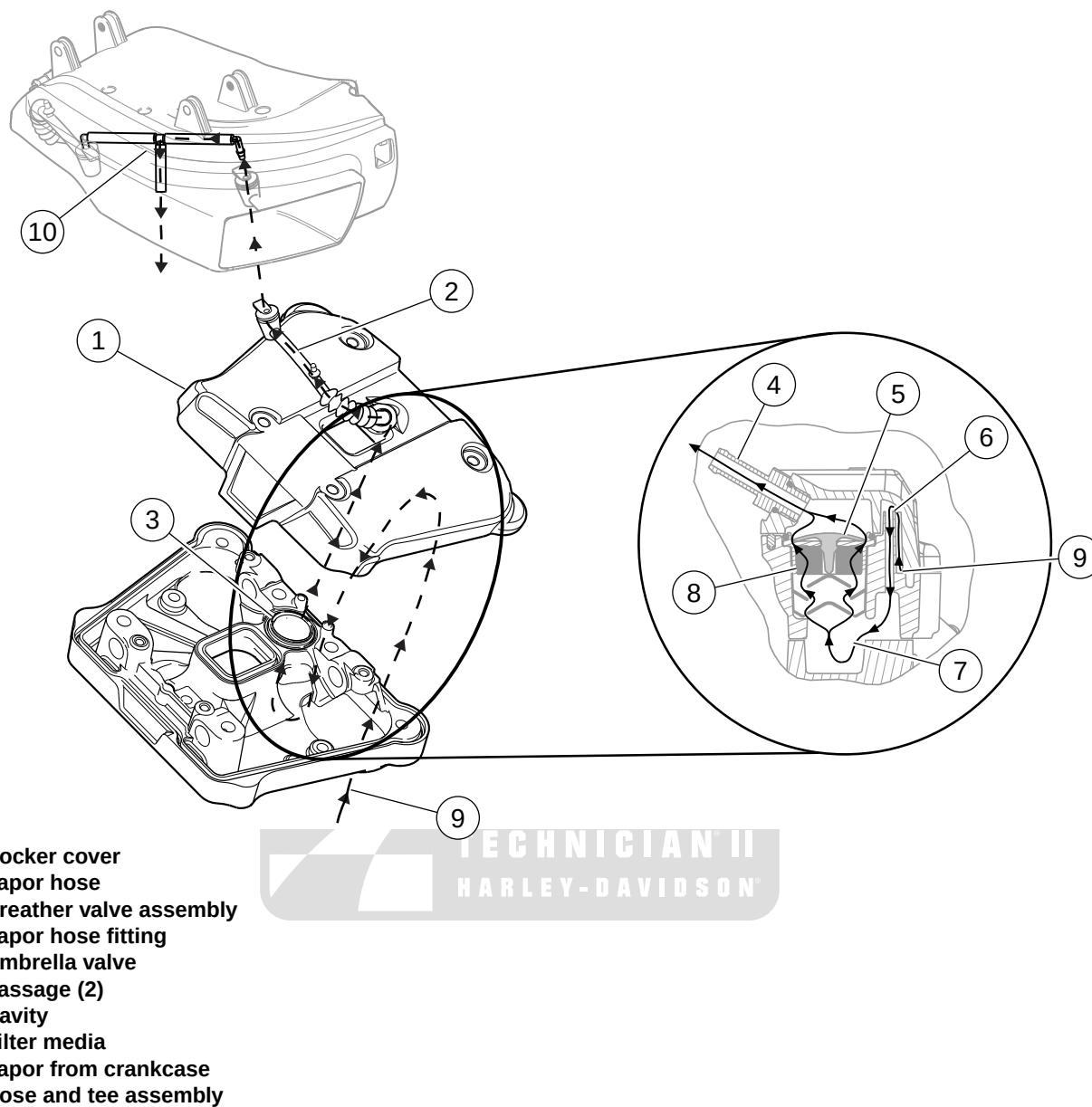


Figure 3-7. Crankcase Breathing System: XR Models

TROUBLESHOOTING

3.7

DIAGNOSING VALVE TRAIN NOISE

To diagnose and correct noisy hydraulic lifters and valve train components, use the following procedures:

1. With engine and oil at normal operating temperature, check oil pressure at 2000 RPM. If oil pressure is above 50 PSI (345 kN/m²) or below 5 PSI (34 kN/m²), inspect oil pump, crankcase passages and oil hoses for restrictions or blockage. Repair or replace parts as necessary.
2. If oil is reaching the hydraulic lifters, remove and inspect. See [3.19 VALVE TAPPETS](#). Clean lifter bore of all foreign material. Replace hydraulic lifter if required.
3. Examine pushrod, lifter and lifter block for proper fit and any signs of unusual wear. Replace parts as necessary.
4. Visually inspect camshaft lobes for abnormal wear.
5. Remove camshafts and pinion gear, clean and inspect for wear and fit. Replace parts as necessary.
6. Remove cylinder head and rocker box assemblies. Check rocker arm end play and check for binding. Inspect valve stems for scuffing and check stem to guide clearance. Check valve seats for signs of looseness or shifting.
7. Reface valves and valve seats.

COMPRESSION TEST

PART NUMBER	TOOL NAME
HD-33223-1	CYLINDER COMPRESSION GAUGE

Satisfactory engine performance depends upon a mechanically sound engine. In many cases, unsatisfactory performance is caused by combustion chamber leakage. A compression test can help determine the source of cylinder leakage.

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

1. Disconnect spark plug wires. Clean around spark plug base and remove spark plugs.
2. Connect CYLINDER COMPRESSION GAUGE (Part No. HD-33223-1) to front cylinder per manufacturer's instructions.
3. Make sure transmission is in neutral. With throttle plate in wide open position, crank engine continuously through 5 to 7 full compression strokes.
4. Note gauge readings at the end of the first and last compression strokes. Record test results.
5. Connect CYLINDER COMPRESSION GAUGE to rear cylinder and repeat Steps 3 and 4.
 - a. Compression is normal if final readings are within the range specified in [Table 3-22](#), and do not indicate more than a 10 psi (0.689 Bar) variance between cylinders.
 - b. If compression is below 100 psi (6.89 Bar) for 883 cc engines or 150 psi (10.3 Bar) for 1200 cc engines, refer to [Table 3-23](#).

6. Inject approximately 1/2 oz. (15 ml) SAE 30 engine oil into each cylinder and repeat the compression tests on both cylinders. Readings that are considerably higher during the second test indicate worn piston rings.

NOTE

After completing the compression test(s) and reinstalling the spark plugs, make sure the throttle plate is in the closed position before starting the engine.

Table 3-22. Normal Compression Ranges

ENGINE	COMPRESSION	
	PSI	BAR
XL883 cc	165-180	11.4-12.4
XL1200 cc	200-225	13.8-15.5
XR1200 cc	170-185	11.7-12.8

Table 3-23. Compression Test Results

DIAGNOSIS	TEST RESULTS
Ring trouble	Compression low on first stroke, tends to build up on the following strokes, but does not reach normal. Improves considerably when oil is added to cylinder.
Valve trouble	Compression low on first stroke, does not build up much on following strokes. Does not improve considerably with the addition of oil. Check for correct pushrod length.
Head gasket leak	Same reaction as valve trouble.

CYLINDER LEAKAGE TEST

PART NUMBER	TOOL NAME
HD-35667-A	CYLINDER LEAKDOWN TESTER

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 CYLINDER LEAKDOWN TESTER (Part No. HD-35667-A) and follow the specific instructions supplied with the tester.

The following are some general instructions that apply to Harley-Davidson V-twin engines:

1. Run engine until it reaches normal operating temperature.
2. Stop engine. Clean dirt from around spark plugs and remove the spark plugs.
3. Remove the air cleaner and set the throttle in the wide open position.
4. The piston in the cylinder being tested must be at top dead center of compression stroke (both valves closed) during the test.

5. To keep the engine from turning over when air pressure is applied to the cylinder, engage transmission in fifth gear and lock the rear brake.

NOTE

Before performing the cylinder leakage test, verify that the tester itself is free from leakage to obtain the most accurate test results. With a soap solution [applied around all tester fittings], connect the cylinder leakdown tester to the compressed air source and look for any bubbles that would indicate leakage from the tester.

6. Following the manufacturer's instructions, perform a cylinder leakage test on the front cylinder. Make a note of the percent of leakage. Leakage greater than 12% indicates internal engine problems.
7. Listen for air leaks at induction module intake, exhaust pipe and head gasket. Air escaping through the induction module indicates a leaking intake valve. Air escaping through the exhaust pipe indicates a leaking exhaust valve.

NOTE

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

8. Repeat procedure on rear cylinder.

NOTE

After completing the cylinder leakage test(s) and reinstalling the spark plugs, make sure the throttle plate is in the closed position before starting the engine.

DIAGNOSING SMOKING ENGINE OR HIGH OIL CONSUMPTION

Perform [3.7 TROUBLESHOOTING, Compression Test](#) or [3.7 TROUBLESHOOTING, Cylinder Leakage Test](#) as described previously. If further testing is needed, remove suspect head(s) and inspect for the following:

Check Prior to Cylinder Head Removal

1. Oil tank overfilled.
2. Oil carryover.
3. Breather hose restricted.
4. Restricted oil filter.

Check After Cylinder Head Removal

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

5. Cylinder head casting's porosity allowing oil to drain into combustion chamber.
6. O-ring damaged or missing from oil pump/crankcase junction.

ADJUSTMENT AND 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 outlined in [3.15 TOP END OVERHAUL: DISASSEMBLY, Stripping Motorcycle for Top End 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 in [3.12 REMOVING ENGINE FROM CHASSIS](#).

NOTE

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. If fitting is damaged, clutch cable must be replaced.

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 [1.35 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.

ENGINE LUBRICATION SYSTEM

3.8

OIL PUMP OPERATION

See [Figure 3-8](#) or [Figure 3-9](#). 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 and has fewer lobes than the scavenge pump, allowing for greater pressure development. The scavenge pump returns oil to the

tank and has more lobes than the feed pump allowing for greater oil flow.

XL Models: Both rotor sets are driven off a common shaft that is coupled by gears to the crankshaft.

XR Models: The feed rotor set is driven by flats on the front intake camshaft. The scavenge rotor set is driven by flats on the rear exhaust camshaft.

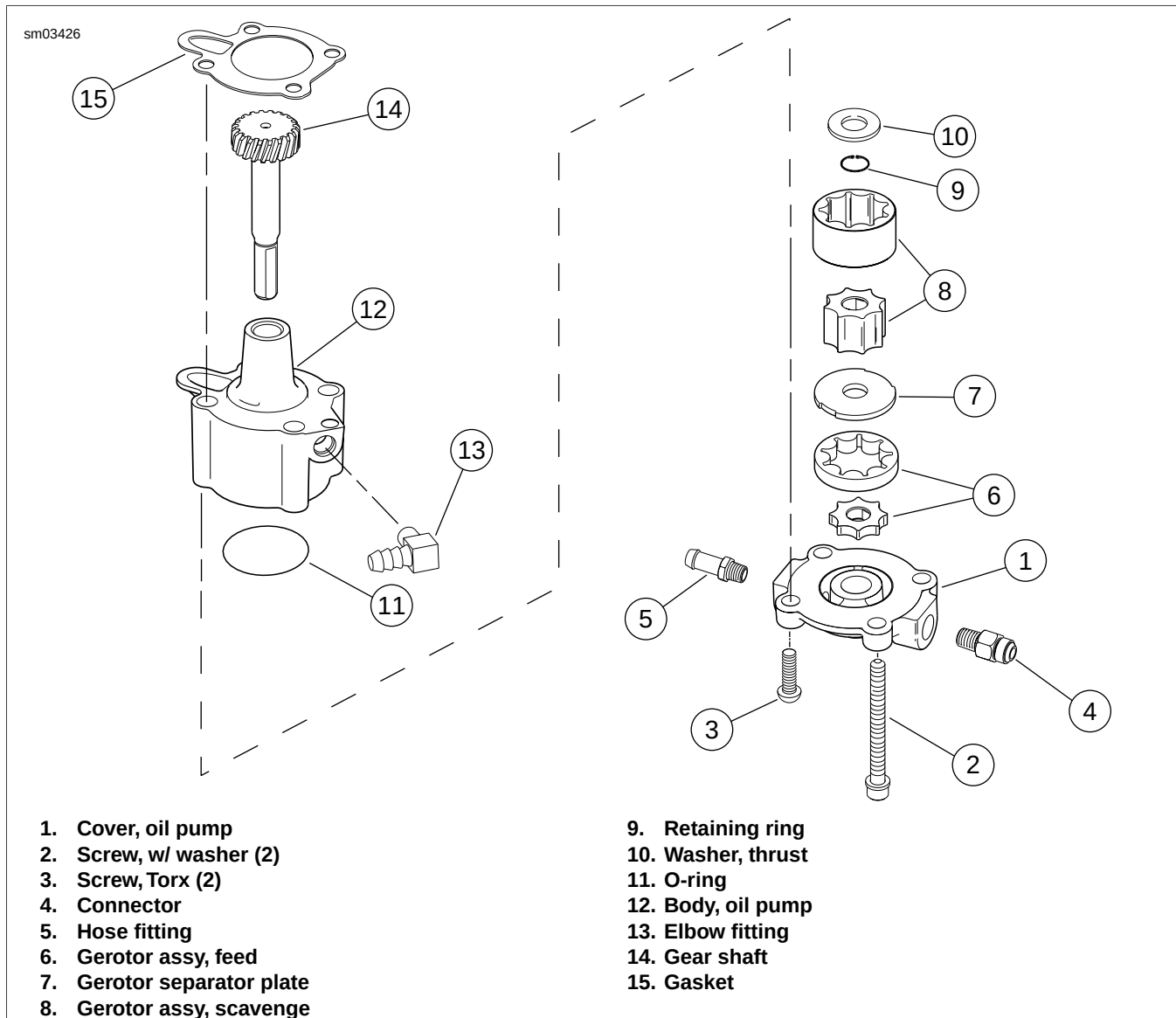
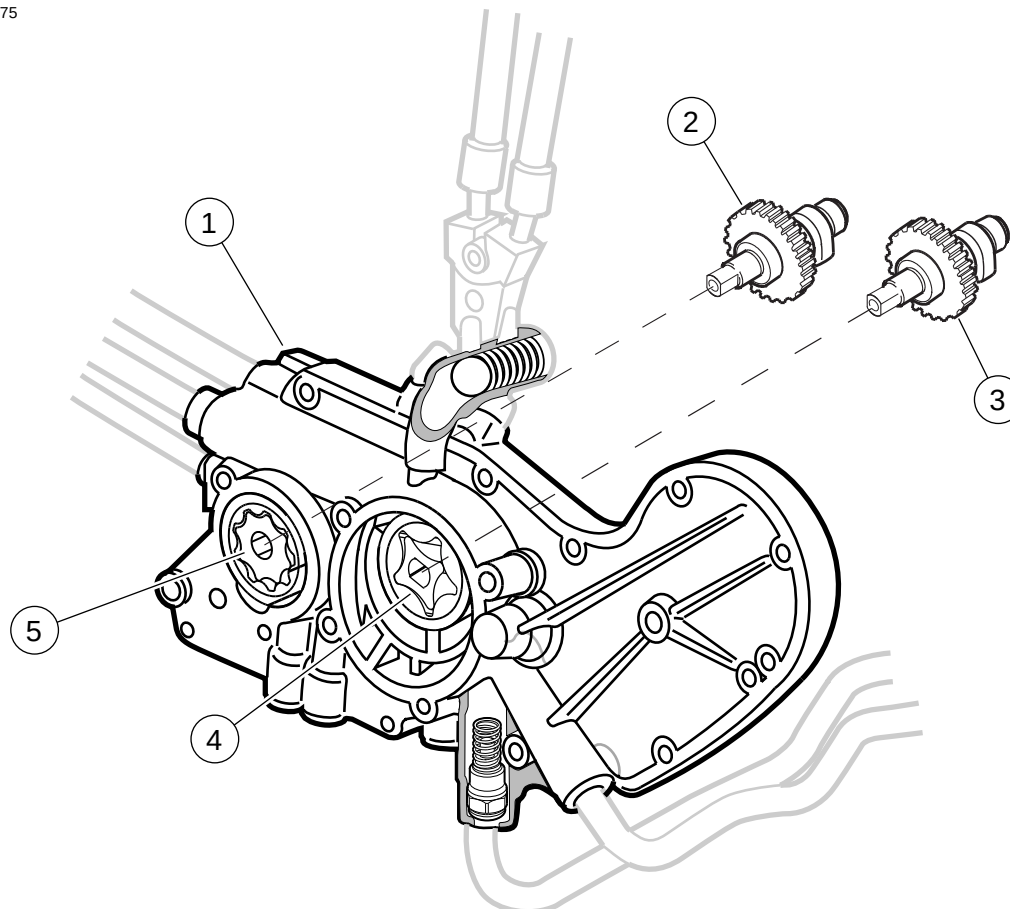


Figure 3-8. Oil Pump: XL Models

sm05375



- | | |
|------------------------------------|-------------------------|
| 1. Housing, oil pump | 4. Feed rotor set |
| 2. Exhaust camshaft, rear cylinder | 5. - Scavenge rotor set |
| 3. Intake camshaft, front cylinder | |

Figure 3-9. Oil Pump: XR Models

Each gerotor-type gear set has two parts; an inner and an outer gerotor. The inner gerotor has one less lobe than the outer

gerotor. Both gerotors have fixed centers which are offset to each other.

See [Figure 3-10](#). As the crankshaft rotates, the cavity between the inner and outer gerotors on the inlet side of the pump increases in volume. This creates a vacuum causing oil to be drawn in. The cavity continues to increase until the volume is equivalent to that of the missing lobe on the inner gerotor. Note that the inlet and outlet sides of the pump are sealed by the tips and lobes of the inner and outer gerotors.

See [Figure 3-11](#). Continued rotation moves the pocket of oil to the outlet side of the pump. In this area, the cavity decreases in volume as the gerotor lobes mesh causing the oil to be squeezed out the discharge port. As the cavity on the outlet side is emptied, a second seal formed by the tips and lobes of the inner and outer gerotors prevents oil on the outlet side (high pressure) from being transferred to the inlet side (low pressure). In operation, the gerotors provide a continuous flow of oil.

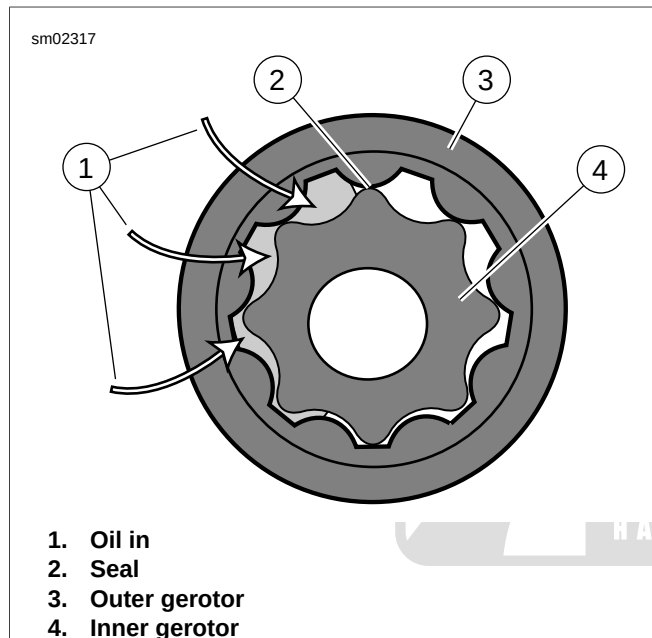


Figure 3-10. Inlet Side Oil Flow

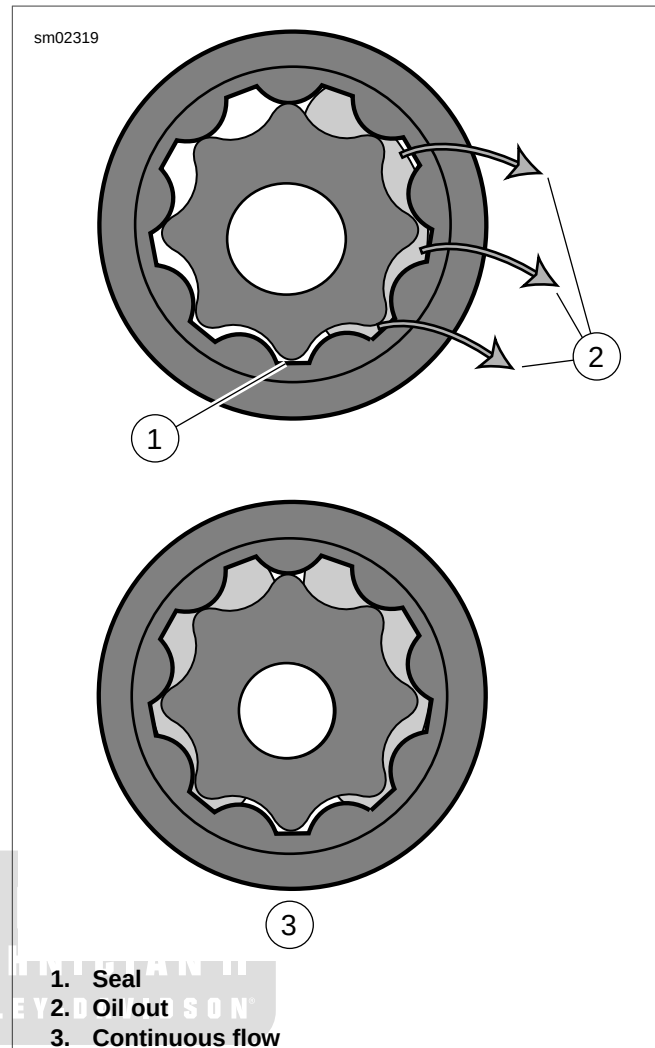


Figure 3-11. Outlet Side Oil Flow

OIL FLOW: XL MODELS

NOTE

The following paragraph numbers correspond with the numbered callouts in the [Figure 3-12](#) 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

See [3.24 OIL PUMP: XL MODELS](#) for a complete explanation of the gerotor 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 indicator lamp switch** and shuts off the oil pressure indicator lamp.
6. Oil flowing from the filter adapter opens the **check ball**. The check ball opens at 10-13 psi (69-90 kPa) 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. From this cavity, oil is also fed to the piston jets.
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 **crank pin**. Oil is forced through the crank pin 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 gearcase through a **passage** in the head, cylinder, and crankcase.
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 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.

OIL FLOW: XR MODELS

NOTE

The following paragraph numbers correspond with the numbered callouts in the [Figure 3-13](#) foldout.

1. Oil is gravity-fed from the oil tank to the gerotor-style oil pump through a **feed hose and internal passages**. Oil enters the inlet cavity of the **feed pump**.

NOTE

See [3.25 OIL PUMP: XR MODELS](#) for a complete explanation of the gerotor pump.

2. The feed pump transfers oil through a **passage** in the pump housing to a point where it splits direction. The pump is capable of delivering more oil than can flow through the engine. When oil pressure exceeds approximately 50 psi (345 kPa), the **bypass valve** will open allowing oil to circulate back into the inlet side of the feed pump.
3. Part of the oil passes through an **internal passage** toward the oil filter and part heads toward the oil cooler line.
4. Oil flowing toward the oil cooler exits the oil pump housing through a **line** that is connected via a quick connect fitting at each end, and enters the lower end of the oil cooler. Oil flows up through the oil cooler and exits the upper end where it flows back to the oil pump housing.
5. A **thermostat** is located where the oil cooler return line connects to the oil pump housing. No oil from the oil cooler will flow past the thermostat until the engine oil temperature reaches 190°F (88°C). Once the **thermostat** begins to open, oil from the oil cooler flows past it while oil flow directly from the feed pump is restricted, providing cooled oil for engine lubrication. When the **thermostat** reaches full open position, a seal on the end seals off oil flow directly from the pump and all oils passes through the oil cooler, past the **thermostat**, and towards the oil filter.
6. Oil flowing to the filter passes through an **internal passage** to the oil filter mount.
7. Oil flows through the **filter mount cavity** to the oil filter.
8. 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 attaches the filter to filter mount).
9. Adequate oil pressure in the filter supply passage activates the **oil pressure indicator lamp switch** and shuts off the oil pressure indicator lamp.
10. Oil flowing from the filter adapter opens the **check ball**. The check ball opens at 5-7 psi (34-48 kPa) oil pressure.
11. With the check ball open, oil flows into the **crankcase feed galley**.

12. 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. From this cavity, oil is also fed to the piston jets.
13. Also from the feed galley in the crankcase, oil flows through a cross drilled passage to the **check valve assembly** and to the cylinder heads through **flexible lines**. Oil across the cylinder heads and through passages that surround the exhaust ports. Oil exits each cylinder head near the exhaust port.
14. **Oil exiting** the heads flows to the **return oil manifold** where it is mixed with the scavenge oil from the scavenge pump (25) and is pushed back to the tank.
15. Also from the feed galley in the crankcase, oil enters an **intersecting passage** in the oil pump body and cam support. Oil flow is then routed to the **outer bearing** of the rear intake camshaft. A cast-in passage allows oil into a cavity that surrounds the end of the pinion gear shaft.
16. From the same **cavity** near the end of the pinion shaft, oil enters the center hole in the **oil pump rotor cover** which intersects with a passage that carries oil to the outer bearings of the front intake camshaft and rear exhaust camshaft and is used to lubricate the cam bearings.
17. The outer bearing of the front exhaust camshaft is lubricated through a **drilled passage** that intersects with the feed galley.
18. Crankcase end of bearings of the cams are fed through holes in the camshaft.
19. A small amount of oil flows from the feed galley in the right crankcase 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.
20. 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 **crank pin**. Oil is forced through the crank pin to properly lubricate the rod bearing assembly.
21. Oil flows up passages in the **push rods** to the rocker arm shafts and bushings.
22. The valve stems are lubricated by oil supplied through drilled oil holes in the **rocker arms**.
23. 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 settles to the bottom of the gearcase where the scavenge pump will collect it.
24. Feed oil to the rocker area is returned to the gearcase through a **passage** in the cylinder head, cylinder, and crankcase.
25. Oil collected in the **sump** is splash-fed to the pistons, cylinder walls and flywheel components.
26. Oil collected in the sump area returns to the scavenge pump through an **internal passage** located in the rear section of the sump housing. 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.
27. Oil collected in the gearcase passes through a **passage** in the oil pump body and cam support and is also collected by the scavenge pump.
28. The **scavenge pump** pushes the collected oil back to the oil tank.
29. Crankcase vents to oil tank.

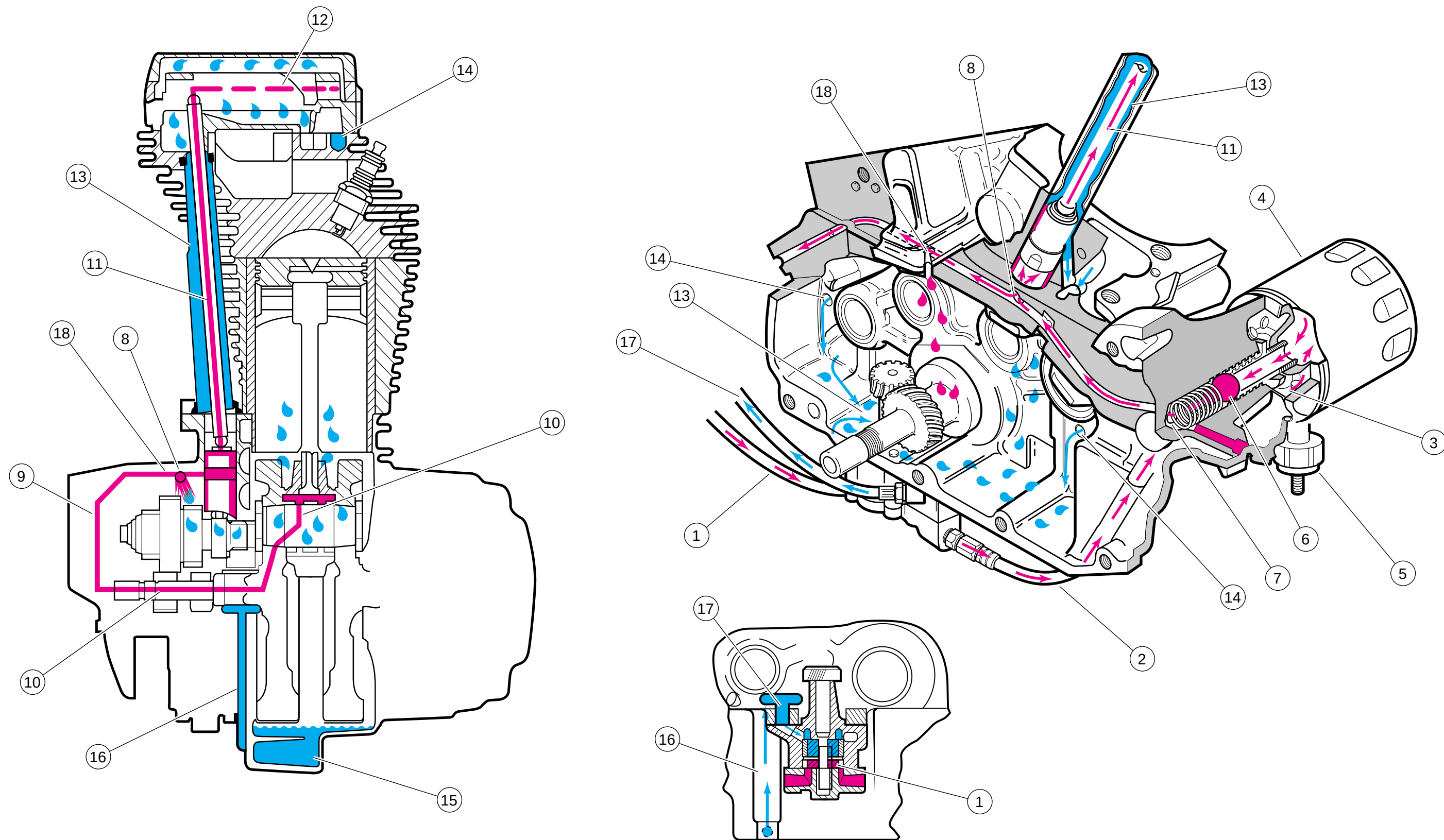


Figure 3-12. Lubrication Diagram: XL Models (Red=Feed Oil, Blue=Return Oil)

Figure 3-12.

Lubrication Diagram: XL Models (Red=Feed Oil, Blue=Return Oil)

Figure 3-12.

Lubrication Diagram: XL Models (Red=Feed Oil, Blue=Return Oil)

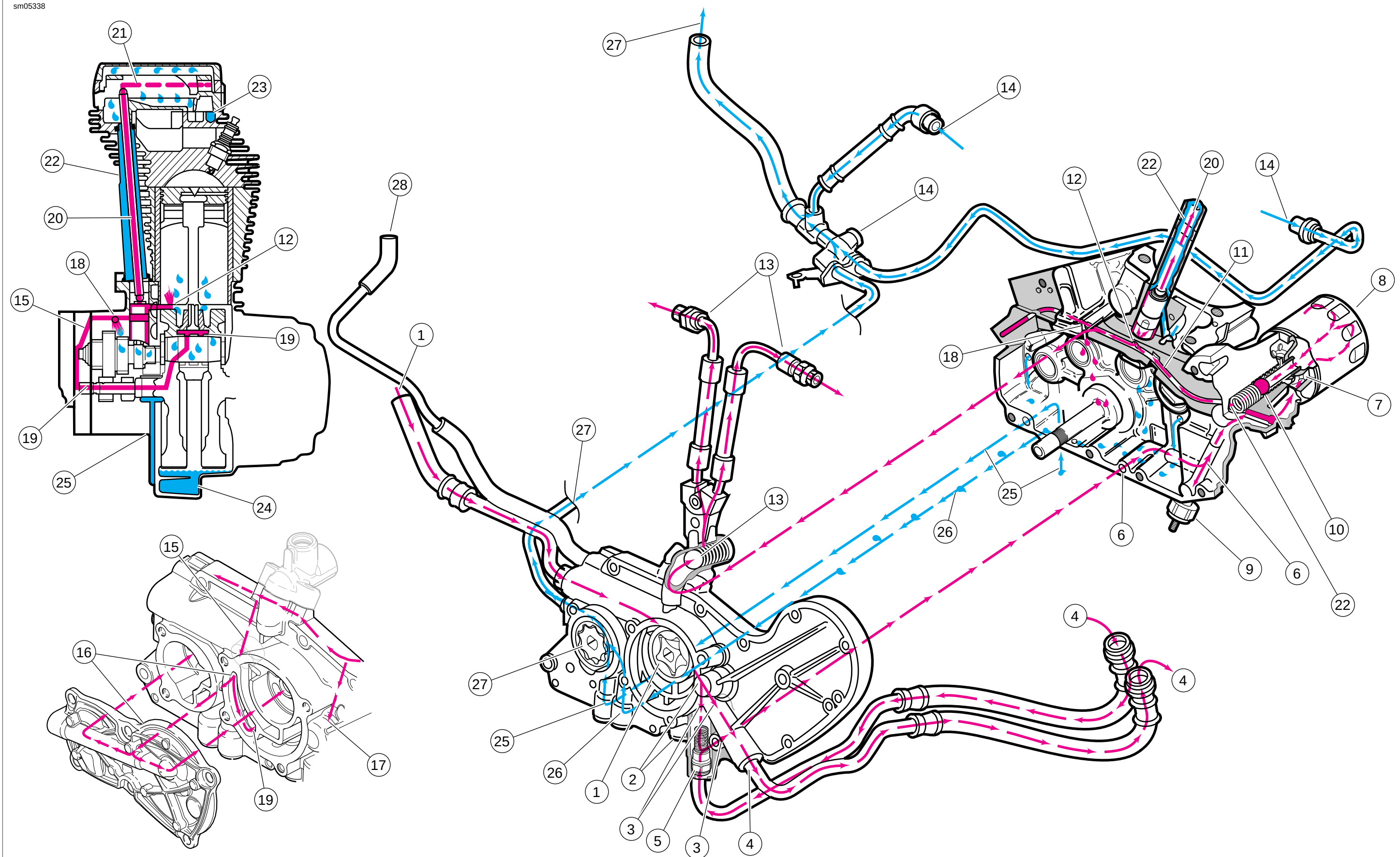


Figure 3-13. Lubrication Diagram: XR Models (Red=Feed Oil, Blue=Return Oil)

Figure 3-13.

Lubrication Diagram: XR Models (Red=Feed Oil, Blue=Return Oil)

Figure 3-13.

Lubrication Diagram: XR Models (Red=Feed Oil, Blue=Return Oil)

HOW TO USE THIS SECTION

3.9

TYPICAL SYMPTOMS

Symptoms indicating a need for engine repair are often misleading, but generally if more than one symptom is present, possible causes can be narrowed down to make at least a partial diagnosis. An above normal consumption of oil, for example, could be caused by several mechanical faults (see [1.35 TROUBLESHOOTING](#)). But when accompanied by a blue-gray smoke from the exhaust, and when low compression is present, it indicates the rings need replacing. Low compression by itself, however, indicates improperly seated valves, not worn rings.

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

Most frequently, valves, rings, pins, bushings, and bearings need attention at about the same time. If the symptoms can be narrowed down through the process of elimination to indicate that any one of the above components is worn, it is best to give attention to all of the cylinder head and cylinder parts.

TOP END REPAIR

NOTE

During top end disassembly, the engine may be left in the chassis for service.

If servicing only cylinder head components, pistons, cylinders and/or upper rod bushings, see [3.10 TOP END SERVICE](#). Two options are available depending upon engine status.

- [3.10 TOP END SERVICE, Engine in Chassis](#).
- [3.10 TOP END SERVICE, Engine Removed from Chassis](#).

BOTTOM END REPAIR

NOTE

Servicing components in the cam compartment requires only partial disassembly. This can be done with the engine left in the chassis.

After disassembling as far as the cylinder heads you may find that bottom end repair is necessary. Bottom end service may require either partial or complete disassembly of the engine.

- To service the cam compartment, see [3.11 BOTTOM END SERVICE, Engine in Chassis](#).
- To service components in the flywheel compartment, the engine must be removed and the crankcase halves split. See [3.11 BOTTOM END SERVICE, Engine Removed From Chassis](#).



TOP END SERVICE

3.10

ENGINE IN CHASSIS

Table 3-24. Engine in Chassis

SERVICE PROCEDURE	COMPONENT REPAIR PROCEDURES
Remove parts necessary to gain access to all components above cylinder deck. See 3.15 TOP END OVERHAUL: DISASSEMBLY, Stripping Motorcycle for Top End Repair .	
Continue with 3.15 TOP END OVERHAUL: DISASSEMBLY . Remove/repair sub-assembly components only if necessary.	
Remove rocker arm outer covers. Remove crankcase breathers. See 3.15 TOP END OVERHAUL: DISASSEMBLY, Cylinder Heads .	*Inspect and repair as necessary. See 3.5 CRANKCASE BREATHING SYSTEM: XL MODELS or 3.6 CRANKCASE BREATHING SYSTEM: XR MODELS .
Remove cylinder heads. See 3.15 TOP END OVERHAUL: DISASSEMBLY, Cylinder Heads .	*Inspect and repair as necessary. See 3.21 CYLINDER HEAD .
Remove push rods, push rod covers and tappet covers. See 3.15 TOP END OVERHAUL: DISASSEMBLY, Cylinder Heads . Remove tappets. See 3.19 VALVE TAPPETS, Removal .	*Inspect and repair as necessary. See 3.19 VALVE TAPPETS .
Remove cylinders and pistons. See 3.15 TOP END OVERHAUL: DISASSEMBLY, Cylinder and Piston .	*Inspect and repair as necessary. See 3.22 CYLINDER AND PISTON . Inspect upper connecting rod and repair as necessary. See 3.22 CYLINDER AND PISTON, Connecting Rod Bushings .
Complete all appropriate steps under 3.16 TOP END OVERHAUL: ASSEMBLY .	
Complete motorcycle assembly. See 3.16 TOP END OVERHAUL: ASSEMBLY, Assembling Motorcycle After Top End Repair .	
* When this step is completed during top end service, you may advance to 3.16 TOP END OVERHAUL: ASSEMBLY , if no other work is to be done.	

ENGINE REMOVED FROM CHASSIS

Table 3-25. Engine Removed from Chassis

SERVICE PROCEDURE	COMPONENT REPAIR PROCEDURES
Remove engine from chassis. See 3.12 REMOVING ENGINE FROM CHASSIS .	
Start 3.15 TOP END OVERHAUL: DISASSEMBLY . Remove and repair subassembly components as necessary.	
Remove rocker arm outer covers. Remove crankcase breathers. See 3.15 TOP END OVERHAUL: DISASSEMBLY, Cylinder Heads .	*Inspect and repair as necessary. See 3.5 CRANKCASE BREATHING SYSTEM: XL MODELS or 3.6 CRANKCASE BREATHING SYSTEM: XR MODELS .
Remove cylinder heads. See 3.15 TOP END OVERHAUL: DISASSEMBLY, Cylinder Heads .	*Inspect and repair as necessary. See 3.21 CYLINDER HEAD .
Remove push rods, push rod covers and tappet covers. See 3.15 TOP END OVERHAUL: DISASSEMBLY, Cylinder Heads . Remove tappets. See 3.19 VALVE TAPPETS, Removal .	*Inspect and repair as necessary. See 3.19 VALVE TAPPETS .
Remove cylinders and pistons. See 3.15 TOP END OVERHAUL: DISASSEMBLY, Cylinder and Piston .	*Inspect and repair as necessary. See 3.22 CYLINDER AND PISTON . Inspect upper connecting rod and repair as necessary. See 3.22 CYLINDER AND PISTON, Connecting Rod Bushings .
Complete all appropriate steps under 3.16 TOP END OVERHAUL: ASSEMBLY .	
Install engine in motorcycle. Complete all appropriate steps under 3.13 INSTALLING ENGINE IN CHASSIS .	
Complete motorcycle assembly. See 3.16 TOP END OVERHAUL: ASSEMBLY, Assembling Motorcycle After Top End Repair .	
* When this step is completed during top end service, you may advance to 3.16 TOP END OVERHAUL: ASSEMBLY if no other work is to be done.	

BOTTOM END SERVICE

3.11

ENGINE IN CHASSIS

Table 3-26. Engine in Chassis: Cam Compartment Service

SERVICE PROCEDURE	COMPONENT REPAIR PROCEDURES
Remove parts necessary to gain access to all components above cylinder deck. See 3.15 TOP END OVERHAUL: DISASSEMBLY, Stripping Motorcycle for Top End Repair .	
Continue with 3.15 TOP END OVERHAUL: DISASSEMBLY . Remove/repair sub-assembly components only if necessary.	
Remove rocker arm outer covers. Remove crankcase breathers. See 3.15 TOP END OVERHAUL: DISASSEMBLY, Cylinder Heads .	Inspect and repair as necessary. See 3.5 CRANKCASE BREATHING SYSTEM: XL MODELS or 3.6 CRANKCASE BREATHING SYSTEM: XR MODELS .
Remove push rods, push rod covers and tappet covers. See 3.15 TOP END OVERHAUL: DISASSEMBLY, Cylinder Heads . Remove tappets. See 3.17 BOTTOM END OVERHAUL: DISASSEMBLY, Tappets .	Inspect and repair as necessary. See 3.19 VALVE TAPPETS .
Continue with 3.17 BOTTOM END OVERHAUL: DISASSEMBLY .	
Remove gear case cover and cam gears. See 3.20 GEARCASE COVER AND CAM GEARS .	*Inspect and repair as necessary. See 3.20 GEARCASE COVER AND CAM GEARS .
Remove oil pump components. See 3.24 OIL PUMP: XL MODELS or 3.25 OIL PUMP: XR MODELS .	Inspect and repair as necessary. See 3.24 OIL PUMP: XL MODELS or 3.25 OIL PUMP: XR MODELS .
Complete all appropriate steps under 3.18 BOTTOM END OVERHAUL: ASSEMBLY .	
Complete motorcycle assembly. See 3.16 TOP END OVERHAUL: ASSEMBLY, Assembling Motorcycle After Top End Repair .	
* When this step is completed during bottom end service, you may advance to 3.18 BOTTOM END OVERHAUL: ASSEMBLY , if no other work is to be done.	

ENGINE REMOVED FROM CHASSIS

Table 3-27. Engine Removed from Chassis: Flywheel Compartment Service or Complete Engine Overhaul

SERVICE PROCEDURE	COMPONENT REPAIR PROCEDURES
Remove engine from chassis. See 3.12 REMOVING ENGINE FROM CHASSIS .	
Start 3.15 TOP END OVERHAUL: DISASSEMBLY . Remove and repair subassembly components as necessary.	
Remove rocker arm outer covers. Remove crankcase breathers. See 3.15 TOP END OVERHAUL: DISASSEMBLY, Cylinder Heads .	Inspect and repair as necessary. See 3.5 CRANKCASE BREATHING SYSTEM: XL MODELS or 3.6 CRANKCASE BREATHING SYSTEM: XR MODELS .
Remove cylinder heads. See 3.15 TOP END OVERHAUL: DISASSEMBLY, Cylinder Heads .	Inspect and repair as necessary. See 3.21 CYLINDER HEAD .
Remove push rods, push rod covers and tappet covers. See 3.15 TOP END OVERHAUL: DISASSEMBLY, Cylinder Heads . Remove tappets. See 3.17 BOTTOM END OVERHAUL: DISASSEMBLY, Tappets .	Inspect and repair as necessary. See 3.19 VALVE TAPPETS .
Remove cylinders and pistons. See 3.15 TOP END OVERHAUL: DISASSEMBLY, Cylinder and Piston .	Inspect and repair as necessary. See 3.22 CYLINDER AND PISTON . Inspect upper connecting rod and repair as necessary. See 3.22 CYLINDER AND PISTON, Connecting Rod Bushings .
Continue with 3.17 BOTTOM END OVERHAUL: DISASSEMBLY . Remove and repair subassembly components as necessary.	
Remove gearcase cover and cam gears. See 3.20 GEARCASE COVER AND CAM GEARS .	Inspect and repair as necessary. See 3.20 GEARCASE COVER AND CAM GEARS .
Remove oil pump. See 3.24 OIL PUMP: XL MODELS or 3.25 OIL PUMP: XR MODELS .	Inspect and repair as necessary. See 3.24 OIL PUMP: XL MODELS or 3.25 OIL PUMP: XR MODELS .
Complete all appropriate steps under 3.17 BOTTOM END OVERHAUL: DISASSEMBLY, Crankcase to split crankcases and remove flywheel assembly, piston jets, etc.	Inspect and repair as necessary. See 3.23 CRANKCASE . Inspect and repair transmission assembly as necessary. See 5.10 TRANSMISSION REMOVAL AND DISASSEMBLY , 5.11 TRANSMISSION ASSEMBLY , 5.15 TRANSMISSION INSTALLATION and related subjects.
Complete all appropriate steps under 3.18 BOTTOM END OVERHAUL: ASSEMBLY .	
Complete all appropriate steps under 3.16 TOP END OVERHAUL: ASSEMBLY .	
Install engine in motorcycle. Complete all appropriate steps under 3.13 INSTALLING ENGINE IN CHASSIS .	
Complete motorcycle assembly. See 3.16 TOP END OVERHAUL: ASSEMBLY, Assembling Motorcycle After Top End Repair .	

REMOVING ENGINE FROM CHASSIS

3.12

GENERAL

If it becomes necessary to remove the engine from the motorcycle, follow the step-by-step procedure below. It is important to follow the procedure as outlined, particularly in the areas of stabilizer link and engine mount disassembly.

PROCEDURE: XL MODELS

PART NUMBER	TOOL NAME
HD-45967	SHOP DOLLY
HD-45968	FAT JACK
HD-46284	ENGINE HOOK

⚠ WARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

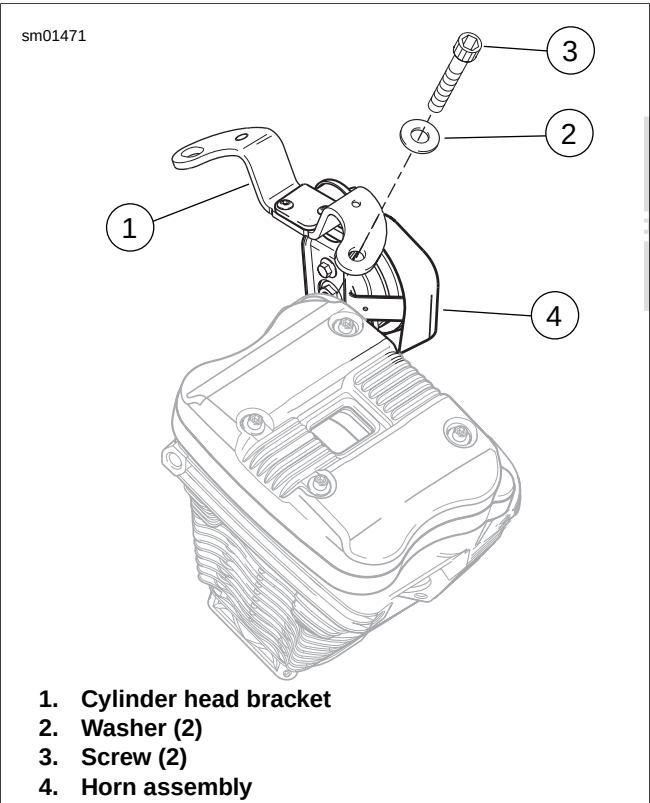


Figure 3-14. Horn and Cylinder Head Bracket (Models With Side Mounted Horn Only)

1. Position vehicle upright. Purge the fuel supply hose of high pressure gasoline. Disconnect fuel supply hose from fuel pump module. See [4.6 FUEL TANK: XL MODELS](#).
2. Remove seat.
3. Remove left side cover. See [2.20 LEFT SIDE COVER](#).

⚠ WARNING

Prevent accidental vehicle start-up, which could cause death or serious injury. First disconnect negative (-) battery cable at engine and then positive (+) cable from battery. (00280b)

4. Disconnect negative (-) battery cable from ground stud on crankcase. Disconnect positive (+) battery cables at battery. See [1.17 BATTERY MAINTENANCE](#).
5. Drain primary chaincase/transmission fluid. See [1.14 TRANSMISSION LUBRICANT](#).
6. Drain oil tank. See [1.6 ENGINE OIL AND FILTER](#). Do not install drain plug back in end of drain hose at this time.
7. Unplug O2 sensor connectors [137], [138] and remove exhaust pipes and mufflers. See [4.15 EXHAUST SYSTEM: XL MODELS](#).
8. Remove right front footrest assembly and rear brake linkage.
 - a. Models equipped with mid-mount foot controls: see [2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS](#).
 - b. Models equipped with forward foot controls: see [2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS](#).
9. Remove screw, washer and exhaust pipe clamp bracket from sprocket cover. Remove two screws securing sprocket cover to engine case. Remove sprocket cover.
10. Loosen rear axle nut and move rear axle all the way forward. Tighten axle nut enough to hold the axle and wheel in position in the rear fork. Remove rear drive belt from transmission sprocket. See [5.7 DRIVE BELT](#).
11. Remove transmission sprocket. See [5.16 TRANSMISSION SPROCKET](#).
12. Remove exhaust system interconnect. See [4.15 EXHAUST SYSTEM: XL MODELS](#).
13. Disconnect oil tank feed, drain and return hoses from oil tank. See [3.27 OIL TANK](#). Pull drain hose up through drain hose sleeve in rear of engine crankcase and remove hose from vehicle.
14. Drain and remove fuel tank. See [4.6 FUEL TANK: XL MODELS](#).
15. Models with side mounted horn: unplug wiring harness connectors from horn. See [Figure 3-14](#). Remove two screws (3) and washers (2). Remove cylinder head bracket (1) with horn (4) from cylinder heads as a unit.
16. Models with front mounted horn: unplug horn connectors and remove horn from horn bracket. See [6.37 HORN](#).
17. Remove air cleaner cover, air filter and air cleaner backing plate. See [4.4 AIR CLEANER: XL MODELS](#). California models: remove EVAP purge hose from induction module.

- See [4.21 EVAPORATIVE EMISSIONS CONTROL \(CA MODELS\)](#).
18. See [4.10 INDUCTION MODULE: XL MODELS](#) and unplug the following connectors from the induction module:
 - a. Fuel injector connectors [84], [85].
 - b. Temperature/Manifold absolute pressure (TMAP) sensor connector [80].
 - c. Idle Air Control (IAC) connector [87].
 - d. Throttle Position (TP) sensor connector [88].
 19. Unplug the following electrical connectors from the engine:
 - a. Ground wire at powertrain ground stud on crankcase.
 - b. Spark plug wires.
 - c. Oil pressure switch connector [120]. See [6.36 OIL PRESSURE SWITCH](#).
 - d. Crank position (CKP) sensor connector [79]. See [6.28 CRANK POSITION SENSOR \(CKP\)](#).
 - e. Alternator AC connector [46]. See [6.3 VOLTAGE REGULATOR](#).
 - f. Neutral indicator switch connector [136]. See [6.31 NEUTRAL INDICATOR SWITCH](#).
 - g. Vehicle speed sensor (VSS) connector [65]. See [6.30 VEHICLE SPEED SENSOR \(VSS\)](#).
 - h. Starter relay wire (GN) at starter motor. See [6.13 STARTER](#).
 - i. Engine Temperature (ET) sensor connector [90]. Cut and remove barbed cable strap securing sensor harness to H-bracket. See [4.9 ENGINE TEMPERATURE \(ET\) SENSOR](#).
 20. Disconnect clutch cable and remove from clutch lever on left handlebar. See [2.31 CLUTCH CONTROL](#). Remove cable clips securing clutch cable to frame left front down-tube.
 21. Remove push-in fastener securing right wire harness caddy to coil bracket. Discard push-in fastener. Remove screw securing ignition switch to coil bracket. Unplug spark plug wires from coil. Unplug ignition coil harness connector [83] from coil. Remove coil and bracket from frame. See [6.19 IGNITION COIL](#).
 22. Remove screw securing left wire harness caddy to right wire harness caddy. Separate caddies. See [6.33 ELECTRICAL CADDIES, Wire Harness Caddy: XL Models](#).
 23. Unplug the following harness connectors located in the wire harness caddies:
 - a. Instruments connector [20].
 - b. Headlamp connector [38].
 - c. Right hand control connector (black) [22].
 - d. Left hand control connector (gray) [24].
 - e. Front turn signal connector [31].
 24. Slide left wire harness caddy between frame and engine, toward right side of vehicle. Move wire harness caddies and wiring harnesses out of the way.
 25. Remove induction module and intake manifold as a unit. See [4.10 INDUCTION MODULE: XL MODELS](#). Secure induction module/intake manifold assembly and throttle cables out of the way.
 26. **California models:** remove EVAP canister and disconnect hoses. See [4.21 EVAPORATIVE EMISSIONS CONTROL \(CA MODELS\)](#).
 27. See [Figure 3-15](#). Remove screws (3, 4), grounding strap (2), stabilizer link (1) and spacer (5).
 28. See [Figure 3-16](#). Remove upper stabilizer link (2) and upper frame bracket (3):
 - a. Remove screw (4) securing stabilizer link to engine bracket (1).
 - b. Remove screws (5) and washers (8). Remove horn bracket (9) (models with front mounted horn) and upper stabilizer link bracket with stabilizer link.
 29. See [Figure 3-17](#). Remove lower stabilizer link (1) and lower frame bracket (2):
 - a. Remove screw (3) securing stabilizer link to engine crankcase boss.
 - b. Remove screws (4), washers (5) and lower frame bracket with stabilizer link.

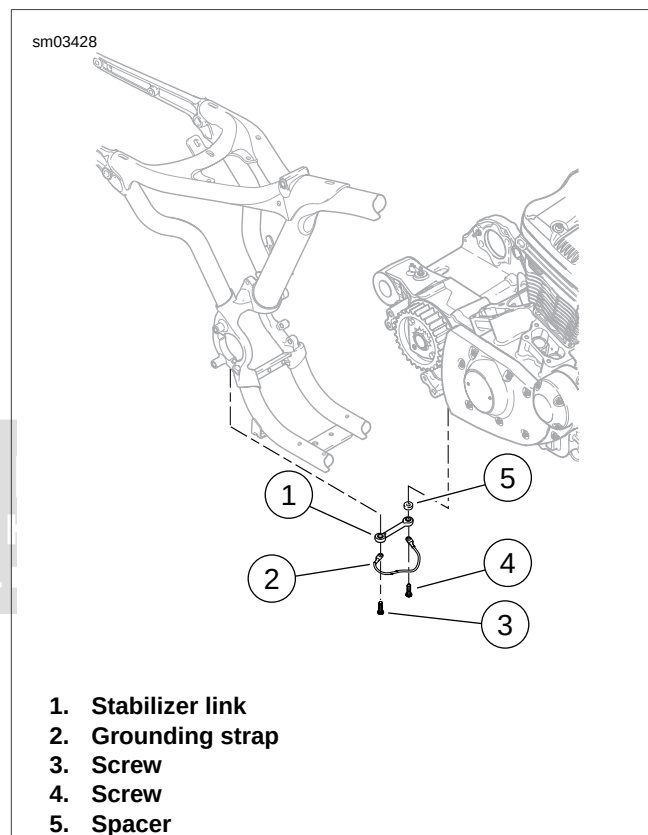


Figure 3-15. Rear Stabilizer Link Assembly: Typical (XL Model Shown)

30. Remove rider left footrest and mounting bracket assembly and shift lever.

- a. **Models equipped with mid-mount foot controls:** see [2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS](#).
- b. **Models equipped with forward foot controls:** see [2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS](#).

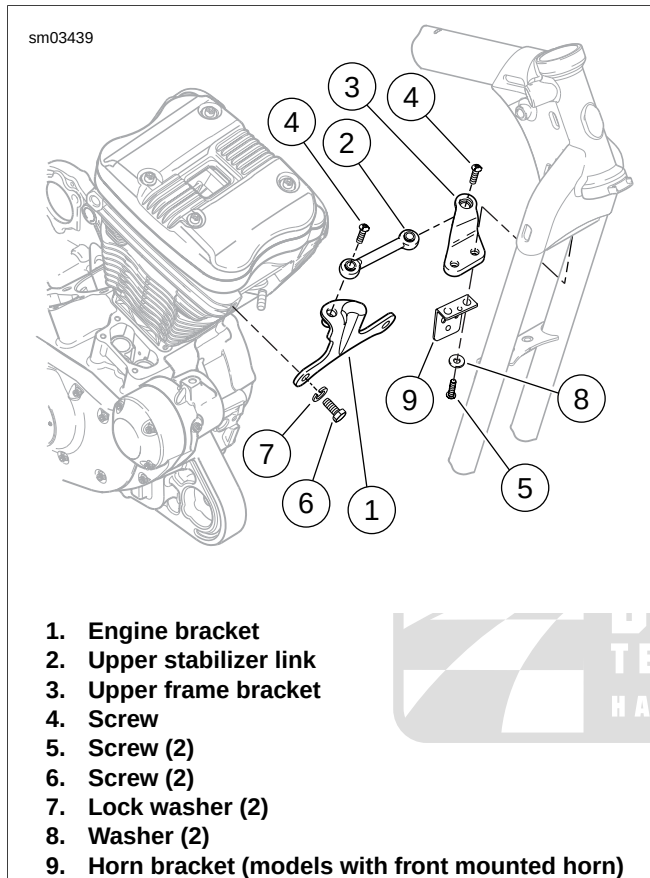


Figure 3-16. Upper Front Stabilizer Link Assembly: Typical (XL Model Shown)

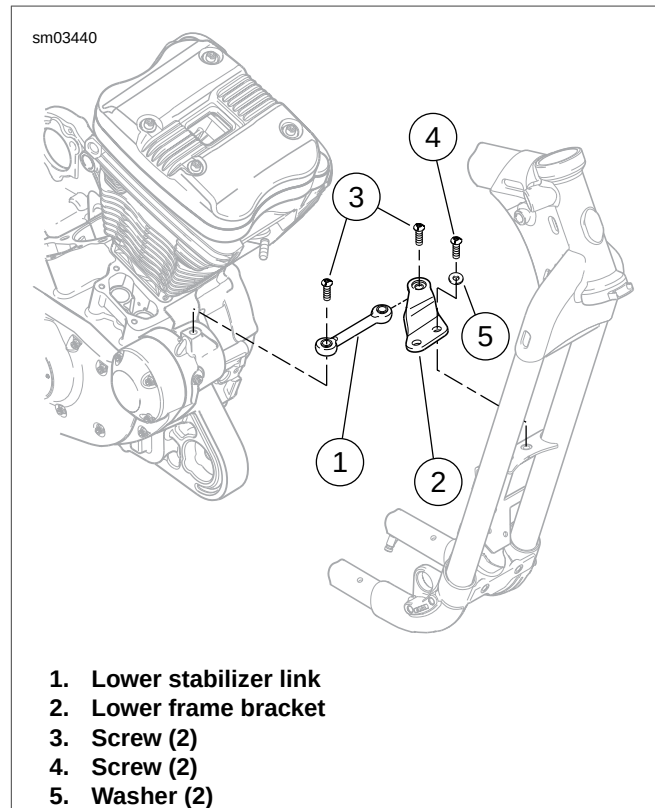


Figure 3-17. Lower Front Stabilizer Link Assembly: Typical (XL Model Shown)

31. **Models equipped with passenger foot rests:** remove left passenger footrest and mounting bracket assembly. See [2.43 PASSENGER FOOTRESTS](#).

NOTE

When removing rear brake master cylinder reservoir and securing it out of the way in the next step, make sure to keep the reservoir upright. If the reservoir is allowed to hang upside down, air bubbles could be introduced into the rear master cylinder via the feed hose. If this happens, the rear brake must be bled to remove all air from the hydraulic brake system. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#).

32. Remove rear brake master cylinder remote reservoir. Do not disconnect hose from reservoir. See [2.15 REAR BRAKE MASTER CYLINDER RESERVOIR](#). Secure reservoir upright, out of the way.
33. Remove rear stop lamp switch from battery tray. Unplug rear stop lamp switch connectors [121].
Remove screw and p-clamp securing rear brake hose to battery tray.
Carefully pull rear stop lamp switch and brake lines out of the way. Be careful not to bend or kink metal brake lines. See [6.27 REAR STOP LAMP SWITCH](#).

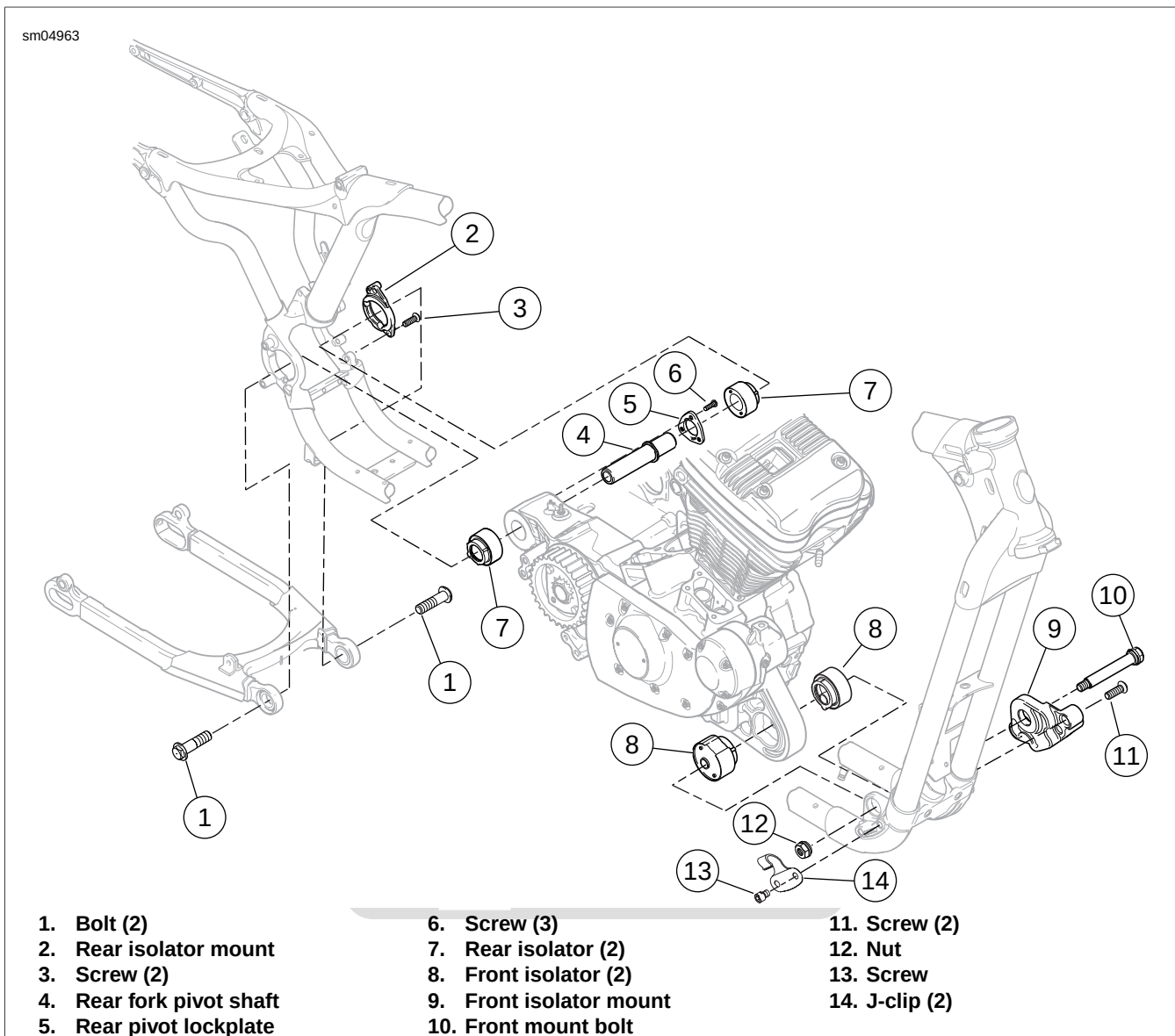


Figure 3-18. Engine Mount/Isolator Components (typical)

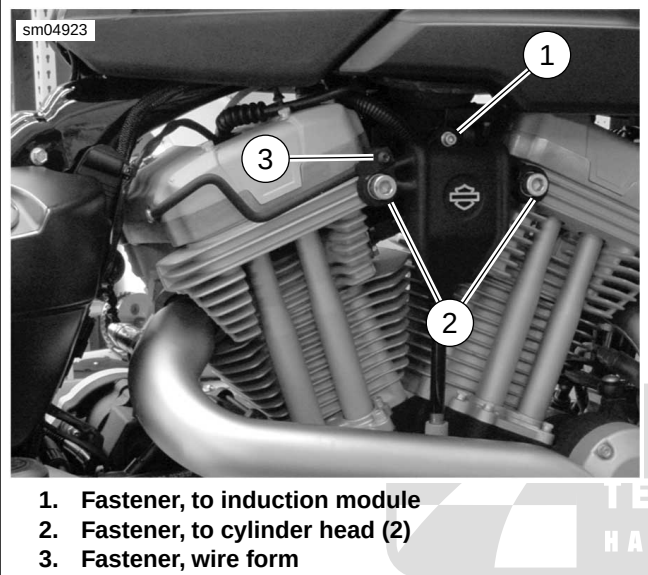
34. With the aid of a FAT JACK (Part No. HD-45968), support motorcycle on SHOP DOLLY (Part No. HD-45967).
35. See [Figure 3-18](#). Remove fasteners (13) and j-clip (14) from each side of frame.
36. Loosen, but do not remove, two front isolator mounting bracket screws (11) on left side of engine.
37. Loosen, but do not remove, two rear isolator mounting bracket screws (3) on left side of engine.
38. Attach ENGINE HOOK (Part No. HD-46284) and engine hoist. Carefully raise engine enough to relieve pressure from mounting bolts.
39. Remove front engine mount bolt (10) and nut (12).
40. Remove two screws (11) and front isolator mount (9).
41. Remove two rear engine mount/rear fork pivot bolts (1). Pull rear fork back until fork pivot bosses clear the frame.
42. Remove oil tank vent hose from oil tank. See [3.27 OIL TANK](#).
43. Remove two screws (3) and rear isolator mounting bracket (2) from frame.
44. Lift engine as necessary and swing assembly out from chassis toward the left side. Swing rear of engine out first. Then remove engine from chassis.

PROCEDURE: XR MODELS

PART NUMBER	TOOL NAME
HD-45967	SHOP DOLLY
HD-45968	FAT JACK
HD-46284	ENGINE HOOK

⚠ WARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)



- 1. Fastener, to induction module
- 2. Fastener, to cylinder head (2)
- 3. Fastener, wire form

Figure 3-19. Induction Module Cover and Wire Form

- 1. Position vehicle upright. Purge the fuel supply hose of high pressure gasoline. Disconnect fuel supply hose from fuel pump module. See [4.7 FUEL TANK: XR MODELS](#).
- 2. Remove seat. See [2.39 SEAT: XR MODELS](#).
- 3. Remove left side cover. See [2.20 LEFT SIDE COVER](#).

⚠ WARNING

Prevent accidental vehicle start-up, which could cause death or serious injury. First disconnect negative (-) battery cable at engine and then positive (+) cable from battery. (00280b)

- 4. Disconnect negative (-) battery cable from ground stud on crankcase. Disconnect positive (+) battery cables at battery. Remove battery. See [1.17 BATTERY MAINTENANCE](#).
- 5. Drain primary chaincase/transmission fluid. See [1.14 TRANSMISSION LUBRICANT](#).
- 6. Drain oil tank. See [1.6 ENGINE OIL AND FILTER](#). Do not install drain plug back in end of drain hose at this time.

- 7. See [Figure 3-19](#). Remove fasteners (1, 2, 3) and remove induction module cover. Cut tie strap securing TP sensor harness to side plate.
- 8. Disconnect O2 sensor connectors [137], [138] and remove exhaust pipes and mufflers as an assembly. See [4.16 EXHAUST SYSTEM: XR MODELS](#).
- 9. Remove these parts if present:
 - a. **California models:** remove EVAP canister and disconnect hoses. See [4.21 EVAPORATIVE EMISSIONS CONTROL \(CA MODELS\)](#).
 - b. **All other models:** remove siren if equipped. See [6.35 OPTIONAL SECURITY SIREN](#).
- 10. See [Figure 3-20](#). Remove two fasteners (1) retaining siren/canister mount plate and brake line (2) retainer.
- 11. Remove three screws securing sprocket cover to engine case. Remove sprocket cover.
- 12. Remove belt guard and debris deflector from rear fork.
- 13. Remove fastener securing right shock absorber to the rear fork.
- 14. Loosen rear axle nut and move rear axle all the way forward. Tighten axle nut enough to hold the axle and wheel in position in the rear fork. Remove rear drive belt. See [5.7 DRIVE BELT](#).
- 15. Remove transmission sprocket only if transmission or engine are to be disassembled. See [5.16 TRANSMISSION SPROCKET](#).
- 16. Disconnect rear stop lamp switch connectors [121].
- 17. Remove rear brake line from clamps at the bottom of left rear fork.

NOTE

When securing rear master cylinder out of the way in the next step, make sure to keep the reservoir upright. If the reservoir is allowed to hang upside down, air bubbles could be introduced into the rear master cylinder. If this happens, the rear brake must be bled to remove all air from the hydraulic brake system.

- 18. See [Figure 3-21](#). Remove fasteners (1) and remove rider's right footrest including master cylinder assembly and rear brake linkage. Be careful not to bend or kink metal brake line and remove assembly out left side of motorcycle. Tie assembly, with master cylinder upright, out of the way.
- 19. Disconnect oil tank feed, drain and return hoses from oil tank. See [3.27 OIL TANK](#). Pull drain hose up through drain hose sleeve in rear of engine crankcase and remove hose from vehicle.
- 20. Unplug horn connectors and remove horn from horn bracket. See [6.37 HORN](#).
- 21. Remove fasteners securing air cleaner to fuel tank. Drain and remove fuel tank. See [4.7 FUEL TANK: XR MODELS](#).
- 22. Remove air cleaner from induction module as an assembly. See [4.5 AIRBOX: XR MODELS](#). California models: remove EVAP purge hose from induction module. See [4.21 EVAPORATIVE EMISSIONS CONTROL \(CA MODELS\)](#).

23. See [4.11 INDUCTION MODULE: XR MODELS](#) and unplug the following connectors from the induction module:
 - a. Fuel injector connectors [84], [85].
 - b. Temperature/Manifold absolute pressure (TMAP) sensor connector [80].
 - c. Idle Air Control (IAC) connector [87].
 - d. Throttle Position (TP) sensor connector [88].
24. Unplug the following electrical connectors from the engine:
 - a. Ground wire at powertrain ground stud on crankcase.
 - b. Spark plug wires.
 - c. Oil pressure switch connector [120]. See [6.36 OIL PRESSURE SWITCH](#).
 - d. Crank position (CKP) sensor connector [79]. See [6.28 CRANK POSITION SENSOR \(CKP\)](#).
 - e. Alternator AC connector [46] and DC connector [77]. See [6.3 VOLTAGE REGULATOR](#).
 - f. Neutral indicator switch connector [136]. See [6.31 NEUTRAL INDICATOR SWITCH](#).
 - g. Vehicle speed sensor (VSS) connector [65]. See [6.30 VEHICLE SPEED SENSOR \(VSS\)](#).
 - h. Starter relay wire (GN) at starter motor. See [6.13 STARTER](#).
 - i. Engine Temperature (ET) sensor connector [90]. Cut and remove barbed cable strap securing sensor harness to H-bracket. See [4.9 ENGINE TEMPERATURE \(ET\) SENSOR](#).
25. If equipped, disconnect jiffy stand sensor connector [133] and remove sensor. See [6.34 JIFFY STAND SWITCH: INTERNATIONAL MODELS](#).
26. Disconnect clutch cable and remove from clutch lever on left handlebar. See [2.31 CLUTCH CONTROL](#). Remove cable from oil cooler mount and clips securing clutch cable to left front downtube.
27. See [Figure 3-22](#). Remove oil cooler fasteners (1) from frame mounts (2) and remove oil cooler. It is not necessary to disconnect the oil hoses attached to the oil cooler. Tie oil cooler to engine.
28. Remove fastener retaining coil bracket to backbone electrical caddy. Remove screw securing ignition switch to coil bracket. Unplug spark plug wires from coil. Unplug ignition coil harness connector [83] from coil. Remove coil and bracket from frame. Position ignition switch out of the way. See [6.19 IGNITION COIL](#).
29. Remove induction module, leaving cables attached. See [4.11 INDUCTION MODULE: XR MODELS](#). Secure induction module assembly and throttle cables out of the way.
30. See [Figure 3-23](#). Remove screws (3, 4), grounding strap (2), stabilizer link (1) and spacer (5).



Figure 3-20. Siren/Canister Mount Plate and Brake Line

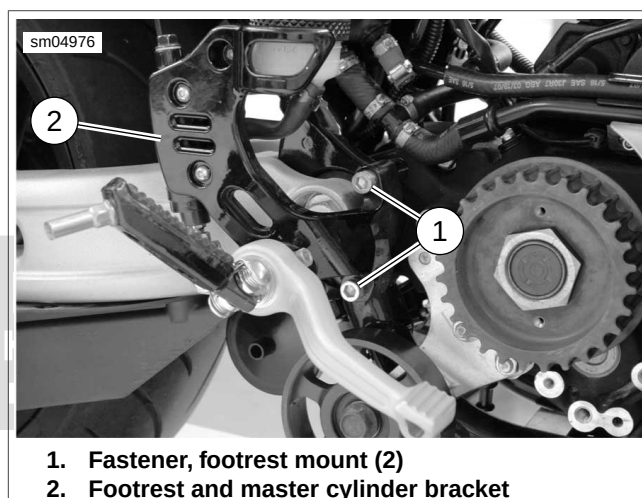


Figure 3-21. Right Footrest and Rear Master Cylinder

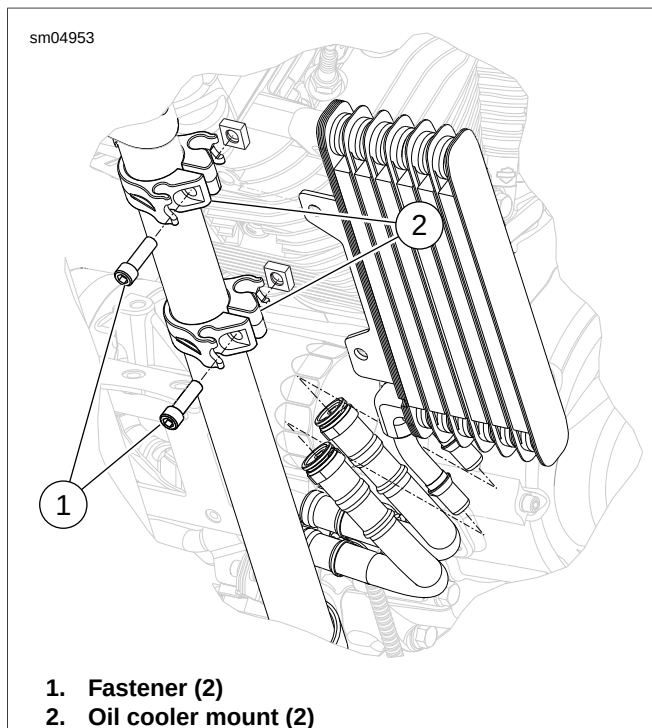


Figure 3-22. Oil Cooler Mounts

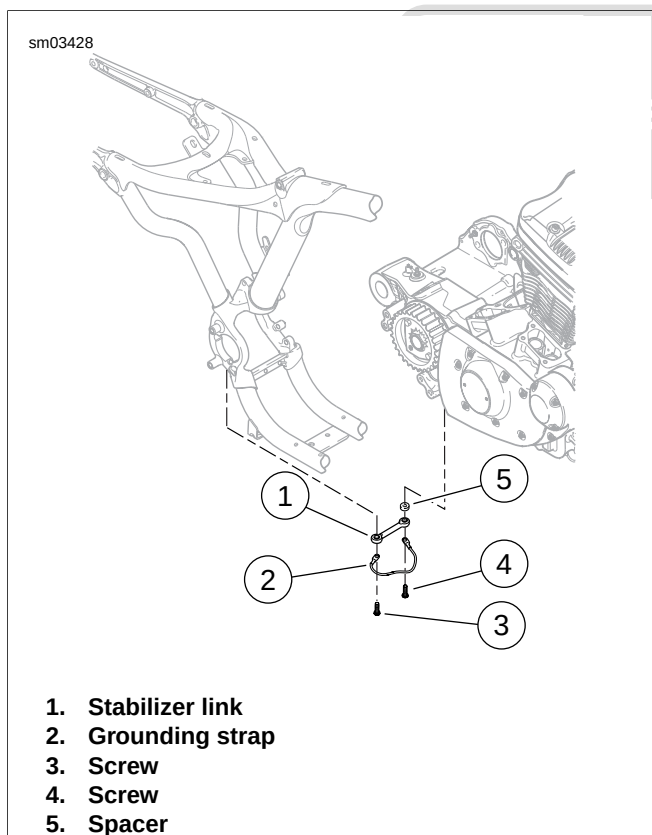


Figure 3-23. Rear Stabilizer Link Assembly: Typical (XL Model Shown)

31. See [Figure 3-24](#). Remove upper stabilizer link (2) and upper frame bracket (3):
 - a. Remove screw (4) securing stabilizer link to engine bracket (1).
 - b. Remove screws (5) and washers (8). Remove horn bracket (9) and upper stabilizer link bracket (3) with stabilizer link.
32. See [Figure 3-25](#). Remove lower stabilizer link (1) and lower frame bracket (2) as an assembly:
 - a. Remove screw (3) securing stabilizer link to engine crankcase boss.
 - b. Remove screws (4), washers (5) and lower frame bracket with stabilizer link.
33. See [Figure 3-26](#). Remove fastener (1) and disconnect shift linkage from transmission shift lever.
34. Remove fasteners (2) and remove rider left footrest and mounting bracket assembly along with foot shift lever and linkage.

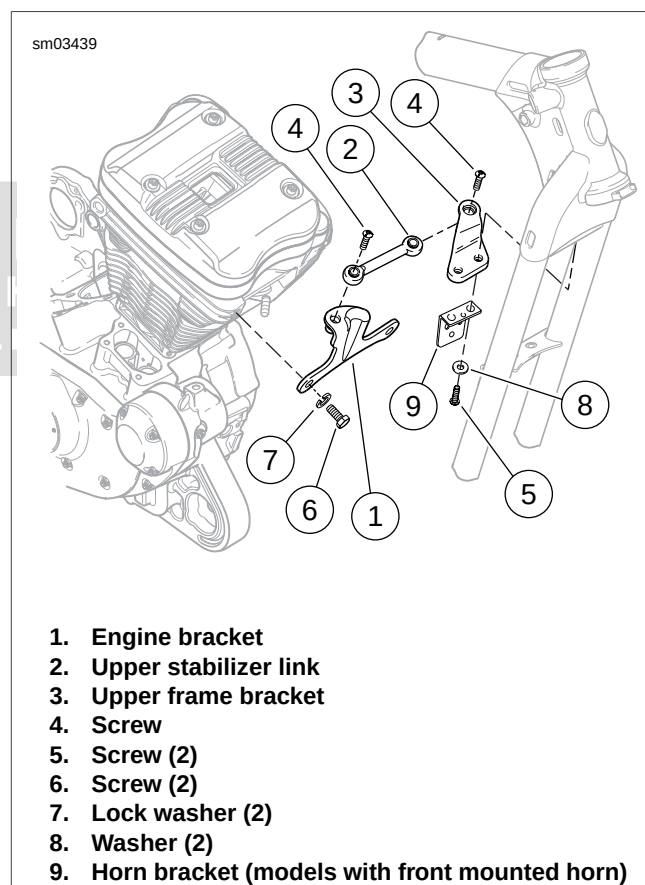


Figure 3-24. Upper Front Stabilizer Link Assembly: Typical (XL Model Shown)

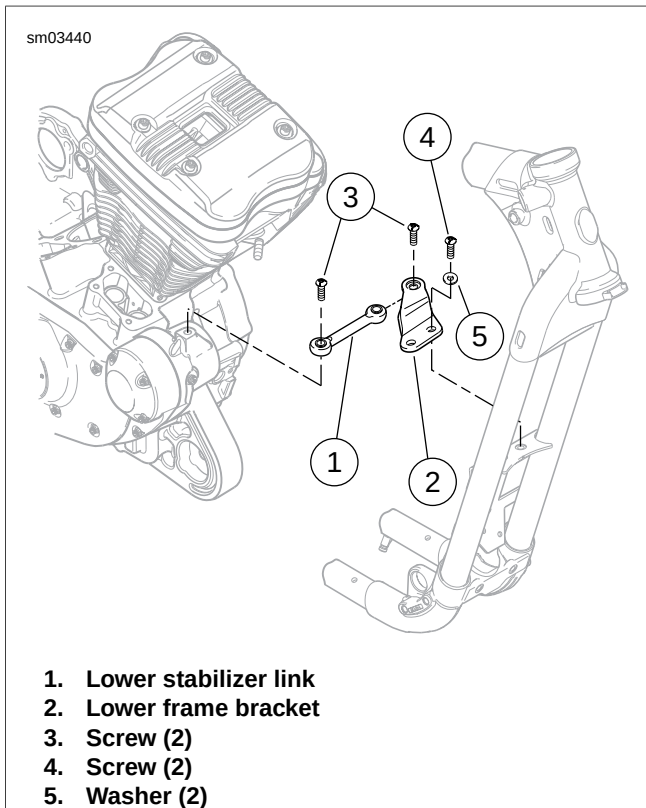


Figure 3-25. Lower Front Stabilizer Link Assembly: Typical (XL Model Shown)

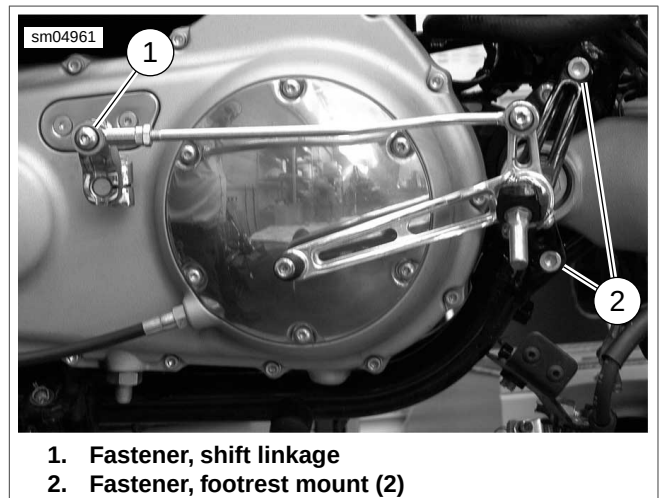


Figure 3-26. Left Footrest and Shift Linkage

35. With the aid of a FAT JACK (Part No. HD-45968), support motorcycle on SHOP DOLLY (Part No. HD-45967).
36. See [Figure 3-27](#). Remove fasteners (13) and j-clip (14) from each side of frame.
37. Loosen, but do not remove, two front isolator mounting bracket screws (11) on left side of engine.
38. Loosen, but do not remove, two rear isolator mounting bracket screws (3) on left side of engine.
39. Attach ENGINE HOOK (Part No. HD-46284) and engine hoist. Carefully raise engine enough to relieve pressure from mounting bolts.
40. Remove front engine mount bolt (10) and nut (12).
41. Remove two screws (11) and front isolator mount (9).
42. Remove two rear engine mount/rear fork pivot bolts (1). Pull rear fork back until fork pivot bosses clear the frame.
43. Remove oil tank vent hose from oil tank. See [3.27 OIL TANK](#).
44. Remove two screws (3) and rear isolator mounting bracket (2) from frame.

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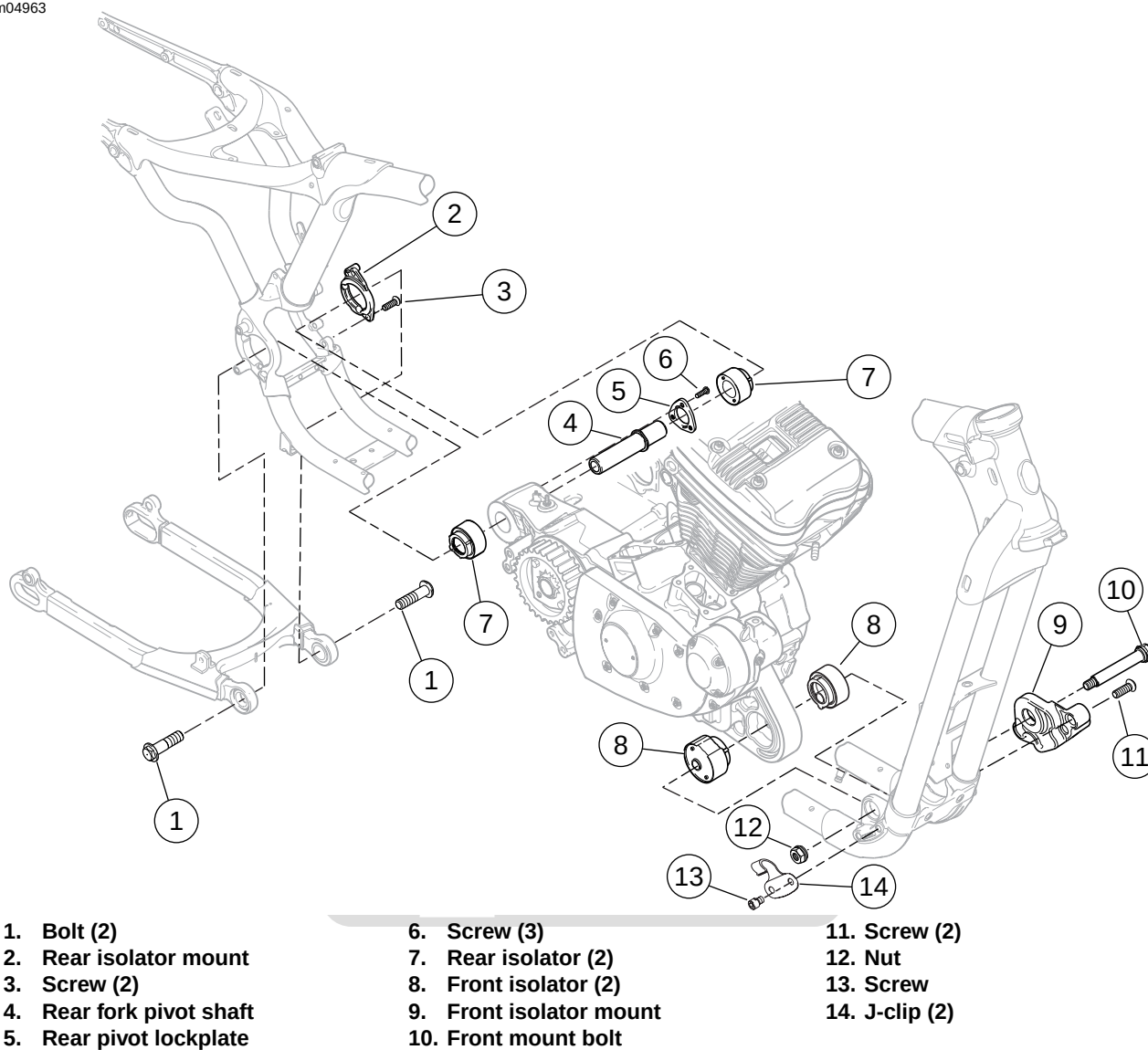


Figure 3-27. Engine Mount/Isolator Components (typical)

45. Rotate backbone electrical caddy to the left to allow room to lift the engine.

46. Lift engine as necessary and swing assembly out from left side of chassis, rear of engine first. Remove engine from chassis.

INSTALLING ENGINE IN CHASSIS

3.13

GENERAL

When installing the engine in the motorcycle, follow the step-by-step procedure below. It is important to follow the procedure as outlined, particularly in the areas of stabilizer link and engine mount assembly.

PROCEDURE: XL MODELS

PART NUMBER	TOOL NAME
HD-45967	SHOP DOLLY
HD-45968	FAT JACK
HD-46284	ENGINE HOOK

- See [Figure 3-18](#). Make sure pivot shaft (4) and rear pivot lockplate (5) are mounted on engine mounting boss at rear of engine. Position right rear isolator (7) on pivot shaft on rear of engine. Do not install left rear isolator at this time.
- Position right front isolator (8) on front of engine. Do not install left front isolator at this time.
- Attach ENGINE HOOK (Part No. HD-46284) and engine hoist to engine.
- Lift engine and swing assembly into chassis from left side. Swing front of engine in first.
- Install left rear isolator (7) over pivot shaft (4). Install rear isolator mount (2) over left rear isolator and attach to frame with two screws (3). Do not tighten screws at this time.
- Raise or lower engine until right front isolator lines up with mounting hole in frame.
- Install left front isolator (8) and front isolator mount (9) to left side of frame with two screws (11). Do not tighten screws at this time.
- Insert front engine mount bolt (10) from left side, through isolators and crankcase boss. Place nut (12) on bolt but do not tighten at this time.
- Tighten two screws (11) securing front isolator mount (9) to 25-35 ft-lbs (33.9-47.5 Nm).
- Tighten two screws (3) securing rear isolator mount (2) to 25-35 ft-lbs (33.9-47.5 Nm).
- Using **new** hose clamp, install oil tank vent hose at oil tank. See [3.27 OIL TANK](#).
- Swing rear fork into position and install rear fork pivot/engine mount bolts (1). Tighten to 60-70 ft-lbs (81.4-95.0 Nm).
- Tighten front engine mount bolt (10) and nut (12) to 60-70 ft-lbs (81.4-95.0 Nm).
- Remove ENGINE HOOK (Part No. HD-46284).
- With the aid of a FAT JACK (Part No. HD-45968), remove motorcycle from SHOP DOLLY (Part No. HD-45967).
- Carefully move rear stop lamp switch and brake lines into place and secure switch assembly to battery tray with bolt. Tighten to 72-120 **in-lbs** (8.1-13.6 Nm). Secure flexible brake hose to battery tray with p-clamp and screw. Tighten to 30-40 **in-lbs** (3.4-4.5 Nm). Plug rear stop lamp switch connectors [121] into rear stop lamp switch. See [6.27 REAR STOP LAMP SWITCH](#).
- Install rear brake master cylinder remote reservoir. Secure with screw with captive washer. Tighten to 20-25 **in-lbs** (2.3-2.8 Nm). Install reservoir cover. See [2.15 REAR BRAKE MASTER CYLINDER RESERVOIR](#).
- Models equipped with passenger foot rests:** Install left passenger footrest assembly. Tighten mounting screws to 45-50 ft-lbs (61-68 Nm). See [2.43 PASSENGER FOOTRESTS](#).
- Install shift lever and rider left footrest and mounting bracket assembly:
 - Models equipped with mid-mount foot controls:** see [2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS](#).
 - Models equipped with forward foot controls:** see [2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS](#).
- See [Figure 3-17](#). Install lower front stabilizer link and frame bracket:
 - Install lower frame bracket (2) with stabilizer link (1), and secure with screws (4) and washers (5). Tighten screws to 25-35 ft-lbs (33.9-47.5 Nm).
 - Install screw (3) securing stabilizer link to engine crankcase boss. Tighten screw to 25-35 ft-lbs (33.9-47.5 Nm).
- See [Figure 3-16](#). Install upper stabilizer link (2) and upper frame bracket (3):
 - Install upper frame bracket with stabilizer link, horn bracket (9) (models with front mounted horn), screws (5) and washers (8). Tighten screws to 25-35 ft-lbs (33.9-47.5 Nm).
 - Install screw (4) securing stabilizer link to engine bracket (1). Tighten screw to 25-35 ft-lbs (33.9-47.5 Nm).
- See [Figure 3-15](#). Install spacer (5), rear stabilizer link (1), grounding strap (2) and screws (3, 4). Tighten screws to 25-35 ft-lbs (33.9-47.5 Nm).
- California models: install EVAP canister and hoses. See [4.21 EVAPORATIVE EMISSIONS CONTROL \(CA MODELS\)](#).
- Install induction module and intake manifold. See [4.10 INDUCTION MODULE: XL MODELS](#).

25. Position left and right wire harness caddies on either side of frame backbone. Plug in the following connectors, located in the caddies:
 - a. Instruments connector [20].
 - b. Headlamp connector [38].
 - c. Right hand control connector (black) [22].
 - d. Left hand control connector (gray) [24].
 - e. Front turn signal connector [31].
26. Mount caddies together. Make sure tabs on caddies engage each other and frame backbone bracket. Secure with screw. See [6.32 MAIN WIRING HARNESS](#).
27. Position ignition coil and bracket on frame behind steering head. Be certain all wiring harnesses from front end of motorcycle, as well as right wire harness caddy mounting boss and throttle cables are positioned properly between coil bracket uprights.
28. Plug ignition coil harness connector [83] into coil. See [6.19 IGNITION COIL](#). Mount ignition switch to coil bracket with screw. Tighten screw to 34-45 **in-lbs** (4.0-5.1 Nm). Secure right wire harness caddy to coil bracket with new push-in fastener.
29. Connect clutch cable to clutch lever on left handlebar. Attach clutch cable (along with wiring harness and front O2 sensor harness) to frame front left downtube with cable clips. Adjust clutch. See [2.31 CLUTCH CONTROL](#).
30. Plug the following electrical connectors into the engine:
 - a. Engine Temperature (ET) sensor connector [90]. Secure sensor harness to H-bracket with barbed cable strap. To avoid damage to sensor when vehicle is in operation, position cable strap on harness so there is a loop in harness between sensor and H-bracket. Press barbed prong of cable strap into hole in boss in H-bracket. See [4.9 ENGINE TEMPERATURE \(ET\) SENSOR](#).
 - b. Starter relay wire (GN) at starter motor. See [6.13 STARTER](#).
 - c. Vehicle speed sensor (VSS) connector [65]. See [6.30 VEHICLE SPEED SENSOR \(VSS\)](#).
 - d. Neutral indicator switch connector [136]. See [6.31 NEUTRAL INDICATOR SWITCH](#).
 - e. Alternator AC connector [46]. See [6.3 VOLTAGE REGULATOR](#).
 - f. Crank position (CKP) sensor connector [79]. See [6.28 CRANK POSITION SENSOR \(CKP\)](#).
 - g. Oil pressure switch connector [120]. See [6.36 OIL PRESSURE SWITCH](#).
 - h. Spark plug wires.
 - i. Ground wire at powertrain ground stud on crankcase.
31. See [4.10 INDUCTION MODULE: XL MODELS](#) and plug the following connectors into the induction module:
 - a. Throttle position (TP) sensor connector [88].
 - b. Idle air control (IAC) connector [87].
 - c. Temperature/manifold absolute pressure (TMAP) sensor connector [80].
 - d. Fuel injector connectors [84], [85].
32. **Models with front mounted horn:** install horn. See [6.37 HORN](#).
33. **Models with side mounted horn:** See [Figure 3-14](#). Install cylinder head bracket (1) with horn (4) onto cylinder heads as a unit. Secure with two screws (3) and washers (2). Tighten screws to 17-24 ft-lbs (23.1-32.6 Nm). Plug wiring harness connectors into horn.
34. Install air cleaner backing plate, air filter and air cleaner cover. See [4.4 AIR CLEANER: XL MODELS](#). California models: install EVAP purge hose on induction module. See [4.21 EVAPORATIVE EMISSIONS CONTROL \(CA MODELS\)](#).

 WARNING

When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)

35. Install fuel tank. Tighten screws to 15-20 ft-lbs (20.4-27.1 Nm). Attach quick-connect fitting on fuel line to fuel tank fitting. Gently tug on quick-connect fitting to make sure it is securely locked in place. See [4.6 FUEL TANK: XL MODELS](#).
36. Feed oil drain hose down through drain hose sleeve in rear of engine crankcase. Using new hose clamps, install oil tank feed, drain and return hoses onto oil tank. Install drain plug in end of drain hose and secure with worm drive clamp. Tighten clamp securely. See [3.27 OIL TANK](#).
37. Install exhaust system interconnect. See [4.15 EXHAUST SYSTEM: XL MODELS](#).
38. Install transmission sprocket. See [5.16 TRANSMISSION SPROCKET](#).
39. Install rear drive belt and hand-tighten rear axle. Final belt adjustment will be performed later. See [5.7 DRIVE BELT](#).
40. Install sprocket cover. Secure with two screws. Note that long screw goes in top hole, short screw in bottom hole. Do not tighten screws at this time.
41. Install exhaust pipe clamp bracket, washer and screw to sprocket cover. Tighten to 30-33 ft-lbs (40.7-44.8 Nm). Now tighten other two sprocket cover screws to 80-120 **in-lbs** (9.0-13.6 Nm).

42. Install right front footrest assembly and rear brake linkage.
 - a. **Models equipped with mid-mount foot controls:** see [2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS](#).
 - b. **Models equipped with forward foot controls:** see [2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS](#).
43. Install exhaust pipes and mufflers. Plug in O2 sensor connectors [137], [138]. Make sure rear O2 sensor harness is routed toward left side of motorcycle before looping back to harness connector so that harness does not contact exhaust pipe or port. See [4.15 EXHAUST SYSTEM: XL MODELS](#).
44. Fill oil tank. See [1.6 ENGINE OIL AND FILTER, Changing Oil and Filter](#).
45. Fill primary chaincase/transmission with transmission lubricant. See [1.14 TRANSMISSION LUBRICANT](#).
46. Adjust belt tension and rear wheel alignment. Tighten rear axle nut to 95-105 ft-lbs (129-142 Nm). Install **new** e-clip. See [1.16 REAR BELT DEFLECTION](#).

WARNING

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

47. Connect positive (+) battery cables to battery. Connect negative (-) battery cable to ground point on engine crankcase. See [1.17 BATTERY MAINTENANCE](#).
48. Install left side cover. See [2.20 LEFT SIDE COVER](#).

WARNING

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

49. Install seat.

PROCEDURE: XR MODELS

PART NUMBER	TOOL NAME
HD-45967	SHOP DOLLY
HD-45968	FAT JACK
HD-46284	ENGINE HOOK

1. See [Figure 3-27](#). Make sure pivot shaft (4) and rear pivot lockplate (5) are mounted on engine mounting boss at rear of engine. Position right rear isolator (7) on pivot shaft on rear of engine. Do not install left rear isolator at this time.
2. Position right front isolator (8) on front of engine. Do not install left front isolator at this time.
3. Attach ENGINE HOOK (Part No. HD-46284) and engine hoist to engine.

4. Lift engine and swing assembly into chassis from left side. Swing front of engine in first.
5. Install left rear isolator (7) over pivot shaft (4). Install rear isolator mount (2) over left rear isolator and attach to frame with two screws (3). Do not tighten screws at this time.
6. Raise or lower engine until right front isolator lines up with mounting hole in frame.
7. Install left front isolator (8) and front isolator mount (9) to left side of frame with two screws (11). Do not tighten screws at this time.
8. Insert front engine mount bolt (10) from left side, through isolators and crankcase boss. Place nut (12) on bolt but do not tighten at this time.
9. Tighten two screws (11) securing front isolator mount (9) to 25-35 ft-lbs (33.9-47.5 Nm).
10. Tighten two screws (3) securing rear isolator mount (2) to 25-35 ft-lbs (33.9-47.5 Nm).
11. Using **new** hose clamp, install oil tank vent hose at oil tank. See [3.27 OIL TANK](#).
12. Swing rear fork into position and install rear fork pivot/engine mount bolts (1). Tighten to 60-70 ft-lbs (81.4-95.0 Nm).
13. Tighten front engine mount bolt (10) and nut (12) to 60-70 ft-lbs (81.4-95.0 Nm).
14. Install j-clip (14) to each side of frame. Tighten fasteners (13) to 45-50 ft-lbs (61.0-67.8 Nm).
15. Remove ENGINE HOOK (Part No. HD-46284).
16. With the aid of a FAT JACK (Part No. HD-45968), remove motorcycle from SHOP DOLLY (Part No. HD-45967).
17. See [Figure 3-25](#). Install lower front stabilizer link and frame bracket:
 - a. Install lower frame bracket (2) with stabilizer link (1), and secure with screws (4) and washers (5). Tighten screws to 25-35 ft-lbs (33.9-47.5 Nm).
 - b. Install screw (3) securing stabilizer link to engine crankcase boss. Tighten screw to 25-35 ft-lbs (33.9-47.5 Nm).
18. See [Figure 3-24](#). Install upper stabilizer link (2) and upper frame bracket (3):
 - a. Install upper frame bracket with stabilizer link, horn bracket (9) (models with front mounted horn), screws (5) and washers (8). Tighten screws to 25-35 ft-lbs (33.9-47.5 Nm).
 - b. Install screw (4) securing stabilizer link to engine bracket (1). Tighten screw to 25-35 ft-lbs (33.9-47.5 Nm).
19. See [Figure 3-23](#). Install spacer (5), rear stabilizer link (1), grounding strap (2) and screws (3, 4). Tighten screws to 25-35 ft-lbs (33.9-47.5 Nm).
20. See [Figure 3-26](#). Install shift lever and rider left footrest and mounting bracket assembly. Tighten fasteners (2) to 45-50 ft-lb (61.0-67.8 Nm).

21. Connect shift linkage to transmission shift lever. Tighten fastener (1) to 10-15 ft-lbs (13.6-20.3 Nm).
 22. Install induction module and intake manifold. See [4.11 INDUCTION MODULE: XR MODELS](#).
 23. Rotate backbone wire harness caddy down into place.
 24. See [6.19 IGNITION COIL](#). Position ignition coil and bracket on backbone caddy behind steering head. Be certain all wiring harnesses from front end of motorcycle, as well as right wire harness caddy mounting boss and throttle cables are positioned properly between coil bracket uprights.
 25. Plug ignition coil harness connector [83] into coil. Mount ignition switch to coil bracket with screw. Tighten screw to 34-45 **in-lbs** (4.0-5.1 Nm). Secure right wire harness caddy to coil bracket with new push-in fastener.
 26. Connect clutch cable to clutch lever on left handlebar and secure to lower oil cooler mount. Attach clutch cable (along with wiring harness and front O2 sensor harness) to frame front left downtube with cable clips. Adjust clutch. See [2.31 CLUTCH CONTROL](#).
 27. See [Figure 3-22](#). Install the oil cooler to the frame mounts. Tighten fasteners (1) to 36-60 **in-lbs** (4.1-6.8 Nm)
 28. Plug the following electrical connectors into the engine:
 - a. Engine Temperature (ET) sensor connector [90]. Secure sensor harness to H-bracket with barbed cable strap. To avoid damage to sensor when vehicle is in operation, position cable strap on harness so there is a loop in harness between sensor and H-bracket. Press barbed prong of cable strap into hole in boss in H-bracket. See [4.9 ENGINE TEMPERATURE \(ET\) SENSOR](#).
 - b. Starter relay wire (GN) at starter motor. See [6.13 STARTER](#).
 - c. Vehicle speed sensor (VSS) connector [65]. See [6.30 VEHICLE SPEED SENSOR \(VSS\)](#).
 - d. Neutral indicator switch connector [136]. See [6.31 NEUTRAL INDICATOR SWITCH](#).
 - e. Alternator AC connector [46]. Secure to right downtube with a tie strap. See [6.3 VOLTAGE REGULATOR](#).
 - f. Connect voltage regulator DC connector [77] and secure to frame cross member with tie strap. See [6.3 VOLTAGE REGULATOR](#).
 - g. Crank position (CKP) sensor connector [79]. See [6.28 CRANK POSITION SENSOR \(CKP\)](#).
 - h. Oil pressure switch connector [120]. See [6.36 OIL PRESSURE SWITCH](#).
 - i. Spark plug wires.
 - j. Ground wire at powertrain ground stud on crankcase.
 29. See [4.11 INDUCTION MODULE: XR MODELS](#) and plug the following connectors into the induction module:
 - a. Throttle Position (TP) sensor connector [88].
 - b. Idle Air Control (IAC) connector [87].
 - c. Temperature/Manifold absolute pressure (TMAP) sensor connector [80].
 - d. Fuel injector connectors [84], [85].
 30. Install and connect jiffy stand sensor. See [6.34 JIFFY STAND SWITCH: INTERNATIONAL MODELS](#).
 31. Install and connect horn. See [6.37 HORN](#).
 32. See [Figure 3-19](#). Install induction module cover. Secure TP sensor harness to cover during installation. Tighten fasteners (2) to 20-24 ft-lbs (27.1-32.5 Nm). Tighten fastener (1) to 84-108 **in-lbs** (9.5-12.2 Nm). Tighten fastener (3) to 84-108 **in-lbs** (9.5-12.2 Nm).
 33. Install air cleaner assembly on induction module. Connect breather hoses to rocker box fittings. See [4.5 AIRBOX: XR MODELS](#). California models: install EVAP purge hose on induction module. See [4.21 EVAPORATIVE EMISSIONS CONTROL \(CA MODELS\)](#).
-  **WARNING**
- When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)**
34. Install fuel tank. Tighten screws to 15-20 ft-lbs (20.4-27.1 Nm). Attach quick-connect fitting on fuel line to fuel tank fitting. Gently tug on quick-connect fitting to make sure it is securely locked in place. See [4.7 FUEL TANK: XR MODELS](#).
 35. Secure air filter assembly to fuel tank with two screws.
 36. Feed oil drain hose down through drain hose sleeve in rear of engine crankcase. Using new hose clamps, install oil tank feed, drain and return hoses onto oil tank. Install drain plug in end of drain hose and secure with worm drive clamp. Tighten clamp securely. See [3.27 OIL TANK](#).
 37. See [Figure 3-21](#). Install right rider footrest assembly and rear master cylinder assembly. Tighten fasteners (1) to 45-50 ft-lbs (61.0-67.8 Nm).
 38. See [Figure 3-20](#). Secure brake line and siren/canister mount plate to frame and rear fork. Tighten fasteners (1) to 17-22 ft-lbs (23.0-29.8 Nm). Connect rear brake light switch connectors.
 39. Install these parts if present:
 - a. **California models:** install EVAP canister and hoses. See [4.21 EVAPORATIVE EMISSIONS CONTROL \(CA MODELS\)](#).
 - b. **All other models:** install siren if equipped. See [6.35 OPTIONAL SECURITY SIREN](#).
 40. If removed, install transmission sprocket. See [5.16 TRANSMISSION SPROCKET](#).

41. Install rear drive belt and hand-tighten rear axle. Final belt adjustment will be performed later. See [5.7 DRIVE BELT](#).
42. Secure right shock absorber to rear fork and tighten fastener to 30-45 ft-lb (40.7-61.0 Nm)
43. Install belt guard and debris deflector.
44. Install sprocket cover. Tighten rear (larger) screw to 30-33 ft-lbs (40.7-44.8 Nm). Tighten forward and lower (smaller) screws to 80-120 **in-lbs** (9.0-13.6 Nm).
45. Install exhaust pipes and mufflers. See [4.16 EXHAUST SYSTEM: XR MODELS](#).

NOTE

It is important to route and secure the front O2 sensor harness correctly to prevent premature harness failure. Closely follow the procedure in [4.14 OXYGEN SENSOR, Installation](#).

46. Plug in O2 sensor connectors [137], [138]. Make sure each O2 sensor harness is routed and secured correctly. See [4.14 OXYGEN SENSOR, Installation](#).
47. Fill oil tank. See [1.6 ENGINE OIL AND FILTER, Changing Oil and Filter](#).
48. Fill primary chaincase/transmission with transmission lubricant. See [1.14 TRANSMISSION LUBRICANT](#).

49. Adjust belt tension and rear wheel alignment. Tighten rear axle nut to 95-105 ft-lbs (129-142 Nm). Install **new** e-clip. See [1.16 REAR BELT DEFLECTION](#).

⚠ WARNING

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

50. Connect positive (+) battery cables to battery. Connect negative (-) battery cable to ground point on engine crankcase. See [1.17 BATTERY MAINTENANCE](#).
51. Install left side cover. See [2.20 LEFT SIDE COVER](#).

⚠ WARNING

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

52. Install seat.



GENERAL

PART NUMBER	TOOL NAME
HD-46503	OIL LINE REMOVER, 1/2 IN.
HD-49096	OIL LINE REMOVER, 3/8 IN.

See [Figure 3-28](#). The oil lines used in the Precision Cooling System incorporate flanged oil lines and quick connect fittings. These fittings can be separated using either the OIL LINE REMOVER, 1/2 IN. (Part No. HD-46503) or OIL LINE REMOVER, 3/8 IN. (Part No. HD-49096) like that shown in [Figure 3-29](#), depending on line diameter.

1. See [Figure 3-29](#). Close the OIL LINE REMOVER over the oil line. Match the notches in the tool flange to the U-bends in the retainer clip.
2. Rotate the tool to expand the spring clip.
3. Use finger and thumb to hold the OIL LINE REMOVER squarely against the fitting to keep the spring clip expanded. Use only enough pressure to hold the tool square. Excess pressure will prevent simultaneously pulling the line and tool from the fitting.
4. Pull the oil line and the tool from the fitting.
5. To assemble, push the oil line squarely into quick connect fitting to connect. Always apply a light film of clean engine oil to the oil line to ease assembly and prevent damage to the connector o-ring.

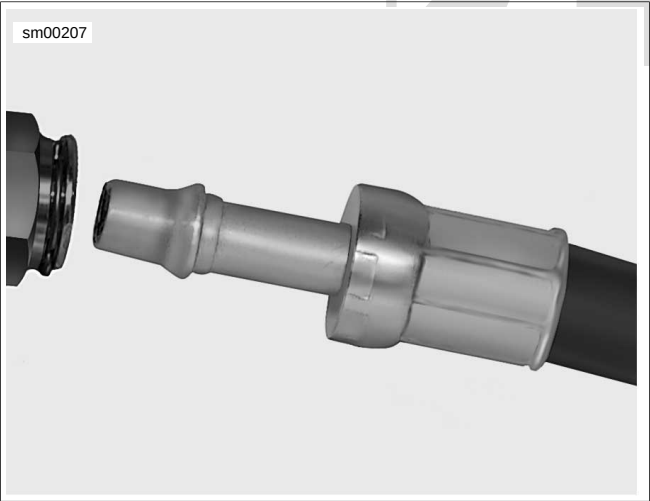


Figure 3-28. Flanged Oil Line



Figure 3-29. Oil Line Remover

RETURN OIL MANIFOLD

PART NUMBER	TOOL NAME
HD-49096	OIL LINE REMOVER, 3/8 IN.

Removal

1. Disconnect and remove battery. See [1.17 BATTERY MAINTENANCE](#).
2. Remove exhaust system. See [4.16 EXHAUST SYSTEM: XR MODELS](#).
3. Drain oil tank. See [1.6 ENGINE OIL AND FILTER](#).
4. Remove oil drain hose from sleeve in rear engine crankcase.
5. Remove battery positive (+) cable from starter motor. See [6.13 STARTER](#).
6. See [Figure 3-31](#). From right side of motorcycle, remove fastener (1) securing oil manifold.
7. See [Figure 3-30](#). Disconnect oil return hose (2) from oil tank.
8. Remove rear cylinder head oil line (1) from quick connect fitting using OIL LINE REMOVER, 3/8 IN. (Part No. HD-49096) while sliding return oil manifold back off from rigid oil lines and remove assembly from engine.

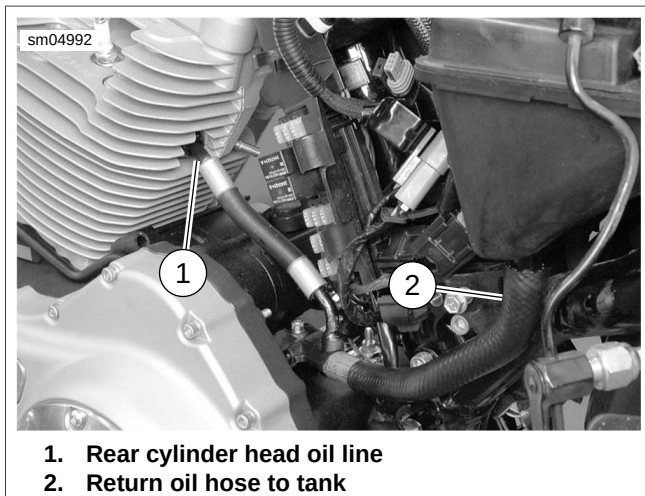


Figure 3-30. Rear Cylinder Oil Line



Figure 3-31. Return Oil Manifold

Installation

NOTE

Used o-rings can leak. Always install **new** o-rings when performing repairs.

1. Install **new** o-rings in manifold assembly and apply a light film of oil to them.
2. Start return oil manifold on rigid lines and install rear cylinder head oil line in quick connect fitting. Ensure it is securely held by the retainer clip.
3. See [Figure 3-31](#). Slide oil manifold onto rigid lines and secure with screw (1). Tighten to 84-108 **in-lbs** (9.5-12.2 Nm).
4. Connect oil return hose to oil tank. Secure with clamp.
5. Install and connect oil tank drain hose. Install and secure plug in drain hose.
6. Connect battery positive (+) cable to starter. See [6.13 STARTER](#).
7. Install and connect battery. See [1.17 BATTERY MAINTENANCE](#).

8. Fill oil tank with the appropriate oil. See [1.6 ENGINE OIL AND FILTER](#).

CYLINDER HEAD OIL RETURN LINES

PART NUMBER	TOOL NAME
HD-49096	OIL LINE REMOVER, 3/8 IN.

Removal

1. Remove return oil manifold. See [3.14 PRECISION COOLING SYSTEM: XR MODELS](#), Return Oil Manifold.
2. See [Figure 3-32](#). Remove fastener (1) and raise retainer until alignment pin (2) is clear of bore in crankcase. Roll retainer out from beneath rigid oil lines to remove.
3. See [Figure 3-33](#). Remove nut (1) and washer.
4. Separate front oil line (2) from cylinder head using OIL LINE REMOVER, 3/8 IN. (Part No. HD-49096).
5. Separate rear oil line (3) from cylinder head using OIL LINE REMOVER, 3/8 IN. (Part No. HD-49096).
6. If front oil line needs to be completely removed, remove electric starter. See [6.13 STARTER](#).
7. If necessary, remove quick connect fitting from cylinder head.

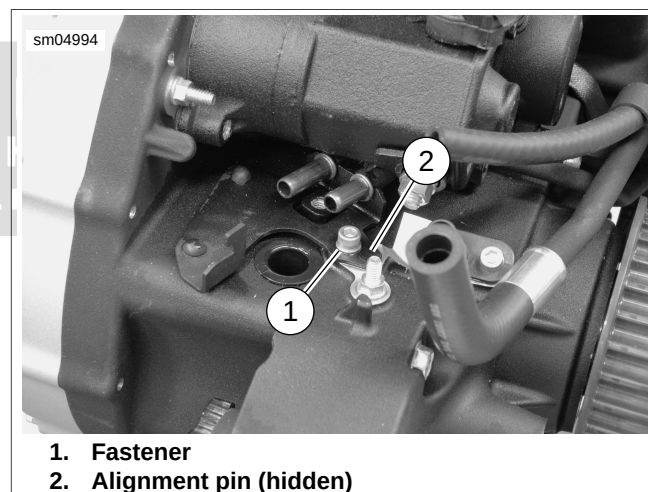


Figure 3-32. Rigid Oil Line Retainer

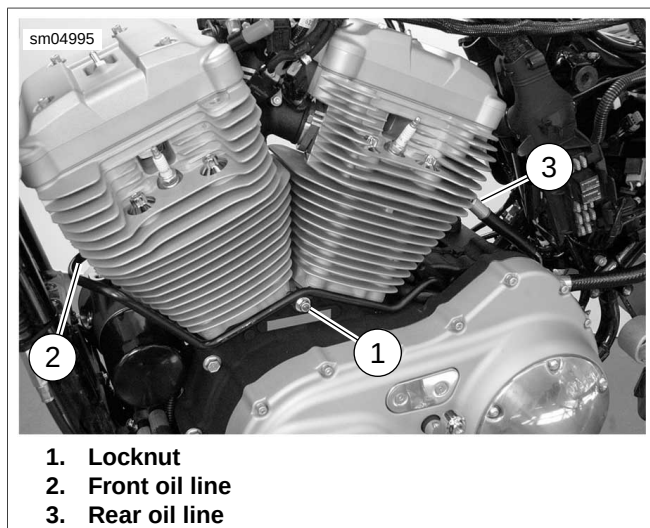


Figure 3-33. Cylinder Head Oil Lines

Installation

NOTE

Used o-rings can leak. Always install **new** o-rings when performing repairs.

1. If removed from cylinder head, install quick connect fittings with **new** o-rings. Tighten to 108-156 **in-lbs** (12.2-17.6 Nm).
2. Install new internal o-rings in quick connect fittings.
3. If removed, place front cylinder head oil line on engine and install electric starter. See [6.13 STARTER](#).

NOTE

Apply a light film of oil to the end of the line before inserting it into the fitting.

4. See [Figure 3-33](#). Connect front oil line (2) to cylinder head. Ensure it is securely held by the retainer clip.
5. Secure front line to crankcase with locknut (1) and washer. Tighten to 84-108 **in-lbs** (9.5-12.2 Nm).
6. See [Figure 3-32](#). Roll retainer under rigid lines at rear of crankcase and orient so alignment pin is in bore in case. Ensure flanges on lines are on the manifold side of the retainer. Secure with fastener (1) and tighten to 84-108 **in-lbs** (9.5-12.2 Nm).
7. Install return oil manifold. See [3.14 PRECISION COOLING SYSTEM: XR MODELS, Return Oil Manifold](#).
8. See [Figure 3-33](#). Connect rear oil line (3) to cylinder head. Ensure it is securely held by the retainer clip.

CYLINDER HEAD OIL FEED ASSEMBLY

Removal

1. Disconnect the battery. See [1.17 BATTERY MAINTENANCE](#).
2. Drain oil tank. See [1.6 ENGINE OIL AND FILTER](#).
3. See [Figure 3-34](#). Disconnect flare nuts (1) from each cylinder head.

4. Pull oil feed hose connector (2) straight up to remove feed hose assembly from check valve assembly (3).
5. Remove two fasteners (4) and remove check valve assembly (3).
6. See [Figure 3-35](#). Carefully clamp assembly in vise and remove plug fitting (7).
7. Remove spring (5) and ball (4).
8. If necessary, remove flare fittings from cylinder heads.
9. Inspect components for wear or damage and replace as necessary.

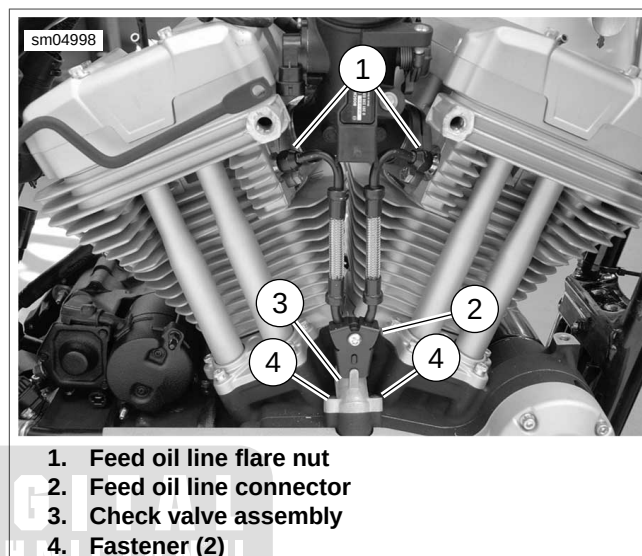


Figure 3-34. Cylinder Head Oil Feed Assembly

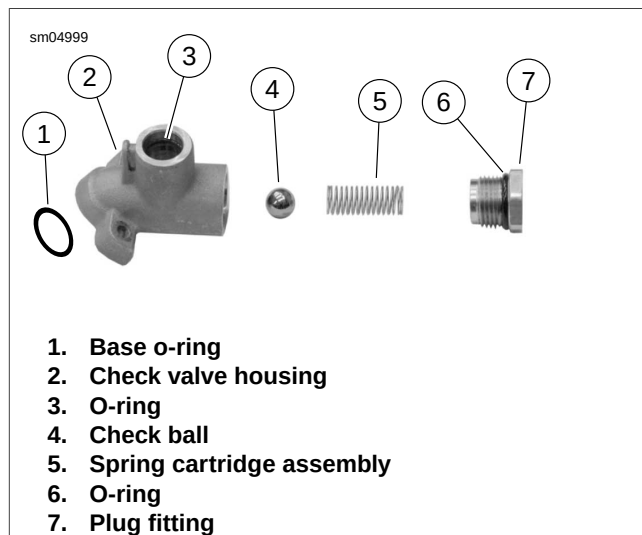


Figure 3-35. Check Valve Components

Installation

1. See [Figure 3-35](#). Install ball (4) and spring (5) into housing (2).

NOTE

Used o-rings can leak. Always install **new** o-rings when performing repairs.

2. Install **new** o-ring (6) on check valve plug fitting (7) and install fitting. Tighten to 15-21 ft-lbs (20.3-28.5 Nm).
3. Install **new** o-ring (3) in bore of housing.
4. Install housing (2) with **new** base o-ring (1). Tighten fasteners to 84-108 **in-lbs** (9.5-12.2 Nm).
5. If removed, apply Loctite Threadlocker and Sealant (243) to the flare fittings and install in cylinder heads with **new** o-rings. Tighten fittings to 22-26 ft-lbs (29.8-35.3 Nm).

NOTE

Apply a light film of oil to the end of the line before inserting it into the fitting.

6. See [Figure 3-34](#). Push oil feed hose assembly straight down to install. Connect oil line flare nuts (1) to cylinder head flare fittings. Hold lines to prevent rotation and tighten to 13-17 ft-lbs (17.6-23.0 Nm).
7. Install and connect battery. See [1.17 BATTERY MAINTENANCE](#).
8. Fill oil tank with the appropriate oil. See [1.6 ENGINE OIL AND FILTER](#).

OIL PUMP LINES

PART NUMBER	TOOL NAME
HD-46503	OIL LINE REMOVER, 1/2 IN.
HD-49096	OIL LINE REMOVER, 3/8 IN.

Removal

1. Remove return oil manifold. See [3.14 PRECISION COOLING SYSTEM: XR MODELS, Return Oil Manifold](#).
2. See [Figure 3-36](#). Remove fastener (1) and raise retainer until alignment pin (2) is clear of bore in crankcase. Roll retainer out from beneath rigid oil lines to remove.
3. See [Figure 3-37](#). Remove return oil line (1) from gearcase cover using OIL LINE REMOVER, 3/8 IN. (Part No. HD-49096).
4. If return oil line needs to be completely removed, remove electric starter. See [6.13 STARTER](#).
5. Remove feed oil line (2) from gearcase cover using OIL LINE REMOVER, 1/2 IN. (Part No. HD-46503).
6. Disconnect vent hose (3) from fitting on oil pump.
7. See [Figure 3-38](#). Remove locknut (1) and washer. Remove oil cooler line retainer (2) from lines.
8. See [Figure 3-37](#). Release each oil cooler line (4, 5) from bottom of gearcase cover using OIL LINE REMOVER, 1/2 IN. (Part No. HD-46503).
9. If necessary, remove quick connect fittings.

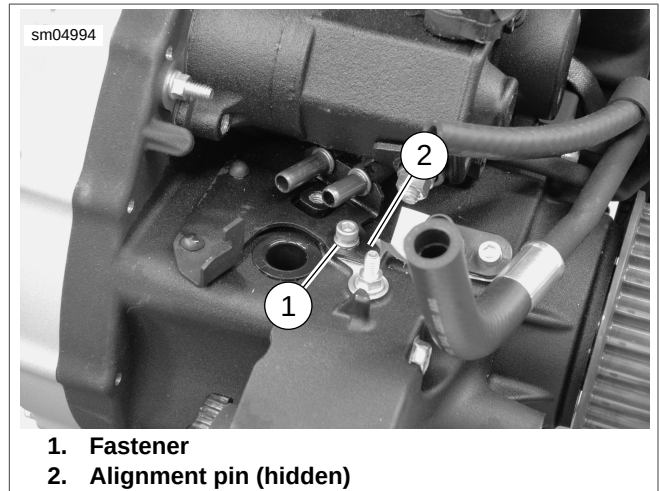


Figure 3-36. Rigid Oil Line Retainer

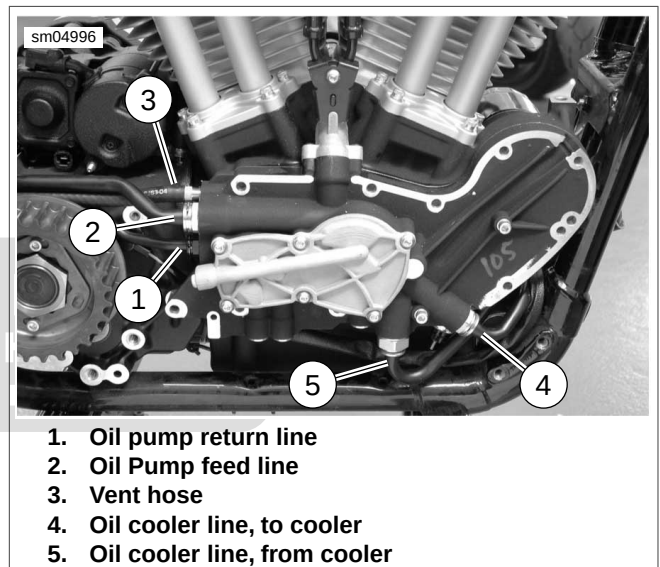


Figure 3-37. Oil Pump Lines

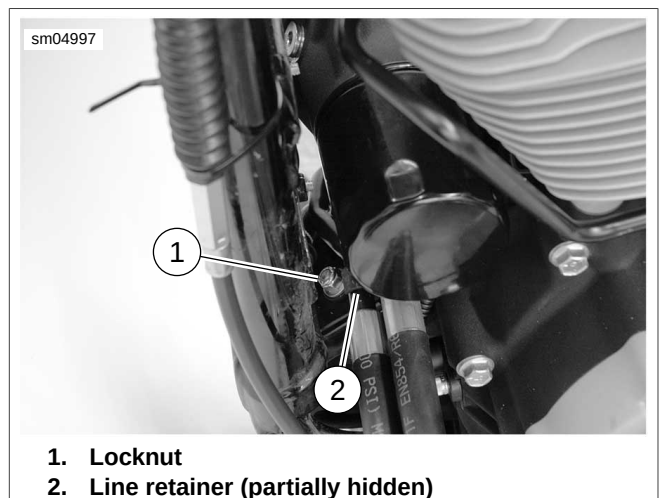


Figure 3-38. Oil Cooler Line Retainer

Installation

NOTE

Used o-rings can leak. Always install **new** o-rings when performing repairs.

- 1. If removed, install quick connect fittings with **new** o-rings. Tighten to 108-156 **in-lbs** (12.2-17.6 Nm).
- 2. Install **new** o-rings in quick connect fittings.

NOTE

Apply a light film of oil to the end of each line before inserting it into the fitting.

- 3. See [Figure 3-37](#). Connect oil cooler lines (4, 5) to lower gearcase cover. Ensure each is securely held by the retainer clip.
- 4. See [Figure 3-38](#). Install oil cooler line retainer (2) and tighten nut (1) securely.
- 5. See [Figure 3-37](#). If removed, place return line (1) on engine and install electric starter. See [6.13 STARTER](#).
- 6. Connect vent (3), feed oil (2) and return oil (1) lines to oil pump body and cam support. Ensure each is securely held by the retainer clip.
- 7. See [Figure 3-36](#). Roll retainer under rigid lines at rear of crankcase and orient so alignment pin (2) is in bore in case. Ensure flanges on lines are on the manifold side of the retainer. Secure with screw (1) and tighten to 84-108 **in-lbs** (9.5-12.2 Nm).
- 8. Install return oil manifold. See [3.14 PRECISION COOLING SYSTEM: XR MODELS, Return Oil Manifold](#).
- 9. Fill oil tank with the appropriate oil. See [1.6 ENGINE OIL AND FILTER](#).

OIL COOLER

PART NUMBER	TOOL NAME
HD-46503	OIL LINE REMOVER, 1/2 IN.

Removal

- 1. Disconnect the battery. See [1.17 BATTERY MAINTENANCE](#).
- 2. Drain oil tank. See [1.6 ENGINE OIL AND FILTER](#).
- 3. Using OIL LINE REMOVER, 1/2 IN. (Part No. HD-46503), separate oil cooler lines from oil cooler.
- 4. See [Figure 3-39](#). Remove fasteners (1) securing oil cooler to frame brackets.
- 5. Remove oil cooler from motorcycle.

- 6. If necessary, remove oil cooler rigid lines from gearcase cover. See [3.14 PRECISION COOLING SYSTEM: XR MODELS, Oil Pump Lines](#).

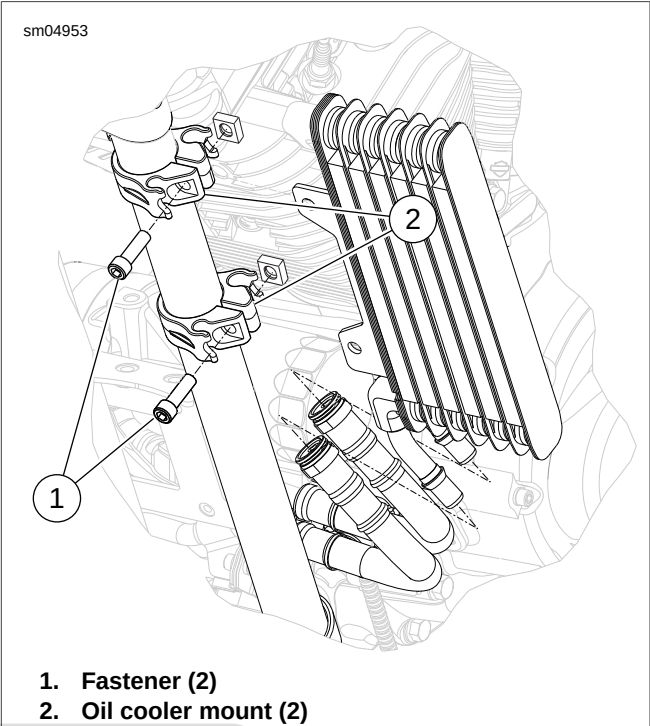


Figure 3-39. Oil Cooler Mounts

Installation

NOTE

Used o-rings can leak. Always install **new** o-rings when performing repairs.

- 1. Install **new** o-rings in quick connect fittings.
- 2. If removed, install oil cooler rigid lines. See [3.14 PRECISION COOLING SYSTEM: XR MODELS, Oil Pump Lines](#).
- 3. See [Figure 3-39](#). Secure oil cooler to frame brackets. Tighten fasteners (1) to 36-60 **in-lbs** (4.1-6.8 Nm).

NOTE

Apply a light film of oil to the end of the line before inserting it into the fitting.

- 4. Connect oil lines to oil cooler fittings. Ensure each is securely held by the retainer clip.
- 5. Fill the oil tank. See [1.6 ENGINE OIL AND FILTER](#).
- 6. Connect the battery. See [1.17 BATTERY MAINTENANCE](#).

TOP END OVERHAUL: DISASSEMBLY

3.15

GENERAL

This section describes disassembling the top end of the engine, from the cylinder deck up. To perform a complete top end overhaul, follow all steps listed in this section. Then follow all steps listed in the following sections, including inspection and repair procedures: [3.21 CYLINDER HEAD](#), [3.22 CYLINDER AND PISTON](#), and [3.19 VALVE TAPPETS](#).

NOTE

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

STRIPPING MOTORCYCLE FOR TOP END REPAIR

⚠ WARNING

When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)

1. Purge the fuel supply hose of high pressure gasoline. Disconnect fuel supply hose from fuel pump module. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).
2. Remove seat.

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

3. Unplug main fuse. See [6.38 MAIN FUSE](#).
4. Unplug O2 sensor connectors [137], [138] and remove exhaust pipes and mufflers. See [4.15 EXHAUST SYSTEM: XL MODELS](#) or [4.16 EXHAUST SYSTEM: XR MODELS](#).
5. Disconnect spark plug cables from spark plugs.
6. Drain and remove fuel tank. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).
7. **Models with side mounted horn:** unplug wiring harness connectors from horn. See [Figure 3-14](#). Remove two screws (3) and washers (2). Remove cylinder head bracket (1) and horn (4) from cylinder heads as an assembly.

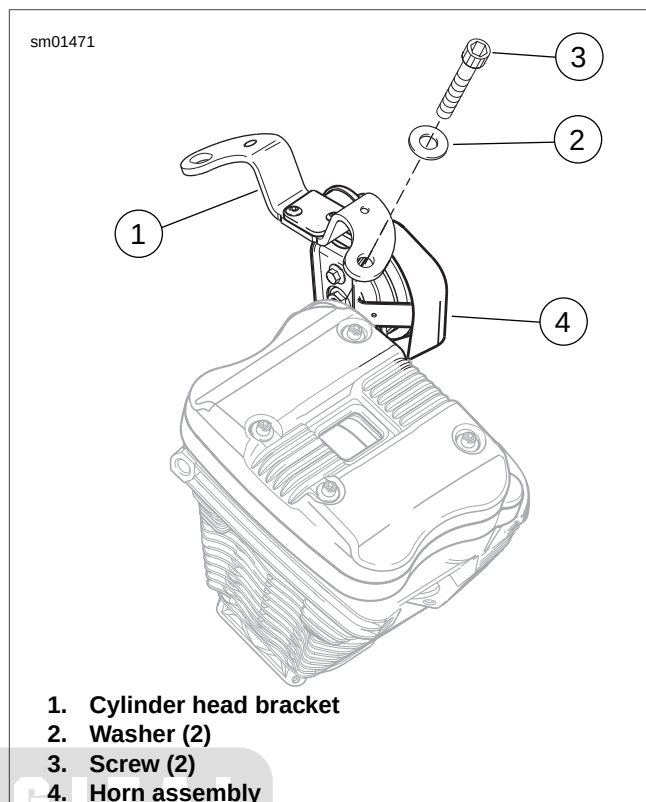


Figure 3-40. Horn and Cylinder Head Bracket (Models With Side Mounted Horn Only)

8. **Models with front mounted horn:** unplug horn connectors and remove horn from horn bracket. See [6.37 HORN](#).
9. Remove air cleaner assembly:
 - a. **XL models:** remove cover, air filter and air cleaner backing plate. See [4.4 AIR CLEANER: XL MODELS](#).
 - b. **California models:** remove EVAP purge hose from induction module. See [4.21 EVAPORATIVE EMISSIONS CONTROL \(CA MODELS\)](#).
10. See [4.10 INDUCTION MODULE: XL MODELS](#) or [4.11 INDUCTION MODULE: XR MODELS](#) and unplug the following connectors from the induction module and remove induction module:
 - a. Fuel injector connectors [84], [85].
 - b. Temperature/Manifold absolute pressure (TMAP) sensor connector [80].
 - c. Idle Air Control (IAC) connector [87].
 - d. Throttle Position (TP) sensor connector [88].
11. Secure induction module assembly and throttle cables out of the way.

12. See [Figure 3-41](#). Remove upper front stabilizer link and frame bracket:
- Remove screw (4) securing stabilizer link (2) to engine bracket (1).
 - Remove screws (5) and washers (8). Remove horn bracket (9) (models with front mounted horn) and frame bracket (3) with stabilizer link.

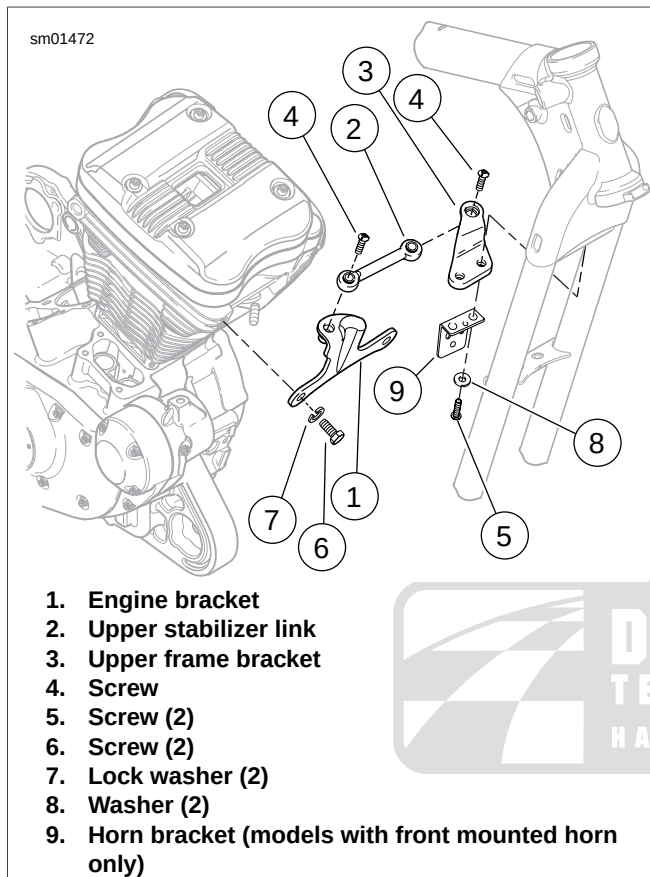


Figure 3-41. Upper Front Stabilizer Link Assembly (typical)

CYLINDER HEADS

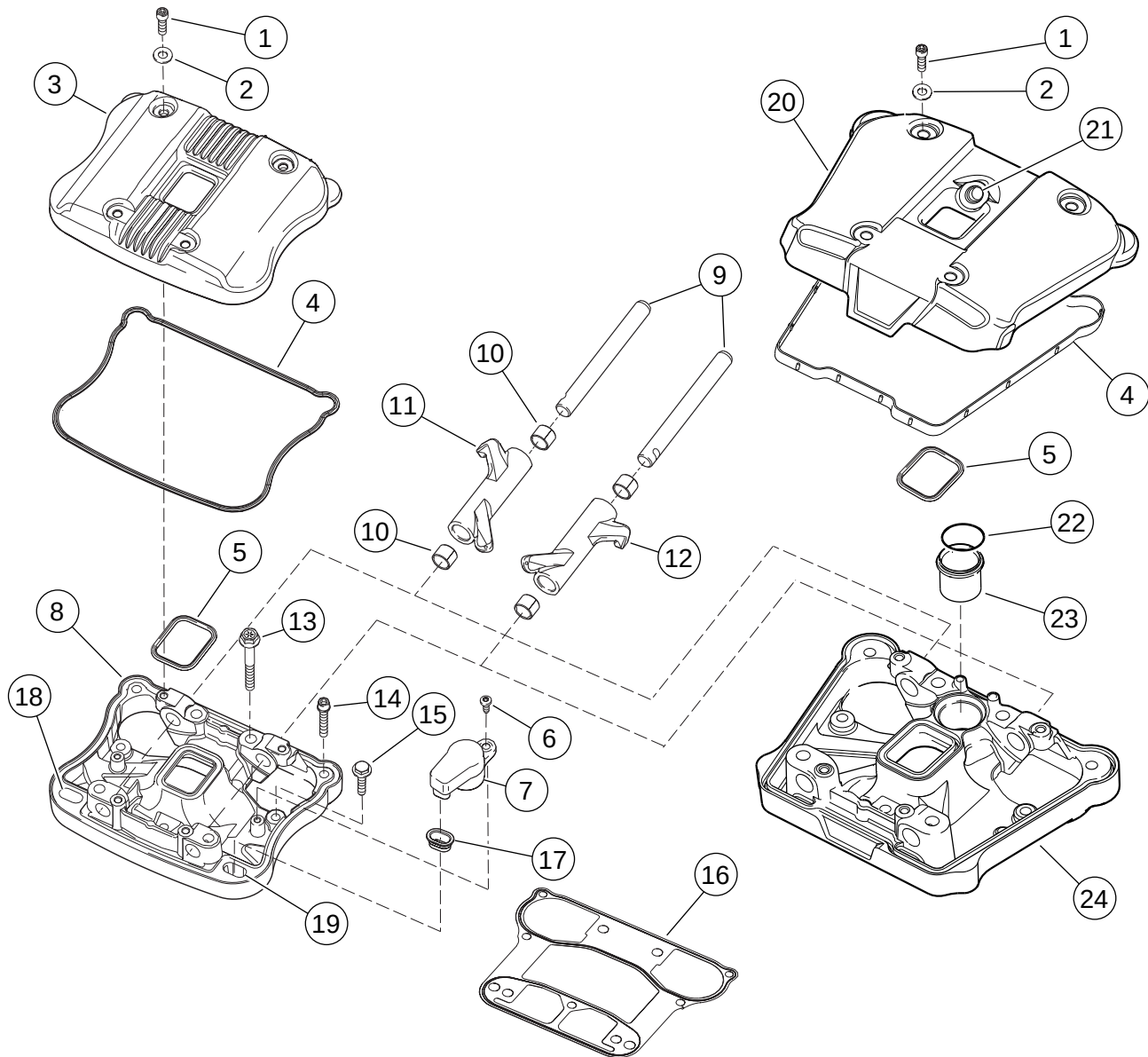
Disassembling Rocker Covers

CAUTION

Prevent engine damage. Washers and fasteners used in the engine are hardened parts. Do not use unhardened parts. (00544b)

- Remove spark plugs.
- See [Figure 3-42](#). Remove four screws with captive washers (1) and sealing washers (2). Remove outer rocker cover (3) or (20). Discard sealing washers.
- Remove and discard gaskets (4, 5).
- Rotate crankshaft until both valves are closed on head being removed.

sm01473



1. Screw w/ captive washer (4)
2. Sealing washer (4)
3. Outer rocker cover: XL Models
4. Gasket
5. Gasket
6. Screw
7. Breather assembly: XL Models
8. Inner rocker cover: XL Models
9. Rocker arm shaft (2)
10. Rocker arm bushing (4)
11. Rocker arm
12. Rocker arm

13. Bolt (4)
14. Screw (2)
15. Bolt (3)
16. Gasket
17. Breather seal: XL Models
18. Breather location: Front Cylinder: XL Models
19. Breather location: Rear Cylinder: XL Models
20. Outer rocker cover: XR Models
21. Breather hose fitting hole: XR Models
22. O-ring: XR Models
23. Breather filter and valve assembly: XR Models
24. Inner rocker cover: XR Models

Figure 3-42. Rocker Cover Assembly

5. See [Figure 3-43](#). Remove hardware securing inner rocker cover to cylinder head in the following order.
 - a. Remove two screws and washers (1).
 - b. Remove three bolts and washers (2).
 - c. Loosen four rocker arm bolts (3) in 1/4-1/2 turn increments using a cross pattern. This relieves valve spring pressure evenly on inner rocker cover.

NOTE

Remove each inner rocker cover as an assembly; then disassemble as required.

6. See [Figure 3-42](#). Remove inner rocker cover (8) or (24). Remove and discard gasket (16).
7. Remove breather assembly:
 - a. **XL models:** remove screw (6), breather assembly (7) and breather seal (17). Discard seal.
 - b. **XR models:** push breather assembly (23) and o-ring (22) out from the under side.

NOTE

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.

8. See [Figure 3-44](#). Remove rocker arm shafts by tapping them out using a hammer and a soft metal punch.

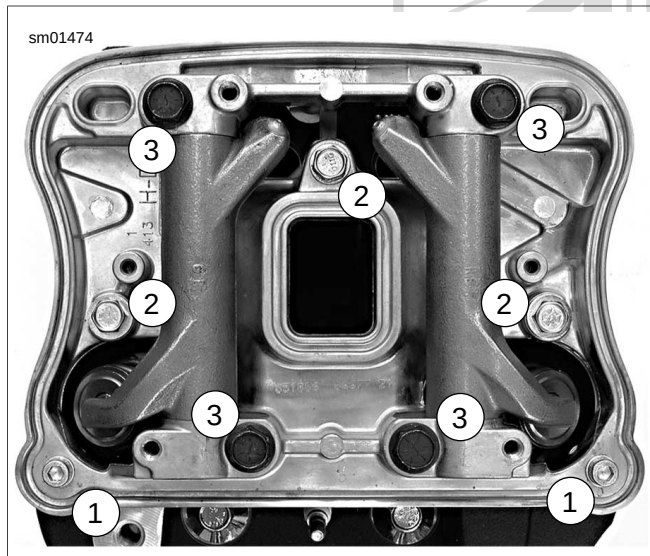
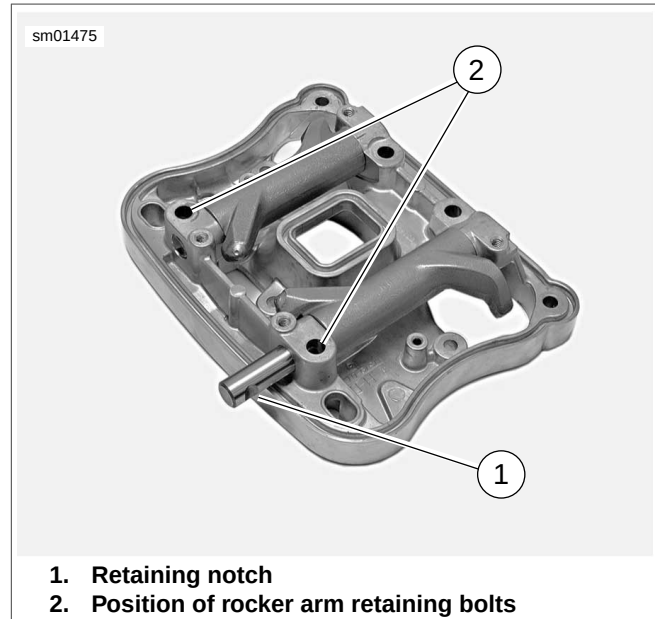


Figure 3-43. Inner Rocker Cover Fasteners (typical - XL shown)



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

Figure 3-44. Removing Rocker Arm Shafts (typical - XL shown)

9. See [Figure 3-42](#). Remove rocker arms (11, 12); mark them for reassembly in their original locations.
10. Repeat these steps for other rocker cover.

Removing Cylinder Head

NOTE

See [Figure 3-45](#) or [Figure 3-46](#). To avoid distortion of the cylinder head, cylinder and crankcase studs, gradually loosen (or tighten) head screws in the sequence shown.

1. **XR Models:** Remove Precision Cooling lines. See [3.14 PRECISION COOLING SYSTEM: XR MODELS, Cylinder Head Oil Return Lines](#).
2. See [Figure 3-45](#) and [Figure 3-46](#). Loosen each head bolt 1/8-turn following the sequence shown.

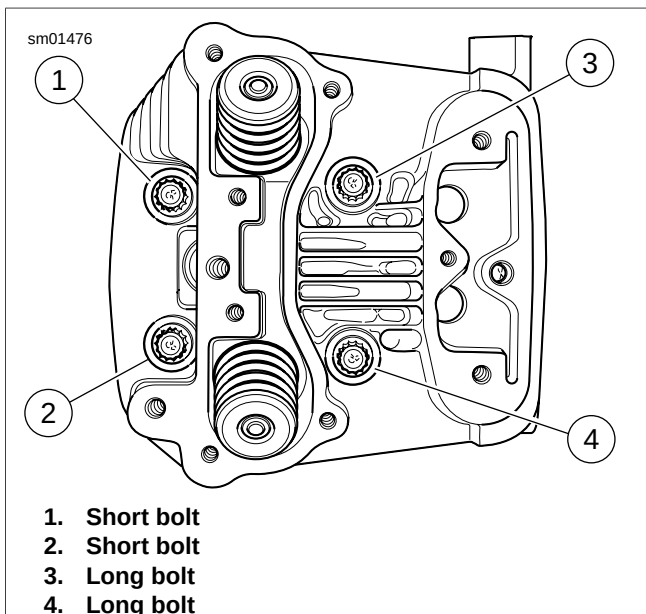


Figure 3-45. Front Cylinder Head Screw Loosening/Tightening Sequence (typical)

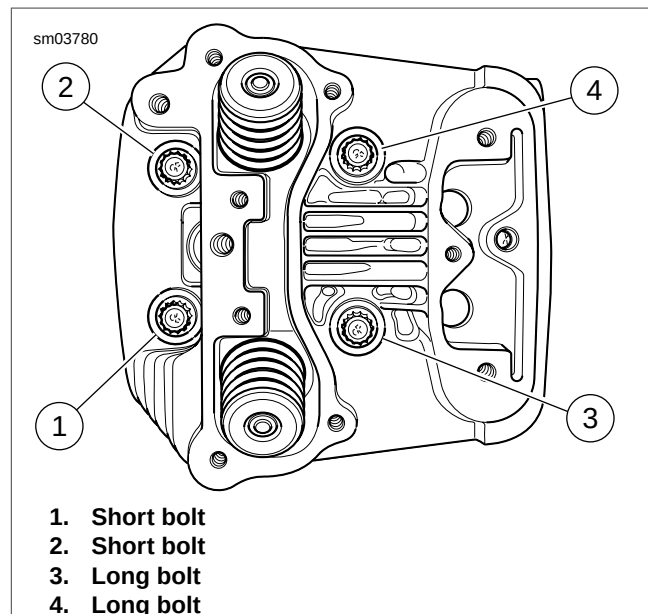
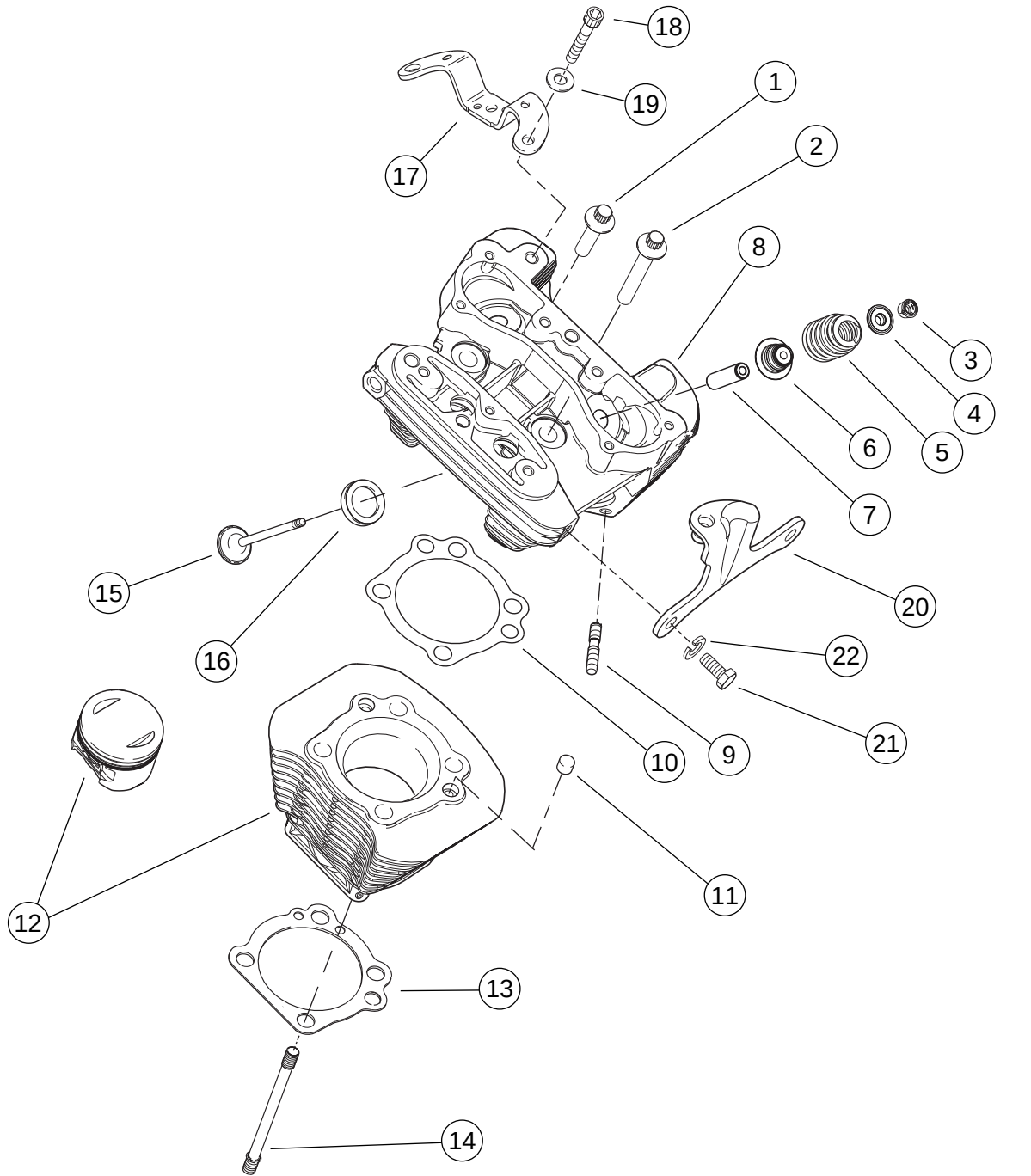


Figure 3-46. Rear Cylinder Head Screw Loosening/Tightening Sequence (typical)

3. Continue loosening in 1/8-turn increments until screws are loose. Remove head screws.
4. See [Figure 3-47](#). Remove cylinder head (8) and head gasket (10). Discard head gasket.
5. Repeat previous steps for other head.



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- | | |
|--|--|
| 1. Head bolt, short (2) | 12. Cylinder w/ piston and rings |
| 2. Head bolt, long (2) | 13. Cylinder base gasket |
| 3. Valve collar retainer (4) | 14. Cylinder base stud (4) |
| 4. Upper valve spring collar (2) | 15. Valve (1) intake, (1) exhaust |
| 5. Valve spring (2) | 16. Valve seat (2) |
| 6. Valve seal and lower valve spring collar assembly (2) | 17. Cylinder head bracket* |
| 7. Valve guide, intake and exhaust (2) | 18. Screw (2)* |
| 8. Cylinder head | 19. Washer (2)* |
| 9. Exhaust port stud (2) | 20. Stabilizer link bracket (front cylinder head only) |
| 10. Cylinder head gasket | 21. Screw (2) |
| 11. Dowel (2) | 22. Lock washer (2) |

Figure 3-47. Cylinder Head, Cylinder and Piston Assembly (typical) (*Models with Side Mounted Horn Only)

Disassembling Push Rods and Covers

1. See [Figure 3-48](#). Remove push rod covers (2), o-rings (1, 3) and push rods (4). Mark the location and orientation (top and bottom) of each push rod. Discard o-rings.
2. Remove socket screws (5) and washers (6). Remove retainer (7) and gasket (8). Discard gasket.
3. Repeat above steps for other cylinder.

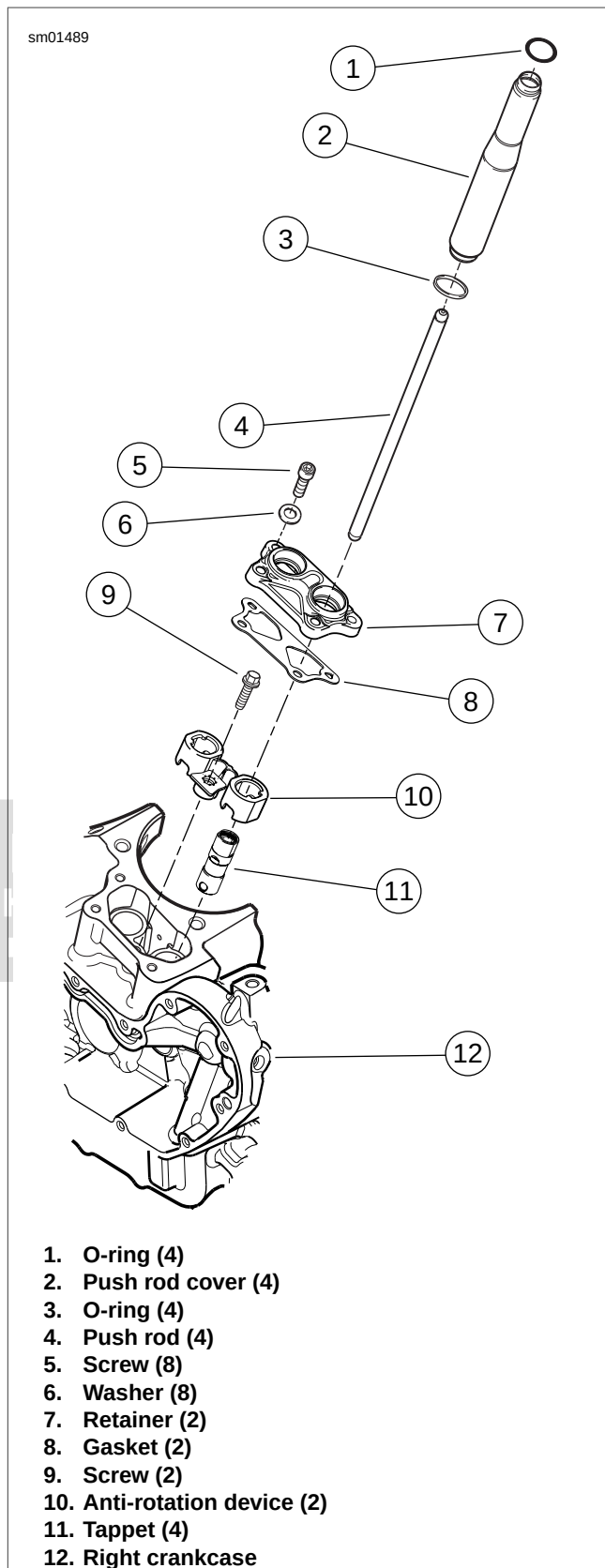


Figure 3-48. Middle Valve Train Components

CYLINDER AND PISTON

PART NUMBER	TOOL NAME
HD-34623-C	PISTON PIN LOCK RING REMOVER/INSTALLER
HD-42320-A	PISTON PIN REMOVER
HD-42322	PISTON SUPPORT PLATE

1. See [Figure 3-49](#). Clean crankcase around base of cylinder (7) to prevent dirt and debris from entering crankcase while removing cylinder.

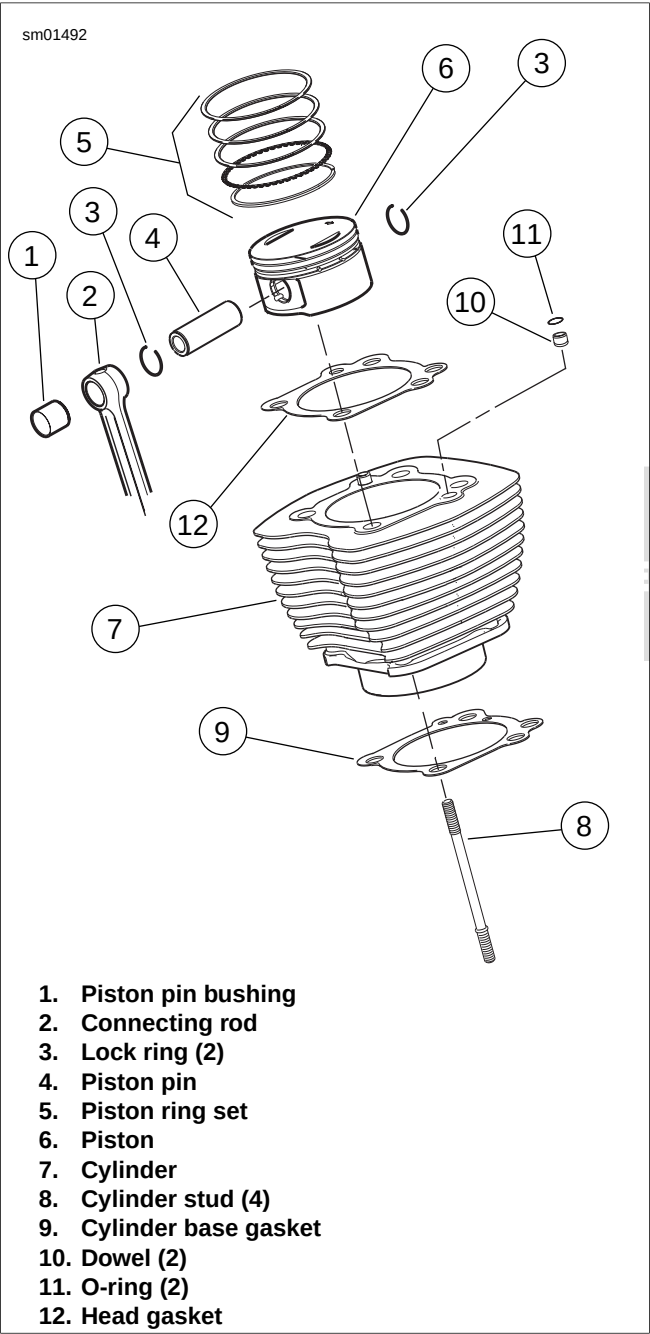


Figure 3-49. Cylinder and Piston

2. Turn engine over until piston (6) of cylinder being removed is at bottom of its stroke.

3. Carefully raise cylinder 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 or plastic hammer perpendicular to cylinder fins. Never try to pry cylinder up.

4. Carefully lift cylinder over piston and cylinder studs (8). Do not allow piston to fall against cylinder studs.

NOTE

To avoid damage to piston assembly and/or cylinder studs, do not allow piston to fall against studs.

5. Discard cylinder base gasket (9).

NOTE

With cylinder removed, be careful not to bend the cylinder studs. The slightest bend could cause a stress riser and could lead to stud failure.

6. Install a 6.0 in. (150 mm) length of 1/2 in. (12.7 mm) I.D. plastic or rubber hose over each cylinder stud. This will protect the studs and the pistons.

CAUTION

Handle piston with extreme care. The alloy used in these pistons is very hard. Any scratches, gouges or other marks in the pistons could score the cylinder during engine operation and cause engine damage. (00546b)

WARNING

Wear safety glasses or goggles when removing or installing piston pin retaining rings. Piston pin retaining rings are compressed in the ring groove and can fly out when removed from the groove, which could result in serious eye injury. (00293a)

7. See [Figure 3-50](#). Remove piston pin lock ring as follows:
- a. Insert PISTON PIN LOCK RING REMOVER/INSTALLER (Part No. HD-34623-C) into piston pin bore until claw on tool is positioned in slot of piston (directly under lock ring).
 - b. Squeeze handles of tool together and pull from bore. Hold a shop towel over bore during removal in the event that the lock ring should fly out. Remove lock ring from claw and discard.

NOTES

- It is not necessary to remove both piston pin lock rings during piston removal. Leave second lock ring in piston pin bore.
- Do not reuse piston pin lock rings. Removal may weaken lock rings and they may break or dislodge if reused, resulting in engine damage.
- See [Figure 3-51](#). Piston pin has tapered ends to help seat the round lock rings.

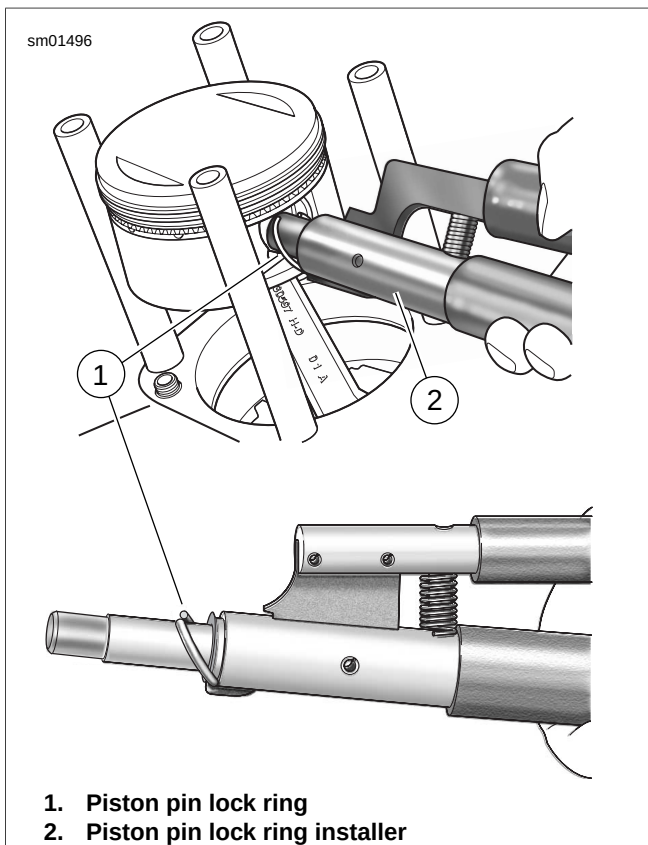


Figure 3-50. Removing Piston Pin Lock Ring

NOTE

To avoid damage to piston or cylinder base studs, use **PISTON SUPPORT PLATE** (Part No. HD-42322) to secure piston in place while removing piston pin.

8. Remove piston pin. Since pin is a loose fit in piston, pin should easily slide out. If pin is difficult to remove, use **PISTON PIN REMOVER** (Part No. HD-42320-A), as follows:
 - a. See [Figure 3-52](#). Remove acorn nut and spacer (1) from rod end of tool.
 - b. Slide rod end through piston pin. Install spacer and acorn nut on end of rod.
 - c. Position rubber coated tips (2) of tool on flat on each side of piston pin bore.
 - d. Hold tool body (3) and turn handle (4) clockwise until piston pin is pulled free of bore.
9. Remove piston from connecting rod. Be sure to hold connecting rod shank upright to prevent it from striking crankcase.
10. Place a 3.0 in. (76.2 mm) length of 1.0 in. (25.4 mm) I.D. foam-type water pipe insulation around each connecting rod to prevent damage.
11. Mark each pin boss with either an "F" or an "R" to indicate front or rear cylinder, respectively.

12. See [Figure 3-53](#). Spread piston rings outward until they clear grooves in piston and lift off.

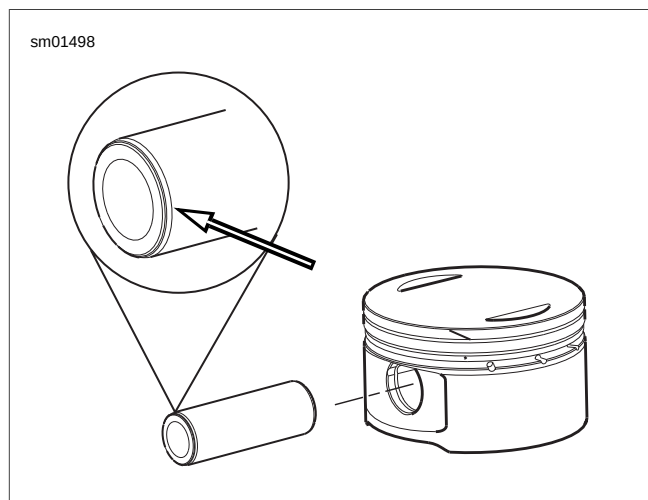


Figure 3-51. Tapered Ends on Piston Pin

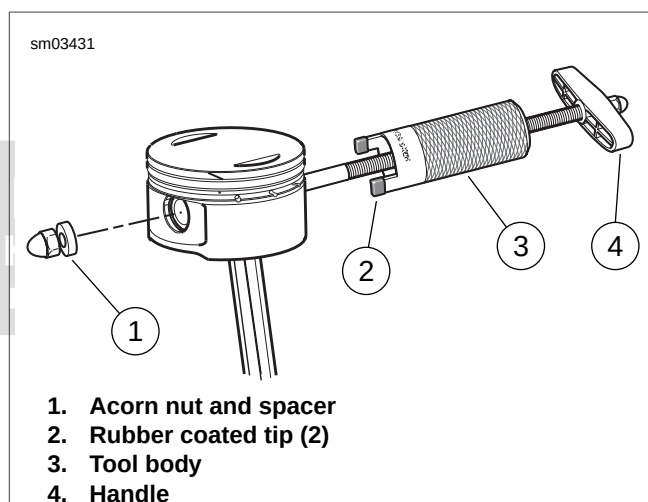


Figure 3-52. Removing Piston Pin with HD-42320-A Piston Pin Remover



Figure 3-53. Removing Piston Rings (typical; XL shown)

GENERAL

This section describes assembling the top end of the engine, from the cylinder deck up. If the engine crankcase has been disassembled for repair, it must be assembled before assembling the top end of the engine. See [3.18 BOTTOM END OVERHAUL: ASSEMBLY](#).

PISTON AND CYLINDER

PART NUMBER	TOOL NAME
HD-34623-C	PISTON PIN LOCK RING REMOVER/INSTALLER
HD-42322	PISTON SUPPORT PLATE
HD-96333-51E	PISTON RING COMPRESSOR

1. Slide approximately 6.0 in. (152 mm) of plastic tubing, rubber hose or conduit over each cylinder stud to protect cylinder studs and piston from damage.

NOTE

See [Figure 3-54](#). **New** 883 cc and 1200 cc pistons must be installed with the arrows on the top and side of the piston pointing toward the front of the engine.

2. Install piston assembly over connecting rod.
3. Install piston pin.

NOTE

You may wish to place clean shop towels over cylinder and lifter bores prior to the next step, to prevent the piston pin lock ring from falling into the crankcase.

4. See [Figure 3-55](#). Install **new** piston pin lock rings with the PISTON PIN LOCK RING REMOVER/INSTALLER (Part No. HD-34623-C). 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.

NOTE

Avoid damage to cylinder and piston. Always use new lock ring. Make sure lock ring groove is clean and lock ring seats firmly in groove. If it does not, discard the lock ring. Never install a used lock 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.



Figure 3-54. Arrows on Piston Must Point Toward Front of Engine (typical; XL shown)

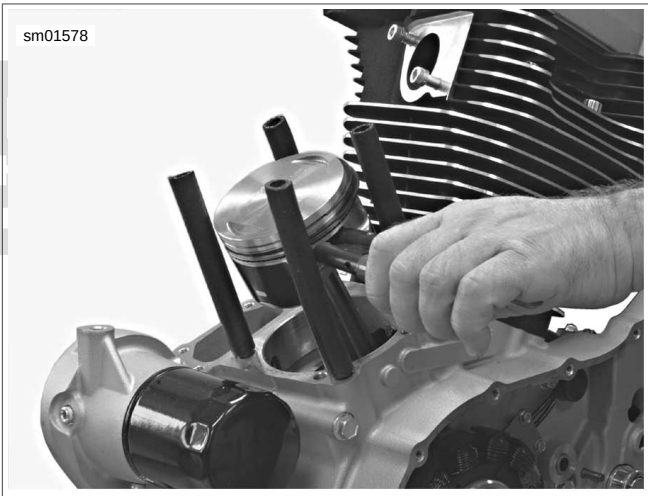


Figure 3-55. Installing Piston Lock Rings

5. See [Figure 3-56](#). Make sure the piston ring end gaps are properly positioned as shown.
6. Lubricate cylinder wall, piston, pin and rod bushing with engine oil.
7. Remove cylinder stud sleeves. Install a **new** cylinder base gasket. Make sure the piston does not bump the studs or crankcase.

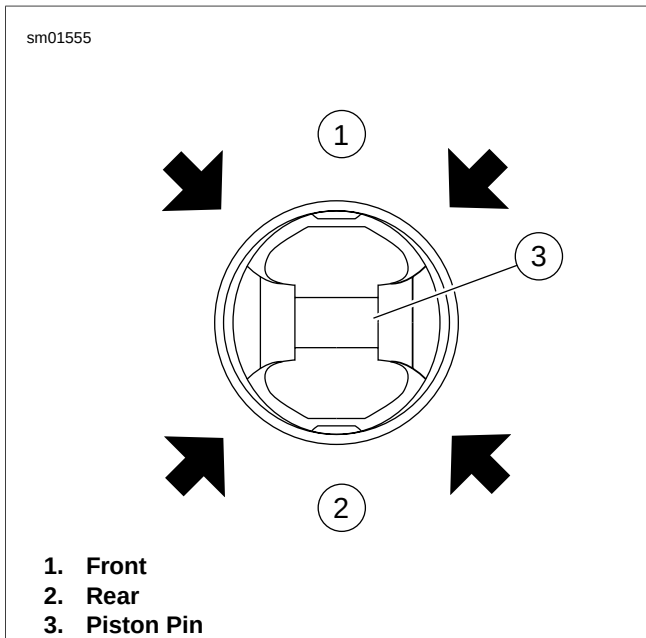


Figure 3-56. Position Ring End Gaps at Arrows

8. See [Figure 3-57](#). Install PISTON SUPPORT PLATE (Part No. HD-42322) as shown. Turn engine to rest piston on support plate.
9. See [Figure 3-58](#). Compress the piston rings using PISTON RING COMPRESSOR (Part No. HD-96333-51E).
10. Gently slide cylinder over cylinder base studs and piston crown, resting it on the top of the ring compressor band as shown.
11. Push the cylinder down with a firm, quick motion until the bottom of the cylinder bore slides below the piston ring area.
12. Remove the piston ring compressor and piston support plate, and push the cylinder all the way down onto the crankcase cylinder deck.
13. Repeat above procedure for other piston and cylinder.

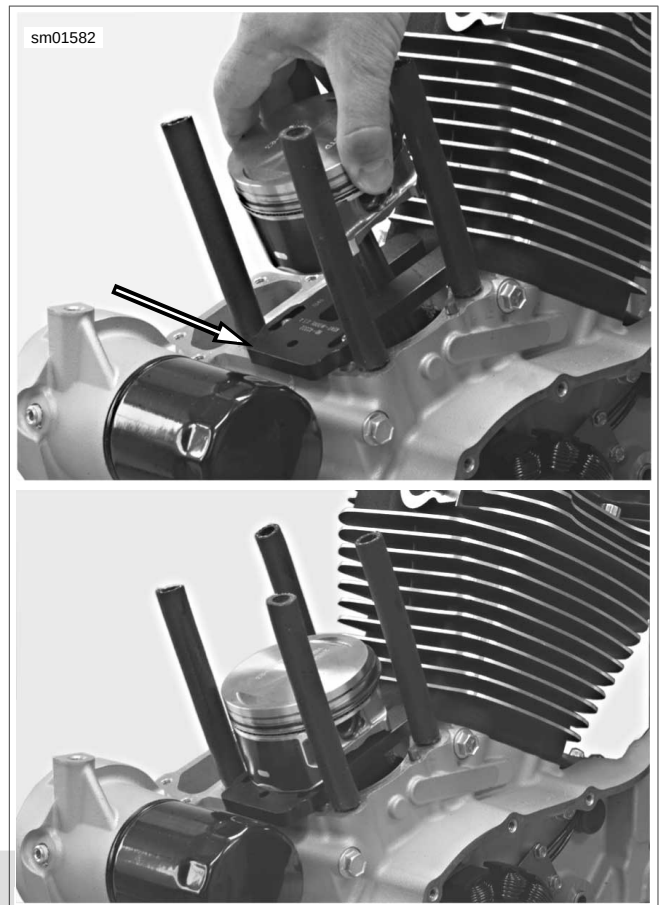


Figure 3-57. Piston Support Plate



Figure 3-58. Installing Cylinder Over Piston

PUSH RODS, COVERS, AND RETAINERS

1. See [Figure 3-59](#). If anti-rotation devices (10) and tappets (11) have been removed, install them now. See [3.18 BOTTOM END OVERHAUL: ASSEMBLY, Tappets](#).
2. Install retainer (7) with **new** gasket (8). Secure with screws (5) and washers (6). Tighten to 80-110 **in-lbs** (9.0-12.4 Nm).

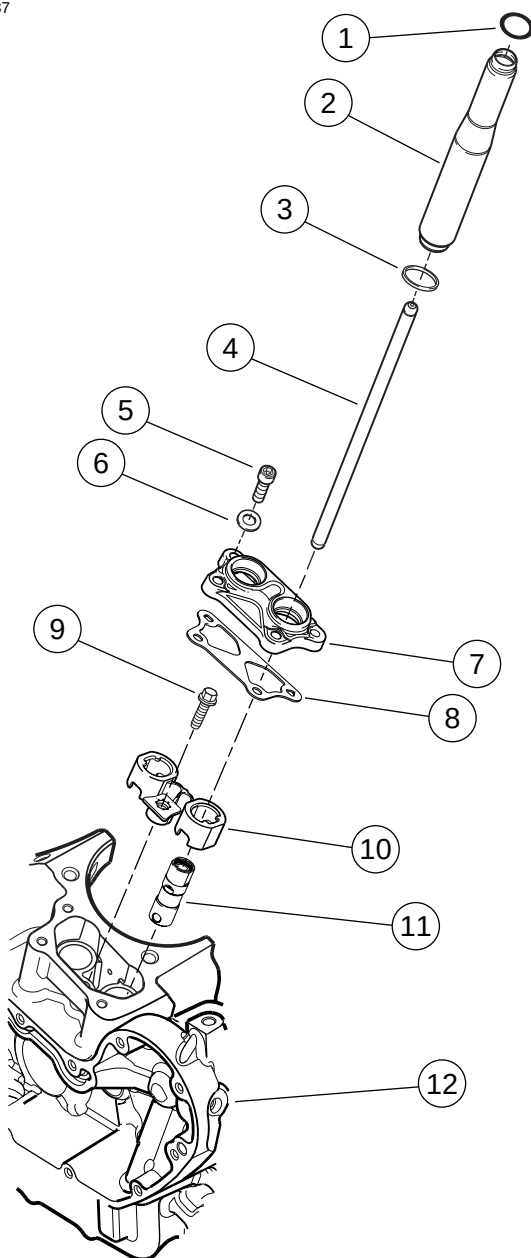
3. Install **new** o-rings (3) in recesses in retainer. Press push rod covers (2) into o-rings.
4. Repeat previous steps for other cylinder.
5. Identify push rod color coding and length, and respective push rod positions in engine (refer to [Table 3-28](#)). Slide intake and exhaust push rods (4) down inside push rod covers until they rest on seat at top of tappet (11).

Table 3-28. Push Rod Specifications

POSITION	COLOR CODE	LENGTH		PART NO.
		IN.	CM	
Intake (front and rear)	1 band: orange	10.746	27.295	17909-02
Exhaust (front and rear)	1 band: purple	10.800	27.432	17908-02



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1. O-ring (4)
2. Push rod cover (4)
3. O-ring (4)
4. Push rod (4)
5. Screw (8)
6. Washer (8)
7. Retainer (2)
8. Gasket (2)
9. Screw (2)
10. Anti-rotation device (2)
11. Tappet (4)
12. Right crankcase

Figure 3-59. Middle Valve Train Components

CYLINDER HEAD

NOTES

- Push rod covers and lower cover retainers **MUST** be installed prior to installing cylinder heads. If this has not been done, see [3.16 TOP END OVERHAUL: ASSEMBLY, Push Rods, Covers, and Retainers](#).
 - Thoroughly clean and lubricate threads of cylinder head screws before installation. Friction caused by dirt and grime will result in a false torque indication.
1. See [Figure 3-61](#). Coat mating surfaces of cylinder base studs (14) and head bolts (1 and 2) 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 bolts from studs. Wipe or blow dry thread surfaces.
 4. Thoroughly clean and dry gasket surfaces of cylinder (12) and cylinder head (8).

NOTE

See [Figure 3-60](#). The cylinder head gasket is unique for XR models and has metal patches (2) that must be installed against the cylinder head. When installing the gasket on the cylinder, be sure the words "THIS SIDE UP" (1) and the metal patches (2) are visible.

5. Install a **new** head gasket to cylinder.
6. Carefully lower cylinder head over studs and position on dowels. Use great care so as not to disturb head gasket.

NOTE

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

7. Lightly coat threads, underside of flange and bottom face of cylinder head bolts in clean Harley-Davidson 20W50 engine oil. Wipe off excess oil.
8. Start cylinder head bolts (1 and 2) onto cylinder studs, two short bolts on left side of engine, two long bolts on right. Tighten all bolts only finger tight at this time.

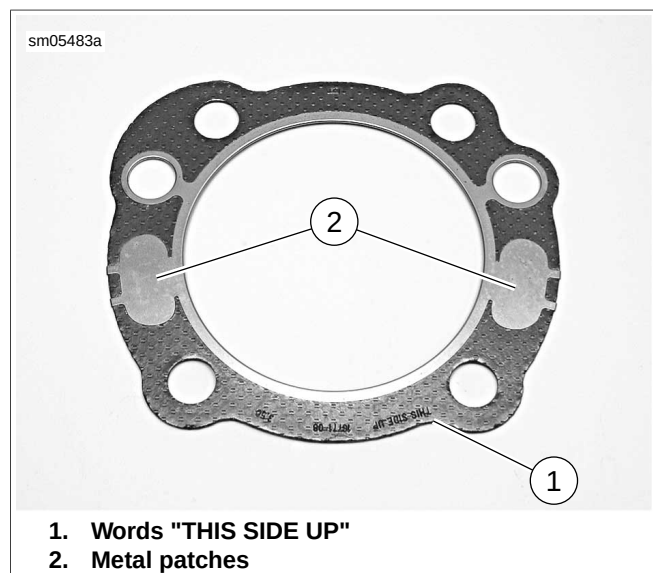
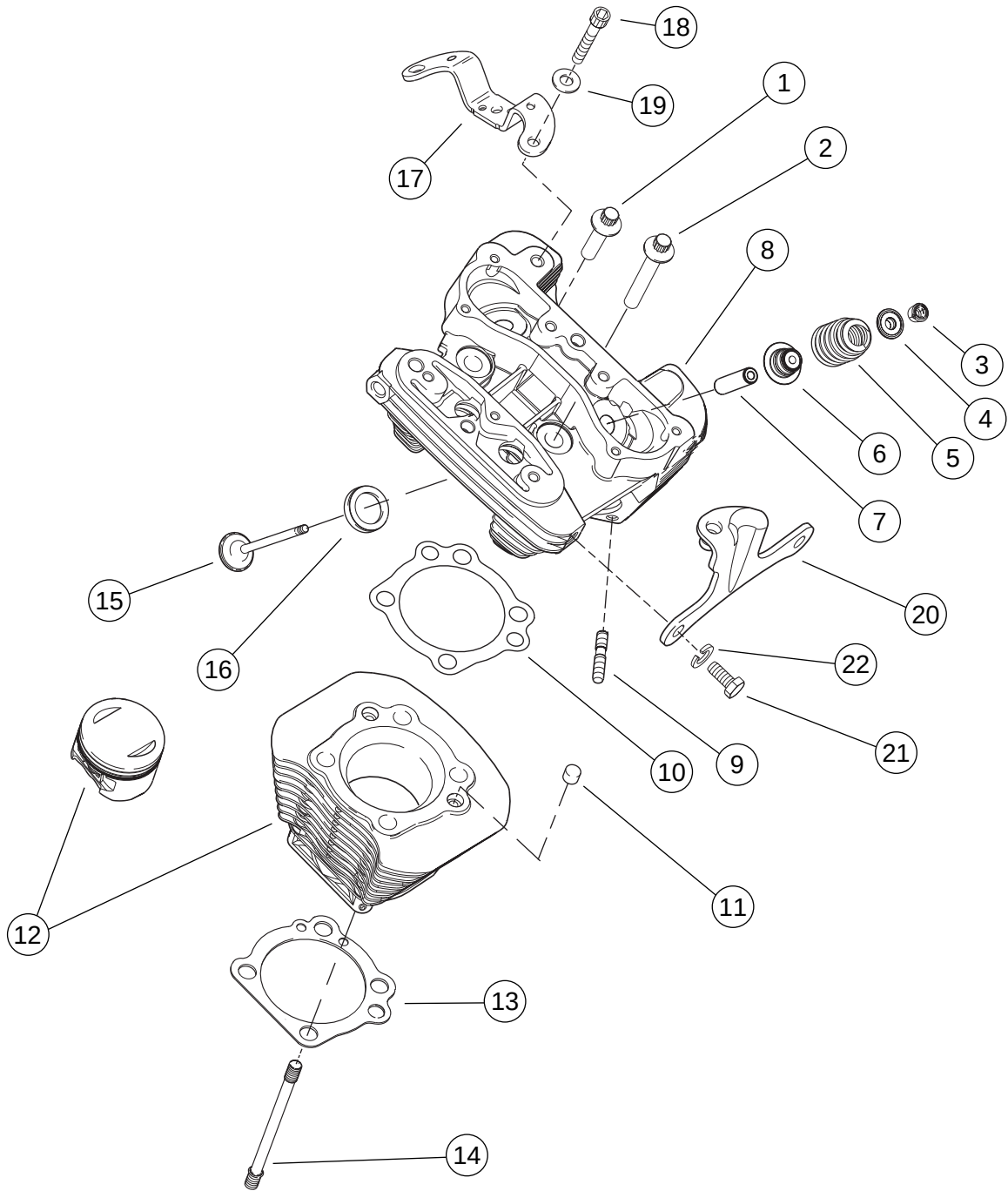


Figure 3-60. Cylinder Head Gasket: XR Models



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- | | |
|--|--|
| 1. Head bolt, short (2) | 12. Cylinder w/ piston and rings |
| 2. Head bolt, long (2) | 13. Cylinder base gasket |
| 3. Valve collar retainer (4) | 14. Cylinder base stud (4) |
| 4. Upper valve spring collar (2) | 15. Valve (1) intake, (1) exhaust |
| 5. Valve spring (2) | 16. Valve seat (2) |
| 6. Valve seal and lower valve spring collar assembly (2) | 17. Cylinder head bracket* |
| 7. Valve guide, intake and exhaust (2) | 18. Screw (2)* |
| 8. Cylinder head | 19. Washer (2)* |
| 9. Exhaust port stud (2) | 20. Stabilizer link bracket (front cylinder head only) |
| 10. Cylinder head gasket | 21. Screw (2) |
| 11. Dowel (2) | 22. Lock washer (2) |

Figure 3-61. Cylinder Head, Cylinder and Piston Assembly (typical) (*Models with Side Mounted Horn Only)

NOTE

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.

9. See [Figure 3-62](#) and [Figure 3-63](#). For each cylinder head, start with bolt numbered one, as shown. In increasing numerical sequence (i.e.: 1, 2, 3, 4), tighten head bolts in the following steps:
 - a. Tighten each bolt to 96-120 **in-lbs** (11-14 Nm).
 - b. Tighten each bolt to 13-15 **ft-lbs** (18-20 Nm).
 - c. **Loosen all bolts.**
10. After head bolts are loosened from initial torque, tighten bolts in three stages. Tighten in increasing numerical sequence (i.e.: 1, 2, 3, 4), as follows:
 - a. Tighten each bolt to 96-120 **in-lbs** (11-14 Nm).
 - b. Tighten each bolt to 13-15 **ft-lbs** (18-20 Nm).
 - c. See [Figure 3-64](#). Mark cylinder head and head bolt shoulder with a line as shown (View A).
 - d. Tighten each bolt an additional 85°-95° (View B).
11. Repeat above procedure for other cylinder head.
12. **XR Models:** Install Precision Cooling oil lines. See [3.14 PRECISION COOLING SYSTEM: XR MODELS, Cylinder Head Oil Return Lines](#).

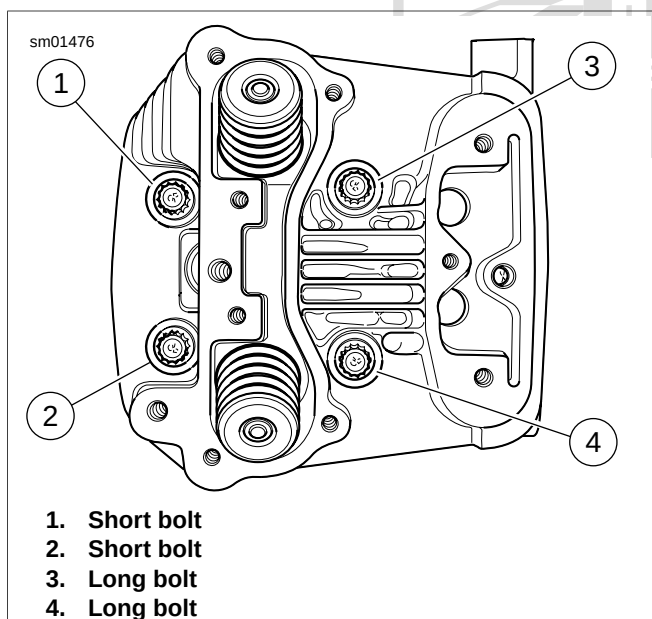


Figure 3-62. Front Cylinder Head Screw Loosening/Tightening Sequence (typical)

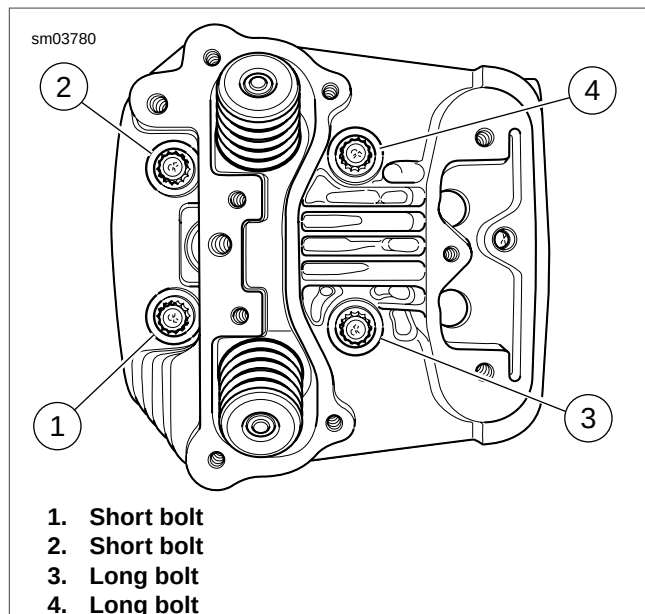


Figure 3-63. Rear Cylinder Head Screw Loosening/Tightening Sequence (typical)

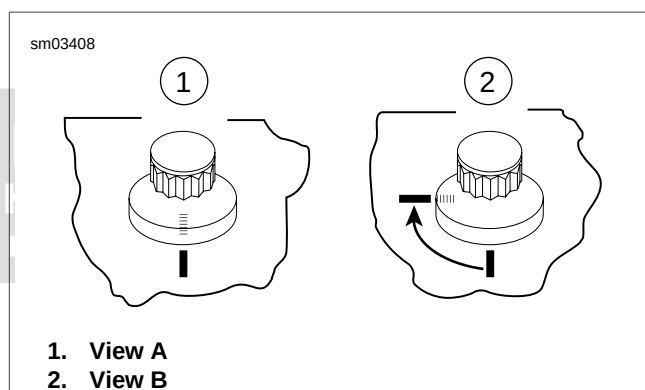


Figure 3-64. Tightening Head Bolts

ROCKER COVERS

NOTE

Before installing a rocker cover assembly on a cylinder head, turn engine over so that both lifters for that cylinder are on the base circle (the lowest position) of the cams.

1. See [Figure 3-65](#). Install **new** gasket (16), with the bead facing up. Place inner rocker cover assembly (8) or (24) (with rocker arms and shafts) into position, fitting ends of push rods in rocker arm sockets.

NOTE

To avoid damage to push rods or rocker arms, do not turn engine over until both push rods can be turned with fingers.

2. Install fasteners (13, 15, 14). Slowly snug all fasteners in small increments (one turn at a time). Use a cross pattern on the four large bolts (13) that fasten the inner rocker

cover to the head. This will bleed the lifters. Tighten fasteners in the following sequence:

- a. Tighten bolts (13) to 18-22 ft-lbs (24.4-29.8 Nm).
- b. Tighten bolts (15) to 135-155 **in-lbs** (15.3-17.5 Nm).
- c. Tighten screws (14) to 135-155 **in-lbs** (15.3-17.5 Nm).

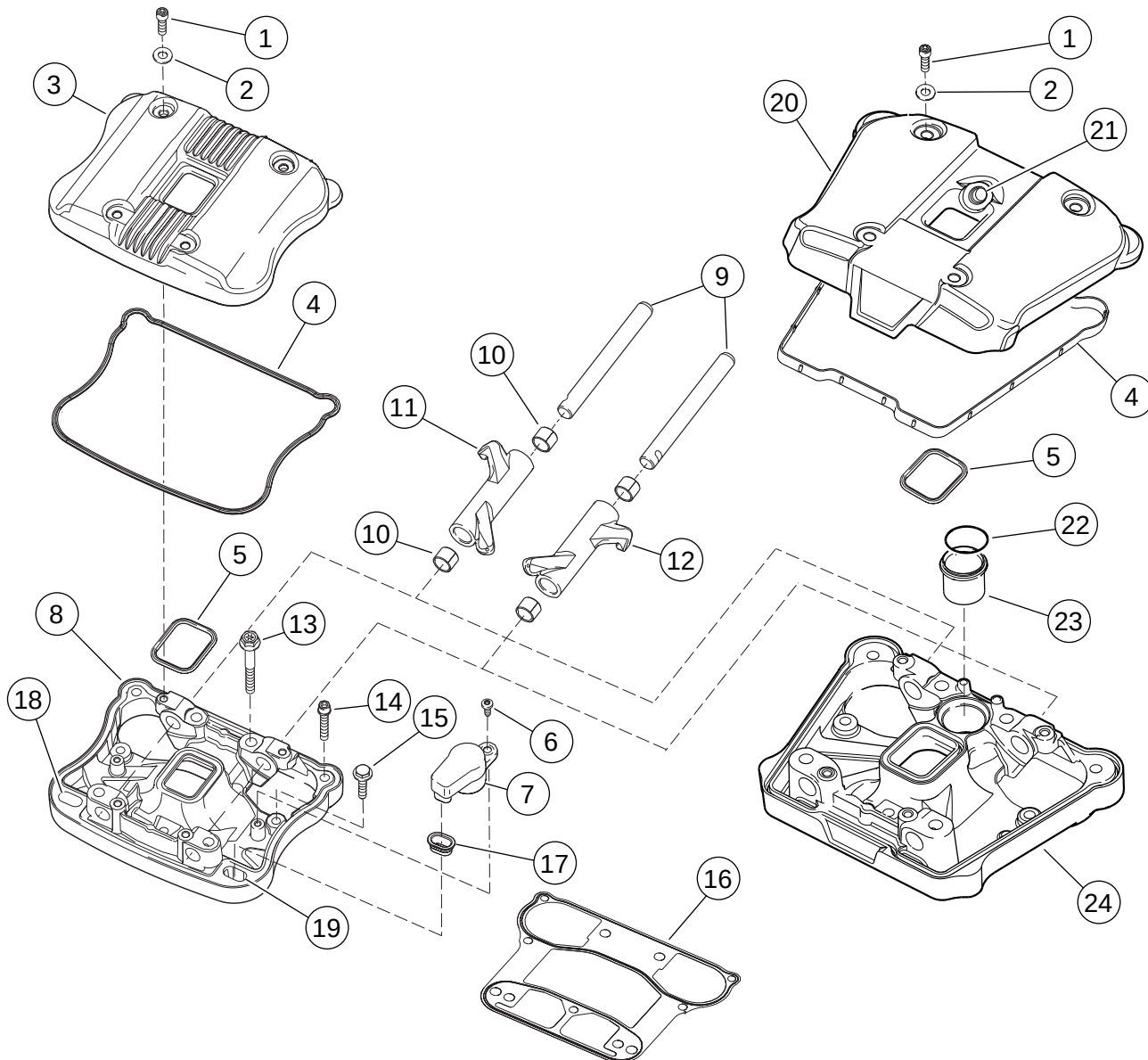
NOTE

XL models: See [Figure 3-65](#). Breather location in inner rocker cover is different between front and rear cylinders.

3. Install breather:
 - a. **XL models:** Install breather (7) with **new** breather seal (17) and secure with screw (6). Tighten to 35-55 **in-lbs** (4.0-6.2 Nm).
 - b. **XR models:** Install **new** o-ring (22) on breather assembly (23) and install in cavity in inner rocker cover.
4. Place **new** gaskets (4, 5) on inner rocker cover.
5. Install outer rocker cover (3) or (20) on inner rocker cover. Install screws with captive washers (1) and **new** sealing washers (2). Tighten screws to 120-168 **in-lbs** (13.5-19.0 Nm).



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- | | |
|----------------------------------|---|
| 1. Screw w/ captive washer (4) | 13. Bolt (4) |
| 2. Sealing washer (4) | 14. Screw (2) |
| 3. Outer rocker cover: XL Models | 15. Bolt (3) |
| 4. Gasket | 16. Gasket |
| 5. Gasket | 17. Breather seal: XL Models |
| 6. Screw | 18. Breather location: Front Cylinder: XL Models |
| 7. Breather assembly: XL Models | 19. Breather location: Rear Cylinder: XL Models |
| 8. Inner rocker cover: XL Models | 20. Outer rocker cover: XR Models |
| 9. Rocker arm shaft (2) | 21. Breather hose fitting hole: XR Models |
| 10. Rocker arm bushing (4) | 22. O-ring: XR Models |
| 11. Rocker arm | 23. Breather filter and valve assembly: XR Models |
| 12. Rocker arm | 24. Inner rocker cover: XR Models |

Figure 3-65. Rocker Cover Assembly

ASSEMBLING MOTORCYCLE AFTER TOP END REPAIR

1. See [Figure 3-66](#). Install upper front stabilizer link and frame bracket:
 - a. Install upper frame bracket (3) with upper stabilizer link (2), horn bracket (9) (models with front mounted horn), screws (5) and washers (8). Tighten screws to 25-35 ft-lbs (33.9-47.5 Nm).
 - b. Install screw (4) securing stabilizer link to engine bracket (1). Tighten screw to 25-35 ft-lbs (33.9-47.5 Nm).
2. Install induction module assembly. See [4.10 INDUCTION MODULE: XL MODELS](#) or [4.11 INDUCTION MODULE: XR MODELS](#). Plug the following connectors into the induction module:
 - a. Throttle Position (TP) sensor connector [88].
 - b. Idle Air Control (IAC) connector [87].
 - c. Temperature/Manifold absolute pressure (TMAP) sensor connector [80].
 - d. Fuel injector connectors [84], [85].
3. Install air cleaner assembly:
 - a. **XL models:** Install backing plate, air filter and air cleaner cover. See [4.4 AIR CLEANER: XL MODELS](#).
 - b. **XR models:** Install airbox assembly and connect crankcase vent hoses. See [4.5 AIRBOX: XR MODELS](#).
 - c. **California models:** install EVAP purge hose on induction module. See [4.21 EVAPORATIVE EMISSIONS CONTROL \(CA MODELS\)](#).
4. **Models with front mounted horn:** install horn. See [6.37 HORN](#).
5. **Models with side mounted horn:** See [Figure 3-67](#). Install cylinder head bracket (1) with horn (4) onto cylinder heads as a unit. Secure with two screws (3) and washers (2). Tighten screws to 17-24 ft-lbs (23.1-32.6 Nm). Plug wiring harness connectors into horn.

WARNING

When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)

6. Install fuel tank. Tighten screws to 15-20 ft-lbs (20.4-27.1 Nm). Attach quick-connect fitting on fuel line to fuel tank fitting. Gently tug on quick-connect fitting to make sure it is securely locked in place. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).
7. Install exhaust pipes and mufflers. Plug in O2 sensor connectors [137], [138]. See [4.15 EXHAUST SYSTEM: XL MODELS](#) or [4.16 EXHAUST SYSTEM: XR MODELS](#).
8. Connect spark plug cables to spark plugs.
9. Plug in main fuse. See [6.38 MAIN FUSE](#).

WARNING

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

10. Install seat.

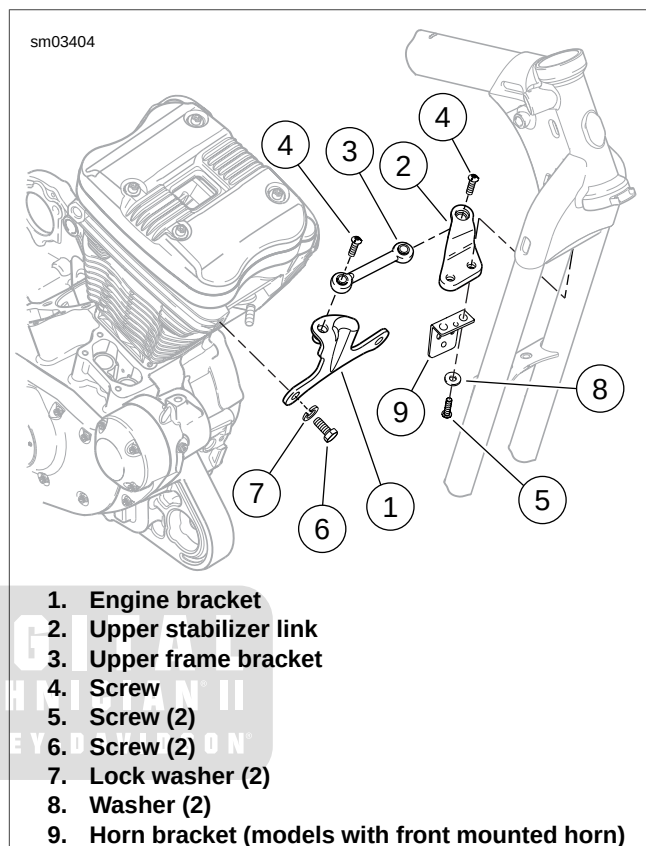


Figure 3-66. Upper Front Stabilizer Link Assembly (typical)

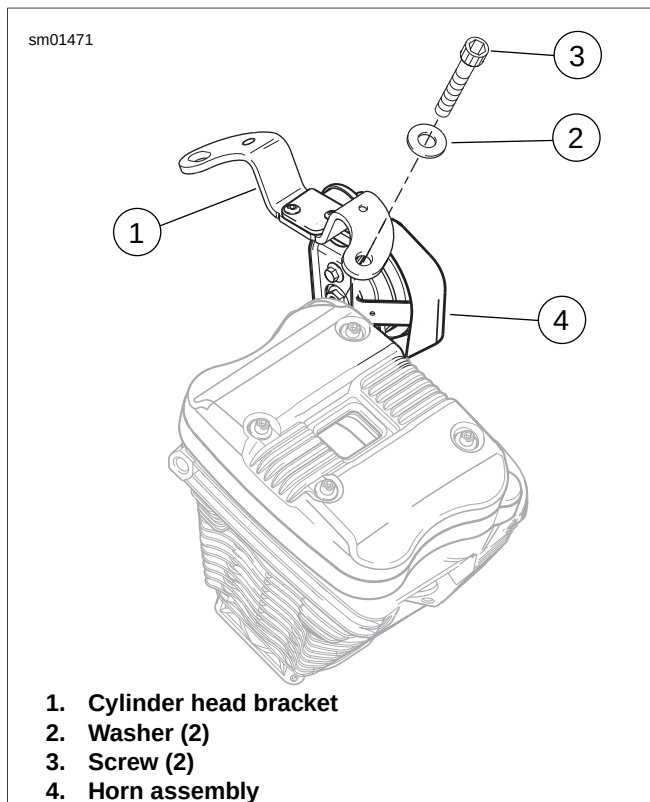


Figure 3-67. Horn and Cylinder Head Bracket (Models With Side Mounted Horn Only)



BOTTOM END OVERHAUL: DISASSEMBLY

3.17

GENERAL

This section describes disassembling the bottom end of the engine. If engine overhaul requires disassembly of crankcases, remove engine from vehicle as described in [3.12 REMOVING ENGINE FROM CHASSIS](#). Then disassemble top end of engine. See [3.15 TOP END OVERHAUL: DISASSEMBLY, Cylinder Heads](#) and [3.15 TOP END OVERHAUL: DISASSEMBLY, Cylinder and Piston](#).

Thoroughly clean area around gearcase cover and tappets. Blow loose dirt from crankcase with low pressure compressed air.

The oil pump design and function differs between XL and XR models. See [3.8 ENGINE LUBRICATION SYSTEM](#) for more information.

TAPPETS

1. See [Figure 3-68](#). Remove screw (1).
2. Remove anti-rotation device (2). Tag anti-rotation device for location (front/rear cylinder) as it is removed.
3. Remove tappet (3). Tag tappet for location (front/rear cylinder) and function (intake/exhaust) as it is removed. This will simplify installation.
4. Repeat previous steps for other cylinder.
5. Place tappets in clean plastic bags to keep out dust, dirt and debris.

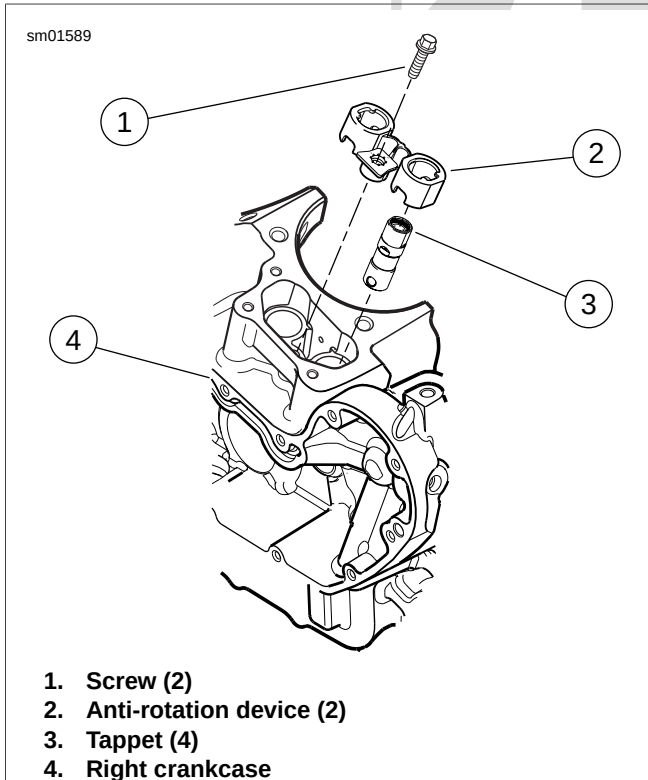


Figure 3-68. Tappet Removal

OIL PUMP: XL MODELS

1. Remove oil pump feed and return hoses. Mark hoses for later installation. Discard hose clamps.
2. See [Figure 3-69](#). Carefully remove two screws (2) that secure pump to crankcase. Pump will drop with screws removed. Discard mounting gasket.
3. If oil pump requires repair, see [3.24 OIL PUMP: XL MODELS](#).

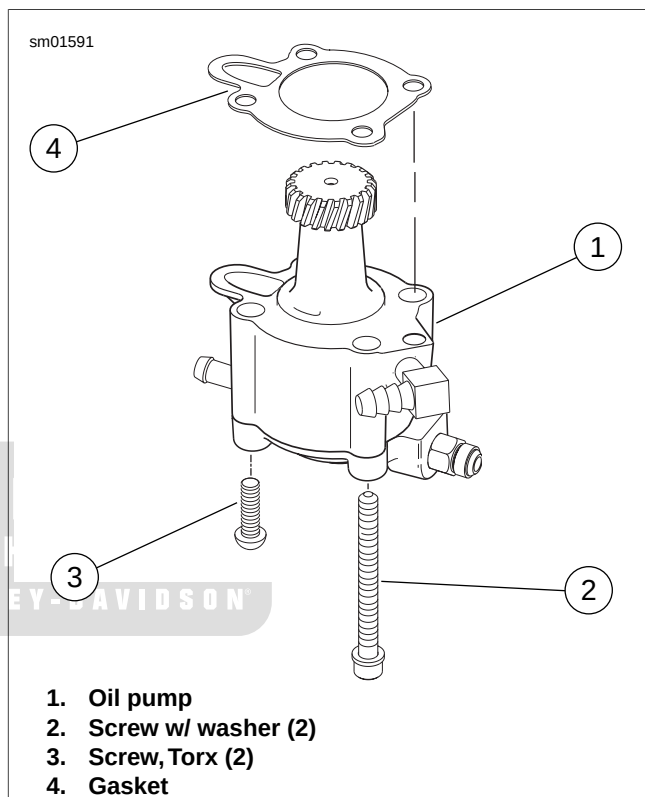


Figure 3-69. Oil Pump: XL Models

GEARCASE COVER AND CAM GEARS: XL MODELS

⚠ WARNING

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

1. Remove any parts that will interfere with gearcase disassembly (i.e., exhaust pipe, footrest, air cleaner, brake pedal, etc.).
2. Check for minimum cam gear end play; see [3.20 GEARCASE COVER AND CAM GEARS, Assembly and Installation](#). Record readings.

3. See [Figure 3-70](#). Place a pan under gearcase to collect oil. Remove cover screws (6). 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.

4. Remove cam gears (1, 2, 3, and 4). Carefully mark each component for installation reference.

NOTE

Nut (11) is secured by Loctite-262 on the nut threads.

5. Remove nut (11). Slide pinion gear (5) and oil pump drive gear (12) off pinion shaft.

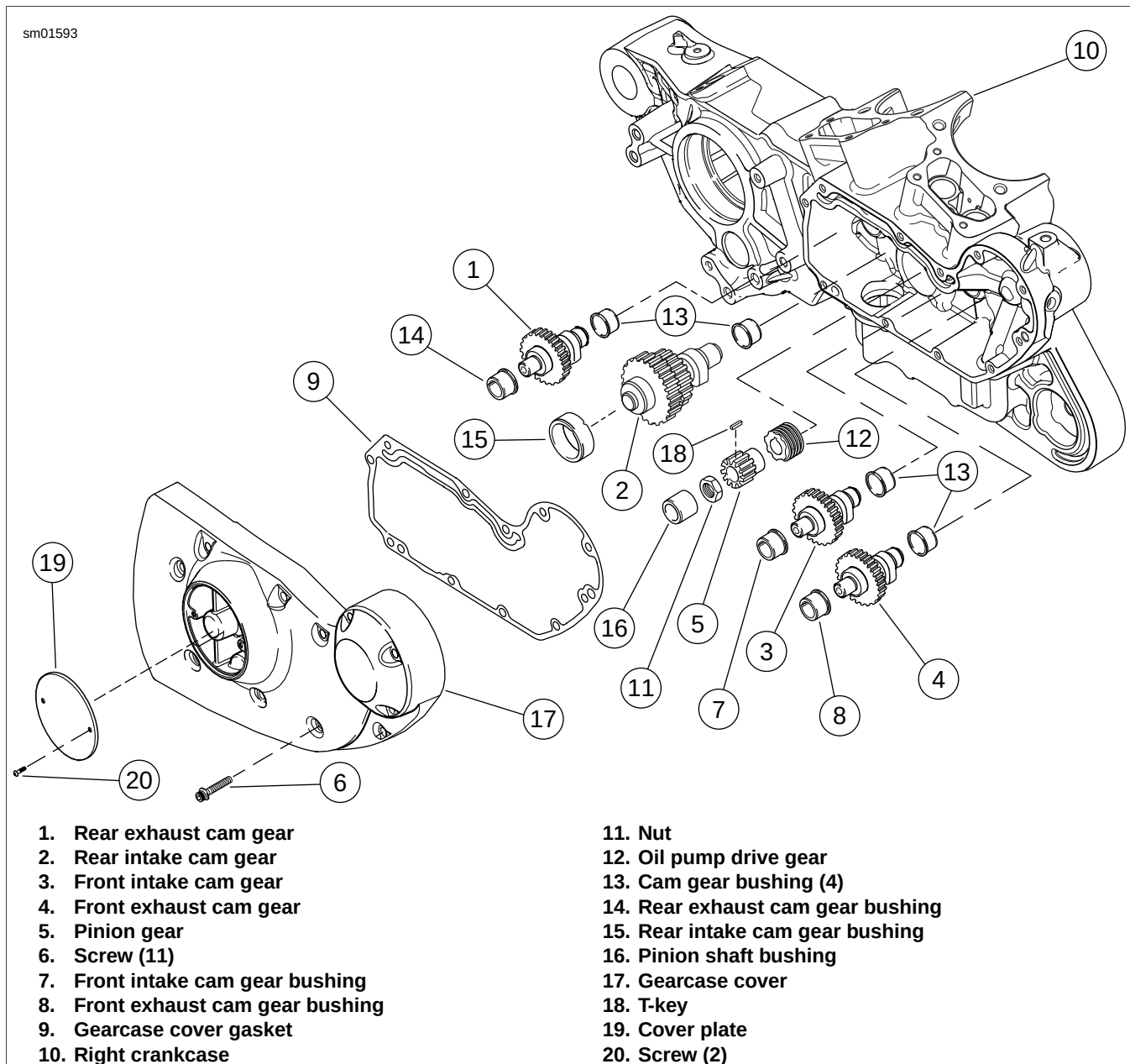


Figure 3-70. Gearcase and Valve Train Components: XL Models

OIL PUMP HOUSING/GEARCASE COVER AND CAM GEARS: XR MODELS

The oil pump on XR models is integrated into the gearcase cover. The oil pump rotors can be removed with the gearcase cover in place if necessary however, it is not necessary to remove the oil pump rotors to remove the gearcase cover.

WARNING

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

1. Remove any parts that will interfere with gearcase disassembly (i.e., exhaust pipe, footrest, air cleaner, brake pedal, etc.).
2. Remove inner rocker cover to remove valve spring pressure from camshafts. See [3.15 TOP END OVERHAUL: DISASSEMBLY, General](#)
3. Check cam gear end play; see [3.20 GEARCASE COVER AND CAM GEARS, Assembly and Installation](#). Record readings.
4. Place a pan under gearcase to collect oil.
5. See [Figure 3-71](#). Remove nine fasteners (1) and remove cover (2).
6. See [Figure 3-72](#). Remove rigid lines (1) and vent hose (2) from gearcase cover. See [3.14 PRECISION COOLING SYSTEM: XR MODELS, Oil Pump Lines](#). Mark lines and hoses for later installation. Discard hose clamps.
7. Remove two check valve housing screws (3).
8. Remove six screws (4) and remove oil pump cover (5). Discard o-rings.
9. Remove three fasteners (6). Loosely install oil pump cover to prevent rotors from falling out unexpectedly.

NOTE

Never pry gearcase cover off. If gearcase cover is difficult to remove, tap lightly with a rawhide hammer.

10. Carefully remove gearcase cover. Discard old gasket.

NOTE

If oil pump requires repair, see [3.25 OIL PUMP: XR MODELS](#).

11. See [Figure 3-73](#). Remove cam gears (1, 2, 3, and 4). Carefully mark each component to verify correct installation.

NOTE

Nut (5) is secured by Loctite-262.

12. Remove nut (5). Slide pinion gear (6) and spacer (7) off pinion shaft.
13. Remove oil pump cover. Mark rotors with a permanent marker to identify outer surfaces. Remove rotors from housing.

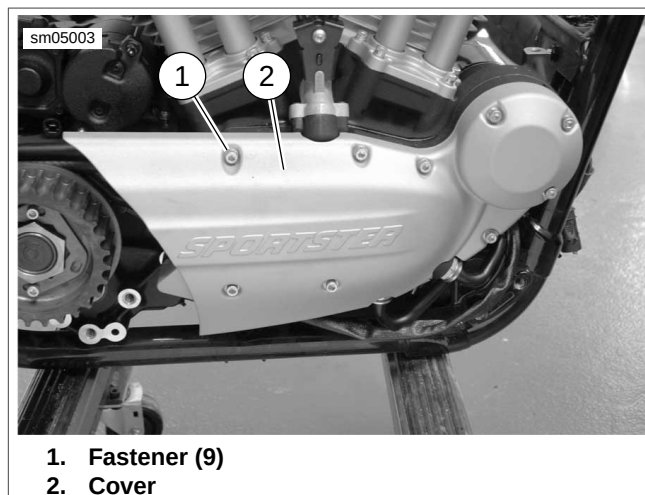


Figure 3-71. Oil Pump Cover: XR Models

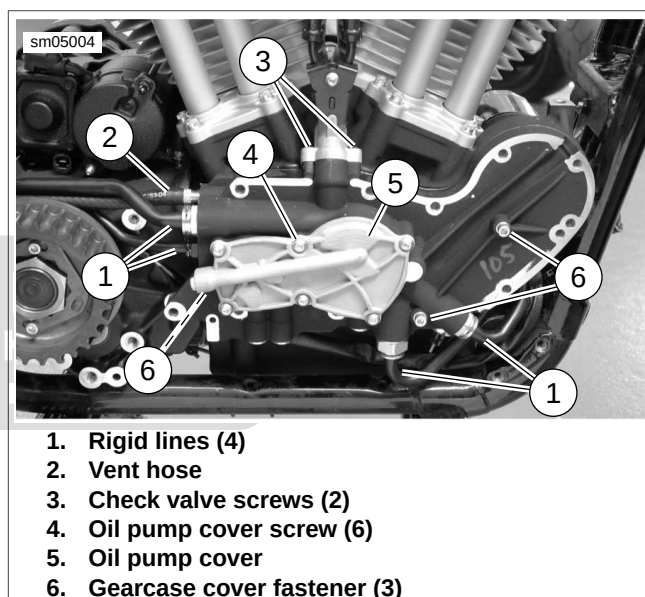


Figure 3-72. Gearcase Cover and Oil Pump: XR Models

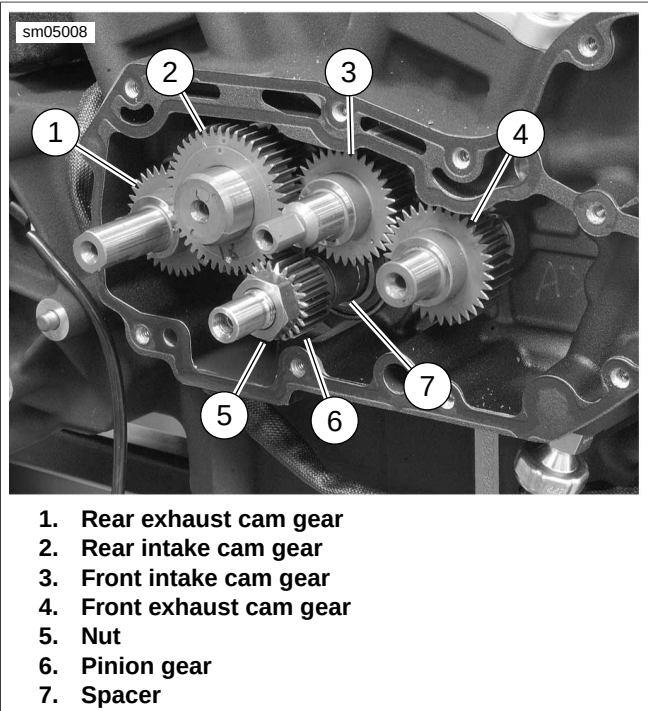


Figure 3-73. Cam Gears: XR Models

CRANKCASE

1. Remove clutch and primary drive components. See [5.5 PRIMARY DRIVE AND CLUTCH: XL MODELS](#).
2. Remove starter motor. See [6.13 STARTER](#).
3. Mount crankcase assembly in engine stand. Position crankcase so that it is tilted at a 45° angle, right side down.

CAUTION

Do not rotate right crankcase half in engine stand such that flywheel sprocket shaft is facing down. The flywheel assembly can fall out, resulting in parts damage or moderate injury. (00553b)

NOTE

- See [Figure 3-74](#). Crankcase assembly has 17 fasteners; 15 inserted from left side and two inserted from right side.
4. See [Figure 3-74](#). Remove 15 crankcase fasteners (eleven long and four short) from left side of crankcase assembly.

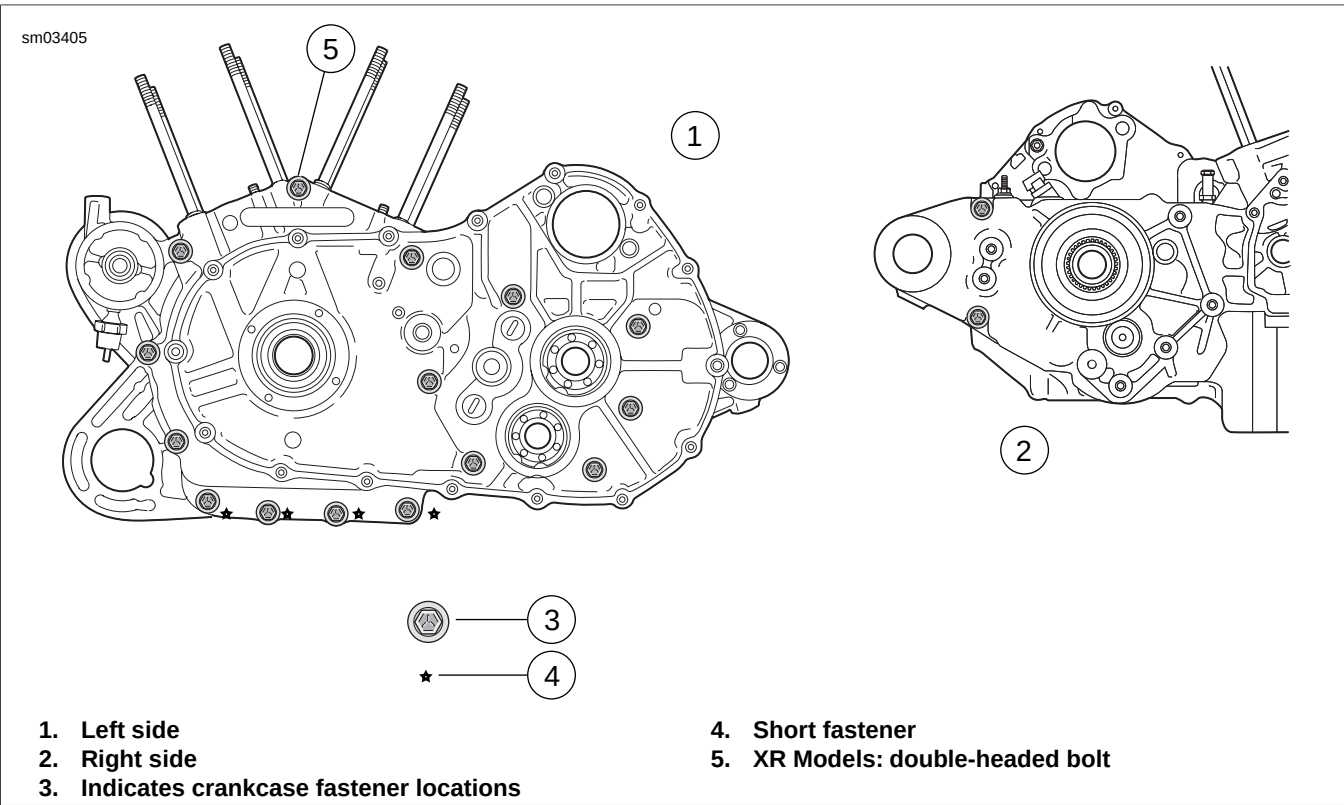


Figure 3-74. Crankcase Fasteners

5. Remove two fasteners from right side of crankcase assembly.
6. Tap crankcase gently with rawhide mallet to loosen and separate the halves. See [Figure 3-75](#). Remove left crankcase assembly with transmission.

NOTE

Flywheel assembly slides off left main bearing by hand. No tools are required for this operation.

7. See [Figure 3-76](#). Remove the flywheel assembly from right crankcase.

8. Remove transmission assembly from left crankcase. See [5.10 TRANSMISSION REMOVAL AND DISASSEMBLY](#).

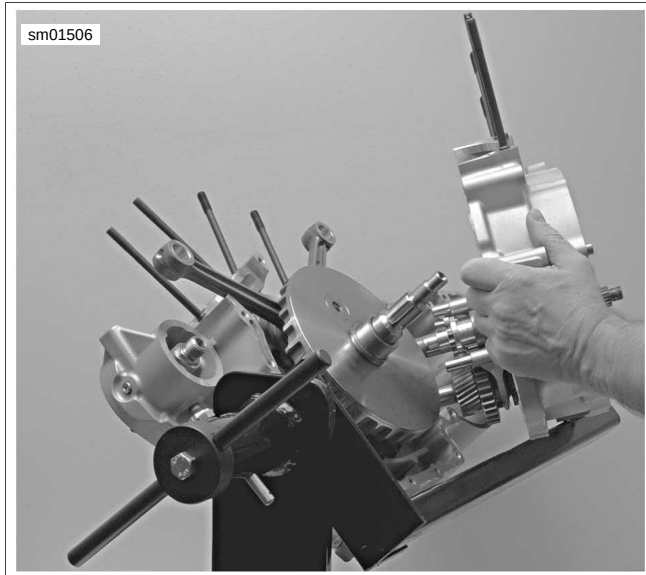


Figure 3-75. Separating Crankcase Halves

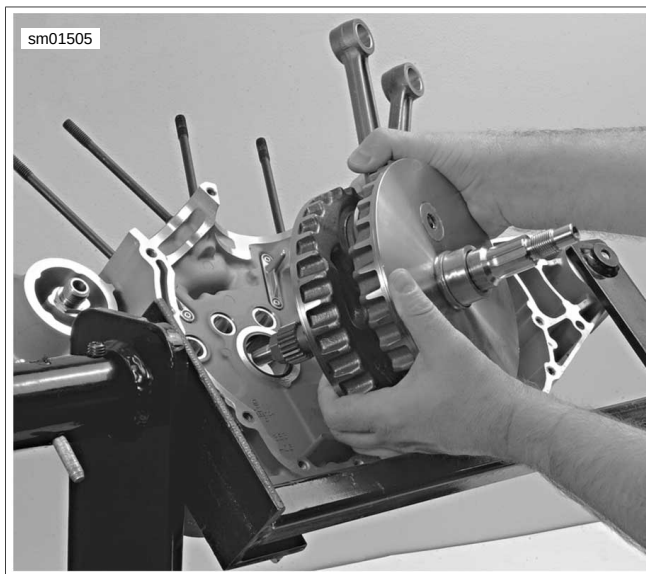
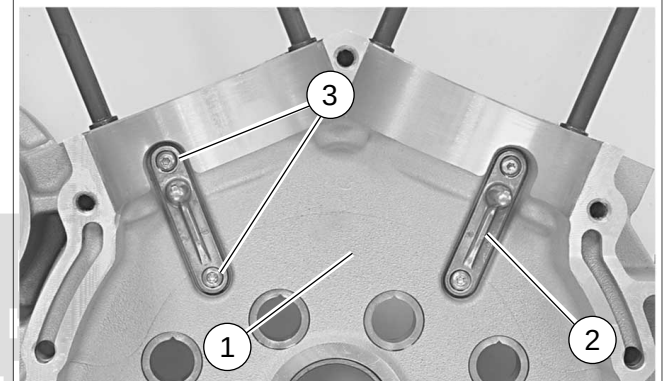
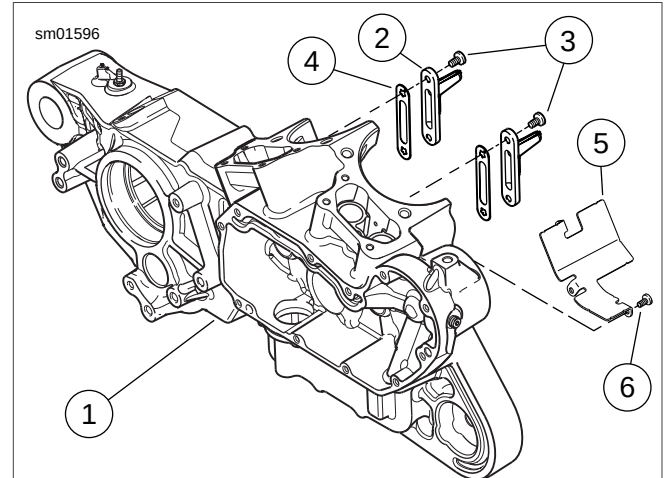


Figure 3-76. Removing Flywheels from Right Crankcase

Removing Piston Oil Jets

1. See [Figure 3-77](#). Remove two TORX screws (3) from each piston oil jet assembly (2) to free piston oil jets from right crankcase (1).
2. Remove piston oil jets and gaskets (4) from right crankcase. Discard gaskets.

3. **XR Models:** Remove three screws (6) and oil deflector plate (5).



1. Right crankcase
2. Piston oil jet (2)
3. Screw (4)
4. Gasket (2)
5. Oil deflector plate (XR models only)
6. Screw (3) (XR models only)

Figure 3-77. Piston Oil Jet Assemblies

Removing Cylinder Base Studs

If cylinder base studs require replacement, proceed as follows.

1. Thread a 3/8"-16 nut onto cylinder base stud.
2. Thread a second nut onto stud until it contacts the first nut.
3. Tighten nuts against each other.
4. Placing wrench on first (lower) nut installed, remove stud from cylinder deck.
5. Loosen nuts and remove from cylinder base stud.

BOTTOM END OVERHAUL: ASSEMBLY

3.18

CRANKCASE

PART NUMBER	TOOL NAME
B-45520	GEAR DETENT ASSEMBLY AID
B-45655	CRANKCASE BEARING REMOVER/INSTALLER
B-45676-A	SPROCKET SHAFT SEAL/SPACER INSTALLER
HD-42326-B	CRANKSHAFT GUIDE TOOL
HD-42579-A	SPROCKET SHAFT BEARING/SEAL INSTALLATION TOOL
HD-42720-2	CRANKCASE BEARING REMOVER/INSTALLER BASE
J-5586-A	TRANSMISSION SHAFT RETAINING RING PLIERS

Installing Piston Oil Jets

NOTES

- Gaskets that are missing, distorted, pinched or otherwise damaged will result in either oil leakage or low oil pressure.
 - See [Figure 3-78](#). Gasket (4) is part of piston oil jet (2) assembly and is not sold separately.
- See [Figure 3-78](#). With oil jet pointed upward, install **new** piston oil jet assemblies (2) with gaskets (4) in right crankcase.
 - Apply Loctite Low Strength Threadlocker 222 (purple) to threads of TORX screws (3) and screws (6).
 - Install TORX screws to secure piston oil jet assembly to crankcase. Tighten to 25-35 **in-lbs** (2.8-4.0 Nm).
 - XR Models:** Install oil deflector plate (5) using three screws (6). Tighten screws to 25-35 **in-lbs** (2.8-3.9 Nm)

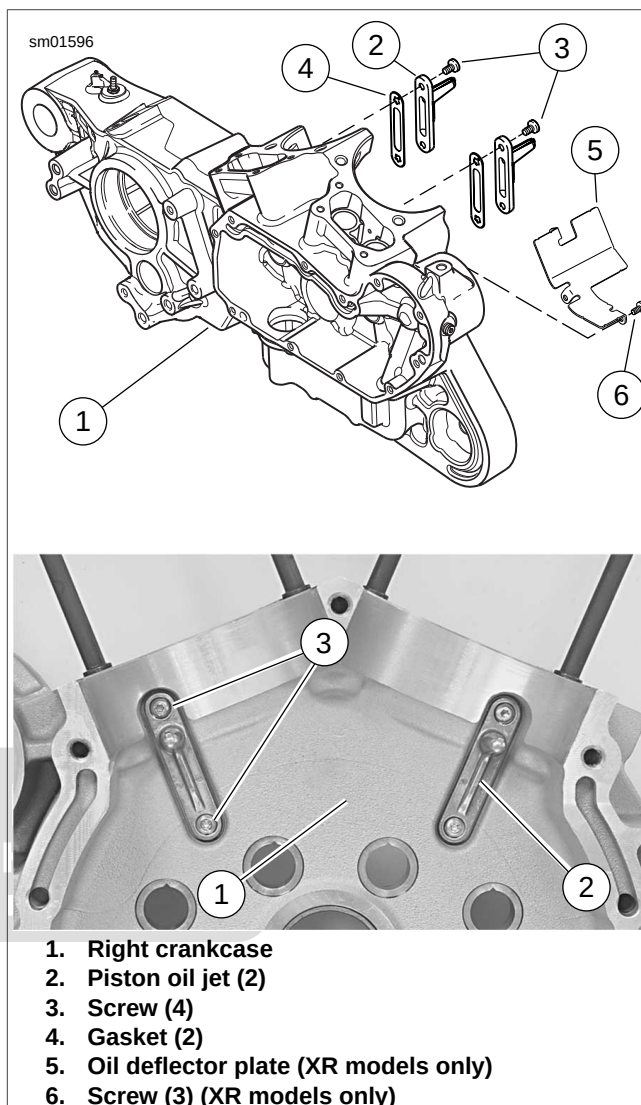


Figure 3-78. Piston Oil Jet Assemblies

Installing Pinion Shaft Bearings

- See [Figure 3-79](#) and [Figure 3-80](#). Lubricate pinion shaft and pinion shaft bearing with clean Harley-Davidson 20W50 engine oil.
- Slip bearing on pinion shaft.
- Using TRANSMISSION SHAFT RETAINING RING PLIERS (Part No. J-5586-A), install **new** retaining ring (10) in groove of pinion shaft bearing inner race. Make sure retaining ring is fully seated in groove.

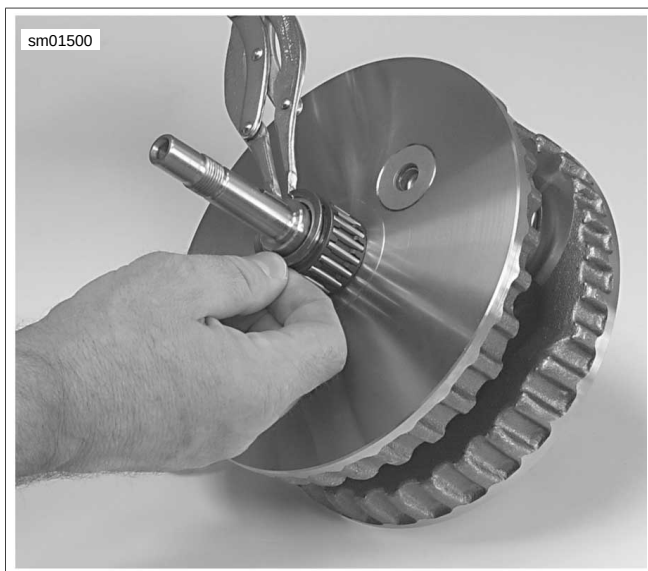


Figure 3-79. Installing Pinion Shaft Bearing and Retaining Ring

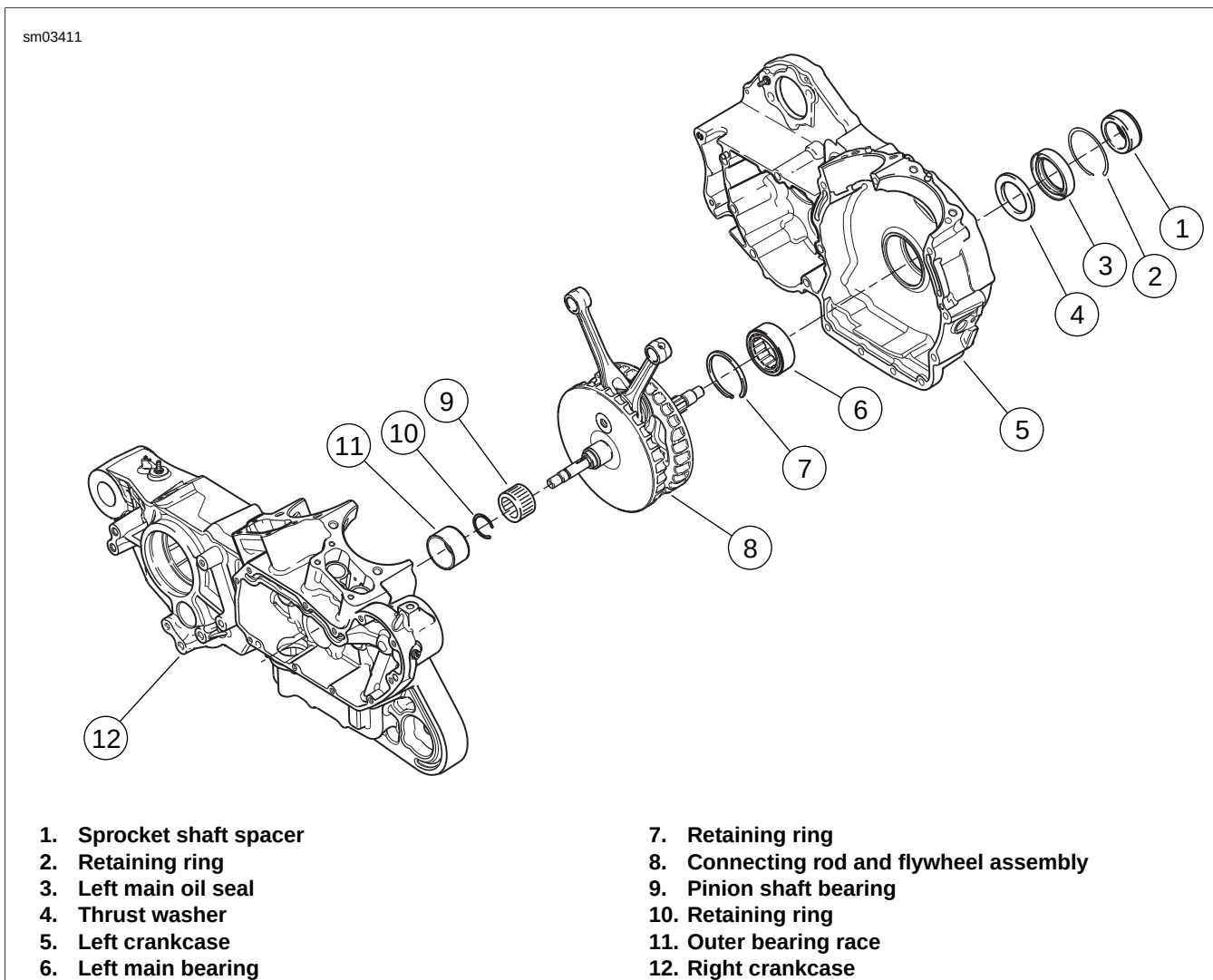


Figure 3-80. Crankcase and Flywheel Assembly (typical; XL model shown)

Installing Left Main Bearing

NOTE

When installing the left main bearing, the bearing presses from the inside of the left crankcase toward the outside. A shoulder is incorporated into the left crankcase which allows the bearing to be installed in one direction only.

1. See [Figure 3-81](#). Using CRANKCASE BEARING REMOVER/INSTALLER (Part No. B-45655) and CRANKCASE BEARING REMOVER/INSTALLER BASE (Part No. HD-42720-2), press left main bearing into the left crankcase.
 - a. Place support tube (1) on press bed with recessed cup end facing up.
 - b. With the inboard side of the left crankcase (2) facing upward, position crankshaft bearing bore (3) over support tube.
 - c. Place left main bearing (4) over bearing bore. Insert pilot/driver (5) through left main bearing, through crankshaft bearing bore and into support tube.
 - d. Apply pressure with press ram (6) until left main bearing bottoms out in bearing bore.
2. See [Figure 3-82](#). See [Figure 3-80](#). Install **new** retaining ring (7) from the inside of the left crankcase.

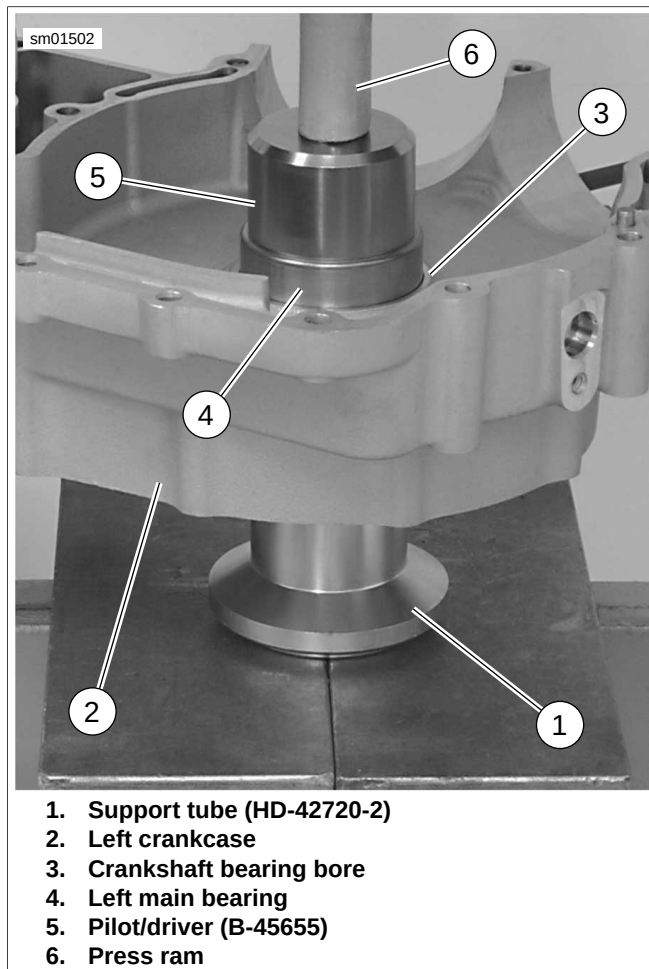


Figure 3-81. Installing Left Main Bearing in Crankcase

Assembling Crankcase Halves

1. If not already done, install transmission assembly in left crankcase. See [5.15 TRANSMISSION INSTALLATION](#).

NOTE

See [Figure 3-83](#). The Gear Detent Assembly Aid is used to move the gear detent lever clear of the shifter drum for assembly purposes.

2. See [Figure 3-83](#). Retract detent assembly in right case half and install GEAR DETENT ASSEMBLY AID (Part No. B-45520) until it has bottomed in right case half.

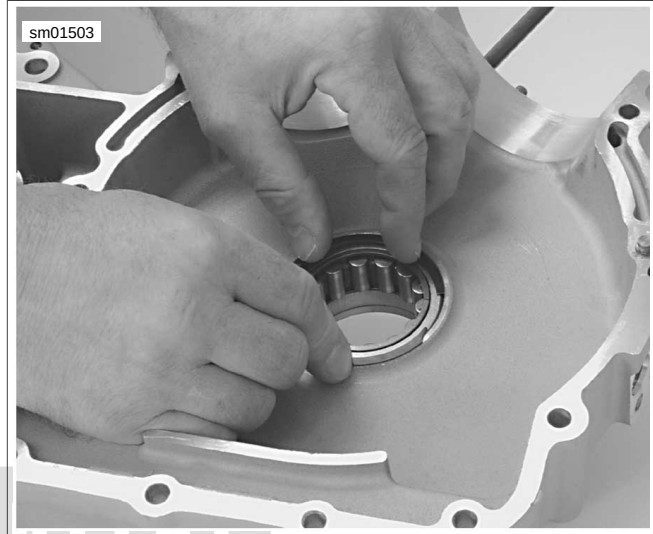


Figure 3-82. Installing Left Main Bearing Retaining Ring

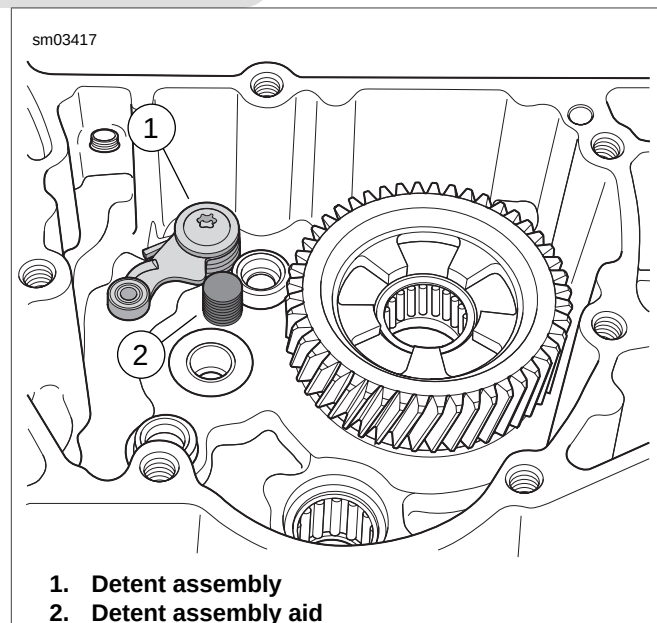


Figure 3-83. Using Gear Detent Assembly Aid (Part No. B-45520)

3. Shift transmission to 1st gear.

4. Lubricate left main bearing with clean Harley-Davidson 20W-50 engine oil.
5. Assemble crankcase halves together.
 - a. See [Figure 3-84](#). Install flywheel assembly in right crankcase. Slide pinion shaft through outer race in right crankcase.
 - b. Slide CRANKSHAFT GUIDE TOOL (Part No. HD-42326-B) onto flywheel sprocket shaft.
 - c. Apply a thin coat of GRAY HIGH-PERFORMANCE SEALANT (Part No. 99650-02) to crankcase joint faces.
 - d. See [Figure 3-85](#). Carefully fit crankcases together.

NOTE

See [Figure 3-86](#). XR models have a double-ended bolt in position 8 used to secure the front cylinder head oil return line.

- e. See [Figure 3-86](#). Apply a few drops of LOCTITE 271 (red) to last few threads of each crankcase fastener and install fasteners (thirteen long and four short) in crankcase assembly, in locations shown.
 - f. Tighten fasteners to 15-19 ft-lbs (20.3-25.8 Nm) in the sequence shown in [Figure 3-86](#).
6. Remove transmission gear detent assembly aid.

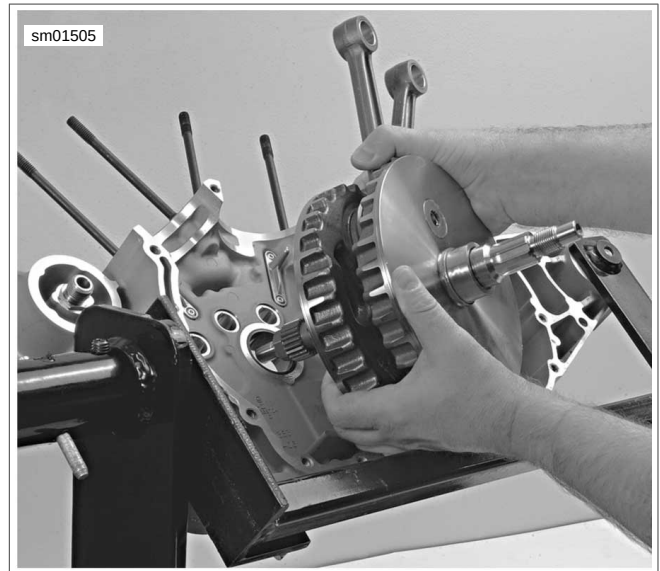


Figure 3-84. Installing Flywheels in Right Crankcase

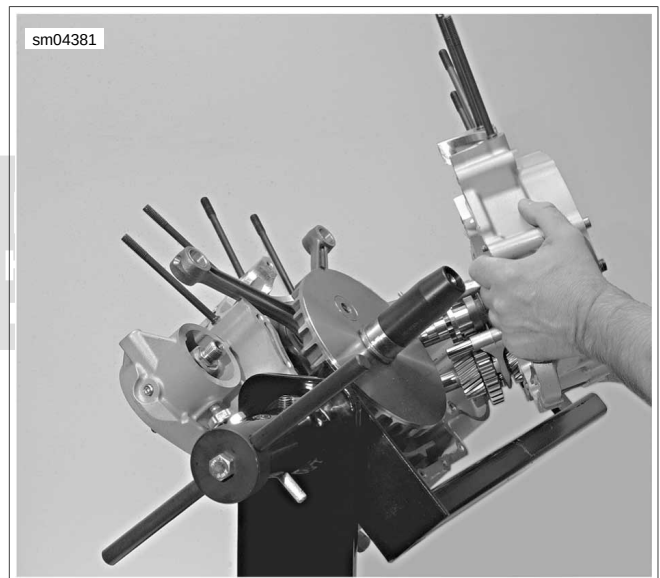


Figure 3-85. Assembling Crankcases with Crankshaft Guide Tool (Part No. HD-42326-B)



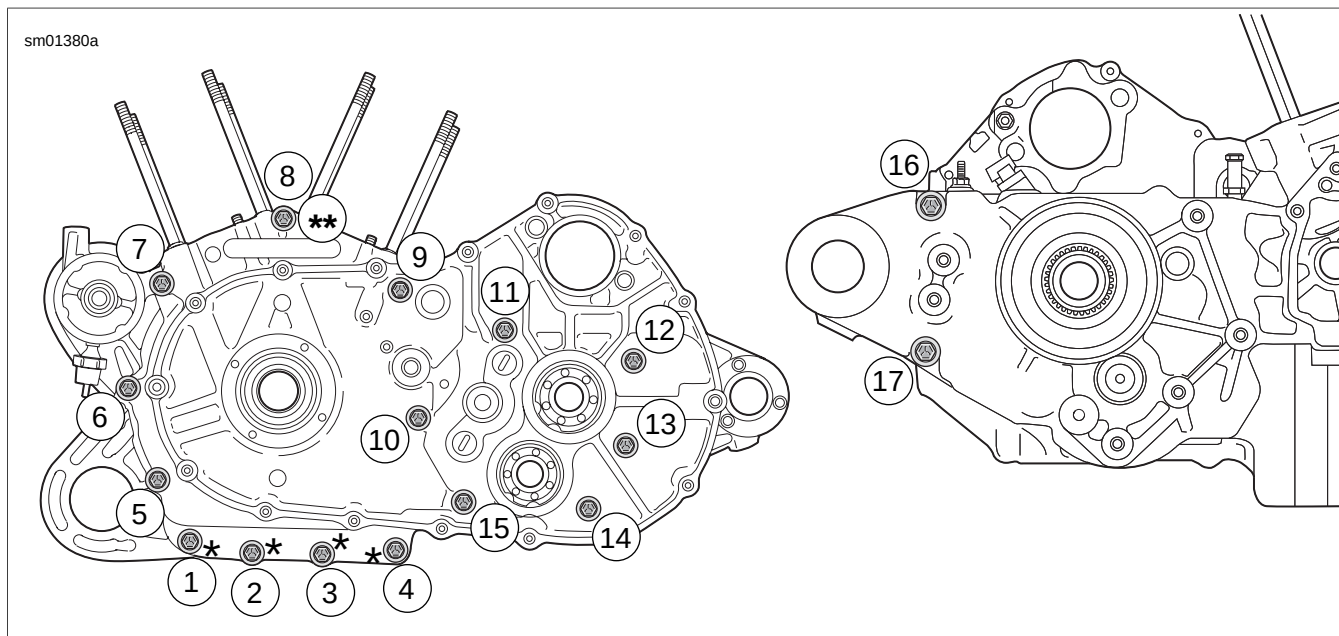


Figure 3-86. Crankcase Fastener Torque Sequence (* - Short Fasteners; ** - Double-ended Bolt: XR Models)

7. See [Figure 3-87](#) and [Figure 3-88](#). Install spacer in I.D. of **new** seal. With the open (lipped) side of seal facing outward, center seal/spacer assembly over bearing bore.



Figure 3-87. Open (Lipped) Side of Seal Faces Out

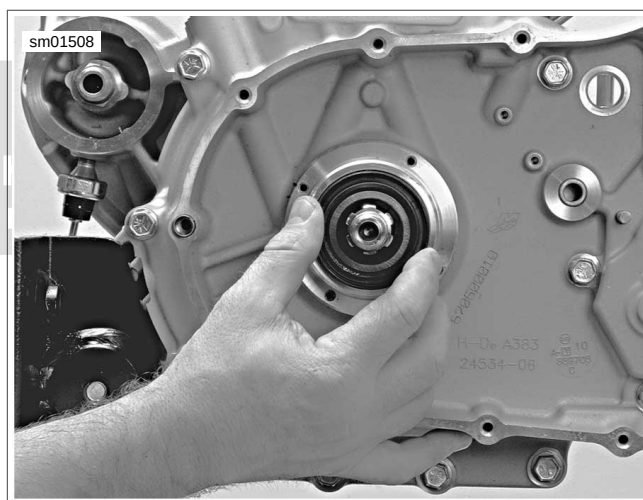


Figure 3-88. Install Spacer and Seal

NOTE

Do not remove the spacer after installation or the new seal will have to be discarded and the procedure repeated.

8. See [Figure 3-89](#). Install bearing seal and spacer.
 - a. Center seal/spacer driver (2) over seal, so that the sleeve (smaller O.D.) seats between seal wall and garter spring.
 - b. Assemble SPROCKET SHAFT BEARING/SEAL INSTALLATION TOOL (Part No. HD-42579-A) (1) and SPROCKET SHAFT SEAL/SPACER INSTALLER (Part No. B-45676-A) onto sprocket shaft.
 - c. Rotate handle clockwise until the spacer makes contact with the bearing. Remove tool from sprocket shaft.

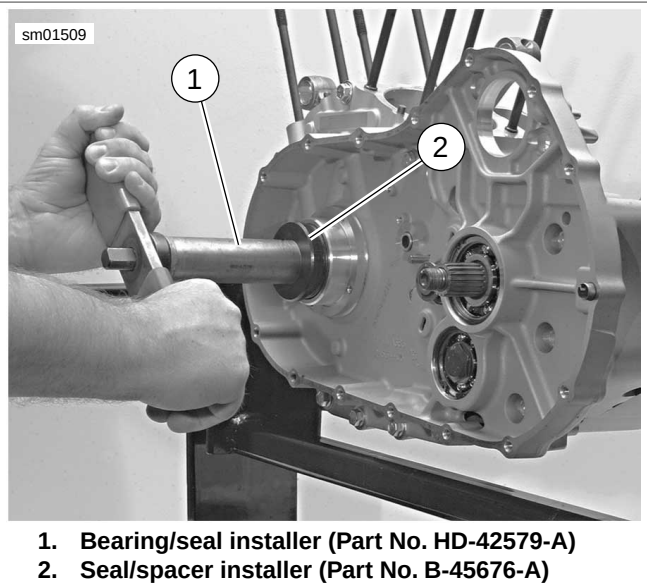


Figure 3-89. Install Bearing Seal/Spacer

9. See [Figure 3-80](#). Install retaining ring (2) into groove in sprocket shaft bearing bore.

Installing Cylinder Base Studs

See [Figure 3-90](#). If cylinder studs were removed, install them as follows.

1. Pack clean towels into crankcase opening.
2. Place a steel ball into a head screw (1).
3. 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.
4. 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.
5. Remove air gun. Use a torque wrench to tighten stud to 120-240 **in-lbs** (13.6-27.1 Nm).

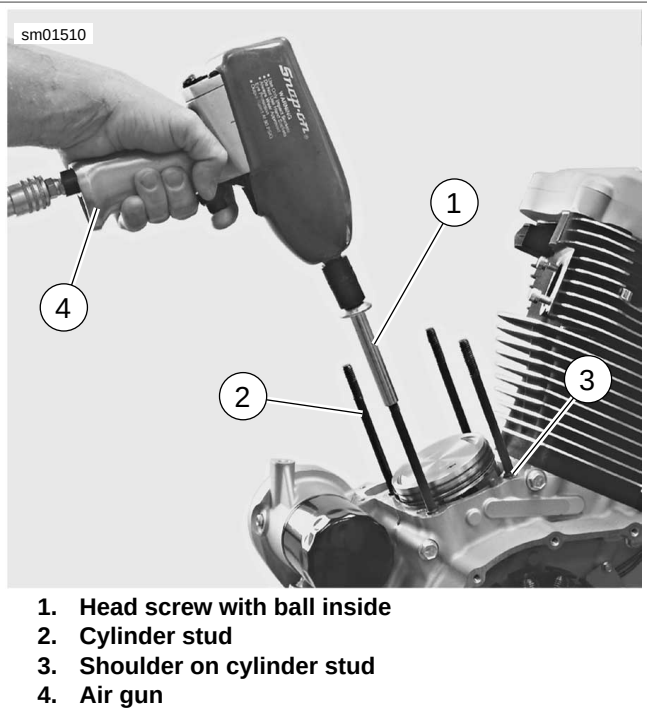


Figure 3-90. Cylinder Studs

CAM GEARS AND GEARCASE COVER: XL MODELS

PART NUMBER	TOOL NAME
HD-43984	CRANKSHAFT LOCKING TOOL

1. See [Figure 3-91](#). Make sure shaft key (18) is installed on flywheel pinion shaft. Install oil pump drive gear (12) and pinion gear (5) on pinion shaft.

NOTE

Timing mark on pinion gear tooth is aligned with keyway in I.D. of pinion gear, as shown in [Figure 3-92](#). The timing mark will allow you to easily position pinion gear over shaft key and against oil pump drive gear on pinion shaft.

2. See [Figure 3-91](#). Clean threads on pinion shaft and nut (11). Apply several drops of LOCTITE THREADLOCKER 262 (red) to threads of nut.

NOTE

See [Figure 3-91](#). When using CRANKSHAFT LOCKING TOOL, Do NOT use impact wrench to drive nut (11) onto pinion shaft.

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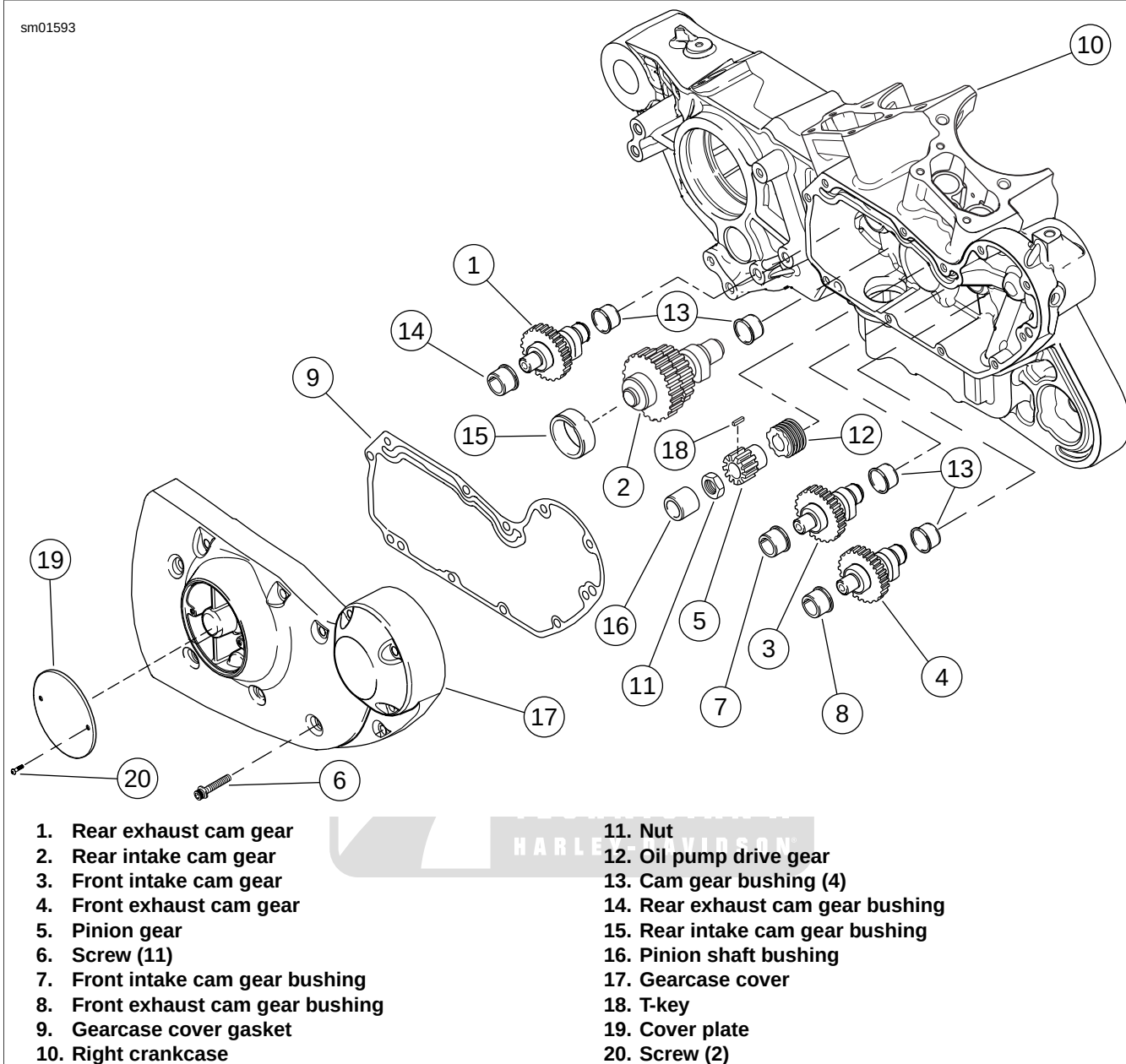


Figure 3-91. Gearcase and Valve Train Components: XL Models

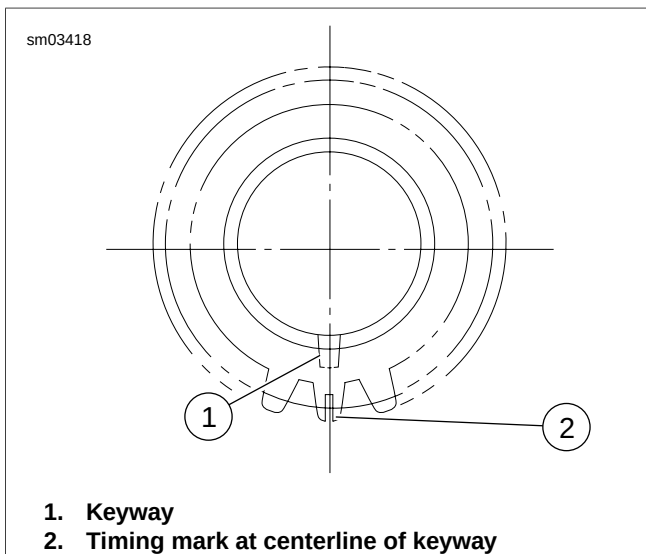


Figure 3-92. Pinion Gear Timing Mark and Keyway

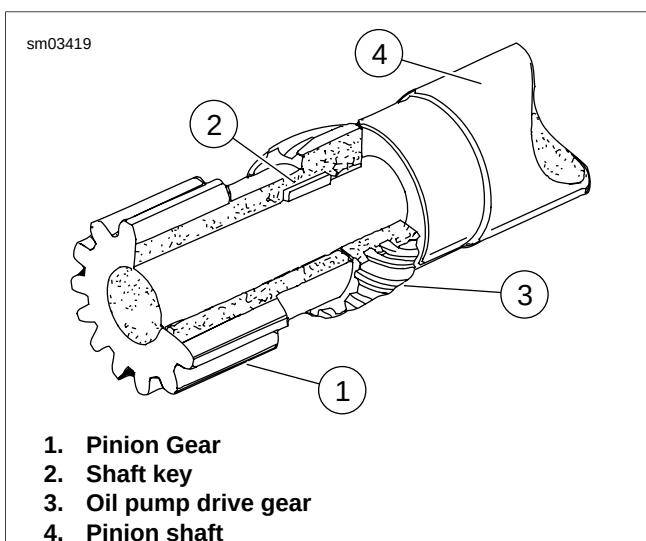


Figure 3-93. Oil Pump Drive Gear and Pinion Gear Installed on Pinion Shaft

3. See [Figure 3-94](#). Install CRANKSHAFT LOCKING TOOL (Part No. HD-43984) over pinion shaft. Install nut on pinion shaft. Tighten nut to 19-21 ft-lbs (26-29 Nm). Then tighten nut an additional 15-19 degrees of rotation. Remove CRANKSHAFT LOCKING TOOL (Part No. HD-43984).

NOTE

See [Figure 3-95](#). Because of the larger diameter additional gear (which meshes with the pinion gear) on the outboard end of the rear intake (2) cam gear, the rear exhaust (1) and front intake (3) cam gears must both be installed before the rear intake cam gear is installed.

4. Lubricate all cams and all cam bushings in right crankcase with clean Harley-Davidson 20W-50 engine oil.

5. See [Figure 3-95](#). Rotate crankshaft until timing mark on pinion gear (5) points exactly at centerline of rear intake cam bushing.

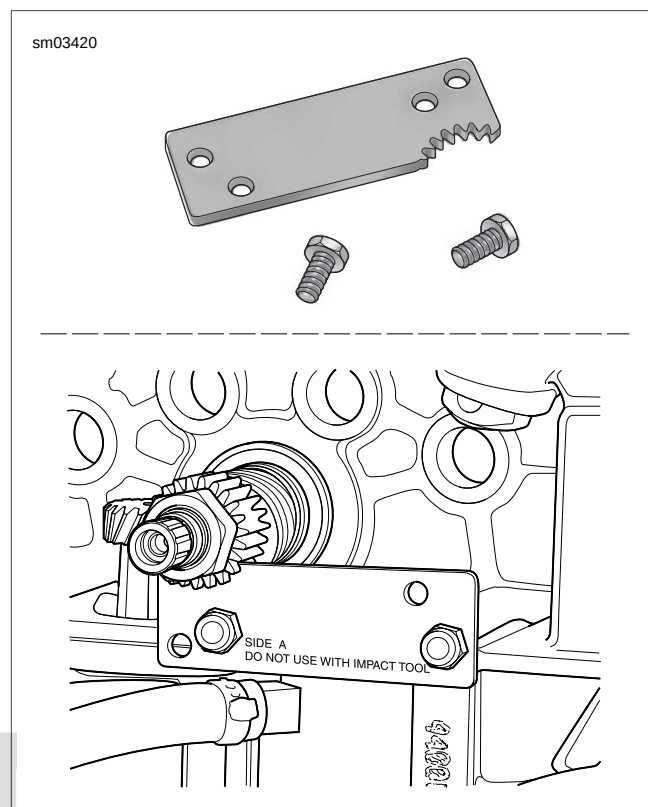


Figure 3-94. Crankshaft Locking Tool (Part No. HD-43984)

6. Install rear exhaust cam (1). Rotate cam until timing mark (a slot) points exactly at centerline of rear intake cam bushing.
7. Install front intake cam (3). Rotate cam until slotted timing mark points exactly at centerline of rear intake cam bushing.

NOTE

See [Figure 3-95](#). "V" marks on rear intake cam (2) are not used for timing of Sportster model engines.

8. Install rear intake cam (2). As you install this cam, rotate it so that the three timing marks (dots) line up exactly with timing marks on the pinion gear, rear exhaust cam and front intake cam.
9. Install front exhaust cam (4). As you install this cam, rotate it so that its timing mark (a dot) lines up with timing mark (dot) of front intake cam.

NOTE

Make sure all timing marks on cams just installed line up correctly, as shown in [Figure 3-95](#). If necessary, remove a cam, rotate it slightly, and re-install it. If timing marks are off even one tooth, engine will not run correctly.

10. See [Figure 3-91](#). Install a new dry gasket (9) on gearcase cover (17).

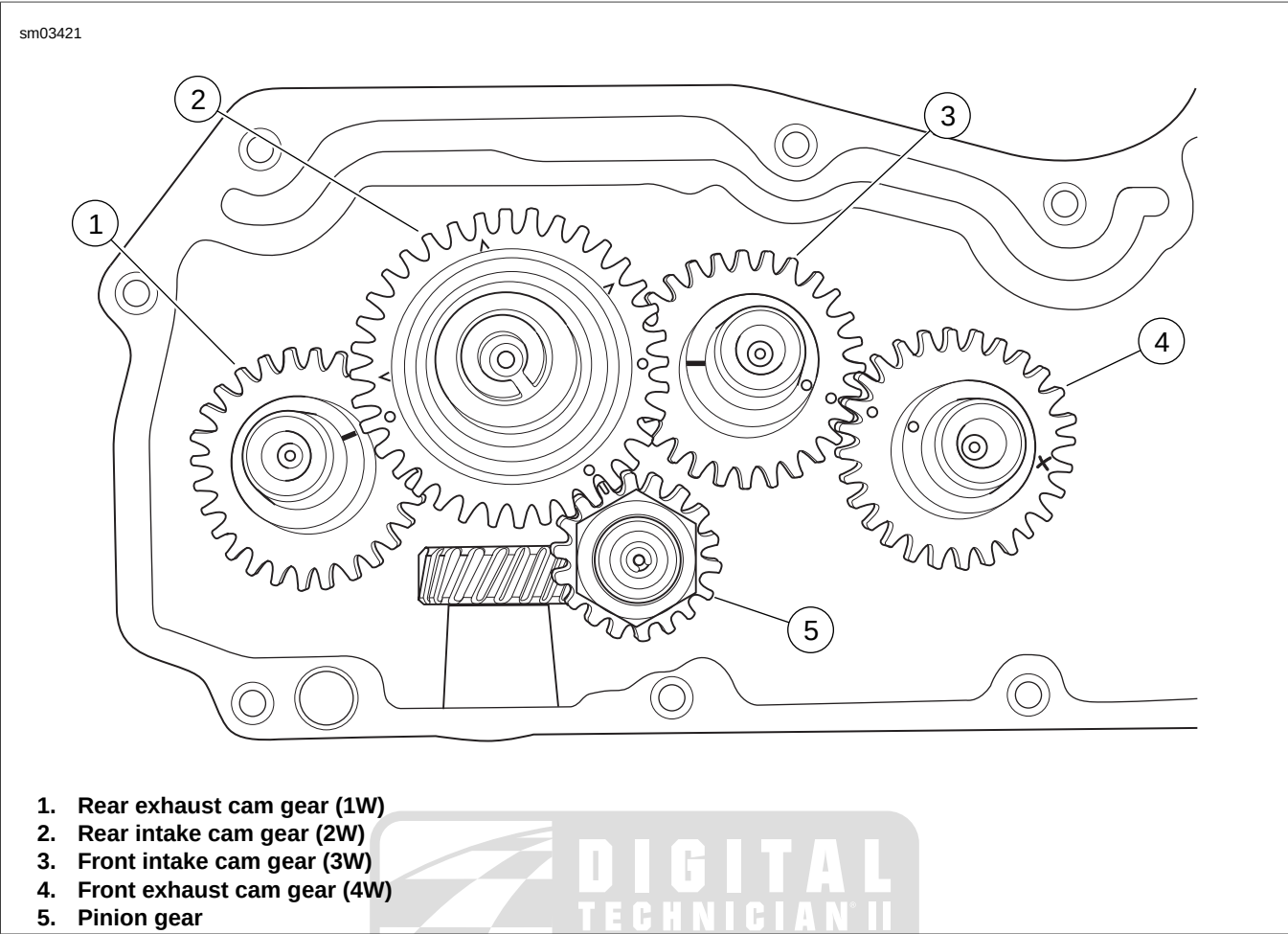


Figure 3-95. Cam, Pinion Gear and Timing Mark Indexing (Cam #2 "V" marks are not used for timing)

11. Lubricate all cam bushings in gearcase cover with clean Harley-Davidson 20W-50 engine oil.
12. Install gearcase cover over all gears and onto right crankcase. Secure cover to crankcase with 11 socket head screws. Tighten screws evenly to 80-110 **in-lbs** (9.0-12.4 Nm) according to the tightening sequence shown in [Figure 3-96](#).
13. Check cam gear end play through tappet bores in right crankcase, 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 cam gear toward gearcase cover.
 - c. Using a feeler gauge, measure gap between bushing (in crankcase) and cam gear shaft thrust face (shoulder). This is cam gear end play.
 - d. Compare your cam gear end play measurements with the [3.2 SPECIFICATIONS](#). Make repairs as required if end gap is less than the minimum specified, or greater than the maximum specified (Service Wear Limits).

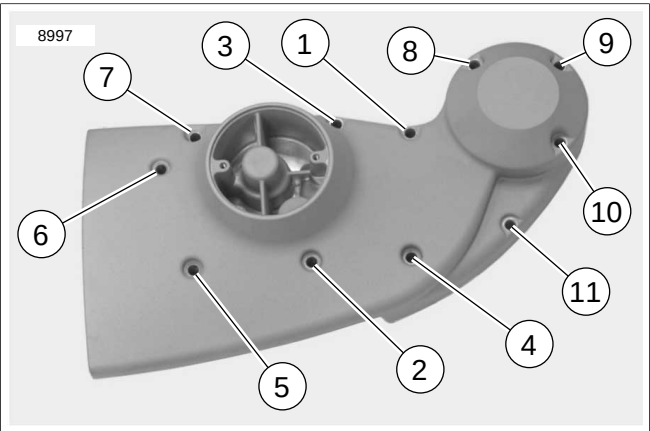


Figure 3-96. Gearcase Cover Mounting Screw Torque Sequence

CAM GEARS AND GEARCASE COVER: XR MODELS

PART NUMBER	TOOL NAME
HD-43984	CRANKSHAFT LOCKING TOOL

1. See [Figure 3-97](#). Make sure shaft key (10) is installed on flywheel pinion shaft. Install spacer (7) and pinion gear (6) on pinion shaft.

NOTE

Timing mark on pinion gear tooth is aligned with keyway in I.D. of pinion gear, as shown in [Figure 3-98](#). The timing mark will allow you to easily position pinion gear over shaft key and against oil pump drive gear on pinion shaft.

2. See [Figure 3-97](#). Clean threads on pinion shaft and nut (5). Apply several drops of LOCTITE THREADLOCKER 262 (red) to threads of nut.

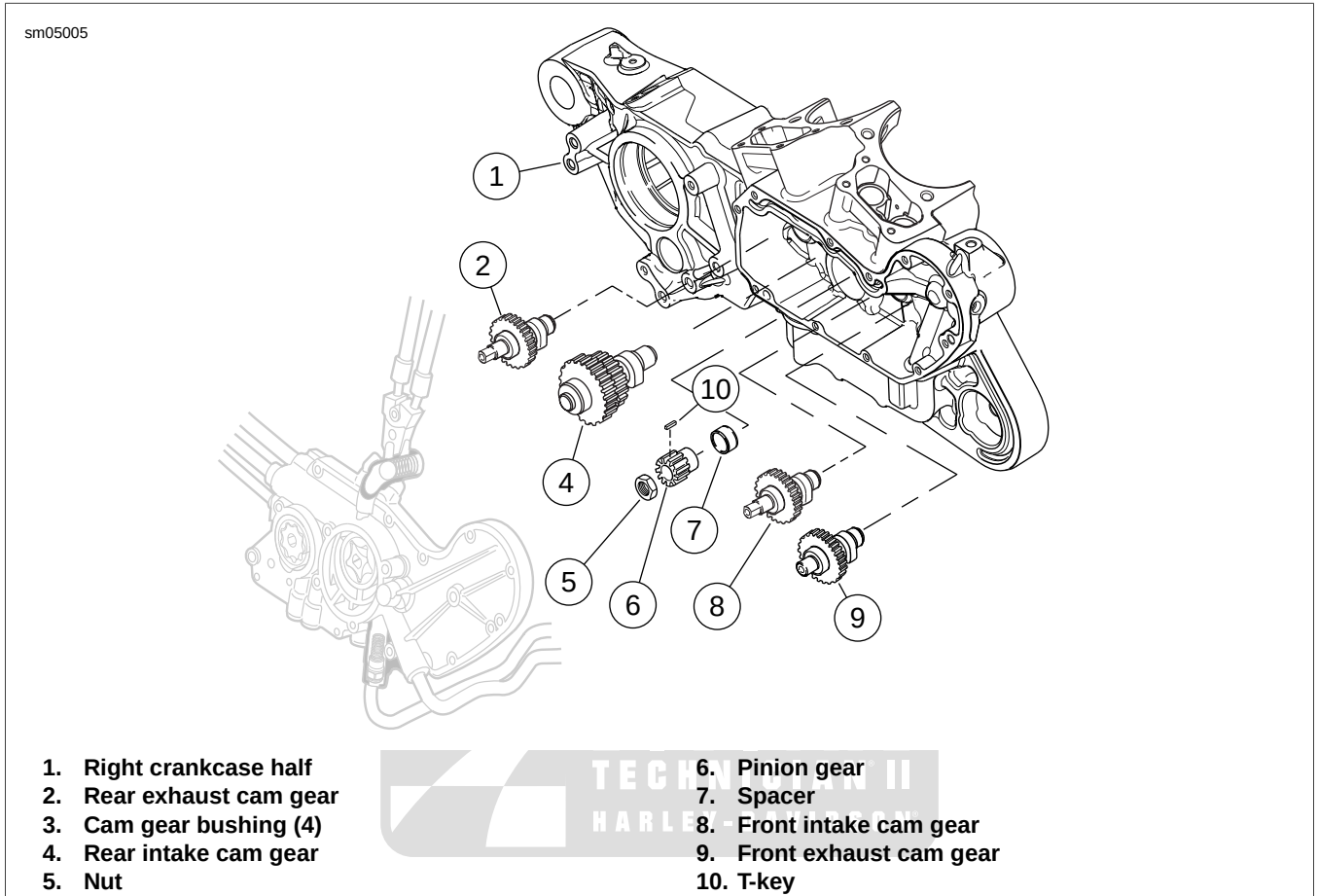


Figure 3-97. Gearcase and Valve Train Components: XR Models

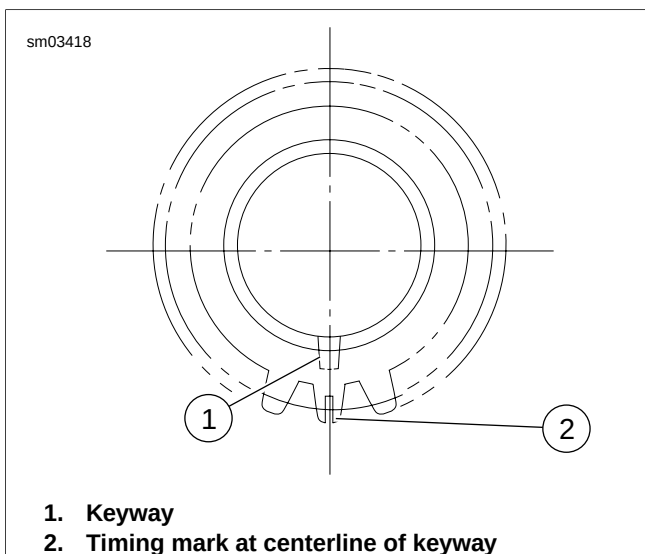


Figure 3-98. Pinion Gear Timing Mark and Keyway

NOTE

See [Figure 3-99](#). When using CRANKSHAFT LOCKING TOOL, Do NOT use impact wrench to drive nut onto pinion shaft.

3. See [Figure 3-99](#). Install CRANKSHAFT LOCKING TOOL (Part No. HD-43984) over pinion shaft. Install nut on pinion shaft. Tighten nut to 19-21 ft-lbs (26-29 Nm). Then tighten nut an additional 15-19 degrees of rotation. Remove CRANKSHAFT LOCKING TOOL (Part No. HD-43984).

NOTE

See [Figure 3-100](#). Because of the larger diameter gear on the outboard end of the rear intake cam gear (2), the rear exhaust (1) and front intake (3) cam gears must be installed before the rear intake cam gear is installed.

4. Lubricate all cams and all cam bores in right crankcase with clean Harley-Davidson 20W-50 engine oil.
5. See [Figure 3-100](#). Rotate crankshaft until timing mark on pinion gear (5) points exactly at centerline of rear intake cam bore.

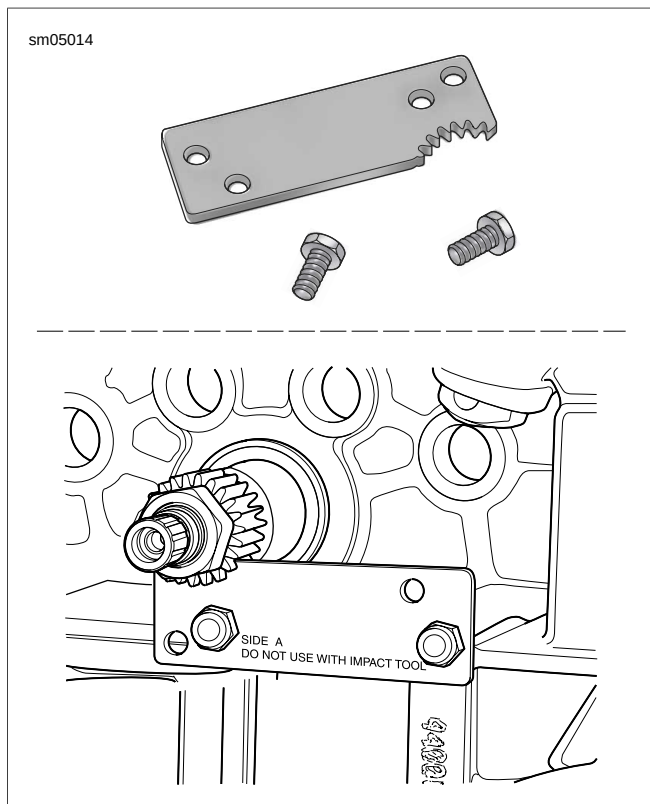


Figure 3-99. Crankshaft Locking Tool (Part No. HD-43984)

6. Install rear exhaust cam (1). Rotate cam until timing mark (a slot) points exactly at centerline of rear intake cam bore.
7. Install front intake cam (3). Rotate cam until slotted timing mark points exactly at centerline of rear intake cam bore.

NOTE

See [Figure 3-100](#). "V" marks on rear intake cam (2) are not used for timing of Sportster model engines.

8. Install rear intake cam (2). As you install this cam, rotate it so that the three timing marks (dots) line up exactly with timing marks on the pinion gear, rear exhaust cam and front intake cam.
9. Install front exhaust cam (4). As you install this cam, rotate it so that its timing mark (a dot) lines up with timing mark (dot) of front intake cam.

NOTE

Make sure all timing marks on cams line up correctly, as shown in [Figure 3-100](#). If necessary, remove a cam, rotate it slightly, and re-install it. If timing marks are off even one tooth, engine will not run correctly.

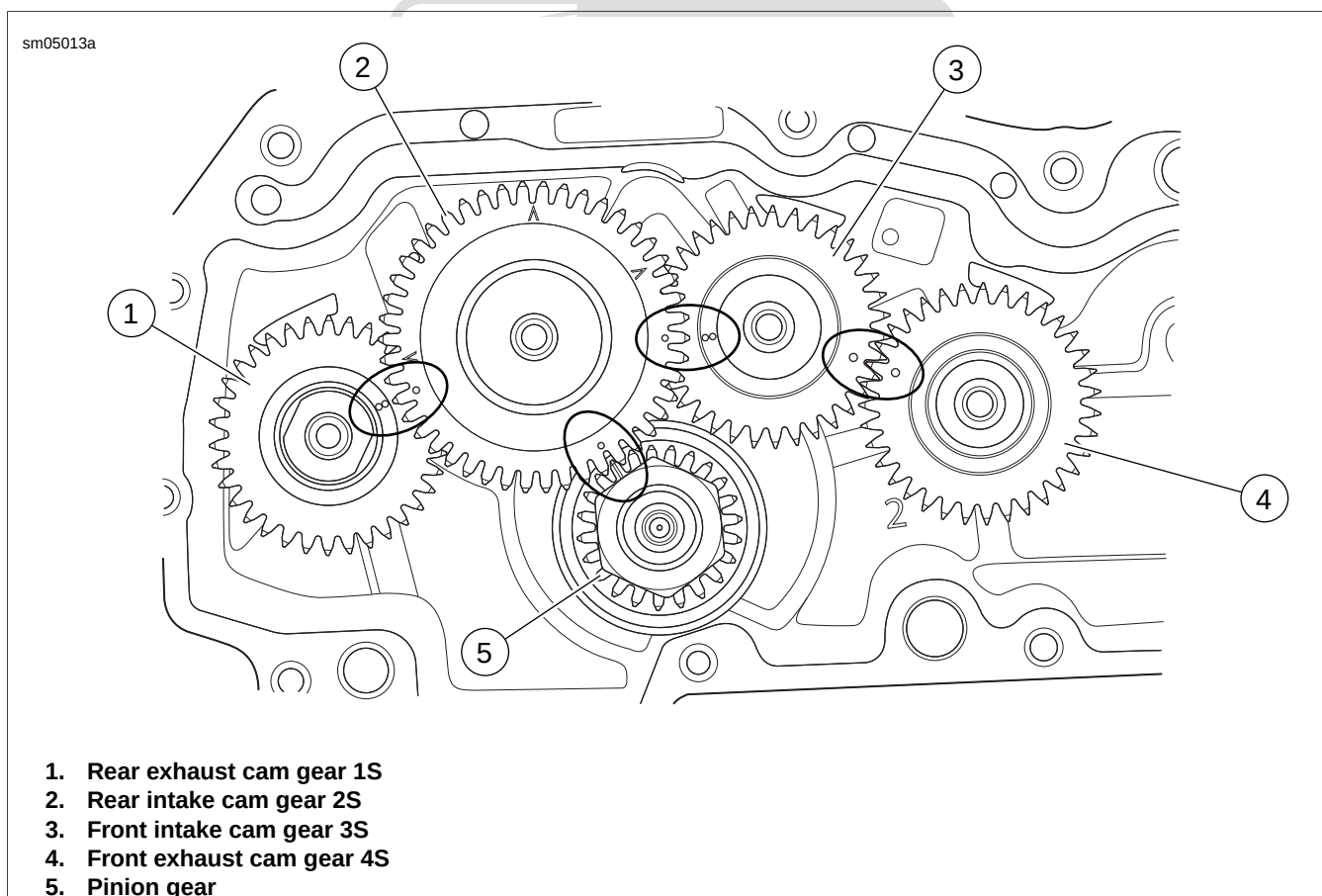


Figure 3-100. Cam, Pinion Gear and Timing Mark Indexing: XR Models (Cam #2 "V" marks are not used for timing)

10. Lubricate all cam bores in gearcase cover with clean Harley-Davidson 20W-50 engine oil.
11. [Figure 3-101](#). Install gearcase cover with **new** gasket and secure with three fasteners (6). Tighten fasteners to 80-110 **in-lbs** (9.0-12.4 Nm).
12. Install oil pump rotors. Be sure they are oriented the same as when they were removed.
13. Install new o-rings in oil pump cover and install using six fasteners (4). Tighten fasteners to 80-110 **in-lbs** (9.0-12.4 Nm).
14. Install check valve housing using a new base o-ring. Tighten fasteners (3) to 84-108 **in-lbs** (9.5-12.2 Nm).
15. Connect rigid lines (1) and vent hose (2). See [3.14 PRECISION COOLING SYSTEM: XR MODELS, Oil Pump Lines](#).
16. See [Figure 3-102](#). Install gearcase and oil pump cover. Secure with 9 socket fasteners. Tighten in the sequence shown to 80-110 **in-lbs** (9.0-12.4 Nm).
17. Check cam gear end play through tappet bores in right crankcase, 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 cam gear toward gearcase cover.
 - c. Using a feeler gauge, measure gap between bore (in crankcase) and cam gear shaft thrust face (shoulder). This is cam gear end play.
 - d. Compare your cam gear end play measurements with the [3.2 SPECIFICATIONS](#). Make repairs as required if end gap is less than the minimum specified, or greater than the maximum specified (Service Wear Limits).

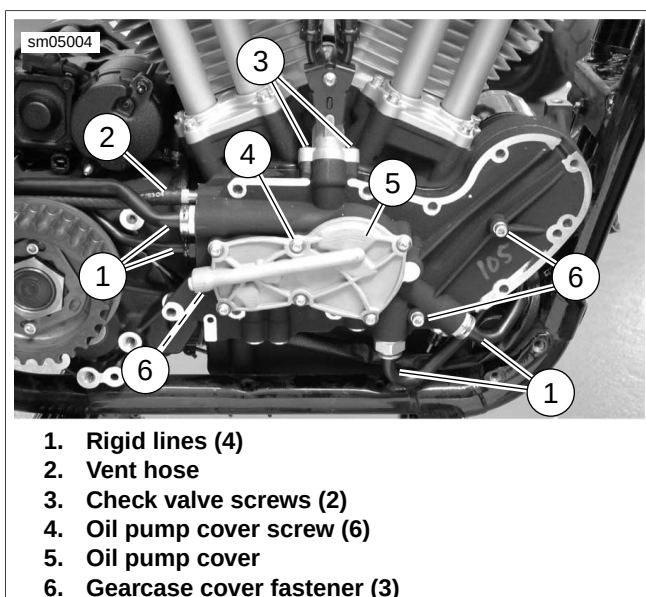


Figure 3-101. Gearcase Cover and Oil Pump: XR Models

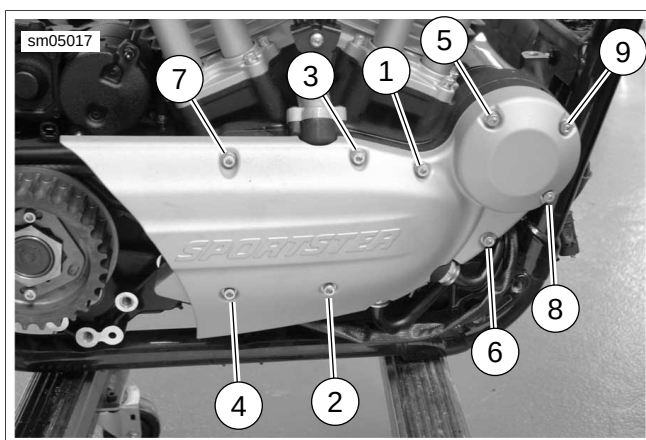


Figure 3-102. Oil Pump Cover Torque Sequence: XR Models

TAPPETS

1. See [Figure 3-103](#). Rotate engine so that both tappets (3) 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) for smooth initial operation.
3. Insert both tappets (intake and exhaust) into anti-rotation device (2) with flats at upper end of each tappet positioned so they will be facing front and rear when assembly is installed in engine, and the tappet oil feed hole is facing toward the gear cover.
4. Install anti-rotation device with tappets into bore in right crankcase (4). Secure with screw (1). Tighten to 80-110 **in-lbs** (9.0-12.4 Nm).

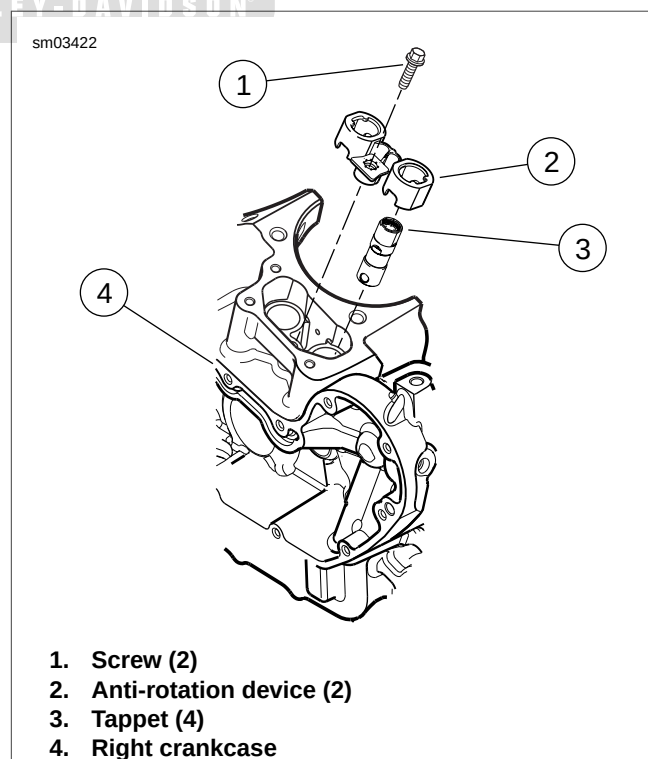


Figure 3-103. Tappet Installation

ASSEMBLING TOP END OF ENGINE

To continue with engine assembly, see [3.16 TOP END OVERHAUL: ASSEMBLY](#).



GENERAL

See [Figure 3-104](#). 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.

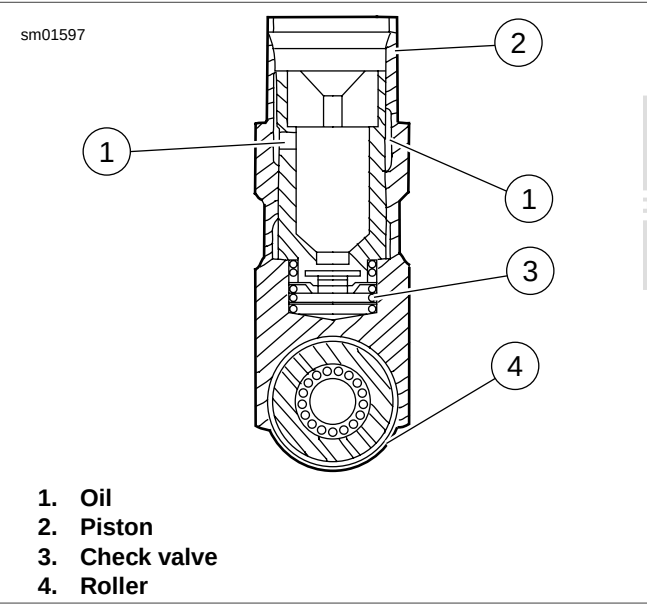


Figure 3-104. Tappet Assembly

REMOVAL

See [3.17 BOTTOM END OVERHAUL: DISASSEMBLY, Tappets](#) to remove tappets from engine.

CLEANING AND INSPECTION

WARNING

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

1. Clean all parts, except roller/tappet assembly, thoroughly in solvent. Blow dry with compressed air.
2. Refer to [Table 3-29](#). Inspect valve tappets for excessive clearance in guide. Accurately measure tappet bore inner diameter with a gauge. 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. Recommended service practice is tappet replacement.
4. Check tappet roller end clearance.
5. Tappets should be soaked in clean engine oil and kept covered until assembly.

Table 3-29. Valve Tappet Specifications

ITEM	VALUE	SERVICE WEAR LIMIT
Tappet clearance in guide	0.0008-0.0020 in. (0.020-0.051 mm)	0.0030 in. (0.076 mm)
Tappet roller free play (clearance on pin)	0.0006-0.0010 in. (0.015-0.025 mm)	0.0015 in. (0.038 mm)
Tappet roller end clearance	0.008-0.022 in. (0.203-0.559 mm)	0.026 in. (0.660 mm)

INSTALLATION

To install tappets, see [3.18 BOTTOM END OVERHAUL: ASSEMBLY, Tappets](#).

GEARCASE COVER AND CAM GEARS

3.20

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 AND DISASSEMBLY

See [3.17 BOTTOM END OVERHAUL: DISASSEMBLY, Gearcase Cover and Cam Gears: XL Models](#) or [3.17 BOTTOM END OVERHAUL: DISASSEMBLY, Oil Pump Housing/Gearcase Cover and Cam Gears: XR Models](#) to remove gearcase cover and cam gears from engine.

CLEANING, INSPECTION AND REPAIR

1. Thoroughly clean gearcase compartment, gearcase cover and gears in solvent to remove oil and carbon deposits.

⚠ WARNING

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

2. Blow out all gearcase cover oil passages and bushings with low pressure compressed air.
3. Clean old gasket material from gearcase and gearcase cover faces with cleaning solvent.

Cam and Pinion Gear Identification, Inspection and Selection

See [Figure 3-105](#). Cam lobes are stamped with a number (1, 2, 3, or 4) followed by a letter. The number identifies the cam location/function:

The letter indicates the cam lobe profile. Use only "W" cams in all XL models. Use only "S" cams in XR models.

Table 3-30. Cam Identification

CAM LOCATION	XL	XR
Rear Exhaust	1W	1S
Rear Intake	2W	2S
Front Intake	3W	3S
Front Exhaust	4W	4S

NOTE

Prior to changing any cam gears, check gear shaft fit within corresponding bushings. Worn bushings can cause excessive backlash.

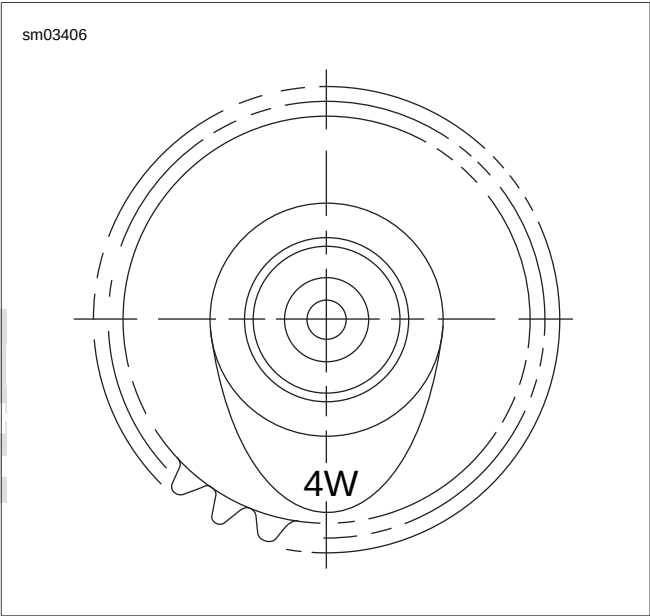
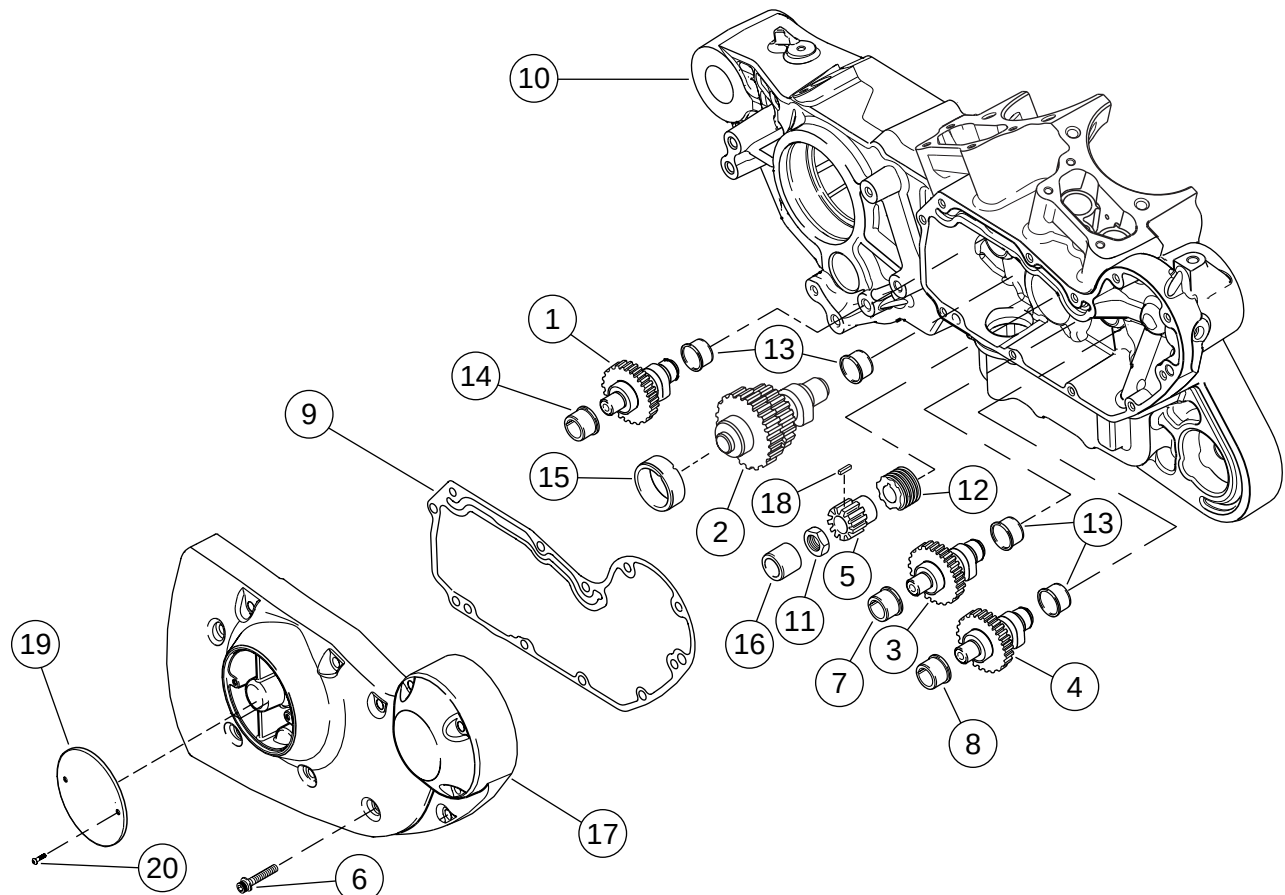


Figure 3-105. Cam Identification (typical; XL shown)

BUSHING INSPECTION AND REMOVAL: XL ONLY

PART NUMBER	TOOL NAME
HD-95760-69A	BUSHING AND BEARING PULLER

sm03407



- | | |
|--|--|
| 1. Rear exhaust cam gear | 11. Nut |
| 2. Rear intake cam gear | 12. Oil pump drive gear |
| 3. Front intake cam gear | 13. Cam gear bushing (4) (XL models only) |
| 4. Front exhaust cam gear | 14. Rear exhaust cam gear bushing (XL models only) |
| 5. Pinion gear | 15. Rear intake cam gear bushing (XL models only) |
| 6. Screw (11) | 16. Pinion shaft bushing (XL models only) |
| 7. Front intake cam gear bushing (XL models only) | 17. Gearcase cover |
| 8. Front exhaust cam gear bushing (XL models only) | 18. T-key |
| 9. Gearcase cover gasket | 19. Cover plate |
| 10. Right crankcase | 20. Screw (2) |

Figure 3-106. Gearcase and Valve Train Components (XL model shown)

- See [Figure 3-106](#). Bushings (7, 8, 13, 14, 15, 16) are press fit in gearcase cover and crankcase. Inspect each bushing against its corresponding cam gear shaft or pinion gear shaft. Refer to [Table 3-31](#) for clearances and service wear limits.
- See [Figure 3-107](#). Use BUSHING AND BEARING PULLER (Part No. HD-95760-69A) to remove bushings from gearcase cover and crankcase.

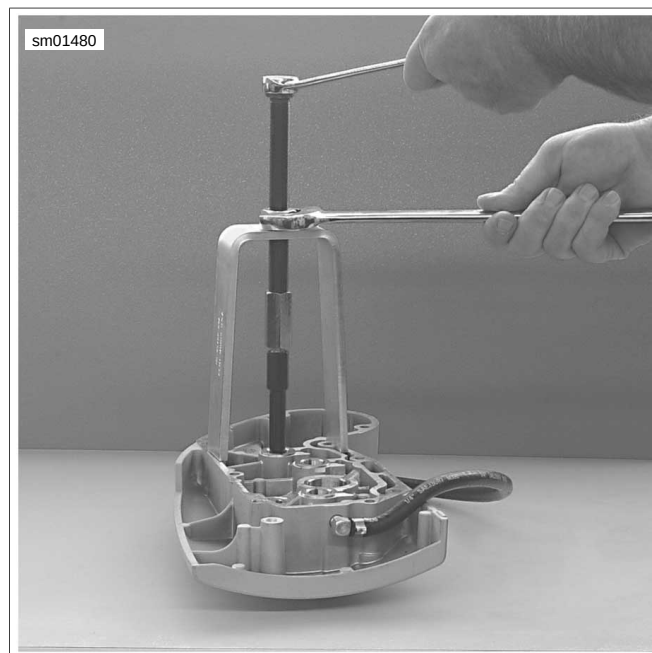


Figure 3-107. Removing Cam Bushing from Gearcase Cover

BUSHING INSTALLATION: XL ONLY

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

See [Figure 3-108](#). Each cam gear bushing, to be installed in right crankcase, 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, ream the bushing to correct size. See [3.20 GEARCASE COVER AND CAM GEARS, Bushing Reaming: XL Only](#).

Table 3-31. Inspection

GEAR SHAFT	CORRECT CLEARANCE		SERVICE WEAR LIMIT	
	IN.	MM	IN.	MM
Cam	0.0007-0.0022	0.018-0.056	0.003	0.08
Pinion	0.0023-0.0043	0.058-0.109	0.005	0.13

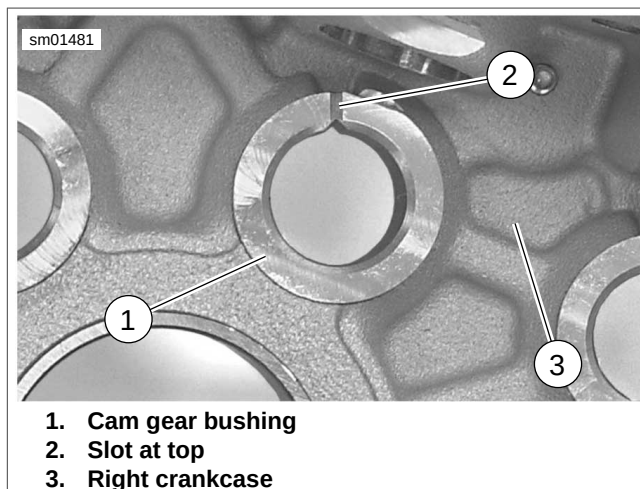


Figure 3-108. Cam Gear Bushing Installed in Crankcase

Cam Gear Bushings (Except Rear Intake Bushing) in Gearcase Cover

1. See [Figure 3-106](#). 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, line-ream the bushing to correct size. See [3.20 GEARCASE COVER AND CAM GEARS, Bushing Reaming: XL Only](#).

Rear Intake Cam Gear Bushing in Gearcase Cover

See [Figure 3-106](#). 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.

1. See [Figure 3-109](#). 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.
2. After you install the **new** bushing in the gearcase cover, line-ream the bushing to the correct size. See [3.20 GEARCASE COVER AND CAM GEARS, Bushing Reaming: XL Only](#).

Pinion Shaft Bushing in Gearcase Cover

1. See [Figure 3-106](#). Using an arbor press, install pinion shaft bushing (16) in gearcase cover (17) 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 3-110](#). 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, line-ream the bushing to the correct size. See [3.20 GEAR-CASE COVER AND CAM GEARS, Bushing Reaming: XL Only](#).

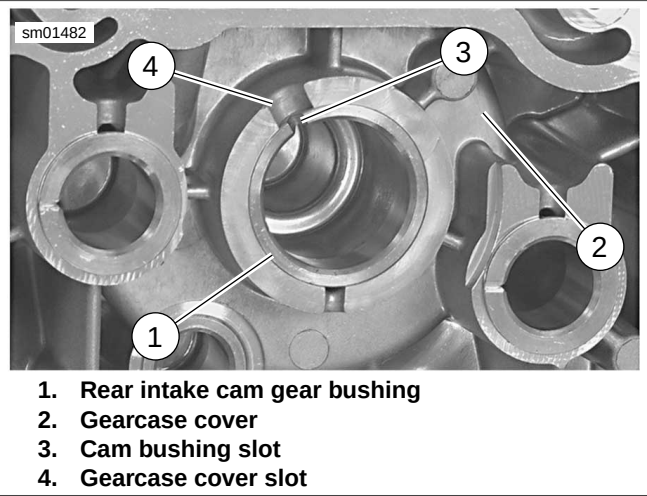


Figure 3-109. Rear Intake Cam Gear Bushing Installed in Gearcase Cover

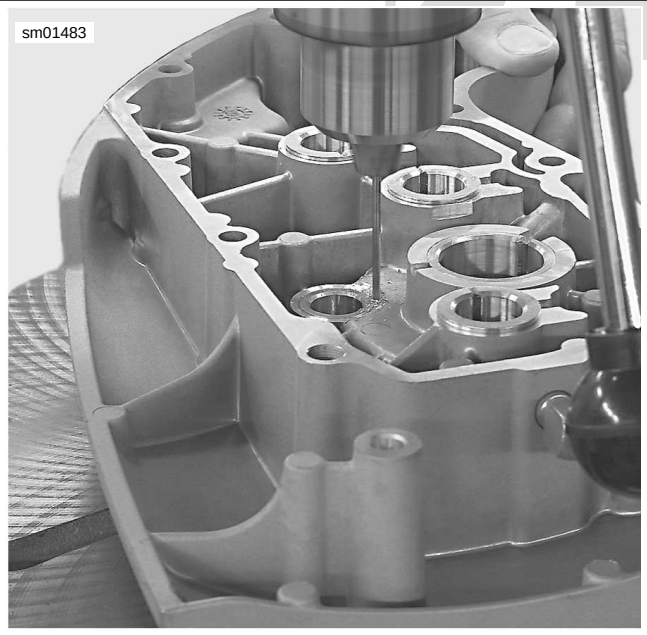


Figure 3-110. Drilling Pinion Bushing Dowel Pin Hole in Gearcase Cover

BUSHING REAMING: XL ONLY

PART NUMBER	TOOL NAME
HD-38871	CAMSHAFT BUSHING REAMER PILOT
HD-94803-67	REAR INTAKE CAM GEAR BUSHING REAMER
HD-94812-1	PINION SHAFT BUSHING REAMER
HD-94812-87	PINION SHAFT BUSHING REAMER

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 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

1. Separate two halves of crankcase, if not already done. Place right crankcase on flat surface with gearcase side up.
2. See [Figure 3-111](#). Position CAMSHAFT BUSHING REAMER PILOT (Part No. HD-38871) onto gearcase side of crankcase; upper right and lower left indexing holes in pilot must be placed over dowels in crankcase. Insert two bolts (supplied with pilot) through two remaining holes in pilot, and into threaded holes of crankcase. Tighten bolts securely.
3. Insert a standard 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.

⚠ WARNING

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

5. Thoroughly clean right crankcase, removing all metal chips/shavings. Blow out all bushing bores and oil passages using low pressure compressed air.

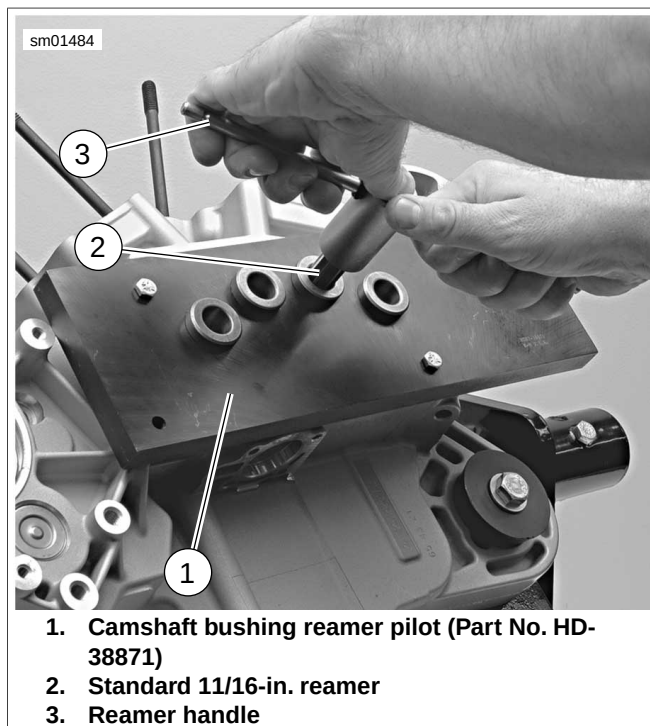


Figure 3-111. Reaming Cam Gear Bushing in Right Crankcase

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 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 to perform the following line reaming procedures.

1. See [Figure 3-106](#). Bushings (7, 8 and 14) to be reamed must be installed in gearcase cover (17) as described in [3.20 GEARCASE COVER AND CAM GEARS, Bushing Installation: XL Only](#). Attach gearcase cover to right crankcase (10), which has been disassembled from left crankcase, 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, 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 two previous steps for remaining two cam gear bushings (except rear intake bushing) in gearcase cover, if required.
5. Separate gearcase cover from right crankcase. Inspect bushings for proper cam gear shaft fit. Repeat line reaming operation if necessary.

⚠ WARNING

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

6. Thoroughly clean gearcase cover, removing all metal chips/shavings. Blow out all bushing bores and oil passages using low pressure compressed air.

Rear Intake Cam Gear Bushing in Gearcase Cover

NOTE

A newly installed rear intake cam gear bushing in the gearcase cover must be line reamed, using the right crankcase 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 to perform the following line reaming procedures.

1. See [Figure 3-106](#). Rear intake cam gear bushing (15) must be installed in gearcase cover (17) as described in [3.20 GEARCASE COVER AND CAM GEARS, Bushing Installation: XL Only](#).
2. Identify the previously reamed rear intake cam gear bushing (13) in right crankcase (10), which has been disassembled from left crankcase. 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, attach gearcase cover to right crankcase, 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. Inspect bushing for proper cam gear shaft fit. Repeat line reaming operation if necessary.

⚠ WARNING

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

6. Thoroughly clean gearcase cover, removing all metal chips/shavings. Blow out all bushing bores and oil passages using low pressure 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 and PINION SHAFT BUSHING REAMER (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 to perform the following line reaming procedure.

1. See [Figure 3-106](#). Pinion shaft bushing (16) must be installed in gearcase cover (17) as described in [3.20 GEARCASE COVER AND CAM GEARS, Bushing Installation: XL Only](#). Attach gearcase cover to right crankcase (10), which has been disassembled from left crankcase, securing with a minimum of three mounting screws.
2. See [Figure 3-112](#). 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. Inspect bushing for proper pinion shaft fit. Repeat line reaming operation if necessary.

WARNING

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

5. Remove pilot from right crankcase roller race. Thoroughly clean gearcase cover, removing all metal chips/shavings.

Blow out all bushing bores and oil passages using low pressure compressed air.

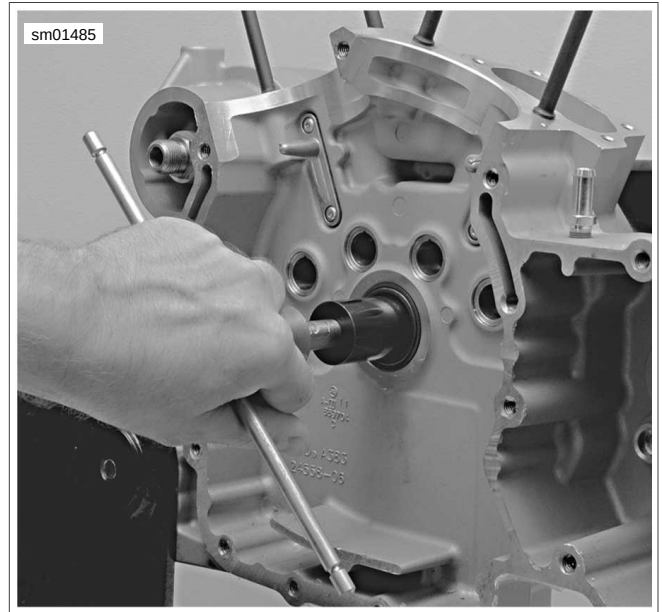


Figure 3-112. Line Reaming Pinion Shaft Bushing

ASSEMBLY AND INSTALLATION

See [3.18 BOTTOM END OVERHAUL: ASSEMBLY, Cam Gears and Gearcase Cover: XL Models](#) or [3.18 BOTTOM END OVERHAUL: ASSEMBLY, Cam Gears and Gearcase Cover: XR Models](#) to install cam gears and gearcase cover in engine.

CYLINDER HEAD

3.21

REMOVAL

See [3.15 TOP END OVERHAUL: DISASSEMBLY, Cylinder Heads](#) to remove cylinder head from engine.

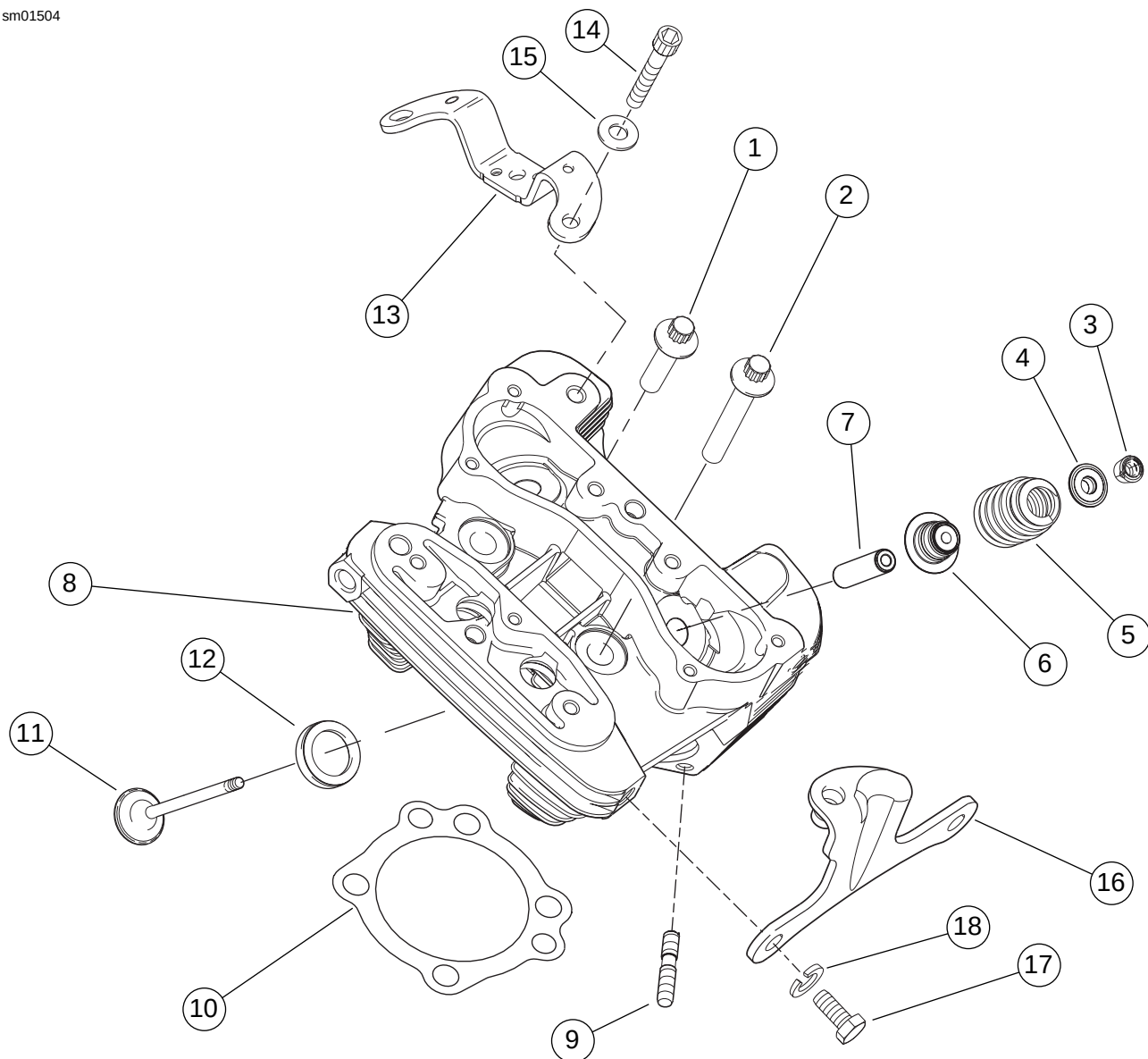
DISASSEMBLY

PART NUMBER	TOOL NAME
HD-34736-B	VALVE SPRING COMPRESSOR

1. See [Figure 3-113](#). Remove two screws (17), lock washers (18) and stabilizer link bracket (16) from front head.
2. See [Figure 3-114](#). Clamp VALVE SPRING COMPRESSOR (Part No. HD-34736-B) in vice and compress valve spring (item 5, [Figure 3-113](#)).



sm01504



- | | |
|--|--|
| 1. Head bolt, short (2) | 10. Cylinder head gasket |
| 2. Head bolt, long (2) | 11. Valve (1) intake, (1) exhaust |
| 3. Valve collar retainer (4) | 12. Valve seat (2) |
| 4. Upper valve spring collar (2) | 13. Cylinder head bracket* |
| 5. Valve spring (2) | 14. Screw (2)* |
| 6. Valve seal and lower valve spring collar assembly (2) | 15. Washer (2)* |
| 7. Valve guide, intake and exhaust (2) | 16. Stabilizer link bracket (front cylinder head only) |
| 8. Cylinder head | 17. Screw (2) |
| 9. Exhaust port stud (2) | 18. Lock washer (2) |

Figure 3-113. Cylinder Head Assembly (typical) (* Vehicles with Side Mounted Horn Only)

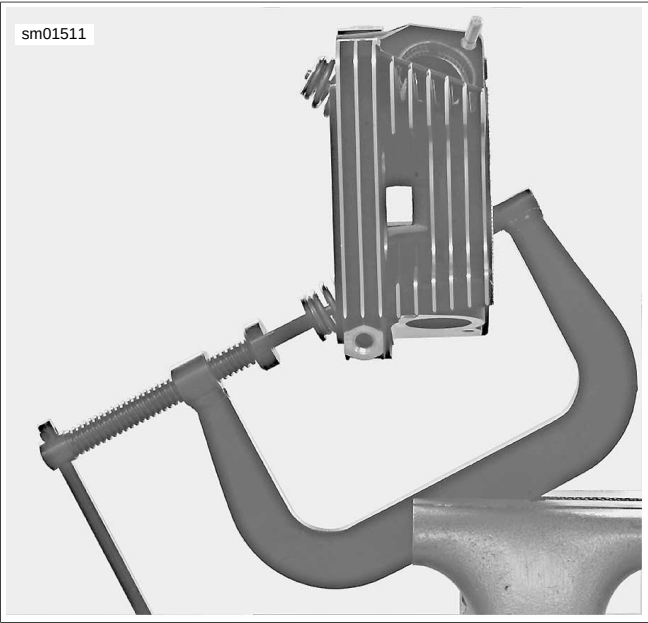


Figure 3-114. Compressing Valve Springs (Valve Spring Compressor, Part No. HD-34376-B)

3. See [Figure 3-113](#). Remove valve collar retainers (3), upper valve spring collar (4) and valve spring (5). Mark valve collar retainers for reassembly in original positions.
4. Use a fine tooth file to remove any burrs on the valve stem at the retainer groove. Mark valve to ensure that it will be reassembled in the same head.
5. Remove valve (11), and valve seal and lower valve spring collar assembly (6) by hand. No special tools are required to remove valve seal and lower valve spring collar assembly.
6. Repeat above procedure for other valve. Then disassemble other head following same procedure.

CLEANING AND INSPECTION

PART NUMBER	TOOL NAME
B-45525	VALVE GUIDE HONE
HD-34751	VALVE GUIDE CLEANING BRUSH
HD-96796-47	VALVE SPRING TESTER

Cylinder Heads



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

1. Bead blast or scrape carbon from head and valve ports. Be careful to avoid scratching or nicking cylinder head-to-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 valve 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. See [Figure 3-115](#). Check head gasket surface on head for flatness. Machine or replace any head which exceeds SERVICE WEAR LIMIT of 0.006 in. (0.152 mm).



Figure 3-115. Checking Gasket Surface: Must Be Flat Within 0.006 in. (0.152 mm)

Rocker Arm Assemblies

1. Check each rocker arm at pad end and push rod end for uneven wear or pitting. Replace rocker arm if either condition exists.

NOTE

Most of the wear in rocker arm shafts and bores results from the up and down movement of the pushrods and valves. Therefore, the following measurements should be taken top-to-bottom on rocker arm shafts and bores.

2. See [Figure 3-116](#). Measure and record rocker arm shaft diameter at the positions where rocker arm bushings ride and where shaft fits in inner rocker cover.

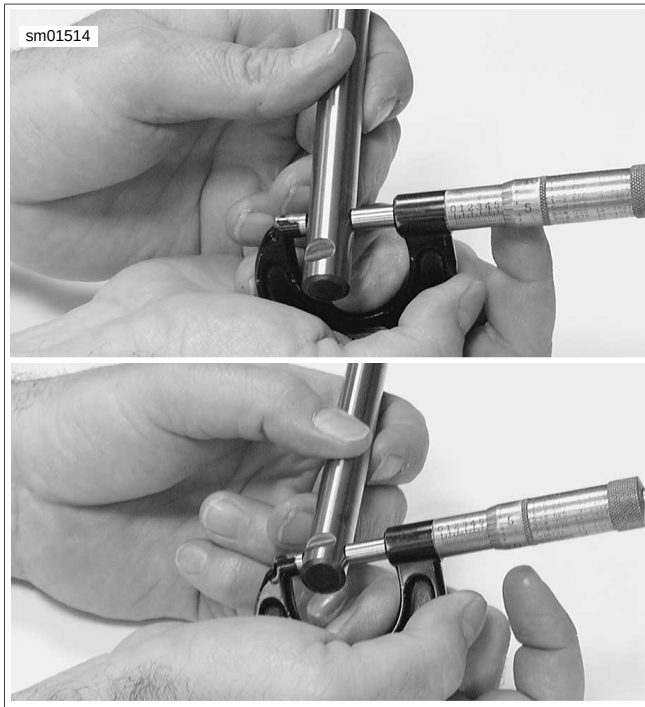


Figure 3-116. Measuring Rocker Arm Shaft Diameter at Bushing Position (top) and Cover Position (bottom)

3. Measure and record rocker arm shaft bore diameters.
 - a. See [Figure 3-117](#). Measure rocker arm shaft bore in inner rocker cover.
 - b. See [Figure 3-118](#). Measure rocker arm bushing inner diameter.
4. Check clearances and measurements obtained in step 3 against specifications in [3.2 SPECIFICATIONS](#). Repair or replace parts exceeding Service Wear Limits. If rocker arm bushings require replacement, see [3.21 CYLINDER HEAD, Replacing Rocker Arm Bushings](#).
5. See [Figure 3-119](#). Assemble rocker arms and rocker arm shafts into inner rocker cover.
6. Check end play of rocker arm with feeler gauge. Replace rocker arm or inner rocker cover or both if end play exceeds 0.025 in. (0.635 mm).

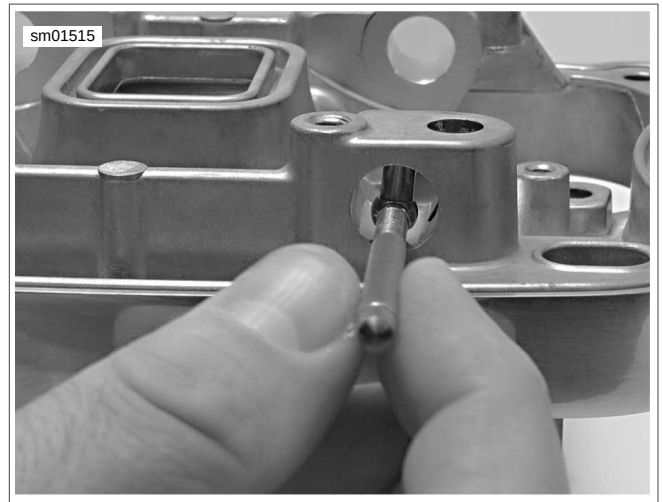


Figure 3-117. Measuring Rocker Arm Shaft Bore Diameter in Inner Rocker Cover



Figure 3-118. Measuring Rocker Arm Bushing Inner Diameter

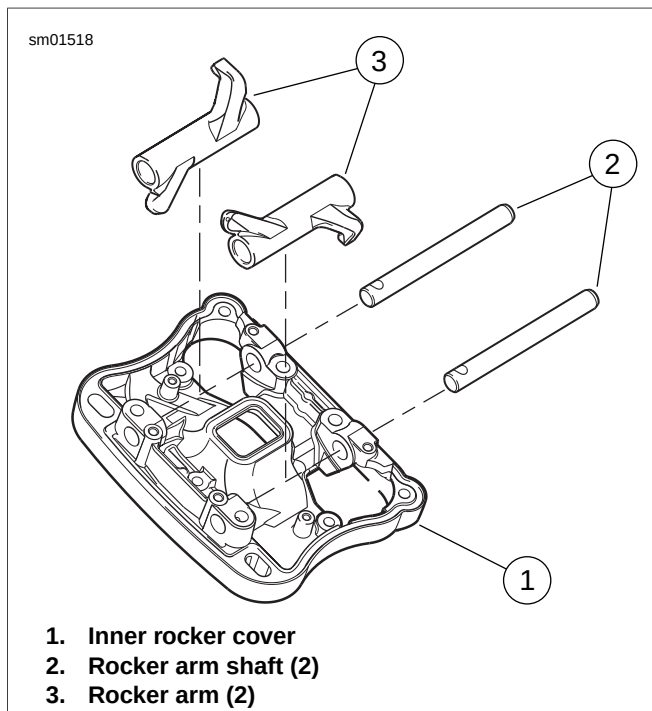


Figure 3-119. Assembling Inner Rocker Cover (typical; XL shown)

Valves

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

Valve Seats

NOTE

Valve seats are subject to wear, pitting, and burning. Resurface valve seats whenever valves are refinished.

1. Inspect valve seats for cracking, chipping or burning. Replace valve seats if any evidence of these conditions exists.



Figure 3-120. Measuring Valve Stem Protrusion

2. See [Figure 3-120](#). Check valve seats for recession by measuring valve stem protrusion.
 - a. Wipe valve seats and valve faces clean. Insert valve into valve guide.
 - b. Measure valve stem protrusion from end of valve stem to machined surface of head upon which the lower valve collar sits, as shown. If valve stem protrudes more than 2.082 in. (52.883 mm), replace valve seat or cylinder head.

NOTE

Replacing a valve seat is a complex operation requiring special equipment. If the valve seat is loose or is not fully seated in the head, seat movement will prevent the proper transfer of heat from the valve. The valve seat surface must be flush with (or below) the head surface. See [3.2 SPECIFICATIONS](#) for valve seat-to-cylinder head fit.

Valve Guides

1. Clean valve guides by lightly honing with VALVE GUIDE HONE (Part No. B-45525).
2. Scrub valve guides with VALVE GUIDE CLEANING BRUSH (Part No. HD-34751) and hot soapy water. Measure valve stem outer diameter and valve guide inner diameter. Check measurements against See [3.2 SPECIFICATIONS](#).

Valve Springs

1. Inspect valve springs for broken or discolored coils.

NOTE

A single valve spring is used for each valve. The inner and outer springs are combined into one progressively wound, tapered spring.

2. See [Figure 3-121](#). Check free length of each spring with caliper as shown. Test compression force of spring using

VALVE SPRING TESTER (Part No. HD-96796-47). Compare with [3.2 SPECIFICATIONS](#). If spring length is shorter than specification, or if spring compression force is below specification, replace spring.

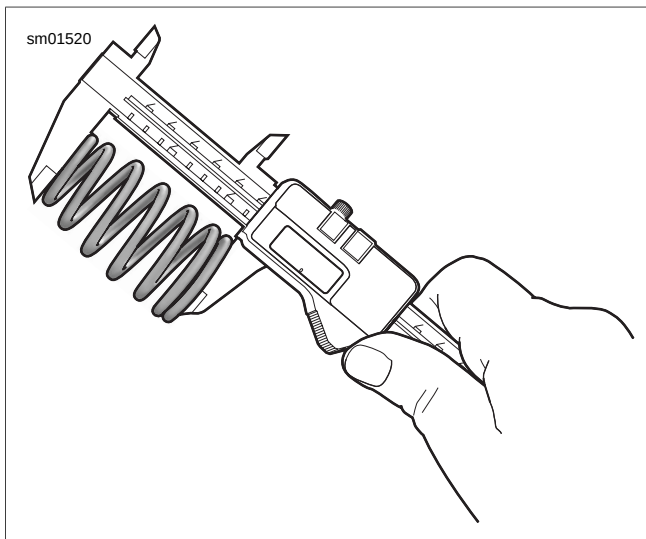


Figure 3-121. Checking Spring Free Length

Spark Plug Threads

Inspect spark plug threads for damage. If threads in cylinder head are damaged, a special plug type insert can be installed using a 12 mm spark plug repair kit.

Push Rods

Examine push rods, particularly the ball ends. Replace any rods that are bent, worn, discolored, or broken.

REPLACING ROCKER ARM BUSHINGS

PART NUMBER	TOOL NAME
HD-94804-57	ROCKER ARM BUSHING REAMER

1. See [Figure 3-122](#). 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 using a discarded rocker arm shaft.
2. Press replacement bushing into rocker arm, flush with rocker arm end, and split portion of bushing towards top of rocker arm.
3. Using remaining old bushing as a pilot, line ream **new** bushing with **ROCKER ARM BUSHING REAMER** (Part No. HD-94804-57).
4. Repeat for other end of rocker arm.

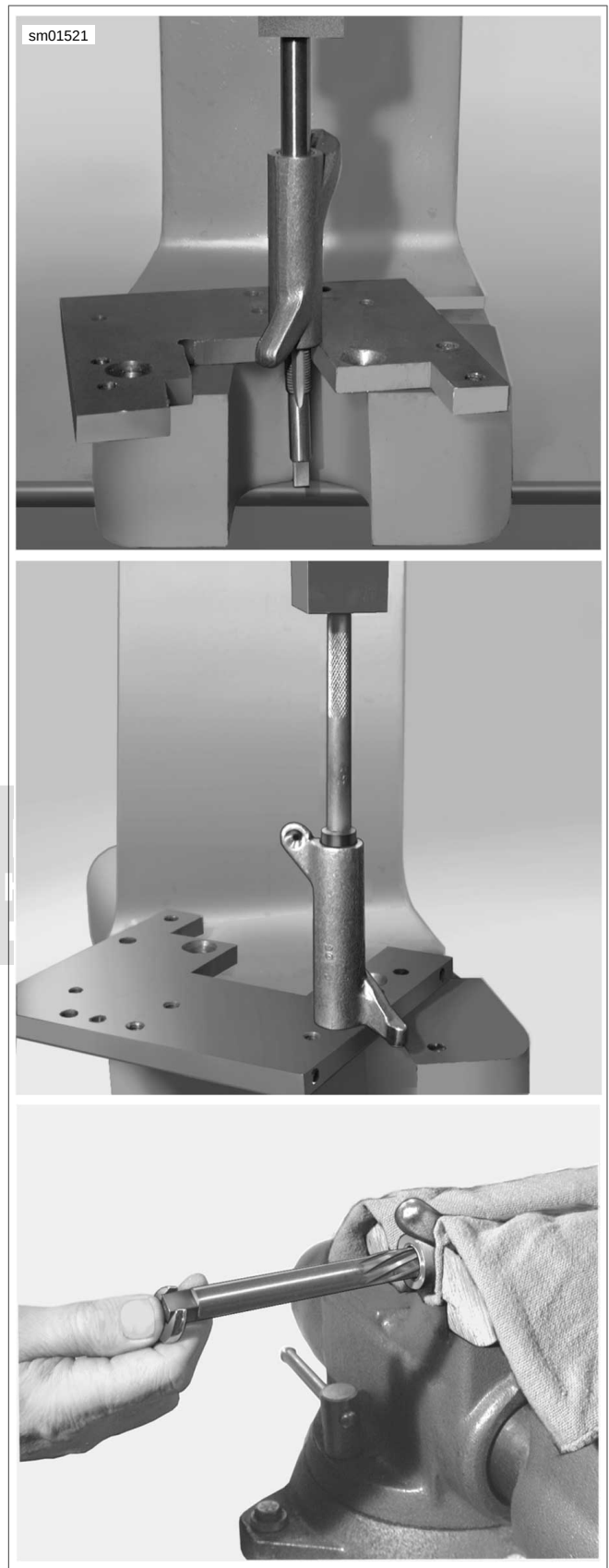


Figure 3-122. Replacing Rocker Arm Bushings

REPLACING VALVE GUIDES

PART NUMBER	TOOL NAME
B-45523	VALVE GUIDE REAMER
B-45524	VALVE GUIDE REMOVER/INSTALLER
B-45525	VALVE GUIDE HONE
HD-34751	VALVE GUIDE CLEANING BRUSH
HD-39782-A	CYLINDER HEAD SUPPORT STAND
HD-39786	CYLINDER HEAD HOLDING FIXTURE
HD-39847	REAMER T-HANDLE
HD-39964	REAMER LUBRICANT

Valve guide replacement, if necessary, must be done before valve seat is ground. It is the valve stem bore in valve guide that determines valve seat grinding location. Valve stem-to-valve guide clearances are listed in [Table 3-32](#). If valve stems and/or valve guides are worn beyond service wear limits, install new parts.

Removal

NOTES

- *Cylinder head support stand keeps valve guide and valve seat perpendicular. If perpendicularity is not achieved, the cylinder head valve guide bore will be damaged during the press procedure.*
 - *Lock ring is present on OEM intake and exhaust valve guides on XR models only.*
1. See [Figure 3-123](#). Prepare cylinder head for valve guide replacement.
 - a. **XR models:** Remove and discard lock ring from valve guide groove.
 - b. Insert sleeve of intake (4 or 6) or exhaust (5 or 7) seat adapter into tube at top of CYLINDER HEAD SUPPORT STAND (Part No. HD-39782-A) (3).
 - c. Position cylinder head so that valve seat is centered on seat adapter.

NOTE

Do not press out the valve guide from the bottom of the cylinder head. Carbon buildup on the combustion chamber side of the valve guide can deeply gouge the cylinder head bore diminishing the likelihood of achieving the proper interference fit and possibly requiring replacement of the cylinder head casting.

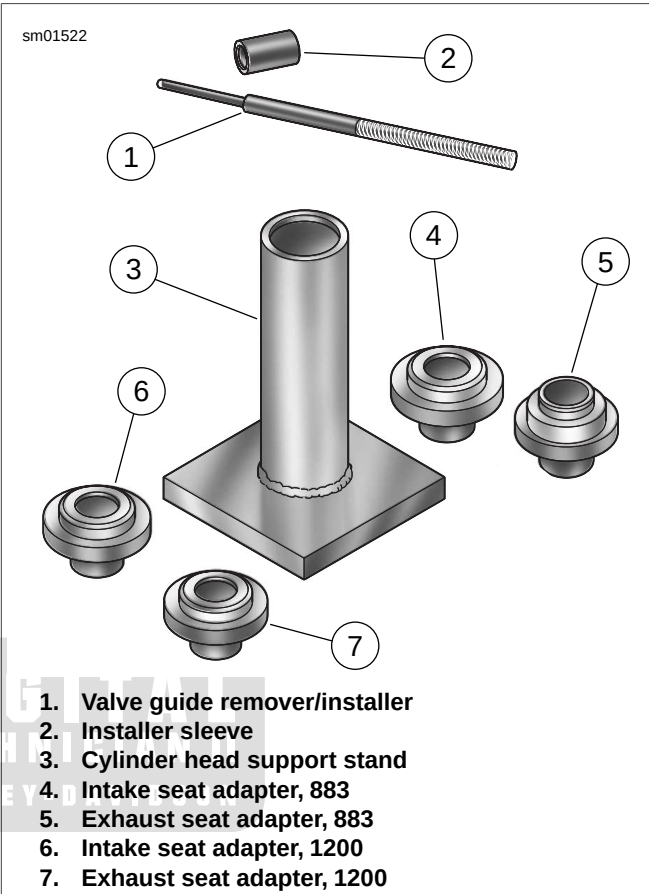


Figure 3-123. Valve Guide Replacement Tools

Table 3-32. Valve Stem Clearance/Service Wear Limits

VALVE	CLEARANCE	SERVICE WEAR LIMIT
Intake	0.001-0.003 in. (0.0254-0.0762 mm)	0.0035 in. (0.0965 mm)
Exhaust	0.001-0.003 in. (0.0254-0.0762 mm)	0.0035 in. (0.0965 mm)

Table 3-33. Valve Guide Remover/Installer Components

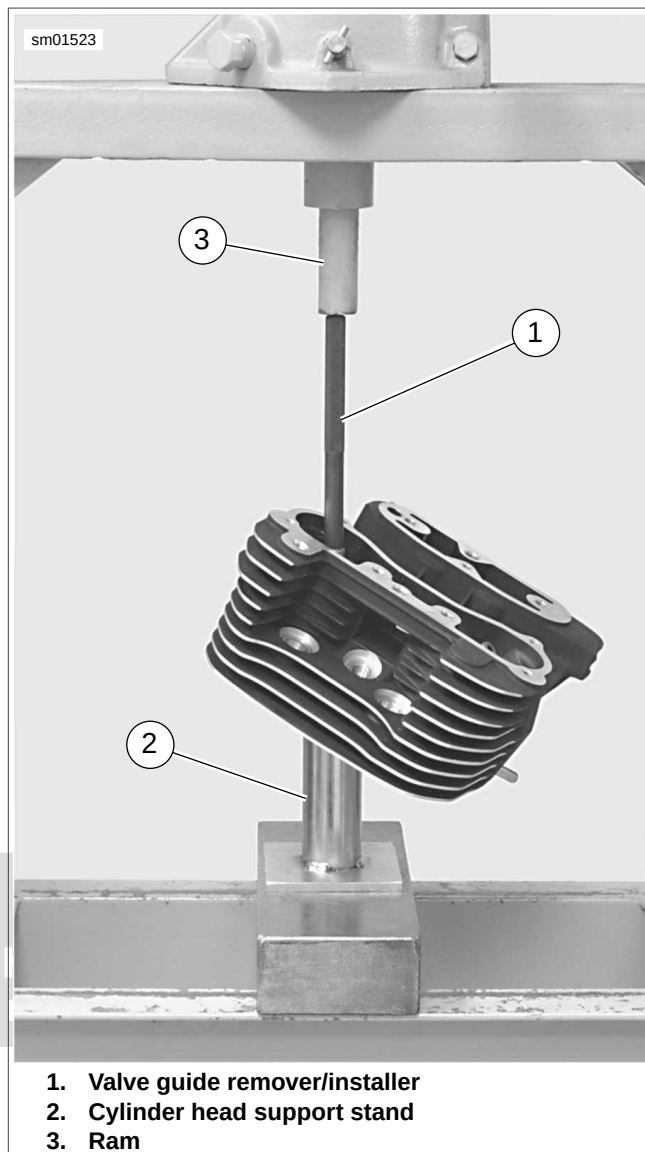
PART NO	ITEM
B-45524	Valve guide remover/installer with installer sleeve
HD-39782-A	Cylinder head support stand
HD-39782-2	Intake seat adapter, 883
HD-39782-3	Exhaust seat adapter, 883
HD-39782-6	Intake seat adapter, 1200
HD-39782-7	Exhaust seat adapter, 1200

2. See [Figure 3-124](#). At top of the cylinder head, insert VALVE GUIDE REMOVER/INSTALLER (Part No. B-45524) (1) into valve guide bore until tool shoulder contacts end of valve guide.

NOTE

Installer sleeve (item 2, [Figure 3-123](#)) is not used for removal of valve guide.

3. Center VALVE GUIDE REMOVER/INSTALLER under ram (3) of press. Apply pressure until valve guide drops free of cylinder head. Discard valve guide.

**Figure 3-124. Removing Shoulderless Valve Guide****Installation****NOTE**

Only a single replacement oversize valve guide is available. The O.D. of the replacement valve guide must be machined to the correct size and proper interference fit.

1. Check valve guide to valve guide bore clearance.
 - a. Measure outer diameter of a new standard valve guide.
 - b. Measure the cylinder head valve guide bore. The valve guide diameter should be 0.0020-0.0033 in. (0.0508-0.0838 mm) larger than cylinder head valve guide bore.
 - c. If interference fit is within specification, a replacement standard valve guide will be used. If interference fit is not within specification, obtain oversize valve guide and machine valve guide O.D. as needed.

NOTE

Since some material is typically removed from the cylinder head valve guide bore when the valve guide is pressed out, it is common to go to the larger size for the proper interference fit.

2. Measure cylinder head bore and outside diameter of replacement valve guide to verify correct interference fit.

NOTE

Cylinder head support stand keeps valve guide and valve seat perpendicular. If perpendicularity is not achieved, cylinder head valve guide bore will be damaged during the press procedure.

3. Prepare cylinder head for valve guide replacement.
 - a. See [Figure 3-123](#). Insert sleeve of intake (4 or 6) or exhaust (5 or 7) seat adapter into tube at top of cylinder head support stand (3). Position cylinder head so that valve seat is centered on seat adapter.
 - b. Apply Vaseline to lightly lubricate external surfaces of valve guide. Spread lubricant so that thin film covers entire surface area.
 - c. At top of cylinder head, start valve guide into bore.
 - d. Place installer sleeve (2) over valve guide and then insert VALVE GUIDE REMOVER/INSTALLER (1) into installer sleeve.
 - e. See [Figure 3-125](#). Center VALVE GUIDE REMOVER/INSTALLER (1) under ram of press and apply pressure only until valve guide is started in bore and then back off ram slightly to allow valve guide to center itself.

NOTE

Always back off ram to allow the valve guide to find center. Pressing valve guide into cylinder head in one stroke can bend remover/installer, break valve guide, distort cylinder head casting and/or damage cylinder head valve guide bore.

- f. Verify that cylinder head support stand (3) and VALVE GUIDE REMOVER/INSTALLER are square. Center VALVE GUIDE REMOVER/INSTALLER under ram and press valve guide further into bore, then back off ram again to allow valve guide to find center.
- g. Repeat previous step and then apply pressure to VALVE GUIDE REMOVER/INSTALLER until installer sleeve (2) contacts machined area of cylinder head surrounding valve guide.
- h. **XR models:** Install **new** lock ring into valve guide groove. Make sure that lock ring is square and fully seated in the groove.

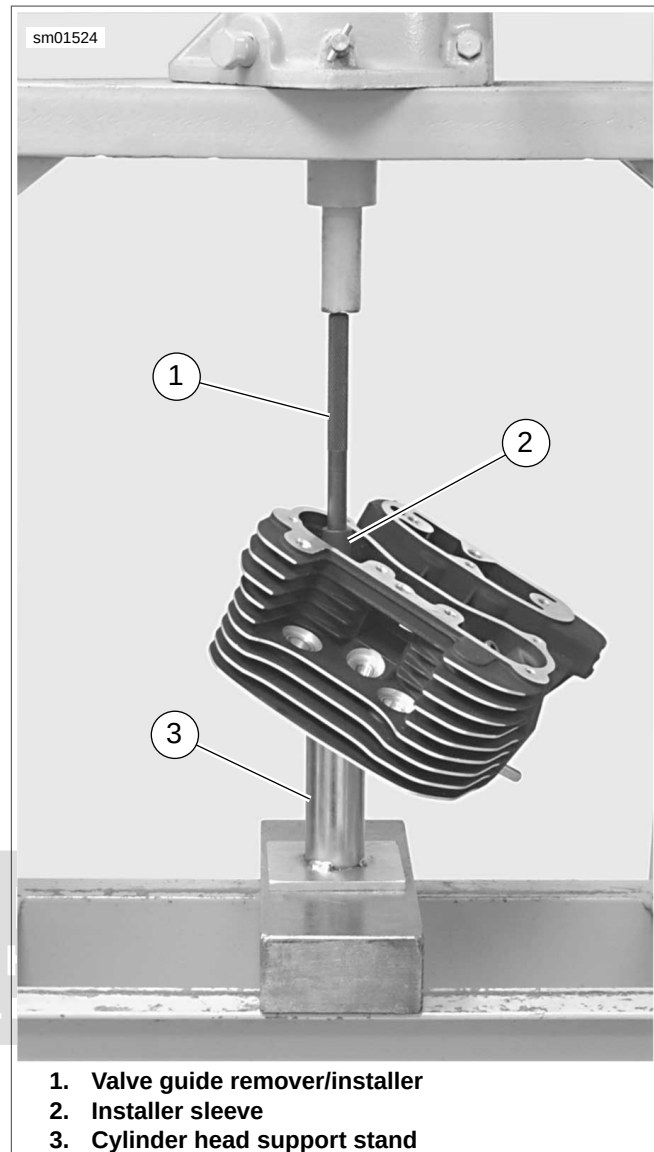


Figure 3-125. Installing Shoulderless Valve Guide

4. Secure cylinder head for service.
 - a. See [Figure 3-126](#). Thread 12 mm end of CYLINDER HEAD HOLDING FIXTURE (Part No. HD-39786) into cylinder head spark plug hole.
 - b. Clamp tool in vise at a 45 degree angle or one that offers a comfortable working position.

NOTE

Valve guides must be reamed to within 0.0005-0.0001 in. (0.013-0.0025 mm) of finished size.

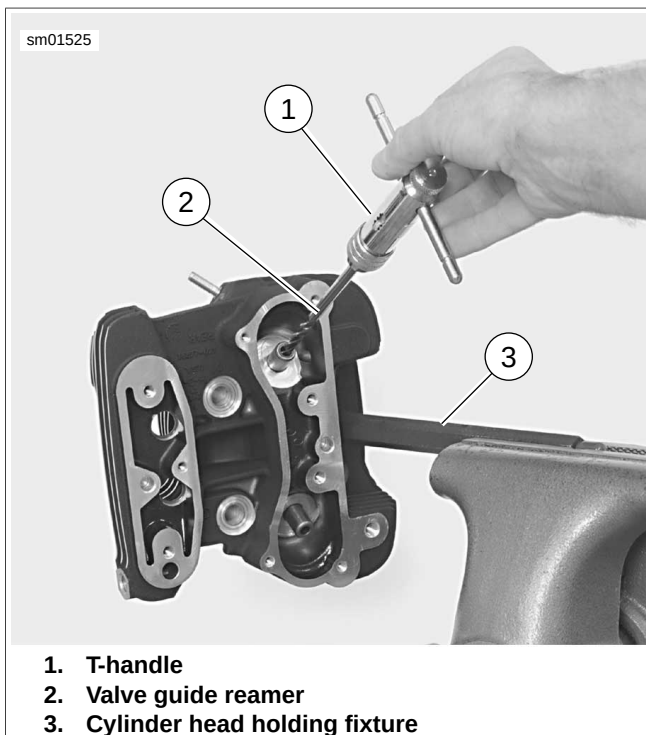


Figure 3-126. Reaming Valve Guide Bore

NOTES

- Avoid damage to valve guide bore. Never back reamer out of valve guide.
 - For best results, do not push on reamer or apply pressure to the reamer handle. While excessive pressure results in a rough cut, bore will be tapered if pressure is not centrally applied.
- Obtain the VALVE GUIDE REAMER (Part No. B-45523) (2) and REAMER T-HANDLE (Part No. HD-39847) (1).
 - Install T-handle on reamer.
 - Start bit of reamer into bore at top of cylinder head.
 - Placing thumb on drive socket of REAMER T-HANDLE, apply slight pressure on reamer while rotating in a clockwise direction.
 - Continue rotating REAMER T-HANDLE until entire bit has passed through valve guide bore and shank of reamer rotates freely.
 - Remove T-handle from reamer. Carefully pulling on bit, draw shaft of reamer out combustion chamber side of valve guide.

NOTE

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

WARNING

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

- Direct compressed air into the valve guide bore to remove any metal shavings or debris.
- See [Figure 3-127](#). Clean valve guide bore with the VALVE GUIDE CLEANING BRUSH (Part No. HD-34751) (1).
- See [Figure 3-128](#). Obtain the VALVE GUIDE HONE (Part No. B-45525) and REAMER LUBRICANT (Part No. HD-39964).
 - Install hone in a high speed electric drill.
 - Apply REAMER LUBRICANT to finishing stones of hone and valve guide bore.
 - Start finishing stones of hone into bore.
 - Activating the drill, move the entire length of the finishing stone arrangement forward and backward through the bore for 10 to 12 complete strokes. Work for a crosshatch pattern of approximately 60°.

NOTE

The hone is not intended for the removal of material.

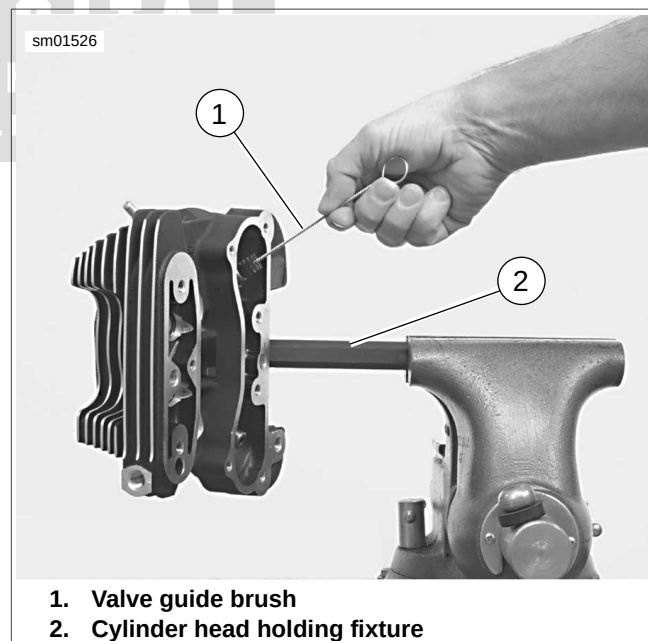


Figure 3-127. Scrubbing Valve Guide Bore

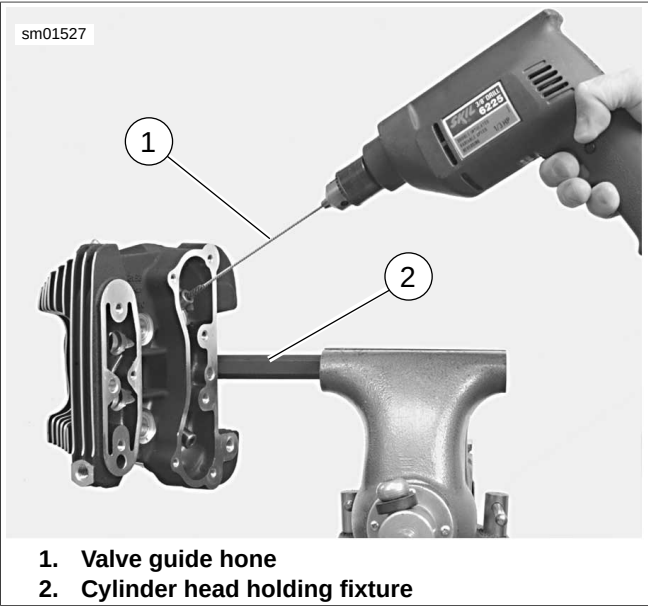


Figure 3-128. Honing Valve Guide Bore

NOTE

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

WARNING

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

9. Direct low pressure compressed air into the valve guide bore to remove any debris.
10. See [Figure 3-127](#). Clean bore with the VALVE GUIDE CLEANING BRUSH (1).

NOTE

Always verify valve stem to valve guide clearance after honing, since a worn reamer may cut the bore undersize.

11. Check valve stem to valve guide clearance.
 - a. Measure the inside diameter of the valve guide with an inside ball micrometer.
 - b. Measure the outside diameter of the valve stem with an outside micrometer.
 - c. Refer to [Table 3-32](#). If the clearance between valve stem and valve guide is not within the limits shown, the low end being preferable, then the valve stem may be excessively worn or the valve guide bore undercut.

12. Clean cylinder head assembly again.
 - a. Using cleaning solvent, thoroughly clean cylinder head and valve guide bore.
 - b. Scrub valve guide bore with the VALVE GUIDE CLEANING BRUSH. For best results, use a thin engine oil and clean valve guide bore with the type of swabs or patches found in gun cleaning kits.
 - c. Continue to wipe bore until clean cloth shows no evidence of dirt or debris. Follow up with a thorough wash in hot soapy water.

WARNING

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

13. Blow parts dry with low pressure compressed air.

REFACING VALVE SEATS

PART NUMBER	TOOL NAME
B-35758-52A	CUTTER PILOT
HD-34751	VALVE GUIDE CLEANING BRUSH
HD-35758-C	NEWAY VALVE SEAT CUTTER SET
HD-39786	CYLINDER HEAD HOLDING FIXTURE

NOTES

- Check that valve stem to valve guide clearance is correct before refacing. Refer to [Table 3-32](#). If new valve guides must be installed, see [3.21 CYLINDER HEAD, Replacing Valve Guides](#) and complete that task before refacing valve seats.
 - This procedure is not based on the lapping of valves. The end result is an interference fit between the 45° valve face and the valve seat which will be 46°.
1. Secure cylinder head for servicing.
 - a. Thread 12 mm end of CYLINDER HEAD HOLDING FIXTURE (Part No. HD-39786) into cylinder head spark plug hole.
 - b. Clamp fixture in vise and further tighten cylinder head onto the fixture to prevent any movement during operation.
 - c. Place cylinder head at a 45° angle or one that offers a comfortable working position.
 2. In order to determine the correct location of the 46° valve seat in the head, measure the width of the valve to be used and subtract 0.080 in. (2.032 mm) from that number.
 3. Set your dial caliper to the lesser measurement and lock it down for quick reference. This is the location of your valve seat.
 4. Use a permanent magic marker to highlight the valve seat area that is going to be cut. Be sure to highlight all three angles. Allow marker to dry before proceeding.

NOTES

- Always make sure cutter blades and cutter pilot are clean before beginning the cutting process. The correct cleaning brush is supplied with the Neway tool set.
- Always make sure the inside of the valve guide is clean by using VALVE GUIDE BRUSH.

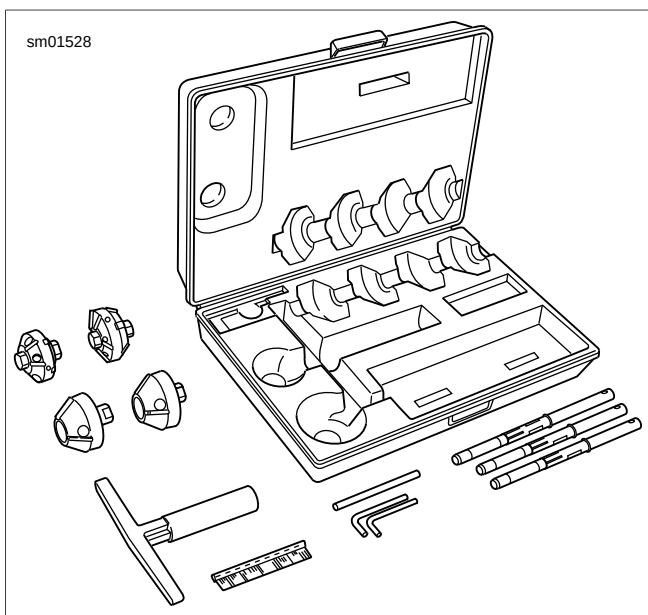


Figure 3-129. Neway Valve Seat Cutter Set (Part no. HD-35758-C)

5. See [Figure 3-129](#). Obtain the NEWAY VALVE SEAT CUTTER SET (Part No. HD-35758-C). Select the correct CUTTER PILOT (Part No. B-35758-52A). Securely seat the pilot by pushing down and turning using the installation tool supplied in the tool set.
6. Choose the proper 46° cutter (intake or exhaust) and gently slide the cutter onto the pilot. Be careful not to drop the cutter onto the valve seat.
7. While applying a constant and consistent pressure, remove just enough material to show a complete clean-up on the 46° angle. Do not remove any more metal than is necessary to clean up the valve seat (that is, to provide a uniform finish and remove pitting).

NOTES

- If the width of the clean-up angle is greater on one side of the valve seat than the other, the valve guide may need to be replaced due to improper installation.
 - After making the 46° cut, if you discover a groove cut completely around the valve seat, this means the blades of the cutter are in alignment and need to be staggered. This is accomplished by loosening all of the blades from the cutter body and moving each blade slightly in its cradle in opposite directions on the cutter. The tool needed to loosen the blades is supplied in the tool set. A permanent magic marker mark every 90° will help in determining where new angles are.
8. Next, with your dial caliper locked to the predetermined setting, measure the 46° cut at the outermost edge at the

widest point of the circle to determine what cut needs to be made next.

- a. If the 46° cut is too high (towards the combustion chamber), use the 31° cutter to lower the valve seat closer to the port.
- b. If the 46° cut is too low, use the 60° cutter to raise the valve seat or move it away from the port.

NOTES

- Because you are using the top measurement of the valve seat as a reference point, it will usually be necessary to use the 31° cutter following the initial 46° cut.
 - Always highlight the valve seat with the permanent magic marker in order to verify the location of the 46° valve seat.
9. If the location of the valve seat is not correct, repeat previous two steps.
 10. When you accomplish a complete clean-up of the 46° angle and the width is at least 0.062 in. (1.575 mm), proceed to the next step.
 11. Select the proper 60° cutter and gently slide the cutter down the cutter pilot to the valve seat.
 12. Remove just enough material to provide an even valve seat width of 0.040-0.062 in. (1.016-1.575 mm).
 13. Remove cutter and cutter pilot.
 14. Repeat the process on any valve seat that needs service.
 15. Insert valve to be used in the valve guide and bottom on the valve seat. Positioning the cylinder head port upwards and with slight thumb pressure against the valve, completely fill the port with solvent to make sure there is a proper seal between the valve and the valve seat.

NOTE

Hold pressure against the valve for a minimum of 10 seconds. If any leakage occurs, examine the valve seat for irregularities or defects and if necessary repeat the above cutting process.

16. Clean valves, cylinder head and valve seats in solvent. Follow up with a thorough wash in hot soapy water.
17. Scrub valve guide bores with VALVE GUIDE CLEANING BRUSH (Part No. HD-34751) and hot, soapy water.

⚠ WARNING

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

18. Blow parts dry with low pressure compressed air.

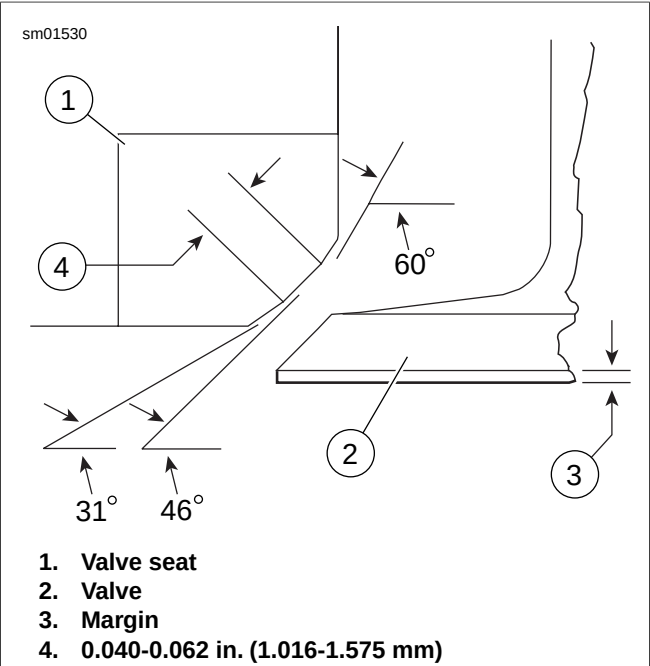


Figure 3-130. Intake and Exhaust Valve and Seat Dimensions

Replacing Valve Seats

Replacing a valve seat is a complex operation requiring special equipment. If the valve seat is loose or is not fully seated in the head, then valve seat movement will prevent the proper transfer of heat from the valve. The valve seat surface must be flush with (or below) the head surface. See [3.2 SPECIFICATIONS](#) for valve seat-to-cylinder head fit.

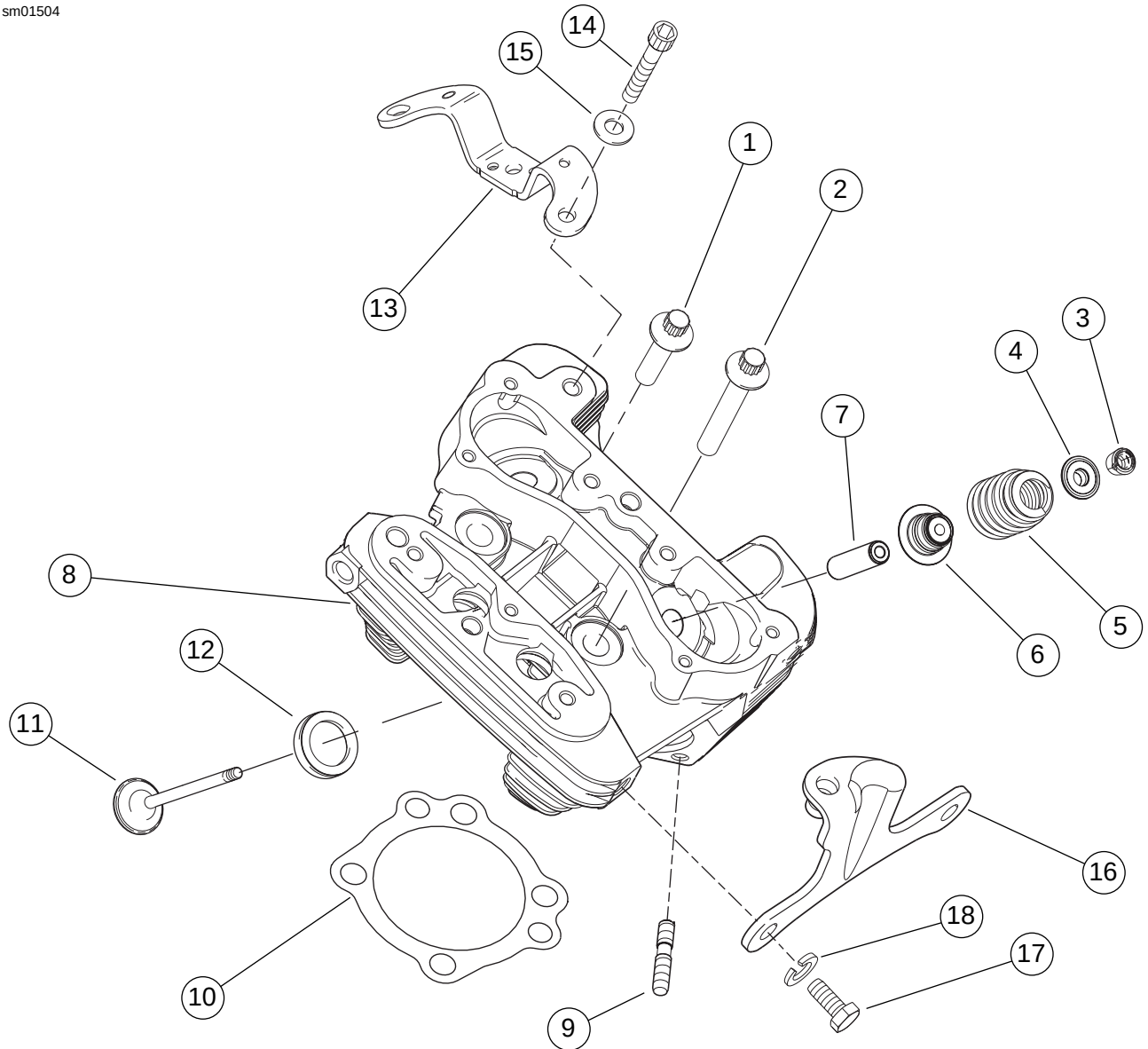
ASSEMBLY

PART NUMBER	TOOL NAME
HD-34736-B	VALVE SPRING COMPRESSOR

1. Apply a liberal amount of engine oil to the valve stem.
2. See [Figure 3-131](#). Insert valve (11) into valve guide (7) and bottom valve on valve seat (12).



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- | | |
|--|--|
| 1. Head bolt, short (2) | 10. Cylinder head gasket |
| 2. Head bolt, long (2) | 11. Valve (1) intake, (1) exhaust |
| 3. Valve collar retainer (4) | 12. Valve seat (2) |
| 4. Upper valve spring collar (2) | 13. Cylinder head bracket* |
| 5. Valve spring (2) | 14. Screw (2)* |
| 6. Valve seal and lower valve spring collar assembly (2) | 15. Washer (2)* |
| 7. Valve guide, intake and exhaust (2) | 16. Stabilizer link bracket (front cylinder head only) |
| 8. Cylinder head | 17. Screw (2) |
| 9. Exhaust port stud (2) | 18. Lock washer (2) |

Figure 3-131. Cylinder Head Assembly (typical) (* Vehicles with Side Mounted Horn Only)

3. See [Figure 3-132](#). Place a protective sleeve over the valve stem keeper groove. Coat the protective sleeve with oil.

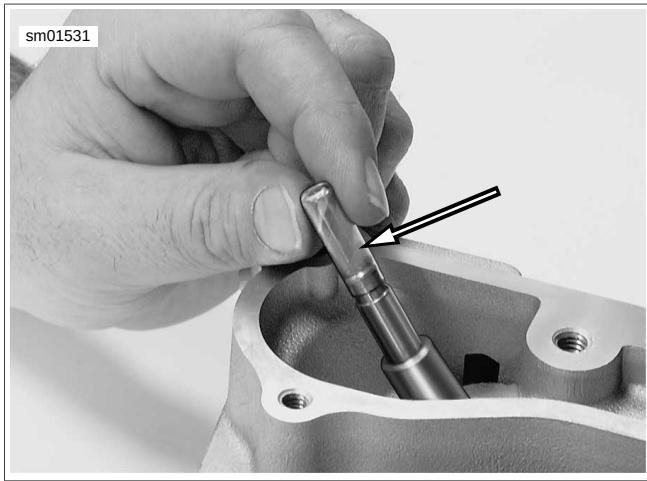


Figure 3-132. Valve Guide Seal Protector Sleeve

NOTES

- 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, causing leakage around the valve stem, excessive oil consumption and valve sticking.
- See [Figure 3-133](#). The valve seal is incorporated into the lower valve collar and is installed by hand. NO SPECIAL TOOLS ARE REQUIRED.
- The valve seal is completely installed when the lower valve collar contacts the machined surface of the head.



Figure 3-133. Valve Seal and Lower Valve Collar Assembly (seal and lower collar replaced as assembly only)

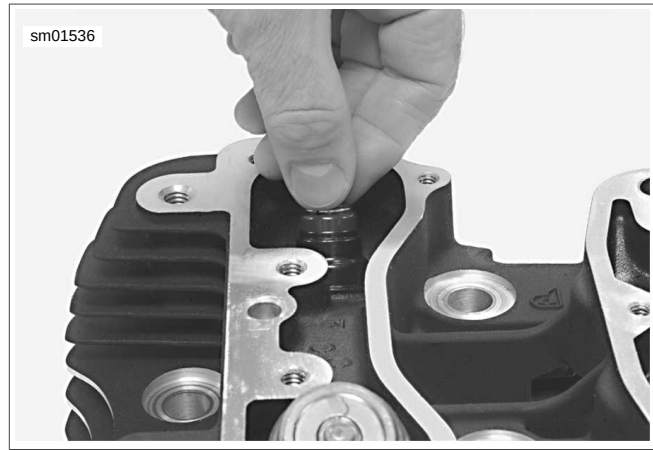


Figure 3-134. Valve Seal and Lower Valve Collar Assembly Installation

4. See [Figure 3-134](#). Place a **new** seal and lower valve collar assembly over valve stem and onto valve guide.

NOTES

- Do not remove valve after seal is installed. Otherwise, sharp edges on keeper groove will damage seal.
 - A single valve spring is used for each valve. The inner and outer springs are combined into one progressively wound, tapered spring.
5. See [Figure 3-131](#). Install valve spring (5) and upper collar (4).
 6. See [Figure 3-135](#). Compress valve spring with VALVE SPRING COMPRESSOR (Part No. HD-34736-B).
 7. See [Figure 3-131](#). Insert valve collar retainers (3) into upper collar (4), making sure they engage groove in valve stem. The retainer gaps should be equal.
 8. Release and remove VALVE SPRING COMPRESSOR.
 9. Repeat previous steps for remaining valve(s).
 10. Install stabilizer link bracket (16) to front head with two screws (17) and lock washers (18). Tighten to 55-65 ft-lbs (74.6-88.2 Nm).

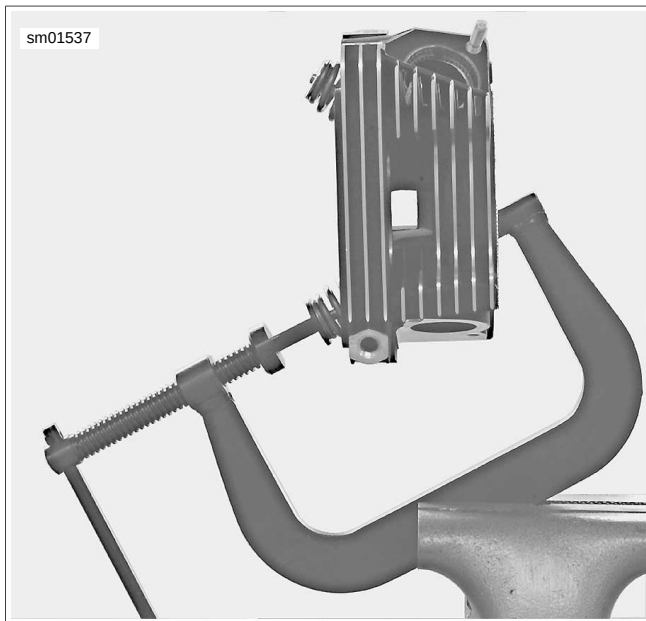


Figure 3-135. Compress Valve Spring with Valve Spring Compressor (Part No. HD-34736-B)

INSTALLATION

NOTE

*Push rod covers and lower cover retainers **MUST** be installed prior to installing cylinder heads. See [3.16 TOP END OVERHAUL: ASSEMBLY, Cylinder Head](#).*

See [3.16 TOP END OVERHAUL: ASSEMBLY, Cylinder Head](#) to install cylinder head onto engine.



CYLINDER AND PISTON

3.22

REMOVAL AND DISASSEMBLY

See [3.15 TOP END OVERHAUL: DISASSEMBLY, Cylinder and Piston](#) to remove cylinder and piston from engine.

CLEANING, INSPECTION AND REPAIR

PART NUMBER	TOOL NAME
HD-33446-86	TORQUE PLATE BOLTS
HD-33446-B	CYLINDER TORQUE PLATES

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.

⚠ WARNING

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

2. Clean oil passage in cylinder with low pressure 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. A piston pin properly fitted to upper connecting rod bushing has a 0.00125-0.00175 in. (0.0317-0.0444 mm) clearance in bushing.
 - b. If piston pin-to-bushing clearance exceeds 0.002 in. (0.0508 mm), replace worn parts. See [3.22 CYLINDER AND PISTON, Connecting Rod Bushings](#).
6. Clean piston pin lock 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, flywheel and connecting rod assembly must be replaced. This requires removing and disassembling engine crankcase.

Checking Gasket Surface

NOTE

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

1. See [Figure 3-136](#). 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 3-136. Checking Gasket Surfaces

Measuring Cylinder Bore

1. See [Figure 3-137](#). Remove any burrs from the cylinder gasket surfaces.
2. Install a head and base gasket, and CYLINDER TORQUE PLATES (Part No. HD-33446-B) and TORQUE PLATE BOLTS (Part No. HD-33446-86) . Tighten the bolts using the same method used when installing the cylinder head screws. See [3.21 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.

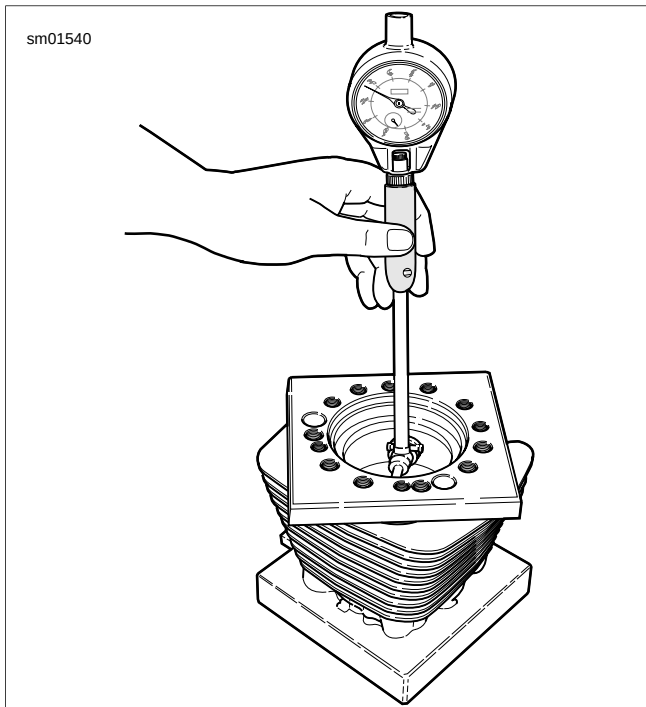
3. Take cylinder bore measurement in ring path, starting about 1/2 in. (13 mm) from top of cylinder, measuring from front to rear, and then side to side. Record readings.
4. Repeat measurement at center, and then at bottom of ring path. Record readings. This process will determine if cylinder is out-of-round (or "egged") and will also show any cylinder taper or bulge. Refer to [Table 3-34](#). If cylinder is not scuffed or scored and is within service limit, see [3.22 CYLINDER AND PISTON](#).

Table 3-34. Cylinder Bore Service Wear Limits

BORE SIZE	883 CC	1200 CC
Standard bore	3.0035 in. (76.289 mm)	3.5008 in. (88.920 mm)
0.005 in. (0.13 mm) OS bore	3.0078 in. (76.398 mm)	3.5050 in. (89.027 mm)
0.010 in. (0.25 mm) OS bore	3.0128 in. (76.525 mm)	3.5100 in. (89.154 mm)
XR 1200 Models: Oversized pistons are not available. Replace piston and/or cylinder if exceeds wear limits.		

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 [3.2 SPECIFICATIONS](#).

**Figure 3-137. Measuring Cylinder Bore****Measuring Piston to Cylinder Fit****NOTE**

This inspection is very heat sensitive. Do not check piston running clearance immediately after honing or deglazing cylinder. Even holding the piston in your hand for too long can cause measurements to vary by as much as 0.002 in. (0.051 mm). Both piston and cylinder must be at room temperatures before proceeding.

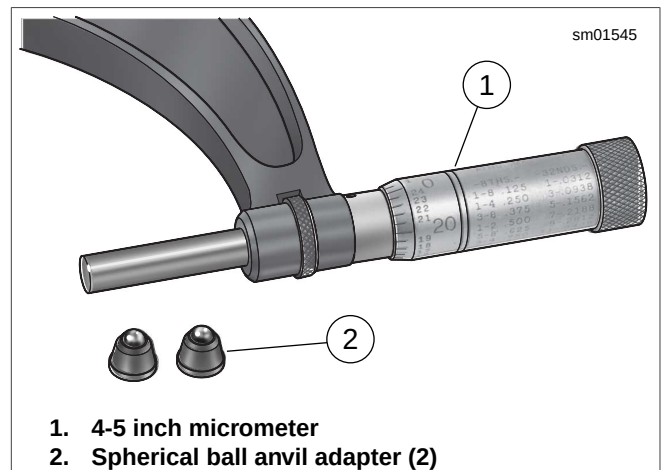
Measure the piston running clearance. Proceed as follows:

NOTE

Check the piston clearance in the cylinder in which the piston will run. The torque plates must be installed on the cylinder to simulate an assembled cylinder for accurate measurement of cylinder.

**Figure 3-138. Measurement Area (typical; XL model shown)**

1. See [Figure 3-138](#). the measurement is taken on bare aluminum to avoid measuring errors. An oval-shaped opening in the coating is present on each side of the piston for proper placement of the micrometer.

**Figure 3-139. Micrometer with Anvil Adapters****NOTE**

The oval openings are too small for a standard flat anvil micrometer. Using such a device would result in measuring errors. See [Figure 3-139](#). Use a 3-4 inch blade or ball anvil

style micrometer, or a 4-5 inch micrometer with spherical ball anvil adapters.

- Measure the piston skirt at the oval openings and then transfer that measurement to a dial bore gauge.
- Using a grease pencil, mark the top, middle and bottom of the piston ring travel zone in the cylinder bore. Measure

at markings in cylinder parallel and perpendicular to crankshaft.

- Replace piston and/or cylinder if running clearance exceeds 0.003 in. (0.076 mm).

Boring and Honing Cylinder

Table 3-35. Cylinder Final Bore Sizes

BORE SIZE	883 CC		1200 CC	
	IN.	MM	IN.	MM
Standard bore*	3.0005	76.213	3.4978	88.844
0.005 in. (0.13 mm) OS bore	3.0048	76.323	3.502	88.95
0.010 in. (0.25 mm) OS bore	3.0098	76.449	3.507	89.08
* All bore sizes + 0.0002 in. (0.00508 mm)				
XR 1200 Models: Oversized pistons are not available. Replace piston and/or cylinder if exceeds wear limits.				

- 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.
- 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.

See [Table 3-35](#) for final cylinder bore sizes after honing.

NOTES

- When cylinder requires oversize re-boring to beyond 0.010 in. (0.25 mm), 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.

CAUTION

Failure to remove all abrasive particles may result in premature cylinder, piston and ring wear and engine failure. (00537b) .

- Thoroughly wash the cylinder bore with liquid dishwashing soap and warm water to remove all abrasive particles and residual grit. Continue cleaning until a clean cloth shows no remaining dirt or debris.

WARNING

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

- Hot rinse the cylinder and dry with moisture free low pressure compressed air.

- Immediately apply a thin film of clean engine oil to a clean white paper towel and thoroughly wipe the inside of the cylinder.

NOTE

After wiping the cylinder with a clean, oiled paper towel, the towel will be dark with contamination. Repeat this process using a new lightly oiled paper towel each time until the towel remains white. The cylinder is now clean.

- With the cylinder at room temperature, check the piston clearance in the cylinder in which the piston will run.

Fitting Piston Rings

See [Figure 3-140](#). 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:

- See [Figure 3-141](#). Place piston in cylinder about 1/2 in. (13 mm) from top. Set ring to be checked inside cylinder, squarely against piston. Remove piston and check ring end gap with thickness gauge. See [3.2 SPECIFICATIONS](#) for tolerance.

NOTE

See piston ring gap Service Wear Limits in [3.2 SPECIFICATIONS](#) for end gap dimensions. Do not file rings to obtain proper gap.

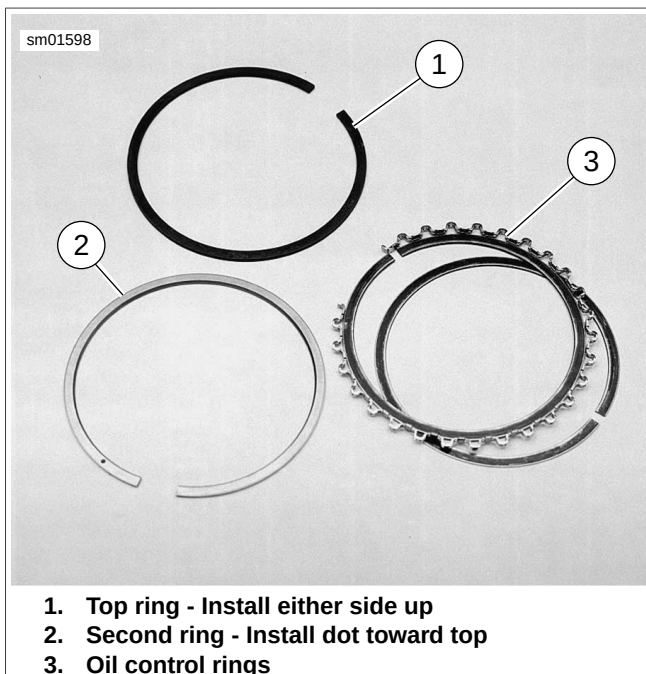


Figure 3-140. Piston Rings



Figure 3-141. Measuring Ring End Gap

⚠ WARNING

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

2. Use low pressure compressed air to remove any dirt or dust that may have settled in piston oil drain holes and ring grooves. Apply clean engine oil to piston ring grooves.
3. See [Figure 3-142](#). Install oil control ring expander spring. Make sure ends of spring point upward. Spiral bottom oil control ring into space in ring groove below expander spring. Position oil control ring gap 90° from gap in expander spring. Spiral top oil control ring into space in ring groove above expander spring. Position oil control ring gap 180° from gap in bottom oil control ring

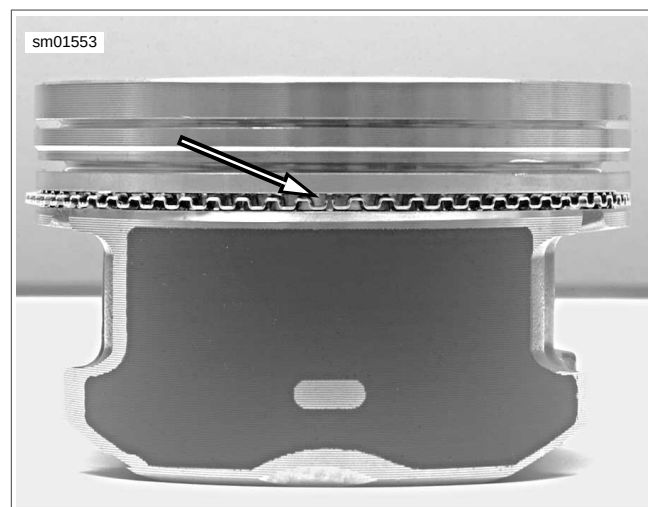


Figure 3-142. Installing Oil Control Ring Expander Spring (typical; XL model shown)

4. See [Figure 3-143](#). Use a piston ring expander tool to slip compression rings over piston into their respective grooves. Install second compression ring first, then top compression ring. Be extremely careful not to over expand or twist rings, or damage piston surface when installing rings.

NOTE

Install second compression ring with dot towards top of piston.



Figure 3-143. Installing Piston Rings (typical; XL model shown)

5. See [Figure 3-144](#). Position 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.

6. See [Figure 3-145](#). Check for proper side clearance with thickness gauge, as shown. See [3.2 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.

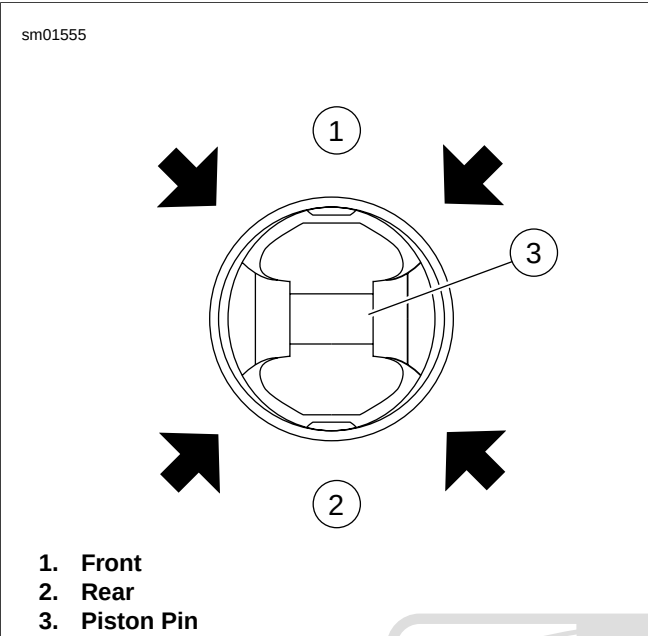


Figure 3-144. Position Ring End Gaps at Arrows



Figure 3-145. Measuring Ring Clearance in Groove (typical; XL model shown)

CONNECTING ROD BUSHINGS

PART NUMBER	TOOL NAME
HD-35102	WRIST PIN BUSHING HONE
HD-39964	REAMER LUBRICANT
HD-94800-26A	CONNECTING ROD BUSHING REAMER
HD-95952-33C	CONNECTING ROD CLAMPING TOOL
HD-95970-32D	CONNECTING ROD BUSHING REMOVER/INSTALLER

Removing Upper Connecting Rod Bushings

NOTES

- Replace the upper connecting rod bushing if the piston pin to rod bushing clearance exceeds 0.002 in. (0.051 mm).
 - Place clean shop towels in and around the crankcase bore to prevent chips and shavings from falling into the crankcase.
 - If CONNECTING ROD CLAMPING TOOL (Part No. HD-95952-33C) holes are too small, enlarge the holes in the tool.
- See [Figure 3-146](#). Obtain the CONNECTING ROD CLAMPING TOOL and install as follows:
 - Slide clamp (2) over connecting rod so that slots engage cylinder head studs. Exercise caution to avoid scratching or bending studs.
 - With the knurled side up, screw threaded cylinders (1) onto studs to secure position of clamp.
 - Alternately turn each clamp thumbscrew (3) a few turns to gradually fix position of connecting rod. Turning only one thumbscrew will move rod off-center, while tightening second thumbscrew can cause rod to flex or bend.
 - Install rubber hoses over remaining two cylinder studs.
 - See [Figure 3-147](#). Obtain the CONNECTING ROD BUSHING REMOVER/INSTALLER (Part No. HD-95970-32D).
 - Sparingly apply graphite lubricant to threads of bolt (6) to prolong service life and ensure smooth operation.
 - Slide receiver cup (5) onto bolt with the closed side facing bolt head.
 - Insert bolt through upper connecting rod bushing.

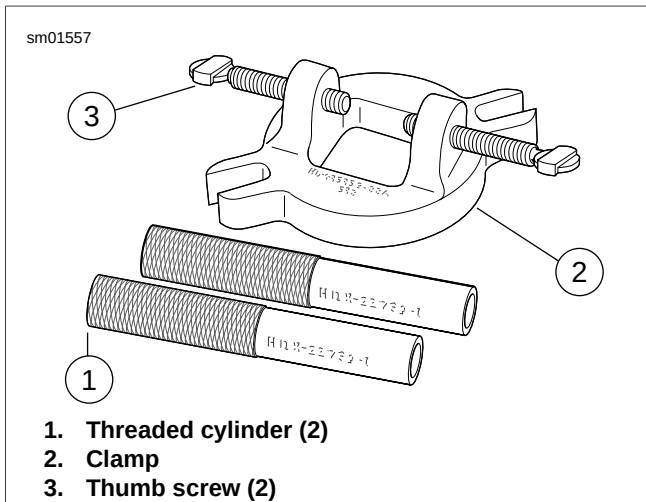


Figure 3-146. Connecting Rod Clamping Tool (Part No. HD-95952-33C)

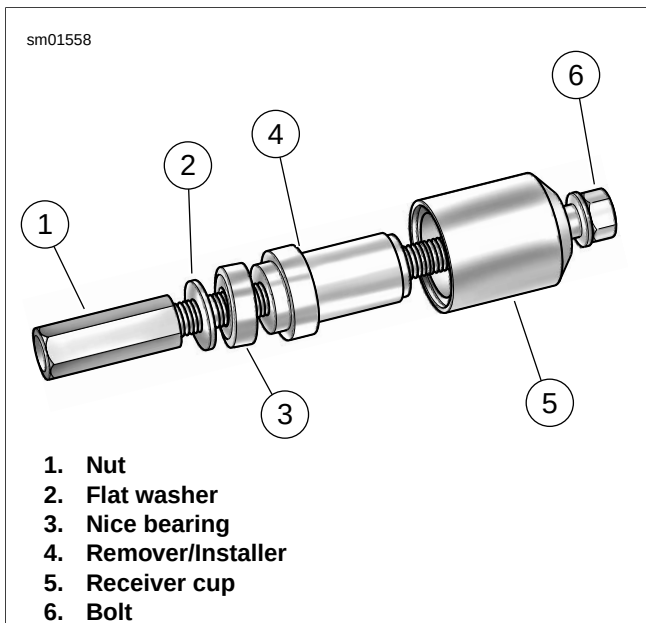


Figure 3-147. Connecting Rod Bushing Remover/Installer (Part No. HD-95970-32D)

4. Remove bushing as follows:
 - a. See [Figure 3-148](#). Slide remover side of remover/installer onto bolt. The driver is stamped to ensure proper orientation.
 - b. See [Figure 3-147](#). Slide Nice bearing (3) and flat washer (2) onto bolt (6) until they contact remover/installer (4).
 - c. Thread nut (1) onto bolt until assembly is snug.
 - d. Using two box end wrenches, tighten nut on bolt until bushing is free.
 - e. Remove nut from bolt. Remove flat washer, Nice bearing and remover/installer. Remove bolt from bushing bore.
 - f. Remove bushing from receiver cup and discard.

NOTE

Leave **CONNECTING ROD CLAMPING TOOL** installed during bushing installation procedure which follows.

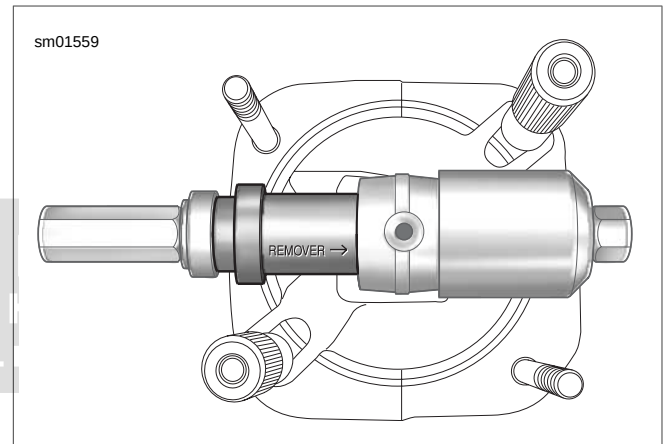


Figure 3-148. Remover Stackup. Use Remover Side Of Remover/Installer

Installing Upper Connecting Rod Bushings

1. See [Figure 3-147](#). Obtain the CONNECTING ROD BUSHING REMOVER/INSTALLER (Part No. HD-95970-32D).
 - a. Sparingly apply graphite lubricant to threads of bolt (6) to prolong service life and ensure smooth operation.
 - b. Slide receiver cup (5) onto bolt with the closed side facing bolt head.
 - c. Insert bolt through upper connecting rod bushing bore.
 - d. See [Figure 3-149](#). Slide **new** bushing onto bolt. Start bushing into bore. Verify that center of slot in bushing (2) is aligned with oil hole in connecting rod (3). Also, be sure that bushing is square in bore and not cocked.
 - e. Slide installer side of remover/installer (1) onto bolt until shoulder contacts bushing. The remover/installer is stamped to ensure proper orientation.
 - f. See [Figure 3-147](#). Slide Nice bearing (3) and flat washer (2) onto bolt until they contact remover/installer.
 - g. Thread nut (1) onto bolt until assembly is snug.
 - h. Using two box end wrenches, tighten nut on bolt until collar on remover/installer bottoms against connecting rod. See [Figure 3-150](#).
2. Remove nut from bolt and remove flat washer, Nice bearing and remover/installer. Remove bolt from bushing bore, but exercise caution to avoid scratching or gouging bushing.

NOTE

Leave **CONNECTING ROD CLAMPING TOOL** installed during bushing reaming procedure which follows.

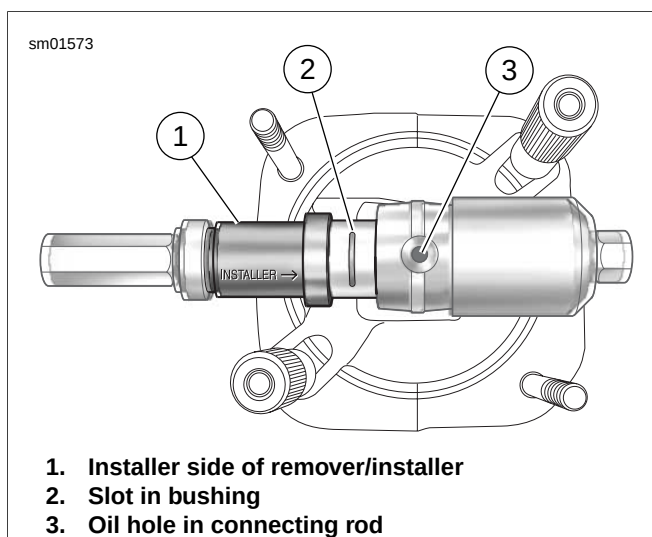


Figure 3-149. Installer Stackup

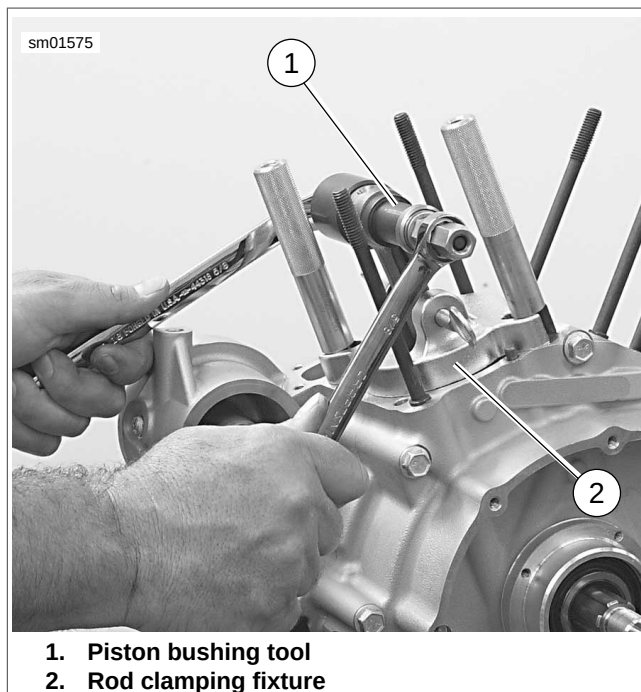


Figure 3-150. Installing New Piston Pin Bushing

Reaming Upper Connecting Rod Bushings

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.

1. Clean up and size bushing to 0.0010-0.0005 in. (0.025-0.013 mm) undersize using the CONNECTING ROD BUSHING REAMER (Part No. HD-94800-26A) .
 - a. Carefully insert bit of reamer into upper connecting rod bushing. Do not apply lubricant to reamer or bushing. Ream the bushing dry or cut will not be accurate.
 - b. Install a 11/16-inch 12-pt socket and T-handle on reamer lug.
 - c. Placing thumb on drive socket, apply slight pressure on reamer while rotating handle/drive socket in a clockwise direction.

NOTE

For best results, do not push on reamer or apply pressure to the reamer handle. While excessive pressure results in a rough cut, bushing bore will be tapered if pressure is not centrally applied.

- d. Continue rotating handle/drive socket until entire bit has passed through bushing and shank of reamer rotates freely in the bore.

NOTE

Never back reamer out of connecting rod or bushing will be damaged.

2. Remove T-handle and socket, and carefully pulling on bit, draw shaft of reamer out of connecting rod bushing.

NOTE

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

3. Using contact cleaner or cleaning solvent, thoroughly wipe upper connecting rod and bushing of any metal shavings or debris.

NOTE

Leave CONNECTING ROD CLAMPING TOOL installed during bushing honing procedure which follows.

Honing Upper Connecting Rod Bushings

1. Obtain the WRIST PIN BUSHING HONE (Part No. HD-35102) and REAMER LUBRICANT (Part No. HD-39964) to hone bushing to final size. 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.
 - a. Install hone in a high speed electric drill.
 - b. Apply reamer lubricant to finishing stones of hone and inside of upper connecting rod bushing.
 - c. Start finishing stones of hone into bushing.
 - d. Activating the drill, move the entire length of the finishing stone arrangement forward and backward through the bushing bore for 10 to 12 complete strokes. Work for a crosshatch pattern of approximately 60°.

NOTE

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

2. Using contact cleaner or cleaning solvent, thoroughly wipe upper connecting rod and bushing of any metal shavings or debris. Continue wiping until a clean cloth shows no evidence of dirt or debris.
3. Lightly oil a good piston pin and insert it into the upper connecting rod bushing bore to feel for the proper interference fit. The pin should slide in and out of the bushing without binding, but also without pivoting or rocking.
4. Remove CONNECTING ROD CLAMPING TOOL.
5. Remove shop towels exercising caution that shavings, chips and other debris do not fall into crankcase.

Repair

If connecting rod is bent, do not attempt to straighten. Flywheel and connecting rod assembly must be replaced. Straightening connecting rods by bending will damage the bearing on the crank pin and the piston pin bushing.

ASSEMBLY AND INSTALLATION

See [3.16 TOP END OVERHAUL: ASSEMBLY, Piston and Cylinder](#) to install piston and cylinder onto engine.



CRANKCASE

3.23

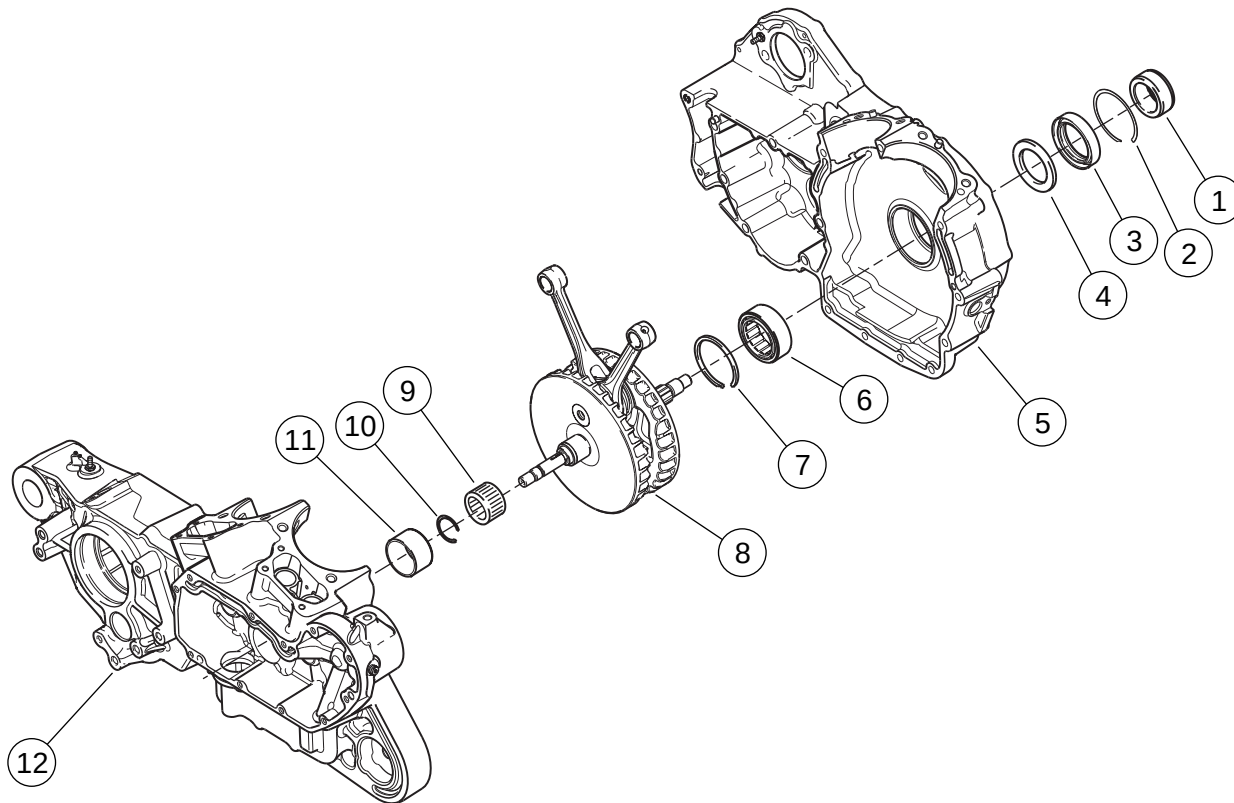
GENERAL

When connecting rod and flywheel assembly, pinion shaft bearing, or sprocket shaft bearing are in need of replacement, 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).

NOTE

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

sm03411



1. Sprocket shaft spacer
2. Retaining ring
3. Left main oil seal
4. Thrust washer
5. Left crankcase
6. Left main bearing

7. Retaining ring
8. Connecting rod and flywheel assembly
9. Pinion shaft bearing
10. Retaining ring
11. Outer bearing race
12. Right crankcase

Figure 3-151. Crankcase and Flywheel Assembly (typical; XL model shown)

REMOVAL

1. Remove engine from motorcycle. See [3.12 REMOVING ENGINE FROM CHASSIS](#).
2. Disassemble top end of engine. See [3.15 TOP END OVERHAUL: DISASSEMBLY, Cylinder Heads](#) and [3.15 TOP END OVERHAUL: DISASSEMBLY, Cylinder and Piston](#).

DISASSEMBLY

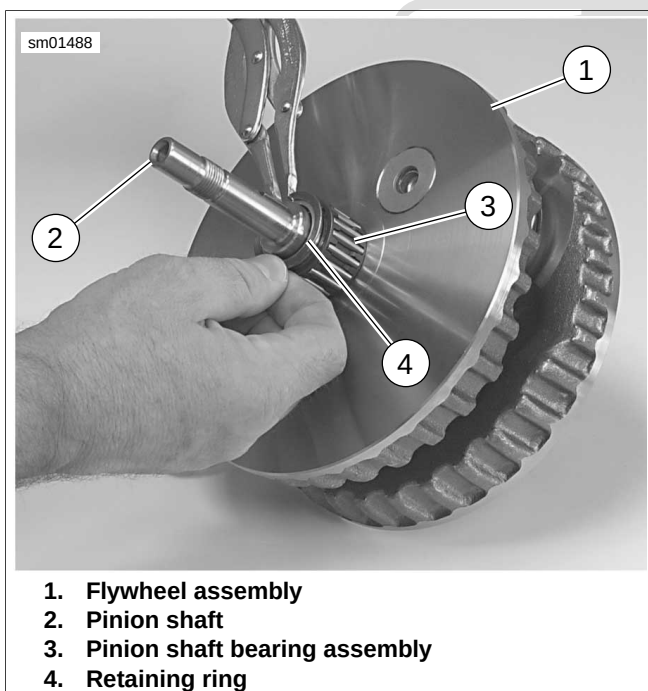
PART NUMBER	TOOL NAME
B-45655, HD-42720-2, HD-46663	CRANKCASE BEARING REMOVER/INSTALLER WITH ADAPTER
HD-34902-7	END CAP
HD-34902-C	BEARING RACE REMOVER AND INSTALLER KIT
HD-44358	FLYWHEEL SUPPORT FIXTURE
HD-95637-46B	CLAW PULLER WEDGE ATTACHMENT
J-5586-A	TRANSMISSION SHAFT RETAINING RING PLIERS

1. Disassemble crankcase, see [3.17 BOTTOM END OVERHAUL: DISASSEMBLY, Crankcase](#).

NOTE

See [Figure 3-151](#). If it is necessary to remove either the pinion shaft bearing (9) or left main bearing (6), proceed as follows:

2. See [Figure 3-152](#). Pinion shaft bearing assembly (3) will remain on pinion shaft (2) when flywheel assembly (1) is removed from right crankcase. Using TRANSMISSION SHAFT RETAINING RING PLIERS (Part No. J-5586-A), remove retaining ring (4) and slip bearing off pinion shaft.



1. Flywheel assembly
2. Pinion shaft
3. Pinion shaft bearing assembly
4. Retaining ring

Figure 3-152. Removing Pinion Shaft Bearing Retaining Ring

3. See [Figure 3-153](#). Place flywheel assembly in FLYWHEEL SUPPORT FIXTURE (Part No. HD-44358). Pull sprocket shaft bearing inner race with CLAW PULLER WEDGE ATTACHMENT (Part No. HD-95637-46B) with BEARING RACE REMOVER AND INSTALLER KIT (Part No. HD-34902-C) and END CAP (Part No. HD-34902-7).

NOTE

The sprocket shaft inner race is not replaceable. If it is worn or damaged, the crankshaft assembly must be replaced.

4. See [Figure 3-153](#). See [Figure 3-151](#). Remove outer left main bearing retaining ring (2).
5. See [Figure 3-151](#). Remove left main oil seal (3) from left crankcase using Snap-On Tool (Part No. CJ 114, Body Dent Puller).
6. Remove thrust washer (4) next to left main bearing (6).

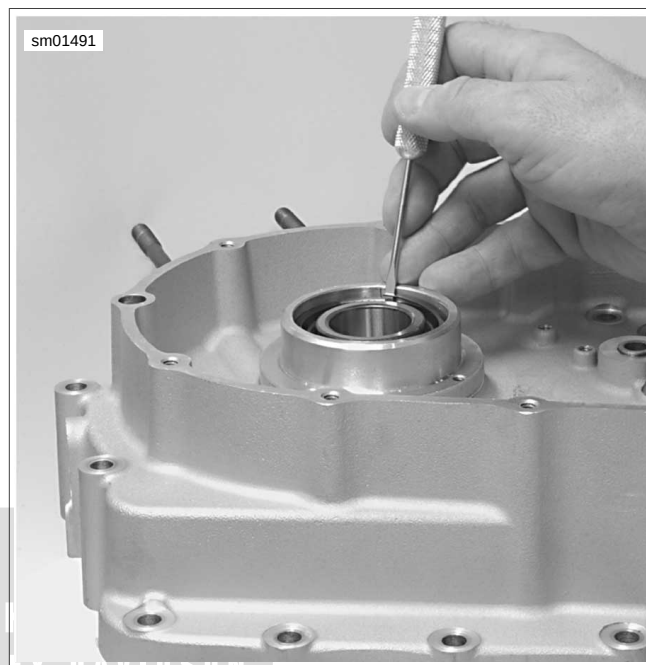


Figure 3-153. Removing Left Main Oil Seal Retaining Ring

7. See [Figure 3-154](#) and [Figure 3-151](#). Remove left main bearing retaining ring (7) from the inside of the left crankcase (5).

NOTE

When removing the left main bearing, the bearing presses from the outside of the left crankcase toward the inside. A shoulder is incorporated into the left crankcase which allows the bearing to be removed in one direction only.

8. See [Figure 3-155](#). Using CRANKCASE BEARING REMOVER/INSTALLER WITH ADAPTER (Part No. B-45655, HD-42720-2, HD-46663) press left main bearing out of the left crankcase.
 - a. Place support tube (1) on press bed with recessed cup end facing up.
 - b. With the outboard side of the left crankcase (2) facing upward, position crankshaft bearing bore (3) over support tube.
 - c. Place adapter (4) over left main bearing. Insert pilot/driver (5) through adapter, through left main bearing and into support tube.
 - d. Carefully apply pressure with press ram (6) until left main bearing drops free.

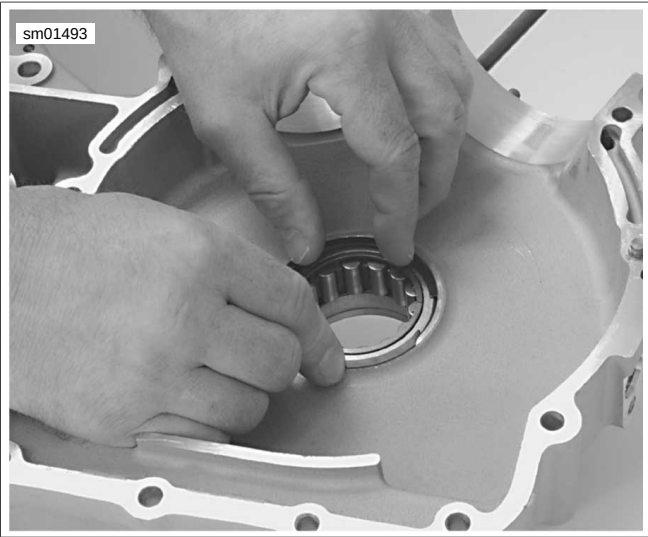


Figure 3-154. Removing Left Main Bearing Retaining Ring

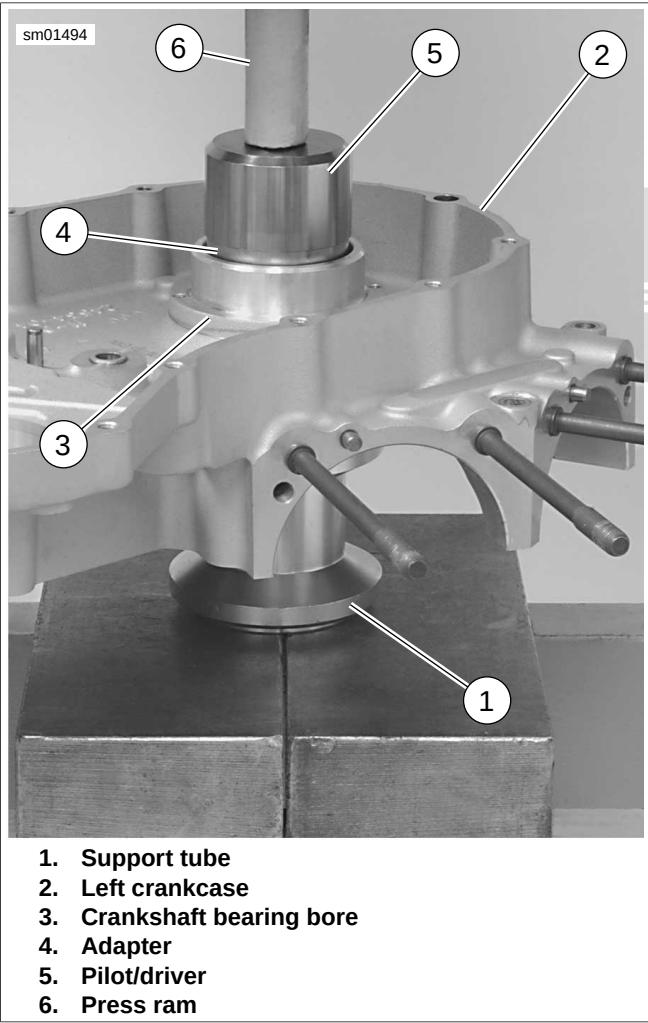


Figure 3-155. Removing Left Main Bearing from Crankcase

FITTING PINION BEARINGS

PART NUMBER	TOOL NAME
HD-34902-7	END CAP
J-21686-12	FORCING SCREW
J-7830-5	BRIDGE
SNAP-ON TOOLS STOCK NO. CJ950	BEARING SEPARATOR

See [Figure 3-151](#). The outer race (11) is a pressed-in bushing in the right crankcase. The inner race is pressed on the pinion shaft.

See [Figure 3-156](#). To remove pinion shaft inner race, use BEARING SEPARATOR (Part No. Snap-on Tools Stock No. CJ950), three items from END CAP (Part No. HD-34902-7), BRIDGE (Part No. J-7830-5) and FORCING SCREW (Part No. J-21686-12), and two bolts. Apply heat to race to aid removal. Four sizes of pinion bearings are available.

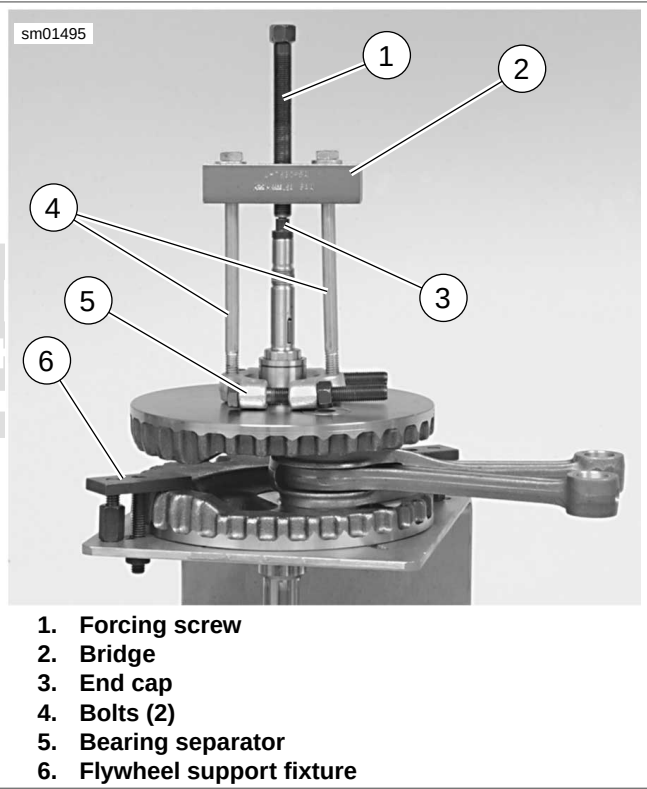


Figure 3-156. Pulling Pinion Shaft Inner Bearing

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 (O.D.) of the inner race and the smallest measured inside diameter (I.D.) 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 3-157](#). Installed inner races are identified at the factory as shown.

See [Figure 3-158](#). Outer races are identified at the factory as shown.

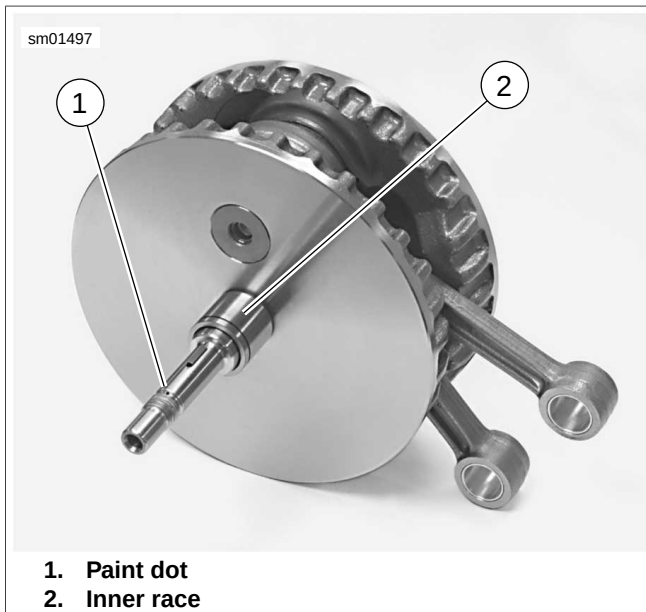


Figure 3-157. Factory Inner Race Sizes

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 3-159](#). Pinion bearings are identified as shown.

Bearing Selection

Select bearings using the identification information given for inner and outer races and bearings. Refer to [Table 3-39](#).

NOTE

If either inner or outer race show wear, measure both races to confirm correct bearing fit of 0.0002-0.0008 in. (0.005-0.020 mm). The service wear limit of the outer race I.D. is 1.5672 in. (39.807 mm).

Table 3-36. Inner Race Specifications

RACE O.D.		CLASS	IDENTIFICATION*
IN.	MM		
1.2498-1.2500	31.745-31.750	A	White
1.2496-1.2498	31.740-31.745	B	Green
* Paint dot on end of spline.			

Table 3-37. Roller Specifications

ROLLER O.D. (A)	IDENTIFICATION (PACKAGE COLOR)
Largest	Red
	Blue
	White (Grey)
Smallest	Green

Table 3-38. Outer Race Specifications

RACE I.D.		CLASS NO.	STAMPED IDENTIFICATION*
IN.	MM		
1.5646-1.5648	39.741-39.746	1	1
1.5648-1.5650	39.746-39.751	2	2
1.5650-1.5652	39.751-39.756	3	3
* Stamped number inside crankcase near race.			

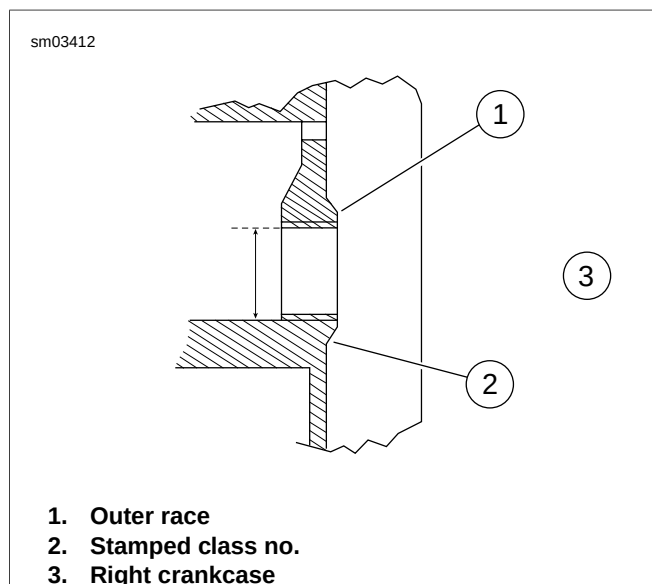


Figure 3-158. Factory Outer Race Sizes

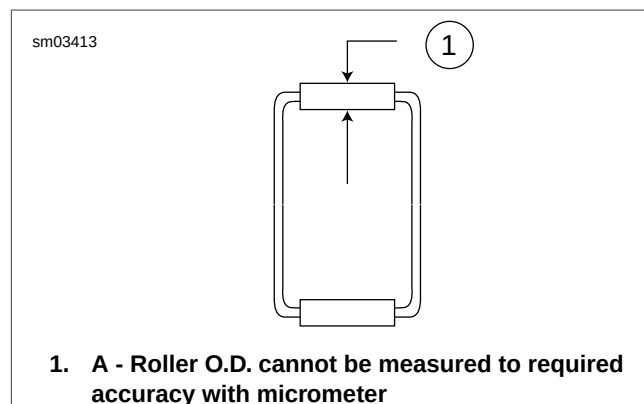


Figure 3-159. Bearing Identification

Table 3-39. Pinion Shaft Bearing Selection

FACTORY STAMPED NUMBER	OUTER RACE I.D.	BEARING SIZE AS IDENTIFIED BY COLOR CODING				
	over 1.5658 in. (39.771 mm)	Service Wear Limit Exceeded - Replace Outer Race and Resize				
	1.5656-1.5658 in. (39.766-39.771 mm)			Red	Blue	
	1.5654-1.5656 in. (39.761-39.766 mm)		Red	Blue	White-Gray	
	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 O.D. (in.)		1.2496-1.2498	1.2498-1.2500	1.2500-1.2502	1.2502-1.2504	1.2504-1.2506
Inner Race O.D. (mm)		31.740-31.745	31.745-31.750	31.750-31.755	31.755-31.760	31.760-31.765
Factory Color Code		Green	White			

NOTE

Removal and installation of the inner and outer bearing races require the use of shop-made tools. Dimensions for fabricating the tools are shown in [Figure 3-161](#), [Figure 3-162](#), and [Figure 3-163](#).

- See [Table 3-40](#). Measure I.D. of outer race at four places with a dial bore gauge. Take measurement on I.D. where bearing rollers ride. Record the four measurements.

Table 3-40. Used Pinion Bearing Outer Race Specifications

ITEM	SPECIFICATION
Largest I.D. allowed	1.5672 in. (39.807 mm)
Roundness of I.D.	within 0.0002 in. (0.005 mm)
Taper	within 0.0002 in. (0.005 mm)

- 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.

- 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.

- Lap the outer race. See [3.23 CRANKCASE, Lapping Engine Main Bearing Races](#). The race must be lapped until all wear marks are removed.
- After lapping race, again measure I.D. of race at four places and record the measurements.
- Check measurements against the specifications listed in [Table 3-40](#).
- If lapping increased bore I.D. to larger than 1.5672 in. (39.807 mm), go to next step. 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.

NOTE

Always use the smallest outer race I.D. measurement and the largest O.D. inner race measurement when selecting bearings.

- Press the outer race from the right crankcase. Press **new** outer race into crankcase flush with inside edge of cast-in insert.
- The **new** outer race must be lapped slightly to true and align with left case bearing, and to meet the specifications in [Table 3-41](#). See [3.23 CRANKCASE, Lapping Engine Main Bearing Races](#).

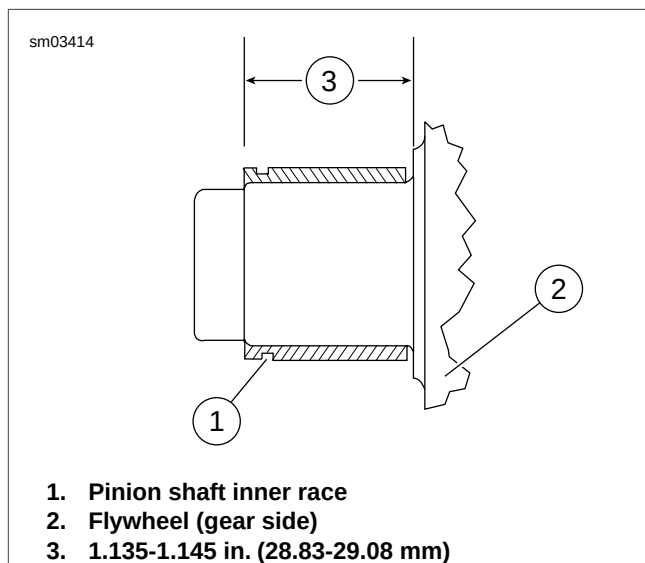
Table 3-41. New Pinion Bearing Outer Race Fit and Finish

ITEM	SPECIFICATION
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

- See [Figure 3-156](#). Pull inner race from pinion shaft using BEARING SEPARATOR (Part No. Snap-on Tools Stock No. CJ950), three items from END CAP (Part No. HD-34902-7), BRIDGE (Part No. J-7830-5) and FORCING SCREW (Part No. J-21686-12), and two bolts. Apply heat to race to aid removal.
- Press **new** inner race on pinion shaft using shop-made tool. When the tool bottoms against the flywheel, the correct inner race location is automatically established as shown in [Figure 3-160](#). The **new** inner race must be ground by a machinist to an O.D. dimension range based on the finished lapped I.D. of the outer race, as shown in [Table 3-39](#). See the example that follows.

Table 3-42. Inner Race Fit and Finish

ITEM	SPECIFICATION
Roundness	within 0.0002 in. (0.005 mm)
Taper	within 0.0002 in. (0.005 mm)
Surface finish	16 RMS

**Figure 3-160. Inner Race Location****Inner Bearing Finish Example**

The following example illustrates how to determine the required inner race O.D.

- If smallest measured I.D. of outer race is 1.5651 in. (39.754 mm) the [Table 3-39](#) indicates an inner race O.D. 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 O.D. range. This will prevent grinding outer race undersize and gives a more easily achieved tolerance range.

- Grind inner race O.D. to the middle of the desired range as determined by [Table 3-39](#). Measure O.D. at four places and check that specifications in [Table 3-42](#) are met.
- For example purposes:
 - the largest measured O.D. of inner race after grinding is 1.2499 in. (31.747 mm) O.D.
 - Refer to [Table 3-39](#). With a 1.5651 in. (39.754 mm) I.D. outer race and a 1.2499 in. (31.747 mm) O.D. inner race, a blue bearing is required.

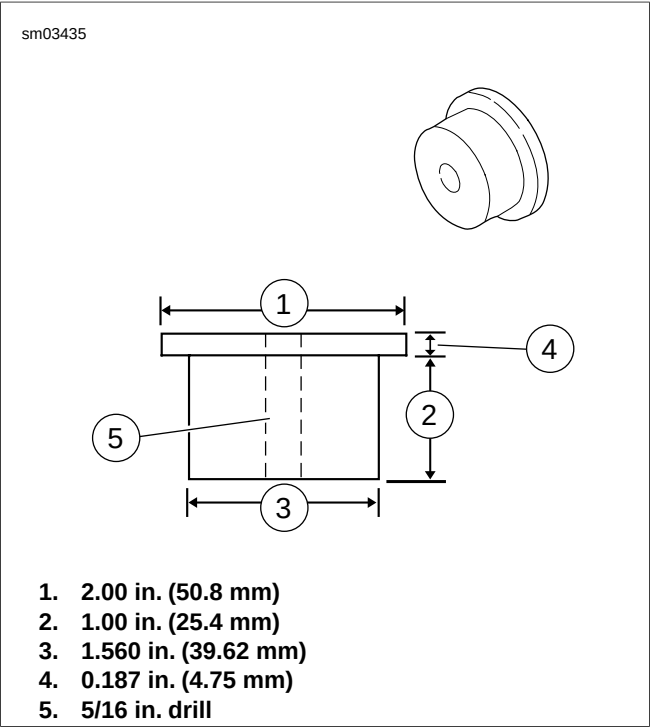


Figure 3-161. Pinion Shaft Outer Race Installation Tool

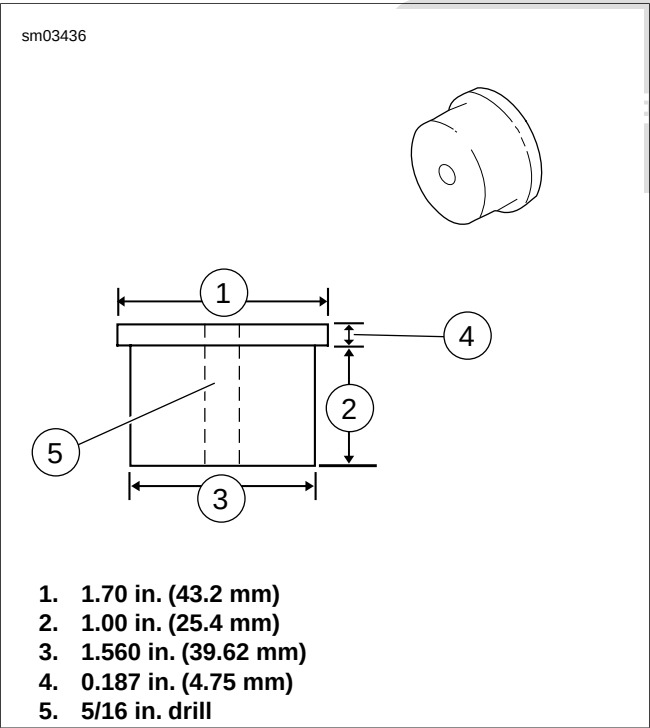


Figure 3-162. Pinion Shaft Outer Race Removal Tool

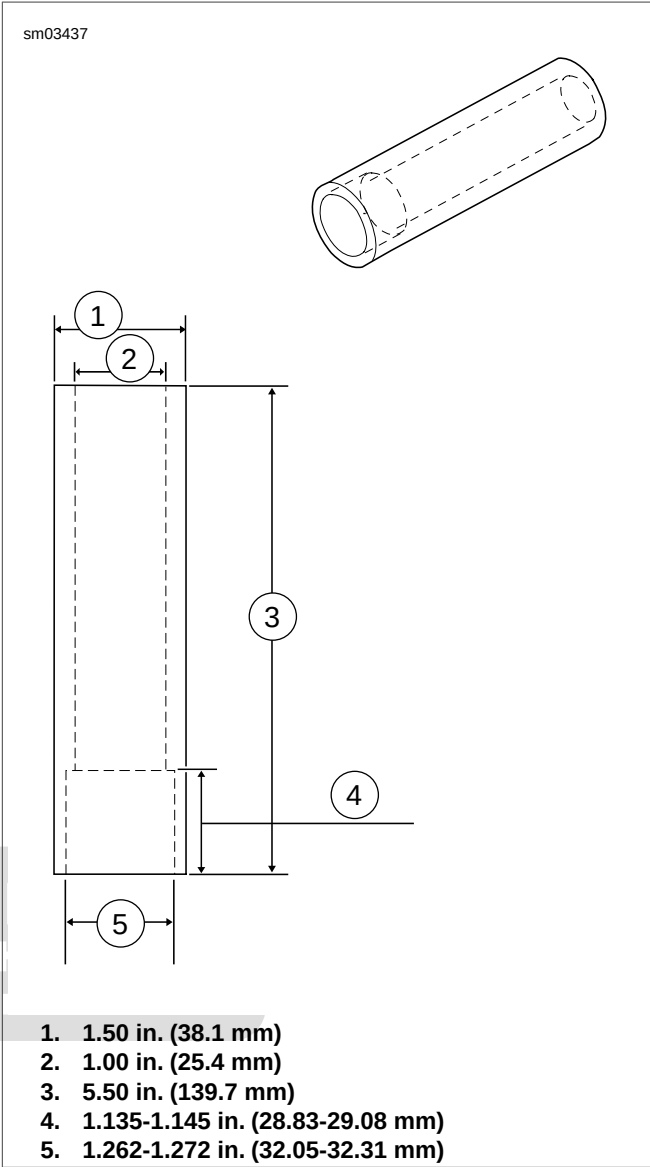


Figure 3-163. Pinion Shaft Inner Race Installation Tool

LAPPING ENGINE MAIN BEARING RACES

PART NUMBER	TOOL NAME
HD-46287	LAPPING TOOL ADAPTER
HD-96710-40C	CRANKCASE MAIN BEARING LAPPING TOOL
HD-96718-87	CRANKCASE MAIN BEARING LAP

1. See [Figure 3-164](#). Obtain CRANKCASE MAIN BEARING LAPPING TOOL (Part No. HD-96710-40C). Assemble CRANKCASE MAIN BEARING LAP (Part No. HD-96718-87) to lapping handle.

NOTE

Left main bearing must be installed in left crankcase in order to use LAPPING TOOL ADAPTER (Part No. HD-46287) in the next step. See [3.18 BOTTOM END OVERHAUL: ASSEMBLY, Crankcase](#).

2. Assemble LAPPING TOOL ADAPTER (Part No. HD-46287) to left main bearing.

3. Secure right and left crankcase halves with three crankcase stud bolts (top center and bottom left and right).
4. Insert lap shaft with arbor assembled through pinion bearing bushing and into lapping tool adapter. Tighten arbor expansion collars using a length of 0.156 in. (3.96 mm) rod as spanner until arbor begins to drag. Do not adjust arbor snug in bushing or bushing will bell, a condition where hole is larger at ends than it is in the center.
5. Withdraw arbor far enough to 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.
6. At frequent intervals, remove lap from crankcase, wash and inspect bushing. Lapping is completed when entire bushing surface has a dull, satin finish rather than a glossy, smooth appearance.
7. When finished, flush off lap tool using cleaning solvent and dry using compressed air. Apply fresh, light coat of fine lapping compound.

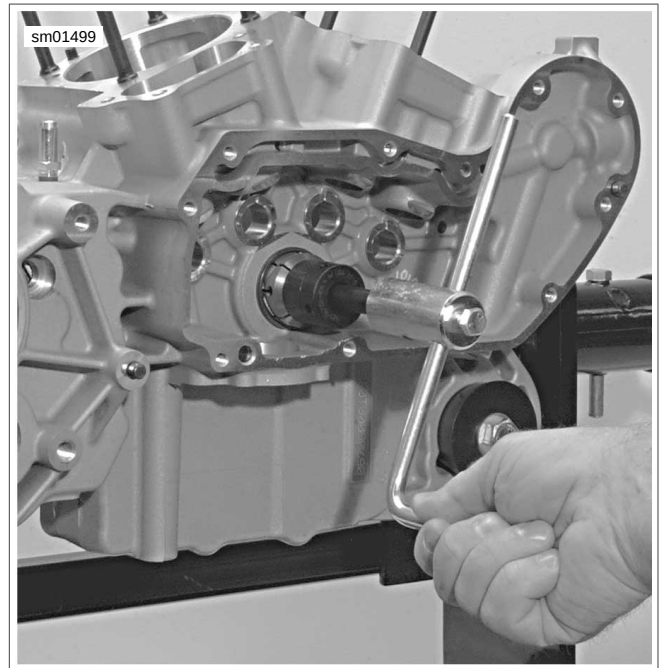


Figure 3-164. Lapping Pinion Shaft Main Bearing

ASSEMBLING CRANKCASE HALVES

To assemble bottom end, see [3.18 BOTTOM END OVERHAUL: ASSEMBLY](#).



OIL PUMP: XL MODELS

3.24

GENERAL

The oil pump seldom needs servicing. Before you disassemble an oil pump suspected of not producing adequate oil pressure, be sure that all possible related malfunctions have been eliminated.

1. Make sure all oil line connections are tight and that lines are not pinched or damaged.

2. Check 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 or sludge.
3. Check for a grounded oil pressure switch wire [120] or faulty switch if oil pressure indicator light fails to go out with engine running.

See [3.8 ENGINE LUBRICATION SYSTEM](#), [3.27 OIL TANK](#) and [6.36 OIL PRESSURE SWITCH](#) for additional information.

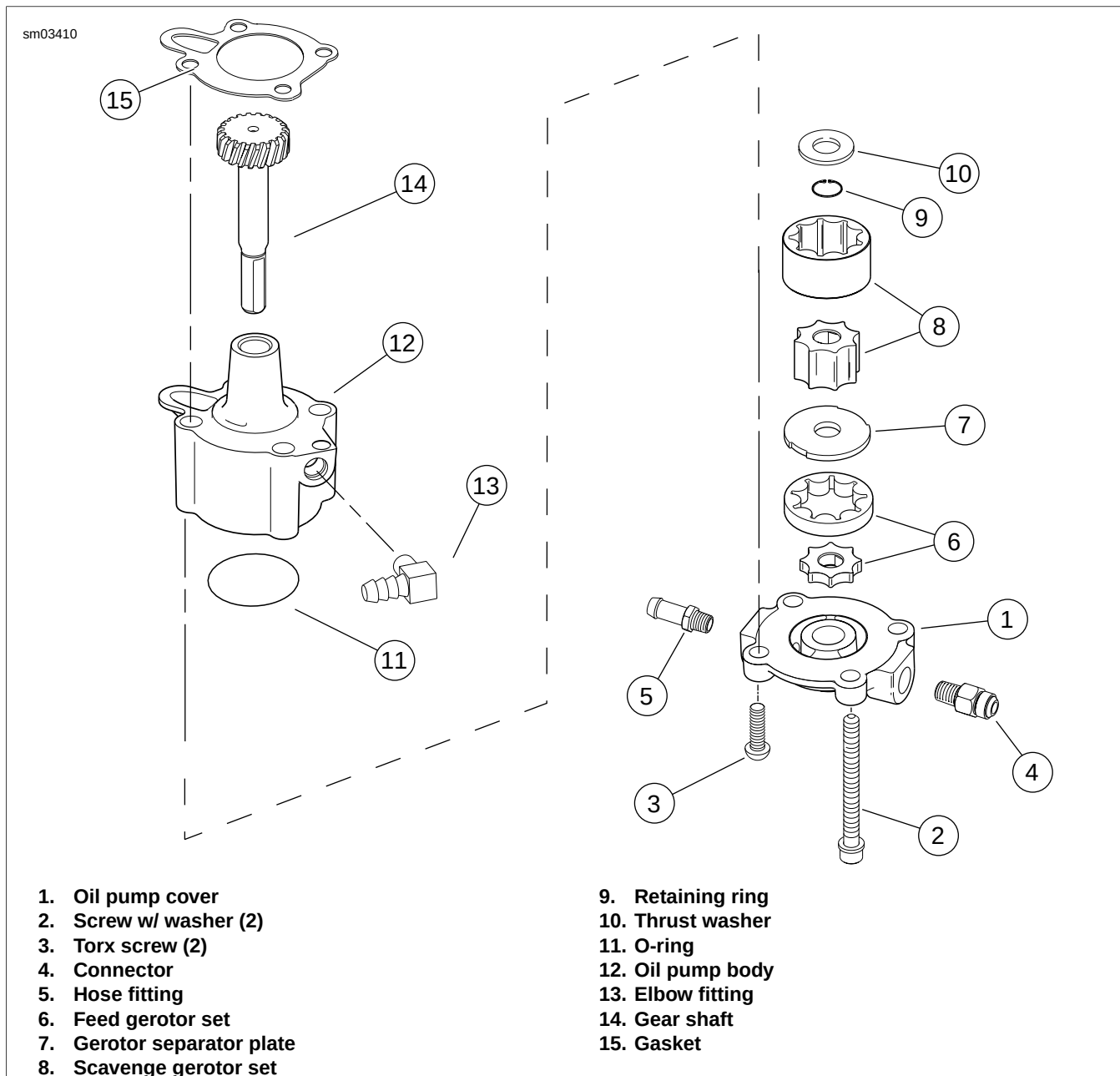


Figure 3-165. Oil Pump: XL Models

REMOVAL

NOTE

The oil pump can be removed with engine in frame and without removing gearcase cover.

1. Drain oil from oil tank.

NOTE

See [Figure 3-166](#). Do not remove oil pump feed fitting (2) from the pump (1). Hold oil pump feed fitting and loosen large high pressure hose fitting nut (3). Then remove high pressure hose (4) from oil pump feed fitting.

2. See [Figure 3-166](#). Remove high pressure feed hose (4) from oil pump (1).

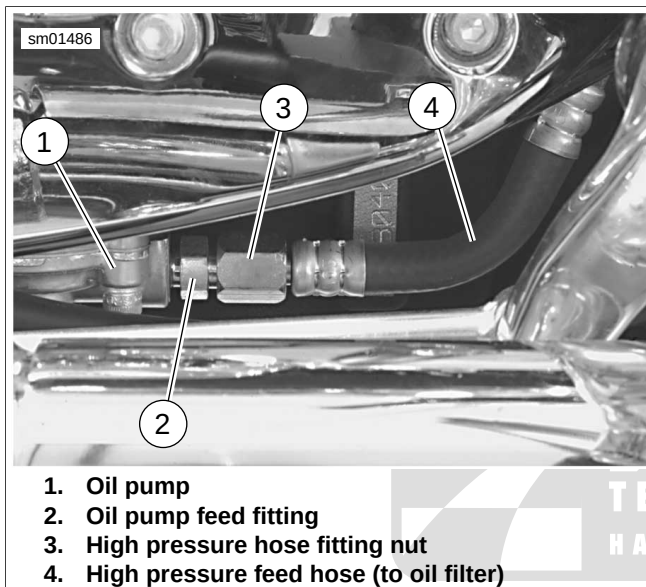


Figure 3-166. Oil Pump Feed Hose

NOTE

See [Figure 3-165](#). The oil pump is designed to be removed as a complete assembly by removing the two long screws (2) at opposite corners of the pump. The other two screws (3) hold the pump together so that it may be removed and installed as a unit.

3. See [Figure 3-165](#). Carefully remove two screws (2) that secure oil pump to crankcase. Pump will drop with screws removed. Discard mounting gasket (15).
4. Disconnect and tag the two remaining oil hoses from the pump.

DISASSEMBLY

1. See [Figure 3-165](#). Remove two Torx screws (3). Lift cover (1) off body (12). Remove and discard o-ring (11).
2. Slide both pieces of feed gerotor set (6), separator plate (7) and both pieces of scavenge gerotor set (8) off gear shaft (14).
3. Remove and discard retaining ring (9). Remove thrust washer (10) and gear shaft.

CLEANING AND INSPECTION

⚠ WARNING

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

1. Clean all parts in cleaning solvent. Blow out holes and oil passages with compressed air.
2. See [Figure 3-167](#). Inspect both gerotor sets for wear.
 - a. Mesh pieces of each set together as shown.
 - b. Use a feeler gauge to determine clearance.
 - c. The SERVICE WEAR LIMIT between gerotors is 0.004 in. (0.102 mm). Replace gerotors as a set if clearance exceeds this dimension.
 - d. Measure thickness of feed gerotors with a micrometer. Replace gerotors as a set if they are not the same thickness.

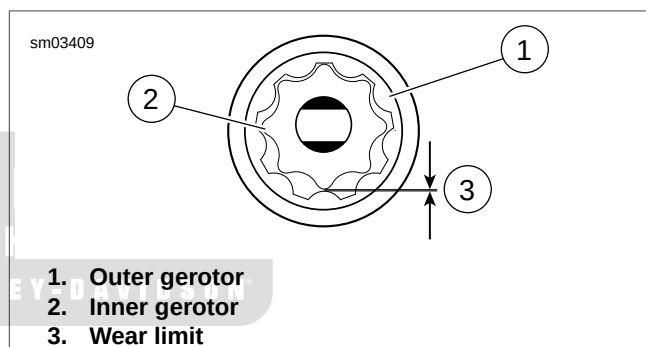


Figure 3-167. Gerotor Wear Limits

ASSEMBLY

NOTE

Liberally coat all moving parts with clean engine oil to ensure easy assembly and smooth operation at start-up.

1. See [Figure 3-165](#). Install gear shaft (14) through oil pump body (12). Position thrust washer (10) over end of shaft. Install **new** retaining ring (9) into groove in shaft.
2. Insert inner gerotor of the scavenge gerotor set (8) over gear shaft.
3. Place outer gerotor over inner to complete scavenge set.
4. Position separator plate (7) into case and line up slots on perimeter with tabs inside oil pump body.
5. Place feed gerotor set (6) over gear shaft.
6. Install a **new** o-ring (11) into groove in oil pump cover (1). Place cover onto pump body. Install two Torx cover screws (3). Tighten to 70-80 **in-lbs** (7.9-9.0 Nm).

INSTALLATION

1. See [Figure 3-165](#). Place **new** mounting gasket (15) in position.
2. Secure pump to crankcase with two screws (2). Tighten to 125-150 **in-lbs** (14.1-16.9 Nm).

NOTE

Use **new** hose clamps to secure oil tank feed hose and vent hose to oil pump fittings. If fittings were removed, use **TEFLON PIPE SEALANT** or **HYLOMAR** on fitting threads.

3. Install hoses on oil pump. Attach oil tank feed hose to hose fitting (5) with **new** clamp. Attach oil tank vent hose to elbow fitting (13) with **new** clamp.
4. See [Figure 3-166](#). If oil pump feed fitting (2) was removed for any reason, install fitting in oil pump (1) cover. Tighten to 55-65 **in-lbs** (6.2-7.4 Nm).
5. If high pressure feed hose (4), was removed completely, install end opposite high pressure fitting nut (3) in crankcase. Tighten to 60-90 **in-lbs** (6.8-10.2 Nm).
6. Install high pressure feed hose fitting nut (3) onto feed fitting on front of oil pump. Hold oil pump feed fitting with a wrench and tighten high pressure hose fitting nut to 85-105 **in-lbs** (9.6-11.8 Nm).
7. Fill oil tank with proper oil. See [1.6 ENGINE OIL AND FILTER](#).



OIL PUMP: XR MODELS

3.25

GENERAL

The oil pump seldom needs servicing. Before you disassemble an oil pump suspected of not producing adequate oil pressure, be sure that all possible related malfunctions have been eliminated.

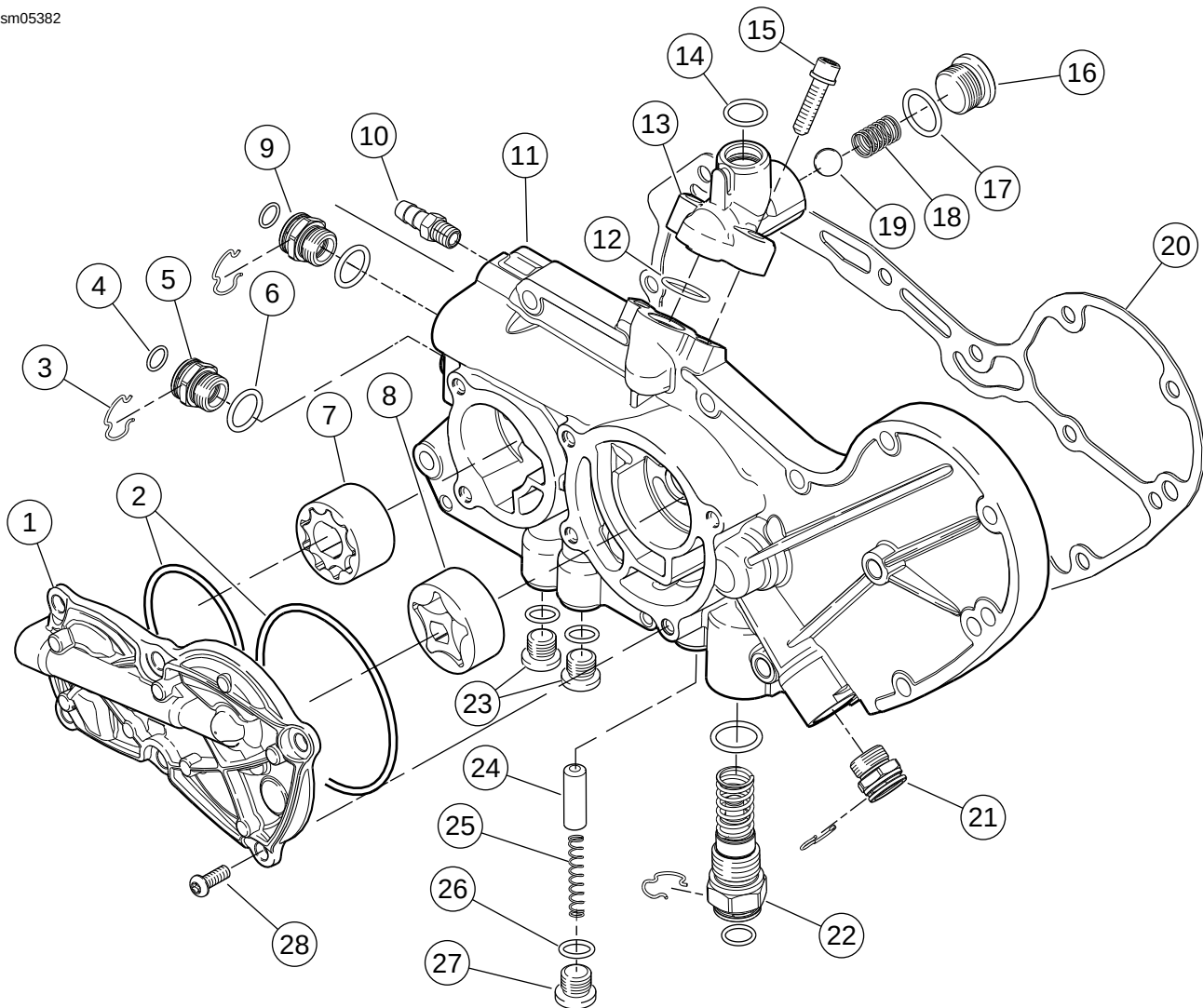
1. Make sure all oil line connections are tight and that lines are not pinched or damaged.

2. Check 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 or sludge.
3. Check for a grounded oil pressure switch wire [120] or faulty switch if oil pressure indicator light fails to go out with engine running.

See [3.8 ENGINE LUBRICATION SYSTEM](#), [3.27 OIL TANK](#) and [6.36 OIL PRESSURE SWITCH](#) for additional information.



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1. Oil pump rotor cover
2. O-rings, rotor cover
3. Retainer
4. O-ring, internal (1 each fitting)
5. Line connector fitting, return oil
6. O-ring, external (1 each fitting)
7. Scavenge gerotor set
8. Feed gerotor set
9. Line connector fitting, supply oil
10. Vent line fitting

11. Oil pump/gearcase housing
12. O-ring
13. Check valve housing, cylinder head oil
14. O-ring
15. Fastener (2)
16. Plug
17. O-ring
18. Spring
19. Check ball
20. Gasket

21. Line connector fitting, oil to cooler
22. Thermostat (oil from cooler)
23. Plugs
24. Bypass valve shuttle
25. Spring, bypass valve
26. O-ring
27. Plug
28. Fastener (6)

Figure 3-168. Oil Pump: XR Models

DISASSEMBLY

NOTE

The oil pump can be removed with engine in frame and without removing gearcase cover.

1. Drain oil from oil tank.
2. Place pan under oil pump to collect oil.
3. See [Figure 3-169](#). Remove nine fasteners (1) and remove gearcase and oil pump cover (2).
4. See [Figure 3-170](#). Remove oil cooler rigid lines (3) from gearcase cover. See [3.14 PRECISION COOLING SYSTEM: XR MODELS, Oil Pump Lines](#).
5. Remove six screws (1) and remove oil pump cover (2). Discard cover o-rings.

NOTE

If oil pump rotors are to be re-used, they must be installed in the original location and orientation as when they are removed. Failure to do so can result in accelerated wear and possible engine failure.

6. See [Figure 3-171](#). Wipe the oil film from the exposed surfaces of the rotors (1, 2) and mark each rotor using a permanent marker to aid in reassembly.

NOTE

The surface tension of the remaining oil film will make the rotors "stick" against the bottom of the bore. Never use a metallic tool to remove oil pump rotors because damage may result, requiring that the rotors or gearcase cover be replaced with new parts.

7. Grasp the outer rotor (1) of each stage and pull from housing bore.
8. Remove each inner rotor (2).
9. Remove the thermostat fitting (3) and spring.
10. Remove the plug and bypass valve components (4).
11. If necessary, remove remaining line connector fittings from gearcase cover.
12. Remove and discard all used o-rings.

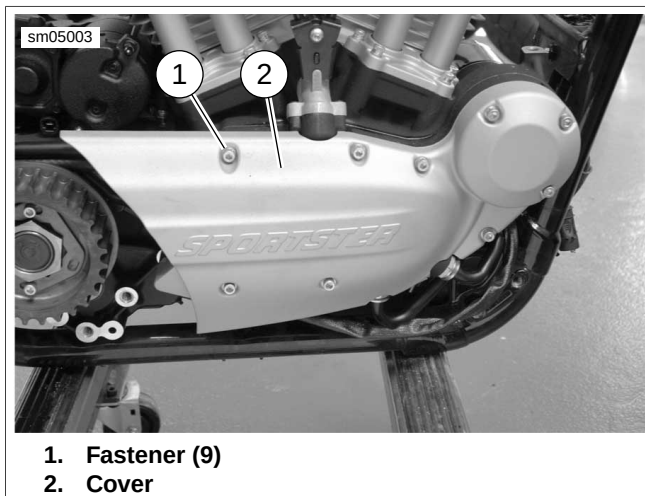


Figure 3-169. Oil Pump Cover: XR Models

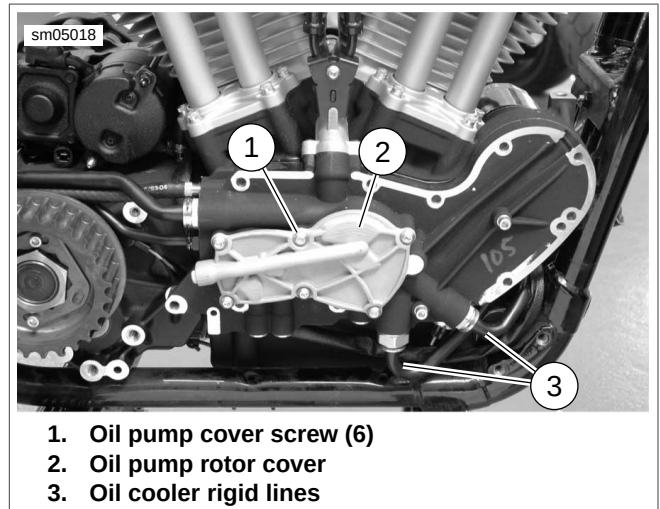


Figure 3-170. Oil Pump Rotor Cover: XR Models

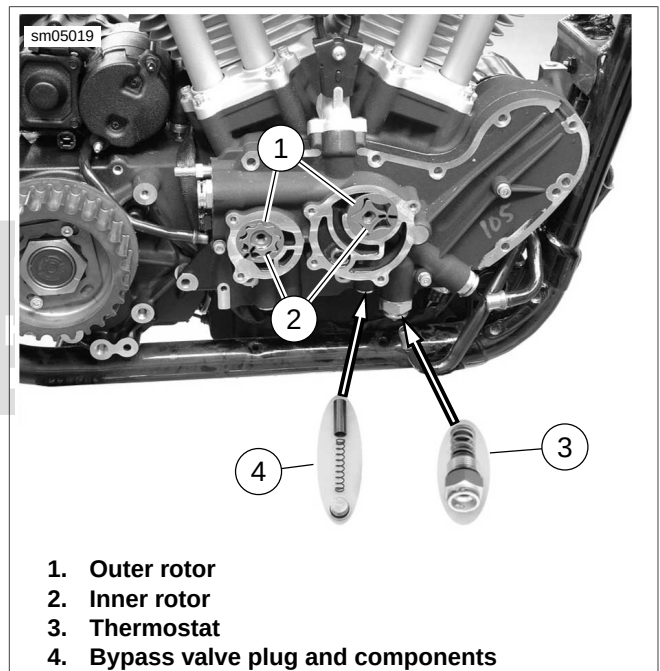


Figure 3-171. Oil Pump: XR Models

CLEANING AND INSPECTION

⚠ WARNING

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

1. Clean all parts in cleaning solvent. Blow out holes and oil passages with compressed air.

2. See [Figure 3-172](#). Inspect both gerotor sets for wear.
 - a. Mesh pieces of each set together as shown.
 - b. Use a feeler gauge to determine clearance.
 - c. The SERVICE WEAR LIMIT between gerotors is 0.004 in. (0.102 mm). Replace gerotors as a set if clearance exceeds this dimension.
 - d. Measure thickness of feed gerotors with a micrometer. Replace gerotors as a set if they are not the same thickness.
3. See [Figure 3-173](#). Inspect thermostat spring for distortion or cracks. Inspect rubber seal for damage. Replace thermostat assembly as necessary.

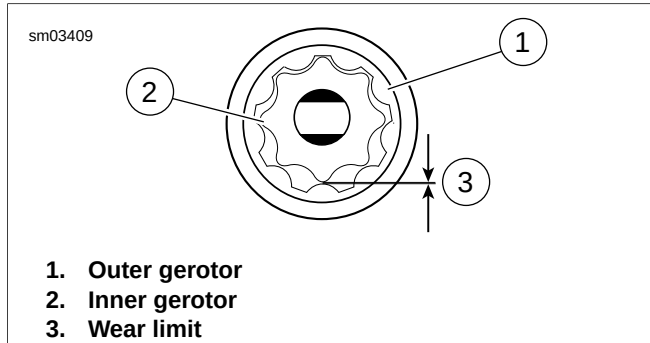


Figure 3-172. Gerotor Wear Limits



Figure 3-173. Thermostat: XR Models

ASSEMBLY

NOTE

Used o-rings can leak. Always install **new** o-rings when performing repairs.

1. Install **new** internal o-rings in each line connector fitting.
2. Install **new** external o-rings on all connector fittings that have been removed.

NOTE

Apply a light coat of new engine oil to the shuttle valve components and oil pump rotors during assembly.

3. See [Figure 3-171](#). Install bypass valve components (4). Tighten plug to 108-156 **in-lbs** (12.2-17.6 Nm).
4. Install thermostat and oil cooler line fitting (3).

NOTE

If oil pump rotors are to be re-used, they must be installed in the original location and orientation as when they were removed. Make sure the mark made during disassembly is visible when installing the rotors. Failure to do so can result in accelerated wear and possible engine failure.

5. Install each outer rotor (1) in its original location.
6. Install each inner rotor (2) in its original location.
7. See [Figure 3-170](#). Install **new** o-rings in oil pump rotor cover and install cover using six fasteners (1). Tighten fasteners to 80-110 **in-lbs** (9.0-12.4 Nm).
8. Install oil cooler rigid lines (3) to quick connect fittings. See [3.14 PRECISION COOLING SYSTEM: XR MODELS, Oil Pump Lines](#).
9. See [Figure 3-174](#). Install oil pump/cam support housing cover. Secure with 9 socket fasteners. Tighten in the sequence shown to 80-110 **in-lbs** (9.0-12.4 Nm).

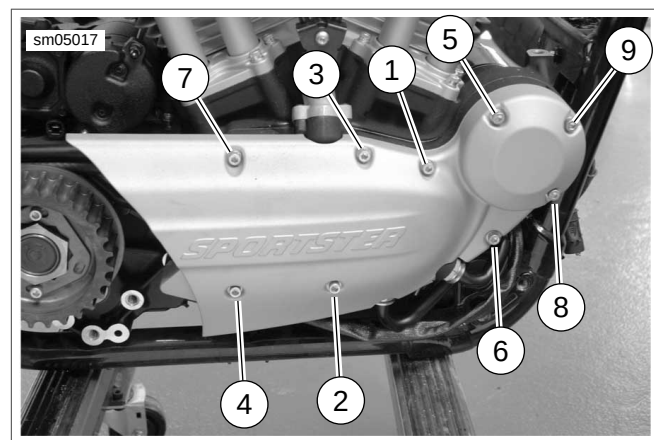


Figure 3-174. Oil Pump Cover Torque Sequence: XR Models

OIL FILTER MOUNT

3.26

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 indicator lamp switch in the filter mount, which turns off the oil pressure indicator lamp.

The check ball in the filter adapter opens at:

- **XL Models:** 10-13 psi (69-90 kPa) oil pressure.
- **XR Models:** 5-7 psi (34-48 kPa) oil pressure.

Filtered oil leaves the filter, flowing past the check ball.

DISASSEMBLY

1. Remove oil filter. See [1.6 ENGINE OIL AND FILTER](#).

NOTE

The engine oil check valve components are located in the Precision Cooling System cylinder head feed circuit. See [3.14 PRECISION COOLING SYSTEM: XR MODELS, Cylinder Head Oil Feed Assembly](#) for service information.

2. See [Figure 3-175](#). Remove oil filter adapter (1) from oil filter mount (2).
3. Remove check ball (3) and spring (4).
4. **XL Models:** Remove oil pressure indicator lamp switch (5).

CLEANING AND INSPECTION

WARNING

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

Thoroughly clean all parts in cleaning solvent. Blow out holes and passages using compressed air.

ASSEMBLY

NOTE

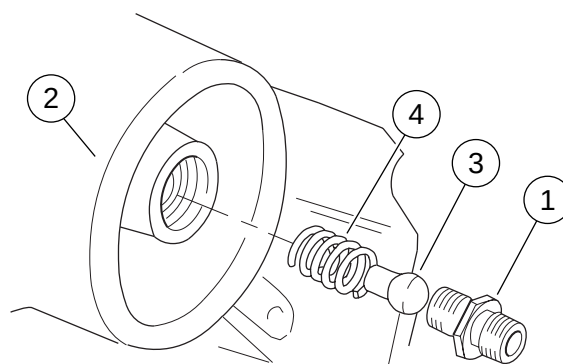
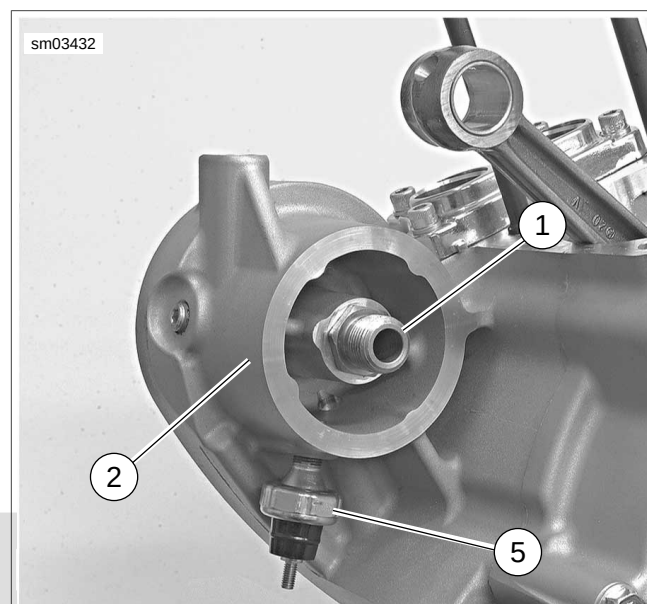
Use **TEFLON® PIPE SEALANT** or **HYLOMAR®** on all fittings installed to oil filter mount.

1. See [Figure 3-175](#). **XL Models:** Install oil pressure indicator lamp switch (5). Tighten to 50-70 **in-lbs** (5.6-7.9 Nm).
2. Place spring (4) and check ball (3) into threaded hole at center of mount (2). Push oil filter adapter against ball to compress spring.

NOTE

The **new** oil filter adapter has one end coated with pre-applied **LOCTITE** on the threads; that end must be installed into the oil filter mount.

3. Install threaded end (with **LOCTITE**) into threaded hole at center of mount. Tighten oil filter adapter to 96-144 **in-lbs** (10.9-16.3 Nm).



1. Oil filter adapter
2. Oil filter mount (part of right crankcase housing)
3. Check ball
4. Spring
5. Oil pressure indicator lamp switch

Figure 3-175. Oil Filter Mount, Typical (XL model shown)

4. Connect oil pressure switch wire [120] to oil pressure indicator lamp switch.
5. Install oil filter. Fill oil tank with proper oil. See [1.6 ENGINE OIL AND FILTER, Changing Oil and Filter](#).

OIL TANK

3.27

OIL HOSE ROUTING: XL MODELS

See [Figure 3-176](#). The feed, vent and return ports are located on the bottom of the oil tank to reduce under seat congestion. A hose routes the oil from the feed port at the lower right front corner to a fitting on the oil pump.

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 routes the oil back to the tank where the cycle is repeated.

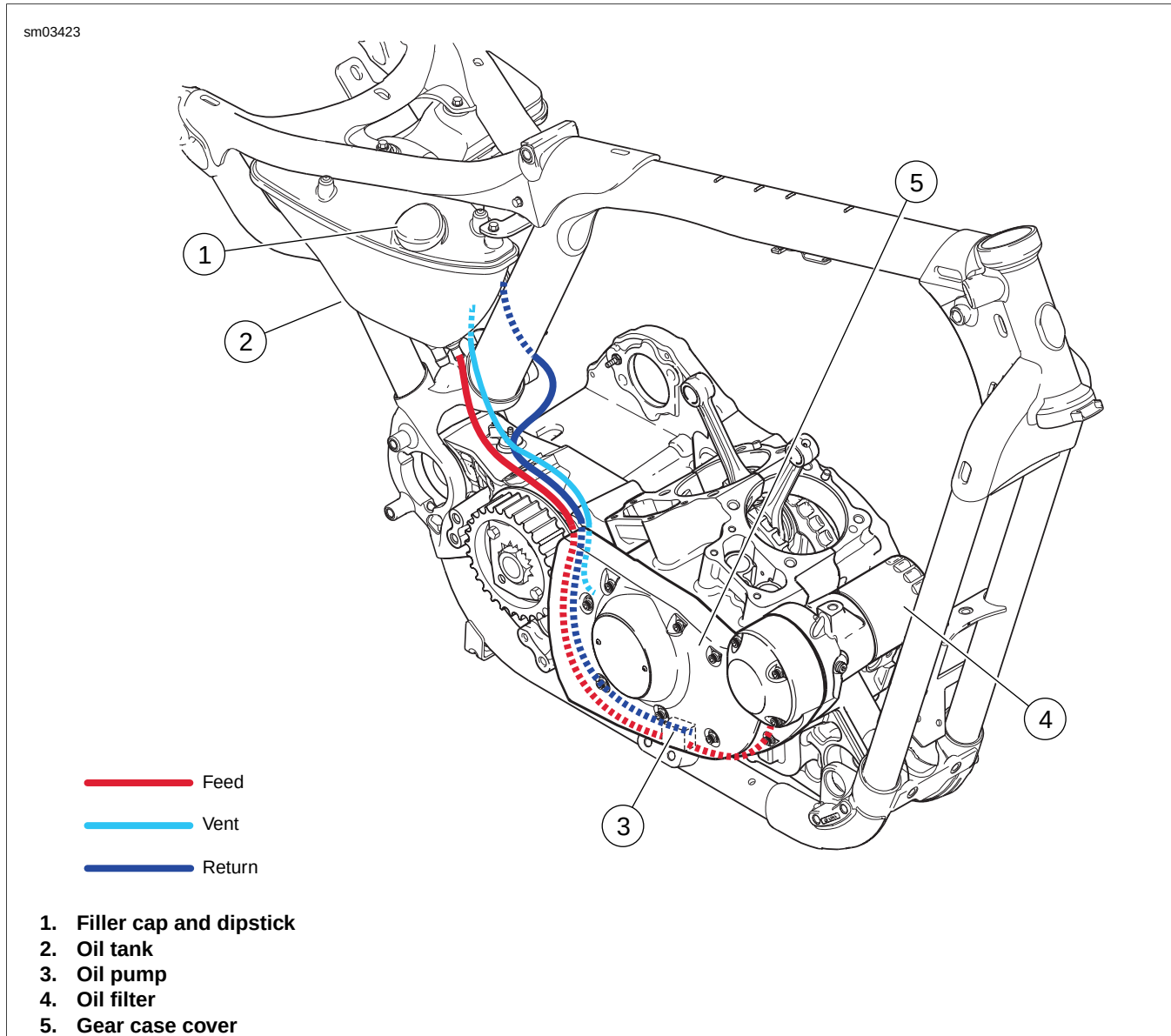


Figure 3-176. Engine Oil Tank, Oil Filter and Hose Routing Locations: XL Models

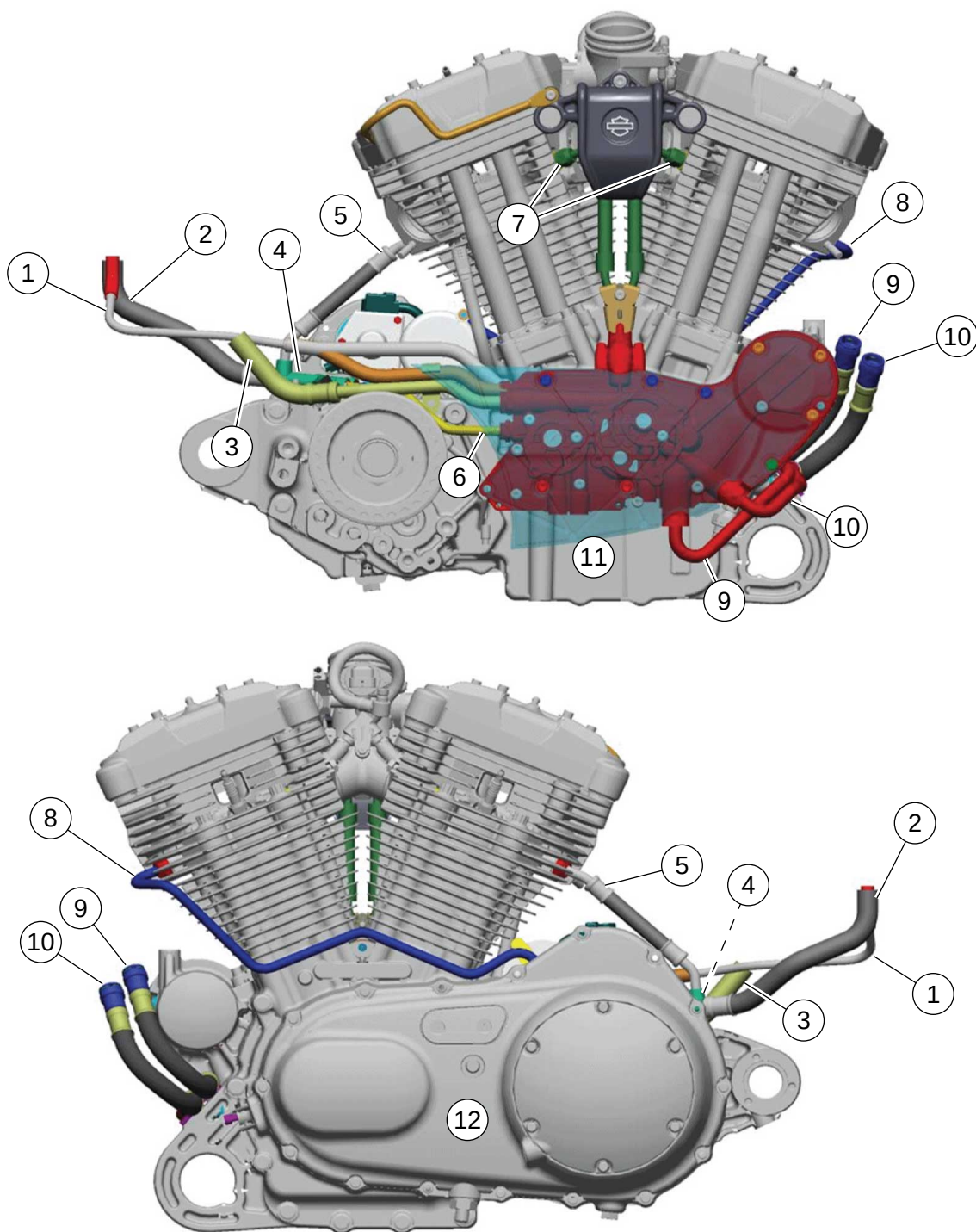
OIL LINE ROUTING: XR MODELS

See [Figure 3-177](#). The feed, vent and return ports are located on the bottom of the oil tank to reduce under seat congestion. A hose routes the oil from the feed port at the lower right front corner to a fitting on the oil pump.

Oil travels to the feed pump through an internal passage in the pump housing. The feed pump pushes oil to the oil cooler, oil

filter, and cylinder heads. Oil used for lubricating internal engine components eventually drains into the sump where the scavenge pump collects it and routes it back to the oil tank. Oil used to cool the cylinder heads joins with return oil from the scavenge pump and is also returned to the oil tank. For a more detailed explanation, see [3.8 ENGINE LUBRICATION SYSTEM, Oil Flow: XR Models](#).

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- | | |
|---------------------------------------|--|
| 1. Vent line | 7. Cylinder head feed oil lines |
| 2. Return oil to tank | 8. Front cylinder head return oil line |
| 3. Supply oil from tank | 9. Oil from oil cooler |
| 4. Return oil manifold | 10. Oil to oil cooler |
| 5. Rear cylinder head return oil line | 11. Engine view, right side |
| 6. Return oil from pump | 12. Engine view, left side |

Figure 3-177. Engine Oil Line Routing: XR Models

REMOVAL

1. Remove seat.
2. Remove left side cover. See [2.20 LEFT SIDE COVER](#).

⚠ WARNING

Prevent accidental vehicle start-up, which could cause death or serious injury. First disconnect negative (-) battery cable at engine and then positive (+) cable from battery. (00280b)

3. Disconnect negative (-) battery cable from ground stud on crankcase. Disconnect positive (+) battery cables at battery. See [1.17 BATTERY MAINTENANCE](#).
4. Drain oil tank as follows (the oil filter need not be removed unless it is due to be replaced):
 - a. Remove filler cap/dipstick assembly from oil tank.
 - b. See [Figure 3-178](#). Place a suitable container directly under the drain hose (1) at the bottom rear of the engine crankcase. The container must be able to hold approximately 4 quarts (3.8 liters).
 - c. Loosen worm drive clamp (2) and pull drain plug (3) from end of drain hose. Completely drain engine oil from oil tank.
 - d. Replace drain plug into end of drain hose and tighten worm drive clamp securely.
5. Remove right side cover by gently prying bottom lip off tab on oil tank. Then lift top of cover off two stanchions molded into top of oil tank.
6. Remove rear belt guard. See [2.24 BELT GUARD AND DEBRIS DEFLECTOR](#).

NOTE

For ease of assembly, mark oil tank hoses for identification; oil feed, drain, vent and return, as they are removed from oil tank.

7. See [Figure 3-179](#). Remove clamp (18) and disconnect drain hose (9) from oil tank (1).

8. Remove clamp (17) from upper end of feed oil hose (8) and disconnect hose from oil tank.
9. Remove clamp (16) from upper end of return oil hose (6) and disconnect hose from oil tank.
10. Remove rear fender. See [2.34 REAR FENDER: ALL XL MODELS EXCEPT XL 1200N](#), [2.35 REAR FENDER AND LICENSE PLATE BRACKET: XL 1200N](#) or [2.36 REAR FENDER: XR MODELS](#).
11. See [Figure 3-179](#). Remove clamp (16) from upper end of vent oil hose (7) and disconnect hose from oil tank (1).
12. Remove three screws (5) and remove oil tank from right side of motorcycle.

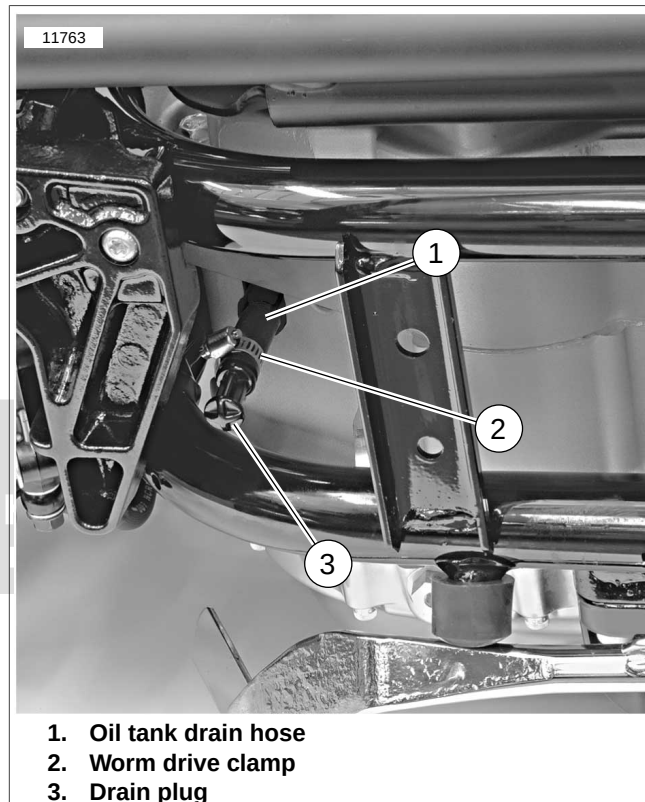
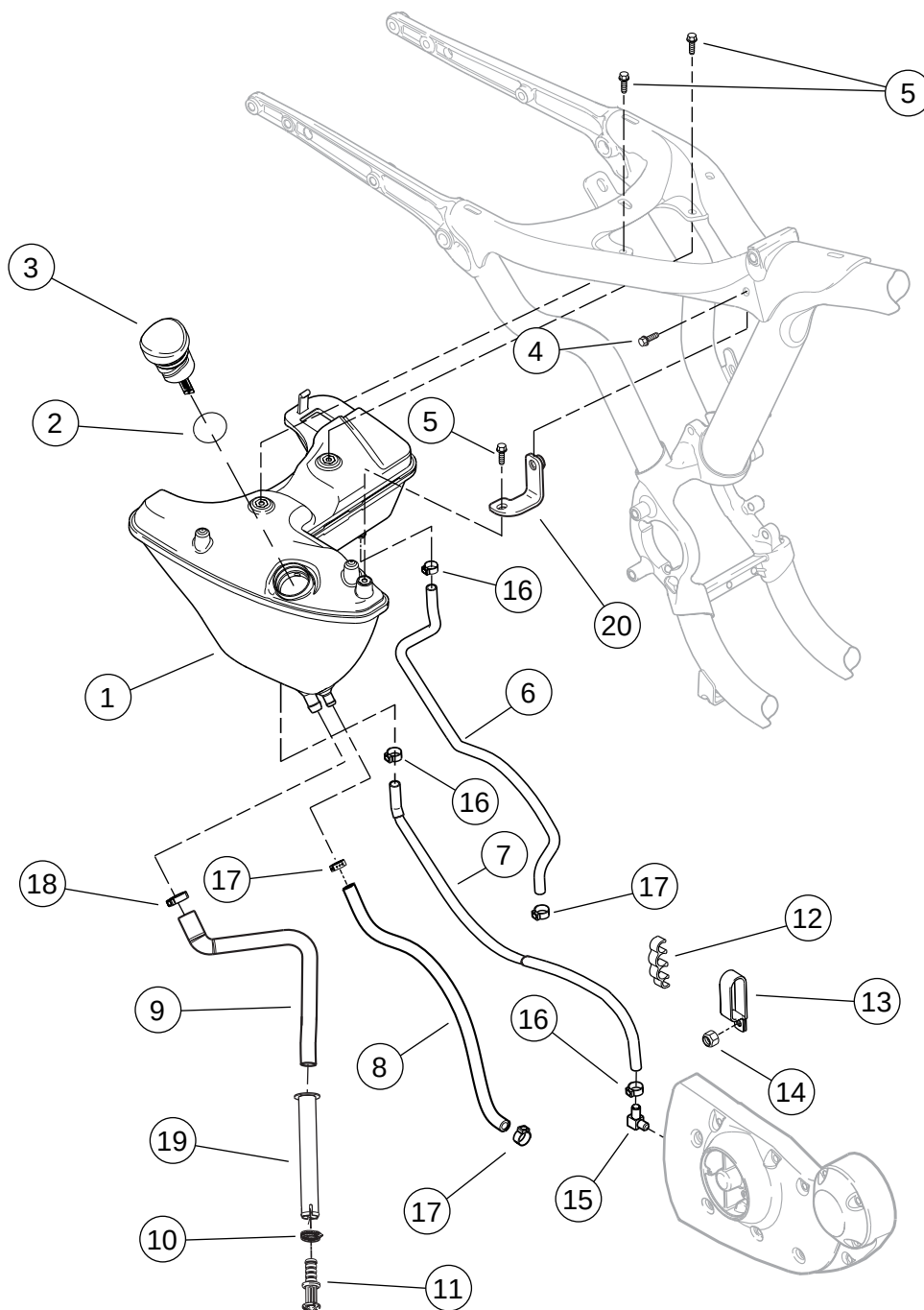


Figure 3-178. Oil Tank Drain Hose

sm03424



- | | |
|--------------------------------|---------------------------|
| 1. Oil tank | 11. Drain plug |
| 2. O-ring | 12. Hose clip |
| 3. Filler cap/dipstick | 13. Clamp |
| 4. Screw | 14. Lock nut |
| 5. Oil tank mounting screw (3) | 15. Elbow fitting |
| 6. Return oil hose | 16. Clamp (3) |
| 7. Vent oil hose | 17. Clamp (3) |
| 8. Feed oil hose | 18. Clamp |
| 9. Drain oil hose | 19. Oil drain hose sleeve |
| 10. Worm drive clamp | 20. Bracket |

Figure 3-179. Engine Oil Tank Assembly: XL Models

INSTALLATION

NOTE

See [Figure 3-179](#). The vent oil hose (7) is composed of a flexible hose originating at the gearcase cover elbow fitting (15), mated to a hard plastic line, then another flexible hose at the oil tank vent fitting.

1. See [Figure 3-179](#). Slide oil tank (1) into position in frame from right side of vehicle.
2. Install oil tank mounting screw (5) through bracket (20) and loosely screw into oil tank to hold tank in place. Install remaining two mounting screws (5) through frame and screw into oil tank. Tighten all three fasteners to 36-60 in-lbs (4.1-6.8 Nm).
3. Install marked oil vent hose (7), feed hose (8), drain hose (9) and return hose (6) in their proper locations on oil tank fittings. Secure with new clamps (16, 17, 18).
4. Install rear fender. See [2.34 REAR FENDER: ALL XL MODELS EXCEPT XL 1200N](#), [2.35 REAR FENDER AND LICENSE PLATE BRACKET: XL 1200N](#) or [2.36 REAR FENDER: XR MODELS](#).
5. Install rear belt guard. See [2.24 BELT GUARD AND DEBRIS DEFLECTOR](#).

6. Install right side cover.
 - a. Engage two holes on top of cover onto stanchions on top of oil tank.
 - b. Rotate bottom end of cover downward until bottom lip of cover snaps in place on tab on bottom of oil tank.
7. Fill oil tank and install filler cap/dipstick. See [1.6 ENGINE OIL AND FILTER, Checking and Adding Oil](#).

WARNING

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

8. Connect positive (+) battery cables to battery. Connect negative (-) battery cable to ground point on engine crankcase. See [1.17 BATTERY MAINTENANCE](#).
9. Install left side cover. See [2.20 LEFT SIDE COVER](#).

WARNING

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

10. Install seat.



TABLE OF CONTENTS

SUBJECT	PAGE NO.
4.1 FASTENER TORQUE VALUES.....	4-1
4.2 SPECIFICATIONS: FUEL SYSTEM.....	4-4
4.3 ELECTRONIC FUEL INJECTION (EFI).....	4-5
4.4 AIR CLEANER: XL MODELS.....	4-6
4.5 AIRBOX: XR MODELS.....	4-8
4.6 FUEL TANK: XL MODELS.....	4-9
4.7 FUEL TANK: XR MODELS.....	4-16
4.8 THROTTLE POSITION (TP) SENSOR.....	4-21
4.9 ENGINE TEMPERATURE (ET) SENSOR.....	4-25
4.10 INDUCTION MODULE: XL MODELS.....	4-28
4.11 INDUCTION MODULE: XR MODELS.....	4-34
4.12 IDLE AIR CONTROL (IAC).....	4-38
4.13 TEMPERATURE MANIFOLD ABSOLUTE PRESSURE (TMAP) SENSOR.....	4-42
4.14 OXYGEN SENSOR.....	4-46
4.15 EXHAUST SYSTEM: XL MODELS.....	4-48
4.16 EXHAUST SYSTEM: XR MODELS.....	4-52
4.17 FUEL INJECTORS.....	4-54
4.18 FUEL PUMP.....	4-57
4.19 FUEL PRESSURE TEST.....	4-62
4.20 INTAKE LEAK TEST.....	4-64
4.21 EVAPORATIVE EMISSIONS CONTROL (CA MODELS).....	4-66



NOTES



FASTENER TORQUE VALUES

4.1

FASTENER TORQUE VALUES IN THIS CHAPTER

The table below lists torque values for all fasteners presented in this chapter.

FASTENER	TORQUE VALUE		NOTES
Air cleaner breather screw	120-144 in-lbs	13.6-16.3 Nm	4.4 AIR CLEANER: XL MODELS, Installation
Air cleaner cover screw	36-60 in-lbs	4.1-6.8 Nm	4.4 AIR CLEANER: XL MODELS, Installation
Air filter screw	40-60 in-lbs	4.5-6.8 Nm	4.4 AIR CLEANER: XL MODELS, Installation
Brake rod-to-bell crank screw	120-180 in-lbs	13.6-20.4 Nm	4.15 EXHAUST SYSTEM: XL MODELS, Installation
Cylinder head bracket screw	17-24 ft-lbs	23.1-32.6 Nm	4.17 FUEL INJECTORS, Installation
Cylinder head exhaust port nut	96-120 in-lbs	10.9-13.6 Nm	4.15 EXHAUST SYSTEM: XL MODELS, Installation
Cylinder head oil feed flare fitting, Precision Cooling	22-26 ft-lbs	29.8-35.3 Nm	4.11 INDUCTION MODULE: XR MODELS, Installation
Cylinder head oil feed line flare nut, Precision Cooling	13-17 ft-lbs	17.6-23.0 Nm	4.11 INDUCTION MODULE: XR MODELS, Installation
Engine temperature sensor	120-168 in-lbs	13.6-19.0 Nm	4.9 ENGINE TEMPERATURE (ET) SENSOR, Installation
EVAP canister clip mounting screw	36-60 in-lbs	4.1-6.8 Nm	4.21 EVAPORATIVE EMISSIONS CONTROL (CA MODELS), Charcoal Canister
EVAP canister guard screw	35-45 in-lbs	4.0-5.1 Nm	4.21 EVAPORATIVE EMISSIONS CONTROL (CA MODELS), Charcoal Canister
EVAP canister mounting bracket screw	17-22 ft-lbs	23.1-29.9 Nm	4.21 EVAPORATIVE EMISSIONS CONTROL (CA MODELS), Charcoal Canister
EVAP canister mounting bracket screw	17-22 ft-lbs	23.1-29.9 Nm	4.21 EVAPORATIVE EMISSIONS CONTROL (CA MODELS), Charcoal Canister
Exhaust flange nut	96-120 in-lbs	10.8-13.6 Nm	4.16 EXHAUST SYSTEM: XR MODELS, Installation
Exhaust pipe clamp (rear) nut	15-19 ft-lbs	20.4-25.8 Nm	4.15 EXHAUST SYSTEM: XL MODELS, Installation
Exhaust pipe clamp bracket screw	30-33 ft-lbs	40.7-44.8 Nm	4.15 EXHAUST SYSTEM: XL MODELS, Installation
Filler housing screws	40-45 in-lbs	4.5-5.1 Nm	4.7 FUEL TANK: XR MODELS, Assemble Fuel Tank
Front muffler mount-to-frame fastener	45-50 ft-lbs	61.0-67.8 Nm	4.16 EXHAUST SYSTEM: XR MODELS, Installation
Fuel hose retaining bracket screw	60 in-lbs	6.8 Nm	4.17 FUEL INJECTORS, Installation
Fuel pump/sender harness grounding screw	19-36 in-lbs	2.1-4.1 Nm	4.18 FUEL PUMP, Assembly
Fuel pump bracket mounting screw	19-36 in-lbs	2.1-4.1 Nm	4.18 FUEL PUMP, Assembly
Fuel pump module mounting screw	40-45 in-lbs	4.5-5.1 Nm	4.18 FUEL PUMP, Installation
Fuel tank cover fastener	24-30 in-lbs	2.7-3.4 Nm	4.7 FUEL TANK: XR MODELS, Installing Fuel Tank
Fuel tank front fastener	15-20 ft-lbs	20.3-27.1 Nm	4.7 FUEL TANK: XR MODELS, Installing Fuel Tank
Fuel tank mounting screw	15-20 ft-lbs	20.4-27.1 Nm	4.6 FUEL TANK: XL MODELS, Installing Fuel Tank
Fuel tank mounting screw	15-20 ft-lbs	20.4-27.1 Nm	4.10 INDUCTION MODULE: XL MODELS, Installation
Fuel tank mounting screw	15-20 ft-lbs	20.4-27.1 Nm	4.17 FUEL INJECTORS, Installation
Fuel tank rear fastener	15-20 ft-lbs	20.3-27.1 Nm	4.7 FUEL TANK: XR MODELS, Installing Fuel Tank
IAC mounting screw	60 in-lbs	6.8 Nm	4.10 INDUCTION MODULE: XL MODELS, Assembly

FASTENER	TORQUE VALUE		NOTES
IAC mounting screw	60 in-lbs	6.8 Nm	4.11 INDUCTION MODULE: XR MODELS, Assembly
IAC mounting screw	60 in-lbs	6.8 Nm	4.12 IDLE AIR CONTROL (IAC), Installation: XL Models
IAC mounting screw (XR models)	60 in-lbs	6.8 Nm	4.12 IDLE AIR CONTROL (IAC), Installation: XR Models
Induction module cover-to-cylinder head fastener	20-24 ft-lbs	27.1-32.5 Nm	4.11 INDUCTION MODULE: XR MODELS, Installation
Induction module cover-to-cylinder head fastener	20-24 ft-lbs	27.1-32.5 Nm	4.13 TEMPERATURE MANIFOLD ABSOLUTE PRESSURE (TMAP) SENSOR, Installation: XR Models
Induction module cover-to-induction module fastener	84-108 in-lbs	9.5-12.2 Nm	4.11 INDUCTION MODULE: XR MODELS, Installation
Induction module cover-to-induction module fastener	84-108 in-lbs	9.5-12.2 Nm	4.13 TEMPERATURE MANIFOLD ABSOLUTE PRESSURE (TMAP) SENSOR, Installation: XR Models
Induction module cover-to-wire form fastener	84-108 in-lbs	9.5-12.2 Nm	4.11 INDUCTION MODULE: XR MODELS, Installation
Induction module cover-to-wire form fastener	84-108 in-lbs	9.5-12.2 Nm	4.13 TEMPERATURE MANIFOLD ABSOLUTE PRESSURE (TMAP) SENSOR, Installation: XR Models
Induction module mounting bracket screw	84-108 in-lbs	9.5-12.2 Nm	4.10 INDUCTION MODULE: XL MODELS, Installation
Induction module-to-intake manifold screw	35 in-lbs	4.0 Nm	4.10 INDUCTION MODULE: XL MODELS, Assembly
Induction module-to-intake manifold screw	60 in-lbs	6.8 Nm	4.10 INDUCTION MODULE: XL MODELS, Assembly
Intake manifold mounting screw	96-120 in-lbs	10.9-13.6 Nm	4.10 INDUCTION MODULE: XL MODELS, Installation
Intake manifold mounting screw	96-120 in-lbs	10.9-13.6 Nm	4.11 INDUCTION MODULE: XR MODELS, Installation
Interconnect bracket-to-frame fastener	30-33 ft-lbs	40.7-44.7 Nm	4.16 EXHAUST SYSTEM: XR MODELS, Installation
Lower muffler mount nut	30-33 ft-lbs	40.7-44.7 Nm	4.16 EXHAUST SYSTEM: XR MODELS, Installation
Muffler interconnect bracket mounting screw	30-33 ft-lbs	40.7-44.8 Nm	4.15 EXHAUST SYSTEM: XL MODELS, Installation
Muffler-to-front muffler mount fastener	120-180 in-lbs	16.9-20.3 Nm	4.16 EXHAUST SYSTEM: XR MODELS, Installation
Muffler-to-interconnect bracket screw	15-19 ft-lbs	20.4-25.8 Nm	4.15 EXHAUST SYSTEM: XL MODELS, Installation
Muffler-to-muffler bolt	120-180 in-lbs	16.9-20.3 Nm	4.16 EXHAUST SYSTEM: XR MODELS, Installation
Muffler torca clamp nut	38-43 ft-lbs	51.6-58.4 Nm	4.15 EXHAUST SYSTEM: XL MODELS, Installation
Muffler-to-rear muffler mount fastener	120-180 in-lbs	16.9-20.3 Nm	4.16 EXHAUST SYSTEM: XR MODELS, Installation
O2 sensor	29-44 ft-lbs	39.3-59.7 Nm	4.15 EXHAUST SYSTEM: XL MODELS, Installation
Oxygen sensor	29-44 ft-lbs	39.3-59.7 Nm	4.14 OXYGEN SENSOR, Installation
Rear muffler mount-to-frame fastener	15-20 ft-lbs	20.3-27.1 Nm	4.16 EXHAUST SYSTEM: XR MODELS, Installation
Sprocket cover screw: XL models	80-120 in-lbs	9.0-13.6 Nm	4.15 EXHAUST SYSTEM: XL MODELS, Installation
Throttle cable bracket screw: XR models	60 in-lbs	6.8 Nm	4.11 INDUCTION MODULE: XR MODELS, Assembly

FASTENER	TORQUE VALUE		NOTES
TMAP sensor screw	60 in-lbs	6.8 Nm	4.13 TEMPERATURE MANIFOLD ABSOLUTE PRESSURE (TMAP) SENSOR, Installation: XR Models
TP sensor mounting screw (XR models)	29 in-lbs	3.3 Nm	4.8 THROTTLE POSITION (TP) SENSOR, Installation: XR Models
TP sensor screw	35 in-lbs	4.0 Nm	4.8 THROTTLE POSITION (TP) SENSOR, Installation: XL Models
TP sensor screw	35 in-lbs	4.0 Nm	4.13 TEMPERATURE MANIFOLD ABSOLUTE PRESSURE (TMAP) SENSOR, Installation: XL Models



SPECIFICATIONS: FUEL SYSTEM

4.2

SPECIFICATIONS: 2009 SPORTSTER MODELS

Table 4-1. Capacities: 2009 Sportster 883 Models

ITEM	XL 883 XL 883R		XL 883C CUSTOM		XL 883L LOW	
	U.S.	LITERS	U.S.	LITERS	U.S.	LITERS
Fuel tank (total)	3.30 gal.	12.49	4.50 gal.	17.03	3.30 gal.	12.49
Oil tank with filter	2.80 qt.	2.65	2.80 qt.	2.65	2.80 qt.	2.65
Transmission (approximate)	1.00 qt.	0.95	1.00 qt.	0.95	1.00 qt.	0.95
Low fuel warning light on	0.80 gal.	3.03	1.00 gal.	3.79	0.80 gal.	3.03

Table 4-2. Capacities: 2009 Sportster 1200 Models

ITEM	XL 1200C CUSTOM		XL 1200R ROADSTER		XL 1200L LOW		XL 1200N NIGHTSTER		XR 1200	
	U.S.	LITERS	U.S.	LITERS	U.S.	LITERS	U.S.	LITERS	U.S.	LITERS
Fuel tank (total)	4.50 gal.	17.03	4.50 gal.	17.03	4.50 gal.	17.03	3.30 gal.	12.49	3.50 gal.	13.25
Oil tank with filter	2.80 qt.	2.65	2.80 qt.	2.65	2.80 qt.	2.65	2.80 qt.	2.65	2.80 qt.	2.65
Transmission (approximate)	1.00 qt.	0.95	1.00 qt.	0.95	1.00 qt.	0.95	1.00 qt.	0.95	1.00 qt.	0.95
Low fuel warning light on	1.00 gal.	3.79	1.00 gal.	3.79	1.00 gal.	3.79	0.80 gal.	3.03	0.50 gal.	1.89

ELECTRONIC FUEL INJECTION (EFI)

4.3

TROUBLESHOOTING

See the electrical diagnostic manual for troubleshooting and diagnostic information.



AIR CLEANER: XL MODELS

4.4

REMOVAL

1. See [Figure 4-1](#). Remove two screws (1) and trim insert (2) from air cleaner cover (3).
2. Remove air cleaner cover from air cleaner backplate (10). Remove air cleaner seal (4) from air cleaner cover.
3. Remove three screws (5). Remove air filter element (6) and gasket (7) from air cleaner backplate. Discard gasket. If filter element is being removed for cleaning only, proceed to [4.4 AIR CLEANER: XL MODELS, Cleaning, Inspection and Repair](#) which follows.

CAUTION

Install air filter before running engine. Failure to do so can draw debris into the engine and could result in engine damage. (00207a)

4. Remove two breather screws (9) from air cleaner backplate.
5. Remove air cleaner backplate and gasket (11). If snorkel insert (12) needs to be repaired or replaced, remove it from air cleaner backplate.

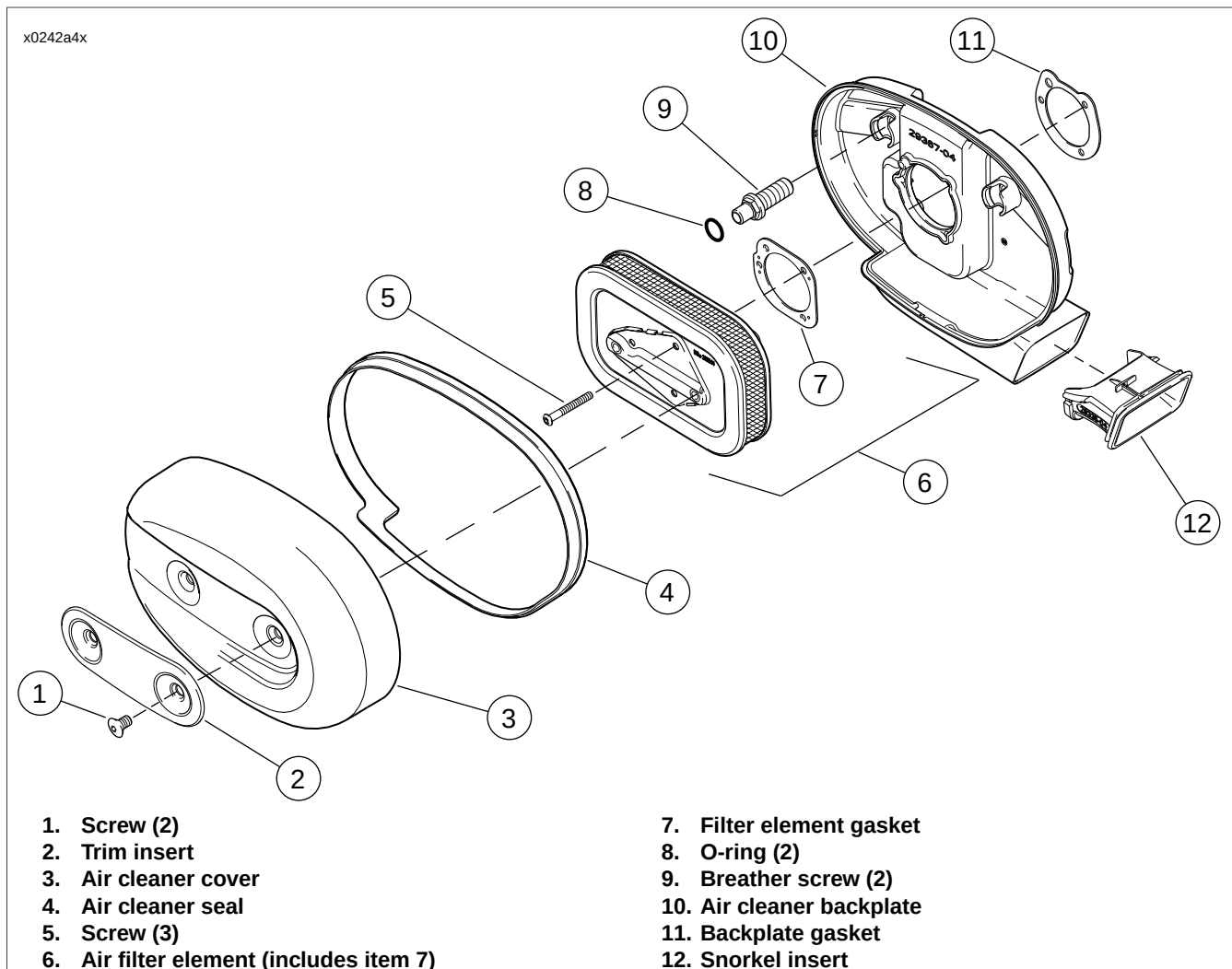


Figure 4-1. Air Cleaner Assembly

CLEANING, INSPECTION AND REPAIR

1. See [Figure 4-1](#). Thoroughly clean air cleaner backplate (10) and inside of air cleaner cover (3).
2. If air filter element (6) is damaged or if filter media cannot be adequately cleaned, replace element and proceed to step 6.

WARNING

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

3. Wash air filter element thoroughly in warm, soapy water. To remove soot and carbon, soak air filter element for 30 minutes in warm water with mild detergent.

WARNING

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

4. Dry air filter element using low-pressure compressed air. Rotate air filter element while moving air nozzle up and down filter element interior. Do not tap air filter element on hard surface.
5. Hold air filter element up to strong light source. Element can be considered sufficiently clean if light is uniformly visible through filter material.
6. Examine o-rings (8). If damaged, replace with new o-ring(s).
7. Examine air cleaner seal (4). If cracked, torn or otherwise damaged, replace with **new** seal.
8. Repair or replace snorkel insert (12) as necessary.

NOTE

On California models, a gravity operated trap door in the air cleaner's snorkel is closed when the engine is not running, to seal the inlet port of the air cleaner backplate. This prevents hydrocarbon vapors emanating from the induction module throat from escaping into the atmosphere. When the vehicle is running, engine vacuum holds the trap door open.

9. On California models, open the trap door in the snorkel with a finger, then release. Observe the trap door to make sure it closes smoothly and completely, without binding.

INSTALLATION

1. See [Figure 4-1](#). If snorkel insert (12) was removed from air cleaner backplate, slide insert into air cleaner backplate and snap into place.
2. Position **new** gasket (11) and air cleaner backplate (10) at induction module air inlet. Secure air cleaner backplate to engine heads with two breather screws (9). Tighten to 120-144 **in-lbs** (13.6-16.3 Nm).
3. Apply a thin coat of engine oil or light grease to o-rings (8). This will help prevent them from being damaged when air filter element is installed.
4. Position **new** gasket (7) on air cleaner backplate. Make sure gasket holes are lined up with backplate holes.
5. Install air filter element (6) onto backplate. Secure with three screws (5). Tighten to 40-60 **in-lbs** (4.5-6.8 Nm).
6. Install air cleaner seal (4) on air cleaner cover (3). To ensure proper sealing, make sure air cleaner seal covers the entire edge of the air cleaner cover.
7. Install air cleaner cover onto backplate. Make sure air cleaner seal fits inside backplate and is not pinched or distorted.
8. Install trim insert (2), and secure insert and air cleaner cover with two screws (1). Tighten to 36-60 **in-lbs** (4.1-6.8 Nm).

REMOVAL

1. Remove the fuel tank. See [4.7 FUEL TANK: XR MODELS](#).
2. Disconnect active intake solenoid connector located at the rear of the airbox.
3. Lift airbox off induction module, trying to leave the interface grommet attached to the induction module.
4. Disconnect crankcase vent hoses from the front and rear rocker cover fittings and remove airbox assembly from motorcycle.
5. Remove filter element as necessary. See [1.25 AIR CLEANER: XR MODELS](#).
6. Inspect hoses, interface grommet and housings for deterioration, cracks, or other damage. Repair or replace as necessary.

INSTALLATION

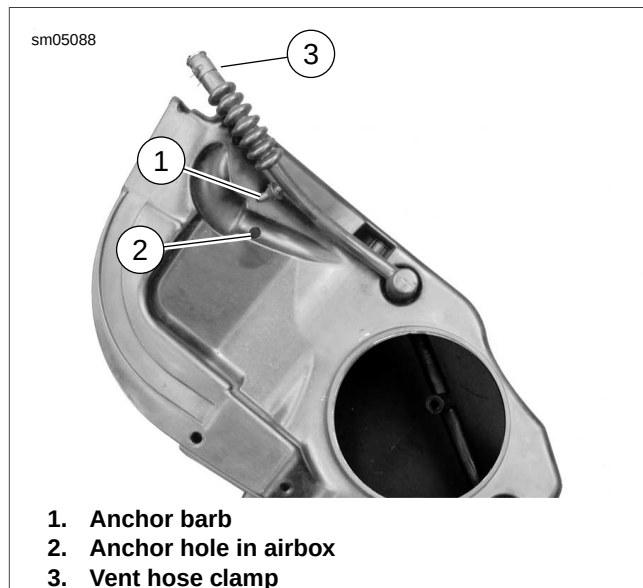
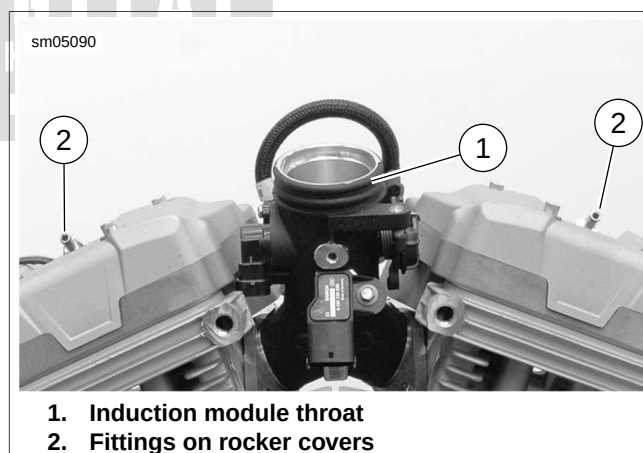
1. See [Figure 4-2](#). Install any hoses that have been removed from the airbox assembly. Ensure the anchor barb (1) of the front crankcase vent hose is securely installed in the hole (2) in the airbox bottom.
2. If removed, install air filter element and cover. See [1.25 AIR CLEANER: XR MODELS](#).
3. See [Figure 4-3](#). If removed, install interface grommet on induction module. Ensure it is completely seated on the throat (1) of the induction module.
4. While holding airbox in approximate installed location, connect crankcase vent hoses to the fittings (2) on the front and rear rocker covers. Ensure clamps are in place.

NOTE

It is extremely important that the interface grommet be correctly and securely installed on the induction module and the airbox. Failure to do so will result in ingestion of dirt and debris that would otherwise be caught by the filter element, resulting in possible decrease of engine life.

5. Place airbox assembly over interface grommet and work grommet into airbox opening until securely seated. Edge of hole in airbox will completely encircle the groove molded in the grommet when installed correctly.

6. Mate active air solenoid connector.
7. Install fuel tank. See [4.7 FUEL TANK: XR MODELS](#).

**Figure 4-2. Front Crankcase Vent Hose****Figure 4-3. Airbox Connections**

FUEL TANK: XL MODELS

4.6

GENERAL

⚠ WARNING

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

NOTE

See [Figure 4-4](#). Turn the fuel filler cap (2 or 13) clockwise until at least three clicks are heard in order to verify that it is securely fastened to the fuel tank (1 or 12).

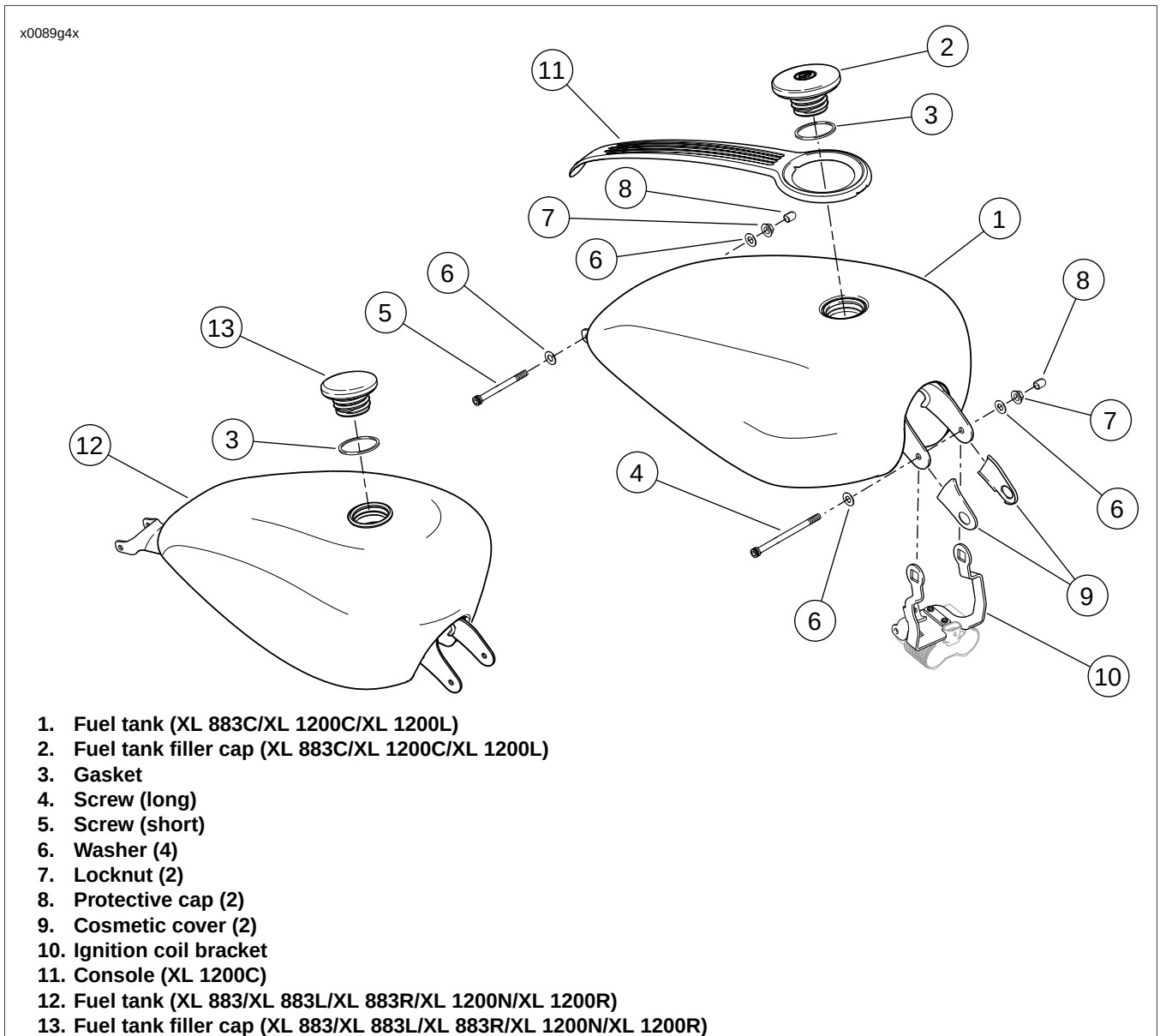


Figure 4-4. Fuel Tank and Mounting Hardware

PURGING AND DISCONNECTING FUEL SUPPLY HOSE

WARNING

When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)

WARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

1. Purge the fuel supply line of high pressure gasoline.
 - a. Open left side cover. See [2.20 LEFT SIDE COVER](#).
 - b. See [Figure 4-5](#). Remove fuel pump fuse (1) located in fuse panel in front of battery.
 - c. Start engine and allow vehicle to run.
 - d. When engine stalls, operate starter for 3 seconds to remove any remaining fuel from fuel hose.
 - e. Shut off ignition and reinstall fuel pump fuse.

WARNING

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

2. See [Figure 4-6](#). Push up on release sleeve (1) on fuel pump quick-connect fitting and pull down on fuel supply hose fitting (2) to disconnect fuel supply hose (3) from fuel pump module (4). Immediately clean up any fuel spills.

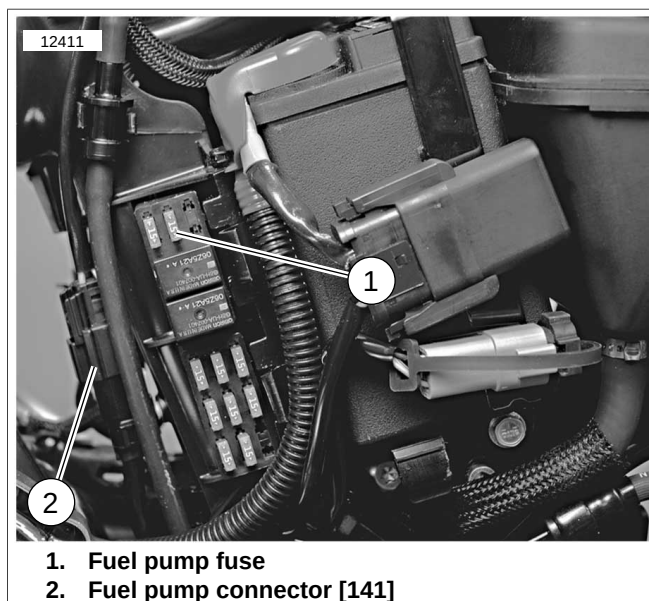


Figure 4-5. Fuel Pump Fuse and Connector

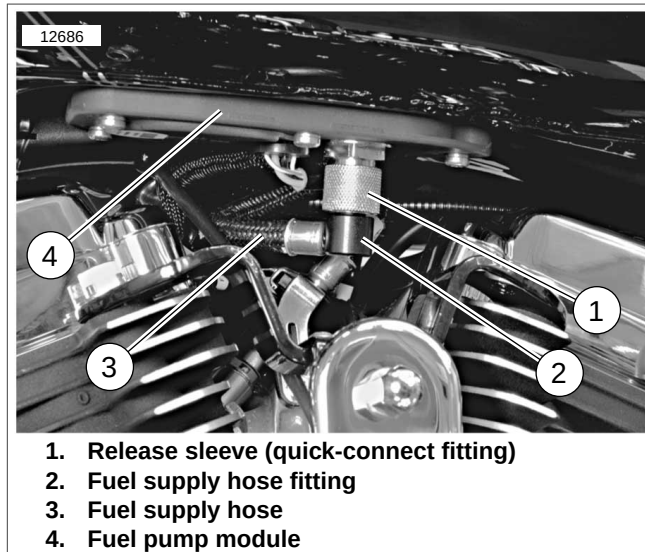


Figure 4-6. Fuel Tank Quick-Connect Fitting

REMOVING FUEL TANK

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Remove main fuse. See [6.38 MAIN FUSE](#).
2. Remove seat.

NOTE

If the fuel tank is being removed only to gain access to items otherwise hidden, it is not necessary to drain the fuel from the tank. If the fuel tank is to be disassembled or repaired, follow the step below to drain the fuel.

3. Drain fuel tank:
 - a. Obtain a suitable fuel transfer pump with a long, flexible nozzle.
 - b. Position vehicle upright. Remove fuel tank filler cap.
 - c. Insert fuel transfer pump nozzle into fuel tank filler spout. Aim nozzle toward right side of fuel tank to avoid contacting and damaging fuel pump assembly.
 - d. Direct the pump output into a suitable container.
 - e. Pump fuel until fuel tank is empty.
 - f. Immediately wipe up any spilled fuel.
4. See [Figure 4-7](#). Remove vent hose from fuel tank vent nipple. Remove cable clip (3) securing fuel pump wiring harness (2) to mounting boss on H-bracket.
5. See [Figure 4-5](#). Unplug fuel pump connector (2) [141].
6. See [Figure 4-4](#). Remove protective caps (8), lock nuts (7), screws (4, 5) and washers (6) from front and rear of fuel tank.
7. Place a clean, soft cloth over front of fuel tank to keep tank from contacting top fork clamp and damaging paint. Lift

up rear of fuel tank. Remove fuel pump harness from clip on wire harness caddy latch clip on frame backbone.

8. Lift fuel tank off motorcycle.
9. Remove fuel pump assembly. See [4.18 FUEL PUMP](#).

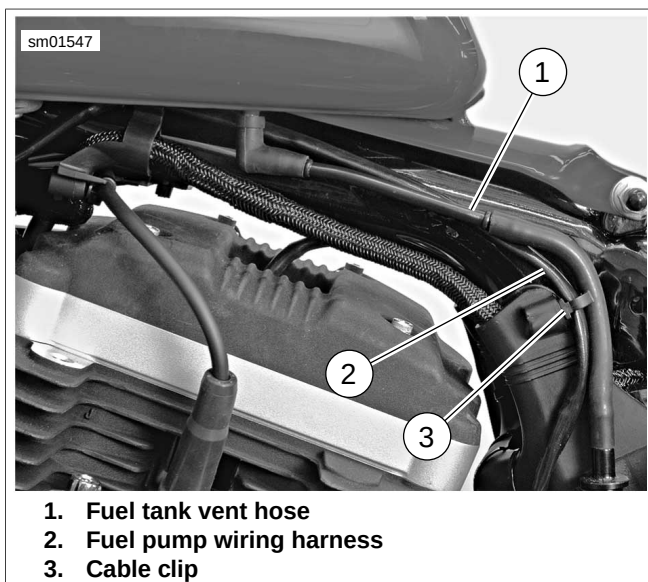


Figure 4-7. Fuel Tank Vent Hose

CLEANING AND INSPECTION

⚠ WARNING

When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)

Extreme caution should be taken when repairing fuel tanks. Make sure all traces of fuel are purged before making an open flame repair.

1. Clean fuel tank interior with commercial cleaning solvent or a soap and water solution. Shake fuel tank to agitate cleaning agent.
2. Thoroughly flush fuel tank after cleaning. Allow fuel tank to air dry.
3. Carefully inspect fuel hose and vent hose for damage, cuts, cracks, holes, wear or general deterioration. Replace as necessary.
4. Inspect the fuel tank for leaks or other damage. If a damaged fuel tank cannot be successfully repaired, replace it.

INSTALLING FUEL TANK

NOTE

Be sure wiring harnesses do not get pinched between fuel tank and frame during tank installation.

1. Install fuel pump into fuel tank using **new** gasket. See [4.18 FUEL PUMP](#).

2. See [Figure 4-8](#). Position fuel tank on motorcycle. Make certain that front fuel tank brackets are located outboard of ignition coil bracket (8).
3. Place washer (4) on long screw (2). Push screw through front fuel tank bracket, ignition coil bracket and frame, from right to left. Place second washer over screw and hand-start lock nut (5).

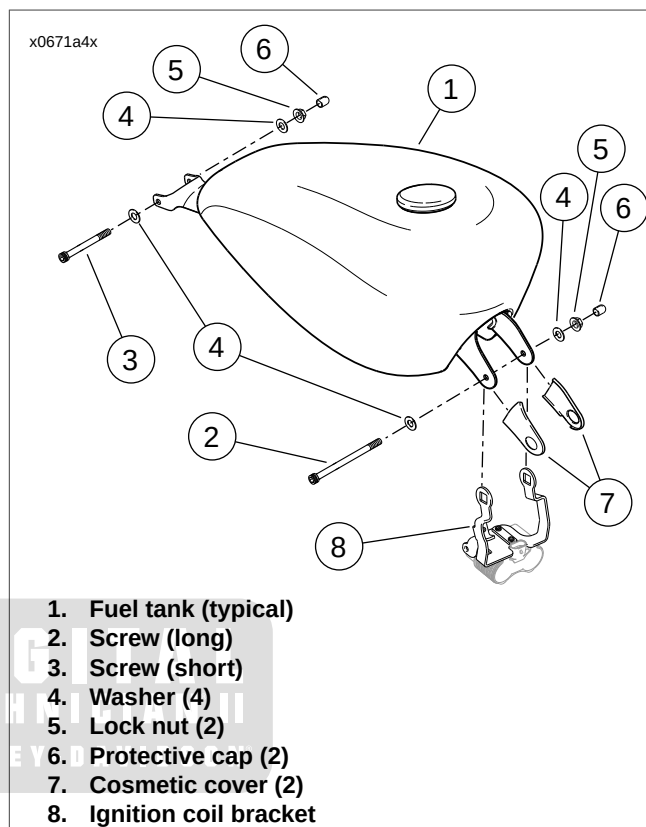


Figure 4-8. Fuel Tank Mounting (Typical)

4. See [Figure 4-9](#). Place a clean, soft cloth over front of fuel tank to keep tank from contacting top fork clamp and damaging paint. Lift up rear of fuel tank. Place fuel pump wiring harness (1) into clip on wire harness caddy latch clip on frame backbone tube. Make sure harness forms a loop (5) between caddy latch clip and fuel pump module (6) to avoid pinching harness between fuel tank and frame backbone tube.
5. Route fuel pump wiring harness down along left side of H-bracket. Secure with cable clip (3). Push clip into hole in mounting boss (2) on H-bracket.
6. See [Figure 4-5](#). Plug in fuel pump connector (2) [141].
7. Lower rear of fuel tank into position. See [Figure 4-8](#). Place washer (4) on short screw (3). Push screw through rear fuel tank bracket and frame, from right to left. Place second washer over screw and hand-start lock nut (5).
8. Tighten both front and rear fuel tank mounting screws to 15-20 ft-lbs (20.4-27.1 Nm). Install protective caps (6) on screw ends.
9. See [Figure 4-7](#). Install vent hose onto fuel tank vent nipple.

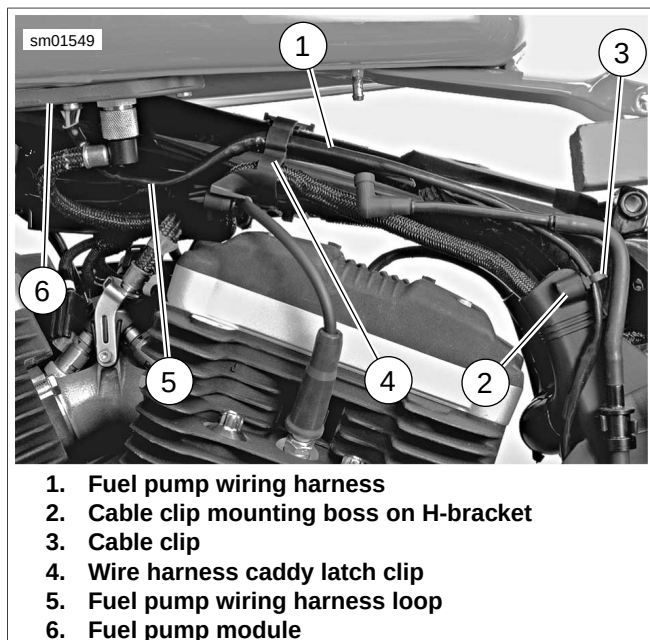


Figure 4-9. Fuel Pump Wiring Harness Routing

RECONNECTING FUEL HOSE AND FILLING FUEL TANK

⚠ WARNING

To prevent spray of fuel, be sure quick-connect fittings are properly mated. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00268a)

1. See [Figure 4-6](#). Push up on release sleeve (1) and push fuel hose fitting (2) into fuel pump module fuel pump quick-connect fitting. Pull down on release sleeve to lock quick-connect fitting. Tug on fuel hose fitting to make sure it is securely locked in place.
2. See [Figure 4-7](#). Install vent hose onto vent nipple on fuel tank.

⚠ WARNING

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

⚠ WARNING

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

3. Fill fuel tank and carefully inspect for leaks around fuel pump module.
4. Install main fuse. See [6.38 MAIN FUSE](#).

5. Turn ignition switch ON and verify fuel pump is activated. Carefully inspect for leaks at quick-connect fitting. Turn ignition switch OFF.

⚠ WARNING

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

6. Install seat.

VAPOR VALVE

⚠ WARNING

Excessive pressure can build in the fuel tank if vapor valve is not mounted vertically with long fitting to top. Leaks due to excessive pressure can cause a fire or explosion, which could result in death or serious injury. (00265a)

See [Figure 4-10](#). The fuel tank (1) is vented through a stand-pipe (vent tube) within the tank. A hose (2) at the base of the fuel tank is connected to the standpipe.

⚠ WARNING

Keep vent and vapor valve lines away from exhaust and engine. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00263a)

See [Figure 4-11](#). The fuel tank vent hose (2) is connected to a vapor valve (4) located beneath the seat in front of the battery tray. On non-California models, another hose (5) vents the vapor valve to the atmosphere. On California models, that hose is routed to the charcoal canister. See [4.21 EVAPORATIVE EMISSIONS CONTROL \(CA MODELS\)](#).

NOTES

- See [Figure 4-12](#). 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.
- See [Figure 4-12](#). Do NOT force vapor valve (1) into clip (2). Forcing valve in to clip could cause clip to break, necessitating replacement of entire wiring harness guide (4).

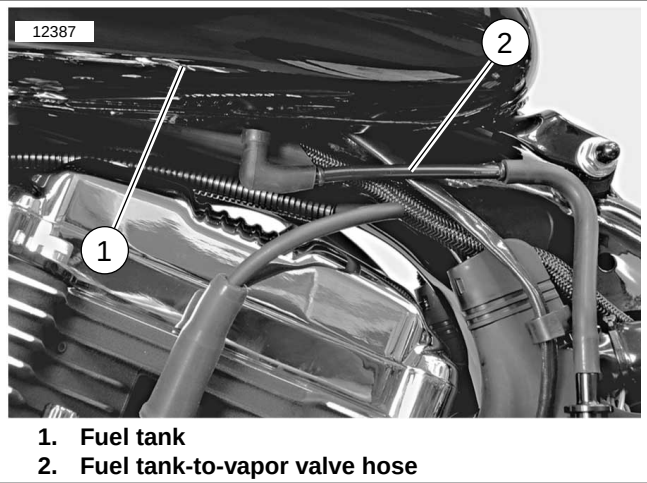


Figure 4-10. Fuel Tank Venting System

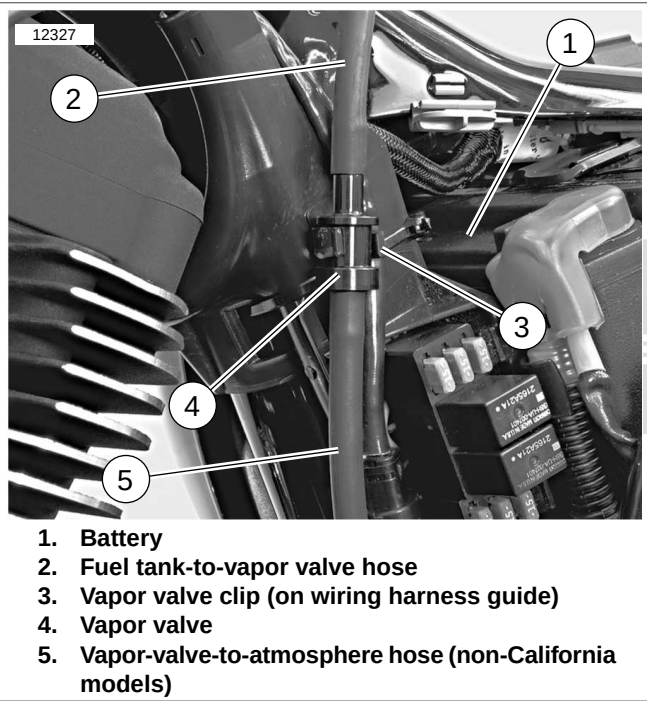


Figure 4-11. Vapor Valve Assembly

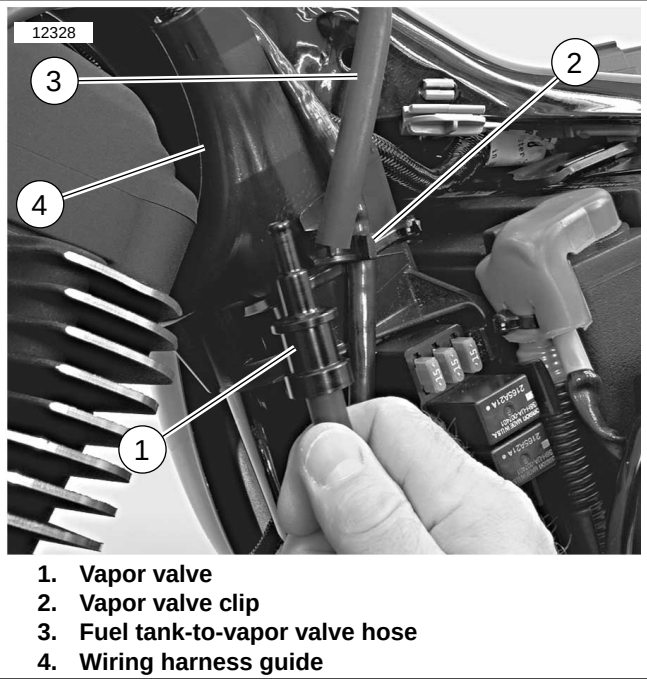


Figure 4-12. Vapor Valve Mounting

CONSOLE REPLACEMENT

PART NUMBER	TOOL NAME
HD-47114	CONSOLE ALIGNMENT RING

In addition to the CONSOLE ALIGNMENT RING (Part No. HD-47114), other special tools are needed:

- Temporary use of a smaller diameter fuel filler cap (H-D Part Number 61272-92B). This is the original equipment cap found on 2004 or later XL 883, XL 883L, XL 883R and XL 1200R models, as well as many other Harley-Davidson models.
- Approximately 18 in. (460 mm) fishing line (or string) to aid in removing the existing console.

Removal

⚠ WARNING

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

1. Remove seat.
2. See [Figure 4-13](#). Remove the original fuel filler cap (2) from the fuel tank (1) and set it aside. Obtain a small diameter Harley-Davidson fuel filler cap (5) and screw it into the fuel filler opening.
3. See [Figure 4-14](#). Insert the fishing line (2) between the rear of the fuel tank and the plastic liner (1) on the underside of the original console.

NOTE

Raise the ends of the fishing line away from the fuel tank to avoid scuffing the tank finish.

4. Using a side-to-side "sawing" motion, work the fishing line toward the front of the fuel tank to break the adhesive bond between the console and the tank.
5. Carefully remove the console and liner from the fuel tank and discard it.

NOTES

- Be careful not to scratch the paint on the fuel tank when removing the adhesive.
 - To avoid damaging the fuel tank finish, do not use tools or abrasive cleaners to remove the adhesive residue that remains on the fuel tank surface. Try to stay within the area that will be covered by the new console.
6. See [Figure 4-15](#). To remove any adhesive residue remaining on the fuel tank surface:
 - a. Carefully peel off as much adhesive as possible, using your thumb and fingers only.

NOTE

Use of cleaning compounds other than isopropyl alcohol may damage fuel tank finish. Test in inconspicuous area.

- b. Clean the top of the fuel tank with a mixture of 50% to 70% isopropyl alcohol and 30% to 50% distilled water or, if necessary, straight isopropyl alcohol.
- c. Allow the fuel tank surface to dry thoroughly.

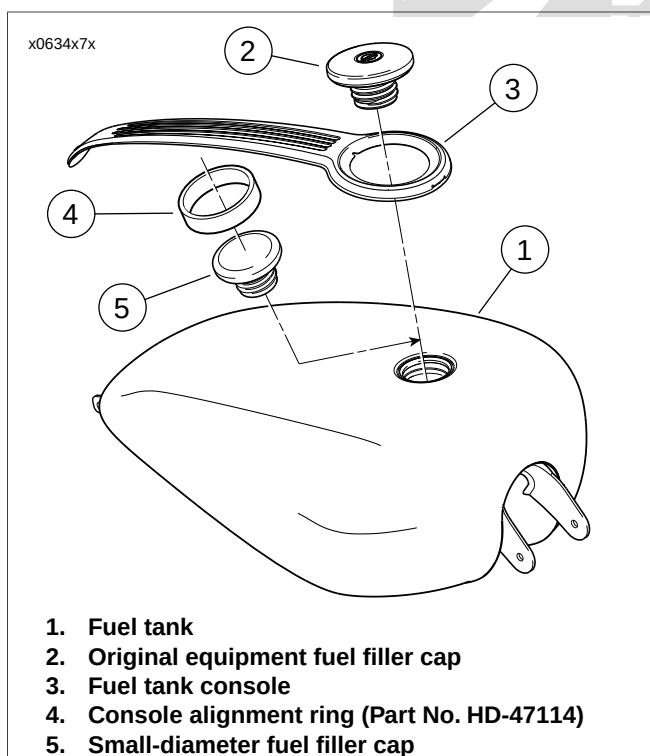


Figure 4-13. Replacing Console: XL 1200C

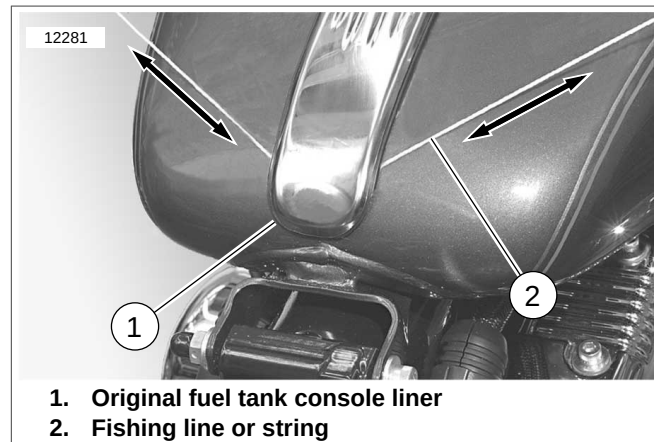


Figure 4-14. Removing Existing Console

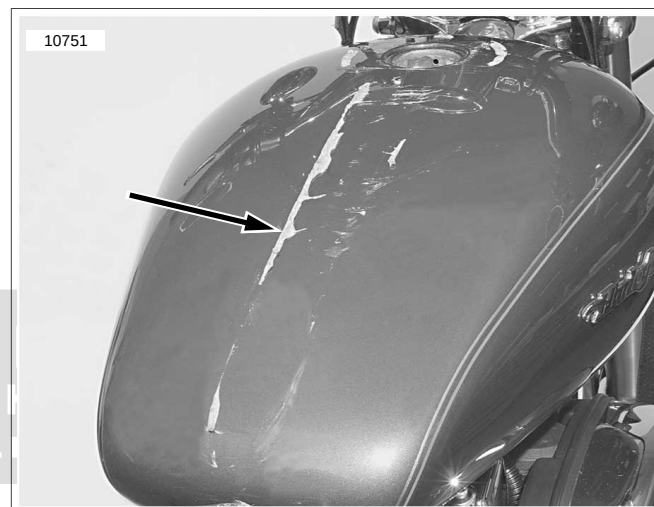


Figure 4-15. Removing Adhesive Residue

Installation

1. See [Figure 4-16](#). Measure and mark the centerline of the fuel tank at the rear of the tank.
2. Obtain the new fuel tank console. Measure and mark the centerline of the console at the rear of the panel.
3. See [Figure 4-17](#). Place CONSOLE ALIGNMENT RING (Part No. HD-47114) over the fuel filler cap.
4. Peel the liner from the adhesive backing of the console.
5. See [Figure 4-18](#). Position the console over the fuel tank without touching the adhesive to the tank surface. Center the large hole over the CONSOLE ALIGNMENT RING (Part No. HD-47114) tool, and align the mark on the rear of the console with the mark made on the rear of the fuel tank.
6. Slide the front of the console down over the CONSOLE ALIGNMENT RING (Part No. HD-47114) tool onto the fuel tank. Bring the rear of the console down, keeping the marks aligned.
7. Press the console firmly against the top of the fuel tank and hold pressure for 30 seconds. After releasing pres-

sure, avoid direct contact with the console for about 20 minutes, then remove the CONSOLE ALIGNMENT RING (Part No. HD-47114) tool.

8. Remove the small-diameter fuel filler cap and install the original fuel filler cap.

WARNING

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

9. Install seat.
10. Allow AT LEAST 24 hours after applying the console before exposing the area to vigorous washing, strong water spray or extreme weather. The adhesive bond will increase to maximum strength after about 72 hours at normal room temperatures.

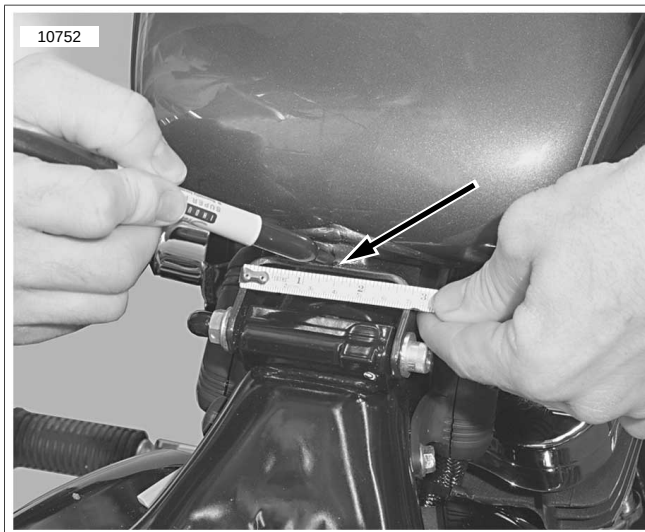


Figure 4-16. Marking Fuel Tank Centerline

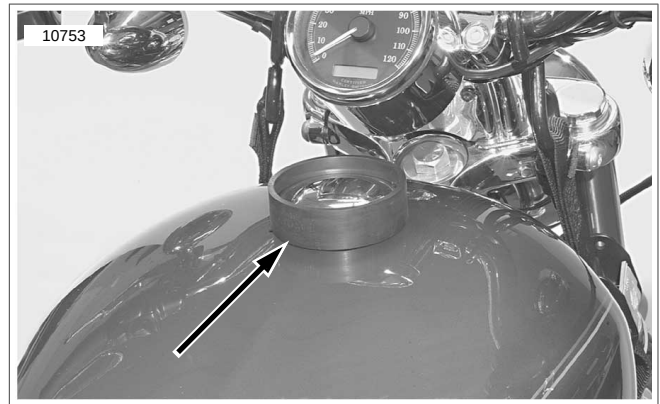


Figure 4-17. Placing Console Alignment Ring Tool (Part No. HD-47114)



Figure 4-18. Positioning Console on Fuel Tank

FUEL TANK: XR MODELS

4.7

GENERAL

WARNING

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

PURGING AND DISCONNECTING FUEL SUPPLY HOSE

WARNING

When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)

WARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

1. Purge the fuel supply line of high pressure gasoline.
 - a. Open left side cover. See [2.20 LEFT SIDE COVER](#).
 - b. See [Figure 4-19](#). Remove fuel pump fuse (1) located in fuse panel in front of battery.
 - c. Start engine and allow vehicle to run.
 - d. When engine stalls, operate starter for 3 seconds to remove any remaining fuel from fuel hose.
 - e. Shut off ignition and reinstall fuel pump fuse.

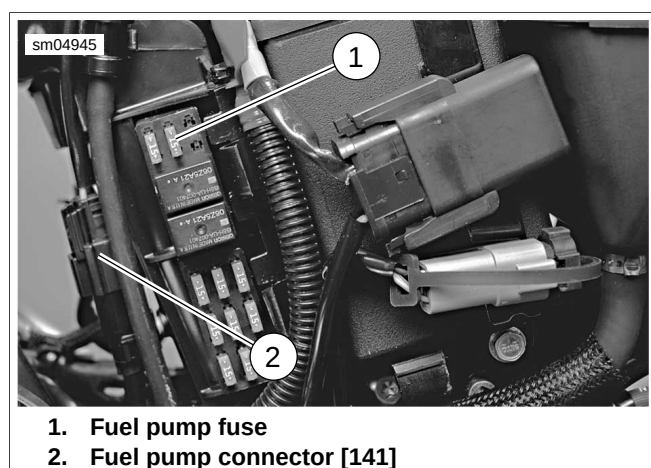


Figure 4-19. Fuel Pump Fuse and Connector

WARNING

Gasoline can drain from quick-connect fitting when removing fuel line. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00267a)

2. See [Figure 4-20](#). Push up on release sleeve (1) on fuel pump quick-connect fitting and pull down on fuel supply hose fitting (2) to disconnect fuel supply hose (3). Immediately clean up any fuel spills.

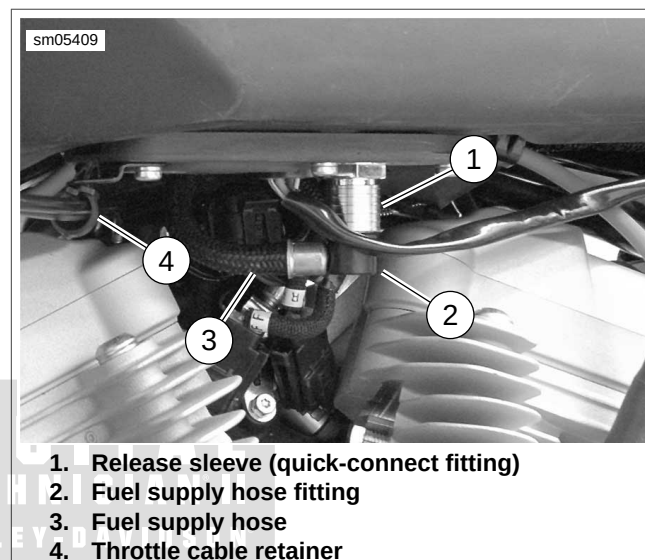


Figure 4-20. Fuel Tank Quick-Connect Fitting

REMOVING FUEL TANK

1. Purge the fuel supply line of high pressure gasoline. Disconnect fuel line from fuel tank. See [4.7 FUEL TANK: XR MODELS, Purging and Disconnecting Fuel Supply Hose](#).

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

2. Remove main fuse. See [6.38 MAIN FUSE](#).

NOTE

If the fuel tank is being removed only to gain access to items otherwise hidden, it is not necessary to drain the fuel from the tank. If the fuel tank is to be disassembled or repaired, follow the steps below to drain the fuel.

3. Drain fuel tank:
 - a. Obtain a suitable fuel transfer pump with a long, flexible nozzle.
 - b. Position vehicle upright. Remove fuel tank filler cap.
 - c. Insert fuel transfer pump nozzle into fuel tank filler spout. Aim nozzle toward right side of fuel tank to avoid contacting and damaging fuel pump assembly.
 - d. Direct the pump output into a suitable container.
 - e. Pump fuel until fuel tank is empty.
 - f. Replace fuel tank filler cap.
 - g. Immediately wipe up any spilled fuel.
4. See [Figure 4-20](#). Remove retainer (4) securing throttle cables to plate on bottom of fuel tank.

NOTE

See [Figure 4-21](#). Short screws (2) secure trim ring to fuel tank cover only. It is not necessary to remove these screws unless either trim ring or fuel tank cover is being replaced.

5. See [Figure 4-21](#). Remove four long screws (1) that secure trim ring (4) and fuel tank cover (5) to fuel tank.
6. Carefully lift fuel tank cover off fuel tank. Slide cover forward slightly as it is lifted to clear sides of fuel tank.
7. See [Figure 4-22](#). Remove vent hose (3) from fuel tank vent fitting (4). With a gentle twisting motion, pull ground wire connector [210] (5) straight up off pin on fuel tank retaining ring (6).
8. Remove vent hose and ground wire from trough in center of fuel tank. Pull vent hose and ground wire back out of the way.
9. See [Figure 4-19](#). Unplug fuel pump connector [141] (2).

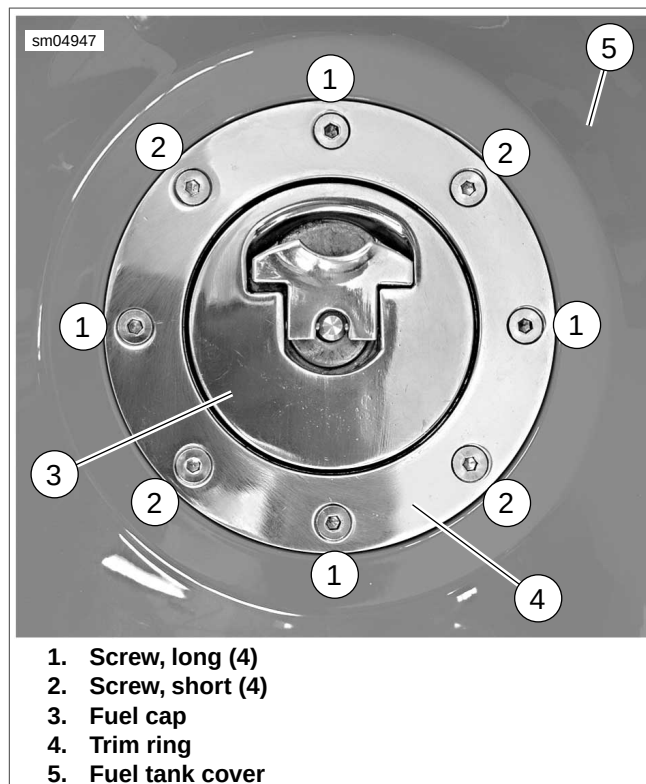


Figure 4-21. Fuel Cap and Trim Ring

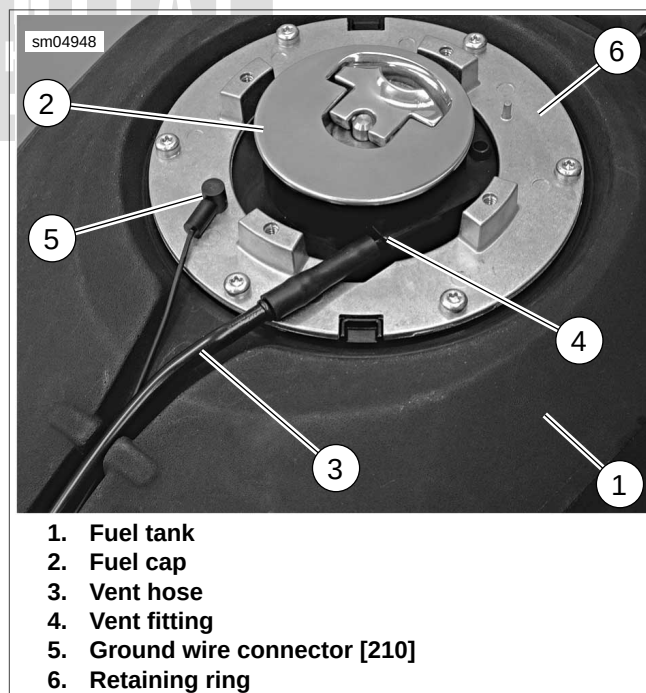


Figure 4-22. Fuel Tank Vent Hose and Ground Wire

10. See [Figure 4-23](#). Remove two screws and washers (3) securing airbox to bottom of fuel tank.
11. Remove screw with washer (4) from rear of fuel tank. Remove protective plastic cap (not shown) from threaded end of screw (6). Remove screw, washers and lock nut.

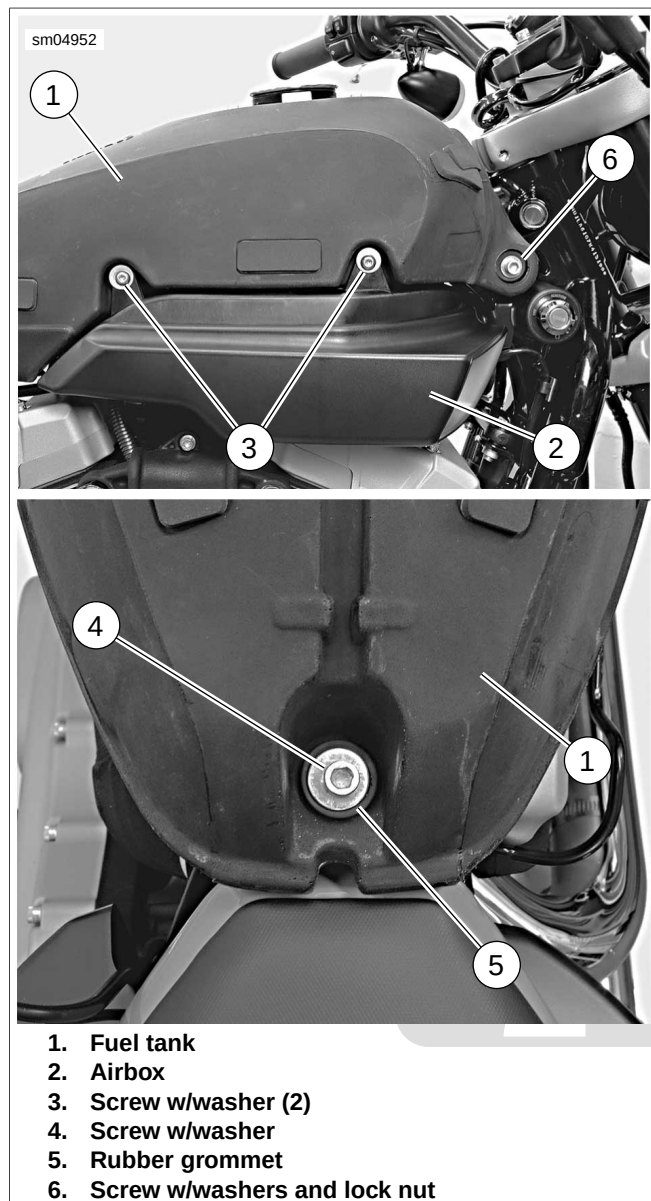


Figure 4-23. Fuel Tank and Airbox Mounting Fasteners

12. Lift fuel tank off motorcycle.

NOTE

See [Figure 4-26](#). Metal bushings (4) inside the grommets (3) may fall when fuel tank is lifted off vehicle. Make sure they do not fall out and become lost.

13. Remove fuel pump assembly from fuel tank. See [4.18 FUEL PUMP](#).

DISASSEMBLE FUEL TANK

⚠ WARNING

When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)

1. See [Figure 4-24](#). Remove filler cap (1) with o-ring (2).
2. Remove screws (7) and clamp ring (3).

3. Remove top ring (4).
4. Remove o-ring (5).

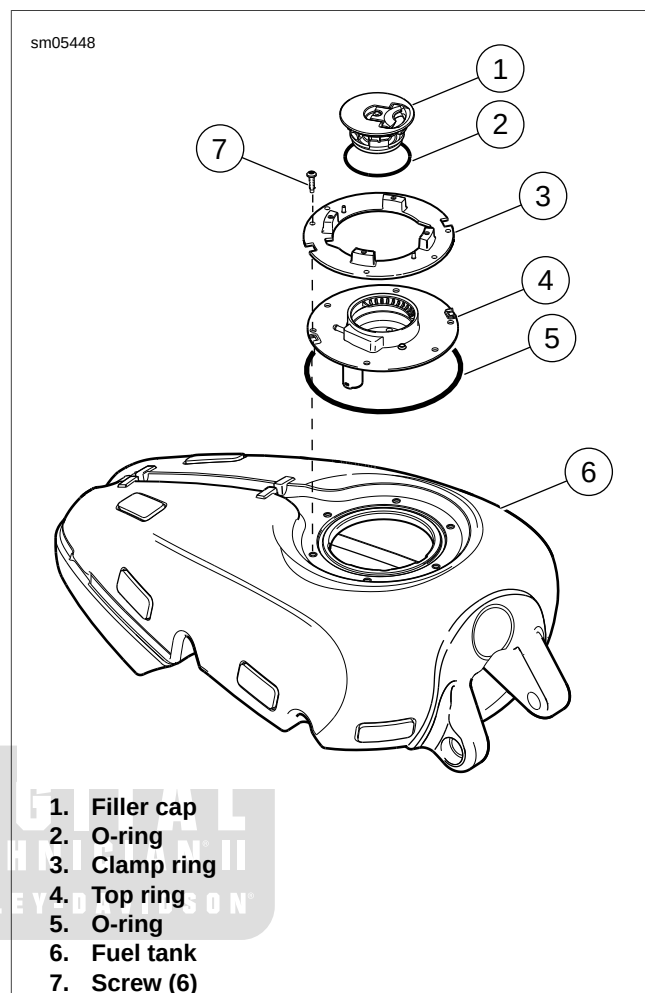


Figure 4-24. Fuel Tank Assembly

CLEANING AND INSPECTION

⚠ WARNING

When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)

Extreme caution should be taken when repairing fuel tanks. Make sure all traces of fuel are purged before making an open flame repair.

1. Clean fuel tank interior with commercial cleaning solvent or a soap and water solution. Shake fuel tank to agitate cleaning agent.
2. Thoroughly flush fuel tank after cleaning. Allow fuel tank to air dry.
3. Carefully inspect fuel hose and vent hose for damage, cuts, cracks, holes, wear or general deterioration. Replace as necessary.

- Inspect the fuel tank for leaks or other damage. If a damaged fuel tank cannot be successfully repaired, replace it.

ASSEMBLE FUEL TANK

⚠ WARNING

When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)

- See [Figure 4-24](#). Install O-ring (5) on top ring (4). Ensure it is seated properly.
- Install top ring and clamp ring with screws (7).
- See [Figure 4-25](#). Tighten screws in the sequence shown to 40-45 **in-lbs** (4.5-5.1 Nm).
- See [Figure 4-24](#). Install filler cap (1) with O-ring (2).

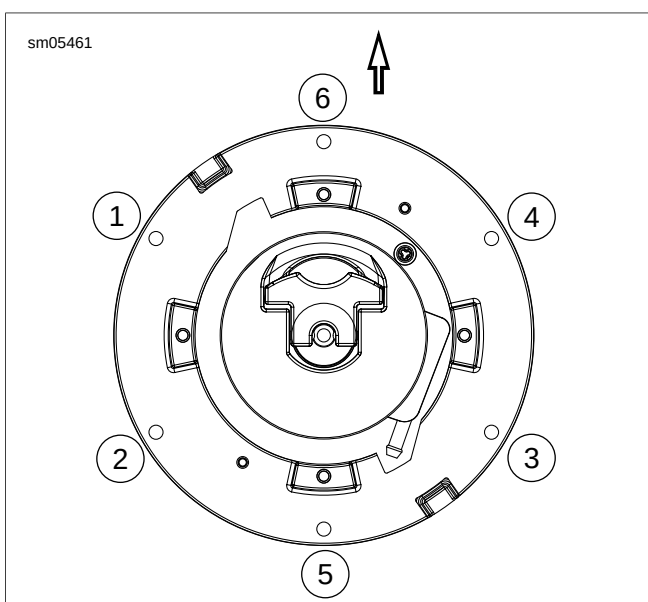


Figure 4-25. Filler Housing Torque Sequence

INSTALLING FUEL TANK

NOTE

Be sure that wiring harnesses do not get pinched between fuel tank and frame during tank installation.

- Install fuel pump into fuel tank using **new** gasket. See [4.18 FUEL PUMP](#).
- See [Figure 4-26](#). Install rubber grommets (3) in both front mounting holes of fuel tank. Insert metal bushings (4) into rubber grommets, oriented as shown. Make certain clip nut (5) is installed on frame bracket.
- Position fuel tank on motorcycle. Make certain that ignition coil bracket is positioned between tank mount and frame and that airbox mounting brackets are correctly mated.
- Insert screw (6) with washer (2) through fuel tank front mounting brackets and vehicle frame. Install remaining

washer and lock nut (7) on other end of screw. Do not tighten at this time.

- Secure pump harness to main harness retainer located under fuel tank.
- Make certain metal bushing (4) is located inside rear lower rubber grommet (3) of fuel tank. Install screw (1), washer (2), and upper grommet (3) and thread into clip nut (5). Tighten to 15-20 ft-lbs (20.3-27.1 Nm).
- Tighten front screw (6) and nut (7) to 15-20 ft-lbs (20.3-27.1 Nm).

NOTE

Be sure airbox grommet is securely installed on induction module and airbox opening. See [4.5 AIRBOX: XR MODELS](#). An improperly seated grommet could lead to accelerated engine wear.

- Secure airbox to brackets on bottom of fuel tank.
- See [Figure 4-20](#). Secure throttle cables to bottom of fuel tank using a **new** loop retainer.
- See [Figure 4-22](#). Connect vent hose (3) and ground wire (5) as shown. Route ground wire and vent hose in trough in top of tank.
- See [Figure 4-21](#). Install fuel tank cover and secure with four screws (1). Tighten screws to 24-30 **in-lbs** (2.7-3.4 Nm).
- Connect fuel pump connector [141].
- Connect fuel supply fitting. See [4.7 FUEL TANK: XR MODELS, Reconnecting Fuel Hose and Filling Fuel Tank](#).

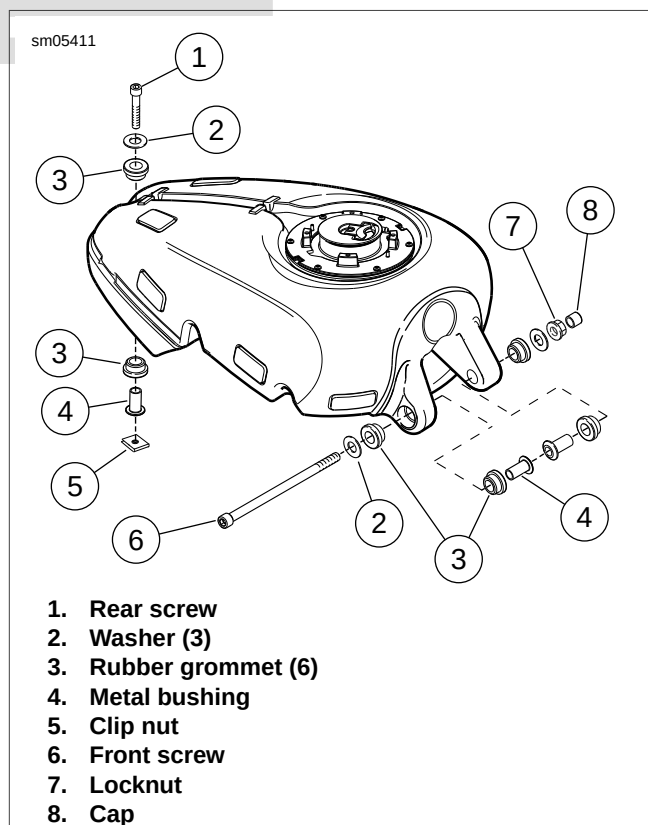


Figure 4-26. Fuel Tank Mounting

RECONNECTING FUEL HOSE AND FILLING FUEL TANK

WARNING

To prevent spray of fuel, be sure quick-connect fittings are properly mated. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00268a)

1. See [Figure 4-20](#). Push up on release sleeve (1) and push fuel hose fitting (2) into fuel pump module fuel pump quick-connect fitting. Pull down on release sleeve to lock quick-connect fitting. Tug on fuel hose fitting to make sure it is securely locked in place.

WARNING

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

WARNING

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

2. Fill fuel tank and carefully inspect for leaks around fuel pump module.
3. Install main fuse. See [6.38 MAIN FUSE](#).
4. Turn ignition switch ON and verify fuel pump is activated. Carefully inspect for leaks at quick-connect fitting and induction module. Turn ignition switch OFF.
5. Install left side cover.



THROTTLE POSITION (TP) SENSOR

4.8

GENERAL

WARNING

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

See [Figure 4-27](#). The Throttle Position (TP) sensor is located on the side of the induction module and monitors the physical position of the throttle shaft.

Refer to the ELECTRICAL DIAGNOSTIC MANUAL for information on the function and testing of the TP sensor.

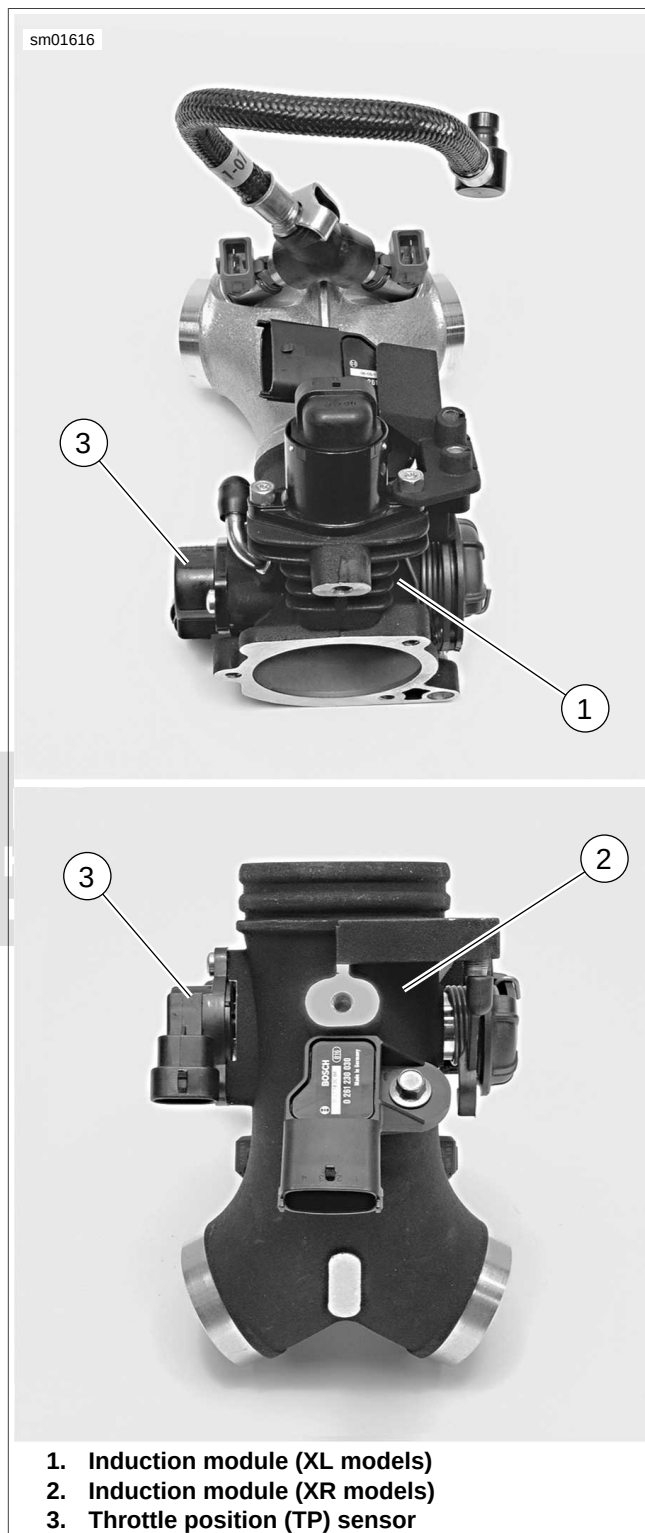


Figure 4-27. Throttle Position (TP) Sensor Location (Induction Module Removed From Vehicle for Clarity)

REMOVAL: XL MODELS

NOTE

It is not necessary to remove the induction module from XL model vehicles in order to replace the TP sensor.

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Unplug main fuse. See [6.38 MAIN FUSE](#).
2. Remove air cleaner cover, air filter element and backing plate assembly. See [4.4 AIR CLEANER: XL MODELS](#).

NOTE

It is important to prevent contaminants from entering the TPS connectors. Cover both the harness connector and the TPS connector cavity with tape immediately after disconnecting harness.

3. See [Figure 4-28](#). Unplug TP sensor harness connector [88B] from connector socket [88A] (4). Cover both connectors with tape.
4. Remove two screws (5) and detach TP sensor (3) from induction module (1).

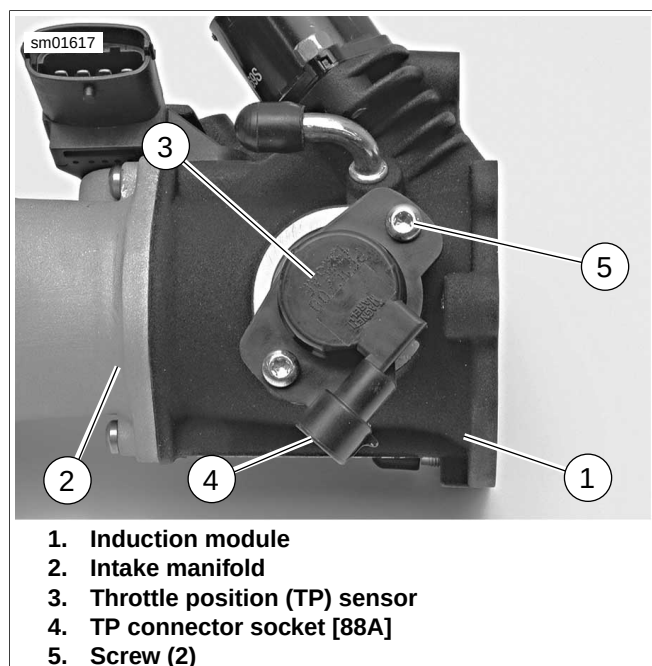


Figure 4-28. Throttle Position (TP) Sensor Removal (XL Models)

INSTALLATION: XL MODELS

NOTES

- Throttle must be closed for proper installation of throttle position sensor.
- See [Figure 4-28](#). Note orientation of TP sensor (3) relative to induction module (1) body; connector socket is at

approximately the 7 o'clock position, facing toward intake manifold (2).

1. See [Figure 4-29](#). Fit pocket (3) of TP sensor (2) over throttle shaft (4). Orient TP sensor correctly and line up mounting holes in sensor with holes in body of induction module (1).
2. Make sure TP sensor body is flush against mounting boss on induction module body. Install two screws (5) to fasten sensor to induction module. Tighten screws to 35 in-lbs (4.0 Nm).
3. Open and close throttle plates and check for proper operation. Be sure mechanism operates smoothly without binding or sticking.
4. Connect TP sensor harness socket connector [88B] to sensor pin connector [88A].
5. Install air cleaner backing plate assembly, air filter element and air cleaner cover. See [4.4 AIR CLEANER: XL MODELS](#).
6. Install main fuse and close left side cover. See [6.38 MAIN FUSE](#).
7. Start vehicle and check for proper throttle operation and correct idle speed.

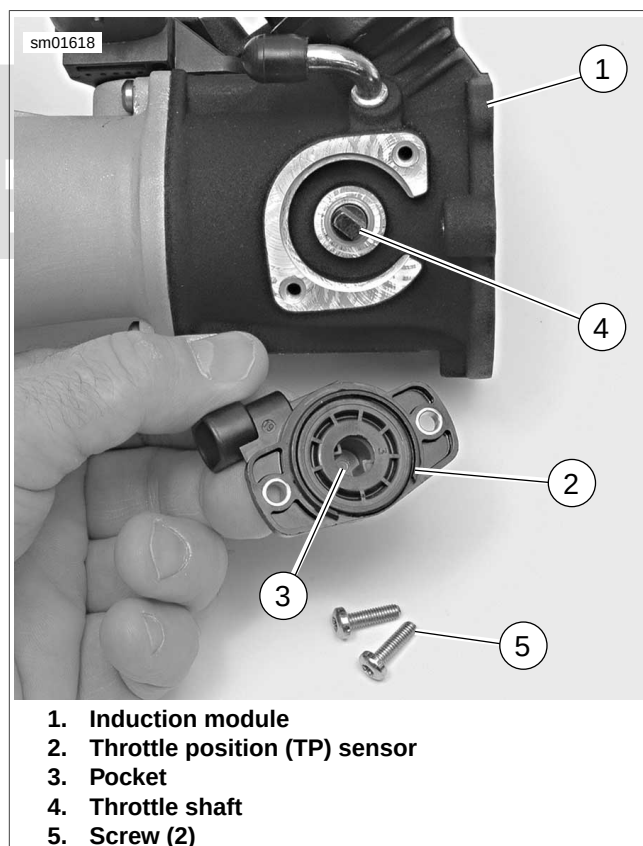


Figure 4-29. Throttle Position (TP) Sensor Installation (XL Models)

REMOVAL: XR MODELS

WARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

WARNING

Gasoline can drain from quick-connect fitting when removing fuel line. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00267a)

1. Purge the fuel supply hose of high pressure gasoline. Disconnect fuel supply hose from fuel pump module. See [4.7 FUEL TANK: XR MODELS](#).

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

2. Unplug main fuse. See [6.38 MAIN FUSE](#).
3. Remove fuel tank and airbox. See [4.7 FUEL TANK: XR MODELS](#) and [4.5 AIRBOX: XR MODELS](#).

NOTE

It is important to prevent contaminants from entering the TPS connectors. Cover both the harness connector and the TPS connector cavity with tape immediately after disconnecting harness.

4. See [Figure 4-30](#). Unplug TP sensor harness connector [88B] from connector socket [88A] (3). Cover both connectors with tape.
5. Remove induction module from vehicle. See [4.11 INDUCTION MODULE: XR MODELS](#).
6. Remove two screws (4) and detach TP sensor (2) from induction module (1).

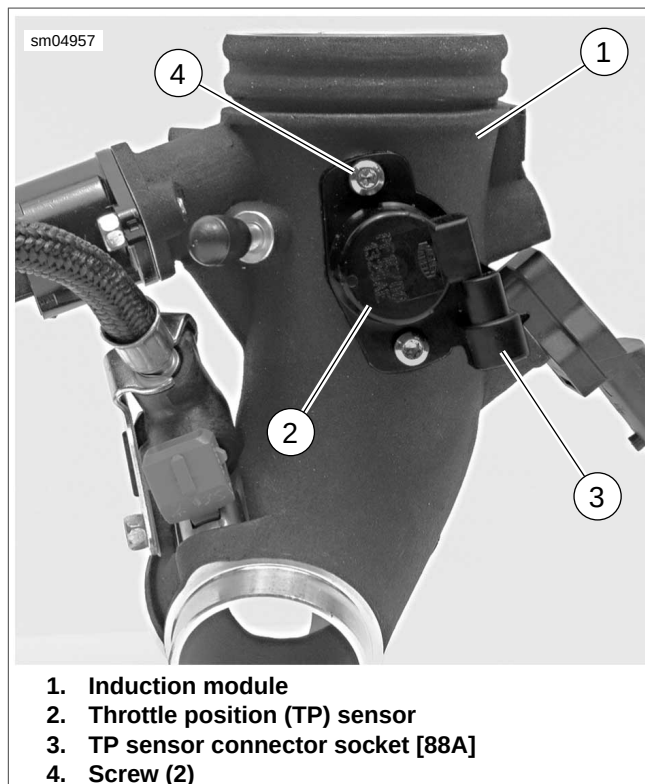


Figure 4-30. Throttle Position (TP) Sensor Removal (XR Models)

INSTALLATION: XR MODELS

NOTES

- Throttle must be closed for proper installation of throttle position sensor.
 - See [Figure 4-30](#). Note installed orientation of TP sensor (2) relative to induction module (1) body; connector socket is at approximately the 5:00 o'clock position.
1. See [Figure 4-31](#). Place sensor over throttle shaft with the connector housing (1) facing toward the mounting flange (2) as shown.
 2. Rotate the TP sensor counterclockwise into position as shown in [Figure 4-30](#).
 3. Make sure TP sensor body is flush against mounting boss on induction module body. Install two screws (4). Tighten to 29 in-lbs (3.3 Nm).
 4. Open and close throttle plate and check for proper operation. Be sure mechanism operates smoothly without binding or sticking.

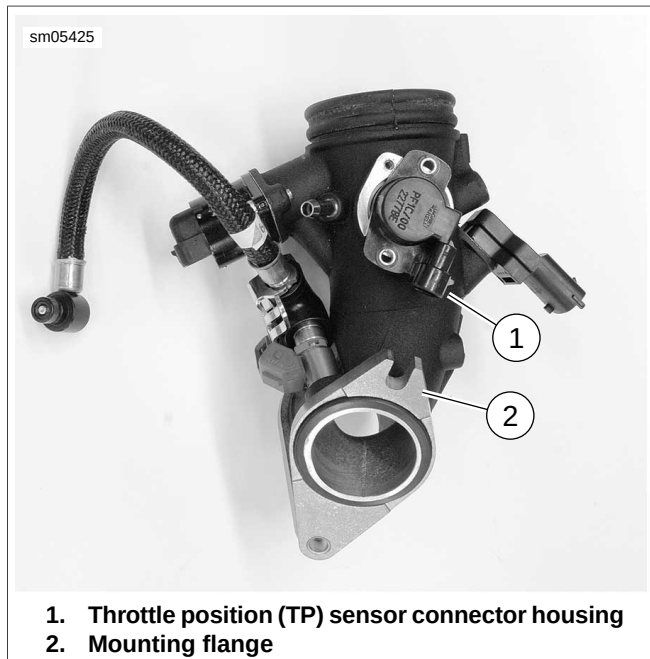


Figure 4-31. Throttle Position (TP) Sensor Installation (XR Models)

5. Install induction module. See [4.11 INDUCTION MODULE: XR MODELS](#).
6. Plug TP sensor harness connector [88B] into connector socket [88A] on TP sensor.
7. Install airbox assembly and fuel tank. See [4.5 AIRBOX: XR MODELS](#) and [4.7 FUEL TANK: XR MODELS](#).

⚠ WARNING

To prevent spray of fuel, be sure quick-connect fittings are properly mated. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00268a)

8. Connect fuel hose to fuel pump module. Fill fuel tank and carefully check for leaks around fuel hose fitting. See [4.7 FUEL TANK: XR MODELS](#)
9. Plug in main fuse. See [6.38 MAIN FUSE](#).
10. Turn ignition switch on and again check for leaks at the quick connect fitting and at the induction module.
11. Start vehicle and check for proper throttle operation and correct idle speed.



ENGINE TEMPERATURE (ET) SENSOR

4.9

GENERAL

See [Figure 4-32](#). The engine temperature (ET) sensor is located in the top of the rear cylinder head.

Refer to the ELECTRICAL DIAGNOSTIC MANUAL for information on the function and testing of the ET sensor.

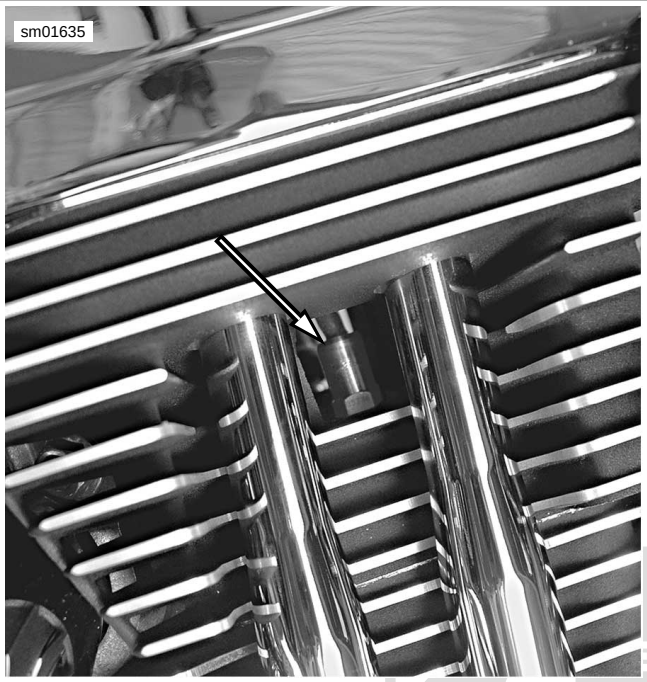


Figure 4-32. Engine Temperature (ET) Sensor Location

REMOVAL

PART NUMBER	TOOL NAME
HD-48116-A	TEMPERATURE SENSOR SOCKET

⚠ WARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

⚠ WARNING

Gasoline can drain from quick-connect fitting when removing fuel line. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00267a)

1. Purge the fuel supply hose of high pressure gasoline. Disconnect fuel supply hose from fuel pump module. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

2. Unplug main fuse. See [6.38 MAIN FUSE](#).
3. Remove fuel tank. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).
4. See [Figure 4-33](#) or [Figure 4-34](#). Disconnect the ET sensor connector [90] (3) located on right side of H-bracket.
5. Cut barbed cable strap (2) to free sensor harness from H-bracket.
6. **XR models:** See [Figure 4-34](#). Disconnect the breather hose (1) from the rear cylinder to gain access to the sensor.
7. Remove ET sensor as follows:
 - a. Attach a universal joint, 6-in. extension and ratchet to TEMPERATURE SENSOR SOCKET (Part No. HD-48116-A).
 - b. See [Figure 4-35](#). Fit engine temperature sensor harness (2) into slot in temperature sensor socket (3).
 - c. Slide socket down harness, through square hole in center of rear rocker cover assembly and fit onto ET sensor (1).
 - d. See [Figure 4-36](#). Once you have installed the temperature sensor socket (1) onto the sensor (4), secure the sensor harness to the socket extension (3) with tape (6). This will facilitate removal of the sensor.
 - e. Remove ET sensor from rear cylinder head.

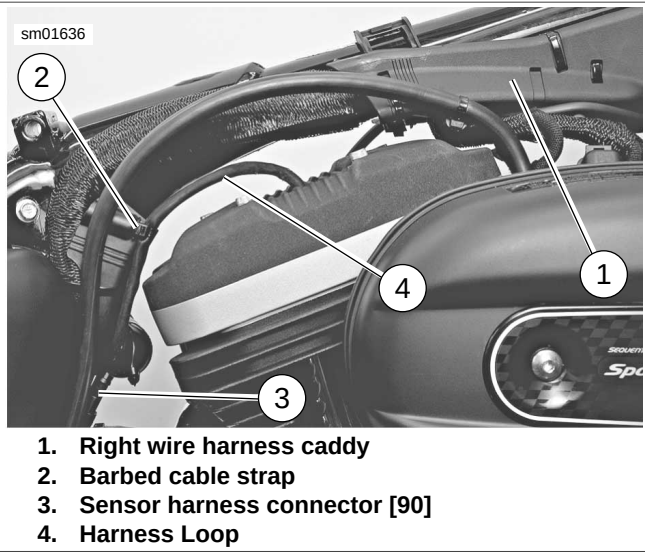


Figure 4-33. Engine Temperature Sensor Harness: XL Models

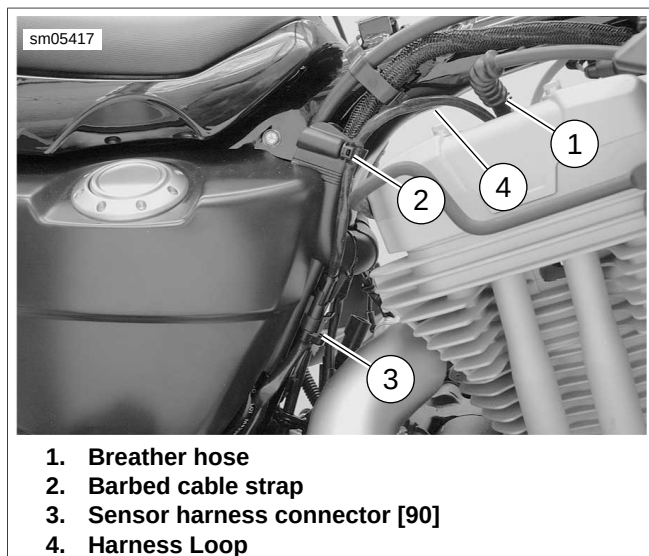


Figure 4-34. Engine Temperature Sensor Harness: XR Models

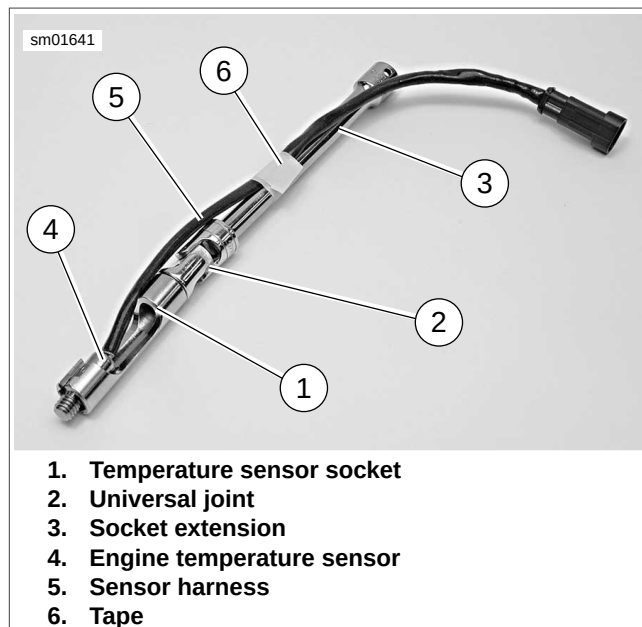


Figure 4-36. Tape Sensor Harness to Extension (Sensor Removed from Vehicle for Clarity)

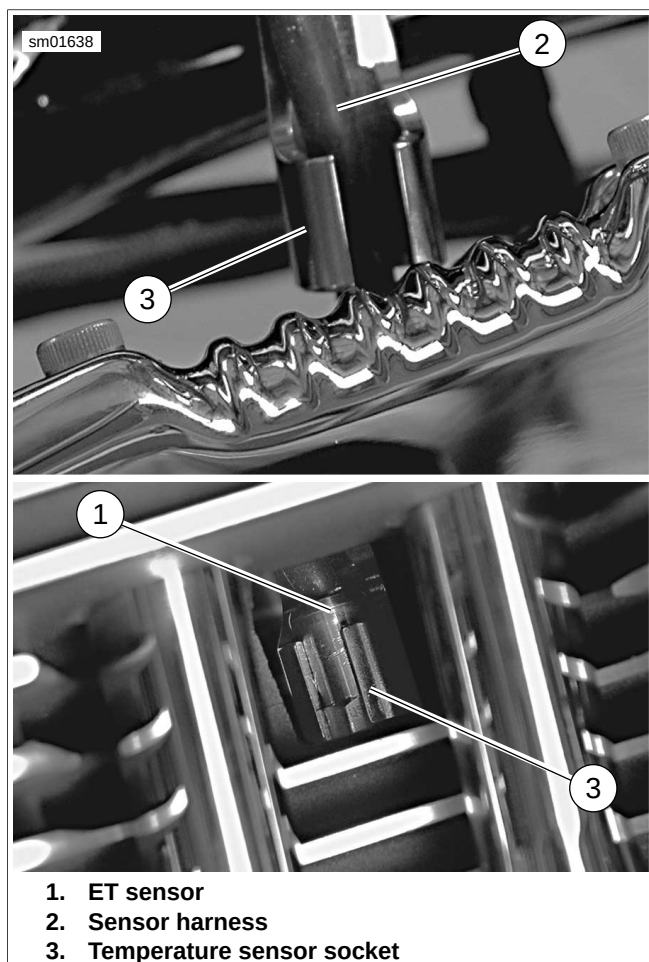


Figure 4-35. Installing Engine Temperature Sensor Socket (XL shown)

INSTALLATION

1. See [Figure 4-36](#). Fit engine temperature sensor (4) into temperature sensor socket (1).

NOTE

The next step is very important. The sensor harness **MUST** be able to turn with the socket and extension. If it does not, it will be damaged when the sensor is installed in the cylinder head.

2. Holding sensor in place in socket, wrap a piece of tape (6) around sensor harness (5) and socket extension (3).
3. Slide assembly down into top of rear head and carefully thread sensor into head. Make sure sensor does not become cross-threaded. Tighten to 120-168 **in-lbs** (13.6-19.0 Nm).

NOTE

See [Figure 4-33](#). Make sure there is a loop (4) in sensor harness when securing harness. If harness is pulled tight, it could be damaged during vehicle operation.

4. See [Figure 4-33](#) or [Figure 4-34](#). Use a barbed cable strap (2) to secure sensor harness. Position cable strap so harness forms a loop (4) between sensor and cable strap.
5. Connect sensor connector [90] (3) and secure to caddy.
6. Install fuel tank and connect fuel supply hose. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).
7. Install main fuse and close left side cover. See [6.38 MAIN FUSE](#).

⚠ WARNING

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

8. Install seat.



INDUCTION MODULE: XL MODELS

4.10

GENERAL

The XL model induction module is a side-draft unit with a separate intake manifold. The induction module includes the throttle body, fuel injectors, TMAP sensor, TP sensor and IAC.

REMOVAL

⚠ WARNING

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

⚠ WARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

⚠ WARNING

Gasoline can drain from quick-connect fitting when removing fuel line. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00267a)

1. Purge the fuel supply hose of high pressure gasoline. Disconnect fuel supply hose from fuel pump module. See [4.6 FUEL TANK: XL MODELS](#).

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

2. Unplug main fuse. See [6.38 MAIN FUSE](#).
3. Remove air cleaner cover, air filter and backing plate assembly. See [4.4 AIR CLEANER: XL MODELS](#).
4. Remove seat.
5. Loosen (but do not remove) front fuel tank mounting screw. Remove rear fuel tank mounting screw, washers and nut. Carefully pivot rear of fuel tank upward and prop in position. See [4.6 FUEL TANK: XL MODELS](#).
6. See [Figure 4-37](#). Remove screw (2) and mounting bracket (1).

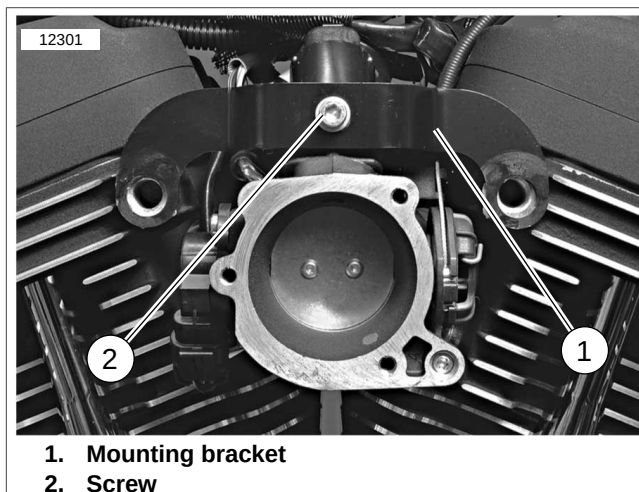


Figure 4-37. Induction Module Mounting Bracket

7. See [Figure 4-38](#). Unplug the following connectors:
 - a. front fuel injector (4) connector [84],
 - b. rear fuel injector (5) connector [85],
 - c. TMAP sensor (6) connector [80],
 - d. IAC (7) connector [87],

NOTE

It is important to prevent contaminants from entering the TPS connectors. Cover both the harness connector and the TPS connector cavity with tape immediately after disconnecting harness.

- e. TP sensor (8) connector [88].
8. **California models only:** remove purge hose from fitting (9) on induction module (1).

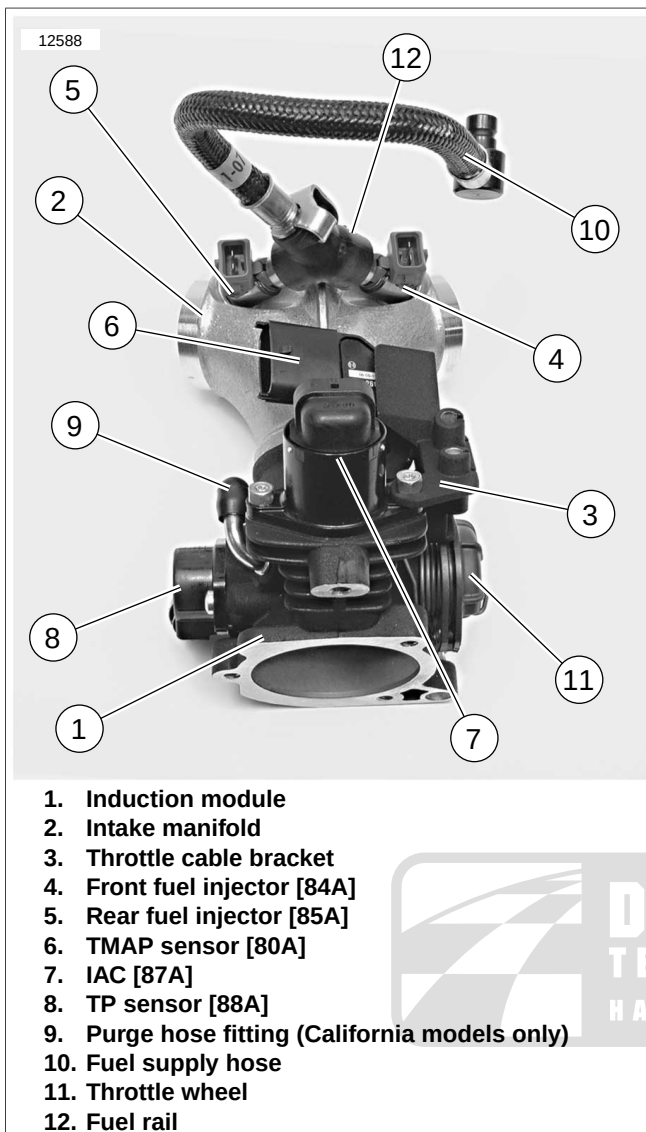


Figure 4-38. Induction Module Assembly (Removed from Vehicle for Clarity)

9. See [Figure 4-39](#). Slide rubber boot off idle control cable assembly (1).
10. Loosen jam nut (3).
11. Loosen cable adjuster as far as possible to provide maximum slack in idle cable.

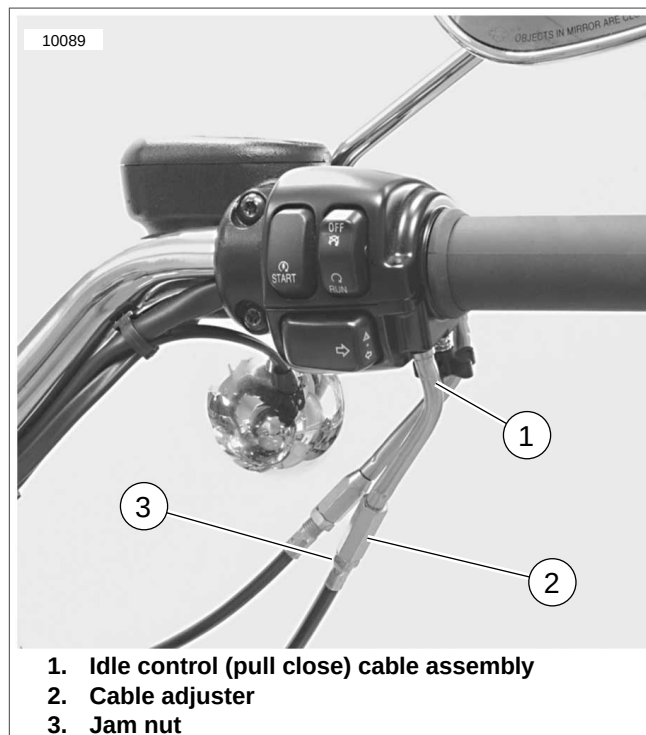


Figure 4-39. Idle Control Cable Adjustment

12. See [Figure 4-40](#). Loosen two screws (2) securing intake manifold to heads on left side of vehicle, but do not remove screws.
13. See [Figure 4-41](#). Remove two screws (3) securing intake manifold to heads on right side of vehicle.
14. Pull mounting flanges (4) away from heads as much as possible and pull induction module and intake manifold assembly toward the right side, away from vehicle.

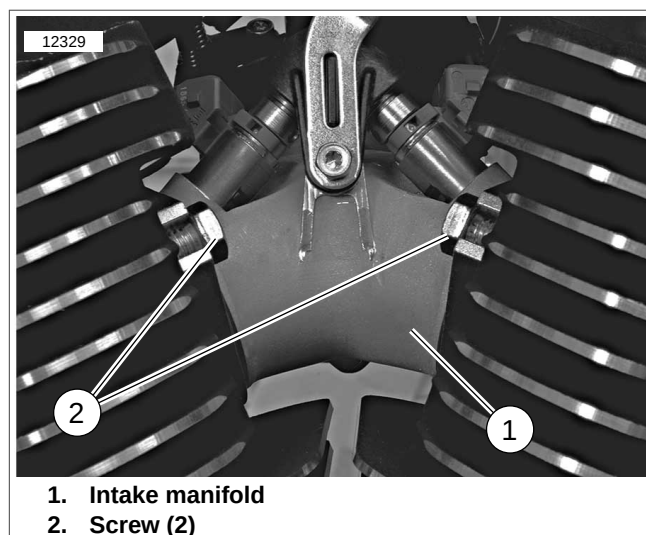


Figure 4-40. Intake Manifold Mounting Screws: Left Side

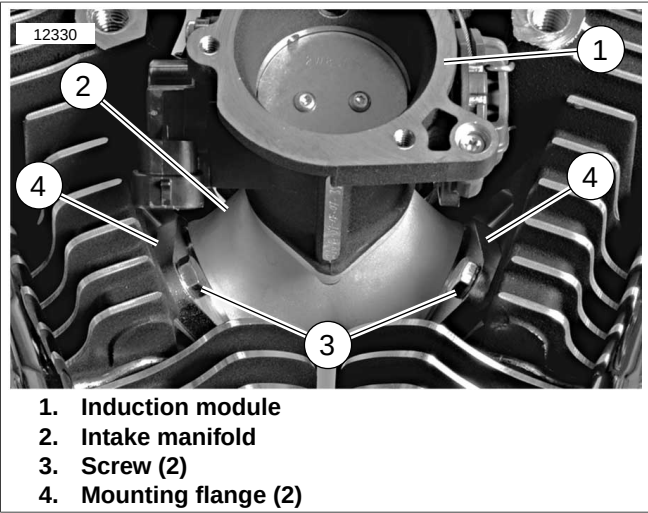


Figure 4-41. Intake Manifold Mounting Screws: Right Side

15. See [Figure 4-42](#). Remove throttle cable (5) from throttle wheel (7)
- a. Lift throttle cable housing (1) up out of cable guide (3) in throttle/idle cable bracket (2).
 - b. Slide throttle cable (5) out through slot (4) in cable guide.
 - c. Unwind throttle cable from groove in throttle wheel (7).
 - d. Slide cable out through slot (8) and remove throttle cable barrel (6) from throttle wheel.

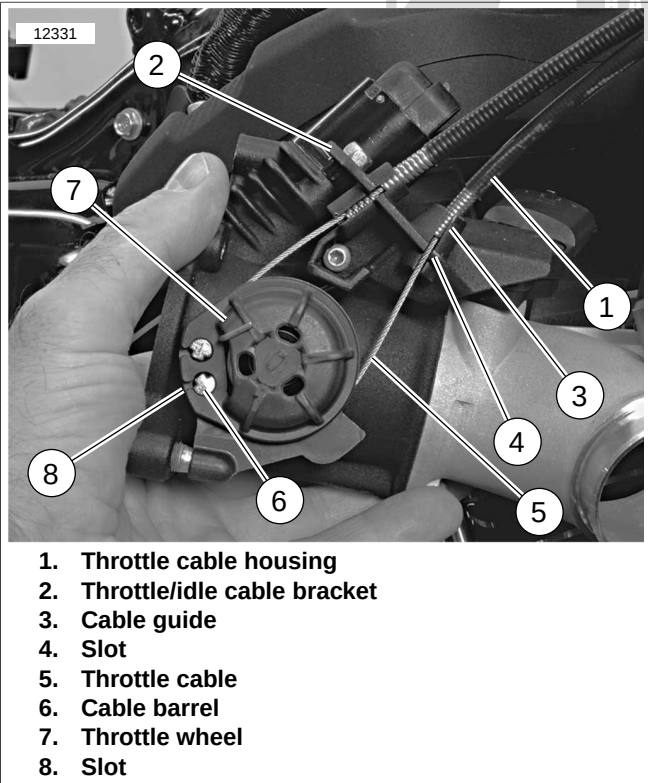


Figure 4-42. Removing/Installing Throttle Cable

16. See [Figure 4-43](#). In a similar fashion, remove idle cable (3) from throttle wheel (6):
- a. Lift idle cable housing (1) and spring (2) up out of cable guide (7) in throttle/idle cable bracket.
 - b. Slide idle cable (3) out through slot in cable guide.
 - c. Unwind idle cable from groove in throttle wheel (6).
 - d. Slide cable out through slot (5) and remove idle cable barrel (4) from throttle wheel.
17. Remove induction module and intake manifold from vehicle.

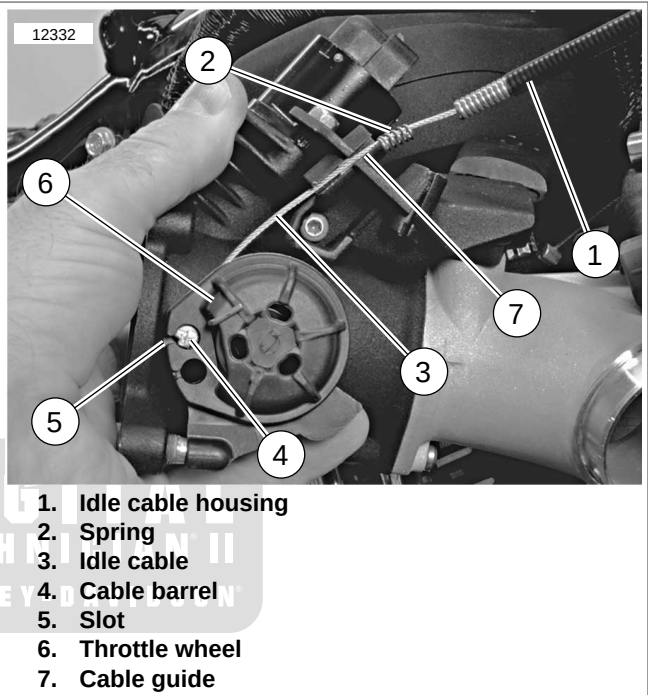


Figure 4-43. Removing/Installing Idle Cable

DISASSEMBLY

PART NUMBER	TOOL NAME
HD-25070	HEAT GUN

⚠ WARNING

Gasoline can drain from the fuel line when disconnected from induction module. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00269a)

1. Remove fuel hose, fuel rail and fuel injectors. See [4.17 FUEL INJECTORS](#).
2. See [Figure 4-44](#). Remove screws (1, 2) and cable bracket (3) from induction module (4).

NOTE

When removing the IAC, the mounting screws **MUST** be heated to soften the thread sealant and avoid breakage during removal. Use **ONLY HEAT GUN** (Part No. HD-25070) to heat the screws. **NEVER** use an open flame.

3. Remove the following assemblies:
 - a. TP Sensor. See [4.8 THROTTLE POSITION \(TP\) SENSOR](#).
 - b. TMAP sensor. See [4.13 TEMPERATURE MANIFOLD ABSOLUTE PRESSURE \(TMAP\) SENSOR](#).
 - c. IAC. See [4.12 IDLE AIR CONTROL \(IAC\)](#).
4. See [Figure 4-45](#). Remove two screws (3) to separate induction module (1) from intake manifold (2). Discard o-ring (4).

NOTE

At this level of disassembly, induction module contains no more serviceable parts. If induction module is determined to be damaged or defective, replace it.

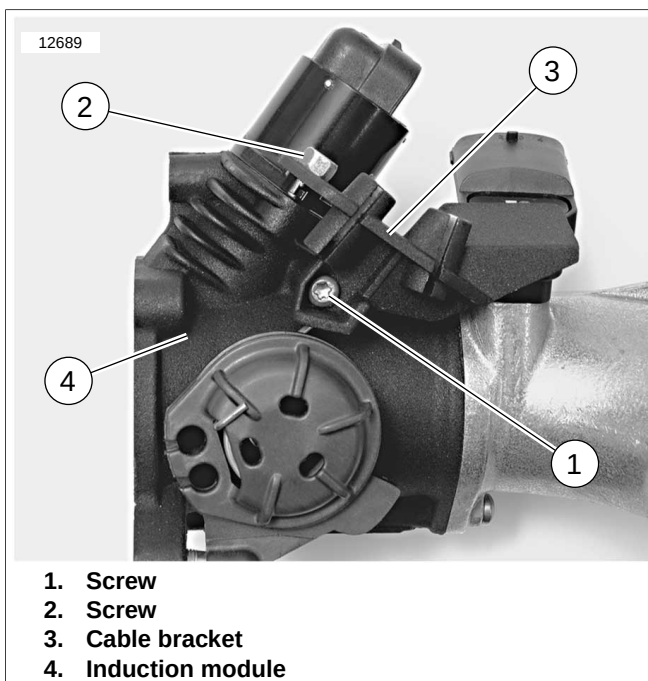


Figure 4-44. Removing/Installing Cable Bracket

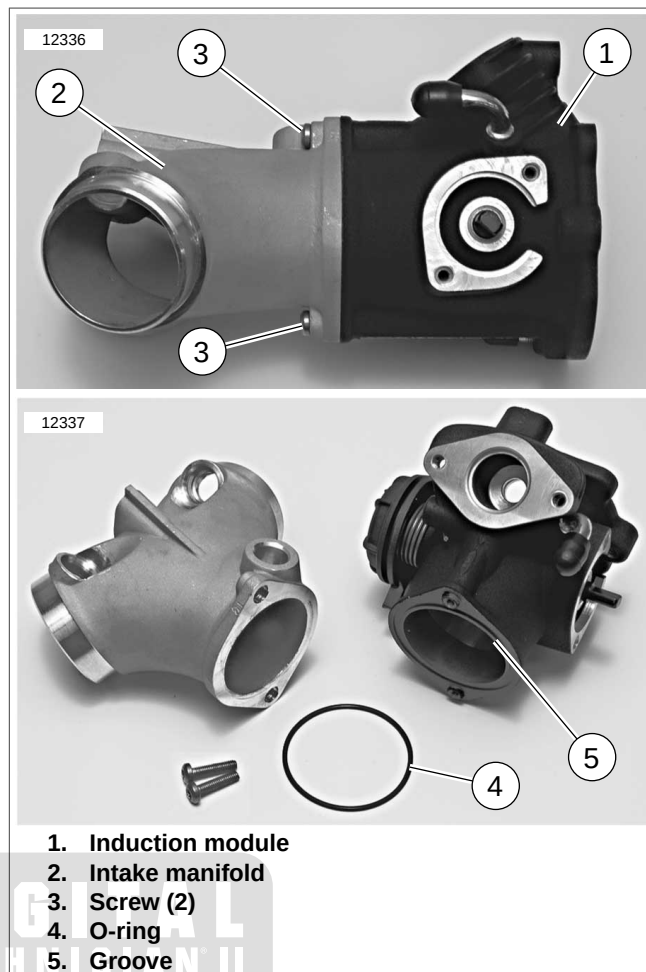


Figure 4-45. Induction Module Assembly

ASSEMBLY

1. See [Figure 4-45](#). Place **new** o-ring (4) into groove (5) in induction module (1) mating surface.
2. Mate induction module to intake manifold (2). Secure with two screws (3). Tighten screws to 35 **in-lbs** (4.0 Nm).
3. Install the following assemblies:
 - a. TP Sensor. See [4.8 THROTTLE POSITION \(TP\) SENSOR](#).
 - b. TMAP sensor. See [4.13 TEMPERATURE MANIFOLD ABSOLUTE PRESSURE \(TMAP\) SENSOR](#).
 - c. IAC. See [4.12 IDLE AIR CONTROL \(IAC\)](#).

NOTE

Do not install IAC mounting screw on throttle wheel side of induction module until cable bracket is installed in the next step. Install other IAC mounting screw but do not tighten at this time.

4. See [Figure 4-44](#). Install cable bracket (3) onto induction module (4). Secure with screws (1, 2). Install both screws finger-tight. Then tighten both IAC mounting screws to 60 **in-lbs** (6.8 Nm). Tighten side screw (1) to 60 **in-lbs** (6.8 Nm).

5. Install fuel injectors, fuel rail and fuel hose. See [4.17 FUEL INJECTORS](#).

INSTALLATION

1. See [Figure 4-40](#). Make sure two mounting screws (2) are screwed into heads two or three turns.
2. See [Figure 4-46](#). Install mounting flanges (1) on intake manifold (5) with counterbore (2) facing away from manifold and open slotted ends of flanges facing away from induction module (6) as shown in the figure.
3. Place a **new** seal (3) into each mounting flange with the beveled edge (4) facing the mounting flange counterbore.

NOTE

When induction module is positioned on manifold mounting screws, be sure the flanges are installed correctly on the manifold. Also be sure the rubber seals are in place.

4. See [Figure 4-40](#). Place induction module assembly in position between engine heads. Slide open slotted ends of mounting flanges under heads of two mounting screws (2) on left side of engine.
5. See [Figure 4-41](#). Holding induction module/intake manifold assembly in place, install two mounting screws (3) into remaining mounting flange holes. Tighten all four screws finger-tight.
6. See [Figure 4-37](#). Install mounting bracket (1) and screw (2). Tighten screw finger-tight.
7. Temporarily install two breather screws through mounting bracket. Thread breather screws into cylinder heads finger-tight. This will properly line up induction module assembly.
8. Tighten screw installed in step 6. to 84-108 **in-lbs** (9.5-12.2 Nm).
9. Tighten all four intake manifold mounting screws to 96-120 **in-lbs** (10.9-13.6 Nm).
10. See [Figure 4-43](#). Install idle cable barrel (4) into throttle wheel (6). Slide idle cable (3) through slot (5) and wind around groove in throttle wheel.
11. Pull cable through slot in cable guide (7). Slide spring (2) and end of idle cable housing (1) down into cable guide.
12. See [Figure 4-42](#). Install throttle cable barrel (6) into throttle wheel (7). Slide throttle cable through slot (8) and wind around groove in throttle wheel.
13. Pull cable through slot (4) in cable guide (3). Slide end of throttle cable housing (1) down into cable guide.
14. Adjust throttle and idle cables. See [1.27 THROTTLE CONTROL](#).

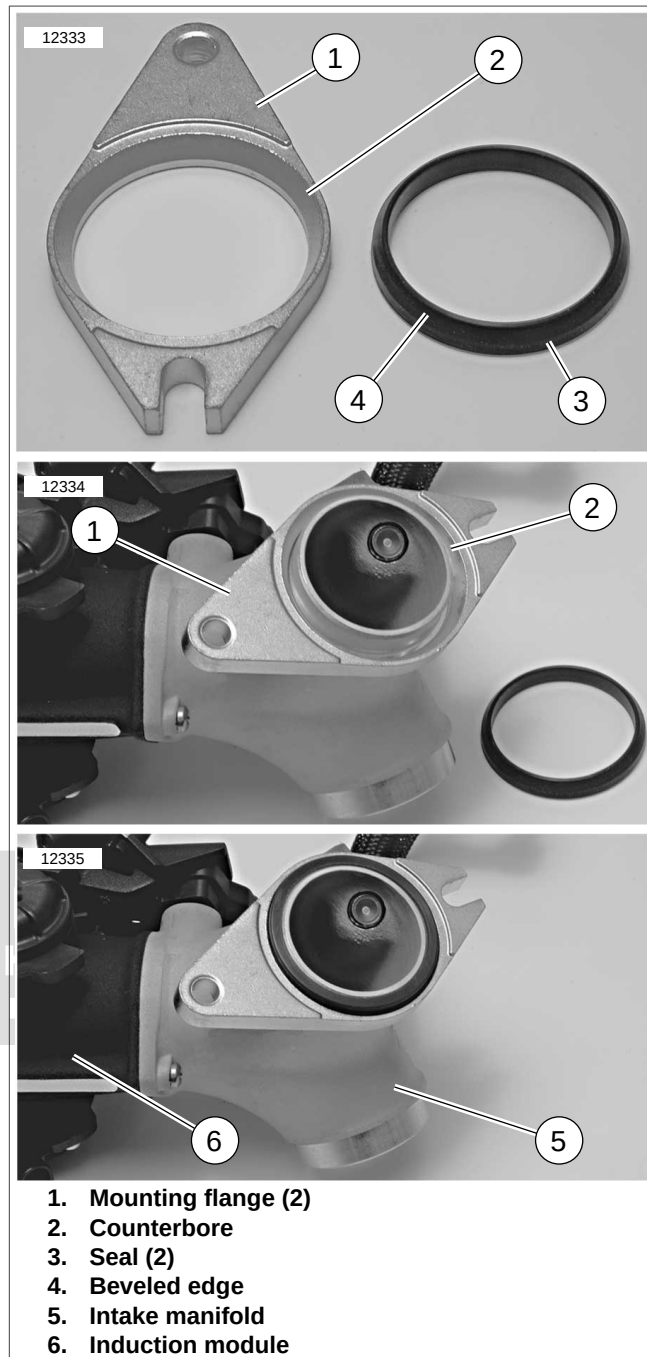


Figure 4-46. Installing Mounting Flange and Seal

15. **California models only:** See [Figure 4-47](#). Install purge hose onto fitting (2) on induction module (1).
16. See [Figure 4-48](#). Plug in the following connectors:
 - a. Front fuel injector (1) connector [84],
 - b. Rear fuel injector (2) connector [85],
 - c. TMAP sensor (3) connector [80],
 - d. IAC (4) connector [87],
 - e. TP sensor (5) connector [88].
17. Remove prop from under rear of fuel tank. Lower rear of fuel tank into position and install screw, washer and nut

in fuel tank rear mounting holes. Tighten front and rear mounting screws to 15-20 ft-lbs (20.4-27.1 Nm). Install protective caps on screw ends. See [4.6 FUEL TANK: XL MODELS](#).

18. Remove breather screws that were temporarily installed in step 7. Install air cleaner backing plate assembly, air filter element and air cleaner cover. See [4.4 AIR CLEANER: XL MODELS](#).

⚠ WARNING

To prevent spray of fuel, be sure quick-connect fittings are properly mated. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00268a)

19. Connect fuel hose to fuel pump module. Fill fuel tank and carefully check for leaks around fuel pump module. See [4.6 FUEL TANK: XL MODELS](#).
20. Install main fuse and close left side cover. See [6.38 MAIN FUSE](#).
21. Turn Ignition/Light Key Switch to ON and then back to OFF to reset idle air control to park position.

⚠ WARNING

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

22. Install seat.
23. Road test vehicle.

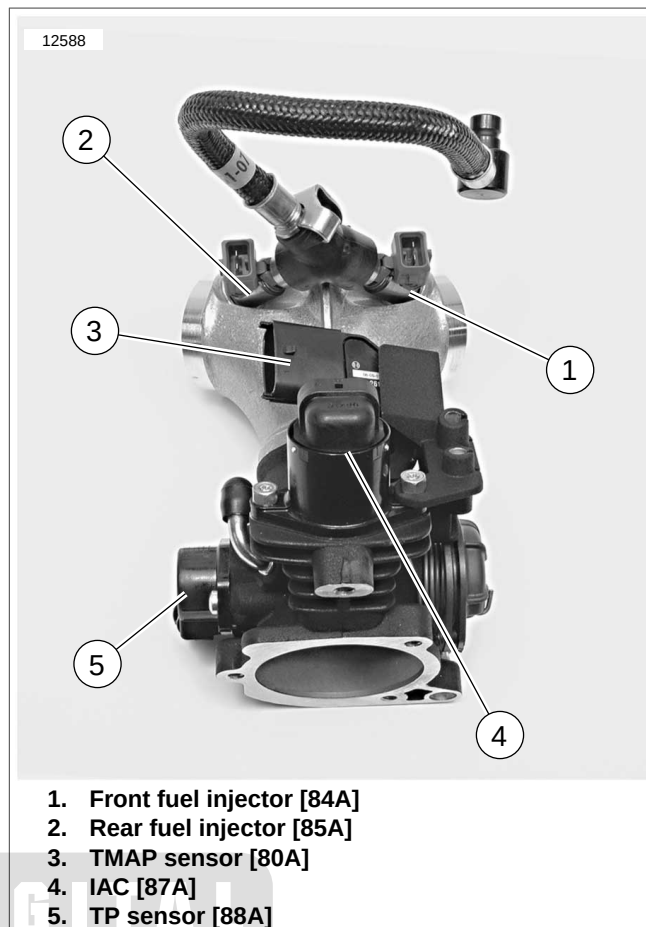


Figure 4-48. Induction Module Electrical Connectors

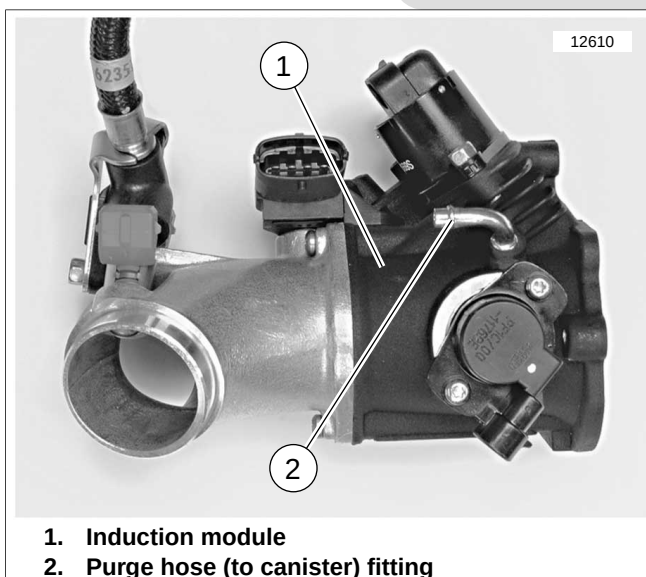


Figure 4-47. Purge Hose Fitting (California Models Only)

INDUCTION MODULE: XR MODELS

4.11

GENERAL

XR models use a down-draft induction module. The induction module and intake manifold are incorporated into a one-piece unit that includes the throttle body, fuel injectors, TMAP sensor, TP sensor and IAC.

REMOVAL

⚠ WARNING

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

1. Purge the fuel supply hose of high pressure gasoline. Disconnect fuel supply hose from fuel pump module. See [4.7 FUEL TANK: XR MODELS](#).

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

2. Unplug main fuse. See [6.38 MAIN FUSE](#).
3. Remove fuel tank and airbox. See [4.7 FUEL TANK: XR MODELS](#) and [4.5 AIRBOX: XR MODELS](#).
4. See [Figure 4-49](#). Remove socket head bolts (3), fastener (1) and fastener (2).
5. Pull cover away from induction module and disengage cable retainer from back side of cover. Remove cover.
6. Disengage throttle cables from induction module. See [2.30 THROTTLE CABLES: ALL MODELS](#).
7. See [Figure 4-50](#). Unplug the following connectors:
 - a. front fuel injector (3) connector [84],
 - b. rear fuel injector (4) connector [85],
 - c. TMAP sensor (5) connector [80],
 - d. IAC (6) connector [87],

NOTE

It is important to prevent contaminants from entering the TPS connectors. Cover both the harness connector and the TPS connector cavity with tape immediately after disconnecting harness.

- e. TP sensor (7) connector [88].
8. **California models:** Remove purge hose from fitting (8).
 9. See [Figure 4-51](#). Disconnect oil line flare nuts (1) from flare fittings (2) in cylinder heads. Remove flare fittings (2) from cylinder heads.
 10. Loosen screws that secure induction module to cylinder heads on left side of vehicle several turns. It is not necessary to remove them completely.

11. Remove two screws (3) securing induction module to cylinder heads on right side of vehicle.
12. Remove induction module from engine.

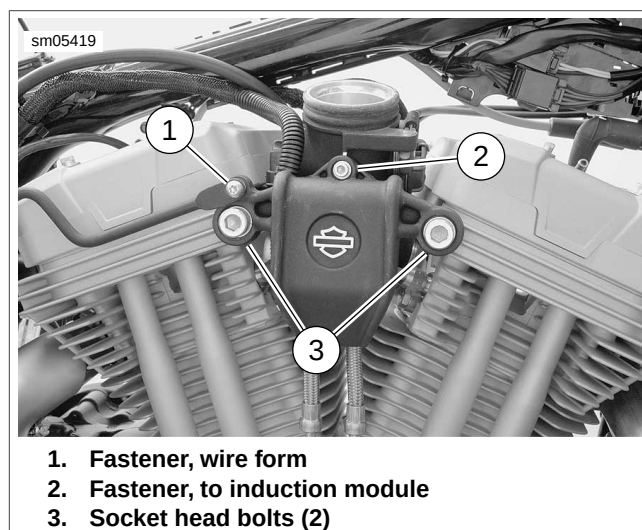


Figure 4-49. Induction Module Cover

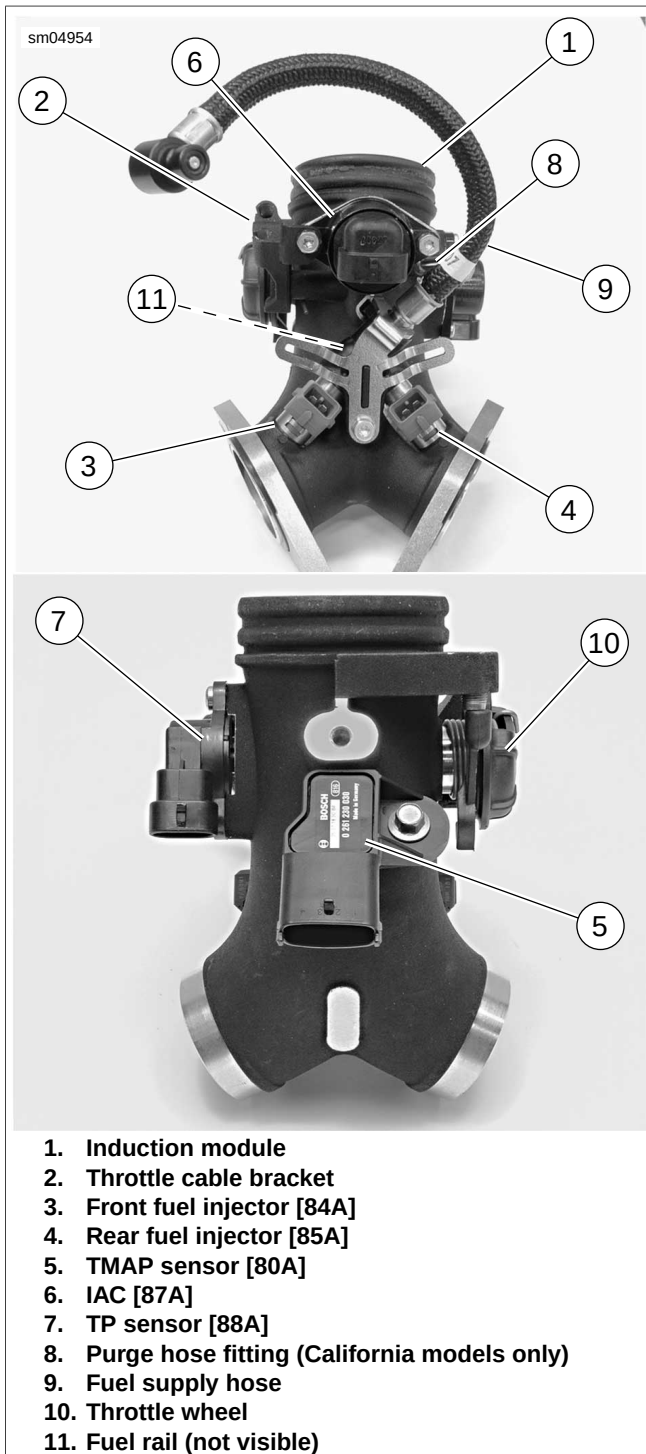


Figure 4-50. Induction Module Assembly (Removed from Vehicle for Clarity)

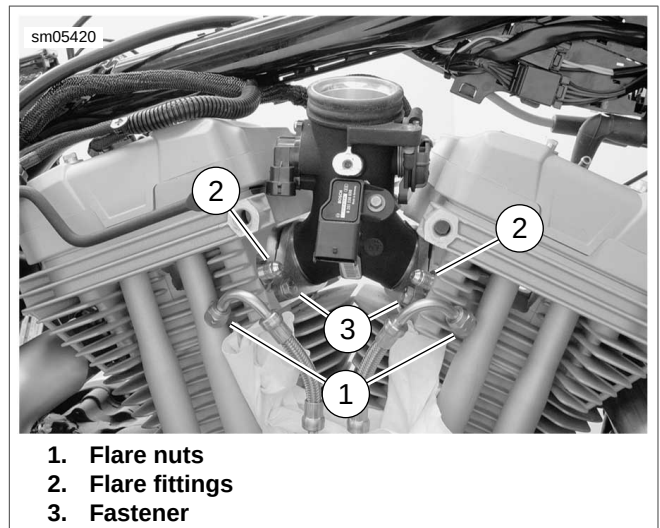


Figure 4-51. Remove Induction Module

DISASSEMBLY

PART NUMBER	TOOL NAME
HD-25070	HEAT GUN

1. See [Figure 4-52](#). Remove retainer (7). Remove fuel rail (8) with hose (4) and injectors (10) from the induction module.

2. Remove hose (4) and injectors (10) from fuel rail.

3. Remove cable bracket (12).

NOTE

Screws (16) **MUST** be heated to soften the thread sealant and avoid breakage during removal. Use **ONLY HEAT GUN** (Part No. HD-25070) to heat the screws. **NEVER** use an open flame.

4. Remove IAC (3). See [4.12 IDLE AIR CONTROL \(IAC\), Removal: XR Models](#).
5. Remove TMAP (15), and TP sensor (1).
6. Remove mounting flanges (14) and seals (13).

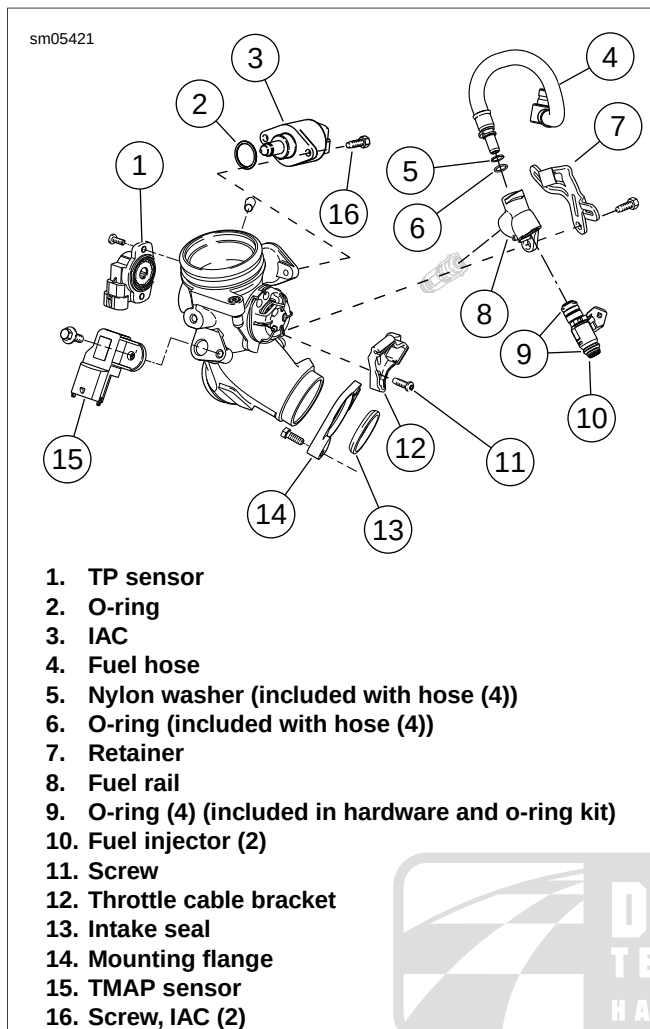


Figure 4-52. Induction Module

INSTALLATION

1. Make sure the two left side mounting screws are installed two or three turns into the heads.
2. See [Figure 4-53](#). Install mounting flanges (3) on induction module with counterbore (1) facing toward the engine.
3. Place a **new** seal (4) into each mounting flange with the beveled edge (2) facing the mounting flange counterbore. Rotate the flanges so the slotted mounting hole is on the same side as the IAC solenoid.

NOTE

When induction module is positioned on manifold mounting screws, be sure the flanges are installed correctly on the manifold. Also be sure the rubber seals are in place.

4. See [Figure 4-51](#). Place induction module assembly in position between engine heads. Slide open slotted ends of mounting flanges under heads of two mounting screws on left side of engine.
5. While holding induction module assembly in place, install two mounting screws (3) into remaining mounting flange holes. Tighten all four screws finger-tight.
6. Tighten all four mounting screws to 96-120 **in-lbs** (10.9-13.6 Nm).
7. Inspect o-rings on flare fittings (2) and replace as necessary. Install flare fittings in cylinder heads and tighten to 22-26 ft-lbs (29.8-35.3 Nm).
8. Connect oil line flare nuts (1) to flare fittings (2) and tighten to 13-17 ft-lbs (17.6-23.0 Nm).
9. Install throttle cables. See [2.30 THROTTLE CABLES: ALL MODELS](#).
10. Adjust throttle and idle cables. See [1.27 THROTTLE CONTROL](#).

ASSEMBLY

1. See [Figure 4-52](#). Install the following assemblies:
 - a. TP Sensor. See [4.8 THROTTLE POSITION \(TP\) SENSOR](#).
 - b. TMAP sensor. See [4.13 TEMPERATURE MANIFOLD ABSOLUTE PRESSURE \(TMAP\) SENSOR](#).
 - c. IAC. See [4.12 IDLE AIR CONTROL \(IAC\)](#).

NOTE

Do not install IAC mounting screw on throttle wheel side of induction module until cable bracket is installed in the next step. Install other IAC mounting screw but do not tighten at this time.

2. Install cable bracket (12) onto induction module. Apply Loctite Threadlocker 243 (blue) to the threads of screw (11). Install screw finger-tight. Then tighten both IAC mounting screws to 60 **in-lbs** (6.8 Nm). Tighten screw (11) to 60 **in-lbs** (6.8 Nm).
3. Install fuel injectors, fuel rail and fuel hose. See [4.17 FUEL INJECTORS](#).

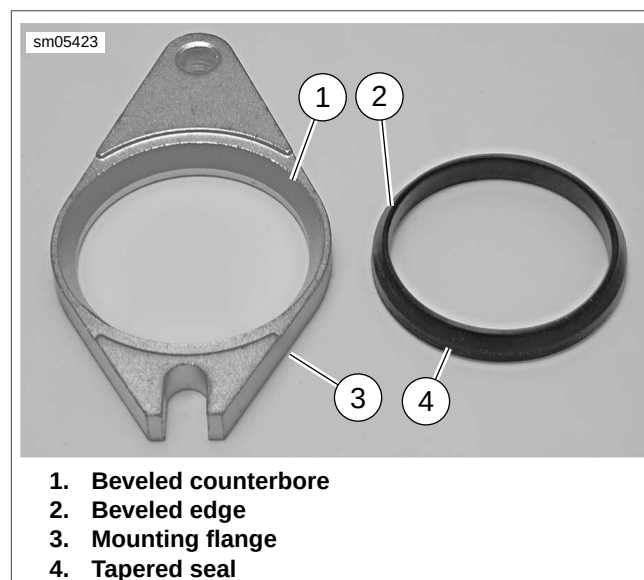


Figure 4-53. Mounting Flange and Seal

11. **California models only:** See [Figure 4-50](#). Install purge hose onto fitting (8) on induction module (1).

12. Plug in the following connectors:

- a. Front fuel injector (3) connector [84],
- b. Rear fuel injector (4) connector [85],
- c. TMAP sensor (5) connector [80],
- d. IAC (6) connector [87],

NOTE

Apply Harley-Davidson Electrical Contact Lubricant part number 99861-02 to the TPS connector and terminals prior to connecting to TPS.

- e. TP sensor (7) connector [88].
13. See [Figure 4-49](#). Install induction module cover. Secure TP sensor harness to cover during installation using a new cable tie with anchor. Install all fasteners finger tight before final tightening any. Tighten socket head bolts (3) to 20-

24 ft-lbs (27.1-32.5 Nm). Tighten fastener (2) to 84-108 **in-lbs** (9.5-12.2 Nm). Tighten fastener (1) to 84-108 **in-lbs** (9.5-12.2 Nm).

- 14. Install airbox. See [4.5 AIRBOX: XR MODELS](#).
- 15. Install fuel tank. See [4.7 FUEL TANK: XR MODELS](#).
- 16. Fill fuel tank and carefully check for leaks around fuel pump module and quick connector. See [4.7 FUEL TANK: XR MODELS](#).
- 17. Install main fuse and close left side cover. See [6.38 MAIN FUSE](#).
- 18. Turn key switch to ON and then back to OFF to reset idle air control to park position.
- 19. Start vehicle and check for fuel leaks.
- 20. Road test vehicle.



IDLE AIR CONTROL (IAC)

4.12

GENERAL

WARNING

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

See [Figure 4-54](#). The Electronic Control Module (ECM) uses the Idle Air Control (IAC) to control engine idle speed.

Refer to the ELECTRICAL DIAGNOSTIC MANUAL for information on the function and testing of the IAC.

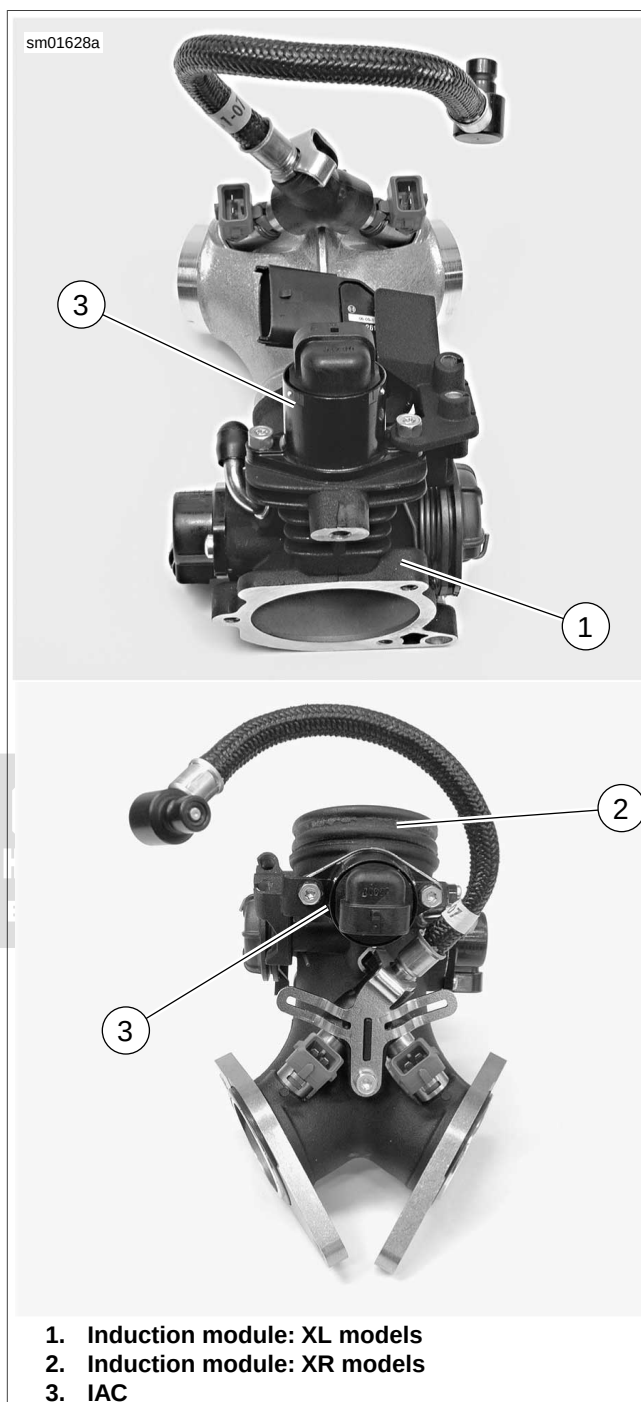


Figure 4-54. Idle Air Control (IAC) Location (Induction Module Removed From Vehicle for Clarity)

REMOVAL: XL MODELS

PART NUMBER	TOOL NAME
HD-25070	HEAT GUN

NOTE

It is not necessary to remove the fuel tank, induction module or induction module mounting bracket in order to replace the IAC.

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Unplug main fuse. See [6.38 MAIN FUSE](#).
2. Remove air cleaner cover, air filter element and backing plate assembly. See [4.4 AIR CLEANER: XL MODELS](#).
3. See [Figure 4-55](#). Unplug harness connector [87B] from IAC connector [87A] (1).

NOTE

Screws (2) **MUST** be heated to soften the thread sealant and avoid breakage during removal. Use **ONLY** HEAT GUN (Part No. HD-25070) to heat the screws. **NEVER** use an open flame.

4. Using a six-point socket (not a Torx wrench), remove two screws (2) in the following order:
 - a. Heat fastener nearest to throttle bracket for two minutes using HEAT GUN (Part No. HD-25070). Remove screw.
 - b. Heat remaining screw for one minute and remove.
5. See [Figure 4-56](#). Grasp IAC and rotate clockwise until IAC mounting tab (1) clears throttle cable bracket (2).
6. With a gentle twisting motion, pull IAC straight out of induction module body.

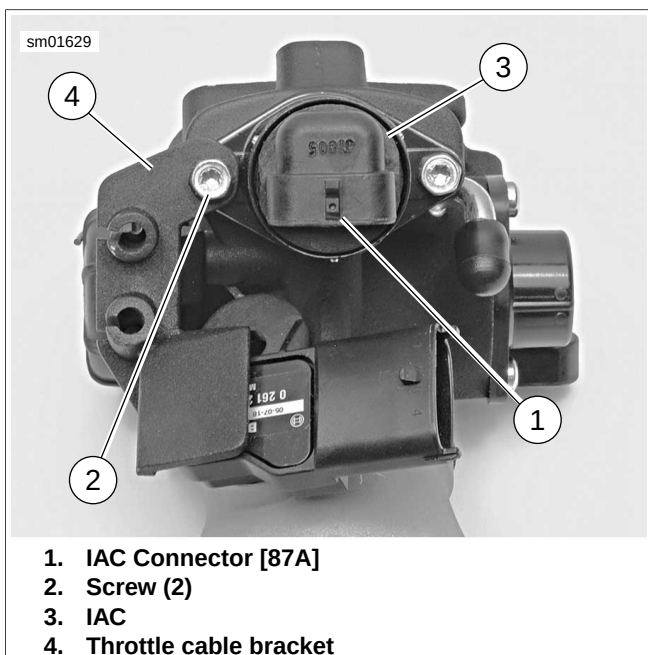


Figure 4-55. IAC Removal/Installation (XL Models)

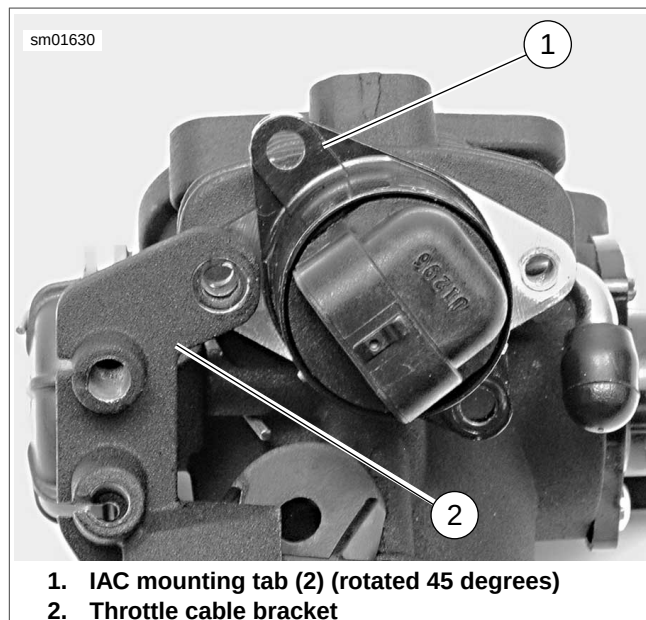


Figure 4-56. Removing/Installing IAC (XL Models)

INSTALLATION: XL MODELS

1. See [Figure 4-57](#). If re-using IAC (1), inspect o-ring (2) for cuts, tears or signs of deterioration. Install **new** o-ring if necessary.
2. Clean all locking agent from the threads of the attachment screws and holes. Blow debris from screw holes using low-pressure compressed air.
3. Apply a thin coat of **clean** engine oil to o-ring.
4. Note orientation and position of IAC, shown in [Figure 4-55](#). Rotate IAC approximately 45 degrees clockwise from this position (see [Figure 4-56](#).) so IAC mounting tab will clear throttle cable bracket (4) when IAC is installed.
5. With a gentle twisting motion, insert IAC into induction module.
6. Rotate IAC so that harness connector faces intake manifold and mounting tab is underneath tab on throttle cable bracket.
7. See [Figure 4-55](#). Apply a drop of Loctite Threadlocker and Sealant 243 (blue) the threads of each screw (2).
8. Install two screws (2). Using a six-point socket (not a Torx wrench), tighten to 60 **in-lbs** (6.8 Nm).
9. Plug harness connector [87B] into IAC connector [87A] (1).
10. Install air cleaner backing plate assembly, air filter element and air cleaner cover. See [4.4 AIR CLEANER: XL MODELS](#).
11. Install main fuse and close left side cover. See [6.38 MAIN FUSE](#).
12. Road test vehicle.



Figure 4-57. IAC and O-ring (All Models)

REMOVAL: XR MODELS

PART NUMBER	TOOL NAME
HD-25070	HEAT GUN

NOTE

It is not necessary to remove the fuel tank, airbox or induction module from the vehicle in order to replace the IAC.

WARNING

Gasoline can drain from quick-connect fitting when removing fuel line. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00267a)

1. Purge the fuel supply hose of high pressure gasoline. Disconnect fuel supply hose from fuel pump module. See [4.7 FUEL TANK: XR MODELS](#).

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

2. Unplug main fuse. See [6.38 MAIN FUSE](#).
3. See [Figure 4-58](#). Unplug harness connector [87B] from IAC connector [87A] (1).

NOTE

Screws (2) *MUST* be heated to soften the thread sealant and avoid breakage during removal. Use *ONLY* HEAT GUN (Part No. HD-25070) to heat the screws. *NEVER* use an open flame.

4. Using a six-point socket (not a Torx wrench), remove two screws (2) in the following order:
 - a. Heat fastener nearest to throttle bracket for two minutes using HEAT GUN (Part No. HD-25070). Remove screw.
 - b. Heat remaining screw for one minute and remove.
5. See [Figure 4-59](#). Grasp IAC and rotate counterclockwise until IAC mounting tab (1) clears throttle cable bracket (2).
6. With a gentle twisting motion, pull IAC straight out of induction module body.

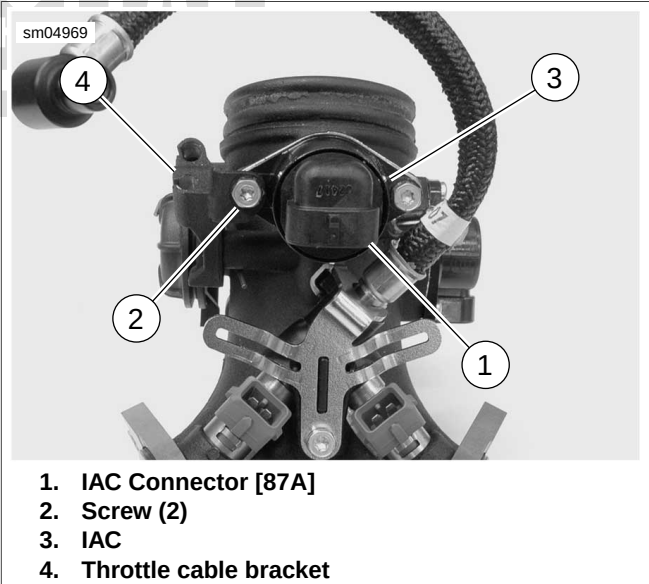
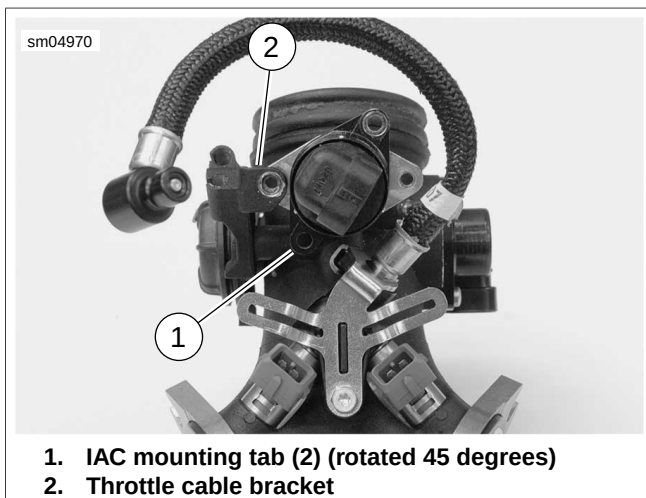


Figure 4-58. IAC Removal/Installation (XR Models)



1. IAC mounting tab (2) (rotated 45 degrees)
2. Throttle cable bracket

Figure 4-59. Removing/Installing IAC (XR Models)

INSTALLATION: XR MODELS

1. See [Figure 4-57](#). If re-using IAC (1), inspect o-ring (2) for cuts, tears or signs of deterioration. If necessary, replace with **new** o-ring.
2. Clean all locking agent from the threads of the attachment screws and holes. Blow debris from screw holes using low-pressure compressed air.

3. Apply a thin coat of **clean** engine oil to o-ring.
4. Note orientation and position of IAC, shown in [Figure 4-58](#). Rotate IAC approximately 45 degrees counterclockwise from this position (see [Figure 4-59](#).) so IAC mounting tab will clear throttle cable bracket (4) when IAC is installed.
5. With a gentle twisting motion, insert IAC into induction module.
6. Rotate IAC so that harness connector points straight down and mounting tab is underneath tab on throttle cable bracket.
7. See [Figure 4-58](#). Apply a drop of Loctite Threadlocker and Sealant 243 (blue) the threads of each screw (2).
8. See [Figure 4-58](#). Install two screws (2). Using a six-point socket (not a TORX wrench), tighten to 60 **in-lbs** (6.8 Nm).
9. Plug harness connector [87B] into IAC connector [87A] (1).
10. Connect fuel hose to fuel pump module. Fill fuel tank with gasoline. See [4.7 FUEL TANK: XR MODELS](#).
11. Plug in main fuse and close left side cover. See [6.38 MAIN FUSE](#).
12. Turn on ignition switch and start vehicle. Carefully check for leaks around fuel hose fitting.
13. Road test vehicle.



TEMPERATURE MANIFOLD ABSOLUTE PRESSURE (TMAP) SENSOR

4.13

GENERAL

WARNING

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

See [Figure 4-60](#). The Temperature Manifold Absolute Pressure (TMAP) sensor (1) performs the dual functions of monitoring air temperature and air pressure in the intake manifold.

Refer to the ELECTRICAL DIAGNOSTIC MANUAL for information on the function and testing of the TMAP sensor.

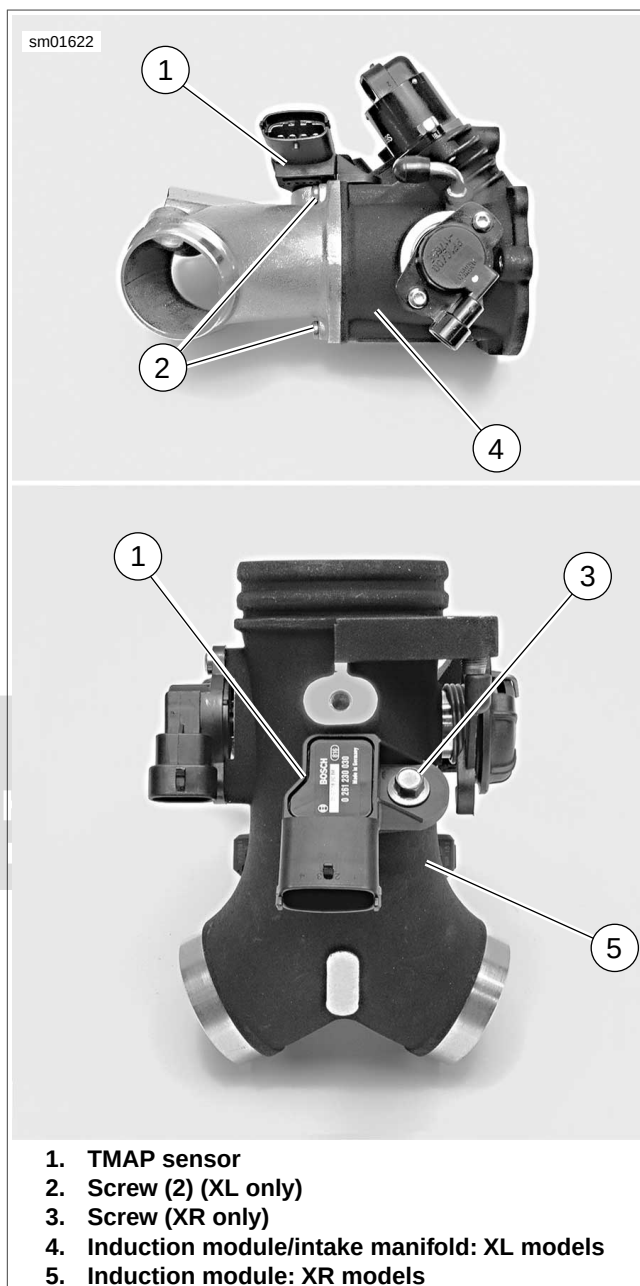


Figure 4-60. TMAP Sensor Location (Induction Module Removed From Vehicle for Clarity)

REMOVAL: XL MODELS

NOTE

It is not necessary to remove the fuel tank from the vehicle in order to replace the TMAP sensor.

⚠ WARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

⚠ WARNING

Gasoline can drain from quick-connect fitting when removing fuel line. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00267a)

1. Unplug main fuse. See [6.38 MAIN FUSE](#).
2. Remove air cleaner cover, air filter element and backing plate assembly. See [4.4 AIR CLEANER: XL MODELS](#).
3. Remove fuel rail and fuel injectors. See [4.17 FUEL INJECTORS](#). This will allow access to the two screws that secure the induction module to the intake manifold.
4. See [Figure 4-60](#). Remove two screws (2) and separate induction module from intake manifold. See [4.10 INDUCTION MODULE: XL MODELS](#).
5. See [Figure 4-61](#). Pull induction module away from intake manifold far enough so that TMAP sensor retaining bracket (1) clears TMAP sensor body (2).
6. Unplug harness connector [80B] from TMAP connector [80A] (3).
7. Grasp TMAP sensor and with a gentle twisting motion, pull sensor straight up out of intake manifold body.

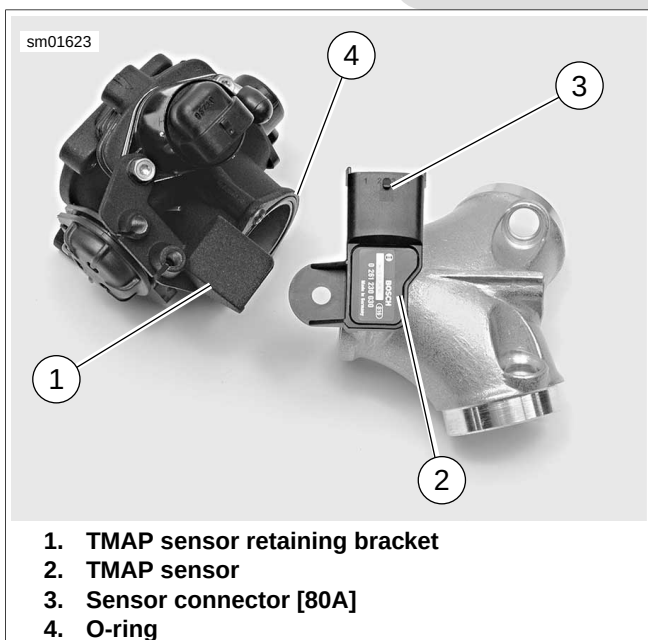


Figure 4-61. TMAP Sensor Removal/Installation (Induction Module Removed From Vehicle for Clarity)

INSTALLATION: XL MODELS

1. See [Figure 4-62](#). If re-using TMAP sensor (1), inspect o-ring (2) in groove of sensor for cuts, tears or signs of deterioration. Install **new** o-ring if necessary.
2. Apply a thin coat of **clean** engine oil to TMAP sensor o-ring.
3. See [Figure 4-61](#). With a gentle twisting motion, insert sensor (2) into intake manifold with connector [80A] (3) facing rear cylinder head.
4. Plug harness connector [80B] into TMAP sensor.
5. Examine o-ring (4) between induction module and intake manifold for cuts, tears or signs of deterioration. Install **new** o-ring if necessary. Make certain o-ring is fully seated in its grove in induction module body.
6. See [Figure 4-60](#). Mate induction module to intake manifold and secure with two screws (2) Tighten to 35 **in-lbs** (4.0 Nm).
7. Install fuel injectors and fuel rail. See [4.17 FUEL INJECTORS](#).
8. Install air cleaner backing plate assembly, air filter element and air cleaner cover. See [4.4 AIR CLEANER: XL MODELS](#).

⚠ WARNING

To prevent spray of fuel, be sure quick-connect fittings are properly mated. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00268a)

⚠ WARNING

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

⚠ WARNING

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

9. Connect fuel hose to fuel pump module. Fill fuel tank and carefully check for leaks around fuel pump module. See [4.6 FUEL TANK: XL MODELS, Reconnecting Fuel Hose and Filling Fuel Tank](#).
10. Install main fuse and close left side cover. See [6.38 MAIN FUSE](#).

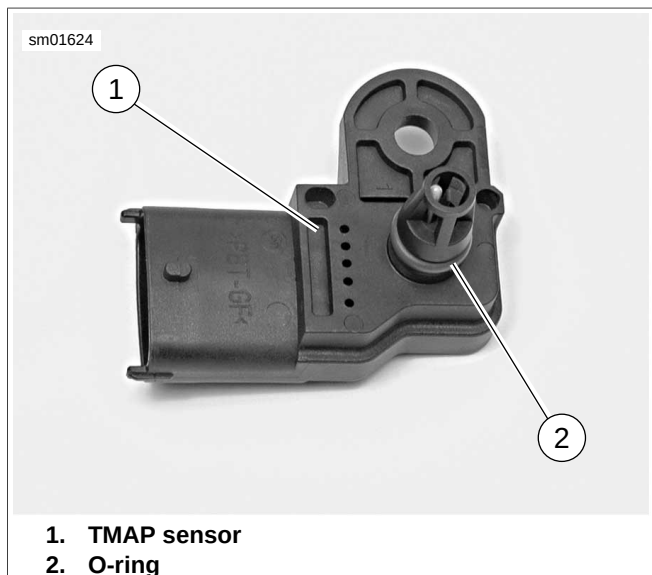


Figure 4-62. TMAP Sensor

REMOVAL: XR MODELS

NOTE

It is not necessary to remove the fuel tank, airbox or induction module from the vehicle in order to replace the TMAP sensor.

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Unplug main fuse. See [6.38 MAIN FUSE](#).

NOTE

See [Figure 4-64](#). TMAP sensor harness and TP sensor harness are attached to inside of induction module cover (1). It is not necessary to remove the retainer securing these harnesses to the induction module cover in order to access TMAP sensor.

2. See [Figure 4-63](#). Remove socket head bolts (3), fastener (1) and fastener (2).
3. See [Figure 4-64](#). Carefully rotate induction module cover (1) out of the way.
4. Unplug TMAP sensor harness connector [80B] (2). Remove screw (4).
5. Grasp TMAP sensor (3) and with a gentle twisting motion, pull sensor straight up out of induction module body.

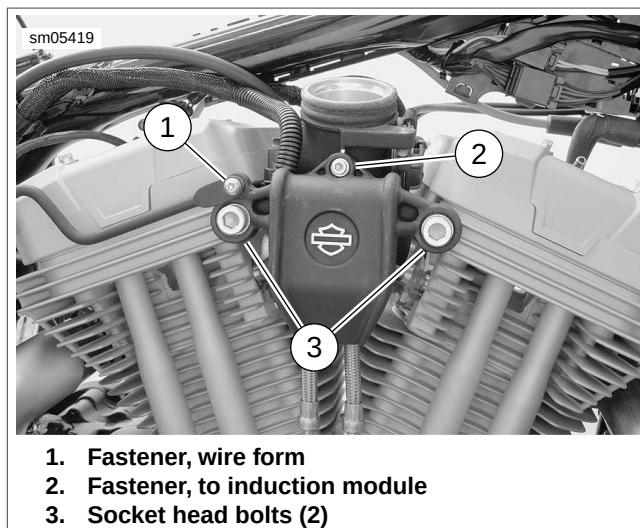


Figure 4-63. Induction Module Cover

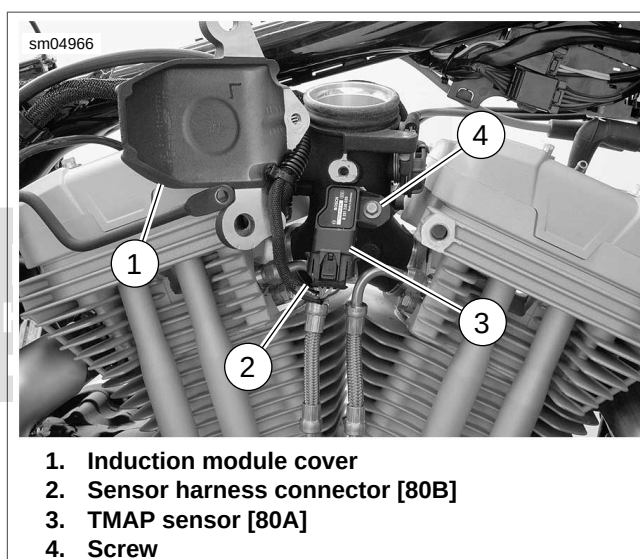


Figure 4-64. TMAP Sensor: XR Models (airbox removed for clarity of photo)

INSTALLATION: XR MODELS

1. See [Figure 4-62](#). If re-using TMAP sensor (1), inspect o-ring (2) for cuts, tears or signs of deterioration. If necessary, replace with **new** o-ring.
2. Apply a thin coat of **clean** engine oil to TMAP sensor o-ring.
3. See [Figure 4-64](#). With a gentle twisting motion, insert sensor (3) into induction module with connector [80A] pointing down. Secure sensor to induction module with screw (4). Tighten to 60 **in-lbs** (6.8 Nm).
4. Plug sensor harness connector [80B] (2) into TMAP sensor.

NOTE

Install all fasteners finger tight before final tightening any.

5. See [Figure 4-63](#). Rotate induction module cover into place between cylinder heads. Install fasteners (1, 2, 3) finger tight.
6. Tighten socket head bolts (3) to 20-24 ft-lbs (27.1-32.5 Nm). Tighten fastener (2) to 84-108 **in-lbs** (9.5-12.2 Nm). Tighten fastener (1) to 84-108 **in-lbs** (9.5-12.2 Nm).
7. Plug in main fuse. See [6.38 MAIN FUSE](#).



OXYGEN SENSOR

4.14

GENERAL

NOTE

Photographs of XL models will be used throughout this process. Although the exact location of the O2 sensors vary slightly between XL models and XR models, replacement procedures are essentially the same. For ease of installation, note harness routing prior to removal.

See [Figure 4-65](#). The oxygen (O2) sensors are installed in threaded bosses on the inboard side of front and rear exhaust pipes.

NOTE

Both Oxygen sensors are identical. However, if they will be reused, it is best to mark them FRONT or REAR and return each to the exhaust pipe in which it was originally mounted.

Refer to the ELECTRICAL DIAGNOSTIC MANUAL for information on the function and testing of the O2 sensors.

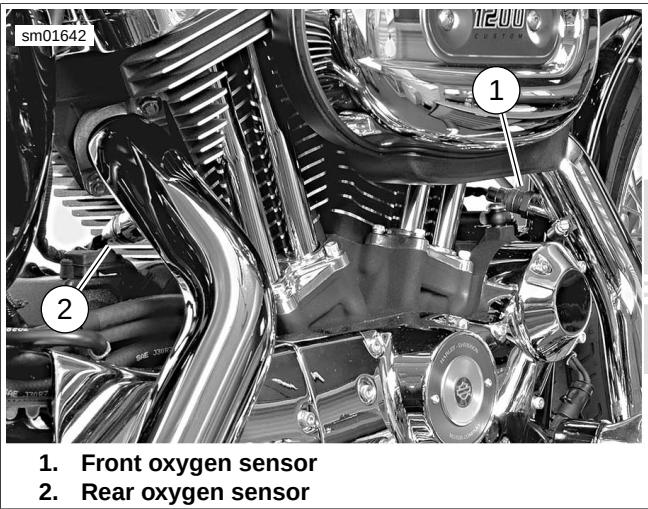


Figure 4-65. Oxygen Sensor Locations, typical (XL model shown)

REMOVAL

PART NUMBER	TOOL NAME
HD-48262	OXYGEN SENSOR SOCKET
HD-48647	OXYGEN SENSOR SOCKET

1. Unplug sensor connector:
 - a. **Front O2 sensor:** see [Figure 4-66](#). Remove frame clip (2). Unplug sensor connector [138A] (3) from wiring harness connector [138B].
 - b. **Rear O2 sensor:** see [Figure 4-67](#). Disengage connector [137] (2) from mounting tab. Unplug connector [137A] from wiring harness connector [137B].

2. Using the appropriate tool, remove sensor from mounting boss on exhaust pipe. If reusing sensor, be careful not to damage sensor harness.
 - a. **XL Models:** OXYGEN SENSOR SOCKET (Part No. HD-48262).
 - b. **XR Models:** OXYGEN SENSOR SOCKET (Part No. HD-48647).

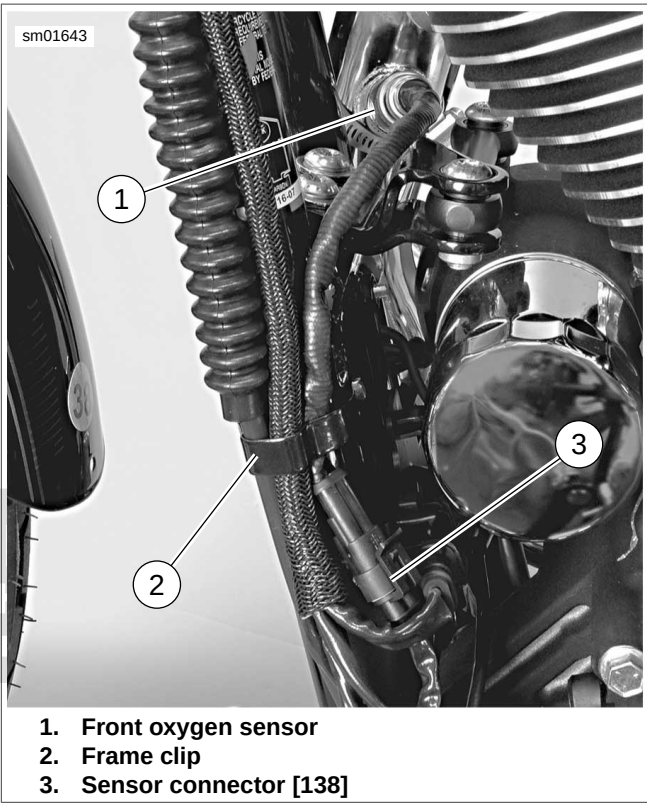


Figure 4-66. Front Oxygen Sensor and Connector, typical (XL model shown)

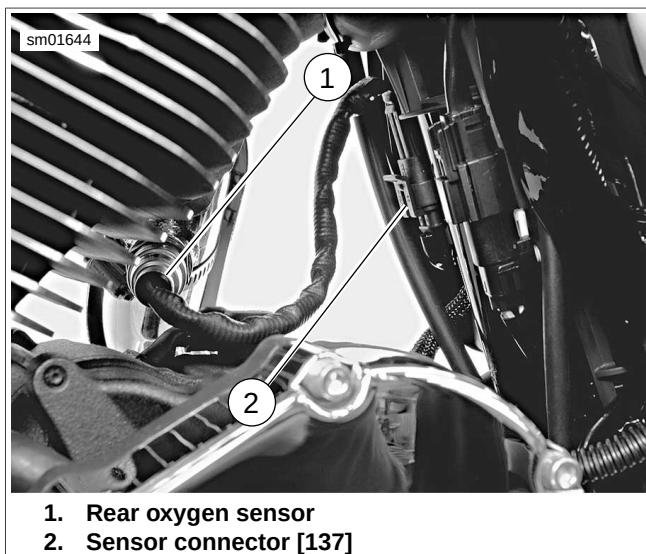


Figure 4-67. Rear Oxygen Sensor and Connector, typical (XL model shown)

INSTALLATION

NOTES

- Do not install sensors that have been dropped or impacted by other components. Damage to the sensor element may

NOTE

Route rear O2 sensor harness in a loop away from exhaust system, toward left side of vehicle (as shown in the photo) to avoid contact with exhaust port or exhaust pipe.

have occurred. Replacement sensor assemblies have threads coated with anti-seize lubricant and new seal rings.

- Apply a thin coat of anti-seize to threads of each oxygen sensor prior to installing in header. Do not use any other grease or sealant product on sensor threads. The electrical connector must also be clean and free of any dielectric grease.
- If sensor is being reused, install **new** seal ring and coat sensor threads with anti-seize.
 - Install sensor into threaded boss on exhaust pipe and tighten to 29-44 ft-lbs (39.3-59.7 Nm).
 - Route sensor harness to mating connector and connect:
 - Front O2 sensor:** see [Figure 4-66](#). Plug sensor connector [138A] (3) into wiring harness connector [138B]. Install frame clip (2) over sensor harness, clutch cable and wiring harness on left frame down-tube.
 - Rear O2 sensor:** see [Figure 4-67](#). Plug connector [137A] (2) into wiring harness connector [137B]. Engage connector assembly onto mounting tab on bracket.



EXHAUST SYSTEM: XL MODELS

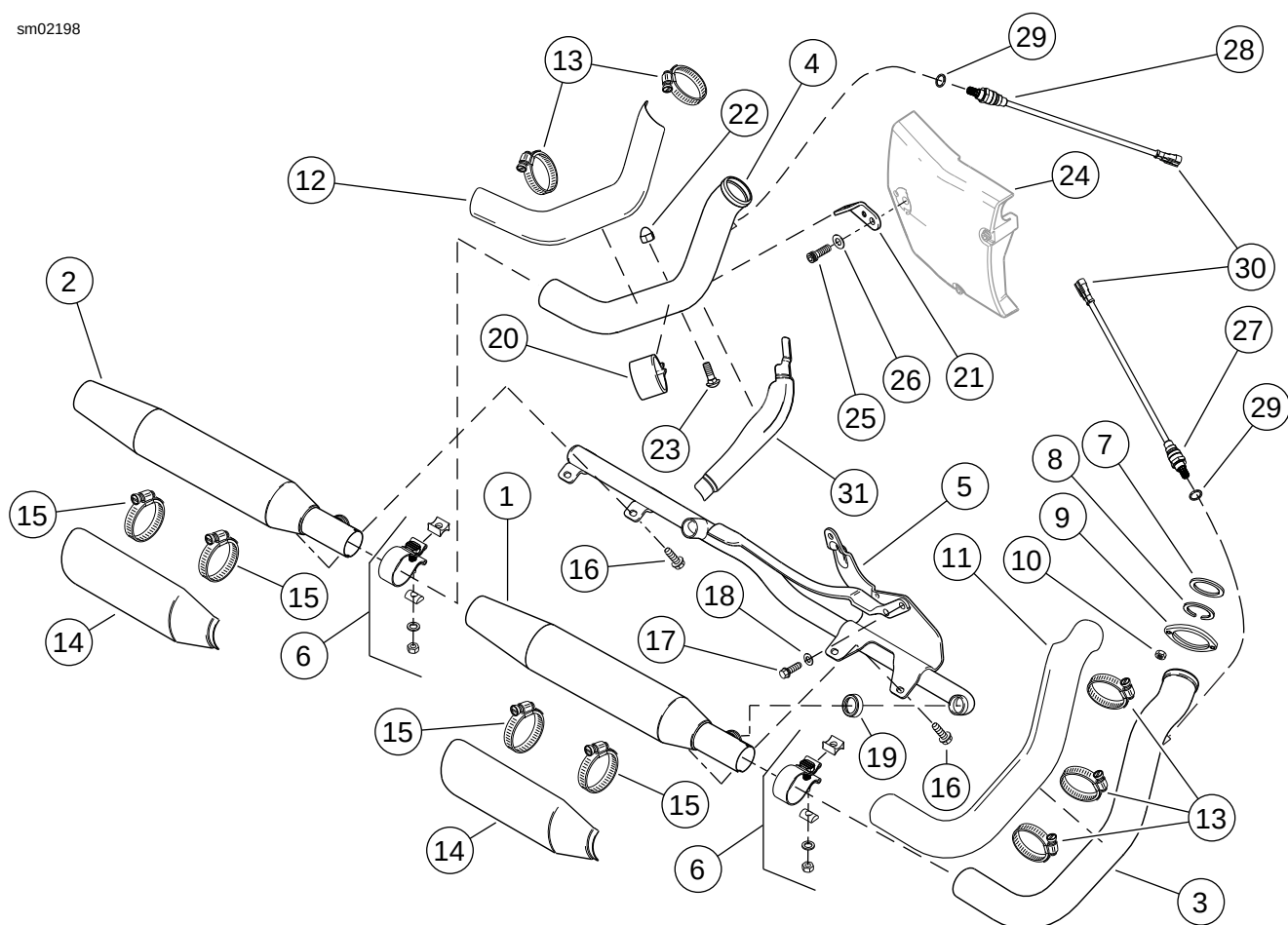
4.15

GENERAL

PART NUMBER	TOOL NAME
PFSX916	SNAP-ON WRENCH

To facilitate removing exhaust pipe header nuts, use SNAP-ON WRENCH (Part No. PFSX916).

sm02198



- | | | |
|--------------------------------------|---|--|
| 1. Muffler, front | 12. Heat shield, rear exhaust pipe | 23. Screw |
| 2. Muffler, rear | 13. Worm drive clamp (5) | 24. Engine sprocket cover |
| 3. Exhaust pipe, front | 14. Muffler heat shield (2) (California, HDI, England only) | 25. Screw |
| 4. Exhaust pipe, rear | 15. Worm drive clamp (4) | 26. Washer |
| 5. Muffler interconnect bracket | 16. Flanged bolt (4) | 27. Front O2 sensor assembly |
| 6. Torca muffler clamp assembly (2) | 17. Screw (3) | 28. Rear O2 sensor assembly |
| 7. Exhaust port gasket (2) | 18. Washer (3) | 29. Seal ring (2) |
| 8. Exhaust gasket retaining ring (2) | 19. Muffler interconnect gasket (2) | 30. O2 sensor connectors (2): [137], [138] |
| 9. Exhaust pipe flange (2) | 20. Exhaust pipe clamp | 31. Heat shield, rear exhaust pipe (mid-control vehicles only) |
| 10. Nut (4) | 21. Exhaust pipe clamp bracket | |
| 11. Heat shield, front exhaust pipe | 22. Acorn nut | |

Figure 4-68. Exhaust System, All XL Models

REMOVAL

Mufflers and Exhaust Pipes

NOTE

See [Figure 4-69](#). Vehicles with mid controls are equipped with an extra heat shield (2) on the rear exhaust pipe.

1. See [Figure 4-68](#). Remove heat shields:
 - a. **Vehicles with mid controls:** remove worm drive clamps (13) from heat shield (12) completely. Remove bottom heat shield.
 - b. **All vehicles:** open worm drive clamps (13) and remove exhaust pipe heat shields (11, 12).
 - c. **California, HDI and England models:** open worm drive clamps (15) and remove muffler heat shields (14).
2. Unplug O2 sensor connectors (30). Front connector [138] is mounted on left front frame downtube. Rear connector [137] is attached to H-bracket behind engine on right side of vehicle.
3. Remove nuts (10) from front and rear cylinder head exhaust studs.
4. Remove flanged bolts (16) securing front and rear mufflers (1, 2) to muffler interconnect bracket (5).
5. Loosen Torca muffler clamp assemblies (6) on front and rear mufflers. Remove mufflers. Discard muffler interconnect gaskets (19).
6. Remove and discard Torca clamp assemblies; they are 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 torca muffler clamp assemblies be discarded and replaced each time they are removed.

7. Remove nut (22) and screw (23) from exhaust pipe clamp (20). Separate exhaust pipe clamp from clamp bracket (21).
8. Remove front and rear exhaust pipes (3, 4). Slide exhaust pipe clamp off rear exhaust pipe.
9. Remove exhaust port gasket (7), retaining ring (8) and exhaust pipe flange (9) from each exhaust pipe. Discard gasket.
10. Remove O2 sensor assemblies (27, 28) from front and rear exhaust pipes. Discard gaskets (29). See [4.14 OXYGEN SENSOR](#).

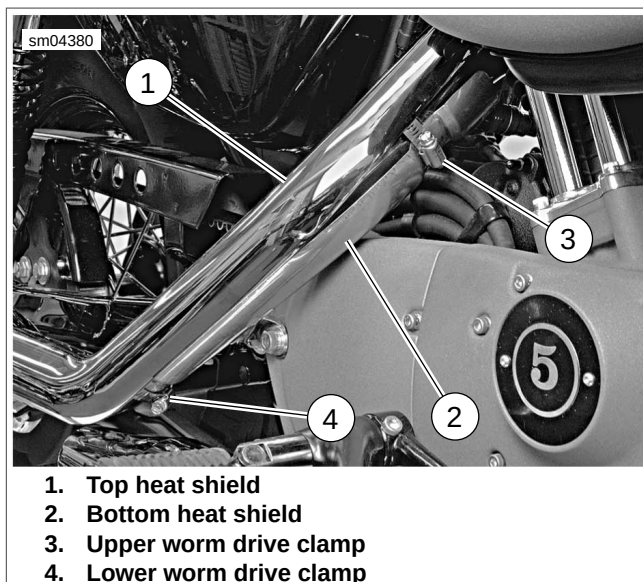


Figure 4-69. Rear Exhaust Pipe Heat Shields: Vehicles with Mid Controls

Muffler Interconnect Bracket

1. See [Figure 4-70](#). Remove screw (6), washer (5) and exhaust pipe clamp bracket (4). Remove two screws (2, 3). Remove sprocket cover (1).
2. See [Figure 4-71](#). Remove rear brake rod (1) at bell crank (2).
3. See [Figure 4-68](#). Remove three screws (17) and washers (18) securing muffler interconnect bracket (5) to engine crankcase. Remove muffler interconnect bracket.

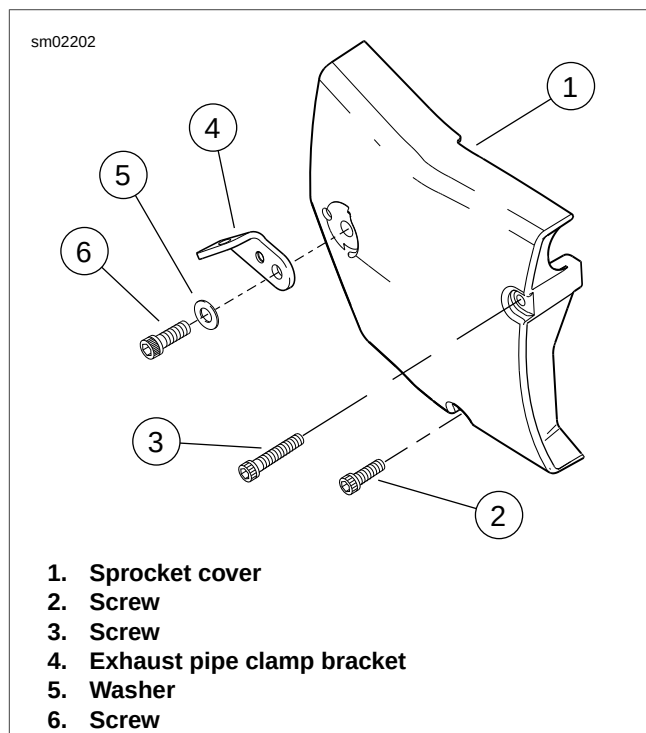


Figure 4-70. Sprocket Cover

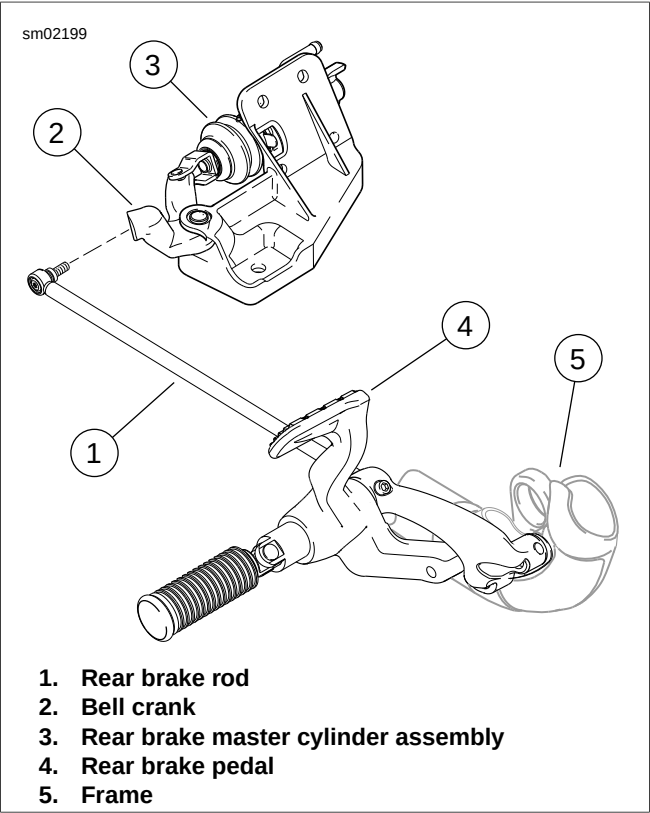


Figure 4-71. Rear Brake Linkage

INSTALLATION

PART NUMBER	TOOL NAME
PFSX916	SNAP-ON SWIVEL BALL SOCKET EXTENSION

Muffler Interconnect Bracket

- See [Figure 4-68](#). Install muffler interconnect bracket (5) to engine case with three screws (17) and washers (18). Tighten to 30-33 ft-lbs (40.7-44.8 Nm).
- See [Figure 4-71](#). Apply two drops of LOCTITE 243 (Part. No. 99642-97) to rear brake rod ball stud screw. Attach rear brake rod (1) to bell crank (2). Tighten screw to 120-180 **in-lbs** (13.6-20.4 Nm).
- See [Figure 4-70](#). Install sprocket cover (1). Secure with two screws (2, 3). Note that long screw goes in top hole, short screw in bottom hole. Do not tighten screws at this time.
- Install exhaust pipe clamp bracket (4), washer (5) and screw (6). Tighten to 30-33 ft-lbs (40.7-44.8 Nm). Now tighten screws (2, 3) to 80-120 **in-lbs** (9.0-13.6 Nm).

Exhaust Pipes and Mufflers

NOTES

- To facilitate installing exhaust pipe header nuts, use SNAP-ON SWIVEL BALL SOCKET EXTENSION (Part No. PFSX916).
- If the O2 sensors are being reused, apply a thin coat of anti-seize to threads of each sensor prior to installing in

header. Do not use any other grease or sealant product on sensor threads. The electrical connector must also be clean and free of any dielectric grease.

- See [Figure 4-68](#). If the front and rear O2 sensor assemblies (27, 28) are being reused, install **new** seal rings (29) onto each sensor. Apply a thin coat of anti-seize to the sensor threads.
- Install sensor assemblies into front and rear exhaust pipes. Tighten to 29-44 ft-lbs (39.3-59.7 Nm). See [4.14 OXYGEN SENSOR](#).
- Place exhaust pipe flange (9), exhaust gasket retaining ring (8) and **new** exhaust port gasket (7) over front end of each exhaust pipe (3, 4). Position flange so that inside counterbore faces cylinder head exhaust port.
- Position front ends of front and rear exhaust pipes into front and rear cylinder heads, respectively. Position holes in flanges over mounting studs and loosely install nuts (10). Do not tighten nuts at this time.
- Install exhaust pipe clamp (20) on rear exhaust pipe (4) with square hole facing down. Assemble exhaust pipe clamp to exhaust pipe clamp bracket (21) with screw (23) and acorn nut (22). Make sure bracket fits between ends of clamp. Do not tighten at this time.
- Install **new** muffler interconnect gaskets (19) in interconnect mating holes in mufflers (1, 2).
- Place **new** Torca clamp assemblies (6) over slotted end of each muffler. Install each muffler onto the end of its respective exhaust pipe.
- Rotate both mufflers until their mounting bosses line up with holes in muffler interconnect bracket. Carefully mate each muffler with exhaust port in interconnect bracket. Loosely install flanged bolts (16). Do not tighten at this time.
- Tighten exhaust system fasteners in the following sequence:
 - Tighten four flanged bolts securing mufflers to interconnect bracket to 15-19 ft-lbs (20.4-25.8 Nm).
 - Tighten four nuts at cylinder head exhaust studs to 96-120 **in-lbs** (10.9-13.6 Nm).
 - Tighten two Torca clamps to 38-43 ft-lbs (51.6-58.4 Nm).
 - Tighten rear exhaust pipe clamp nut (22) to 15-19 ft-lbs (20.4-25.8 Nm).
- Plug in O2 sensor connectors (30). Front connector [138] is mounted on left front frame downtube. Rear connector [137] is attached to H-bracket behind engine on right side of vehicle. See [4.14 OXYGEN SENSOR](#).

11. Install heat shields:

- a. Open worm drive clamps (13) and install heat shields (11, 12) on exhaust pipes. Position each clamp so that screw is on the outboard side in the most accessible position.
- b. **Vehicles with mid controls:** See [Figure 4-69](#). Tighten lower worm drive clamp (4) a few turns. Slide lower portion of bottom heat shield (2) into lower worm drive clamp. Engage upper portion of bottom heat shield into upper worm drive clamp (3).
- c. **All vehicles:** Tighten all exhaust pipe heat shield clamps securely.
- d. **California, HDI and England models:** open worm drive clamps (15) and install muffler heat shields (14) on mufflers. Position each clamp so that screw is on the outboard side in the most accessible position. Tighten clamps securely.



EXHAUST SYSTEM: XR MODELS

4.16

GENERAL

PART NUMBER	TOOL NAME
PFSX916	SNAP-ON WRENCH

To facilitate removing exhaust pipe header nuts, use SNAP-ON WRENCH (Part No. PFSX916).

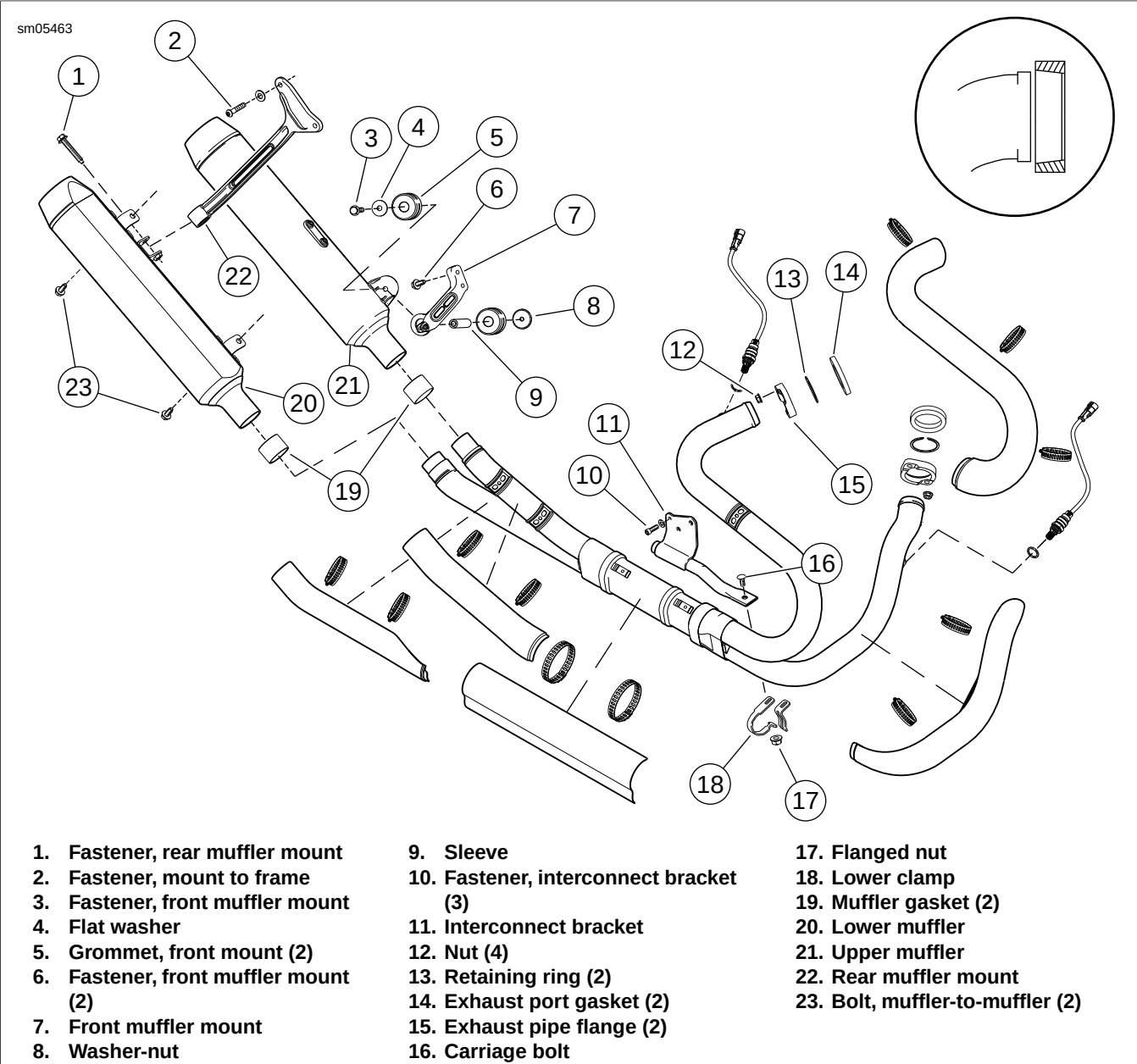


Figure 4-72. Exhaust System: XR Models

REMOVAL

Mufflers

- See [Figure 4-72](#). Remove forward muffler mount fastener (3) and washer-nut (8).
- Remove two bolts (23) fastening mufflers together.
- Slide upper muffler (21) back off header pipe to remove.
- Remove rear muffler mount fastener (1).

5. Rotate lower muffler (20) counterclockwise to disengage from the rear mount (22) and slide back off header pipe to remove.
6. Remove mount grommets (5) and sleeve (9).
7. Inspect rear mount (22) and replace if damaged.
8. Inspect muffler seals (19) and replace if necessary:
 - a. Pull seal out of muffler using a hook-type tool.
 - b. Push **new** seal into place being careful not to distort or damage the new seal.
2. If removed, install rear mount (22), front mount (7), and interconnect bracket (11).
 - a. Tighten fasteners (2) to 15-20 ft-lbs (20.3-27.1 Nm).
 - b. Tighten fasteners (6) to 45-50 ft-lbs (61.0-67.8 Nm).
 - c. Tighten fasteners (10) to 30-33 ft-lbs (40.7-44.7 Nm).

NOTE

Use care not to damage exhaust port gaskets (14) when positioning header pipes in exhaust port area.

Header Pipes

1. Remove mufflers.
2. Disconnect O2 sensor connectors. Remove sensor if necessary. See [4.14 OXYGEN SENSOR](#).
3. See [Figure 4-72](#). Loosen or remove head pipe heat shields to gain access to header pipe flange nuts (12).
4. Remove flange nuts (12) and pull flanges (15) off from studs.
5. Remove nut (17) and carriage bolt (16) from lower clamp (18).

NOTE

Be careful not to drop or hit header pipe assembly. Damage to the catalytic converter may result.

6. Remove header pipe assembly from vehicle.
7. Inspect exhaust port gasket (14) and replace if necessary.
 - a. Pry gasket from exhaust port in cylinder head being careful not to damage the bore.
 - b. Push new gasket into place with the larger ID facing the header pipe, as shown in the inset in [Figure 4-72](#).
8. Remove retainer rings (13) and flanges (15) if necessary.
9. If necessary, remove mount brackets (7, 22) and interconnect bracket (11).

INSTALLATION

Header Pipes

1. See [Figure 4-72](#). If removed, install flanges (15) and retaining rings (13).

3. Place head pipe assembly in position and loosely secure lower clamp (18) with carriage bolt (16) and flange nut (17).
4. Install flanges (15) and secure with nuts (12) finger tight. do not tighten until mufflers are installed.
5. Install mufflers.

Mufflers

1. Place lower muffler (20) on header pipe. Rotate until rear mount fastener (1) can be installed. Loosely install fastener (1).
2. Place upper muffler (21) on header pipe.
3. Install muffler-to-muffler bolts (23) finger tight.
4. Install grommets (5), sleeve (9), fastener (3), washer (4) and washer nut (8). Tighten to 120-180 **in-lbs** (16.9-20.3 Nm).
5. Tighten muffler-to-muffler bolts (23) to 120-180 **in-lbs** (16.9-20.3 Nm).
6. Tighten rear mount fastener (1) to 120-180 **in-lbs** (16.9-20.3 Nm).
7. Be sure header pipes are clear of idler pulley and tighten nut (17) to 30-33 ft-lbs (40.7-44.7 Nm).
8. Tighten the exhaust flange nuts (12) to 96-120 **in-lbs** (10.8-13.6 Nm).
9. Install heat shields.
10. Install and connect the O2 sensors. See [4.14 OXYGEN SENSOR](#).

FUEL INJECTORS

4.17

GENERAL

⚠ WARNING

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

Refer to the ELECTRICAL DIAGNOSTIC MANUAL for information on the function and testing of the fuel injectors.

REMOVAL

⚠ WARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

1. Purge the fuel supply hose of high pressure gasoline. Disconnect fuel supply hose from fuel pump module. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

2. Unplug main fuse. See [6.38 MAIN FUSE](#).
3. **XL Models with side-mounted horn:** See [Figure 4-73](#). Remove screws (3), washers (2) and cylinder head bracket (1) from engine. Unplug harness connectors [122] from horn (4).
4. **XL Models with 4.5 gallon (17.0 liter) fuel tank:** Access to the fuel injectors and fuel rail may be easier if the fuel tank is raised up as follows:
 - a. Remove seat.
 - b. Loosen (but do not remove) front fuel tank mounting screw. Remove rear fuel tank mounting screw, washers and nut. See [4.6 FUEL TANK: XL MODELS](#).
 - c. Place a clean shop cloth between front of fuel tank and front fork upper bracket to protect fuel tank finish. Carefully pivot rear of fuel tank upward and prop in position with a block of soft wood or other suitable device.
5. See [Figure 4-76](#). Unplug engine sub-harness connectors from fuel injector connectors [84A], [85A] (7, 8).
6. Remove screw (5) and retaining bracket (2).

NOTE

See [Figure 4-76](#). If the fuel supply hose (1) or fuel rail (6) are not to be replaced, it is not necessary to separate them. Skip the next step.

7. Disassemble fuel supply hose (1) from fuel rail (6) as follows:
 - a. Hold fuel rail in place and with a gentle twisting motion, pull fuel supply hose straight up out of fuel rail.
8. Hold fuel injectors (9, 10) in place by pressing down on harness connectors (7, 8) and with a gentle rocking motion, pull fuel rail off injectors.
9. With a gentle twisting motion, pull fuel injectors out of intake manifold (XL models) or induction module (XR models).
10. Remove and discard O-rings (11).

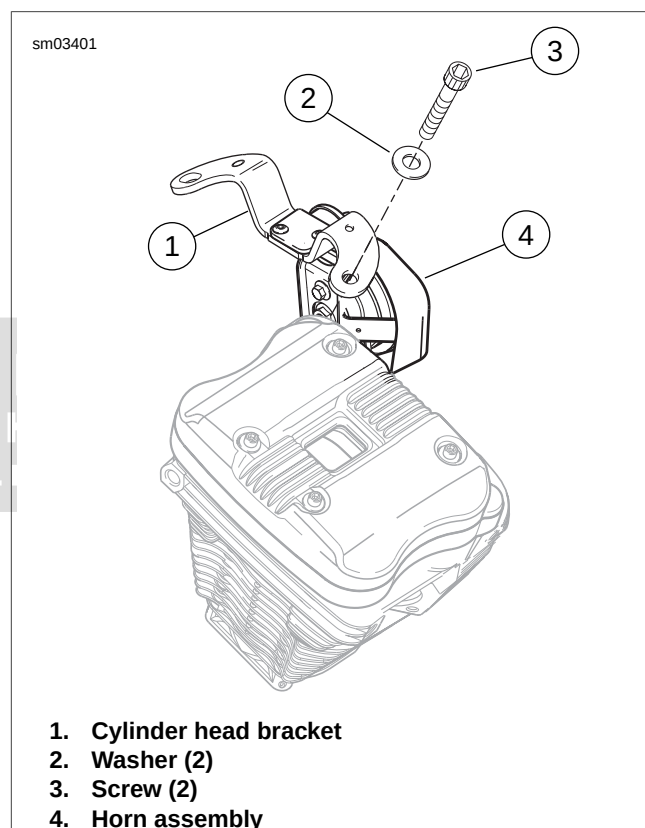


Figure 4-73. Horn and Cylinder Head Bracket (XL Models With Side Mounted Horn Only)

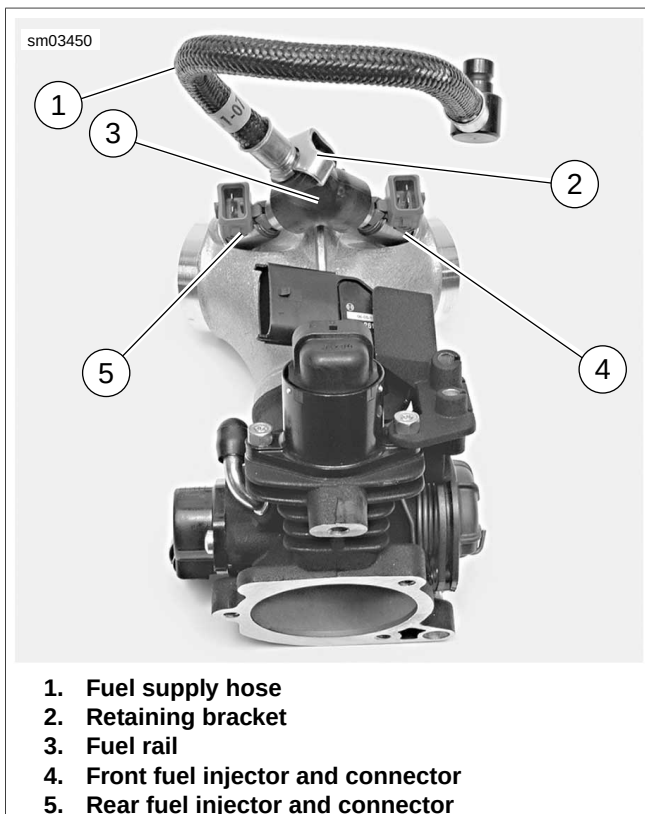


Figure 4-74. Fuel Injector Assembly Location: XL Models

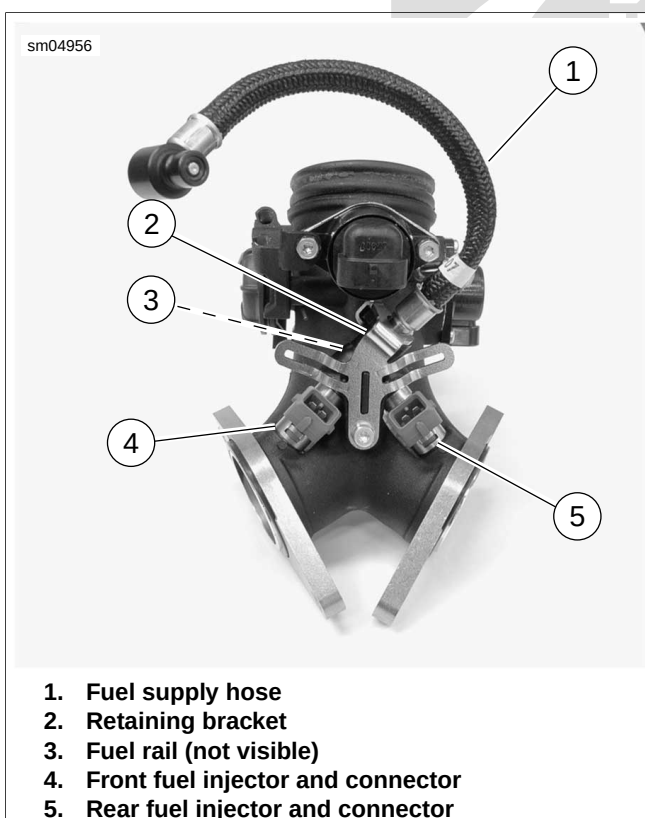


Figure 4-75. Fuel Injector Assembly Location: XR Models

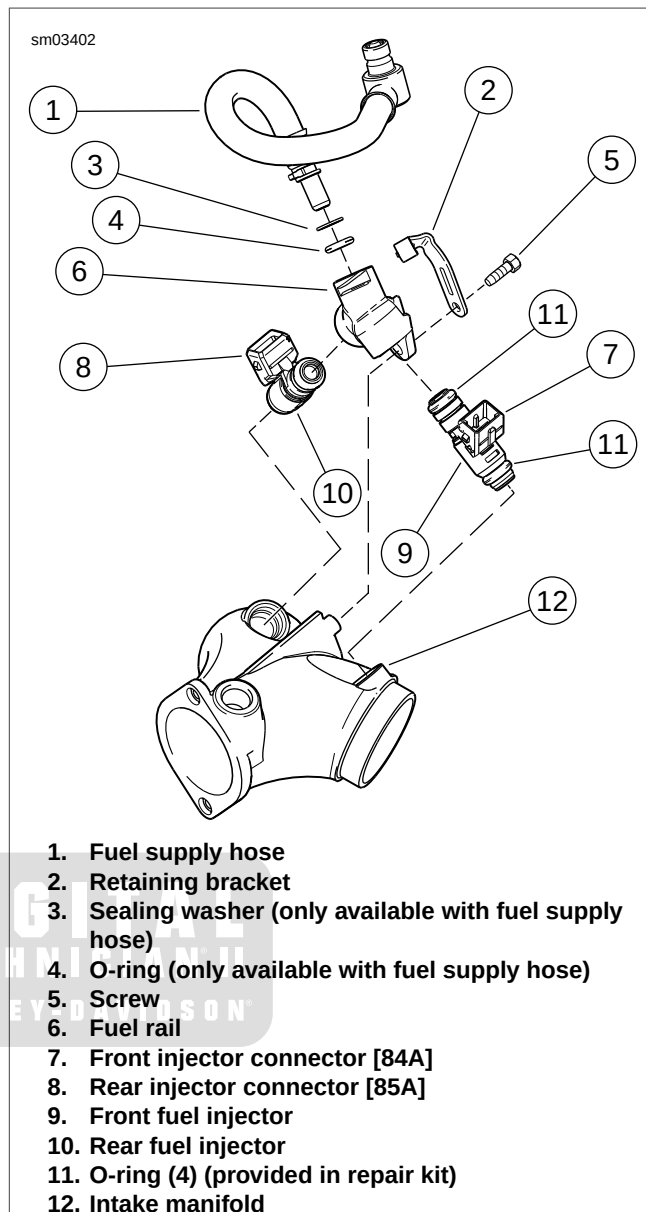


Figure 4-76. Fuel Injector Assemblies (typical: XL model shown)

INSTALLATION

1. See [Figure 4-76](#). Apply a thin coat of clean engine oil to **new** fuel injector O-rings (11). Install O-rings onto fuel injectors (9, 10).
2. Push fuel injectors into intake manifold (XL models) or induction module (XR models) with harness connectors (7, 8) facing up. Rotate fuel injectors so that harness connectors are positioned, as shown in either [Figure 4-74](#) or [Figure 4-75](#) depending on model being serviced.
3. Gently press fuel rail onto free end of fuel injectors. Press fuel rail down until hole in fuel rail molded-in bracket lines up with mounting hole in intake manifold (12).

NOTE

An alternate method of assembly is to first install rear fuel injector in the intake manifold (XL models) or induction module (XR models) and front fuel injector in the fuel rail. Then install

the assembly onto the intake manifold (XL models) or induction module (XR models).

4. If the fuel supply hose and fuel rail were separated in the disassembly procedure, reassemble as follows:
 - a. See [Figure 4-76](#). Inspect sealing washer (3) and O-ring (4) for damage. If either require replacement, install a **new** fuel line kit.
 - b. Lightly coat O-ring with clean engine oil. Push fuel supply hose into fuel rail bore until collar on hose is flush with top of fuel rail.

NOTE

The fuel supply hose must be oriented properly when installing the retaining bracket. See [Figure 4-77](#).

5. See [Figure 4-76](#). Install retaining bracket (2) and fastener (5) as follows:
 - a. See [Figure 4-77](#). Orient fuel supply hose so that locating flange (2) is positioned as shown.
 - b. Install retaining bracket (3) so that U-shaped opening in bracket fits around fuel supply hose and locating flange as shown.
 - c. See [Figure 4-76](#). Secure retaining bracket (2) with screw (5). Tighten to 60 **in-lbs** (6.8 Nm).

NOTE

XR Models: See [Figure 4-75](#). The fuel injector harness leads must **NEVER** be routed between the retaining bracket (2) and induction module body. Improper routing will result in chafing of the insulation resulting in poor engine performance.

6. Connect engine sub-harness connectors to the fuel injectors. Ensure wire harnesses are routed outside the wings of retaining bracket (2) on XR models.

WARNING

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

7. **XL Models with 4.5 gallon (17.0 liter) fuel tank:** if the fuel tank was raised up to gain access to the fuel injectors, install fuel tank and seat:
 - a. Remove prop from under rear of fuel tank. Lower rear of fuel tank into position and install screw, washer and nut in fuel tank rear mounting holes. Tighten front and rear mounting screws to 15-20 ft-lbs (20.4-27.1 Nm). Install protective caps on screw ends. See [4.6 FUEL TANK: XL MODELS](#).
 - b. Install seat.
8. Connect fuel hose to fuel pump module. Fill fuel tank and carefully check for leaks around fuel pump module. See [4.6 FUEL TANK: XL MODELS](#).
9. **XL Models with side-mounted horn:** See [Figure 4-73](#). Plug harness connectors [122] into horn (4). Mount cylinder head bracket (1) on engine. Secure with washers (2) and screws (3). Tighten to 17-24 ft-lbs (23.1-32.6 Nm).
10. Install main fuse and close left side cover. See [6.38 MAIN FUSE](#).

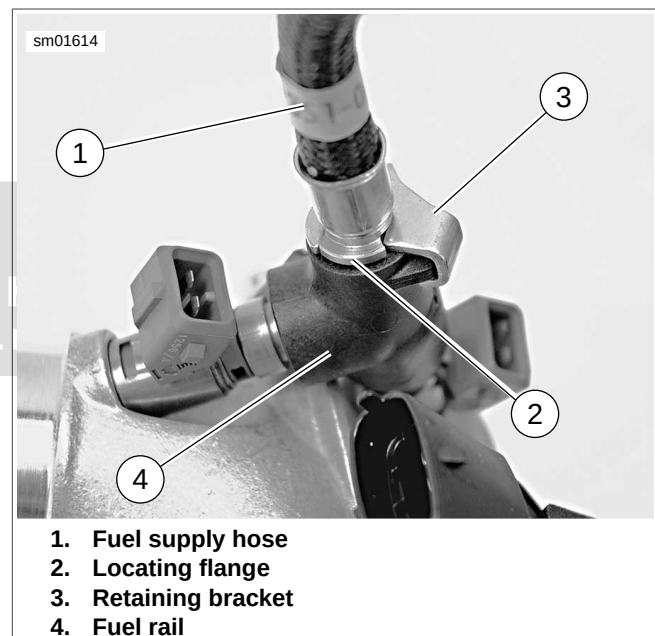


Figure 4-77. Mounting Fuel Hose and Fuel Rail (Typical: XL Model Shown)

FUEL PUMP

4.18

GENERAL

⚠ WARNING

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

⚠ WARNING

Do not replace the special Teflon coated fuel pump wiring with ordinary bulk wire. Ordinary insulation materials can deteriorate when put in contact with gasoline and cause an explosion, which could result in death or serious injury. (00566b)

NOTE

Carefully inspect fuel hose for cuts, tears, holes or other damage. Replace hose if any damage is found. Even a small hole can cause a reduction in fuel pressure.

Refer to the ELECTRICAL DIAGNOSTIC MANUAL for information on the function and testing of the fuel pump.

REMOVAL

⚠ WARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

1. Purge the fuel supply hose of high pressure gasoline. Disconnect fuel supply hose from fuel pump module. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

2. Unplug main fuse. See [6.38 MAIN FUSE](#).
3. See [Figure 4-78](#). Unplug fuel pump harness connector [141] (1), located forward of fuse/relay block on left side of vehicle.
4. **XL Models:** Remove seat.
5. Drain and remove fuel tank from vehicle. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).
6. See [Figure 4-79](#). Lay fuel tank upside-down on a soft cloth.
7. Remove five screws (3).
8. Carefully lift fuel pump module out of fuel tank. See [Figure 4-80](#). To facilitate removal, tilt module when it is almost completely free of fuel tank.

9. See [Figure 4-78](#). Remove and discard cover plate seal (7).

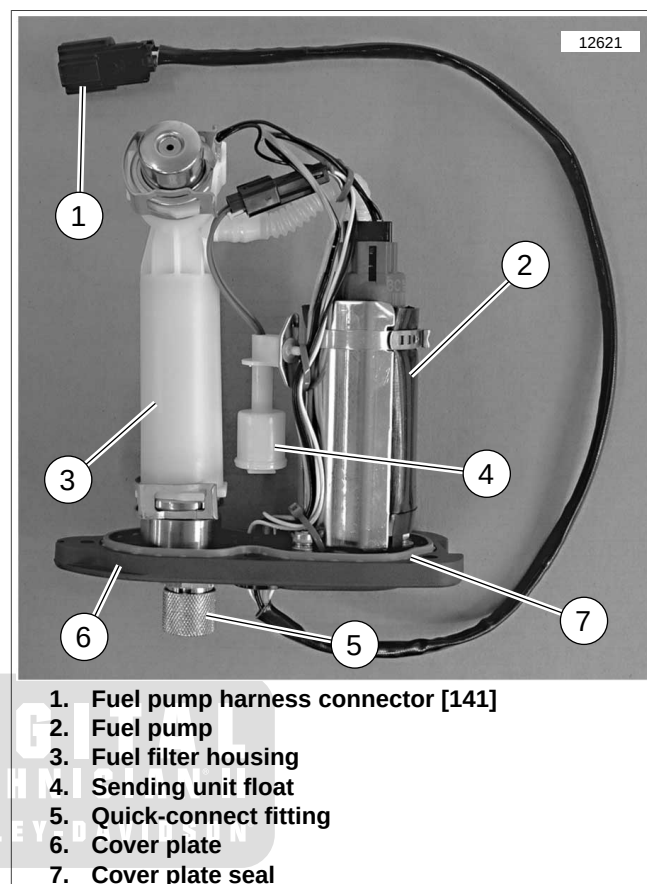


Figure 4-78. Fuel Pump Module

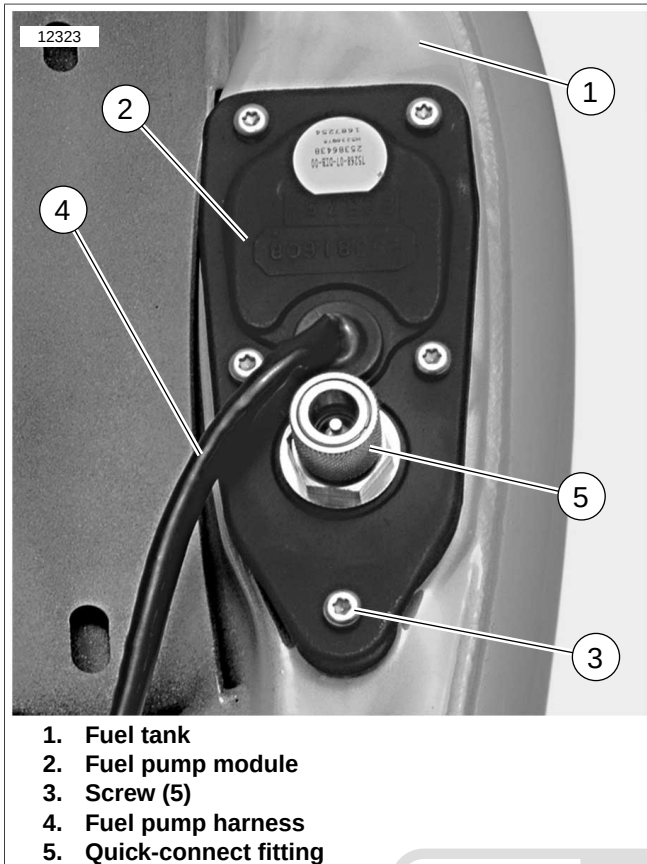


Figure 4-79. Fuel Pump Module: All Models (XL Shown)



Figure 4-80. Removing/Installing Fuel Pump Module: All Models (XL Shown)

DISASSEMBLY

The disassembly procedure is broken down into the following groups:

- Pressure regulator and filter housing.
- Fuel pump assembly and pump bracket.
- Low fuel level sensor assembly.
- Fuel pump/sender harness.

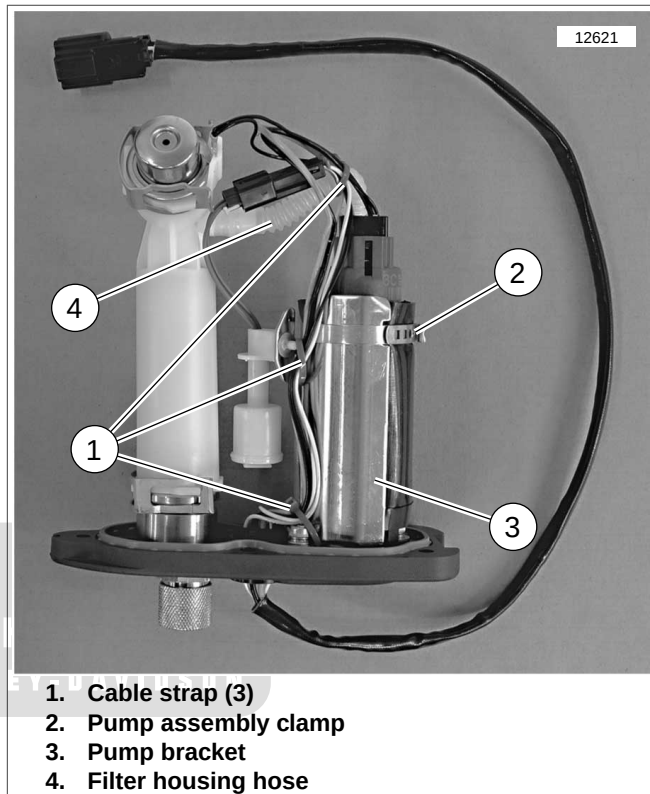


Figure 4-81. Fuel Pump Assembly: Location of Cable Straps and Pump Clamp

NOTE

See [Figure 4-81](#). When disassembling or assembling the fuel pump and sender assembly, refer to this figure for the relative positions of the wiring harness cable straps (1) and pump assembly clamp (2).

Pressure Regulator and Filter Housing

1. See [Figure 4-81](#). Cut and discard cable strap (1) securing wiring harness to the filter housing hose (4).
2. See [Figure 4-82](#). Remove ground clip (12) from top of filter housing (23).
3. Remove and discard clamp (1). Remove filter housing hose from top of fuel pump (2).
4. Remove retaining clip (24) from top of filter housing and remove pressure regulator (22).
5. Remove second retaining clip (24) from bottom of filter housing and remove filter housing. Remove fuel filter element (25) from housing.

6. Remove o-ring (26) from filter housing mount (19).

Fuel Pump Assembly and Pump Bracket

1. See [Figure 4-81](#). Make note of the location of any cable straps securing wiring harness to the fuel pump bracket (3). Cut and discard cable straps.
2. See [Figure 4-82](#). Unplug fuel pump harness connector [86] (13).
3. Unplug low fuel level sensor connector from fuel pump/sender harness (14).
4. Remove and discard clamp (1). Remove filter housing hose (11) from top of fuel pump (2).
5. Remove and discard pump assembly clamp (7). Remove pump assembly with pump insulator (3) from pump bracket (5).
6. Remove push nut (16) and low fuel level sensor assembly (17) from pump bracket.
7. Remove three screws w/lock washers (6) and remove pump bracket from cover plate (9).

Low Fuel Level Sensor Assembly

1. See [Figure 4-81](#). Make note of the location of cable strap (1) securing low fuel level sensor connector to filter housing hose (4). Cut and discard cable strap.
2. See [Figure 4-82](#). Unplug low fuel level sensor connector (15) from fuel pump/sender harness (14).
3. Remove push nut (16) and low fuel level sensor assembly (17) from pump bracket (5).

Fuel Pump/Sender Harness

1. See [Figure 4-81](#). Make note of the location of cable straps (1) securing fuel pump/sender harness to fuel pump bracket (3) and filter housing hose (4). Cut and discard cable straps.
2. See [Figure 4-82](#). Unplug low fuel level sensor connector (15) from fuel pump/sender harness (14). Unplug fuel pump harness connector [86] (13) from fuel pump.
3. Remove screw w/lock washer (6) securing fuel pump/sender harness grounding eyelet to pump bracket (5).
4. Remove retaining ring (18). Remove fuel pump/sender harness from cover plate (9).

ASSEMBLY

The assembly procedure is broken down into the following groups:

- Fuel pump/sender harness.
- Low fuel level sensor assembly.
- Fuel pump assembly and pump bracket.
- Pressure regulator and filter housing.

Fuel Pump/Sender Harness

1. See [Figure 4-82](#). Install fuel pump/sender harness (14) into cover plate (9). Secure with retaining ring (18).

2. Secure fuel pump/sender harness grounding eyelet to pump bracket (5) using screw w/lock washer (6). Tighten to 19-36 **in-lbs** (2.1-4.1 Nm).
3. Plug low fuel level sensor connector (15) into fuel pump/sender harness. Plug fuel pump harness connector [86] (13) into fuel pump (2).
4. See [Figure 4-81](#). Secure wiring harness to fuel pump bracket (3) and filter housing hose (4) with cable straps (1).

Low Fuel Level Sensor Assembly

1. See [Figure 4-82](#). Install low fuel level sensor assembly (17) onto pump bracket (5). Secure with push nut (16).
2. Plug low fuel level sensor connector (15) into fuel pump/sender harness (14).
3. See [Figure 4-81](#). Secure low fuel level sensor connector and fuel pump/sender harness to filter housing hose (4) with cable strap (1).

Fuel Pump Assembly and Pump Bracket

1. See [Figure 4-82](#). Install pump bracket (5) onto cover plate (9). Secure with three screws w/lock washers (6). Tighten to 19-36 **in-lbs** (2.1-4.1 Nm).
2. Install low fuel level sensor assembly (17) onto pump bracket. Secure with push nut (16).
3. Install fuel pump assembly (2) with pump insulator (3) onto pump bracket. Secure with pump assembly clamp (7) (for relative position of clamp, see [Figure 4-81](#).)
4. Install filter housing hose (11) on top of fuel pump. Secure with clamp (1).
5. Plug in fuel pump harness connector [86] (13).
6. See [Figure 4-81](#). Secure fuel pump/sender harness to fuel pump bracket (3) with cable straps (1).

Pressure Regulator and Filter Housing

1. See [Figure 4-82](#). Examine o-ring (26) for cuts, tears, cracking or other damage. Replace with **new** o-ring if necessary (only available as part of filter kit). Install o-ring onto filter housing mount (19).
2. Install fuel filter element (25) into filter housing (23). Install filter housing onto filter housing mount. Secure with retaining clip (24) at bottom of housing, making sure that clip is oriented exactly as shown in [Figure 4-82](#).
3. Install pressure regulator (22) on top of filter housing. Secure with second retaining clip (24), making sure that clip is oriented exactly as shown in [Figure 4-82](#).
4. Install filter housing hose (11) on top of fuel pump (2). Secure with clamp (1).
5. Install ground clip (12) on top of filter housing.
6. See [Figure 4-81](#). Secure fuel pump/sender harness to filter housing hose (4) with cable strap (1).

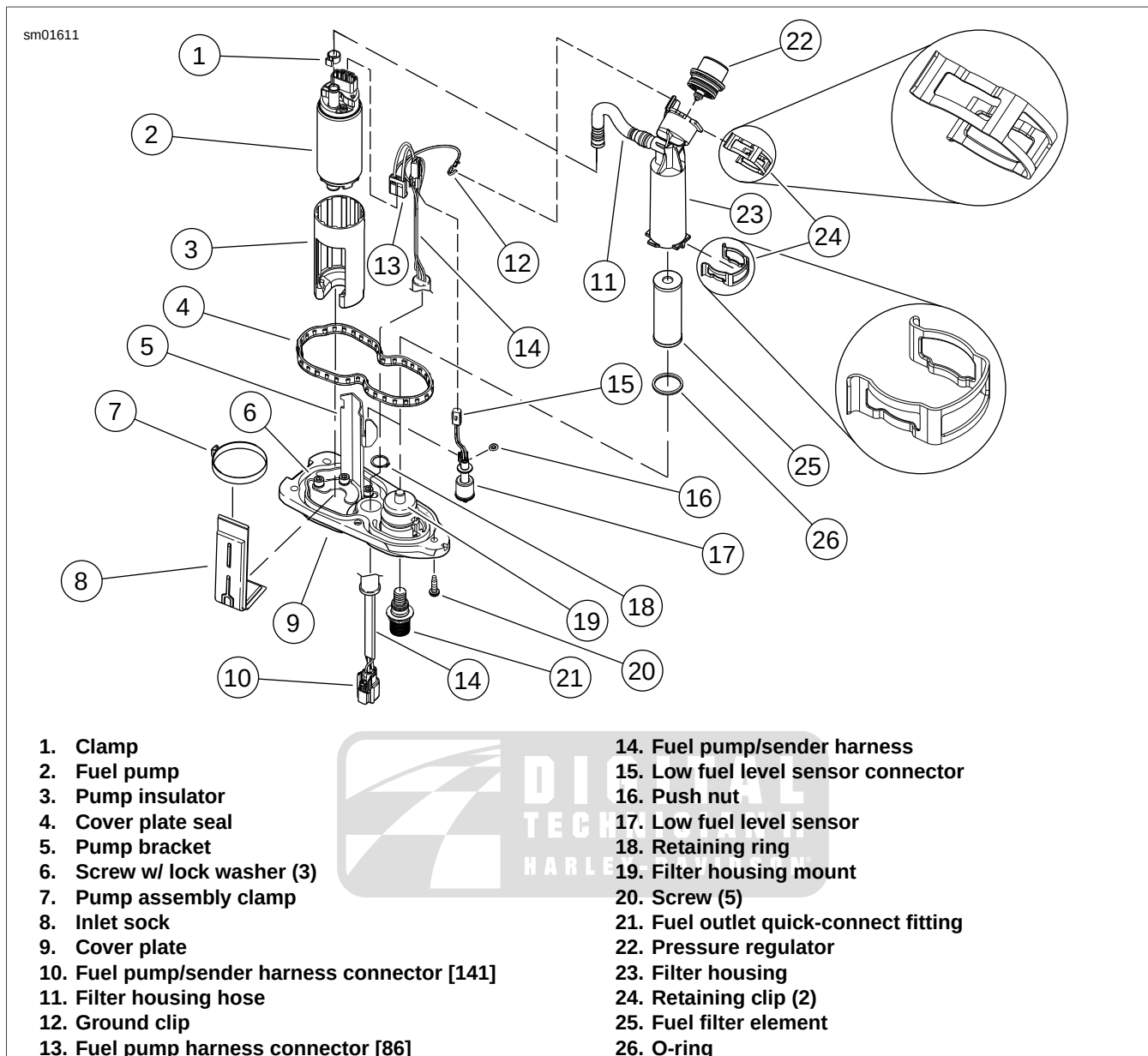


Figure 4-82. Fuel Pump and Sender Assembly

INSTALLATION

- See [Figure 4-82](#). Install **new** cover plate seal (4) into groove in cover plate (9).
- Carefully install fuel pump module into fuel tank. See [Figure 4-80](#). To facilitate installation, tilt module as you begin to lower it into fuel tank, as shown in the photo. Then straighten module to complete installation.
- See [Figure 4-79](#). Install five screws (3). Tighten to 40-45 **in-lbs** (4.5-5.1 Nm).
- Install fuel tank on vehicle. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).
 - Make sure fuel pump harness fits in wire harness caddy latch clip with loop in harness between latch clip and fuel pump module to avoid harness being pinched between fuel tank and frame backbone.
 - Plug in fuel pump harness connector [141].
 - Connect vent hose to fuel tank vent nipple.
- Connect fuel hose to fuel tank. Fill fuel tank and carefully check for leaks around fuel pump module. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).
- Install main fuse. Close left side cover. See [6.38 MAIN FUSE](#).

7. Turn ignition switch ON and verify fuel pump is activated. Carefully inspect for leaks at quick-connect fitting. Turn ignition switch OFF.

⚠ WARNING

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

8. **XL Models:** Install seat.



FUEL PRESSURE TEST

4.19

GENERAL

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

⚠ WARNING

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

The fuel pump delivers fuel to the fuel hose, a cavity in the induction module that supplies the fuel injectors, and to the pressure regulator. Excess fuel pressure is bypassed to the fuel tank through the pressure regulator.

See [Figure 4-83](#). The fuel pump fuse is located in a fuse panel behind the left side cover. The fuel pump can be turned on with DIGITAL TECHNICIAN II (Part No. HD-48650) or by applying battery voltage to the fuel pump fuse.

Improper fuel system pressure may contribute to one of the following conditions:

- Cranks, but won't run.
- Cuts out (may feel like ignition problem).
- Hesitation, loss of power or poor fuel economy.

NOTE

Refer to the *ELECTRICAL DIAGNOSTIC MANUAL* for further information on the function and testing of the fuel system.

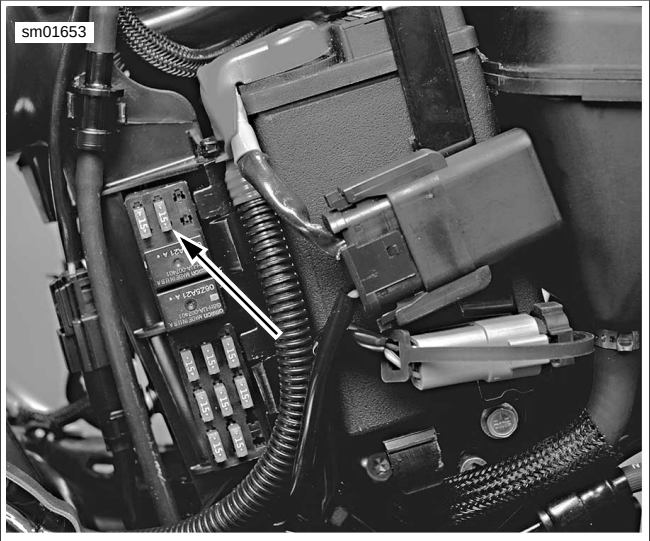


Figure 4-83. Fuel Pump Fuse

TESTING

PART NUMBER	TOOL NAME
HD-41182	FUEL PRESSURE GAUGE
HD-44061	FUEL PRESSURE GAUGE ADAPTER

NOTE

Be sure to avoid kinking the fuel hose when installing or removing fuel pressure gauge and adapter.

1. Purge the fuel supply hose of high pressure gasoline. Disconnect fuel supply hose from fuel pump module. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).
2. See [Figure 4-84](#). Attach FUEL PRESSURE GAUGE ADAPTER (Part No. HD-44061) (1) as follows:
 - a. See [Figure 4-85](#). Pull up on sleeve of fuel tank quick-connect fitting (2) and insert neck of FUEL PRESSURE GAUGE ADAPTER (3) into quick-connect fitting.
 - b. While pushing up on bottom of adapter, pull down on sleeve until it "clicks" into the locked position. Tug on adapter to be sure that it is locked in place and will not come free.
 - c. In the same manner, connect vehicle's fuel supply hose fitting (1) to quick-connect fitting (4) on FUEL PRESSURE GAUGE ADAPTER.

⚠ WARNING

To prevent spray of fuel, be sure quick-connect fittings are properly mated. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00268a)

3. Verify that the fuel valve (item 6, [Figure 4-85](#).) and air bleed petcock on the FUEL PRESSURE GAUGE (Part No. HD-41182) are closed.
4. See [Figure 4-84](#). Remove protective cap from free end of fuel pressure gauge adapter. Connect fuel pressure gauge to Schroeder valve.
5. Start and idle engine to pressurize the fuel system. Open the fuel valve to allow the flow of fuel down the hose of the pressure gauge.
6. Position the clear air bleed tube in a suitable container and open and close the air bleed petcock to purge the gauge and hose of air. Repeat this step several times until only solid fuel (without bubbles) flows from the air bleed tube. Close the petcock.
7. Open and close throttle to change engine speed. Note the reading of the pressure gauge. Fuel pressure should remain steady at 55-62 psi (380-425 kPa).

NOTE

If fuel pressure gauge reading is not within specifications, see *ELECTRICAL DIAGNOSTIC MANUAL* for further diagnosis.

8. Turn the engine OFF. Position the air bleed tube in a suitable container. Open the air bleed petcock to relieve the fuel system pressure and purge the pressure gauge of gasoline.

⚠ WARNING

Gasoline can drain from the adapter when gauge is removed. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00254a)

9. Remove fuel pressure gauge from the adapter. Install protective cap over Schroeder valve.

⚠ WARNING

Gasoline can drain from the fuel line and adapter when removed. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00255a)

10. Pull up on knurled sleeve of FUEL PRESSURE GAUGE ADAPTER quick-connect fitting and remove vehicle's fuel supply hose from adapter. Release adapter from fuel tank in the same manner.

⚠ WARNING

To prevent spray of fuel, be sure quick-connect fittings are properly mated. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00268a)

11. Push up on release sleeve of fuel pump quick-connect fitting and push fuel hose fitting into quick-connect fitting. Pull down on release sleeve to lock quick-connect fitting. Tug on fuel hose fitting to make sure it is securely locked in place.

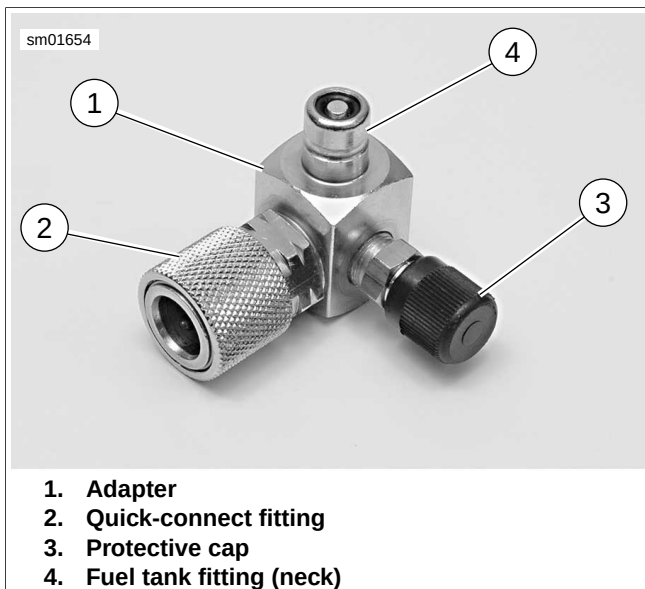


Figure 4-84. Fuel Pressure Gauge Adapter (Part No. HD-44061)

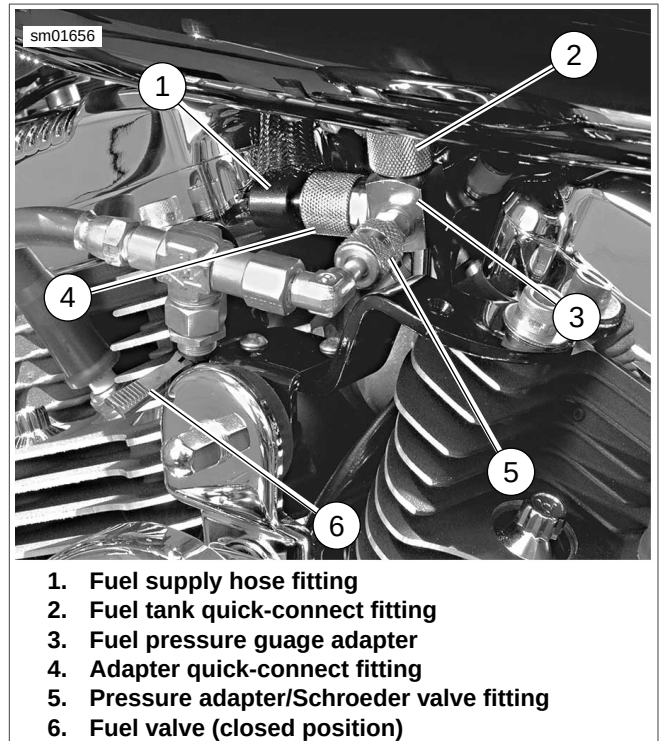


Figure 4-85. Assembling Adapter, Gauge and Fuel Supply Hose to Fuel Tank: All Models (XL 1200C Shown)

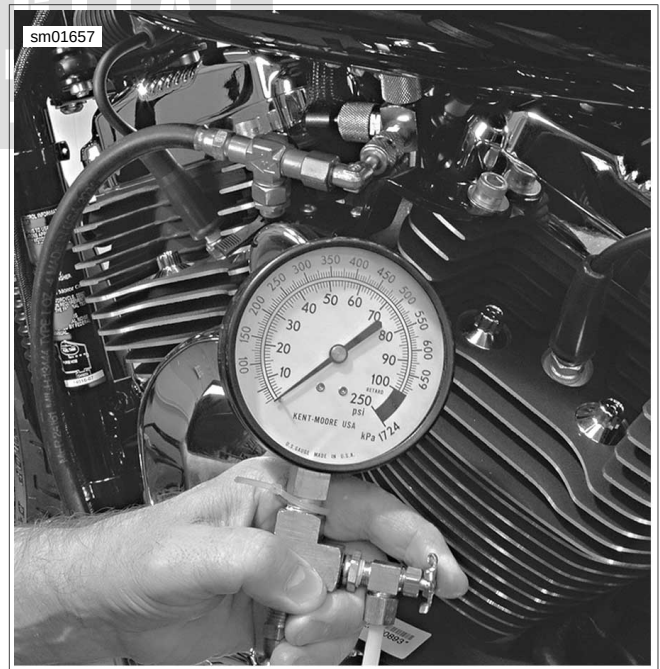


Figure 4-86. Fuel Pressure Gauge Installed: All Models (XL 1200C Shown)

INTAKE LEAK TEST

GENERAL

⚠ WARNING

Do not allow open flame or sparks near propane. Propane is extremely flammable, which could cause death or serious injury. (00521b)

⚠ WARNING

Read and follow warnings and directions on propane bottle. Failure to follow warnings and directions can result in death or serious injury. (00471b)

NOTES

- To prevent false readings, keep air cleaner cover installed when performing test.
- Do not direct propane into air cleaner; false readings will result.
- Be careful when testing vehicle with Screamin' Eagle air cleaner assembly. This type of air cleaner has an open backing plate. Even with air cleaner cover on, directing nozzle too close to backing plate can give false readings.

LEAK TESTER

PART NUMBER	TOOL NAME
HD-41417	PROPANE ENRICHMENT KIT

Parts List

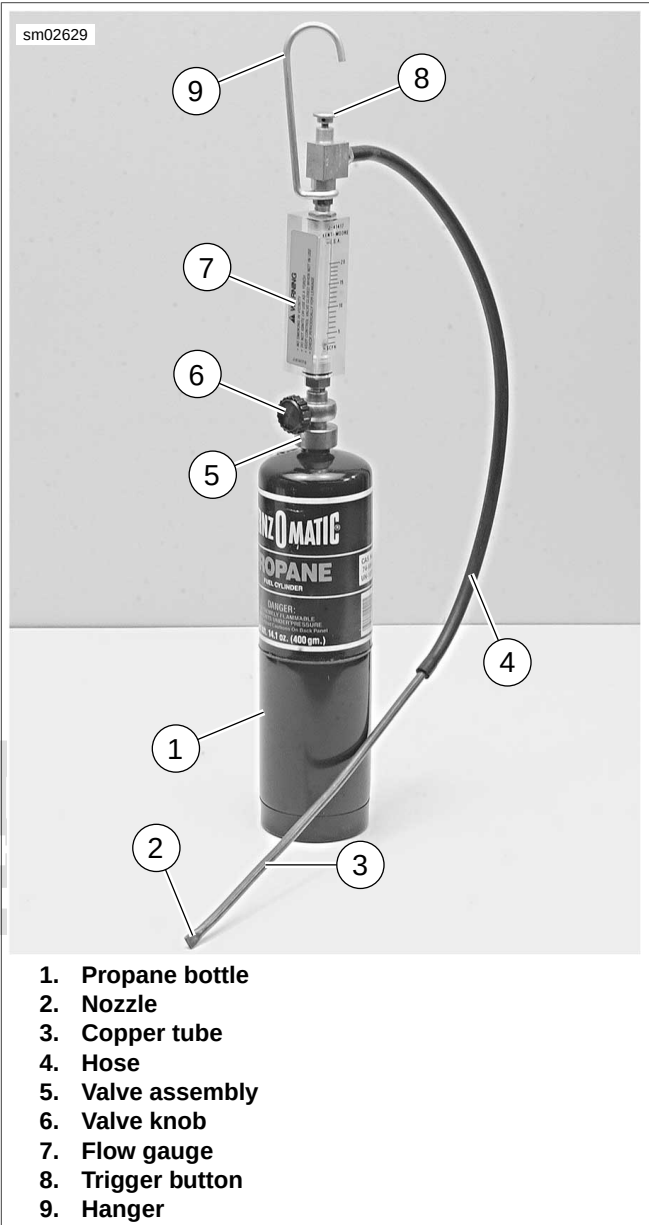
- Standard 14 oz. propane cylinder.
- PROPANE ENRICHMENT KIT (Part No. HD-41417).

Tester Assembly

- See [Figure 4-87](#). Make sure valve knob (6) is closed (fully clockwise).
- Screw valve assembly (5) onto propane bottle (1).

Tester Adjustment

- See [Figure 4-87](#). Press and hold trigger button (8).
- Slowly open valve knob (6) until pellet in flow gauge (7) rises to between 5 and 10 SCFH on gauge.
- Release trigger button.



- Propane bottle
- Nozzle
- Copper tube
- Hose
- Valve assembly
- Valve knob
- Flow gauge
- Trigger button
- Hanger

Figure 4-87. Leak Tester

PROCEDURE

- Start engine.
- Warm up engine to operating temperature.

NOTE

Do not direct propane stream toward air cleaner. If propane enters air cleaner, a false reading will be obtained.

- See [Figure 4-88](#). Aim nozzle (3) toward possible sources of leak such as intake manifold mating surfaces.
- Press and release trigger button (2) to dispense propane. Tone of engine will change when propane enters source of leak. Repeat as necessary to detect leak.

5. When test is finished, close valve knob (turn knob fully clockwise).

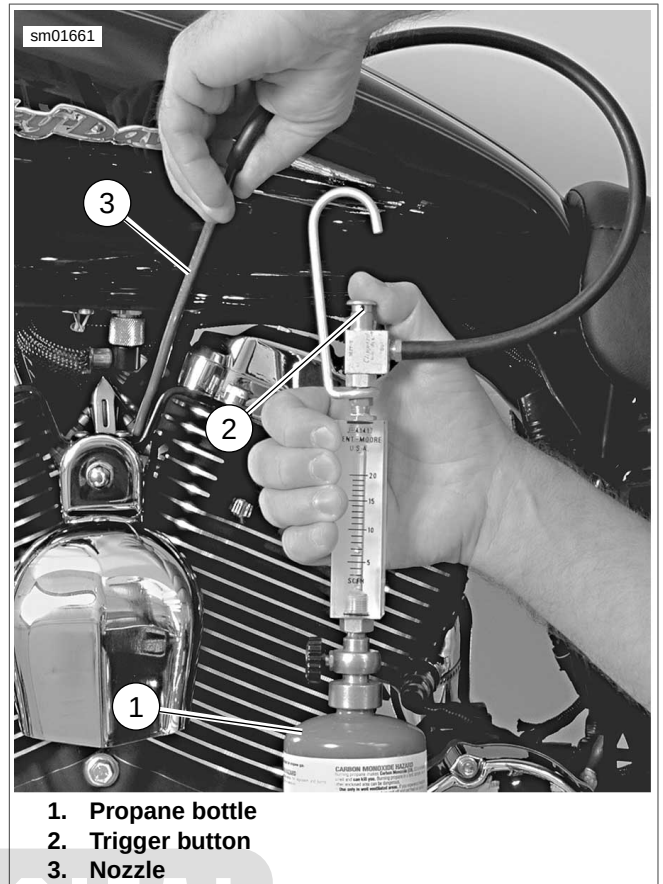


Figure 4-88. Checking for Leaks: All Models (XL 1200C Shown)



EVAPORATIVE EMISSIONS CONTROL (CA MODELS)

4.21

GENERAL

Harley-Davidson motorcycles sold in the state of California are equipped with an evaporative (EVAP) emissions control system. The EVAP system prevents fuel hydrocarbon vapors from escaping into the atmosphere and is designed to meet the California Air Resource Board (CARB) regulations in effect at the time of manufacture.

See [Figure 4-89](#). The EVAP functions in the following manner:

- Hydrocarbon vapors in the fuel tank (2, 10) are directed through the vapor valve (4) or vent fitting (9) and stored in the charcoal canister (3). If the vehicle is tipped at an abnormal angle, the vapor valve closes to prevent liquid gasoline from leaking out of the fuel tank into the charcoal canister through the vapor valve hoses (5, 6).
- When the engine is not running, the gravity operated trap door in the air cleaner's snorkel is closed to seal the inlet port of the air cleaner backplate. This prevents hydrocarbon vapors emanating from the induction module throat from escaping into the atmosphere.
- When the engine is running, the vacuum created in the inlet pulls the gravity-operated trap door open allowing air to enter. Intake venturi negative pressure (vacuum) slowly draws off the hydrocarbon vapors from the charcoal canister through the canister-to-induction module purge hose. These vapors pass through the intake and are burned as part of normal combustion in the engine.

WARNING

Keep evaporative emissions vent lines away from exhaust and engine. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00266a)

NOTE

The EVAP system has been designed to operate with a minimum of maintenance. Check that all hoses are properly connected, are not pinched, kinked, cracked or torn, and are routed properly. Improper connections could leak charcoal from canister.

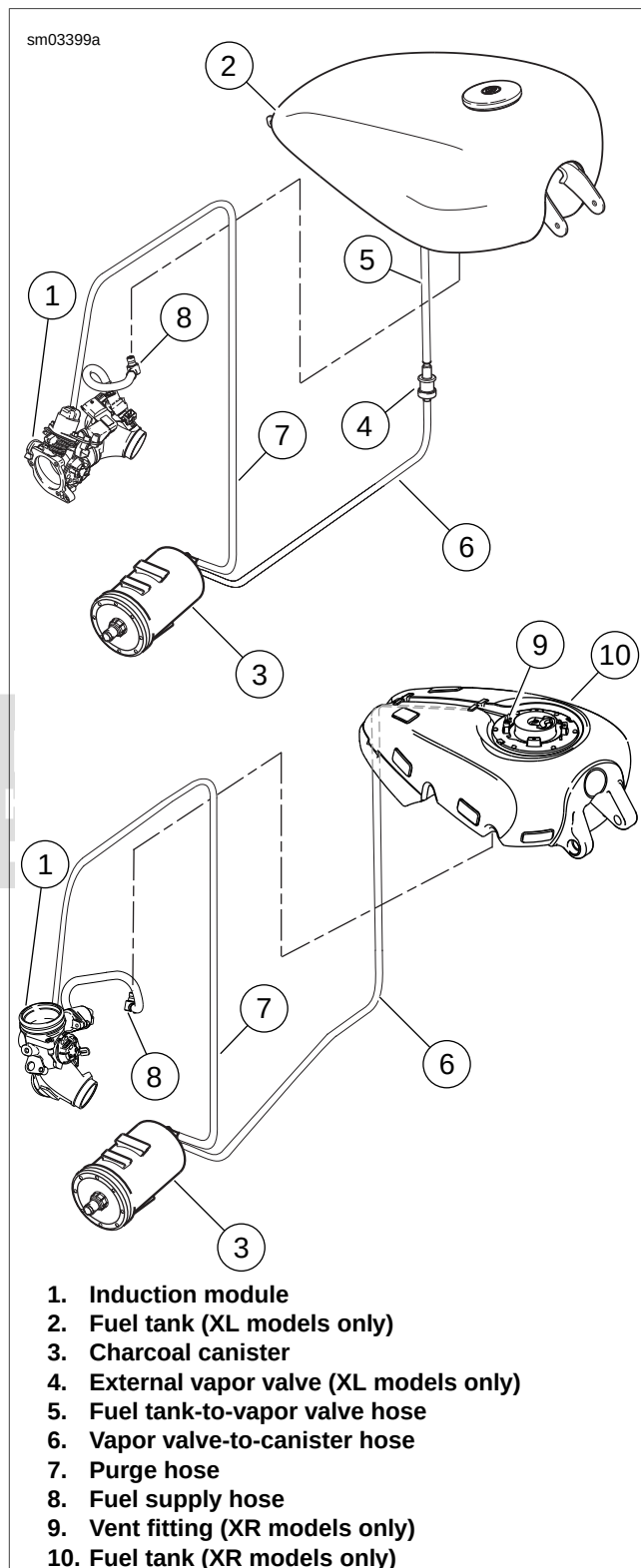


Figure 4-89. California Evaporative Emissions Control System (typical)

CHARCOAL CANISTER

The charcoal canister is mounted to a bracket attached to the rear brake master cylinder bracket, near the bottom of the frame in front of the rear fork pivot point.

Removal

1. See [Figure 4-90](#). Remove two screws (1) and canister guard (2).
2. Mark the two hoses (9, 10) connected to charcoal canister (6). Disconnect hoses from canister.
3. Depress locking tabs at left end of canister clip (5). Slide canister towards left side of vehicle until it disengages from canister clip.
4. Remove two screws (7) and washers (8) to detach canister clip from canister mounting bracket (3).

CAUTION

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

CAUTION

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

NOTE

If D.O.T. 4 brake fluid contacts painted surfaces, IMMEDIATELY flush area with clear water.

5. **XL Models:** If canister mounting bracket requires repair/replacement, proceed as follows:
 - a. Drain rear master cylinder reservoir and detach reservoir hose from rear master cylinder. See [2.15 REAR BRAKE MASTER CYLINDER RESERVOIR](#).
 - b. Remove two screws (4) to detach canister mounting bracket from rear master cylinder mounting bracket.
6. **XR Models:** See [Figure 4-91](#). If canister mounting bracket requires repair/replacement, remove two screws (2) to detach canister mounting bracket from frame.

NOTE

It is not necessary to remove brake line clamp screw (1).

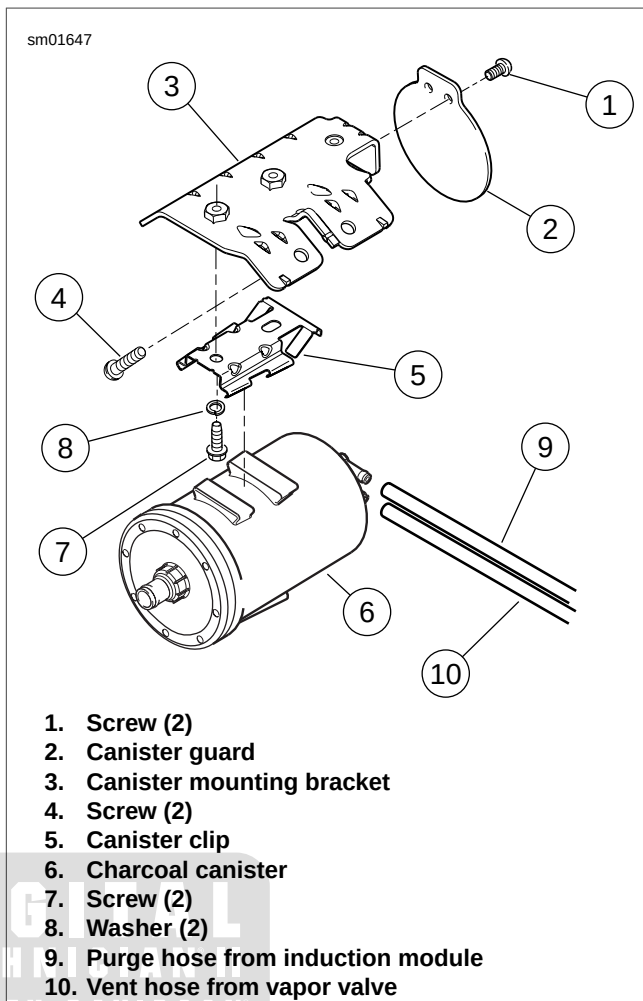


Figure 4-90. Charcoal Canister Mounting (Typical)

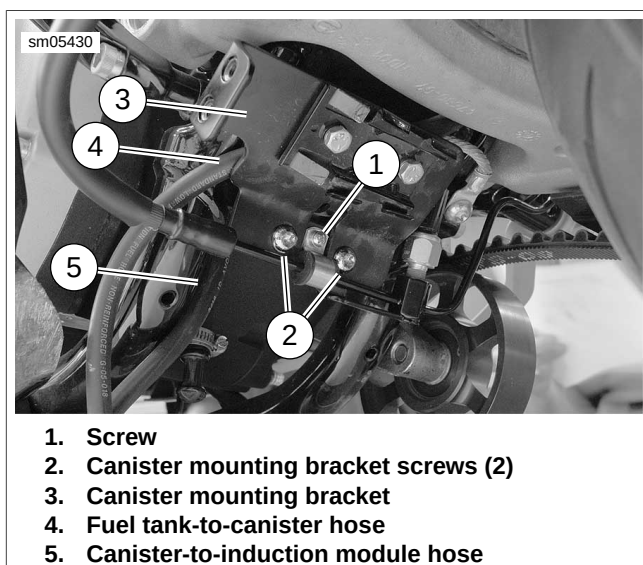


Figure 4-91. Charcoal Canister Mount: XR Models

Installation

CAUTION

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

CAUTION

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

NOTE

If D.O.T. 4 brake fluid contacts painted surfaces, IMMEDIATELY flush area with clear water.

1. **XL Models:** See [Figure 4-90](#). If canister mounting bracket (3) was removed, proceed as follows:
 - a. Attach bracket (3) and rear brake line bracket (not visible) to rear master cylinder mounting bracket and frame with two screws (4). Tighten to 17-22 ft-lbs (23.1-29.9 Nm).
 - b. Attach rear master cylinder reservoir feed hose to rear master cylinder feed hose port fitting.
 - c. With motorcycle upright, fill reservoir with Harley-Davidson D.O.T. 4 BRAKE FLUID until the fluid level reaches the UPPER mark on the reservoir. See [2.15 REAR BRAKE MASTER CYLINDER RESERVOIR](#).
 - d. Bleed rear brake system. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#).
2. **XR Models:** See [Figure 4-91](#). If canister mounting bracket (3) was removed, proceed as follows:
 - a. Apply Loctite Threadlocker 243 (blue) to the threads of the mounting screws (2).
 - b. Install bracket and tighten screws (2) to 17-22 ft-lbs (23.1-29.9 Nm).
3. See [Figure 4-90](#). Attach canister clip (5) to canister mounting bracket with two screws (7) and two washers (8). Tighten to 36-60 **in-lbs** (4.1-6.8 Nm).
4. Starting at left side of canister clip, slide charcoal canister (6) to the right until tabs on canister clip lock canister in place. Bend tabs outward somewhat if canister is not held securely.
5. See [Figure 4-92](#). Connect two hoses (1, 2), marked during disassembly, to their proper fittings on canister.
6. See [Figure 4-90](#). Install canister guard (2) using two screws (1). Tighten to 35-45 **in-lbs** (4.0-5.1 Nm).

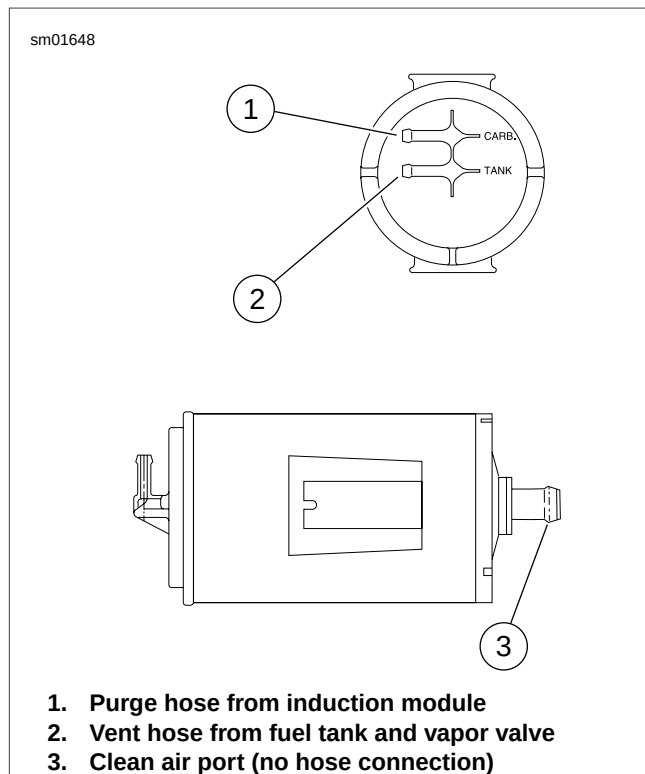


Figure 4-92. Charcoal Canister Connections

VAPOR VALVE: XL MODELS

Removal

NOTES

- On XL Models, the vapor valve is located beneath the seat in front of the battery, in a clip molded into frame-mounted H-bracket.
 - On XR Models, the vapor valve is incorporated in the fuel tank filler housing. See [4.7 FUEL TANK: XR MODELS](#) for service procedures.
1. Open left side cover. See [2.20 LEFT SIDE COVER](#).
 2. See [Figure 4-93](#). Carefully remove vapor valve (2) from clip (4) molded into H-bracket (6).
 3. Mark two hoses (1, 3) connected to upper and lower fittings of vapor valve. Remove hoses from fittings.

NOTE

On non-California models, charcoal canister is absent and bottom hose of vapor valve is vented to the atmosphere.

Installation

WARNING

Keep vent and vapor valve lines away from exhaust and engine. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00263a)

NOTE

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. See [Figure 4-93](#). Hold vapor valve (2) in an upright position with the long necked end pointing up. Insert top fitting of vapor valve into fuel tank-to-vapor valve hose (1). Install bottom vapor valve fitting into vapor valve-to-canister hose (3).
2. Carefully push body of vapor valve into clip (4) molded into H-bracket (6).

NOTE

Do NOT force vapor valve into clip. Forcing valve in to clip could cause clip to break, necessitating replacement of entire wiring harness guide.

3. Close left side cover.

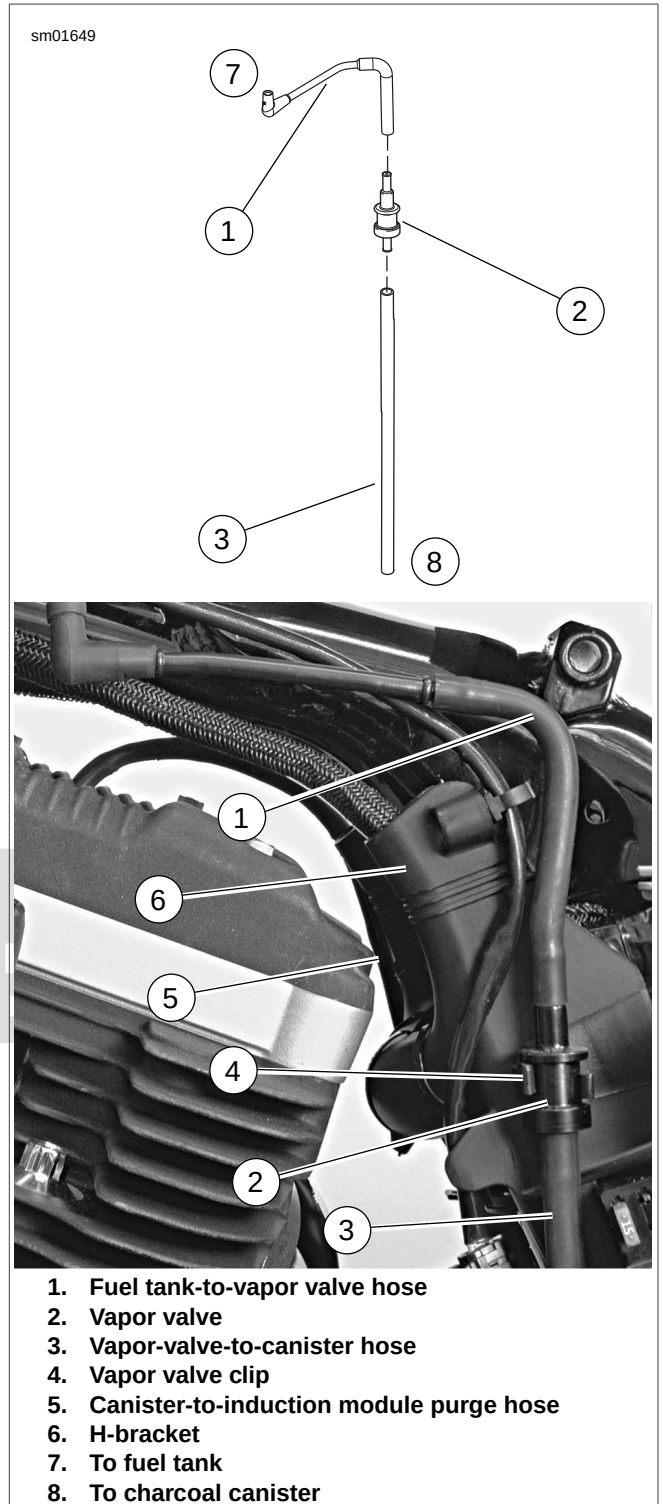


Figure 4-93. Vapor Valve and Hose Routing: XL California Models

HOSE ROUTING

See [Figure 4-89](#), and then see Canister Hose Routings.

Induction Module

See [Figure 4-94](#). Route the evaporative emissions control hose at the induction module as shown. **For XL models:** to access

the hose, remove the fuel tank and air cleaner/backplate assembly as necessary.

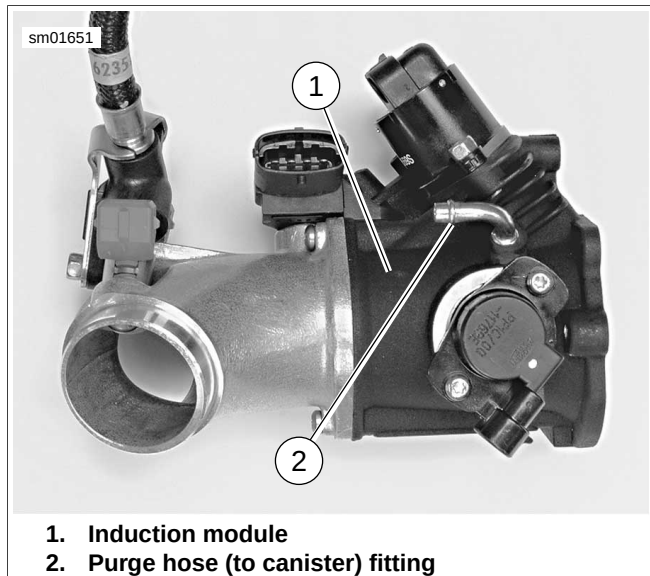


Figure 4-94. Emissions Hose Routing at Induction Module

Canister Hose Routings: XL Models

1. See [Figure 4-93](#). Connect vapor valve-to-canister hose (3) and canister-to-induction module purge hose (5) to labeled fittings on left side of charcoal canister.
2. Route both hoses up behind rear brake reservoir hose, between rear fork pivot point and rear end of crankcase.
3. Connect vapor valve-to-canister hose to bottom of vapor valve (2).
4. Connect fuel tank-to-vapor valve hose (1) at top of vapor valve.
5. See [Figure 4-95](#). Route fuel tank-to-vapor valve hose (2) forward along left side of frame backbone and connect to fitting on bottom of fuel tank (1).
6. Route canister-to-induction module purge hose up right side of frame rear downtube. Continue routing hose forward along right side of frame backbone tube and down, connecting hose to induction module fitting.
7. Secure hose to boss on rear end of right wire harness caddy with a barbed cable strap. Press barbed prong of cable strap into hole in caddy boss. Ensure that hose is positioned up against engine sub-harness. Hose should be routed as far from rear rocker cover as possible.

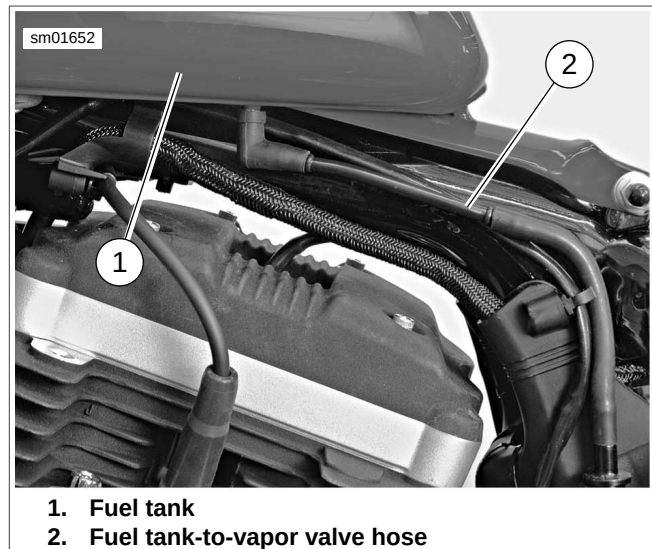


Figure 4-95. Fuel Tank-to-Vapor Valve Hose Routing

Canister Hose Routings: XR Models

1. See [Figure 4-96](#). Route both hoses up past canister mount and between rear fork pivot point and rear end of crankcase as shown.
2. See [Figure 4-97](#). Route fuel vapor hose (4) up along left side of frame rear downtube and outside the left electrical caddy. Connect to vapor tube (2).
3. Connect vapor tube (2) to fitting (1) on fuel tank filler housing and place in channel on top of fuel tank.
4. Secure to electrical caddy with barbed clamp (3).
5. See [Figure 4-98](#). Route canister-to-induction module purge hose (1) up right side of frame rear downtube. Continue routing hose forward along right side of frame backbone tube and down, connecting hose to induction module fitting (3).
6. Secure hose to channels on rear end of right wire harness caddy (4). Ensure that hose is positioned up against engine sub-harness. Secure hose and harness with clamp (2).
7. Connect hoses to labeled fittings on left side of charcoal canister.

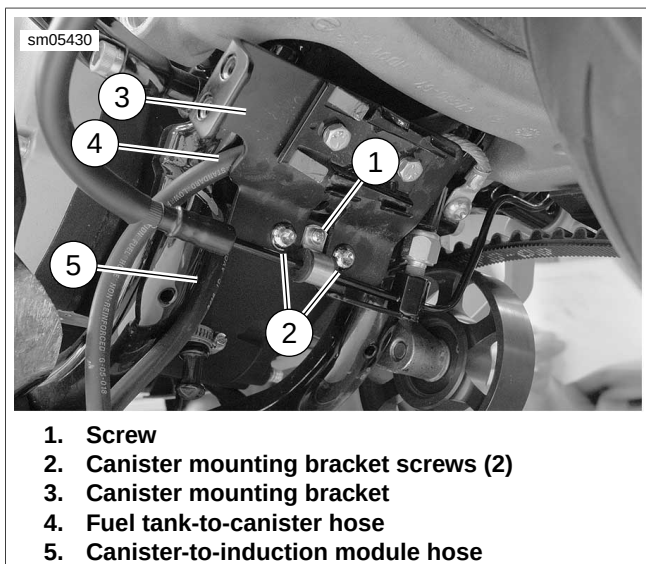


Figure 4-96. Charcoal Canister Mount: XR Models

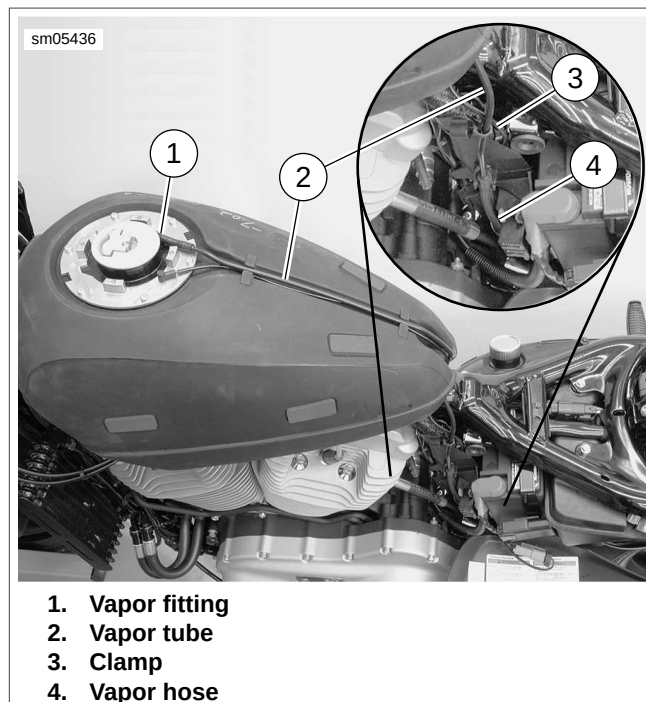


Figure 4-97. Vapor Hose Routing

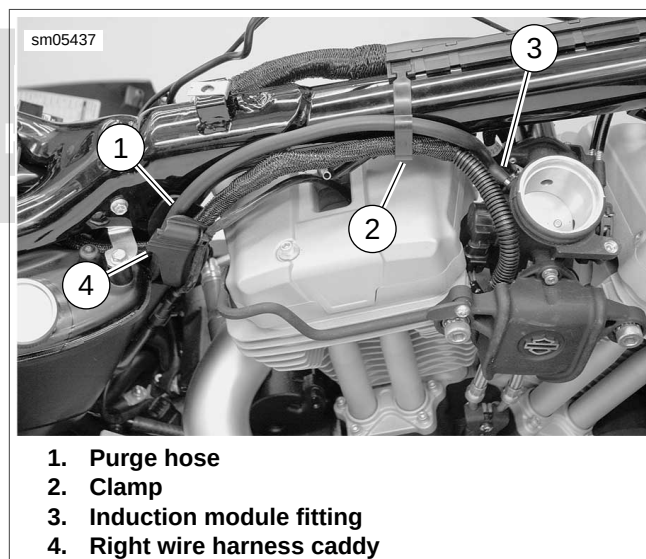


Figure 4-98. Purge Hose Routing

NOTES



TABLE OF CONTENTS

SUBJECT	PAGE NO.
5.1 FASTENER TORQUE VALUES.....	5-1
5.2 SPECIFICATIONS: DRIVE.....	5-3
5.3 PRIMARY CHAIN ADJUSTER.....	5-4
5.4 CLUTCH RELEASE MECHANISM.....	5-9
5.5 PRIMARY DRIVE AND CLUTCH: XL MODELS.....	5-12
5.6 PRIMARY DRIVE AND CLUTCH: XR MODELS.....	5-20
5.7 DRIVE BELT.....	5-30
5.8 TRANSMISSION.....	5-35
5.9 CASE DISASSEMBLY FOR TRANSMISSION REMOVAL.....	5-37
5.10 TRANSMISSION REMOVAL AND DISASSEMBLY.....	5-41
5.11 TRANSMISSION ASSEMBLY.....	5-48
5.12 MAIN DRIVE GEAR AND BEARING.....	5-50
5.13 TRANSMISSION RIGHT CASE BEARINGS.....	5-59
5.14 TRANSMISSION LEFT CASE BEARINGS.....	5-60
5.15 TRANSMISSION INSTALLATION.....	5-61
5.16 TRANSMISSION SPROCKET.....	5-67



NOTES



FASTENER TORQUE VALUES

5.1

FASTENER TORQUE VALUES IN THIS CHAPTER

The table below lists torque values for all fasteners presented in this chapter.

FASTENER	TORQUE VALUE		NOTES
Axle nut, rear	95-105 ft-lbs	129-142 Nm	5.7 DRIVE BELT, Installation
Axle nut, rear	95-105 ft-lbs	129-142 Nm	5.7 DRIVE BELT, Installation
Belt guard screw, front	120-180 in-lbs	13.6-20.3 Nm	5.7 DRIVE BELT, Installation
Clutch cable end fitting	36-60 in-lbs	4.1-6.8 Nm	5.3 PRIMARY CHAIN ADJUSTER, Installation
Clutch inspection cover screw	84-108 in-lbs	9.5-12.2 Nm	5.3 PRIMARY CHAIN ADJUSTER, Installation
Clutch inspection cover screw	84-108 in-lbs	9.5-12.2 Nm	5.4 CLUTCH RELEASE MECHANISM, Assembly and Installation
Countershaft retaining screw	33-37 ft-lbs	44.8-50.2 Nm	5.15 TRANSMISSION INSTALLATION, Shifter Shaft Installation
Crankcase fastener	15-19 ft-lbs	20.3-25.8 Nm	5.15 TRANSMISSION INSTALLATION, Assembling Crankcases
Engine sprocket bolt: XR Models	155-165 ft-lbs	210.0-224.0 Nm	5.6 PRIMARY DRIVE AND CLUTCH: XR MODELS, Installation
Engine sprocket nut	240-260 ft-lbs	326-353 Nm	5.5 PRIMARY DRIVE AND CLUTCH: XL MODELS, Installation
Exhaust pipe clamp bracket final screws	80-120 in-lbs	9.0-13.6 Nm	5.7 DRIVE BELT, Installation
Exhaust pipe clamp bracket initial screw	30-33 ft-lbs	40.7-44.8 Nm	5.7 DRIVE BELT, Installation
Exhaust pipe clamp bracket screw	30-33 ft-lbs	40.7-44.8 Nm	5.16 TRANSMISSION SPROCKET, Installation
Forward and lower sprocket cover screws: XR models	80-120 in-lbs	9.0-13.6 Nm	5.7 DRIVE BELT, Installation
Gear detent assembly screw	90-110 in-lbs	10.2-12.4 Nm	5.15 TRANSMISSION INSTALLATION, Installation
Gear shift lever pinch screw	16-20 ft-lbs	21.7-27.1 Nm	5.3 PRIMARY CHAIN ADJUSTER, Installation
Idler pulley bracket flanged nut: XR models	33-35 ft-lbs	45-47 Nm	5.7 DRIVE BELT, Idler Pulley: XR Models Only
Idler pulley fastener: XR models	70-80 ft-lbs	95-109 Nm	5.7 DRIVE BELT, Idler Pulley: XR Models Only
Lower shock absorber screw	45-50 ft-lbs	61-68 Nm	5.7 DRIVE BELT, Installation
Lower shock absorber screw	45-50 ft-lbs	61-68 Nm	5.7 DRIVE BELT, Installation
Muffler interconnect bracket mounting screw	30-33 ft-lbs	40.7-44.8 Nm	5.16 TRANSMISSION SPROCKET, Installation
Neutral indicator switch	120-180 in-lbs	13.6-20.3 Nm	5.15 TRANSMISSION INSTALLATION, Assembling Crankcases
Primary chain adjuster lock nut	20-25 ft-lbs	27.1-33.9 Nm	5.3 PRIMARY CHAIN ADJUSTER, Installation
Primary cover screw	100-120 in-lbs	11.3-13.5 Nm	5.3 PRIMARY CHAIN ADJUSTER, Installation
Primary drain plug	14-30 ft-lbs	19.0-40.7 Nm	5.3 PRIMARY CHAIN ADJUSTER, Installation
Rear sprocket cover screw: XR models	30-33 ft-lbs	40.7-44.7 Nm	5.7 DRIVE BELT, Installation
Rider footrest support bracket mounting screw	45-50 ft-lbs	61-68 Nm	5.4 CLUTCH RELEASE MECHANISM, Assembly and Installation
Rider footrest support mounting bracket	45-50 ft-lbs	61-68 Nm	5.16 TRANSMISSION SPROCKET, Installation
Secondary drive belt deflector screws	36-60 in-lbs	4.1-6.8 Nm	5.7 DRIVE BELT, Installation
Sprocket cover fastener, large: XR models	30-33 ft-lbs	40.7-44.8 Nm	5.7 DRIVE BELT, Idler Pulley: XR Models Only

FASTENER	TORQUE VALUE		NOTES
Sprocket cover fastener, large: XR models	30-33 ft-lbs	40.7-44.8 Nm	5.16 TRANSMISSION SPROCKET, Installation
Sprocket cover fastener, small: XR models	80-120 in-lbs	9.0-13.6 Nm	5.7 DRIVE BELT, Idler Pulley: XR Models Only
Sprocket cover fastener, small: XR models	80-120 in-lbs	9.0-13.6 Nm	5.16 TRANSMISSION SPROCKET, Installation
Sprocket cover screw	80-120 in-lbs	9.0-13.6 Nm	5.16 TRANSMISSION SPROCKET, Installation
Transmission mainshaft nut	70-80 ft-lbs	95.0-108.6 Nm	5.5 PRIMARY DRIVE AND CLUTCH: XL MODELS, Installation
Transmission mainshaft nut	70-80 ft-lbs	95.0-108.6 Nm	5.6 PRIMARY DRIVE AND CLUTCH: XR MODELS, Installation
Transmission sprocket lockplate	90-110 in-lbs	10.2-12.4 Nm	5.16 TRANSMISSION SPROCKET, Installation
Transmission sprocket nut	50 ft-lbs	68 Nm	5.16 TRANSMISSION SPROCKET, Installation/See TRANSMISSION SPROCKET section for special procedure.



SPECIFICATIONS: DRIVE

5.2

2009 SPORTSTER SPECIFICATIONS

Table 5-1. Sprocket Teeth: 2009 Sportster Models

DRIVE	ITEM	NUMBER OF TEETH					
		XL 883 MODELS		XL 1200 MODELS		XR 1200	
		U.S. MODELS	WORLD MODELS	U.S. MODELS	WORLD MODELS	WORLD MODELS	JAPAN MODELS
Primary	Engine	34	34	38	38	34	38
	Clutch	57	57	57	57	57	57
Final	Transmission	28	28	29	30	28	28
	Rear wheel	68	68	68	68	68	68

Table 5-2. Overall Gear Ratios: 2009 Sportster Models

GEAR	XL 883 MODELS	XL 1200 MODELS		XR 1200 MODEL	
	ALL MODELS	U.S. MODELS	WORLD MODELS	WORLD MODELS	JAPAN MODELS
1st	10.782	9.315	9.004	10.782	9.647
2nd	7.702	6.653	6.432	7.702	6.891
3rd	5.728	4.948	4.783	5.728	5.125
4th	4.748	4.102	3.965	4.748	4.248
5th	4.071	3.517	3.400	4.071	3.643

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 5-3. Wet Clutch Multiple Disc Specifications

ITEM	NEW COMPONENTS		SERVICE WEAR LIMITS	
	IN	MM	IN	MM
CLUTCH PLATE THICKNESS				
Friction plate (fiber)	0.8666 ± 0.0031	2.200 ± 0.079	N/A	N/A
Steel plate	0.0629 ± 0.0020	1.598 ± 0.051	N/A	N/A
Clutch pack	N/A	N/A	0.6610 (minimum)	16.787 (minimum)
MAXIMUM ALLOWABLE WARPAGE				
Friction plate (fiber)	N/A	N/A	0.0059	0.150
Steel plate	N/A	N/A	0.0059	0.150

PRIMARY CHAIN ADJUSTER

5.3

GENERAL

The primary chain adjuster mechanism maintains proper tension on the primary chain.

An opening between the primary drive and transmission compartments allows the same lubricant supply to lubricate moving parts in both areas. 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 [5.5 PRIMARY DRIVE AND CLUTCH: XL MODELS](#).

REMOVAL

Primary Cover

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect battery cables (negative (-) cable first) before proceeding. (00307a)

1. Disconnect negative (-) battery cable from stud on engine crankcase behind starter motor assembly. See [1.17 BATTERY MAINTENANCE](#).
2. Open left side cover. See [2.20 LEFT SIDE COVER](#).
3. Remove positive (+) battery cable from battery positive (+) terminal. See [1.17 BATTERY MAINTENANCE](#).
4. Close left side cover.
5. Remove left side rider footrest and mounting bracket assembly.
 - a. **Models equipped with mid-mount foot controls:** see [2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS](#) or [2.42 RIDER FOOT CONTROLS: XR MODELS](#) for removal procedure.
 - b. **Models equipped with forward foot controls:** see [2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS](#) for removal procedure.
6. See [Figure 5-1](#). Place a drain pan under the engine. Remove drain plug (4) and drain lubricant from primary drive housing.
7. Loosen lock nut (6). Turn chain adjuster screw (5) counterclockwise to relax primary chain tension.
8. Remove gear shifter lever and rubber washer from transmission shifter shaft.
9. See [Figure 5-2](#). Slide rubber boot (1) on clutch cable adjuster (2) upward to expose adjuster mechanism. Loosen jam nut (3) from adjuster. Turn adjuster to shorten cable housing until there is a large amount of freeplay at clutch hand lever. See [1.13 CLUTCH, Adjustment](#).
10. See [Figure 5-3](#). Remove six screws (1) and clutch inspection cover (2). Remove quad ring (7) from groove in primary cover (8). Discard quad ring.

11. Slide hex lockplate and attached spring (3) from flats of adjusting screw (9).
12. Turn adjusting screw clockwise to release ramp assembly (5) and coupling mechanism (6). As the adjusting screw is turned, ramp assembly moves forward. Remove nut (4) from end of adjusting screw.
13. Remove hook of ramp from cable coupling. Remove clutch cable end from slot in coupling. Remove coupling and ramp assembly.
14. Turn cable end fitting (14) counterclockwise to remove clutch cable lower section from primary cover. Remove and discard o-ring (12) from cable end fitting.
15. Remove sixteen screws with captive washers (11) securing primary cover to engine crankcase. Remove cover and gasket (10). Discard gasket.
16. See [Figure 5-4](#). Remove and discard shifter shaft oil seal (4).
17. Clean all metal parts in a non-volatile cleaning solution or solvent.

⚠ WARNING

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

18. Blow parts dry with low pressure compressed air.

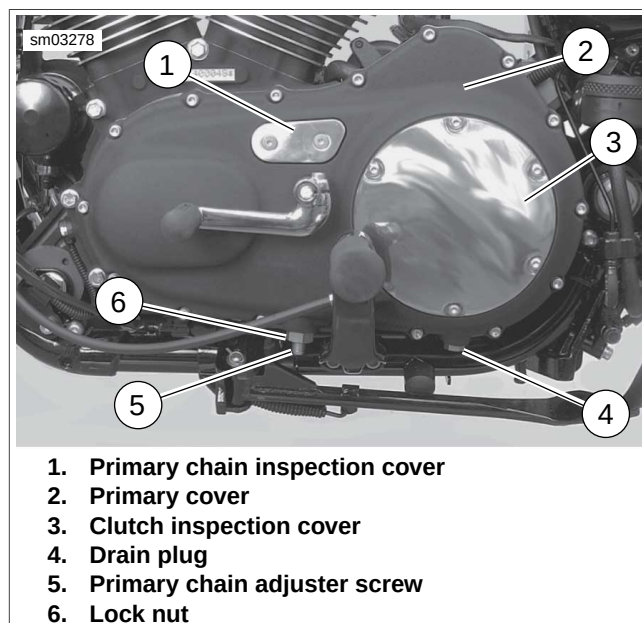


Figure 5-1. Primary Cover: All Models (XL Model Shown)

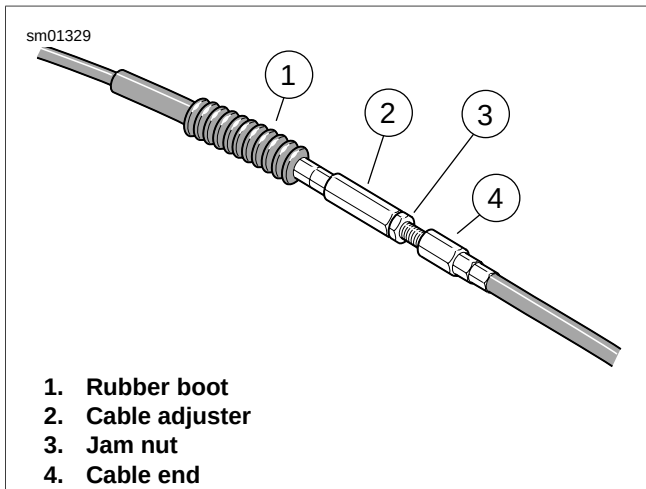


Figure 5-2. Clutch Cable Adjuster Mechanism

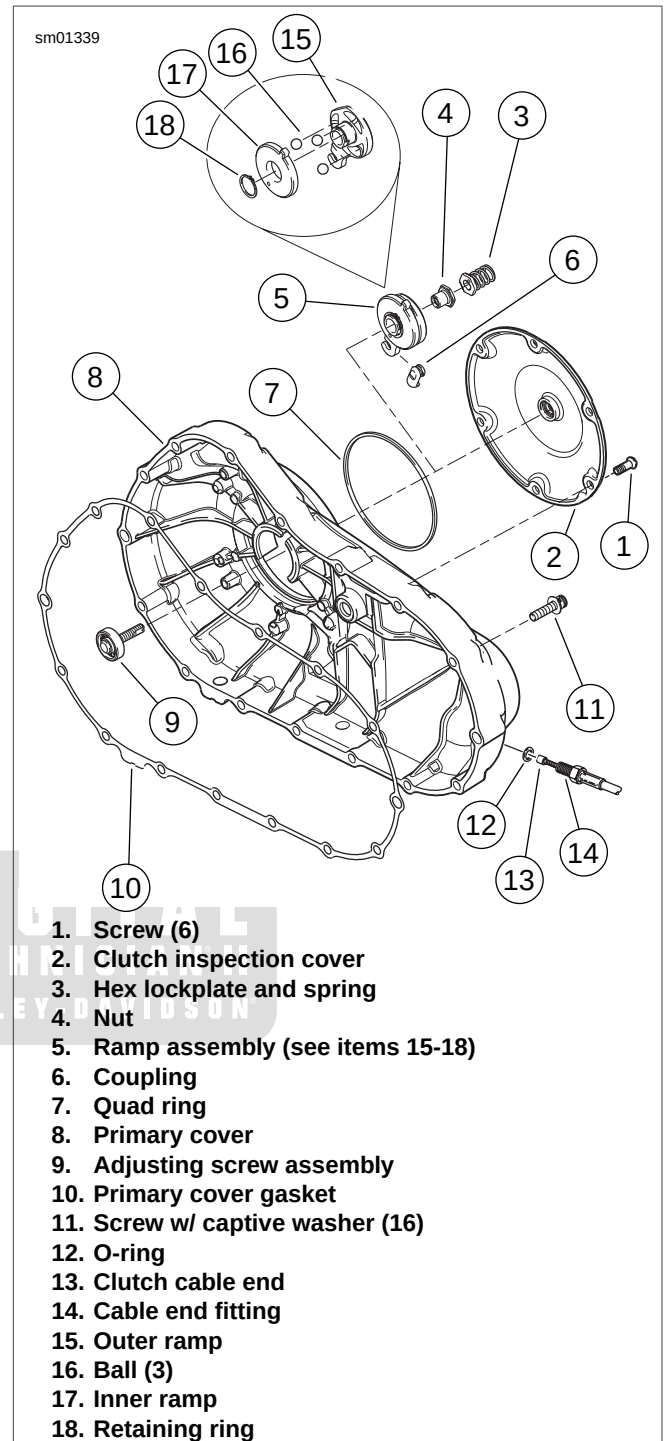


Figure 5-3. Clutch Release Mechanism and Primary Cover

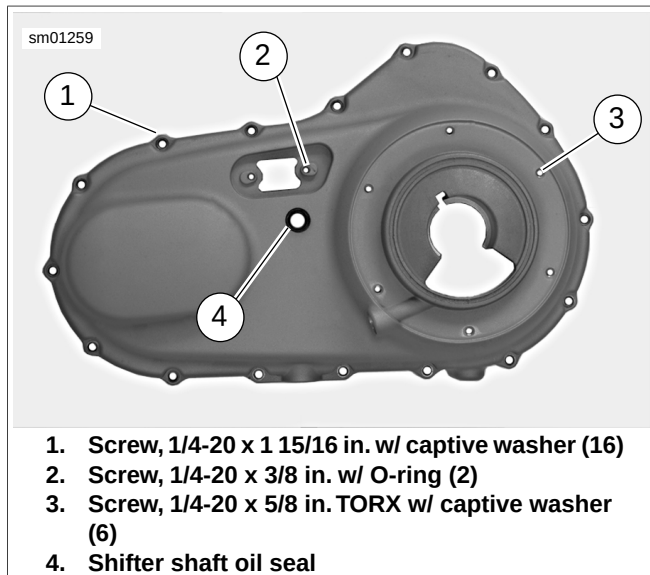


Figure 5-4. Outer Primary Cover

Primary Chain Adjuster

See [Figure 5-5](#). Remove lock nut (1) from adjuster screw (4). Turn adjuster screw out of threaded boss in primary cover (3).

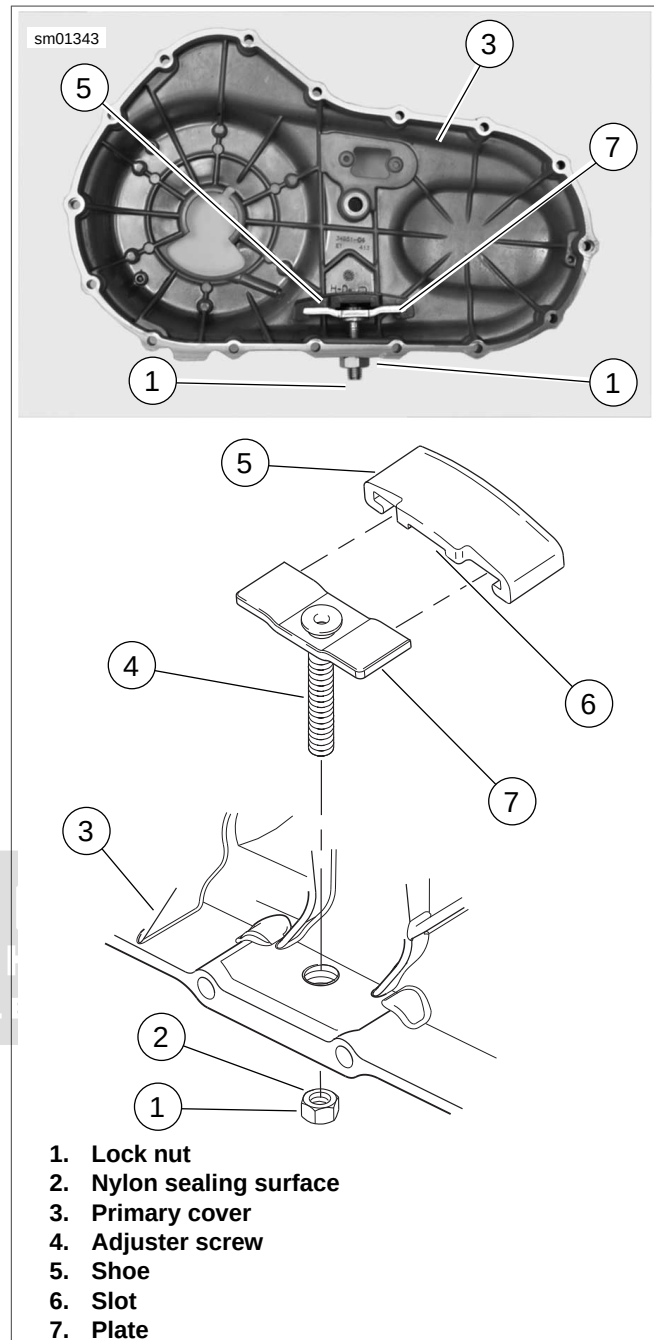


Figure 5-5. Primary Chain Adjuster Assembly

INSTALLATION

Primary Chain Adjuster

1. See [Figure 5-5](#). Inspect primary chain adjuster shoe (5). If badly worn or damaged, it must be replaced.
2. Position adjuster inside primary cover (3) with closed side of shoe against cover. Thread adjuster screw (4) all the way into tapped boss at bottom of primary cover.
3. At outside of cover, thread lock nut (1) onto adjuster screw with nylon sealing surface (2) toward cover. A 1/4-inch allen wrench may be inserted into end of adjuster screw to hold it while threading lock nut.

Primary Cover

1. See [Figure 5-4](#). Install **new** shifter shaft oil seal (4).
2. See [Figure 5-3](#). Install **new** gasket (10) on primary cover (8).
3. Install primary cover and gasket using sixteen screws with captive washers (11). Tighten to 100-120 **in-lbs** (11.3-13.5 Nm) in the sequence shown in [Figure 5-6](#).
4. Remove foreign material from magnetic drain plug. Install plug and tighten to 14-30 ft-lbs (19.0-40.7 Nm).
5. Install **new** o-ring (12) over cable end fitting (14) of clutch cable lower section. Turn fitting clockwise to install into primary cover (8). Tighten fitting to 36-60 **in-lbs** (4.1-6.8 Nm).
6. Fit coupling (6) over cable end (13) with rounded side of coupling inboard and ramp connector button outboard. With retaining ring side of ramp assembly (5) facing inward, place hook of ramp around coupling button and rotate assembly counterclockwise until tang on inner ramp (17) fits in slot of primary cover (8).
7. Thread nut (4) on adjusting screw assembly (9) until slot of screw is accessible with a screwdriver. Fit nut hex into recess of outer ramp (15) and turn adjusting screw counterclockwise until resistance is felt. Back off adjusting screw 1/4 turn.
8. Slide lockplate and spring (3) 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.
9. Fill transmission to proper level with fresh lubricant. See [1.14 TRANSMISSION LUBRICANT](#).
10. Install **new** quad ring (7) in groove of primary cover. Verify that quad ring is fully seated in groove.
11. Install six screws (1) to secure clutch inspection cover (2) to primary cover. Tighten screws in a crosswise pattern to 84-108 **in-lbs** (9.5-12.2 Nm).
12. See [Figure 5-2](#). Turn cable adjuster (2) clockwise away from jam nut (3) until slack is eliminated.
13. See [Figure 5-7](#). Pull clutch cable ferrule away from clutch lever bracket to check free play. Turn cable adjuster as necessary to obtain 1/16-1/8 in. (1.6-3.2 mm) free play between end of cable ferrule and clutch lever bracket.
14. See [Figure 5-2](#). Hold cable adjuster (2) with 1/2 inch wrench. Using 9/16 inch wrench, tighten jam nut (3) against cable adjuster. Cover cable adjuster mechanism with rubber boot (1).
15. Install left side rider footrest and mounting bracket assembly.
 - a. **Models equipped with mid-mount foot controls:** see [2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS](#) or [2.42 RIDER FOOT CONTROLS: XR MODELS](#) for installation procedure.
 - b. **Models equipped with forward foot controls:** see [2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS](#) for installation procedure.
16. Adjust primary chain tension. See [1.12 PRIMARY CHAIN](#). When tension is set correctly, tighten lock nut to 20-25 ft-lbs (27.1-33.9 Nm).
17. Install rubber washer and gear shift lever on shifter shaft. Secure with pinch screw and washer. Tighten to 16-20 ft-lbs (21.7-27.1 Nm).
18. Open left side cover. See [2.20 LEFT SIDE COVER](#).

WARNING

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

19. Connect positive (+) battery cable to battery positive (+) terminal. See [1.17 BATTERY MAINTENANCE](#).
20. Close left side cover.
21. Connect negative (-) battery cable to stud on engine crankcase behind starter motor assembly. See [1.17 BATTERY MAINTENANCE](#).

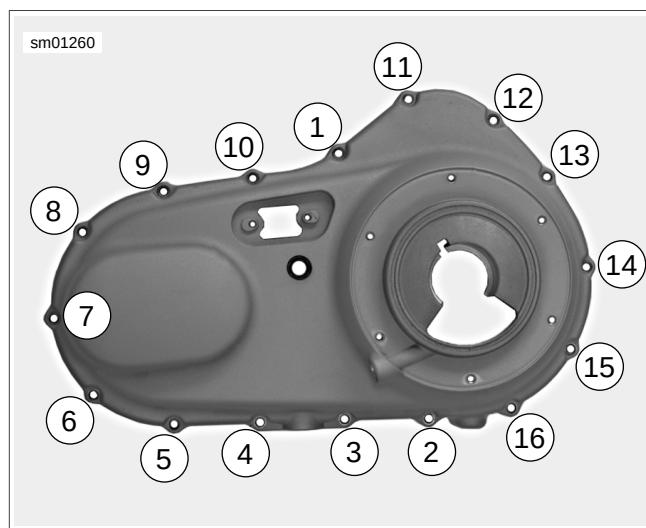


Figure 5-6. Outer Primary Cover Screw Tightening Sequence

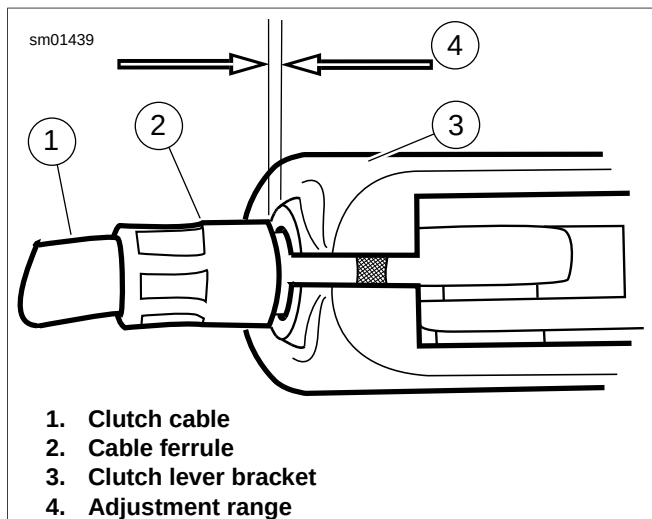


Figure 5-7. Clutch Freeplay: Adjust for 1/16-1/8 in. (1.6-3.2 mm) Gap Between Ferrule and Bracket



CLUTCH RELEASE MECHANISM

5.4

REMOVAL AND DISASSEMBLY

NOTE

For clutch adjustment procedure, see [1.13 CLUTCH](#).

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Unplug main fuse. See [6.38 MAIN FUSE](#).
2. **Models equipped with mid-mount foot controls:** remove left side rider footrest and mounting bracket assembly. See [2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS](#) or [2.42 RIDER FOOT CONTROLS: XR MODELS](#).
3. See [Figure 5-8](#). Slide rubber boot (1) on clutch cable adjuster (2) upward to expose adjuster mechanism. Loosen jam nut (3) from adjuster. Turn adjuster to shorten cable housing until there is a large amount of freeplay at clutch hand lever. See [1.13 CLUTCH](#).
4. See [Figure 5-9](#). Remove six screws (1) and clutch inspection cover (2). Remove and discard quad ring (10).
5. Slide spring (3) with attached hex lockplate (4) from flats of adjusting screw assembly (11).

6. Turn adjusting screw clockwise to release ramp and coupling mechanism (6, 7, 8, 9, 12). As the adjusting screw is turned, ramp assembly moves forward. Remove nut (5) from end of adjusting screw.
7. Remove hook of ramp from cable end coupling (12). Remove clutch cable end (15) from slot in coupling.
8. Remove and discard retaining ring (9) from ramp assembly to separate inner ramp (8) and outer ramp (6). Remove balls (7) from ramp sockets.

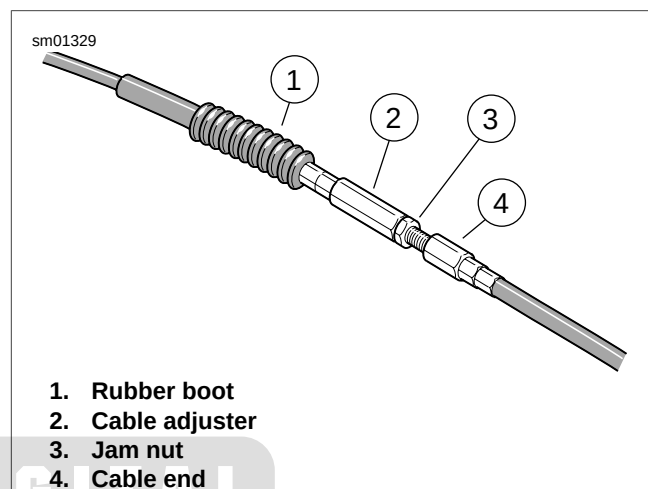


Figure 5-8. Clutch Cable Adjuster Mechanism

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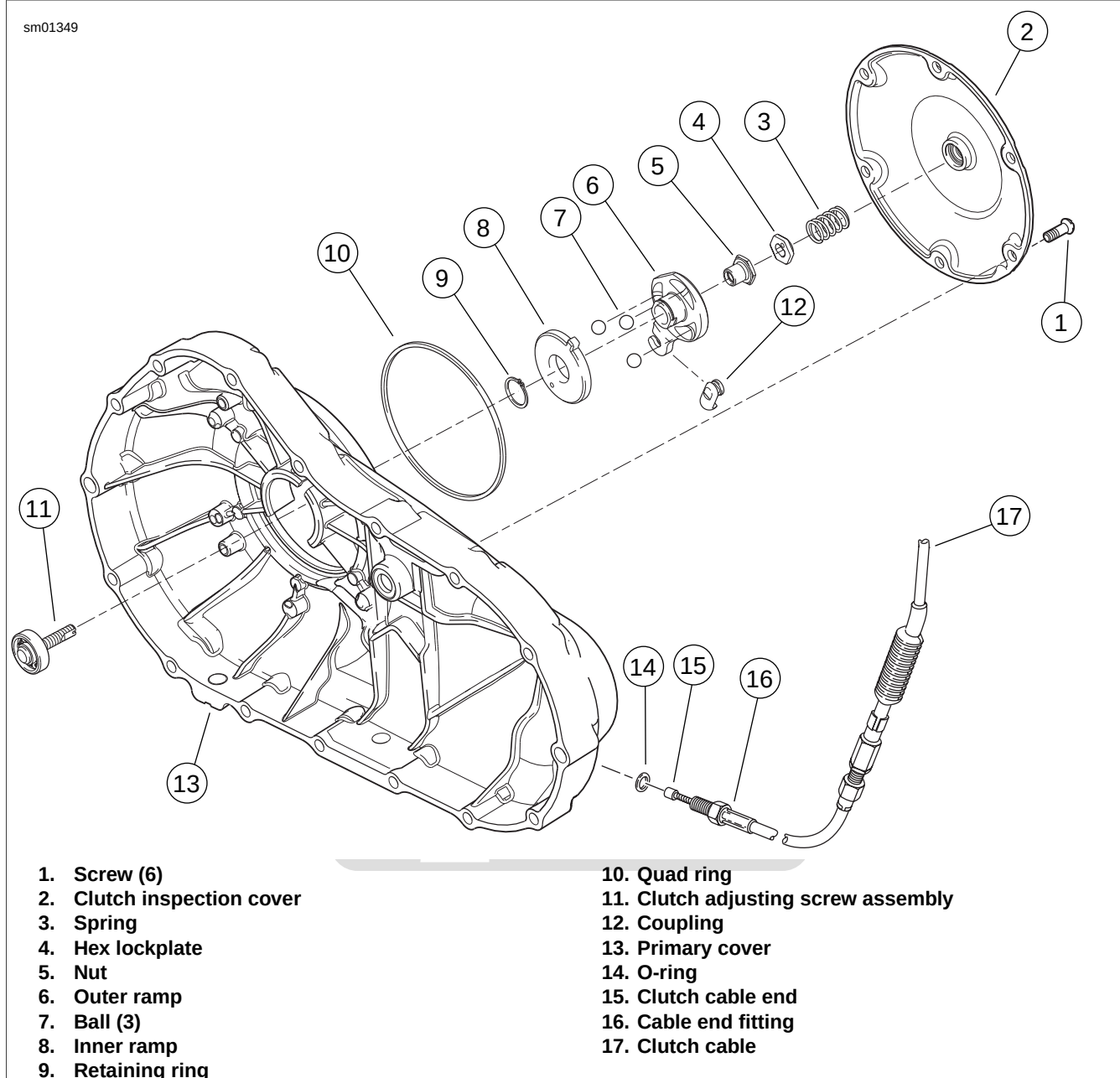


Figure 5-9. Clutch Release Mechanism

CLEANING, INSPECTION AND REPAIR

1. See [Figure 5-9](#). Thoroughly clean all parts in cleaning solvent and dry with a clean, lint-free cloth.
2. Inspect three balls (7) of release ramp and coupling mechanism (6, 7, 8, 9, 12) and ball socket surfaces of inner ramp (8) and outer ramp (6) 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 assembly (17) for frayed or worn ends. Replace cable if damaged or worn. See [2.31 CLUTCH CONTROL](#).

5. Change or add transmission fluid if necessary. See [1.14 TRANSMISSION LUBRICANT](#).

ASSEMBLY AND INSTALLATION

1. See [Figure 5-9](#). Assemble inner and outer ramps.
 - a. Apply a light coat of multi-purpose grease to balls (7) and ramps (6, 8).
 - b. Insert balls in sockets of outer ramp (6).
 - c. Install inner ramp (8) on hub of outer ramp with tang on inner ramp 180° from hook of outer ramp.
 - d. Install **new** retaining ring (9) in groove of outer ramp hub.

2. Install ramp assembly.
 - a. Fit coupling (12) over cable end (15) with the rounded side inboard, the ramp connector button outboard.
 - b. With retaining ring side of ramp assembly facing inward, place hook of ramp around coupling button.
 - c. Rotate assembly counterclockwise until tang on inner ramp fits in slot of primary cover.
3. Secure assembly in place.
 - a. Thread nut (5) on adjusting screw assembly (11) until slot of screw is accessible with a screwdriver.
 - b. Fit nut hex into recess of outer ramp and turn adjusting screw counterclockwise until resistance is felt. Back off adjusting screw 1/4 turn.
4. Slide spring (3) with hex lockplate (4) 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.
5. Install **new** quad ring (10). Verify that quad ring is fully seated in groove of primary cover (13). Install six screws (1) to secure clutch inspection cover (2) to primary cover. Tighten screws in a crosswise pattern to 84-108 **in-lbs** (9.5-12.2 Nm).
6. See [Figure 5-8](#). Turn cable adjuster (2) clockwise away from jam nut (3) until slack is eliminated.
7. See [Figure 5-10](#). Pull clutch cable ferrule away from clutch lever bracket to check free play. Turn cable adjuster as necessary to obtain 1/16-1/8 in. (1.6-3.2 mm) free play between end of cable ferrule and clutch lever bracket.
8. See [Figure 5-8](#). Hold cable adjuster (2) with 1/2 inch wrench. Using 9/16 inch wrench, tighten jam nut (3) against cable adjuster. Cover cable adjuster mechanism with rubber boot (1).
9. **Models equipped with mid-mount foot controls:** install left side rider footrest and mounting bracket assembly. Tighten footrest bracket mounting screws to 45-50 ft-lbs (61-68 Nm). See [2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS](#) or [2.42 RIDER FOOT CONTROLS: XR MODELS](#) for installation procedure.
10. Install main fuse. See [6.38 MAIN FUSE](#).

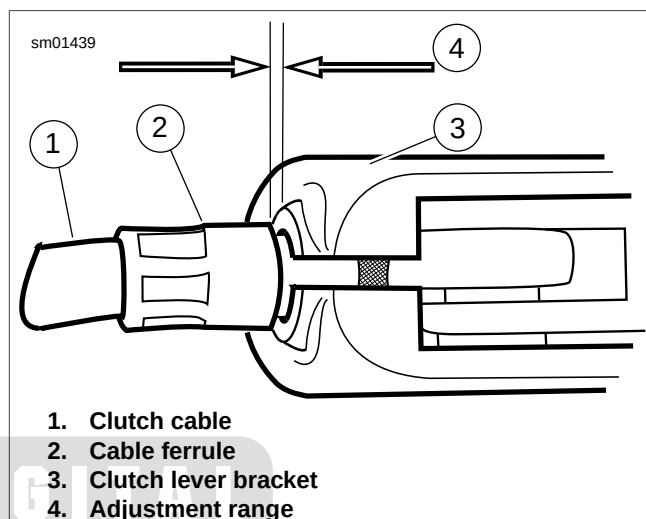


Figure 5-10. Clutch Freeplay: Adjust for 1/16-1/8 in. (1.6-3.2 mm) Gap Between Ferrule and Bracket

PRIMARY DRIVE AND CLUTCH: XL MODELS

5.5

GENERAL

The purpose of the clutch is to smoothly engage and disengage the engine from the rear wheel for starting, stopping, and shifting gears.

See [Figure 5-11](#). The clutch is a wet, multiple-disc unit with one spring plate (8), six steel plates (9), 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:

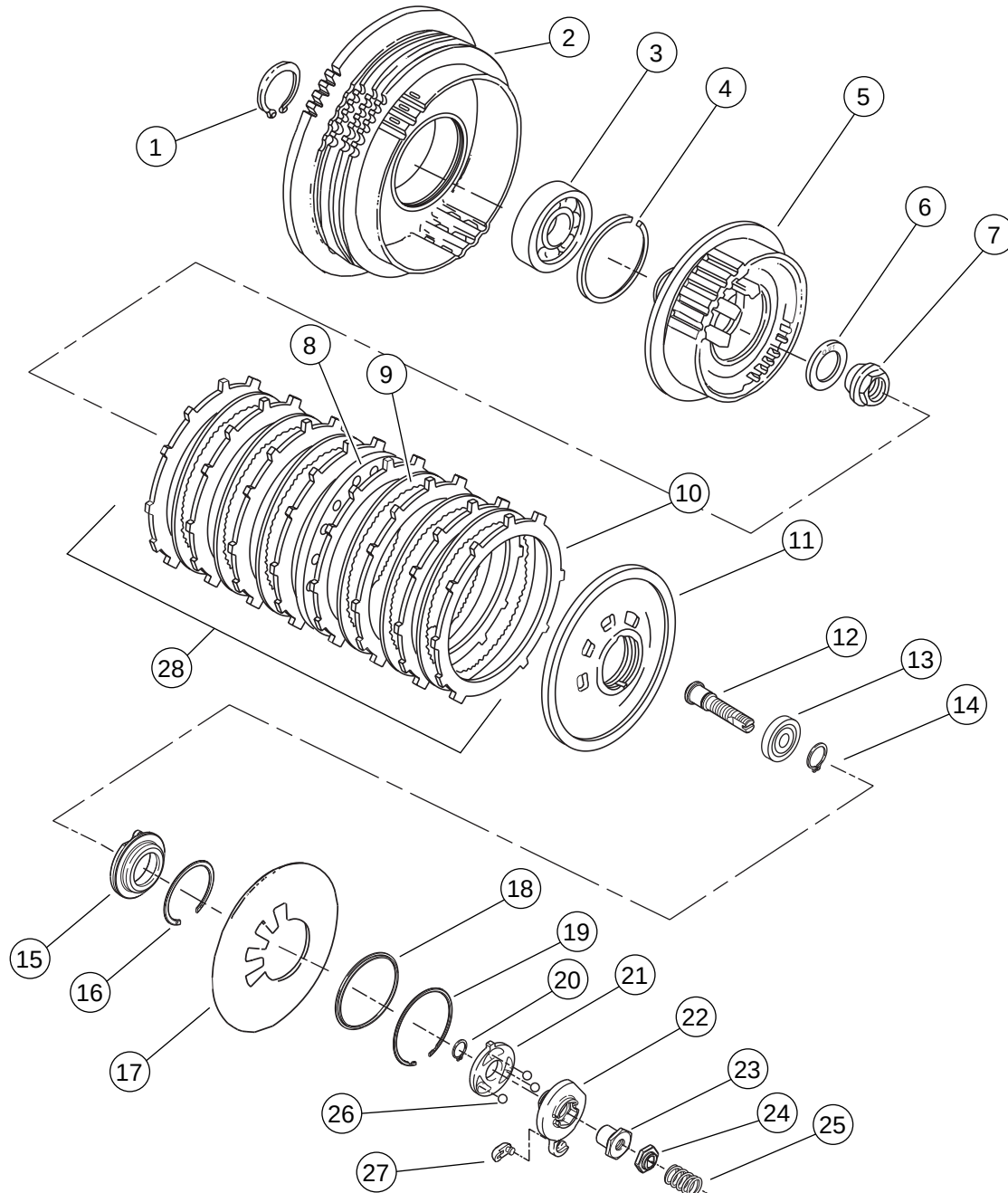
F - St - F - St - F - St - F - Sp - F - St - F - St - F - St - F
(**F** = Friction plate, **St** = Steel plate, **Sp** = Spring plate)

Table 5-4. Clutch Troubleshooting

Symptom	CAUSE (CHECK IN FOLLOWING ORDER	REMEDY
Clutch slips	Incorrect clutch release adjustment	Check and adjust clutch release mechanism.
	Worn clutch plates	Check service wear limits. Replace plates.
Clutch drags	Incorrect clutch release adjustment	Check and adjust clutch release mechanism.
	Worn clutch release ramps or balls	Replace release ramps and/or balls.
	Warped clutch steel plates	Replace clutch steel plates.
	Blade worn or damaged clutch gear splines	Replace clutch gear or hub as required.
	Overfilled primary	Drain lubricant to correct level.



sm01352



1. Retaining ring
2. Clutch shell and sprocket
3. Ball bearing
4. Retaining ring
5. Clutch hub
6. Spring washer
7. Mainshaft nut
8. Spring plate
9. Steel plate (6)
10. Friction plate, fiber (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. Retaining ring
20. Retaining ring
21. Inner ramp
22. Outer ramp
23. Nut
24. Locking plate
25. Clutch adjustment spring
26. Ball (3)
27. Clutch cable coupling
28. Clutch pack (consists of items 8, 9, 10)

Figure 5-11. Clutch Assembly: XL Models

REMOVAL

PART NUMBER	TOOL NAME
HD-38362	SPROCKET LOCKING LINK (883 CC)
HD-46283	SPROCKET LOCKING LINK (1200 CC)

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect battery cables (negative (-) cable first) before proceeding. (00307a)

NOTE

See [Figure 5-11](#). If replacement of clutch pack (28) is the only service work required, perform REMOVAL Steps 1 and 4 only, and then proceed to the NOTES under DISASSEMBLY.

1. Disconnect negative (-) battery cable from stud on engine crankcase behind starter motor assembly. See [1.17 BATTERY MAINTENANCE](#).
2. Open left side cover. See [2.20 LEFT SIDE COVER](#).
3. Remove positive (+) battery cable from battery positive (+) terminal. See [1.17 BATTERY MAINTENANCE](#).
4. Remove primary cover, as described under [5.3 PRIMARY CHAIN ADJUSTER](#). Discard primary cover gasket.

NOTES

- See [Figure 5-12](#). In the next step, you will be positioning the SPROCKET LOCKING LINK (1) on the engine and clutch sprockets. Make sure you do not position the sprocket locking link too close to the shifter shaft (2). If the sprocket locking link contacts the shifter shaft while you are exerting force to loosen the engine sprocket nut, the sprocket locking link may damage the shifter shaft and/or the engine crankcase.
 - To determine the correct sprocket locking link for your application, refer to tool table.
5. See [Figure 5-12](#). Install SPROCKET LOCKING LINK (883 CC) (Part No. HD-38362) or SPROCKET LOCKING LINK (1200 CC) (Part No. HD-46283). Remove the engine sprocket nut. Do not remove engine sprocket at this time.
 6. See [Figure 5-11](#). Remove large retaining ring (16). Remove adjusting screw assembly (12, 13, 14 and 15) from pressure plate (11).

NOTE

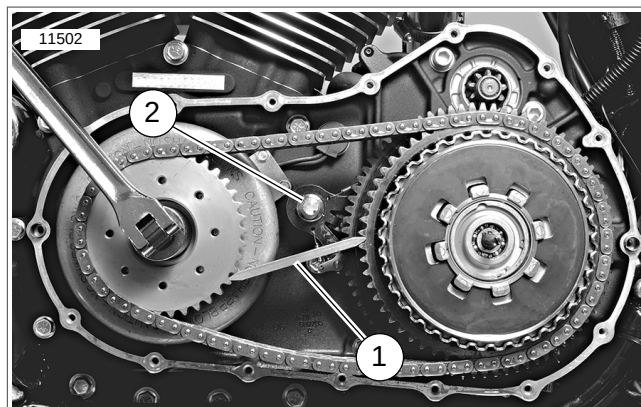
Transmission mainshaft nut (7) has left-hand threads. Turn nut clockwise to loosen and remove from mainshaft.

7. Remove nut (7) and spring washer (6). Remove the clutch assembly, primary chain and engine sprocket as an assembly from the vehicle.
8. Inspect primary chain. If damaged or excessively worn, remove it from engine sprocket and clutch assembly; replace original primary chain with a **new** one.
9. Inspect stator and rotor. See [6.29 ALTERNATOR](#). Replace damaged parts as necessary.

NOTE

If replacement of primary chain is the only service work required, proceed directly to [5.5 PRIMARY DRIVE AND](#)

[CLUTCH: XL MODELS, Installation](#). Skip Step 1 and begin with the NOTE preceding Step 2.



1. Sprocket locking link
2. Shifter shaft

Figure 5-12. Using Sprocket Locking Link (Part No. HD-46283 or HD-38362) to Loosen Engine Sprocket Nut

DISASSEMBLY

PART NUMBER	TOOL NAME
HD-38515-91	CLUTCH SPRING FORCING SCREW
HD-38515-A	SPRING COMPRESSING TOOL

NOTES

- See [Figure 5-11](#). If replacement of clutch pack (28) is the only service work required, perform DISASSEMBLY Steps 2 - 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 5-11](#). With clutch assembly removed from primary chaincase, 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. Secure the adjusting screw assembly with retaining ring (16).

⚠ WARNING

Disassemble clutch using a spring compressing tool. The diaphragm spring is compressed and, if removed without proper tools can fly out, which could result in death or serious injury. (00292a)

2. Thread the CLUTCH SPRING FORCING SCREW (Part No. HD-38515-91) (1, [Figure 5-13](#)) onto the clutch adjusting screw (12, [Figure 5-11](#)). Place the bridge (2, [Figure 5-13](#)) of SPRING COMPRESSING TOOL (Part No. HD-38515-A) against diaphragm spring (17, [Figure 5-11](#)). Thread the tool handle (3, [Figure 5-13](#)) onto end of forcing screw.

NOTE

[Figure 5-11](#). Turn compressing tool handle only enough to remove retaining ring (19) and spring seat (18). Excessive

compression of diaphragm spring could damage clutch pressure plate.

3. See [Figure 5-11](#). 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 retaining ring (19) and spring seat (18).
4. Remove and discard retaining ring. Remove spring seat from the groove in clutch hub (5) prongs. Remove the assembly of diaphragm spring (17), pressure plate (11), adjusting screw components (12, 13, 14 and 15) and compressing tool.
5. Turn the compressing tool handle counterclockwise until the clutch spring forcing screw disconnects from the clutch adjusting screw. Remove spring seat and diaphragm spring from pressure plate assembly.
6. Remove retaining ring (16) and adjusting screw assembly from pressure plate. 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 (28) from the clutch hub. The clutch pack consists of one spring plate (8), six steel plates (9), and eight friction (fiber) plates (10).

NOTE

See [Figure 5-11](#). 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. If necessary, disassemble clutch shell and clutch hub as follows:
 - a. Remove retaining ring (1) from inboard end of clutch hub (5).
 - b. Using an arbor press, separate clutch hub from assembly of clutch shell (2), bearing (3), and retaining ring (4).
 - c. Remove retaining ring (4) from groove in clutch shell.
 - d. Press on the inboard side of bearing (3) outer race to remove bearing from clutch shell.

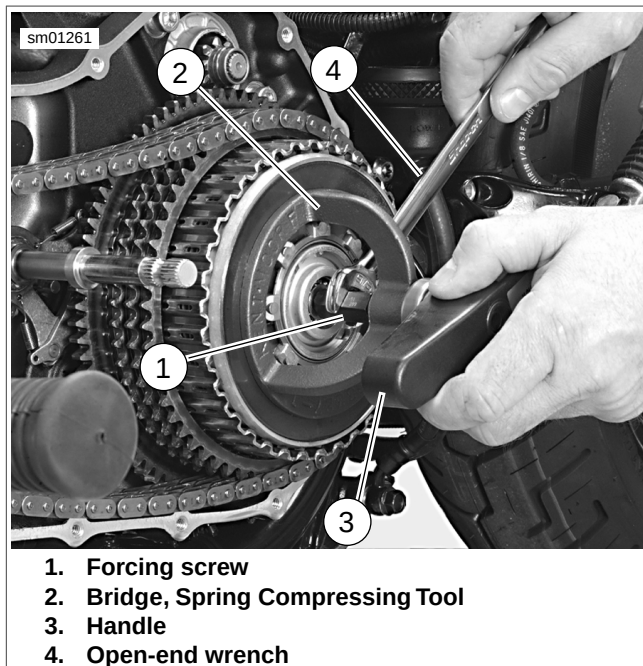


Figure 5-13. Compressing Clutch Diaphragm Spring

INSPECTION AND REPAIR

NOTE

See [Figure 5-11](#). If replacement of clutch pack (28) is the only service work required, perform all INSPECTION AND REPAIR steps (except Step 2f), and then proceed to the NOTES under ASSEMBLY.

⚠ WARNING

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

1. See [Figure 5-11](#). Wash all parts, except the friction (driven) plates (10) and bearings (3 and 13), in a non-volatile cleaning solution or solvent. Blow parts dry with low pressure compressed air.
2. Examine the clutch components as follows:
 - a. Inspect all clutch plates for wear and discoloration.
 - b. Inspect all fiber plates (10) for worn lining surfaces or checked or chipped linings.
 - c. Inspect each steel (drive) plate (9) for grooves.
 - d. Place each steel plate on a flat surface. Using a feeler gauge, check for flatness in several places. Replace any plates that are damaged, or warped more than 0.006 in. (0.15 mm).
 - e. See [Figure 5-14](#). 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.

- f. See [Figure 5-11](#). Inspect clutch shell ball bearing (3) for smoothness by rotating clutch shell while holding clutch hub. If bearing is rough or binds, it must be replaced.
- g. See [Figure 5-15](#). Check the primary chain sprocket (3) and the starter ring gear (4) on the clutch shell (1). If either sprocket or ring gear are badly worn or damaged, replace the clutch shell.
- h. Check the slots (5, 6) that mate with the clutch plates on both clutch shell and clutch hub (2). If slots are worn or damaged, replace shell and/or hub.
- i. See [Figure 5-11](#). Check the diaphragm spring (17) for cracks or bent tabs. Install a **new** spring if either condition exists.

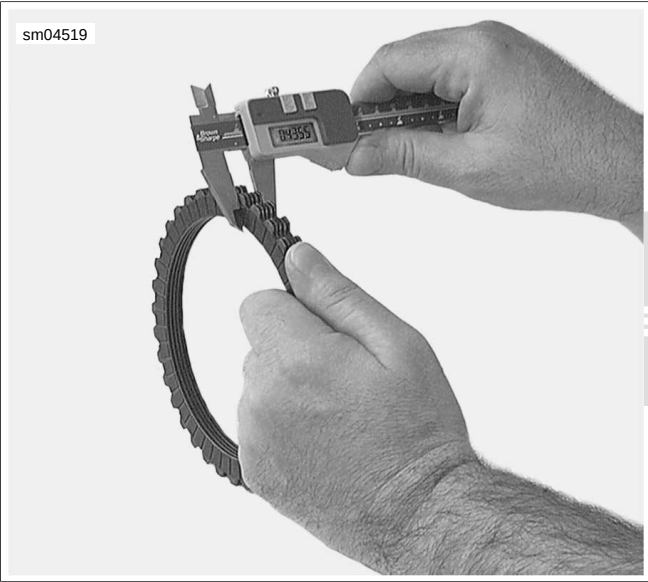


Figure 5-14. Measuring Clutch Friction Plates

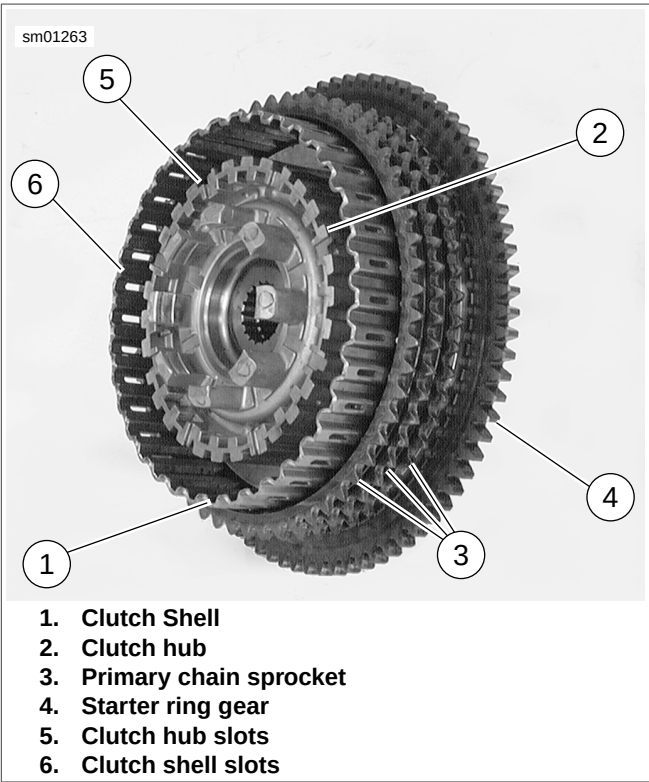


Figure 5-15. Checking Clutch Hub and Clutch Shell

ASSEMBLY

PART NUMBER	TOOL NAME
HD-38515-91	CLUTCH SPRING FORCING SCREW
HD-38515-A	SPRING COMPRESSING TOOL

NOTES

- See [Figure 5-11](#). If replacement of clutch pack (28) is the only service work required, perform all ASSEMBLY Steps except 2, 5 and 6, and then proceed to the NOTE under INSTALLATION.
 - **Observe all WARNING and CAUTION statements which apply to the steps specified.**
1. Submerge and soak all friction and steel plates in GENUINE HARLEY-DAVIDSON FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT for at least five minutes.
 2. See [Figure 5-16](#). If the clutch hub (1) and clutch shell (4) was disassembled, press **new** ball bearing (3) into clutch shell and secure bearing with a **new** retaining ring (2). Press inboard end of clutch hub into clutch shell bearing and secure with a **new** retaining ring (5) on end of hub.
 3. See [Figure 5-11](#). The clutch pack (28) consists of one spring plate (8), six steel plates (9) and eight friction (fiber) plates (10). Install clutch pack into clutch shell in the following order:
F - St - F - St - F - St - F - Sp - F - St - F - St - F - St - F
(F = Friction plate, St = Steel plate, Sp = Spring plate)
 4. See [Figure 5-11](#). Place pressure plate (11) onto clutch pack (28).

5. If disassembled, assemble bearing (13) and adjusting screw (12) in release plate (15); secure with **new** retaining ring (14).
6. Install adjusting screw assembly (12, 13, 14, 15) into pressure plate (11), noting that two tabs on perimeter of release plate (15) must be inserted into corresponding recesses in pressure plate. Secure adjusting screw assembly with **new** retaining ring (16).
7. Position diaphragm spring (17) with its concave side facing inboard (toward pressure plate), onto pressure plate assembly.
8. Position spring seat (18) with its flat, larger outer diameter side facing inboard (toward diaphragm spring).
9. Install a **new** retaining ring (19) onto convex (outboard) side of diaphragm spring.
10. See [Figure 5-11](#) and [Figure 5-13](#). Thread the CLUTCH SPRING FORCING SCREW (Part No. HD-38515-91) (1, [Figure 5-13](#)) onto the clutch adjusting screw (12, [Figure 5-11](#)). Place the bridge (2, [Figure 5-13](#)) of SPRING COMPRESSING TOOL (Part No. HD-38515-A) against diaphragm spring (17, [Figure 5-11](#)). Thread the tool handle (3, [Figure 5-13](#)) onto end of forcing screw. Do not tighten compressing tool against diaphragm spring at this time.
11. See [Figure 5-17](#). Align square openings of pressure plate and diaphragm spring (1) so the assembly can be installed over prongs of clutch hub (2). Place assembly of spring seat (5), retaining ring (3), diaphragm spring, pressure plate, adjusting screw components (4) and compressing tool onto clutch hub and against clutch pack (28, [Figure 5-11](#)).

NOTE

See [Figure 5-11](#). Turn compressing tool handle only enough to install spring seat (18) and retaining ring (19). Excessive compression of diaphragm spring (17) could damage clutch pressure plate (11).

12. See [Figure 5-13](#). Place an open-end wrench (4) on the clutch spring forcing screw (1) flats to prevent the forcing screw from turning.
13. See [Figure 5-11](#). Turn compressing tool handle clockwise until diaphragm spring (17) compresses just enough to install spring seat (18) and retaining ring (19) into the groove in clutch hub (5) prongs.
14. With retaining ring positioned against flange face (outboard side) of spring seat and fully seated in groove of clutch hub, carefully loosen and remove compressing tool.

NOTE

When the compressing tool is removed, the diaphragm spring will move outward forcing the spring seat up into the inside of the retaining ring. The spring seat provides an operating surface for the diaphragm spring at the same time preventing the retaining ring from coming out during operation.

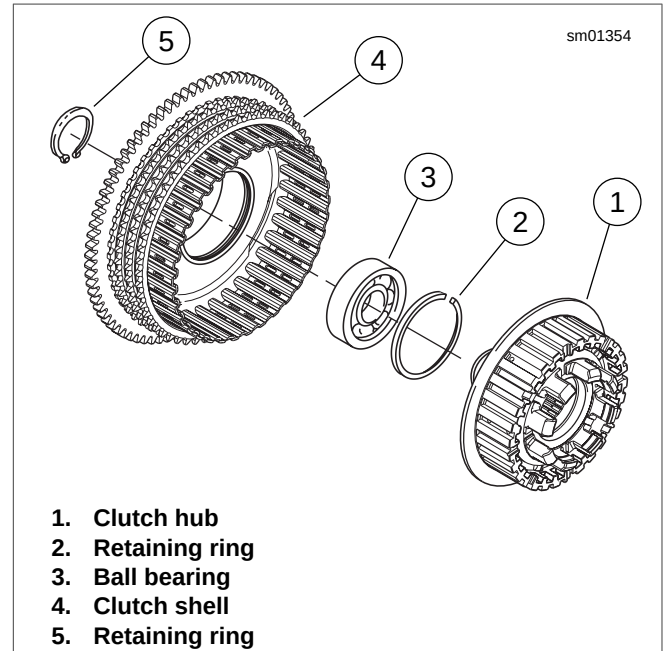


Figure 5-16. Clutch Hub and Shell Assembly

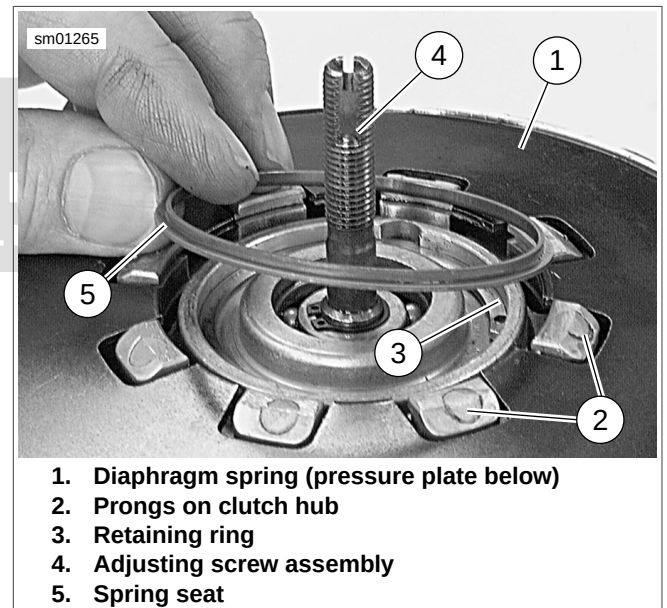


Figure 5-17. Spring Seat Installation

INSTALLATION

PART NUMBER	TOOL NAME
HD-38362	SPROCKET LOCKING LINK (883 CC)
HD-46283	PRIMARY DRIVE LOCKING TOOL (1200 CC)

NOTE

See [Figure 5-11](#). If replacement of clutch pack (28) is the only service work required, perform **INSTALLATION** last step only.

1. See [Figure 5-11](#). Remove retaining ring (16). Remove adjusting screw assembly (12, 13, 14, 15) from pressure

plate (11). This allows installation of the transmission mainshaft nut and washer.

NOTE

Prior to installing engine sprocket nut and transmission mainshaft nut, thoroughly clean threads of engine sprocket shaft, engine sprocket nut, transmission mainshaft and mainshaft nut to remove any oil that might contaminate and interfere with locking agent.

2. Prior to installing engine sprocket nut and transmission mainshaft nut, thoroughly clean threads of engine sprocket shaft, engine sprocket nut, transmission mainshaft and mainshaft nut to remove any oil that might contaminate and interfere with locking agent.

NOTE

See [Figure 5-18](#). In the next step, you will be positioning the **SPROCKET LOCKING LINK (883 CC) (Part No. HD-38362)** or **PRIMARY DRIVE LOCKING TOOL (1200 CC) (Part No. HD-46283)** (1) on the engine and clutch sprockets. Make sure you do not position the sprocket locking link too close to the shifter shaft (2). If the sprocket locking link contacts the shifter shaft while you are exerting force to tighten the engine sprocket nut, the sprocket locking link may damage the shifter shaft and/or the engine crankcase.

3. See [Figure 5-18](#). Install **SPROCKET LOCKING LINK (883 CC) (Part No. HD-38362)** or **PRIMARY DRIVE LOCKING TOOL (1200 CC) (Part No. HD-46283)**.
4. Apply two or three drops of **LOCTITE Threadlocker 262 (red)** onto threads of engine sprocket shaft.
5. Install engine sprocket nut. Tighten to 240-260 ft-lbs (326-353 Nm).

NOTE

See [Figure 5-19](#). Washer (2) must be installed with the word "out" facing the transmission mainshaft nut (1). Incorrect assembly can result in clutch and/or transmission failure.

6. See [Figure 5-19](#). Apply two or three drops of **LOCTITE Threadlocker 262 (red)** onto threads on end of transmission mainshaft. Install spring washer (2) and mainshaft nut (1) (left-hand threads) on transmission mainshaft. Tighten nut to 70-80 ft-lbs (95.0-108.6 Nm).
7. Remove **SPROCKET LOCKING LINK**.
8. See [Figure 5-20](#). Install adjusting screw assembly (1) in pressure plate, noting that two tabs on perimeter of release plate must be inserted into corresponding recesses in pressure plate. Secure assembly with a **new** retaining ring (2).
9. Install primary cover using **new** gasket. See [5.3 PRIMARY CHAIN ADJUSTER](#).
10. Adjust primary chain and clutch. See [1.12 PRIMARY CHAIN](#) and [1.13 CLUTCH](#).
11. Fill transmission with **GENUINE HARLEY-DAVIDSON FORMULA+ TRANSMISSION AND PRIMARY CHAIN-CASE LUBRICANT**. See [1.14 TRANSMISSION LUBRICANT](#).
12. Connect battery. See [1.17 BATTERY MAINTENANCE](#).

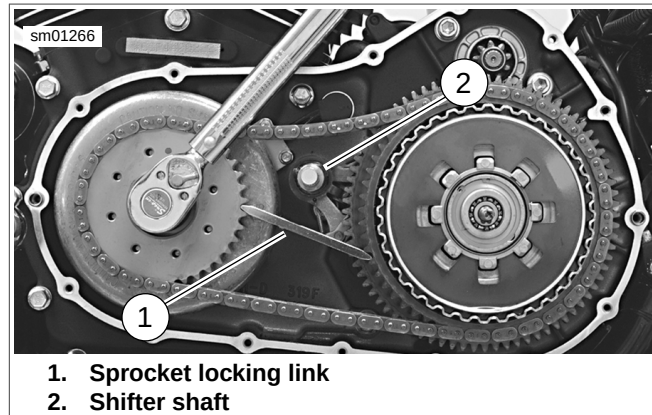


Figure 5-18. Tighten Engine Sprocket Fastener (typical)

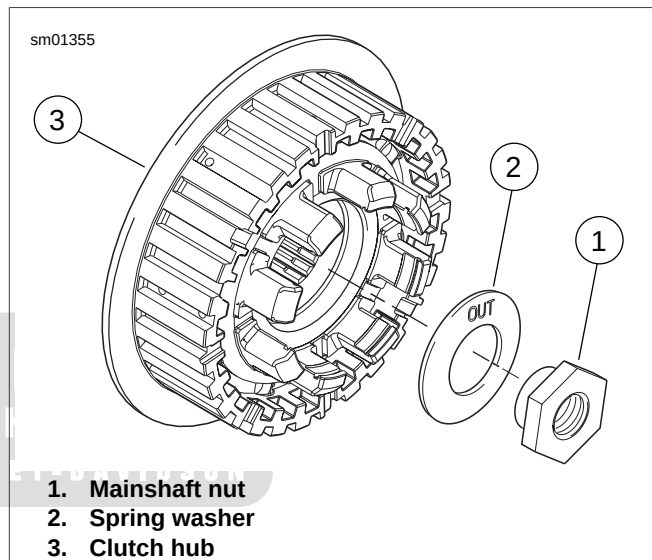


Figure 5-19. Mainshaft Nut and Washer

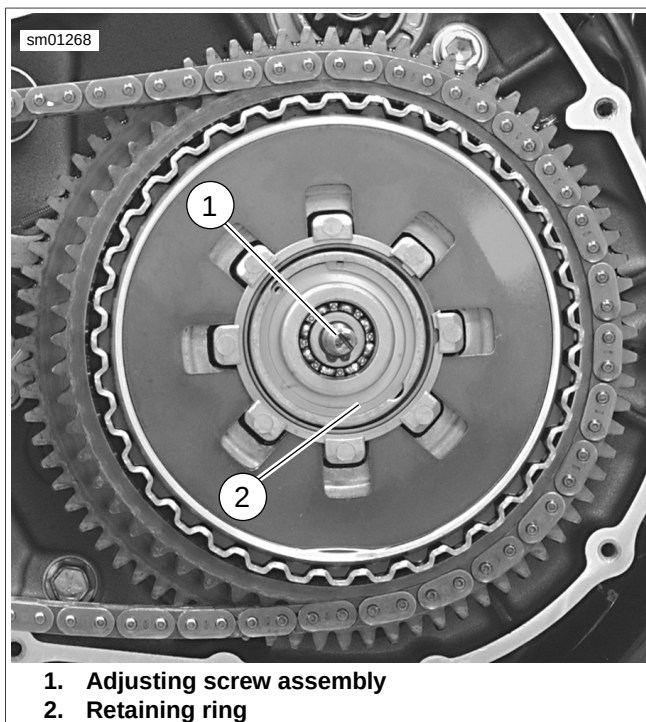


Figure 5-20. Clutch Adjusting Screw Assembly and Retaining Ring



PRIMARY DRIVE AND CLUTCH: XR MODELS

5.6

GENERAL

The purpose of the clutch is to smoothly disengage and engage the engine from the rear wheel for starting, stopping and shifting gears.

See [Figure 5-21](#). The clutch is a wet, multiple-disc clutch with steel plates and fiber (friction) plates stacked alternately in the clutch shell. The pack consists of seven fiber plates, seven steel plates, one narrow fiber plate, one damper spring and one damper spring seat. The fiber plates (clutch driving plates) are keyed to the clutch shell, which is driven by the engine through the primary chain. The steel plates (clutch driven plates) are keyed to the clutch hub, which drives the rear wheel through the transmission and secondary drive belt.

When the clutch is engaged (clutch lever released), the diaphragm spring applies strong force against the pressure plate.

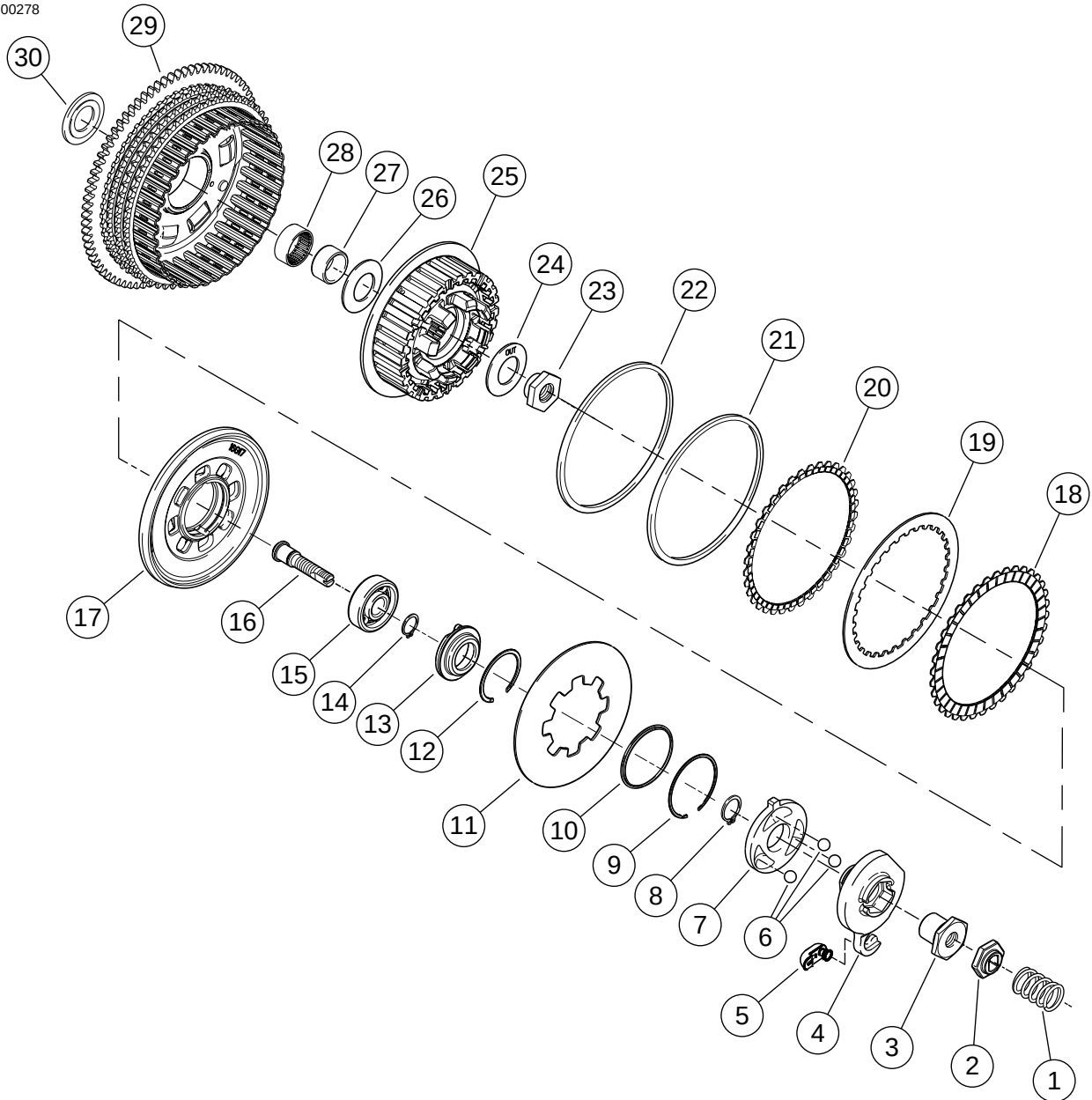
The pressure plate then presses the clutch plates together causing the plates to turn as a single unit. The result is that the rotational force of the clutch shell is transmitted through the clutch plates to the clutch hub. As long as the transmission is set in a forward gear, power from the engine will be transmitted to the rear wheel.

When the clutch is disengaged (clutch lever pulled to left handlebar grip), the pressure plate is pulled outward (by clutch cable action) against the diaphragm spring, thereby compressing the diaphragm spring. With the pressure plate retracted, strong inward force no longer squeezes the clutch plates together. The fiber plates are now free to rotate at a different relative speed than that of the steel plates (i.e. Slip-page between the clutch plates occurs). The result is that the rotational force of the clutch shell is no longer fully transmitted through the "unlocked" clutch plates to the clutch hub. The engine is free to rotate at a different speed than the rear wheel.

Table 5-5. Clutch Troubleshooting

SYMPTOM	CHECK ORDER	CAUSE	REMEDY
Clutch slips	1	Incorrect clutch release adjustment.	Check and adjust clutch release mechanism.
	2	Worn clutch plates.	Check service wear limits. Replace plates.
Clutch drags	1	Incorrect clutch release adjustment.	Check and adjust clutch release mechanism.
	2	Worn clutch release ramps or balls.	Replace release ramps and/or balls.
	3	Warped clutch steel plates.	Replace clutch steel plates.
	4	Blade worn or damaged clutch gear splines.	Replace clutch gear or hub as required.
	5	Overfilled primary.	Drain lubricant to correct level.

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- | | | |
|-------------------|-----------------------------------|-------------------------------|
| 1. Spring | 11. Diaphragm spring | 21. Damper spring |
| 2. Lockplate | 12. Retaining ring | 22. Damper spring seat |
| 3. Nut | 13. Release plate | 23. Mainshaft nut |
| 4. Outer ramp | 14. Retaining ring | 24. Washer |
| 5. Coupling | 15. Bearing | 25. Clutch hub |
| 6. Ball (3) | 16. Adjusting screw | 26. Inner thrust washer |
| 7. Inner ramp | 17. Pressure plate | 27. Needle bearing inner race |
| 8. Retaining ring | 18. Friction plate, fiber (7) | 28. Needle bearing |
| 9. Retaining ring | 19. Steel plate (7) | 29. Clutch shell and sprocket |
| 10. Spring seat | 20. Friction plate, narrow, fiber | 30. Outer thrust washer |

Figure 5-21. Clutch Assembly: XR Models

REMOVAL

PART NUMBER	TOOL NAME
HD-38362	SPROCKET LOCKING LINK

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect battery cables (negative (-) cable first) before proceeding. (00307a)

1. Disconnect negative (-) battery cable from stud on engine crankcase behind starter motor assembly. See [1.17 BATTERY MAINTENANCE](#).
2. Open left side cover. See [2.20 LEFT SIDE COVER](#).
3. Remove positive (+) battery cable from battery positive (+) terminal. See [1.17 BATTERY MAINTENANCE](#).
4. Remove primary cover and discard primary cover gasket. See [5.3 PRIMARY CHAIN ADJUSTER](#).

NOTES

- See [Figure 5-22](#). Make sure not to position the sprocket locking link (1) too close to the shifter shaft (2). If the sprocket locking link contacts the shifter shaft while you are exerting force to loosen the engine sprocket bolt, damage to the shifter shaft and/or the engine crankcase may result.
 - The engine sprocket bolt is a single-use fastener and must be replaced with a **new** bolt whenever it is removed.
5. See [Figure 5-22](#). Install SPROCKET LOCKING LINK (Part No. HD-38362). Remove and discard the engine sprocket bolt. Do not remove engine sprocket at this time.
 6. See [Figure 5-21](#). Remove large retaining ring (12). Remove adjusting screw assembly (13, 14, 15 and 16) from pressure plate (17).

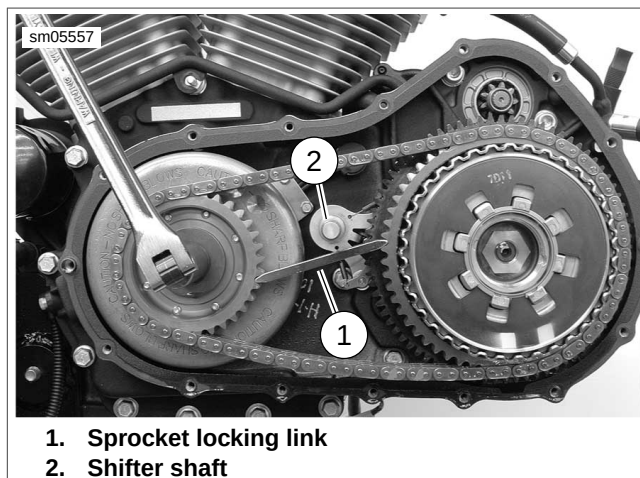
NOTE

Transmission mainshaft nut (23) has left-hand threads. Turn nut clockwise to loosen and remove from mainshaft.

7. Remove nut (23) and spring washer (24). Remove the clutch assembly, primary chain and engine sprocket from the vehicle as an assembly.
8. Inspect primary chain. If damaged or excessively worn, remove it from engine sprocket and clutch assembly and replace it with a **new** one.
9. Inspect stator and rotor. See [6.20 CHARGING SYSTEM](#). Replace damaged parts as necessary.

NOTE

If replacement of primary chain is the only service work required, proceed directly to [5.6 PRIMARY DRIVE AND CLUTCH: XR MODELS, Installation](#). Skip Step 1 of that procedure and begin with the NOTE preceding Step 2.



1. Sprocket locking link
2. Shifter shaft

Figure 5-22. Loosen Engine Sprocket Bolt

DISASSEMBLY

PART NUMBER	TOOL NAME
HD-38515-91	CLUTCH SPRING FORCING SCREW
HD-38515-A	SPRING COMPRESSING TOOL

1. See [Figure 5-21](#). With clutch assembly removed from primary chaincase, install adjusting screw assembly (13, 14, 15 and 16) into pressure plate (17), noting that two tabs on perimeter of release plate (13) must be inserted into corresponding recesses in pressure plate. Secure the adjusting screw assembly with retaining ring (12).

WARNING

Disassemble clutch using a spring compressing tool. The diaphragm spring is compressed and, if removed without proper tools can fly out, which could result in death or serious injury. (00292a)

2. See [Figure 5-23](#). Thread the CLUTCH SPRING FORCING SCREW (Part No. HD-38515-91) onto the clutch adjusting screw. Place the bridge of SPRING COMPRESSING TOOL (Part No. HD-38515-A) against diaphragm spring. Thread the tool handle onto end of forcing screw.

NOTE

See [Figure 5-21](#). Turn compressing tool handle only enough to remove retaining ring (9) and spring seat (10). Excessive compression of diaphragm spring could damage clutch pressure plate.

3. See [Figure 5-21](#). 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 retaining ring (9) and spring seat (10).
4. Remove and discard retaining ring. Remove spring seat from the groove in clutch hub prongs. Remove the diaphragm spring (11), pressure plate (17), adjusting screw components (13, 14, 15 and 16) and compressing tool as an assembly.
5. Turn the compressing tool handle counterclockwise until the clutch spring forcing screw disconnects from the clutch

- adjusting screw. Remove spring seat and diaphragm spring from pressure plate assembly.
6. Remove retaining ring (12) and adjusting screw assembly from pressure plate. If necessary, disassemble adjusting screw assembly. See [5.6 PRIMARY DRIVE AND CLUTCH: XR MODELS, Adjusting Screw Disassembly/Assembly](#)
7. Remove the clutch pack from the clutch hub. The clutch pack consists of seven friction (fiber) plates (18), seven steel plates (19), one narrow friction plate (20), one damper spring (21) and one seat (22).

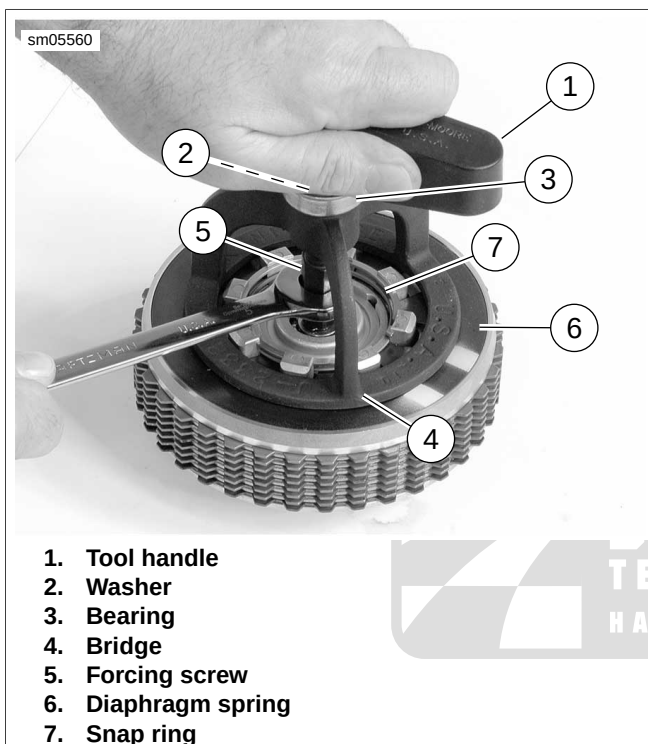


Figure 5-23. Compressing Diaphragm Spring: XR Models

CLUTCH PACK CLEANING AND INSPECTION

1. Separate the pack into the following components:
 - a. Seven fiber plates.
 - b. Seven steel plates.
 - c. One narrow fiber plate.
 - d. One damper spring.
 - e. One damper spring seat.

WARNING

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

2. Wash all parts in cleaning solvent, except fiber (friction) plates and needle bearing in the clutch hub/shell. Blow dry with compressed air.
3. Examine the clutch components as follows:
 - a. Check all clutch plates for wear and discoloration.
 - b. Inspect each steel (drive) plate for grooves.
 - c. Place each steel plate on a flat surface. Using a feeler gauge, check for flatness in several places. Replace any plates that are damaged or are warped more than 0.006 in. (0.15 mm).
4. Inspect the damper spring for cracks or distortion. Install a **new** spring if either condition exists.
5. See [Figure 5-24](#). Check fiber plates for thickness.
 - a. Wipe the lubricant from the eight fiber plates (7 regular and 1 narrow) and stack them on top of each other.
 - b. Measure the thickness of the eight stacked fiber plates with a dial caliper or micrometer. The minimum thickness must be 0.661 in. (16.789 mm).
 - c. If the thickness is less than specified, discard the fiber plates and steel plates. Install a new set of both friction and steel plates.
6. See [Figure 5-25](#). Inspect primary chain sprocket (1) and the starter ring gear (2) on the clutch shell. If either sprocket or ring gear are badly worn or damaged, replace the clutch shell.
7. Inspect slots that mate with the clutch plates on both clutch shell (4) and hub (3). If slots are worn or damaged, replace shell and/or hub.



Figure 5-24. Measuring Friction Plates

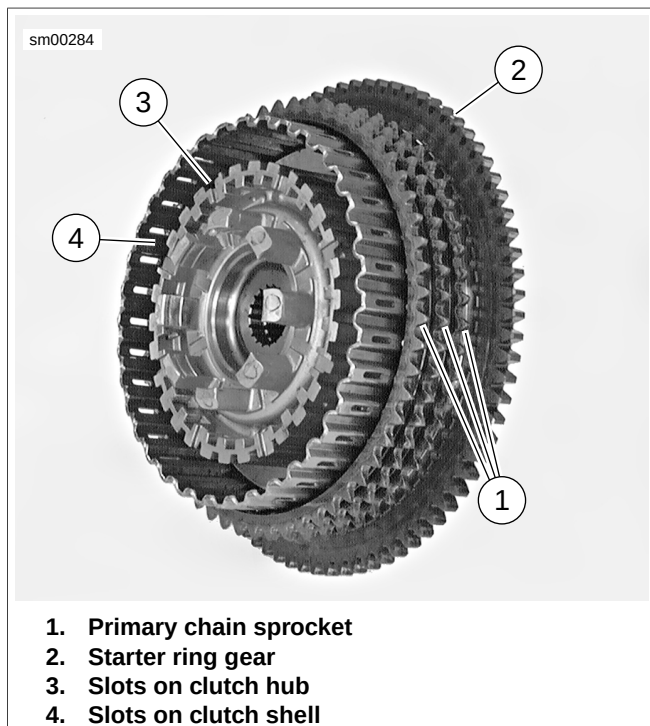


Figure 5-25. Checking Clutch Shell (Shell Removed from Primary Shaft)

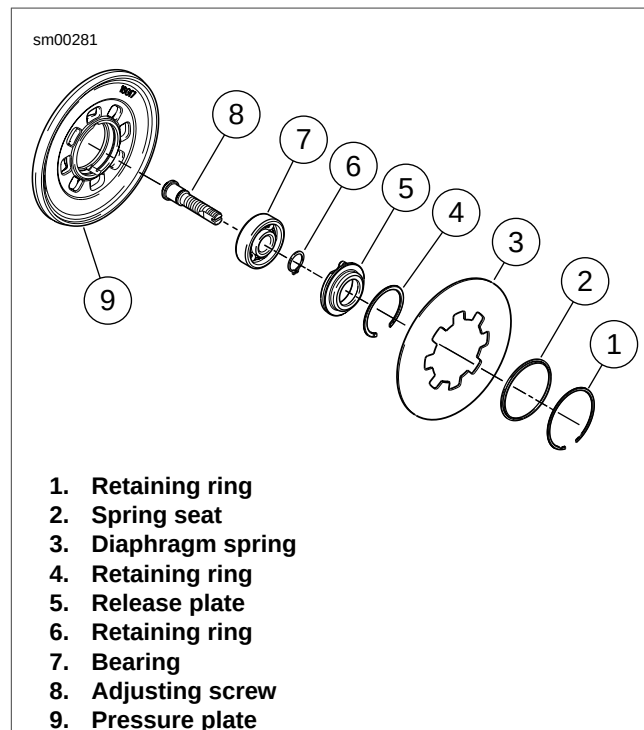


Figure 5-26. Adjusting Screw Assembly

ADJUSTING SCREW DISASSEMBLY/ASSEMBLY

1. See [Figure 5-26](#). Remove adjusting screw assembly.
 - a. Remove large retaining ring.
 - b. Remove adjusting screw assembly from pressure plate.
2. If necessary, disassemble adjusting screw assembly.
 - a. Remove and discard small retaining ring (6).
 - b. Separate the adjusting screw (8) from the bearing (7) and release plate (5).
 - c. Remove bearing (7) from release plate (5).
3. Replace components as required and reassemble adjusting screw assembly in reverse order.
4. Install adjusting screw assembly into pressure plate.
 - a. See [Figure 5-41](#). Align two tabs on perimeter of release plate with corresponding recesses (3) in pressure plate.
 - b. Secure the adjusting screw assembly with **new** retaining ring.

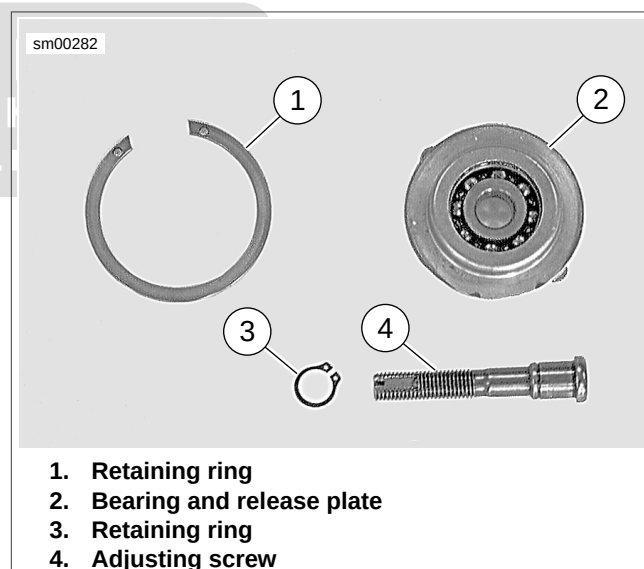


Figure 5-27. Adjusting Screw Assembly

CLUTCH SHELL/HUB INSPECTION

1. Inspect engine sprocket for damage or excessive wear. Replace as required.
2. Disassemble adjusting screw assembly and inspect bearing, release plate, and adjusting screw. See [5.6 PRIMARY DRIVE AND CLUTCH: XR MODELS, Adjusting Screw Disassembly/Assembly](#).
3. Remove clutch hub from clutch shell. Inspect primary chain sprocket and the starter ring gear on the clutch shell.

4. Inspect slots that mate with the clutch plates on both clutch shell and hub.
5. See [Figure 5-28](#). Inspect the clutch shell compensating spring set.

NOTE

It is possible for the compensating springs to float and move during inspection. This condition is normal.

6. See [Figure 5-29](#). Inspect clutch shell needle bearing for smoothness. Rotate the clutch shell while holding the clutch hub. If bearing is rough or binds, it must be replaced. See [5.6 PRIMARY DRIVE AND CLUTCH: XR MODELS, Clutch Shell Bearing Replacement](#).
7. See [Figure 5-30](#). Inspect clutch shell bearing inner race on the back side of the clutch hub for pitting and wear. If the inner race shows any signs of damage, the complete hub assembly must be replaced.
8. Replace damaged parts as necessary.

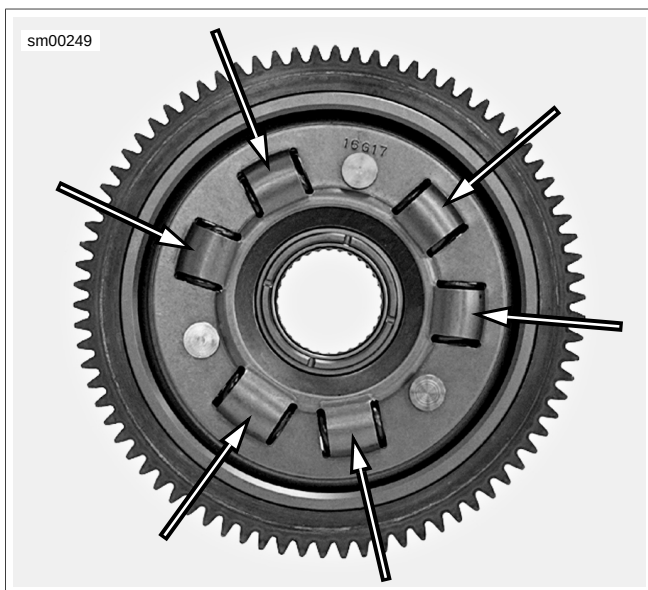


Figure 5-28. Compensating Spring Set



Figure 5-29. New Needle Bearing in Clutch Shell

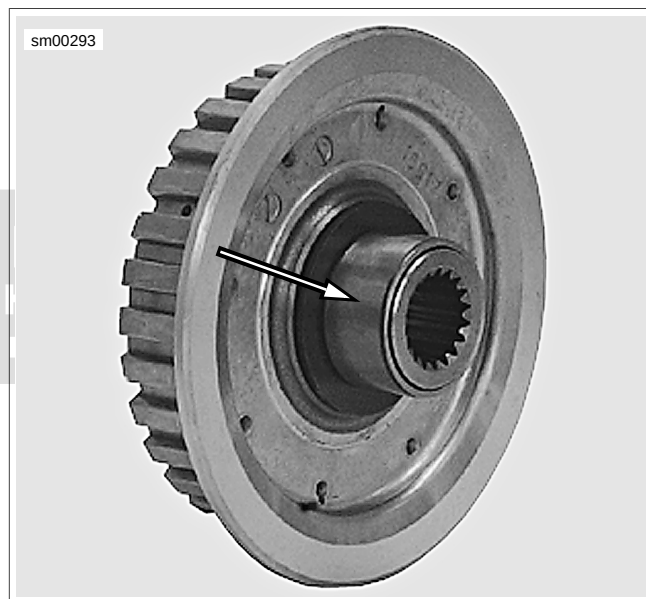


Figure 5-30. Clutch Hub Bearing Race

CLUTCH SHELL BEARING REPLACEMENT

PART NUMBER	TOOL NAME
B-45926	CLUTCH SHELL BEARING REMOVER/INSTALLER

NOTE

The clutch shell uses a caged needle bearing that corresponds to an inner race installed on the clutch hub.

1. See [Figure 5-32](#). Place clutch shell on support blocks with sprocket side facing up.

NOTE

The CLUTCH SHELL BEARING REMOVER/INSTALLER (Part No. B-45926) is clearly marked for removal and installation purposes.

2. See [Figure 5-32](#). Insert removal end of tool into bearing assembly and remove bearing from clutch shell.
3. See [Figure 5-33](#). Remove bearing guide from end of CLUTCH SHELL BEARING REMOVER/INSTALLER (Part No. B-45926).
4. Place **new** needle bearing onto installer end of tool and insert the bearing guide to prevent the bearing from falling off during installation and to align bearing with clutch shell.
5. See [Figure 5-34](#). Place clutch shell on support blocks with sprocket side facing up.
6. Press bearing into clutch shell until tool bottoms on the shell. This will be the correct installed height.

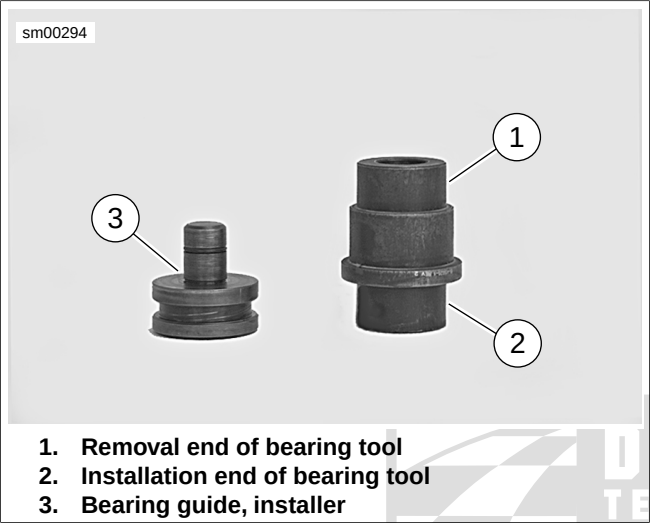


Figure 5-31. Clutch Shell Bearing Remover/Installer

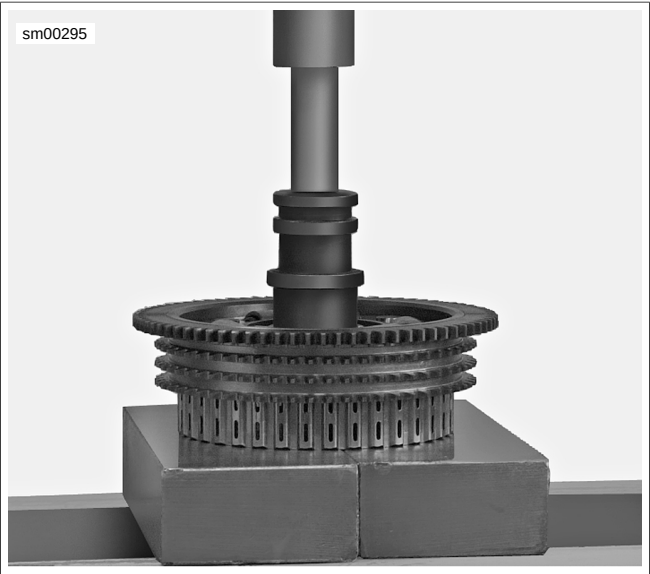


Figure 5-32. Removing Clutch Shell Needle Bearing



Figure 5-33. Bearing Installer

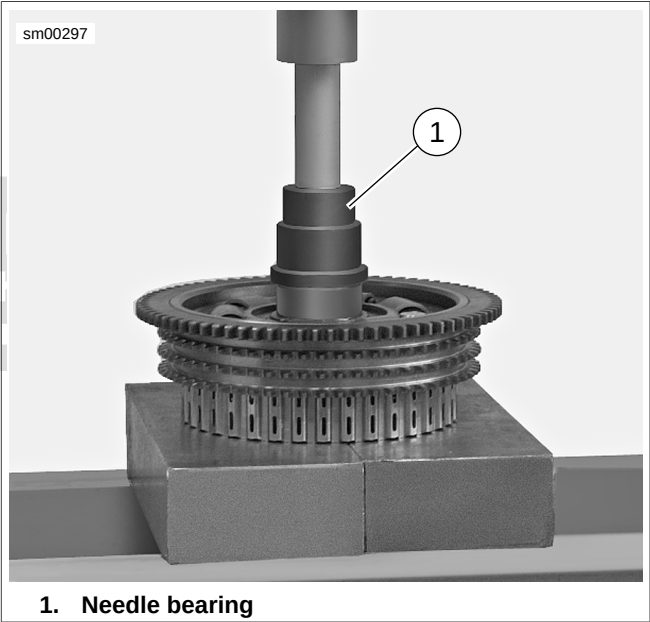


Figure 5-34. Installing Clutch Shell Needle Bearing

ASSEMBLY

PART NUMBER	TOOL NAME
HD-38515-A	SPRING COMPRESSING TOOL

1. Submerge and soak all friction and steel plates in GENUINE HARLEY-DAVIDSON FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT for at least five minutes.
2. See [Figure 5-35](#). Install narrow friction plate on the clutch hub, engaging tabs on plate with slots in clutch shell.
3. See [Figure 5-36](#). Install damper spring seat (5) on clutch hub so that it seats inboard of narrow friction plate (4).
4. Install damper spring (1) on clutch hub with the concave side up (facing opposite damper spring seat).

5. Install a steel plate and then a friction plate on the clutch hub. Install six remaining sets in the same manner, alternating between steel plates and friction plates.

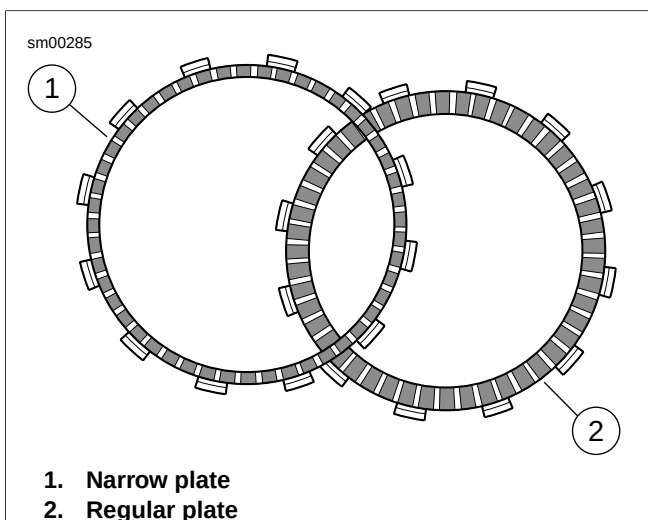


Figure 5-35. Friction Plates

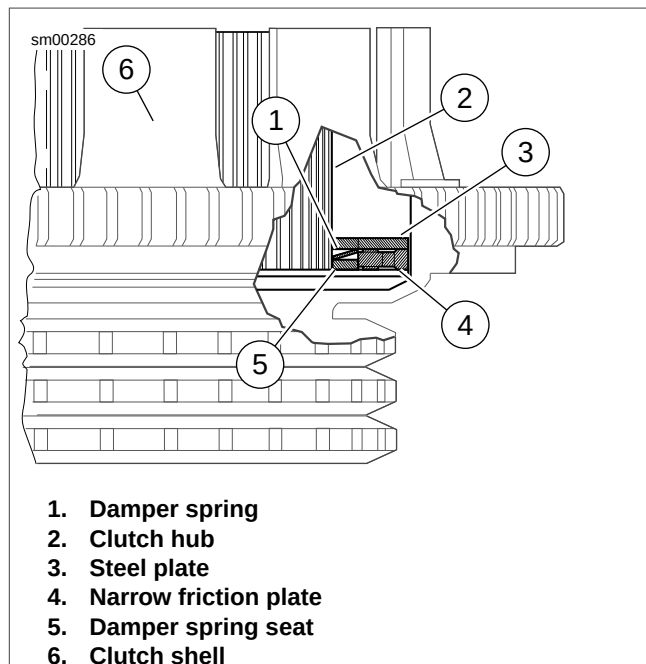


Figure 5-36. Clutch Pack Stack-Up (Cut-Away View)

6. Place pressure plate, diaphragm spring, adjusting screw assembly with **new** retaining ring and spring seat onto clutch pack.
7. Compress diaphragm spring and install retaining ring:
 - a. See [Figure 5-37](#). Align square openings of pressure plate and diaphragm spring so that the assembly can be installed over prongs on clutch hub.
 - b. Position spring seat with its larger outer diameter side toward diaphragm spring.

NOTE

See [Figure 5-38](#). Turn compressing tool handle only the amount required to install spring seat and snap ring. Excessive compression of diaphragm spring could damage clutch pressure plate.

- c. See [Figure 5-38](#). Install SPRING COMPRESSING TOOL (Part No. HD-38515-A) onto clutch hub against diaphragm spring.
- d. Place a wrench on the clutch spring forcing screw flats to prevent the forcing screw from turning.
- e. Turn compressing tool handle clockwise until diaphragm spring compresses just enough to install new retaining ring into the groove in clutch hub prongs.
- f. With retaining ring fully seated in groove of clutch hub, carefully loosen and remove compression tool.

NOTE

When the compressing tool is removed, the diaphragm spring will move outward forcing the spring seat up into the inside of the retaining ring. The spring seat provides an operating surface for the diaphragm spring at the same time preventing the retaining ring from coming out during operation.

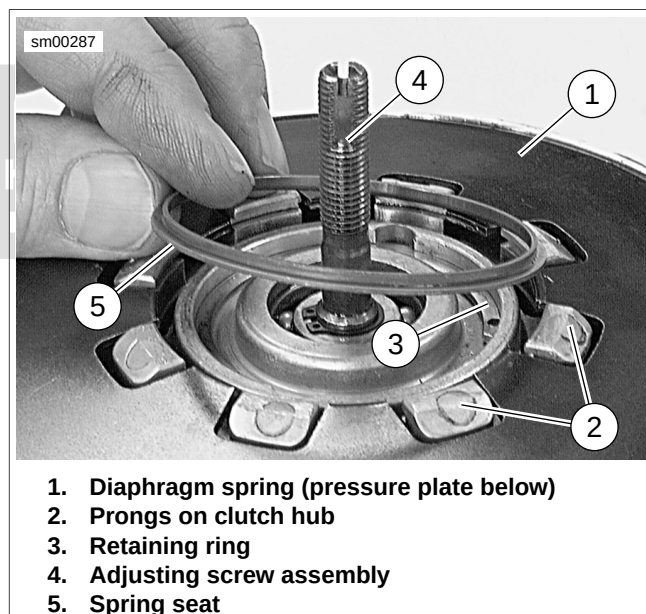


Figure 5-37. Spring Seat Installation

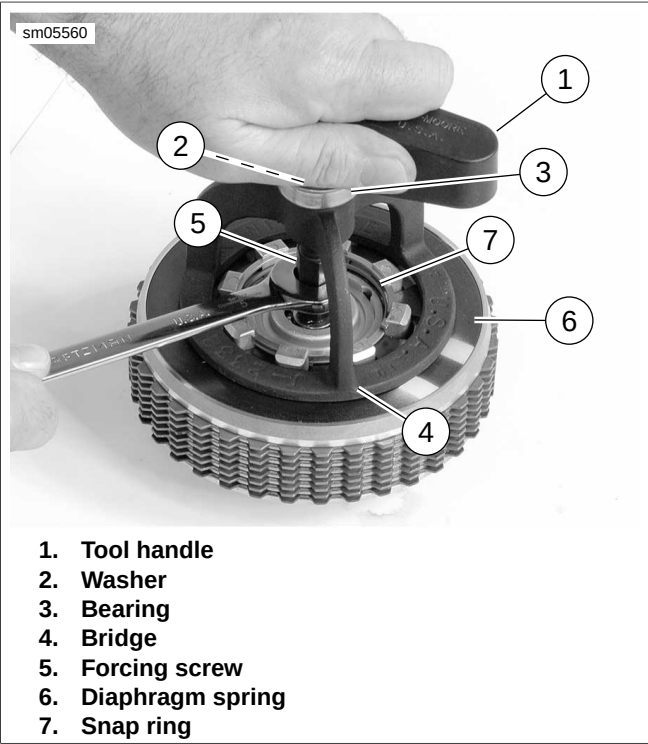


Figure 5-38. Compressing Diaphragm Spring: XR Models

INSTALLATION

PART NUMBER	TOOL NAME
HD-38362	SPROCKET LOCKING LINK

1. See [Figure 5-21](#). Remove retaining ring (12). Remove adjusting screw assembly (13, 14, 15, 16) from pressure plate (17) to allow installation of the transmission mainshaft nut and washer.

NOTE

Prior to installing engine sprocket bolt and transmission mainshaft nut, thoroughly clean threads of engine sprocket shaft, transmission mainshaft and mainshaft nut to remove any oil that might contaminate and interfere with locking agent.

2. Thoroughly clean threads of engine sprocket shaft, transmission mainshaft and mainshaft nut to remove any oil.

NOTE

See [Figure 5-39](#). Make sure not to position the sprocket locking link (1) too close to the shifter shaft (2). If the sprocket locking link contacts the shifter shaft while you are exerting force to tighten the engine sprocket bolt, damage to the shifter shaft and/or the engine crankcase may result.

3. See [Figure 5-39](#). Install SPROCKET LOCKING LINK (Part No. HD-38362) (1).
4. Install **new** engine sprocket bolt. Tighten to 155-165 ft-lbs (210.0-224.0 Nm).

NOTE

See [Figure 5-40](#). Washer (2) must be installed with the word "out" facing the transmission mainshaft nut (1). Incorrect assembly can result in clutch and/or transmission failure.

5. See [Figure 5-40](#). Apply two or three drops of LOCTITE Threadlocker 262 (red) onto threads on end of transmission mainshaft. Install spring washer (2) and mainshaft nut (1) (left-hand threads) on transmission mainshaft. Tighten nut to 70-80 ft-lbs (95.0-108.6 Nm).
6. Remove SPROCKET LOCKING LINK.
7. See [Figure 5-41](#). Install adjusting screw assembly in pressure plate, noting that two tabs on perimeter of release plate must be inserted into corresponding recesses in pressure plate. Secure assembly with a **new** retaining ring.
8. Install primary cover using **new** gasket. See [5.3 PRIMARY CHAIN ADJUSTER](#).
9. Adjust primary chain and clutch. See [1.12 PRIMARY CHAIN](#) and [1.13 CLUTCH](#).
10. Fill transmission with GENUINE HARLEY-DAVIDSON FORMULA+ TRANSMISSION AND PRIMARY CHAIN-CASE LUBRICANT. See [1.14 TRANSMISSION LUBRICANT](#).
11. Connect battery. See [1.17 BATTERY MAINTENANCE](#).

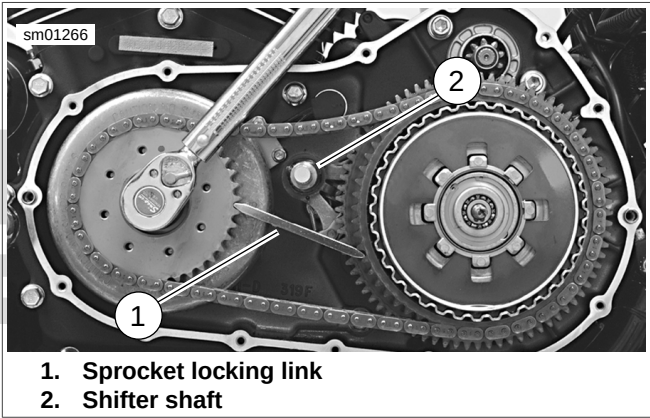


Figure 5-39. Tighten Engine Sprocket Fastener (typical)

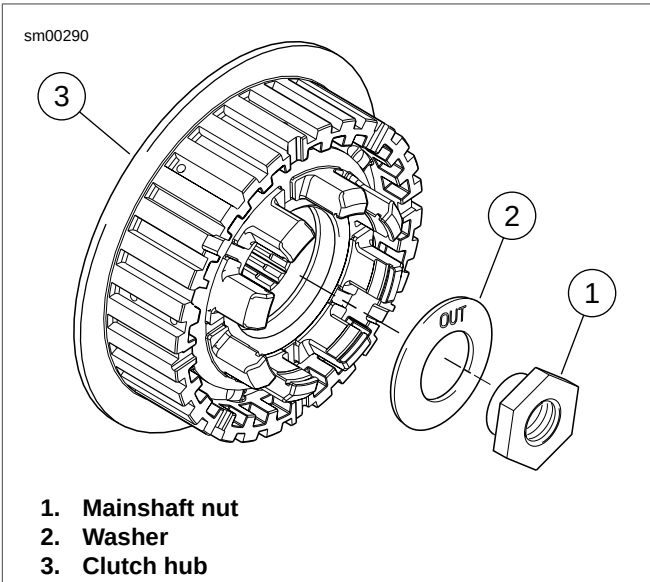


Figure 5-40. Mainshaft Nut and Washer

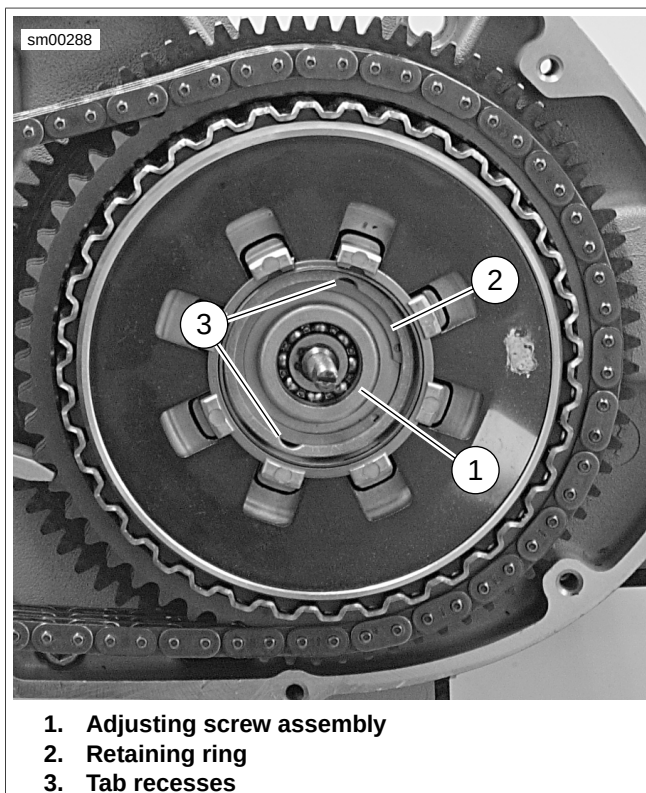


Figure 5-41. Clutch Adjusting Screw Assembly and Retaining Ring



DRIVE BELT

5.7

REMOVAL

XL Models

1. Remove both mufflers and rear exhaust pipe. See [4.15 EXHAUST SYSTEM: XL MODELS](#).
2. **Models equipped with mid-mount foot controls:** Remove right side rider footrest/brake pedal and mounting bracket assembly. See [2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS](#).
3. See [Figure 5-42](#). Remove screw (6), washer (5) and exhaust pipe clamp bracket (4). Remove two screws (2, 3). Remove sprocket cover (1).
4. See [Figure 5-43](#). Remove and discard e-clip (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.
5. See [Figure 5-44](#). Remove right lower shock absorber screw (2), washer (3) and lock nut (1).

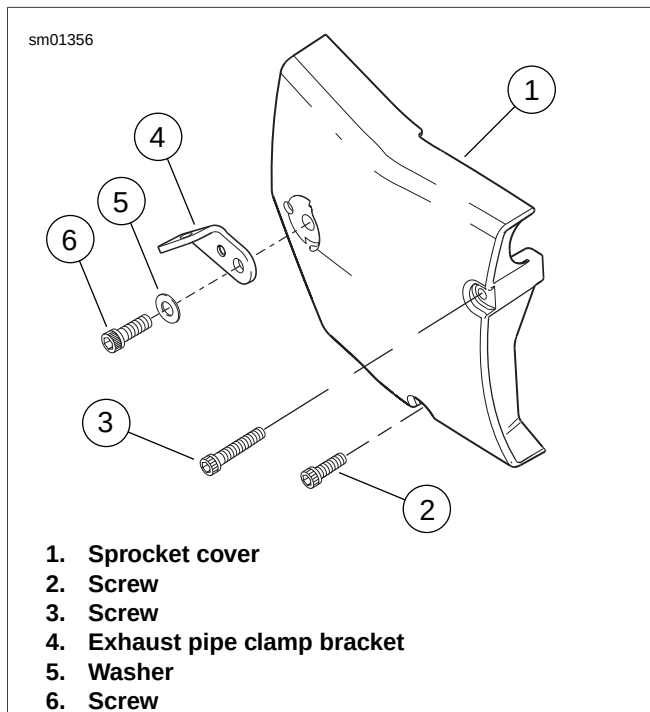


Figure 5-42. Sprocket Cover: XL Models

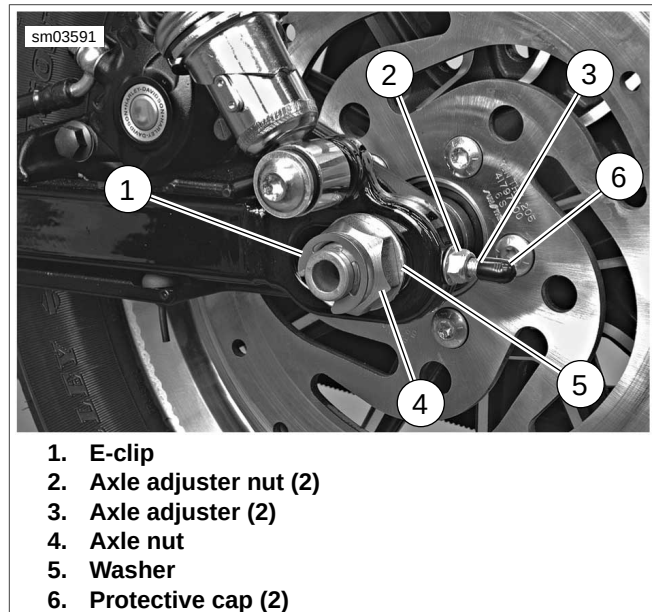


Figure 5-43. Secondary Drive Belt Adjustment (typical; XL model shown)

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TECHNICIAN II
HARLEY-DAVIDSON®

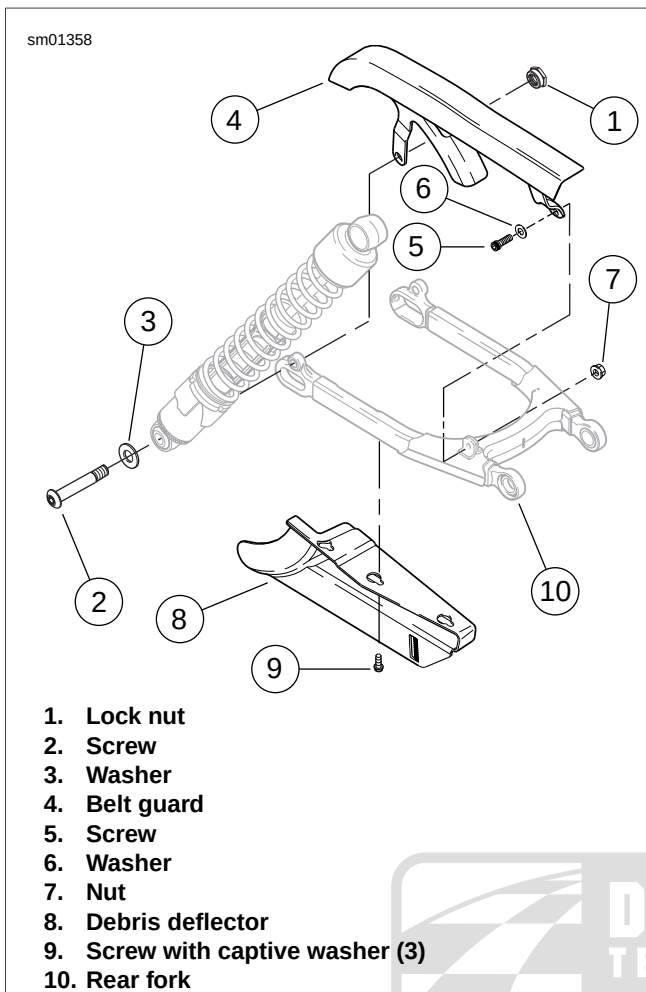


Figure 5-44. Belt Guard/Debris Deflector: XL Models

6. Remove nut (7), screw (5) and washer (6) securing front of belt guard (4) to rear fork (10). Remove belt guard.
7. Loosen, but do not remove three screws with captive washers (9) securing debris deflector (8) to rear fork. Slide debris deflector forward until keyway slots in deflector clear screw heads. Remove debris deflector.

⚠ WARNING

Never bend belt forward into a loop smaller than the drive sprocket diameter. Never bend belt into a reverse loop. Over bending can damage belt resulting in premature failure, which could cause loss of control and death or serious injury. (00339a)

8. Remove belt.

XR Models

1. Remove exhaust system. See [4.16 EXHAUST SYSTEM: XR MODELS](#).
2. See [Figure 5-45](#). Remove screws (2, 3, 4). Remove sprocket cover (1).
3. See [Figure 5-43](#). Remove and discard e-clip (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.

4. Remove right lower shock absorber screw, washer and lock nut. See [2.26 SHOCK ABSORBERS](#).

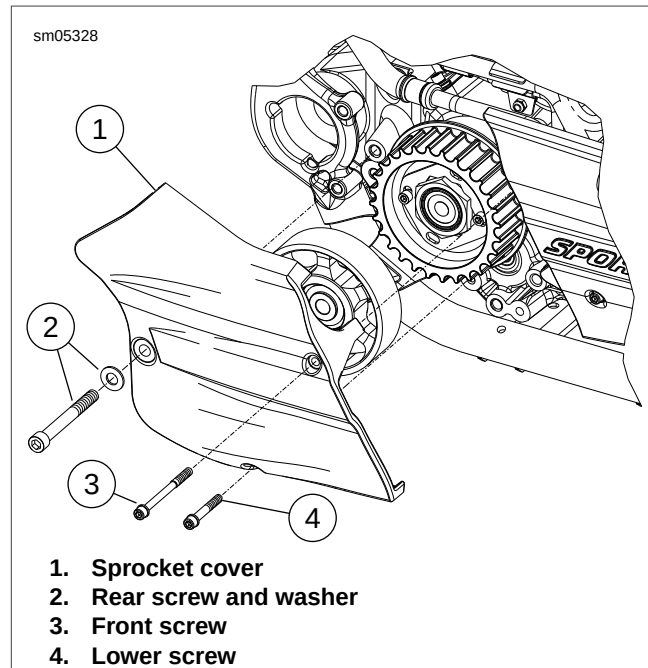


Figure 5-45. Sprocket Cover: XR Models

5. Remove belt guard and debris deflector. See [2.24 BELT GUARD AND DEBRIS DEFLECTOR](#).

⚠ WARNING

Never bend belt forward into a loop smaller than the drive sprocket diameter. Never bend belt into a reverse loop. Over bending can damage belt resulting in premature failure, which could cause loss of control and death or serious injury. (00339a)

6. Remove belt.

INSTALLATION

XL Models

1. Install belt onto sprockets.
2. See [Figure 5-44](#). Install belt guard (4). Install screw (5), washer (6) and nut (7) securing front of belt guard to rear fork (10). Tighten to 120-180 **in-lbs** (13.6-20.3 Nm).
3. Position debris deflector (8) in place on underside of rear fork (10).
4. Fit large end of keyway slots in deflector over screw heads and captive washers (9). Slide deflector rearward to lock screws in slots. Tighten screws to 36-60 **in-lbs** (4.1-6.8 Nm).
5. Install right lower shock absorber screw (2), washer (3) and lock nut (1). Tighten to 45-50 **ft-lbs** (61-68 Nm).
6. See [Figure 5-42](#). Install sprocket cover (1). Secure with two screws (2, 3). Note that long screw goes in top hole,

short screw in bottom hole. Do not tighten screws at this time.

7. Install exhaust pipe clamp bracket (4), washer (5) and screw (6). Tighten to 30-33 ft-lbs (40.7-44.8 Nm). Now tighten screws (2, 3) to 80-120 **in-lbs** (9.0-13.6 Nm).
8. **Models equipped with mid-mount foot controls:** Install right side rider footrest/brake pedal and mounting bracket assembly. See [2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS](#).
9. Install rear exhaust pipe and both mufflers. See [4.15 EXHAUST SYSTEM: XL MODELS](#).
10. Adjust belt tension and rear wheel alignment. See [1.16 REAR BELT DEFLECTION](#).
11. See [Figure 5-43](#). Tighten rear axle nut (4) to 95-105 ft-lbs (129-142 Nm). Install **new** e-clip (1).

XR Models

1. Install belt onto sprockets.

2. Install belt guard and debris deflector. See [2.24 BELT GUARD AND DEBRIS DEFLECTOR](#).
3. Install right lower shock absorber screw, washer and lock nut. Tighten to 45-50 ft-lbs (61-68 Nm). See [2.26 SHOCK ABSORBERS](#).
4. See [Figure 5-45](#). Install sprocket cover (1). Note that longer screw goes in top hole, short screw in bottom hole.
 - a. Tighten screw (2) to 30-33 ft-lbs (40.7-44.7 Nm)
 - b. Tighten screws (3, 4) to 80-120 **in-lbs** (9.0-13.6 Nm).
5. Install exhaust system. See [4.16 EXHAUST SYSTEM: XR MODELS](#).
6. Adjust belt tension and rear wheel alignment. See [1.16 REAR BELT DEFLECTION](#).
7. See [Figure 5-43](#). Tighten rear axle nut (4) to 95-105 ft-lbs (129-142 Nm). Install **new** e-clip (1).



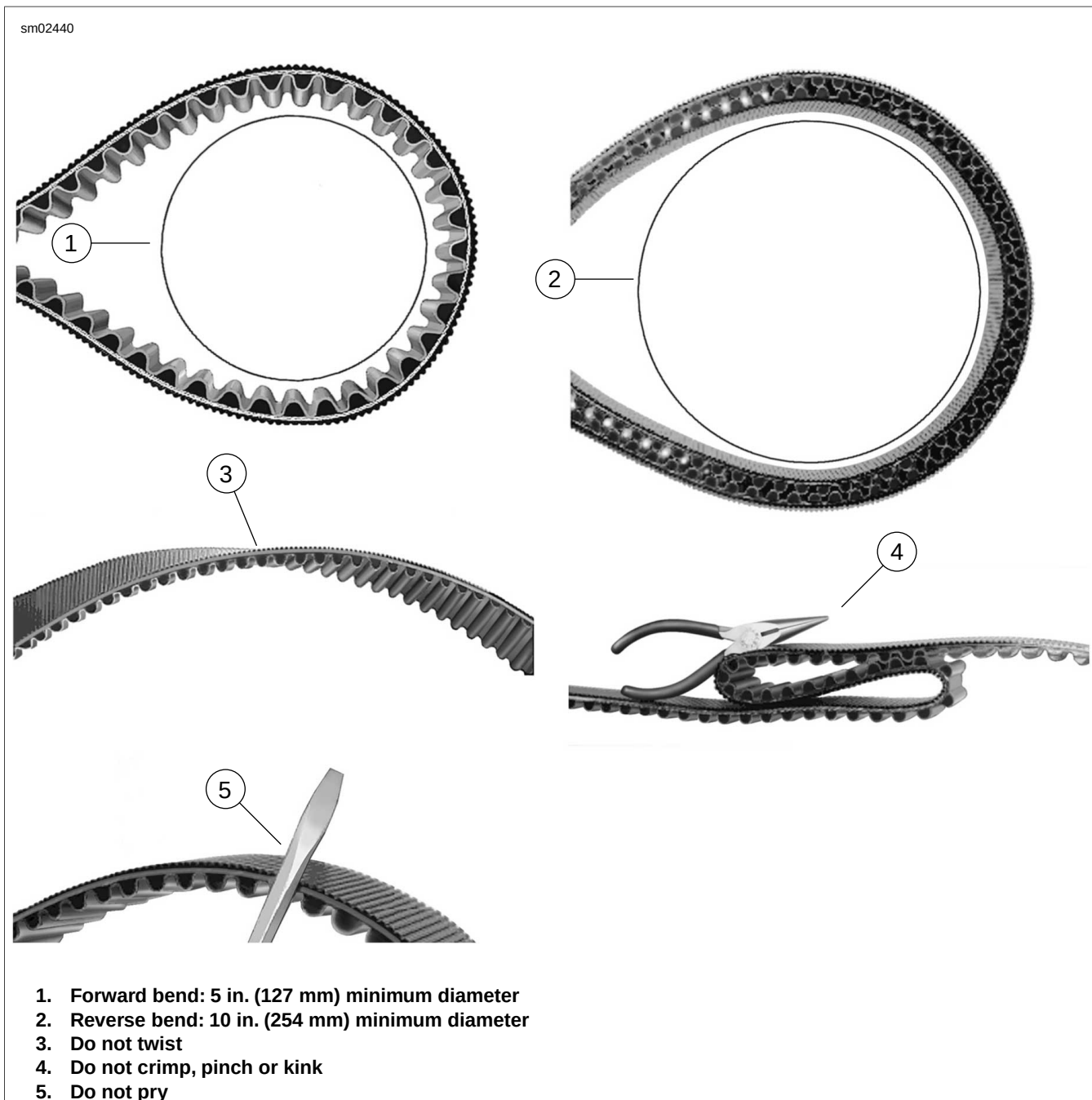


Figure 5-46. Proper Drive Belt Handling

IDLER PULLEY: XR MODELS ONLY

Removal

1. See [Figure 5-47](#). Remove sprocket cover (1).

NOTE

It is not necessary to remove the drive belt completely.

2. Remove tension from drive belt and slide belt off drive sprocket (5). See [5.7 DRIVE BELT, Removal](#).

NOTE

If exhaust system interference prevents removal, loosen all exhaust system mount fasteners and flange nuts. Pull exhaust

system away from engine to allow room to remove idler assembly.

3. Remove nuts (3) and washers (4). Remove idler pulley and bracket assembly from vehicle.
4. Inspect idler pulley (7) by spinning and checking for bearing wear. See [1.15 REAR BELT AND SPROCKETS, Inspection](#).

NOTE

The idler pulley bearings can not be replaced separately.

5. If idler pulley needs replacement, remove fastener (8) and bushings (2). Discard idler pulley and replace with **new** idler pulley (7).

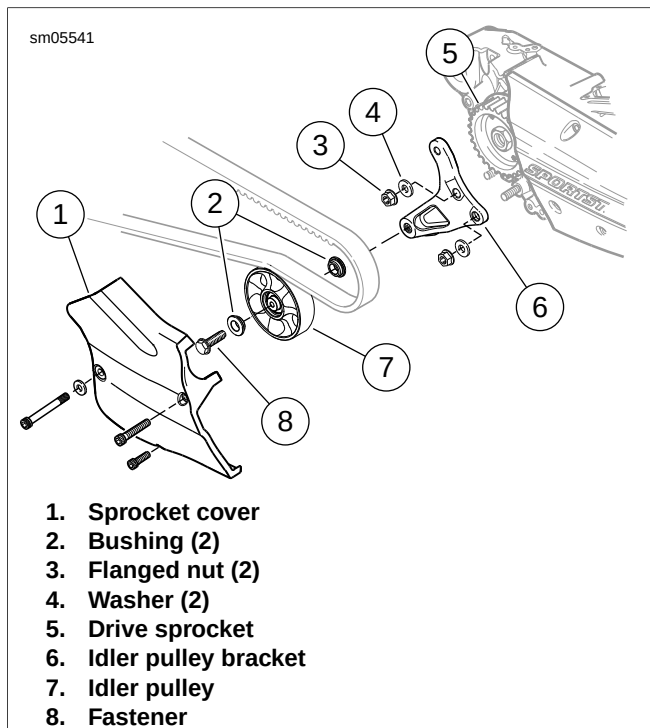


Figure 5-47. Drive Belt Idler: XR Models

Installation

1. See [Figure 5-47](#). Install **new** or existing idler pulley (7), if removed. Tighten fastener (8) to 70-80 ft-lbs (95-109 Nm).
2. Install idler pulley and bracket assembly. Install washers (4) and flanged nuts (3), and tighten to 33-35 ft-lbs (45-47 Nm).
3. Install drive belt and adjust belt tension and wheel alignment. See [1.16 REAR BELT DEFLECTION](#).
4. Install sprocket cover. Tighten rear (larger) screw to 30-33 ft-lbs (40.7-44.8 Nm). Tighten forward and lower (smaller) screws to 80-120 **in-lbs** (9.0-13.6 Nm).
5. If loosened, align and tighten exhaust system components. See [4.16 EXHAUST SYSTEM: XR MODELS](#)



TRANSMISSION

5.8

GENERAL

See [Figure 5-48](#). 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 dogs on the mainshaft and countershaft, into and out of mesh with the other gears.



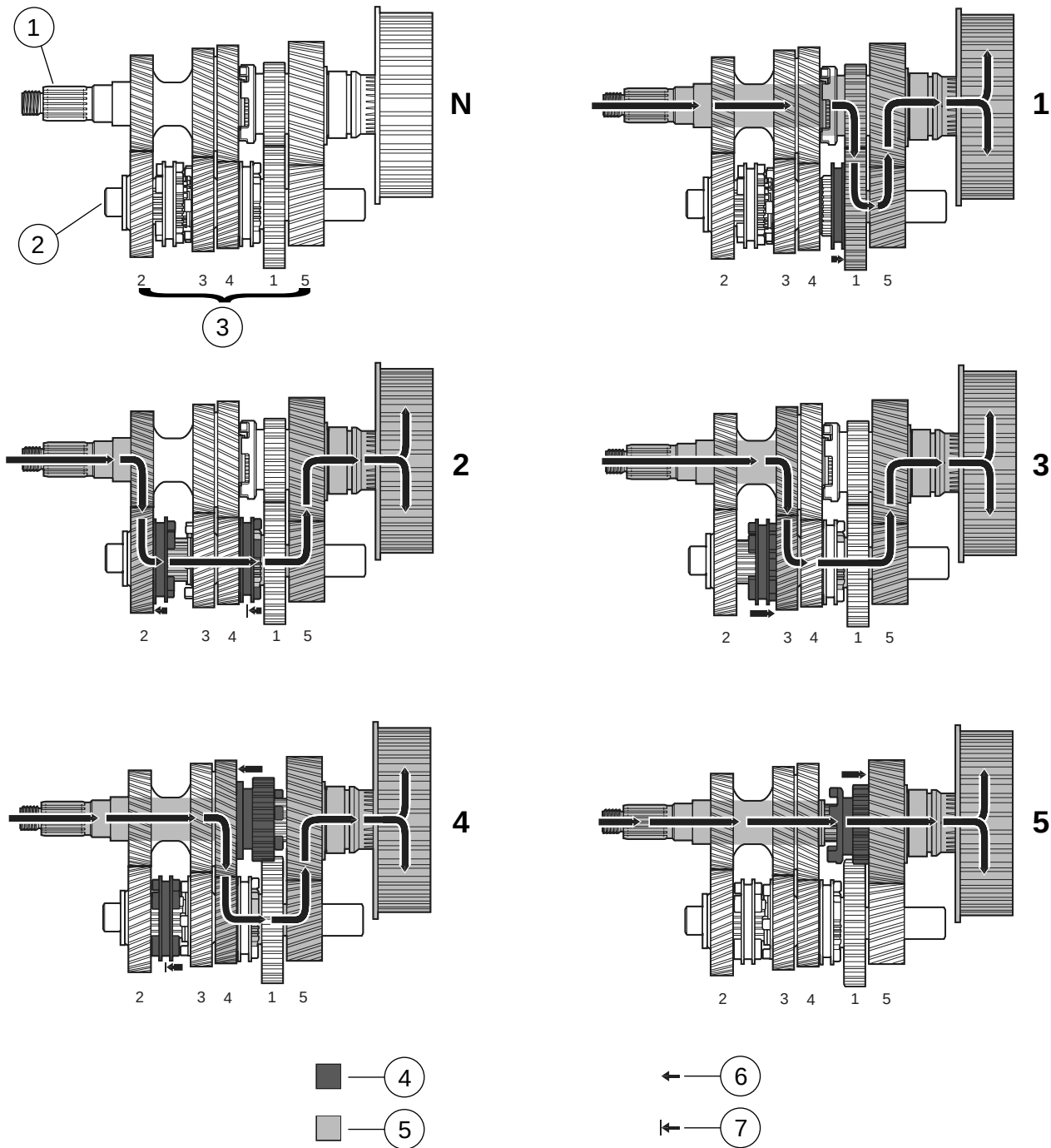


Figure 5-48. Transmission Power Flow

CASE DISASSEMBLY FOR TRANSMISSION REMOVAL

5.9

GENERAL

The rear compartment of the left and right crankcase halves form the transmission case. Servicing of transmission components requires removing the engine and disassembling (splitting) the crankcase.

ENGINE REMOVAL AND DISASSEMBLY

PART NUMBER	TOOL NAME
HD-42310-45	ENGINE SUPPORT CRADLE

1. Remove engine from chassis. See [3.12 REMOVING ENGINE FROM CHASSIS](#).
2. Support engine using ENGINE SUPPORT CRADLE (Part No. HD-42310-45) and the appropriate engine stand.
3. Disassemble top end. See [3.15 TOP END OVERHAUL: DISASSEMBLY](#).
4. Remove primary cover, clutch assembly, primary chain and engine sprocket. See [5.5 PRIMARY DRIVE AND CLUTCH: XL MODELS](#) or [5.6 PRIMARY DRIVE AND CLUTCH: XR MODELS](#).
5. Disassemble gearcase. See [3.17 BOTTOM END OVERHAUL: DISASSEMBLY](#).
6. Remove transmission sprocket.
7. See [Figure 5-49](#). Place transmission in 1st gear. Remove countershaft retaining screw (1).
8. Place transmission in neutral. See [Figure 5-50](#). Unplug neutral switch connector [131] (2) by pulling connector straight off neutral switch (1). Remove neutral switch and flat washer.
9. See [Figure 5-51](#). Verify shifter drum detent is visible in neutral switch hole indicating that transmission is in neutral.

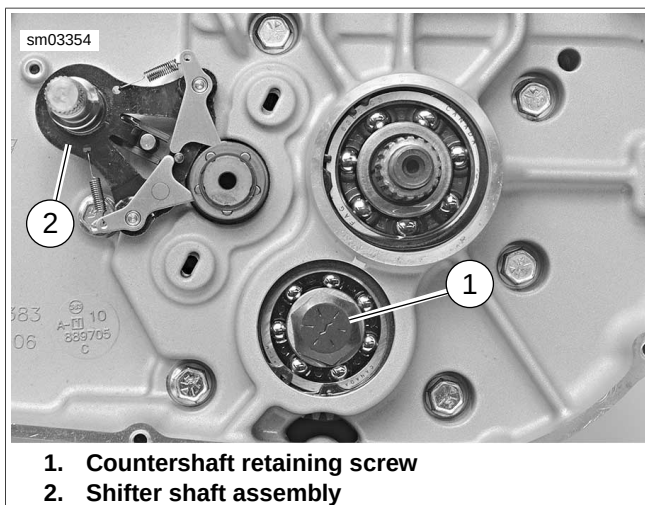


Figure 5-49. Countershaft Retaining Screw

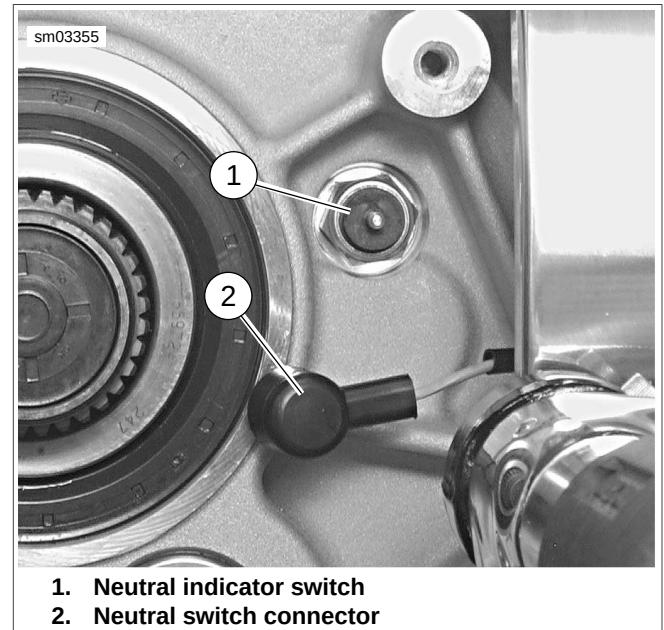


Figure 5-50. Neutral Switch and Connector

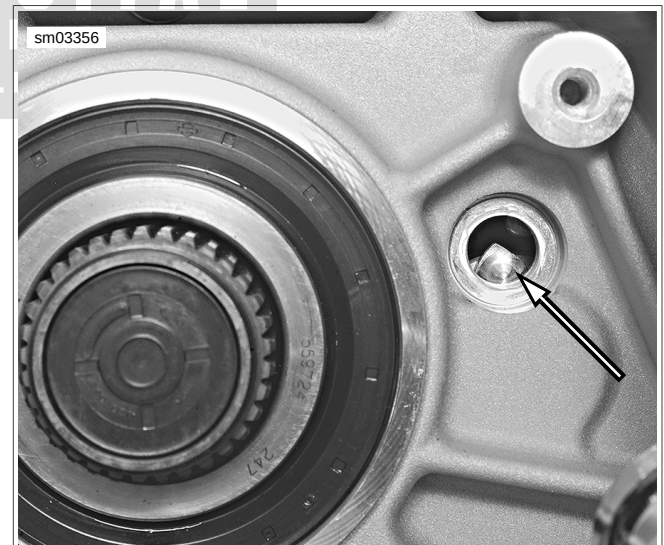


Figure 5-51. Shifter Drum Neutral Detent

10. See [Figure 5-52](#) and [Figure 5-53](#). Depress ratchet arms (item 2, [Figure 5-52](#)) in order to clear the shifter drum, and remove shifter shaft assembly from left crankcase half.
11. Remove starter. See [6.13 STARTER](#).
12. See [Figure 5-54](#). With transmission still in neutral, scribe a line on the end of the shifter drum at the 12 o'clock position for later reference.

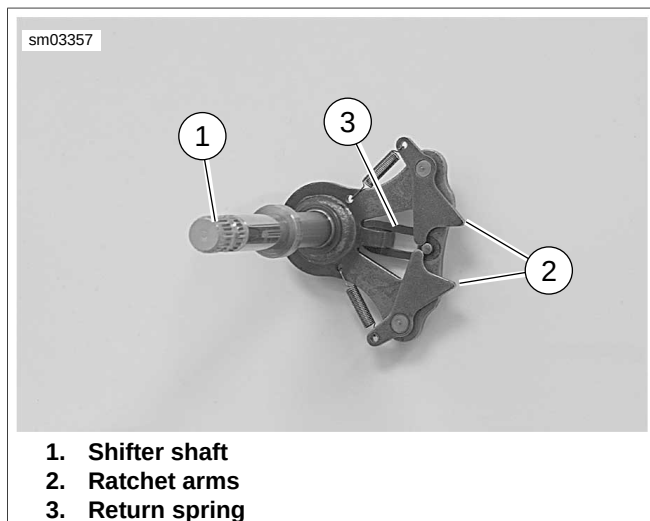


Figure 5-52. Shifter Shaft Assembly

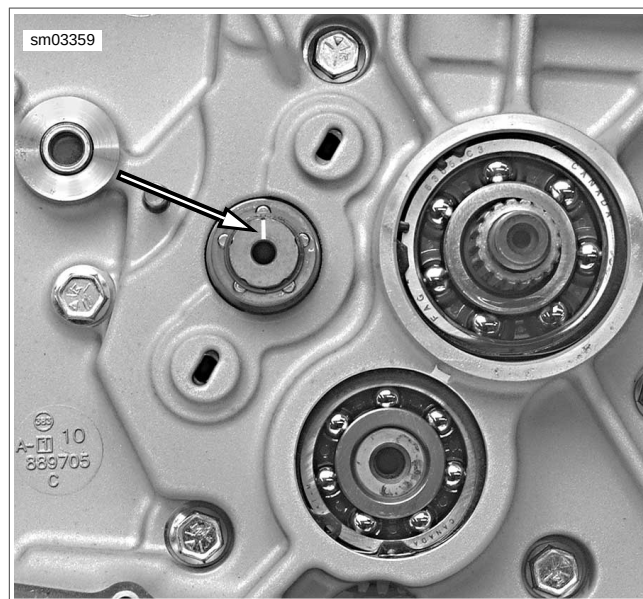


Figure 5-54. Scribed Line on Shifter Drum at 12 o'clock

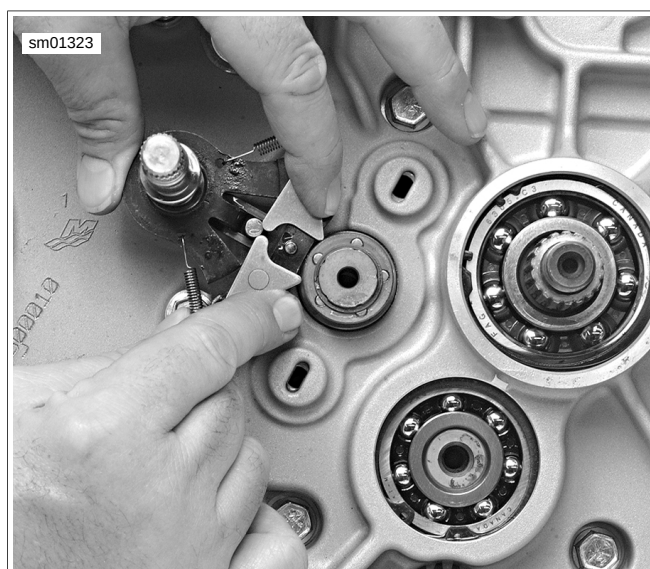


Figure 5-53. Removing Shifter Shaft Assembly

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TECHNICIAN II
HARLEY-DAVIDSON®

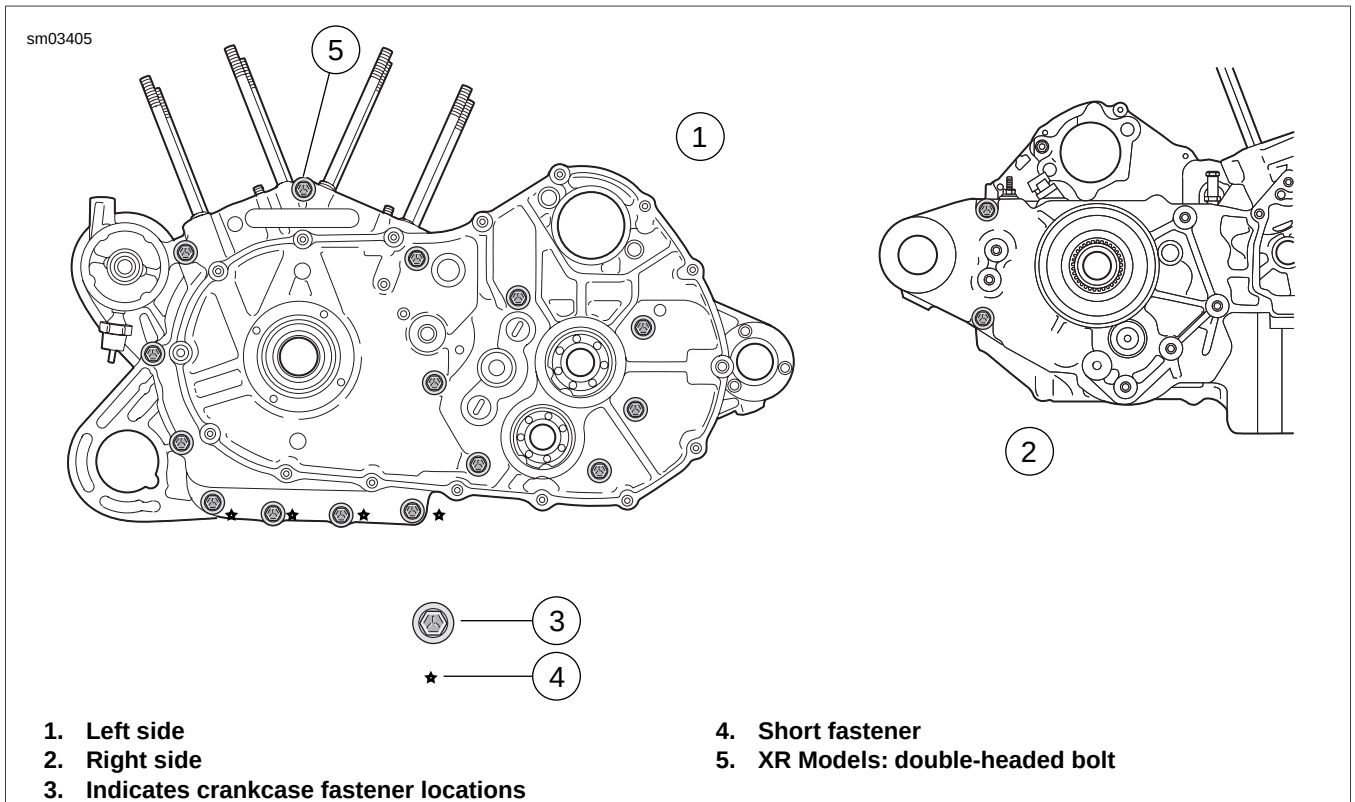


Figure 5-55. Crankcase Fasteners

NOTE

Crankcase assembly has 17 fasteners; 15 inserted from left side and two inserted from right side. Make certain all fasteners have been removed before attempting to separate crankcase halves.

13. See [Figure 5-55](#). Remove 15 crankcase fasteners (11 long and four short) from left side of crankcase assembly. Remove two fasteners from right side of crankcase assembly.
14. Tap crankcase gently with rawhide mallet to loosen and separate the halves. See [Figure 5-56](#). Remove left crankcase assembly with transmission.

NOTE

Flywheel assembly slides off left main bearing by hand. No tools are required for this operation.

15. See [Figure 5-57](#). Remove flywheel assembly from right crankcase half.

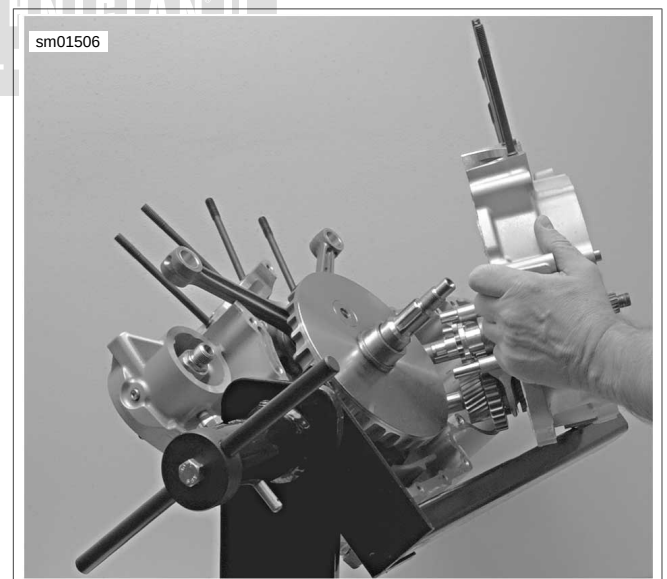


Figure 5-56. Separating Crankcase Halves

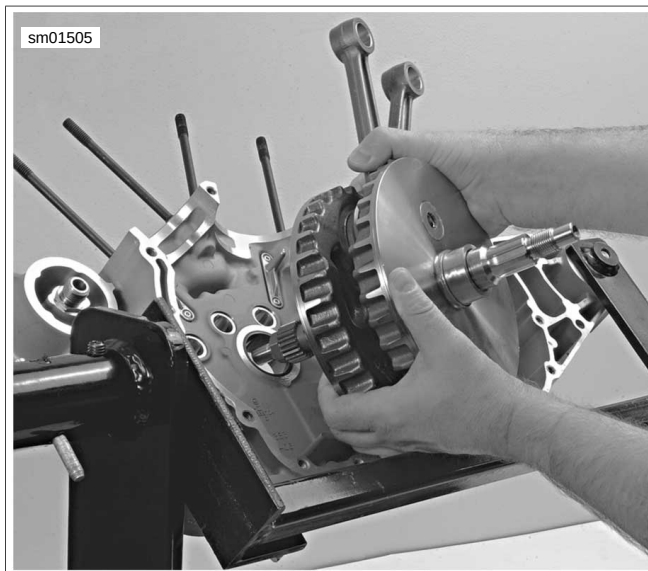


Figure 5-57. Removing Flywheel Assembly From Right Crankcase Half (typical, XL model shown)

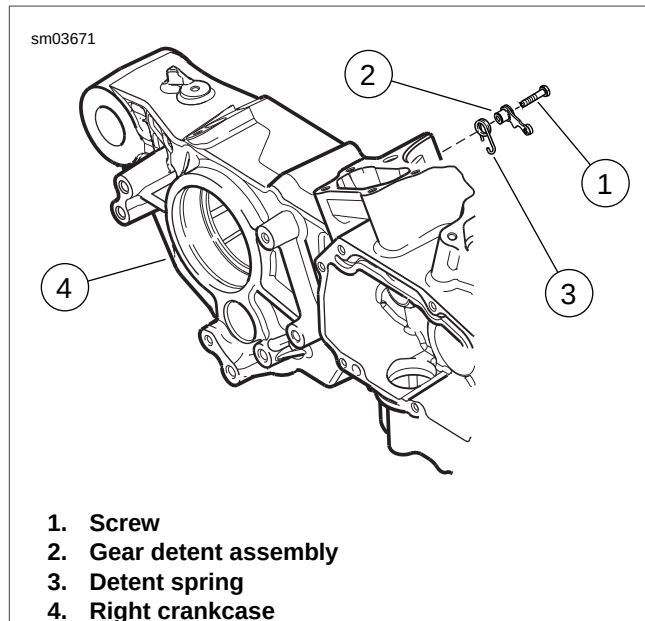


Figure 5-58. Gear Detent Assembly

16. See [Figure 5-58](#). Remove screw (1), gear detent assembly (2) and detent spring (3) from inside transmission cavity of right crankcase (4).



TRANSMISSION REMOVAL AND DISASSEMBLY5.10

TRANSMISSION REMOVAL FROM LEFT CRANKCASE

PART NUMBER	TOOL NAME
B-43895-1	TRANSMISSION REMOVER

NOTE

See [Figure 5-59](#). Shifter design allows for one common part number for both countershaft shifter forks. As the transmission runs, each shifter fork develops a certain wear pattern with its mating parts. For this reason, it is important that each shifter fork be reinstalled in its original location.

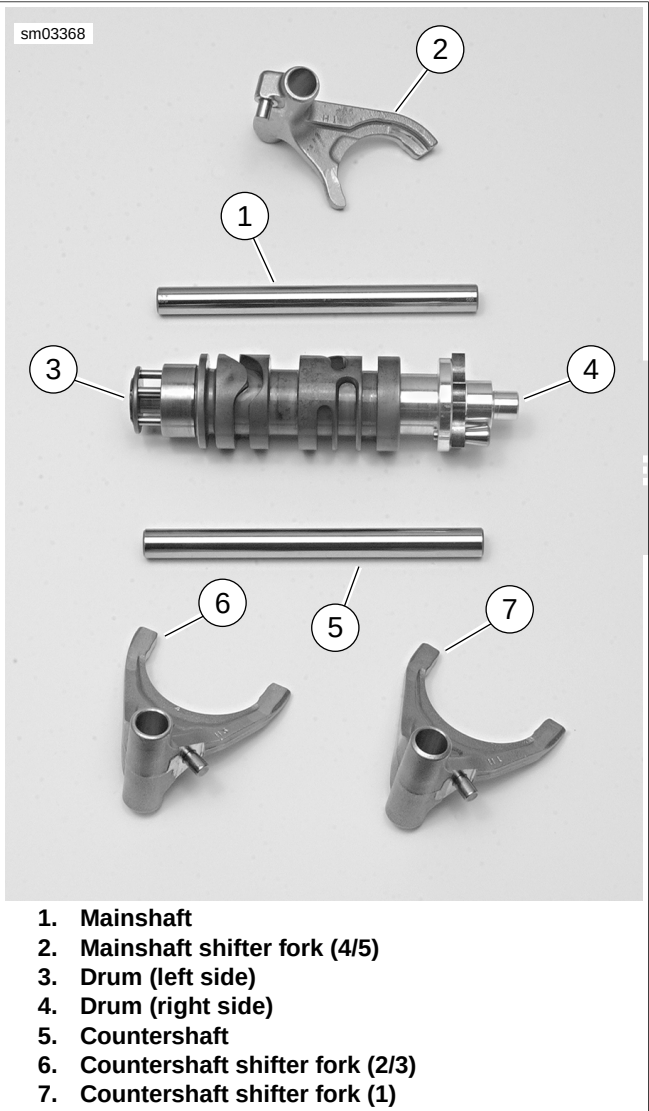


Figure 5-59. Shifter Forks, Drum and Shafts

1. See [Figure 5-60](#). Remove shifter fork shafts by inserting a small flat punch in the slots and tapping on the end of each shaft until it falls free.

NOTE

Carefully tap on alternate sides of the shaft using the provided slots.

2. See [Figure 5-61](#). Remove shifter drum (1) and shifter forks (2). Mark each shifter fork as it is removed, so it can be reinstalled in the same location.

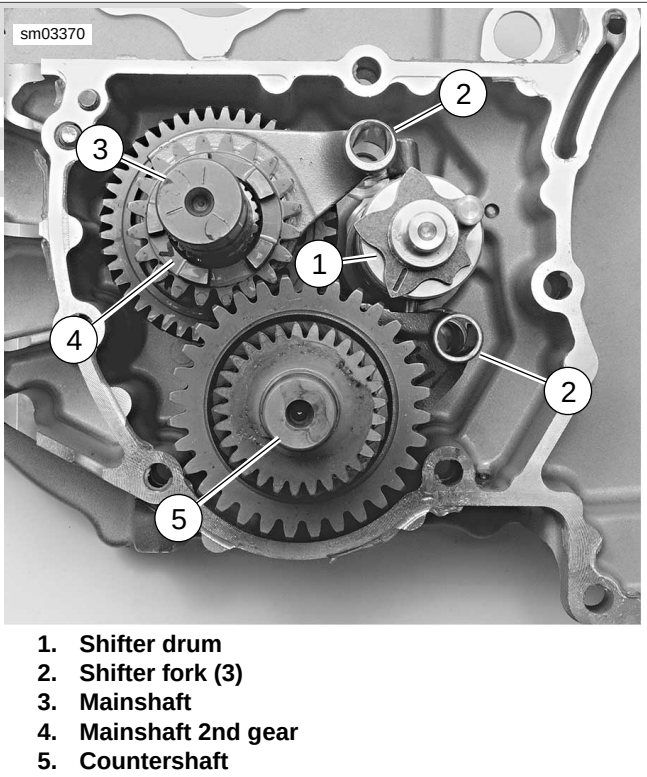
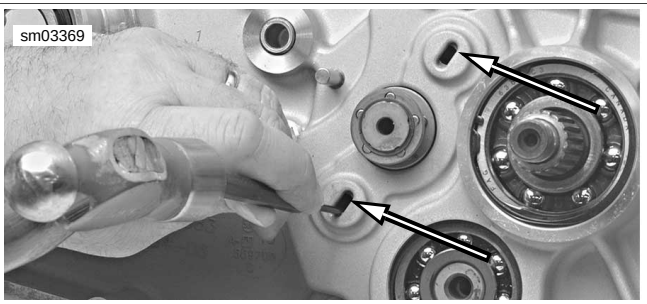
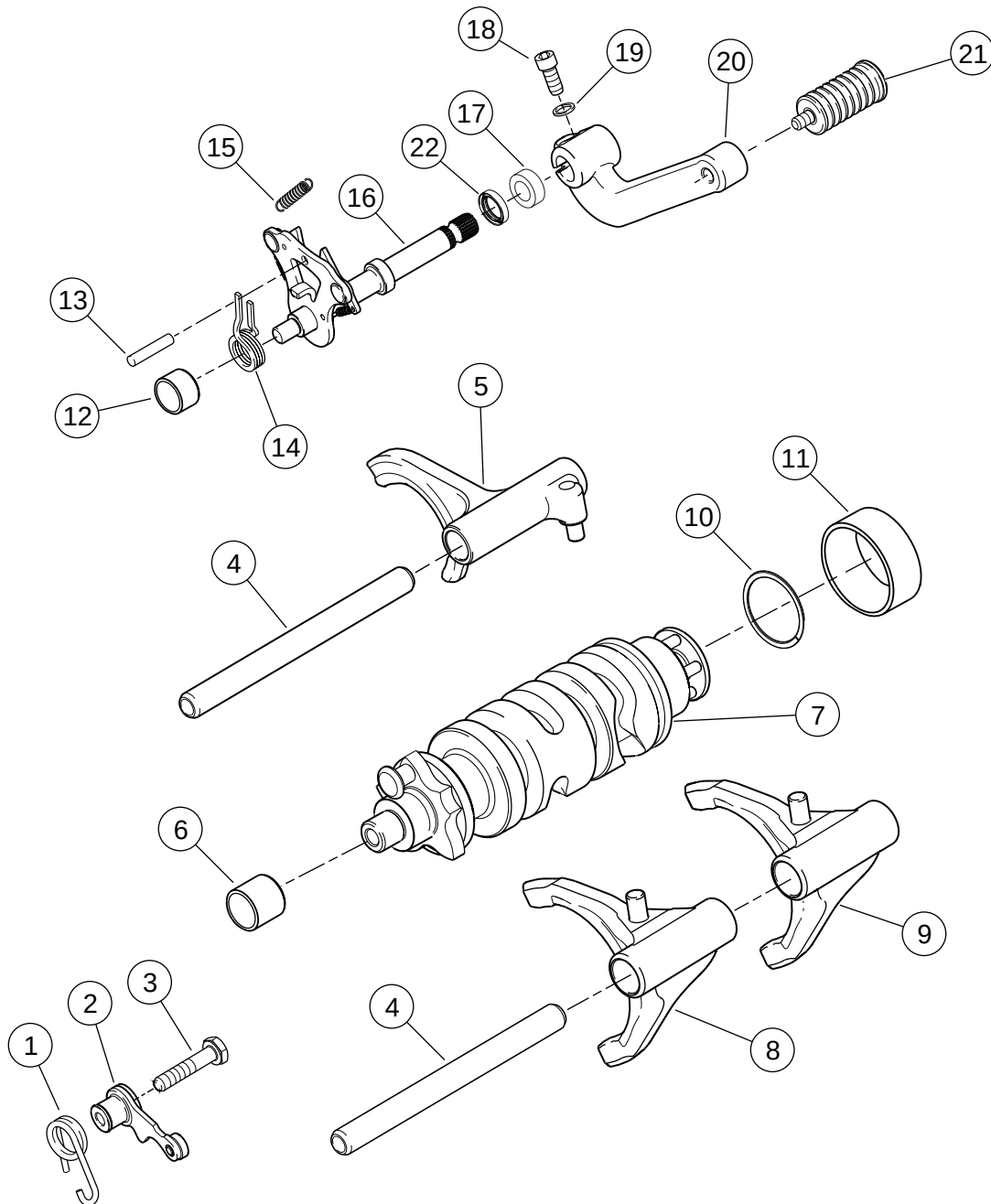


Figure 5-61. Transmission Assembly

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1. Detent spring
2. Detent spring sleeve assembly
3. Screw
4. Shifter fork shaft (2)
5. Shifter fork (4th/5th)
6. Right hand crankcase bushing
7. Shifter cam assembly
8. Shifter fork (1st)
9. Shifter fork (2nd/3rd)
10. Retaining ring
11. Bearing

12. Bushing
13. Shifter stop pin
14. Shifter return spring
15. Extension spring
16. Shifter lever assembly
17. Rubber washer
18. Screw
19. Washer
20. Foot shift lever
21. Shifter peg
22. Oil seal

Figure 5-62. Shifter Mechanism

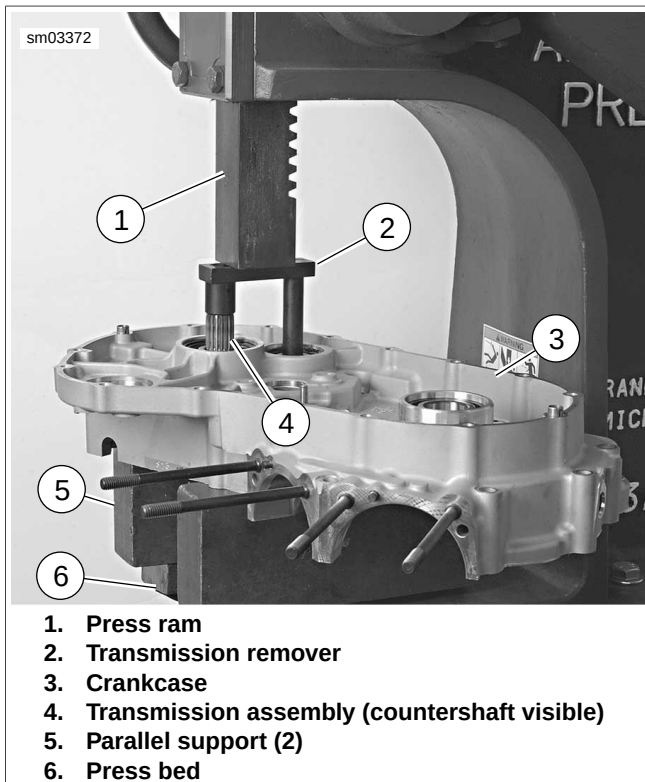


Figure 5-63. Pressing Transmission From Left Crankcase

⚠ WARNING

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

3. See [Figure 5-63](#). Remove left crankcase half and transmission assembly (4) from engine stand.
 - a. Place crankcase half (3) and transmission assembly (4) on arbor press (1) and support transmission assembly on parallel supports (5).
 - b. Press transmission assembly using TRANSMISSION REMOVER (Part No. B-43895-1) (2) to remove transmission assembly from crankcase half.
 - c. Remove crankcase from press.



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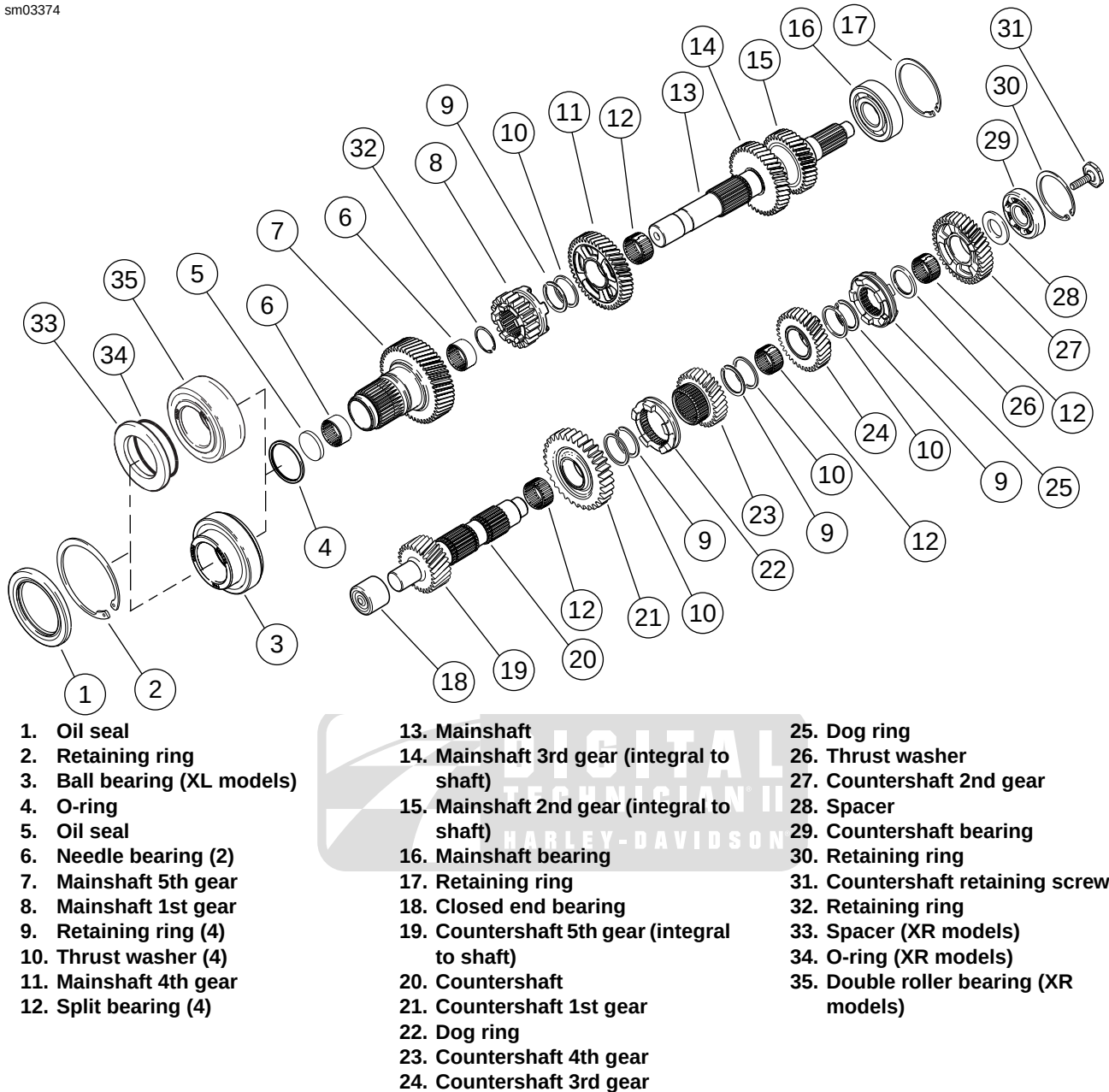


Figure 5-64. Transmission Assembly

MAINSHAFT/COUNTERSHAFT

NOTES

- 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.
- See [Figure 5-65](#). As each component is removed, place it on a clean surface in the exact order of removal.

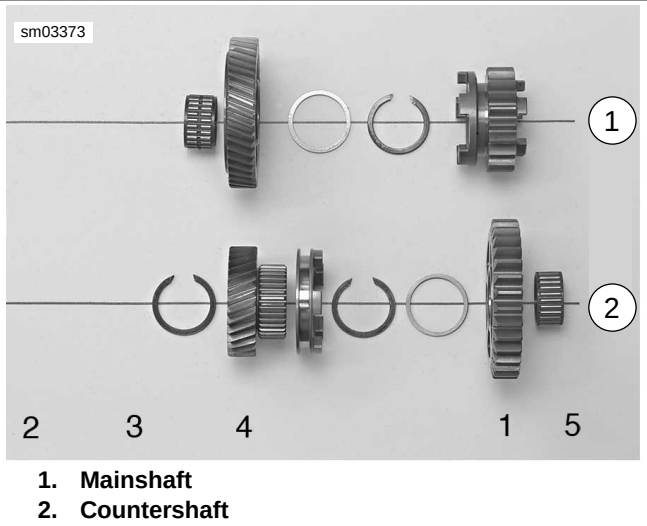


Figure 5-65. Transmission Parts Identification

MAINSHAFT DISASSEMBLY

PART NUMBER	TOOL NAME
J-5586-A	TRANSMISSION SHAFT RETAINING RING PLIERS

NOTES

- Mainshaft 2nd and 3rd gears are integral to the shaft.
- Mainshaft 1st gear is directional. Mark gear when removed for correct installation.
- Once the transmission assembly has been pressed out of the left crankcase half, the mainshaft and countershaft assemblies can be serviced separately.
- All thrust washers are one common part number. This transmission requires no shimming.

⚠ WARNING

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

NOTE

Use correct retaining ring pliers and correct tips. Verify that tips are not excessively worn or damaged.

1. See [Figure 5-66](#). Remove 1st gear (1).
2. Use TRANSMISSION SHAFT RETAINING RING PLIERS (Part No. J-5586-A) to expand and remove retaining ring (2). Discard retaining ring.
3. Slide thrust washer (3) off end of mainshaft.
4. Remove 4th gear (4) and split bearing (5). Discard bearing.

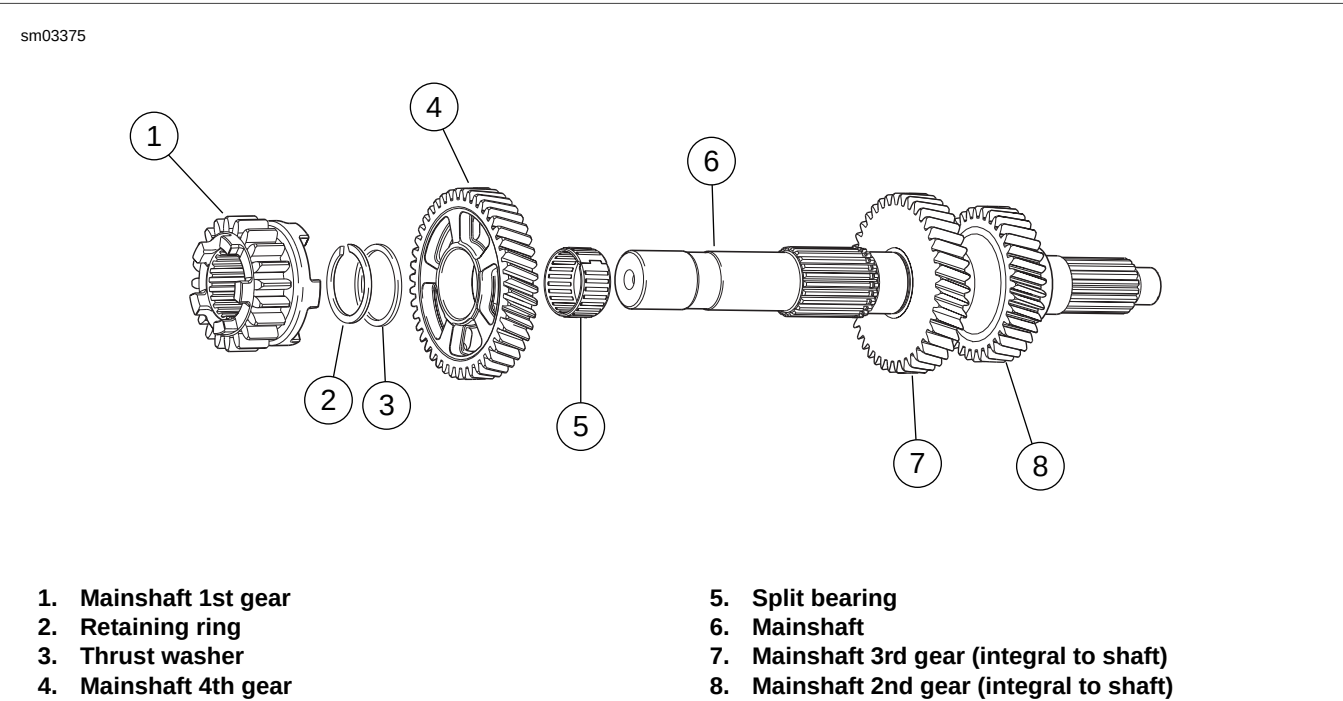


Figure 5-66. Transmission Mainshaft Assembly Once Removed from Left Crankcase/Disassembly

Cleaning and Inspection

WARNING

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

1. Clean all parts in 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.

COUNTERSHAFT DISASSEMBLY

PART NUMBER	TOOL NAME
J-5586-A	RETAINING RING PLIERS

NOTES

- Countershaft 5th gear is integral to the shaft.
- Once the transmission assembly has been pressed out of the left crankcase half, the mainshaft and countershaft assemblies can be serviced separately.
- All thrust washers are one common part number. This transmission requires no shimming.
- Use correct retaining ring pliers with correct tips. Verify that tips are not excessively worn or damaged.

WARNING

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

1. See [Figure 5-67](#). Remove spacer (19) and 2nd gear (18) from the end of the of the countershaft (2). Remove and discard split bearing (17).
2. Remove spacer (16).

NOTE

When removing the dog ring (15), it is important to mark the direction of the ring on the shaft as parts establish wear patterns.

3. Remove dog ring (15).
4. Using RETAINING RING PLIERS (Part No. J-5586-A), expand and remove retaining ring (14). Discard retaining ring.
5. Remove thrust washer (13), 3rd gear (12), and split bearing (11). Discard bearing.
6. Remove thrust washer (10).
7. Expand, remove and discard retaining ring (9).
8. Remove 4th gear (8) and dog ring (7).
9. Expand, remove and discard retaining ring (6).
10. Remove thrust washer (5), 1st gear (4) and split bearing (3). Discard bearing.

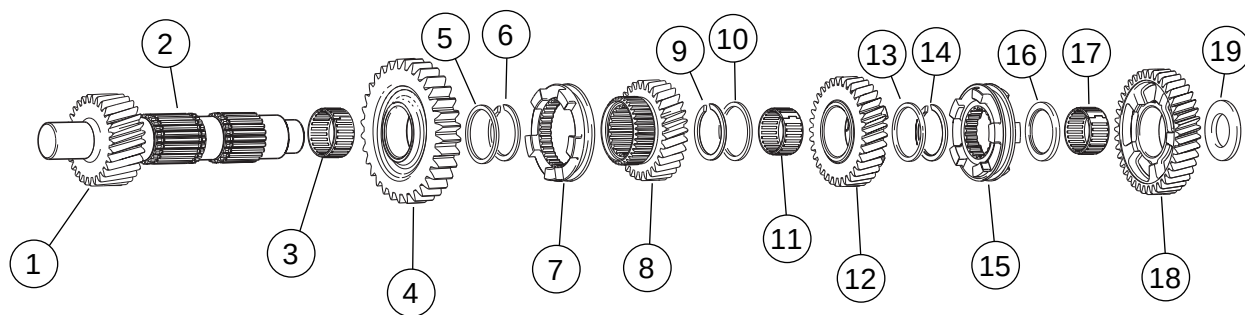
Cleaning and Inspection

WARNING

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

1. Clean all parts (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.

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- | | | |
|---|---------------------------|---------------------------|
| 1. Countershaft 5th gear
(integral to shaft) | 8. Countershaft 4th gear | 15. Dog ring |
| 2. Countershaft | 9. Retaining ring | 16. Spacer |
| 3. Split bearing | 10. Thrust washer | 17. Split bearing |
| 4. Countershaft 1st gear | 11. Split bearing | 18. Countershaft 2nd gear |
| 5. Thrust washer | 12. Countershaft 3rd gear | 19. Spacer |
| 6. Retaining ring | 13. Thrust washer | |
| 7. Dog ring | 14. Retaining ring | |

Figure 5-67. Transmission Countershaft Assembly Once Removed from Left Crankcase/Disassembly



TRANSMISSION ASSEMBLY

5.11

MAINSHAFT ASSEMBLY

PART NUMBER	TOOL NAME
J-5586-A	RETAINING RING PLIERS

⚠ WARNING

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

NOTES

- Use correct retaining ring pliers and correct tips. Verify that tips are not excessively worn or damaged.
 - During assembly, the split bearings and the internal bores of the gears must be lubricated with Harley-Davidson FORMULA+ TRANSMISSION AND PRIMARY CHAIN-CASE LUBRICANT prior to assembly. Leaving these parts dry could accelerate wear at start-up.
1. See [Figure 5-68](#). Install **new** split bearing (5) in 4th gear position on mainshaft.
 2. Install 4th gear (4) and thrust washer (3).
 3. Using RETAINING RING PLIERS (Part No. J-5586-A), expand and install new retaining ring (2).
 4. Install 1st gear (1).

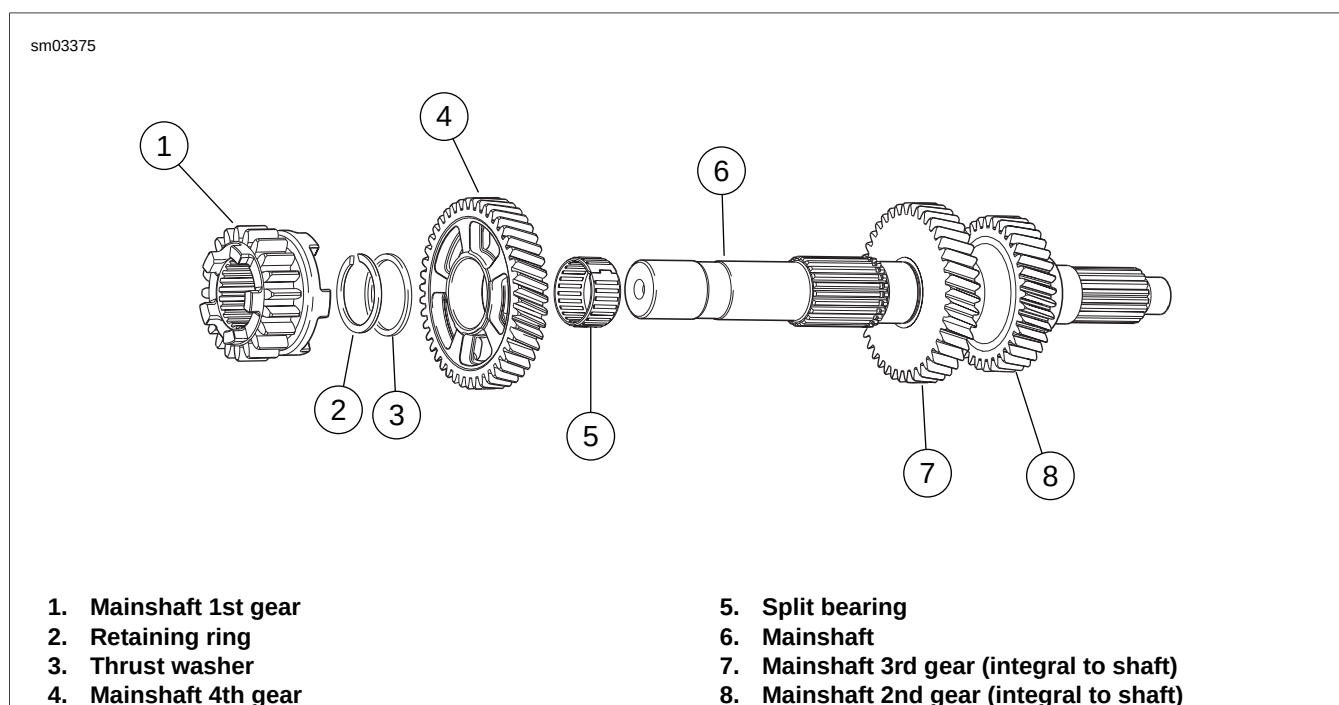


Figure 5-68. Transmission Mainshaft Assembly Once Removed from Left Crankcase/Disassembly

COUNTERSHAFT ASSEMBLY

PART NUMBER	TOOL NAME
J-5586-A	RETAINING RING PLIERS

⚠ WARNING

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

NOTES

- Use correct retaining ring pliers and correct tips. Verify that tips are not excessively worn or damaged.
 - During assembly, the split bearings and the internal bores of the gears must be lubricated with Harley-Davidson FORMULA+ TRANSMISSION AND PRIMARY CHAIN-CASE LUBRICANT prior to assembly. Leaving these parts dry could accelerate wear at start-up.
1. See [Figure 5-69](#). Install **new** split bearing (3) in 1st gear position on mainshaft.
 2. Install 1st gear (4) and thrust washer (5).

3. Using RETAINING RING PLIERS (Part No. J-5586-A), expand and install **new** retaining ring (6).
 4. Install dog ring (7) onto 4th gear (8). Now install dog ring and gear assembly onto countershaft.
 5. Expand and install **new** retaining ring (9).
 6. Install thrust washer (10).
 7. Install **new** split bearing (11) in 3rd gear position on mainshaft.
 8. Install 3rd gear (12) and thrust washer (13).
 9. Expand and install **new** retaining ring (14).
 10. Install dog ring (15). Make sure to install with dog ring facing same direction as when it was removed.
 11. Install spacer (16).
 12. Install **new** split bearing (17) in 2nd gear position on shaft.
 13. Install 2nd gear (18) and spacer (19).
- NOTE**
At this point both mainshaft and countershaft sub-assemblies are ready to be pressed into the left crankcase half.

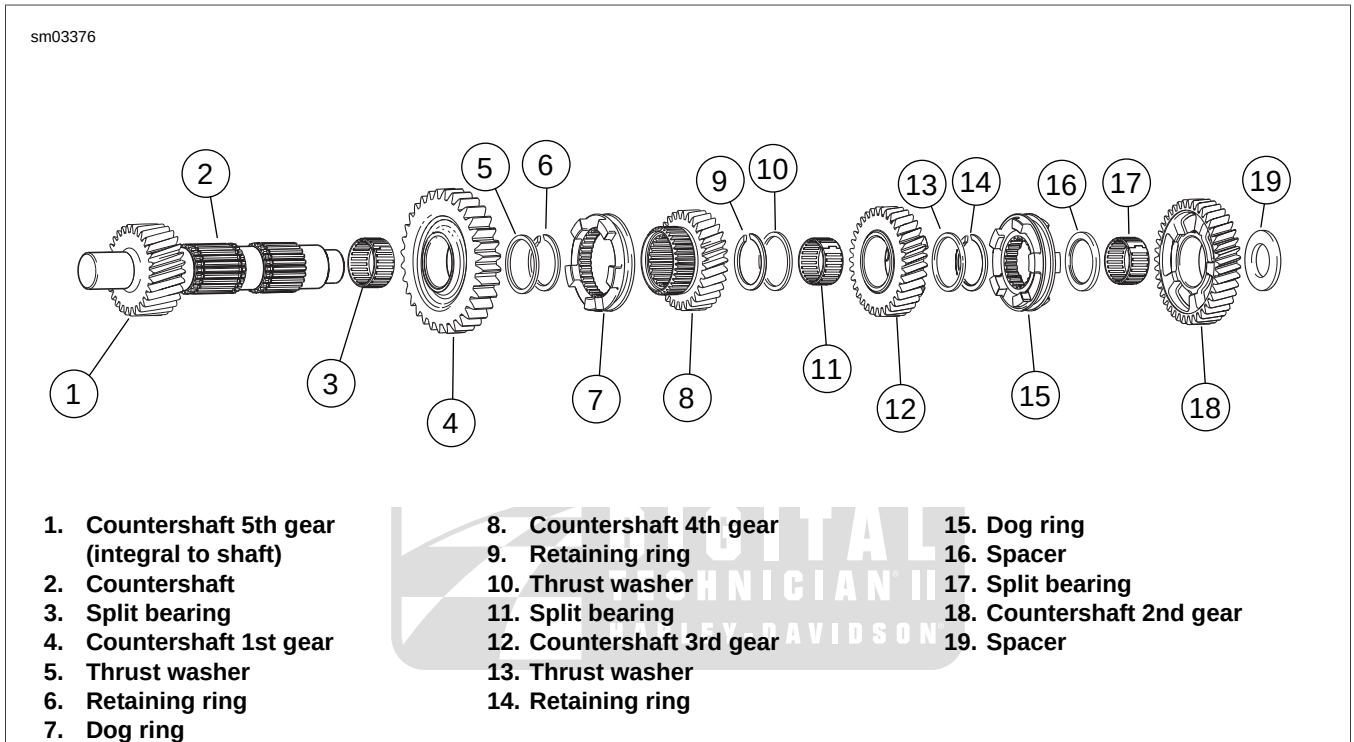


Figure 5-69. Transmission Countershaft Assembly Once Removed from Left Crankcase/Disassembly

MAIN DRIVE GEAR AND BEARING

5.12

GENERAL

NOTE

See [Figure 5-70](#). When removing the main drive gear (2), the gear is pressed out against the resistance of the ball bearing

(7 or 14) inner race. Without any support at the inner race, the bearing is destroyed. Whenever the main drive gear is removed the main drive gear bearing must also be replaced.

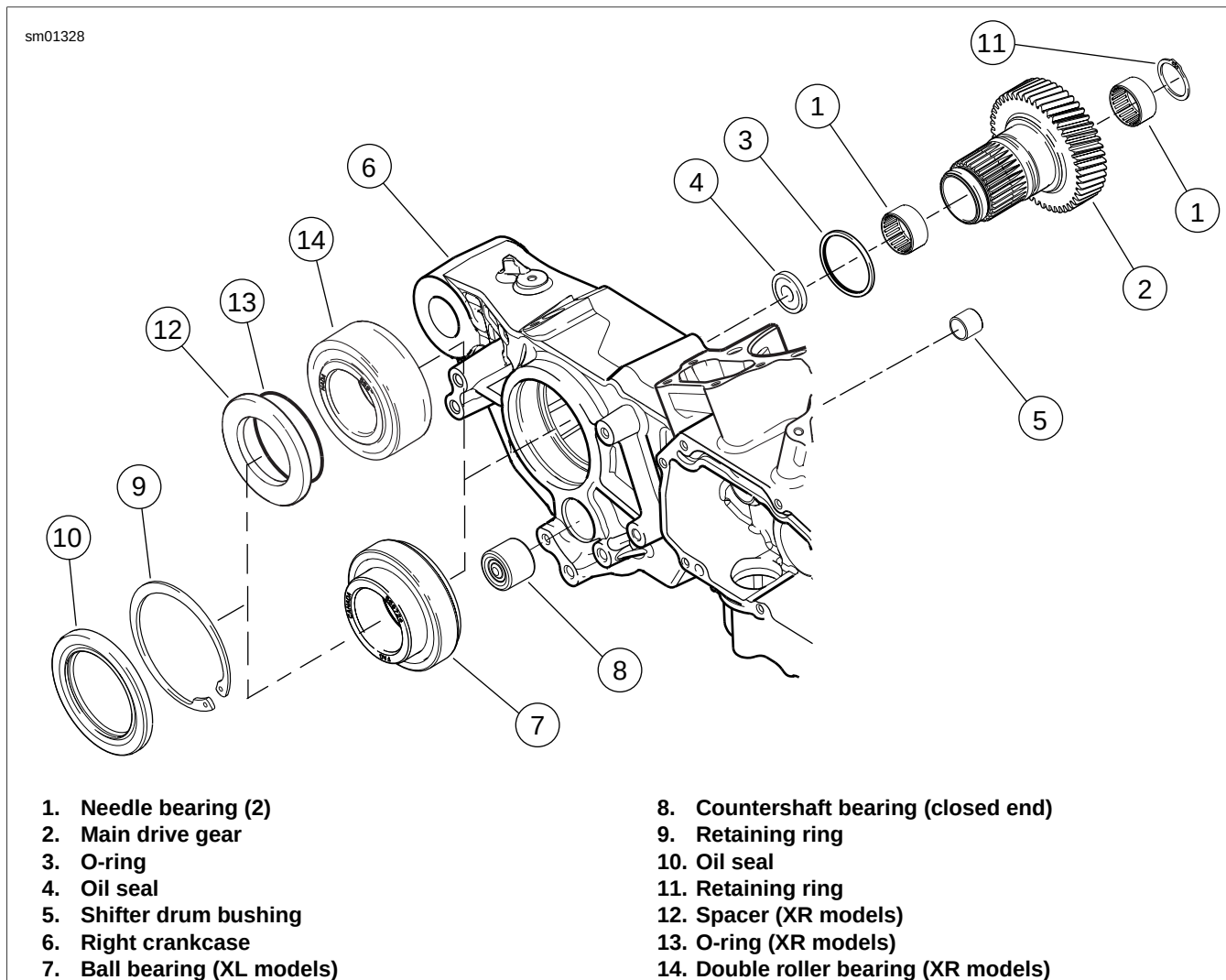


Figure 5-70. Main Drive Gear and Bearing Assembly

REMOVAL

PART NUMBER	TOOL NAME
B-45847	CROSS PLATE
HD-35316-11	RECEIVER CUP
HD-35316-13	BEARING DRIVER
HD-35316-4A	8 IN. BOLT
HD-35316-7	WASHER
HD-35316-9	BEARING DRIVER
HD-35316-D	MAIN DRIVE GEAR REMOVER AND INSTALLER SET

Main Drive Gear

1. Split crankcases. See [5.9 CASE DISASSEMBLY FOR TRANSMISSION REMOVAL](#).
2. See [Figure 5-71](#). From inside right crankcase, tap out seal (3) at end of main drive gear (1). Discard seal.
3. Obtain MAIN DRIVE GEAR REMOVER AND INSTALLER SET (Part No. HD-35316-D). See [Figure 5-72](#). Position CROSS PLATE (Part No. B-45847) (1) on right crankcase as shown. Position cross plate so that roll pins (2) fit into crankcase mating screw holes and bolt hole (3) in cross plate is centered over main drive gear (4).

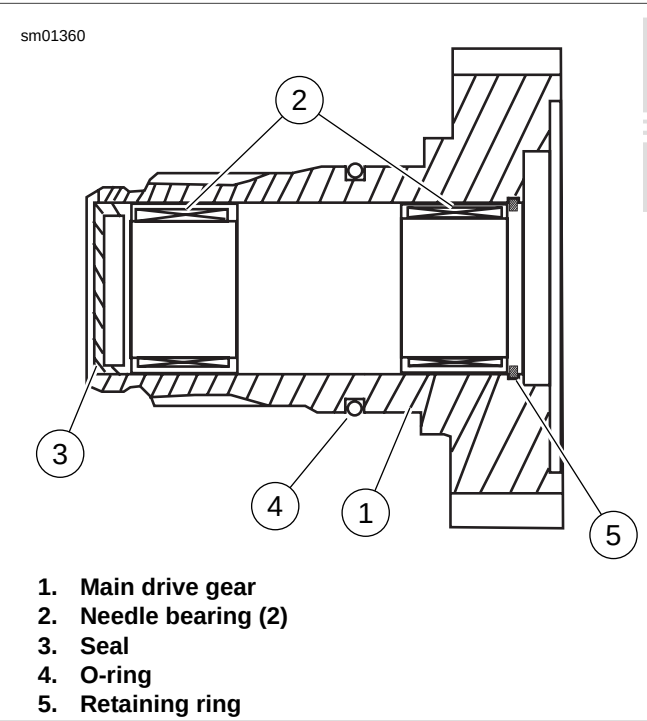


Figure 5-71. Main Drive Gear Assembly (typical)

4. See [Figure 5-73](#). Insert 8 IN. BOLT (Part No. HD-35316-4A) (2) through cross plate (1) and main drive gear (3).
5. At outside of case, place WASHER (Part No. HD-35316-7) (4), NICE BEARING (5), FLAT WASHER (6) and NUT (7) over end of bolt. Tighten nut until main drive gear is free.

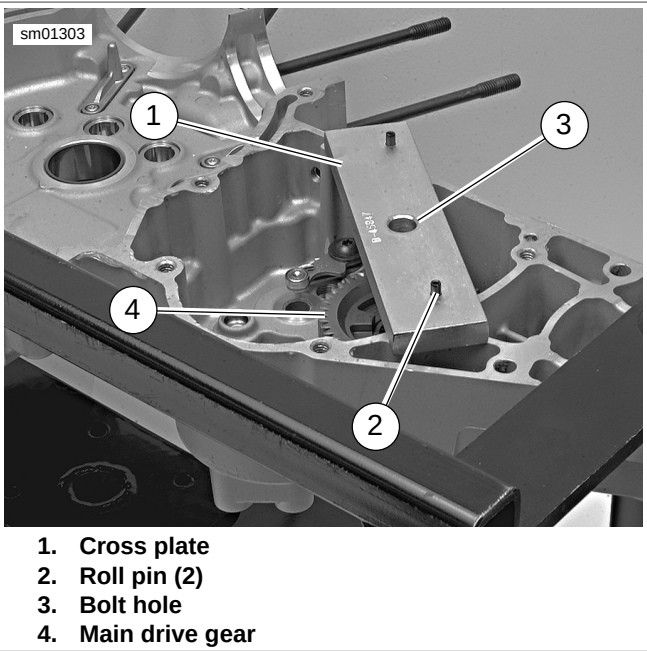


Figure 5-72. Positioning Cross Plate (typical)

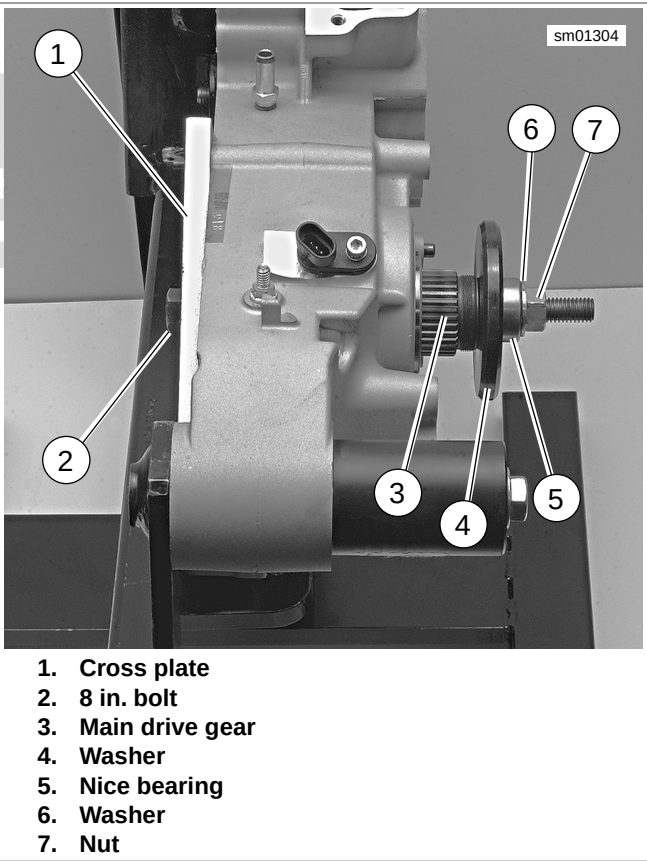


Figure 5-73. Removing Main Drive Gear (typical)

Main Drive Gear Ball Bearing

⚠ WARNING

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

NOTE

Use correct retaining ring pliers and correct tips. Verify that tips are not excessively worn or damaged.

- 1. See [Figure 5-70](#). Remove and discard oil seal (10). Remove and discard main drive gear bearing retaining ring (9).
- 2. **XR Models:** remove spacer (12) and o-ring (13).
- 3. See [Figure 5-74](#). Install driver components: From inside crankcase, position bearing driver (2) over main drive gear bearing.
 - a. **XL Models:** BEARING DRIVER (Part No. HD-35316-9).
 - b. **XR Models:** BEARING DRIVER (Part No. HD-35316-13).
- 4. Insert 8 IN. BOLT (Part No. HD-35316-4A) (1) through bearing driver and bearing.
- 5. At outside of case, slide RECEIVER CUP (Part No. HD-35316-11) (3) onto bolt and over bearing. Install NICE BEARING (4), FLAT WASHER (5) and NUT (6) over end of bolt.

NOTE

Support bearing remover assembly as you remove bearing in the following step. Entire assembly will fall out of crankcase when bearing comes free.

- 6. Tighten nut until main drive gear ball bearing is free.
- 7. Discard main drive gear ball bearing.

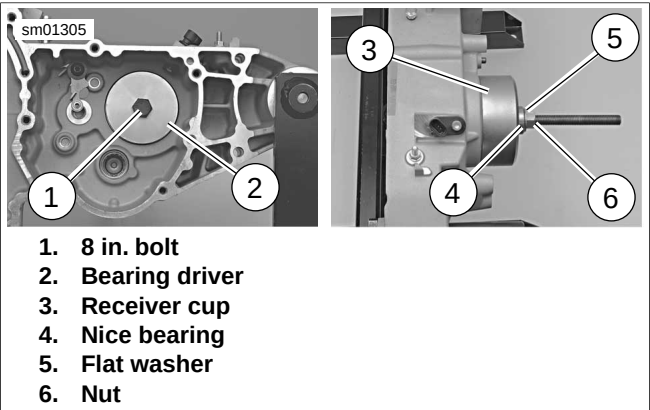


Figure 5-74. Removing Main Drive Gear Bearing (typical, XL model shown)

DISASSEMBLY

PART NUMBER	TOOL NAME
HD-95637-46B	BEARING RACE PULLER

- 1. See [Figure 5-70](#). Remove retaining ring (11) from inboard end of main drive gear (2). Discard retaining ring.
- 2. See [Figure 5-71](#). Drive out needle bearings (2) from inside bore of main drive gear (1) using appropriate bearing and bushing puller. Discard needle bearings. Do not reuse bearings after removal from drive gear bore.
- 3. Remove and discard o-ring (4).

NOTE

When the main drive gear is removed, a portion of the bearing inner race remains attached to the main drive gear. This inner race must be removed before the main drive gear can be re-installed.

- 4. See [Figure 5-75](#). Attach BEARING RACE PULLER (Part No. HD-95637-46B) (3) to inner race (2) on main drive gear (1).
- 5. Place main drive gear with bearing race puller assembly onto press bed as shown in the photo.

NOTE

Provide a soft surface to catch the main drive gear when it falls free in the next step.

- 6. Press main drive gear out of inner bearing race. Discard inner bearing race.

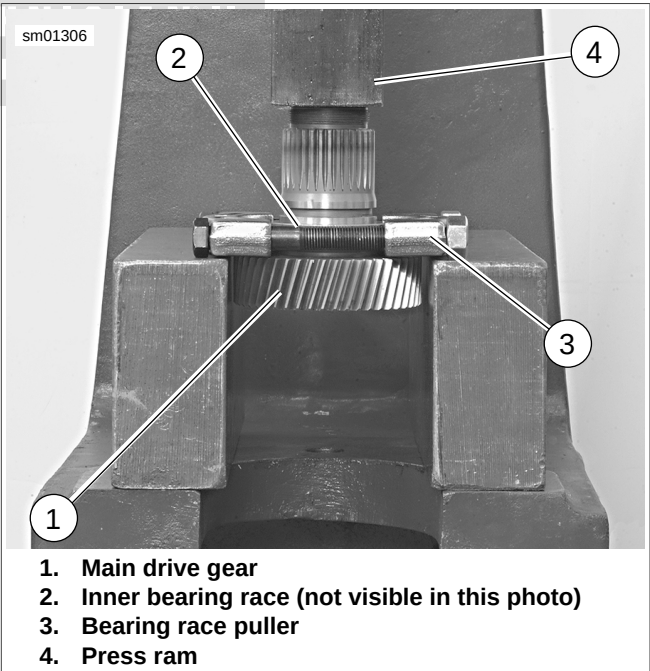


Figure 5-75. Removing Inner Bearing Race From Main Drive Gear (typical)

ASSEMBLY

PART NUMBER	TOOL NAME
HD-47855	INNER/OUTER MAIN DRIVE GEAR NEEDLE BEARING INSTALLATION TOOL: XL MODELS
HD-48643	INNER/OUTER MAIN DRIVE GEAR NEEDLE BEARING INSTALLATION TOOL: XR MODELS

NOTE

The correct installed bearing depth is reached when the installation tool bottoms on the gear.

1. See [Figure 5-76](#) or [Figure 5-77](#). Place main drive gear (4) on press bed with gear end facing up.
2. Place needle bearing (3) squarely into end of drive gear with lettered side of bearing facing up. Always press on lettered side of bearing to install. Insert the appropriate installation tool (2) with end stamped "INNER" facing needle bearing.
 - a. **XL Models:** Use INNER/OUTER MAIN DRIVE GEAR NEEDLE BEARING INSTALLATION TOOL: XL MODELS (Part No. HD-47855)
 - b. **XR Models:** Use INNER/OUTER MAIN DRIVE GEAR NEEDLE BEARING INSTALLATION TOOL: XR MODELS (Part No. HD-48643)
3. Press in the inner bearing until the installation tool bottoms on the main drive gear.

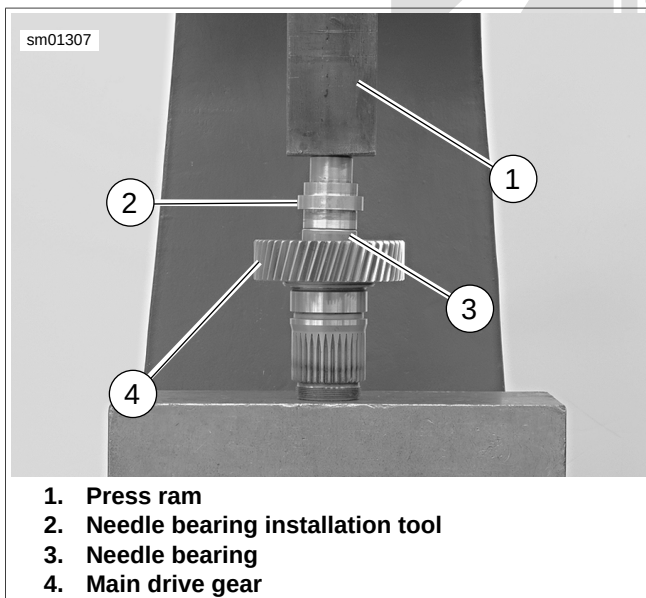


Figure 5-76. Pressing Inner Needle Bearing Assembly into Main Drive Gear: XL Models

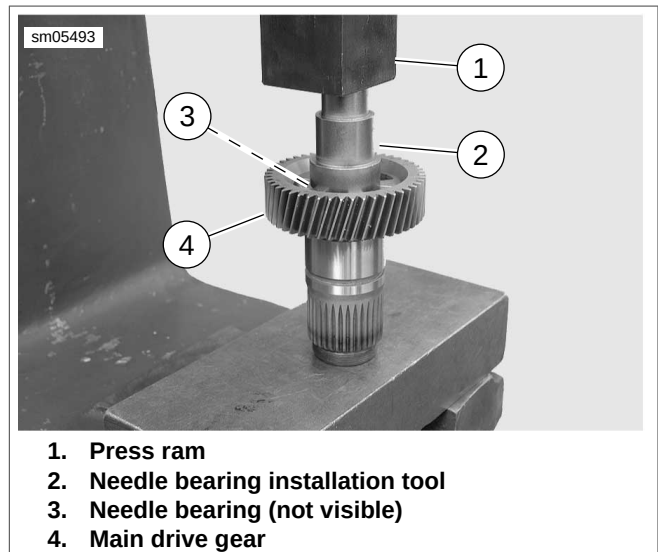


Figure 5-77. Pressing Inner Needle Bearing Assembly into Main Drive Gear: XR Models

4. See [Figure 5-78](#) or [Figure 5-79](#). Place main drive gear (4) on press bed with gear end facing down.
5. Place needle bearing (3) squarely into end of drive gear with lettered side of bearing facing up. Always press on lettered side of bearing to install. Insert installation tool (2) with end stamped "OUTER" facing needle bearing.
6. Press in the outer needle bearing until the installation tool bottoms on the main drive gear.
7. See [Figure 5-70](#). Install **new** retaining ring (11) in inboard end of main drive gear (2).

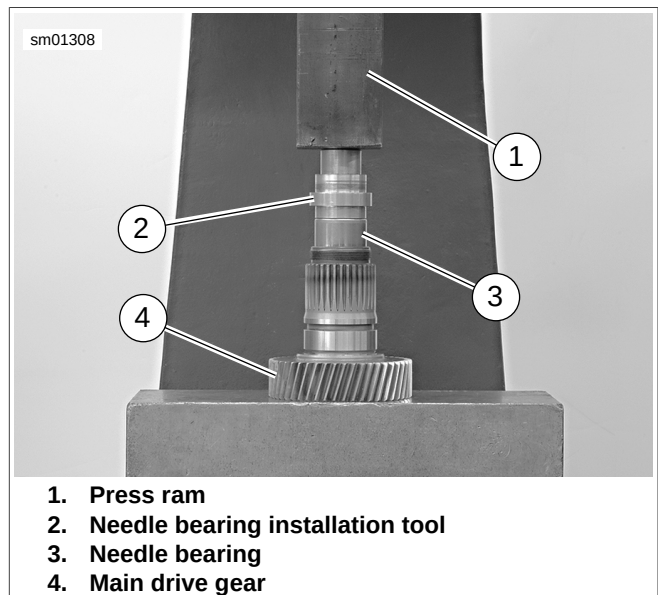


Figure 5-78. Pressing Outer Needle Bearing Assembly into Main Drive Gear: XL Models

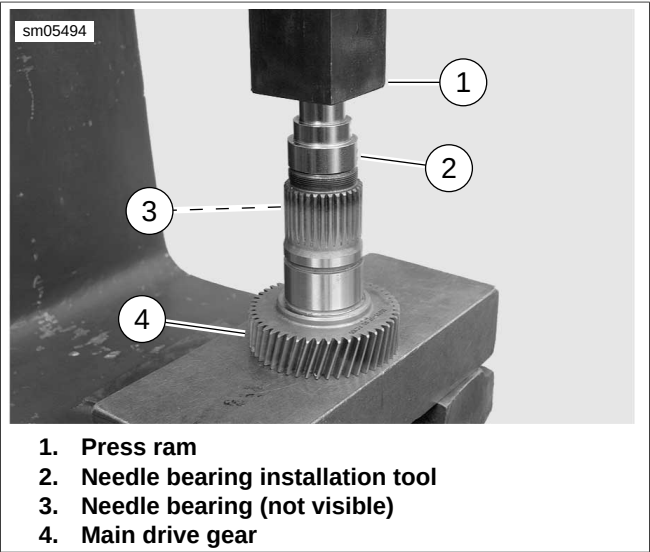


Figure 5-79. Pressing Outer Needle Bearing Assembly into Main Drive Gear: XR Models

INSTALLATION

PART NUMBER	TOOL NAME
B-45847	CROSS PLATE
HD-35316-12	INSTALLER CUP
HD-35316-13	BEARING DRIVER
HD-35316-4A	8 IN. BOLT
HD-35316-7	WASHER
HD-35316-8	BEARING DRIVER
HD-35316-C	MAIN DRIVE GEAR REMOVER AND INSTALLER SET
HD-47856	MAIN DRIVE GEAR SEAL INSTALLER KIT
HD-47856-1	INSTALLER
HD-47856-2	PILOT
HD-47856-4	ADAPTER
HD-47856-5	LARGE NUT

Main Drive Gear Bearing: XL Models

- See [Figure 5-80](#). Place CROSS PLATE (Part No. B-45847) (1) on right crankcase as shown. Position cross plate so that roll pins (2) fit into crankcase mating screw holes and bolt hole (3) in cross plate is centered over crankcase bearing bore (4).
- See [Figure 5-81](#). Insert 8 IN. BOLT (Part No. HD-35316-4A) (2) through cross plate (1) and main drive gear bearing bore.
- Place main drive gear bearing (3), BEARING DRIVER (Part No. HD-35316-8) (4), NICE BEARING (5), FLAT WASHER (6) and NUT (7) over end of bolt.

NOTE

Do not continue to tighten nut after bearing bottoms against lip in crankcase bearing bore. Tightening nut too much can break lip in bearing bore casting.

- Tighten nut until main drive gear bearing bottoms against lip cast into crankcase bearing bore.
- Remove main drive gear bearing installer tool.

WARNING

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

NOTE

Use correct retaining ring pliers and correct tips. Verify that tips are not excessively worn or damaged.

- See [Figure 5-84](#). At outside of case install **new** beveled retaining ring (9) in groove inside bearing bore with beveled side facing outside of case.
- Lubricate main drive gear bearing with GENUINE HARLEY-DAVIDSON FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT.

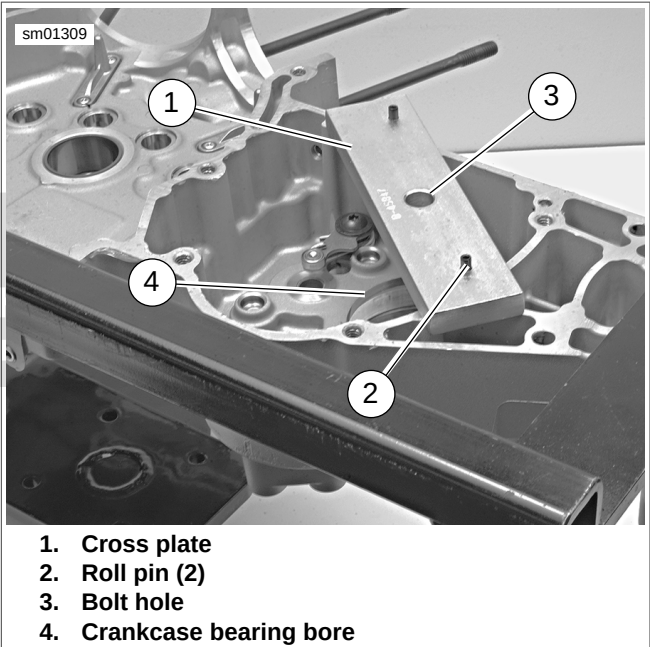


Figure 5-80. Positioning Cross Plate: XL Models

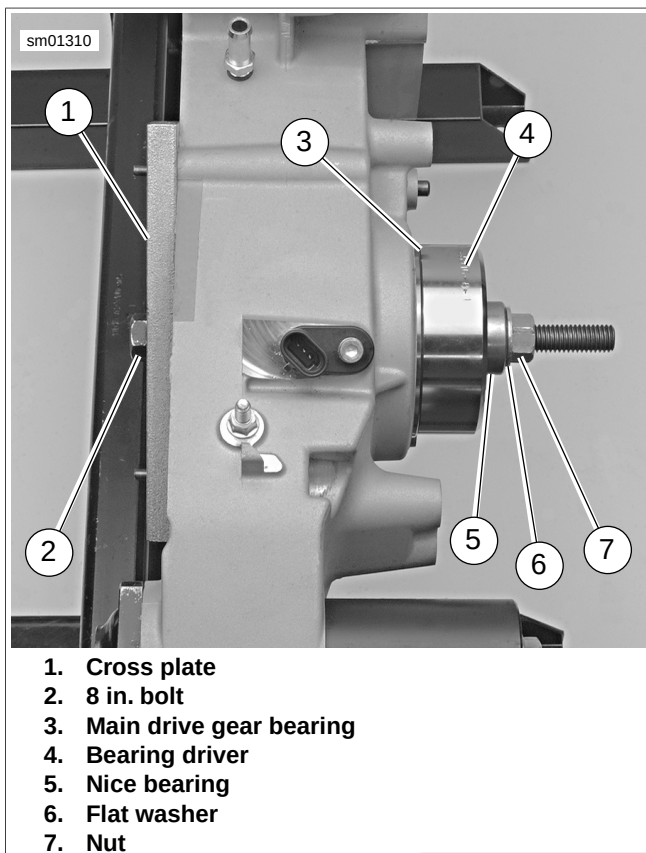


Figure 5-81. Installing Main Drive Gear Bearing: XL Models

Main Drive Gear Bearing: XR Models

NOTE

Due to the design of the bearing, BEARING DRIVER (Part No. HD-35316-13) and an arbor press must be used to press the main drive gear bearing on all XR models.

1. See [Figure 5-82](#). From the outside of the case, position the main drive gear bearing (3) and bearing driver (2) over bearing bore in crankcase.
2. Press on main drive gear bearing driver until driver bottoms against lip cast into crankcase bearing bore.

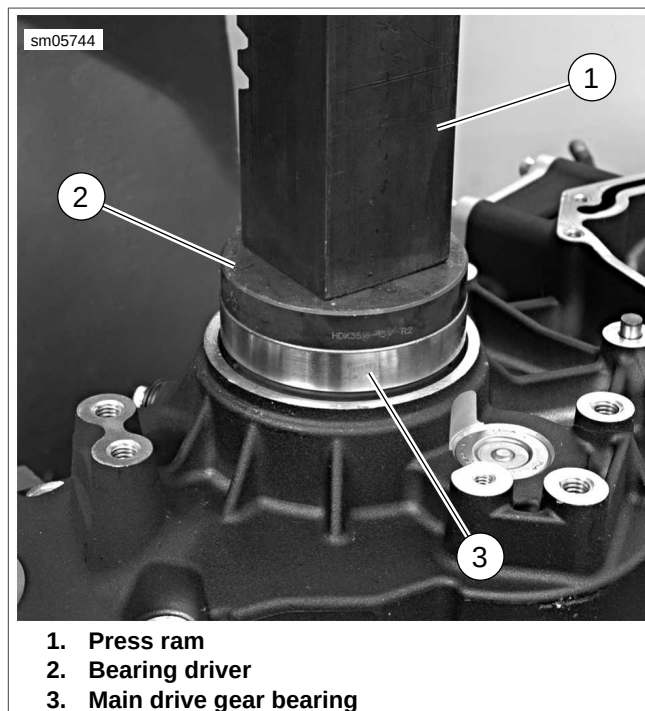


Figure 5-82. Installing Main Drive Gear Bearing: XR Models

Main Drive Gear

1. See [Figure 5-83](#). Lubricate both main drive gear needle bearing assemblies with HARLEY-DAVIDSON SPECIAL PURPOSE GREASE.
2. See [Figure 5-84](#). Install new o-ring (3) into groove in main drive gear (2). Lubricate o-ring with GENUINE HARLEY-DAVIDSON FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT

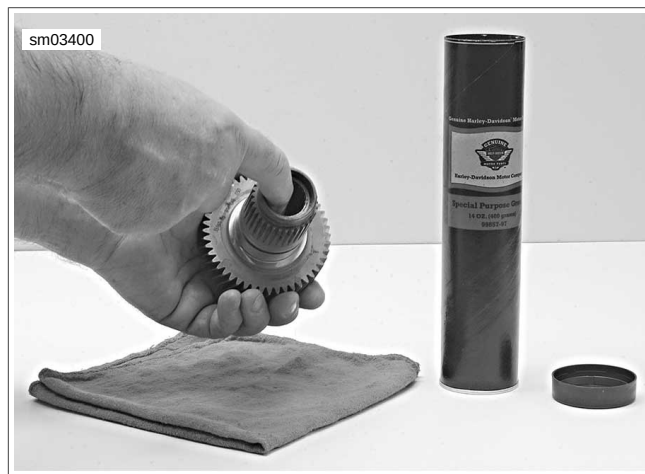
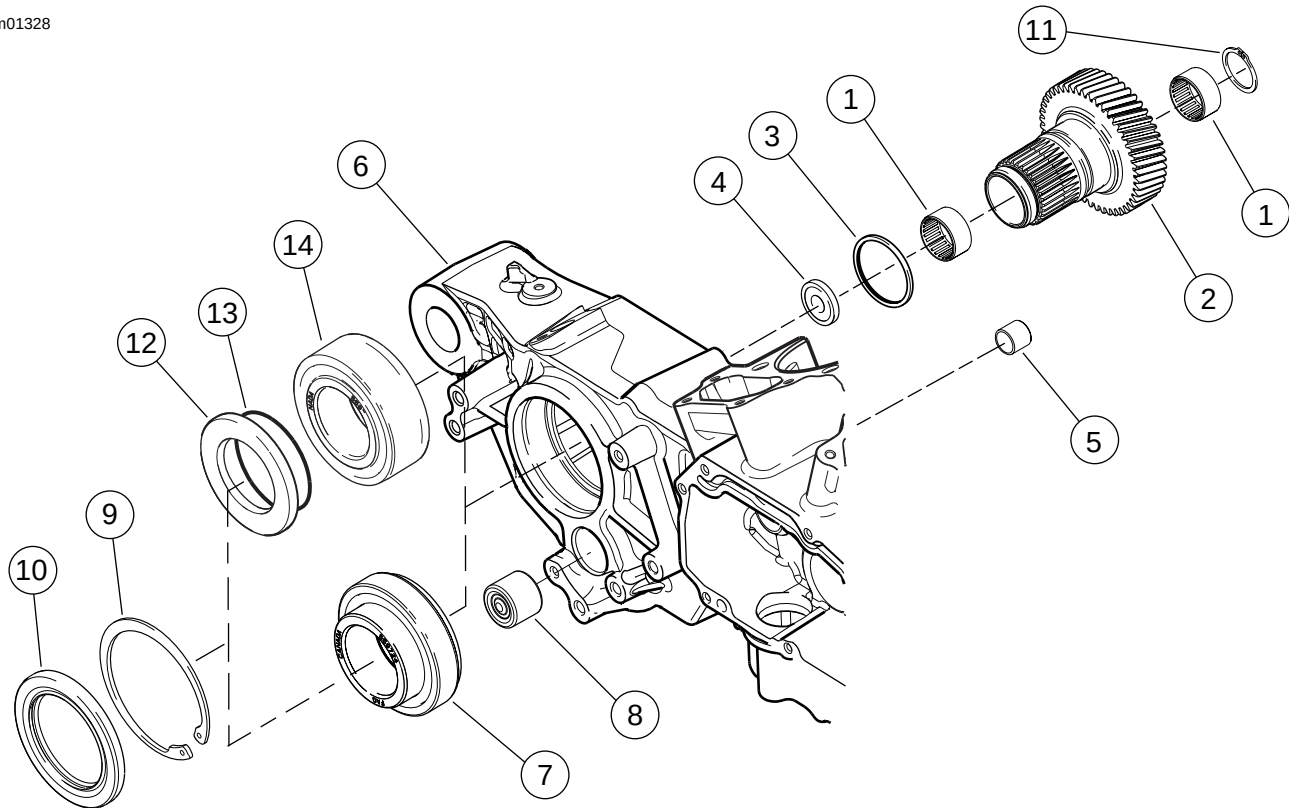


Figure 5-83. Lubricating Main Drive Gear Needle Bearing

sm01328



- | | |
|-----------------------------|---------------------------------------|
| 1. Needle bearing (2) | 8. Countershaft bearing (closed end) |
| 2. Main drive gear | 9. Retaining ring |
| 3. O-ring | 10. Oil seal |
| 4. Oil seal | 11. Retaining ring |
| 5. Shifter drum bushing | 12. Spacer (XR models) |
| 6. Right crankcase | 13. O-ring (XR models) |
| 7. Ball bearing (XL models) | 14. Double roller bearing (XR models) |

Figure 5-84. Main Drive Gear and Bearing Assembly

- See [Figure 5-85](#). Insert 8 IN. BOLT (Part No. HD-35316-4A) (1) through WASHER (Part No. HD-35316-7) (2) and main drive gear (3). From inside of case insert bolt with washer and main drive gear through inner race of main drive gear bearing.
- At outside of case, place INSTALLER CUP (Part No. HD-35316-12) (4), NICE BEARING (5), FLAT WASHER (6) and NUT (7) over end of bolt. Tighten nut until main drive gear bottoms against main drive gear bearing.
- Remove MAIN DRIVE GEAR REMOVER AND INSTALLER SET (Part No. HD-35316-C) set.
- See [Figure 5-84](#). Tap in **new** oil seal (4) at threaded end of main drive gear to a depth of 0.060-0.030 in. (1.524-0.762 mm).

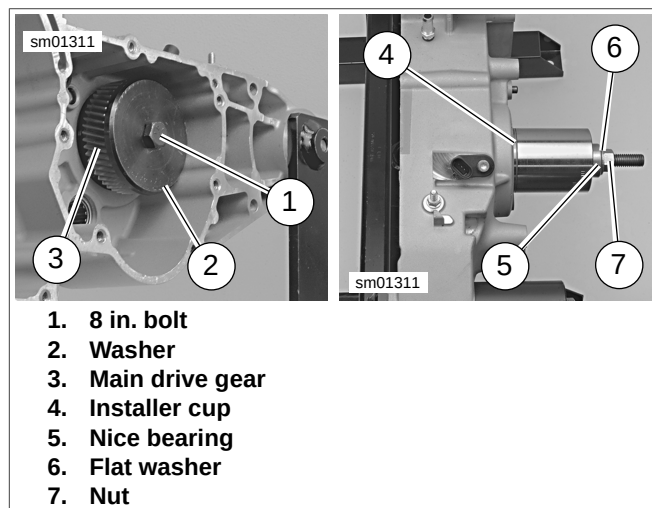


Figure 5-85. Installing Main Drive Gear (typical)

Main Drive Gear Seal

1. **XR Models:** See [Figure 5-84](#). Install spacer (12) and new o-ring(13) onto main drive gear.
2. Obtain MAIN DRIVE GEAR SEAL INSTALLER KIT (Part No. HD-47856).
3. See [Figure 5-86](#). From outside of crankcase, install PILOT (Part No. HD-47856-2) over end of main drive gear bearing inner race.
4. Coat lips of **new** main drive gear seal with GENUINE HARLEY-DAVIDSON FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT.
5. See [Figure 5-87](#). Place seal over pilot and position seal squarely in end of crankcase bore.

NOTE

ADAPTER (Part No. HD-47856-4) and main drive gear have left-hand threads.

6. See [Figure 5-88](#). Thread ADAPTER (Part No. HD-47856-4) onto end of main drive gear several turns. Do NOT tighten on drive gear. Doing so could make it difficult to remove adapter after seal has been installed.

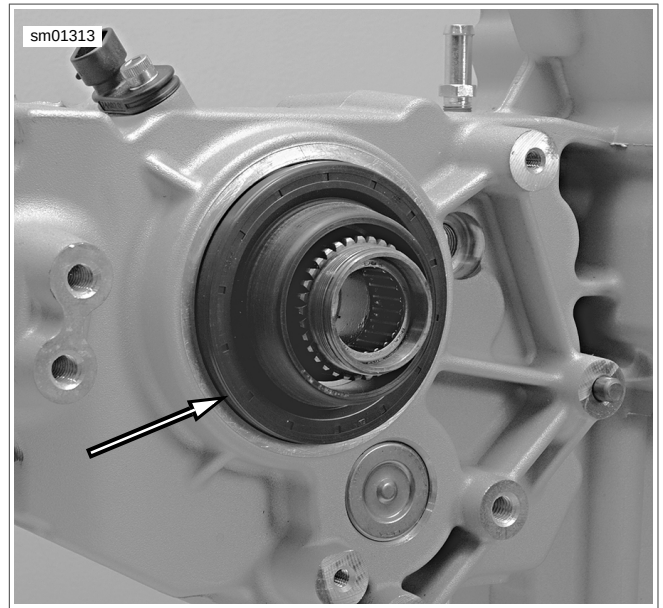


Figure 5-87. Install Main Drive Gear Seal (typical, XL model shown)

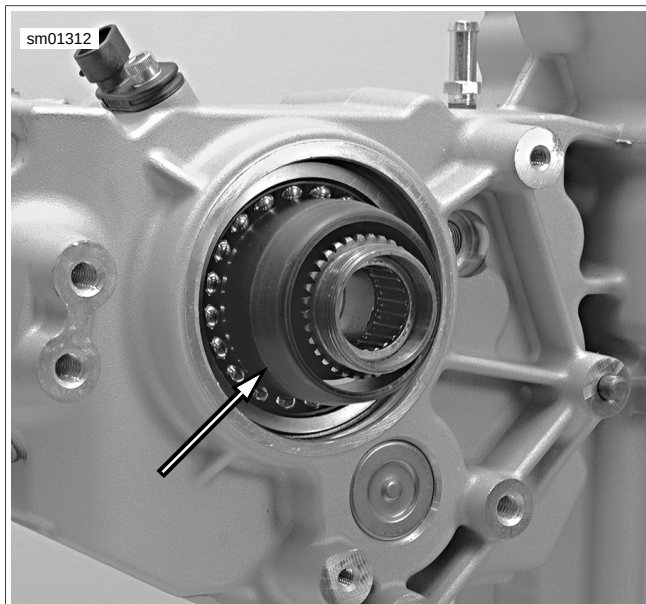


Figure 5-86. Install Pilot (typical, XL model shown)

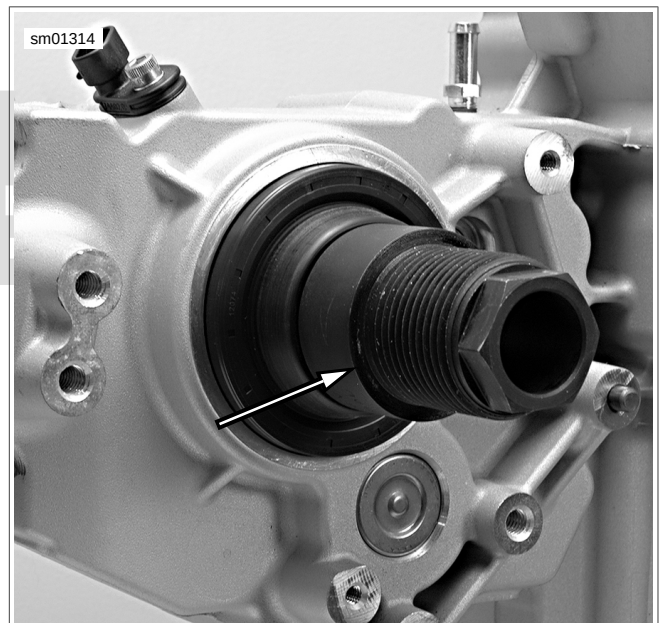


Figure 5-88. Install Adapter (typical, XL model shown)

7. See [Figure 5-89](#). Slide INSTALLER (Part No. HD-47856-1) over adapter until cupped end of installer is flat against seal.
8. See [Figure 5-90](#). Thread LARGE NUT (Part No. HD-47856-5) onto end of adapter, until it tightens against installer.
9. See [Figure 5-91](#). Place crow's foot wrench (1) with 1/2 inch drive breaker bar (2) on large nut. Place an adjustable wrench (3) on flats of hex head cast into end of adapter.
10. Holding adjustable wrench, tighten large nut with crow's foot wrench until outer face of seal is flush with outer edge of crankcase bore.

NOTE

It is acceptable to recess seal to about 0.030 in. (0.762 mm) below outer edge of bore. Seal will be controlled by tool.

11. Remove nut, installer, adapter and pilot.

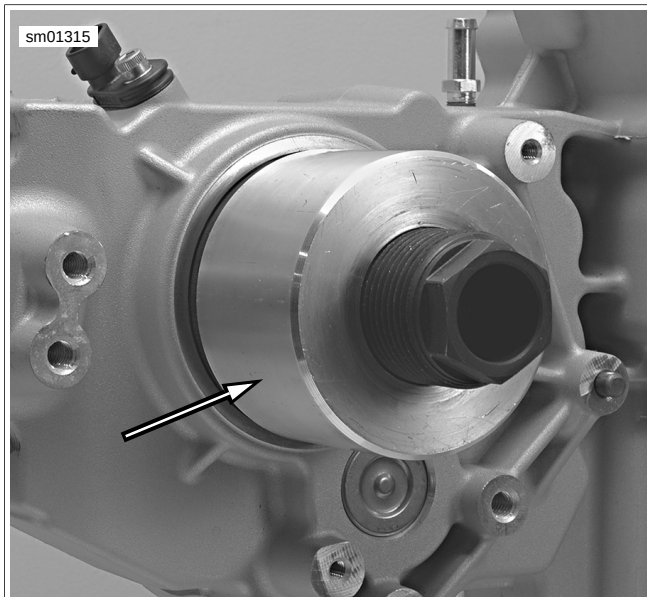


Figure 5-89. Place Installer over Adapter (typical, XL model shown)

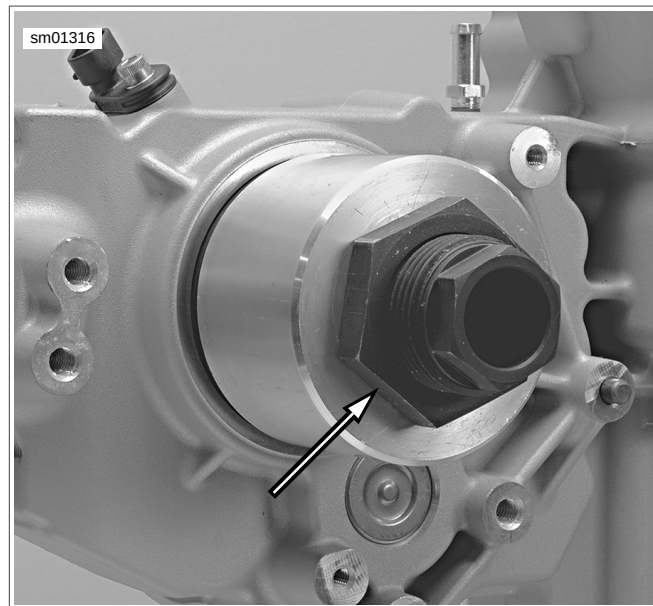
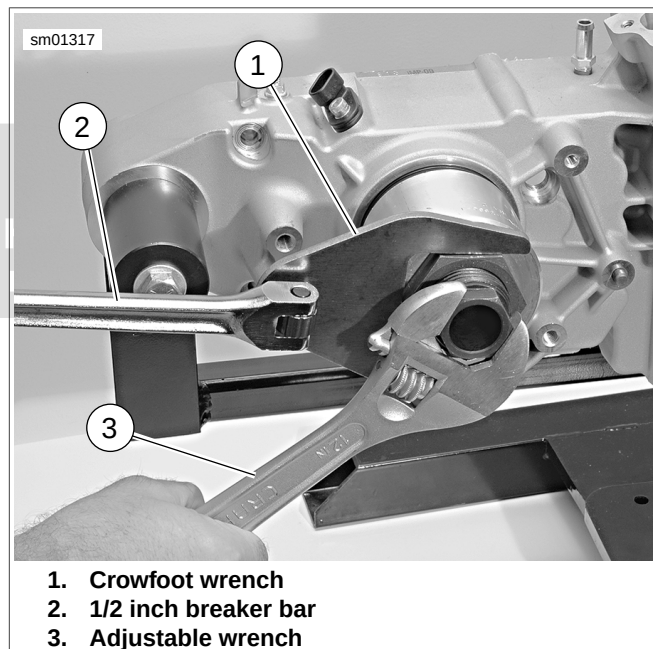


Figure 5-90. Install Nut (typical, XL model shown)



1. Crowfoot wrench
2. 1/2 inch breaker bar
3. Adjustable wrench

Figure 5-91. Press Seal Into Crankcase (typical, XL model shown)

TRANSMISSION RIGHT CASE BEARINGS

5.13

REMOVAL

PART NUMBER	TOOL NAME
HD-95760-69A	BUSHING AND BEARING PULLER
HD-95765-69A	1/2 IN. COLLET

Split crankcases. See [5.9 CASE DISASSEMBLY FOR TRANSMISSION REMOVAL](#).

Countershaft Needle Bearing

See [Figure 5-84](#). From inside transmission case use appropriate bearing driver/puller to remove countershaft bearing (8) from crankcase bore.

Shifter Drum Bushing

1. The shifter drum bushing (5) is a press fit in the right crankcase half. Inspect the bushing against the corresponding end of the shifter drum for proper fit and wear.
2. If bushing is to be replaced, use BUSHING AND BEARING PULLER (Part No. HD-95760-69A) with 1/2 IN. COLLET (Part No. HD-95765-69A) to remove bushing from crankcase bore.

INSTALLATION

PART NUMBER	TOOL NAME
A-157C	SNAP-ON BUSHING DRIVER SET

Countershaft Needle Bearing

1. Find a suitable bearing driver 1-1/4 in. in diameter.
2. See [Figure 5-84](#). From the outside of the case place the countershaft bearing (8) 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 flush or 0.030 in. (0.762 mm) below the outside surface of the case.
3. Lubricate bearing with GENUINE HARLEY-DAVIDSON FORMULA+ TRANSMISSION AND PRIMARY CHAIN-CASE LUBRICANT.

Shifter Drum Bushing

1. See [Figure 5-84](#). Using SNAP-ON BUSHING DRIVER SET (Part No. A-157C) with a 1/2 in. adapter (Part No. A157-8), install **new** bushing (5).
2. Lubricate bushing with GENUINE HARLEY-DAVIDSON FORMULA+ TRANSMISSION AND PRIMARY CHAIN-CASE LUBRICANT.



TRANSMISSION LEFT CASE BEARINGS

5.14

REMOVAL

PART NUMBER	TOOL NAME
PR-36	SNAP-ON SNAP RING PLIERS

Mainshaft and Countershaft Bearings

1. Split crankcases. See [5.9 CASE DISASSEMBLY FOR TRANSMISSION REMOVAL](#).
2. Remove shifter forks and drum. See [5.10 TRANSMISSION REMOVAL AND DISASSEMBLY](#).
3. Remove countershaft and mainshaft. See [5.10 TRANSMISSION REMOVAL AND DISASSEMBLY](#).
4. Inspect the mainshaft and countershaft ball bearings for pitting, scoring, discoloration or other damage.
5. See [Figure 5-93](#). If bearing replacement is required, remove retaining rings (1, 2) using SNAP-ON SNAP RING PLIERS (Part No. PR-36). Press out bearings (3, 4) from the inside of the crankcase.

Shifter Drum Bushing

Inspect the shifter drum bushing for pitting, scoring, discoloration or excessive wear. If bushing requires replacement press bushing out of crankcase from primary side toward inside of case.

INSTALLATION

Mainshaft and Countershaft Bearings

1. Place crankcase on press with inside surface of crankcase downward.
2. Lay bearing squarely over bore with printed side of bearing upward. Place a pressing tool (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. Place crankcase on press with outside surface of crankcase downward.
2. See [Figure 5-92](#). Lay bushing squarely over bore. Using a pressing tool larger than diameter of bushing, press bushing into bore until bushing contacts shoulder in left crankcase half. If using a pressing tool larger than diameter of bushing, the pressing tool will bottom against crankcase when bushing is flush with top surface.

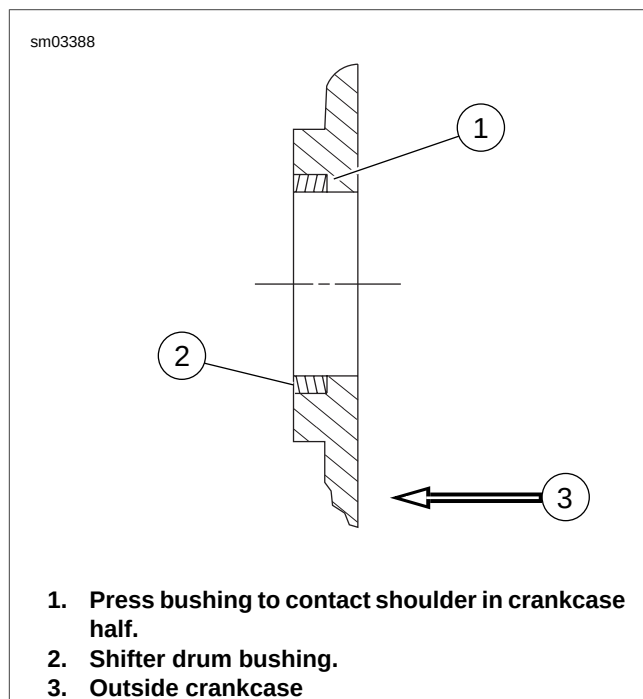


Figure 5-92. Shifter Drum Bushing Assembly

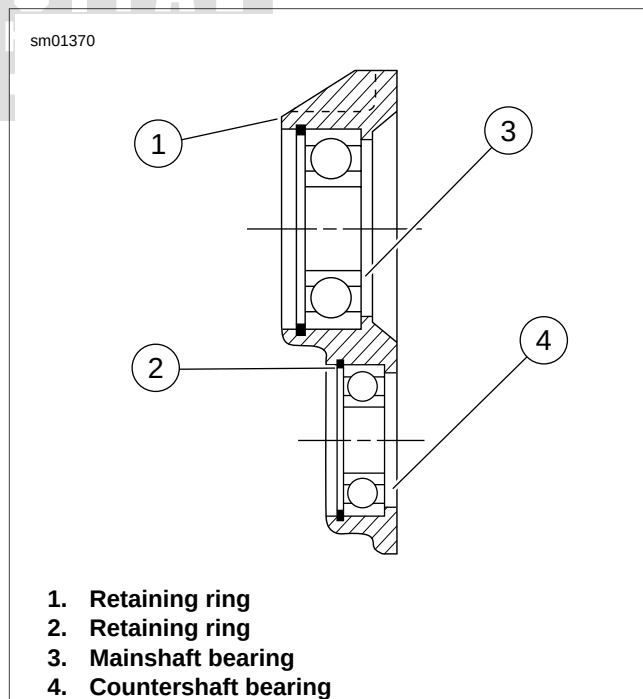


Figure 5-93. Ball Bearing Assembly

GENERAL

NOTE

Before reinstalling transmission and reassembling crankcase halves, perform any necessary engine overhaul procedures. See [3.11 BOTTOM END SERVICE](#) and [3.10 TOP END SERVICE](#).

After reassembling transmission, verify that all parts have been properly installed. See [Figure 5-64](#).

- [3.11 BOTTOM END SERVICE](#)
- [3.10 TOP END SERVICE](#)
- [5.13 TRANSMISSION RIGHT CASE BEARINGS](#)
- [5.14 TRANSMISSION LEFT CASE BEARINGS](#)

INSTALLATION

PART NUMBER	TOOL NAME
B-43985	TRANSMISSION REMOVAL AND INSTALLATION TOOL
B-43985-4	COUNTERSHAFT GUIDE
HD-46285	TRANSMISSION ASSEMBLY FIXTURE

1. See [Figure 5-94](#). Assemble detent spring (3) onto gear detent assembly (2). Install detent assembly with spring into place in transmission cavity of right crankcase (4). Secure with screw (1). Tighten to 90-110 in-lbs (10.2-12.4 Nm).
2. See [Figure 5-95](#). Place transmission assembly (2) onto TRANSMISSION ASSEMBLY FIXTURE (Part No. HD-46285) (3) on press bed. Use support block(s) (4) if necessary.
3. Obtain TRANSMISSION REMOVAL AND INSTALLATION TOOL (Part No. B-43985) kit.
4. Screw COUNTERSHAFT GUIDE (Part No. B-43985-4) (1) into end of countershaft.

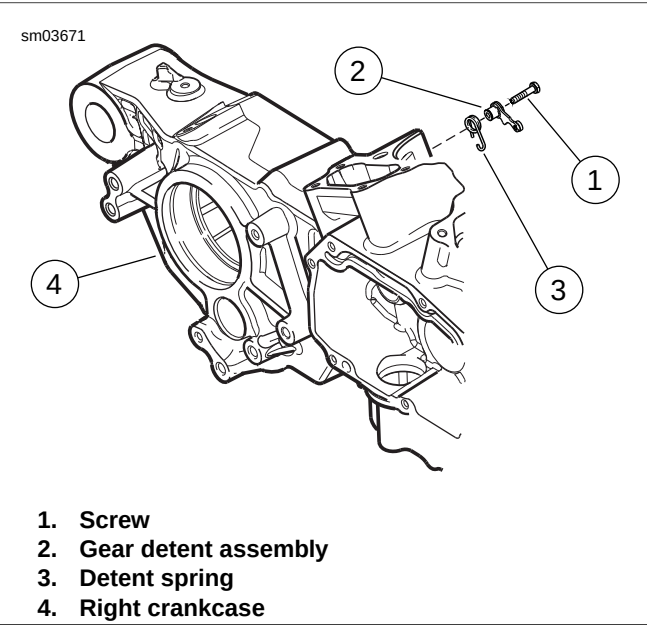


Figure 5-94. Gear Detent Assembly

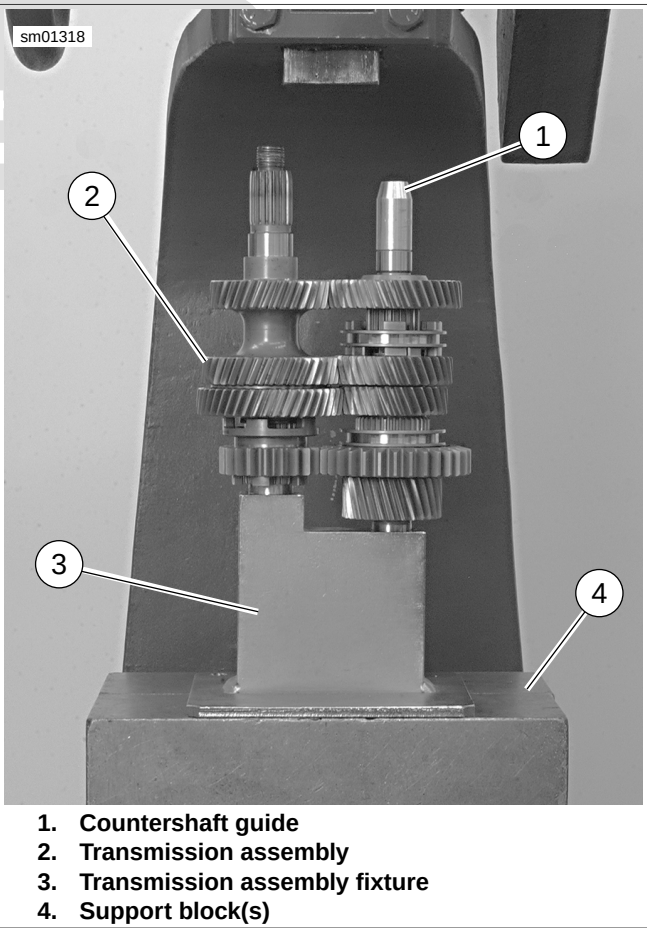


Figure 5-95. Transmission Assembly on Fixture

5. See [Figure 5-96](#). Install left crankcase (3) over transmission assembly (4).
6. Place TRANSMISSION INSTALLER (2) over mainshaft and countershaft bearings in crankcase.
7. Position crankcase and transmission assemblies on press so that transmission installer is under press ram (1).

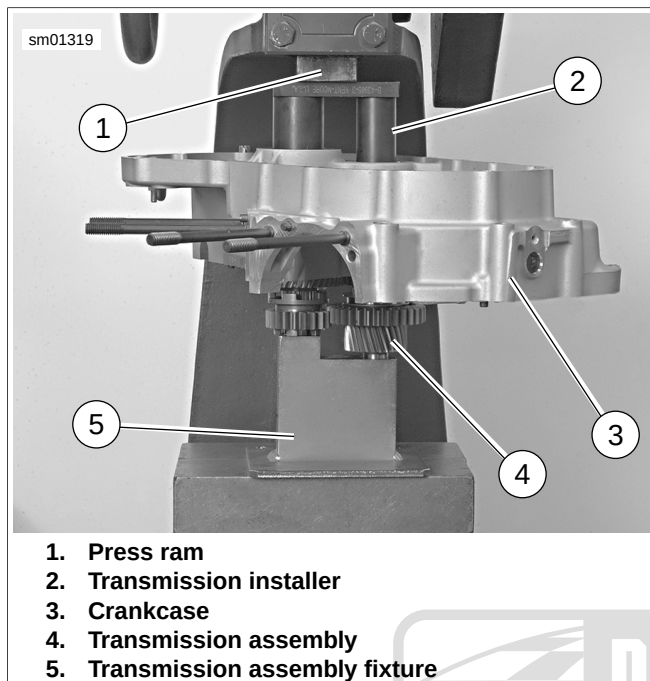


Figure 5-96. Pressing Transmission into Left Crankcase

SION AND PRIMARY CHAINCASE LUBRICANT (Part No. 99851-05) before assembly.

1. Place 2nd/3rd gear shifter fork onto dog ring between countershaft 2nd and 3rd gears.
2. Install shifter drum into left case half with previously scribed line at 12 o'clock position. This will place shifter drum in neutral position.

NOTE

See [Figure 5-98](#). Install shifter fork shafts in the left case half by lightly tapping on the end of the shaft with a brass or hard plastic hammer until shaft is seated in bore.

3. Place 1st gear shifter fork onto dog ring between countershaft 1st and 4th gear gears. Install shifter fork shaft through two installed shifter forks and into left crankcase half.
4. Install 4th/5th gear shifter fork onto sliding gear with dogs located on mainshaft. Install remaining shifter fork shaft through last installed shifter fork and into left crankcase half.

NOTE

See [Figure 5-98](#). Install shifter fork shafts in the left case half by lightly tapping on the end with a brass hammer until seated in bore.

NOTE

Make sure crankcase does not begin to tilt when pressed onto transmission assembly. It may be necessary to place press ram on transmission installer closer to mainshaft to keep the crankcase level.

8. Press crankcase onto transmission assembly until shafts bottom out on bearings.
9. Remove left crankcase with transmission assembly from press.

NOTE

When removing crankcase and transmission assembly from fixture, make sure mainshaft 1st gear does not fall off shaft. Gear could be damaged if it strikes a hard surface.

SHIFTER FORKS AND DRUM ASSEMBLY

NOTES

- See [Figure 5-97](#). Shifter design allows for one common part number for both countershaft shifter forks. As the transmission runs, each shifter fork develops a certain wear pattern with its mating parts. For this reason, it is important that each shifter fork be reinstalled in its original location.
- Always lubricate the shaft bore in each shifter fork with GENUINE HARLEY-DAVIDSON FORMULA+ TRANSMIS-

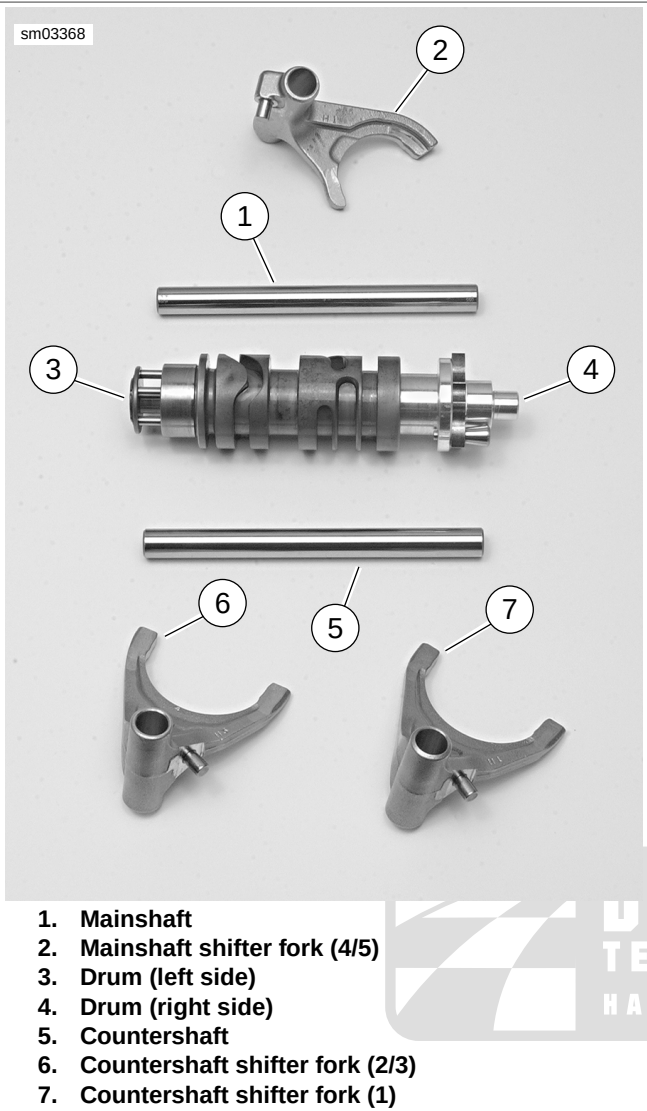


Figure 5-97. Shifter Forks, Drum and Shafts

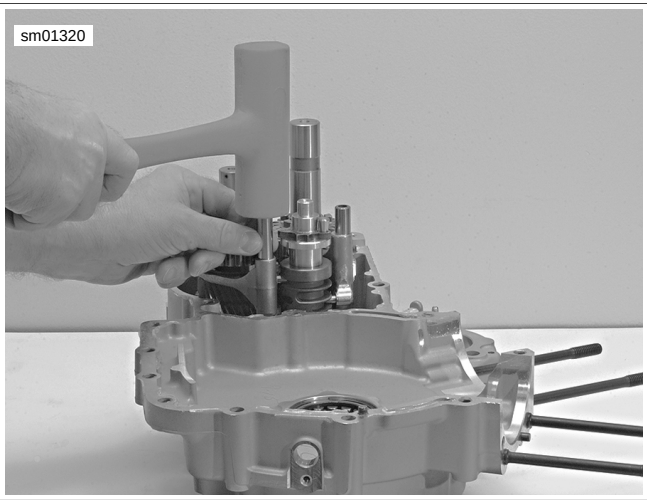


Figure 5-98. Installing Shifter Fork Shafts

ASSEMBLING CRANKCASES

PART NUMBER	TOOL NAME
B-45520	GEAR DETENT ASSEMBLY AID
HD-42326-A	CRANKSHAFT GUIDE TOOL

NOTE

See [Figure 5-99](#). The GEAR DETENT ASSEMBLY AID (Part No. B-45520) is used to move the gear detent lever clear of the shifter drum for assembly purposes.

1. See [Figure 5-99](#). Retract detent assembly in right case half and thread GEAR DETENT ASSEMBLY AID into neutral switch hole until it has bottomed in right case half.
2. See [Figure 5-100](#). Install flywheel assembly into right crankcase half.

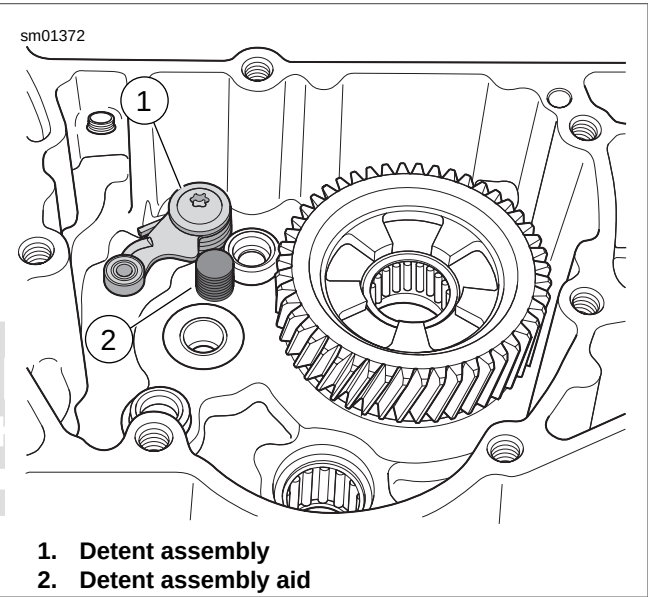


Figure 5-99. Using Gear Detent Assembly Aid (Part No. B-45520)

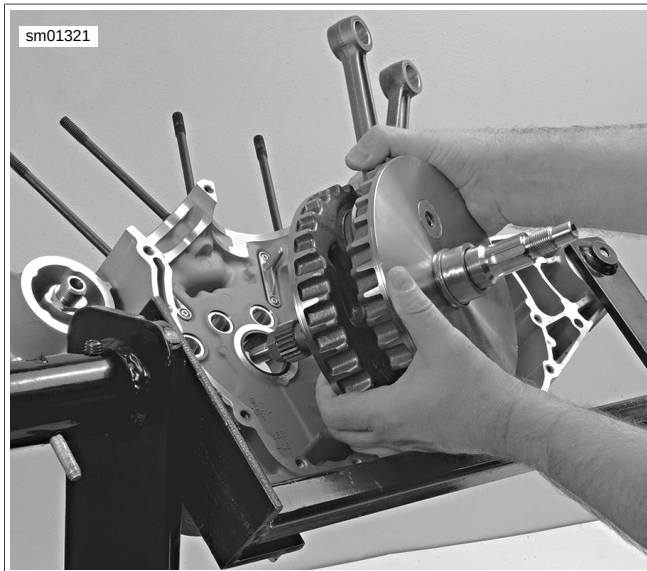


Figure 5-100. Installing Flywheel Assembly In Right Crankcase

CAUTION

Do not rotate right crankcase half in engine stand such that flywheel sprocket shaft is facing down. The flywheel assembly can fall out, resulting in parts damage or moderate injury. (00553b)

NOTE

Transmission must be in first gear when assembling crankcases. If transmission is in neutral, shifter drum detent will contact gear detent assembly aid when crankcases are assembled, possibly resulting in damage to shifter drum assembly and/or crankcase.

3. Place transmission in 1st gear.

4. See [Figure 5-101](#). Assemble crankcase halves together.
 - a. Slide CRANKSHAFT GUIDE TOOL (Part No. HD-42326-A) onto flywheel sprocket shaft.
 - b. Apply a thin coat of GRAY HIGH-PERFORMANCE SEALANT (Part No. 99650-02) to crankcase joint faces.
 - c. Lubricate main drive gear inner bearings with GENUINE HARLEY-DAVIDSON FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT.
 - d. Carefully fit crankcases together.
 - e. See [Figure 5-102](#). Apply several drops of LOCTITE 262 (red) to last few threads of each crankcase fastener and install fasteners in crankcase (insert eleven long and four short from left side, two long from right side), in locations shown.
 - f. Tighten fasteners to 15-19 ft-lbs (20.3-25.8 Nm) in the sequence shown in [Figure 5-102](#).
5. Remove GEAR DETENT ASSEMBLY AID and install neutral indicator switch and flat washer. Tighten to 120-180 **in-lbs** (13.6-20.3 Nm).

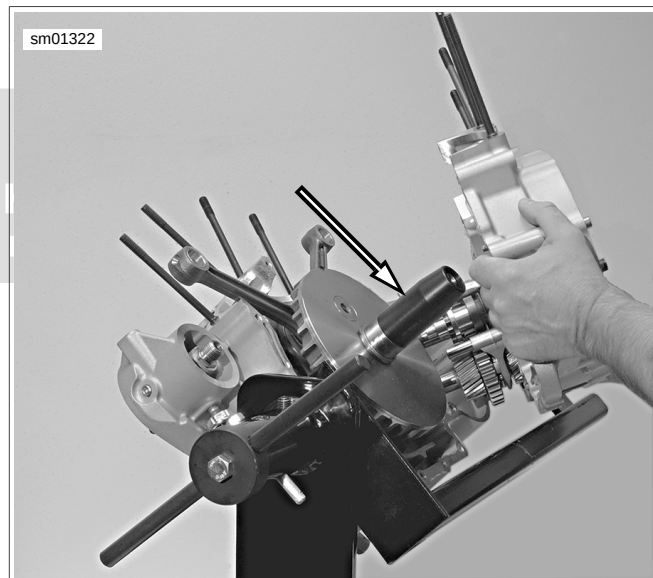


Figure 5-101. Assembling Crankcases With Crankshaft Guide Tool (Part No. HD-42326-A)

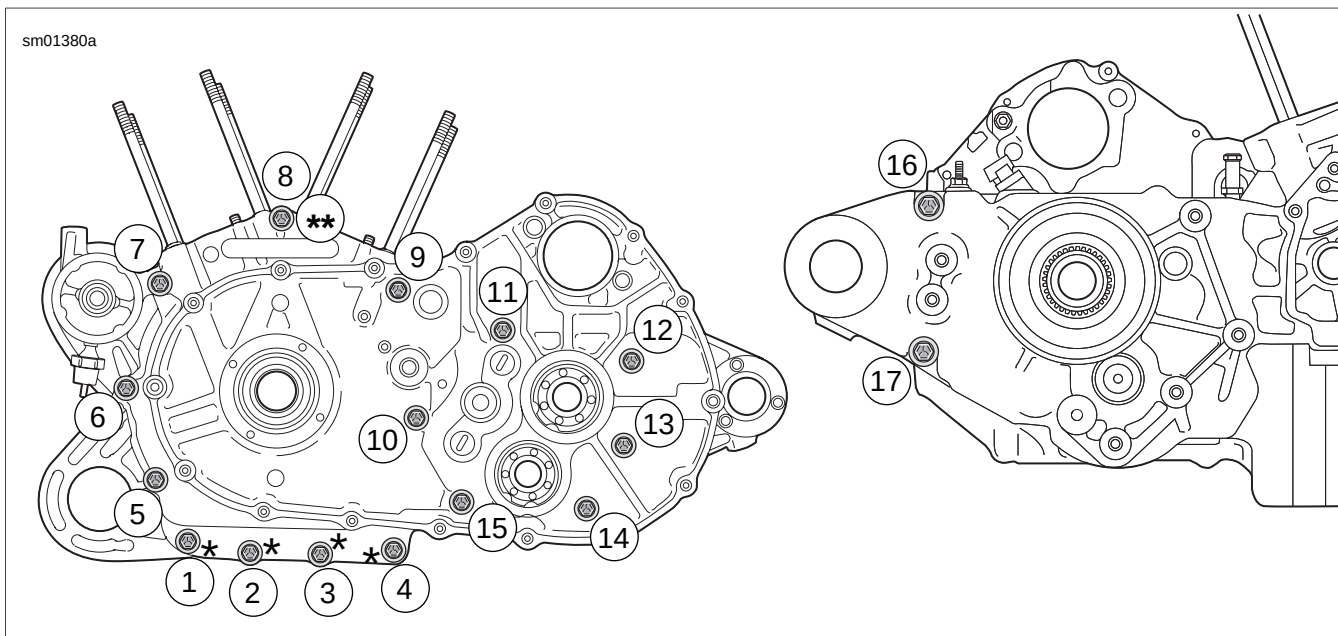


Figure 5-102. Crankcase Fastener Torque Sequence (* - Short Fasteners; ** - Double-ended Bolt: XR Models)

SHIFTER SHAFT INSTALLATION

1. See [Figure 5-103](#). Correctly install shifter return spring onto the reverse side of the shifter shaft assembly before placing shaft in left crankcase half.

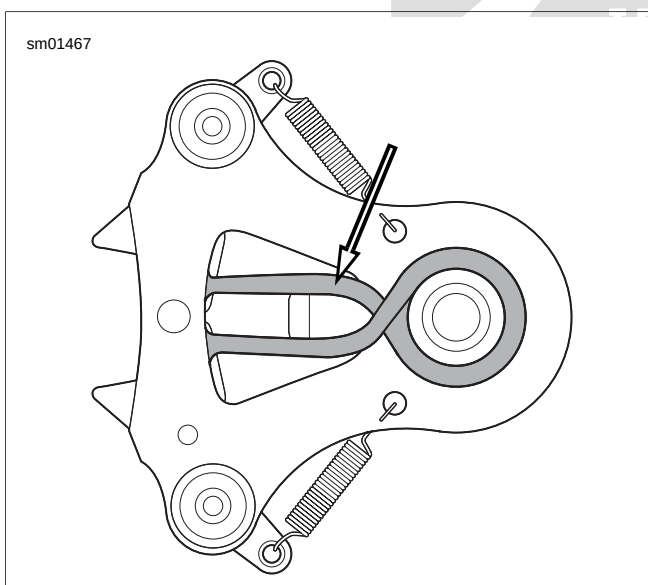


Figure 5-103. Shifter Shaft Return Spring (Correctly Installed)

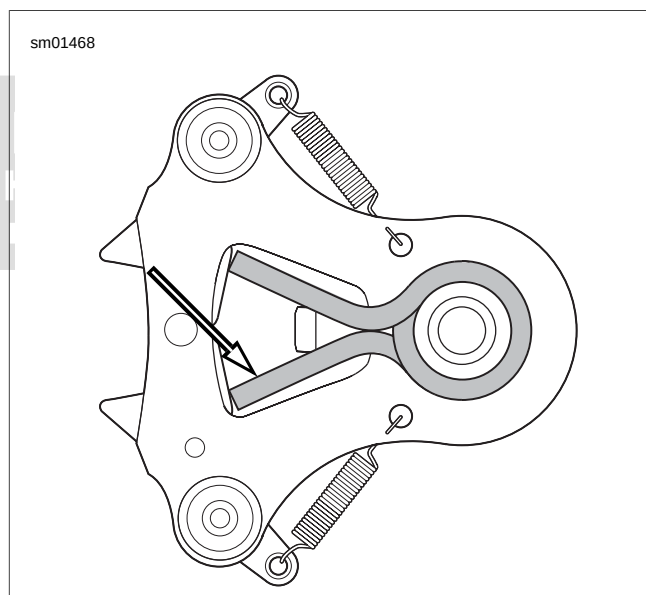


Figure 5-104. Shifter Shaft Return Spring (Incorrectly Installed)

2. See [Figure 5-105](#). Depress ratchet arms and insert shaft assembly into the bushing in the left case half and release. Ratchet arms should now be inside the end plate of the shifter drum contacting the shifter drum pins.

NOTE

See [Figure 5-105](#). The shifter shaft return spring can be installed incorrectly and then assembled in the left crankcase half. Failure to install the spring properly will result in improper shifting.

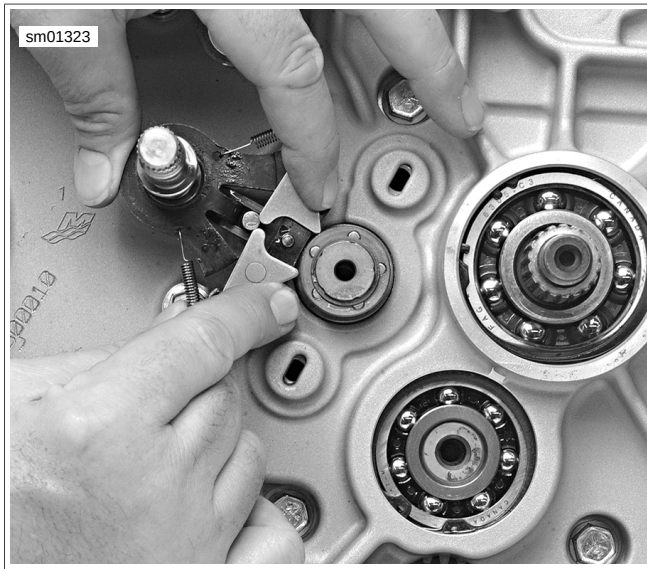


Figure 5-105. Installing Shifter Shaft Assembly

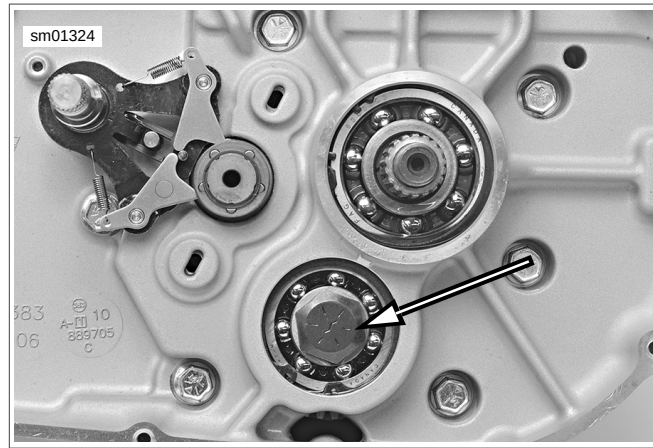


Figure 5-106. Countershaft Retaining Screw

3. See [Figure 5-106](#). Apply several drops of LOCTITE 262 (red) to last few threads of countershaft retaining screw. Thread screw into end of shaft.
4. Place transmission in gear and tighten screw to 33-37 ft-lbs (44.8-50.2 Nm).
5. Install transmission sprocket. See [5.16 TRANSMISSION SPROCKET](#).
6. Continue assembling engine. See appropriate sections of [3.18 BOTTOM END OVERHAUL: ASSEMBLY](#) and [3.16 TOP END OVERHAUL: ASSEMBLY](#).
7. Install primary chain and engine sprocket, clutch assembly, and primary cover. See [5.5 PRIMARY DRIVE AND CLUTCH: XL MODELS](#) or [5.6 PRIMARY DRIVE AND CLUTCH: XR MODELS](#).
8. Install engine in chassis. See [3.13 INSTALLING ENGINE IN CHASSIS](#).



TRANSMISSION SPROCKET

5.16

REMOVAL

PART NUMBER	TOOL NAME
HD-42310-45	ENGINE CRADLE
HD-46282-1A	SPROCKET HOLDING TOOL ADAPTER
HD-46282-A	TRANSMISSION SPROCKET HOLDING TOOL SET
HD-46288	MAINSHAFT LOCK NUT WRENCH

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

All Models

1. Unplug main fuse. See [6.38 MAIN FUSE](#).
2. Shift transmission into neutral.

XL Models

1. Remove rear muffler and rear exhaust pipe. See [4.15 EXHAUST SYSTEM: XL MODELS](#).
2. See [Figure 5-107](#). Remove screw (6), washer (5) and exhaust pipe clamp bracket (4). Remove two screws (2, 3) and remove sprocket cover (1).
3. Remove belt guard. See [2.24 BELT GUARD AND DEBRIS DEFLECTOR](#).
4. Remove rear drive belt from transmission sprocket. Pull belt back out of the way. Do not bend belt too tightly or twist belt. See [5.7 DRIVE BELT](#).
5. See [Figure 5-108](#). Remove screw and washer (6) from exhaust interconnect bracket.

XR Models

1. Remove exhaust system. See [4.16 EXHAUST SYSTEM: XR MODELS](#).
2. Remove three screws securing sprocket cover to engine crankcase. Remove sprocket cover.
3. Remove belt guard. See [2.24 BELT GUARD AND DEBRIS DEFLECTOR](#).
4. Remove two screws securing rear brake master cylinder assembly, rider footrest and mounting bracket to vehicle's frame. Carefully pull assembly back out of the way and secure to frame with cable strap or bungee cord. Be careful not to kink or bend metal portion of brake line.
5. Remove rear drive belt from transmission sprocket. Pull belt back out of the way. Do not bend belt too tightly or twist belt. See [5.7 DRIVE BELT](#).

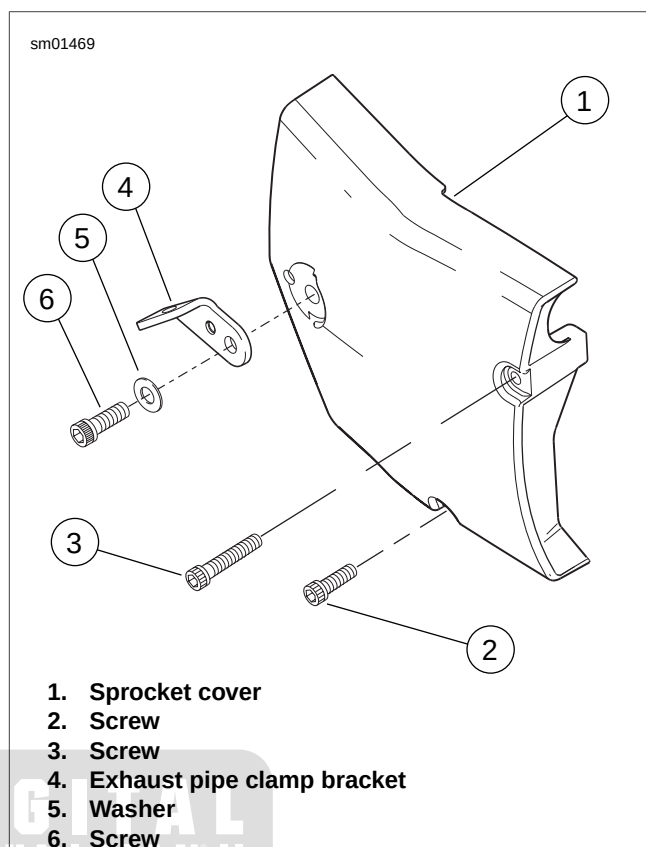


Figure 5-107. Sprocket Cover: XL Models

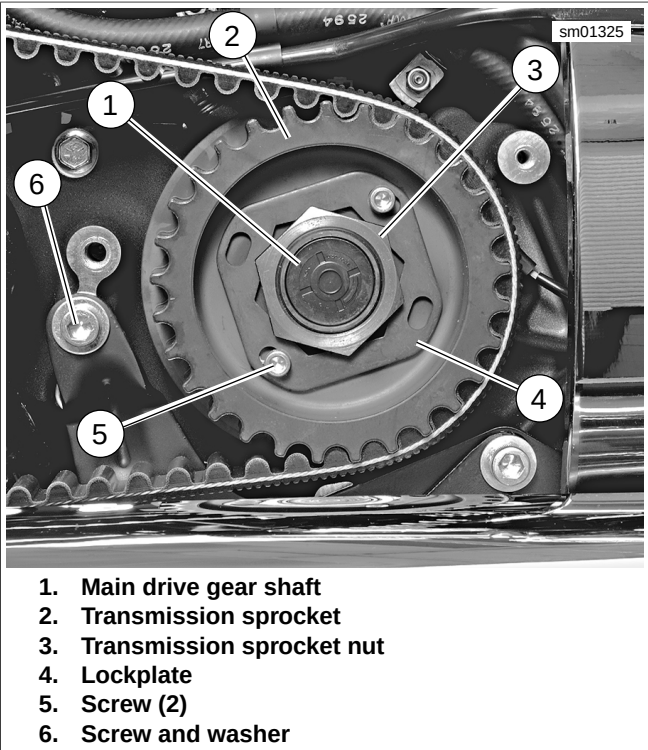


Figure 5-108. Transmission Sprocket Assembly: All Models (XL Model Shown)

All Models

1. See [Figure 5-108](#). Remove two screws (5) and sprocket lockplate (4).

NOTES

- See [Figure 5-110](#). On XR models and XL models without passenger footrests, install **SPROCKET HOLDING TOOL ADAPTER** (Part No. HD-46282-1A) into bottom footrest bracket hole in frame. Place handle of tool underneath adapter.
 - If the engine has been removed from the motorcycle and is mounted in the **ENGINE CRADLE** (Part No. HD-42310-45), the rear crankcase support also serves as a tool stop for the sprocket holding tool.
2. See [Figure 5-109](#). Use **TRANSMISSION SPROCKET HOLDING TOOL SET** (Part No. HD-46282-A) (1), **MAIN-SHAFT LOCK NUT WRENCH** (Part No. HD-46288) (2), and a breaker bar (3) to remove transmission sprocket nut. Place handle of sprocket holding tool under bottom of footrest bracket. Turn nut **clockwise** to loosen and remove it.

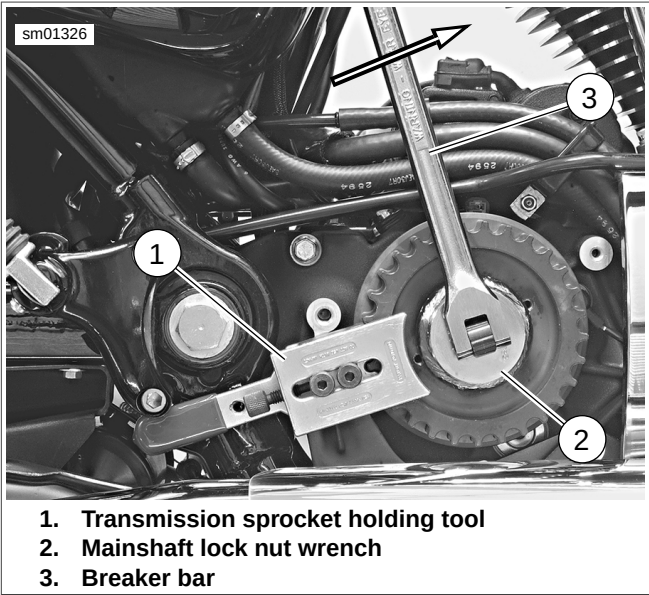


Figure 5-109. Removing Transmission Lock Nut: All Models (XL Model with Passenger Footrests Shown)

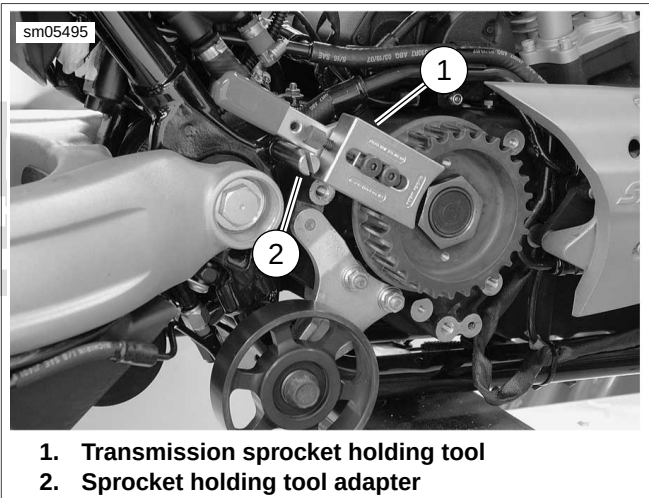


Figure 5-110. Sprocket Holding Tool and Adapter (Shown in Installation Position on XR Model)

INSTALLATION

PART NUMBER	TOOL NAME
HD-46282	TRANSMISSION SPROCKET HOLDING TOOL
HD-46282-1A	SPROCKET HOLDING TOOL ADAPTER
HD-46288	MAINSHAFT LOCK NUT WRENCH

All Models

1. See [Figure 5-108](#). Install transmission sprocket (2) onto main drive gear shaft (1).

NOTE

See [Figure 5-110](#). On XR models, and XL models without passenger footrests, screw **SPROCKET HOLDING TOOL**

ADAPTER (Part No. HD-46282-1A) into top footrest bracket hole in frame. Place handle of tool on top of adapter.

2. Shift transmission into neutral. Apply a few drops of LOCTITE THREADLOCKER 262 (red) to the **left-hand threads** of transmission sprocket nut (3). Apply a thin film of clean Harley-Davidson 20W-50 engine oil to the back face of the sprocket nut. Turn the nut **counterclockwise** to install it onto main drive gear shaft.
 - a. See [Figure 5-111](#). Use TRANSMISSION SPROCKET HOLDING TOOL (Part No. HD-46282) (1), MAIN-SHAFT LOCK NUT WRENCH (Part No. HD-46288) (2), and a torque wrench (3). Place handle of sprocket holding tool on top of footrest bracket. Tighten nut to 50 ft-lbs (68 Nm) initial torque, **ONLY**.
 - b. See [Figure 5-112](#). 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°.

NOTE

The lockplate has four screw holes and can be turned to either side, so you should be able to find a position without having to additionally tighten the nut. If you cannot align the screw holes properly, the nut may be additionally **TIGHTENED** until the screw holes line up, but do not exceed 45° as specified above. Never **LOOSEN** nut to align the screw holes.

- d. See [Figure 5-108](#). Install lockplate (4) over nut (3) so that two of lockplate's four drilled holes (diagonally opposite) align with sprocket's (2) two tapped holes.

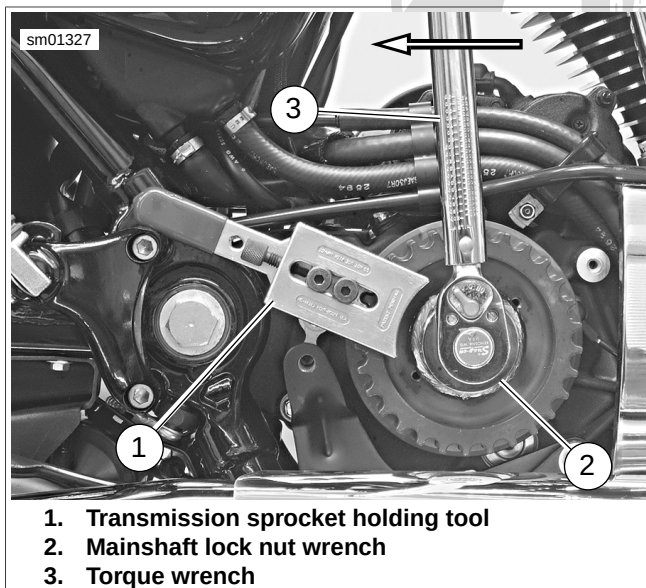


Figure 5-111. Tightening Transmission Lock nut: All Models (XL Model with Passenger Footrests Shown)

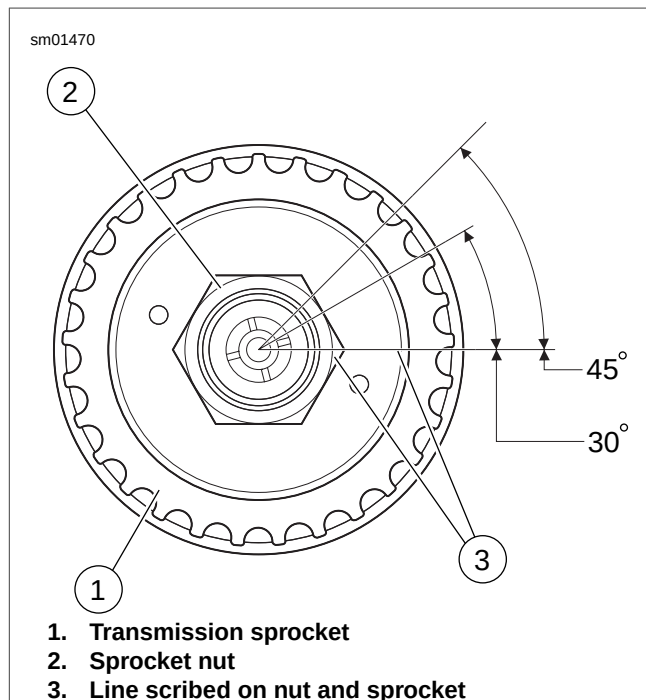


Figure 5-112. Transmission Sprocket Nut Final Tightening Procedure

NOTE

To maximize the lockplate's security, you must install **BOTH** screws to secure the lockplate.

3. Install socket head screws through two of the four holes in lockplate, then into two corresponding tapped holes in sprocket.
4. Tighten socket head screws (5) to 90-110 **in-lbs** (10.2-12.4 Nm).
5. **XR models and XL models without passenger footrests:** remove SPROCKET HOLDING TOOL ADAPTER (Part No. HD-46282-1A).

XL Models

1. See [Figure 5-108](#). Install screw and washer (6) to secure muffler interconnect bracket to engine crankcase. Tighten to 30-33 ft-lbs (40.7-44.8 Nm).
2. Install rear drive belt onto transmission sprocket. See [5.7 DRIVE BELT](#).
3. Adjust rear belt deflection and rear wheel alignment. See [1.16 REAR BELT DEFLECTION](#).
4. Install belt guard. See [2.24 BELT GUARD AND DEBRIS DEFLECTOR](#).
5. See [Figure 5-107](#). Install sprocket cover (1). Secure with two screws (2, 3). Note that long screw goes in top hole, short screw in bottom hole. Do not tighten screws at this time.
6. Install exhaust pipe clamp bracket (4), washer (5) and screw (6). Tighten to 30-33 ft-lbs (40.7-44.8 Nm) . Now tighten screws (2, 3) to 80-120 **in-lbs** (9.0-13.6 Nm).

7. Install rear exhaust pipe and rear muffler. See [4.15 EXHAUST SYSTEM: XL MODELS](#).

XR Models

1. Install rear drive belt onto transmission sprocket. See [5.7 DRIVE BELT](#).
2. Adjust rear belt deflection and rear wheel alignment. See [1.16 REAR BELT DEFLECTION](#).
3. Attach rear brake master cylinder, rider footrest and mounting bracket assembly to frame with two screws. Tighten to 45-50 ft-lbs (61-68 Nm).
4. Install belt guard. See [2.24 BELT GUARD AND DEBRIS DEFLECTOR](#).

5. Install sprocket cover. Secure with three screws. Note that of the two smaller diameter screws securing cover, longer screw goes in top hole, shorter screw in bottom hole. Larger diameter screw goes in rear hole. Tighten rear (larger) screw to 30-33 ft-lbs (40.7-44.8 Nm). Tighten forward and lower (smaller) screws to 80-120 **in-lbs** (9.0-13.6 Nm).
6. Install exhaust system. See [4.16 EXHAUST SYSTEM: XR MODELS](#).

All Models

Install main fuse. See [6.38 MAIN FUSE](#).



TABLE OF CONTENTS

SUBJECT	PAGE NO.
6.1 FASTENER TORQUE VALUES.....	6-1
6.2 SPECIFICATIONS: ELECTRICAL.....	6-4
6.3 VOLTAGE REGULATOR.....	6-5
6.4 FUSES AND RELAYS.....	6-10
6.5 MAIN FUSE HOLDER.....	6-11
6.6 SPEEDOMETER: XL SINGLE GAUGE MODELS EXCEPT XL 883C/XL 1200C.....	6-12
6.7 SPEEDOMETER AND TACHOMETER: XL DUAL GAUGE MODELS.....	6-14
6.8 SPEEDOMETER: XL 883C/XL 1200C.....	6-17
6.9 SPEEDOMETER AND TACHOMETER: XR MODELS.....	6-19
6.10 TURN SIGNAL AND SECURITY MODULE (TSM/TSSM/HFSM).....	6-22
6.11 BATTERY CABLES.....	6-24
6.12 BATTERY TRAY.....	6-26
6.13 STARTER.....	6-29
6.14 STARTER SOLENOID.....	6-33
6.15 IGNITION SYSTEM.....	6-36
6.16 IGNITION AND LIGHT SWITCH.....	6-37
6.17 ELECTRONIC CONTROL MODULE (ECM).....	6-39
6.18 SPARK PLUG CABLES.....	6-41
6.19 IGNITION COIL.....	6-44
6.20 CHARGING SYSTEM.....	6-47
6.21 HEADLAMP.....	6-48
6.22 INDICATOR LAMP MODULE.....	6-52
6.23 TAIL LAMP: ALL MODELS EXCEPT XL 1200N.....	6-55
6.24 TURN SIGNALS.....	6-58
6.25 LICENSE PLATE LAMP MODULE: XL 1200N.....	6-65
6.26 REAR LIGHTING CONVERTER MODULE: XL 1200N (DOMESTIC ONLY).....	6-70
6.27 REAR STOP LAMP SWITCH.....	6-72
6.28 CRANK POSITION SENSOR (CKP).....	6-74
6.29 ALTERNATOR.....	6-75
6.30 VEHICLE SPEED SENSOR (VSS).....	6-78
6.31 NEUTRAL INDICATOR SWITCH.....	6-79
6.32 MAIN WIRING HARNESS.....	6-81
6.33 ELECTRICAL CADDIES.....	6-85
6.34 JIFFY STAND SWITCH: INTERNATIONAL MODELS.....	6-91
6.35 OPTIONAL SECURITY SIREN.....	6-93
6.36 OIL PRESSURE SWITCH.....	6-96
6.37 HORN.....	6-98
6.38 MAIN FUSE.....	6-100
6.39 HANDLEBAR SWITCH ASSEMBLIES.....	6-101
6.40 RIGHT HANDLEBAR SWITCHES.....	6-103
6.41 LEFT HANDLEBAR SWITCHES.....	6-109

NOTES



FASTENER TORQUE VALUES

6.1

FASTENER TORQUE VALUES IN THIS CHAPTER

The table below lists torque values for all fasteners presented in this chapter.

FASTENER	TORQUE VALUE		NOTES
Alternator rotor-to-sprocket screw	120-140 in-lbs	13.6-15.8 Nm	6.29 ALTERNATOR, Assembly and Installation
Alternator stator mounting screw	30-40 in-lbs	3.4-4.5 Nm	6.29 ALTERNATOR, Assembly and Installation
Ball head studs (front turn signals)	96-156 in-lbs	10.8-17.6 Nm	6.24 TURN SIGNALS, Front Housing Replacement
Battery negative cable-to-crankcase nut	55-75 in-lbs	6.2-8.5 Nm	6.11 BATTERY CABLES, Installation
Battery negative terminal screw	60-70 in-lbs	6.8-7.9 Nm	6.11 BATTERY CABLES, Installation
Battery positive terminal screw	60-70 in-lbs	6.8-7.9 Nm	6.11 BATTERY CABLES, Installation
Battery strap screw	36-60 in-lbs	4.1-6.8 Nm	6.11 BATTERY CABLES, Installation
Battery tray mounting screw	96-156 in-lbs	10.9-17.6 Nm	6.12 BATTERY TRAY, Installation
Brake (rear) lamp switch screw	72-120 in-lbs	8.1-13.6 Nm	6.12 BATTERY TRAY, Installation
Brake hose clamp-to-battery tray screw	30-40 in-lbs	3.4-4.5 Nm	6.12 BATTERY TRAY, Installation
Brake rear master cylinder reservoir mounting screw	20-25 in-lbs	2.3-2.8 Nm	6.12 BATTERY TRAY, Installation
Brake rear master cylinder reservoir mounting screw	20-25 in-lbs	2.3-2.8 Nm	6.27 REAR STOP LAMP SWITCH, Replacement
Coil mounting bracket screw	35-45 in-lbs	4.0-5.1 Nm	6.19 IGNITION COIL, Installation
Coil mounting screw	24-72 in-lbs	2.7-8.1 Nm	6.19 IGNITION COIL, Installation
Coil mounting screw	24-72 in-lbs	2.7-8.1 Nm	6.19 IGNITION COIL, Installation
Crank position sensor (CKP) screw	80-100 in-lbs	9.0-11.3 Nm	6.28 CRANK POSITION SENSOR (CKP), Installation
ECM fasteners: XR models	18-22 in-lbs	2.0-2.5 Nm	6.17 ELECTRONIC CONTROL MODULE (ECM), Installation
Fender support screw with washer	132-216 in-lbs	14.9-24.4 Nm	6.25 LICENSE PLATE LAMP MODULE: XL 1200N, Installation (HDI Only)
Handlebar clamp screw	12-18 ft-lbs	16.3-24.4 Nm	6.22 INDICATOR LAMP MODULE, Replacement: XL 1200L and XL 1200N/XL 1200L/XL 1200N
Handlebar clamp screw	12-18 ft-lbs	16.3-24.4 Nm	6.22 INDICATOR LAMP MODULE, Replacement: XL 1200L and XL 1200N/XL 1200L/XL 1200N
Handlebar clamp screws	108-132 in-lbs	12.2-14.9 Nm	6.40 RIGHT HANDLEBAR SWITCHES, Installation
Handlebar clamp screws	108-132 in-lbs	12.2-14.9 Nm	6.41 LEFT HANDLEBAR SWITCHES, Installation
Handlebar riser clamp screw	12-18 ft-lbs	16.3 -24.4 Nm	6.22 INDICATOR LAMP MODULE, Replacement: XL 883C and XL 1200C/XL 883C/XL1200C
Handlebar riser clamp screw	12-18 ft-lbs	16.3 -24.4 Nm	6.22 INDICATOR LAMP MODULE, Replacement: XL 883C and XL 1200C/XL 883C/XL1200C
Handlebar riser cover screw	8-12 in-lbs	0.9-1.4 Nm	6.22 INDICATOR LAMP MODULE, Replacement: XL 883C and XL 1200C/XL 883C/XL1200C
Handlebar switch housing screws	35-45 in-lbs	4.0-5.1 Nm	6.40 RIGHT HANDLEBAR SWITCHES, Installation
Handlebar switch housing screws	35-45 in-lbs	4.0-5.1 Nm	6.41 LEFT HANDLEBAR SWITCHES, Installation
Handlebar upper clamp screw	12-18 in-lbs	16.3-24.4 Nm	6.22 INDICATOR LAMP MODULE, Replacement: All Other Models/all except XL 883C/XL 1200C/XL 1200L/XL 1200N
Horn, front mounted, mounting screw	72-108 in-lbs	8.1-12.2 Nm	6.37 HORN, Replacement: Models with Front Mounted Horn

FASTENER	TORQUE VALUE		NOTES
Horn, side mounted, acorn nut	60-180 in-lbs	6.8-20.4 Nm	6.37 HORN, Replacement: Models with Side Mounted Horn
Horn, side mounted, stud nut	80-100 in-lbs	9.0-11.3 Nm	6.37 HORN, Replacement: Models with Side Mounted Horn
Ignition/light switch mounting screw	35-45 in-lbs	4.0-5.1 Nm	6.16 IGNITION AND LIGHT SWITCH, Installation
Jiffy stand switch screw	96-120 in-lbs	10.9-13.6 Nm	6.34 JIFFY STAND SWITCH: INTERNATIONAL MODELS, Installation
License plate lamp housing screw	14-16 in-lbs	1.2-1.3 Nm	6.25 LICENSE PLATE LAMP MODULE: XL 1200N, Installation (HDI Only)
Light switch bracket screw	35-45 in-lbs	4.0-5.1 Nm	6.33 ELECTRICAL CADDIES, Wire Harness Caddy: XL Models
Light switch bracket screw	35-45 in-lbs	4.0-5.1 Nm	6.33 ELECTRICAL CADDIES, Wire Harness Caddy: XR Models
Long post jam nut	65-80 in-lbs	7.3-9.0 Nm	6.14 STARTER SOLENOID, Solenoid Contacts
Neutral indicator switch	120-180 in-lbs	13.6-20.3 Nm	6.31 NEUTRAL INDICATOR SWITCH, Replacement
Oil pressure switch adapter: XR 1200 only	108-158 in-lbs	12.2-17.9 Nm	6.36 OIL PRESSURE SWITCH, Installation
Positive battery cable-to-starter post lock nut	60-85 in-lbs	6.8-9.6 Nm	6.11 BATTERY CABLES, Installation
Rear fender brace screw	20-25 in-lbs	2.3-2.8 Nm	6.25 LICENSE PLATE LAMP MODULE: XL 1200N, Installation (HDI Only)
Rear turn signal housing screws: XR models	30-40 in-lbs	3.4-4.5 Nm	6.24 TURN SIGNALS, Rear Housing Replacement
Rear turn signal housing-to-stalk	96-156 in-lbs	10.9-17.6 Nm	6.24 TURN SIGNALS, Rear Housing Replacement
Riser cover screw	8-12 in-lbs	0.9-1.4 Nm	6.8 SPEEDOMETER: XL 883C/XL 1200C, Installation/XL 883C/XL 1200C only
Riser cover screw	8-12 in-lbs	0.9-1.4 Nm	6.24 TURN SIGNALS, Front Housing Replacement
Riser cover screw	8-12 in-lbs	0.9-1.4 Nm	6.39 HANDLEBAR SWITCH ASSEMBLIES, Connectors/XL 883C/XL 1200C only
Solenoid ring terminal nut	70-90 in-lbs	7.9-10.2 Nm	6.13 STARTER, Field Coil Assembly
Starter end cover screw	90-110 in-lbs	10.2-12.4 Nm	6.13 STARTER, Field Coil Assembly
Starter mounting bolt	13-20 ft-lbs	17.6-27.1 Nm	6.13 STARTER, Installation
Starter positive terminal nut	60-85 in-lbs	6.8-9.6 Nm	6.13 STARTER, Installation
Starter thru bolts	39-65 in-lbs	4.4-7.3 Nm	6.13 STARTER, Field Coil Assembly
Stator harness retainer screw	56 in-lbs	6.3 Nm	6.29 ALTERNATOR, Assembly and Installation/Screw must be flush with plate. Do not exceed torque specification.
Stoplight switch to tee nut	84-120 in-lbs	9.5-13.6 Nm	6.27 REAR STOP LAMP SWITCH, Replacement
Strut cover screw	132-216 in-lbs	14.9-24.4 Nm	6.24 TURN SIGNALS, Rear Housing Replacement
Tail lamp base mounting screw: XL models only	45-48 in-lbs	5.1-5.4 Nm	6.23 TAIL LAMP: ALL MODELS EXCEPT XL 1200N, Base Replacement
Tail lamp base mounting screw: XR models only	36-60 in-lbs	4.1-6.8 Nm	6.23 TAIL LAMP: ALL MODELS EXCEPT XL 1200N, Base Replacement
Tail lamp lens screw	20-24 in-lbs	2.3-2.7 Nm	6.23 TAIL LAMP: ALL MODELS EXCEPT XL 1200N, Bulb Replacement
Tail lamp lens screw	20-24 in-lbs	2.3-2.7 Nm	6.23 TAIL LAMP: ALL MODELS EXCEPT XL 1200N, Base Replacement
Turn signal (front) clamp screw	96-120 in-lbs	10.9-13.6 Nm	6.24 TURN SIGNALS, Front Housing Replacement
Turn signal stalk nut	132-216 in-lbs	14.9-24.4 Nm	6.24 TURN SIGNALS, Rear Housing Replacement

FASTENER	TORQUE VALUE		NOTES
Vehicle speed sensor (VSS) screw	80-100 in-lbs	9.0-11.3 Nm	6.30 VEHICLE SPEED SENSOR (VSS), Installation
Voltage regulator mounting screw	36-60 in-lbs	4.1-6.8 Nm	6.3 VOLTAGE REGULATOR, Installation: XL Models
Voltage regulator mounting screw	36-60 in-lbs	4.1-6.8 Nm	6.3 VOLTAGE REGULATOR, Installation: XR Models



SPECIFICATIONS: ELECTRICAL

6.2

SPECIFICATIONS: 2009 SPORTSTER MODELS

Table 6-1. Ignition System: 2009 Sportster XL Models

COMPONENT	SPECIFICATION	
Ignition timing	not adjustable	
Battery	12 volt, 12 amp/hr, sealed and maintenance free	
Spark plug type	HD-6R12	
Spark plug size	12 mm	
Spark plug gap	0.038-0.043 in.	0.97-1.09 mm
Spark plug torque	12-18 ft-lbs	16.3-24.4 Nm

Table 6-2. Ignition System: 2009 Sportster XR 1200 Model

COMPONENT	SPECIFICATION	
Ignition timing	not adjustable	
Battery	12 volt, 12 amp/hr, sealed and maintenance free	
Spark plug type	10R12X	
Spark plug size	12 mm	
Spark plug gap	0.032-0.038 in.	0.81-0.97 mm
Spark plug torque	12-18 ft-lbs	16.3-24.4 Nm

Table 6-3. Ignition Coil Resistance

RESISTANCE	PRIMARY	SECONDARY
All Models	0.3-0.7 Ohms	1500-2400 Ohms

Table 6-4. Alternator

ITEM	SPECIFICATION
AC voltage output	20-28 VAC per 1000 engine RPM
Stator coil resistance	0.1-0.3 Ohms

Table 6-5. Voltage Regulator

ITEM	SPECIFICATION
Voltage output @ 75 F	14.3-14.7 VDC
Current @ 3600 RPM	32 Amps

Table 6-6. Battery

MODEL	SPECIFICATION
All	12 volt, 12 Ampere hours

Table 6-7. Fuses

ITEM	AMP RATING
Main fuse	30
Battery	15
Ignition	15
Lights	15
Accessories	15
Instruments	15
Fuel Pump	15
Electronic Control Module (ECM)	15
P&A Ign	15
Engine control (XR1200 models only)	15

Table 6-8. Starter Specifications

STARTER DATA	
Free speed	3000 RPM (min.) @ 11.5 V
Free current	90 amp (max.) @ 11.5 V
Cranking current	200 amp (max.) @ 68°F
Stall torque	8.0 ft-lbs (10.8 Nm) @ 2.4 V

Table 6-9. Starter Service Wear Limits

ITEM	IN.	MM.
Brush length (minimum)	0.443	11.0
Commutator runout	0.016	0.41
Commutator diameter (minimum)	1.141	28.98
Commutator mica depth (minimum)	0.008	0.203

VOLTAGE REGULATOR

6.3

GENERAL

See [Figure 6-1](#). The voltage regulator is located between the frame downtubes at the front of the motorcycle. When installing connectors (3, 4) after service, make sure to engage external latches (5) to prevent connectors from separating during vehicle operation.

NOTE

The voltage regulator cannot be repaired. Replace the unit if it fails.

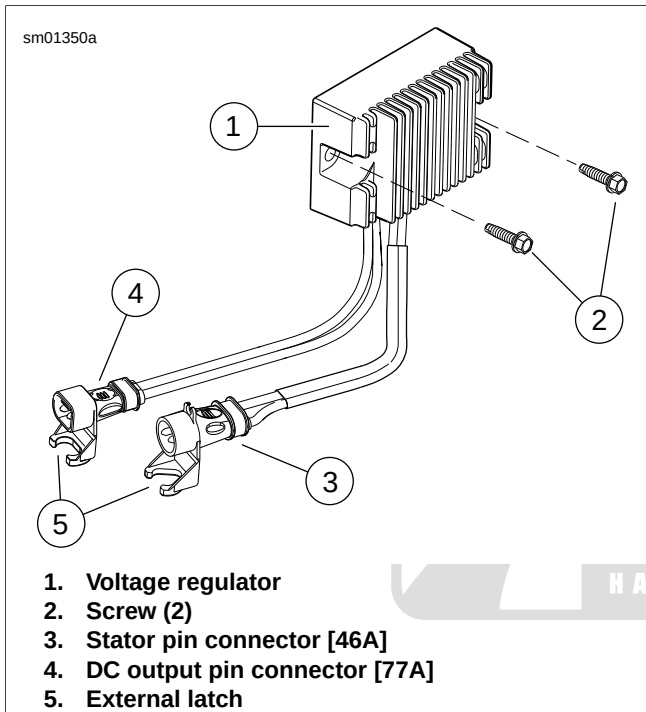


Figure 6-1. Voltage Regulator

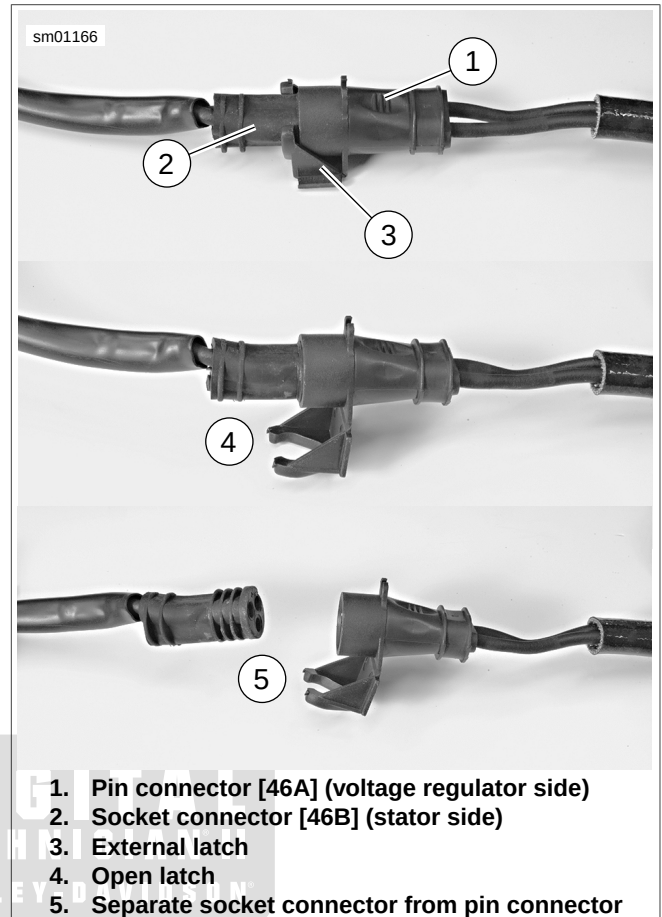


Figure 6-2. Separating Connector Halves (Stator Connector Shown)

REMOVAL: XL MODELS

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Unplug main fuse. See [6.38 MAIN FUSE](#).

NOTE

When unplugging the voltage regulator connectors, pull apart each connector by firmly grasping both connector halves. Do not pull on leads or damage to the wires and/or terminals may result.

2. See [Figure 6-2](#). Unplug stator connector [46]. Lift external latch (3) on pin housing and separate connector halves (5).
3. See [Figure 6-4](#). Gently pry apart clips (2) and remove DC output connector [77] (1) from voltage regulator caddy (3). Lift external latch on pin housing and separate connector halves.

4. See [Figure 6-5](#). Remove screws (2) from locations at top and bottom of voltage regulator. Remove regulator from vehicle, carefully threading harnesses through opening in regulator mounting bracket.

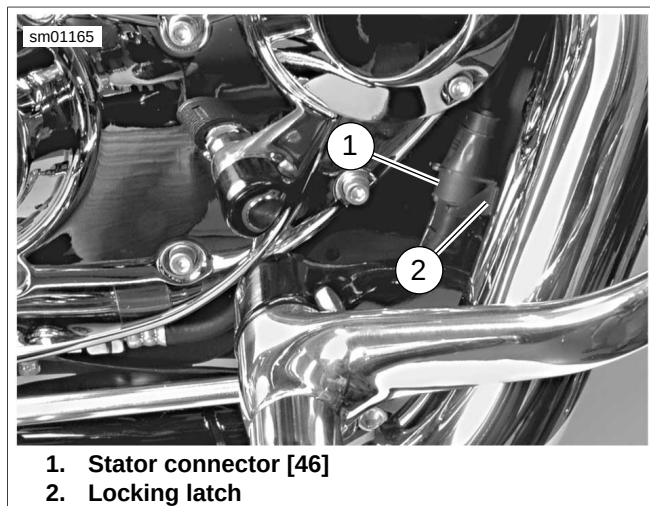


Figure 6-3. Stator Connector [46] Location

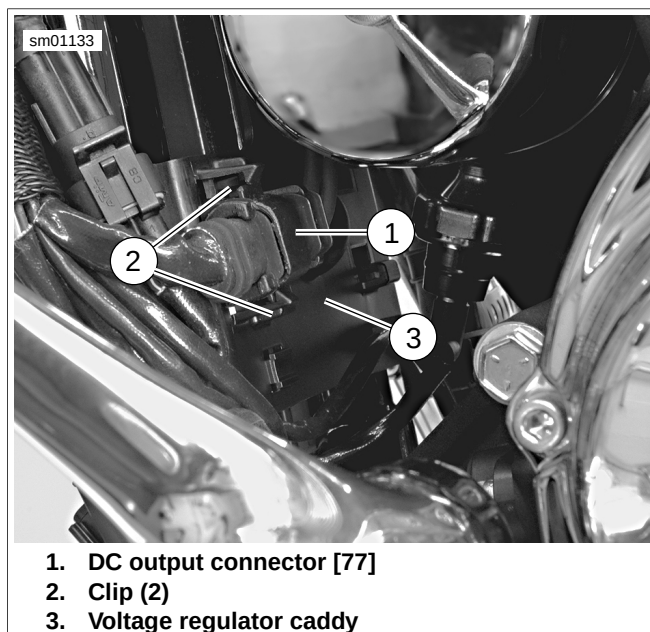


Figure 6-4. DC Output Connector [77] Location

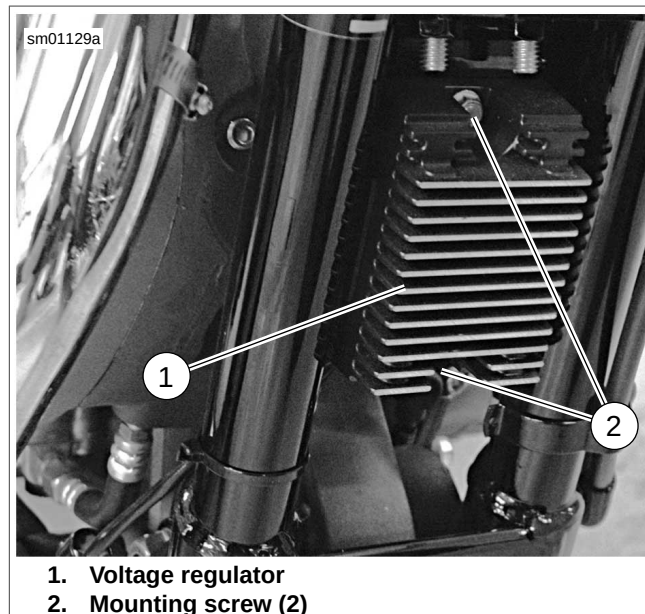


Figure 6-5. Voltage Regulator Location

INSTALLATION: XL MODELS

1. See [Figure 6-6](#). Position voltage regulator close to mounting bracket (1). Orient regulator so cooling fins face forward and wiring harnesses exit regulator body toward right side of vehicle.
2. Thread DC output wiring harness into opening (3) between mounting bracket and frame downtube on right side of vehicle. Route DC output harness connector [77A] toward left side of vehicle.
3. See [Figure 6-7](#). Route stator harness (3) down along between right frame downtube and body of voltage regulator (2), and under voltage regulator caddy (1). Route stator harness connector [46A] toward right side of vehicle.
4. See [Figure 6-6](#). Mount voltage regulator on mounting bracket (1) between frame downtubes and secure with mounting screws at two locations (2). Tighten to 36-60 in-lbs (4.1-6.8 Nm).
5. See [Figure 6-3](#). Plug stator connector [46A] (1) into socket connector [46B]. Fold external locking latch (2) over and lock in place.
6. In the same fashion, plug voltage regulator DC output connector [77A] into socket [77B]. Fold external latch over and lock in place.
7. See [Figure 6-8](#). Snap DC output harness connector assembly (3) into tabs (4) in the voltage regulator caddy (2). Insert DC output cables into cable clip (7) on caddy.
8. Plug in main fuse. See [6.38 MAIN FUSE](#).
9. Test charging system. See the ELECTRICAL DIAGNOSTIC MANUAL.

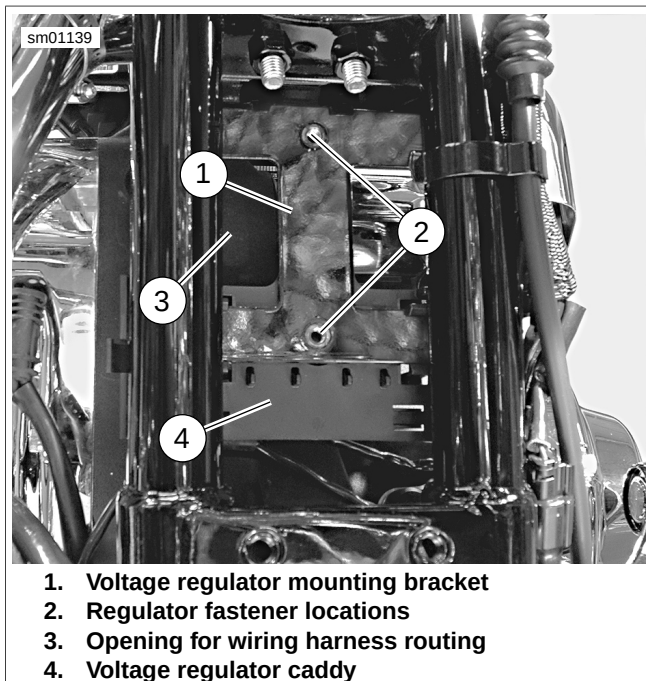


Figure 6-6. Voltage Regulator Mounting Bracket (All Models)

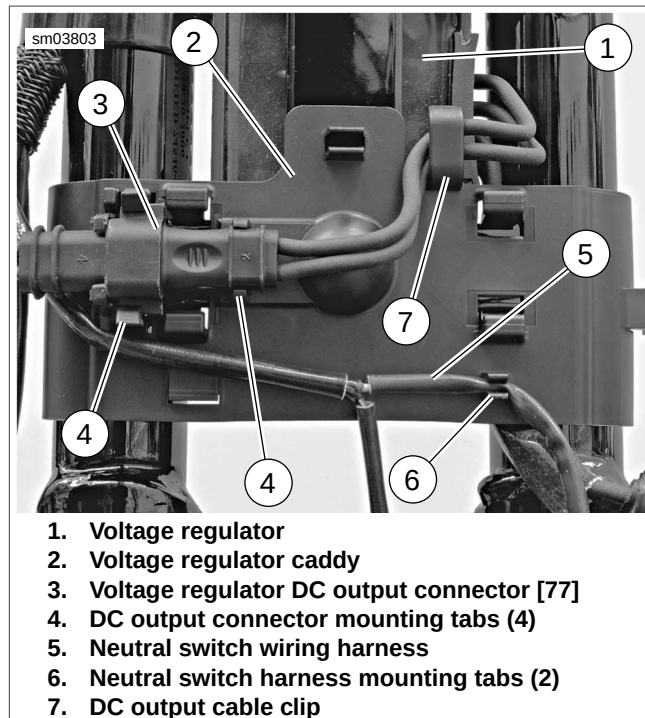


Figure 6-8. Voltage Regulator Caddy: Rear View

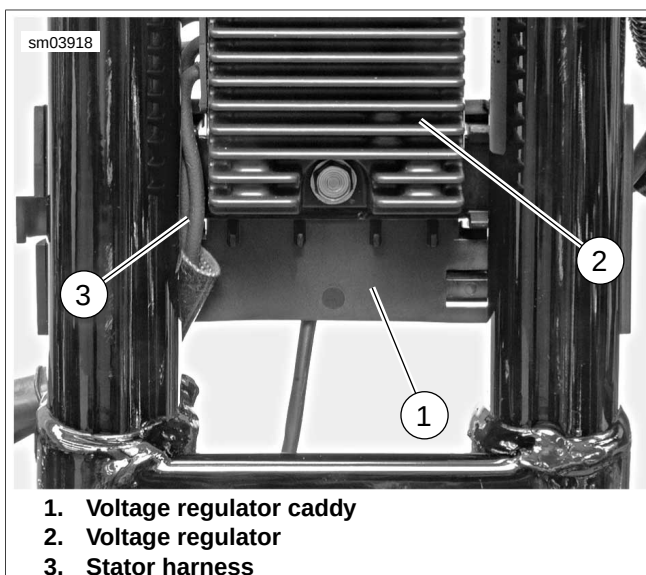


Figure 6-7. Stator Harness Routing

REMOVAL: XR MODELS

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Unplug main fuse. See [6.38 MAIN FUSE](#).

NOTE

When unplugging the voltage regulator connectors, pull apart each connector by firmly grasping both connector halves. Do not pull on leads or damage to the wires and/or terminals may result.

2. See [Figure 6-9](#). Unplug stator connector (4). Carefully pull barbed cable strap (3) from frame.
3. See [Figure 6-10](#). Cut cable strap (1). Lift external latch on connector and separate connector halves.
4. See [Figure 6-11](#). Remove screws (1) from locations at top and bottom of voltage regulator (2). Remove regulator from vehicle, carefully threading harnesses through opening in regulator mounting bracket.

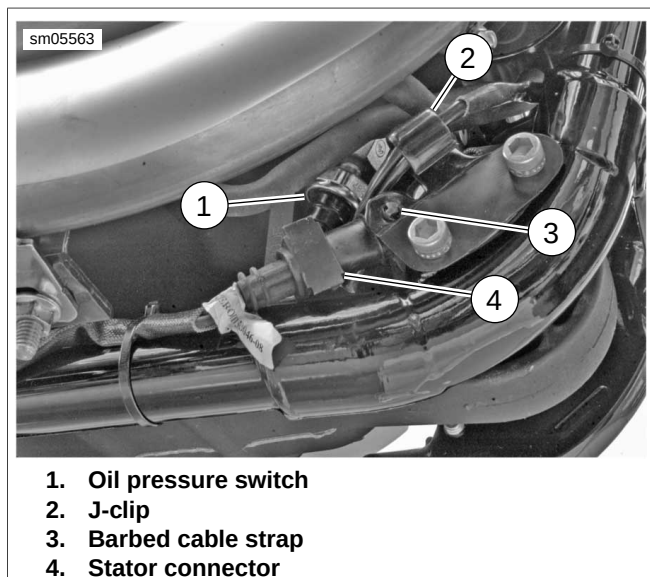


Figure 6-9. Oil Pressure Switch (Right Side View XR 1200)

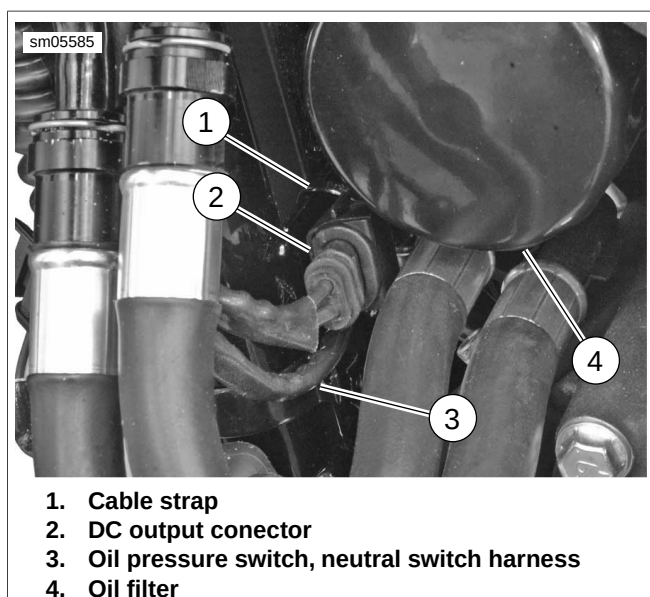


Figure 6-10. DC Output Connector: XR Models

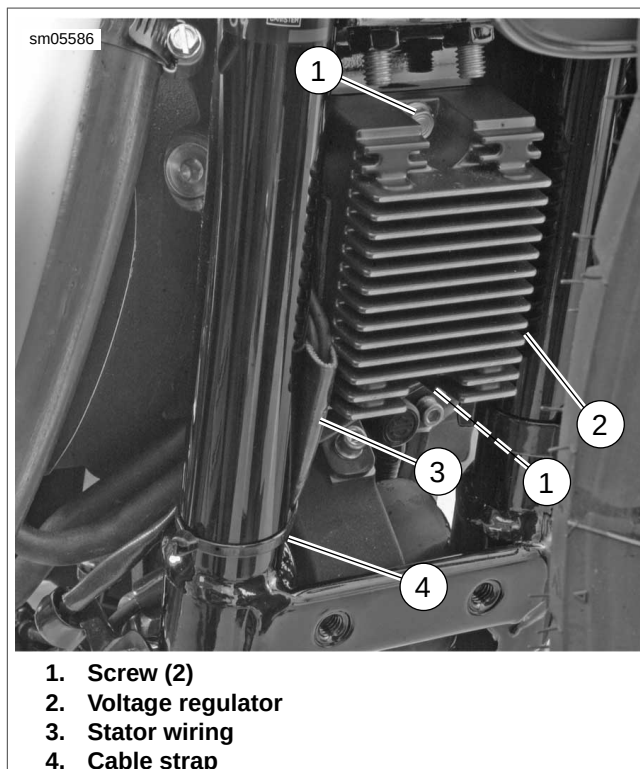


Figure 6-11. Stator Wire Routing: XR Models

INSTALLATION: XR MODELS

1. See [Figure 6-12](#). Position voltage regulator close to mounting bracket (1). Orient regulator so cooling fins face forward and wiring harnesses exit regulator body toward right side of vehicle.
2. Thread DC output wires below mounting bracket . Route DC output connector (2) toward left side of vehicle.
3. Route stator wires (4) down along between right frame downtube and body of voltage regulator. Route stator harness connector [46A] toward right side of vehicle.

NOTE

When installing voltage regulator, make sure wires do not get pinched between bracket and regulator.

4. Mount voltage regulator on mounting bracket and secure with mounting screws. Tighten to 36-60 **in-lbs** (4.1-6.8 Nm).
5. See [Figure 6-13](#). Connect stator connector (1) and fold external latch over and lock in place. Secure stator connector to bracket with barbed cable strap (3).
6. Secure stator wires to right frame down tube with cable strap (2).
7. See [Figure 6-14](#). Connect voltage regulator DC output connector. Fold external latch over and lock in place.
8. Secure DC output connector (2) along with oil pressure switch, neutral switch harness (3) to voltage regulator bracket with cable strap (1).
9. Plug in main fuse. See [6.38 MAIN FUSE](#).

10. Test charging system. See the electrical diagnostic manual.

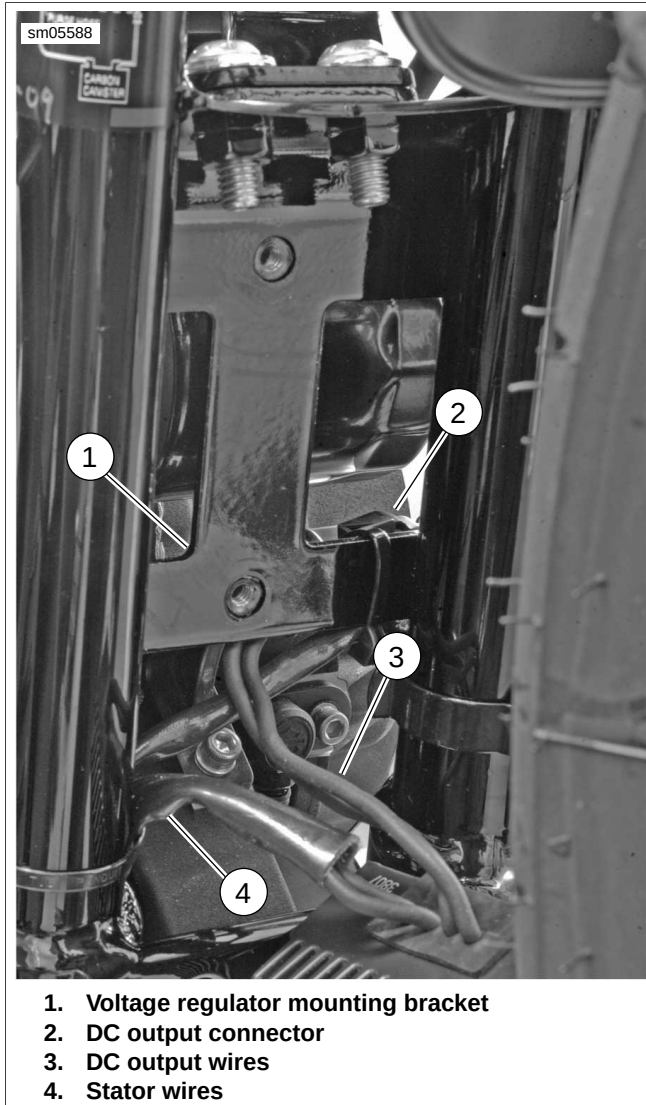


Figure 6-12. Voltage Regulator Wire Routing: XR Models

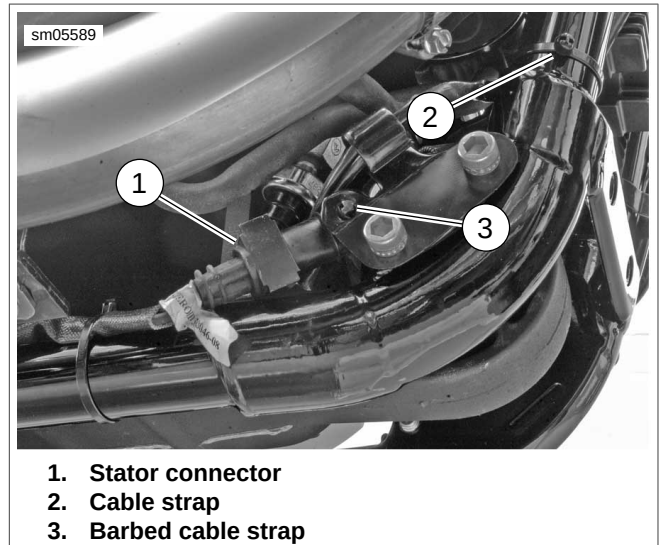


Figure 6-13. Stator Connector: XR Models

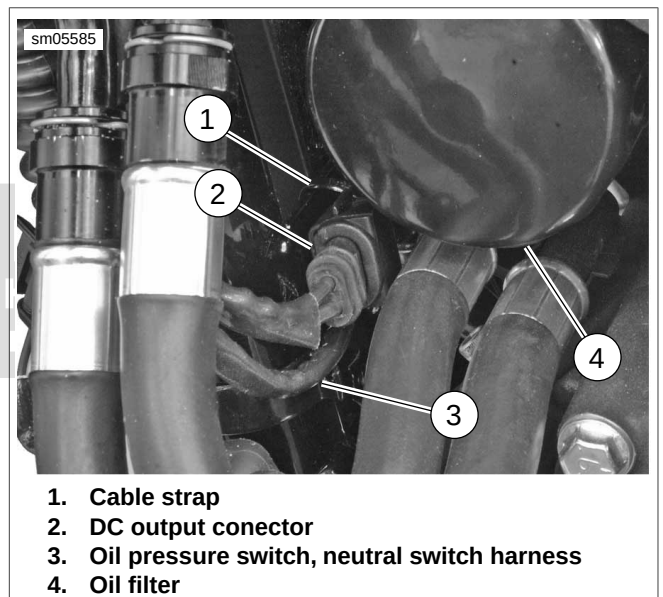


Figure 6-14. DC Output Connector: XR Models

FUSES AND RELAYS

6.4

GENERAL

The starter relay allows a relatively small amount of current flowing through the starter button to control the large current flow required to activate the starter solenoid.

See [Figure 6-15](#). The electrical system relay/fuse block is located in front of the battery under the left side cover. The relays and fuses are mounted in the relay/fuse block. All fuses except the P&A fuse are rated at 15 amperes.

REPLACING FUSES

1. Open left side cover. See [2.20 LEFT SIDE COVER](#).
2. See [Figure 6-15](#). Pull suspect fuse (1-9) from slots in relay/fuse block and inspect for blown condition or other damage.
3. Replace as necessary:
 - a. Insert **new** fuse in appropriate location by lining up spade terminals on fuse with sockets in relay/fuse block.
 - b. Press fuse firmly into sockets.
4. Close left side cover.
5. Turn ignition switch ON and verify proper operation of circuit protected by replacement fuse.

REPLACING RELAYS

1. Open left side cover. See [2.20 LEFT SIDE COVER](#).
2. See [Figure 6-15](#). To unplug old relay (10 or 11), grasp body of relay and with a gentle rocking motion, pull straight out from relay/fuse block.
3. To install **new** relay, line up spade terminals of relay with sockets in relay/fuse block and push relay firmly into sockets.
4. Close left side cover.
5. Turn ignition switch ON and start vehicle to verify proper operation of relay circuits.

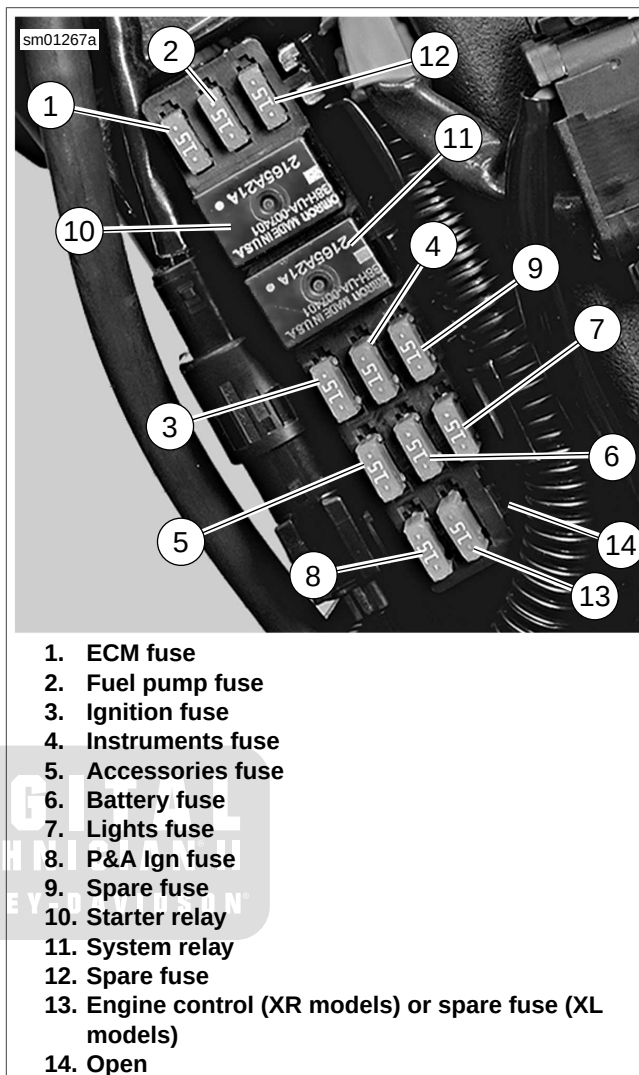


Figure 6-15. Relay/Fuse Blocks (Typical)

MAIN FUSE HOLDER

6.5

GENERAL

The main fuse holder is attached to the battery strap behind the left side cover.

REPLACEMENT

WARNING

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

1. Remove negative battery cable from engine crankcase. See [1.17 BATTERY MAINTENANCE](#).
2. Unplug main fuse. See [6.38 MAIN FUSE](#).
3. Disassemble main fuse holder and remove cable terminals. Replace components as necessary and reassemble. See [A.4 DELPHI MAIN FUSE HOUSING](#) for disassembly/assembly instructions.
4. Install negative battery cable on engine crankcase. See [1.17 BATTERY MAINTENANCE](#).
5. Plug in main fuse.
6. Turn ignition switch ON and verify proper operation of vehicle's electrical system.

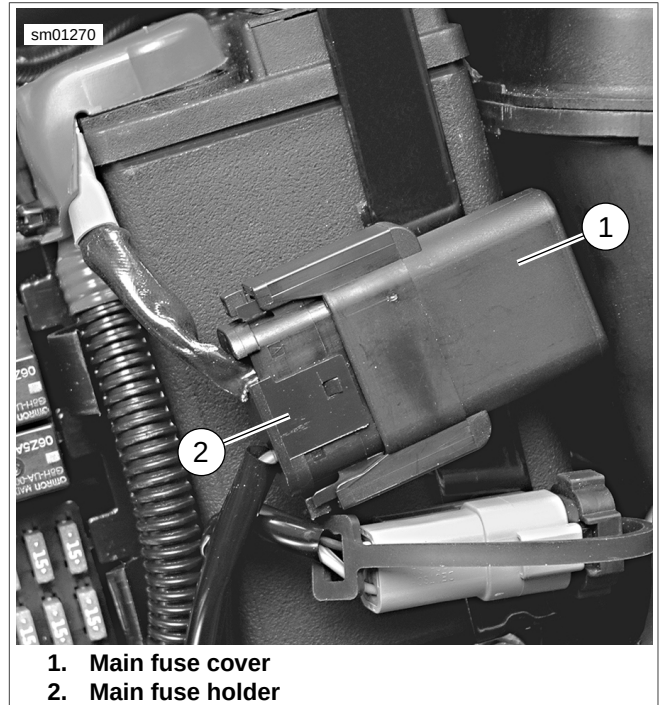


Figure 6-16. Main Fuse and Holder



SPEEDOMETER: XL SINGLE GAUGE MODELS EXCEPT XL 883C/XL 1200C

6.6

REMOVAL

NOTE

The speedometer has a backlight bulb that cannot be replaced. If the bulb fails, replace the entire unit.

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Unplug main fuse. See [6.38 MAIN FUSE](#).
2. See [Figure 6-17](#). Remove reset switch boot (9) from trip odometer reset switch (8) on speedometer housing back plate (5).
3. Remove two screws (7) and back plate.
4. Unplug speedometer socket connector [39B] (10) from back of speedometer.
5. Gently push out speedometer (1) and front gasket (2).
6. Inspect front (2) and back (4) gaskets, speedometer connector [39] and wiring, trip odometer reset switch and wiring and reset switch boot. Repair or replace as required.

INSTALLATION

PART NUMBER	TOOL NAME
HD-45929	CRIMPING TOOL

1. If replacing trip odometer switch:
 - a. Push trip reset socket terminals out the front of the speedometer socket connector half [39B]. See [A.16 PACKARD MICRO-64 CONNECTORS](#).
 - b. Cut off socket terminals and pull faulty switch wires out of connector.
 - c. Push wires of a replacement switch through speedometer connector (sockets 8, 11) and crimp new socket terminals using CRIMPING TOOL (Part No. HD-45929), on replacement switch wiring.
 - d. Draw terminal back into connector until terminal seats.
2. See [Figure 6-17](#). Install front gasket (2) on speedometer (1).
3. Threading speedometer harness and connector [39B] through back gasket (4), install matching tabs of gasket to locating keys in instrument housing/bracket (3).

NOTE

If necessary, lubricate rubber gaskets with alcohol or glass cleaner.

4. Orient face upright and press speedometer into instrument housing/bracket. Wiring must past between locating keys and gasket and through cutout in speedometer back.
5. Plug speedometer socket connector [39] (10) into back of speedometer.
6. Push trip odometer reset switch (8) through back plate (5) and thread on reset switch boot (9).
7. Hold back plate in place with reset switch in rectangular boss in back of speedometer (1) and vent hole (6) at bottom. Secure with screws and tighten.
8. Plug in main fuse.

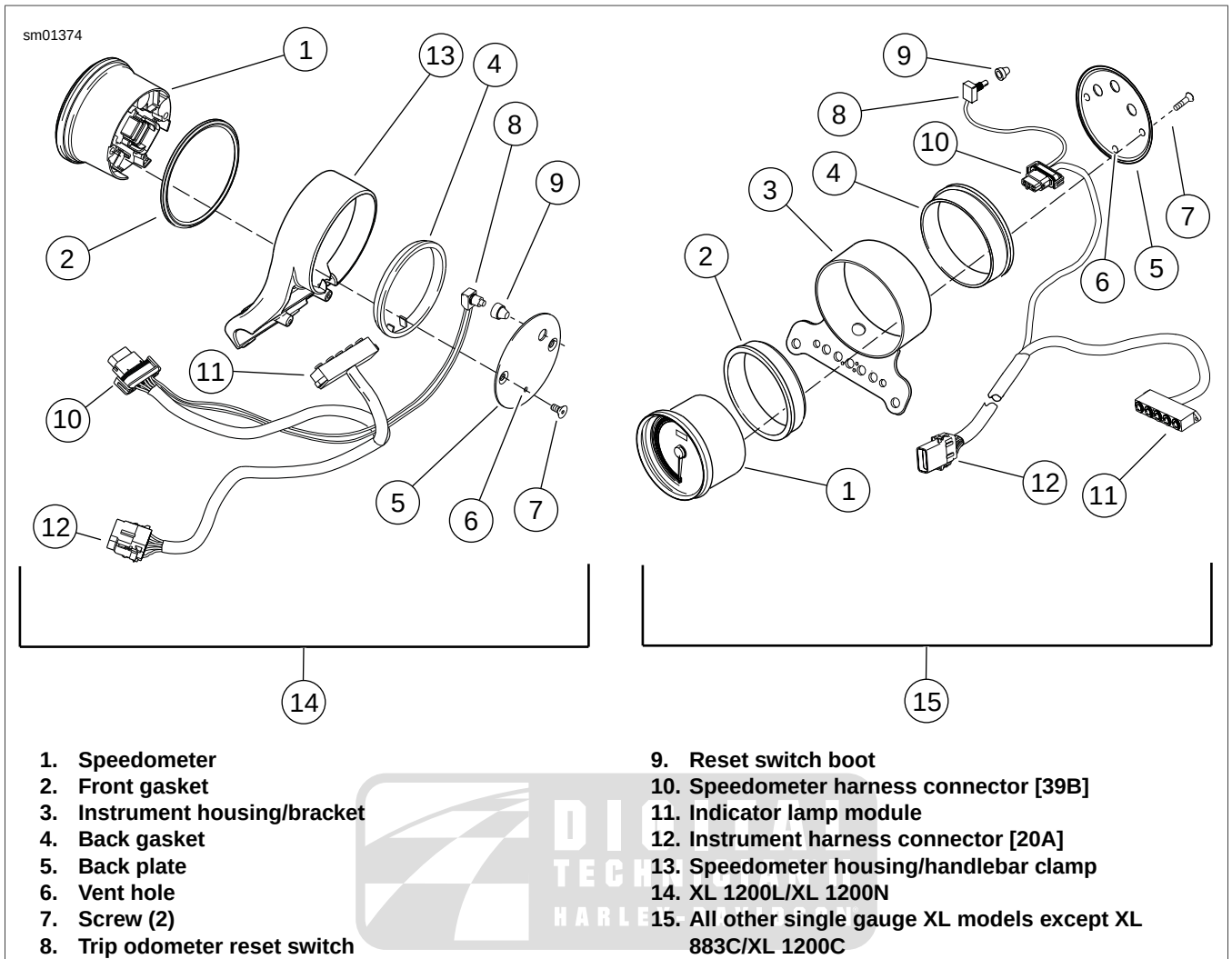


Figure 6-17. Speedometer Components: XL Single Gauge Models Except XL 883C/XL 1200C

SPEEDOMETER AND TACHOMETER: XL DUAL GAUGE MODELS

6.7

SPEEDOMETER REMOVAL

NOTE

The speedometer and tachometer have backlight bulbs that cannot be replaced. If the bulb fails, replace the entire unit.

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Unplug main fuse. See [6.38 MAIN FUSE](#).
2. Remove trip odometer reset boot from housing back plate.
3. Remove screws holding speedometer housing back plate.
4. Open latches on each side of speedometer connector [39] and separate connector halves.
5. Push out the speedometer and front gasket.
6. Inspect front and back gaskets, speedometer connector [39] and wiring, trip odometer reset switch and wiring, and trip reset boot. Repair or replace as required.

SPEEDOMETER INSTALLATION

1. If replacing the trip odometer reset switch, see [6.7 SPEEDOMETER AND TACHOMETER: XL DUAL](#)

[GAUGE MODELS, Trip Odometer Reset Switch Replacement](#).

2. See [Figure 6-18](#). Install front gasket (4) on speedometer (1).
3. Thread wiring through back gasket (8) and install matching tabs of gasket to locating keys in instrument housing/bracket (5).

NOTE

If necessary, lubricate rubber gaskets with alcohol or glass cleaner.

4. Orient face upright and press speedometer (1) into instrument housing/bracket (5). Wiring must pass between locating keys and back gasket and through cutout in speedometer back.
5. Mate speedometer connector halves [39].
6. Push trip odometer reset switch (2) through housing back plate (6) and thread on the trip reset boot (3).
7. Align back plate (6) with vent hole (15) at bottom with reset switch (2) in rectangular boss in back of speedometer (1) and thread in and tighten screws (14).
8. Plug in main fuse. See [6.38 MAIN FUSE](#).

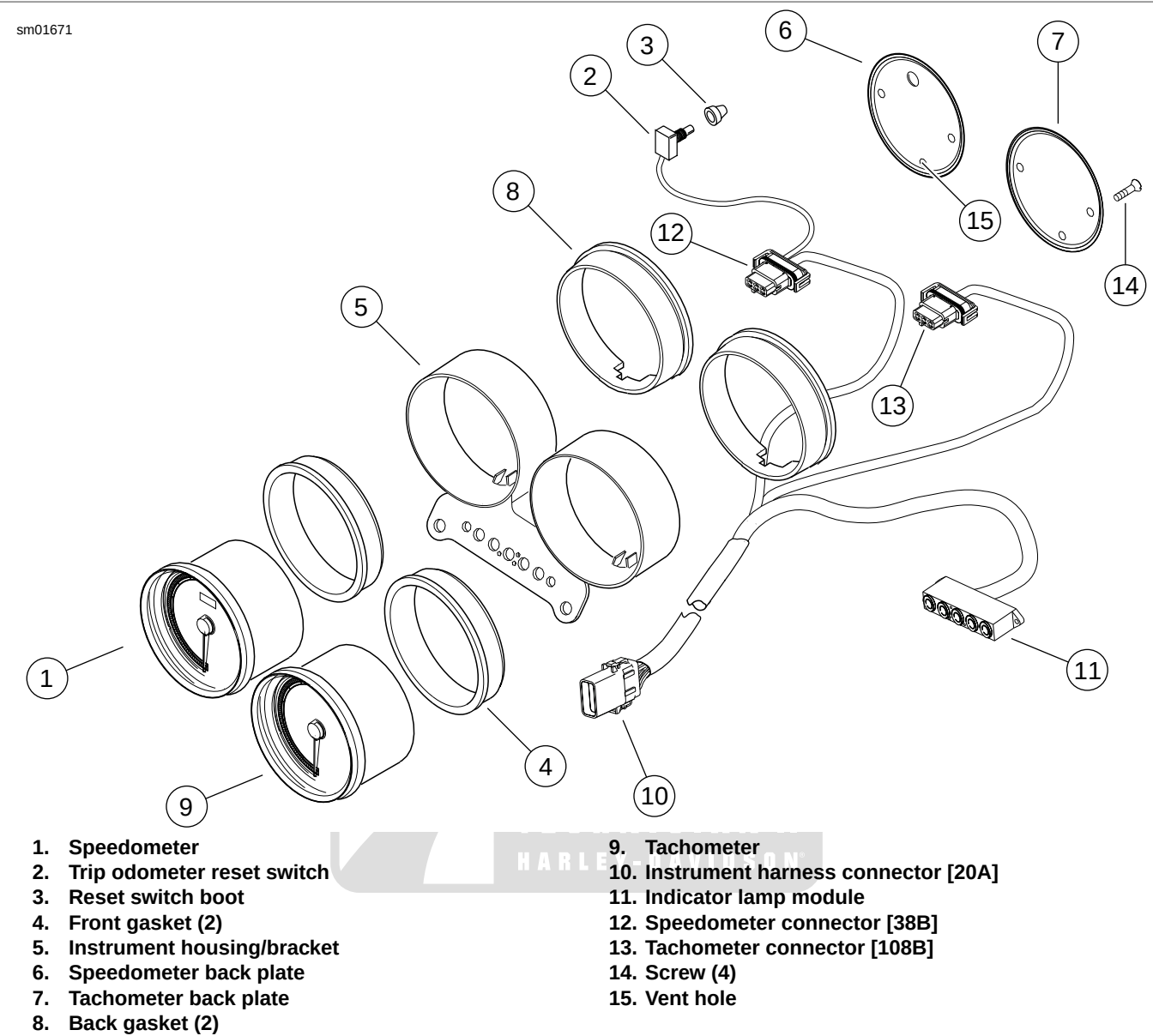


Figure 6-18. Speedometer and Tachometer: Dual Gauge Models

TRIP ODOMETER RESET SWITCH REPLACEMENT

PART NUMBER	TOOL NAME
HD-45929	CRIMPING TOOL

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Unplug main fuse. See [6.38 MAIN FUSE](#).
2. Remove trip odometer reset boot from back plate.
3. Remove screws holding speedometer housing backplate.

4. See [Figure 6-19](#). Open latches on each side of speedometer connector [39] (1) and separate connector halves.
5. Follow instructions to push the trip reset socket terminals out the front of the speedometer socket connector half [39B]. See [A.16 PACKARD MICRO-64 CONNECTORS](#).
6. Cut off the socket terminals and pull the faulty switch out of the connector.
7. Push the wires of a replacement switch through the speedometer connector (sockets 8, 11) and crimp new socket terminals using CRIMPING TOOL (Part No. HD-45929), on replacement switch wiring.
8. Draw the terminal back into the connector until the terminal seats.
9. Position reset switch in squared boss on back of speedometer housing.

10. Align back plate with vent hole on bottom. Install back plate screws and tighten.
11. Replace trip odometer reset switch boot.
12. Plug in main fuse.

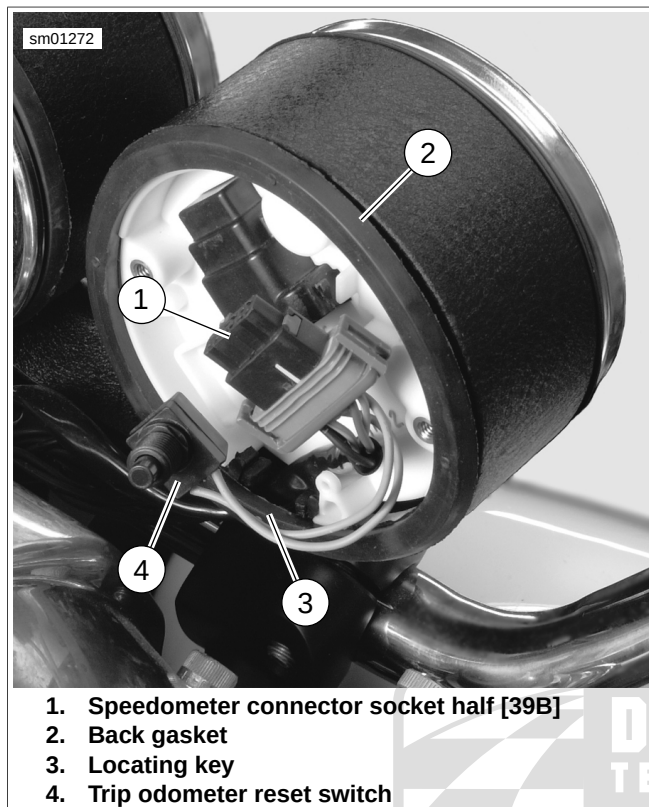


Figure 6-19. Speedometer: Dual Gauge Models

TACHOMETER REMOVAL

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Unplug main fuse. See [6.38 MAIN FUSE](#).
2. Remove screws holding tachometer housing back plate.
3. Open latches on each side of tachometer connector [108] and separate connector halves.
4. Push out the tachometer and front gasket.

5. Inspect front and back gaskets, tachometer connector [108] and wiring. Repair or replace as required.

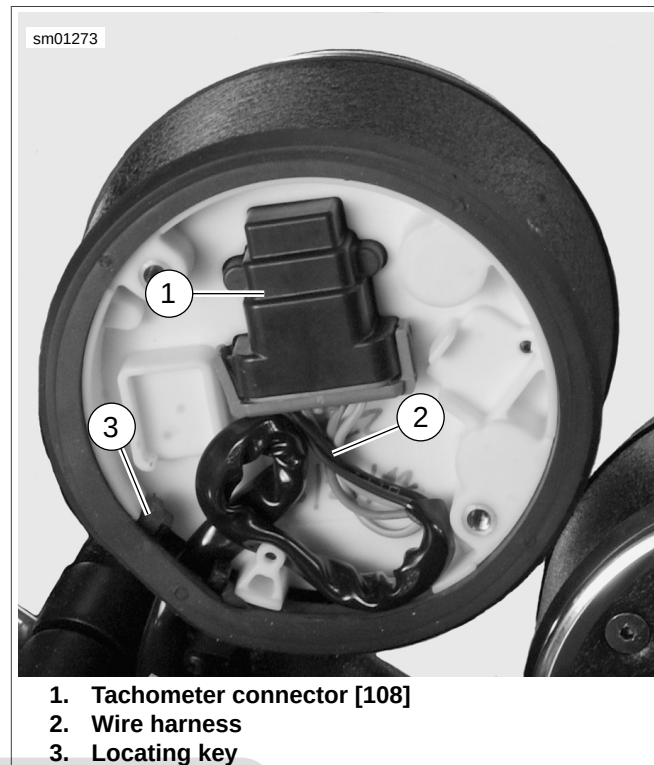


Figure 6-20. Tachometer: Dual Gauge Models

TACHOMETER INSTALLATION

1. See [Figure 6-18](#). Install front gasket (4) on tachometer (9).
2. Thread wiring through back gasket (8) and install gasket matching tabs to locating keys in instrument housing/bracket (5).

NOTE

If necessary, lubricate rubber gaskets with alcohol or glass cleaner.

3. Slide tachometer (9) into housing (5) and press firmly until fully seated.
4. See [Figure 6-20](#). Loop wiring to fit in available space and mate connector [108] halves.
5. See [Figure 6-18](#). Align back plate (7) with vent hole at bottom. Install back plate screws (14) and tighten.
6. Plug in main fuse. See [6.38 MAIN FUSE](#).

SPEEDOMETER: XL 883C/XL 1200C

6.8

REMOVAL

NOTE

The speedometer has a backlight bulb that cannot be replaced. If the bulb fails, replace the entire unit.

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Unplug main fuse. See [6.38 MAIN FUSE](#).
2. Protect fuel tank with a clean, soft cover.
3. See [Figure 6-22](#). Remove two screws (8) and riser cover (9) from back of handlebar riser (4). See [2.32 HANDLEBARS](#).

NOTE

It is not necessary to remove the trip odometer reset switch boot from the back of the speedometer housing in order to remove the speedometer.

4. Remove two screws (5) holding speedometer (1) to speedometer housing/handlebar clamp (3).
5. Using small diameter rod or Allen wrench, gently press through bottom condensation/vent hole in speedometer housing/handlebar clamp to push speedometer from housing.
6. Holding speedometer to prevent damage, depress tabs to separate connector [39B] (7) from speedometer. Remove speedometer.
7. Inspect gasket, speedometer connector [39] and wiring, trip odometer reset switch and wiring, and trip reset boot. Repair or replace as required.

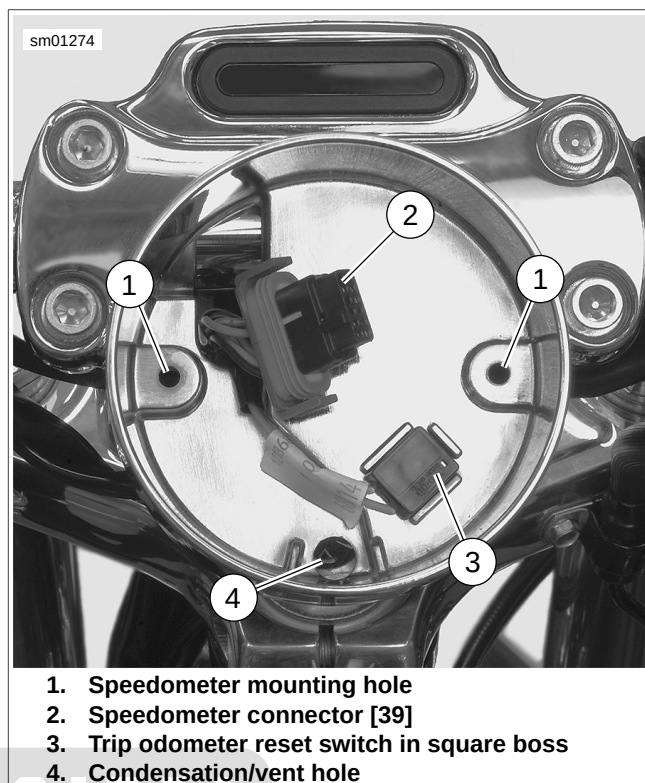


Figure 6-21. Speedometer Housing/Handlebar Clamp (XL883C/XL 1200C)

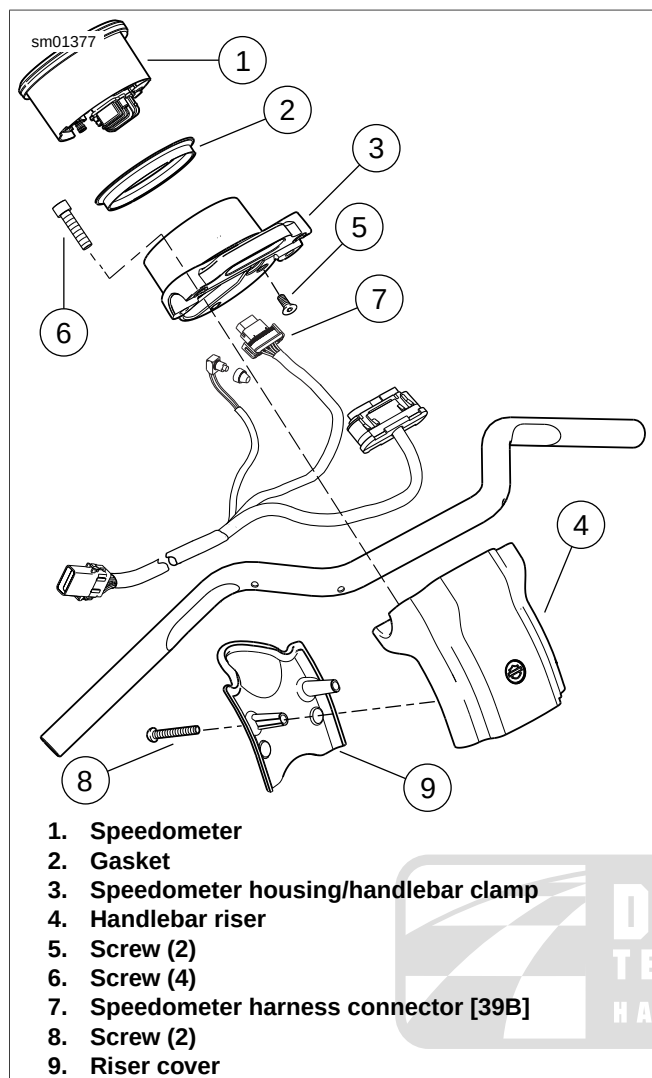


Figure 6-22. Speedometer Components (XL 883C/XL 1200C)

INSTALLATION

PART NUMBER	TOOL NAME
HD-45929	CRIMPING TOOL

1. If replacing the trip odometer switch:
 - a. Push the trip reset socket terminals out the front of the speedometer socket connector half [39B]. See [A.16 PACKARD MICRO-64 CONNECTORS](#).
 - b. Cut off the socket terminals and pull the faulty switch out of the connector.
 - c. Push the wires of a replacement switch through the speedometer connector (sockets 8, 11) and crimp new socket terminals using CRIMPING TOOL (Part No. HD-45929), on replacement switch wiring.
 - d. Draw the terminal back into the connector until the terminal seats.
2. See [Figure 6-22](#). If removed, install gasket (2) in speedometer housing/handlebar clamp (3).

NOTE

Make certain that speedometer harness and trip odometer switch harness are positioned underneath the handlebar, and indicator lamp module harness feeds over the top of the handlebar.

3. If removed, push trip odometer reset switch through speedometer housing/handlebar clamp and into tab square in base of speedometer housing/handlebar clamp and thread on the trip reset boot.
4. Hold speedometer (1) in place and mate speedometer connector [39] halves.

NOTE

If necessary, lubricate gasket with alcohol or glass cleaner.

5. Press speedometer into speedometer housing/handlebar clamp and secure with screws (5).
6. Install riser cover (9) and secure with two screws (8). Make certain that handlebar control harnesses are not pinched between handlebar riser and riser cover. Tighten screws to 8-12 **in-lbs** (0.9-1.4 Nm).
7. Plug in main fuse. See [6.38 MAIN FUSE](#).

SPEEDOMETER AND TACHOMETER: XR MODELS

6.9

SPEEDOMETER REMOVAL

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

NOTE

The speedometer and tachometer have backlight bulbs that cannot be replaced. If the bulb fails, replace the entire unit.

1. Unplug main fuse. See [6.38 MAIN FUSE](#).
2. See [Figure 6-23](#). Remove reset switch boot (11).
3. Remove screws (6) and back cover (5).
4. Disconnect speedometer connector (8).
5. Push out the speedometer (2) with seal (3).

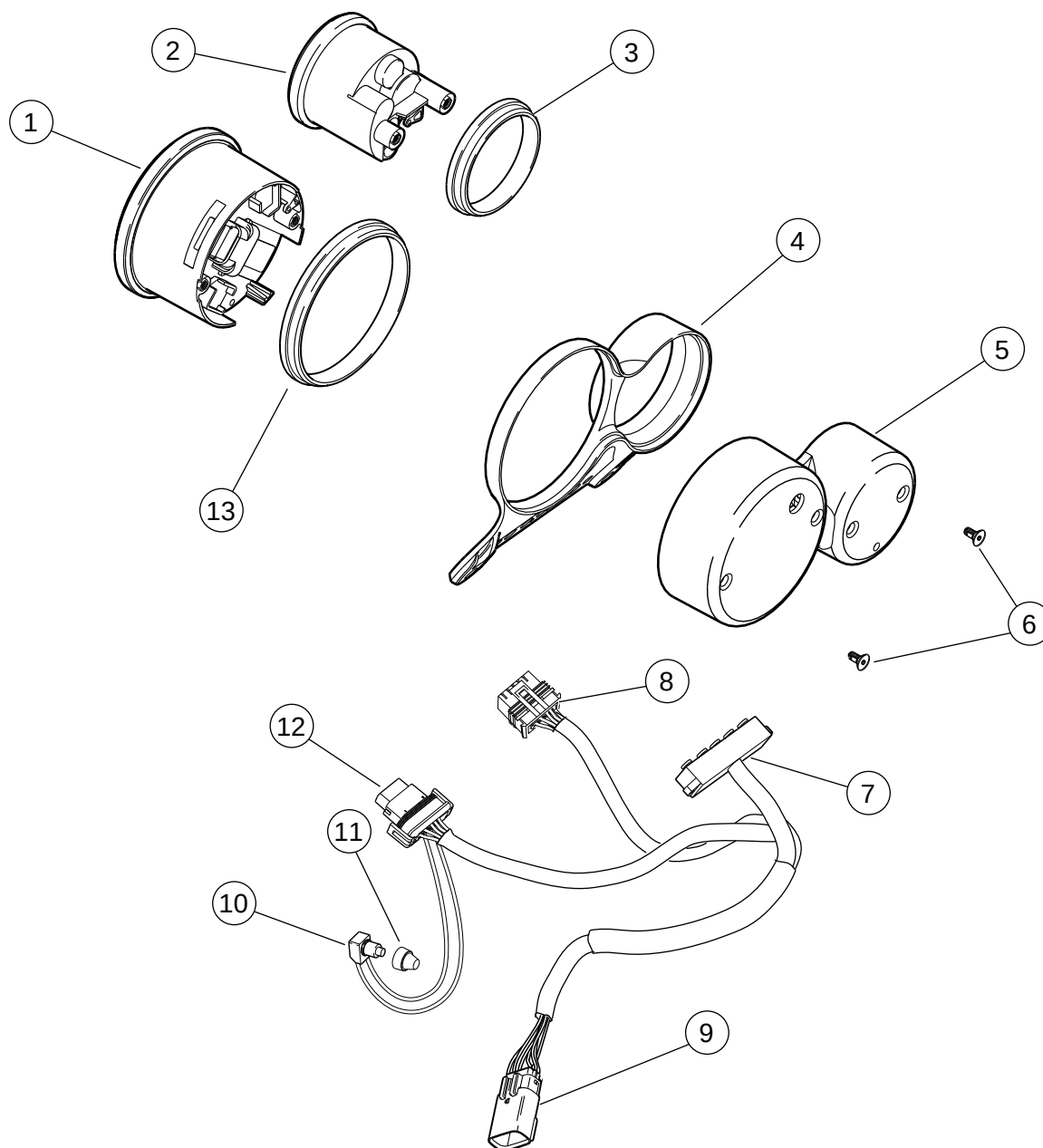
6. Inspect seal (3), speedometer connector (8), and wiring. Repair or replace as required.

SPEEDOMETER INSTALLATION

1. See [Figure 6-23](#). Install seal (3) on speedometer (2).
2. Orient face upright and press speedometer (2) into instrument housing/bracket (4).
3. Install speedometer connector (8).
4. Attach trip odometer reset switch (10) into squared boss on back cover (5) and secure with reset switch boot (11).
5. Place back cover over speedometer and tachometer while positioning harness to avoid damage. Rotate speedometer and tachometer as needed to align mounting holes and install screws (6).
6. Plug in main fuse. See [6.38 MAIN FUSE](#).



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- | | |
|-------------------------------|---------------------------------|
| 1. Tachometer | 8. Speedometer connector |
| 2. Speedometer | 9. Instrument harness connector |
| 3. Speedometer seal | 10. Trip odometer reset switch |
| 4. Instrument housing/bracket | 11. Reset switch boot |
| 5. Back cover | 12. Tachometer connector |
| 6. Screw (4) | 13. Tachometer seal |
| 7. Indicator lamp module | |

Figure 6-23. Speedometer and Tachometer: XR 1200

TRIP ODOMETER RESET SWITCH REPLACEMENT

PART NUMBER	TOOL NAME
HD-45929	CRIMPING TOOL

NOTE

The speedometer and tachometer have backlight bulbs that cannot be replaced. If the bulb fails, replace the entire unit.

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Unplug main fuse. See [6.38 MAIN FUSE](#).
2. See [Figure 6-23](#). Remove reset switch boot (11) from back cover (5).
3. Remove screws (6) and back cover (5).
4. Remove tachometer connector (12).
5. Follow instructions to push the trip reset socket terminals out the front of the tachometer connector. See [A.16 PACKARD MICRO-64 CONNECTORS](#).
6. Cut off the socket terminals and pull the faulty switch out of the connector.
7. Push the wires of a replacement switch through the tachometer connector (sockets 8, 11) and crimp **new** socket terminals using CRIMPING TOOL (Part No. HD-45929), on replacement switch wiring.
8. Draw the terminals back into the connector until the terminal seats.
9. Install tachometer connector (12).
10. Position reset switch in squared boss on back cover (5) and secure with **new** reset switch boot (11).
11. Place back cover over speedometer and tachometer while positioning harness to avoid damage. Rotate speedometer and tachometer as needed to align mounting holes and install screws (6).

12. Plug in main fuse. See [6.38 MAIN FUSE](#).

TACHOMETER REMOVAL

NOTE

The speedometer and tachometer have backlight bulbs that cannot be replaced. If the bulb fails, replace the entire unit.

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Unplug main fuse. See [6.38 MAIN FUSE](#).
2. See [Figure 6-23](#). Remove reset switch boot (11) from back cover (5).
3. Remove screws (6) and back cover (5).
4. Open latches on each side of tachometer connector (12) and separate connector halves.
5. Push out the tachometer with seal (13).
6. Inspect seal, tachometer connector, trip odometer reset switch, reset switch boot, and wiring. Repair or replace as required.

TACHOMETER INSTALLATION

1. If replacing the trip odometer reset switch, see [6.9 SPEEDOMETER AND TACHOMETER: XR MODELS, Trip Odometer Reset Switch Replacement](#).
2. See [Figure 6-23](#). Install seal (13) on tachometer (1).
3. Orient face upright and press tachometer (1) into instrument housing/bracket (4).
4. Attach tachometer connector (12) to tachometer.
5. Attach trip odometer reset switch (10) into squared boss on back cover (5) and secure with reset switch boot (11).
6. Place back cover over speedometer and tachometer while positioning harness to avoid damage. Rotate speedometer and tachometer as needed to align mounting holes and install screws (6).
7. Plug in main fuse. See [6.38 MAIN FUSE](#).

TURN SIGNAL AND SECURITY MODULE (TSM/TSSM/HFSM)

6.10

GENERAL

See [Figure 6-24](#). The Turn Signal Module (TSM) has two major functions:

- Control turn signals.
- Serve as bank angle sensor.

The optional factory-installed security system provides the same functionality as the TSM, but also includes security and immobilization functions.

Two security system modules are available: The Turn Signal Security Module (TSSM) for Japan/Korea markets, and the Hands Free Security Module (HFSM) for all other markets.

See the ELECTRICAL DIAGNOSTIC MANUAL for complete details of the TSM/TSSM/HFSM features and functions.

NOTE

The TSM/TSSM/HFSM cannot be repaired. Replace the unit if it fails.



Figure 6-24. TSM/TSSM/HFSM (TSM Shown)

TESTING

For diagnostic information, see the ELECTRICAL DIAGNOSTIC MANUAL.

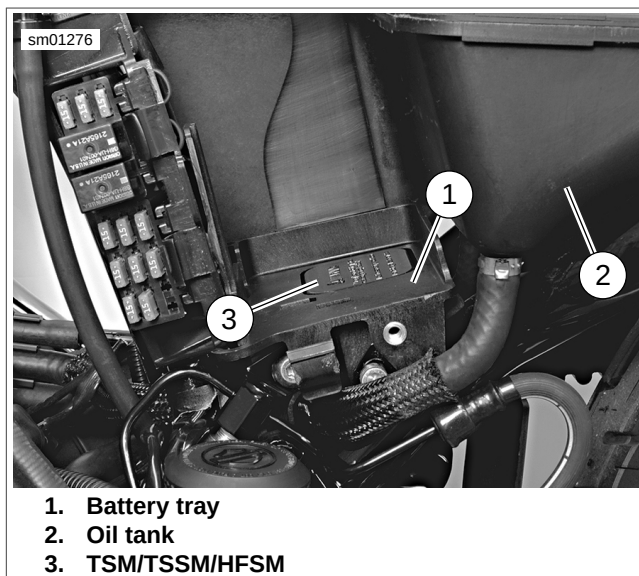


Figure 6-25. TSM/TSSM/HFSM Location: All Models (XL Shown)

REMOVAL

NOTE

See [Figure 6-25](#). The TSM/TSSM/HFSM (3) is located in a cavity in the bottom of the battery tray (1).

1. Remove left side cover. See [2.20 LEFT SIDE COVER](#).
2. Remove battery. See [1.17 BATTERY MAINTENANCE](#).
3. See [Figure 6-26](#). Reach under the battery tray (1) and push upward on TSM/TSSM/HFSM (3) to lift it out of its cavity (2).
4. Grasp top of TSM/TSSM/HFSM and unplug wiring harness connectors: 4-pin connector [208] (5) (HFSM only) has one latch. Unplug this connector first. Then unplug 12-pin connector [30B] (4).
5. Remove TSM/TSSM/HFSM from vehicle.

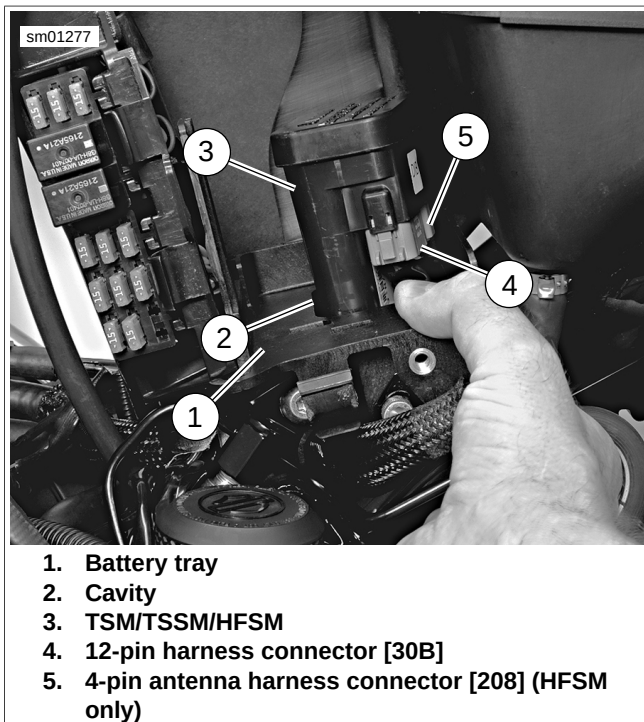


Figure 6-26. TSM/TSSM Connectors: All Models (XL Shown)

INSTALLATION

1. See [Figure 6-26](#). Pull wiring harness connector [208] (5) (HFSM only) and connector [30B] (4) up through cavity (2) in bottom of battery tray (1).
2. Position TSM/TSSM/HFSM (3) over cavity with connector(s) facing oil tank.
3. Plug 4-pin [208] (5) (HFSM only) and 12-pin [30B] (4) wiring harness connectors into TSM/TSSM/HFSM.
4. Lower TSM/TSSM/HFSM into cavity. See [Figure 6-25](#). Make sure top of TSM/TSSM/HFSM is flush with bottom of battery tray.
5. Install battery. Do not install left side cover at this time. See [1.17 BATTERY MAINTENANCE](#).
6. Perform TSM/TSSM/HFSM password learn and setup procedure. See the ELECTRICAL DIAGNOSTIC MANUAL for procedure.
7. Install left side cover. See [2.20 LEFT SIDE COVER](#).



BATTERY CABLES

6.11

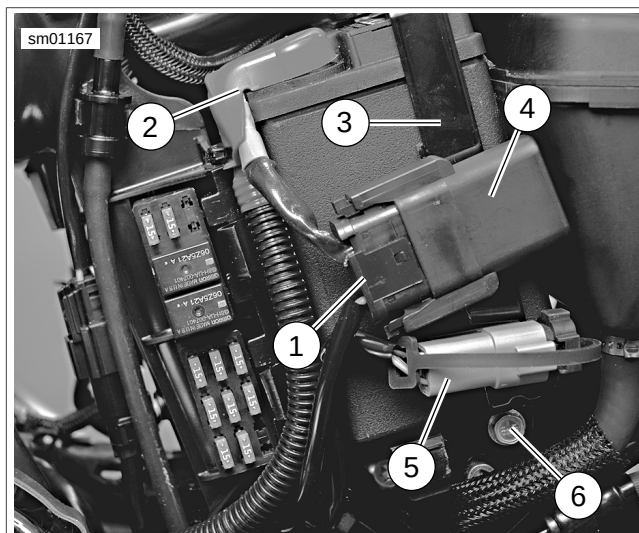
REMOVAL

1. See [Figure 6-27](#). Remove main fuse cover (4) from battery strap (3) by grasping cover and sliding it toward the rear of the motorcycle.
2. Remove data link connector [91A] (5) from battery strap by grasping cover and sliding it toward the rear of the motorcycle.
3. Remove battery strap screw (6). Unhook battery strap (3) from battery tray mount on top of battery and remove strap.

WARNING

Prevent accidental vehicle start-up, which could cause death or serious injury. First disconnect negative (-) battery cable at engine and then positive (+) cable from battery. (00280b)

4. Disconnect negative (-) battery cable from crankcase. Disconnect positive (+) battery cables from battery. See [1.17 BATTERY MAINTENANCE](#).
 - a. Negative cable - See [Figure 6-28](#). Remove nut (2) that secures negative (-) battery cable (1) to ground stud on crankcase boss behind starter motor assembly (3). Remove cable connector from stud. Pull on end of negative (-) cable gently to free it from cable clip (4).
 - b. Positive (+) cable - See [Figure 6-27](#). Lift up protective rubber boot covering battery positive (+) terminal. Remove screw from battery positive (+) terminal and remove positive (+) battery cable from post. Remove positive (+) battery cable from holders on battery tray.
 - c. Remove main fuse wiring harness from battery positive (+) terminal post. Inspect main fuse wiring harness and holder. See [6.5 MAIN FUSE HOLDER, Replacement](#).
5. Note routing of negative (-) battery cable around frame downtube and remove battery with negative (-) battery cable attached.



1. Main fuse and holder [5]
2. Positive (+) battery terminal (under protective rubber boot)
3. Battery strap
4. Main fuse cover
5. Data link connector [91A]
6. Screw and flat washer

Figure 6-27. Main Fuse and Battery Location: All Models (XL Shown)

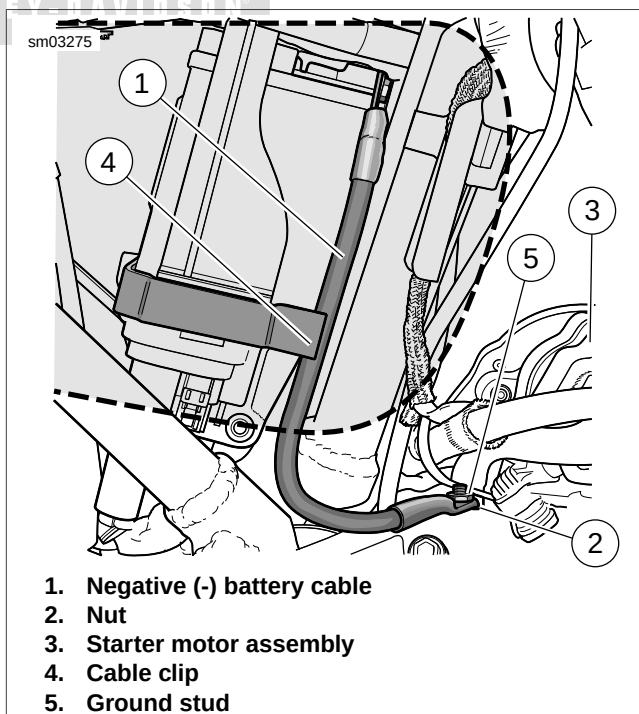


Figure 6-28. Negative (-) Battery Connection

6. Inspect positive (+) and negative (-) cables for cuts, fraying or other damage. See [1.17 BATTERY MAINTENANCE](#).

7. As required, remove negative (-) battery cable from battery.
8. See [Figure 6-29](#). As required, pull back rubber cap (3) and using a 12 mm wrench, remove nut with captive lock washer (5) and positive (+) battery cable (2) from starter post (4).

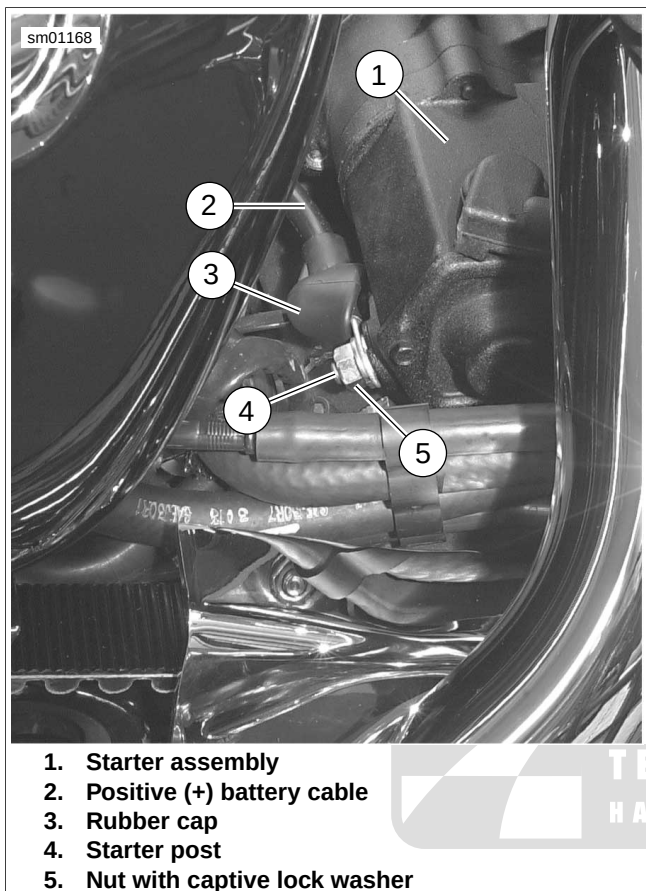


Figure 6-29. Positive (+) Cable Starter Post Connection:
All Models (XL Shown, Right Side View - Rubber Cap Pulled Back)

INSTALLATION

1. Route fastener through negative (-) battery cable ring and into negative (-) battery terminal of a fully charged battery. Position negative (-) battery cable so that it hangs straight down from negative (-) battery terminal. Tighten to 60-70 **in-lbs** (6.8-7.9 Nm).
2. Apply a light coat of petroleum jelly or corrosion retardant material to the negative (-) battery terminal.
3. See [Figure 6-28](#). Slide battery in battery tray. Route negative (-) battery cable (1) around frame downtube.

⚠ WARNING

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

4. See [Figure 6-27](#). With negative (-) battery cable disconnected from ground on crankcase, thread fastener through

main fuse cable first, then through positive (+) battery cable, and into positive (+) battery terminal (2). Tighten to 60-70 **in-lbs** (6.8-7.9 Nm).

5. Apply a light coat of petroleum jelly or corrosion retardant material to the positive (+) battery terminal. Place protective rubber boot over terminal.
6. Hook top of battery strap (3) to battery tray mount on top of battery. Install screw (6) and tighten to 36-60 **in-lbs** (4.1-6.8 Nm).
7. Snap positive (+) battery cable into holders on electrical bracket.
8. Hook main fuse cover (4) to pin on battery strap and slide forward until it snaps into place.
9. Hook data link connector [91A] (5) to pin on battery strap and slide forward until it snaps into place.
10. See [Figure 6-29](#). Install positive (+) battery cable (2) and nut with captive lock washer (5) on starter post (4). Using a 12 mm wrench, tighten lock nut to 60-85 **in-lbs** (6.8-9.6 Nm).
11. Push rubber cap (3) over starter post.
12. See [Figure 6-28](#). Press negative battery cable (1) into cable clip (4).
13. Place negative battery cable connector onto stud on crankcase boss behind starter motor assembly (3). Thread nut (2) onto crankcase ground stud behind starter motor.
14. See [Figure 6-30](#). Press negative battery cable connector against cable stop on crankcase and tighten nut to 55-75 **in-lbs** (6.2-8.5 Nm).

⚠ WARNING

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

15. Install seat.

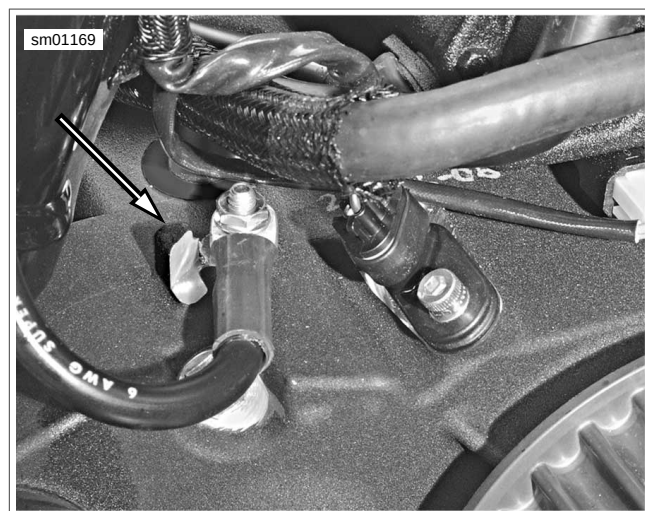


Figure 6-30. Negative Battery Cable Stop on Crankcase

BATTERY TRAY

6.12

GENERAL

See [Figure 6-31](#). The battery tray is located behind the vehicle's left side cover. The battery tray is a light-weight, sturdy plastic assembly which supports the battery, TSM/TSSM/HFSM, and rear brake lamp switch assembly (XL models only).

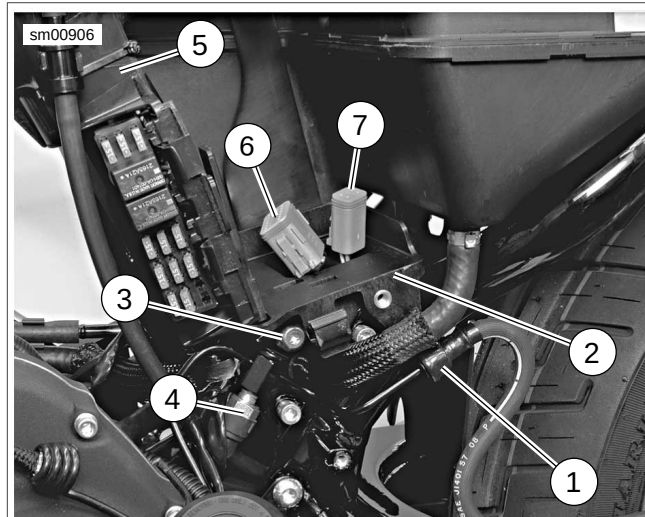
REMOVAL

1. Remove left side cover. See [2.20 LEFT SIDE COVER](#).

⚠ WARNING

Prevent accidental vehicle start-up, which could cause death or serious injury. First disconnect negative (-) battery cable at engine and then positive (+) cable from battery. (00280b)

2. Disconnect battery cables, negative cable first, and remove battery. See [1.17 BATTERY MAINTENANCE](#).
3. Reach under battery tray and push TSM/TSSM/HFSM up from cavity in bottom of tray. Unplug and remove TSM/TSSM/HFSM. See [6.10 TURN SIGNAL AND SECURITY MODULE \(TSM/TSSM/HFSM\)](#).
4. **XL models only:** see [Figure 6-31](#). Reposition rear brake lamp switch as follows:
 - a. Remove rear brake master cylinder reservoir cover by grasping cover and gently pull straight out from reservoir. Unbolt reservoir and secure out of the way with an elastic tiedown cord, mechanic's wire or cable strap. See [2.15 REAR BRAKE MASTER CYLINDER RESERVOIR](#).
 - b. Remove screw securing rear brake hose clamp (1) to battery tray (2).
 - c. Remove TORX screw (3) securing rear brake lamp switch assembly (4) to battery tray. Gently pull brake lamp switch assembly back out of the way. Do not bend or stress metal brake lines.



1. Rear brake hose clamp
2. Battery tray
3. TORX screw
4. Rear brake lamp switch assembly
5. H-bracket
6. TSM/TSSM/HFSM 12-pin connector [30B]
7. 4-pin connector [208B] (HFSM only)

Figure 6-31. Battery Tray Assembly

5. See [Figure 6-32](#). Remove three screws (4) securing battery tray to mounting tabs (5) on frame.
6. See [Figure 6-33](#). Slide H-bracket (1) up frame tube as far as possible and disengage battery tray upright support (3) from tabs (2) on H-bracket.
7. Lift up battery tray slightly so that mounting tabs will clear mounts on frame. See [Figure 6-32](#). As you lift up on tray, pull down gently on end of battery strap support (3) to clear frame and wiring harnesses above battery tray.
8. Slide battery tray out and remove from left side of vehicle.

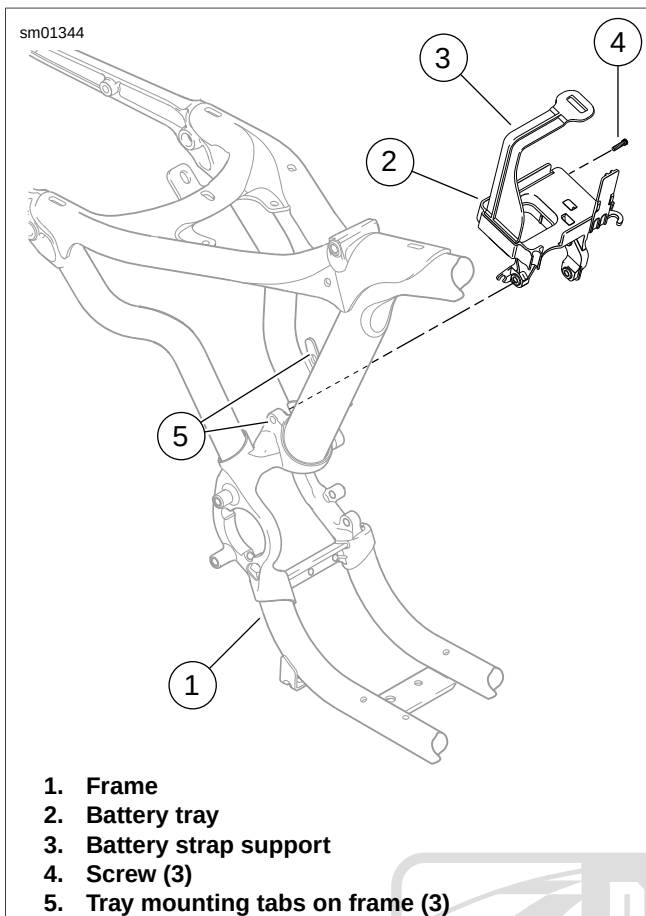


Figure 6-32. Battery Tray Mounting Screws

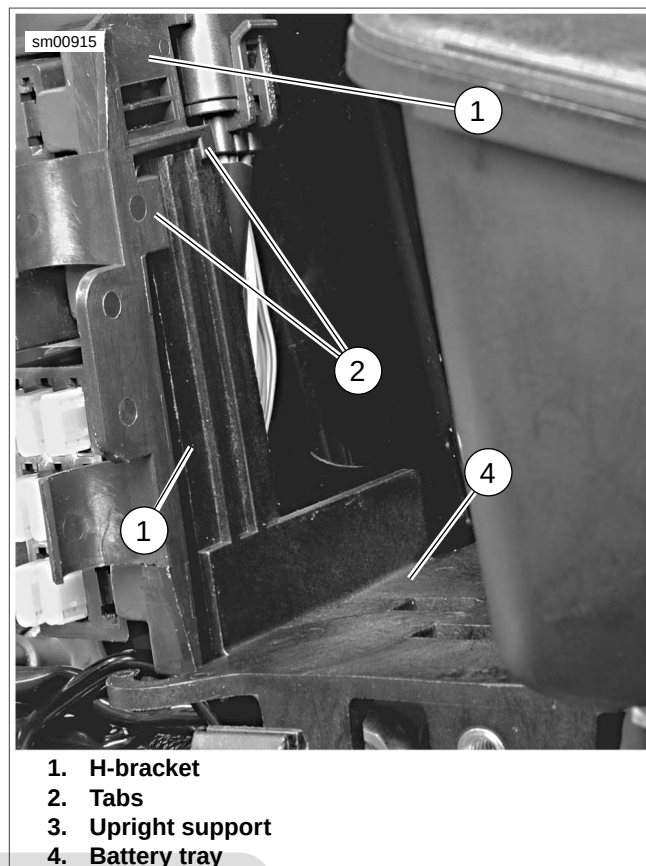


Figure 6-33. Battery Tray H-Bracket Support

INSTALLATION

1. See [Figure 6-31](#). Make sure connector [30B] (6), connector [208B] (7) (HFSM only) and rear brake lamp switch assembly (4) are out of the way.
2. Slide battery tray (2) into place behind H-bracket (5). Make sure battery tray mounting tabs are positioned behind (to the right of) frame mounts.
3. See [Figure 6-33](#). Push H-bracket (1) up as far as possible and engage battery tray upright support (3) into tabs (2) on H-bracket.
4. See [Figure 6-32](#). Install three screws (4) to secure battery tray to frame. Do not tighten screws until all three have been started. Then tighten screws to 96-156 **in-lbs** (10.9-17.6 Nm).
5. **XL models only:** see [Figure 6-31](#). Position rear brake lamp switch as follows:
 - a. Install rear brake lamp switch (4). Secure with TORX screw (3). Tighten to 72-120 **in-lbs** (8.1-13.6 Nm).
 - b. Secure brake hose clamp (1) to battery tray with screw. Tighten to 30-40 **in-lbs** (3.4-4.5 Nm).
 - c. Install rear brake master cylinder reservoir. Secure using screw with captive washer. Tighten to 20-25 **in-lbs** (2.3-2.8 Nm). Install reservoir cover. See [2.15 REAR BRAKE MASTER CYLINDER RESERVOIR](#).

6. Plug connector [30B] into TSM/TSSM/HFSM. If equipped, plug connector [208B] into HFSM. Install TSM/TSSM/HFSM into cavity in bottom of battery tray. See [6.10 TURN SIGNAL AND SECURITY MODULE \(TSM/TSSM/HFSM\)](#).

⚠ WARNING

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

7. Install battery. Connect battery cables, positive (+) cable first. See [1.17 BATTERY MAINTENANCE](#).
8. Install left side cover. See [2.20 LEFT SIDE COVER](#).



STARTER

6.13

GENERAL

The starter is made up of a field coil assembly, solenoid assembly and drive assembly. The repair instructions contained in this section are divided into three major service areas accordingly.

NOTE

For troubleshooting and diagnostic information, see the *ELECTRICAL DIAGNOSTIC MANUAL* for this motorcycle.

Wiring Diagrams

The starting circuit wiring diagram contains information about wiring configuration. For additional information, see the *ELECTRICAL DIAGNOSTIC MANUAL* for this motorcycle.

Paint Touch-Up

On painted starters, paint is applied to the starter after assembly. Many of the procedures in this section involve disassembly of several painted joints. When servicing the starter, paint damage or flaking may occur in the area of these joints. Any damaged paint should be touched up after assembly prior to installation using the appropriate touch up paint. Follow the directions provided with the paint. Paint flaking does not require the starter to be replaced.

REMOVAL

⚠ WARNING

Prevent accidental vehicle start-up, which could cause death or serious injury. First disconnect negative (-) battery cable at engine and then positive (+) cable from battery. (00280b)

1. Remove negative (-) battery cable from stud on engine crankcase boss behind starter motor assembly. See [1.17 BATTERY MAINTENANCE](#).
2. Open left side cover. See [2.20 LEFT SIDE COVER](#).
3. Remove positive (+) battery cable from battery positive (+) terminal. See [1.17 BATTERY MAINTENANCE](#).
4. Close left side cover.
5. Drain transmission lubricant and remove primary cover. See [5.3 PRIMARY CHAIN ADJUSTER](#).
6. Remove rear muffler and exhaust pipe. See [4.15 EXHAUST SYSTEM: XL MODELS](#) or [4.16 EXHAUST SYSTEM: XR MODELS](#).
7. Remove positive (+) battery lead and solenoid wire from starter.

NOTE

A ball hex driver may be required to gain access to the starter mounting bolts.

8. See [Figure 6-34](#). Remove the two starter mounting bolts and washers.
9. Remove starter and gasket from right side of motorcycle.



Figure 6-34. Starter Mounting Bolts

FIELD COIL ASSEMBLY

Disassembly

1. Remove allen head screw to release chrome end cover, if equipped.
2. Remove two Keps nuts to release end cover bracket from thru bolts, if equipped.
3. Pull up rubber boot and remove hex nut with captive lockwasher to release field wire ring terminal from post on solenoid housing.
4. Using a 5/16 inch socket, loosen two thru bolts to release field coil from solenoid housing.
5. Pull field coil with end cap from solenoid housing.
6. Remove armature from field coil. Separating end cap and field coil flanges will facilitate removal.
7. Placing field coil on wooden block to prevent damage, use impact driver to remove two Phillips screws with captive washers from end cap. Discard screws.
8. Remove end cap from field coil.
9. Locate the two brushes attached to the field coil winding. Pushing on inboard side of one brush, grasp free end of brush spring on outboard side with the hooked end of a suitable pick. Raise end of brush spring only as far as necessary to free brush from brush holder. Repeat step to release second brush and then remove brush holder from field coil.

Inspection

1. For testing procedures, see the *ELECTRICAL DIAGNOSTIC MANUAL*.
2. Inspect two o-rings in field coil bore for cuts, tears or signs of deterioration.
3. Place armature in lathe or truing stand and check runout of commutator. Commutators with more than 0.015 in. (0.38 mm) of runout should be replaced or machined on

a lathe. Commutators should be replaced when diameter is less than 1.141 in. (29.98 mm).

4. 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.

NOTES

- See [Figure 6-35](#). If an undercutting machine is not available, undercutting can be done satisfactorily using a thin

hacksaw blade. After undercutting, lightly sand the armature with crocus cloth to remove any burrs.

- Do not use sandpaper or emery cloth on commutator. The abrasive grit may remain on commutator segments and could cause excessive brush wear.
5. Inspect armature roller bearings. Bearings must rotate freely without drag or sticking. Replace the bearings if pitted or grooved.
 6. Replace brush springs if bent or distorted.

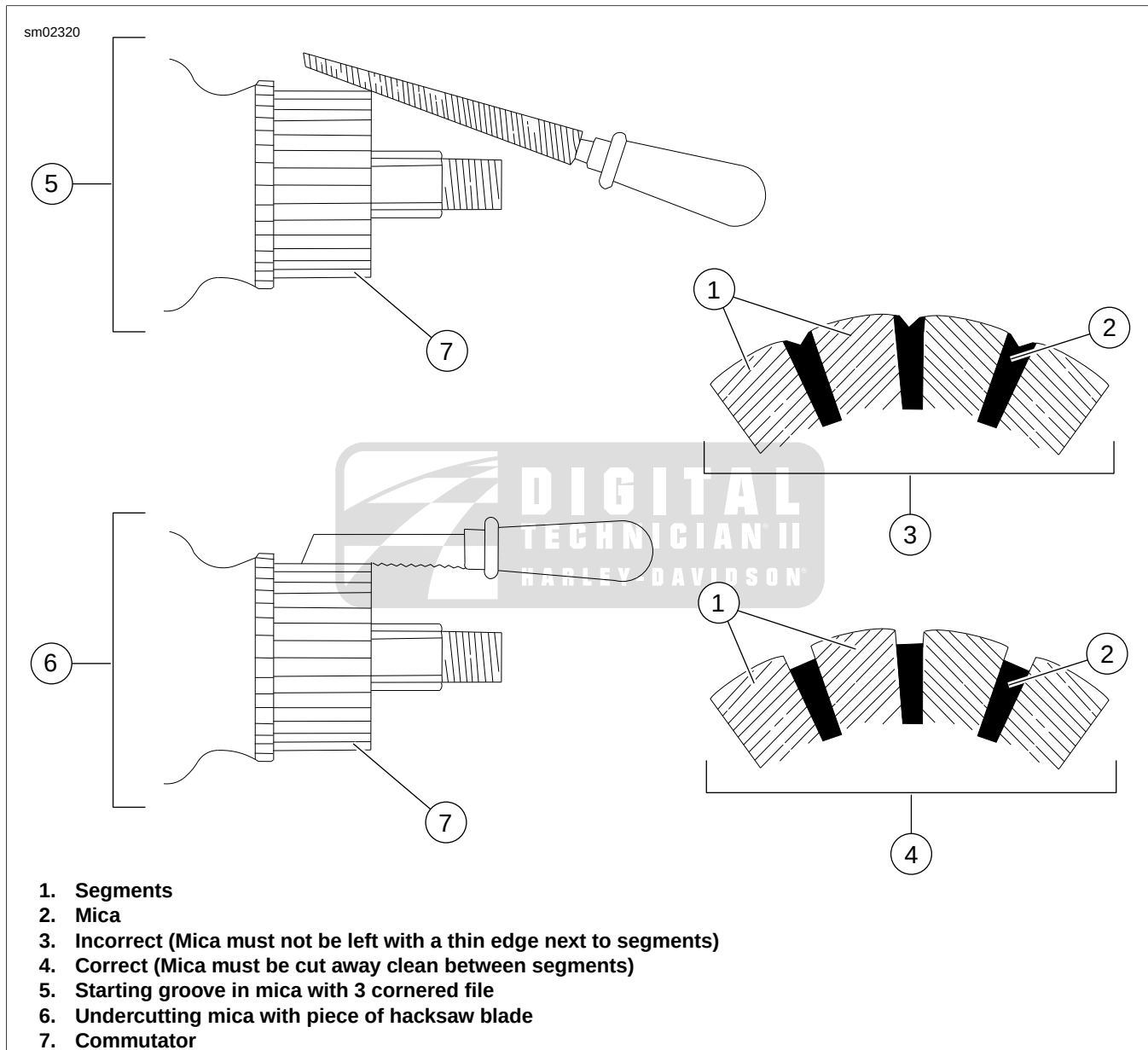


Figure 6-35. Undercutting Mica Separators

Assembly

1. Attach brush holder to field coil. Locate the two brushes attached to the field coil winding. Catch free end of brush spring with the hooked end of a suitable pick. Raise end

of brush spring only as far as necessary to install brush into brush holder. Repeat step to install second brush.

2. Retract all four brushes for armature installation. For good results, obtain four paper clips. Bend free end of each paper clip outward approximately 90°. Then, pushing on

inboard side of brush, insert straight end of paper clip between outboard side of brush and inboard side of brush spring. Properly installed, the paper clip contacts the framework of the brush holder to keep spring pressure off the brush. Repeat step on remaining three brushes as shown in [Figure 6-36](#).

3. Install armature in solenoid housing so that larger bearing on splined end seats in counterbore. Lubricate armature bearings with high temperature grease, such as LUBRI-PLATE 110, before installation.
4. Mate field coil and solenoid housings. For proper assembly, a nub on the field coil housing flange must engage the slot on solenoid housing flange closest to the short (field wire) post on the solenoid housing.
5. Carefully place brush holder over armature. If additional clearance is needed, use a small flat blade screwdriver to gently push back the brushes slightly.
6. When the brush holder is centered over the armature, remove four paper clips to release brush springs. Verify that ends of brush springs make proper contact with brush sides.
7. Install end cap aligning holes in cap with those in brush holder. Start two **new** Phillips screws with captive washers. Alternately tighten Phillips screws until snug.
8. Install thru bolts to fasten field coil to solenoid housing. Using a 5/16 inch socket, alternately tighten thru bolts to 39-65 **in-lbs** (4.4-7.3 Nm).
9. Attach field wire ring terminal to short post on solenoid housing and install hex nut with captive lockwasher. Tighten hex nut to 70-90 **in-lbs** (7.9-10.2 Nm). Cover field wire ring terminal with rubber boot.
10. Install end cover bracket onto threaded end of thru bolts, if equipped. For proper orientation, be sure that the longest end of the bracket (before the bend) is on the field wire side. Install two Keps nuts and alternately tighten until snug.
11. Install allen head screw to fasten chrome end cover to end cover bracket, if equipped. Tighten screw to 90-110 **in-lbs** (10.2-12.4 Nm).

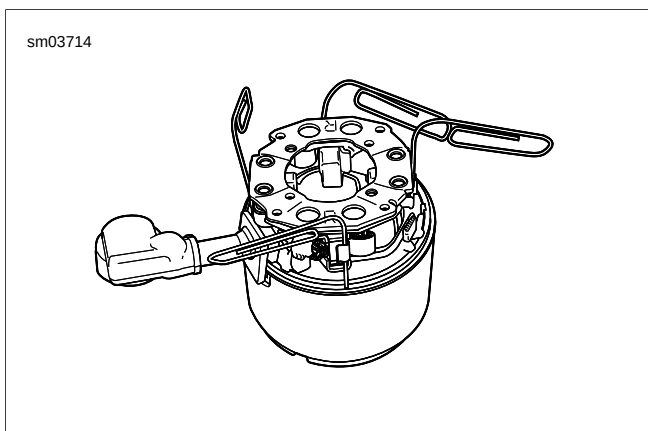


Figure 6-36. Install Paper Clips to Hold Brush Springs

DRIVE ASSEMBLY

Disassembly

1. Remove field coil. See [6.13 STARTER, Field Coil Assembly](#).
2. Pull field coil with end cap from solenoid housing. Hold end cap to field coil to avoid pulling armature out of brush holder. If armature is pulled from brush holder, further disassembly is required.
3. Using a 9 mm socket, remove two hex screws with Phillips recess to release drive housing from solenoid housing.
4. Use a rubber mallet to separate drive and solenoid housings, if necessary.
5. Remove idler gear from bearing cage in drive housing. Remove bearing cage with five steel cylinders from shaft in drive housing.
6. Push on end of drive shaft to remove starter clutch assembly from drive housing.
7. Compressing internal springs, remove snap ring from groove at end of drive shaft.
8. Remove cup, pinion gear, short spring and spring seat from splined end of drive shaft.
9. Push on splined end of drive shaft to remove from starter clutch bore.
10. Remove long spring from drive shaft. Remove steel ball from drive shaft bore.
11. Remove return spring from solenoid plunger shaft.

Inspection

1. Inspect two o-rings in drive housing bore for cuts, tears or signs of deterioration.
2. Replace springs if kinked, elongated or distorted.
3. Inspect pinion gear and drive shaft gear. Replace if pitted, scored, rounded, cracked, chipped or worn.
4. Inspect roller bearings. Bearings must rotate freely without drag or sticking. Replace the bearings if pitted or grooved.
5. Inspect the steel ball for wear, pitting, surface breakdown or other damage.
6. Replace snap ring if bent or distorted.

Assembly

1. Install long spring onto drive shaft. Install steel ball in drive shaft bore. Insert splined end of drive shaft into starter clutch bore (gear side).
2. Insert a deepwell socket into starter clutch bore and stand assembly upright on work bench with the socket side down.
3. Push down on starter clutch, so that installed socket pushes against the drive shaft gear to compress the spring. Holding assembly with spring compressed, install spring seat, short spring, pinion gear and cup on splined end of drive shaft. Be sure that the collar on the pinion gear and the concave side of the cup both face the splined end of the drive shaft.

4. While pushing down to simultaneously compress both the long and short springs installed, install snap ring in groove at splined end of drive shaft. Verify that snap ring is fully seated in the groove and that it resides in concave portion of cup when spring tension is released.
5. Remove deepwell socket from starter clutch bore.
6. Install bearing cage with five steel cylinders onto shaft in drive housing. Be sure that all five steel cylinders are installed in grooves of bearing cage. Install idler gear over bearing cage. Lubricate parts with high temperature grease, such as LUBRIPLATE 110, during assembly.
7. Install starter clutch assembly in drive housing seating the larger bearing in the counterbore. Lubricate bearings with LUBRIPLATE 110 before installation.
8. Apply a light film of Lubriplate 110 to solenoid plunger shaft. Install return spring on solenoid plunger shaft.
9. Mate the solenoid and drive housings and install two hex screws using a 9 mm socket. Alternately tighten hex screws until snug.
10. Lubricate armature bearing with LUBRIPLATE 110. Seating armature bearing in counterbore, mate field coil and solenoid housings. For proper assembly, a nub on the field coil housing flange must engage the slot on solenoid housing flange closest to the short (field wire) post on the solenoid housing.
11. Install field coil. See [6.13 STARTER, Field Coil Assembly](#).
2. See [Figure 6-34](#). Install two starter mounting bolts and washers. Tighten to 13-20 ft-lbs (17.6-27.1 Nm).
3. Install positive (+) battery cable and solenoid wire to solenoid stud. Tighten nut to 60-85 **in-lbs** (6.8-9.6 Nm). Place rubber boot securely over terminal.
4. Install primary cover. See [5.3 PRIMARY CHAIN ADJUSTER](#).
5. Fill primary chaincase / transmission with proper lubricant; see [1.14 TRANSMISSION LUBRICANT](#) for details.
6. Install rear exhaust pipe and muffler. See [4.15 EXHAUST SYSTEM: XL MODELS](#) or [4.16 EXHAUST SYSTEM: XR MODELS](#).

WARNING

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

7. Open left side cover. See [2.20 LEFT SIDE COVER](#).
8. Connect positive (+) battery cable to battery positive (+) terminal. See [1.17 BATTERY MAINTENANCE](#). Close left side cover.
9. Connect negative (-) battery cable to stud on engine crankcase behind starter motor assembly. See [1.17 BATTERY MAINTENANCE](#).

INSTALLATION

1. Install starter and starter gasket from right side of motor-cycle.



STARTER SOLENOID

6.14

SOLENOID ASSEMBLY

Disassembly

1. Remove field coil. See [6.13 STARTER, Field Coil Assembly](#).
2. Pull field coil with end cap from solenoid housing. Hold end cap to field coil to avoid pulling armature out of brush holder. If armature is pulled from brush holder, further disassembly is required.
3. Using a 9 mm socket, remove two hex screws with Phillips recess to release solenoid housing from drive housing.
4. Use a rubber mallet to separate solenoid and drive housings, if necessary.
5. Remove return spring from solenoid plunger shaft.

Assembly

1. Install return spring on solenoid plunger shaft.
2. Mate the solenoid and drive housings and install two hex screws using a 9 mm socket. Alternately tighten hex screws until snug.
3. Lubricate armature bearing with LUBRIPLATE 110. Seating armature bearing in counterbore, mate field coil and solenoid housings. For proper assembly, a nub on the field coil housing flange must engage the slot on solenoid housing flange closest to the short (field wire) post on the solenoid housing.
4. Install field coil. See [6.13 STARTER, Field Coil Assembly](#).

SOLENOID PLUNGER

Disassembly

1. Remove three hex screws to release solenoid cover.

2. Remove rubber gasket from solenoid cover flange.
3. Remove plunger and return spring.

Assembly

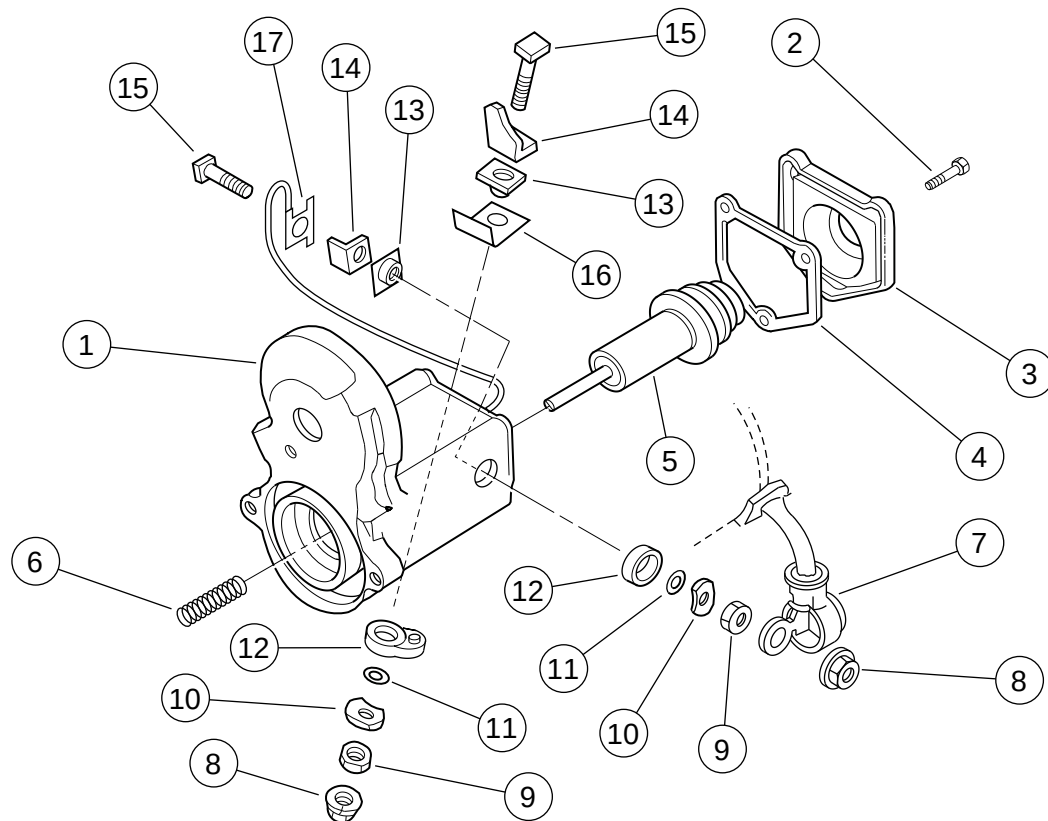
1. Apply a light film of LUBRIPLATE 110 to plunger shaft and install return spring. Install plunger in solenoid.
2. Install **new** rubber gasket on solenoid cover flange.
3. Install three hex screws to secure solenoid cover. Alternately tighten hex screws until snug.

SOLENOID CONTACTS

Disassembly

1. Remove three hex screws to release solenoid cover.
2. Remove rubber gasket from solenoid cover flange.
3. Remove plunger and return spring.
4. Obtain Solenoid Contact Repair Kit.
5. Disassemble short post (field coil):
 - a. See [Figure 6-37](#). Remove hex nut from post, if still installed. Remove jam nut, wave washer, round bushing and o-ring from post.
 - b. On inside of solenoid housing, remove post bolt, hold-in terminal, contact plate and square bushing.
6. Disassemble long post (battery):
 - a. Remove hex nut from post, if still installed. Remove jam nut, wave washer, round bushing and o-ring from post.
 - b. On inside of solenoid housing, remove post bolt, contact plate, square bushing and paper insulator washer.

sm03715



1. Solenoid
2. Hex screw
3. Solenoid cover
4. Rubber gasket
5. Plunger
6. Return spring
7. Rubber boot
8. Hex nut
9. Jam nut

10. Wave washer
11. O-ring
12. Round bushing
13. Square bushing
14. Contact plate
15. Post bolt
16. Paper insulator washer
17. Hold-in terminal

Figure 6-37. Solenoid Assembly

Assembly

1. Assemble short post (field coil):
 - a. From inside solenoid housing, insert sleeve on square bushing into hole in solenoid housing.
 - b. With the foot inboard against solenoid winding, align hole in contact plate with hole in square bushing.
 - c. Slide short post bolt through holes in hold-in terminal, contact plate, square bushing and solenoid housing.
 - d. At outside of solenoid housing, install round bushing, O-ring and wave washer onto end of post. Install jam nut, but do not tighten.
2. Assemble long post (battery):
 - a. On inside of solenoid housing, align hole in paper insulator washer with hole in solenoid housing. Insert sleeve on square bushing into holes.
 - b. With the foot inboard against solenoid winding, align hole in contact plate with hole in square bushing.
 - c. Slide long post bolt through holes in contact plate, square bushing, paper insulator washer and solenoid housing.
 - d. At outside of solenoid housing, install round bushing, o-ring and wave washer onto end of post. Verify that index pin on round bushing engages blind hole in solenoid housing. Install jam nut, but do not tighten.
3. Apply a light film of LUBRIPLATE 110 to plunger shaft and install return spring. Install plunger in solenoid.

4. While depressing plunger, alternately tighten jam nuts to 65-80 **in-lbs** (7.3-9.0 Nm). Verify that contact plates have not rotated out of alignment with plunger.
5. Install **new** rubber gasket on solenoid cover flange.
6. Install three hex screws to secure solenoid cover. Alternately tighten hex screws until snug.



IGNITION SYSTEM

6.15

TROUBLESHOOTING

See the ELECTRICAL DIAGNOSTIC MANUAL for complete troubleshooting information.



IGNITION AND LIGHT SWITCH

6.16

GENERAL

See [Figure 6-38](#). A combination ignition and light switch is located on the right side of the frame in front of the fuel tank.

The motorcycle key unlocks the ignition/light switch. The rider rotates the key to select one of three positions. Refer to [Table 6-10](#).

NOTE

The ignition/light switch cannot be repaired. Replace the unit if it fails.

To lock the switch, the key is removed in either OFF or ACC.

To leave the 4-way flashers and the tail lamp on and lock the switch, the rider can remove the key in ACC. In ACC, the instrument (icon) lamps, 4-way flashers (front and rear directional), horn and brake lamp are on or can be activated. On HDI motorcycles the position lamp and taillight are on.

⚠ WARNING

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

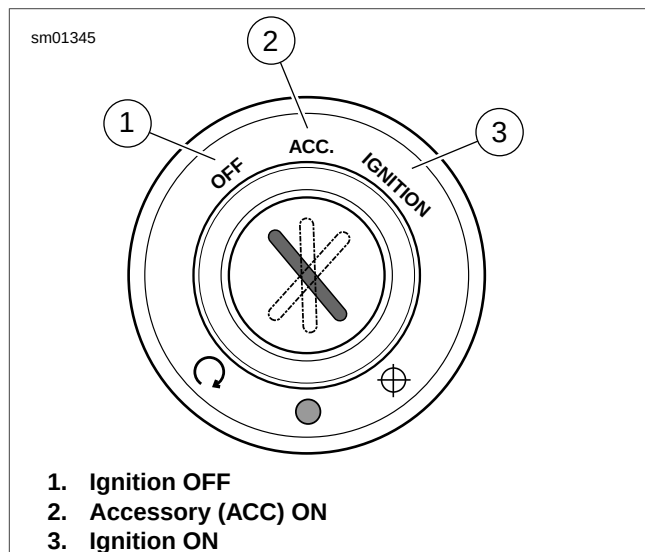


Figure 6-38. Ignition/Light Switch

Table 6-10. Ignition/Headlamp Switch Positions: Sportster Models

LOCATION AND OPERATION	SWITCH POSITION	FUNCTION
Switch is on right side of steering neck. Push in and turn key to operate.	OFF	Ignition and lamps are off. Key may be removed.
	ACC*	Instrument lamps are on. Brake lamp and horn can be activated. Key may be removed except for international models.
	IGNITION*	Ignition and lamps are on.
*International models have an additional function - position lamp and tail lamp are also on.		

REMOVAL

⚠ WARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

1. Purge the fuel supply hose of high pressure gasoline. Disconnect fuel supply hose from fuel pump module. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

2. Unplug main fuse. See [6.38 MAIN FUSE](#).

3. See [Figure 6-39](#). Remove ignition switch face nut (5).
4. Remove seat.
5. Remove fuel tank. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).
6. Remove mounting screw (7). Remove switch cover (3). Remove switch (2) from switch cover (3).
7. Remove harness covering and cut switch wires 3.0 in. (76.2 mm) from switch.

INSTALLATION

PART NUMBER	TOOL NAME
HD-39969	ULTRA TORCH UT-100

1. Slide replacement conduit on harness wires.

⚠ WARNING

Be sure to follow manufacturer's instructions when using the UltraTorch UT-100 or any other radiant heating device. Failure to follow manufacturer's instructions can cause a fire, which could result in death or serious injury. (00335a)

2. Observing color codes, install butt connectors to harness wires. Complete butt splice to **new** ignition switch. Seal butt splice connectors using ULTRA TORCH UT-100 (Part No. HD-39969) or other radiant heating device. See [A.17 SEALED SPLICE CONNECTORS](#) for more detailed information.
3. Slide conduit over butt splice connectors.
4. See [Figure 6-39](#). 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 35-45 **in-lbs** (4.0-5.1 Nm).
6. Tighten face nut (5) to secure switch (2) within cover (3).
7. Using two **new** cable straps (6), secure main harness to frame backbone.
8. Install fuel tank. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).

⚠ WARNING

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

9. Install seat.
10. Plug in main fuse.

⚠ WARNING

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

11. Check ignition/light switch for proper operation.

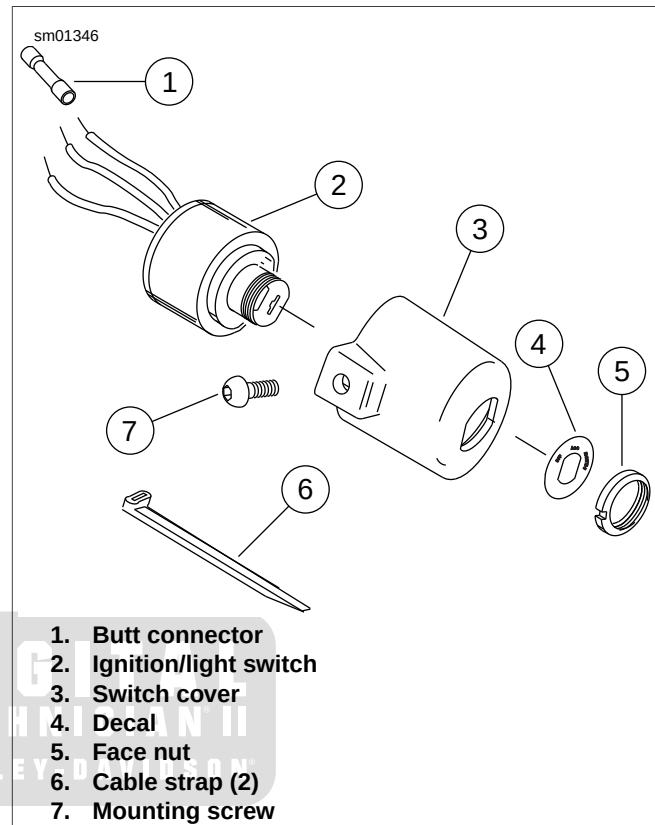


Figure 6-39. Ignition/Light Switch Assembly

ELECTRONIC CONTROL MODULE (ECM)

6.17

GENERAL

See [Figure 6-40](#). The Electronic Control Module (ECM) (1) is mounted in a bracket on the rear fender under the seat. The ECM receives data from sensors such as the crank position (CKP) sensor and the temperature manifold absolute pressure (TMAP) sensor. The ECM uses this data to time the firing of the spark from the ignition coil as well as providing other engine management functions.

NOTE

The ECM cannot be repaired. Replace the unit if it fails.

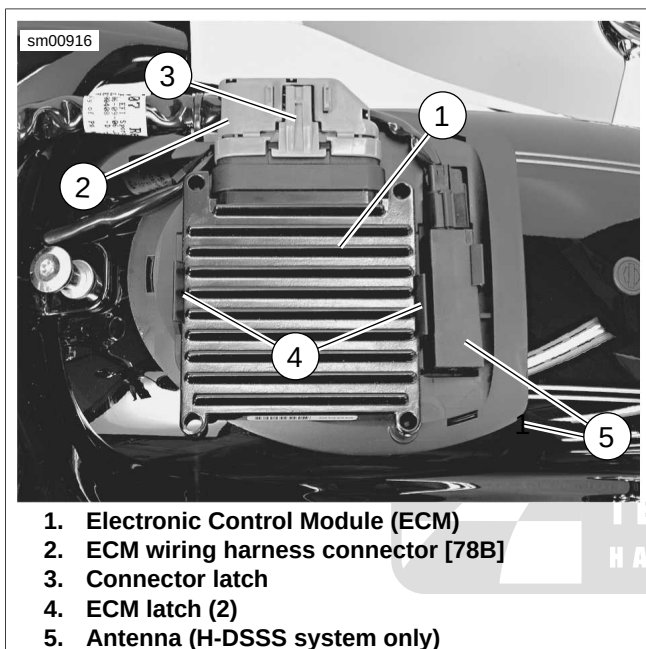


Figure 6-40. Electronic Control Module (ECM): XL Models



Figure 6-41. Electronic Control Module (ECM): XR Models

REMOVAL

XL Models

1. Remove seat.

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

2. Unplug main fuse. See [6.38 MAIN FUSE](#).
3. See [Figure 6-40](#). Depress connector latch (3) and unplug ECM wiring harness connector [78B] (2) from ECM (1).
4. Gently bend back latches (4) and pull ECM straight up from mounting posts.

XR Models

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Unplug main fuse. See [6.38 MAIN FUSE](#).
2. Remove rear fender. See [2.36 REAR FENDER: XR MODELS](#).
3. See [Figure 6-41](#). Remove fasteners (1) and ECM (2).

INSTALLATION

XL Models

1. See [Figure 6-40](#). Install ECM (1) on mounting posts. Press down gently on ECM until latches (4) click, locking ECM in place.
2. Plug ECM wiring harness connector [78B] (2) into ECM. Gently press connector until latch (3) clicks in place.
3. Plug in main fuse.
4. Perform reprogramming and password learn procedure. See the electrical diagnostic manual for instructions.

⚠ WARNING

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

5. Install seat.

XR Models

1. See [Figure 6-41](#). Install ECM (2) and fasteners (1).
2. Tighten fasteners to 18-22 in-lbs (2.0-2.5 Nm).
3. Install rear fender. See [2.36 REAR FENDER: XR MODELS](#).

4. Plug in main fuse.
5. Perform reprogramming and password learn procedure.
See the electrical diagnostic manual for instructions.

⚠ WARNING

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

6. Install seat.



SPARK PLUG CABLES

6.18

GENERAL

Resistor-type high-tension spark plug cables have a carbon-impregnated fabric core (instead of solid wire) for radio noise suppression and improved reliability of electronic components. Use the exact replacement cable for best results.

REMOVAL

⚠ WARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

1. Purge the fuel supply hose of high-pressure gasoline. Disconnect fuel supply hose from fuel pump module. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

2. Unplug main fuse. See [6.38 MAIN FUSE](#).
3. Remove seat. See [2.38 SEAT: XL MODELS](#) or [2.39 SEAT: XR MODELS](#).
4. Remove fuel tank. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).
5. **XL models only:** See [Figure 6-42](#). Remove screw (1) securing left wire harness caddy (2) to right wire harness caddy. See [6.33 ELECTRICAL CADDIES](#). Carefully disengage left wire harness caddy and pull away from frame backbone.

NOTE

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.

6. See [Figure 6-43](#) or [Figure 6-44](#). Pull front spark plug boot and cable (2) from left side ignition coil (1) tower.

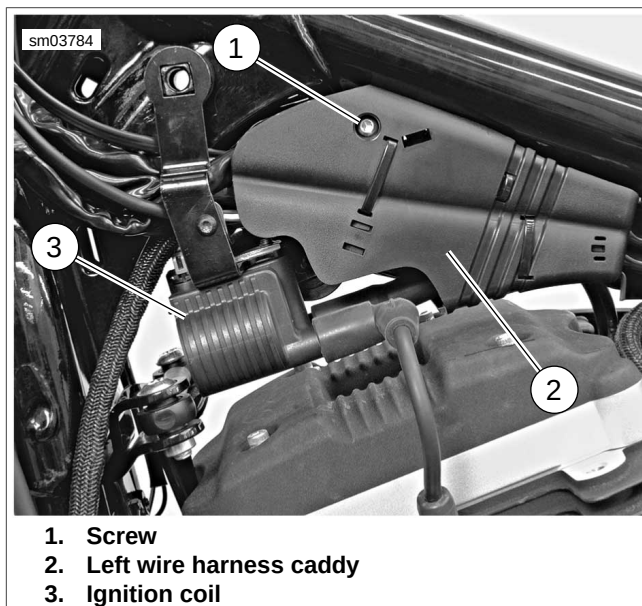


Figure 6-42. Ignition Coil and Left Wire Harness Caddy (XL Models Only)

7. Pull rear spark plug boot (3) and cable from right side ignition coil tower.
8. Unplug spark plug boot and cable assemblies from front and rear spark plugs.
9. **XL models only:** Disengage rear spark plug cable from notch in right wire harness caddy (5) and remove cable from vehicle.
10. **XR models only:** See [Figure 6-44](#). Disengage rear spark plug cable from wire harness caddy (5) and remove cable from vehicle.

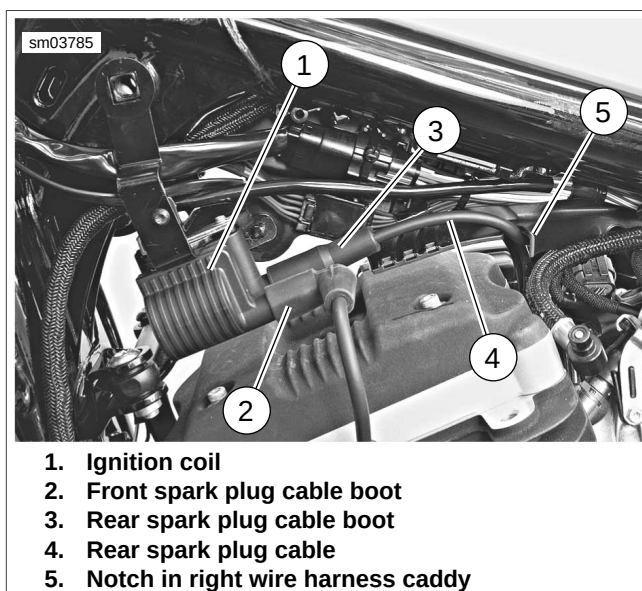


Figure 6-43. Spark Plug Cable Routing (XL Models Only)

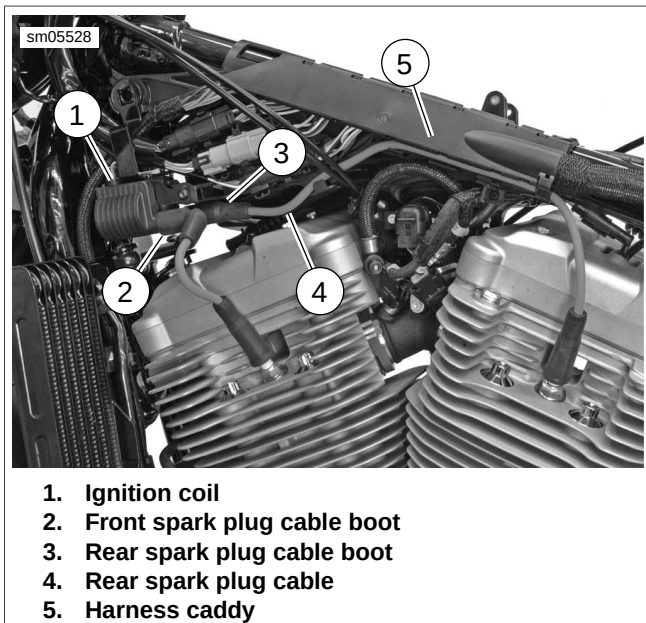


Figure 6-44. Spark Plug Cable Routing (XR Models Shown)

11. **XL models only:** See [Figure 6-45](#). Remove rear spark plug cable (2) from curved trough on wire harness caddy (1). Cut cable strap (4). Feed spark plug cable out from between frame and engine and remove cable from vehicle. Remove cable strap from mounting boss on caddy latch clip (5). Discard cable strap.

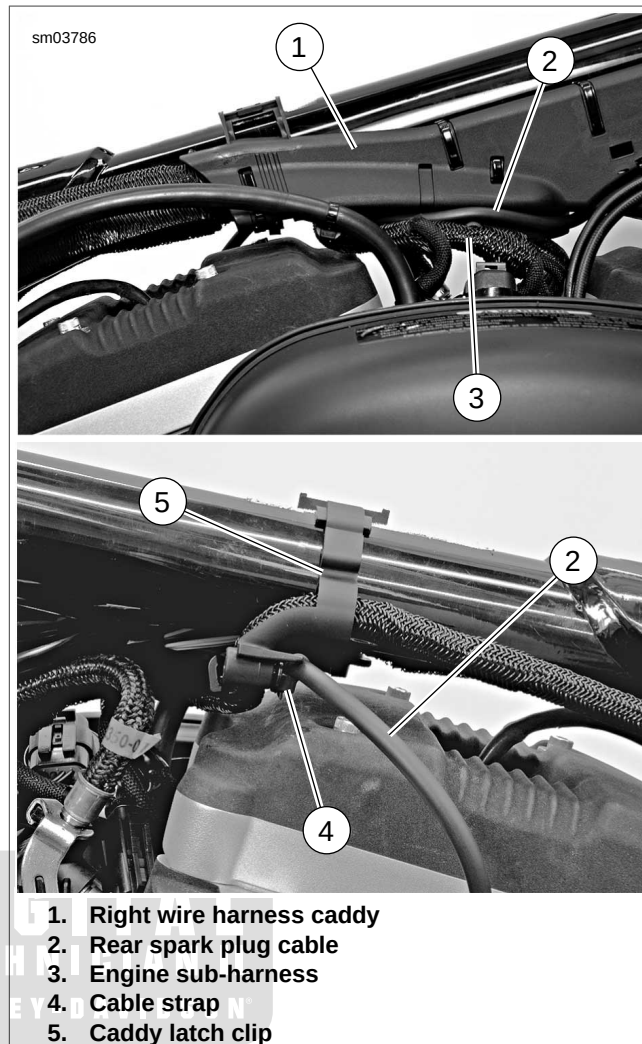


Figure 6-45. Rear Spark Plug Cable Routing (XL Models Only)

INSTALLATION

1. See [Figure 6-43](#) or [Figure 6-44](#). Plug rear spark plug cable boot (3) into right side ignition coil (1) tower.
2. **XL models only:** Route cable between wire harness caddies, and down through notch (5) in right caddy, toward right side of engine.
3. **XR models only:** Route rear spark plug cable through harness caddy (5) as shown.
4. **XL models only:** See [Figure 6-45](#). Route rear spark plug cable (2) in trough in right wire harness caddy (1), over top of engine sub-harness (3) and back toward left side of engine.
5. **XL models only:** See [Figure 6-46](#). Install **new** barbed cable strap (3) onto spark plug cable (1), 7.0-7.25 in. (178-184 mm) from tip of spark plug cable boot (2), orienting cable strap so that spark plug cable is above mounting boss on caddy latch clip when barbed prong on cable strap is inserted in hole in boss. Press cable strap barbed prong firmly into hole in caddy latch clip mounting boss.

6. Plug rear spark plug cable and boot onto rear spark plug until it clicks.
7. See [Figure 6-43](#) or [Figure 6-44](#). Plug front spark plug cable and boot (2) into left side ignition coil (1) tower. Plug other end of cable onto front spark plug until it clicks.

NOTE

Make sure rear spark plug cable is routed properly and cannot chafe against frame, fuel tank or rear cylinder head.

8. **XL models only:** See [Figure 6-42](#). Mate left wire harness caddy (2) to right wire harness caddy. Secure with screw (1) and tighten. See [6.33 ELECTRICAL CADDIES](#).
9. Install fuel tank. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).

WARNING

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

10. Install seat. See [2.38 SEAT: XL MODELS](#) or [2.39 SEAT: XR MODELS](#).
11. Plug in main fuse. See [6.38 MAIN FUSE](#).
12. Start vehicle and verify proper ignition function.

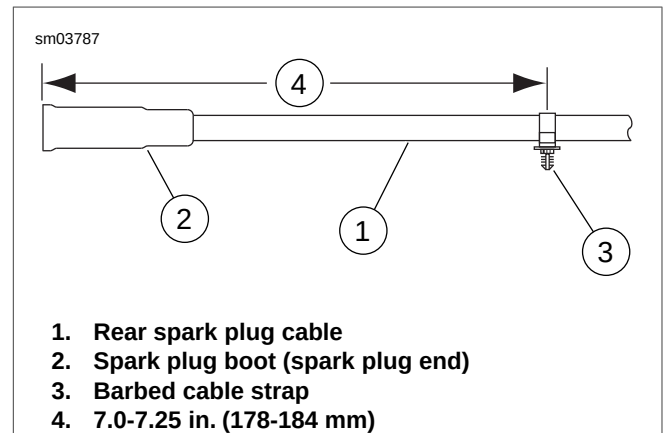


Figure 6-46. Rear Spark Plug Cable and Cable Strap (XL Models Only)



IGNITION COIL

6.19

GENERAL

The ignition coil is attached to a mounting bracket secured by the front fuel tank mounting bolt. The unit is divided into separate front and rear coils that fire the spark plugs one cylinder at a time.

The ignition coil is mounted on the left half of a two-piece bracket assembly. The right half of the bracket assembly secures the ignition switch and right wire harness caddy to the vehicle. The two bracket halves are secured together with a screw.

NOTE

The ignition coil cannot be repaired. Replace the unit if it fails.

TROUBLESHOOTING

See the ELECTRICAL DIAGNOSTIC MANUAL for complete troubleshooting information.

REMOVAL

⚠ WARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

1. Purge the fuel supply hose of high pressure gasoline. Disconnect fuel supply hose from fuel pump module on bottom left side of fuel tank. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

2. Unplug main fuse. See [6.38 MAIN FUSE](#).
3. Remove seat. [2.38 SEAT: XL MODELS](#) or [2.39 SEAT: XR MODELS](#).
4. Remove fuel tank. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).
5. **XL Models Only:** See [Figure 6-47](#). Remove screw (1) securing left wire harness caddy (2) to right wire harness caddy. See [6.33 ELECTRICAL CADDIES](#). Carefully disengage left wire harness caddy and pull away from frame backbone.

NOTE

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.

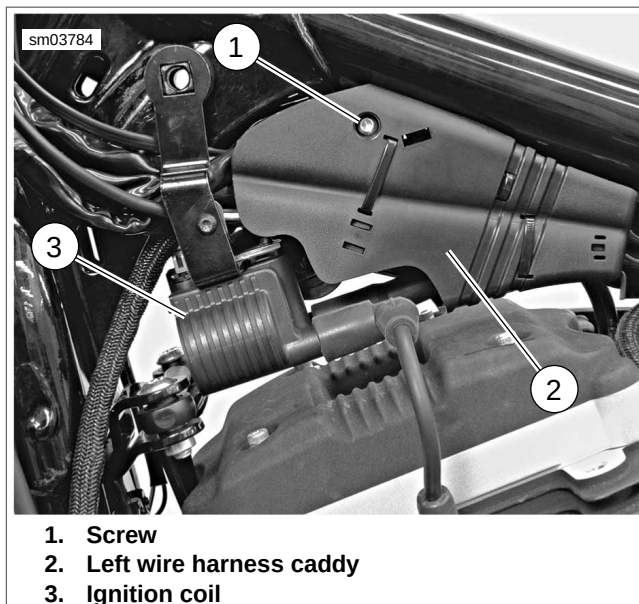


Figure 6-47. Ignition Coil and Left Wire Harness Caddy (XL Models Only)

6. See [Figure 6-48](#) or [Figure 6-49](#). Unplug coil harness connector [83B] (2) from ignition coil (1).
7. Pull front spark plug boot and cable (3) from left ignition coil tower.
8. Pull rear spark plug boot and cable (4) from right ignition coil tower.
9. Remove screw (5) securing coil bracket (6). Remove coil and bracket from vehicle.
10. See [Figure 6-50](#) or [Figure 6-51](#). Remove two screws (4) to separate ignition coil (1) from mounting bracket (2) and plate (3).

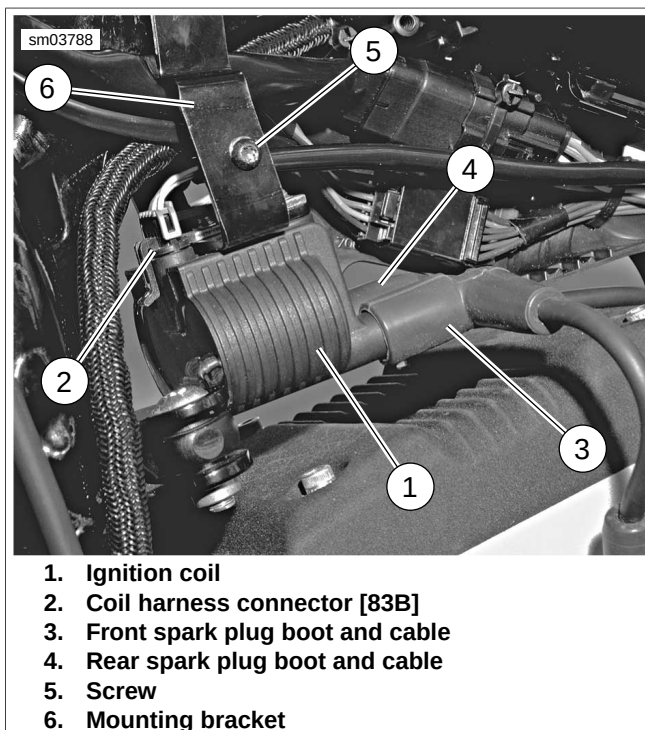


Figure 6-48. Ignition Coil Mounting and Connections: XL Models Only

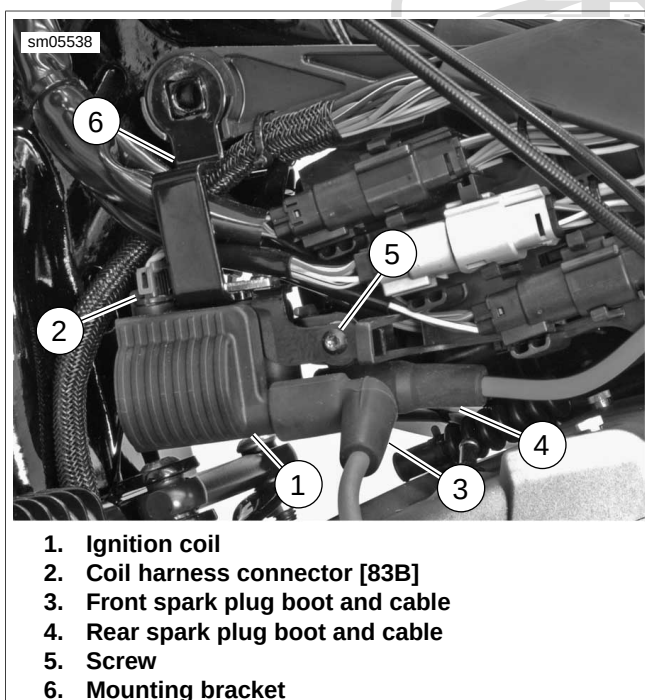


Figure 6-49. Ignition Coil Mounting and Connections: XR Models Only

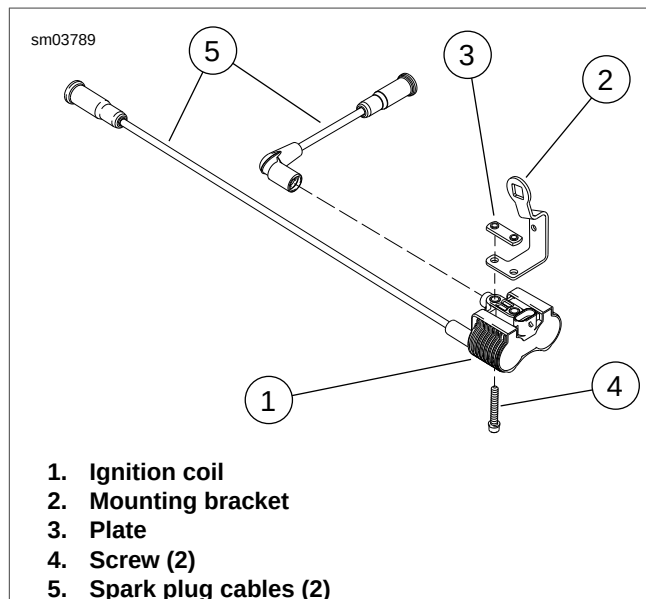


Figure 6-50. Ignition Coil Mounting: XL Models Only

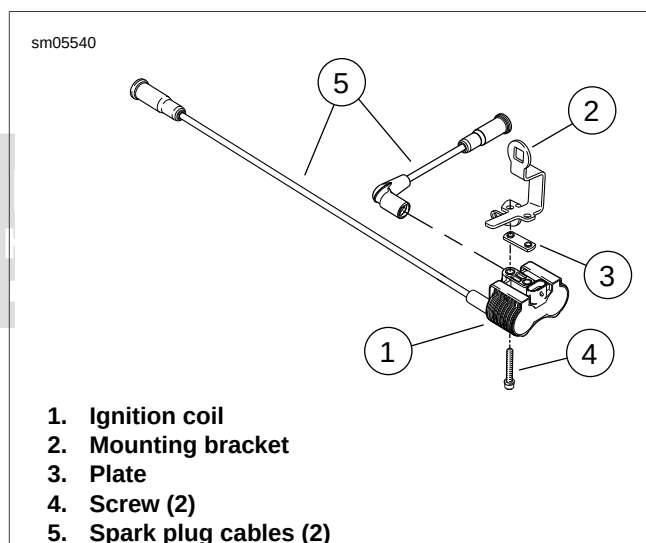


Figure 6-51. Ignition coil Mounting: XR Models Only

INSTALLATION

1. **XL Models Only:** see [Figure 6-50](#). Position **new** ignition coil (1) on underside of mounting bracket (2). Fasten coil to mounting bracket with two screws (4) and nut plate (3). Tighten screws to 24-72 **in-lbs** (2.7-8.1 Nm).
2. **XR Models Only:** see [Figure 6-51](#). Position plate (3) over **new** ignition coil (1). Place screws (4) through coil and plate and secure to mounting bracket (2). Tighten screws to 24-72 **in-lbs** (2.7-8.1 Nm).
3. See [Figure 6-48](#) or [Figure 6-49](#). Slide coil (1) with mounting bracket (6) into position. Make sure all wiring harnesses from front end of vehicle are positioned between coil bracket upright and vehicle frame. Secure bracket with screw (5) and tighten to 35-45 **in-lbs** (4.0-5.1 Nm).

4. Plug spark plug cables into ignition coil towers; front spark plug cable (3) to left side of coil, rear spark plug cable (4) to right side of coil.
5. **XL Models Only:** see [Figure 6-47](#). Mate left wire harness caddy (2) to right wire harness caddy. Secure with screw (1) and tighten. See [6.33 ELECTRICAL CADDIES](#).
6. Install fuel tank. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).

⚠ WARNING

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

7. Install seat. See [2.38 SEAT: XL MODELS](#) or [2.39 SEAT: XR MODELS](#).
8. Plug in main fuse. See [6.38 MAIN FUSE](#).



GENERAL

See [Figure 6-52](#). The charging system consists of the alternator and voltage regulator. See schematic diagram of the charging

system circuit in [B.2 WIRING DIAGRAMS, 2009 Sportster Wiring Diagrams](#).

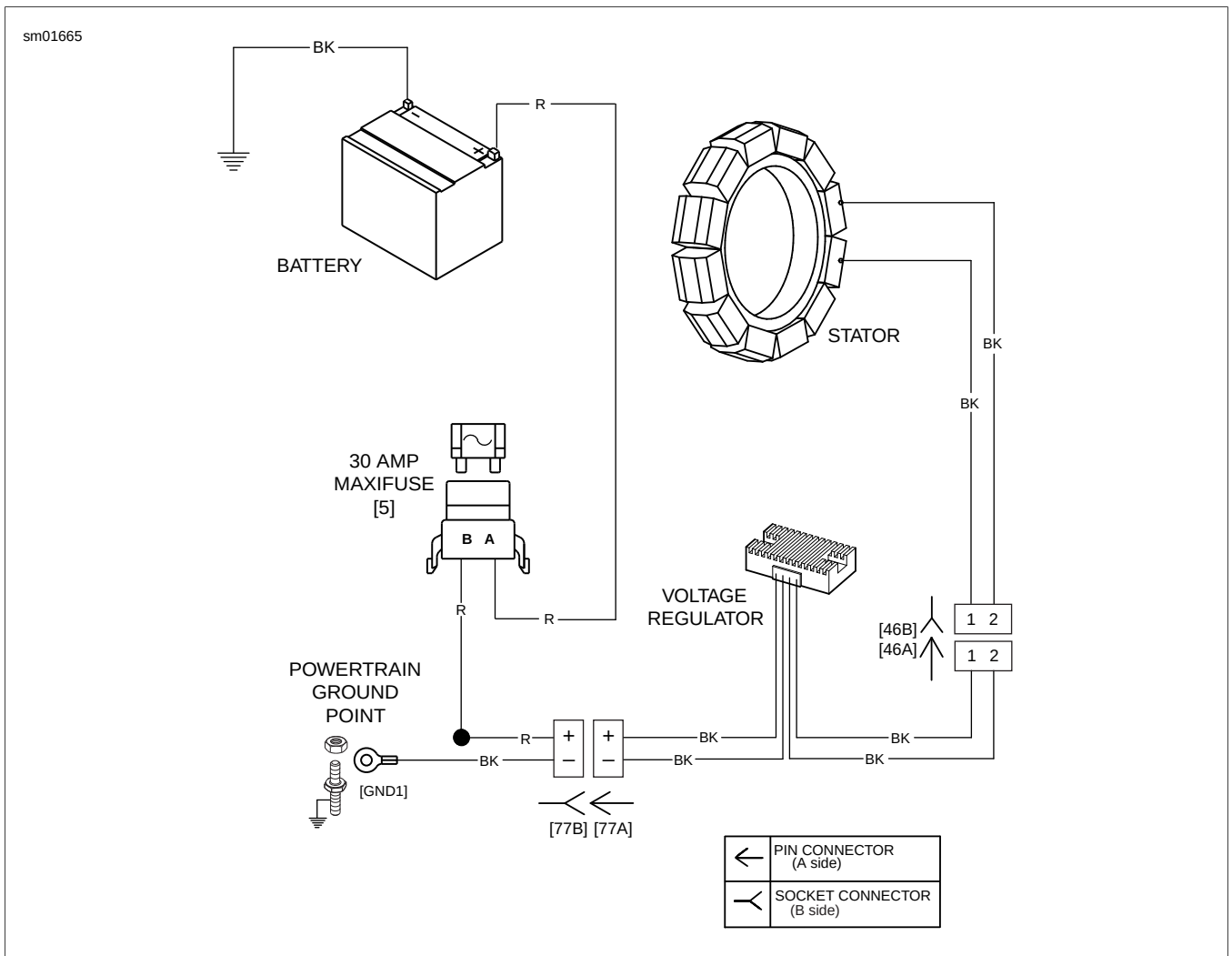


Figure 6-52. Charging System Circuit (All Models)

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.

VOLTAGE REGULATOR

The regulator is a series regulator with shunt control. The circuit combines the functions of rectifying and regulating.

NOTE

For charging system troubleshooting and diagnostic procedures, see ELECTRICAL DIAGNOSTIC MANUAL.

HEADLAMP

6.21

REPLACEMENT: XL 883C/XL 1200C

NOTE

The headlamp is a replaceable bulb (element) type. Replace with the specified H4 halogen bulb, only.

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Unplug main fuse. See [6.38 MAIN FUSE](#).
2. Remove screw and chrome molding ring.
3. See [Figure 6-53](#). Hold headlamp reflector/lens (3) and compress release tabs (6) on sides of headlamp connector [38] (2). Pull connector from spade terminals.
4. Remove headlamp reflector/lens and metal adapter ring (1).
5. Pull rubber boot (5) from rubber finger gasket (4) on back of reflector/lens.
6. See [Figure 6-54](#). Press ends of retaining clip (3) to unhook from notched retaining post (4).
7. Pivot retaining clip back and remove bulb (5).

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

8. Fit replacement bulb (5).

NOTE

The tab opposite the center spade connector of bulb (5) fits the top notch (2) in the reflector which points to the top of the reflector/lens (6).

9. Pivot the retaining clip (3) over the bulb and press the ends into the retaining post (4).
10. If necessary, remove and fit a replacement rubber finger gasket (1).

NOTE

The smaller single notch of the rubber finger gasket (1) will fit over the top notch (2) of the reflector/lens (6).

11. If replacing the small position lamp in the side of the reflector/lens on HDI XL 883C/XL 1200C models:
 - a. Pull the spade connectors from the bulb holder.
 - b. Pull the bulb holder from the reflector/lens.
 - c. Quarter turn the bulb to remove and replace.
 - d. Replace the bulb holder and mate connectors.
12. See [Figure 6-55](#). Install rubber boot with word TOP (1) over top notch.

13. Press center ring (2) down flush with base of bulb (3) and press air out of boot to seal bore of boot to bulb and boot flange to rubber finger gasket.

NOTE

Air will re-enter the rubber boot and raise the center ring above bottom of bulb.

14. See [Figure 6-56](#). Fit the adapter ring (2) to the reflector/lens (7) and fit the adapter ring to the headlamp shell (1).

NOTES

- The two notches on the circumference of the adapter ring will fit the two bulges on rim of headlamp shell.
 - A single tab on the circumference of the reflector will fit the notch on the inside of the adapter ring.
 - The four fingers of the rubber finger gasket are installed between the adapter ring and the reflector/lens.
15. Mate the headlamp connector (3) to the spade connector on the bulb (10).
 16. Press the reflector/lens assembly into the headlamp shell matching the two notches on the moulding ring to the bulges on the headlamp shell.
 17. Rotate the moulding clockwise to lock the moulding ring down on the reflector/lens. Install the moulding ring screw (9) and tighten.
 18. Plug in main fuse. See [6.38 MAIN FUSE](#).
 19. After final assembly, align headlamp as described in [1.31 HEADLAMP ALIGNMENT](#).

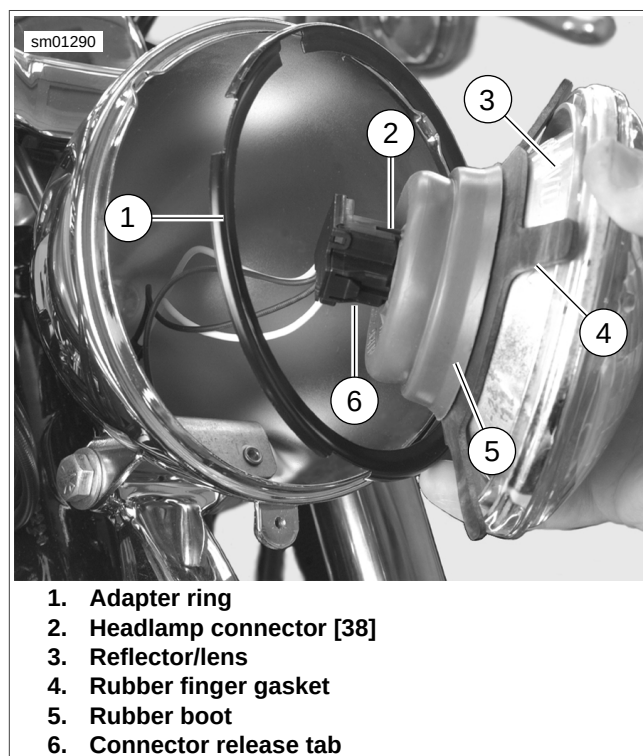


Figure 6-53. Remove Headlamp

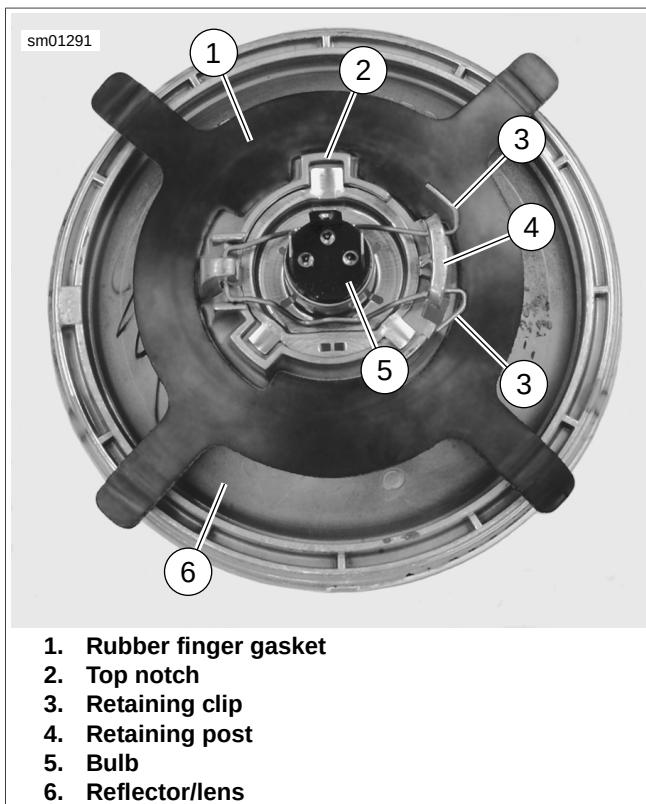


Figure 6-54. Headlamp Assembly

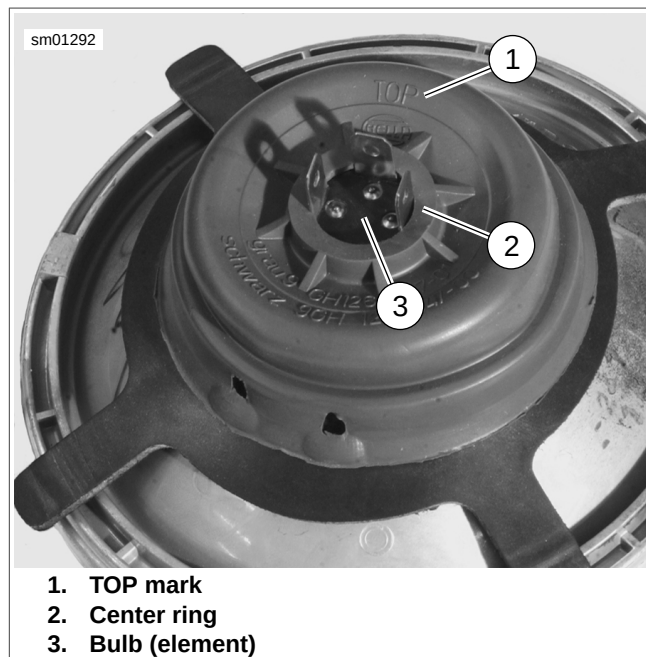


Figure 6-55. Headlamp Boot (TOP Mark)



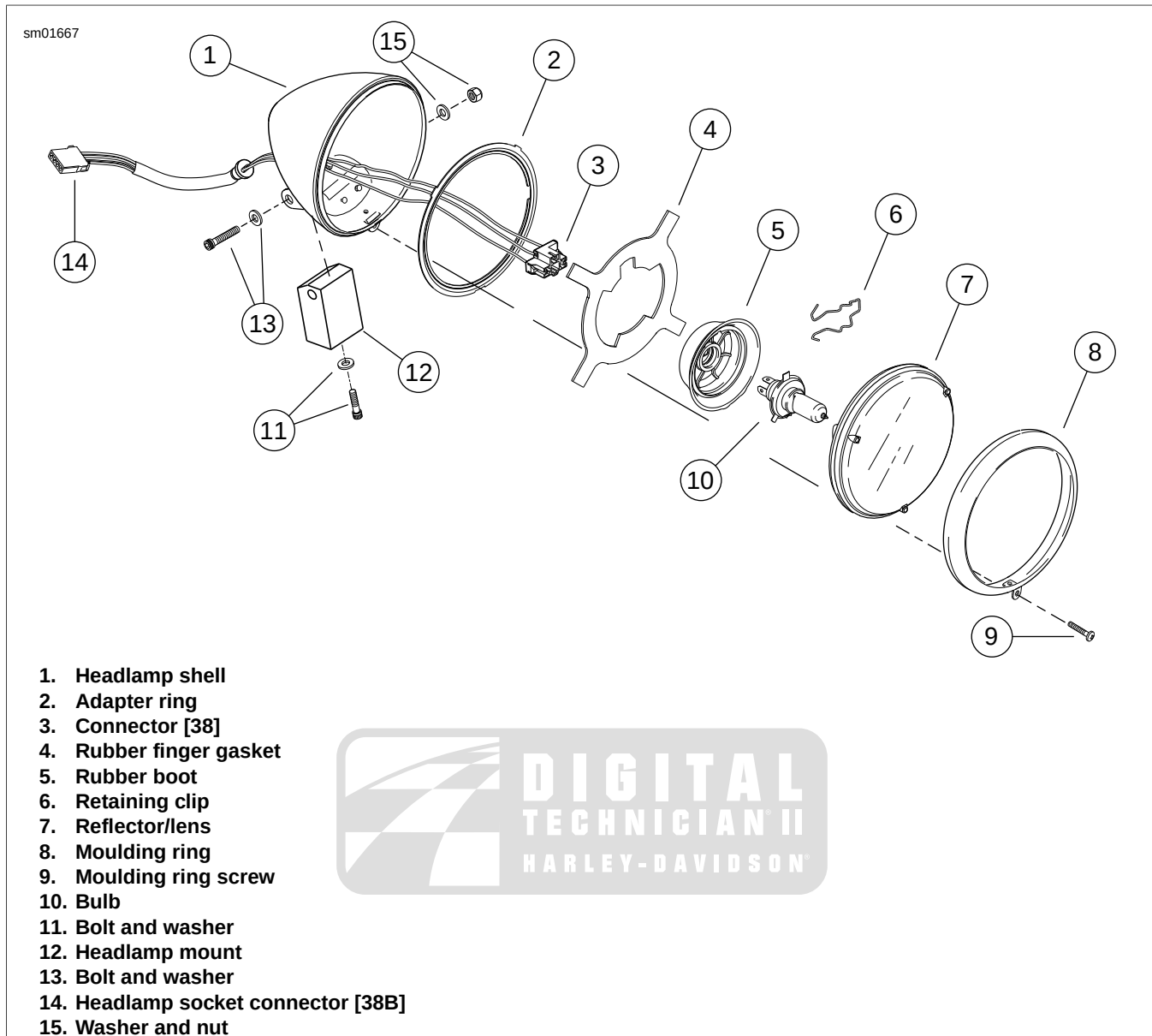


Figure 6-56. Headlamp Components: XL 883C/XL 1200C

REPLACEMENT: ALL MODELS EXCEPT XL 883C/XL 1200C

NOTE

The headlamp is a replaceable bulb (element) type. Replace with the specified H4 halogen bulb, only.

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Unplug main fuse. See [6.38 MAIN FUSE](#).
2. See [Figure 6-57](#). Remove screw (8) and chrome outer molding ring (6).

3. Hold headlamp reflector/lens (5) and compress release tabs on sides of bulb connector (10) to pull connector from spade terminals.
4. Pull rubber boot (3) from back of reflector/lens.
5. Press ends of retaining clip (4) to unhook from notched retaining tabs and pivot retaining clip back.
6. Remove bulb (9).

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

7. Fit replacement bulb (9).

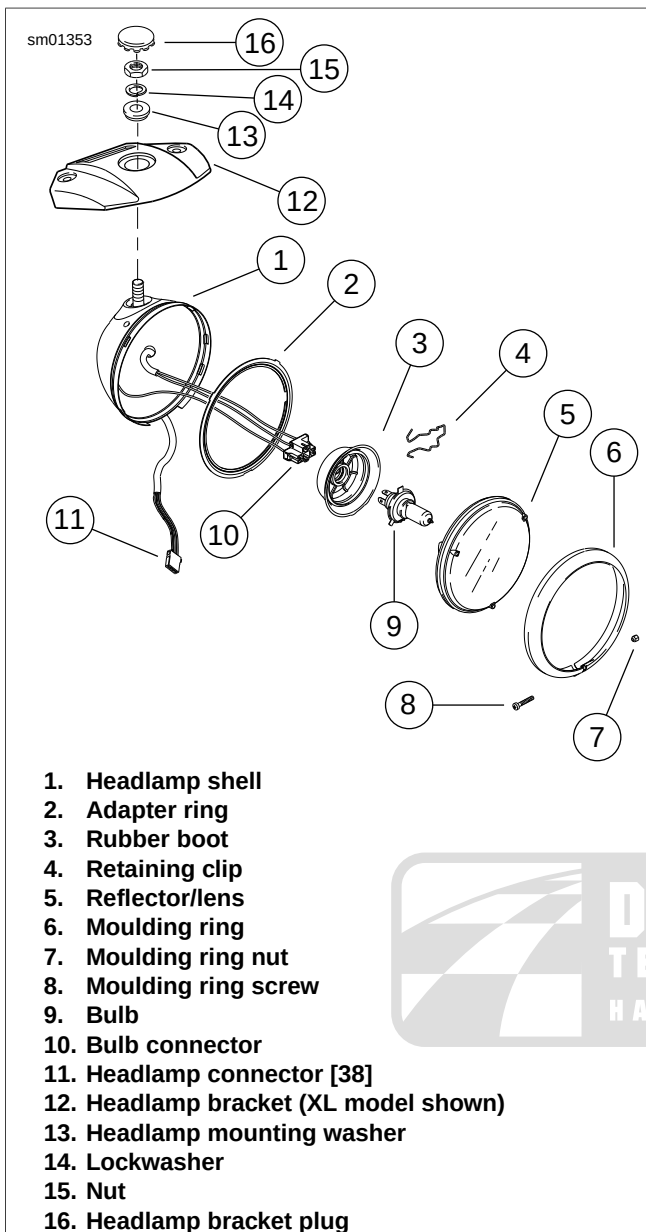


Figure 6-57. Headlamp Components: All Except XL 883C/XL 1200C

NOTE

The tab opposite the center spade connector of bulb fits the top notch in the reflector which points to the top of the reflector/lens.

8. Pivot the retaining clip (4) over the bulb (9) and press the ends into the retaining post.
9. Install rubber boot (3) with word TOP over top notch. Press center ring down flush with base of bulb.
10. See [Figure 6-58](#). If replacing the small position lamp (3) in the side of the reflector/lens on HDI models:
 - a. Pull the spade connectors from the bulb holder.
 - b. Pull the bulb holder from the reflector/lens.
 - c. Quarter turn the bulb to remove and replace.
 - d. Replace the bulb holder and mate connectors.
11. Mate the bulb connector to the bulb.
12. Fit the adapter ring and the reflector/lens to the headlamp shell.
13. Install the moulding ring screw and nut.
14. Plug in main fuse. See [6.38 MAIN FUSE](#).
15. After final assembly, align headlamp as described in [1.31 HEADLAMP ALIGNMENT](#).

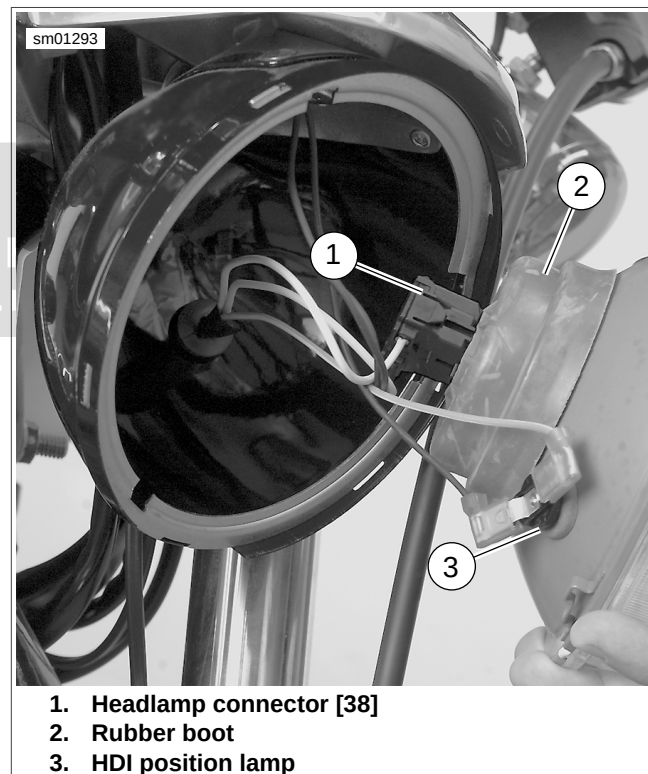


Figure 6-58. HDI Headlamp (XL 1200R Shown)

INDICATOR LAMP MODULE

6.22

GENERAL

The indicator lamps are LEDs housed in a self-contained, non-repairable module. If one indicator lamp fails, the entire module and instrument harness must be replaced.

PRELIMINARY DISASSEMBLY: ALL MODELS

⚠ WARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

1. Position vehicle upright. Purge the fuel supply hose of high pressure gasoline. Disconnect fuel supply hose from fuel pump module. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

2. Unplug main fuse. See [6.38 MAIN FUSE](#).
3. Remove seat.
4. Remove fuel tank. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).
5. See [6.33 ELECTRICAL CADDIES](#):
 - a. **XL models only:** remove screw securing left wire harness caddy to right wire harness caddy.
 - b. Locate instruments connector [20] on right wire harness caddy for XL models and on left side of caddy for XR models. Unplug connector [20A].
6. Make a note of the location of all cable straps securing instrument harness to vehicle. Cut cable straps to free instrument harness.

REPLACEMENT: XL 1200L AND XL 1200N

1. Cover headlamp bracket with a clean soft cloth to protect surface.
2. See [Figure 6-59](#). Holding speedometer housing/handlebar clamp (3), remove four screws securing housing/clamp assembly to handlebar risers.
3. Remove two screws (6) to separate indicator lamp module (4) from speedometer housing/handlebar clamp, trim plate (1) and lens (2).

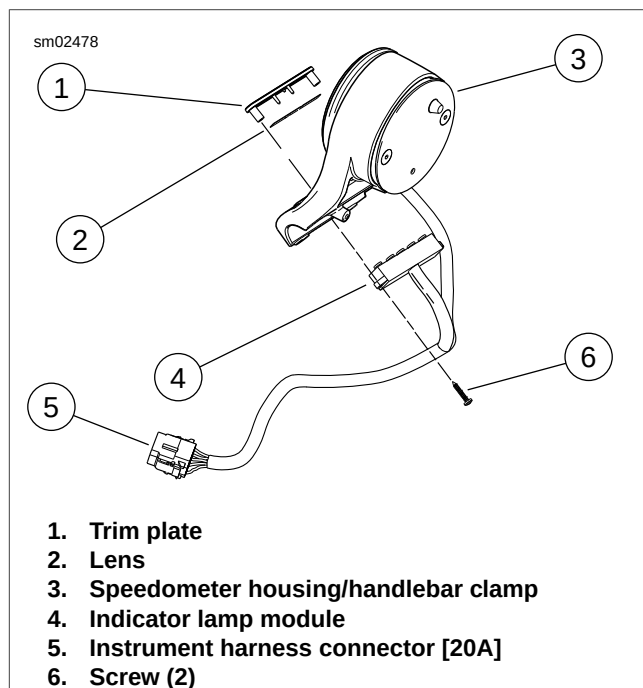


Figure 6-59. Indicator Lamps: XL 1200L/XL 1200N

4. See [6.6 SPEEDOMETER: XL SINGLE GAUGE MODELS EXCEPT XL 883C/XL 1200C](#):
 - a. Remove back plate from speedometer. Unplug harness connector [39B] from back of speedometer.
 - b. Remove trip odometer reset button boot and remove trip odometer reset button from back plate.
5. Remove instrument harness from vehicle.
6. Place **new** instrument harness in position.
7. See [6.6 SPEEDOMETER: XL SINGLE GAUGE MODELS EXCEPT XL 883C/XL 1200C](#):
 - a. Plug harness connector [39B] into back of speedometer.
 - b. Install trip odometer reset button into speedometer back plate and thread on button boot finger-tight.
 - c. Install back plate onto speedometer and secure with two screws.
8. See [Figure 6-59](#). Assemble trim plate (1), lens (2) and indicator lamp module (4) onto speedometer housing/handlebar clamp (3). Secure with two screws (6).
9. Install housing/clamp assembly onto handlebar risers and secure with four screws:
 - a. Tighten front screws first, to 12-18 ft-lbs (16.3-24.4 Nm).
 - b. Tighten rear screws to 12-18 ft-lbs (16.3-24.4 Nm).
10. Proceed to [6.22 INDICATOR LAMP MODULE, Reassembling Vehicle: All Models](#).

REPLACEMENT: XL 883C AND XL 1200C

1. See [Figure 6-60](#). Remove two screws (1) and riser cover (2) from behind handlebar riser (3).
2. Remove four screws (4) securing speedometer housing/handlebar clamp (5) to handlebar riser.
3. Carefully bend back four latches (8) on indicator lamp bezel (6) and remove indicator lamp module (7).
4. See [6.8 SPEEDOMETER: XL 883C/XL 1200C](#).
 - a. Remove two screws securing speedometer to speedometer housing/handlebar clamp. Carefully pull speedometer out of housing.
 - b. Unplug harness connector [39B] from rear of speedometer.
 - c. Remove trip odometer reset button boot and remove trip odometer reset button from back of speedometer housing/handlebar clamp.

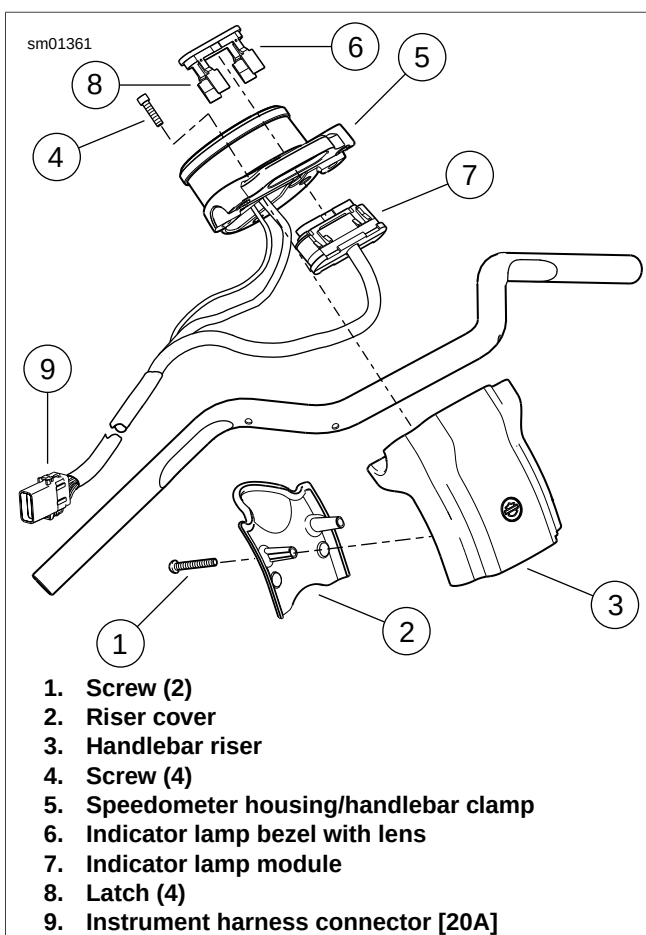


Figure 6-60. Indicator Lamps: XL 883C/XL 1200C

5. Carefully pull harness with connector [39B] and trip odometer reset button from back of speedometer housing/handlebar clamp.
6. Pull instrument harness with connector [20A] up through upper fork bracket and remove harness from vehicle.
7. Place **new** instrument harness in position.

8. Carefully feed connector [20A] end down through upper fork bracket and along left side of frame steering head.

NOTE

Make certain that speedometer harness and trip odometer switch harness are positioned underneath the handlebar, and indicator lamp module harness feeds over the top of the handlebar.

9. Carefully feed end of harness with connector [39B] and trip odometer reset button through back of speedometer housing/handlebar clamp.
10. See [6.8 SPEEDOMETER: XL 883C/XL 1200C](#):
 - a. Install trip odometer reset button into speedometer housing/handlebar clamp and secure with button boot.
 - b. Plug harness connector [39B] into back of speedometer.
 - c. Carefully slide speedometer into speedometer housing/handlebar clamp. Secure with two screws.
11. See [Figure 6-60](#). Install indicator lamp module (7) into back of speedometer housing/handlebar clamp (5). Secure with four latches (8) on indicator lamp bezel (6).
12. Install speedometer housing/handlebar clamp onto handlebar riser (3) and secure with four screws (4):
 - a. Adjust handlebars to desired position.
 - b. Tighten front screws first, to 12-18 ft-lbs (16.3 -24.4 Nm).
 - c. Tighten rear screws to 12-18 ft-lbs (16.3 -24.4 Nm).
13. Install riser cover (2) behind handlebar riser and secure with two screws (1). Make certain that handlebar control harnesses are not pinched between handlebar riser and riser cover. Tighten screws to 8-12 **in-lbs** (0.9-1.4 Nm).
14. Proceed to [6.22 INDICATOR LAMP MODULE, Reassembling Vehicle: All Models](#)

REPLACEMENT: ALL OTHER MODELS

1. Cover headlamp bracket with a clean soft cloth to protect surface.
2. See [Figure 6-61](#). Holding instrument bracket (3), remove two screws with lock washers securing instrument bracket to handlebar risers.
3. Remove two screws (6) to separate indicator lamp module (4) from instrument bracket, trim plate (1) and lens (2).

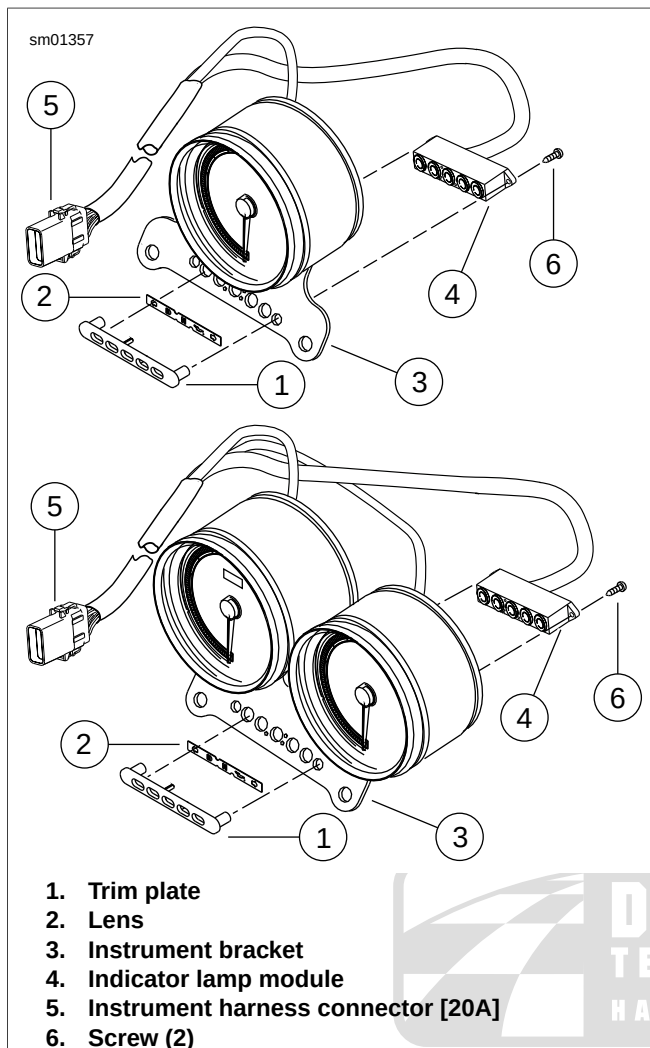


Figure 6-61. Indicator Lamps: All Single and Dual Gauge Models Except XL 883C/XL 1200C/XL 1200L/XL 1200N

4. See [6.6 SPEEDOMETER: XL SINGLE GAUGE MODELS EXCEPT XL 883C/XL 1200C](#), [6.7 SPEEDOMETER AND TACHOMETER: XL DUAL GAUGE MODELS](#), or [6.9 SPEEDOMETER AND TACHOMETER: XR MODELS](#):
 - a. Remove back plate from speedometer. Unplug harness connector [39B] from back of speedometer.
 - b. Remove trip odometer reset button boot and remove trip odometer reset button from back plate.
 - c. **Dual-gauge models:** remove back plate from tachometer. Unplug harness connector [108B] from back of tachometer.
5. Remove instrument harness from vehicle.
6. Place **new** instrument harness in position.

7. See [6.6 SPEEDOMETER: XL SINGLE GAUGE MODELS EXCEPT XL 883C/XL 1200C](#), [6.7 SPEEDOMETER AND TACHOMETER: XL DUAL GAUGE MODELS](#), or [6.9 SPEEDOMETER AND TACHOMETER: XR MODELS](#):
 - a. Plug harness connector [39B] into back of speedometer.
 - b. Install trip odometer reset button into speedometer back plate and thread on button boot finger-tight.
 - c. Install back plate onto speedometer and secure with two screws.
 - d. Dual-gauge models: plug harness connector [108B] into back of tachometer. Install back plate onto tachometer and secure with two screws.
8. See [Figure 6-61](#). Assemble trim plate (1), lens (2) and indicator lamp module (4) onto instrument bracket (3). Secure with two screws (6).
9. Install instrument bracket onto handlebar risers. Tighten screws to 12-18 **in-lbs** (16.3-24.4 Nm).
10. Proceed to [6.22 INDICATOR LAMP MODULE, Reassembling Vehicle: All Models](#).

REASSEMBLING VEHICLE: ALL MODELS

1. **XL models only:** see [6.33 ELECTRICAL CADDIES](#):
 - a. Feed instrument harness between coil bracket uprights, back to right wire harness caddy.
 - b. Plug instrument harness pin connector [20A] into socket connector [20B] in right wire harness caddy.
 - c. Mate right and left wire harness caddies. Secure with screw and tighten.
2. **XR models only:** see [6.33 ELECTRICAL CADDIES](#):
 - a. Feed instrument harness along left side of frame next to left and right hand control harnesses and inside of coil bracket upright.
 - b. Plug instrument harness pin connector [20A] into socket connector [20B] in right wire harness caddy.
3. Secure instrument harness to vehicle with cable straps in locations previously noted.
4. Install fuel tank. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).
5. Plug in main fuse. See [6.38 MAIN FUSE](#).

WARNING

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

6. Install seat.

TAIL LAMP: ALL MODELS EXCEPT XL 1200N

6.23

GENERAL

This section describes the replacement of the tail lamp bulb as well as replacement of the entire tail lamp housing assembly on all models except the XL 1200N. For XL 1200N, see [6.24 TURN SIGNALS](#).

BULB REPLACEMENT

NOTE

Sportsters are equipped with a tail lamp incorporating a rear lighting harness and circuit board to simplify replacement.

1. Make certain ignition switch is turned OFF.
2. See [Figure 6-62](#). Remove two screws and lens (4) from base (3).
3. Depress locking tab and remove 4-Pin multilock connector from circuit board.
4. Turn socket assembly (1) one-quarter turn counterclockwise to release assembly from lens. Remove (pull) assembly from lens. Remove bulb from socket.
5. Coat base of **new** bulb with electrical contact grease (Part No. 99861-90). Install (push) **new** bulb into socket.
6. Install (push) bulb assembly into lens. Turn assembly one-quarter turn clockwise to lock in place.
7. Connect 4-Pin multilock connector to circuit board.
8. Install lens to base with two screws. Tighten screws to 20-24 **in-lbs** (2.3-2.7 Nm)
9. Turn ignition on and test for proper tail lamp operation.

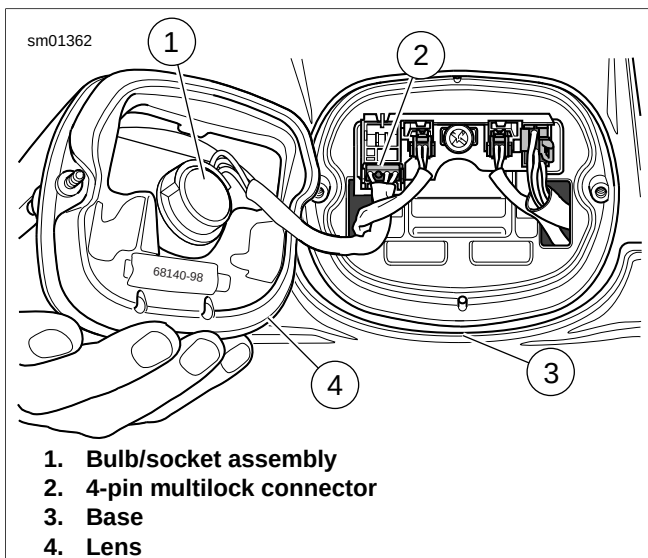


Figure 6-62. Tail Lamp (Typical, XL Models Shown)

BASE REPLACEMENT

PART NUMBER	TOOL NAME
HD-39621-28	PIN TERMINAL REMOVER

Use of the PIN TERMINAL REMOVER (Part No. HD-39621-28) is recommended for this procedure. See [A.1 AMP MULTI-LOCK CONNECTORS](#).

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Unplug main fuse. See [6.38 MAIN FUSE](#).
2. See [Figure 6-62](#). Remove two screws and lens (4) from base (3).
3. Depress locking tab and remove 4-Pin multilock connector from circuit board.
4. See [Figure 6-63](#). Using a terminal pick, depress locking tabs and remove two 2-Pin turn signal connectors and 6-Pin Power In connector from circuit board.
5. **XL models only:** remove base as follows:
 - a. Remove screw, pin housing and circuit board from base.
 - b. Remove base from rear fender.
6. **XR models only:** see [Figure 6-66](#). Remove base as follows:
 - a. Remove pin housing and circuit board from base.
 - b. Remove screws (1, 2) and remove base from frame.
 - c. If replacing base, remove turn signals from base. See [6.24 TURN SIGNALS](#).
7. **XL models only:** install base as follows:
 - a. Install base on rear fender.
 - b. Install screw, pin housing and circuit board to base. Tighten screw to 45-48 **in-lbs** (5.1-5.4 Nm).
8. **XR models only:** see [Figure 6-66](#). Install base as follows:
 - a. Install base to frame with screws (1, 2). Tighten screw to 36-60 **in-lbs** (4.1-6.8 Nm).
 - b. Set pin housing and circuit board onto base.
9. See [Figure 6-65](#). Install connectors to circuit board.
10. Install lens to base with two screws. Tighten screws to 20-24 **in-lbs** (2.3-2.7 Nm)
11. Plug in main fuse. See [6.38 MAIN FUSE](#).
12. Turn ignition on and test for proper tail lamp and turn signal operation.

NOTE

Cavity numbers are on the back side of secondary locks on connector housings.

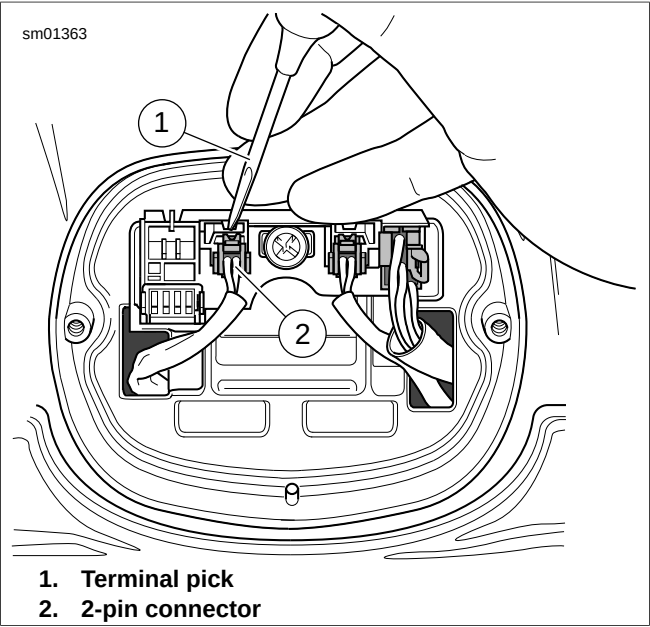


Figure 6-63. Removing 2-Pin Connectors (Typical, XL Models Shown)

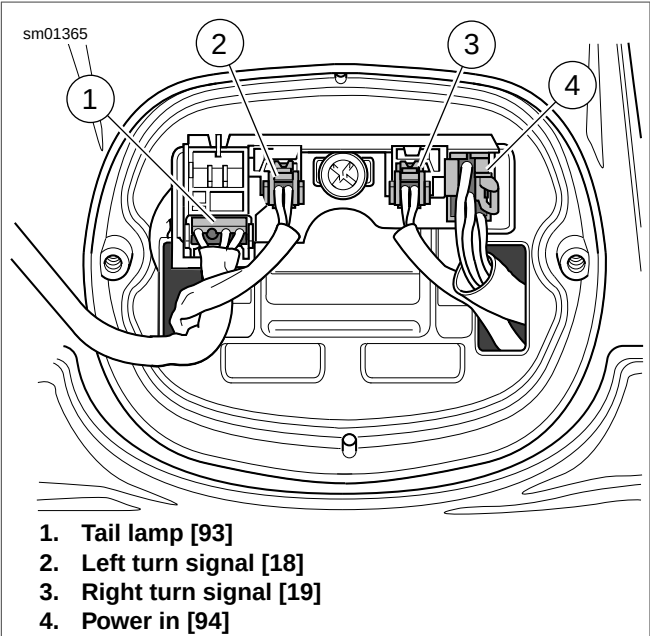


Figure 6-65. Tail Lamp Base Connectors (Typical, XL Models Shown)

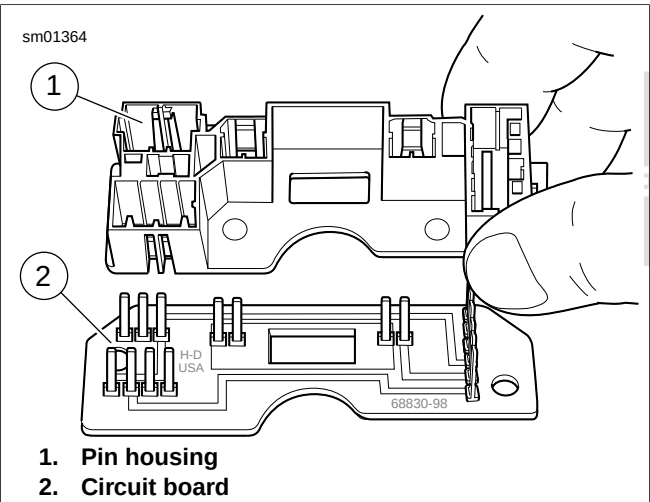


Figure 6-64. Pin Housing and Circuit Board

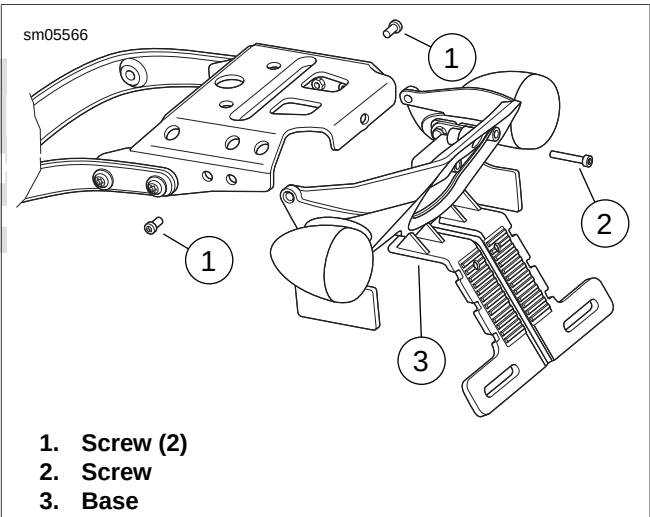


Figure 6-66. Tail Lamp Base: XR 1200 Only

Table 6-11. Connector Specifications

FUNCTION	TYPE	NUMBER	WIRE COLOR	CAVITY
Right turn signal	2-pin Multilock	19	V	1
			BK	2
Left turn signal	2-pin Multilock	18	V	1
			BK	2
Tail lamp	4-pin Multilock	93	BE	1
			O/W*	2
			R/Y	3
			BK	4

Table 6-11. Connector Specifications

FUNCTION	TYPE	NUMBER	WIRE COLOR	CAVITY
Power	6-pin Multilock	94	O/W	1
			BN	2
			BE	3
			R/Y	4
			V	5
			BK	6
* HDI only. OPEN on DOM.				



TURN SIGNALS

6.24

GENERAL

This section describes the replacement of turn signal bulbs, as well as the replacement of the entire turn signal housing assembly.

The rear turn signals on the XL 1200N model also serve as tail lamps and brake lamps. The rear turn signal/brake lamp functions are provided by an electronic converter module. See [6.26 REAR LIGHTING CONVERTER MODULE: XL 1200N \(DOMESTIC ONLY\)](#) for replacement of this module.

BULB REPLACEMENT

NOTES

- The HDI XL 1200N is equipped with LED rear turn signal/brake lamp/tail lamp assemblies. These are sealed units and cannot be disassembled. The entire rear turn signal housing assembly must be replaced. See [6.24 TURN SIGNALS, Rear Housing Replacement](#).
 - The Domestic XL 1200N is equipped with dual filament rear turn signal bulbs to provide rear turn signal, brake lamp and tail lamp functions.
 - All other models are equipped with single filament rear turn signal bulbs.
1. Insert coin in notch of front or rear turn signal lens cap. Carefully twist coin until lens cap pops out of turn signal housing.
 2. Replace bulb.
 - a. Push bulb and turn counterclockwise.
 - b. Pull bulb from socket when tab on bulb clears opening on socket.
 - c. Push **new** bulb in and turn clockwise to lock in place.
 3. Snap lens cap back into housing.

FRONT HOUSING REPLACEMENT

⚠ WARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

1. Purge the fuel supply hose of high pressure gasoline. Disconnect fuel supply hose from fuel pump module. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

2. Unplug main fuse. See [6.38 MAIN FUSE](#).
3. Remove fuel tank. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).

4. Separate left and right wire harness caddies. See [6.32 MAIN WIRING HARNESS](#).
5. On XL 883C/XL 1200C models, remove riser cover from the back of the handlebar riser. See [2.32 HANDLEBARS](#).
6. See [Figure 6-67](#). Locate turn signal connector [31] (4) mounted on right wire harness caddy (2). Depress latch (5) and separate connector halves.
7. Remove the corresponding socket terminals from connector [31B]. See [A.1 AMP MULTILOCK CONNECTORS](#).
8. See [Figure 6-68](#). Using a 4 mm Allen wrench, loosen the Allen screw in the front of the hand lever bracket to release the turn signal housing ball end stud.
9. Pull the wire conduit through the coil bracket, the fork clamp and handlebar clips.
10. See [Figure 6-69](#). Inspect the ball head stud (1) and replace as required. Tighten **new** ball head studs to 96-156 **in-lbs** (10.8-17.6 Nm).
11. Lay old turn signal housing and wires next to **new** and cut **new** wires to length.
12. Trim sheath back approximately 2.5 in. (63.5 mm) and crimp **new** socket terminals onto wires.
13. On XL 883C/XL 1200C models, route wires through handlebar clips, between fork clamp and decorative cover and then through coil bracket.
14. On all models except XL 883C/XL 1200C, route wires through handlebar clips, between fork clamp and head lamp bracket and then through coil bracket.
15. See [Figure 6-69](#). Install housing ball end stud (1) into the lever bracket and aim to front. Using a 4 mm Allen wrench, tighten clamp screw to 96-120 **in-lbs** (10.9-13.6 Nm).
16. Insert socket terminals into turn signal connector. Refer to [Table 6-12](#).
17. Mate connector [31] halves. Reassemble left and right wire harness caddies. See [6.32 MAIN WIRING HARNESS](#).
18. Install fuel tank. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).
19. On XL 883C/XL 1200C models, install riser cover. Make certain that handlebar control harnesses are not pinched between handlebar riser and riser cover. Tighten screws to 8-12 **in-lbs** (0.9-1.4 Nm).
20. Plug in main fuse. See [6.38 MAIN FUSE](#).

⚠ WARNING

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

21. Turn ignition switch ON and verify correct turn signal operation.

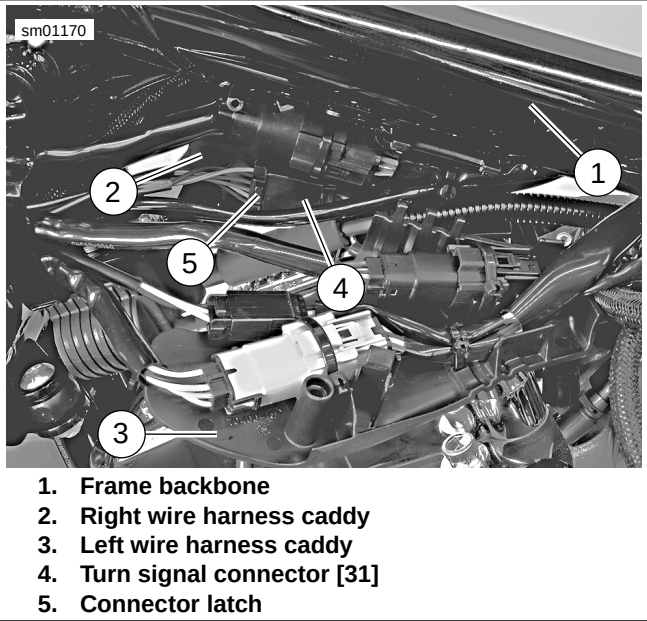


Figure 6-67. Turn Signal Connector [31]

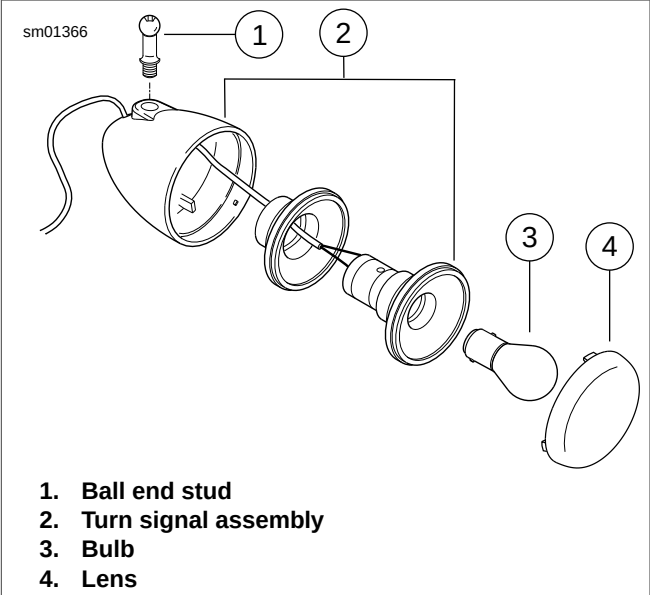


Figure 6-69. Front Turn Signal Components



Figure 6-68. Turn Signal Ball Stud Allen Screw

Table 6-12. Front Turn Signal Connector [31] Wire Colors

HAND	WIRE COLOR	CAVITY
Right turn signal	BK	1
	BN	2
	BE (DOM only)	3
Left turn signal	BE (DOM only)	4
	V	5
	BK	6

REAR HOUSING REPLACEMENT

Preliminary Vehicle Disassembly: All Models

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Unplug main fuse. See [6.38 MAIN FUSE](#).
2. **All but XR 1200:** remove seat.

Disconnect Wiring: All Models Except XL 1200N

1. See [Figure 6-70](#). Remove two screws (2) and tail lamp lens (3) from tail lamp base (4).
2. See [Figure 6-71](#). Remove left and right turn signal connectors (1, 2). Pull turn signal wiring harnesses through harness access holes in tail lamp base (3).
3. **All but XR 1200:** see [Figure 6-72](#). Disengage turn signal wiring harnesses from wire retention brackets (1).
4. Proceed directly to Remove and Disassemble Turn Signal Assembly: All But XR 1200 or Remove and Disassemble Turn Signal Assembly: XR 1200.

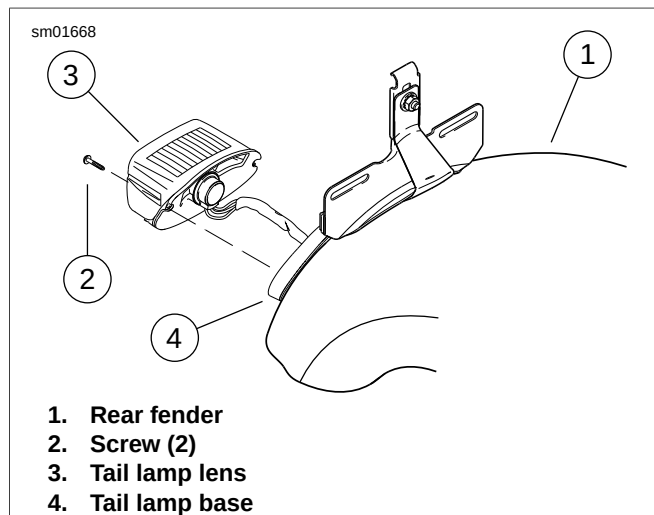


Figure 6-70. Removing/Installing Tail Lamp Lens, Typical: All Models Except XL 1200N

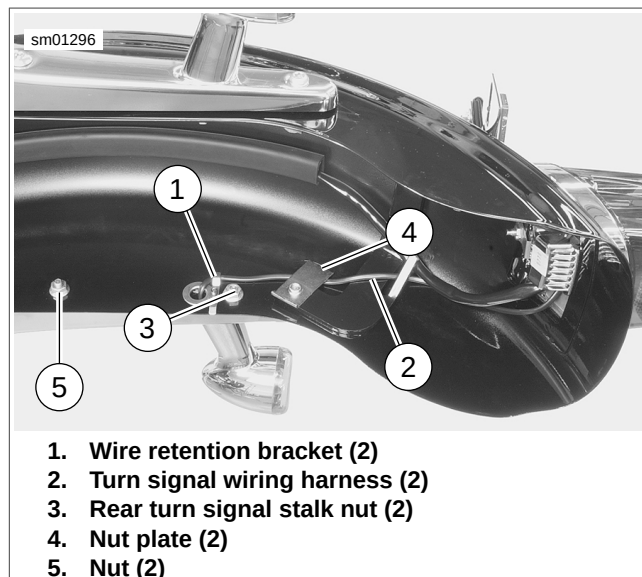


Figure 6-72. Turn Signal Wire Routing: All Models Except XL 1200N and XR 1200

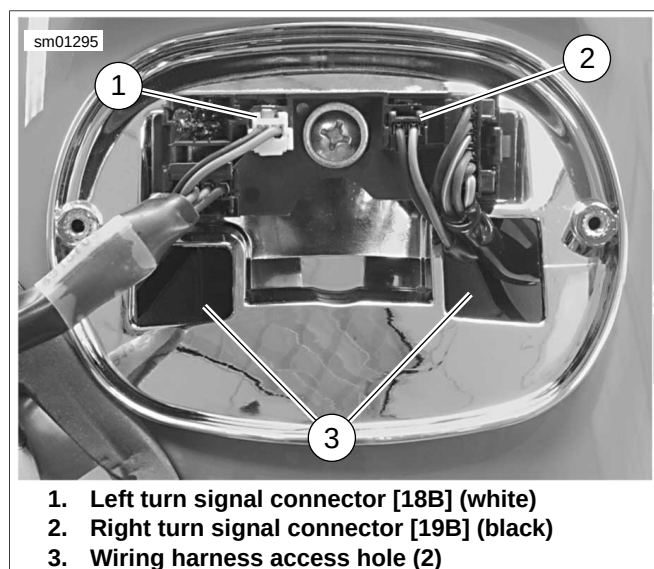


Figure 6-71. Turn Signal Connectors, Typical: All Models Except XL 1200N

Disconnect Wiring: XL 1200N

1. Position vehicle upright on a suitable lift with rear wheel elevated.
2. Remove rear wheel. See [2.4 WHEELS](#).
3. See [Figure 6-73](#). Unplug rear lighting harness connectors [18], [19] (1, 2).
4. See [Figure 6-74](#). Remove left rear lighting harness (3) from harness bracket (1). Repeat this step for right rear lighting harness.
5. Remove lighting harness from lower bracket harness clips (2). Repeat this step for right rear lighting harness.
6. See [Figure 6-75](#). Pull both rear lighting harnesses (2, 3) through feed-through holes (4, 5) in rear fender.
7. Proceed directly to Remove and Disassemble Turn Signal Assembly: All Models.

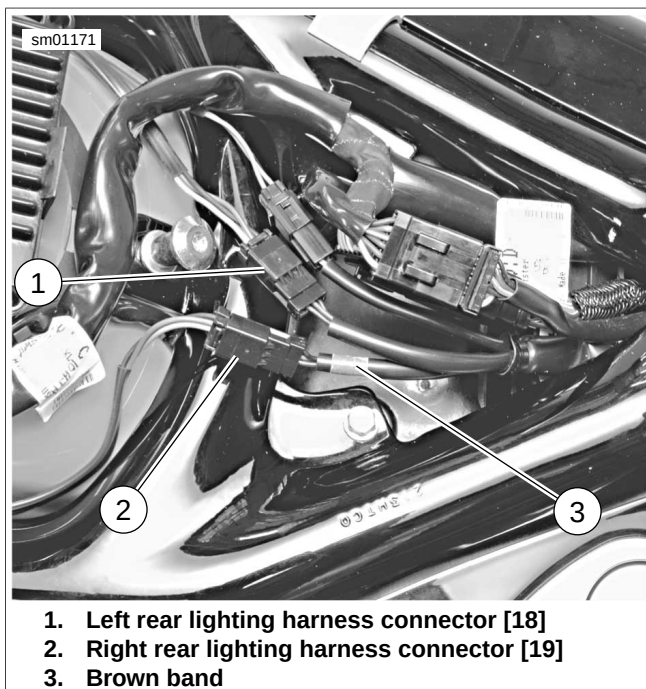


Figure 6-73. Rear Lighting Harness Connectors: XL 1200N

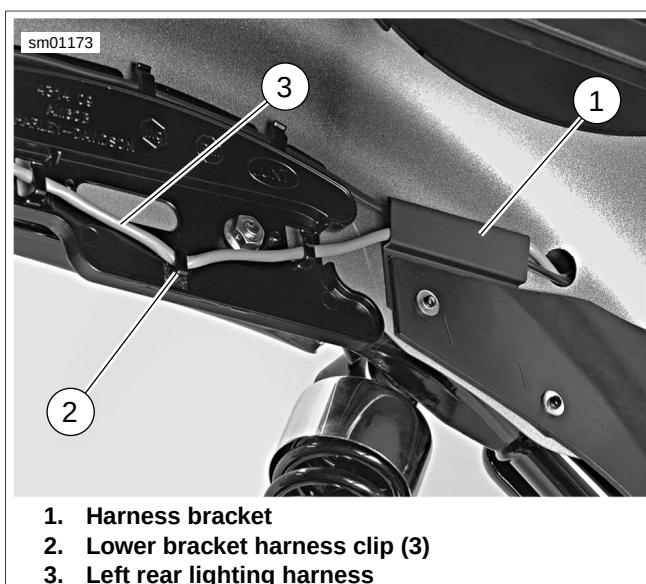


Figure 6-74. Rear Lighting Harness Removal/Installation: XL 1200N (Typical)

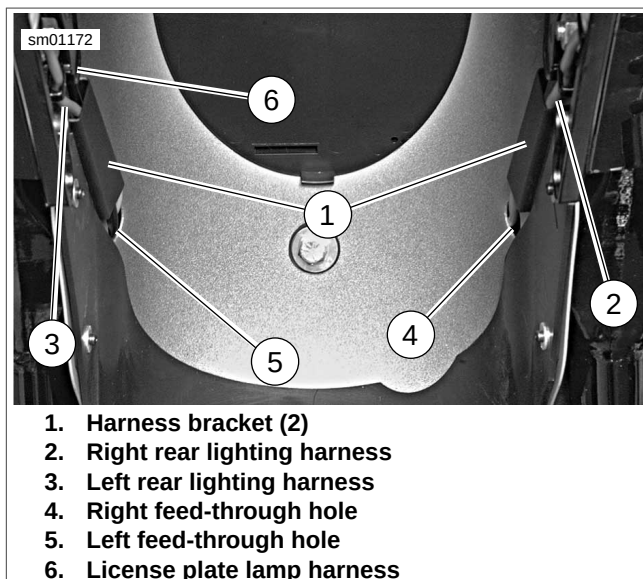


Figure 6-75. Lighting Harnesses and Harness Brackets (View from Inside Rear Fender): XL 1200N

Remove and Disassemble Turn Signal Assembly: All But XR 1200

1. See [Figure 6-76](#). Remove screws (3, 4), washers (5), nuts (7) and nut plate (8). Remove rear fender strut covers (1) with attached turn signal assemblies (2) from rear fender struts. Carefully feed turn signal harnesses through holes in fender and fender struts as you remove the strut cover and turn signal assembly.
2. Remove socket terminals from left and right turn signal connectors [18B], [19B]. See [A.1 AMP MULTILOCK CONNECTORS](#).
3. See [Figure 6-77](#). Unscrew and remove turn signal stalk (5) and fender strut cover from each turn signal assembly. Mount (4) will separate from turn signal housing (3).
4. Lay old turn signal housing and wires next to **new** and cut **new** wires to length. Trim sheath back approximately 2.5 in. (63.5 mm). Crimp **new** terminals onto wires.

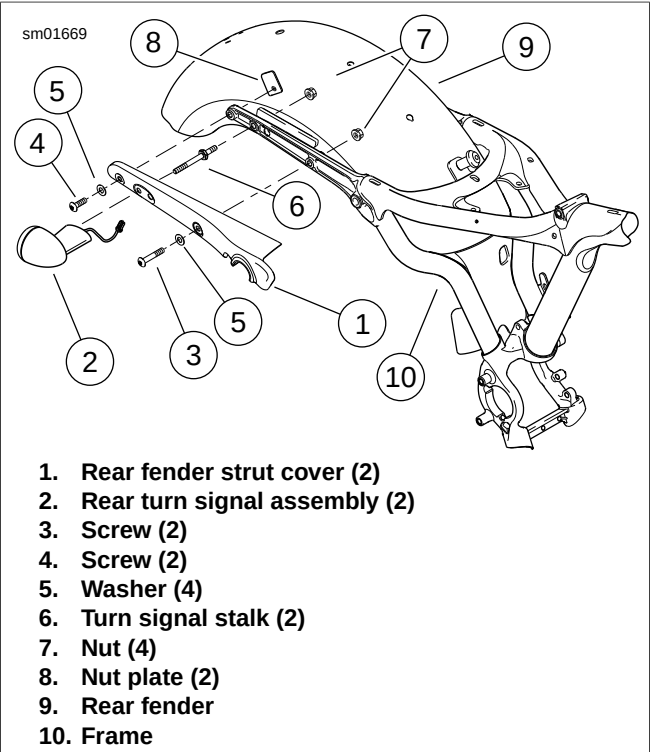


Figure 6-76. Rear Fender Mounting Components: Typical

Reassemble and Install Turn Signal Assembly: All But XR 1200

- See [Figure 6-77](#). Install each turn signal housing (3) and mount (4) to rear fender strut cover (item 1, [Figure 6-76](#)) with turn signal stalk (5). Tighten to 96-156 **in-lbs** (10.9-17.6 Nm).
- Press wiring harness terminal sockets into left and right connector housings [18B], [19B].
 - All models except XL 1200N:** Refer to [Table 6-13](#).
 - XL 1200N (Domestic):** Refer to [Table 6-14](#).
 - XL 1200N (HDI):** Refer to [Table 6-15](#).
- Install rear fender strut covers over fender struts. Push turn signal wiring harness through appropriate hole in strut and fender.
- See [Figure 6-76](#). Thread nut (7) onto turn signal stalk (6) from inside fender. Finger-tighten nut only at this time.
- Secure fender to each fender strut with screw (3), washer (5) and nut (7) in fender mounting hole. Install screw (4), washer and nut plate (8) in aft mounting hole. Finger-tighten screws only at this time.

Table 6-13. Rear Turn Signal Connector Wire Colors: All Models Except XL 1200N

ITEM	WIRE COLOR	CAVITY
Left turn signal [18] (white)	V	1
	BK	2
Right turn signal [19] (black)	V	1
	BK	2

Table 6-14. Rear Lighting Connector Wire Colors: XL 1200N (Domestic)

ITEM	WIRE COLOR	CAVITY
Left turn signal/brake/tail lamp [19]	BK	1
	V	2
	BE	3
Right turn signal/brake/tail lamp [18] (brown band on harness)	BK	1
	V	2
	BE	3

Table 6-15. Rear Lighting Connector Wire Colors: XL 1200N (HDI)

ITEM	WIRE COLOR	CAVITY
Left turn signal/brake/tail lamp [19]	BK	1
	V	2
	O/W	3
Right turn signal/brake/tail lamp [18] (brown band on harness)	R/Y	4
	BK	1
	BN	2
	O/W	3
	R/Y	4

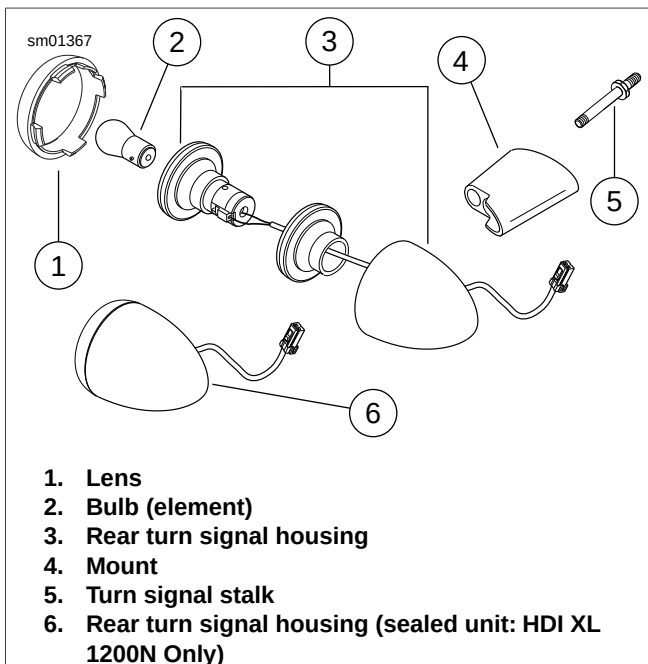


Figure 6-77. Rear Turn Signal Components

NOTE

XL 1200N (Domestic): see [Figure 6-78](#). Make certain that tab (3) on nut plate (2) fits into slot (4) in fender brace (1) when securing nut plate with rearmost fender mounting screw (5).

6. Now tighten mounting screws in the following sequence:
 - a. Tighten turn signal stalk nuts to 132-216 **in-lbs** (14.9-24.4 Nm).
 - b. Tighten strut cover screws to 132-216 **in-lbs** (14.9-24.4 Nm).

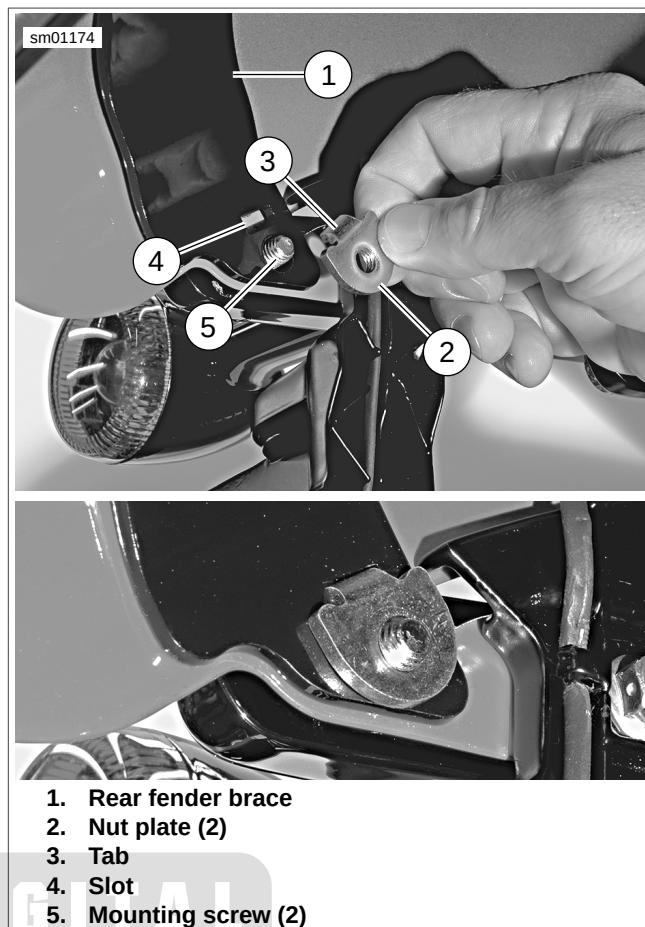


Figure 6-78. Rear Fender Nut Plate: XL 1200N (Domestic Only)

Remove and Disassemble Turn Signal Assembly: XR 1200

1. Remove socket terminals from left and right turn signal connectors. See [A.1 AMP MULTILOCK CONNECTORS](#).
2. See [Figure 6-79](#). Remove screws ((6), plate (4), reflector (3) and turn signal housing (2).
3. Lay old turn signal housing and wires next to **new** and cut **new** wires to length. Trim sheath back approximately 2.5 in. (63.5 mm). Crimp **new** terminals onto wires.

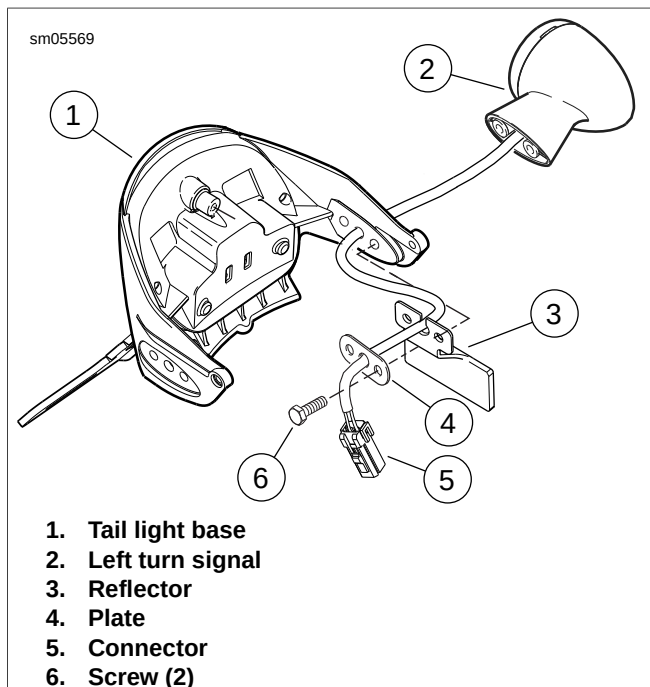


Figure 6-79. Turn Signal Housing Removal: XR 1200

Reassemble and Install Turn Signal Assembly: XR 1200

1. See [Figure 6-79](#). Install turn signal housing (2), reflector (3), and plate (4) with screws (6). Tighten screws to 30-40 in-lbs (3.4-4.5 Nm).
2. Press wiring harness terminal sockets into left and right connector housings [18B], [19B]. Refer to [Table 6-13](#).

Connect Wiring: All Models Except XL 1200N

1. **All but XR 1200:** See [Figure 6-72](#). Engage turn signal wiring harness (2) in wire retention bracket (1) on each side of rear fender.
2. See [Figure 6-71](#). Push left and right turn signal wiring harnesses through corresponding harness access holes (3) in tail lamp base.
3. Plug left turn signal connector [18] (1) and right connector [19] (2) into left and right sockets located on rear lighting circuit board in tail lamp base.
4. See [Figure 6-70](#). Attach tail lamp lens (3) to tail lamp base (4) with two screws (2).

5. Proceed directly to Final Assembly: All Models.

Connect Wiring: XL 1200N

1. See [Figure 6-75](#). Insert each rear lighting harness (2, 3) through feed-through holes (4, 5) in rear fender.
2. See [Figure 6-74](#). Install left rear lighting harness (3) into lower bracket harness clips (2). Repeat this step for right rear lighting harness.
3. Install left rear lighting harness into harness bracket (1). Repeat this step for right rear lighting harness.
4. See [Figure 6-73](#). Plug in both rear lighting harness connectors [18], [19] (1, 2). Note that right rear lighting harness connector mates with connector with brown band (3) on harness.
5. Install rear wheel. See [2.4 WHEELS](#). Make certain rear wheel is properly aligned and rear drive belt is properly tensioned. See [1.16 REAR BELT DEFLECTION](#).
6. Remove vehicle from lift.
7. Proceed directly to Final Assembly: All Models.

Final Assembly: All Models

1. Install main fuse. See [6.38 MAIN FUSE](#).

⚠ WARNING

Be sure headlamp, tail and stop lamp and turn signals are operating properly before riding. Poor visibility of rider to other motorists can result in death or serious injury. (00478b)

2. Turn ignition/light switch ON and check rear lighting.
 - a. Make sure tail lamp is lit. **XL 1200N:** make sure both tail lamps are lit.
 - b. Depress turn signal switches and make sure all turn signals are operating properly.
 - c. Operate front or rear brake and make sure brake lamp illuminates. **XL 1200N:** make sure both brake lamps illuminate.

⚠ WARNING

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

3. Install seat, if removed.

LICENSE PLATE LAMP MODULE: XL 1200N

6.25

GENERAL

Unlike all other XL models, the XL 1200N is equipped with a convertible side-mount license plate bracket that incorporates a separate license plate lamp module. The module contains two LEDs which are not individually replaceable. If they fail, replace the lamp module.

REMOVAL (DOMESTIC ONLY)

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Unplug main fuse. See [6.38 MAIN FUSE](#).
2. Position motorcycle upright on suitable lift with rear wheel elevated.
3. Remove rear wheel. See [2.4 WHEELS](#).
4. Remove seat.
5. See [Figure 6-80](#). Unplug license plate lamp connector [40].
6. See [Figure 6-81](#). Carefully pull license plate lamp harness (6) through feed-through hole (5) on left side of fender.
7. Remove license plate lamp harness from fender harness clip (1) on left side of fender.
8. See [Figure 6-82](#). Remove license plate lamp harness (3) from upper license plate bracket harness clips (1) and harness channel (2).
9. Remove two screws (4) and license plate lamp module (5) from license plate bracket.

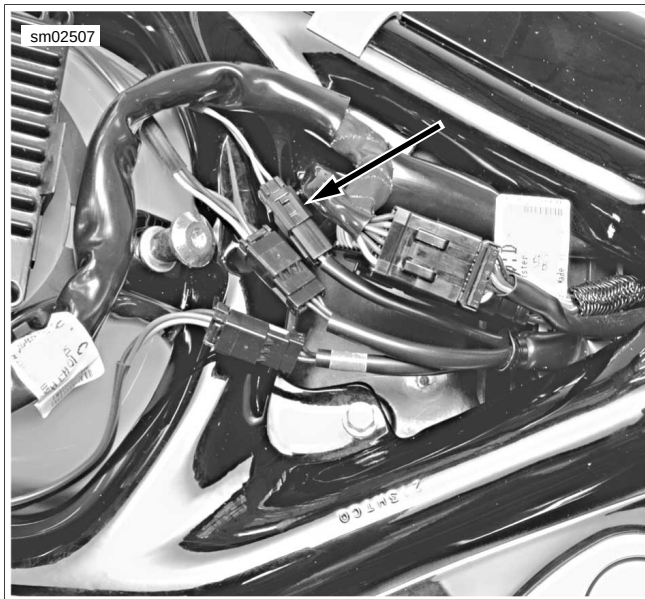
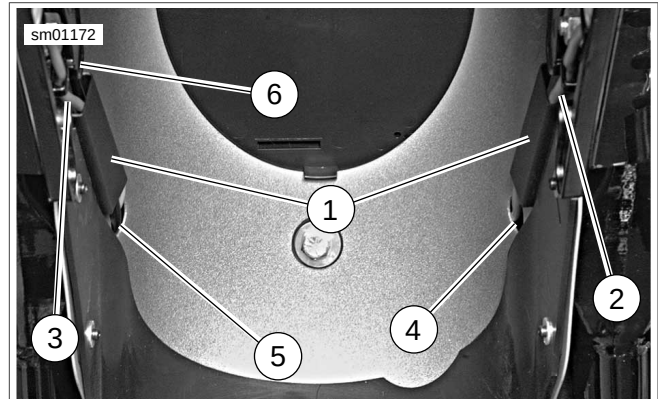
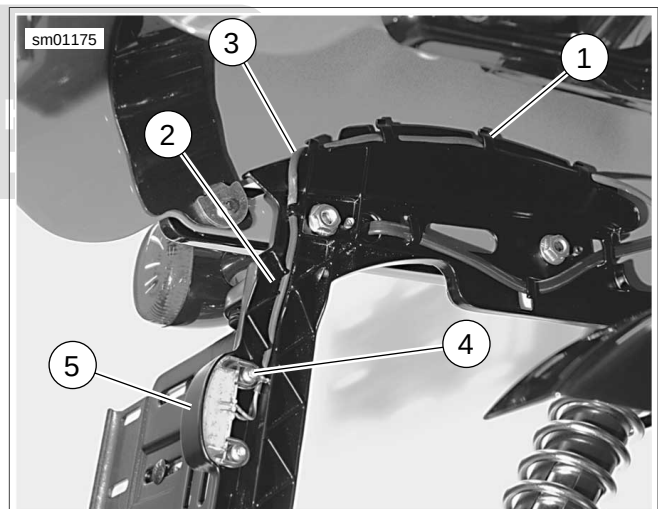


Figure 6-80. License Plate Lamp Connector [40]



1. Harness bracket (2)
2. Right rear lighting harness
3. Left rear lighting harness
4. Right feed-through hole
5. Left feed-through hole
6. License plate lamp harness

Figure 6-81. Lighting Harnesses and Harness Brackets (View from Inside Rear Fender): XL 1200N



1. Upper license plate bracket harness clip (5)
2. Harness channel
3. License plate lamp harness
4. Screw (2)
5. License plate lamp module

Figure 6-82. Removing/Installing License Plate Lamp Module: XL 1200N

INSTALLATION (DOMESTIC ONLY)

1. See [Figure 6-82](#). Install **new** license plate lamp module (5) into convertible side mount license plate bracket. Secure with two screws (4).
2. Feed license plate lamp harness (3) up through harness channel (2). Insert harness into upper license plate bracket harness clips (1).

3. See [Figure 6-81](#). Insert license plate lamp harness (6) into fender harness clip (1) on left side of fender.
4. Feed harness through feed-through hole (5) on left side of rear fender.
5. See [Figure 6-80](#). Plug in license plate lamp connector [40].

⚠ WARNING

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

6. Install seat.
7. Install rear wheel. See [2.4 WHEELS](#). Make certain rear wheel is properly aligned and rear drive belt is properly tensioned. See [1.16 REAR BELT DEFLECTION](#).
8. Plug in main fuse. See [6.38 MAIN FUSE](#).
9. Remove vehicle from lift.

⚠ WARNING

Be sure headlamp, tail and stop lamp and turn signals are operating properly before riding. Poor visibility of rider to other motorists can result in death or serious injury. (00478b)

10. Turn ignition switch ON. Verify that license plate lamp module is operating properly. Turn ignition switch OFF.

REMOVAL (HDI ONLY)

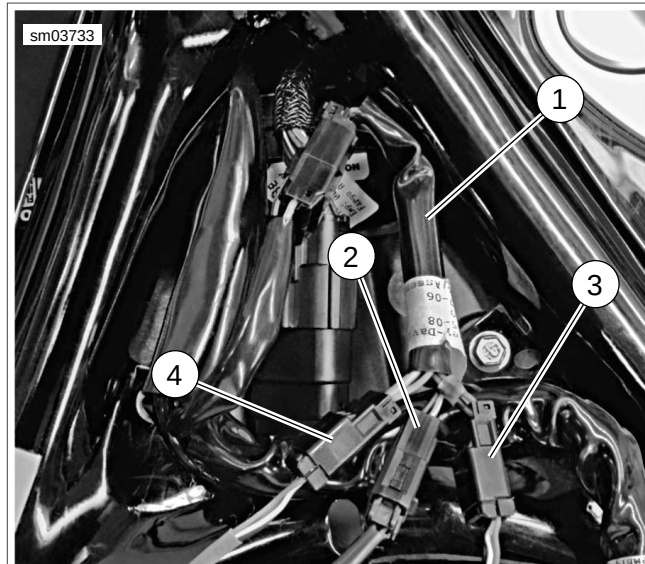
See [Figure 6-83](#). The XL 1200N built for international markets incorporates a center-mounted license plate holder and lamp assembly.



Figure 6-83. License Plate Holder and Lamp Assembly: XL 1200N (HDI)

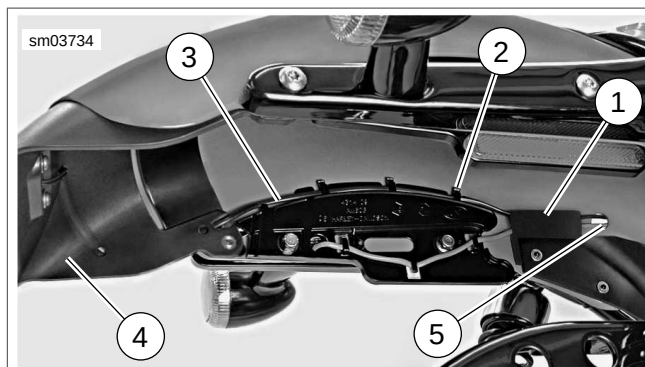
1. Position vehicle upright on a suitable lift. Unplug main fuse. See [6.38 MAIN FUSE](#).
2. Remove seat. See [2.38 SEAT: XL MODELS](#).
3. Remove rear wheel. See [2.4 WHEELS](#).
4. See [Figure 6-84](#). Unplug license plate lamp harness connector [40] (2).

5. See [Figure 6-85](#). Remove license plate lamp harness (3) from harness bracket (1) and three harness clips (2). Feed harness and connector in through hole in rear fender.
6. See [Figure 6-86](#). Remove two fender support screws with washers (4). Remove screw with washer (5) securing rear fender to fender brace (2). Remove fender brace and license plate holder assembly (1) from vehicle.



1. Interconnect harness
2. License plate lamp harness connector [40]
3. Right turn signal/brake/tail lamp harness connector [19]
4. Left turn signal/brake/tail lamp harness connector [18]

Figure 6-84. Rear Lighting Interconnect Harness: XL 1200N (HDI)



1. Harness bracket
2. Harness clip (3)
3. License plate lamp harness
4. License plate holder
5. Feedthrough hole

Figure 6-85. License Plate Holder and Lamp Harness Mounting: XL 1200N (HDI)

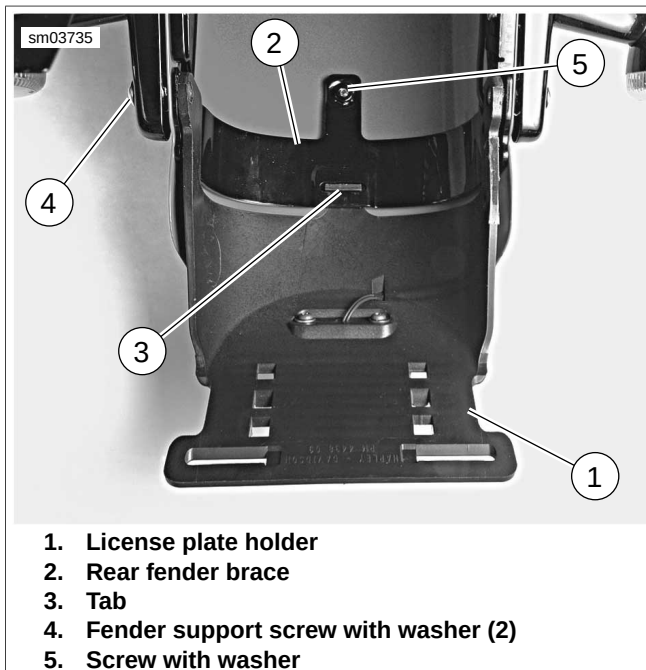


Figure 6-86. License Plate Holder: XL 1200N (HDI)

7. See [Figure 6-87](#). Remove two screws with washers (2) securing license plate lamp housing to license plate holder (1). See [Figure 6-88](#). Separate lamp housing (3) and gasket (2) from license plate holder (1).



Figure 6-87. License Plate Holder and Lamp Mounting Screws: XL 1200N (HDI)

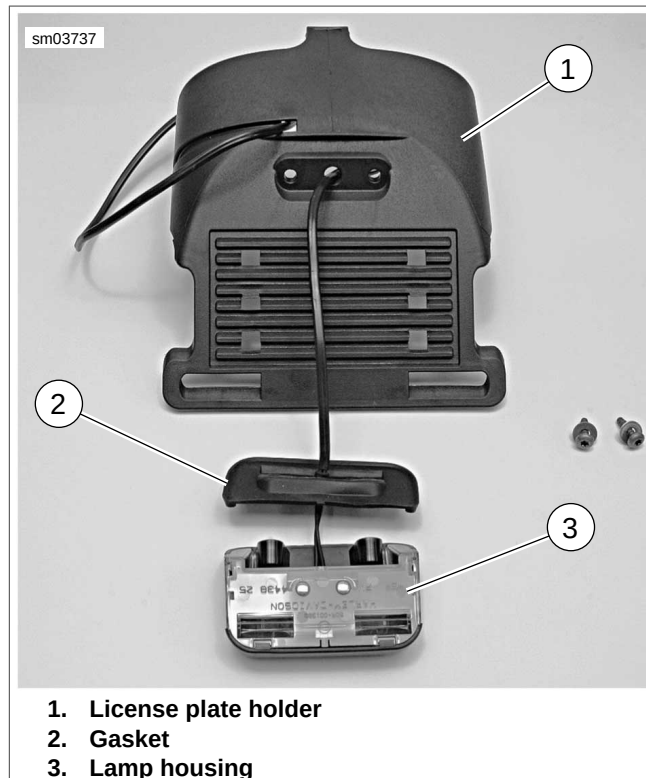


Figure 6-88. Lamp Housing Separated from License Plate Holder: XL 1200N (HDI)

8. See [Figure 6-89](#). Insert the tip of a small flat bladed screwdriver (3) into each slot (2) in lamp housing. Gently tilt screwdriver handle outward (away from lamp housing) just enough to disengage housing from cover. Separate housing from cover and slide housing away from tabs (4) in cover.
9. See [Figure 6-90](#). If replacing a light bulb (2), gently pull bulb straight out of socket assembly (3). Push **new** light bulb into socket.

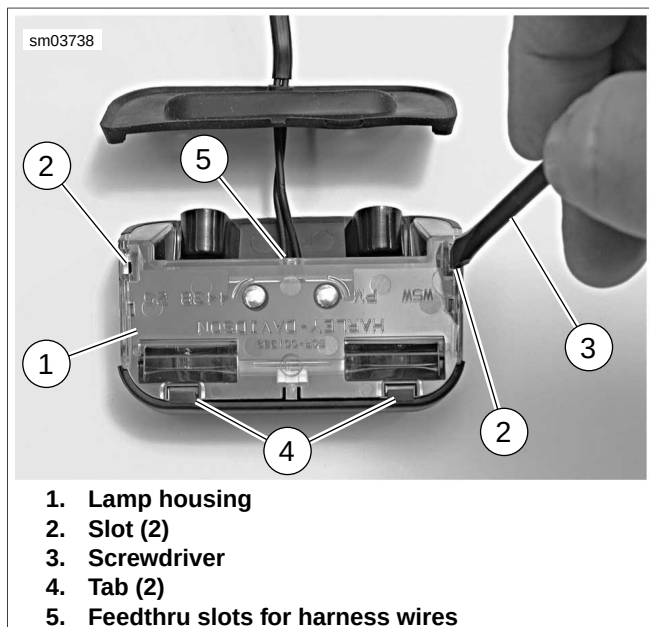


Figure 6-89. Removing License Plate Lamp Housing Cover: XL 1200N (HDI)



Figure 6-90. Replacing License Plate Light Bulbs: XL 1200N (HDI)

INSTALLATION (HDI ONLY)

1. If reusing license plate lamp housing, see [Figure 6-90](#). Carefully fit housing cover (4) onto lamp housing (1), sliding tabs on cover (5) into slots (6) in housing. Make sure harness wires fit into feedthrough slots in housing. Gently snap cover onto housing, being careful not to pinch wires.
2. See [Figure 6-88](#). Fit gasket (2) onto lamp housing (3).

3. See [Figure 6-87](#). Install lamp housing onto license plate holder (1) with lamp housing cover facing upward. Secure with two screws (2). Tighten to 14-16 **in-lbs** (1.2-1.3 Nm).
4. See [Figure 6-86](#). Fit tab (3) on license plate holder (1) into slot in rear fender brace (2). Install assembly onto vehicle. Install screw with washer (5) through fender and into fender brace. Tighten only finger-tight at this time.
5. Install two screws with washers (4) through fender struts, fender, fender brace and into threaded inserts in license plate holder. See [Figure 6-91](#). Make sure license plate holder threaded inserts (3) fit into holes (4) in fender brace (2). Tighten to 132-216 **in-lbs** (14.9-24.4 Nm).
6. Now tighten screw securing fender to center of fender brace to 20-25 **in-lbs** (2.3-2.8 Nm).
7. See [Figure 6-85](#). Install license plate lamp harness (3) into three clips (2) in fender bracket. Feed harness and connector through feedthrough hole (5) in fender. Press harness into harness bracket (1).
8. See [Figure 6-84](#). Plug license plate lamp harness connector [40B] into interconnect harness connector [40B] (2).
9. Install rear wheel. See [2.4 WHEELS](#).

WARNING

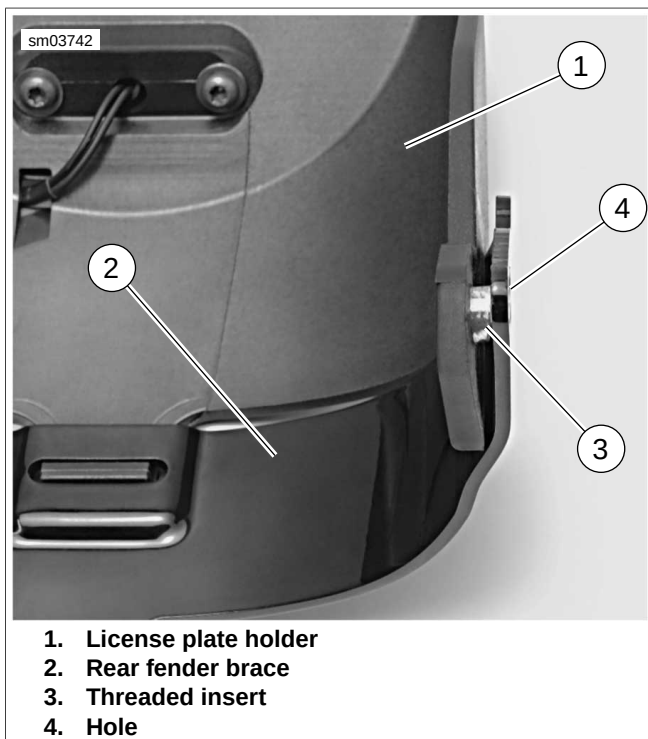
After installing seat, pull upward on seat to be sure it is locked in position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070b)

10. Install seat. See [2.38 SEAT: XL MODELS](#).
11. Plug in main fuse. See [6.38 MAIN FUSE](#).

WARNING

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

12. Turn ignition switch to IGNITION and check license plate lamp to make sure both bulbs are lit. Turn ignition switch OFF.



**Figure 6-91. License Plate Holder and Rear Fender Brace:
XL 1200N (HDI)**



REAR LIGHTING CONVERTER MODULE: XL 1200N (DOMESTIC ONLY)

6.26

GENERAL

NOTE

HDI XL 1200N models are equipped with a sealed LED tail lamp, brake lamp and turn signal assembly in each rear turn signal housing. Instead of a rear lighting converter module, this model is equipped with an interconnect harness between main harness rear lighting connector [7B] and the turn signal [18] and [19] and license plate lamp [40] harness connectors.

The domestic XL 1200N rear turn signal lamps also serve as tail lamps and brake lamps. Dual filament bulbs provide these features; one filament provides the tail lamp function while the other filament provides the dual function of turn signal and brake lamp.

In order for a single filament to function both as turn signal and brake lamp, a converter module is required. See [Figure 6-92](#). The converter module (1) is incorporated into an interconnect harness that connects the main wiring harness to the rear lighting harnesses.

See [Figure 6-93](#). The converter module (3) is located in front of the battery, under the frame "Y" section.

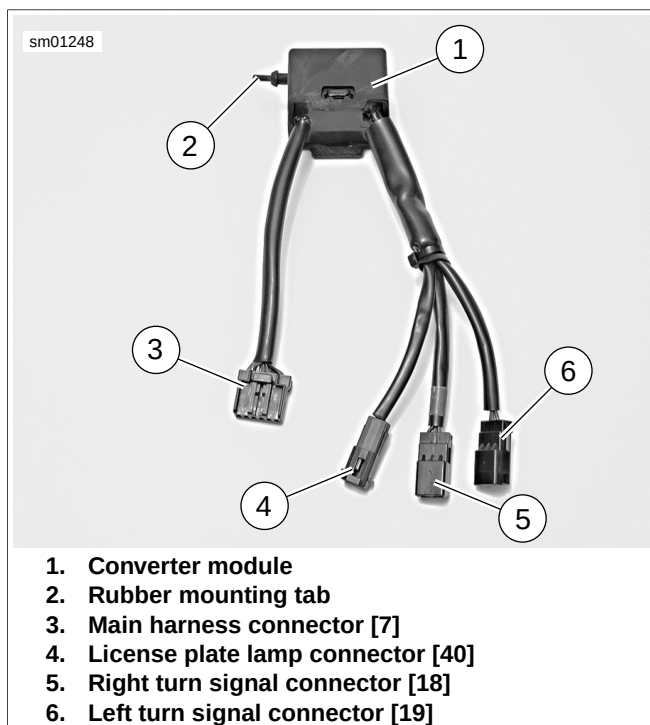


Figure 6-92. Converter and Interconnect Harness

REMOVAL

1. Remove seat.
2. Open left side cover. See [2.20 LEFT SIDE COVER](#).

⚠ WARNING

Prevent accidental vehicle start-up, which could cause death or serious injury. First disconnect negative (-) battery cable at engine and then positive (+) cable from battery. (00280b)

3. Remove battery. See [1.17 BATTERY MAINTENANCE](#).
4. See [Figure 6-94](#). Unplug the following harness connectors:
 - a. Left rear lighting harness [19] (1)
 - b. Right rear lighting harness [18] (2)
 - c. License plate lamp harness [40] (3)
 - d. Main wiring harness [7] (4)
5. See [Figure 6-95](#). Push in on converter module rubber mounting tab to release it from hole in frame.
6. See [Figure 6-96](#). Reach up under frame "Y" section and pull converter module down. Carefully remove module and interconnect harness assembly from vehicle.

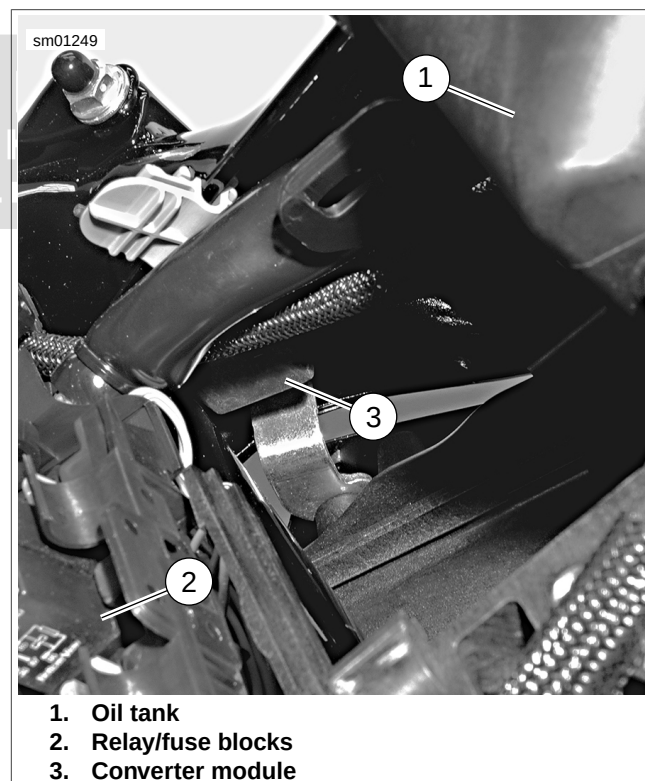


Figure 6-93. Converter Module Location

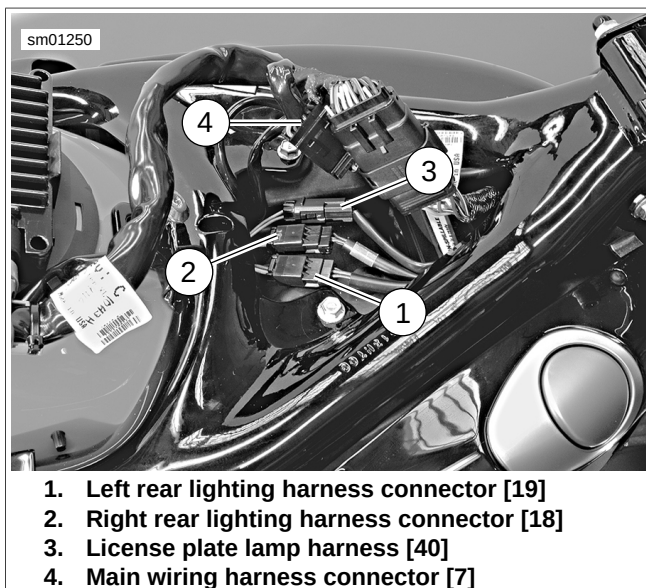


Figure 6-94. Rear Lighting Harness Connectors: XL 1200N

INSTALLATION

1. See [Figure 6-96](#). Feed converter module/interconnect harness connectors up through battery compartment, forward of battery strap bracket.
2. Position converter module up inside frame, under "Y" section. See [Figure 6-95](#). Pull rubber mounting tab through hole in frame to secure module.
3. See [Figure 6-94](#). Plug in the following harness connectors:
 - a. Left rear lighting harness [19] (1)
 - b. Right rear lighting harness [18] (2)
 - c. License plate lamp harness [40] (3)
 - d. Main wiring harness [7] (4)
4. Install battery and connect battery cables. See [1.17 BATTERY MAINTENANCE](#).

WARNING

Be sure headlamp, tail and stop lamp and turn signals are operating properly before riding. Poor visibility of rider to other motorists can result in death or serious injury. (00478b)

5. Close left side cover. See [2.20 LEFT SIDE COVER](#).

6. Turn ignition switch ON and test rear lighting functions. Make sure tail lamps, brake lamps and turn signals operate properly. Make sure license plate lamp is illuminated. Turn ignition switch OFF.

WARNING

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

7. Install seat.

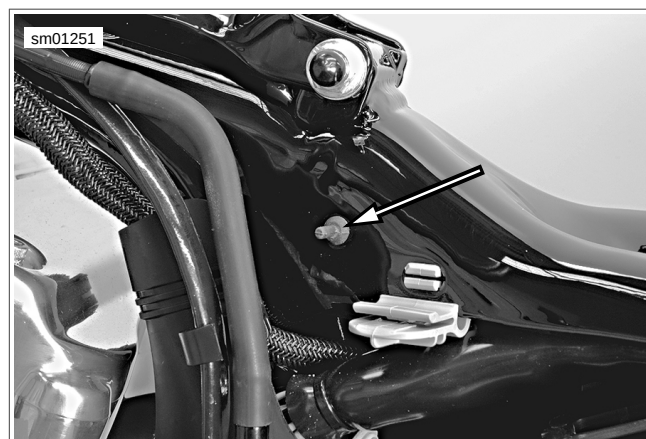


Figure 6-95. Converter Module Rubber Mounting Tab

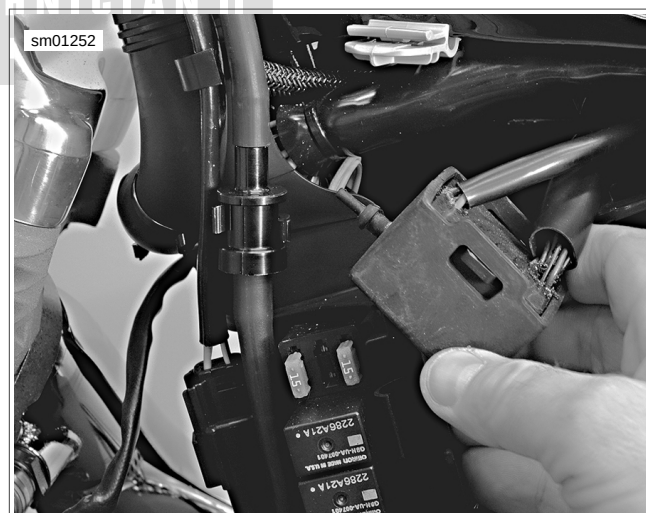


Figure 6-96. Removing/Installing Converter Module

REAR STOP LAMP SWITCH

6.27

GENERAL

XL models only: See [Figure 6-97](#). The rear stop lamp switch (3) is located behind the rear brake master cylinder reservoir under the left side cover. The rear stop lamp switch is threaded into a tee nut in the rear brake line.

XR models only: The rear stop lamp switch is located underneath the motorcycle near the rear brake master cylinder reservoir. The rear stop lamp switch is threaded into a tee nut in the rear brake line.

The stop lamp switch is an open type switch which closes with hydraulic pressure. When the pressure in the line reaches a preset level, the rear stop lamp switch is tripped and the rear stop lamp illuminates.

NOTE

The rear stop lamp switch cannot be repaired. Replace the unit if it fails.

REPLACEMENT

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Remove left side cover. See [2.20 LEFT SIDE COVER](#). Remove main fuse. See [6.38 MAIN FUSE](#).
2. **XL models only:** move rear brake master cylinder reservoir out of the way:
 - a. Remove the rear brake master cylinder reservoir cover; grasp cover and pull straight away from reservoir.
 - b. Remove reservoir mounting screw and secure reservoir upright out of the way. See [2.15 REAR BRAKE MASTER CYLINDER RESERVOIR](#).
3. See [Figure 6-97](#) or [Figure 6-98](#). Pull terminal sockets from spade connections (4) on stop lamp switch.
4. Remove stop lamp switch (3) from tee nut (2).
5. Thread **new** stoplight switch (3) to tee nut (2) on brake line. Tighten switch to 84-120 **in-lbs** (9.5-13.6 Nm).
6. Install terminal sockets on switch spade connections (4).
7. **XL models only:** Install rear brake master cylinder reservoir:
 - a. Replace the reservoir mounting screw. Tighten to 20-25 **in-lbs** (2.3-2.8 Nm).
 - b. Replace the plastic guard around the reservoir.
8. Install main fuse. Install left side cover.

WARNING

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

9. Refill master cylinder and bleed brakes. See [1.8 BLEEDING HYDRAULIC BRAKE SYSTEM](#). Test operation of rear brake.

WARNING

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

10. Test operation of brake lamp with the rear brake applied and the ignition/light switch turned ON.

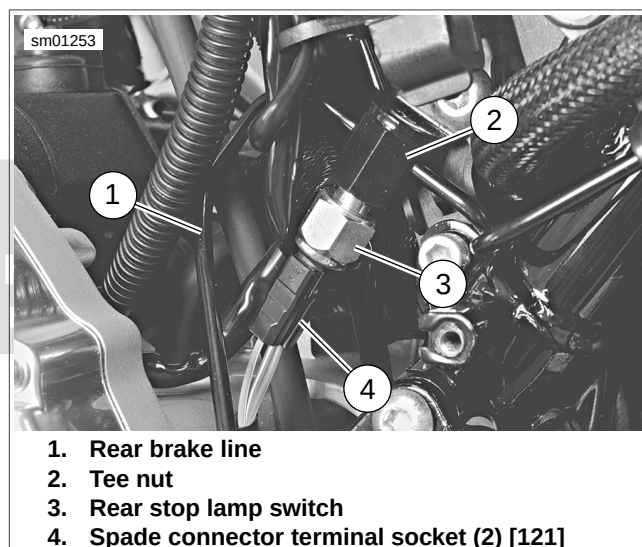


Figure 6-97. Rear Stop Lamp Switch: XL Models Only

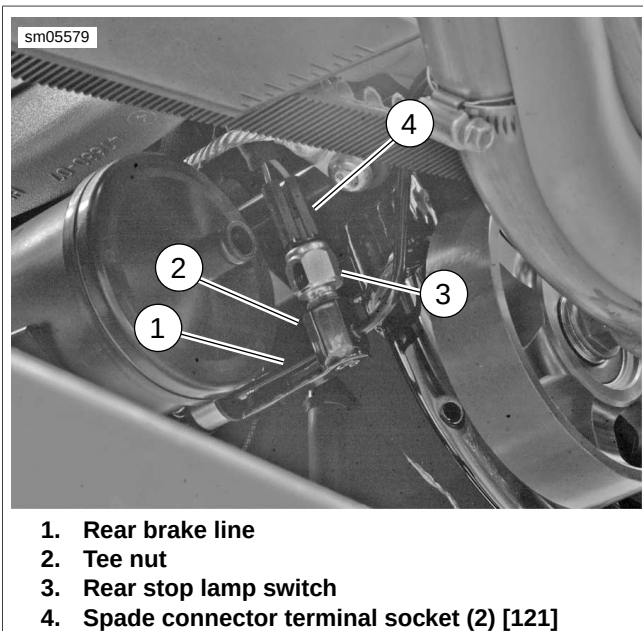


Figure 6-98. Rear Stop Lamp Switch: XR Models Only



CRANK POSITION SENSOR (CKP)

6.28

GENERAL

The crank position (CKP) sensor is a variable reluctance (VR) sensor that generates an AC signal by sensing the passing of the 30 teeth cast into the engine's left side flywheel. Two consecutive teeth are missing in the flywheel to establish a reference point. The CKP sensor sends a signal to the Electronic Control Module (ECM). This signal is used to reference engine position (TDC) and engine speed. The CKP sensor is located near the lower front left corner of the engine crankcase.

NOTE

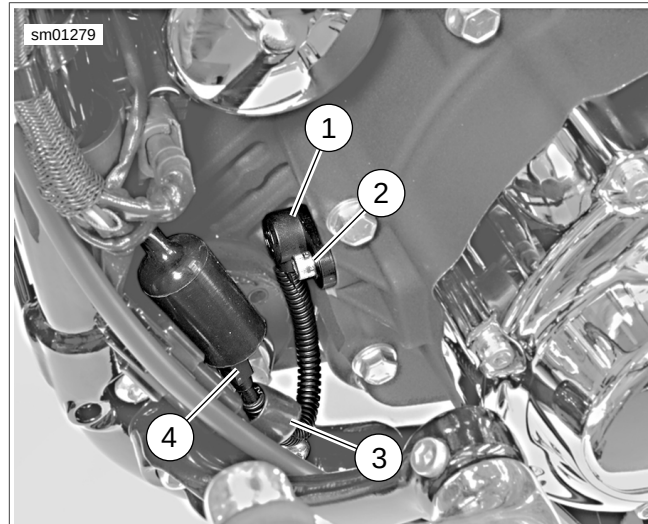
The crank position sensor cannot be repaired. Replace the unit if it fails.

REMOVAL

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Unplug main fuse. See [6.38 MAIN FUSE](#).
2. See [Figure 6-99](#). Disconnect CKP sensor harness connector [79A] from wiring harness connector [79B] (4), located along left frame downtube.
3. Remove CKP wire harness from j-clip (3).
4. Remove screw (2). Carefully remove CKP sensor (1) and o-ring from engine crankcase.



1. Crank position (CKP) sensor
2. Screw
3. Wire harness j-clip
4. CKP sensor harness connector [79] (under protective rubber boot)

Figure 6-99. Crank Position (CKP) Sensor (Typical, XL Model Shown)

INSTALLATION

NOTE

The CKP sensor o-ring has a blue teflon coating that provides lubrication during installation. It is not necessary to coat the o-ring with engine oil or other lubricant to install it.

1. See [Figure 6-99](#). Carefully install CKP sensor (1) and o-ring into engine crankcase with screw (2). Tighten to 80-100 **in-lbs** (9.0-11.3 Nm).
2. Route CKP sensor wiring harness through j-clip (3).
3. Attach CKP sensor harness connector [79A] to wiring harness connector [79B] (4).
4. Plug in main fuse. See [6.38 MAIN FUSE](#).
5. Start engine and verify operation.

ALTERNATOR

6.29

REMOVAL AND DISASSEMBLY

1. Open left side cover. See [2.20 LEFT SIDE COVER](#).

⚠ WARNING

Prevent accidental vehicle start-up, which could cause death or serious injury. First disconnect negative (-) battery cable at engine and then positive (+) cable from battery. (00280b)

2. Disconnect negative battery cable from crankcase. Disconnect positive (+) battery cables from battery. See [1.17 BATTERY MAINTENANCE](#). Close left side cover.
3. Remove primary cover. See [5.3 PRIMARY CHAIN ADJUSTER](#).
4. Remove clutch assembly, primary chain and engine sprocket/rotor assembly as a unit. See [5.5 PRIMARY DRIVE AND CLUTCH: XL MODELS](#) or [5.6 PRIMARY DRIVE AND CLUTCH: XR MODELS](#).
5. Remove/disassemble rotor and/or stator, as required. Refer to the following procedures.

Rotor

1. Remove bolts securing alternator rotor to engine sprocket.
2. See [Figure 6-100](#). 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 6-101](#). Open external latch (4) and unplug stator harness (2) connector [46B] from voltage regulator harness (3) connector [46A] (1). See [6.3 VOLTAGE REGULATOR](#) for procedure.
2. Make note of cable strap positions and remove cable straps from stator harness.
3. Withdraw stator harness from opening between right crankcase half and gear case cover.
4. See [Figure 6-102](#). Using a T-27 TORX driver, remove and discard screws (3) securing stator to left crankcase half.
5. Remove two screws (9) and harness retainer (8).
6. Remove stator harness grommet (10) from left crankcase half.
7. Withdraw stator harness from grommet hole in left crankcase half. Remove stator.

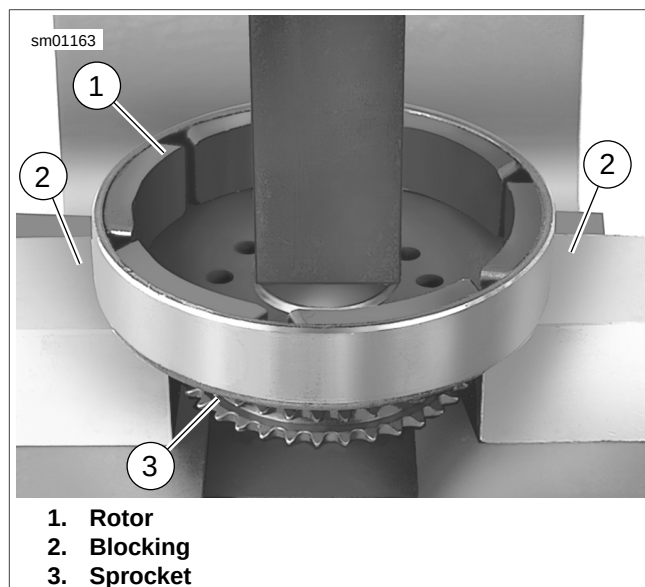


Figure 6-100. Removing Rotor from Sprocket

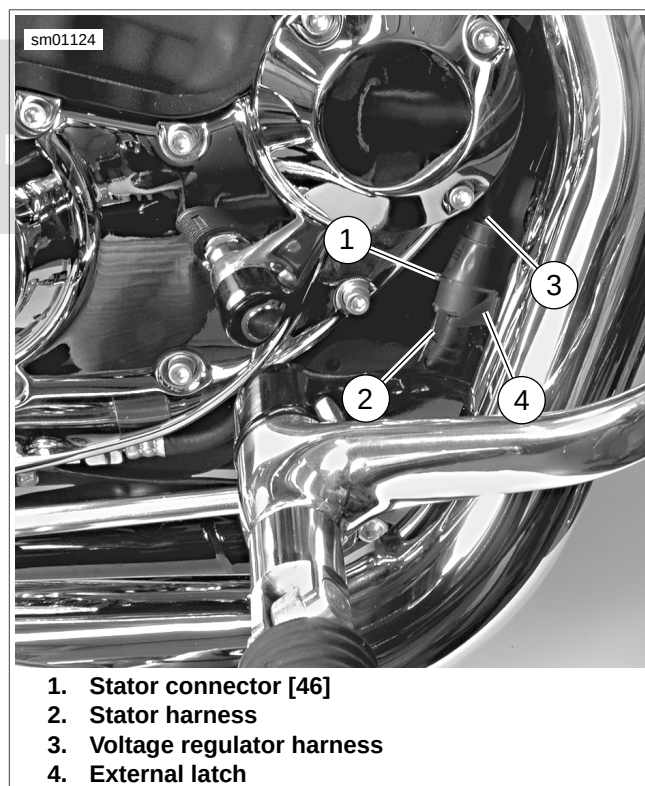
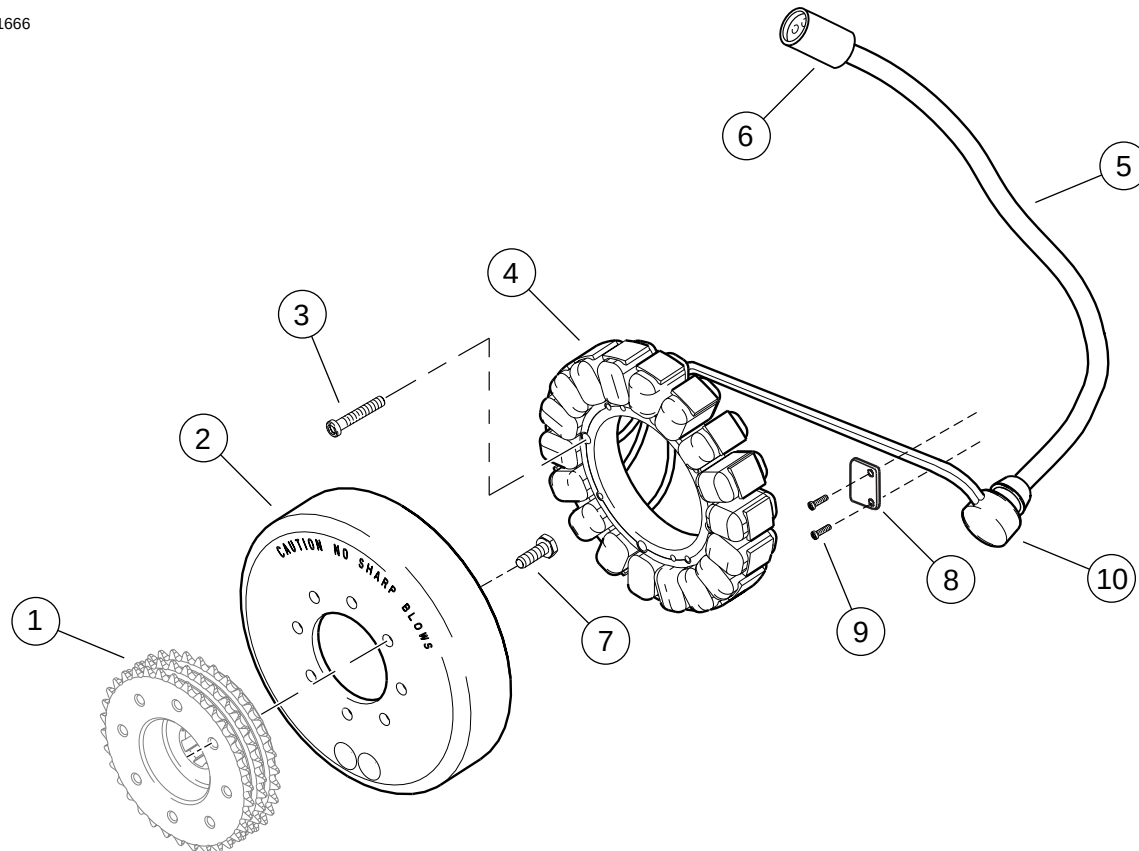


Figure 6-101. Stator Connector Location (Typical, XL Models Shown)

sm01666



1. Motor sprocket
2. Rotor
3. Screw (4)
4. Stator
5. Stator wiring harness
6. Connector [46B]
7. Bolt (8)
8. Stator harness retainer
9. Screw (2)
10. Stator harness grommet



Figure 6-102. Alternator Components

CLEANING AND INSPECTION

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, perform the applicable procedures which follow:

Stator

1. See [Figure 6-102](#). Feed stator wiring harness (5) with attached grommet (10) into open grommet hole in left crankcase half.
2. Apply a light coating of clean engine oil or chaincase lubricant to grommet. Press grommet into hole in left crankcase half.
3. Position stator (4) on left crankcase half. Secure stator using **new** TORX screws. Use TORX driver to tighten screws to 30-40 **in-lbs** (3.4-4.5 Nm).
4. Position stator harness retainer (8) over harness and onto engine crankcase with mounting holes facing aft. Secure with two screws (9). Make sure harness is not pinched. Tighten screws to 56 **in-lbs** (6.3 Nm) (maximum). Do not exceed torque specification.
5. Route stator wiring harness across top of crankcase halves to right side of engine. Route stator harness downward

through opening between right crankcase half and gear-case cover.

6. Route stator harness forward and then upward along inboard side of right frame downtube.
7. See [Figure 6-101](#). Connect stator harness (2) to voltage regulator harness (3) at connector [46] (1) and lock external latch (4) in place. See [6.3 VOLTAGE REGULATOR](#) for procedure.
8. Secure stator harness and neutral switch with cable straps as noted from stator removal.

Rotor

1. See [Figure 6-103](#). 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.
2. Position a section of pipe (3) with an inside diameter larger than the sprocket mounting hub over center of rotor.
3. Press rotor onto sprocket. Tighten screws to 120-140 in-lbs (13.6-15.8 Nm).

Final Assembly

1. Install clutch assembly, primary chain and engine sprocket/rotor assembly as a unit. See [5.5 PRIMARY DRIVE AND CLUTCH: XL MODELS](#) or [5.6 PRIMARY DRIVE AND CLUTCH: XR MODELS](#).
2. Install primary cover, left footrest assembly and gear shift lever. See [5.3 PRIMARY CHAIN ADJUSTER](#).
3. Open left side cover. See [2.20 LEFT SIDE COVER](#).

⚠ WARNING

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

4. Connect battery cables, positive (+) cable first. See [1.17 BATTERY MAINTENANCE](#). Close left side cover.
5. Test charging system. See ELECTRICAL DIAGNOSTIC MANUAL.

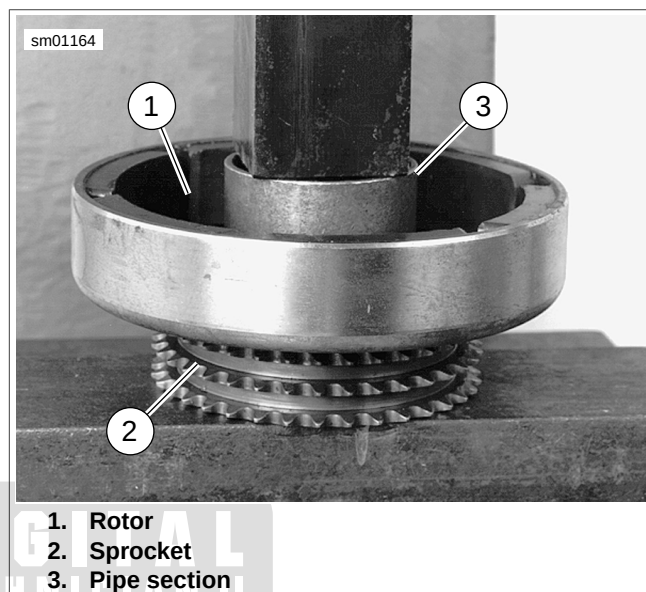


Figure 6-103. Pressing Rotor onto Sprocket

VEHICLE SPEED SENSOR (VSS)

6.30

GENERAL

The vehicle speed sensor (VSS) is powered and monitored by the Electronic Control Module (ECM). The ECM processes the vehicle speed signal and transmits this signal to the turn signal module/turn signal security module (TSM/TSSM) and speedometer through serial data.

NOTE

The vehicle speed sensor cannot be repaired. Replace the unit if it fails.

REMOVAL

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Unplug main fuse. See [6.38 MAIN FUSE](#).
2. See [Figure 6-104](#). Disconnect VSS harness connector [65A] (1) from VSS (3) mounted on rear of engine case below starter motor assembly.
3. Remove screw (2). Carefully remove VSS and o-ring from engine crankcase.

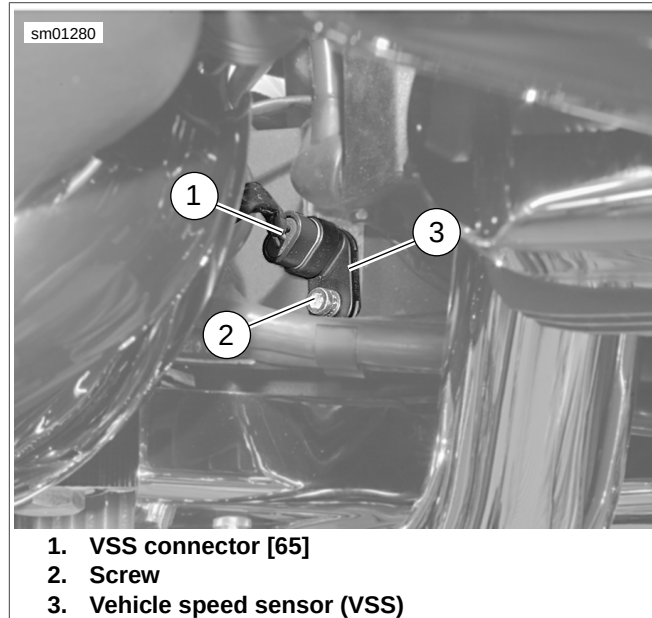


Figure 6-104. Vehicle Speed Sensor: All Models (XL Shown)

INSTALLATION

NOTE

The new VSS o-ring has a teflon coating that provides lubrication during installation. It is not necessary to coat the o-ring with engine oil or other lubricant to install it.

1. See [Figure 6-104](#). Carefully install VSS (3) and o-ring into engine crankcase with screw (2). Tighten to 80-100 in-lbs (9.0-11.3 Nm).
2. Attach VSS harness connector [65A] (1) to VSS.
3. Plug in main fuse. See [6.38 MAIN FUSE](#).
4. Start engine and test ride motorcycle to verify proper operation.

NEUTRAL INDICATOR SWITCH

6.31

GENERAL

See [Figure 6-105](#). The neutral indicator switch (1) is threaded into the right crankcase half (3) immediately forward of the main drive gear (4). A short jumper wire assembly (2) connects the switch to the harness connector [136] under the engine crankcase.

A pin on the shifter drum contacts the neutral indicator switch plunger, completing the neutral indicator circuit.

A motorcycle whose neutral indicator lamp does not light can be tested to determine if the problem can be found:

- In a burned out indicator lamp, the wire harness to the instruments or in the main wire harness.
- In the neutral indicator switch and its jumper wire.

If switch requires replacement, the rear muffler and rear exhaust pipe must be removed to remove the transmission sprocket cover. The 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.

NOTE

The neutral indicator switch cannot be repaired. Replace the switch if it fails.

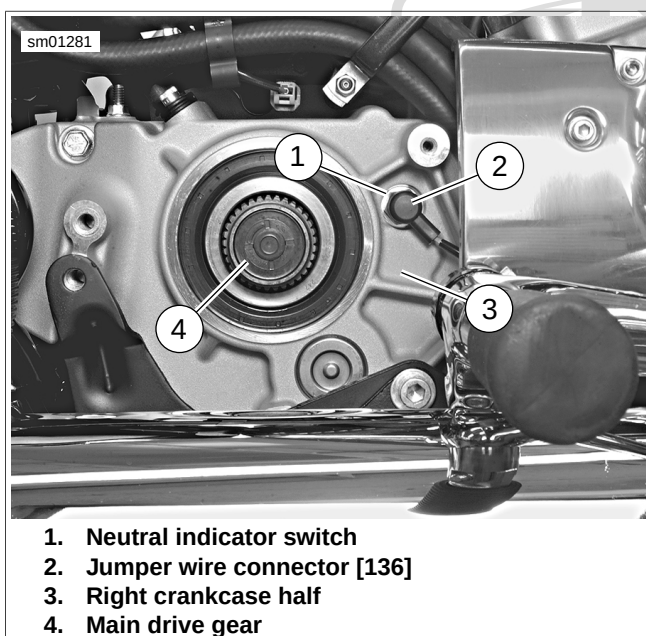


Figure 6-105. Neutral Indicator Switch Location: All Models (XL Shown)

REPLACEMENT

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Unplug main fuse. See [6.38 MAIN FUSE](#).
2. **XL models:** remove rear muffler and exhaust pipe. See [4.15 EXHAUST SYSTEM: XL MODELS](#). **XR models:** remove exhaust system. See [4.16 EXHAUST SYSTEM: XR MODELS](#).
3. Remove sprocket cover and rear drive belt from transmission sprocket. See [5.7 DRIVE BELT](#).
4. Remove transmission sprocket. See [5.16 TRANSMISSION SPROCKET](#).
5. See [Figure 6-106](#). Unplug jumper wire connector (2) from neutral indicator switch (1). Remove switch with washer from right crankcase half (3).
6. Note routing of neutral switch jumper wire down between crankcase and rear of gearcase cover.
7. If necessary in order to unplug neutral switch jumper wire from neutral switch harness connector [136], cut cable strap securing neutral switch harness and stator harness to bottom right frame tube under oil pump.
8. Install **new** neutral indicator switch with washer and tighten to 120-180 **in-lbs** (13.6-20.3 Nm).
9. Plug **new** neutral switch jumper wire into neutral indicator switch [131]. Route jumper wire in same way that old jumper was routed.
10. Plug jumper wire pin connector [136A] into harness socket connector [136B]. Secure neutral switch harness and stator harness with cable strap to bottom right frame tube under oil pump.
11. Install transmission sprocket. See [5.16 TRANSMISSION SPROCKET](#).
12. Install secondary drive belt and sprocket cover. See [5.7 DRIVE BELT](#).
13. Adjust drive belt tension and rear wheel alignment. See [1.16 REAR BELT DEFLECTION](#).
14. **XL models:** install rear muffler and exhaust pipe. See [4.15 EXHAUST SYSTEM: XL MODELS](#). **XR models:** install exhaust system. See [4.16 EXHAUST SYSTEM: XR MODELS](#).
15. Plug in main fuse. See [6.38 MAIN FUSE](#).
16. Turn ignition switch on and check the operation of the neutral indicator lamp.

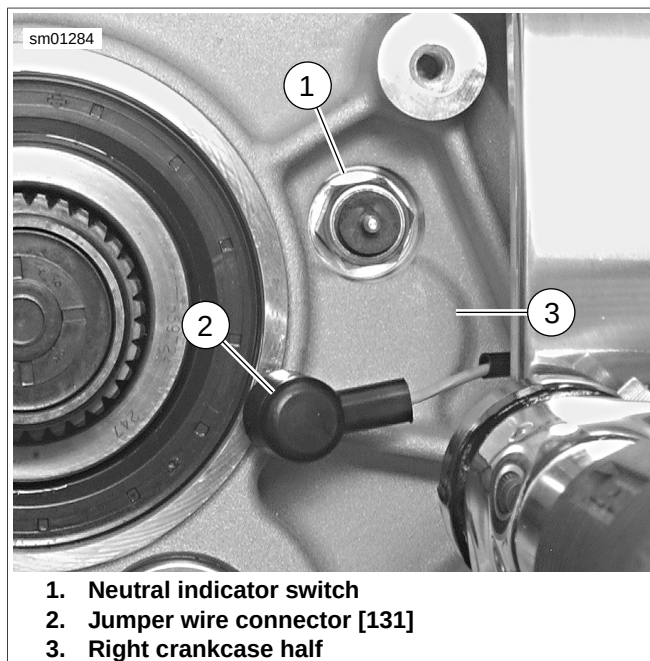


Figure 6-106. Neutral Indicator Switch: All Models (XL Shown)



MAIN WIRING HARNESS

6.32

GENERAL

The main wiring harness supplies power to all electrical systems on the vehicle. It is an electrical conduit, passing signals from sensors and switches, as well transferring data between the ECM, TSM/TSSM/HFSM and speedometer.

Various wiring sub-harnesses, such as the engine sub-harness, handlebar control harnesses, instruments harness and rear lighting harness are connected to the main wiring harness. These sub-harnesses are discussed elsewhere in this manual.

See [B.2 WIRING DIAGRAMS](#) of this manual for wiring schematics. See the ELECTRICAL DIAGNOSTIC MANUAL for testing and troubleshooting information.

REMOVAL

WARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

1. Purge the fuel supply hose of high pressure gasoline. Disconnect fuel supply hose from fuel pump module. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).
2. Remove seat. [2.38 SEAT: XL MODELS](#) or [2.39 SEAT: XR MODELS](#).
3. Remove left side cover. See [2.20 LEFT SIDE COVER](#).

WARNING

Prevent accidental vehicle start-up, which could cause death or serious injury. First disconnect negative (-) battery cable at engine and then positive (+) cable from battery. (00280b)

4. Disconnect battery cables, negative cable first, and remove battery. See [1.17 BATTERY MAINTENANCE](#).
5. Remove fuel tank. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).
6. Remove wire harness caddy. See [6.33 ELECTRICAL CADDIES](#).
7. See [Figure 6-107](#). Cut cable strap (2) securing ET sensor harness to H-bracket (1).

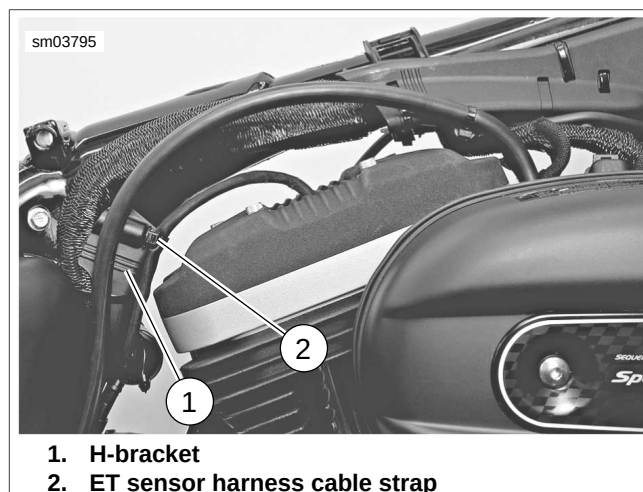


Figure 6-107. Remove/Install Cable Straps

8. Unplug the following harness connectors from the main harness:
 - a. Oil pressure switch [120B],
 - b. Voltage regulator DC output [77B],
 - c. Crank Position (CKP) sensor [79B],
 - d. Front oxygen (O2) sensor [138B],
 - e. Rear oxygen (O2) sensor [137B],
 - f. Neutral switch jumper [136B],
 - g. Engine temperature (ET) sensor [90B],
 - h. Horn [122B],
 - i. ECM [78B],
 - j. Harness ground wire at engine crankcase [GND1],
 - k. Rear stop lamp switch [121B],
 - l. Vehicle speed sensor (VSS) [65B],
 - m. Green starter motor wire [128B].
 - n. **Vehicles with optional security siren:** Unplug security siren connector [142B].
9. **Vehicles with front mounted horn:** Remove horn wire harness from clip attached to right front frame downtube.
10. Locate engine sub-harness connector [145A] and rear lighting sub-harness connector [7A] on top of oil tank. Unplug both sub-harnesses from main harness.
11. Pull P&A battery harness/connector [160B] and fuel sender resistor assembly/connector [200] out from recess in top left rear corner of oil tank, under frame.

12. Remove TSM/TSSM/HFSM. See [6.10 TURN SIGNAL AND SECURITY MODULE \(TSM/TSSM/HFSM\)](#):
 - a. Reach under battery tray and push TSM/TSSM/HFSM up from cavity in bottom of tray.
 - b. Unplug harness connector [30B].
 - c. **H-DSSS equipped models:** unplug antenna connector [208B].
13. Remove wiring harness from two frame clips on front left frame downtube.
14. Remove vapor valve from clip on H-bracket. See [4.21 EVAPORATIVE EMISSIONS CONTROL \(CA MODELS\)](#).
15. Remove battery tray. See [6.12 BATTERY TRAY](#).
16. Pull H-bracket away from rear frame downtube.
17. Remove main wiring harness from left side of vehicle, carefully sliding wire harness caddies between rear cylinder and frame as harness is removed.

INSTALLATION

See [Figure 6-108](#). The main wiring harness can be divided up into four "bundles", originating at the H-bracket (1). These bundles are:

Lower left bundle (2) including:

- Rear stop lamp switch wires [121B],
- Crankcase ground [GND1],
- Fuel pump connector [141A],
- Siren connector [142B],
- TSM/TSSM/HFSM connector [30B],
- Main fuse holder [5],
- Data link connector [91A],
- Rear oxygen (O2) sensor connector [137B].

Lower right bundle (3) including:

- Vehicle speed sensor (VSS) connector [65B],
- Green starter motor wire [128B].
- Engine Temperature (ET) sensor connector [90B],

Upper left bundle (4) including:

- ECM connector [78B],
- Engine sub-harness connector [145A],
- P&A battery connector [160B],
- Rear lighting sub-harness connector [7A],
- Fuel sender resistor assembly/connector [200].

Upper right bundle (5) including:

- Hand control connectors [22B], [24B],
- Headlamp connector [38A],
- Front turn signal connector [31A],
- Instruments connector [20B],
- Horn wires [122B],
- Ignition/light switch [33],
- Coil connector [83B],
- Neutral switch connector [136B],
- Oil pressure switch connector [120B],
- Crank position (CKP) sensor connector [79B],
- Front oxygen (O2) sensor connector [138B],
- Voltage regulator DC output connector [77B].



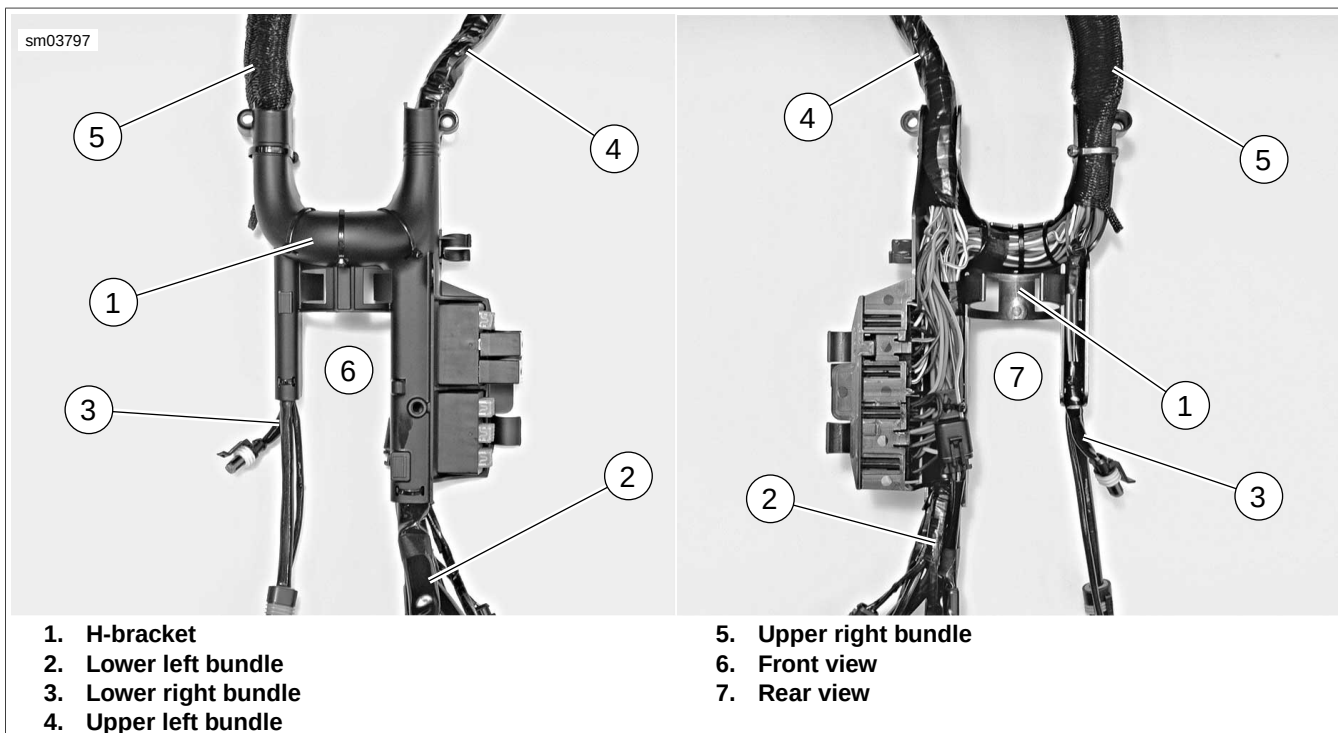


Figure 6-108. Main Wiring Harness H-bracket

- See [Figure 6-108](#). Loosely position **new** main wiring harness on vehicle. From left side of vehicle, slide H-bracket (1) into position on rear frame downtube, guiding each wire bundle toward its respective area on the vehicle. Make sure lower right bundle (3) and upper right bundle (5) with wire harness caddies feed out toward right side of vehicle. Press H-bracket onto rear frame downtube until it snaps in place.
 - Feed upper left bundle (4) up over top of oil tank. Make sure engine sub-harness also feeds up into that area.
 - Feed upper right bundle along frame backbone toward front of vehicle.
 - Feed TSM/TSSM/HFSM harness connector into position under battery tray location.
- NOTE**
- The TSM/TSSM/HFSM harness connector **MUST** be in position before the battery tray is installed. Make sure the harness feeds over the top of the oil tank return hose.*
- Install battery tray. See [6.12 BATTERY TRAY](#). Make sure battery tray interlocks with H-bracket on left side. Make sure to re-attach rear brake hose fasteners and rear brake master cylinder reservoir.
 - Plug connector [30B] into TSM/TSSM/HFSM. **H-DSSS equipped models:** plug in antenna connector [208B].
 - Lower TSM/TSSM/HFSM into place in bottom of battery tray.
 - Snap vapor valve into clip on left side of H-bracket. See [4.21 EVAPORATIVE EMISSIONS CONTROL \(CA MODELS\)](#).
 - Slide P&A battery harness and connector [160B] and fuel sender resistor assembly/connector [200] into recess in top left rear corner of oil tank, under frame.
 - Plug rear lighting connector [7B] into main harness connector [7A].
 - Plug engine sub-harness connector [145B] into main harness connector [145A].
 - Slide left wire harness caddy between front cylinder head and frame, from right side of vehicle toward left side.
 - Make sure harness (part of upper right bundle) containing neutral switch connector [136B], CKP sensor connector [79B], oil pressure switch connector [120B], front O2 sensor connector [138B] and voltage regulator DC output connector [77B] runs down front left frame downtube.
 - Vehicles with front mounted horn:** Install horn wire harness in clip attached to rear of right front frame downtube.
 - Install wire harness caddy. See [6.33 ELECTRICAL CADDIES](#).

16. Plug in the following harness connectors:
 - a. Oil pressure switch [120B],
 - b. Voltage regulator DC output [77B],
 - c. Crank Position (CKP) sensor [79B],
 - d. Front oxygen (O2) sensor [138B],
 - e. Rear oxygen (O2) sensor [137B],
 - f. Neutral switch jumper [136B],
 - g. Engine temperature (ET) sensor [90B],
 - h. Horn [122B],
 - i. ECM [78B],
 - j. Harness ground wire at engine crankcase [GND1],
 - k. Rear stop lamp switch [121B],
 - l. Vehicle speed sensor (VSS) [65B],
 - m. Green starter motor wire [128B].
 - n. **Vehicles with optional security siren:** Plug in security siren connector [142B].
17. **XL models only:** Secure clutch cable and wiring harness running down left frame downtube with two frame clips. Make sure lower frame clip also captures front O2 sensor harness and frame clip is positioned as close to bottom of upper voltage regulator bracket as possible.
18. **XR models only:** Secure wiring harness running down left frame downtube onto both oil cooler bracket clips.
19. See [Figure 6-107](#). Secure ET sensor harness to H-bracket (1) with a barbed cable strap (2). Make sure there is a loop in the harness between the ET sensor and the H-bracket to avoid damaging harness during vehicle operation.
20. Install fuel tank. See [Figure 6-109](#). Make sure fuel pump harness rests in harness clip (5) on wire harness caddy latch clip (2). See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).

NOTE

Make sure there is a loop in fuel pump harness between caddy latch clip and fuel pump module to avoid pinching harness between fuel tank and frame backbone. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).

⚠ WARNING

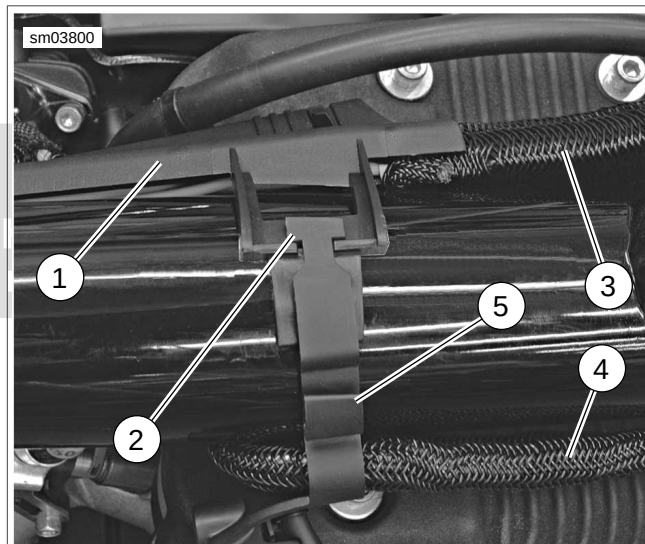
Connect positive (+) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00068a)

21. Install battery and connect battery cables, positive (+) cable first. See [1.17 BATTERY MAINTENANCE](#).
22. Install left side cover. See [2.20 LEFT SIDE COVER](#).

⚠ WARNING

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

23. Install seat. See [2.38 SEAT: XL MODELS](#) or [2.39 SEAT: XR MODELS](#).
24. Start vehicle and test operation of all electrical functions: headlamp, tail lamp(s), turn signals, brake lamp(s), indicator lamps, instruments, horn and handlebar controls.



1. Right wire harness caddy
2. Wire harness caddy latch clip
3. Main harness
4. Engine sub-harness
5. Fuel pump harness clip

**Figure 6-109. Right Wire Harness Caddy Latch Clip
(Typical, XL Models Shown)**

ELECTRICAL CADDIES

6.33

GENERAL

Two electrical caddies are used on all Sportster models. They are:

- **Voltage regulator caddy:** located between the front frame downtubes below the voltage regulator. This caddy supports the voltage regulator DC output connector [77] and the neutral switch wiring harness.
- **Wire harness caddy:** a matched pair of caddies located under the fuel tank. This assembly supports handlebar control harness connectors [22] and [24], instruments connector [20], headlamp connector [38] and front turn signals connector [31]. This caddy assembly also supports the rear spark plug cable, main harness, engine sub-harness and throttle cables.

VOLTAGE REGULATOR CADDY: XL MODELS ONLY

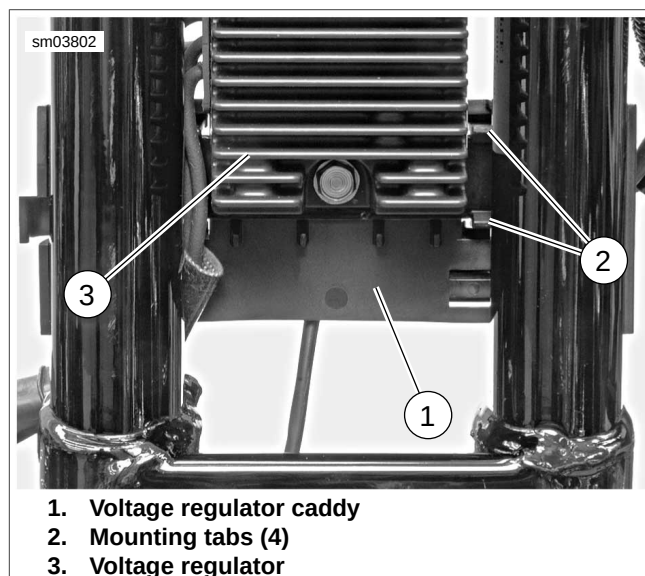
See [Figure 6-110](#). The voltage regulator caddy (1) is attached to the lower end of the voltage regulator mounting bracket by four tabs (2) located on the caddy.

Removal

1. See [Figure 6-111](#). Remove DC output connector [77] (3) from mounting tabs (4) on caddy (2). Remove DC output cables from cable clip (7).
2. Remove neutral switch harness (5) from mounting tabs (6) on voltage regulator caddy.
3. Grasp caddy and gently pull straight away from frame downtubes. It may be necessary to bend four tabs (item 2, [Figure 6-110](#)) back slightly to disengage caddy from voltage regulator bracket on frame.
4. Carefully slide caddy out from between frame front downtubes and engine toward left side of motorcycle.

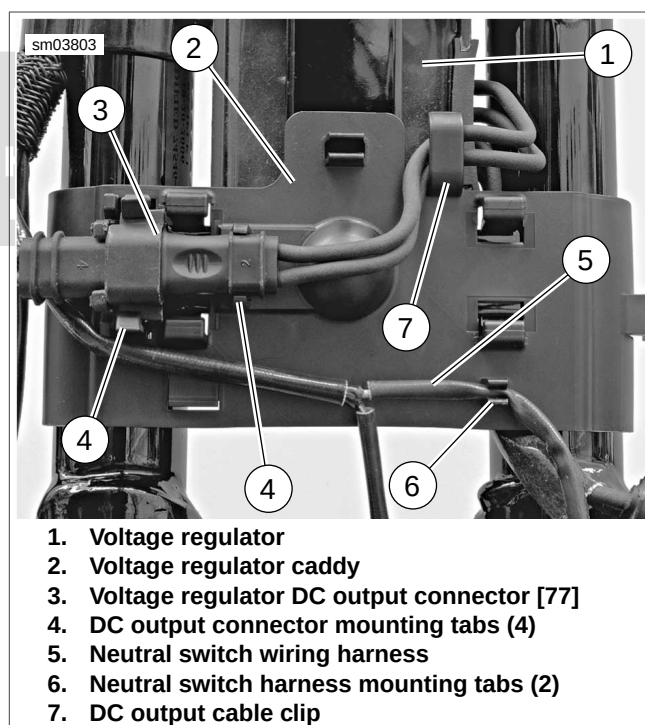
Installation

1. Slide **new** voltage regulator caddy from left side of motorcycle, in between frame front downtubes and engine, below voltage regulator.
2. See [Figure 6-110](#). Line up four caddy mounting tabs (2) with bottom of voltage regulator (3) mounting bracket and press into place.
3. See [Figure 6-111](#). Press neutral switch wiring harness (5) into tabs (6) on caddy (2).
4. Install voltage regulator DC output cables into cable clip (7) on caddy. Press voltage regulator DC output connector [77] (3) into mounting tabs (4) on caddy.



1. Voltage regulator caddy
2. Mounting tabs (4)
3. Voltage regulator

Figure 6-110. Voltage Regulator Caddy: Front View



1. Voltage regulator
2. Voltage regulator caddy
3. Voltage regulator DC output connector [77]
4. DC output connector mounting tabs (4)
5. Neutral switch wiring harness
6. Neutral switch harness mounting tabs (2)
7. DC output cable clip

Figure 6-111. Voltage Regulator Caddy: Rear View

WIRE HARNESS CADDY: XL MODELS

See [Figure 6-112](#). The wire harness caddy assembly (1, 2) is secured to the ignition switch bracket (3) with two push-in fasteners (6, 7), and to the frame with mounting tabs hooked onto a bracket under the frame backbone tube. The left and right wire harness caddies are locked together with three tabs (see [Figure 6-113](#)) and secured with a screw (item 12, [Figure 6-112](#)).

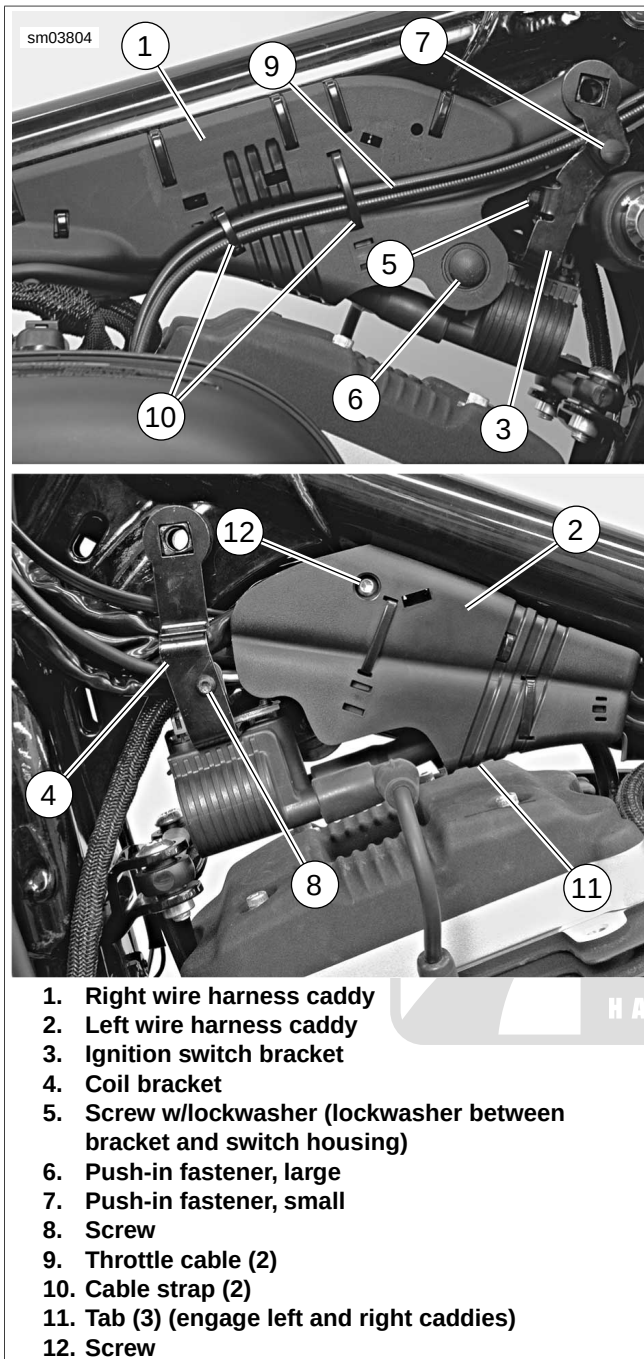


Figure 6-112. Wire Harness Caddy Assembly

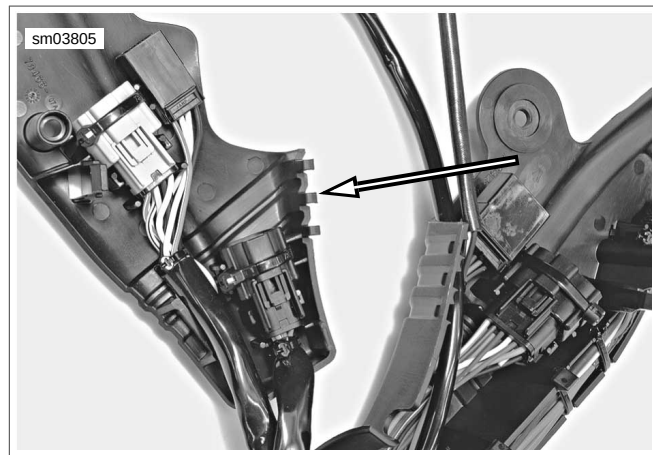


Figure 6-113. Wire Harness Caddy: Locking Tabs

Removal

⚠ WARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

1. Purge the fuel supply hose of high pressure gasoline. Disconnect fuel supply hose from fuel pump module. See [4.6 FUEL TANK: XL MODELS](#).

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

2. Unplug main fuse. See [6.38 MAIN FUSE](#).
3. Remove seat.
4. Remove fuel tank. See [4.6 FUEL TANK: XL MODELS](#).
5. See [Figure 6-112](#). Remove screw (8) and disengage coil bracket (4) from mounting boss on frame.
6. See [Figure 6-114](#). Unhook caddy latch clip (2) from right wire harness caddy (1).

NOTE

It is not necessary to remove rear spark plug cable from wire harness caddy latch clip, unless latch clip is being replaced.

7. If necessary, cut cable strap securing rear spark plug cable to caddy latch clip.
8. Remove engine sub-harness from loop in caddy latch clip.
9. See [Figure 6-112](#). Remove screw (12) and carefully disengage left wire harness caddy (2) from right wire harness caddy (1).
10. Cut two cable straps (10) securing throttle cables (9) to right wire harness caddy.
11. See [Figure 6-115](#). Disengage rear spark plug cable (2) from trough in right wire harness caddy (1). Cut barbed

cable strap securing engine sub-harness (3) to right wire harness caddy (1).

12. California models: Cut barbed cable strap (5) securing EVAP canister purge hose (4) to rear of right wire harness caddy.
13. See [Figure 6-112](#). Remove and discard push-in fasteners (6, 7). Unhook right wire harness caddy from frame backbone bracket. Lower ignition switch bracket (3) from mounting bosses on frame to free right wire harness caddy.

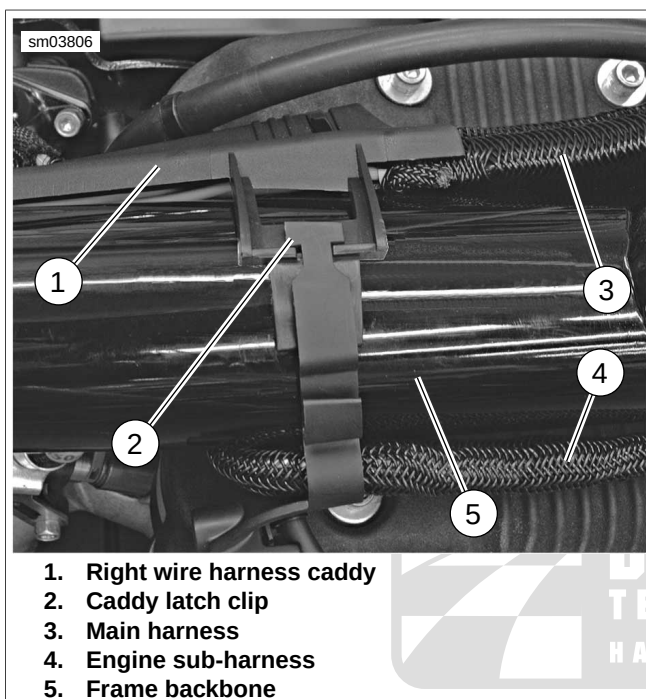


Figure 6-114. Right Wire Harness Caddy Latch Clip

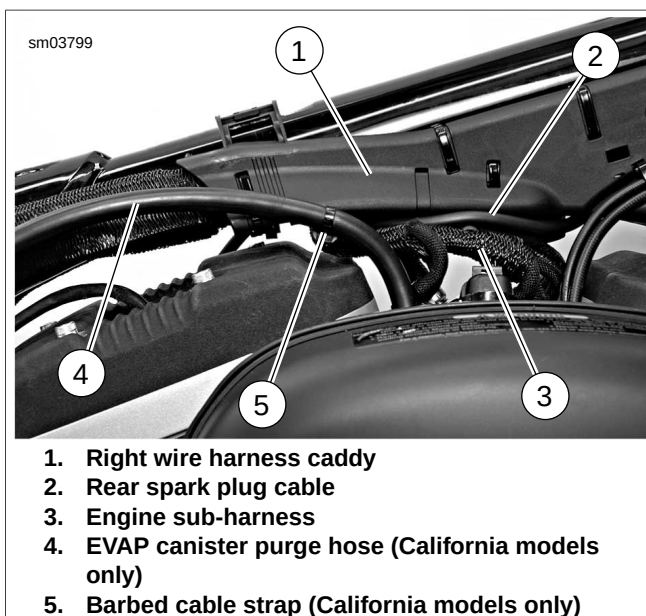


Figure 6-115. Rear Spark Plug Cable Routing

14. See [Figure 6-116](#). Unplug the following connectors:
 - a. Headlamp connector [38B] (4).
 - b. Left hand control connector (gray) [24B] (3).
 - c. Right hand control connector (black) [22B] (5).
 - d. Front turn signal connector [31B] (6).
 - e. Instruments connector [20A] (7).
15. Make a note of the location of all cable straps securing harnesses and harness connectors to left and right wire harness caddies. Cut cable straps and remove harnesses and connectors from caddies. Remove wire harness caddies from vehicle.

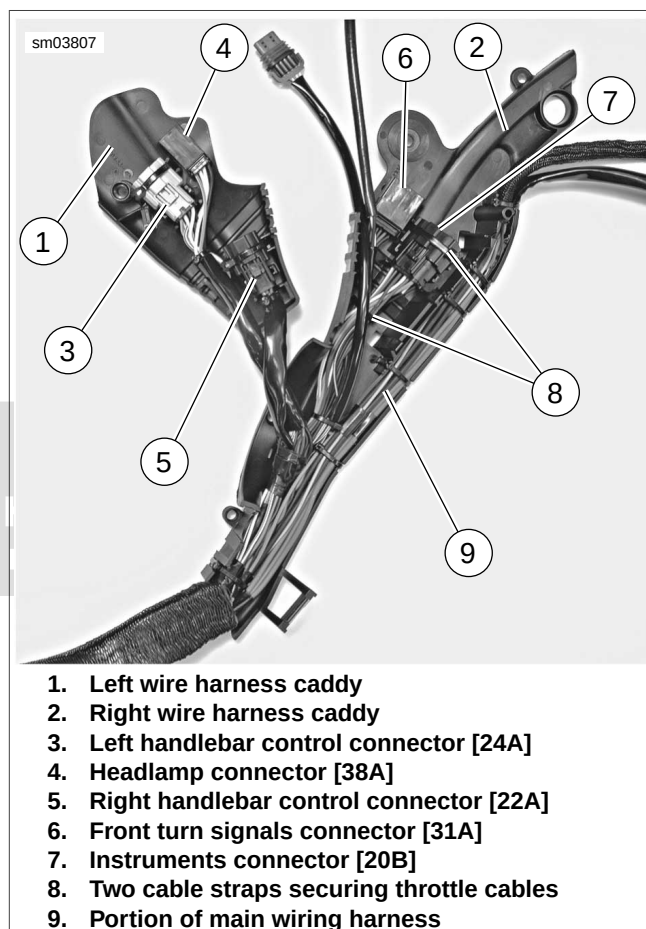


Figure 6-116. Wire Harness Caddies (Removed from Vehicle for Clarity)

Installation

1. See [Figure 6-116](#). Fit portion of main wiring harness (9) and ignition switch harness along top of right wire harness caddy (2) and secure with cable straps, as shown in the figure.
2. Mount front turn signals connector [31A] (6) onto mounting tab on right wire harness caddy.
3. See [Figure 6-112](#). Place throttle cables (9) in groove in right wire harness caddy (1).

4. See [Figure 6-116](#). Place instruments connector [20B] (7) into right wire harness caddy (2). Secure connector and throttle cables with a cable strap (8). Secure throttle cables and harnesses (as shown in the figure) with a second cable strap.
5. Mount handlebar control connectors [22A], [24A] (5, 3) to left wire harness caddy (1) with cable straps. Mount headlamp connector [38A] (4) onto tab on left wire harness caddy.
6. See [Figure 6-112](#). Hook right wire harness caddy (1) into bracket on frame backbone. Secure front of caddy onto ignition switch bracket mounting boss on right side of frame. Raise ignition switch bracket (3) up into position and mount it onto boss on frame.

NOTE

Make sure ignition switch bracket upright is outboard of right wire harness caddy and throttle cables on right side of frame.

7. Secure right wire harness caddy to ignition switch bracket with **new** push-in fasteners (6, 7).
8. See [Figure 6-114](#). Install caddy latch clip (2) onto right wire harness caddy (1). Make sure engine sub-harness (4) is routed in loop in caddy latch clip.
9. See [Figure 6-117](#). Raise coil bracket (5) up into position and mount it on boss on left side of frame. Secure coil bracket to ignition switch bracket with screw (6). Tighten to 35-45 **in-lbs** (4.0-5.1 Nm).

NOTE

Make sure coil bracket upright is outboard of all wire harnesses leading to front of vehicle on left side of frame.

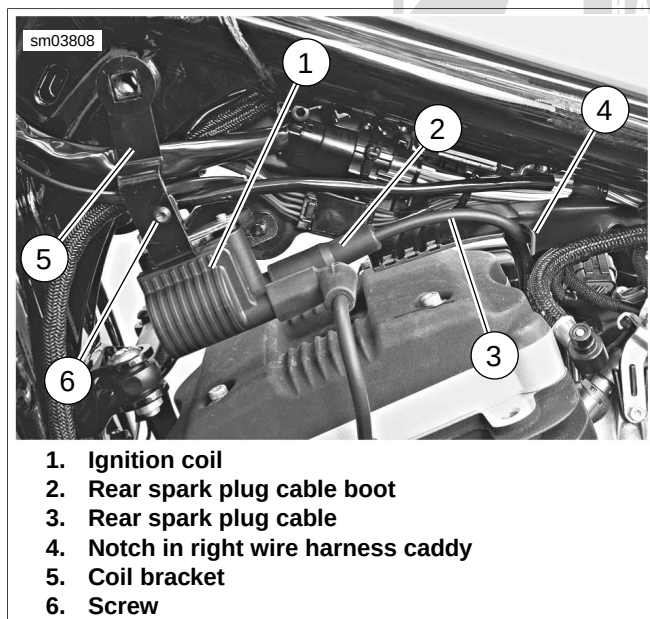


Figure 6-117. Rear Spark Plug Cable Routing

10. Route rear spark plug cable (3) from ignition coil (1) tower down through notch (4) in right wire harness caddy.
11. See [Figure 6-115](#). Route rear spark plug cable (2) in right wire harness caddy trough.

12. Route engine sub-harness (3) around trough in right wire harness caddy. Secure sub-harness to caddy trough with a cable strap. Run strap through hole in boss that originally secured engine sub-harness.
13. **California models:** Secure EVAP canister purge hose (4) to rear of right wire harness caddy with a barbed cable strap (5).
14. Plug in the following connectors:
 - a. Instruments connector [20A] (7).
 - b. Front turn signal connector [31B (6)].
 - c. Right hand control connector (black) [22B] (5).
 - d. Left hand control connector (gray) [24B] (3).
 - e. Headlamp connector [38B] (4).
15. See [Figure 6-112](#). Mate left wire harness caddy (2) to right wire harness caddy (1). Secure with screw (12) and tighten.
16. See [Figure 6-118](#). If barbed cable strap (3) securing rear spark plug cable (1) to caddy latch clip was cut, install **new** barbed cable strap 7.0-7.25 in. (178-184 mm) from tip of spark plug cable boot (2), orienting cable strap so that spark plug cable is above mounting boss on caddy latch clip when barbed prong on cable strap is inserted in hole in boss. Press cable strap barbed prong firmly into hole in caddy latch clip mounting boss.

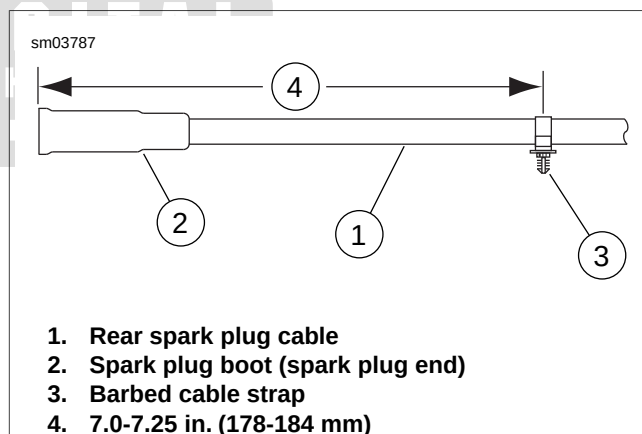


Figure 6-118. Rear Spark Plug Cable and Cable Strap (XL Models Only)

17. Make sure rear spark plug cable is plugged onto rear spark plug.
18. Install fuel tank. See [4.6 FUEL TANK: XL MODELS](#).

⚠ WARNING

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

19. Install seat.
20. Plug in main fuse. See [6.38 MAIN FUSE](#).

⚠ WARNING

Be sure headlamp, tail and stop lamp and turn signals are operating properly before riding. Poor visibility of rider to other motorists can result in death or serious injury. (00478b)

21. Start vehicle and test the operation of headlamp, turn signals, brake lamp(s), indicator lamps, instruments and handlebar controls.

WIRE HARNESS CADDY: XR MODELS

Removal

⚠ WARNING

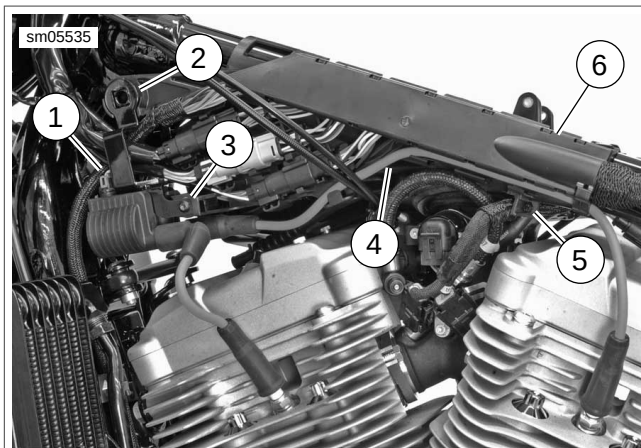
To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

1. Purge the fuel supply hose of high pressure gasoline. Disconnect fuel supply hose from fuel pump module. See [4.7 FUEL TANK: XR MODELS](#).

⚠ WARNING

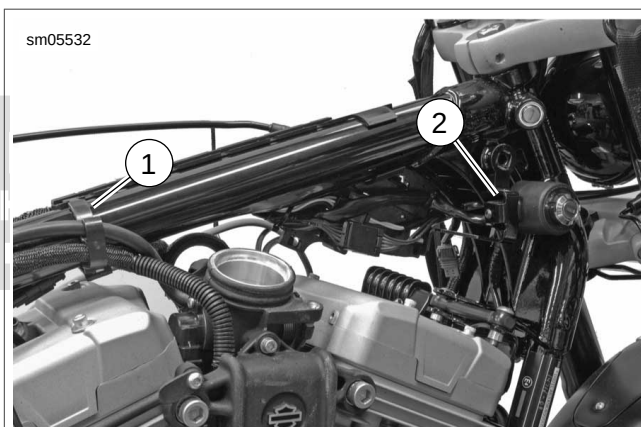
To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

2. Unplug main fuse. See [6.38 MAIN FUSE](#).
3. Remove seat.
4. Remove fuel tank. See [4.7 FUEL TANK: XR MODELS](#).
5. Remove airbox. See [4.5 AIRBOX: XR MODELS](#).
6. See [Figure 6-119](#). Remove screw (3), connector (1) and disengage coil bracket (2) from mounting boss on frame.
7. Remove rear spark plug wire (4) from caddy. Support coil away from engine and caddy.
8. Separate push-in fastener (5) from caddy.
9. See [Figure 6-120](#). Unhook caddy latch clip (1) from right side of frame.
10. See [Figure 6-121](#). Detach connector (2) from right side of caddy.
11. Cut two cable straps (1) from right side of caddy.
12. See [Figure 6-119](#). Remove cover (6) from caddy.
13. See [Figure 6-122](#). Cut remaining five cable straps from left side of caddy.
14. Pull caddy away from frame and move ignition switch away from caddy. Support ignition switch away from engine.
15. Pull connectors from left side of caddy and remove caddy from motorcycle.



1. Coil connector
2. Coil bracket
3. Screw
4. Rear spark plug wire
5. Push-in fastener
6. Cover

Figure 6-119. XR Caddy Removal



1. Latch clip
2. Ignition switch bracket

Figure 6-120. Caddy Latch Clip

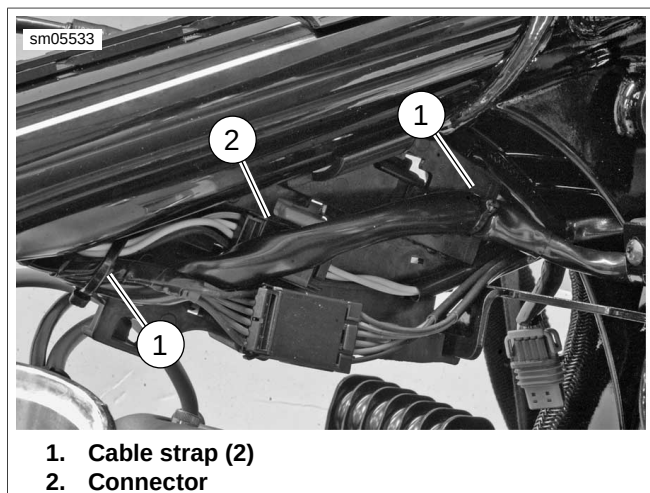


Figure 6-121. Right Side Connectors

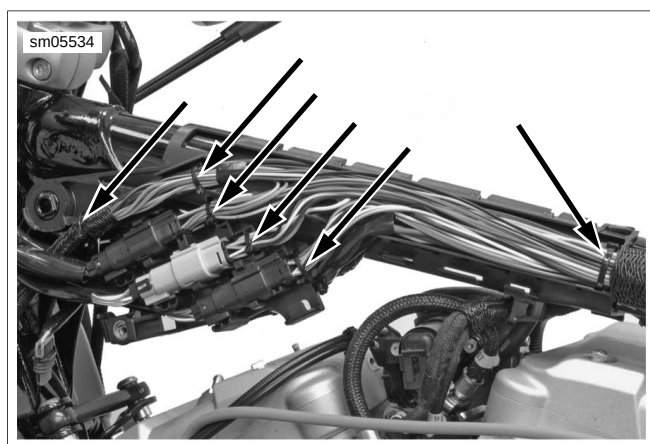


Figure 6-122. Cable Strap Locations

Installation

1. See [Figure 6-122](#). Place caddy in position next to motorcycle frame, Attach ignition switch bracket into position on caddy and place caddy on motorcycle frame.
2. Install connectors on left side of caddy.
3. Install five cable straps to secure connector wires in position on left side of caddy.
4. See [Figure 6-121](#). Attach connector (2) to right side of caddy.

5. Install two cable straps (1) as shown on right side of caddy. Make sure wires on left side of caddy are also secured with the rearward cable strap.
6. See [Figure 6-120](#). Make sure harness and purge hose (California models) are attached to caddy latch clip (1). Install latch clip on right side of frame.
7. See [Figure 6-119](#). Install cover (6) on caddy.
8. Install push-in fastener (5).
9. See [Figure 6-119](#). Slip lower end of coil bracket (2) into caddy slot. make sure coil bracket is flush with end of ignition switch bracket and attach top end of coil bracket to mounting boss on frame.
10. Install connector (1) and then screw (3). Tighten screw (3) to 35-45 **in-lbs** (4.0-5.1 Nm).
11. Install rear spark plug wire (4) on caddy.
12. Install airbox. See [4.5 AIRBOX: XR MODELS](#).
13. Install fuel tank. See [4.7 FUEL TANK: XR MODELS](#).

⚠ WARNING

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

14. Install seat.
15. Plug in main fuse. See [6.38 MAIN FUSE](#).

⚠ WARNING

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

⚠ WARNING

Be sure headlamp, tail and stop lamp and turn signals are operating properly before riding. Poor visibility of rider to other motorists can result in death or serious injury. (00478b)

16. Start vehicle and test the operation of headlamp, turn signals, brake lamp(s), indicator lamps, instruments and handlebar controls.

6.34

GENERAL

See [Figure 6-123](#). International models are equipped with a jiffy stand interlock feature. If the rider attempts to start the engine or pushes the starter button while the transmission is in gear and the jiffy stand is down, the jiffy stand interlock system will not permit the engine to run. The message "SidE StAnd" will scroll across the odometer to indicate this to the rider. Raising the jiffy stand (or putting the transmission in neutral) will permit the engine to run and clear the message.

If the jiffy stand falls out of the fully retracted position while riding at speeds greater than 10 mph (15 km/h), the jiffy stand interlock system will maintain engine operation and alert the rider about this by illuminating the indicators (flash twice) and scroll the message "SidE StAnd" across the odometer. The message will remain until the system detects the jiffy stand in the fully retracted position again. The rider may continue to operate the vehicle while in this mode. The rider may clear the text messages at any time by pressing the trip switch once while the vehicle is powered up.

⚠ WARNING

The jiffy stand locks when placed in the full forward (down) position with vehicle weight on it. If the jiffy stand is not in the full forward (down) position with vehicle weight on it, the vehicle can fall over which could result in death or serious injury. (00006a)

⚠ WARNING

Always park motorcycle on a level, firm surface. An unbalanced motorcycle can fall over, which could result in death or serious injury. (00039a)

⚠ WARNING

Be sure jiffy stand is fully retracted before riding. If jiffy stand is not fully retracted, it can contact the road surface causing a loss of vehicle control, which could result in death or serious injury. (00007a)

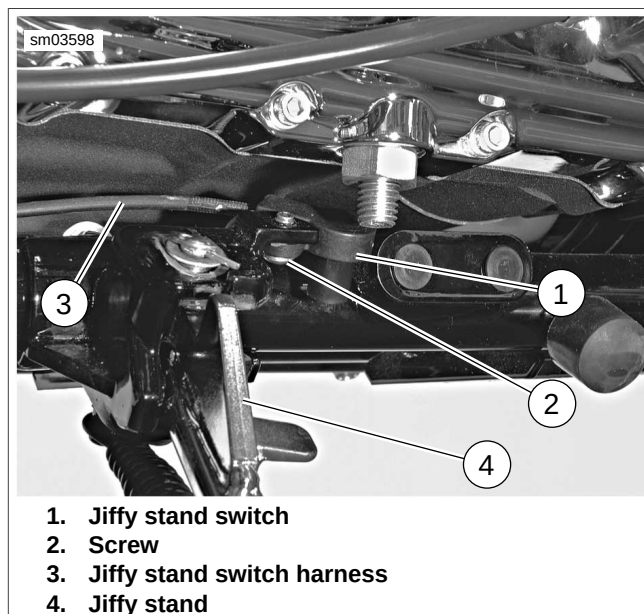


Figure 6-123. Jiffy Stand Switch

REMOVAL

1. Position vehicle upright on a suitable lift.
2. See [Figure 6-124](#). Unplug jiffy stand switch harness connector [133] (2), located next to left front frame downtube, by front electrical caddy.
3. See [Figure 6-125](#). Cut cable strap (2) securing jiffy stand switch harness (1) to frame under left side of engine.
4. See [Figure 6-123](#). Remove screw (2). Remove jiffy stand switch (1) and harness from vehicle.

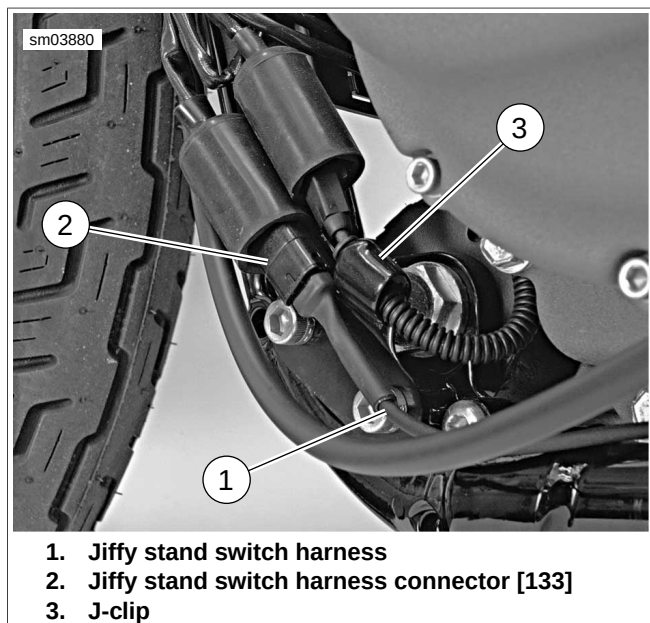


Figure 6-124. Jiffy Stand Switch Harness Connector

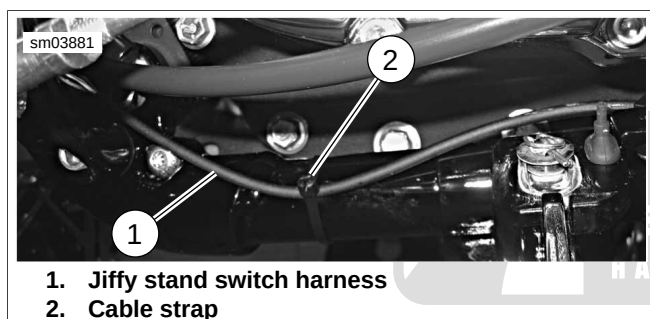


Figure 6-125. Jiffy Stand Switch Harness Routing

INSTALLATION

- See [Figure 6-123](#). Install jiffy stand switch (1), attach with screw (2), finger-tight.

NOTE

See [Figure 6-126](#). Make sure jiffy stand switch (1) is correctly aligned with switch mounting tab (2) on jiffy stand bracket (3). If switch is not properly aligned with mounting tab when screw is tightened, switch or mounting tab may be damaged.

- See [Figure 6-126](#). With switch (1) properly aligned with switch mounting tab (2) on jiffy stand bracket (3), tighten screw to 96-120 **in-lbs** (10.9-13.6 Nm).

- See [Figure 6-125](#). Route jiffy stand switch harness (1) forward along frame under left side of engine. Secure harness to frame with **new** cable strap (2), making sure harness is routed on outboard side of frame as shown in the figure.
- See [Figure 6-124](#). Plug jiffy stand switch harness connector [133A] (2) into main harness connector [133B].

NOTE

See [Figure 6-124](#). Do not route jiffy stand switch harness (1) through j-clip (3). This puts undue stress on harness wires. Harness could chafe against j-clip, possibly causing harness to fail.

- Test **new** jiffy stand switch:
 - Disengage clutch and place vehicle in gear.
 - Turn ignition switch ON. With jiffy stand down and clutch disengaged, attempt to start vehicle. Engine should not start. The message "SidE StAnd" should scroll across the odometer display.
 - Retract jiffy stand. With clutch disengaged and transmission in gear, attempt to start vehicle. Engine should start and run. The "SidE StAnd" message should clear from the odometer display.
 - Shift transmission into neutral. Turn ignition switch OFF.

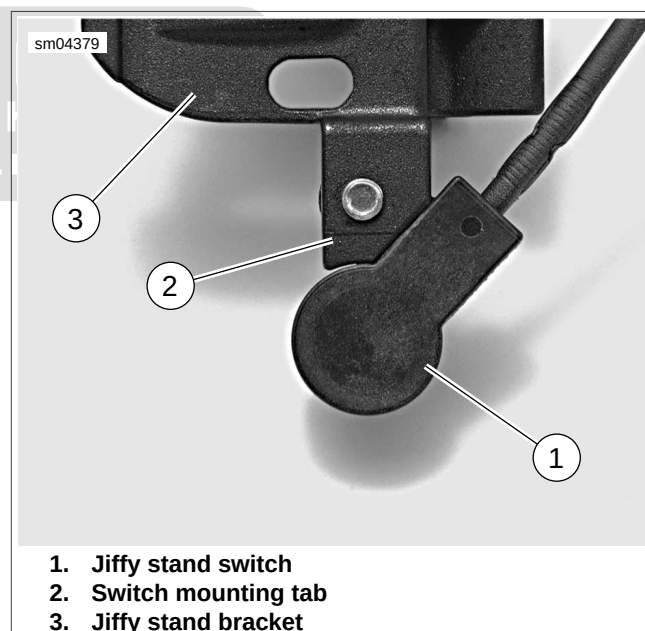


Figure 6-126. Mounting Jiffy Stand Switch: Top View (Assembly Removed from Vehicle for Clarity)

OPTIONAL SECURITY SIREN

6.35

GENERAL

See [Figure 6-127](#). The security siren (1) is a self-contained unit with its own replaceable power supply (9-volt battery). The unit is mounted on a bracket attached to the rear brake master cylinder (3) mounting bracket under the rear fork pivot point.

The siren's internal 9-volt battery is rechargeable and does not need to be replaced on a regular basis. Battery life under normal conditions is approximately three to six years.

NOTE

The internal siren battery may not charge if the vehicle's battery is less than 12.5 volts.

REMOVAL

1. See [Figure 6-127](#). Disarm security system. While system is disarmed, unplug siren harness connector [142B] (2) from siren assembly (1).
2. See [Figure 6-128](#). Gently pry up on two tabs (2) while pulling siren housing (1) toward the left side of the motorcycle. This will disengage siren mounting bosses (3) from mounting bracket. Allow siren assembly to drop down and remove from vehicle.

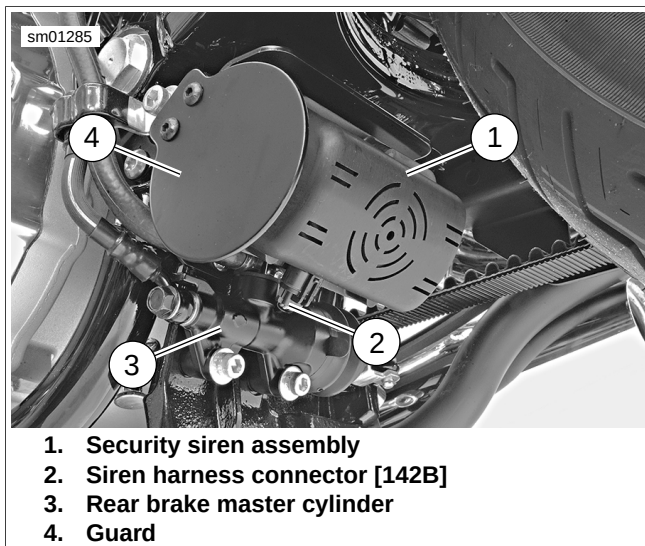
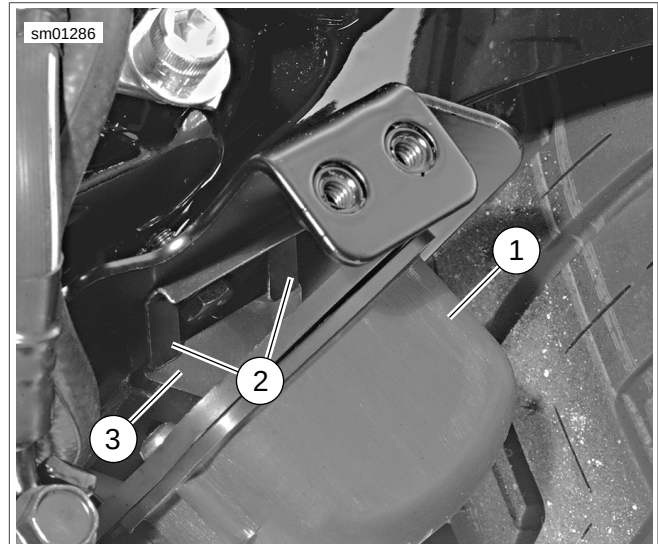


Figure 6-127. Security Siren

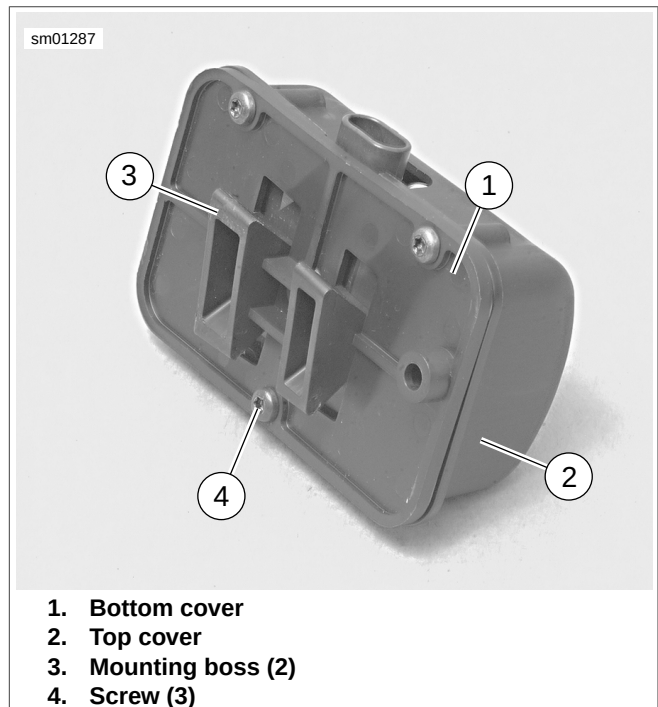


1. Security siren housing
2. Tab (2)
3. Siren housing mounting boss (2)

Figure 6-128. Security Siren Mount (Guard Removed for Clarity)

DISASSEMBLY

1. See [Figure 6-129](#). Remove three screws (4) and bottom cover (1) from top cover (2) of security siren assembly.
2. See [Figure 6-130](#). Remove security siren (1) from top cover (3).



1. Bottom cover
2. Top cover
3. Mounting boss (2)
4. Screw (3)

Figure 6-129. Security Siren Housing

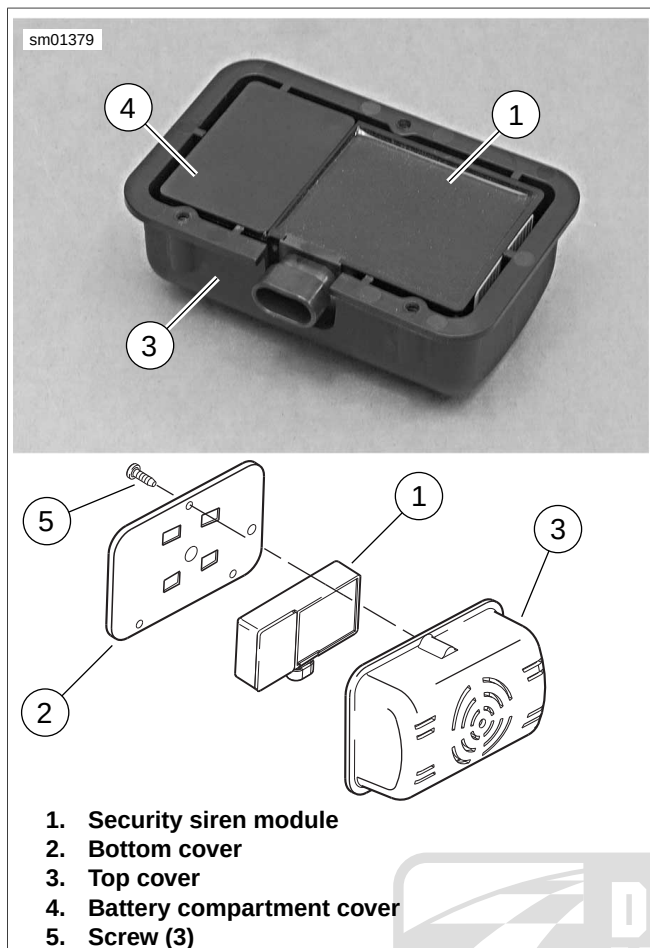


Figure 6-130. Security Siren Assembly

BATTERY REPLACEMENT

Schedule

The siren's internal 9 volt battery is rechargeable and does not need to be replaced on a regular basis. Battery life under normal conditions is approximately three to six years.

NOTES

- See [Figure 6-131](#) and [Figure 6-132](#). Early style siren will work with both TSSM and HFSM. Late style siren will only work with HFSM.
- The internal siren battery may not charge if the vehicle's battery is less than 12.5 volts.

Battery Replacement: Early Style Siren

- Disarm system and remove siren.

- See [Figure 6-131](#). Remove battery cover.
 - Place the siren module on a flat and sturdy table with the potted section (area with epoxy covering circuit board) facing up and towards you.
 - Position a knife blade at a 45 degree angle to the long side of the siren case. Insert the knife blade between the siren case and battery cover at one of the two accessible corners of the battery cover. Keep the blade slightly higher towards the battery cover as this helps keep the blade away from the battery seal.
 - Slowly twist the blade towards the battery cover and the cover will pop off.

NOTES

- For protection against corrosion, battery terminals and battery clip are covered with a special grease. Do not wipe away this substance. Apply all available existing grease to terminals on new battery.
 - Only a 9 volt nickel metal hydride battery should be used in the siren.
- Replace battery by removing old battery from polarized battery clip. Install a **new** 9 volt nickel metal hydride battery.
 - Reinstall battery cover.
 - Carefully replace the rubber seal.
 - Align battery cover with case placing round corners on cover away from connector [142A]. Snap cover into place.
 - Install siren and check operation. If siren is working properly, it will respond with two chirps after receiving the arm command.

Battery Replacement: Late Style Siren

- Disarm system and remove siren.
- See [Figure 6-132](#). With a small screwdriver or pick, push the catches (1) in through the two slots (2) in the end of the siren to release the battery cover (3).

NOTES

- For protection against corrosion, battery terminals and battery clip are covered with a special grease. Do not wipe away this substance. Apply all available existing grease to terminals on new battery.
 - Only a 9 volt nickel metal hydride battery should be used in the siren.
- Replace battery (4) by removing old battery from polarized battery clip.
 - Recharge and re-install or install a **new** 9 volt nickel metal hydride battery.
 - Reinstall battery cover (3).
 - Carefully replace the rubber seal (5) on the cover.
 - Align battery cover with case placing round corners on cover away from connector [142A] (6).
 - Snap cover into place.

6. Install siren and check operation. If siren is working properly, it will respond with two chirps after receiving the arm command.

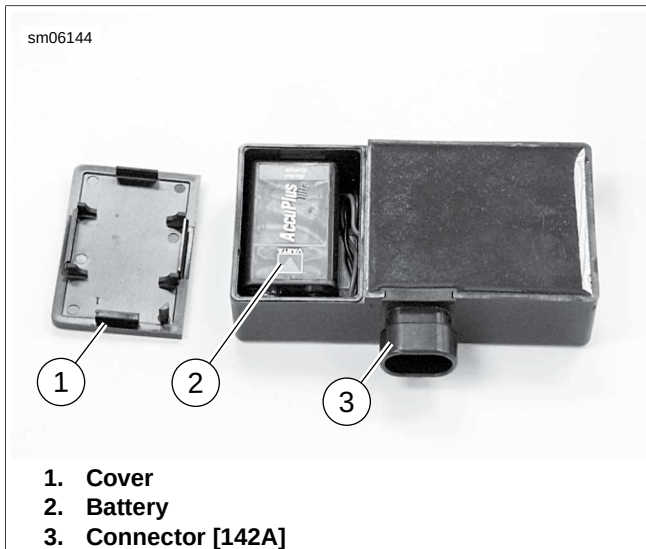


Figure 6-131. Siren Battery Compartment (Early Style Siren)

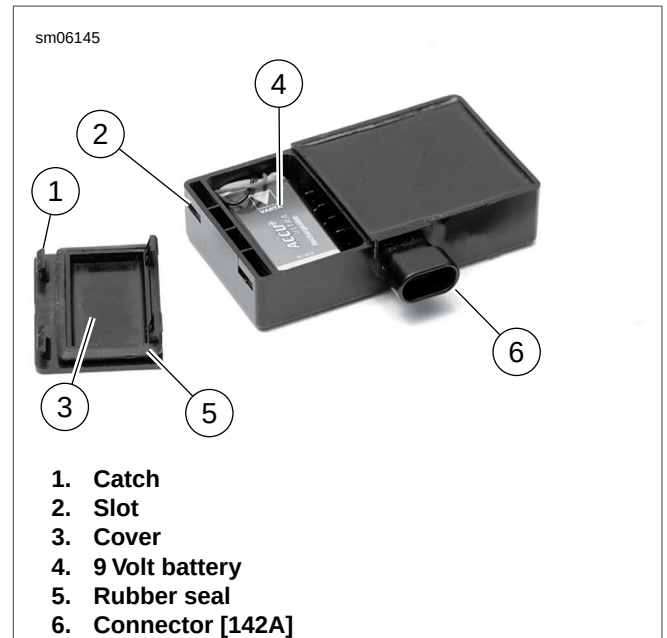


Figure 6-132. Siren Battery Compartment (Late Style Siren)

ASSEMBLY

1. See [Figure 6-130](#). Place security siren module (1) inside top cover (3) with siren connector [142A] positioned in cutout in cover and siren battery compartment cover (4) visible.
2. See [Figure 6-129](#). Place bottom cover (1) on top cover (2) and secure with three screws (4).

INSTALLATION

1. See [Figure 6-128](#). Position siren (1) in mounting bracket so that mounting bosses (3) align with mounting clips in bracket and connector socket [142A] faces rear master cylinder.
2. Slide siren housing toward the right side of the vehicle until tabs (2) lock siren in place.
3. See [Figure 6-127](#). Plug harness connector [142B] (2) into siren connector socket [142A].
4. Check siren operation. If siren is working properly, it will respond with two chirps after receiving the arm command.

OIL PRESSURE SWITCH

6.36

GENERAL

The oil pressure signal lamp 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 lamp circuit and causing the indicator lamp to illuminate.

See [Figure 6-133](#). The oil pressure switch is located under the oil filter mount at the front of the engine crankcase.

NOTE

The oil pressure switch cannot be repaired. Replace the unit if it fails.

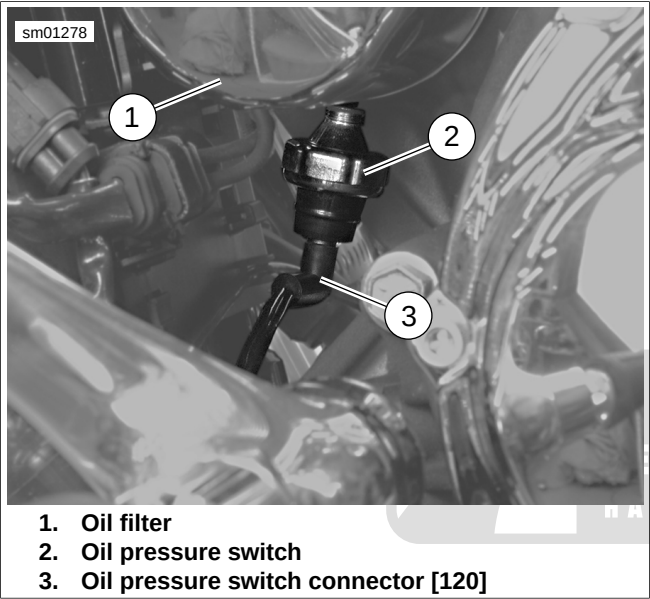


Figure 6-133. Oil Pressure Indicator Lamp Switch (Left Side View XL 1200C)

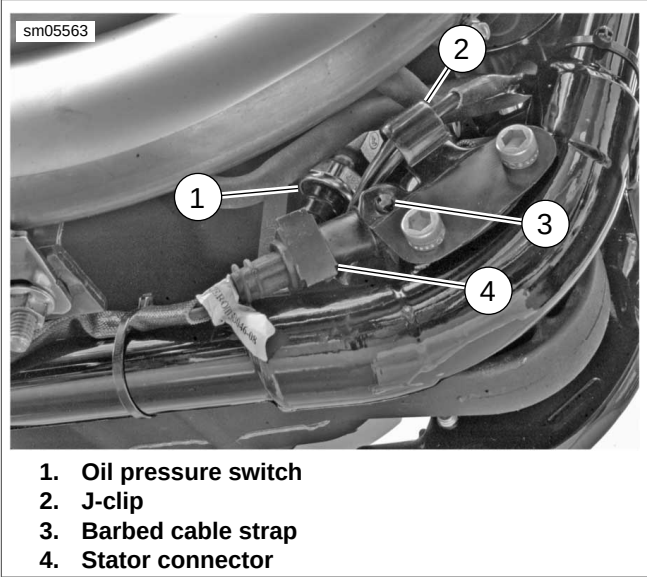


Figure 6-134. Oil Pressure Switch (Right Side View XR 1200)

REMOVAL

PART NUMBER	TOOL NAME
HD-41675	OIL PRESSURE SENDING UNIT WRENCH

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Unplug main fuse. See [6.38 MAIN FUSE](#).
2. See [Figure 6-133](#). Remove wiring harness connector [120] (3) by pulling elbow connector straight down from stud on oil pressure switch (2).
3. **XL models only:** remove voltage regulator DC output connector and neutral switch wiring harness from voltage regulator caddy. Remove caddy. See [6.33 ELECTRICAL CADDIES](#).
4. **XR models only:** see [Figure 6-134](#). Disconnect voltage regulator stator connector (4). Reposition neutral switch wire and voltage regulator stator wire as needed.
5. Place a container under vehicle to catch any oil that may leak out when oil pressure switch is removed.

NOTE

XR models only: hold oil pressure switch adapter with a wrench to prevent the adapter from being removed while removing the oil pressure switch.

6. Using OIL PRESSURE SENDING UNIT WRENCH (Part No. HD-41675), remove oil pressure switch.

INSTALLATION

PART NUMBER	TOOL NAME
HD-41675	OIL PRESSURE SENDING UNIT WRENCH

1. **XR models only:** if, during removal, oil pressure switch adapter came out with oil pressure switch, install adapter in the following way:
 - a. Separate oil pressure switch from adapter.
 - b. Remove old O-ring and install a **new** O-ring.
 - c. Install adapter and tighten to 108-158 **in-lbs** (12.2-17.9 Nm).

NOTE

Perform following step only if original oil pressure switch is being re-installed. **New** switches have a sealant contact patch on the mounting threads. If **new** switch is being installed, begin with step 2.

2. Coat threads of oil pressure switch with LOCTITE 565 HIGH PERFORMANCE PIPE SEALANT with TEFLON.
3. See [Figure 6-133](#). Install oil pressure switch (2). Using OIL PRESSURE SENDING UNIT WRENCH (Part No. HD-41675), tighten switch snugly. DO NOT OVERTIGHTEN.

4. **XL models only:** install voltage regulator caddy and attach DC output connector and neutral switch wiring harness to caddy. See [6.33 ELECTRICAL CADDIES](#).
5. **XR models only:** see [Figure 6-134](#).
 - a. Reposition neutral switch wire and stator wire (4).
 - b. Secure stator connector to bracket with barbed cable strap (3) and make sure neutral switch wire and oil pressure switch wires are secured in J-clip (2).
 - c. Mate halves of stator connector and secure with lock.

NOTE

Oil pressure switch connector [120] must always face away from vehicle.

6. Attach wiring harness connector [120] (3) to oil pressure switch. Make sure connector points away from motorcycle.
7. Plug in main fuse. See [6.38 MAIN FUSE](#).

NOTE

If an appreciable amount of oil leaked out when oil pressure switch was removed, it will have to be replaced with fresh oil.

8. Check oil level in oil tank. See [1.6 ENGINE OIL AND FILTER](#). Top off oil level if necessary.
9. Start engine and test oil pressure switch for proper operation. Check oil pressure switch for leaks.



HORN

6.37

TROUBLESHOOTING

If the horn does not sound or sounds weak, check for the following:

- Discharged battery. To charge battery, see [1.17 BATTERY MAINTENANCE](#).
- Loose, frayed or damaged wiring to horn terminal.

If battery is charged and wiring appears to be in good condition, perform a VOLTAGE TEST for the following:

- Inoperative horn switch.
- Open circuit to horn.
- Open ground to frame.
- Inoperative horn.

VOLTAGE TEST

1. Remove terminal clips from horn spade connectors.
2. Connect voltmeter leads, positive (+) to wire terminal and negative (-) to ground.
3. Turn ignition switch ON and press horn switch.
4. If battery voltage is not present, check for the following:
 - a. Horn switch is inoperative. Replace switch. See [6.41 LEFT HANDLEBAR SWITCHES](#).
 - b. Wiring to horn is open. Repair wiring.
5. If battery voltage is present, check for the following:
 - a. Ground is open between mounting hardware or ground wire. Repair wiring.
 - b. Horn is inoperative. Replace horn. See [6.37 HORN, Replacement: Models with Front Mounted Horn](#) or [6.37 HORN, Replacement: Models with Side Mounted Horn](#).

REPLACEMENT: MODELS WITH FRONT MOUNTED HORN

1. See [Figure 6-135](#). Remove terminal clips from horn spade connectors (1, 3).
2. Remove screws (4) and lock washers (6) from horn bracket (2) and remove horn assembly (5).
3. Install horn assembly with screws and washers into horn bracket. Tighten screws to 72-108 **in-lbs** (8.1-12.2 Nm).
4. Install the yellow wire with black tracer to the left spade connector (3) and the black wire to the right spade connector (1).

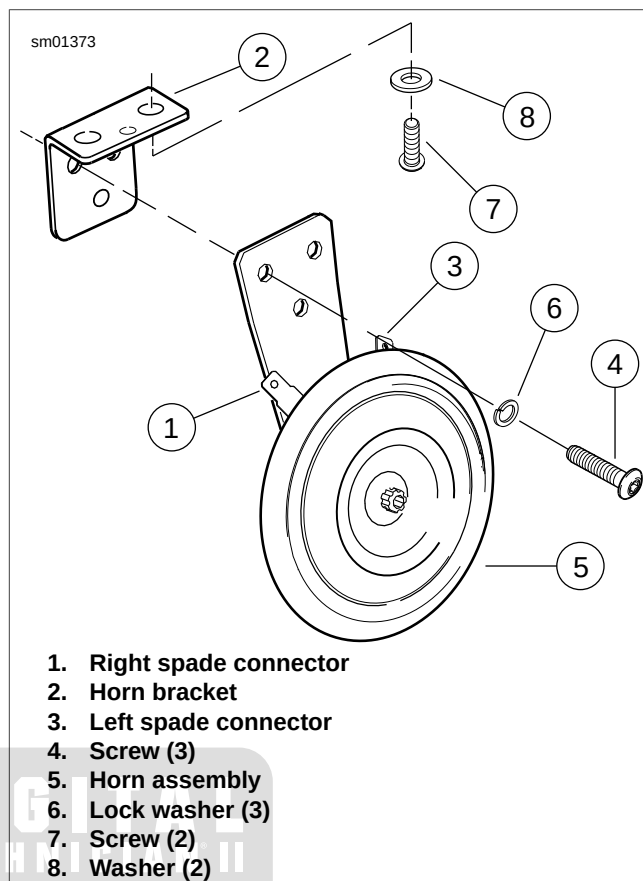


Figure 6-135. Horn Components (Models with Front Mounted Horn)

REPLACEMENT: MODELS WITH SIDE MOUNTED HORN

1. See [Figure 6-136](#). Remove terminal clips from horn spade connections on back of horn (12).
2. Remove acorn nut (3) and lock washer (4) to free horn assembly from rubber mount (6) stud.
3. Remove wire conduit from clamp (9) at back of support bracket (5).
4. Remove nut (10) from circular recess at back of chrome cover and bracket (2) and remove horn (12) from cover and bracket.
5. Slide horn (12) into chrome cover and bracket (2) pushing stud at back of horn assembly through hole in horn support bracket (5). Apply two drops of LOCTITE THREAD-LOCKER 271 (red) to threads of nut (10). Install nut (10) on horn stud and tighten to 80-100 **in-lbs** (9.0-11.3 Nm).
6. Attach the yellow wire with black tracer to front terminal and the black wire to rear terminal. Push wire conduit into clamp (9) at back of horn bracket (5).
7. Install support bracket (5) on rubber mount (6) stud with lock washer (4) and acorn nut (3). Tighten acorn nut (3) to 60-180 **in-lbs** (6.8-20.4 Nm).

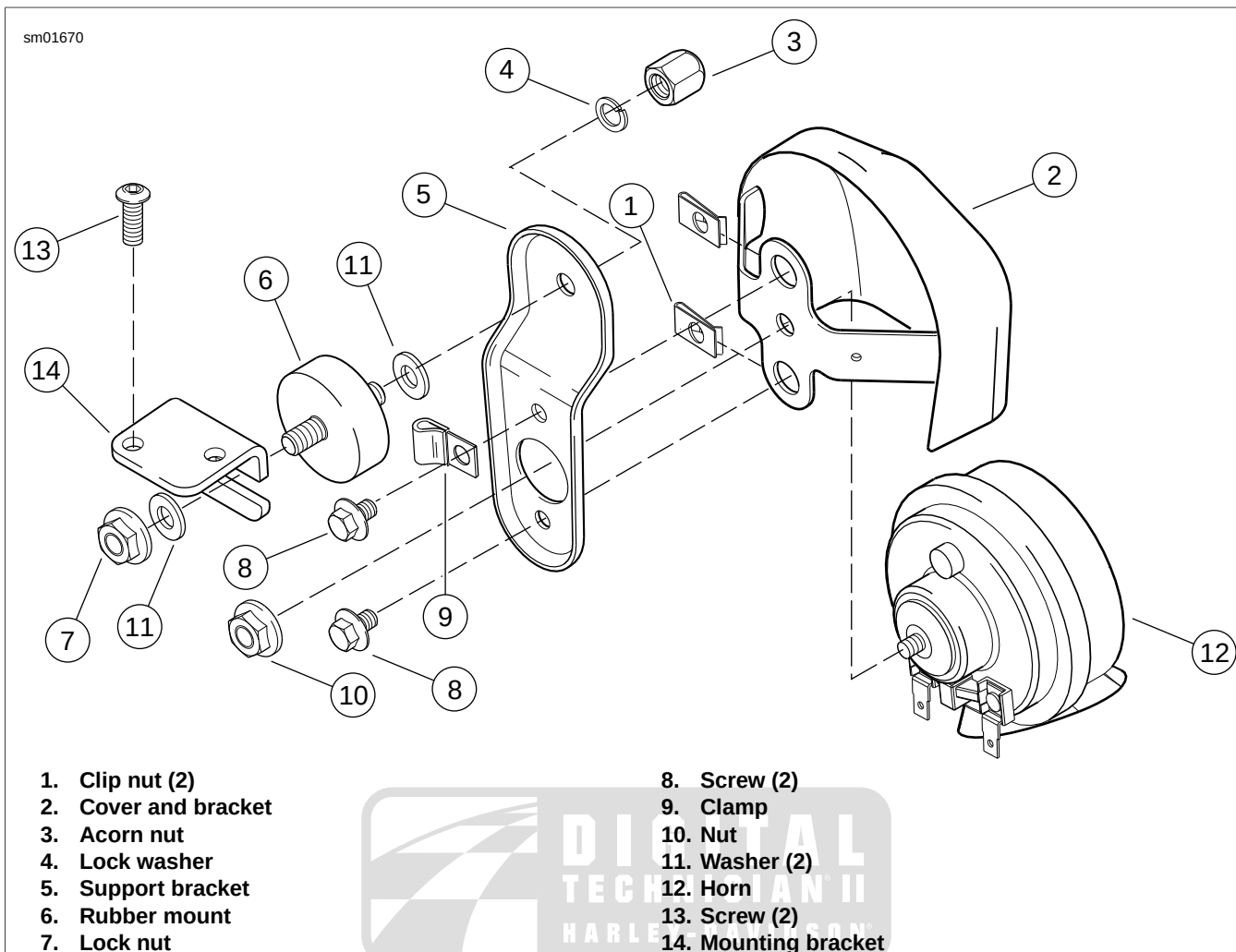


Figure 6-136. Horn Components (Models with Side Mounted Horn)

MAIN FUSE

6.38

GENERAL

Fuses prevent the electrical overload of a circuit. A fuse closes a circuit as long as current (amperage) flowing through the fuse does not exceed the ampere rating of the fuse. If the circuit current exceeds the fuse ampere rating, the fuse opens and the current flow is interrupted.

See [Figure 6-137](#). The main fuse is located in a holder [5] (1) mounted on the battery strap (2) under the left side cover. The main fuse is rated at 30 Amperes.

REMOVAL

1. Open left side cover. See [2.20 LEFT SIDE COVER](#).
2. See [Figure 6-137](#). Squeeze cover release latches (4) together and pull fuse holder [5] (1) from protective cover (3).
3. See [Figure 6-138](#). Grasp fuse holder (2) and pull main fuse (1) straight out.
4. If you are performing other procedures before re-installing the main fuse, close the left side cover.

INSTALLATION

1. Open left side cover. See [2.20 LEFT SIDE COVER](#).
2. See [Figure 6-138](#). Install main fuse (1) by lining up spade terminals on fuse with sockets in fuse holder [5] (2). Press fuse firmly into holder.
3. See [Figure 6-137](#). While holding protective cover (3) in place, push fuse holder [5] (1) into cover until cover release latches (4) snap into place.
4. Close left side cover.

WARNING

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

5. Turn ignition switch ON and verify proper operation of electrical system.

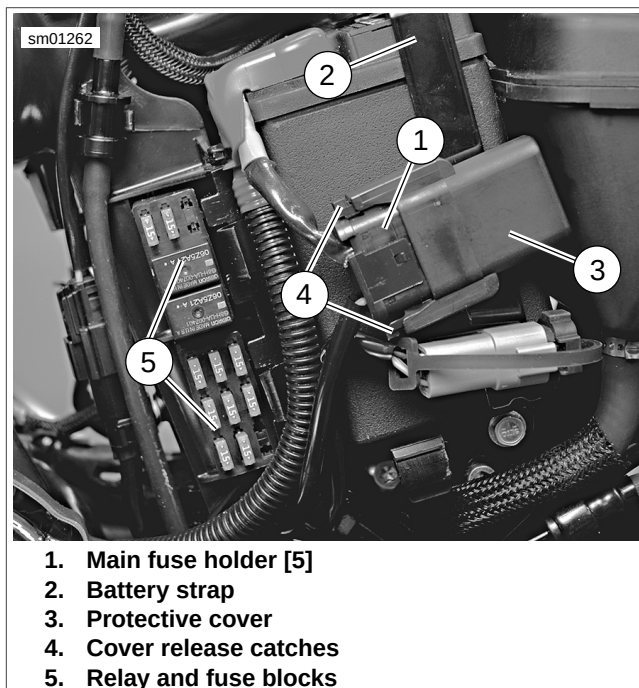


Figure 6-137. 30 Amp Main Fuse Location: All Models (XL Model Shown)

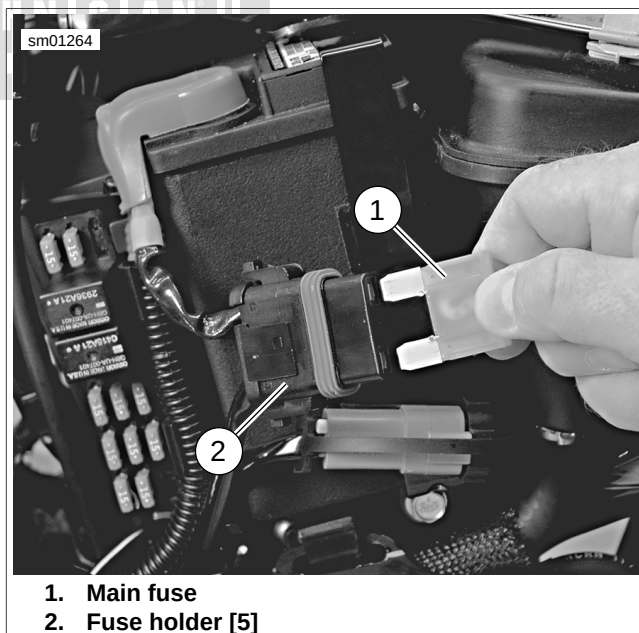


Figure 6-138. Removing/Installing Main Fuse: All Models (XL Model Shown)

HANDLEBAR SWITCH ASSEMBLIES

6.39

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

- On certain models, the turn signal wiring is routed through the lower switch housings and handlebars.
- To replace or repair individual switches in either the right or left handlebar switch assemblies, see [6.40 RIGHT HANDLEBAR SWITCHES](#) or [6.41 LEFT HANDLEBAR SWITCHES](#).

REPAIR PROCEDURES

PART NUMBER	TOOL NAME
HD-25070	ROBINAIR HEAT GUN
HD-39969	ULTRA TORCH UT-100
HD-41183	HEAT SHIELD ATTACHMENT

See [6.40 RIGHT HANDLEBAR SWITCHES](#) and [6.41 LEFT HANDLEBAR SWITCHES](#). The removal and installation steps listed apply when replacing the entire switch assembly, switch housing or handlebars.

The information below is useful when repairing handlebar switch assemblies.

- To better access wires and avoid damaging conduit with radiant heating device, push conduit back and secure with extra 7.0 in. (177.8 mm) cable strap in kit.
- Strip 0.5 in (12.7 mm) of insulation off switch wires. Twist stripped ends of switch wires until all strands are tightly coiled.
- Cut dual wall heat-shrink tubing, supplied in repair kit into 1.0 in. (25.4 mm) segments. Slide tubing over each wire of **new** switch assembly.
- Splice existing and **new** switch wires, matching wire colors. Solder the spliced connections. For best results, do one wire at a time.
- Center the heat-shrink tubing over the soldered splices.

WARNING

Be sure to follow manufacturer's instructions when using the UltraTorch UT-100 or any other radiant heating device. Failure to follow manufacturer's instructions can cause a fire, which could result in death or serious injury. (00335a)

- Avoid directing heat toward any fuel system component. Extreme heat can cause fuel ignition/explosion resulting in death or serious injury.
 - Avoid directing heat toward any electrical system component other than the connectors on which heat shrink work is being performed.
 - Always keep hands away from tool tip area and heat shrink attachment.
- See [Figure 6-139](#). Using the ULTRA TORCH UT-100 (Part No. HD-39969) or ROBINAIR HEAT GUN (Part No. HD-25070) with HEAT SHIELD ATTACHMENT (Part No. HD-41183) 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.
 - 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.

WARNING

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

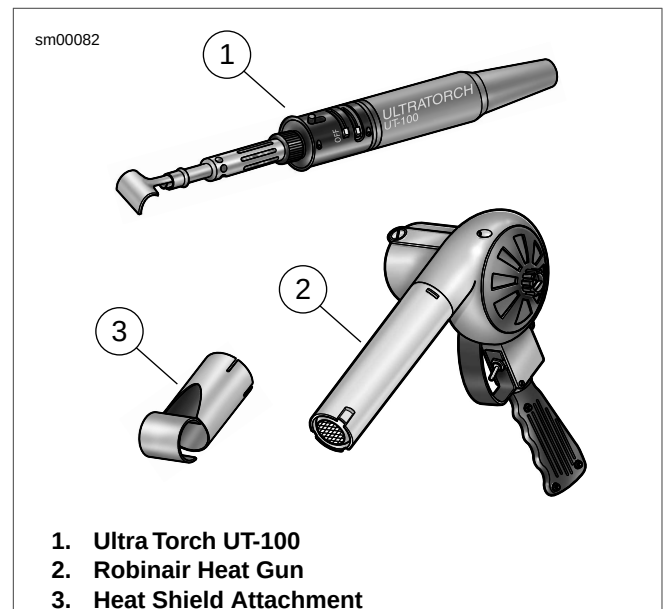


Figure 6-139. Radiant Heating Devices

CONNECTORS

⚠ WARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

1. Purge the fuel supply hose of high pressure gasoline. Disconnect fuel supply hose from fuel pump module. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).

⚠ WARNING

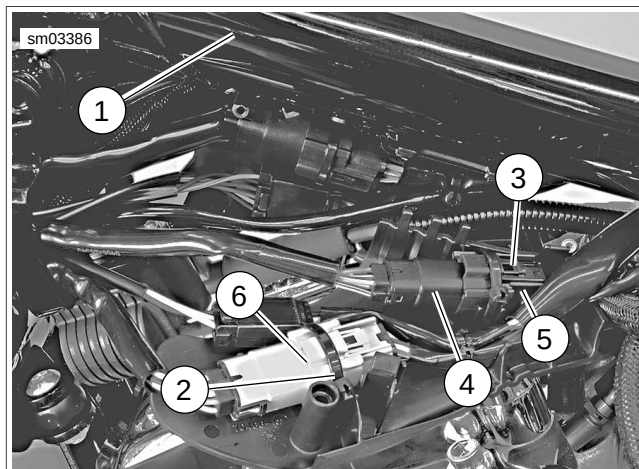
To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

2. Unplug main fuse. See [6.38 MAIN FUSE](#).
3. Remove fuel tank. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).
4. Separate left and right wire harness caddies. See [6.33 ELECTRICAL CADDIES](#).
5. On XL 883C/XL 1200C models, remove riser cover from the back of the handlebar riser. See [2.32 HANDLEBARS](#).
6. See [Figure 6-140](#) or [Figure 6-141](#). Locate right handlebar connector [22] (4, 5) mounted on left wire harness caddy (2). Press latch (3) and separate connector halves.
7. In the same manner, locate left handlebar connector [24] (6), press latch and separate connector halves.
8. To remove socket or pin halves for routing or to service Molex electrical connectors, see [A.9 MOLEX CONNECTORS](#).
9. Mate right handlebar connector [22] halves. Mate left handlebar connector [24] halves.
10. Reassemble left and right wire harness caddies. See [6.33 ELECTRICAL CADDIES](#).
11. Replace fuel tank. See [4.6 FUEL TANK: XL MODELS](#) or [4.7 FUEL TANK: XR MODELS](#).
12. On XL 883C/XL 1200C models, replace riser cover. Make certain that handlebar control harnesses are not pinched between handlebar riser and riser cover. Tighten screws to 8-12 in-lbs (0.9-1.4 Nm).
13. Plug in main fuse. See [6.38 MAIN FUSE](#).

⚠ WARNING

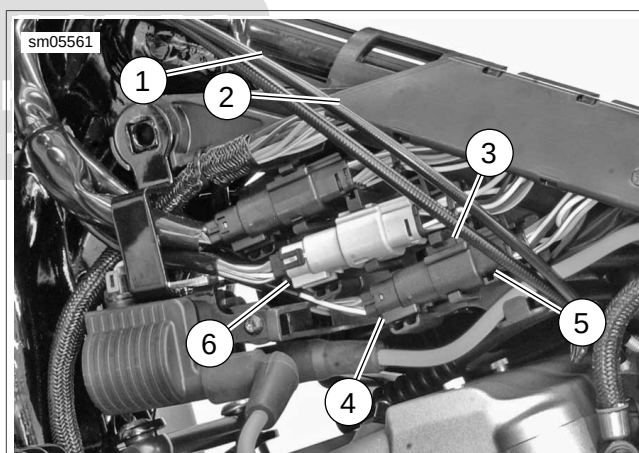
Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

14. Turn ignition switch ON and verify correct operation of handlebar switches.



1. Frame backbone
2. Left wire harness caddy
3. Connector latch
4. Right handlebar pin connector [22A]
5. Right handlebar socket connector [22B]
6. Left handlebar control connector [24]

Figure 6-140. Handlebar Connectors (XL Models Only)



1. Frame backbone
2. Left wire harness caddy
3. Connector latch
4. Right handlebar pin connector [22A]
5. Right handlebar socket connector [22B]
6. Left handlebar control connector [24]

Figure 6-141. Handlebar Connectors (XR 1200 Models Only)

RIGHT HANDLEBAR SWITCHES

6.40

REMOVAL

NOTE

The removal and installation steps listed apply when replacing the entire switch assembly, switch housing or handlebars.

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Remove main fuse. See [6.38 MAIN FUSE](#).

NOTE

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

2. See [Figure 6-142](#). Place the cardboard insert between the brake lever and lever bracket.
3. Using a T27 TORX drive head, remove the two screws with flat washers securing the handlebar clamp to the master cylinder housing. Remove the brake lever/master cylinder assembly and clamp from the handlebar.
4. Using a T25 TORX drive head, remove the upper and lower switch housing screws.
5. 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.

6. Remove the brass ferrules from the notches on the inboard side of the throttle control grip. Remove the ferrules from the cable end fittings.
7. Remove the throttle control grip from the end of the handlebar.
8. 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.



Figure 6-142. Install Cardboard Insert

DISASSEMBLY

CAUTION

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

1. Place the cardboard insert between the brake lever and lever bracket.
2. Using a T25 TORX drive head, remove the upper and lower switch housing screws.
3. If replacing lower housing switches, perform steps 4 through 7 before continuing to repair section. If replacing upper housing switches, proceed directly to repair section.
4. See [Figure 6-151](#). Using a T27 TORX drive head, loosen the upper screw (1) securing the handlebar switch clamp to the master cylinder housing. Remove the lower clamp screw with flat washer (2).
5. Remove the brass ferrules from the notches on the inboard side of the throttle control grip. Remove the ferrules from the cable end fittings.
6. Remove the friction shoe from the end of the tension adjuster screw.

NOTE

The friction shoe is a loose fit and may fall out or become dislodged if the lower switch housing is turned upside down or shaken.

7. Remove the throttle control grip from the end of the handlebar.

SWITCH REPAIR/REPLACEMENT

Upper Housing Repair

NOTE

Replace the engine stop and engine start switches as a single assembly even if only one switch is determined to be faulty.

1. See [Figure 6-143](#). From inside the switch housing, remove the screw with lockwasher (4) to release the bracket (5). Remove the bracket and switch assembly from the housing.
2. Move cable conduit (3) from beneath wing of bracket. Cut wires 0.25 in. (6.4 mm) from old switches (1, 2). Discard old switch and bracket assembly.
3. Slide conduit forward over cut ends of switch wires and cut off 0.5 in. (12.7 mm) of conduit (3) material. Push conduit back to access switch wires.
4. See [Figure 6-144](#). Separate **new** engine stop switch (2) and engine start switch (1) wires into two bundles.

NOTE

Replacement stop switch and start switch wires are cut to length, 2.5 in. (63.5 mm) and 2.0 in. (50.8 mm) respectively, and partially stripped.

5. See [6.39 HANDLEBAR SWITCH ASSEMBLIES](#) for information on splicing and general repair practices.
6. Loop switch wires so that spliced lengths are positioned as shown in [Figure 6-144](#). Route wires downstream of splices beneath wing on engine stop switch side of bracket as shown in [Figure 6-143](#).
7. See [Figure 6-144](#). Install a **new** 7.0 in. (177.8 mm) cable strap (5) beneath wing on engine start switch side (1) of bracket and capture wire splices (4).
8. Place switch assembly into upper housing aligning hole in bracket with threaded hole in boss. Be sure that bracket is fully seated. The step at the edge of the boss captures the bottom edge of the bracket, while tabs on each side of the bracket fit in slots cast into the housing.
9. See [Figure 6-143](#). Install screw and lockwasher (4) to secure bracket (5) inside housing. Verify that wing on engine stop switch (2) side of bracket captures edge of conduit (3) as shown.
10. Securely tighten cable strap to draw splices to bracket. Remove any excess cable strap material.
11. Continue with [6.40 RIGHT HANDLEBAR SWITCHES, Assembly](#).

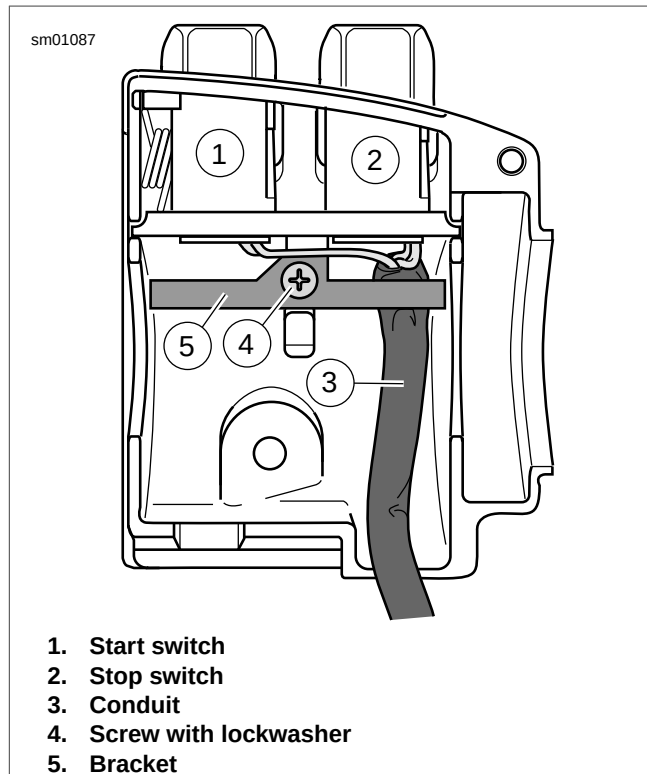


Figure 6-143. Upper Housing Without Splices

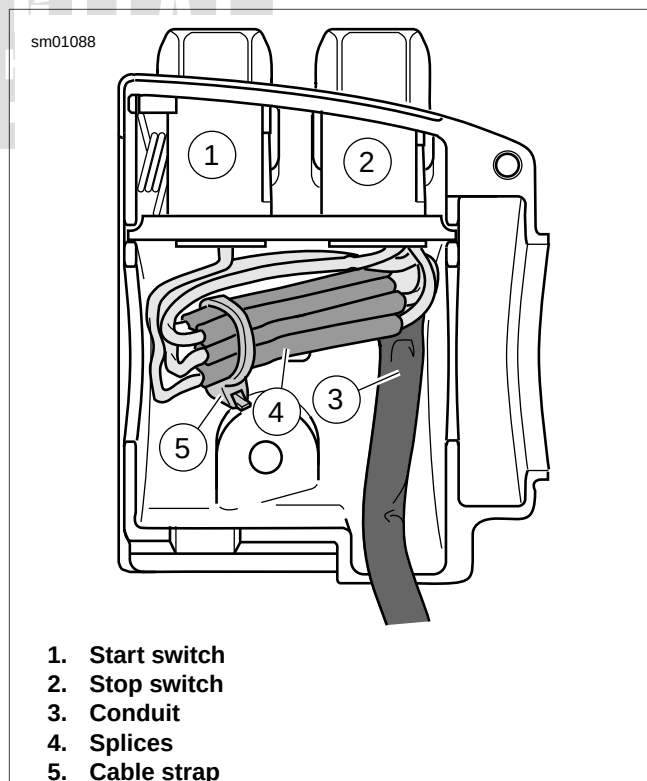


Figure 6-144. Upper Housing With Splices

Lower Housing Repair

1. From inside the switch housing, carefully cut cable strap to free conduit from the turn signal switch bracket.
2. Remove the screw with lockwasher to release the turn signal switch bracket. Remove the bracket and switch assembly from the housing.
3. Continue with **TURN-RIGHT SIGNAL SWITCH** or **FRONT STOPLIGHT SWITCH** procedures which follow.

Turn-Right Signal Switch

1. Perform steps in **LOWER HOUSING REPAIR**.
2. Cut wire 1.5 in. (38.1 mm) from old switch. Discard old switch assembly.

NOTE

Replacement turn-right signal switch wires are cut to length of 1.5 in. (38.1 mm) and partially stripped.

3. See [6.39 HANDLEBAR SWITCH ASSEMBLIES](#) for information on splicing and general repair practices.
4. Continue with [6.40 RIGHT HANDLEBAR SWITCHES, Assembly](#).

Front Stoplight Switch

1. Perform steps in **LOWER HOUSING REPAIR**.
2. 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.
3. Cut wires 1.0 in. (25.4 mm) from old switch. Discard old switch.

NOTE

Replacement stoplight switch wires are cut to length of 2.5 in. (63.5 mm) and partially stripped.

4. See [6.39 HANDLEBAR SWITCH ASSEMBLIES](#) for information on splicing and general repair practices.
5. 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.
6. 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.
7. See [Figure 6-145](#). Push down on switch (1) so that it bottoms against housing and wires (3) run in groove at base of cavity. With the concave side facing outward, insert wedge (2) between switch and outboard side of switch housing.
8. 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.
9. Continue with [6.40 RIGHT HANDLEBAR SWITCHES, Assembly](#).

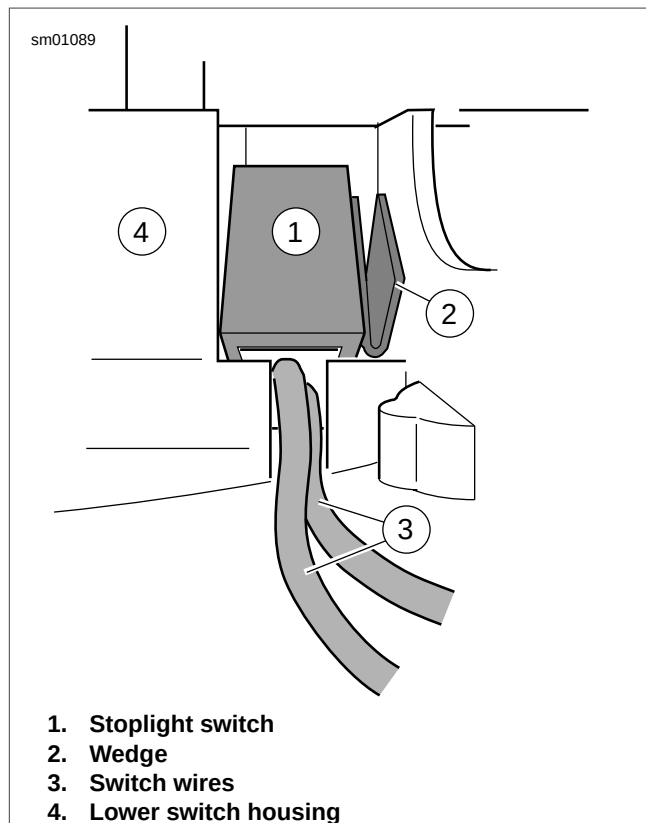


Figure 6-145. Install Stoplight Switch

ASSEMBLY

1. See [Figure 6-146](#). Insert tapered end of **new** 7.0 in. (177.8 mm) cable strap (1) into round hole in turn signal switch bracket (2) and then feed back through using the adjacent hole. Reserve the oblong hole for the bracket screw.

NOTE

Be sure that all splices are positioned above the turn signal switch bracket.

2. Place the turn signal switch assembly into the housing, aligning the oblong hole in the bracket with the threaded hole in the boss. Be sure that the bracket is fully seated. Tabs on each side of bracket are captured in slots cast into switch housing.
3. Start screw with lockwasher to secure bracket inside housing.

CAUTION

If routed incorrectly, wires can be pinched by casting or handlebar resulting in switch failure. (00542b)

4. Loop switch wires so that spliced lengths are positioned across bracket.
5. Capturing conduit about 0.25 in. (6.4 mm) from end, securely tighten cable strap to draw conduit to bracket. Remove any excess cable strap material.
6. Install second 7.0 in. (177.8 mm) cable strap capturing conduit and wire splices. Securely tighten cable strap to

draw splices to conduit. Remove any excess cable strap material.

7. Tighten screw to secure bracket inside housing.
8. Route wire bundle to upper switch housing by gently pressing conduit into channel next to angular arm of bracket. Secure bundle to arm using third cable strap. Cut any excess cable strap material. If necessary, bend angular arm of bracket downward to firmly secure front stoplight switch in position.
9. See [6.40 RIGHT HANDLEBAR SWITCHES, Installation](#).
 - a. If lower housing switches were replaced, perform the entire procedure.
 - b. If upper housing switches were replaced, begin with step 11.

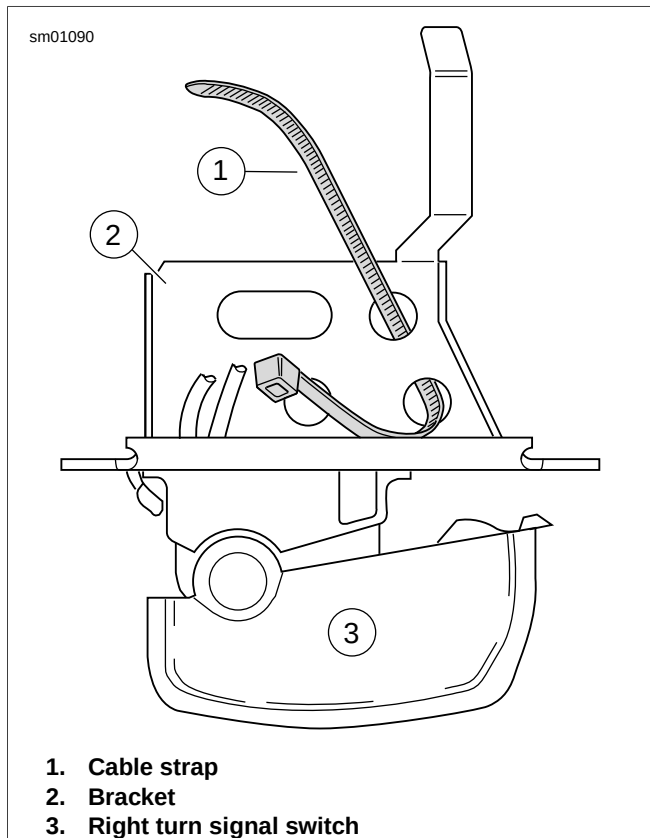


Figure 6-146. Insert Cable Strap in Switch Bracket

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.

2. See [Figure 6-148](#). Route the cable (2) to the upper switch housing as shown.
3. 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 in. (3.2 mm).
4. 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.

5. See [Figure 6-149](#). Position lower switch housing beneath the throttle control grip. Install the brass ferrules (4) onto the cable so that the end fittings seat in the ferrule recess. Seat the ferrules in their respective notches (3) on the throttle control grip. Verify that the cables are captured in the grooves (2) molded into the grip.
6. Position the upper switch housing over the handlebar and lower switch housing.
7. Verify that the wire harness conduit runs in the depression at the bottom of the handlebar. Be sure that the upper switch housing harness will not be pinched under the handlebar when the switch housing screws are tightened.
8. Start the upper and lower switch housing screws, but do not tighten.

CAUTION

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

INSTALLATION

1. See [Figure 6-147](#). Push the throttle and idle control cables into the lower switch housing until they snap in place. Note the different diameter inserts crimped into the end of the throttle and idle cable housings.
 - a. Push the silver insert (2) of throttle cable housing into the hole in front of tension adjuster screw (3).
 - b. Push the gold insert (1) of idle cable housing into the hole at the rear of tension adjuster screw (3).

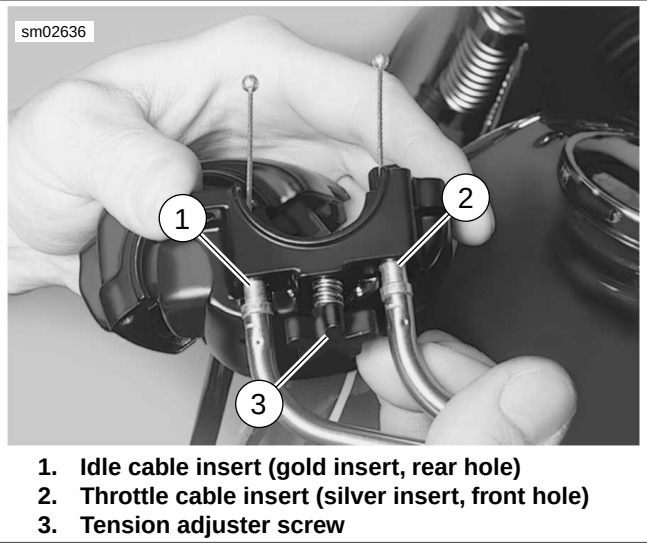


Figure 6-147. Right Lower Switch Housing

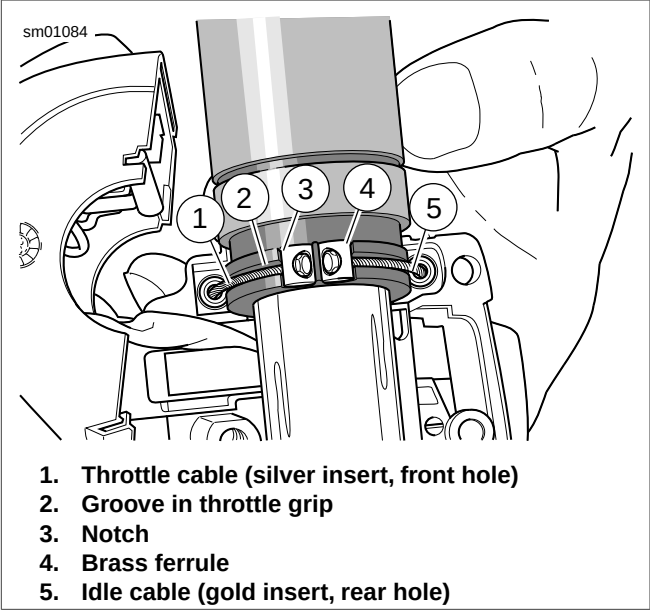


Figure 6-149. Throttle Cable Attachment

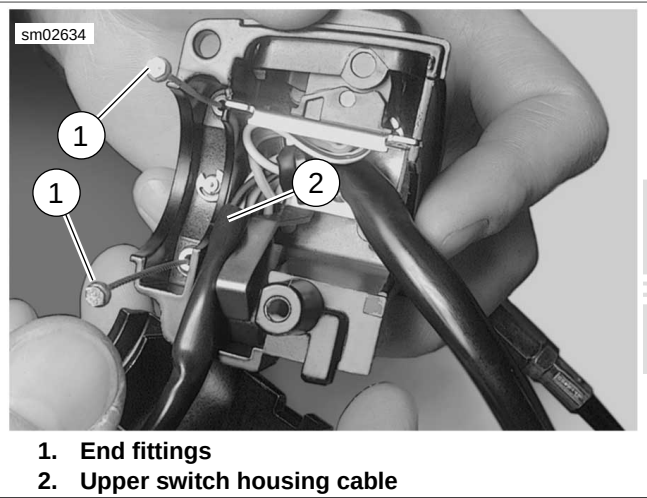


Figure 6-148. Route Cable to Upper Switch Housing

9. See [Figure 6-150](#). Position the brake lever/master cylinder assembly inboard of the switch housing assembly, engaging the tab (2) on the lower switch housing in the groove (3) at the top of the brake lever bracket.
10. Align the holes in the handlebar switch clamp with those in the master cylinder housing and start the two screws (with flat washers). Position for rider comfort. Beginning with the top screw, tighten to specification using a T27 TORX drive head. Refer to [Table 6-16](#).
11. Using a T25 TORX drive head, tighten lower and upper switch housing screws to specification. Refer to [Table 6-16](#).

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.

Table 6-16. Handlebar Switch Assembly Fasteners

FASTENER	TORQUE
Handlebar clamp screws	108-132 in-lbs (12.2-14.9 Nm)
Switch housing screws	35-45 in-lbs (4.0-5.1 Nm)

12. Remove the cardboard insert between the brake lever and lever bracket.
13. Adjust throttle cables. See [2.30 THROTTLE CABLES: ALL MODELS](#)
14. Install main fuse. See [6.38 MAIN FUSE](#).

⚠ WARNING

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

15. Test the switches for proper operation.

16. Secure wire harness to handlebar as necessary.

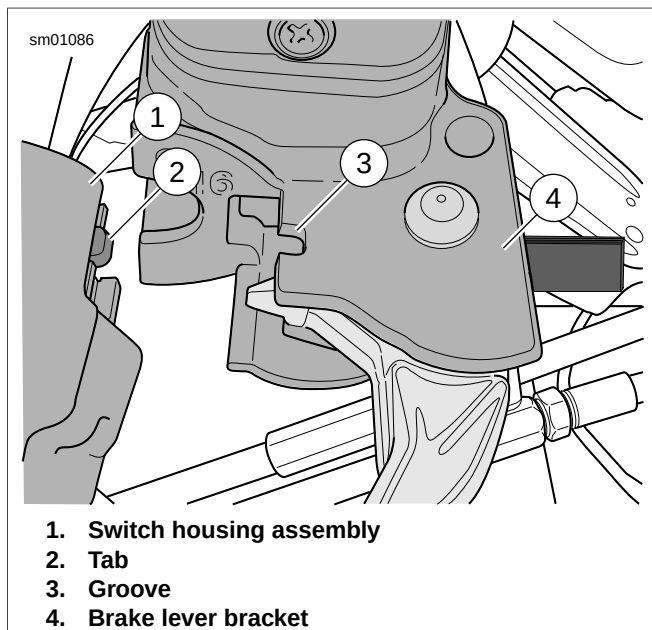


Figure 6-150. Switch Housing Alignment (typical)



Figure 6-151. Handlebar Switch Clamp Screws



LEFT HANDLEBAR SWITCHES

6.41

REMOVAL

NOTE

The removal and installation steps listed apply when replacing the entire switch assembly, switch housing or handlebars.

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)

1. Remove main fuse. See [6.38 MAIN FUSE](#).
2. Using a T25 TORX drive head, loosen but do not remove the upper and lower switch housing screws.
3. Using a T27 TORX drive head, remove the two screws with flat washers securing the handlebar clamp to the clutch lever bracket. Remove the clutch hand lever assembly and clamp from the handlebar.
4. Remove the upper and lower switch housing screws.
5. Remove the grip sleeve from the end of the handlebar if damaged.

DISASSEMBLY

1. Using a T25 TORX drive head, remove the upper and lower switch housing screws.
2. If replacing lower housing switches, perform next step before continuing to repair section. If replacing upper housing switches, proceed directly to repair section.
3. Using a T27 TORX drive head, loosen the upper screw securing the handlebar clamp to the clutch lever bracket. Remove the lower clamp screw with flat washer.

SWITCH REPAIR/REPLACEMENT

Upper Housing Repair

NOTE

Replace the horn switch and high/low beam switch as a single assembly even if only one switch is determined to be faulty.

1. See [Figure 6-152](#). From inside the switch housing, remove the screw with lockwasher (4) to release the bracket (5). Remove bracket and switch assembly from the housing.
2. Move cable conduit (3) from beneath wing of bracket. Cut wires 0.25 in. (6.4 mm) from old switches (1, 2). Discard old switch and bracket assembly.
3. Slide conduit forward over cut ends of switch wires and cut off 0.5 in. (12.7 mm) of conduit (3) material. Push conduit back to access switch wires.
4. Separate the **new** horn switch (1) and high/low beam switch (2) wires into two bundles.

NOTE

Replacement high/low beam switch and horn switch wires are cut to length of 2.5 in. (63.5 mm) and 2.0 in. (50.8 mm) respectively, and partially stripped.

5. See [6.39 HANDLEBAR SWITCH ASSEMBLIES](#) for information on splicing and general repair practices.
6. Loop switch wires so that spliced lengths are positioned as shown in [Figure 6-153](#). Route wires downstream of splices beneath wing on high/low beam switch side of bracket as shown in [Figure 6-152](#).
7. See [Figure 6-153](#). Install a **new** 7.0 in. (177.8 mm) cable strap (5) beneath wing on horn switch side (1) of bracket and capture wire splices (4).
8. Place switch assembly into upper housing aligning hole in bracket with threaded hole in boss. Be sure that bracket is fully seated. The step at the edge of the boss captures the bottom edge of the bracket, while tabs on each side of the bracket fit in slots cast into the housing.
9. See [Figure 6-152](#). Install screw and lockwasher (4) to secure bracket (5) inside housing. Verify that wing on high/low switch (2) side of bracket captures edge of conduit (3) as shown.
10. Securely tighten cable strap to draw splices to bracket. Remove any excess cable strap material.
11. Continue with [6.41 LEFT HANDLEBAR SWITCHES, Assembly](#).

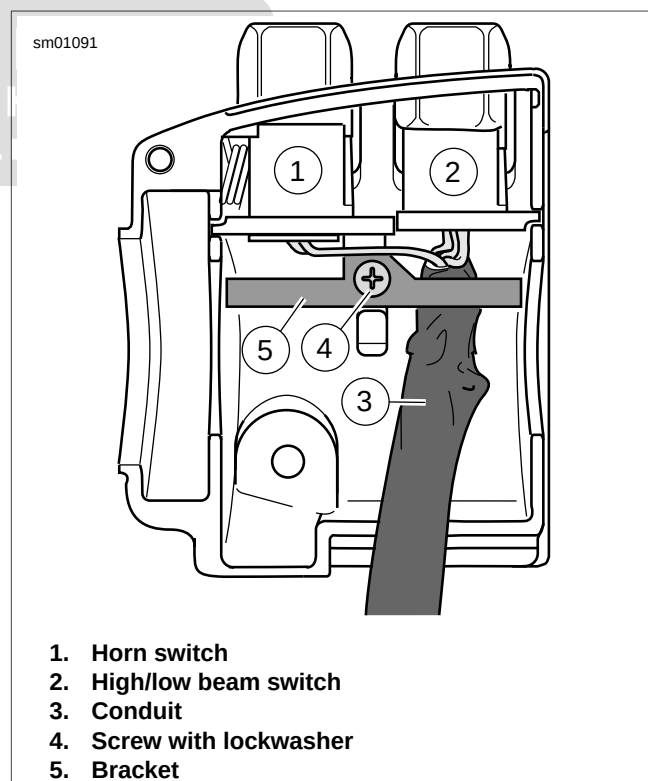


Figure 6-152. Upper Housing Without Splices

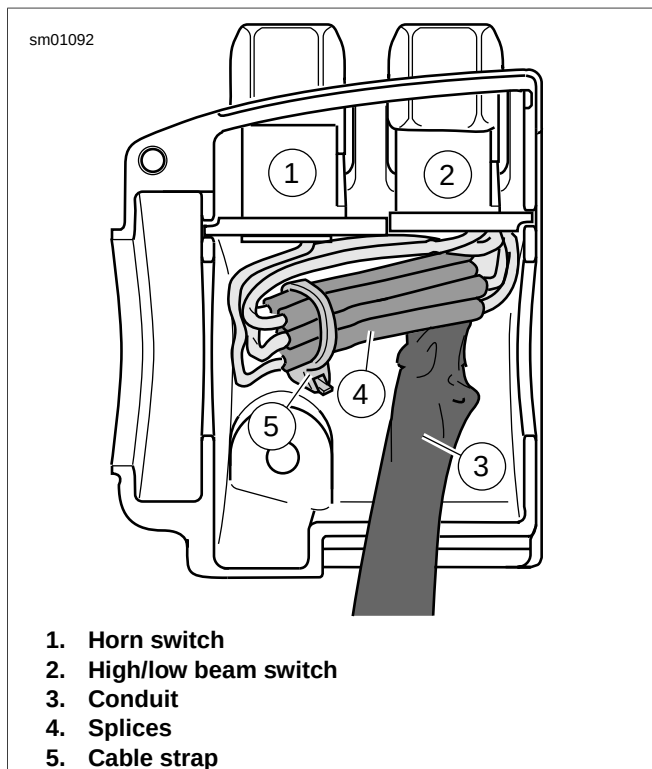


Figure 6-153. Upper Housing With Splices

3. See [6.39 HANDLEBAR SWITCH ASSEMBLIES](#) for information on splicing and general repair practices.
4. Continue with [6.41 LEFT HANDLEBAR SWITCHES, Assembly](#).

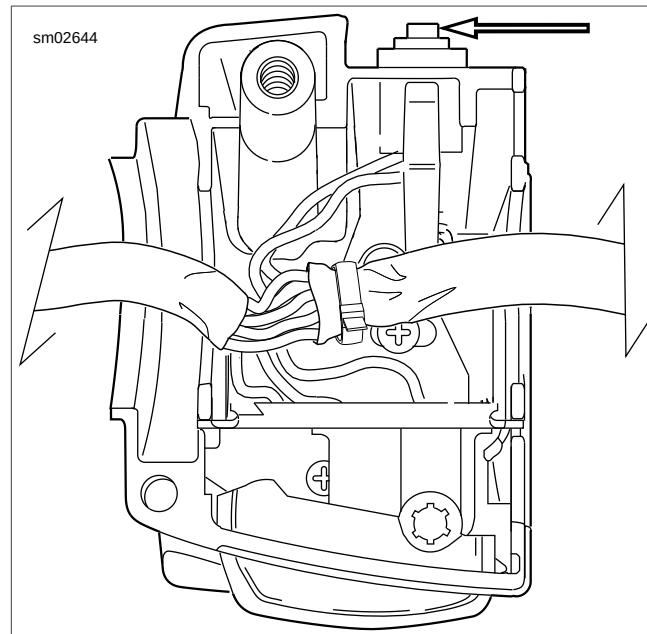


Figure 6-154. Clutch Interlock Switch

Lower Housing Repair

1. From inside the switch housing, carefully cut cable strap to free conduit from the turn signal switch bracket.
2. Remove screw with lockwasher to release the turn signal switch bracket. Remove the bracket and switch assembly from the housing.
3. Continue with TURN-LEFT SIGNAL SWITCH or CLUTCH INTERLOCK SWITCH procedures.

Turn-Left Signal Switch

1. Perform steps in LOWER HOUSING REPAIR.
2. Cut wires 1.5 in. (38.1 mm) from old switch (Turn-L(eft) Signal Switch). Discard switch assembly.

NOTE

Replacement turn-right signal switch wires are cut to length of 1.5 in. (38.1 mm) and partially stripped.

3. See [6.39 HANDLEBAR SWITCH ASSEMBLIES](#) for information on splicing and general repair practices.
4. Continue with [6.41 LEFT HANDLEBAR SWITCHES, Assembly](#).

Clutch Interlock Switch

1. Perform steps in LOWER HOUSING REPAIR.
2. See [Figure 6-154](#). Cut wires 0.25 in. (6.4 mm) from old switch. Discard switch assembly.

NOTE

Replacement turn-right signal switch wires are cut to length and partially stripped.

ASSEMBLY

1. See [Figure 6-155](#). Insert tapered end of new 7.0 in. (177.8 mm) cable strap (1) into round hole in turn signal switch bracket (2) and then feed back through using the adjacent hole. Reserve the oblong hole for the bracket screw.

NOTE

Be sure that all splices are positioned above the turn signal switch bracket.

2. Place the turn signal switch assembly (3) into the housing, aligning the oblong hole in the bracket with the threaded hole in the boss. Be sure that the bracket is fully seated. Tabs on each side of bracket are captured in slots cast into switch housing.
3. Start screw with lockwasher to secure bracket inside housing.

CAUTION

If routed incorrectly, wires can be pinched by casting or handlebar resulting in switch failure. (00542b)

4. Loop switch wires so that spliced lengths are positioned across bracket.
5. Capturing conduit about 0.25 in. (6.4 mm) from end, securely tighten cable strap to draw conduit to bracket. Remove any excess cable strap material.
6. Tighten screw to secure bracket inside housing.
7. Route wire bundle to upper switch housing below and then forward of the main wire harness, positioning conduit in channel next to angular arm of bracket. Secure bundle to

- arm using new cable strap. Cut any excess cable strap material.
8. See [6.41 LEFT HANDLEBAR SWITCHES, Installation](#).
 - a. If lower housing switches were replaced, perform the whole procedure.
 - b. If upper housing switches were replaced, begin with step 7.
 9. Verify the operation of the clutch interlock switch. See the ELECTRICAL DIAGNOSTIC MANUAL.

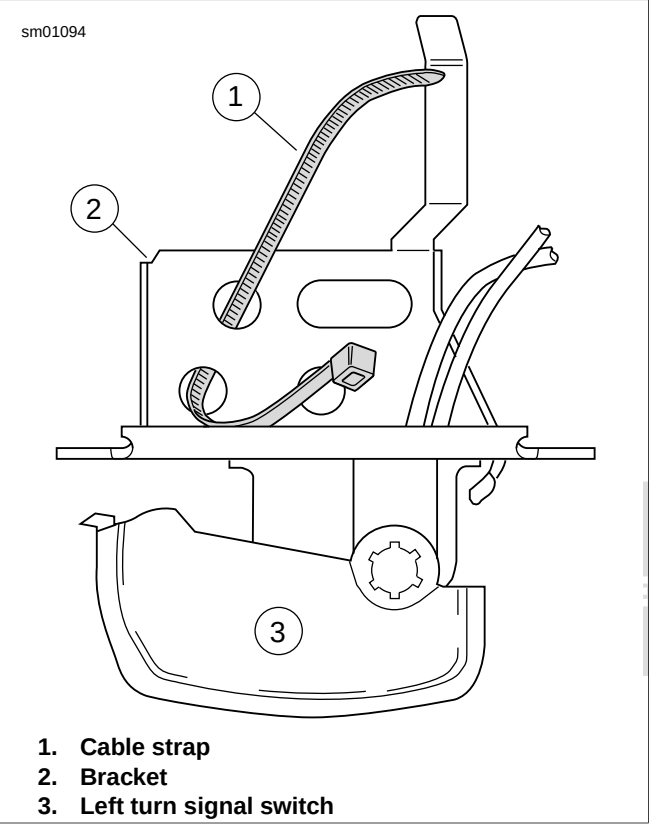


Figure 6-155. Insert Cable Strap in Switch Bracket

INSTALLATION

1. If the grip sleeve was removed, thoroughly clean handlebar to remove all adhesive residue. Pour adhesive into new grip. Roll grip to evenly distribute adhesive on inside surfaces. Install grip on handlebar with a twisting motion.
2. See [Figure 6-156](#). Install upper and lower switch housings on handlebar. Be sure that ribs (2) on outboard side of switch housings fit in grooves (3) molded into grip.
3. Verify that the wire harness conduit runs in the groove at the bottom of the handlebar. Be sure that the upper switch housing harness will not be pinched under the handlebar when the switch housing screws are tightened.
4. Start the upper and lower switch housing screws, but do not tighten.
5. See [Figure 6-157](#). Position the clutch hand lever assembly inboard of the switch housing assembly, engaging the tab

- (3) on the lower switch housing in the groove (2) at the bottom of the clutch lever bracket.
6. Align the holes in the handlebar switch clamp with those in the clutch lever bracket and start the two screws (with flat washers). Position for rider comfort. Beginning with the top screw, tighten screws to specification. Refer to [Table 6-17](#).
7. Using a T25 TORX drive head, tighten lower and upper switch housing screws to specification. Refer to [Table 6-17](#).

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.

Table 6-17. Handlebar Switch Assembly Fasteners

FASTENER	TORQUE
Handlebar clamp screws	108-132 in-lbs (12.2-14.9 Nm)
Switch housing screws	35-45 in-lbs (4.0-5.1 Nm)

8. Install main fuse. See [6.38 MAIN FUSE](#).

⚠ WARNING

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

9. Test the switches for proper operation.
10. Secure wire harness to handlebar as necessary.

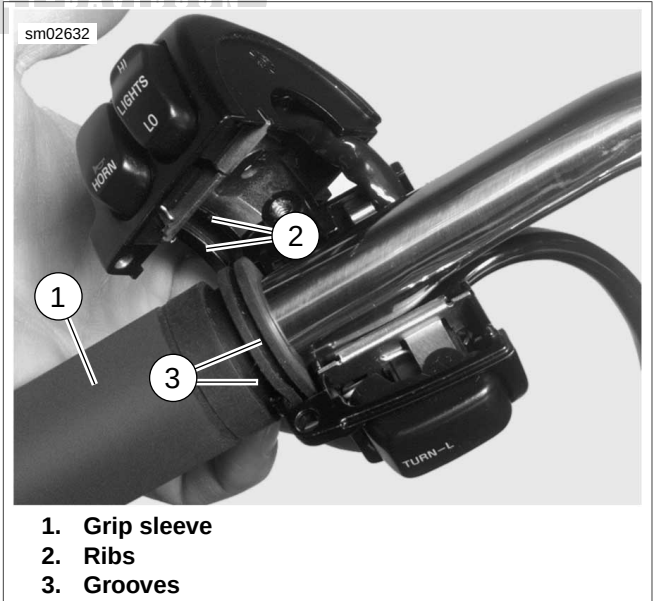


Figure 6-156. Left Handlebar Switch Housings

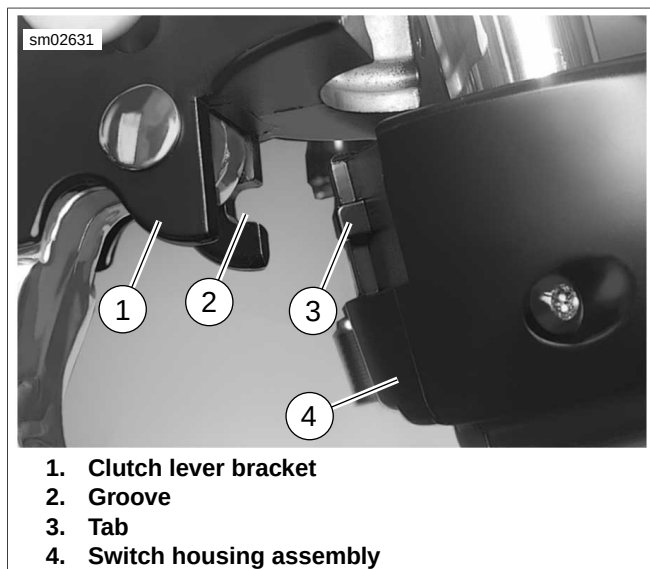


Figure 6-157. Clutch Lever Bracket



TABLE OF CONTENTS

SUBJECT	PAGE NO.
A.1 AMP MULTILOCK CONNECTORS.....	A-1
A.2 AUTOFUSE ELECTRICAL CONNECTORS.....	A-5
A.3 DELPHI CONNECTORS.....	A-6
A.4 DELPHI MAIN FUSE HOUSING.....	A-8
A.5 DEUTSCH ELECTRICAL CONNECTORS.....	A-10
A.6 DEUTSCH STANDARD TERMINAL REPAIR.....	A-14
A.7 DEUTSCH SOLID BARREL MINI TERMINAL REPAIR.....	A-15
A.8 DEUTSCH MINI TERMINAL REPAIR.....	A-17
A.9 MOLEX CONNECTORS.....	A-18
A.10 PACKARD 150 METRI-PACK CONNECTORS.....	A-22
A.11 PACKARD 280 METRI-PACK RELAY AND FUSE BLOCK CONNECTORS.....	A-24
A.12 PACKARD 480 METRI-PACK CONNECTORS.....	A-25
A.13 PACKARD 630 METRI-PACK CONNECTORS.....	A-26
A.14 PACKARD METRI-PACK TERMINALS.....	A-27
A.15 PACKARD ECM CONNECTOR.....	A-29
A.16 PACKARD MICRO-64 CONNECTORS.....	A-31
A.17 SEALED SPLICE CONNECTORS.....	A-34



NOTES



AMP MULTILOCK CONNECTOR REPAIR

PART NUMBER	TOOL NAME
HD-41609	AMP MULTILOCK CRIMPER

General

AMP Multilock connectors are found between wire harnesses and component wiring and may be either floating or anchored to the frame with attachment clips.

See [Figure A-1](#). Attachment clips (1) on the pin housings are fitted to T-studs on the motorcycle frame. The T-studs identify OE connector locations. To maintain serviceability, always return connectors to OE locations after service.

Obtain the necessary tools to repair the connector and terminals.

NOTE

For terminal crimping use the AMP MULTILOCK CRIMPER (Part No. HD-41609).

Separating Pin and Socket Housings

1. If necessary, slide connector attachment clip T-stud to the large end of the opening.
2. See [Figure A-1](#). Depress the release button (2) on the socket terminal side of the connector and pull the socket housing (3) out of the pin housing (4).

Mating Pin and Socket Housings

1. Hold the housings to match wire color to wire color.
2. Insert the socket housing into the pin housing until it snaps in place.
3. If OE location is a T-stud, fit large opening end of attachment clip over T-stud and slide connector to engage T-stud to small end of opening.

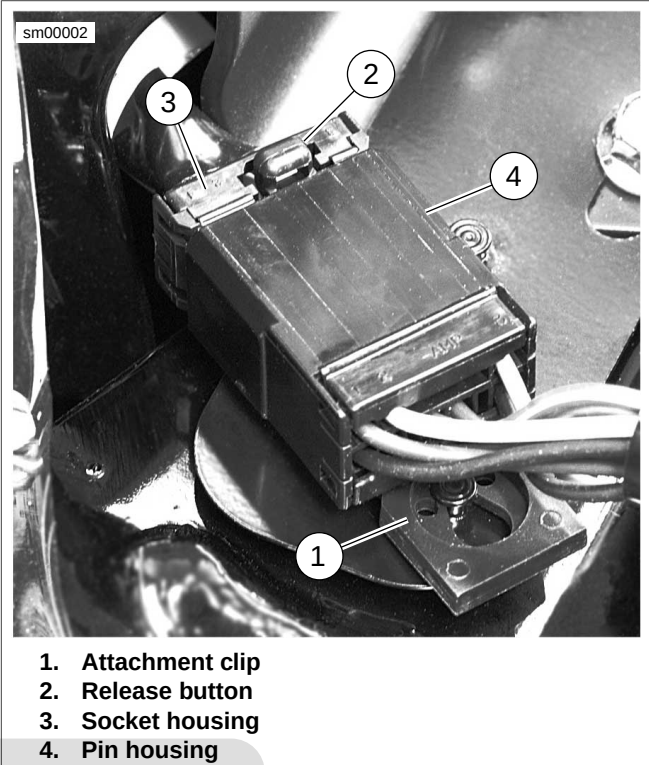


Figure A-1. AMP Multilock Connector

Removing Terminals from Housing

1. See [Figure A-2](#). Bend back the latch (1) to free one end of secondary lock (2) then repeat on the opposite end. Hinge the secondary lock outward.
2. Look in the terminal side of the connector (opposite the secondary lock) and note the cavity next to each terminal.
3. Insert a pick or pin into the terminal cavity until it stops.

NOTE

If socket/pin terminal tool is not available, a push pin/safety pin or a Snap-on pick (Part No. TT600-3) may be used.

4. Press the tang in the housing to release the terminal.
 - a. **Socket:** Lift the socket tang (8) up.
 - b. **Pin:** Press the pin tang (7) down.

NOTE

A "click" is heard if the tang is released.

5. Gently tug on wire to pull wire and terminal from cavity.

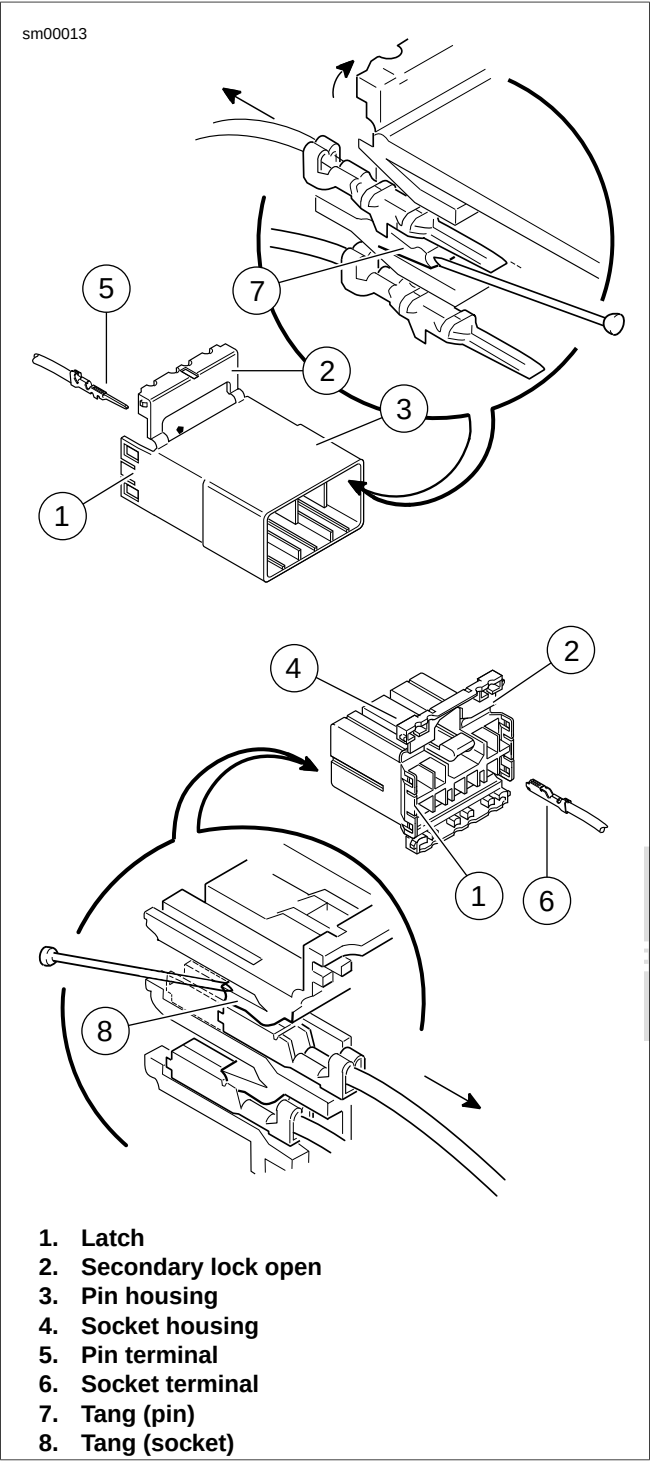


Figure A-2. AMP Multilock Connector: Socket and Pin Housings

Inserting Terminals into Housing

NOTE

See [Figure A-3](#). Cavity numbers are stamped into the secondary locks of both the socket and pin housings. Match the wire color to the cavity number found on the wiring diagram.

1. Hold the terminal so the catch faces the tang in the chamber. Insert the terminal into its numbered cavity until it snaps in place.

NOTES

- Up and down can be determined by the position of the release button, the button is the top of the connector.
 - On the pin side of the connector, tangs are positioned at the bottom of each cavity, so the slot in the pin terminal (on the side opposite the crimp tails) must face downward.
 - On the socket side, tangs are at the top of each cavity, so the socket terminal slot (on the same side as the crimp tails) must face upward.
2. Gently tug on wire end to verify that the terminal is locked in place.
 3. Rotate the hinged secondary lock inward until tabs fully engage latches on both sides of connector.

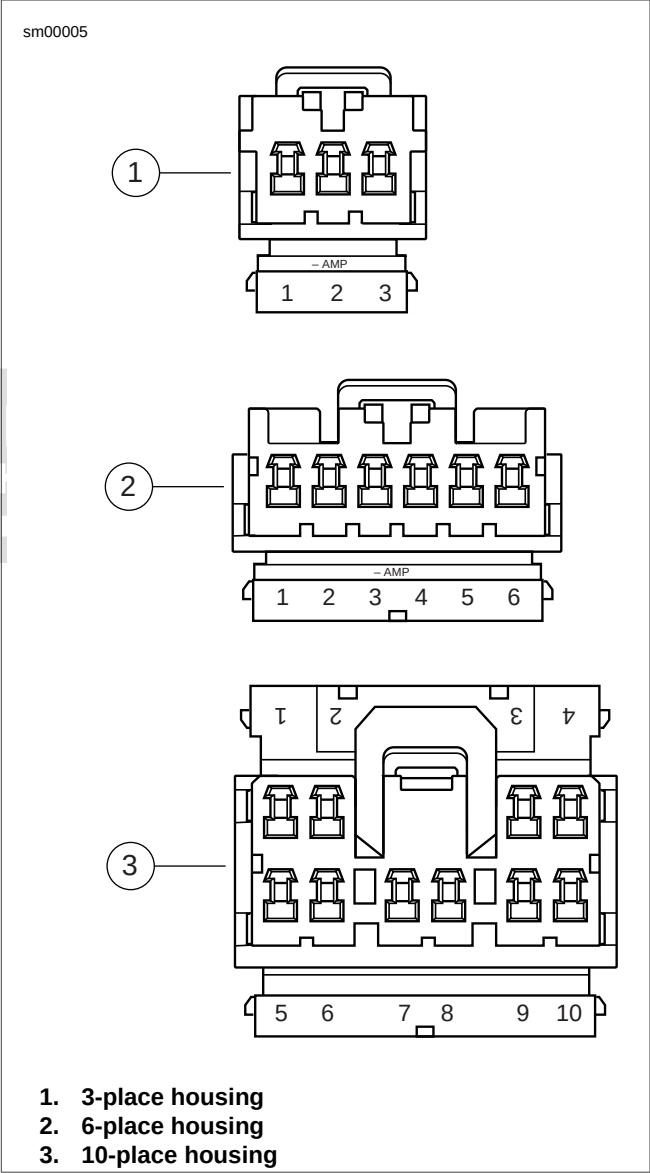


Figure A-3. AMP Multilock Connector: Cavity Numbers on Secondary Locks (Socket Housings Shown)

Preparing Wire Leads for Crimping

1. Strip 5/32 in. (4.0 mm) of insulation from the wire lead.

- 2. See [Figure A-2](#) and [Figure A-5](#). Select the pin/socket terminals from the parts catalog and identify the insulation crimp tails (1) and the wire crimp tails (2) and the groove for the crimp tool locking bar (3).
- 3. Identify the wire lead gauge and the corresponding crimper tool and nesting die. Refer to [Table A-1](#).

Table A-1. AMP Multilock Connector: Crimp Tool Wire Gauge/Nest

WIRE GAUGE	NEST
20	Front
16	Middle
18	Rear

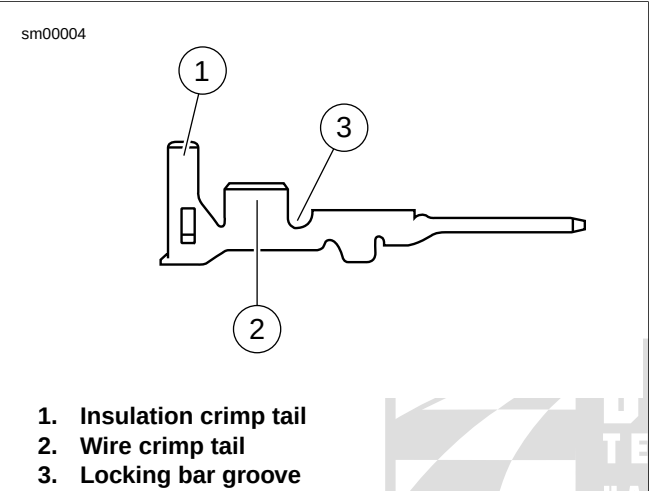


Figure A-4. AMP Multilock Connector: Pin Terminal

- 1. See [Figure A-6](#). Squeeze the handles to cycle the AMP MULTILOCK CRIMPER (Part No. HD-41609) to the fully open position (1).
- 2. Raise locking bar by pushing up on bottom flange (2).

NOTE

See [Figure A-2](#) and [Figure A-5](#). Hold the terminal with the insulation crimp tail (1) facing up. The tool will hold the terminal by the locking bar groove (3) and crimp the wire crimp tail (2) around the bare wire of the stripped lead and the insulation crimp tail around the insulation.

- 3. See [Figure A-6](#). With the insulation crimp tail facing upward, insert terminal (pin or socket) (3) through the locking bar, so that the closed side of the terminal rests on the nest of the crimp tool.
- 4. Release locking bar to lock position of contact (4). When correctly positioned, the locking bar fits snugly in the space at the front of the core crimp tails.
- 5. Insert stripped end of lead (5) until ends make contact with locking bar.
- 6. Verify that wire is positioned so that wire crimp tails squeeze bare wire strands, while insulation crimp tails fold over the wire lead insulation.
- 7. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
- 8. Raise up locking bar (7) and remove crimped terminal.

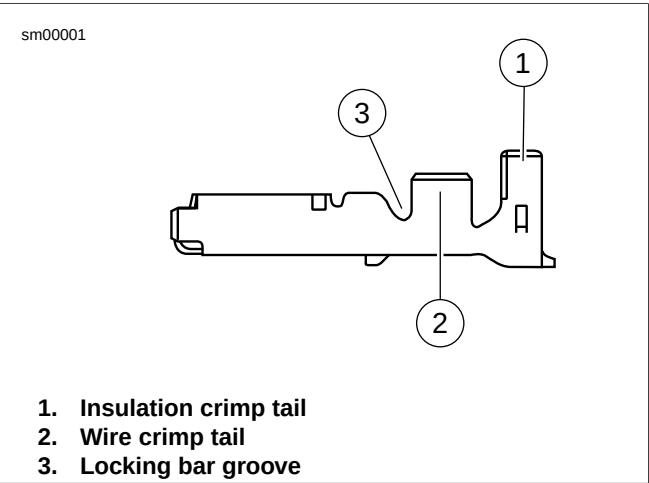


Figure A-5. AMP Multilock Connector: Socket Terminal

Crimping Terminals to Leads

NOTE

Crimping with an Amp Multilock tool is a one step operation. One squeeze crimps both the wire core and the insulation tails.

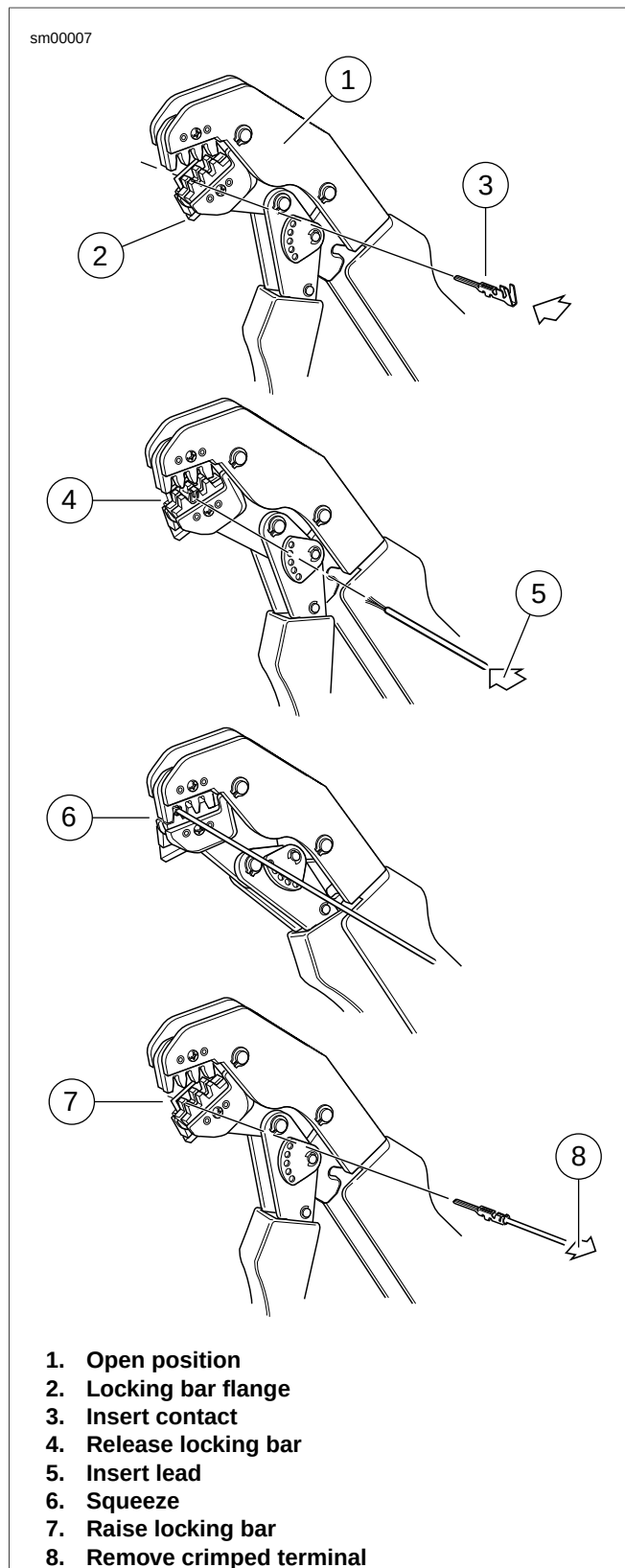


Figure A-6. AMP Multilock Connector: Terminal Crimping Procedure

Inspecting Crimped Terminals

See [Figure A-7](#). Inspect the wire core crimp (2) and insulation crimp (1). Distortion should be minimal.

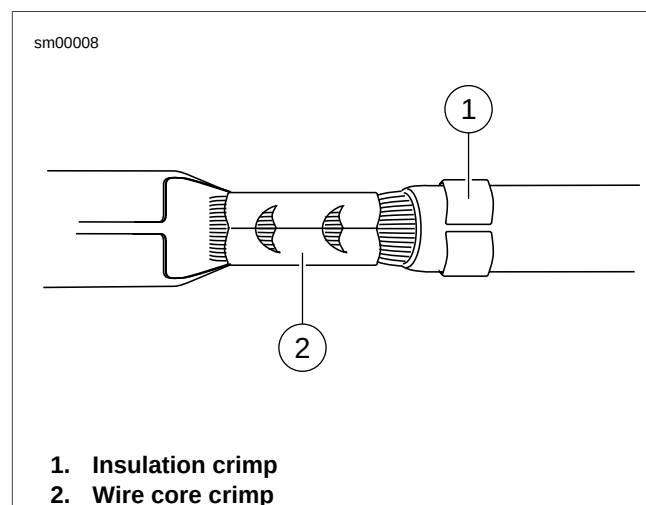


Figure A-7. AMP Multilock Connector: Terminal Crimp

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AUTOFUSE ELECTRICAL CONNECTORS

A.2

AUTOFUSE CONNECTOR REPAIR

PART NUMBER	TOOL NAME
GA500A	SNAP-ON TERMINAL PICK

General

Autofuse electrical connector terminals are found in ignition switches and some fuse blocks.

Disassembly

1. Obtain SNAP-ON TERMINAL PICK (Part No. GA500A).
2. See [Figure A-8](#) or [Figure A-9](#). Insert smallest pair of pins into chamber on mating end of socket housing to depress tangs on each side of terminal simultaneously.
3. Gently pull on wire to remove terminal from wire end of socket housing.
4. If necessary, crimp **new** terminals on wires.

Assembly

1. Using a thin flat blade, like that on a hobby knife, carefully bend tang on each side of terminal outward away from terminal body.
2. With the open side of the terminal facing rib on wire end of socket housing, insert terminal into chamber until it locks in place.

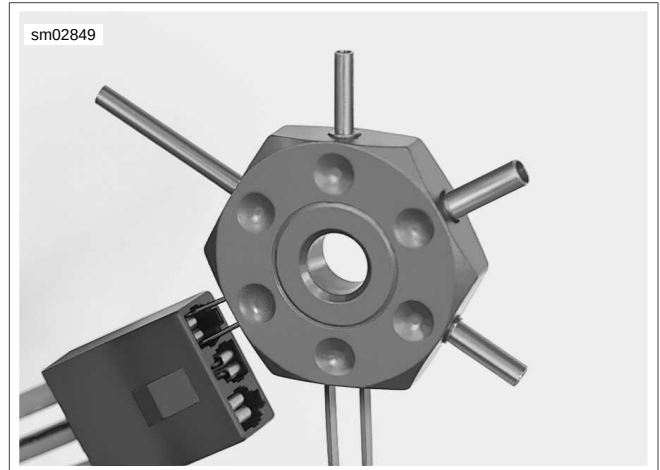


Figure A-8. Removing Autofuse Terminal from Ignition Switch

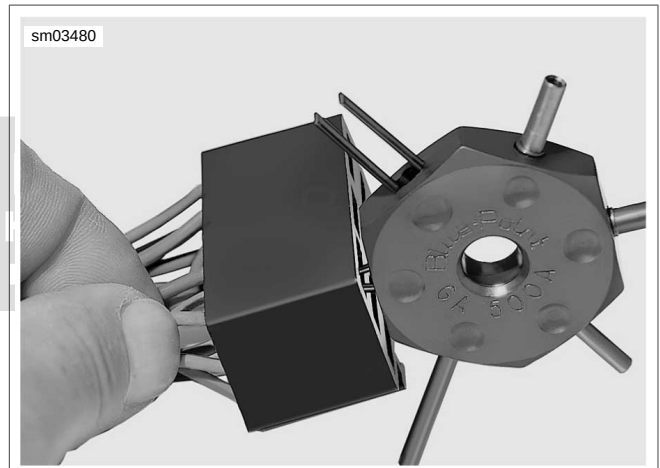


Figure A-9. Removing Autofuse Terminal from Fuse Block

DELPHI CONNECTORS

A.3

DELPHI CONNECTOR REPAIR

General

Delphi connectors are embossed with the brand name, Delphi, on the housing latch.

Separating Pin and Socket Housings

See [Figure A-10](#). Bend back the external latch(es) slightly and separate pin and socket halves of connector.

Mating Pin and Socket Housings

Push pin and socket halves of connector together until external latch(es) engage.

Removing Socket Terminals

NOTE

Although the parts of the different Delphi connectors vary in appearance, the instructions which follow will work for all. The only exception is the oil pressure sender connector [139B], the terminals of which are removed like the Packard push-to-seat connectors. Therefore, see [A.10 PACKARD 150 METRI-PACK CONNECTORS](#) to remove/install terminals in this connector.

1. See [Figure A-11](#). If present, free one side of wire lock (1) from ear on wire end of socket housing, then release the other side. Release wires from channels in wire lock and remove from socket housing.
2. Use a fingernail to pry colored terminal lock (2) loose and then remove from mating end of socket housing.
3. Using a thin flat blade, like the unsharpened edge of a hobby knife, gently pry tang (3) outward away from terminal, and then tug on wire to back terminal out wire end of chamber. Do not pull on wire until tang is released or terminal will be difficult to remove.

Installing Socket Terminals

NOTE

For wire location purposes, alpha or numeric characters are stamped into the wire end of each socket housing.

1. Gently push tang on socket housing inward toward chamber. With the open side of the terminal facing the tang, push terminal into chamber at wire end of socket housing.
2. Gently tug on wire to verify that terminal is locked and will not back out of chamber. If necessary, use fingernail to push tang into engagement with terminal.
3. Install colored terminal lock onto mating end of socket housing.
4. If present, seat wires in separate channels of wire lock and then push channels **inside** chambers at wire end of socket housing. Fully installed, slot on each side of wire lock engages ear on socket housing.



Figure A-10. Delphi Connector: Socket Housing Latch

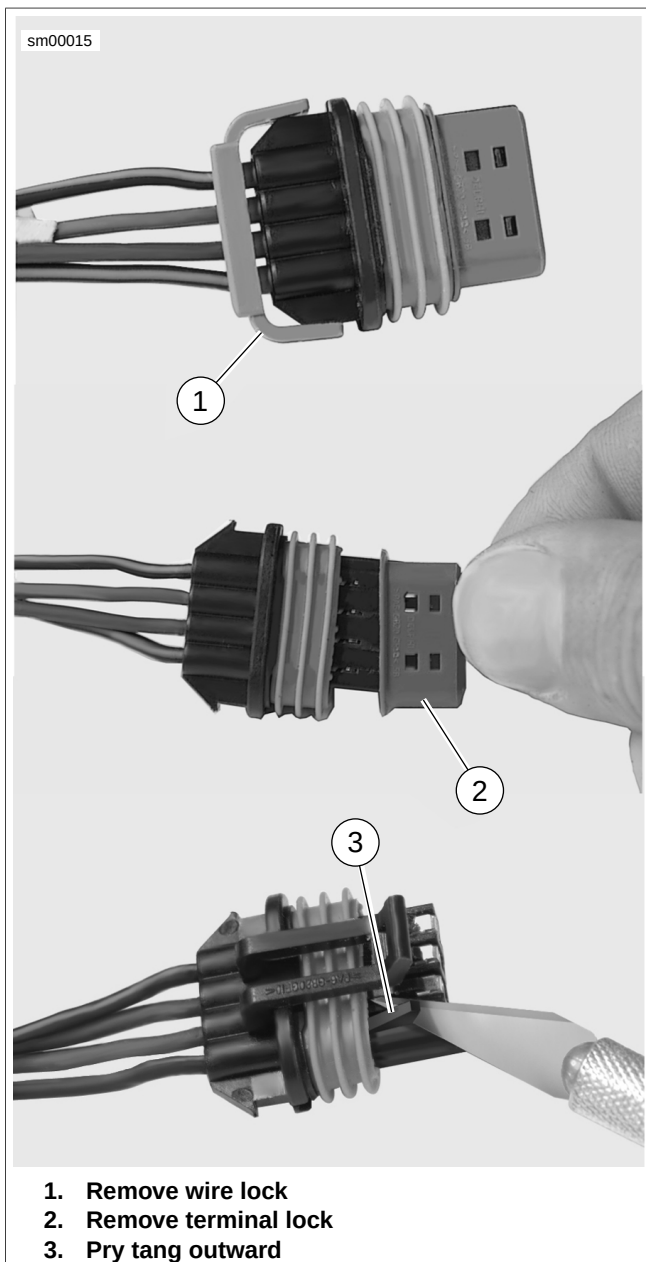


Figure A-11. Delphi Connector: Removing Socket Terminals

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DELPHI MAIN FUSE HOUSING

A.4

DELPHI MAIN FUSE HOUSING REPAIR

General

A Delphi Main fuse connector completes the circuit through the main fuse.

Removing Main Fuse

1. See [Figure A-12](#). Depress latches on main fuse cover (1) and then slide cover off of connector (2).
2. Holding the connector (fuse holder), pull the main fuse out of the connector.

Installing Main Fuse

1. Insert the blade terminals of the main fuse into the sockets of the connector and press the main fuse into the connector.
2. Slide the cover over the fuse until the cover clicks into place.

NOTE

If removed from an OE attachment such as a grooved fuse block cover, engage cover and slide into place.

Removing Socket Terminals

1. Disconnect battery. See [1.17 BATTERY MAINTENANCE](#).
2. See [Figure A-13](#). Disengage slots (1) on secondary lock (2) from tabs (3) and remove secondary lock.
3. Insert flat blade of pick or small screwdriver into opening (4) until it stops.
4. Tug on cable to pull socket from connector housing. Pivot the pick toward the terminal body to release the latch if necessary.
5. Repeat to remove remaining socket terminal.

Installing Socket Terminals

1. See [Figure A-14](#). Carefully bend tang outward away from the terminal body.
2. Properly orient terminal to the cavity in the housing and push terminal into connector housing until it clicks in place. Verify that socket will not back out of chamber.
3. Push rubber seal into connector housing.
4. Repeat to install remaining socket terminal.
5. Install secondary lock onto connector housing. be sure slots engage tabs on sides of connector housing.
6. Connect battery cables. See [1.17 BATTERY MAINTENANCE](#).

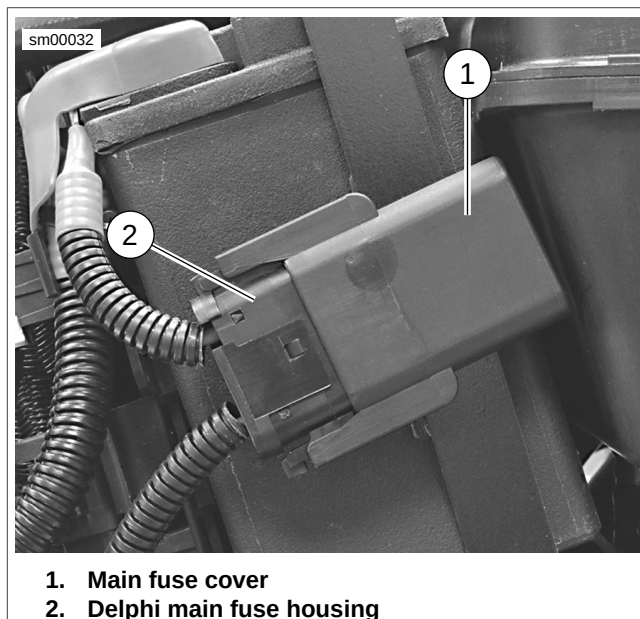


Figure A-12. Delphi Connector Housing: Main Fuse

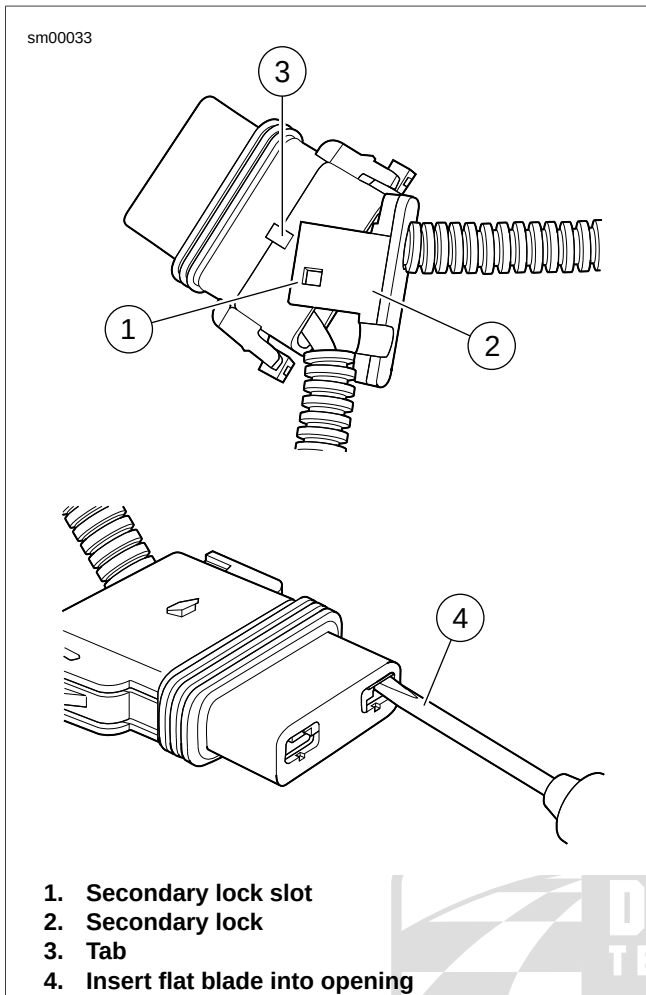


Figure A-13. Delphi Main Fuse Housing: Remove Socket Terminals

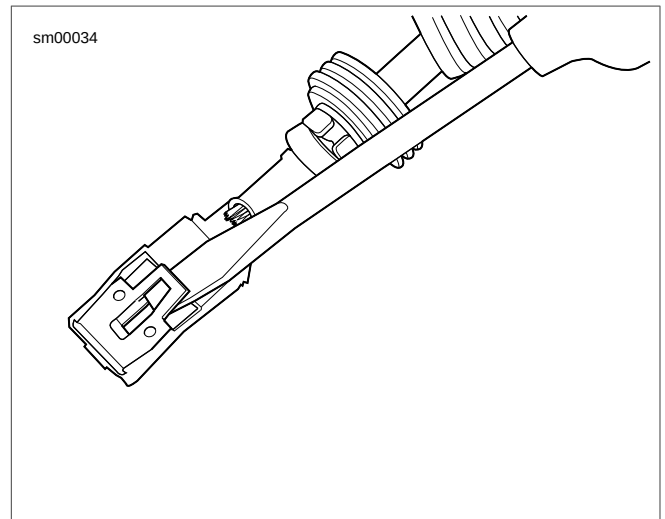


Figure A-14. Delphi Main Fuse Housing: Bend Tang

DEUTSCH CONNECTOR REPAIR

PART NUMBER	TOOL NAME
HD-41475	DEUTSCH CONNECTOR SERVICE KIT
HD-41475-100	FLAT BLADE L-HOOK

General

Deutsch connectors are colored coded for location purposes. Those connectors associated with **left** side accessories, such as the front and rear **left** turn signals, are **gray**. All other connectors, including those associated with right side accessories, are **black**.

NOTE

A *DEUTSCH CONNECTOR SERVICE KIT* (Part No. HD-41475) contains a selection of wire seals, internal seals, seal plugs, secondary locking wedges, attachment clips and socket/pin terminals. Also included is a compartmented storage box, carrying case and a *FLAT BLADE L-HOOK* (Part No. HD-41475-100) is used for the removal of all types of locking wedges.

Separating Pin and Socket Housings

See [Figure A-15](#). To separate the connector halves, depress the external latch(es) (1) on the socket housing (2) while rocking the pin (3) and socket housings.

NOTES

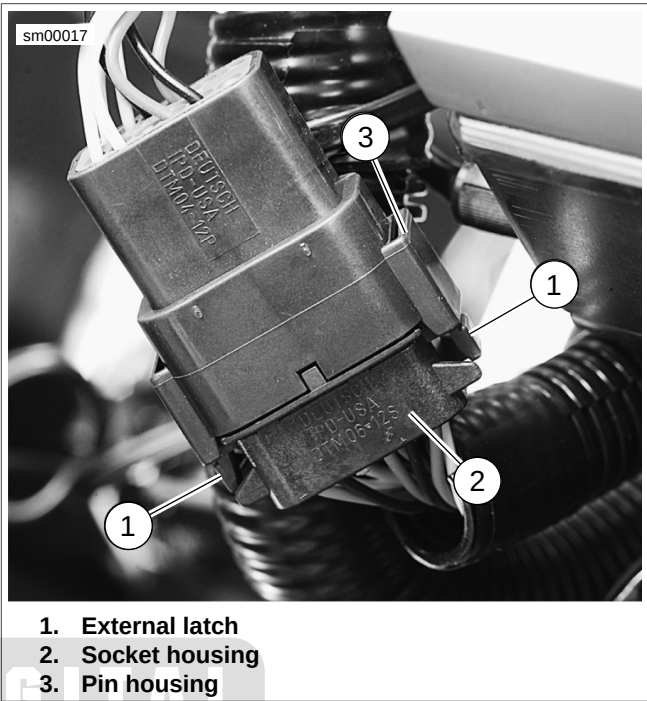
- Generally, the socket housing is found on the accessory side, while the pin housing is plumbed to the wiring harness.
- Two-, three-, four- and six-place Deutsch connectors have one latch on the connector.
- Eight- and twelve-place connectors have a latch on each side. Simultaneously press both latches to separate the connector.

Mating Pin and Socket Housings

1. Align the connectors to match the wire lead colors.
 - a. **For One External Latch:** Two-, three-, four- and six-place Deutsch connectors have one external latch on the socket half of the connector. To fit the halves of the connector together, the latch on the socket side must be aligned with the latch cover on the pin side.
 - b. **For Two External Latches:** (8-place and 12-place) Align the tabs on the socket housing with the grooves on the pin housing.
2. Insert socket housing into pin housing until it snaps or clicks into place.

For Two External Latches: (8-place and 12-place) 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.
3. If necessary, fit the attachment clip to the pin housing.

4. Place large end of slot on attachment clip over T-stud on frame. Push assembly forward to engage small end of slot.



1. External latch
2. Socket housing
3. Pin housing

Figure A-15. Deutsch Connector

Removing Socket Terminals

1. See [Figure A-16](#). Insert a small screwdriver between the socket housing and locking wedge in-line with the groove (in-line with the pin holes if the groove is absent). Turn the screwdriver 90 degrees to pop the wedge up and remove the secondary locking wedge.
2. See [Figure A-19](#). Use a pick or small screwdriver to depress terminal latches inside socket housing and back out sockets through holes in rear wire seal.

NOTE

If wire leads require **new** terminals, see the instructions for crimping terminals.

Installing Socket Terminals

1. Match wire lead color to connector cavity.
2. See [Figure A-18](#). Fit rear wire seal (1) into back of socket housing (2), if removed.
3. Grasp wire lead (3) approximately 1.0 in. (25.4 mm) behind the socket terminal. Gently push socket through hole in wire seal into its chambers until it "clicks" in place.
4. A tug on the wire will confirm that it is properly locked in place.

NOTE

Seal plugs (6) are installed through the wire seals of unused chambers. If removed, seal plugs must be replaced to seal the connector.

5. Install internal seal (4) on lip of socket housing, if removed.
6. Insert tapered end of secondary locking wedge (5) into socket housing and press down until it snaps in place. The wedge fits into the center groove within the socket housing and holds the terminal latches tightly closed.

NOTES

- See [Figure A-17](#). While rectangular wedges do not require a special orientation, the conical secondary locking wedge of the 3-place connector must be installed with the arrow (1) pointing toward the external latch.
- If the secondary locking wedge does not slide into the installed position easily, verify that all terminals are fully installed in the socket housing. The lock indicates when terminals are not properly installed by not entering its fully installed position.

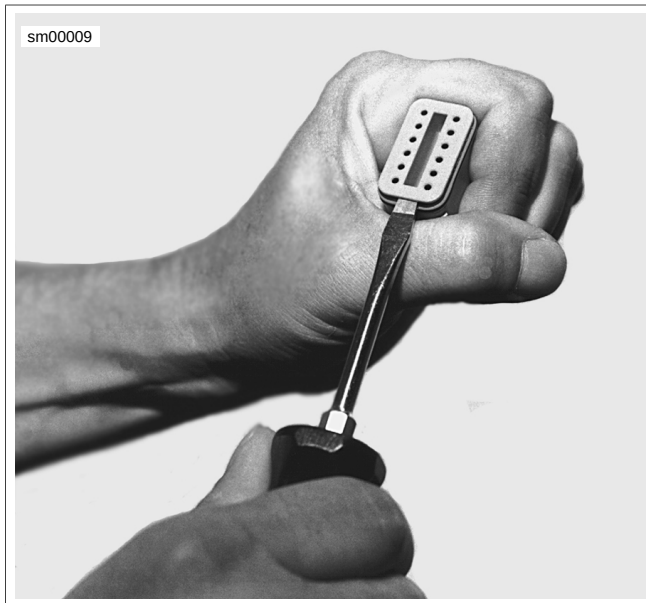


Figure A-16. Deutsch Connector: Remove Secondary Locking Wedge

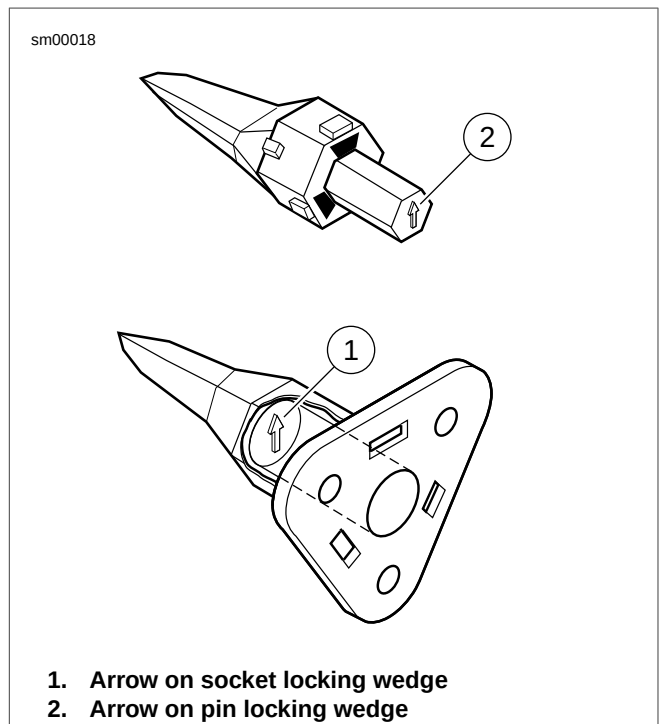


Figure A-17. Deutsch Connector: 3-Place Locking Wedges

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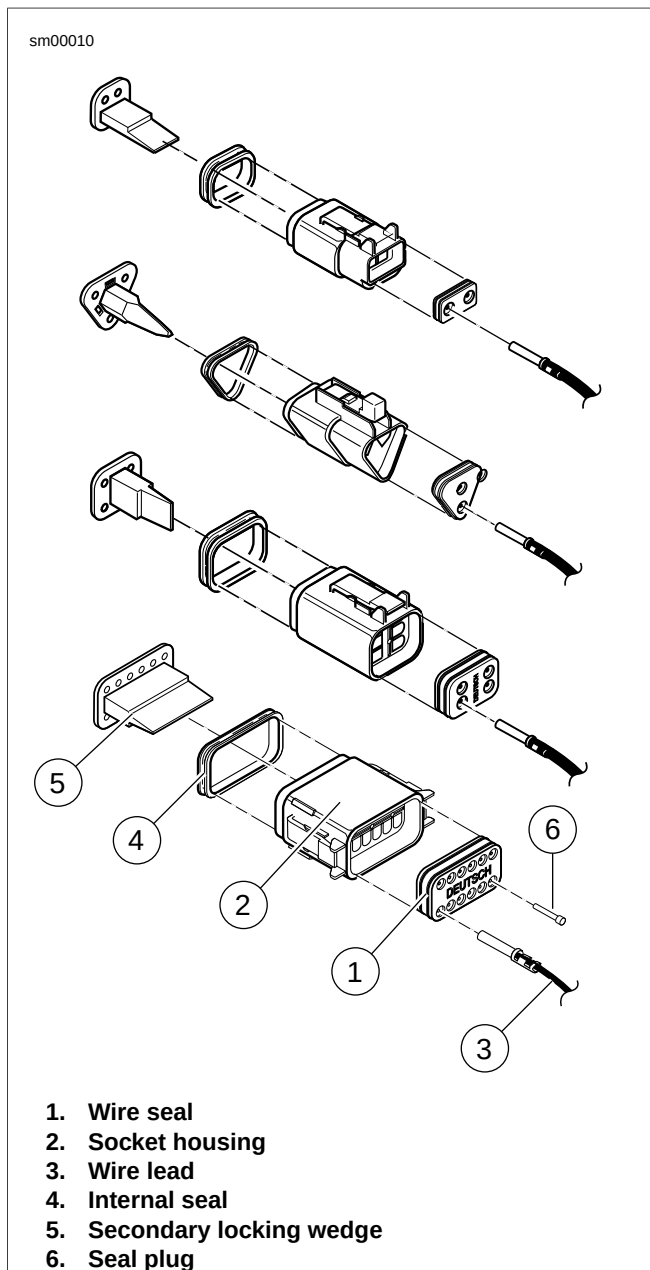


Figure A-18. Deutsch Connector: 2, 3, 4 and 12-Place Socket Housings

Removing Pin Terminals

1. Use the hooked end of a stiff piece of mechanics wire, a needle nose pliers or the FLAT BLADE L-HOOK (Part No. HD-41475-100) to remove the secondary locking wedge.
2. Gently depress terminal latches inside pin housing and back out pins through holes in wire seal.

NOTES

- If wire leads require **new** terminals, see the instructions for crimping terminals.
- If it should become necessary to replace a pin or socket housing, please note that the 8-place and 12-place gray and black connectors are not interchangeable. Since loc-

ation of the alignment tabs differ between the black and gray connectors, plugs or receptacles must be replaced by those of the same color.

- When replacing both socket and pin housings, then the black may be substituted for the gray, and vice versa. The socket and pin housings of all other connectors are interchangeable, that is, the black may be mated with the gray, since the alignment tabs are absent and the orientation of the external latch is the same.

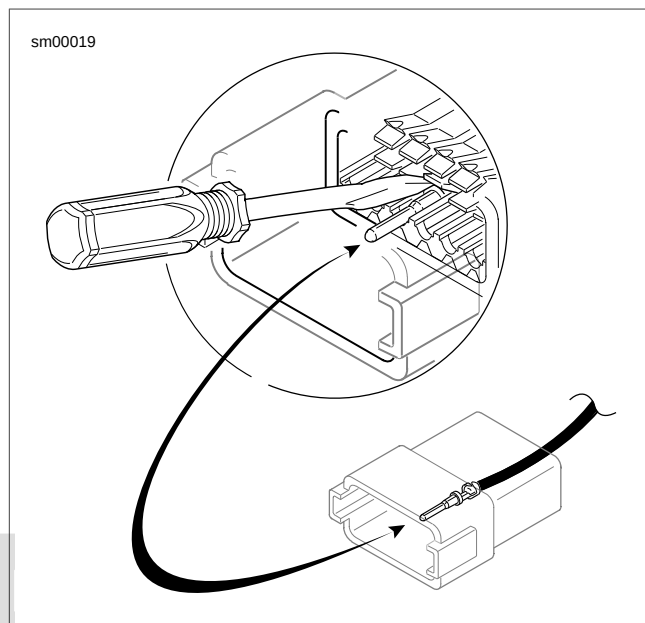


Figure A-19. Deutsch Connector: Depress Terminal Latch and Back Out Pin

Installing Pin Terminals

1. See [Figure A-20](#). Fit wire seal (1) into back of pin housing (2).
2. Grasp wire lead approximately 1.0 in. (25.4 mm) behind the pin terminal (3). Gently push pin through holes in wire seal into its respective numbered chamber until it "clicks" in place.

NOTE

A tug on the wire lead will confirm that a pin is locked in place.

3. Insert tapered end of secondary locking wedge (4) into pin housing and press down until it snaps in place.

NOTES

- The wedge fits in the center groove of the pin housing and holds the terminal latches tightly closed.
- See [Figure A-17](#). While rectangular wedges do not require a special orientation, the conical secondary locking wedge of the 3-place connector must be installed with the arrow (2) pointing toward the external latch.
- If the secondary locking wedge does not slide into the installed position easily, verify that all terminals are fully installed in the pin housing. The lock indicates when terminals are not properly installed by not entering its fully installed position.

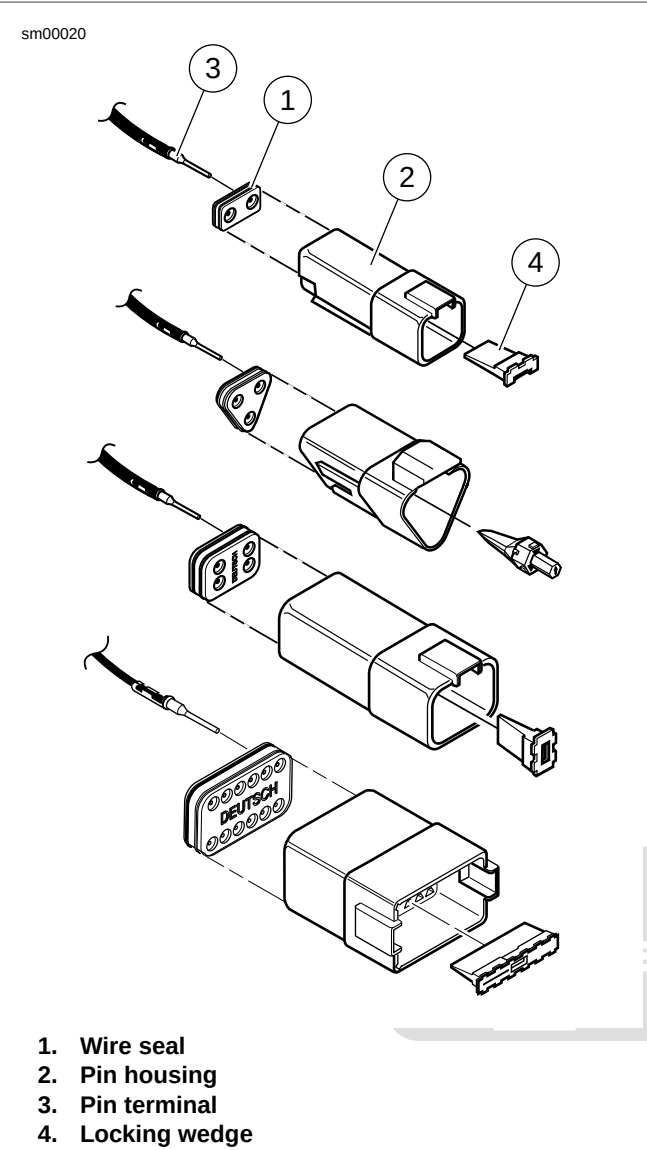


Figure A-20. Deutsch Connector: 2, 3, 4 and 12-Place Pin Housings

Crimping Terminals

Identify which of the types of Deutsch terminals are used with the connector and follow the corresponding crimping instructions. Refer to [Table A-2](#).



Table A-2. Deutsch Connector: Terminal Crimping Instructions

TYPE	CRIMPING INSTRUCTIONS
Standard (with crimp tails)	A.6 DEUTSCH STANDARD TERMINAL REPAIR
Mini Terminal (solid barrel)	A.7 DEUTSCH SOLID BARREL MINI TERMINAL REPAIR
Mini Terminal (with crimp tails)	A.8 DEUTSCH MINI TERMINAL REPAIR

DEUTSCH STANDARD TERMINAL REPAIR

A.6

DEUTSCH STANDARD TERMINAL CRIMPS

PART NUMBER	TOOL NAME
HD-39965-A	DEUTSCH TERMINAL CRIMP TOOL

Preparing Wire Leads for Crimping

1. Use a shop gauge to determine gauge of wire lead.
2. Strip lead removing 5/32 in. (4.0 mm) of insulation.

Crimping Terminal to Lead

1. See [Figure A-21](#). Squeeze the handles of the DEUTSCH TERMINAL CRIMP TOOL (Part No. HD-39965-A) to open the jaws. Push the locking bar (1) up.
2. Insert (2) terminal (socket/pin) through hole of the locking bar, so that the rounded side of the contact barrel rests in the nest (concave split level area) with the crimp tails facing upward. To match the wire gauge to the crimp tool die, refer to [Table A-3](#).
3. Release locking bar to lock terminal in die.

NOTE

If the crimp tails are slightly out of vertical alignment, the crimp tool automatically rotates the terminal so that the tails face

straight upward. When positioned, the locking bar fits snugly in the space between the contact band and the core crimp tails.

4. Insert stripped wire core between crimp tails until ends make contact with locking bar. Verify that wire is positioned so that short pair of crimp tails squeeze bare wire strands, while long pair folds over the insulation.
5. Squeeze handle of crimp tool until tightly closed. Tool automatically opens after the terminal is crimped.
6. Raise locking bar up and remove wire lead and terminal.

Inspecting Crimps

Inspect the wire core and insulation crimps. Distortion should be minimal.

Table A-3. Deutsch Standard Terminal Crimp: Wire Gauge To Die

WIRE GAUGE (AWG)	CRIMP TOOL DIE
20	Front
16-18	Middle

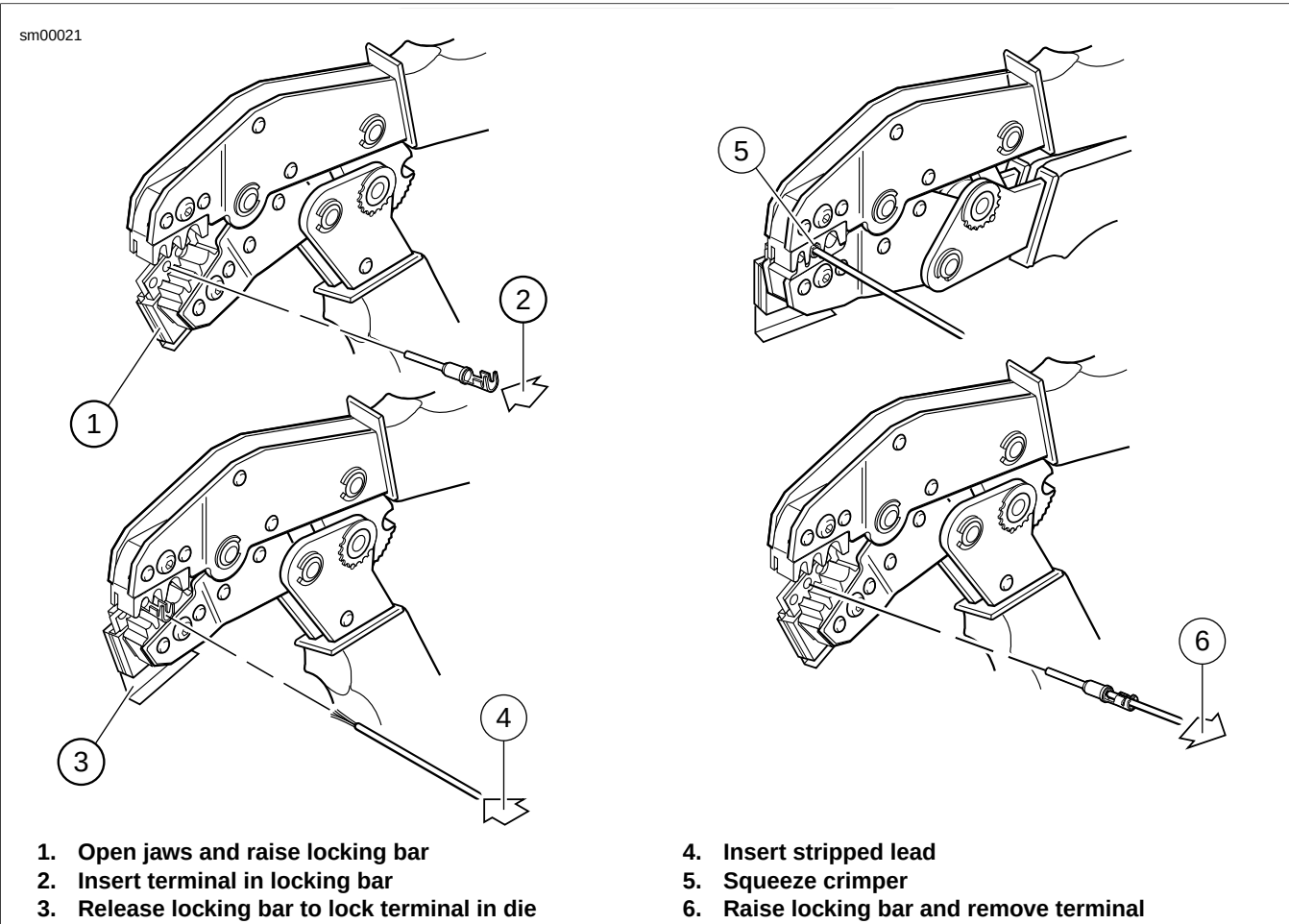


Figure A-21. Crimping a Deutsch Standard Terminal

DEUTSCH SOLID BARREL MINI TERMINAL REPAIR

A.7

DEUTSCH SOLID BARREL TERMINAL CRIMPS

PART NUMBER	TOOL NAME
HD-42879	ELECTRICAL CRIMPER TOOL

Preparing Wire Leads For Crimping

For size 20, 16 and 12 contacts, wire ranges 26-12 AWG.

Strip wire lead removing 1/4 in. (6.4 mm) of insulation.

Adjusting Crimper Tool

1. See [Figure A-22](#). Squeeze the ELECTRICAL CRIMPER TOOL (Part No. HD-42879) handles to cycle the crimp tool to open.
2. Remove locking pin (1) from selector knob (2).
3. Raise selector knob and rotate until selected wire size stamped on wheel is aligned with "SEL. NO." arrow (3).
4. Loosen knurled locknut (4) and turn adjusting screw (5) clockwise (in) until it stops.

Crimping a Barrel Contact To Wire Lead

1. See [Figure A-23](#). Turn tool over and drop contact barrel (1) into indenter cover (2) hole with the wire end out.
2. Turn adjusting screw counterclockwise (out) until contact is flush with bottom of depression in indenter cover. Tighten knurled locknut.
3. Slowly squeeze handles of crimp tool until contact is centered between the four indenter points (3).
4. Insert bare wire core strands of stripped wire lead (4) into contact barrel. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
5. Remove wire lead with crimped contact from indenter.

NOTE

Tool must be readjusted when changing contact size/type.

6. Install pin to lock selector knob.

Inspecting Crimps

Inspect the crimp. All core wire strands are to be crimped in the barrel.

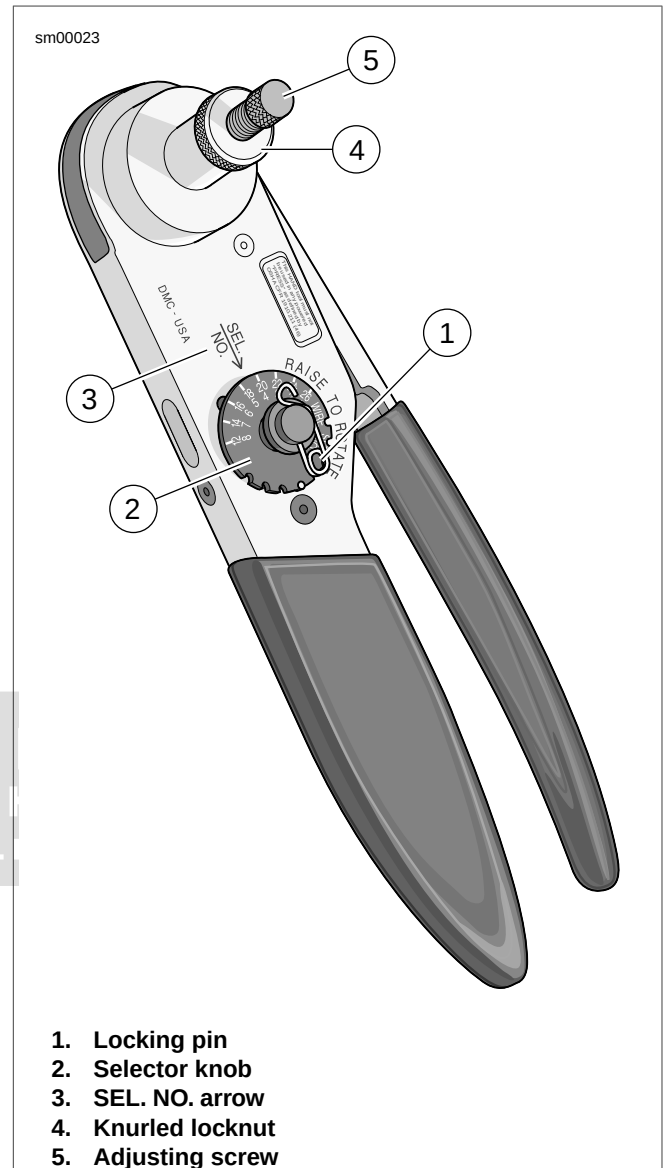


Figure A-22. Electrical Crimper Tool (HD-42879)

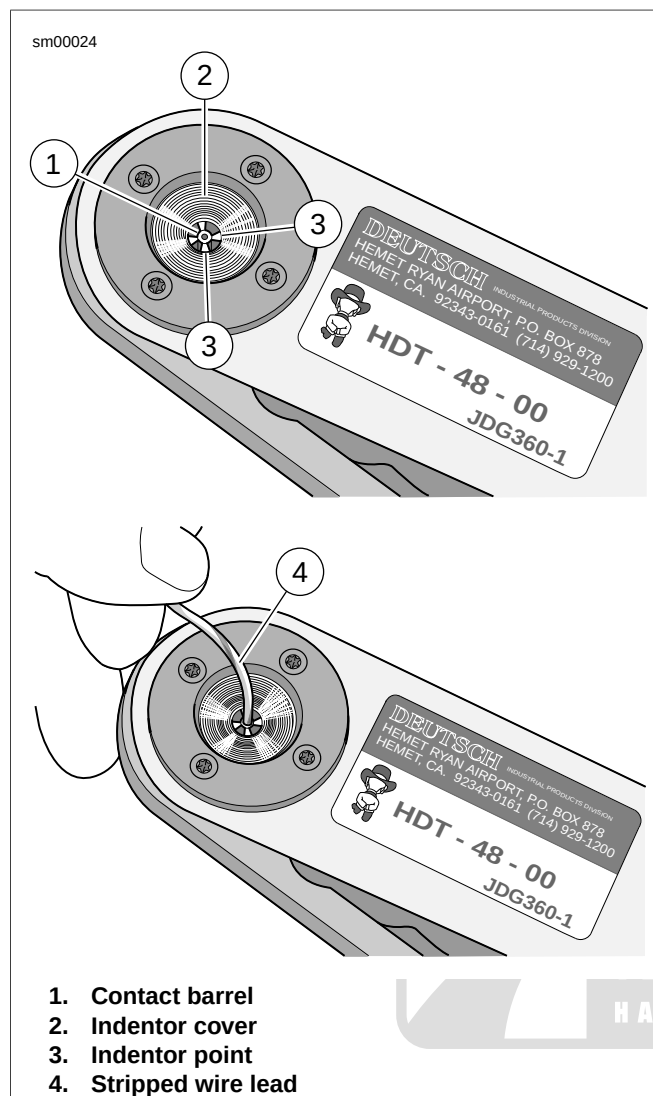


Figure A-23. Deutsch Solid Barrel

DEUTSCH MINI TERMINAL CRIMPS

PART NUMBER	TOOL NAME
HD-38125-7	PACKARD TERMINAL CRIMPER

Preparing Wire Leads for Crimping

Strip wire lead removing 5/32 in. (4.0 mm) of insulation.

Crimping a Mini Terminal to Wire Lead

1. See [Figure A-24](#). Compress the handles of PACKARD TERMINAL CRIMPER (Part No. HD-38125-7) until the ratchet (2) automatically opens.

NOTE

Always perform core crimp before insulation crimp.

2. Position the core crimp on die E (1) of the crimper. Be sure the core crimp tails are facing the forming jaws.
3. Gently apply pressure to handles of tool until crimpers just secure the core crimp tails.
4. Insert stripped wire core stands between crimp tails. Position wire so that short pair of crimp tails squeeze bare wire strands, while long pair squeeze over the insulation.
5. Squeeze handle of crimper until tightly closed. Tool automatically opens when the crimping sequence is complete.

NOTE

If the crimper does not open, it can be opened by squeezing the ratchet trigger (2).

6. Position the insulation crimp on nest C of the crimper. Be sure the insulation crimp tails are facing the forming jaws.
7. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.

Inspecting Crimps

Inspect the core and insulation crimps. Distortion should be minimal.

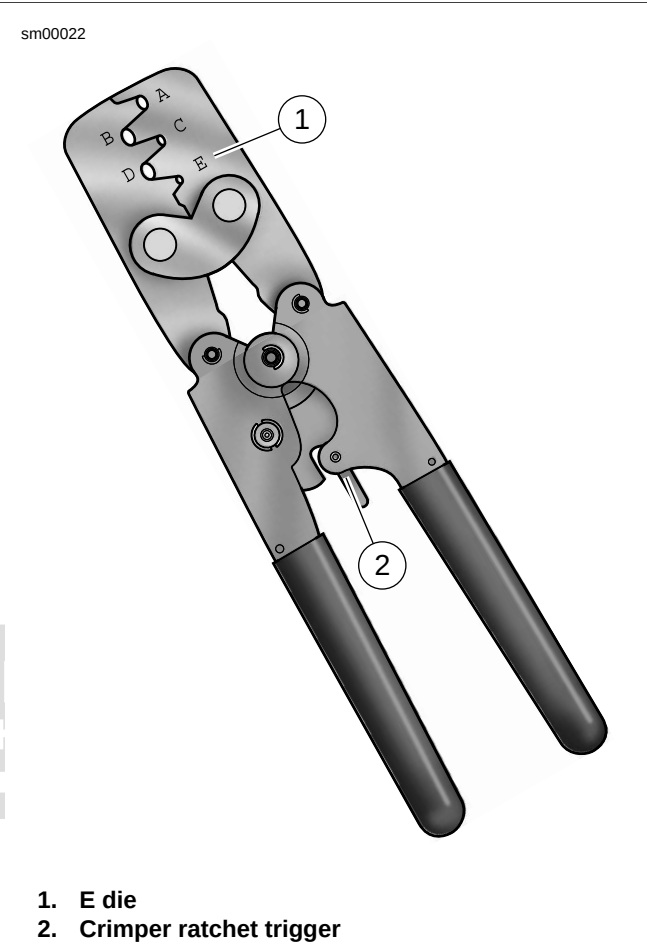


Figure A-24. Packard Terminal Crimper (HD-38125-7)

MOLEX CONNECTOR REPAIR

PART NUMBER	TOOL NAME
HD-48114	MOLEX ELECTRICAL CONNECTOR TERMINAL REMOVER

Separating Pin and Socket Housings

See [Figure A-25](#). Depress the latch while pulling the pin and socket housings apart.

Mating Pin and Socket Housings

1. Orient the latch on the pin housing to the latch pocket on the socket housing so the rails on the outside of the pin housings lines up with the tunnels on the socket housing.
2. Press the housings together until the latch clicks.

Removing Terminals

1. Pull the secondary lock up, approximately 3/16 in. (4.8 mm), until it stops.
 - a. **Socket Housing:** See [Figure A-26](#). Use a small screwdriver in the pry slot. The slot next to the external latch provides a pivot point.
 - b. **Pin Housing:** See [Figure A-27](#). Use needle nose pliers to engage the D-holes in the center of the secondary lock.

NOTE

Do not remove the secondary lock from the connector housing.

2. See [Figure A-28](#). Insert MOLEX ELECTRICAL CONNECTOR TERMINAL REMOVER (Part No. HD-48114) into the pin hole next to the terminal until the tool bottoms.
 - a. **Socket Housing:** The pin holes are inside the terminal openings.
 - b. **Pin Housing:** The pin holes are outside the pins.
3. Pressing the terminal remover to the bottom of the pin hole, gently pull on the wire to remove wire terminal from its cavity.

Installing Terminals

1. See [Figure A-29](#). From the wiring diagram, match the wire color to its numbered terminal cavity.

NOTE

Cavity numbers (1) are stamped on the housing at the ends of the cavity rows. The cavity number can be determined by counting the cavities up or down along the row from each stamped number.

2. Orient the terminal so that the tang (2) opposite the open crimp engages the slot (3) in the cavity.
3. Push the terminal into the cavity.
4. Gently tug on wire to verify that the terminal is captured by the secondary lock.

5. With all terminals installed, push the secondary lock into the socket housing to lock the wire terminals into the housing.

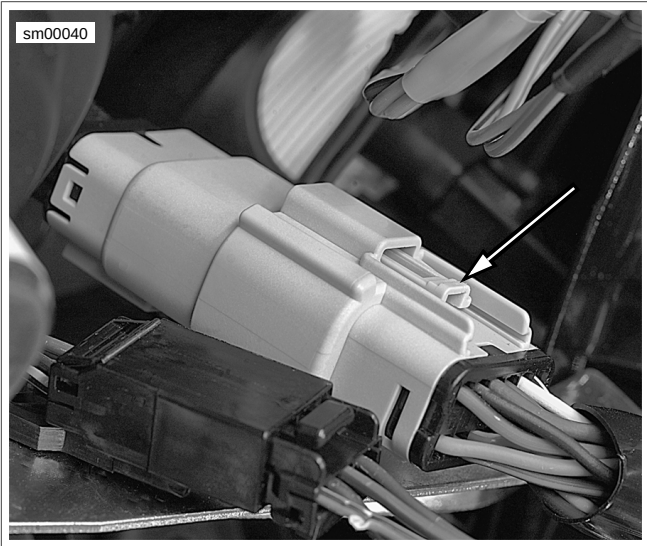


Figure A-25. Molex Connector: Latch

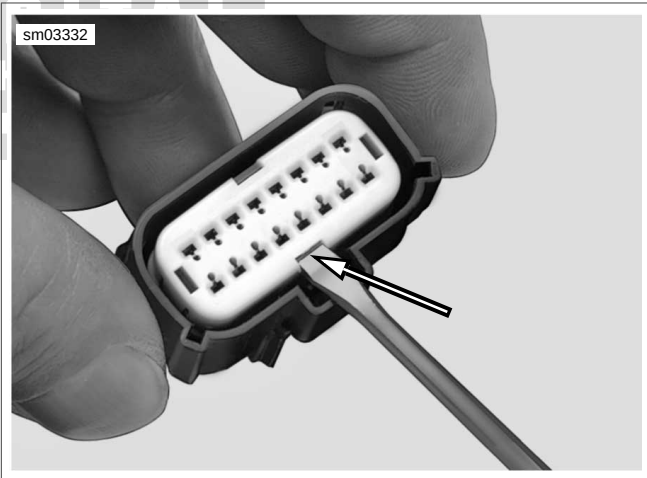


Figure A-26. Secondary Lock Pry Slot (Socket Housing)

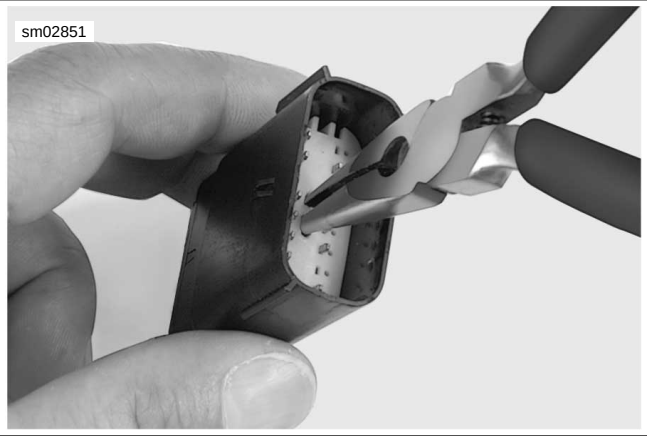


Figure A-27. Pull Up Secondary Lock (Pin Housing)

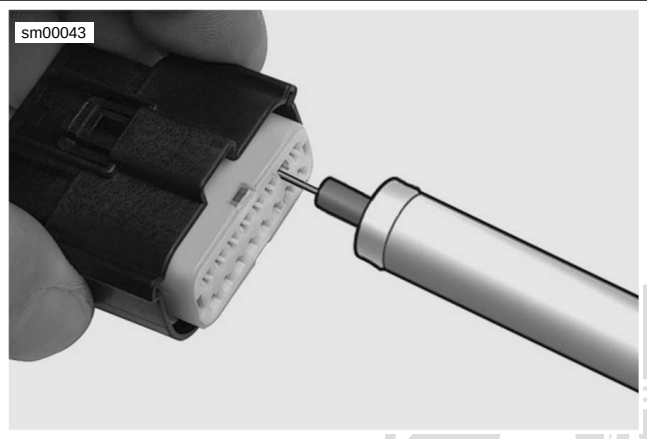
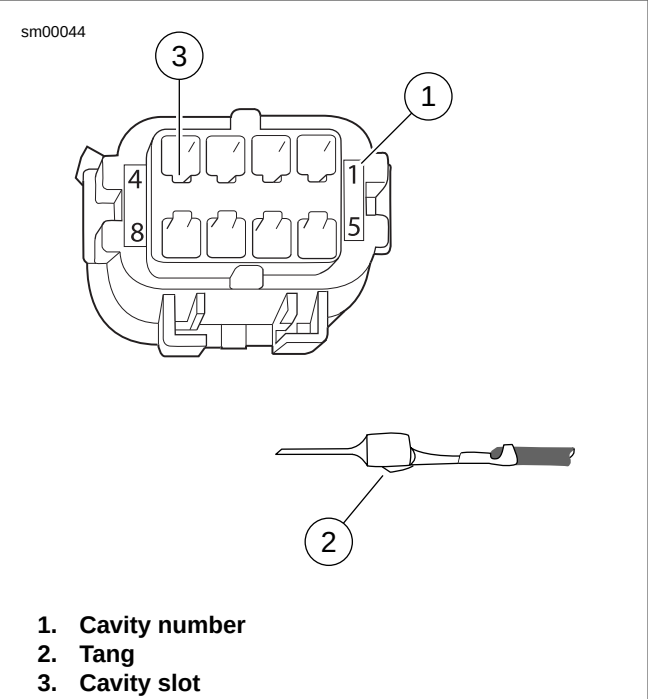


Figure A-28. Molex Connector: Terminal Remover (HD-48114)



- 1. Cavity number
- 2. Tang
- 3. Cavity slot

Figure A-29. Molex Connector: Pin Cavities and Wire Terminal

CRIMP TERMINAL TO LEAD

PART NUMBER	TOOL NAME
HD-48119	ELECTRICAL CRIMP TOOL

Prepare Lead

1. Cut the damaged terminal close to the back of the terminal to leave as much wire length as possible.
2. Strip approximately 3/16 in. (4.70-5.60 mm) of insulation from the end of the wire lead.

NOTE

The strip length is the same for both pin and socket terminals and for wire gauges from 22 to 14.

Prepare Tool

1. Identify the punch/die in the jaws of the ELECTRICAL CRIMP TOOL (Part No. HD-48119) for the wire gauge. Refer to [Table A-4](#).
2. Squeeze and release the handles to open the tool.

NOTE

The crimp tool automatically opens when the handles are released.

3. See [Figure A-30](#). Hold fully open tool at approximately 45 degrees.

NOTE

Do NOT tighten the locknut holding the locator bars. The bars must float to accommodate the different terminal gauges.

Table A-4. Crimp Tool Wire Gauge Punch/Die

AWG (WIRE GAUGE)	PUNCH/DIE
22	Left
18-20	Middle
14-16*	Right
* Crimp 16 AWG pin terminals in the 18-20 middle die.	

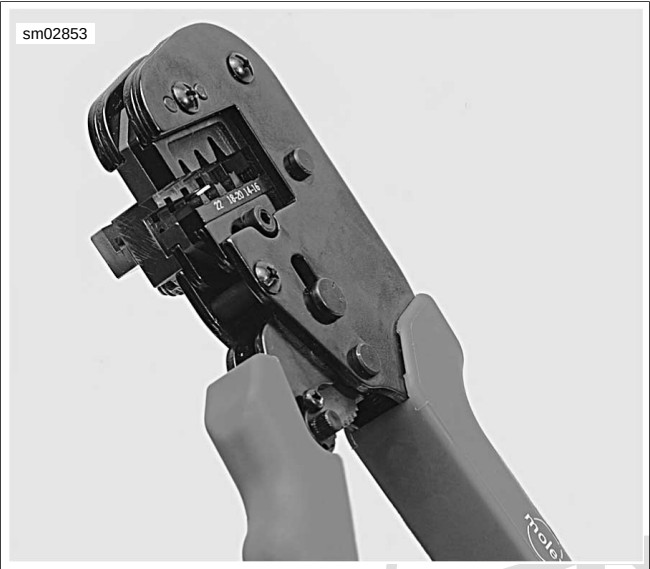


Figure A-30. Open Electrical Crimp Tool (HD-48119) at 45 Degrees

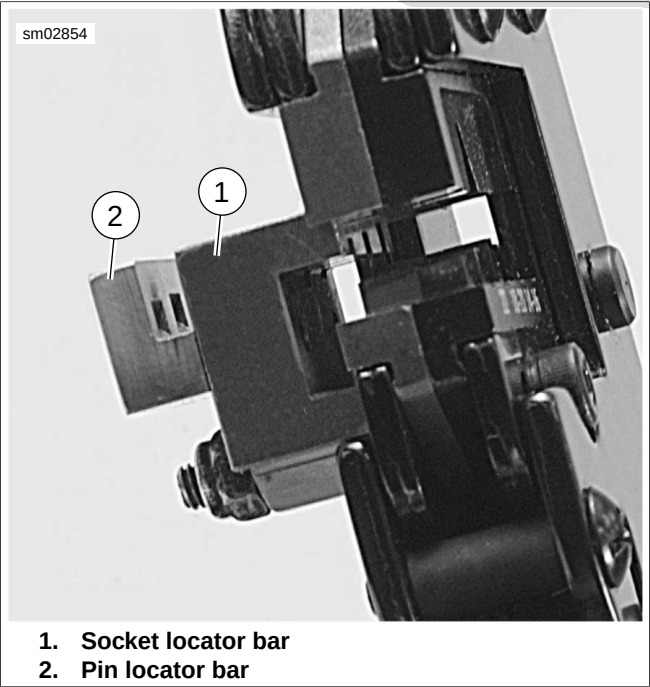


Figure A-31. Terminal Locator Bars

Position Terminal in the Punch/Die

- See [Figure A-32](#). With the crimp tails up, place the terminal through the punch/die into the square opening in the socket locator bar.
 - Socket Terminal:** See [Figure A-31](#). A socket terminal stops against the back face of the socket locator bar (1).
 - Pin Terminal:** See [Figure A-33](#). The tip of a pin terminal passes through the socket locator bar and stops in the notch in the face of the pin locator bar.
- See [Figure A-34](#). Ratchet the handles together until the crimp tails are held in vertical alignment between the punch and the die.

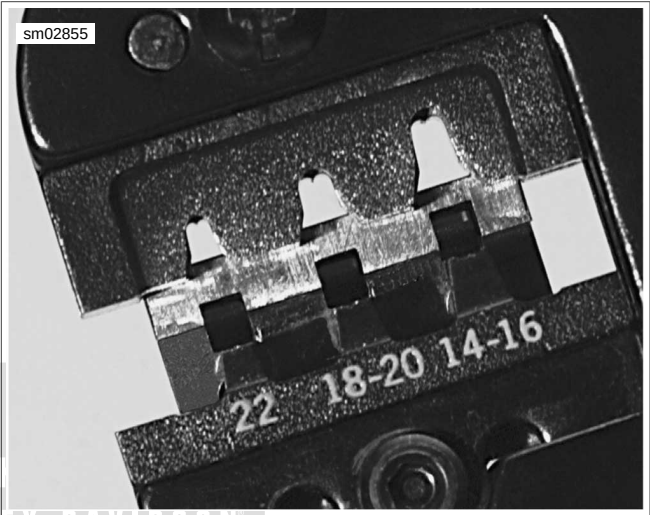


Figure A-32. Square Openings in Socket Locator Bar

Insert Stripped Lead

See [Figure A-35](#). Insert the stripped end (wire core) between the crimp tails at an up angle until the wire core touches the face of the socket locator bar above the square opening.

NOTES

- The insulation must extend through the insulation crimp tails.*
- Insert the wire with little or no pressure. Pressing on the lead will bend the wire core.*

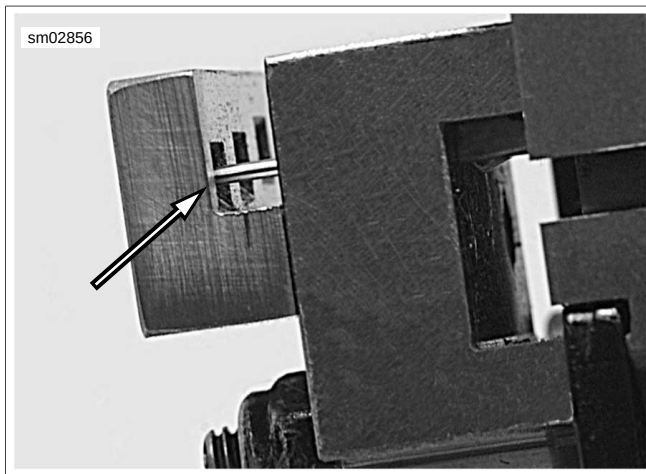


Figure A-33. Pin Terminal against Pin Locator Bar

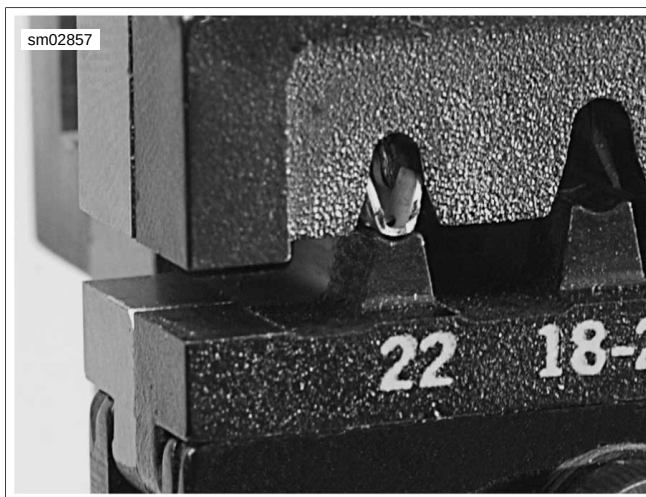


Figure A-34. Crimp Tails in Vertical Alignment between Punch and Die

Crimp Terminal to Lead

1. Holding the wire lead in position touching the locator face at an angle, quickly and smoothly squeeze the crimp tool closed.
2. Final squeeze the handles to open the tool and release the terminal.

NOTE

A stuck or jammed tool can be opened by pressing the ratchet release lever found between the handles. Do **not** force the handles open or closed.

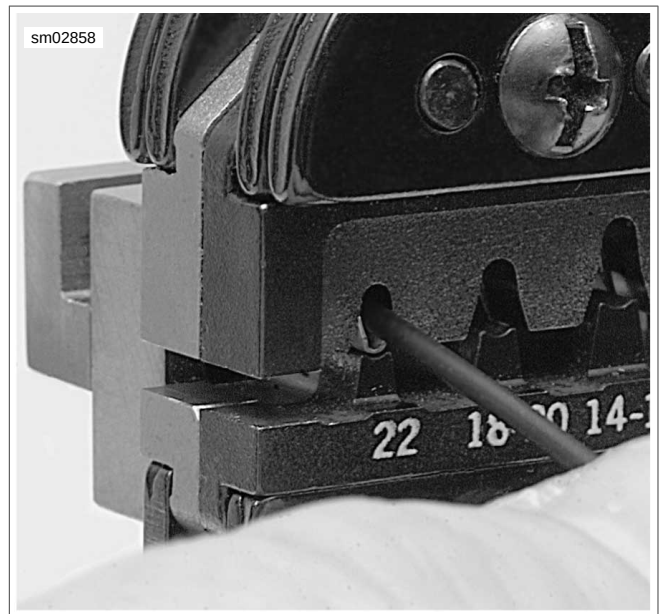


Figure A-35. Stripped Lead at Up Angle

Inspect Crimp

1. **Inspect Crimp:** Inspect the core and insulation crimp.
 - a. See [Figure A-36](#). The core tails should be creased into the wire strands at the core crimp (1).
 - b. Strands (2) of wire should be visible beyond the core crimp but not forward into the terminal shell.
 - c. The insulation tails should be folded into the insulation (3) without piercing or cutting the insulation.
 - d. Distortion should be minimal.
2. **Test Crimp:** Hold the terminal and pull the lead.

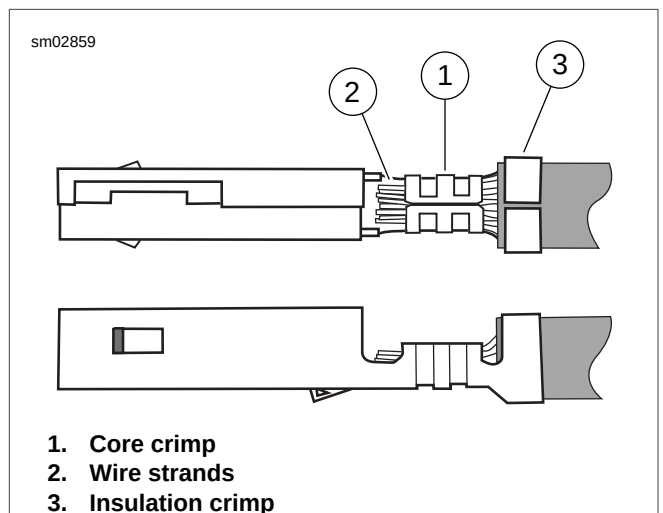


Figure A-36. Terminal Crimp

150 METRI-PACK CONNECTOR REPAIR

General

Metri-Pack connectors are embossed with the initials (P.E.D.).

There are two types of connectors in this series:

- Pull-to-Seat
- Push-to-Seat

Separating Pin and Socket Housings

Bend back the external latch slightly and separate the pin and socket halves of the connector.

Mating Pin and Socket Housings

Align the wire colors and push the pin and socket halves of the connector together.

Removing Socket Terminal

1. See [Figure A-37](#) for pull-to-seat connector or [Figure A-38](#) for push to seat connector. Remove wire lock (1) from wire end of socket housing on push-to-seat type connectors.

NOTE

For best results, free one side of wire lock first and then release the other side.

2. Find the locking tang in the mating end of the connector.

NOTE

The tangs are always positioned in the middle of the chamber and are on the same side as the external latch.

3. Gently insert a safety pin into the chamber about 1/8 in. (3.2 mm).
 - a. **For pull-to-seat:** Stay between the terminal and the chamber wall and pivot the end of the pin toward the terminal body.
 - b. **For push-to-seat:** There is a small opening for the pin.
4. When a click is heard, remove the pin and repeat the procedure.

NOTE

The click is the sound of the tang returning to the locked position as it slips from the point of the pin.

5. Pick at the tang until the clicking stops and the pin seems to slide in deeper than it had previously. This is an indication that the tang has been depressed.

NOTE

On those terminals that have been extracted on multiple occasions, the click may not be heard, but pivot the pin as if the click was heard at least 3 times.

6. Remove the pin.
 - a. **For pull-to-seat:** Push on the lead to extract the terminal from the mating end of the connector.
 - b. **For push-to-seat:** Pull on the lead to draw the terminal out the wire end.

Inserting Socket Terminal

NOTE

For wire location purposes, alpha characters are stamped into the socket housings.

1. See [Figure A-37](#) for pull-to-seat connector or [Figure A-38](#) for push to seat connector. Using a thin flat blade, like that on a hobby knife, carefully bend the tang outward away from the terminal body.
2. Gently pull or push on the lead to install the terminal back into the chamber. A click is heard when the terminal is properly seated.
3. Gently pull or push on the lead to verify that the terminal is locked in place.

For push-to-seat: See [Figure A-38](#). Seat wires in separate channels of wire lock and then push channels **inside** chambers at wire end of socket housing. Fully installed, slot on each side of wire lock engages ear on socket housing.

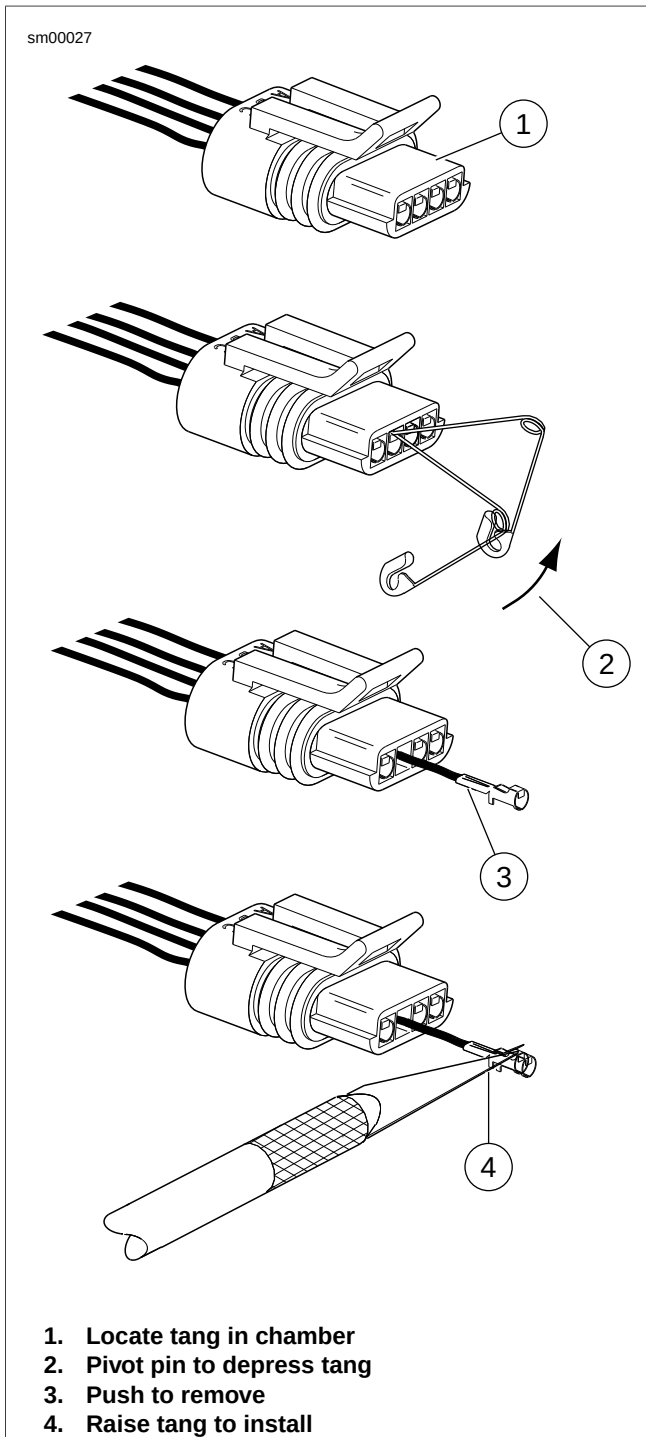


Figure A-37. 150 Metri-Pack Connector: Pull-to-Seat

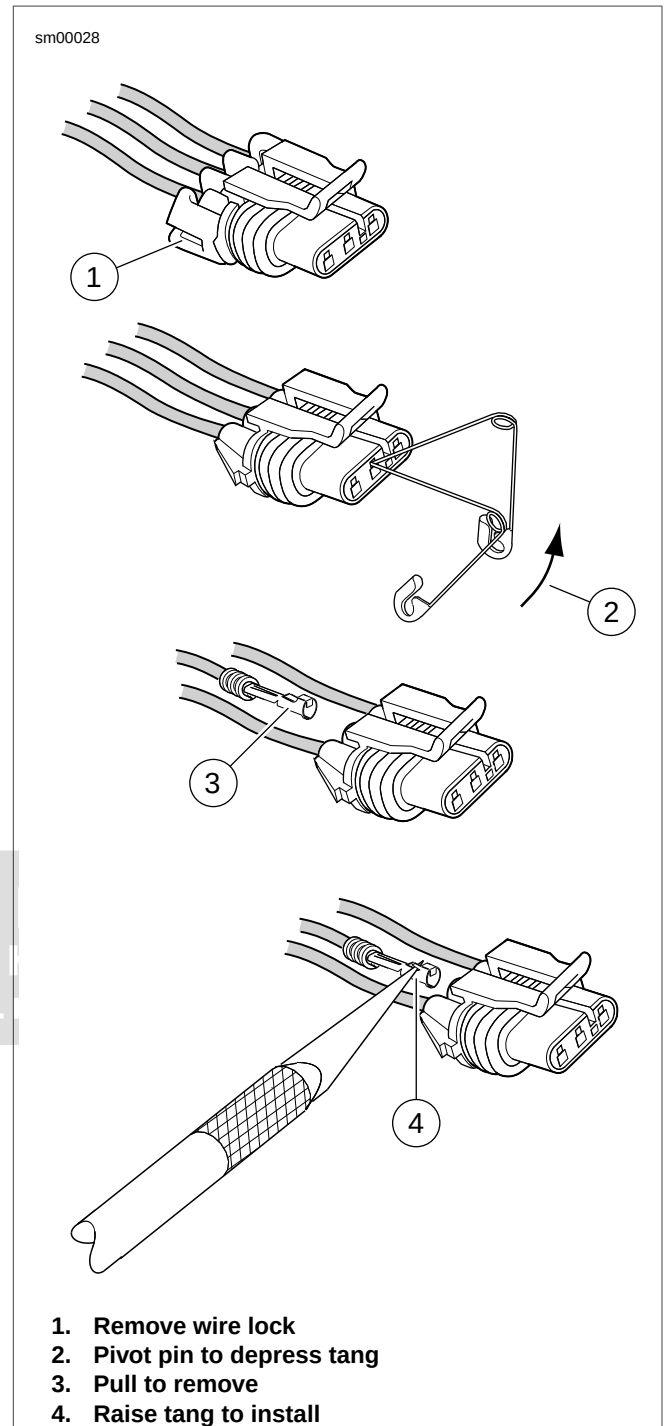


Figure A-38. 150 Metri-Pack Connector: Push-to-Seat

PACKARD 280 METRI-PACK RELAY AND FUSE BLOCK CONNECTORS

A.11

FUSE BLOCK REPAIR

Removing Socket Terminals

1. See [Figure A-39](#). To remove secondary locks, insert end of small flat blade screwdriver (1) under lip of locking wedge (2) and gently pry up secondary lock.

NOTE

For best results, start with locking wedge on outboard side of secondary lock.

2. Looking into chamber at top of fuse block, note the tang next to each socket terminal.
3. Using a thin flat blade, like that on a hobby knife, gently push tang away from terminal, and then tug on wire to back terminal out.

Installing Socket Terminals

1. Match the wire lead color to the fuse block terminal cavity.

NOTES

- Refer to the main harness wiring diagram for wire lead color codes.
 - See [Figure A-40](#). The main fuse block terminal cavity is identified as alpha (1) and numeric (2) coordinates. Refer to the main harness wiring diagram for fuse block terminal cavity coordinates.
2. With the open side of the socket terminal facing the tang, push lead into chamber at the wire end of the fuse block. A click is heard when the terminal is properly engaged.
 3. Gently tug on the wire to verify that the terminal is locked in place and will not back out of the chamber.
 4. Install the secondary locks. With the locking wedges positioned above the tangs in each chamber, slide flat side of secondary lock into slot (between rows), and push down until it bottoms.

Crimping Terminals

Terminals are crimped twice; once over the wire core and a second time over the insulation/seal.

A correctly crimped terminal may require different crimping dies found on separate crimpers.

NOTE

The wiring diagram indicates when one socket terminal is be crimped to two wire leads.

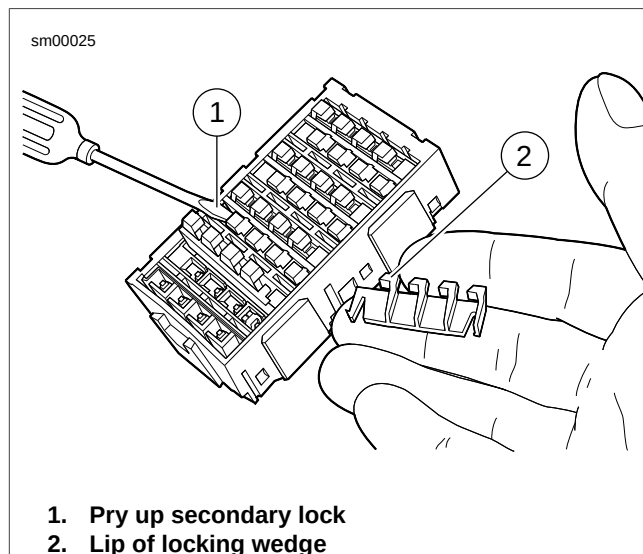


Figure A-39. Fuse Block: Remove Secondary Locks

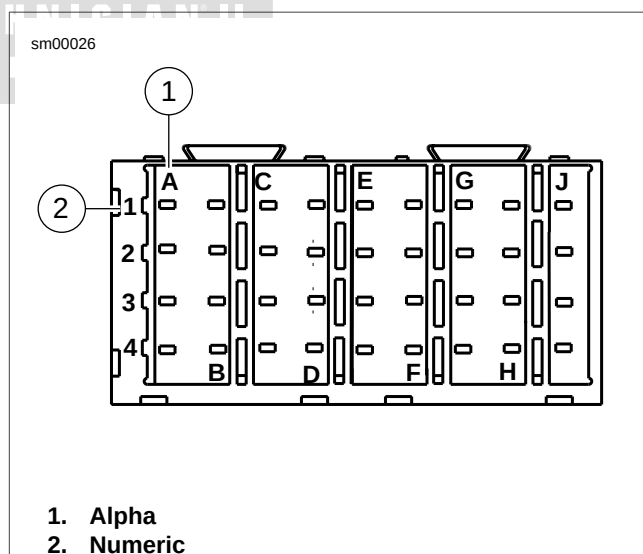


Figure A-40. Fuse Block: Coordinates (typical)

PACKARD 480 METRI-PACK CONNECTORS

A.12

480 METRI-PACK CONNECTOR REPAIR

General

A 480 Metri-Pack (P.E.D.) connector is frequently used for the B+ (battery voltage) connector to power P&A accessories.

Referred to as Packard connectors, Metri-Pack connectors are embossed with the initials P.E.D.

See [Figure A-41](#). An AFL housing (5) is used on many ignition/light switches. The secondary lock (4) must be opened before removing the terminal from the housing.

Separating Pin and Socket Housings

NOTE

Cut any cable strap anchoring the wire conduits of the pin (accessory connector housing) and the socket (B+) housing.

See [Figure A-41](#). Using small flat blade screwdriver, press button (1) on pin housing (red wire) side of the connector and pull apart the pin and socket housings.

Mating Pin and Socket Housings

Orient the latch on the socket housing to the button catch on the pin housing and press the housings together.

Removing Socket Terminals

1. See [Figure A-41](#). Bend back the latch (2) slightly and free one side of secondary lock, then repeat to release the opposite side. Rotate the secondary lock outward on hinge to access terminal in chamber of connector housing.
2. On the mating end of the connector, note the tang in the square shaped opening centered next to the terminal. Gently insert the point of a stick pin or large safety pin into the opening (3) between the tang and the chamber wall until it stops.
3. Pivot the end of the pin toward the terminal body to press the tang.
4. Remove the pin and then pull terminal out of the wire end of connector housing.
5. If necessary, crimp **new** terminals on wires. See [A.14 PACKARD METRI-PACK TERMINALS](#).

Installing Socket Terminals

1. Carefully bend the tang outward away from the terminal body.
2. With the tang on the same side as the square shaped opening in the mating end of the connector housing, feed terminal into wire end of connector housing until it "clicks" in place.

3. Verify that terminal will not back out of the chamber. A slight tug on the cable will confirm that it is locked.
4. Rotate the hinged secondary lock inward until latches fully engage tabs on both sides of connector housing.

NOTE

If removed, install **new** anchored cable strap in O.E. location. Tighten cable strap to capture conduit of both accessory connector and B+ connector approximately 1.0 in. (25.4 mm) from housings.

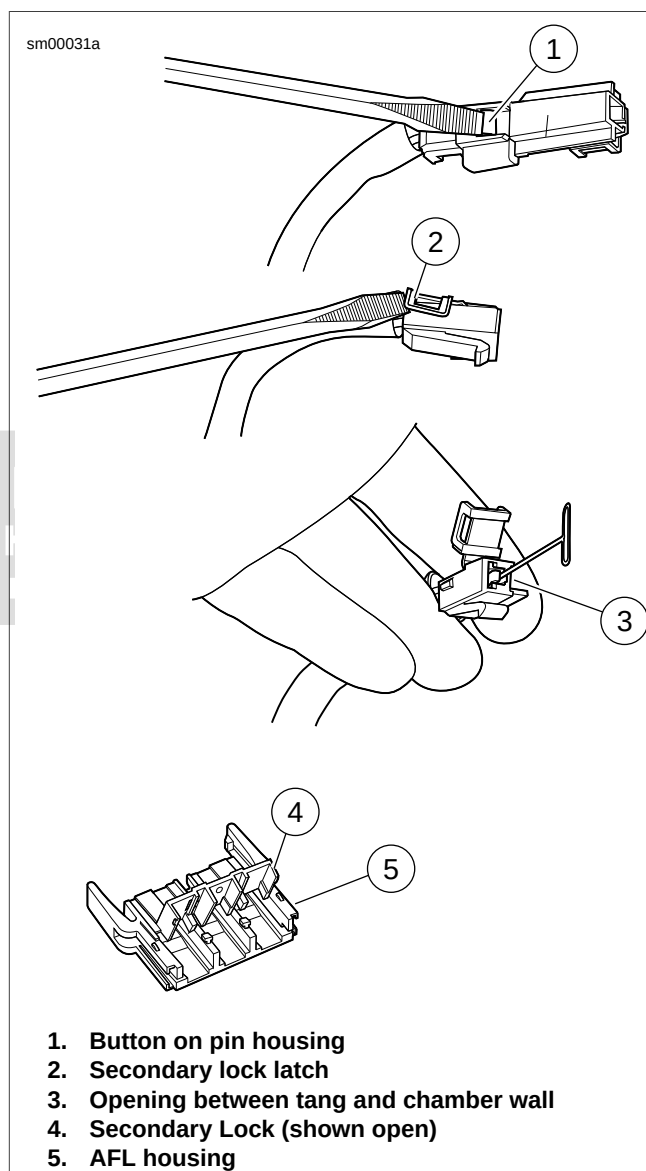


Figure A-41. 480 Metri-Pack Connector: Remove Socket Terminal

PACKARD 630 METRI-PACK CONNECTORS

A.13

630 METRI-PACK CONNECTOR REPAIR

PART NUMBER	TOOL NAME
SNAP-ON TT600-3	SNAP-ON PICK

General

Referred to as Packard connectors, Metri-Pack 630 series connectors are embossed with the initials P.E.D.

Separating Pin and Socket Housings

NOTE

If necessary, remove connector from barbed anchor or other retaining device.

Bend back the external latch slightly and separate pin and socket halves of the connector.

Mating Pin and Socket Housings

Orient the latch to the catch and push the pin and socket halves of the connector together until the latch "clicks".

NOTE

If removed, install connector on barbed anchor or other OE retaining device.

Removing Socket Terminal

1. Bend back the latch slightly and free one side of the secondary lock. Repeat the step to unlatch the other side.
2. Rotate the secondary lock outward on hinge to view the terminals in the chambers of the connector housing. The locking tang is on the side opposite the crimp tails and

engages a rib in the chamber wall to lock the terminal in place.

3. Moving to the mating end of the connector, take note of the small opening on the chamber wall side of each terminal.
4. Insert SNAP-ON PICK (Part No. SNAP-ON TT600-3) into opening until it stops. Pivot the end of the pick toward the terminal to depress the locking tang.
5. Remove the pick and gently tug on the wire to pull the terminal from the wire end of the connector. Repeat steps if the terminal is still locked in place.
6. If necessary, crimp **new** terminals on wires. Refer to [A.14 PACKARD METRI-PACK TERMINALS](#).

Installing Socket Terminal

NOTE

Refer to the wiring diagrams to match wire lead colors to alpha characters molded into the secondary locks of each connector housing.

1. Using a thin flat blade, like that of a hobby knife, carefully bend the tang outward away from the terminal body.
2. With the tang facing the chamber wall, push the lead into the chamber at the wire end of the connector. A click is heard when the terminal is properly seated.
3. Gently tug on the wire end to verify that the terminal is locked in place and will not back out of the chamber.
4. Rotate the hinged secondary lock inward until tabs fully engage latches on both sides of connector.

PACKARD METRI-PACK TERMINALS

A.14

METRI-PACK TERMINAL CRIMPS

PART NUMBER	TOOL NAME
HD-38125-6	PACKARD TERMINAL CRIMP TOOL
HD-38125-7	PACKARD TERMINAL CRIMPER
HD-38125-8	PACKARD CRIMPING TOOL

Matching Terminal To Crimper

Metri-Pack connectors embossed with the initials P.E.D. require Packard crimp tools to crimp terminals to wire leads.

Terminals are crimped twice to a wire lead, once over the wire core and a second time over the insulation/seal.

See [Figure A-42](#). A completed crimp may require two different crimping dies found on PACKARD TERMINAL CRIMP TOOL (Part No. HD-38125-6) and/or PACKARD TERMINAL CRIMPER (Part No. HD-38125-7). The terminal (pin or socket) and the wire lead gauge will determine the core crimp die and the insulator/seal die.

NOTE

The PACKARD CRIMPING TOOL (Part No. HD-38125-8) will also crimp sealed splice connectors in wire gauge sizes 18-20, 14-16 and 10-12.

Preparing Wire Lead

Use a wire stripper to strip off the insulation and expose 5/32 in. (4.0 mm) of wire core.

Crimping Wire Core

NOTE

Metri-Pack terminal crimps require two steps. Always perform **Crimping Wire Core** before **Crimping Insulation/Seal**.

1. Squeeze and release handles until ratchet automatically opens.
2. Identify the corresponding sized nest for the core crimp.
3. Position the core crimp in the die. Be Sure the core crimp tails are facing the forming jaws.
4. Gently squeeze the handles until crimpers just secure the core crimp tails.
5. Insert stripped wire between crimp tails. Verify that wire is positioned so that short pair of crimp tails squeeze core wire strands, while long pair is positioned over the insulation or seal material.
6. Squeeze handles tightly closed. Release grip and the tool will automatically open.

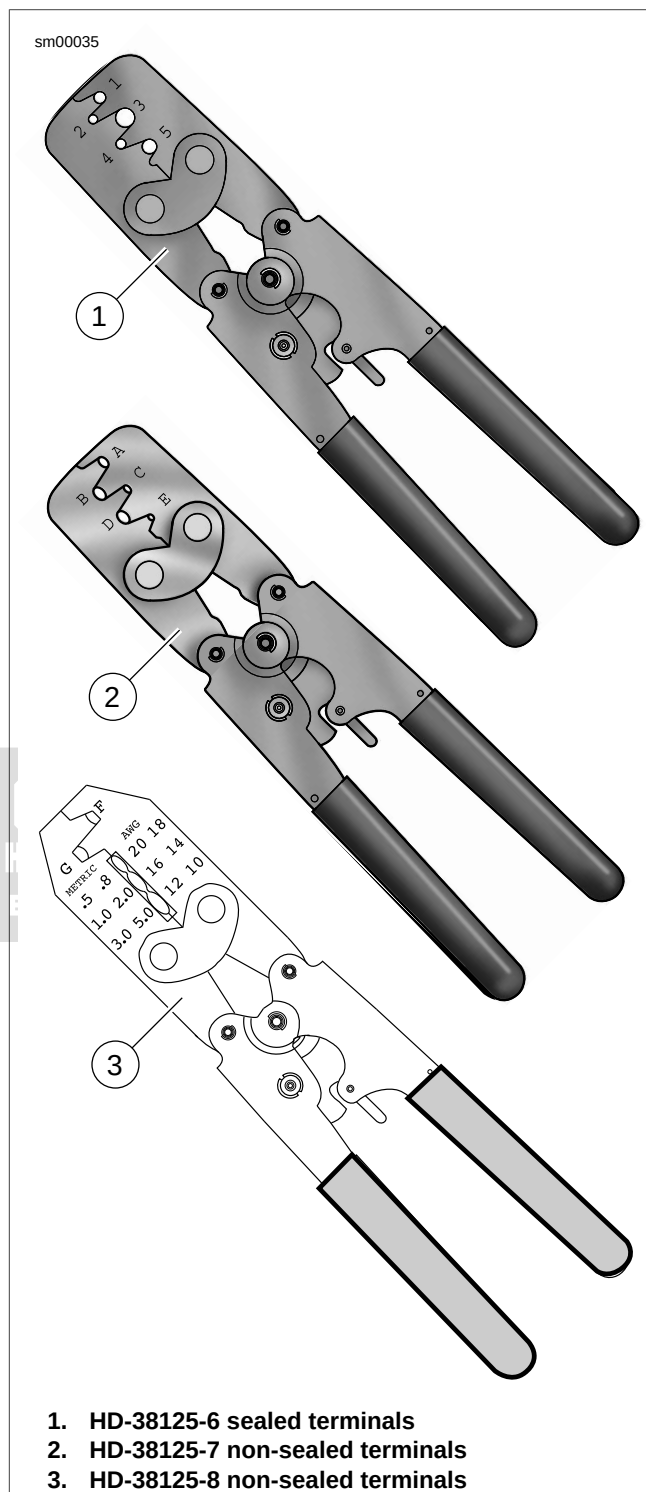


Figure A-42. Metri-Pack Terminal Crimp Tools

Crimping Insulation/Seal

NOTE

Always perform **Crimping Wire Core** before **Crimping Insulation/Seal**.

1. See [Figure A-43](#). Identify the correct die for the insulation/seal crimp (2).
2. Position the insulation/seal crimp in the nest. Be sure the insulation/seal crimp tails are facing the forming jaws.
3. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimp is complete.

Inspecting Crimps

1. See [Figure A-43](#). Inspect the wire core crimp (1). The tails should be folded in on the wire core without any distortion or excess wire strands.
2. Inspect the insulation (2) or seal (3) crimp. The tails of the terminal should be wrapped around the insulation without distortion.

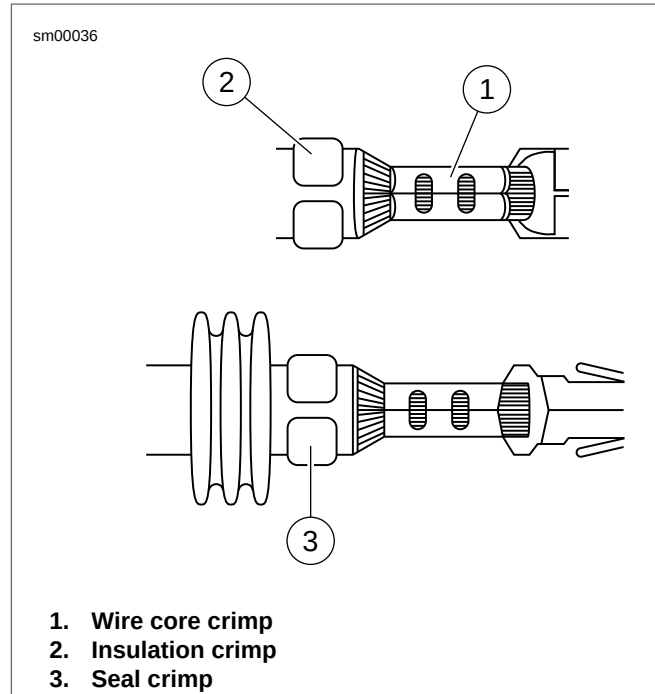


Figure A-43. Metri-Pack Connector: Inspect Core and Insulation/Seal Crimps



PACKARD ECM CONNECTOR

A.15

PACKARD 100W CONNECTOR REPAIR

General

A Packard 100W connector connects the electronic control module (ECM) to the main harness.

NOTE

For vehicles with 73-pin connectors, see [A.16 PACKARD MICRO-64 CONNECTORS](#) and [A.14 PACKARD METRI-PACK TERMINALS](#).

Separating Socket Housing From ECM

See [Figure A-44](#). While pressing the connector into the ECM, press the thumb lever (1) against the connector until the latch (2) pops out of the catch (3) on the ECM.

Mating Socket Housing To ECM

Push the connector into the ECM until the latch is captured by the catch on the ECM.

Removing Socket Terminal

1. See [Figure A-45](#). Gently press latch (1) on each side of the clear plastic secondary lock (2) and remove. For best results, release one side at a time.
2. Carefully cut cable strap (3) to free strain relief collar (4) from conduit (5).
3. See [Figure A-46](#). Using a thin blade, gently pry at seam at back of socket housing to release three plastic pins (1) from slots in housing. Separate and spread halves of socket housing.
4. Push on wire lead to free terminal from chamber.

Installing Socket Terminal

1. From inside socket housing, gently pull on wire to draw terminal into chamber.
2. Exercising caution to avoid pinching wires, press halves of socket housing together until three plastic pins fully engage slots in housing.
3. Install **new** cable strap in groove of strain relief collar capturing cable conduit.
4. With the two ribs on the secondary lock on the same side as the external latch, install over terminals until latches lock in place.

Crimping Terminals

If necessary, crimp new terminals on wire leads. See [A.14 PACKARD METRI-PACK TERMINALS](#).

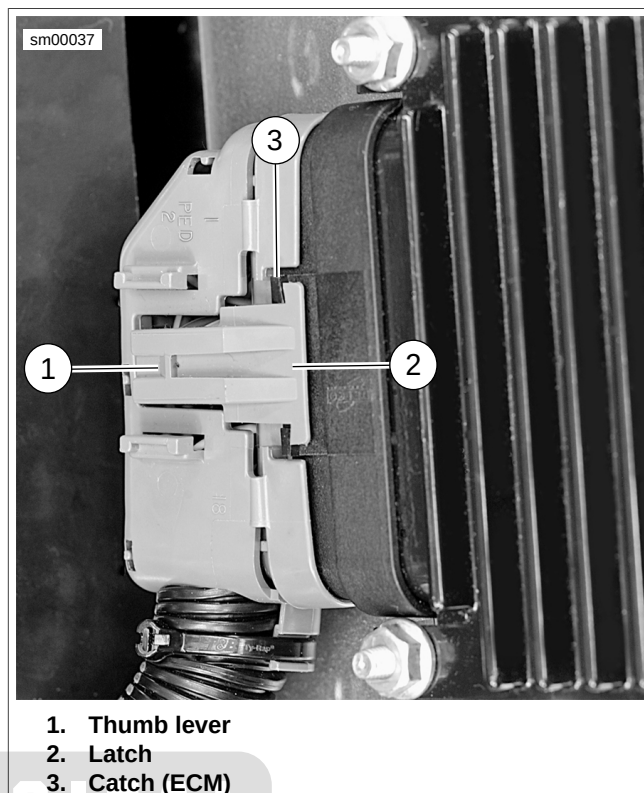


Figure A-44. Packard 100W to ECM (Typical)

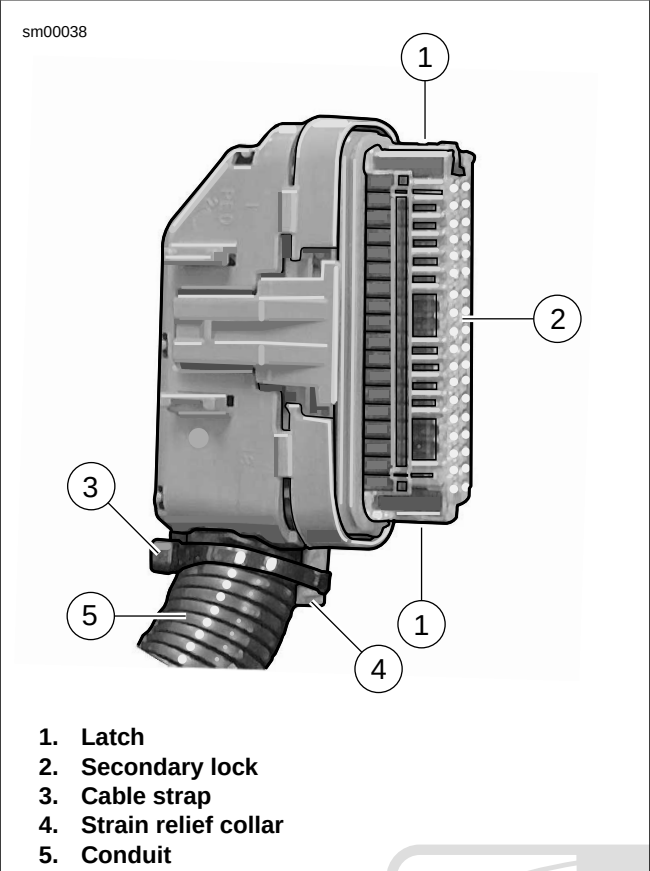


Figure A-45. Packard 100W Connector

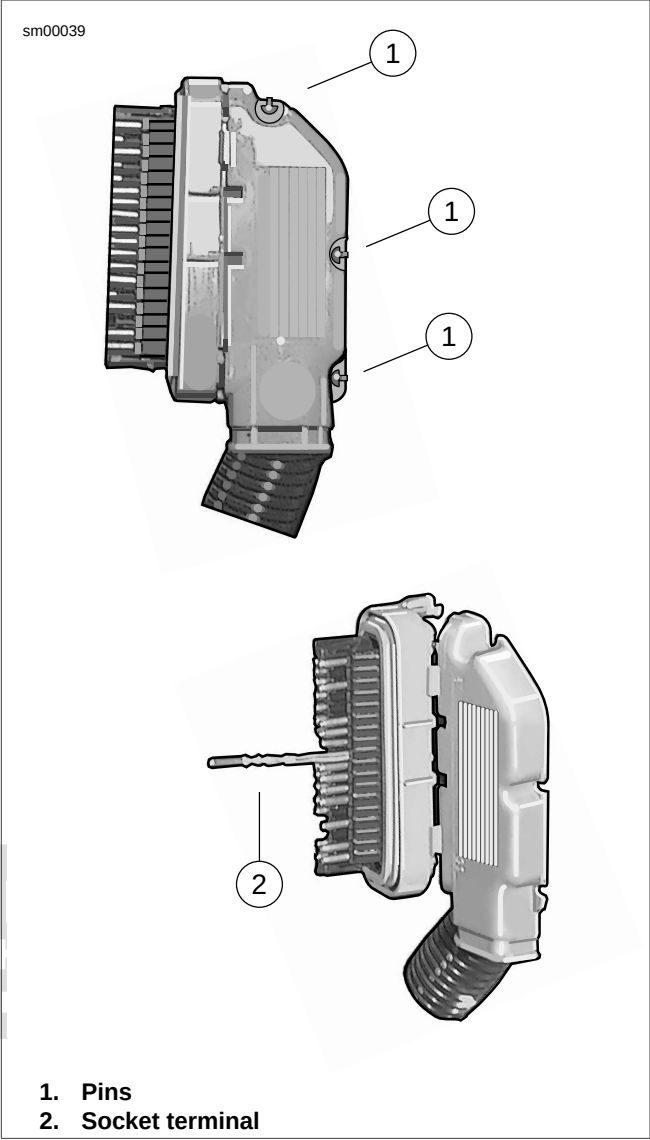


Figure A-46. Packard 100W Connector: Separate Halves of Socket Housing

PACKARD MICRO-64 CONNECTORS

A.16

PACKARD MICRO-64 CONNECTOR REPAIR

PART NUMBER	TOOL NAME
HD-45928	PACKARD MICRO-64 TERMINAL REMOVER
HD-45929	PACKARD MICRO-64 TERMINAL CRIMPER

General

Packard Micro-64 connectors are frequently found on speedometers, tachometers and the ECM of Touring Models. For pin 73 of these ECMs, see [A.10 PACKARD 150 METRI-PACK CONNECTORS](#).

Separating Pin and Socket Housings

Bend back the external latches slightly and separate the pin and socket housings.

Mating Pin and Socket Housings

Orient the wire lead colors and push the pin and socket housings of the connector together until the latches click.

Removing Terminal

1. See [Figure A-49](#). Locate the head of the secondary lock (1) on one side of the connector housing.
2. Insert the blade of a small screwdriver between the center ear of the lock and the connector housing and gently pry out lock. When partially removed, pull lock from connector housing.
3. Locate pin hole (2) between terminals on mating end of connector.
4. See [Figure A-50](#). Obtain the PACKARD MICRO-64 TERMINAL REMOVER (Part No. HD-45928).
5. See [Figure A-48](#). Push the adjacent terminals all the way into the connector housing and then insert tool into hole until it bottoms.
6. Leaving the tool installed, gently tug on wires to pull either one or both terminals from wire end of connector. Remove tool.



Figure A-47. Packard Micro 64 Terminal Remover (HD-45928)

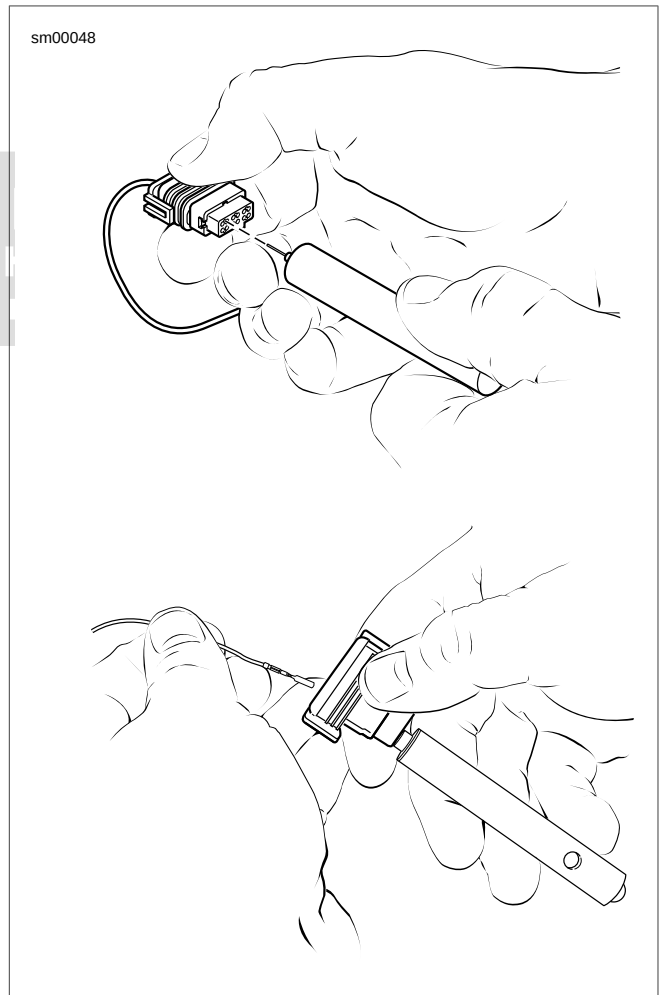


Figure A-48. Packard Micro 64 Connector: Insert Tool and Remove Terminal

Installing Terminal

1. Insert terminal into its respective numbered chamber on wire end of connector. No special orientation of the terminal is necessary.

NOTE

See [Figure A-49](#). For wire location purposes, the corners of the socket housing are stamped (3) with the numbers 1, 6, 7 and 12, representing terminals 1-6 on one side, and 7-12 on the other.

2. Bottom the terminal in the chamber and then gently tug on the wire to verify that it is locked in place.

NOTE

Once the terminal is removed it may not lock in place when first reinstalled. Until the lock engages, move the terminal back and forth slightly while wiggling the lead.

3. Since the terminal remover tool releases two terminals simultaneously, repeat step 2 on the adjacent terminal even if it was not pulled from the connector housing.
4. With the center ear on the head of the secondary lockpin facing the mating end of the connector, push secondary lock in until head is flush with the connector housing.

Preparing Wire Leads for Crimping

Strip lead removing 1/8 in. (3.0 mm) of insulation.

Crimping Terminals

1. Inspect **new** socket terminal for bent or deformed contact and crimp tails. Replace as necessary.
2. See [Figure A-51](#). Squeeze the handles of the PACKARD MICRO-64 TERMINAL CRIMPER (Part No. HD-45929) to cycle the tool to the fully open position (1).
3. Raise locking bar and barrel holder by pushing up on bottom tab with index finger (2).
4. With the crimp tails facing upward, insert terminal through locking bar into front hole in barrel holder (20-22 gauge wire) (3).
5. Release locking bar to lock position of contact. When correctly positioned, the locking bar fits snugly in the space at the front of the core crimp tails and the closed side of the terminal rests on the outer nest of the crimp tool.
6. Insert wires between crimp tails until ends make contact with locking bar. Verify that wire is positioned so that wide pair of crimp tails squeeze bare wire strands, while the narrow pair folds over the insulation material.
7. Squeeze handle of crimp tool until tightly closed (4). Tool automatically opens when the crimping sequence is complete.
8. Raise locking bar and barrel holder to remove contact.

Inspecting Crimps

Inspect the quality of the core and insulation crimps. Distortion should be minimal.

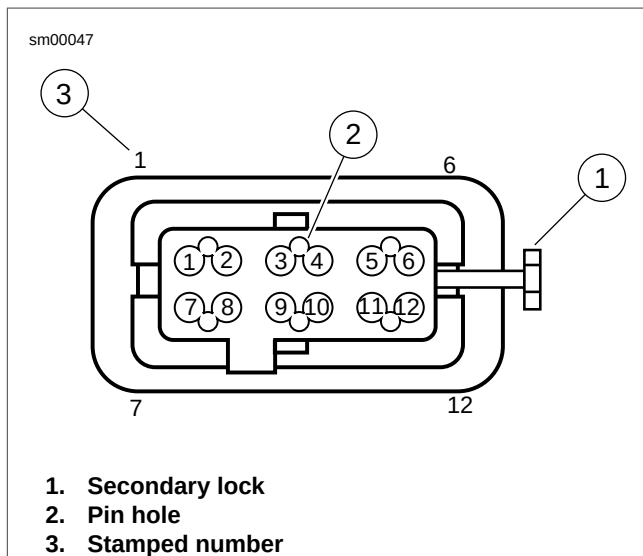


Figure A-49. Packard Micro 64 Connector: Housing

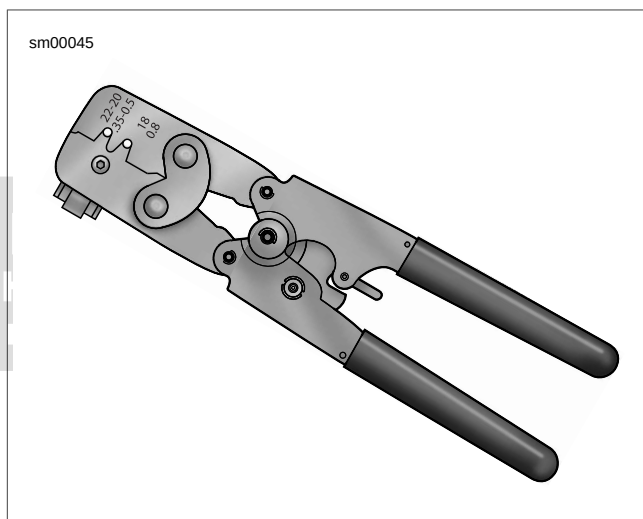


Figure A-50. Packard Micro 64 Terminal Crimper (HD-45929)



Figure A-51. Packard Micro 64 Connector: Terminal in Crimper

DIGITAL
TECHNICIAN II
HARLEY-DAVIDSON®

SEALED SPLICE CONNECTORS

A.17

SEALED SPLICE CONNECTOR REPAIR

PART NUMBER	TOOL NAME
HD-25070	ROBINAIR HEAT GUN
HD-38125-8	PACKARD CRIMPING TOOL
HD-39969	ULTRA TORCH UT-100
HD-41183	HEAT SHIELD ATTACHMENT

General

Splice connectors and several OE ring terminal connectors use heat shrink covering to seal the connection.

Preparing Wire Leads

NOTE

If adjacent wires are to be spliced, stagger the splices so that the sealed splice connectors will not touch each other but are located at different positions along the length of the wires.

- Using a shop gauge, identify the gauge of the wire.
- Match the wire gauge to a sealed splice connector by color and part number. Refer to [Table A-5](#).
- Using a wire stripper, cut and strip a length of insulation off the wire ends. Refer to [Table A-5](#) for the strip length.

Table A-5. Sealed Splice Connectors

WIRE GAUGE	COLOR	PART NO.	STRIP LENGTH
18-20 (0.5-0.8 mm)	Red	70585-93	3/8 in. (9.5 mm)
14-16 (1.0-2.0 mm)	Blue	70586-93	3/8 in. (9.5 mm)
10-12 (3.0-5.0 mm)	Yellow	70587-93	3/8 in. (9.5 mm)

NOTE

If any copper wire strands are cut off of the wire core, trim the end and strip the wire again in a larger gauge stripper.

Splicing Wire Leads

NOTE

See [Figure A-53](#). The connector is crimped twice - one side and then the other.

- See [Figure A-52](#). Open the PACKARD CRIMPING TOOL (Part No. HD-38125-8) ratchet by squeezing the handles closed.
- Match the connector color to the wire gauge crimp die in the jaws and insert one end of the sealed connector.
- Gently squeeze the handles until the connector is held in the jaws.
- See [Figure A-53](#). Feed the stripped end of a wire into the connector until the wire stops inside the metal insert (1).

- Squeeze the handles tightly closed to crimp the lead in the insert (2). The tool automatically opens when the crimping is complete.
- Slide the connector to the other half of the metal insert. Insert the stripped wire lead (1) until it stops, and crimp the lead in the insert (2).

WARNING

Be sure to follow manufacturer's instructions when using the UltraTorch UT-100 or any other radiant heating device. Failure to follow manufacturer's instructions can cause a fire, which could result in death or serious injury. (00335a)

- Avoid directing heat toward any fuel system component. Extreme heat can cause fuel ignition/explosion resulting in death or serious injury.
 - Avoid directing heat toward any electrical system component other than the connectors on which heat shrink work is being performed.
 - Always keep hands away from tool tip area and heat shrink attachment.
- Use an ULTRA TORCH UT-100 (Part No. HD-39969), or a ROBINAIR HEAT GUN (Part No. HD-25070) with a HEAT SHIELD ATTACHMENT (Part No. HD-41183), to heat the connector from the center of the crimp (3) out to each end.

NOTE

It is acceptable for the splice to rest against the heat shrink tool attachment.

Inspecting Seals

See [Figure A-53](#). Allow the splice to cool and inspect the seal. The insulation should appear smooth and cylindrical. Melted sealant will have extruded out the ends (4) of the insulation.

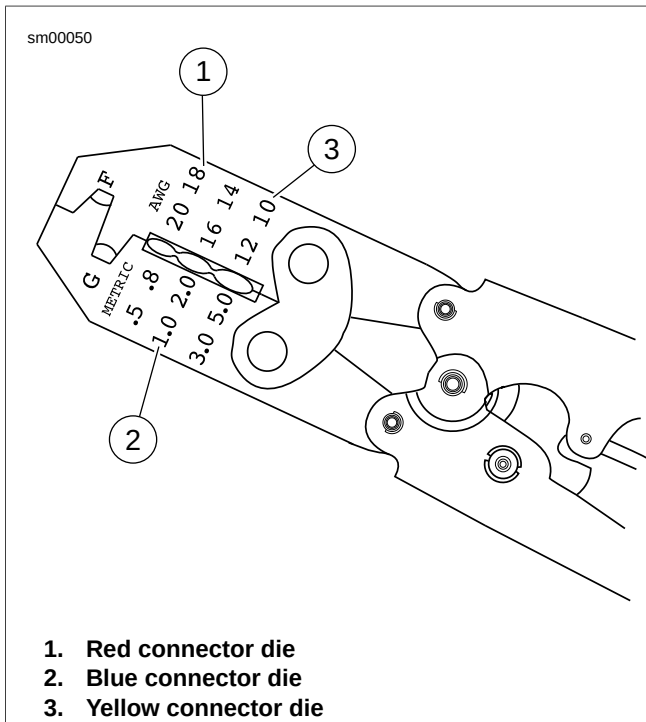


Figure A-52. Packard Crimping Tool (HD-38125-8)

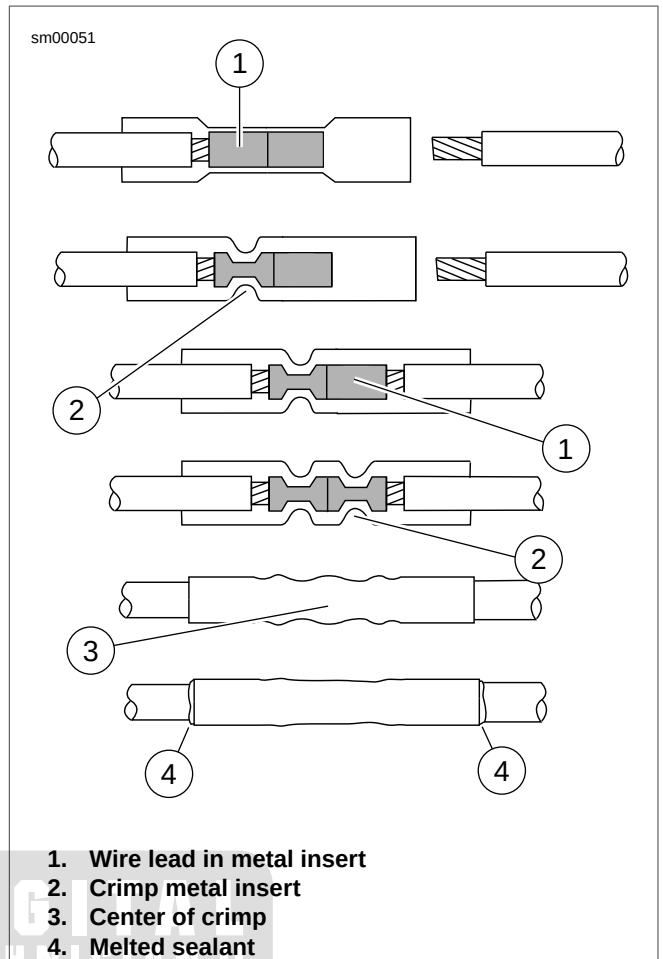


Figure A-53. Sealed Splice Connector

NOTES



TABLE OF CONTENTS

SUBJECT	PAGE NO.
B.1 CONNECTORS.....	B-1
B.2 WIRING DIAGRAMS.....	B-3



NOTES



CONNECTORS

B.1

CONNECTOR LOCATIONS

Function/Location

Refer to [Table B-1](#). On the motorcycle, a connector can be identified by its function and location.

Place and Color

The place (number of wire cavities of a connector housing) and color of the connector can also aid identification.

Connector Number

On wiring diagrams and in service/repair instructions, connectors are identified by a number in brackets.

Repair Instructions

Refer to [Table B-1](#). The repair instructions in Appendix A are by connector type.

Table B-1. 2009 Sportster Connector Locations

NO.	DESCRIPTION	TYPE	LOCATION
[5]	MAXIFUSE	2-place Metri-Pack, black	On battery strap, behind left side cover
[7]	Tail lamp harness to main harness	6-place Multilock, black	Under seat
[18]	Left rear turn signal	2-place Multilock, white	Inside tail lamp lens
[19]	Right rear turn signal	2-place Multilock, black	Inside tail lamp lens
[20]	Instruments	12-place Molex, black	Under fuel tank
[22]	Right hand controls	6-place Molex, black	Under fuel tank
[24]	Left hand controls and horn	8-place Molex, gray	Under fuel tank
[30]	TSM/TSSM/HFSM	12-place Deutsch, gray	Under battery
[31]	Front turn signals	6-place Molex, black	Under fuel tank
[33]	Ignition switch	-	Right side of frame behind neck
[38]	Headlamp	4-place Multilock, black	Under fuel tank
[39]	Speedometer (XL)	12-place Packard Micro-64, black	Back of speedometer
[39]	Tachometer (XR)	5-place Packard	Back of speedometer
[46]	Voltage regulator to stator	2-place Lyall, black	In front of engine crankcase
[61]	Fuse block	Spade terminals	Behind left side cover
[65]	Vehicle Speed Sensor (VSS)	3-place Packard, black	Right rear top of crankcase
[77]	Voltage regulator (DC output)	2-place Lyall, black	In front of engine crankcase
[78]	Electronic Control Module (ECM)	36-place Packard, gray	Under seat
[79]	Crankshaft Position (CKP) sensor	2-place Deutsch, black	Front of left crankcase
[80]	Temperature Manifold Absolute Pressure (TMAP) sensor	4-place Packard, black	Top of intake manifold
[83]	Ignition coil	4-place Delphi, black	Back of coil, under fuel tank
[84]	Front injector	2-place Delphi, black	Top of intake manifold
[85]	Rear injector	2-place Delphi, black	Top of intake manifold
[87]	Idle Air Control (IAC)	4-place Delphi, black	Top of induction module
[88]	Throttle Position (TP) sensor	3-place Delphi, black	Behind air cleaner backing plate
[90]	Engine Temperature (ET) sensor	2-place Delphi, black	Above induction module, right side
[91]	Data link connector	4-place Deutsch, gray	On battery strap, behind left side cover
[93]	Tail lamp	4-place Multilock, black	Inside tail lamp lens
[94]	Tail lamp power in	6-place Multilock, black	Inside tail lamp lens
[108]	Tachometer	12-place Packard Micro-64, gray	Back of tachometer
[119]	Relay/fuse block	5-place Amp, spade terminals	Fuse/relay block, behind left side cover

Table B-1. 2009 Sportster Connector Locations

NO.	DESCRIPTION	TYPE	LOCATION
[120]	Oil pressure switch	90° post terminal, black	Oil pressure switch, under oil filter mount
[121]	Rear stoplight switch	Spade terminals, black	Stop lamp switch, under battery tray
[122]	Horn	90° spade terminals, black	Between cylinders, left side
[128]	Starter solenoid	Locking spade terminal, white	Starter solenoid
[133]	Jiffy Stand Sensor (HDI)	3-place, black	Left side along frame toward front of engine
[136]	Neutral switch	1-place molded jumper, black	Right side frame, beneath gearcase cover
[137]	Rear oxygen sensor	2-place Amp, black	On H-bracket
[138]	Front oxygen sensor	2-place Amp, black	Electrical caddie behind voltage regulator
[141]	Fuel pump and low fuel switch	4-place Molex, black	Forward of relay/fuse blocks
[142]	Security siren	3-place Packard, black	Under frame
[145]	Engine harness	16-place Molex, black	Under seat
[160]	B+ connector	1-place Packard, gray	Under seat
[178]	Active intake solenoid	2-place	Right side behind air box
[200]	Fuel sender resistor assembly	3-place Molex, black	Under seat
[208]	HFSM antenna connector	4-place Deutsch, gray	Under battery
[209]	Security antenna	2-place Molex, black	Under seat
[GND1]	Powertrain ground	Ring terminal	Crankcase housing, top rear



WIRING DIAGRAMS

B.2

WIRING DIAGRAM INFORMATION

Wire Color Codes

Wire traces on wiring diagrams are labeled with alpha codes. Refer to [Table B-2](#).

For Solid Color Wires: See [Figure B-1](#). The alpha code identifies wire color (3).

For Striped Wires: The code is written with a slash (/) between the solid color code and the stripe code (4). For example, a trace labeled GN / Y is a green wire with a yellow stripe.

Wiring Diagram Symbols

See [Figure B-1](#). On wiring diagrams and in service/repair instructions, connectors are identified by a number in brackets (1). The letter (2) inside the brackets identifies whether the housing is a socket or pin housing.

A=Pin: The letter A after a connector number and the pin symbol (6) identifies a pin housing.

B=Socket: The letter B after a connector number and the socket symbol (5) identifies a socket housing.

Other symbols found on the wiring diagrams include the symbol for a diode (7), a symbol for a wire-to-wire connection (8), a symbol verifying that no connection (9) between two wire traces exists, symbols for actual (10) and virtual (11) splices, and a symbol identifying two wires that are twisted together (12).

Actual splices (10) are splices where two wires are connected together at a specific location along a wire. Virtual splices (11) are splices shown connected anywhere along a wire, usually used in a wiring or schematic diagram for clarity.

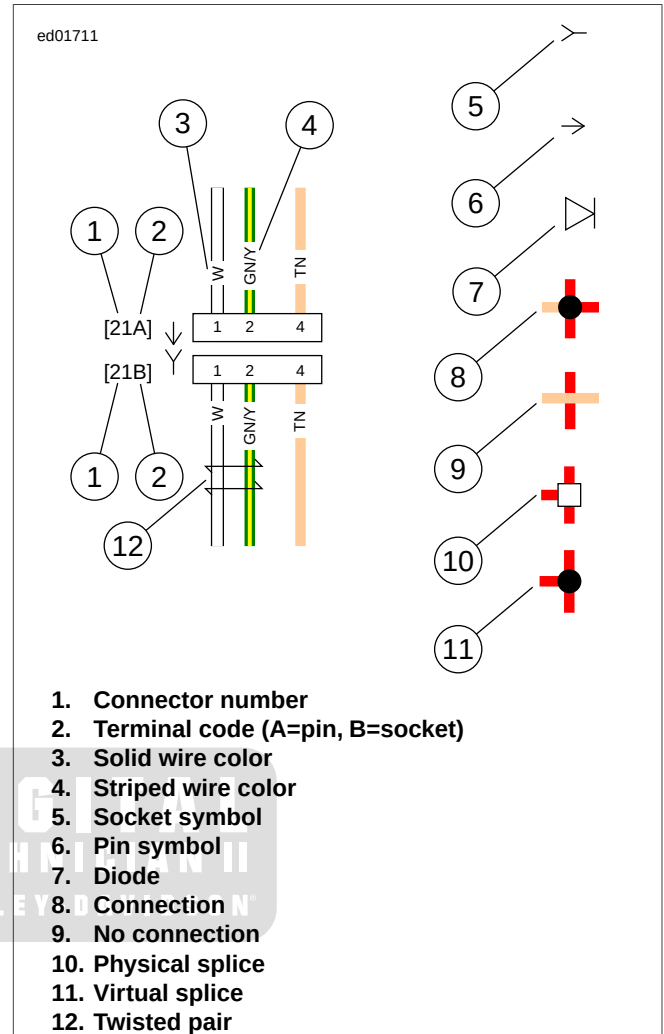


Figure B-1. Connector/Wiring Diagram Symbols (typical)

Table B-2. Wire Color Codes

ALPHA CODE	WIRE COLOR
BE	Blue
BK	Black
BN	Brown
GN	Green
GY	Gray
LGN	Light Green
O	Orange
PK	Pink
R	Red
TN	Tan
V	Violet
W	White
Y	Yellow

2009 SPORTSTER WIRING DIAGRAMS

Refer to the table below for wiring diagram information.

Wiring Diagram List

DIAGRAM	LOCATION
Main Harness (XL): 2009 Sportster DOM. and INT. Models	Figure B-2
Indicator Lamps and Controls (XL): 2009 Sportster DOM. and INT. Models	Figure B-3
Starting and Charging: 2009 Sportster DOM. and INT. Models	Figure B-4
Engine Management (1 of 2) (XL): 2009 Sportster DOM. and INT. Models	Figure B-5
Engine Management (2 of 2) (XL): 2009 Sportster DOM. and INT. Models	Figure B-6
Lights (1 of 2) (XL): 2009 Sportster DOM. and INT. Models	Figure B-7
Lights (2 of 2) (XL): 2009 Sportster DOM. and INT. Models	Figure B-8
Horn and Instruments (XL): 2009 Sportster DOM. and INT. Models	Figure B-9
Security (1 of 2) (XL): 2009 Sportster DOM. and INT. Models	Figure B-10
Security (2 of 2) (XL): 2009 Sportster DOM. and INT. Models	Figure B-11
Main Harness (XR): 2009 Sportster DOM. and INT. Models	Figure B-12
Indicator Lamps and Controls (XR): 2009 Sportster DOM. and INT. Models	Figure B-13
Engine Management (1 of 2) (XR): 2009 Sportster DOM. and INT. Models	Figure B-14
Engine Management (2 of 2) (XR): 2009 Sportster DOM. and INT. Models	Figure B-15
Lights (1 of 2) (XR): 2009 Sportster DOM. and INT. Models	Figure B-16
Lights (2 of 2) (XR): 2009 Sportster DOM. and INT. Models	Figure B-17
Horn and Instruments (XR): 2009 Sportster DOM. and INT. Models	Figure B-18
Security (1 of 2) (XR): 2009 Sportster DOM. and INT. Models	Figure B-19
Security (2 of 2) (XR): 2009 Sportster DOM. and INT. Models	Figure B-20

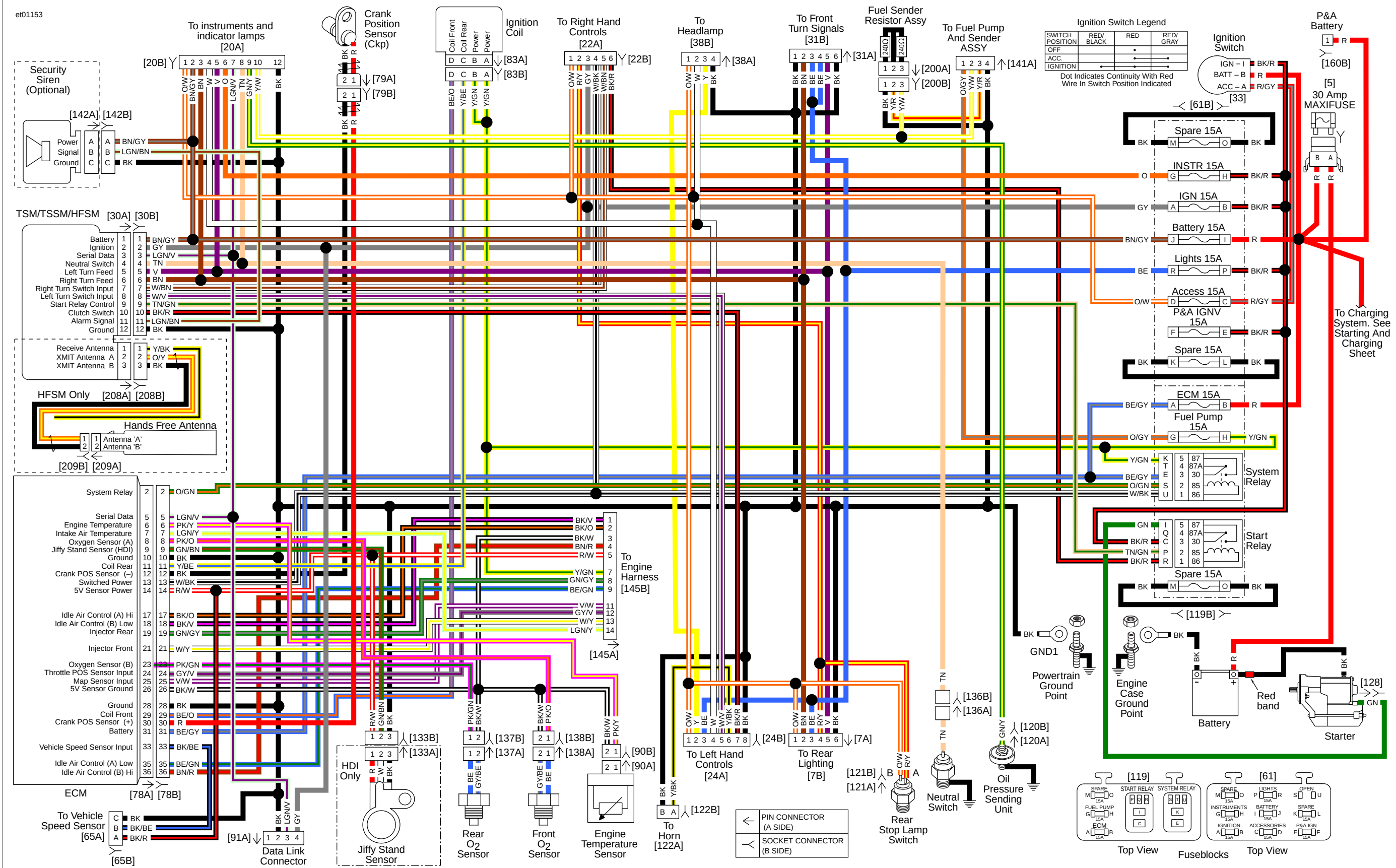


Figure B-2. Main Harness (XL): 2009 Sportster DOM and INT. Models

Figure B-2.

Main Harness (XL): 2009 Sportster DOM. and INT. Models

Figure B-2.

Main Harness (XL): 2009 Sportster DOM. and INT. Models

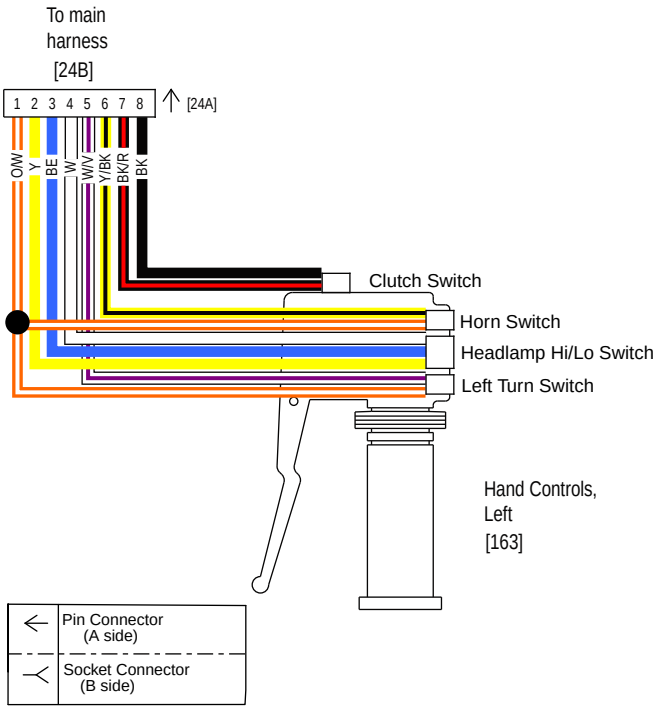
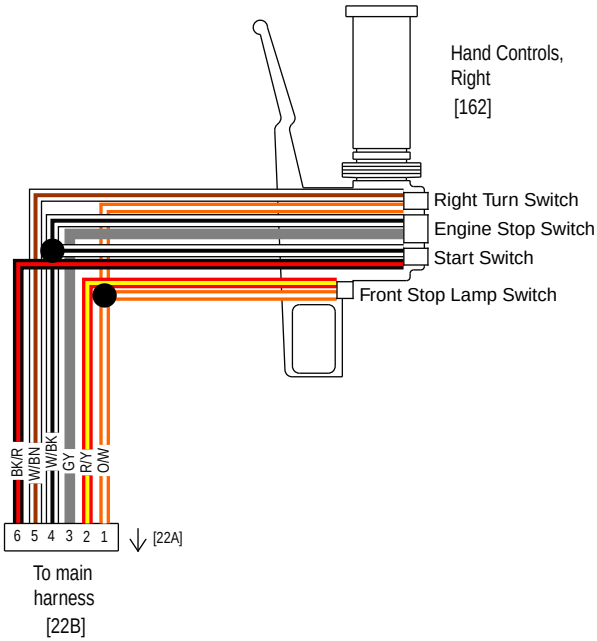
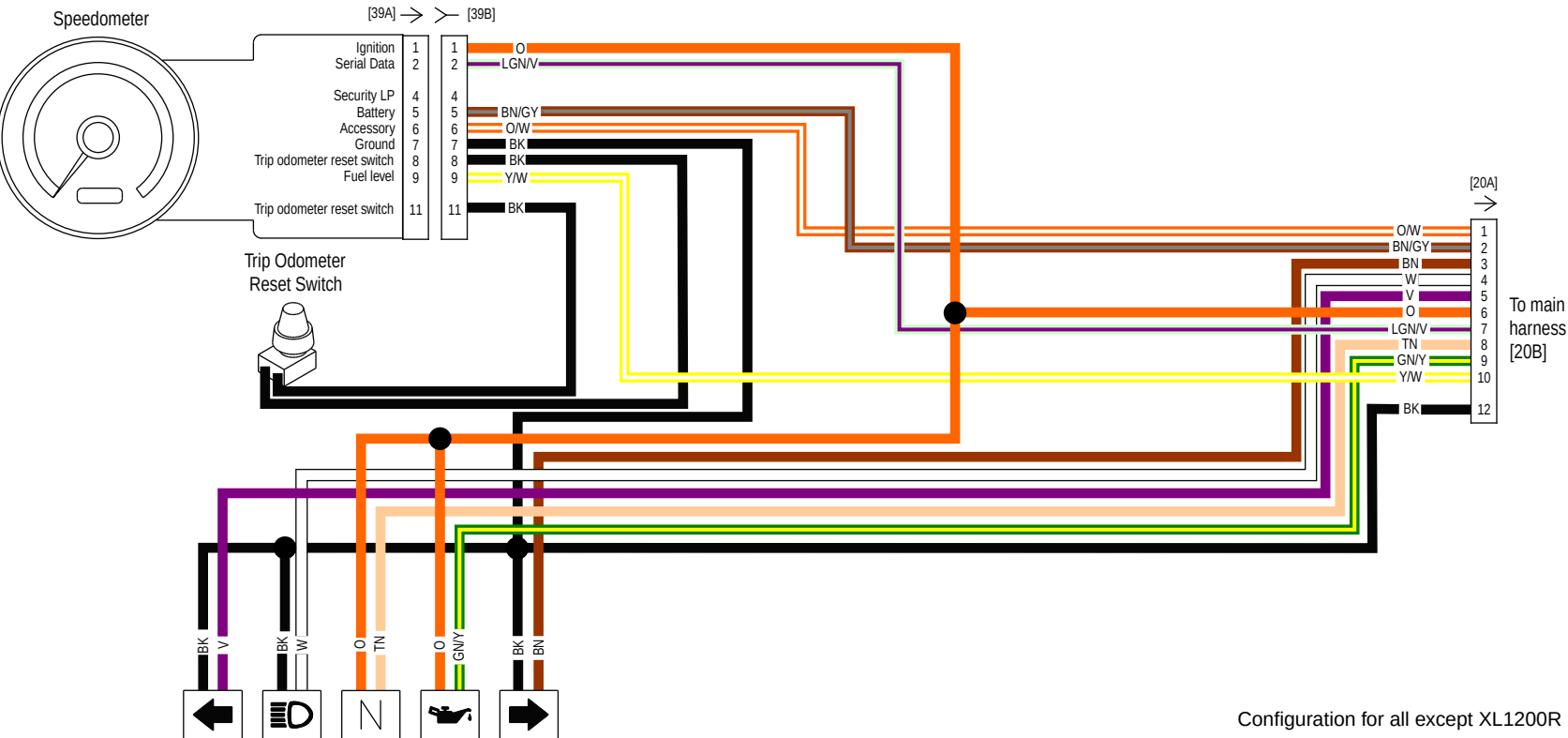
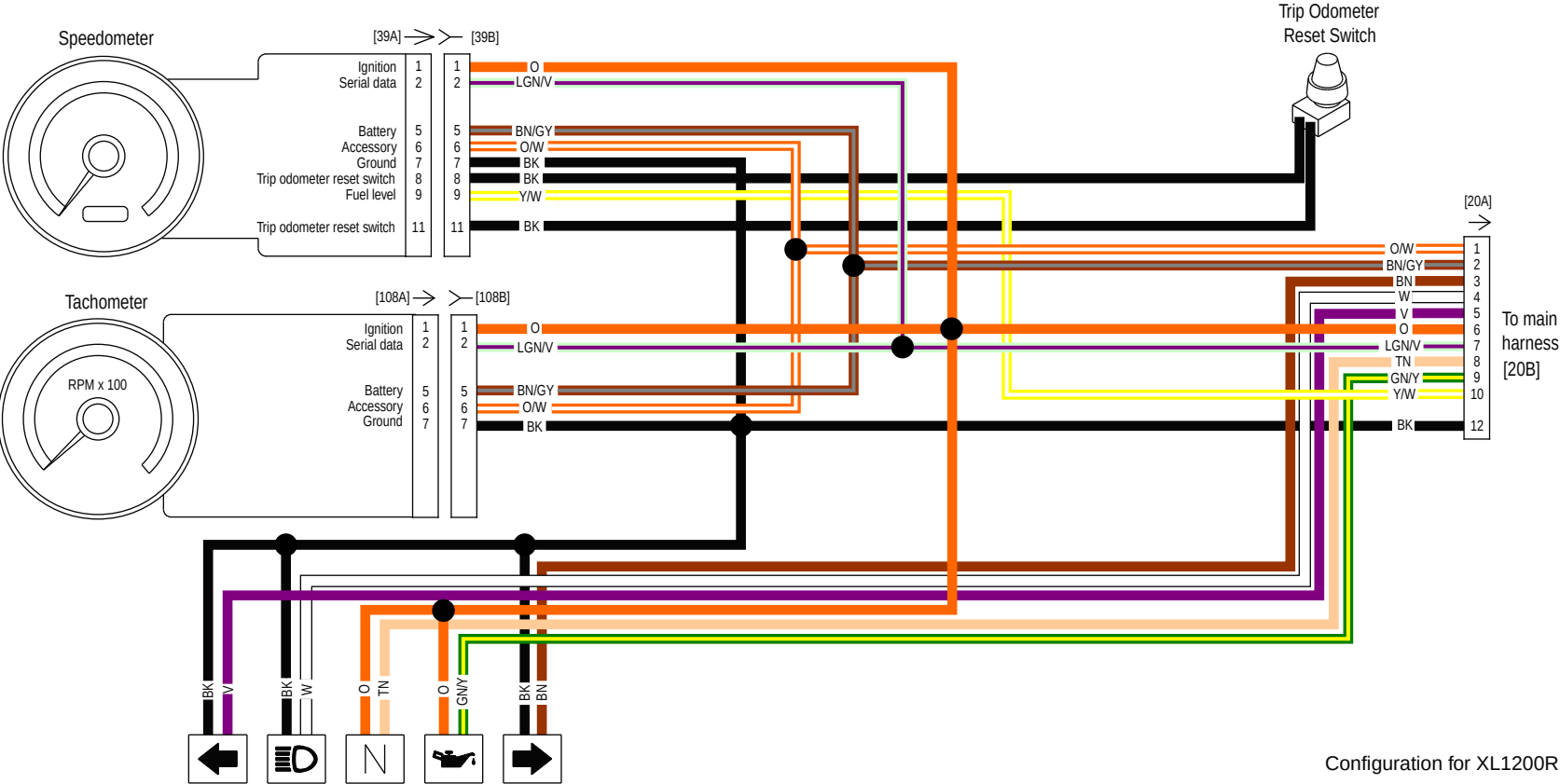


Figure B-3. Indicator Lamps and Controls (XL): 2009 Sportster DOM. and INT. Models

Figure B-3.
Indicator Lamps and Controls (XL): 2009 Sportster DOM.
and INT. Models

Figure B-3.
Indicator Lamps and Controls (XL): 2009 Sportster DOM.
and INT. Models

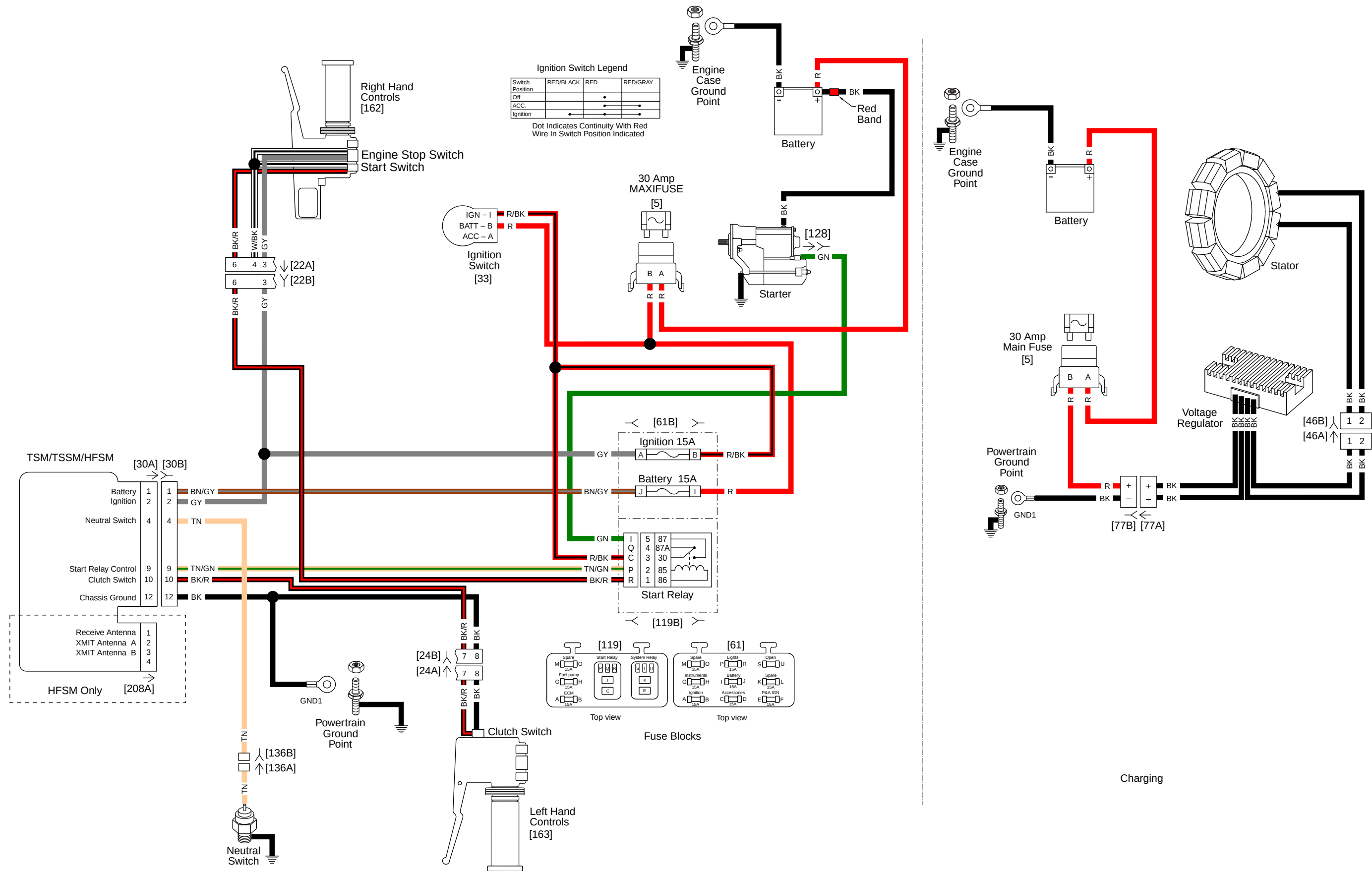


Figure B-4. Starting and Charging: 2009 Sportster DOM. and INT. Models

Figure B-4.
Starting and Charging: 2009 Sportster DOM. and INT. Models

Figure B-4.
Starting and Charging: 2009 Sportster DOM. and INT. Models

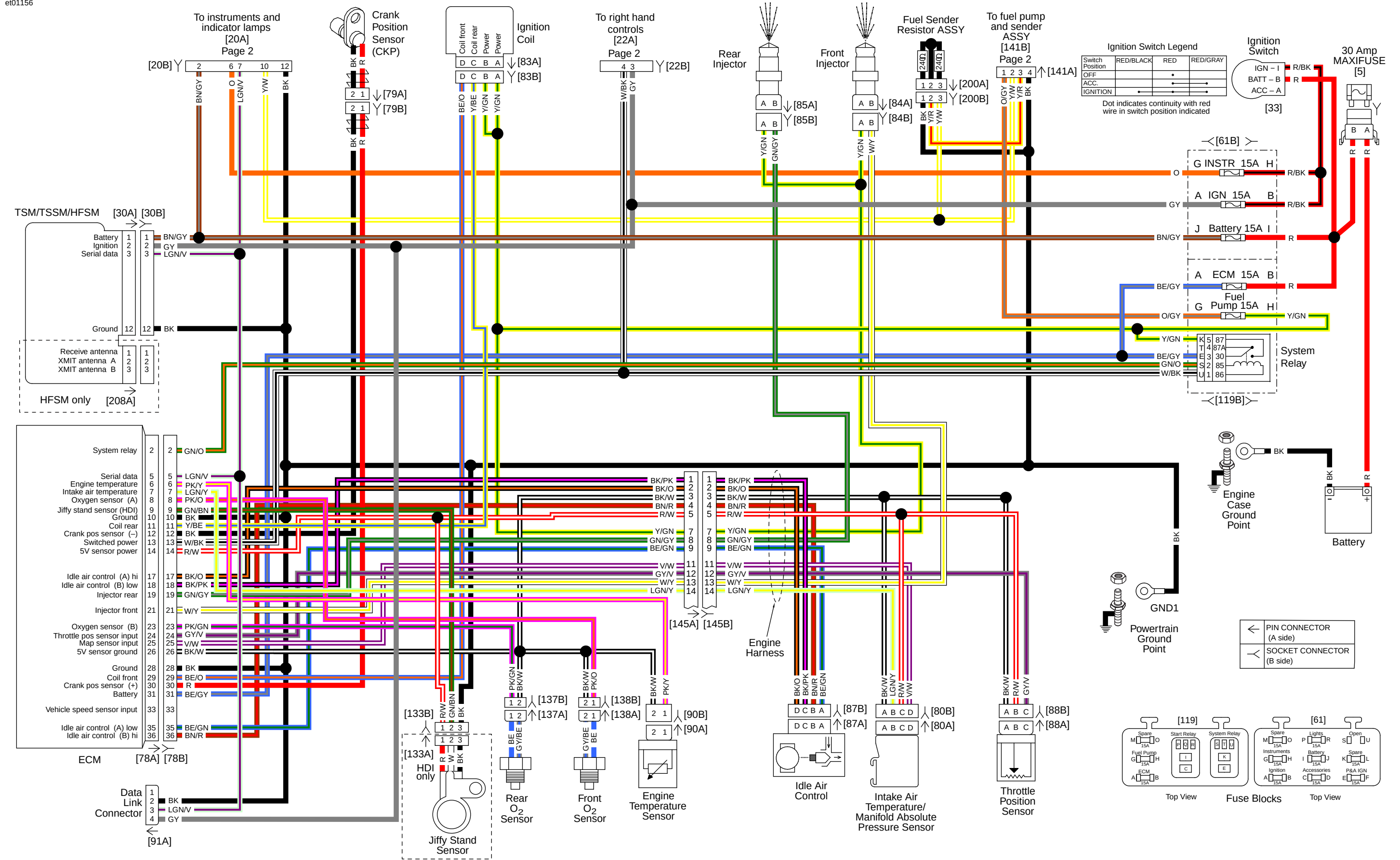
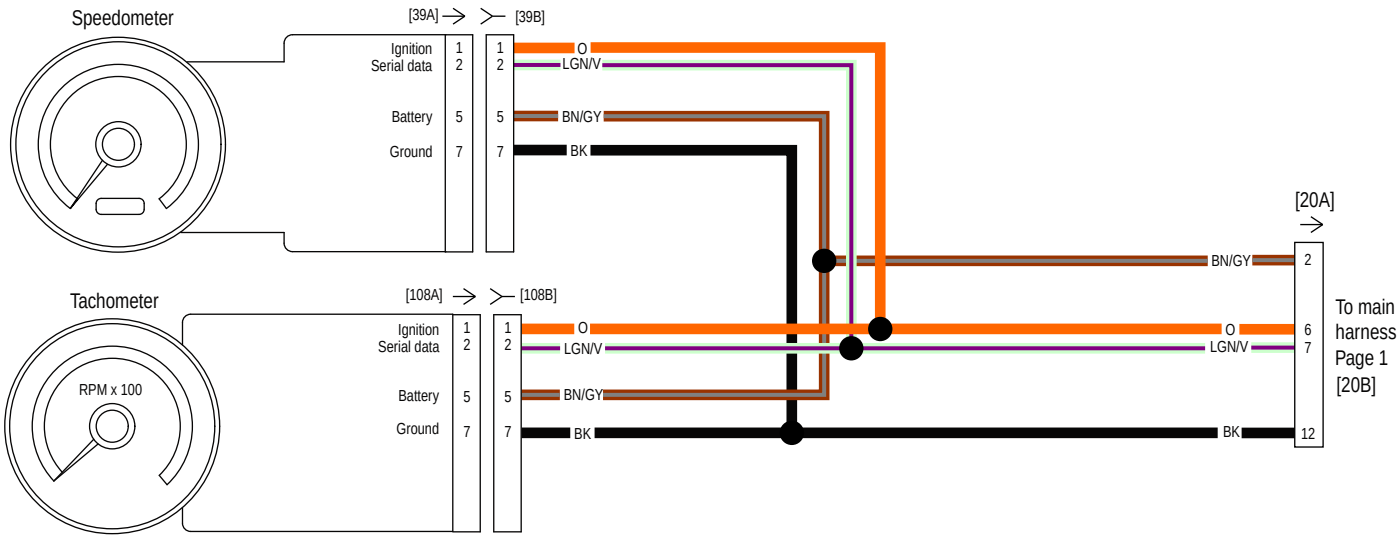


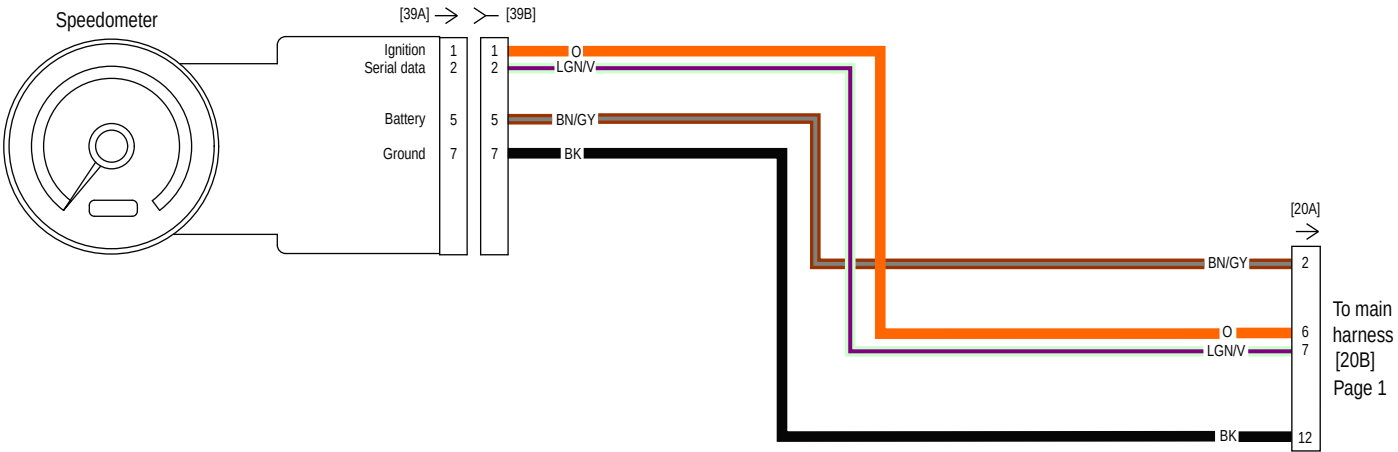
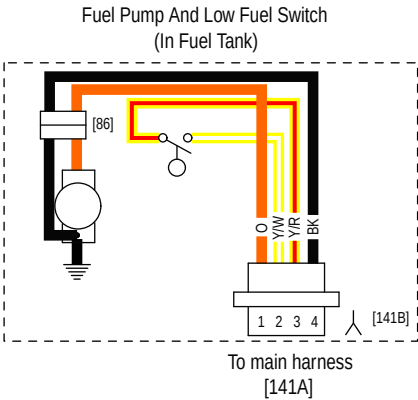
Figure B-5. Engine Management (1 of 2) (XL): 2009 Sportster DOM and INT Models

Figure B-5.
Engine Management (1 of 2) (XL): 2009 Sportster DOM. and
INT. Models

Figure B-5.
Engine Management (1 of 2) (XL): 2009 Sportster DOM. and
INT. Models



Configuration for XL1200R



←	Pin connector (A side)
↗	Socket connector (B side)

Configuration for all except XL1200R

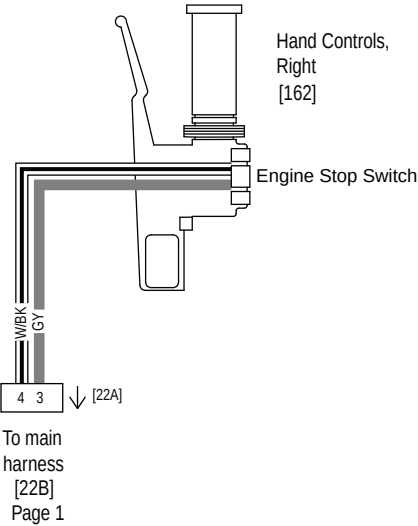


Figure B-6. Engine Management (2 of 2) (XL): 2009 Sportster DOM. and INT. Models

Figure B-6.
Engine Management (2 of 2) (XL): 2009 Sportster DOM. and
INT. Models

Figure B-6.
Engine Management (2 of 2) (XL): 2009 Sportster DOM. and
INT. Models

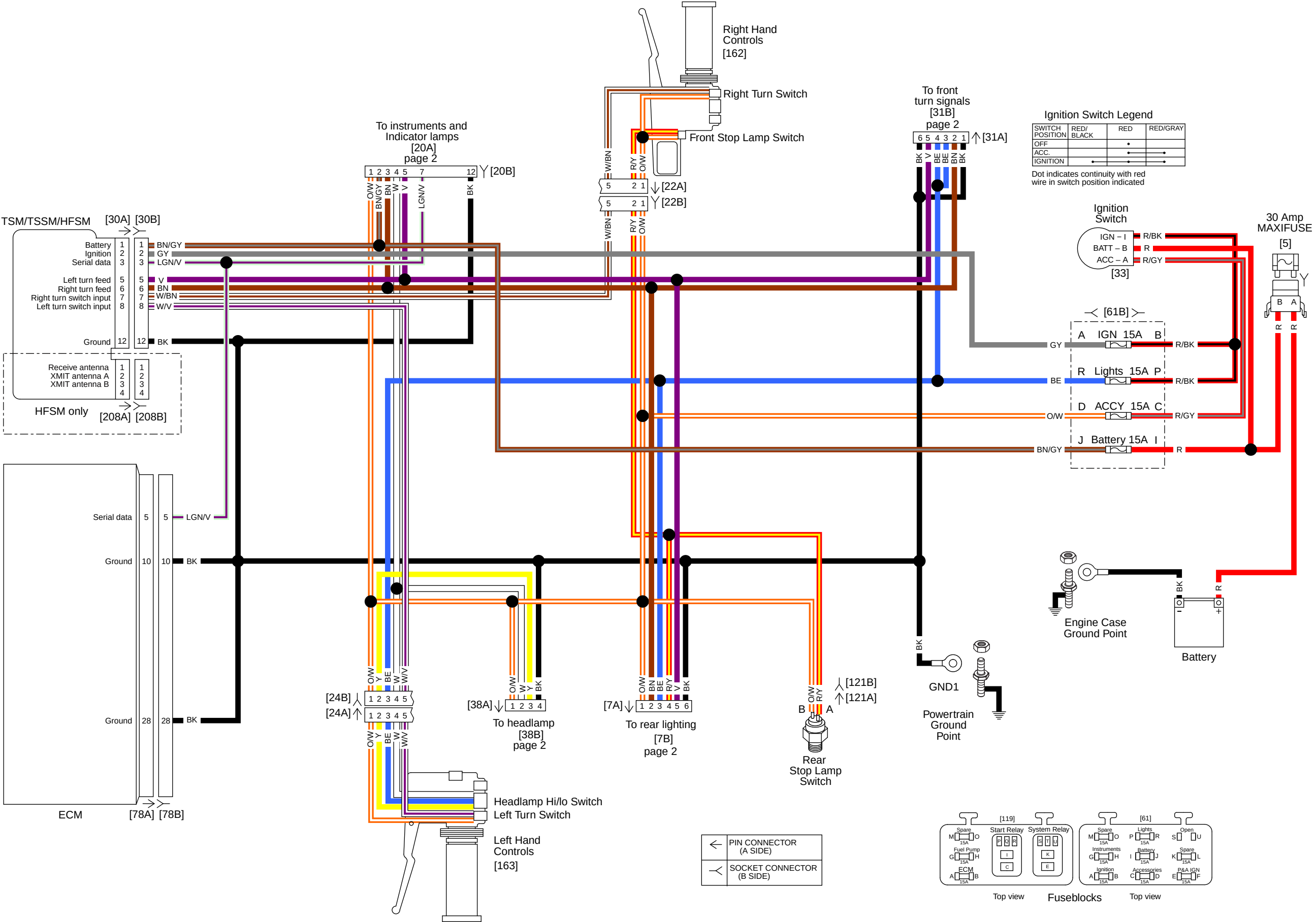


Figure B-7. Lights (1 of 2) (XL): 2009 Sportster DOM. and INT. Models

Figure B-7.

Lights (1 of 2) (XL): 2009 Sportster DOM. and INT. Models

Figure B-7.

Lights (1 of 2) (XL): 2009 Sportster DOM. and INT. Models

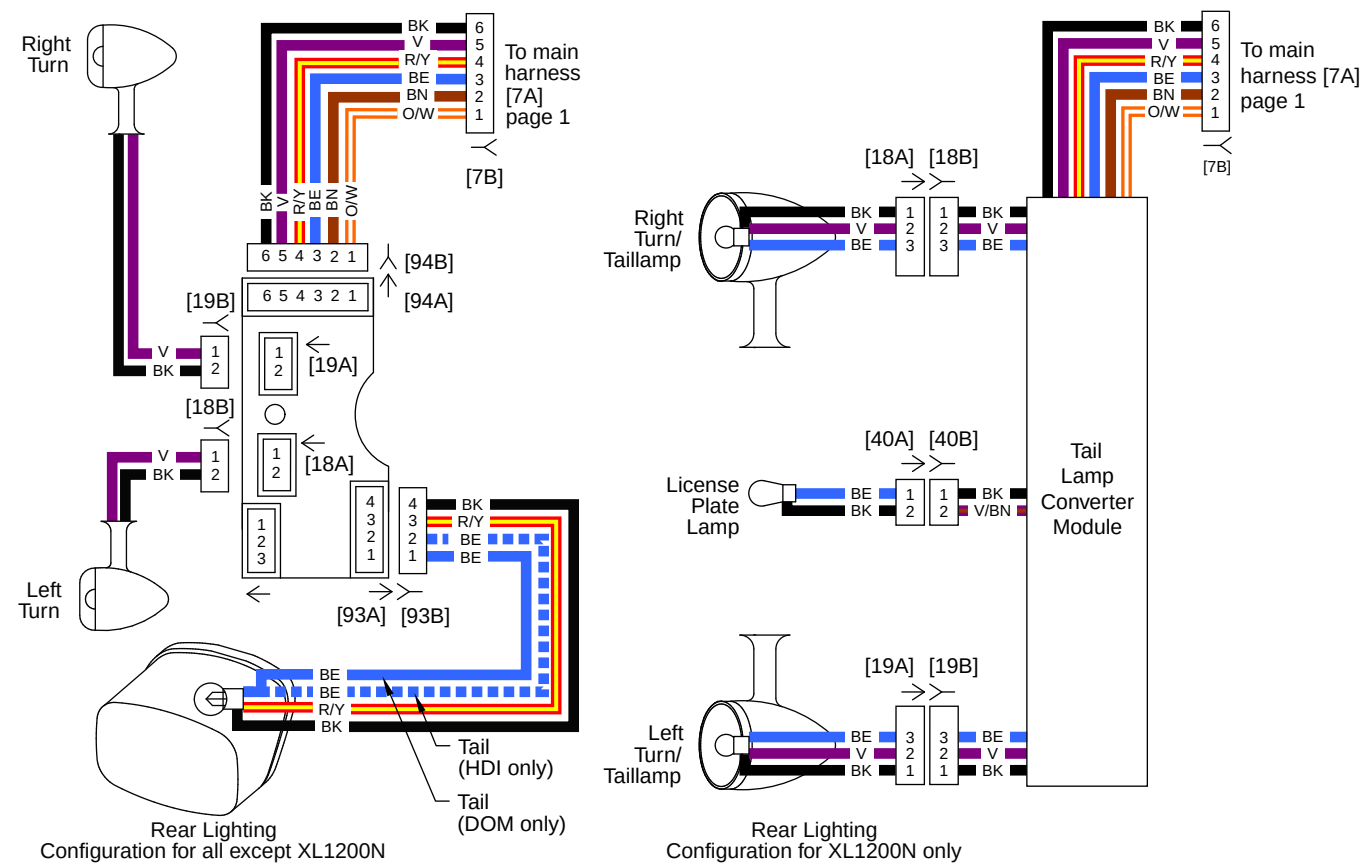
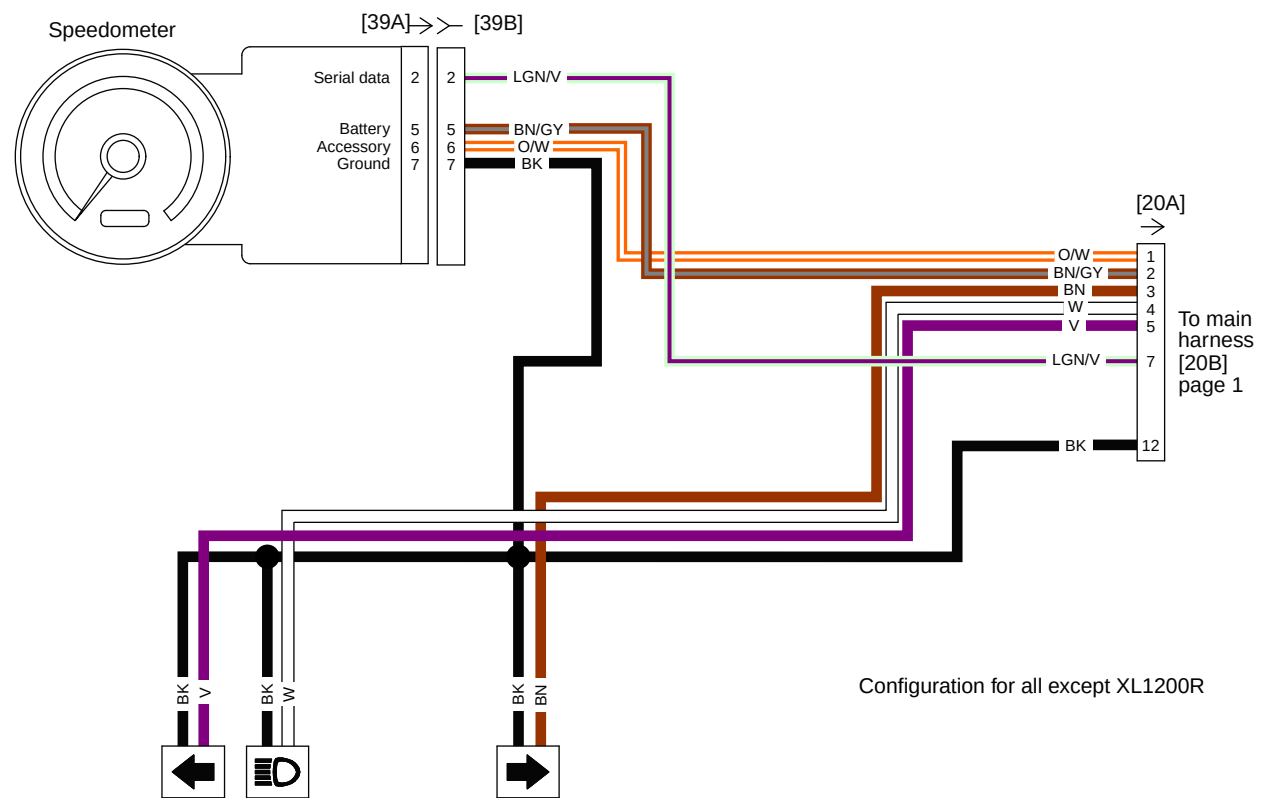
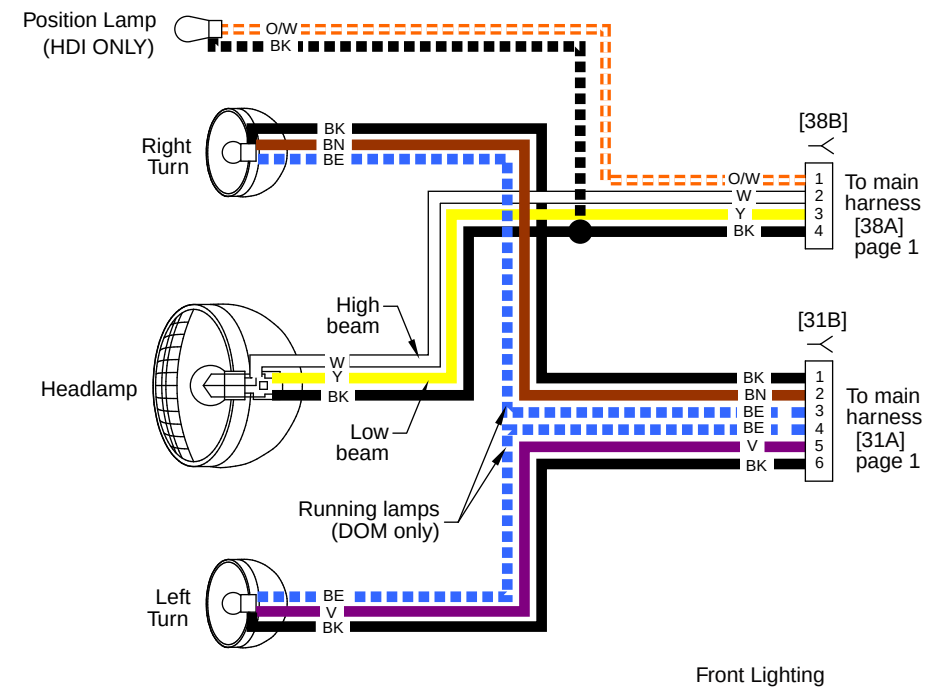
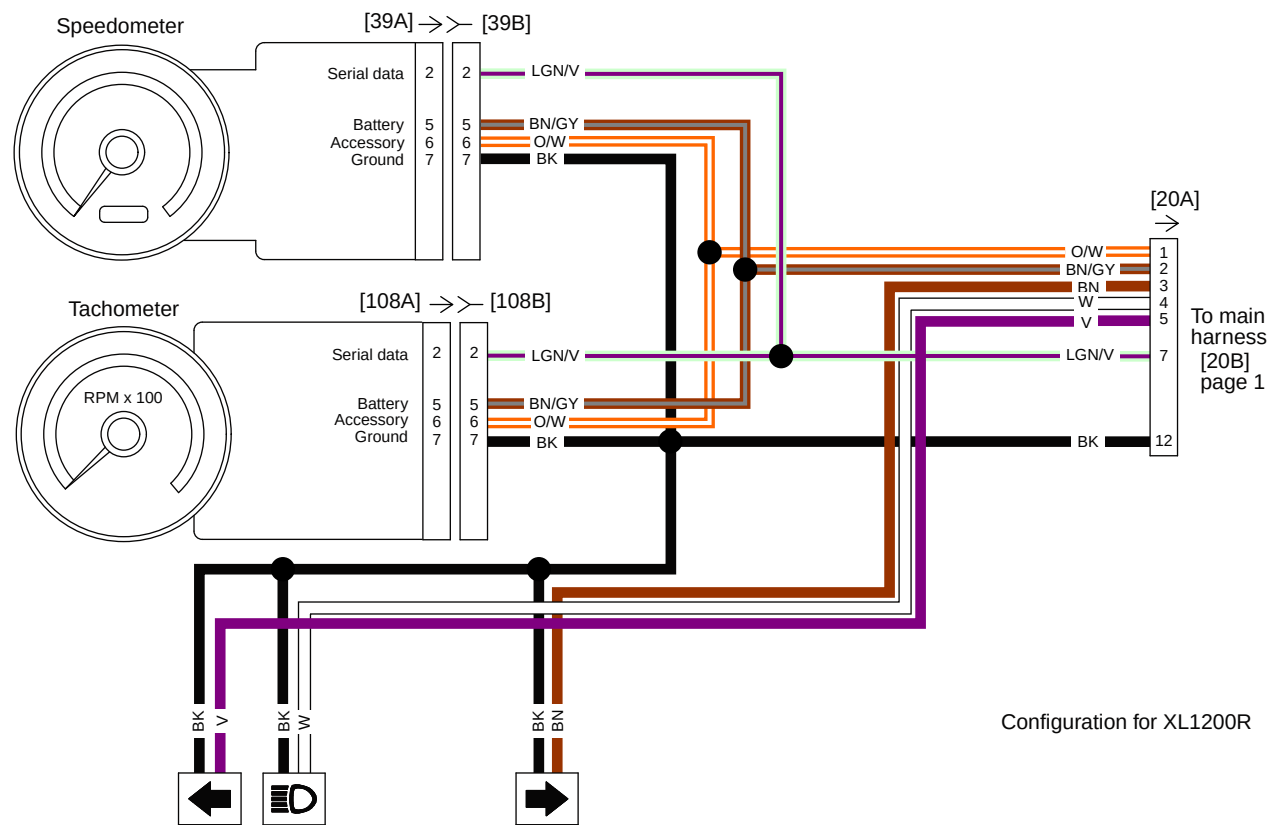


Figure B-8. Lights (2 of 2) (XL): 2009 Sportster DOM. and INT. Models

Figure B-8.

Lights (2 of 2) (XL): 2009 Sportster DOM. and INT. Models

Figure B-8.

Lights (2 of 2) (XL): 2009 Sportster DOM. and INT. Models

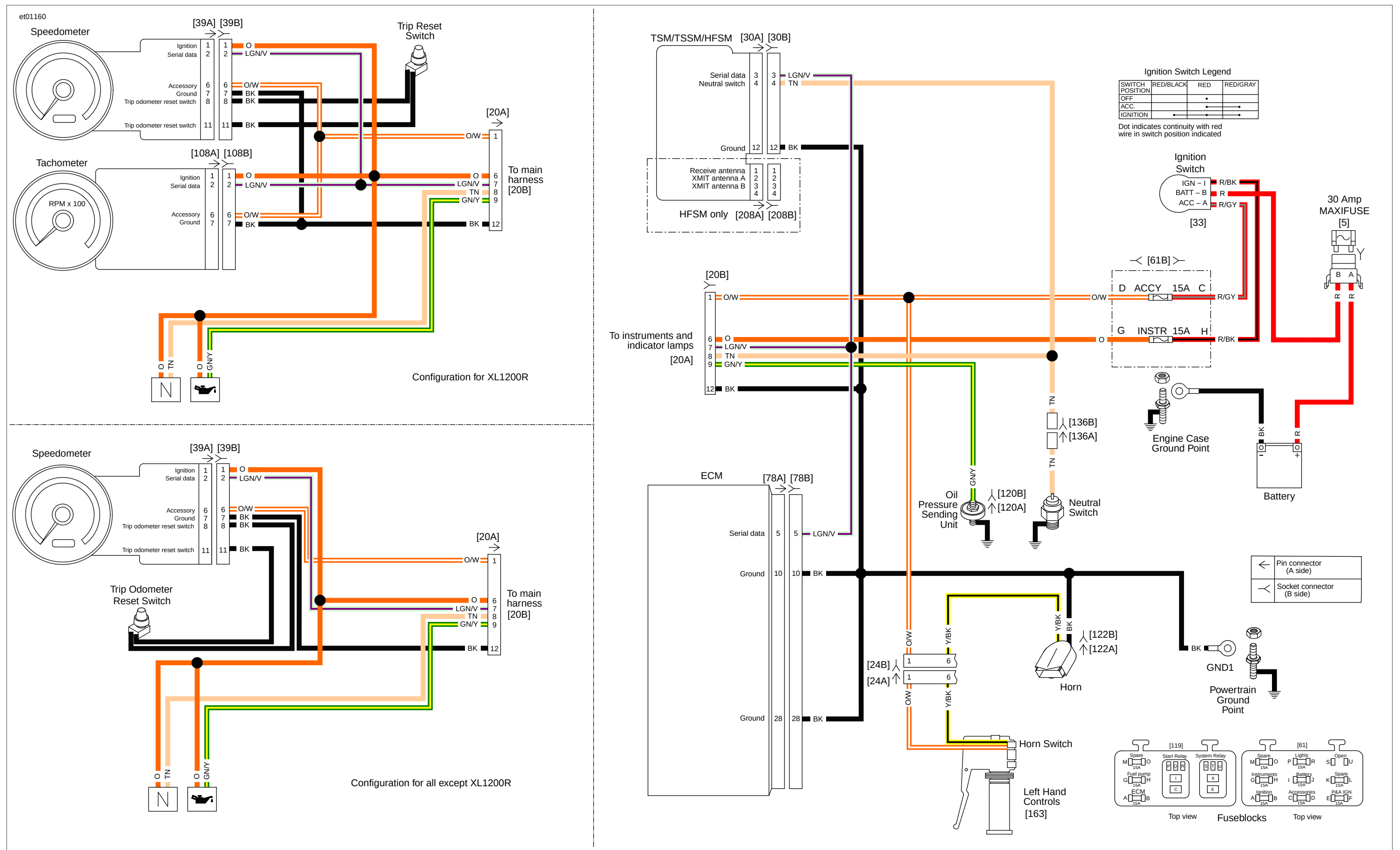


Figure B-9. Horn and Instruments (XL): 2009 Sportster DOM. and INT. Models

Figure B-9.
Horn and Instruments (XL): 2009 Sportster DOM. and INT.
Models

Figure B-9.
Horn and Instruments (XL): 2009 Sportster DOM. and INT.
Models

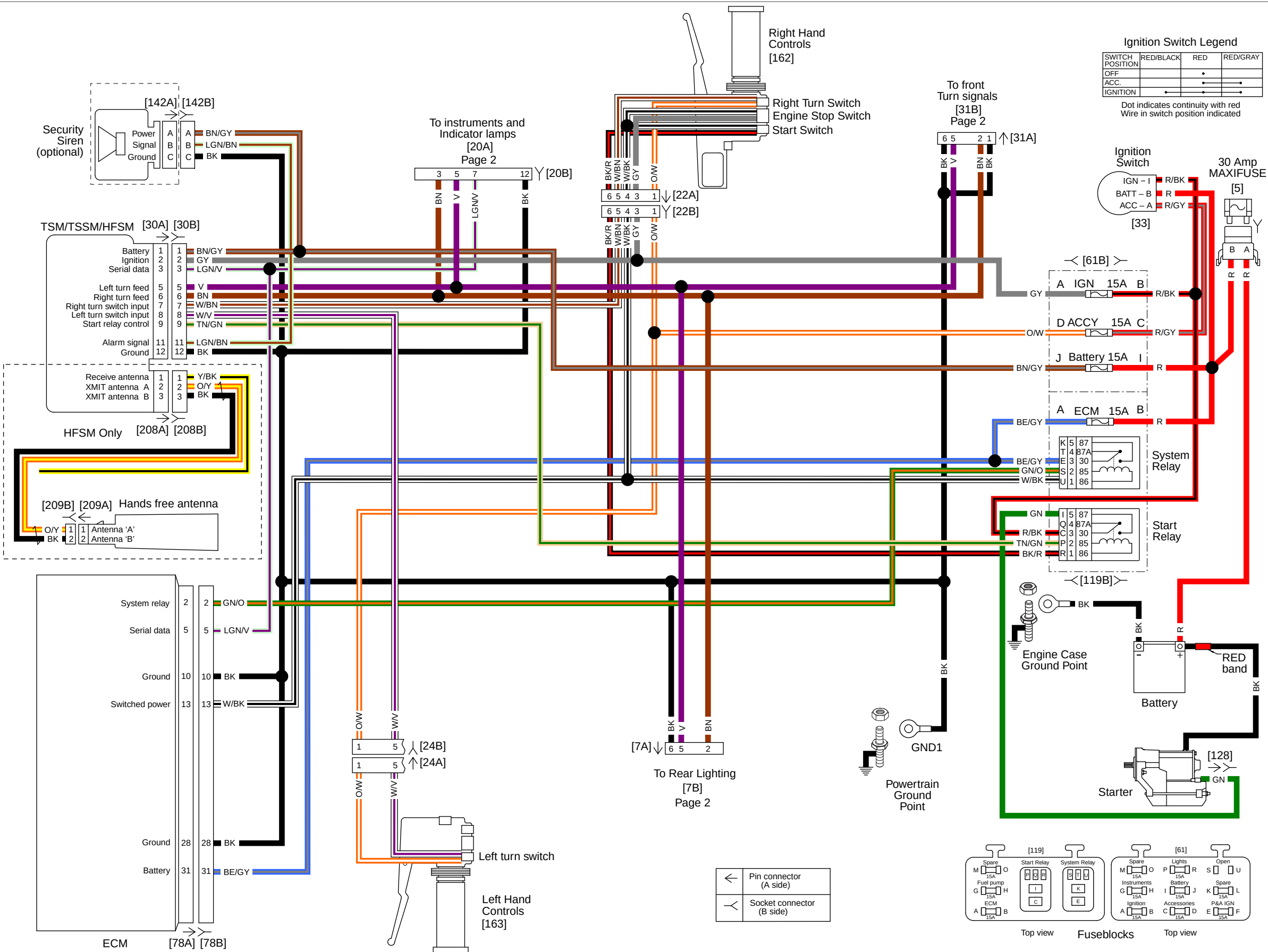


Figure B-10. Security (1 of 2) (XL): 2009 Sportster DOM and INT Models

Figure B-10.

Security (1 of 2) (XL): 2009 Sportster DOM. and INT. Models

Figure B-10.

Security (1 of 2) (XL): 2009 Sportster DOM. and INT. Models

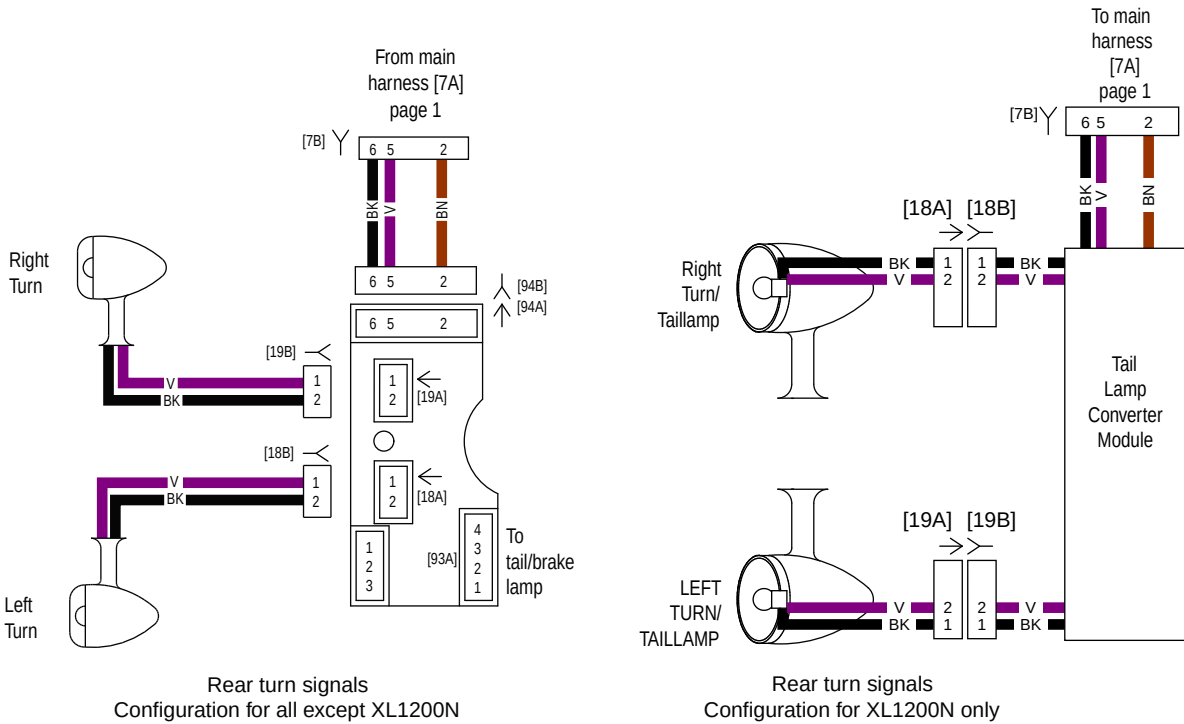
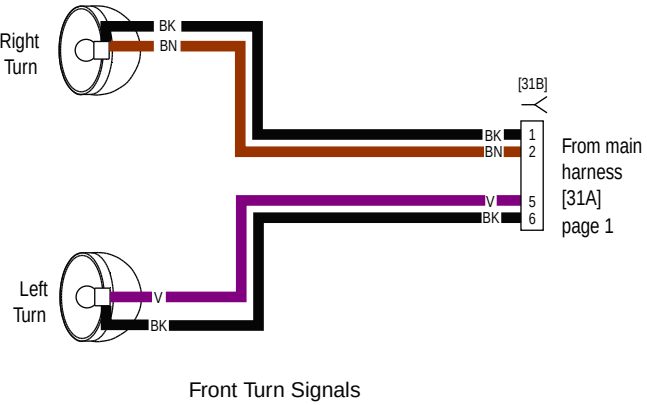
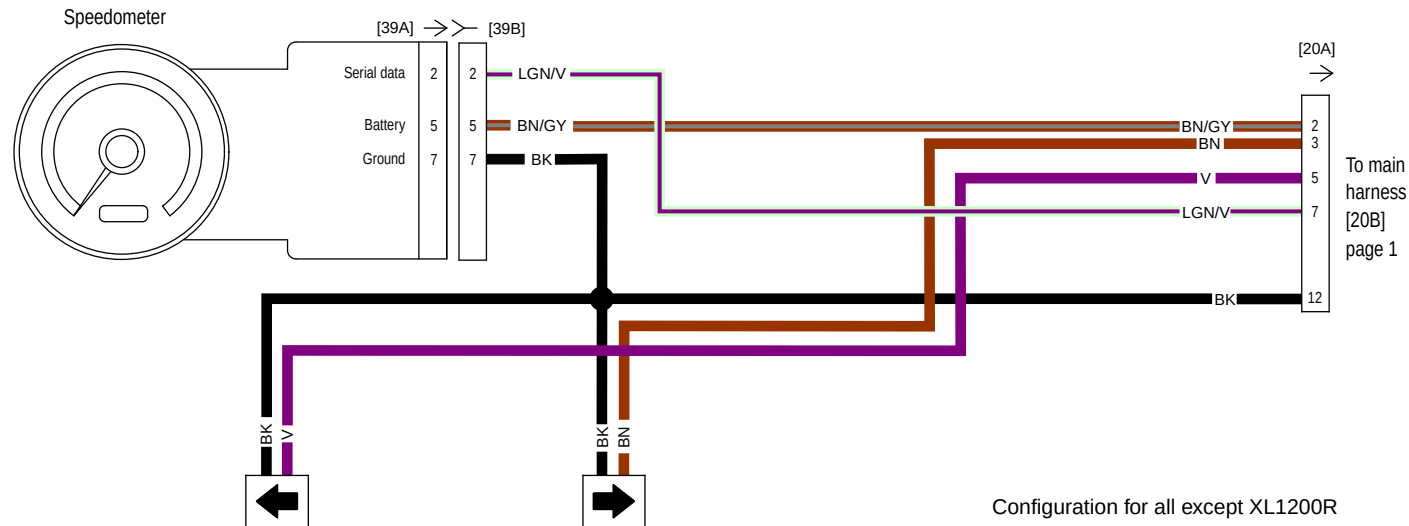
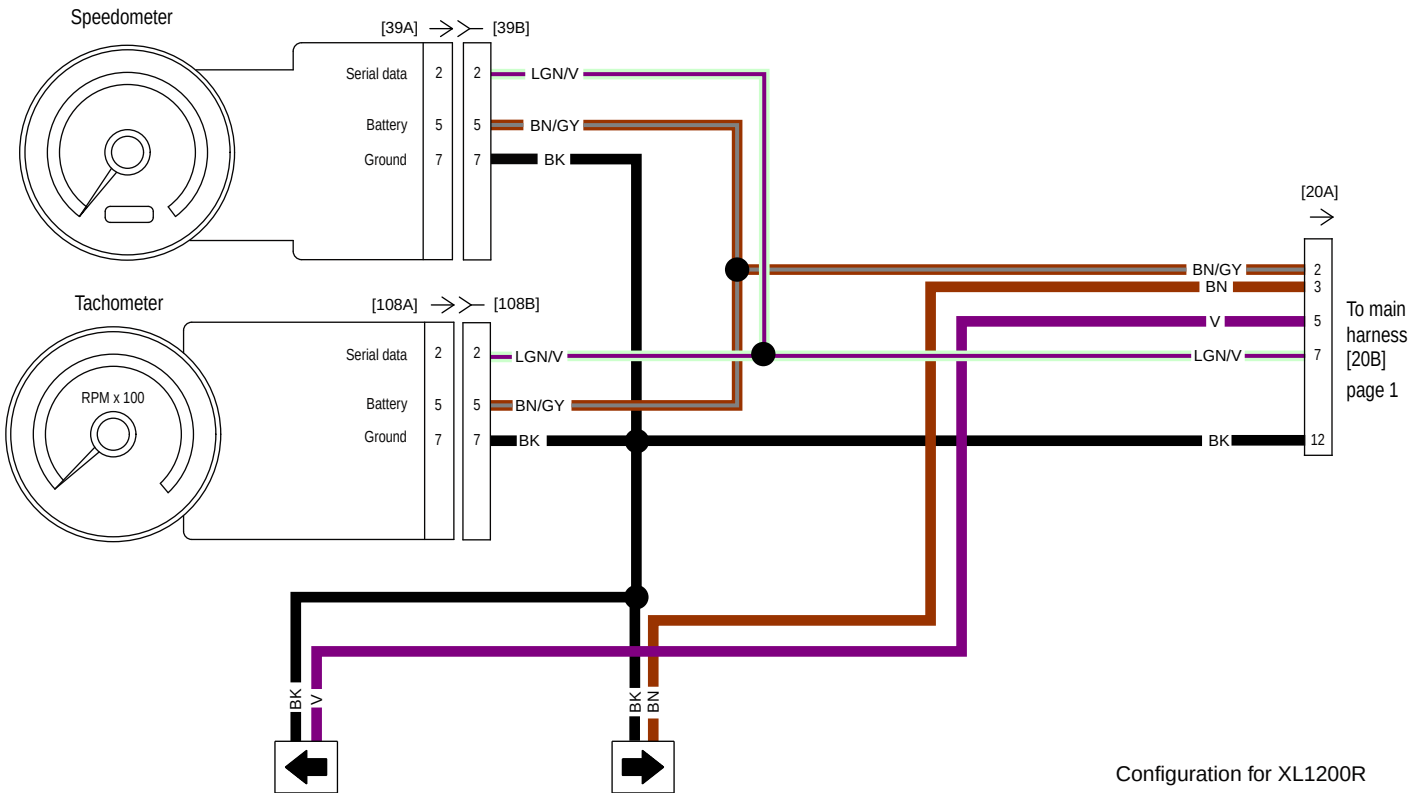


Figure B-11. Security (2 of 2) (XL): 2009 Sportster DOM. and INT. Models

Figure B-11.

Security (2 of 2) (XL): 2009 Sportster DOM. and INT. Models

Figure B-11.

Security (2 of 2) (XL): 2009 Sportster DOM. and INT. Models

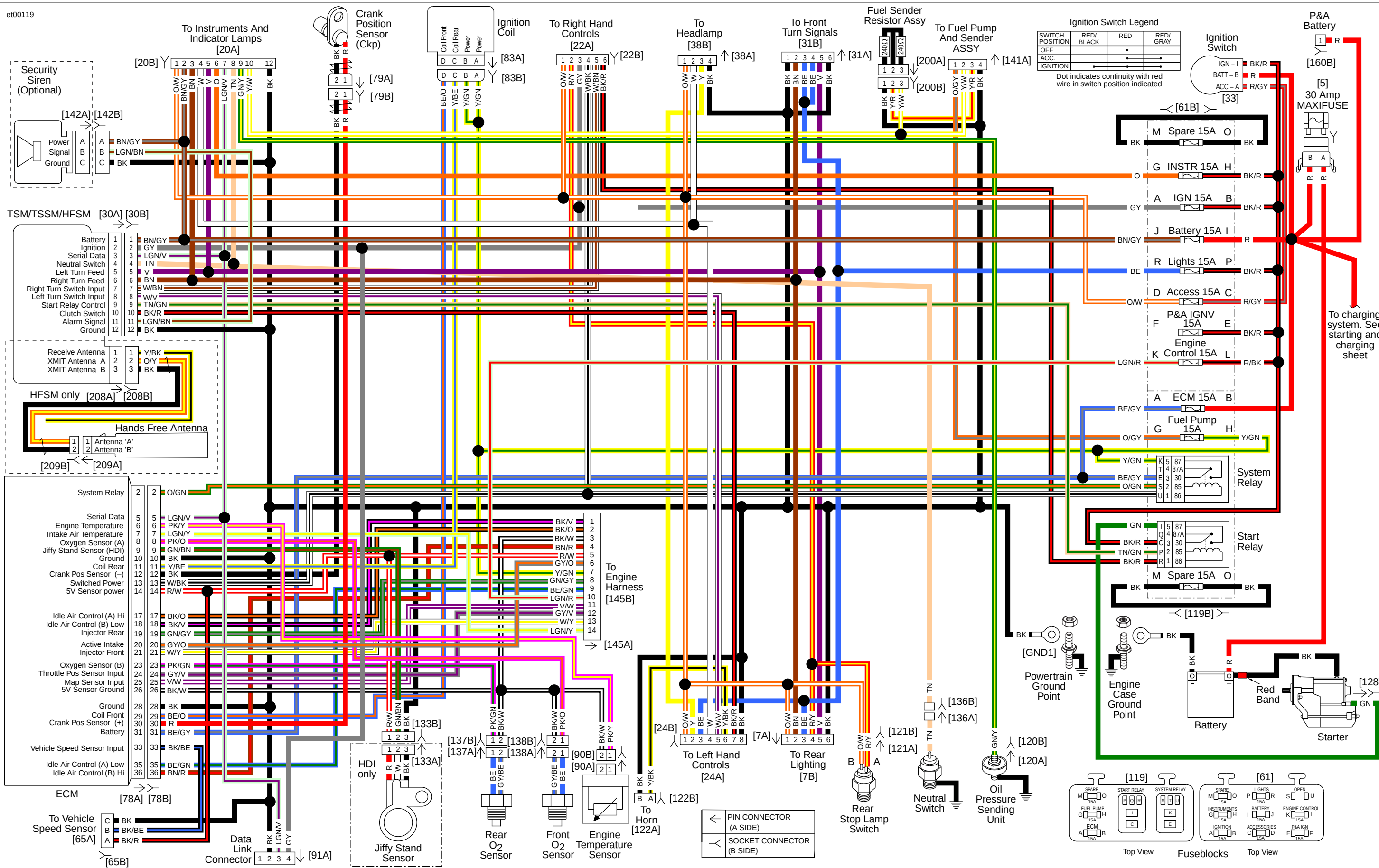


Figure B-12. Main Harness (XR): 2009 Sportster DOM. and INT. Models

Figure B-12.

Main Harness (XR): 2009 Sportster DOM. and INT. Models

Figure B-12.

Main Harness (XR): 2009 Sportster DOM. and INT. Models

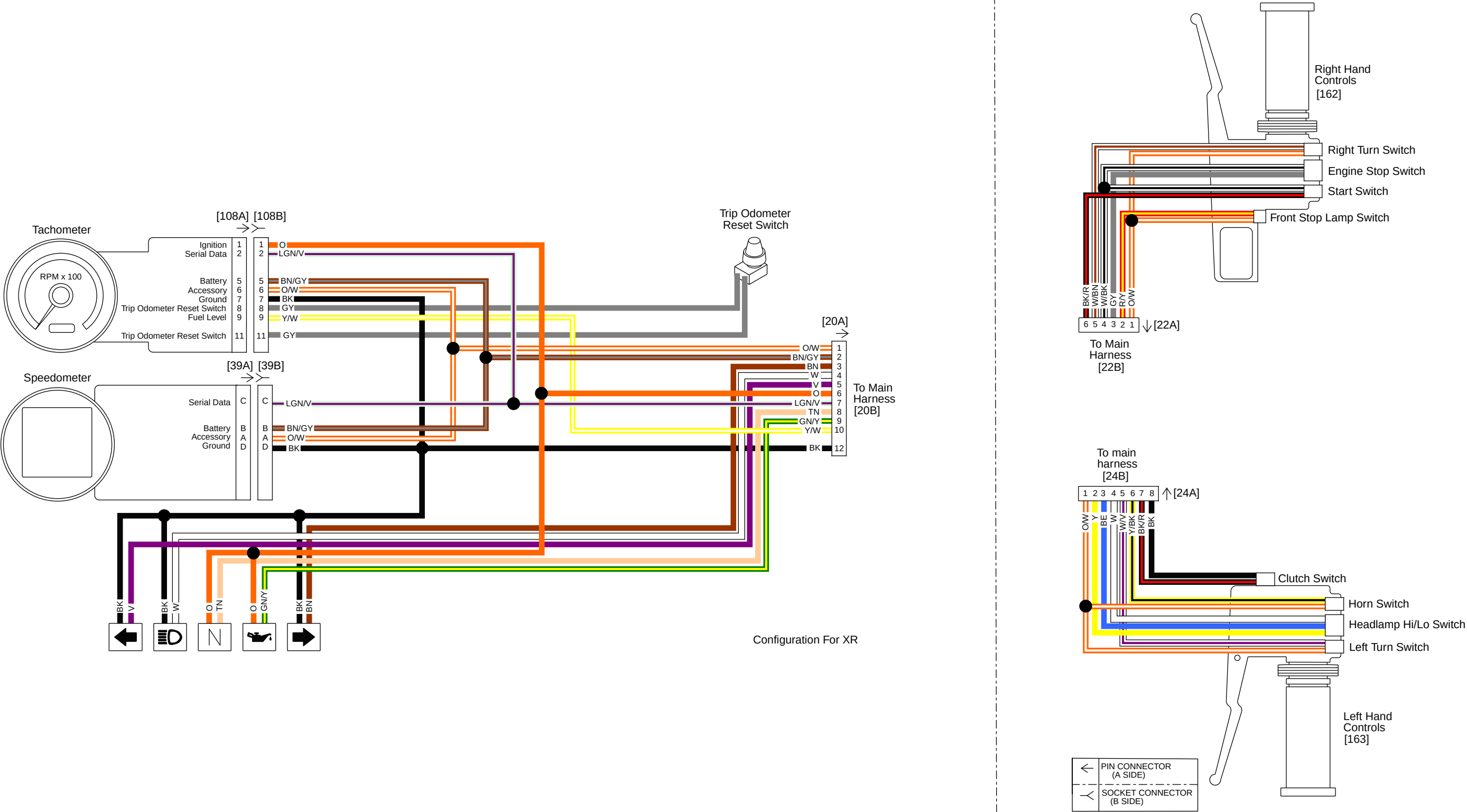


Figure B-13. Indicator Lamps and Controls (XR): 2009 Sportster DOM. and INT. Models

Figure B-13.
Indicator Lamps and Controls (XR): 2009 Sportster DOM.
and INT. Models

Figure B-13.
Indicator Lamps and Controls (XR): 2009 Sportster DOM.
and INT. Models

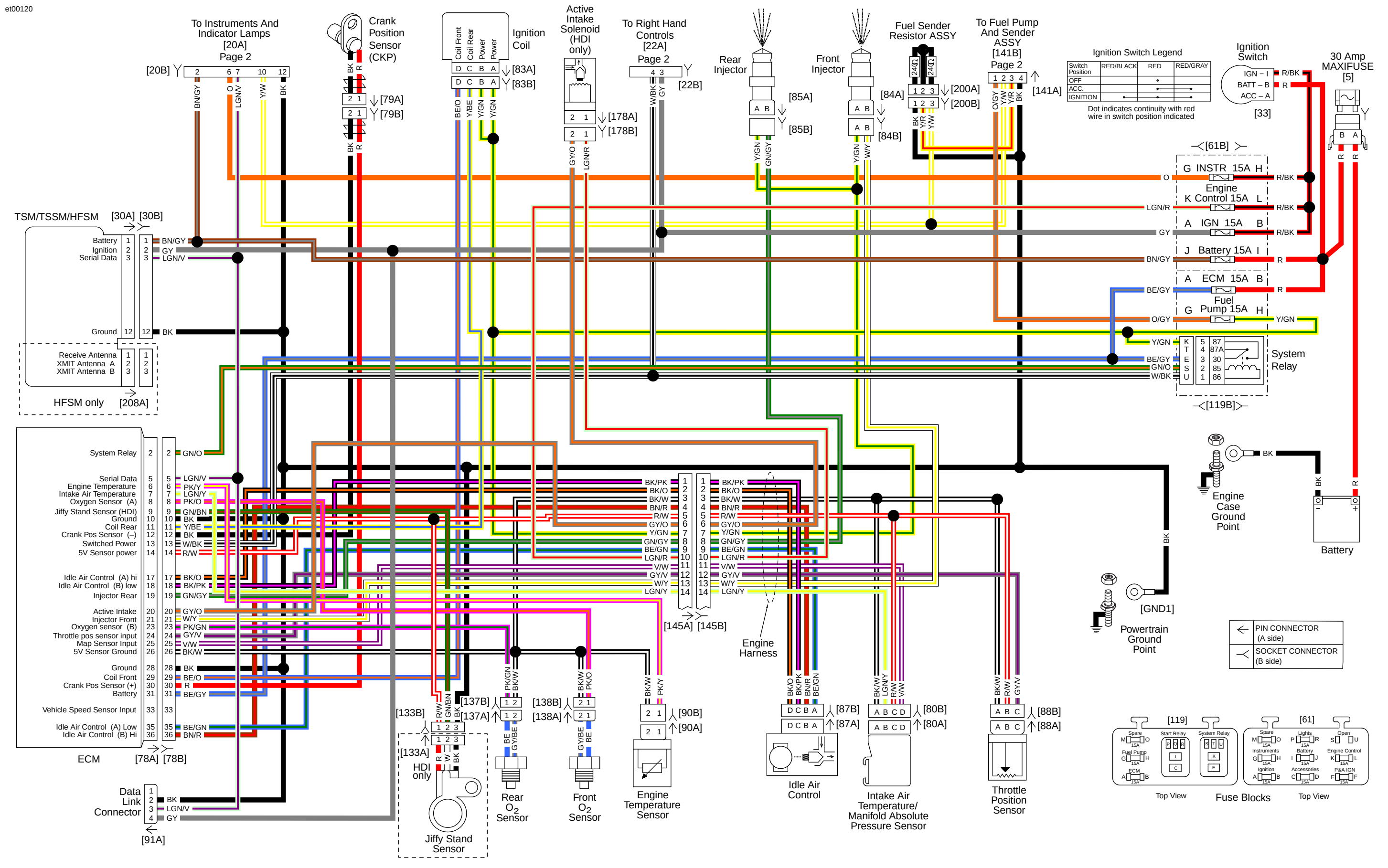
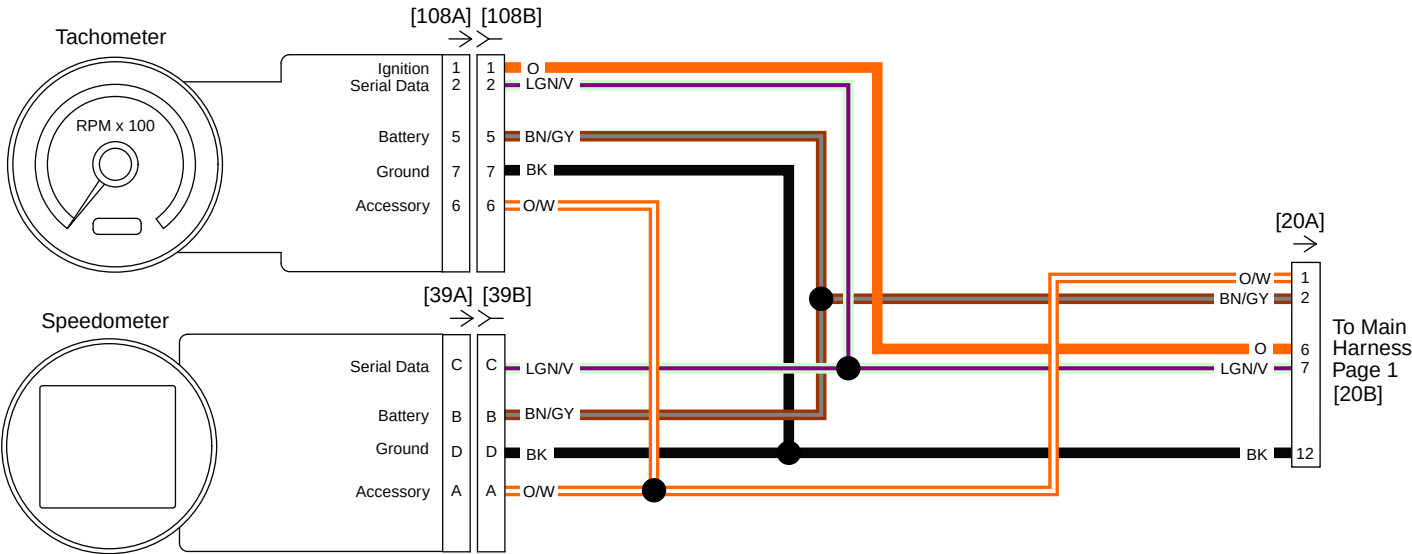


Figure B-14. Engine Management (1 of 2) (XR): 2009 Sportster DOM. and INT. Models

Figure B-14.
Engine Management (1 of 2) (XR): 2009 Sportster DOM. and
INT. Models

Figure B-14.
Engine Management (1 of 2) (XR): 2009 Sportster DOM. and
INT. Models



Configuration For XR

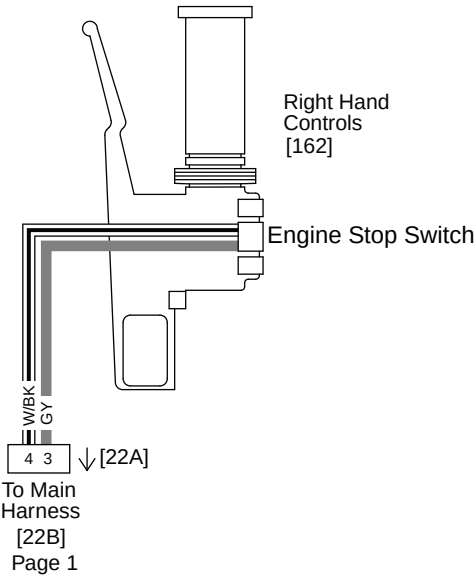
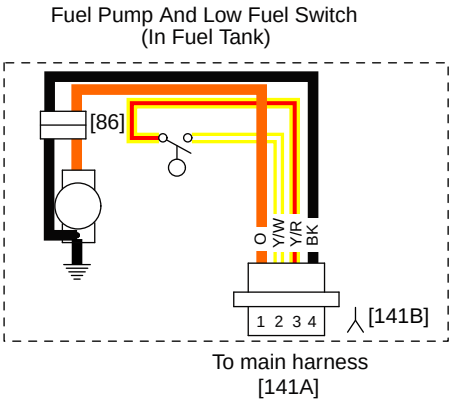


Figure B-15. Engine Management (2 of 2) (XR): 2009 Sportster DOM. and INT. Models

Figure B-15.
Engine Management (2 of 2) (XR): 2009 Sportster DOM. and
INT. Models

Figure B-15.
Engine Management (2 of 2) (XR): 2009 Sportster DOM. and
INT. Models

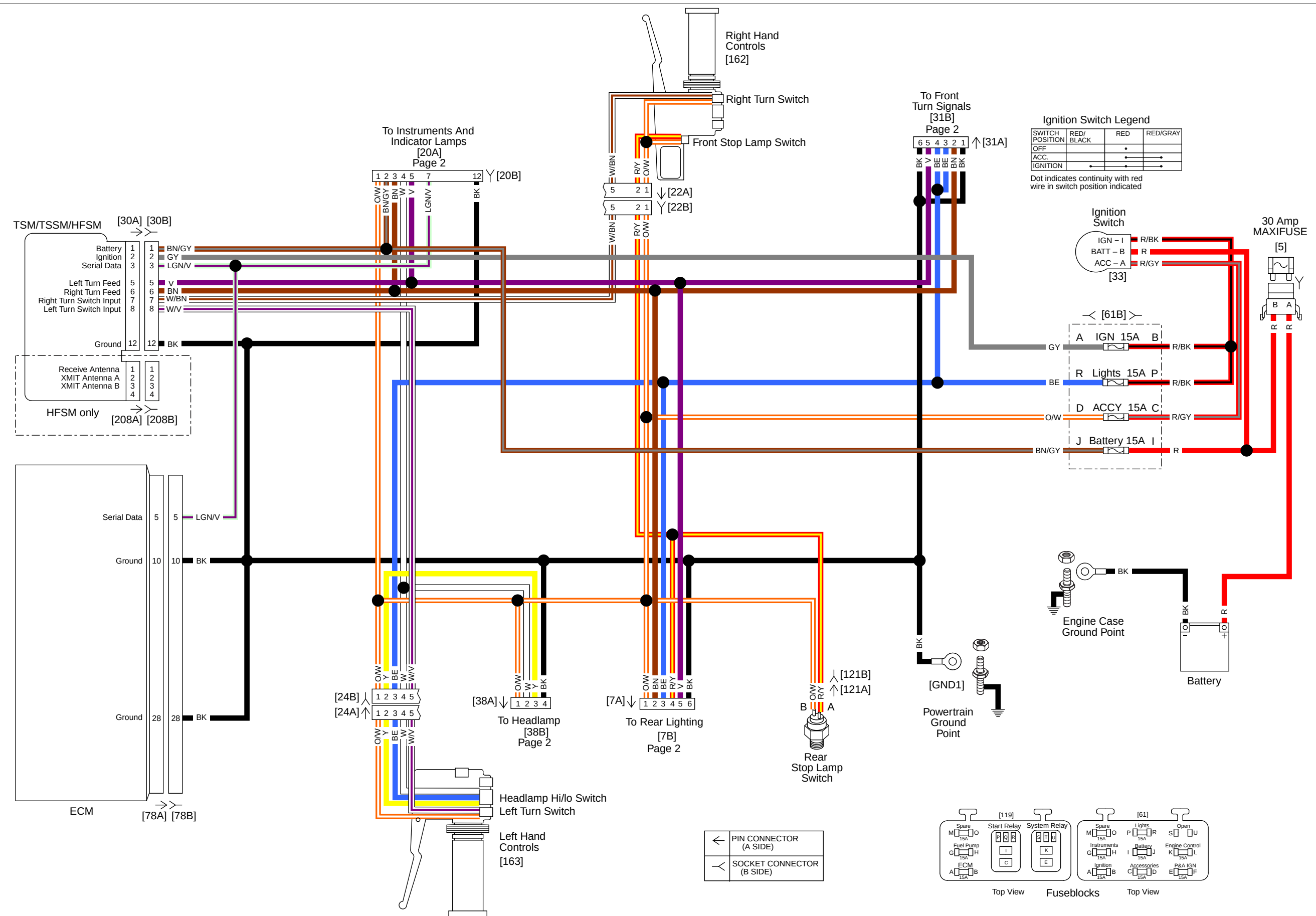


Figure B-16. Lights (1 of 2) (XR): 2009 Sportster DOM. and INT. Models

Figure B-16.

Lights (1 of 2) (XR): 2009 Sportster DOM. and INT. Models

Figure B-16.

Lights (1 of 2) (XR): 2009 Sportster DOM. and INT. Models

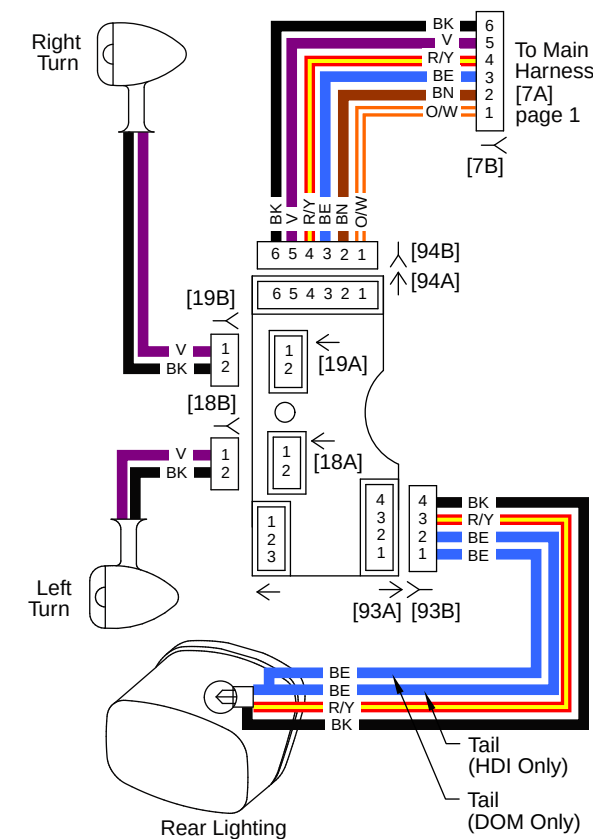
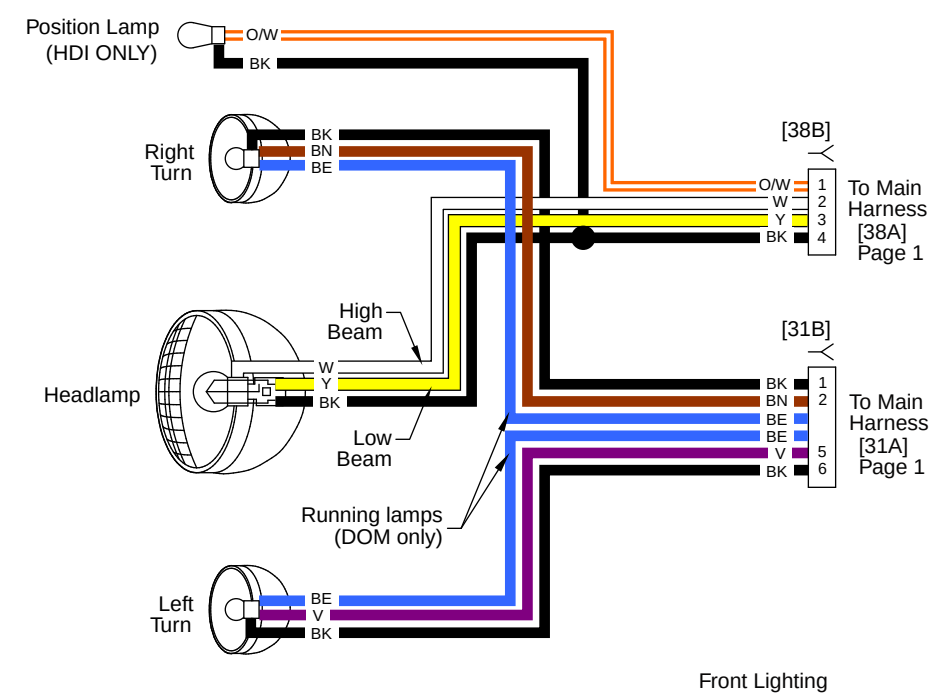
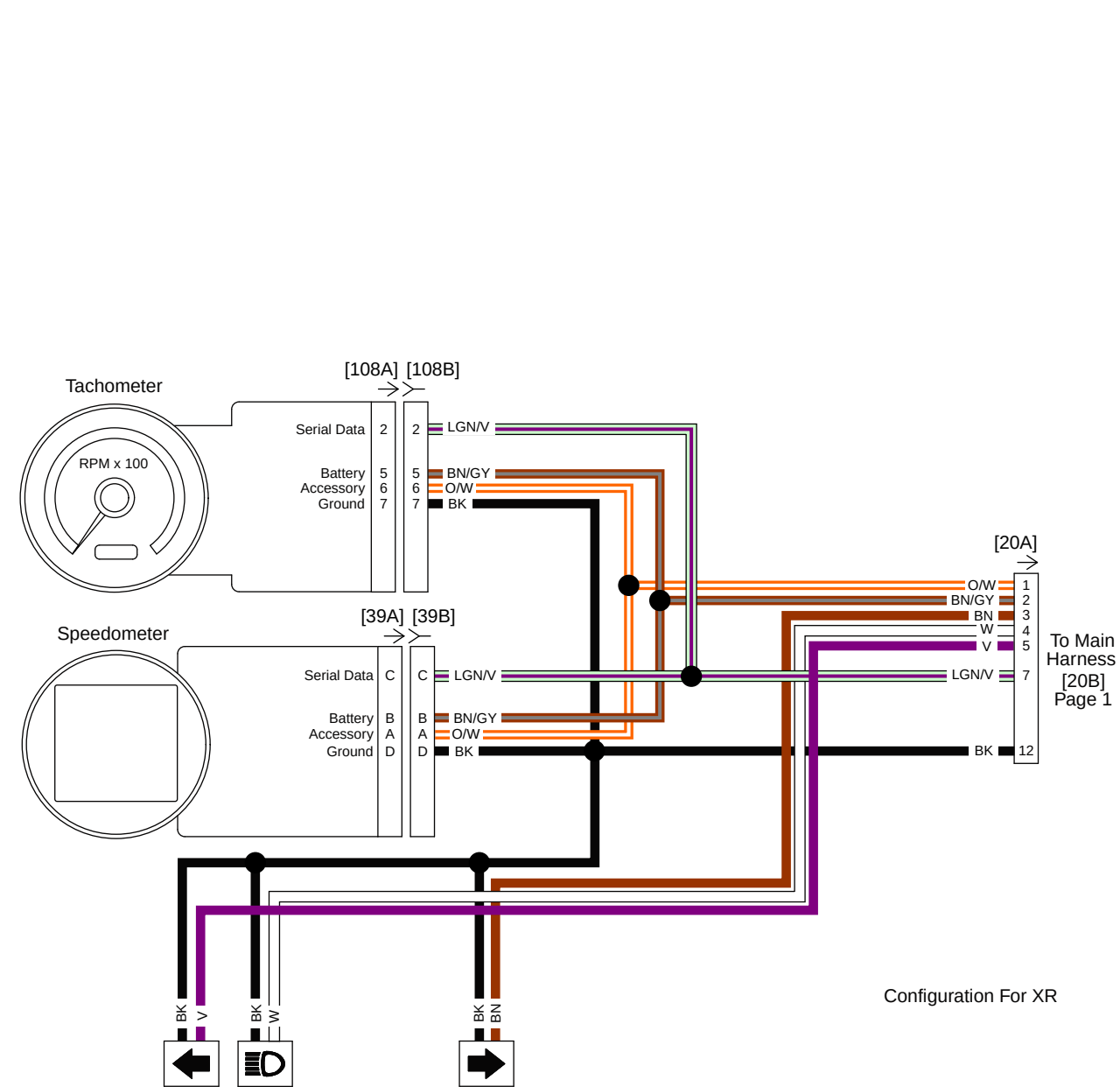


Figure B-17. Lights (2 of 2) (XR): 2009 Sportster DOM. and INT. Models

Figure B-17.

Lights (2 of 2) (XR): 2009 Sportster DOM. and INT. Models

Figure B-17.

Lights (2 of 2) (XR): 2009 Sportster DOM. and INT. Models

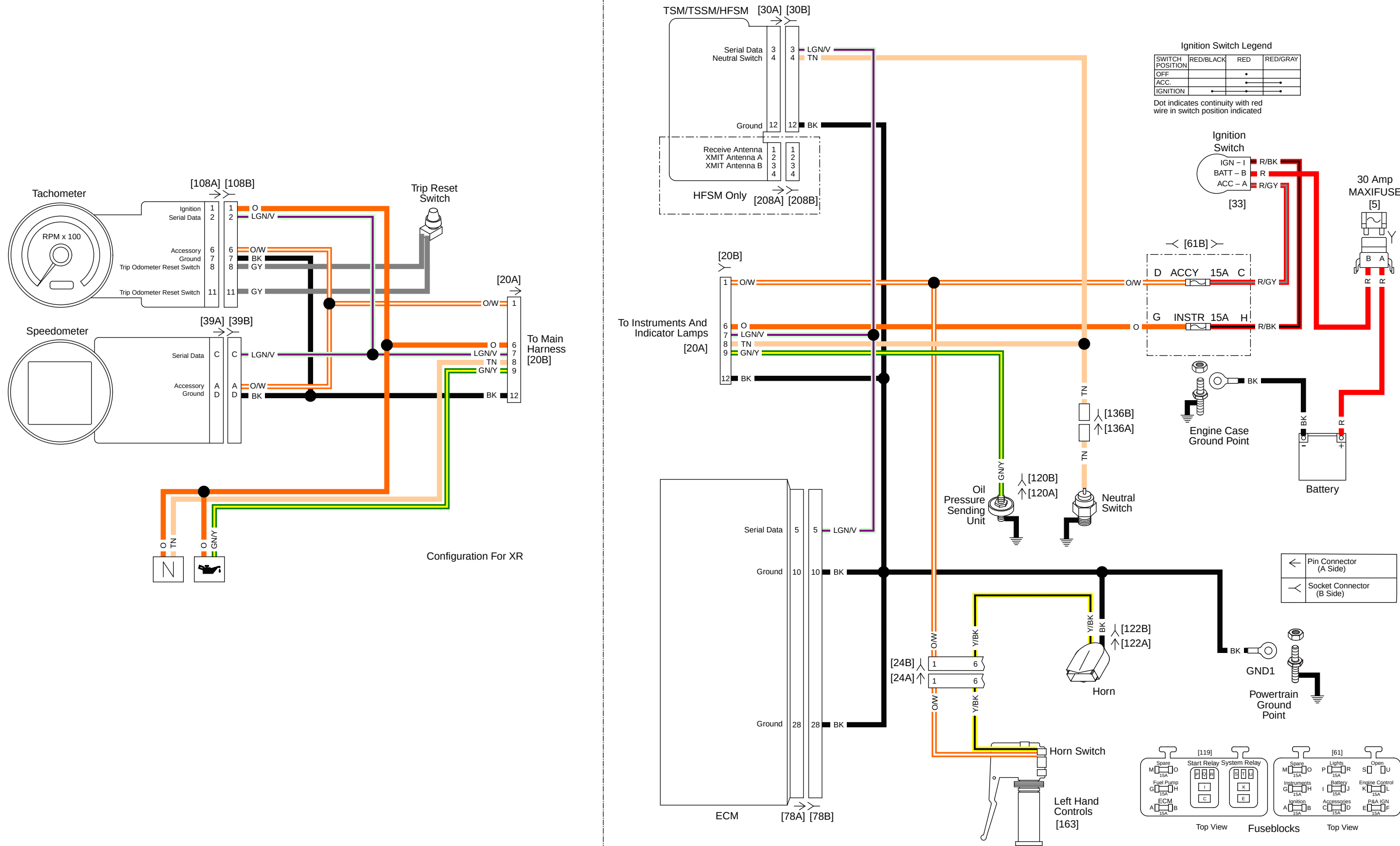


Figure B-18.
Horn and Instruments (XR): 2009 Sportster DOM. and INT.
Models

Figure B-18.
Horn and Instruments (XR): 2009 Sportster DOM. and INT.
Models

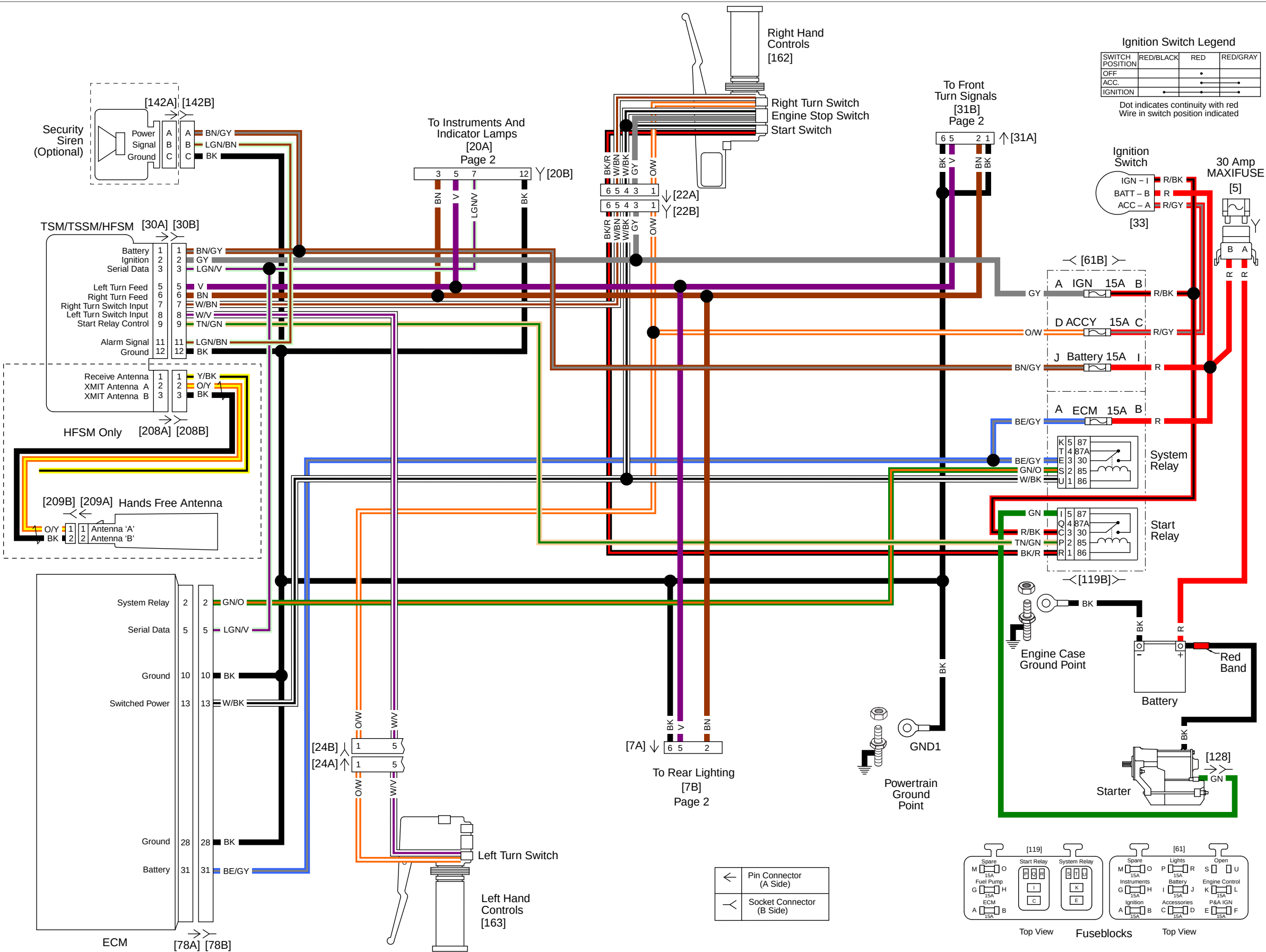
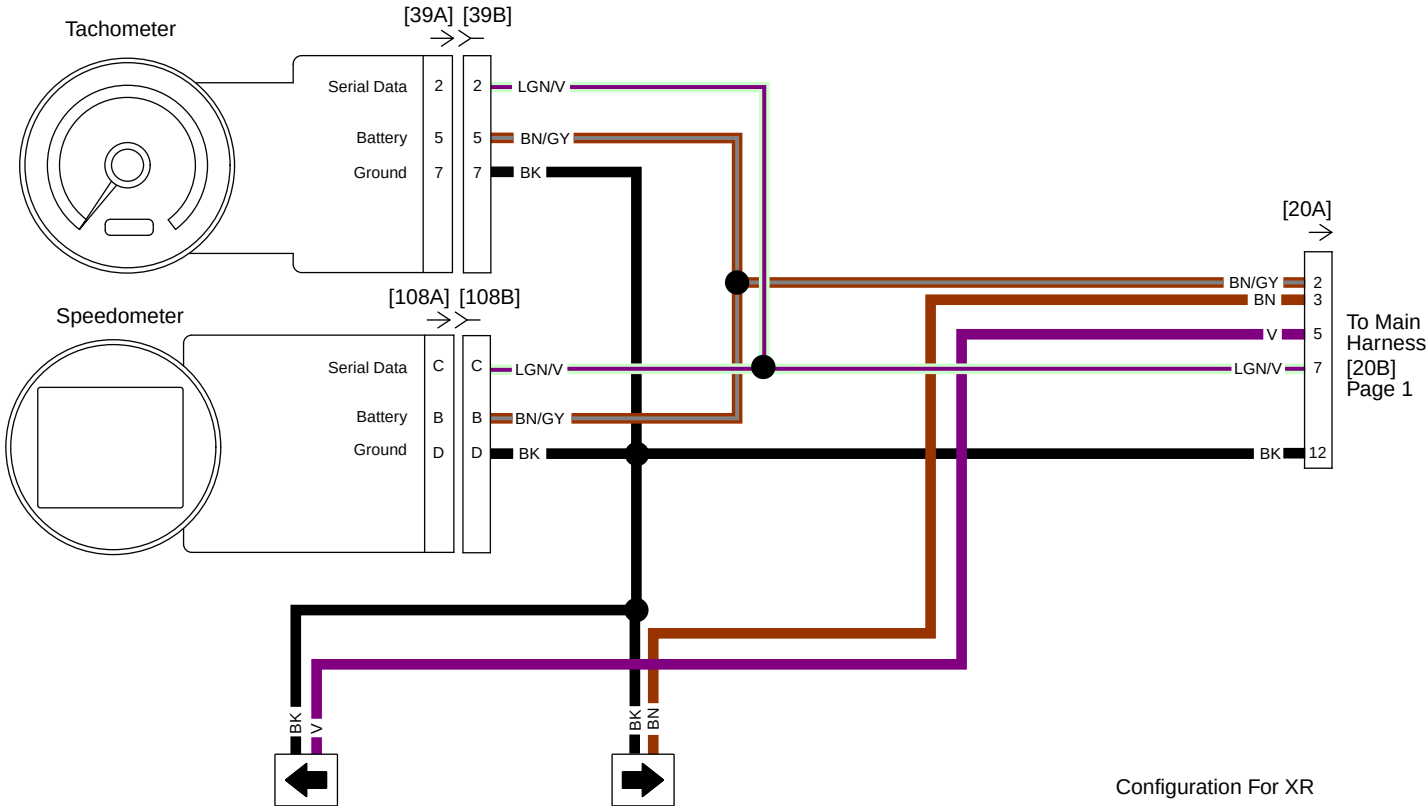


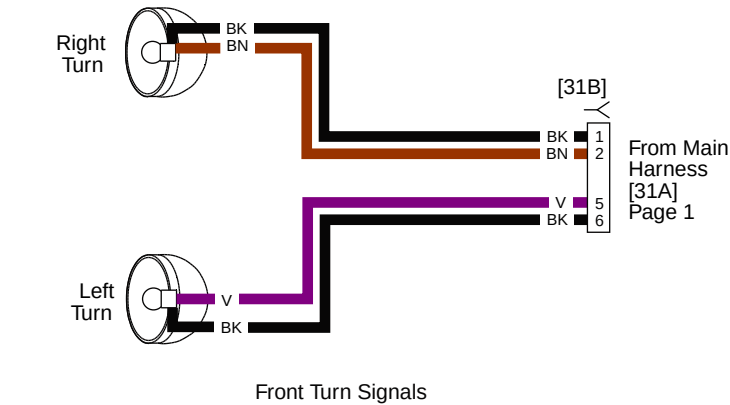
Figure B-19. Security (1 of 2) (XR): 2009 Sportster DOM and INT Models

Figure B-19.
Security (1 of 2) (XR): 2009 Sportster DOM. and INT. Models

Figure B-19.
Security (1 of 2) (XR): 2009 Sportster DOM. and INT. Models



Configuration For XR



←	PIN CONNECTOR (A SIDE)
↙	SOCKET CONNECTOR (B SIDE)

Figure B-20. Security (2 of 2) (XR): 2009 Sportster DOM. and INT. Models

Figure B-20.

Security (2 of 2) (XR): 2009 Sportster DOM. and INT. Models

Figure B-20.

Security (2 of 2) (XR): 2009 Sportster DOM. and INT. Models

TABLE OF CONTENTS

SUBJECT	PAGE NO.
C.1 METRIC CONVERSION.....	C-1
C.2 FLUID CONVERSIONS.....	C-2
C.3 TORQUE CONVERSIONS.....	C-3



NOTES



METRIC CONVERSION

C.1

CONVERSION TABLE

Table C-1. Metric Conversions

MILLIMETERS to INCHES (MM x 0.03937 = IN)								INCHES to MILLIMETERS (IN 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

FLUID CONVERSIONS

C.2

UNITED STATES SYSTEM

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

- 1 pint (U.S.) = 16 fluid ounces (U.S.)
- 1 quart (U.S.) = 2 pints (U.S.) = 32 fl. oz. (U.S.)
- 1 gallon (U.S.) = 4 quarts (U.S.) = 128 fl. oz. (U.S.)

METRIC SYSTEM

Fluid volume measurements in this Service Manual include the metric system equivalents. In the metric system, 1 liter (L) = 1,000 milliliters (mL). Should you need to convert from U.S. units-of-measure to metric units-of-measure (or vice versa), refer to the following:

- fluid ounces (U.S.) x 29.574 = milliliters
- pints (U.S.) x 0.473 = liters
- quarts (U.S.) x 0.946 = liters
- gallons (U.S.) x 3.785 = liters
- milliliters x 0.0338 = fluid ounces (U.S.)
- liters x 2.114 = pints (U.S.)
- liters x 1.057 = quarts (U.S.)
- liters x 0.264 = gallons (U.S.)

BRITISH IMPERIAL SYSTEM

Fluid volume measurements in this Service Manual do not include the British Imperial (Imp.) system equivalents. The following conversions exist in the British Imperial system:

- 1 pint (Imp.) = 20 fluid ounces (Imp.)
- 1 quart (Imp.) = 2 pints (Imp.)
- 1 gallon (Imp.) = 4 quarts (Imp.)

Although the same unit-of-measure terminology as the U.S. system is used in the British Imperial (Imp.) system, the actual volume of each British Imperial unit-of-measure differs from its U.S. counterpart. The U.S. fluid ounce is larger than the British Imperial fluid ounce. However, the U.S. pint, quart, and gallon are smaller than the British Imperial pint, quart, and gallon, respectively. Should you need to convert from U.S. units to British Imperial units (or vice versa), refer to the following:

- fluid ounces (U.S.) x 1.042 = fluid ounces (Imp.)
- pints (U.S.) x 0.833 = pints (Imp.)
- quarts (U.S.) x 0.833 = quarts (Imp.)
- gallons (U.S.) x 0.833 = gallons (Imp.)
- fluid ounces (Imp.) x 0.960 = fluid ounces (U.S.)
- pints (Imp.) x 1.201 = pints (U.S.)
- quarts (Imp.) x 1.201 = quarts (U.S.)
- gallons (Imp.) x 1.201 = gallons (U.S.)



TORQUE CONVERSIONS

C.3

UNITED STATES SYSTEM

The U.S. units of torque, foot pounds and inch pounds, are used in this service manual. To convert units, use the following equations:

- foot pounds (ft-lbs) $\times 12.00000$ = inch pounds (**in-lbs**).
- inch pounds (**in-lbs**) $\times 0.08333$ = foot pounds (ft-lbs).

METRIC SYSTEM

All metric torque specifications are written in Newton-meters (Nm). To convert metric to United States units and United States to metric, use the following equations:

- Newton meters (Nm) $\times 0.737563$ = foot pounds (ft-lbs).
- Newton meters (Nm) $\times 8.85085$ = inch pounds (**in-lbs**).
- foot pounds (ft-lbs) $\times 1.35582$ = Newton meters (Nm).
- inch pounds (**in-lbs**) $\times 0.112985$ = Newton meters (Nm).



NOTES



TABLE OF CONTENTS

SUBJECT	PAGE NO.
D.1 COMPENSATING SPROCKET.....	D-1



NOTES



COMPENSATING SPROCKET

D.1

GENERAL

Sportster models sold in the Japanese market are equipped with a rear wheel compensating sprocket.

Periodic inspection of the compensator components is recommended. This should be done any time the rear wheel is removed.

REMOVAL AND DISASSEMBLY

1. Remove rear wheel. See [2.4 WHEELS](#).
2. See [Figure D-1](#). Remove final drive sprocket assembly (2) and spacer (6).
3. Pull sprocket isolators (5) from compensator bowl (7).

NOTE

Only remove compensator bowl (7) from rear wheel (8) if necessary. Bolts (3) are one-time usage only. If removed, they must be discarded and replaced with **new bolts**.

4. If necessary, remove bolts with captive washers (3) and compensator bowl from rear wheel (8). Discard bolts.

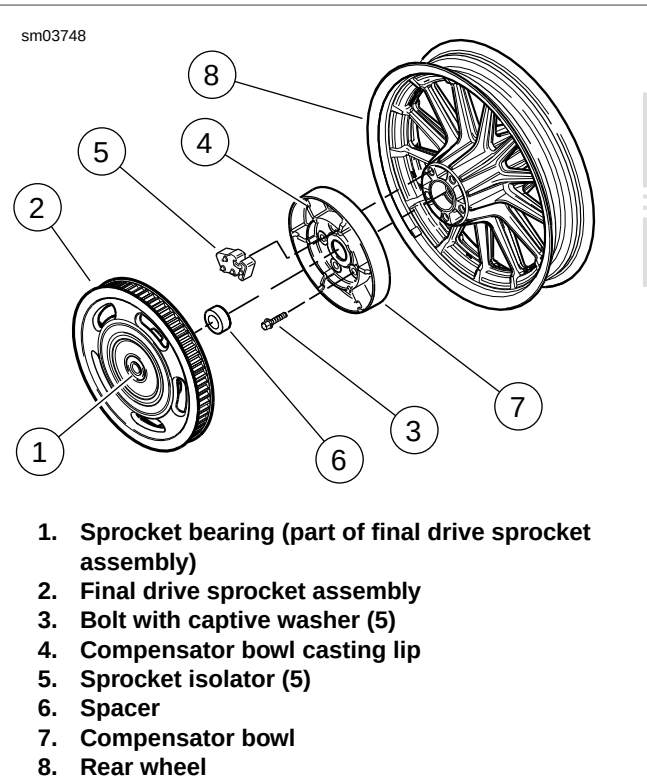


Figure D-1. Compensating Sprocket

CLEANING, INSPECTION AND REPAIR

1. See [Figure D-1](#). Wipe inside of compensator bowl (7) and final drive sprocket (2) with a clean, damp cloth.
2. Inspect sprocket bearing (1). If bearing surface is rough or if bearing was leaking grease, replace bearing. See [D.1 COMPENSATING SPROCKET, Sprocket Bearing Replacement](#).

3. Inspect sprocket isolators (5) for damage, deterioration, missing chunks or excessive debris beyond normal wear marks. Replace if necessary.

SPROCKET BEARING REPLACEMENT

PART NUMBER	TOOL NAME
HD-48921	REAR WHEEL COMPENSATOR SPROCKET BEARING REMOVER/INSTALLER

Removal

1. Remove rear wheel. See [2.4 WHEELS, Rear Wheel](#).
2. Pull sprocket from bowl.
3. See [Figure D-2](#). Obtain the REAR WHEEL COMPENSATOR SPROCKET BEARING REMOVER/INSTALLER (Part No. HD-48921).

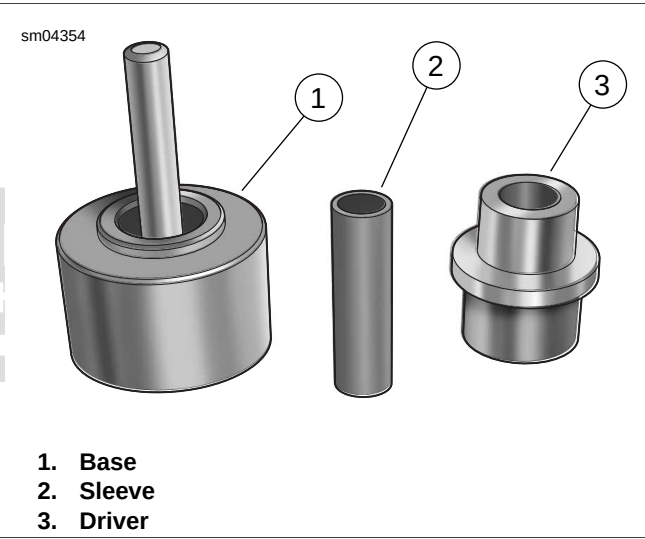


Figure D-2. Rear Wheel Compensator Sprocket Bearing Remover/Installer (Part No. HD-48921)

4. See [Figure D-3](#). Place parallel press blocks on deck of arbor press. Leave gap between press blocks to accommodate base pin in next step.
5. Position base (1) on press blocks with the large OD top-side.
6. Slide sleeve (2) over base pin.
7. See [Figure D-4](#). With the inboard side facing up, slide sprocket (1) over sleeve until it rests on base.
8. Slide small OD of driver (2) over sleeve until contact is made with inner race of bearing.
9. Center driver under ram and apply pressure until bearing drops into base. Disassemble tool and discard bearing.

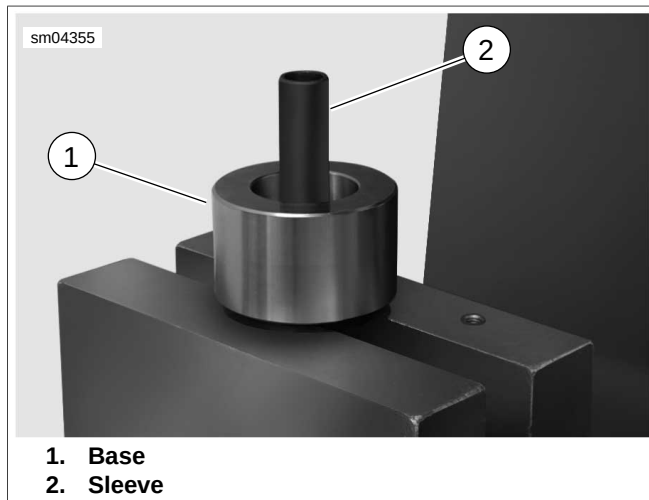


Figure D-3. Position Tool for Bearing Removal

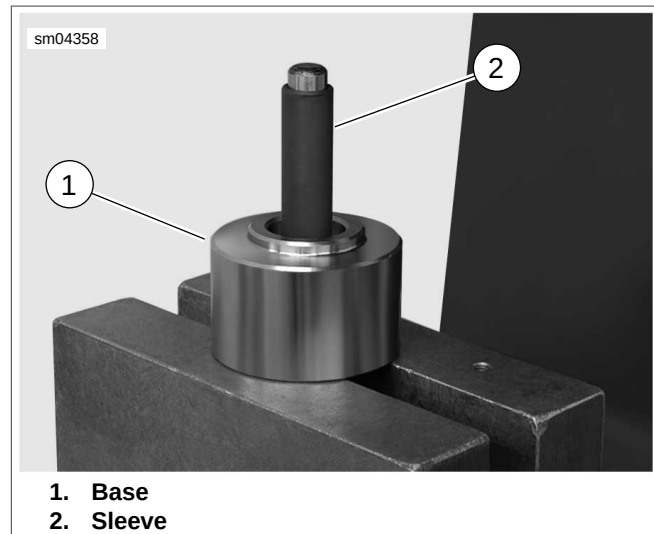


Figure D-5. Position Tool for Bearing Installation

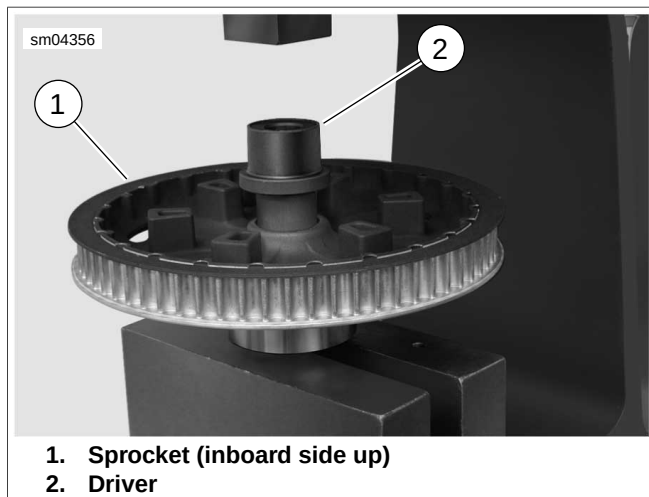


Figure D-4. Remove Compensator Sprocket Bearing

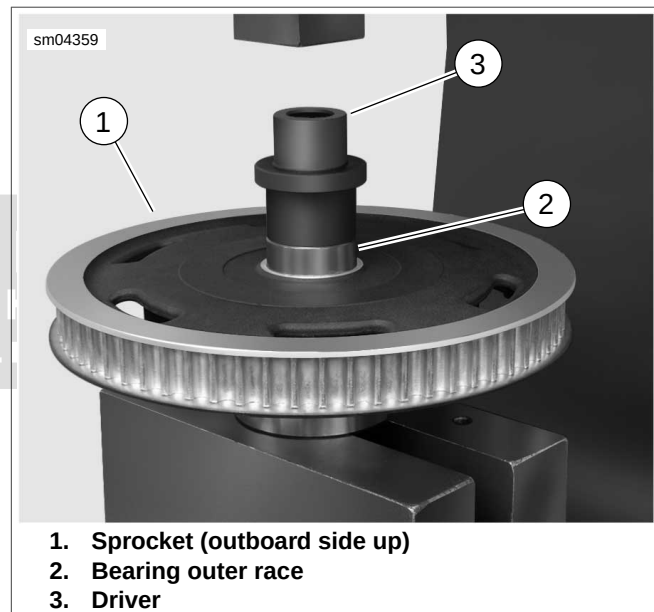


Figure D-6. Install Compensator Sprocket Bearing

Installation

1. See [Figure D-2](#). Obtain the REAR WHEEL COMPENSATOR SPROCKET BEARING REMOVER/INSTALLER (Part No. HD-48921).
2. See [Figure D-5](#). Position base (1) on deck of arbor press with the small OD topside.
3. Slide sleeve (2) over base pin.
4. Verify that sprocket bearing bore is clean and dry.
5. See [Figure D-6](#). With the outboard side facing up, slide sprocket (1) over sleeve until it rests on base.
6. Slide bearing (2) over sleeve.
7. Slide large OD of driver (3) over sleeve until contact is made with outer race of bearing.
8. Center driver under ram and apply pressure until bearing makes firm contact with counterbore in sprocket.
9. Turn sprocket over and verify that bearing is fully seated.

ASSEMBLY AND INSTALLATION

NOTES

- See [Figure D-1](#). Only remove compensator bowl (7) from rear wheel (8) if necessary. Bolts (3) are one-time usage only. If removed, they must be discarded and replaced with **new** bolts.
- **New** compensator bowl bolts are equipped with a LOC-TITE patch on the threads. Do not apply any additional LOCTITE.

1. See [Figure D-1](#). If compensator bowl (7) was removed, install bowl onto rear wheel with **new** bolts with captive washers (3). Tighten bolts as follows:
 - a. Tighten bolts in a star pattern (every other bolt) to 60 ft-lbs (81.3 Nm).
 - b. Loosen screws 1/2 turn.
 - c. Retighten all five screws in the same star pattern to 80 ft-lbs (108.5 Nm).

NOTE

Do not lubricate inside of compensator bowl (7), sprocket (2) or sprocket isolators (5) with any type of oil based lubricant. Use ONLY soapy water or window cleaner on isolators to facilitate their installation. Do not install isolators dry.

2. See [Figure D-7](#). Lubricate isolators (1) with soapy water or window cleaner. Install isolators (1) into compensator bowl (2).

NOTE

Inner spacer can be identified by a radial groove machined into its surface. Inner spacer is also thicker than outer spacer. Make sure to install the correct spacer between compensator bowl and sprocket.

3. See [Figure D-1](#). Install spacer (6) by placing on bowl casting lip (4).

NOTE

Use extreme caution to make sure that spacer does not fall out when assembling sprocket onto compensator bowl. If spacer is not present when rear axle is tightened, compensator sprocket and bearing will be damaged.

4. Install sprocket (2) onto compensator bowl (7).
5. Install rear wheel. See [2.4 WHEELS](#).

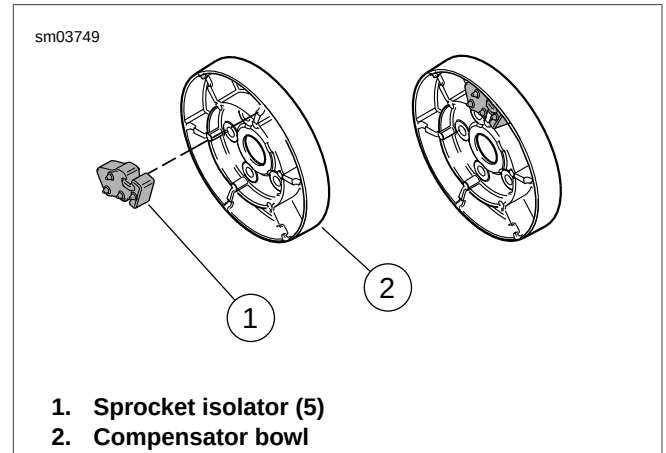


Figure D-7. Installing Sprocket Isolators



NOTES



[TABLE OF CONTENTS](#)

SUBJECT	PAGE NO.
E.1 GLOSSARY.....	E-1



NOTES



GLOSSARY

E.1

ACRONYMS AND ABBREVIATIONS

Table E-1. Acronyms and Abbreviations

ACRONYM OR ABBREVIATION	DESCRIPTION
A	Amperes
AC	Alternating Current
ACC	Accessory
ACR	Automatic Compression Release
AGM	Absorbed Glass Mat (battery)
AMP	Ampere
AWG	American Wire Gauge
B+	Battery Voltage
BAS	Bank Angle Sensor
BTDC	Before Top Dead Center
C	Celsius (Centigrade)
CA	California
CAL	Calibration
CC	Cubic Centimeters
CCA	Cold Cranking Amps
CKP	Crankshaft Position
cm	Centimeter
DC	Direct Current
DLC	Data Link Connector
DOM	Domestic
DTC	Diagnostic Trouble Code
DVOM	Digital Volt Ohm Meter
ECM	Electronic Control Module
ECT	Engine Coolant Temperature
EEPROM	Electrically Erasable Programmable Read Only Memory
EFI	Electronic Fuel Injection
ET	Engine Temperature
EVAP	Evaporative Emissions Control System
F	Fahrenheit
ft-lbs	Foot-Pounds
fl oz.	Fluid Ounce
g	Gram
GAL	Gallon
GAWR	Gross Axle Weight Rating
GND	Ground (electrical)
GVWR	Gross Vehicle Weight Rating
HDI	Harley-Davidson International
H-DSSS	Harley-Davidson Smart Security System
HFSM	Hands Free Security Module
Hg	Mercury

Table E-1. Acronyms and Abbreviations

ACRONYM OR ABBREVIATION	DESCRIPTION
IAC	Idle Air Control
IAT	Intake Air Temperature
IC	Instrument Cluster
ID	Inside Diameter
IGN	Ignition Light/Key Switch
In.	Inch
INJ PW	Injector Pulse Width
in-lbs	Inch-Pounds
Kg	Kilogram
Km	Kilometer
kPa	Kilopascal
km/hr	Kilometers Per Hour
L	Liter
LCD	Liquid Crystal Display
LED	Light Emitting Diode
mA	Milliampere
MAP	Manifold Absolute Pressure
ml	milliliter
mm	millimeter
MPH	Miles Per Hour
ms	millisecond
Nm	Newton-Meter
N/A	Not Applicable
no.	Number
O ₂	Oxygen
OD	Outside Diameter
OEM	Original Equipment Manufacturer
oz	Ounce
P&A	Parts and Accessories
PN	Part Number
PSI	Pounds per Square Inch
PWM signal	Pulse Width Modulated signal
RES	Reserve
RPM	Revolutions Per Minute
SCFH	Cubic Feet per Hour at Standard Conditions
TCA	Throttle Control Actuator
TDC	Top Dead Center
TGS	Twist Grip Sensor
TP	Throttle Position
TMAP	Intake Air Temperature/Manifold Absolute Pressure
TSM	Turn Signal Module
TSSM	Turn Signal/Security Module
V	Volt

Table E-1. Acronyms and Abbreviations

ACRONYM OR ABBREVIATION	DESCRIPTION
VAC	Volts of Alternating Current
VDC	Volts of Direct Current
VIN	Vehicle Identification Number
VSS	Vehicle Speed Sensor



NOTES



Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
98716-87A	STORAGE COVER	1.34 STORAGE, Placing in Storage
99863-01A	GLOBAL BATTERY CHARGER	1.17 BATTERY MAINTENANCE, Storage
A-157C	SNAP-ON BUSHING DRIVER SET	5.13 TRANSMISSION RIGHT CASE BEARINGS, Installation
B-35758-52A	CUTTER PILOT	3.21 CYLINDER HEAD, Refacing Valve Seats
B-42571	FORK SEAL DRIVER	2.22 FRONT FORK: XR MODELS, Assembly
B-42571	FORK SEAL DRIVER	2.22 FRONT FORK: XR MODELS, Assembly
B-43895-1	TRANSMISSION REMOVER	5.10 TRANSMISSION REMOVAL AND DISASSEMBLY, Transmission Removal From Left Crankcase
B-43985	TRANSMISSION REMOVAL AND INSTALLATION TOOL	5.15 TRANSMISSION INSTALLATION, Installation
B-43985-4	COUNTERSHAFT GUIDE	5.15 TRANSMISSION INSTALLATION, Installation
B-45520	GEAR DETENT ASSEMBLY AID	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Crankcase
B-45520	GEAR DETENT ASSEMBLY AID	5.15 TRANSMISSION INSTALLATION, Assembling Crankcases
B-45523	VALVE GUIDE REAMER	3.21 CYLINDER HEAD, Replacing Valve Guides
B-45524	VALVE GUIDE REMOVER/INSTALLER	3.21 CYLINDER HEAD, Replacing Valve Guides
B-45525	VALVE GUIDE HONE	3.21 CYLINDER HEAD, Cleaning and Inspection
B-45525	VALVE GUIDE HONE	3.21 CYLINDER HEAD, Replacing Valve Guides
B-45655	CRANKCASE BEARING REMOVER/INSTALLER	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Crankcase
B-45655, HD-42720-2, HD-46663	CRANKCASE BEARING REMOVER/INSTALLER WITH ADAPTER	3.23 CRANKCASE, Disassembly
B-45676-A	SPROCKET SHAFT SEAL/SPACER INSTALLER	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Crankcase
B-45847	CROSS PLATE	5.12 MAIN DRIVE GEAR AND BEARING, Removal
B-45847	CROSS PLATE	5.12 MAIN DRIVE GEAR AND BEARING, Installation
B-45926	CLUTCH SHELL BEARING REMOVER/INSTALLER	5.6 PRIMARY DRIVE AND CLUTCH: XR MODELS, Clutch Shell Bearing Replacement
GA500A	SNAP-ON TERMINAL PICK	A.2 AUTOFUSE ELECTRICAL CONNECTORS, Autofuse Connector Repair
HD-25070	HEAT GUN	4.10 INDUCTION MODULE: XL MODELS, Disassembly
HD-25070	ROBINAIR HEAT GUN	6.39 HANDLEBAR SWITCH ASSEMBLIES, Repair Procedures
HD-25070	ROBINAIR HEAT GUN	A.17 SEALED SPLICE CONNECTORS, Sealed Splice Connector Repair
HD-33223-1	CYLINDER COMPRESSION GAUGE	3.7 TROUBLESHOOTING, Compression Test
HD-33416	UNIVERSAL DRIVER HANDLE	2.23 FORK STEM AND BRACKET ASSEMBLY, Cleaning, Inspection and Repair
HD-33446-86	TORQUE PLATE BOLTS	3.22 CYLINDER AND PISTON, Cleaning, Inspection and Repair
HD-33446-B	CYLINDER TORQUE PLATES	3.22 CYLINDER AND PISTON, Cleaning, Inspection and Repair
HD-34623-C	PISTON PIN LOCK RING REMOVER/INSTALLER	3.15 TOP END OVERHAUL: DISASSEMBLY, Cylinder and Piston
HD-34623-C	PISTON PIN LOCK RING REMOVER/INSTALLER	3.16 TOP END OVERHAUL: ASSEMBLY, Piston and Cylinder
HD-34736-B	VALVE SPRING COMPRESSOR	3.21 CYLINDER HEAD, Disassembly
HD-34736-B	VALVE SPRING COMPRESSOR	3.21 CYLINDER HEAD, Assembly

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
HD-34751	VALVE GUIDE CLEANING BRUSH	3.21 CYLINDER HEAD, Cleaning and Inspection
HD-34751	VALVE GUIDE CLEANING BRUSH	3.21 CYLINDER HEAD, Replacing Valve Guides
HD-34751	VALVE GUIDE CLEANING BRUSH	3.21 CYLINDER HEAD, Refacing Valve Seats
HD-34902-7	END CAP	3.23 CRANKCASE, Disassembly
HD-34902-7	END CAP	3.23 CRANKCASE, Fitting Pinion Bearings
HD-34902-7	END CAP	3.23 CRANKCASE, Fitting Pinion Bearings
HD-34902-C	BEARING RACE REMOVER AND INSTALLER KIT	3.23 CRANKCASE, Disassembly
HD-35102	WRIST PIN BUSHING HONE	3.22 CYLINDER AND PISTON, Connecting Rod Bushings
HD-35316-11	RECEIVER CUP	5.12 MAIN DRIVE GEAR AND BEARING, Removal
HD-35316-12	INSTALLER CUP	5.12 MAIN DRIVE GEAR AND BEARING, Installation
HD-35316-13	BEARING DRIVER	5.12 MAIN DRIVE GEAR AND BEARING, Removal
HD-35316-13	BEARING DRIVER	5.12 MAIN DRIVE GEAR AND BEARING, Installation
HD-35316-4A	8 IN. BOLT	5.12 MAIN DRIVE GEAR AND BEARING, Removal
HD-35316-4A	8 IN. BOLT	5.12 MAIN DRIVE GEAR AND BEARING, Removal
HD-35316-4A	8 IN. BOLT	5.12 MAIN DRIVE GEAR AND BEARING, Installation
HD-35316-4A	8 IN. BOLT	5.12 MAIN DRIVE GEAR AND BEARING, Installation
HD-35316-7	WASHER	5.12 MAIN DRIVE GEAR AND BEARING, Removal
HD-35316-7	WASHER	5.12 MAIN DRIVE GEAR AND BEARING, Installation
HD-35316-8	BEARING DRIVER	5.12 MAIN DRIVE GEAR AND BEARING, Installation
HD-35316-9	BEARING DRIVER	5.12 MAIN DRIVE GEAR AND BEARING, Removal
HD-35316-C	MAIN DRIVE GEAR REMOVER AND INSTALLER SET	5.12 MAIN DRIVE GEAR AND BEARING, Installation
HD-35316-D	MAIN DRIVE GEAR REMOVER AND INSTALLER SET	5.12 MAIN DRIVE GEAR AND BEARING, Removal
HD-35381A	BELT TENSION GAUGE	1.16 REAR BELT DEFLECTION, Rear Drive Belt: Sportster Models
HD-35457	BLACK LIGHT LEAK DETECTOR	1.35 TROUBLESHOOTING, Lubrication System
HD-35667-A	CYLINDER LEAKDOWN TESTER	3.7 TROUBLESHOOTING, Cylinder Leakage Test
HD-35758-C	NEWAY VALVE SEAT CUTTER SET	3.21 CYLINDER HEAD, Refacing Valve Seats
HD-36583	FORK SEAL AND BUSHING INSTALLATION TOOL	2.21 FRONT FORK: XL MODELS, Assembly
HD-38125-6	PACKARD TERMINAL CRIMP TOOL	A.14 PACKARD METRI-PACK TERMINALS, Metri-Pack Terminal Crimps
HD-38125-7	PACKARD TERMINAL CRIMPER	A.8 DEUTSCH MINI TERMINAL REPAIR, Deutsch Mini Terminal Crimps
HD-38125-7	PACKARD TERMINAL CRIMPER	A.14 PACKARD METRI-PACK TERMINALS, Metri-Pack Terminal Crimps
HD-38125-8	PACKARD CRIMPING TOOL	A.14 PACKARD METRI-PACK TERMINALS, Metri-Pack Terminal Crimps
HD-38125-8	PACKARD CRIMPING TOOL	A.17 SEALED SPLICE CONNECTORS, Sealed Splice Connector Repair
HD-38362	SPROCKET LOCKING LINK (883 CC)	5.5 PRIMARY DRIVE AND CLUTCH: XL MODELS, Removal

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
HD-38362	SPROCKET LOCKING LINK (883 CC)	5.5 PRIMARY DRIVE AND CLUTCH: XL MODELS, Installation
HD-38362	SPROCKET LOCKING LINK (883 CC)	5.5 PRIMARY DRIVE AND CLUTCH: XL MODELS, Installation
HD-38362	SPROCKET LOCKING LINK	5.6 PRIMARY DRIVE AND CLUTCH: XR MODELS, Removal
HD-38362	SPROCKET LOCKING LINK	5.6 PRIMARY DRIVE AND CLUTCH: XR MODELS, Installation
HD-38515-91	CLUTCH SPRING FORCING SCREW	5.5 PRIMARY DRIVE AND CLUTCH: XL MODELS, Disassembly
HD-38515-91	CLUTCH SPRING FORCING SCREW	5.5 PRIMARY DRIVE AND CLUTCH: XL MODELS, Assembly
HD-38515-91	CLUTCH SPRING FORCING SCREW	5.6 PRIMARY DRIVE AND CLUTCH: XR MODELS, Disassembly
HD-38515-A	SPRING COMPRESSING TOOL	5.5 PRIMARY DRIVE AND CLUTCH: XL MODELS, Disassembly
HD-38515-A	SPRING COMPRESSING TOOL	5.5 PRIMARY DRIVE AND CLUTCH: XL MODELS, Assembly
HD-38515-A	SPRING COMPRESSING TOOL	5.6 PRIMARY DRIVE AND CLUTCH: XR MODELS, Disassembly
HD-38515-A	SPRING COMPRESSING TOOL	5.6 PRIMARY DRIVE AND CLUTCH: XR MODELS, Assembly
HD-38871	CAMSHAFT BUSHING REAMER PILOT	3.20 GEARCASE COVER AND CAM GEARS, Bushing Reaming: XL Only
HD-39301-A	STEERING HEAD BEARING RACE REMOVAL TOOL	2.23 FORK STEM AND BRACKET ASSEMBLY, Cleaning, Inspection and Repair
HD-39302	STEERING HEAD BEARING RACE INSTALLATION TOOL	2.23 FORK STEM AND BRACKET ASSEMBLY, Assembly and Installation
HD-39621-28	PIN TERMINAL REMOVER	6.23 TAIL LAMP: ALL MODELS EXCEPT XL 1200N, Base Replacement
HD-39782-A	CYLINDER HEAD SUPPORT STAND	3.21 CYLINDER HEAD, Replacing Valve Guides
HD-39786	CYLINDER HEAD HOLDING FIXTURE	3.21 CYLINDER HEAD, Replacing Valve Guides
HD-39786	CYLINDER HEAD HOLDING FIXTURE	3.21 CYLINDER HEAD, Refacing Valve Seats
HD-39847	REAMER T-HANDLE	3.21 CYLINDER HEAD, Replacing Valve Guides
HD-39964	REAMER LUBRICANT	3.21 CYLINDER HEAD, Replacing Valve Guides
HD-39964	REAMER LUBRICANT	3.22 CYLINDER AND PISTON, Connecting Rod Bushings
HD-39965-A	DEUTSCH TERMINAL CRIMP TOOL	A.6 DEUTSCH STANDARD TERMINAL REPAIR, Deutsch Standard Terminal Crimps
HD-39969	ULTRA TORCH UT-100	6.16 IGNITION AND LIGHT SWITCH, Installation
HD-39969	ULTRA TORCH UT-100	6.39 HANDLEBAR SWITCH ASSEMBLIES, Repair Procedures
HD-39969	ULTRA TORCH UT-100	A.17 SEALED SPLICE CONNECTORS, Sealed Splice Connector Repair
HD-41177	FORK TUBE HOLDER	1.22 FRONT FORK OIL, Changing Fork Oil: XR Models
HD-41177	FORK TUBE HOLDER	1.22 FRONT FORK OIL, Changing Fork Oil: XR Models
HD-41177	FORK TUBE HOLDER	1.22 FRONT FORK OIL, Changing Fork Oil: XR Models

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
HD-41177	FORK TUBE HOLDER	1.22 FRONT FORK OIL, Changing Fork Oil: XR Models
HD-41177	FORK TUBE HOLDER	2.22 FRONT FORK: XR MODELS, Disassembly
HD-41177	FORK TUBE HOLDER	2.22 FRONT FORK: XR MODELS, Disassembly
HD-41177	FORK TUBE HOLDER	2.22 FRONT FORK: XR MODELS, Disassembly
HD-41177	FORK TUBE HOLDER	2.22 FRONT FORK: XR MODELS, Assembly
HD-41177	FORK TUBE HOLDER	2.22 FRONT FORK: XR MODELS, Assembly
HD-41182	FUEL PRESSURE GAUGE	4.19 FUEL PRESSURE TEST, Testing
HD-41183	HEAT SHIELD ATTACHMENT	6.39 HANDLEBAR SWITCH ASSEMBLIES, Repair Procedures
HD-41183	HEAT SHIELD ATTACHMENT	A.17 SEALED SPLICE CONNECTORS, Sealed Splice Connector Repair
HD-41417	PROPANE ENRICHMENT KIT	4.20 INTAKE LEAK TEST, Leak Tester
HD-41475	DEUTSCH CONNECTOR SERVICE KIT	A.5 DEUTSCH ELECTRICAL CONNECTORS, Deutsch Connector Repair
HD-41475-100	FLAT BLADE L-HOOK	A.5 DEUTSCH ELECTRICAL CONNECTORS, Deutsch Connector Repair
HD-41609	AMP MULTILOCK CRIMPER	A.1 AMP MULTILOCK CONNECTORS, AMP Multilock Connector Repair
HD-41675	OIL PRESSURE SENDING UNIT WRENCH	6.36 OIL PRESSURE SWITCH, Removal
HD-42310-45	ENGINE SUPPORT CRADLE	5.9 CASE DISASSEMBLY FOR TRANSMISSION REMOVAL, Engine Removal and Disassembly
HD-42310-45	ENGINE CRADLE	5.16 TRANSMISSION SPROCKET, Removal
HD-42311	HARLEY-DAVIDSON OIL FILTER WRENCH	1.6 ENGINE OIL AND FILTER, Changing Oil and Filter
HD-42320-A	PISTON PIN REMOVER	3.15 TOP END OVERHAUL: DISASSEMBLY, Cylinder and Piston
HD-42322	PISTON SUPPORT PLATE	3.15 TOP END OVERHAUL: DISASSEMBLY, Cylinder and Piston
HD-42322	PISTON SUPPORT PLATE	3.16 TOP END OVERHAUL: ASSEMBLY, Piston and Cylinder
HD-42326-A	CRANKSHAFT GUIDE TOOL	5.15 TRANSMISSION INSTALLATION, Assembling Crankcases
HD-42326-B	CRANKSHAFT GUIDE TOOL	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Crankcase
HD-42579-A	SPROCKET SHAFT BEARING/SEAL INSTALLATION TOOL	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Crankcase
HD-42720-2	CRANKCASE BEARING REMOVER/INSTALLER BASE	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Crankcase
HD-42879	ELECTRICAL CRIMPER TOOL	A.7 DEUTSCH SOLID BARREL MINI TERMINAL REPAIR, Deutsch Solid Barrel Terminal Crimps
HD-43984	CRANKSHAFT LOCKING TOOL	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Cam Gears and Gearcase Cover: XL Models
HD-44060-B	WHEEL BEARING INSTALLER/REMOVER	2.4 WHEELS, Sealed Wheel Bearings
HD-44061	FUEL PRESSURE GAUGE ADAPTER	4.19 FUEL PRESSURE TEST, Testing
HD-44067-A	HARLEY-DAVIDSON OIL FILTER WRENCH	1.6 ENGINE OIL AND FILTER, Changing Oil and Filter
HD-44358	FLYWHEEL SUPPORT FIXTURE	3.23 CRANKCASE, Disassembly
HD-45928	PACKARD MICRO-64 TERMINAL REMOVER	A.16 PACKARD MICRO-64 CONNECTORS, Packard Micro-64 Connector Repair

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
HD-45929	CRIMPING TOOL	6.6 SPEEDOMETER: XL SINGLE GAUGE MODELS EXCEPT XL 883C/XL 1200C, Installation
HD-45929	PACKARD MICRO-64 TERMINAL CRIMPER	A.16 PACKARD MICRO-64 CONNECTORS, Packard Micro-64 Connector Repair
HD-45966	FRONT FORK COMPRESSOR	1.22 FRONT FORK OIL, Changing Fork Oil: XR Models
HD-45966	FRONT FORK COMPRESSOR	1.22 FRONT FORK OIL, Changing Fork Oil: XR Models
HD-45966	FRONT FORK COMPRESSOR	1.22 FRONT FORK OIL, Changing Fork Oil: XR Models
HD-45966	FRONT FORK COMPRESSOR	2.22 FRONT FORK: XR MODELS, Disassembly
HD-45966	FRONT FORK COMPRESSOR	2.22 FRONT FORK: XR MODELS, Disassembly
HD-45966	FRONT FORK COMPRESSOR	2.22 FRONT FORK: XR MODELS, Assembly
HD-45967	SHOP DOLLY	2.29 REAR ENGINE MOUNT/ISOLATOR, Removal
HD-45967	SHOP DOLLY	3.12 REMOVING ENGINE FROM CHASSIS, Procedure: XL Models
HD-45967	SHOP DOLLY	3.12 REMOVING ENGINE FROM CHASSIS, Procedure: XR Models
HD-45967	SHOP DOLLY	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
HD-45967	SHOP DOLLY	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
HD-45968	FAT JACK	2.4 WHEELS, Rear Wheel
HD-45968	FAT JACK	2.28 FRONT ENGINE MOUNT/ISOLATOR, Removal
HD-45968	FAT JACK	2.29 REAR ENGINE MOUNT/ISOLATOR, Installation
HD-45968	FAT JACK	3.12 REMOVING ENGINE FROM CHASSIS, Procedure: XL Models
HD-45968	FAT JACK	3.12 REMOVING ENGINE FROM CHASSIS, Procedure: XR Models
HD-45968	FAT JACK	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
HD-45968	FAT JACK	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
HD-46281	BEARING REMOVER/INSTALLER TOOL	2.25 REAR FORK, Disassembly
HD-46282	TRANSMISSION SPROCKET HOLDING TOOL	5.16 TRANSMISSION SPROCKET, Installation
HD-46282-1A	SPROCKET HOLDING TOOL ADAPTER	5.16 TRANSMISSION SPROCKET, Removal
HD-46282-1A	SPROCKET HOLDING TOOL ADAPTER	5.16 TRANSMISSION SPROCKET, Installation
HD-46282-1A	SPROCKET HOLDING TOOL ADAPTER	5.16 TRANSMISSION SPROCKET, Installation
HD-46282-A	TRANSMISSION SPROCKET HOLDING TOOL SET	5.16 TRANSMISSION SPROCKET, Removal
HD-46283	SPROCKET LOCKING LINK (1200 CC)	5.5 PRIMARY DRIVE AND CLUTCH: XL MODELS, Removal
HD-46283	PRIMARY DRIVE LOCKING TOOL (1200 CC)	5.5 PRIMARY DRIVE AND CLUTCH: XL MODELS, Installation
HD-46283	PRIMARY DRIVE LOCKING TOOL (1200 CC)	5.5 PRIMARY DRIVE AND CLUTCH: XL MODELS, Installation
HD-46284	ENGINE HOOK	3.12 REMOVING ENGINE FROM CHASSIS, Procedure: XL Models

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
HD-46284	ENGINE HOOK	3.12 REMOVING ENGINE FROM CHASSIS, Procedure: XR Models
HD-46284	ENGINE HOOK	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
HD-46285	TRANSMISSION ASSEMBLY FIXTURE	5.15 TRANSMISSION INSTALLATION, Installation
HD-46287	LAPPING TOOL ADAPTER	3.23 CRANKCASE, Lapping Engine Main Bearing Races
HD-46288	MAINSHAFT LOCK NUT WRENCH	5.16 TRANSMISSION SPROCKET, Removal
HD-46288	MAINSHAFT LOCK NUT WRENCH	5.16 TRANSMISSION SPROCKET, Installation
HD-46503	OIL LINE REMOVER, 1/2 IN.	3.14 PRECISION COOLING SYSTEM: XR MODELS, General
HD-46503	OIL LINE REMOVER, 1/2 IN.	3.14 PRECISION COOLING SYSTEM: XR MODELS, Oil Pump Lines
HD-47114	CONSOLE ALIGNMENT RING	4.6 FUEL TANK: XL MODELS, Console Replacement
HD-47852	INNER FORK NUT REMOVER/INSTALLER	1.22 FRONT FORK OIL, Changing Fork Oil: XR Models
HD-47852	INNER FORK NUT REMOVER/INSTALLER	1.22 FRONT FORK OIL, Changing Fork Oil: XR Models
HD-47852	INNER FORK NUT REMOVER/INSTALLER	2.22 FRONT FORK: XR MODELS, Disassembly
HD-47852	INNER FORK NUT REMOVER/INSTALLER	2.22 FRONT FORK: XR MODELS, Assembly
HD-47855	INNER/OUTER MAIN DRIVE GEAR NEEDLE BEARING INSTALLATION TOOL: XL MODELS	5.12 MAIN DRIVE GEAR AND BEARING, Assembly
HD-47856	MAIN DRIVE GEAR SEAL INSTALLER KIT	5.12 MAIN DRIVE GEAR AND BEARING, Installation
HD-47856-1	INSTALLER	5.12 MAIN DRIVE GEAR AND BEARING, Installation
HD-47856-2	PILOT	5.12 MAIN DRIVE GEAR AND BEARING, Installation
HD-47856-4	ADAPTER	5.12 MAIN DRIVE GEAR AND BEARING, Installation
HD-47856-5	LARGE NUT	5.12 MAIN DRIVE GEAR AND BEARING, Installation
HD-48114	MOLEX ELECTRICAL CONNECTOR TERMINAL REMOVER	A.9 MOLEX CONNECTORS, Molex Connector Repair
HD-48116-A	TEMPERATURE SENSOR SOCKET	4.9 ENGINE TEMPERATURE (ET) SENSOR, Removal
HD-48119	ELECTRICAL CRIMP TOOL	A.9 MOLEX CONNECTORS, Crimp Terminal to Lead
HD-48262	OXYGEN SENSOR SOCKET	4.14 OXYGEN SENSOR, Removal
HD-48287	TRIPLE TREE WEDGE TOOL	2.22 FRONT FORK: XR MODELS, Removal
HD-48287	TRIPLE TREE WEDGE TOOL	2.22 FRONT FORK: XR MODELS, Installation
HD-48386	OIL PRESSURE SENDING UNIT WRENCH	3.4 OIL PRESSURE, Checking Oil Pressure
HD-48643	INNER/OUTER MAIN DRIVE GEAR NEEDLE BEARING INSTALLATION TOOL: XR MODELS	5.12 MAIN DRIVE GEAR AND BEARING, Assembly
HD-48645	SPANNER WRENCH	1.20 SHOCK ABSORBER ADJUSTMENT, Shock Absorber Preload Adjustment: Sportster Models
HD-48647	OXYGEN SENSOR SOCKET	4.14 OXYGEN SENSOR, Removal
HD-48650	DIGITAL TECHNICIAN II	1.28 IDLE SPEED AND IGNITION TIMING, Idle Speed
HD-48650	DIGITAL TECHNICIAN II	4.19 FUEL PRESSURE TEST, General
HD-48856	AXLE ALIGNMENT PLUG SET	1.16 REAR BELT DEFLECTION, Wheel Alignment
HD-48921	REAR WHEEL COMPENSATOR SPROCKET BEARING REMOVER/INSTALLER	D.1 COMPENSATING SPROCKET, Sprocket Bearing Replacement

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
HD-49096	OIL LINE REMOVER, 3/8 IN.	3.14 PRECISION COOLING SYSTEM: XR MODELS, General
HD-59000B	OIL LEVEL GAUGE	1.22 FRONT FORK OIL, Changing Fork Oil: XR Models
HD-59000B	OIL LEVEL GAUGE	1.22 FRONT FORK OIL, Changing Fork Oil: XR Models
HD-59000B	OIL LEVEL GAUGE	2.22 FRONT FORK: XR MODELS, Assembly
HD-59000B	OIL LEVEL GAUGE	2.22 FRONT FORK: XR MODELS, Assembly
HD-59000-B	HARLEY-DAVIDSON PRO-LEVEL OIL GAUGE	1.22 FRONT FORK OIL, Changing Fork Oil: XL Models
HD-94681-80	SPOKE WRENCH	2.8 TRUING LACED WHEELS, Lateral Truing
HD-94800-26A	CONNECTING ROD BUSHING REAMER	3.22 CYLINDER AND PISTON, Connecting Rod Bushings
HD-94803-67	REAR INTAKE CAM GEAR BUSHING REAMER	3.20 GEARCASE COVER AND CAM GEARS, Bushing Reaming: XL Only
HD-94804-57	ROCKER ARM BUSHING REAMER	3.21 CYLINDER HEAD, Replacing Rocker Arm Bushings
HD-94812-1	PINION SHAFT BUSHING REAMER	3.20 GEARCASE COVER AND CAM GEARS, Bushing Reaming: XL Only
HD-94812-87	PINION SHAFT BUSHING REAMER	3.20 GEARCASE COVER AND CAM GEARS, Bushing Reaming: XL Only
HD-94820-75A	SPANNER WRENCH	1.20 SHOCK ABSORBER ADJUSTMENT, Shock Absorber Preload Adjustment: Sportster Models
HD-95637-46B	CLAW PULLER WEDGE ATTACHMENT	3.23 CRANKCASE, Disassembly
HD-95637-46B	BEARING RACE PULLER	5.12 MAIN DRIVE GEAR AND BEARING, Disassembly
HD-95760-69A	BUSHING AND BEARING PULLER	3.20 GEARCASE COVER AND CAM GEARS, Bushing Inspection and Removal: XL Only
HD-95760-69A	BUSHING AND BEARING PULLER	5.13 TRANSMISSION RIGHT CASE BEARINGS, Removal
HD-95765-69A	1/2 IN. COLLET	5.13 TRANSMISSION RIGHT CASE BEARINGS, Removal
HD-95952-33C	CONNECTING ROD CLAMPING TOOL	3.22 CYLINDER AND PISTON, Connecting Rod Bushings
HD-95970-32D	CONNECTING ROD BUSHING REMOVER/INSTALLER	3.22 CYLINDER AND PISTON, Connecting Rod Bushings
HD-96333-51E	PISTON RING COMPRESSOR	3.16 TOP END OVERHAUL: ASSEMBLY, Piston and Cylinder
HD-96710-40C	CRANKCASE MAIN BEARING LAPPING TOOL	3.23 CRANKCASE, Lapping Engine Main Bearing Races
HD-96718-87	CRANKCASE MAIN BEARING LAP	3.23 CRANKCASE, Lapping Engine Main Bearing Races
HD-96796-47	VALVE SPRING TESTER	3.21 CYLINDER HEAD, Cleaning and Inspection
HD-96921-125	OIL PRESSURE GAUGE ADAPTER	3.4 OIL PRESSURE, Checking Oil Pressure
HD-96921-52D	OIL PRESSURE TEST GAUGE KIT	3.4 OIL PRESSURE, Checking Oil Pressure
HD-96925-58	OIL PRESSURE GAUGE ADAPTER	3.4 OIL PRESSURE, Checking Oil Pressure
HD-99500-80	WHEEL TRUING STAND	2.8 TRUING LACED WHEELS, Lateral Truing
HD-99500-80	WHEEL TRUING AND BALANCING STAND	2.9 CHECKING CAST WHEEL RUNOUT, Radial Runout
J-21686-12	FORCING SCREW	3.23 CRANKCASE, Fitting Pinion Bearings
J-21686-12	FORCING SCREW	3.23 CRANKCASE, Fitting Pinion Bearings

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
J-5586-A	TRANSMISSION SHAFT RETAINING RING PLIERS	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Crankcase
J-5586-A	TRANSMISSION SHAFT RETAINING RING PLIERS	3.23 CRANKCASE, Disassembly
J-5586-A	TRANSMISSION SHAFT RETAINING RING PLIERS	5.10 TRANSMISSION REMOVAL AND DISASSEMBLY, Mainshaft Disassembly
J-7830-5	BRIDGE	3.23 CRANKCASE, Fitting Pinion Bearings
J-7830-5	BRIDGE	3.23 CRANKCASE, Fitting Pinion Bearings
PFSX916	SNAP-ON WRENCH	4.15 EXHAUST SYSTEM: XL MODELS, General
PR-36	SNAP-ON SNAP RING PLIERS	5.14 TRANSMISSION LEFT CASE BEARINGS, Removal
SNAP-ON TOOLS STOCK NO. CJ950	BEARING SEPARATOR	3.23 CRANKCASE, Fitting Pinion Bearings
SNAP-ON TOOLS STOCK NO. CJ950	BEARING SEPARATOR	3.23 CRANKCASE, Fitting Pinion Bearings
SNAP-ON TT600-3	SNAP-ON PICK	A.13 PACKARD 630 METRI-PACK CONNECTORS, 630 Metri-Pack Connector Repair



2009 Sportster Models Service Manual

FASTENER	TORQUE VALUE		NOTES
Air cleaner breather screw	120-144 in-lbs	13.6-16.3 Nm	4.4 AIR CLEANER: XL MODELS, Installation
Air cleaner cover screw	36-60 in-lbs	4.1-6.8 Nm	1.4 MAINTENANCE SCHEDULE, General
Air cleaner cover screw	36-60 in-lbs	4.1-6.8 Nm	1.24 AIR CLEANER: XL MODELS, Installation
Air cleaner cover screw	36-60 in-lbs	4.1-6.8 Nm	4.4 AIR CLEANER: XL MODELS, Installation
Air filter element screw	40-60 in-lbs	4.5-6.8 Nm	1.4 MAINTENANCE SCHEDULE, General
Air filter element screw	40-60 in-lbs	4.5-6.8 Nm	1.24 AIR CLEANER: XL MODELS, Installation
Air filter screw	40-60 in-lbs	4.5-6.8 Nm	4.4 AIR CLEANER: XL MODELS, Installation
Alternator rotor-to-sprocket screw	120-140 in-lbs	13.6-15.8 Nm	6.29 ALTERNATOR, Assembly and Installation
Alternator stator mounting screw	30-40 in-lbs	3.4-4.5 Nm	6.29 ALTERNATOR, Assembly and Installation
Anti-rotation device mounting screw	80-110 in-lbs	9.0-12.4 Nm	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Tappets
Axle (front) pinch screw	21-27 ft-lbs	28.5-36.6 Nm	2.11 FRONT BRAKE CALIPER: XL MODELS, Installation
Axle (front) pinch screw	41-48 in-lbs	55.6-65.1 Nm	2.12 FRONT BRAKE CALIPER: XR MODELS, Installation
Axle (front) pinch screw: XL Models	21-27 ft-lbs	28.5-36.6 Nm	2.4 WHEELS, Front Wheel
Axle (front) pinch screw: XR Models	41-48 ft-lbs	55.6-65.1 Nm	2.4 WHEELS, Front Wheel
Axle nut, front	60-65 ft-lbs	81-88 Nm	2.4 WHEELS, General
Axle nut, front	60-65 ft-lbs	81-88 Nm	2.4 WHEELS, Front Wheel
Axle nut, front	60-65 ft-lbs	81-88 Nm	2.11 FRONT BRAKE CALIPER: XL MODELS, Installation
Axle nut, front	60-65 ft-lbs	81-88 Nm	2.12 FRONT BRAKE CALIPER: XR MODELS, Installation
Axle nut, rear	95-105 ft-lbs	129-142 Nm	1.16 REAR BELT DEFLECTION, Belt Deflection Adjustment
Axle nut, rear	95-105 ft-lbs	129-142 Nm	1.16 REAR BELT DEFLECTION, Wheel Alignment
Axle nut, rear	95-105 ft-lbs	129-142 Nm	2.4 WHEELS, General
Axle nut, rear	95-105 ft-lbs	129-142 Nm	2.4 WHEELS, Rear Wheel
Axle nut, rear	95-105 ft-lbs	129-142 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Axle nut, rear	95-105 ft-lbs	129-142 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Axle nut, rear	95-105 ft-lbs	129-142 Nm	5.7 DRIVE BELT, Installation
Axle nut, rear	95-105 ft-lbs	129-142 Nm	5.7 DRIVE BELT, Installation
Ball head studs (front turn signals)	96-156 in-lbs	10.8-17.6 Nm	6.24 TURN SIGNALS, Front Housing Replacement
Battery cable connector nut	55-75 in-lbs	6.2-8.5 Nm	1.17 BATTERY MAINTENANCE, Battery Installation and Connection
Battery negative cable-to-crankcase nut	55-75 in-lbs	6.2-8.5 Nm	6.11 BATTERY CABLES, Installation
Battery negative terminal screw	60-70 in-lbs	6.8-7.9 Nm	1.4 MAINTENANCE SCHEDULE, General
Battery negative terminal screw	60-70 in-lbs	6.8-7.9 Nm	1.17 BATTERY MAINTENANCE, Battery Installation and Connection
Battery negative terminal screw	60-70 in-lbs	6.8-7.9 Nm	6.11 BATTERY CABLES, Installation
Battery positive terminal screw	60-70 in-lbs	6.8-7.9 Nm	1.17 BATTERY MAINTENANCE, Battery Installation and Connection
Battery positive terminal screw	60-70 in-lbs	6.8-7.9 Nm	6.11 BATTERY CABLES, Installation
Battery strap screw	36-60 in-lbs	4.1-6.8 Nm	1.17 BATTERY MAINTENANCE, Battery Installation and Connection
Battery strap screw	36-60 in-lbs	4.1-6.8 Nm	6.11 BATTERY CABLES, Installation
Battery terminal bolts	60-70 in-lbs	6.8-7.9 Nm	2.22 FRONT FORK: XR MODELS, Installation

2009 Sportster Models Service Manual

FASTENER	TORQUE VALUE		NOTES
Battery tray mounting screw	96-156 in-lbs	10.9-17.6 Nm	6.12 BATTERY TRAY, Installation
Belt guard screw, front	120-180 in-lbs	13.6-20.3 Nm	5.7 DRIVE BELT, Installation
Belt guard screw, front (XL)	120-180 in-lbs	13.6-20.4 Nm	2.24 BELT GUARD AND DEBRIS DEFLECTOR, Belt Guard: XL Models
Belt guard screw (XR), front	72-96 in-lbs	8.1-10.8 Nm	2.24 BELT GUARD AND DEBRIS DEFLECTOR, Belt Guard: XR Models
Bleeder valve	35-61 in-lbs	4.0-6.9 Nm	1.8 BLEEDING HYDRAULIC BRAKE SYSTEM, Bleeding Front Brake: All Models
Bleeder valve	35-61 in-lbs	4.0-6.9 Nm	1.8 BLEEDING HYDRAULIC BRAKE SYSTEM, Bleeding Rear Brake: All Models
Brake (rear) disc screw	30-45 ft-lbs	40.7-61.1 Nm	2.4 WHEELS, Rear Wheel
Brake (rear) hose clamp-to-frame screw	30-40 in-lbs	3.4-4.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Brake (rear) lamp switch screw	72-120 in-lbs	8.1-13.6 Nm	6.12 BATTERY TRAY, Installation
Brake (rear) line/switch tee bracket screw	72-120 in-lbs	8.14-13.6 Nm	2.18 BRAKE LINES, Rear Brake Line: XL Models
Brake (rear) line/switch tee bracket screw	17-22 in-lbs	1.9-2.5 Nm	2.18 BRAKE LINES, Rear Brake Line: XR Models
Brake bridge bolt, front caliper	12-18 ft-lbs	16.9-24.5 Nm	2.12 FRONT BRAKE CALIPER: XR MODELS, Assembly
Brake caliper bleeder valve	35-61 in-lbs	4.0-6.9 Nm	2.10 FRONT BRAKE MASTER CYLINDER, Installation
Brake caliper bleeder valve	35-61 in-lbs	4.0-6.9 Nm	2.11 FRONT BRAKE CALIPER: XL MODELS, Assembly
Brake caliper bleeder valve	35-61 in-lbs	4.0-6.9 Nm	2.12 FRONT BRAKE CALIPER: XR MODELS, Assembly
Brake caliper bleeder valve	35-61 in-lbs	4.0-6.9 Nm	2.18 BRAKE LINES, Front Brake Line: All Models
Brake caliper bleeder valve	35-61 in-lbs	4.0-6.9 Nm	2.18 BRAKE LINES, Rear Brake Line: XL Models
Brake caliper bleeder valve	35-61 in-lbs	4.0-6.9 Nm	2.18 BRAKE LINES, Rear Brake Line: XR Models
Brake disc mounting screw	16-24 ft-lbs	21.7-32.6 Nm	2.4 WHEELS, Front Wheel/Cast front wheel
Brake disc mounting screw	16-24 ft-lbs	21.7-32.6 Nm	2.4 WHEELS, Front Wheel/Cast front wheel
Brake disc mounting screw	16-24 ft-lbs	21.7-32.6 Nm	2.4 WHEELS, Front Wheel/Laced front wheel
Brake front caliper mounting bolt	28-38 ft-lbs	38.0-51.6 Nm	2.11 FRONT BRAKE CALIPER: XL MODELS, Installation
Brake front caliper mounting bolt	28-38 ft-lbs	38.0-51.6 Nm	2.12 FRONT BRAKE CALIPER: XR MODELS, Installation
Brake front cover master cylinder reservoir cover screw	9-17 in-lbs	1.0-2.0 Nm	2.10 FRONT BRAKE MASTER CYLINDER, Installation
Brake front master cylinder clamp screw	108-132 in-lbs	12.2-14.9 Nm	2.10 FRONT BRAKE MASTER CYLINDER, Installation
Brake front master cylinder reservoir cover screw	9-17 in-lbs	1.0-2.0 Nm	2.11 FRONT BRAKE CALIPER: XL MODELS, Installation
Brake hose clamp-to-battery tray screw	30-40 in-lbs	3.4-4.5 Nm	2.18 BRAKE LINES, Rear Brake Line: XL Models
Brake hose clamp-to-battery tray screw	30-40 in-lbs	3.4-4.5 Nm	6.12 BATTERY TRAY, Installation
Brake hose clamp-to-rear fork screw	30-40 in-lbs	3.4-4.5 Nm	1.16 REAR BELT DEFLECTION, Belt Deflection Adjustment
Brake hose clamp-to-rear fork screw	30-40 in-lbs	3.4-4.5 Nm	2.18 BRAKE LINES, Rear Brake Line: XL Models

2009 Sportster Models Service Manual

FASTENER	TORQUE VALUE		NOTES
Brake lamp switch, rear	80-123 in-lbs	9.0-13.9 Nm	2.18 BRAKE LINES, Rear Brake Line: XL Models
Brake lamp switch, rear	80-123 in-lbs	9.0-13.9 Nm	2.18 BRAKE LINES, Rear Brake Line: XR Models
Brake line banjo bolt	20-25 ft-lbs	27.1-33.9 Nm	2.10 FRONT BRAKE MASTER CYLINDER, Installation
Brake line banjo bolt	20-25 ft-lbs	27.1-33.9 Nm	2.11 FRONT BRAKE CALIPER: XL MODELS, Installation
Brake line banjo bolt	20-25 ft-lbs	27.1-33.9 Nm	2.12 FRONT BRAKE CALIPER: XR MODELS, Installation
Brake line banjo bolt	20-25 ft-lbs	27.1-33.9 Nm	2.16 REAR BRAKE CALIPER: XL MODELS, Installation
Brake line banjo bolt	20-25 ft-lbs	27.1-33.9 Nm	2.17 REAR BRAKE CALIPER: XR MODELS, Installation
Brake line banjo bolt	20-25 ft-lbs	27.1-33.9 Nm	2.18 BRAKE LINES, Front Brake Line: All Models
Brake line banjo bolt	20-25 ft-lbs	27.1-33.9 Nm	2.18 BRAKE LINES, Front Brake Line: All Models
Brake line banjo bolt	20-25 ft-lbs	27.1-33.9 Nm	2.18 BRAKE LINES, Rear Brake Line: XL Models
Brake line banjo bolt	20-25 ft-lbs	27.1-33.9 Nm	2.18 BRAKE LINES, Rear Brake Line: XR Models
Brake line-to-front fork bracket clamp screw	45-65 in-lbs	5.1-7.4 Nm	2.18 BRAKE LINES, Front Brake Line: All Models
Brake line-to-front fork lower bracket clamp screw	120-168 in-lbs	13.6-19.0 Nm	2.18 BRAKE LINES, Front Brake Line: All Models
Brake pad pin	131-173 in-lbs	14.8-19.6 Nm	1.9 BRAKE PADS AND DISCS: XL MODELS, Brake Pad Replacement: Rear
Brake pad pin	131-173 in-lbs	14.8-19.6 Nm	1.10 BRAKE PADS AND DISCS: XR MODELS, Brake Pad Replacement: Rear
Brake pad pin	131-173 in-lbs	14.8-19.6 Nm	2.11 FRONT BRAKE CALIPER: XL MODELS, Installing Brake Pads in Caliper
Brake pad pin	131-173 in-lbs	14.8-19.6 Nm	2.16 REAR BRAKE CALIPER: XL MODELS, Installation
Brake pad pin, front caliper	11-14 ft-lbs	14.7-19.6 Nm	2.12 FRONT BRAKE CALIPER: XR MODELS, Assembly
Brake pad pin plug	18-25 in-lbs	2.0-2.9 Nm	1.9 BRAKE PADS AND DISCS: XL MODELS, Brake Pad Replacement: Front
Brake pad pin plug	18-25 in-lbs	2.0-2.9 Nm	1.9 BRAKE PADS AND DISCS: XL MODELS, Brake Pad Replacement: Rear
Brake pad pin plug	18-25 in-lbs	2.0-2.9 Nm	1.10 BRAKE PADS AND DISCS: XR MODELS, Brake Pad Replacement: Rear
Brake pad pin plug	18-25 in-lbs	2.0-2.9 Nm	2.11 FRONT BRAKE CALIPER: XL MODELS, Installing Brake Pads in Caliper
Brake pad pin plug	18-25 in-lbs	2.0-2.9 Nm	2.16 REAR BRAKE CALIPER: XL MODELS, Installation
Brake pad pins, front caliper	131-173 in-lbs	14.8-19.6 Nm	1.10 BRAKE PADS AND DISCS: XR MODELS, Brake Pad Replacement: Front
Brake pedal clevis screw	96-156 in-lbs	10.9-17.6 Nm	2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS, Right Footrest and Rear Brake Pedal Assembly
Brake pedal clevis screw	96-156 in-lbs	10.9-17.6 Nm	2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS, Right Footrest and Rear Brake Pedal Assembly

2009 Sportster Models Service Manual

FASTENER	TORQUE VALUE		NOTES
Brake rear master cylinder banjo bolt; XL models	20-25 ft-lbs	27.1-33.9 Nm	2.13 REAR BRAKE MASTER CYLINDER: XL MODELS, Installation
Brake rear master cylinder banjo bolt; XR models	20-25 ft-lbs	27.1-33.9 Nm	2.14 REAR BRAKE MASTER CYLINDER: XR MODELS, Installation
Brake rear master cylinder mounting bracket screw; XL models	17-22 ft-lbs	23.1-29.9 Nm	2.13 REAR BRAKE MASTER CYLINDER: XL MODELS, Installation
Brake rear master cylinder mounting bracket screw; XL models	17-22 ft-lbs	23.1-29.9 Nm	2.13 REAR BRAKE MASTER CYLINDER: XL MODELS, Installation
Brake rear master cylinder mounting screw; XL models	17-22 ft-lbs	23.1-29.9 Nm	2.13 REAR BRAKE MASTER CYLINDER: XL MODELS, Installation
Brake rear master cylinder mounting screw; XR models	72-96 in-lbs	8.1-10.9 Nm	2.14 REAR BRAKE MASTER CYLINDER: XR MODELS, Installation
Brake rear master cylinder pushrod nut; XR models	130-173 in-lbs	14.7-19.6 Nm	2.14 REAR BRAKE MASTER CYLINDER: XR MODELS, Assembly
Brake rear master cylinder pushrod shoulder nut	130-173 in-lbs	14.7-19.6 Nm	2.13 REAR BRAKE MASTER CYLINDER: XL MODELS, Assembly
Brake rear master cylinder reservoir mounting screw	20-25 in-lbs	2.3-2.8 Nm	2.15 REAR BRAKE MASTER CYLINDER RESERVOIR, Installation: XL Models
Brake rear master cylinder reservoir mounting screw	20-25 in-lbs	2.3-2.8 Nm	2.25 REAR FORK, Installation
Brake rear master cylinder reservoir mounting screw	20-25 in-lbs	2.3-2.8 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Brake rear master cylinder reservoir mounting screw	20-25 in-lbs	2.3-2.8 Nm	6.12 BATTERY TRAY, Installation
Brake rear master cylinder reservoir mounting screw	20-25 in-lbs	2.3-2.8 Nm	6.27 REAR STOP LAMP SWITCH, Replacement
Brake rear master cylinder reservoir mounting screw; XR models	36-60 in-lbs	4.1-6.8 Nm	2.15 REAR BRAKE MASTER CYLINDER RESERVOIR, Installation: XR Models
Brake rod-to-bell crank screw	120-180 in-lbs	13.6-20.4 Nm	2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS, Right Footrest and Rear Brake Pedal Assembly
Brake rod-to-bell crank screw	120-180 in-lbs	13.6-20.4 Nm	2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS, Right Footrest and Rear Brake Pedal Assembly
Brake rod-to-bell crank screw	120-180 in-lbs	13.6-20.4 Nm	4.15 EXHAUST SYSTEM: XL MODELS, Installation
Brake rod-to-brake pedal screw	120-180 in-lbs	13.6-20.4 Nm	2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS, Right Footrest and Rear Brake Pedal Assembly
Brake rod-to-brake pedal screw	120-180 in-lbs	13.6-20.4 Nm	2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS, Right Footrest and Rear Brake Pedal Assembly
Breather screw	35-55 in-lbs	4.0-6.2 Nm	3.16 TOP END OVERHAUL: ASSEMBLY, Rocker Covers
Caliper pad pin	131-173 in-lbs	14.8-19.6 Nm	1.9 BRAKE PADS AND DISCS: XL MODELS, Brake Pad Replacement: Front
Captive screw	9-17 in-lbs	1.0-2.0 Nm	1.8 BLEEDING HYDRAULIC BRAKE SYSTEM, Bleeding Front Brake: All Models
Captive screw	9-17 in-lbs	1.0-2.0 Nm	1.9 BRAKE PADS AND DISCS: XL MODELS, Brake Pad Replacement: Front

2009 Sportster Models Service Manual

FASTENER	TORQUE VALUE		NOTES
Chain tensioner nut	20-25 ft-lbs	27.1-33.9 Nm	1.4 MAINTENANCE SCHEDULE, General
Clutch cable end fitting	36-108 in-lbs	4.1-12.2 Nm	2.31 CLUTCH CONTROL, Assembly and Installation
Clutch cable end fitting	36-60 in-lbs	4.1-6.8 Nm	5.3 PRIMARY CHAIN ADJUSTER, Installation
Clutch inspection cover screw	84-108 in-lbs	9.5-12.2 Nm	1.4 MAINTENANCE SCHEDULE, General
Clutch inspection cover screw	84-108 in-lbs	9.5-12.2 Nm	1.13 CLUTCH, Adjustment
Clutch inspection cover screw	84-108 in-lbs	9.5-12.2 Nm	1.14 TRANSMISSION LUBRICANT, Transmission Lubrication: Sportster Models
Clutch inspection cover screw	84-108 in-lbs	9.5-12.2 Nm	2.31 CLUTCH CONTROL, Assembly and Installation
Clutch inspection cover screw	84-108 in-lbs	9.5-12.2 Nm	5.3 PRIMARY CHAIN ADJUSTER, Installation
Clutch inspection cover screw	84-108 in-lbs	9.5-12.2 Nm	5.4 CLUTCH RELEASE MECHANISM, Assembly and Installation
Clutch lever anti-rattle spring screw	8-13 in-lbs	0.9-1.5 Nm	2.31 CLUTCH CONTROL, Assembly and Installation
Clutch lever handlebar clamp screw	108-132 in-lbs	12.2-14.9 Nm	2.31 CLUTCH CONTROL, Assembly and Installation
Clutch lever handlebar clamp screw	108-132 in-lbs	12.2-14.9 Nm	2.32 HANDLEBARS, Installation
Coil mounting bracket screw	35-45 in-lbs	4.0-5.1 Nm	6.19 IGNITION COIL, Installation
Coil mounting screw	24-72 in-lbs	2.7-8.1 Nm	6.19 IGNITION COIL, Installation
Coil mounting screw	24-72 in-lbs	2.7-8.1 Nm	6.19 IGNITION COIL, Installation
Countershaft retaining screw	33-37 ft-lbs	44.8-50.2 Nm	5.15 TRANSMISSION INSTALLATION, Shifter Shaft Installation
Crankcase fastener	15-19 ft-lbs	20.3-25.8 Nm	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Crankcase
Crankcase fastener	15-19 ft-lbs	20.3-25.8 Nm	5.15 TRANSMISSION INSTALLATION, Assembling Crankcases
Crank position sensor (CKP) screw	80-100 in-lbs	9.0-11.3 Nm	6.28 CRANK POSITION SENSOR (CKP), Installation
Cylinder head bolts	96-120 in-lbs	11-14 Nm	3.16 TOP END OVERHAUL: ASSEMBLY, Cylinder Head/See procedure
Cylinder head bolts	13-15 ft-lbs	18-20 Nm	3.16 TOP END OVERHAUL: ASSEMBLY, Cylinder Head/See procedure
Cylinder head bolts	96-120 in-lbs	11-14 Nm	3.16 TOP END OVERHAUL: ASSEMBLY, Cylinder Head/See procedure
Cylinder head bolts	13-15 ft-lbs	18-20 Nm	3.16 TOP END OVERHAUL: ASSEMBLY, Cylinder Head/See procedure
Cylinder head bracket screw	17-24 ft-lbs	23.1-32.6 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Cylinder head bracket screw	17-24 ft-lbs	23.1-32.6 Nm	3.16 TOP END OVERHAUL: ASSEMBLY, Assembling Motorcycle After Top End Repair
Cylinder head bracket screw	17-24 ft-lbs	23.1-32.6 Nm	4.17 FUEL INJECTORS, Installation
Cylinder head exhaust port nut	96-120 in-lbs	10.9-13.6 Nm	2.10 FRONT BRAKE MASTER CYLINDER, Installation
Cylinder head exhaust port nut	96-120 in-lbs	10.9-13.6 Nm	4.15 EXHAUST SYSTEM: XL MODELS, Installation

2009 Sportster Models Service Manual

FASTENER	TORQUE VALUE		NOTES
Cylinder head oil feed flare fitting, Precision Cooling	22-26 ft-lbs	29.8-35.3 Nm	3.14 PRECISION COOLING SYSTEM: XR MODELS, Cylinder Head Oil Feed Assembly
Cylinder head oil feed flare fitting, Precision Cooling	22-26 ft-lbs	29.8-35.3 Nm	4.11 INDUCTION MODULE: XR MODELS, Installation
Cylinder head oil feed line flare nut, Precision Cooling	13-17 ft-lbs	17.6-23.0 Nm	3.14 PRECISION COOLING SYSTEM: XR MODELS, Cylinder Head Oil Feed Assembly
Cylinder head oil feed line flare nut, Precision Cooling	13-17 ft-lbs	17.6-23.0 Nm	4.11 INDUCTION MODULE: XR MODELS, Installation
Cylinder stud	120-240 in-lbs	13.6-27.1 Nm	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Crankcase
Debris deflector screw (XL)	36-60 in-lbs	4.1-6.8 Nm	2.24 BELT GUARD AND DEBRIS DEFLECTOR, Debris Deflector: XL Models
Debris deflector screw (XR)	72-96 in-lbs	8.1-10.8 Nm	2.24 BELT GUARD AND DEBRIS DEFLECTOR, Debris Deflector: XR Models
ECM fasteners: XR models	18-22 in-lbs	2.0-2.5 Nm	6.17 ELECTRONIC CONTROL MODULE (ECM), Installation
Engine mount (front) bolt	60-70 ft-lbs	81.4-95.0 Nm	2.28 FRONT ENGINE MOUNT/ISOLATOR, Installation
Engine sprocket bolt: XR Models	155-165 ft-lbs	210.0-224.0 Nm	5.6 PRIMARY DRIVE AND CLUTCH: XR MODELS, Installation
Engine sprocket nut	240-260 ft-lbs	326-353 Nm	5.5 PRIMARY DRIVE AND CLUTCH: XL MODELS, Installation
Engine temperature sensor	120-168 in-lbs	13.6-19.0 Nm	4.9 ENGINE TEMPERATURE (ET) SENSOR, Installation
EVAP canister clip mounting screw	36-60 in-lbs	4.1-6.8 Nm	4.21 EVAPORATIVE EMISSIONS CONTROL (CA MODELS), Charcoal Canister
EVAP canister guard screw	35-45 in-lbs	4.0-5.1 Nm	4.21 EVAPORATIVE EMISSIONS CONTROL (CA MODELS), Charcoal Canister
EVAP canister mounting bracket screw	17-22 ft-lbs	23.1-29.9 Nm	4.21 EVAPORATIVE EMISSIONS CONTROL (CA MODELS), Charcoal Canister
EVAP canister mounting bracket screw	17-22 ft-lbs	23.1-29.9 Nm	4.21 EVAPORATIVE EMISSIONS CONTROL (CA MODELS), Charcoal Canister
Exhaust flange nut	96-120 in-lbs	10.8-13.6 Nm	4.16 EXHAUST SYSTEM: XR MODELS, Installation
Exhaust pipe clamp (rear) nut	15-19 ft-lbs	20.4-25.8 Nm	4.15 EXHAUST SYSTEM: XL MODELS, Installation
Exhaust pipe clamp bracket final screws	80-120 in-lbs	9.0-13.6 Nm	5.7 DRIVE BELT, Installation
Exhaust pipe clamp bracket initial screw	30-33 ft-lbs	40.7-44.8 Nm	5.7 DRIVE BELT, Installation
Exhaust pipe clamp bracket screw	30-33 ft-lbs	40.7-44.8 Nm	2.29 REAR ENGINE MOUNT/ISOLATOR, Installation
Exhaust pipe clamp bracket screw	30-33 ft-lbs	40.7-44.8 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Exhaust pipe clamp bracket screw	30-33 ft-lbs	40.7-44.8 Nm	4.15 EXHAUST SYSTEM: XL MODELS, Installation
Exhaust pipe clamp bracket screw	30-33 ft-lbs	40.7-44.8 Nm	5.16 TRANSMISSION SPROCKET, Installation
Fender (front) mounting screw	96-156 in-lbs	10.9-17.6 Nm	2.21 FRONT FORK: XL MODELS, Installation
Fender (rear) mounting screw	132-216 in-lbs	14.9-24.4 Nm	2.34 REAR FENDER: ALL XL MODELS EXCEPT XL 1200N, Installation
Fender support screw with washer	132-216 in-lbs	14.9-24.4 Nm	6.25 LICENSE PLATE LAMP MODULE: XL 1200N, Installation (HDI Only)

2009 Sportster Models Service Manual

FASTENER	TORQUE VALUE		NOTES
Filler housing screws	40-45 in-lbs	4.5-5.1 Nm	4.7 FUEL TANK: XR MODELS, Assemble Fuel Tank
Footrest bracket fastener	45-50 ft-lbs	61.0-67.8 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Footrest bracket fastener: XR models	45-50 ft-lbs	61.0-67.8 Nm	2.42 RIDER FOOT CONTROLS: XR MODELS, Left Footrest and Shift Lever Assembly
Footrest bracket screw (XR)	45-50 ft-lbs	61-68 Nm)	2.43 PASSENGER FOOTRESTS, XR Models
Footrest clevis fastener: XR models	20-24 ft-lbs	27.1-32.5 Nm	2.42 RIDER FOOT CONTROLS: XR MODELS, Right Footrest and Rear Brake Pedal Assembly
Footrest clevis fastener: XR models	20-24 ft-lbs	27.1-32.5 Nm	2.42 RIDER FOOT CONTROLS: XR MODELS, Left Footrest and Shift Lever Assembly
Footrest mount fastener	45-50 ft-lb	61.0-67.8 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Footrest mount fastener: XR models	45-50 ft-lb	61.0-67.8 Nm	1.13 CLUTCH, Adjustment
Footrest mount fastener: XR models	45-50 ft-lb	61.0-67.8 Nm	1.14 TRANSMISSION LUBRICANT, Transmission Lubrication: Sportster Models
Footrest wear peg	72-108 in-lbs	8.1-12.2 Nm	2.42 RIDER FOOT CONTROLS: XR MODELS, Right Footrest and Rear Brake Pedal Assembly
Footrest wear peg	72-108 in-lbs	8.1-12.2 Nm	2.42 RIDER FOOT CONTROLS: XR MODELS, Left Footrest and Shift Lever Assembly
Fork cap: XR models	21-29 ft-lbs	29-39 Nm	1.22 FRONT FORK OIL, Changing Fork Oil: XR Models
Fork cap: XR models	21-29 ft-lbs	29-39 Nm	1.22 FRONT FORK OIL, Changing Fork Oil: XR Models
Fork cap: XR models	150-195 in-lbs	17-22 Nm	2.22 FRONT FORK: XR MODELS, Assembly
Fork cap: XR models	21-29 ft-lbs	29-39 Nm	2.22 FRONT FORK: XR MODELS, Assembly/Second torque. Tighten to this torque second.
Fork cap: XR models	21-29 ft-lbs	29-39 Nm	2.22 FRONT FORK: XR MODELS, Assembly
Fork cap to retainer nut: XR models	150-195 in-lbs	17-22 Nm	1.22 FRONT FORK OIL, Changing Fork Oil: XR Models
Fork cap to retainer nut: XR models	150-195 in-lbs	17-22 Nm	1.22 FRONT FORK OIL, Changing Fork Oil: XR Models
Fork cap to retainer nut: XR models	150-195 in-lbs	17-22 Nm	2.22 FRONT FORK: XR MODELS, Assembly
Fork cartridge fastener	132-216 in-lbs	14.9-24.4 Nm	2.22 FRONT FORK: XR MODELS, Assembly
Fork slider tube cap	22-58 ft-lbs	29.9-78.7 Nm	1.22 FRONT FORK OIL, Changing Fork Oil: XL Models
Fork slider tube cap	22-58 ft-lbs	29.9-78.7 Nm	1.22 FRONT FORK OIL, Changing Fork Oil: XL Models
Fork slider tube fastener	132-216 in-lbs	14.9-24.4 Nm	2.21 FRONT FORK: XL MODELS, Assembly
Fork stem bolt, final	72-96 in-lbs	8.1-10.9 Nm	2.23 FORK STEM AND BRACKET ASSEMBLY, Assembly and Installation
Fork stem bolt, initial	23-27 ft-lbs	31.2-36.6 Nm	2.23 FORK STEM AND BRACKET ASSEMBLY, Assembly and Installation
Fork stem pinch screw	30-35 ft-lbs	40.7-47.5 Nm	1.19 STEERING HEAD BEARINGS, Adjustment

2009 Sportster Models Service Manual

FASTENER	TORQUE VALUE		NOTES
Fork stem pinch screw	30-35 ft-lbs	40.7-47.5 Nm	2.23 FORK STEM AND BRACKET ASSEMBLY, Assembly and Installation
Forward and lower sprocket cover screws: XR models	80-120 in-lbs	9.0-13.6 Nm	2.29 REAR ENGINE MOUNT/ISOLATOR, Installation
Forward and lower sprocket cover screws: XR models	80-120 in-lbs	9.0-13.6 Nm	5.7 DRIVE BELT, Installation
Front cylinder oil line retainer nut	84-108 in-lbs	9.5-12.2 Nm	3.14 PRECISION COOLING SYSTEM: XR MODELS, Cylinder Head Oil Return Lines
Front engine mount bolt	60-70 ft-lbs	81.4-95.0 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Front engine mount bolt	60-70 ft-lbs	81.4-95.0 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Front fender (XL) mounting screw	96-156 in-lbs	10.9-17.6 Nm	2.33 FRONT FENDER, XL Models
Front fender (XR) mounting screw	15-19 ft-lbs	20.4-25.8 Nm	2.33 FRONT FENDER, XR Models
Front fender bracket (XR) screw	36-60 in-lbs	4.1-6.8 Nm	2.33 FRONT FENDER, XR Models
Front fork bracket pinch screw	30-35 ft-lbs	40.7-47.5 Nm	2.21 FRONT FORK: XL MODELS, Installation
Front fork bracket pinch screw	30-35 ft-lbs	40.7-47.5 Nm	2.22 FRONT FORK: XR MODELS, Installation
Front fork lower bracket pinch screw	30-35 ft-lbs	40.7-47.5 Nm	1.19 STEERING HEAD BEARINGS, Adjustment
Front fork oil drain screw	13-17 in-lbs	1.5-2.0 Nm	1.22 FRONT FORK OIL, Changing Fork Oil: XL Models
Front fork slider tube cap	22-58 ft-lbs	29.9-78.7 Nm	2.21 FRONT FORK: XL MODELS, Installation
Front master cylinder cover screw	9-17 in-lbs	1.0-2.0 Nm	1.10 BRAKE PADS AND DISCS: XR MODELS, Brake Pad Replacement: Front
Front master cylinder cover screw	9-17 in-lbs	1.0-2.0 Nm	2.12 FRONT BRAKE CALIPER: XR MODELS, Installation
Front master cylinder reservoir cover screw	9-17 in-lbs	1.0-2.0 Nm	1.4 MAINTENANCE SCHEDULE, General
Front muffler mount-to-frame fastener	45-50 ft-lbs	61.0-67.8 Nm	4.16 EXHAUST SYSTEM: XR MODELS, Installation
Fuel hose retaining bracket screw	60 in-lbs	6.8 Nm	4.17 FUEL INJECTORS, Installation
Fuel pump/sender harness grounding screw	19-36 in-lbs	2.1-4.1 Nm	4.18 FUEL PUMP, Assembly
Fuel pump bracket mounting screw	19-36 in-lbs	2.1-4.1 Nm	4.18 FUEL PUMP, Assembly
Fuel pump module mounting screw	40-45 in-lbs	4.5-5.1 Nm	1.4 MAINTENANCE SCHEDULE, General
Fuel pump module mounting screw	40-45 in-lbs	4.5-5.1 Nm	1.29 FUEL SUPPLY FILTER, Installation
Fuel pump module mounting screw	40-45 in-lbs	4.5-5.1 Nm	4.18 FUEL PUMP, Installation
Fuel tank cover fastener	24-30 in-lbs	2.7-3.4 Nm	4.7 FUEL TANK: XR MODELS, Installing Fuel Tank
Fuel tank front fastener	15-20 ft-lbs	20.3-27.1 Nm	4.7 FUEL TANK: XR MODELS, Installing Fuel Tank
Fuel tank mounting screw	15-20 ft-lbs	20.4-27.1 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Fuel tank mounting screw	15-20 ft-lbs	20.4-27.1 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Fuel tank mounting screw	15-20 ft-lbs	20.4-27.1 Nm	3.16 TOP END OVERHAUL: ASSEMBLY, Assembling Motorcycle After Top End Repair
Fuel tank mounting screw	15-20 ft-lbs	20.4-27.1 Nm	4.6 FUEL TANK: XL MODELS, Installing Fuel Tank

2009 Sportster Models Service Manual

FASTENER	TORQUE VALUE		NOTES
Fuel tank mounting screw	15-20 ft-lbs	20.4-27.1 Nm	4.10 INDUCTION MODULE: XL MODELS, Installation
Fuel tank mounting screw	15-20 ft-lbs	20.4-27.1 Nm	4.17 FUEL INJECTORS, Installation
Fuel tank rear fastener	15-20 ft-lbs	20.3-27.1 Nm	4.7 FUEL TANK: XR MODELS, Installing Fuel Tank
Gearcase/oil pump housing cover fastener	80-110 in-lbs	9.0-12.4 Nm	3.25 OIL PUMP: XR MODELS, Assembly
Gearcase and oil pump cover fastener	80-110 in-lbs	9.0-12.4 Nm	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Cam Gears and Gearcase Cover: XR Models
Gearcase cover fastener: XR models	80-110 in-lbs	9.0-12.4 Nm	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Cam Gears and Gearcase Cover: XR Models
Gearcase cover screw	80-110 in-lbs	9.0-12.4 Nm	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Cam Gears and Gearcase Cover: XL Models
Gearcase housing plug	108-156 in-lbs	12.2-17.6 Nm	3.25 OIL PUMP: XR MODELS, Assembly
Gear detent assembly screw	90-110 in-lbs	10.2-12.4 Nm	5.15 TRANSMISSION INSTALLATION, Installation
Gear shift lever pinch screw	16-20 ft-lbs	21.7-27.1 Nm	2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS, Left Footrest and Shift Lever Assembly
Gear shift lever pinch screw	16-20 ft-lbs	21.7-27.1 Nm	2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS, Left Footrest and Shift Lever Assembly
Gear shift lever pinch screw	16-20 ft-lbs	21.7-27.1 Nm	5.3 PRIMARY CHAIN ADJUSTER, Installation
Handlebar clamp screw	108-132 in-lbs	12.2-14.9 Nm	1.4 MAINTENANCE SCHEDULE, General
Handlebar clamp screw	12-18 ft-lbs	16.3-24.4 Nm	6.22 INDICATOR LAMP MODULE, Replacement: XL 1200L and XL 1200N/XL 1200L/XL 1200N
Handlebar clamp screw	12-18 ft-lbs	16.3-24.4 Nm	6.22 INDICATOR LAMP MODULE, Replacement: XL 1200L and XL 1200N/XL 1200L/XL 1200N
Handlebar clamp screws	108-132 in-lbs	12.2-14.9 Nm	6.40 RIGHT HANDLEBAR SWITCHES, Installation
Handlebar clamp screws	108-132 in-lbs	12.2-14.9 Nm	6.41 LEFT HANDLEBAR SWITCHES, Installation
Handlebar riser clamp screw	12-18 ft-lbs	16.3 -24.4 Nm	6.22 INDICATOR LAMP MODULE, Replacement: XL 883C and XL 1200C/XL 883C/XL1200C
Handlebar riser clamp screw	12-18 ft-lbs	16.3 -24.4 Nm	6.22 INDICATOR LAMP MODULE, Replacement: XL 883C and XL 1200C/XL 883C/XL1200C
Handlebar riser cover screw	8-12 in-lbs	0.9-1.4 Nm	6.22 INDICATOR LAMP MODULE, Replacement: XL 883C and XL 1200C/XL 883C/XL1200C
Handlebar riser cover screw (XL 883C/XL 1200C)	8-12 in-lbs	0.9-1.4 Nm	2.32 HANDLEBARS, Installation
Handlebar riser mounting bolt (XL 883C/XL 1200C)	30-40 ft-lbs	40.7-54.3 Nm	2.32 HANDLEBARS, Installation
Handlebar switch housing screw	35-45 in-lbs	4.0-5.1 Nm	1.4 MAINTENANCE SCHEDULE, General
Handlebar switch housing screw	35-45 in-lbs	4.0-5.1 Nm	1.27 THROTTLE CONTROL, Cable Inspection and Lubrication
Handlebar switch housing screw	35-45 in-lbs	4.0-5.1 Nm	2.30 THROTTLE CABLES: ALL MODELS, Assembly and Installation
Handlebar switch housing screw	35-45 in-lbs	4.0-5.1 Nm	2.31 CLUTCH CONTROL, Assembly and Installation

2009 Sportster Models Service Manual

FASTENER	TORQUE VALUE		NOTES
Handlebar switch housing screw	35-45 in-lbs	4.0-5.1 Nm	2.32 HANDLEBARS, Installation
Handlebar switch housing screw	35-45 in-lbs	4.0-5.1 Nm	2.32 HANDLEBARS, Installation
Handlebar switch housing screws	35-45 in-lbs	4.0-5.1 Nm	6.40 RIGHT HANDLEBAR SWITCHES, Installation
Handlebar switch housing screws	35-45 in-lbs	4.0-5.1 Nm	6.41 LEFT HANDLEBAR SWITCHES, Installation
Handlebar upper clamp/speedometer housing screw (XL 883C/XL 1200C)	12-18 ft-lbs	16.3-24.4 Nm	2.32 HANDLEBARS, Installation
Handlebar upper clamp/speedometer housing screw (XL 883C/XL 1200C)	12-18 ft-lbs	16.3-24.4 Nm	2.32 HANDLEBARS, Installation
Handlebar upper clamp screw	12-18 in-lbs	16.3-24.4 Nm	6.22 INDICATOR LAMP MODULE, Replacement: All Other Models/all except XL 883C/XL 1200C/XL 1200L/XL 1200N
Headlamp Allen head capscrew	30-35 ft-lbs	40.7-47.5 Nm	1.31 HEADLAMP ALIGNMENT, Headlamp Adjustment: Sportster Models
Headlamp clamp nut	120-240 in-lbs	14-27 Nm	1.31 HEADLAMP ALIGNMENT, Headlamp Adjustment: Sportster Models
High pressure feed hose fitting (to crankcase)	60-90 in-lbs	6.8-10.2 Nm	3.24 OIL PUMP: XL MODELS, Installation
High pressure feed hose fitting nut	85-105 in-lbs	9.6-11.8 Nm	3.24 OIL PUMP: XL MODELS, Installation
Horn, front mounted, mounting screw	72-108 in-lbs	8.1-12.2 Nm	6.37 HORN, Replacement: Models with Front Mounted Horn
Horn, side mounted, acorn nut	60-180 in-lbs	6.8-20.4 Nm	6.37 HORN, Replacement: Models with Side Mounted Horn
Horn, side mounted, stud nut	80-100 in-lbs	9.0-11.3 Nm	6.37 HORN, Replacement: Models with Side Mounted Horn
Hub plate mounting screw	16-24 ft-lbs	21.7-32.6 Nm	2.4 WHEELS, Front Wheel/Cast front wheel
IAC mounting screw	60 in-lbs	6.8 Nm	4.10 INDUCTION MODULE: XL MODELS, Assembly
IAC mounting screw	60 in-lbs	6.8 Nm	4.11 INDUCTION MODULE: XR MODELS, Assembly
IAC mounting screw	60 in-lbs	6.8 Nm	4.12 IDLE AIR CONTROL (IAC), Installation: XL Models
IAC mounting screw (XR models)	60 in-lbs	6.8 Nm	4.12 IDLE AIR CONTROL (IAC), Installation: XR Models
Idler pulley bracket flanged nut: XR models	33-35 ft-lbs	45-47 Nm	5.7 DRIVE BELT, Idler Pulley: XR Models Only
Idler pulley fastener: XR models	70-80 ft-lbs	95-109 Nm	5.7 DRIVE BELT, Idler Pulley: XR Models Only
Ignition/light switch mounting screw	35-45 in-lbs	4.0-5.1 Nm	6.16 IGNITION AND LIGHT SWITCH, Installation
Ignition switch mounting screw	34-45 in-lbs	4.0-5.1 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Ignition switch mounting screw	34-45 in-lbs	4.0-5.1 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Induction module cover-to-cylinder head fastener	20-24 ft-lbs	27.1-32.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Induction module cover-to-cylinder head fastener	20-24 ft-lbs	27.1-32.5 Nm	4.11 INDUCTION MODULE: XR MODELS, Installation
Induction module cover-to-cylinder head fastener	20-24 ft-lbs	27.1-32.5 Nm	4.13 TEMPERATURE MANIFOLD ABSOLUTE PRESSURE (TMAP) SENSOR, Installation: XR Models

2009 Sportster Models Service Manual

FASTENER	TORQUE VALUE		NOTES
Induction module cover-to-induction module fastener	84-108 in-lbs	9.5-12.2 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Induction module cover-to-induction module fastener	84-108 in-lbs	9.5-12.2 Nm	4.11 INDUCTION MODULE: XR MODELS, Installation
Induction module cover-to-induction module fastener	84-108 in-lbs	9.5-12.2 Nm	4.13 TEMPERATURE MANIFOLD ABSOLUTE PRESSURE (TMAP) SENSOR, Installation: XR Models
Induction module cover-to-wire form fastener	84-108 in-lbs	9.5-12.2 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Induction module cover-to-wire form fastener	84-108 in-lbs	9.5-12.2 Nm	4.11 INDUCTION MODULE: XR MODELS, Installation
Induction module cover-to-wire form fastener	84-108 in-lbs	9.5-12.2 Nm	4.13 TEMPERATURE MANIFOLD ABSOLUTE PRESSURE (TMAP) SENSOR, Installation: XR Models
Induction module mounting bracket screw	84-108 in-lbs	9.5-12.2 Nm	4.10 INDUCTION MODULE: XL MODELS, Installation
Induction module-to-intake manifold screw	35 in-lbs	4.0 Nm	4.10 INDUCTION MODULE: XL MODELS, Assembly
Induction module-to-intake manifold screw	60 in-lbs	6.8 Nm	4.10 INDUCTION MODULE: XL MODELS, Assembly
Inner fender screw: XR models	72-120 in-lbs	8.1-13.6 Nm	2.36 REAR FENDER: XR MODELS, Installation
Inner fork nut, right: XR models	69-83 ft-lbs	93-113 Nm	1.22 FRONT FORK OIL, Changing Fork Oil: XR Models/Hand tighten. Then tighten to torque.
Inner fork nut, right: XR models	69-83 ft-lbs	93-113 Nm	2.22 FRONT FORK: XR MODELS, Assembly/Hand tighten. Then tighten to torque.
Inner rocker cover bolt, large	18-22 ft-lbs	24.4-29.8 Nm	3.16 TOP END OVERHAUL: ASSEMBLY, Rocker Covers
Inner rocker cover bolt, small	135-155 in-lbs	15.3-17.5 Nm	3.16 TOP END OVERHAUL: ASSEMBLY, Rocker Covers
Inner rocker cover screw	135-155 in-lbs	15.3-17.5 Nm	3.16 TOP END OVERHAUL: ASSEMBLY, Rocker Covers
Intake manifold mounting screw	96-120 in-lbs	10.9-13.6 Nm	4.10 INDUCTION MODULE: XL MODELS, Installation
Intake manifold mounting screw	96-120 in-lbs	10.9-13.6 Nm	4.11 INDUCTION MODULE: XR MODELS, Installation
Interconnect bracket-to-frame fastener	30-33 ft-lbs	40.7-44.7 Nm	4.16 EXHAUST SYSTEM: XR MODELS, Installation
Isolator (front) mounting bracket screw	25-35 ft-lbs	33.9-47.5 Nm	2.28 FRONT ENGINE MOUNT/ISOLATOR, Installation
Isolator (front) mounting bracket screw	25-35 ft-lbs	33.9-47.5 Nm	2.29 REAR ENGINE MOUNT/ISOLATOR, Installation
Isolator mount screw, front	25-35 ft-lbs	33.9-47.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Isolator mount screw, front	25-35 ft-lbs	33.9-47.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Isolator mount screw, rear	25-35 ft-lbs	33.9-47.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Isolator mount screw, rear	25-35 ft-lbs	33.9-47.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models

2009 Sportster Models Service Manual

FASTENER	TORQUE VALUE		NOTES
Jiffy stand switch screw	96-120 in-lbs	10.9-13.6 Nm	6.34 JIFFY STAND SWITCH: INTERNATIONAL MODELS, Installation
License plate bracket mounting screw	20-25 in-lbs	2.3-2.8 Nm	2.34 REAR FENDER: ALL XL MODELS EXCEPT XL 1200N, Installation
License plate lamp housing screw	14-16 in-lbs	1.2-1.3 Nm	6.25 LICENSE PLATE LAMP MODULE: XL 1200N, Installation (HDI Only)
Light switch bracket screw	35-45 in-lbs	4.0-5.1 Nm	6.33 ELECTRICAL CADDIES, Wire Harness Caddy: XL Models
Light switch bracket screw	35-45 in-lbs	4.0-5.1 Nm	6.33 ELECTRICAL CADDIES, Wire Harness Caddy: XR Models
Long post jam nut	65-80 in-lbs	7.3-9.0 Nm	6.14 STARTER SOLENOID, Solenoid Contacts
Lower fork bracket pinch screw	30-35 ft-lbs	40.7-47.5 Nm	2.23 FORK STEM AND BRACKET ASSEMBLY, Assembly and Installation
Lower front retainer plate fastener	45-50 ft-lbs	61.0-67.8 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Lower handlebar clamp bolts	30-40 ft-lbs	40.7-54.3 Nm	2.32 HANDLEBARS, Installation
Lower muffler mount nut	30-33 ft-lbs	40.7-44.7 Nm	4.16 EXHAUST SYSTEM: XR MODELS, Installation
Lower shock absorber fastener	30-45 ft-lbs	40.7-61.0 Nm	2.17 REAR BRAKE CALIPER: XR MODELS, Installation
Lower shock absorber fastener	30-45 ft-lb	40.7-61.0 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Lower shock absorber screw	45-50 ft-lbs	61-68 Nm	5.7 DRIVE BELT, Installation
Lower shock absorber screw	45-50 ft-lbs	61-68 Nm	5.7 DRIVE BELT, Installation
Mirror stem lock nut	96-144 in-lbs	10.9-16.3 Nm	2.10 FRONT BRAKE MASTER CYLINDER, Installation
Mirror stem lock nut	96-144 in-lbs	10.9-16.3 Nm	2.31 CLUTCH CONTROL, Assembly and Installation
Muffler bracket-to-footrest bracket screw (XR)	15-19 ft-lbs	20.4-25.8 Nm	2.43 PASSENGER FOOTRESTS, XR Models
Muffler interconnect bracket mounting screw	30-33 ft-lbs	40.7-44.8 Nm	4.15 EXHAUST SYSTEM: XL MODELS, Installation
Muffler interconnect bracket mounting screw	30-33 ft-lbs	40.7-44.8 Nm	5.16 TRANSMISSION SPROCKET, Installation
Muffler-to-front muffler mount fastener	120-180 in-lbs	16.9-20.3 Nm	4.16 EXHAUST SYSTEM: XR MODELS, Installation
Muffler-to-interconnect bracket screw	15-19 ft-lbs	20.4-25.8 Nm	4.15 EXHAUST SYSTEM: XL MODELS, Installation
Muffler-to-muffler bolt	120-180 in-lbs	16.9-20.3 Nm	4.16 EXHAUST SYSTEM: XR MODELS, Installation
Muffler torca clamp nut	38-43 ft-lbs	51.6-58.4 Nm	4.15 EXHAUST SYSTEM: XL MODELS, Installation
Muffler-to-rear muffler mount fastener	120-180 in-lbs	16.9-20.3 Nm	4.16 EXHAUST SYSTEM: XR MODELS, Installation
Neutral indicator switch	120-180 in-lbs	13.6-20.3 Nm	5.15 TRANSMISSION INSTALLATION, Assembling Crankcases
Neutral indicator switch	120-180 in-lbs	13.6-20.3 Nm	6.31 NEUTRAL INDICATOR SWITCH, Replacement
O2 sensor	29-44 ft-lbs	39.3-59.7 Nm	4.15 EXHAUST SYSTEM: XL MODELS, Installation

2009 Sportster Models Service Manual

FASTENER	TORQUE VALUE		NOTES
Oil cooler fastener	36-60 in-lbs	4.1-6.8 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models/Apply Loctite Threadlocker 243 (blue)
Oil cooler fastener	36-60 in-lbs	4.1-6.8 Nm	3.14 PRECISION COOLING SYSTEM: XR MODELS, Oil Cooler/Apply Loctite Threadlocker 243 (blue)
Oil deflector plate screw	25-35 in-lbs	2.8-3.9 Nm	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Crankcase
Oil filter adapter	96-144 in-lbs	10.9-16.3 Nm	3.26 OIL FILTER MOUNT, Assembly
Oil pressure indicator switch	50-70 in-lbs	5.6-7.9 Nm	3.26 OIL FILTER MOUNT, Assembly
Oil pressure switch adapter: XR 1200 only	108-158 in-lbs	12.2-17.9 Nm	6.36 OIL PRESSURE SWITCH, Installation
Oil pump cover screws	70-80 in-lbs	7.9-9.0 Nm	3.24 OIL PUMP: XL MODELS, Assembly
Oil pump feed fitting	55-65 in-lbs	6.2-7.4 Nm	3.24 OIL PUMP: XL MODELS, Installation
Oil pump rotor cover screw: XR models	80-110 in-lbs	9.0-12.4 Nm	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Cam Gears and Gearcase Cover: XR Models
Oil pump rotor cover screw: XR models	80-110 in-lbs	9.0-12.4 Nm	3.25 OIL PUMP: XR MODELS, Assembly
Oil pump-to-crankcase screw	125-150 in-lbs	14.1-16.9 Nm	3.24 OIL PUMP: XL MODELS, Installation
Oil tank mounting screw	36-60 in-lbs	4.1-6.8 Nm	3.27 OIL TANK, Installation
Outer rocker cover screw	120-168 in-lbs	13.5-19.0 Nm	3.16 TOP END OVERHAUL: ASSEMBLY, Rocker Covers
Oxygen sensor	29-44 ft-lbs	39.3-59.7 Nm	4.14 OXYGEN SENSOR, Installation
Passenger footrest support bracket screw	45-50 ft-lbs	61-68 Nm	2.25 REAR FORK, Installation
Passenger footrest support bracket screw	45-50 ft-lbs	61-68 Nm	2.43 PASSENGER FOOTRESTS, XL Models
Passenger footrest support bracket screw	45-50 ft-lbs	61-68 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Passenger pillion retainer post screw: XR models	36-60 in-lbs	4.1-6.8 Nm	2.36 REAR FENDER: XR MODELS, Installation
Pinion shaft locking nut	19-21 ft-lbs	26-29 Nm	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Cam Gears and Gearcase Cover: XL Models
Pinion shaft locking nut	19-21 ft-lbs	26-29 Nm	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Cam Gears and Gearcase Cover: XR Models
Piston oil jet screw	25-35 in-lbs	2.8-4.0 Nm	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Crankcase
Positive battery cable-to-starter post lock nut	60-85 in-lbs	6.8-9.6 Nm	6.11 BATTERY CABLES, Installation
Precision cooling check valve housing fastener	84-108 in-lbs	9.5-12.2 Nm	3.14 PRECISION COOLING SYSTEM: XR MODELS, Cylinder Head Oil Feed Assembly
Precision cooling check valve housing fastener	84-108 in-lbs	9.5-12.2 Nm	3.18 BOTTOM END OVERHAUL: ASSEMBLY, Cam Gears and Gearcase Cover: XR Models
Precision cooling check valve plug fitting	15-21 ft-lbs	20.3-28.5 Nm	3.14 PRECISION COOLING SYSTEM: XR MODELS, Cylinder Head Oil Feed Assembly
Primary chain adjuster lock nut	20-25 ft-lbs	27.1-33.9 Nm	5.3 PRIMARY CHAIN ADJUSTER, Installation

2009 Sportster Models Service Manual

FASTENER	TORQUE VALUE		NOTES
Primary chaincase drain plug	14-30 ft-lbs	19.0-40.7 Nm	1.4 MAINTENANCE SCHEDULE, General
Primary chaincase drain plug	14-30 ft-lbs	19.0-40.7 Nm	1.14 TRANSMISSION LUBRICANT, Transmission Lubrication: Sportster Models/Apply LOCTITE THREADLOCKER 565 (white).
Primary chain inspection cover	84-120 in-lbs	9.5-13.6 Nm	1.12 PRIMARY CHAIN, Adjustment
Primary chain inspection cover screw	84-120 in-lbs	9.5-13.6 Nm	1.4 MAINTENANCE SCHEDULE, General
Primary chain lock nut	20-25 ft-lbs	27.1-33.9 Nm	1.12 PRIMARY CHAIN, Adjustment
Primary cover screw	100-120 in-lbs	11.3-13.5 Nm	5.3 PRIMARY CHAIN ADJUSTER, Installation
Primary drain plug	14-30 ft-lbs	19.0-40.7 Nm	5.3 PRIMARY CHAIN ADJUSTER, Installation
Push rod retainer screw	80-110 in-lbs	9.0-12.4 Nm	3.16 TOP END OVERHAUL: ASSEMBLY, Push Rods, Covers, and Retainers
Quick connect fitting	108-156 in-lbs	12.2-17.6 Nm	3.14 PRECISION COOLING SYSTEM: XR MODELS, Oil Pump Lines
Quick connect fitting, cylinder head return oil	108-156 in-lbs	12.2-17.6 Nm	3.14 PRECISION COOLING SYSTEM: XR MODELS, Cylinder Head Oil Return Lines
Rear caliper mounting bolt	14-18 ft-lbs	19.6-24.5 Nm	2.17 REAR BRAKE CALIPER: XR MODELS, Installation
Rear caliper pin bolt	14-18 ft-lbs	19.6-24.5 Nm	2.17 REAR BRAKE CALIPER: XR MODELS, Installation
Rear fender brace screw	20-25 in-lbs	2.3-2.8 Nm	2.35 REAR FENDER AND LICENSE PLATE BRACKET: XL 1200N, Assembly and Installation
Rear fender brace screw	20-25 in-lbs	2.3-2.8 Nm	6.25 LICENSE PLATE LAMP MODULE: XL 1200N, Installation (HDI Only)
Rear fender support screw	132-216 in-lbs	14.9-24.4 Nm	2.35 REAR FENDER AND LICENSE PLATE BRACKET: XL 1200N, Assembly and Installation
Rear fork pivot/engine mount bolt	60-70 ft-lbs	81.4-95.0 Nm	2.25 REAR FORK, Installation
Rear fork pivot/engine mount bolt	60-70 ft-lbs	81.4-95.0 Nm	2.29 REAR ENGINE MOUNT/ISOLATOR, Installation
Rear fork pivot/engine mount bolt	60-70 ft-lbs	81.4-95.0 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Rear fork pivot/engine mount bolt	60-70 ft-lbs	81.4-95.0 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Rear muffler mount-to-frame fastener	15-20 ft-lbs	20.3-27.1 Nm	4.16 EXHAUST SYSTEM: XR MODELS, Installation
Rear rigid oil line retainer screw	84-108 in-lbs	9.5-12.2 Nm	3.14 PRECISION COOLING SYSTEM: XR MODELS, Cylinder Head Oil Return Lines
Rear rigid oil line retainer screw	84-108 in-lbs	9.5-12.2 Nm	3.14 PRECISION COOLING SYSTEM: XR MODELS, Oil Pump Lines
Rear sprocket cover screw: XR models	30-33 ft-lbs	40.7-44.7 Nm	2.29 REAR ENGINE MOUNT/ISOLATOR, Installation
Rear sprocket cover screw: XR models	30-33 ft-lbs	40.7-44.7 Nm	5.7 DRIVE BELT, Installation
Rear stop light switch bracket screw	72-120 in-lbs	8.1-13.6 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Rear turn signal housing screws: XR models	30-40 in-lbs	3.4-4.5 Nm	6.24 TURN SIGNALS, Rear Housing Replacement
Rear turn signal housing-to-stalk	96-156 in-lbs	10.9-17.6 Nm	6.24 TURN SIGNALS, Rear Housing Replacement
Rear turn signal stalk nut	132-216 in-lbs	14.9-24.4 Nm	2.35 REAR FENDER AND LICENSE PLATE BRACKET: XL 1200N, Assembly and Installation

2009 Sportster Models Service Manual

FASTENER	TORQUE VALUE		NOTES
Return oil manifold screw	84-108 in-lbs	9.5-12.2 Nm	3.14 PRECISION COOLING SYSTEM: XR MODELS, Return Oil Manifold
Rider footrest bracket mounting screw	45-50 ft-lbs	61-68 Nm	2.31 CLUTCH CONTROL, Assembly and Installation
Rider footrest support bracket mounting screw	45-50 ft-lbs	61-68 Nm	1.13 CLUTCH, Adjustment
Rider footrest support bracket mounting screw	45-50 ft-lbs	61-68 Nm	1.14 TRANSMISSION LUBRICANT, Transmission Lubrication: Sportster Models
Rider footrest support bracket mounting screw	45-50 ft-lbs	61-68 Nm	2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS, Right Footrest and Rear Brake Pedal Assembly
Rider footrest support bracket mounting screw	45-50 ft-lbs	61-68 Nm	2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS, Left Footrest and Shift Lever Assembly
Rider footrest support bracket mounting screw	45-50 ft-lbs	61-68 Nm	2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS, Right Footrest and Rear Brake Pedal Assembly
Rider footrest support bracket mounting screw	45-50 ft-lbs	61-68 Nm	2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS, Left Footrest and Shift Lever Assembly
Rider footrest support bracket mounting screw	45-50 ft-lbs	61-68 Nm	5.4 CLUTCH RELEASE MECHANISM, Assembly and Installation
Rider footrest support mounting bracket	45-50 ft-lbs	61-68 Nm	5.16 TRANSMISSION SPROCKET, Installation
Riser cover screw	8-12 in-lbs	0.9-1.4 Nm	6.8 SPEEDOMETER: XL 883C/XL 1200C, Installation/XL 883C/XL 1200C only
Riser cover screw	8-12 in-lbs	0.9-1.4 Nm	6.24 TURN SIGNALS, Front Housing Replacement
Riser cover screw	8-12 in-lbs	0.9-1.4 Nm	6.39 HANDLEBAR SWITCH ASSEMBLIES, Connectors/XL 883C/XL 1200C only
Seat post mounting screw	96-156 in-lbs	10.9-17.6 Nm	2.35 REAR FENDER AND LICENSE PLATE BRACKET: XL 1200N, Assembly and Installation
Seat post screw	96-156 in-lbs	10.9-17.6 Nm	2.34 REAR FENDER: ALL XL MODELS EXCEPT XL 1200N, Installation
Secondary drive belt deflector screws	36-60 in-lbs	4.1-6.8 Nm	5.7 DRIVE BELT, Installation
Shifter peg: XR models	96-144 in-lbs	10.9-16.3 Nm	2.42 RIDER FOOT CONTROLS: XR MODELS, Left Footrest and Shift Lever Assembly
Shifter peg screw	96-144 in-lbs	10.9-16.3 Nm	2.40 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH MID-MOUNT CONTROLS, Left Footrest and Shift Lever Assembly
Shifter peg screw	96-144 in-lbs	10.9-16.3 Nm	2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS, Left Footrest and Shift Lever Assembly
Shifter rod-to-shift lever screw	120-180 in-lbs	13.6-20.4 Nm	2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS, Left Footrest and Shift Lever Assembly
Shifter rod-to-shift lever screw	120-180 in-lbs	13.6-20.4 Nm	2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS, Left Footrest and Shift Lever Assembly
Shifter rod-to-shift lever screw	120-180 in-lbs	13.6-20.4 Nm	2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS, Adjusting Shift Pedal

2009 Sportster Models Service Manual

FASTENER	TORQUE VALUE		NOTES
Shift linkage fastener	120-180 in-lbs	13.6-20.3 Nm	2.42 RIDER FOOT CONTROLS: XR MODELS, Left Footrest and Shift Lever Assembly
Shift linkage pivot bolt	10-15 ft-lbs	13.6-20.3 Nm	1.13 CLUTCH, Adjustment
Shift linkage pivot bolt	10-15 ft-lbs	13.6-20.3 Nm	1.14 TRANSMISSION LUBRICANT, Transmission Lubrication: Sportster Models
Shift linkage pivot bolt	10-15 ft-lbs	13.6-20.3 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Shift pedal clevis screw	18-22 ft-lbs	24.4-29.9 Nm	2.41 RIDER FOOT CONTROLS: XL MODELS EQUIPPED WITH FORWARD CONTROLS, Left Footrest and Shift Lever Assembly
Shift rod screw (XR)	120-180 in-lbs	13.6-20.4 Nm	2.42 RIDER FOOT CONTROLS: XR MODELS, Adjusting Shift Pedal
Shock absorber mounting screw	45-50 ft-lbs	61-68 Nm	2.4 WHEELS, Rear Wheel
Shock absorber mounting screw	45-50 ft-lbs	61-68 Nm	2.24 BELT GUARD AND DEBRIS DEFLECTOR, Belt Guard: XL Models
Shock absorber mounting screw	45-50 ft-lbs	61-68 Nm	2.26 SHOCK ABSORBERS, Installation
Shock absorber mounting screw	45-50 ft-lbs	61-68 Nm	2.26 SHOCK ABSORBERS, Installation
Single caliper cast front wheel hub plate screw	16-24 ft-lbs	21.7-32.6 Nm	2.4 WHEELS, Sealed Wheel Bearings
Siren/canister bracket; rear brake line fastener	17-22 ft-lbs	23.0-29.8 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Solenoid ring terminal nut	70-90 in-lbs	7.9-10.2 Nm	6.13 STARTER, Field Coil Assembly
Spark plug	12-18 ft-lbs	16.3-24.4 Nm	1.18 SPARK PLUGS, Inspection
Spark plug (XL)	12-18 ft-lbs	16.3-24.4 Nm	1.4 MAINTENANCE SCHEDULE, General
Spark plug (XL)	12-18 ft-lbs	16.3-24.4 Nm	1.4 MAINTENANCE SCHEDULE, General
Spoke nipple	55 in-lbs	6.2 Nm	1.4 MAINTENANCE SCHEDULE, General
Spoke nipple	55 in-lbs	6.2 Nm	1.11 TIRES AND WHEELS, Wheel Spokes
Spoke nipple	55 in-lbs	6.2 Nm	2.5 WHEEL LACING: 16 INCH RIM, Procedure
Spoke nipple	55 in-lbs	6.2 Nm	2.6 WHEEL LACING: 19 INCH RIM, Procedure
Spoke nipple	55 in-lbs	6.2 Nm	2.7 WHEEL LACING: 21 INCH RIM, Procedure
Spoke nipple	55 in-lbs	6.2 Nm	2.8 TRUING LACED WHEELS, Radial Truing
Sprocket (rear) mounting screw - FINAL torque	80 ft-lbs	108.0 Nm	2.4 WHEELS, Rear Wheel
Sprocket (rear) mounting screw - INITIAL torque	60 ft-lbs	81.3 Nm	2.4 WHEELS, Rear Wheel
Sprocket compensator bowl bolt - FINAL torque	80 ft-lbs	108.5 Nm	D.1 COMPENSATING SPROCKET, Assembly and Installation/Tighten in a star pattern
Sprocket compensator bowl bolt - INITIAL torque	60 ft-lbs	81.3 Nm	D.1 COMPENSATING SPROCKET, Assembly and Installation/Tighten in a star pattern
Sprocket cover fastener, large: XR models	30-33 ft-lbs	40.7-44.8 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Sprocket cover fastener, large: XR models	30-33 ft-lbs	40.7-44.8 Nm	5.7 DRIVE BELT, Idler Pulley: XR Models Only
Sprocket cover fastener, large: XR models	30-33 ft-lbs	40.7-44.8 Nm	5.16 TRANSMISSION SPROCKET, Installation
Sprocket cover fastener, small: XR models	80-120 in-lbs	9.0-13.6 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models

2009 Sportster Models Service Manual

FASTENER	TORQUE VALUE		NOTES
Sprocket cover fastener, small: XR models	80-120 in-lbs	9.0-13.6 Nm	5.7 DRIVE BELT, Idler Pulley: XR Models Only
Sprocket cover fastener, small: XR models	80-120 in-lbs	9.0-13.6 Nm	5.16 TRANSMISSION SPROCKET, Installation
Sprocket cover screw	80-120 in-lbs	9.0-13.6 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Sprocket cover screw	80-120 in-lbs	9.0-13.6 Nm	5.16 TRANSMISSION SPROCKET, Installation
Sprocket cover screw: XL models	80-120 in-lbs	9.0-13.6 Nm	2.29 REAR ENGINE MOUNT/ISOLATOR, Installation
Sprocket cover screw: XL models	80-120 in-lbs	9.0-13.6 Nm	2.29 REAR ENGINE MOUNT/ISOLATOR, Installation
Sprocket cover screw: XL models	80-120 in-lbs	9.0-13.6 Nm	4.15 EXHAUST SYSTEM: XL MODELS, Installation
Stabilizer link (lower front) frame bracket mounting screw	25-35 ft-lbs	33.9-47.5 Nm	2.27 STABILIZER LINKS, Lower Front Stabilizer Link
Stabilizer link (lower front) frame bracket mounting screw	25-35 ft-lbs	33.9-47.5 Nm	2.29 REAR ENGINE MOUNT/ISOLATOR, Installation
Stabilizer link (lower front) frame bracket mounting screw	25-35 ft-lbs	33.9-47.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Stabilizer link (lower front) frame bracket mounting screw	25-35 ft-lbs	33.9-47.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Stabilizer link (lower front) frame bracket mounting screw	25-35 ft-lbs	33.9-47.5 Nm	3.16 TOP END OVERHAUL: ASSEMBLY, Assembling Motorcycle After Top End Repair
Stabilizer link (upper front) engine bracket mounting screw	55-65 ft-lbs	74.6-88.2 Nm	2.27 STABILIZER LINKS, Upper Front Stabilizer Link
Stabilizer link (upper front) frame bracket mounting screw	25-35 ft-lbs	33.9-47.5 Nm	2.27 STABILIZER LINKS, Upper Front Stabilizer Link
Stabilizer link (upper front) frame bracket mounting screw	25-35 ft-lbs	33.9-47.5 Nm	2.28 FRONT ENGINE MOUNT/ISOLATOR, Installation
Stabilizer link (upper front) frame bracket mounting screw	25-35 ft-lbs	33.9-47.5 Nm	2.29 REAR ENGINE MOUNT/ISOLATOR, Installation
Stabilizer link (upper front) frame bracket mounting screw	25-35 ft-lbs	33.9-47.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Stabilizer link (upper front) frame bracket mounting screw	25-35 ft-lbs	33.9-47.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Stabilizer link (upper front) frame bracket mounting screw	25-35 ft-lbs	33.9-47.5 Nm	3.16 TOP END OVERHAUL: ASSEMBLY, Assembling Motorcycle After Top End Repair
Stabilizer link bracket to front head screws and lock washers	55-65 ft-lbs	74.6-88.2 Nm	3.21 CYLINDER HEAD, Assembly
Stabilizer link screw	25-35 ft-lbs	33.9-47.5 Nm	2.27 STABILIZER LINKS, Upper Front Stabilizer Link
Stabilizer link screw	25-35 ft-lbs	33.9-47.5 Nm	2.27 STABILIZER LINKS, Lower Front Stabilizer Link
Stabilizer link screw	25-35 ft-lbs	33.9-47.5 Nm	2.27 STABILIZER LINKS, Rear Stabilizer Link
Stabilizer link screw	25-35 ft-lbs	33.9-47.5 Nm	2.28 FRONT ENGINE MOUNT/ISOLATOR, Installation
Stabilizer link screw	25-35 ft-lbs	33.9-47.5 Nm	2.28 FRONT ENGINE MOUNT/ISOLATOR, Installation

2009 Sportster Models Service Manual

FASTENER	TORQUE VALUE		NOTES
Stabilizer link screw	25-35 ft-lbs	33.9-47.5 Nm	2.29 REAR ENGINE MOUNT/ISOLATOR, Installation
Stabilizer link screw	25-35 ft-lbs	33.9-47.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Stabilizer link screw	25-35 ft-lbs	33.9-47.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Stabilizer link screw	25-35 ft-lbs	33.9-47.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XL Models
Stabilizer link screw	25-35 ft-lbs	33.9-47.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Stabilizer link screw	25-35 ft-lbs	33.9-47.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Stabilizer link screw	25-35 ft-lbs	33.9-47.5 Nm	3.13 INSTALLING ENGINE IN CHASSIS, Procedure: XR Models
Starter end cover screw	90-110 in-lbs	10.2-12.4 Nm	6.13 STARTER, Field Coil Assembly
Starter mounting bolt	13-20 ft-lbs	17.6-27.1 Nm	6.13 STARTER, Installation
Starter positive terminal nut	60-85 in-lbs	6.8-9.6 Nm	6.13 STARTER, Installation
Starter thru bolts	39-65 in-lbs	4.4-7.3 Nm	6.13 STARTER, Field Coil Assembly
Stator harness retainer screw	56 in-lbs	6.3 Nm	6.29 ALTERNATOR, Assembly and Installation/Screw must be flush with plate. Do not exceed torque specification.
Stoplight switch to tee nut	84-120 in-lbs	9.5-13.6 Nm	6.27 REAR STOP LAMP SWITCH, Replacement
Strut cover screw	132-216 in-lbs	14.9-24.4 Nm	6.24 TURN SIGNALS, Rear Housing Replacement
Tail lamp base mounting screw	45-48 in-lbs	5.1-5.4 Nm	2.34 REAR FENDER: ALL XL MODELS EXCEPT XL 1200N, Installation
Tail lamp base mounting screw: XL models only	45-48 in-lbs	5.1-5.4 Nm	6.23 TAIL LAMP: ALL MODELS EXCEPT XL 1200N, Base Replacement
Tail lamp base mounting screw: XR models only	36-60 in-lbs	4.1-6.8 Nm	6.23 TAIL LAMP: ALL MODELS EXCEPT XL 1200N, Base Replacement
Tail lamp lens screw	20-24 in-lbs	2.3-2.7 Nm	6.23 TAIL LAMP: ALL MODELS EXCEPT XL 1200N, Bulb Replacement
Tail lamp lens screw	20-24 in-lbs	2.3-2.7 Nm	6.23 TAIL LAMP: ALL MODELS EXCEPT XL 1200N, Base Replacement
Tail section bolts: XR models	72-120 in-lbs	8.1-13.6 Nm	2.36 REAR FENDER: XR MODELS, Installation
Throttle cable bracket screw: XR models	60 in-lbs	6.8 Nm	4.11 INDUCTION MODULE: XR MODELS, Assembly
TMAP sensor screw	60 in-lbs	6.8 Nm	4.13 TEMPERATURE MANIFOLD ABSOLUTE PRESSURE (TMAP) SENSOR, Installation: XR Models
TP sensor mounting screw (XR models)	29 in-lbs	3.3 Nm	4.8 THROTTLE POSITION (TP) SENSOR, Installation: XR Models
TP sensor screw	35 in-lbs	4.0 Nm	4.8 THROTTLE POSITION (TP) SENSOR, Installation: XL Models
TP sensor screw	35 in-lbs	4.0 Nm	4.13 TEMPERATURE MANIFOLD ABSOLUTE PRESSURE (TMAP) SENSOR, Installation: XL Models
Transmission mainshaft nut	70-80 ft-lbs	95.0-108.6 Nm	5.5 PRIMARY DRIVE AND CLUTCH: XL MODELS, Installation

2009 Sportster Models Service Manual

FASTENER	TORQUE VALUE		NOTES
Transmission mainshaft nut	70-80 ft-lbs	95.0-108.6 Nm	5.6 PRIMARY DRIVE AND CLUTCH: XR MODELS, Installation
Transmission sprocket lockplate	90-110 in-lbs	10.2-12.4 Nm	5.16 TRANSMISSION SPROCKET, Installation
Transmission sprocket nut	50 ft-lbs	68 Nm	5.16 TRANSMISSION SPROCKET, Installation/See TRANSMISSION SPROCKET section for special procedure.
Turn signal (front) clamp screw	96-120 in-lbs	10.9-13.6 Nm	2.31 CLUTCH CONTROL, Assembly and Installation
Turn signal (front) clamp screw	96-120 in-lbs	10.9-13.6 Nm	6.24 TURN SIGNALS, Front Housing Replacement
Turn signal (rear) stalk nut	132-216 in-lbs	14.9-24.4 Nm	2.34 REAR FENDER: ALL XL MODELS EXCEPT XL 1200N, Installation
Turn signal stalk nut	132-216 in-lbs	14.9-24.4 Nm	6.24 TURN SIGNALS, Rear Housing Replacement
Upper handlebar clamp screw, front	12-18 ft-lbs	16.3-24.4 Nm	2.32 HANDLEBARS, Installation
Upper handlebar clamp screw, front	12-18 ft-lbs	16.3-24.4 Nm	2.32 HANDLEBARS, Installation
Upper handlebar clamp screw, rear	12-18 ft-lbs	16.3-24.4 Nm	2.32 HANDLEBARS, Installation
Upper handlebar clamp screw, rear	12-18 ft-lbs	16.3-24.4 Nm	2.32 HANDLEBARS, Installation
Valve stem nut	12-15 in-lbs	1.4-1.7 Nm	2.19 TIRES, Installation
Vehicle speed sensor (VSS) screw	80-100 in-lbs	9.0-11.3 Nm	6.30 VEHICLE SPEED SENSOR (VSS), Installation
Vertical headlamp adjustment bolt	30-35 ft-lbs	40.7-47.5 Nm	1.31 HEADLAMP ALIGNMENT, Headlamp Adjustment: Sportster Models
Voltage regulator mounting screw	36-60 in-lbs	4.1-6.8 Nm	6.3 VOLTAGE REGULATOR, Installation: XL Models
Voltage regulator mounting screw	36-60 in-lbs	4.1-6.8 Nm	6.3 VOLTAGE REGULATOR, Installation: XR Models



	1
150 Metri-Pack Connector Repair.....	A-22
	4
480 Metri-Pack Connector Repair.....	A-25
	6
630 Metri-Pack Connector Repair.....	A-26
	A
AIRBOX: XR MODELS	
Installation.....	4-8
Removal.....	4-8
Air Cleaner	
Cleaning, Inspection and Repair.....	4-6
Air Cleaner: XL Models	
Cleaning, Inspection and Repair.....	1-73
General.....	1-73
Installation.....	1-74
Removal.....	1-73
Air Cleaner: XR Models	
Cleaning, Inspection and Repair.....	1-76
General.....	1-75
Installation.....	1-76
Removal.....	1-75
Air Cleaner (XL Models)	
Installation.....	4-7
Removal.....	4-6
Alternator	
Assembly and Installation.....	6-76
Cleaning and Inspection.....	6-76
Removal and Disassembly.....	6-75
AMP Multilock Connector	
Repair.....	A-1
Appendix C: Compensating Sprocket	
Assembly and Installation.....	D-2
General.....	D-1
Removal and Disassembly.....	D-1
Appendix D: Compensating Sprocket	
Cleaning, Inspection and Repair.....	D-1
Sprocket Bearing Replacement.....	D-1
Assembly and Installation	
Rotor.....	6-77
Stator.....	6-76
Autofuse Electrical Connector.....	
Assembly.....	A-5
Disassembly.....	A-5

B

Battery	
Disconnection and Removal.....	1-53
Installation and Connection.....	1-55
Maintenance.....	1-52
Battery Cables	
Installation.....	6-25
Removal.....	6-24
Battery Maintenance	
Charging Battery.....	1-54
Cleaning and Inspection.....	1-54
Storage.....	1-56
Battery Tray.....	
Installation.....	6-27
Removal.....	6-26

Belt Guard and Debris Deflector	
Belt Guard: XL Models.....	2-128
Belt Guard: XR Models.....	2-128
Debris Deflector: XL Models.....	2-128
Debris Deflector: XR Models.....	2-129
Bleeding Hydraulic Brake System.....	
Bleeding Front Brake: All Models.....	1-20
Bleeding Rear Brake: All Models.....	1-22
Bottom End Overhaul: Assembly	
Cam Gears and Gearcase Cover: XR Models.....	3-86
Bottom End Overhaul: Disassembly	
Crankcase.....	3-76
Gearcase Cover/Oil Pump Housing and Cam Gears: XR Models.....	3-74
Gearcase Cover and Cam Gears: XL Models.....	3-73
General.....	3-73
Oil Pump: XL Models.....	3-73
Tappets.....	3-73
Bottom End Overhaul (Assembly)	
Cam Gears and Gearcase Cover: XL Models.....	3-83
Cam Gears and Gearcase Cover: XL Models.....	3-86
Crankcase.....	3-78
Tappets.....	3-89
Top End of Engine.....	3-90
Bottom End Service	
Engine in Chassis.....	3-32
Engine Removed From Chassis.....	3-33
Brake Lines	
Front Brake Line: All Models.....	2-97
Rear Brake Line: XL Models.....	2-100
Rear Brake Line: XR Models.....	2-101
Brake Pads and Discs	
Brake Pad Replacement (Front): XR Models.....	1-31
Brake Pad Replacement (Rear): XR Models.....	1-33
Inspection: XL Models.....	1-24
Inspection: XR Models.....	1-31
Replacement (Front): XL Models.....	1-25
Replacement (Rear): XL Models.....	1-27
Brakes	
General.....	1-18
Inspection.....	1-18
Troubleshooting.....	1-18
Bulb Chart.....	
Bulb Requirements	
Bulb Chart.....	1-14

C

Cable and Chassis Lubrication.....	
Foot Shift Lever and Rear Brake Pedal.....	1-72
General.....	1-72
Jiffy Stand.....	1-72
Steering Head Bearings.....	1-72
Cam Gears	
Cleaning, Inspection and Identification.....	3-92
Case Disassembly for Transmission Removal	
Engine Removal and Disassembly.....	5-37
Cast Wheel Runout.....	
Lateral Runout.....	2-42
Charging System.....	
Alternator.....	6-47
Voltage Regulator.....	6-47
Checking Cast Wheel Runout	
Radial Runout.....	2-42
Cleaning	
Bearings.....	1-6
Cleaning Process.....	1-6
Part Protection.....	1-6
Rust or Corrosion Removal.....	1-6

Cleaning, Inspection and Repair	
Boring and Honing Cylinder	3-116
Checking Gasket Surface	3-114
Fitting Piston Rings	3-116
Measuring Cylinder Bore	3-114
Measuring Piston to Cylinder Fit	3-115
Clutch	
Adjusting Screw Disassembly/Assembly	5-24
Adjustment	1-41
General	5-20
Clutch Adjusting Screw	5-24
Clutch Control	2-146
Assembly and Installation	2-148
Removal and Disassembly: Clutch Cable	2-146
Removal and Disassembly: Clutch Hand Control	2-147
Removal and Disassembly: Clutch Lever and Clutch Cable	2-147
Clutch Interlock Switch	
Replacement	6-110
Clutch Release Mechanism	
Assembly and Installation	5-10
Cleaning, Inspection and Repair	5-10
Removal and Disassembly	5-9
Clutch Shell	
Bearing Replacement	5-25
Connecting Rod Bushings	
Honing Upper Connecting Rod Bushings	3-121
Installing Upper Connecting Rod Bushings	3-120
Reaming Upper Connecting Rod Bushings	3-120
Removing Upper Connecting Rod Bushings	3-118
Repair	3-121
Connectors	
Location	B-1
Conversions	
Fluid	C-2
Length	C-1
Torque	C-3
Countershaft	
Assembly	5-48
Disassembly	5-46
Crankcase	3-122
Assembling Halves	3-129
Disassembly	3-123
Fitting Pinion Bearings	3-124
Lapping Engine Main Bearing Races	3-128
Removal	3-122
Removing Cylinder Base Studs	3-77
Removing Piston Oil Jets	3-77
Crankcase Breathing System	
XL Models	3-15
XR Models	3-16
Crank Position Sensor (CKP)	6-74
Installation	6-74
Removal	6-74
Critical Fasteners	
Inspection	1-86
Cylinder and Piston	
Assembly and Installation	3-121
Cleaning, Inspection and Repair	3-114
Connecting Rod Bushings	3-118
Removal and Disassembly	3-114
Cylinder Head	
Assembly	3-110

Cleaning and Inspection: Heads	3-100
Cleaning and Inspection: Push Rods	3-103
Cleaning and Inspection: Rocker Arm Assemblies	3-100
Cleaning and Inspection: Spark Plug Threads	3-103
Cleaning and Inspection: Valve Guides	3-102
Cleaning and Inspection: Valves	3-102
Cleaning and Inspection: Valve Seats	3-102
Cleaning and Inspection: Valve Springs	3-102
Disassembly	3-98
Installation	3-113
Refacing Valve Seats	3-108
Refacing Valve Seats: Replacement	3-110
Removal	3-98
Replacing Rocker Arm Bushings	3-103
Replacing Valve Guides	3-104

Cylinder Heads

Disassembling Push Rods and Covers	3-59
Disassembling Rocker Covers	3-54
Removing Cylinder Head	3-56

D

Delphi Connector	
Repair	A-6
Deutsch Connector	
Crimping Mini Terminals	A-17
Crimping Solid Barrel Terminals	A-15
Crimping Standard Terminals	A-14
Repair	A-10
Drive Belt System	
Idle Pulley	1-45

E

Electrical Caddies	
General	6-85
Voltage Regulator Caddy	6-85
Wire Harness Caddy	6-85
Wire Harness Caddy:XR Models	6-89
Electronic Control Module (ECM)	6-39
Installation	6-39
Removal	6-39
Electronic Fuel Injection (EFI)	
Troubleshooting	4-5
Engine	3-11
Engine Lubrication System	
Oil Flow: XL Models	3-23
Oil Flow: XR Models	3-23
Oil Pump	3-20
Engine Mounts and Stabilizer Links	
Inspection	1-82
Engine Oil	
Grades	1-8
Temperature Recommendations	1-8
Winter Lubrication	1-9
Engine Oil and Filter	
Changing	1-16
Checking and Adding Oil	1-15
Engine Temperature (ET) Sensor	
General	4-25
Installation	4-26
Removal	4-25
Evaporative Emissions Control: CA Models	
Charcoal Canister Installation	4-68
Charcoal Canister Removal	4-67

General.	4-66
Hose Routing.	4-69
Vapor Valve.	4-68
Exhaust System	
Exhaust System Leak Check.	1-78
Exhaust System: XL Models	
General.	4-48
Installation.	4-50
Removal.	4-49
Exhaust System: XR Models	
General.	4-52
Installation.	4-53
Removal.	4-52
F	
Fluid/Lubricant Requirements	
Brake Component Grease.	1-85
Brake Fluid.	1-85
Engine Oil.	1-85
Front Fork Oil.	1-85
Primary Drive/Transmission Lubricant.	1-85
Fluid Conversions.	C-2
Fork Lock	
Installation.	2-183
Removal.	2-183
Fork Stem and Bracket Assembly	
Assembly and Installation.	2-127
Cleaning, Inspection and Repair.	2-126
Removal and Disassembly.	2-126
Front Brake Caliper	
Assembly.	2-56
Assembly.	2-63
Cleaning, Inspection and Repair.	2-55
Disassembly.	2-53
Installation.	2-58
Installing Brake Pads in Caliper.	2-57
Lubricating Pins and Boots.	2-56
Removal.	2-52
Front Brake Caliper: XR Models	
Assembly.	2-63
Cleaning, Inspection and Repair.	2-62
Disassembly.	2-61
Installation.	2-64
Removal.	2-60
Front Brake Line: All Models	
Installation.	2-99
Removal.	2-97
Front Brake Master Cylinder	
Assembly.	2-47
Cleaning, Inspection and Repair.	2-47
Disassembly.	2-45
General.	2-43
Inspection.	2-43
Installation.	2-48
Removal.	2-43
Front Engine Mount/Isolator	
Installation.	2-138
Removal.	2-137
Front Fender	
XL Models.	2-156
XR Models.	2-156
Front Fork	
Assembly.	2-112

Cleaning, Inspection and Repair.	2-112
Disassembly.	2-110
Removal.	2-110
Front Fork: XL Models.	2-110
Installation.	2-113
Front Fork: XR Models	
Assembly.	2-119
Cleaning and Inspection.	2-119
General.	2-115
Installation.	2-124
Removal.	2-115
Front Fork Oil	
Changing: XL Models.	1-65
Changing: XR Models.	1-66
Fuel and Oil	
Gasoline Blends.	1-8
Fuel Injectors	
General.	4-54
Installation.	4-55
Removal.	4-54
Fuel Pressure Test	
General.	4-62
Testing.	4-62
Fuel Pump	
Assembly.	4-59
Disassembly.	4-58
General.	4-57
Installation.	4-60
Removal.	4-57
Fuel Supply Filter.	1-81
Installation.	1-81
Removal.	1-81
Fuel Tank	
Cleaning and Inspection.	4-11
Console Replacement.	4-13
Installation.	4-11
Removal.	4-10
Fuel Tank: XR Models	
Assemble.	4-19
Cleaning and Inspection.	4-18
Disassemble.	4-18
General.	4-16
Installing Fuel Tank.	4-19
Purging and Disconnecting Fuel Supply Hose.	4-16
Reconnecting Fuel Hose and Filling Fuel Tank.	4-20
Removing Fuel Tank.	4-16
Fuel Tank (XL Models).	4-9
Purging and Disconnecting Fuel Supply Hose.	4-10
Reconnecting Fuel Hose and Filling Fuel Tank.	4-12
Vapor Valve.	4-12
Fuse Block Repair.	A-24

G

Gasoline	
Octane Ratings.	1-8
Type.	1-8
Gearcase Cover and Cam Gears	
Assembly and Installation.	3-97
Bushing Installation: XL Models.	3-94
Bushing Reaming.	3-95
Bushing Replacement: XL Models.	3-92
General.	3-92
Removal and Disassembly.	3-92

Glossary	
Acronyms and Abbreviations	E-1
H	
Handlebars	
Installation	2-153
Removal	2-150
Handlebar Switches	
Connectors	6-102
General Procedures	6-101
General Repair Procedures	6-101
Left	6-109
Right	6-103
Headlamp	
Replacement (All models except XL 883C/XL 1200C)	6-50
Replacement (XL 883C/XL 1200C)	6-48
Headlamp Alignment	
Check	1-83
Headlamp Adjustment	1-83
Horn	
Replacement (Models with Front Mounted Horn)	6-98
Replacement (Models with Side Mounted Horn)	6-98
Troubleshooting	6-98
Voltage Test	6-98
How To Use This Section	
Bottom End Repair	3-29
Top End Repair	3-29
Typical Symptoms	3-29
I	
Idle Air Control (IAC)	
General	4-38
Installation: XL Models	4-39
Installation: XR Models	4-41
Removal: XL Models	4-39
Removal: XR Models	4-40
Idle Pulley	
Inspection	1-45
Idle Speed and Ignition Timing	
Idle Speed	1-80
Ignition Timing	1-80
Ignition/Light Switch	6-37
Installation	6-37
Removal	6-37
Ignition Coil	6-44
Installation	6-45
Removal	6-44
Troubleshooting	6-44
Ignition System	
Troubleshooting	6-36
Indicator Lamp Module	6-52
Preliminary Disassembly (All Models)	6-52
Reassembling Vehicle (All models)	6-54
Replacement: All Other Models	6-53
Replacement: XL 1200L and XL 1200N	6-52
Replacement (XL 883C/XL 1200C)	6-53
Induction Module	
Installation	4-32
Induction Module: XR Models	
Assembly	4-36
Disassembly	4-35
General	4-34

Installation	4-36
Removal	4-34
Induction Module (XL Models)	4-28
Assembly	4-31
Disassembly	4-30
Removal	4-28
Installation	
Countershaft Needle Bearing	5-59
Exhaust Pipes and Mufflers	4-50
Muffler Interconnect Bracket	4-50
Shifter Drum Bushing	5-59
Installing Engine in Chassis	3-43
XL Models	3-43
XR Models	3-45
Intake Leak Test	
General	4-64
Leak Tester: Parts List	4-64
Leak Tester: Tester Adjustment	4-64
Leak Tester: Tester Assembly	4-64
Procedure	4-64

J

Jiffy Stand	2-167
Cleaning and Lubrication	2-167
Installation	2-168
Interlock	2-167
Removal	2-167
Jiffy Stand Switch: International Models	
General	6-91
Installation	6-92
Removal	6-91

L

Laced Wheels	
Truing	2-39
Left Handlebar Switch	
Assembly	6-110
Disassembly	6-109
Installation	6-111
Removal	6-109
Switch Repair/Replacement	6-109
Left Side Cover	
Closing Left Side Cover	2-108
General	2-107
Installing Left Side Cover	2-109
Opening Left Side Cover	2-107
Removing Left Side Cover	2-108
License Plate Lamp Module: XL 1200N	
Installation (HDI Only)	6-68
Removal (HDI Only)	6-66
License Plate Lamp Module (XL 1200N)	
General	6-65
Installation (Domestic Only)	6-65
Removal (Domestic Only)	6-65
Loctite	i-II

M

Main Drive Gear and Bearing	
Assembly	5-53
Disassembly	5-52
General	5-50
Installation: Bearing	5-54
Installation: Main Drive Gear	5-55

Installation: Main Drive Gear Seal.	5-57
Removal: Ball Bearing.	5-52
Removal: Main Drive Gear.	5-51
Main Fuse	
Installation.	6-100
Removal.	6-100
Main-Fuse	
General.	6-100
Main Fuse Holder.	6-11
Replacement.	6-11
Main Fuse Housing	
Repair.	A-8
Mainshaft	
Assembly.	5-48
Disassembly.	5-45
Mainshaft and Countershaft Bearings	
Installation.	5-60
Maintenance	
Idler Pulley.	1-45
Maintenance Schedule	
General.	1-10
Main Wiring Harness	
General.	6-81
Installation.	6-82
Removal.	6-81
Metric System.	C-2
Metri-Pack Terminals	
Crimping.	A-27
Molex Connector	
Repair.	A-18
Terminal Crimps.	A-19
N	
Neutral Indicator Switch.	6-79
Replacement.	6-79
O	
Octane Rating.	1-8
Odometer Reset Switch	
Replacement: XL Models.	6-15
Odometer Reset Switch,	
Replacement: XR Models.	6-21
Oil Filter Mount.	3-137
Assembly.	3-137
Cleaning and Inspection.	3-137
Disassembly.	3-137
Oil Pressure	
Checking Oil Pressure.	3-13
Indicator Lamp.	3-12
Oil Pressure Switch.	6-96
Installation.	6-97
Removal.	6-96
Oil Pump.	3-130
Oil Pump.	3-133
Assembly.	3-131
Cleaning and Inspection.	3-131
Cleaning and Inspection.	3-135
Disassembly.	3-131
Disassembly: XR Models.	3-134
Installation.	3-132
Removal.	3-131
Oil Pump: XR Models	
Assembly.	3-136

Oil Tank	
Installation.	3-142
Oil Hose Routing: XL Models.	3-138
Oil Hose Routing: XR Models.	3-138
Removal.	3-140
Optional Security Siren	
Battery Replacement.	6-94
Oxygen Sensors	
General.	4-46
Installation.	4-47
Removal.	4-46

P

Packard 100W Connector	
Repair.	A-29
Packard Micro-64 Connector	
Repair.	A-31
Passenger Footrests.	2-181
XL Models.	2-181
XR Models.	2-181
Precision Cooling System	
Cylinder Head Oil Feed.	3-50
Cylinder Head Oil Return Lines.	3-49
General Information.	3-48
Oil Cooler.	3-52
Oil Pump Lines.	3-51
Return Oil Manifold.	3-48
Primary Chain	
Adjustment.	1-40
Inspection.	1-39
Primary Chain Adjuster	
General.	5-4
Installation: Primary Chain Adjuster.	5-6
Installation: Primary Cover.	5-7
Removal: Primary Chain Adjuster.	5-6
Removal: Primary Cover.	5-4
Primary Drive/Clutch	
Assembly.	5-16
Disassembly.	5-14
General.	5-12
Inspection and Repair.	5-15
Installation.	5-18
Removal.	5-14
Primary Drive/Clutch: XR Models	
Clutch Pack Cleaning and Inspection.	5-23
Clutch Shell/Hub Inspection.	5-24
Removal.	5-22

R

Rear Belt and Sprockets.	1-45
Cleaning.	1-45
Inspection.	1-45
Rear Belt Deflection	
Adjustment.	1-48
Wheel Alignment.	1-49
Rear Brake Caliper	
Assembly.	2-86
Cleaning, Inspection and Repair.	2-85
Disassembly.	2-84
Installation.	2-87
Lubricating Rear Caliper Bolt Pins and Boots.	2-85
Removal.	2-82

Rear Brake Caliper: XR Models		Removal.	6-70
Assembly.	2-93	Rear Stop Lamp Switch.	6-72
Cleaning, Inspection and Repair.	2-93	Replacement.	6-72
Disassembly.	2-91	Removal	
Installation.	2-94	Countershaft Needle Bearing.	5-59
Removal.	2-90	Muffler Interconnect Bracket.	4-49
Rear Brake Line: XL Models		Mufflers and Exhaust Pipes.	4-49
Installation.	2-100	Shifter Drum Bushing.	5-59
Removal.	2-100	Removal and Disassembly	
Rear Brake Line: XR Models		Rotor.	6-75
Installation.	2-102	Stator.	6-75
Removal.	2-101	Removing Engine from Chassis.	3-34
Rear Brake Master Cylinder.	2-65	XL Models.	3-34
Cleaning, Inspection and Repair.	2-69	XR Models.	3-38
Cleaning, Inspection and Repair.	2-75	Repair and Replacement Procedures	
General.	2-73	Bearings.	1-5
Inspection.	2-65	Bushings.	1-5
Inspection.	2-73	Exhaust System Leakage.	1-6
Rear Brake Master Cylinder: XL Models		Gaskets.	1-5
Assembly.	2-70	Gears.	1-6
Disassembly.	2-68	Hardware and Threaded Parts.	1-5
Installation.	2-72	Lip Type Seals.	1-5
Removal.	2-65	O-Rings (Preformed Packings).	1-6
Rear Brake Master Cylinder: XR Models		Part Replacement.	1-6
Assembly.	2-76	Shafts.	1-6
Disassembly.	2-74	Threadlocking Agents.	1-5
Installation.	2-77	Wiring, Hoses and Lines.	1-5
Removal.	2-73	Replacing Valve Guides	
Rear Brake Master Cylinder Reservoir		Installation.	3-105
General.	2-79	Removal.	3-104
Installation: XL Models.	2-80	Rider Foot Controls: XR Models	
Installation: XR Models.	2-81	Adjusting Shift Pedal.	2-180
Removal: XL Models.	2-79	Left Footrest and Shift Lever Assembly.	2-179
Removal: XR Models.	2-80	Right Footrest and Rear Brake Pedal Assembly.	2-179
Rear Drive Belt		Rider Foot Controls (Models Equipped with Mid-Mount Controls)	
General.	1-47	Left Footrest and Shift Lever Assembly.	2-173
Rear Engine Mount/Isolator		Right Footrest and Rear Brake Pedal Assembly.	2-173
Installation.	2-141	Rider Foot Controls (XL Models Equipped with Forward Controls)	
Removal.	2-139	Adjusting Shift Pedal.	2-178
Rear Fender: All Models Except XL 1200N		Left Footrest and Shift Lever Assembly.	2-176
General.	2-157	Right Footrest and Rear Brake Pedal Assembly.	2-175
Installation.	2-159	Right Handlebar Switch	
Removal.	2-157	Assembly.	6-105
Rear Fender: XR Models		Disassembly.	6-103
Installation.	2-166	Installation.	6-106
Removal.	2-166	Removal.	6-103
Rear Fender and License Plate Bracket: XL 1200N		Switch Repair/Replacement.	6-104
Assembly and Installation.	2-163		
General.	2-161		
Removal and Disassembly.	2-161		
Rear Fork			
Assembly.	2-131		
Cleaning and Inspection.	2-131		
Disassembly.	2-130		
General.	2-130		
Installation.	2-131		
Removal.	2-130		
Rear Fork Bearings			
Lubrication.	1-64		
Replacement.	1-64		
Rear Lighting Converter Module: XL 1200N (Domestic Only)			
General.	6-70		
Installation.	6-71		

S

Removal: XL Models.	5-30
Removal: XR Models.	5-31
Security Siren, Optional.	6-93
Assembly.	6-95
Disassembly.	6-93
Installation.	6-95
Removal.	6-93
Service Bulletins.	i-I
Service Preparation.	i-I
Servicing a New Motorcycle.	1-4
Shift Drum Bushing	
Installation.	5-60
Shifter Forks and Drum	
Assembly.	5-62
Shock Absorbers.	2-133
Cleaning and Inspection.	2-133
Installation.	2-133
Rear Shock Preload Adjustment.	1-62
Removal.	2-133
Shop Practices.	1-4
Checking Torques.	1-5
Cleaning.	1-4
Disassembly and Assembly.	1-5
Magnetic Parts Trays.	1-5
Removing Parts.	1-4
Safety.	1-4
Spark Plug Cables.	6-41
Inspection.	1-59
Installation.	6-42
Removal.	6-41
Spark Plugs.	1-58
Inspection.	1-58
Specifications	
2009 Sportster Models.	4-4
2009 Sportster Models.	6-4
2009 Sportster Specifications.	5-3
Sportster Specifications.	2-8
Speedometer	
Installation.	6-12
Installation.	6-14
Removal.	6-12
Removal.	6-14
Speedometer: XL883C/XL 1200C	
Installation.	6-18
Removal.	6-17
Speedometer and Tachometer: XR Models	
Odometer Replacement.	6-21
Speedometer Installation.	6-19
Speedometer Removal.	6-19
Tachometer Installation.	6-21
Tachometer Removal.	6-21
Sportster Specifications	
Chassis Specifications.	2-8
Tire Specifications.	2-9
Sprocket Bearing Replacement	
Installation.	D-2
Removal.	D-1
SPX Kent-Moore.	i-II
Stabilizer Links.	2-135
Lower Front Stabilizer Link: Installation.	2-135
Lower Front Stabilizer Link: Removal.	2-135
Rear Stabilizer Link: Installation.	2-136
Rear Stabilizer Link: Removal.	2-136

Upper Front Stabilizer Link: Installation.	2-135
Upper Front Stabilizer Link: Removal.	2-135
Starter	
Drive Assembly.	6-31
Field Coil Assembly.	6-29
General.	6-29
Installation.	6-32
Removal.	6-29
Starter Solenoid Repair.	6-33
Steering Head Bearings	
Adjustment.	1-60
Lubrication.	1-60
Stoplight Switch	
Replacement.	6-105
Storage	
General.	1-88
Placing In Storage.	1-88
Removal.	1-88
System Fuses and Relays.	6-10
Replacing Fuses.	6-10
Replacing Relays.	6-10

T

Tachometer	
Installation.	6-16
Removal.	6-16
Tail Lamp: All Models except XL 1200N	
Base Replacement.	6-55
Bulb Replacement.	6-55
General.	6-55
Temperature Manifold Absolute Pressure (TMAP) Sensor	
General.	4-42
Installation: XL Models.	4-43
Installation: XR Models.	4-44
Removal: XL Models.	4-42
Removal: XR Models.	4-44
Throttle Cables	
Assembly and Installation.	2-144
Removal and Disassembly.	2-142
Throttle Cables: XL Models	
Cleaning, Inspection and Repair.	2-144
Throttle Control	
Cable Adjustment.	1-79
Cable Inspection and Lubrication.	1-79
Throttle Position (TP) Sensor	
Installation: XR Models.	4-23
Removal: XR Models.	4-23
Throttle Position Sensor	
General.	4-21
Installation: XL Models.	4-22
Removal: XL Models.	4-22
Tire Replacement	
Inspection.	1-37
When To Replace.	1-37
Tires.	2-103
Checking Runout.	2-105
Cleaning, Inspection and Repair.	2-104
Installation.	2-104
Removal.	2-103
Wear Bar Indicators.	1-37
Wheel Balancing.	2-106
Tires and Wheels	
Tires.	1-36

Wheel Bearings.....	1-37	Cylinder Leakage Test.....	3-18
Wheel Spokes.....	1-37	Diagnosing Smoking Engine or High Oil	
Tool Safety		Consumption.....	3-19
Air Tools.....	1-6	Diagnosing Valve Train Noise.....	3-18
Hammers.....	1-7	Electrical System.....	1-92
Pliers/Cutters/Pry bars.....	1-6	Engine.....	1-90
Punches/Chisels.....	1-7	Handling.....	1-92
Ratchets and Handles.....	1-7	Lubrication System.....	1-91
Screwdrivers.....	1-7	Transmission.....	1-92
Sockets.....	1-7	Truing Laced Wheels	
Storage Units.....	1-7	General.....	2-39
Wrenches.....	1-6	Lateral Truing.....	2-39
Top End Overhaul: Assembly		Radial Truing.....	2-40
Assembling Motorcycle.....	3-71	Turn Signal/Security Module.....	6-22
Cylinder Head.....	3-65	Installation.....	6-23
General.....	3-62	Removal.....	6-22
Piston and Cylinder.....	3-62	Testing.....	6-22
Push Rods, Covers, and Retainers.....	3-63	Turn Signals	
Rocker Covers.....	3-68	Bulb Replacement.....	6-58
Top End Overhaul: Disassembly		Front Housing Replacement.....	6-58
Cylinder and Piston.....	3-60	General.....	6-58
Cylinder Heads.....	3-54	Rear Housing Replacement.....	6-59
General.....	3-53	Turn Signal Switch Replacement	
Stripping Motorcycle for Top End Repair.....	3-53	Left.....	6-105
Top End Service		Right.....	6-110
Engine in Chassis.....	3-30		
Engine Removed from Chassis.....	3-31	V	
Torque Conversion.....	C-3	V.I.N.	
Trademarks		Vehicle Identification Number.....	2-11
Harley-Davidson.....	i-II	Valve Tappets	
Referenced Products.....	i-II	Cleaning and Inspection.....	3-91
Transmission		General.....	3-91
Assembly, countershaft.....	5-48	Installation.....	3-91
Assembly, mainshaft.....	5-48	Removal.....	3-91
Cleaning and Inspection, countershaft.....	5-46	Vapor Valve	
Cleaning and Inspection, mainshaft.....	5-46	Installation.....	4-69
Disassembly, countershaft.....	5-46	Removal.....	4-68
Disassembly, mainshaft.....	5-45	Vehicle Identification Number	
Disassembly, mainshaft/countershaft.....	5-45	Abbreviated.....	2-11
General.....	5-35	Vehicle Identification Number (V.I.N.).....	2-11
Removal, left crankcase.....	5-41	Vehicle Speed Sensor.....	6-78
Transmission Case Bearings		Installation.....	6-78
Installation, left.....	5-60	Removal.....	6-78
Transmission Installation		Voltage Regulator	
Assembling Crankcases.....	5-63	General.....	6-5
General.....	5-61	Installation: XL Models.....	6-6
Installation.....	5-61	Installation: XR Models.....	6-8
Shifter Shaft Installation.....	5-65	Removal: XL Models.....	6-5
Transmission Left Case Bearings		Removal: XR Models.....	6-7
Removal: Mainshaft and Countershaft Bearings... ..	5-60	W	
Removal: Shifter Drum Bushing.....	5-60	Wheel Lacing	
Transmission Lubrication		19 In. Rim.....	2-31
Changing Lubricant.....	1-44	21 In. Rim.....	2-35
Check Lubricant Level.....	1-43	Wheel Lacing: 16 Inch Rim	
Transmission Right Case Bearings		General.....	2-28
Installation.....	5-59	Procedure.....	2-28
Removal.....	5-59	Wheel Lacing: 21 In. Rim	
Transmission Sprocket		Procedure.....	2-35
Removal.....	5-67	Wheels	
Troubleshooting		Front Wheel.....	2-14
Adjustment and Testing.....	3-19	General.....	2-13
Brakes.....	1-92	Rear.....	2-20
Compression Test.....	3-18		

Sealed Bearings.....	2-24
Troubleshooting.....	2-13
Winter Lubrication.....	1-9
Wiring Diagrams.....	B-3

X

XR Models	
Installation.....	2-181
Removal.....	2-181







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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



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2009 Harley-Davidson Sportster Models Electrical Diagnostic Manual (99495-09)

Please clip out and mail to:

Service Communications Department

Harley-Davidson Motor Company

P.O. Box 653

Milwaukee, WI USA 53201

NOTES



ABOUT THIS MANUAL

GENERAL

This electrical diagnostic service manual has been prepared with two purposes in mind. First, it will acquaint the user with the construction of the Harley-Davidson product and assist in the performance of repair. Secondly, it will introduce to the professional Harley-Davidson Technician the latest field-tested and factory-approved diagnostic 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

Refer to the table below for the content layout of this manual.

NO.	CHAPTER
1	Starting / Charging
2	Instruments
3	TSM/HFSM
4	Engine Management
A	Appendix A Connector Repair
B	Appendix B Wiring
C	Appendix C Conversions
D	Appendix D Glossary
E	Appendix E TSM/TSSM (Japan/Korea)

Use the TABLE OF CONTENTS (which follows this FOREWORD) and the INDEX (at the back of this manual) to quickly locate subjects. Sections and topics in this manual are sequentially numbered for easy navigation.

For example, a cross-reference shown as **2.1 SPECIFICATIONS** refers to chapter 2 CHASSIS, heading 2.1 SPECIFICATIONS.

For quick and easy reference, all pages contain a section number followed by a page number. For example, **page 3-5** refers to page 5 in section 3.

A number of acronyms and abbreviations are used in this document. See the [D.1 GLOSSARY](#) for a list of acronyms, abbreviations and definitions.

PREPARATION FOR SERVICE

WARNING

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

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

NOTES

- To avoid unnecessary disassembly, carefully read all relative service information before repair work is started.*
- In figure legends, the number which follows the name of a part indicates the quantity necessary for one complete assembly.*
- When servicing a vehicle equipped with the Harley-Davidson Smart Security System (H-DSSS), you must first disarm the security system. Either keep the fob in close proximity to the vehicle, or use Digital Technician II to disable the security system while the vehicle is being serviced and re-enable the system after service is completed.*

SERVICE BULLETINS

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

USE GENUINE REPLACEMENT PARTS

WARNING

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

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

WARNINGS AND CAUTIONS

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

WARNING

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

CAUTION

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

CAUTION

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

NOTE

Refers to important information, and is placed in italic type. It is recommended that you take special notice of these items.

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

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

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

Kent-Moore Products

All tools mentioned in this manual with an "HD", "J" or "B" preface must be ordered through SPX Kent-Moore. For ordering

information or product returns, warranty or otherwise, visit www.spx.com.

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, please contact Loctite Corp. at www.loctite.com.

PRODUCT REGISTERED MARKS

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

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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.

STARTING / CHARGING

1.1 STARTER TROUBLESHOOTING

General.....	1-1
Starter Troubleshooting.....	1-1

1.2 STARTING SYSTEM DIAGNOSIS

Diagnostics.....	1-3
Diagnostic Notes.....	1-3
Job/Time Code Values.....	1-3

1.3 DIAGNOSTICS/TROUBLESHOOTING

Voltage Drop.....	1-11
-------------------	------

1.4 STARTER ACTIVATION CIRCUITS

Starter Activation Circuits.....	1-12
----------------------------------	------

1.5 TESTING STARTER ON MOTORCYCLE

Start Relay Test.....	1-13
Starter Current Draw Test.....	1-13

1.6 TESTING STARTER ON BENCH

Free Running Current Draw Test.....	1-15
Starter Solenoid.....	1-15
Solenoid Pull-In Test.....	1-15
Solenoid Hold-In Test.....	1-15
Solenoid Return Test.....	1-16
Testing.....	1-16
Armature.....	1-16
Brushes and Brush Holder.....	1-18

1.7 CHARGING SYSTEM

General.....	1-20
Alternator.....	1-20
Voltage Regulator.....	1-20
Troubleshooting.....	1-20
Battery.....	1-20
Wiring.....	1-20
Testing.....	1-24
Milliampere Draw Test.....	1-24
Total Current Draw Test.....	1-24
Current and Voltage Output Test: Using HD-48053.....	1-25
Current and Voltage Output Test: Using Load Tester.....	1-25
Stator Check.....	1-26
AC Output Check.....	1-27

1.8 BATTERY TESTING

General.....	1-28
Voltmeter Test.....	1-28
Conductance Test.....	1-28
Load Test.....	1-28

INSTRUMENTS

2.1 CHECKING FOR DIAGNOSTIC TROUBLE CODES

Check Engine Lamp.....	2-1
Security Lamp.....	2-2
Turn Signal Module (TSM).....	2-2
Turn Signal Security Module (TSSM) or Hands-Free Security Module (HFSM).....	2-2
Code Types.....	2-3
Current.....	2-3

Historic.....	2-3
Retrieving Diagnostic Trouble Codes.....	2-3
Multiple Diagnostic Trouble Codes.....	2-3

2.2 INITIAL DIAGNOSTIC CHECK: ODOMETER

General.....	2-4
Diagnostic Notes.....	2-4
Circuit Diagram/Wire Harness Connector Table.....	2-4
Job/Time Code Values.....	2-5
Reprogramming ECM.....	2-5
Initial Diagnostics.....	2-5
Diagnostic Tips.....	2-5
Diagnostic Notes.....	2-5
Other Diagnostic Trouble Codes.....	2-5

2.3 ODOMETER SELF-DIAGNOSTICS

General.....	2-13
Diagnostics.....	2-13
Diagnostic Tips.....	2-13
Diagnostic Notes.....	2-13

2.4 SPEEDOMETER/TACHOMETER

General.....	2-15
Trip Odometer Reset Switch.....	2-15
Speedometer Theory of Operation.....	2-15
Odometer Theory of Operation.....	2-15
Tachometer Theory of Operation.....	2-15
Diagnostics.....	2-16
Diagnostic Notes.....	2-16

2.5 BREAKOUT BOX: SPEEDOMETER/TACHOMETER

General.....	2-20
Speedometer: XL only.....	2-20
Installation.....	2-20
Removal.....	2-20
Tachometer.....	2-20
Installation.....	2-20
Removal.....	2-20

2.6 INDICATOR LAMPS

General.....	2-21
Job/Time Code Values.....	2-21
Diagnostics.....	2-21
Diagnostic Notes.....	2-21

2.7 DTC B1004, B1005

General.....	2-26
Diagnostics.....	2-26
Diagnostic Tips.....	2-26
Diagnostic Notes.....	2-26

2.8 DTC B1006, B1007

General.....	2-30
Accessory or Ignition Line Overvoltage.....	2-30

2.9 DTC B1008

General.....	2-32
Trip Odometer Reset Switch Closed.....	2-32
Diagnostics.....	2-32
Diagnostic Notes.....	2-32

2.10 DTC U1016, U1255

General.....	2-34
--------------	------

TABLE OF CONTENTS

Loss of ECM Serial Data.....	2-34
Diagnostics.....	2-34
Diagnostic Notes.....	2-34

2.11 DTC U1064, U1255

General.....	2-39
Loss of TSM/TSSM/HFSM Serial Data.....	2-39
Diagnostics.....	2-39
Diagnostic Notes.....	2-39

2.12 DTC U1300, U1301 OR BUS ER

General.....	2-44
Serial Data Low or Serial Data Open/High.....	2-44
Diagnostics.....	2-44
Diagnostic Tips.....	2-44
Diagnostic Notes.....	2-44

TSM/HFSM

3.1 TURN SIGNAL OVERVIEW

General.....	3-1
Security System: Japan/Korea.....	3-1
Turn Signal Functions.....	3-1
Manual Cancellation.....	3-1
Automatic Cancellation.....	3-1
Bank Angle Functions.....	3-1
Bank Angle Restart.....	3-1
Clutch/Neutral Interlock.....	3-1
Security System H-DSSS.....	3-1

3.2 HARLEY-DAVIDSON SMART SECURITY SYSTEM

Components.....	3-2
Security Immobilization.....	3-2
HFSM Features.....	3-3

3.3 H-DSSS ACTUATION

General.....	3-5
Sidecar Configuration.....	3-5
Actuation.....	3-5
Fob Assignment.....	3-5
Power Disruption and Configuring.....	3-5

3.4 PERSONAL IDENTIFICATION NUMBER (PIN)

General.....	3-6
Initial Pin Entry.....	3-6
Changing the Pin.....	3-6
Modifying an Existing Pin.....	3-6

3.5 ARMING/DISARMING SECURITY SYSTEM

Hands-Free Fob.....	3-8
Security Lamp (Key Icon).....	3-8
Arming.....	3-8
Disarming.....	3-9
Automatic Disarming.....	3-9
Disarming with a Personal Identification Number (PIN).....	3-9

3.6 WARNINGS AND ALARMS

Warnings.....	3-10
Alarm.....	3-10
Activation.....	3-10
Deactivation.....	3-10
Siren Chirp Mode (Confirmation).....	3-10
Chirpless Mode.....	3-10
Chirp Mode.....	3-10
Switching Modes.....	3-10

3.7 SERVICE/EMERGENCY FUNCTIONS

Transport Mode.....	3-11
To Enter Transport Mode.....	3-11
To Exit Transport Mode.....	3-11
Service Mode.....	3-11
Four-Way Flashing.....	3-11
To Arm the HFSM with the Hazard Warning Flashers ON.....	3-11
To Disarm the HFSM and Turn the Hazard Warning Flashers OFF.....	3-11

3.8 TROUBLESHOOTING

Turn Signals (TSM/HFSM).....	3-12
Security System (HFSM).....	3-12
Diagnostics Mode.....	3-12
Troubleshooting.....	3-12

3.9 CHECKING FOR DIAGNOSTIC TROUBLE CODES

General.....	3-13
Security/Lamp Diagnostics.....	3-13
Code Types.....	3-14
Current.....	3-14
Historic.....	3-14
Retrieving DTCs.....	3-14
Multiple DTCs/Priority Order.....	3-15

3.10 INITIAL DIAGNOSTIC CHECK: TSM/HFSM

General.....	3-16
Diagnostic Notes.....	3-16
Circuit Diagram/Wire Harness Connector Table.....	3-16
Job/Time Codes.....	3-16
Reprogramming ECM.....	3-16
Initial Diagnostics.....	3-16
Diagnostic Tips.....	3-16
Diagnostic Notes.....	3-16
Other DTCs.....	3-17

3.11 ODOMETER SELF-DIAGNOSTICS

General.....	3-24
Diagnostics.....	3-24
Diagnostic Tips.....	3-24
Diagnostic Notes.....	3-24

3.12 BREAKOUT BOX: TSM/HFSM

General.....	3-26
Installation.....	3-26
Removal.....	3-26

3.13 FAILS TO DISARM (HFSM ONLY)

General.....	3-28
Job/Time Codes.....	3-28
Diagnostics.....	3-28
Diagnostic Tips.....	3-28
Diagnostic Notes.....	3-28

3.14 DTC B0563

General.....	3-31
Diagnostics.....	3-31
Diagnostic Tips.....	3-31
Diagnostic Notes.....	3-31

3.15 TSM/HFSM: TURN SIGNAL ERRORS AND DTCS

General.....	3-32
Diagnostics.....	3-32
Job/Time Codes.....	3-32
Diagnostic Tips.....	3-32
Diagnostic Notes.....	3-34

3.16 DTC B1131, B1132 (HFSM ONLY)

General.....	3-48
Diagnostics.....	3-48
Diagnostic Tips.....	3-48
Diagnostic Notes.....	3-48

3.17 DTC B1134

General.....	3-51
Diagnostics.....	3-51
Diagnostic Notes.....	3-51

3.18 DTCS B1135, B1136, B1141, AND B1142

Diagnostics.....	3-54
DTC B1135 Accelerometer Fault.....	3-54
DTC B1136 Accelerometer Tip-Over Self-Test Fault and DTC B1142 Internal Fault.....	3-54
DTC B1141 Ignition Switch Open/Low.....	3-54
Diagnostic Notes.....	3-54

3.19 DTC B1143, B1144, B1145 (HFSM ONLY)

General.....	3-58
DTC B1143: Security Antenna Short-to-Ground.....	3-58
DTC B1144: Security Antenna Short-to-Voltage.....	3-58
Diagnostics.....	3-58
Diagnostic Notes.....	3-58

3.20 DTC B1154, B1155

Diagnostics.....	3-61
Diagnostic Tips.....	3-61
Diagnostic Notes.....	3-61

3.21 DTC U1016, U1255

General.....	3-65
Diagnostics.....	3-65
Diagnostic Notes.....	3-65

3.22 DTC U1300, U1301 OR BUS ER

Diagnostics.....	3-70
------------------	------

Diagnostic Tips.....	3-70
Diagnostic Notes.....	3-70

3.23 TSM/HFSM: PASSWORD LEARN

General.....	3-71
Password Learning.....	3-71

3.24 HFSM MAINTENANCE

General.....	3-72
Hands-Free Fob.....	3-72
Schedule.....	3-72
Battery Replacement.....	3-72
Smart Siren (If Installed).....	3-72
Schedule.....	3-72
Battery Replacement: Early Style Siren.....	3-72
Battery Replacement: Late Style Siren.....	3-72

ENGINE MANAGEMENT

4.1 SPECIFICATIONS

Specifications.....	4-1
---------------------	-----

4.2 EFI SYSTEM

General.....	4-3
Troubleshooting.....	4-3

4.3 EFI DIAGNOSTIC INTRODUCTION

System Problems.....	4-5
No Start.....	4-5
Poor Performance.....	4-5
Check Engine Lamp.....	4-5
Resolving Problems.....	4-5

4.4 CHECKING FOR DIAGNOSTIC TROUBLE CODES: EFI

Check Engine Lamp.....	4-6
Code Types.....	4-7
Current.....	4-7
Historic.....	4-7
Retrieving Diagnostic Trouble Codes.....	4-7
Multiple Diagnostic Trouble Codes.....	4-8

4.5 INITIAL DIAGNOSTIC CHECK: EFI

General.....	4-9
Diagnostic Notes.....	4-9
Circuit Diagram/Wire Harness Connector Table.....	4-9
Reprogramming ECM.....	4-9
Initial Diagnostics.....	4-9
General Information.....	4-9
Diagnostic Tips.....	4-9
Diagnostic Notes.....	4-9
Other DTCs.....	4-9

4.6 ODOMETER SELF-DIAGNOSTICS

General.....	4-20
Diagnostics.....	4-20
Diagnostic Tips.....	4-20
Diagnostic Notes.....	4-20

TABLE OF CONTENTS

4.7 BREAKOUT BOX: EFI

General.....	4-22
Installation.....	4-22
Removal.....	4-22

4.8 WIGGLE TEST

General.....	4-23
Procedure.....	4-23

4.9 ENGINE CRANKS, BUT WILL NOT START

General.....	4-24
Diagnostics.....	4-24
Diagnostic Notes.....	4-24
Diagnostic Tips.....	4-24

4.10 NO ECM POWER

General.....	4-31
No Spark/No Check Engine Lamp at Key On.....	4-31
Diagnostics.....	4-31
Diagnostic Notes.....	4-31

4.11 STARTS, THEN STALLS

General.....	4-36
Diagnostic Trouble Codes U1300, U1301, or BUS ER.....	4-36
Diagnostics.....	4-36
Diagnostic Tips.....	4-36
Diagnostic Notes.....	4-36

4.12 FUEL SYSTEM ELECTRICAL TEST

General.....	4-42
Diagnostics.....	4-42
Diagnostic Notes.....	4-42

4.13 SYSTEM RELAY CHECK

General.....	4-50
System Relay.....	4-50
Diagnostics.....	4-50
Diagnostic Notes.....	4-50

4.14 IDLE AIR CONTROL

General.....	4-55
IAC Operation.....	4-55
Diagnostic Trouble Code P0505: Loss of Idle Speed Control.....	4-55
Diagnostics.....	4-55
Diagnostic Tips.....	4-55
Diagnostic Notes.....	4-55

4.15 MISFIRE AT IDLE OR UNDER LOAD

General.....	4-60
Misfire at Idle or Under Load.....	4-60
Diagnostics.....	4-60
Diagnostic Notes.....	4-60

4.16 DTC P0107, P0108, P0112, P0113

General.....	4-66
MAP Signal.....	4-66
IAT Signal.....	4-66

Diagnostics.....	4-66
Diagnostic Tips: MAP Sensor.....	4-66
Diagnostic Notes: MAP Sensor.....	4-66
Diagnostic Tips: IAT Sensor.....	4-67
Diagnostic Notes: IAT Sensor.....	4-67

4.17 DTC P0117, P0118

General.....	4-73
ET Sensor.....	4-73
Diagnostics.....	4-73
Diagnostic Tips.....	4-73
Diagnostic Notes.....	4-73

4.18 DTC P0122, P0123

General.....	4-77
TP Sensor.....	4-77
Diagnostics.....	4-77
Diagnostic Tips.....	4-77
Diagnostic Notes.....	4-78

4.19 DTC P0131, P0132, P0134, P0151, P0152, P0154

General.....	4-82
Oxygen Sensor.....	4-82
Diagnostics.....	4-82
Diagnostic Tips.....	4-82
Diagnostic Notes.....	4-82

4.20 DTC P0261, P0262, P0263, P0264

General.....	4-87
Fuel Injectors.....	4-87
Diagnostics.....	4-87
Diagnostic Notes.....	4-87

4.21 DTC P0373, P0374

General.....	4-93
CKP Sensor.....	4-93
Diagnostics.....	4-93
Diagnostic Tips.....	4-93
Diagnostic Notes.....	4-93

4.22 DTC P0501, P0502

General.....	4-96
Vehicle Speed Sensor (VSS).....	4-96
Diagnostics.....	4-96
Diagnostic Notes.....	4-96

4.23 DTC P0562, P0563

General.....	4-100
Battery Voltage.....	4-100
Diagnostics.....	4-100
Diagnostic Tips.....	4-100
Diagnostic Notes.....	4-100

4.24 DTC P0603, P0605

General.....	4-104
ECM Failure.....	4-104
Diagnostics.....	4-104
DTC P0603.....	4-104
DTC P0605.....	4-104

4.25 DTC P0661, P0662

General.....	4-105
Active Intake Solenoid (HDI XR Models Only).....	4-105
Diagnostics.....	4-105
Diagnostic Notes.....	4-105

4.26 DTC P1009, P1010

General.....	4-109
Password Problem.....	4-109
Diagnostics.....	4-109
Diagnostic Notes.....	4-109

4.27 DTC P1351, P1352, P1354, P1355

General.....	4-114
Ignition Coil.....	4-114
Diagnostics.....	4-114
Diagnostic Notes.....	4-114

4.28 DTC P1501, P1502

General.....	4-119
Jiffy Stand Sensor (HDI).....	4-119
Diagnostics.....	4-119
Diagnostic Notes.....	4-119

4.29 DTC U1064, U1255

General.....	4-124
Loss of TSM/TSSM/HFSM Serial Data.....	4-124
Diagnostics.....	4-124
Diagnostic Notes.....	4-124

4.30 DTC U1097, U1255

General.....	4-129
Loss of Speedometer Serial Data.....	4-129
Diagnostics.....	4-129
Diagnostic Notes.....	4-129

4.31 FUEL PRESSURE TEST

General.....	4-134
Diagnostics.....	4-134
Low Fuel Pressure.....	4-134
High Fuel Pressure.....	4-134

APPENDIX A CONNECTOR REPAIR

A.1 AMP MULTILOCK CONNECTORS

AMP Multilock Connector Repair.....	A-1
General.....	A-1
Separating Pin and Socket Housings.....	A-1
Mating Pin and Socket Housings.....	A-1
Removing Terminals from Housing.....	A-1
Inserting Terminals into Housing.....	A-2
Preparing Wire Leads for Crimping.....	A-2
Crimping Terminals to Leads.....	A-4
Inspecting Crimped Terminals.....	A-4

A.2 DELPHI CONNECTORS

Delphi Connector Repair.....	A-6
General.....	A-6
Separating Pin and Socket Housings.....	A-6
Mating Pin and Socket Housings.....	A-6

Removing Socket Terminals.....	A-6
Installing Socket Terminals.....	A-6

A.3 DEUTSCH 1-PLACE ELECTRICAL CONNECTORS

Deutsch 1-Place Connector Repair.....	A-8
Separating Pin and Socket Housings.....	A-8
Mating Pin and Socket Housings.....	A-8
Removing Socket Terminals.....	A-8
Installing Socket Terminals.....	A-8

A.4 DEUSCH ELECTRICAL CONNECTORS

Deutsch Connector Repair.....	A-9
General.....	A-9
Separating Pin and Socket Housings.....	A-9
Mating Pin and Socket Housings.....	A-9
Removing Socket Terminals.....	A-9
Installing Socket Terminals.....	A-9
Removing Pin Terminals.....	A-11
Installing Pin Terminals.....	A-11
Crimping Terminals.....	A-12

A.5 DEUTSCH STANDARD TERMINALS

Deutsch Standard Terminal Crimps.....	A-13
Preparing Wire Leads for Crimping.....	A-13
Crimping Terminal to Lead.....	A-13
Inspecting Crimps.....	A-13

A.6 DEUTSCH MINI-TERMINAL CRIMPS

Deutsch Mini Terminal Crimps.....	A-14
Preparing Wire Leads for Crimping.....	A-14
Crimping a Mini Terminal to Wire Lead.....	A-14
Inspecting Crimps.....	A-14

A.7 DEUTSCH SOLID BARREL TERMINALS

Deutsch Solid Barrel Terminal Crimps.....	A-15
Preparing Wire Leads For Crimping.....	A-15
Adjusting Crimper Tool.....	A-15
Crimping a Barrel Contact To Wire Lead.....	A-15
Inspecting Crimps.....	A-15

A.8 RELAY AND FUSE BLOCKS

Fuse Block Repair.....	A-17
Removing Socket Terminals.....	A-17
Installing Socket Terminals.....	A-17
Crimping Terminals.....	A-17

A.9 150 METRI-PACK CONNECTORS

150 Metri-Pack Connector Repair.....	A-18
General.....	A-18
Separating Pin and Socket Housings.....	A-18
Mating Pin and Socket Housings.....	A-18
Removing Socket Terminal.....	A-18
Inserting Socket Terminal.....	A-18

A.10 280 METRI-PACK CONNECTORS

280 Metri-Pack Connector Repair.....	A-20
General.....	A-20
Separating Pin and Socket Housings.....	A-20
Mating Pin and Socket Housings.....	A-20
Removing Socket Terminals.....	A-20

TABLE OF CONTENTS

Installing Socket Terminals.....	A-20
Crimping Terminals.....	A-20
A.11 480 METRI-PACK CONNECTORS	
480 Metri-Pack Connector Repair.....	A-22
General.....	A-22
Separating Pin and Socket Housings.....	A-22
Mating Pin and Socket Housings.....	A-22
Removing Socket Terminals.....	A-22
Installing Socket Terminals.....	A-22
A.12 630 METRI-PACK CONNECTORS	
630 Metri-Pack Connector Repair.....	A-23
General.....	A-23
Separating Pin and Socket Housings.....	A-23
Mating Pin and Socket Housings.....	A-23
Removing Socket Terminal.....	A-23
Installing Socket Terminal.....	A-23
A.13 800 METRI-PACK CONNECTORS	
Delphi Main Fuse Housing Repair.....	A-24
General.....	A-24
Removing Main Fuse.....	A-24
Installing Main Fuse.....	A-24
Removing Socket Terminals.....	A-24
Installing Socket Terminals.....	A-24
A.14 METRI-PACK TERMINALS	
Metri-Pack Terminal Crimps.....	A-26
Matching Terminal To Crimper.....	A-26
Preparing Wire Lead.....	A-26
Crimping Wire Core.....	A-26
Crimping Insulation/Seal.....	A-26
Inspecting Crimps.....	A-27
A.15 MOLEX CONNECTORS	
Molex Connector Repair.....	A-28
Separating Pin and Socket Housings.....	A-28
Mating Pin and Socket Housings.....	A-28
Removing Terminals.....	A-28
Installing Terminals.....	A-28
A.16 PACKARD ECM CONNECTOR	
Packard 100W Connector Repair.....	A-30
General.....	A-30
Separating Socket Housing From ECM.....	A-30
Mating Socket Housing To ECM.....	A-30
Removing Socket Terminal.....	A-30
Installing Socket Terminal.....	A-30
Crimping Terminals.....	A-30
A.17 PACKARD MICRO-64 CONNECTORS	
Packard Micro-64 Connector Repair.....	A-32
General.....	A-32
Separating Pin and Socket Housings.....	A-32
Mating Pin and Socket Housings.....	A-32
Removing Terminal.....	A-32
Installing Terminal.....	A-33
Preparing Wire Leads for Crimping.....	A-33
Crimping Terminals.....	A-33
Inspecting Crimps.....	A-33

A.18 SEALED SPLICE CONNECTORS

Sealed Splice Connector Repair.....	A-35
General.....	A-35
Preparing Wire Leads.....	A-35
Splicing Wire Leads.....	A-35
Inspecting Seals.....	A-35

APPENDIX B WIRING

B.1 CONNECTORS

Connector Locations.....	B-1
Function/Location.....	B-1
Place and Color.....	B-1
Connector Number.....	B-1
Repair Instructions.....	B-1

B.2 WIRING DIAGRAMS

Wiring Diagram Information.....	B-3
Wire Color Codes.....	B-3
Wiring Diagram Symbols.....	B-3
2009 Sportster Wiring Diagrams.....	B-4

APPENDIX C CONVERSIONS

C.1 METRIC CONVERSION

Conversion Table.....	C-1
-----------------------	-----

C.2 FLUID CONVERSIONS

United States System.....	C-2
Metric System.....	C-2
British Imperial System.....	C-2

C.3 TORQUE CONVERSIONS

United States System.....	C-3
Metric System.....	C-3

APPENDIX D GLOSSARY

D.1 GLOSSARY

Acronyms and Abbreviations.....	D-1
---------------------------------	-----

APPENDIX E TSM/TSSM (JAPAN/KOREA)

E.1 TSM/TSSM (JAPAN/KOREA) OVERVIEW

General.....	E-1
TSM.....	E-1
TSSM.....	E-1
Troubleshooting.....	E-1

E.2 TSM/TSSM FEATURES

Turn Signal Functions.....	E-2
TSM/TSSM Features.....	E-2
Bank Angle Function.....	E-2
Clutch/Neutral Interlock Functions.....	E-2
TSM/TSSM Features.....	E-2
Security Alarm and Immobilization Functions.....	E-2
TSSM Feature.....	E-2

E.3 VEHICLE DELIVERY

General.....	E-4
Configuring A TSSM.....	E-4
Sidcar Configuration.....	E-4
Power Disruption and Configuring.....	E-4
Key Fob Assignment: TSSM.....	E-4
Pin Entry: TSSM.....	E-5
Changing the Pin: TSSM.....	E-7

E.4 TURN SIGNAL FUNCTIONS

General.....	E-8
Automatic Cancellation.....	E-8
Manual Cancellation.....	E-8
Four-Way Flashing.....	E-8
Diagnostics Mode.....	E-8

E.5 BANK ANGLE FUNCTION

General.....	E-9
Operation.....	E-9

E.6 SECURITY SYSTEM FUNCTIONS (TSSM ONLY)

General.....	E-10
Security System Operation.....	E-10
Security System Options: TSSM.....	E-10
Alarm Sensitivity: TSSM.....	E-10
Sensitivity.....	E-10
Transport Mode.....	E-11
Auto-Arming Function: TSSM.....	E-11
Storage Mode: TSSM.....	E-12

E.7 ARMING/DISARMING (TSSM ONLY)

General.....	E-13
Security Lamp.....	E-13
Using Key FOB: TSSM.....	E-13
General.....	E-13
Arming the System.....	E-13
Disarming the System.....	E-13
Troubleshooting.....	E-13
Using the Pin.....	E-13
General.....	E-13
Disarming the System.....	E-13

E.8 DIAGNOSTIC TROUBLE CODES (DTC)

TSM/TSSM.....	E-15
Code Types.....	E-16
Current.....	E-16
Historic.....	E-16
Retrieving Diagnostic Trouble Codes.....	E-16
Multiple Diagnostic Trouble Codes.....	E-17

E.9 INITIAL DIAGNOSTIC CHECK: TSM/TSSM

General.....	E-18
Diagnostic Notes.....	E-18
Circuit Diagram/Wire Harness Connector Table.....	E-18
Job/Time Code Values.....	E-18
Reprogramming ECM.....	E-18
Initial Diagnostics.....	E-18
Diagnostic Tips.....	E-18

Diagnostic Notes.....	E-18
Other DTCs.....	E-18

E.10 ODOMETER SELF-DIAGNOSTICS

General.....	E-26
Diagnostics.....	E-26
Diagnostic Tips.....	E-26
Diagnostic Notes.....	E-26

E.11 BREAKOUT BOX: TSM/TSSM

General.....	E-28
Installation.....	E-28
Removal.....	E-29

E.12 FAILS TO DISARM (TSSM ONLY)

General.....	E-30
Security Equipped Vehicles Only.....	E-30
Job/Time Code Values.....	E-30
Diagnostics.....	E-30
Diagnostic Tips.....	E-30
Diagnostic Notes.....	E-30

E.13 TURN SIGNAL ERRORS: B1121, B1122, B1141

General.....	E-33
Job/Time Code Values.....	E-33
Diagnostics.....	E-33
Diagnostic Tips: All.....	E-33
Diagnostic Notes: All Turn Signal Flowcharts.....	E-35

E.14 DTC B0563

General.....	E-46
Battery Voltage High.....	E-46
Diagnostics.....	E-46
Diagnostic Tips.....	E-46
Diagnostic Notes.....	E-46

E.15 DTC B1131, B1132

General.....	E-47
Alarm Output Low (DTC B1131) or Alarm Output High (DTC B1132).....	E-47
Diagnostics.....	E-47
Diagnostic Tips.....	E-47
Diagnostic Notes.....	E-47

E.16 DTC B1134

General.....	E-50
Starter Output High.....	E-50
Diagnostics.....	E-50
Diagnostic Notes.....	E-50

E.17 DTC B1135

General.....	E-53
Accelerometer Fault: B1135.....	E-53

E.18 DTC B1154, B1155

General.....	E-54
Diagnostic Notes.....	E-54

TABLE OF CONTENTS

E.19 DTC U1016, U1255

General.....E-58
Loss of ECM Serial Data.....E-58
Diagnostics.....E-58
Diagnostic Notes.....E-58

E.20 DTC U1300, U1301 OR BUS ER

General.....E-63
Serial Data Low or Serial Data Open/High.....E-63
Diagnostics.....E-63
Diagnostic Tips.....E-63
Diagnostic Notes.....E-63

E.21 TSM/TSSM: PASSWORD LEARN

General.....E-64
Password Learning.....E-64

E.22 TSSM MAINTENANCE

General.....E-65
Key FOB.....E-65
Schedule.....E-65
Battery Replacement.....E-65
Siren (If Installed).....E-65
Schedule.....E-65
Battery Replacement: Early Style Siren.....E-65
Battery Replacement: Late Style Siren.....E-66

REFERENCE MATERIAL

TOOLS.....I
TORQUE VALUES.....V
INDEX.....VII



TABLE OF CONTENTS

SUBJECT	PAGE NO.
1.1 STARTER TROUBLESHOOTING.....	1-1
1.2 STARTING SYSTEM DIAGNOSIS.....	1-3
1.3 DIAGNOSTICS/TROUBLESHOOTING.....	1-11
1.4 STARTER ACTIVATION CIRCUITS.....	1-12
1.5 TESTING STARTER ON MOTORCYCLE.....	1-13
1.6 TESTING STARTER ON BENCH.....	1-15
1.7 CHARGING SYSTEM.....	1-20
1.8 BATTERY TESTING.....	1-28



NOTES



STARTER TROUBLESHOOTING

1.1

GENERAL

The troubleshooting tables contain detailed procedures to solve and correct problems. Follow [1.2 STARTING SYSTEM DIAGNOSIS](#) to diagnose starting system problems. The [1.3 DIA-](#)

[GNOSTICS/TROUBLESHOOTING, Voltage Drop](#) procedure will help you to locate poor connections or components with excessive voltage drops.

STARTER TROUBLESHOOTING

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.
	Short-circuited or open between electrodes.	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 start relay, especially relay ground wire (grounds through TSM/TSSM/HFSM).	Tighten connections or repair or replace wire(s).
Start switch, engine stop switch, clutch switch or neutral switch	Poor switch contacts or open switch.	Replace switch.
Start relay	Open coil winding.	Replace relay.
	Poor or no continuity at relay points.	Replace relay.
	TSM/TSSM/HFSM has disabled start relay.	Disarm security system.
Solenoid	Poor contact condition caused by burnt contact.	Polish contact surface or replace solenoid assembly
	Pull-in winding open or short-circuited.	Repair or replace solenoid assembly.
	Hold-in winding open or short-circuited.	Repair or 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.	Correct by undercutting.
	Field winding grounded.	Replace starter.
	Armature winding grounded or short-circuited.	Replace starter.
	Free running current draw out of range.	Replace starter.
	Reduction gears damaged.	Replace starter.
	Insufficient brush spring tension.	Replace starter.
	Disconnected lead wire between solenoid and field windings.	Repair or replace lead wire.
	Ball bearing sticks.	Replace bearing.
Temperature	Incorrect oil for low temperature.	Use recommended viscosity oil for temperature range. Consult Owner's Manual.

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.
	Short-circuited or open between electrodes.	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 pinion.
	Pinion does not run in overrunning direction.	Replace overrunning clutch.
	Poor sliding condition of spline teeth.	Remove foreign materials, dirt or replace overrunning clutch or pinion shaft.
	Reduction gears damaged.	Replace overrunning clutch and idler gear.
Gear teeth on clutch shell	Excessively worn teeth.	Replace clutch shell.

Table 1-3. Starter Does Not Stop Running

SOURCE OF PROBLEM	PROBABLE CAUSE	SOLUTION
Start switch or start relay	Unopened contacts.	Replace start switch or start relay.
	Poor return caused by sticky switch or relay contacts.	Replace start switch or start relay.
Gear teeth on clutch shell	Excessively worn teeth.	Replace clutch shell.
Solenoid	Return spring worn.	Replace spring.
	Coil layer shorted.	Replace solenoid.
	Contact plate melted and stuck.	Replace solenoid.

STARTING SYSTEM DIAGNOSIS

1.2

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. See [1.3 DIAGNOSTICS/TROUBLESHOOTING, Voltage Drop](#).
2. Remove starter motor. Connect jumper wires as described in [1.6 TESTING STARTER ON BENCH, Free Running Current Draw Test](#).
3. Connect BREAKOUT BOX (Part No. HD-42682) to TSM/TSSM/HFSM as follows:
 - a. On models with a TSM/HFSM, see [3.12 BREAKOUT BOX: TSM/HFSM](#).
 - b. On models with a TSSM (Japan/Korea), see [E.11 BREAKOUT BOX: TSM/TSSM](#).
4. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) gray terminal socket probe and patch cord.
5. Closely inspect handlebar controls for pinched wiring.
6. If the neutral switch or ground is open, a reading of several hundred ohms is normal due to the neutral indicator lamp (LED).

7. See [1.5 TESTING STARTER ON MOTORCYCLE, Starter Current Draw Test](#).

Job/Time Code Values

Dealership technicians filing warranty claims should use the job/time code values printed in **bold text** underneath the appropriate repair.

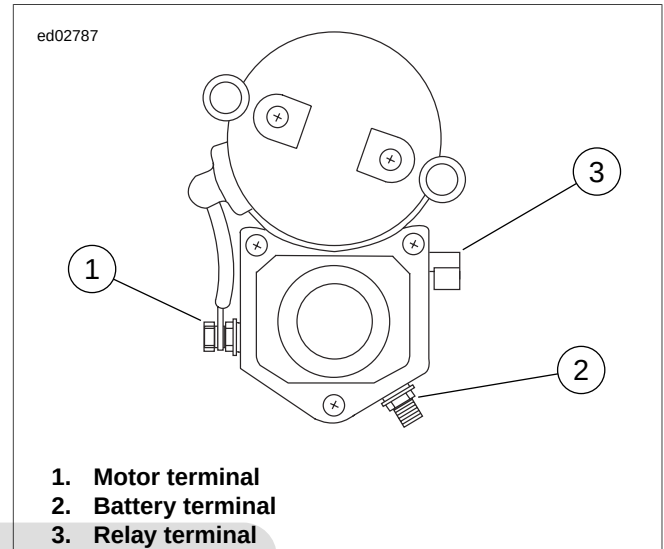


Figure 1-1. Starter Terminals

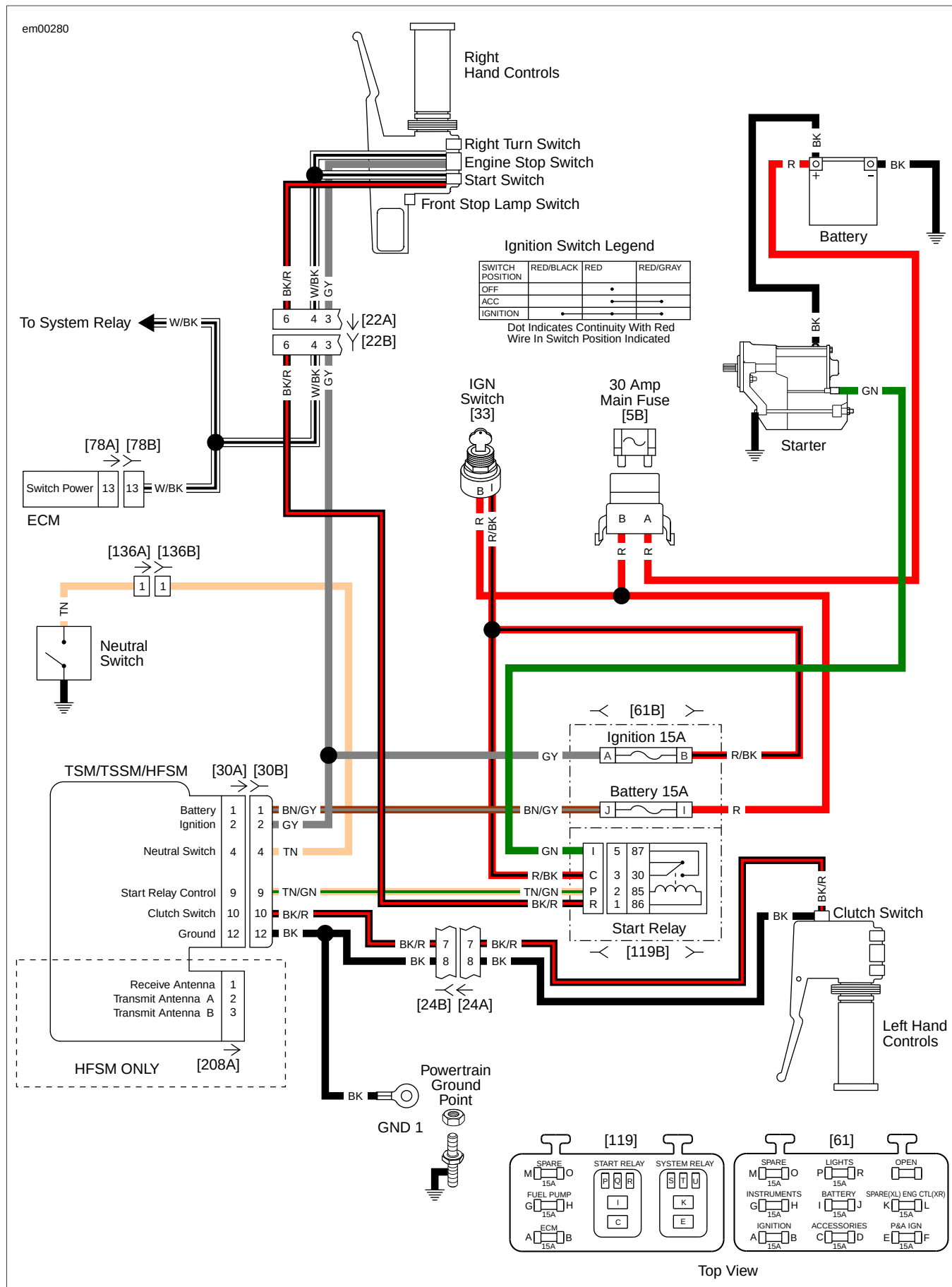
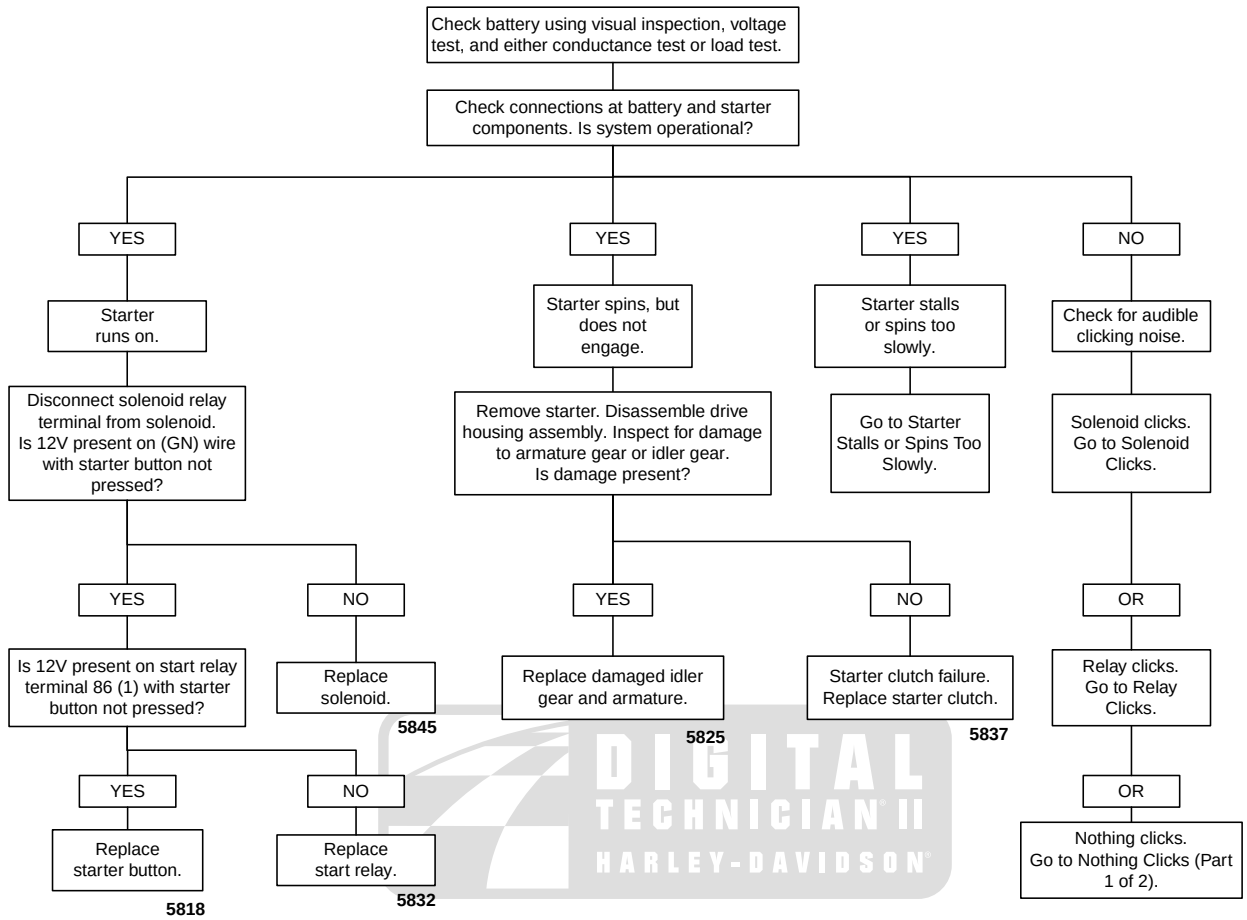


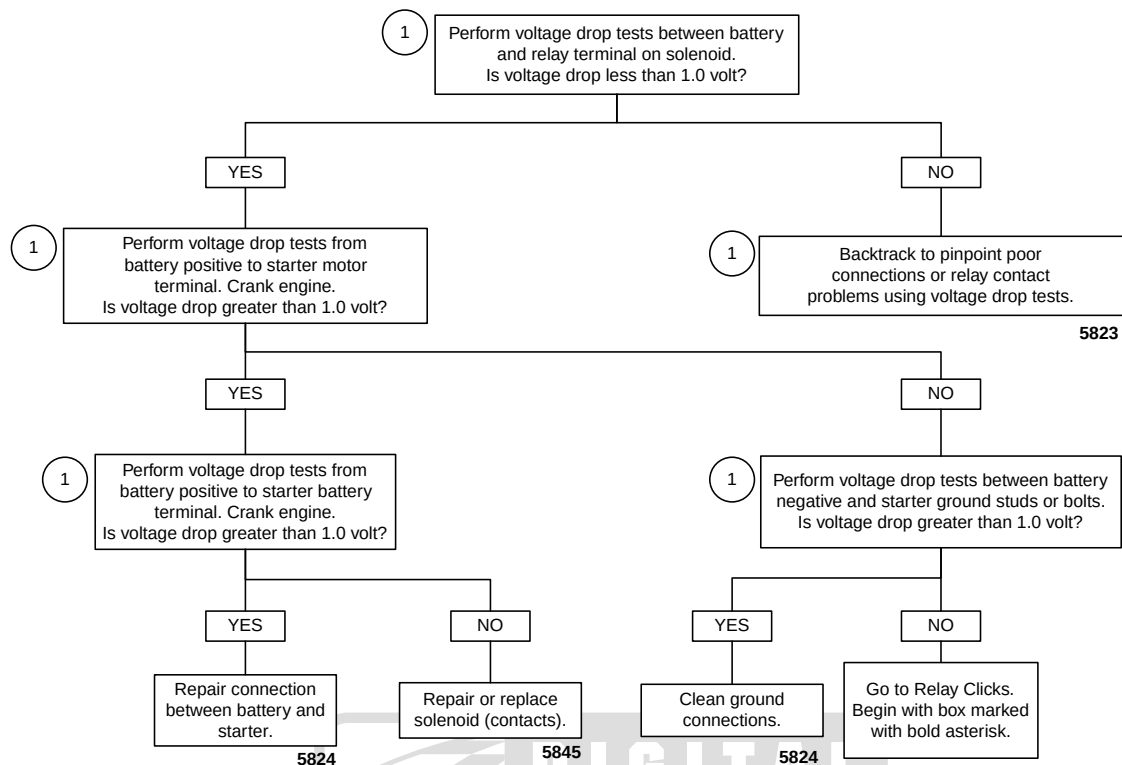
Figure 1-2. Starting Circuit Schematic

Initial Starter Test



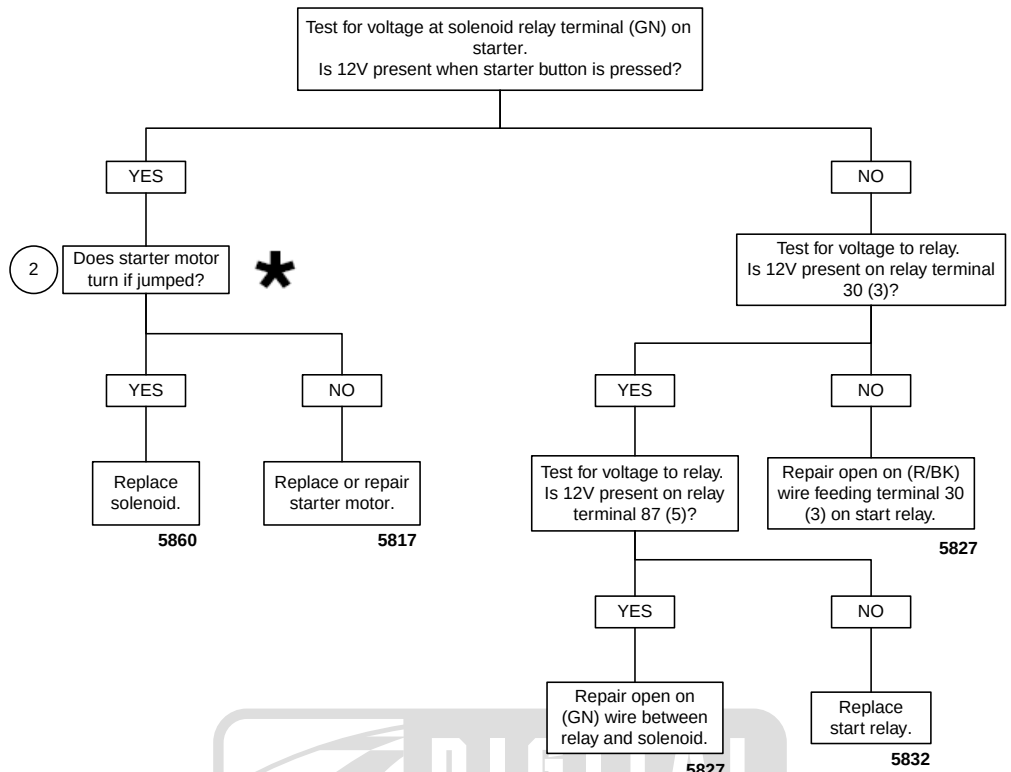
fc01944_en

Solenoid Clicks

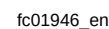


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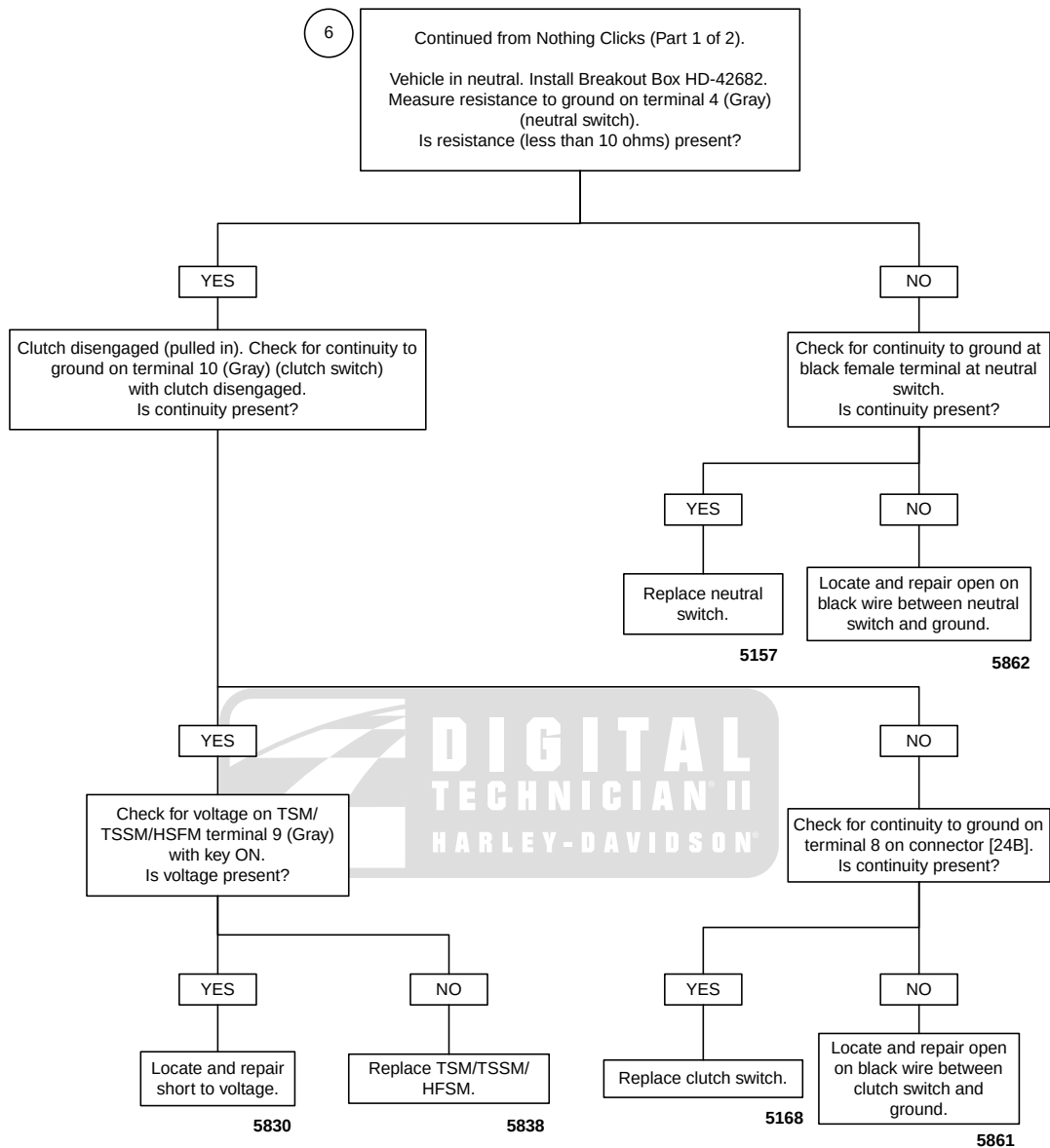
Relay Clicks



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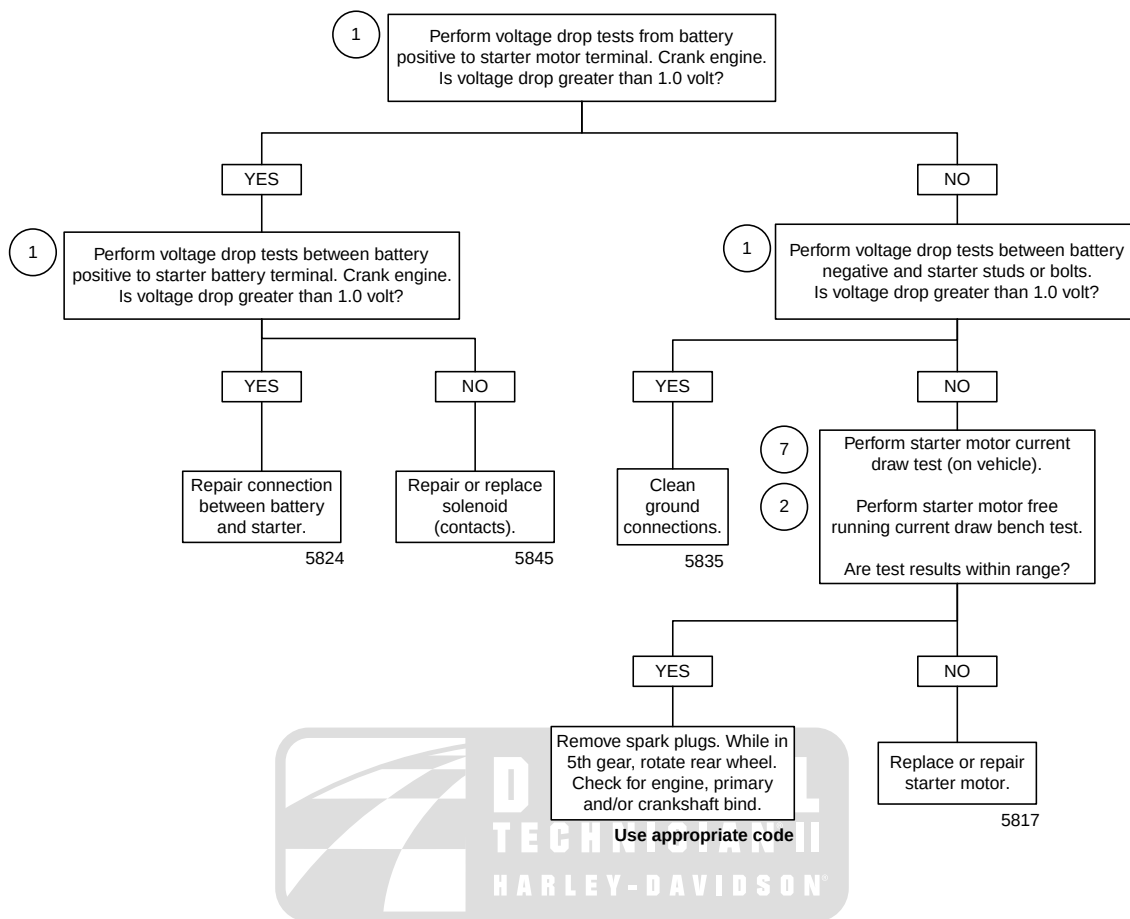


Nothing Clicks (Part 2 of 2)



fc01947_en

Starter Stalls or Spins Too Slowly



fc01006_en

DIAGNOSTICS/TROUBLESHOOTING

1.3

VOLTAGE DROP

Check the integrity of all wiring, switches, fuses 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 1-3](#). 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 1-3](#). 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. An ideal circuit's voltage drop would be 0 volt or no voltage dropped, meaning no difference in potential.
4. See ITEM C in [Figure 1-3](#). 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.

5. Typically, a good circuit will drop less than 1.0 volt. If the voltage drop is greater, backtrack through the connections

until the source of the potential difference is found. The benefits of doing it this way are speed and accuracy.

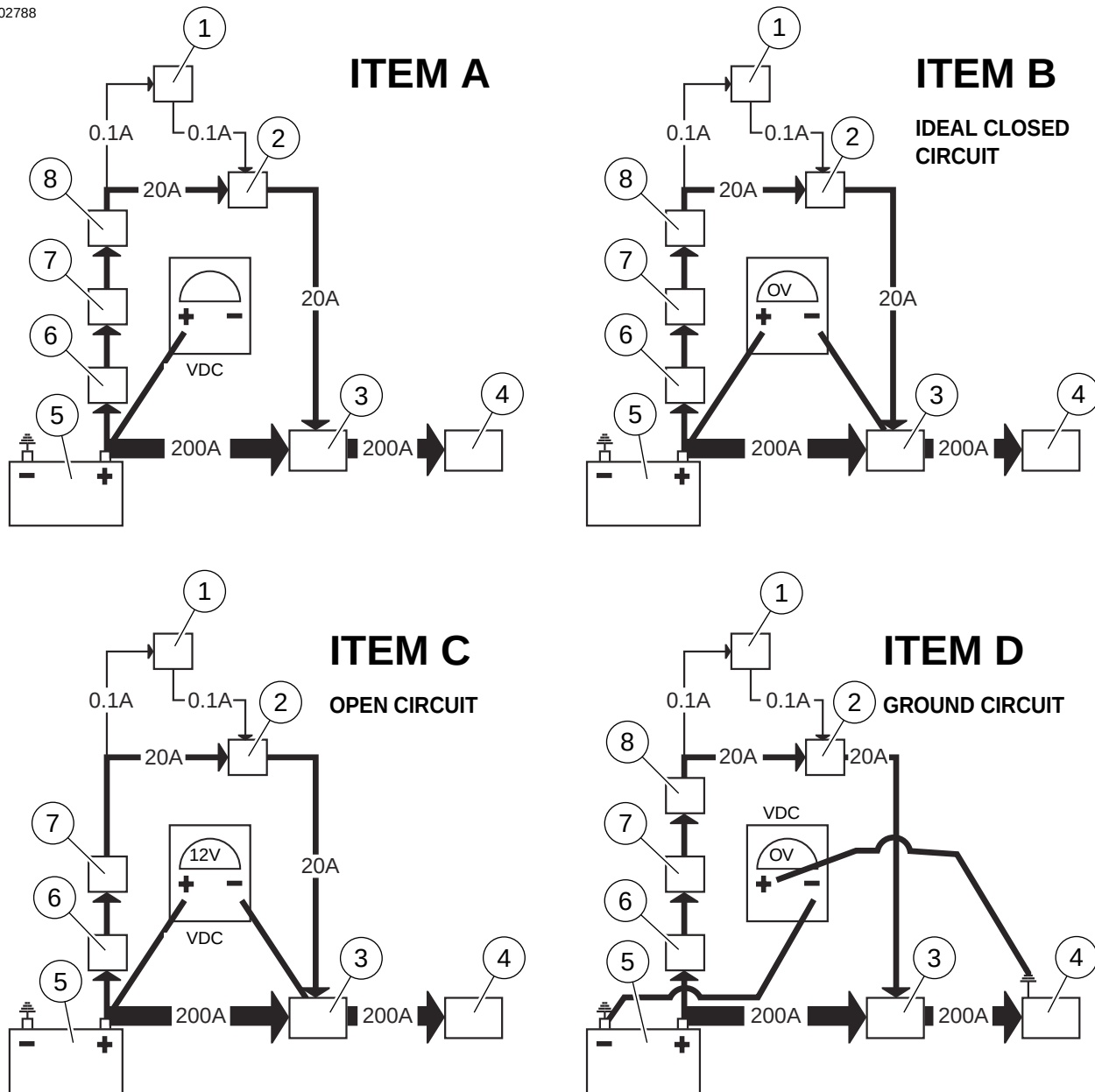
- a. Readings are not as sensitive to real battery voltage.
 - b. Readings show the actual voltage dropped, not just the presence of voltage.
 - c. This tests the system as it is actually being used. It is more accurate and will display hard to find poor connections.
 - d. This approach can be used on lighting circuits, ignition circuits, etc. Start from most positive and go to most negative (the destination or component).
6. See ITEM D in [Figure 1-3](#). 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.

STARTER ACTIVATION CIRCUITS

1.4

STARTER ACTIVATION CIRCUITS

ed02788



1. Start switch
2. Relay
3. Solenoid
4. Starter
5. Battery
6. MAXIFUSE
7. Ignition switch
8. Ignition fuse

Figure 1-3. Typical Circuitry. Refer to wiring diagrams for more information.

TESTING STARTER ON MOTORCYCLE

1.5

START RELAY TEST

1. Open left side cover.
2. See [Figure 1-4](#). Locate start relay (1) in relay/fuse block (2) forward of battery (3) on motorcycle's left side.
3. If replacing old start relay:
 - a. To unplug old relay, grasp body of relay and with a gentle rocking motion, pull straight out from relay/fuse block.
 - b. To plug in **new** relay, line up spade terminals of relay with sockets in relay/fuse block and push relay firmly into sockets.
4. The start relay can be tested using the motorcycle's 12 volt battery and a multimeter.
 - a. See [Figure 1-4](#). Unplug start relay (1) from relay/fuse block (2).
 - b. See [Figure 1-5](#). To energize the relay, connect the negative battery terminal to the relay terminal "85" (or "2") and relay terminal "86" (or "1") to the positive battery terminal.
 - c. Check for continuity between relay terminals "3" (or "30") and "5" (or "87"). A good relay shows continuity (continuity tester lamp "on" or a zero ohm reading on the ohmmeter). A malfunctioning relay will not show continuity and must be replaced.
5. If start relay is functioning properly, plug it into relay/fuse block and proceed to [1.5 TESTING STARTER ON MOTORCYCLE, Starter Current Draw Test](#).

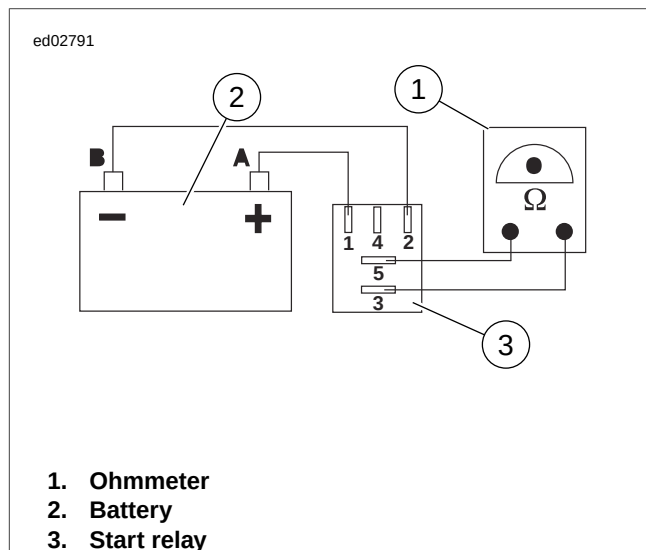


Figure 1-5. Start Relay Test

STARTER CURRENT DRAW TEST

NOTES

- 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 battery. Proceed as follows:

1. Verify that transmission is in neutral. Disconnect spark plug wires from spark plug terminals.
2. Clamp induction ammeter over positive battery cable next to starter.
3. With Ignition Switch ON, turn engine over by pressing starter switch while reading the ammeter. Disregard initial high current reading which is normal when engine is first turned over.
 - a. Typical starter current draw will range from 160 to 200 amperes.
 - b. If starter current draw exceeds 250 amperes, the problem may be in the starter or starter drive. Remove starter for further tests. See the Service Manual.

NOTE

A DC current probe may be used if an induction ammeter is not available.

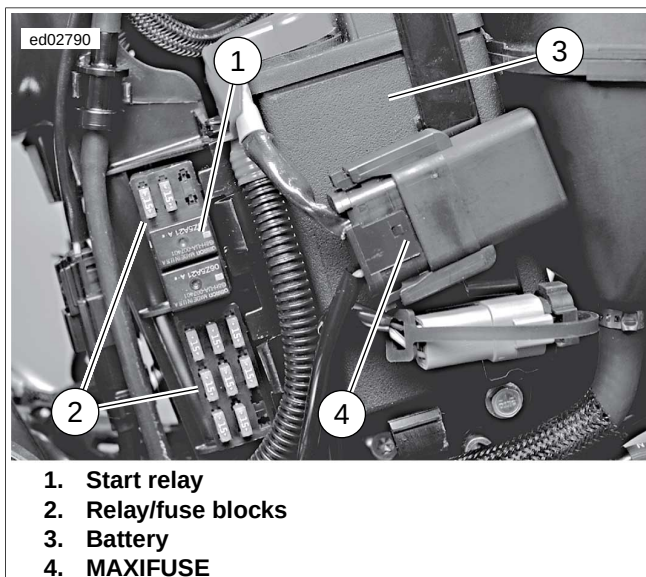


Figure 1-4. Start Relay (Typical)

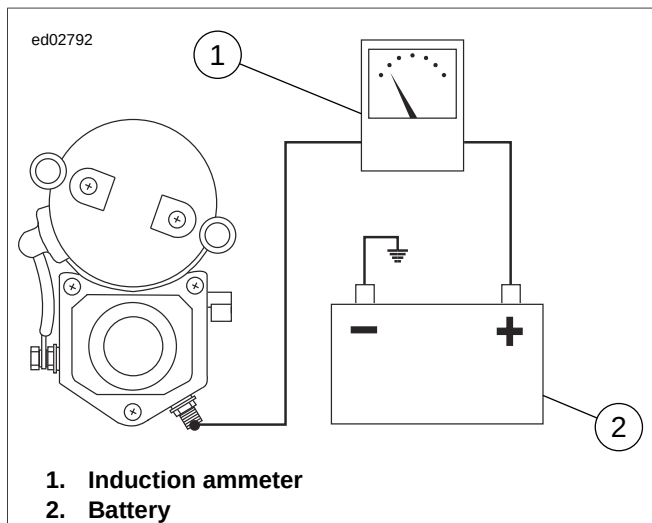


Figure 1-6. Starter Current Draw Test



TESTING STARTER ON BENCH

1.6

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 one end to the starter mounting flange.
 - b. Connect the other end to the negative (-) terminal of a fully charged battery.
3. Connect a second heavy jumper cable (6 gauge minimum).
 - a. Connect one end to the positive (+) terminal of the battery.
 - b. Connect the other end to the battery terminal on the starter solenoid. Place an induction ammeter over cable.
4. Connect a smaller jumper cable (14 gauge minimum).
 - a. Connect one end to the positive (+) terminal of the battery.
 - b. Connect the other end to the solenoid relay terminal.
5. Check ammeter reading.
 - a. Ammeter should show 90 amps maximum.
 - b. If reading is higher, disassemble starter for inspection. See the service manual.
 - 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.

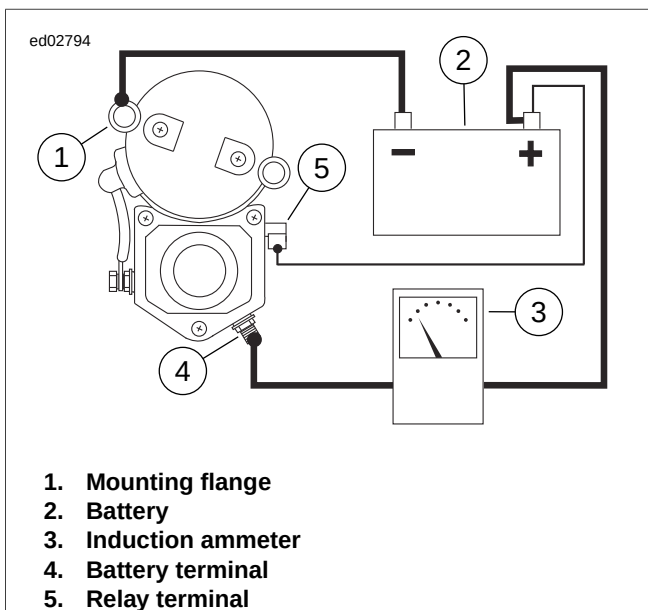


Figure 1-7. Free Running Current Draw Test

STARTER SOLENOID

Do not disassemble solenoid. Before testing, disconnect field wire from motor terminal as shown in [Figure 1-8](#).

Each test should be performed for only 3-5 seconds to prevent damage to solenoid.

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 shaft.
 - a. If starter shaft extends strongly, solenoid is working properly.
 - b. If starter shaft does not extend strongly, replace the solenoid.

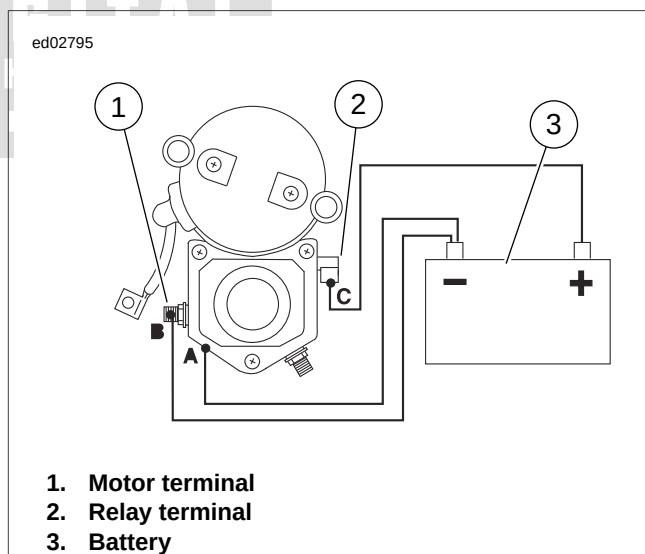


Figure 1-8. Pull-In Test

SOLENOID HOLD-IN TEST

1. See [Figure 1-9](#). With test leads still connected in the manner specified in the previous [1.6 TESTING STARTER ON BENCH, Solenoid Pull-In Test](#), disconnect solenoid motor terminal/battery negative test lead at negative battery post only; reconnect loose end of this test lead to positive battery post instead.

2. Observe starter shaft.
 - a. If starter shaft remains extended, solenoid is working properly.
 - b. If starter shaft retracts, replace the solenoid.

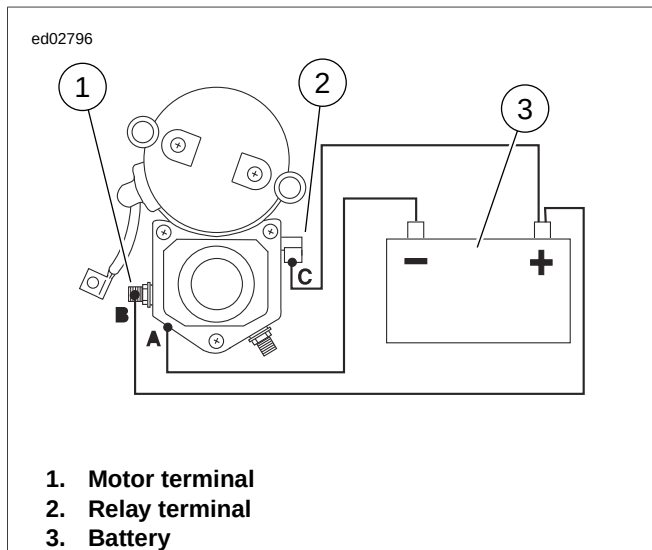


Figure 1-9. Hold-In Test

SOLENOID RETURN TEST

1. See [Figure 1-10](#). With test leads still connected in the manner specified at the end of the previous [1.6 TESTING STARTER ON BENCH. Solenoid Hold-In Test](#), disconnect solenoid relay terminal/positive battery post test lead at either end.
2. Observe starter pinion.
 - a. If starter shaft retracts, solenoid is working properly.
 - b. If starter shaft does not retract, replace the solenoid.

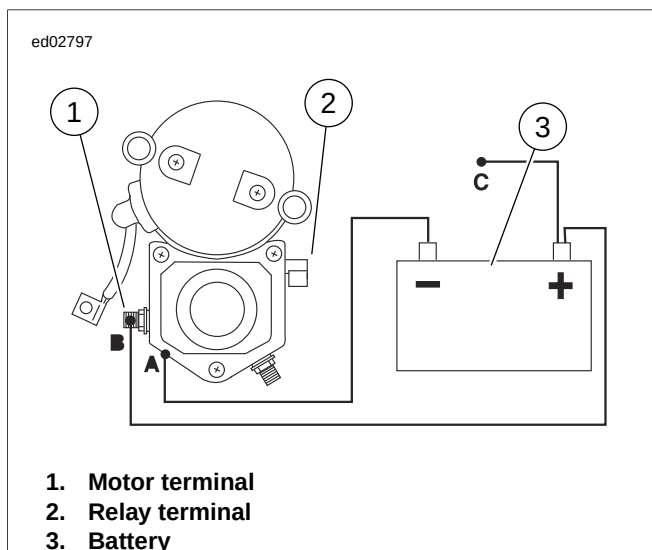


Figure 1-10. Return Test

TESTING

Armature

1. Remove armature and brush holder from field coil. See the service manual.
2. Place armature in lathe or truing stand and check runout of commutator. Commutators with more than 0.015 in. (0.38 mm) of runout should be replaced or machined on a lathe. Commutators should be replaced when diameter is less than 1.141 in. (29.98 mm).
3. 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.

NOTES

- See [Figure 1-11](#). If an undercutting machine is not available, undercutting can be done satisfactorily using a thin hacksaw blade. After undercutting, lightly sand the armature with crocus cloth to remove any burrs.
 - Do not use sandpaper or emery cloth on commutator. The abrasive grit may remain on commutator segments and could cause excessive brush wear.
4. See [Figure 1-12](#). Check for a SHORTED ARMATURE.
 - a. Place armature on growler.
 - b. Hold a thin steel strip (hacksaw blade), against the armature core and slowly turn armature.
 - c. A shorted armature will cause the steel strip to vibrate and be attracted to the core. Replace the armature if shorted.
 5. See [Figure 1-13](#). Check for a GROUNDED ARMATURE with an ohmmeter or continuity tester.
 - a. Touch one probe to any commutator segment.
 - b. Touch the other probe to the armature core.
 - c. There should be no continuity (infinite ohms). If there is continuity, the armature is grounded. Replace a grounded armature.
 6. See [Figure 1-14](#). Check for an OPEN ARMATURE with an ohmmeter or continuity tester.
 - a. Check for continuity between all commutator segments.
 - b. There should be continuity (0 ohms) at all test points. If there is no continuity at any test point, then the armature is open. Replace an open armature.

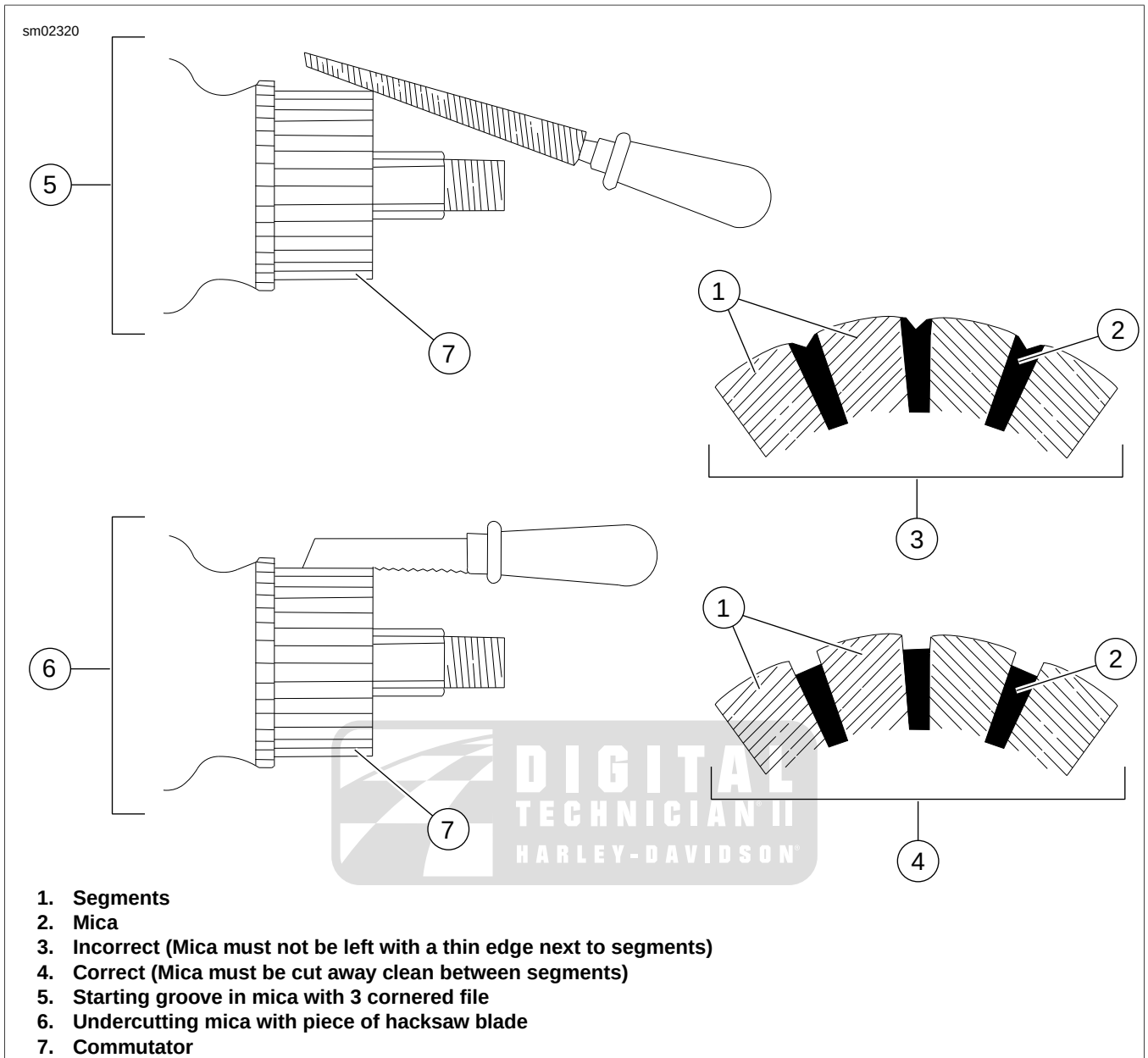


Figure 1-11. Undercutting Mica Separators

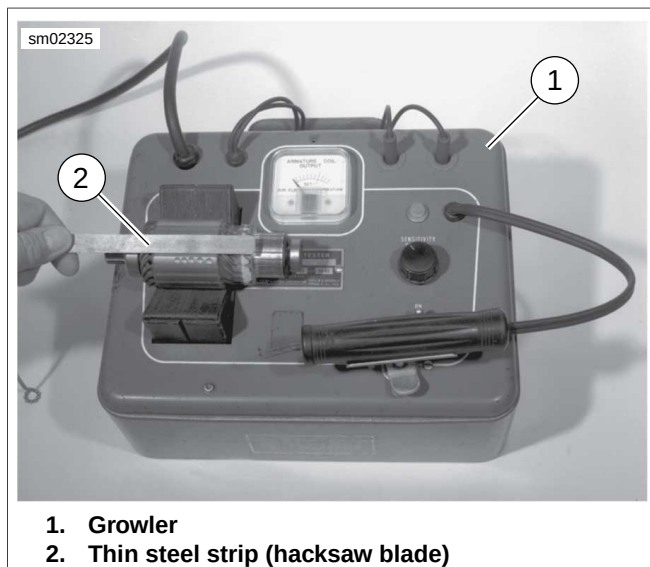


Figure 1-12. Shorted Armature Test Using Growler

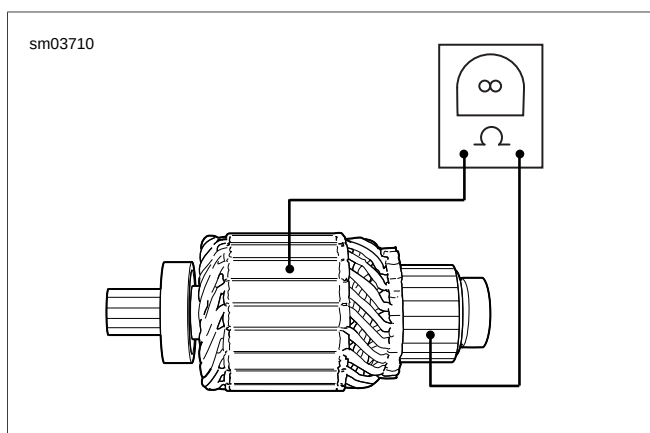


Figure 1-13. Grounded Armature Test

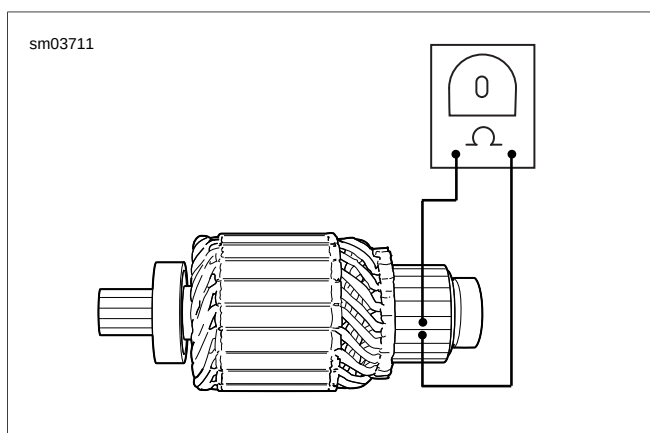


Figure 1-14. Armature Open Test

2. Measure the brush length. If any one of four brushes is less than 0.433 in. (11 mm), replace the field coil and brush holder assembly. No further testing is necessary.
3. See [Figure 1-15](#). Check for a GROUNDED FIELD COIL WINDING with an ohmmeter or continuity tester.
 - a. Touch one probe to the field coil housing (frame).
 - b. Touch the other probe to each of two brushes attached to the field coil winding.
 - c. There should be no continuity (infinite ohms). If there is continuity at either brush, then the field coil winding is grounded. Replace the field coil/brush holder assembly if grounded.
4. See [Figure 1-16](#). Check for an OPEN FIELD COIL WINDING with an ohmmeter or continuity tester.
 - a. Touch one probe to the field wire.
 - b. Touch the other probe to each of the two brushes attached to the field coil winding(s).
 - c. There should be continuity (0 ohms). If there is no continuity at either brush, then the field coil winding(s) are open. Replace the field coil/brush holder assembly if open.
5. See [Figure 1-17](#). Test the BRUSH HOLDER INSULATION with an ohmmeter or continuity tester.
 - a. Touch one probe to the holder plate.
 - b. Touch the other probe to each of the positive (insulated) brush holders.
 - c. There should be no continuity (infinite ohms). If there is continuity at either brush holder, replace the field coil/brush holder assembly.
 - d. Touch one probe to the non-insulated brush holders and the other probe to the holder plate. If any resistance is measured, replace the field coil/brush holder assembly.

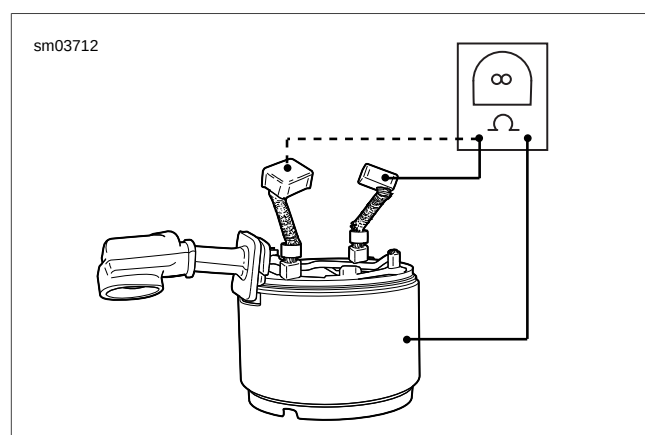


Figure 1-15. Grounded Field Test

Brushes and Brush Holder

1. Remove armature and brush holder from field coil. See the service manual.

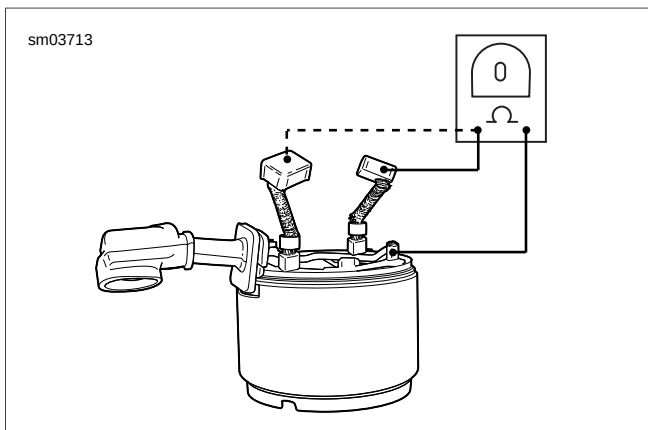


Figure 1-16. Open Field Test

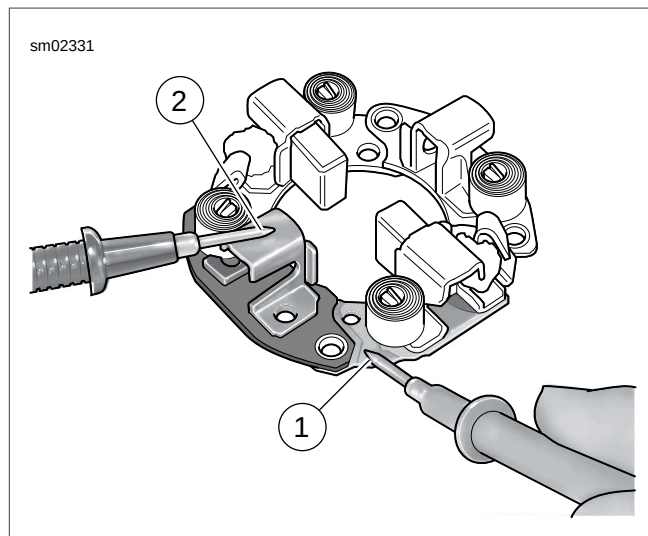


Figure 1-17. Brush Holder Insulation Test



GENERAL

The charging system consists of the alternator and regulator. The charging system circuit is shown in [Figure 1-20](#).

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 1-18](#). The voltage regulator (1) is a series regulator with shunt control. The circuit combines the functions of rectifying and regulating.

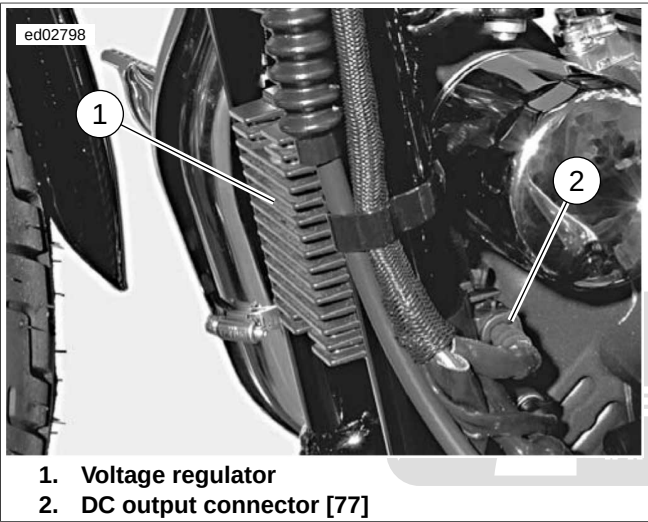


Figure 1-18. Voltage Regulator (Typical)

TROUBLESHOOTING

PART NUMBER	TOOL NAME
HD-48053	ELECTRICAL SYSTEM TESTER

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 [1.8 BATTERY TESTING](#) for battery testing procedures. Battery must be fully charged in order to perform a load test, or starting or charging tests. However, a partially discharged battery may be tested using the BATTERY TEST function of the ELECTRICAL SYSTEM TESTER (Part No. HD-48053).

Wiring

See [Figure 1-19](#). The stator connector plug and socket connection must be clean and tight.

Check for corroded or loose connections in the charging circuit. See [Figure 1-20](#).



Figure 1-19. Stator Connector [46] (typical)

em00279

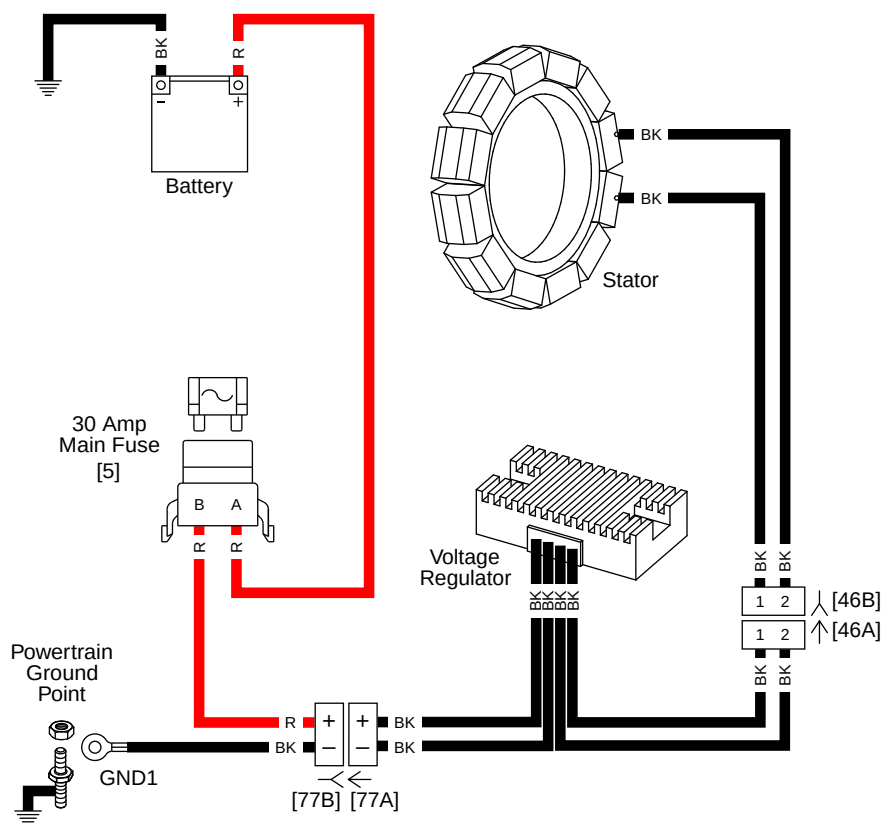
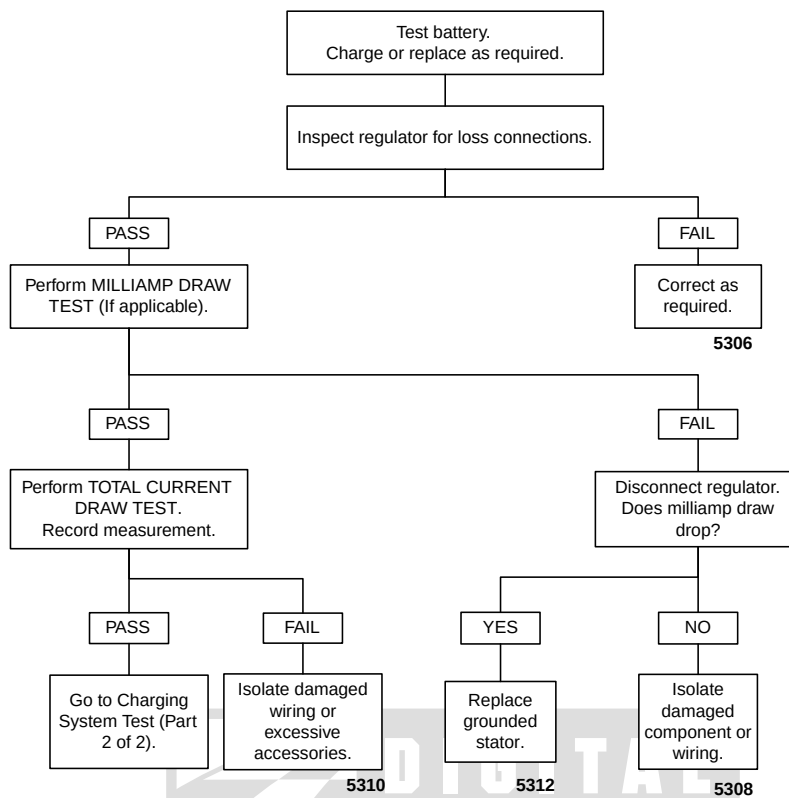


Figure 1-20. Charging System Circuit

Charging System Test (Part 1 of 2)

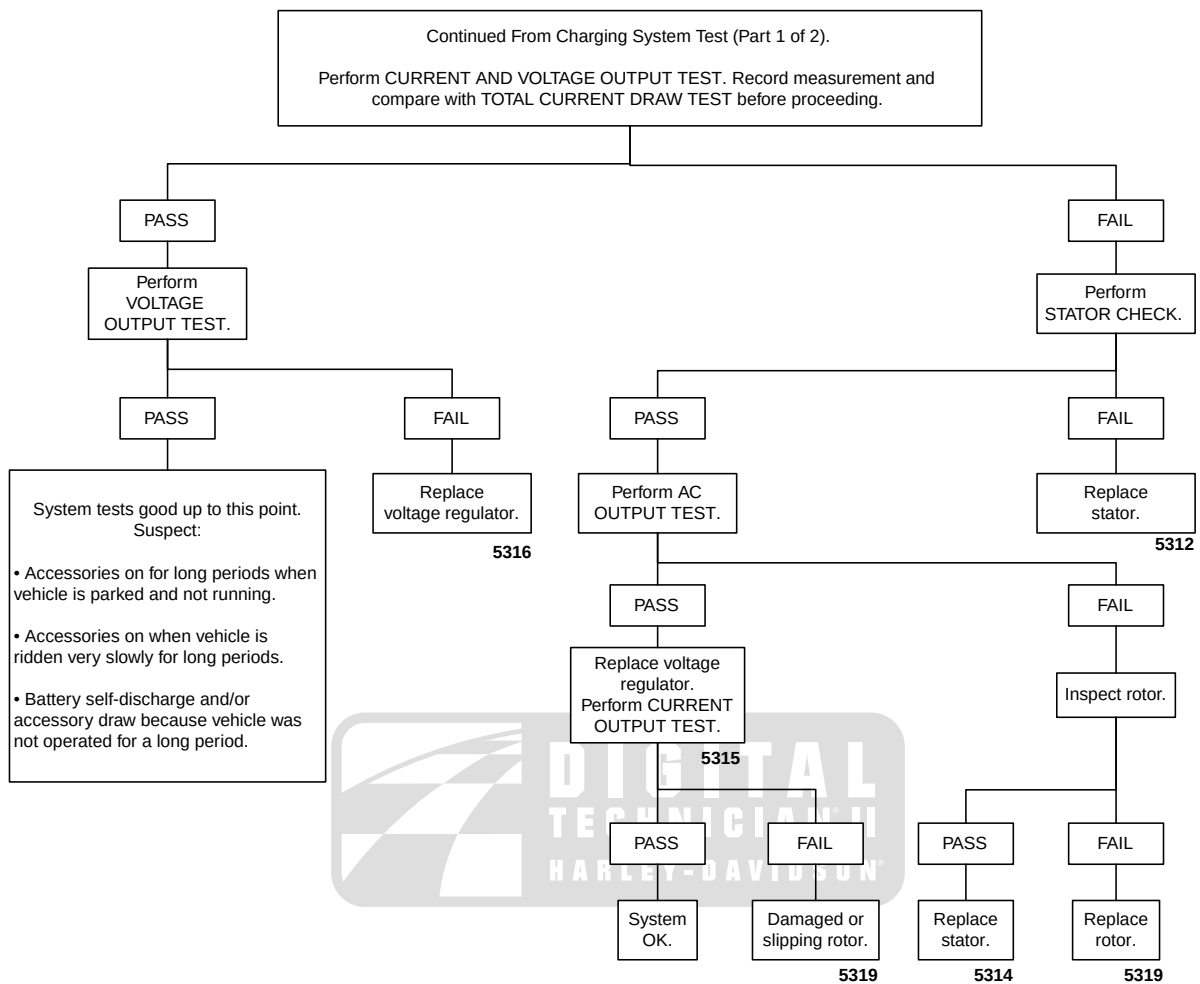


NOTE

Whenever a charging system component fails a test and is replaced, re-test the system to be sure the problem has been corrected.

fc01948_en

Charging System Test (Part 2 of 2)



fc01061_en

TESTING

PART NUMBER	TOOL NAME
HD-48053	ADVANCED BATTERY CONDUCTANCE AND ELECTRICAL SYSTEM ANALYZER

Milliampere Draw Test

NOTES

- 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 cable and ground.
 - TSM/TSSM/HFSM will continue to draw 16-25 mA for 30 seconds after ignition is turned off. Any disruption and reconnection of battery power, such as disconnecting the battery to place a meter in series, will cause TSM/TSSM/HFSM to draw 16-25 mA for 30 seconds.
- See [Figure 1-21](#). Connect ammeter between negative battery cable and crankcase ground. With this arrangement, you will also pick up any regulator drain.
 - With ignition switch turned to OFF and all lights and accessories off, observe current reading.
 - Refer to [Table 1-4](#). Add voltage regulator draw to appropriate value for TSM/TSSM/HFSM. If sum is greater than reading observed on ammeter, draw is within limits.
 - 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.

Table 1-4. Maximum Meter Reading (Averaged)

ITEM	DRAW IN MILLIAMPERES
Voltage regulator	1
Speedometer	1
Tachometer (if equipped)	1
TSM (non-security models)	1
TSSM (disarmed)	3
TSSM (armed)	3
TSSM (storage mode)	1
HFSM	1
Security siren	20.0*

* Siren will draw for 2-24 hours from time motorcycle battery is connected and 0.05 milliamperes once siren battery is charged. For best results, disconnect siren during milliampere draw test.

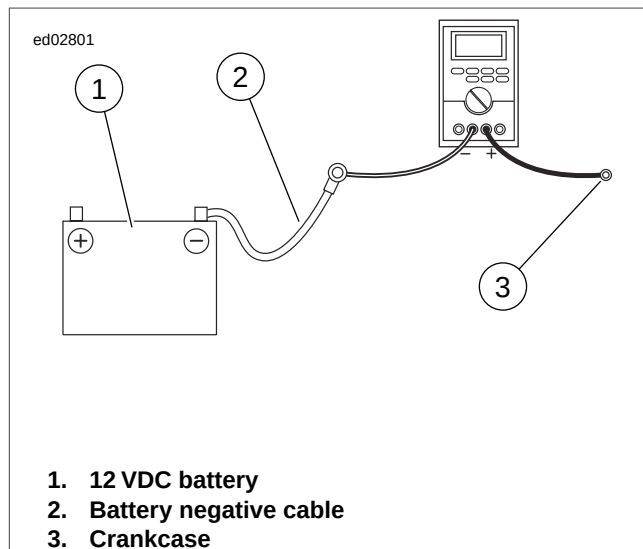


Figure 1-21. Milliampere Draw Test (Ignition turned to OFF)

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.

NOTE

If a load tester is unavailable, an ammeter with current probe may be used.

WARNING

Turn battery load tester OFF before connecting tester cables to battery terminals. Connecting tester cables with load tester ON can cause a spark and battery explosion, which could result in death or serious injury. (00252a)

- See [Figure 1-22](#). To check for this condition, place load tester induction pickup or current probe pickup over battery negative cable.
- Disconnect stator plug from voltage regulator. Start the motorcycle and run the engine at 2000 RPM.
- With ignition and all continuously running lights and accessories turned on (headlamp on high beam), read the total current draw.
- Compare this reading to the reading obtained after performing the CURRENT AND VOLTAGE OUTPUT TEST.
 - The current output should exceed current draw by 3.5 amps minimum.
 - If output does not meet specifications, there may be too many accessories for the charging system to handle.
- Reconnect voltage regulator after testing.

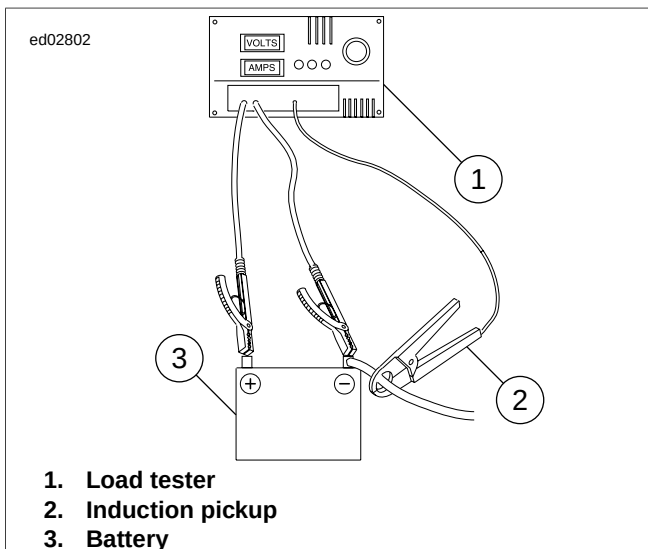


Figure 1-22. Check Current Draw (Ignition Switch On)

Current and Voltage Output Test: Using HD-48053

1. Connect the ADVANCED BATTERY CONDUCTANCE AND ELECTRICAL SYSTEM ANALYZER (Part No. HD-48053) leads to the vehicle's battery.
2. Follow the instructions in the analyzer's instruction manual to perform a Charging System Test.

See [Figure 1-23](#). The test results will include a decision on the charging system's condition and the measured output voltage at idle and at 3000 RPM. The analyzer's printer will provide you with a printout including one of two possible test results:

- CHARGING SYSTEM NORMAL - No problem found.
- CHARGING SYSTEM PROBLEM - The analyzer detected a problem and will display one of the three following results:
 1. LOW CHARGING VOLTS - The alternator is not supplying sufficient current for the system's electrical loads.
 2. HIGH CHARGING VOLTS - The voltage output from the alternator exceeds the normal regulator limits.
 3. INVESTIGATE VOLT OUTPUT - The rev voltage is lower than the idle voltage.

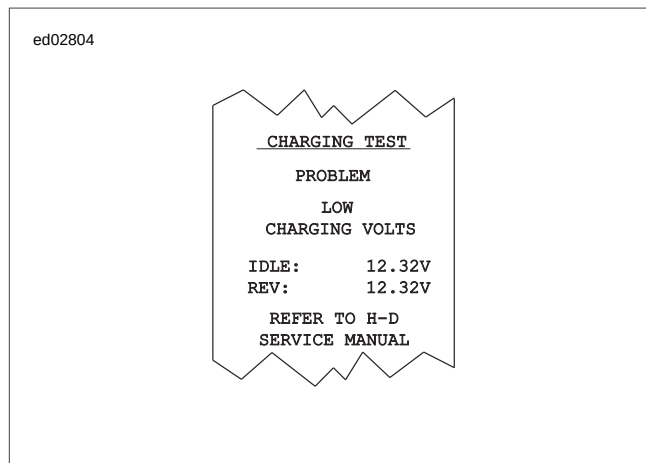


Figure 1-23. Charging System Test Results Printout

Current and Voltage Output Test: Using Load Tester

1. See [Figure 1-24](#). Connect load tester.
 - a. Connect negative and positive leads to battery terminals.
 - b. Place load tester induction pickup over positive regulator cable.
2. Run the engine at 3000 RPM. Increase the load as required to obtain a constant 13.0 VDC. Do not leave any load switch turned on for more than 20 seconds or overheating and tester damage can occur.
3. The current output should be 24-30 amps. Make note of measurement for use in Total Current Draw Test.

NOTE

Rider's habits may require output test at lower RPM.

4. See [Figure 1-24](#). 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.
 - b. If voltage is higher, voltage regulator is not functioning properly or connections are loose or dirty.

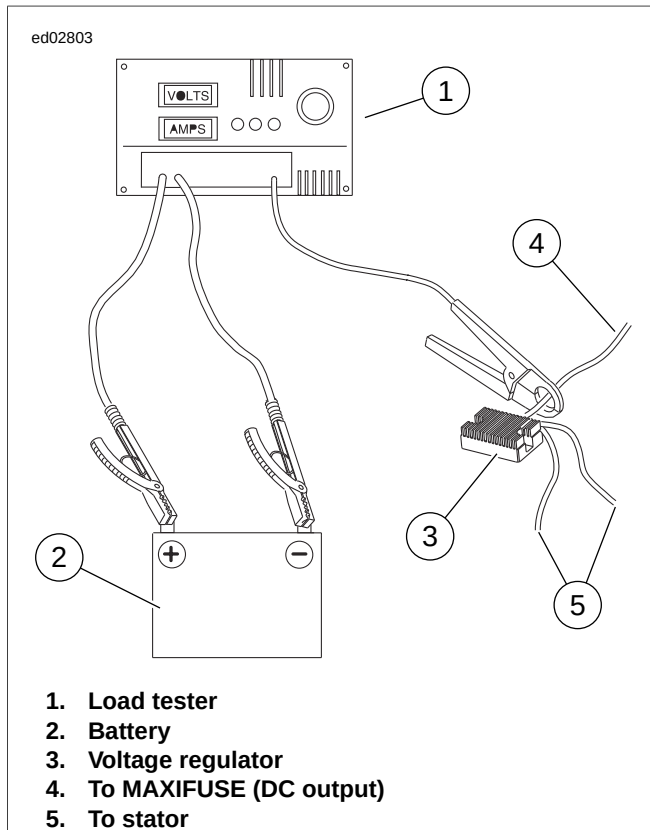


Figure 1-24. Current and Voltage Output Test

Stator Check

1. Turn ignition switch OFF.
2. Connect an ohmmeter.
 - a. Open latch and separate socket connector from pin connector.
 - b. See [Figure 1-25](#). Insert one ohmmeter lead into a stator connector (1) socket.
 - c. Attach the other lead to a suitable ground (4).
3. Test for continuity with ohmmeter set to the ohms scale (2).
 - a. A good stator will show no continuity between either stator socket and ground.
 - b. Any other reading indicates a grounded stator which must be replaced.
4. See [Figure 1-26](#). Remove ground lead. Check resistance across stator sockets.
5. Test for resistance with ohmmeter set on the RX1 scale.
 - a. Resistance across the stator sockets should be 0.1-0.3 ohms.
 - b. If the resistance is higher, the stator is damaged and must be replaced.

NOTE

Verify that meter reads 0 ohms when probes are shorted together. If not, subtract lowest value from resistance value of stator.

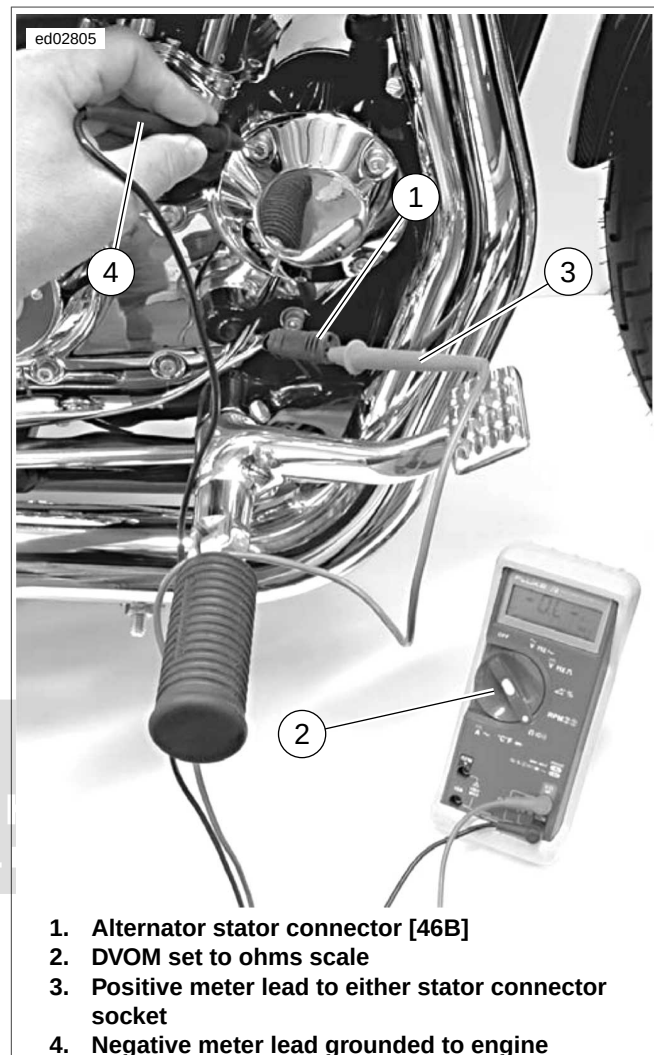


Figure 1-25. Test for Grounded Stator (Typical)

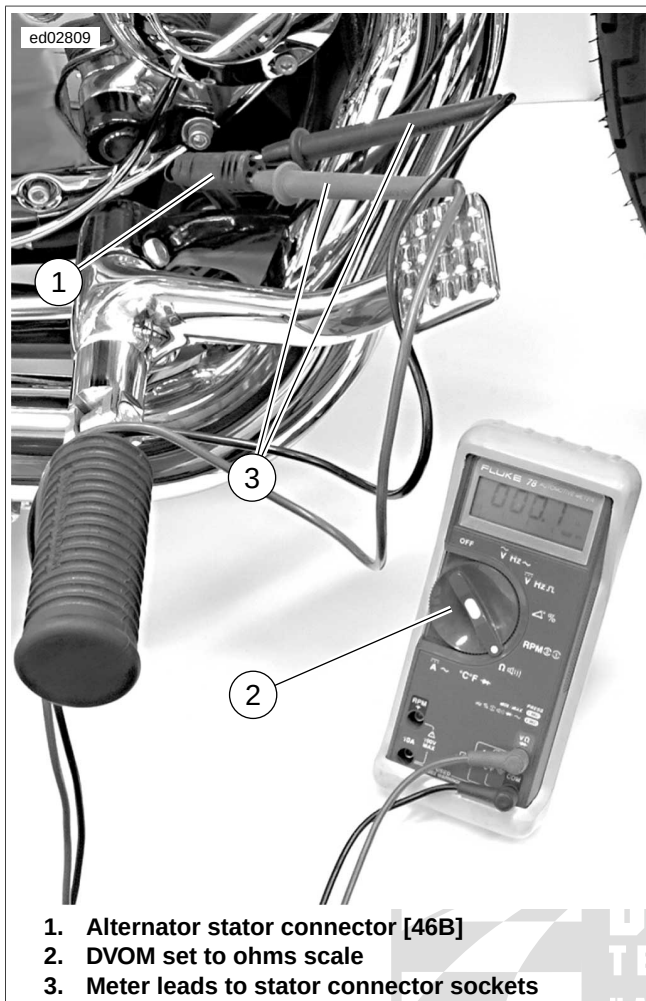


Figure 1-26. Check for Stator Resistance (Typical)

AC Output Check

1. See [Figure 1-27](#). Test AC output.
 - a. Disconnect voltage regulator connector from alternator stator wiring.
 - b. Connect an AC voltmeter across both stator connector sockets.
 - c. Run the engine at 2000 RPM. The AC output should be 40-56 volts AC (approximately 20-28 volts AC per 1000 RPM).

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 voltage regulator. Replace as required.
3. Check the output again as previously described under CURRENT AND VOLTAGE OUTPUT TEST.

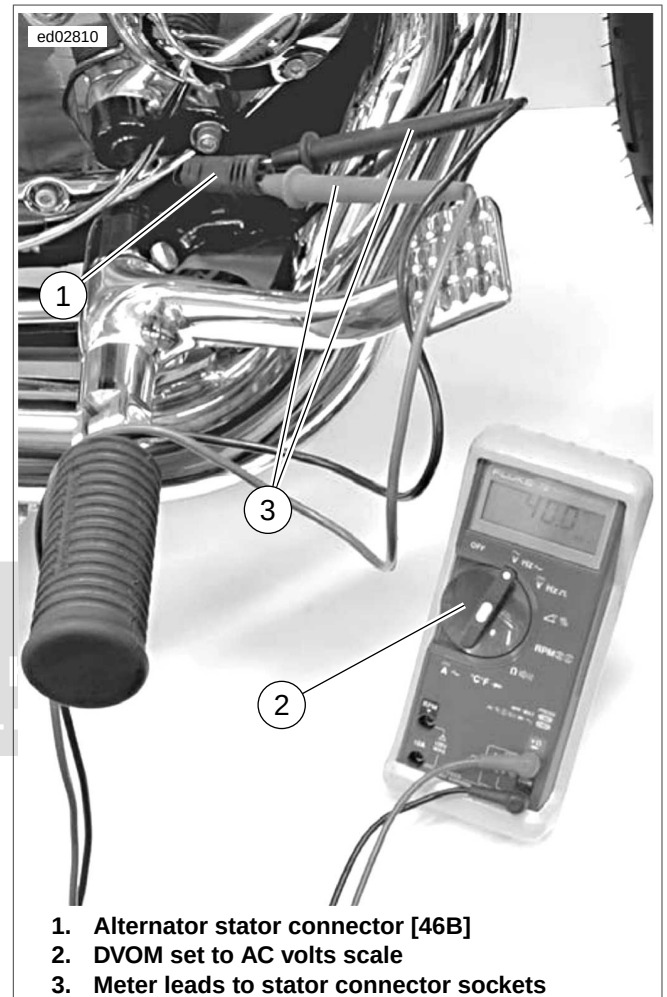


Figure 1-27. Check Stator AC Voltage Output (Typical)

BATTERY TESTING

GENERAL

Three different procedures may be performed to provide a good indicator of battery condition: a voltage test, a conductance test, or a load test.

A battery may be tested, whether fully charged or not, via conductance test. In order to perform a load test, however, the battery must be fully charged.

VOLTMETER TEST

The voltmeter test provides a general indicator of battery state of charge or condition. Check the voltage of the battery to verify that it is in a 100% fully charged condition. Refer to [Table 1-5](#).

If the open circuit (disconnected) voltage reading is below 12.6V, charge the battery and then recheck the voltage after the battery has set for one to two hours. If the voltage reading is 12.7V or above, perform the Load Test described in this section.

Table 1-5. Voltmeter Test For Battery Charge Conditions

VOLTAGE	STATE OF CHARGE
12.7	100%
12.6	75%
12.3	50%
12.0	25%
11.8	0%

CONDUCTANCE TEST

PART NUMBER	TOOL NAME
HD-48053	ADVANCED BATTERY CONDUCTANCE AND ELECTRICAL SYSTEM ANALYZER

Test the battery using the ADVANCED BATTERY CONDUCTANCE AND ELECTRICAL SYSTEM ANALYZER (Part No. HD-48053). Perform a battery test as follows:

1. Connect the HD-48053 analyzer leads to the vehicle battery lead terminal, not to bolt or wire terminal.

NOTE

Connect the tester directly to the lead terminals of the battery, and not the bolts.

2. Follow the instructions in the analyzer instruction manual to perform a battery test.

The test results will include a decision on the battery condition and the measured state of charge.

See [Figure 1-28](#). The analyzer printer will provide you with a printout including one of six possible test results:

- GOOD BATTERY - Return the battery to service.
- GOOD-RECHARGE - Fully charge the battery and return to service.
- CHARGE & RETEST - Fully charge the battery and retest.
- REPLACE BATTERY - Replace the battery and retest.
- BAD CELL-REPLACE - Replace the battery and retest.
- BATTERY NOISE - Remove surface charge from battery and retest.

NOTES

- A *REPLACE BATTERY* test result may also mean a poor connection between the battery cables and the vehicle. After disconnecting the battery cables from the battery, retest the battery using the out-of-vehicle test before replacing.
- Connect the tester directly to the lead terminals of the battery, and not the bolts.

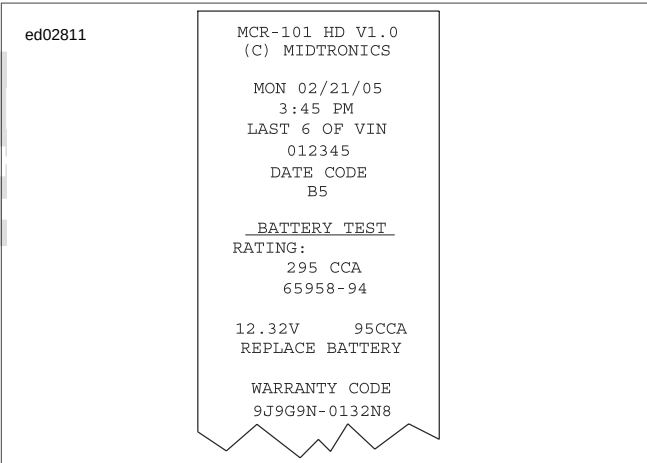


Figure 1-28. Battery Test Results Printout

LOAD TEST

To load test the battery, proceed as follows:

⚠ WARNING

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

1. Remove battery from motorcycle.
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

Turn battery load tester OFF before connecting tester cables to battery terminals. Connecting tester cables with load tester ON can cause a spark and battery explosion, which could result in death or serious injury. (00252a)

4. See [Figure 1-29](#). Connect tester leads to battery posts and place induction pickup over negative (black) cable.

NOTE

To avoid load tester and/or battery damage, do not leave the load tester switch turned ON for more than 20 seconds.

5. Refer to [Table 1-6](#). 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

Turn battery load tester OFF before disconnecting tester cables to battery terminals. Disconnecting tester cables with load tester ON can cause a spark and battery explosion, which could result in death or serious injury. (00253a)

⚠ WARNING

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

CAUTION

Do not over-tighten bolts on battery terminals. Use recommended torque values. Over-tightening battery terminal bolts could result in damage to battery terminals. (00216a)

6. Install the battery in the motorcycle.

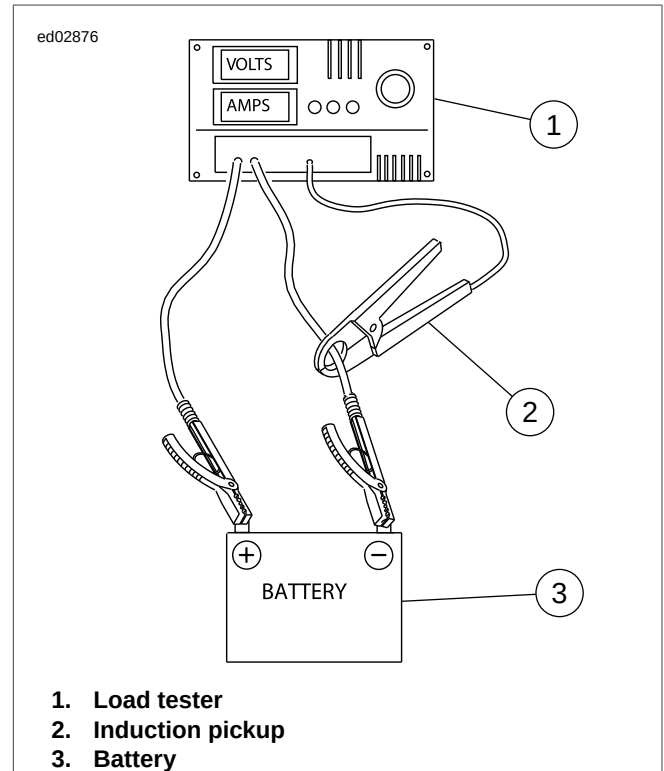


Figure 1-29. Load Test Battery

Table 1-6. Battery Load Test

COLD CRANKING AMPERAGE (CCA)	100%	50%
Sportster models	205	102.5

NOTES



TABLE OF CONTENTS

SUBJECT	PAGE NO.
2.1 CHECKING FOR DIAGNOSTIC TROUBLE CODES.....	2-1
2.2 INITIAL DIAGNOSTIC CHECK: ODOMETER.....	2-4
2.3 ODOMETER SELF-DIAGNOSTICS.....	2-13
2.4 SPEEDOMETER/TACHOMETER.....	2-15
2.5 BREAKOUT BOX: SPEEDOMETER/TACHOMETER.....	2-20
2.6 INDICATOR LAMPS.....	2-21
2.7 DTC B1004, B1005.....	2-26
2.8 DTC B1006, B1007.....	2-30
2.9 DTC B1008.....	2-32
2.10 DTC U1016, U1255.....	2-34
2.11 DTC U1064, U1255.....	2-39
2.12 DTC U1300, U1301 OR BUS ER.....	2-44



NOTES



CHECKING FOR DIAGNOSTIC TROUBLE CODES

2.1

CHECK ENGINE LAMP

See [Figure 2-1](#). To diagnose Electronic Control Module (ECM) system problems, begin by observing the behavior of the check engine lamp (2).

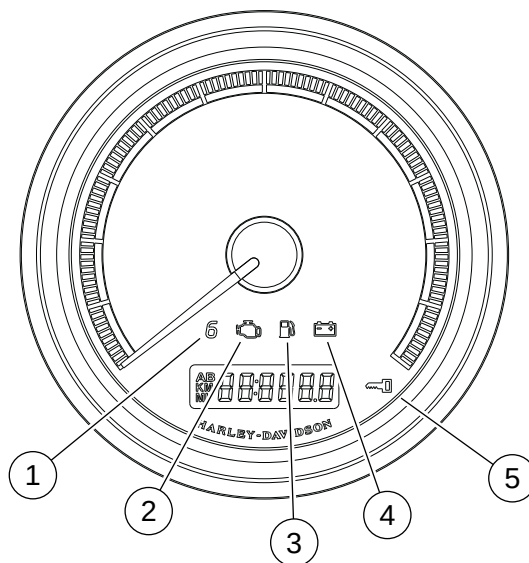
NOTES

- See [Figure 2-2](#). "Key ON" means that the Ignition Switch is turned to IGNITION and the Engine Stop Switch is set to RUN (although the engine is **not** running).
 - When the Ignition Switch is turned to IGNITION, the check engine lamp will illuminate for approximately four seconds and then turn off.
 - If the check engine lamp is not illuminated at Ignition ON, the problem is likely to be an instrument failure. See [2.2 INITIAL DIAGNOSTIC CHECK: ODOMETER](#).
 - If the check engine lamp illuminates late (after 20 seconds), the problem is most likely a serial data bus failure. Test for Diagnostic Trouble Codes (DTCs) using speedometer self diagnostics. See [2.2 INITIAL DIAGNOSTIC CHECK: ODOMETER](#).
 - If the check engine lamp fails to turn off after the initial four-second period, see [2.2 INITIAL DIAGNOSTIC CHECK: ODOMETER](#).
1. See [Figure 2-3](#). After the check engine lamp turns off following the first four-second illumination period, one of three events may occur:
 - a. The lamp remains off. This indicates there are no current fault conditions or stored DTCs currently detected by the ECM.
 - b. The lamp remains off for only four seconds and then illuminates for an eight-second period. This indicates a DTC is stored, but no current DTC exists.
 - c. The lamp remains on beyond the eight-second period. This indicates a current DTC exists.
 2. See [2.1 CHECKING FOR DIAGNOSTIC TROUBLE CODES, Code Types](#) for a complete description of DTC formats.

NOTE

Some DTCs can be fully diagnosed only during actuation. For example, a problem with the ignition coil will be considered a current fault even after the problem is corrected, since the ECM will not know of its resolution until after the coil is exercised by the vehicle start sequence. In this manner, there may sometimes be a false indication of the current DTC.

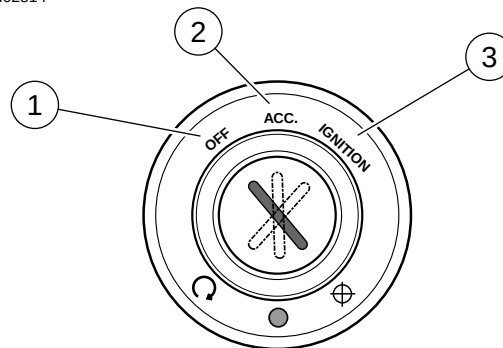
ed01721



1. Sixth gear indicator (not used)
2. Check engine lamp
3. Low fuel lamp
4. Battery lamp
5. Security lamp (key icon)

Figure 2-1. Indicator Lamps (Typical)

ed02814



1. Ignition OFF
2. Accessory (ACC) ON
3. Ignition ON

Figure 2-2. Ignition Switch

SECURITY LAMP

Turn Signal Module (TSM)

If the turn signals flash six 4-way flashes shortly after key ON, it indicates a Diagnostic Trouble Code (DTC) has been logged sometime in the last three ignition cycles.

Turn Signal Security Module (TSSM) or Hands-Free Security Module (HFSM)

See [Figure 2-3](#). To diagnose Turn Signal Security Module (TSSM) or Hands-Free Security Module (HFSM) system problems, begin by observing the behavior of the security lamp (4).

NOTES

- To provide an indication of TSSM/HFSM DTCs, the security lamp is enabled on TSSM/HFSM models.
- See [Figure 2-3](#). "Key ON" means that the Ignition Switch is turned to IGNITION and the Engine Stop Switch is set to RUN (although the engine is **not** running).
- When the Ignition Switch is turned ON, the security lamp will illuminate for approximately four seconds and then turn off.
- If the security lamp is not illuminated at Key ON, the problem is likely to be an instrument failure. See [2.2 INITIAL DIAGNOSTIC CHECK: ODOMETER](#).
- If the security lamp illuminates late (after 20 seconds), the problem is most likely a serial data bus failure. Test for

DTCs using speedometer self diagnostics. See [2.2 INITIAL DIAGNOSTIC CHECK: ODOMETER](#).

- If the security lamp fails to turn off after the initial four-second period, a problem exists in the instrumentation. See [2.2 INITIAL DIAGNOSTIC CHECK: ODOMETER](#).
- See [Figure 2-3](#). After the security lamp turns off following the first four-second illumination period, one of three events may occur:
 - The lamp remains off. This indicates there are no current fault conditions or stored DTCs currently detected by the TSSM/HFSM.
 - The lamp stays off for only four seconds and then comes back on for an eight-second period. This indicates a DTC is stored, but no current DTC exists.
 - The lamp remains on beyond the eight-second period. This indicates a current DTC exists.
 - See [2.1 CHECKING FOR DIAGNOSTIC TROUBLE CODES, Code Types](#) for a complete description of DTC formats.

NOTE

Some DTCs can only be fully diagnosed during actuation. For example, a problem with the turn signals will be considered a current fault even after the problem is corrected, since the TSM/TSSM/HFSM will not know of its resolution until after the turn signals are activated. In this manner, there may sometimes be a false indication of the current DTC.

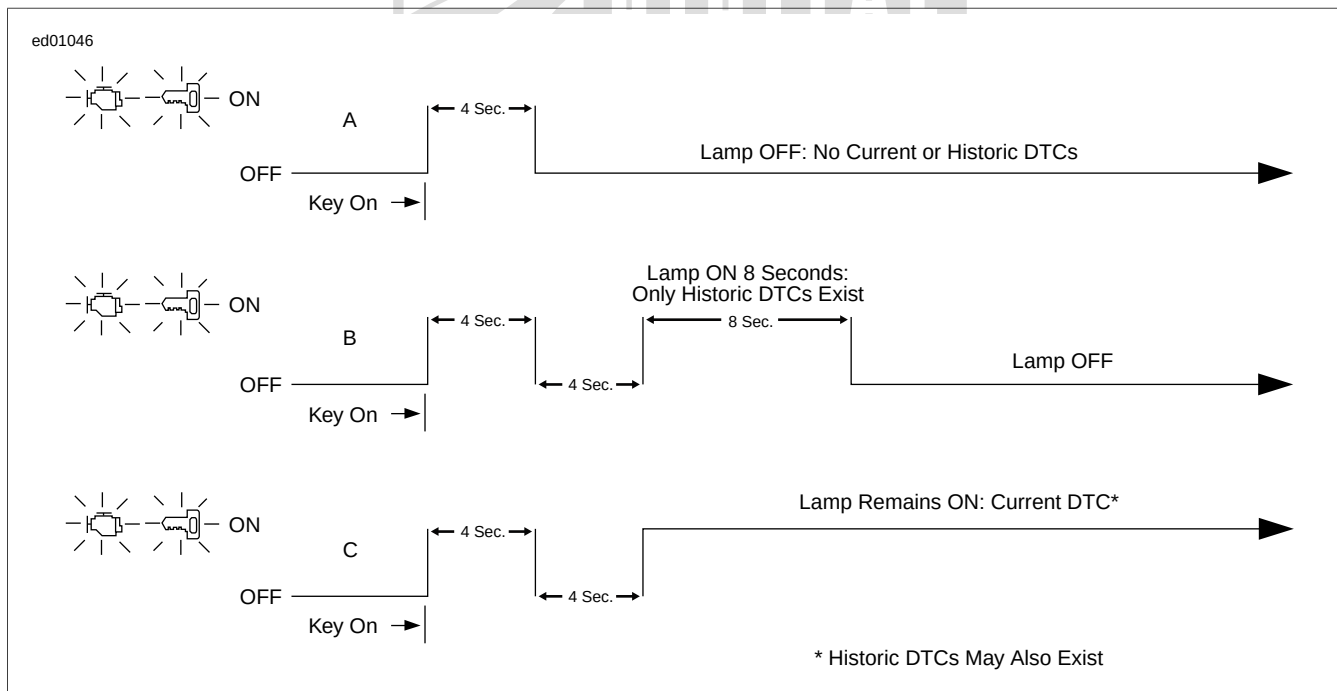


Figure 2-3. Check Engine and Security Lamp Operation

CODE TYPES

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

There are two types of DTCs: current and historic. If a DTC is stored, it can be read using DIGITAL TECHNICIAN II (Part No. HD-48650) or odometer self-diagnostics. See [2.3 ODOMETER SELF-DIAGNOSTICS](#).

All DTCs reside in the memory of the ECM, TSM/TSSM/HFSM, speedometer or tachometer until the code is cleared.

Current

Current DTCs are those which presently disrupt motorcycle operation. See the appropriate flowcharts for solutions.

Historic

If a particular problem happens to resolve itself, the active status problem is dropped and it becomes a historic fault rather than a current fault. Historic DTCs are stored for a length of time to assist in the diagnosis of intermittent faults.

Historic DTCs are cleared after a total of 50 trips has elapsed. A trip consists of a start and run cycle. After the 50 trip retention period, the historic DTC is automatically erased from memory providing no subsequent faults of the same type are detected in that period.

DTCs can only be identified as historic using DIGITAL TECHNICIAN II (Part No. HD-48650), a computer-based diagnostic package.

It is important to note that historic DTCs may also be present whenever the system indicates the existence of a current fault. See [2.1 CHECKING FOR DIAGNOSTIC TROUBLE CODES, Multiple Diagnostic Trouble Codes](#) if multiple DTCs are found.

Diagnostic charts are designed for use with current DTCs and as a result they frequently suggest wire repair or part replacement.

RETRIEVING DIAGNOSTIC TROUBLE CODES

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

The engine management system provides two levels of diagnostics.

- The most sophisticated mode employs DIGITAL TECHNICIAN II (Part No. HD-48650), a computer-based diagnostic package.
- The second mode requires using the odometer self diagnostics. See [4.6 ODOMETER SELF-DIAGNOSTICS](#).

MULTIPLE DIAGNOSTIC TROUBLE CODES

While it is possible for more than one fault to occur and set more than one DTC, there are several conditions which may result in **one** fault setting **multiple** DTCs. For example, serial data DTCs (DTC U1016, U1064, U1097, U1300 and U1301) may be accompanied by other DTCs. **Always** correct the serial data DTCs before resolving other DTCs.

For proper resolution of multiple DTCs, refer to [Table 2-3](#).



INITIAL DIAGNOSTIC CHECK: ODOMETER

2.2

GENERAL

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

See [Figure 2-4](#). Constant power is supplied to the speedometer through terminal 5 of connector [39] on XL, and the tachometer through terminal 5 of connector [108] on XR. The odometer turns on when power is applied to terminal 1. The speedometer on XL, and tachometer on XR, proceeds through an initialization sequence every time power is removed and re-applied to terminal 6. See [Figure 2-1](#). The visible part of this sequence is the check engine lamp, security lamp, backlighting and odo-

meter display. Upon key ON (engine stop switch set to RUN), the check engine lamp and security lamp will illuminate for four seconds and then (if parameters are normal) will turn off.

To locate faulty circuits or other system problems, follow the diagnostic flowcharts and tests in this section. For a systematic approach, always begin with [2.2 INITIAL DIAGNOSTIC CHECK: ODOMETER, Initial Diagnostics](#). Read the general information and then work your way through the flowchart box by box.

Loss of power on any of the three power inputs will change speedometer behavior on XL or XR, and tachometer on XR. Refer to [Table 2-1](#) or [Table 2-2](#), depending on the model.

Table 2-1. XL Speedometer or XR Tachometer Function Chart - Loss of Input

TERMINAL 5 (CONSTANT)	TERMINAL 1 (IGN)	TERMINAL 6 (ACC)	TERMINAL 7 (GRD)	TERMINAL 8 AND 11 (TRIP ODOMETER RESET SWITCH)
Instrument is completely non-functional	Will not "WOW"	Instrument will be non-functional in accessory and ignition modes	Instrument completely non-functional	No trip odometer reset switch function
Diagnostic absent	Instrument will indicate vehicle speed (zero)	Security lamp still performs 4-second bulb check in ignition mode	Diagnostic absent	Will not "WOW"
	Security lamp still functions	Trip odometer reset switch functions only in OFF position		
	Check engine lamp and battery lamp non-functional			
	Diagnostics absent			

Table 2-2. XR Speedometer Function Chart - Loss of Input

TERMINAL A (CONSTANT)	TERMINAL B (ACC)	TERMINAL D (GRD)
Instrument is completely non-functional	Instrument will be non-functional in accessory and ignition modes	Instrument completely non-functional
Diagnostic absent		Diagnostic absent

Diagnostic Notes

If a numbered circle appears adjacent to a flowchart box, 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.

Circuit Diagram/Wire Harness Connector Table

When working through a flowchart, 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 [2.5 BREAKOUT BOX: SPEEDOMETER/TACHOMETER](#).

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.

Reprogramming ECM

Diagnostic charts frequently suggest ECM replacement. In the event an ECM needs to be replaced, it must be reprogrammed using a computer-based diagnostic package called DIGITAL TECHNICIAN II (Part No. HD-48650). See your dealer. Password learn procedure must also be performed. See [3.23 TSM/HFSM: PASSWORD LEARN](#) or [E.21 TSM/TSSM: PASSWORD LEARN](#).

INITIAL DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-42682	BREAKOUT BOX
HD-46601	INSTRUMENT HARNESS ADAPTERS

Diagnostic Tips

- See [Figure 2-4](#). If Odometer reads "BUS Er" while ignition switch is turned to ON (engine stop switch at RUN with

the engine off), check diagnostic link for an open or short to ground between data link connector [91A] terminal 3 and ECM connector [78] terminal 5, TSM/TSSM/HFSM connector [30] terminal 3, speedometer connector [39] terminal 2 (on XL, terminal C on XR) or tachometer (if equipped) connector [108] terminal 2.

- Check for an open diagnostic test terminal between data link connector [91A] terminal 3 and TSM/TSSM/HFSM connector [30] terminal 3. With ignition switch turned to ON, transmit data should be typically 0.6-0.8 volts. The range of acceptable operation is greater than 0.0 volts and less than 7.0 volts.
- To identify intermittents, wiggle instrument and/or vehicle harness while performing steps in the Initial Diagnostic Check charts.

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. Connect BREAKOUT BOX (Part No. HD-42682) (black) between speedometer connector [39A] and [39B] on XL, or tachometer connector [108A] and [108B] on XR using INSTRUMENT HARNESS ADAPTERS (Part No. HD-46601). See [2.4 SPEEDOMETER/TACHOMETER](#).

All Odometer DTCs are listed in [Table 2-3](#).

Table 2-3. Odometer Diagnostic Trouble Code (DTC) Priority Chart

DTC	RANKING	FAULT CONDITION	SOLUTION
U1300	1	Serial data bus shorted low	2.12 DTC U1300, U1301 OR BUS ER
U1301	2	Serial data bus shorted high	2.12 DTC U1300, U1301 OR BUS ER
U1016	3	Loss of ECM serial data	2.10 DTC U1016, U1255
U1064	4	Loss of TSM/TSSM/HFSM serial data	2.11 DTC U1064, U1255
U1255	5	Missing response from other module (TSM/TSSM/HFSM and/or ECM) at startup	2.11 DTC U1064, U1255
B1007	6	Ignition line overvoltage	2.8 DTC B1006, B1007
B1006	7	Accessory line overvoltage	2.8 DTC B1006, B1007
B1008	8	Reset switch closed	2.9 DTC B1008
B1004	9	Fuel level sending unit low	2.7 DTC B1004, B1005
B1005	10	Fuel level sending unit high/open	2.7 DTC B1004, B1005

Other Diagnostic Trouble Codes

See [3.10 INITIAL DIAGNOSTIC CHECK: TSM/HFSM](#) or [E.9 INITIAL DIAGNOSTIC CHECK: TSM/TSSM](#) for any DTCs related to the TSM, TSSM or HFSM.

See [4.5 INITIAL DIAGNOSTIC CHECK: EFI](#) for any DTCs related to the ECM.

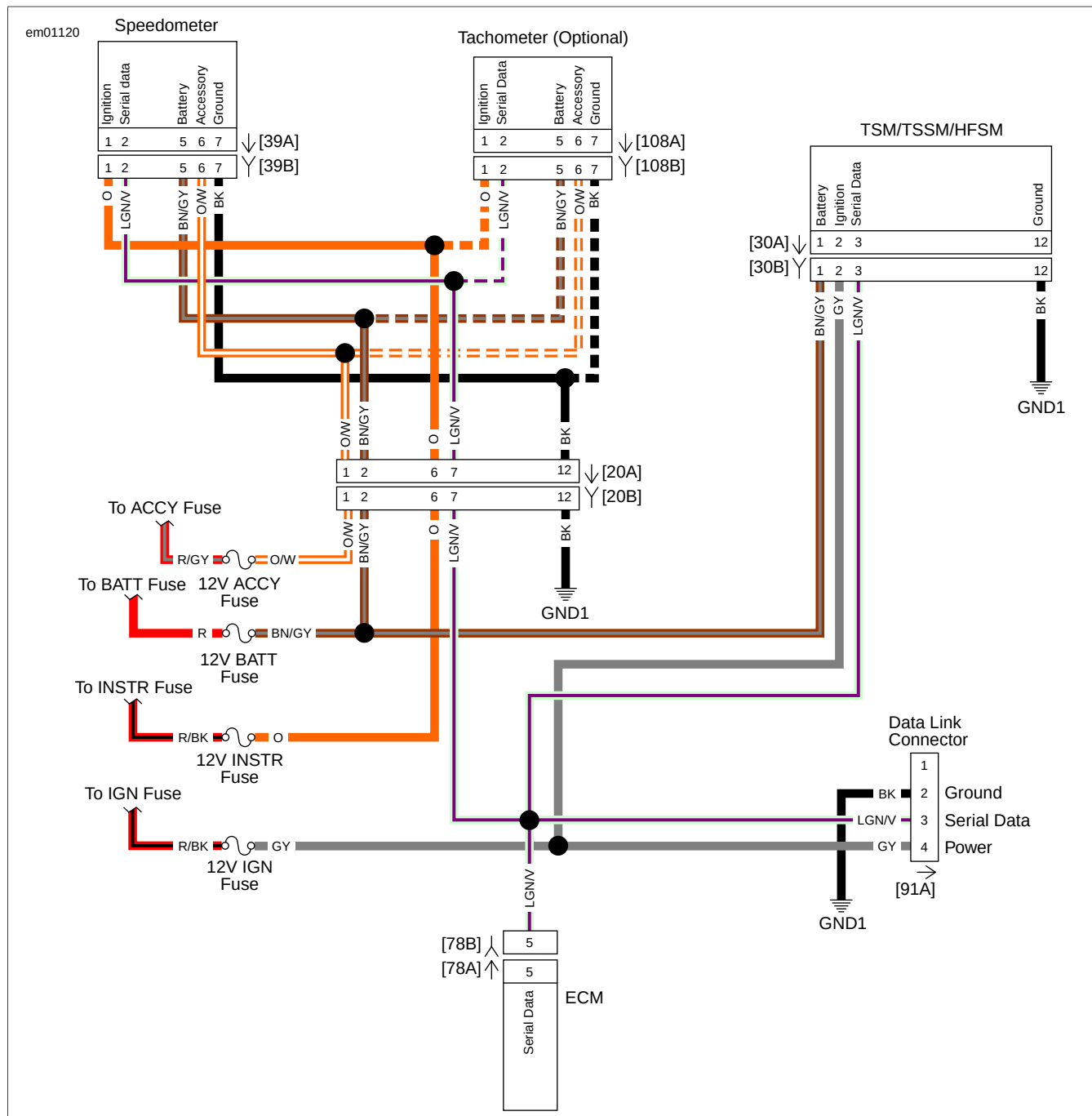


Figure 2-4. Serial Data Circuit (XL)

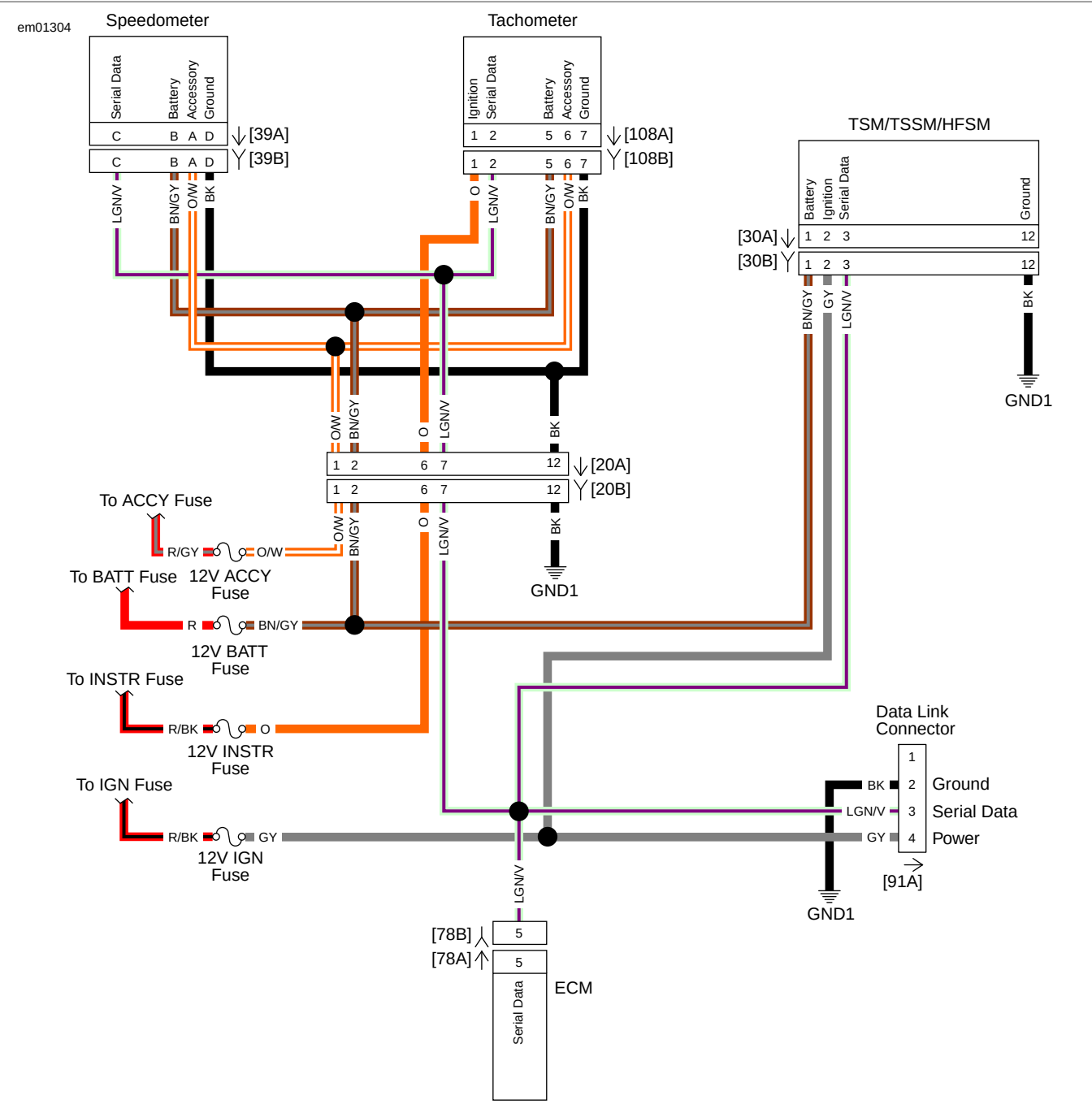


Figure 2-5. Serial Data Circuit (XR)

Table 2-4. Wire Harness Connectors

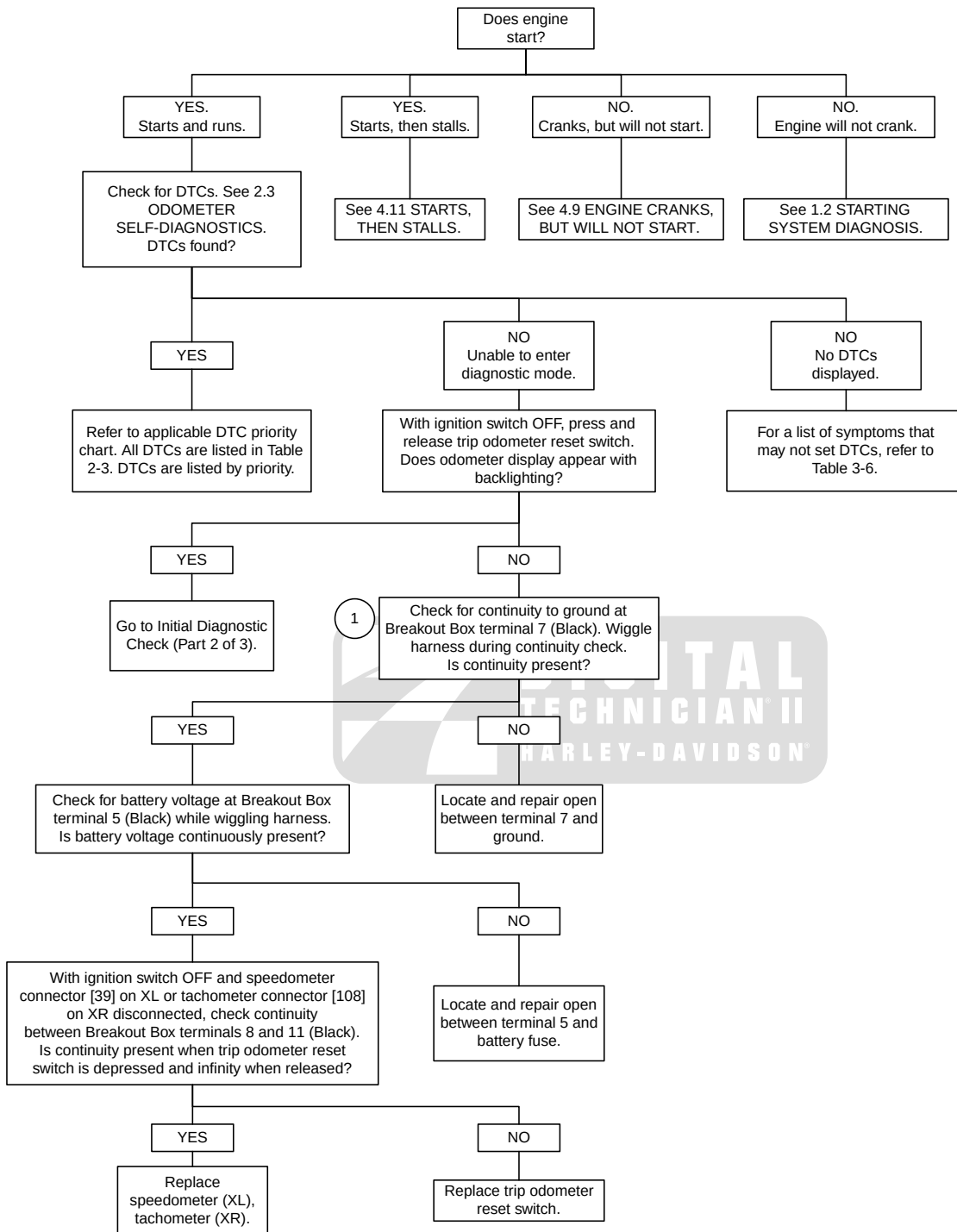
NO.	DESCRIPTION	TYPE	LOCATION
[20]	Instruments	12-place Molex	Under fuel tank
[30]	TSM/TSSM/HFSM	12-place Deutsch	Under battery
[39]	Speedometer (XL)	12-place Packard	Back of speedometer
[39]	Speedometer (XR)	5-place Packard	Back of speedometer
[78]	ECM	36-place Packard	Under seat

Table 2-4. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[91A]	Data link connector	4-place Deutsch	On battery strap, behind left side cover
[108]	Tachometer (if equipped)	12-place Packard	Back of tachometer

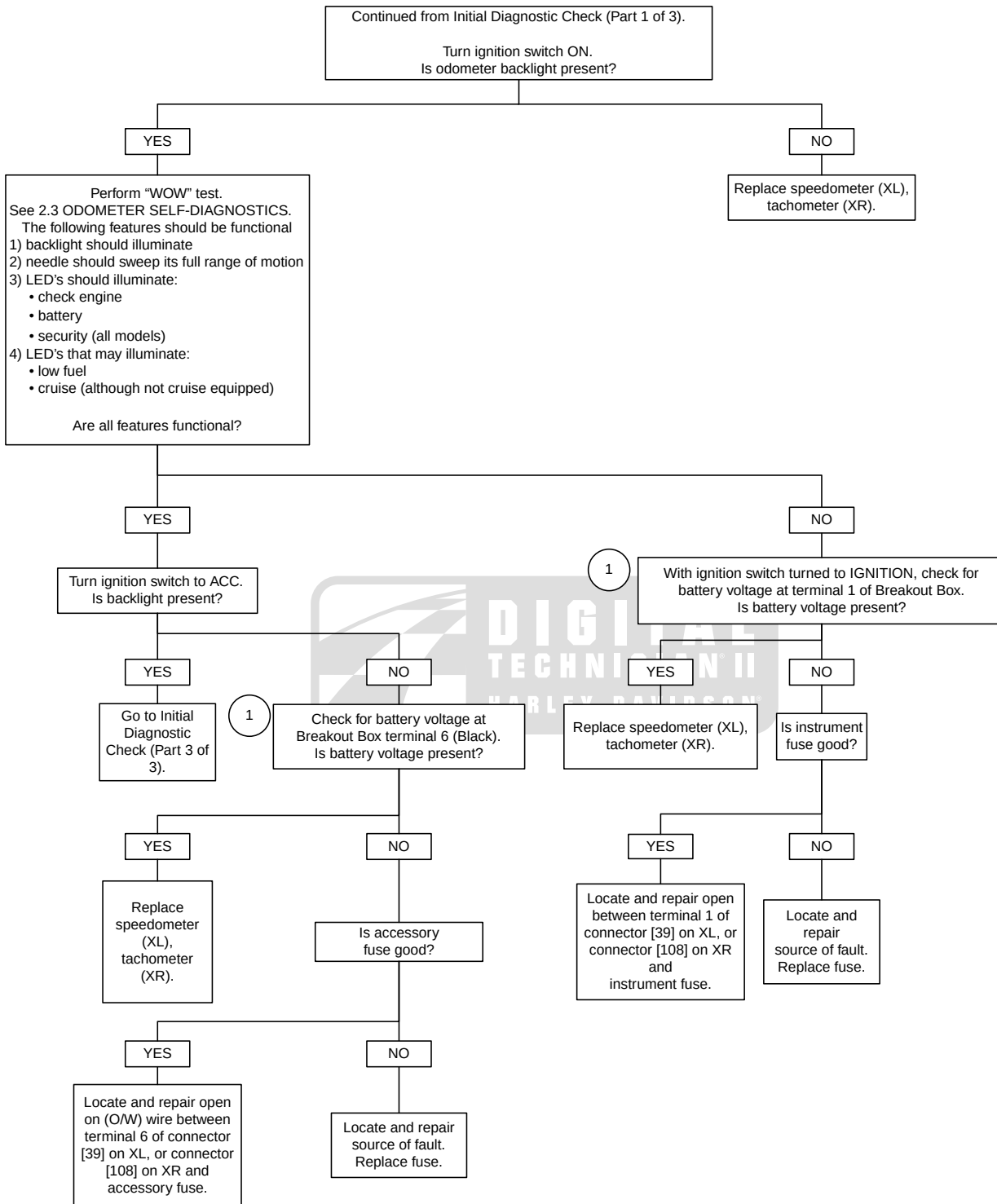


Initial Diagnostic Check (Part 1 of 3)



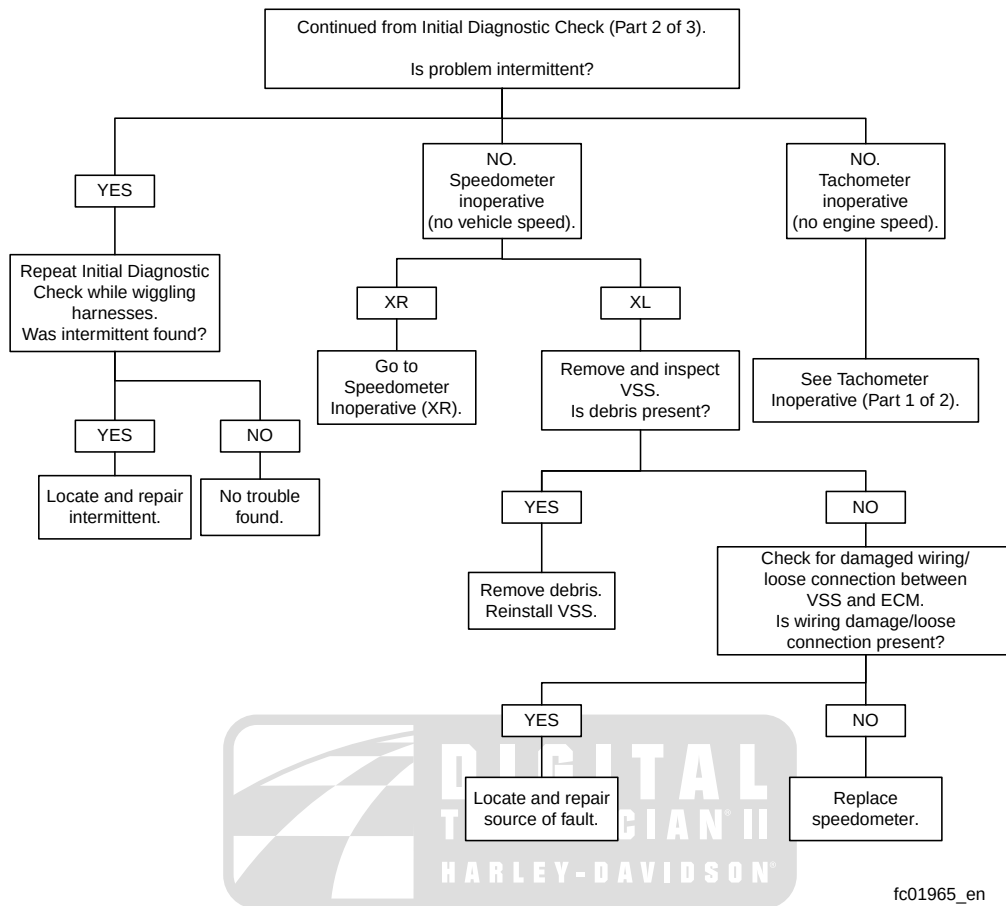
fc01964_en

Initial Diagnostic Check (Part 2 of 3)

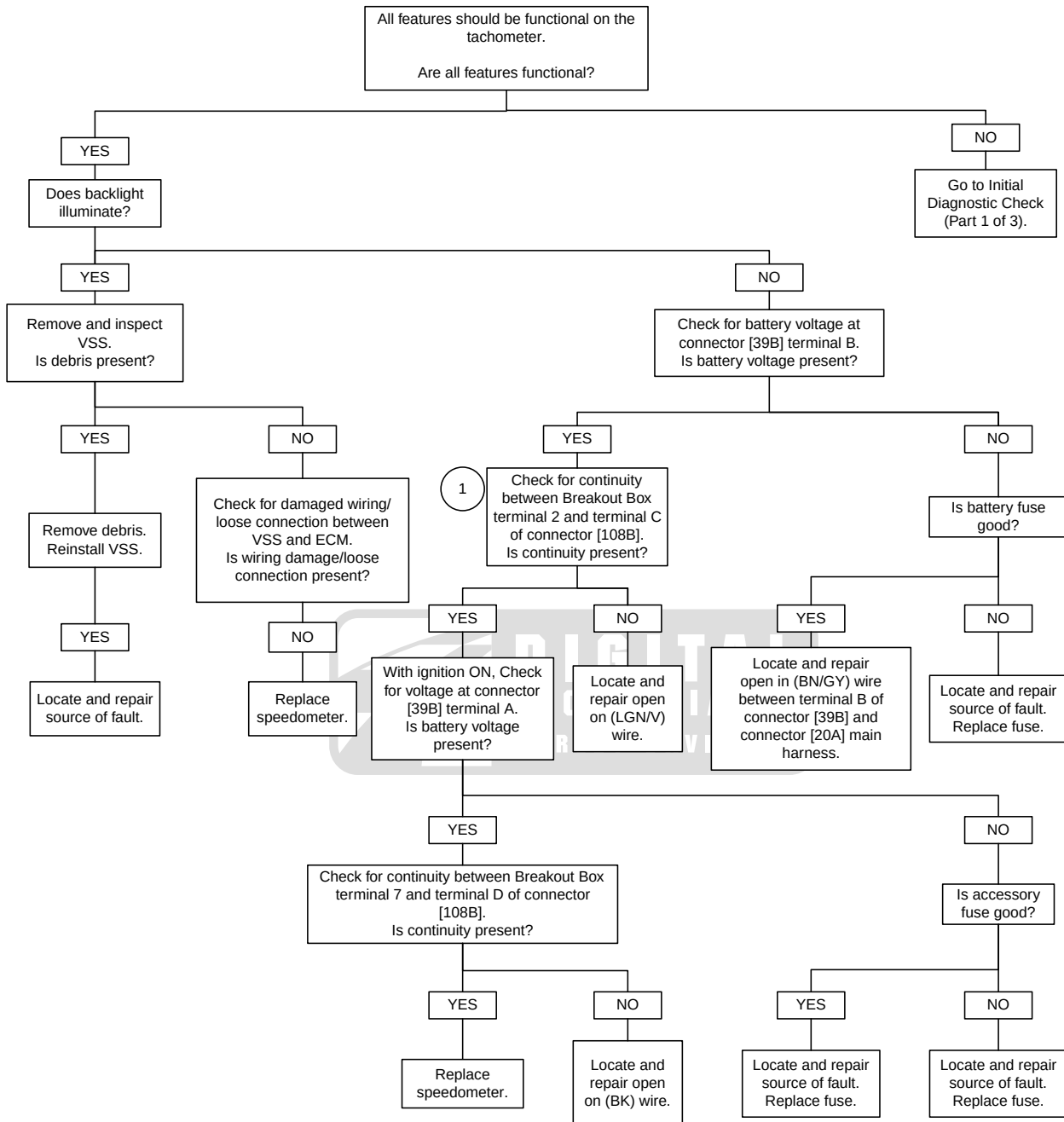


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Initial Diagnostic Check (Part 3 of 3)



Speedometer Inoperative, XR



fc01931_en

ODOMETER SELF-DIAGNOSTICS

2.3

GENERAL

The speedometer on XL and the tachometer on XR are capable of displaying and clearing speedometer, tachometer, TSM/TSSM/HFSM, and ECM Diagnostic Trouble Codes (DTCs) (diagnostic mode).

DIAGNOSTICS

Diagnostic Tips

- For a quick check of instrument function, a "WOW" test can be performed. See [Figure 2-7](#). Press and hold trip odometer reset switch, then turn ignition switch ON. Release trip odometer reset switch. Background lighting should illuminate, gauge needle should sweep its full range of motion, and indicator lamps (check engine, low fuel, battery and security) should illuminate.
- If instrument module fails "WOW" test, check for battery, ground, ignition, trip odometer reset switch and accessory wiring to speedometer on XL and tachometer on XR. If any feature in the speedometer on XL and tachometer on

XR is non-functional, see [2.2 INITIAL DIAGNOSTIC CHECK: ODOMETER](#).

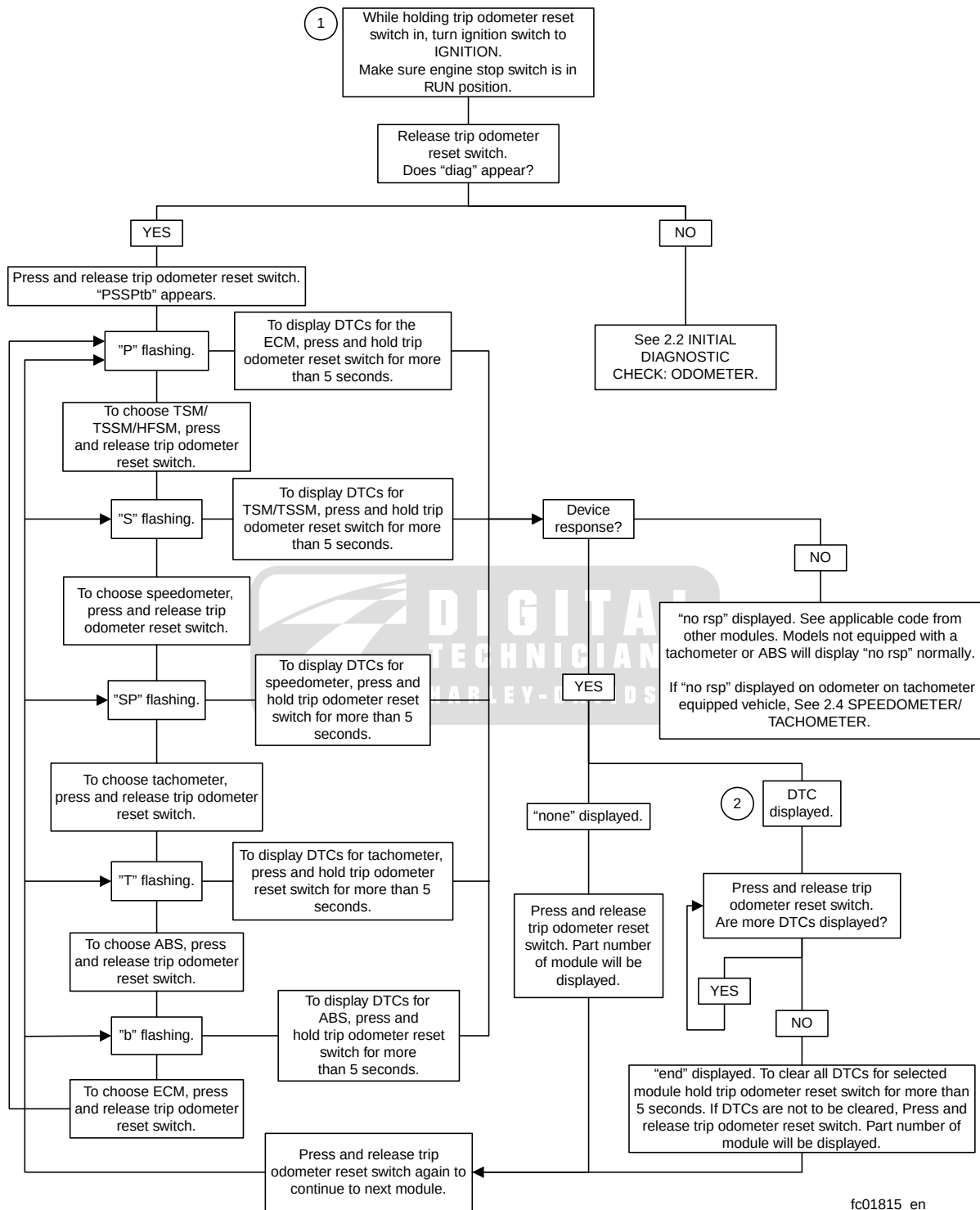
Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. To exit diagnostic mode, turn ignition switch OFF.
2. To clear DTCs for the selected module:
 - a. Press and hold the trip odometer reset switch for more than 5 seconds to display available modules, release.
 - b. Press the trip odometer reset switch to choose the module.
 - c. Press and hold the trip odometer reset switch for more than 5 seconds to display the DTC, release.
 - d. Press and hold the trip odometer reset switch for more than 5 seconds to clear the DTCs for the selected module.



Odometer Self-Diagnostics



SPEEDOMETER/TACHOMETER

2.4

GENERAL

See [Figure 2-6](#). The speedometer on XL and tachometer on XR consists of a warning display and four status lamps. The lamps include: check engine, low fuel, battery, and security.

Trip Odometer Reset Switch

[Figure 2-7](#). Pressing the trip odometer reset switch provides the following capabilities:

- Change the odometer display between mileage, trip A and trip B values (press and immediately release).
- Reset an individual trip odometer (press and hold 2-3 seconds).
- Gain access to the diagnostic mode and clear DTCs. See [2.3 ODOMETER SELF-DIAGNOSTICS](#).
- Display odometer while ignition switch is OFF. Press and hold trip odometer reset switch while ignition switch is OFF and odometer mileage will be displayed.
- On models with dual scale speedometers, toggle between miles/kilometers on odometer and trip odometer display. To toggle display, turn ignition switch ON. Press and hold trip odometer reset switch while odometer is displayed. Release switch when change is noted. (If trip odometer reset switch is held while trip odometer is displayed, trip odometer will reset).

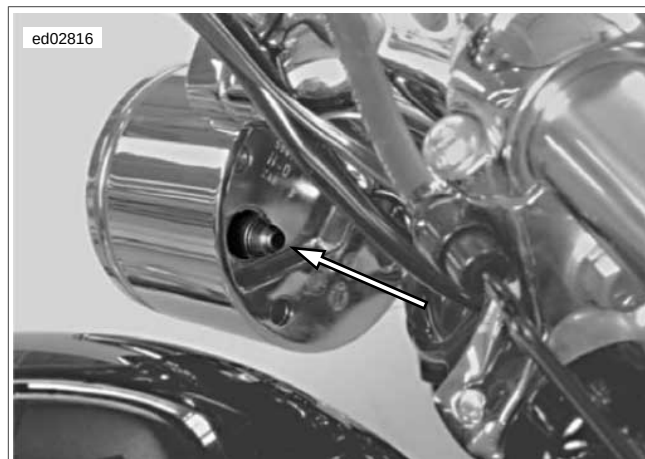


Figure 2-7. Trip Odometer Reset Switch (Typical)

SPEEDOMETER THEORY OF OPERATION

The speedometer circuit consists of a Vehicle Speed Sensor (VSS), the ECM, the trip odometer reset switch and the speedometer. The VSS is mounted on the rear of the engine crankcase behind the starter motor assembly. The sensor circuitry is that of a Hall-effect sensor 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 the ECM circuitry, converted into serial data then sent to the speedometer. The vehicle speed serial data is also transmitted to the TSM/TSSM/HFSM for turn signal cancellation.

ODOMETER THEORY OF OPERATION

The odometer mileage is permanently stored and will not be lost when electrical power is turned off or disconnected. The trip odometer reset switch allows switching between the odometer, trip odometer A and trip odometer B displays.

To zero the trip odometer, have the desired trip odometer display visible and press and hold the trip odometer reset switch. 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/kilometers. The trip odometers can display six numbers with a tenth of a mile accuracy for a maximum of 99999.9 miles/kilometers.

TACHOMETER THEORY OF OPERATION

See [Figure 2-8](#). The tachometer receives serial data from the ECM. The tachometer interprets the serial data and converts it into tachometer needle movement.

NOTE

Indicator lamps in the tachometer face may illuminate during a "WOW" test, even though they do not function during normal vehicle operation.

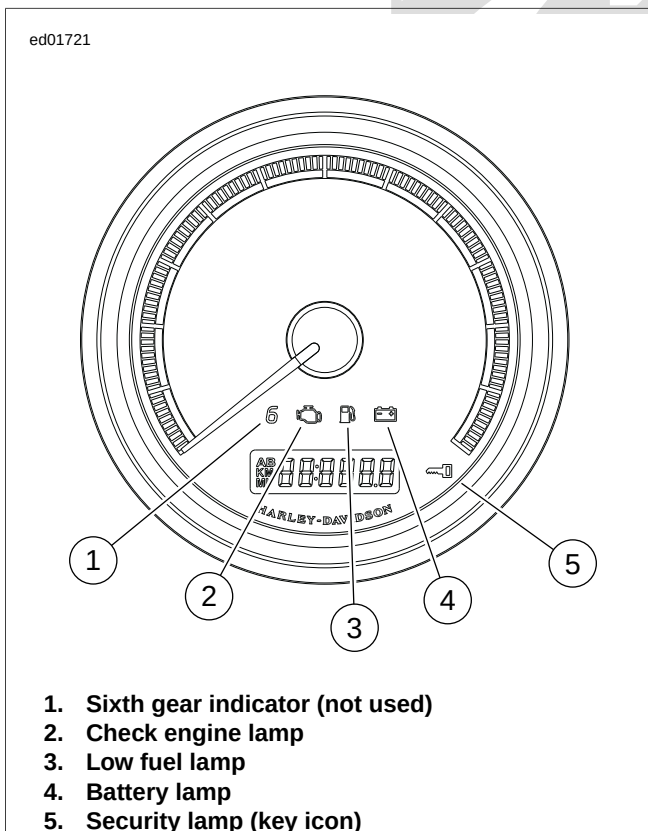


Figure 2-6. Indicator Lamps (Typical)

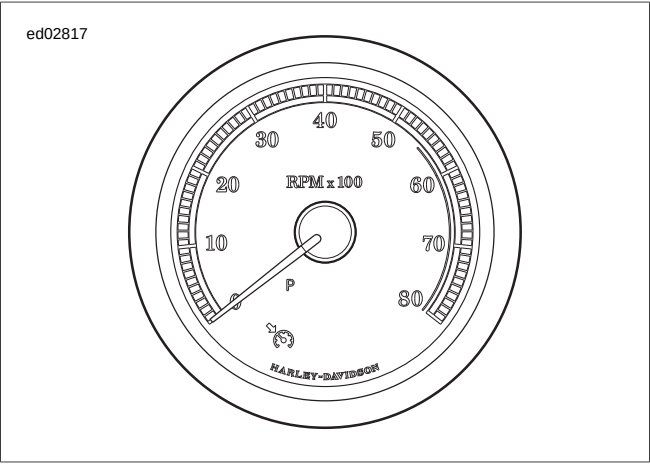


Figure 2-8. Tachometer (Typical)

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX
HD-46601	INSTRUMENT HARNESS ADAPTERS

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. If problems are intermittent, wiggle harness while performing tests.

2. Connect BREAKOUT BOX (Part No. HD-42682) (black) between tachometer connector [108A] (at the back of the tachometer) and wire harness connector [108B] using INSTRUMENT HARNESS ADAPTERS (Part No. HD-46601). See [2.5 BREAKOUT BOX: SPEEDOMETER/TACHOMETER](#).
3. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), black pin probe and patch cord.

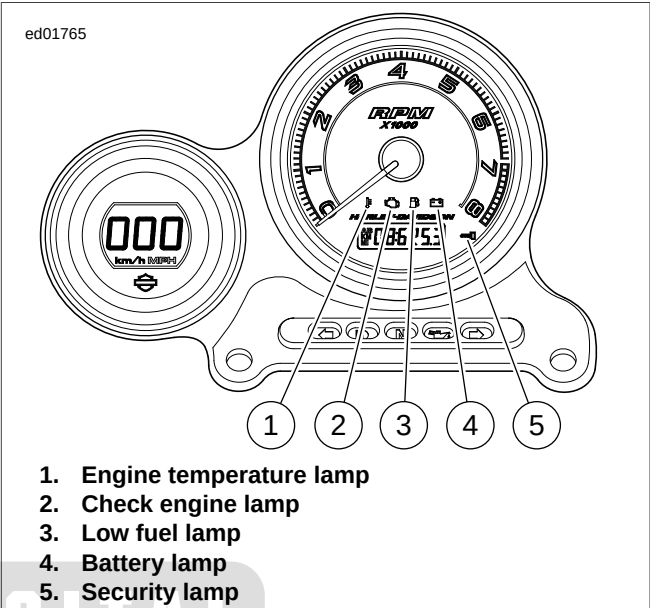


Figure 2-9. Instruments (XR)

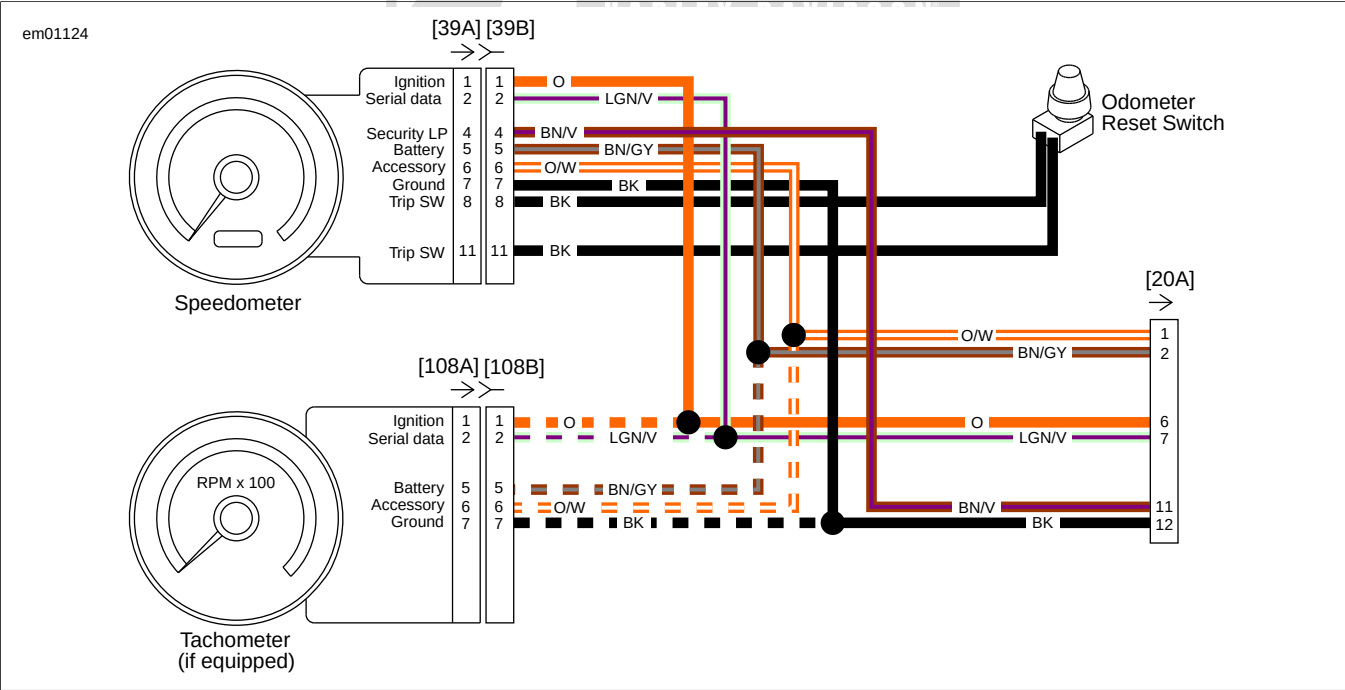


Figure 2-10. Speedometer/Tachometer Circuit (XL)

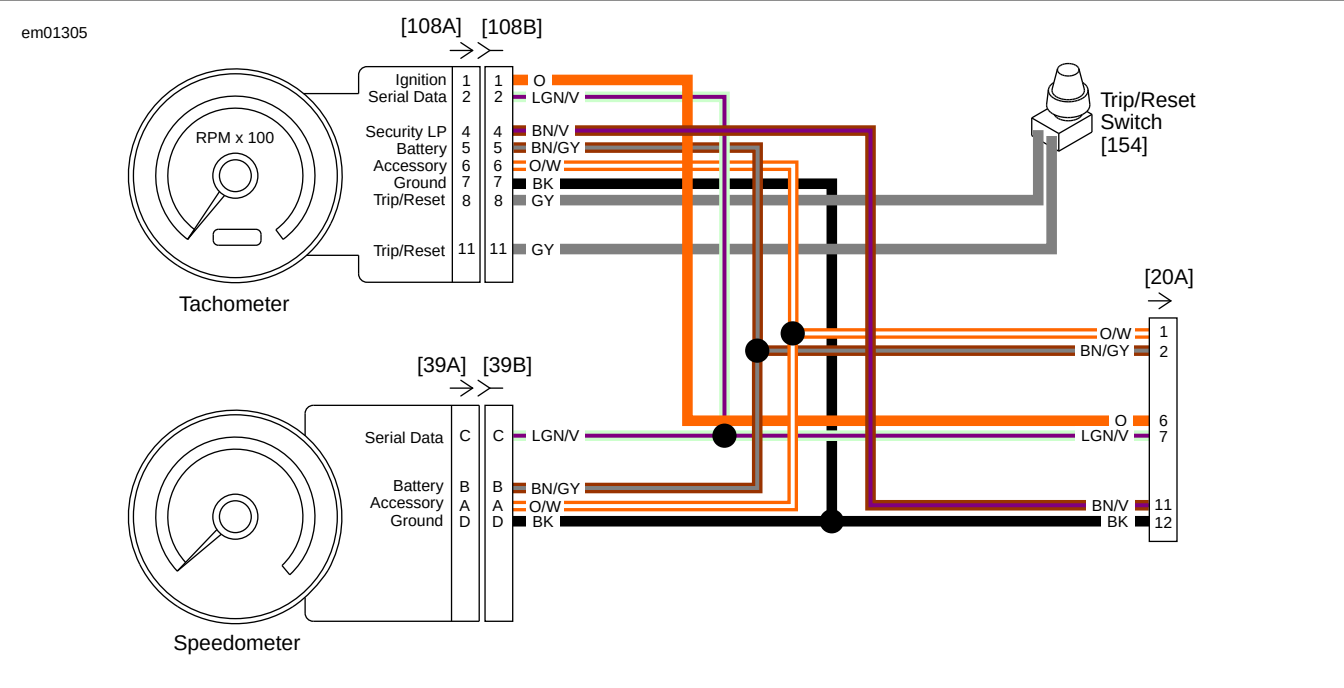
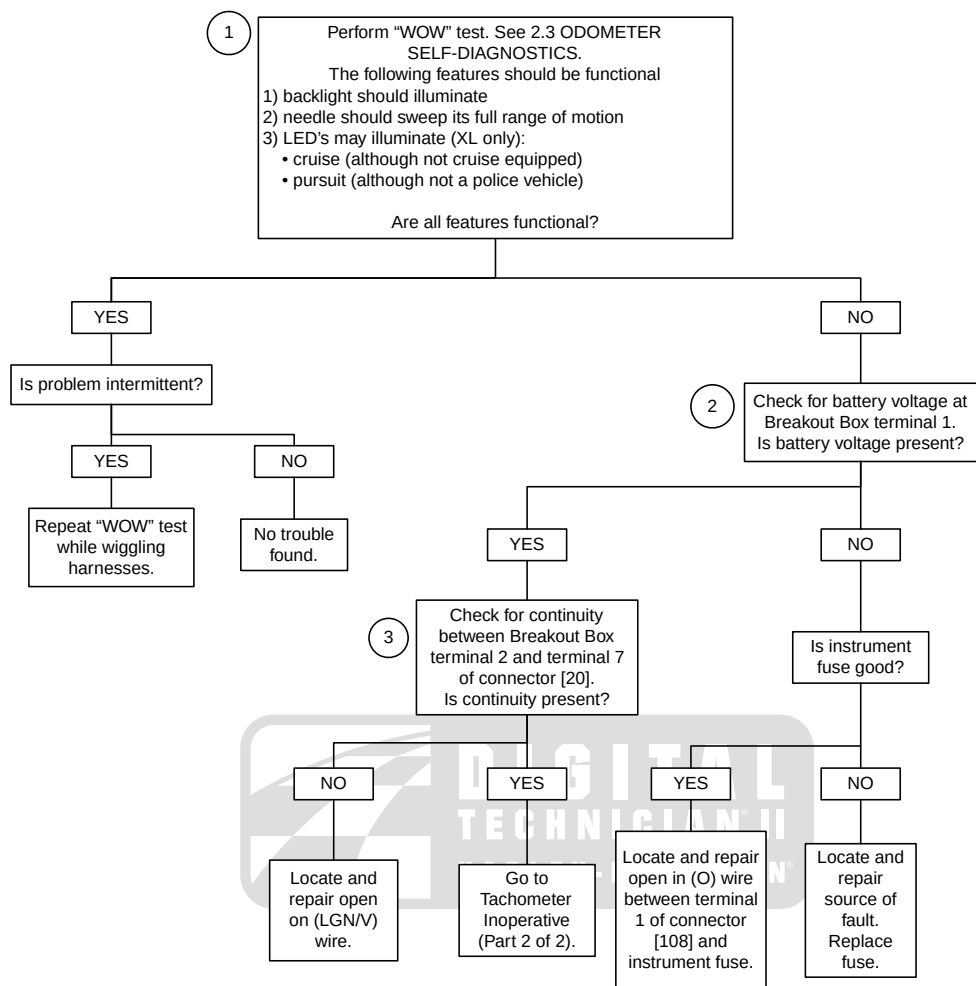


Figure 2-11. Speedometer/Tachometer Circuit (XR)

Table 2-5. Wire Harness Connectors

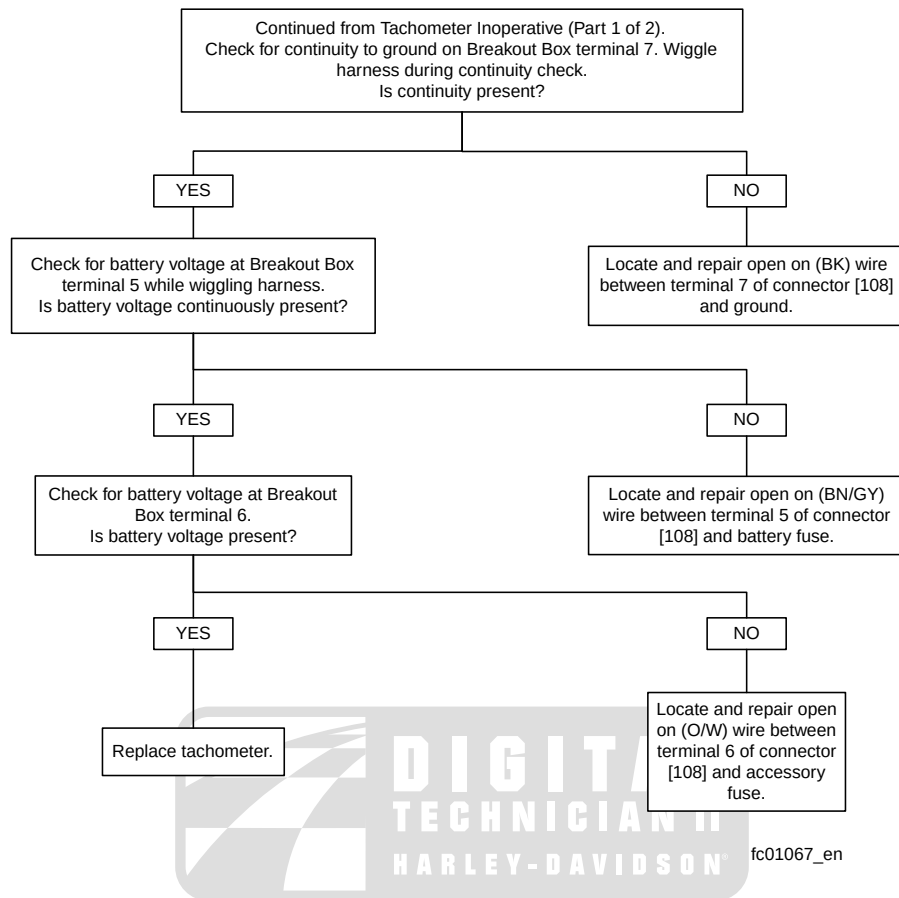
NO.	DESCRIPTION	TYPE	LOCATION
[20]	Instruments	12-place Molex	Under fuel tank
[39]	Speedometer (XL)	12-place Packard	Back of speedometer
[39]	Speedometer (XR)	5-place Packard	Back of speedometer
[108]	Tachometer (if equipped)	12-place Packard	Back of tachometer

Tachometer Inoperative (Part 1 of 2)



fc01966_en

Tachometer Inoperative (Part 2 of 2)



BREAKOUT BOX: SPEEDOMETER/TACHOMETER

2.5

GENERAL

PART NUMBER	TOOL NAME
HD-42682	BREAKOUT BOX
HD-46601	INSTRUMENT HARNESS ADAPTERS

The BREAKOUT BOX (Part No. HD-42682) and INSTRUMENT HARNESS ADAPTERS (Part No. HD-46601) connect to the speedometer connector [39] (XL only) or tachometer connector [108]. Used in conjunction with a DVOM, the breakout box allows circuit diagnosis of wiring harness and connections without having to probe with sharp objects

NOTE

See wiring diagrams for speedometer and tachometer terminal functions.

SPEEDOMETER: XL ONLY

PART NUMBER	TOOL NAME
HD-42682	BREAKOUT BOX
HD-46601	INSTRUMENT HARNESS ADAPTERS

Installation

1. See [Figure 2-12](#). Press latch on connector [39B].
2. Connect INSTRUMENT HARNESS ADAPTERS (Part No. HD-46601) to connectors [39A] and [39B].
3. Attach black connectors from BREAKOUT BOX (Part No. HD-42682) to INSTRUMENT HARNESS ADAPTERS (Part No. HD-46601).

Removal

1. Disconnect BREAKOUT BOX (Part No. HD-42682) from INSTRUMENT HARNESS ADAPTERS (Part No. HD-46601).
2. Detach INSTRUMENT HARNESS ADAPTERS (Part No. HD-46601) from connectors [39A] and [39B].
3. See [Figure 2-12](#). Plug wire harness connector [39B] into speedometer connector [39A].



Figure 2-12. Speedometer Connector [39] on XL or Tachometer Connector [108] on XR (Typical)

TACHOMETER

PART NUMBER	TOOL NAME
HD-42682	BREAKOUT BOX
HD-46601	INSTRUMENT HARNESS ADAPTERS

Installation

1. Press latch on connector [108B].
2. Connect INSTRUMENT HARNESS ADAPTERS (Part No. HD-46601) to connectors [108A] and [108B].
3. Attach black connectors from BREAKOUT BOX (Part No. HD-42682) to INSTRUMENT HARNESS ADAPTERS (Part No. HD-46601).

Removal

1. Disconnect BREAKOUT BOX (Part No. HD-42682) from INSTRUMENT HARNESS ADAPTERS (Part No. HD-46601).
2. Detach INSTRUMENT HARNESS ADAPTERS (Part No. HD-46601) from connectors [108A] and [108B].
3. Plug wire harness connector [108B] into tachometer connector [108A].

INDICATOR LAMPS

2.6

GENERAL

See [Figure 2-13](#). All models are equipped with Light Emitting Diode (LED) indicator lamps, which must be replaced as a complete assembly with harness.

Job/Time Code Values

Dealership technicians filing warranty claims should use the job/time code values printed in **bold text** underneath the appropriate repair.

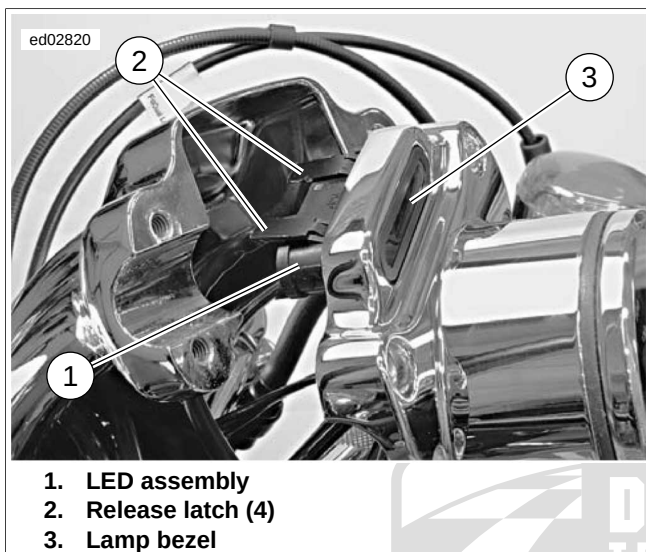


Figure 2-13. Indicator Lamp Assembly (Typical)

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), gray pin probe and patch cord.

em01121

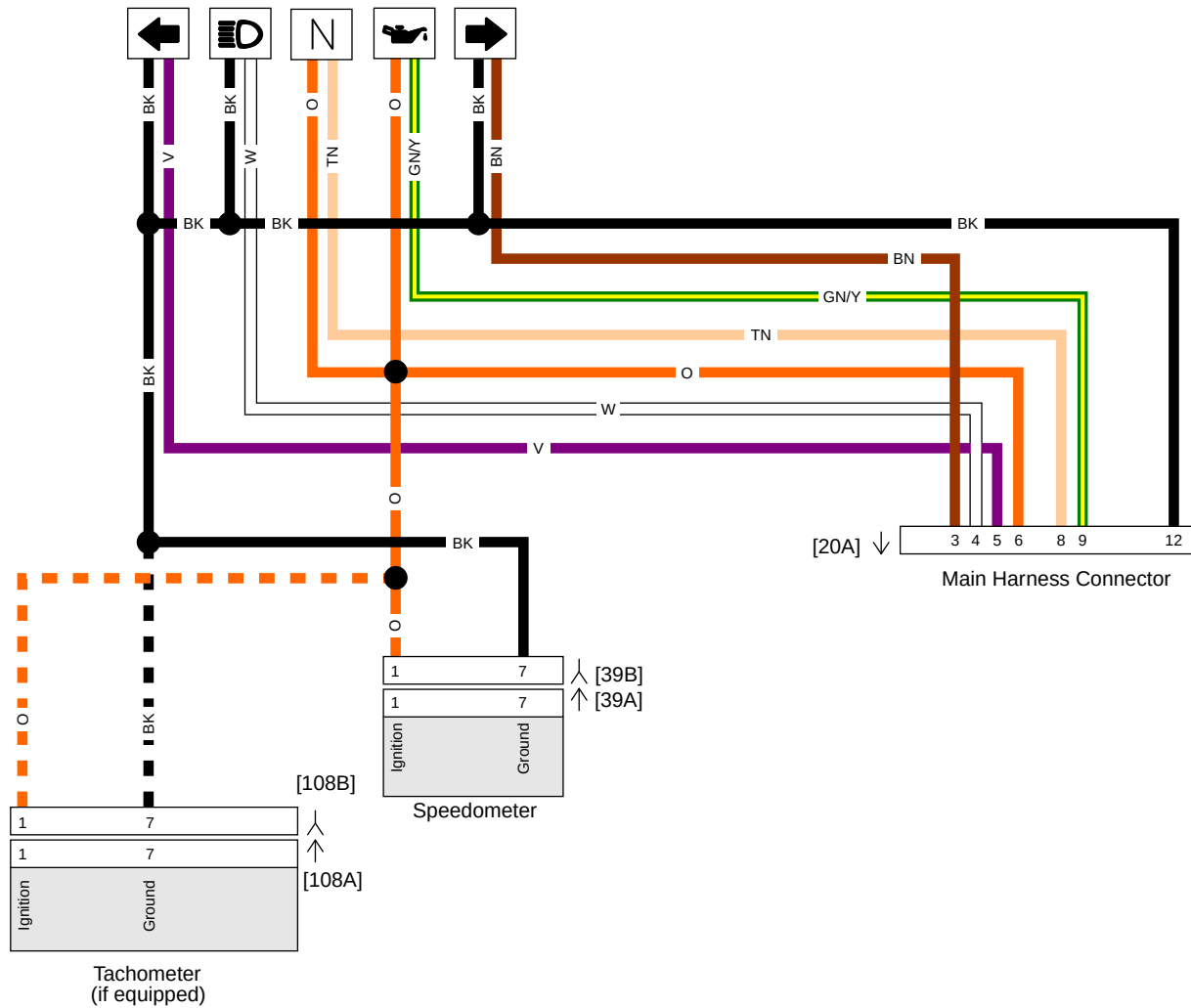


Figure 2-14. Indicator Lamp Circuit (XL)

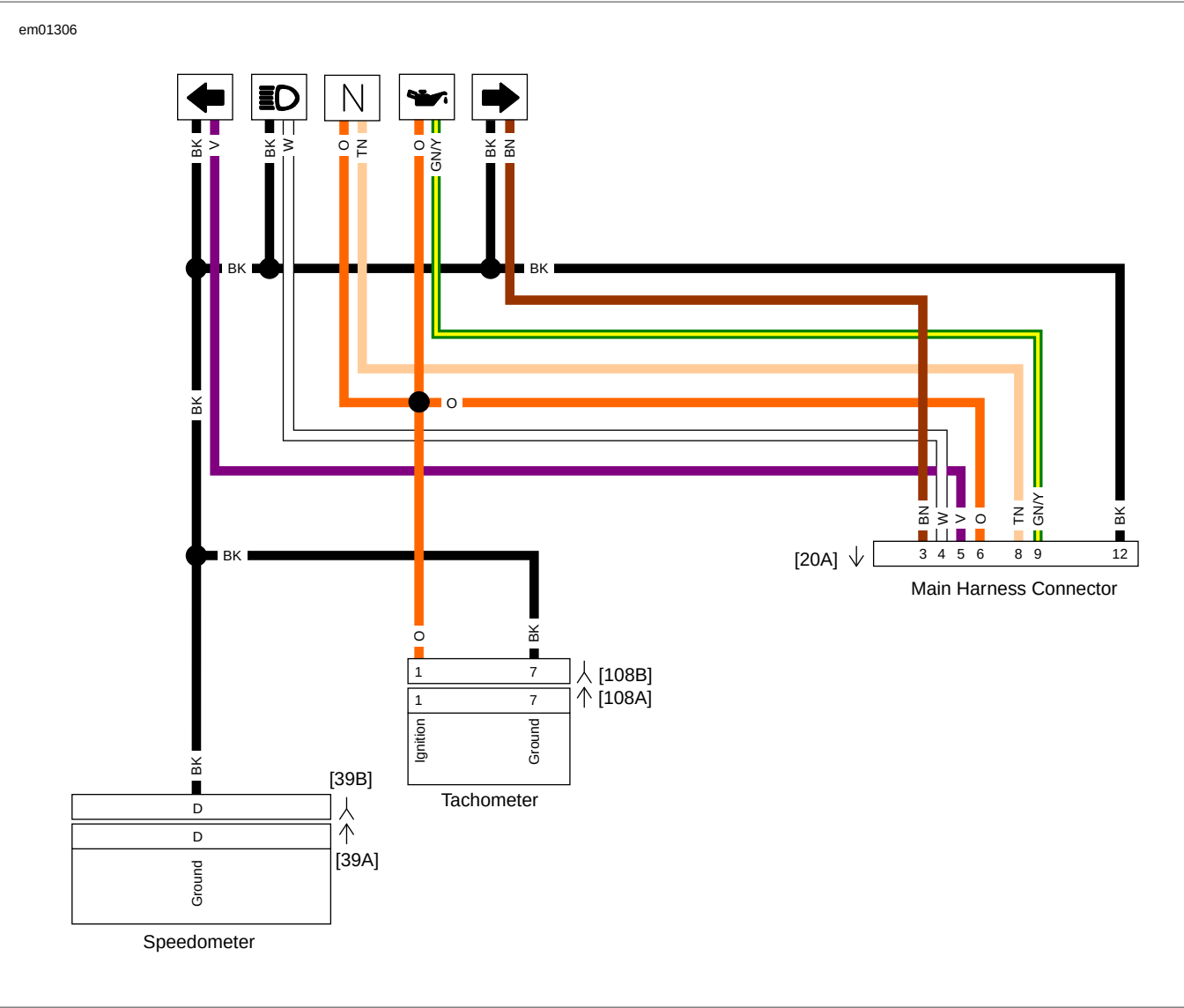
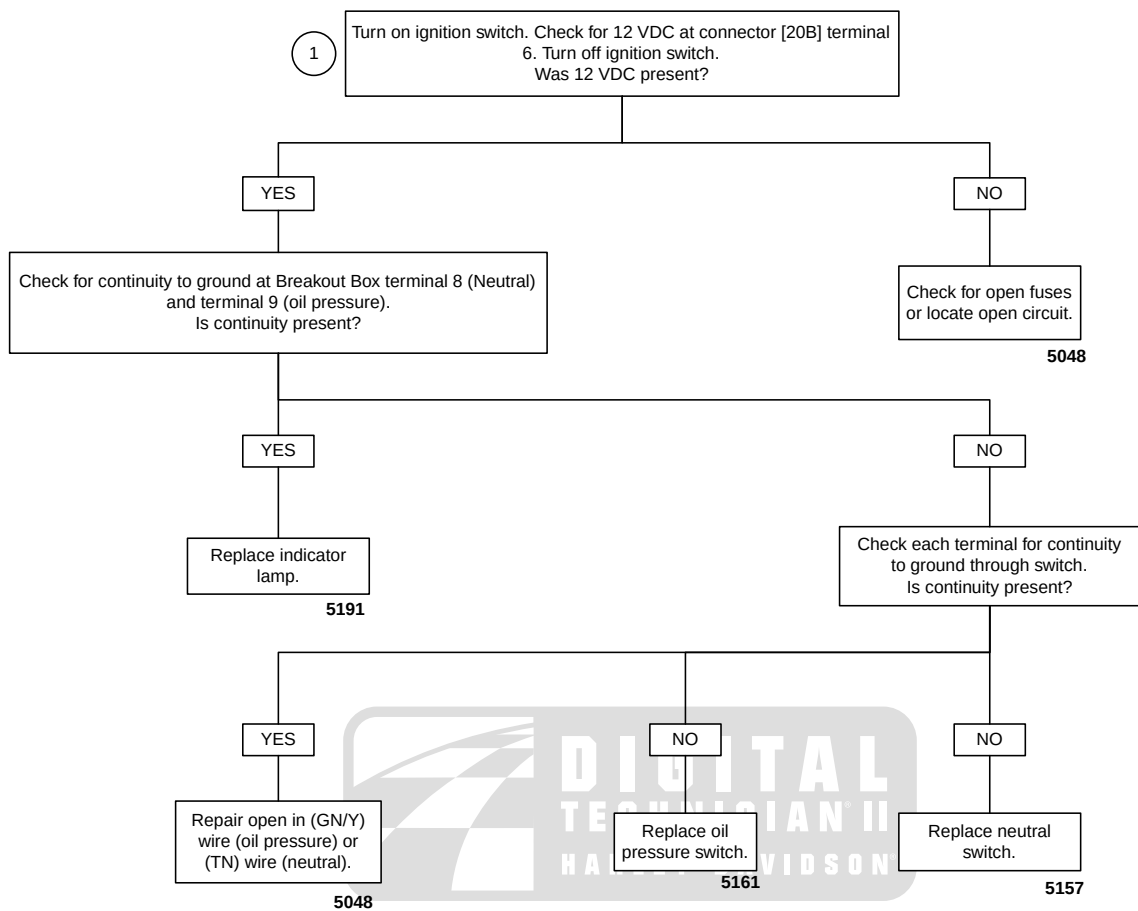


Figure 2-15. Indicator Lamp Circuit (XR)

Table 2-6. Wire Harness Connectors

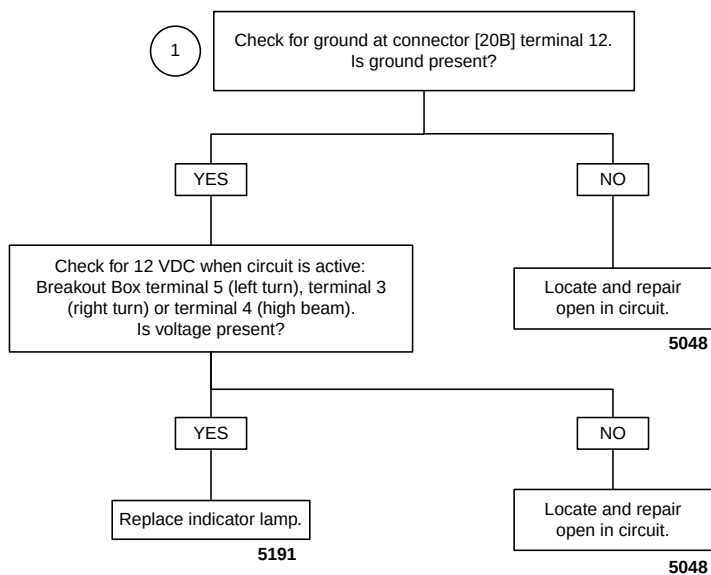
NO.	DESCRIPTION	TYPE	LOCATION
[20]	Instruments	12-place Molex	Under fuel tank
[39]	Speedometer (XL)	12-place Packard	Back of speedometer
[39]	Speedometer (XR)	5-place Packard	Back of speedometer
[108]	Tachometer (if equipped)	12-place Packard	Back of tachometer

Oil Pressure or Neutral Indicator Will Not Function



fc01068_en

High Beam or R/L Turn Signal Indicator Will Not Function



fc01069_en



DTC B1004, B1005

2.7

GENERAL

See [Figure 2-16](#). The fuel level is monitored by the speedometer terminal "9" of connector [39] (Y/W) XL or Tachometer connector [108] XR.

- If the voltage on terminal "9" of connector [39] XL and connector [108] XR exceeds the lower limit for greater than or equal to 15 seconds, DTC B1004 will set.
- If the voltage on terminal "9" of connector [39] XL and connector [108] XR exceeds the upper limit (or is open) for greater than or equal to 15 seconds, DTC B1005 will set.

Table 2-7. Code Description

DTC	DESCRIPTION
B1004	Fuel level sending unit low
B1005	Fuel level sending unit high/open



Figure 2-16. Speedometer Connector [39] on XL or Tachometer [108] on XR (Typical)

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX
HD-46601	INSTRUMENT HARNESS ADAPTERS

Diagnostic Tips

If fuel gauge is performing erratically (possible false DTCs), review [Table 2-8](#) for proper functionality.

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), brown pin probe and patch cord.
2. Connect BREAKOUT BOX (Part No. HD-42682) and INSTRUMENT HARNESS ADAPTERS (Part No. HD-46601) between wire harness and speedometer XL or tachometer XR.

Table 2-8. Testing Fuel Sender Resistor Assembly

FUEL LEVEL	[39B] PIN 2 RESISTANCE TO GROUND
Low	2000 ohms $\pm$ 200
High	10000 ohms $\pm$ 200

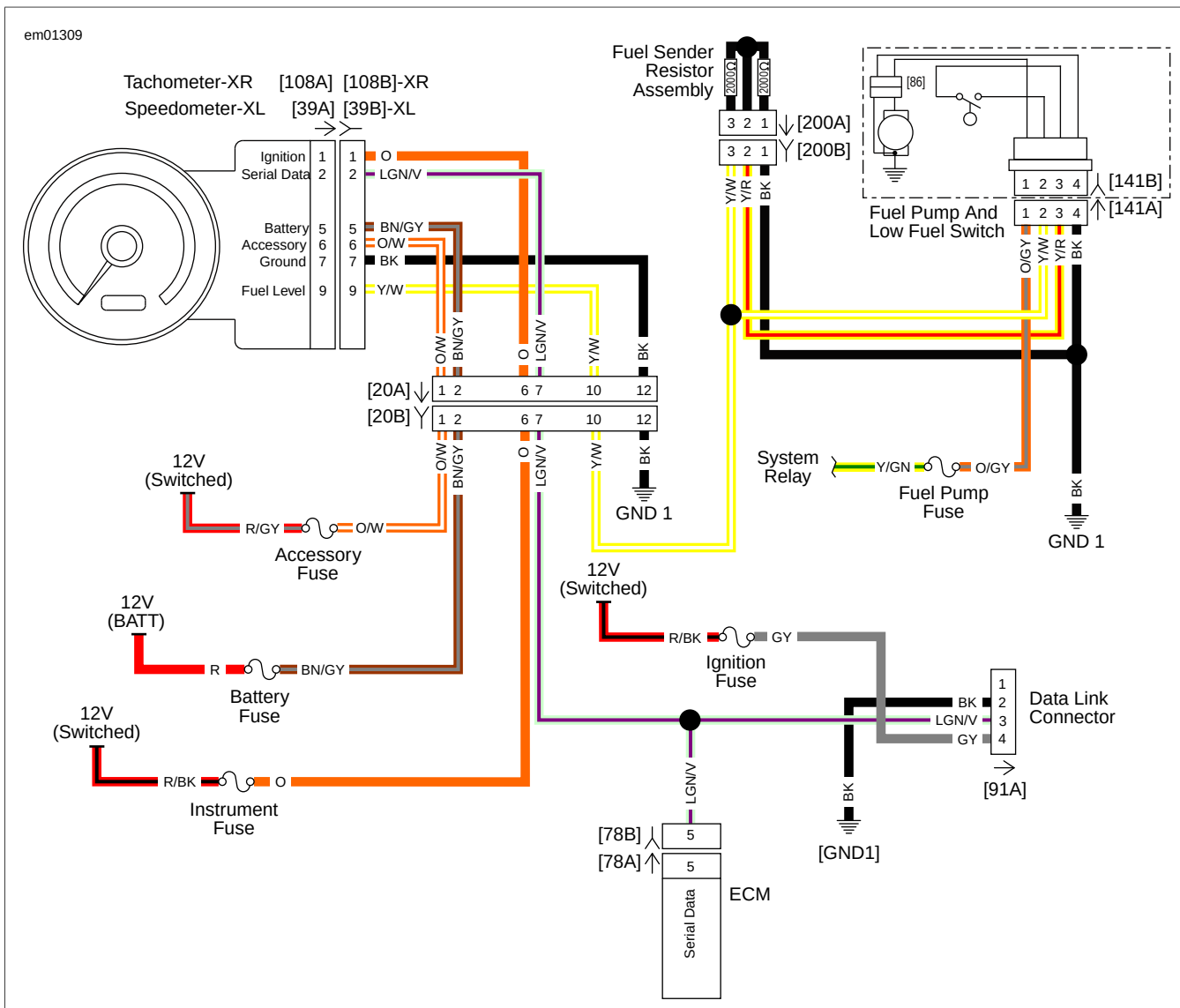
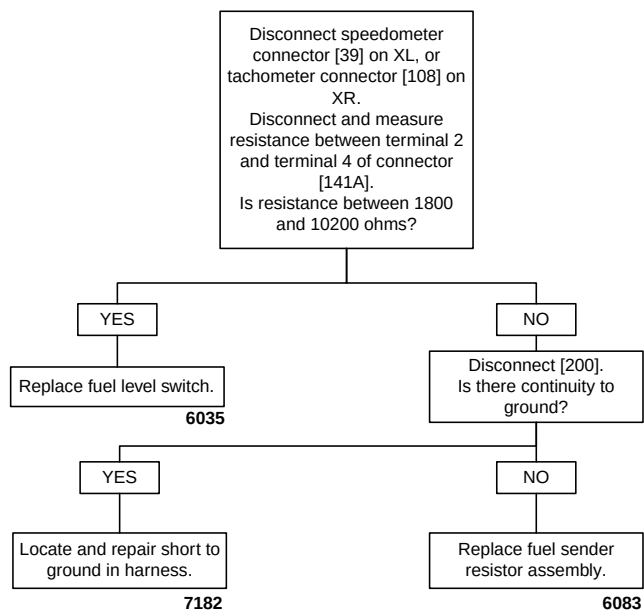


Figure 2-17. Fuel Sender Circuitry

Table 2-9. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[20]	Instruments	12-place Molex	Under fuel tank
[39]	Speedometer (XL)	12-place Packard	Back of speedometer
[78]	ECM	36-place Packard	Under seat
[91A]	Data link connector	4-place Deutsch	On battery strap, behind left side cover
[108]	Tachometer (XR)	12-place Packard	Back of tachometer
[141]	Fuel pump and low fuel switch	4-place Molex	Forward of relay/fuse blocks
[200]	Fuel sender resistor assembly	3-place Molex	Under seat

DTC B1004

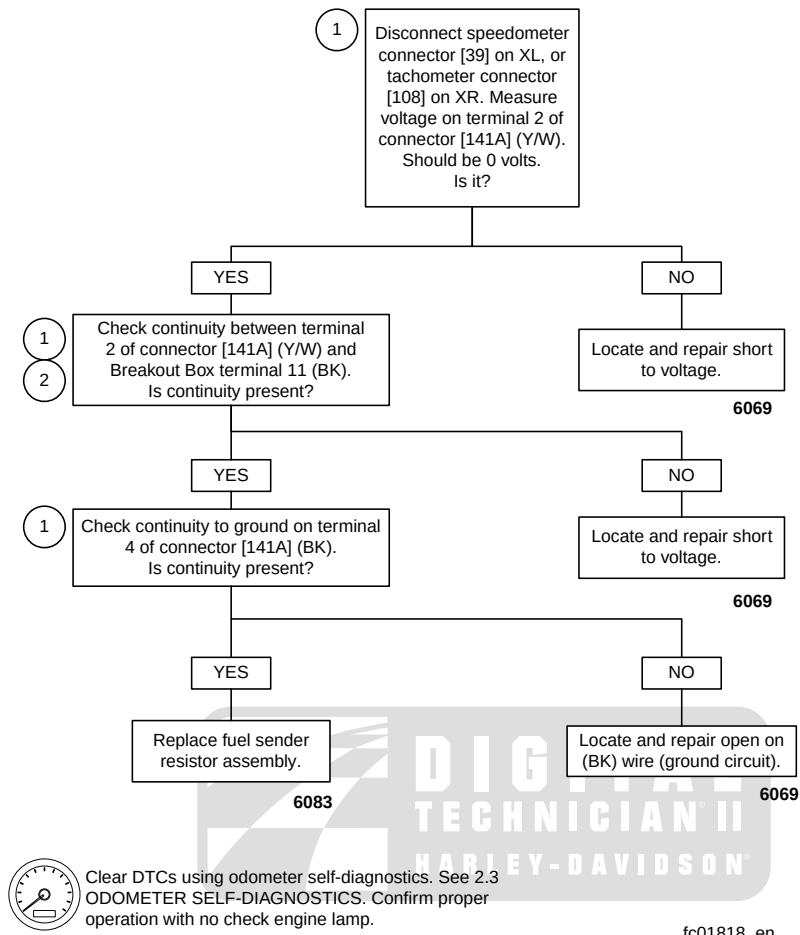


Clear DTCs using odometer self-diagnostics. See 2.3 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

fc01949_en



DTC B1005



DTC B1006, B1007

2.8

GENERAL

Accessory or Ignition Line Overvoltage

Ignition and accessory voltage is constantly monitored by the speedometer (terminal 1 ignition and terminal 6 accessory). If the battery voltage fails to meet normal operating parameters, a DTC is set.

- DTC B1006 is displayed when accessory line voltage is greater than 16.0 volts for longer than 5 seconds.
- DTC B1007 is displayed when ignition line voltage is greater than 16.0 volts for longer than 5 seconds.

NOTE

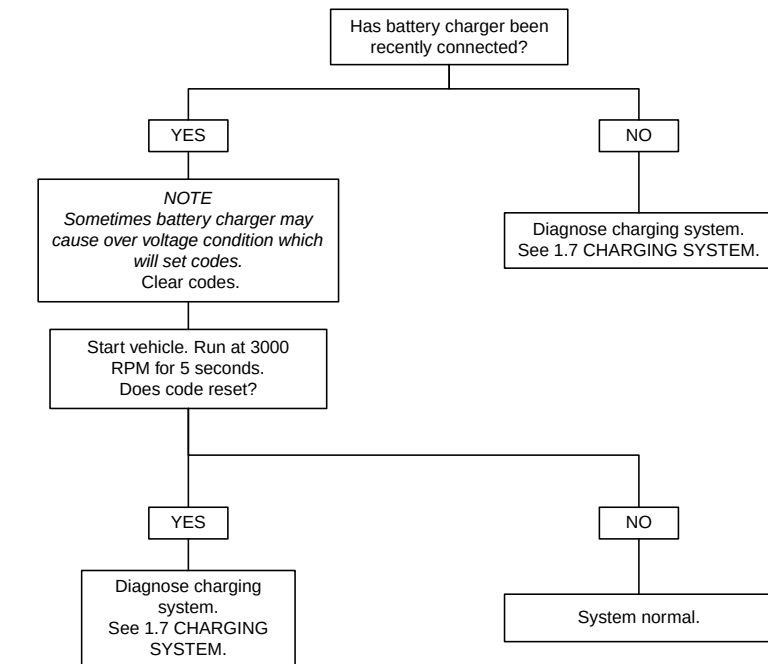
ECM or TSM/TSSM/HFSM may also set a battery voltage DTC.

Table 2-10. Code Description

DTC	DESCRIPTION
B1006	Accessory line overvoltage
B1007	Ignition line overvoltage



DTCs B1006 and B1007



Clear DTCs using odometer self-diagnostics. See 2.3 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

fc01819_en



DTC B1008

GENERAL

Trip Odometer Reset Switch Closed

Diagnostic Trouble Code (DTC) B1008 will be set if trip odometer reset switch terminals are in a constant shorted state.

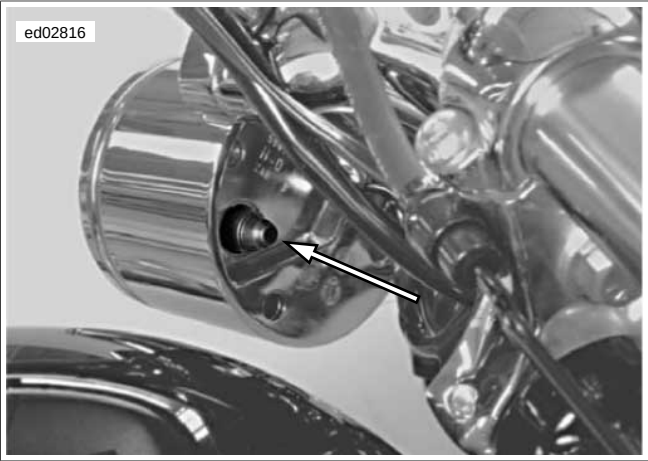


Figure 2-18. Trip Odometer Reset Switch (Typical)

Table 2-11. Code Description

DTC	DESCRIPTION
B1008	Trip odometer reset switch closed

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-42682	BREAKOUT BOX
HD-46601	INSTRUMENT HARNESS ADAPTERS

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

Table 2-12. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[39]	Speedometer (XL)	12-place Packard	Back of speedometer
[108]	Tachometer (XR)	12-place Packard	Back of tachometer

1. Disconnect speedometer connector [39] on XL, or tachometer connector [108] on XR (at the back of the speedometer). See [2.5 BREAKOUT BOX: SPEEDOMETER/TACHOMETER](#).
2. Connect BREAKOUT BOX (Part No. HD-42682) (black) to wire harness connector [39B] on XL, wire harness connector [108B] on XR using INSTRUMENT HARNESS ADAPTERS (Part No. HD-46601), **leaving speedometer XL, or tachometer XR disconnected.**

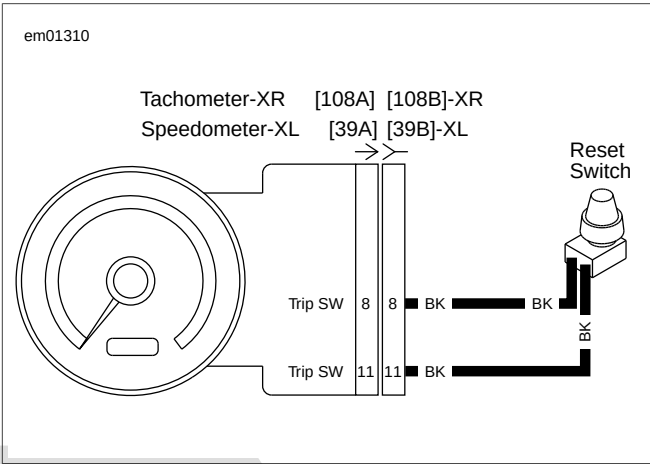
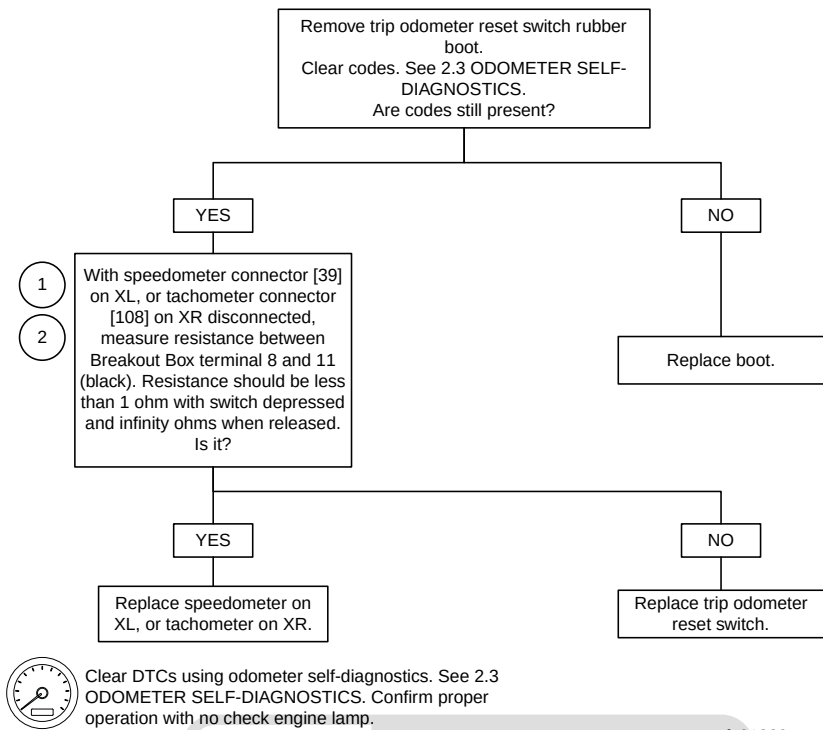


Figure 2-19. Trip Odometer Reset Switch Circuit

DTC B1008



fc01820_en



DTC U1016, U1255

2.10

GENERAL

Loss of ECM Serial Data

The serial data line provides a means for the ECM, TSM/TSSM/HFSM, speedometer on XL and tachometer on XR to communicate their current status. When all operating parameters on the serial data line are within specifications, a state of health message is sent between the components.

- DTC U1016 indicates that the ECM is not capable of sending this state of health message.
- DTC U1255 indicates that no messages were present during power up of the current key cycle.
- DTC U1016 indicates that there was communication on the data bus since power up, but communication was lost or interrupted during that key cycle.

Table 2-13. Code Description

DTC	DESCRIPTION
U1016	Loss of all ECM serial data (state of health)
U1255	Serial data error/missing message

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-42682	BREAKOUT BOX
HD-46601	INSTRUMENT HARNESS ADAPTERS
HD-48637	ECM BREAKOUT BOX

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. Connect BREAKOUT BOX (Part No. HD-42682) (black) between speedometer connector [39A] on XL, or tachometer connector [108A] on XR and wire harness connector [39B] on XL, or wire harness connector [108B] on XR using INSTRUMENT HARNESS ADAPTERS (Part No. HD-46601). See [2.5 BREAKOUT BOX: SPEEDOMETER/TACHOMETER](#).
2. Use ECM BREAKOUT BOX (Part No. HD-48637).



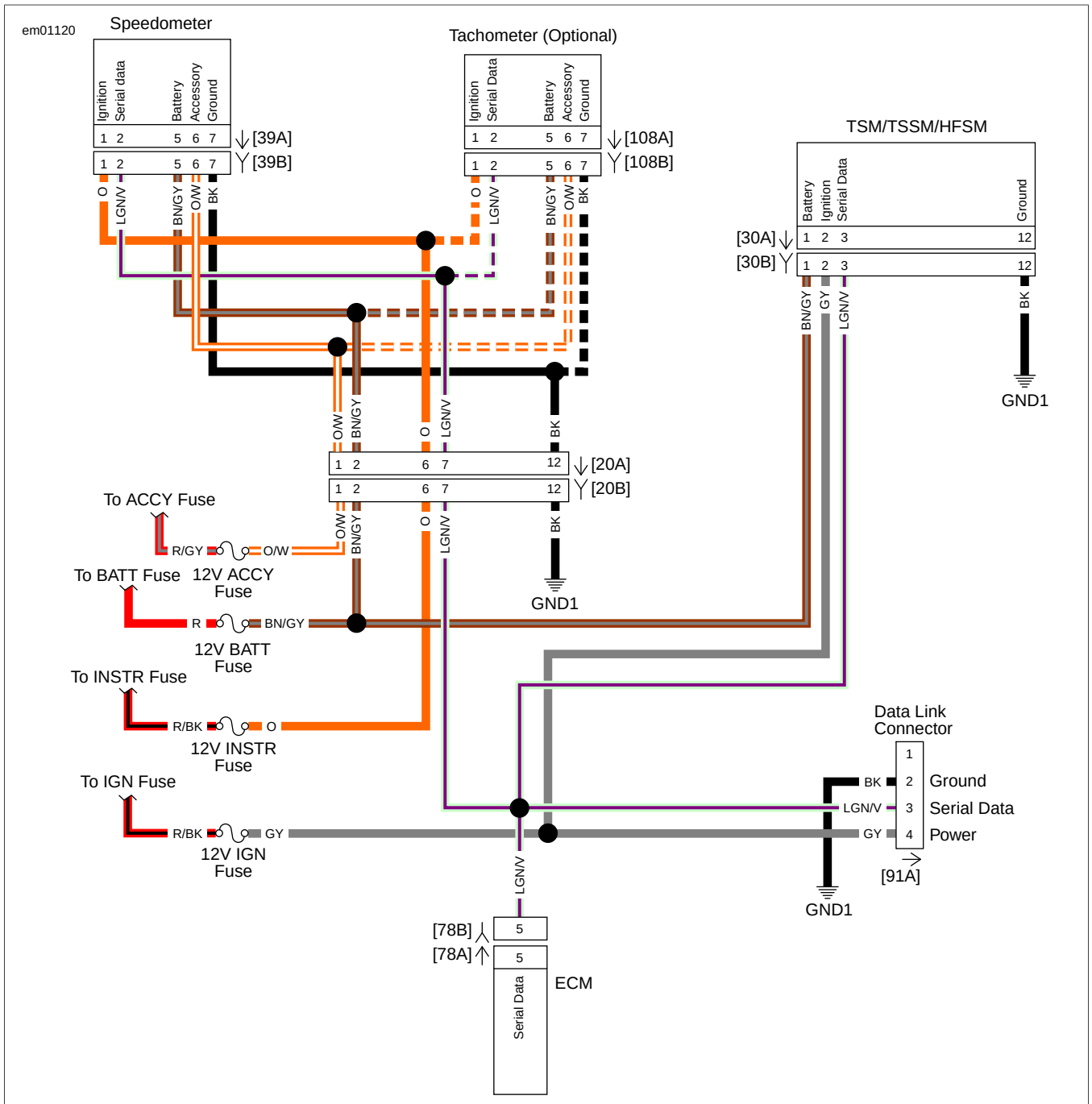


Figure 2-20. Serial Data Circuit (XL)

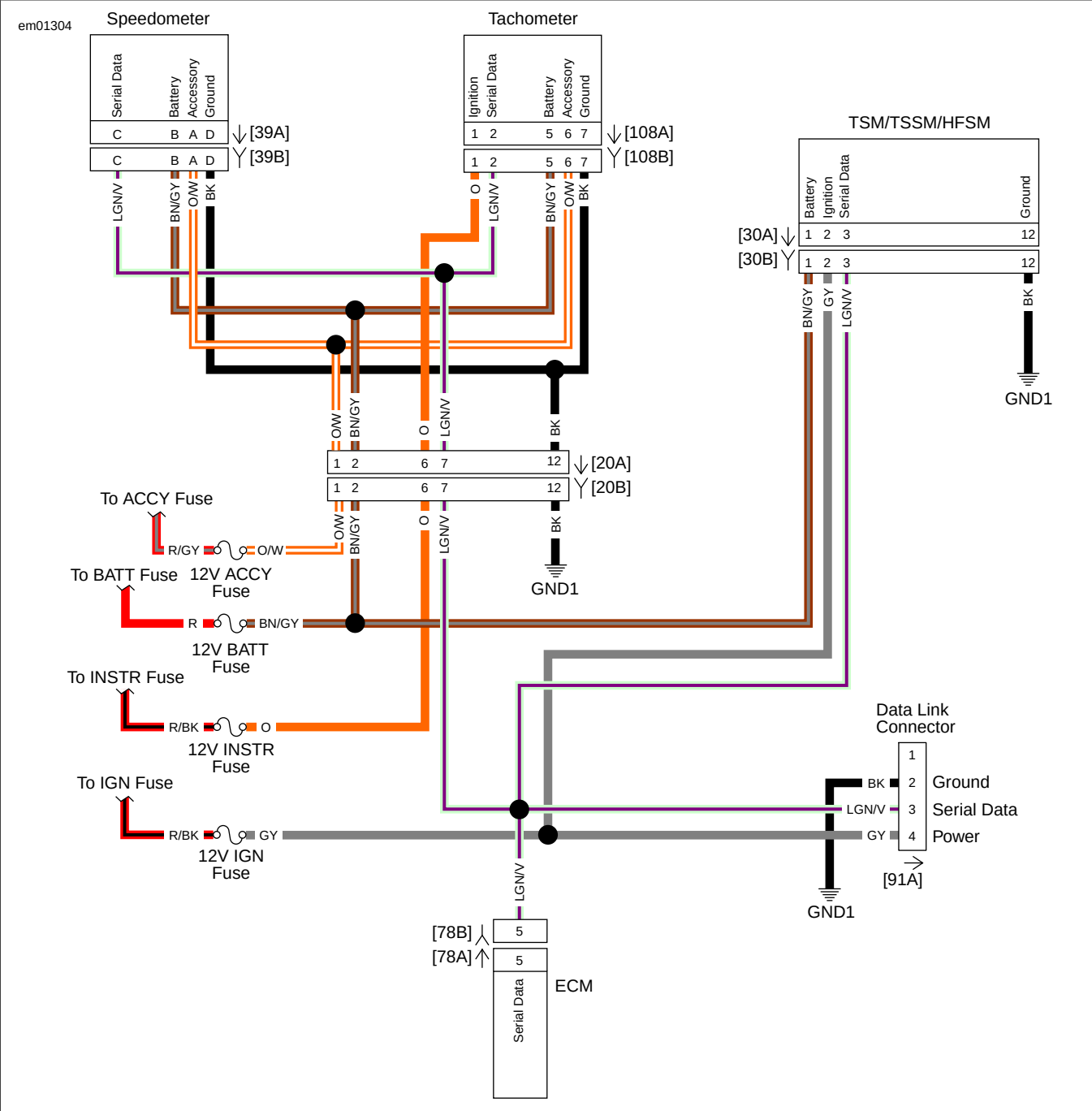


Figure 2-21. Serial Data Circuit (XR)

Table 2-14. Wire Harness Connectors

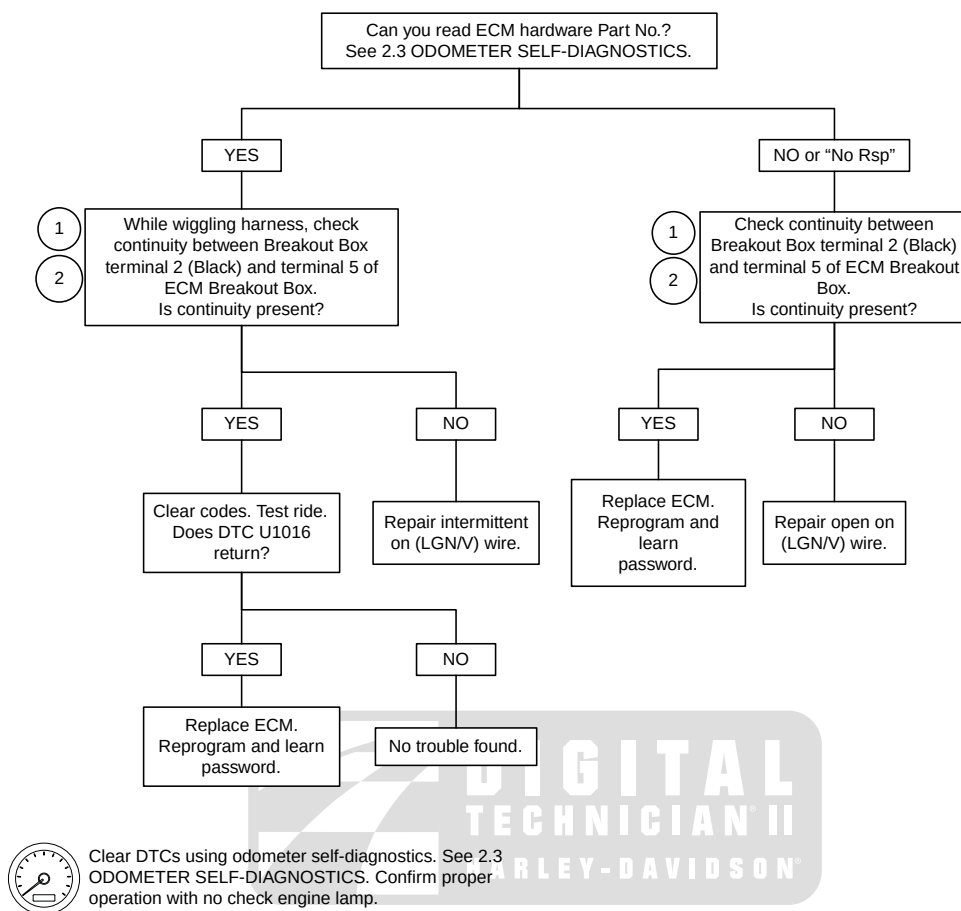
NO.	DESCRIPTION	TYPE	LOCATION
[20]	Instruments	12-place Molex	Under fuel tank
[30]	TSM/TSSM/HFSM	12-place Deutsch	Under battery
[39]	Speedometer (XL)	12-place Packard	Back of speedometer
[39]	Speedometer (XR)	5-place Packard	Back of speedometer
[78]	ECM	36-place Packard	Under seat

Table 2-14. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[91A]	Data link connector	4-place Deutsch	On battery strap, behind left side cover
[108]	Tachometer (if equipped)	12-place Packard	Back of tachometer



DTCs U1016 and U1255



fc01821_en

DTC U1064, U1255

2.11

GENERAL

Loss of TSM/TSSM/HFSM Serial Data

The serial data line provides a means for the ECM, TSM/TSSM/HFSM, speedometer, and tachometer to communicate their current status. When all operating parameters on the serial data line are within specifications, a state of health message is sent between the components.

- DTC U1064 indicates that the TSM/TSSM/HFSM is not receiving this state of health message.
- DTC U1255 indicates that no messages were present during power up of the current key cycle.
- DTC U1064 indicates that there was communication on the data bus since power up, but communication was lost or interrupted during that key cycle.

Table 2-15. Code Description

DTC	DESCRIPTION
U1064	Loss of TSM/TSSM/HFSM serial data
U1255	Serial data error/missing message

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-42682	BREAKOUT BOX
HD-46601	INSTRUMENT HARNESS ADAPTERS

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. Connect BREAKOUT BOX (Part No. HD-42682) as follows:
 - a. Mate black socket housing on Breakout Box with speedometer connector [39A] on XL, or tachometer connector [108A] on XR using INSTRUMENT HARNESS ADAPTERS (Part No. HD-46601).
 - b. Mate black pin housing on Breakout Box with wire harness connector [39B] on XL, or wire harness connector [108B] on XR using INSTRUMENT HARNESS ADAPTERS (Part No. HD-46601).
 - c. Mate gray socket housing on Breakout Box with TSM/TSSM/HFSM connector [30A].
 - d. Mate gray pin housing on Breakout Box with wire harness connector [30B].



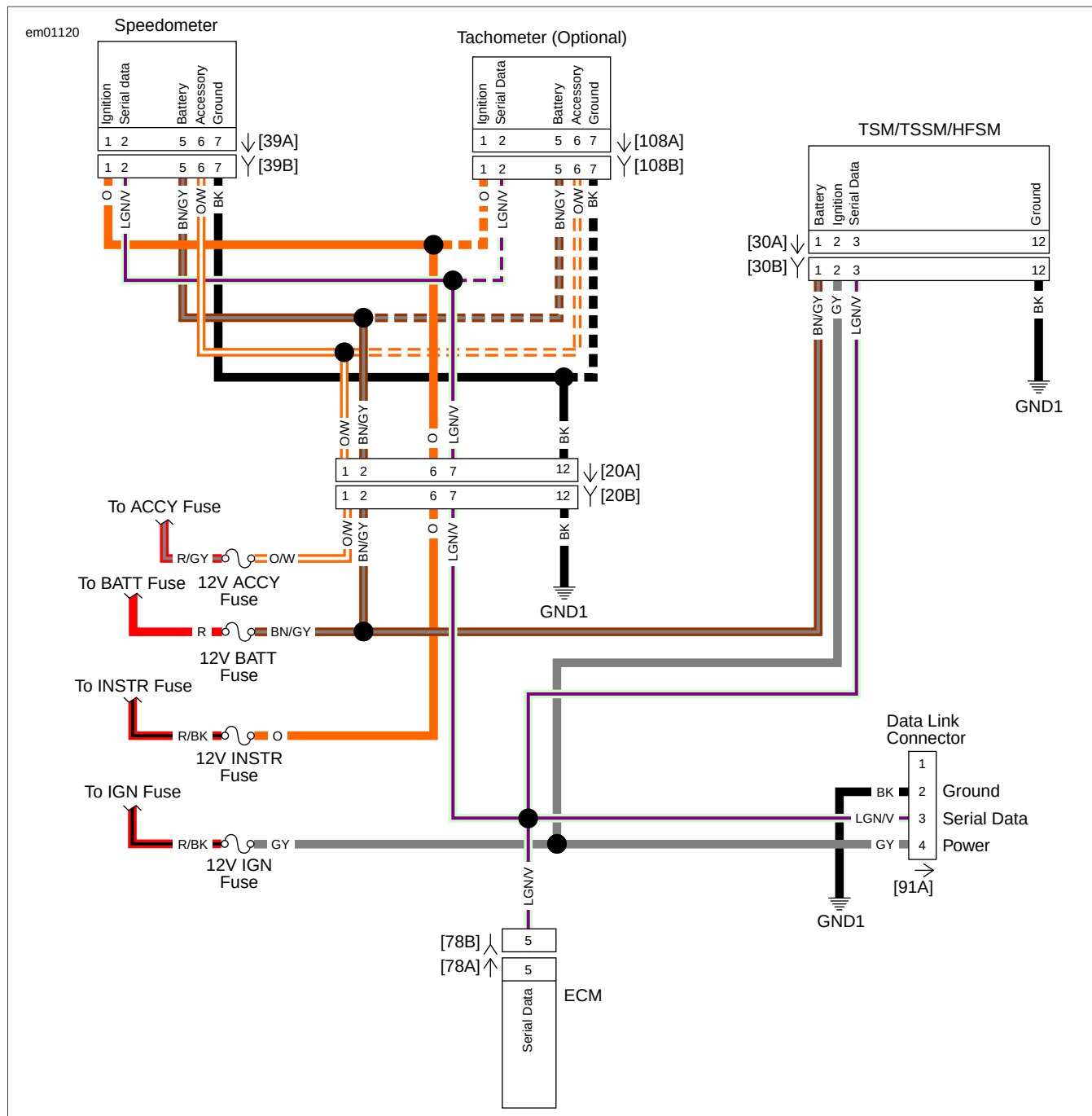


Figure 2-22. Serial Data Circuit (XL)

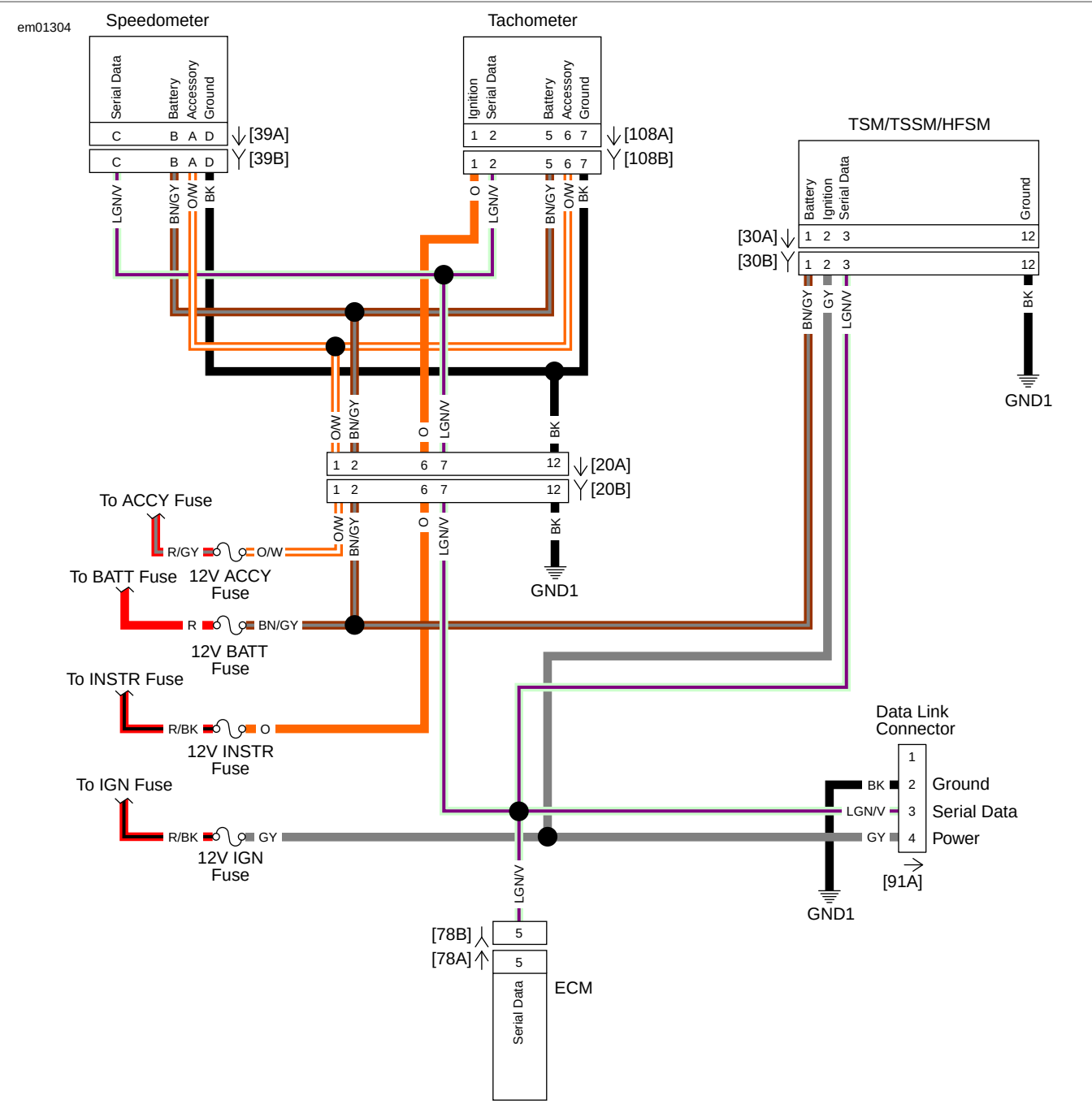


Figure 2-23. Serial Data Circuit (XR)

Table 2-16. Wire Harness Connectors

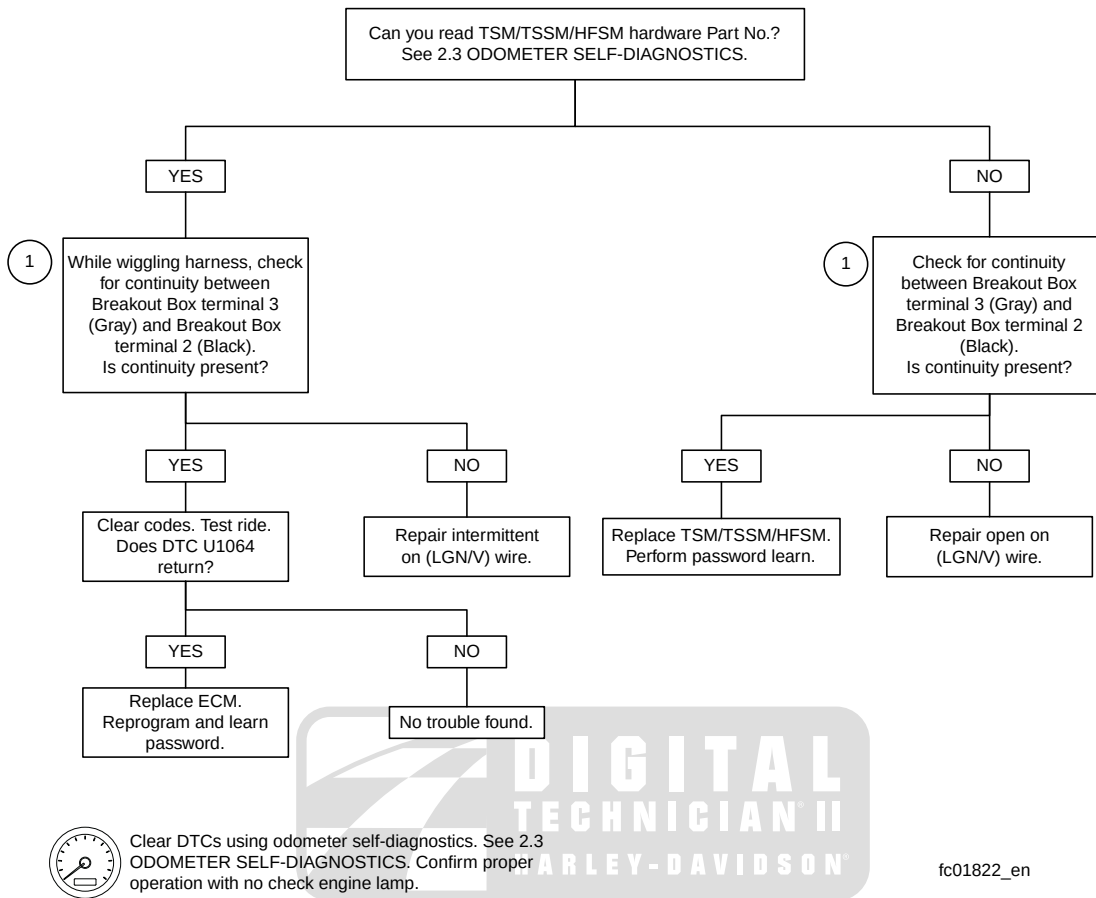
NO.	DESCRIPTION	TYPE	LOCATION
[20]	Instruments	12-place Molex	Under fuel tank
[30]	TSM/TSSM/HFSM	12-place Deutsch	Under battery
[39]	Speedometer (XL)	12-place Packard	Back of speedometer
[39]	Speedometer (XR)	5-place Packard	Back of speedometer
[78]	ECM	36-place Packard	Under seat

Table 2-16. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[91A]	Data link connector	4-place Deutsch	On battery strap, behind left side cover
[108]	Tachometer (if equipped)	12-place Packard	Back of tachometer



DTCs U1064 and U1255



DTC U1300, U1301 OR BUS ER

2.12

GENERAL

Serial Data Low or Serial Data Open/High

The typical serial data voltage range is 0 volts (inactive) to 7 volts (active). Due to the short pulse, voltages will be much lower on a DVOM. In analog mode, a DVOM reading serial data will show continuous voltage when active, typically 0.6-0.8 volts. The range for acceptable operations is 0-7.0 volts.

Table 2-17. Code Description

DTC	DESCRIPTION
U1300	Serial data low
U1301	Serial data open/high



Figure 2-24. Data Link Connector [91A] (Behind Left Side Cover)

DIAGNOSTICS

Diagnostic Tips

- If serial data is shorted, these Diagnostic Trouble Codes (DTCs) will automatically cause the check engine lamp to illuminate. The odometer will read "BUS Er" in this condition.
- DTCs P1009 and P1010 may accompany DTCs U1300 and U1301.

Diagnostic Notes

If a U1300, U1301 or "BUS Er" is present, perform diagnostic procedures listed in [4.11 STARTS, THEN STALLS](#).

TABLE OF CONTENTS

SUBJECT	PAGE NO.
3.1 TURN SIGNAL OVERVIEW.....	3-1
3.2 HARLEY-DAVIDSON SMART SECURITY SYSTEM.....	3-2
3.3 H-DSSS ACTUATION.....	3-5
3.4 PERSONAL IDENTIFICATION NUMBER (PIN).....	3-6
3.5 ARMING/DISARMING SECURITY SYSTEM.....	3-8
3.6 WARNINGS AND ALARMS.....	3-10
3.7 SERVICE/EMERGENCY FUNCTIONS.....	3-11
3.8 TROUBLESHOOTING.....	3-12
3.9 CHECKING FOR DIAGNOSTIC TROUBLE CODES.....	3-13
3.10 INITIAL DIAGNOSTIC CHECK: TSM/HFSM.....	3-16
3.11 ODOMETER SELF-DIAGNOSTICS.....	3-24
3.12 BREAKOUT BOX: TSM/HFSM.....	3-26
3.13 FAILS TO DISARM (HFSM ONLY).....	3-28
3.14 DTC B0563.....	3-31
3.15 TSM/HFSM: TURN SIGNAL ERRORS AND DTCS.....	3-32
3.16 DTC B1131, B1132 (HFSM ONLY).....	3-48
3.17 DTC B1134.....	3-51
3.18 DTCS B1135, B1136, B1141, AND B1142.....	3-54
3.19 DTC B1143, B1144, B1145 (HFSM ONLY).....	3-58
3.20 DTC B1154, B1155.....	3-61
3.21 DTC U1016, U1255.....	3-65
3.22 DTC U1300, U1301 OR BUS ER.....	3-70
3.23 TSM/HFSM: PASSWORD LEARN.....	3-71
3.24 HFSM MAINTENANCE.....	3-72



NOTES



TURN SIGNAL OVERVIEW

3.1

GENERAL

The TSM has two major functions:

- Control turn signals.
- Serve as BAS.

The optional, factory-installed, Harley-Davidson Smart Security System (**H-DSSS**) includes a HFSM, which provides the same functions as the TSM, but also includes security and immobilization functions.

SECURITY SYSTEM: JAPAN/KOREA

The security system on motorcycles sold in Japan and Korea meet the regulatory requirements for those countries. The system incorporates a TSSM. Complete details on operation, troubleshooting, and diagnostics are found in [E.1 TSM/TSSM \(JAPAN/KOREA\) OVERVIEW](#).

TURN SIGNAL FUNCTIONS

- **Manual turn signal control:** Manual activation/deactivation of left and right turn signal flashing sequences.
- **Automatic turn signal cancellation:** Automatic cancellation of left and right turn signal flashing sequences based on either vehicle speed, vehicle acceleration or turn completion.
- **Hazard warning 4-way flashers:** Four-way left and right turn signal flashing capability.
- **Turn signal lamp diagnostics:** Self-diagnostics for short circuit and open lamp conditions on both left and right turn signal systems. See [3.9 CHECKING FOR DIAGNOSTIC TROUBLE CODES](#).

NOTE

The turn signals cannot be activated or deactivated when the ignition switch is in the ACC position. The turn signals can only be activated or deactivated with the ignition switch in the IGNITION position.

MANUAL CANCELLATION

To stop the turn signals from flashing, briefly depress the turn signal switch a second time.

To switch turn direction signals, depress the switch for the opposite turn signal. The first signal is cancelled and the opposite side begins flashing.

AUTOMATIC CANCELLATION

Press the left or right turn switch to activate automatic turn signal cancellation. There is no need to hold the turn switch in when approaching the turn. The TSM/HFSM will not cancel the signal before the turn is actually completed.

- When the directional switch is released, the system starts a 20 count. As long as the vehicle is traveling above 7

MPH (11.3 km/h) the directional will always cancel after 20 flashes if the system does not recognize any other input.

- If the vehicle speed drops to 7 MPH (11.3 km/h) or less, including stopped, the directionals will continue to flash. Counting will resume when vehicle speed reaches 8 MPH (12.9 km/h) and will automatically cancel when the count total equals 20 as stated above.
- The turn signals will cancel within two seconds upon turn completion. A sensor inside the TSM/HFSM cancels the signal after the vehicle has been returned to an upright position.

NOTE

The bank angle cancellation function has an automatic calibration feature. Ride the motorcycle for 0.25 miles (0.4 km) at steady speeds (upright) to calibrate the system. Performance of bank angle function may not be optimal until this calibration is performed. This self-calibration is performed automatically every time the vehicle is started and ridden.

BANK ANGLE FUNCTIONS

- **Emergency engine shutdown:** Will provide engine shutdown when vehicle is tipped over.
- **Emergency outputs disable:** Will disable turn signal lamps and starter motor when vehicle is tipped over.

BANK ANGLE RESTART

The engine will shut off automatically if the vehicle is tipped over. The turn signals, starter motor, ECM, fuel pump and coil will be disabled.

The odometer displays "tIP" when a tip over condition is detected.

To restart the motorcycle after shutdown has occurred:

1. Return the motorcycle to an upright position.
2. Cycle the ignition switch OFF-ON before restarting the motorcycle.

CLUTCH/NEUTRAL INTERLOCK

- **Disables starter:** Disables starter until either the clutch lever is pulled in or transmission neutral is selected.
- **Diagnostics:** Provides diagnostics for clutch and neutral switch faults.

SECURITY SYSTEM H-DSSS

See [3.2 HARLEY-DAVIDSON SMART SECURITY SYSTEM](#).

COMPONENTS

The H-DSSS consists of three components:

- **Hands-Free Security Module:** See [Figure 3-1](#). A electronic module that functions both as the TSM and as the HFSM.
- **Hands-Free Antenna:** See [Figure 3-1](#). Mounted under the seat of the motorcycle.
- **Hands-Free Fob:** See [Figure 3-2](#). A remote control device, intended to be carried by the rider whenever the vehicle is being operated.

NOTE

Do not relocate any of the Security System components.



Figure 3-1. HFSM and Antenna



Figure 3-2. Hands-Free Fob w/Serial Number Label

SECURITY IMMOBILIZATION

The HFSM provides security and immobilization functions not found on the TSM. The HFSM will disable the starter and ignition system. Additional functions include the ability to alternately flash the left and right turn signals and sound a siren (if equipped) if a theft attempt is detected.

NOTE

The siren must be in the Chirp Mode for the siren to chirp on arming or disarming. See [3.6 WARNINGS AND ALARMS, Siren Chirp Mode \(Confirmation\)](#).

Conditions that activate the security system when system is armed include:

- **Detecting tampering of the ignition circuit:** Turn signals flash three times, optional siren chirps once and then turns off. If the tampering continues, a second warning will activate after four seconds. Continued tampering will cause the alarm to activate for 30 seconds and then turn off. The two warnings/alarm cycle is repeated for each tampering incident.
- **Detecting vehicle movement:** Turn signals flash three times, optional siren chirps once and then turns off. If the vehicle is not returned to its original position, a second warning will activate after four seconds. If the vehicle is not returned to its original position, the alarm activates for 30 seconds then turns off. The two warnings/alarm cycle may repeat a maximum of 10 times with a 10 second pause between cycles.
- **Detecting that a battery or ground disconnect has occurred while armed:** Siren, if installed, activates its self-alarm mode. Turn signals will not flash.

See [3.5 ARMING/DISARMING SECURITY SYSTEM](#) for more information.

NOTE

Disconnect the battery to prevent the siren (if installed) from activating within 5 seconds of turning the ignition switch to OFF/FORK LOCK. If the HFSM is armed, you must turn the ignition switch to IGNITION with a fob within range, again turn the ignition switch to OFF/FORK LOCK and remove the MAXIFUSE before the 5-second arming period expires. With the MAXIFUSE removed, the battery can be disconnected.

HFSM FEATURES

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

The following information applies only to motorcycles equipped with the Hands-Free Security System (HFSM).

- **Security lamp:** See [Figure 3-3](#). A lamp (key icon) within the speedometer face on XL, or tachometer face on XR, tells the rider if the system is armed or disarmed.
- **Personal code disarming:** If the fob is not available, the HFSM allows the rider to disable the security alarm and immobilization functions with a five-digit personal code.
- **Arming confirmation:** When the HFSM is armed, the system provides visual feedback (confirmation) to the rider by flashing the turn signals and an audible "chirp" if equipped with the optional smart siren and chirp mode is enabled.
- **Disarming confirmation:** When the HFSM is disarmed, the system provides an audible "chirp" (confirmation) if equipped with the optional smart siren and chirp mode is enabled.
- **Transport mode:** It is possible to arm the security system without enabling the motion detector for one ignition cycle. This allows the vehicle to be moved in an immobilized state.
- **Starter/ignition disable:** When armed the starter and ignition system are disabled.
- **Security system alarm:** See [Figure 3-4](#). The system will alternately flash the left and right turn signals and sound an optional Security Siren if a vehicle security condition is detected while the system is armed.
- **Dealer service mode:** This mode allows the dealer to disable security system via DIGITAL TECHNICIAN II (Part

No. HD-48650). Dealer service mode is exited when module detects an assigned fob in range.

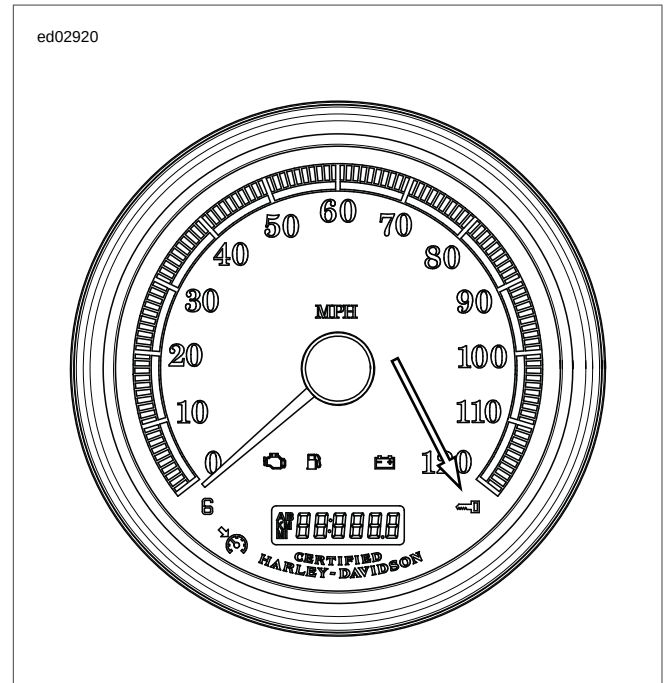


Figure 3-3. Security Lamp (Key Icon) (Typical)



Figure 3-4. Security Siren



H-DSSS ACTUATION

3.3

GENERAL

Setting up a vehicle TSM/HFSM depends on whether the vehicle has a TSM or the optional HFSM security system installed.

SIDECAR CONFIGURATION

WARNING

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

All motorcycles ship with the H-DSSS set for use **without** a sidecar installed. If a motorcycle is equipped with a TSM, no further actuation is required.

ACTUATION

Actuation consists of assigning two fobs to the system, and entering an initial PIN. The PIN can be changed by the rider at any time.

1. Configure HFSM motorcycles by assigning **both** fobs to the vehicle.
2. Configure HFSM motorcycles by entering a PIN picked by the owner. The personal code allows the owner to operate the system if the fob is lost or inoperable. Record the PIN in the Owner's Manual and instruct the customer to carry a copy (use the wallet card found in the Owner's Manual). See [3.4 PERSONAL IDENTIFICATION NUMBER \(PIN\)](#).

Once the system has been activated, it will always "arm" within 5 seconds of turning the ignition switch to **OFF** and no motor-cycle motion.

FOB ASSIGNMENT

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

Use DIGITAL TECHNICIAN II (Part No. HD-48650) to assign both fobs to the H-DSSS. Follow the menu prompts in the DIGITAL TECHNICIAN II (Part No. HD-48650) display and scan the fob serial number with the bar code reader, or key-in the number from the keyboard. See a Harley-Davidson dealer.

NOTE

Each fob has a unique serial number. The label should be removed from the fob and attached to a blank NOTES page in the Owner's Manual for reference.

POWER DISRUPTION AND CONFIGURING

PART NUMBER	TOOL NAME
HD-42682	BREAKOUT BOX

The HFSM will not enter PIN entry mode on the first attempt after battery voltage has been removed from terminal 1. This will occur after any of the following:

- Battery disconnect or power drain.
- Battery fuse removal.
- Connecting BREAKOUT BOX (Part No. HD-42682) to HFSM connector.

Therefore, after all battery reconnects, the configuration sequence must be modified as follows:

1. Set Engine Stop Switch to **OFF**, cycle ignition switch **IGNITION-OFF-IGNITION-OFF-IGNITION** and press left turn signal switch **twice**.
2. Repeat steps listed above.
3. Continue with PIN entry sequence listed.

PERSONAL IDENTIFICATION NUMBER (PIN)

3.4

GENERAL

The PIN consists of five digits. Each digit can be any number from 1-9. There can be no zeros (0) in the PIN. The PIN **must** be used to disarm the security system in case the fob becomes unavailable.

INITIAL PIN ENTRY

To enter a PIN on a motorcycle with no PIN previously installed during HFSM actuation, refer to [Table 3-1](#).

Table 3-1. Entering an Initial PIN: HFSM

STEP	ACTION	CONFIRMATION
1	Select a five-digit (1 through 9) initial PIN and record in the Owner's Manual and on the wallet card.	
2	With an assigned fob present, set engine stop switch to OFF .	
3	Cycle ignition switch IGNITION-OFF-IGNITION-OFF-IGNITION .	
4	Press left turn signal button twice.	Turn signals flash three times.
5	Press right turn signal button once.	Five dashes appear in the odometer window. The first dash flashes.
6	Enter first digit (a) of initial PIN by pressing left turn signal button until desired digit is displayed in odometer.	
7	Press right turn signal button once.	The digit (a) replaces the dash in the odometer. The second dash flashes.
8	Enter second digit (b) of initial PIN by pressing left turn signal button until desired digit is displayed in odometer.	
9	Press right turn signal button once.	The digit (b) replaces the dash in the odometer. The third dash flashes.
10	Enter third digit (c) of initial PIN by pressing left turn signal button until desired digit is displayed in odometer.	
11	Press right turn signal button once.	The digit (c) replaces the dash in the odometer. The fourth dash flashes.
12	Enter fourth digit (d) of initial PIN by pressing left turn signal button until desired digit is displayed in odometer.	
13	Press right turn signal button once.	The digit (d) replaces the dash in the odometer. The fifth dash flashes.
14	Enter fifth digit (e) of initial PIN by pressing left turn signal button until desired digit is displayed in odometer.	
15	Press right turn signal button once.	The digit (e) replaces the dash in the odometer. The first digit flashes.
16	Turn the ignition switch to OFF .	

CHANGING THE PIN

To change a PIN, refer to [Table 3-2](#). The rider can change the PIN at any time.

Modifying an Existing Pin

If a PIN was previously entered, the odometer will display the equivalent digit. Each additional press of the left turn switch will increment the digit.

Examples:

- To advance from 5 to 6, press and release the left turn switch 1 time.
- To advance from 8 to 2, press and release the left turn switch 3 times (9-1-2).

Table 3-2. Changing the PIN: HFSM

STEP	ACTION	CONFIRMATION	NOTES
1	Select a 5-digit (1 thru 9) personal code and record in the Owner's Manual and on the wallet card.		
2	With fobs present, cycle ignition switch IGNITION-OFF-IGNITION-OFF-IGNITION .		
3	Press left turn signal button 2 times.	Turn signals will flash 3 times.	
4	Press right turn signal button 1 time.	Current PIN will appear in odometer. The first digit will flash.	
5	Enter first digit (a) of new PIN by pressing left turn signal button until desired digit is displayed in odometer.		
6	Press right turn signal button 1 time.	The new digit will replace the current in the odometer. The second digit will flash.	
7	Enter second digit (b) of new PIN by pressing left turn signal button until desired digit is displayed in odometer.		
8	Press right turn signal button 1 time.	The new digit will replace the current in the odometer. The third digit will flash.	
9	Enter third digit (c) of new PIN by pressing left turn signal button until desired digit is displayed in odometer.		
10	Press right turn signal button 1 time.	The new digit will replace the dash in the odometer. The fourth digit will flash.	
11	Enter fourth digit (d) of new PIN by pressing left turn signal button until desired digit is displayed in odometer.		
12	Press right turn signal button 1 time.	The new digit will replace the current in the odometer. The fifth digit will flash.	
13	Enter fifth digit (e) of new PIN by pressing left turn signal button until desired digit is displayed in odometer.		
14	Press right turn signal button 1 time.	The new digit will replace the current in the odometer. The first digit will flash.	
15	Turn the ignition switch to OFF .		Turning ignition switch to OFF stores PIN.

ARMING/DISARMING SECURITY SYSTEM

HANDS-FREE FOB

See [Figure 3-6](#). The HFSM's reception range for the Hands-Free Fob signal depends on a specific receiver pattern. The range will be an arm's length.

NOTES

- *Environmental and geographic conditions may affect signal range.*
- *Always have the fob present whenever the motorcycle is operated.*
- *Do not place fob in metal enclosure, and do not place it closer than 3.0 in. (80.0 mm) to the hands-free antenna, cellular phones, PDAs, displays and other electronic devices while operating the motorcycle. That may prevent the fob from disarming the security system.*
- *Fob battery should be replaced every year. See [3.24 HFSM MAINTENANCE](#).*



Figure 3-6. Hands-Free Fob

Table 3-3. Security Lamp Status

LAMP	MODE
Does not flash.	No security system (TSM only), security system not armed.
Flashes every second.	Two minute timeout after failed PIN entry attempt or a battery reconnect has occurred while armed.
Flashes every 2.5 seconds.	Security system armed.
Flashes 4 times a second.	PIN entry mode.
Stays on solid with ignition switch OFF.	Arming is starting up. You have 5 seconds before system is armed.
Stays on solid with ignition switch ON.	If solid for more than 4 seconds after ignition switch is turned to IGNITION, a current DTC is present.

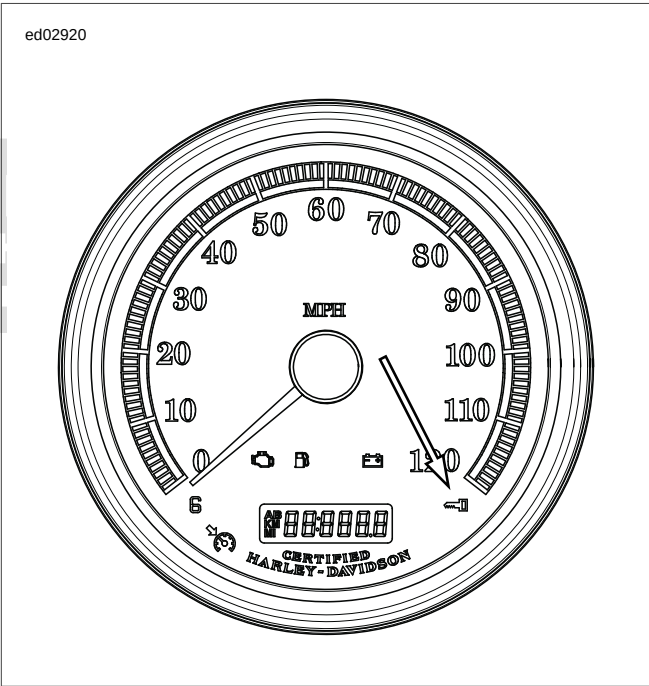


Figure 3-7. Security Lamp (Key Icon) (Typical)

SECURITY LAMP (KEY ICON)

Refer to [Table 3-3](#). See [Figure 3-7](#). The security lamp (key icon) in the speedometer face on XL, and tachometer on XR, provides feedback to the rider confirming armed or disarmed status.

ARMING

The H-DSSS automatically arms within five seconds when the motorcycle is parked and the ignition switch is turned to **OFF** and motion is not detected.

Confirmation: On arming, the turn signals flash twice and the security siren will "chirp" twice if chirp function is activated. While armed, the security lamp (key icon) will flash every 2.5 seconds. Refer to [Table 3-3](#).

DISARMING

There are two ways to disarm the H-DSSS:

- Automatic disarming.
- Disarming with a PIN.

Automatic Disarming

Always have the fob present when riding, loading, fueling, moving, parking or servicing the motorcycle. Carry the fob in a convenient pocket. The H-DSSS disarms automatically when the ignition switch is turned to IGNITION. On disarming, the security siren will chirp once (if chirp function is activated) and

the security lamp (key icon) will turn ON solid for four seconds then go out. Refer to [Table 3-4](#).

Disarming with a Personal Identification Number (PIN)

See [3.4 PERSONAL IDENTIFICATION NUMBER \(PIN\)](#) to enter an initial PIN to actuate the system.

Refer to [Table 3-4](#). If you make an error while disarming the HFSM using the PIN, the alarm will activate for 30 seconds after the last digit is entered. After a failed attempt, the security lamp will flash once every second for 2 minutes. **During this time, the vehicle will not accept any attempt to enter a PIN.**

Table 3-4. Entering the PIN to Disarm HFSM (Example: 3-1-3-1-3)

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set engine stop switch to OFF .		
2	Turn ignition switch to IGNITION .		
3	Hold both turn switches in until confirmation. *	Security lamp blinks at fast rate and "0- - -" is displayed in the odometer. The first digit will flash.	System is ready for PIN entry.
4	Enter first digit of code (3) by pressing left turn switch 3 times.		
5	Press right turn switch 1 time.	The first digit will be displayed and the next dash will flash in the odometer.	Serves as "enter" key.
6	Enter second digit of code (1) by pressing left turn switch 1 time.		
7	Press right turn switch 1 time.	The first two digits will be displayed and the next dash will flash in the odometer.	Serves as "enter" key.
8	Enter third digit of code (3) by pressing left turn switch 3 times.		
9	Press right turn switch 1 time.	The first three digits will be displayed and the next dash will flash in the odometer.	Serves as "enter" key.
10	Enter fourth digit of code (1) by pressing left turn switch 1 time.		
11	Press right turn switch 1 time.	The first four digits will be displayed and the next dash will flash in the odometer.	Serves as "enter" key.
12	Enter fifth digit of code (3) by pressing left turn switch 3 times.		
13	Press right turn switch 1 time.	Security lamp stops blinking and the odometer displays miles.	System is disarmed.

* This must be done within two seconds of turning the ignition switch to IGNITION. If system issues a warning before the security system flashes at a fast rate, then cycle ignition switch OFF until security key icon flashes at 2.5 second rate before re-attempting PIN entry.

WARNINGS AND ALARMS

3.6

WARNINGS

A warning consists of three alternate flashes of the turn signals and chirp from the optional security siren. Warnings are issued from an armed HFSM in the following order:

1. **First Warning:** A warning is issued whenever a person without a fob present attempts to move the motorcycle or turns the ignition switch to **IGNITION**.
2. **Second Warning:** If the motion continues or the ignition switch is not turned back to **OFF**, a second warning is issued within four seconds of the first.
3. **Alarm:** If the motion continues or the ignition switch is not turned to **OFF** past the second warning, the H-DSSS will go into full alarm.

ALARM

Activation

In the full alarm state, the turn signals flash alternately, and if equipped with the security siren, the siren will sound.

After 30 seconds of alarm, if no further motorcycle motion is detected, the alarm will stop.

NOTE

*Motorcycle must be returned to original parked position with ignition switch turned to **OFF**.*

If motorcycle motion continues, the alarm will start again continue for another 30 seconds.

The HFSM will repeat the alarm cycles 10 times for a total of five minutes, with a 10-second pause between alarm cycles.

NOTES

- *During warnings and alarms, the starter motor and the ignition remain disabled.*
- *The alarm will also activate the LED and vibration or audible modes of a Harley-Davidson Security Pager. A pager*

can operate either in silent or in combination with an optional smart siren. The range of the pager can be up to 0.50 mile (0.89 km).

Deactivation

The alarm cycles can be discontinued at any time by moving an assigned fob to the motorcycle. The presence of the fob will terminate the alarm.

SIREN CHIRP MODE (CONFIRMATION)

Chirpless Mode

In the chirpless mode, the siren does not chirp on arming or disarming.

NOTE

Even when armed in the chirpless mode, the siren still chirps warnings on movement and will activate the alarm through cycles.

Chirp Mode

On arming in the chirp mode, the siren responds with two chirps. When disarming, the siren responds with a single chirp.

Switching Modes

Cycling quickly through two armings and disarmings will switch the system from either the chirpless mode or the chirp mode to its opposite.

1. With the fob present, the Ignition Switch to ON and the system disarmed, turn the Ignition Switch OFF.
2. When the system arms (2 flashes of turn signals), immediately turn the Ignition Switch to ON.
3. When the system disarms, then immediately turn the Ignition Switch OFF.
4. When the system arms (2 flashes of turn signals), immediately turn the Ignition Switch to ON and wait for system to disarm.

SERVICE/EMERGENCY FUNCTIONS

3.7

TRANSPORT MODE

It is possible to arm the security system without enabling the motion detector for one ignition cycle. This allows the vehicle to be picked up and moved in an armed state, however, any attempt to start the engine will trigger the alarm.

To Enter Transport Mode

1. Turn the Ignition Switch to IGNITION.
2. Set the Engine Stop Switch to OFF.
3. With an assigned fob within range, turn the Ignition Switch from IGNITION to ACC.
4. Simultaneously press both the left and the right turn signal switches. This must be done within five seconds of turning the Ignition Switch to ACC.
5. After the turn signals flash once, turn the Ignition Switch to OFF and the module is armed.
6. Confirmation: Turn signal blinks three times when armed for one ignition cycle.

To Exit Transport Mode

Return the system to normal operation:

With the fob present, turn the Ignition Switch to IGNITION to disarm the HFSM. To cancel the transport mode, set the Engine Stop Switch to RUN.

SERVICE MODE

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

With a fob present, the HFSM can be configured for service by disabling the security system with DIGITAL TECHNICIAN II (Part No. HD-48650).

Once disabled, the motorcycle can be operated without an assigned fob present. To maintain the Service Mode, the assigned fobs must be kept out of range. If the fob appears in range, the Service Mode will be exited.

FOUR-WAY FLASHING

If it is necessary to leave a motorcycle parked along side the road, the hazard warning four-way flashers can be turned ON with the H-DSSS armed.

To Arm the HFSM with the Hazard Warning Flashers ON

1. Turn the ignition switch to IGNITION.
2. Simultaneously press both left and right turn signal switches to turn the four-way flashers ON. The four-way flashers will continue for two hours.
3. Turn the ignition switch to OFF to arm the H-DSSS

To Disarm the HFSM and Turn the Hazard Warning Flashers OFF

1. With a fob present, turn the ignition switch to IGNITION.
2. Simultaneously press the left and right turn signal switches.

TROUBLESHOOTING

3.8

TURN SIGNALS (TSM/HFSM)

Verify the operation of the turn signals and the integrity of the fuse protecting the turn signals before further troubleshooting.

SECURITY SYSTEM (HFSM)

If the fob is present, and the security system is issuing "warnings" or "Alarm" when the motorcycle is moved, the reason may be one of the following:

1. Strong electromagnetic interference in the area you have parked.
 - a. Verify you have not placed your fob in a metal enclosure or within 3.0 in. (80.0 mm) of other electronic devices.
 - b. Place fob on the vehicle seat and turn the Ignition Switch to IGNITION. After the system disarms, the fob can be placed back in its carrying location.
 - c. Move the motorcycle approximately 15 feet (4.57 m) away from the current parking spot.
2. The fob battery is dead. Use PIN to disarm the vehicle. Replace fob battery.
3. Fob is damaged. Use PIN to disarm the vehicle. Replace the fob.

NOTES

- *If your Security Icon is staying solid ON while you are riding the vehicle, take your vehicle to your dealer as soon as practical.*
- *Always lock the fork and take the ignition key with you for added protection.*

DIAGNOSTICS MODE

The TSM/HFSM measures the current when the turn signals are used. If there is a burned out light bulb on one side, the remaining light and the corresponding turn signal indicator flash at double the normal rate starting with the fifth flash.

Other diagnostic conditions monitored include:

- Short circuit in the turn signal wiring.
- Open circuit in the turn signal wiring.
- Stuck turn signal switch.

NOTES

- *A stuck turn signal switch will disable the automatic turn signal cancellation feature.*
- *If a stuck switch is detected, you must hold the left and right turn signal switches in for more than one second to activate the four-way flashers.*

See [3.9 CHECKING FOR DIAGNOSTIC TROUBLE CODES](#) for more information.

TROUBLESHOOTING

To resolve TSM/HFSM faults, follow three basic steps:

1. Retrieve DTCs using odometer self-diagnostics. See [3.11 ODOMETER SELF-DIAGNOSTICS](#).
2. Diagnose system problems. This involves using special tools and the diagnostic flowcharts in this section.
3. Correct problems through the replacement and/or repair of the affected components.

After repairs are performed, the work must be validated. This involves clearing the DTCs and confirming proper vehicle operation as indicated by the behavior of the turn signals.

CHECKING FOR DIAGNOSTIC TROUBLE CODES

3.9

GENERAL

Problems fall into at least one of five categories:

- Turn signal malfunction.
- Bank angle (engine disable).
- Clutch/neutral interlock (starter enable).
- Security lamp problem.
- Security system malfunction.

SECURITY/LAMP DIAGNOSTICS

To diagnose system problems, start by observing the behavior of the security lamp.

NOTES

- See [Figure 3-8](#). "Key ON" means that the Ignition Switch is turned to IGNITION and the Engine Stop Switch is set to RUN (although the engine is **not** running).
- See [Figure 3-9](#). When the Ignition Switch is turned to ON, the security lamp will illuminate for approximately four seconds and then turn off.
- If the security lamp is not illuminated at Key ON or if it fails to turn OFF after the initial four-second period, the speedometer on XL, or the tachometer on XR, may need to be replaced. See [3.11 ODOMETER SELF-DIAGNOSTICS](#). If "BUS Er" is displayed on the odometer, it may take up to twenty seconds for the security lamp to illuminate.
- The security lamp will also light for eight seconds after the bulb check if historic Diagnostic Trouble Codes (DTCs) are present. The security lamp will stay on if current DTCs are set. If a historic DTC is present, the security lamp will light for 2 ignition cycles or until the DTC is cleared manually.

See [Figure 3-10](#). After the lamp turns off after being illuminated for the first four-second period, one of three events may occur:

- The lamp remains off. This indicates there are no current fault conditions or stored historic DTCs currently detected by the HFSM (A).
- The lamp stays off for only four seconds and then comes back on for an eight-second period. This indicates a historic DTC is stored, but no current DTC exists (B).
- The lamp remains on beyond the eight-second period. This indicates a current DTC exists (C).

NOTE

See [3.9 CHECKING FOR DIAGNOSTIC TROUBLE CODES, Code Types](#) for a complete description of DTC formats.

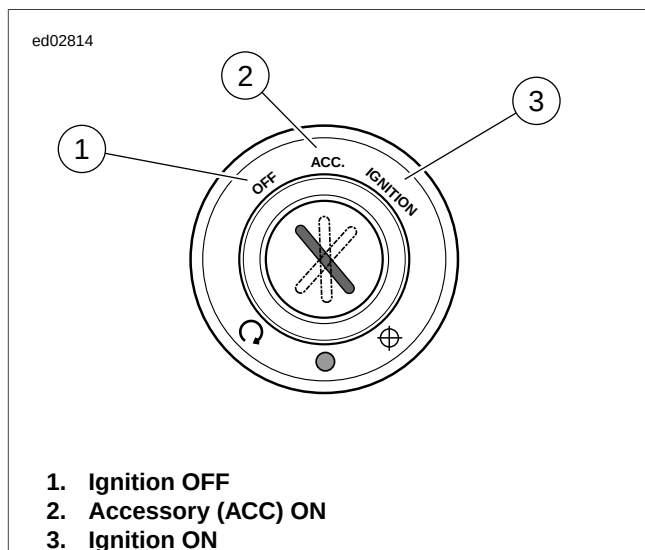


Figure 3-8. Ignition Switch

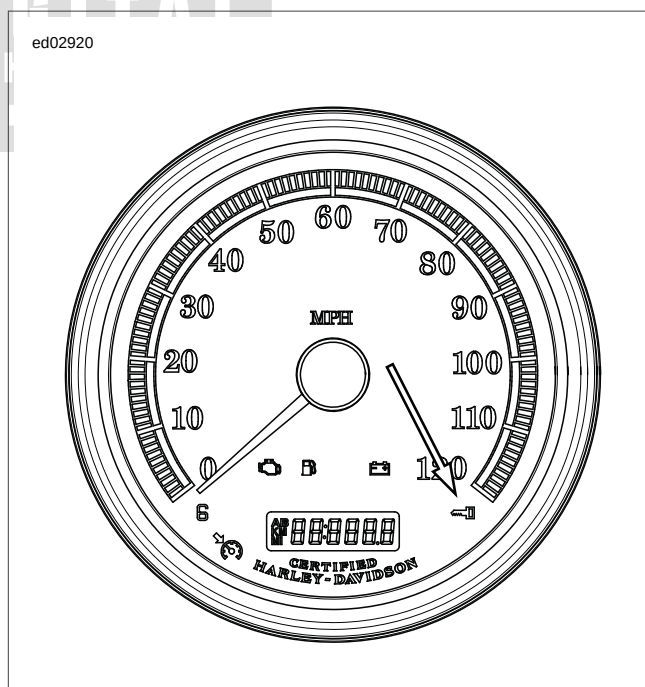


Figure 3-9. Security Lamp (Key Icon) (Typical)

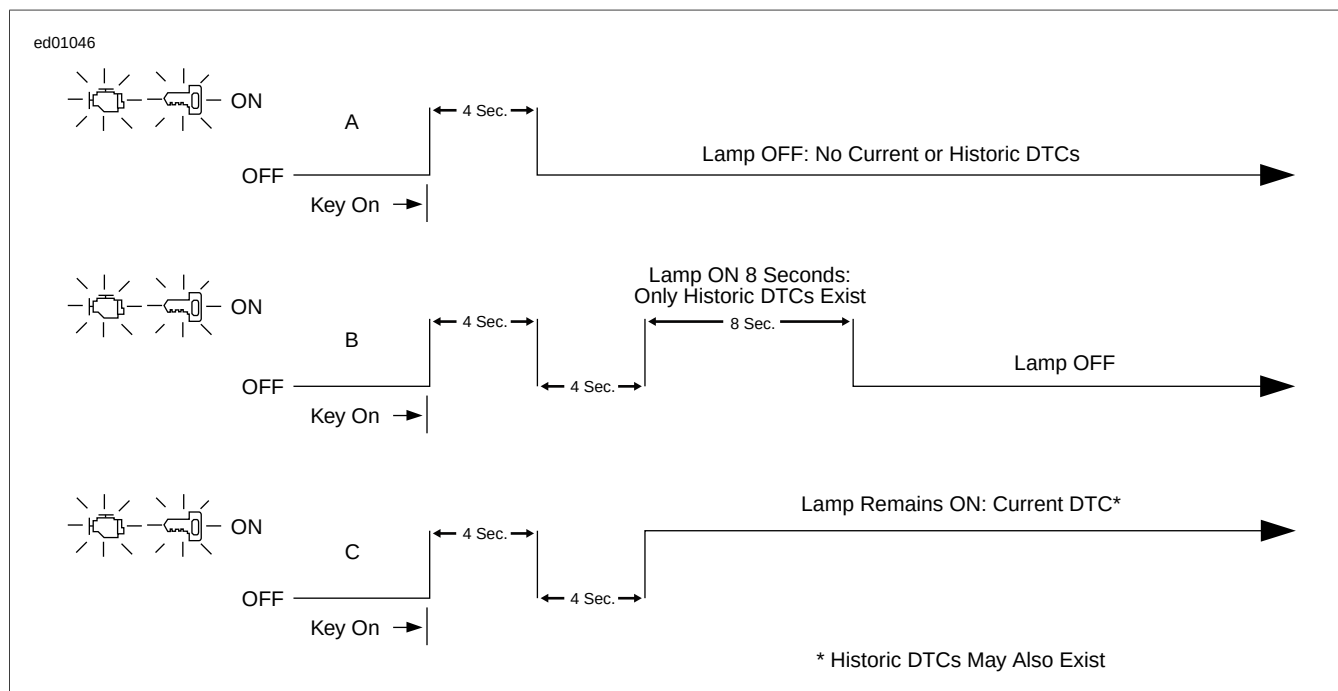


Figure 3-10. Security Lamp Operation

CODE TYPES

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

There are two types of DTCs:

- **Current**
- **Historic**

If a DTC is stored, it can be read using either a computer-based diagnostic package called DIGITAL TECHNICIAN II (Part No. HD-48650) or odometer self-diagnostics. See [3.11 ODOMETER SELF-DIAGNOSTICS](#).

NOTES

- Odometer self-diagnostics will display both current and historic DTCs. To differentiate between current and historic DTCs, the DIGITAL TECHNICIAN II (Part No. HD-48650) must be employed.
- All DTCs reside in the memory of the ECM, TSM/HFSM, speedometer or tachometer until the DTC is cleared by use of the odometer self-diagnostics. See [3.11 ODOMETER SELF-DIAGNOSTICS](#).
- An historic DTC is also cleared after a total of 50 ignition cycles has elapsed. After the 50 ignition cycle retention period, the DTC is automatically erased from memory providing that no subsequent faults of the same type are detected in that period.

Current

Current DTCs are those which are present during the current ignition cycle. See the appropriate flowcharts for solutions.

Historic

If a particular problem happens to resolve itself, the active status problem is dropped and it becomes a historic DTC rather than a current DTC. For example, intermittent output shorts can become typical historic DTCs.

Historic DTCs are stored for 50 ignition cycles after any DTC was last set as current to assist in the diagnosis of intermittent faults. On the 50th cycle, the DTC will clear itself. The security lamp will only indicate the existence of historic DTCs for two ignition cycles.

It is important to note that historic DTCs will exist whenever the system indicates the existence of a current fault. See [3.9 CHECKING FOR DIAGNOSTIC TROUBLE CODES, Multiple DTCs/Priority Order](#) if multiple DTCs are found.

Diagnostic charts are designed for use with current DTCs and as a result they frequently suggest part replacement. When diagnosing a historic DTC the charts can be helpful but should not lead to part replacement without verification the part is faulty.

RETRIEVING DTCS

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

The TSM/HFSM supports two levels of diagnostics.

- The most sophisticated mode employs a computer-based diagnostic package called DIGITAL TECHNICIAN II (Part No. HD-48650).
- The second mode requires using the odometer self diagnostics. Speedometer, tachometer (if equipped), TSM/HFSM and ECM DTCs can be accessed and cleared. See [3.11 ODOMETER SELF-DIAGNOSTICS](#).

MULTIPLE DTCS/PRIORITY ORDER

While it is possible for more than one fault to occur and set more than one DTC, there are several conditions which may result in **one** fault setting **multiple** DTCs:

Serial data DTCs (U1016, U1255, U1300 and U1301) may be accompanied by other DTCs. **Always** correct the serial data DTCs before resolving the other DTCs.

Refer to [Table 3-5](#). This table lists the DTCs in priority order. Correct DTCs in priority order.

Table 3-5. TSM/HFSM DTCs and Fault Conditions

PRIORITY	DTC	FAULT CONDITION	DIAGNOSTICS
1	U1300	J1850 Short-to-ground	3.22 DTC U1300, U1301 OR BUS ER.
2	U1301	J1850 Short-to-battery	3.22 DTC U1300, U1301 OR BUS ER.
3	U1016	Loss of serial communications - ECM	3.21 DTC U1016, U1255
4	U1255	Loss of serial communications - General	3.21 DTC U1016, U1255
5	B1142	HFSM2 Internal fault	3.18 DTCS B1135, B1136, B1141, AND B1142.
6	B1135	Accelerometer periodic test fault	3.18 DTCS B1135, B1136, B1141, AND B1142.
7	B1136 (HFSM)	Accelerometer tip-over self-test fault	3.18 DTCS B1135, B1136, B1141, AND B1142.
8	B1154	Clutch switch input short-to-ground	3.20 DTC B1154, B1155.
9	B1155	Neutral switch input short-to-battery	3.20 DTC B1154, B1155.
10	B1134	Start relay output short-to-battery	3.17 DTC B1134.
11	B1121 (TSM)	Left turn lamp output open circuit	3.15 TSM/HFSM: TURN SIGNAL ERRORS AND DTCS.
	B1121 (HFSM)	Left turn lamp output open circuit	3.15 TSM/HFSM: TURN SIGNAL ERRORS AND DTCS.
12	B1122 (TSM)	Right turn lamp output open circuit	3.15 TSM/HFSM: TURN SIGNAL ERRORS AND DTCS.
	B1122 (HFSM)	Right turn lamp output open circuit	3.15 TSM/HFSM: TURN SIGNAL ERRORS AND DTCS.
13	B1123 (HFSM)	Left turn lamp output short-to-ground	3.15 TSM/HFSM: TURN SIGNAL ERRORS AND DTCS.
14	B1124 (HFSM)	Right turn lamp output short-to-ground	3.15 TSM/HFSM: TURN SIGNAL ERRORS AND DTCS.
15	B1125 (HFSM)	Left turn lamp output short-to-battery	3.15 TSM/HFSM: TURN SIGNAL ERRORS AND DTCS.
16	B1126 (HFSM)	Right turn lamp output short-to-battery	3.15 TSM/HFSM: TURN SIGNAL ERRORS AND DTCS.
17	B1143 (HFSM)	Security antenna short-to-ground	3.19 DTC B1143, B1144, B1145 (HFSM ONLY).
18	B1144 (HFSM)	Security antenna short-to-battery	3.19 DTC B1143, B1144, B1145 (HFSM ONLY).
19	B1145 (HFSM)	Security antenna open	3.19 DTC B1143, B1144, B1145 (HFSM ONLY).
20	B0563	Battery voltage high	3.14 DTC B0563.
21	B1131 (HFSM)	Alarm output short-to-ground	3.16 DTC B1131, B1132 (HFSM ONLY).
22	B1132 (HFSM)	Alarm output short-to-battery	3.16 DTC B1131, B1132 (HFSM ONLY).
23	B1141 (TSM)	Ignition switch open/low	3.15 TSM/HFSM: TURN SIGNAL ERRORS AND DTCS.
24	B1141 (HFSM)	Ignition switch open/low	3.18 DTCS B1135, B1136, B1141, AND B1142.

INITIAL DIAGNOSTIC CHECK: TSM/HFSM

3.10

GENERAL

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

To locate faulty circuits or other system problems, follow the diagnostic flowcharts. For a systematic approach, always begin with INITIAL DIAGNOSTICS. Read the general information and then work your way through the flowchart box by box.

Diagnostic Notes

If a numbered circle appears adjacent to a flowchart 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.

Circuit Diagram/Wire Harness Connector Table

When working through a flowchart, 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 [3.12 BREAKOUT BOX: TSM/HFSM](#).

To perform the circuit checks with any degree of efficiency, a familiarity with the various wire connectors is also necessary.

Job/Time Codes

Some charts may contain warranty job/time codes. Dealership technicians filing warranty claims should use the job/time code values printed in **bold text** underneath the appropriate repair.

Reprogramming ECM

Diagnostic charts frequently suggest ECM replacement. In the event an ECM needs to be replaced, it must be reprogrammed

using a computer-based diagnostic package called DIGITAL TECHNICIAN II (Part No. HD-48650). See your dealer. Password learn procedure must also be performed. See [3.23 TSM/HFSM: PASSWORD LEARN](#).

INITIAL DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-42682	BREAKOUT BOX
HD-46601	INSTRUMENT HARNESS ADAPTERS

Diagnostic Tips

- If odometer reads "BUS Er" with the Ignition Switch turned to IGNITION (Engine Stop Switch at RUN with the engine off), check data bus for an open or short to ground between data link connector [91A] terminal 3 and ECM connector [78B] terminal 5, HFSM connector [30B] terminal 3, speedometer connector [39B] terminal 2 on XL, or tachometer (if equipped) connector [108B] terminal 2.
- Check for an open diagnostic test terminal between data link connector [91A] terminal 3 and TSM/HFSM connector [30B] terminal 3. With Ignition Switch turned ON, serial data bus voltage should be typically 0.6-0.8 volts. The range of acceptable voltage is 0-7.0 volts.
- To identify intermittents, wiggle wire harness while performing steps in the diagnostic check charts.

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

- Connect BREAKOUT BOX (Part No. HD-42682) between wire harness connector [39B] on XL, and connector [108B] on XR and speedometer connector [39A] on XL, or tachometer connector [108B] on XR using INSTRUMENT HARNESS ADAPTERS (Part No. HD-46601). See [2.5 BREAKOUT BOX: SPEEDOMETER/TACHOMETER](#).
- Compare TSM/HFSM system behavior to symptoms in [Table 3-6](#).

Table 3-6. Symptoms That May Not Set Diagnostic Trouble Codes

SYMPTOM	SOLUTION
HFSM: Fails to disarm	HFSM Fails to Disarm.
TSM/HFSM: Turn signal will not cancel	Will Not Cancel Upon Turn Completion.
TSM/HFSM: Turn signal cancels erratically	Cancels Erratically.
TSM/HFSM: Turn signal flashes double normal rate, all bulbs good	Flash at Double Normal Rate, All Bulbs Work.
TSM: Turn signals will not flash	DTCs B1121, B1122, and B1141, Will Not Flash, 4-Way Flashers Inoperable (Part 1 of 4)
HFSM: Symptom - Will not flash. No codes or DTC B1141	DTC B1141, Will Not Flash, No Codes

Other DTCs

See [2.5 BREAKOUT BOX: SPEEDOMETER/TACHOMETER](#)

for any DTCs related to the speedometer.

See [4.5 INITIAL DIAGNOSTIC CHECK: EFI](#) for any DTCs related to the ECM.

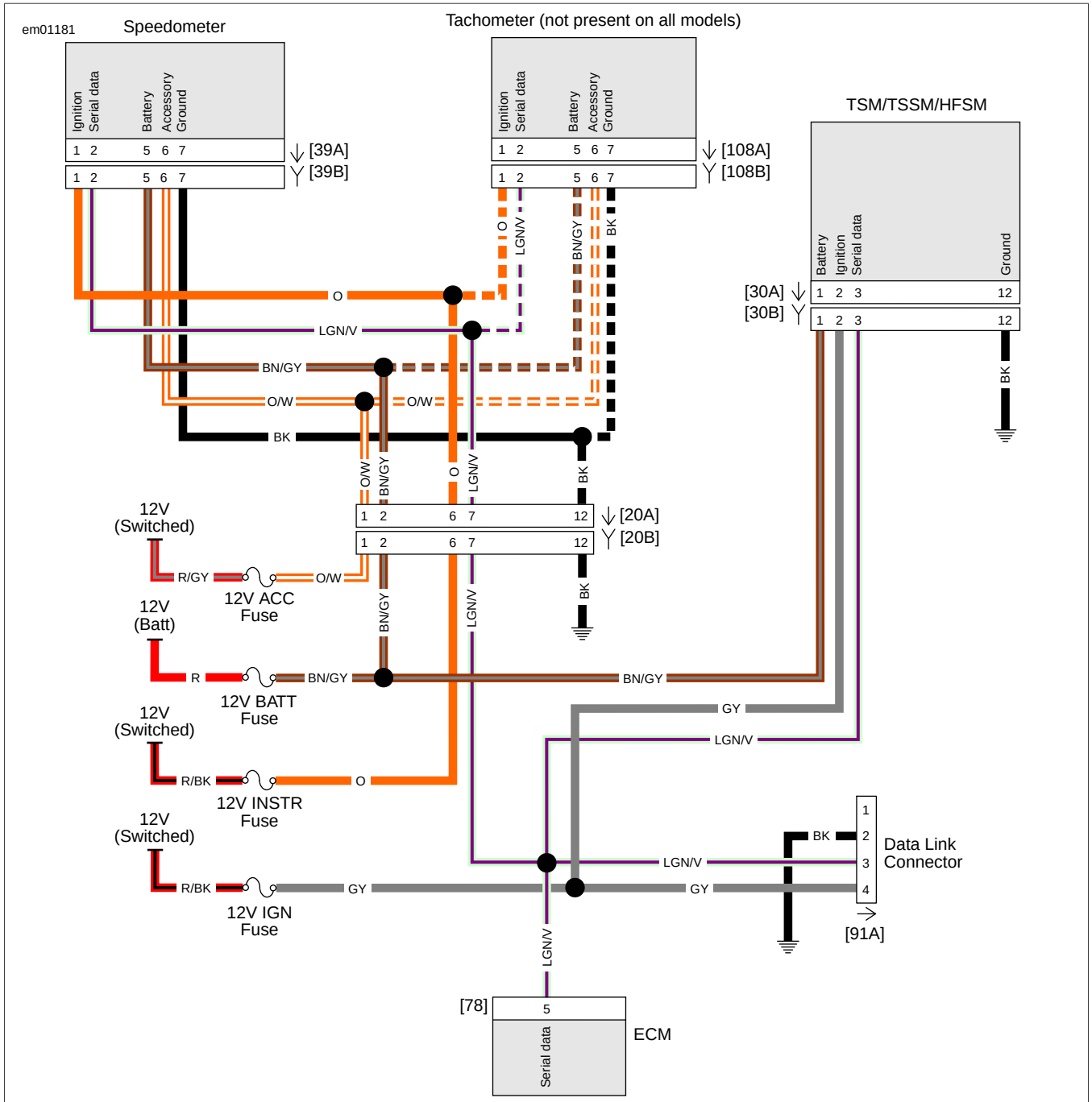


Figure 3-11. Initial Diagnostic Check (XL)

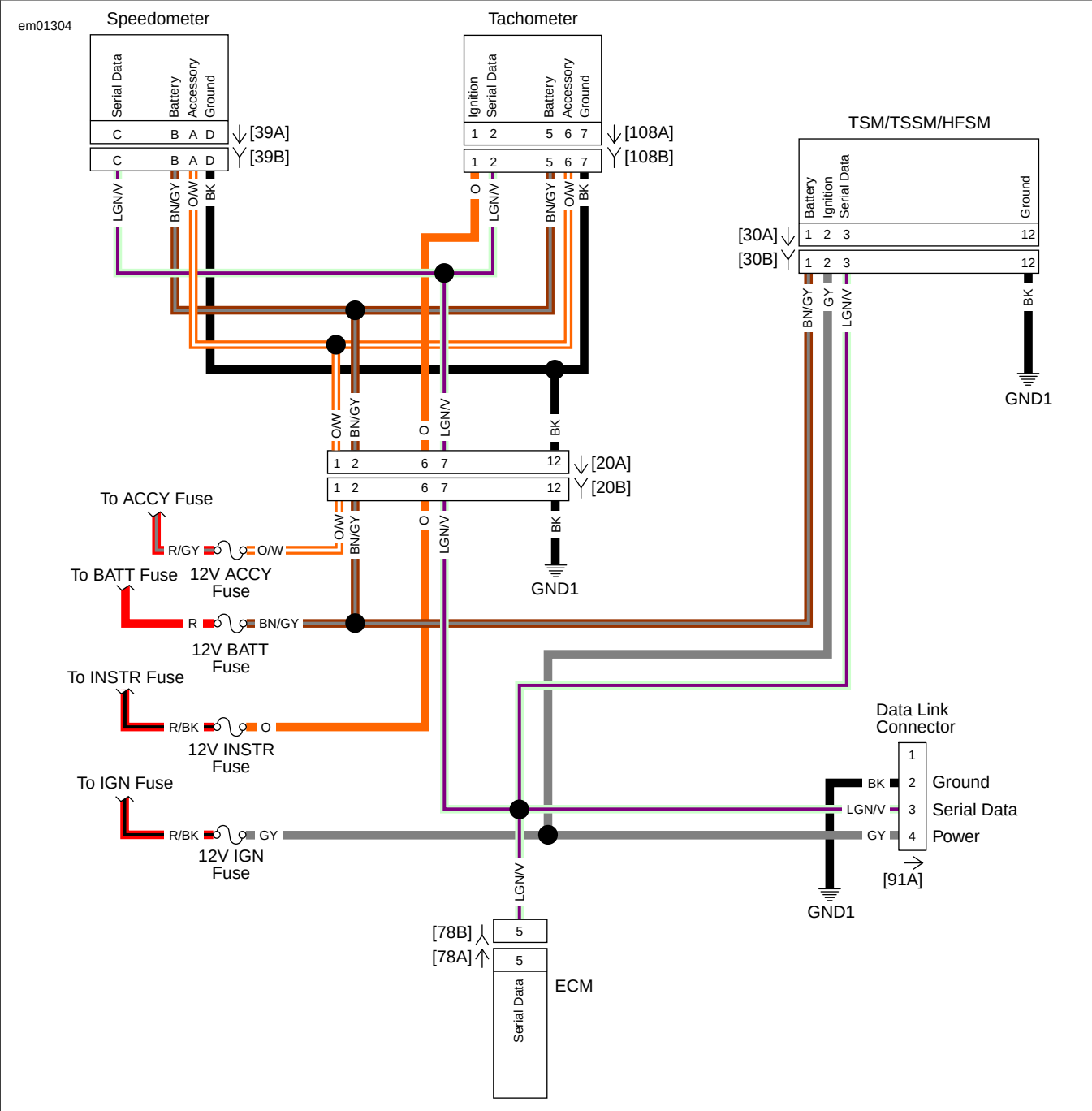


Figure 3-12. Initial Diagnostic Check (XR)

Table 3-7. Wire Harness Connectors

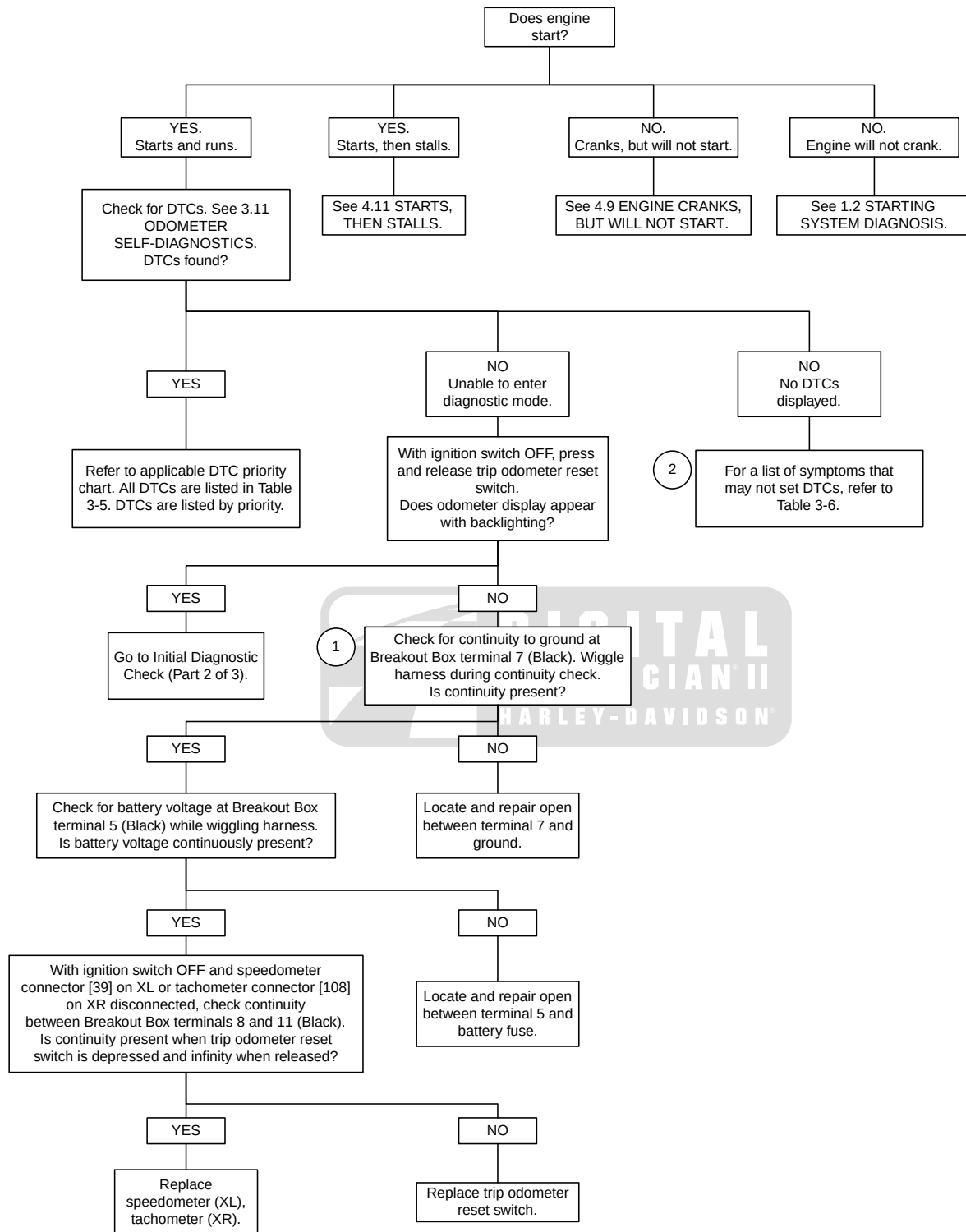
NO.	DESCRIPTION	TYPE	LOCATION
[20]	Instruments	12-place Molex	Under console
[30]	TSM/HFSM	12-place Deutsch	Under battery
[39]	Speedometer (XL)	12-place Packard	Back of speedometer
[39]	Speedometer (XR)	5-place Packard	Back of speedometer
[78]	ECM	36-place Packard	Under seat

Table 3-7. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[91]	Data link connector	4-place Deutsch	On battery strap, behind left side cover
[108]	Tachometer (if equipped)	12-place Packard	Back of tachometer

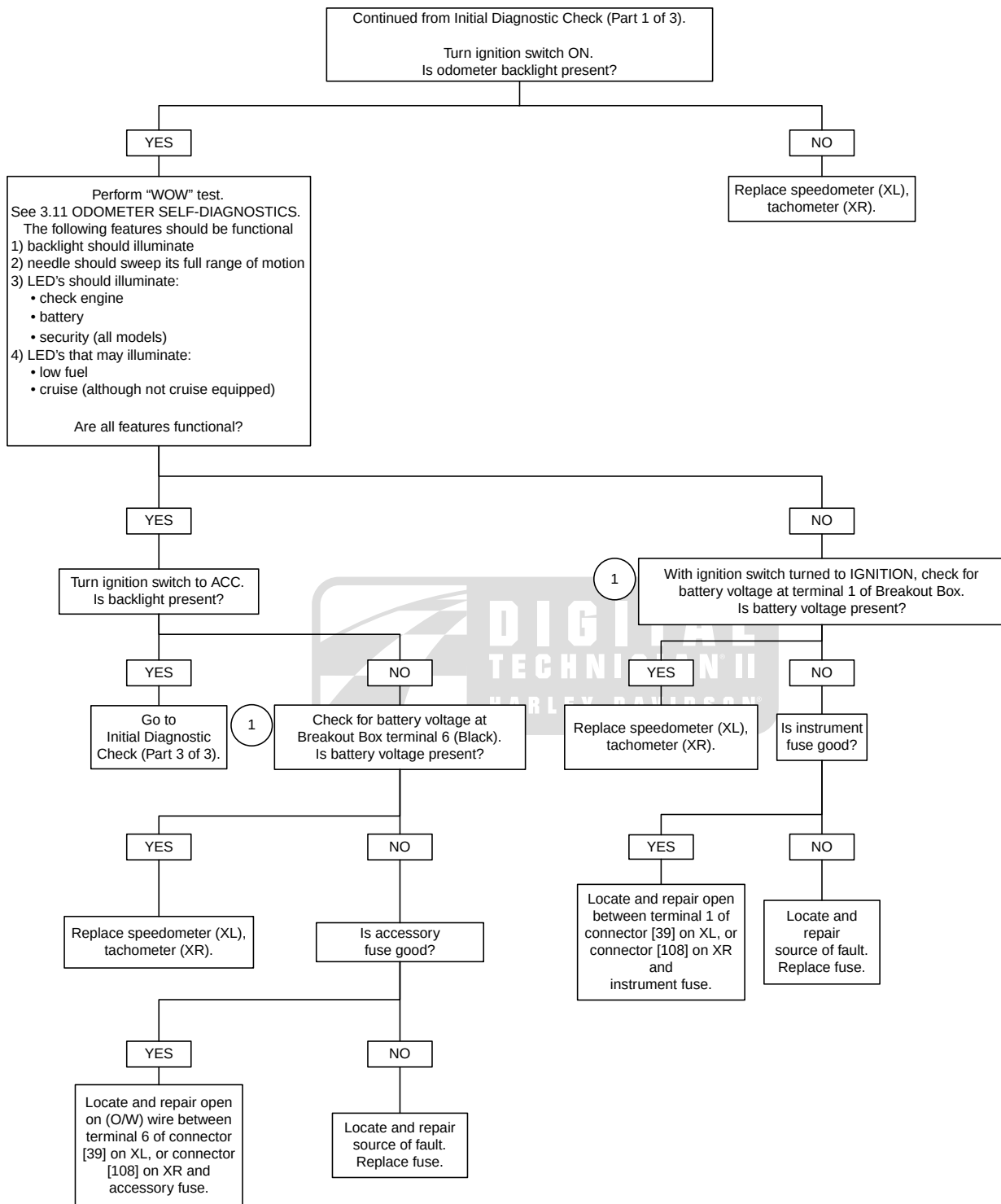


Initial Diagnostic Check (Part 1 of 3)



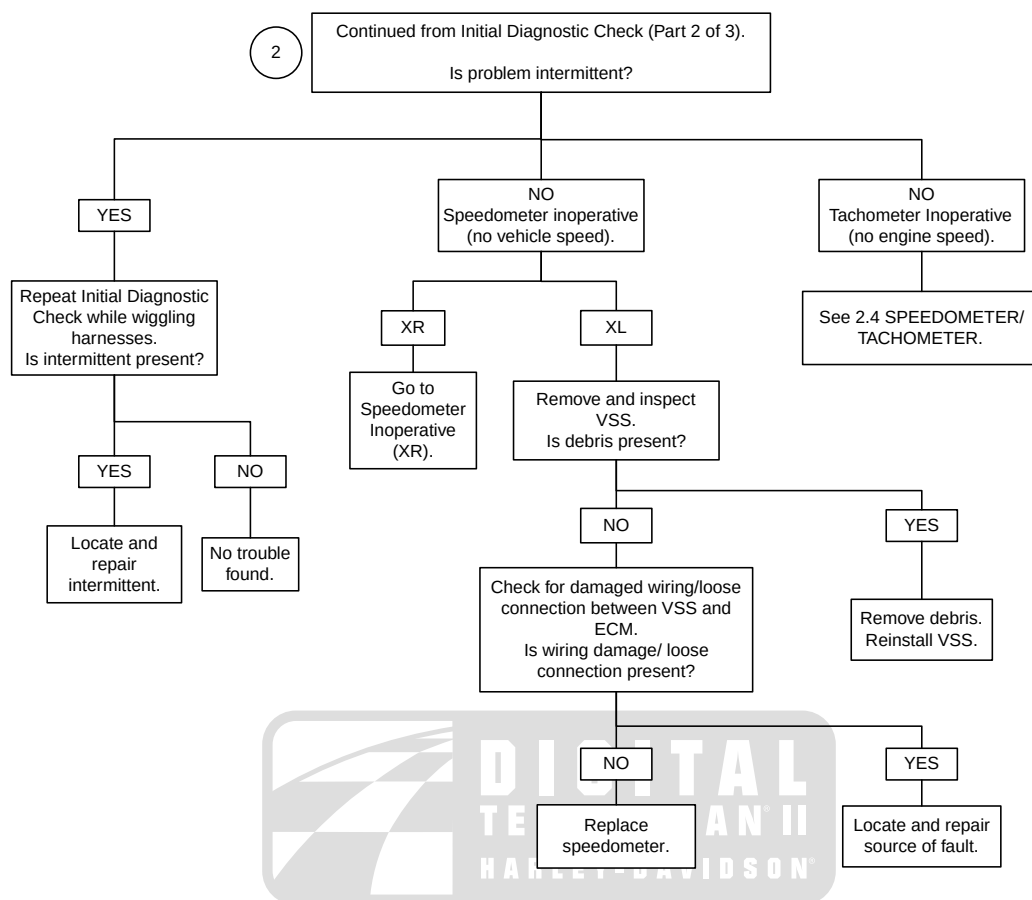
fc01962_en

Initial Diagnostic Check (Part 2 of 3)



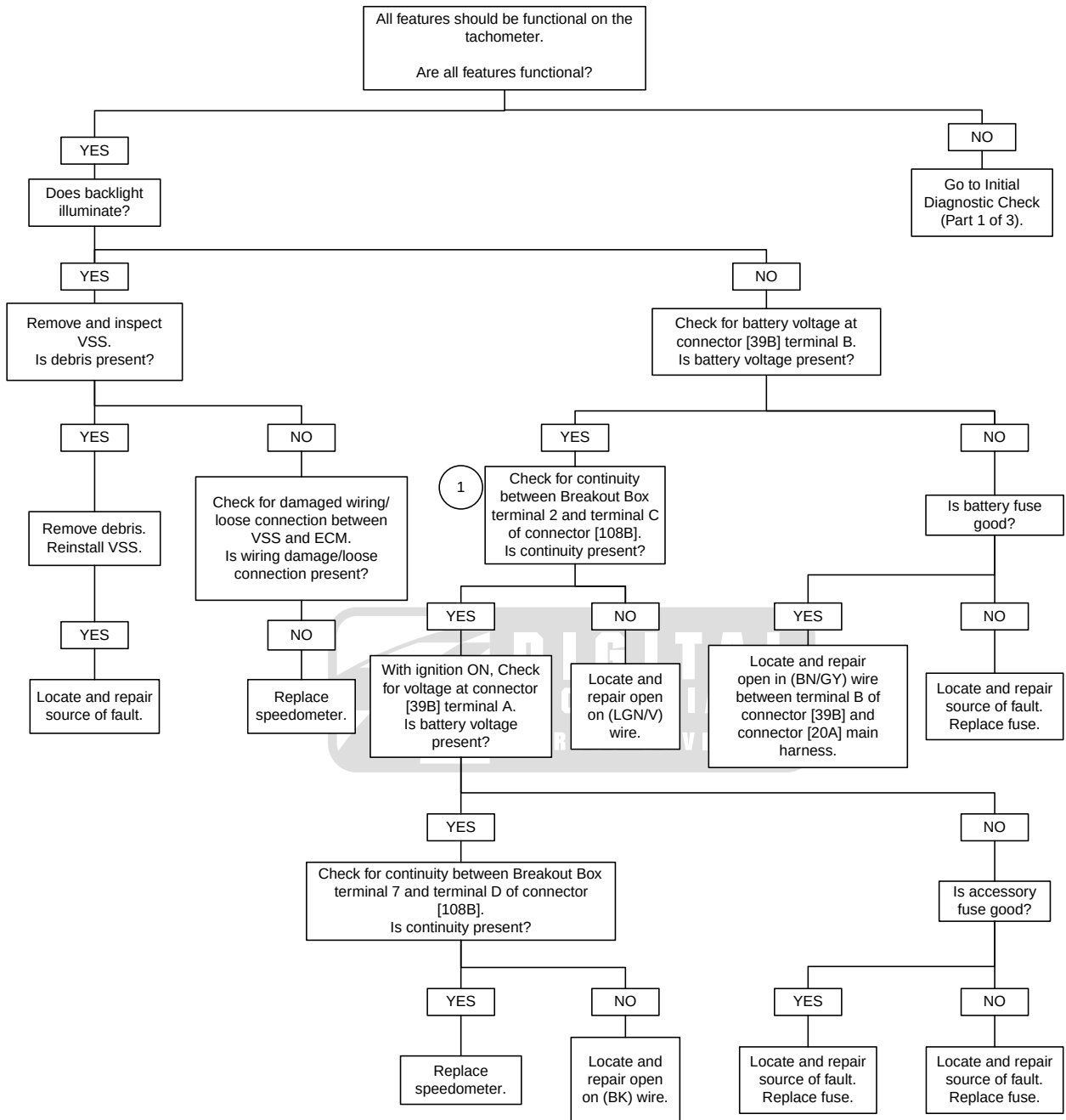
fc01961_en

Initial Diagnostic Check (Part 3 of 3)



fc01960_en

Speedometer Inoperative (XR)



fc01931_en

ODOMETER SELF-DIAGNOSTICS

3.11

GENERAL

The speedometer on XL, and tachometer on XR, are capable of displaying and clearing speedometer, tachometer, TSM/HFSM, and Electronic Control Module (ECM) Diagnostic Trouble Codes (DTCs) (diagnostic mode).

DIAGNOSTICS

Diagnostic Tips

- For a quick check of speedometer on XL, and tachometer on XR functions, a "WOW" test can be performed. See [Figure 3-13](#) and [Figure 3-14](#). Press and hold trip odometer reset switch then turn ignition switch ON. Release trip odometer reset switch. See [Figure 3-15](#). Background lighting should illuminate, gauge needles should sweep their full range of motion, and indicator lamps (battery, security, low fuel, and check engine) should illuminate.
- If speedometer on XL, or tachometer on XR, fails "WOW" test, check for battery, ground, ignition, trip odometer reset switch, and accessory wiring to speedometer on XL, or tachometer on XR. If any feature in the speedometer is non-functional, see [2.2 INITIAL DIAGNOSTIC CHECK: ODOMETER](#).

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

- To exit diagnostic mode, turn ignition switch OFF.
- To clear DTCs for the selected module, press the trip odometer reset switch for more than 5 seconds when a DTC is displayed. This procedure will clear all DTCs for the selected module.

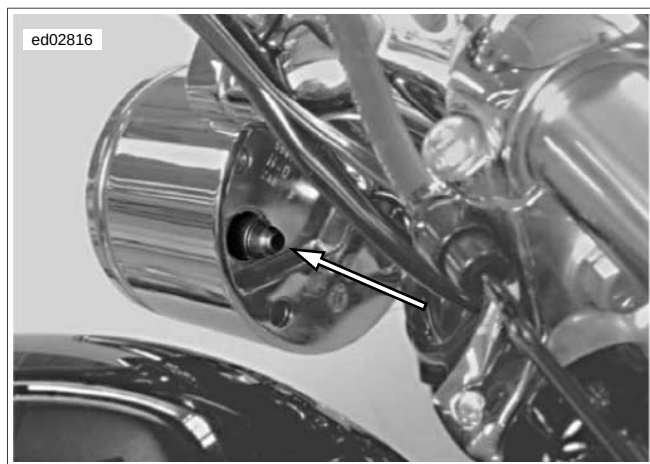


Figure 3-13. Trip Odometer Reset Switch (Typical)

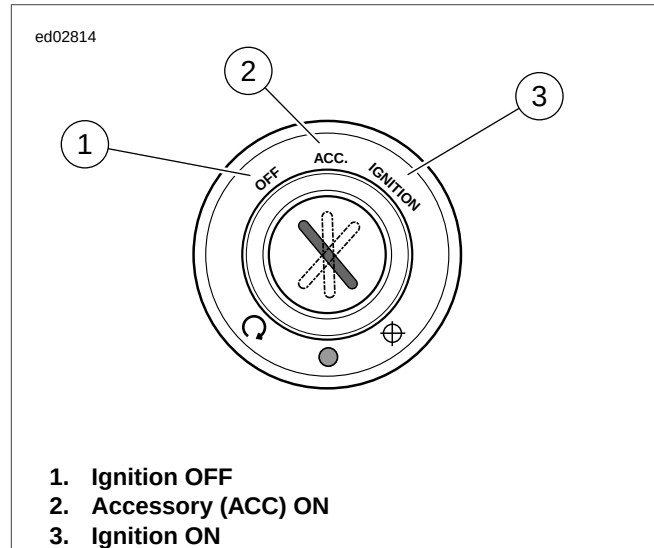


Figure 3-14. Ignition Switch

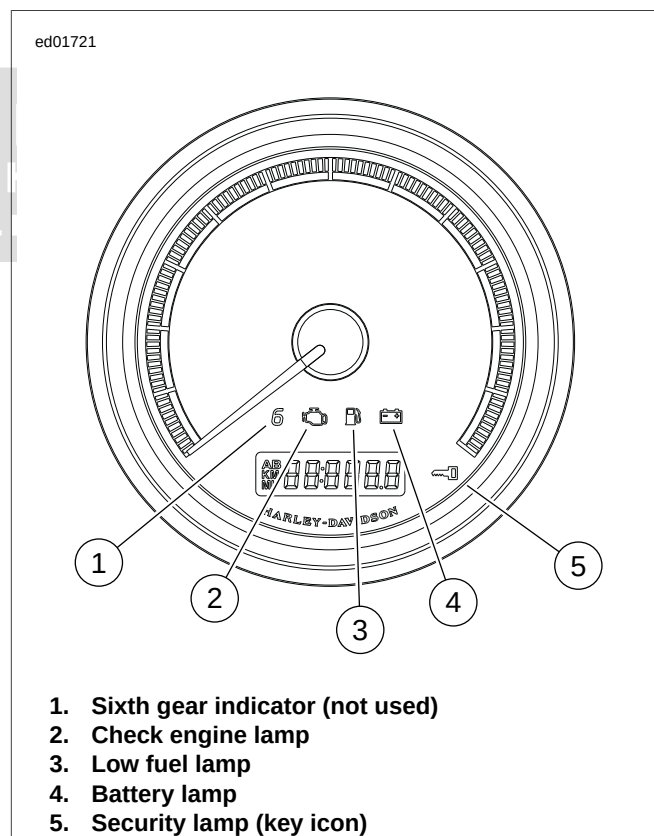
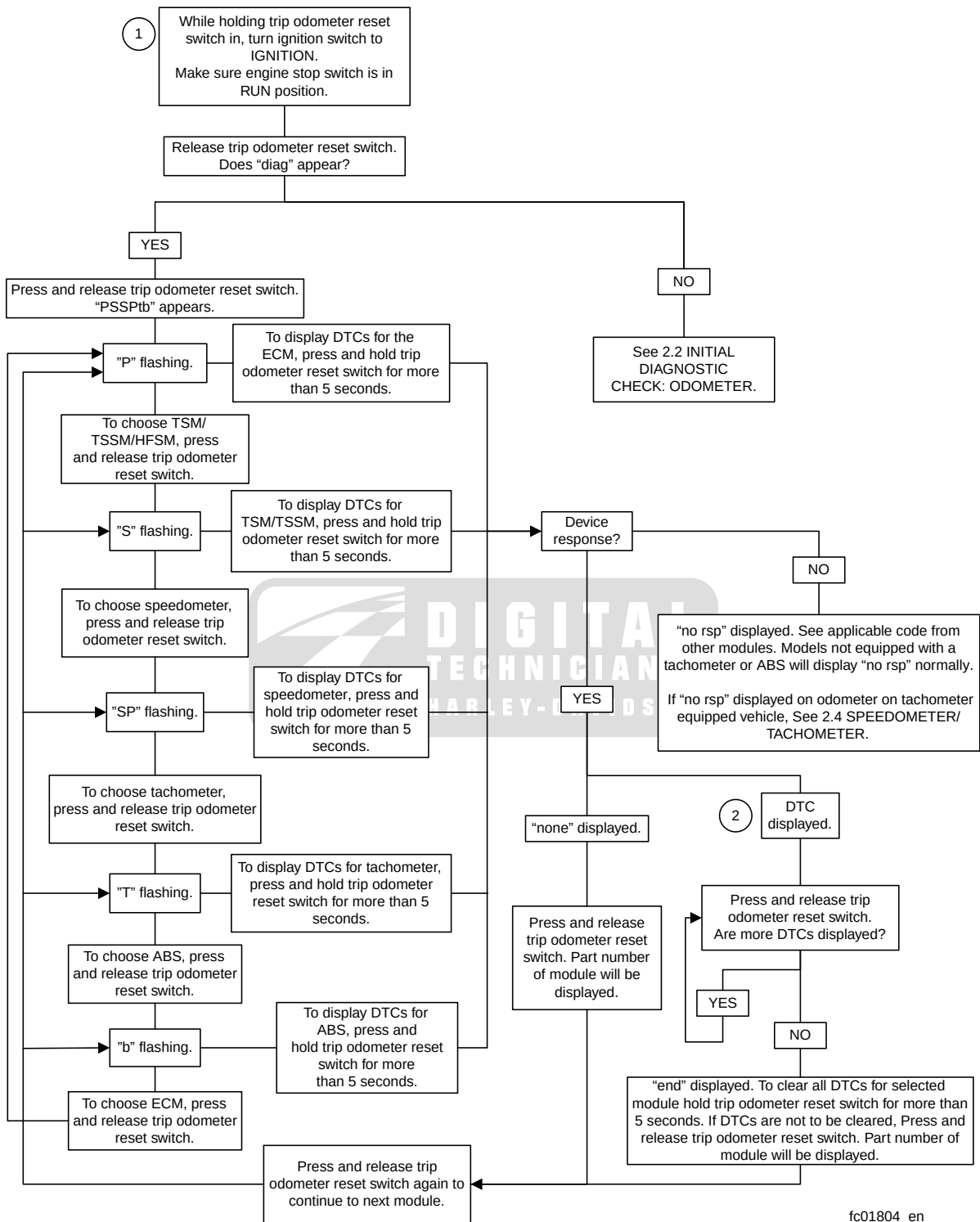


Figure 3-15. Warning Lamps (Typical)

Odometer Self-Diagnostics



BREAKOUT BOX: TSM/HFSM

3.12

GENERAL

PART NUMBER	TOOL NAME
HD-42682	BREAKOUT BOX

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

NOTE

For HFSM: Disarm security system, then remove MAXIFUSE while the system remains disarmed.

1. Remove left side cover and battery. See Service Manual.
2. See [Figure 3-16](#). Reach under battery tray and lift TSM/HFSM from cavity in bottom of tray.
3. See [Figure 3-17](#). Disconnect harness connector(s) from TSM/HFSM:
 - a. **For HFSM:** Depress latches on antenna connector [208B] and remove from antenna connector [208A] (4).
 - b. Depress latches on main harness connector [30B] and remove from main connector [30A] (1).
4. Route main harness connector [30B] back down through cavity and out left side of vehicle under battery tray.
5. **For HFSM:** Route antenna connector [208B] down through cavity and out left side of vehicle under battery tray.
6. Reinstall battery.
7. See [Figure 3-18](#). Attach Breakout Box to connectors:
 - a. Mate gray socket housing on Breakout Box with TSM/HFSM connector [30A].
 - b. Mate gray pin housing on Breakout Box with vehicle harness connector [30B].
8. **For HFSM:** Mate antenna connector [208B] to HFSM.

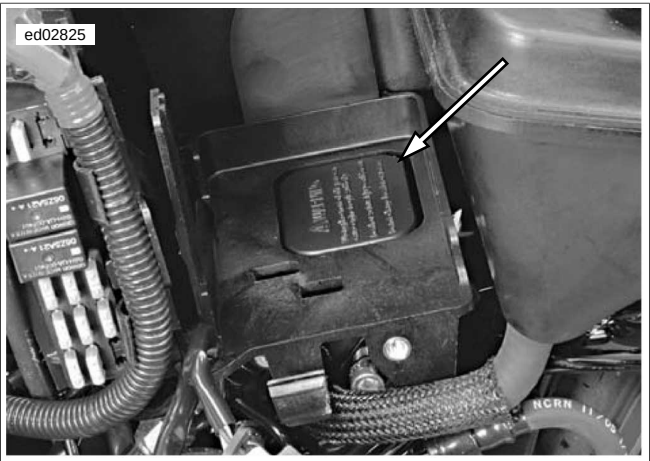


Figure 3-16. TSM/HFSM Location

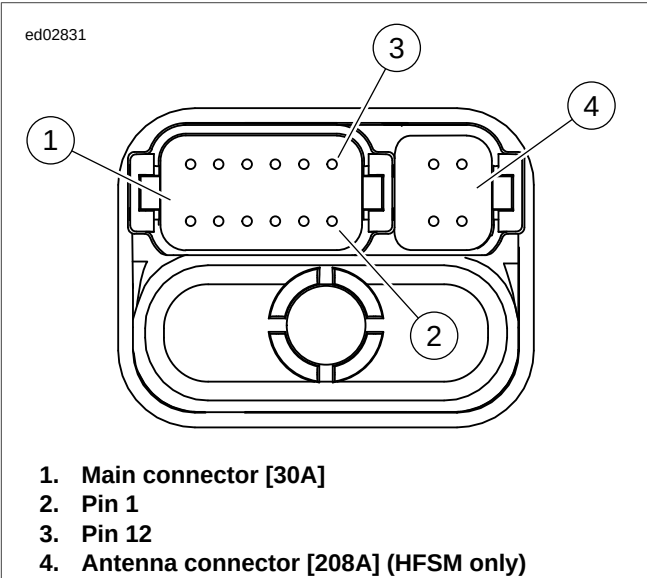
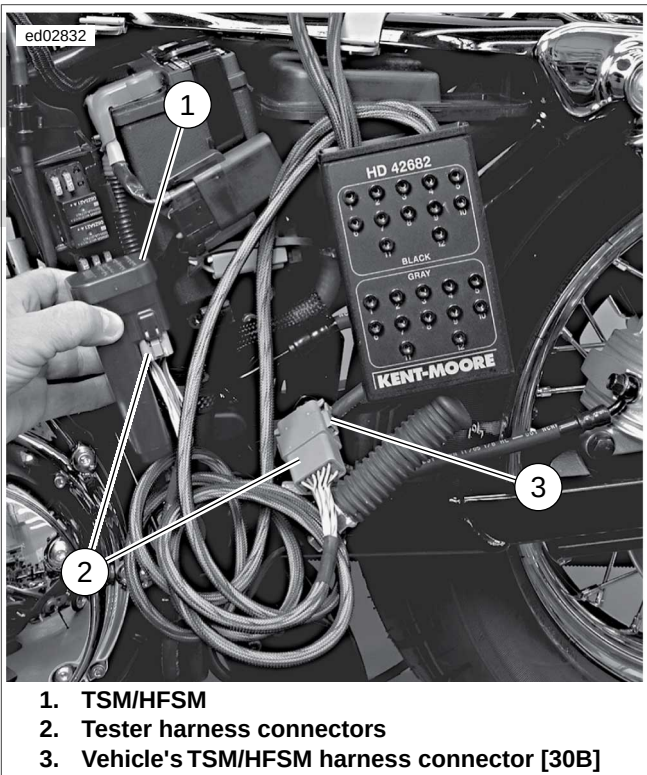


Figure 3-17. TSM/HFSM Connector(s)



1. TSM/HFSM
2. Tester harness connectors
3. Vehicle's TSM/HFSM harness connector [30B]

Figure 3-18. Breakout Box: TSM/HFSM

REMOVAL

1. See [Figure 3-17](#). **For HFSM:** Depress latches on antenna connector [208B] and disconnect from HFSM antenna connector [208A] (4).

2. Disconnect Breakout Box from vehicle:
 - a. Depress latches and detach gray Breakout Box socket connector from TSM/HFSM main harness connector [30A] (1).
 - b. See [Figure 3-18](#). Detach gray Breakout Box connector from TSM/HFSM main harness connector [30B] (3).
3. Remove battery. Route TSM/HFSM main harness connector [30B] up through cavity in bottom of battery tray.
4. **For HFSM:**
 - a. Route antenna harness connector [208B] up through cavity in bottom of battery tray.
 - b. Mate antenna connector [208B] to HFSM.
5. Mate TSM/HFSM main harness connector [30B] to TSM/HFSM.
6. Position TSM/HFSM with connector(s) facing toward rear of vehicle. Lower TSM/HFSM down into cavity in bottom of battery tray.
7. Install battery, MAXIFUSE and left side cover. See Service Manual.

NOTE

Vehicle will not start with TSM/HFSM disconnected or incorrectly mounted.

Table 3-8. TSM/HFSM Connector [30B]

TERMINAL	FUNCTION	TERMINAL	FUNCTION
1	Battery	7	Right turn switch input
2	Ignition	8	Left turn switch input
3	Serial Data	9	Start relay control
4	Neutral switch	10	Clutch switch
5	Left turn feed	11	Alarm signal
6	Right turn feed	12	Ground



FAILS TO DISARM (HFISM ONLY)

3.13

GENERAL

If the HFSM does not respond or responds weakly (limited range or will not consistently disarm with fob within normal range), follow the flowchart.



Figure 3-19. HFSM and Antenna

JOB/TIME CODES

Dealership technicians filing warranty claims should use the job/time codes printed in **bold text** underneath the appropriate repair.

DIAGNOSTICS

Diagnostic Tips

- Verify that the hands-free antenna or a cell phone is not within 3.0 in. (80.0 mm) of key fob.
- Interference from physical surroundings may affect RF transmission. Place fob next to motorcycle or move motorcycle to a new location and retest.
- See [Figure 3-19](#). Verify that antenna is in OE location and that seat has not been replaced with a metal base seat.
- Check for damage to antenna wire.
- See [Figure 3-20](#). Verify fob battery (1) voltage is at least 2.9 volts. See [3.24 HFSM MAINTENANCE](#).
- Fob serial number (2) is located inside fob. Open fob by twisting a thin blade in the thumbnail slot between fob halves.

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. After a battery disconnect, the HFSM will not enter the configuration mode on the first attempt. All attempts to assign a job or enter the configuration mode will require at least two attempts.

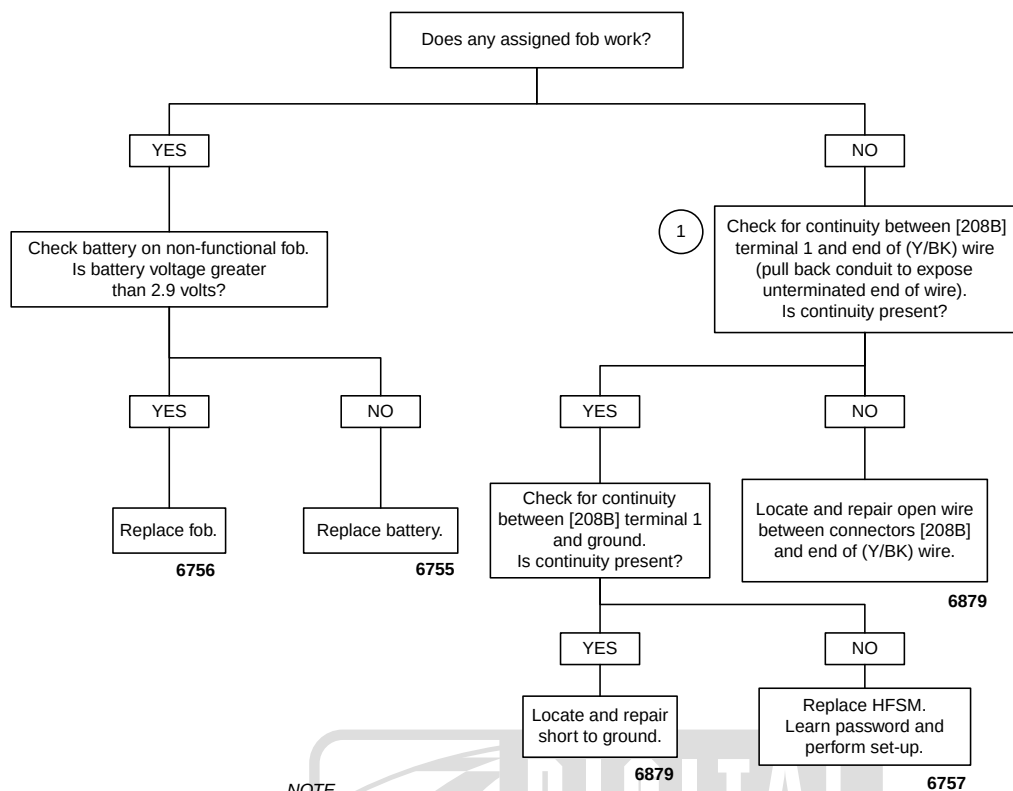


Figure 3-20. Open Fob: HFSM



NO.	DESCRIPTION	TYPE	LOCATION
[30]	HFSM	12-place Deutsch	Under battery
[208]	HFSM	4-place Deutsch	Under battery
[209]	Security antenna	2-place Molex	Under seat

HFSM Fails to Disarm



NOTE

The fob for the HFSM must be assigned using DIGITAL TECHNICIAN II (Part No. HD-48650). This can also validate fob operation when connected to the motorcycle.

fc01127_en

DTC B0563

3.14

GENERAL

The TSM/HFSM continually checks the battery voltage during IGN/OFF and IGN/RUN power modes. If the voltage exceeds 16.0 Volts for more than 5.0 ± 0.5 seconds, the TSM/HFSM sets DTC B0563.

DIAGNOSTICS

Diagnostic Tips

- This DTC may set when the vehicle is placed on a battery charger, on fast charge, for a long period of time.
- The HFSM does not illuminate the security lamp when this DTC is set.

Diagnostic Notes

See [1.7 CHARGING SYSTEM](#) tests to correct. Problem may be faulty voltage regulator.



TSM/HFSM: TURN SIGNAL ERRORS AND DTCS

3.15

GENERAL

The turn signals will automatically cancel based on either the speed/acceleration of the vehicle or upon turn completion. See [3.1 TURN SIGNAL OVERVIEW](#).

TSM/HFSM: For turn signal diagnostics based on symptoms, refer to [Table 3-10](#).

TSM DTCs Only: Refer to [Table 3-11](#).

HFSM DTCs Only: Refer to [Table 3-12](#).

Table 3-10. Turn Signal Errors: TSM/HFSM

DTC	SYMPTOM	START WITH FLOWCHART
N/A	Will not cancel on turn completion	Will Not Cancel Upon Turn Completion
N/A	Cancels erratically	Cancels Erratically
N/A	Flash at double normal rate while all bulbs are working	Flash at Double Normal Rate, All Bulbs Work

Table 3-11. Turn Signal DTCs: TSM Only

DTC	SYMPTOM	START WITH FLOWCHART
B1121	Turn signals will not flash, 4-way flashers inoperable	DTCs B1121, B1122, and B1141, Will Not Flash, 4-Way Flashers Inoperable (Part 1 of 6)
B1122		
B1141		



Table 3-12. Turn Signal DTCs: HFSM Only

DTC	SYMPTOM	START WITH FLOWCHART
B1121	Left turn signal open	DTCs B1121 and B1122, Turn Signal Lamp Open Circuit
B1122	Right turn signal open	
B1123	Left turn signal short-to-ground	DTCs B1123 and B1124
B1124	Right turn signal short-to-ground	
B1125	Left turn signal short-to-voltage	DTCs B1125 and B1126
B1126	Right turn signal short-to-voltage	

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX

Job/Time Codes

Dealership technicians filing warranty claims should use the job/time code printed in **bold text** underneath the appropriate repair in the diagnostic flowcharts.

Diagnostic Tips

- **TSM Only:** DTCs B1121 and B1122 will illuminate the security lamp. DTC B1141 will **not** illuminate the security lamp.
- **HFSM Only:** DTCs B1121, B1122, B1123, B1124, B1125, and B1126 will illuminate the security lamp.
- **TSM/HFSM:** When an over current or short-to-ground condition is detected, it will turn off the turn lamp outputs.

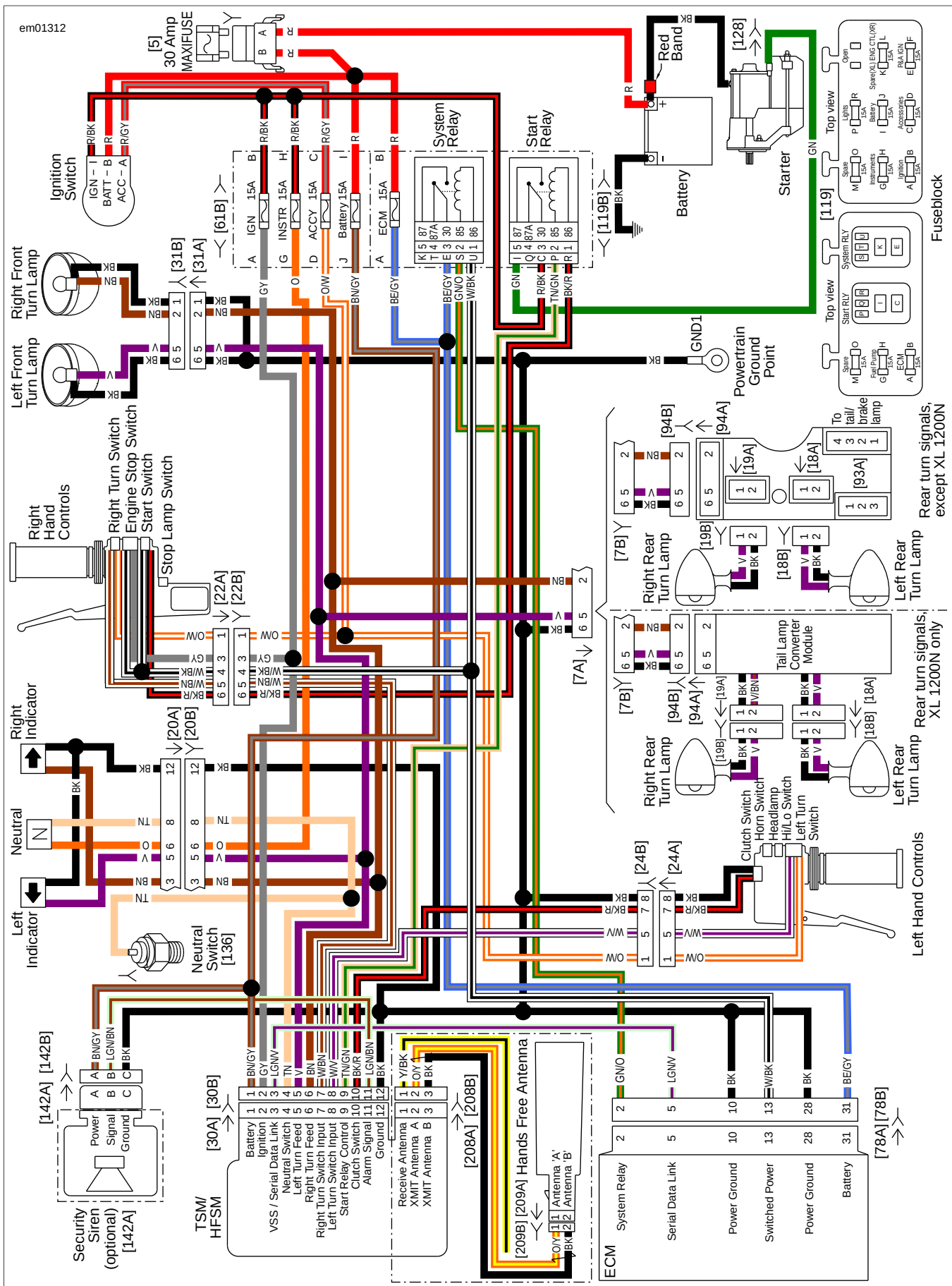


Figure 3-22. Turn Signal Circuit

Table 3-13. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[5]	MAXIFUSE	2-place Metri-Pack, black	On battery strap, behind left side cover
[7]	Rear lighting	6-place Multilock	Under seat
[18]	Left rear turn signal	2-place Multilock	Inside tail lamp lens
[19]	Right rear turn signal	2-place Multilock	Inside tail lamp lens
[20]	Instruments	12-place Molex	Under fuel tank
[22]	Right handlebar controls	6-place Molex	Under fuel tank
[24]	Left handlebar controls	8-place Molex	Under fuel tank
[30]	TSM/HFSM	12-place Deutsch	Under battery
[31]	Front turn signals	6-place Multilock	Under fuel tank
[61B]	Fuse block	Spade terminals	Behind left side door
[78]	ECM	36-place Packard	Under seat
[94]	Tail lamp power in	6-place Multilock, black	Inside tail lamp lens
[119]	Relay/fuse block	5-place Amp, spade terminals	Fuse/relay block, behind left side cover
[128]	Starter solenoid	Locking spade terminal, white	Stater solenoid
[136]	Neutral switch	1-place molded jumper, black	Right side frame, beneath gear case cover
[142]	Security siren	3-place Packard, black	Under frame
[208]	HFSM antenna connector	4-place Deutsch, gray	Under battery
[209]	Security antenna	Ring terminal	Crankcase housing, top rear

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

- Gain access to vehicle's TSM/HFSM:
 - Remove battery. See Service Manual for procedure.
 - Unplug and remove TSM/HFSM from battery tray.
 - Reroute wiring harness so TSM/HFSM may be reconnected while removed from vehicle
 - Reconnect TSM/HFSM.
- Perform the following procedure:
 - See [Figure 3-23](#). Position TSM/HFSM in same orientation it is mounted on vehicle. Turn Ignition Switch on. Turn 4-way flashers on by depressing both left and right turn signal switches simultaneously. Turn Ignition Switch off; 4-way flashers should continue to flash.
 - Tilt TSM/HFSM greater than 45 degrees to the left.
 - Repeat step a.
 - Tilt TSM/HFSM greater than 45 degrees to the right.
- To enable diagnostic mode, see [3.9 CHECKING FOR DIAGNOSTIC TROUBLE CODES](#).
- Connect BREAKOUT BOX (Part No. HD-42682) (gray) between TSM/HFSM connector [30A] and wiring harness connector [30B]. See [3.12 BREAKOUT BOX: TSM/HFSM](#).
- Closely inspect handlebar controls for pinched wiring.
- Connect gray HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) to connector [22] (right) or connector [24] (left).
- Replace HFSM if DTC is current (lamp ON continuously, cleared codes return during operation). If DTC is historic, check for intermittents.

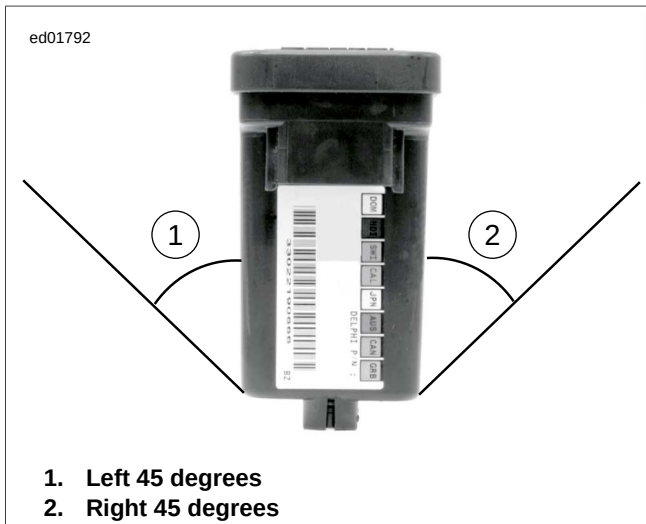
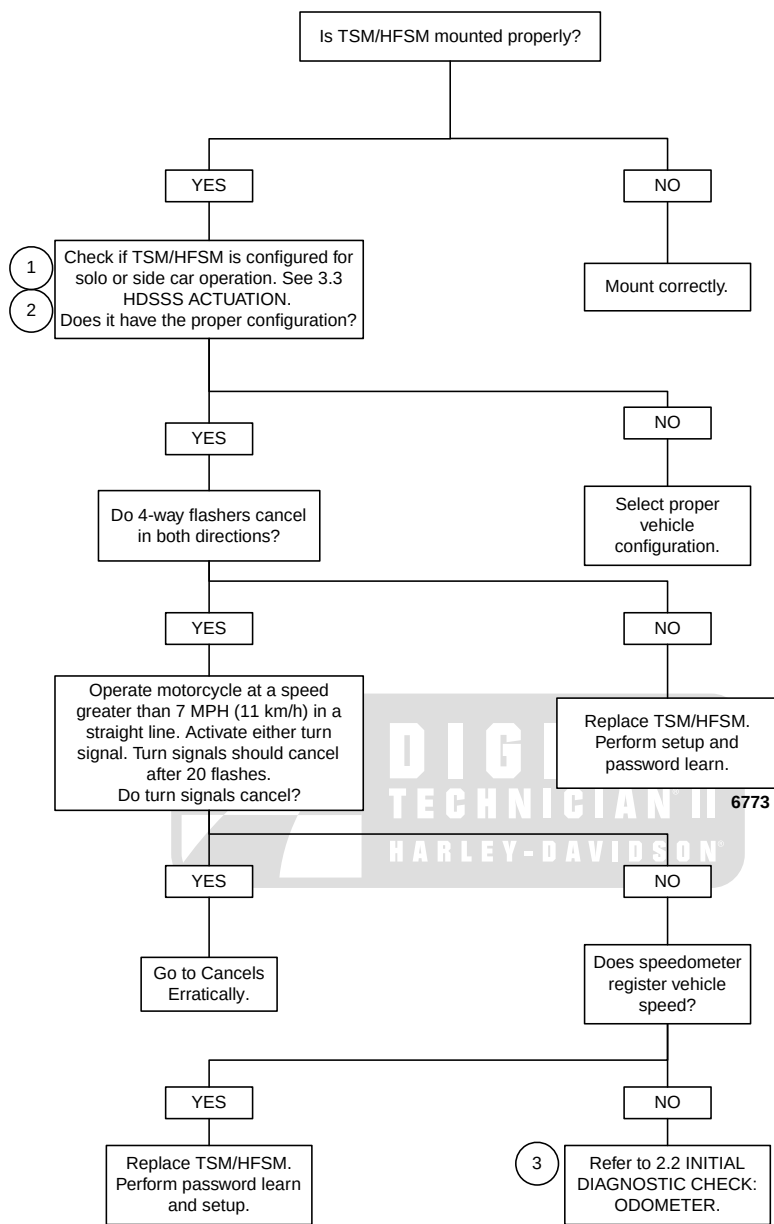


Figure 3-23. Tilting: TSM/HFSM



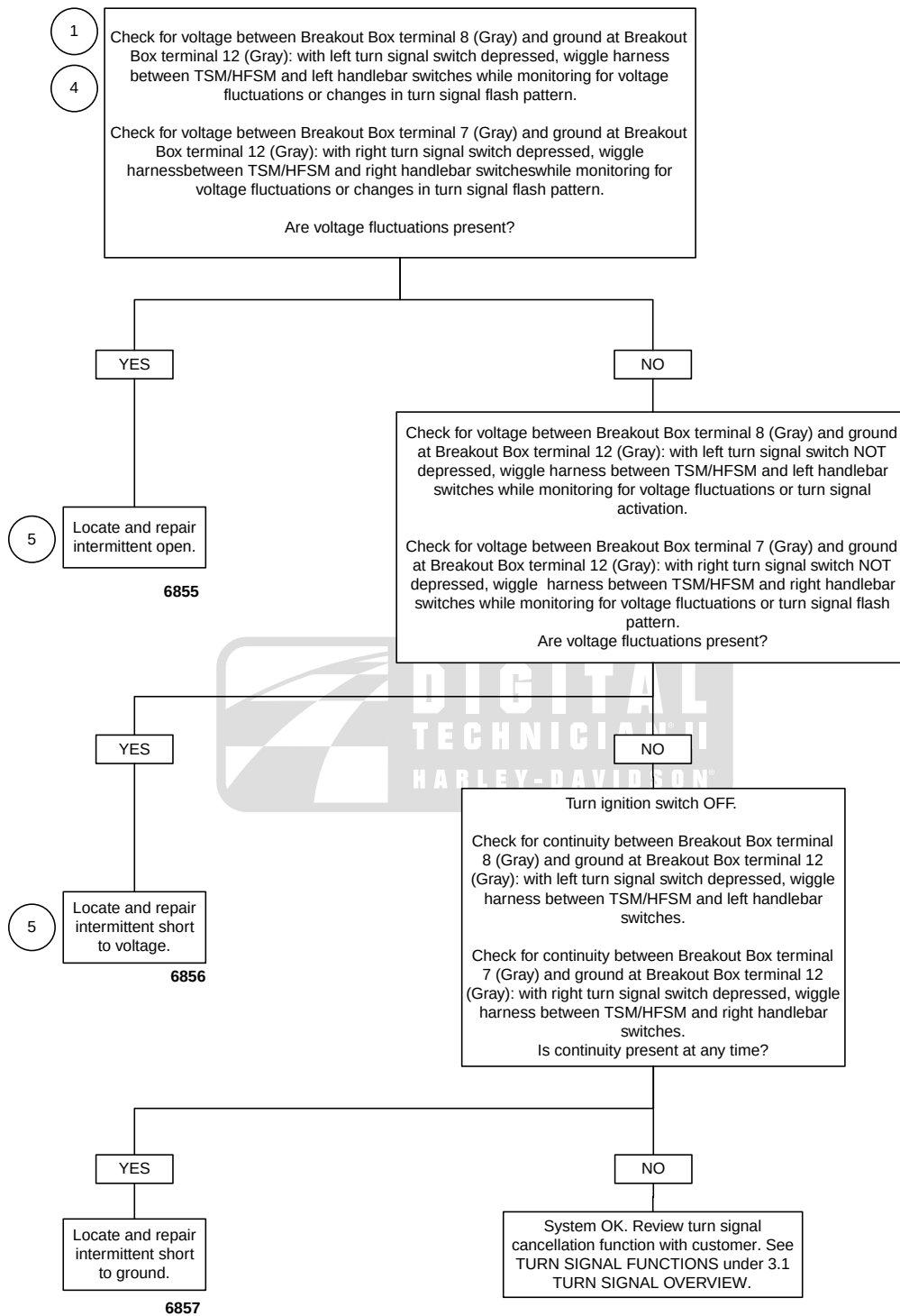
Will Not Cancel Upon Turn Completion



6773

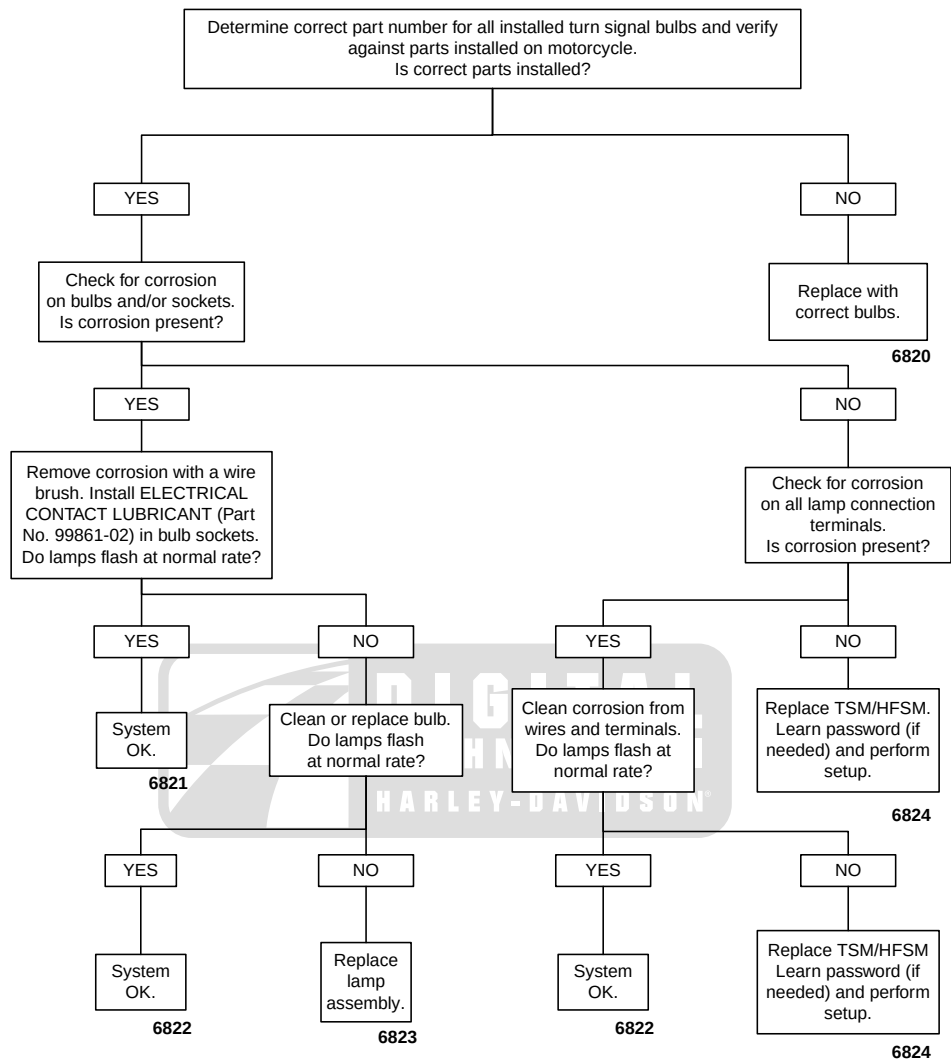
fc01950_en

Cancels Erratically



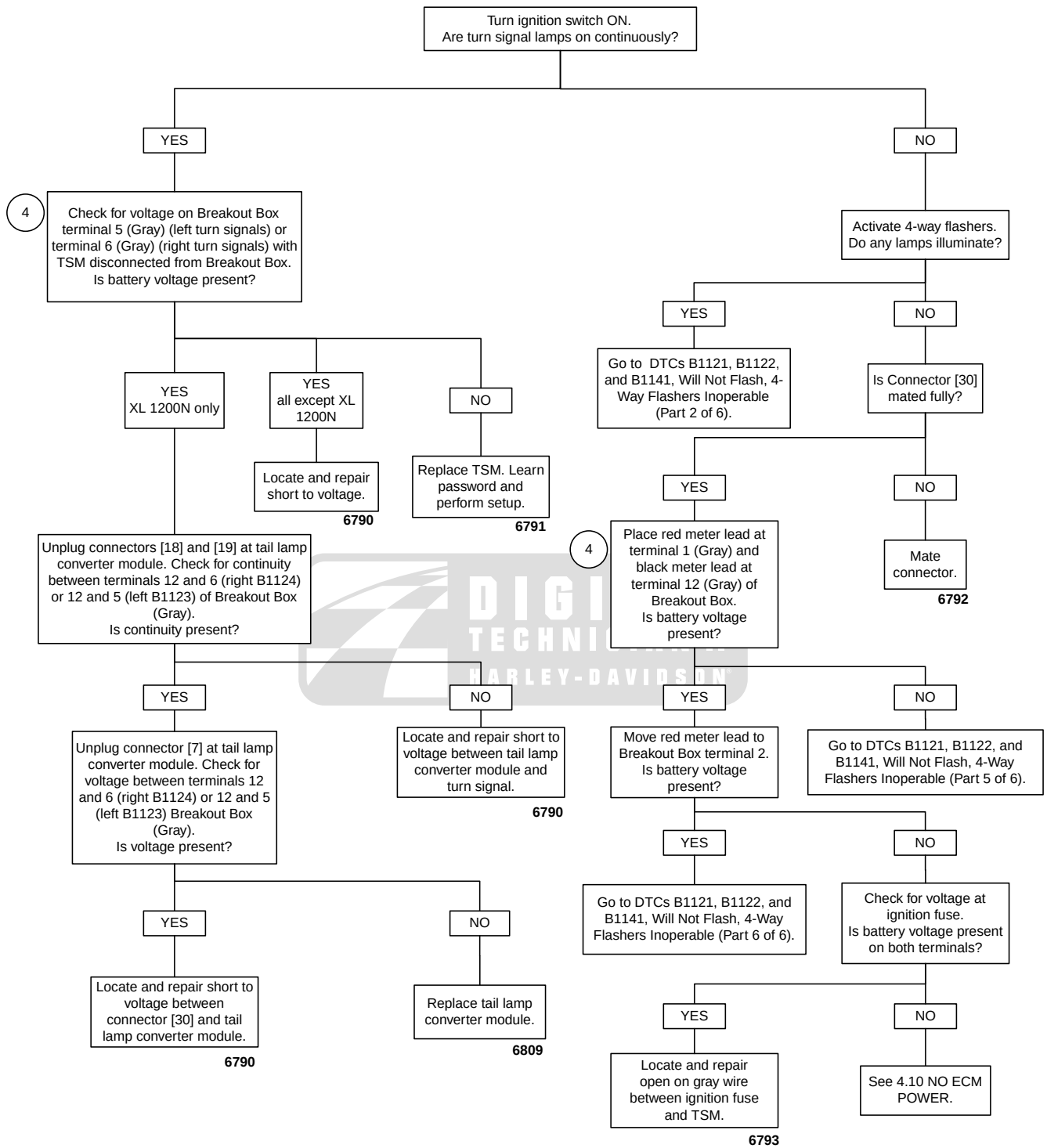
fc01951_en

Flash at Double Normal Rate, All Bulbs Work



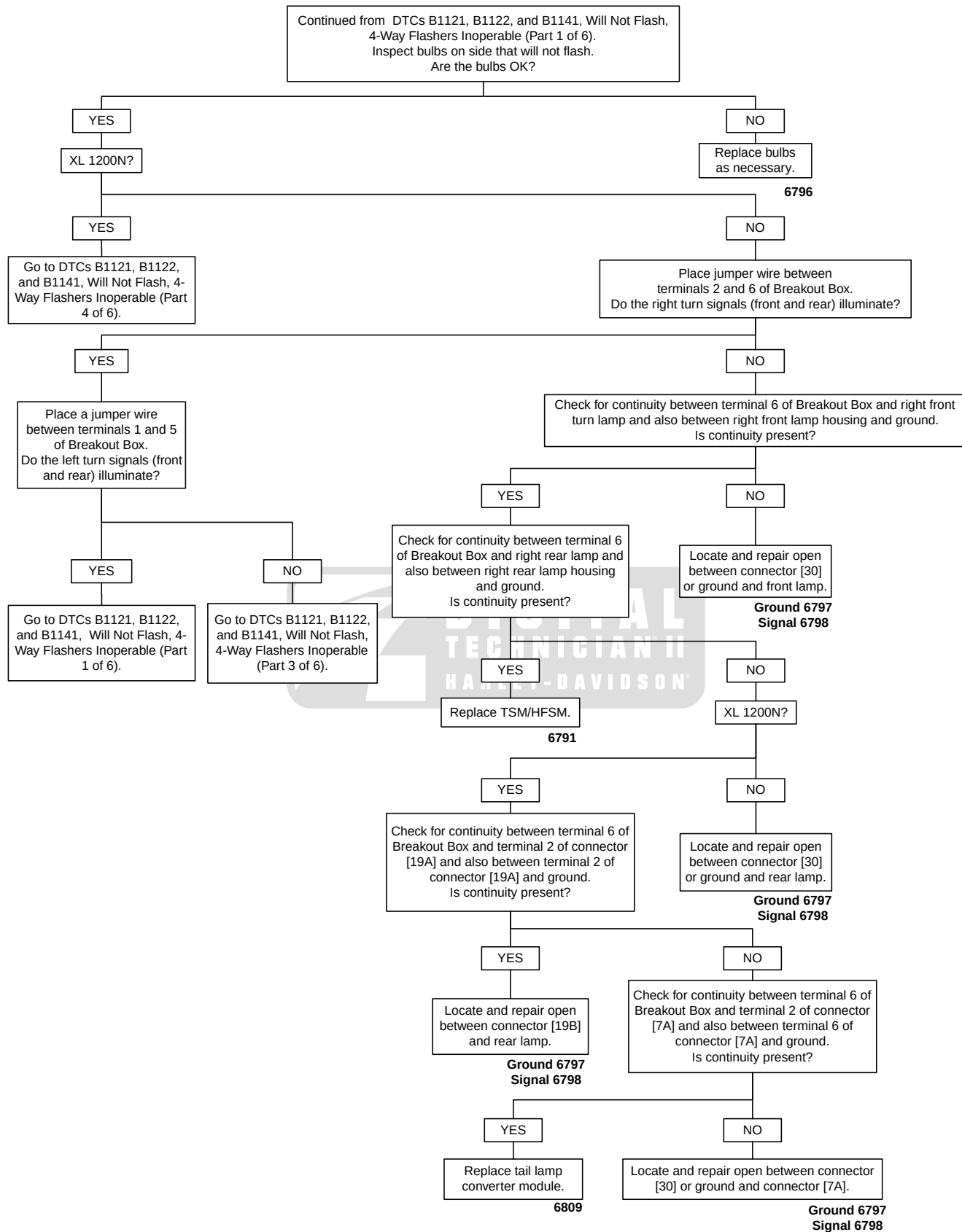
fc01130_en

DTCs B1121, B1122, and B1141, Will Not Flash, 4-Way Flashers Inoperable (Part 1 of 6)



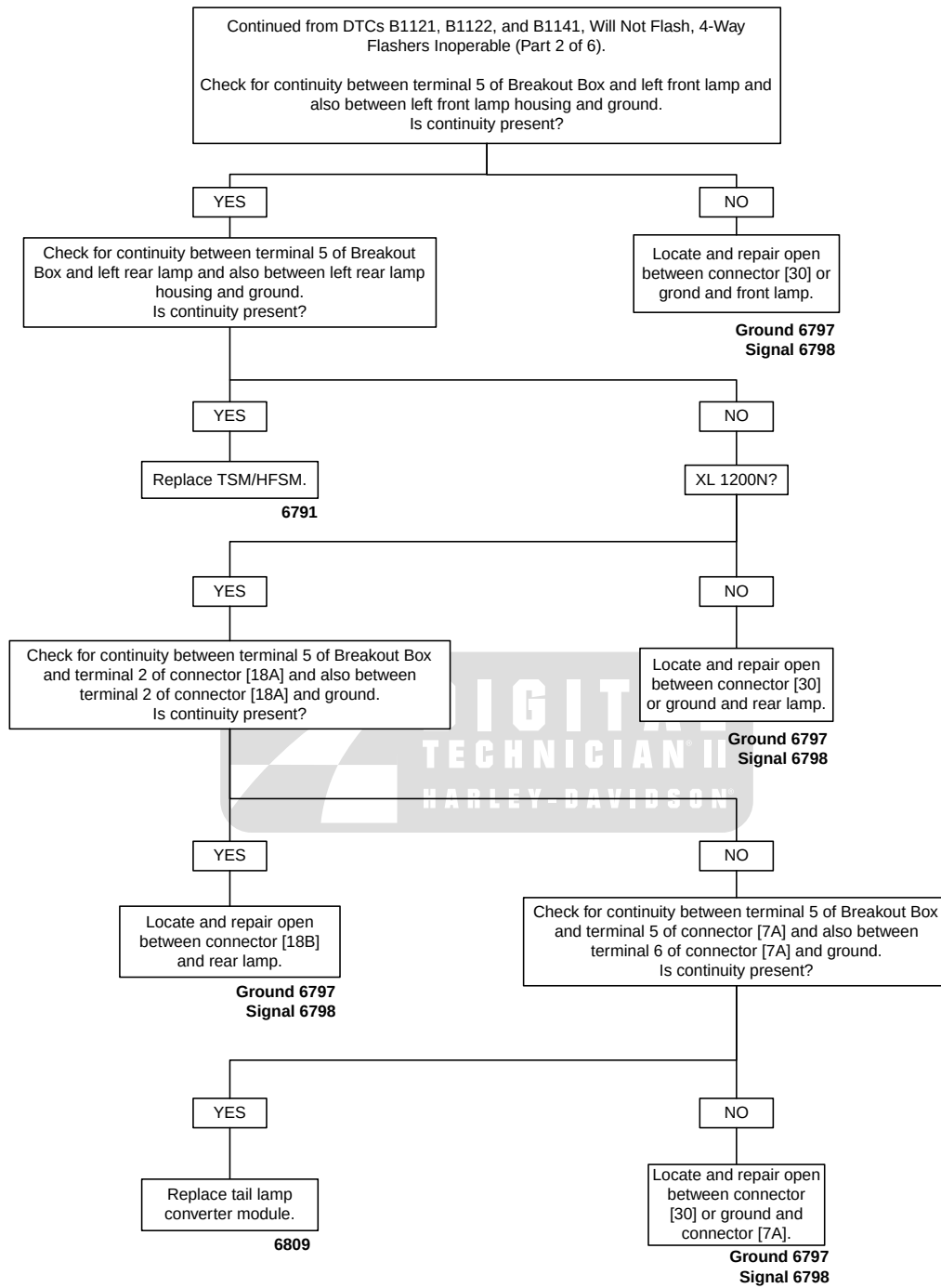
fc01952_en

DTCs B1121, B1122, and B1141, Will Not Flash, 4-Way Flashers Inoperable (Part 2 of 6)



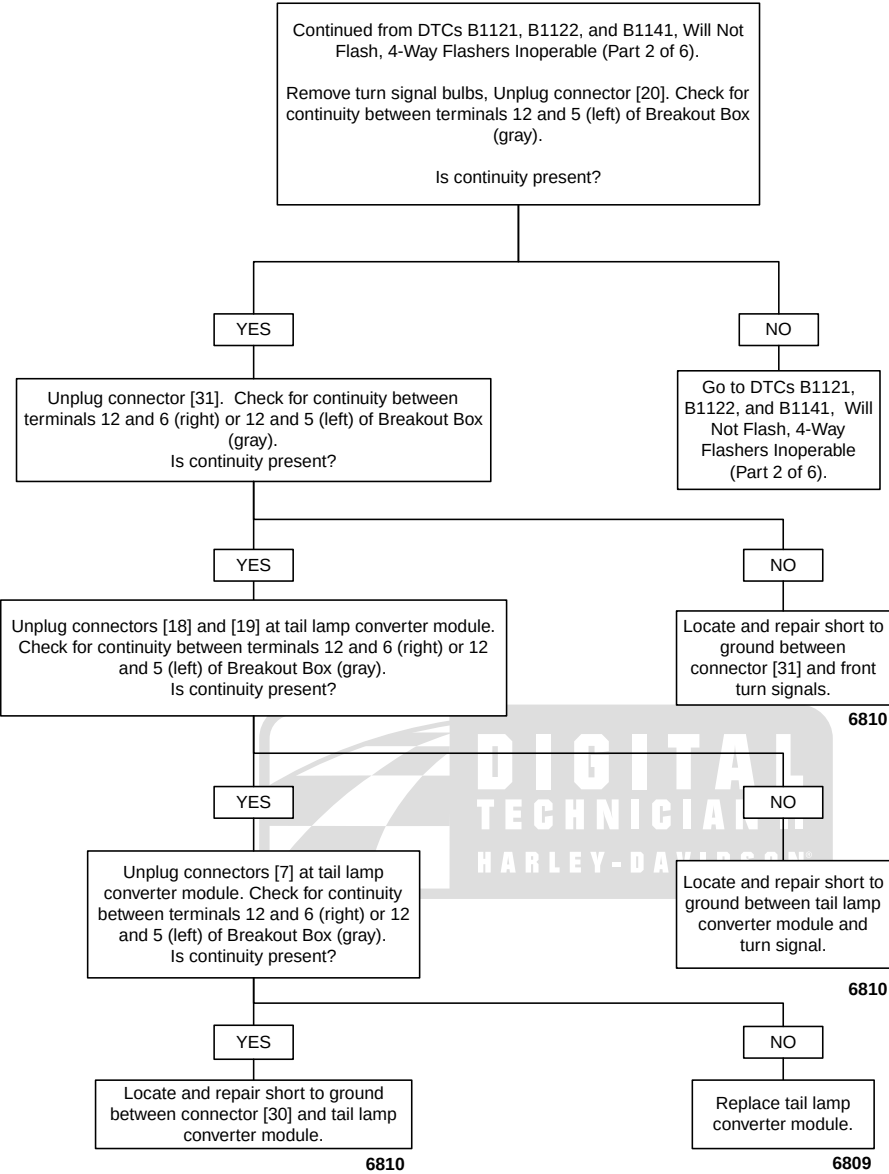
fc01953_en

DTCs B1121, B1122, and B1141, Will Not Flash, 4-Way Flashers Inoperable (Part 3 of 6)



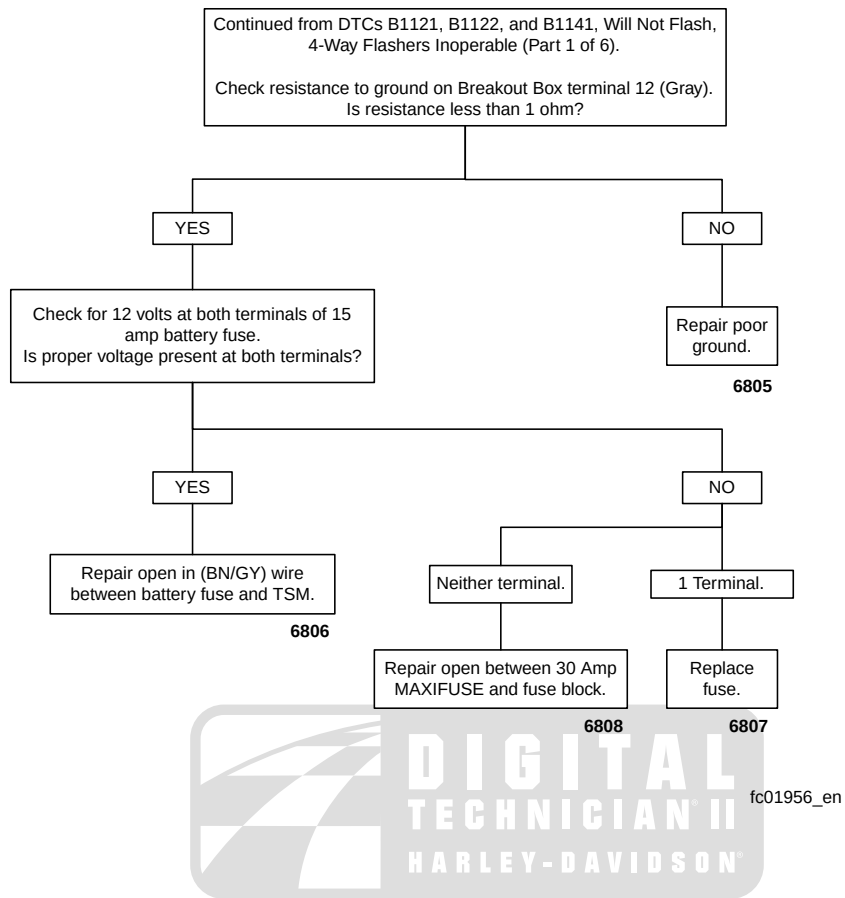
fc01954_en

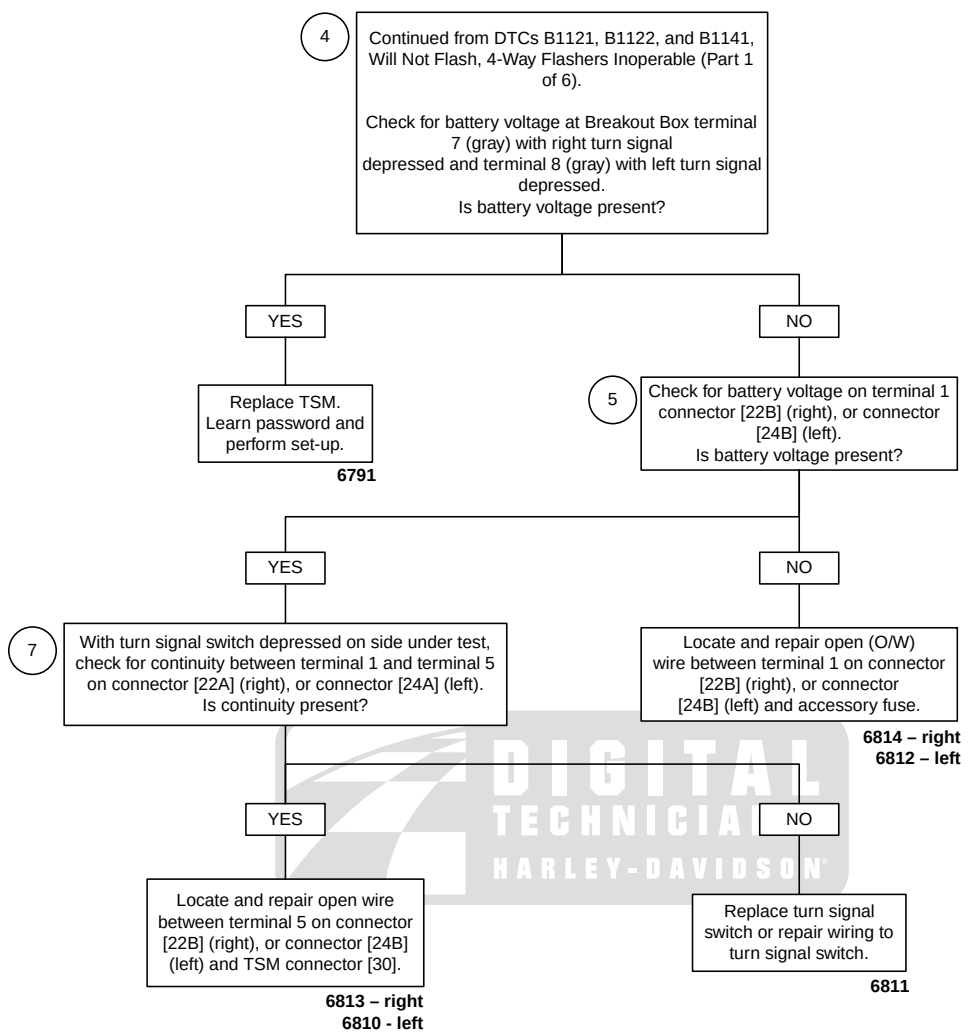
DTCs B1121, B1122, and B1141, Will Not Flash, 4-Way Flashers Inoperable (Part 4 of 6)



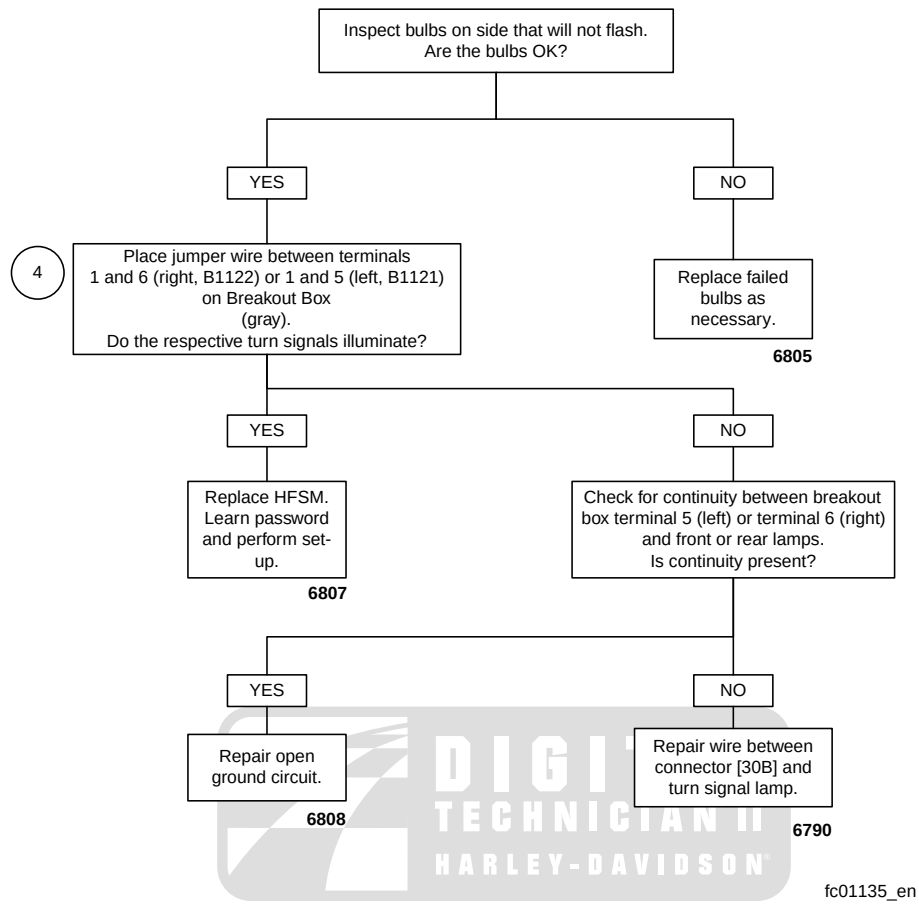
fc01955_en

DTCs B1121, B1122, and B1141, Will Not Flash, 4-Way Flashers Inoperable (Part 5 of 6)

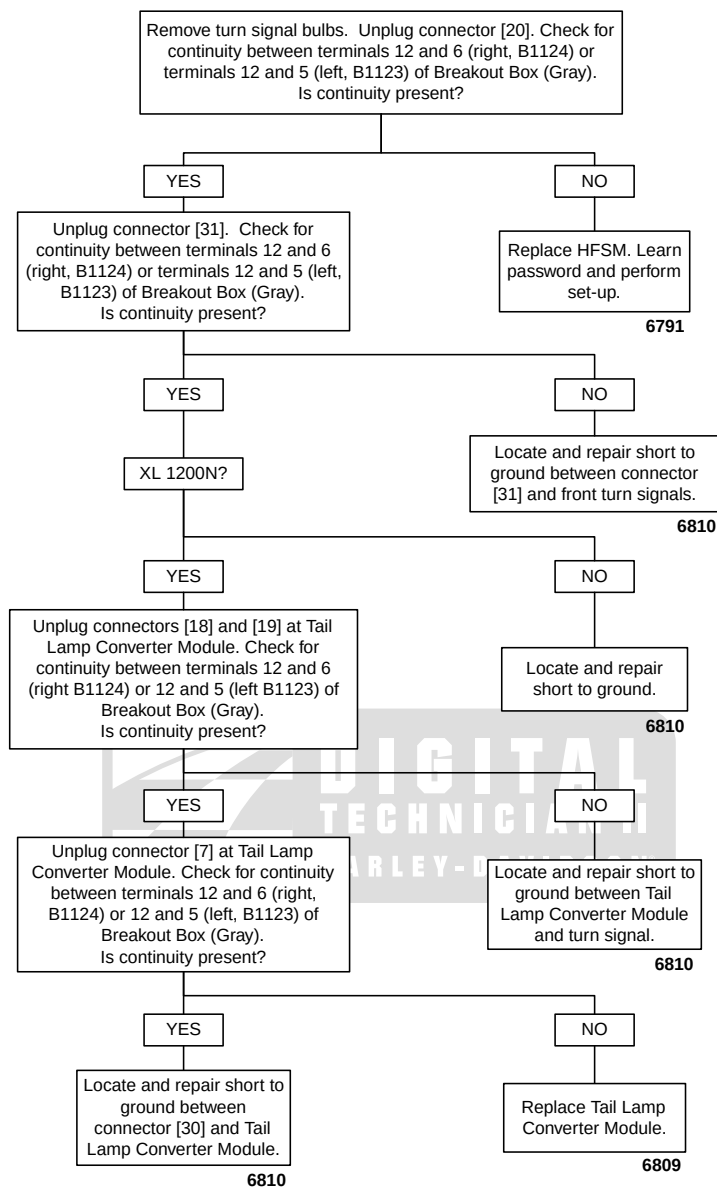


DTCs B1121, B1122, and B1141, Will Not Flash, 4-Way Flashers Inoperable (Part 6 of 6)

DTCs B1121 and B1122, Turn Signal Lamp Open Circuit

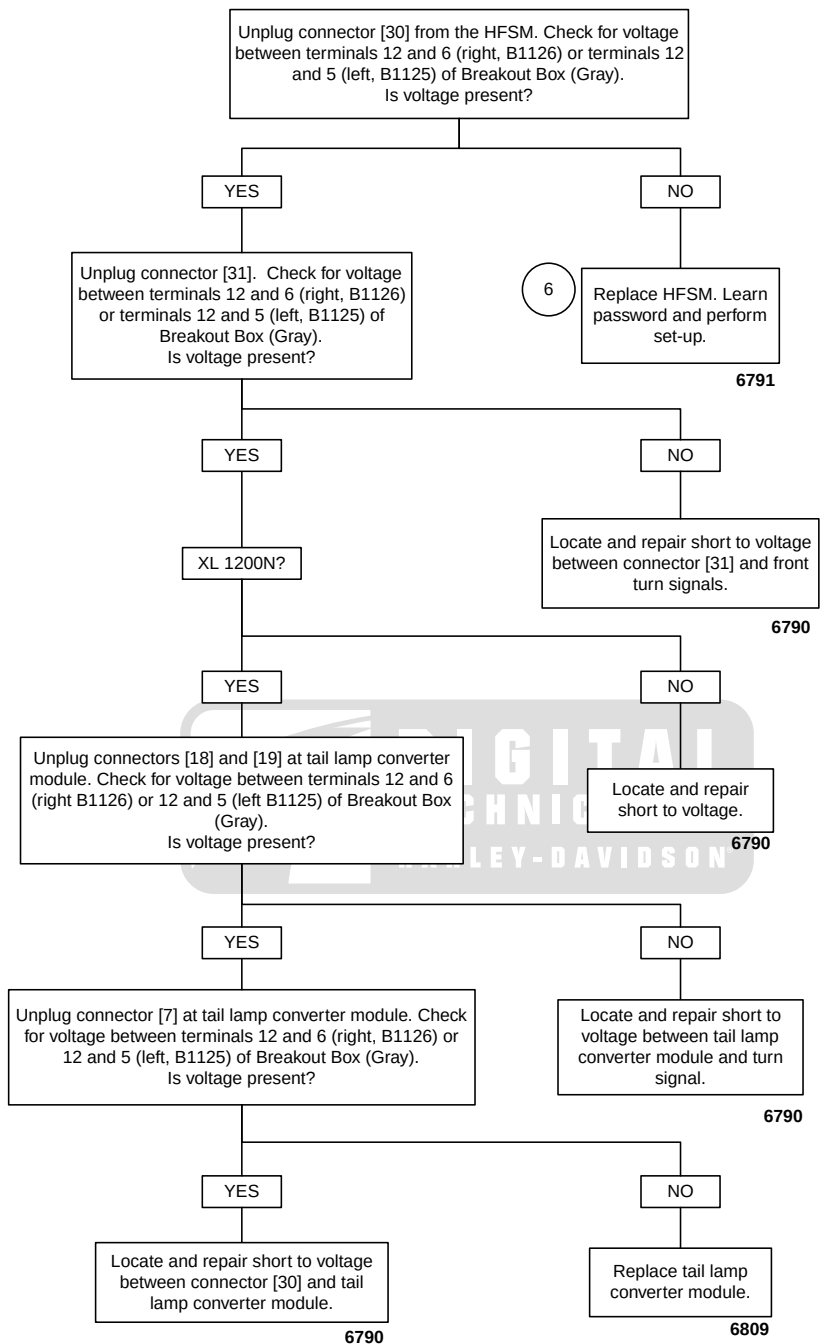


DTCs B1123 and B1124



fc01136_en

DTCs B1125 and B1126



fc01137_en

DTC B1131, B1132 (HFSM ONLY)

3.16

GENERAL

NOTE

This section applies only to those vehicles equipped with the optional security system.

See [Figure 3-24](#). An alarm cycle is activated when the HFSM is connected, the siren has been armed by the HFSM and a security event occurs. See [3.6 WARNINGS AND ALARMS](#). Under normal armed operation, the siren input (terminal "B") is driven low by the HFSM to trigger the audible alarm. When the siren input is driven high by the HFSM the audible alarm stops.



Figure 3-24. Security Siren

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX

Diagnostic Tips

- If the siren is armed and the internal siren battery is dead, shorted, disconnected, or has been charging for a period

longer than 24 hours, the siren will respond with three chirps on arming instead of two.

- The internal siren battery may not charge if the vehicle's battery is less than 12.5 volts.
- If the siren does not chirp two or three times on a valid arming command from the HFSM, the chirp function has been disabled, the siren is either not connected, not working, or the siren wiring was opened or shorted while the siren was disarmed.
- If the siren enters the self-driven mode where it is powered from the siren internal nine-volt battery, the turn-signal lamps will not alternately flash. If the HFSM activates the siren, the turn-signal lamps will flash. If the siren has been armed and a security event occurs, and the siren is in self-driven mode, the siren will alarm for 20 to 30 seconds and then turn off for 5 to 10 seconds. This alarm cycle will be repeated ten times if the siren is in the self-driven mode.
- If the siren does not stop alarming after it has been armed, then either the HFSM output or siren input may be shorted to ground, or the siren vehicle battery connection is open or shorted to ground, or the siren vehicle ground connection is open, or a security event has occurred. See [3.6 WARNINGS AND ALARMS](#) for a description of alarm functions.

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

- Use BREAKOUT BOX (Part No. HD-42682) and HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), gray pin probe and patch cord. See [3.12 BREAKOUT BOX: TSM/HFSM](#).
- Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), gray socket probe and patch cord.
- Having the correct multimeter ohm scale is important for this test. Some meters may read infinity for high ohm values. If this is the case, check your ohm scale and retest.

Table 3-14. Siren Alarm Output DTCs

DTC	SYMPTOM	START WITH FLOWCHART
B1131	Alarm output low	DTCs B1131 and B1132
B1132	Alarm output high	

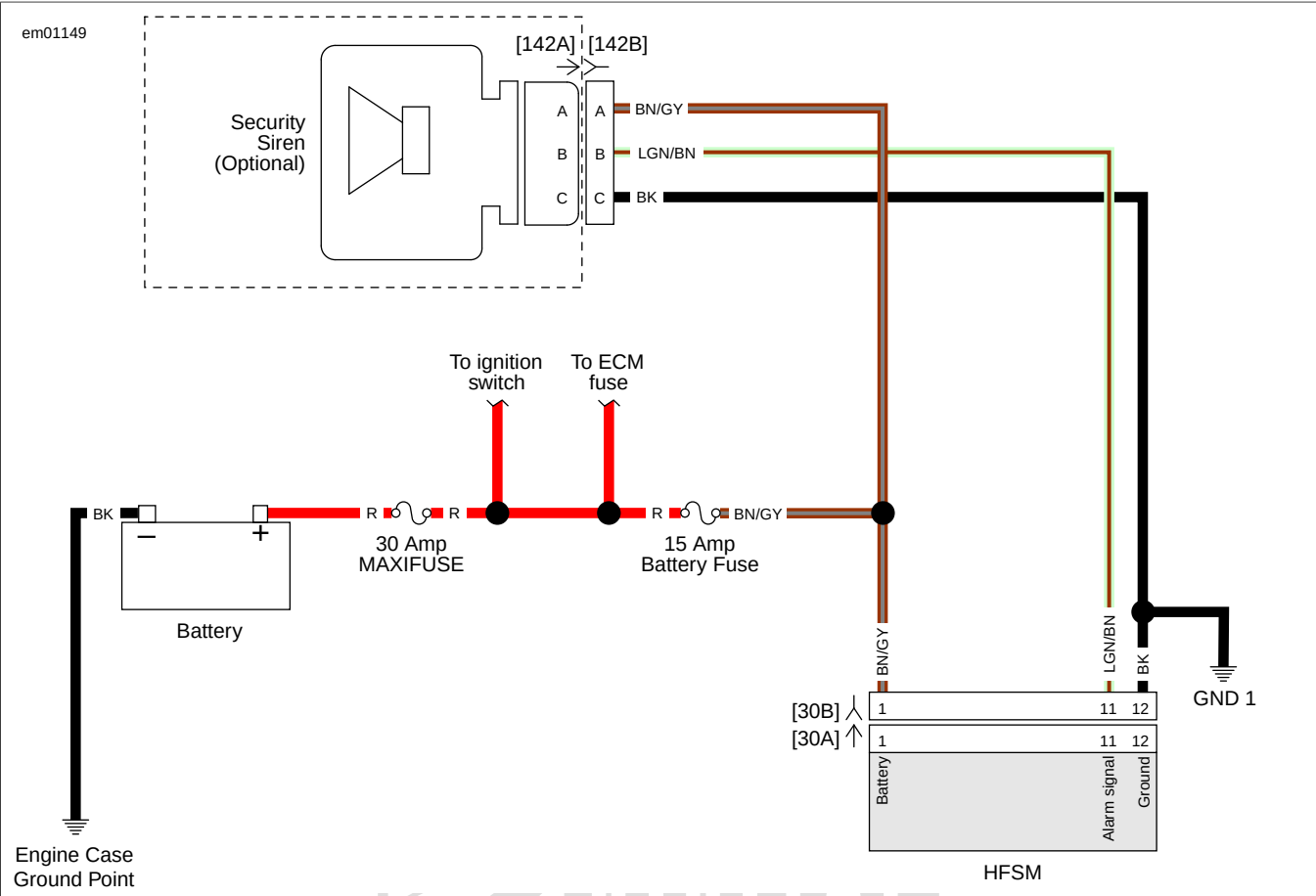
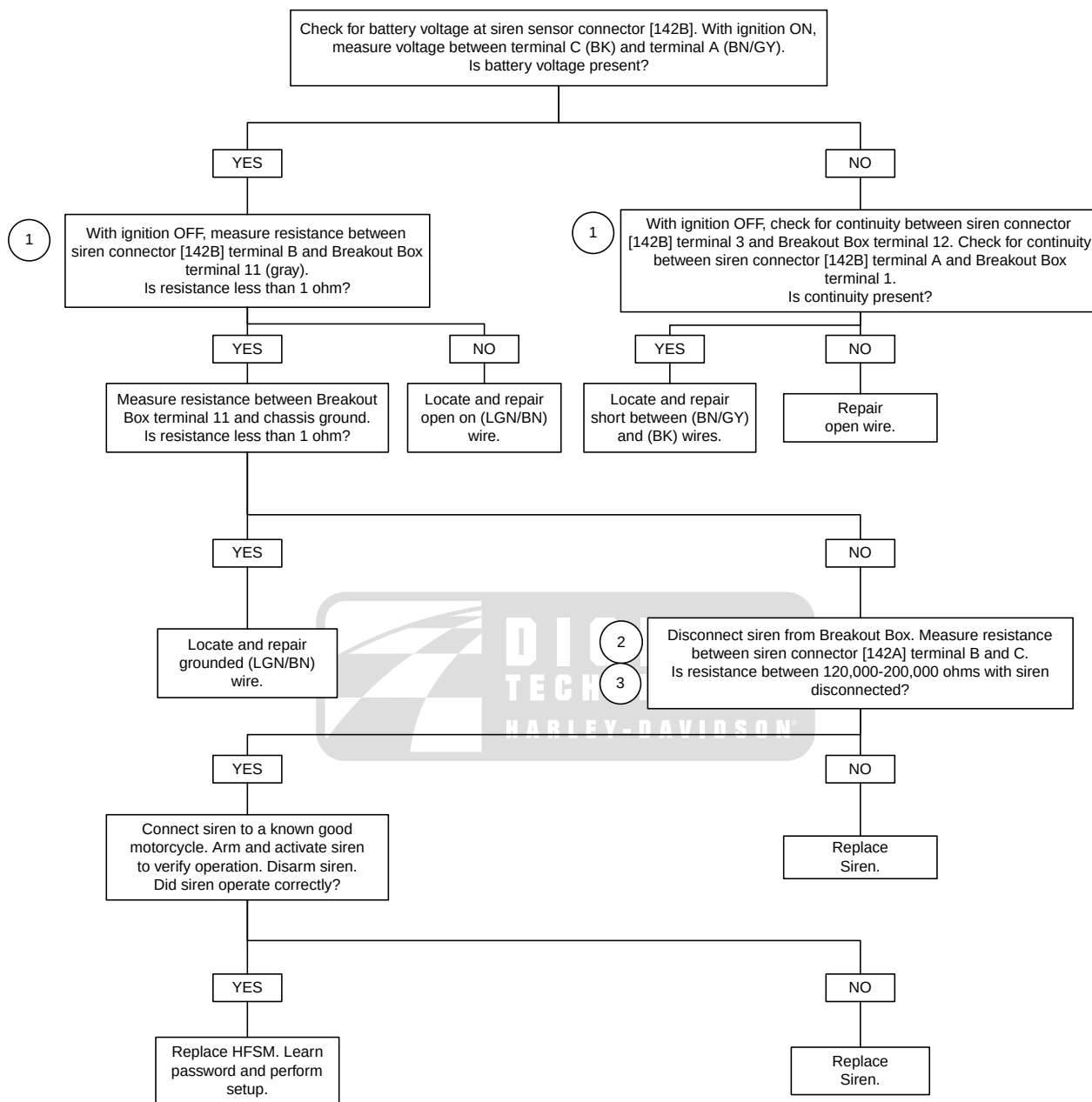


Figure 3-25. Smart Siren Circuit

Table 3-15. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[30]	HFSM	12-place Deutsch	Electrical panel behind fender extension
[142]	Security siren	3-place Packard	Electrical panel behind fender extension

DTCs B1131 and B1132



Clear DTCs using odometer self-diagnostics. See 3.11
 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation
 with no check engine lamp.

fc01806_en

DTC B1134

3.17

GENERAL

With the HFSM (if equipped) disarmed, Ignition Switch turned to IGNITION, and Engine Stop Switch set to RUN, (see [Figure 3-26](#)) the start relay is grounded. Battery voltage is applied to the start relay and coil which are grounded through the TSM/HFSM. DTC B1134 is set when that ground is not established through the TSM/HFSM.

Table 3-16. Code Description

DTC	DESCRIPTION
B1134	Starter output high

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-42682	BREAKOUT BOX

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. Connect BREAKOUT BOX (Part No. HD-42682), gray to wire harness connector [30] leaving TSM/HFSM disconnected. See [3.12 BREAKOUT BOX: TSM/HFSM](#).



Figure 3-26. Start Relay



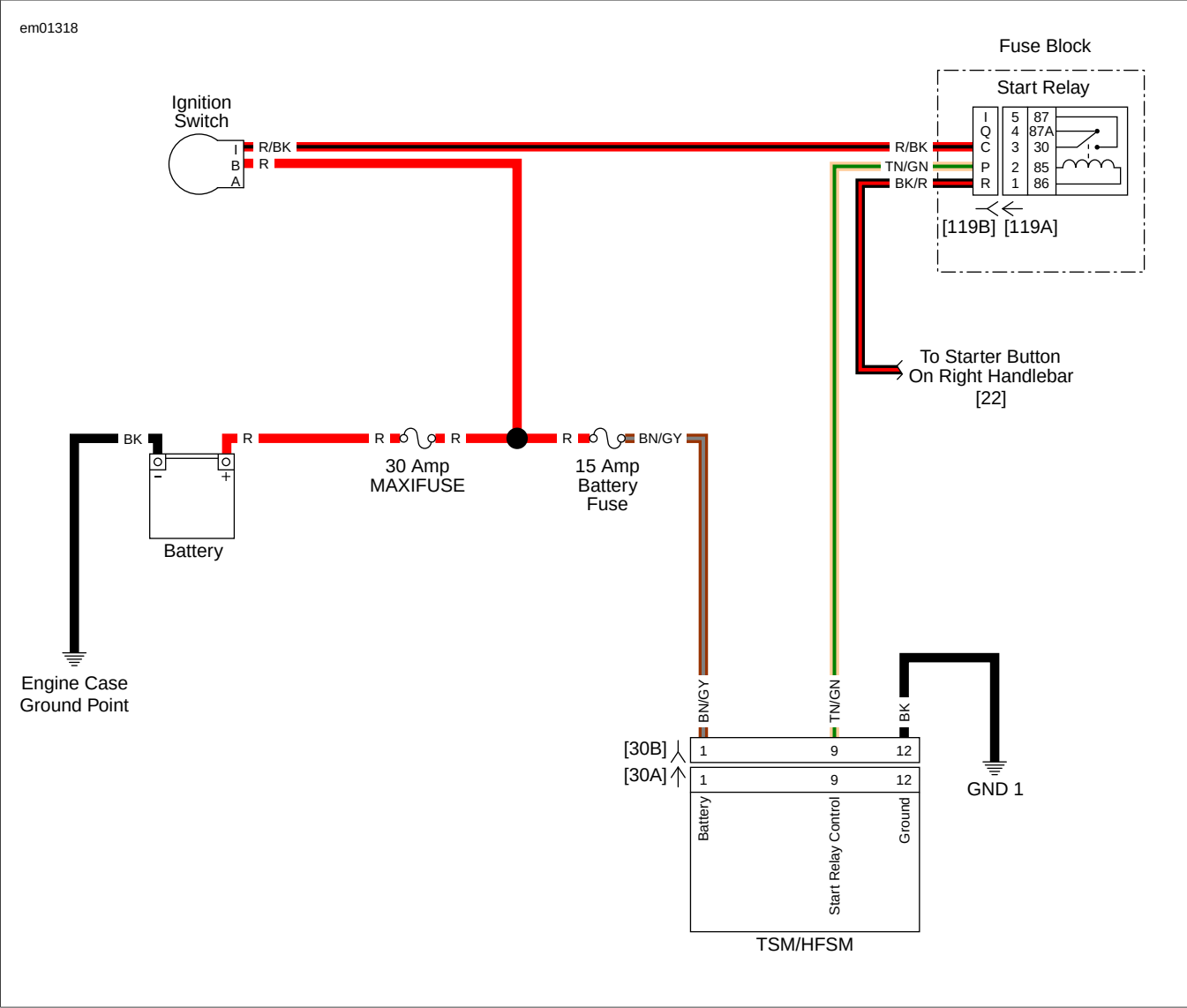
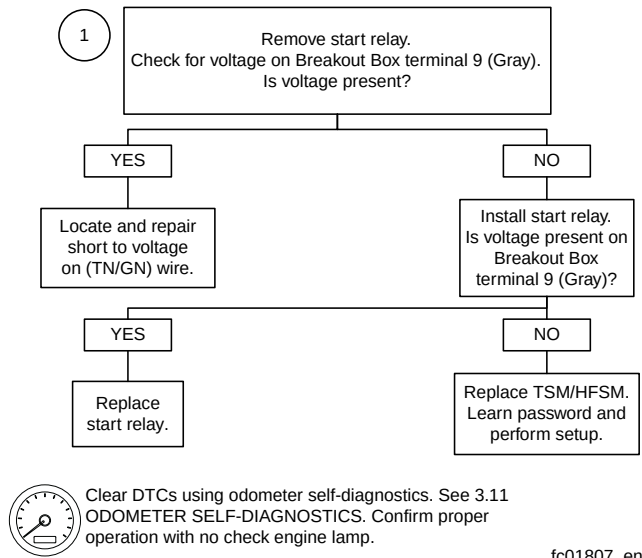


Figure 3-27. Starter TSM/HFSM Circuits

Table 3-17. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[22]	Right handlebar controls	6-place Molex	Under fuel tank
[30]	TSM/HFSM	12-place Deutsch	Under battery
[119]	Start relay	5-place Amp	Under left side cover

DTC B1134

DTCS B1135, B1136, B1141, AND B1142

3.18

DIAGNOSTICS

DTC B1135 Accelerometer Fault

DTC B1135 indicates a failure which requires replacement of the TSM/HFSM.

NOTE

When DTC B1135 is set, the tip-over engine shutdown, HFSM tamper alarm and bank angle sensors are disabled. The security lamp will also illuminate when this code is set.

DTC B1136 ACCELEROMETER TIP-OVER SELF-TEST FAULT AND DTC B1142 INTERNAL FAULT

DTCs B1136 and B1142 indicates a failure which requires replacement of the HFSM.

DTC B1141 IGNITION SWITCH OPEN/LOW

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX

DTC B1141: Ignition Switch Open/Low is a symptom of Will Not Flash and can be diagnosed using the flowcharts.

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. Connect BREAKOUT BOX (Part No. HD-42682) (gray) between TSM/HFSM connector [30A] and wiring harness connector [30B]. See [3.12 BREAKOUT BOX: TSM/HFSM](#).
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), gray terminal probe and patch cord.

Table 3-18. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[5]	MAXIFUSE	2-place Metri-Pack, black	On battery strap, behind left side cover
[7]	Rear lighting	6-place Multilock	Under seat
[18]	Left rear turn signal	2-place Multilock	Inside tail lamp lens
[19]	Right rear turn signal	2-place Multilock	Inside tail lamp lens
[20]	Instruments	12-place Molex	Under fuel tank
[22]	Right handlebar controls	6-place Molex	Under fuel tank
[24]	Left handlebar controls	8-place Molex	Under fuel tank
[30]	TSM/HFSM	12-place Deutsch	Under battery
[31]	Front turn signals	6-place Multilock	Under fuel tank
[61B]	Fuse block	Spade terminals	Behind left side door
[78]	ECM	36-place Packard	Under seat
[94]	Tail lamp power in	6-place Multilock, black	Inside tail lamp lens
[119]	Relay/fuse block	5-place Amp, spade terminals	Fuse/relay block, behind left side cover
[128]	Starter solenoid	Locking spade terminal, white	Stater solenoid
[136]	Neutral switch	1-place molded jumper, black	Right side frame, beneath gear case cover
[142]	Security siren	3-place Packard, black	Under frame
[208]	HFSM antenna connector	4-place Deutsch, gray	Under battery
[209]	Security antenna	Ring terminal	Crankcase housing, top rear

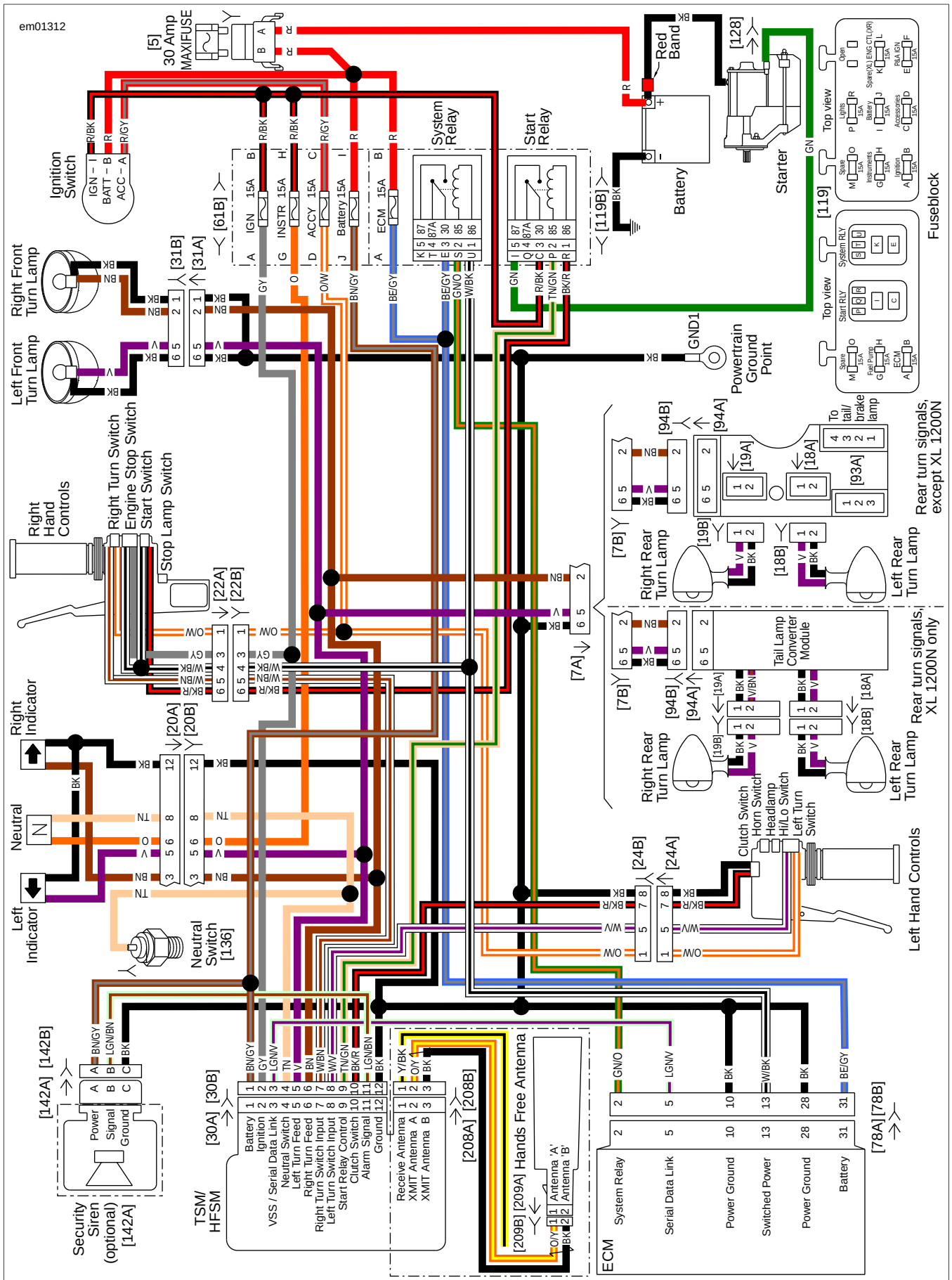
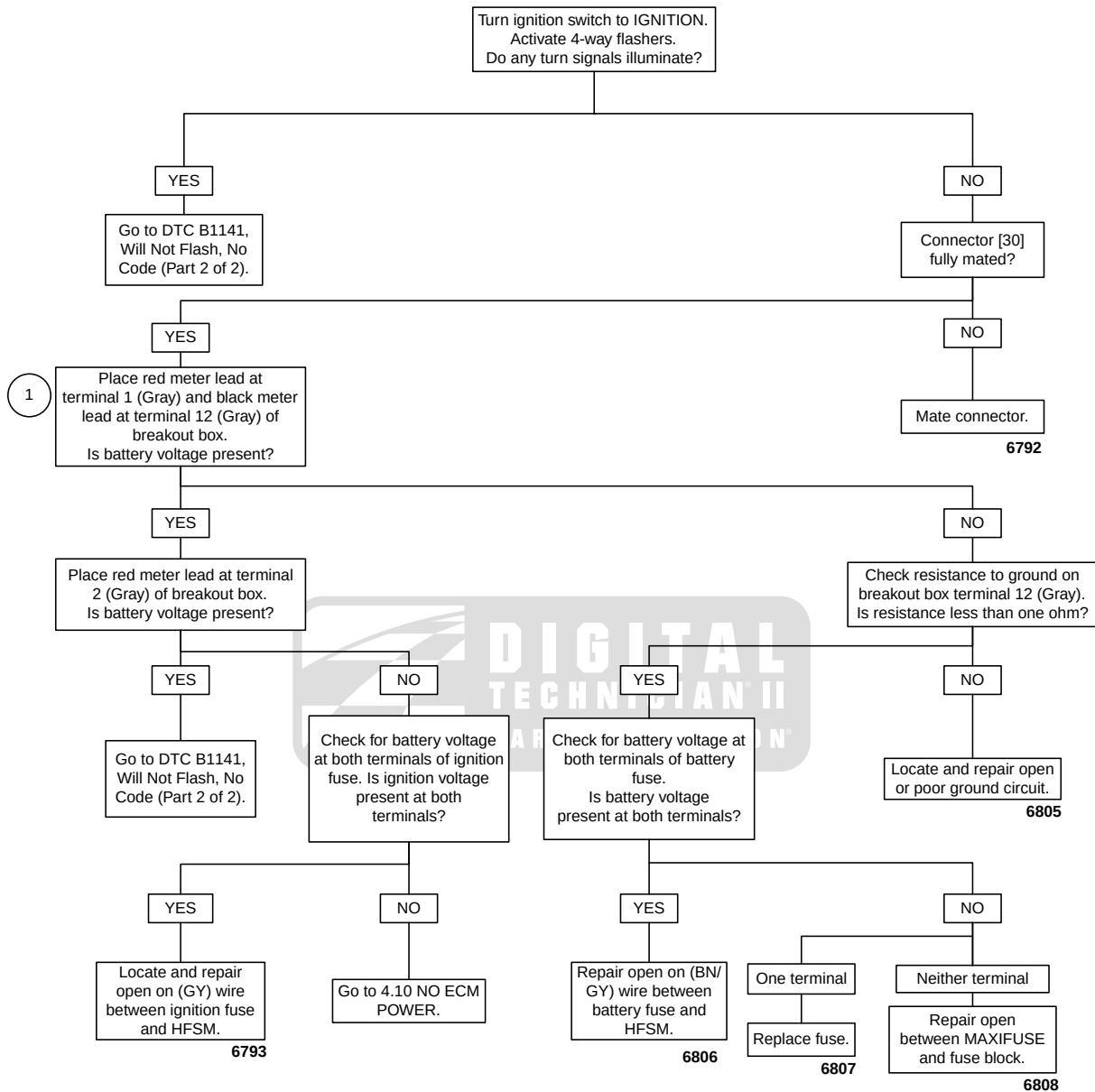


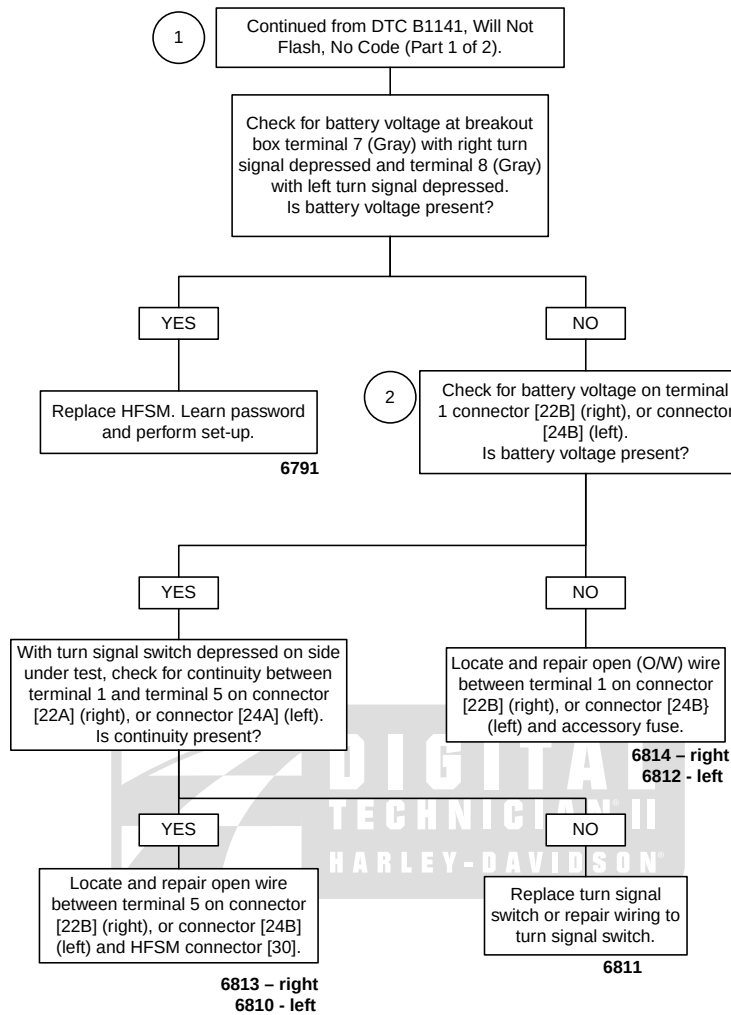
Figure 3-28. Turn Signal Circuit

DTC B1141, Will Not Flash, No Codes (Parts 1 of 2)



fc01958_en

DTC B1141, Will Not Flash, No Codes (Parts 2 of 2)



fc01959_en

DTC B1143, B1144, B1145 (HFSM ONLY)

3.19

GENERAL

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT

DTCs B1143, B1144 and B1145 will set when faults occur to the security antenna circuit used to transmit to the fob. Refer to [Table 3-19](#).

DTC B1143: Security Antenna Short-to-Ground

1. Disconnect antenna connector [208] from HFSM.
2. Using the black male of HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) attach it to connector [208B].
3. Measure resistance between [208B] terminal 2, 3 and ground. Is the resistance greater or less than 1 ohm?
 - a. If the resistance is less than 1 ohm, locate and repair short-to-ground. Use job code 6879.
 - b. If the resistance is greater than 1 ohm, replace the HFSM, learn password and perform set-up. Use job code 6791.

DTC B1144: Security Antenna Short-to-Voltage

1. With the ignition ON, disconnect antenna connector [208] from HFSM.
2. Using the black male of HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) attach it to connector [208B].
3. Check the voltage between [208B] terminal 2, 3 and ground. Is there voltage present?
 - a. If there is voltage present, locate and repair short-to-voltage. Use job code 6879.
 - b. If there is not voltage present, replace the HFSM, learn password and perform set-up. Use job code 6791.

Table 3-19. Security Antenna DTCs

DTC	CONDITION	DIAGNOSTICS
B1143	Security antenna short-to-ground	DTC B1143: Security Antenna Short-to-Ground
B1144	Security antenna short-to-voltage	DTC B1144: Security Antenna Short-to-Voltage
B1145	Security antenna open	DTC B1145

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. Use black male HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) to connector [208B].
2. If DTC is current (lamp on continuously, cleared codes return during operation), replace HFSM. If DTC is historic, check for intermittents.
3. Connect light blue male HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) to connector [209B] and black male HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) to connector [208B].

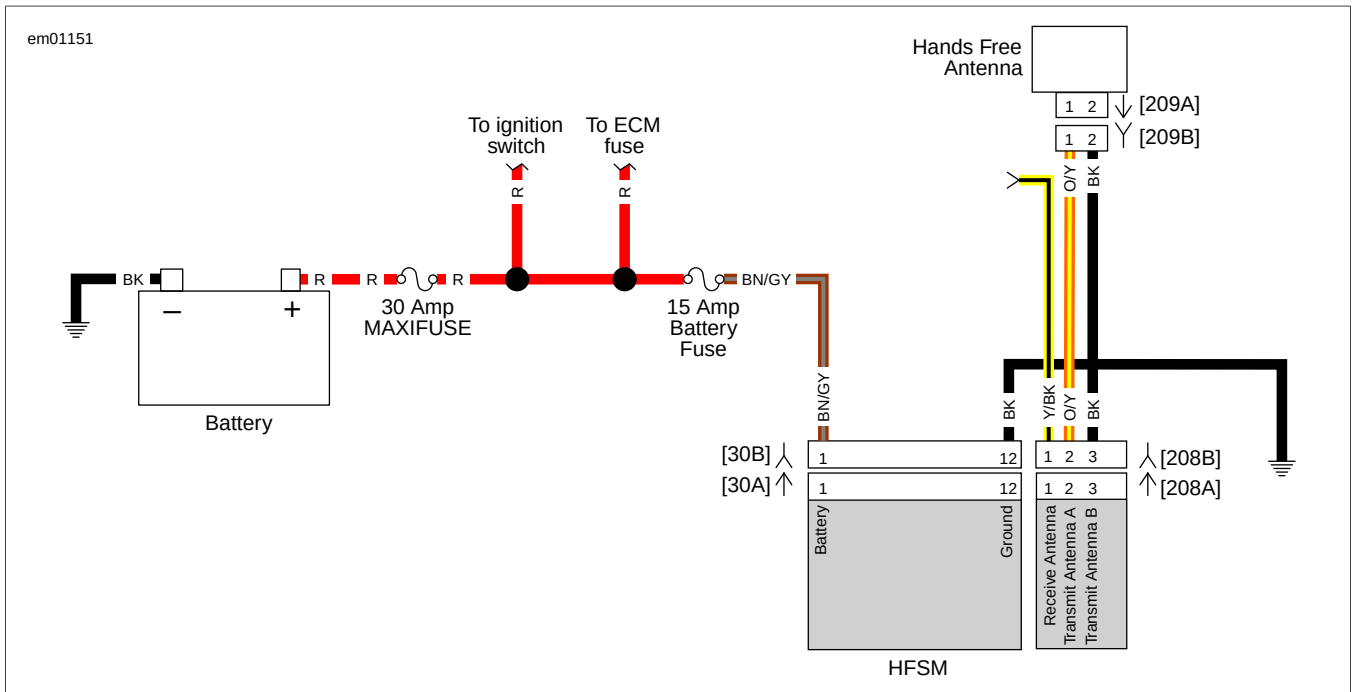
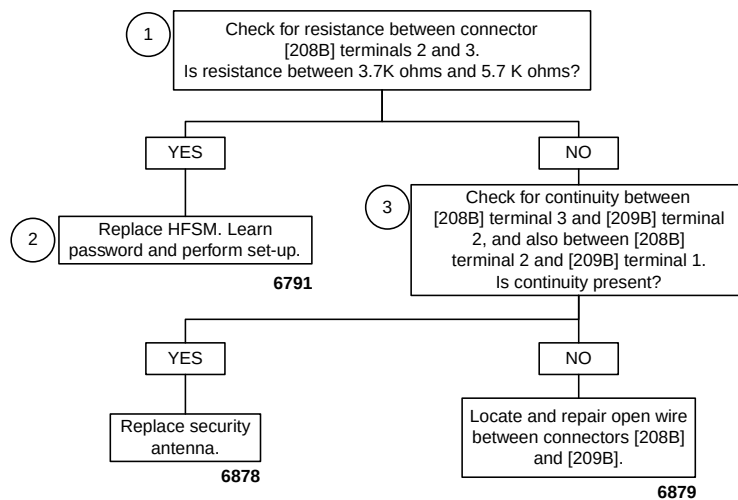


Figure 3-29. Security Antenna Circuit

Table 3-20. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[30]	HFSM	12-place Deutsch	Electrical panel behind fender extension
[208]	HFSM	4-place Deutsch	Electrical panel behind fender extension
[209]	Security antenna	2-place Molex	Under seat

DTC B1145

fc01144_en



DTC B1154, B1155

3.20

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-42682	BREAKOUT BOX

Diagnostic Tips

DTCs B1154 and B1155 will set when either the clutch switch circuit or the neutral switch circuit is shorted to ground at speeds greater than 10 MPH (16 km/h) for more than 60 seconds. Refer to [Table 3-21](#).

Table 3-21. Clutch/Neutral Switch DTCs

DTC	SYMPTOM
B1154	Clutch switch short-to-ground
B1155	Neutral switch short-to-ground

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. Connect BREAKOUT BOX (Part No. HD-42682) to HFSM. [3.12 BREAKOUT BOX: TSM/HFSM](#).
2. If DTC is current (lamp on continuously, clear codes return during operation), replace HFSM. If DTC is historic, check for intermittents.
3. A reading of several hundred ohms is normal due to the neutral indicator lamp (LED).



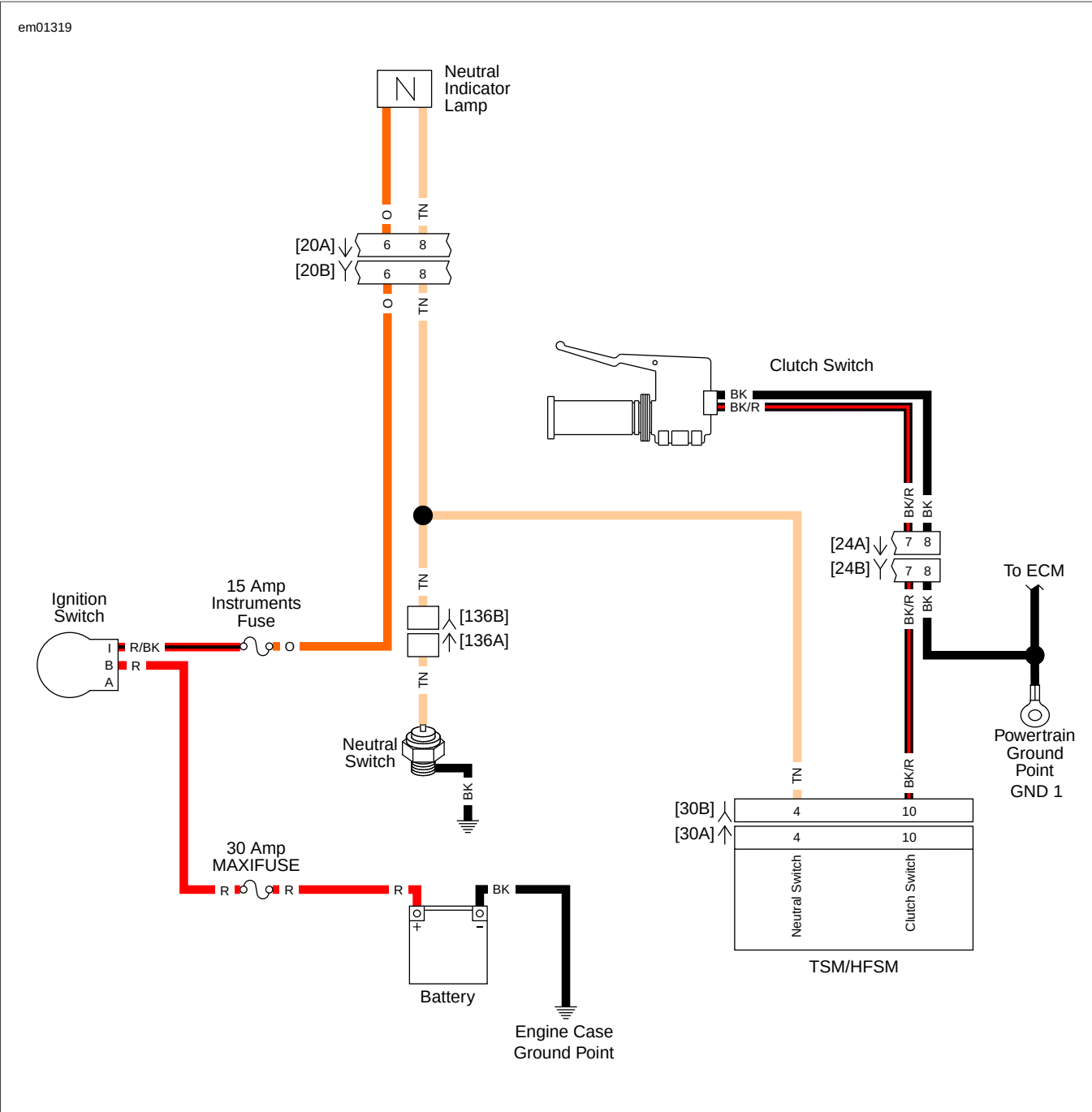
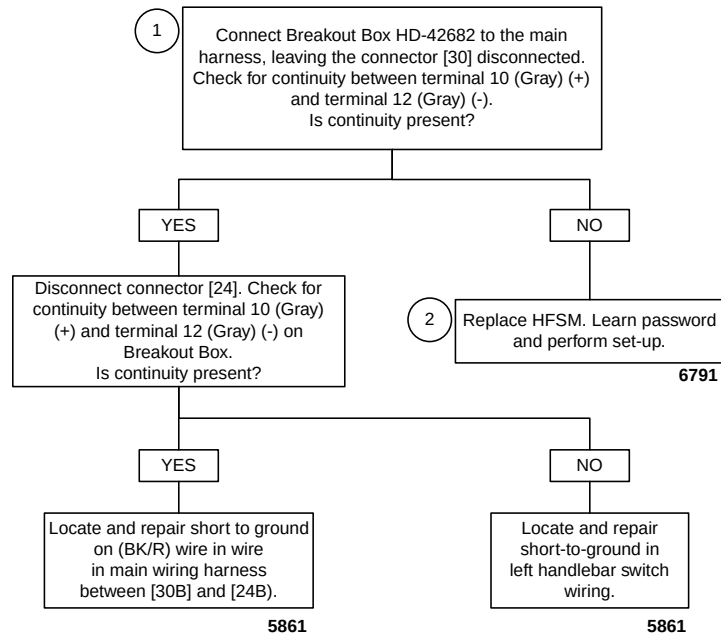


Figure 3-30. Clutch and Neutral Interlock Circuits

Table 3-22. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[20]	Instruments	12-place Molex	Under fuel tank
[24]	Left handlebar controls	8-place Molex	Under fuel tank
[30]	TSM/HFSM	12-place Deutsch	Under battery

DTC B1154

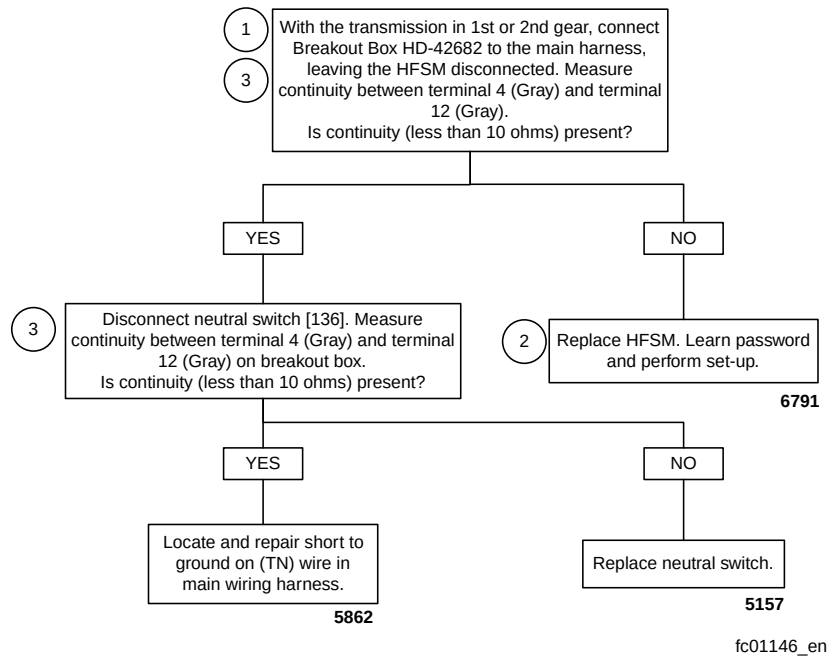


NOTE

This DTC may occur if the vehicle is ridden with clutch disengaged (pulled in) at speeds greater than 10 MPH (16 km/h) for more than 60 seconds (coasting down a long mountain road).

fc01145_en



DTC B1155

DTC U1016, U1255

3.21

GENERAL

The serial data connector provides a means for the ECM (see [Figure 3-32](#) for XL, and [Figure 3-33](#) for XR), TSM/HFSM, and speedometer and tachometer to communicate their current status. When all operating parameters on the serial data bus are within specifications, a state of health message is sent between the components.

- DTC U1016 indicates that the ECM is not capable of sending this state of health message.
- DTC U1255 indicates that no messages were present during power up of the current key cycle.
- DTC U1016 indicates that there was communication on the data bus since power up, but communication was lost or interrupted during that key cycle.

Table 3-23. Code Description

DTC	CONDITION
U1016	Loss of all ECM serial data (state of health)
U1255	Serial data error/missing message



Figure 3-31. ECM Location

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-42682	BREAKOUT BOX
HD-43876	BREAKOUT BOX

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. Connect BREAKOUT BOX (Part No. HD-42682) (gray) between TSM/HFSM connector [30A] and wire harness connector [30B]. See [3.12 BREAKOUT BOX: TSM/HFSM](#).
2. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness and ECM. See [4.7 BREAKOUT BOX: EFI](#).

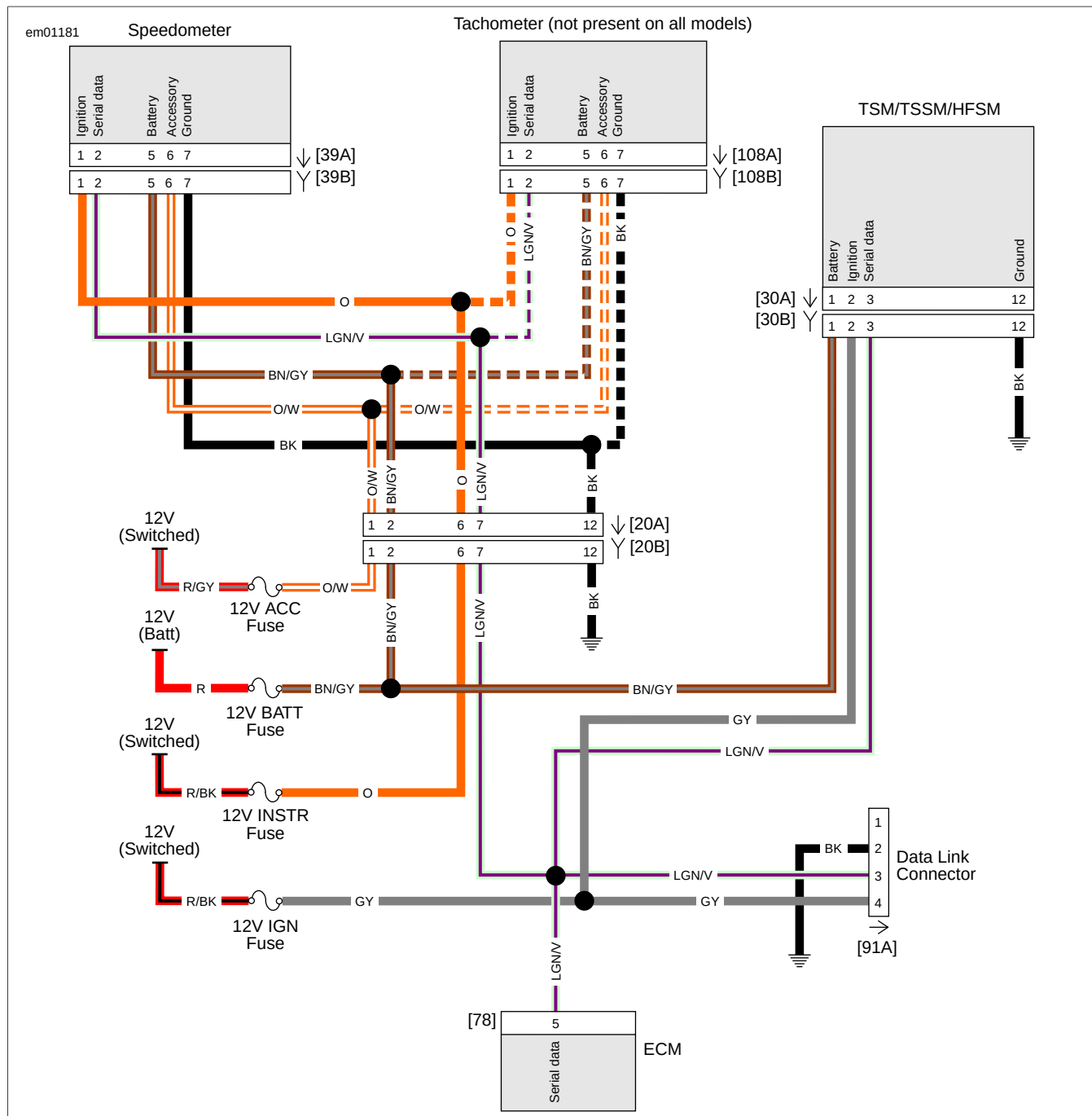


Figure 3-32. Serial Data Circuit (XL)

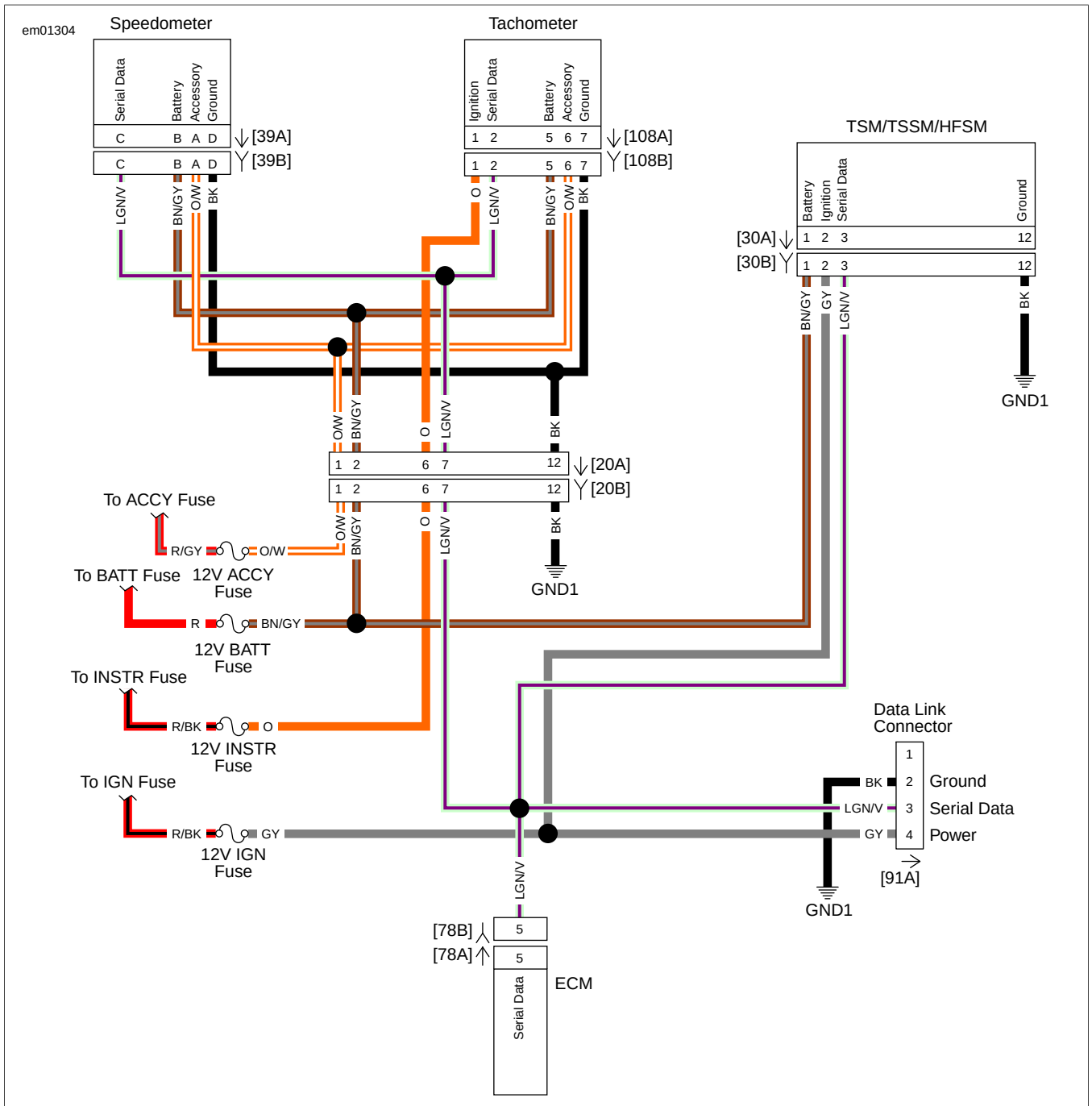


Figure 3-33. Serial Data Circuit (XR)

Table 3-24. Wire Harness Connectors

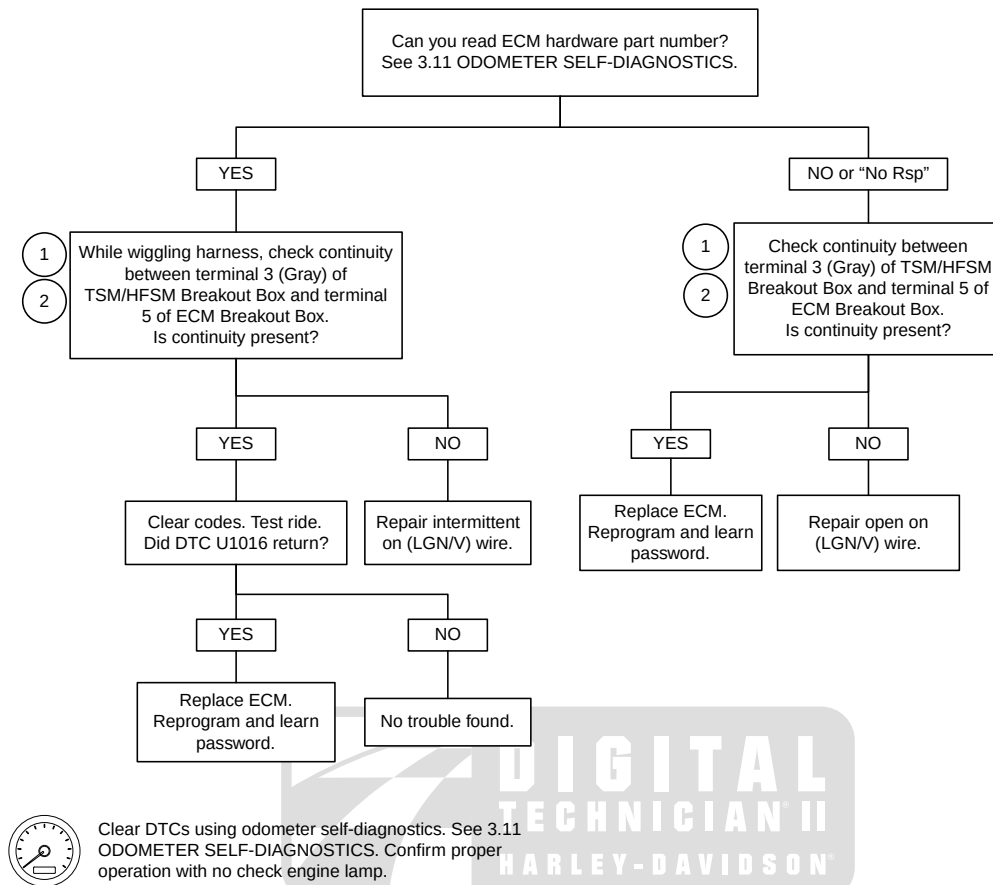
NO.	DESCRIPTION	TYPE	LOCATION
[20]	Instruments	12-place Molex	Under fuel tank
[30]	TSM/HFSM	12-place Deutsch	Under battery
[39]	Speedometer (XL)	12-place Packard	Back of speedometer
[39]	Speedometer (XR)	5-place Packard	Back of speedometer display
[78]	ECM	36-place Packard	Under seat

Table 3-24. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[91]	Data link connector	4-place Deutsch	On battery strap, behind left side cover
[108]	Tachometer (if equipped)	12-place Packard	Back of tachometer



DTCs U1016 and U1255



fc01808_en

DTC U1300, U1301 OR BUS ER

3.22

DIAGNOSTICS

The typical serial data voltage range is 0 volts (inactive) to 7 volts (active). Due to the short pulse, voltages will be much lower on a DVOM. In analog mode, a DVOM reading serial data will show continuous voltage when active, typically 0.6-0.8 volts. The range for acceptable operations is 0-7.0 volts.

Diagnostic Tips

- If serial data is shorted, these Diagnostic Trouble Codes (DTCs) will automatically cause the check engine lamp to illuminate. The odometer will read "BUS Er" in this condition.
- DTCs P1009 and P1010 may accompany DTCs U1300 and U1301.

Diagnostic Notes

If a U1300, U1301 or "BUS Er" is present, perform diagnostic procedures listed in [4.11 STARTS, THEN STALLS](#).



Figure 3-34. Data Link Connector [91A]

Table 3-25. Code Description

DTC	DESCRIPTION	START WITH FLOWCHART
U1300	Serial data low	4.11 STARTS, THEN STALLS
U1301	Serial data open/high	4.11 STARTS, THEN STALLS



TSM/HFSM: PASSWORD LEARN

3.23

GENERAL

If the ECM or TSM/HFSM is faulty, follow the instructions in the service manual for ECM or TSM/HFSM replacement. Then, to determine if password learn is necessary, refer to [Table 3-26](#).

Table 3-26. Password Learn

DEVICE REPLACED	IS PASSWORD LEARN NECESSARY?
ECM	Yes
TSM	No *
TSM/HFSM	Yes
* If a TSM has been replaced by a HFSM, or a HFSM has been replaced by a TSM, password learn is necessary.	

PASSWORD LEARNING

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

To perform password learning procedure, refer to [Table 3-27](#). When finished, continue with all instructions under [3.3 H-DSSS ACTUATION](#).

Always perform all appropriate instructions under [3.3 H-DSSS ACTUATION](#) after TSM/HFSM replacement or removal.

NOTE

Fob assignment must be performed at an authorized Harley-Davidson dealer using DIGITAL TECHNICIAN II (Part No. HD-48650).

Table 3-27. Setting TSM/HFSM and ECM Password

NO.	ACTION	CONFIRMATION	NOTES
	Ignition must be turned off for at least 15 seconds.	With Ignition Switch turned off, Check Engine Lamp and Security Lamp will be off.	
1	Install new TSM/HFSM or ECM. Perform all steps under 3.3 H-DSSS ACTUATION .		
2	Set Engine Stop Switch to RUN .		
3	Turn Ignition Switch ON .	Verify Check Engine Lamp and Security Lamp illuminate and then turn off.	TSM/HFSM enables start relay.
4	Attempt normal start one time.	Engine starts and stalls. Check Engine Lamp illuminates and stays on.	Password has not been learned. ECM sets DTC P1009.
5	Wait ten seconds. Security Lamp will illuminate and stay on.	Security Lamp illuminates.	ECM enters Password Learning mode for ten minutes. Do not cycle Ignition Switch or interrupt vehicle power or Password Learn will be unsuccessful.
6	Wait until Security Lamp turns off.		This takes ten minutes.
7	Quickly (within two seconds) turn Ignition Switch OFF-ON .		ECM must not be allowed to shutdown.
8	Wait until Security Lamp turns off.		This takes ten minutes.
9	Quickly (within two seconds) turn Ignition Switch OFF-ON .		ECM must not be allowed to shutdown.
10	Wait until Security Lamp turns off.		This takes ten minutes.
11	Quickly (within two seconds) turn Ignition Switch OFF-ON .		ECM must not be allowed to shutdown.
12	Turn Ignition Switch OFF . Wait 15 seconds before turning Ignition Switch on. Turn Ignition Switch ON and start engine to confirm successful Password Learn procedure. Clear DTCs.		
13	Perform all steps under 3.3 H-DSSS ACTUATION .		

HFSM MAINTENANCE

3.24

GENERAL

The HFSM uses a battery in the fob and siren. These are the only parts requiring periodic maintenance.

HANDS-FREE FOB

Schedule

Replace the fob battery every year.

Battery Replacement

1. See [Figure 3-35](#). Open the fob case.
 - a. Place a thin blade in the thumbnail slot (1) between the 2 halves of the case.
 - b. Slowly twist the blade.
2. Replace battery (2).
 - a. Remove the original battery.
 - b. Install a **new** battery with the positive (+) side down. Use a Panasonic® 2032 or equivalent.
3. With O-ring (3) in place, align case halves and snap case halves together.

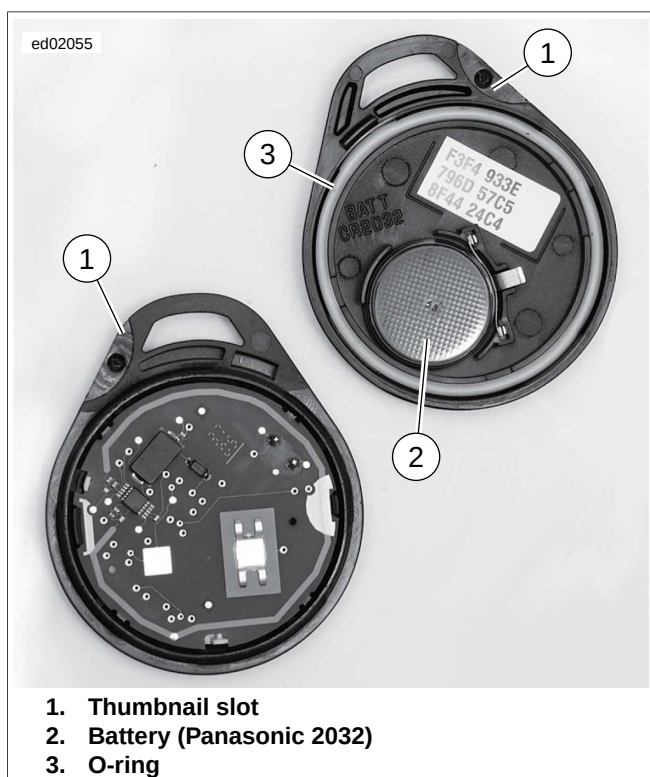


Figure 3-35. Open Fob: HFSM

SMART SIREN (IF INSTALLED)

Schedule

The siren's internal 9 volt battery is rechargeable and does not need to be replaced on a regular basis. Battery life under normal conditions is approximately three to six years.

NOTES

- See [Figure 3-36](#) and [Figure 3-37](#). Early style siren will work with both TSSM and HFSM. Late style siren will only work with HFSM.
- The internal siren battery may not charge if the vehicle's battery is less than 12.5 volts.

Battery Replacement: Early Style Siren

1. Disarm system and remove siren.
2. See [Figure 3-36](#). Remove battery cover.
 - a. Place the siren module on a flat and sturdy table with the potted section (area with epoxy covering circuit board) facing up and towards you.
 - b. Position a knife blade at a 45 degree angle to the long side of the siren case. Insert the knife blade between the siren case and battery cover at one of the two accessible corners of the battery cover. Keep the blade slightly higher towards the battery cover as this helps keep the blade away from the battery seal.
 - c. Slowly twist the blade towards the battery cover and the cover will pop off.

NOTES

- For protection against corrosion, battery terminals and battery clip are covered with a special grease. Do not wipe away this substance. Apply all available existing grease to terminals on new battery.
 - Only a 9 volt nickel metal hydride battery should be used in the siren.
3. Replace battery by removing old battery from polarized battery clip. Install a **new** 9 volt nickel metal hydride battery.
 4. Reinstall battery cover.
 - a. Carefully replace the rubber seal.
 - b. Align battery cover with case placing round corners on cover away from connector [142A]. Snap cover into place.
 5. Install siren and check operation. If siren is working properly, it will respond with two chirps after receiving the arm command.

Battery Replacement: Late Style Siren

1. Disarm system and remove siren.
2. See [Figure 3-37](#). With a small screwdriver or pick, push the catches (1) in through the two slots (2) in the end of the siren to release the battery cover (3).

NOTES

- For protection against corrosion, battery terminals and battery clip are covered with a special grease. Do not wipe away this substance. Apply all available existing grease to terminals on new battery.
 - Only a 9 volt nickel metal hydride battery should be used in the siren.
3. Replace battery (4) by removing old battery from polarized battery clip.
 4. Recharge and re-install or install a **new** 9 volt nickel metal hydride battery.
 5. Reinstall battery cover (3).
 - a. Carefully replace the rubber seal (5) on the cover.
 - b. Align battery cover with case placing round corners on cover away from connector [142A] (6).
 - c. Snap cover into place.
 6. Install siren and check operation. If siren is working properly, it will respond with two chirps after receiving the arm command.

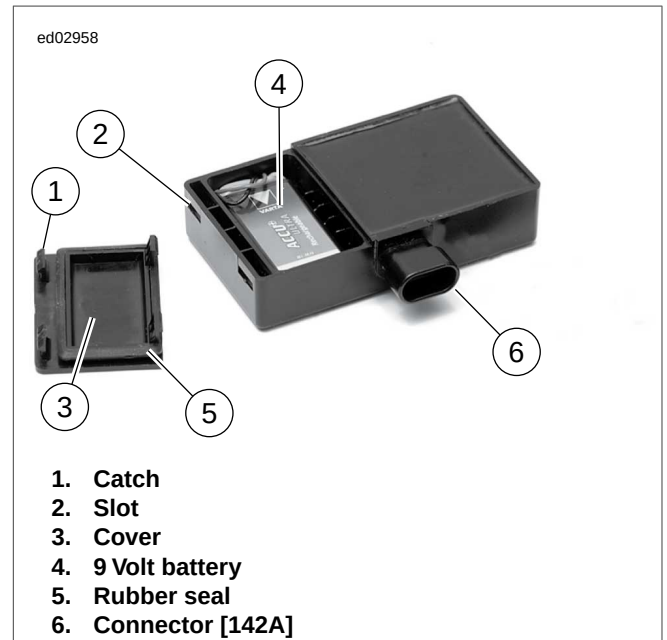


Figure 3-37. Siren Battery Compartment (Late Style Siren)

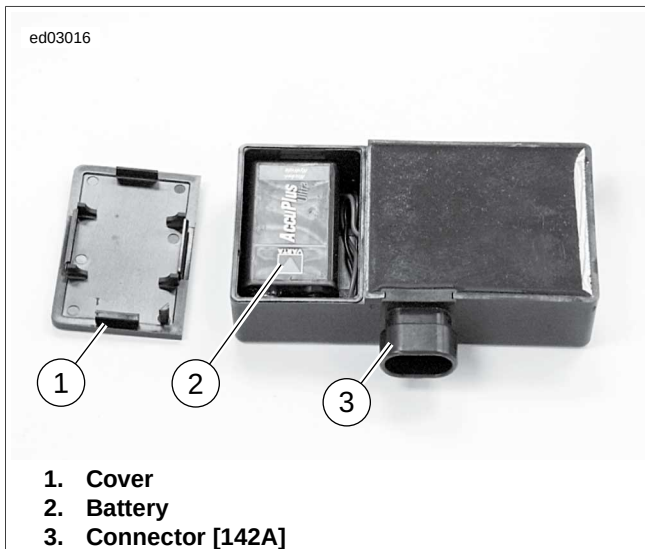


Figure 3-36. Battery Compartment (Early Style Siren)

DIGITAL
TECHNICIAN II
 HARLEY-DAVIDSON®

NOTES



TABLE OF CONTENTS

SUBJECT	PAGE NO.
4.1 SPECIFICATIONS.....	4-1
4.2 EFI SYSTEM.....	4-3
4.3 EFI DIAGNOSTIC INTRODUCTION.....	4-5
4.4 CHECKING FOR DIAGNOSTIC TROUBLE CODES: EFI.....	4-6
4.5 INITIAL DIAGNOSTIC CHECK: EFI.....	4-9
4.6 ODOMETER SELF-DIAGNOSTICS.....	4-20
4.7 BREAKOUT BOX: EFI.....	4-22
4.8 WIGGLE TEST.....	4-23
4.9 ENGINE CRANKS, BUT WILL NOT START.....	4-24
4.10 NO ECM POWER.....	4-31
4.11 STARTS, THEN STALLS.....	4-36
4.12 FUEL SYSTEM ELECTRICAL TEST.....	4-42
4.13 SYSTEM RELAY CHECK.....	4-50
4.14 IDLE AIR CONTROL.....	4-55
4.15 MISFIRE AT IDLE OR UNDER LOAD.....	4-60
4.16 DTC P0107, P0108, P0112, P0113.....	4-66
4.17 DTC P0117, P0118.....	4-73
4.18 DTC P0122, P0123.....	4-77
4.19 DTC P0131, P0132, P0134, P0151, P0152, P0154.....	4-82
4.20 DTC P0261, P0262, P0263, P0264.....	4-87
4.21 DTC P0373, P0374.....	4-93
4.22 DTC P0501, P0502.....	4-96
4.23 DTC P0562, P0563.....	4-100
4.24 DTC P0603, P0605.....	4-104
4.25 DTC P0661, P0662.....	4-105
4.26 DTC P1009, P1010.....	4-109
4.27 DTC P1351, P1352, P1354, P1355.....	4-114
4.28 DTC P1501, P1502.....	4-119
4.29 DTC U1064, U1255.....	4-124
4.30 DTC U1097, U1255.....	4-129
4.31 FUEL PRESSURE TEST.....	4-134

NOTES



SPECIFICATIONS

4.1

SPECIFICATIONS

Table 4-1. General Specifications

IGNITION	DATA
Idle speed	1000 ± 50 RPM
Spark plug size	12 mm
Spark plug gap	0.038-0.043 in (0.97-1.09 mm)
Spark plug gap (XR)	0.032-0.038 in (0.81-0.97 mm)
Spark plug type	Harley-Davidson No. 6R12 (no substitute)
Spark plug type (XR)	Harley-Davidson No. 10R12X
Ignition coil primary resistance at room temperature	0.3-0.7 ohms
Ignition coil secondary resistance at room temperature	1500-2400 ohms

Table 4-2. Fuse Ratings

ITEM	RATING (AMPERES)
ECM fuse	15
Fuel pump fuse	15
Ignition fuse	15
Instruments fuse	15
Accessory fuse	15
Battery fuse	15
Lights fuse	15
P&A ignition fuse	15
Main fuse	30
Engine Control	15



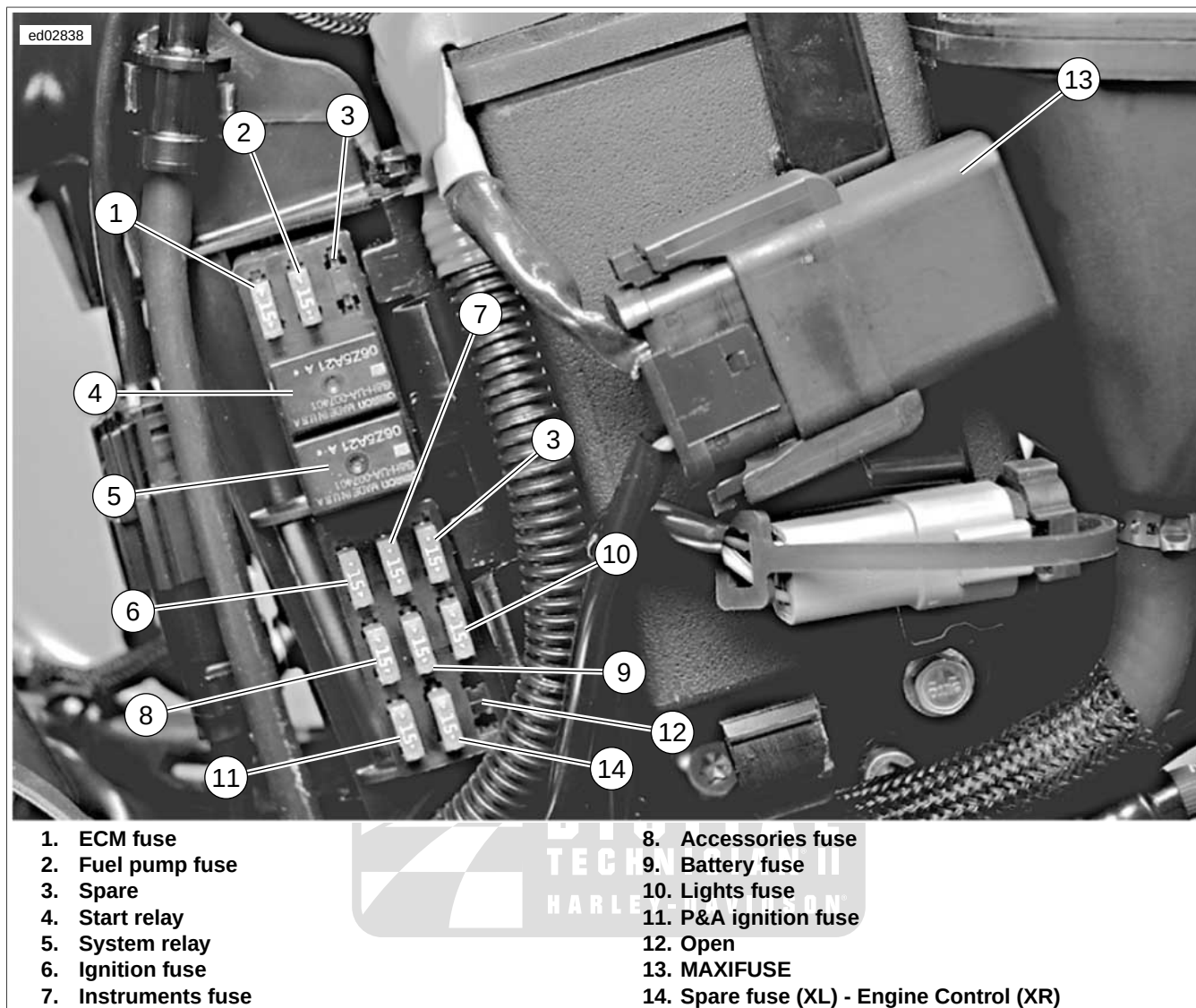


Figure 4-1. Fuses and Relays

GENERAL

The engine management system consists of the following components:

- Electronic Control Module (ECM).
- Crankshaft Position (CKP) Sensor.
- Combination Intake Air Temperature (IAT)/Manifold Absolute Pressure (MAP) Sensor (TMAP).
- Idle Air Control (IAC).
- Throttle Position (TP) Sensor.
- Vehicle Speed Sensor (VSS).
- Turn Signal Module (TSM) or optional, factory-installed Turn Signal Security Module (TSSM) (Japan/Korea) or Hands-Free Security Module (HFSM). This includes an integrated Bank Angle Sensor (BAS).
- Ignition Coil.
- Jiffy Stand Sensor (HDI).
- Oxygen Sensors.
- Active Intake Solenoid (HDI).

The ECM is mounted under the seat. It computes the spark advance for proper ignition timing based on sensor inputs from CKP, TMAP and TP sensors, and regulates the low-voltage circuits between battery and ignition coil.

The ECM contains all of the solid state components used in the ignition system. The dwell time for the ignition coil is also calculated in the microprocessor and is dependent upon battery voltage. The programmed dwell is an added feature to give adequate spark at all speeds. (The ECM has added protection against transient voltages, continuous reverse voltage protection, and damage due to jump starts.) The ECM is fully

enclosed to protect it from vibration, dust, water or oil. This unit is a non-repairable item. If it fails, it must be replaced.

The CKP sensor is located in the front left side of the crankcase. The CKP sensor generates an AC signal which is sent to the ECM where it is used to reference engine position (TDC) and speed. It functions by taking readings off the 30 teeth on the left side flywheel (two teeth are missing to establish a reference point).

The TMAP sensor is located on top of the intake manifold. The TMAP sensor monitors the intake manifold pressure (vacuum) and intake air temperature and sends the information to the ECM where the module adjusts the spark timing and fuel curve for optimum performance.

The BAS is within the TSM/TSSM/HFSM. If the vehicle tips over, the engine will be shut off. Once the sensor is tripped, the motorcycle must be uprighted, turned off and then on again before the engine can be restarted. This is communicated across the data bus.

Front and rear coils fire each spark plug independently (one cylinder at a time - no wasted spark). The coil also has an extra terminal to monitor current on the coil secondary circuit. This is used for knock detection and combustion diagnostics.

The ignition system gives a spark near top dead center for starting. At RPM and loads above this, the system gives a spark advance that varies between 0 and 50.

The IAT, ET, TP and oxygen sensors are used to provide information to the ECM to fine tune spark and fuel delivery. The VSS is used as an input for idle speed control.

The oxygen sensors monitor the exhaust gas for oxygen content. The fuel/air mixture is then adjusted to maintain an optimal air/fuel ratio.

TROUBLESHOOTING

See the diagnostic charts for troubleshooting information.

4-4 2009 Sportster Diagnostics: Engine Management

EFI DIAGNOSTIC INTRODUCTION

4.3

SYSTEM PROBLEMS

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 security disabled 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 4-3](#). The check engine lamp indicates the Electronic Control Module (ECM) has determined a fault condition exists. There may also be starting or performance problems.

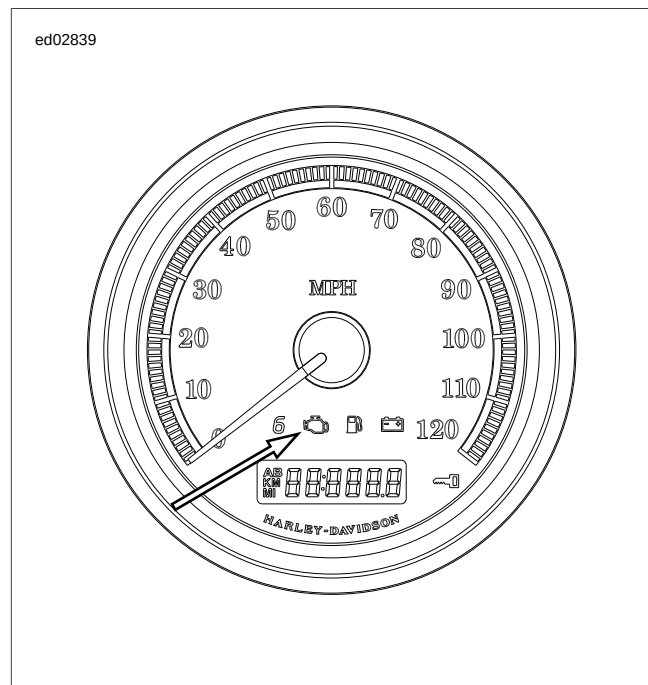


Figure 4-3. Check Engine Lamp (Typical)



RESOLVING PROBLEMS

To resolve system problems, five basic steps are involved. In order of occurrence, they are:

1. Check for DTCs by using odometer self-diagnostics. See [4.4 CHECKING FOR DIAGNOSTIC TROUBLE CODES: EFI](#).
2. Retrieve DTCs by using odometer self-diagnostics. See [4.6 ODOMETER SELF-DIAGNOSTICS](#).
3. Diagnose system problems. This involves using special tools and the diagnostic flowcharts 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 DTCs and confirming proper vehicle operation as indicated by the lack of DTCs.

CHECKING FOR DIAGNOSTIC TROUBLE CODES: EFI

4.4

CHECK ENGINE LAMP

To diagnose system problems, start by observing the behavior of the check engine lamp.

NOTES

- See [Figure 4-4](#). "Key ON" means that the Ignition Switch is turned to IGNITION and the Engine Stop Switch is set to RUN (although the engine is not running).
 - When the Ignition Switch is turned ON, the check engine lamp will illuminate for approximately four seconds and then turn off.
 - 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 see [4.6 ODOMETER SELF-DIAGNOSTICS](#).
 - If the check engine lamp comes on late (after 20 seconds), the problem is likely a serial data bus failure. Test for Diagnostic Trouble Codes (DTCs) using odometer self diagnostics. See [4.6 ODOMETER SELF-DIAGNOSTICS](#).
1. 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 DTCs currently detected by the Electronic Control Module (ECM).
 - b. The lamp stays off for only four seconds and then comes back on for an eight-second period. This indicates a code is stored, but no current DTC exists.
 - c. The lamp remains on beyond the eight-second period. This indicates a current DTC exists.

2. See [4.4 CHECKING FOR DIAGNOSTIC TROUBLE CODES: EFI, Code Types](#) for a complete description of DTC formats.

NOTE

Some DTCs 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 ECM 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.

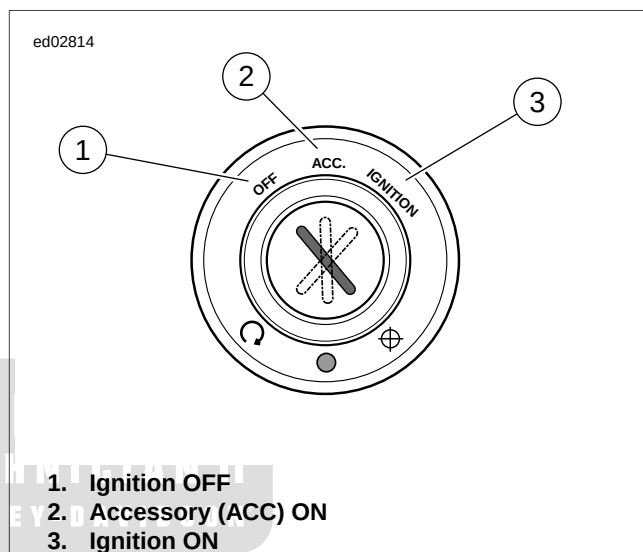


Figure 4-4. Ignition Switch

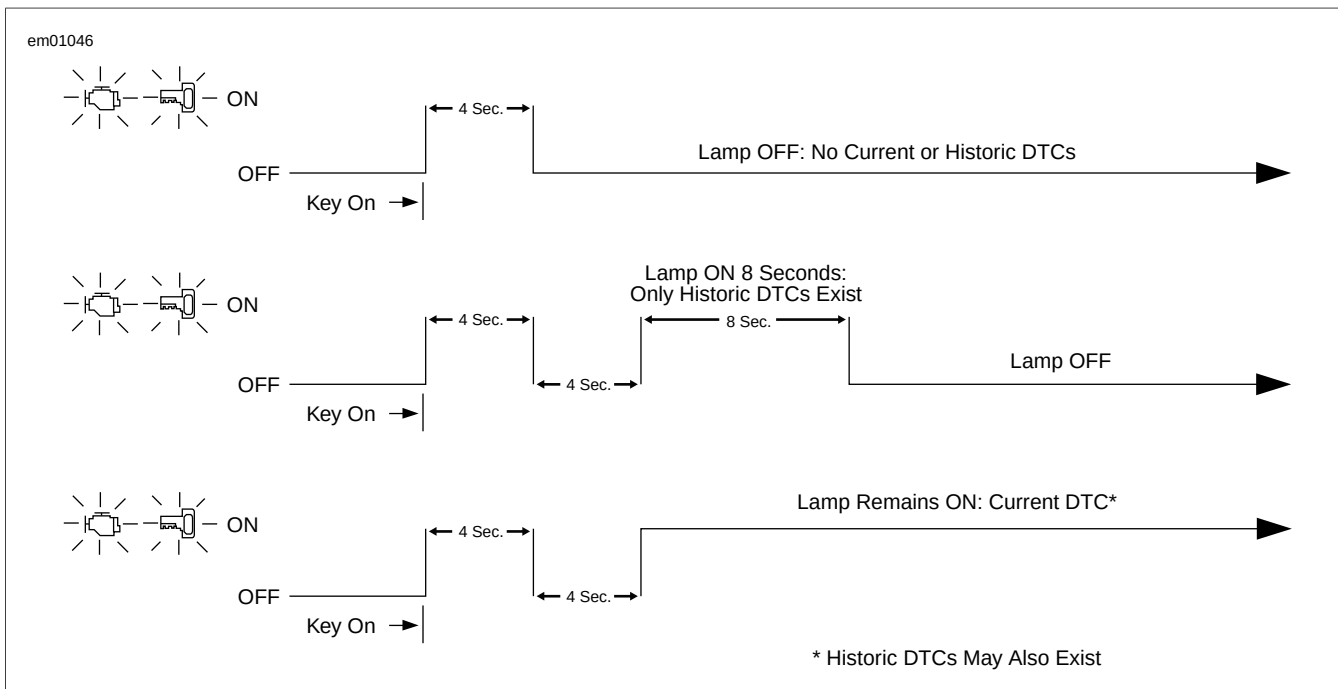


Figure 4-5. Check Engine Lamp Operation

CODE TYPES

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

There are two types of DTCs: current and historic. If a DTC is stored, it can be read using either a computer-based diagnostic package called DIGITAL TECHNICIAN II (Part No. HD-48650) or odometer self-diagnostics. See [4.6 ODOMETER SELF-DIAGNOSTICS](#).

NOTES

- To differentiate between current and historic DTCs, a computer-based diagnostic package called DIGITAL TECHNICIAN II (Part No. HD-48650) must be employed.
- All DTCs reside in the memory of the ECM, TSM/TSSM/HFSM, speedometer or tachometer until the DTC is cleared by use of the odometer self-diagnostics. See [4.6 ODOMETER SELF-DIAGNOSTICS](#).
- A historic DTC is also cleared after a total of 50 trips has elapsed. A trip consists of a start and run cycle. After the 50 trip retention period, the DTC is automatically erased from memory providing that no subsequent faults of the same type are detected in that period.

Current

Current DTCs are those which are present during the current ignition cycle. See the appropriate flowcharts for solutions.

Historic

If a particular problem happens to resolve itself, the active status problem is dropped and it becomes a historic DTC rather than a current DTC.

Historic DTCs can only be retrieved using a computer-based diagnostic package called DIGITAL TECHNICIAN II (Part No. HD-48650).

Historic DTCs are stored for 50 ignition cycles after any DTC was last set as current to assist in the diagnosis of intermittent faults. On the 50th cycle, the DTC will clear itself. The check engine lamp will not indicate the existence of only historic DTCs.

It is important to note that historic DTCs will exist whenever the system indicates the existence of a current fault. See [4.4 CHECKING FOR DIAGNOSTIC TROUBLE CODES: EFI, Multiple Diagnostic Trouble Codes](#) if multiple DTCs are found.

Diagnostic charts are designed for use with current DTCs and as a result they frequently suggest part replacement. When diagnosing a historic DTC the charts can be helpful but should not lead to part replacement without verification the part is faulty.

RETRIEVING DIAGNOSTIC TROUBLE CODES

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

The engine management system provides two levels of diagnostics.

- The most sophisticated mode employs a computer-based diagnostic package called DIGITAL TECHNICIAN II (Part No. HD-48650).
- The second mode requires using the odometer self diagnostics. Speedometer, tachometer (if equipped), TSM/TSSM/HFSM and ECM DTCs can be accessed and cleared. See [4.6 ODOMETER SELF-DIAGNOSTICS](#).

MULTIPLE DIAGNOSTIC TROUBLE CODES

While it is possible for more than one fault to occur and set more than one DTC, there are several conditions which may result in **one** fault setting **multiple** DTCs:

Serial data DTCs (U1016, U1064, U1097, U1255, U1300 and U1301) may be accompanied by other DTCs. **Always** correct the serial data DTCs before resolving the other DTCs.

Refer to [Table 4-7](#). This table gives most ECM DTCs a priority ranking.



INITIAL DIAGNOSTIC CHECK: EFI

4.5

GENERAL

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

To locate faulty circuits or other system problems, follow the diagnostic flowcharts in this section. For a systematic approach, always begin with [4.5 INITIAL DIAGNOSTIC CHECK: EFI, General](#). Read the general information and then work your way through the flowchart box by box.

Diagnostic Notes

If a numbered circle appears adjacent to a flowchart 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.

Circuit Diagram/Wire Harness Connector Table

When working through a flowchart, 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 digital volt/ohmmeter (DVOM) are required. See [4.7 BREAKOUT BOX: EFI](#).

To perform the circuit checks with any degree of efficiency, a familiarity with the various wire connectors is also necessary.

Reprogramming ECM

Diagnostic charts frequently suggest ECM replacement. In the event an ECM needs to be replaced, it must be reprogrammed using a computer-based diagnostic package called DIGITAL TECHNICIAN II (Part No. HD-48650). See your dealer. Password learn procedure must also be performed. See [3.23 TSM/HFSM: PASSWORD LEARN](#).

INITIAL DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-42682	BREAKOUT BOX
HD-46601	INSTRUMENT HARNESS ADAPTERS

General Information

The diagnostic check is an organized approach to identifying a problem caused by an electronic control system malfunction.

Diagnostic Tips

- If odometer reads "BUS Er" with the ignition switch turned ON (engine stop switch at RUN with the engine off), check data bus for an open or short to ground. between data link connector [91A] terminal 3 and ECM connector [78B] terminal 5, TSM/TSSM/HFSM connector [30B] terminal 3, speedometer connector [39B] terminal 2 (XL), terminal C (XR) or tachometer (if equipped) connector [108B] terminal 2.
- Check for an open data test terminal between data link connector [91A] terminal 3 and TSM/TSSM/HFSM connector [30B] terminal 3. With ignition key turned ON, serial data bus voltage should be typically 0.6-0.8 volts. The range of acceptable voltage is 0-7.0 volts.
- To identify intermittents, wiggle instrument and/or vehicle harness while performing steps in the Diagnostic Check charts.

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. Compare engine behavior to symptoms tables.
 - a. Starts hard. Refer to [Table 4-4](#).
 - b. Hesitates, stumbles, surges, misfires and/or sluggish performance. Refer to [Table 4-5](#).
 - c. Engine exhaust emits black smoke or fouls plugs. Refer to [Table 4-6](#).
2. Connect BREAKOUT BOX (Part No. HD-42682) and INSTRUMENT HARNESS ADAPTERS (Part No. HD-46601) between wire harness and speedometer on XL, and tachometer on XR. See [2.5 BREAKOUT BOX: SPEEDOMETER/TACHOMETER](#)

All EFI diagnostic codes are listed in [Table 4-7](#).

Other DTCs

See [3.10 INITIAL DIAGNOSTIC CHECK: TSM/HFSM](#) for any codes related to the TSM, TSSM or HFSM.

See [2.2 INITIAL DIAGNOSTIC CHECK: ODOMETER](#) for any codes related to the speedometer or tachometer.

Table 4-3. Typical Scan Values for Engine Data

ITEM		MIN. VALUE	MAX. VALUE	HOT IDLE
TMAP sensor	MAP sensor	10 kPa	104 kPa	10.3-13.3 in. Hg (35-45 kPa)
		0 Volt	5.1 Volts	
	IAT Sensor	3° F (-16° C)	248° F (120° C)	104-140° F (40-60° C)
		0.0 Volts	5.0 Volts	2.0-3.5 Volts
TP sensor		0	100	0%
		0.2 Volt	4.5 Volts	0.2-1.0 Volt
IAC pintle		0	155	20-50 steps
RPM		800	5600	1000
ET sensor		3° F (-16° C)	464° F (240° C)	230-300° F (110-150° C)
		0.0 Volt	5.0 Volts	0.5-1.5 Volts
INJ PW front		0	50 ms	2-4 ms
INJ PW rear		0	50 ms	2-4 ms
Advance front		0	50°	10-15°
Advance rear		0	50°	10-15°
VSS		0	120	0 MPH (km/h)
Battery voltage		10	15	13.4 Volts
ENG RUN		Off	Run	Run
Idle RPM		800	1250	1000

NOTE

Hot idle specifications are with stock exhaust, the engine operating at 1000 RPM and an engine temperature of approx-

imately 260° F (127° C). Idle settings may be changed with the idle set procedure. See the service manual.

Table 4-4. Engine Starts Hard

CAUSE	SOLUTION
Battery discharged	1.7 CHARGING SYSTEM, Troubleshooting.
Spark plugs	4.15 MISFIRE AT IDLE OR UNDER LOAD.
Spark plug wires	4.15 MISFIRE AT IDLE OR UNDER LOAD.
Ignition coil	4.15 MISFIRE AT IDLE OR UNDER LOAD.
Valve sticking	See Section 3 in the Service Manual.
Water or dirt in fuel system	Drain and refill with fresh fuel.
Loss of battery power to ECM terminal 31*	4.10 NO ECM POWER.
* Codes will not clear (although they appear to).	

Table 4-5. Engine Performance Problems

CAUSE	SOLUTION
Manifold leak NOTE: When manifold leak is large enough, IAC will close to 0 and code P0505 will set.	A low IAC count may also indicate an air leak.
TMAP sensor plugged or not operating properly	4.16 DTC P0107, P0108, P0112, P0113.

Table 4-5. Engine Performance Problems

CAUSE	SOLUTION
Water or dirt in fuel system	Drain and refill with fresh fuel.
Spark plugs	4.15 MISFIRE AT IDLE OR UNDER LOAD.
Throttle plate not opening fully	See Throttle Cable Adjustment in the service manual.
Low fuel pressure	See the service manual.

Table 4-6. Engine Exhaust Emits Black Smoke or Fouls Plugs

CAUSE	SOLUTION
Clogged air filter	See Air Cleaner Filter in the Service Manual.
TMAP sensor plugged or not operating properly	4.16 DTC P0107, P0108, P0112, P0113.

Table 4-7. EFI Diagnostic Trouble Codes (DTC) and Fault Conditions

RANKING	DTC	FAULT CONDITION	SOLUTION
1	P0605	ECM flash error	4.24 DTC P0603, P0605
2	P0603	ECM EEPROM error	4.24 DTC P0603, P0605
3	"BUS Er"	Serial data bus shorted low/open/high	4.11 STARTS, THEN STALLS
4	U1300	ECM serial data low	4.11 STARTS, THEN STALLS
5	U1301	ECM serial data open/high	4.11 STARTS, THEN STALLS
6	U1300	TSM/TSSM/HFSM serial data low	4.11 STARTS, THEN STALLS
7	U1301	TSM/TSSM/HFSM serial data open/high	4.11 STARTS, THEN STALLS
8	U1300	speedometer/tachometer serial data low	4.11 STARTS, THEN STALLS
9	U1301	speedometer/tachometer serial data open/high	4.11 STARTS, THEN STALLS
10	U1064	Loss of TSM/TSSM/HFSM serial data at ECM	4.29 DTC U1064, U1255
11	U1064	Loss of TSM/TSSM/HFSM serial data at speedometer	4.29 DTC U1064, U1255
12	U1016	Loss of all ECM serial data (state of health) at TSM/TSSM/HFSM	3.21 DTC U1016, U1255
		Loss of all ECM serial data (state of health) at speedometer	3.21 DTC U1016, U1255
		Loss of vehicle speed	3.21 DTC U1016, U1255
		Loss of vehicle inhibit motion	3.21 DTC U1016, U1255
		Loss of powertrain security status	3.21 DTC U1016, U1255
13	U1097	Loss of speedometer serial data at TSM/TSSM/HFSM	4.30 DTC U1097, U1255
14	U1255	Missing response at TSM/TSSM/HFSM	3.21 DTC U1016, U1255
15	U1255	Missing response at speedometer	4.30 DTC U1097, U1255
16	P1003	System relay contacts open	4.13 SYSTEM RELAY CHECK
17	P1002	System relay coil high/shorted	4.13 SYSTEM RELAY CHECK
18	P1001	System relay coil open/low	4.13 SYSTEM RELAY CHECK
19	P1004	System relay contacts closed	4.13 SYSTEM RELAY CHECK
20	P1009	Incorrect password	4.26 DTC P1009, P1010

Table 4-7. EFI Diagnostic Trouble Codes (DTC) and Fault Conditions

RANKING	DTC	FAULT CONDITION	SOLUTION
21	P1010	Missing password (starts then stalls)	4.26 DTC P1009, P1010
22	P0373	CKP sensor intermittent	4.21 DTC P0373, P0374
23	P0374	CKP sensor synch error	4.21 DTC P0373, P0374
24	P0122	TP sensor open/low	4.18 DTC P0122, P0123
25	P0123	TP sensor high	4.18 DTC P0122, P0123
26	P1501	Jiffy stand sensor low	4.25 DTC P0661, P0662
27	P1502	Jiffy stand sensor high	4.25 DTC P0661, P0662
28	P0107	MAP sensor open/low	4.16 DTC P0107, P0108, P0112, P0113
29	P0108	MAP sensor high	4.16 DTC P0107, P0108, P0112, P0113
30	P0117	ET sensor voltage low	4.17 DTC P0117, P0118
31	P0118	ET sensor open/high	4.17 DTC P0117, P0118
32	P0112	IAT sensor voltage low	4.18 DTC P0122, P0123
33	P0113	IAT sensor open/high	4.18 DTC P0122, P0123
34	P1351	Front ignition coil open/low	4.27 DTC P1351, P1352, P1354, P1355
35	P1354	Rear ignition coil open/low	4.27 DTC P1351, P1352, P1354, P1355
36	P1352	Front ignition coil high/shorted	4.27 DTC P1351, P1352, P1354, P1355
37	P1355	Rear ignition coil high/shorted	4.27 DTC P1351, P1352, P1354, P1355
38	P0261	Front injector open/low	4.20 DTC P0261, P0262, P0263, P0264
39	P0263	Rear injector open/low	4.20 DTC P0261, P0262, P0263, P0264
40	P0262	Front injector high	4.20 DTC P0261, P0262, P0263, P0264
41	P0264	Rear injector high	4.20 DTC P0261, P0262, P0263, P0264
42	P0562	Battery voltage low	4.23 DTC P0562, P0563
43	P0563	Battery voltage high	4.23 DTC P0562, P0563
44	P0501	VSS sensor low	4.22 DTC P0501, P0502
45	P0502	VSS sensor high	4.22 DTC P0501, P0502
46	P0505	Loss of idle speed control	4.19 DTC P0131, P0132, P0134, P0151, P0152, P0154
47	P0661	Intake solenoid low/open	4.25 DTC P0661, P0662
48	P0662	Intake solenoid high/shorted	4.25 DTC P0661, P0662
49	P0131	Front O2 sensor low (lean O2)	4.19 DTC P0131, P0132, P0134, P0151, P0152, P0154
50	P0151	Rear O2 sensor low (lean)	4.19 DTC P0131, P0132, P0134, P0151, P0152, P0154
51	P0132	Front O2 sensor high (rich)	4.19 DTC P0131, P0132, P0134, P0151, P0152, P0154
52	P0152	Rear O2 sensor high (rich)	4.19 DTC P0131, P0132, P0134, P0151, P0152, P0154
53	P0134	Front O2 sensor open/not responding	4.19 DTC P0131, P0132, P0134, P0151, P0152, P0154
54	P0154	Rear O2 sensor open/not responding	4.19 DTC P0131, P0132, P0134, P0151, P0152, P0154

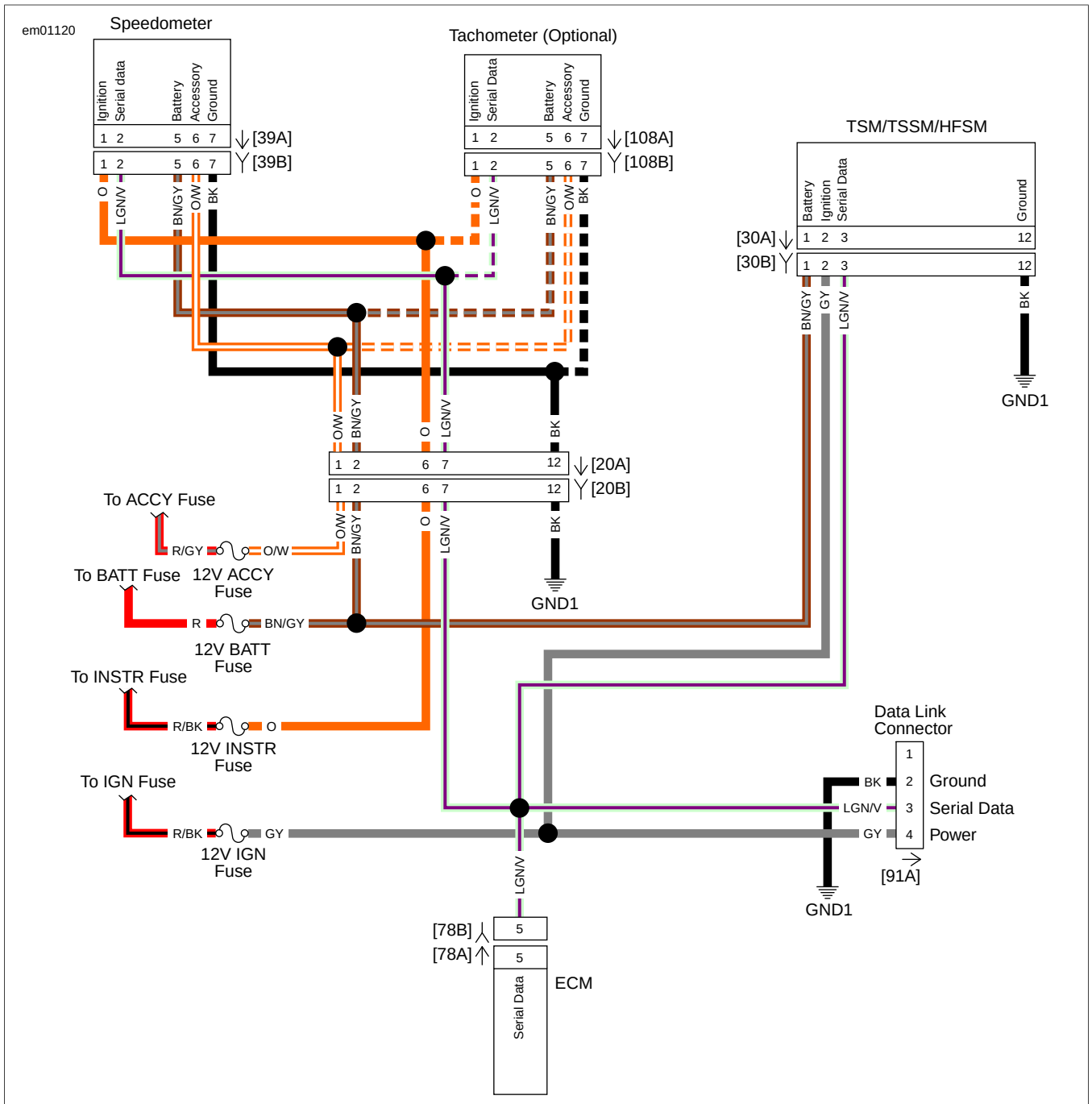


Figure 4-6. Diagnostic Check (XL)

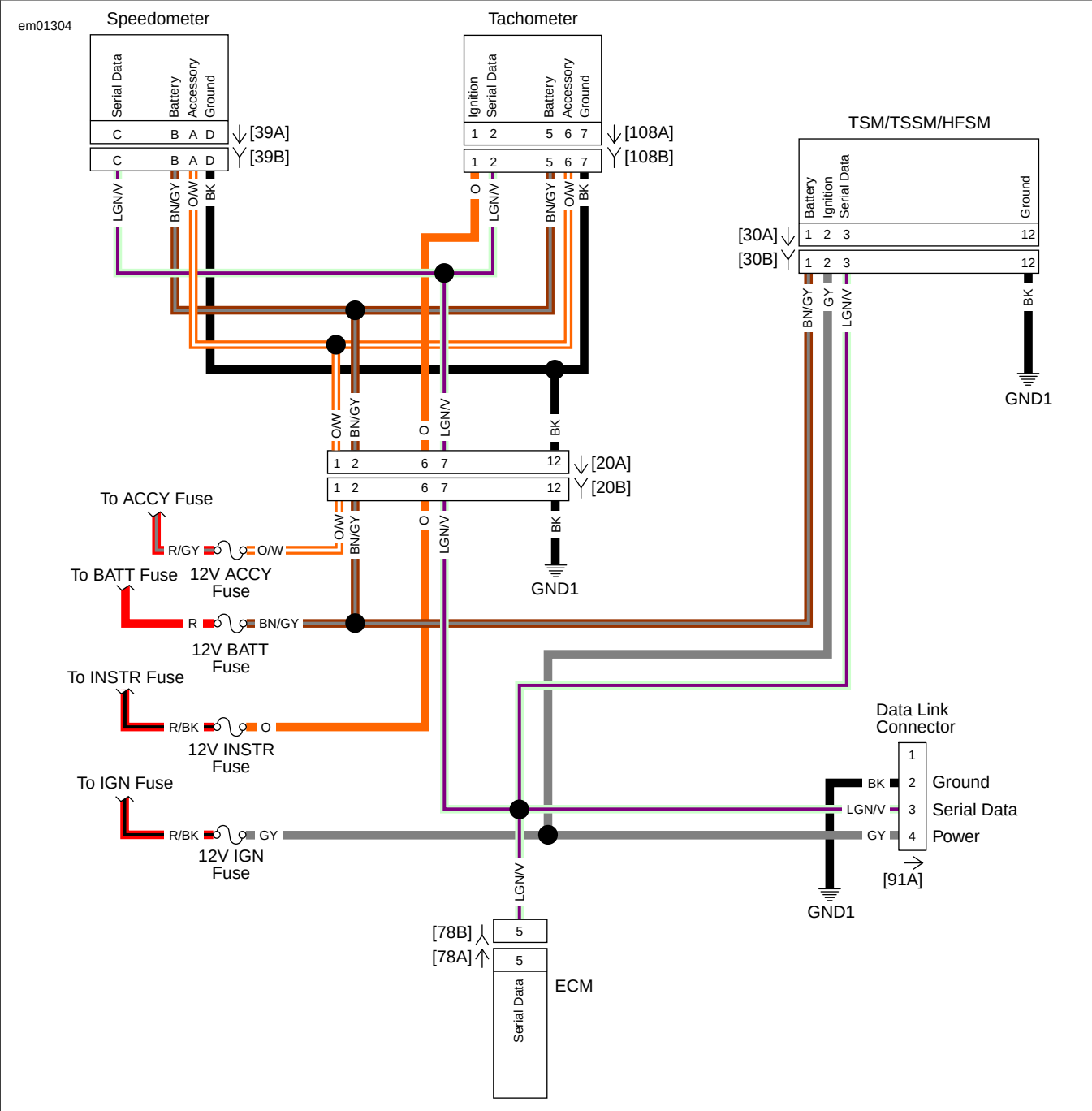


Figure 4-7. Serial Data Circuit (XR)

Table 4-8. Wire Harness Connectors

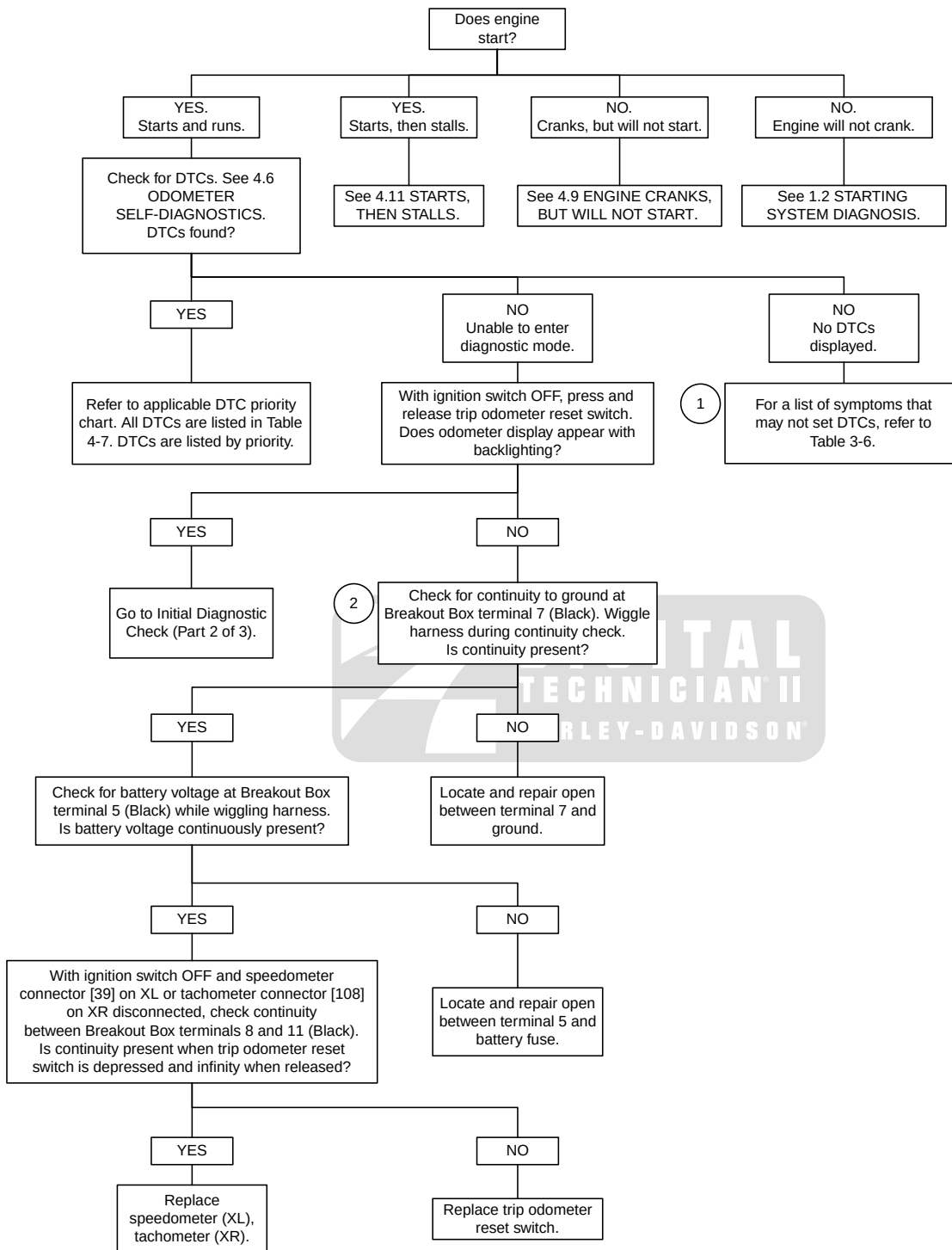
NO.	DESCRIPTION	TYPE	LOCATION
[20]	Instruments	12-place Molex	Under fuel tank
[30]	TSM/TSSM/HFSM	12-place Deutsch	Under battery tray
[39]	Speedometer (XL)	12-place Packard	Back of speedometer
[39]	Speedometer (XR)	5-place Packard	Back of speedometer
[78]	ECM	36-place Packard	Under seat

Table 4-8. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[91]	Data link connector	4-place Deutsch	Under left side cover
[108]	Tachometer (if equipped)	12-place Packard	Back of tachometer

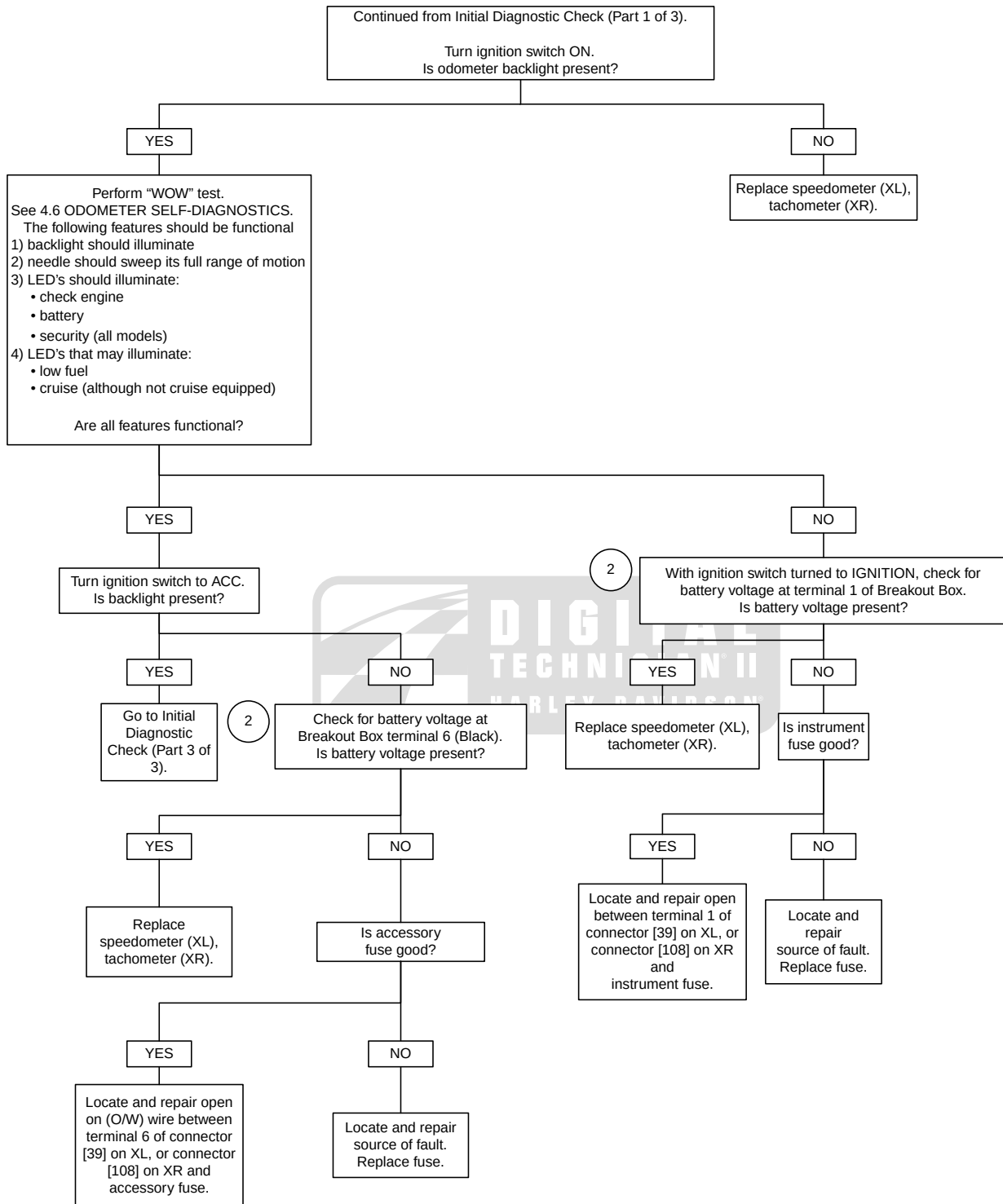


Initial Diagnostic Check (Part 1 of 3)



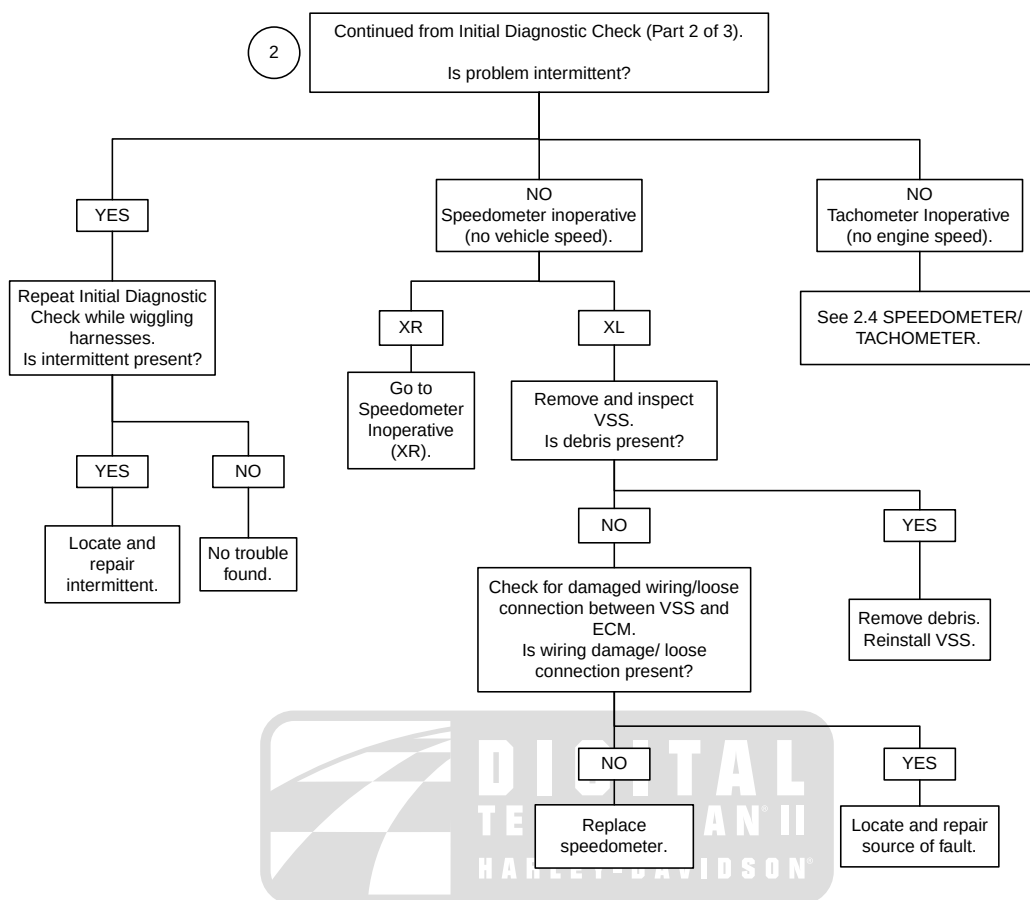
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Initial Diagnostic Check (Part 2 of 3)



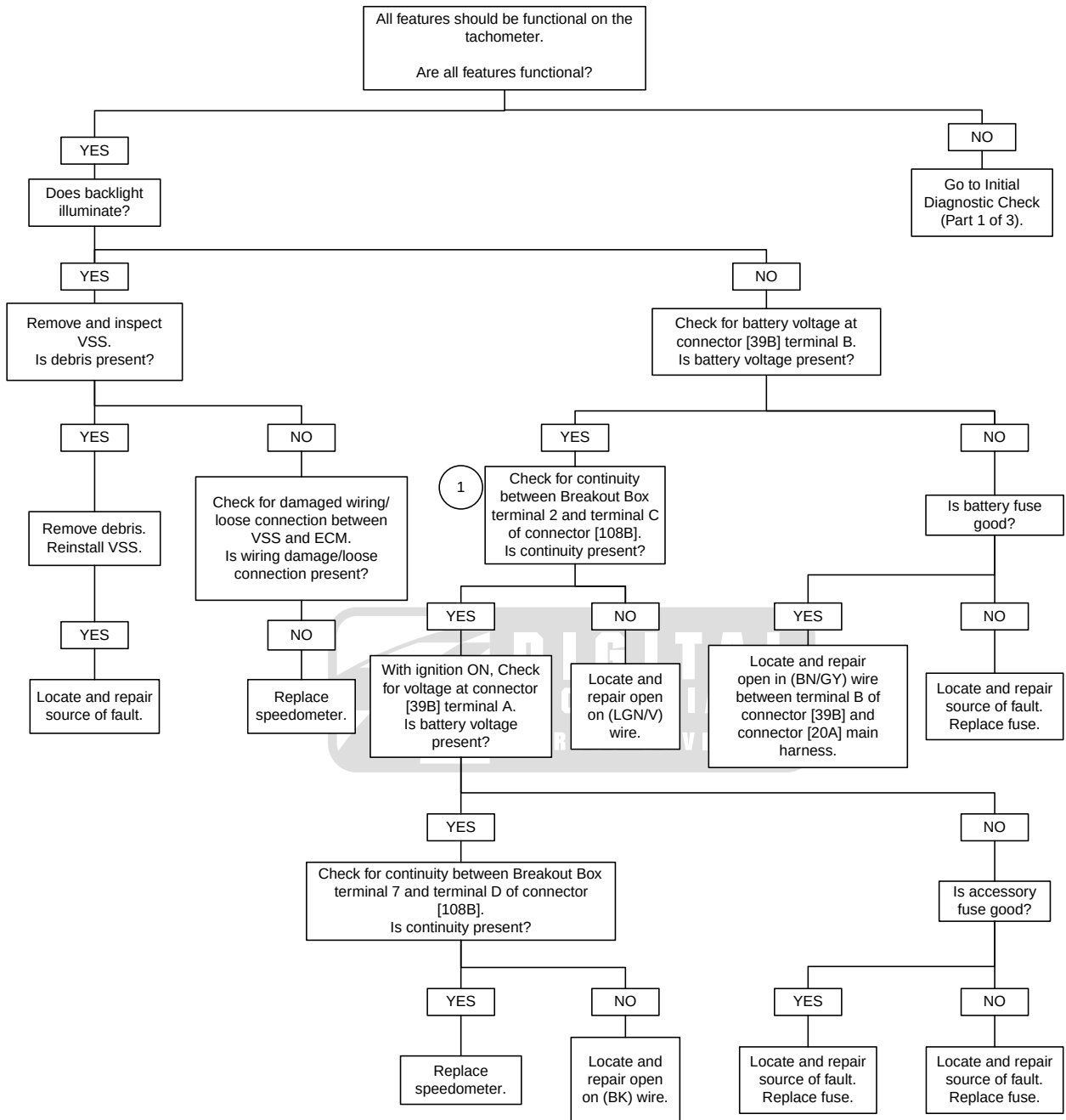
fc02006_en

Initial Diagnostic Check (Part 3 of 3)



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Speedometer Inoperative (XR)



fc01931_en

ODOMETER SELF-DIAGNOSTICS

4.6

GENERAL

The speedometer on XL and the tachometer on XR are capable of displaying and clearing speedometer, tachometer, TSM/TSSM/HFSM, and ECM trouble codes (DTCs) (diagnostic mode).

DIAGNOSTICS

Diagnostic Tips

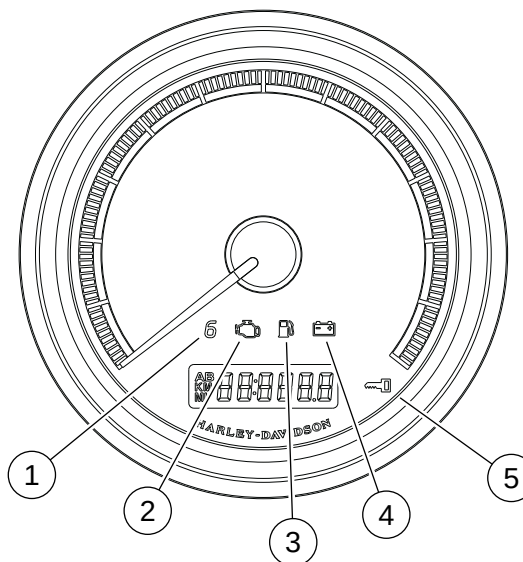
- For a quick check of speedometer on XL and the tachometer on XR functions, a "WOW" test can be performed. See [Figure 4-9](#). Press and hold trip odometer reset switch then turn ignition switch ON. Release trip odometer reset switch. Background lighting should illuminate, speedometer on XL and the tachometer on XR the needle should sweep its full range of motion, and indicator lamps (sixth gear, check engine, low fuel, battery and security) should illuminate.
- If speedometer on XL and the tachometer on XR fails "WOW" test, check for battery, ground, ignition, trip odometer reset switch and accessory to speedometer. If any feature in the speedometer is non-functional, see [2.2 INITIAL DIAGNOSTIC CHECK: ODOMETER](#).

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

- To exit diagnostic mode, turn ignition switch OFF.
- To clear DTCs for the selected module, press the trip odometer reset switch for more than 5 seconds when a DTC is displayed. This procedure will clear all DTCs for the selected module.

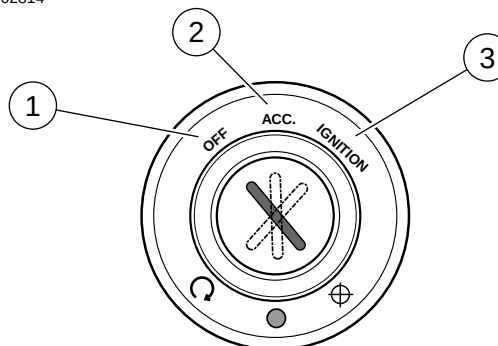
ed01721



1. Sixth gear indicator (not used)
2. Check engine lamp
3. Low fuel lamp
4. Battery lamp
5. Security lamp (key icon)

Figure 4-8. Warning Lamps (Typical)

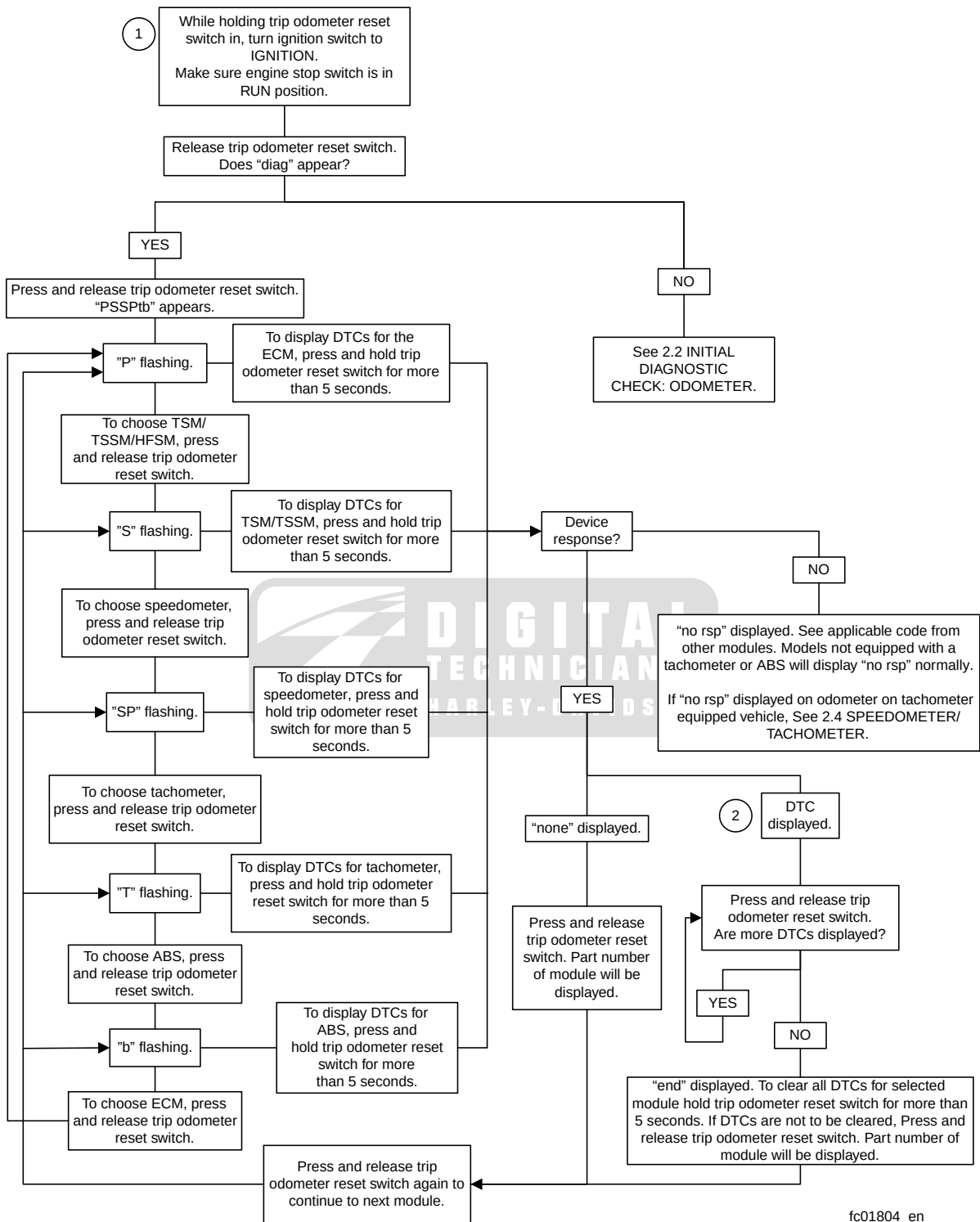
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1. Ignition OFF
2. Accessory (ACC) ON
3. Ignition ON

Figure 4-9. Ignition Switch

Odometer Self-Diagnostics



BREAKOUT BOX: EFI

GENERAL

PART NUMBER	TOOL NAME
HD-43876	BREAKOUT BOX

The BREAKOUT BOX (Part No. HD-43876) splices into the main harness. Used in conjunction with a digital volt/ohmmeter DVOM, it allows circuit diagnosis of wiring harness and connections without having to probe with sharp objects.

NOTE

See wiring diagrams for ECM terminal functions.

INSTALLATION

PART NUMBER	TOOL NAME
HD-43876	BREAKOUT BOX

1. Remove seat to gain access to ECM.
2. See [Figure 4-10](#). Press latch (1) on ECM connector (2) to separate pin and socket halves [78].
3. See [Figure 4-11](#). Attach BREAKOUT BOX (Part No. HD-43876) (1) between ECM (2) and ECM wiring harness.
 - a. Attach BREAKOUT BOX (Part No. HD-43876) pin connector (3) to ECM harness socket connector [78B] (4).
 - b. Attach BREAKOUT BOX (Part No. HD-43876) socket connector (5) to ECM pin connector [78A] (6).

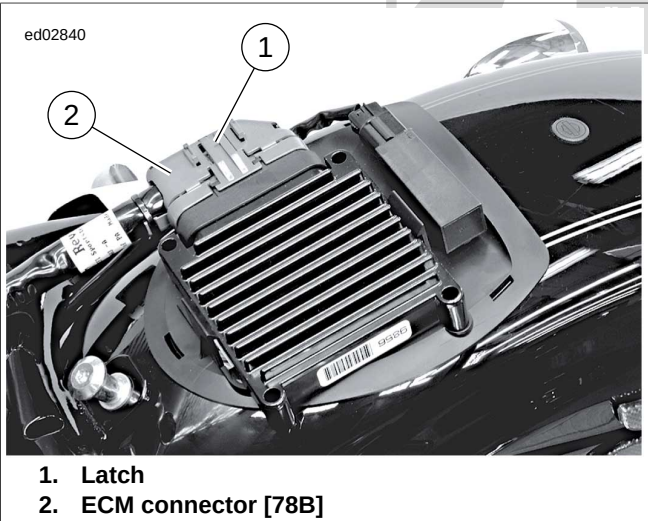
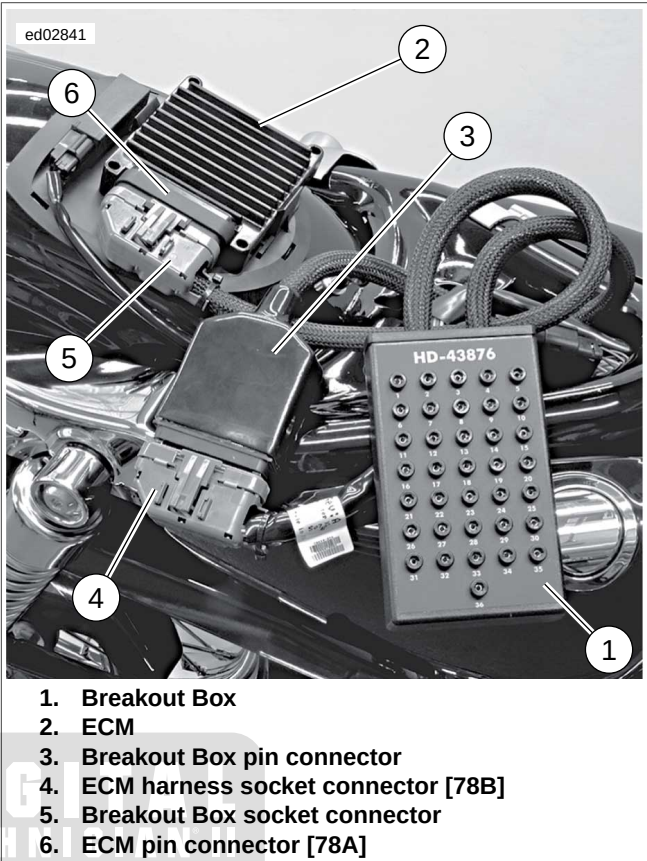


Figure 4-10. ECM Location (Typical)



1. Breakout Box
2. ECM
3. Breakout Box pin connector
4. ECM harness socket connector [78B]
5. Breakout Box socket connector
6. ECM pin connector [78A]

Figure 4-11. Installed Breakout Box (Typical)

REMOVAL

PART NUMBER	TOOL NAME
HD-43876	BREAKOUT BOX

1. See [Figure 4-11](#). Depress latch on BREAKOUT BOX (Part No. HD-43876) socket connector (5). Detach connector from ECM pin connector [78A] (6).
2. Detach BREAKOUT BOX (Part No. HD-43876) pin connector (3) from ECM harness socket connector [78B] (4).
3. Reattach ECM harness connector to ECM.
4. Install seat.

⚠ WARNING

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

WIGGLE TEST

4.8

GENERAL

The wiggle test indicates the presence of intermittents in a wiring harness.

PROCEDURE

PART NUMBER	TOOL NAME
HD-43876	BREAKOUT BOX

NOTE

When diagnosing Electronic Control Module (ECM) connections, use a BREAKOUT BOX (Part No. HD-43876) to simplify the procedure. See [4.7 BREAKOUT BOX: EFI](#).

1. See [Figure 4-12](#). Connect digital volt/ohmmeter (DVOM) to wiring harness between the suspect connections. Set DVOM to read voltage changes.
2. Start motorcycle engine and run at idle.

3. Shake or wiggle harness to detect intermittents. If intermittents are present, radical voltage changes will register on the DVOM.

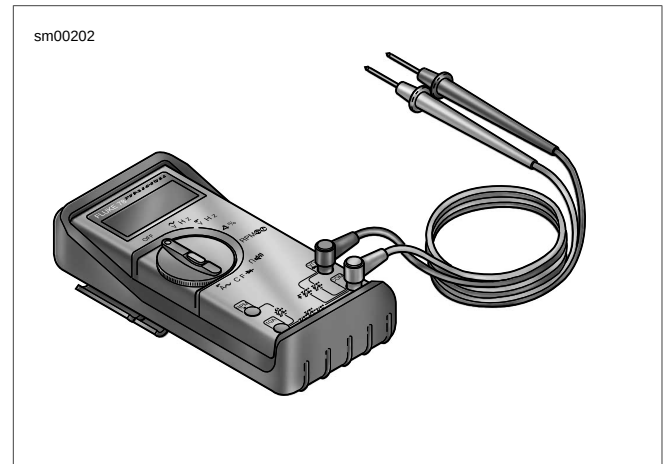


Figure 4-12. Fluke 78 Multimeter (DVOM)



ENGINE CRANKS, BUT WILL NOT START

4.9

GENERAL

If the starter will not crank the engine, the problem is not EFI related. See

- CHAPTER 1 - STARTING / CHARGING.
- CHAPTER 3 - TSM/HFSM.
- Appendix E - TSM/TSSM (Japan/Korea).

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-26792	SPARK TESTER
HD-34730-2C	FUEL INJECTOR TEST LAMP
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX
HD-44687	IGNITION COIL CIRCUIT TEST ADAPTER
MCR-101 HD	ELECTRICAL SYSTEM ANALYZER

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. Check for DTCs. See [4.4 CHECKING FOR DIAGNOSTIC TROUBLE CODES: EFI, Retrieving Diagnostic Trouble Codes](#).
2. Check the condition of the battery. Perform a voltage test and recharge if below 12.6V. Check battery connections and perform either a conductance test using ELECTRICAL SYSTEM ANALYZER (Part No. MCR-101 HD) , or a load test. Replace the battery if necessary. See Battery in the service manual.
3. Connect BREAKOUT BOX (Part No. HD-43876). See [4.7 BREAKOUT BOX: EFI](#).
4. Remove spark plug cable from spark plug.
 - a. Visually check condition of plug.
 - b. See [Figure 4-13](#). 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.

NOTE

Engine will not spark with both spark plugs removed. When checking for spark, use SPARK TESTER (Part No. HD-26792) with both plugs installed.

5. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), gray pin probe and patch cord.
6. Typically, when IAC is not functioning, the engine will not start unless throttle is opened and the engine will stall when throttle is closed.
7. See [Figure 4-14](#). Plug IGNITION COIL CIRCUIT TEST ADAPTER (Part No. HD-44687) and FUEL INJECTOR

TEST LAMP (Part No. HD-34730-2C) into Breakout Box terminals 13 and 11. Start engine. If lamp flashes, no problem is found. Repeat for Breakout Box terminals 13 and 29.

8. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), brown socket probe and patch cord.

Diagnostic Tips

Check TP sensor value with a DVOM. If TP sensor is equal to or greater than 3.8 volts, system is in "clear flood" mode and engine will not start. While spark is present, fuel is shut off. Problem can be mechanical, such as throttle cables stuck

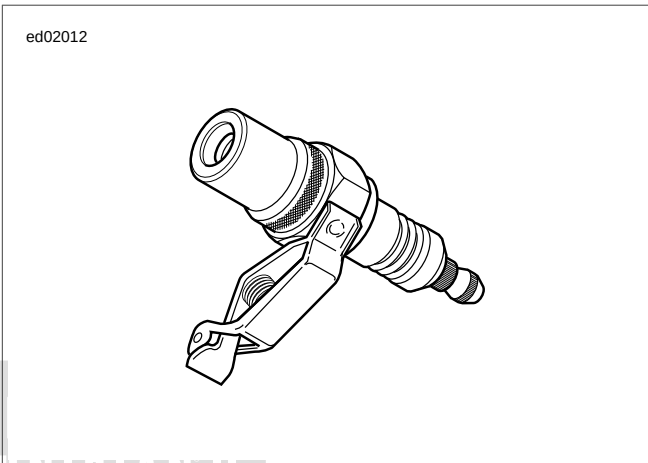


Figure 4-13. Spark Tester

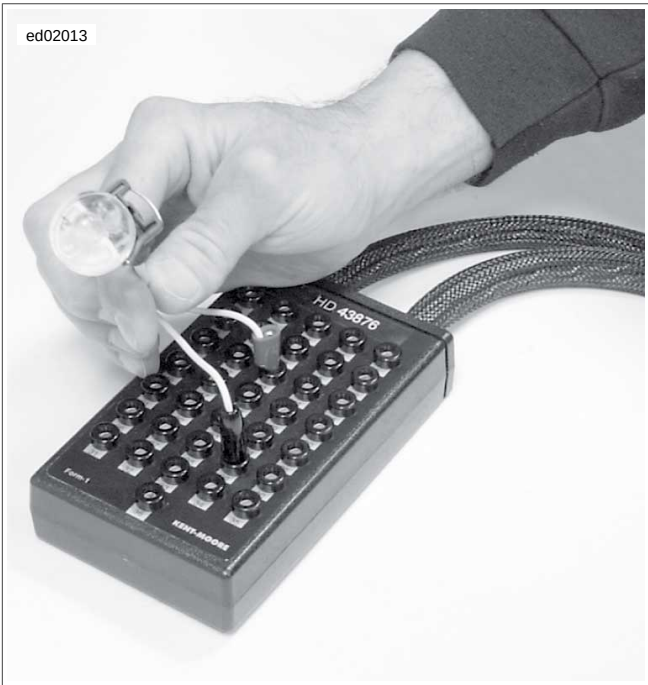


Figure 4-14. Ignition Coil Circuit Test

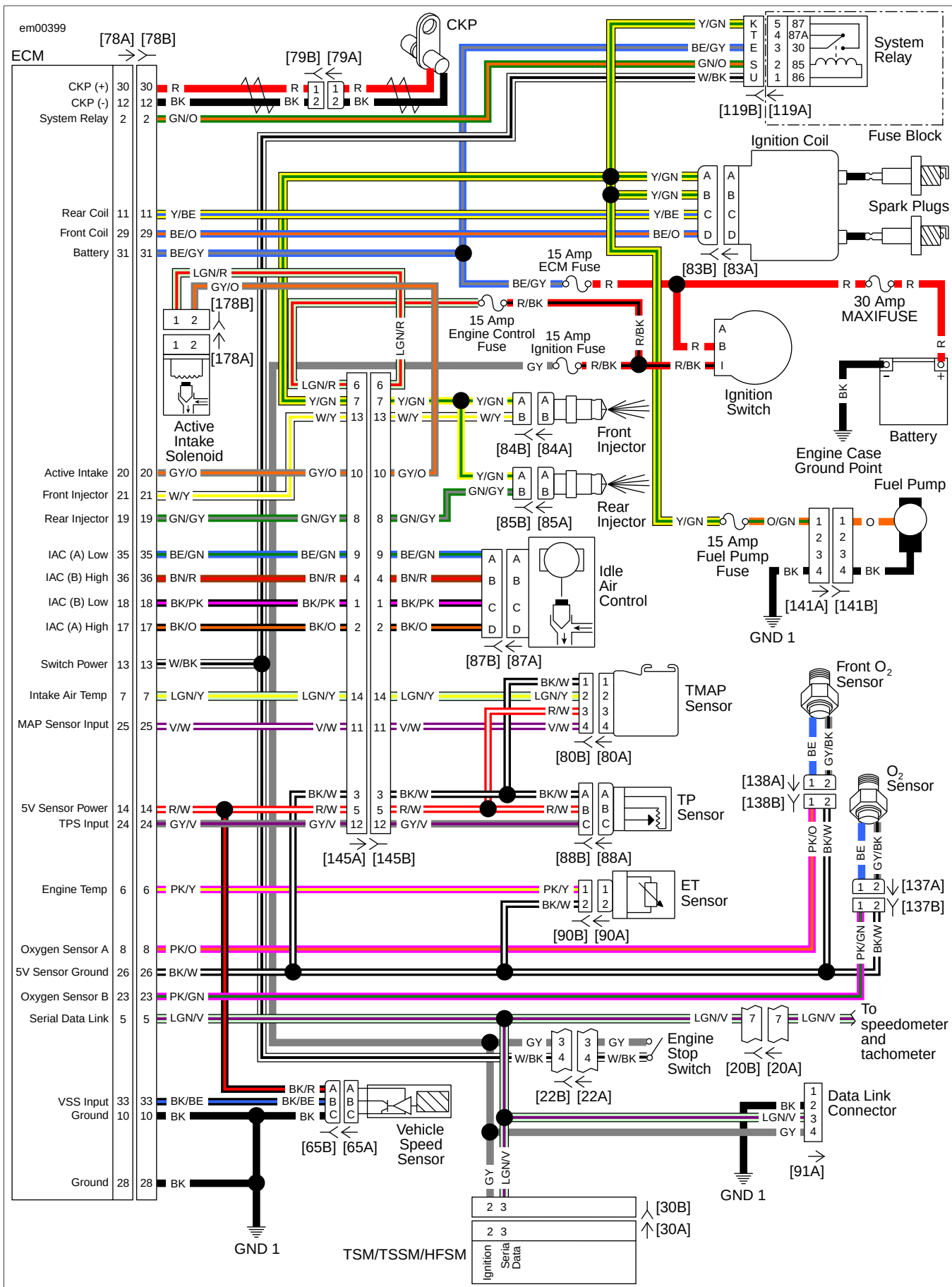
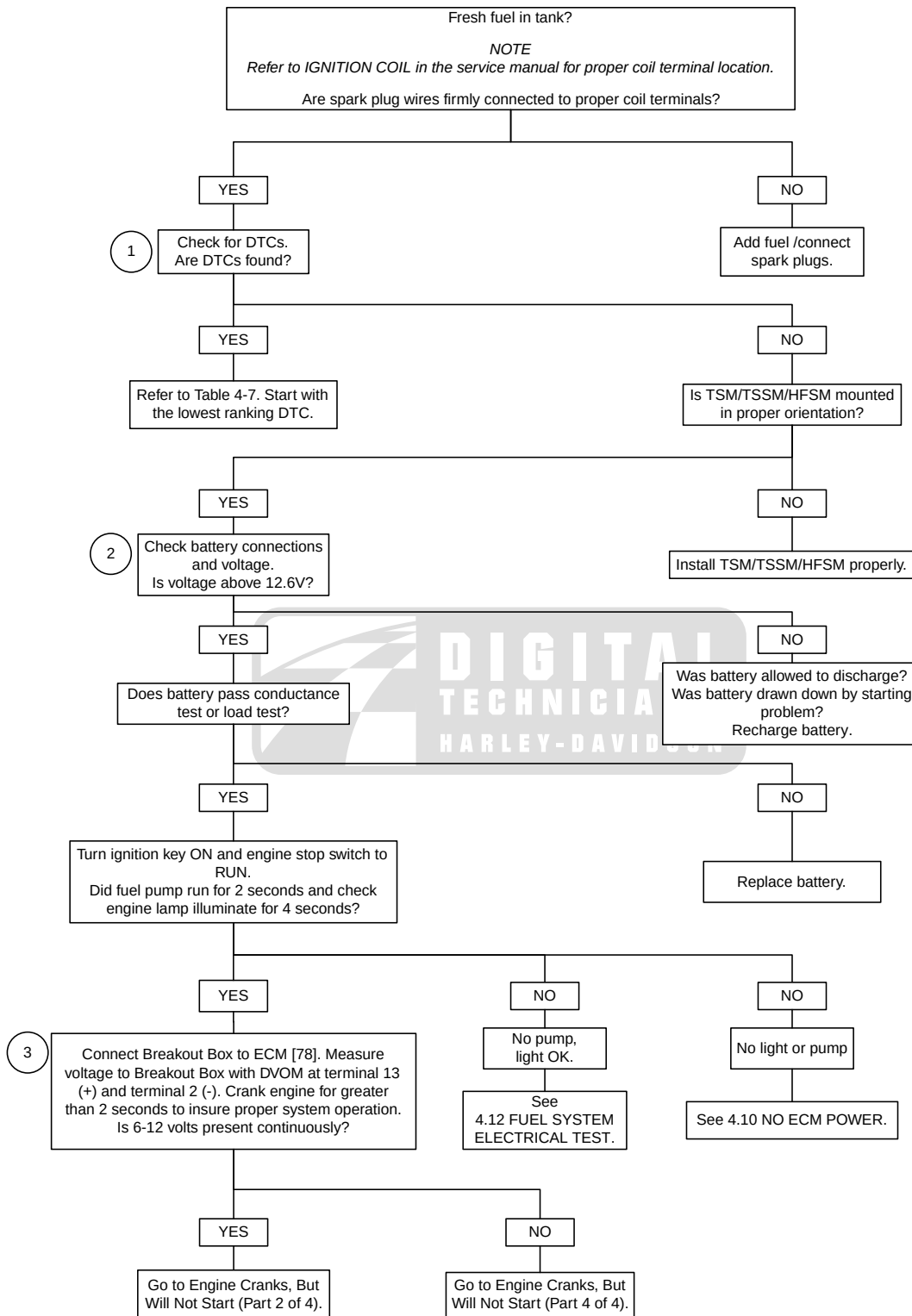


Figure 4-15. EFI System Circuit

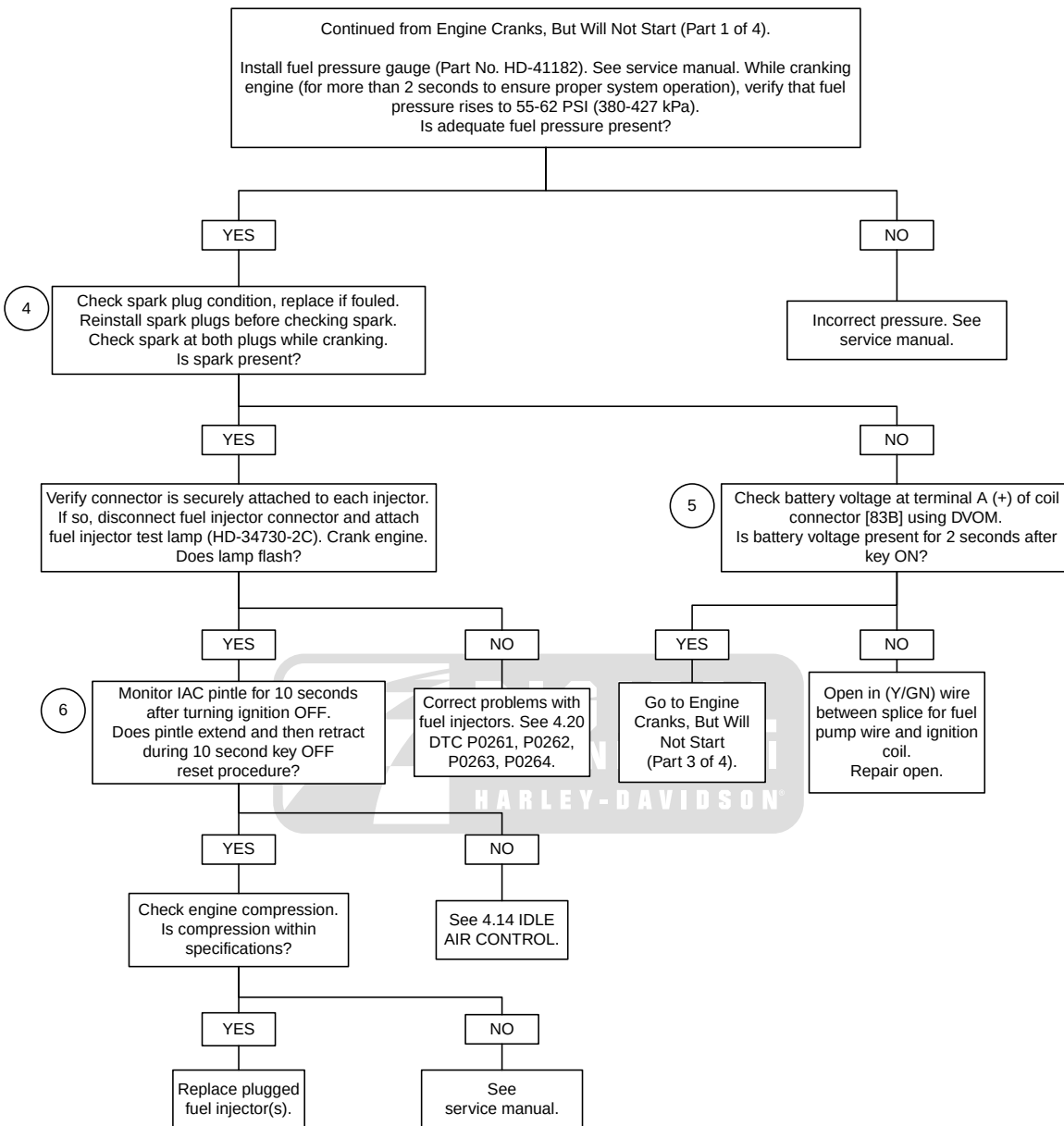
Table 4-9. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[20]	Instruments	12-place Molex, black	Under fuel tank
[30]	TSM/TSSM/HFSM	12-place Deutsch, gray	Under battery
[22]	Right handlebar controls	6-place Molex	Under fuel tank
[33]	Ignition switch	-	Right side of frame behind neck
[65]	VSS	3-place Packard	Right rear top of crankcase
[78]	ECM	36-place Packard	Under seat
[79]	CKP sensor	2-place Mini-Deutsch	Front of left crankcase
[80]	TMAP sensor	4-place Packard, black	
[83]	Ignition coil	4-place Delphi	Back of coil
[84]	Front injector	2-place Delphi, black	Top of intake manifold
[85]	Rear injector	2-place Delphi, black	Top of intake manifold
[87]	IAC	4-place Delphi, black	Top of induction module
[88]	TP sensor	3-place Delphi, black	Behind air cleaner backing plate
[90]	ET sensor	2-place Delphi, black	Above induction module, right side
[91A]	Data link connector	4-place Deutsch, gray	On battery strap, behind left side cover
[119]	Relay/fuse block	5-place Amp, spade terminals	Fuse/relay block, behind left side cover
[137]	Rear oxygen sensor	2-place Amp, black	On H-bracket
[138]	Front oxygen sensor	2-place Amp, black	Electrical caddy behind voltage regulator
[141]	Fuel pump and low fuel switch	4-place Molex, black	Forward of relay/fuse blocks
[145]	Engine harness	16-place Molex, black	Under seat
[178]	Active Intake Solenoid (HDI)	2-place Amp	Rear of air box

Engine Cranks, But Will Not Start (Part 1 of 4)



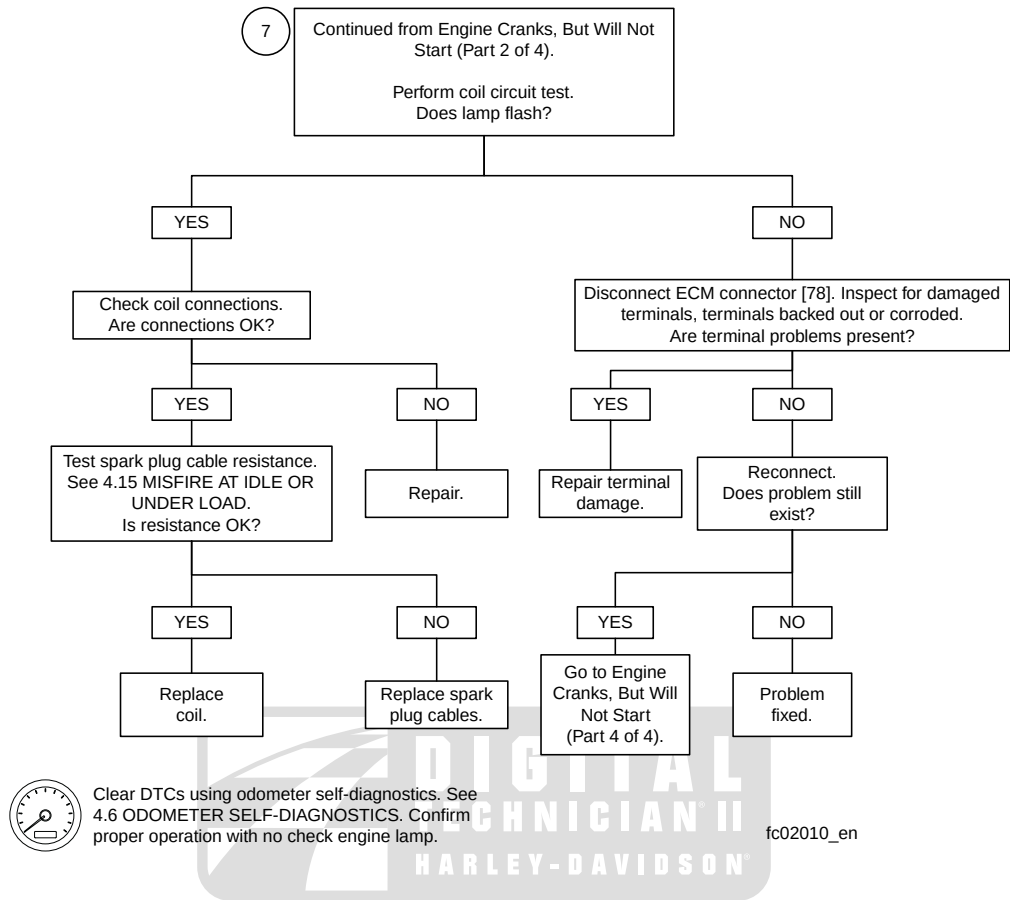
Engine Cranks, But Will Not Start (Part 2 of 4)



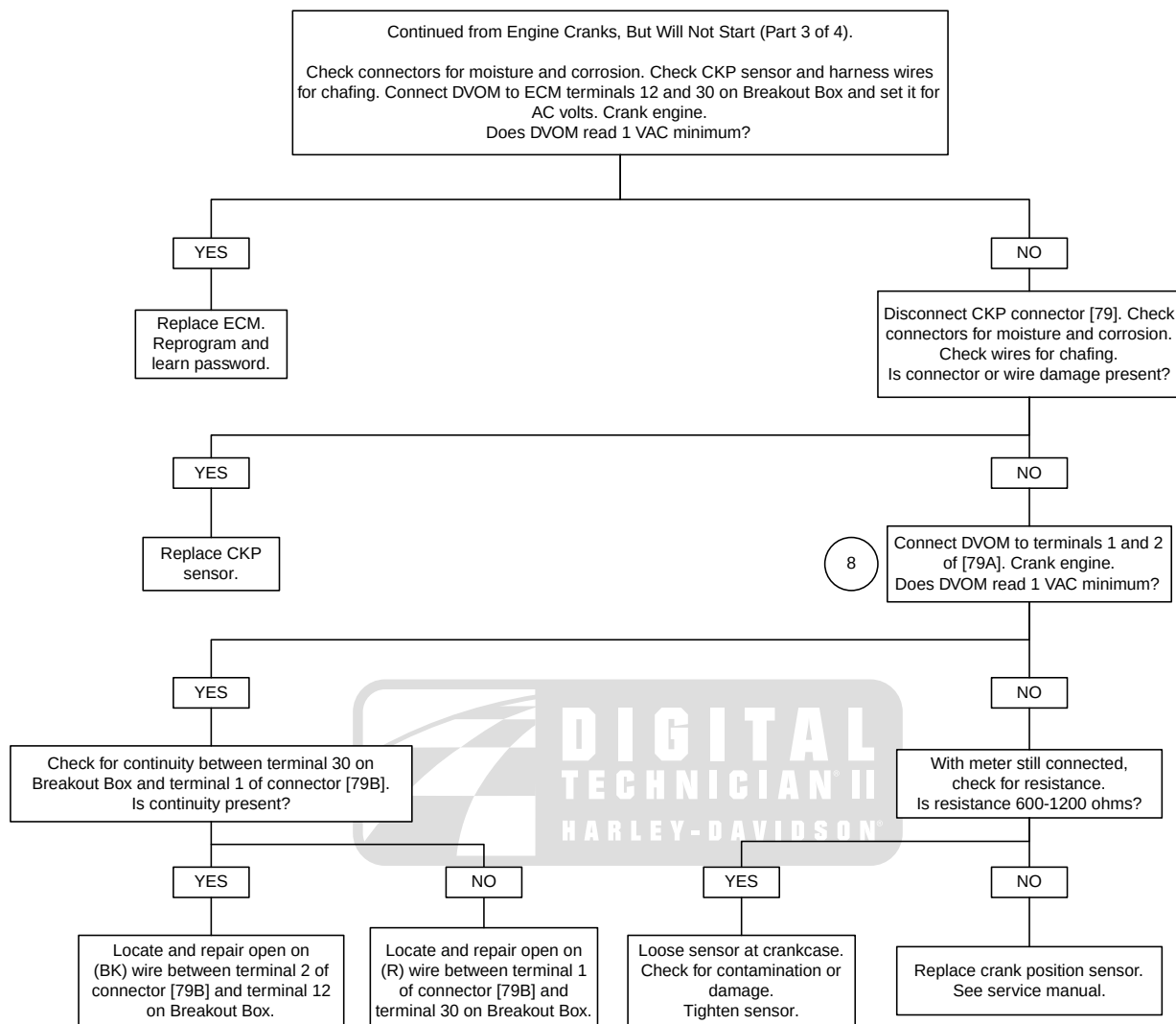
Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

fc02009_en

Engine Cranks, But Will Not Start (Part 3 of 4)



Engine Cranks, But Will Not Start (Part 4 of 4)



Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

fc02011_en

NO ECM POWER

4.10

GENERAL

No Spark/No Check Engine Lamp at Key On

Constant power is supplied to the ECM through terminal "31". The ECM turns on when power is applied to terminal "13" of connector [78]. The ECM goes through an initialization sequence every time power is removed and re-applied to terminal "13". 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.

If battery power is absent at ECM terminal "31":

- DTCs cannot be cleared. Tool will show them as cleared but will be present next time ignition key is cycled.
- ECM cannot be re-flashed.
- Vehicle will start but IAC pintle will not reset at key OFF. Eventually pintle will be out of position causing performance problems.

NOTE

The key ON sequence also activates the idle air control motor. If power from terminal "31" is disrupted (blown fuse, etc.) always turn the key OFF wait 10 seconds then turn the key ON to reset the motor to the default position.

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. Connect BREAKOUT BOX (Part No. HD-43876). See [4.7 BREAKOUT BOX: EFI](#).
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), gray probes and patch cords.



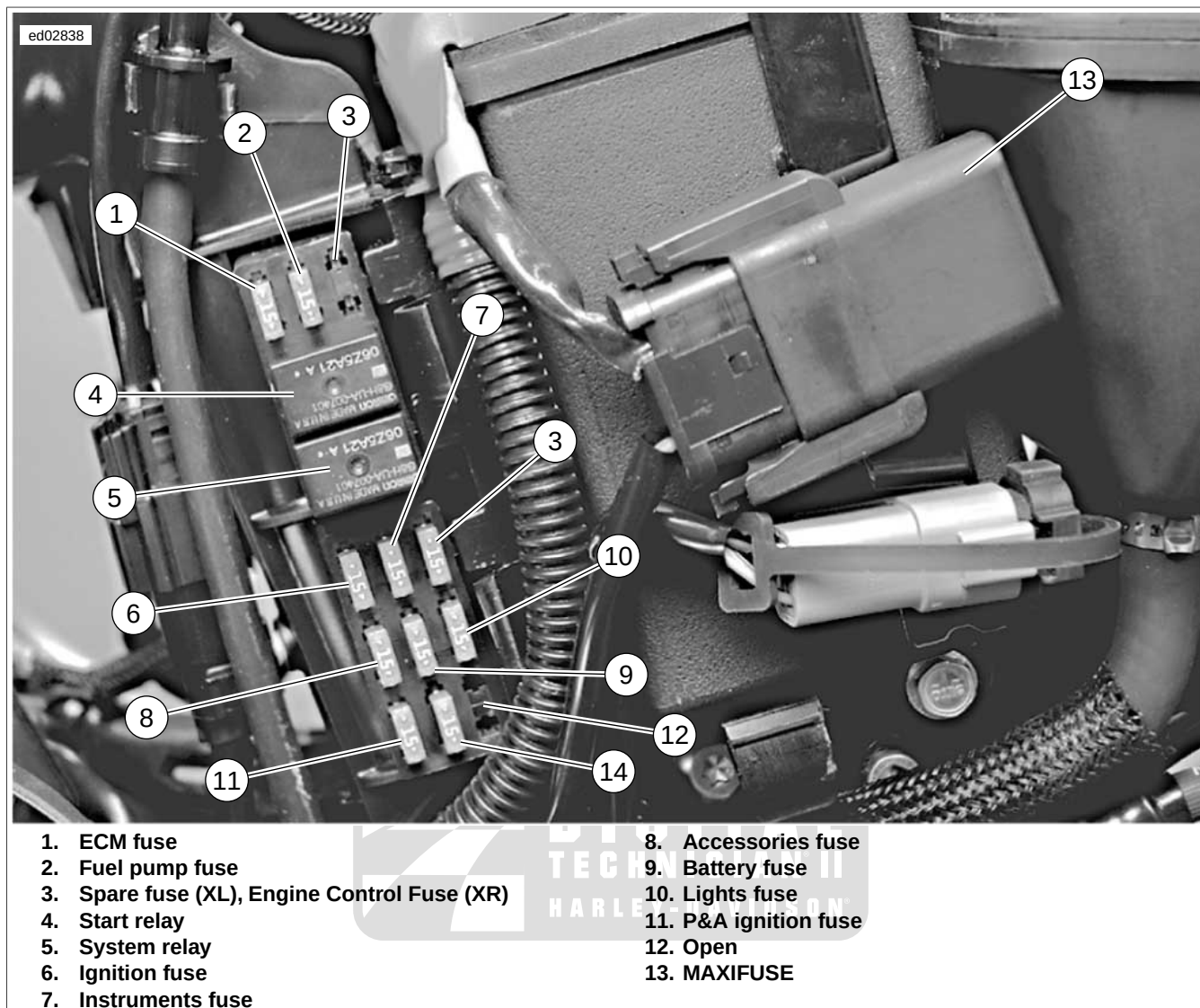
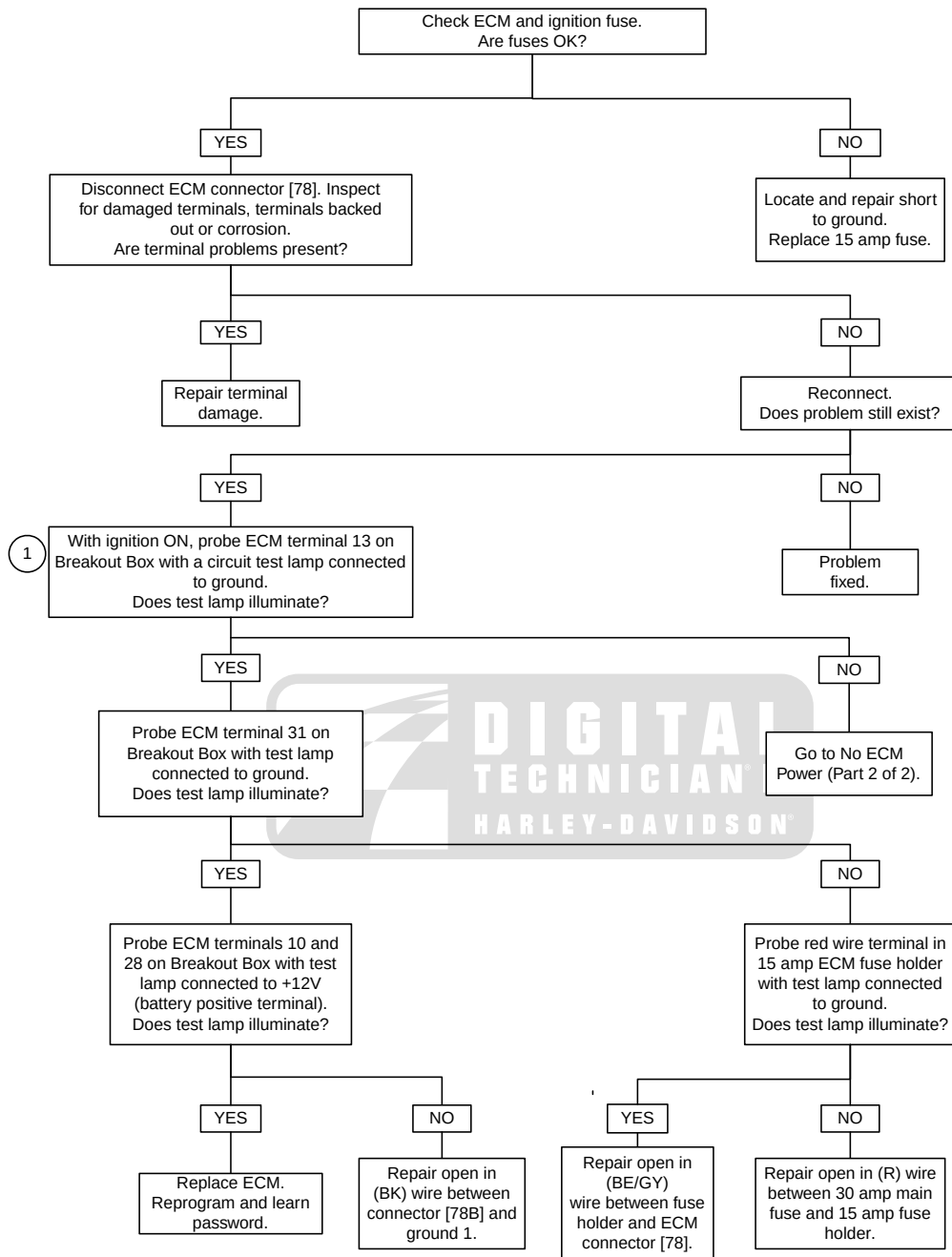


Figure 4-16. Fuses and Relays

Figure 4-17. ECM Power Circuit Diagram

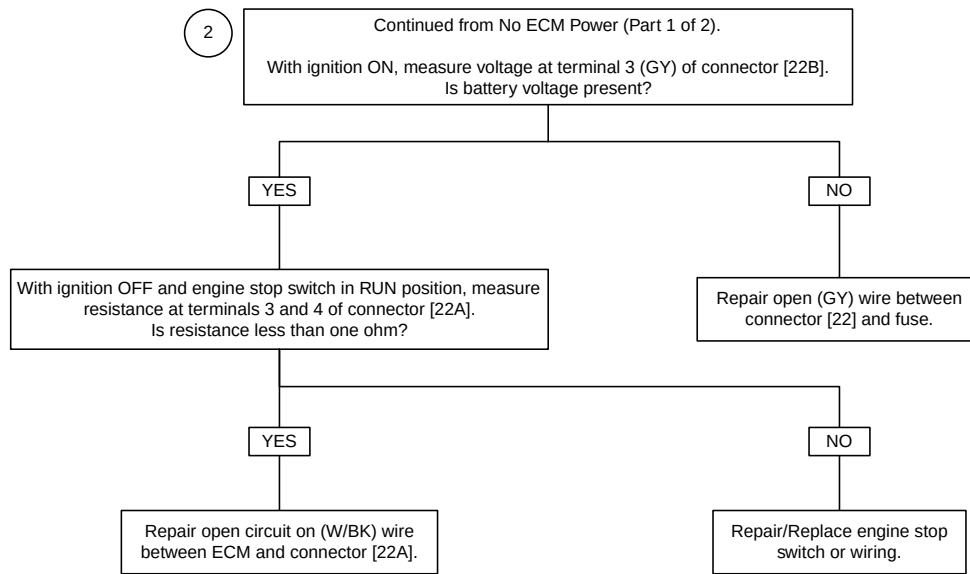
NO.	DESCRIPTION	TYPE	LOCATION
[22]	Right handlebar controls	6-place Molex	Under fuel tank
[78]	Electronic Control Module (ECM)	36-place Packard	Under seat
[GND 1]	ECM ground	Ring terminal	Engine crankcase

No ECM Power (Part 1 of 2)



fc01967_en

No ECM Power (Part 2 of 2)



Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.



fc01826_en

STARTS, THEN STALLS

4.11

GENERAL

Diagnostic Trouble Codes U1300, U1301, or BUS ER

The typical serial data voltage range is 0 volt (inactive) to 7 volts (active). Due to the short pulse, voltages will be much lower on a digital volt/ohmmeter (DVOM). In analog mode, a DVOM reading serial data will show continuous voltage when active, typically 0.6-0.8 volt. The range for acceptable operations is greater than 0 and less than 7.0 volts.

NOTE

Problems in the fuel system or idle air control system may also create this symptom.

Table 4-11. Code Description

DTC	DESCRIPTION
U1300	Serial data low
U1301	Serial data open/high



Figure 4-18. Data Link Connector [91A]

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT

Diagnostic Tips

- If serial data is shorted, these codes will automatically trip the check engine light.
- DTCs P1009 and P1010 may accompany DTCs U1300 and U1301.

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), black socket probes and patch cord.
2. Unplug the neutral switch connector [136]. Using a DVOM, test for continuity to ground. When the transmission is in neutral, continuity should exist. When the transmission is in gear, there should not be continuity to ground through the neutral switch.



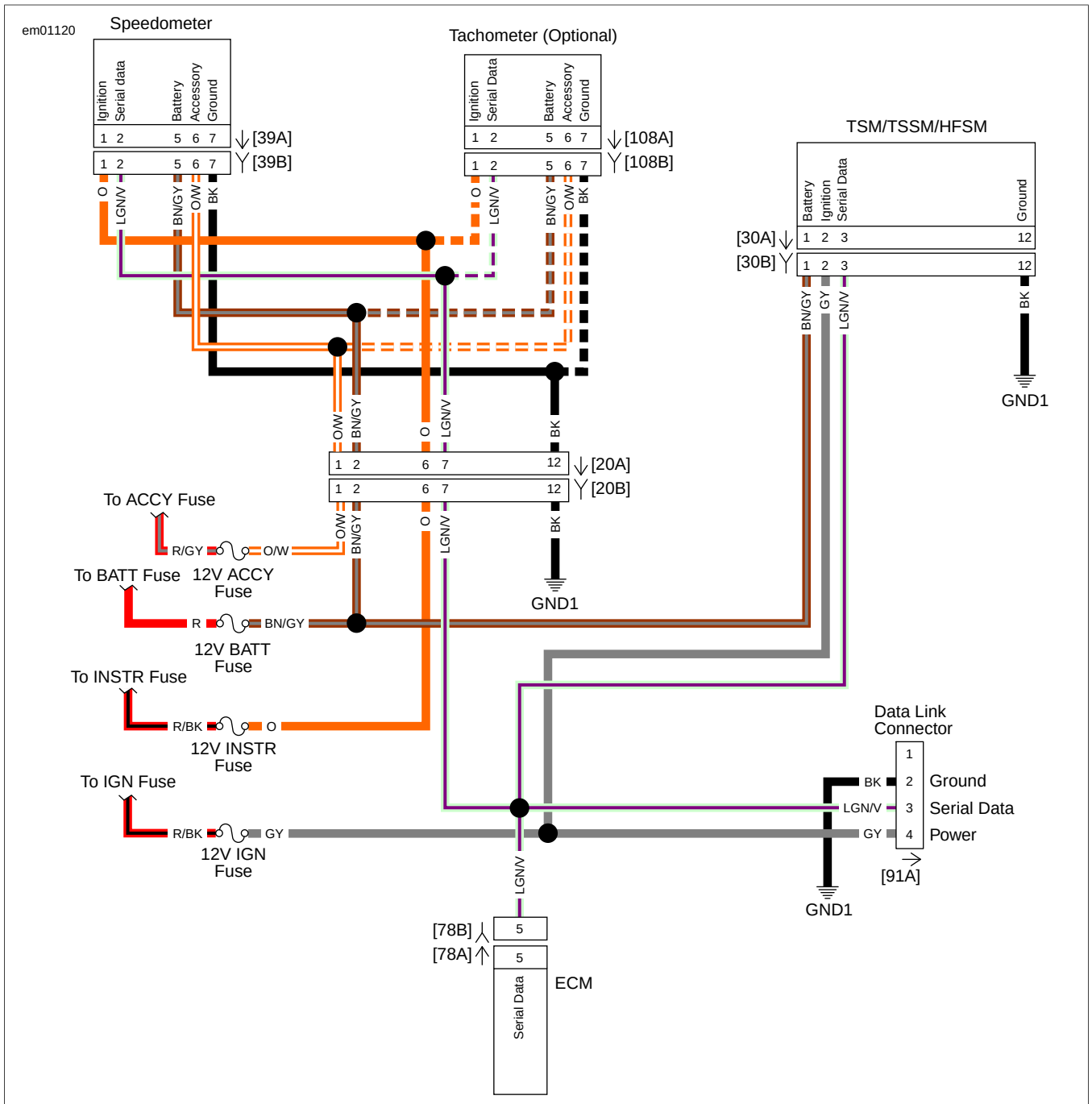


Figure 4-19. Serial Data Circuit (XL)

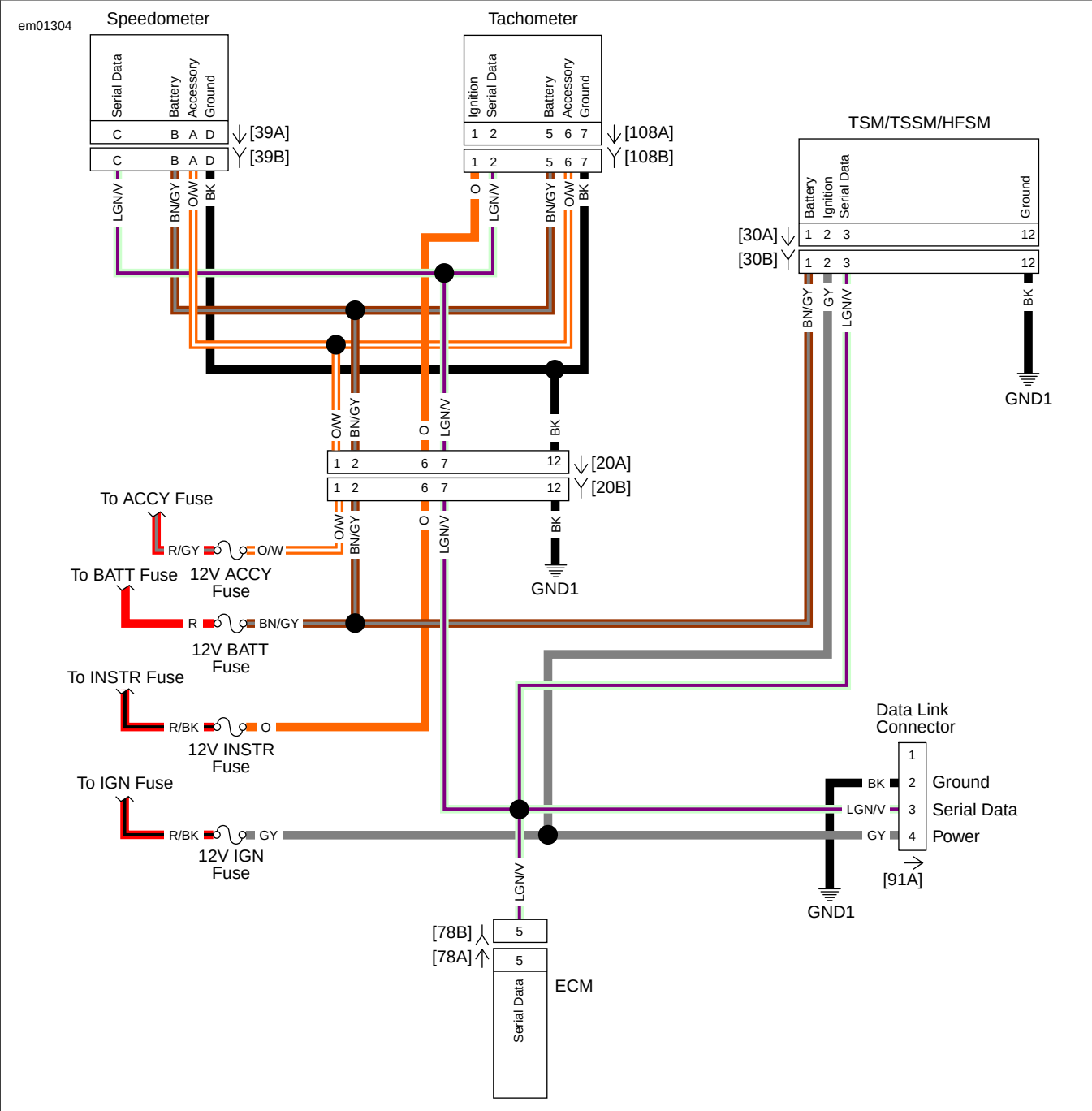


Figure 4-20. Serial Data Circuit (XR)

Table 4-12. Wire Harness Connectors

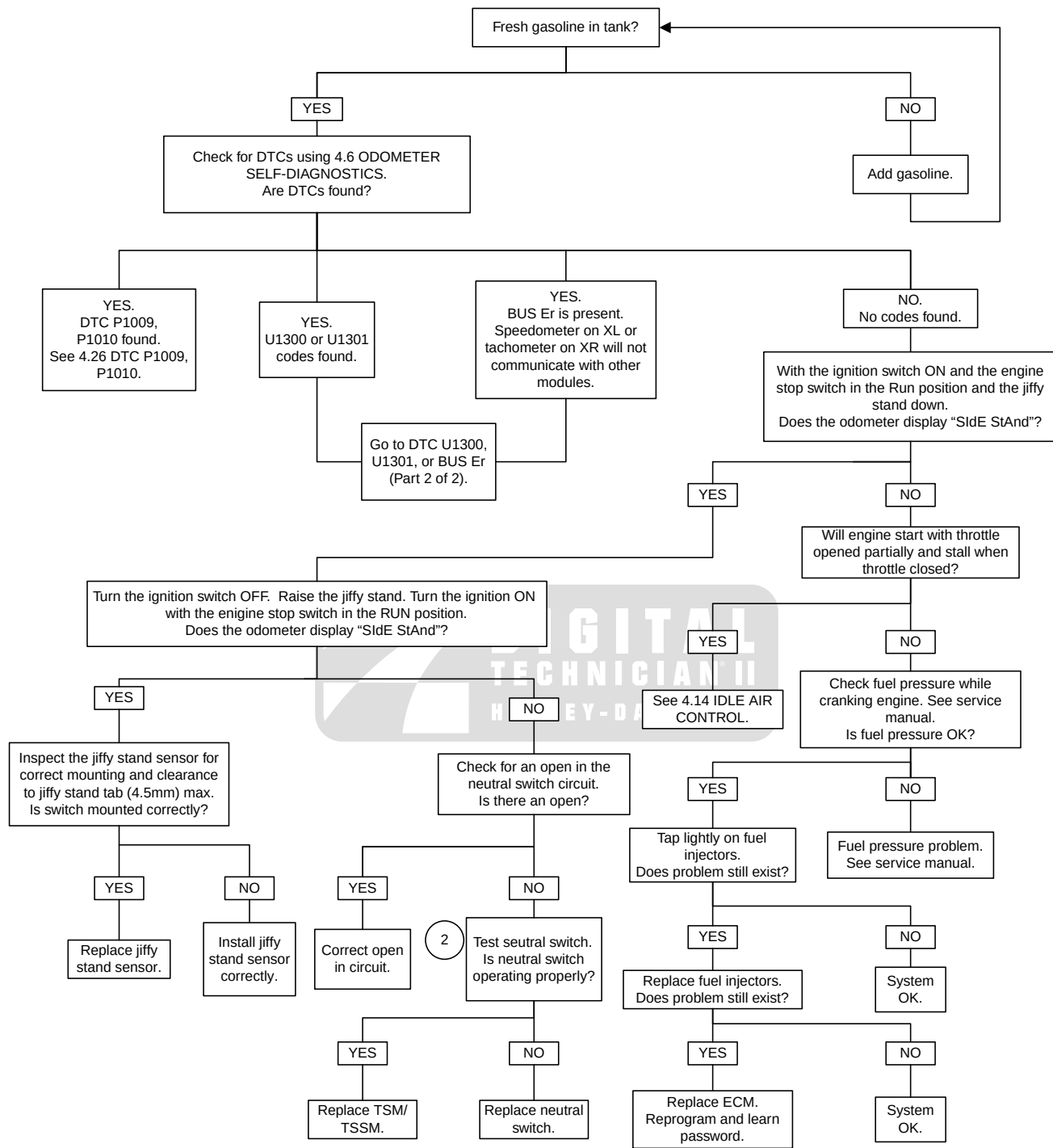
NO.	DESCRIPTION	TYPE	LOCATION
[20]	Instruments	12-place Molex	Under fuel tank
[30]	TSM/TSSM/HFSM	12-place Deutsch	Under battery tray
[39]	Speedometer (XL)	12-place Packard	Back of speedometer
[39]	Speedometer (XR)	5-place Packard	Back of speedometer
[78]	ECM	36-place Packard	Under seat

Table 4-12. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[91]	Data link connector	4-place Deutsch	Under left side cover
[108]	Tachometer (if equipped)	12-place Packard	Back of tachometer



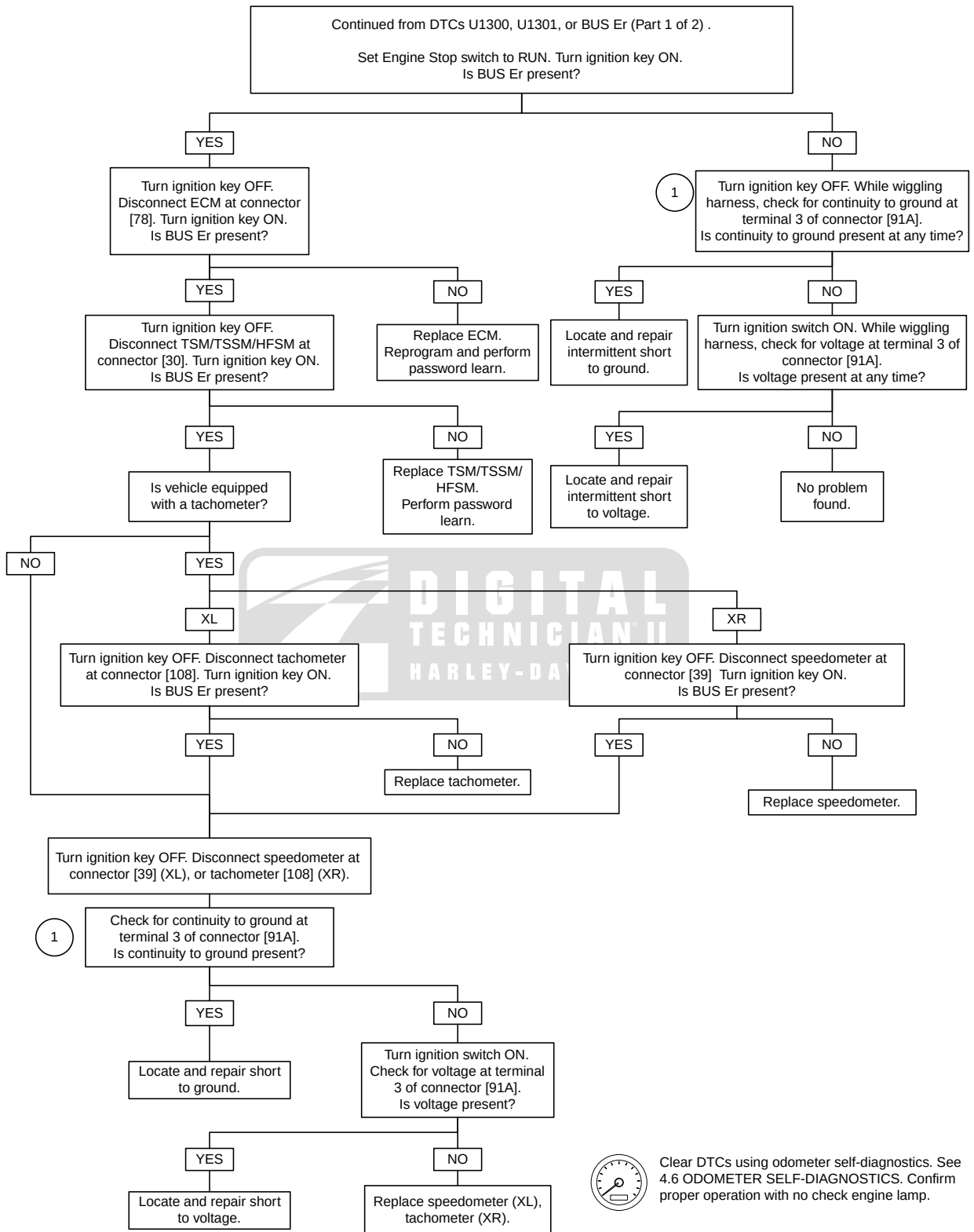
DTCs U1300, U1301, or BUS Er (Part 1 of 2)



Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

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DTCs U1300, U1301, or BUS Er (Part 2 of 2)



fc01969_en

GENERAL

With the Ignition Switch ON and the Engine Stop Switch at RUN, the Electronic Control Module (ECM) will energize the system relay to complete the circuit to the in-tank fuel pump. It will remain on as long as the engine is cranking or running, and the ECM is receiving ignition reference pulses from the CKP sensor. If there are no reference pulses, the ECM will de-energize the system relay within 2 seconds after ignition is ON or engine has stalled, or immediately after the ignition is shut OFF.

The fuel pump delivers fuel to the injectors. The pressure regulator is where the system pressure is controlled. Excess fuel flow is bypassed into the fuel tank through the pressure regulator. When the engine is stopped, the pump can be turned on by applying battery voltage and ground to the fuel pump connector [141A]. See [Figure 4-21](#). The fuel pump connector is located forward of the fuse blocks. Improper fuel system pressure may contribute to one or all of the following symptoms.

- Engine cranks, but won't run.
- Engine cuts out (may feel like ignition problems).
- Hesitation, loss of power and poor fuel economy.

NOTE

After turning ignition OFF, you must wait 10 seconds before turning the ignition back ON to get the fuel pump to reprime. This time out period is necessary for the fuel pump and IAC to reset.

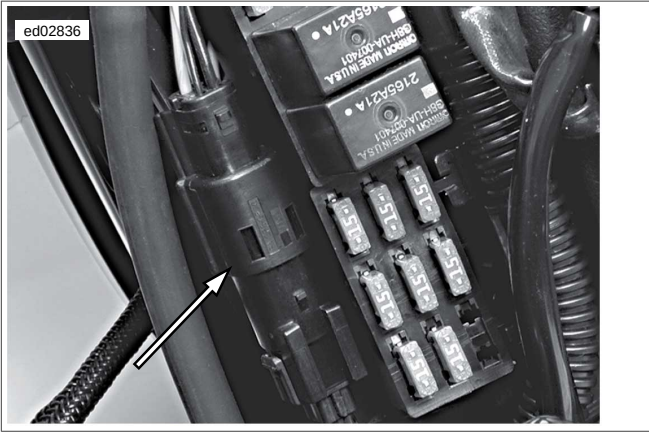


Figure 4-21. Fuel Pump Connector [141]

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. Turns on fuel pump if wiring is OK. If pump runs, problem is in basic fuel delivery.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), gray probe and patch cord.
3. Connect BREAKOUT BOX (Part No. HD-43876). See [4.7 BREAKOUT BOX: EFI](#).
4. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), purple pin probe and patch cord.

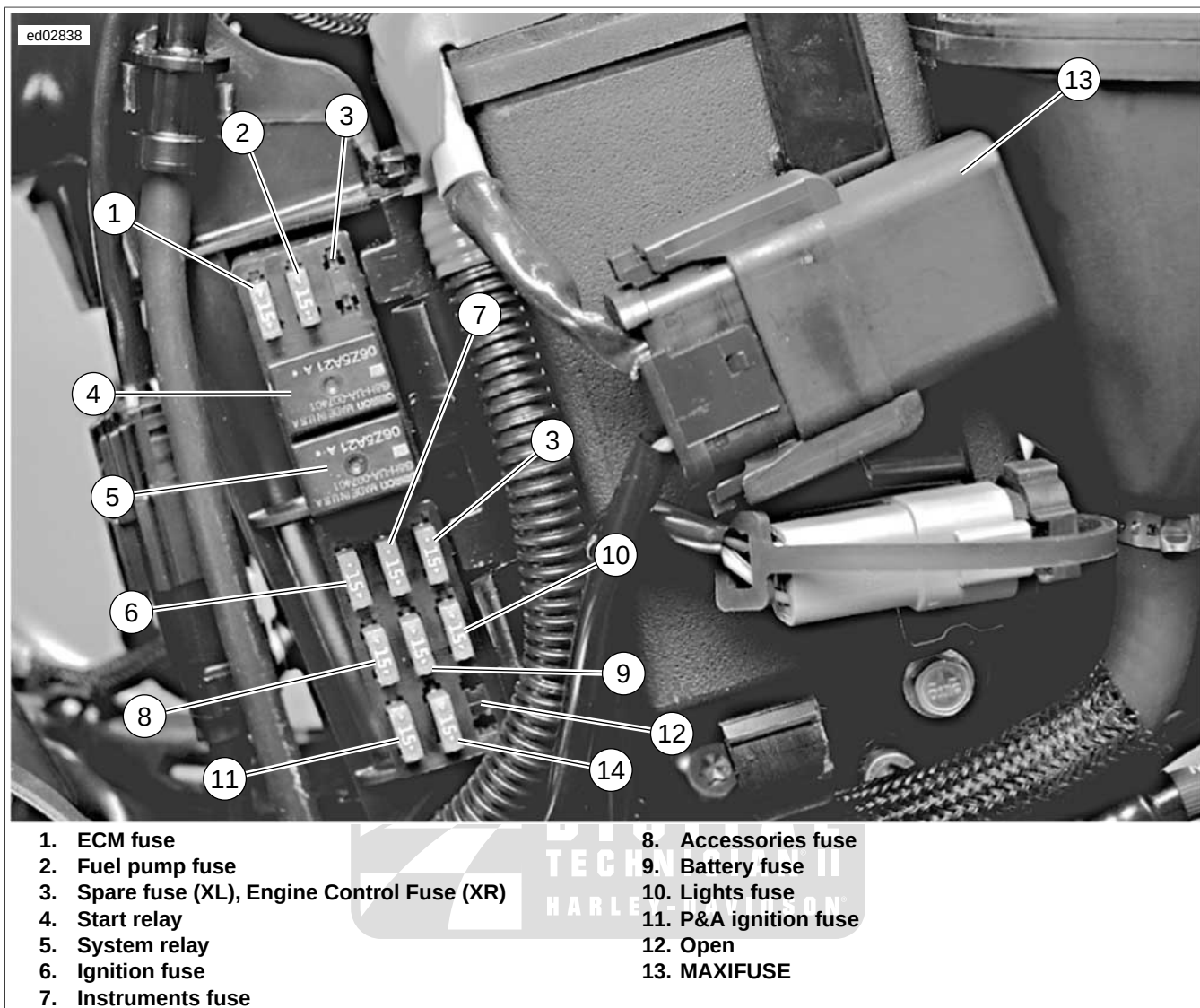


Figure 4-22. Fuses and Relays

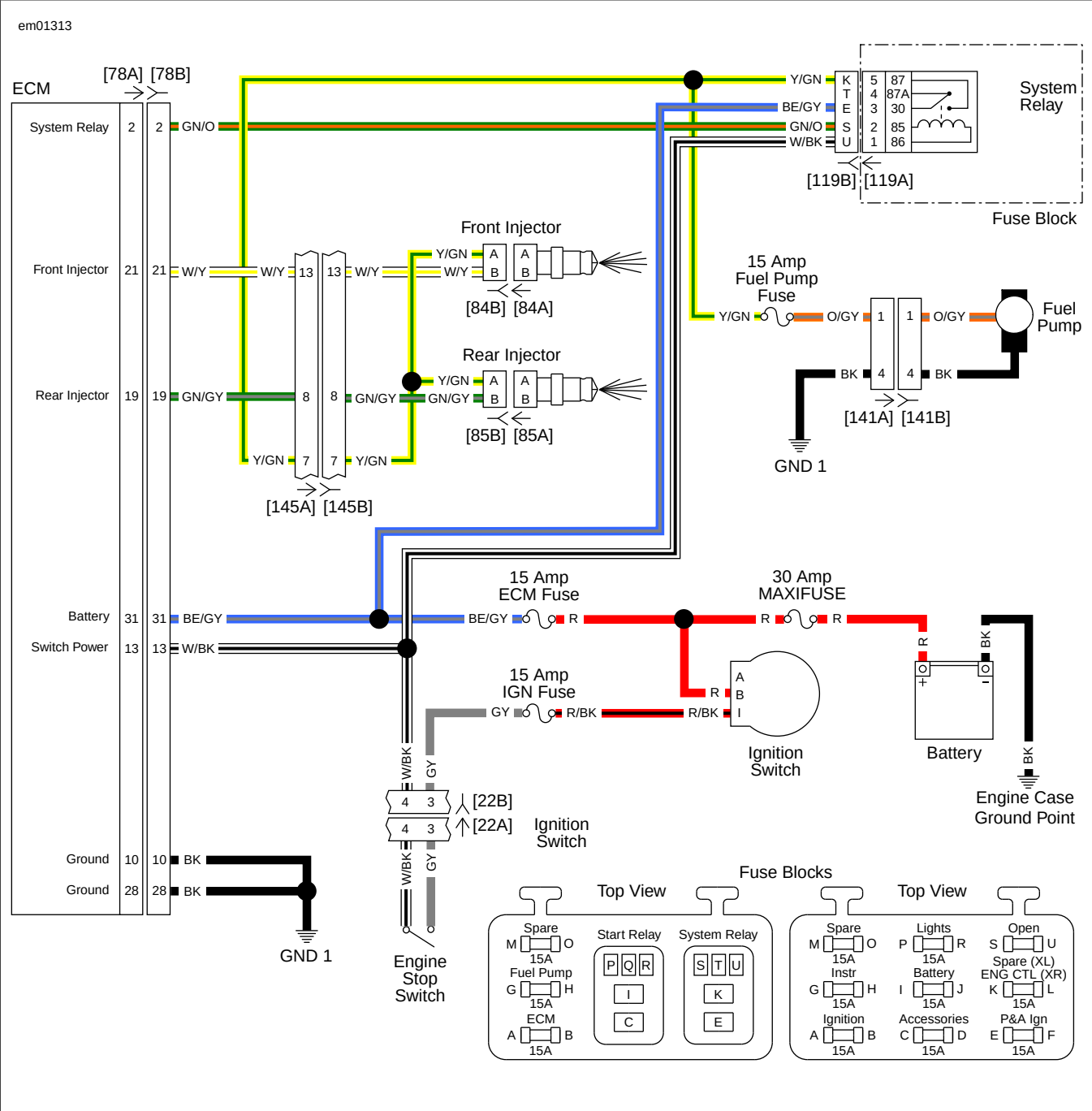


Figure 4-23. Fuel Pump Circuit

Table 4-13. Wire Harness Connectors

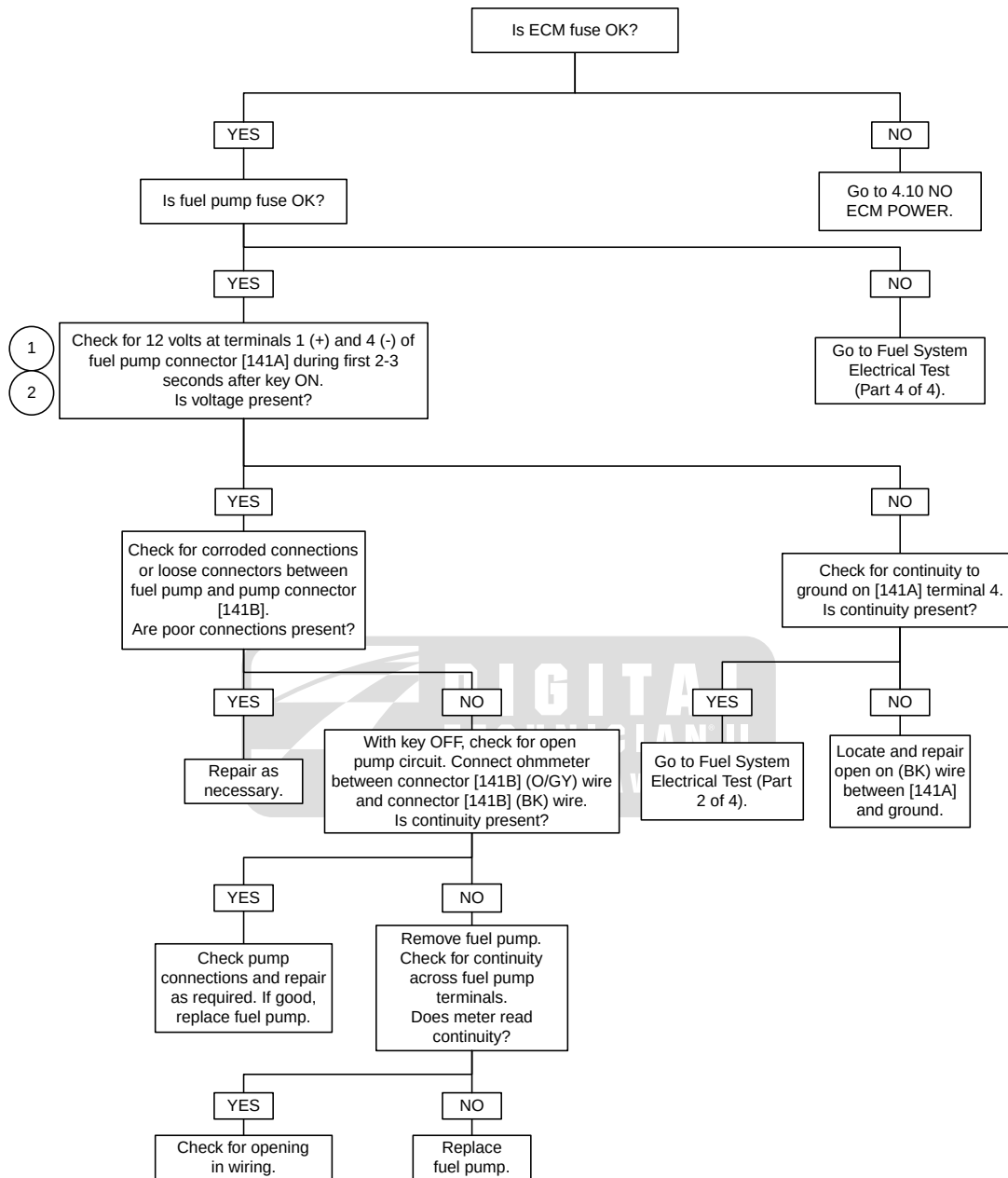
NO.	DESCRIPTION	TYPE	LOCATION
[22]	Right handlebar controls	6-place Molex	Under fuel tank
[78]	ECM	36-place Packard	Under seat
[84]	Front injector	2-place Delphi, black	Top of intake manifold
[85]	Rear injector	2-place Delphi, black	Top of intake manifold
[119]	System relay	5-place Amp	Under left side cover

Table 4-13. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[141]	Fuel pump	4-place Molex	Left side, in front of fuse/relay blocks
[145]	Engine harness	16-place Molex	Under seat

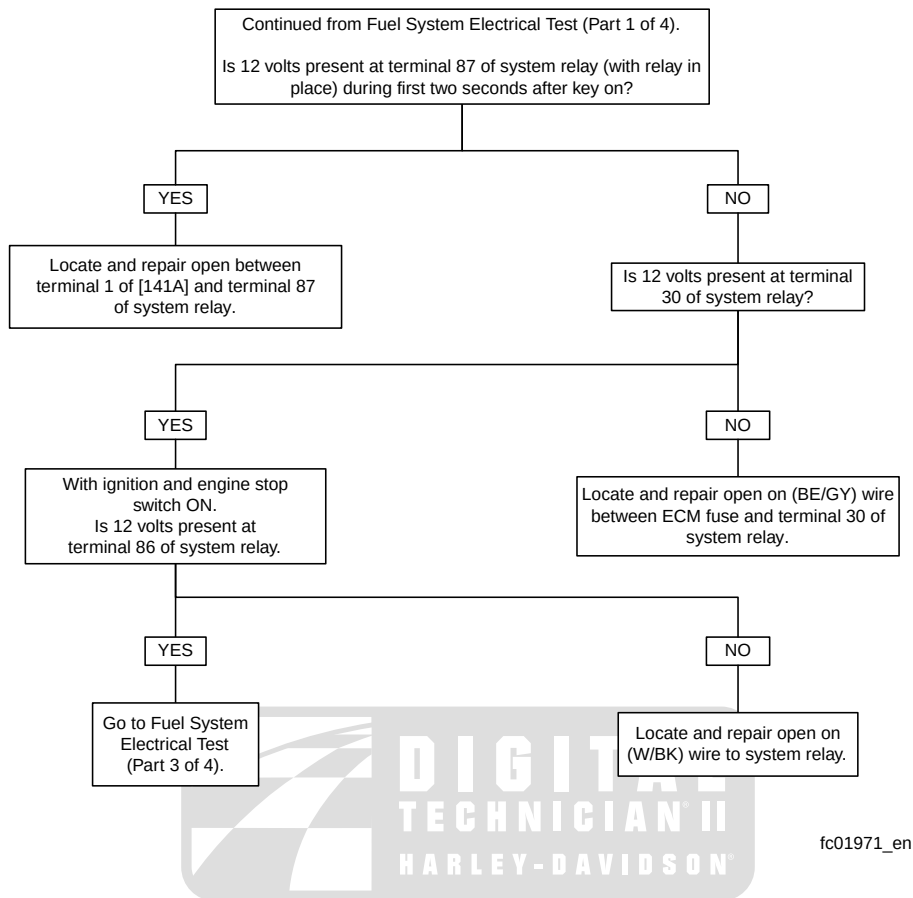


Fuel System Electrical Test (Part 1 of 4)

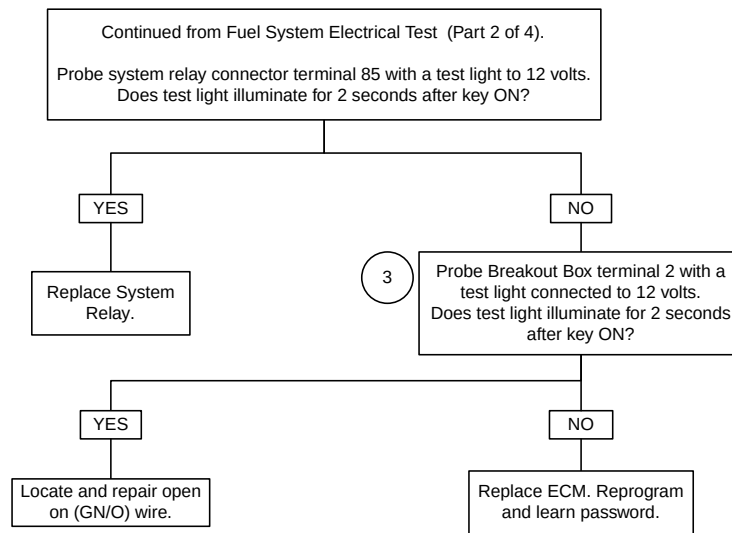


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Fuel System Electrical Test (Part 2 of 4)



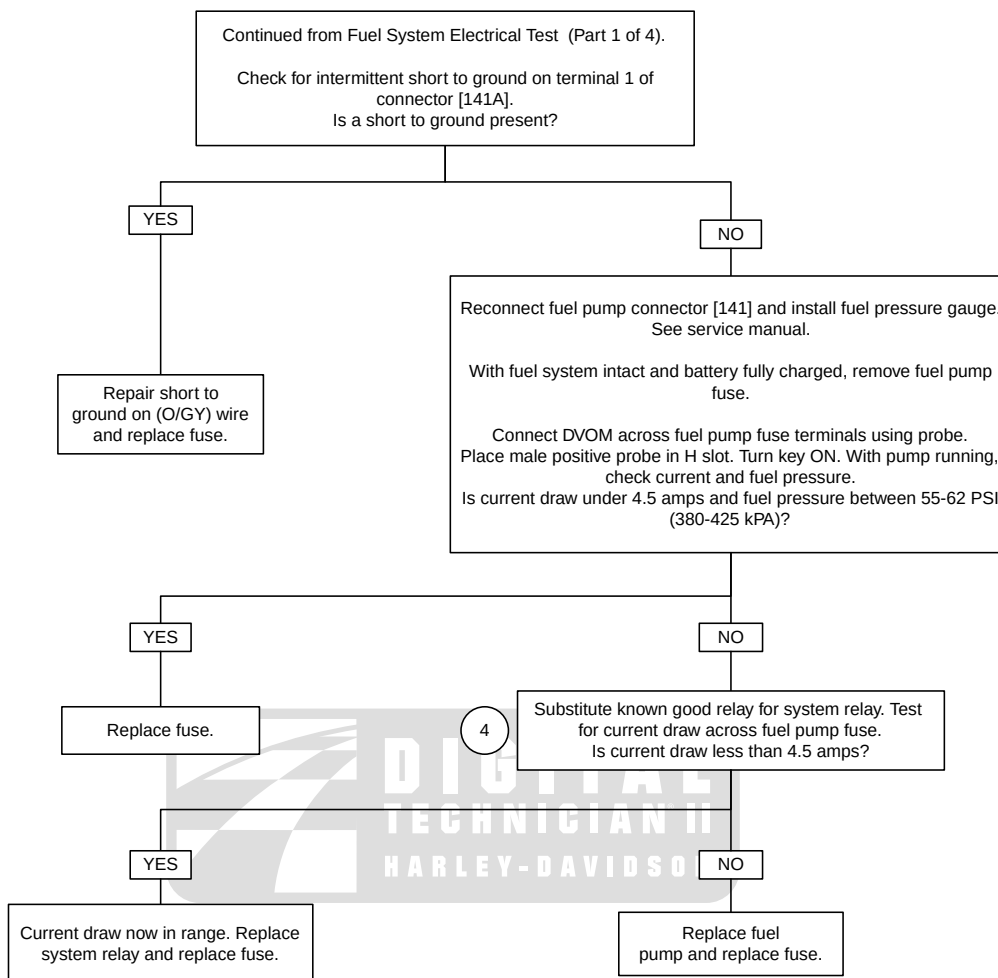
Fuel System Electrical Test (Part 3 of 4)



fc01207_en



Fuel System Electrical Test (Part 4 of 4)



fc01208_en

SYSTEM RELAY CHECK

4.13

GENERAL

System Relay

See [Figure 4-24](#). With the ignition switch ON and the engine stop switch at RUN, the ECM will energize the system relay to complete the circuit to the in-tank fuel pump, ignition coil, and fuel injectors. They will remain powered as long as the engine is cranking or running, and the ECM is receiving ignition reference pulses from the CKP sensor. If there are no reference pulses, the ECM will de-energize the system relay within 2 seconds after ignition is ON or engine has stalled, or immediately after the ignition is shut OFF.

Table 4-14. Code Description

DTC	DESCRIPTION
P1001	System relay coil open/low
P1002	System relay coil high/shorted
P1003	System relay contacts open
P1004	System relay contacts closed

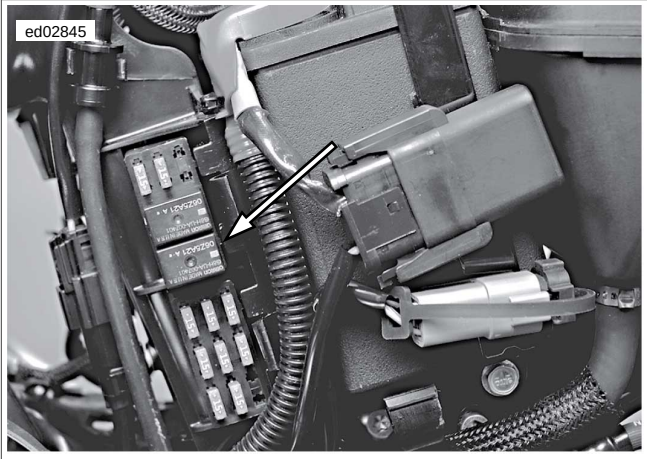


Figure 4-24. System Relay

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

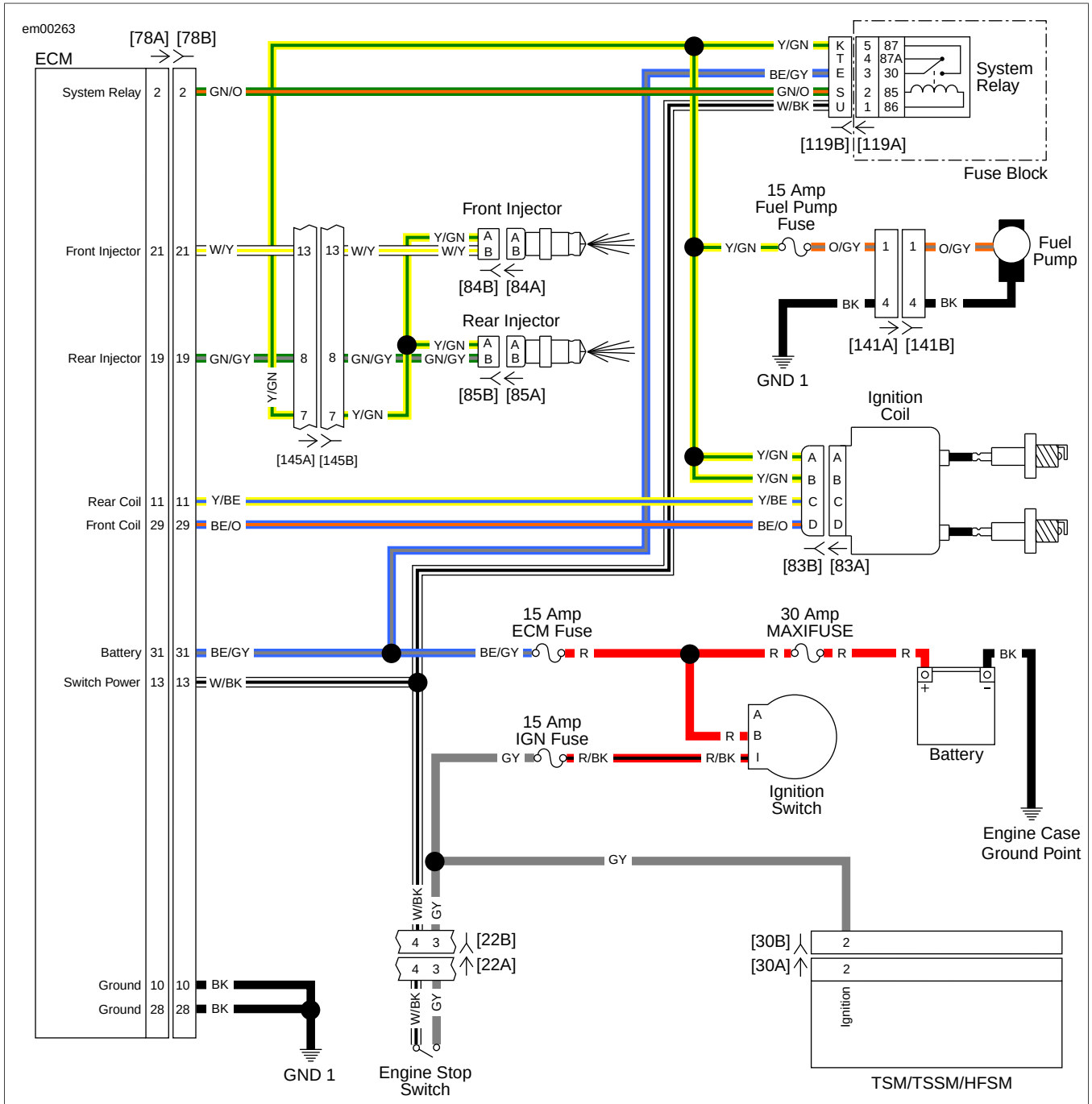
Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

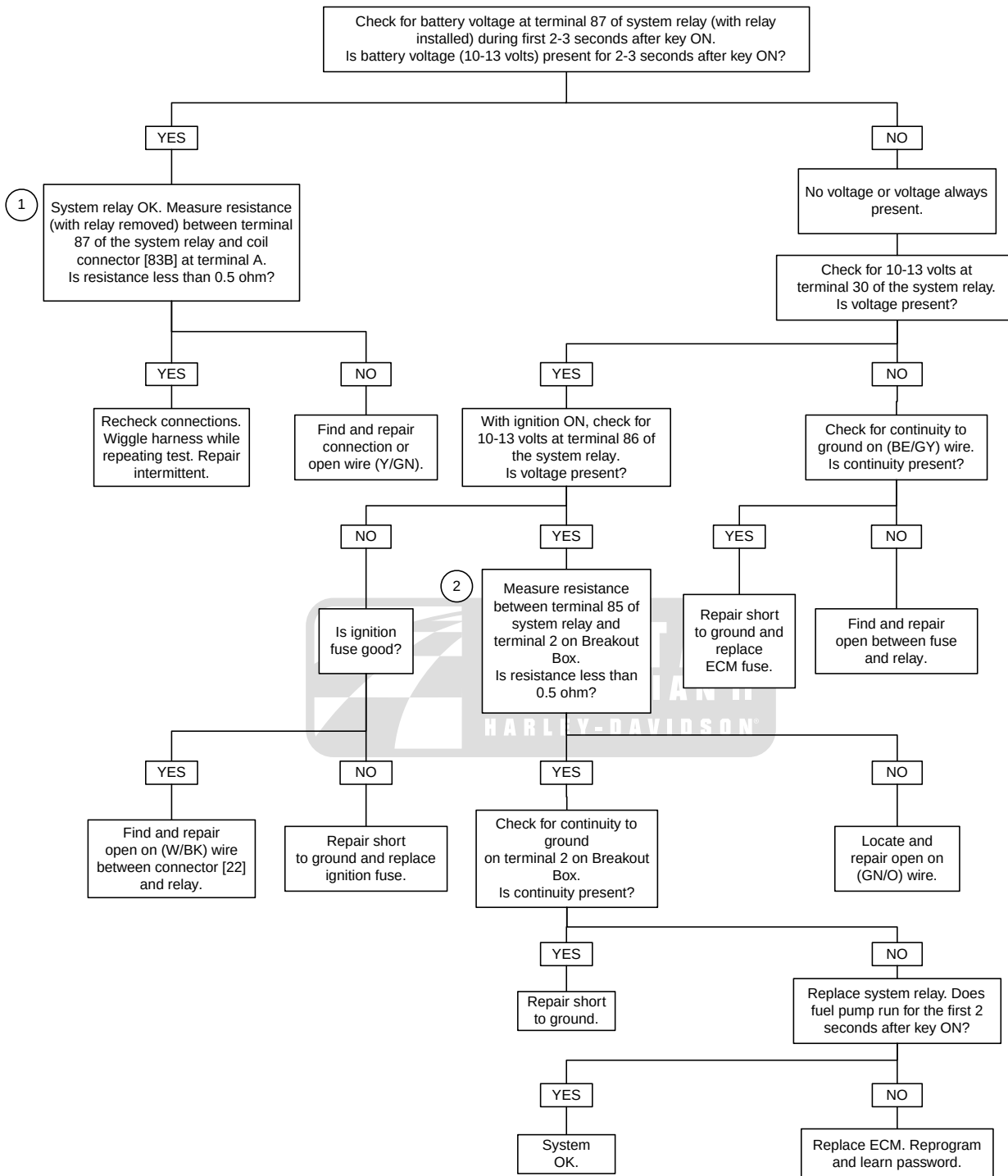
1. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), gray pin probe and patch cord.
2. Connect BREAKOUT BOX (Part No. HD-43876) to ECM. See [4.7 BREAKOUT BOX: EFI](#).

Table 4-15. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[22]	Right handlebar controls	6-place Molex	Under fuel tank
[30]	TSM/TSSM/HFSM	12-place Deutsch, gray	Under battery
[78]	ECM	36-place Packard	Under seat
[83]	Ignition coil	4-place Delphi	Back of coil
[84]	Front injector	2-place Delphi, black	Top of intake manifold
[85]	Rear injector	2-place Delphi, black	Top of intake manifold
[119]	System relay	5-place Amp	Under left side cover
[141]	Fuel pump and low fuel switch	4-place Molex, black	Forward of relay/fuse blocks
[145]	Engine harness	16-place Molex	Under seat



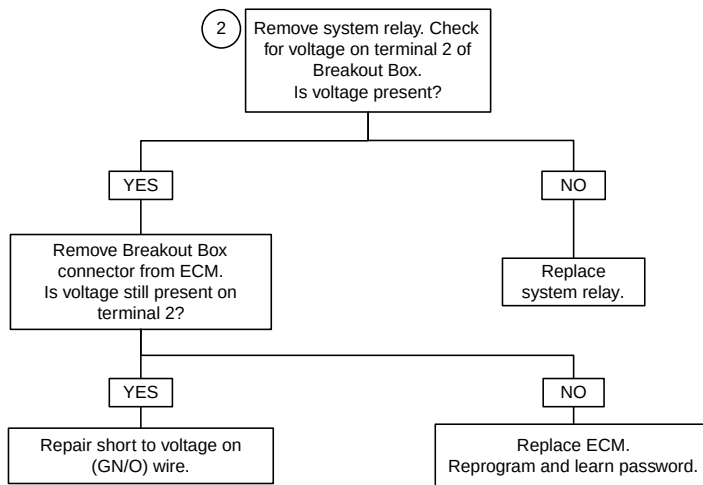
DTCs P1001 and P1003



Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

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DTC P1002

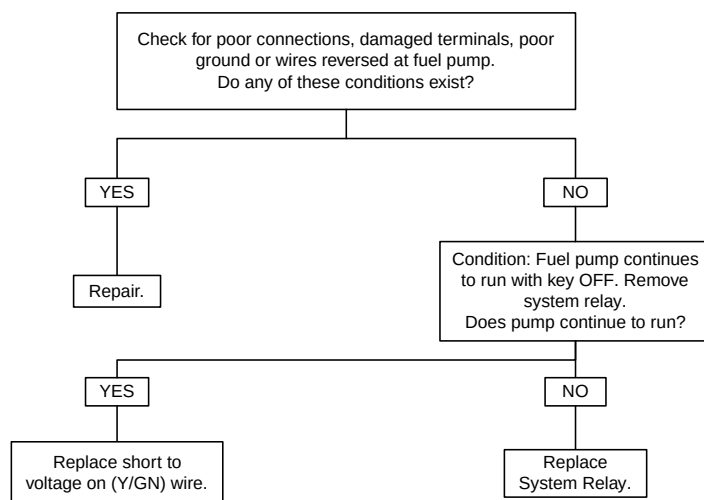


Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

fc01829_en



DTC P1004



Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

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IDLE AIR CONTROL

4.14

GENERAL

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

IAC Operation

The ECM controls engine idle speed by moving the Idle Air Control (IAC) to open or close a passage around the throttle plate. It does this by sending voltage pulses to the proper motor winding of the IAC. This causes the pintle to move in or out of the IAC a given distance for each pulse received.

- To increase idle speed, the ECM retracts the pintle, allowing more air to flow through the throttle body.
- To decrease idle speed, the ECM extends the pintle, allowing less air to flow through the throttle body.

The IAC position is measured in steps. This can be done only by using the DIGITAL TECHNICIAN II (Part No. HD-48650).

- A high number of steps represents a retracted pintle and open passage around throttle plate. This correlates with an increase in the amount of air flowing through the throttle body.
- Zero steps represents a fully extended pintle. A zero reading indicates an abnormal condition in which the pintle has been fully extended and has consequently closed the passage around throttle plate.

Each time the ignition is turned off, the ECM resets the IAC by sending enough pulses to extend the pintle and effectively close the throttle body. The fully extended value is the ECM reference point. A given number of steps are then calculated by the ECM for use in setting the proper idle speed and IAC position.

NOTE

Warm idle speed is controlled by the ECM and can be adjusted only by using the DIGITAL TECHNICIAN II (Part No. HD-48650).

Diagnostic Trouble Code P0505: Loss of Idle Speed Control

Loss of idle speed control will result if the idle RPM is 200 from preset idle speed and IAC motor is at zero or maximum for greater than 5 seconds. This code may occur with others for

a multiple code situation. Resolve the other codes first to correct.

Table 4-16. Code Description

DTC	DESCRIPTION
P0505	Loss of idle speed control

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-41404-B	HARNES CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Diagnostic Tips

Engine idle speed can be adversely affected by the following:

- A loss of idle speed control does not necessarily imply the IAC actuator or wiring has failed. It can be caused by a number of conditions such as an intake air leak, improperly adjusted throttle stop (factory set) or a misfiring cylinder.
- Leaking injectors will cause fuel imbalance and poor idle quality due to different air/fuel ratios in each cylinder. To check for leaky injectors, first remove the air cleaner. See Air Cleaner in the service manual. Then, with the throttle wide open, turn key ON for 2 seconds and then OFF for 2 seconds five consecutive times. Replace the fuel injector if there is any evidence of raw fuel in the bores. See Fuel Injectors in the service manual.
- Vacuum leaks. To check for vacuum, see Intake Leak Test in the service manual.
- Contaminated fuel.
- Excessive oil in the crankcase (oil sumping).
- TP sensor reading of greater than 1% (possible throttle cable misadjustment) or battery voltage reading of less than 9 volts or a VSS greater than 0 will disable idle speed control.
- If there is a loss of battery power at ECM terminal 31, vehicle will start but IAC pintle will not reset at key OFF. Eventually pintle will be out of position causing performance problems.

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. When the engine is stopped, the IAC pintle extends and then retracts to a fixed "Park" position for increased air-flow and idle speed during the next engine start sequence. This key OFF reset procedure takes 10 seconds to perform.

2. Test lamp behavior may follow two patterns. The color of the lights is not relevant to IAC operation.
 - a. **Normal behavior:** At key ON, test lights will alternately flash and then remain steady on to confirm ECM signals. At key OFF lights alternately flash and go out after 10 second reset procedure.
 - b. **Problem indicated:** One or more lights fail to illuminate during key ON/key OFF cycle.

NOTE

There is a remote possibility that one of the circuits is shorted to voltage which would have been indicated by a steady light. Disconnect ECM and turn the ignition ON. Probe terminals to check for this condition.

3. Connect BREAKOUT BOX (Part No. HD-43876) to EFI wire harness only, leaving ECM disconnected. See [4.7 BREAKOUT BOX: EFI](#).
4. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), gray pin probe and patch cord.
5. Repair faulty ECM connection or replace ECM. If ECM requires replacement, see ECM in the service manual.

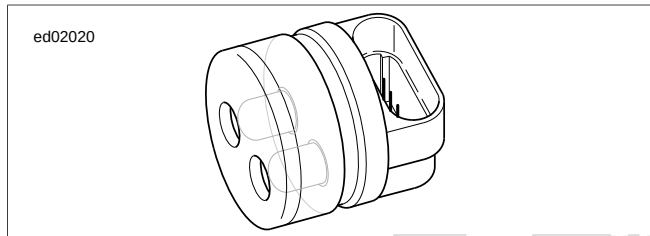


Figure 4-26. IAC Test Lamp (Part No. HD-41199-3)

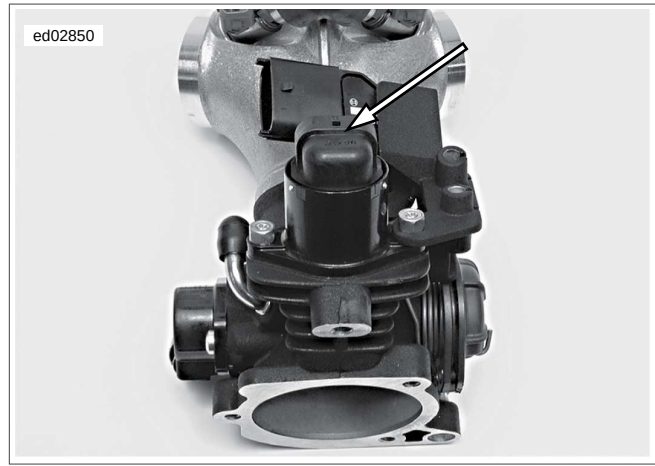


Figure 4-27. IAC Connector (typical)

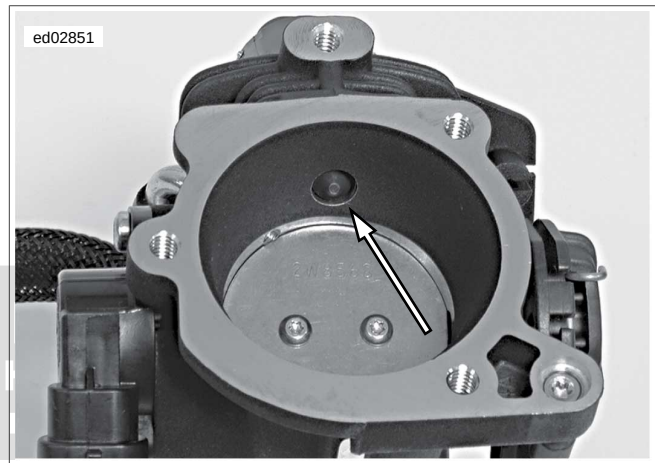


Figure 4-28. IAC Pintle (typical)

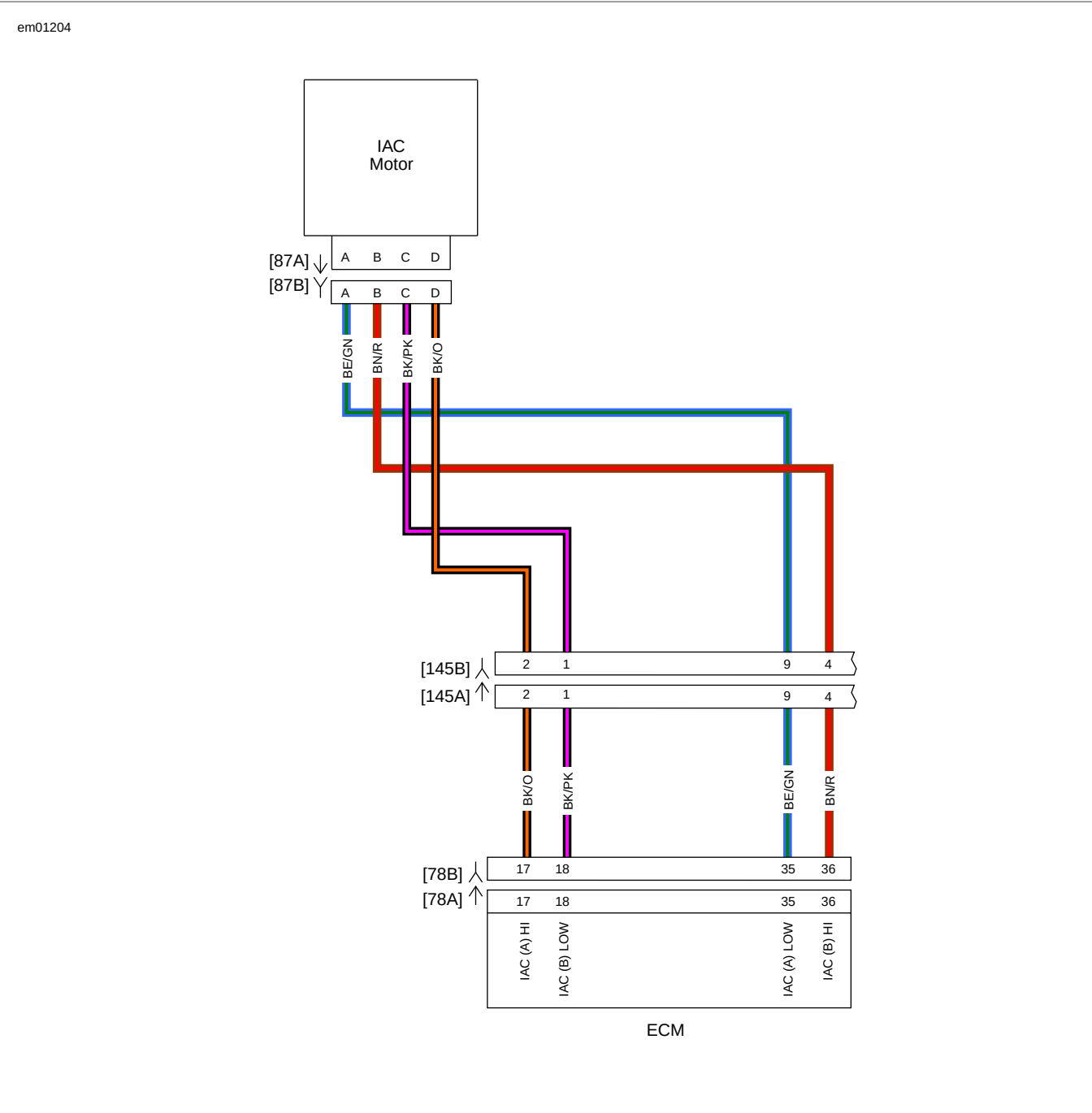
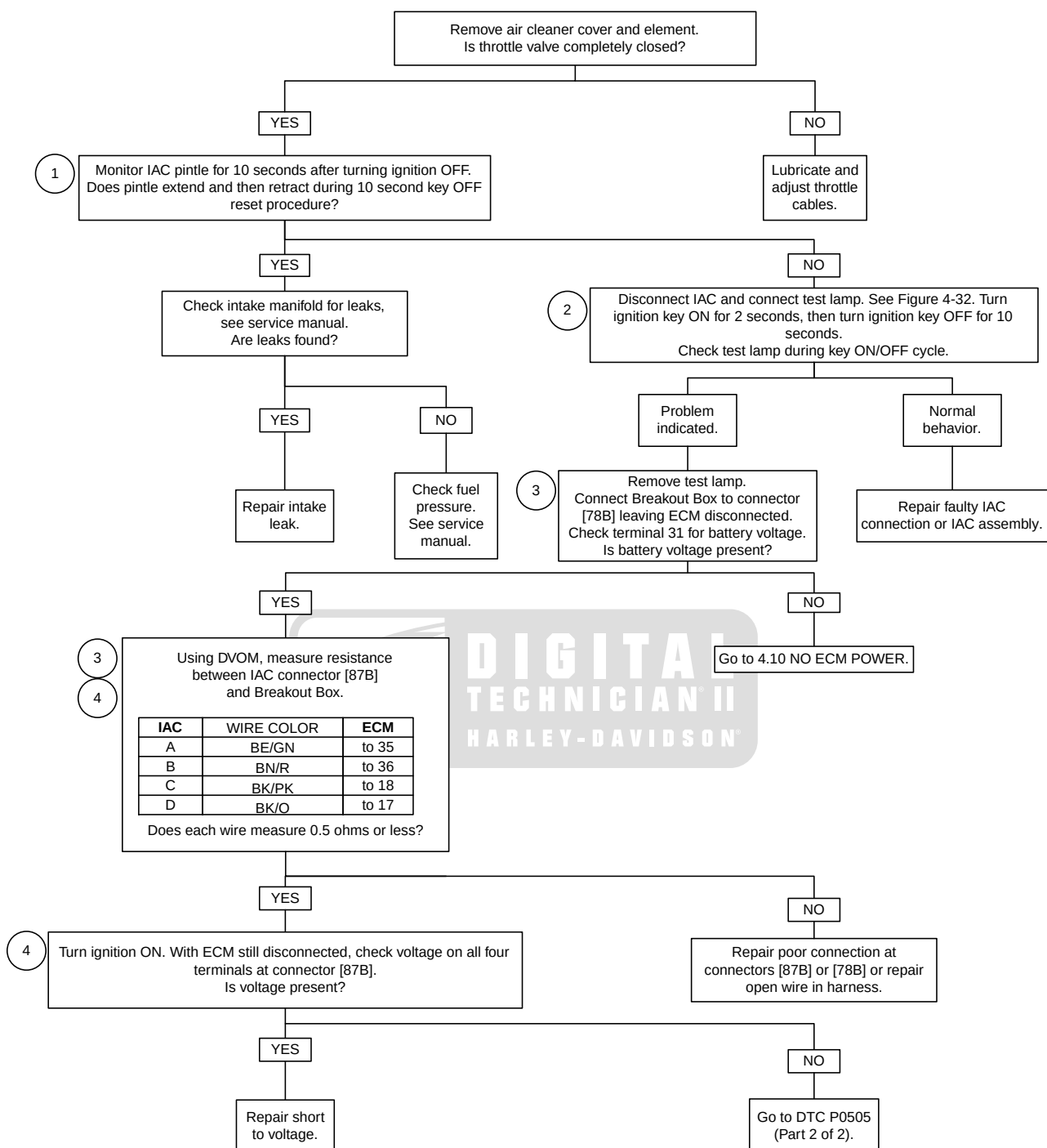


Figure 4-29. IAC Circuit

Table 4-17. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM	36-place Packard	Under seat
[87]	IAC	4-place Delphi	Beneath fuel tank
[145]	Engine harness	16-place Molex	Under seat

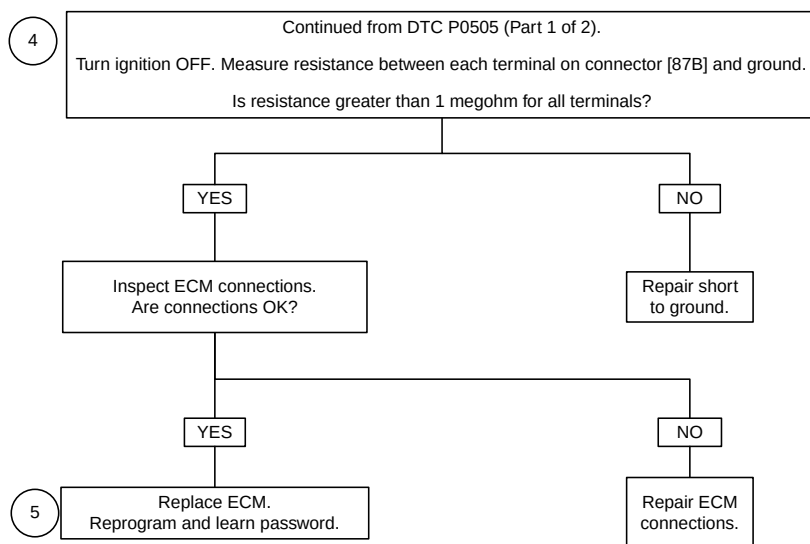
DTC P0505 (Part 1 of 2)



Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

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DTC P0505 (Part 2 of 2)



Clear DTCs using odometer self-diagnostics. See 4.6
ODOMETER SELF-DIAGNOSTICS. Confirm proper
operation with no check engine lamp.

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MISFIRE AT IDLE OR UNDER LOAD

4.15

GENERAL

Misfire at Idle or Under Load

- Battery condition and connections may also cause misfires. See Battery in the service manual for more information.
- Fuel system problems may also cause misfires. See the service manual and then see symptom tables under [4.5 INITIAL DIAGNOSTIC CHECK: EFI](#).
- Mechanical problems with the engine may cause misfires. See service manual for more information.
- Vehicle modifications including intake and exhaust may cause misfires.

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-26792	SPARK TESTER
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

WARNING

Wipe up spilled fuel and dispose of rags in a suitable manner. An open spark around gasoline could cause a fire or explosion, resulting in death or serious injury. (00518b)

- Connect BREAKOUT BOX (Part No. HD-43876) between wire harness and ECM. See [4.7 BREAKOUT BOX: EFI](#).

NOTE

Engine will not spark with both spark plugs removed. When checking for spark, use SPARK TESTER (Part No. HD-26792) with both plugs installed.

- See [Figure 4-30](#). A SPARK TESTER (Part No. HD-26792) must be used to verify adequate secondary voltage (25,000 volts) at the spark plug.
 - Turn ignition switch OFF.
 - Remove spark plug cable from spark plug. Visually check plug condition.
 - Attach cable to SPARK TESTER (Part No. HD-26792). Clip tester to cylinder head bolt.
 - While cranking engine, watch for spark to jump tester gap on leads.
 - Reinstall and repeat procedure on other spark plug cable.

Table 4-18. Spark Plug Cables

SPECIFICATION	FRONT	REAR
Length in.	6.25-6.6	19.37-19.63
Length mm	158-168	492-499
Resistance-ohms	2159-3086	4842-13087

- Perform spark plug cable resistance test.
 - 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.
 - Using an ohmmeter, touch probes to terminals on each end plug cable.
 - Compare resistance values to [Table 4-18](#). Replace cables not meeting specifications. Reinstall and repeat procedure on other spark plug cable.
- If carbon tracking is evident on outside of coil towers, replace ignition coil and inspect spark plug cables. Cables must be clean and tight. Excessive cable resistance or faulty connections can cause coil damage.
- 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 ignition coil in the service manual.
- Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), red pin probe and patch cord to relay and gray pin probe and patch cord to the coil connector [83B].

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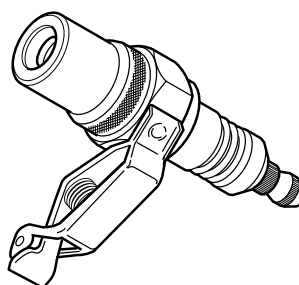


Figure 4-30. Spark Tester

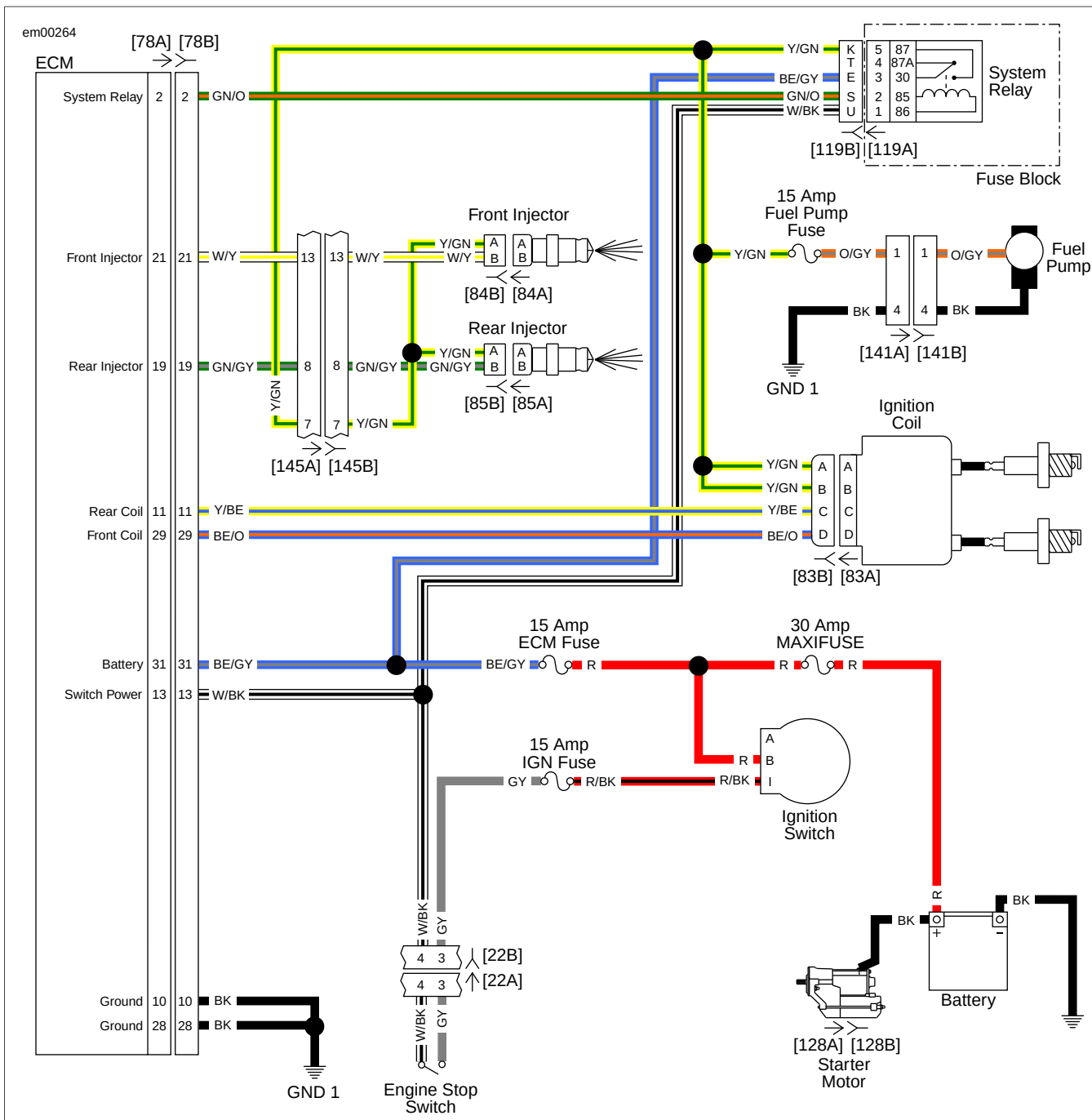


Figure 4-31. Ignition Coil Circuit Diagram

Table 4-19. Wire Harness Connectors

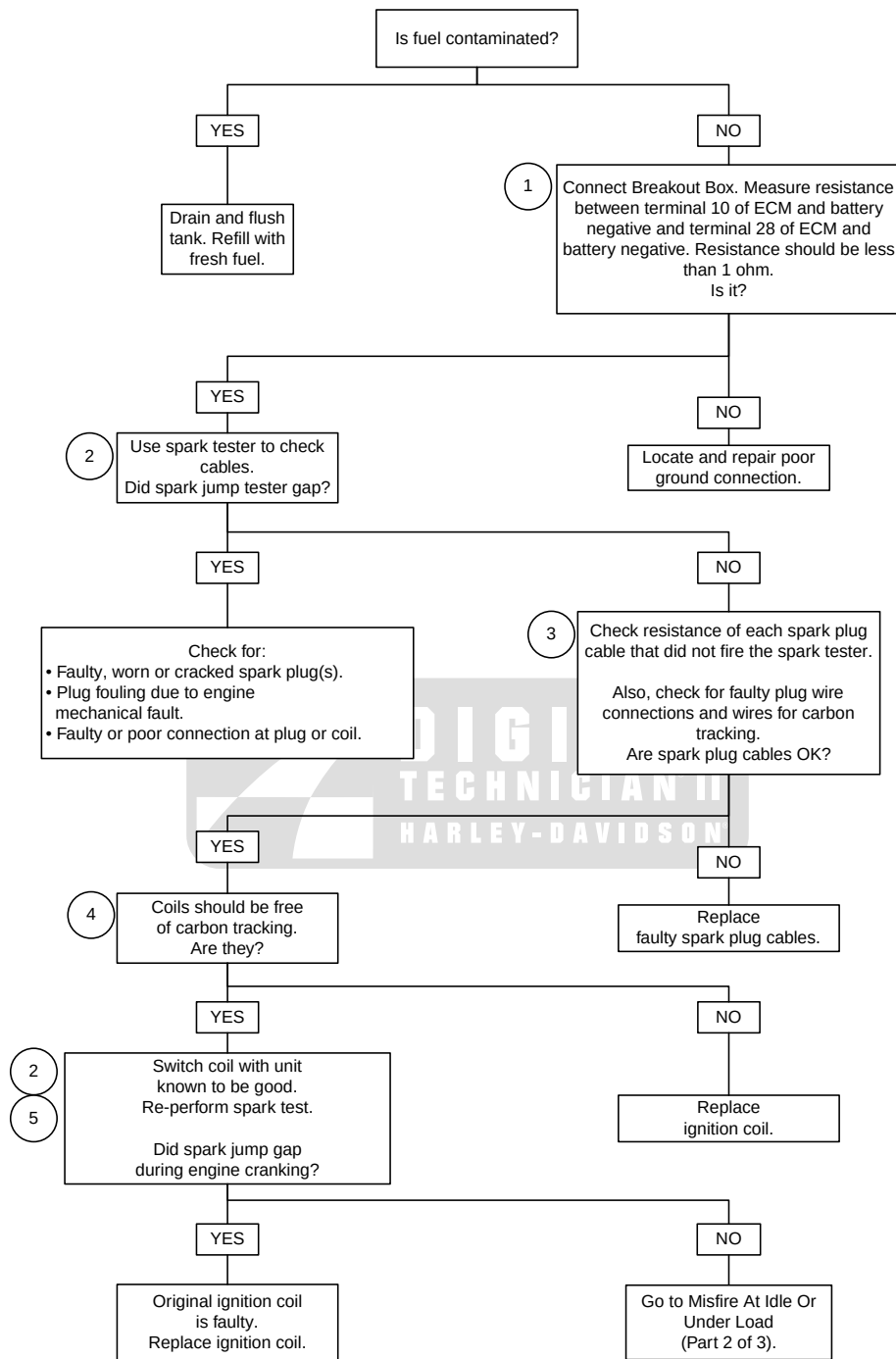
NO.	DESCRIPTION	TYPE	LOCATION
[22]	Right handlebar controls	6-place Molex	Under fuel tank
[78]	ECM	36-place Packard	Under seat
[83]	Ignition coil	4-place Delphi	Back of coil
[84]	Front injector	2-place Delphi, black	Top of intake manifold
[85]	Rear injector	2-place Delphi, black	Top of intake manifold
[119]	System relay	5-place Amp	Under left side cover

Table 4-19. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[128]	Starter solenoid	Locking spade terminal, white	Starter solenoid
[141]	Fuel pump	4-place Molex	Left side, in front of fuse/relay blocks
[145]	Engine harness	16-place Molex	Under seat

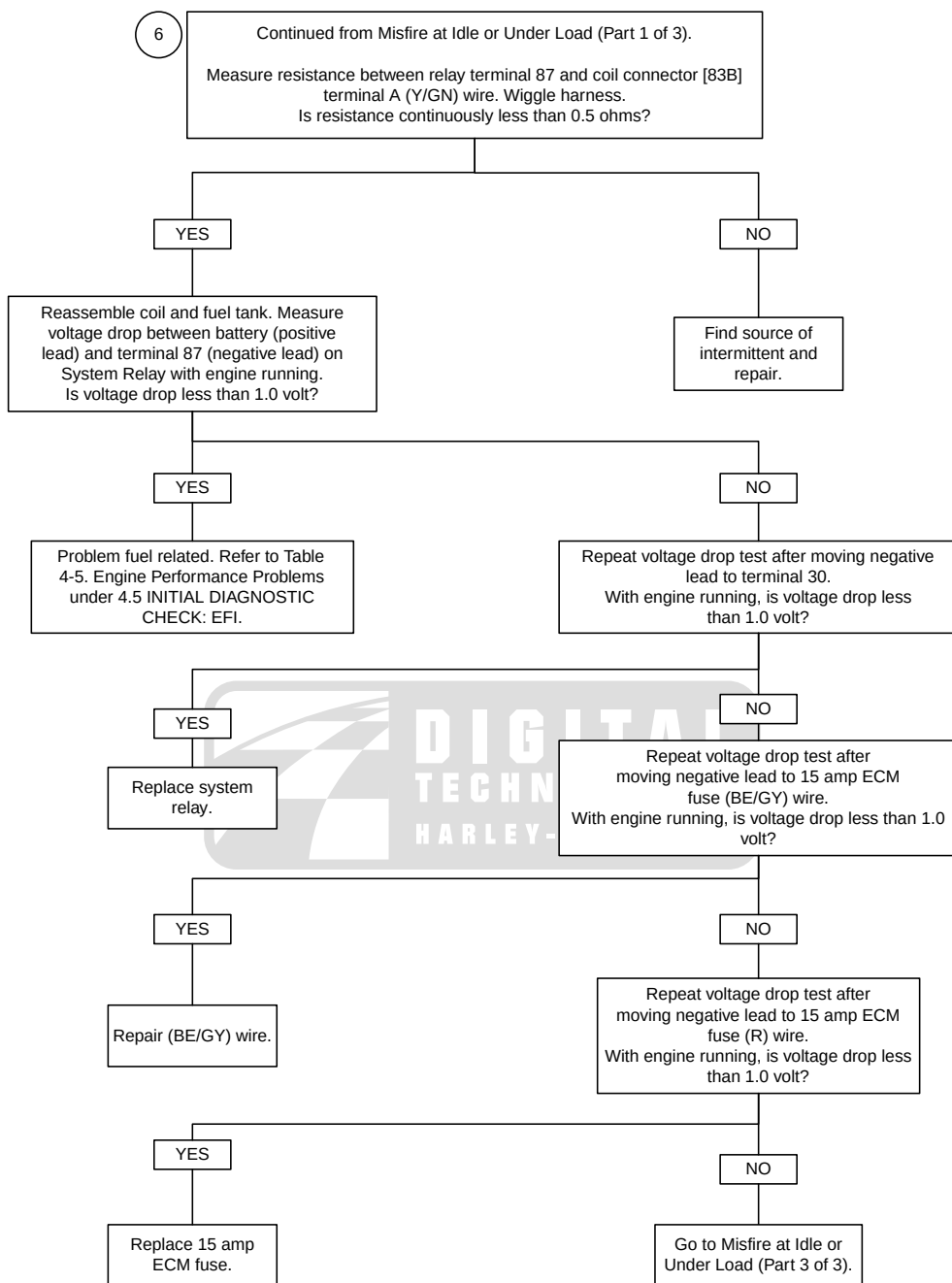


Misfire at Idle or Under Load (Part 1 of 3)



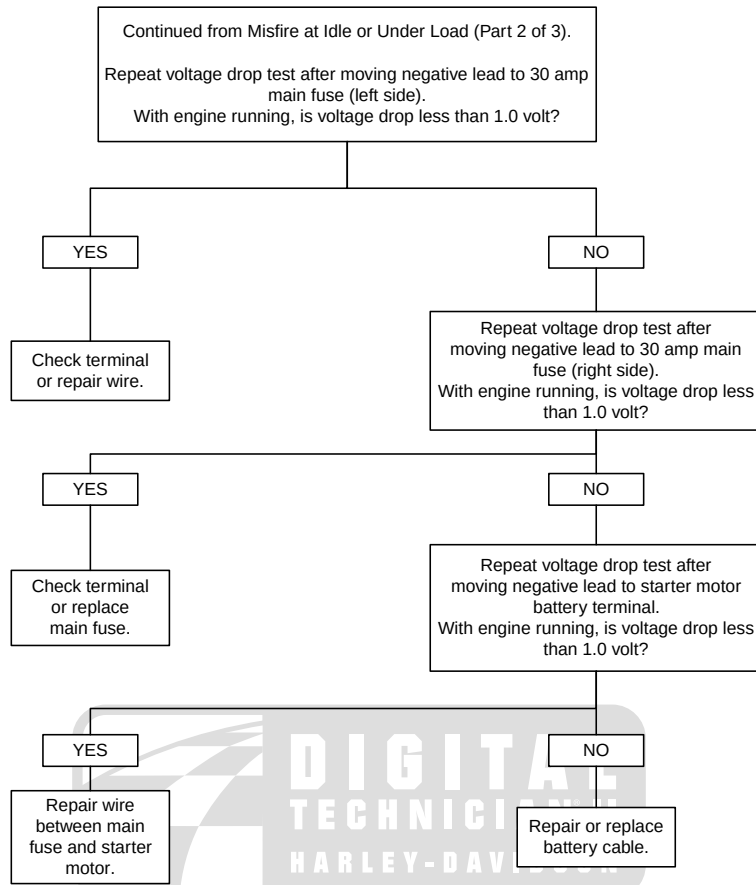
fc01215_en

Misfire at Idle or Under Load (Part 2 of 3)



fc01216_en

Misfire at Idle or Under Load (Part 3 of 3)



fc01217_en

GENERAL

See [Figure 4-32](#). The Temperature Manifold Absolute Pressure (TMAP) sensor provides the functions of both an Intake Air Temperature (IAT) sensor and a Manifold Absolute Pressure (MAP) sensor in one unit.

The TMAP sensor is supplied 5 volts from ECM terminal "14" and sends IAT and MAP signals back to ECM terminals "7" and "25" respectively.

MAP Signal

The MAP signal varies in accordance with engine vacuum and atmospheric barometric pressure. Changes in barometric pressure are influenced by weather and altitude.

IAT Signal

The IAT portion of the TMAP sensor is a thermistor device, meaning that at a specific temperature, it will have a specific resistance across its terminals. As this resistance varies, so does the voltage on terminal "7" of the ECM.

- At high temperatures, the resistance of the IAT sensor is very low, which effectively lowers the signal voltage on terminal "7".
- At low temperatures, the resistance is very high, allowing the voltage to rise close to 5 volts.

The ECM monitors this voltage to compensate for various operating conditions.



Figure 4-32. TMAP Sensor (Typical)

Table 4-20. Code Description

DTC	DESCRIPTION
P0107	MAP sensor open/low
P0108	MAP sensor high
P0112	IAT sensor voltage low
P0113	IAT sensor open/high

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-23738	VACUUM PUMP
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Diagnostic Tips: MAP Sensor

- DTC P0107 or P0108 will set if the MAP sensor signal is out of range. DTC P0108 can only be detected with the engine running.
- MAP sensor output check. Using the VACUUM PUMP (Part No. HD-23738), apply a vacuum to the pressure port of the TMAP sensor. The MAP signal voltage should lower as the vacuum is applied.
- The TMAP, Jiffy Stand, and TP sensors are connected to the same reference line (+5V Vref). If the reference line goes to ground or open, multiple codes will be set (DTC P0107, P0108, P0122, P0123).

Diagnostic Notes: MAP Sensor

Each reference number below correlates to a circled number on the flowchart(s).

1. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness and ECM. See [4.7 BREAKOUT BOX: EFI](#).
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), gray pin probes and patch cords.

Diagnostic Tips: IAT Sensor

Check the following conditions:

- **Poor connection:** Inspect ECM and harness connector [78] for backed out terminals, improper mating, inoperative locks, improperly formed or damaged terminals, poor terminal- to-wire connection and damaged harness.
- **Perform [4.8 WIGGLE TEST](#) to locate intermittents:** If connections and harness check out OK, use a DVOM to check the IAT sensor voltage reading while moving related connectors and wiring harness. If the failure is induced, the IAT sensor voltage reading will change.
- **Shifted sensor:** Refer to [Table 4-21](#). This table may be used to test the intake air temperature sensor at various temperature levels in order to evaluate the possibility of a shifted (out-of-calibration) sensor which may result in driveability problems.
- An intermittent may be caused by a poor connection, rubbed through wire insulation or an inoperative wire inside the insulation.

NOTE

All voltage and resistance values are approximate (20%). Measure IAT sensor resistance between ECM terminal 7 and system ground (ECM terminal 26).

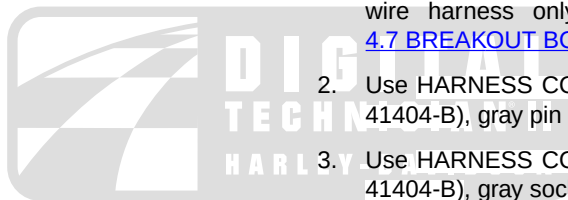
Table 4-21. Bosch TMAP Air Temp

DEG C	OHMS	VOLTs	DEG F
-20	15614	4.7	-4
-10	9426	4.5	14
0	5887	4.3	32
10	3791	4.0	50
20	2511	3.6	68
25	2063	3.4	77
30	1715	3.2	86
40	1200	2.7	104
50	851	2.3	122
60	612	1.9	140
70	446	1.5	158
80	329.5	1.2	176
90	246.2	1.0	194
100	186	0.8	212

Diagnostic Notes: IAT Sensor

Each reference number below correlates to a circled number on the flowchart(s).

1. Connect BREAKOUT BOX (Part No. HD-43876) to EFI wire harness only (leave ECM disconnected). See [4.7 BREAKOUT BOX: EFI](#).
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), gray pin probes and patch cords.
3. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), gray socket probes and patch cords.
4. Replace TMAP sensor. See the service manual.



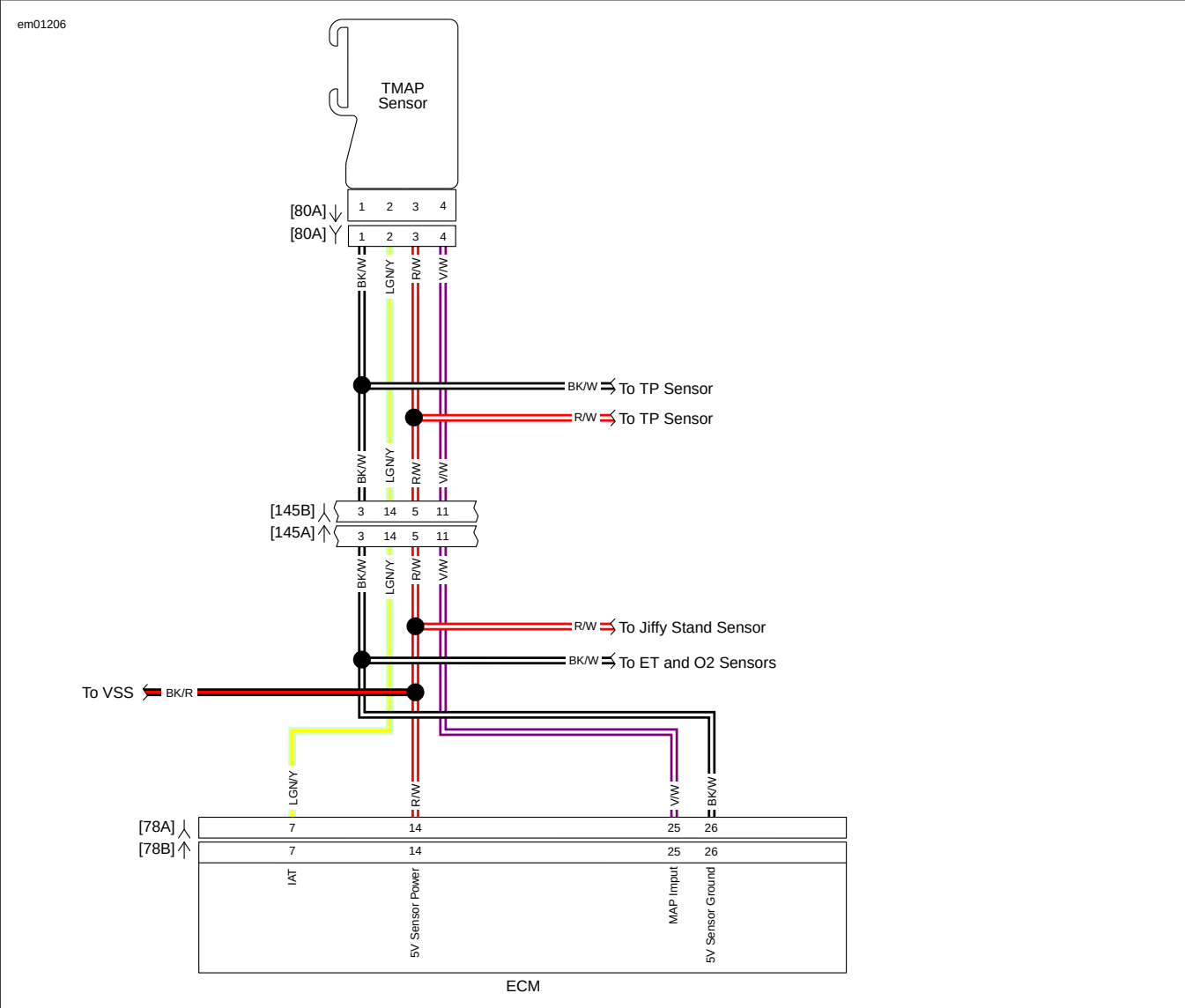
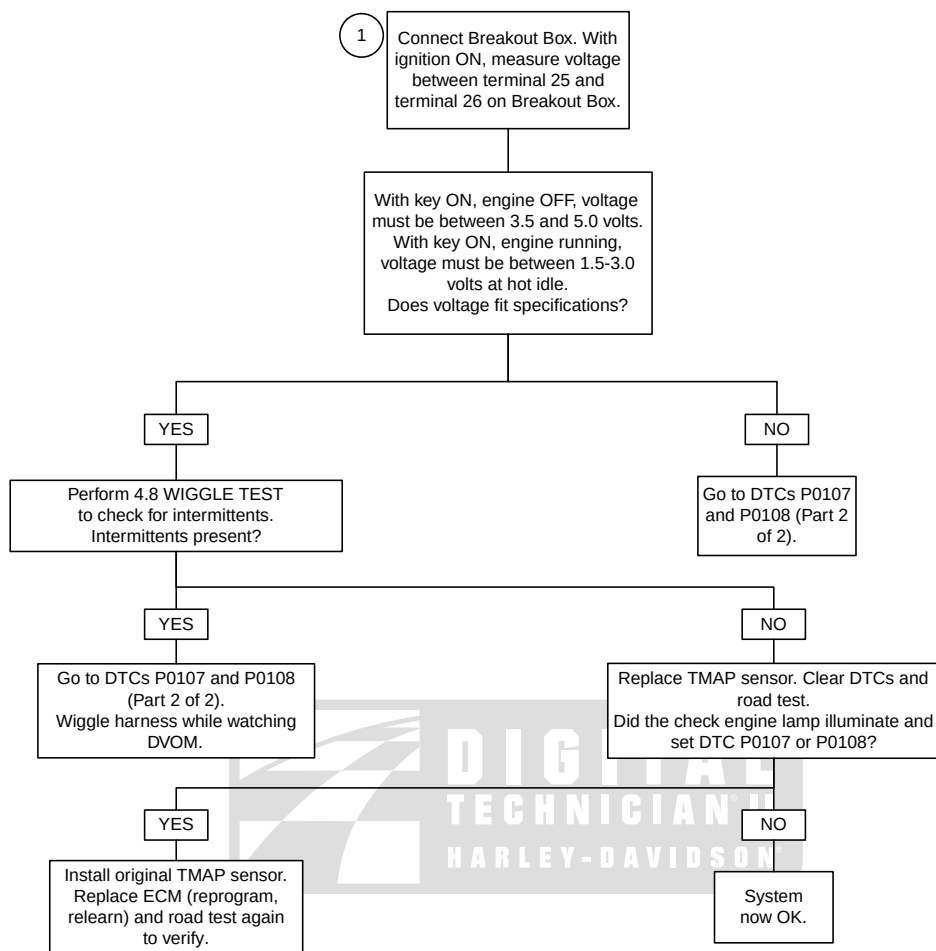


Table 4-22. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM	36-place Packard	Under seat
[80]	TMAP sensor	4-place Packard	Top of induction module (XL), Side of induction module (XR)
[145]	Engine Harness	16-place Molex	Under seat

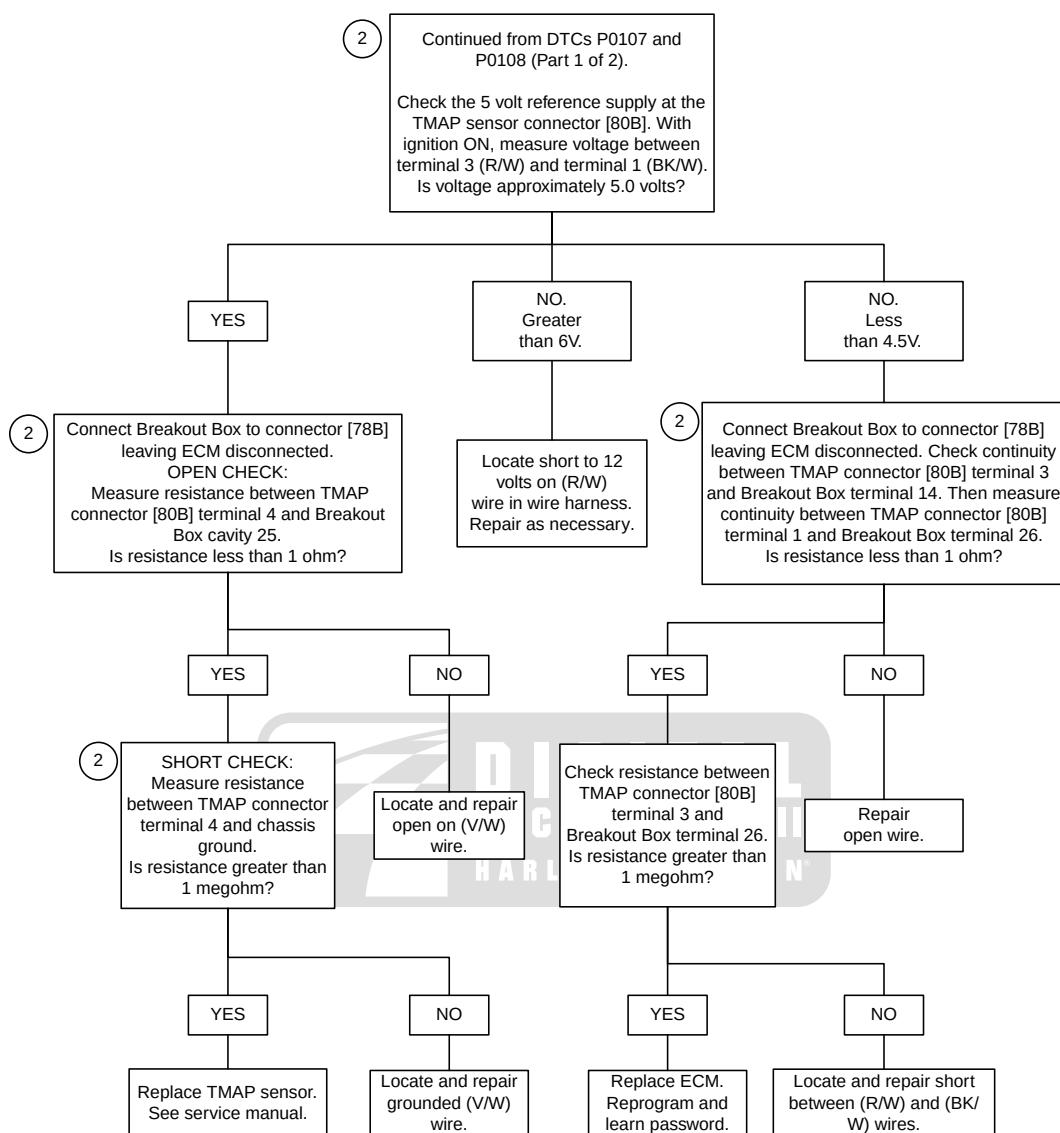
DTCs P0107 and P0108 (Part 1 of 2)



Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

fc01974_en

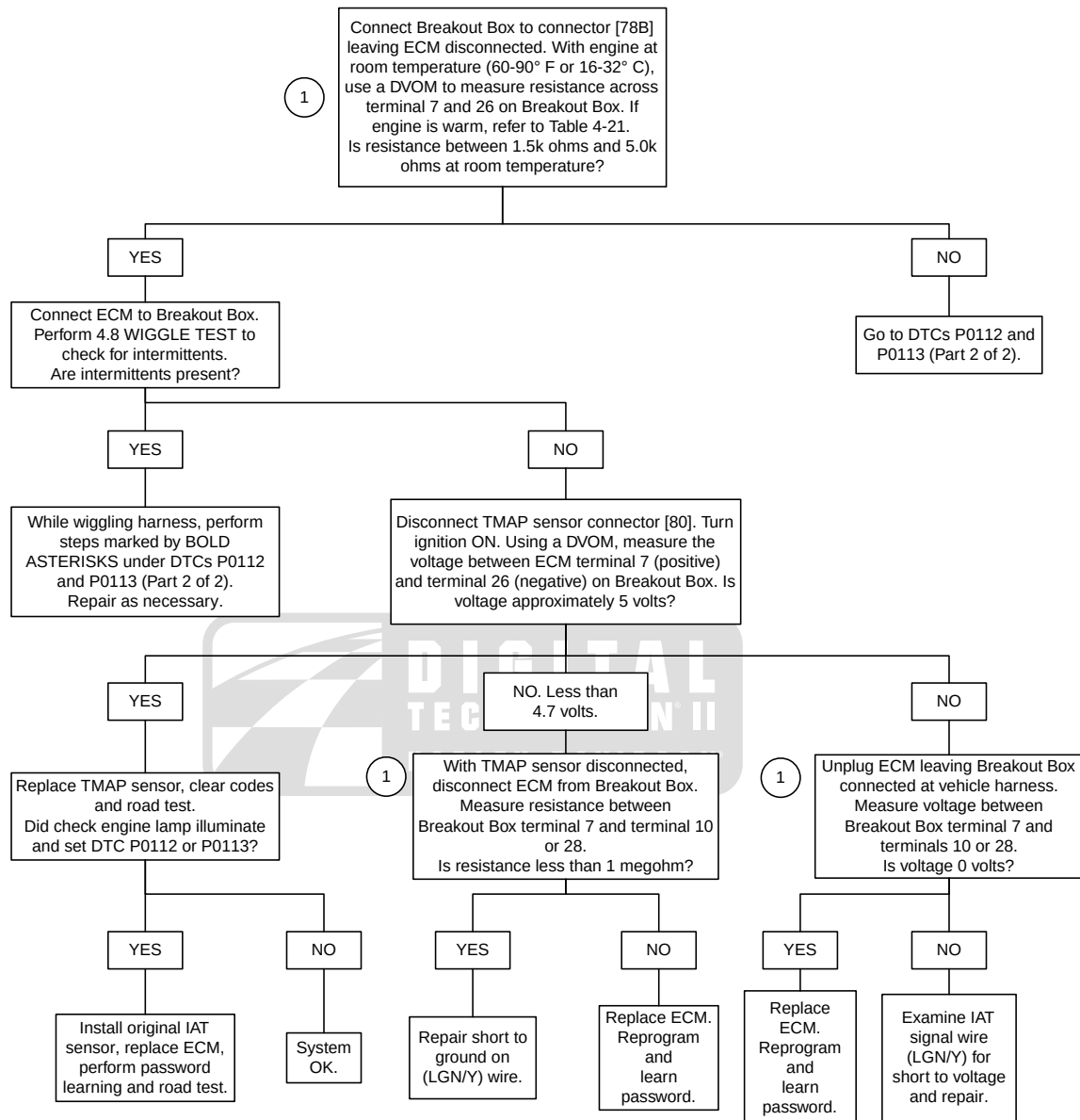
DTCs P0107 and P0108 (Part 2 of 2)



Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

fc01975_en

DTCs P0112 and P0113 (Part 1 of 2)



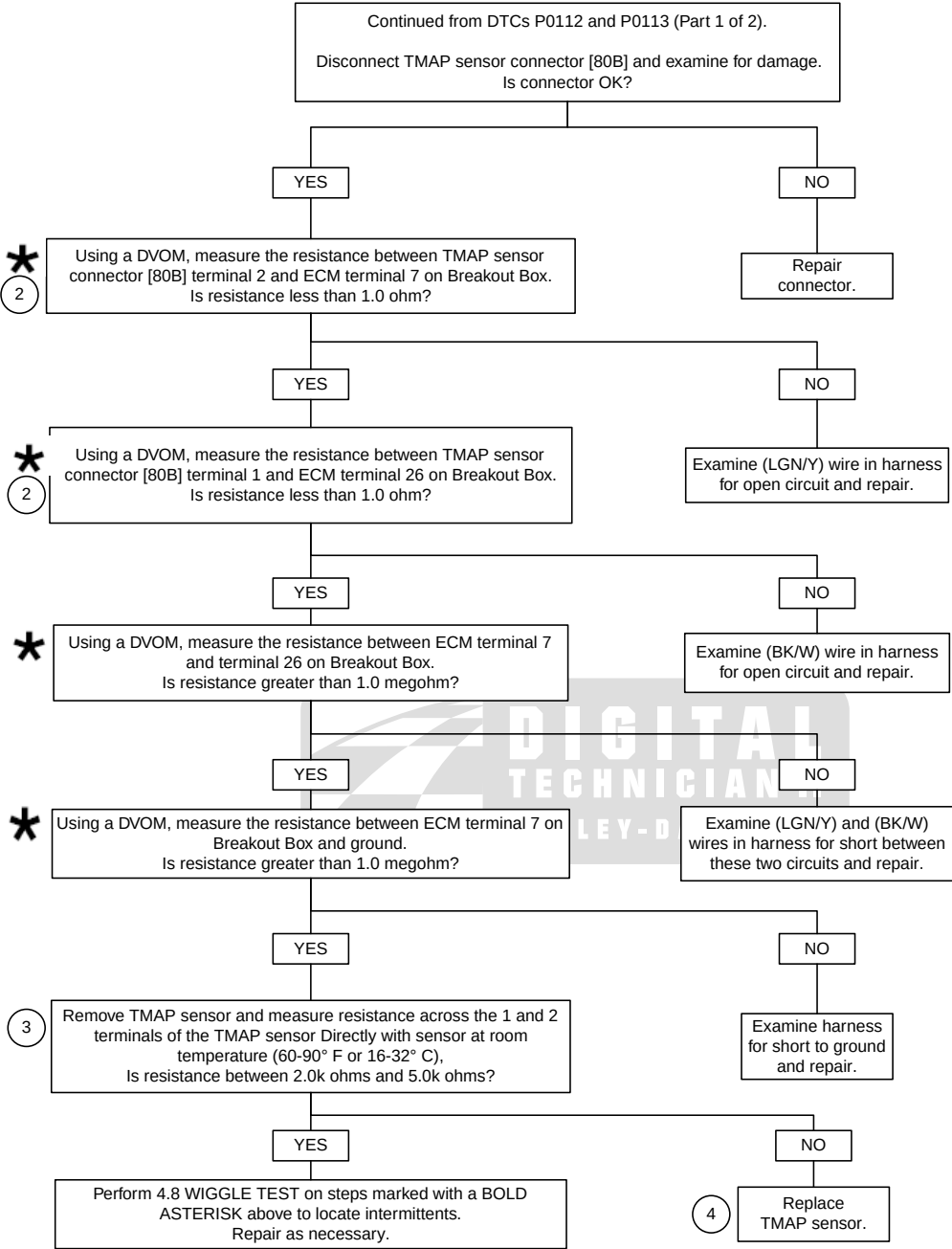
At some point in the flowchart you may be instructed to jump directly to a the box with the bold asterisk. Disregard the asterisk (but not the instruction box) if your normal progression through the chart brings you to this location.



Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

fc01976_en

DTCs P0112 and P0113 (Part 2 of 2)



Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.



At some point in the flowchart you may be instructed to jump directly to a the box with the bold asterisk. Disregard the asterisk (but not the instruction box) if your normal progression through the chart brings you to this location.

fc01977_en

DTC P0117, P0118

4.17

GENERAL

ET Sensor

The ECM supplies and monitors a voltage signal (terminal "6") to one side of the Engine Temperature (ET) sensor. The other side of the ET sensor is connected to a common sensor ground (terminal "26") of the ECM.

See [Figure 4-34](#). The ET sensor is a thermistor device, which means that at a specific temperature it will have a specific resistance across its terminals. As this resistance varies, so does the voltage (terminal "6").

- At high temperatures, the resistance of the sensor is very low, which effectively lowers the signal voltage on terminal "6".
- At low temperatures, the resistance is very high, allowing the voltage to rise close to 5 volts.

The ECM monitors this voltage to compensate for various operating conditions. The ECM also uses the sensor input as a reference for determining IAC pintle position.



Figure 4-34. Engine Temperature Sensor

Table 4-23. Code Description

DTC	DESCRIPTION
P0117	ET sensor voltage low
P0118	ET sensor open/high

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Diagnostic Tips

Once the engine is started, the ET voltage should lower steadily in two stages.

Check the following conditions:

- Poor connection:** Inspect ECM and harness connector [78] for backed out terminals, improper mating, inoperative locks, improperly formed or damaged terminals, poor terminal- to-wire connection and damaged harness.
- Perform [4.8 WIGGLE TEST](#) to locate intermittents:** If connections and harness check out OK, use a DVOM to check the engine temperature sensor voltage reading while moving related connectors and wiring harness. If the failure is induced, the engine temperature sensor voltage reading will change.
- Shifted sensor:** Refer to [Table 4-24](#). This table may be used to test the engine temperature sensor at various temperature levels in order to evaluate the possibility of a shifted (out-of-calibration) sensor which may result in driveability problems.
- An intermittent may be caused by a poor connection, rubbed through wire insulation or an inoperative wire inside the insulation.

NOTE

All voltage and resistance values are approximate ($\pm 20\%$). Measure ET sensor resistance between ECM terminal 6 and system ground (ECM terminal 26).

Table 4-24. ET Sensor Table

TEMP °C	RESIST- ANCE	COLD VOLTAGE	HOT VOLTAGE	TEMP °F
-20	98936	4.9		-4
-10	56102	4.8		14
0	32957	4.5		32
10	20000	4.3		50
20	12511	3.9		68
25	10000	3.6		77
30	8045	3.4		86
40	5304	2.9		104
50	3577	2.4		122
60	2470	1.9		140
70	1739	1.5		158
80*	1246	1.2	4.0	176
90*	907.7	0.9	3.7	194
100	671.2		3.4	212

* Between 80-90 °C the ECM changes scaling. Voltages for ECT sensor will shift scales in that range. This provides proper sensor resolution for all temperatures.

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1.

Connect BREAKOUT BOX (Part No. HD-43876) to EFI wire harness only (leave ECM disconnected). See [4.7 BREAKOUT BOX: EFI](#).
2.

Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), gray pin probes and patch cords.
3.

Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), gray socket probes and patch cords.
4.

Replace ET sensor. See the service manual.

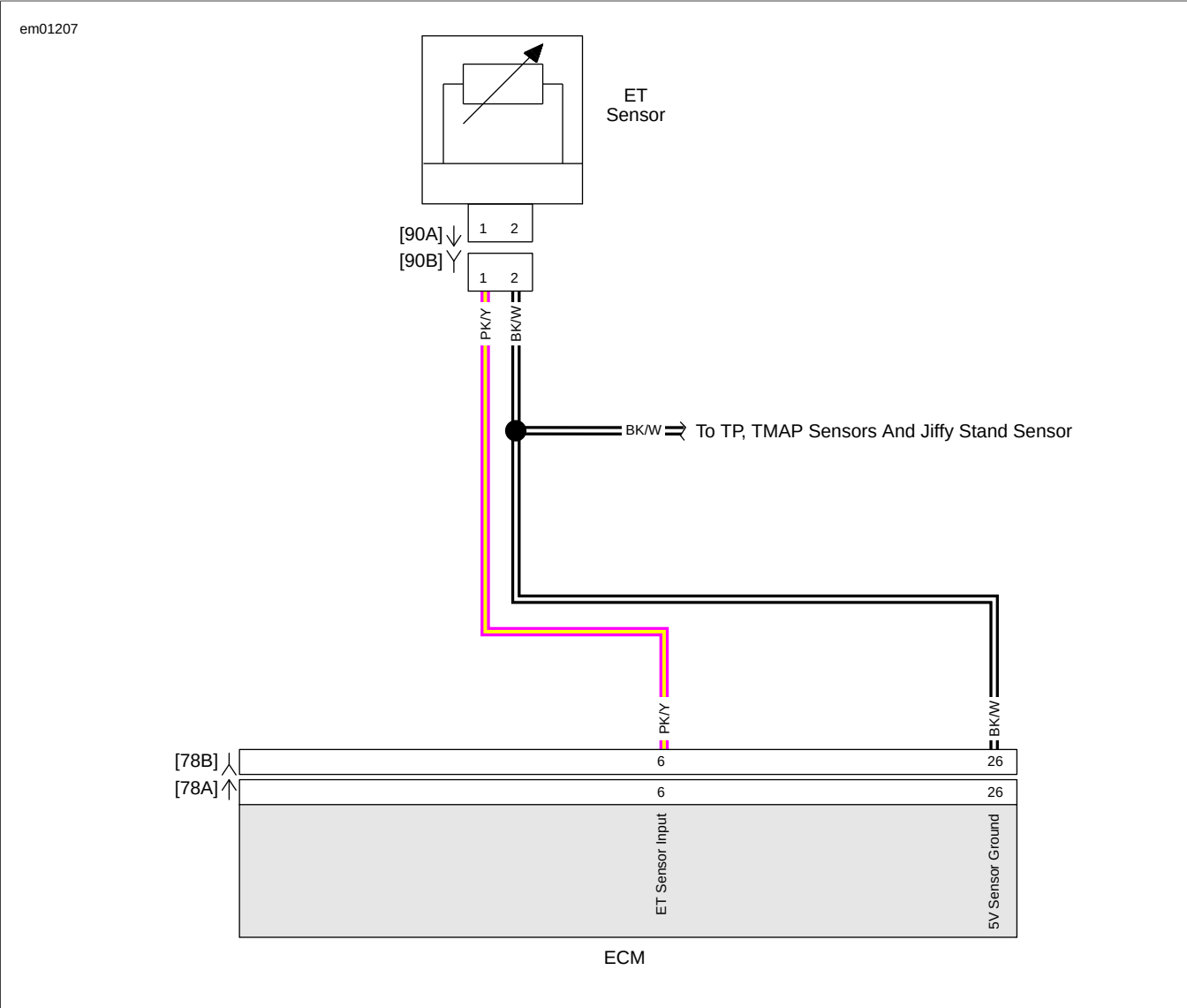
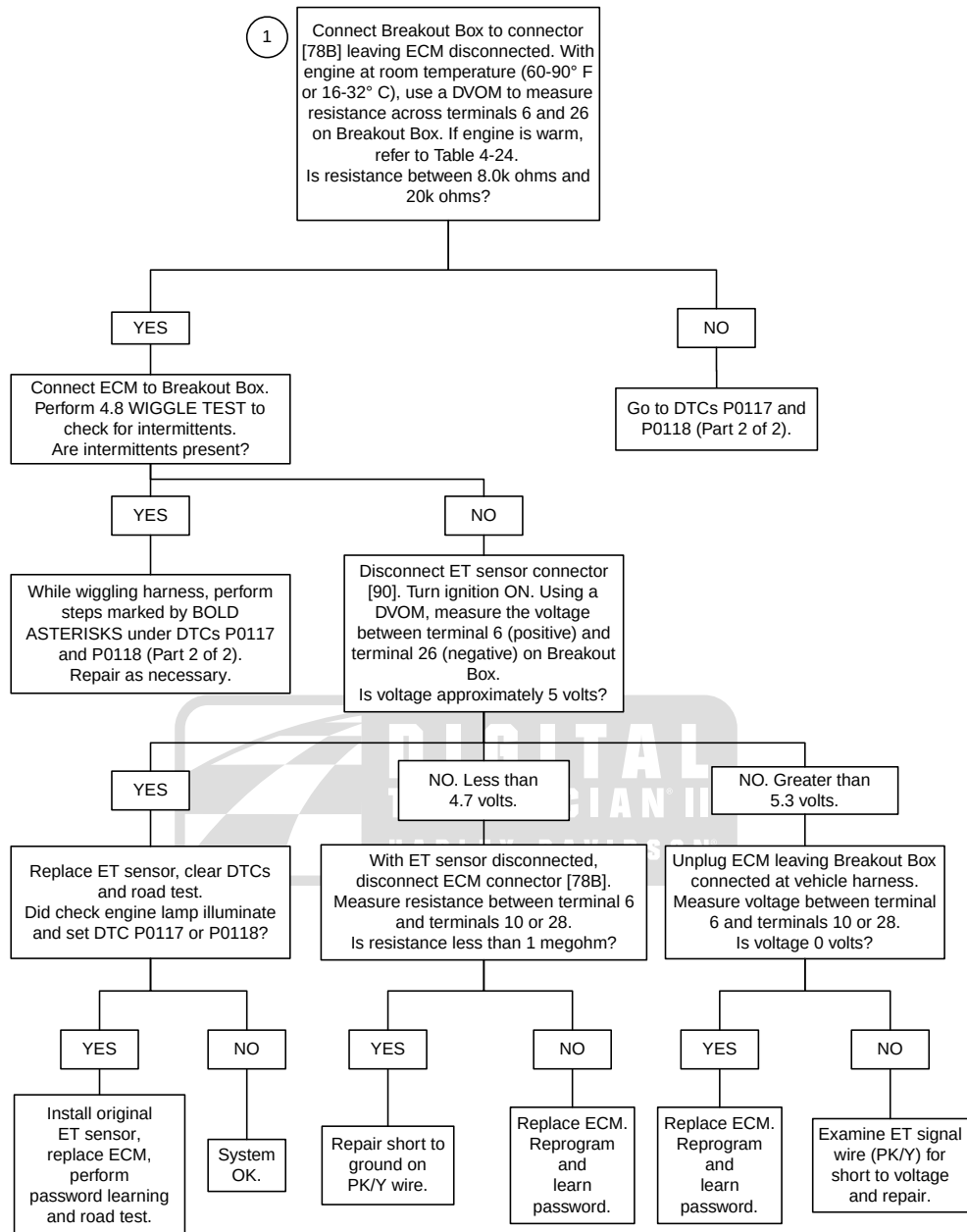


Figure 4-35. ET Sensor Circuit

Table 4-25. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM	36-place Packard	Under seat
[90]	ET sensor	2-place Delphi	Above throttle body, right side

DTCs P0117 and P0118 (Part 1 of 2)



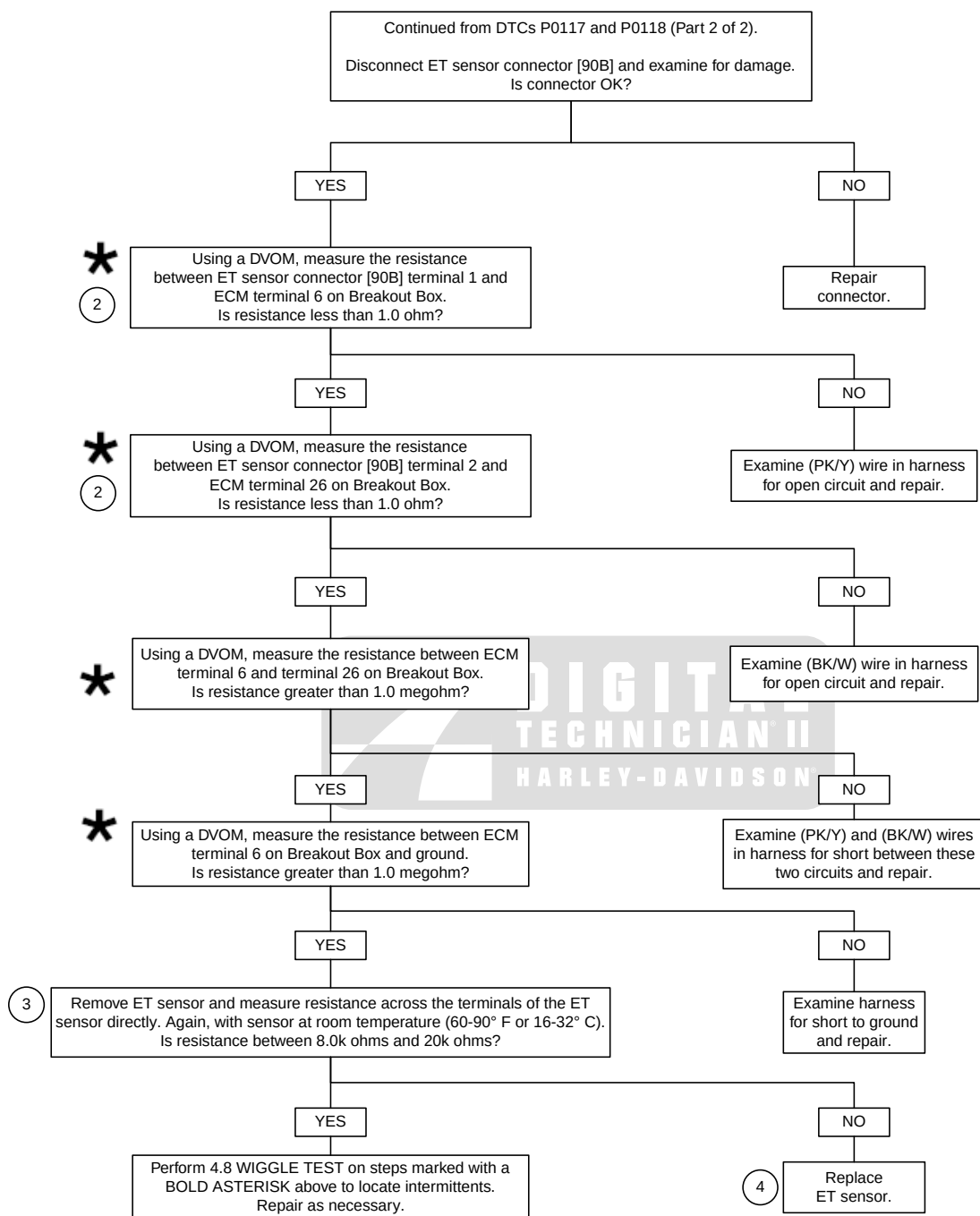
Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.



At some point in the flowchart you may be instructed to jump directly to a the box with the bold asterisk. Disregard the asterisk (but not the instruction box) if your normal progression through the chart brings you to this location.

fc01978_en

DTCs P0117 and P0118 (Part 2 of 2)



Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.



At some point in the flowchart you may be instructed to jump directly to a the box with the bold asterisk. Disregard the asterisk (but not the instruction box) if your normal progression through the chart brings you to this location.

fc01979_en

GENERAL

TP Sensor

The ECM supplies a 5 Volt signal (terminal 14) to the TP sensor. The TP sensor sends a signal back to the ECM (terminal 24). The returned signal varies in voltage according to throttle position.

- At idle (closed throttle), the signal is typically in the range of 0.20-0.80 Volts.
- At wide open throttle, the signal is normally 4.0-4.9 Volts.

A DTC P0122 or P0123 will set if the TP sensor voltage signal does not fall within the acceptable range.

NOTE

When servicing the TP sensor connector on XR models only, apply Harley-Davidson Electrical Contact Lubricant to the TP sensor connector terminals prior to connecting the TP sensor.

Table 4-26. Code Description

DTC	DESCRIPTION
P0122	TP sensor open/low
P0123	TP sensor high

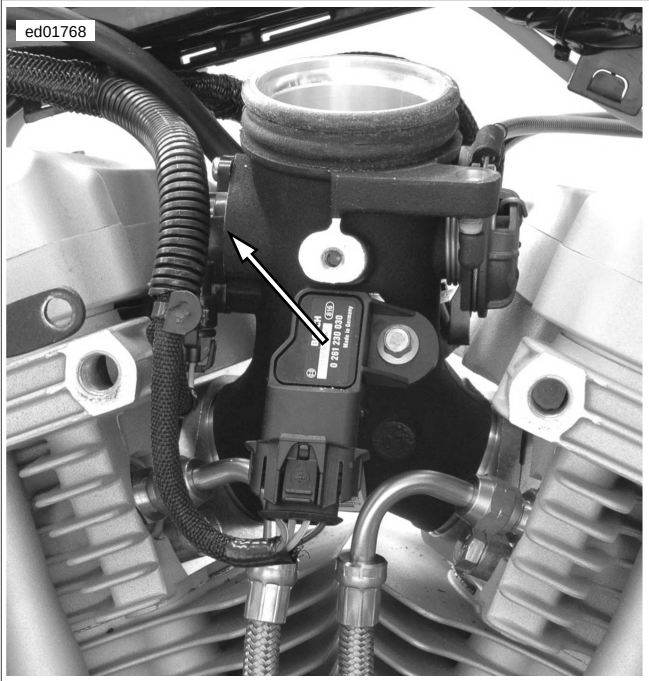


Figure 4-37. TP Sensor Location (XR)



Figure 4-36. TP Sensor Location (XL)

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Diagnostic Tips

The DVOM reads throttle position in volts. Voltage should increase at a steady rate as the throttle is moved from idle to wide open. A short to ground or open on the (GY/V) or (R/W) wires also will result in a DTC P0122. A short to ground or open on the (R/W) wire (+5v REF) sets multiple codes as described below.

NOTES

The TMAP, Jiffy Stand, and TP sensors are connected to the same reference line (+5V Vref). If the reference line goes to ground or open, multiple codes will be set (DTC P0107, P0108, P0122, P0123, P1501, P1502). Start with the trouble code having the lowest ranking value.

Check for the following conditions:

- **Poor Connection:** Inspect ECM and harness connector [78B] for backed out terminals, improper mating, inoperative locks, improperly formed or damaged terminals, poor terminal- to-wire connection and damaged harness.
- Perform [4.8 WIGGLE TEST](#) to locate intermittents: If connections and harness check out OK, monitor TP sensor voltage using a DVOM while moving related connectors

and wiring harness. If the failure is induced, the TP sensor voltage reading will change.

- **TP sensor scaling:** Observe the TP sensor voltage display while opening the throttle with engine stopped and Ignition Switch ON. Display should vary from closed TP sensor voltage (when throttle is closed) to greater than 4.0 volts (when throttle is held wide open). As the throttle is **slowly** moved, the voltage should change gradually without spikes or low voltages being observed.
- **Check TP sensor voltage reading with DVOM.** If TP sensor is equal to or greater than 3.8 volts then the system is in "clear flood" mode and engine will not start. While spark is present, fuel is shut off. Problem can be mechanical, such as stuck throttle cables.

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. Connect a BREAKOUT BOX (Part No. HD-43876) between EFI wire harness and ECM before measuring voltage. See [4.7 BREAKOUT BOX: EFI](#). Using a DVOM to measure voltage, take reading across terminal 24 (positive lead) and terminal 26 (negative lead) on BREAKOUT BOX (Part No. HD-43876).
2. Replace TP sensor. See the service manual.
3. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), gray pin probes and patch cords.

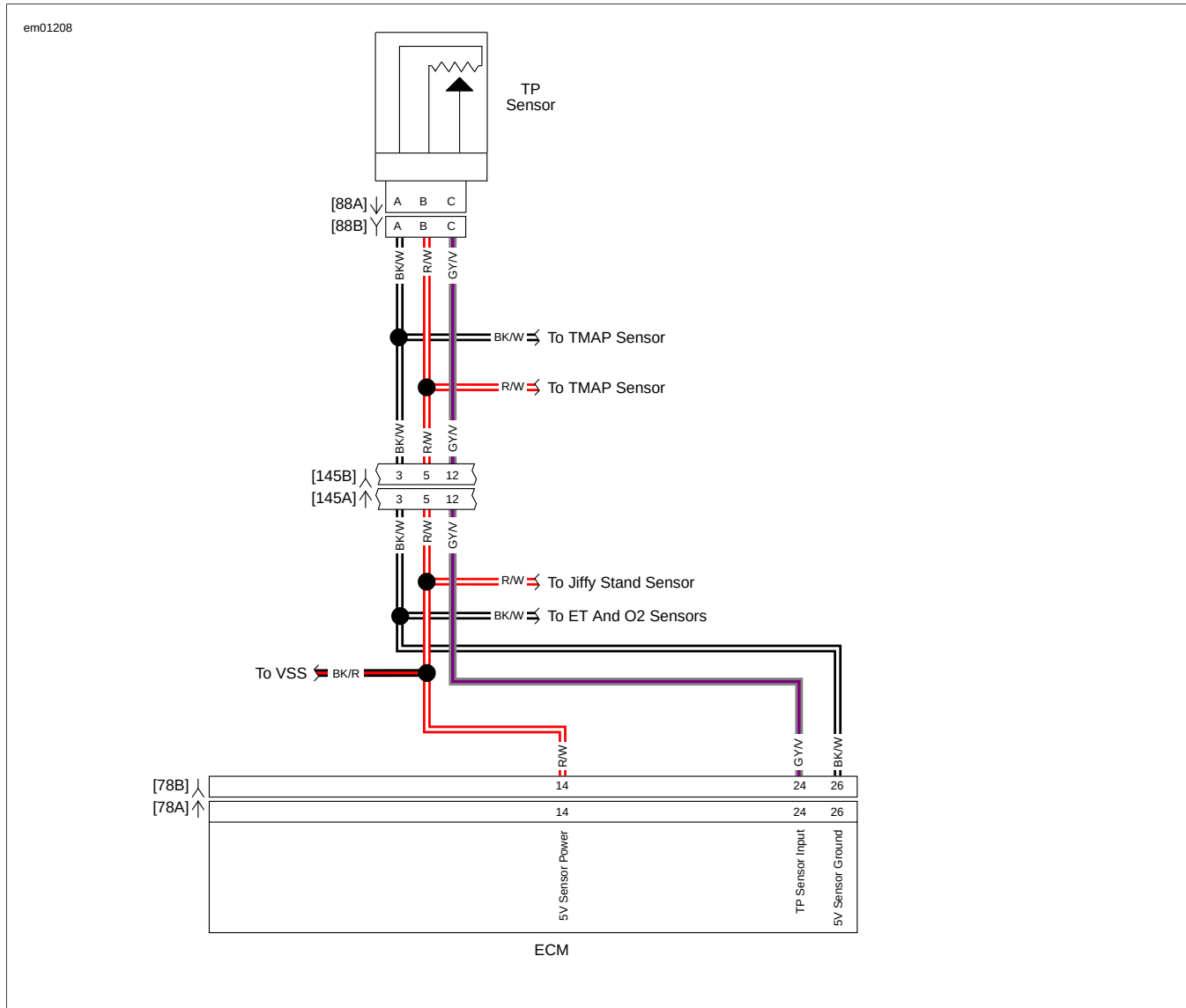


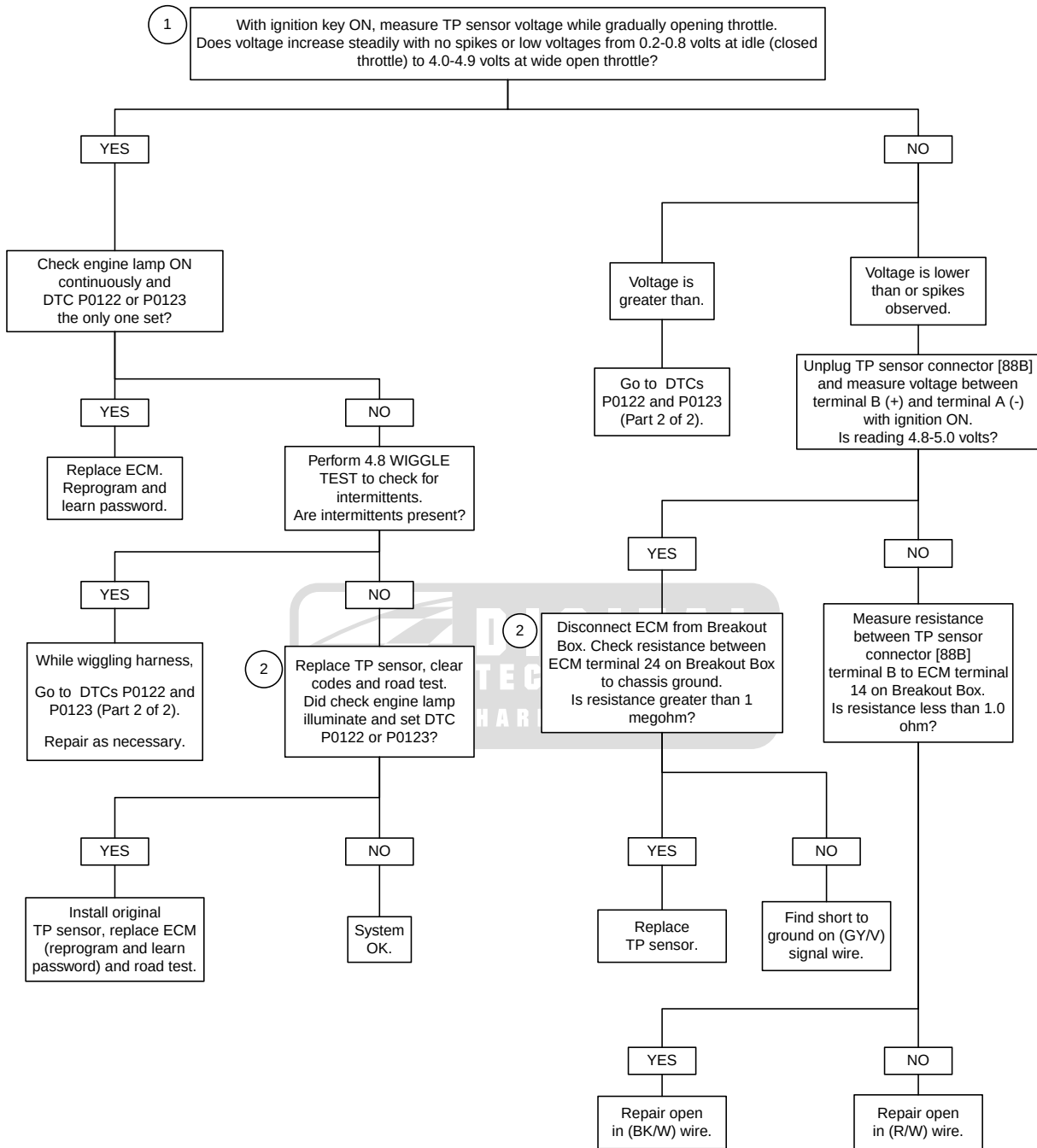
Figure 4-38. TP Sensor Circuit

Table 4-27. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM	36-place Packard	Under seat
[88]	TP sensor	3-place Delphi	Behind air cleaner housing
[145]	Engine harness	16-place Molex	Under seat



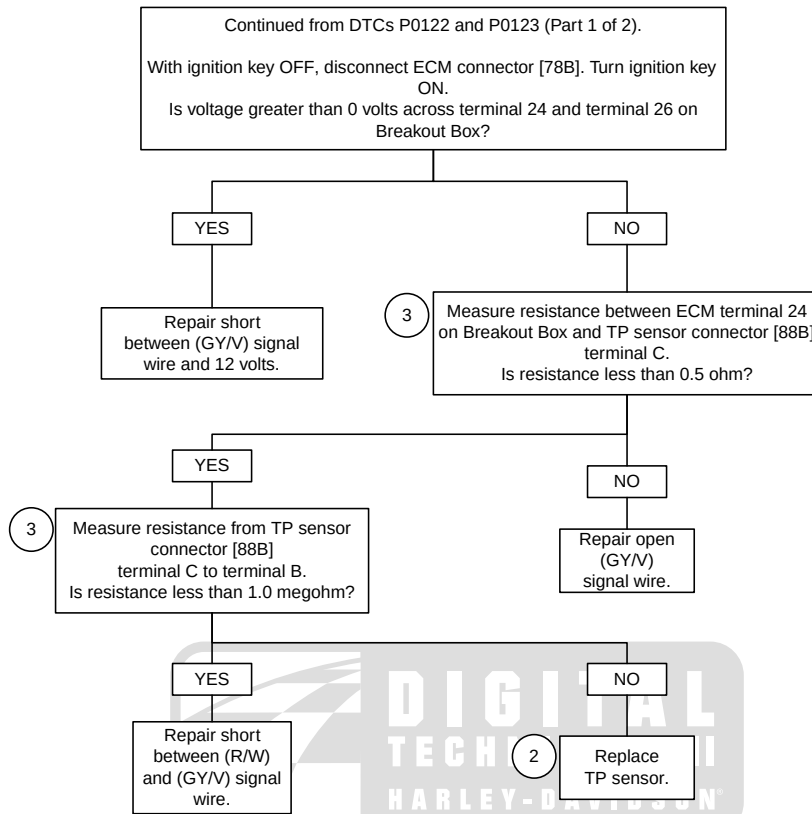
DTCs P0122 and P0123 (Part 1 of 2)



Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

fc01980_en

DTCs P0122 and P0123 (Part 2 of 2)



Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

fc01981_en

DTC P0131, P0132, P0134, P0151, P0152, P0154

4.19

GENERAL

Oxygen Sensor

See [Figure 4-39](#). The Oxygen (O₂) sensor provides a signal to the ECM which indicates whether the engine is running rich or lean.

- A DTC P0131 (front) or P0151 (rear) is set when the ECM detects an excessively lean condition for a specified length of time. DTCs may also set if O₂ sensor fails.
- A DTC P0132 (front) or P0152 (rear) is set when the ECM detects an excessively rich condition for a specified length of time. DTCs may also set if O₂ sensor fails.
- A DTC P0134 is set when the front O₂ sensor circuit is open or sensor is too cold to respond. A DTC P0154 is set when the rear O₂ sensor circuit is open or sensor is too cold to respond.

When the air/fuel mixture is ideal, approximately 14.6 parts air to 1 part fuel, the voltage will be approximately 0.45V.

Table 4-28. Code Description

DTC	DESCRIPTION
P0131	Front O ₂ sensor low or engine running lean
P0132	Engine running rich
P0134	Front O ₂ sensor open/not responding/high
P0151	Rear O ₂ sensor low or engine running lean
P0152	Engine running rich
P0154	Rear O ₂ sensor open/not responding/high



Figure 4-39. Oxygen Sensor

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-43876	BREAKOUT BOX
HD-48650	DIGITAL TECHNICIAN II

Diagnostic Tips

Diagnostic codes for the O₂ sensor may be seen during the vehicle break-in period. The O₂ sensor diagnostic codes will not illuminate the check engine lamp for current or historic codes and will only be indicated by DIGITAL TECHNICIAN II (Part No. HD-48650) or odometer self-diagnostics. If the diagnostic codes are reported during the break-in period, clear or ignore the codes until the break-in period is completed. All historic O₂ sensor diagnostic codes are to be ignored and cleared.

The DVOM displays the signal from the O₂ sensor in volts. This voltage will have an average value tending towards lean, rich or ideal value depending on operating temperature of the engine, engine speed and throttle position. An open/short to voltage or short to ground in the (PK/O) wire (front) and (PK/GN) wire (rear) will cause the engine to run rich (short to ground) or lean (short to voltage) until fault is detected. Once fault is detected, vehicle will run in open loop.

Check for the following conditions:

- **Poor connection.** Inspect the ECM harness connector [78], fuel injector connectors [84, 85] and O₂ sensor connector wiring for backed out terminals, improper mating, inoperative locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harness.
- **Dirty/stuck open injectors.** The motorcycle may run lean (dirty/clogged injectors) or rich (stuck open injectors) if there is an injector problem. This could also cause poor fuel economy and performance.
- **Loose oxygen sensor.** If the O₂ sensor is loose, engine performance may be affected. This could also show up as a slow changing O₂ sensor voltage.
- **Loose/leaking exhaust.** This can cause a poor ground connection for sensor or allow fresh air into the exhaust system. If fresh air enters exhaust system, the O₂ sensor will read a lean condition, causing the system to go rich.
- **Engine misfire.** See [4.15 MISFIRE AT IDLE OR UNDER LOAD](#).

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. Connect a BREAKOUT BOX (Part No. HD-43876) between EFI wire harness and ECM before measuring voltage. See [4.7 BREAKOUT BOX: EFI](#).
2. 5 volts is typical for a cold engine. Once the O₂ sensors are up to operating temperature, typical voltage is 0.45 volt.
3. See Intake Leak Test in the service manual.

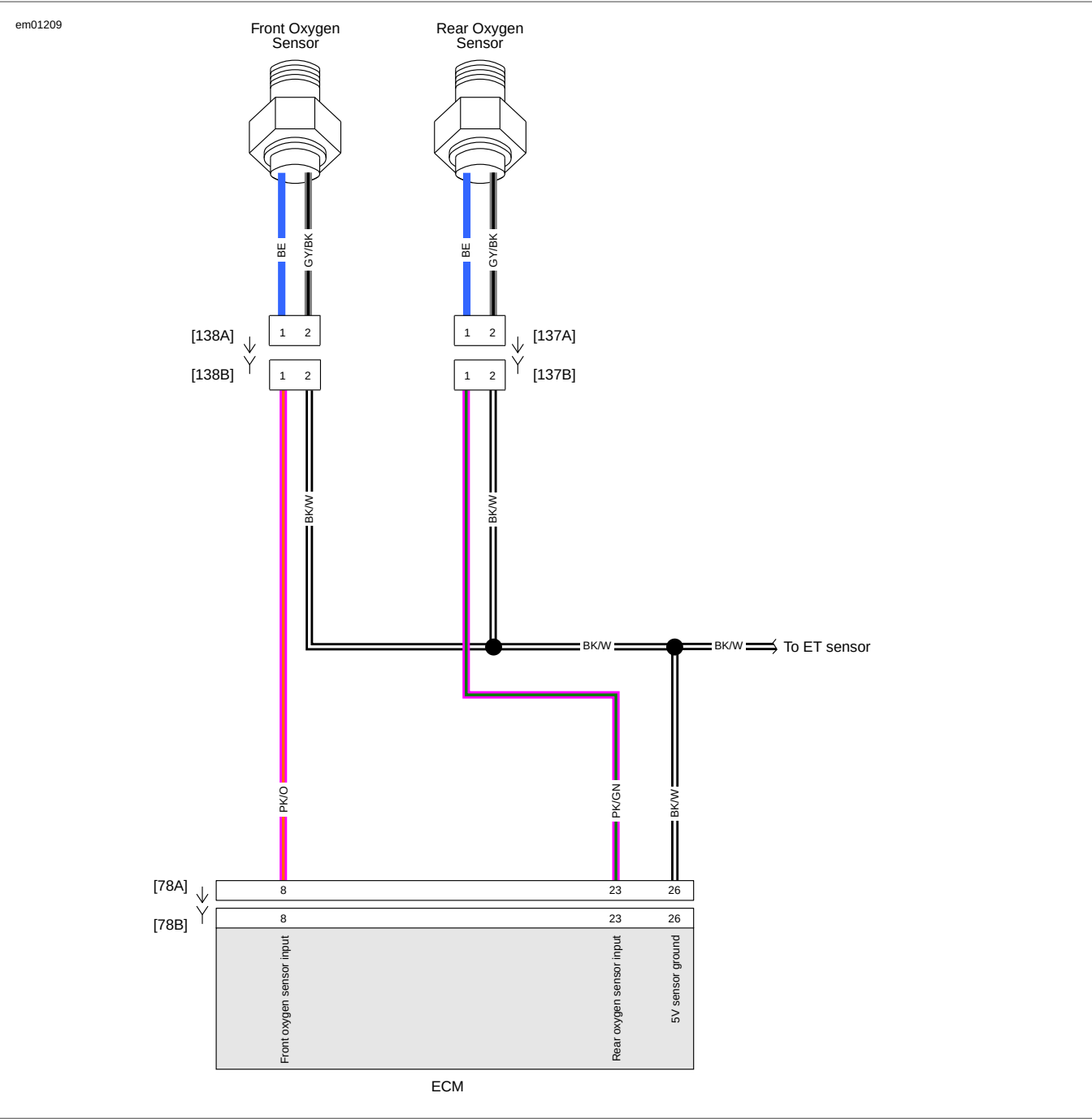
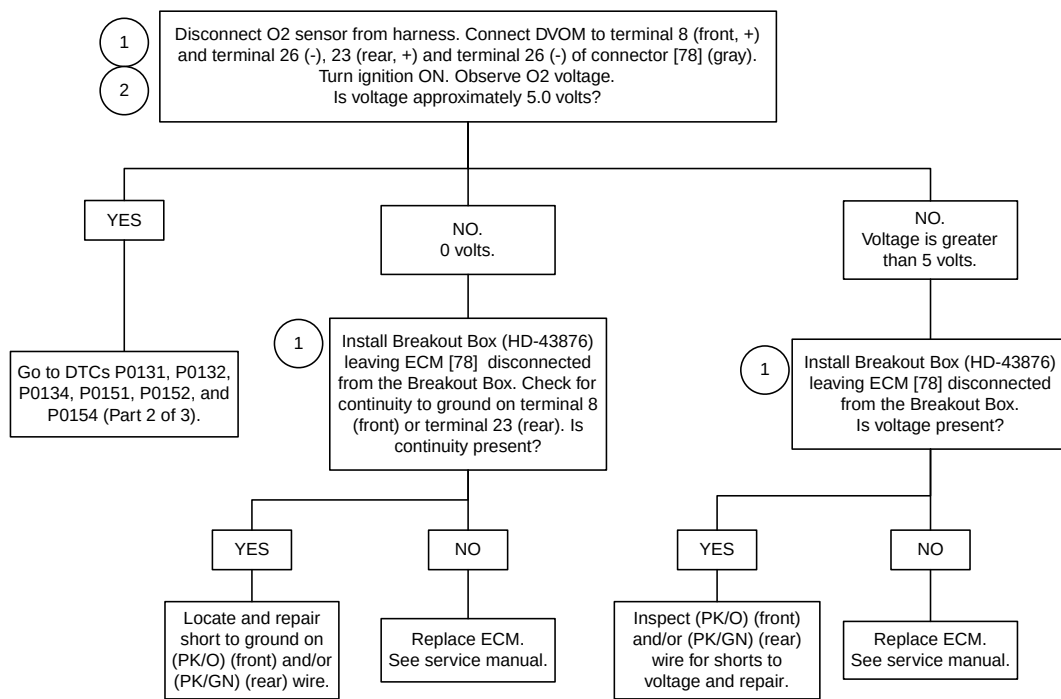


Figure 4-40. Oxygen Sensor

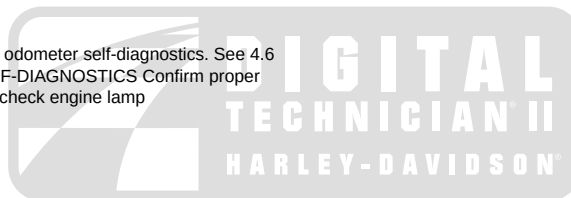
Table 4-29. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM	36-place Packard	Under seat
[137]	Rear O2 sensor	2-place Amp	H-bracket
[138]	Front O2 sensor	2-place Amp	Voltage regulator electrical caddy

DTCs P0131, P0132, P0134, P0151, P0152, and P0154 (Part 1 of 3)

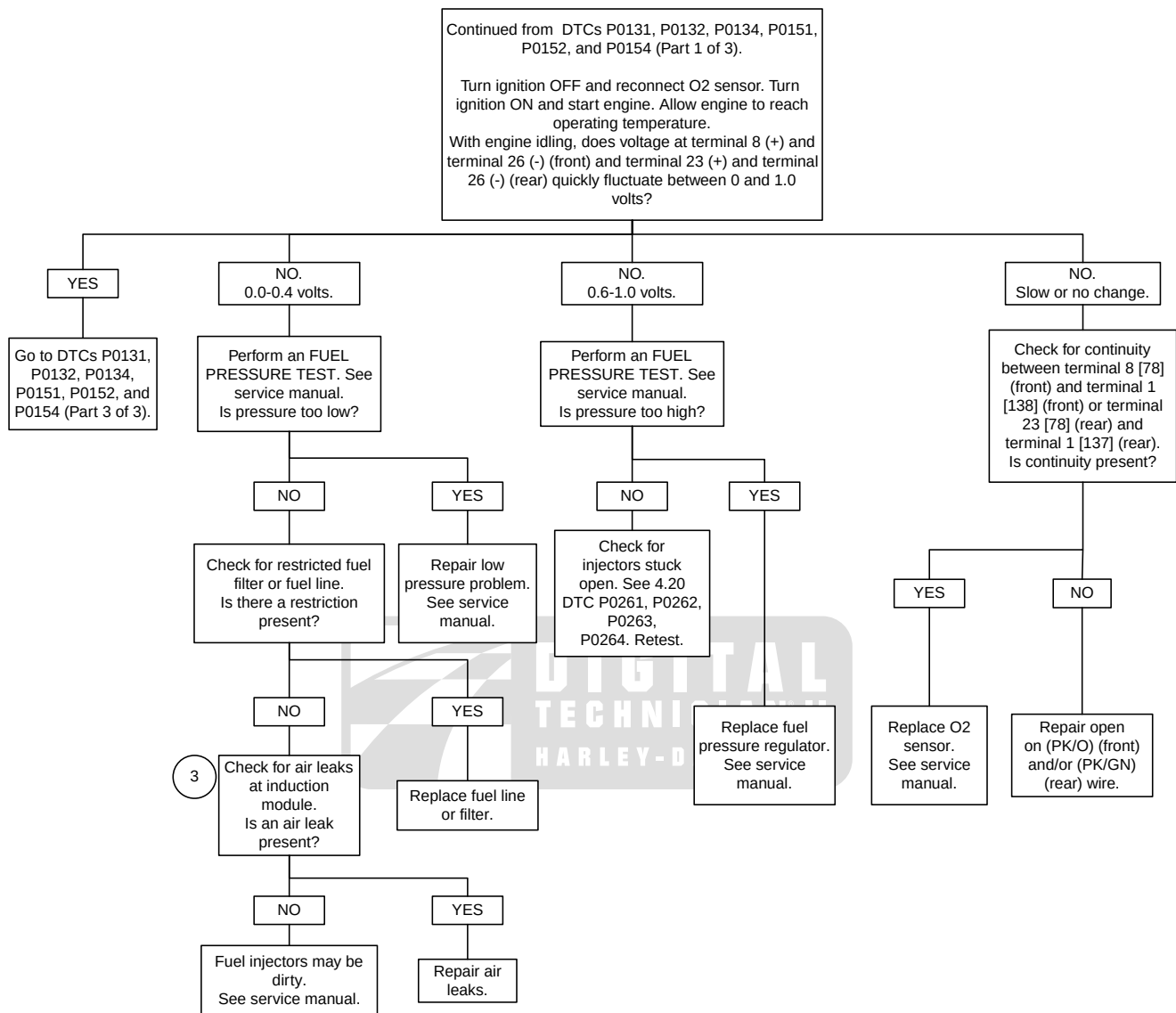


Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS Confirm proper operation with no check engine lamp



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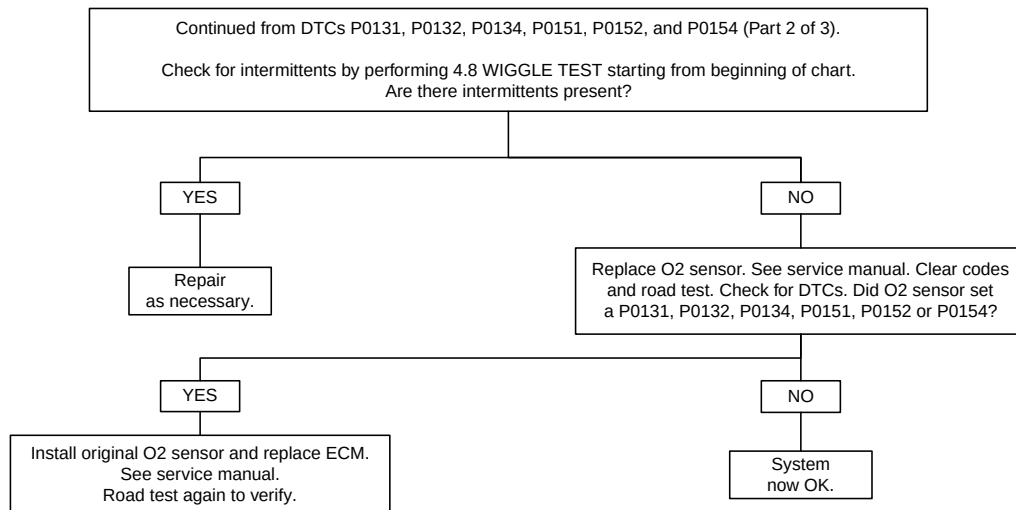
DTCs P0131, P0132, P0134, P0151, P0152, and P0154 (Part 2 of 3)



Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

fc01983_en

DTCs P0131, P0132, P0134, P0151, P0152, and P0154 (Part 3 of 3)



Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.



fc01984_en

DTC P0261, P0262, P0263, P0264

4.20

GENERAL

Fuel Injectors

The fuel injectors are solenoids that allow pressurized fuel into the intake tract. The injectors are timed to the engine cycle and triggered sequentially. The power for the injectors comes from the system relay. The system relay also provides power for the fuel pump and the ignition coil. The ECM provides the path to ground to trigger the injectors.

NOTE

ECM fuse and system relay failures or wiring harness problems will cause 12 volt power to be lost to both injectors, ignition coils and fuel pump.

Table 4-30. Code Description

DTC	DESCRIPTION
P0261	Front injector open/low
P0262	Front injector high
P0263	Rear injector open/low
P0264	Rear injector high

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. See the service manual for all service information.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), purple pin probe and patch cord.
3. Connect a BREAKOUT BOX (Part No. HD-43876) between EFI wire harness and ECM. See [4.7 BREAKOUT BOX: EFI](#).

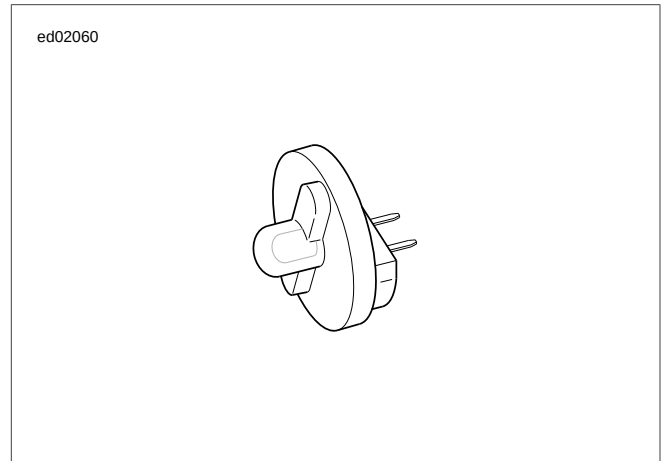


Figure 4-41. Fuel Injector Test Lamp (Part No. HD-34730-2C)

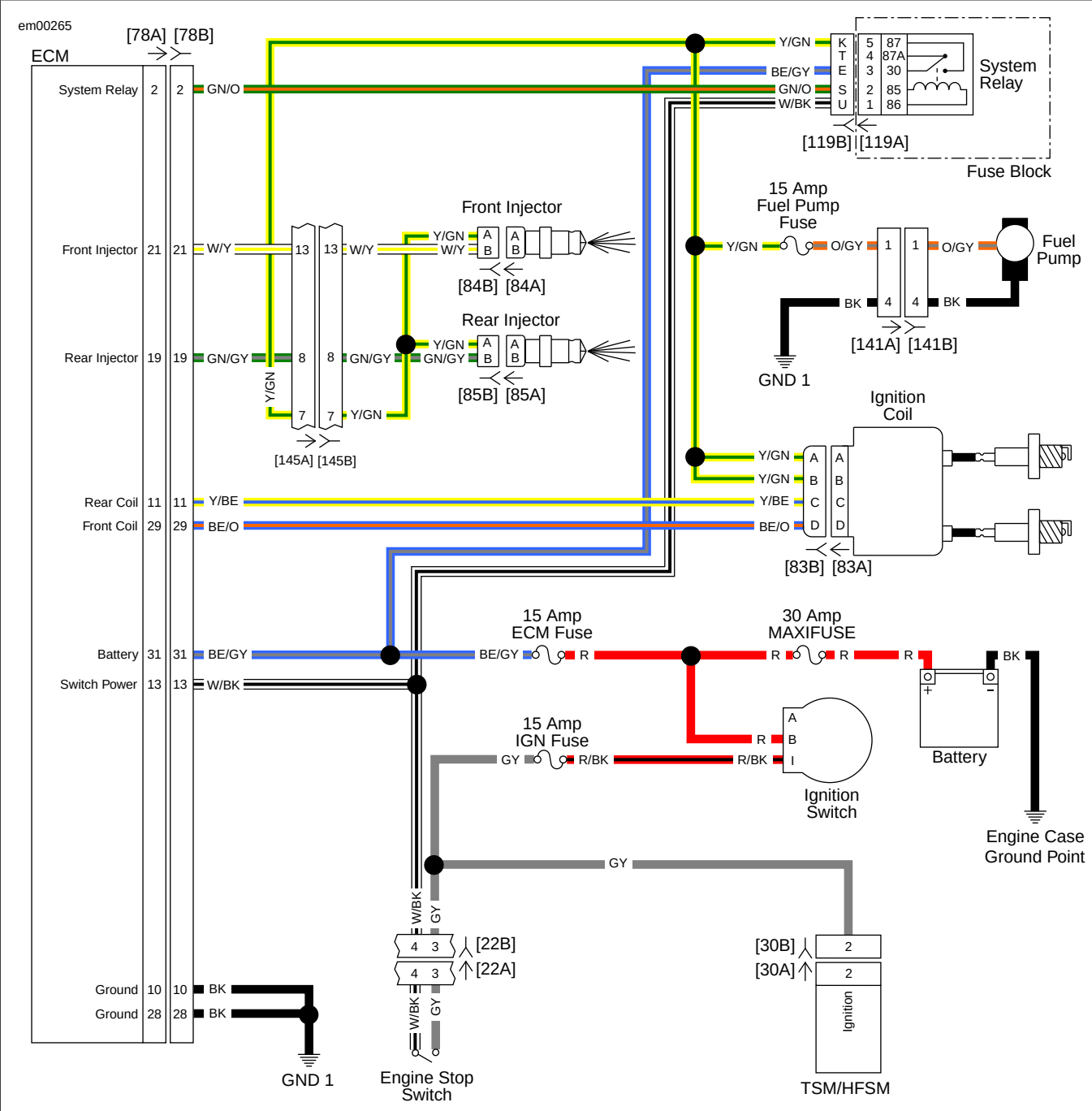


Figure 4-42. Fuel Injector Circuit

Table 4-31. Wire Harness Connectors

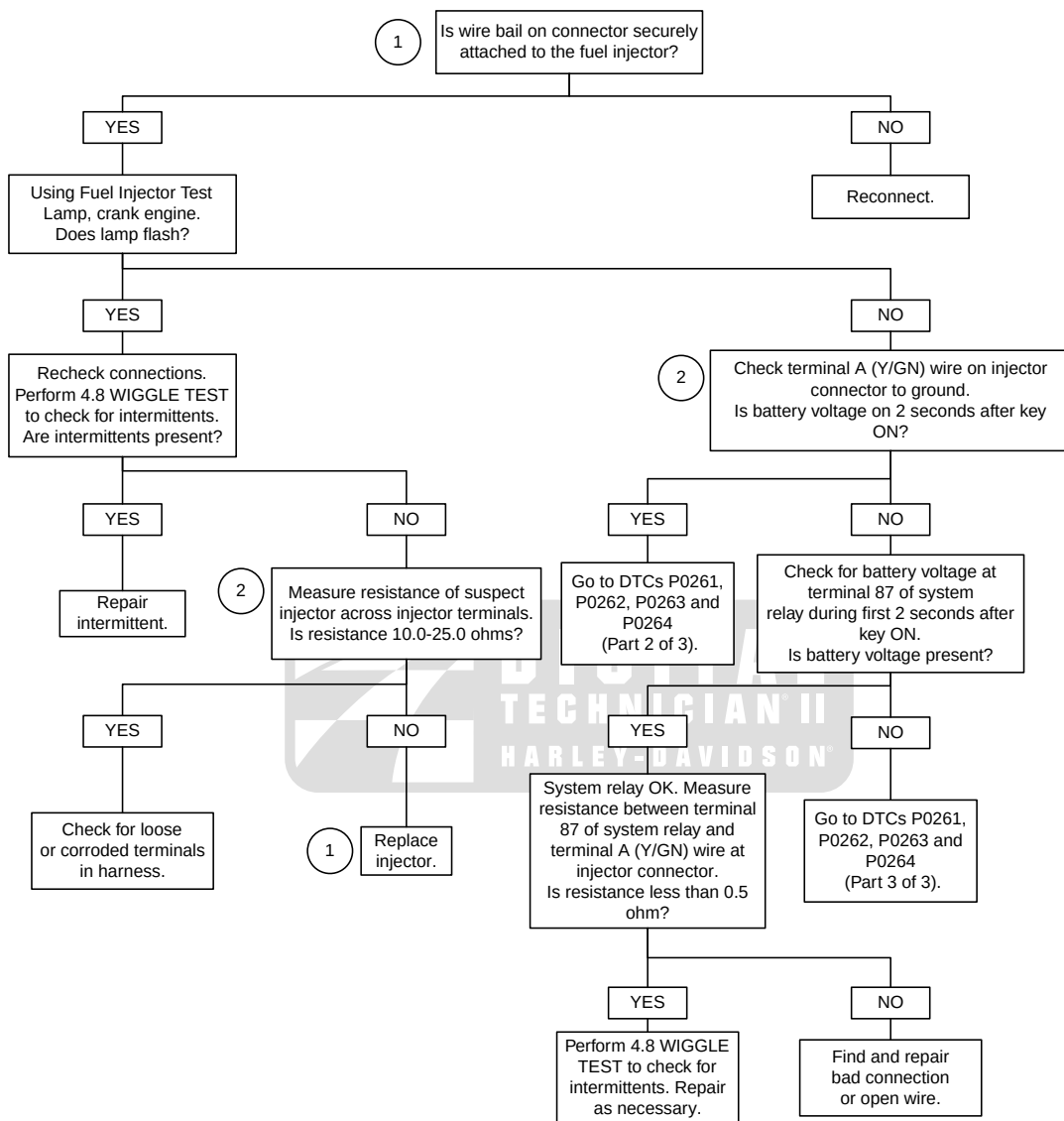
NO.	DESCRIPTION	TYPE	LOCATION
[22]	Right hand controls	6-place Molex, black	Under fuel tank
[30]	TSM/TSSM/HFSM	12-place Deutsch, gray	Under battery
[78]	ECM	36-place Packard	Under seat
[83]	Ignition coil	4-place Delphi, black	Back of coil, under fuel tank
[84]	Front injector	2-place Delphi	Beneath fuel tank
[85]	Rear injector	2-place Delphi	Beneath fuel tank

Table 4-31. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[119]	Relay/fuse block	5-place Amp, spade terminals	Fuse/relay block, behind left side cover
[141]	Fuel pump and low fuel switch	4-place Molex, black	Forward of relay/fuse blocks
[145]	Engine harness	16-place Molex	Under seat



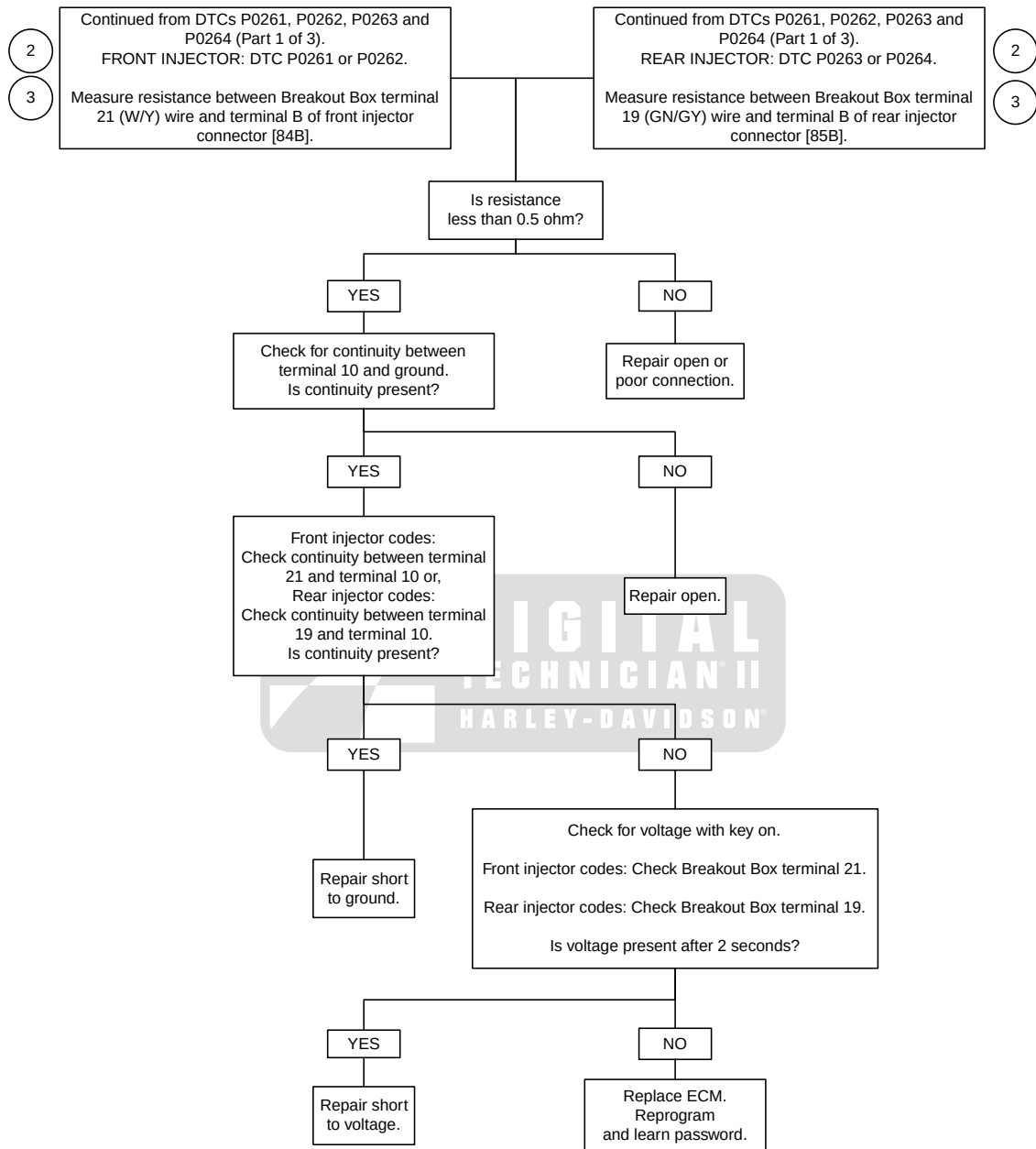
DTCs P0261, P0262, P0263, and P0264 (Part 1 of 3)



Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

fc01985_en

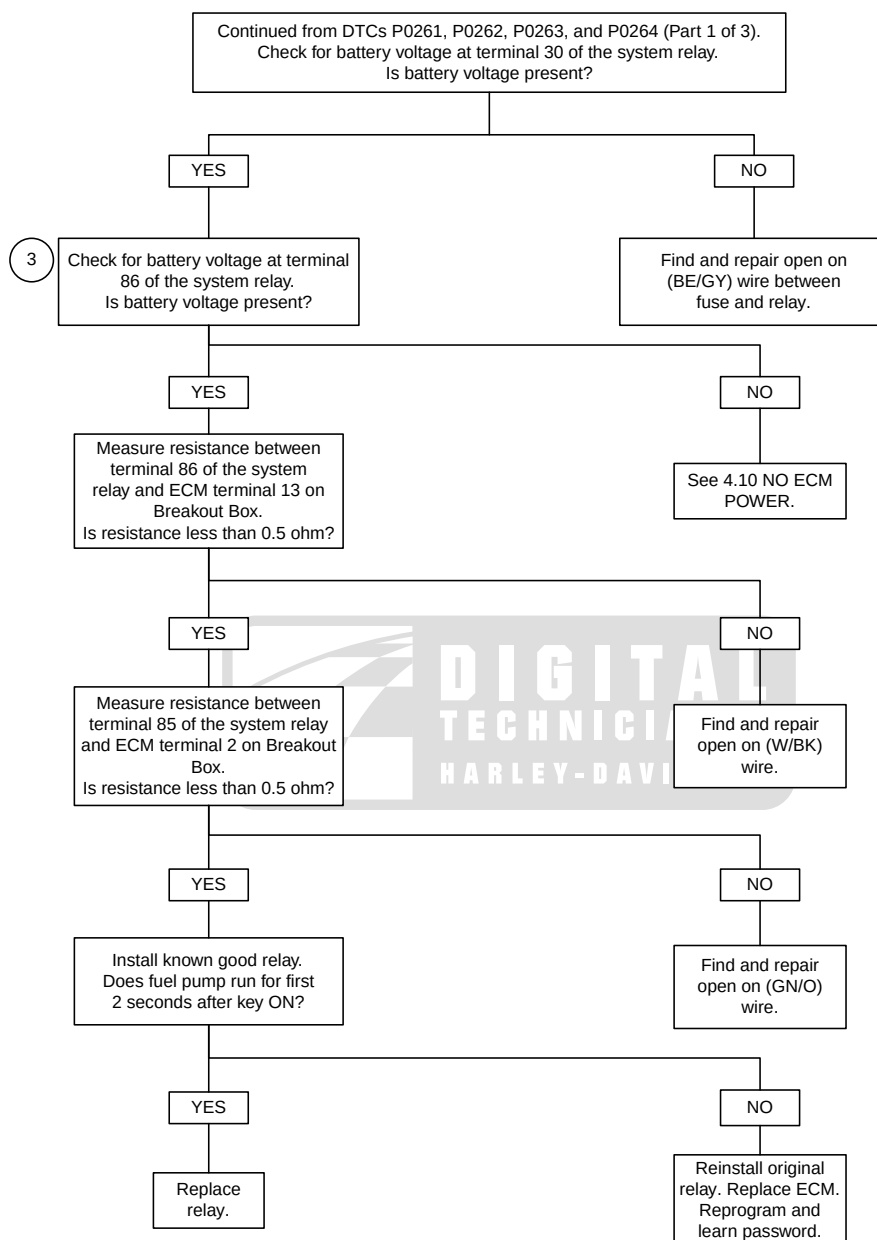
DTCs P0261, P0262, P0263, and P0264 (Part 2 of 3)



Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

fc01986_en

DTCs P0261, P0262, P0263, and P0264 (Part 3 of 3)



Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

fc01987_en

DTC P0373, P0374

GENERAL

CKP Sensor

See [Figure 4-43](#). The Crankshaft Position (CKP) sensor (1) is located on the front of the left engine crankcase. The sensor harness connector [79] (3) is located under a protective boot (2) behind the front left frame downtube.

If the CKP sensor signal is weak or absent, DTC P0373 or P0374 will be set.

NOTE

If signal is not detected or cannot synchronize (DTC P0374), engine will not start.

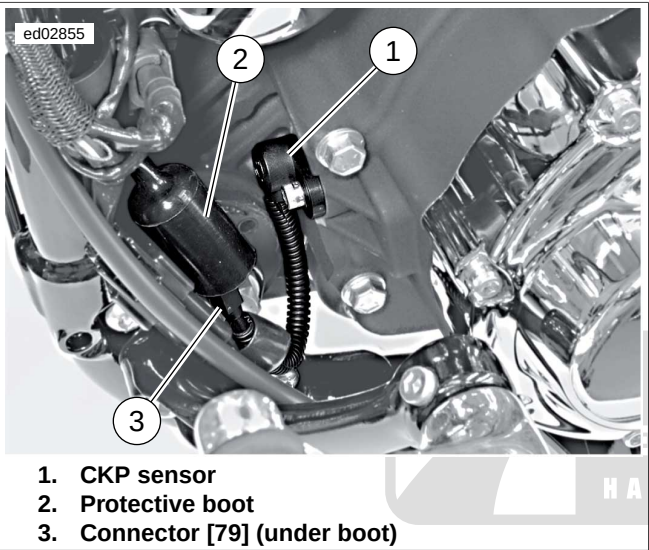


Figure 4-43. CKP Sensor Location (typical)

Table 4-32. Code Description

DTC	DESCRIPTION
P0373	CKP sensor intermittent
P0374	CKP sensor synch error

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Diagnostic Tips

Engine must be cranked for more than five seconds without CKP signal to set code.

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. Connect BREAKOUT BOX (Part No. HD-43876) to ECM wire harness only (leave ECM disconnected). See [4.7 BREAKOUT BOX: EFI](#).
2. One megohm is very high resistance.
3. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), brown socket probes and patch cords.
4. For testing purposes, install sensor without running wiring along normal path. Disconnect and route wiring properly if system is now OK.

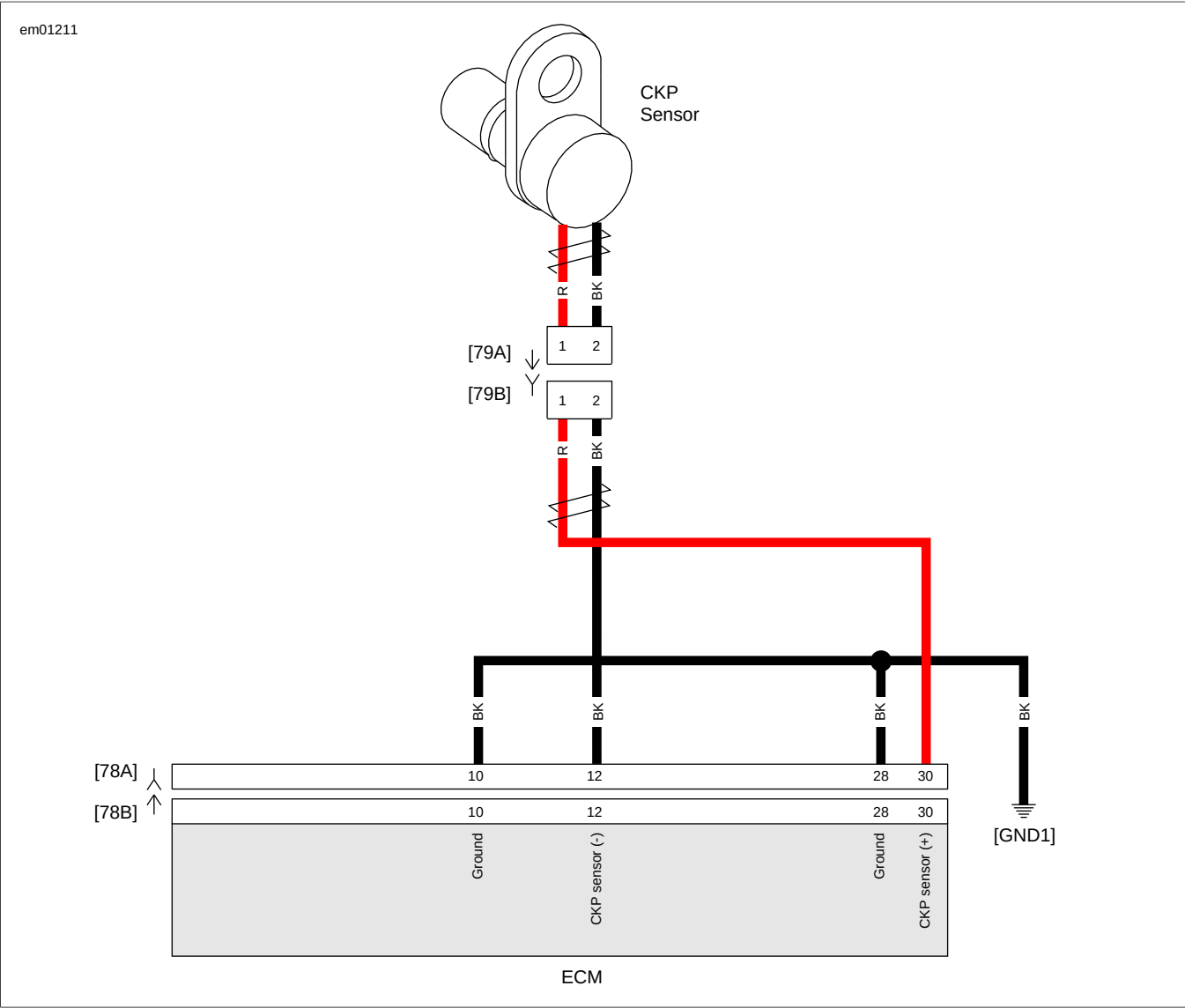


Figure 4-44. CKP Sensor Circuit

Table 4-33. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM	36-place Packard	Under seat
[79]	CKP sensor	2-place Mini-Deutsch	Front of left crankcase

DTC P0501, P0502

4.22

GENERAL

Vehicle Speed Sensor (VSS)

See [Figure 4-45](#). The VSS is powered and monitored by the ECM. The ECM processes the vehicle speed signal and transmits this signal to the TSM/TSSM/ HFSM and speedometer over the serial data circuit.

Table 4-34. Code Description

DTC	DESCRIPTION
P0501	VSS low
P0502	VSS high/open

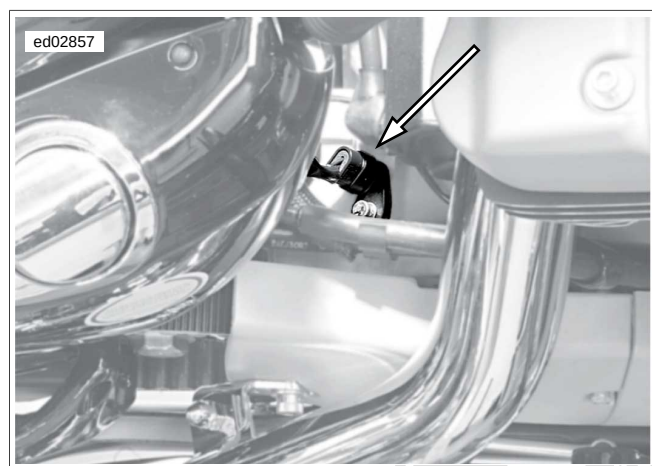


Figure 4-45. Vehicle Speed Sensor and Connector

NOTE

The MAP, TP, jiffy stand, and VSS sensors are connected to the same reference line (+5V Vref). If the reference line goes to ground or open, multiple codes will be set (DTC P0107, P0108, P0122, P0123, P0501, P0502, P01501, P01502). Start with the trouble code having the lowest ranking value.

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. The speedometer has a built-in diagnostic mode. See [2.3 ODOMETER SELF-DIAGNOSTICS](#).
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), black pin probe and patch cord.
3. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness and ECM. See [4.7 BREAKOUT BOX: EFI](#).

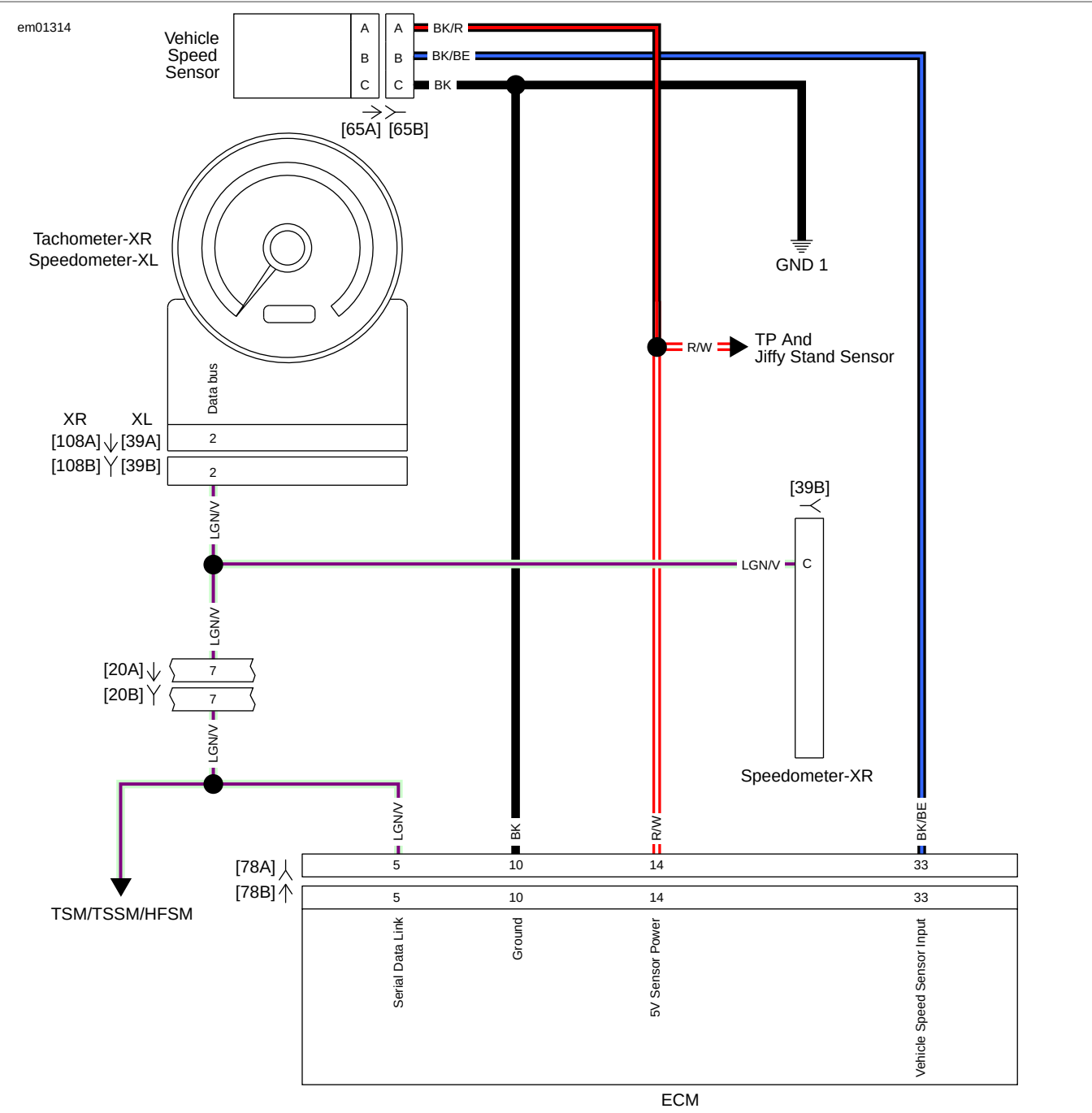
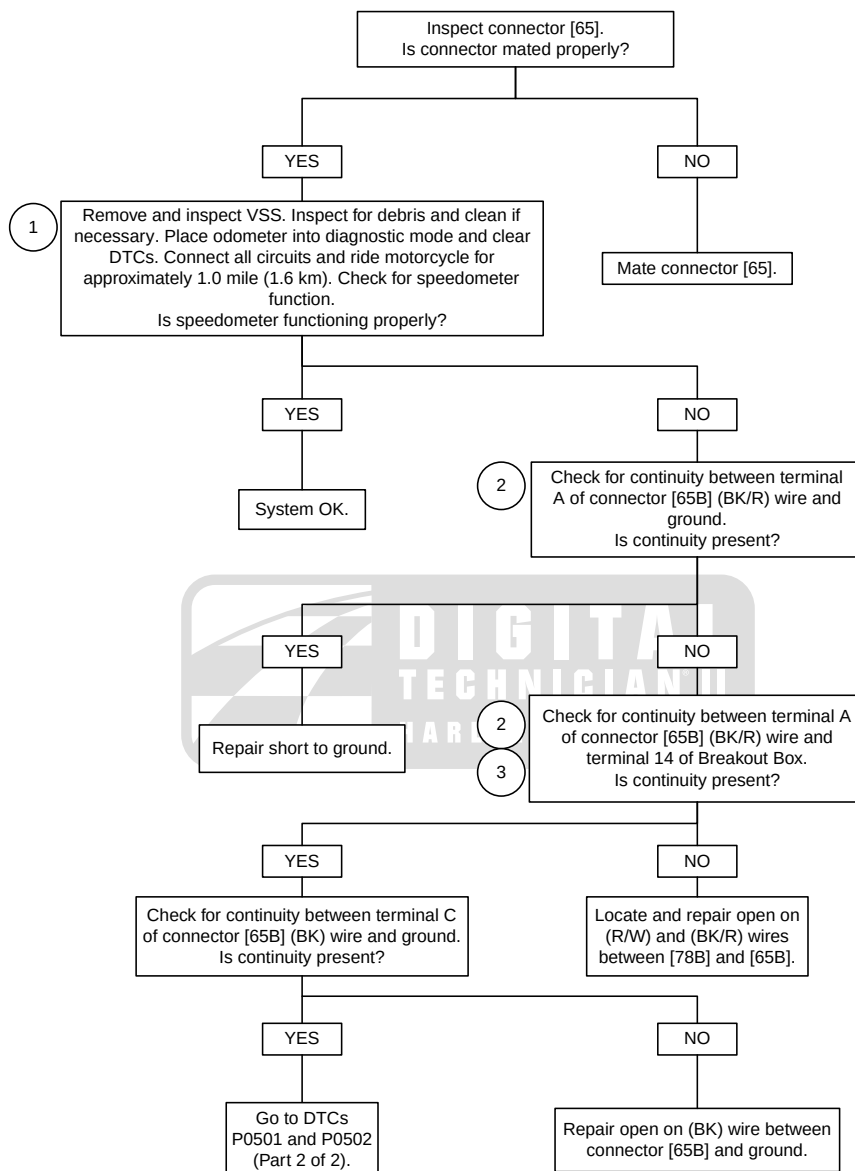


Figure 4-46. Vehicle Speed Sensor

Table 4-35. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[20]	Instruments	12-place Molex	Under fuel tank
[39]	Speedometer (XL)	12-place Packard	Back of speedometer
[39]	Speedometer (XR)	5-place Packard	Back of speedometer
[65]	VSS	3-place Delphi	Rear of transmission case
[78]	ECM	36-place Packard	Under seat
[108]	Tachometer (XR)	12-place Packard	Back of tachometer

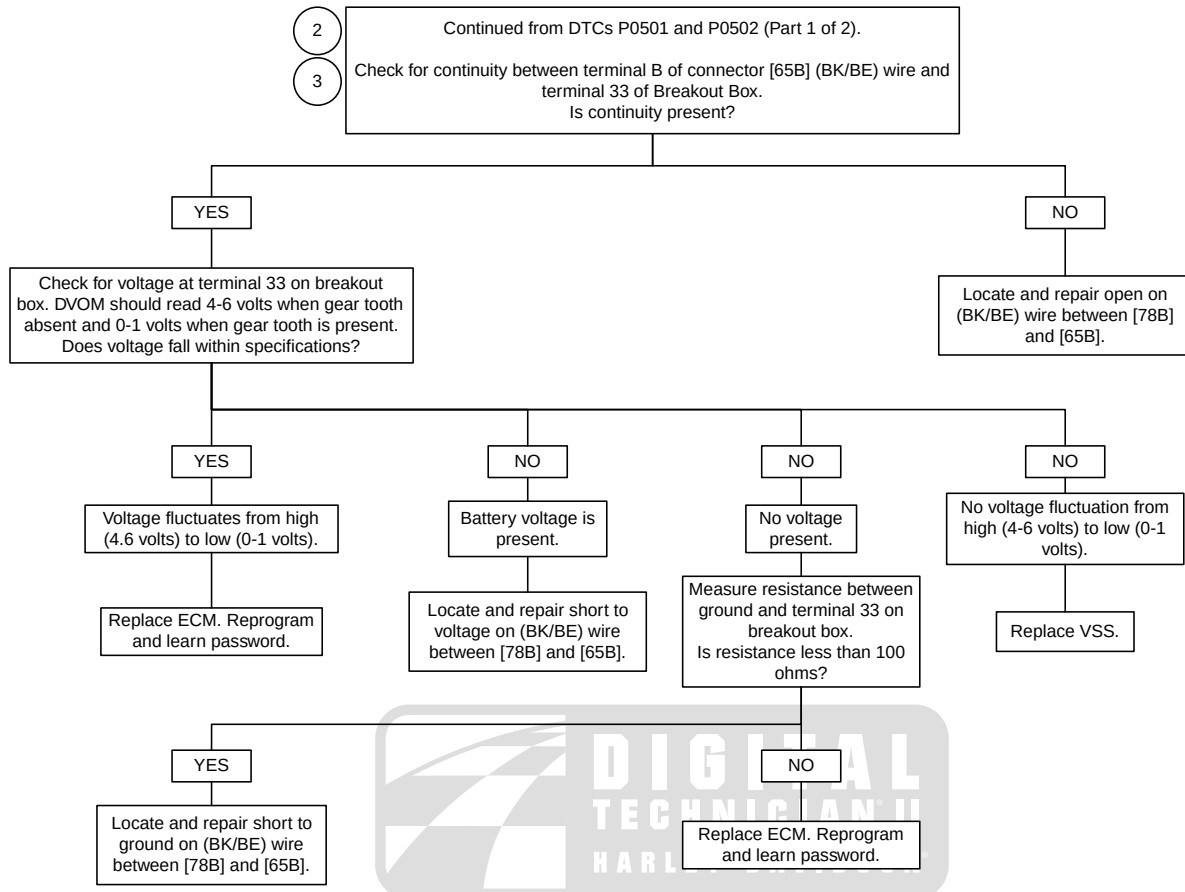
DTCs P0501 and P0502 (Part 1 of 2)



Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

fc01988_en

DTCs P0501 and P0502 (Part 2 of 2)



Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

fc01989_en

DTC P0562, P0563

4.23

GENERAL

Battery Voltage

See [Figure 4-48](#). Battery voltage is monitored by the Electronic Control Module (ECM) (terminal "13"). If the battery voltage fails to meet normal operating parameters, a code is set.

NOTE

When either Diagnostic Trouble Code (DTC) P0562 or P0563 is set, the battery icon in the speedometer on XL, tachometer on XR, will illuminate.

- DTC P0562 is displayed when battery voltage is less than 12.2 volts at idle and voltage does not increase when engine speed is greater than 2000 RPM.
- DTC P0563 is displayed when battery positive voltage is greater than 15.0 volts for more than 4 seconds.

NOTES

- Warm idle speed will be automatically increased if battery voltage is low at idle.
- TSM/TSSM/HFSM problems may also set DTC P0562 or P0563.

Table 4-36. Code Description

DTC	DESCRIPTION
P0562	Battery voltage low
P0563	Battery voltage high

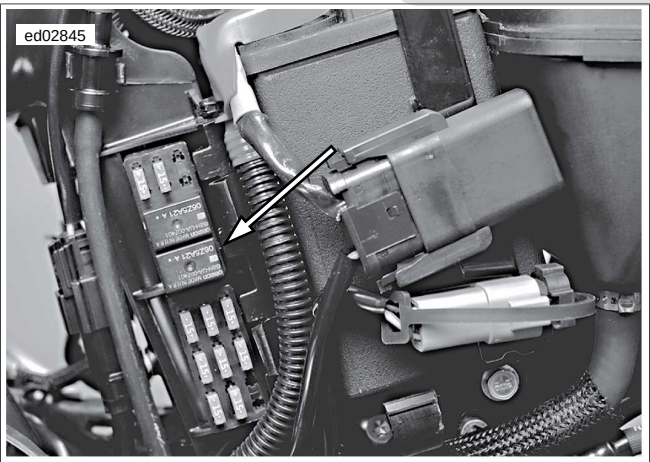


Figure 4-47. System Relay

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-43876	BREAKOUT BOX

Diagnostic Tips

- Low voltage generally indicates a loose wire, corroded connections, battery and/or a charging system problem.
- A high voltage condition may be caused by a faulty voltage regulator.

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. Was battery allowed to discharge or be drawn down by a starting problem?
 - a. Yes. Charge battery.
 - b. No. See [1.7 CHARGING SYSTEM, Troubleshooting](#).
2. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness and ECM. See [4.7 BREAKOUT BOX: EFI](#).
3. Use DVOM with RPM Pick-up to check RPM on vehicles without tachometers.
4. This checks for voltage drops in the ECM circuit.
 - a. Place (+) probe to battery positive terminal.
 - b. Place (-) probe to (W/BK) terminal on Breakout Box.
5. Problem is most likely the ground connection at the frame.

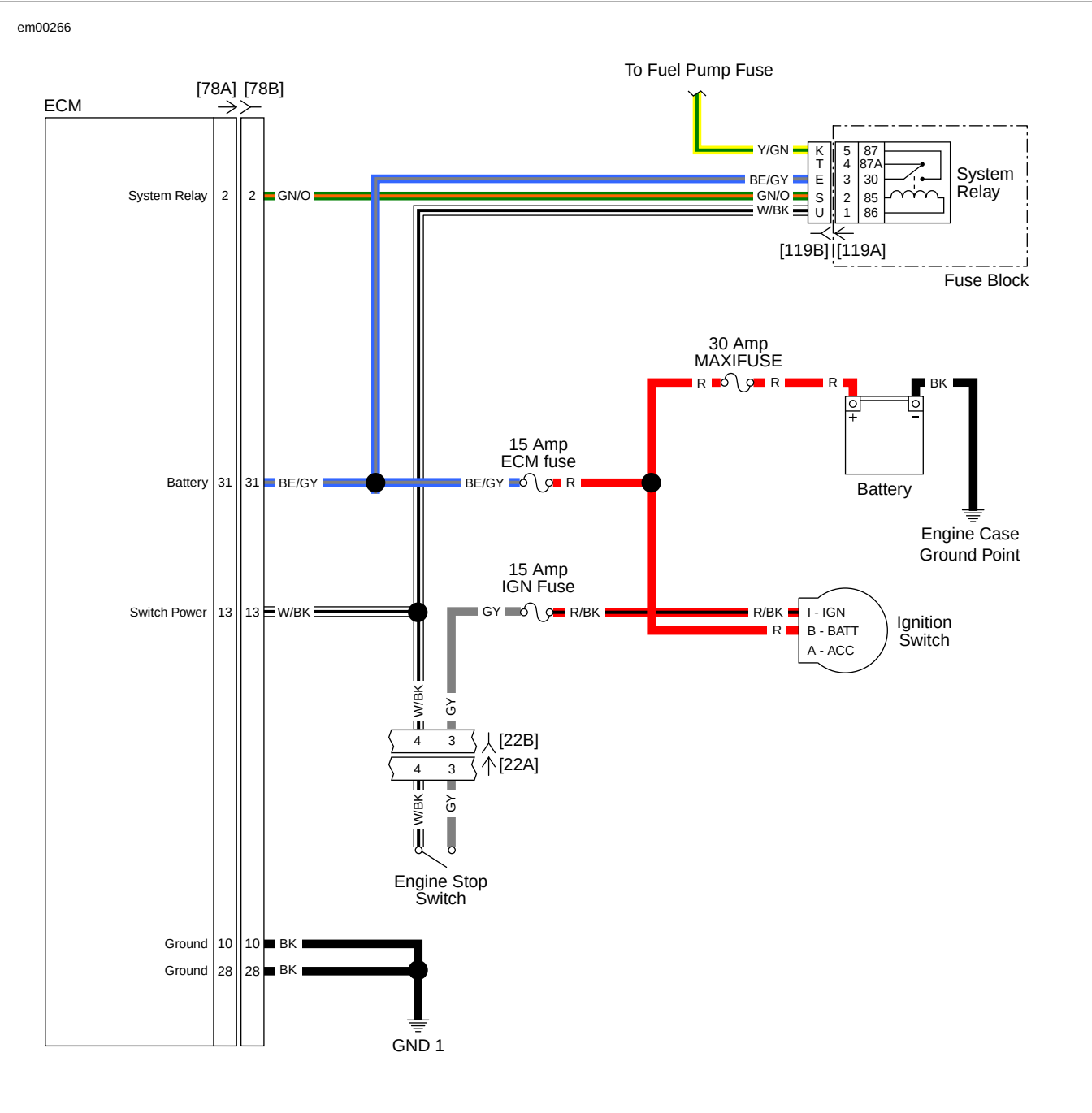
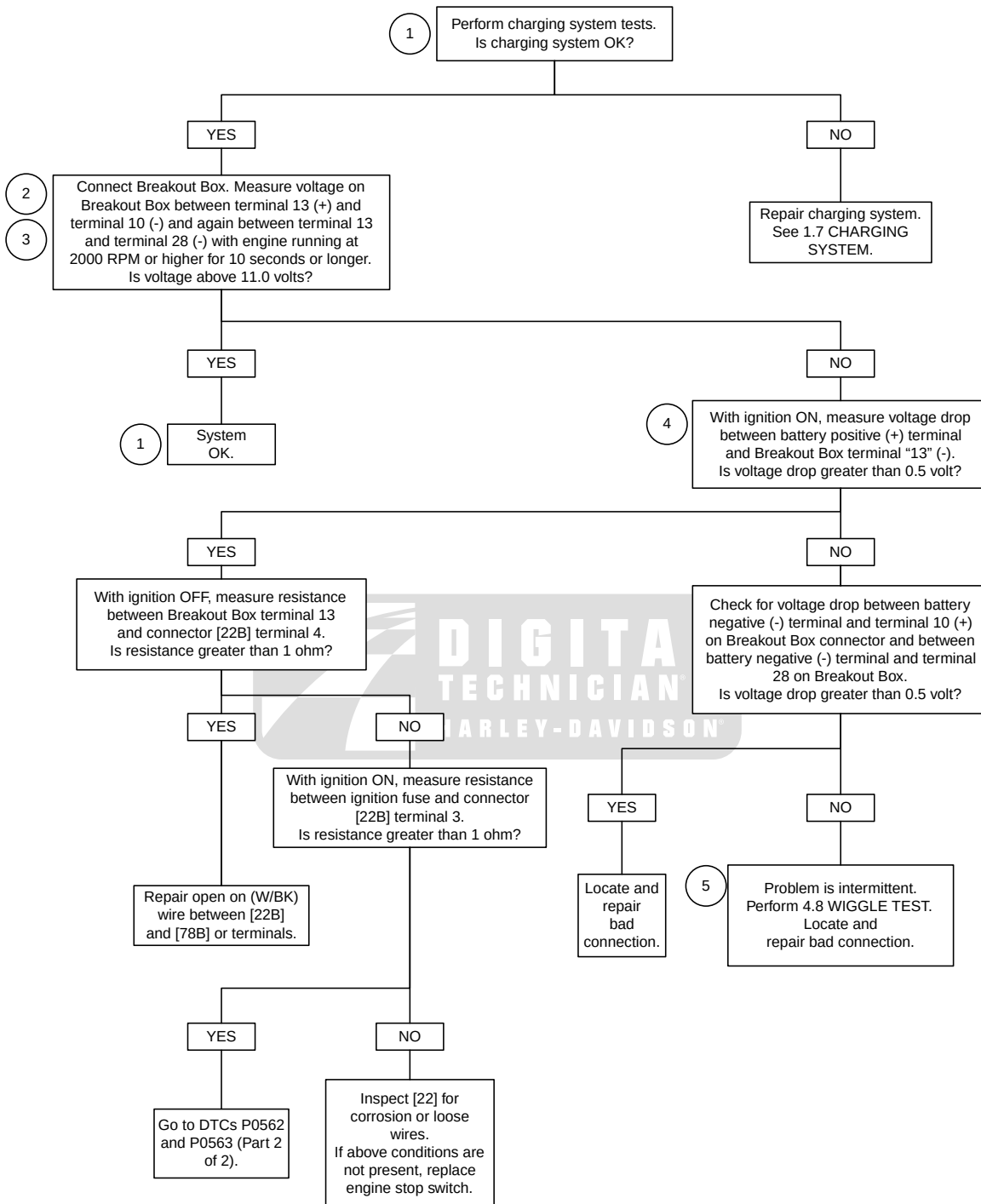


Figure 4-48. Ignition Power Circuit

Table 4-37. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[22]	Right handlebar controls	6-place Molex	Under fuel tank
[78]	ECM	36-place Packard	Under seat
[119]	System relay	5-place Amp	Under left side cover

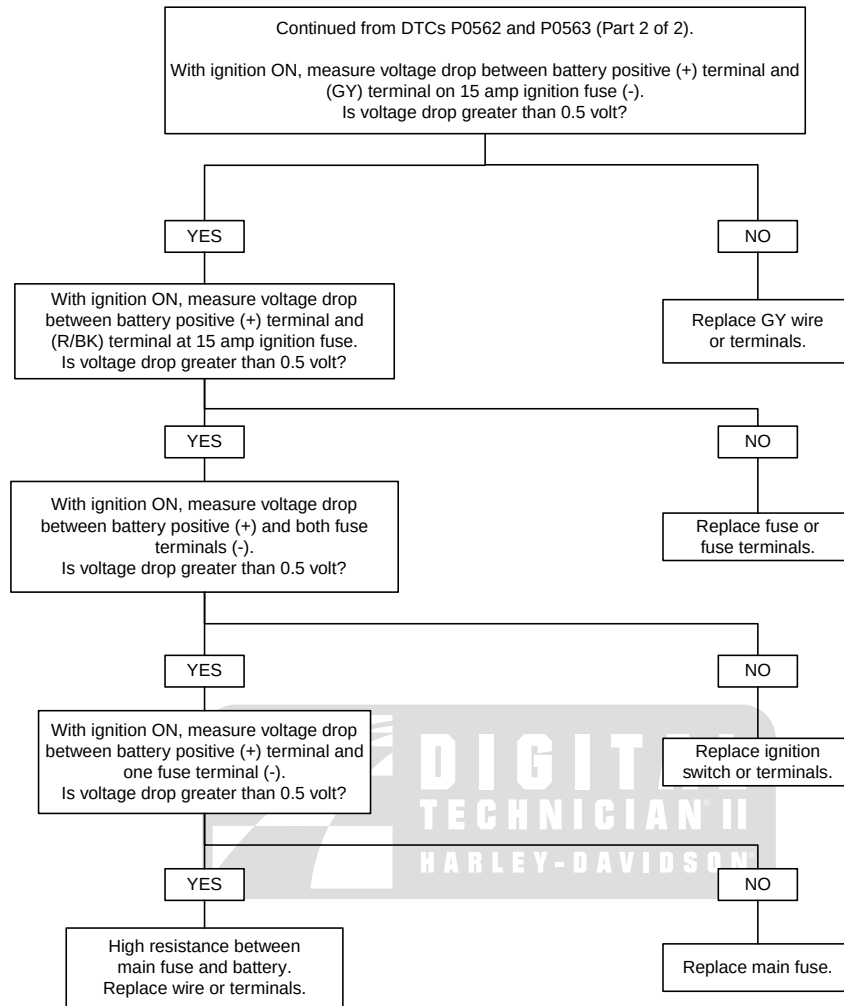
DTCs P0562 and P0563 (Part 1 of 2)



Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

fc01990_en

DTCs P0562 and P0563 (Part 2 of 2)



Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

fc01991_en

DTC P0603, P0605

4.24

GENERAL

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

ECM Failure

Refer to [Table 4-38](#). The DTCs listed indicate a failure which requires replacement of the ECM. See the Service Manual for replacement information.

NOTE

After replacing ECM, reprogram, perform password learning procedure and clear codes. ECM must be reprogrammed using the DIGITAL TECHNICIAN II (Part No. HD-48650). See your dealer. Password learn procedure must also be performed. See [3.23 TSM/HFSM: PASSWORD LEARN](#).

Table 4-38. Code Description

DTC	DESCRIPTION
P0603	ECM EEPROM error
P0605	ECM flash error

DIAGNOSTICS

These codes are set under two conditions.

- If DTC P0603 or P0605 occur during normal operation, replace ECM. Reprogram and learn password.
- If DTC P0603 or P0605 occur during or after reprogramming, perform the following:

DTC P0603

1. Clear DTCs.
2. Power down the vehicle. Wait 10 seconds.
3. Turn ignition ON.
4. Replace ECM if codes reappear.

DTC P0605

1. Clear DTCs.
2. Power down the vehicle.
3. Attempt to reprogram ECM using correct calibration.
4. Restart vehicle. If code reappears, replace ECM.



DTC P0661, P0662

4.25

GENERAL

Active Intake Solenoid (HDI XR Models Only)

The active intake solenoid regulates the amount of air that enters the air cleaner. The active intake solenoid opens when vehicle speed exceeds 45 MPH (70 km/h) with 50% or greater throttle opening. Once open, active intake will close when vehicle speed falls below 40 MPH (65 km/h). The power for the active intake solenoid comes from the engine control fuse. The ECM provides the path to ground to trigger the active intake solenoid.

Table 4-39. Code Description

DTC	DESCRIPTION
P0661	Active intake solenoid open/low
P0662	Active intake high/shorted

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

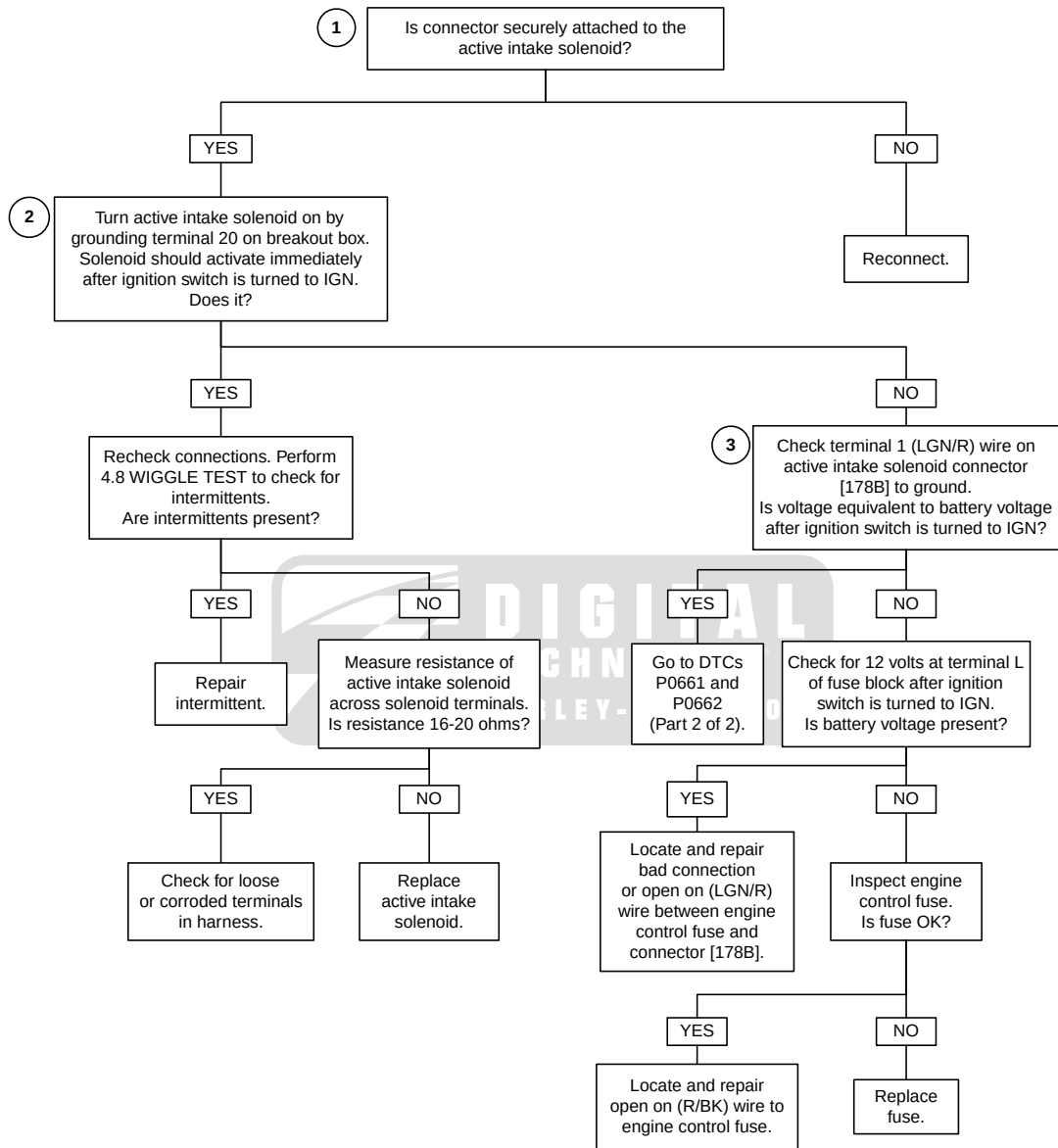
1. See the service manual for all service information.
2. Connect a BREAKOUT BOX (Part No. HD-43876) between EFI wire harness and ECM. See [4.7 BREAKOUT BOX: EFI](#)
3. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), purple terminal probe and patch cord.



Table 4-40. Wire Harness Connectors

4-106 2009 Sportster Diagnostics: Engine Management

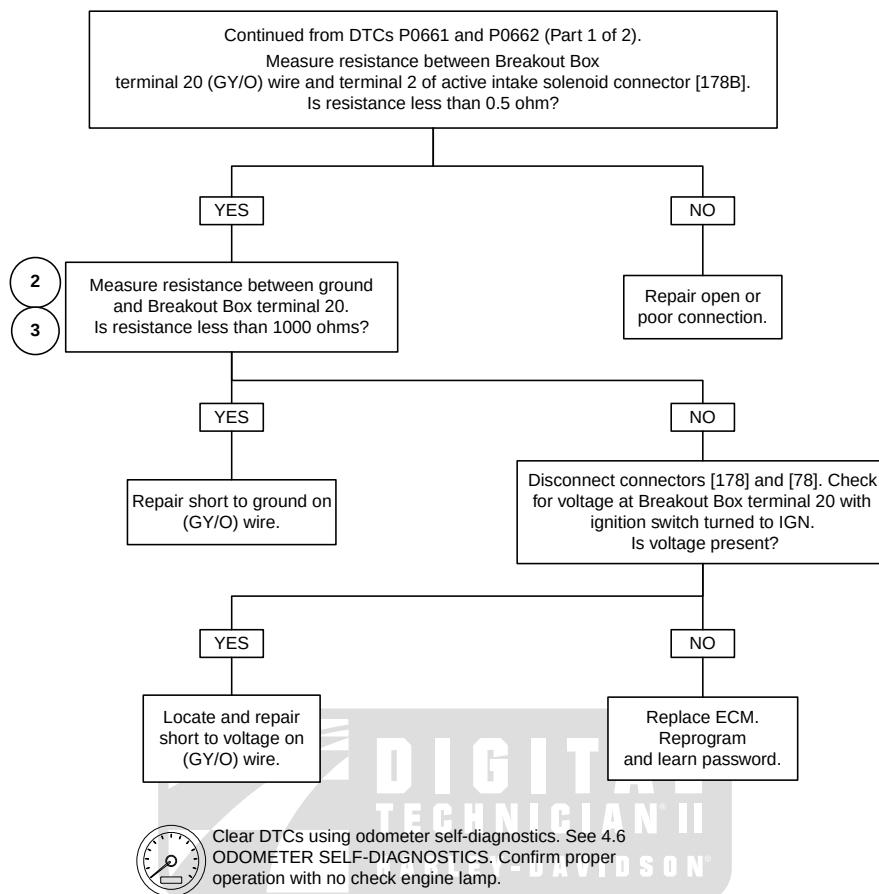
DTCs P0661 and P0662 (Part 1 of 2)



Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

fc01992_en

DTCs P0661 and P0662 (Part 2 of 2)



fc01993_en

DTC P1009, P1010

4.26

GENERAL

Password Problem

The ECM and TSM/TSSM/HFSM exchange passwords during operation. An incorrect password or missing password will set a diagnostic code.

NOTE

If the TSM/TSSM/HFSM is not connected to the wiring harness, the vehicle will not start.

Table 4-41. Code Description

DTC	DESCRIPTION
P1009	Incorrect password
P1010	Missing password

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. DTC P1009 may be set if a recent ECM or TSM/TSSM/HFSM replacement did not follow the correct password assignment procedure. See [3.23 TSM/HFSM: PASSWORD LEARN](#) for details.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), black socket probes and patch cord.
3. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness and ECM. See [4.7 BREAKOUT BOX: EFI](#).
4. Historic codes DTC U1300 or DTC U1301 would also have been set. Clear codes.
5. See the service manual for TSM/TSSM/HFSM replacement. See [3.23 TSM/HFSM: PASSWORD LEARN](#) for the password learning procedure.



Figure 4-50. Data Link Connector [91A]



Figure 4-51. TSM/TSSM/HFSM

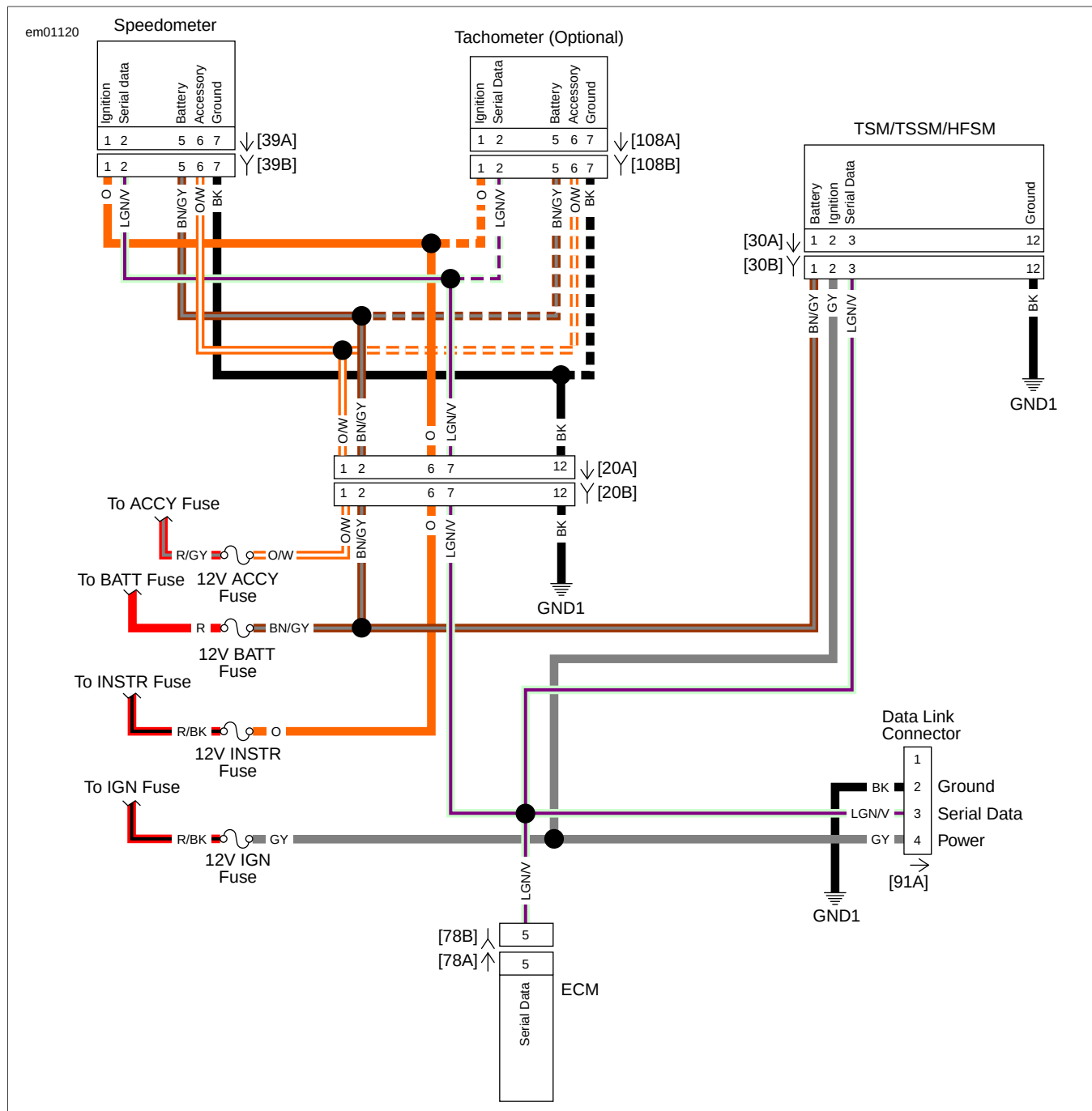


Figure 4-52. Serial Data Circuit (XL)

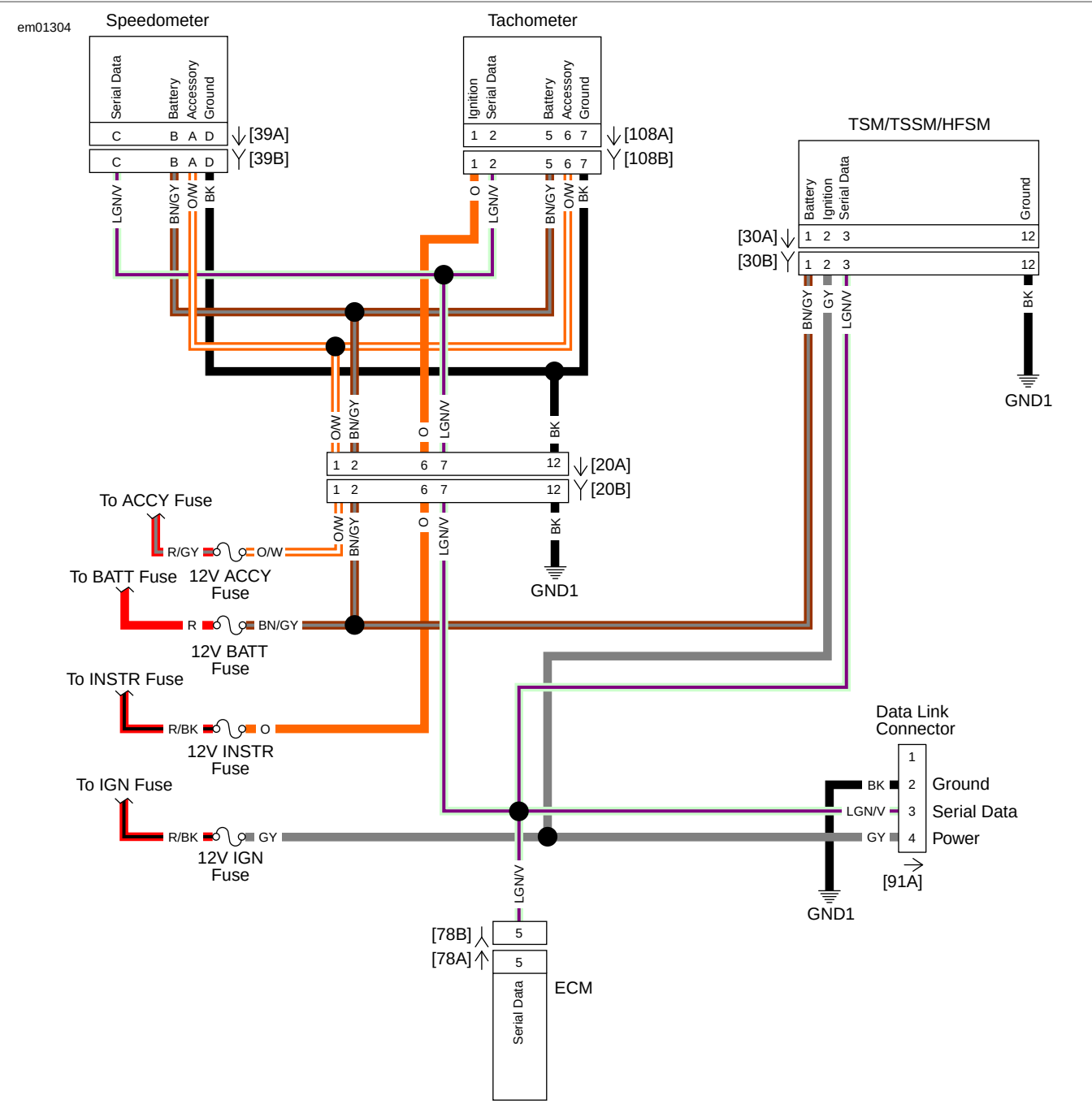


Figure 4-53. Serial Data Circuit (XR)

Table 4-42. Wire Harness Connectors

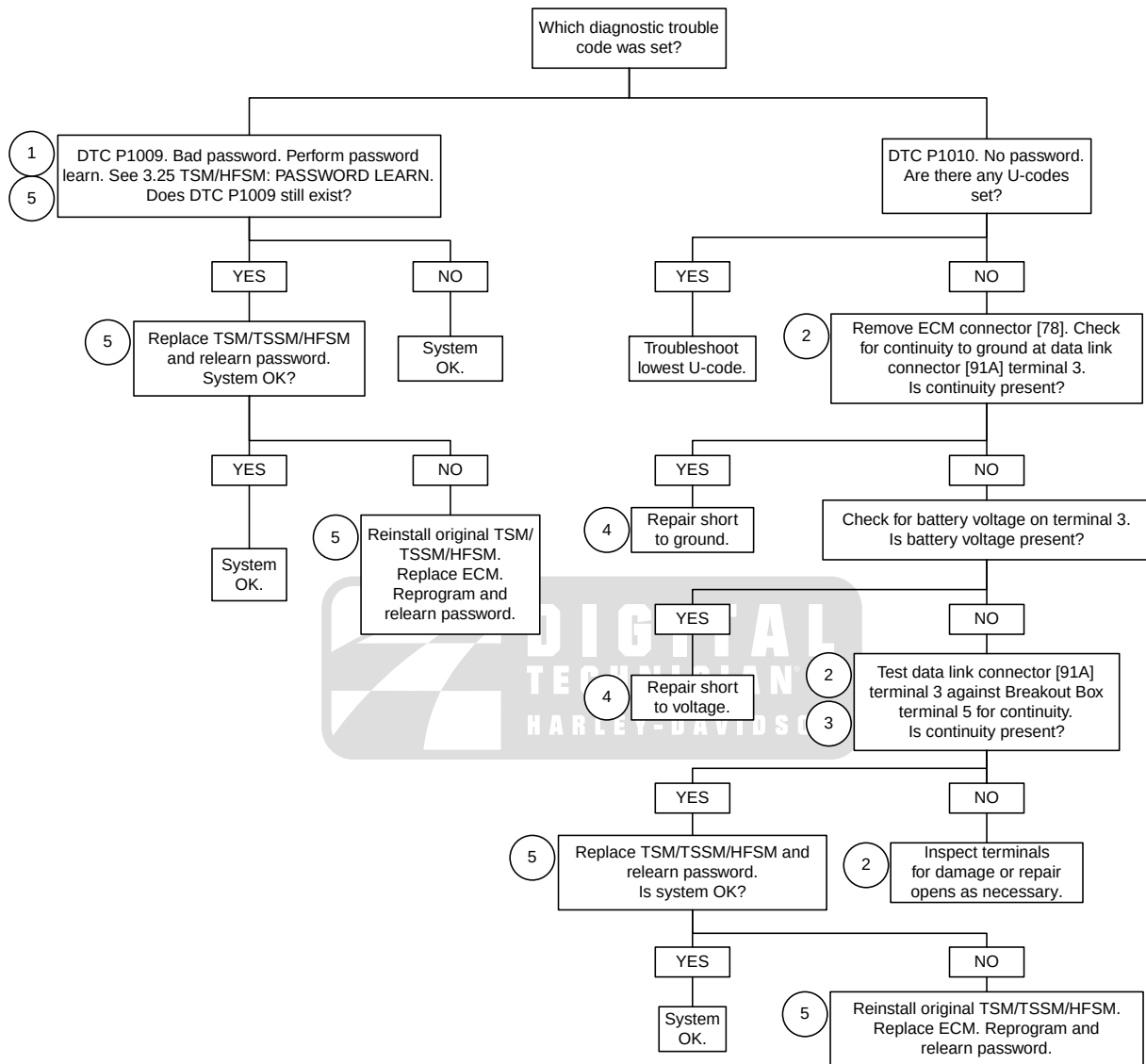
NO.	DESCRIPTION	TYPE	LOCATION
[20]	Instruments	12-place Molex	Under fuel tank
[30]	TSM/TSSM/HFSM	12-place Deutsch	Under battery tray
[39]	Speedometer (XL)	12-place Packard	Back of speedometer
[39]	Display (XR)	5-place Packard	Back of speedometer
[78]	ECM	36-place Packard	Under seat

Table 4-42. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[91]	Data link connector	4-place Deutsch	Under left side cover
[108]	Tachometer (if equipped)	12-place Packard	Back of tachometer



DTCs P1009 and P1010



Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

fc01857_en

DTC P1351, P1352, P1354, P1355

4.27

GENERAL

Ignition Coil

Ignition coil DTCs will set if the ignition coil primary voltage is out of range. This could occur if there is an open coil or loss of power to the coil. If front and rear DTCs are set simultaneously, it is likely a coil power failure or a coil failure.

The coil receives power from the system relay at the same time that the fuel pump and injectors are activated. The system relay is active for the first 2 seconds after the ignition switch is turned ON and then shuts off until RPM is detected from the CKP sensor, at which time it is reactivated. The ECM is responsible for turning on the system relay by providing the ground to activate the relay, which in turn powers the coil.

Table 4-43. Code Description

DTC	DESCRIPTION
P1351	Front ignition coil open/low
P1352	Front ignition coil high/shorted
P1354	Rear ignition coil open/low
P1355	Rear ignition coil high/shorted

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-34730-2C	FUEL INJECTOR TEST LAMP
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX
HD-44687	IGNITION COIL CIRCUIT TEST ADAPTER

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), gray pin probes and patch cord.

NOTE

Gently connect test lamp to connector [83B]. Forcefully inserting test lamp will result in ignition connector terminal damage.

2. See [Figure 4-54](#). Plug IGNITION COIL CIRCUIT TEST ADAPTER (Part No. HD-44687) and FUEL INJECTOR TEST LAMP (Part No. HD-34730-2C) into Breakout Box. Note that cranking the engine with test lamp in place of the ignition coil can sometimes cause a DTC P1351, P1352, P1354 or P1355. This condition is normal and does not by itself indicate a malfunction. DTCs must be cleared if this condition occurs.

3. Connect BREAKOUT BOX (Part No. HD-43876) between EFI wire harness and ECM. See [4.7 BREAKOUT BOX: EFI](#).
4. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), gray socket probes and patch cord.

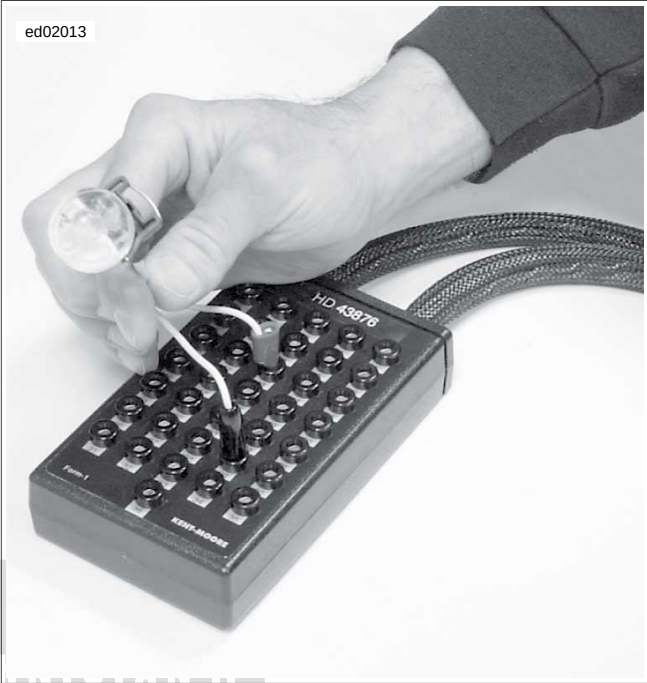


Figure 4-54. Ignition Coil Circuit Test

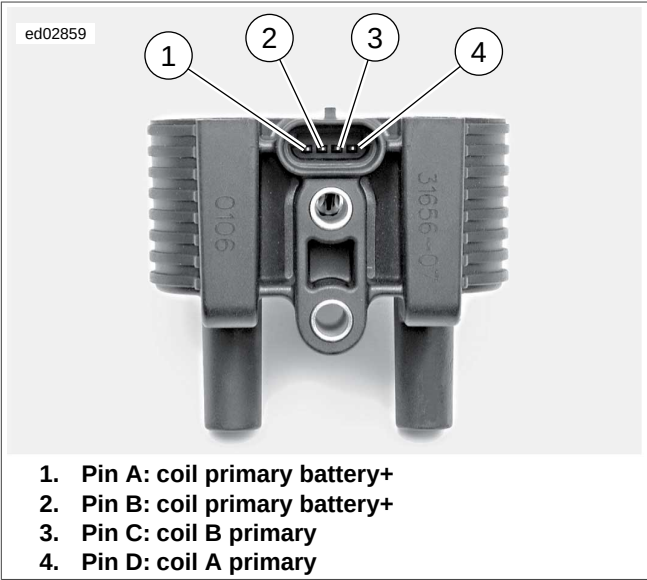


Figure 4-55. Ignition Coil Connector Terminals

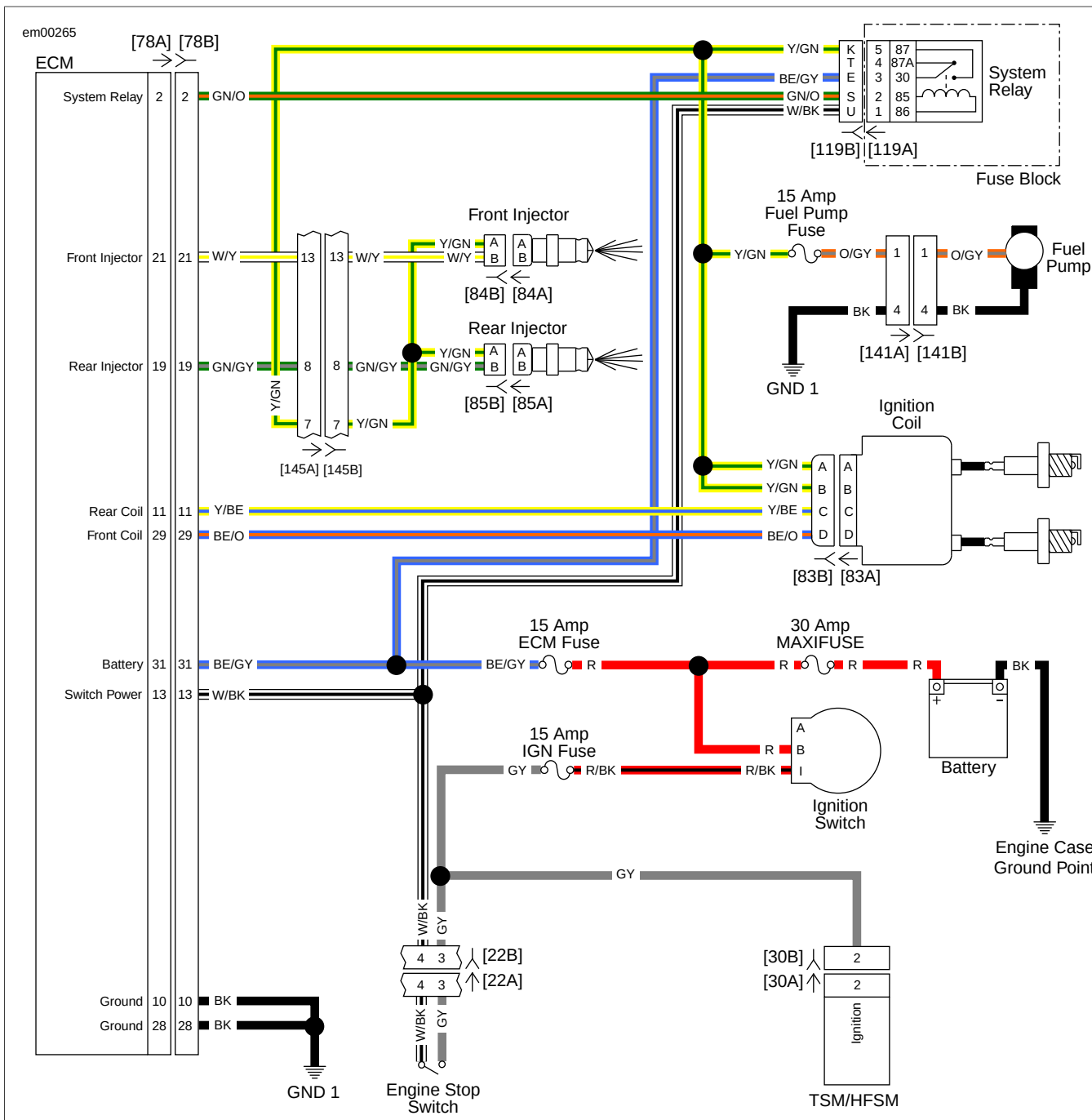


Figure 4-56. Ignition Coil Circuit

Table 4-44. Wire Harness Connectors

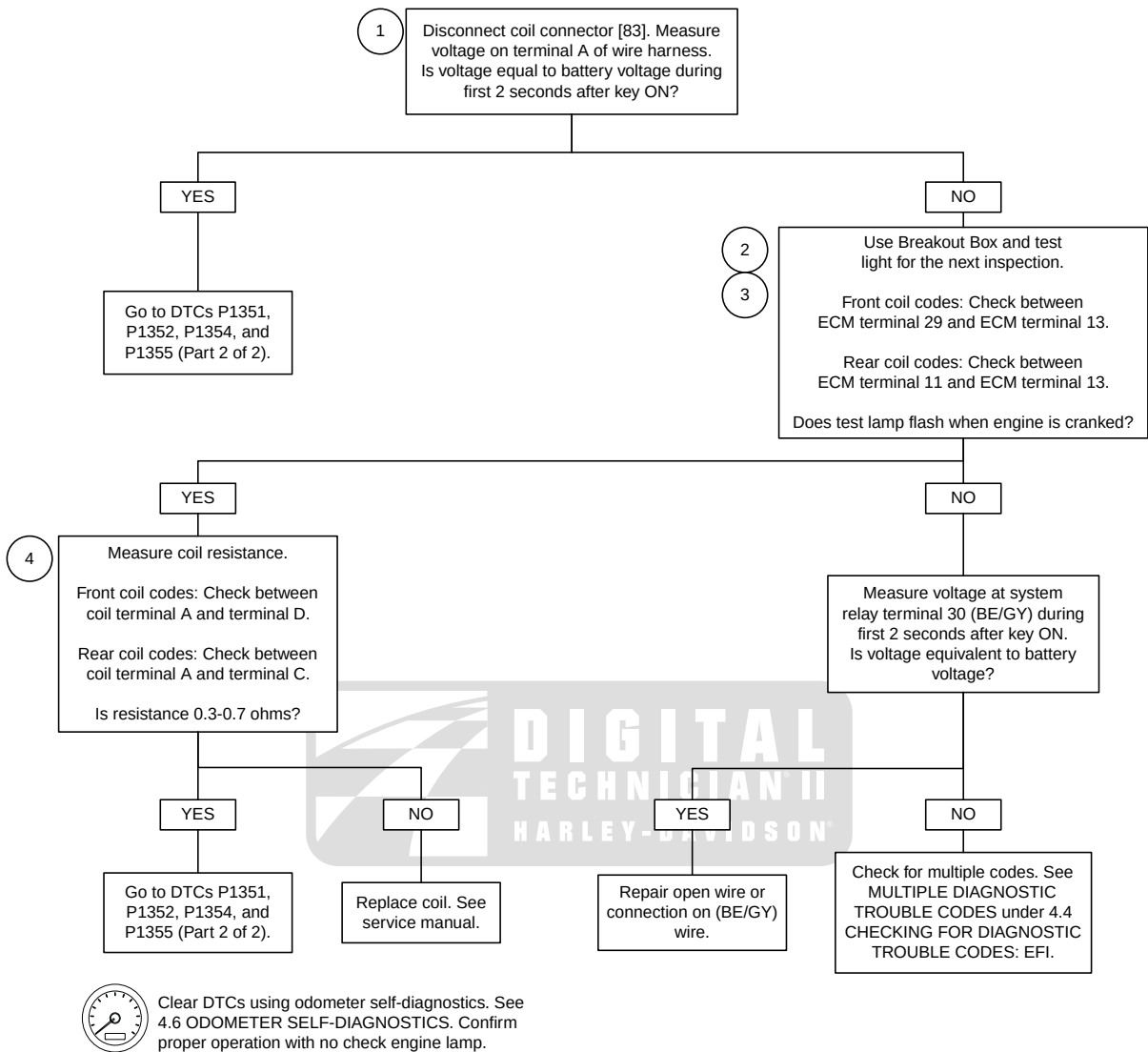
NO.	DESCRIPTION	TYPE	LOCATION
[22]	Right handlebar controls	6-place Molex	Under fuel tank
[30]	TSM/TSSM/HFSM	12-place Deutsch, gray	Under battery
[78]	ECM	36-place Packard	Under seat
[83]	Ignition coil	4-place Delphi	Back of coil
[84]	Front injector	2-place Delphi, black	Top of intake manifold
[85]	Rear injector	2-place Delphi, black	Top of intake manifold

Table 4-44. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[119]	System relay	5-place Amp	Under left side cover
[141]	Fuel pump and low fuel switch	4-place Molex, black	Forward of relay/fuse blocks
[145]	Engine harness	16-place Molex	Under seat

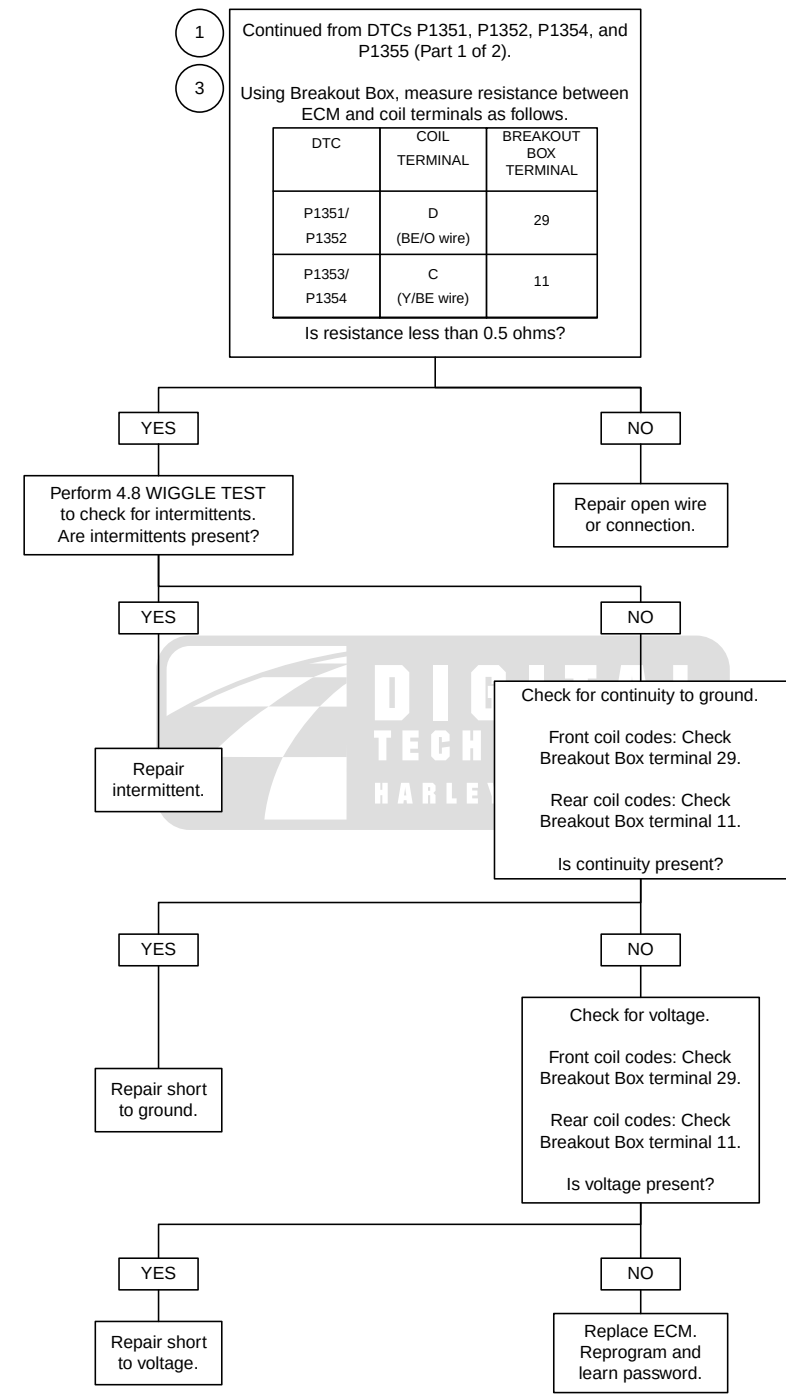


DTCs P1351, P1352, P1354, and P1355 (Part 1 of 2)



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DTCs P1351, P1352, P1354, and P1355 (Part 2 of 2)



Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

fc01995_en

DTC P1501, P1502

4.28

GENERAL

Jiffy Stand Sensor (HDI)

The jiffy stand sensor utilizes a Hall effect sensor to monitor jiffy stand position. When the jiffy stand is fully retracted the sensor picks up the presence of the metal tab mounted to the jiffy stand. The metal tab is moved away from the sensor as the jiffy stand is extended. When the jiffy stand is extended the engine will start and run only if the TSM/TSSM/HFSM determines the transmission is in neutral. Otherwise the engine will start and stall. This is done by monitoring the neutral switch input to the TSM/TSSM/HFSM and communicating that input over the serial data circuit to the ECM.

The jiffy stand sensor also has a Fail Enable Mode. This mode allows the engine to start and run if the system recognizes a problem with the jiffy stand sensor circuit. If a problem exists or if the transmission is put in gear with the jiffy stand extended the odometer will display "SlidE Stand". Code P1501 or P1502 will set if the jiffy stand sensor circuits are out of range.

See [Figure 4-57](#). The jiffy stand sensor is powered and monitored by the ECM. The ECM (terminal 14) supplies the 5V reference to the jiffy stand sensor connector [133] (terminal 1). See [Figure 4-58](#). The jiffy stand sensor (terminal 2) sends a signal back to the ECM (terminal 9). This signal is how the ECM determines if the jiffy stand is retracted or extended. The jiffy stand sensor (terminal 3) is grounded through the Powertrain Ground Point [GND 1].

NOTE

The ECM supplies not only the jiffy stand sensor but also the VSS, the TP sensor, and the TMAP sensor with a 5V reference signal from terminal 14.

Table 4-45. Code Description

DTC	DESCRIPTION
P1501	Jiffy Stand Sensor low
P1502	Jiffy Stand Sensor high

DIAGNOSTICS

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. Unplug the neutral switch connector [136]. Using a DVOM, test for continuity to ground. When the transmission is in neutral, continuity should exist. When the transmission is in gear, there should not be continuity to ground through the neutral switch.

2. See the service manual for TSM/TSSM/HFSM replacement. See [3.23 TSM/HFSM: PASSWORD LEARN, Password Learning](#) for the password learning procedure.
3. When the jiffy stand is retracted, voltage on terminal 9 should be approximately 1.5-2V. When the jiffy stand is extended, the voltage on terminal 9 should be approximately 4-4.5V.

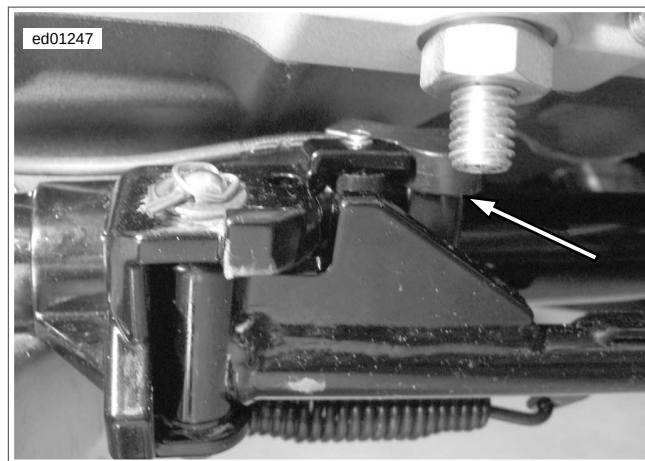


Figure 4-57. Jiffy Stand Sensor



Figure 4-58. Jiffy Stand Sensor Connector

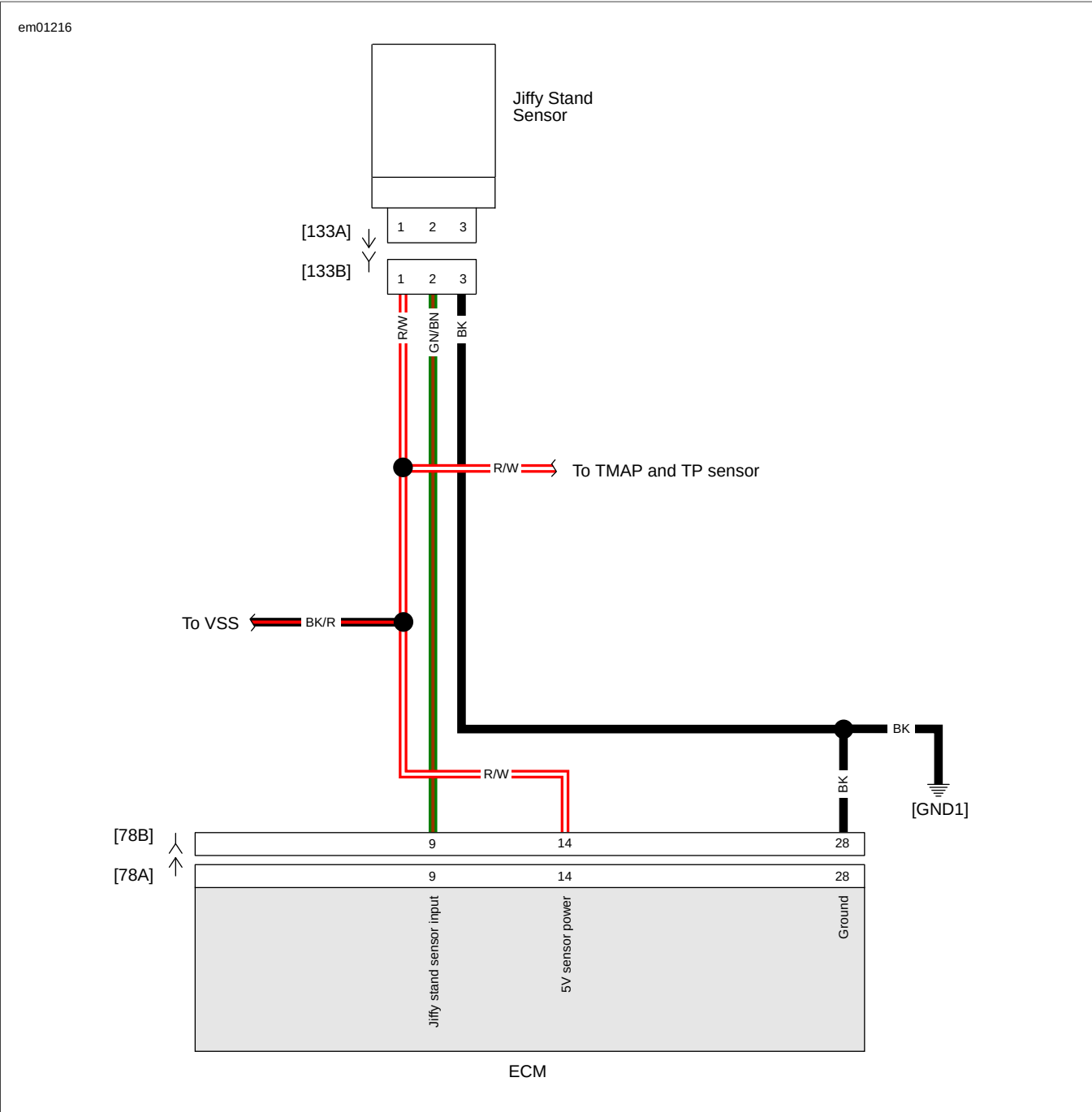
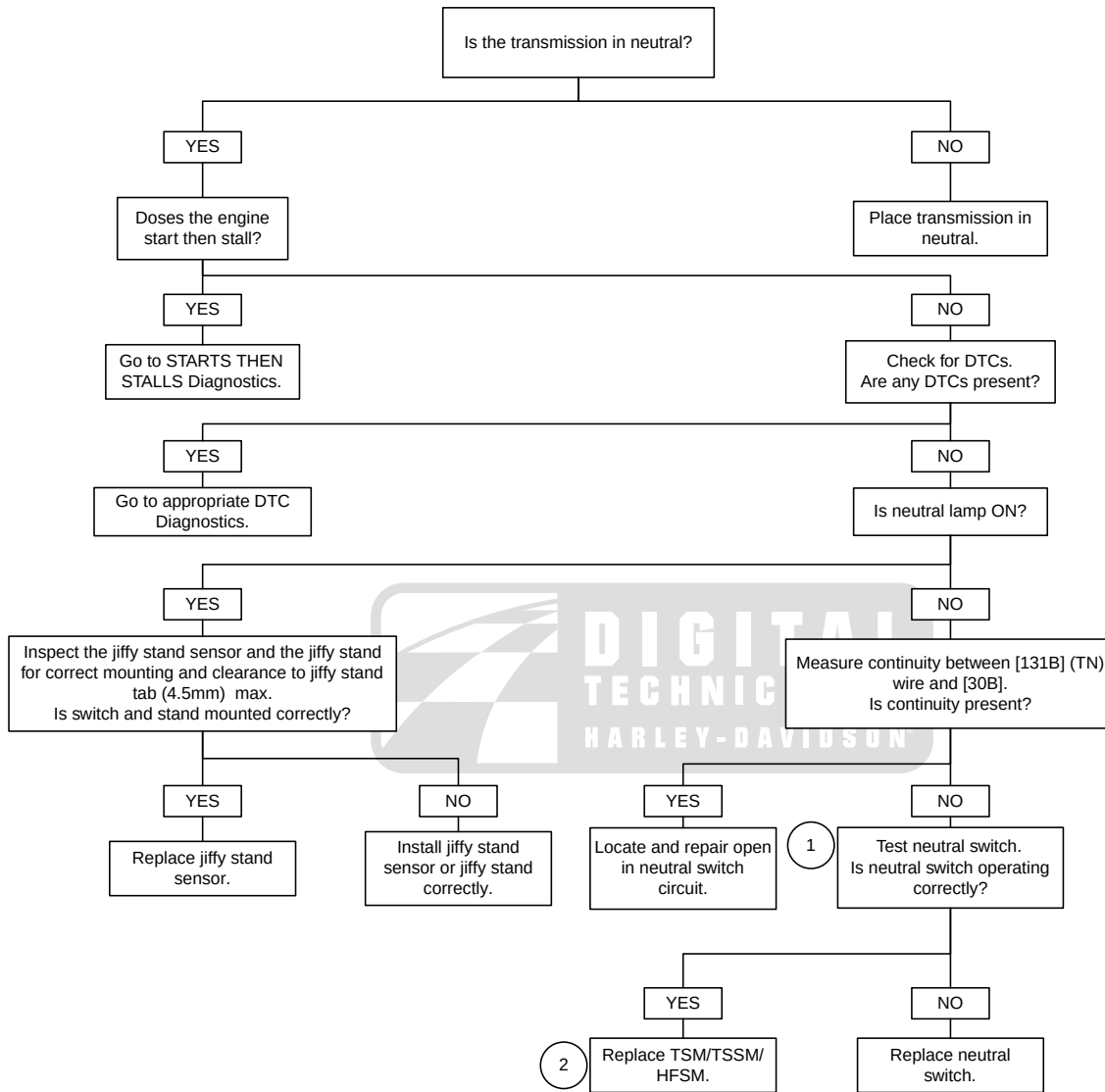


Figure 4-59. Jiffy Stand Sensor Circuit

Table 4-46. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM	36-place Packard	Under seat
[133]	Jiffy Stand Sensor	3-place Molex	Left along frame toward front of engine

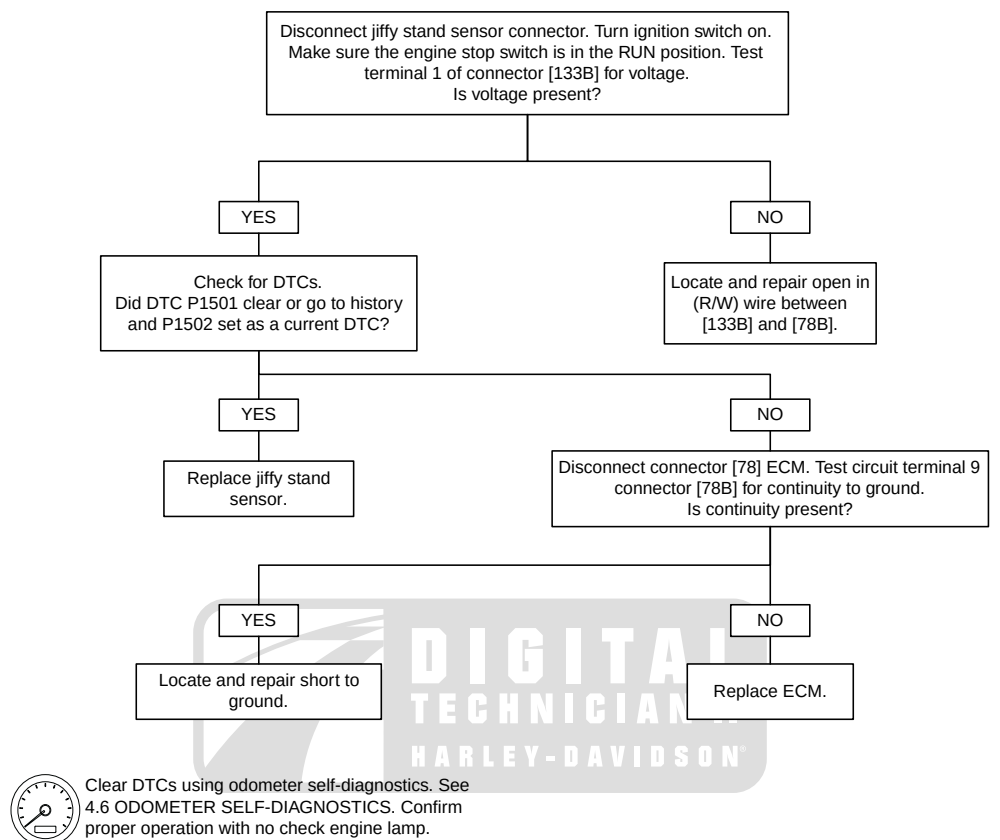
Side Stand Displayed on Odometer



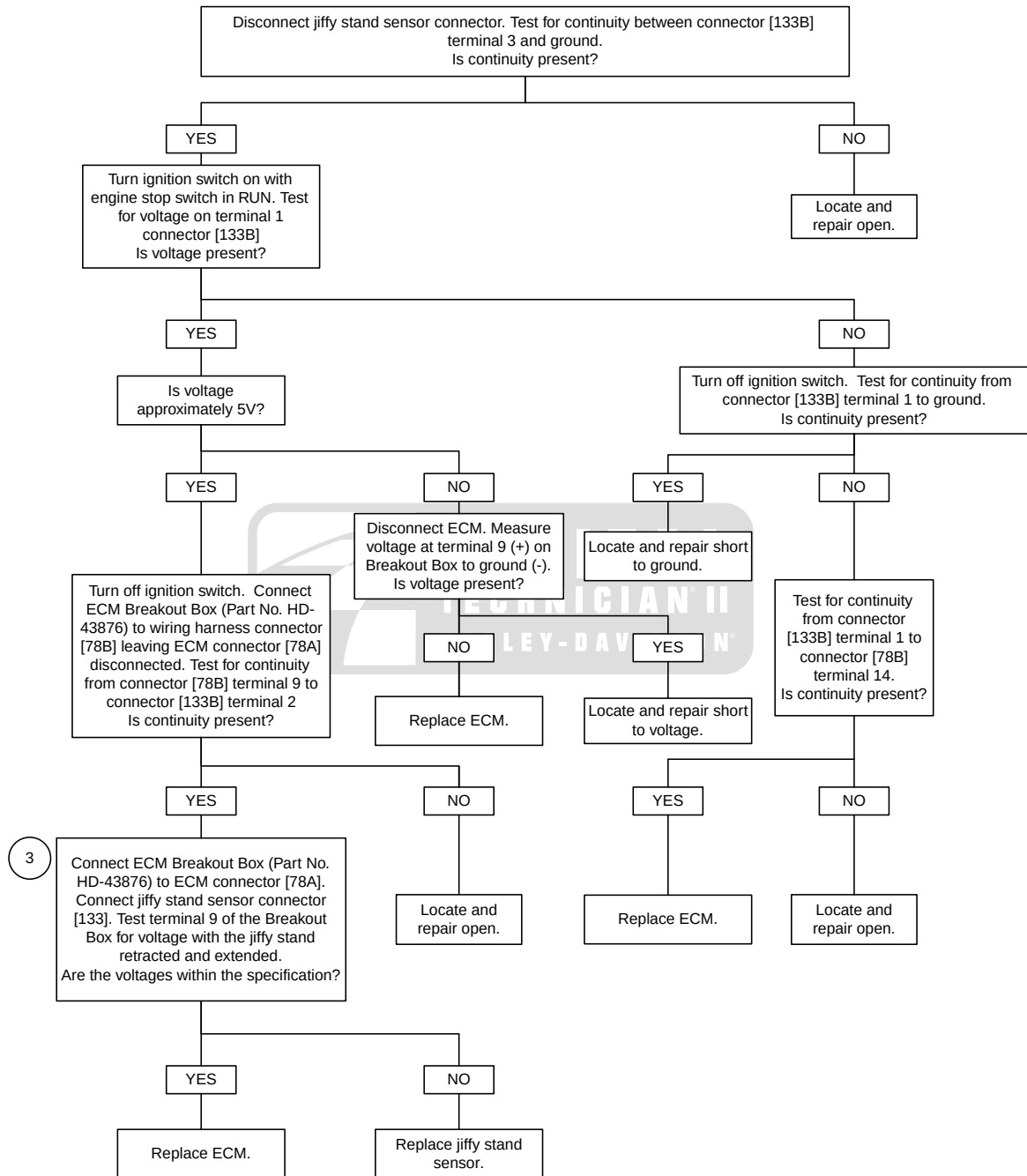
Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

fc01860_en

DTC P1501



DTC P1502



Clear DTCs using odometer self-diagnostics. See 4.6 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

fc01862_en

DTC U1064, U1255

4.29

GENERAL

Loss of TSM/TSSM/HFSM Serial Data

The serial data connector provides a means for the Electronic Control Module (ECM), TSM/TSSM/HFSM and speedometer on XL, and tachometer on XR, to communicate their current status. When all operating parameters on the serial data link are within specifications, a state of health message is sent between the components. A Diagnostic Trouble Code (DTC) U1064 indicates that the TSM/TSSM/HFSM is not receiving this state of health message. A DTC U1255 indicates that no messages were present during power up of the current key cycle. A DTC U1064 indicates that there was communication on the data bus since power up, but communication was lost or interrupted during that key cycle.

Table 4-47. Code Description

DTC	DESCRIPTION
U1064	Loss of TSM/TSSM/HFSM serial data
U1255	Serial data error/missing message

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-42682	BREAKOUT BOX
HD-46601	INSTRUMENT HARNESS ADAPTER

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. Connect BREAKOUT BOX (Part No. HD-42682) as follows:
 - a. Mate black socket housing on Breakout Box with speedometer connector [39A] on XL, and tachometer connector [108A] on XR, using INSTRUMENT HARNESS ADAPTER (Part No. HD-46601).
 - b. Mate black pin housing on Breakout Box with speedometer harness connector [39B] on XL, and tachometer connector [108B] on XR, using INSTRUMENT (Part No. HD-46601).
 - c. Mate gray socket housing on Breakout Box with TSM/TSSM/HFSM connector [30A].
 - d. Mate gray pin housing on Breakout Box with harness connector [30B].



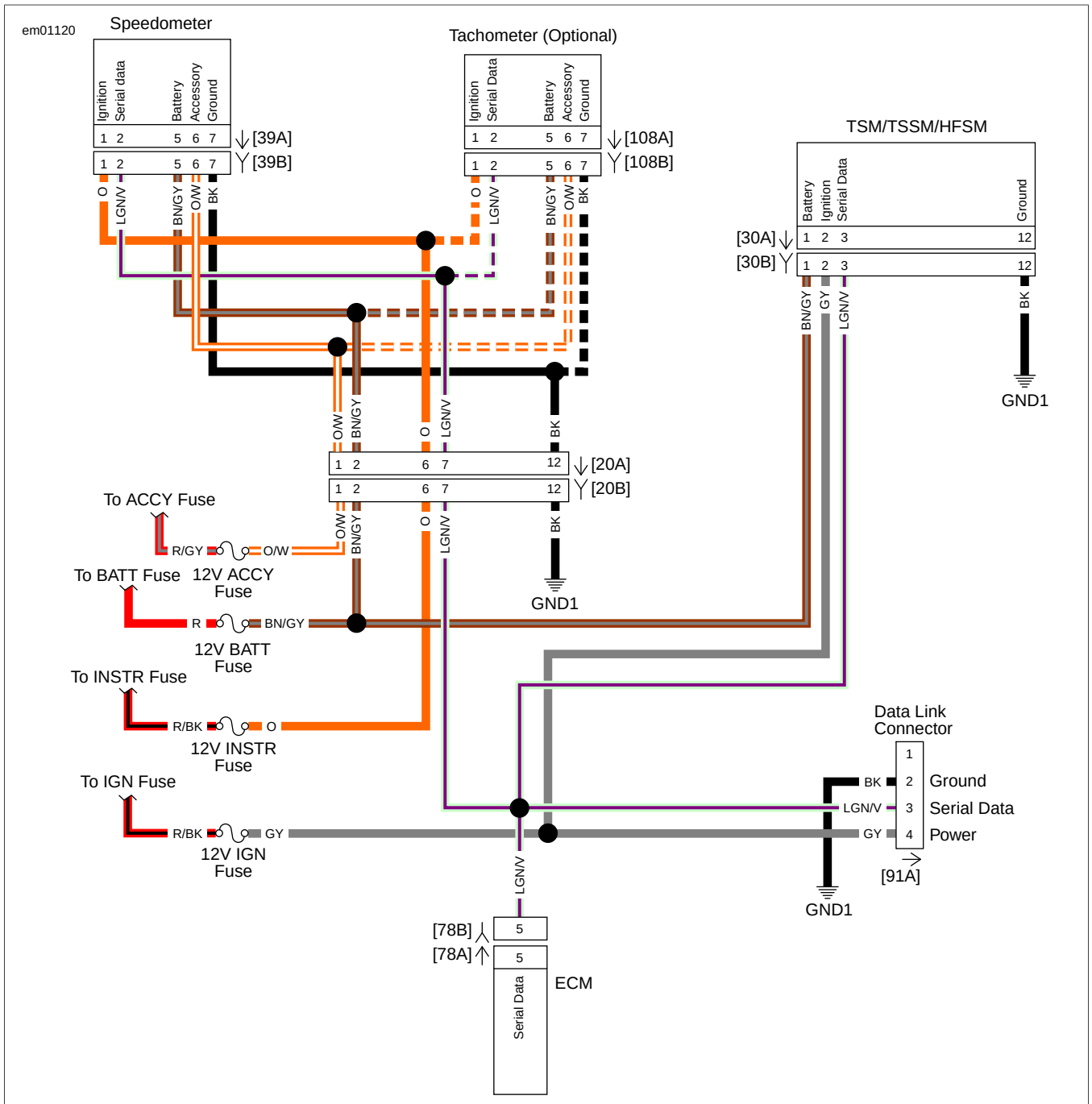


Figure 4-60. Serial Data Circuit (XL)

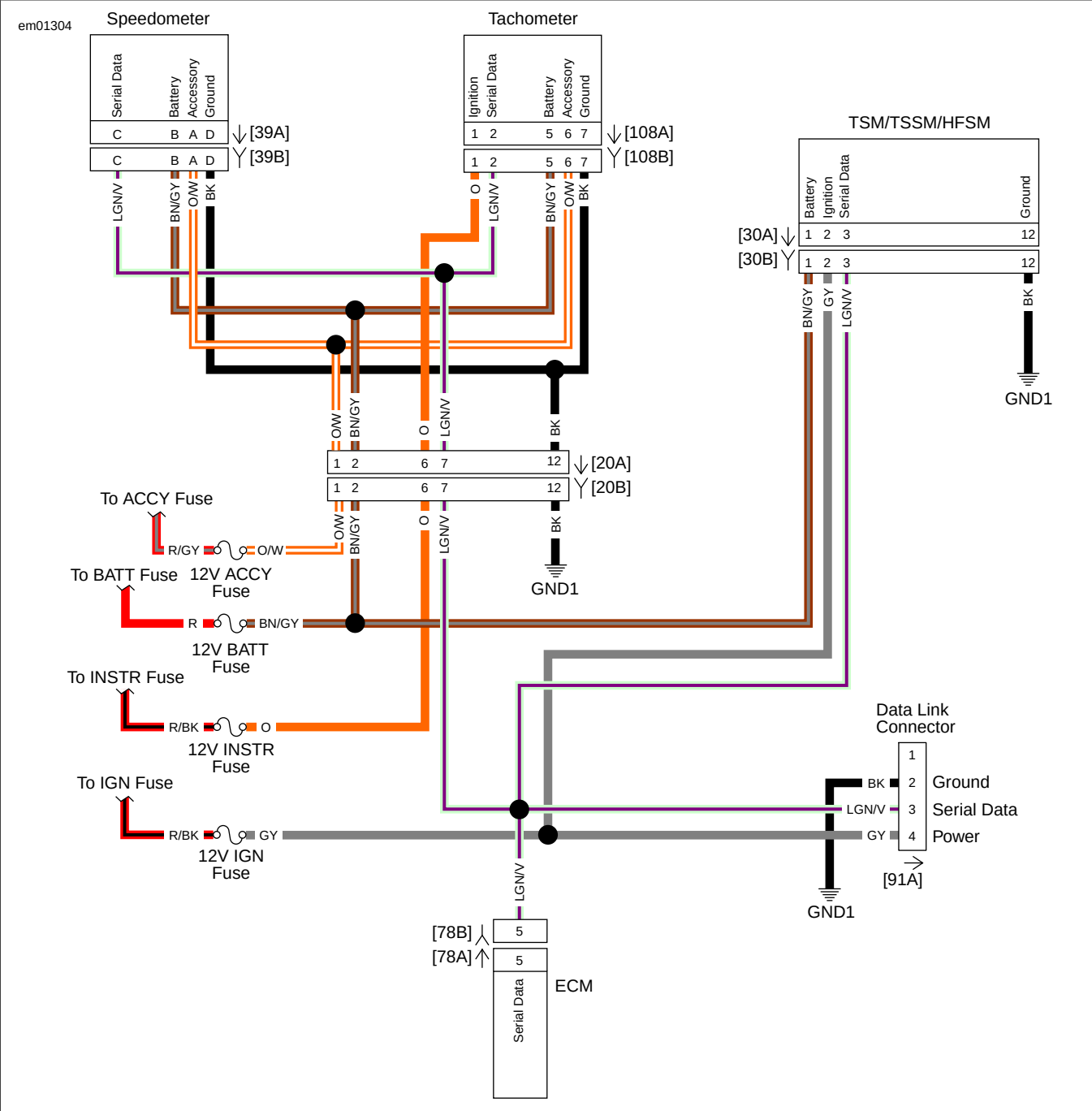


Figure 4-61. Serial Circuit Data (XR)

Table 4-48. Wire Harness Connectors

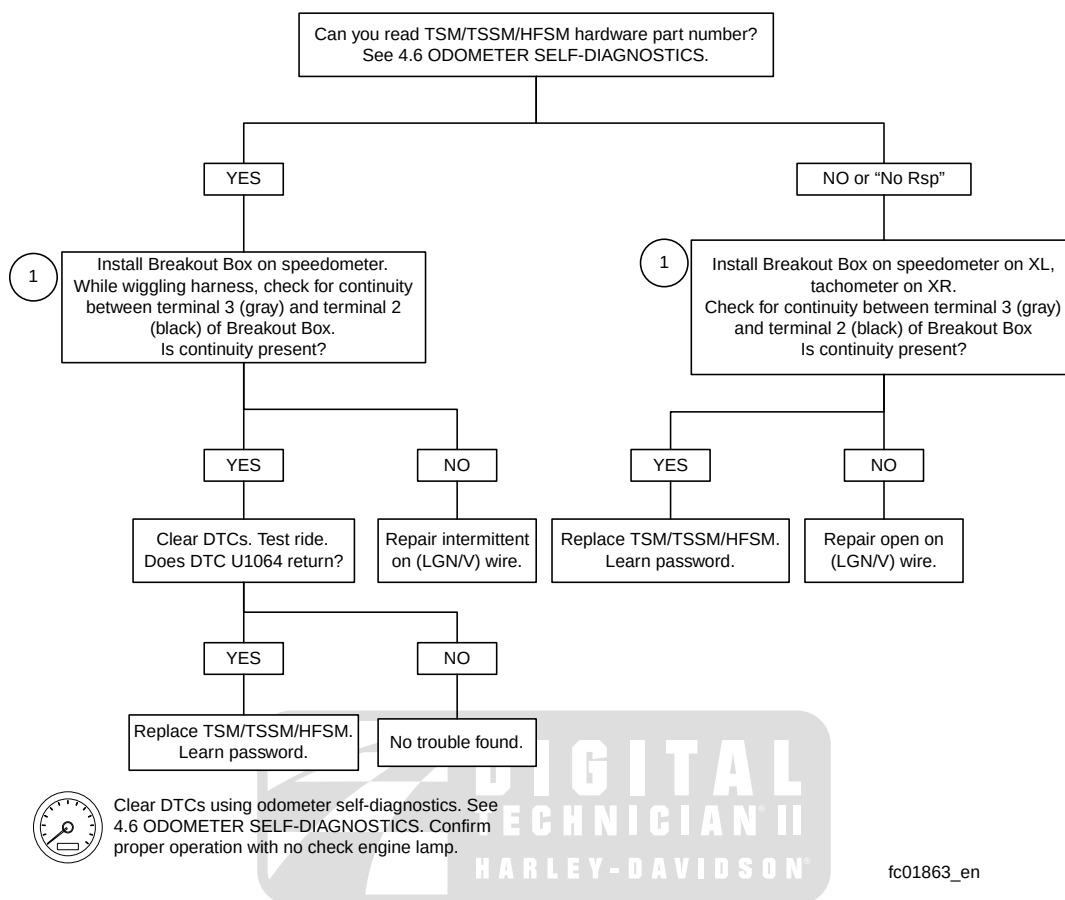
NO.	DESCRIPTION	TYPE	LOCATION
[20]	Instruments	12-place Molex	Under fuel tank
[30]	TSM/TSSM/HFSM	12-place Deutsch	Under battery
[39]	Speedometer (XL)	12-place Packard	Back of speedometer
[39]	Display (XR)	5-place Packard	Back of speedometer
[78]	ECM	36-place Packard	Under seat

Table 4-48. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[91]	Data link connector	4-place Deutsch	Behind left side cover
[108]	Tachometer (if equipped)	12-place Packard	Back of tachometer



DTCs U1064 and U1255



DTC U1097, U1255

4.30

GENERAL

Loss of Speedometer Serial Data

The serial data connector provides a means for the speedometer on XL, and tachometer on XR, Electronic Control Module (ECM) and TSM/TSSM/HFSM to communicate their current status. When all operating parameters on the serial data link are within specifications, a state of health message is sent between the components. A Diagnostic Trouble Code (DTC) U1097 indicates that the speedometer on XL, and tachometer on XR, is not capable of sending this state of health message. A DTC U1255 indicates that no messages were present during power up of the current key cycle. A DTC U1097 indicates that there was communication on the data bus since power up, but communication was lost or interrupted during that key cycle.

Table 4-49. Code Description

DTC	DESCRIPTION
U1097	Loss of all speedometer serial data (state of health)
U1255	Missing message at speedometer

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-42682	BREAKOUT BOX
HD-43876	BREAKOUT BOX
HD-46601	INSTRUMENT HARNESS ADAPTER

NOTE

If DTC is historic and not current, wiggle wire harness while performing voltage and continuity tests to identify intermittents.

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. Connect BREAKOUT BOX (Part No. HD-43876) to wire harness connector [78B]. Leave ECM [78A] disconnected. See [4.7 BREAKOUT BOX: EFI](#).
2. Connect BREAKOUT BOX (Part No. HD-42682) (black) to wire harness connector [39B] on XL, and connector [108B] on XR, using INSTRUMENT (Part No. HD-46601). Leave speedometer [39A] on XL, and connector [108A] on XR, disconnected. See [2.5 BREAKOUT BOX: SPEEDOMETER/TACHOMETER](#).



Figure 4-62. Speedometer Connector [39] on XL, and tachometer connector [108A] on XR (Typical)

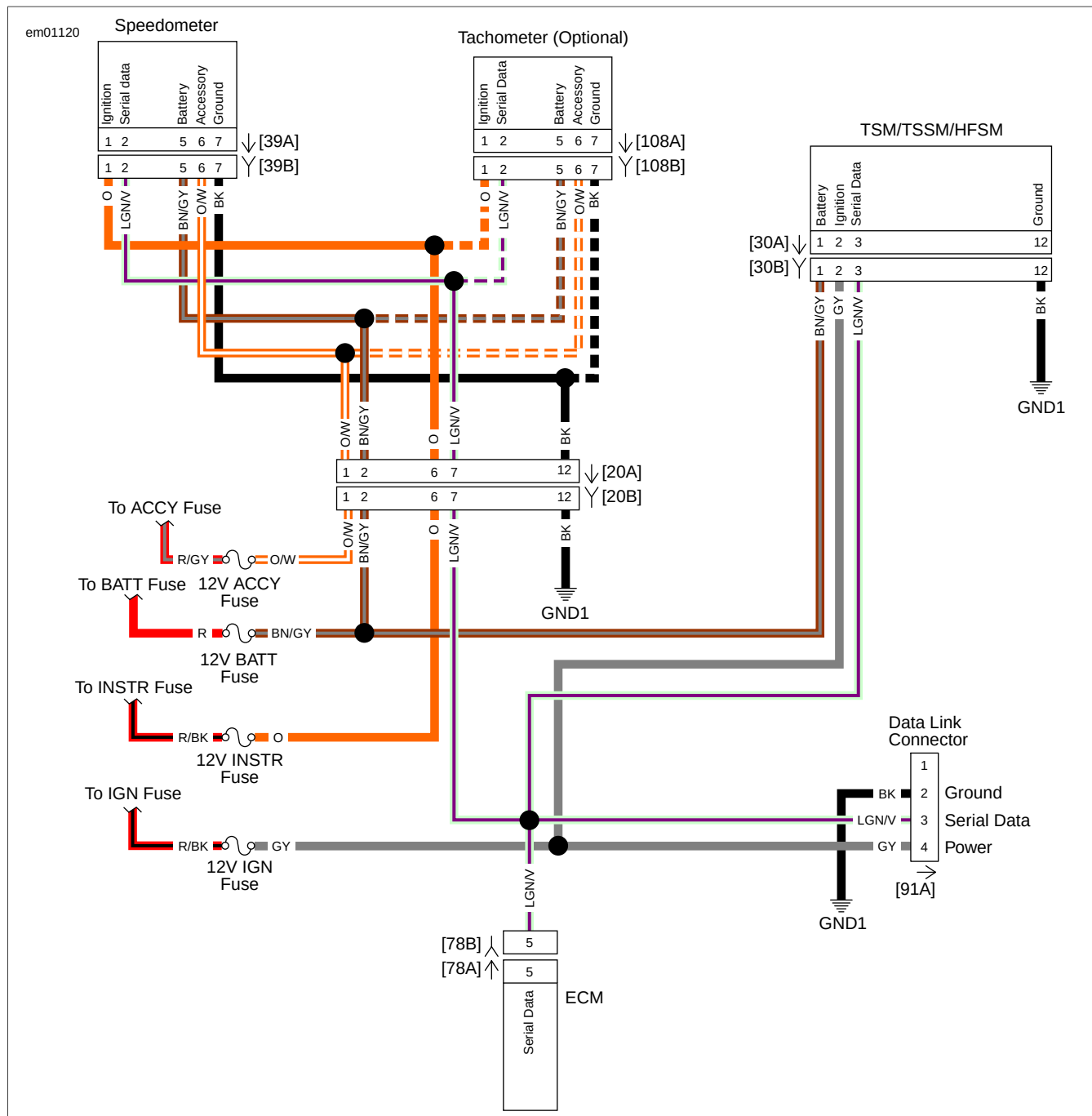


Figure 4-63. Serial Data Circuit (XL)

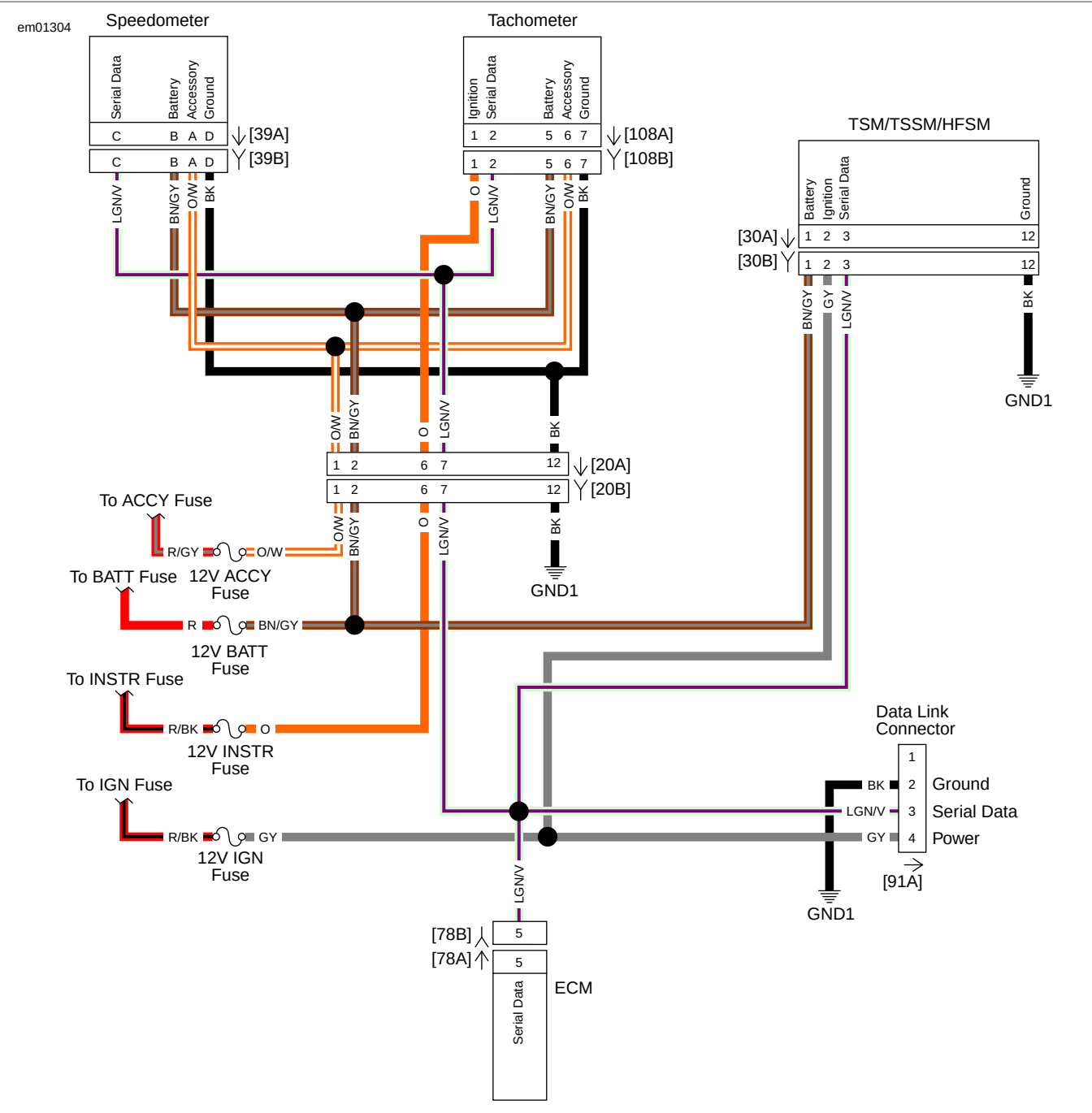


Figure 4-64. Serial Data Circuit (XR)

Table 4-50. Wire Harness Connectors

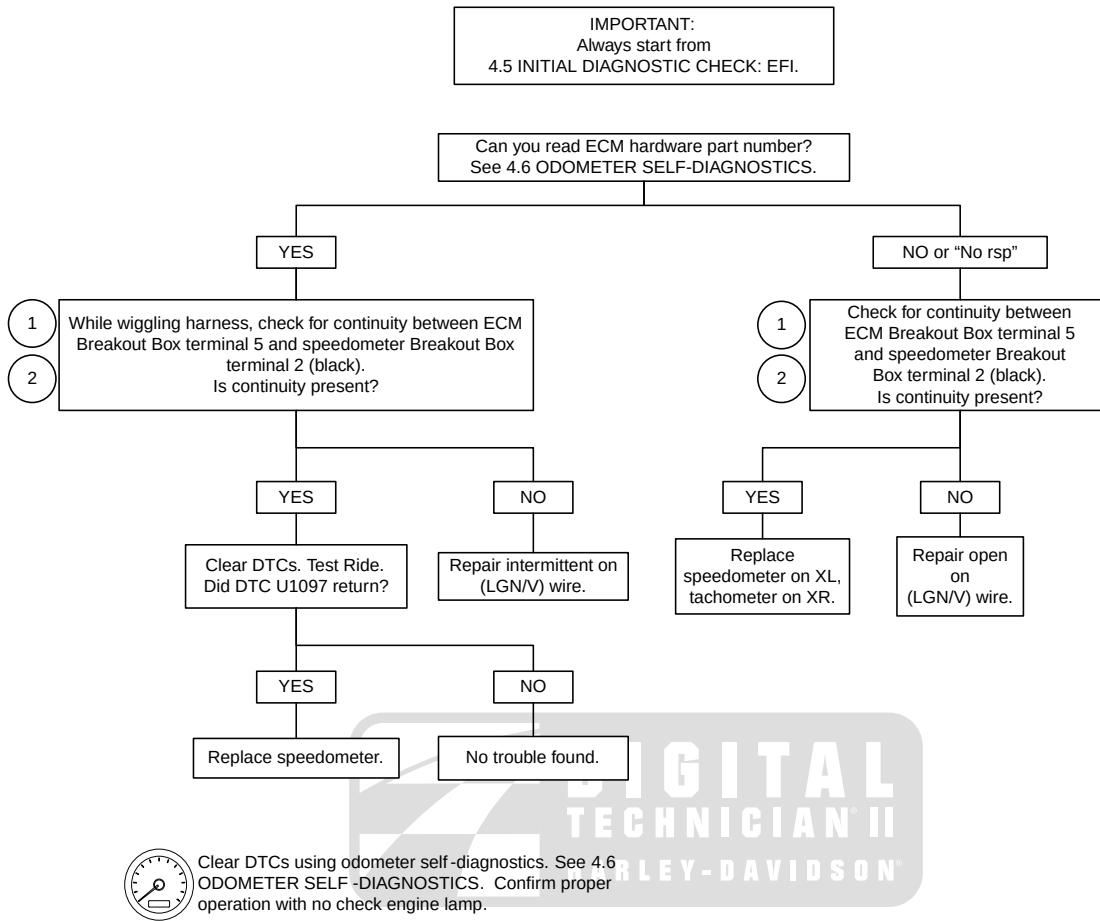
NO.	DESCRIPTION	TYPE	LOCATION
[20]	Instruments	12-place Molex	Under fuel tank
[30]	TSM/TSSM/HFSM	12-place Deutsch	Under battery
[39]	Speedometer (XL)	12-place Packard	Back of speedometer
[39]	Display (XR)	5-place Packard	Back of speedometer
[78]	ECM	36-place Packard	Under seat

Table 4-50. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[91]	Data link connector	4-place Deutsch	Behind left side cover
[108]	Tachometer (if equipped)	12-place Packard	Back of tachometer



DTCs U1097 and U1255



fc01864_en

FUEL PRESSURE TEST

4.31

GENERAL

The fuel pump delivers fuel through the fuel line, to a cavity in the induction module. This cavity directs the fuel to the fuel injectors and pressure regulator. The pressure regulator controls the fuel pressure by passing excess fuel back to the fuel tank. Improper fuel pressure may contribute to one of the following symptoms:

- cranks, but won't run
- cut out (may feel like ignition problem)
- hesitation, loss of power, or poor fuel economy

If incorrect fuel pressure is suspected, perform a fuel pressure test. See the service manual for the required tools and procedure for performing a fuel pressure test.

DIAGNOSTICS

Perform a fuel pressure test. See the service manual. The fuel pressure should remain steady between 55-62 PSI (380-425 KPa). If pressure does not hold steady, follow either the low fuel pressure or high fuel pressure procedure, depending on the symptom.

Low Fuel Pressure

1. Check the fuel filter or pump inlet screen for restrictions. If the concern is found, clean the pump inlet screen or replace the fuel filter.
2. If the concern was not corrected, inspect for a:
 - restricted pressure line or flex hose between the fuel tank and the test gauge.
 - faulty fuel pump.
 - restricted check valve fitting assembly.
 - leak inside the tank caused by faulty coupling hose or connection, such as a hose at the filter or pump. This condition can be identified, if the fuel level in the tank is low, by a ringing sound inside the tank during the first 2 seconds after key on. This is caused by the high pressure fuel spraying against the inside of the tank.
 - faulty fuel pressure regulator.

Once the concern is located, repair as needed.

High Fuel Pressure

1. Inspect the check valve fitting assembly and the fuel tank. If the concern is found correct as needed.
2. If the concern was not corrected, replace the fuel regulator.



TABLE OF CONTENTS

SUBJECT	PAGE NO.
A.1 AMP MULTILOCK CONNECTORS.....	A-1
A.2 DELPHI CONNECTORS.....	A-6
A.3 DEUTSCH 1-PLACE ELECTRICAL CONNECTORS.....	A-8
A.4 DEUSCH ELECTRICAL CONNECTORS.....	A-9
A.5 DEUTSCH STANDARD TERMINALS.....	A-13
A.6 DEUTSCH MINI-TERMINAL CRIMPS.....	A-14
A.7 DEUTSCH SOLID BARREL TERMINALS.....	A-15
A.8 RELAY AND FUSE BLOCKS.....	A-17
A.9 150 METRI-PACK CONNECTORS.....	A-18
A.10 280 METRI-PACK CONNECTORS.....	A-20
A.11 480 METRI-PACK CONNECTORS.....	A-22
A.12 630 METRI-PACK CONNECTORS.....	A-23
A.13 800 METRI-PACK CONNECTORS.....	A-24
A.14 METRI-PACK TERMINALS.....	A-26
A.15 MOLEX CONNECTORS.....	A-28
A.16 PACKARD ECM CONNECTOR.....	A-30
A.17 PACKARD MICRO-64 CONNECTORS.....	A-32
A.18 SEALED SPLICE CONNECTORS.....	A-35



NOTES



AMP MULTILOCK CONNECTOR REPAIR

PART NUMBER	TOOL NAME
HD-41609	AMP MULTILOCK CRIMPER

General

AMP Multilock connectors are found between wire harnesses and component wiring and may be either floating or anchored to the frame with attachment clips.

See [Figure A-1](#). Attachment clips (1) on the pin housings are fitted to T-studs on the motorcycle frame. The T-studs identify OE connector locations. To maintain serviceability, always return connectors to OE locations after service.

Obtain the necessary tools to repair the connector and terminals.

NOTE

For terminal crimping use the AMP MULTILOCK CRIMPER (Part No. HD-41609).

Separating Pin and Socket Housings

1. If necessary, slide connector attachment clip T-stud to the large end of the opening.
2. See [Figure A-1](#). Depress the release button (2) on the socket terminal side of the connector and pull the socket housing (3) out of the pin housing (4).

Mating Pin and Socket Housings

1. Hold the housings to match wire color to wire color.
2. Insert the socket housing into the pin housing until it snaps in place.
3. If OE location is a T-stud, fit large opening end of attachment clip over T-stud and slide connector to engage T-stud to small end of opening.

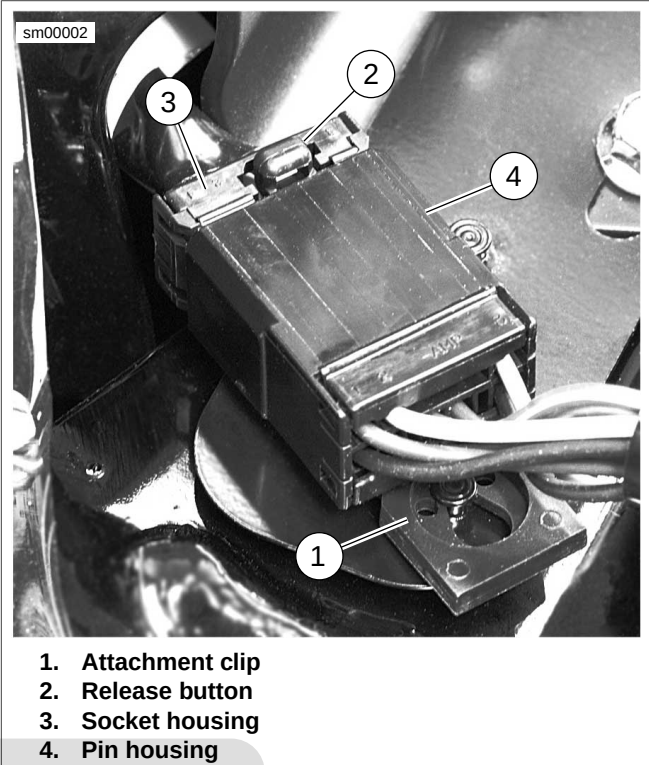


Figure A-1. AMP Multilock Connector

Removing Terminals from Housing

1. See [Figure A-2](#). Bend back the latch (1) to free one end of secondary lock (2) then repeat on the opposite end. Hinge the secondary lock outward.
2. Look in the terminal side of the connector (opposite the secondary lock) and note the cavity next to each terminal.
3. Insert a pick or pin into the terminal cavity until it stops.

NOTE

If socket/pin terminal tool is not available, a push pin/safety pin or a Snap-on pick (Part No. TT600-3) may be used.

4. Press the tang in the housing to release the terminal.
 - a. **Socket:** Lift the socket tang (8) up.
 - b. **Pin:** Press the pin tang (7) down.

NOTE

A "click" is heard if the tang is released.

5. Gently tug on wire to pull wire and terminal from cavity.

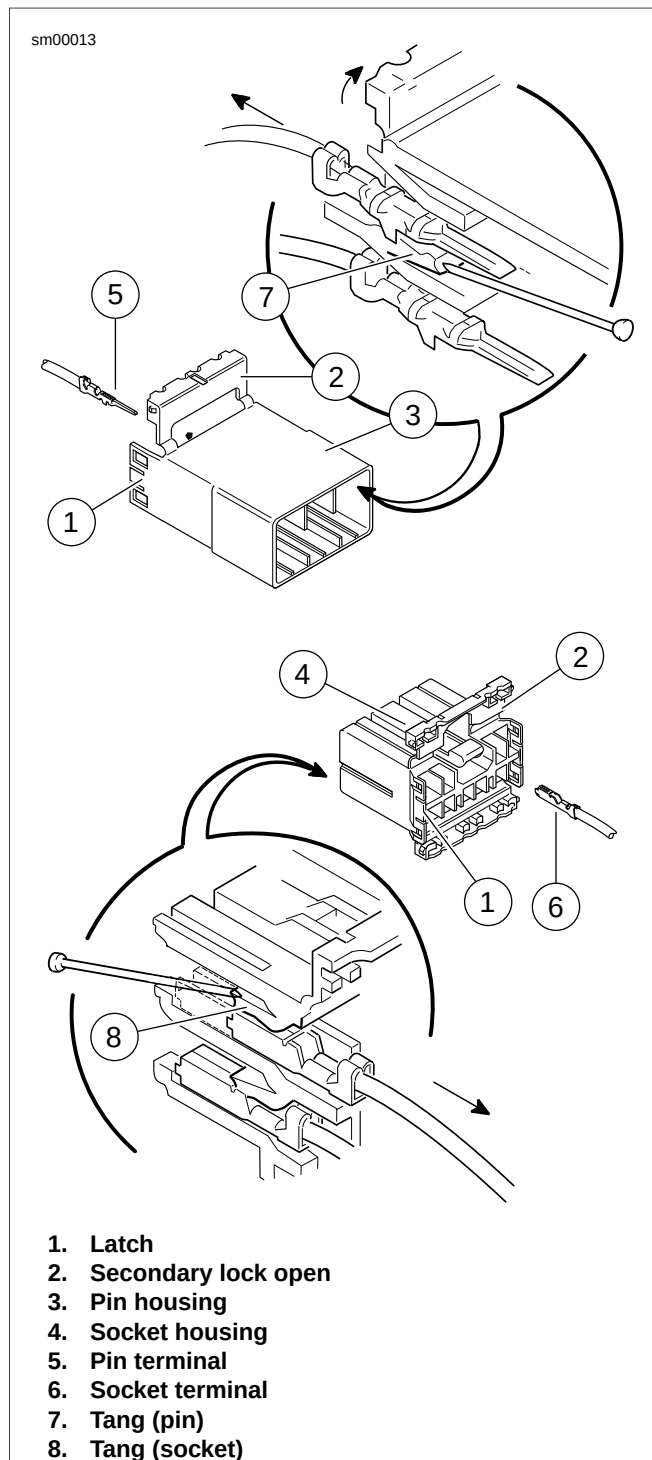


Figure A-2. AMP Multilock Connector: Socket and Pin Housings

Inserting Terminals into Housing

NOTE

See [Figure A-3](#). Cavity numbers are stamped into the secondary locks of both the socket and pin housings. Match the wire color to the cavity number found on the wiring diagram.

1. Hold the terminal so the catch faces the tang in the chamber. Insert the terminal into its numbered cavity until it snaps in place.

NOTES

- Up and down can be determined by the position of the release button, the button is the top of the connector.
 - On the pin side of the connector, tangs are positioned at the bottom of each cavity, so the slot in the pin terminal (on the side opposite the crimp tails) must face downward.
 - On the socket side, tangs are at the top of each cavity, so the socket terminal slot (on the same side as the crimp tails) must face upward.
2. Gently tug on wire end to verify that the terminal is locked in place.
 3. Rotate the hinged secondary lock inward until tabs fully engage latches on both sides of connector.

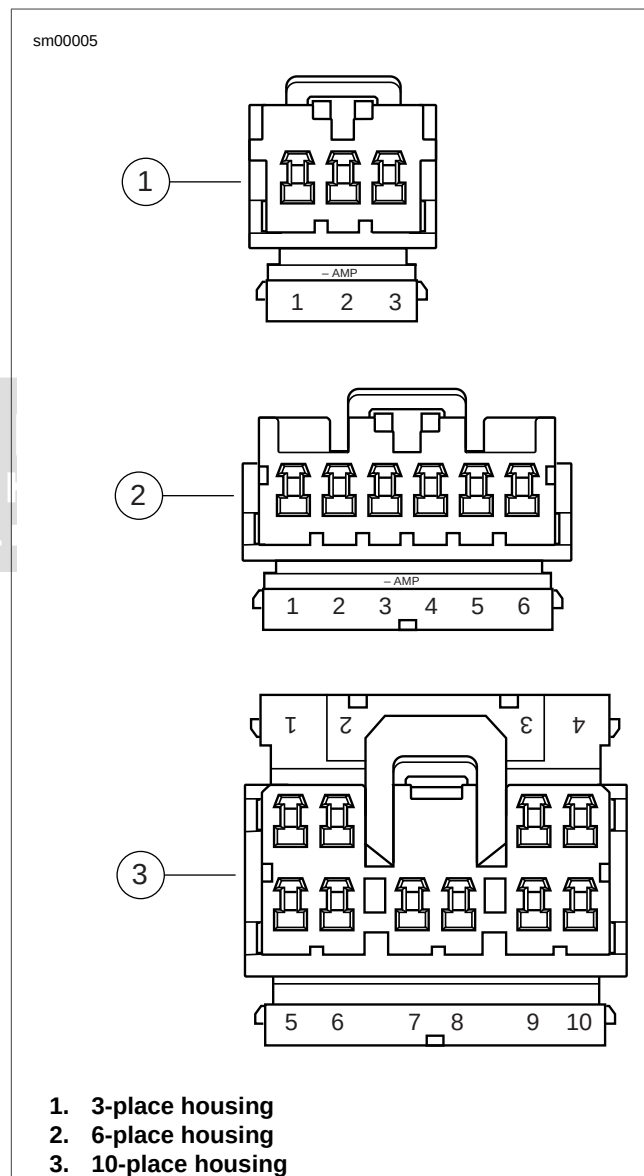


Figure A-3. AMP Multilock Connector: Cavity Numbers on Secondary Locks (Socket Housings Shown)

Preparing Wire Leads for Crimping

1. Strip 5/32 in. (4.0 mm) of insulation from the wire lead.

2. See [Figure A-2](#) and [Figure A-5](#). Select the pin/socket terminals from the parts catalog and identify the insulation crimp tails (1) and the wire crimp tails (2) and the groove for the crimp tool locking bar (3).
3. Identify the wire lead gauge and the corresponding crimper tool and nesting die. Refer to [Table A-1](#).

Table A-1. AMP Multilock Connector: Crimp Tool Wire Gauge/Nest

WIRE GAUGE	NEST
20	Front
16	Middle
18	Rear

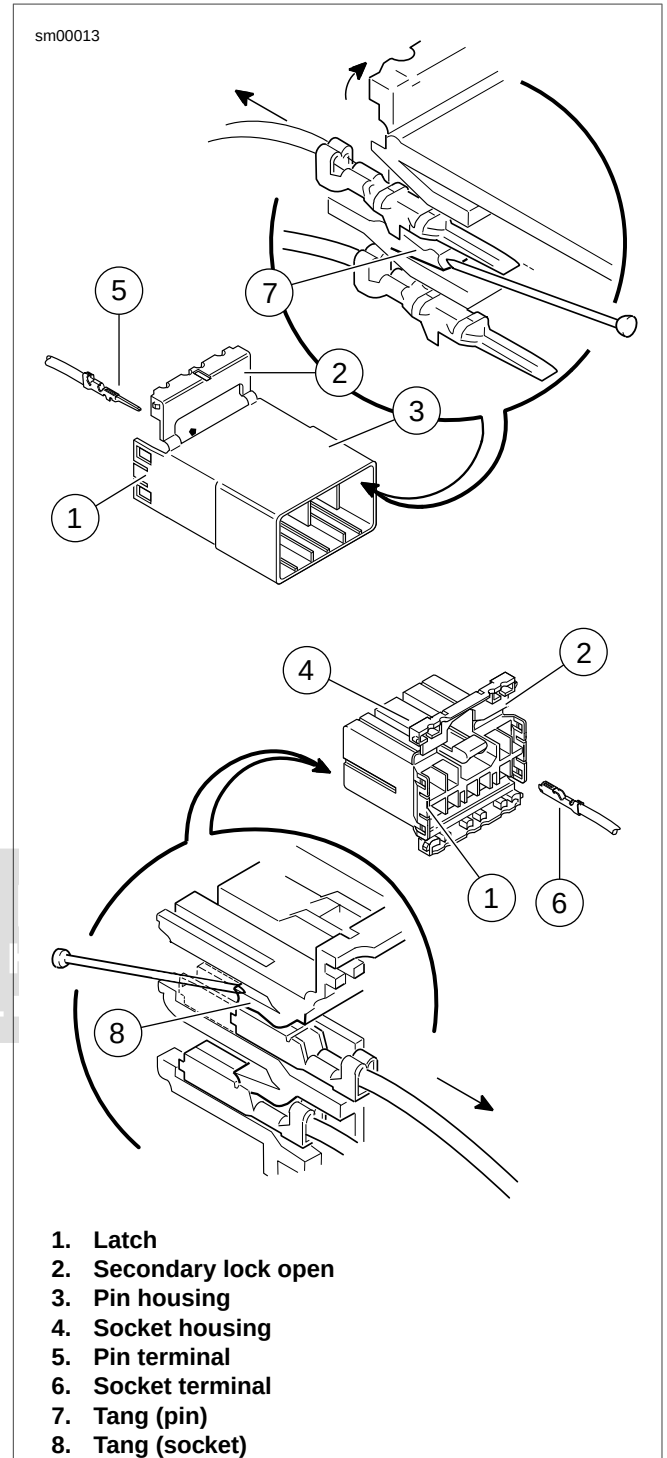


Figure A-4. AMP Multilock Connector: Socket and Pin Housings

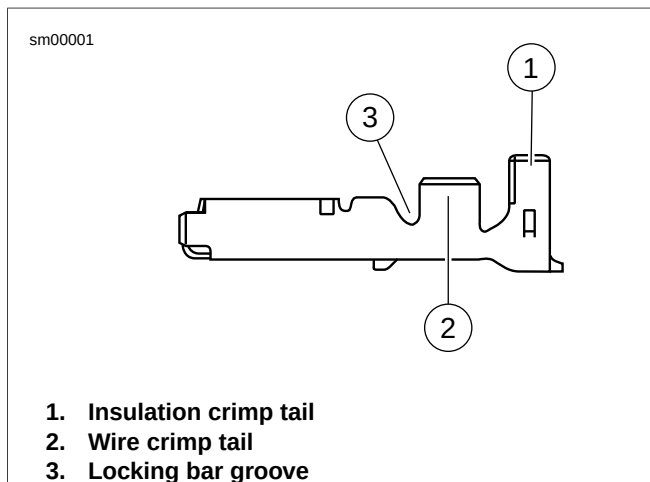


Figure A-5. AMP Multilock Connector: Socket Terminal

Crimping Terminals to Leads

NOTE

Crimping with an Amp Multilock tool is a one step operation. One squeeze crimps both the wire core and the insulation tails.

1. See [Figure A-6](#). Squeeze the handles to cycle the AMP MULTILOCK CRIMPER (Part No. HD-41609) to the fully open position (1).
2. Raise locking bar by pushing up on bottom flange (2).

NOTE

See [Figure A-2](#) and [Figure A-5](#). Hold the terminal with the insulation crimp tail (1) facing up. The tool will hold the terminal by the locking bar groove (3) and crimp the wire crimp tail (2) around the bare wire of the stripped lead and the insulation crimp tail around the insulation.

3. See [Figure A-6](#). With the insulation crimp tail facing upward, insert terminal (pin or socket) (3) through the locking bar, so that the closed side of the terminal rests on the nest of the crimp tool.
4. Release locking bar to lock position of contact (4). When correctly positioned, the locking bar fits snugly in the space at the front of the core crimp tails.
5. Insert stripped end of lead (5) until ends make contact with locking bar.
6. Verify that wire is positioned so that wire crimp tails squeeze bare wire strands, while insulation crimp tails fold over the wire lead insulation.
7. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
8. Raise up locking bar (7) and remove crimped terminal.

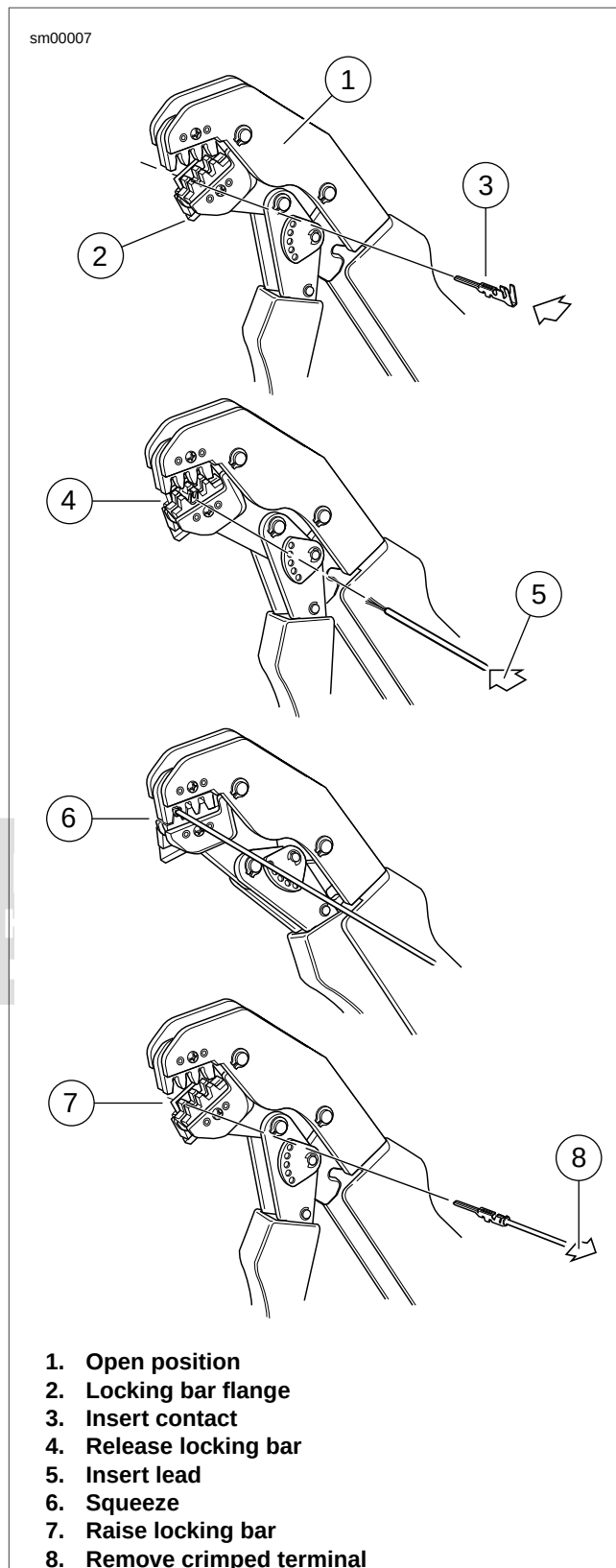


Figure A-6. AMP Multilock Connector: Terminal Crimping Procedure

Inspecting Crimped Terminals

See [Figure A-7](#). Inspect the wire core crimp (2) and insulation crimp (1). Distortion should be minimal.

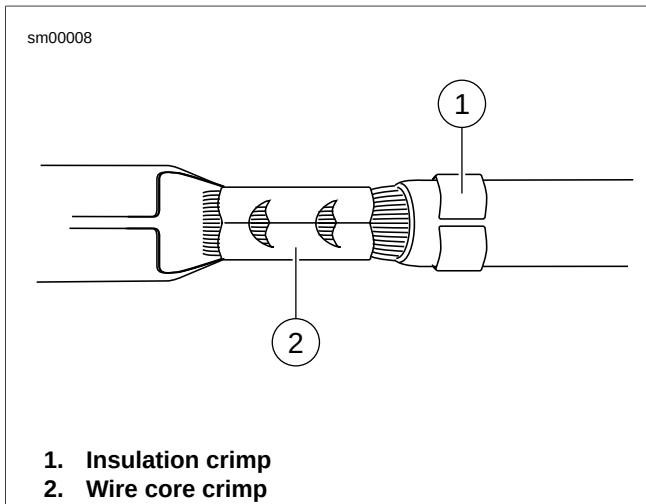


Figure A-7. AMP Multilock Connector: Terminal Crimp



DELPHI CONNECTORS

A.2

DELPHI CONNECTOR REPAIR

General

Delphi connectors are embossed with the brand name, Delphi, on the housing latch.

Separating Pin and Socket Housings

See [Figure A-8](#). Bend back the external latch(es) slightly and separate pin and socket halves of connector.

Mating Pin and Socket Housings

Push pin and socket halves of connector together until external latch(es) engage.

Removing Socket Terminals

NOTE

Although the parts of the different Delphi connectors vary in appearance, the instructions which follow will work for all. The only exception is the oil pressure sender connector [139B], the terminals of which are removed like the Packard push-to-seat connectors. Therefore, see [A.9 150 METRI-PACK CONNECTORS](#) to remove/install terminals in this connector.

1. See [Figure A-9](#). If present, free one side of wire lock (1) from ear on wire end of socket housing, then release the other side. Release wires from channels in wire lock and remove from socket housing.
2. Use a fingernail to pry colored terminal lock (2) loose and then remove from mating end of socket housing.
3. Using a thin flat blade, like the unsharpened edge of a hobby knife, gently pry tang (3) outward away from terminal, and then tug on wire to back terminal out wire end of chamber. Do not pull on wire until tang is released or terminal will be difficult to remove.

Installing Socket Terminals

NOTE

For wire location purposes, alpha or numeric characters are stamped into the wire end of each socket housing.

1. Gently push tang on socket housing inward toward chamber. With the open side of the terminal facing the tang, push terminal into chamber at wire end of socket housing.
2. Gently tug on wire to verify that terminal is locked and will not back out of chamber. If necessary, use fingernail to push tang into engagement with terminal.
3. Install colored terminal lock onto mating end of socket housing.
4. If present, seat wires in separate channels of wire lock and then push channels **inside** chambers at wire end of socket housing. Fully installed, slot on each side of wire lock engages ear on socket housing.



Figure A-8. Delphi Connector: Socket Housing Latch

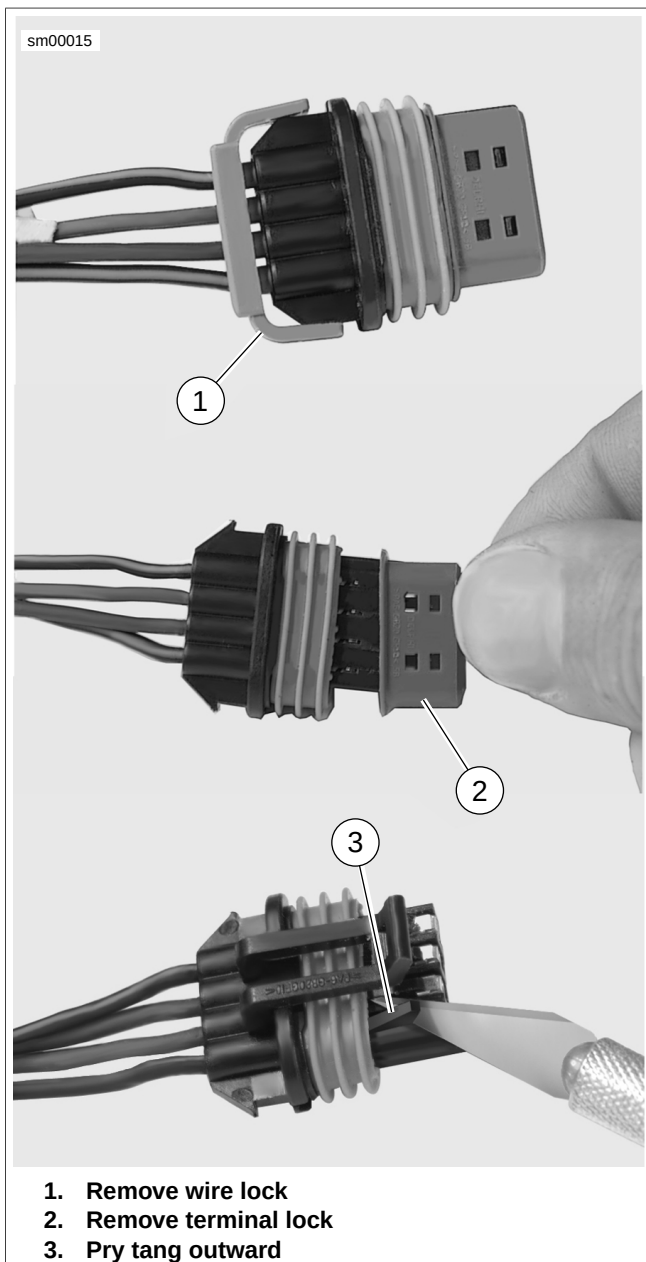


Figure A-9. Delphi Connector: Removing Socket Terminals

DEUTSCH 1-PLACE CONNECTOR REPAIR**Separating Pin and Socket Housings**

Depress external latch and separate the pin and socket housings of the Deutsch one place connector found on voltage regulators.

Mating Pin and Socket Housings

Orient the housings so the latch faces the catch and push the housings together until it clicks.

Removing Socket Terminals**NOTE**

Rough handling or careless storage can result in tool damage. Exercise care to avoid cracking or breaking the thin plastic construction.

1. Pull rear wire seal from back of housing and slide down voltage regulator cable to move out of the way.
2. See [Figure A-10](#). Using terminal pick tool (Deutsch® 114008) (1), install tool onto voltage regulator cable so that the tapered end is in the wire end of the housing (2).
3. Push tool into wire end of housing until it bottoms. Gently tug on housing to pull from terminal (3).
4. Remove tool from voltage regulator cable.

Installing Socket Terminals

1. Insert terminal into wire end of housing until it "clicks" in place. Verify that terminal will not back out of housing. A slight tug on the voltage regulator cable will confirm that it is properly locked in place.
2. Fit rear wire seal into back of housing.

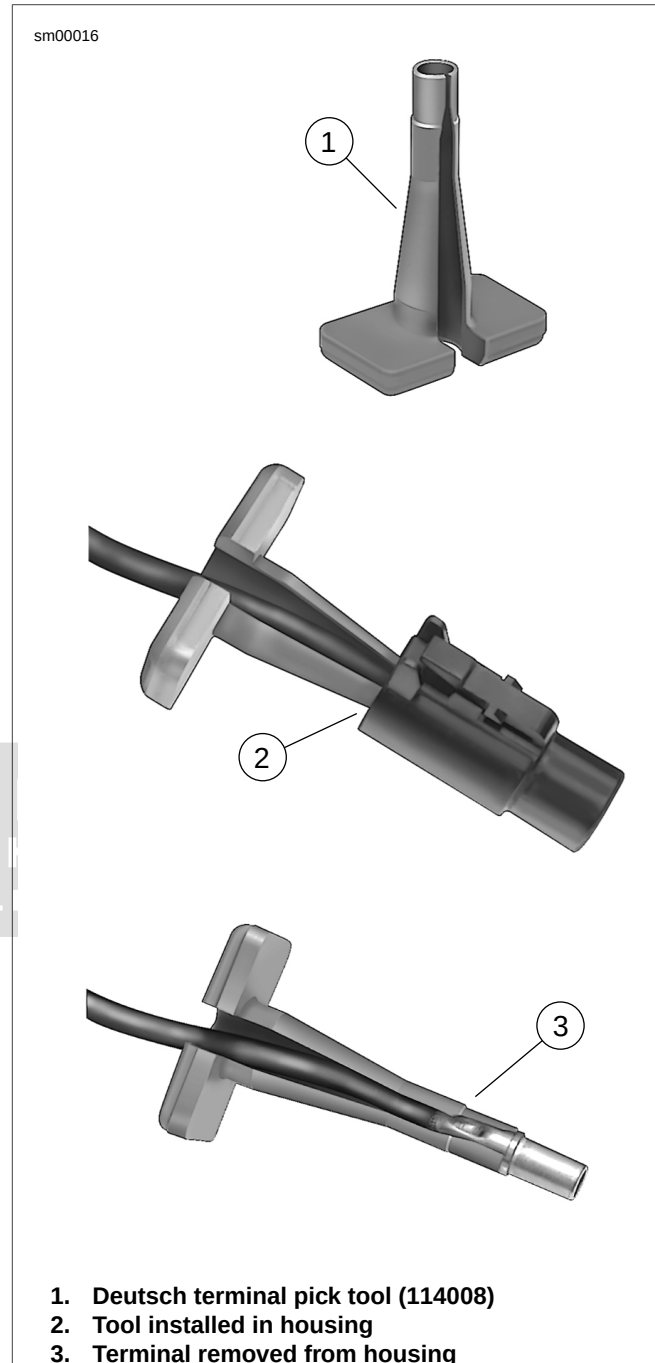


Figure A-10. Deutsch 1-Place Connector: Remove Socket/Pin Housing

DEUSCH ELECTRICAL CONNECTORS

A.4

DEUTSCH CONNECTOR REPAIR

PART NUMBER	TOOL NAME
HD-41475	DEUTSCH CONNECTOR SERVICE KIT
HD-41475-100	FLAT BLADE L-HOOK

General

Deutsch connectors are colored coded for location purposes. Those connectors associated with **left** side accessories, such as the front and rear **left** turn signals, are **gray**. All other connectors, including those associated with right side accessories, are **black**.

NOTE

A **DEUTSCH CONNECTOR SERVICE KIT** (Part No. HD-41475) contains a selection of wire seals, internal seals, seal plugs, secondary locking wedges, attachment clips and socket/pin terminals. Also included is a compartmented storage box, carrying case and a **FLAT BLADE L-HOOK** (Part No. HD-41475-100) is used for the removal of all types of locking wedges.

Separating Pin and Socket Housings

See [Figure A-10](#). To separate the connector halves, depress the external latch(es) (1) on the socket housing (2) while rocking the pin (3) and socket housings.

NOTES

- Generally, the socket housing is found on the accessory side, while the pin housing is plumbed to the wiring harness.
- Two-, three-, four- and six-place Deutsch connectors have one latch on the connector.
- Eight- and twelve-place connectors have a latch on each side. Simultaneously press both latches to separate the connector.

Mating Pin and Socket Housings

- Align the connectors to match the wire lead colors.
 - For One External Latch:** Two-, three-, four- and six-place Deutsch connectors have one external latch on the socket half of the connector. To fit the halves of the connector together, the latch on the socket side must be aligned with the latch cover on the pin side.
 - For Two External Latches:** (8-place and 12-place) Align the tabs on the socket housing with the grooves on the pin housing.
- Insert socket housing into pin housing until it snaps or clicks into place.

For Two External Latches: (8-place and 12-place) 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.
- If necessary, fit the attachment clip to the pin housing.

- Place large end of slot on attachment clip over T-stud on frame. Push assembly forward to engage small end of slot.



Figure A-11. Deutsch Connector

Removing Socket Terminals

- See [Figure A-12](#). Insert a small screwdriver between the socket housing and locking wedge in-line with the groove (in-line with the pin holes if the groove is absent). Turn the screwdriver 90 degrees to pop the wedge up and remove the secondary locking wedge.
- See [Figure A-15](#). Use a pick or small screwdriver to depress terminal latches inside socket housing and back out sockets through holes in rear wire seal.

NOTE

If wire leads require **new** terminals, see the instructions for crimping terminals.

Installing Socket Terminals

- Match wire lead color to connector cavity.
- See [Figure A-14](#). Fit rear wire seal (1) into back of socket housing (2), if removed.
- Grasp wire lead (3) approximately 1.0 in. (25.4 mm) behind the socket terminal. Gently push socket through hole in wire seal into its chambers until it "clicks" in place.
- A tug on the wire will confirm that it is properly locked in place.

NOTE

Seal plugs (6) are installed through the wire seals of unused chambers. If removed, seal plugs must be replaced to seal the connector.

5. Install internal seal (4) on lip of socket housing, if removed.
6. Insert tapered end of secondary locking wedge (5) into socket housing and press down until it snaps in place. The wedge fits into the center groove within the socket housing and holds the terminal latches tightly closed.

NOTES

- See [Figure A-13](#). While rectangular wedges do not require a special orientation, the conical secondary locking wedge of the 3-place connector must be installed with the arrow (1) pointing toward the external latch.
- If the secondary locking wedge does not slide into the installed position easily, verify that all terminals are fully installed in the socket housing. The lock indicates when terminals are not properly installed by not entering its fully installed position.

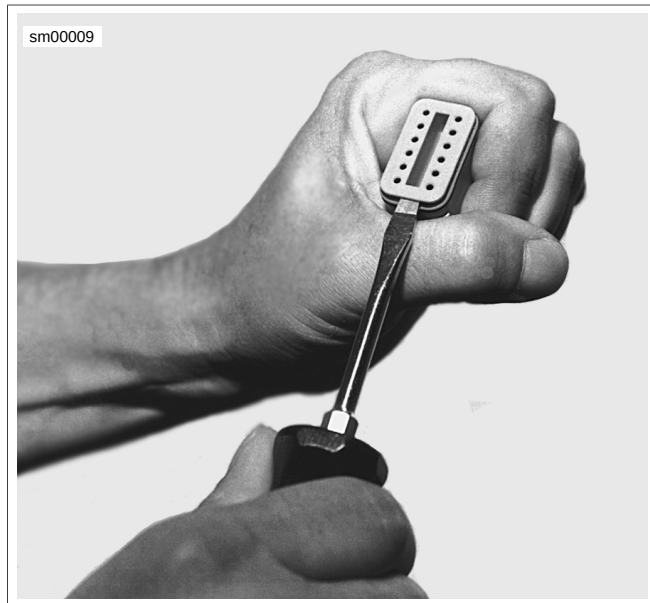


Figure A-12. Deutsch Connector: Remove Secondary Locking Wedge

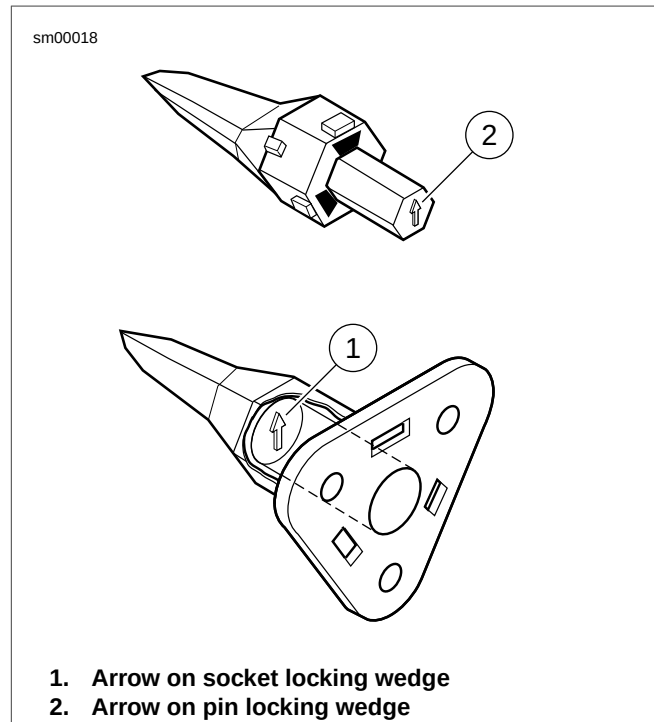


Figure A-13. Deutsch Connector: 3-Place Locking Wedges

DIGITAL
TECHNICIAN II
HARLEY-DAVIDSON®

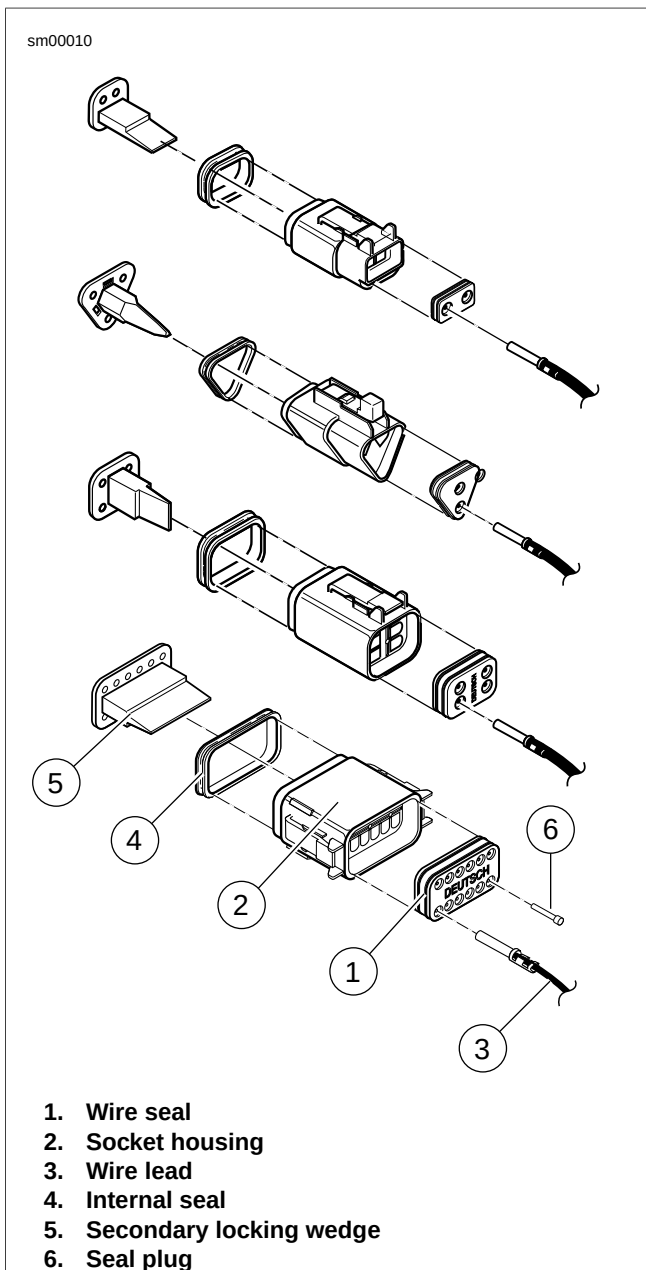


Figure A-14. Deutsch Connector: 2, 3, 4 and 12-Place Socket Housings

Removing Pin Terminals

1. Use the hooked end of a stiff piece of mechanics wire, a needle nose pliers or the FLAT BLADE L-HOOK (Part No. HD-41475-100) to remove the secondary locking wedge.
2. Gently depress terminal latches inside pin housing and back out pins through holes in wire seal.

NOTES

- If wire leads require **new** terminals, see the instructions for crimping terminals.
- If it should become necessary to replace a pin or socket housing, please note that the 8-place and 12-place gray and black connectors are not interchangeable. Since loc-

ation of the alignment tabs differ between the black and gray connectors, plugs or receptacles must be replaced by those of the same color.

- When replacing both socket and pin housings, then the black may be substituted for the gray, and vice versa. The socket and pin housings of all other connectors are interchangeable, that is, the black may be mated with the gray, since the alignment tabs are absent and the orientation of the external latch is the same.

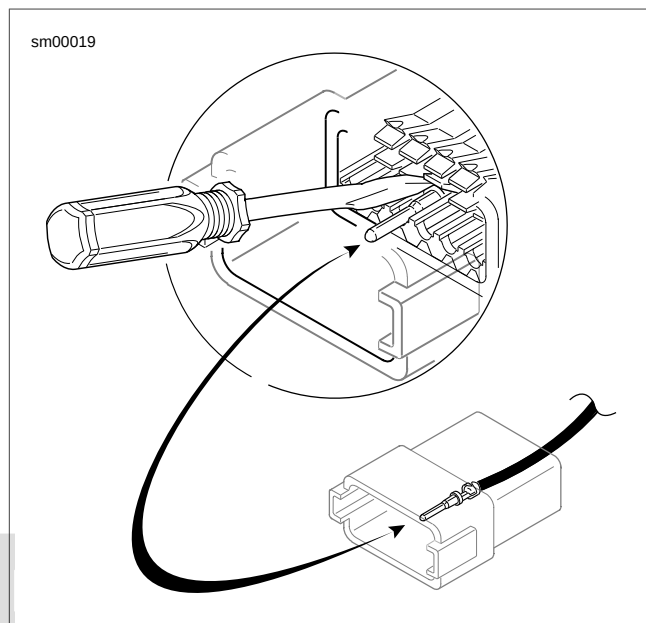


Figure A-15. Deutsch Connector: Depress Terminal Latch and Back Out Pin

Installing Pin Terminals

1. See [Figure A-16](#). Fit wire seal (1) into back of pin housing (2).
2. Grasp wire lead approximately 1.0 in. (25.4 mm) behind the pin terminal (3). Gently push pin through holes in wire seal into its respective numbered chamber until it "clicks" in place.

NOTE

A tug on the wire lead will confirm that a pin is locked in place.

3. Insert tapered end of secondary locking wedge (4) into pin housing and press down until it snaps in place.

NOTES

- The wedge fits in the center groove of the pin housing and holds the terminal latches tightly closed.
- See [Figure A-13](#). While rectangular wedges do not require a special orientation, the conical secondary locking wedge of the 3-place connector must be installed with the arrow (2) pointing toward the external latch.
- If the secondary locking wedge does not slide into the installed position easily, verify that all terminals are fully installed in the pin housing. The lock indicates when terminals are not properly installed by not entering its fully installed position.

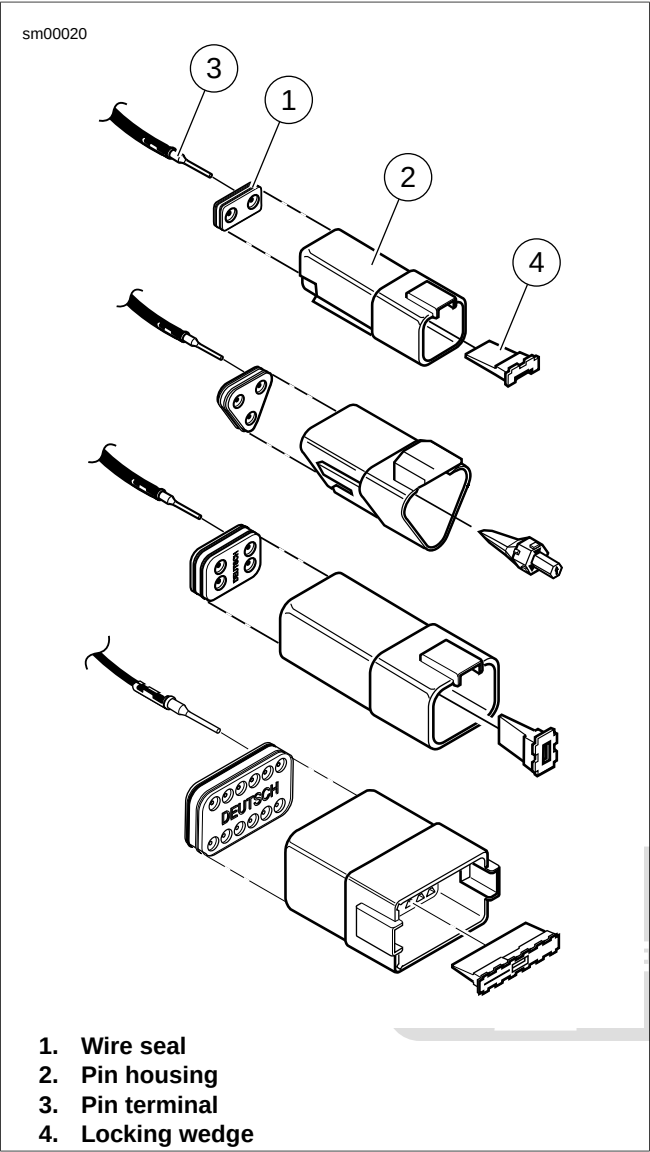


Figure A-16. Deutsch Connector: 2, 3, 4 and 12-Place Pin Housings

Crimping Terminals

Identify which of the types of Deutsch terminals are used with the connector and follow the corresponding crimping instructions. Refer to [Table A-2](#).



Table A-2. Deutsch Connector: Terminal Crimping Instructions

TYPE	CRIMPING INSTRUCTIONS
Standard (with crimp tails)	A.5 DEUTSCH STANDARD TERMINALS
Mini Terminal (solid barrel)	A.7 DEUTSCH SOLID BARREL TERMINALS
Mini Terminal (with crimp tails)	A.6 DEUTSCH MINI-TERMINAL CRIMPS

DEUTSCH STANDARD TERMINALS

A.5

DEUTSCH STANDARD TERMINAL CRIMPS

PART NUMBER	TOOL NAME
HD-39965-A	DEUTSCH TERMINAL CRIMP TOOL

Preparing Wire Leads for Crimping

1. Use a shop gauge to determine gauge of wire lead.
2. Strip lead removing 5/32 in. (4.0 mm) of insulation.

Crimping Terminal to Lead

1. See [Figure A-17](#). Squeeze the handles of the DEUTSCH TERMINAL CRIMP TOOL (Part No. HD-39965-A) to open the jaws. Push the locking bar (1) up.
2. Insert (2) terminal (socket/pin) through hole of the locking bar, so that the rounded side of the contact barrel rests in the nest (concave split level area) with the crimp tails facing upward. To match the wire gauge to the crimp tool die, refer to [Table A-3](#).
3. Release locking bar to lock terminal in die.

NOTE

If the crimp tails are slightly out of vertical alignment, the crimp tool automatically rotates the terminal so that the tails face

straight upward. When positioned, the locking bar fits snugly in the space between the contact band and the core crimp tails.

4. Insert stripped wire core between crimp tails until ends make contact with locking bar. Verify that wire is positioned so that short pair of crimp tails squeeze bare wire strands, while long pair folds over the insulation.
5. Squeeze handle of crimp tool until tightly closed. Tool automatically opens after the terminal is crimped.
6. Raise locking bar up and remove wire lead and terminal.

Inspecting Crimps

Inspect the wire core and insulation crimps. Distortion should be minimal.

Table A-3. Deutsch Standard Terminal Crimp: Wire Gauge To Die

WIRE GAUGE (AWG)	CRIMP TOOL DIE
20	Front
16-18	Middle

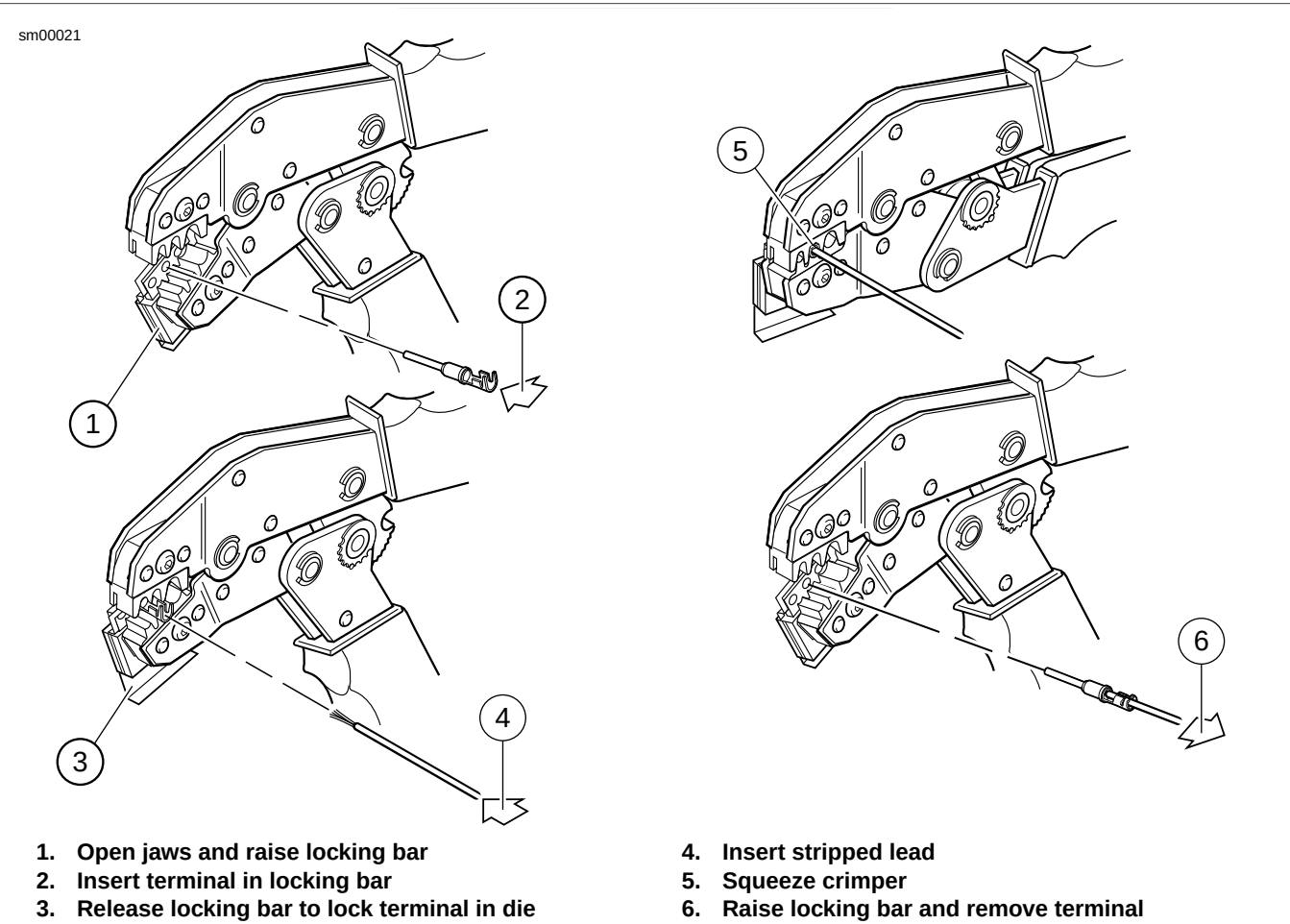


Figure A-17. Crimping a Deutsch Standard Terminal

DEUTSCH MINI TERMINAL CRIMPS

PART NUMBER	TOOL NAME
HD-38125-7	PACKARD TERMINAL CRIMPER

Preparing Wire Leads for Crimping

Strip wire lead removing 5/32 in. (4.0 mm) of insulation.

Crimping a Mini Terminal to Wire Lead

1. See [Figure A-18](#). Compress the handles of PACKARD TERMINAL CRIMPER (Part No. HD-38125-7) until the ratchet (2) automatically opens.

NOTE

Always perform core crimp before insulation crimp.

2. Position the core crimp on die E (1) of the crimper. Be sure the core crimp tails are facing the forming jaws.
3. Gently apply pressure to handles of tool until crimpers just secure the core crimp tails.
4. Insert stripped wire core stands between crimp tails. Position wire so that short pair of crimp tails squeeze bare wire strands, while long pair squeeze over the insulation.
5. Squeeze handle of crimper until tightly closed. Tool automatically opens when the crimping sequence is complete.

NOTE

If the crimper does not open, it can be opened by squeezing the ratchet trigger (2).

6. Position the insulation crimp on nest C of the crimper. Be sure the insulation crimp tails are facing the forming jaws.
7. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.

Inspecting Crimps

Inspect the core and insulation crimps. Distortion should be minimal.

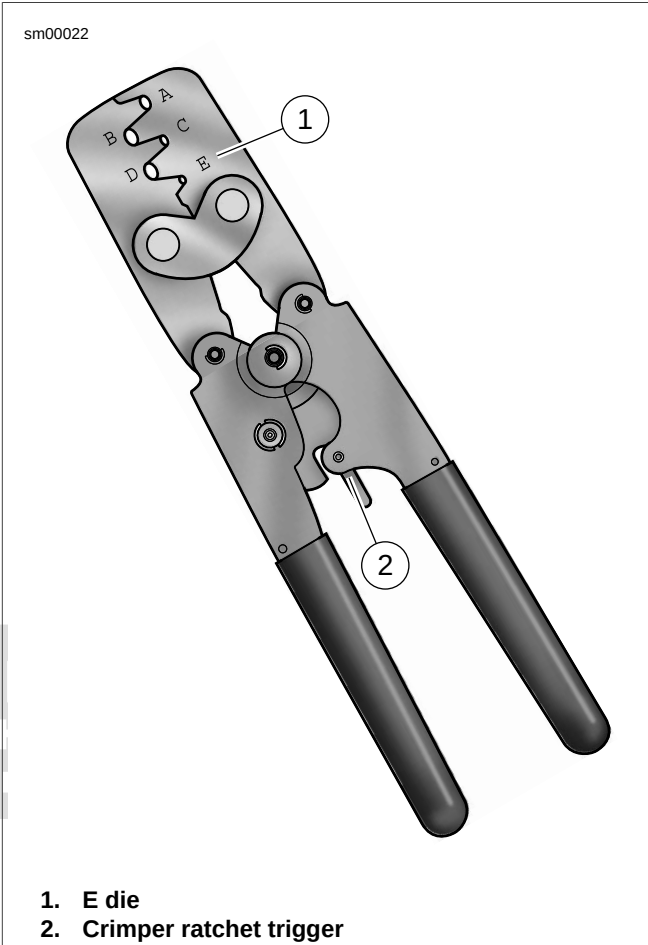


Figure A-18. Packard Terminal Crimper (HD-38125-7)

DEUTSCH SOLID BARREL TERMINALS

A.7

DEUTSCH SOLID BARREL TERMINAL CRIMPS

PART NUMBER	TOOL NAME
HD-42879	ELECTRICAL CRIMPER TOOL

Preparing Wire Leads For Crimping

For size 20, 16 and 12 contacts, wire ranges 26-12 AWG.

Strip wire lead removing 1/4 in. (6.4 mm) of insulation.

Adjusting Crimper Tool

1. See [Figure A-19](#). Squeeze the ELECTRICAL CRIMPER TOOL (Part No. HD-42879) handles to cycle the crimp tool to open.
2. Remove locking pin (1) from selector knob (2).
3. Raise selector knob and rotate until selected wire size stamped on wheel is aligned with "SEL. NO." arrow (3).
4. Loosen knurled locknut (4) and turn adjusting screw (5) clockwise (in) until it stops.

Crimping a Barrel Contact To Wire Lead

1. See [Figure A-20](#). Turn tool over and drop contact barrel (1) into indenter cover (2) hole with the wire end out.
2. Turn adjusting screw counterclockwise (out) until contact is flush with bottom of depression in indenter cover. Tighten knurled locknut.
3. Slowly squeeze handles of crimp tool until contact is centered between the four indenter points (3).
4. Insert bare wire core strands of stripped wire lead (4) into contact barrel. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
5. Remove wire lead with crimped contact from indenter.

NOTE

Tool must be readjusted when changing contact size/type.

6. Install pin to lock selector knob.

Inspecting Crimps

Inspect the crimp. All core wire strands are to be crimped in the barrel.

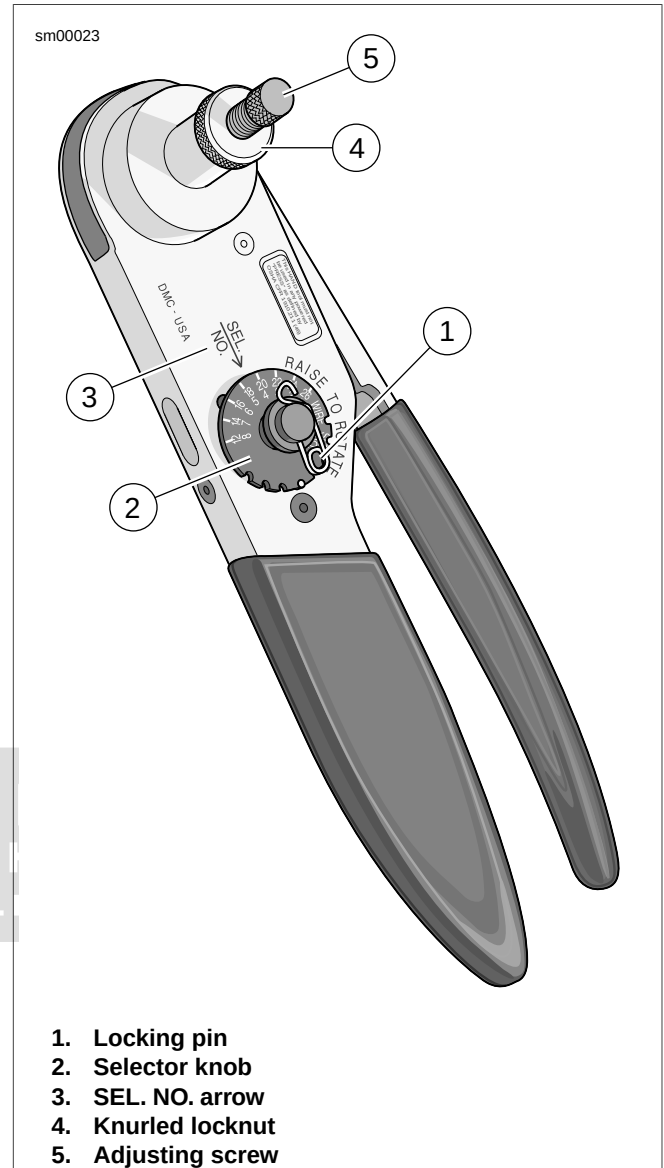


Figure A-19. Electrical Crimper Tool (HD-42879)

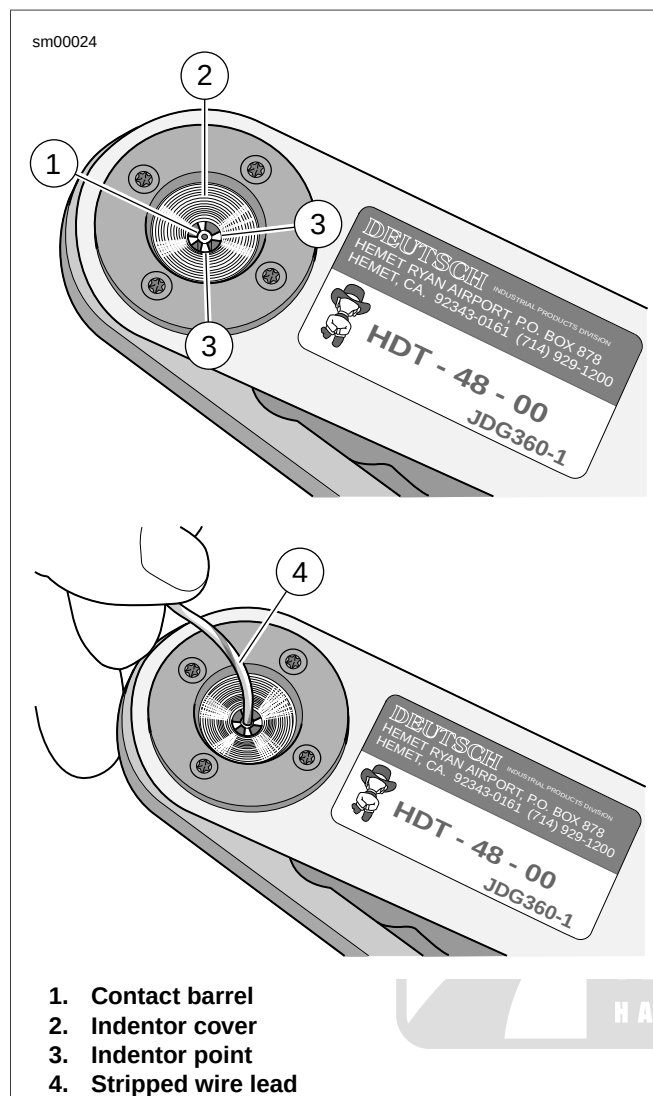


Figure A-20. Deutsch Solid Barrel

RELAY AND FUSE BLOCKS

A.8

FUSE BLOCK REPAIR

Removing Socket Terminals

1. See [Figure A-21](#). To remove secondary locks, insert end of small flat blade screwdriver (1) under lip of locking wedge (2) and gently pry up secondary lock.

NOTE

For best results, start with locking wedge on outboard side of secondary lock.

2. Looking into chamber at top of fuse block, note the tang next to each socket terminal.
3. Using a thin flat blade, like that on a hobby knife, gently push tang away from terminal, and then tug on wire to back terminal out.

Installing Socket Terminals

1. Match the wire lead color to the fuse block terminal cavity.

NOTES

- Refer to the main harness wiring diagram for wire lead color codes.
 - See [Figure A-22](#). The main fuse block terminal cavity is identified as alpha (1) and numeric (2) coordinates. Refer to the main harness wiring diagram for fuse block terminal cavity coordinates.
2. With the open side of the socket terminal facing the tang, push lead into chamber at the wire end of the fuse block. A click is heard when the terminal is properly engaged.
 3. Gently tug on the wire to verify that the terminal is locked in place and will not back out of the chamber.
 4. Install the secondary locks. With the locking wedges positioned above the tangs in each chamber, slide flat side of secondary lock into slot (between rows), and push down until it bottoms.

Crimping Terminals

Terminals are crimped twice; once over the wire core and a second time over the insulation/seal.

A correctly crimped terminal may require different crimping dies found on separate crimpers.

NOTE

The wiring diagram indicates when one socket terminal is be crimped to two wire leads.

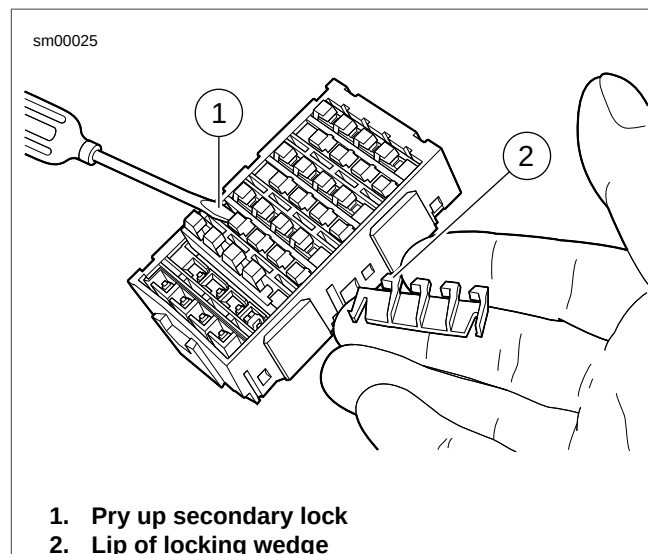


Figure A-21. Fuse Block: Remove Secondary Locks

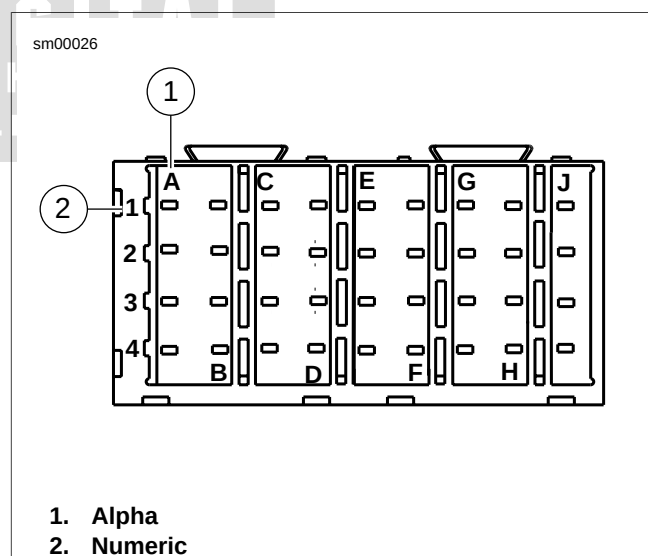


Figure A-22. Fuse Block: Coordinates (typical)

150 METRI-PACK CONNECTORS

A.9

150 METRI-PACK CONNECTOR REPAIR

General

Metri-Pack connectors are embossed with the initials (P.E.D.).

There are two types of connectors in this series:

- Pull-to-Seat
- Push-to-Seat

Separating Pin and Socket Housings

Bend back the external latch slightly and separate the pin and socket halves of the connector.

Mating Pin and Socket Housings

Align the wire colors and push the pin and socket halves of the connector together.

Removing Socket Terminal

1. See [Figure A-23](#) for pull-to-seat connector or [Figure A-24](#) for push to seat connector. Remove wire lock (1) from wire end of socket housing on push-to-seat type connectors.

NOTE

For best results, free one side of wire lock first and then release the other side.

2. Find the locking tang in the mating end of the connector.

NOTE

The tangs are always positioned in the middle of the chamber and are on the same side as the external latch.

3. Gently insert a safety pin into the chamber about 1/8 in. (3.2 mm).
 - a. **For pull-to-seat:** Stay between the terminal and the chamber wall and pivot the end of the pin toward the terminal body.
 - b. **For push-to-seat:** There is a small opening for the pin.
4. When a click is heard, remove the pin and repeat the procedure.

NOTE

The click is the sound of the tang returning to the locked position as it slips from the point of the pin.

5. Pick at the tang until the clicking stops and the pin seems to slide in deeper than it had previously. This is an indication that the tang has been depressed.

NOTE

On those terminals that have been extracted on multiple occasions, the click may not be heard, but pivot the pin as if the click was heard at least 3 times.

6. Remove the pin.
 - a. **For pull-to-seat:** Push on the lead to extract the terminal from the mating end of the connector.
 - b. **For push-to-seat:** Pull on the lead to draw the terminal out the wire end.

Inserting Socket Terminal

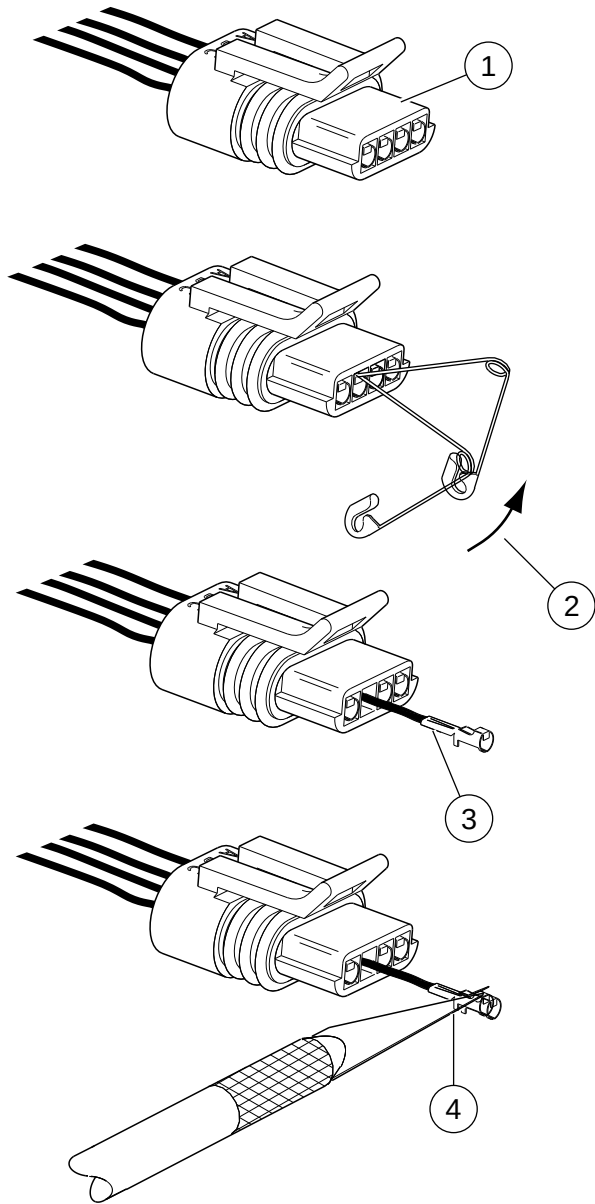
NOTE

For wire location purposes, alpha characters are stamped into the socket housings.

1. See [Figure A-23](#) for pull-to-seat connector or [Figure A-24](#) for push to seat connector. Using a thin flat blade, like that on a hobby knife, carefully bend the tang outward away from the terminal body.
2. Gently pull or push on the lead to install the terminal back into the chamber. A click is heard when the terminal is properly seated.
3. Gently pull or push on the lead to verify that the terminal is locked in place.

For push-to-seat: See [Figure A-24](#). Seat wires in separate channels of wire lock and then push channels **inside** chambers at wire end of socket housing. Fully installed, slot on each side of wire lock engages ear on socket housing.

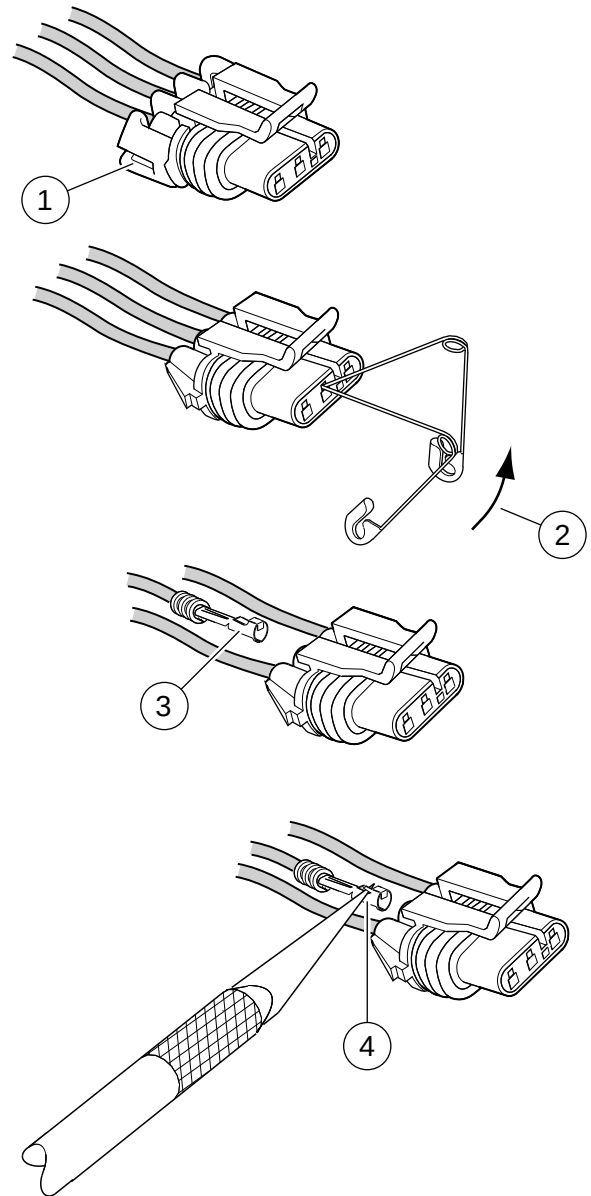
sm00027



1. Locate tang in chamber
2. Pivot pin to depress tang
3. Push to remove
4. Raise tang to install

Figure A-23. 150 Metri-Pack Connector: Pull-to-Seat

sm00028



1. Remove wire lock
2. Pivot pin to depress tang
3. Pull to remove
4. Raise tang to install

Figure A-24. 150 Metri-Pack Connector: Push-to-Seat

280 METRI-PACK CONNECTOR REPAIR

General

See [Figure A-25](#). Called Packard connectors, Metri-Pack series connectors are embossed with the initials (P.E.D.)

Separating Pin and Socket Housings

Depress the wireform and use a rocking motion to detach the socket connector half.

Mating Pin and Socket Housings

Align the groove in the socket housing with the tab in the pin housing. Push the pin and socket halves of the connector together until the latch clicks.

Removing Socket Terminals

1. See [Figure A-26](#). Pry rubber seal from wire end of connector and move seal down wires (1) toward conduit. Hold the connector so that the wireform is facing down.
2. Looking into the wire end of the connector, insert the point of a safety pin (2) between the top of the terminal and the inside chamber wall.
3. Push safety pin completely into chamber while watching terminal on mating end of connector. When terminal is observed moving forward slightly, tang is depressed. Remove safety pin.

NOTE

Repeat as necessary until the terminal can be pushed out of the connector.

4. Push on wire end of the lead to extract the terminal from the mating end of the connector.
5. If necessary, crimp new terminals on wires. See [A.14 METRI-PACK TERMINALS, Metri-Pack Terminal Crimps](#).

Installing Socket Terminals

NOTE

Terminal cavities are lettered on the socket housing. To match the wire lead colors to the terminal cavity, refer to the wiring diagram.

1. See [Figure A-26](#). Using a thin flat blade, like a hobby knife (4), carefully bend the tang outward away from the terminal body.
2. Gently pull on the wire lead (5) to draw the terminal back into the chamber. The tang faces opposite the wireform as it enters the chamber.

NOTE

A "click" is heard when the terminal is properly seated.

3. Push on lead to verify that terminal is locked in place.
4. Fit rubber wire seal back into wire end of connector.

Crimping Terminals

If necessary, crimp new terminals on the wire leads. Refer to [A.14 METRI-PACK TERMINALS, Metri-Pack Terminal Crimps](#).

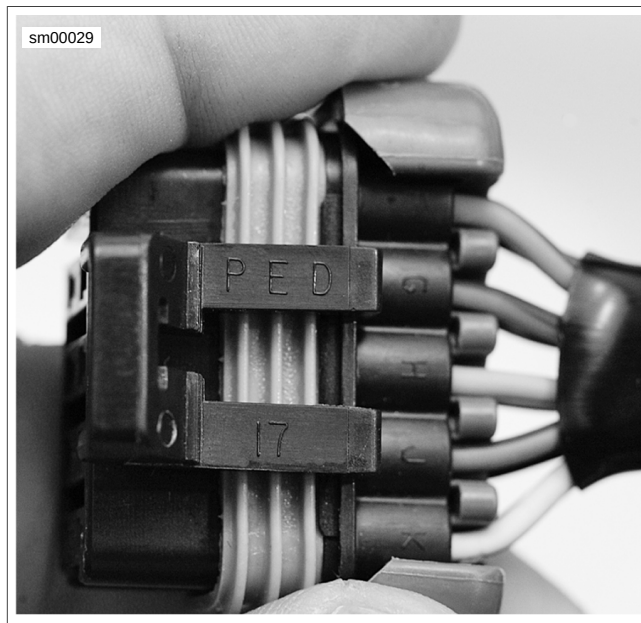
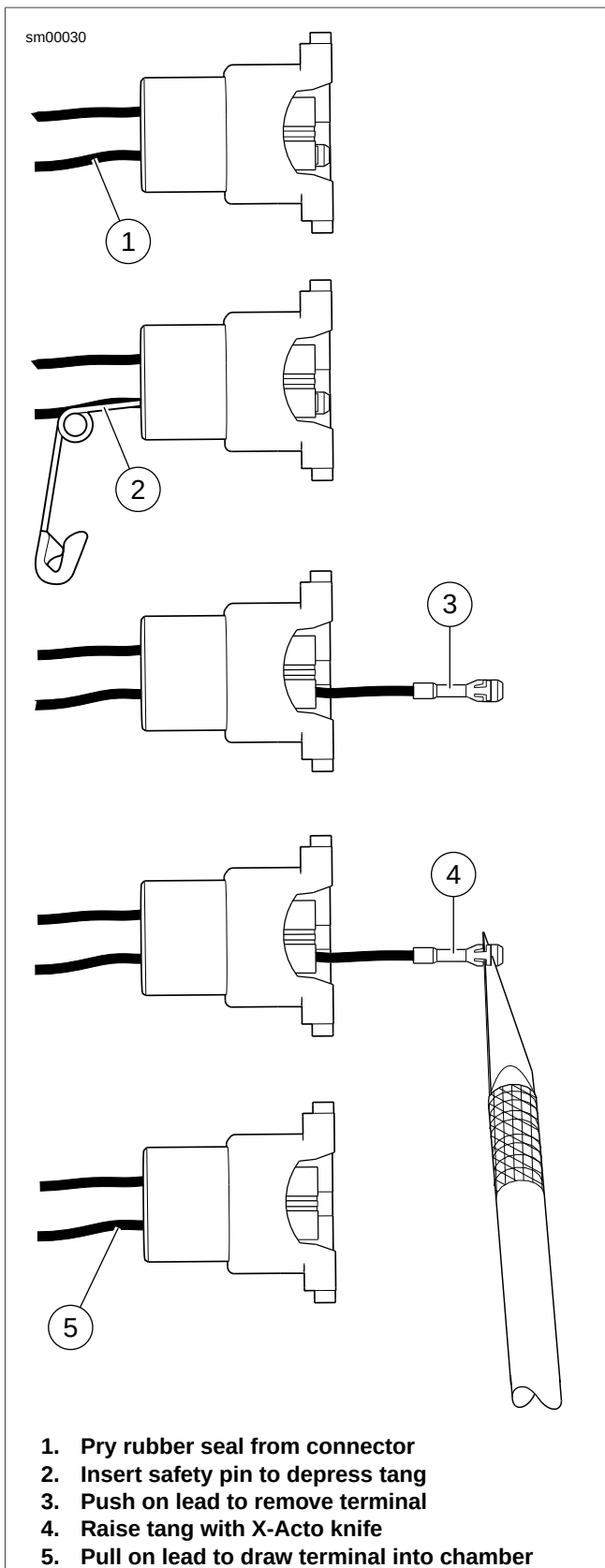


Figure A-25. 280 Metri-Pack Connector (P.E.D.)



**Figure A-26. 280 Metri-Pack Connector: Remove/Install
Socket Terminal**

DIGITAL
TECHNICIAN II
HARLEY-DAVIDSON®

480 METRI-PACK CONNECTORS

A.11

480 METRI-PACK CONNECTOR REPAIR

General

A 480 Metri-Pack (P.E.D.) connector is frequently used for the B+ (battery voltage) connector to power P&A accessories.

Referred to as Packard connectors, Metri-Pack connectors are embossed with the initials P.E.D.

See [Figure A-27](#). An AFL housing (5) is used on many ignition/light switches. The secondary lock (4) must be opened before removing the terminal from the housing.

Separating Pin and Socket Housings

NOTE

Cut any cable strap anchoring the wire conduits of the pin (accessory connector housing) and the socket (B+) housing.

See [Figure A-27](#). Using small flat blade screwdriver, press button (1) on pin housing (red wire) side of the connector and pull apart the pin and socket housings.

Mating Pin and Socket Housings

Orient the latch on the socket housing to the button catch on the pin housing and press the housings together.

Removing Socket Terminals

1. See [Figure A-27](#). Bend back the latch (2) slightly and free one side of secondary lock, then repeat to release the opposite side. Rotate the secondary lock outward on hinge to access terminal in chamber of connector housing.
2. On the mating end of the connector, note the tang in the square shaped opening centered next to the terminal. Gently insert the point of a stick pin or large safety pin into the opening (3) between the tang and the chamber wall until it stops.
3. Pivot the end of the pin toward the terminal body to press the tang.
4. Remove the pin and then pull terminal out of the wire end of connector housing.
5. If necessary, crimp **new** terminals on wires. See [A.14 METRI-PACK TERMINALS](#).

Installing Socket Terminals

1. Carefully bend the tang outward away from the terminal body.
2. With the tang on the same side as the square shaped opening in the mating end of the connector housing, feed terminal into wire end of connector housing until it "clicks" in place.

3. Verify that terminal will not back out of the chamber. A slight tug on the cable will confirm that it is locked.
4. Rotate the hinged secondary lock inward until latches fully engage tabs on both sides of connector housing.

NOTE

If removed, install **new** anchored cable strap in O.E. location. Tighten cable strap to capture conduit of both accessory connector and B+ connector approximately 1.0 in. (25.4 mm) from housings.

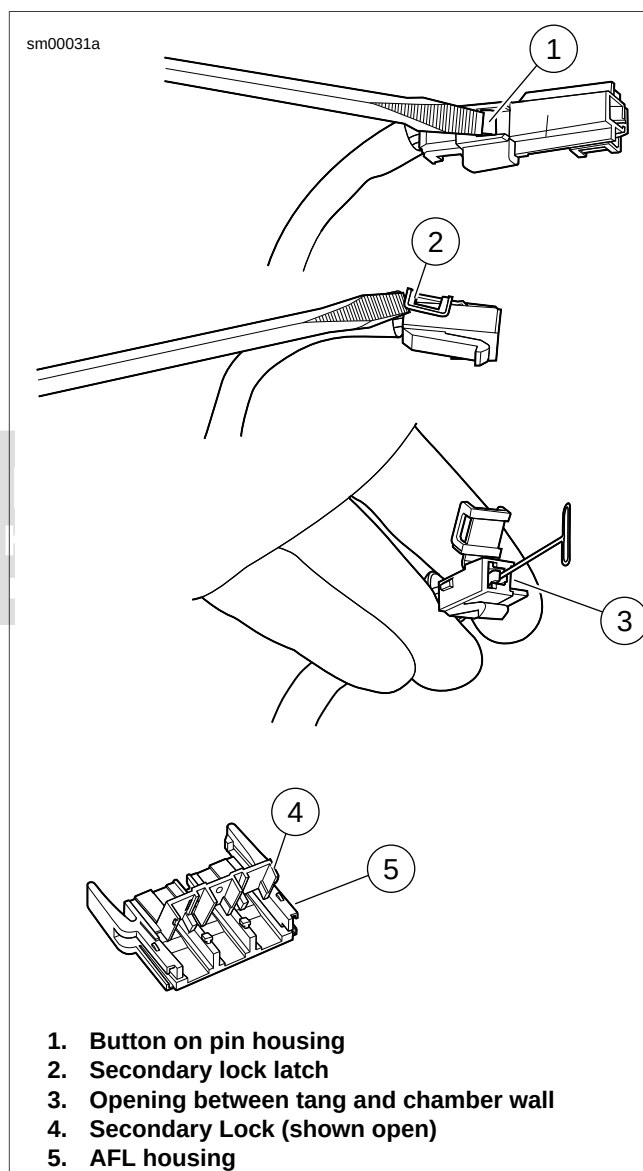


Figure A-27. 480 Metri-Pack Connector: Remove Socket Terminal

630 METRI-PACK CONNECTORS

A.12

630 METRI-PACK CONNECTOR REPAIR

PART NUMBER	TOOL NAME
SNAP-ON TT600-3	SNAP-ON PICK

General

Referred to as Packard connectors, Metri-Pack 630 series connectors are embossed with the initials P.E.D.

Separating Pin and Socket Housings

NOTE

If necessary, remove connector from barbed anchor or other retaining device.

Bend back the external latch slightly and separate pin and socket halves of the connector.

Mating Pin and Socket Housings

Orient the latch to the catch and push the pin and socket halves of the connector together until the latch "clicks".

NOTE

If removed, install connector on barbed anchor or other OE retaining device.

Removing Socket Terminal

1. Bend back the latch slightly and free one side of the secondary lock. Repeat the step to unlatch the other side.
2. Rotate the secondary lock outward on hinge to view the terminals in the chambers of the connector housing. The locking tang is on the side opposite the crimp tails and

engages a rib in the chamber wall to lock the terminal in place.

3. Moving to the mating end of the connector, take note of the small opening on the chamber wall side of each terminal.
4. Insert SNAP-ON PICK (Part No. SNAP-ON TT600-3) into opening until it stops. Pivot the end of the pick toward the terminal to depress the locking tang.
5. Remove the pick and gently tug on the wire to pull the terminal from the wire end of the connector. Repeat steps if the terminal is still locked in place.
6. If necessary, crimp **new** terminals on wires. Refer to [A.14 METRI-PACK TERMINALS](#).

Installing Socket Terminal

NOTE

Refer to the wiring diagrams to match wire lead colors to alpha characters molded into the secondary locks of each connector housing.

1. Using a thin flat blade, like that of a hobby knife, carefully bend the tang outward away from the terminal body.
2. With the tang facing the chamber wall, push the lead into the chamber at the wire end of the connector. A click is heard when the terminal is properly seated.
3. Gently tug on the wire end to verify that the terminal is locked in place and will not back out of the chamber.
4. Rotate the hinged secondary lock inward until tabs fully engage latches on both sides of connector.

DELPHI MAIN FUSE HOUSING REPAIR

General

A Delphi Main fuse connector completes the circuit through the main fuse.

Removing Main Fuse

1. See [Figure A-28](#). Depress latches on main fuse cover (1) and then slide cover off of connector (2).
2. Holding the connector (fuse holder), pull the main fuse out of the connector.

Installing Main Fuse

1. Insert the blade terminals of the main fuse into the sockets of the connector and press the main fuse into the connector.
2. Slide the cover over the fuse until the cover clicks into place.

NOTE

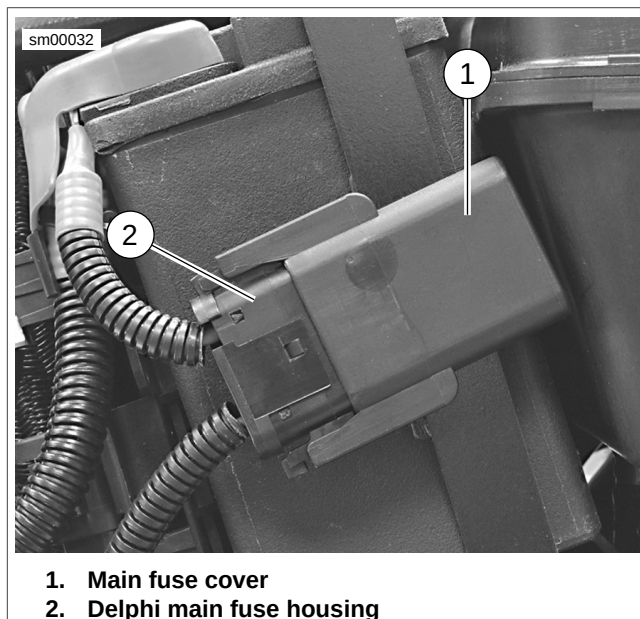
If removed from an OE attachment such as a grooved fuse block cover, engage cover and slide into place.

Removing Socket Terminals

1. See [Figure A-29](#). Gently pull socket housing to disengage slots (1) on secondary lock (2) from tabs (3) on socket housing. Free secondary lock from cables and set aside.
2. Take note of the opening on one side of the socket terminal. Gently insert flat blade of pick (Snap-On TT600-5) or small screwdriver into opening (4) until it stops. Pivot the pick toward the terminal body and hold in position.
3. Tug on cable to pull socket from wire end of socket housing. A firm tug is necessary to overcome the resistance of the rubber seal.
4. Repeat to remove remaining socket terminal.

Installing Socket Terminals

1. See [Figure A-30](#). Carefully bend tang outward away from the terminal body.
2. Feed socket into wire end of socket housing until it clicks in place. Verify that socket will not back out of chamber. A slight tug on the cable will confirm that it is locked.
3. Push rubber seal into wire end of socket housing.
4. Repeat to install remaining socket terminal.
5. Install secondary lock onto cables and then push onto wire end of socket housing until slots engage tabs on sides of socket housing.



1. Main fuse cover
2. Delphi main fuse housing

Figure A-28. Delphi Connector Housing: Main Fuse

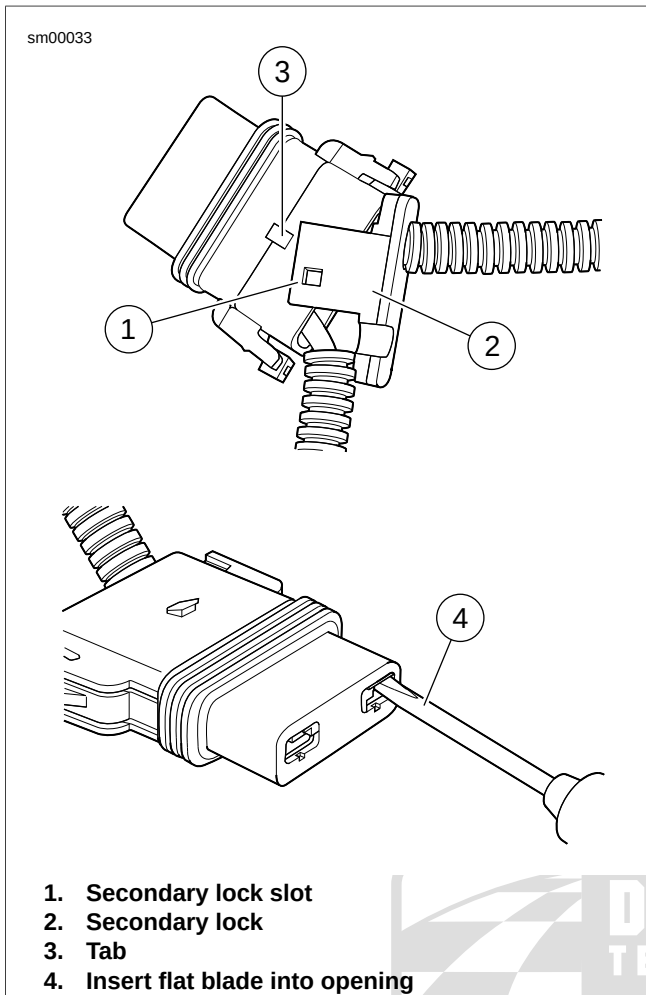


Figure A-29. Delphi Main Fuse Housing: Remove Socket Terminals

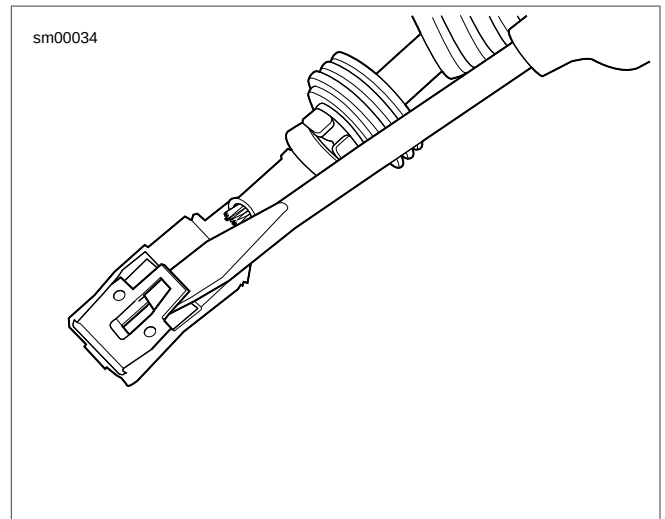


Figure A-30. Delphi Main Fuse Housing: Bend Tang

METRI-PACK TERMINALS

METRI-PACK TERMINAL CRIMPS

PART NUMBER	TOOL NAME
HD-38125-6	PACKARD TERMINAL CRIMP TOOL
HD-38125-7	PACKARD TERMINAL CRIMPER
HD-38125-8	PACKARD CRIMPING TOOL

Matching Terminal To Crimper

Metri-Pack connectors embossed with the initials P.E.D. require Packard crimp tools to crimp terminals to wire leads.

Terminals are crimped twice to a wire lead, once over the wire core and a second time over the insulation/seal.

See [Figure A-31](#). A completed crimp may require two different crimping dies found on PACKARD TERMINAL CRIMP TOOL (Part No. HD-38125-6) and/or PACKARD TERMINAL CRIMPER (Part No. HD-38125-7). The terminal (pin or socket) and the wire lead gauge will determine the core crimp die and the insulator/seal die.

NOTE

The PACKARD CRIMPING TOOL (Part No. HD-38125-8) will also crimp sealed splice connectors in wire gauge sizes 18-20, 14-16 and 10-12.

Preparing Wire Lead

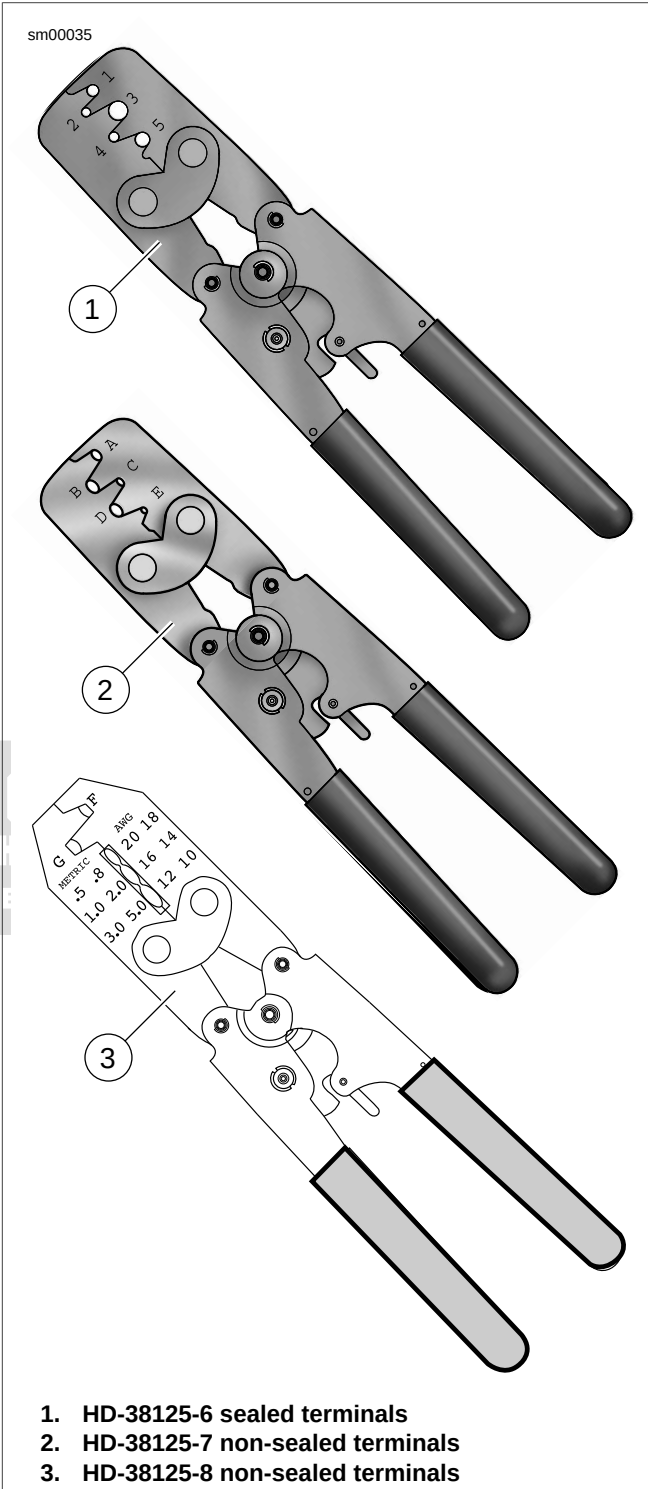
Use a wire stripper to strip off the insulation and expose 5/32 in. (4.0 mm) of wire core.

Crimping Wire Core

NOTE

Metri-Pack terminal crimps require two steps. Always perform **Crimping Wire Core** before **Crimping Insulation/Seal**.

1. Squeeze and release handles until ratchet automatically opens.
2. Identify the corresponding sized nest for the core crimp.
3. Position the core crimp in the die. Be Sure the core crimp tails are facing the forming jaws.
4. Gently squeeze the handles until crimpers just secure the core crimp tails.
5. Insert stripped wire between crimp tails. Verify that wire is positioned so that short pair of crimp tails squeeze core wire strands, while long pair is positioned over the insulation or seal material.
6. Squeeze handles tightly closed. Release grip and the tool will automatically open.



1. See [Figure A-32](#). Identify the correct die for the insulation/seal crimp (2).
2. Position the insulation/seal crimp in the nest. Be sure the insulation/seal crimp tails are facing the forming jaws.
3. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimp is complete.

Inspecting Crimps

1. See [Figure A-32](#). Inspect the wire core crimp (1). The tails should be folded in on the wire core without any distortion or excess wire strands.
2. Inspect the insulation (2) or seal (3) crimp. The tails of the terminal should be wrapped around the insulation without distortion.

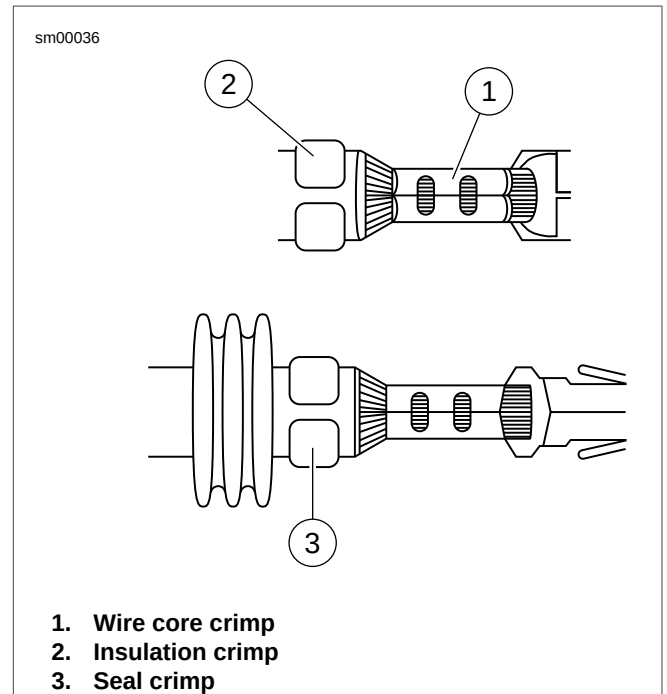


Figure A-32. Metri-Pack Connector: Inspect Core and Insulation/Seal Crimps



MOLEX CONNECTOR REPAIR

PART NUMBER	TOOL NAME
HD-48114	MOLEX ELECTRICAL CONNECTOR TERMINAL REMOVER

Separating Pin and Socket Housings

See [Figure A-33](#). Depress the latch while pulling the pin and socket housings apart.

Mating Pin and Socket Housings

1. Orient the latch on the pin housing to the latch pocket on the socket housing so the rails on the outside of the pin housings lines up with the tunnels on the socket housing.
2. Press the housings together until the latch clicks.

Removing Terminals

1. Pull the secondary lock up, approximately 3/16 in. (4.8 mm), until it stops.
 - a. **Socket Housing:** See [Figure A-34](#). Use a small screwdriver in the pry slot. The slot next to the external latch provides a pivot point.
 - b. **Pin Housing:** See [Figure A-35](#). Use needle nose pliers to engage the D-holes in the center of the secondary lock.

NOTE

Do not remove the secondary lock from the connector housing.

2. See [Figure A-36](#). Insert MOLEX ELECTRICAL CONNECTOR TERMINAL REMOVER (Part No. HD-48114) into the pin hole next to the terminal until the tool bottoms.
 - a. **Socket Housing:** The pin holes are inside the terminal openings.
 - b. **Pin Housing:** The pin holes are outside the pins.
3. Pressing the terminal remover to the bottom of the pin hole, gently pull on the wire to remove wire terminal from its cavity.

Installing Terminals

1. See [Figure A-37](#). From the wiring diagram, match the wire color to its numbered terminal cavity.

NOTE

Cavity numbers (1) are stamped on the housing at the ends of the cavity rows. The cavity number can be determined by counting the cavities up or down along the row from each stamped number.

2. Orient the terminal so that the tang (2) opposite the open crimp engages the slot (3) in the cavity.
3. Push the terminal into the cavity.
4. Gently tug on wire to verify that the terminal is captured by the secondary lock.

5. With all terminals installed, push the secondary lock into the socket housing to lock the wire terminals into the housing.

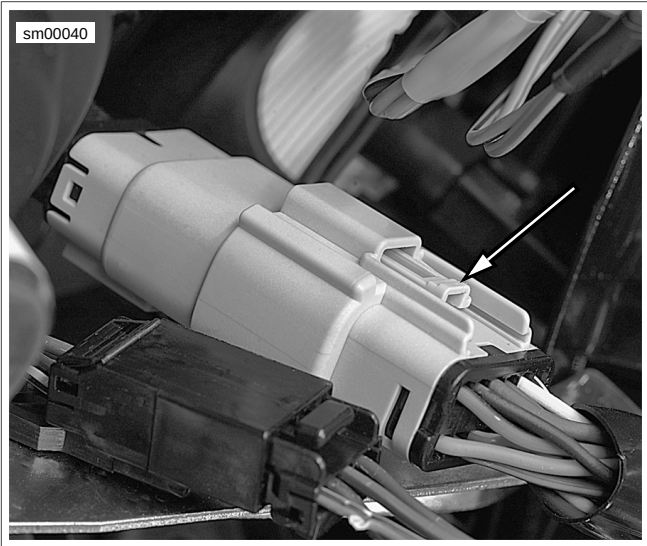


Figure A-33. Molex Connector: Latch

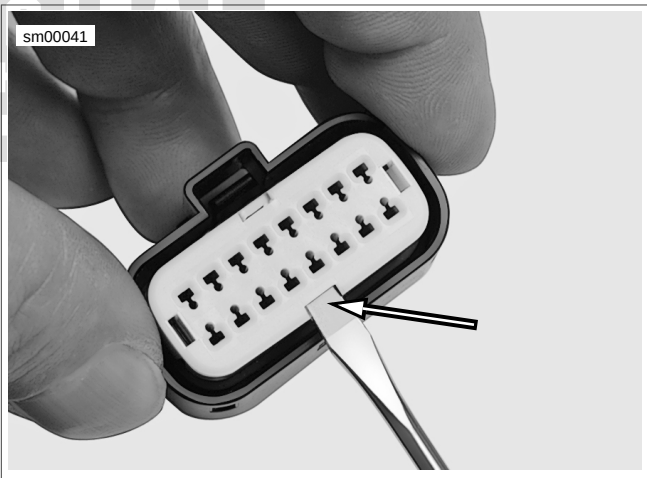


Figure A-34. Molex Connector: Secondary Lock Pry Slot (Socket Housing)

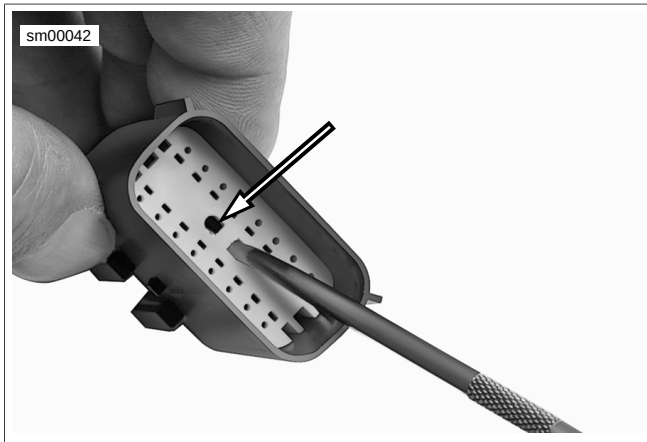


Figure A-35. Molex Connector: Secondary Lock D-Holes (Pin Housing)

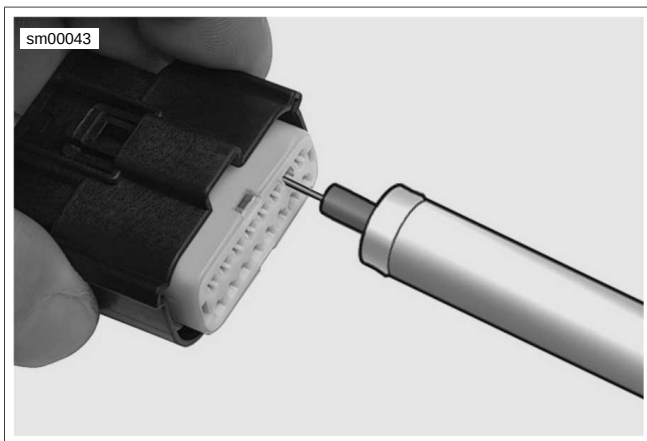


Figure A-36. Molex Connector: Terminal Remover (HD-48114)

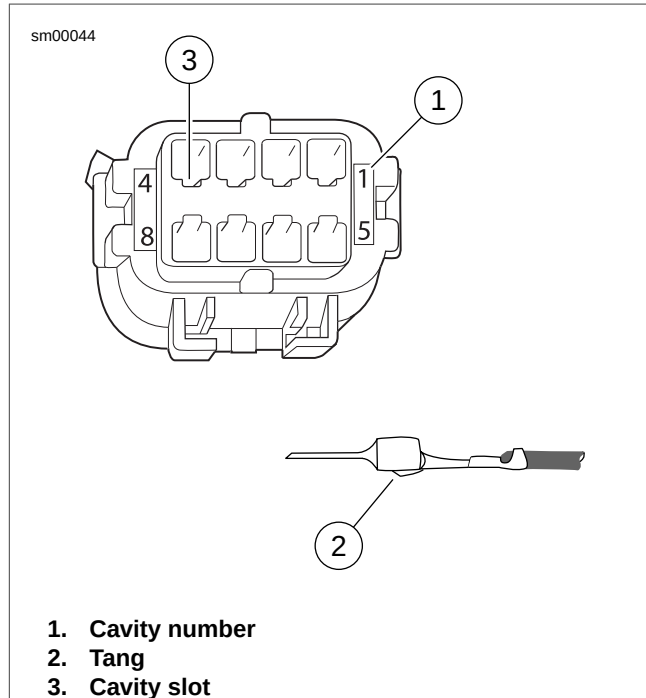


Figure A-37. Molex Connector: Pin Cavities and Wire Terminal

DIGITAL
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PACKARD 100W CONNECTOR REPAIR**General**

A Packard 100W connector connects the electronic control module (ECM) to the main harness.

NOTE

For vehicles with 73-pin connectors, see [A.17 PACKARD MICRO-64 CONNECTORS](#) and [A.14 METRI-PACK TERMINALS](#).

Separating Socket Housing From ECM

See [Figure A-38](#). While pressing the connector into the ECM, press the thumb lever (1) against the connector until the latch (2) pops out of the catch (3) on the ECM.

Mating Socket Housing To ECM

Push the connector into the ECM until the latch is captured by the catch on the ECM.

Removing Socket Terminal

1. See [Figure A-39](#). Gently press latch (1) on each side of the clear plastic secondary lock (2) and remove. For best results, release one side at a time.
2. Carefully cut cable strap (3) to free strain relief collar (4) from conduit (5).
3. See [Figure A-40](#). Using a thin blade, gently pry at seam at back of socket housing to release three plastic pins (1) from slots in housing. Separate and spread halves of socket housing.
4. Push on wire lead to free terminal from chamber.

Installing Socket Terminal

1. From inside socket housing, gently pull on wire to draw terminal into chamber.
2. Exercising caution to avoid pinching wires, press halves of socket housing together until three plastic pins fully engage slots in housing.
3. Install **new** cable strap in groove of strain relief collar capturing cable conduit.
4. With the two ribs on the secondary lock on the same side as the external latch, install over terminals until latches lock in place.

Crimping Terminals

If necessary, crimp new terminals on wire leads. See [A.14 METRI-PACK TERMINALS](#).

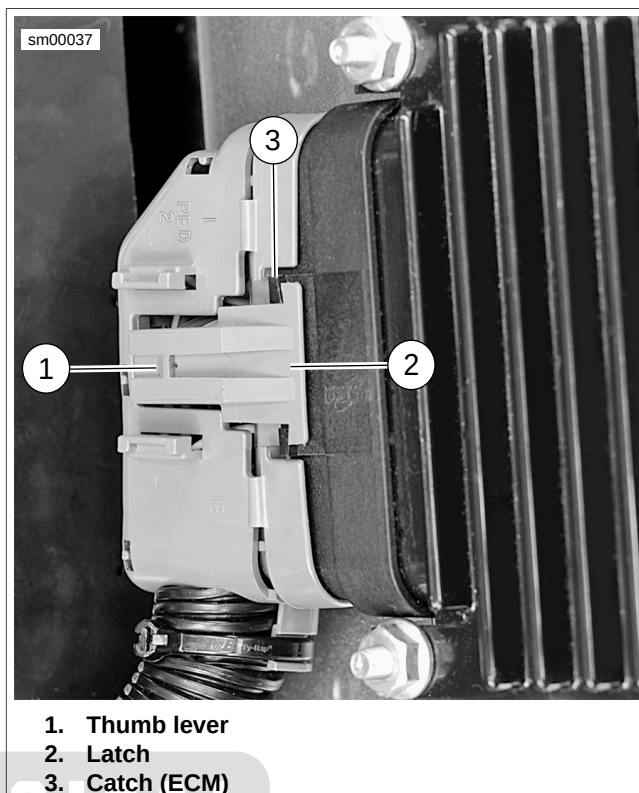


Figure A-38. Packard 100W to ECM (Typical)

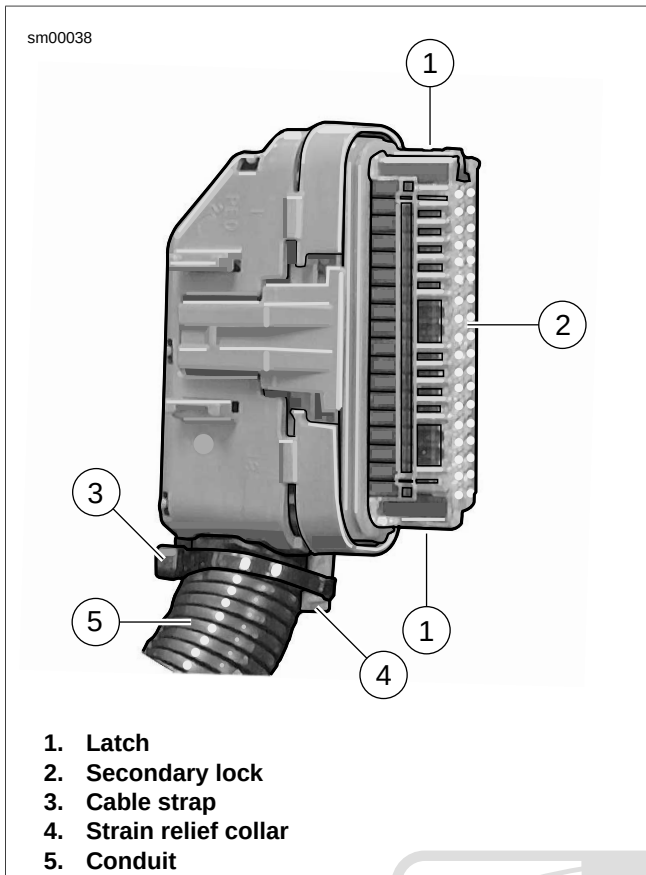


Figure A-39. Packard 100W Connector

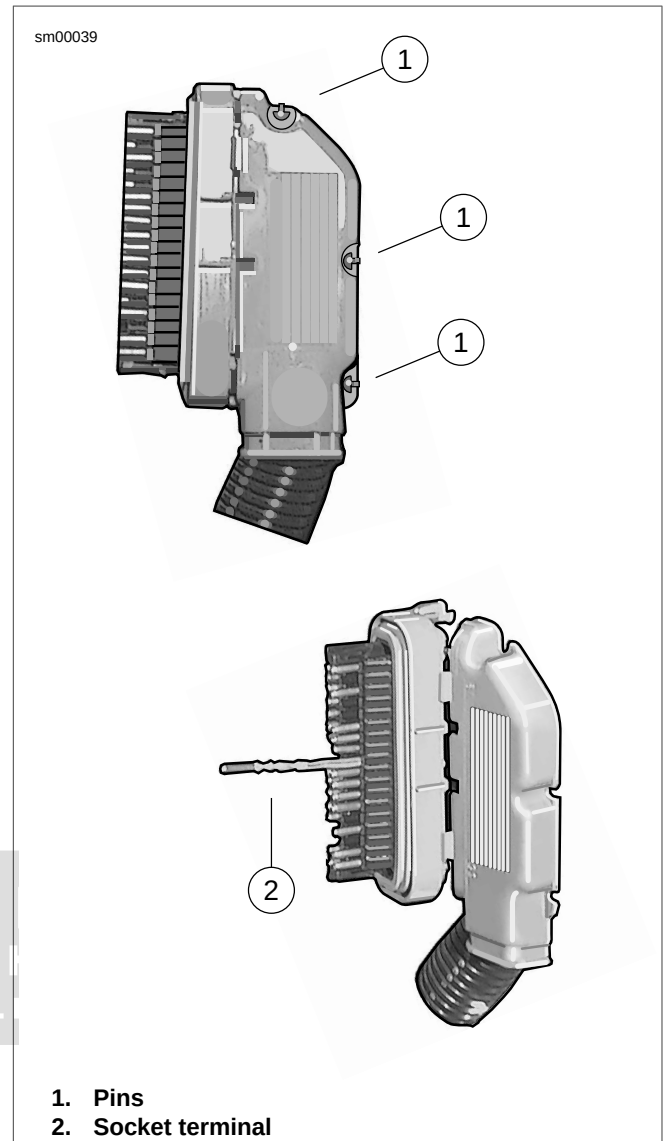


Figure A-40. Packard 100W Connector: Separate Halves of Socket Housing

PACKARD MICRO-64 CONNECTORS

A.17

PACKARD MICRO-64 CONNECTOR REPAIR

PART NUMBER	TOOL NAME
HD-45928	PACKARD MICRO-64 TERMINAL REMOVER
HD-45929	PACKARD MICRO-64 TERMINAL CRIMPER

General

Packard Micro-64 connectors are frequently found on speedometers, tachometers and the ECM of Touring Models. For pin 73 of these ECMs, see [A.9 150 METRI-PACK CONNECTORS](#).

Separating Pin and Socket Housings

Bend back the external latches slightly and separate the pin and socket housings.

Mating Pin and Socket Housings

Orient the wire lead colors and push the pin and socket housings of the connector together until the latches click.

Removing Terminal

1. See [Figure A-43](#). Locate the head of the secondary lock (1) on one side of the connector housing.
2. Insert the blade of a small screwdriver between the center ear of the lock and the connector housing and gently pry out lock. When partially removed, pull lock from connector housing.
3. Locate pin hole (2) between terminals on mating end of connector.
4. See [Figure A-44](#). Obtain the PACKARD MICRO-64 TERMINAL REMOVER (Part No. HD-45928).
5. See [Figure A-42](#). Push the adjacent terminals all the way into the connector housing and then insert tool into hole until it bottoms.
6. Leaving the tool installed, gently tug on wires to pull either one or both terminals from wire end of connector. Remove tool.



Figure A-41. Packard Micro 64 Terminal Remover (HD-45928)

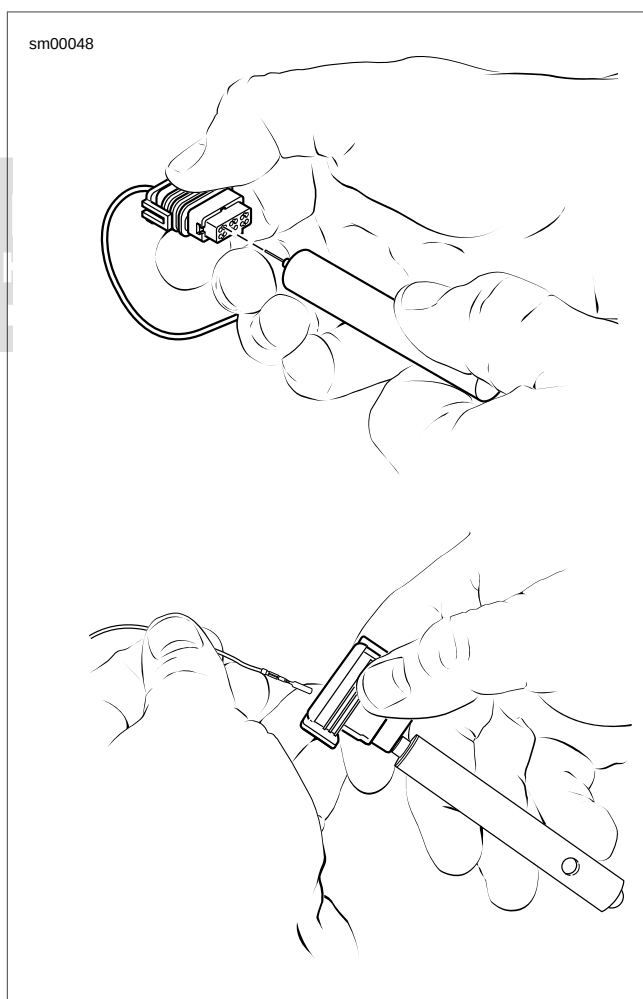


Figure A-42. Packard Micro 64 Connector: Insert Tool and Remove Terminal

Installing Terminal

1. Insert terminal into its respective numbered chamber on wire end of connector. No special orientation of the terminal is necessary.

NOTE

See [Figure A-43](#). For wire location purposes, the corners of the socket housing are stamped (3) with the numbers 1, 6, 7 and 12, representing terminals 1-6 on one side, and 7-12 on the other.

2. Bottom the terminal in the chamber and then gently tug on the wire to verify that it is locked in place.

NOTE

Once the terminal is removed it may not lock in place when first reinstalled. Until the lock engages, move the terminal back and forth slightly while wiggling the lead.

3. Since the terminal remover tool releases two terminals simultaneously, repeat step 2 on the adjacent terminal even if it was not pulled from the connector housing.
4. With the center ear on the head of the secondary lockpin facing the mating end of the connector, push secondary lock in until head is flush with the connector housing.

Preparing Wire Leads for Crimping

Strip lead removing 1/8 in. (3.0 mm) of insulation.

Crimping Terminals

1. Inspect **new** socket terminal for bent or deformed contact and crimp tails. Replace as necessary.
2. See [Figure A-45](#). Squeeze the handles of the PACKARD MICRO-64 TERMINAL CRIMPER (Part No. HD-45929) to cycle the tool to the fully open position (1).
3. Raise locking bar and barrel holder by pushing up on bottom tab with index finger (2).
4. With the crimp tails facing upward, insert terminal through locking bar into front hole in barrel holder (20-22 gauge wire) (3).
5. Release locking bar to lock position of contact. When correctly positioned, the locking bar fits snugly in the space at the front of the core crimp tails and the closed side of the terminal rests on the outer nest of the crimp tool.
6. Insert wires between crimp tails until ends make contact with locking bar. Verify that wire is positioned so that wide pair of crimp tails squeeze bare wire strands, while the narrow pair folds over the insulation material.
7. Squeeze handle of crimp tool until tightly closed (4). Tool automatically opens when the crimping sequence is complete.
8. Raise locking bar and barrel holder to remove contact.

Inspecting Crimps

Inspect the quality of the core and insulation crimps. Distortion should be minimal.

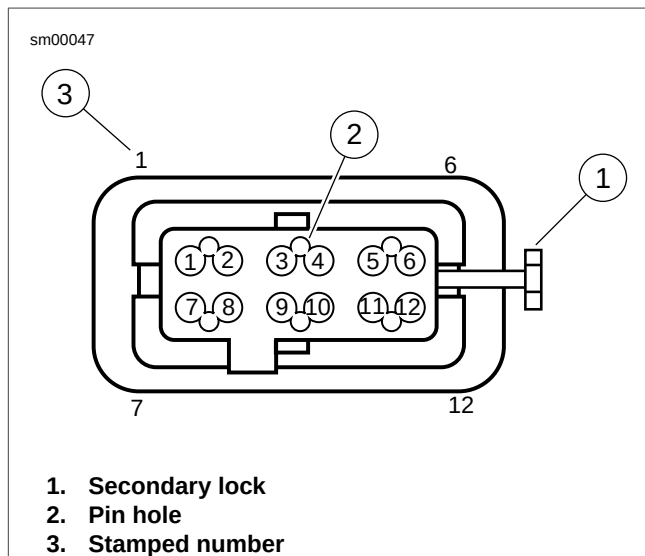


Figure A-43. Packard Micro 64 Connector: Housing

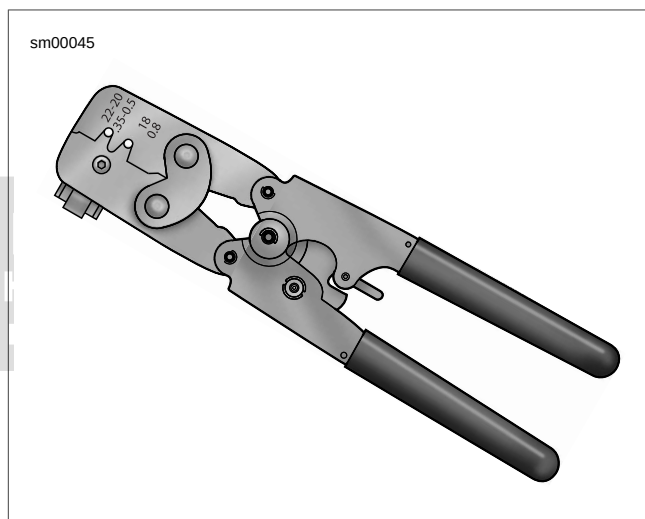


Figure A-44. Packard Micro 64 Terminal Crimper (HD-45929)



Figure A-45. Packard Micro 64 Connector: Terminal in Crimper

DIGITAL
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HARLEY-DAVIDSON®

SEALED SPLICE CONNECTORS

A.18

SEALED SPLICE CONNECTOR REPAIR

PART NUMBER	TOOL NAME
HD-25070	ROBINAIR HEAT GUN
HD-38125-8	PACKARD CRIMPING TOOL
HD-39969	ULTRA TORCH UT-100
HD-41183	HEAT SHIELD ATTACHMENT

General

Splice connectors and several OE ring terminal connectors use heat shrink covering to seal the connection.

Preparing Wire Leads

NOTE

If adjacent wires are to be spliced, stagger the splices so that the sealed splice connectors will not touch each other but are located at different positions along the length of the wires.

- Using a shop gauge, identify the gauge of the wire.
- Match the wire gauge to a sealed splice connector by color and part number. Refer to [Table A-4](#).
- Using a wire stripper, cut and strip a length of insulation off the wire ends. Refer to [Table A-4](#) for the strip length.

Table A-4. Sealed Splice Connectors

WIRE GAUGE	COLOR	PART NO.	STRIP LENGTH
18-20 (0.5-0.8 mm)	Red	70585-93	3/8 in. (9.5 mm)
14-16 (1.0-2.0 mm)	Blue	70586-93	3/8 in. (9.5 mm)
10-12 (3.0-5.0 mm)	Yellow	70587-93	3/8 in. (9.5 mm)

NOTE

If any copper wire strands are cut off of the wire core, trim the end and strip the wire again in a larger gauge stripper.

Splicing Wire Leads

NOTE

See [Figure A-47](#). The connector is crimped twice - one side and then the other.

- See [Figure A-46](#). Open the PACKARD CRIMPING TOOL (Part No. HD-38125-8) ratchet by squeezing the handles closed.
- Match the connector color to the wire gauge crimp die in the jaws and insert one end of the sealed connector.
- Gently squeeze the handles until the connector is held in the jaws.
- See [Figure A-47](#). Feed the stripped end of a wire into the connector until the wire stops inside the metal insert (1).

- Squeeze the handles tightly closed to crimp the lead in the insert (2). The tool automatically opens when the crimping is complete.
- Slide the connector to the other half of the metal insert. Insert the stripped wire lead (1) until it stops, and crimp the lead in the insert (2).

WARNING

Be sure to follow manufacturer's instructions when using the UltraTorch UT-100 or any other radiant heating device. Failure to follow manufacturer's instructions can cause a fire, which could result in death or serious injury. (00335a)

- Avoid directing heat toward any fuel system component. Extreme heat can cause fuel ignition/explosion resulting in death or serious injury.
 - Avoid directing heat toward any electrical system component other than the connectors on which heat shrink work is being performed.
 - Always keep hands away from tool tip area and heat shrink attachment.
- Use an ULTRA TORCH UT-100 (Part No. HD-39969), or a ROBINAIR HEAT GUN (Part No. HD-25070) with a HEAT SHIELD ATTACHMENT (Part No. HD-41183), to heat the connector from the center of the crimp (3) out to each end.

NOTE

It is acceptable for the splice to rest against the heat shrink tool attachment.

Inspecting Seals

See [Figure A-47](#). Allow the splice to cool and inspect the seal. The insulation should appear smooth and cylindrical. Melted sealant will have extruded out the ends (4) of the insulation.

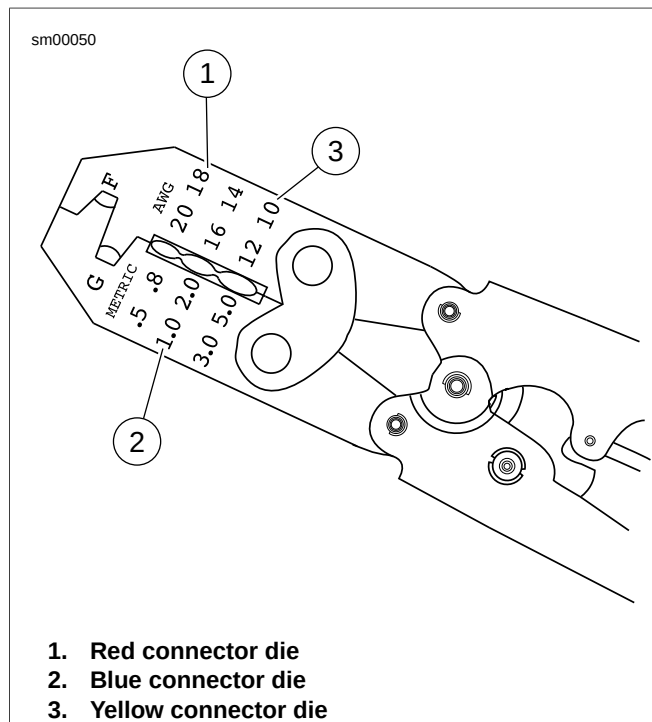


Figure A-46. Packard Crimping Tool (HD-38125-8)

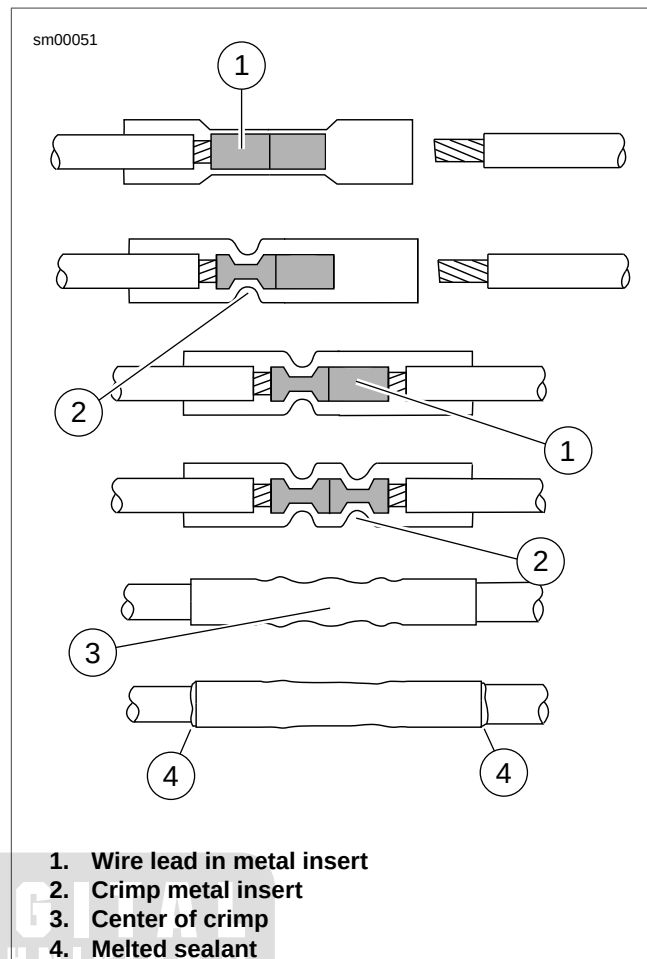


Figure A-47. Sealed Splice Connector

TABLE OF CONTENTS

SUBJECT	PAGE NO.
B.1 CONNECTORS.....	B-1
B.2 WIRING DIAGRAMS.....	B-3



NOTES



CONNECTORS

B.1

CONNECTOR LOCATIONS

Function/Location

Refer to [Table B-1](#). On the motorcycle, a connector can be identified by its function and location.

Place and Color

The place (number of wire cavities of a connector housing) and color of the connector can also aid identification.

Connector Number

On wiring diagrams and in service/repair instructions, connectors are identified by a number in brackets.

Repair Instructions

Refer to [Table B-1](#). The repair instructions in Appendix A are by connector type.

Table B-1. 2009 Sportster Connector Locations

NO.	DESCRIPTION	TYPE	LOCATION
[5]	MAXIFUSE	2-place Metri-Pack, black	On battery strap, behind left side cover
[7]	Tail lamp harness to main harness	6-place Multilock, black	Under seat
[18]	Left rear turn signal	2-place Multilock, white	Inside tail lamp lens
[19]	Right rear turn signal	2-place Multilock, black	Inside tail lamp lens
[20]	Instruments	12-place Molex, black	Under fuel tank
[22]	Right hand controls	6-place Molex, black	Under fuel tank
[24]	Left hand controls and horn	8-place Molex, gray	Under fuel tank
[30]	TSM/TSSM/HFSM	12-place Deutsch, gray	Under battery
[31]	Front turn signals	6-place Molex, black	Under fuel tank
[33]	Ignition switch	-	Right side of frame behind neck
[38]	Headlamp	4-place Multilock, black	Under fuel tank
[39]	Speedometer (XL)	12-place Packard Micro-64, black	Back of speedometer
[39]	Tachometer (XR)	5-place Packard	Back of speedometer
[46]	Voltage regulator to stator	2-place Lyall, black	In front of engine crankcase
[61]	Fuse block	Spade terminals	Behind left side cover
[65]	Vehicle Speed Sensor (VSS)	3-place Packard, black	Right rear top of crankcase
[77]	Voltage regulator (DC output)	2-place Lyall, black	In front of engine crankcase
[78]	Electronic Control Module (ECM)	36-place Packard, gray	Under seat
[79]	Crankshaft Position (CKP) sensor	2-place Deutsch, black	Front of left crankcase
[80]	Temperature Manifold Absolute Pressure (TMAP) sensor	4-place Packard, black	Top of intake manifold
[83]	Ignition coil	4-place Delphi, black	Back of coil, under fuel tank
[84]	Front injector	2-place Delphi, black	Top of intake manifold
[85]	Rear injector	2-place Delphi, black	Top of intake manifold
[87]	Idle Air Control (IAC)	4-place Delphi, black	Top of induction module
[88]	Throttle Position (TP) sensor	3-place Delphi, black	Behind air cleaner backing plate
[90]	Engine Temperature (ET) sensor	2-place Delphi, black	Above induction module, right side
[91]	Data link connector	4-place Deutsch, gray	On battery strap, behind left side cover
[93]	Tail lamp	4-place Multilock, black	Inside tail lamp lens
[94]	Tail lamp power in	6-place Multilock, black	Inside tail lamp lens
[108]	Tachometer	12-place Packard Micro-64, gray	Back of tachometer
[119]	Relay/fuse block	5-place Amp, spade terminals	Fuse/relay block, behind left side cover

Table B-1. 2009 Sportster Connector Locations

NO.	DESCRIPTION	TYPE	LOCATION
[120]	Oil pressure switch	90° post terminal, black	Oil pressure switch, under oil filter mount
[121]	Rear stoplight switch	Spade terminals, black	Stop lamp switch, under battery tray
[122]	Horn	90° spade terminals, black	Between cylinders, left side
[128]	Starter solenoid	Locking spade terminal, white	Starter solenoid
[133]	Jiffy Stand Sensor (HDI)	3-place, black	Left side along frame toward front of engine
[136]	Neutral switch	1-place molded jumper, black	Right side frame, beneath gearcase cover
[137]	Rear oxygen sensor	2-place Amp, black	On H-bracket
[138]	Front oxygen sensor	2-place Amp, black	Electrical caddie behind voltage regulator
[141]	Fuel pump and low fuel switch	4-place Molex, black	Forward of relay/fuse blocks
[142]	Security siren	3-place Packard, black	Under frame
[145]	Engine harness	16-place Molex, black	Under seat
[160]	B+ connector	1-place Packard, gray	Under seat
[178]	Active intake solenoid	2-place	Right side behind air box
[200]	Fuel sender resistor assembly	3-place Molex, black	Under seat
[208]	HFSM antenna connector	4-place Deutsch, gray	Under battery
[209]	Security antenna	2-place Molex, black	Under seat
[GND1]	Powertrain ground	Ring terminal	Crankcase housing, top rear



WIRING DIAGRAMS

B.2

WIRING DIAGRAM INFORMATION

Wire Color Codes

Wire traces on wiring diagrams are labeled with alpha codes. Refer to [Table B-2](#).

For Solid Color Wires: See [Figure B-1](#). The alpha code identifies wire color (3).

For Striped Wires: The code is written with a slash (/) between the solid color code and the stripe code (4). For example, a trace labeled GN / Y is a green wire with a yellow stripe.

Wiring Diagram Symbols

See [Figure B-1](#). On wiring diagrams and in service/repair instructions, connectors are identified by a number in brackets (1). The letter (2) inside the brackets identifies whether the housing is a socket or pin housing.

A=Pin: The letter A after a connector number and the pin symbol (6) identifies a pin housing.

B=Socket: The letter B after a connector number and the socket symbol (5) identifies a socket housing.

Other symbols found on the wiring diagrams include the symbol for a diode (7), a symbol for a wire-to-wire connection (8), a symbol verifying that no connection (9) between two wire traces exists, symbols for actual (10) and virtual (11) splices, and a symbol identifying two wires that are twisted together (12).

Actual splices (10) are splices where two wires are connected together at a specific location along a wire. Virtual splices (11) are splices shown connected anywhere along a wire, usually used in a wiring or schematic diagram for clarity.

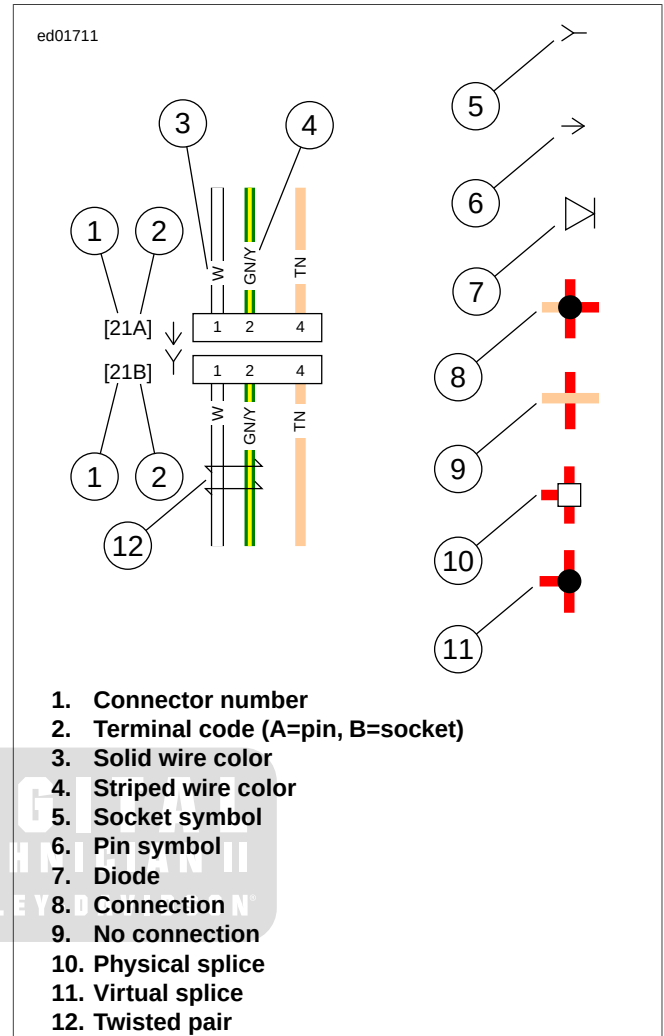


Figure B-1. Connector/Wiring Diagram Symbols (typical)

Table B-2. Wire Color Codes

ALPHA CODE	WIRE COLOR
BE	Blue
BK	Black
BN	Brown
GN	Green
GY	Gray
LGN	Light Green
O	Orange
PK	Pink
R	Red
TN	Tan
V	Violet
W	White
Y	Yellow

2009 SPORTSTER WIRING DIAGRAMS

Refer to the table below for wiring diagram information.

Wiring Diagram List

DIAGRAM	LOCATION
Main Harness (XL): 2009 Sportster DOM. and INT. Models	Figure B-2
Indicator Lamps and Controls (XL): 2009 Sportster DOM. and INT. Models	Figure B-3
Starting and Charging: 2009 Sportster DOM. and INT. Models	Figure B-4
Engine Management (1 of 2) (XL): 2009 Sportster DOM. and INT. Models	Figure B-5
Engine Management (2 of 2) (XL): 2009 Sportster DOM. and INT. Models	Figure B-6
Lights (1 of 2) (XL): 2009 Sportster DOM. and INT. Models	Figure B-7
Lights (2 of 2) (XL): 2009 Sportster DOM. and INT. Models	Figure B-8
Horn and Instruments (XL): 2009 Sportster DOM. and INT. Models	Figure B-9
Security (1 of 2) (XL): 2009 Sportster DOM. and INT. Models	Figure B-10
Security (2 of 2) (XL): 2009 Sportster DOM. and INT. Models	Figure B-11
Main Harness (XR): 2009 Sportster DOM. and INT. Models	Figure B-12
Indicator Lamps and Controls (XR): 2009 Sportster DOM. and INT. Models	Figure B-13
Engine Management (1 of 2) (XR): 2009 Sportster DOM. and INT. Models	Figure B-14
Engine Management (2 of 2) (XR): 2009 Sportster DOM. and INT. Models	Figure B-15
Lights (1 of 2) (XR): 2009 Sportster DOM. and INT. Models	Figure B-16
Lights (2 of 2) (XR): 2009 Sportster DOM. and INT. Models	Figure B-17
Horn and Instruments (XR): 2009 Sportster DOM. and INT. Models	Figure B-18
Security (1 of 2) (XR): 2009 Sportster DOM. and INT. Models	Figure B-19
Security (2 of 2) (XR): 2009 Sportster DOM. and INT. Models	Figure B-20

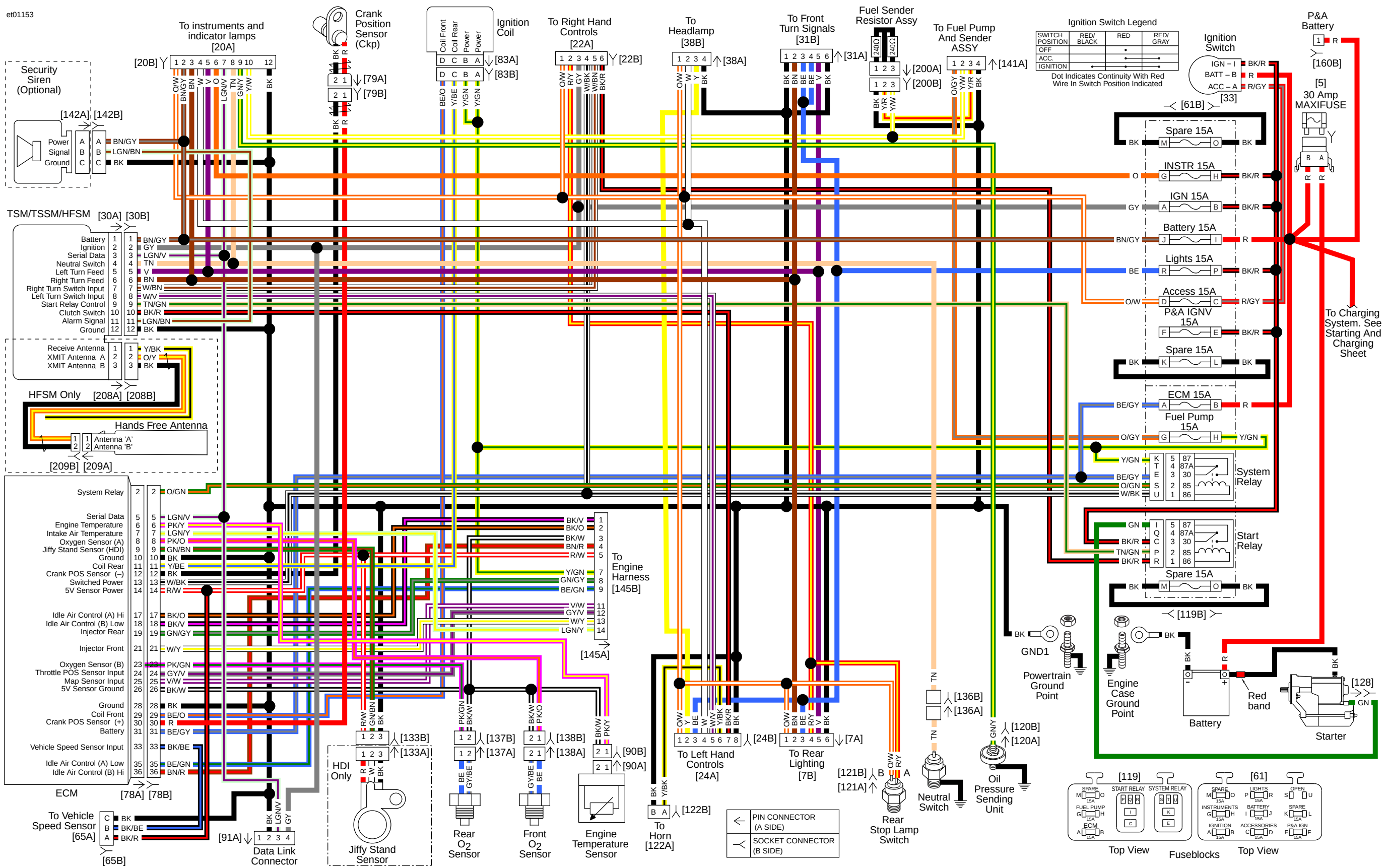


Figure B-2. Main Harness (XL): 2009 Sportster DOM and INT. Models

Figure B-2.

Main Harness (XL): 2009 Sportster DOM. and INT. Models

Figure B-2.

Main Harness (XL): 2009 Sportster DOM. and INT. Models

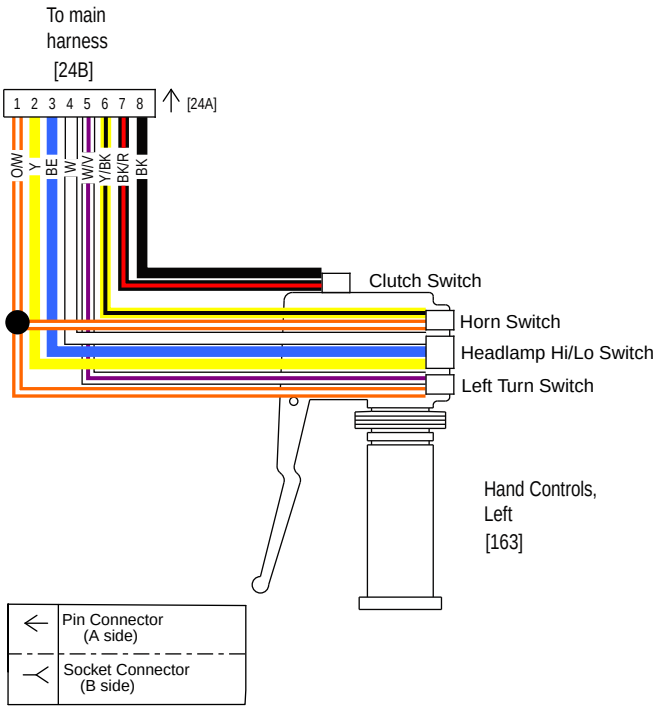
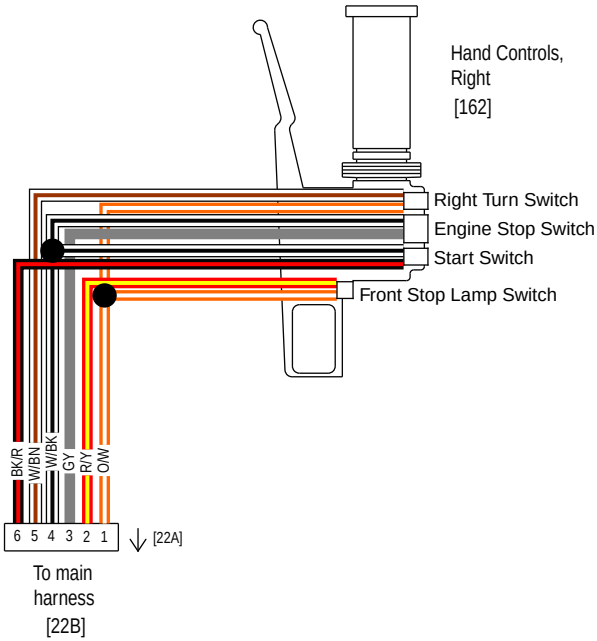
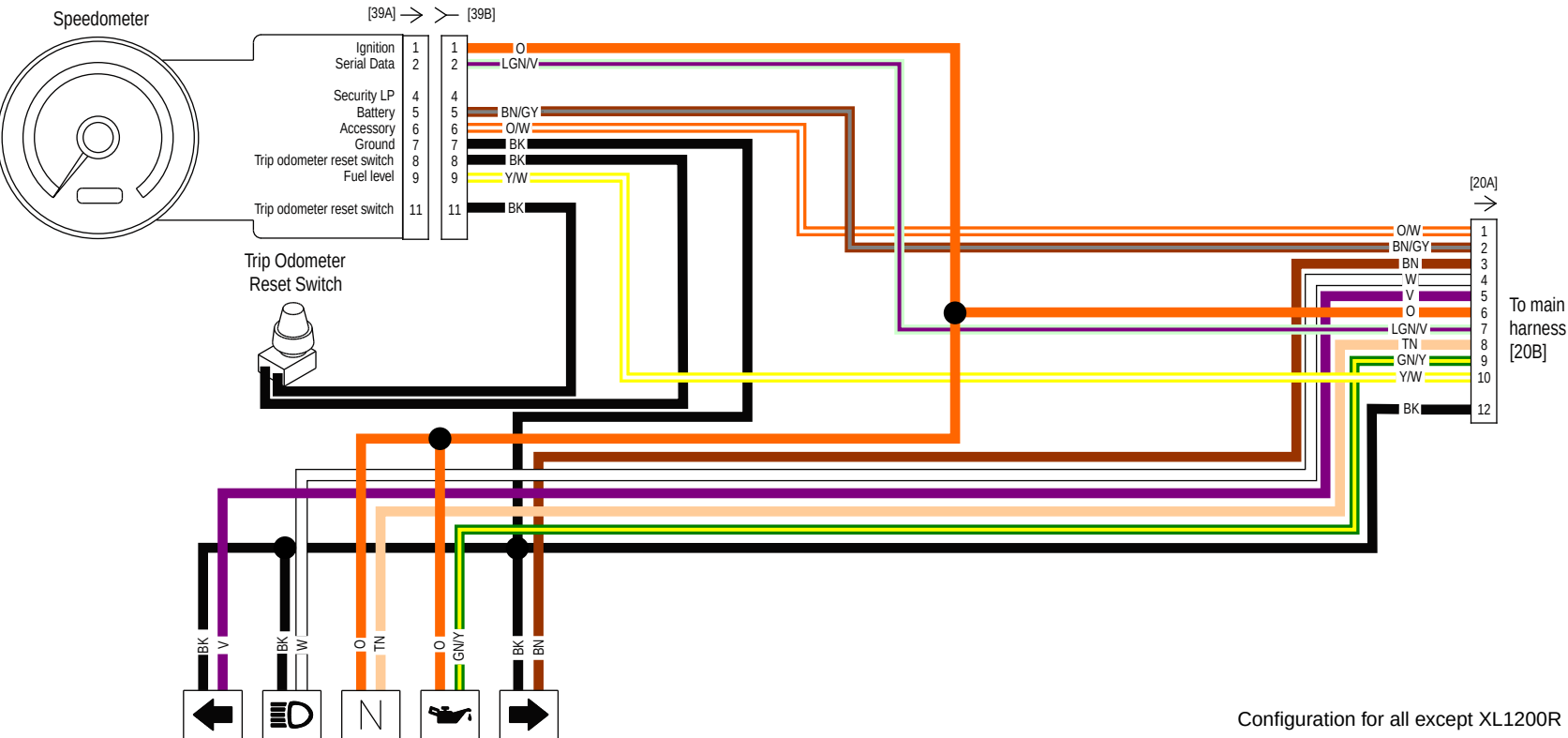
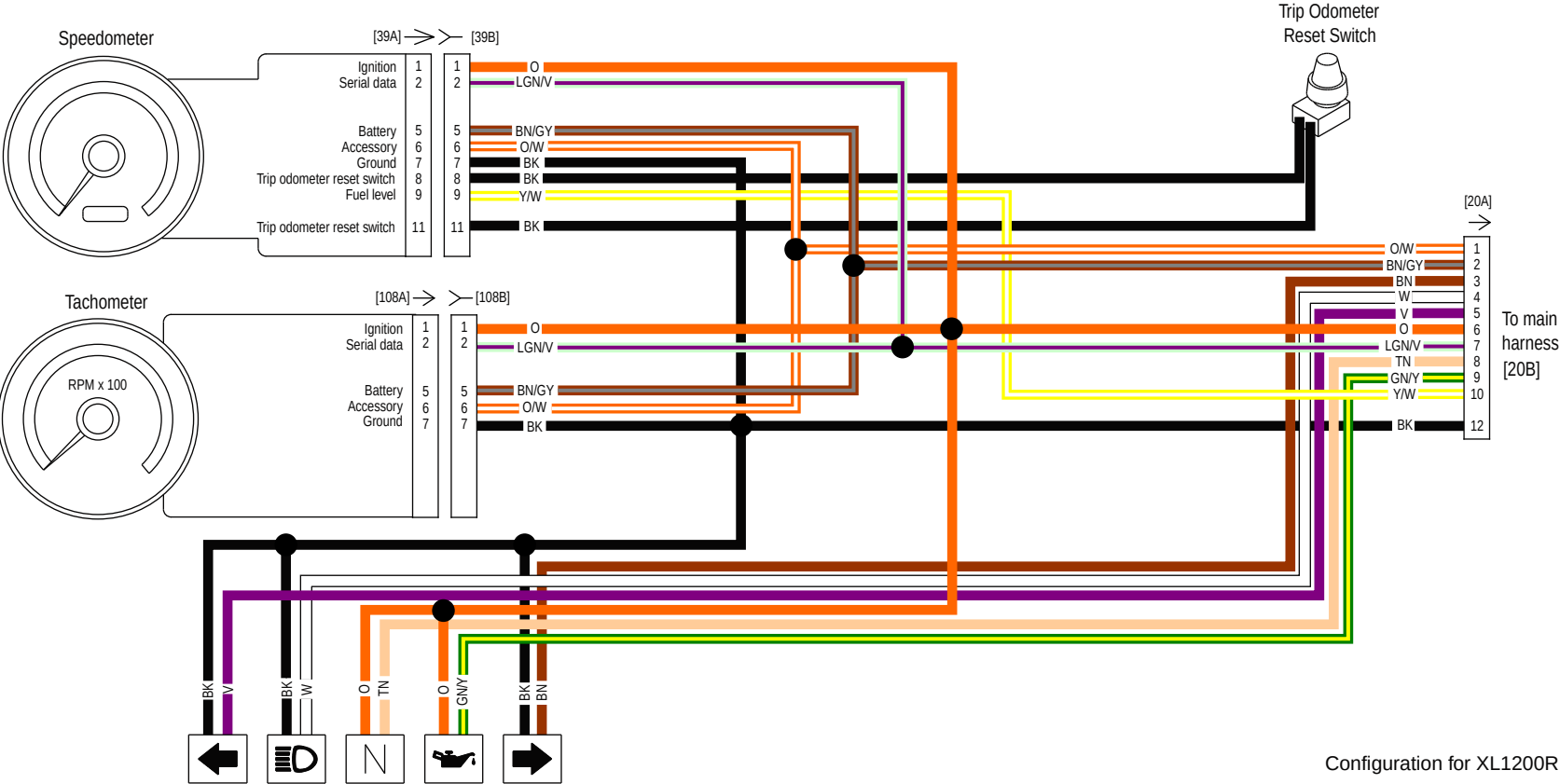


Figure B-3. Indicator Lamps and Controls (XL): 2009 Sportster DOM. and INT. Models

Figure B-3.
Indicator Lamps and Controls (XL): 2009 Sportster DOM.
and INT. Models

Figure B-3.
Indicator Lamps and Controls (XL): 2009 Sportster DOM.
and INT. Models

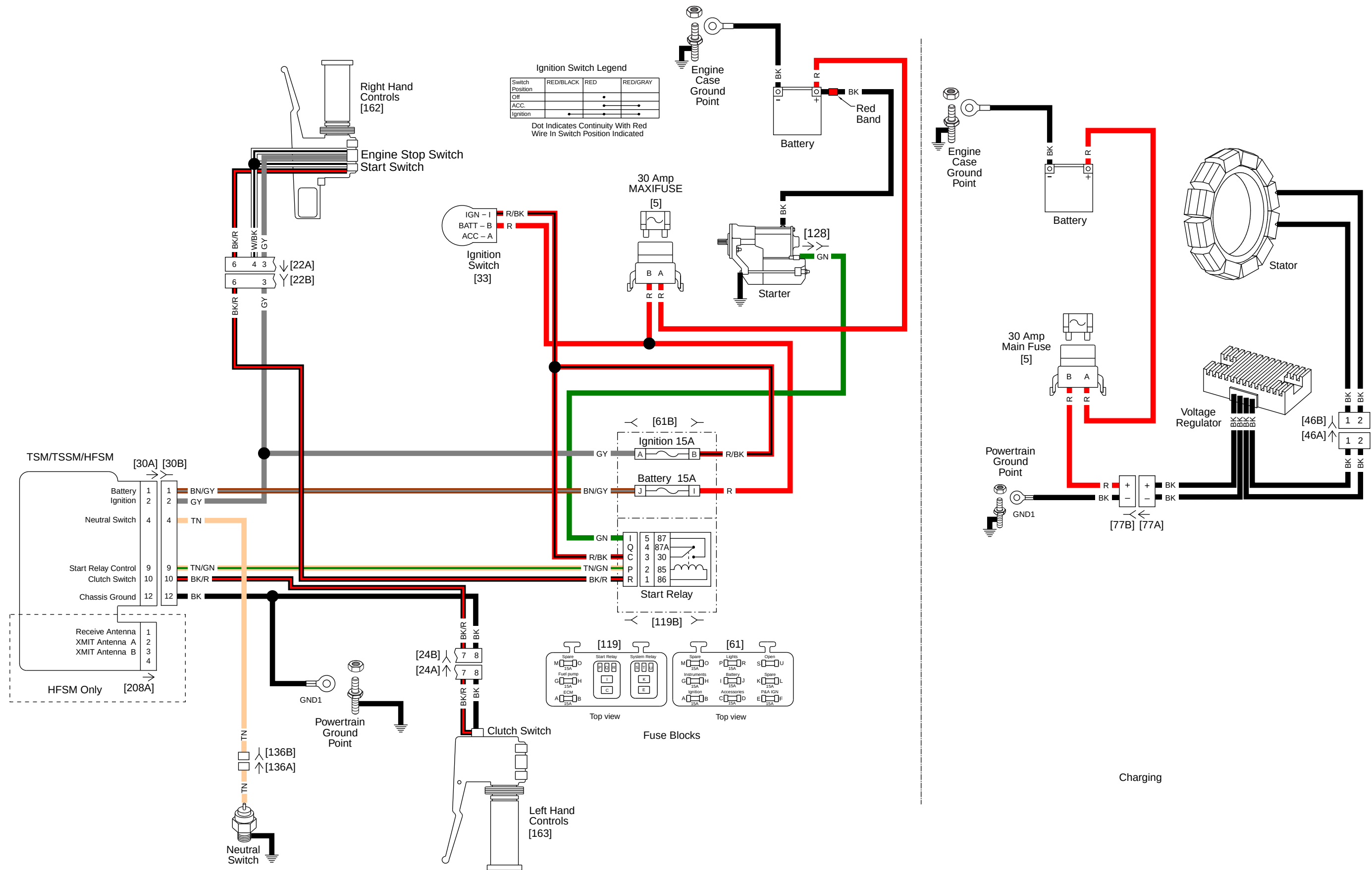


Figure B-4. Starting and Charging: 2009 Sportster DOM. and INT. Models

Figure B-4.
Starting and Charging: 2009 Sportster DOM. and INT. Models

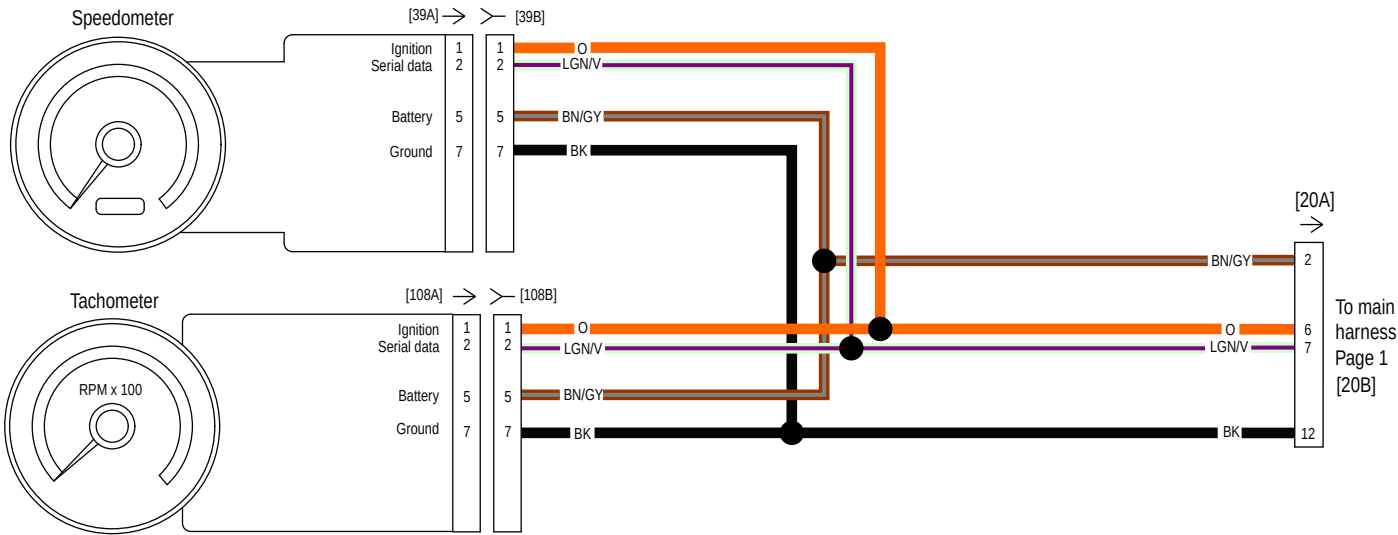
Figure B-4.
Starting and Charging: 2009 Sportster DOM. and INT. Models



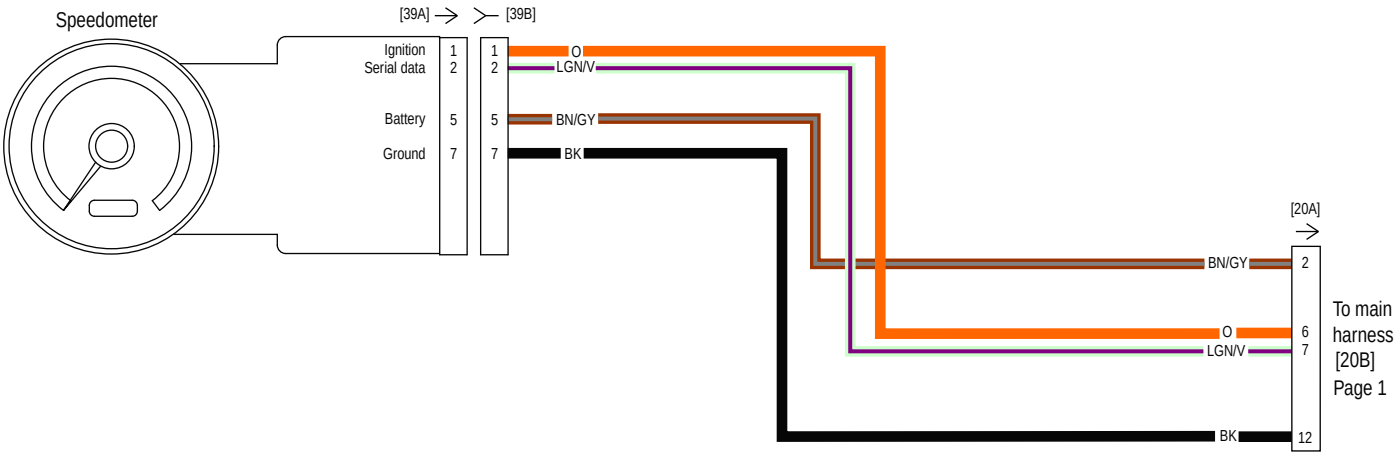
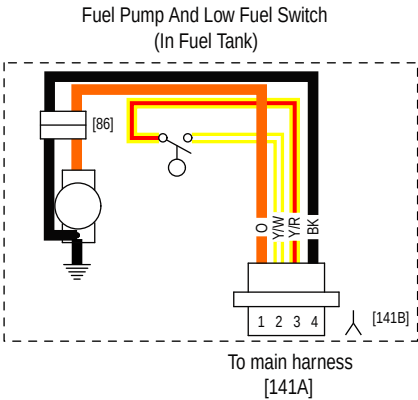
Figure B-5. Engine Management (1 of 2) (XL): 2009 Sportster DOM. and INT. Models

Figure B-5.
Engine Management (1 of 2) (XL): 2009 Sportster DOM. and
INT. Models

Figure B-5.
Engine Management (1 of 2) (XL): 2009 Sportster DOM. and
INT. Models



Configuration for XL1200R



←	Pin connector (A side)
↗	Socket connector (B side)

Configuration for all except XL1200R

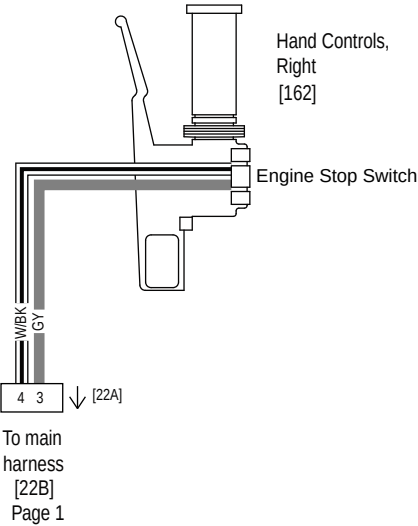


Figure B-6. Engine Management (2 of 2) (XL): 2009 Sportster DOM. and INT. Models

Figure B-6.
Engine Management (2 of 2) (XL): 2009 Sportster DOM. and
INT. Models

Figure B-6.
Engine Management (2 of 2) (XL): 2009 Sportster DOM. and
INT. Models

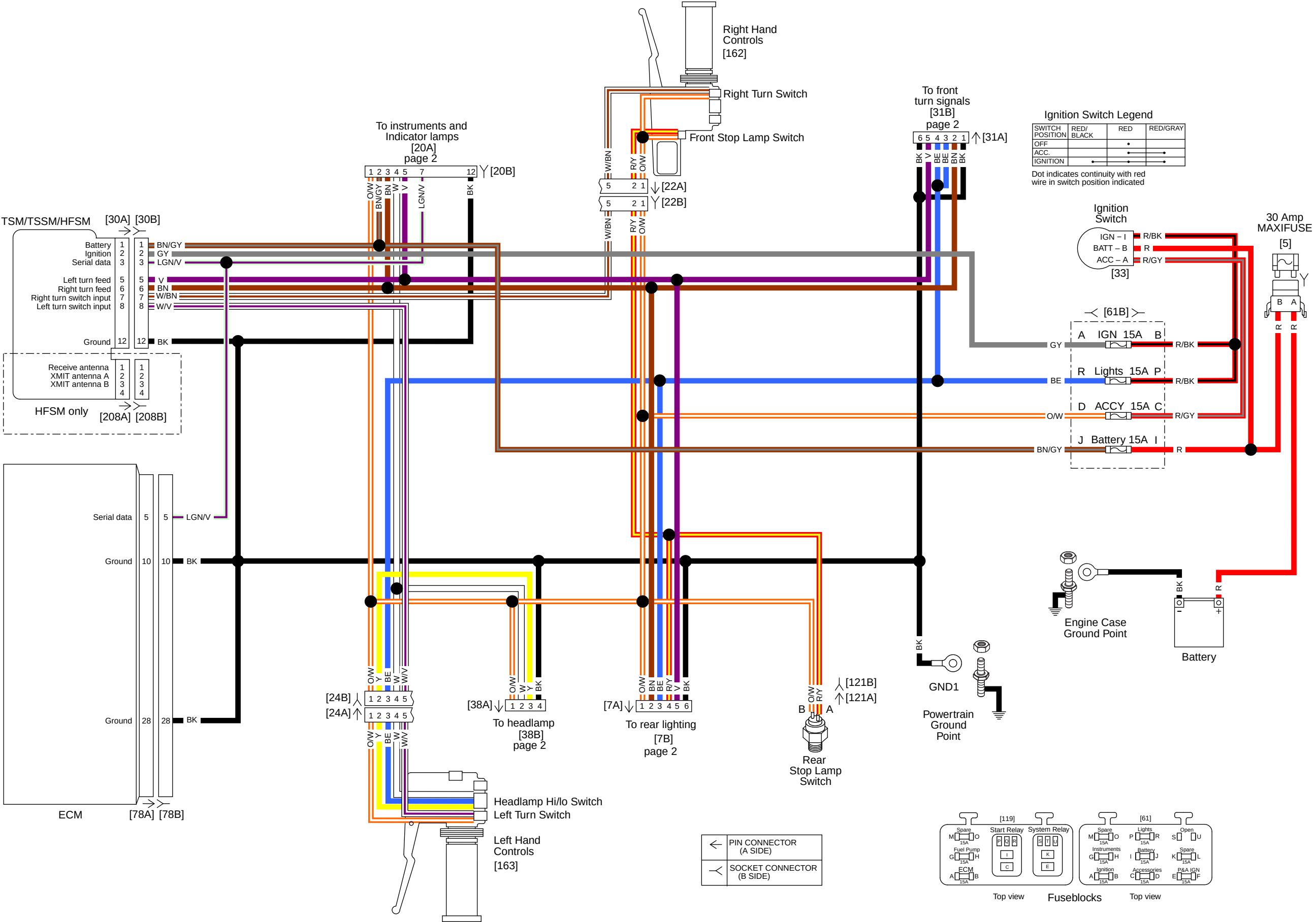


Figure B-7. Lights (1 of 2) (XL): 2009 Sportster DOM. and INT. Models

Figure B-7.

Lights (1 of 2) (XL): 2009 Sportster DOM. and INT. Models

Figure B-7.

Lights (1 of 2) (XL): 2009 Sportster DOM. and INT. Models

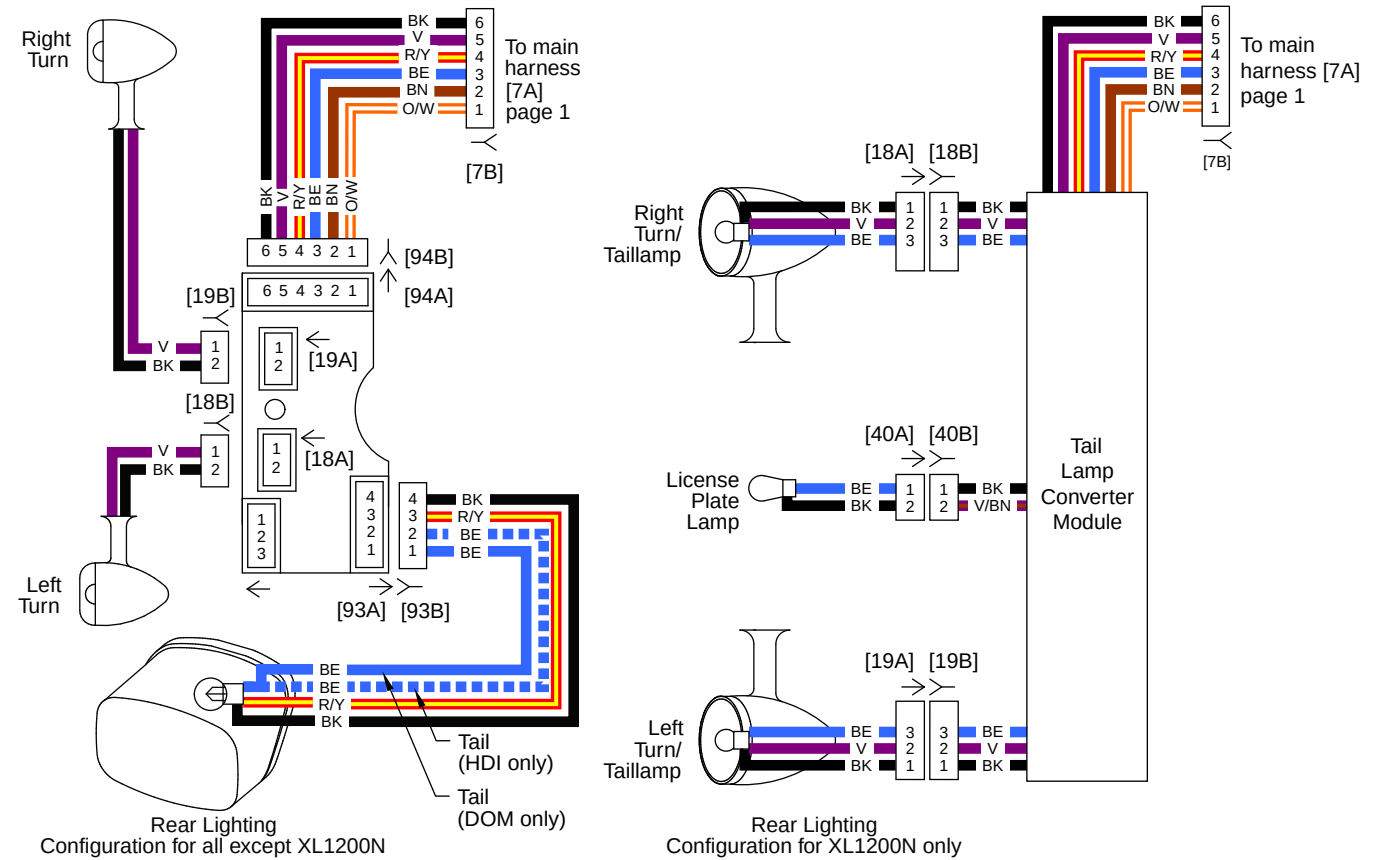
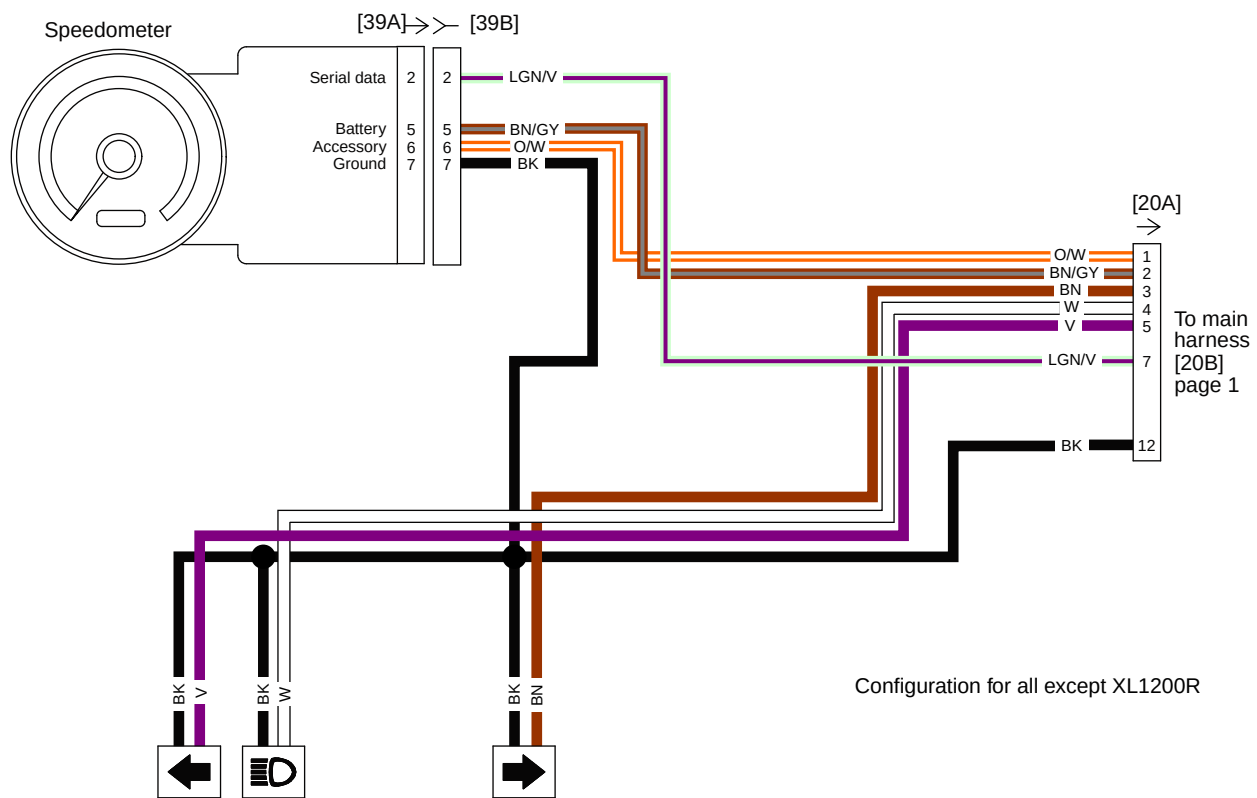
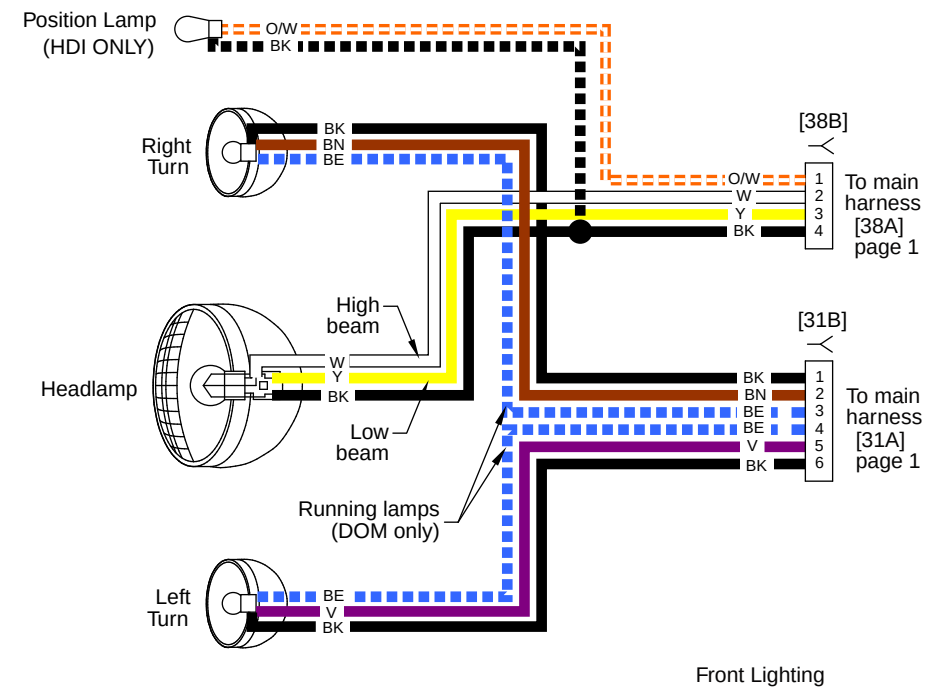
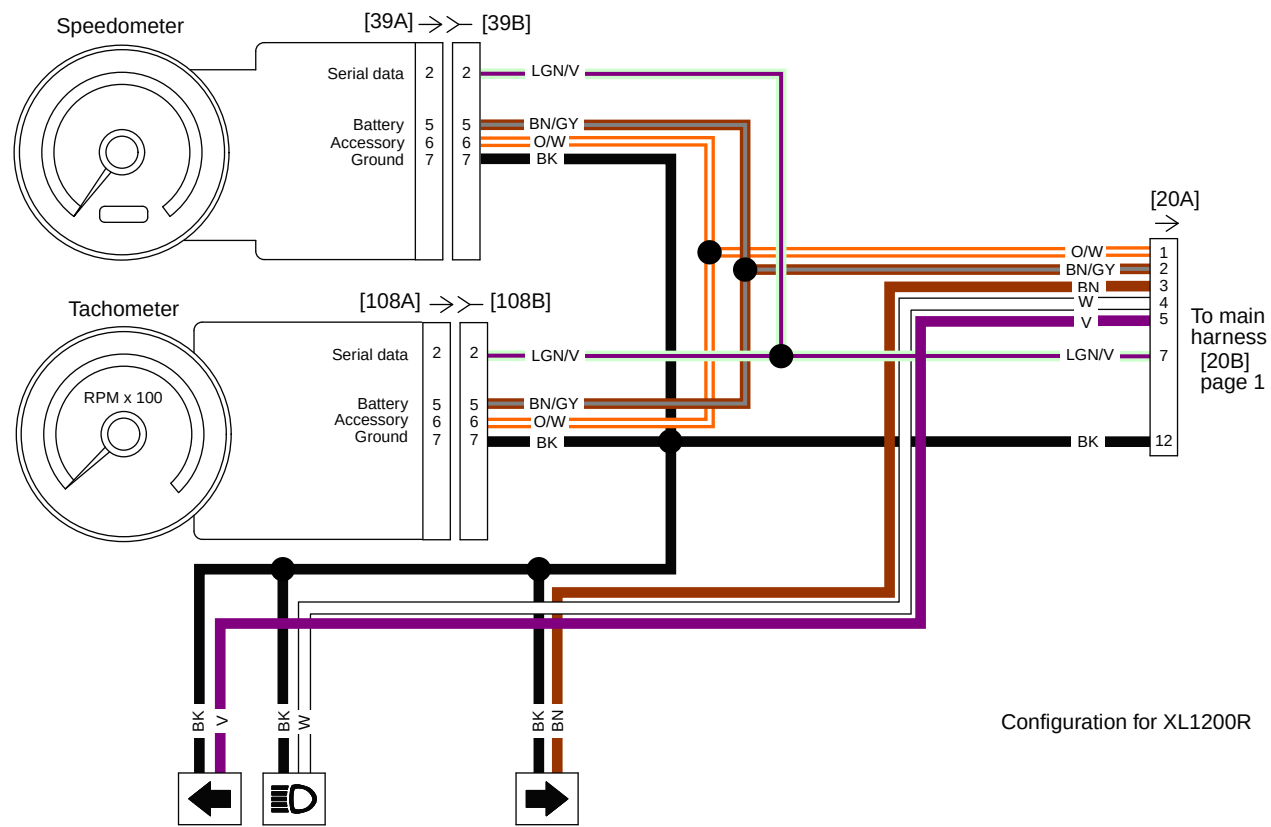


Figure B-8. Lights (2 of 2) (XL): 2009 Sportster DOM. and INT. Models

Figure B-8.

Lights (2 of 2) (XL): 2009 Sportster DOM. and INT. Models

Figure B-8.

Lights (2 of 2) (XL): 2009 Sportster DOM. and INT. Models

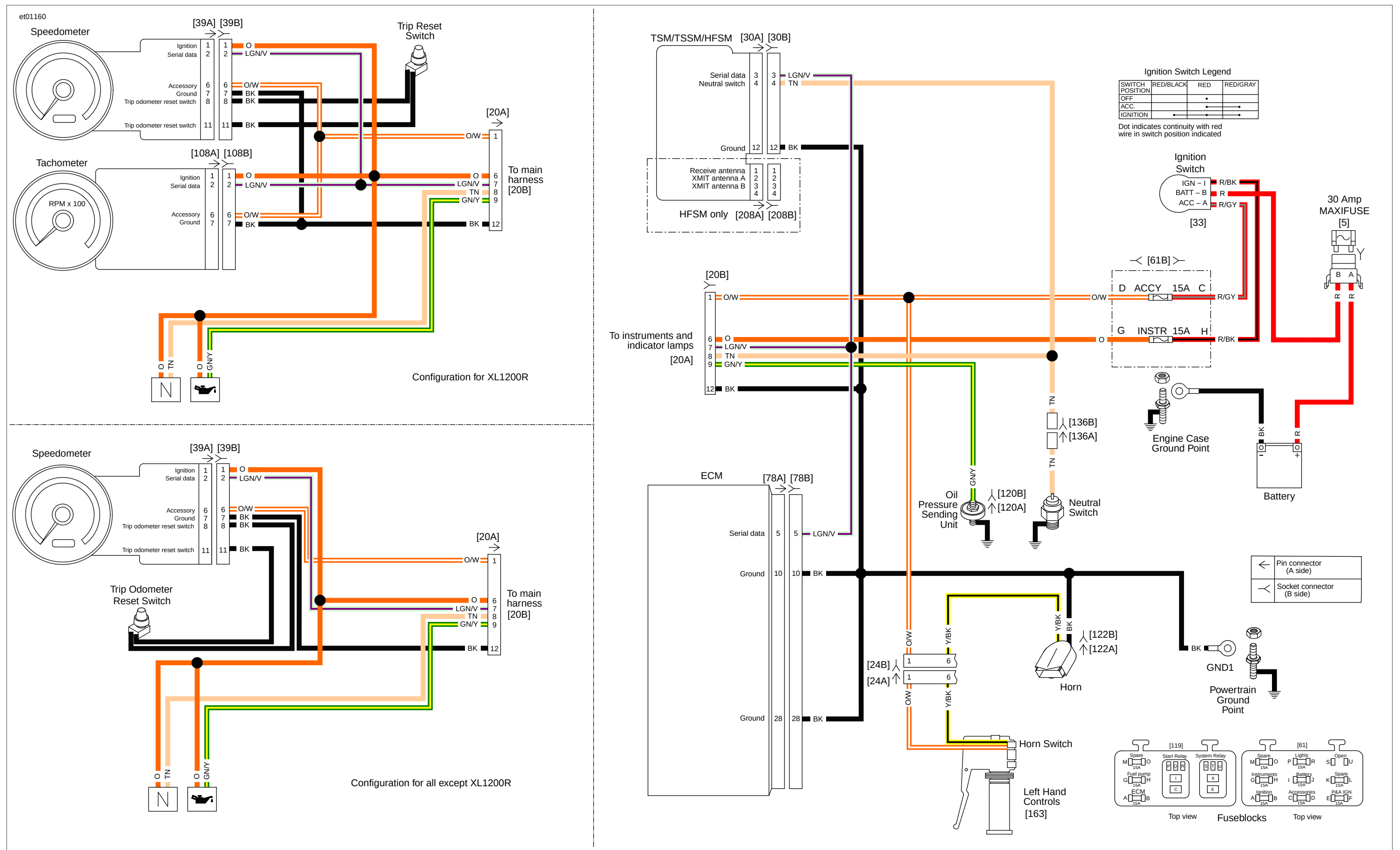


Figure B-9. Horn and Instruments (XL): 2009 Sportster DOM. and INT. Models

Figure B-9.
Horn and Instruments (XL): 2009 Sportster DOM. and INT.
Models

Figure B-9.
Horn and Instruments (XL): 2009 Sportster DOM. and INT.
Models

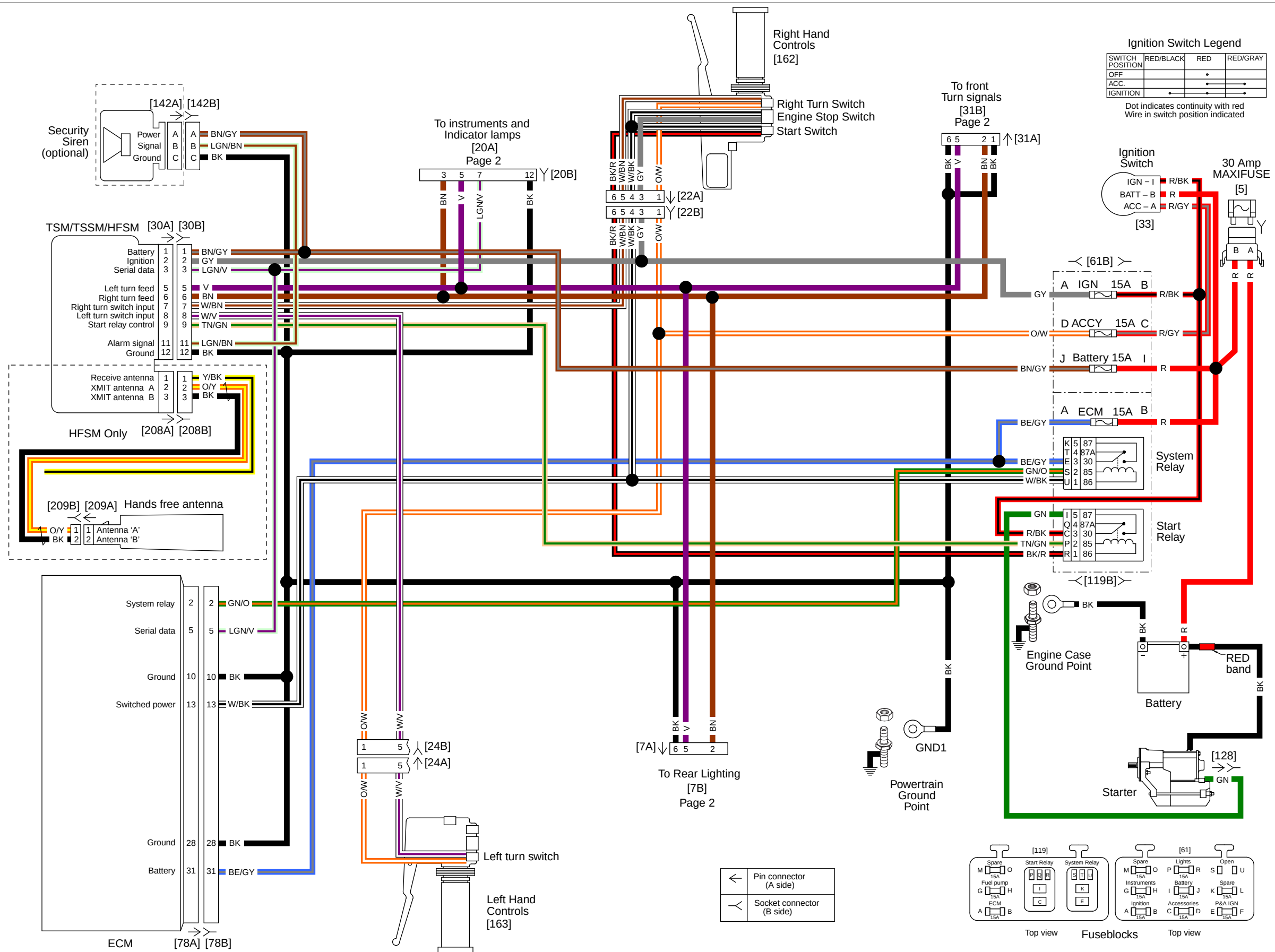
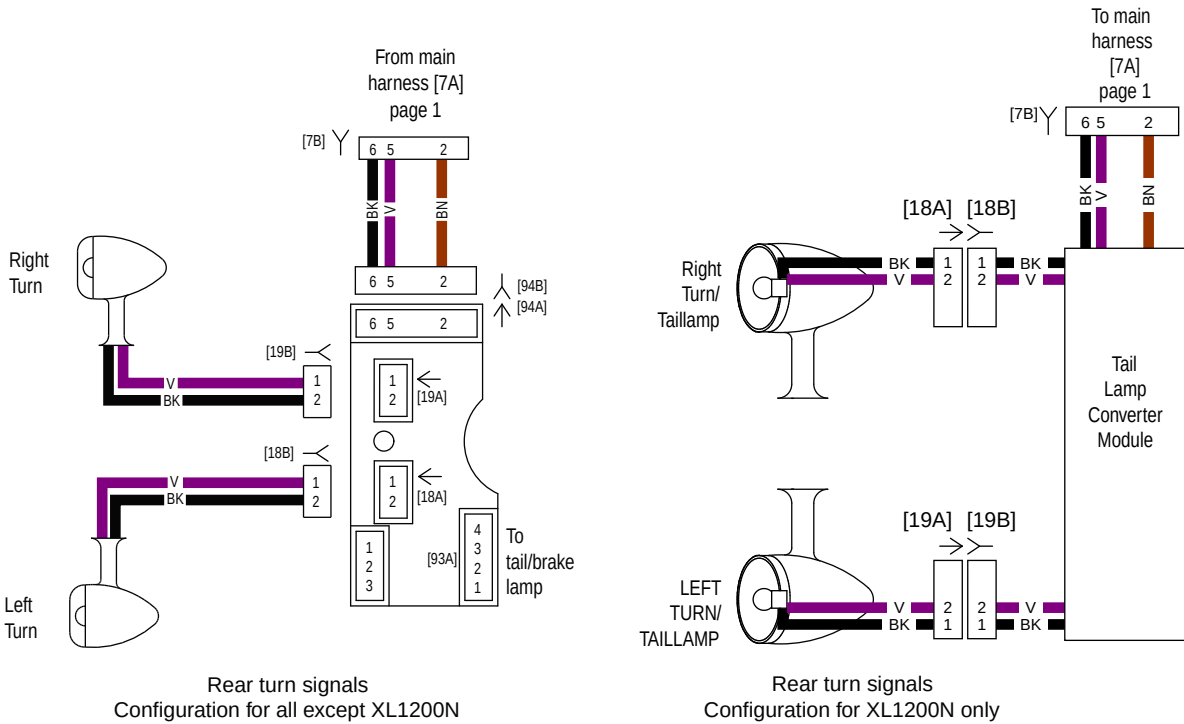
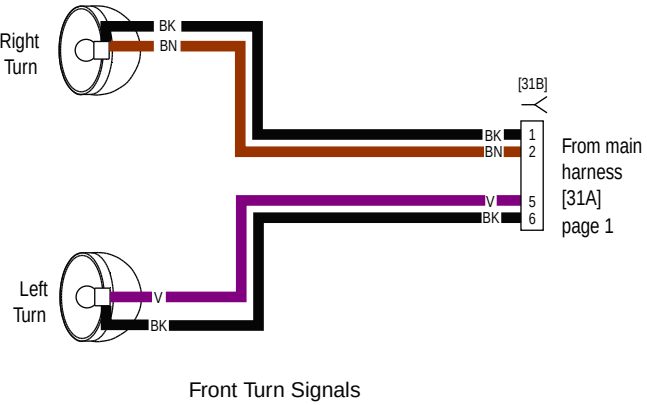
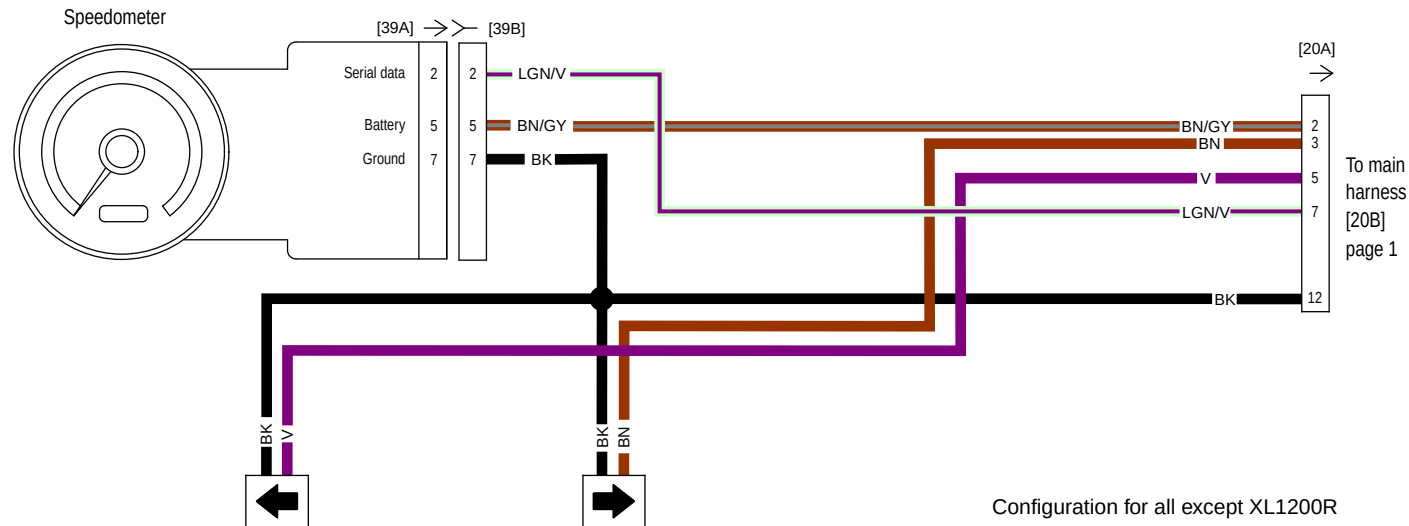
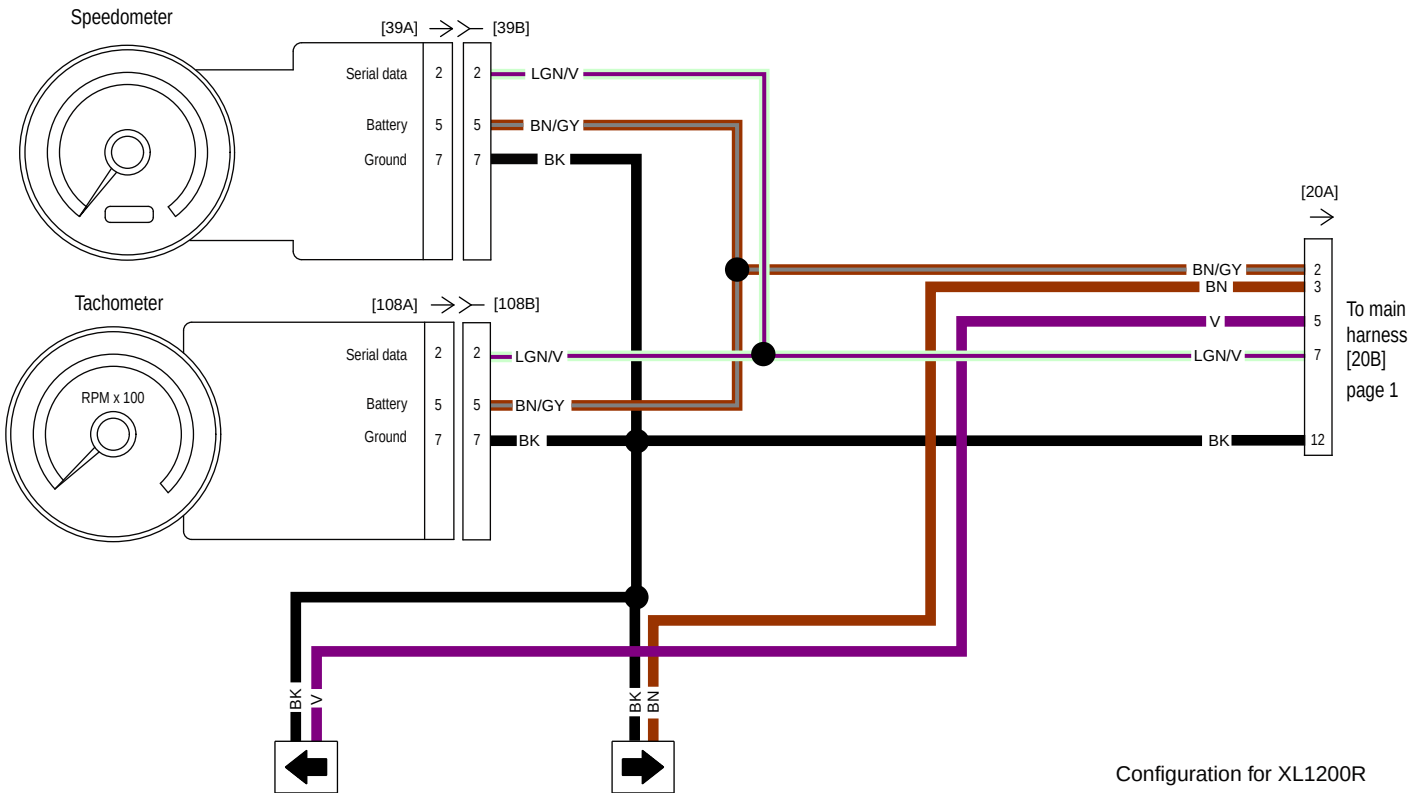


Figure B-10. Security (1 of 2) (XL): 2009 Sportster DOM. and INT. Models

Figure B-10.
Security (1 of 2) (XL): 2009 Sportster DOM. and INT. Models

Figure B-10.
Security (1 of 2) (XL): 2009 Sportster DOM. and INT. Models



←	Pin connector (A side)
↔	Socket connector (B side)

Figure B-11. Security (2 of 2) (XL): 2009 Sportster DOM. and INT. Models

Figure B-11.

Security (2 of 2) (XL): 2009 Sportster DOM. and INT. Models

Figure B-11.

Security (2 of 2) (XL): 2009 Sportster DOM. and INT. Models

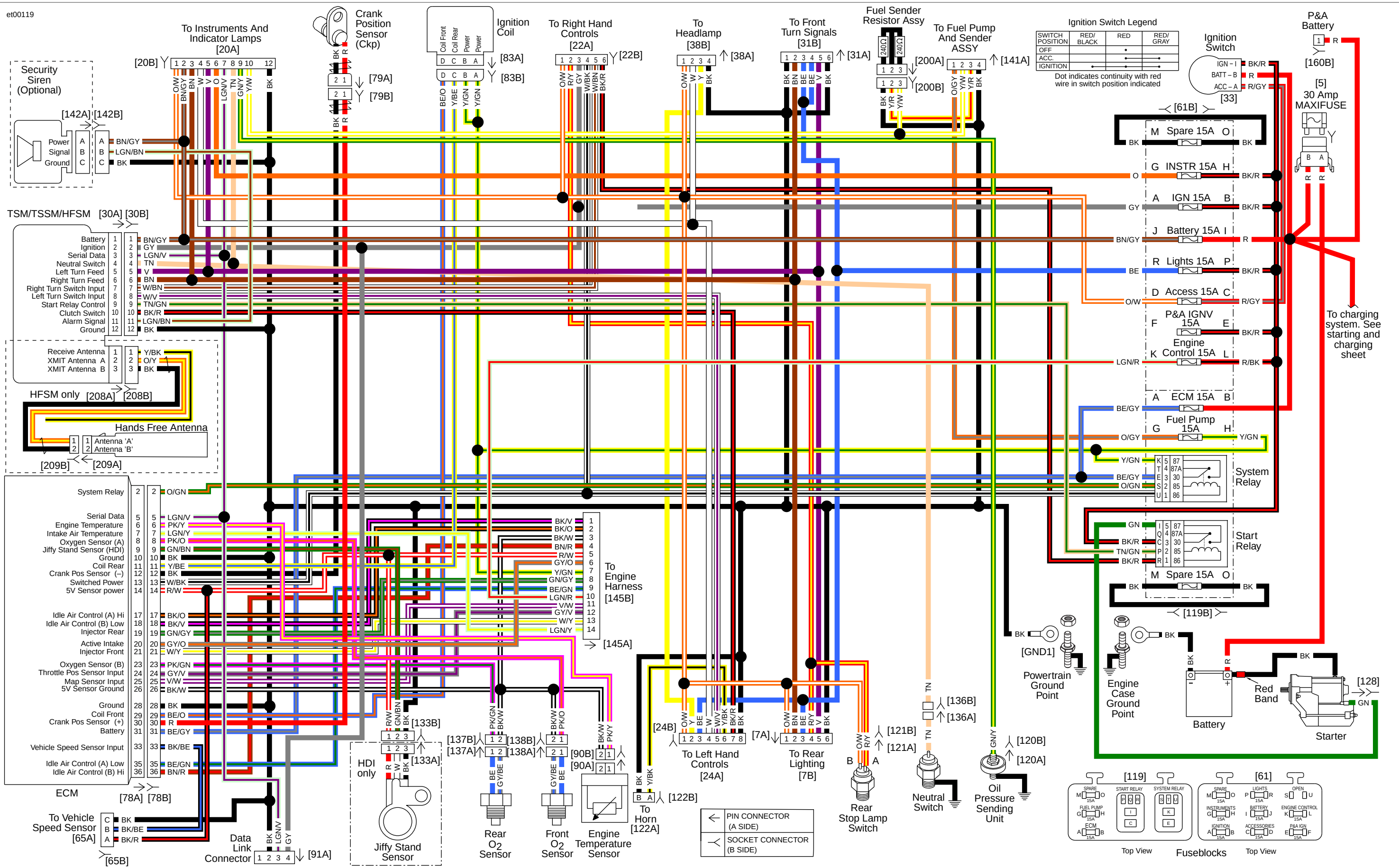


Figure B-12. Main Harness (XR): 2009 Sportster DOM and INT Models

Figure B-12.

Main Harness (XR): 2009 Sportster DOM. and INT. Models

Figure B-12.

Main Harness (XR): 2009 Sportster DOM. and INT. Models

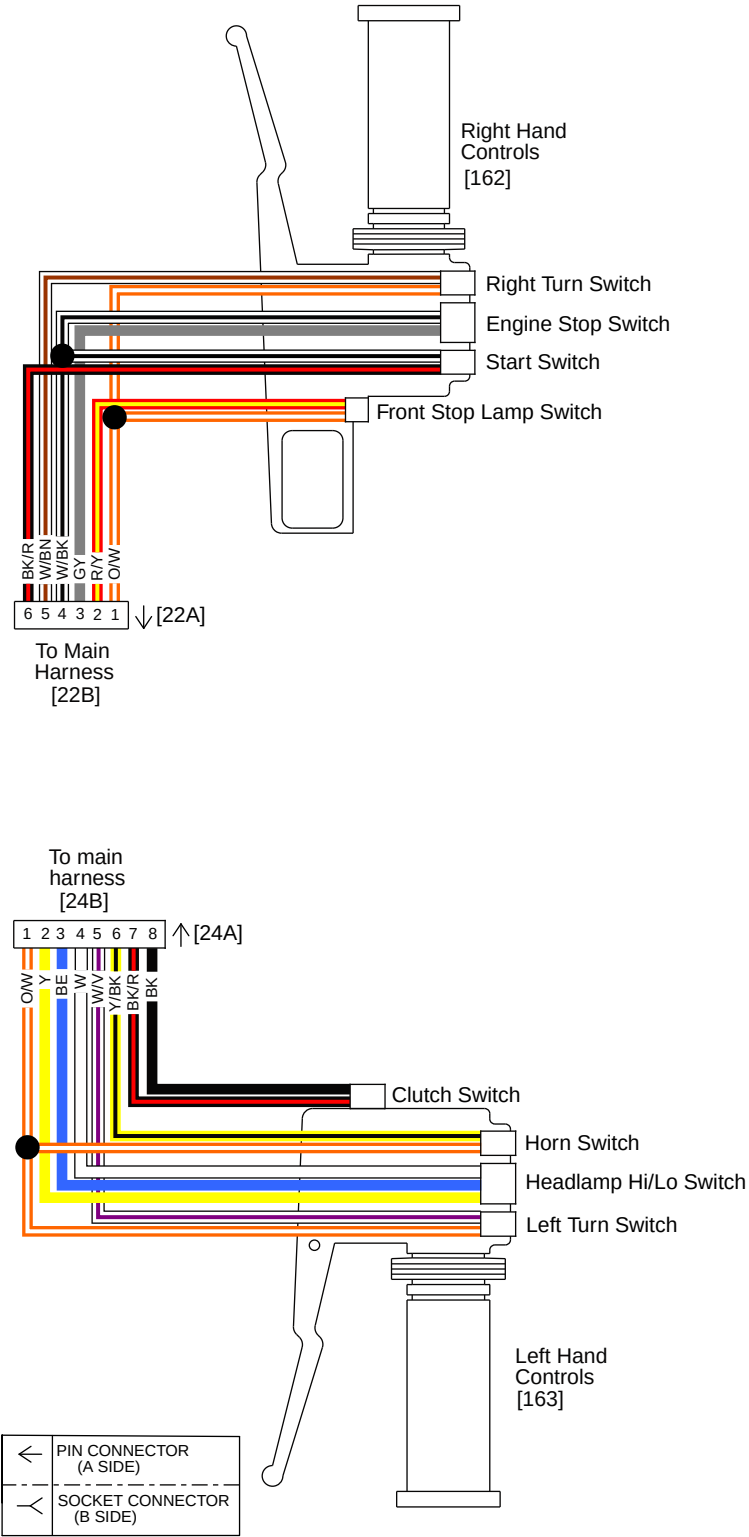
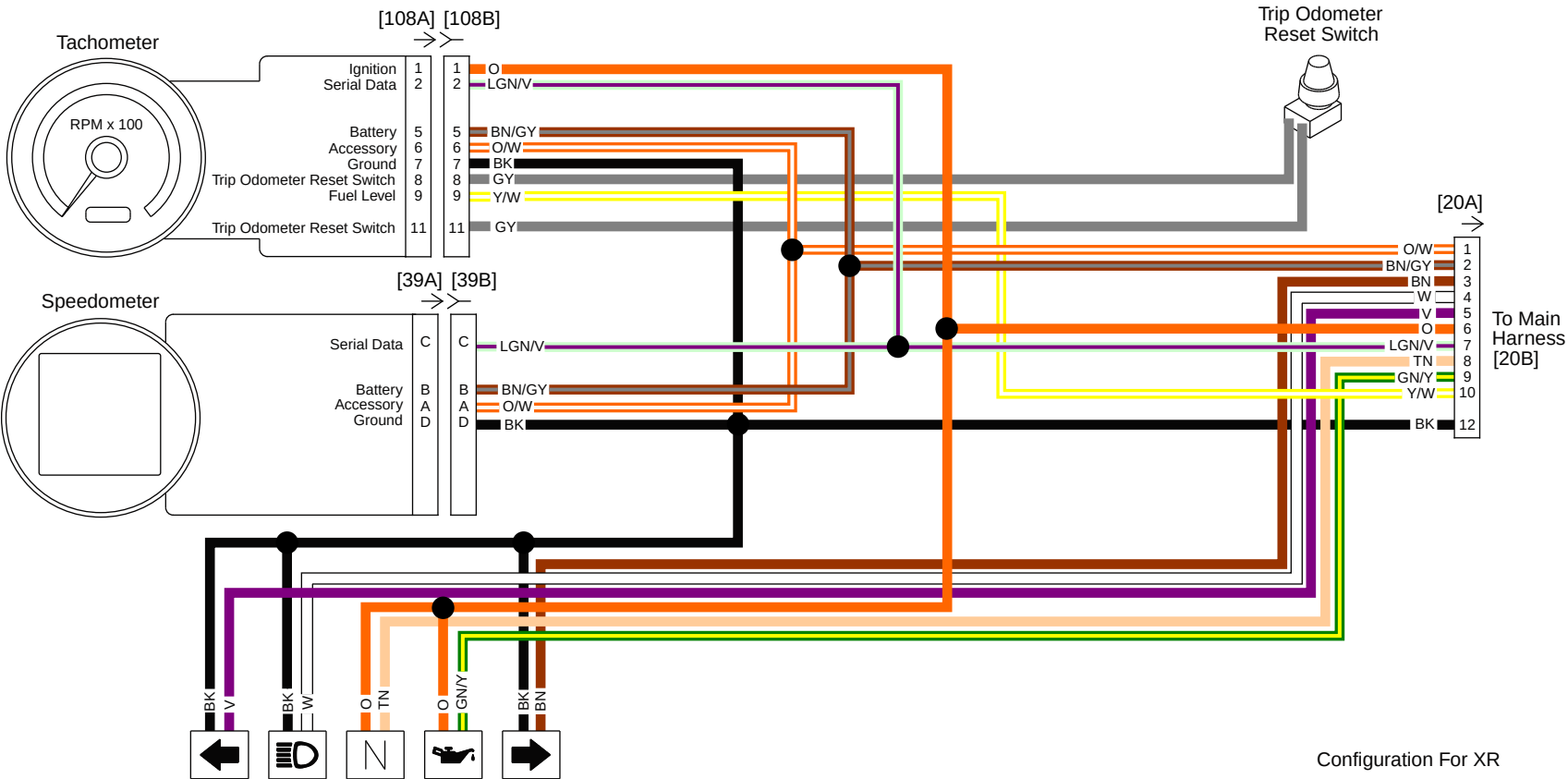


Figure B-13. Indicator Lamps and Controls (XR): 2009 Sportster DOM. and INT. Models

Figure B-13.
Indicator Lamps and Controls (XR): 2009 Sportster DOM.
and INT. Models

Figure B-13.
Indicator Lamps and Controls (XR): 2009 Sportster DOM.
and INT. Models

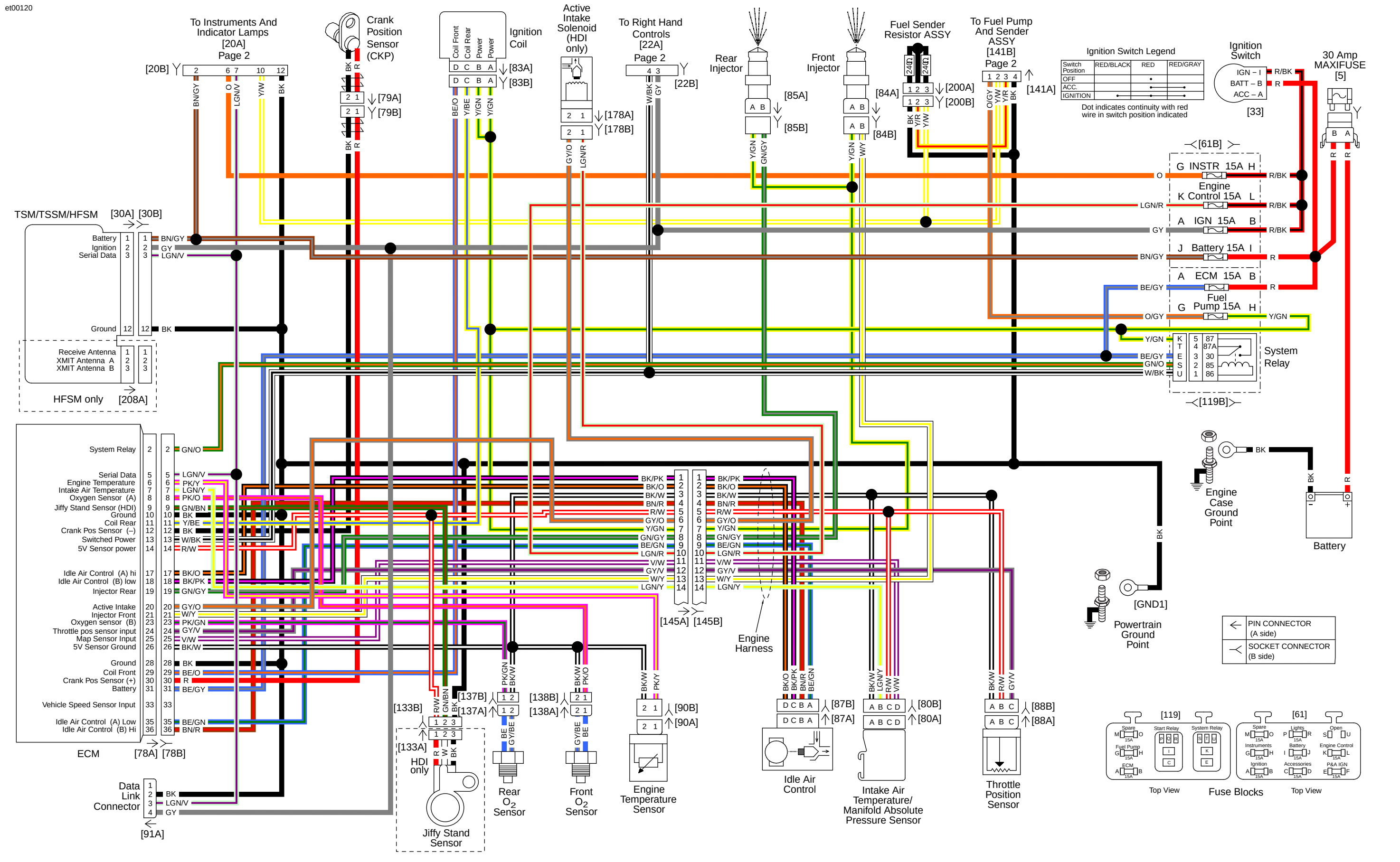
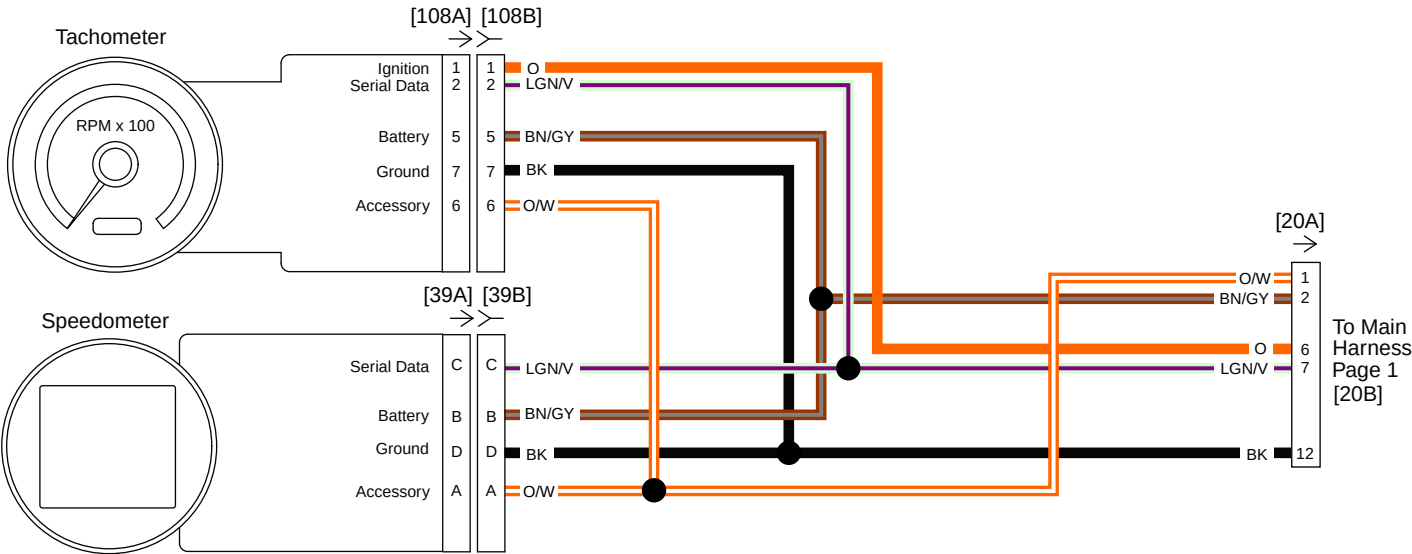


Figure B-14. Engine Management (1 of 2) (XR): 2009 Sportster DOM. and INT. Models

Figure B-14.
Engine Management (1 of 2) (XR): 2009 Sportster DOM. and
INT. Models

Figure B-14.
Engine Management (1 of 2) (XR): 2009 Sportster DOM. and
INT. Models



Configuration For XR

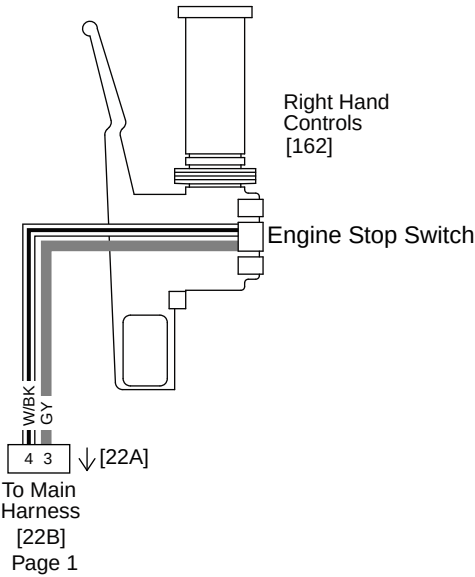
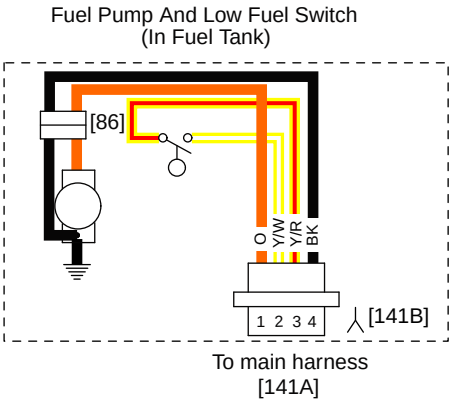


Figure B-15. Engine Management (2 of 2) (XR): 2009 Sportster DOM. and INT. Models

Figure B-15.
Engine Management (2 of 2) (XR): 2009 Sportster DOM. and
INT. Models

Figure B-15.
Engine Management (2 of 2) (XR): 2009 Sportster DOM. and
INT. Models

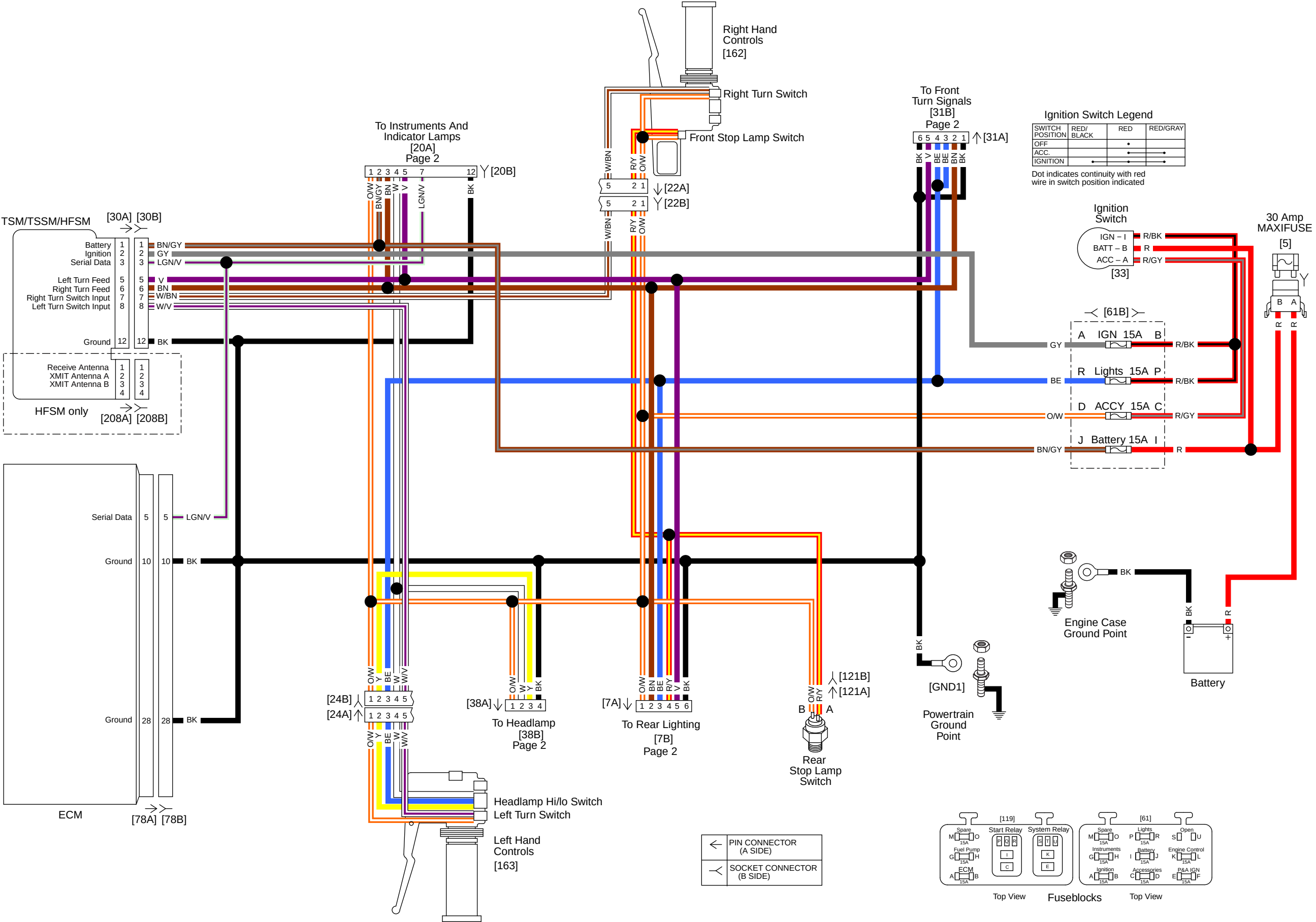


Figure B-16. Lights (1 of 2) (XR): 2009 Sportster DOM. and INT. Models

Figure B-16.

Lights (1 of 2) (XR): 2009 Sportster DOM. and INT. Models

Figure B-16.

Lights (1 of 2) (XR): 2009 Sportster DOM. and INT. Models

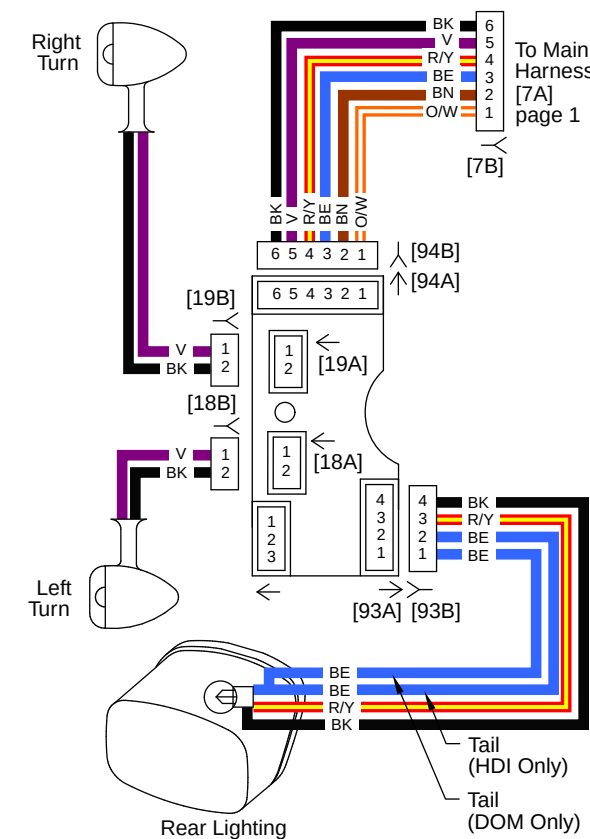
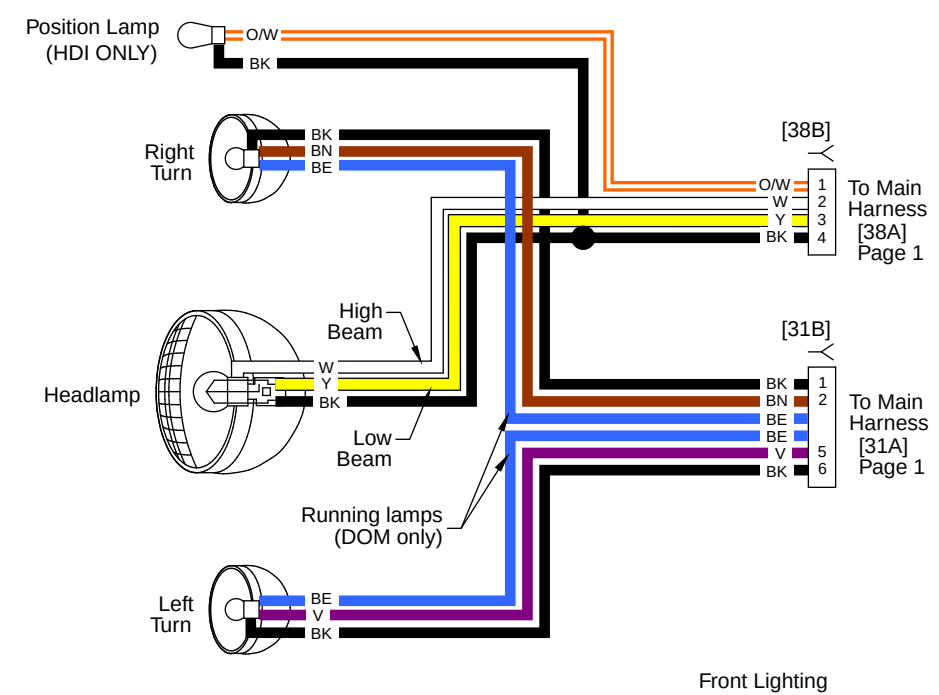
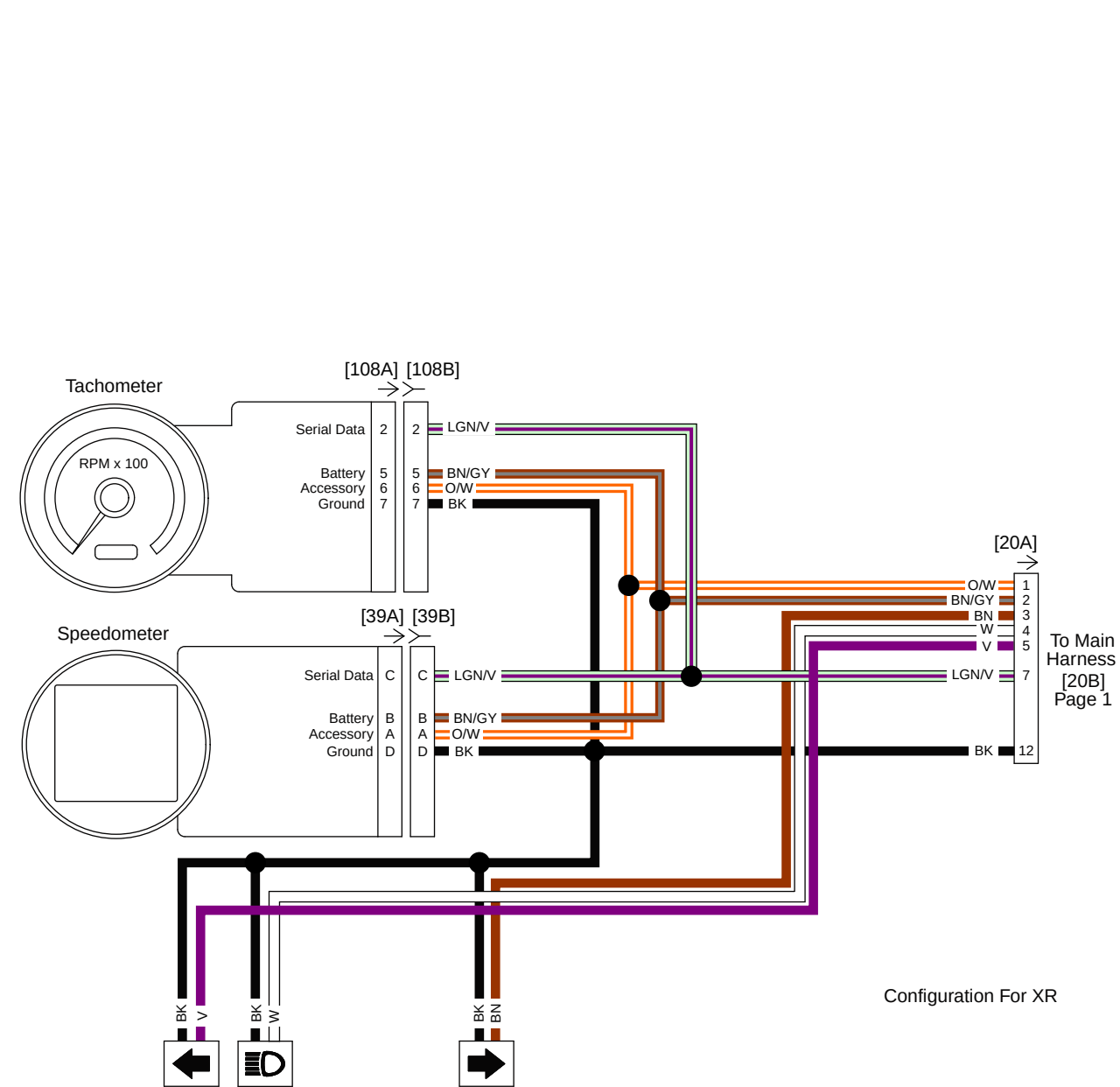


Figure B-17. Lights (2 of 2) (XR): 2009 Sportster DOM. and INT. Models

Figure B-17.

Lights (2 of 2) (XR): 2009 Sportster DOM. and INT. Models

Figure B-17.

Lights (2 of 2) (XR): 2009 Sportster DOM. and INT. Models

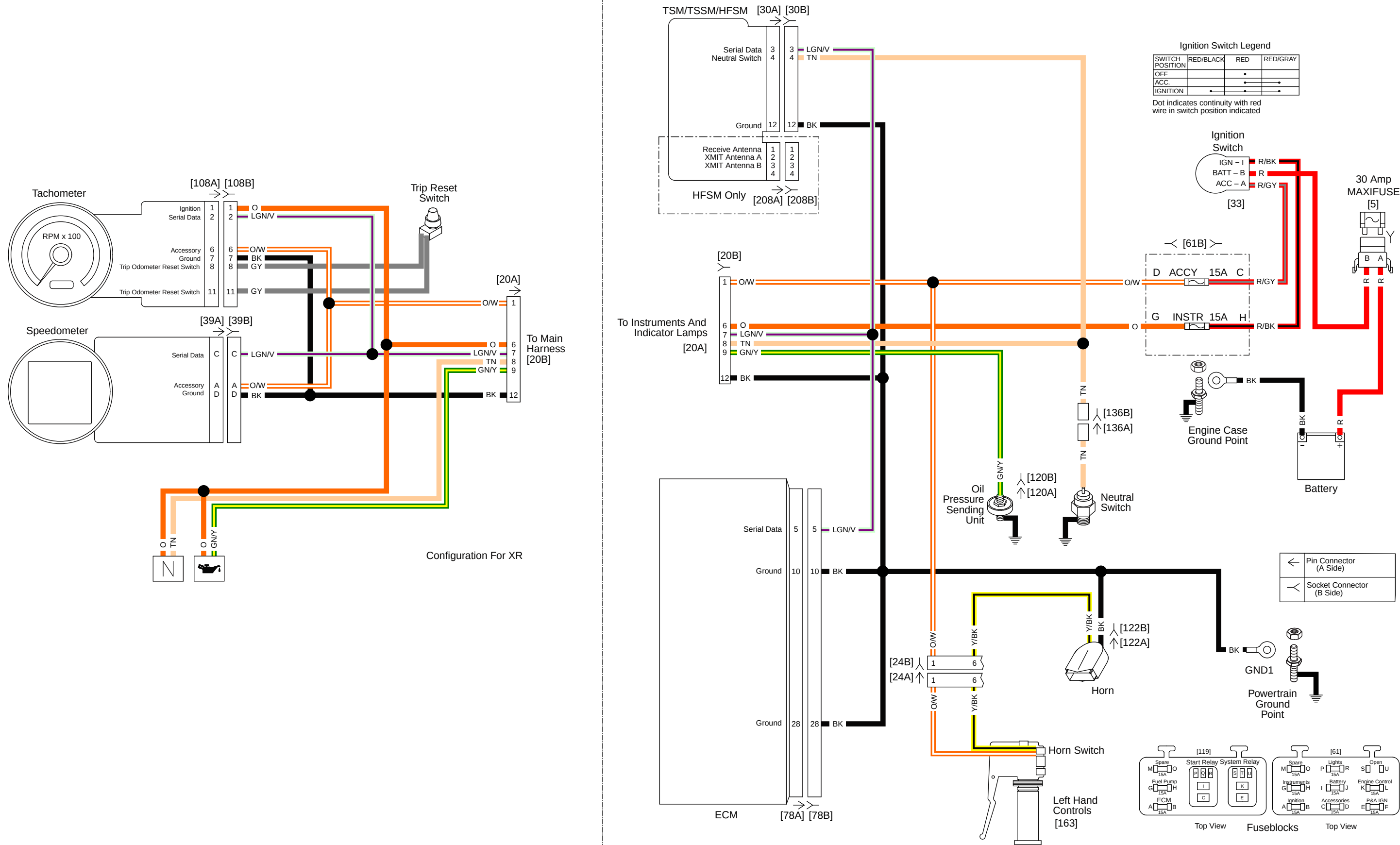


Figure B-18. Horn and Instruments (XR): 2009 Sportster DOM. and INT. Models

Figure B-18.
Horn and Instruments (XR): 2009 Sportster DOM. and INT.
Models

Figure B-18.
Horn and Instruments (XR): 2009 Sportster DOM. and INT.
Models

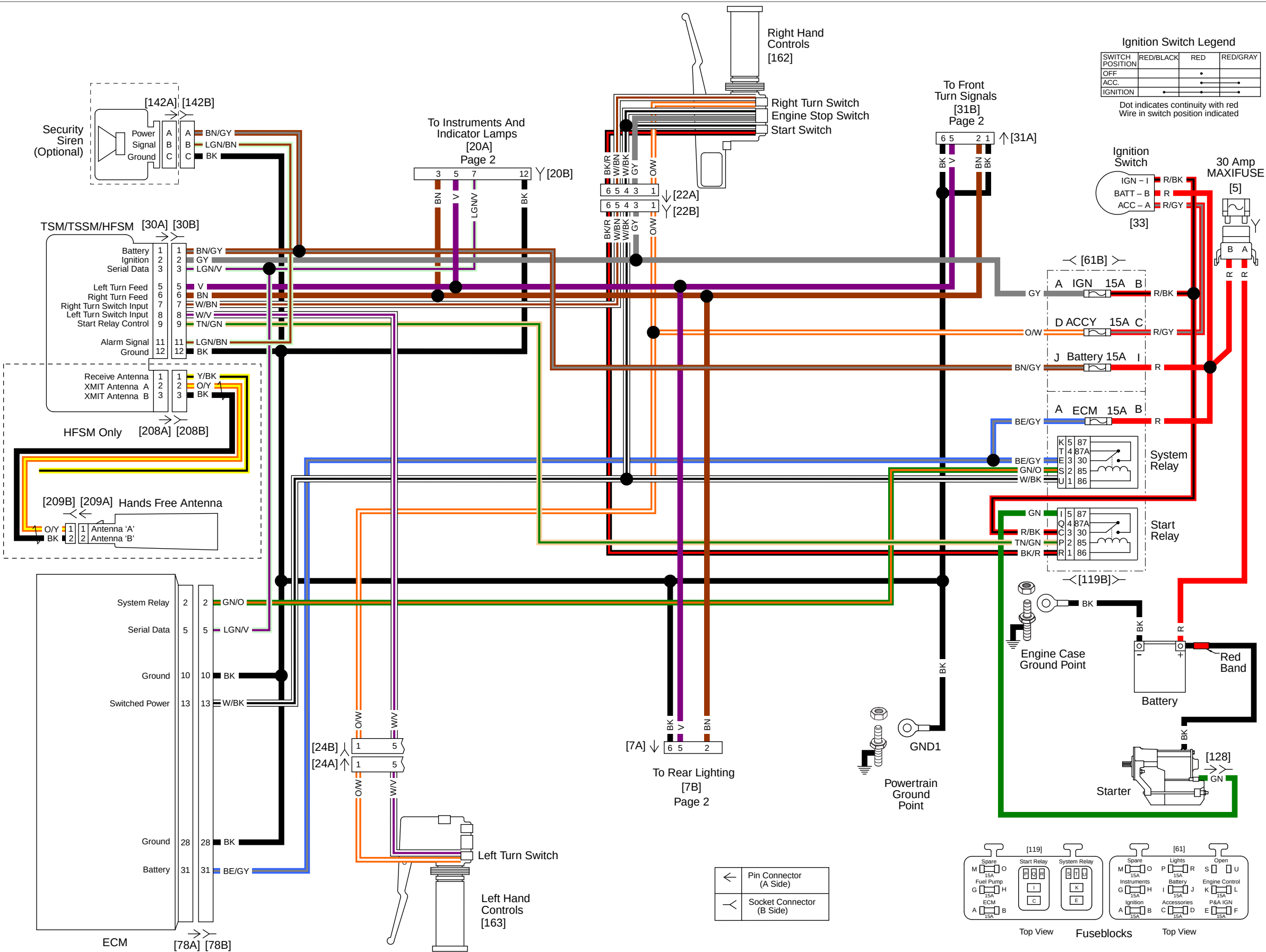
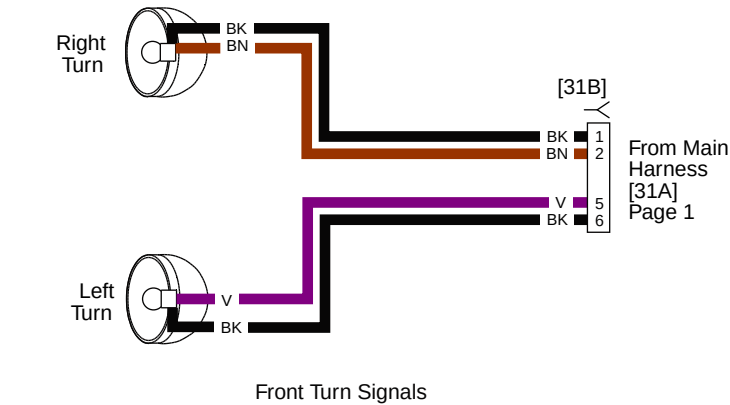
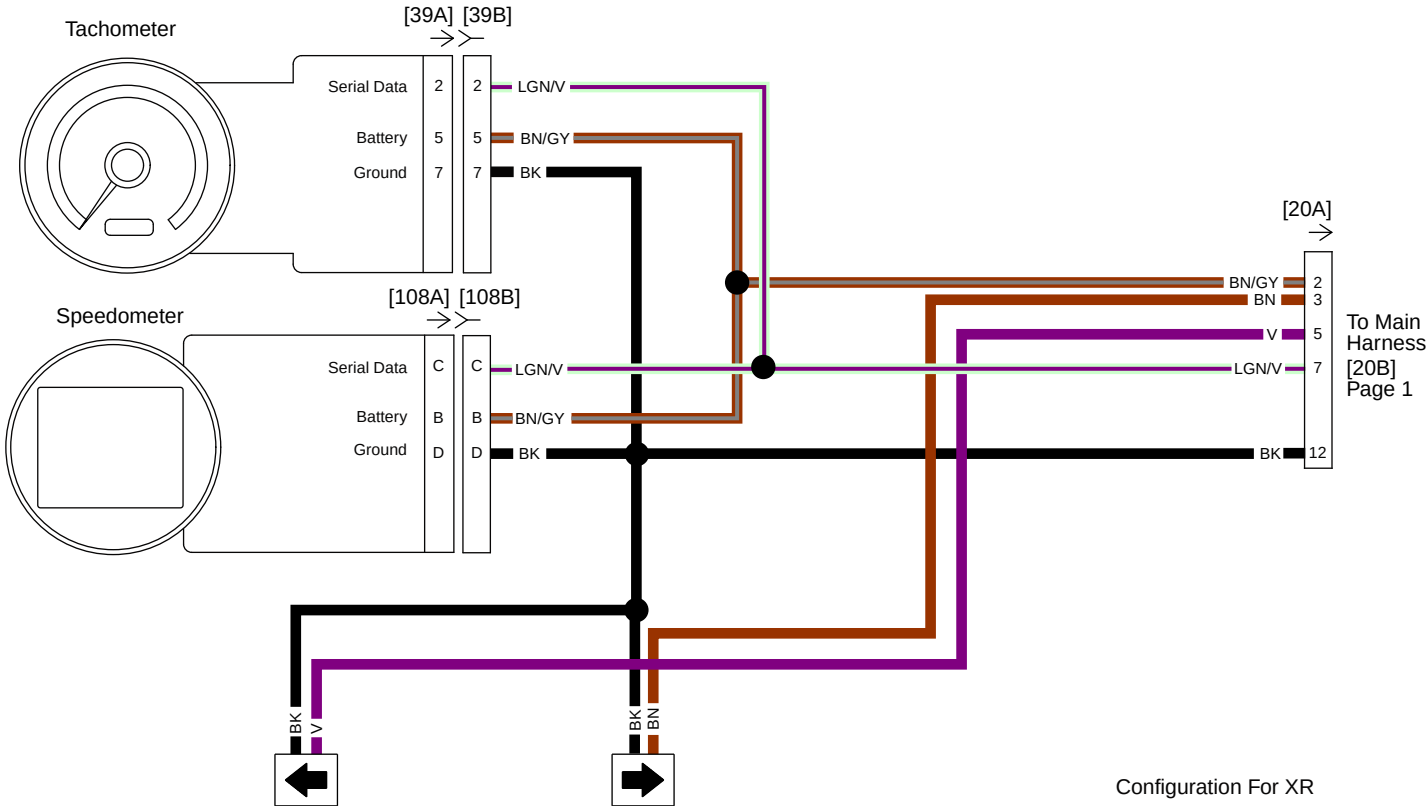


Figure B-19. Security (1 of 2) (XR): 2009 Sportster DOM. and INT. Models

Figure B-19.
Security (1 of 2) (XR): 2009 Sportster DOM. and INT. Models

Figure B-19.
Security (1 of 2) (XR): 2009 Sportster DOM. and INT. Models



←	PIN CONNECTOR (A SIDE)
↙	SOCKET CONNECTOR (B SIDE)

Figure B-20. Security (2 of 2) (XR): 2009 Sportster DOM. and INT. Models

Figure B-20.
Security (2 of 2) (XR): 2009 Sportster DOM. and INT. Models

Figure B-20.
Security (2 of 2) (XR): 2009 Sportster DOM. and INT. Models

TABLE OF CONTENTS

SUBJECT	PAGE NO.
C.1 METRIC CONVERSION.....	C-1
C.2 FLUID CONVERSIONS.....	C-2
C.3 TORQUE CONVERSIONS.....	C-3



NOTES



METRIC CONVERSION

C.1

CONVERSION TABLE

Table C-1. Metric Conversions

MILLIMETERS to INCHES (MM x 0.03937 = IN)								INCHES to MILLIMETERS (IN 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

FLUID CONVERSIONS

C.2

UNITED STATES SYSTEM

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

- 1 pint (U.S.) = 16 fluid ounces (U.S.)
- 1 quart (U.S.) = 2 pints (U.S.) = 32 fl. oz. (U.S.)
- 1 gallon (U.S.) = 4 quarts (U.S.) = 128 fl. oz. (U.S.)

METRIC SYSTEM

Fluid volume measurements in this Service Manual include the metric system equivalents. In the metric system, 1 liter (L) = 1,000 milliliters (mL). Should you need to convert from U.S. units-of-measure to metric units-of-measure (or vice versa), refer to the following:

- fluid ounces (U.S.) x 29.574 = milliliters
- pints (U.S.) x 0.473 = liters
- quarts (U.S.) x 0.946 = liters
- gallons (U.S.) x 3.785 = liters
- milliliters x 0.0338 = fluid ounces (U.S.)
- liters x 2.114 = pints (U.S.)
- liters x 1.057 = quarts (U.S.)
- liters x 0.264 = gallons (U.S.)

BRITISH IMPERIAL SYSTEM

Fluid volume measurements in this Service Manual do not include the British Imperial (Imp.) system equivalents. The following conversions exist in the British Imperial system:

- 1 pint (Imp.) = 20 fluid ounces (Imp.)
- 1 quart (Imp.) = 2 pints (Imp.)
- 1 gallon (Imp.) = 4 quarts (Imp.)

Although the same unit-of-measure terminology as the U.S. system is used in the British Imperial (Imp.) system, the actual volume of each British Imperial unit-of-measure differs from its U.S. counterpart. The U.S. fluid ounce is larger than the British Imperial fluid ounce. However, the U.S. pint, quart, and gallon are smaller than the British Imperial pint, quart, and gallon, respectively. Should you need to convert from U.S. units to British Imperial units (or vice versa), refer to the following:

- fluid ounces (U.S.) x 1.042 = fluid ounces (Imp.)
- pints (U.S.) x 0.833 = pints (Imp.)
- quarts (U.S.) x 0.833 = quarts (Imp.)
- gallons (U.S.) x 0.833 = gallons (Imp.)
- fluid ounces (Imp.) x 0.960 = fluid ounces (U.S.)
- pints (Imp.) x 1.201 = pints (U.S.)
- quarts (Imp.) x 1.201 = quarts (U.S.)
- gallons (Imp.) x 1.201 = gallons (U.S.)



TORQUE CONVERSIONS

C.3

UNITED STATES SYSTEM

The U.S. units of torque, foot pounds and inch pounds, are used in this service manual. To convert units, use the following equations:

- foot pounds (ft-lbs) $\times 12.00000$ = inch pounds (**in-lbs**).
- inch pounds (**in-lbs**) $\times 0.08333$ = foot pounds (ft-lbs).

METRIC SYSTEM

All metric torque specifications are written in Newton-meters (Nm). To convert metric to United States units and United States to metric, use the following equations:

- Newton meters (Nm) $\times 0.737563$ = foot pounds (ft-lbs).
- Newton meters (Nm) $\times 8.85085$ = inch pounds (**in-lbs**).
- foot pounds (ft-lbs) $\times 1.35582$ = Newton meters (Nm).
- inch pounds (**in-lbs**) $\times 0.112985$ = Newton meters (Nm).



NOTES



[TABLE OF CONTENTS](#)

SUBJECT	PAGE NO.
D.1 GLOSSARY.....	D-1



NOTES



GLOSSARY

D.1

ACRONYMS AND ABBREVIATIONS

Table D-1. Acronyms and Abbreviations

ACRONYM OR ABBREVIATION	DESCRIPTION
A	Amperes
AC	Alternating Current
ACC	Accessory
ACR	Automatic Compression Release
AGM	Absorbed Glass Mat (battery)
AMP	Ampere
AWG	American Wire Gauge
B+	Battery Voltage
BAS	Bank Angle Sensor
BTDC	Before Top Dead Center
C	Celsius (Centigrade)
CA	California
CAL	Calibration
CC	Cubic Centimeters
CCA	Cold Cranking Amps
CKP	Crankshaft Position
cm	Centimeter
DC	Direct Current
DLC	Data Link Connector
DOM	Domestic
DTC	Diagnostic Trouble Code
DVOM	Digital Volt Ohm Meter
ECM	Electronic Control Module
ECT	Engine Coolant Temperature
EEPROM	Electrically Erasable Programmable Read Only Memory
EFI	Electronic Fuel Injection
ET	Engine Temperature
EVAP	Evaporative Emissions Control System
F	Fahrenheit
ft-lbs	Foot-Pounds
fl oz.	Fluid Ounce
g	Gram
GAL	Gallon
GAWR	Gross Axle Weight Rating
GND	Ground (electrical)
GVWR	Gross Vehicle Weight Rating
HDI	Harley-Davidson International
H-DSSS	Harley-Davidson Smart Security System
HFSM	Hands Free Security Module
Hg	Mercury

Table D-1. Acronyms and Abbreviations

ACRONYM OR ABBREVIATION	DESCRIPTION
IAC	Idle Air Control
IAT	Intake Air Temperature
IC	Instrument Cluster
ID	Inside Diameter
IGN	Ignition Light/Key Switch
In.	Inch
INJ PW	Injector Pulse Width
in-lbs	Inch-Pounds
Kg	Kilogram
Km	Kilometer
kPa	Kilopascal
km/hr	Kilometers Per Hour
L	Liter
LCD	Liquid Crystal Display
LED	Light Emitting Diode
mA	Milliampere
MAP	Manifold Absolute Pressure
ml	milliliter
mm	millimeter
MPH	Miles Per Hour
ms	millisecond
Nm	Newton-Meter
N/A	Not Applicable
no.	Number
O ₂	Oxygen
OD	Outside Diameter
OEM	Original Equipment Manufacturer
oz	Ounce
P&A	Parts and Accessories
PN	Part Number
PSI	Pounds per Square Inch
RES	Reserve
RPM	Revolutions Per Minute
SCFH	Cubic Feet per Hour at Standard Conditions
TCA	Throttle Control Actuator
TDC	Top Dead Center
TGS	Twist Grip Sensor
TP	Throttle Position
TMAP	Intake Air Temperature/Manifold Absolute Pressure
TSM	Turn Signal Module
TSSM	Turn Signal/Security Module
V	Volt
VAC	Volts of Alternating Current

Table D-1. Acronyms and Abbreviations

ACRONYM OR ABBREVIATION	DESCRIPTION
VDC	Volts of Direct Current
VIN	Vehicle Identification Number
VSS	Vehicle Speed Sensor



NOTES



TABLE OF CONTENTS

SUBJECT	PAGE NO.
E.1 TSM/TSSM (JAPAN/KOREA) OVERVIEW.....	E-1
E.2 TSM/TSSM FEATURES.....	E-2
E.3 VEHICLE DELIVERY.....	E-4
E.4 TURN SIGNAL FUNCTIONS.....	E-8
E.5 BANK ANGLE FUNCTION.....	E-9
E.6 SECURITY SYSTEM FUNCTIONS (TSSM ONLY).....	E-10
E.7 ARMING/DISARMING (TSSM ONLY).....	E-13
E.8 DIAGNOSTIC TROUBLE CODES (DTC).....	E-15
E.9 INITIAL DIAGNOSTIC CHECK: TSM/TSSM.....	E-18
E.10 ODOMETER SELF-DIAGNOSTICS.....	E-26
E.11 BREAKOUT BOX: TSM/TSSM.....	E-28
E.12 FAILS TO DISARM (TSSM ONLY).....	E-30
E.13 TURN SIGNAL ERRORS: B1121, B1122, B1141.....	E-33
E.14 DTC B0563.....	E-46
E.15 DTC B1131, B1132.....	E-47
E.16 DTC B1134.....	E-50
E.17 DTC B1135.....	E-53
E.18 DTC B1154, B1155.....	E-54
E.19 DTC U1016, U1255.....	E-58
E.20 DTC U1300, U1301 OR BUS ER.....	E-63
E.21 TSM/TSSM: PASSWORD LEARN.....	E-64
E.22 TSSM MAINTENANCE.....	E-65



NOTES



TSM/TSSM (JAPAN/KOREA) OVERVIEW

E.1

GENERAL

TSM

The Turn Signal Module (TSM) has two major functions:

- Control turn signals.
- Serve as Bank Angle Sensor (BAS).

TSSM

See [Figure E-1](#). The optional, factory-installed, Harley-Davidson Factory Security System (**H-DFSS**) includes a Turn Signal Security Module (**TSSM**) which provides the same functions as the TSM, but also includes security and immobilization functions.



Figure E-1. TSSM (Japan/Korea)

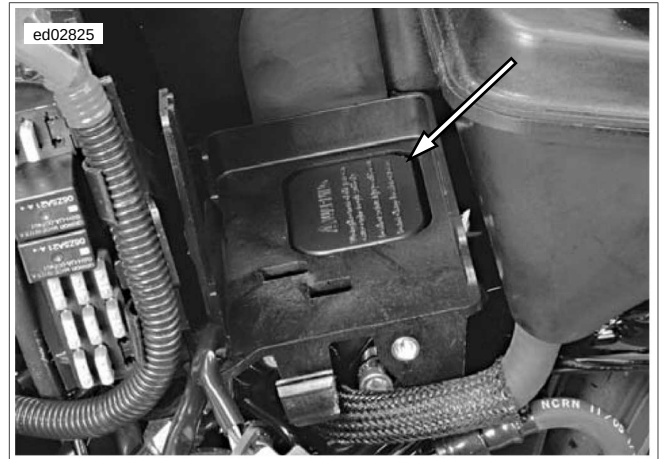


Figure E-2. TSM/TSSM Location

TROUBLESHOOTING

Problems fall into at least one of five categories:

- Turn signal malfunction.
- Bank angle (engine disable).
- Clutch/neutral interlock (starter enable).
- Security lamp problem.
- Security system malfunction.

To resolve TSM/TSSM problems, four basic steps are involved. In order of occurrence, they are:

1. Retrieve DTCs using odometer self-diagnostics. See [E.10 ODOMETER SELF-DIAGNOSTICS](#).
2. Diagnose system problems. This involves using special tools and the diagnostic flowcharts in this section.
3. Correct problems through the replacement and/or repair of the affected components.
4. After repairs are performed, the work must be validated. This involves clearing the DTCs and confirming proper vehicle operation as indicated by the behavior of the turn signals.

TSM/TSSM FEATURES

E.2

TURN SIGNAL FUNCTIONS

TSM/TSSM Features

See [E.4 TURN SIGNAL FUNCTIONS](#) for complete details.

- **Manual turn signal control:** Manual activation/deactivation of left and right turn signal flashing sequences.
- **Automatic turn signal cancellation:** Automatic cancellation of left and right turn signal flashing sequences based on either vehicle speed, vehicle acceleration or turn completion.
- **Emergency flashers:** Four-way left and right turn signal flashing capability.
- **Turn signal lamp diagnostics:** Self-diagnostics for short circuit and open lamp conditions on both left and right turn signal systems.

BANK ANGLE FUNCTION

See [E.5 BANK ANGLE FUNCTION](#) for complete details.

- **Emergency engine shutdown:** Will provide engine shutdown when vehicle is tipped over.
- **Emergency outputs disable:** Will disable turn signal lamps and starter motor when vehicle is tipped over.

CLUTCH/NEUTRAL INTERLOCK FUNCTIONS

TSM/TSSM Features

- **Disables starter:** Disables starter until either the clutch lever is pulled in or transmission neutral is selected.
- **Diagnostics:** Provides diagnostics for clutch and neutral switch faults.

SECURITY ALARM AND IMMOBILIZATION FUNCTIONS

TSSM Feature

The following information applies only to motorcycles with the security option (TSSM). See [E.6 SECURITY SYSTEM FUNCTIONS \(TSSM ONLY\)](#) for more information.

- **Remote arming/disarming:** See [Figure E-3](#). Owners may enable and disable security alarm and immobilization functions with a personally carried transmitter. This transmitter is referred to as a **key fob**. Remote arming/disarming is a function of the TSSM (Japan/Korea) only.
- **Security lamp (key icon):** See [Figure E-4](#). A lamp within the speedometer face on XL, and the tachometer on the XR, tells the rider if the system is armed or disarmed.
- **PIN disarming:** If a key fob is not available, the TSSM allows the rider to disable the security alarm and immobilization functions if the rider knows the previously entered personal identification number (PIN).
- **Arming/disarming confirmation:** When the TSSM is armed, the system provides visual feedback to the rider

by flashing the turn signals and sounding the optional Smart Siren.

- **Auto-arming:** Automatically enables the security alarm and immobilization functions within 30 seconds after the Ignition Switch is switched OFF.

NOTE

Motorcycles sold with a TSSM have auto-arming disabled, but it can be activated. See [E.3 VEHICLE DELIVERY](#).

- **Transport mode:** It is possible to arm the security system without enabling the motion detector for one ignition cycle. This allows the vehicle to be moved in an immobilized state.
- **Starter/ignition disable:** Should the security alarm and immobilization functions be triggered by a vehicle security condition, the starter and ignition system will be disabled.
- **Security system alarm:** See [Figure E-5](#). The system will alternately flash the left and right turn signals and sound an optional Security Siren if a vehicle security condition is detected while the system is armed.

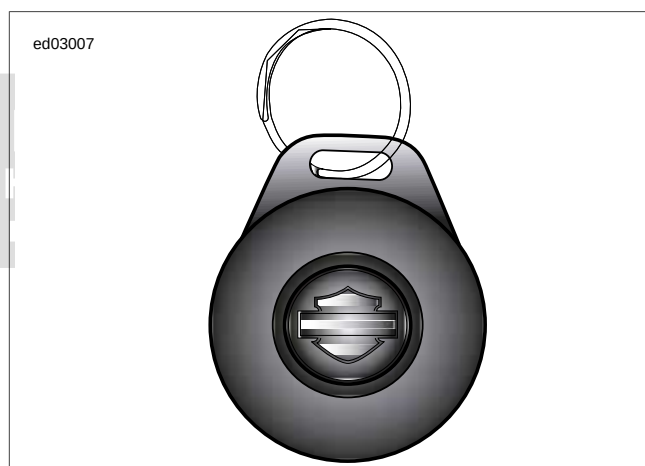


Figure E-3. Key Fob: TSSM

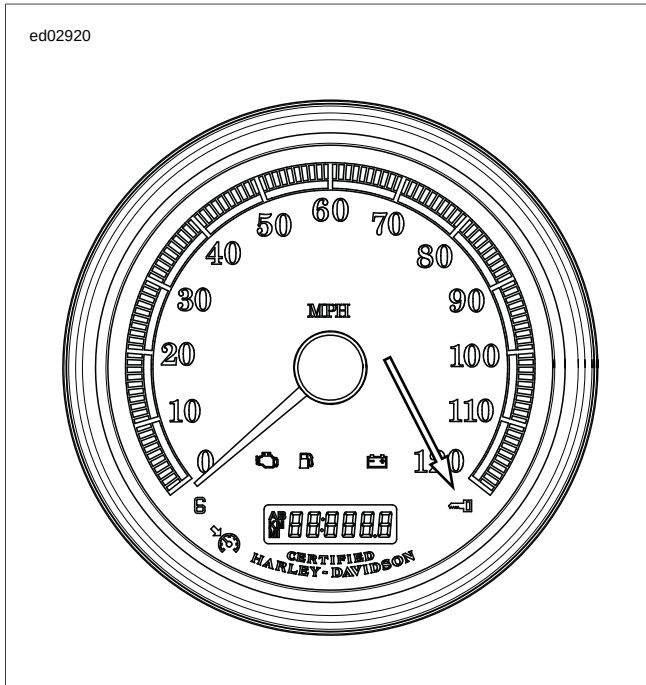


Figure E-4. Security Lamp (Key Icon) (Typical)



Figure E-5. Security Siren



VEHICLE DELIVERY

E.3

GENERAL

WARNING

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

Setting up a vehicle TSM/TSSM depends on whether the vehicle has a TSM or the optional TSSM installed.

All motorcycles ship with the TSM/TSSM set for use **without** a sidecar installed. If a motorcycle is equipped with a TSM, no further configuration is required.

However, if a motorcycle has an optional security system (TSSM) installed, perform the following steps as necessary.

1. Configure TSSM motorcycles by assigning both key fobs to the vehicle. See [E.3 VEHICLE DELIVERY, Key Fob Assignment: TSSM](#).
2. Configure TSSM motorcycles by entering a PIN picked by the owner. The PIN allows the owner to operate the system if the key fob is lost or inoperable. Record this PIN in the Owner's Manual and instruct the customer to carry a copy.

CONFIGURING A TSSM

NOTE

Do not forget to enter a Personal Identification Number (PIN) for TSSM motorcycles. If a PIN is not assigned and both key fobs are lost or damaged while the motorcycle is armed, the TSSM must be replaced.

Changes to TSSM settings are made by a series of programming operations involving the ignition switch, left/right turn signal switches and key fob (security systems).

At certain steps in the programming sequence, the motorcycle may provide confirmation of settings by flashing the turn signals, turn signal indicators and/or security lamp. In addition, when programming a PIN into a TSSM system, the odometer displays the PIN to the user and dynamically updates it as the code is entered or changed.

All programming operations are listed in table format. Follow the numbered steps to configure the system. If a confirmation response is listed, wait for the confirmation before continuing

to the next step. Important information pertaining to certain actions will be found in the NOTES column.

SIDECAR CONFIGURATION

WARNING

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

POWER DISRUPTION AND CONFIGURING

The TSM/TSSM will not enter configuration mode on the first attempt after battery voltage has been removed from terminal "1". This will occur after any of the following situations:

- Battery disconnect or power drain.
- Battery fuse removal.
- Connecting Breakout Box to TSM/TSSM connector.

Therefore, after all battery reconnects, the configuration sequence must be modified as follows.

1. Set Engine Stop Switch to **OFF**, cycle Ignition Switch **ON-OFF-ON-OFF-ON** and press left turn signal switch twice.
2. Repeat step listed above.
3. Continue with configuration sequence listed.

KEY FOB ASSIGNMENT: TSSM

Refer to [Table E-1](#) to assign a key fob to a motorcycle equipped with a TSSM.

The key fob on TSSM motorcycles must be set so it will operate the alarm system on the vehicle. This assignment **must** be completed with no pauses between steps greater than 10 seconds. Turn the ignition switch to OFF after all key fobs have been assigned. The programming mode will also exit after 60 seconds has elapsed without detecting any fob sign-up messages or turn signal switch activity.

Two key fobs may be assigned to the TSSM. The first successful attempt to program a fob will disable all previously assigned fobs. If a second fob is to be programmed, it must be done in the same programming sequence as the initial fob.

Table E-1. Key FOB Assignment: TSSM

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set engine stop switch to OFF .		Verify the security lamp is not blinking (vehicle is disarmed). This assignment procedure must be completed with no pauses between steps greater than 10 seconds.
2	Cycle the ignition switch IGN - OFF - IGN - OFF - IGN .		

Table E-1. Key FOB Assignment: TSSM

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
3	Press left turn switch 2 times and release.	One to four flashes turn signals and indicators depending on vehicle configuration (See E.3 VEHICLE DELIVERY regarding battery disconnects.)	1 flash - Worldwide TSM, no security. 2 flashes - Japan/Korea configuration TSSM.
4	Press right turn switch 1 time and release.	One flash turn signals and indicators	
5	Press left turn switch 1 time and release.	Two flashes turn signals and indicators	
6	Press and hold key fob button until confirmation is received.	Two flashes turn signals and indicators	This may take 10-25 seconds.
7	If you have two key fobs, press and hold button on second key fob until confirmation is received.	Two flashes turn signals and indicators	Optional step.
8	Turn ignition switch to OFF .		

PIN ENTRY: TSSM

NOTE

Do not forget to enter a PIN for TSSM vehicles. If a PIN is not assigned and the key fob is lost or damaged while the vehicle is armed, the TSSM must be replaced.

The TSSM PIN consists of five digits. Each digit can be any number from 1-9. There can be no zeros (0) in the PIN. The PIN **must** be used to disarm the security system in case the key fob becomes unavailable.

Refer to [Table E-2](#) to enter an initial PIN with no PIN previously installed. The procedure listed uses 3-1-3-1-3 as the desired PIN.

NOTE

For better security, do not use 3-1-3-1-3 as a PIN. It is shown as an example only.

Decide what five-digit PIN the owner would like to use. The code will be programmed using the turn signal switches and

key fob. Keep a record of the PIN in a secure place such as your wallet or the Owner's Manual.

- When programming the PIN, the security lamp flashes to provide feedback when entering each digit. The odometer also displays the PIN and the change dynamically.
- The number of security lamp flashes corresponds to the number currently selected for a given digit. Therefore, the lamp may flash 1-9 times depending on the number entered. The five-digit PIN will change in the odometer window and the active digit will blink.
- Press the left turn switch one time to increment each digit.
- Quickly press the key fob button twice to advance to the next digit.

NOTE

The programming mode exits upon turning the ignition switch to OFF, or if no turn signal switch/key fob button activity occurs for 60 seconds. No data is saved for partial configuration attempts if entering a PIN for the first time. If a PIN has previously been entered, the user can change any digit or group of digits.

Table E-2. Entering an Initial TSSM PIN (Example: 3-1-3-1-3) with No PIN Previously Entered

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set engine stop switch to OFF .		Verify the security lamp is not blinking (vehicle is disarmed). This assignment procedure must be completed with no pauses between steps greater than 10 seconds.
2	Cycle the ignition switch ON-OFF-ON-OFF-ON .		
3	Press left turn switch 2 times and release.	One to four flashes turn signals and indicators depending on vehicle configuration (See E.3 VEHICLE DELIVERY regarding battery disconnects).	One flash - Worldwide TSM, no security. Two flashes - Japan/Korea configuration TSSM.

Table E-2. Entering an Initial TSSM PIN (Example: 3-1-3-1-3) with No PIN Previously Entered

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
4	Quickly press key fob button 2 times and release.	One flash turn signals and indicators Odometer displays current five-digit PIN (five dashes if no code entered), first digit blinks.	Vehicle is in PIN entry mode ready to enter or modify first digit.
5	Press left turn switch 1 time and release.	Security lamp flashes 1 - 9 times if code was previously entered.	A lack of confirmation flashes indicates no digit is entered.
6	Press and release left turn switch to advance through the digits. In this example, you will press and release three times.	Blinking digit in odometer display increments, security lamp flashes to indicate each digit selected. In this example, the blinking digit displayed is 3 and the security lamp will flash three times.	You have selected 3 as a number for the first digit.
7	Quickly press key fob button 2 times and release.	Two flashes turn signals and indicators second digit in odometer display blinks.	You have confirmed 3 as a number for the first digit and have advanced to entering the second digit.
8	Press left turn switch 1 time and release.	None	A lack of confirmation flashes indicates no digit is entered.
9	Press and release left turn switch to advance through the digits. In this example, you will perform this step one time.	Blinking digit in odometer display increments, security lamp flashes to indicate each digit selected. In this example, the blinking digit displayed is 1 and the security lamp will flash one time.	You have selected 1 as a number for the second digit.
10	Quickly press key fob button 2 times and release.	Three flashes turn signals and indicators third digit in odometer display blinks.	You have confirmed 1 as a number for the second digit and have advanced to entering the third digit.
11	Press left turn switch 1 time and release.	None	A lack of confirmation flashes indicates no digit is entered.
12	Press and release left turn switch to advance through the digits. In this example, you will repeat this step three times.	Blinking digit in odometer display increments, security lamp flashes to indicate each digit selected. In this example, the blinking digit displayed is 3 and the security lamp will flash three times.	You have selected 3 as a number for the third digit.
13	Quickly press key fob button 2 times and release.	Four flashes turn signals and indicators fourth digit in odometer display blinks.	You have confirmed 3 as a number for the third digit and have advanced to entering the fourth digit.
14	Press left turn switch 1 time and release.	None	A lack of confirmation flashes indicates no digit is entered.
15	Press and release left turn switch to advance through the digits. In this example, you will perform this step one time.	Blinking digit in odometer display increments, security lamp flashes to indicate each digit selected. In this example, the blinking digit displayed is 1 and the security lamp will flash one time.	You have selected 1 as a number for the fourth digit.
16	Quickly press key fob button 2 times and release.	Five flashes turn signals and indicators fifth digit in odometer display blinks.	You have confirmed 1 as a number for the fourth digit and have advanced to entering the fifth digit.
17	Press left turn switch 1 time and release.	None	A lack of confirmation flashes indicates no digit is entered.

Table E-2. Entering an Initial TSSM PIN (Example: 3-1-3-1-3) with No PIN Previously Entered

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
18	Press and release left turn switch to advance through the digits. In this example, you will repeat this step three times.	Blinking digit in odometer display increments, security lamp flashes to indicate each digit selected. In this example, the blinking digit displayed is 3 and the security lamp will flash three times.	You have selected 3 as a number for the fifth digit.
19	Quickly press key fob button 2 times and release.	One flash turn signals and indicators first digit in odometer display blinks.	You have confirmed 3 as a number for the fifth digit and have gone back to the first digit.
20	Turn ignition switch to OFF.		
21	Write down code in Owner's Manual.		
22	Arm the security system and attempt to disarm using PIN entry. Refer to Table E-2 .		

CHANGING THE PIN: TSSM

If a PIN has been previously entered, the security lamp will flash the equivalent digit, and the odometer will display the

existing PIN with the active digit blinking. Each additional press of the left turn switch will increment the digit.

- To advance from 5 to 6, press and release the left turn switch 1 time.
- To advance from 8 to 2, press and release the left turn switch 3 times (9-1-2).



TURN SIGNAL FUNCTIONS

E.4

GENERAL

The TSM/TSSM turn signal feature has several modes:

- Automatic cancellation.
- Manual cancellation.
- Four-way flashing.
- Diagnostics mode.

The turn signals cannot be activated or deactivated when the ignition switch is in the ACC position. The turn signals can only be activated or deactivated with the ignition switch in the IGNITION position.

WARNING

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

AUTOMATIC CANCELLATION

Press the left or right turn switch to activate automatic turn signal cancellation. There is no need to hold the turn switch in when approaching the turn. The TSM/TSSM will not cancel the signal before the turn is actually completed.

- When the directional switch is released, the system starts a 20 count. As long as the vehicle is traveling at more than 7 MPH (11 km/h), the directional will always cancel after 20 flashes, if the system does not recognize any other input.
- If the vehicle speed drops to 7 MPH (11 km/h) or less, including stopped, the directionals will continue to flash. Counting will resume when vehicle speed reaches 8 MPH (12 km/h) and will automatically cancel when the count total equals 20 as stated above.
- The turn signals will cancel within two seconds upon turn completion. A sensor inside the TSM/TSSM cancels the signal after the vehicle has been returned to an upright position.

NOTE

The bank angle cancellation function has an automatic calibration feature. Ride the motorcycle for 0.25 mile (0.4 km) at steady speeds (upright) to calibrate the system. Performance of bank angle function may not be optimal until this calibration is performed. This self-calibration is performed automatically every time the vehicle is started and ridden.

MANUAL CANCELLATION

If you want to stop the turn signals from flashing, briefly depress the turn signal switch a second time.

If you are signalling to turn in one direction and you depress the switch for the opposite turn signal, the first signal is cancelled and the opposite side begins flashing.

FOUR-WAY FLASHING

Use the following method to activate the four-way flashers:

1. With the ignition switch ON and the security system disarmed (models with security only), press the left and right turn signal switches at the same time.
2. Turn the ignition switch OFF and arm the security system if present and desired. The four-way flashers will continue for two hours.
3. To cancel four-way flashing, disarm the security system if necessary, turn the ignition switch ON and press the left and right turn signal switches at the same time.

This system allows a stranded vehicle to be left in the four-way flashing mode and secured until help is found.

If the security system is disarmed while the four-way flashers are active, the lights will flash as follows:

1. TSSM stops four-way flashing mode. Motorcycle sits for 1 second with turn signals off.
2. TSSM performs disarming confirmation (1 flash).
3. Motorcycle sits for 1 second with turn signals off.
4. Motorcycle restarts four-way flashing mode.

DIAGNOSTICS MODE

The TSM/TSSM measures the current when the turn signals are used. If there is a burned out light bulb on one side, the remaining light and the corresponding turn signal indicator flash at double the normal rate starting with the fifth flash.

Other diagnostic conditions monitored include:

- Short circuit in the turn signal wiring.
- Open circuit in the turn signal wiring.
- Stuck turn signal switch.

NOTES

- *A stuck turn signal switch will disable the automatic turn signal cancellation feature.*
- *If a stuck switch is detected, you must hold the left and right turn signal switches in for more than one second to activate the four-way flashers.*

See [E.8 DIAGNOSTIC TROUBLE CODES \(DTC\)](#) for more information.

BANK ANGLE FUNCTION

E.5

GENERAL

The turn signals, starter motor, ECM, fuel pump, and ignition coil will be disabled in the event the vehicle is tipped over.

WARNING

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

OPERATION

The engine will shut off automatically if the vehicle is tipped over. The odometer displays "tIP" when a tip over condition is detected.

To restart the motorcycle after shutdown has occurred:

1. Return the motorcycle to an upright position.
2. Cycle the Ignition Switch OFF-IGN before restarting.



SECURITY SYSTEM FUNCTIONS (TSSM ONLY)

E.6

GENERAL

Security System Operation

The TSSM provides security and immobilization functions not found on the TSM. The TSSM will disable the starter and ignition system. Additional functions include the ability to alternately flash the left and right turn signals and sound a siren (if equipped) if a theft attempt is detected.

Conditions that activate the security system when system is armed include:

- **Detecting tampering of the ignition circuit:** Turn signals flash three times, optional siren chirps once and then turns off. If the tampering continues, a second warning will activate after four seconds. Continued tampering will cause the alarm to activate for 30 seconds and then turn off. The two warnings/alarm cycle is repeated for each tampering incident.
- **Detecting vehicle movement:** Turn signals flash three times, optional siren chirps once and then turns off. If the vehicle is not returned to its original position, a second warning will activate after four seconds. If the vehicle is not returned to its original position, the alarm activates for 30 seconds then turns off. The two warnings/alarm cycle may repeat a maximum of 10 times with a 10 second pause between alarm cycles.
- **Detecting that a battery or ground disconnect has occurred while armed:** Siren, if installed, activates its self-alarm mode. Turn signals will not flash.

See [E.7 ARMING/DISARMING \(TSSM ONLY\)](#) for more information.

NOTE

Always disarm the TSSM before removing or disconnecting the battery to prevent the siren (if installed) from activating. If the TSSM is in auto-arming mode, you must disarm the system and disconnect the battery or remove the battery fuse before the 30 second arming period expires.

Security System Options: TSSM

The following options are only available on the TSSM unit: alarm sensitivity, auto-arming feature, and storage mode.

Default settings for the TSSM include:

- Solo vehicle configuration.
- Medium motion sensitivity on alarm sensitivity.
- All vehicles are shipped with auto-arming disabled.
- Storage mode set to 10 days.

ALARM SENSITIVITY: TSSM

Sensitivity

The TSSM has four sensitivity settings: extremely low, low, medium or high. The selection picked controls the sensitivity of the security system in regards to motion detection.

To set alarm sensitivity, refer to [Table E-3](#).

Table E-3. TSSM Alarm Sensitivity

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set RUN/OFF switch to OFF .		Verify the security lamp is not blinking (vehicle is disarmed).
2	Cycle the ignition switch ON-OFF-ON-OFF-ON .		
3	Press left turn switch 2 times and release.	Two flashes turn signals & indicators depending on vehicle configuration (See E.3 VEHICLE DELIVERY regarding battery disconnects).	Two flashes - Japan/Korea configuration TSSM
4	Press and hold key fob button until confirmation is received.	One flash turn signals and indicators.	
5	Press left turn switch 1 time and release.	Turn signals and indicators flash to indicate option selected.	One flash - extremely low Two flashes - low sensitivity Three flashes - medium sensitivity Four flashes - high sensitivity
6	Press and release left turn switch to advance through options.	Turn signals and indicators flash to indicate option selected.	One flash - extremely low Two flashes - low sensitivity Three flashes - medium sensitivity Four flashes - high sensitivity
7	Turn ignition switch to OFF.		

Transport Mode

It is possible to arm the security system without enabling the motion detector for one ignition cycle. This allows the vehicle to be picked up and moved in an armed state. In this mode, any attempt to hot-wire the vehicle will trigger the security system.

- To enter the transport mode, refer to [Table E-4](#).
- To exit from transport mode and return the system to normal operation/functions, disarm the system using either the key fob or PIN.

NOTE

Transport mode is especially useful when working on the motorcycle. If it is not used, the alarm will activate under many typical service activities.

Table E-4. Transport Mode: TSSM

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set engine stop switch to OFF .		Verify the security lamp is not blinking (vehicle is disarmed).
2	Turn ignition switch to ON .		
3	Press and hold key fob button until confirmation is received.	Three flashes turn signals & indicators.	
4	Turn ignition switch to OFF .		
5	Press and hold key fob button until confirmation is received.	Three flashes turn signals & indicators.	The vehicle can be moved without tripping the alarm.

AUTO-ARMING FUNCTION: TSSM

Auto-arming causes the system to automatically arm itself (no key fob needed) within 30 seconds after the ignition switch is turned OFF. During this period, the security lamp stays on solid to indicate auto-arming is starting up.

The vehicle may be moved during these 30 seconds without triggering the alarm. However, any motion after that period will trigger the security alarm. Upon expiration of the auto-arming period, the turn signals flash twice, the security lamp begins to flash and the siren (if equipped) chirps twice.

The TSSM allows remote arming via the key fob at any time. However, if the system is remotely disarmed (with the key fob) but the ignition switch is not turned ON within 30 seconds, the system will rearm itself when auto-arming is enabled.

Japanese and Korean market motorcycles have auto-arming disabled by default. However, the feature may be enabled if the customer desires.

When auto-arming is disabled, the key fob must be used to arm the security system. To set the auto-arming function, refer to [Table E-5](#).

Table E-5. Selecting TSSM Auto-Arming Function

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set engine stop switch to OFF .		Verify the security lamp is not blinking (vehicle is disarmed).
2	Cycle the ignition switch IGN-OFF-IGN-OFF-IGN .		
3	Press left turn switch 2 times and release.	Two flashes turn signals and indicators (See E.3 VEHICLE DELIVERY regarding battery disconnects).	Two flashes - Japan/Korea configuration TSSM
4	Press and hold key fob button until confirmation is received.	One flash turn signals and indicators.	
5	Press and hold key fob button until confirmation is received.	Two flashes turn signals and indicators.	
6	Press left turn switch 1 time and release.	Turn signals and indicators flash to indicate option selected.	One flash - auto-arming disabled Two flashes - auto-arming enabled
7	Press and release left turn switch to advance through options.	Turn signals and indicators flash to indicate option selected.	
8	Turn ignition switch to OFF .		

STORAGE MODE: TSSM

The TSSM has a special mode for long term storage. This mode prevents the security system from draining the battery after a period of days (10, 20, 60 or infinite) without any ignition switch activity.

- If the TSSM is set to infinite, the system will not go into storage mode.
- Vehicles will enter storage mode whether the security system is armed or disarmed.
- If set to 20 days or greater, the customer must use an approved trickle charger to keep the battery from discharging.

In storage mode, all alarm functions remain active but the receiver is shut down and will not respond to the key fob. The vehicle is immobilized because the starter motor and ECM are disabled. When the storage mode is entered, the security lamp stops flashing to conserve power.

To wake up the TSSM from storage mode, the ignition switch must be turned ON. This will trigger a warning/alarm if the system was previously armed. You must use the key fob or PIN to disarm the system and stop the alarm.

To set the storage mode preferences, refer to [Table E-6](#).

Table E-6. Storage Mode Preferences: TSSM

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set engine stop switch to OFF .		Verify the security lamp is not blinking (vehicle is disarmed).
2	Cycle the ignition switch IGN-OFF-IGN-OFF-IGN .		
3	Press left turn switch 2 times and release.	Two flashes turn signals and indicators depending on vehicle configuration (See E.3 VEHICLE DELIVERY regarding battery disconnects).	Two flashes - Japan/Korea configuration TSSM
4	Press and hold key fob button until confirmation is received.	One flash turn signals and indicators.	
5	Release and then hold key fob button until confirmation is received.	Two flashes turn signals and indicators.	
6	Release and then hold key fob button until confirmation is received.	Three flashes turn signals and indicators.	
7	Press left turn switch 1 time and release.	Turn signals and indicators flash to indicate option selected.	One flash - 10 days Two flashes - 20 days Three flashes - 60 days Four flashes - Infinite
8	Press left turn switch to advance through options.	Turn signals and indicators flash to indicate option selected.	One flash - 10 days Two flashes - 20 days Three flashes - 60 days Four flashes - Infinite
9	Turn ignition switch to OFF.		

ARMING/DISARMING (TSSM ONLY)

E.7

GENERAL

There are two methods to arm the security system:

- Using the key fob.
- Using auto-arming. See [E.6 SECURITY SYSTEM FUNCTIONS \(TSSM ONLY\)](#).

NOTE

The vehicle cannot be armed with the ignition switch turned to IGN.

There are two ways to disarm the system:

- Using the key fob. This method works in all situations **except** before turning ignition switch to IGN when TSSM storage mode is activated.
- Using a PIN.

SECURITY LAMP

Refer to [Table E-7](#). The security lamp within the speedometer on XL, and tachometer on XR, provides feedback to the rider confirming armed or disarmed status.

Table E-7. Security Lamp Status: TSSM

LAMP	MODE
Does not flash.	No security system (TSM), security system not armed or storage mode active.
Flashes every second.	Ten minute timeout after failed PIN entry attempt or a battery reconnect has occurred while armed.
Flashes every 2 seconds.	Security system armed.
Flashes 4 times a second.	PIN entry mode.
Stays on solid with ignition switch turned OFF.	Auto-arming is starting up. You have 30 seconds before system is armed.
Stays on solid with ignition switch turned to IGN.	If solid for more than 4 seconds after ignition switch is turned to IGN, a current DTC is present.

USING KEY FOB: TSSM

General

The TSSM reception range for the key fob signal depends on a specific receiver pattern.

NOTE

Environmental and geographic conditions may affect signal range.

Arming the System

1. Hold key fob horizontal at waist level.
2. Point key fob at the front of the vehicle.
3. Hold down the key fob button until the system responds with two turn signal flashes.

Disarming the System

1. Hold key fob horizontal at waist level.
2. Point key fob at the front of the vehicle.
3. Quickly press the key fob button twice. The system will respond with one turn signal flash.

NOTE

*Disarming function may require practice. The key fob button **must** be pressed twice within 1.5 seconds to send the disarm command. The action is very similar to double-clicking a computer mouse. Light quick taps work best; very hard or very slow taps are less likely to work.*

Troubleshooting

If the key fob button has been pressed numerous times while away from the vehicle, the fob may fall out of synchronization with the TSSM. If this happens, the TSSM might fail to recognize the key fob's commands.

To solve this problem, press and hold the key fob button for 10-15 seconds until the security system responds with two turn signal flashes. After confirmation, you may resume normal fob operation.

USING THE PIN

General

The PIN consists of five digits entered using the left and right turn signal switches. Each digit can be any number from 1-9. The PIN is intended to be used to disarm the motorcycle in case the key fob becomes unavailable or inoperable.

See [E.3 VEHICLE DELIVERY](#) to set a PIN.

Disarming the System

Refer to [Table E-8](#). If you make an error while disarming the TSSM using a PIN, the alarm will activate for 30 seconds after the last digit is entered. After a failed attempt, the security lamp will flash once every second for 10 minutes. **During this time, the vehicle will not accept any attempt to enter a PIN.**

Table E-8. Disarming TSSM with the PIN (Example: 3-1-3-1-3)

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set engine stop switch to OFF .		
2	Turn ignition switch to ACC .		

Table E-8. Disarming TSSM with the PIN (Example: 3-1-3-1-3)

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
3	Hold both turn switches in until confirmation.	Security lamp blinks at fast rate.	System is ready for PIN entry.
4	Enter first digit of code (3) by pressing left turn switch 3 times .		
5	Press right turn switch 1 time .		Serves as "enter" key for first digit.
6	Enter second digit of code (1) by pressing left turn switch 1 time .		
7	Press right turn switch 1 time .		Serves as "enter" key for second digit.
8	Enter third digit of code (3) by pressing left turn switch 3 times .		
9	Press right turn switch 1 time .		Serves as "enter" key for third digit.
10	Enter fourth digit of code (1) by pressing left turn switch 1 time .		Serves as "enter" key for fourth digit.
11	Press right turn switch 1 time .		
12	Enter fifth digit of code (3) by pressing left turn switch 3 times .		System is disarmed. You may use the vehicle or program another key fob.
13	Press right turn switch 1 time .	Security lamp stops blinking.	



DIAGNOSTIC TROUBLE CODES (DTC)

E.8

TSM/TSSM

To diagnose system problems, start by observing the behavior of the security lamp.

NOTES

- See [Figure E-6](#). "Key ON" means that the Ignition Switch is turned to IGNITION (3) and the Engine Stop Switch is set to RUN (although the engine is not running).
- See [Figure E-7](#). When the Ignition Switch is turned ON, the security lamp will illuminate for approximately four seconds and then turn off.
- If the security lamp is not illuminated at Key ON or if it fails to turn OFF after the initial four-second period, the speedometer may need to be replaced. See [E.10 ODO-METER SELF-DIAGNOSTICS](#). If "BUS Er" is displayed on the odometer, it may take up to twenty seconds for the security lamp to illuminate.
- The security lamp will also light for eight seconds after the bulb check if historic Diagnostic Trouble Codes (DTCs) are present. The security lamp will stay on if current DTCs are set. If an historic DTC is present, the security lamp will light for 2 ignition cycles or until the DTC is cleared manually.

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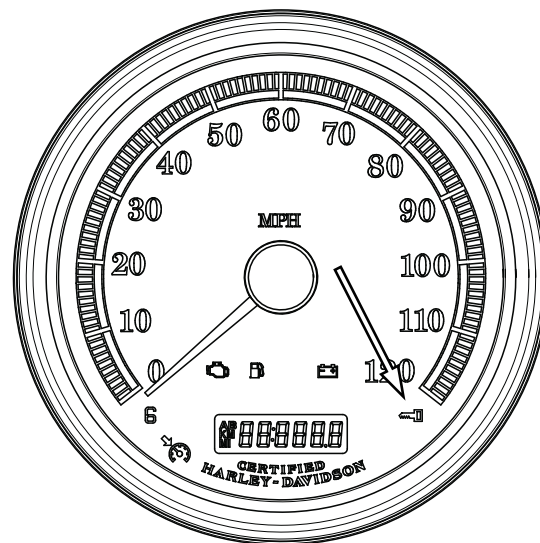
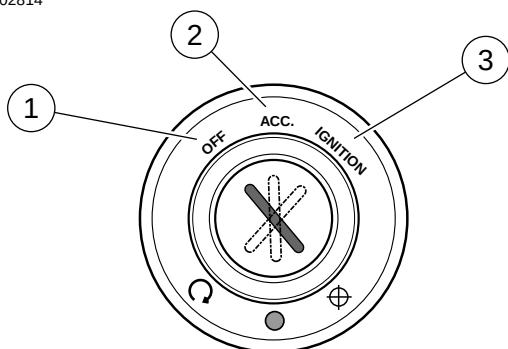


Figure E-7. Security Lamp (Key Icon) (Typical)

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1. Ignition OFF
2. Accessory (ACC) ON
3. Ignition ON

Figure E-6. Ignition Switch

1. See [Figure E-8](#). After the lamp turns off after being illuminated for the first four-second period, one of three events may occur:
 - a. The lamp remains off. This indicates there are no current fault conditions or stored historic DTCs currently detected by the TSSM.
 - b. The lamp stays off for only four seconds and then comes back on for an eight-second period. This indicates a historic DTC is stored, but no current DTC exists.
 - c. The lamp remains on beyond the eight-second period. This indicates a current DTC exists.
2. See [E.8 DIAGNOSTIC TROUBLE CODES \(DTC\), Code Types](#) for a complete description of DTC formats.

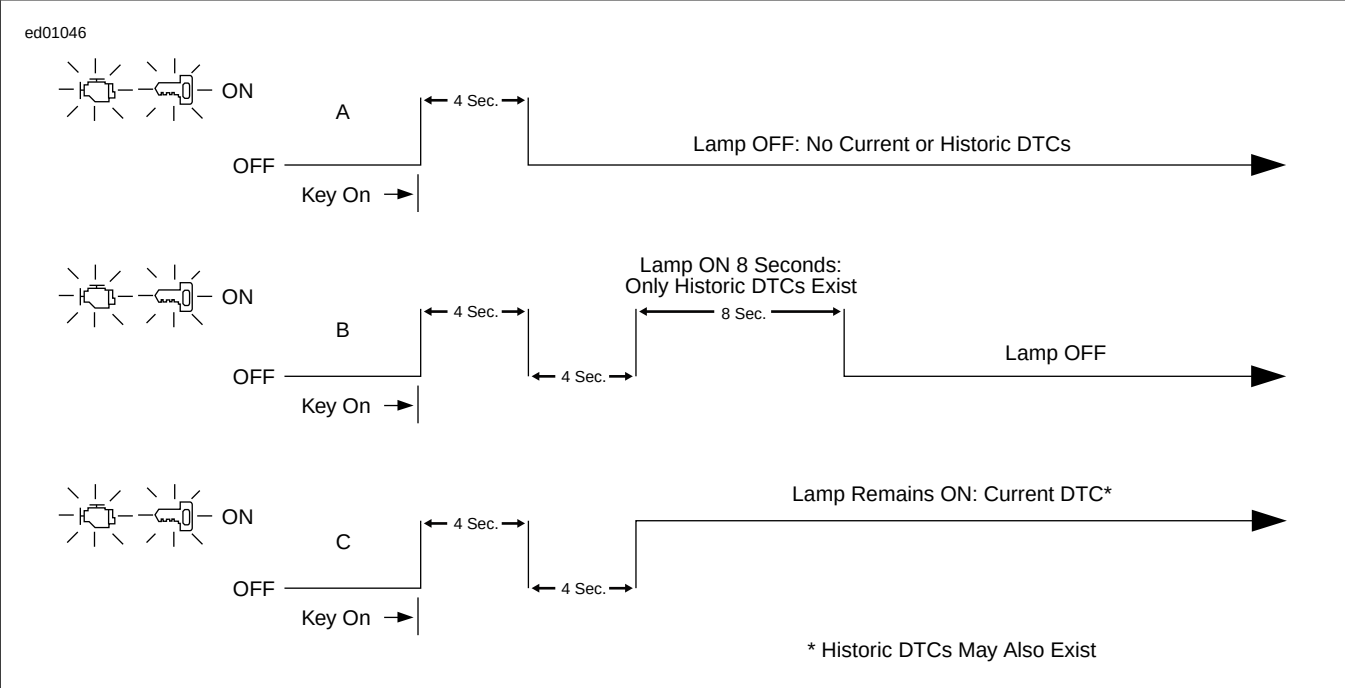


Figure E-8. Security Lamp Operation

CODE TYPES

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

There are two types of DTCs: current and historic. If a DTC is stored, it can be read using either a computer-based diagnostic package called DIGITAL TECHNICIAN II (Part No. HD-48650) or odometer self-diagnostics. See [E.10 ODOMETER SELF-DIAGNOSTICS](#).

NOTES

- Odometer self-diagnostics will display both current and historic DTCs. To differentiate between current and historic DTCs, a computer-based diagnostic package called DIGITAL TECHNICIAN II (Part No. HD-48650) must be employed.
- All DTCs reside in the memory of the ECM, TSM/TSSM, odometer or tachometer until the DTC is cleared by use of the odometer self-diagnostics. See [E.10 ODOMETER SELF-DIAGNOSTICS](#).
- A historic DTC is also cleared after a total of 50 ignition cycles has elapsed. After the 50 ignition cycles retention period, the DTC is automatically erased from memory providing that no subsequent faults of the same type are detected in that period.

Current

Current DTCs are those which are present during the current ignition cycle. See the appropriate flowcharts for solutions.

Historic

If a particular problem happens to resolve itself, the active status problem is dropped and it becomes a historic DTC rather

than a current DTC. For example, intermittent output shorts can become typical historic DTCs.

Historic DTCs are stored for 50 ignition cycles after any DTC was last set as current to assist in the diagnosis of intermittent faults. On the 50th cycle, the DTC will clear itself. The security lamp will only indicate the existence of only historic DTCs for two ignition cycles.

It is important to note that historic DTCs will exist whenever the system indicates the existence of a current fault. See [E.8 DIAGNOSTIC TROUBLE CODES \(DTC\)](#), [Multiple Diagnostic Trouble Codes](#) if multiple DTCs are found.

Diagnostic charts are designed for use with current DTCs and as a result they frequently suggest part replacement. When diagnosing an historic DTC the charts can be helpful but should not lead to part replacement without verification the part is faulty.

RETRIEVING DIAGNOSTIC TROUBLE CODES

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

The TSM/TSSM supports two levels of diagnostics.

- The most sophisticated mode employs a computer-based diagnostic package called DIGITAL TECHNICIAN II (Part No. HD-48650).
- The second mode requires using odometer self-diagnostics. Speedometer, tachometer (if equipped), TSM/TSSM and ECM DTCs can be accessed and cleared. See [E.10 ODOMETER SELF-DIAGNOSTICS](#).

MULTIPLE DIAGNOSTIC TROUBLE CODES

While it is possible for more than one fault to occur and set more than one DTC, there are several conditions which may result in **one** fault setting **multiple** DTCs:

Serial data DTCs (U1016, U1255, U1300 and U1301) may be accompanied by other DTCs. **Always** correct the serial data DTCs before resolving the other DTCs.

Refer to [Table E-9](#). This table gives most TSM/TSSM DTCs a priority ranking.

Table E-9. TSM/TSSM Diagnostic Trouble Codes (DTC) and Fault Conditions

RANKING	DTC	FAULT CONDITION	SOLUTION
1	U1300	J1850 short-to-ground	E.20 DTC U1300, U1301 OR BUS ER.
2	U1301	J1850 short-to-battery	E.20 DTC U1300, U1301 OR BUS ER.
3	U1016	Loss of serial communications - ECM	E.19 DTC U1016, U1255.
4	U1255	Loss of serial communication - general	E.19 DTC U1016, U1255.
5	B1135	Accelerometer fault	E.17 DTC B1135.
6	B1154	Clutch switch input short-to-ground	E.18 DTC B1154, B1155.
7	B1155	Neutral switch input short-to-ground	E.18 DTC B1154, B1155.
8	B1134	Start relay output short-to-ground	E.16 DTC B1134.
9	B1121	Left turn lamp output fault	E.13 TURN SIGNAL ERRORS: B1121, B1122, B1141.
10	B1122	Right turn lamp output fault	E.13 TURN SIGNAL ERRORS: B1121, B1122, B1141.
11	B0563	Battery voltage high	E.14 DTC B0563.
12	B1131	Alarm output short-to-ground	E.15 DTC B1131, B1132.
13	B1132	Alarm output short-to-ground	E.15 DTC B1131, B1132.
14	B1141	Ignition switch input short-to-ground or open	E.13 TURN SIGNAL ERRORS: B1121, B1122, B1141.



INITIAL DIAGNOSTIC CHECK: TSM/TSSM

E.9

GENERAL

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

To locate faulty circuits or other system problems, follow the diagnostic flowcharts. For a systematic approach, always begin with [E.9 INITIAL DIAGNOSTIC CHECK: TSM/TSSM, Initial Diagnostics](#). Read the general information and then work your way through the flowchart box by box.

Diagnostic Notes

If a numbered circle appears adjacent to a flowchart 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.

Circuit Diagram/Wire Harness Connector Table

When working through a flowchart, 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 digital volt/ohmmeter (DVOM) are required. See [E.11 BREAKOUT BOX: TSM/TSSM](#).

To perform the circuit checks with any degree of efficiency, a familiarity with the various wire connectors is also necessary.

Job/Time Code Values

Some charts may contain warranty job/time codes. Dealership technicians filing warranty claims should use the job/time code values printed in **bold text** underneath the appropriate repair.

Reprogramming ECM

Diagnostic charts frequently suggest ECM replacement. In the event an ECM needs to be replaced, it must be reprogrammed

using a computer-based diagnostic package called DIGITAL TECHNICIAN II (Part No. HD-48650). See your dealer. Password learn procedure must also be performed. See [E.21 TSM/TSSM: PASSWORD LEARN](#).

INITIAL DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-42682	BREAKOUT BOX
HD-46601	INSTRUMENT HARNESS ADAPTERS

Diagnostic Tips

- If odometer reads "BUS Er" with the Ignition Switch turned to IGN (Engine Stop Switch at RUN with the engine off), check data bus for an open or short to ground between data link connector [91A] terminal 3 and ECM connector [78B] terminal 5, TSSM connector [30B] terminal 3, speedometer connector [39B] terminal 2 on XL, C on XR, or tachometer (if equipped) connector [108B] terminal 2.
- Check for an open diagnostic test terminal between data link connector [91A] terminal 3 and TSM/TSSM connector [30B] terminal 3. With Ignition Switch turned to IGN, serial data bus voltage should be typically 0.6-0.8 Volt. The range of acceptable voltage is 0-7.0 Volts.
- To identify intermittents, wiggle vehicle harness while performing steps in the Initial Diagnostic Check flowcharts.

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. Connect BREAKOUT BOX (Part No. HD-42682) between wire harness connector [39B] on XL, or connector [108B] on XR, and speedometer connector [39A] on XL, or tachometer connector [108A] on XR, using INSTRUMENT HARNESS ADAPTERS (Part No. HD-46601). See [2.2 INITIAL DIAGNOSTIC CHECK: ODOMETER](#).
2. Compare TSM/TSSM system behavior to symptoms in [Table E-10](#).

All TSM/TSSM DTCs are listed in [Table E-9](#).

Table E-10. Symptoms That May Not Set Diagnostic Trouble Codes

SYMPTOM	SOLUTION
Fails to disarm	E.12 FAILS TO DISARM (TSSM ONLY) .
Turn signal will not cancel or cancels erratically	E.13 TURN SIGNAL ERRORS: B1121, B1122, B1141 .
Turn signal flashes double normal rate, all bulbs good	E.13 TURN SIGNAL ERRORS: B1121, B1122, B1141 .

Other DTCs

See [2.2 INITIAL DIAGNOSTIC CHECK: ODOMETER](#) for any DTCs related to the odometer.

See [4.5 INITIAL DIAGNOSTIC CHECK: EFI](#) for any DTCs related to the ECM.

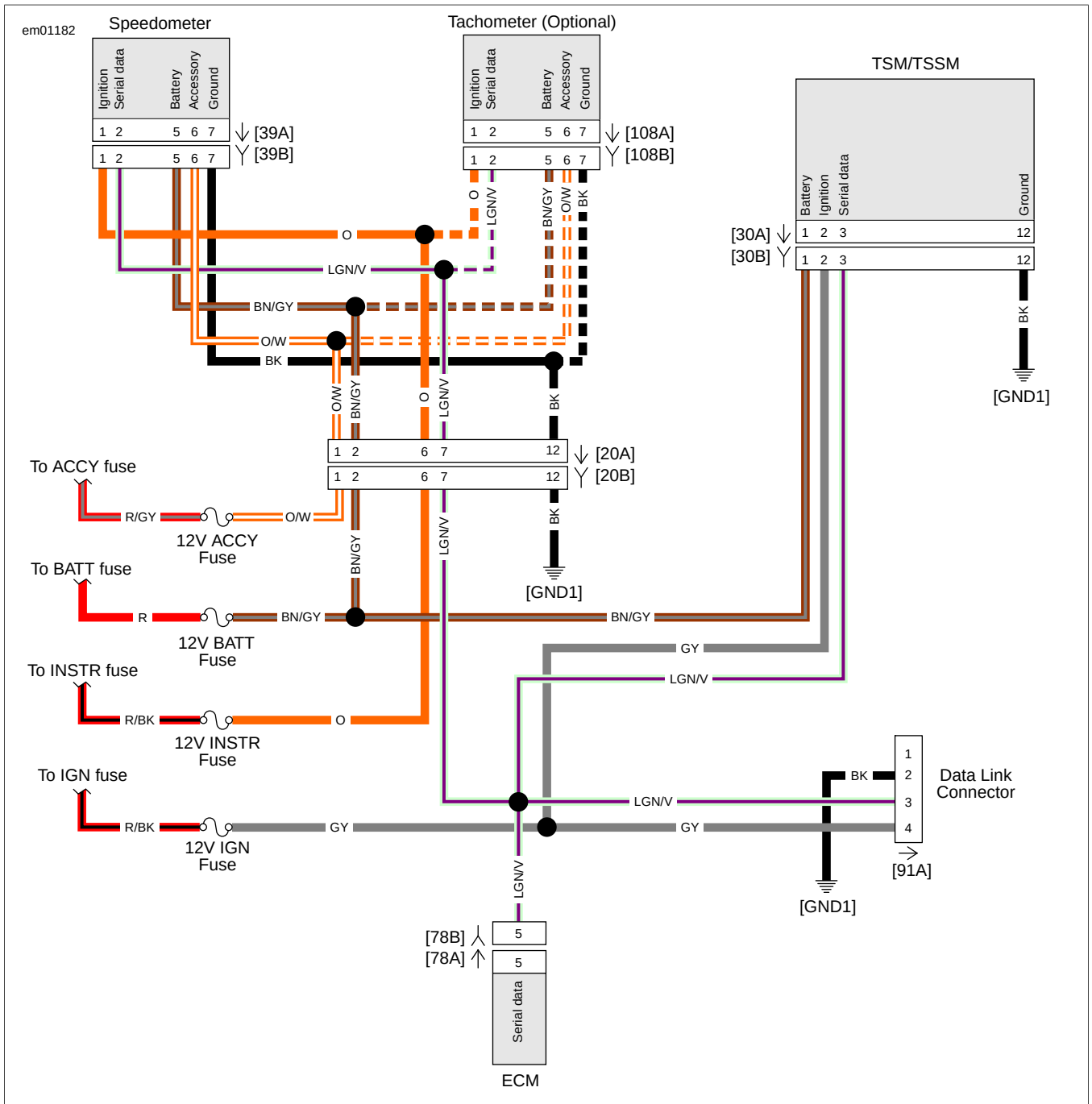


Figure E-9. Diagnostic Check (XL)

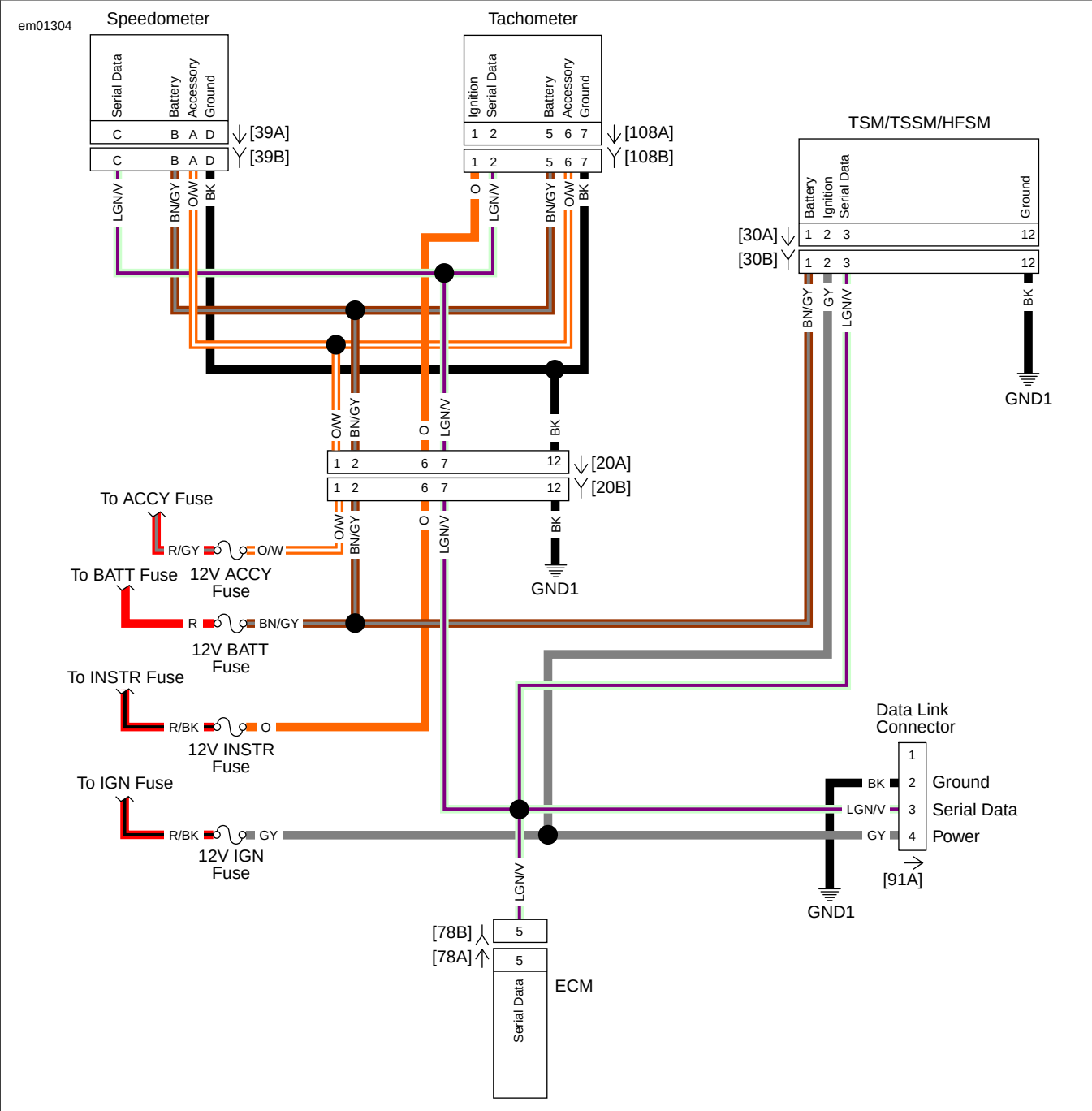


Figure E-10. Diagnostic Check (XR)

Table E-11. Wire Harness Connectors

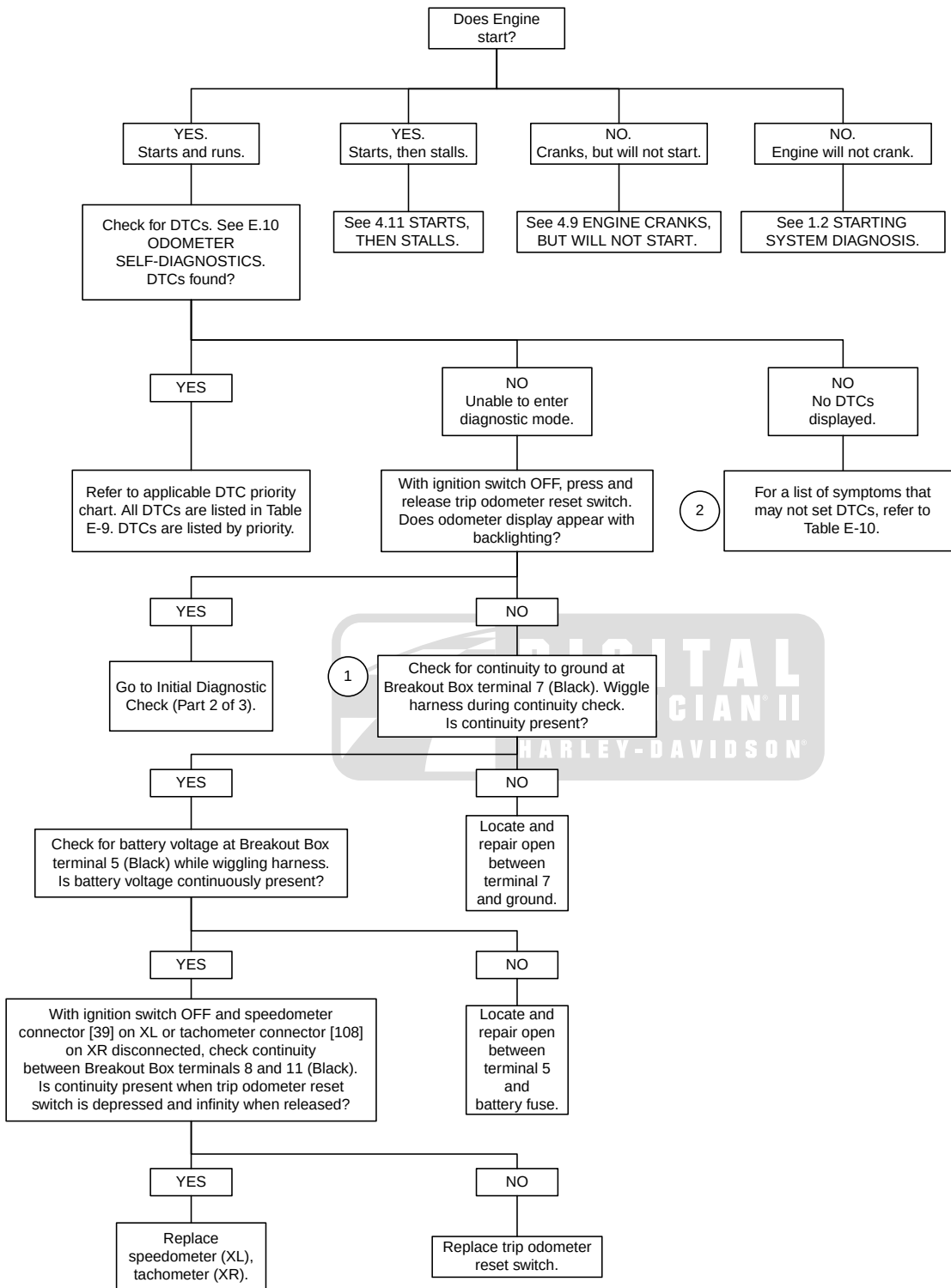
NO.	DESCRIPTION	TYPE	LOCATION
[20]	Instruments	12-place Molex	Under fuel tank
[30]	TSM/TSSM	12-place Deutsch	Under battery tray
[39]	Speedometer (XL)	12-place Packard	Back of speedometer
[39]	Speedometer (XR)	5-place Packard	Back of speedometer
[78]	ECM	36-place Packard	Under seat

Table E-11. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[91]	Data link connector	4-place Deutsch	Under left side cover
[108]	Tachometer (if equipped)	12-place Packard	Back of tachometer

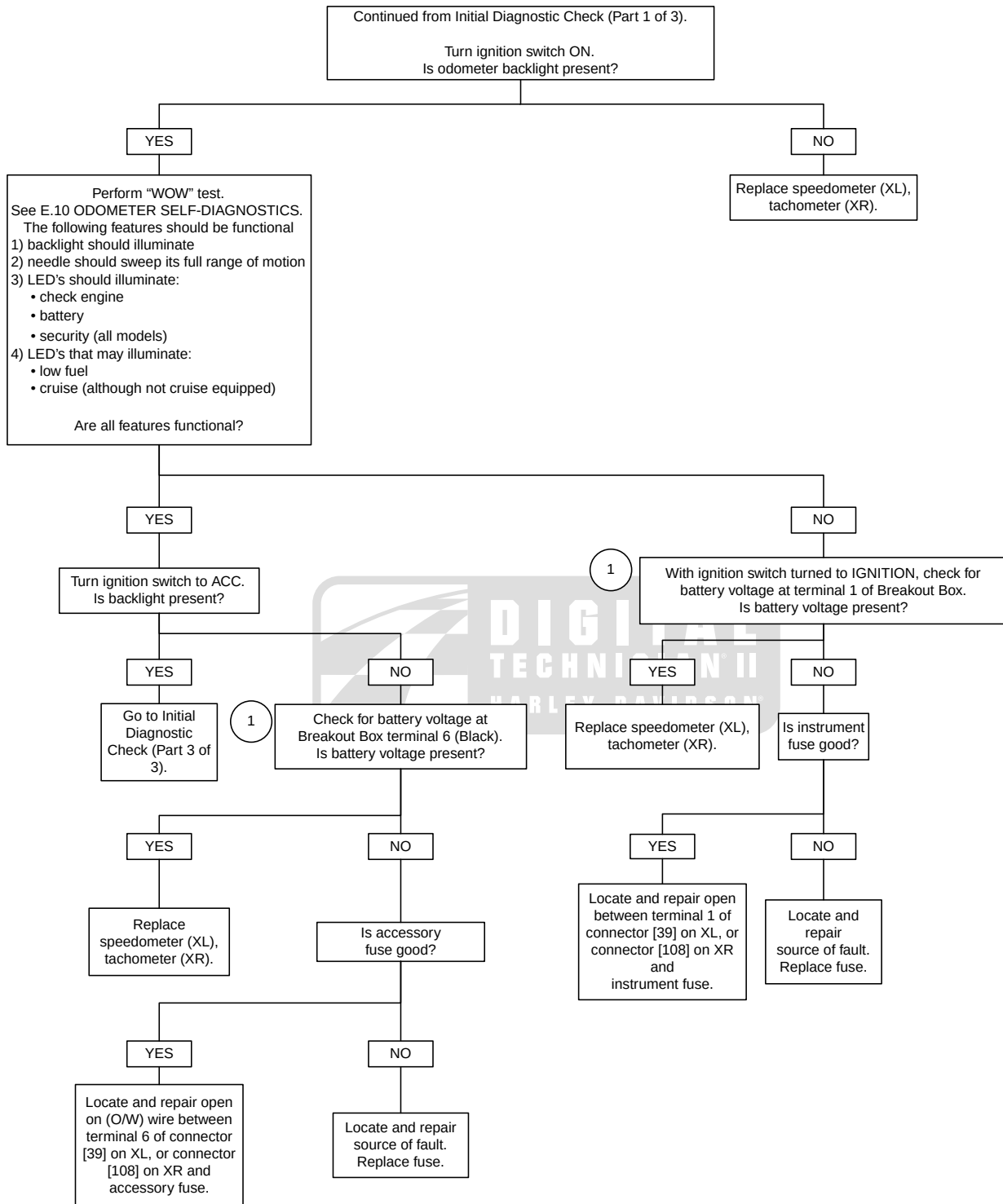


Initial Diagnostic Check (Part 1 of 3)



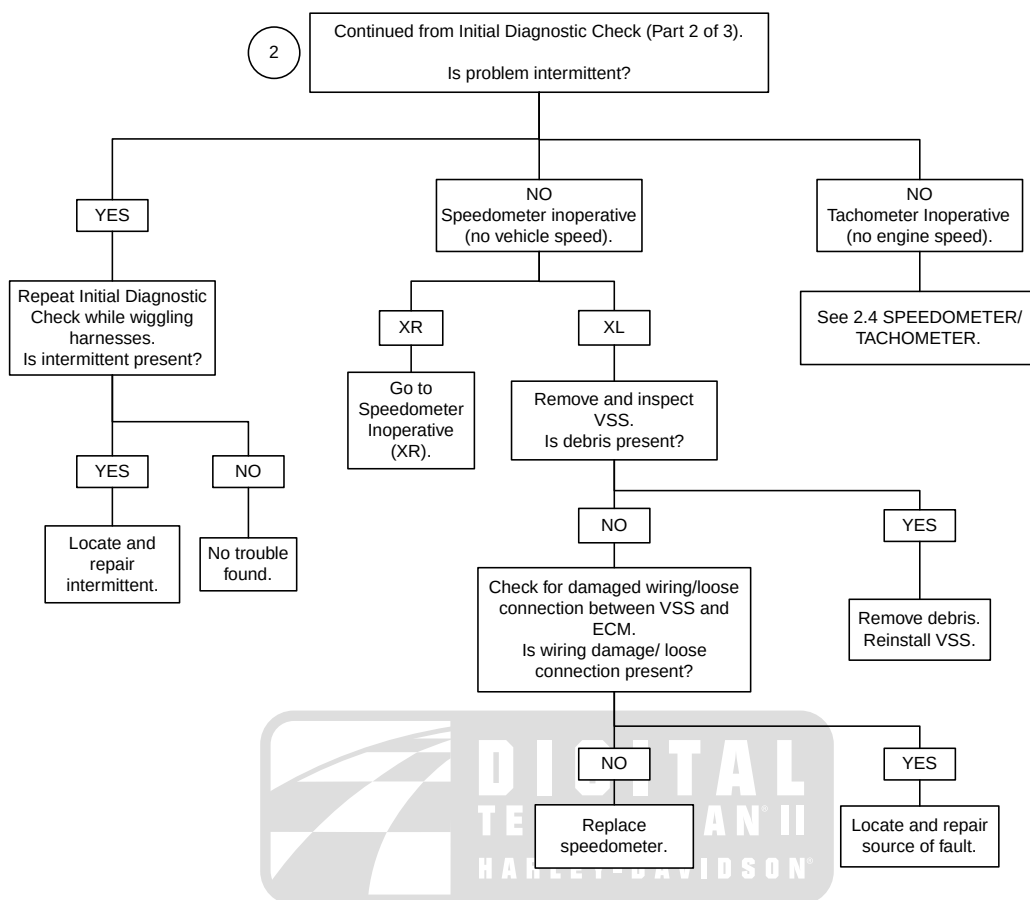
fc01997_en

Initial Diagnostic Check (Part 2 of 3)



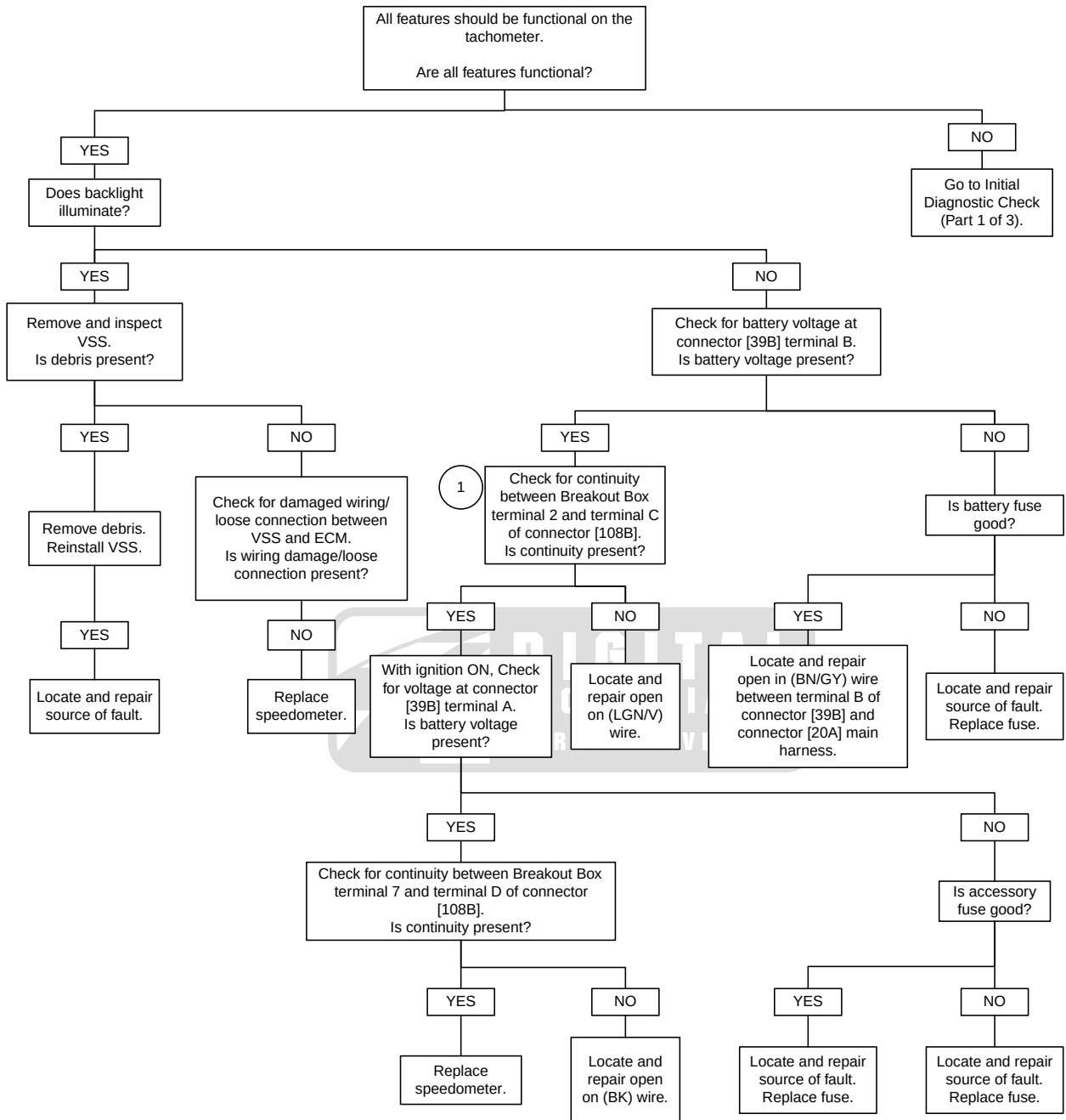
fc02007_en

Initial Diagnostic Check (Part 3 of 3)



fc01960_en

Speedometer Inoperative (XR)



fc01931_en

ODOMETER SELF-DIAGNOSTICS

E.10

GENERAL

The odometer is capable of displaying and clearing speedometer, tachometer, TSM/TSSM, ABS, and ECM DTCs (diagnostic mode).

DIAGNOSTICS

Diagnostic Tips

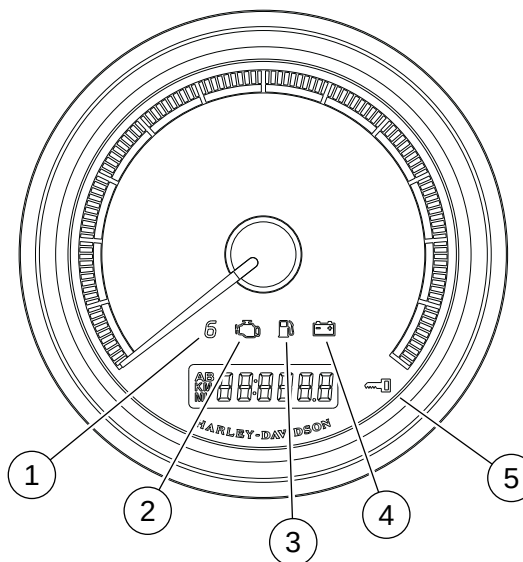
- For a quick check of speedometer (XL) or tachometer (XR) functions, a "WOW" test can be performed. Press and hold trip odometer reset switch then turn ignition switch ON. Release trip odometer reset switch. See [Figure E-11](#). Background lighting should illuminate, gauge needles should sweep their full range of motion, and indicator lamps (battery, security, low fuel, and check engine) should illuminate. All lamps should illuminate, even those not used in normal vehicle operations.
- If speedometer (XL) or tachometer (XR) fails "WOW" test, check for battery, ground, ignition, trip odometer reset switch and accessory wiring to speedometer. If any feature in the speedometer is non-functional, see [2.2 INITIAL DIAGNOSTIC CHECK: ODOMETER](#).

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

- To exit diagnostic mode, turn ignition switch OFF.
- To clear DTCs for the selected module, press the trip odometer reset switch for more than 5 seconds when a DTC is displayed. This procedure will clear all DTCs for the selected module.

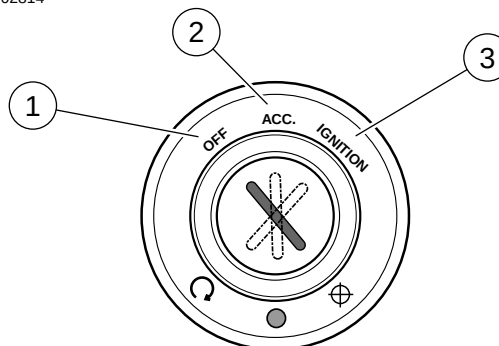
ed01721



1. Sixth gear indicator (not used)
2. Check engine lamp
3. Low fuel lamp
4. Battery lamp
5. Security lamp (key icon)

Figure E-11. Warning Lamps (Typical)

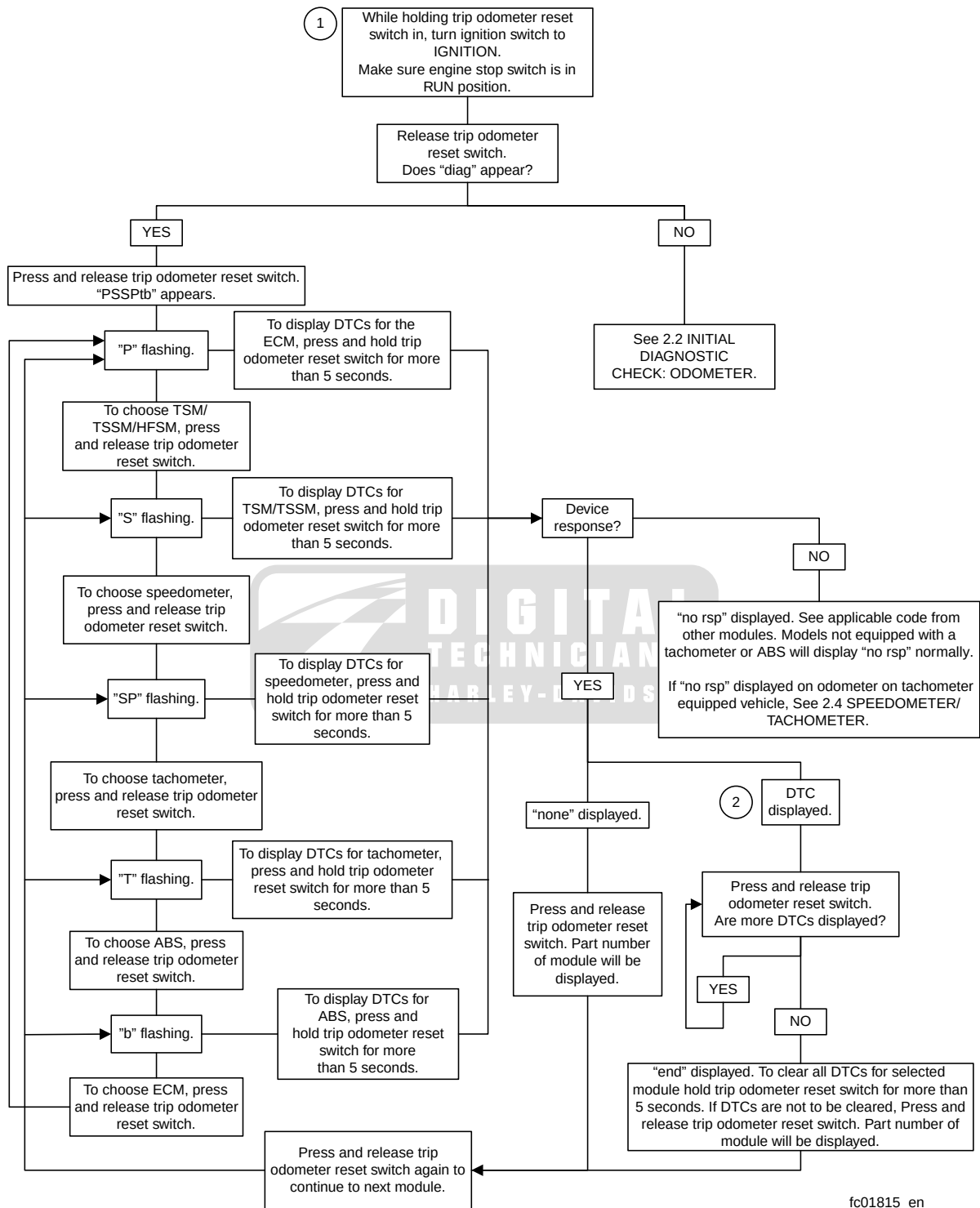
ed02814



1. Ignition OFF
2. Accessory (ACC) ON
3. Ignition ON

Figure E-12. Ignition Switch

Odometer Self-Diagnostics



BREAKOUT BOX: TSM/TSSM

E.11

GENERAL

PART NUMBER	TOOL NAME
HD-42682	BREAKOUT BOX

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

PART NUMBER	TOOL NAME
HD-42682	BREAKOUT BOX

1. Remove left side cover and battery. See the service manual.
2. See [Figure E-13](#). Reach under battery tray and lift TSM/TSSM from cavity in bottom of tray.
3. See [Figure E-14](#). Depress latches on harness connector [30B] and remove from TSM/TSSM connector [30A].
4. Route harness connector [30B] back down through cavity and out left side of vehicle under battery tray.
5. Reinstall battery.
6. See [Figure E-15](#). Attach BREAKOUT BOX (Part No. HD-42682) to connectors:
 - a. Mate gray socket housing on BREAKOUT BOX (Part No. HD-42682) with TSM/TSSM connector [30A].
 - b. Mate gray pin housing on BREAKOUT BOX (Part No. HD-42682) with harness connector [30B].

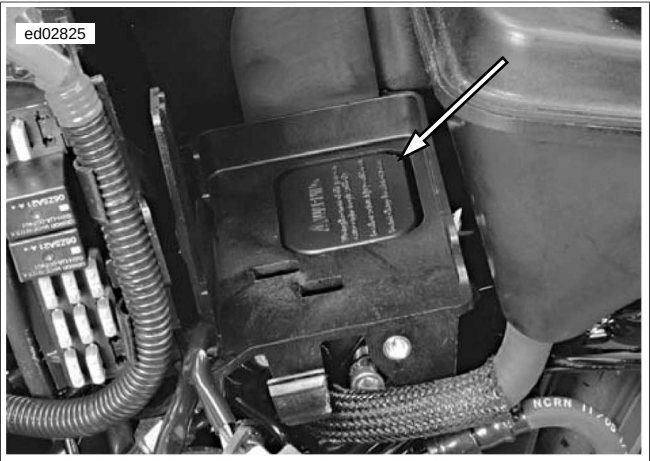


Figure E-13. TSM/TSSM Location

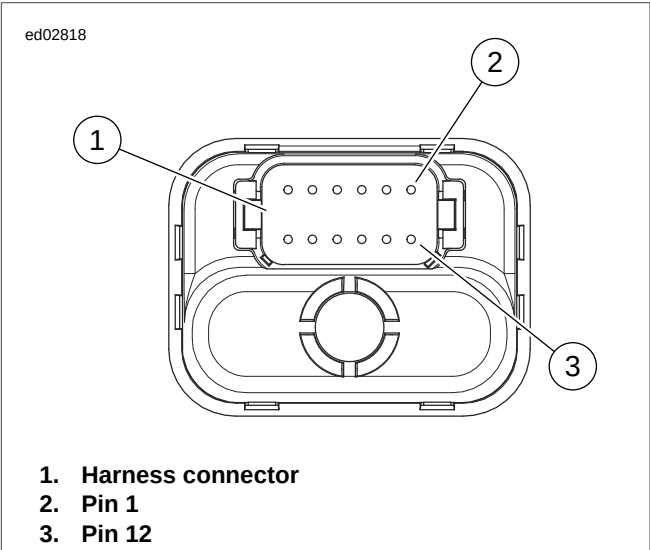


Figure E-14. TSM/TSSM Connector [30A]

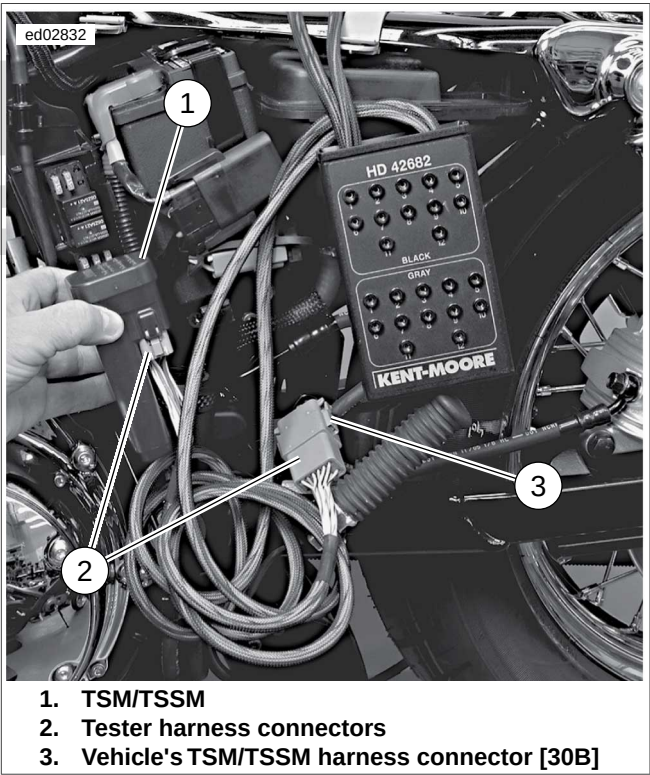


Figure E-15. Breakout Box: TSM/TSSM

REMOVAL

PART NUMBER	TOOL NAME
HD-42682	BREAKOUT BOX

1. Disconnect BREAKOUT BOX (Part No. HD-42682) from vehicle:
 - a. See [Figure E-14](#). Depress latches and detach gray BREAKOUT BOX (Part No. HD-42682) socket connector from TSM/TSSM connector [30A] (1).
 - b. See [Figure E-15](#). Detach gray BREAKOUT BOX (Part No. HD-42682) pin connector from harness connector [30B] (3).

2. Remove battery. Route TSM/TSSM harness connector [30B] up through cavity in bottom of battery tray.
3. Mate harness connector [30B] to TSM/TSSM.
4. Position TSM/TSSM with connector facing toward rear of vehicle. Lower TSM/TSSM down into cavity in bottom of battery tray.
5. Install battery, MAXIFUSE, and left side cover. See the service manual.

NOTE

Vehicle will not start with TSM/TSSM disconnected or incorrectly mounted.

Table E-12. TSM/TSSM Connector [30B]

TERMINAL	FUNCTION	TERMINAL	FUNCTION
1	Battery	7	Right turn switch input
2	Ignition	8	Left turn switch input
3	Serial data	9	Start relay control
4	Neutral switch	10	Clutch switch
5	Left turn feed	11	Alarm signal
6	Right turn feed	12	Ground



FAILS TO DISARM (TSSM ONLY)

E.12

GENERAL

Security Equipped Vehicles Only

This section applies only to those vehicles equipped with the optional TSSM.

NOTE

*Disarming function may require practice. The key fob button **must** be pressed twice within 1.5 seconds to send the disarm command. The action is very similar to double-clicking a computer mouse. Light quick taps work best; very hard or very slow taps are less likely to work.*

The key fob sends a RF signal to activate all remote TSSM functions. The left front turn signal switch wire serves as the vehicle's antenna. If the TSSM does not respond (no confirmation at arming/disarming system) or responds weakly (limited range, won't consistently arm/disarm or synchronize), follow the flowchart.

Job/Time Code Values

Dealership technicians filing warranty claims should use the job/time code values printed in **bold text** underneath the appropriate repair.

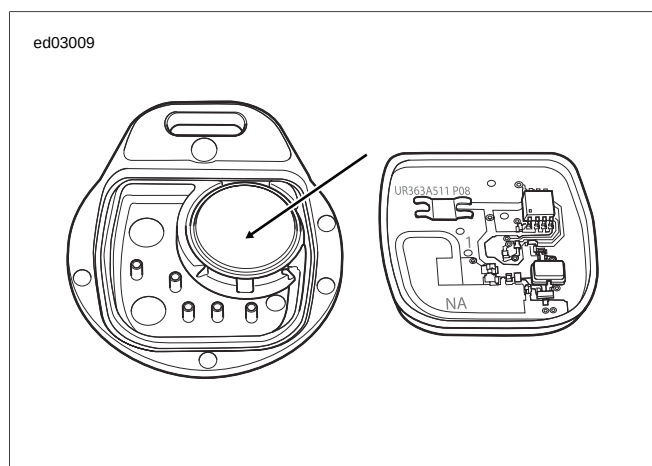


Figure E-16. Key Fob Battery: TSSM

DIAGNOSTICS

Diagnostic Tips

- Verify key fob battery voltage is at least 2.9 volts. See [E.22 TSSM MAINTENANCE](#).
- Interference from physical surroundings may affect RF transmission. Place fob next to left handgrip and disarm with two clicks or move motorcycle to a new location and retest.
- Check for damage to antenna wire. Does left turn signal work?

NOTE

See [E.7 ARMING/DISARMING \(TSSM ONLY\)](#). Use only the proper key fob for your market and TSSM package.

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. After a battery disconnect, the TSSM will not enter the configuration mode on the first attempt. All attempts to assign a fob or enter the configuration mode will require at least two attempts.

DIGITAL
TECHNICIAN II
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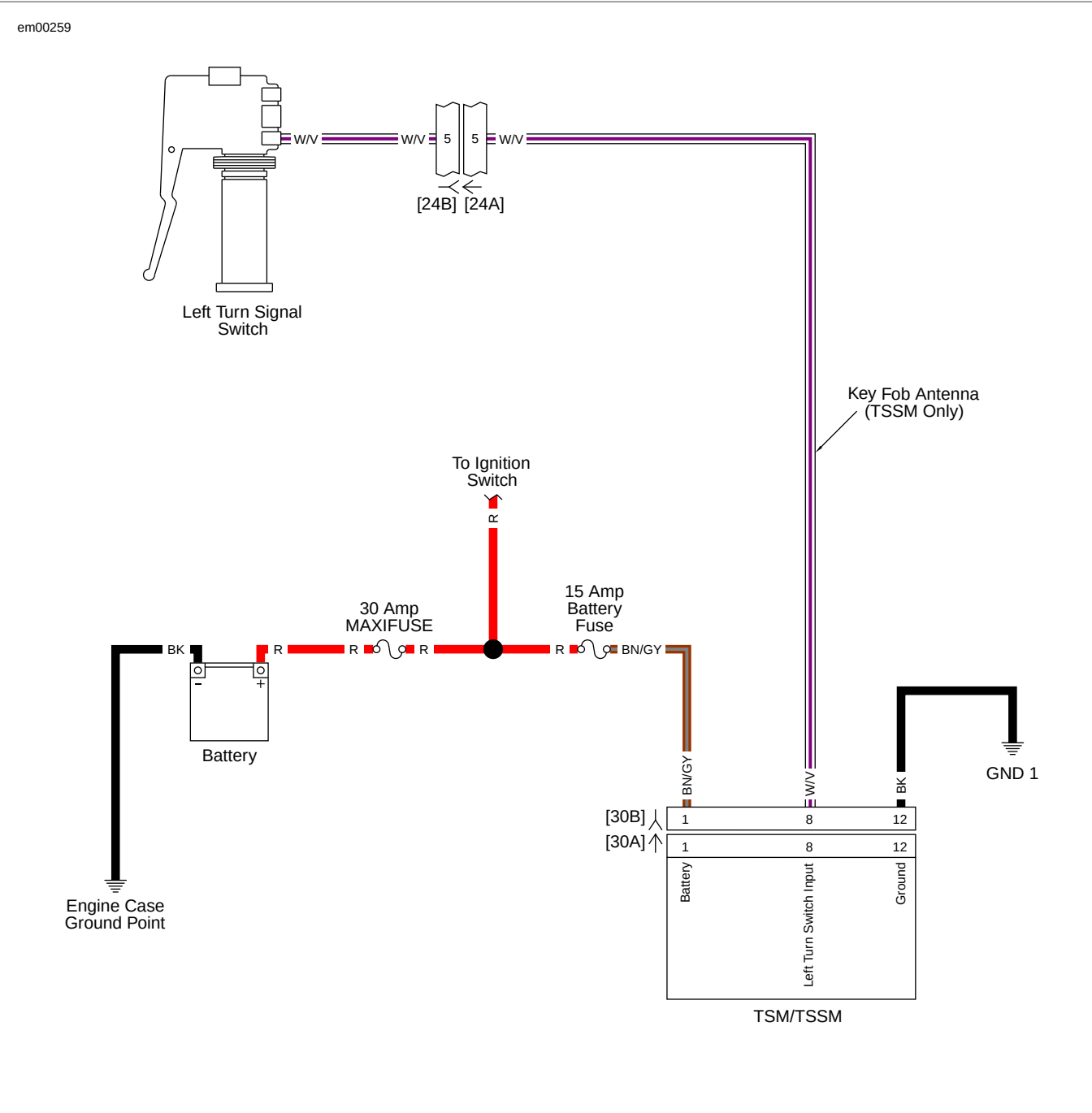
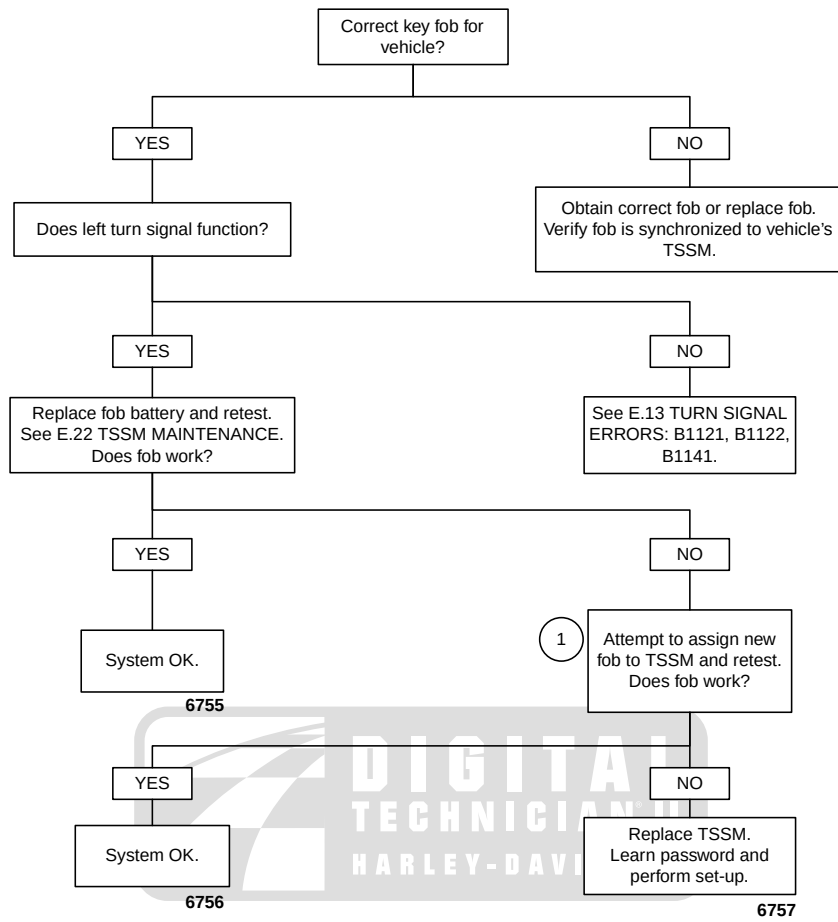


Figure E-17. Antenna Circuit

Table E-13. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[24]	Left hand controls and horn	8-place Molex	Under fuel tank
[30]	TSM/TSSM	12-place Deutsch	Under battery

Fails to Disarm



fc01161_en

TURN SIGNAL ERRORS: B1121, B1122, B1141

E.13

GENERAL

The turn signals will automatically cancel based on either the speed/acceleration of the vehicle or upon turn completion. See [E.4 TURN SIGNAL FUNCTIONS](#).

For turn signal diagnostics, refer to [Table E-14](#).

Job/Time Code Values

Dealership technicians filing warranty claims should use the job/time code values printed in **bold text** underneath the appropriate repair.



Figure E-18. TSM/TSSM

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX

Diagnostic Tips: All

- DTCs B1121 and B1122 will illuminate the security lamp.
- DTC B1141 will not illuminate the security lamp.
- When the TSM/TSSM is in 4-way flasher mode, a fault on either the left or right turn lamp output will not cause either DTC B1121 or DTC B1122 to be set. If fault occurs on both left and right outputs, then both DTC B1121 and DTC B1122 will be set.
- When the TSM/TSSM detects an over current or short to ground condition, it will turn off the turn lamp outputs. The outputs will be automatically reactivated once the fault is removed.

Table E-14. Turn Signal Errors: TSM/TSSM

DTC	SYMPTOM	START WITH FLOWCHART
N/A	Turn signals cancel erratically	Cancels Erratically
B1121, B1122, B1141	Turn signals will not flash, 4-way flashers inoperable	DTC B1121, DTC B1122, DTC B1141, Will Not Flash, 4-Way Flashers Inoperable (Part 1 of 6)
N/A	Turn signals will not cancel upon turn completion	Will Not Cancel Upon Turn Completion
N/A	Left or right turn signals flash at double the normal rate while all bulbs are working	Flash at Double Normal Rate, All Bulbs Working

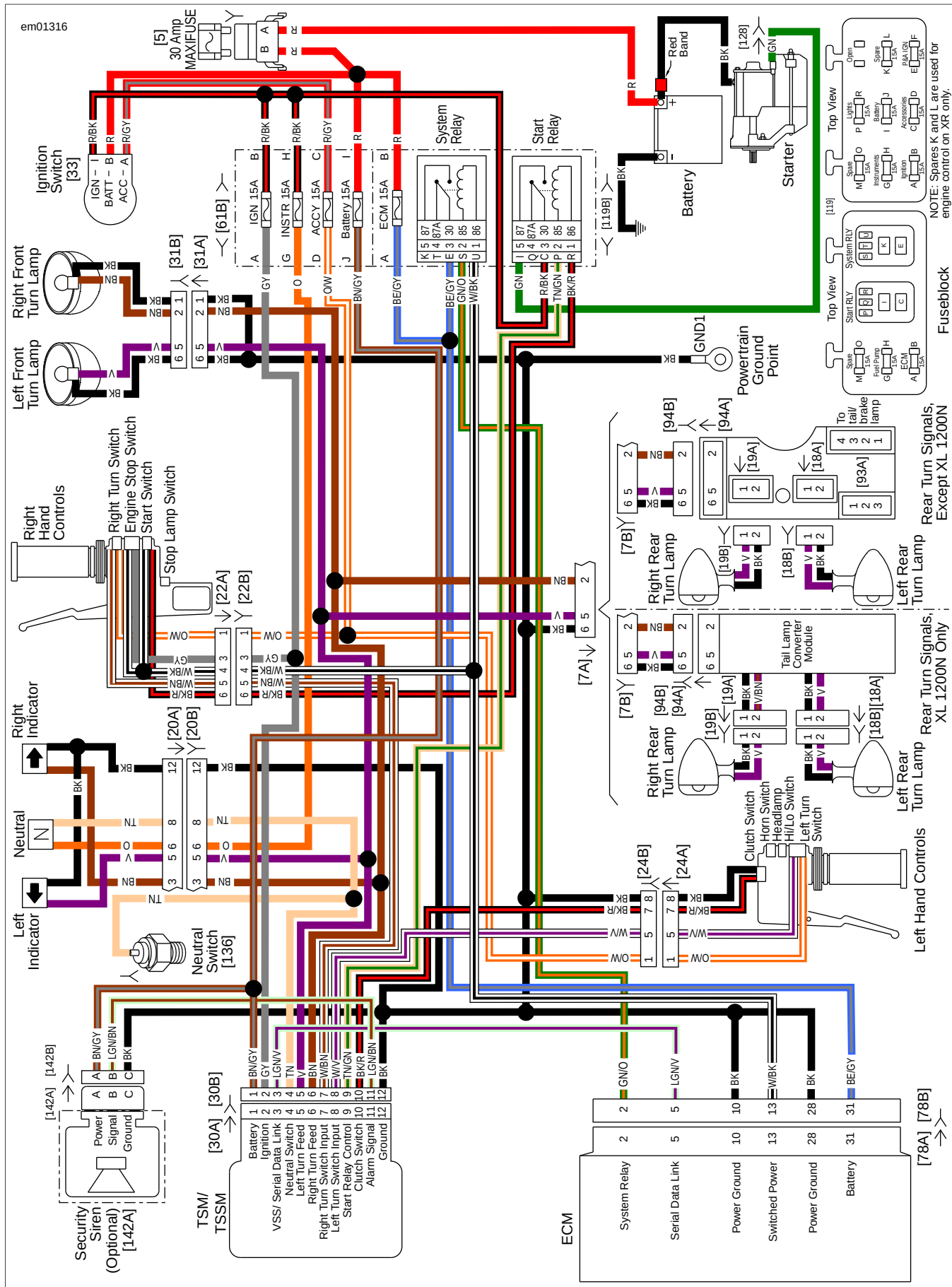


Figure E-19. Turn Signal Circuit (Typical)

Table E-15. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[5]	MAXIFUSE	2-place Metri-Pack, black	On battery strap, behind left side cover
[7]	Rear lighting	6-place Multilock	Under seat
[18]	Left rear turn signal	2-place Multilock	Inside tail lamp lens
[19]	Right rear turn signal	2-place Multilock	Inside tail lamp lens
[20]	Console gauges/indicator lamps	12-place Molex	Under fuel tank
[22]	Right handlebar controls	6-place Molex	Under fuel tank
[24]	Left handlebar controls	8-place Molex	Under fuel tank
[30]	TSM/TSSM	12-place Deutsch	Under battery
[31]	Front turn signals	6-place Multilock	Under fuel tank
[61B]	Fuse block	Spade terminals	Behind left side door
[78]	ECM	36-place Packard	Under seat
[94]	Tail lamp power in	6-place Multilock, black	Inside tail lamp lens
[119]	Relay/fuse block	5-place Amp, spade terminals	Fuse/relay block, behind left side cover
[128]	Starter solenoid	Locking spade terminal, white	Stater solenoid
[136]	Neutral switch	1-place molded jumper, black	Right side frame, beneath gear case cover
[142]	Security siren	3-place Packard, black	Under frame
[208]	TSSM antenna connector	4-place Deutsch, gray	Under battery
[209]	Security antenna	Ring terminal	Crankcase housing, top rear

Diagnostic Notes: All Turn Signal Flowcharts

Each reference number below correlates to a circled number on the flowchart(s).

1. Gain access to vehicle's TSM/TSSM:
 - a. Remove battery. See the Service Manual for procedure.
 - b. Unplug and remove TSM/TSSM from battery tray.
 - c. Reroute wiring harness so TSM/TSSM may be reconnected while removed from vehicle.
 - d. Reconnect TSM/TSSM.
2. Perform the following procedure:
 - a. See [Figure E-20](#). Position TSM/TSSM in same orientation it is mounted on vehicle. Turn Ignition Switch on. Turn 4-way flashers on by depressing both left and right turn signal switches simultaneously. Turn Ignition Switch off. The 4-way flashers should continue to flash.
 - b. Tilt TSM/TSSM greater than 45 degrees to the left.
 - c. Repeat step a.
 - d. Tilt TSM/TSSM greater than 45 degrees to the right.
3. To enable diagnostic mode, see [E.10 ODOMETER SELF-DIAGNOSTICS](#).
4. Connect BREAKOUT BOX (Part No. HD-42682) (gray) between TSM/TSSM connector [30A] and wiring harness connector [30B]. See [E.11 BREAKOUT BOX: TSM/TSSM](#).
5. Closely inspect handlebar controls for pinched wiring.
6. Connect gray HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) adapters and patch cords to connector [22] (right) or connector [24] (left).

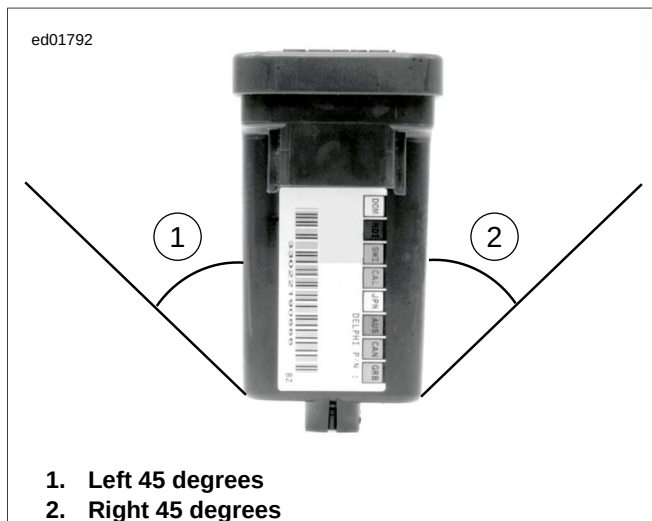
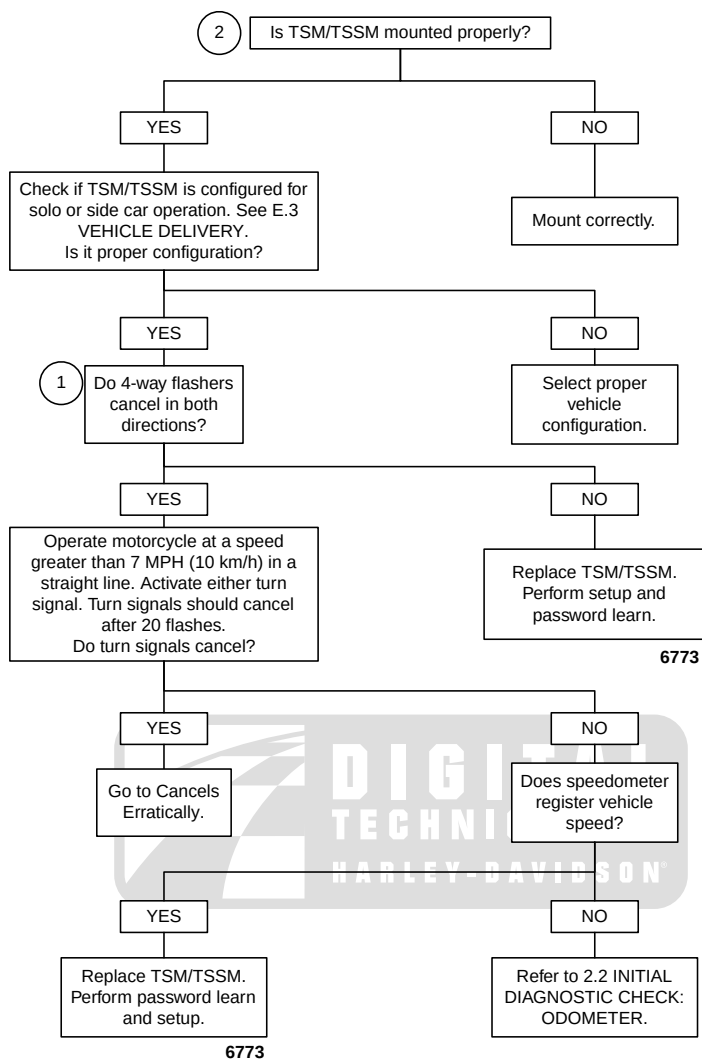


Figure E-20. Tilting: TSM/HFSM

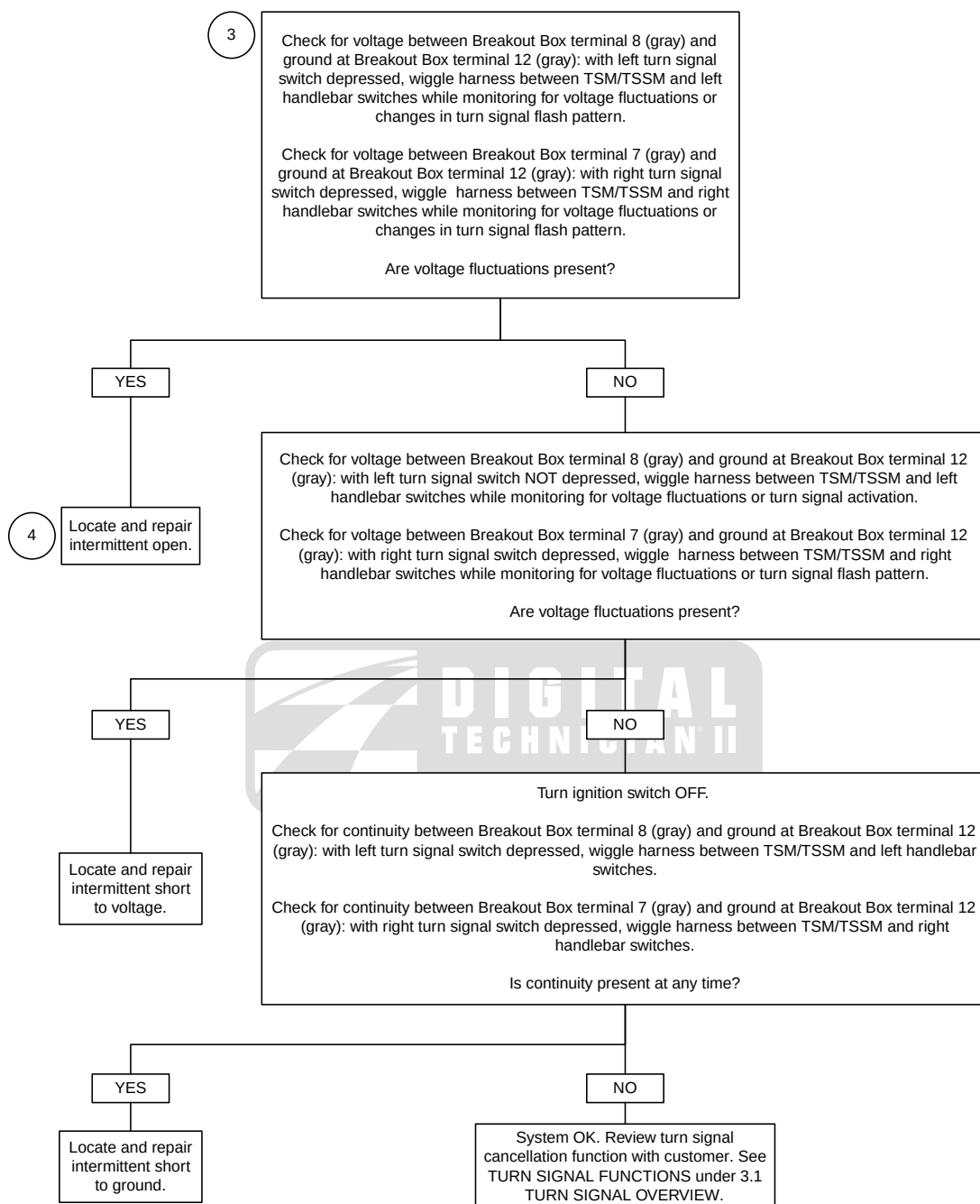


Will Not Cancel Upon Turn Completion



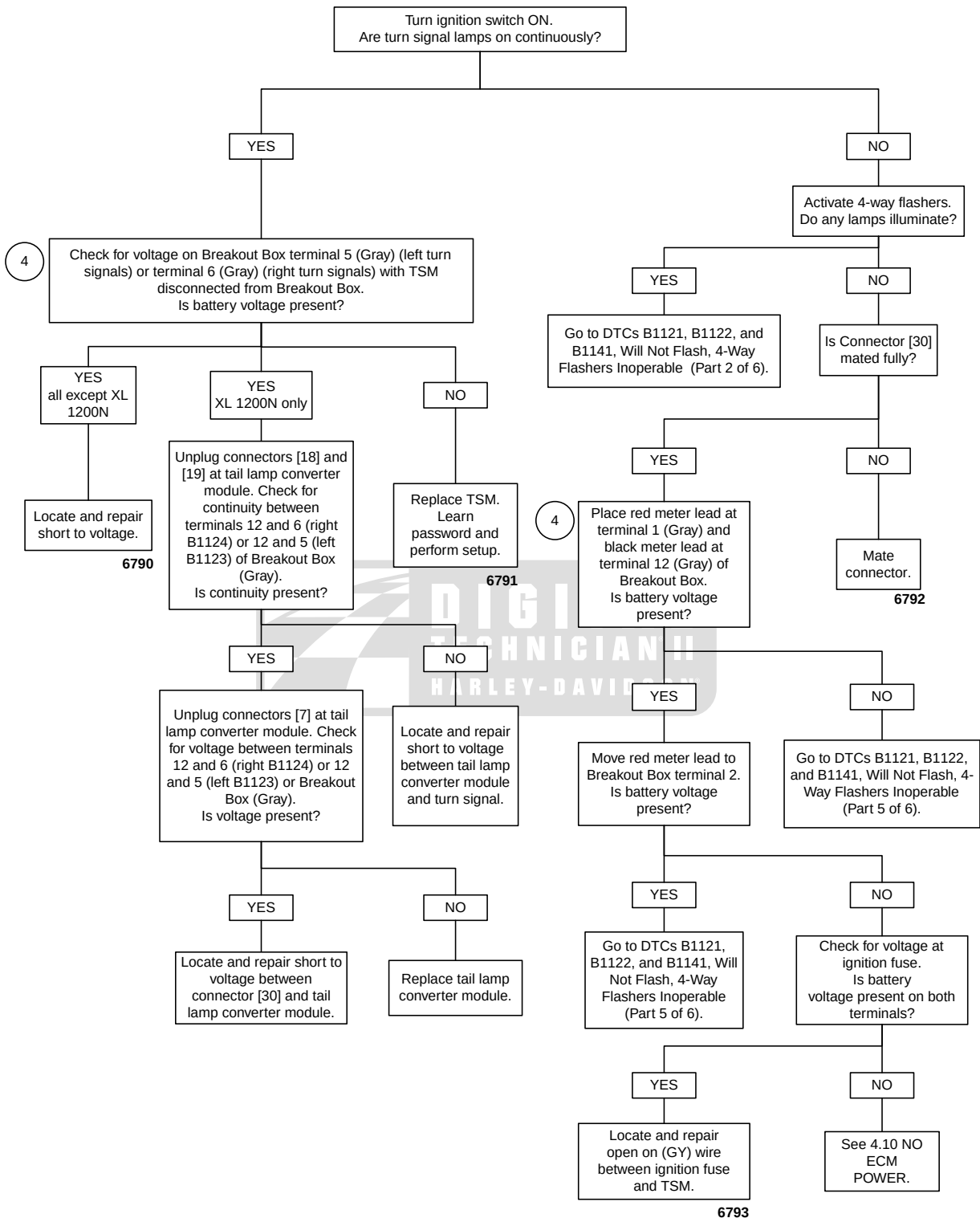
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Cancels Erratically



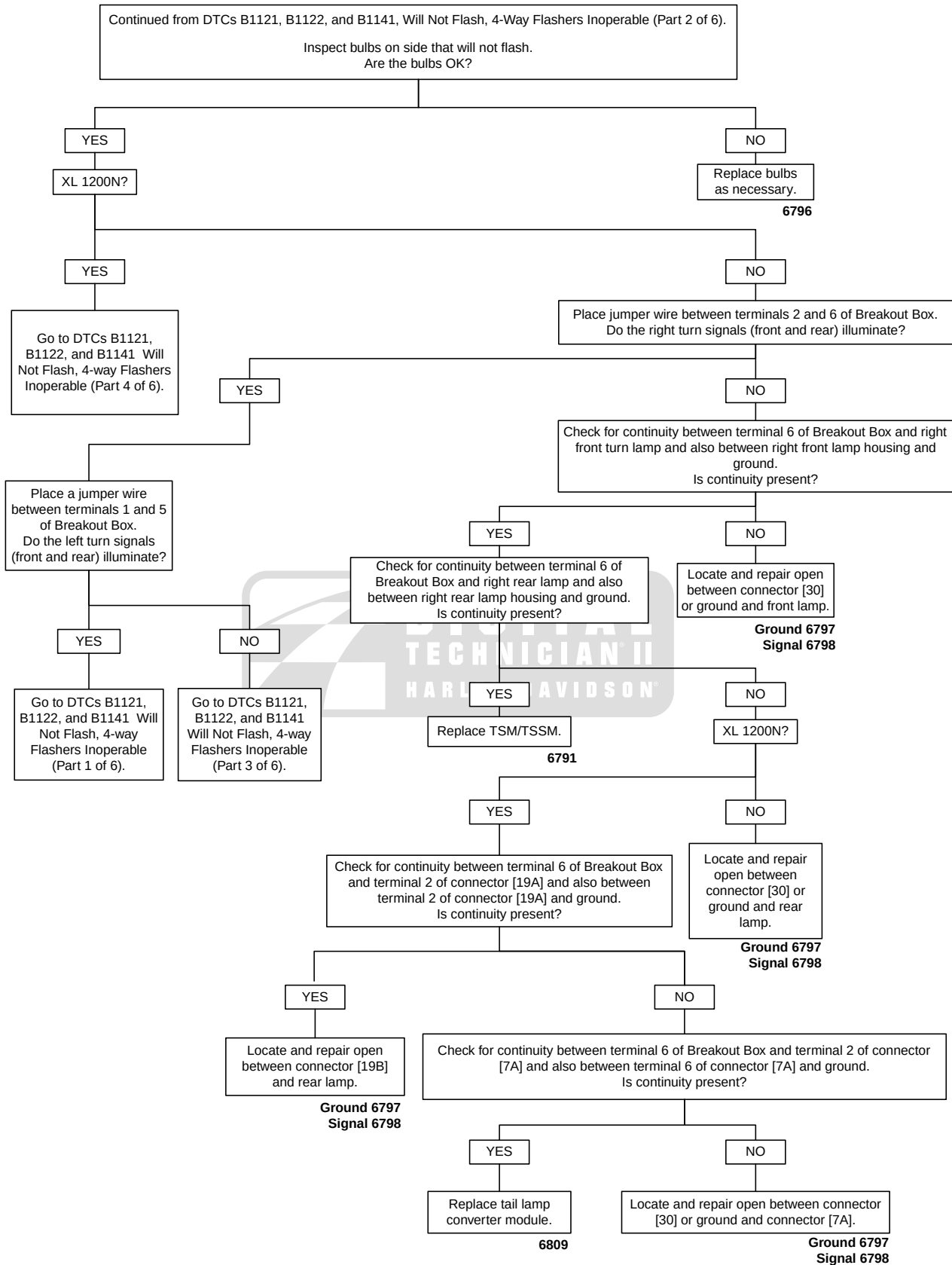
fc01998_en

DTCs B1121, B1122, and B1141, Will Not Flash, 4-Way Flashers Inoperable (Part 1 of 6)



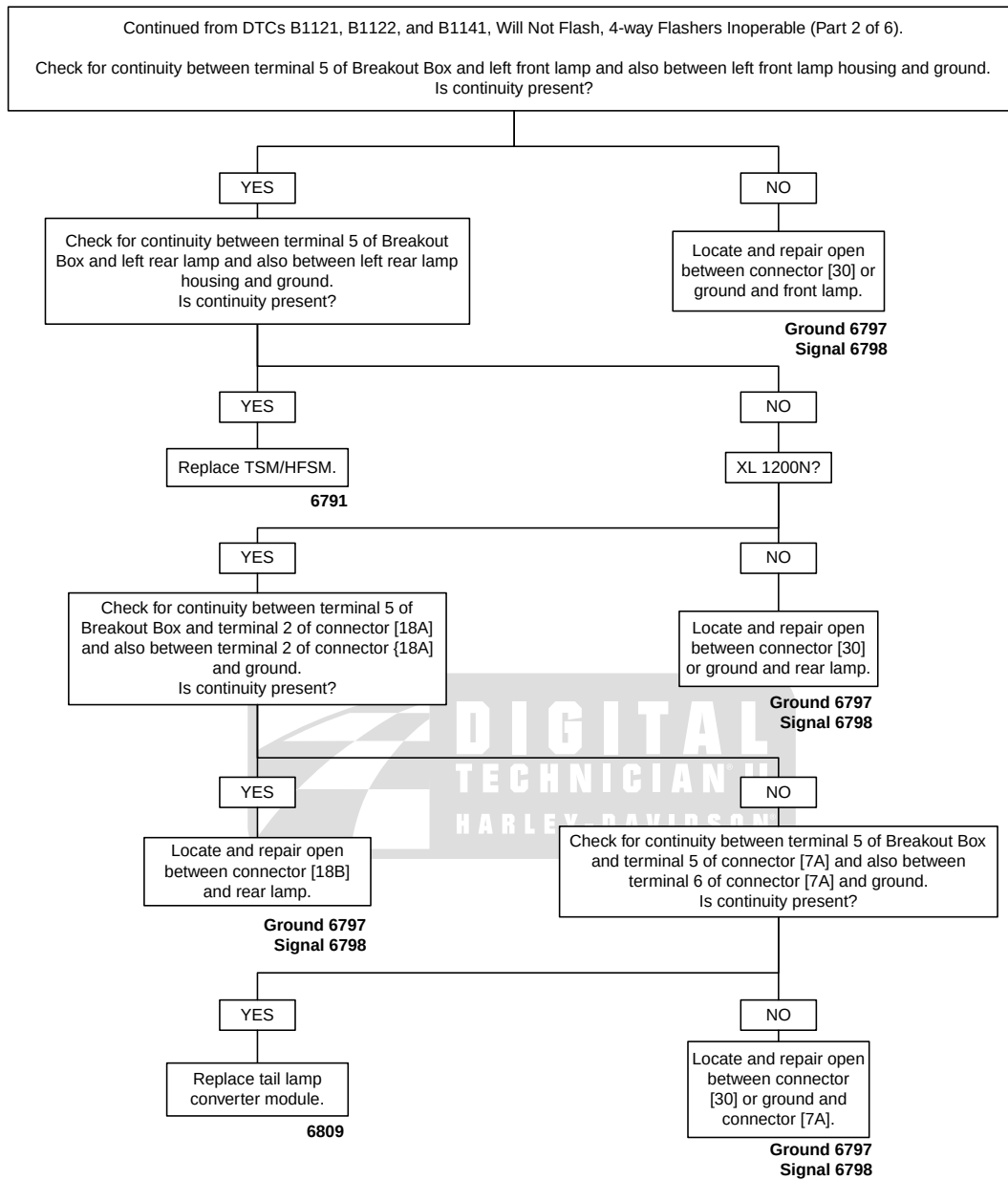
fc01999_en

DTCs B1121, B1122, and B1141, Will Not Flash, 4-Way Flashers Inoperable (Part 2 of 6)



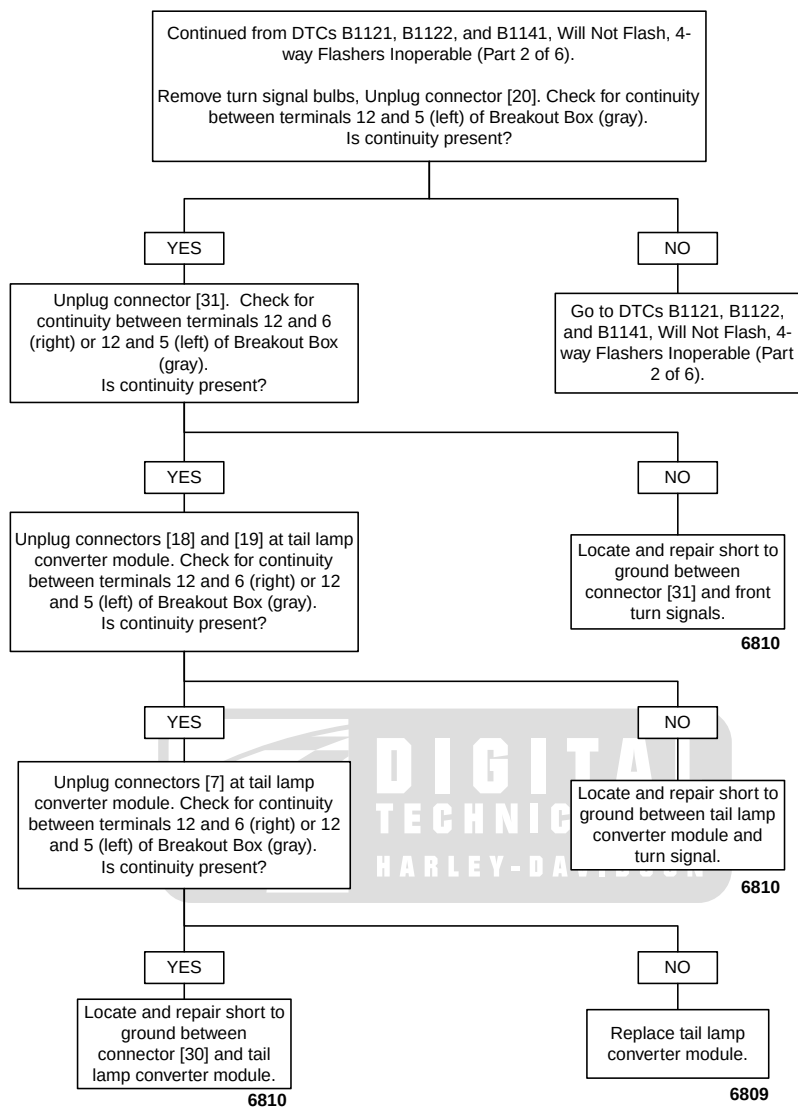
fc02000_en

DTCs B1121, B1122, and B1141, Will Not Flash, 4-Way Flashers Inoperable (Part 3 of 6)



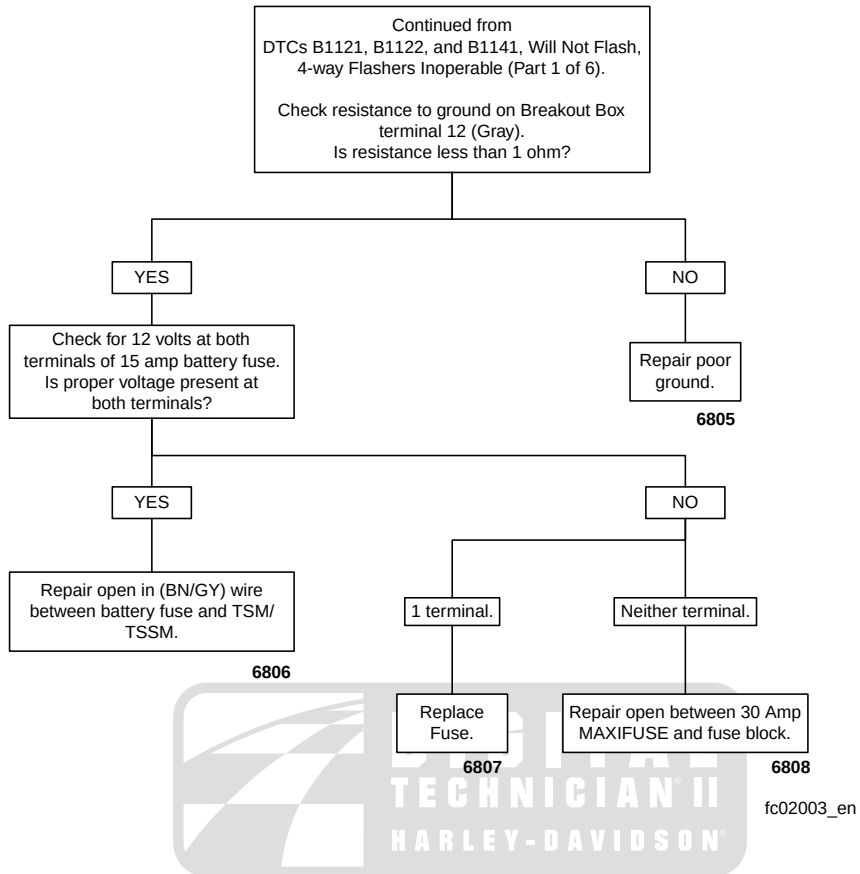
fc02001_en

DTCs B1121, B1122, and B1141, Will Not Flash, 4-Way Flashers Inoperable (Part 4 of 6)

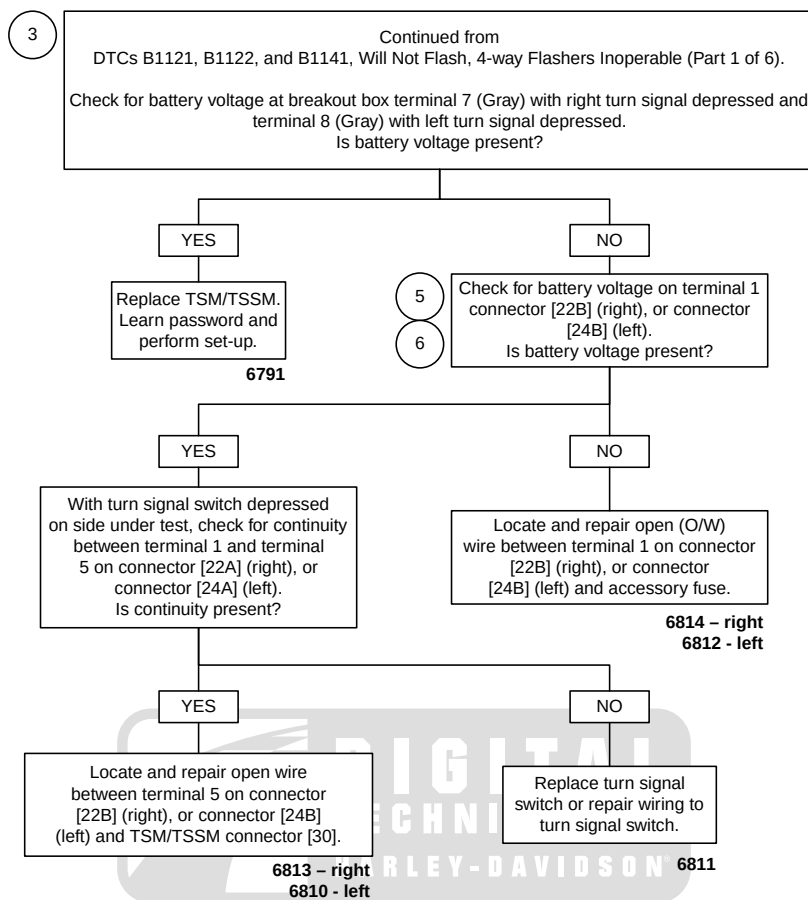


fc02002_en

DTCs B1121, B1122, and B1141, Will Not Flash, 4-Way Flashers Inoperable (Part 5 of 6)

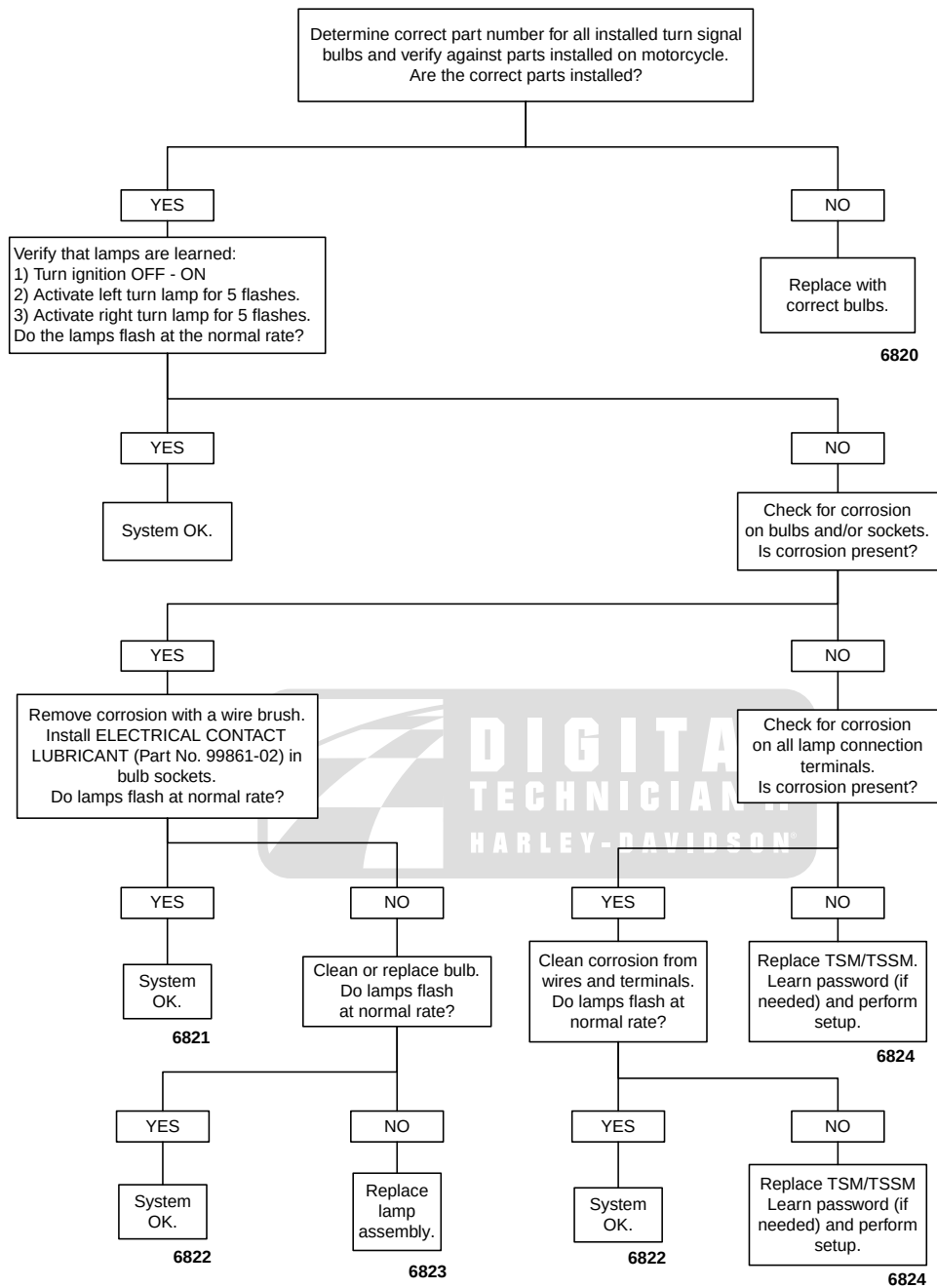


DTCs B1121, B1122, and B1141, Will Not Flash, 4-Way Flashers Inoperable (Part 6 of 6)



fc02004_en

Flash at Double Normal Rate, All Bulbs Working



fc01168_en

DTC B0563

E.14

GENERAL

Battery Voltage High

The TSM/TSSM continually checks the battery voltage during IGN/OFF and IGN/RUN power modes. If the voltage exceeds 16.0 Volts for more than 5.0 ± 0.5 seconds, the TSM/TSSM sets DTC B0563.

DIAGNOSTICS

Diagnostic Tips

- This DTC may set when the vehicle is placed on a battery charger, on fast charge, for a long period of time.
- The TSSM does not illuminate the security lamp when this DTC is set.

Diagnostic Notes

See [1.7 CHARGING SYSTEM](#) tests to correct. Problem may be faulty voltage regulator.



DTC B1131, B1132

E.15

GENERAL

NOTE

This section applies only to those vehicles equipped with the optional security system.

Alarm Output Low (DTC B1131) or Alarm Output High (DTC B1132)

See [Figure E-21](#). An alarm cycle is activated when the TSSM is connected, the siren has been armed by the TSSM and a security event occurs. See [E.6 SECURITY SYSTEM FUNCTIONS \(TSSM ONLY\)](#). Under normal armed operation, the siren input (terminal "2") is driven low by the TSSM to trigger the audible alarm. When the siren input is driven high by the TSSM the audible alarm stops.

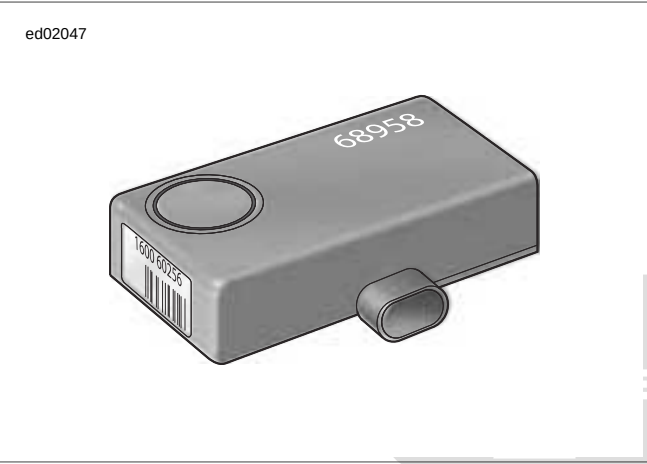


Figure E-21. Security Siren

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX

Diagnostic Tips

- If the siren is armed and the internal siren battery is dead, shorted, disconnected, or has been charging for a period

longer than 24 hours, the siren will respond with three chirps on arming instead of two.

- The internal siren battery may not charge if the vehicle's battery is less than 12.5 volts.
- If the siren does not chirp two or three times on a valid arming command from the TSSM, the siren is either not connected, not working, or the siren wiring was opened or shorted while the siren was disarmed.
- If the siren enters the self-driven mode where it is powered from the siren internal nine-volt battery, the turn-signal lamps will not alternately flash. If the TSSM activates the siren, the turn-signal lamps will flash. If the siren has been armed and a security event occurs, and the siren is in self-driven mode, the siren will alarm for 20 to 30 seconds and then turn off for 5 to 10 seconds. This alarm cycle will be repeated ten times if the siren is in the self-driven mode.
- If the siren does not stop alarming after it has been armed, then either the TSSM output or siren input may be shorted to ground, or the siren vehicle battery connection is open or shorted to ground, or the siren vehicle ground connection is open, or a security event has occurred. See [E.6 SECURITY SYSTEM FUNCTIONS \(TSSM ONLY\)](#) for a description of alarm functions.

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. Use BREAKOUT BOX (Part No. HD-42682) and HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), gray pin probe and patch cord. See [E.11 BREAKOUT BOX: TSM/TSSM](#).
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), gray socket probe and patch cord.
3. Having the correct multimeter ohm scale is important for this test. Some meters may read infinity for high ohm values. If this is the case, check your ohm scale and retest.

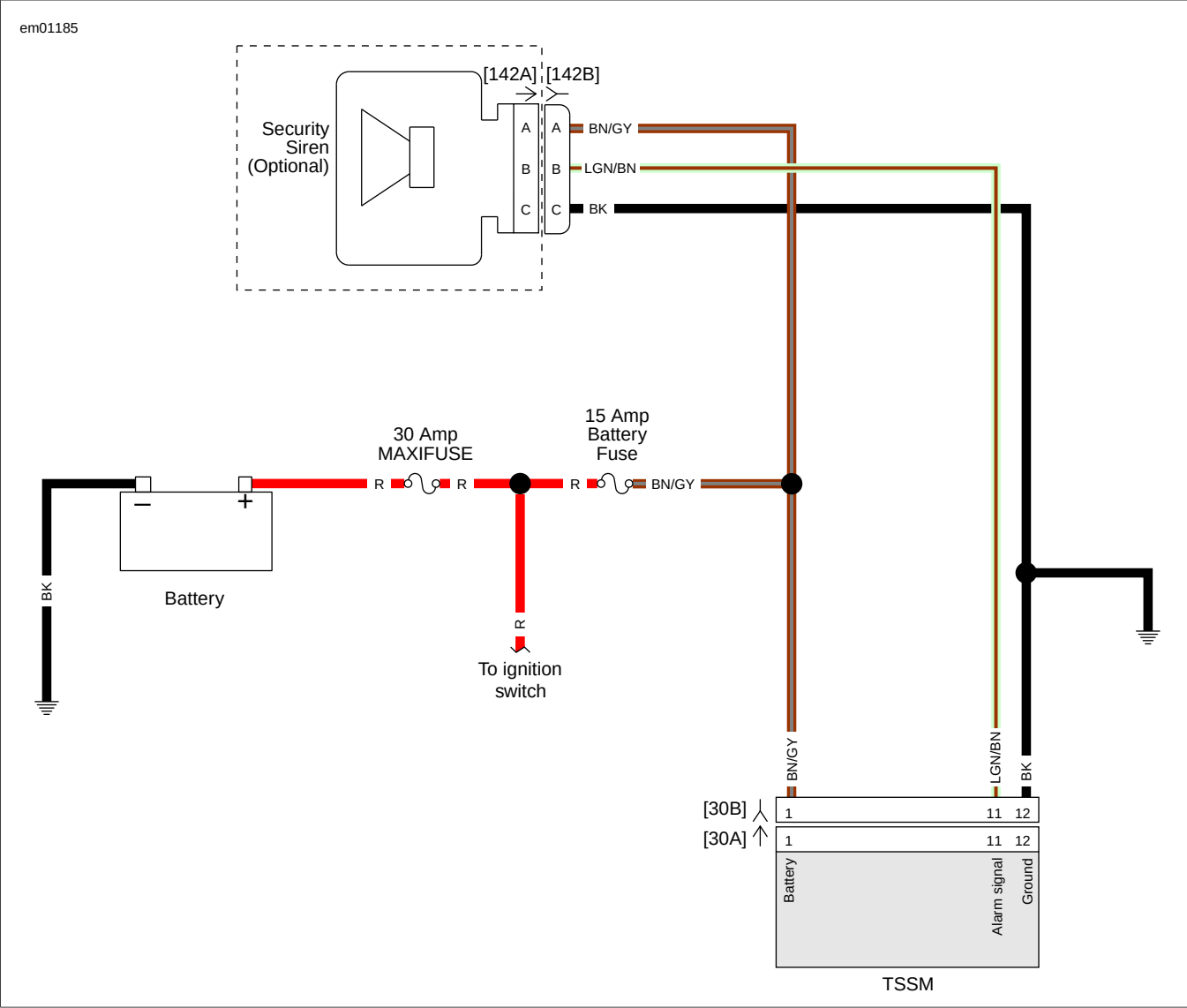
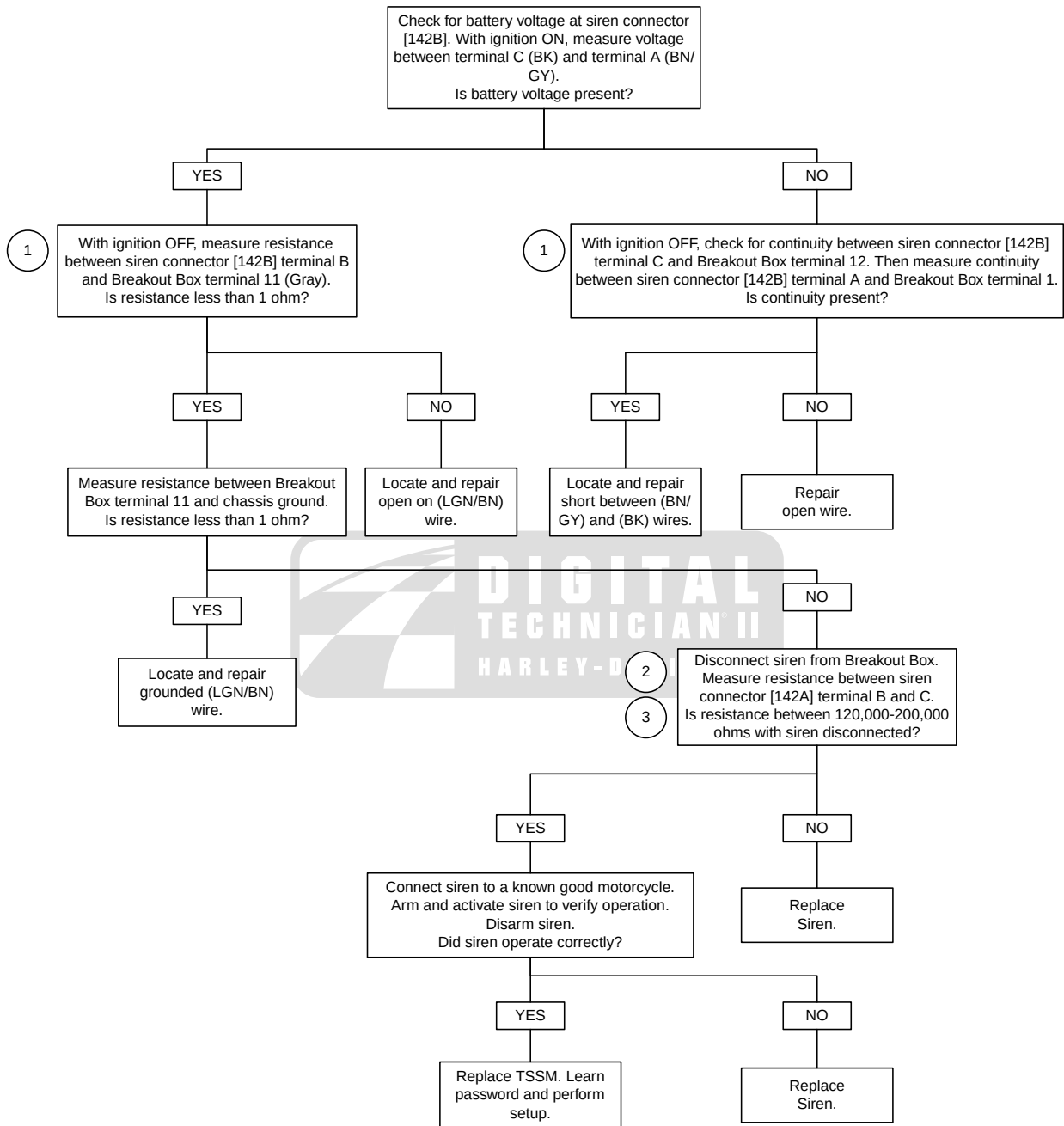


Table E-16. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[30]	TSSM	12-place Deutsch	Under battery
[142]	Security siren (optional)	3-place Packard	Under frame

DTCs B1131 and B1132



Clear DTCs using odometer self-diagnostics. See E.10 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

fc01810_en

DTC B1134

GENERAL

Starter Output High

With the TSM/TSSM disarmed, ignition ON and the RUN/STOP switch in the RUN position, the start relay is grounded. Battery voltage is applied to the start relay and coil which are grounded through the TSM/TSSM. This Diagnostic Trouble Code (DTC) is set when that ground is not established through the TSM/TSSM.

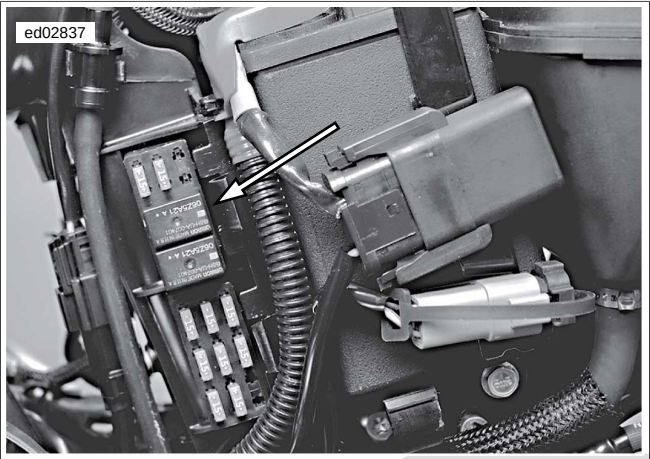


Figure E-23. Start Relay

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-42682	BREAKOUT BOX

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. Connect BREAKOUT BOX (Part No. HD-42682) (gray) to wire harness connector [30] leaving TSM/TSSM disconnected. See [E.11 BREAKOUT BOX: TSM/TSSM](#).



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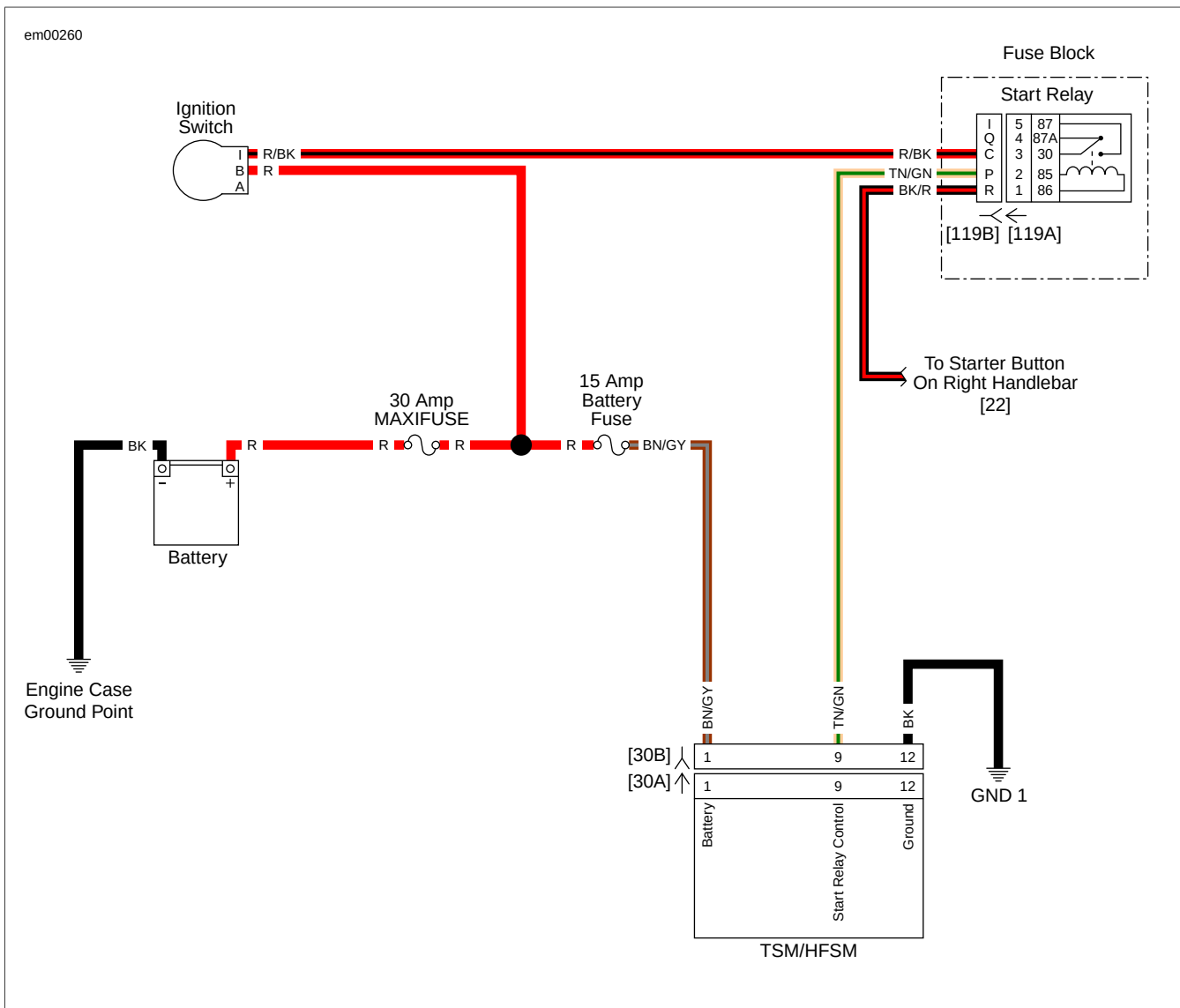
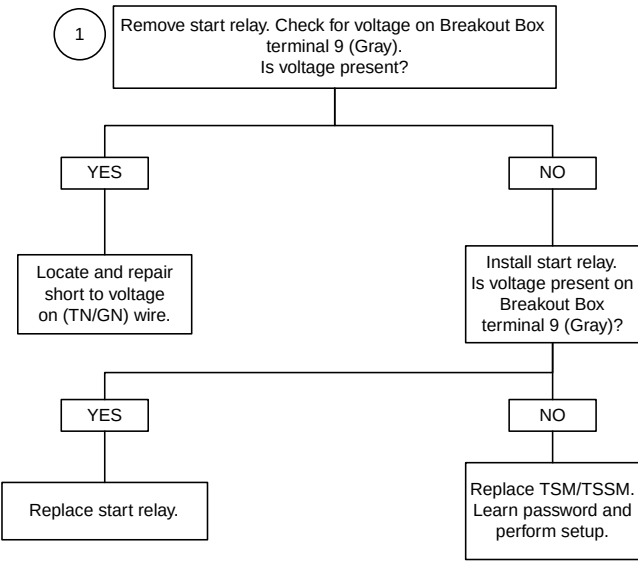


Figure E-24. Starter TSM/TSSM Circuit

Table E-17. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[22]	Right handlebar controls	6-place Molex	Under fuel tank
[30]	TSM/TSSM	12-place Deutsch	Under battery
[119]	Start relay	5-place Amp	Under left side cover

DTC B1134



 Clear DTCs using odometer self-diagnostics. See E.10 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

fc01811_en



DTC B1135

E.17

GENERAL

Accelerometer Fault: B1135

DTC B1135 indicates a failure which requires replacement of the TSM/TSSM.

NOTE

When DTC B1135 is set, the tip-over engine shutdown, TSSM tamper alarm and bank angle sensors are disabled. The security lamp will also illuminate when this code is set.



DTC B1154, B1155

E.18

GENERAL

DTC B1154 may occur if the motorcycle is ridden with the clutch pulled at speeds greater than 10 MPH (16 km/h) for more than 60 seconds (as in coasting down a long mountain road).

DIAGNOSTIC NOTES

PART NUMBER	TOOL NAME
HD-42682	BREAKOUT BOX

Each reference number below correlates to a circled number on the flowchart(s).

1. Connect BREAKOUT BOX (Part No. HD-42682) to TSSM. See [E.11 BREAKOUT BOX: TSM/TSSM](#).
2. If DTC is current (lamp on continuously), clear codes. If the code returns during operation, replace TSSM. If DTC is historic, check for intermittents
3. A reading of several hundred ohms is normal due to the neutral indicator lamp (LED).

Table E-18. Clutch/Neutral Switch DTCs

DTC	SYMPTOM
B1154	Clutch switch short-to-ground
B1155	Neutral switch short-to-ground



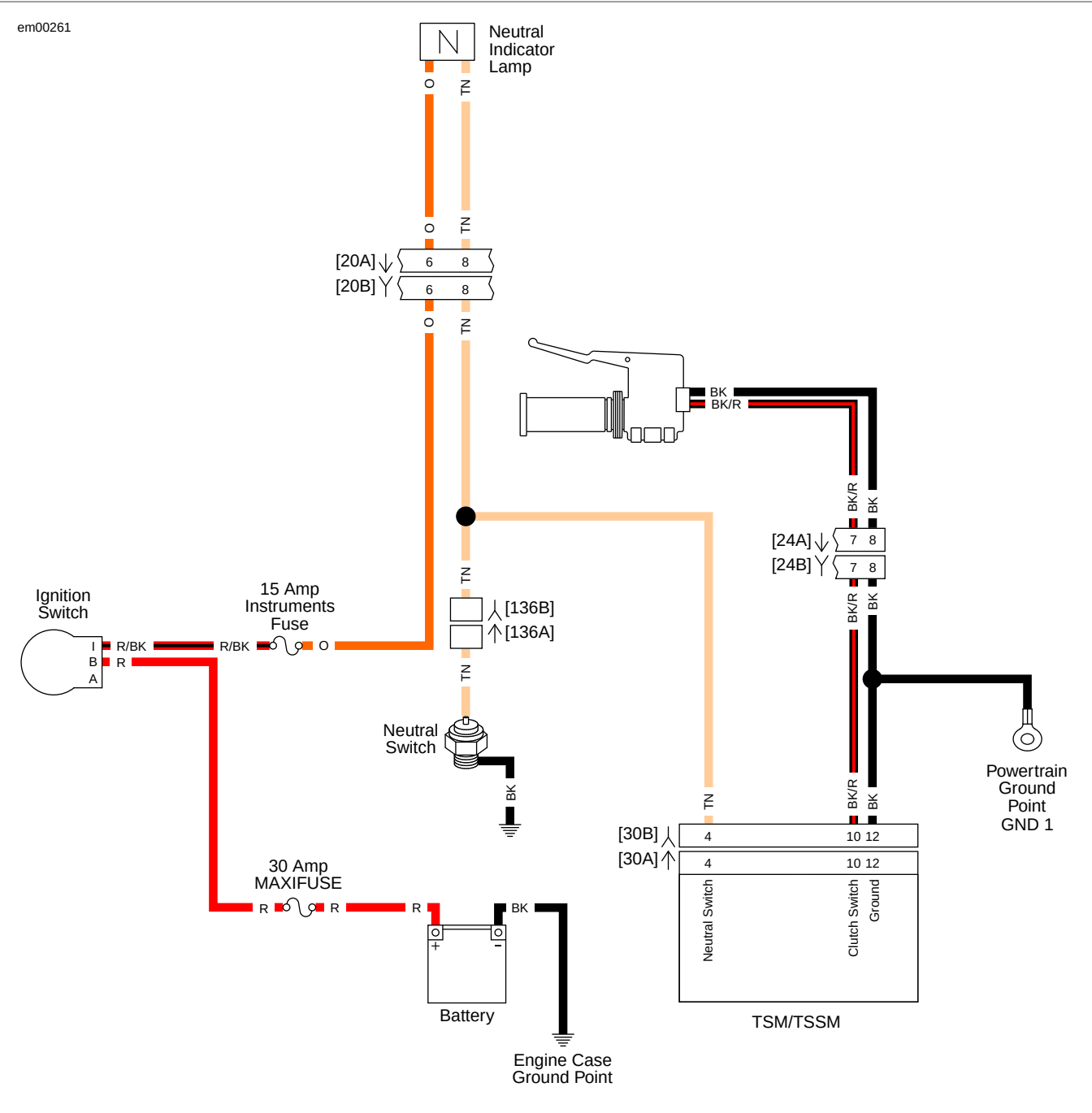
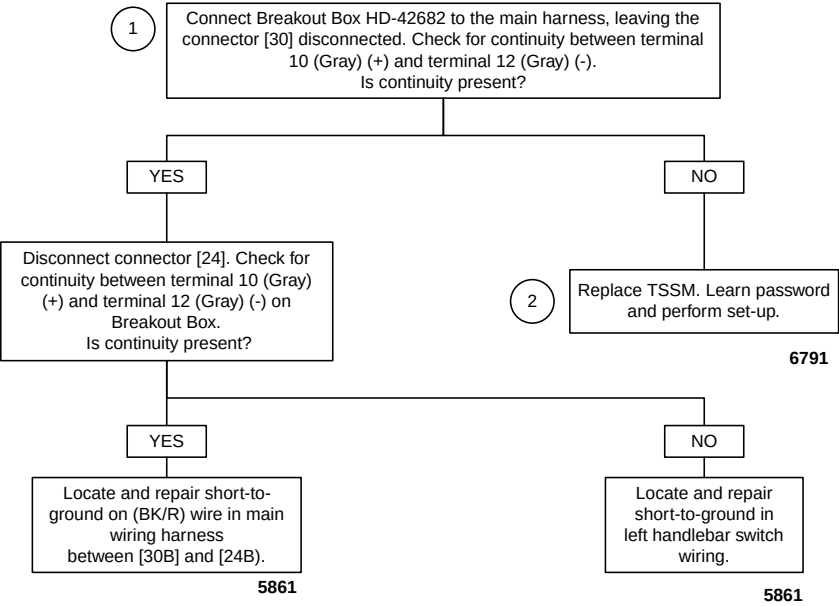


Figure E-25. Clutch and Neutral Interlock Circuits

Table E-19. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[20]	Instruments	12-place Molex	Under fuel tank
[24]	Left handlebar controls (gray)	8-place Molex	Under fuel tank
[30]	TSM/TSSM	12-place Deutsch	Under battery
[136]	Neutral switch	1-place molded jumper, black	Right side frame, beneath gear case cover

DTC B1154

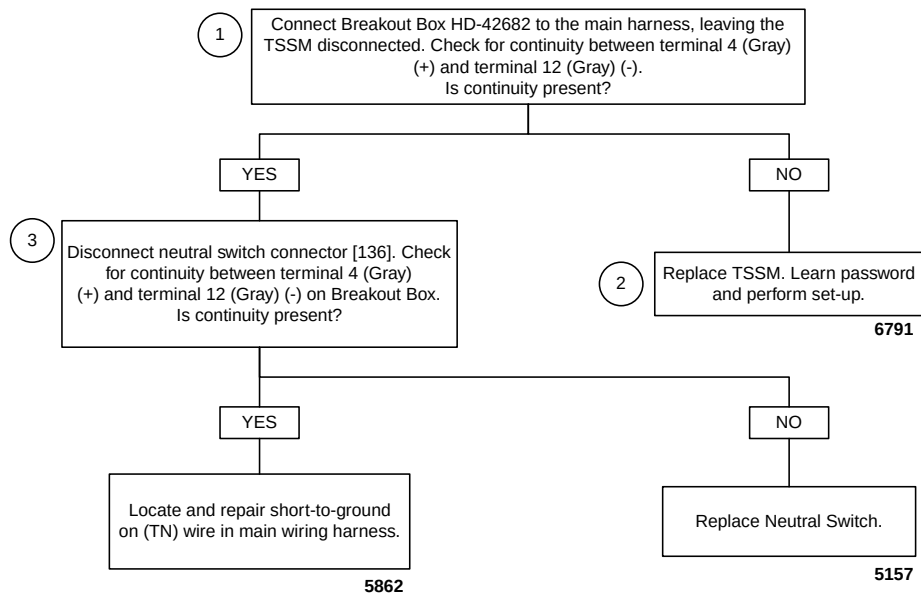


NOTE
This DTC may occur if the vehicle is ridden with clutch disengaged (pulled in) at speeds greater than 10 MPH (16 km/h) for more than 60 seconds (coasting down a long mountain road).

fc01171_en



DTC B1155



NOTE

This DTC may occur if the vehicle is ridden with clutch disengaged (pulled in) at speeds greater than 10 MPH (16 km/h) for more than 60 seconds (coasting down a long mountain road).

fc01172_en



GENERAL

Loss of ECM Serial Data

The serial data connector provides a means for the ECM, TSM/TSSM, and speedometer on XL, or tachometer on XR to communicate their current status. When all operating parameters on the serial data bus are within specifications, a state of health message is sent between the components.

- DTC U1016 indicates that the ECM is not capable of sending this state of health message.
- DTC U1255 indicates that no messages were present during power up of the current key cycle.
- DTC U1016 indicates that there was communication on the data bus since power up, but communication was lost or interrupted during that key cycle.

Table E-20. Code Description

DTC	DESCRIPTION
U1016	Loss of all ECM serial data (state of health)
U1255	Serial data error/missing message

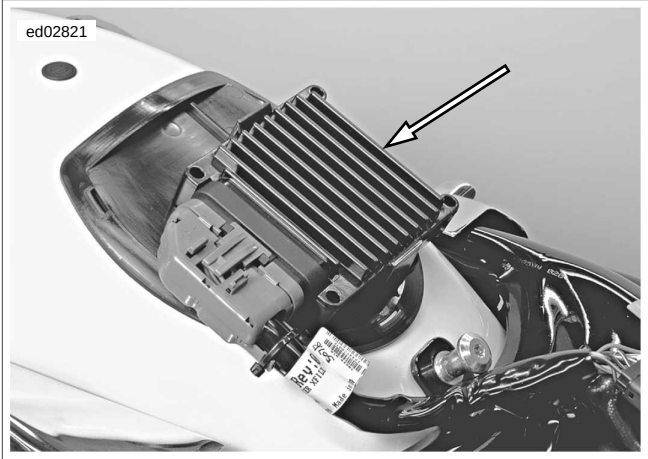


Figure E-26. ECM Location (Typical)

DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-42682	BREAKOUT BOX
HD-43876	BREAKOUT BOX

Diagnostic Notes

Each reference number below correlates to a circled number on the flowchart(s).

1. Connect BREAKOUT BOX (Part No. HD-42682) (gray) between TSM/TSSM connector [30A] and wire harness connector [30B]. See [E.11 BREAKOUT BOX: TSM/TSSM](#).
2. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness and ECM. See [4.7 BREAKOUT BOX: EFI](#).

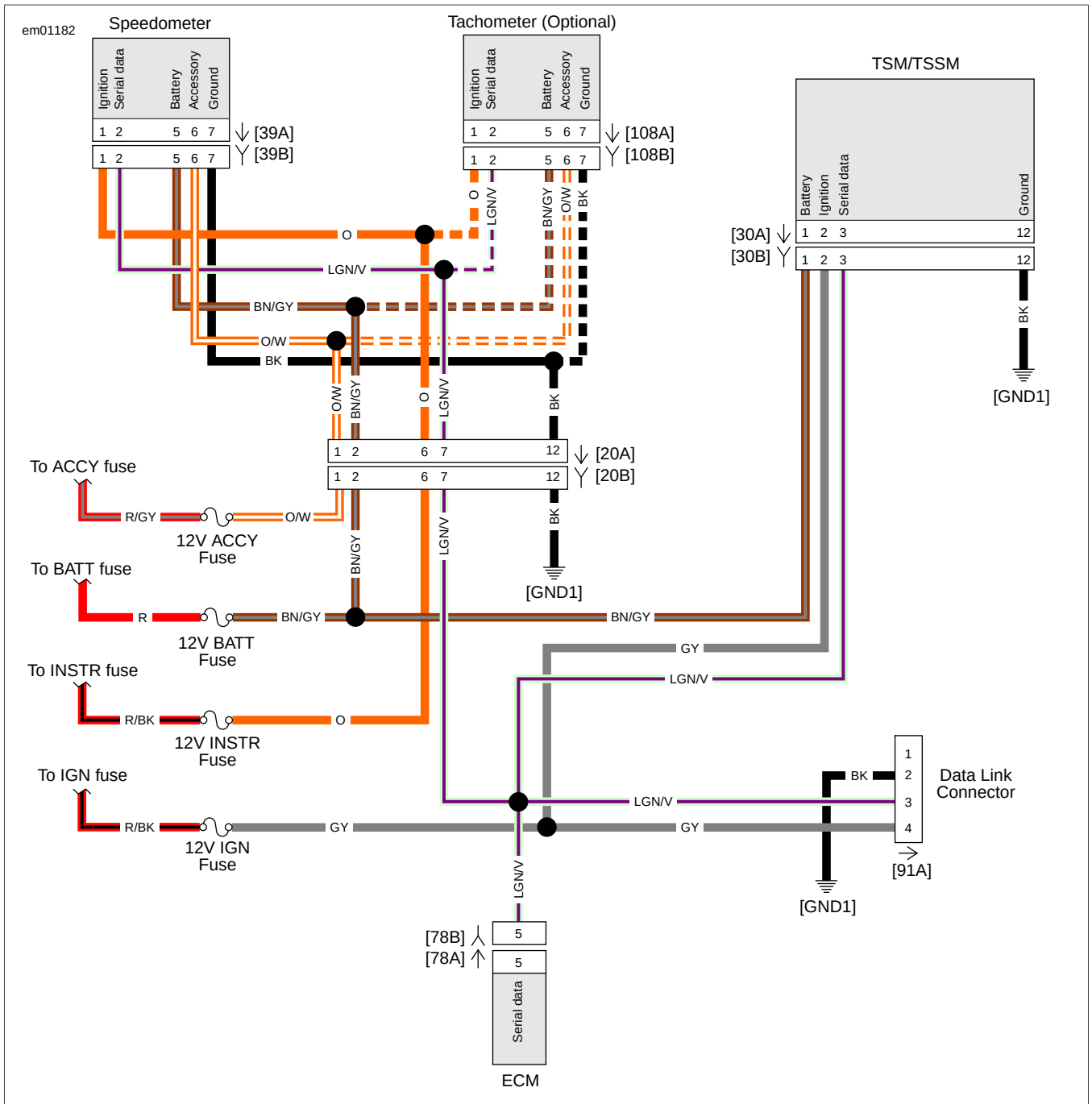


Figure E-27. Serial Data Circuit (XL)

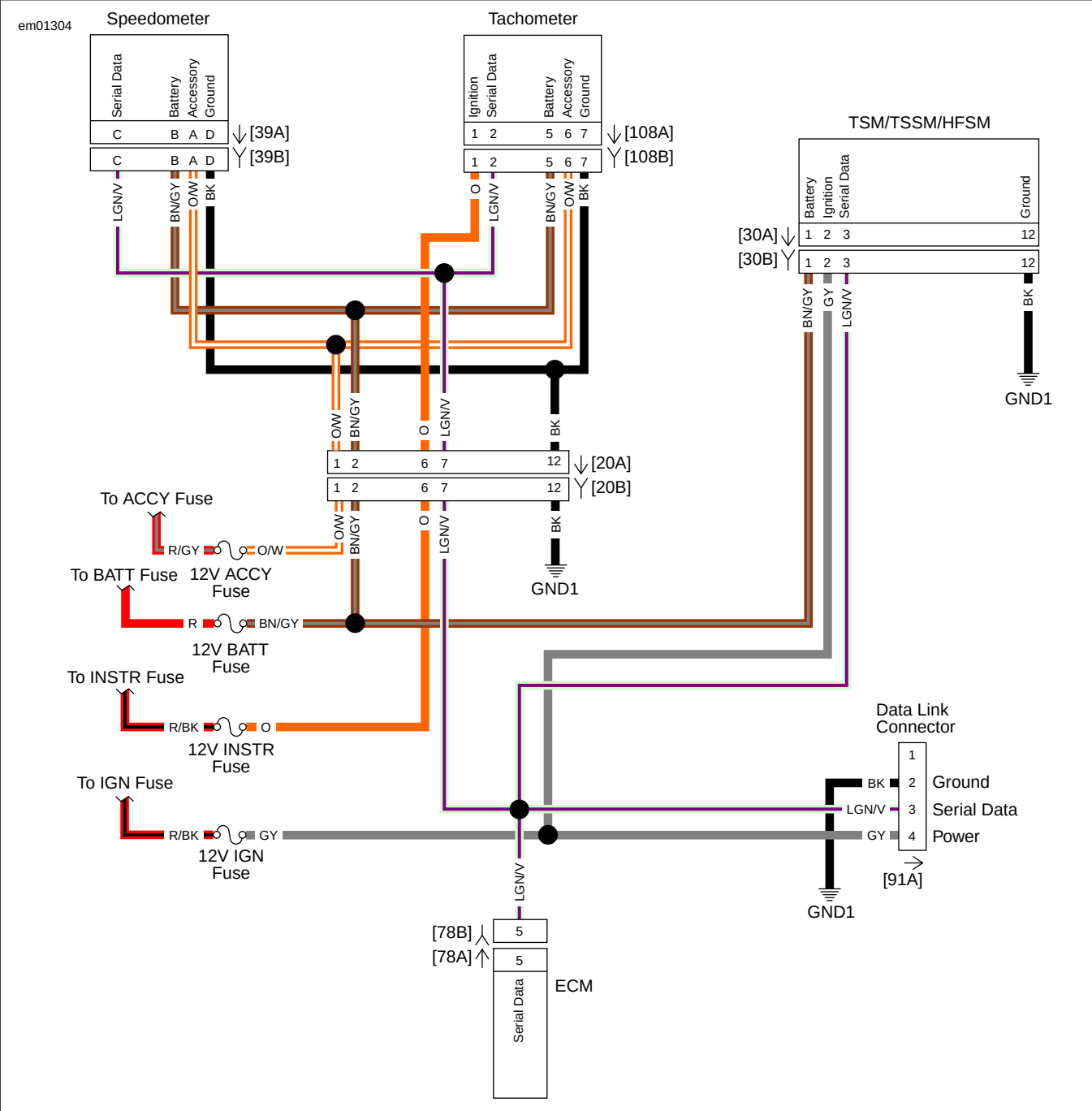


Figure E-28. Serial Data Circuit (XR)

Table E-21. Wire Harness Connectors

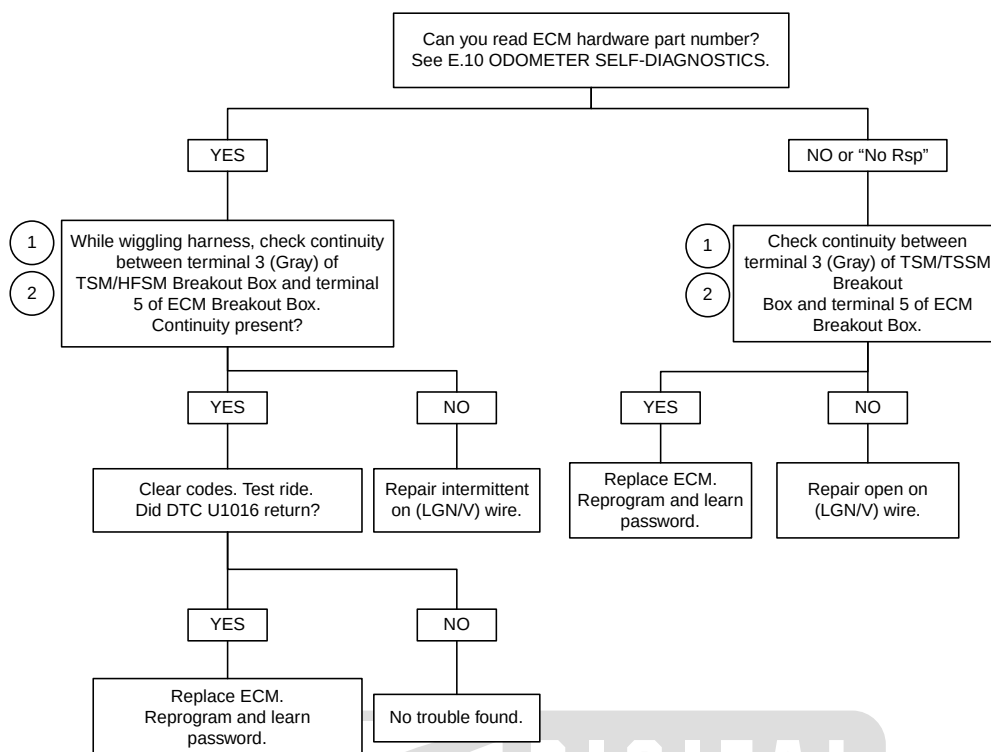
NO.	DESCRIPTION	TYPE	LOCATION
[20]	Instruments	12-place Molex	Under fuel tank
[30]	TSM/TSSM	12-place Deutsch	Under battery
[39]	Speedometer (XL)	12-place Packard	Back of speedometer
[39]	Speedometer (XR)	5-place Packard	Back of speedometer
[78]	ECM	36-place Packard	Under seat

Table E-21. Wire Harness Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[91]	Data link connector	4-place Deutsch	Under left side cover
[108]	Tachometer (if equipped)	12-place Packard	Back of tachometer



DTC U1016



Clear DTCs using odometer self-diagnostics. See E.10 ODOMETER SELF-DIAGNOSTICS. Confirm proper operation with no check engine lamp.

**DIGITAL
TECHNICIAN II**
HARLEY-DAVIDSON®

fc01812_en

DTC U1300, U1301 OR BUS ER

E.20

GENERAL

Serial Data Low or Serial Data Open/High

The typical serial data voltage range is 0 volts (inactive) to 7 volts (active). Due to the short pulse, voltages will be much lower on a DVOM. In analog mode, a DVOM reading serial data will show continuous voltage when active, typically 0.6 to 0.8 volts. The range for acceptable operations is 0 to 7.0 volts.

Table E-22. Code Description

DTC	DESCRIPTION
U1300	Serial data low
U1301	Serial data open/high

DIAGNOSTICS

Diagnostic Tips

- If serial data is shorted, these DTCs will automatically cause the check engine lamp to illuminate. The odometer will read "BUS Er" in this condition.
- DTCs P1009 and P1010 may accompany DTCs U1300 and U1301.

Diagnostic Notes

If a U1300, U1301 or "BUS Er" is present, perform diagnostic procedures listed in [4.11 STARTS, THEN STALLS](#).



TSM/TSSM: PASSWORD LEARN

E.21

GENERAL

If the ECM or TSM/TSSM is faulty, follow the instructions in the Service Manual for ECM or TSM/TSSM replacement. Then, to determine if password learn is necessary, refer to [Table E-23](#).

Table E-23. Password Learn

DEVICE REPLACED	IS PASSWORD LEARN NECESSARY?
ECM	Yes
TSM	No *
TSSM	Yes
* If a TSM has been replaced by a TSSM, or a TSSM has been replaced by a TSM, password learn is necessary.	

PASSWORD LEARNING

To perform password learning procedure, refer to [Table E-24](#). When finished, continue with all instructions under [E.3 VEHICLE DELIVERY](#).

Always perform all appropriate instructions under [E.3 VEHICLE DELIVERY](#) after TSM/TSSM replacement or removal.

NOTE

Do not forget to enter a Personal Identification Number (PIN) for TSSM vehicles. If a code is not assigned and the key fob is lost or damaged while the vehicle is armed, the TSSM must be replaced.

Table E-24. Setting TSM/TSSM and ECM Password

NO.	ACTION	CONFIRMATION	NOTES
	Ignition must be turned off for at least 15 seconds.	With ignition turned off, check engine lamp and security lamp will be off.	
1	Install new TSM/TSSM or ECM. Perform all steps under E.3 VEHICLE DELIVERY .		
2	Set engine stop switch to RUN.		
3	Turn ignition switch ON.	Verify check engine lamp and security lamp illuminate and then turn off.	TSM/TSSM enables starter relay.
4	Attempt normal start one time.	Engine starts and stalls. Check engine lamp illuminates and stays on.	Password has not been learned. ECM sets DTC P1009.
5	Wait ten seconds. security lamp will illuminate and stay on.	Security lamp illuminates.	ECM enters Password Learning mode for ten minutes. Do not cycle ignition switch or interrupt vehicle power or Password Learn will be unsuccessful.
6	Wait until security lamp turns off.		This takes ten minutes.
7	Quickly (within one second) turn ignition switch OFF-ON.		ECM must not be allowed to shutdown.
8	Wait until security lamp turns off.		This takes ten minutes.
9	Quickly (within one second) turn ignition switch OFF-ON.		ECM must not be allowed to shutdown.
10	Wait until security lamp turns off.		This takes ten minutes.
11	Quickly (within one second) turn ignition switch OFF-ON.		ECM must not be allowed to shutdown.
12	Turn ignition switch OFF. Wait 15 seconds before turning ignition switch ON. Turn ignition switch ON and start engine to confirm successful Password Learn procedure. Clear DTCs.		
13	Perform all steps under E.3 VEHICLE DELIVERY .		

TSSM MAINTENANCE

E.22

GENERAL

The TSSM system uses batteries in the key fob and siren. These are the only parts requiring periodic maintenance.

KEY FOB

Schedule

Replace the key fob battery every 2 years.

Battery Replacement

- See [Figure E-29](#). Open the key fob case.
 - Place a thin blade between the 2 halves of the case.
 - Slowly twist the blade.
- Replace battery (1).
 - Remove the original battery.
 - Install a **new** battery with the positive (+) side down. Use a Panasonic® 2032 or equivalent.
- Align case and circuit board (3) as shown. Snap case halves together.
- While standing next to the motorcycle, press and hold the key fob button for 10-15 seconds until the security system responds with two turn signal flashes/siren chirps.

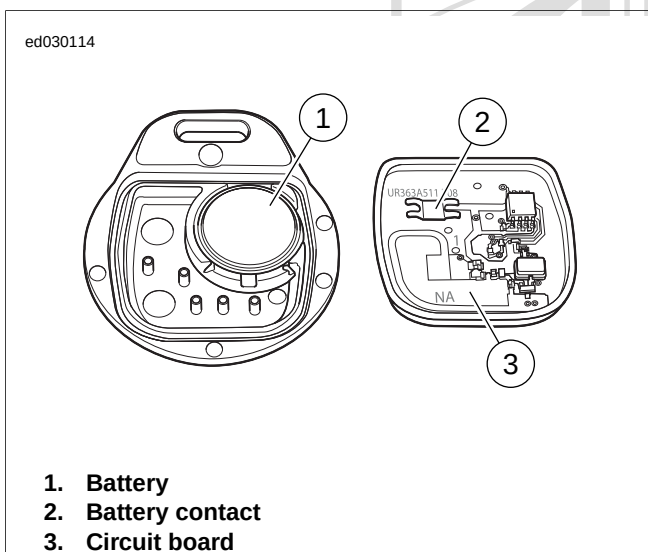


Figure E-29. Open Key Fob: TSSM

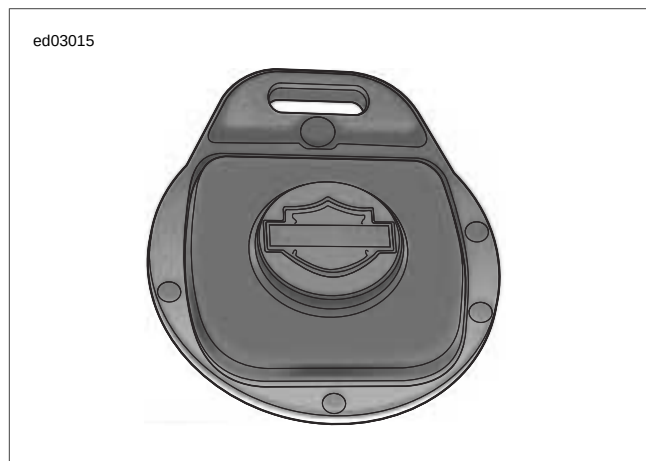


Figure E-30. Key Fob Assembly: TSSM

SIREN (IF INSTALLED)

Schedule

The siren's internal 9 volt battery is rechargeable and does not need to be replaced on a regular basis. Battery life under normal conditions is approximately three to six years.

NOTES

- See [Figure E-31](#) and [Figure E-32](#). Early style siren will work with both TSSM and HFSM. Late style siren will only work with HFSM.
- The internal siren battery may not charge if the vehicle's battery is less than 12.5 volts.

Battery Replacement: Early Style Siren

- Disarm system and remove siren.
- See [Figure E-31](#). Remove battery cover.
 - Place the siren module on a flat and sturdy table with the potted section (area with epoxy covering circuit board) facing up and towards you.
 - Position a knife blade at a 45 degree angle to the long side of the siren case. Insert the knife blade between the siren case and battery cover at one of the two accessible corners of the battery cover. Keep the blade slightly higher towards the battery cover as this helps keep the blade away from the battery seal.
 - Slowly twist the blade towards the battery cover and the cover will pop off.

NOTES

- For protection against corrosion, battery terminals and battery clip are covered with a special grease. Do not wipe away this substance. Apply all available existing grease to terminals on new battery.
- Only a 9 volt nickel metal hydride battery should be used in the siren.

3. Replace battery by removing old battery from polarized battery clip. Install a **new** 9 volt nickel metal hydride battery.
4. Reinstall battery cover.
 - a. Carefully replace the rubber seal.
 - b. Align battery cover with case placing round corners on cover away from connector [142A]. Snap cover into place.
5. Install siren and check operation. If siren is working properly, it will respond with two chirps after receiving the arm command.

Battery Replacement: Late Style Siren

1. Disarm system and remove siren.
2. See [Figure E-32](#). With a small screwdriver or pick, push the catches (1) in through the two slots (2) in the end of the siren to release the battery cover (3).

NOTES

- For protection against corrosion, battery terminals and battery clip are covered with a special grease. Do not wipe away this substance. Apply all available existing grease to terminals on new battery.
 - Only a 9 volt nickel metal hydride battery should be used in the siren.
3. Replace battery (4) by removing old battery from polarized battery clip.
 4. Recharge and re-install or install a **new** 9 volt nickel metal hydride battery.
 5. Reinstall battery cover (3).
 - a. Carefully replace the rubber seal (5) on the cover.
 - b. Align battery cover with case placing round corners on cover away from connector [142A] (6).
 - c. Snap cover into place.
 6. Install siren and check operation. If siren is working properly, it will respond with two chirps after receiving the arm command.

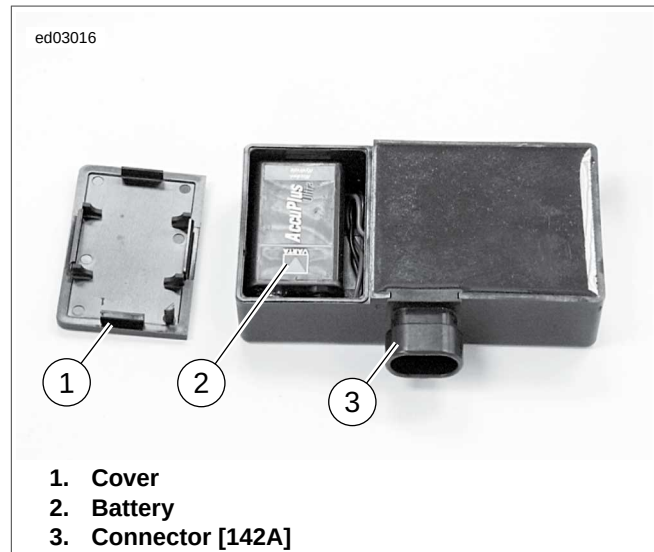


Figure E-31. Battery Compartment (Early Style Siren)



Figure E-32. Siren Battery Compartment (Late Style Siren)

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
HD-23738	VACUUM PUMP	4.16 DTC P0107, P0108, P0112, P0113, Diagnostics
HD-25070	ROBINAIR HEAT GUN	A.18 SEALED SPLICE CONNECTORS, Sealed Splice Connector Repair
HD-26792	SPARK TESTER	4.9 ENGINE CRANKS, BUT WILL NOT START, Diagnostics
HD-26792	SPARK TESTER	4.15 MISFIRE AT IDLE OR UNDER LOAD, Diagnostics
HD-34730-2C	FUEL INJECTOR TEST LAMP	4.9 ENGINE CRANKS, BUT WILL NOT START, Diagnostics
HD-34730-2C	FUEL INJECTOR TEST LAMP	4.27 DTC P1351, P1352, P1354, P1355, Diagnostics
HD-38125-6	PACKARD TERMINAL CRIMP TOOL	A.14 METRI-PACK TERMINALS, Metri-Pack Terminal Crimps
HD-38125-7	PACKARD TERMINAL CRIMPER	A.6 DEUTSCH MINI-TERMINAL CRIMPS, Deutsch Mini Terminal Crimps
HD-38125-7	PACKARD TERMINAL CRIMPER	A.14 METRI-PACK TERMINALS, Metri-Pack Terminal Crimps
HD-38125-8	PACKARD CRIMPING TOOL	A.14 METRI-PACK TERMINALS, Metri-Pack Terminal Crimps
HD-38125-8	PACKARD CRIMPING TOOL	A.18 SEALED SPLICE CONNECTORS, Sealed Splice Connector Repair
HD-39965-A	DEUTSCH TERMINAL CRIMP TOOL	A.5 DEUTSCH STANDARD TERMINALS, Deutsch Standard Terminal Crimps
HD-39969	ULTRA TORCH UT-100	A.18 SEALED SPLICE CONNECTORS, Sealed Splice Connector Repair
HD-41183	HEAT SHIELD ATTACHMENT	A.18 SEALED SPLICE CONNECTORS, Sealed Splice Connector Repair
HD-41404-B	HARNESS CONNECTOR TEST KIT	1.2 STARTING SYSTEM DIAGNOSIS, Diagnostics
HD-41404-B	HARNESS CONNECTOR TEST KIT	2.4 SPEEDOMETER/TACHOMETER, Diagnostics
HD-41404-B	HARNESS CONNECTOR TEST KIT	3.15 TSM/HFSM: TURN SIGNAL ERRORS AND DTCS, Diagnostics
HD-41404-B	HARNESS CONNECTOR TEST KIT	3.16 DTC B1131, B1132 (HFSM ONLY), Diagnostics
HD-41404-B	HARNESS CONNECTOR TEST KIT	3.18 DTCS B1135, B1136, B1141, AND B1142, DTC B1141 Ignition Switch Open/Low
HD-41404-B	HARNESS CONNECTOR TEST KIT	4.9 ENGINE CRANKS, BUT WILL NOT START, Diagnostics
HD-41404-B	HARNESS CONNECTOR TEST KIT	4.9 ENGINE CRANKS, BUT WILL NOT START, Diagnostics
HD-41404-B	HARNESS CONNECTOR TEST KIT	4.10 NO ECM POWER, Diagnostics
HD-41404-B	HARNESS CONNECTOR TEST KIT	4.12 FUEL SYSTEM ELECTRICAL TEST, Diagnostics
HD-41404-B	HARNESS CONNECTOR TEST KIT	4.14 IDLE AIR CONTROL, Diagnostics
HD-41404-B	HARNESS CONNECTOR TEST KIT	4.15 MISFIRE AT IDLE OR UNDER LOAD, Diagnostics
HD-41404-B	HARNESS CONNECTOR TEST KIT	4.16 DTC P0107, P0108, P0112, P0113, Diagnostics
HD-41404-B	HARNESS CONNECTOR TEST KIT	4.16 DTC P0107, P0108, P0112, P0113, Diagnostics
HD-41404-B	HARNESS CONNECTOR TEST KIT	4.17 DTC P0117, P0118, Diagnostics
HD-41404-B	HARNESS CONNECTOR TEST KIT	4.18 DTC P0122, P0123, Diagnostics
HD-41404-B	HARNESS CONNECTOR TEST KIT	4.20 DTC P0261, P0262, P0263, P0264, Diagnostics
HD-41404-B	HARNESS CONNECTOR TEST KIT	4.21 DTC P0373, P0374, Diagnostics
HD-41404-B	HARNESS CONNECTOR TEST KIT	4.25 DTC P0661, P0662, Diagnostics
HD-41404-B	HARNESS CONNECTOR TEST KIT	4.27 DTC P1351, P1352, P1354, P1355, Diagnostics
HD-41404-B	HARNESS CONNECTOR TEST KIT	4.27 DTC P1351, P1352, P1354, P1355, Diagnostics

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
HD-41404-B	HARNESS CONNECTOR TEST KIT	E.13 TURN SIGNAL ERRORS: B1121, B1122, B1141, Diagnostics
HD-41404-B	HARNESS CONNECTOR TEST KIT	E.15 DTC B1131, B1132, Diagnostics
HD-41404-B	HARNESS CONNECTOR TEST KIT	2.6 INDICATOR LAMPS, Diagnostics
HD-41475	DEUTSCH CONNECTOR SERVICE KIT	A.4 DEUSCH ELECTRICAL CONNECTORS, Deutsch Connector Repair
HD-41475-100	FLAT BLADE L-HOOK	A.4 DEUSCH ELECTRICAL CONNECTORS, Deutsch Connector Repair
HD-41609	AMP MULTILOCK CRIMPER	A.1 AMP MULTILOCK CONNECTORS, AMP Multilock Connector Repair
HD-42682	BREAKOUT BOX	1.2 STARTING SYSTEM DIAGNOSIS, Diagnostics
HD-42682	BREAKOUT BOX	2.2 INITIAL DIAGNOSTIC CHECK: ODOMETER, Initial Diagnostics
HD-42682	BREAKOUT BOX	2.4 SPEEDOMETER/TACHOMETER, Diagnostics
HD-42682	BREAKOUT BOX	2.5 BREAKOUT BOX: SPEEDOMETER/TACHOMETER, General
HD-42682	BREAKOUT BOX	2.5 BREAKOUT BOX: SPEEDOMETER/TACHOMETER, Speedometer: XL only
HD-42682	BREAKOUT BOX	2.5 BREAKOUT BOX: SPEEDOMETER/TACHOMETER, Speedometer: XL only
HD-42682	BREAKOUT BOX	2.5 BREAKOUT BOX: SPEEDOMETER/TACHOMETER, Tachometer
HD-42682	BREAKOUT BOX	2.5 BREAKOUT BOX: SPEEDOMETER/TACHOMETER, Tachometer
HD-42682	BREAKOUT BOX	2.7 DTC B1004, B1005, Diagnostics
HD-42682	BREAKOUT BOX	2.9 DTC B1008, Diagnostics
HD-42682	BREAKOUT BOX	2.10 DTC U1016, U1255, Diagnostics
HD-42682	BREAKOUT BOX	2.11 DTC U1064, U1255, Diagnostics
HD-42682	BREAKOUT BOX	3.3 H-DSSS ACTUATION, Power Disruption and Configuring
HD-42682	BREAKOUT BOX	3.10 INITIAL DIAGNOSTIC CHECK: TSM/HFSM, Initial Diagnostics
HD-42682	BREAKOUT BOX	3.12 BREAKOUT BOX: TSM/HFSM, General
HD-42682	BREAKOUT BOX	3.16 DTC B1131, B1132 (HFSM ONLY), Diagnostics
HD-42682	BREAKOUT BOX	3.17 DTC B1134, Diagnostics
HD-42682	BREAKOUT BOX	3.20 DTC B1154, B1155, Diagnostics
HD-42682	BREAKOUT BOX	4.5 INITIAL DIAGNOSTIC CHECK: EFI, Initial Diagnostics
HD-42682	BREAKOUT BOX	4.29 DTC U1064, U1255, Diagnostics
HD-42682	BREAKOUT BOX	E.9 INITIAL DIAGNOSTIC CHECK: TSM/TSSM, Initial Diagnostics
HD-42682	BREAKOUT BOX	E.11 BREAKOUT BOX: TSM/TSSM, General
HD-42682	BREAKOUT BOX	E.15 DTC B1131, B1132, Diagnostics
HD-42682	BREAKOUT BOX	E.16 DTC B1134, Diagnostics
HD-42682	BREAKOUT BOX	4.30 DTC U1097, U1255, Diagnostics

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
HD-42879	ELECTRICAL CRIMPER TOOL	A.7 DEUTSCH SOLID BARREL TERMINALS, Deutsch Solid Barrel Terminal Crimps
HD-43876	BREAKOUT BOX	3.21 DTC U1016, U1255, Diagnostics
HD-43876	BREAKOUT BOX	4.7 BREAKOUT BOX: EFI, General
HD-43876	BREAKOUT BOX	4.9 ENGINE CRANKS, BUT WILL NOT START, Diagnostics
HD-43876	BREAKOUT BOX	4.10 NO ECM POWER, Diagnostics
HD-43876	BREAKOUT BOX	4.12 FUEL SYSTEM ELECTRICAL TEST, Diagnostics
HD-43876	BREAKOUT BOX	4.13 SYSTEM RELAY CHECK, Diagnostics
HD-43876	BREAKOUT BOX	4.14 IDLE AIR CONTROL, Diagnostics
HD-43876	BREAKOUT BOX	4.15 MISFIRE AT IDLE OR UNDER LOAD, Diagnostics
HD-43876	BREAKOUT BOX	4.16 DTC P0107, P0108, P0112, P0113, Diagnostics
HD-43876	BREAKOUT BOX	4.16 DTC P0107, P0108, P0112, P0113, Diagnostics
HD-43876	BREAKOUT BOX	4.17 DTC P0117, P0118, Diagnostics
HD-43876	BREAKOUT BOX	4.18 DTC P0122, P0123, Diagnostics
HD-43876	BREAKOUT BOX	4.19 DTC P0131, P0132, P0134, P0151, P0152, P0154, Diagnostics
HD-43876	BREAKOUT BOX	4.20 DTC P0261, P0262, P0263, P0264, Diagnostics
HD-43876	BREAKOUT BOX	4.22 DTC P0501, P0502, Diagnostics
HD-43876	BREAKOUT BOX	4.25 DTC P0661, P0662, Diagnostics
HD-43876	BREAKOUT BOX	4.26 DTC P1009, P1010, Diagnostics
HD-43876	BREAKOUT BOX	4.27 DTC P1351, P1352, P1354, P1355, Diagnostics
HD-43876	BREAKOUT BOX	4.30 DTC U1097, U1255, Diagnostics
HD-43876	BREAKOUT BOX	E.19 DTC U1016, U1255, Diagnostics
HD-44687	IGNITION COIL CIRCUIT TEST ADAPTER	4.9 ENGINE CRANKS, BUT WILL NOT START, Diagnostics
HD-44687	IGNITION COIL CIRCUIT TEST ADAPTER	4.27 DTC P1351, P1352, P1354, P1355, Diagnostics
HD-45928	PACKARD MICRO-64 TERMINAL REMOVER	A.17 PACKARD MICRO-64 CONNECTORS, Packard Micro-64 Connector Repair
HD-45929	PACKARD MICRO-64 TERMINAL CRIMPER	A.17 PACKARD MICRO-64 CONNECTORS, Packard Micro-64 Connector Repair
HD-46601	INSTRUMENT HARNESS ADAPTERS	2.2 INITIAL DIAGNOSTIC CHECK: ODOMETER, Initial Diagnostics
HD-46601	INSTRUMENT HARNESS ADAPTERS	2.4 SPEEDOMETER/TACHOMETER, Diagnostics
HD-46601	INSTRUMENT HARNESS ADAPTERS	2.5 BREAKOUT BOX: SPEEDOMETER/TACHOMETER, General
HD-46601	INSTRUMENT HARNESS ADAPTERS	2.5 BREAKOUT BOX: SPEEDOMETER/TACHOMETER, Speedometer: XL only
HD-46601	INSTRUMENT HARNESS ADAPTERS	2.5 BREAKOUT BOX: SPEEDOMETER/TACHOMETER, Speedometer: XL only
HD-46601	INSTRUMENT HARNESS ADAPTERS	2.5 BREAKOUT BOX: SPEEDOMETER/TACHOMETER, Tachometer
HD-46601	INSTRUMENT HARNESS ADAPTERS	2.5 BREAKOUT BOX: SPEEDOMETER/TACHOMETER, Tachometer
HD-46601	INSTRUMENT HARNESS ADAPTERS	2.7 DTC B1004, B1005, Diagnostics

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
HD-46601	INSTRUMENT HARNESS ADAPTERS	2.9 DTC B1008, Diagnostics
HD-46601	INSTRUMENT HARNESS ADAPTERS	2.10 DTC U1016, U1255, Diagnostics
HD-46601	INSTRUMENT HARNESS ADAPTERS	2.11 DTC U1064, U1255, Diagnostics
HD-46601	INSTRUMENT HARNESS ADAPTERS	3.10 INITIAL DIAGNOSTIC CHECK: TSM/HFSM, Initial Diagnostics
HD-46601	INSTRUMENT HARNESS ADAPTERS	4.5 INITIAL DIAGNOSTIC CHECK: EFI, Initial Diagnostics
HD-46601	INSTRUMENT HARNESS ADAPTER	4.29 DTC U1064, U1255, Diagnostics
HD-46601	INSTRUMENT HARNESS ADAPTER	4.30 DTC U1097, U1255, Diagnostics
HD-46601	INSTRUMENT HARNESS ADAPTERS	E.9 INITIAL DIAGNOSTIC CHECK: TSM/TSSM, Initial Diagnostics
HD-48053	ELECTRICAL SYSTEM TESTER	1.7 CHARGING SYSTEM, Troubleshooting
HD-48114	MOLEX ELECTRICAL CONNECTOR TERMINAL REMOVER	A.15 MOLEX CONNECTORS, Molex Connector Repair
HD-48637	ECM BREAKOUT BOX	2.10 DTC U1016, U1255, Diagnostics
HD-48650	DIGITAL TECHNICIAN II	2.1 CHECKING FOR DIAGNOSTIC TROUBLE CODES, Code Types
HD-48650	DIGITAL TECHNICIAN II	3.2 HARLEY-DAVIDSON SMART SECURITY SYSTEM, HFSM Features
HD-48650	DIGITAL TECHNICIAN II	3.7 SERVICE/EMERGENCY FUNCTIONS, Service Mode
HD-48650	DIGITAL TECHNICIAN II	3.23 TSM/HFSM: PASSWORD LEARN, Password Learning
HD-48650	DIGITAL TECHNICIAN II	4.14 IDLE AIR CONTROL, General
HD-48650	DIGITAL TECHNICIAN II	4.19 DTC P0131, P0132, P0134, P0151, P0152, P0154, Diagnostics
HD-48650	DIGITAL TECHNICIAN II	4.24 DTC P0603, P0605, General
HD-48650	DIGITAL TECHNICIAN II	E.8 DIAGNOSTIC TROUBLE CODES (DTC), Code Types
MCR-101 HD	ELECTRICAL SYSTEM ANALYZER	4.9 ENGINE CRANKS, BUT WILL NOT START, Diagnostics
SNAP-ON TT600-3	SNAP-ON PICK	A.12 630 METRI-PACK CONNECTORS, 630 Metri-Pack Connector Repair

2009 Harley-Davidson Sportster Models Electrical Diagnostic Manual

FASTENER	TORQUE VALUE	NOTES
No torque values were found in this manual.		





1	
150 Metri-Pack Connector Repair.....	A-18
2	
280 Metri-Pack Connector Repair.....	A-20
4	
480 Metri-Pack Connector Repair.....	A-22
6	
630 Metri-Pack Connector Repair.....	A-23
A	
Active Intake Solenoid (HDI Models Only).....	4-105
AMP Multilock Connector Repair.....	A-1
B	
Bank Angle Sensor (HDJ/Korea).....	E-2
Bank Angle Sensor Description.....	4-3
Bank Angle Sensor Function.....	3-1
Battery Testing.....	1-28
Conductance Test.....	1-28
Load Test.....	1-28
Voltmeter Test.....	1-28
Bus ER.....	4-36
C	
Charging System Testing	
Current Voltage Output Test: Using HD-48053.....	1-25
Current Voltage Output Test: Using Load Tester.....	1-25
Milliampere Draw Test.....	1-24
Total Current Draw Test.....	1-24
Check Engine Lamp EFI.....	4-5
Check Engine Lamp Functionality.....	2-1
CKP Sensor.....	4-93
Connectors	
Location.....	B-1
Conversions	
Fluid.....	C-2
Length.....	C-1
Torque.....	C-3
Crankshaft Position (CKP) Sensor.....	4-3
D	
Delphi Connector	
Repair.....	A-6
Deutsch 1-Place Connector	
Repair.....	A-8
Deutsch Connector	
Crimping Mini Terminals.....	A-14
Crimping Solid Barrel Terminals.....	A-15
Crimping Standard Terminals.....	A-13
Repair.....	A-9
Diagnostic Notes.....	2-4
Diagnostic Trouble Code Types.....	2-3
Current.....	2-3
Historic.....	2-3
Retrieving Diagnostic Trouble Codes.....	2-3
DTC B0563: Battery Voltage High.....	3-31
DTC B0563 Battery Voltage High (HDJ/Korea).....	E-46
DTC B1004 Fuel Level Sending Unit Low.....	2-26
DTC B1005 Fuel Level Sending Unit High/Open.....	2-26
DTC B1006 Accessory Line Overvoltage.....	2-30

DTC B1007 Ignition Line Overvoltage.....	2-30
DTC B1008 Trip Odometer Reset Switch Closed.....	2-32
DTC B1121, B1122, B1141 Turn Signals Will Not Flash, 4-Way Flashers Inoperable.....	3-32
DTC B1123 Left Turn Signal Short-to-Ground.....	3-32
DTC B1124 Right Turn Signal Short-to-Ground.....	3-32
DTC B1125 Left Turn Signal Short-to-Voltage.....	3-32
DTC B1126 Right Turn Signal Short-to-Voltage.....	3-32
DTC B1131 Alarm Output Low.....	3-48
DTC B1131 Alarm Output Low (HDJ/Korea).....	E-47
DTC B1132 Alarm Output High.....	3-48
DTC B1132 Alarm Output High (HDJ/Korea).....	E-47
DTC B1134 Starter Output High.....	3-51
DTC B1134 Starter Output High (HDJ/Korea).....	E-50
DTC B1135 Accelerometer Fault.....	3-54
DTC B1135 Accelerometer Fault (HDJ/Korea).....	E-53
DTC B1136 Accelerometer Tip-Over Self-Test Fault.....	3-54
DTC B1141 Ignition Switch Open/Low.....	3-54
DTC B1142 Internal Fault.....	3-54
DTC B1143 Security Antenna Short-to-Ground.....	3-58
DTC B1144 Security Antenna Short-to-Battery.....	3-58
DTC B1145 Security Antenna Open.....	3-58
DTC B1154 Clutch Switch Short-to-Ground.....	3-61
DTC B1154 Clutch Switch Short-to-Ground (HDJ/Korea).....	E-54
DTC B1155 Neutral Switch Short-to-Ground.....	3-61
DTC B1155 Neutral Switch Short-to-Ground (HDJ/Korea).....	E-54
DTC P0107 MAP Sensor Open/Low.....	4-66
DTC P0112 IAT Sensor Voltage Low.....	4-66
DTC P0113 IAT Sensor Voltage Open/High.....	4-66
DTC P0117 ET Sensor Voltage Low.....	4-73
DTC P0118 ET Sensor Open/High.....	4-73
DTC P0122 TP Sensor Open/Low.....	4-77
DTC P0123 TP Sensor High.....	4-77
DTC P0131 Front Oxygen Sensor Low or Engine Running Lean.....	4-82
DTC P0132 Engine Running Rich.....	4-82
DTC P0134 Front Oxygen Sensor Open/Not Responding/High.....	4-82
DTC P0151 Rear Oxygen Sensor Low or Engine Running Lean.....	4-82
DTC P0152 Engine Running Rich.....	4-82
DTC P0154 Rear Oxygen Sensor Open/Not Responding/High.....	4-82
DTC P0261 Front Injector Open/Low.....	4-87
DTC P0262 Front Injector High.....	4-87
DTC P0263 Rear Injector Open/Low.....	4-87
DTC P0264 Rear Injector High.....	4-87
DTC P0373 CKP Sensor Intermittent.....	4-93
DTC P0374 CKP Sensor Synch Error.....	4-93
DTC P0501 VSS Sensor Low.....	4-96
DTC P0502 VSS Sensor High/Open.....	4-96
DTC P0505 Loss of Idle Speed Control.....	4-55
DTC P0562 Battery Voltage Low.....	4-100
DTC P0563 Battery Voltage High.....	4-100
DTC P0603 ECM EEPROM Error.....	4-104
DTC P0605 ECM Flash Error.....	4-104
DTC P0661 Active Intake Solenoid Open/Low.....	4-105
DTC P0662 Active Intake High/Shorted.....	4-105
DTC P1001 Ssystem Relay Coil Open/Low.....	4-50
DTC P1002 System Relay Coil High/Shorted.....	4-50
DTC P1003 System Relay Contacts Open.....	4-50
DTC P1004 System Relay Contacts Closed.....	4-50
DTC P1009 Incorrect Password.....	4-109
DTC P1010 Missing Password.....	4-109
DTC P1064 Loss of TSM/TSSM/HFSM Serial Data.....	4-124

DTC P1097 Loss of All Speedometer Serial Data (State of Health)	4-129
DTC P1351 Front Ignition Coil Open/Low.	4-109
DTC P1352 Front Ignition Coil High/Shorted.	4-109
DTC P1354 Rear Ignition Coil Open/Low.	4-109
DTC P1355 Rear Ignition Coil High/Shorted.	4-109
DTC P1501 Jiffy Stand Sensor Low.	4-119
DTC P1502 Jiffy Stand Sensor High.	4-119
DTC P-1-8 MAP Sensor High.	4-66
DTC U1016 Loss of All ECM Serial Data.	2-34
DTC U1016 Loss of All ECM Serial Data (State of Health).	E-58
DTC U1064 Loss of TSM/TSSM/HFSM Serial Data.	2-39
DTC U1255 Missing Message at Speedometer.	4-129
DTC U1255 Serial Data Error/Missing Message.	2-34
DTC U1255 Serial Data Error/Missing Message (ECM).	4-124
DTC U1255 Serial Data Error/Missing Message (HDJ/Korea).	E-58
DTC U1300 Serial Data Low.	2-44
DTC U1300 Serial Data Low (ECM).	4-36
DTC U1300 Serial Data Low (HDJ/Korea).	E-63
DTC U1301 Serial Data Open/High.	2-44
DTC U1301 Serial Data Open/High (ECM).	4-36
DTC U1301 Serial Data Open/High (HDJ/Korea).	E-63

E

Electronic Control Module (ECM).	4-3
Electronic Fuel Injection (EFI).	4-3
ET Sensor.	4-73

F

Fluid Conversions.	C-2
Fuel Injectors.	4-87
Fuel Pressure Test.	4-134
Fuel System.	4-42
Fuse Block Repair.	A-17

G

Glossary	
Acronyms and Abbreviations.	D-1

H

Hands-Free Fob Battery.	3-72
Hands-Free Security Module (HFSM).	3-2

I

Idle Air Control Description.	4-3
Idle Air Control Diagnostics.	4-55
Ignition Coil Description.	4-3
Ignition Coil Diagnostics.	4-114
Indicator Lamps.	2-21
Intake Air Temperature (IAT)/Manifold Absolute Pressure (TMAP) sensor.	4-3

J

Jiffy Stand Sensor.	4-119
-----------------------------	-------

K

Key Fob Assignment:TSSM.	E-4
Key Fob Battery.	E-65

L

Loctite.	I-II
------------------	------

M

Main Fuse Housing	
Repair.	A-24
Metric System.	C-2
Metri-Pack Terminals	
Crimping.	A-26
Molex Connector	
Repair.	A-28

O

Odometer Theory of Operation.	2-15
Oxygen Sensor Description.	4-3
Oxygen Sensor Diagnostics.	4-82

P

Packard 100W Connector	
Repair.	A-30
Packard Micro-64 Connector	
Repair.	A-32
Personal Identification Number.	3-6
PIN Entry:TSSM.	E-5

R

Reprogramming ECM.	2-5
----------------------------	-----

S

Sealed Splice.	A-35
Security Lamp.	3-3
Security Lamp (HDJ/Korea).	E-13
Security Lamp (Key Icon).	3-8
Security Lamp Diagnostics.	3-13
Security Lamp Operation.	2-2
Security System Functions (TSSM Only).	E-10
Service/Emergency Functions.	3-11
Service Bulletins.	I-I
Service Preparation.	I-I
Sidecar Configuration.	3-5
Sidecar Configuration (HDJ/Korea).	E-4
Siren.	3-10
Siren Battery.	3-72
Siren Battery (HDJ/Korea).	E-65
Speedometer Functions.	2-4
Speedometer Theory of Operation.	2-15
SPX Kent-Moore.	I-II
Starter	
Testing.	1-16
Starter Activation Circuits.	1-12
Starter Current Draw Test.	1-13
Starter Free Running Current Draw Test.	1-15
Starter Solenoid	
Solenoid Hold-In Test.	1-15
Solenoid Pull-In Test.	1-15
Solenoid Return Test.	1-16
Starter Troubleshooting.	1-1
Starting System Diagnosis.	1-3
Start Relay Test.	1-13
Stator.	1-26
System Relay.	4-50

T

Tachometer Theory of Operation.	2-15
Throttle Position (TP) Sensor Description.	4-3
Throttle Position (TP) Sensor Diagnostics.	4-77

TMAP.....	4-66
Torque Conversion.....	C-3
Trademarks	
Harley-Davidson.....	I-II
Referenced Products.....	I-II
Trip Odometer Reset Switch.....	2-15
TSM/HFSM: Password Learn.....	3-71
TSM/TSSM: Password Learn.....	E-64
Turn Signal Errors: B1121, B1122, B1141.....	E-33
Turn Signal Functions	
4-Way Flashing.....	E-8
Automatic Cancellation.....	E-8
Manual Cancellation.....	E-8
Turn Signal Module Function.....	3-1

V

Vehicle Speed Sensor (VSS) Description.....	4-3
Vehicle Speed Sensor (VSS) Diagnostics.....	4-96

W

Wiggle Test.....	4-23
Wiring Diagrams.....	B-3
WOW Test.....	2-13
WOW Test (HDJ/Korea).....	E-26



