SERVICE MANUAL

XLH® MODELS

1998

OFFICIAL FACTORY MANUAL

PN99484-98

1998 XLH SPORTSTER MODELS

SERVICE MANUAL

The information in this Service Manual applies to the 1998 XLH Sportster models.

PRODUCT 1

CHASSIS 2

ENGINE 3

FUEL SYSTEM 4

ELECTRIC STARTER 5

DRIVE/TRANSMISSION 6

ELECTRICAL 7

INDEX

TABLE OF CONTENTS

SECTION 1 – PRODUCT

Page No.

General 1-1
Servicing a New Motorcycle 1-1
Safe Operating Maintenance 1-1

Regular Maintenance Intervals 1-2

Side Views 1-3

Storage 1-7
General 1-7
Removal from Storage 1-7

Fluid Requirements 1-8
General 1-8
United States System 1-8
British Imperial System 1-8
Metric System 1-8
Wheel Bearing Grease 1-8
Brake Fluid 1-8
Front Fork Oil 1-8
Engine Oil 1-8
Fuel 1-8
Primary Drive/Transmission Lubricant 1-8

Metric Conversion Table 1-9

Fastener Torque Values 1-10

Troubleshooting 1-11
Engine 1-11
Engine Lubrication System 1-12
Electrical System 1-12
Fuel 1-12
Transmission 1-12
Clutch 1-12
Chassis 1-12

Shop Practices 1-13
Repair Notes 1-13
Repair and Replacement Procedures 1-13
Cleaning 1-14

Tool Safety 1-15
Air Tools 1-15
Wrenches 1-15
Pliers/Cutters/Prybars 1-15
Hammers 1-15
Punches/Chisels 1-15
Screwdrivers 1-15
Ratchets and Handles 1-16
Sockets 1-16
Storage Units 1-16

Tools 1-17

SECTION 2 – CHASSIS

Page No.

Specifications 2-1
Tires 2-3
Vehicle Identification Number (V.I.N.) 2-4

Wheels 2-5
General 2-5
Troubleshooting 2-5

Front Wheel 2-7
Removal 2-7
Disassembly 2-7
Cleaning, Inspection, and Repair 2-7
Assembly 2-8
Installation 2-10

Rear Wheel 2-11
Removal 2-11
Disassembly 2-11
Cleaning, Inspection, and Repair 2-11
Assembly 2-12
Installation 2-14

Lacing Wheels 2-16
16-Inch Wheels 2-16
19-Inch Wheels 2-18

Truing Laced Wheel 2-20

Checking Cast Rim Runout 2-22

Tires 2-23
General 2-23
Removal 2-23
Cleaning, Inspection, and Repair 2-23
Installation 2-24

Brakes 2-28
General 2-28
Troubleshooting 2-28

Front Brake Master Cylinder 2-29
Removal/Disassembly 2-29
Cleaning, Inspection, and Repair 2-31
Assembly/Installation 2-31

Rear Brake Master Cylinder 2-33
Adjustment 2-33
Removal/Disassembly 2-33
Cleaning, Inspection, and Repair 2-34
Assembly/Installation 2-34

Rear Brake Linkage and Sprocket Cover 2-36
Removal 2-36
Installation 2-36

Page No.

Front Brake Caliper 2-37
Removal/Disassembly 2-37
Cleaning, Inspection, and Repair 2-38
Assembly 2-38
Installation 2-39

Rear Brake Caliper 2-40
Removal/Disassembly 2-40
Cleaning, Inspection, and Repair 2-41
Assembly 2-41
Installation 2-41

Brake Lines 2-43
Front Brake Line 2-43
Rear Brake Line 2-44

Bleeding Hydraulic System 2-45
General 2-45

Front Fork 2-46
General 2-46
Removal 2-46
Disassembly 2-48
Cleaning, Inspection, and Repair 2-48
Assembly 2-48
Installation 2-48
Disassembly - XL1200S 2-50
Inspection - XL1200S 2-51
Assembly - XL1200S 2-51
Installation - XL1200S 2-53

Fork Stem and Bracket Assembly 2-54
Adjustment 2-54
Lubrication 2-54
Removal/Disassembly 2-54
Cleaning, Inspection, and Repair 2-54
Assembly/Installation 2-54

Rear Fork 2-55
Removal/Disassembly 2-55
Cleaning and Inspection 2-55
Assembly 2-55
Installation 2-55

Rear Shock Absorber 2-56
Adjustment 2-56
Removal 2-56
Disassembly 2-56
Cleaning and Inspection 2-56
Installation 2-56

Throttle Control 2-58
Adjustment 2-58
Removal/Disassembly 2-59
Cleaning, Inspection, and Repair 2-59
Assembly/Installation 2-59

Handlebars 2-60
Removal 2-60
Installation 2-60

Page No.

Clutch Control 2-64
Adjustment 2-64
Removal/Disassembly 2-64
Assembly/Installation 2-65

Exhaust System 2-66
Removal 2-66
Disassembly 2-66
Assembly 2-66
Installation 2-66

Front Fender 2-68
Removal 2-68
Installation 2-68

Rear Fender 2-69
Removal 2-69
Installation 2-70

Jiffy Stand 2-71
General 2-71
Removal 2-71
Cleaning and Lubrication 2-71
Installation 2-72

Seat 2-73
Removal 2-73
Installation 2-73

Page No.

SECTION 3 – ENGINE

Specifications 3-1

Engine 3-5
General 3-5
Adjustment/Testing 3-5

Stripping Motorcycle for Engine Repair 3-8

Installing the Engine 3-11

Cylinder Head 3-13
Removal 3-13
Disassembly 3-15
Cleaning, Inspection, and Repair 3-15
Assembly 3-21
Installation 3-22

Cylinder and Piston 3-24
Removal/Disassembly 3-24
Cleaning, Inspection, and Repair 3-25
Assembly/Installation 3-30

Engine Lubrication System 3-31
Checking and Adding Oil 3-31
Changing Oil and Filter 3-31
Winter Lubrication 3-32
Oil Hose Routing 3-33
Oil Tank 3-34
Oil Pressure Signal Light Switch 3-37
Oil Pressure Signal Light 3-37
Oil Pressure 3-38
Crankcase Breathing System 3-38
Oiling System 3-39
Oil Pump 3-40
Oil Filter Mount 3-42

Valve Tappets 3-44
General 3-44
Removal 3-44
Cleaning and Inspection 3-44
Installation 3-45

Gearcase Cover and Cam Gears 3-46
General 3-46
Removal/Disassembly 3-46
Cleaning, Inspection, and Repair 3-47
Assembly/Installation 3-52

Crankcase 3-54
General 3-54
Adjustment/Testing 3-54
Disassembly 3-54
Cleaning and Inspection 3-58
Replacing Flywheel Washers 3-58
Lapping Connecting Rod Races 3-60
Fitting Rod Bearings 3-60
Fitting Sprocket Bearings 3-62
Fitting Pinion Bearings 3-62
Lapping Engine Main Bearing Races 3-66
Assembly 3-67

SECTION 4 – FUEL SYSTEM

Specifications 4-1

Carburetor 4-2
General 4-2
Troubleshooting 4-3
Vacuum Piston Assembly Troubleshooting 4-5
Operation 4-5
Adjustment 4-12
Operation Check – Vacuum Piston 4-14
Removal 4-14
Disassembly 4-14
Cleaning, Inspection, and Repair 4-14
Assembly 4-16
Installation 4-17

Air Cleaner 4-18
General 4-18
Removal 4-18
Cleaning, Inspection, and Repair 4-19
Installation 4-19

Fuel Supply Valve 4-20
General 4-20
Removal 4-20
Cleaning, Inspection, and Repair 4-20
Installation 4-20

Fuel Tank 4-21
General 4-21
Removal 4-22
Cleaning, Inspection, and Repair 4-22
Installation 4-23

Evaporative Emissions Control – California Models 4-24
General 4-24
Troubleshooting 4-25
Solenoid Electrical Tests – Air Cleaner Butterfly Valve 4-27
Removal 4-30
Cleaning, Inspection, Repair, and Lubrication 4-30
Installation and Adjustment 4-31
Hose Routing 4-32

SECTION 5 – ELECTRIC STARTER

Specifications 5-1

Electric Starter System 5-1
General 5-1
Troubleshooting 5-4
Starting System Diagnosis 5-6

Starter System Testing 5-10
"On-Motorcycle" Tests 5-10

Page No.

Starter 5-11
Removal 5-11
Testing Assembled Starter 5-11
Disassembly, Inspection, and Repair 5-12
Assembly 5-17
Installation 5-17

Starter Solenoid 5-18
General 5-18
Disassembly 5-18
Assembly 5-18

SECTION 6 – DRIVE/TRANSMISSION

Specifications 6-1

Primary Chain 6-3
General 6-3
Adjustment 6-4
Removal 6-4
Installation 6-5

Secondary Drive Belt 6-7
General 6-7
Adjustment 6-7
Cleaning 6-7
Removal and Installation 6-7

Clutch 6-9
General 6-9
Troubleshooting 6-9

Clutch Release Mechanism 6-10
Adjustment 6-10
Disassembly 6-11
Cleaning, Inspection, and Repair 6-11
Assembly 6-11

Primary Drive/Clutch 6-12
Removal 6-12
Disassembly 6-12
Inspection and Repair 6-14
Assembly 6-14
Installation 6-15

Transmission 6-16
General 6-16
Lubrication 6-16

Transmission Case 6-18
General 6-18
Removal 6-18
Cleaning, Inspection, and Repair 6-19

Page No.

Shifter Forks and Drum 6-20
Disassembly 6-20
Cleaning, Inspection, and Repair 6-21
Assembly 6-21

Mainshaft and Countershaft 6-23
Disassembly 6-23
Cleaning, Inspection, and Repair 6-27
Assembly 6-27

Main Drive Gear 6-30
Removal 6-30
Disassembly 6-31
Assembly 6-31
Installation 6-31

Access Door Bearings 6-32
Removal 6-32
Installation 6-32

Right Transmission Case Bearings 6-33
Removal 6-33
Installation 6-33

Transmission Installation and Shifter Pawl Adjustment 6-34

SECTION 7 – ELECTRICAL

Specifications 7-1

Electrical Bracket 7-2
Replace Fuse(s) 7-2
Replace Main Circuit Breaker 7-3
Replace Starter Relay 7-3
Replace Electrical Bracket 7-3

Ignition System 7-5
General 7-5
Troubleshooting 7-6
Diagnostic Charts - All Models Except 1200S 7-9
Checking for Trouble Codes - 1200S 7-14
Check Engine Lamp 7-14
Retrieving Trouble Codes 7-14
Scanalyzer 7-15
Breakout Box Installation 7-18
Diagnostic Check 1200S Sport 7-19
Trouble Code 12 MAP Sensor 7-33
Trouble Code 16 Battery Voltage 7-35
Trouble Code 24 and 25 Ignition Coil 7-37
Trouble Code 35 Tachometer 7-40
Trouble Code 41 Cam Sync Failure 7-41
Trouble Code 44 Bank Angle Sensor 7-42
Trouble Codes 52, 54, 55 Ignition Module Failure 7-44
Ignition Timing 7-45
Static Timing 1200S 7-45
Adjust Timing using Scanalyzer - 1200S 7-45
Static Timing - All except 1200S 7-46
Dynamic Timing 7-46

Page No.

Bank Angle Sensor ... 7-47

MAP Sensor - 1200S ... 7-48

Vacuum-Operated Electric Switch (V.O.E.S.) ... 7-49
Adjustment/Testing ... 7-49
Removal ... 7-50
Installation ... 7-50

Ignition/Light Switch ... 7-51
General ... 7-51
Removal ... 7-51
Installation ... 7-52

Ignition Module - 1200S ... 7-53
General ... 7-53
Removal ... 7-53
Installation ... 7-53

Cam Position Sensor and Rotor

1200S ... 7-54
General ... 7-54
Removal ... 7-54
Installation ... 7-54

Ignition Module - All except 1200S ... 7-55
General ... 7-55
Removal ... 7-55
Installation ... 7-56

Spark Plugs ... 7-57
General ... 7-57
Adjustment ... 7-57
Cleaning and Inspection ... 7-57
Installation ... 7-57

Spark Plug Cables ... 7-58
General ... 7-58
Removal ... 7-58
Inspection ... 7-58
Installation ... 7-58

Ignition Coil ... 7-59
General ... 7-59
Troubleshooting ... 7-59
Removal - All Except 1200S ... 7-59
Installation - All Except 1200S ... 7-60
Removal - 1200S ... 7-60
Installation - 1200S ... 7-60

Charging System ... 7-61
General ... 7-61
Troubleshooting ... 7-61
Adjustment/Testing ... 7-61

Page No.

Alternator ... 7-67
Removal and Disassembly ... 7-67
Cleaning, Inspection, and Repair ... 7-68
Assembly and Installation ... 7-68

Voltage Regulator ... 7-69
General ... 7-69
Removal ... 7-69
Installation ... 7-69

Battery ... 7-70
General ... 7-70
Activating and Testing New Battery ... 7-70
Cleaning and Inspection ... 7-71
Charging ... 7-71
Disconnection and Removal ... 7-72
Storage ... 7-72
Installation and Connection ... 7-72
Battery Cable Replacement ... 7-72

Lamps ... 7-75
General ... 7-75
Adjustment ... 7-75
Removal/Installation ... 7-76

Rear Brake Switch ... 7-80

Handlebar Switches ... 7-81
General ... 7-81
Removal ... 7-81
Installation ... 7-81
Switch Repair/Replacement ... 7-84

Horn ... 7-92
General ... 7-92
Troubleshooting ... 7-92

Neutral Indicator Switch ... 7-94
General ... 7-94
Testing ... 7-94
Removal and Installation ... 7-94

Directional (Turn Signal) Canceller ... 7-95
Operation ... 7-95
Distance Test ... 7-95
Time Test (Alternate) ... 7-96
Rider Preference and Control ... 7-96
Troubleshooting ... 7-96
883 Only ... 7-97
1200 Models ... 7-98
Removal/Installation ... 7-101

Fuses and Main Circuit Breaker ... 7-102
General ... 7-102

Electronic Speedometer ... 7-103

How-it Works 7-104
Speedometer Removal 1200 Models 7-104
Speedometer Installation 1200 Models 7-104
Speedometer Removal 883 Models 7-105
Speedometer Installation 883 Models 7-105
Tachometer Removal 7-105
Tachometer Installation 7-105
Speedometer sensor Replacement 7-105
Odometer reset switch Replacement 7-106
883 Speedometer (Late Model) 7-106
Speedometer/Tachometer Performance Check 7-107
Troubleshooting 7-109

Deutsch Connectors 7-111

Amp Multilock Connectors 7-116

Packard Electrical Connectors 7-120

Sealed Butt Connectors 7-122

Crimp Tables 7-123

Wiring Diagrams 7-127
XL 1200S Domestic and International Models - Main Harness 7-127
XLH All Models, Starting and Charging - XL1200S Front Lamps 7-128
XL 1200S Domestic and International - Ignition Circuit 7-129
XL 1200s Domestic and International - Horn and Instruments 7-130
XL 1200S Domestic and International - Lights 7-131
All XL Domestic and International (Except 1200S) - Main Harness 7-132
All XL Domestic and International (Except 1200S) - Ignition Circuit 7-133
All XL Domestic and International (Except 1200S) - Horn and Instruments 7-134

INDEX I-1

SUBJECT	PAGE NO.
1. General	1-1
2. Regular Maintenance Intervals	1-2
3. Side Views	1-3
4. Storage	1-7
5. Fluid Requirements	1-8
United States System	1-8
British Imperial System	1-8
Metric System	1-8
6. Metric Conversion Table	1-9
7. Fastener Torque Values	1-10
8. Troubleshooting	1-11
9. Shop Practices	1-13
10. Tool Safety	1-15
11. Tools	1-17

GENERAL

SERVICING A NEW MOTORCYCLE

⚠WARNING

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

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

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

After a new motorcycle has been driven its first 500 miles, and again at 5000 miles, a Harley-Davidson dealer should perform the service operations listed in the Regular Maintenance Intervals table on the next page.

SAFE OPERATING MAINTENANCE

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.

⚠CAUTION

- **Do not attempt to retighten engine head bolts. Retightening can cause engine damage.**
- **During the initial 500 mile (800 km) 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.**
- **Do not lubricate the enrichment cable on CV carburetors.**

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 discs for wear.
5. Cables for fraying, crimping and free operation.
6. Engine oil and transmission fluid levels.
7. Wheel spoke tightness, if applicable.
8. Headlamp, tail lamp, brake lamp and directional lamp operation.

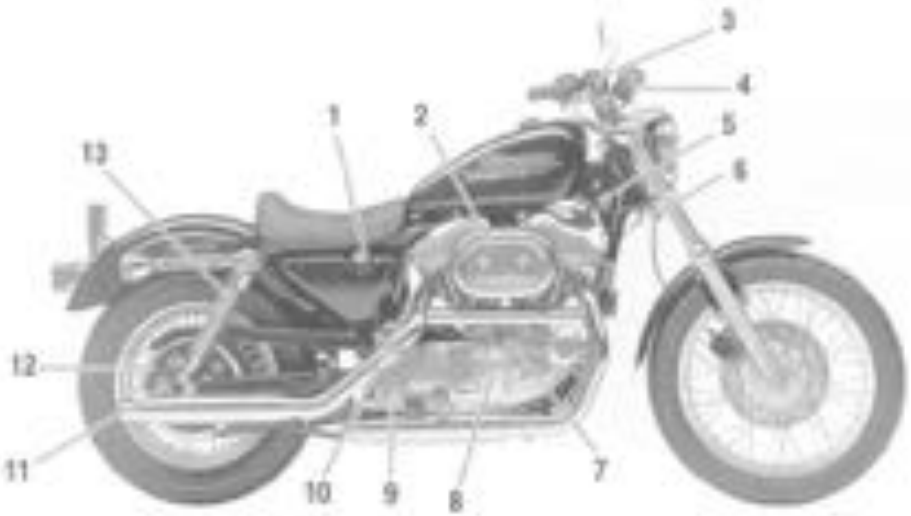
SECTION	ODOMETER READING SERVICE OPERATIONS (see chart code below)	Period	500 mi 800 km	2500 mi 4000 km	5000 mi 8000 km	7500 mi 12000 km	10000 mi 16000 km	12500 mi 20000 km	15000 mi 24000 km	17500 mi 28000 km	20000 mi 32000 km	22500 mi 36000 km	25000 mi 40000 km	27500 mi 44000 km	30000 mi 48000 km	32500 mi 52000 km	35000 mi 56000 km	37500 mi 60000 km	40000 mi 64000 km	42500 mi 68000 km	45000 mi 72000 km	47500 mi 76000 km	50000 mi 80000 km
2	Wheel bearings*						L				L				L				L				L
2	Wheel spoke tightness	1	I		I		I		I		I		I		I		I		I		I		I
2	Tire pressure and inspection for wear/damage	1	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
2	Brake fluid level and condition*		I		I		I		I		I		I		I		I		I		I		I
2	Rear brake pedal height adjustment and freeplay	1	I		I		I		I		I		I		I		I		I		I		I
2	Rear brake linkage				L		L		L		L		L		L		L		L		L		L
2	Brake pad linings and discs for wear		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
3	Condition of rear brake caliper mounting pins and boots				L		L		L		L		L		L		L		L		L		L
3	Front fork oil						R				R				R				R				R
3	Front fork steering adjustment		I		I		L		I		L		I		L		I		L		I		L
3	Rear fork pivot bolt		I		I		I		I		I		I		I		I		I		I		
3	Rear fork bearings*		I		I		L		I		L		I		L		I		L		I		L
3	Condition of rear shock absorbers		I		I		I		I		I		I		I		I		I		I		I
3	Throttle control grip sleeve, speedometer cable	1			L		L		L		L		L		L		L		L		L		L
3	Front brake hand lever, throttle control cables, clutch control cable and hand lever		L		L		L		L		L		L		L		L		L		L		L
3	Jiffy stand		I		L		L		L		L		L		L		L		L		L		L
3	Engine mounts		I		I		I		I		I		I		I		I		I		I		
3	Engine Oil*	1	R	I	R	I	R	I	R	I	R	I	R	I	R	I	R	I	R	I	R	I	R
3	Oil filter		R		R		R		R		R		R		R		R		R		R		R
4	Engine idle speed	1	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
4	Operation of throttle and enrichener controls	1	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
4	Air cleaner		I		I		I		I		I		I		I		I		I		I		I
4	Fuel valve, lines and fittings for leaks		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
4	Fuel tank filler screen				I		I		I		I		I		I		I		I		I		I
4	Air cleaner backplate EVAP butterfly valve operation (if equipped)	1	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
6	Primary chain		I		I		I		I		I		I		I		I		I		I		I
6	Primary chain/gear/transmission lubricant		R	I	R	I	R	I	R	I	R	I	R	I	R	I	R	I	R	I	R	I	R
6	Rear drive belt	1	A		I		I		I		I		I		I		I		I		I		I
6	Clutch adjustment		A		A		A		A		A		A		A		A		A		A		A
7	Ignition timing and MAP sensor (-2002) or vacuum operated electric switch (+2003) vacuum lines				I		I		I		I		I		I		I		I		I		I
7	Spark Angle Sensor				I		I		I		I		I		I		I		I		I		I
7	Operation of all electrical equipment and switches	1	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
7	Spark plugs				I		R		I		R		I		R		I		R		I		R
7	Battery connections		T		T		T		T		T		T		T		T		T		T		T
—	All fasteners except engine head bolts		T		T		T		T		T		T		T		T		T		T		T
—	Road test	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table Code:
A - Adjust
I - Inspect, and if necessary, correct, adjust, clean or replace
L - Lubricate with specified lubricant

*Also perform prior to storage or annually
R - Replace or change
T - Tighten to proper torque
X - Perform

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

XLH 883 – Left Side View (Typical)



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

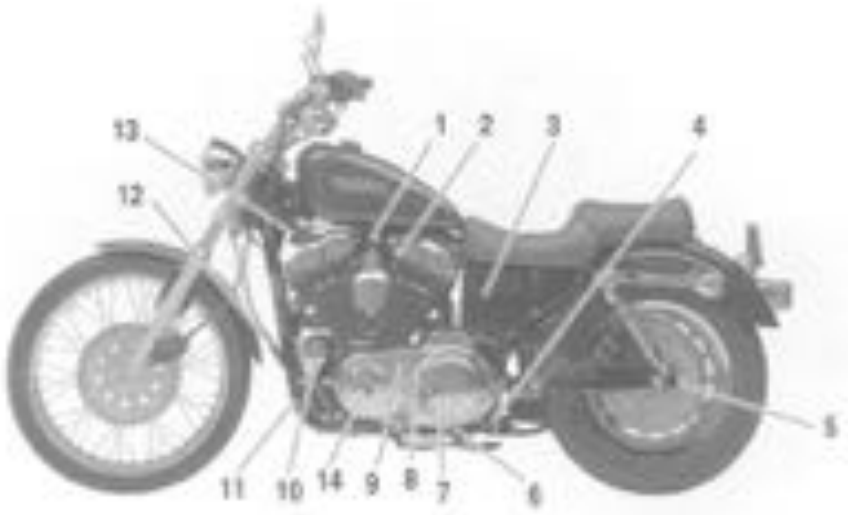
XLH 883 – Right Side View (Typical)

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

XLH 1200 – Left Side View (Typical)

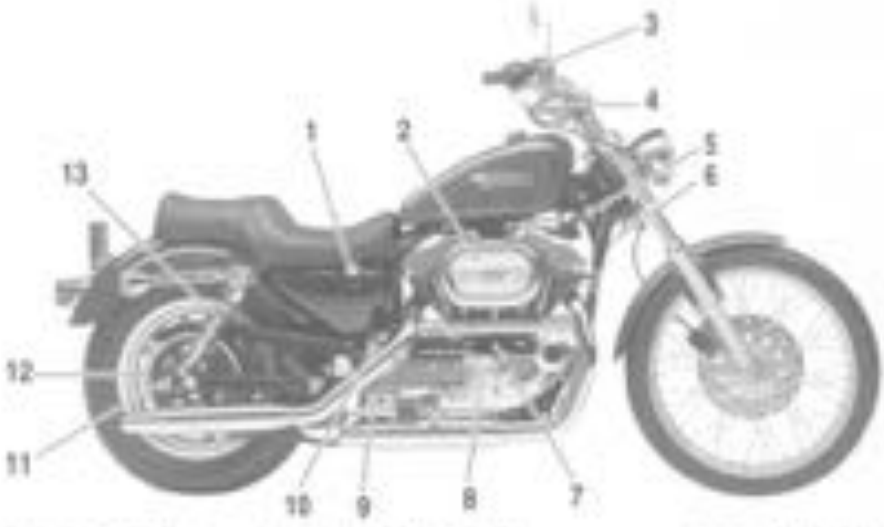
1. Engine oil fill plug & dipstick
2. Carburetor/air cleaner
3. Front brake master cylinder & reservoir
4. Speedometer/tachometer
5. Ignition/light switch
6. Fork lock brackets
7. Timing inspection hole plug
8. Ignition Module
9. Rear brake master cylinder & reservoir
10. Electric starter motor
11. Rear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

XLH 1200 – Right Side View (Typical)



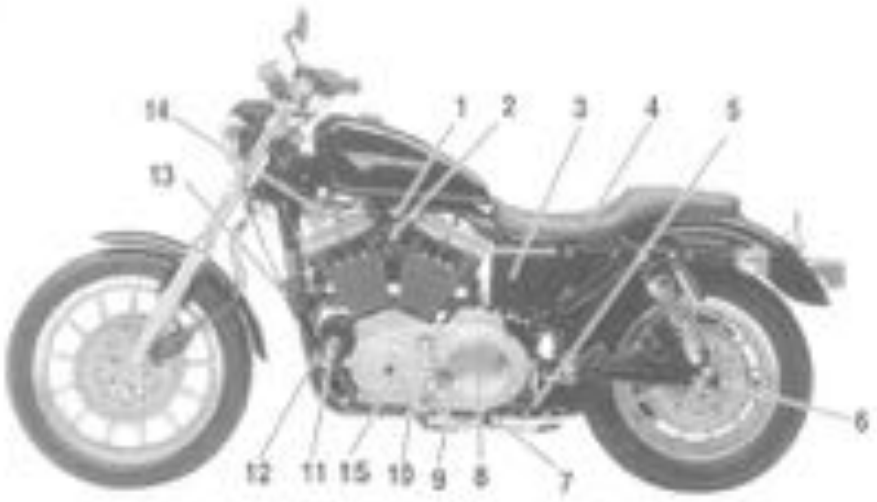
1. Fuel supply valve
2. Carburetor enrichener knob
3. Battery
4. Engine oil tank drain hose
5. Rear axle adjuster
6. Primary & transmission drain plug
7. Clutch inspection cover
8. Primary chain cover
9. Primary chain inspection plug
10. Engine oil filter
11. Voltage regulator
12. Clutch cable adjuster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

XL 1200C Custom - Left Side View (Typical)



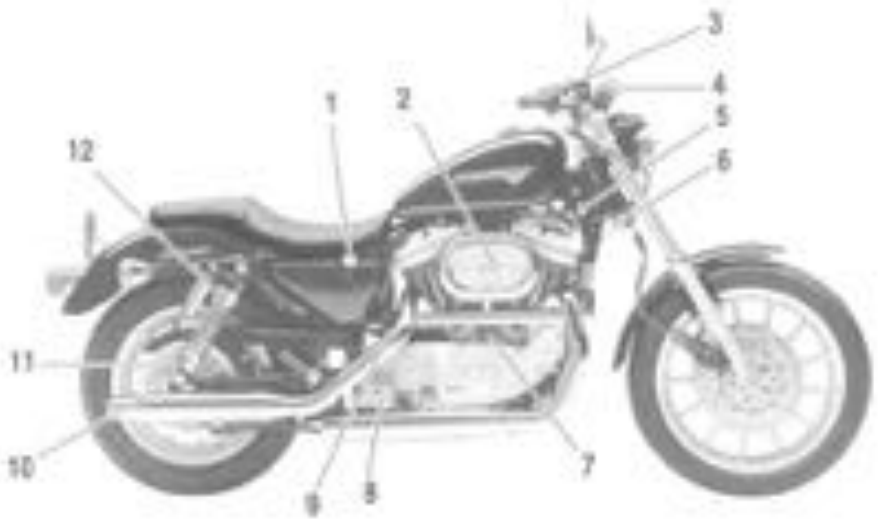
1. Engine oil fill plug & dipstick
2. Carburetor/air cleaner
3. Front brake master cylinder & reservoir
4. Speedometer/tachometer
5. Ignition/light key switch
6. Fork lock brackets
7. Timing inspection hole plug
8. Ignition Module
9. Rear brake master cylinder & reservoir
10. Electric starter motor
11.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

XL 1200C Custom – Right Side View (Typical)



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

XL 1200S Sport– Left Side View (Typical)



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

XLH 1200S Sport– Right Side View (Typical)

STORAGE

GENERAL

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

This work should be performed by your local Harley-Davidson dealer or other qualified technician following Service Manual procedures.

⚠WARNING

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

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

   OR

   Drain all gasoline from the fuel tank. Spray the inside of the fuel tank with one of the commercially available rust preventatives. Follow the manufacturer's instructions.

2. Fill the oil tank. Pinch off (or remove and plug) the line leading from the oil tank bottom to the oil pump feed fitting. This prevents oil from seeping past the check ball into the oil pump and filling the engine flywheel compartment.

3. Remove the spark plugs, inject a few squirts of engine oil into each cylinder and crank the engine 5-6 revolutions. Reinstall spark plugs.

4. Grease wheel bearings and install new seals.

5. Adjust primary chain.

6. Check tire inflation. If the motorcycle will be stored for an extended period of time, securely support the motorcycle under the frame so that all weight is off the tires.

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

⚠WARNING

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

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

⚠WARNING

- **Always unplug or turn off battery charger before connecting or disconnecting charger clamps at battery. Connecting or disconnecting clamps with charger on could cause a spark and a possible battery explosion. A battery explosion may rupture the battery case and spray sulfuric acid onto the surrounding area and personnel, resulting in injury.**

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

9. If motorcycle is to be covered, use a material that will breathe, such as light canvas. Plastic materials that do not breathe promote the formation of condensation.

REMOVAL FROM STORAGE

⚠WARNING

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

1. Charge and install battery.

2. Remove and inspect the spark plugs. Replace if necessary.

3. Clean the air cleaner element.

4. If fuel tank was drained, fill fuel tank with fresh gasoline.

5. If oil feed line was pinched off or plugged, unplug it and reconnect.

6. Start the engine and run until it reaches normal operating temperature.

7. Check engine oil level. Check the transmission lubricant level. Fill to proper levels with correct fluids, if required.

8. Perform all of the checks in the PRE-RIDING CHECKLIST in the Owner's Manual.

FLUID REQUIREMENTS

GENERAL

United States System

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

- 1 pint (U.S.) = 16 fluid ounces (U.S.)
- 1 quart (U.S.) = 2 pints (U.S.) = 32 fl. oz. (U.S.)
- 1 gallon (U.S.) = 4 quarts (U.S.) =128 fl. oz. (U.S.)

British Imperial System

Fluid volume measurements in this Service Manual do not include the British Imperial (Imp.) system equivalents. The following conversions exist in the British Imperial system:

- 1 pint (Imp.) = 20 fluid ounces (Imp.)
- 1 quart (Imp.) = 2 pints (Imp.)
- 1 gallon (Imp.) = 4 quarts (Imp.)

Although the same unit-of-measure terminology as the U.S. system is used in the British Imperial (Imp.) system, the actual volume of each British Imperial unit-of-measure differs from its U.S. counterpart. The U.S. fluid ounce is larger than the British Imperial fluid ounce. However, the U.S. pint, quart and gallon are smaller than the British Imperial pint, quart and gallon, respectively. Should you need to convert from U.S. units to British Imperial units (or vice versa), refer to the following:

- fluid ounces (U.S.) x 1.042 = fluid ounces (Imp.)
- pints (U.S.) x 0.833 = pints (Imp.)
- quarts (U.S.) x 0.833 = quarts (Imp.)
- gallons (U.S.) x 0.833 = gallons (Imp.)

- fluid ounces (Imp.) x 0.960 = fluid ounces (U.S.)
- pints (Imp.) x 1.201 = pints (U.S.)
- quarts (Imp.) x 1.201 = quarts (U.S.)
- gallons (Imp.) x 1.201 = gallons (U.S.)

Metric System

Fluid volume measurements in this Service Manual include the metric system equivalents. In the metric system, 1 liter (L) = 1,000 milliliters (ml). Should you need to convert from U.S. units-of-measure to metric units-of-measure (or vice versa), refer to the following:

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

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

WHEEL BEARING GREASE

Use Harley-Davidson WHEEL BEARING GREASE (H-D Part No. 99855-89).

BRAKE FLUID

⚠WARNING

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

Use only D.O.T. 5 SILICONE HYDRAULIC BRAKE FLUID (H-D Part No. 99932-77).

FRONT FORK OIL

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

ENGINE OIL

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

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

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

FUEL

Use a good quality leaded or unleaded gasoline (87 pump octane or higher). Pump octane is the octane number usually shown on the gas pump.

PRIMARY DRIVE/TRANSMISSION LUBRICANT

Use only Harley-Davidson SPORT TRANS FLUID (H-D Part No. 99854-96 quart (U.S.) size or H-D Part No. 99855-96 gallon (U.S.) size).

METRIC CONVERSION TABLE

MILLIMETERS to INCHES (mm x 0.03937 = inches)								INCHES to MILLIMETERS (inches x 25.40 = mm)							
mm	in.	mm	in.	mm	in.	mm	in.	in.	mm	in.	mm	in.	mm	in.	mm
.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 $^{15}/_{16}$	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 $^{1}/_{8}$	98.42
6	.2362	39	1.535	72	2.834	105	4.134	.040	1.016	1 $^{3}/_{16}$	30.16	2 $^{5}/_{8}$	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 $^{5}/_{16}$	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	.5906	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 $^{1}/_{16}$	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	1.8	48.26	3.3	83.82	4 $^{11}/_{16}$	119.06

FASTENER TORQUE VALUES

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

⚠WARNING

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

ENGLISH

FASTENER	TYPE	MINIMUM TENSILE STRENGTH	MATERIAL	BODY SIZE OR OUTSIDE DIAMETER																
				# (number)							in. (inches)									
				2	3	4	5	6	8	10	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1
	SAE 2 STEEL	74,000 PSI	LOW CARBON								9	12	31	32	47	68	96	110	230	310
	SAE 5 STEEL	120,000 PSI	MEDIUM CARBON HEAT TREAT						144*	22*	10	19	33	54	78	114	154	257	382	587
	SAE 7 STEEL	133,000 PSI	MEDIUM CARBON ALLOY								10	25	44	71	110	154	215	360	570	848
	SAE 8 STEEL	150,000 PSI	MEDIUM CARBON ALLOY								14	26	47	79	119	164	230	380	602	908
	SAE 8 STEEL	150,000 PSI	MEDIUM CARBON ALLOY								14	28	47	79	119	168	230	380	602	908
	SOCKET SET SCREW	212,000 PSI	HIGH CARBON QUENCHED TEMPERED					9*	19*	30*	70*	140*	18	29	43	62	100	146		
	STUDS			Use SAE 2, 5 and 8 values when grade is known, with nut of sufficient strength.																

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

METRIC EQUIVALENTS FOR ENGLISH FASTENERS

FASTENER	TYPE	MINIMUM TENSILE STRENGTH	MATERIAL	BODY SIZE OR OUTSIDE DIAMETER																
				# (number)							mm (millimeters)									
				2	3	4	5	6	8	10	6.4	7.9	9.5	11.1	12.7	14.3	15.9	19.1	22.2	25.4
	SAE 2 STEEL	1,551 kg/cm²	LOW CARBON								0.3	0.6	27.7	44.3	65.0	95.4	132.9	276.4	350.5	428.7
	SAE 5 STEEL	8,436 kg/cm²	MEDIUM CARBON HEAT TREAT						1.6	2.5	13.9	26.3	45.6	74.7	107.9	157.7	213.0	356.4	528.2	811.8
	SAE 7 STEEL	9,350 kg/cm²	MEDIUM CARBON ALLOY								13.0	34.6	60.8	98.3	152.1	213.0	297.3	497.9	788.2	1171.7
	SAE 8 STEEL	10,546 kg/cm²	MEDIUM CARBON ALLOY								19.4	40.1	69.9	107.9	164.8	232.7	318.1	525.5	829.8	1255.6
	SAE 8 STEEL	10,546 kg/cm²	MEDIUM CARBON ALLOY								19.4	40.1	65.0	107.9	164.8	232.7	318.1	525.5	829.8	1255.6
	SOCKET SET SCREW	14,906 kg/cm²	HIGH CARBON QUENCHED TEMPERED					1.2	1.8	3.4	8.1	16.1	24.9	40.1	59.5	87.1	138.3	291.9		
	STUDS			Use SAE 2, 5 and 8 values when grade is known, with nut of sufficient strength.																

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

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

TROUBLESHOOTING

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

ENGINE

Starting Motor Does Not Operate or Does Not Turn Engine Over

1. Engine run switch in OFF position.
2. Ignition switch not on.
3. Discharged battery, loose or corroded connections. (Solenoid chatters.)
4. Starter control relay or solenoid not functioning.
5. Electric starter shaft pinion gear not engaging or over-running clutch slipping.

Engine Turns Over But Does Not Start

1. Fuel tank empty.
2. Fuel valve turned off.
3. Fuel valve or filter clogged.
4. Discharged battery, loose or broken battery terminal connections.
5. Fouled spark plugs.
6. Spark plug cables in bad condition and shorting or cable connections loose.
7. Ignition timing badly out of adjustment.
8. Loose wire connection at coil or battery connection or plug between ignition sensor and module.
9. Ignition coil not functioning.
10. Ignition module not functioning.
11. Ignition sensor not functioning.
12. Sticking or damaged valve or valves.
13. Engine flooded with gasoline as a result of overchoking.
14. Engine oil too heavy (winter operation).

Starts Hard

1. Spark plugs in bad condition, have improper gap or are partially fouled.
2. Spark plug cables in bad condition and shorting.
3. Battery nearly discharged.
4. Loose wire connection at one of the battery terminals, at coil, or at plug between ignition sensor and module.
5. Carburetor controls not adjusted correctly.
6. Ignition coil not functioning.
7. Engine oil too heavy (winter operation).
8. Ignition not timed properly.
9. Fuel tank filler cap vent plugged, or carburetor fuel line closed off restricting fuel flow.
10. Water or dirt in fuel system and carburetor.
11. Enrichener valve inoperative.
12. Air leak at intake manifold.
13. Valves sticking.
14. Air cleaner backplate EVAP butterfly valve (if equipped) stuck closed or inoperative.

Starts But Runs Irregularly or Misses

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

Spark Plug Fouls Repeatedly

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

Pre-Ignition or Detonation (Knocks or Pings)

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

Overheating

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

Valve Train Noise

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

Excessive Vibration

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

ENGINE LUBRICATION SYSTEM

Oil Does Not Return To Oil Tank

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

Engine Uses Too Much Oil or Smokes Excessively

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

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

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

ELECTRICAL SYSTEM

Alternator Does Not Charge

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

Alternator Charge Rate Is Below Normal

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

FUEL

Carburetor Floods

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

TRANSMISSION

Shifts Hard

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

Jumps Out of Gear

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

CLUTCH

Slips

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

Drags or Does Not Release

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

Chatters

1. Friction or steel plates worn, warped, or dragging.

CHASSIS

Irregular / Inadequate Brake Action

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

Handling Irregularities

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

SHOP PRACTICES

REPAIR NOTES

NOTE

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

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

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

SAFETY – Safety is always the most important consideration when performing any job. Be sure you have a complete understanding of the task to be performed. Use common sense. Use the proper tools. Don't just do the job – do the job safely.

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

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

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

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

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

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

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

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

REPAIR AND REPLACEMENT PROCEDURES

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

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

Replace all damaged or missing lubrication fittings.

Use Teflon tape on pipe fitting threads.

WIRING, HOSES AND LINES – Replace hoses, clamps, electrical wiring, electrical switches or fuel lines if they do not meet specifications.

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

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

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

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

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

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

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

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

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

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

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

If a gasket must be made, be sure to cut holes that match up with the mating part. Serious vehicle damage can occur if any flange holes are blocked by the gasket. Use material that is the right type and thickness.

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

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

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

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

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

GEARS – Always check gears for damaged or worn teeth.

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

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

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

Clean all rust from the machined surfaces of new parts.

PART REPLACEMENT – Always replace worn or damaged parts with new parts.

CLEANING

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

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

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

BEARINGS – Remove shields and seals from bearings before cleaning. Clean bearings with permanent shields and seals in solution.

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

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

TOOL SAFETY

AIR TOOLS

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

WRENCHES

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

PLIERS/CUTTERS/PRYBARS

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

HAMMERS

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

PUNCHES/CHISELS

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

SCREWDRIVERS

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

RATCHETS AND HANDLES

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

SOCKETS

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

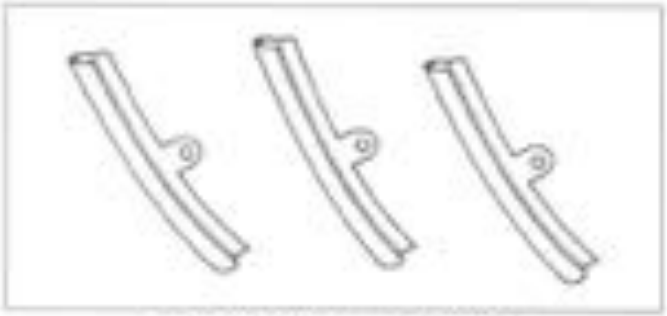
STORAGE UNITS

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

TOOLS

Part No. J-5586 Transmission Shaft Retaining Ring Pliers

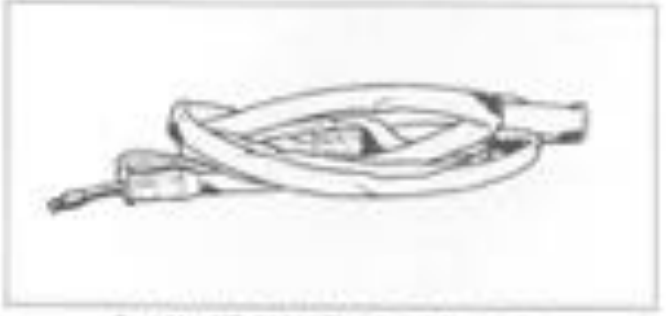
Part No. HD-25070 Robinair Heat Gun



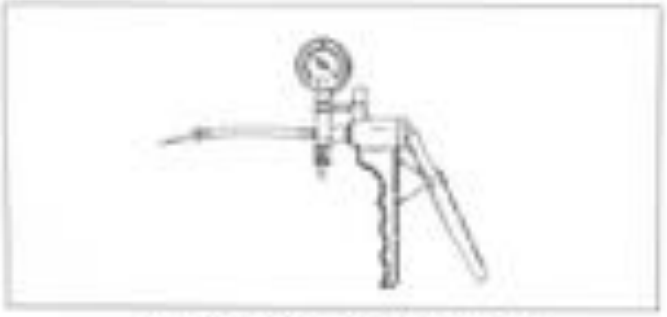
Part No. HD-01289 Rim Protectors

Part No. HD-28431B Fluorescent Additive (24 1-oz. Bottles). Use with HD-35457

Part No. HD-21000 Tire Spreader



Part No. HD-28700 Tire Bead Expander



Part No. HD-23738 Vacuum Pump

Part No. HD-33067 Wheel Bearing Packer

Part No. HD-33071A Wheel Bearing Race Remover/Installer. Use with HD-33418

Part No. HD-33418 Universal Puller Forcing Screw

Part No. HD-33223-1 Cylinder Compression Gauge

Part No. HD-33446A Cylinder Torque Plates

Part No. HD-33413 Carburetor Idle Adjuster

Part No. HD-33813 Inductive Timing Light

Part No. HD-33416 Universal Driver Handle

Part No. HD-34823B Piston Pin Retaining Ring Installer

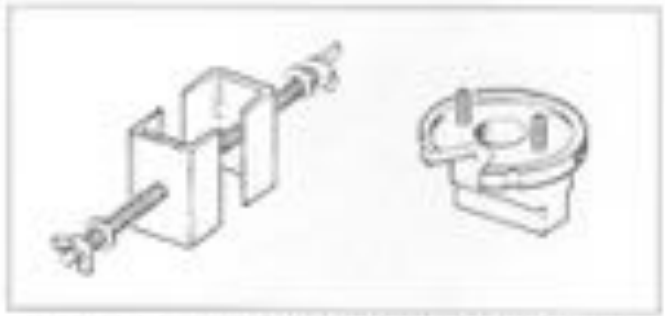
Part No. HD-34643A Shoulderless Valve Guide Seal Installer

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

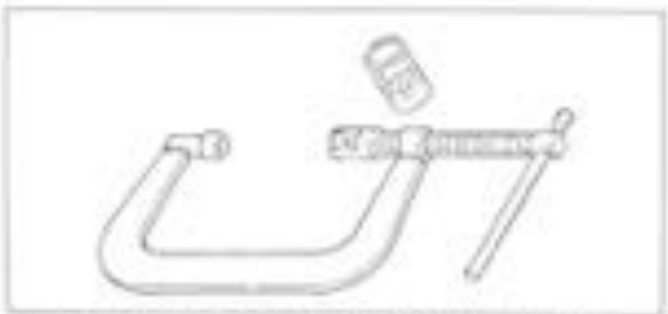
Part No. HD-34723 Valve Guide Hone (8 mm)

Part No. HD-34751 Nylon Valve Guide Cleaning Brush

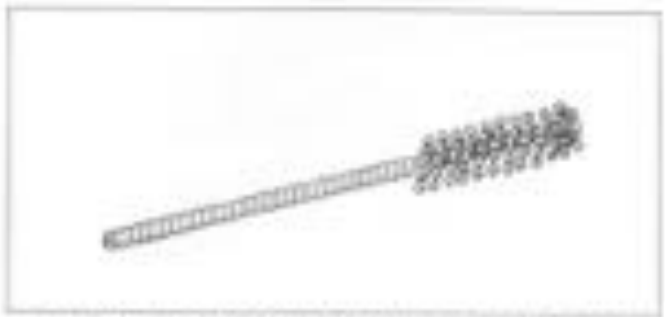
Part No. HD-34731 Shoulderless Valve Guide Installer



Part No. HD-34813 Rose Flywheel Rebuilding Jig



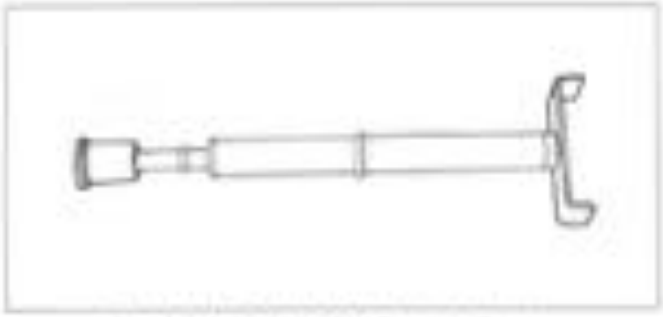
Part No. HD-34736B Valve Spring Compressor



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

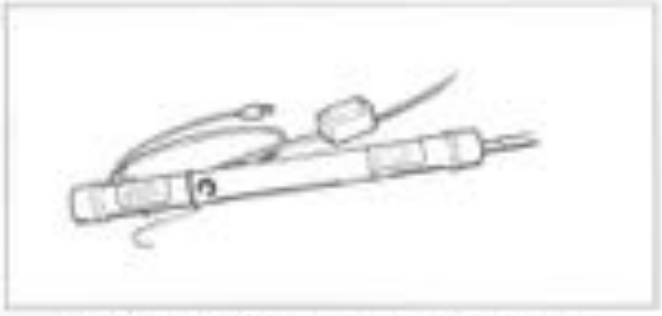
Part No. HD-35316A Main Drive Gear Remover/Installer and Main Drive Gear Bearing Installer

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



Part No. HD-35381 Belt Tension Gauge

Part No. HD-35667A Cylinder Leakdown Tester



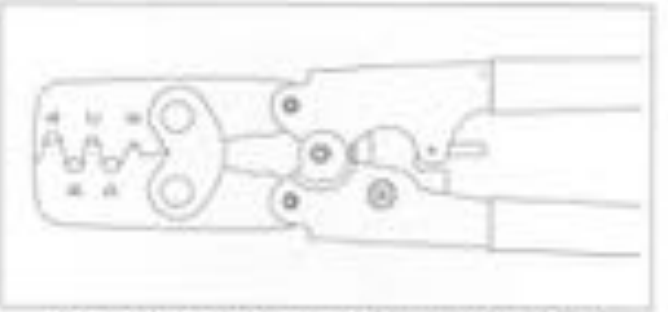
Part No. HD-35457 Black Light Leak Detector

Part No. HD-35758 Neway Valve Seat Cutter Set

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

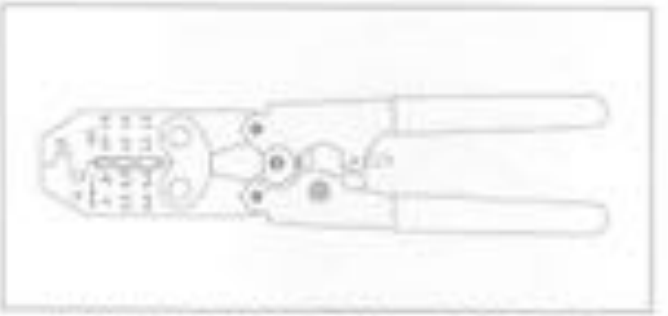
Part No. HD-35801 Intake Manifold Screw Wrench

Part No. HD-36583 Fork Bushing Seal Installer



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

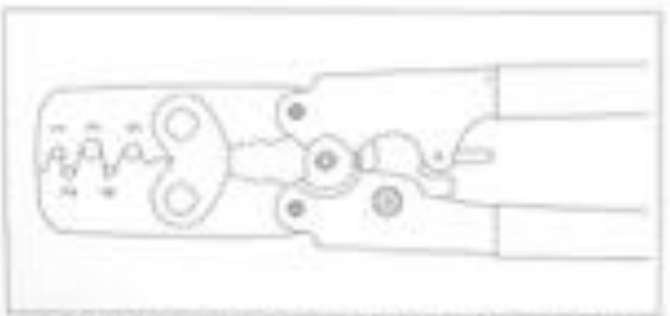
Part No. HD-37404 Countershaft Gear Support Plate



Part No. HD-38125-8 Packard Terminal Crimp Tool

Part No. HD-37642A Inner/Outer Main Drive Gear Needle Bearing Installer

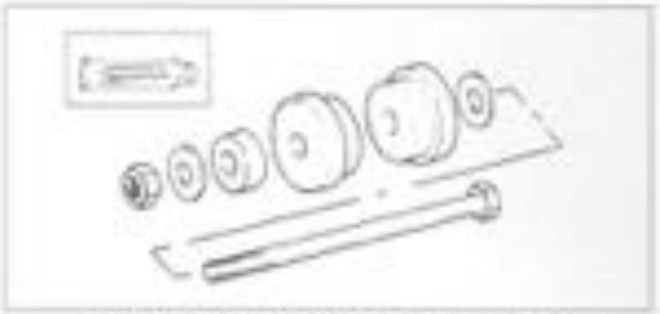
Part No. HD-38361 Cam Gear Gauge Pin Set (0.108 in. (2.74 mm) Diameter)



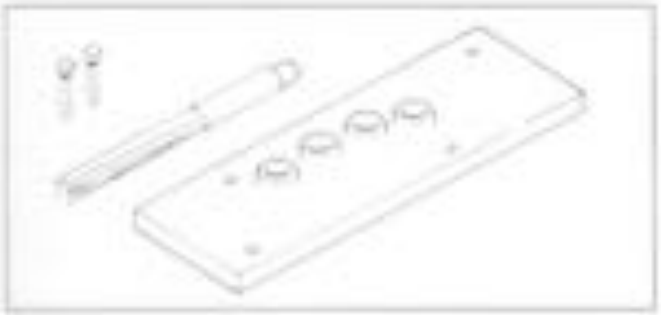
Part No. HD-38125-6 Packard Terminal Crimp Tool (Sealed)

Part No. HD-38362 Sprocket Locking Link

Part No. HD 38515A Clutch Spring Compresser



Part No. HD-39302 Steering Head Bearing Race Installer



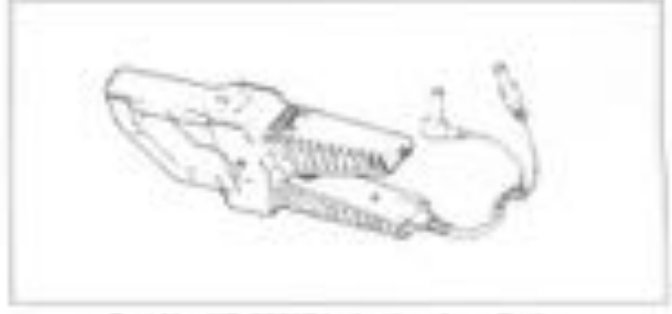
Part No. HD-38871 Camshaft Bushing Plate Pilot and Reamer

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

Part No. HD-39151 Shift Drum Retaining Ring Installer

Part No. HD-39565 Engine Ear

Part No. HD-39391A Steering Head Bearing Race Remover



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

Part No. HD-39621 Electrical Terminal Repair Kit

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

Part No. HD-39782 Cylinder Head Support

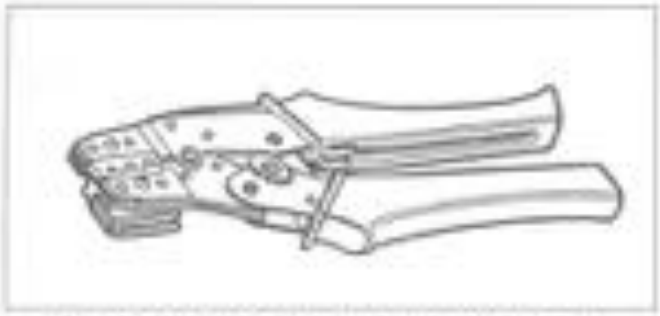
Part No. HD-39847 Universal Ratcheting Tap/Reamer Handle

Part No. HD-39786 Cylinder Head Holding Fixture

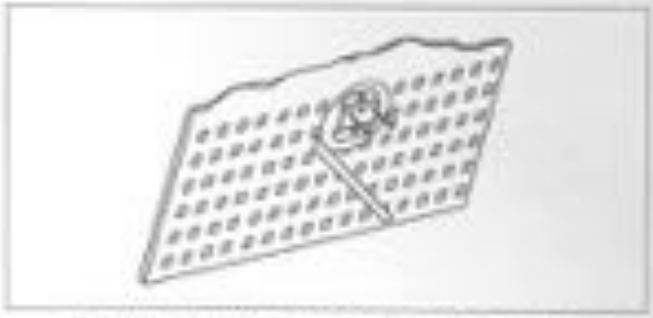
Part No. HD-39932 (Steel) or HD-39932-CAR (Carbide) Intake and Exhaust Valve Guide Reamer

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

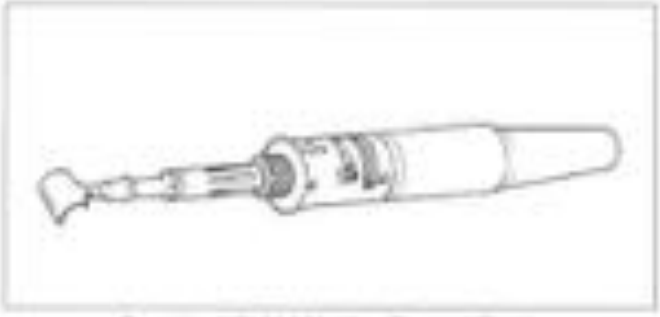
Part No. HD-39964 Reamer Lubricant (Cool Tool)



Part No. HD-39965 Deutsch Terminal Crimp Tool



Part No. HD-41025 Tool Organizational System



Part No. HD-39969 UltraTorch UT-100

Part No. HD-41137 Hose Clamp Pliers

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

Part No. HD-41155 VHS Tape Storage Tower

Part No. HD-39994 Paint Repair Kit

Part No. HD-41177 Fork Tube Holder

Part No. HD-41183 Shrink Attachment

Part No. HD-41321 Sprocket Locking Tool

Part No. HD-41185 Hose Cutting Tool

Part No. HD-41325-95A Scanalyzer Cartridge

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

Part No. HD-41354 Speedometer Tester

Part No. HD-41215 Oil Filter Wrench

Part No. HD-41496-Transmission Case Seal Installer

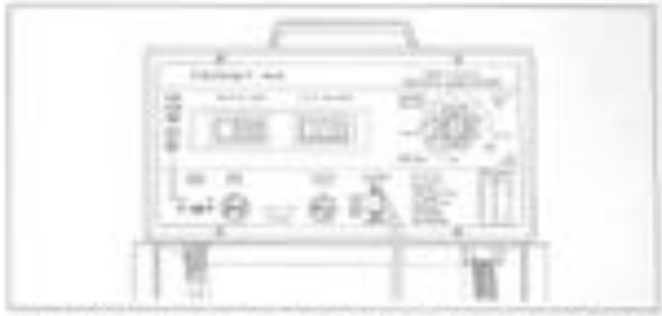
Part No. HD-41506-Crankshaft Locking Tool

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

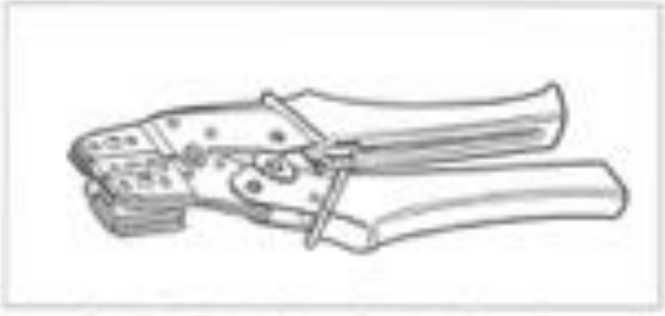
Part No. HD-41549A-Fork Spring Compressing Tool

Part No. HD-42135 Spoke Nipple Driver

Part No. HD-41551-Fork Spring Keeper



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



Part No. HD-41609 Amp Terminal Crimp Tool

Part No. HD-42508 T-40 I.P. and T-45 I.P. Torx Plus Driver

Part No. HD-42579 Sprocket Bearing Seal Installer

Part No. HD-42921 Scanalyzer Cable

Part No. HD-42682 Breakout Box

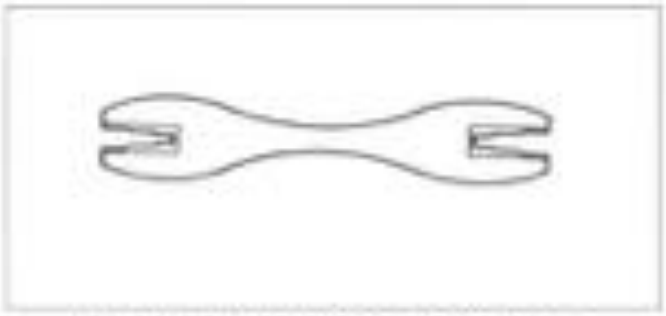
Part No. HD-42962 Breakout Box Adapters

Part No. HD-42774 Seal Installer

Part No. HD-94547-101 Crankshaft Bearing Outer Race Remover/Installer

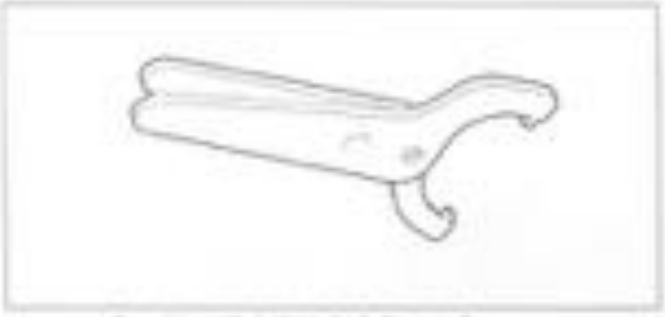
Part No. HD-42879 Electrical Crimp Tool

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



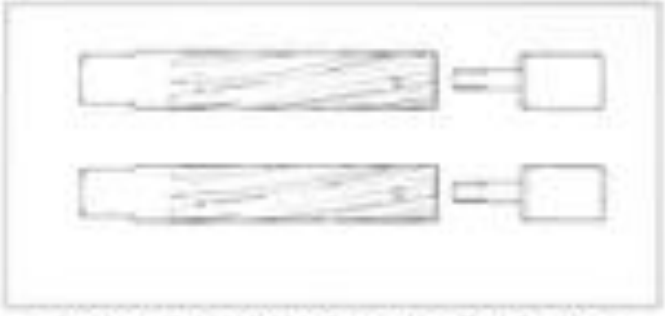
Part No. HD-94681-80 Spoke Nipple Wrench

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



Part No. HD-94700-52C Shock Spanner

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

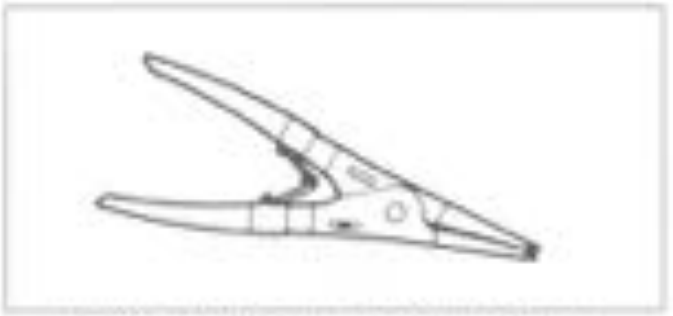


Part No. HD-94800-26A Connecting Rod Bushing
Reamers and Pilots

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

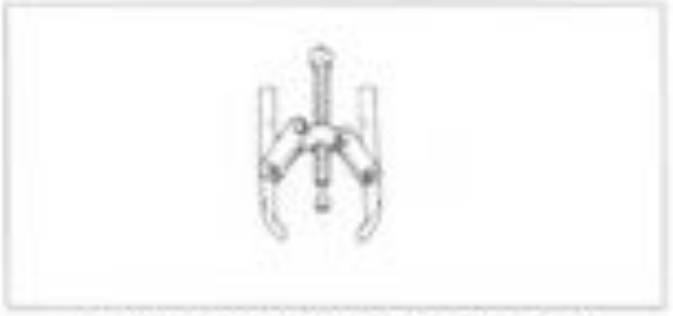
Part No. HD-94803-67 Rear Intake Camshaft
Bushing Reamer

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

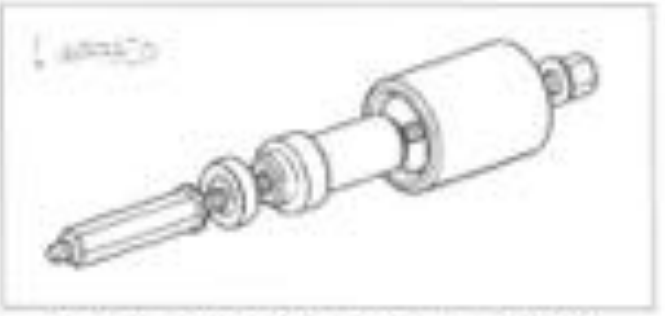


Part No. HD-95017-61 Large External Retaining Ring Pliers

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

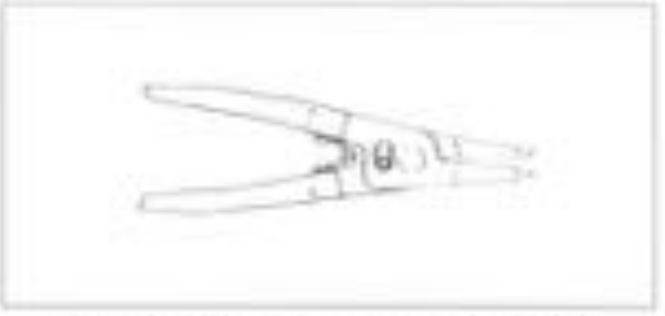


Part No. HD-95635-46 All-Purpose Claw Puller

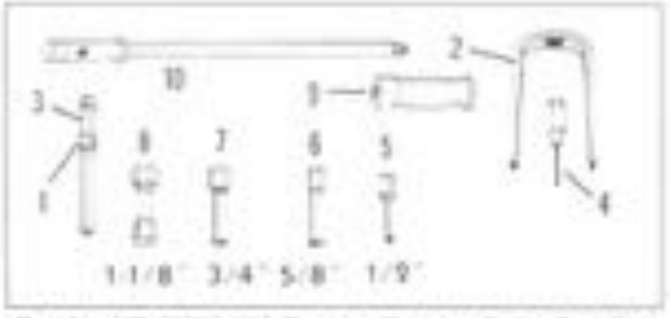


Part No. HD-95970-32C Platen Pin Bushing Tool

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

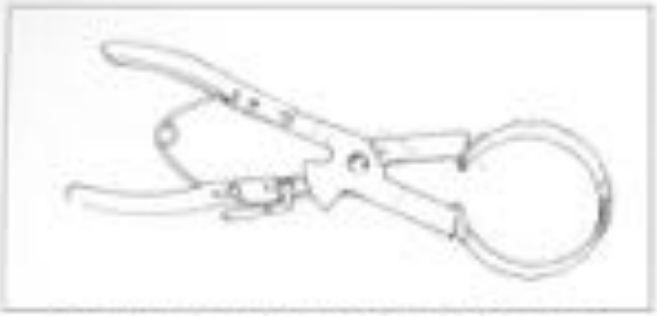


Part No. HD-96215-49 Small Internal Retaining Ring Pliers



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

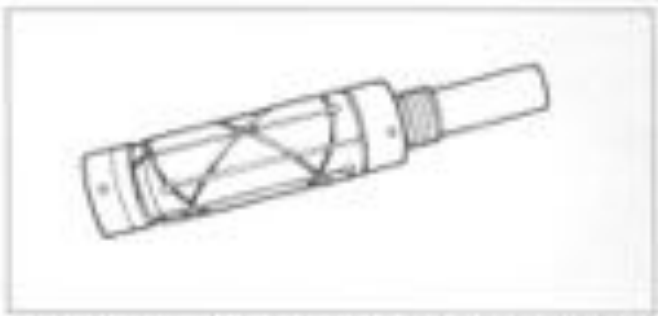
Part No. HD-96295-65D Timing Mark View Plug. Use with HD-33813.



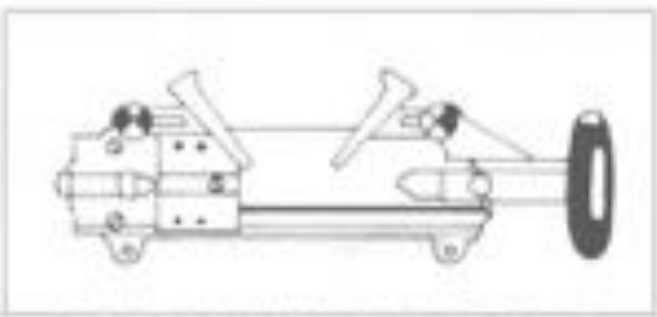
Part No. HD-96333-51B Piston Ring Compressor

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

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



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



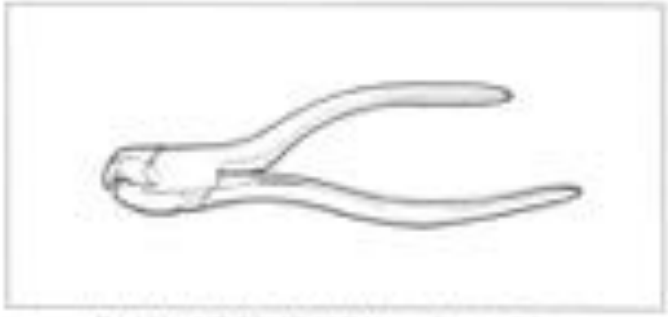
Part No. HD-96650-86 Flywheel Truing Stand

Part No. HD-96796-47 Valve Spring Tester

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

Part No. HD-96921-53A Oil Pressure Gauge

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



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

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

CHASSIS 2

SUBJECT	PAGE NO.
1. Specifications	2-1
2. Wheels	2-5
3. Front Wheel	2-7
4. Rear Wheel	2-11
5. Lacing Wheels	2-16
6. Truing Laced Wheel	2-20
7. Checking Cast Rim Runout	2-22
8. Tires	2-23
9. Brakes	2-28
10. Front Brake Master Cylinder	2-29
11. Rear Brake Master Cylinder	2-33
12. Rear Brake Linkage and Sprocket Cover	2-36
13. Front Brake Caliper	2-37
14. Rear Brake Caliper	2-40
15. Brake Lines	2-43
16. Bleeding Hydraulic System	2-45
17. Front Fork	2-46
18. Fork Stem and Bracket Assembly	2-54
19. Rear Fork	2-55
20. Rear Shock Absorber	2-56
21. Throttle Control	2-58
22. Handlebars	2-60
23. Clutch Control	2-64
24. Exhaust System	2-66
25. Front Fender	2-68
26. Rear Fender	2-69
27. Jiffy Stand	2-71
28. Seat	2-73

SPECIFICATIONS

	XLH 883		XLH 883 HUGGER		XLH 1200		XL 1200C CUSTOM		XL 1200S SPORT	
Dimensions	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
Wheelbase	60.2	1529	59.0	1499	*	*	59.0	1499	*	*
Overall length	87.6	2225	87.25	2216	*	*	87.25	2216	*	*
Overall width	33	838	35	889	35	889	35	889	35	889
Overall height	47.5	1207	49.75	1264	47.5	1207	49.75	1264	49.75	1264
Road clearance	6.70	170.2	4.50	114.3	*	*	*	*	*	*
Weights	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg
Weight (as shipped from the factory)	488	221	485	220	494	224	483	219	497	225.6
Vehicle Weight Ratings The Gross Vehicle Weight Ratings (GVWR) and the Gross Axle Weight Ratings (GAWR) are found on a label on the frame steering head.	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg
GVWR	948	430	*	*	*	*	*	*	*	*
GAWR – Front	353	160	*	*	*	*	*	*	*	*
GAWR – Rear	595	270	*	*	*	*	*	*	*	*
Capacities	U.S. gal.	liters	U.S. gal.	liters	U.S. gal.	liters	U.S. gal.	liters	U.S. gal.	liters
Fuel tank										
Total	3.30	12.5	*	*	3.30	12.5	3.30	12.5	3.30	12.5
Reserve	0.50	1.9	*	*	*	*	.50	1.9	.50	1.9
	U.S. qt.	liters	U.S. qt.	ml	U.S. qt.	ml	U.S. qt.	ml	U.S. qt.	ml
Oil tank – with filter	3.0	2.8	*	*	*	*	*	*	*	*
	U.S. oz.	ml	U.S. oz.	ml	U.S. oz.	ml	U.S. oz.	ml	U.S. oz.	ml
Transmission	32	946	*	*	*	*	*	*	*	*
Front fork (per fork side)										
Wet		268		316	*	*	*	*	*	*
Dry	9.0 10.2	302	10.7 12.1	358	*	*	*	*	*	*
Adjustments										
Rear brake pedal free play	None	*	*	*	*	*	*	*	*	*
Brake Disc	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
Diameter										
Front	11.5	292	*	*	*	*	*	*	*	*
Rear	11.5	292	*	*	*	*	*	*	*	*
Minimum thickness										
Front	0.180	4.57	*	*	*	*	*	*	*	*
Rear	0.205	5.21	*	*	*	*	*	*	*	*
Maximum disc runout (front and rear)	0.008	0.20	*	*	*	*	*	*	*	*

* Same as XLH 883.

SPECIFICATIONS (CONTINUED)

	XLH 883		XLH 883 HUGGER		XLH 1200		XL 1200C CUSTOM		XL 1200S SPORT	
Tire Data	psi	bars	psi	bars	psi	bars	psi	bars	psi	bars
Tire pressure (cold)										
Up to 300 lb. load										
(includes rider, passenger and cargo)										
Front	30	2.1	*	*	*	*	*	*	*	*
Rear	36	2.5	*	*	*	*	*	*	*	*
Up to GVWR maximum load **										
Front	30	2.1	*	*	*	*	*	*	*	*
Rear	40	2.8	*	*	*	*	*	*	*	*
Torque Values	ft-lbs ***	Nm	ft-lbs	Nm	ft-lbs	Nm	ft-lbs	Nm	ft-lbs	Nm
Front axle nut	50-55	68-75	*	*	*	*	*	*	*	*
Rear axle nut	60-65	81-88	*	*	*	*	*	*	*	*
Sprocket mounting bolts										
Cast wheels	55-65	75-88	*	*	*	*	*	*	*	*
Laced wheels	45-55	61-75								
Brake disc mounting screws					*					
Front wheel	16-24	22-33	*	*	*	*	*	*	*	*
Rear wheel	30-45	41-61	*	*		*	*	*	*	*
Brake caliper mounting screws					*					
Front wheel	25-30	34-41	*	*	*	*	*	*	*	*
Rear wheel	15-20	20-27	*	*	*	*	*	*	*	*
Brake master cylinder cover screws	**10-15**	1.1-1.7	*	*	*	*	*	*	*	*
Front brake master cylinder clamp screws	**70-80**	7.9-9.7	*	*	*	*	*	*	*	*
Rear brake master cylinder mounting screws	**155-190**	17.5-21.5	*	*	*	*	*	*	*	*
Rear brake master cylinder cartridge locknut	30-40	41-54	*	*	*	*	*	*	*	*
Brake line banjo fitting bolts	17-22	23-30	*	*	*	*	*	*	*	*
Brake caliper bleeder valve	80-100	9.8-11.3	*	*	*	*	*	*	*	*
Front inboard brake pad retaining screw	40-50	4.5-6.8	*	*	*	*	*	*	*	*
Front fork upper bracket pinch screws	30-35	41-47	*	*	*	*	*	*	*	*
Front fork lower bracket pinch screws	30-35	41-47	*	*	*	*	*	*	*	*
Front axle pinch screw and nut	21-27	28-37	*	*	*	*	*	*	*	*
Front fender mounting fasteners	8-13	11-18	*	*	*	*	*	*	*	*
Rear fender support mounting fasteners	8-13	11-18	*	*	*	*	*	*	*	*
Clutch control clamp screws	**70-80**	7.9-9.0	*	*	*	*	*	*	*	*
Handlebar switch housing screws	**18-24**	2.0-2.7	*	*	*	*	*	*	*	*
Throttle control clamp screws	**18-24**	2.0-2.7	*	*	*	*	*	*	*	*
Handlebar clamp screws	12-15	16-20	*	*	*	*	*	*	*	*
Rear fork pivot shaft	50	68	*	*	*	*	*	*	*	*
Right footrest mount castle nut	35-40	47-54	*	*		*	*	*	*	*
Rear shock absorber					*					
Upper mounting fasteners	21-35	28-47	*	*	*	*	*	*	*	*
Lower mounting fasteners	30-50	41-68	*	*	*	*	*	*	*	*
Front muffler mounting locknut	20-40	27-54	*	*	*	*	*	*	*	*
Rear muffler mounting locknut	10-15	14-20	*	*	*	*	*	*	*	*
Exhaust pipe-to-cylinder head nuts	6-8	8-11	*	*	*	*	*	*	*	*
			*	*	*	*	*	*	*	*

* Same as XLH 883

** Gross Vehicle Weight Rating (GVWR) is printed on a label on the frame steering head

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

SPECIFICATIONS (CONTINUED)

TIRES

⚠WARNING

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

Tire sizes are molded on the sidewall. Refer to the TIRE FITMENT TABLES below. Rim size and contour are cast or stamped into the exterior surface of the rim.

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

Fitment – Tubeless Cast Wheels

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

Tire Fitment – Tube Type Laced Wheels

WHEEL SIZE & POSITION	RIM SIZE & CONTOUR	TUBE SIZE	TIRE SIZE
			DUNLOP D401 ELITE S/T
19 in. – Front	T19 x 2.50 TLA	MJ90-19	100/90-19
16 in. – Rear	T16 x 3.00 D	MT90-16	130/90-16
			DUNLOP TOURING ELITE II
21 in. - Front	T21x 2.15 TLA	3.00 x 21	MH90 - 21 54H
16 in. – Rear	T16 x 3.00 D	MT90-16	MT90 - B16

SPECIFICATIONS (CONTINUED)

VEHICLE IDENTIFICATION NUMBER

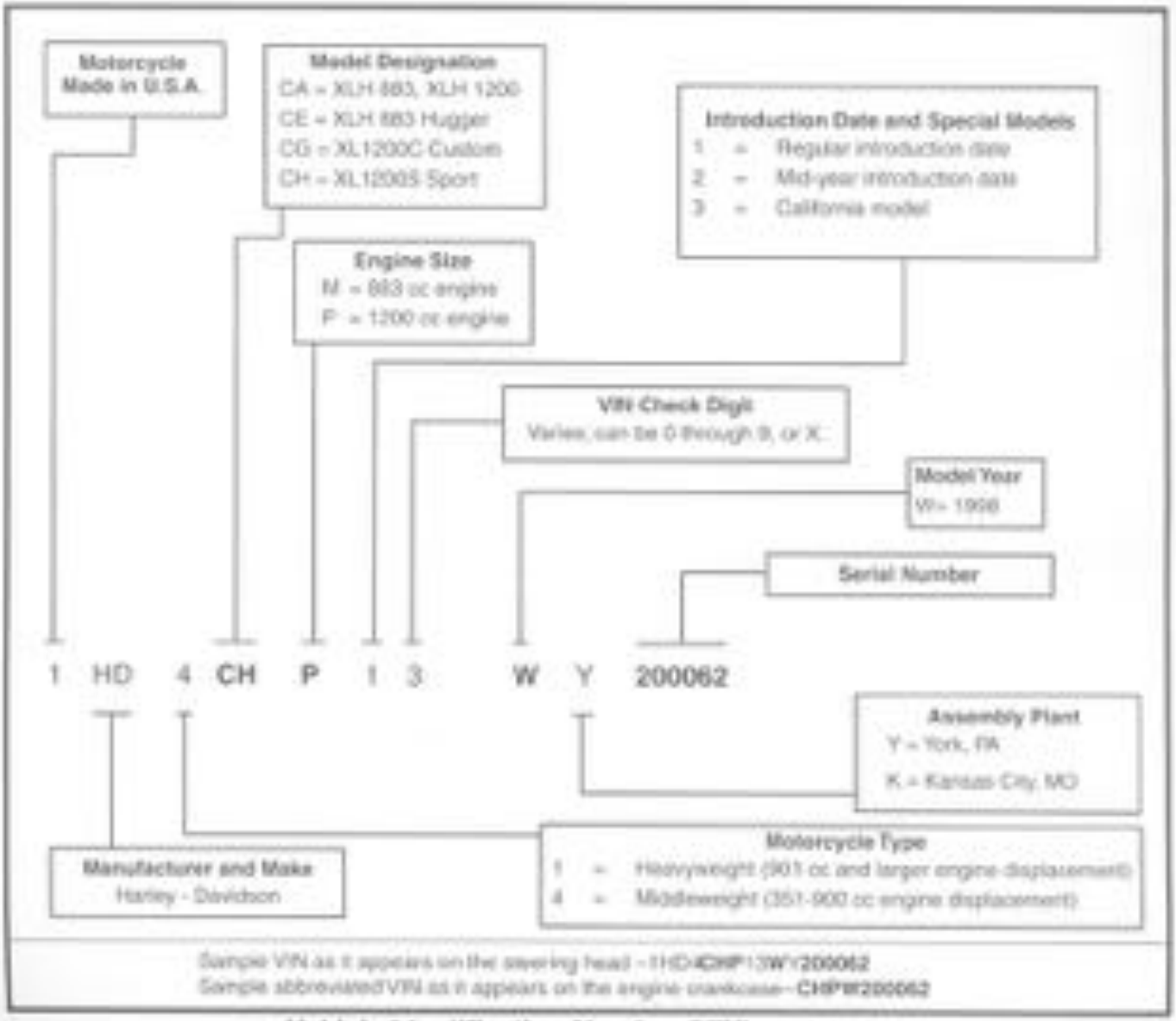
A 17-digit serial number, or Vehicle Identification Number (VIN), is stamped on the right side of the steering head (ex., 1HD4CEM13WY200037).

An abbreviated VIN is stamped on the front left side of the crankcase (ex., CEMW200037). See Figure 2-1.

NOTE

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

Figure 2-1. Abbreviated VIN Location



Vehicle Identification Number (VIN)

WHEELS

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, check the TROUBLESHOOTING guide in Section 1 or see the table below for a list of probable causes.

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

⚠WARNING

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

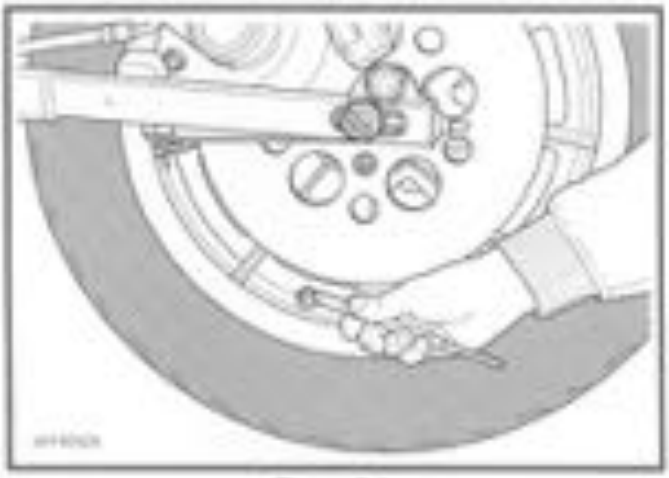


Figure 2-1.

TROUBLESHOOTING

See Figure 2-2. 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.

Wheel Service Chart

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

⚠WARNING

Excessively worn tires adversely affect motorcycle traction, steering and handling and can result in personal injury.

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

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

⚠WARNING

Use the following guidelines when installing a new tire or repairing a flat:

1. **Always locate and eliminate the cause of the original tire failure.**

2. **Do not patch or vulcanize a tire casing. These procedures weaken the casing and increase the risk of a blowout.**

3. **Only patch an inner tube as an emergency measure. Replace the damaged tube as soon as possible.**

4. **Be sure the inner tube is the correct size for the tire casing. Any stretching or wrinkling within the casing will weaken the tube and result in premature failure.**

5. **The use of tires other than those specified can adversely affect handling resulting in personal injury.**

6. **Tires, tubes and wheels are critical safety items. Since the servicing of these components requires special tools and skills, Harley-Davidson recommends that you see your dealer for these services.**

FRONT WHEEL

REMOVAL (Figure 2-2)

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

NOTE

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

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

DISASSEMBLY (Figure 2-3, Figure 2-4)

1. Move wheel to bench area. On the side of the wheel opposite the brake disc (hub plate side of cast wheel), remove external spacer (12) from hub. Pry out oil seal (6). Remove bearing inner race (7) and spacer sleeve (9). Discard oil seal.
2. On brake disc side of wheel, remove oil seal (6), bearing inner race (7), spacer washer (16) and shim pack (15). Discard oil seal.
3. Remove the T-40 TORX® screws (4) and brake disc (5). On cast wheels, remove the T-40 TORX screws to remove the hub plate (11), if necessary. Discard TORX screws.
4. If bearing replacement is necessary, remove the outer bearing races (8) using WHEEL BEARING RACE REMOVER/INSTALLER (Part No. HD-33371A).
5. Remove tire. Remove the tube from the rim, if applicable. See TIRES.
6. If it is necessary to remove the hub from laced wheels, loosen all the spoke nipples and remove the rim and spokes.

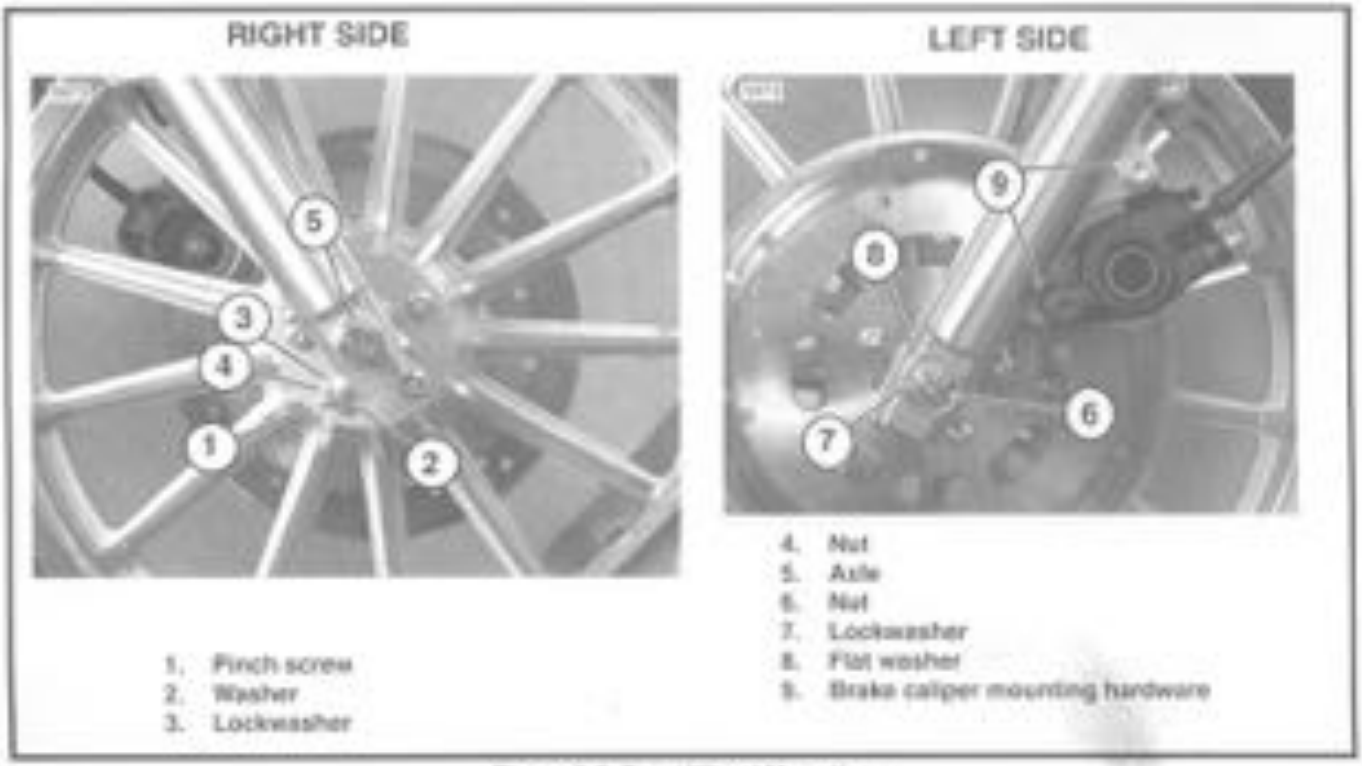
CLEANING, INSPECTION AND REPAIR

1. Thoroughly clean all parts in solvent.

⚠WARNING

Never use compressed air to "spin-dry" bearings. Very high bearing speeds can damage unlubricated bearings. Spinning bearings with compressed air can also cause a bearing to fly apart, which may result in personal injury.

2. Inspect all parts for damage or excessive wear. Inspect bearing races for scoring, discoloration, casing cracks and other damage.
3. Always replace bearing assemblies as a complete set-both bearings, inner and outer races.
4. Inspect shims for tears, cuts or kinks. Replace as necessary.



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

Figure 2-2. Front Wheel Mounting

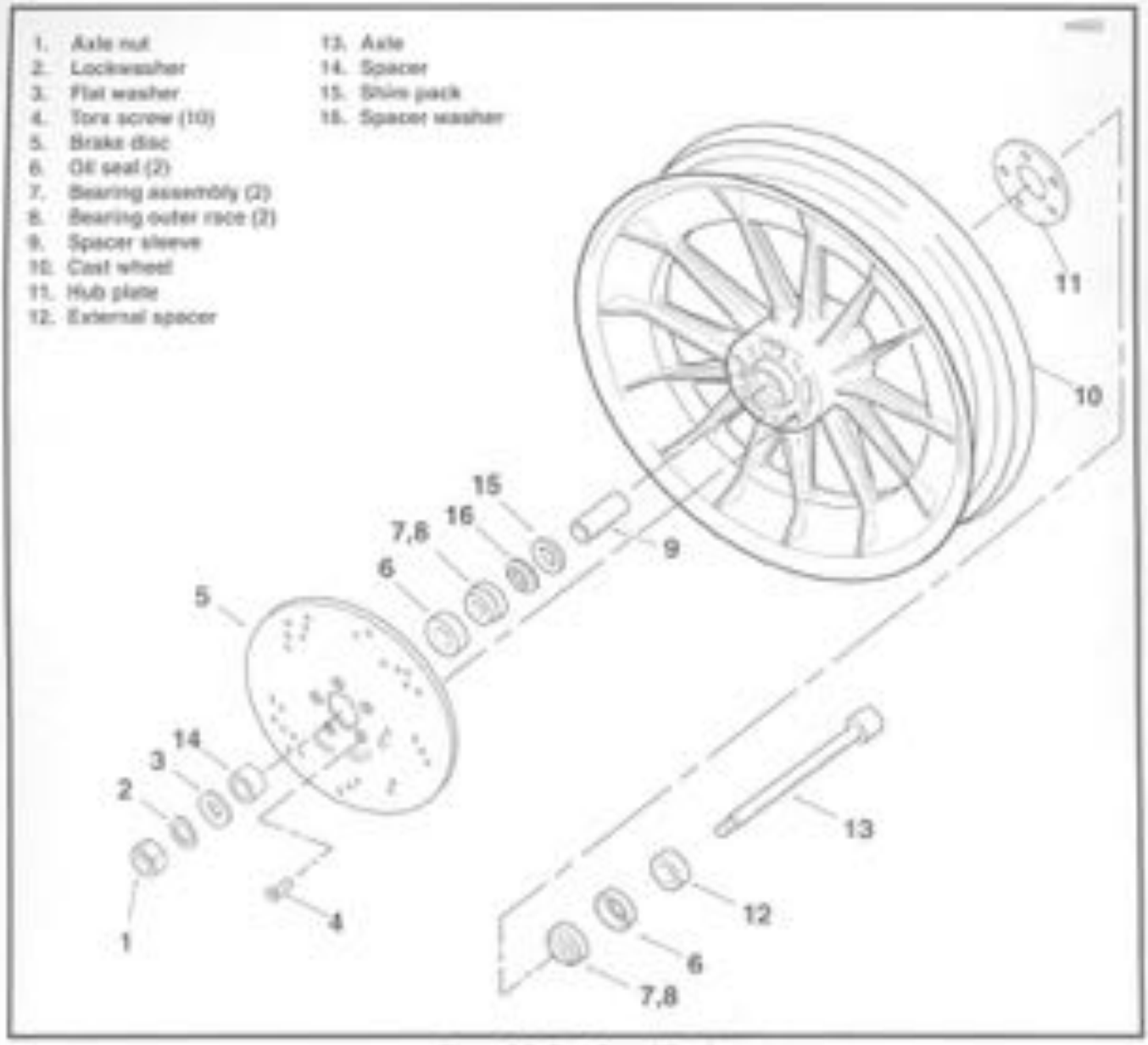


Figure 2-3. Cast Front Wheel

5. Inspect brake disc. Replace disc if warped or badly scored. Measure disc thickness for excessive wear. Minimum acceptable thickness is stamped on side of disc.
6. Obtain a set of **new** oil seals. Obtain **new** T-40 TORX screws, if removed.
7. On laced wheels, replace spokes, rim or hub if damaged.

ASSEMBLY (Figure 2-3, Figure 2-4)

1. On laced wheels, if the hub and rim were disassembled, assemble the hub, spokes and rim. See LACING WHEELS.

⚠WARNING

Do not allow brake fluid, bearing grease, lubricants, etc. to contact brake disc or reduced braking ability will occur, possibly resulting in personal injury and/or vehicle damage.

2. Verify that the brake disc is thoroughly clean. Install disc on hub aligning notch in disc with 1/4-in. (6.35 mm) diameter hole in hub. Secure disc with **new** T-40 TORX screws (4). Tighten screws to 16-24 ft-lbs (22-33 Nm) torque.
3. On cast wheels (Fig. 2-4), install hub plate (11) to wheel hub using **new** T-40 TORX screws, if removed. Tighten screws to 16-24 ft-lbs (22-33 Nm) torque.
4. If removed, press outer races (8) into each side of hub using WHEEL BEARING RACE REMOVER/INSTALLER (Part No. HD-33071A). Apply a liberal amount of bearing grease to bearing outer races after installation.
5. Apply a liberal amount of bearing grease to bearing inner races (7). Pack grease into cavities around rollers. Use of HD-33967 Wheel Bearing Packer is recommended.

NOTE

Use a good quality wheel bearing grease, such as H-D Part No. 99855-89.

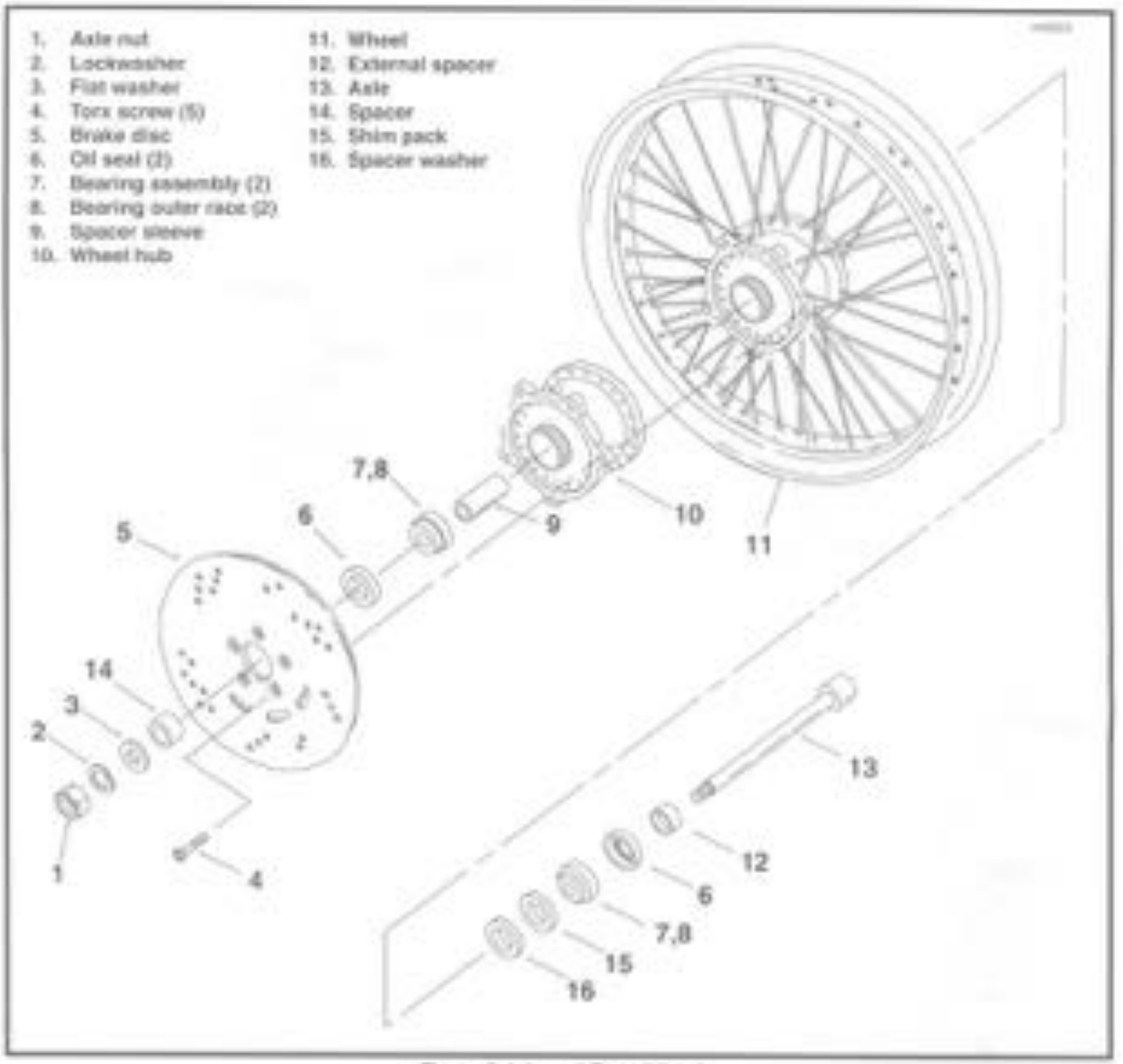


Figure 2-4. Laced Front Wheel

6. Insert shim pack (15) into brake disc side of hub until it contacts counterbore. With the shoulder facing outside, insert spacer washer (16) into hub until it seats against the shims. Insert tapered end of bearing inner race (7) into hub until it contacts shoulder of spacer washer.
7. Lightly coat outside lip of **new** oil seal (6) with clean engine oil. With the open side in, press in oil seal until flush with hub face (to 0.020 in. (0.51 mm) recessed).
8. Pack cavity between oil seal and bearing with bearing grease.
9. On the side of the wheel opposite the brake disc (hub plate side of cast wheel), insert spacer sleeve (9) into hub until it seats in bore on brake disc side. Spacer sleeve must not be cocked or tilted in bore. Insert tapered end of bearing inner race (7) into hub until it contacts end of spacer sleeve.
10. Lightly coat outside lip of **new** oil seal (6) with clean engine oil. With the open side in, press in oil seal until flush with hub face (to 0.020 in. (0.51 mm) recessed).
11. Pack cavity between oil seal and bearing with bearing grease.
12. With the chamfer facing inward, install external spacer (12) in oil seal ID.
13. Install tube on wheel rim, if applicable. Install tire, if removed.
14. Verify that wheel and tire are true. See TRUING LACED WHEEL or CHECKING CAST RIM RUNOUT, whichever applies.

INSTALLATION

1. Position wheel between forks with brake disc on left side of vehicle, external spacer on right. With pinch screw loose, insert threaded end of axle through right side fork. Push axle through fork and wheel hub until it begins to emerge from left side of hub.

2. See Figure 2-5. Push axle through left fork, until axle shoulder contacts external wheel spacer on right fork side.

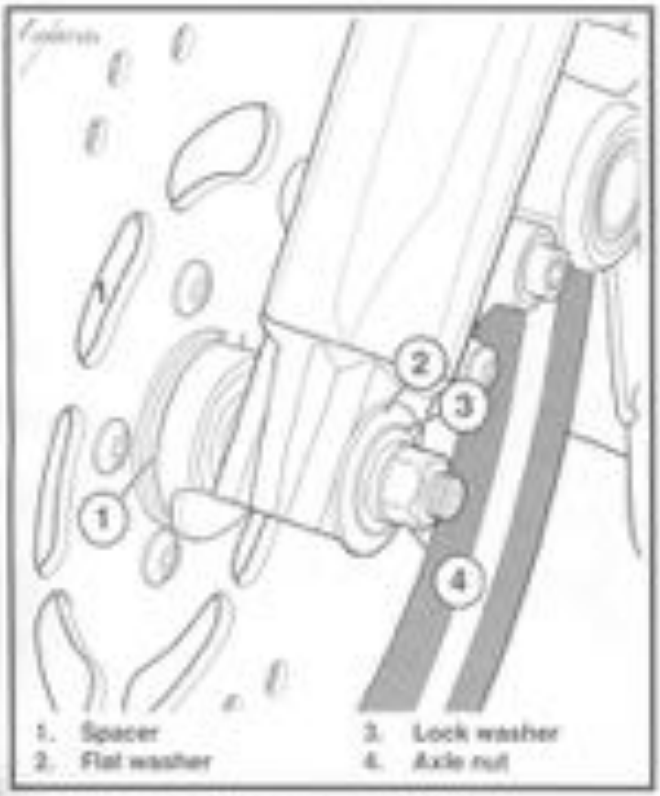


Figure 2-5. Install Spacer

3. See Figure 2-5. Install flat washer (2), lock washer (3) and axle nut (4) over threaded end of axle. Insert screwdriver or steel rod through hole in axle on right side of vehicle. While holding axle stationary, tighten axle nut to 50-55 ft-lbs (68-75 Nm) torque.

4. See Figure 2-2. Tighten pinch screw nut (4) to 21-27 ft-lbs (28-37 Nm) torque.

5. Install brake caliper. Tighten brake caliper mounting screws (9) to 25-30 ft-lbs (34-41 Nm) torque. For more detailed information, see FRONT BRAKE CALIPER, INSTALLATION, in this section.

⚠WARNING

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

6. See Figure 2-6. Mount a magnetic base dial indicator on the brake disc. Set the indicator contact point on the end of the axle. Move the wheel back as far as it will go. Holding the wheel in position, zero the dial indicator gauge. Move the wheel forward as far as it will go. Note the reading of the dial indicator. The lateral movement or end play must fall between 0.002 and 0.006 in. (0.05-0.15 mm). Repeat the procedure to verify the reading.

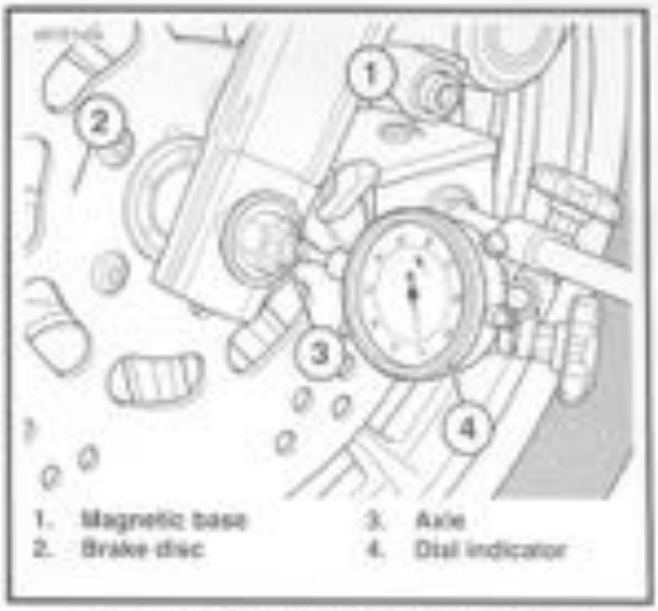


Figure 2-6. Check Wheel Bearing End Play

7. Remove the wheel and substitute thicker spacer shim(s) if the end play must be increased. Use thinner spacer shim(s) to reduce the end play. See the following table for the available spacer shim thicknesses.

Front Wheel Bearing Spacer Shims

Thickness		Part Number
In.	mm	
0.030 to 0.033	0.76 to 0.84	43290-82
0.015 to 0.017	0.38 to 0.43	43291-82
0.0075 to 0.0085	0.190 to 0.215	43292-82
0.0035 to 0.0045	0.089 to 0.114	43293-82
0.0015 to 0.0025	0.038 to 0.064	43294-82

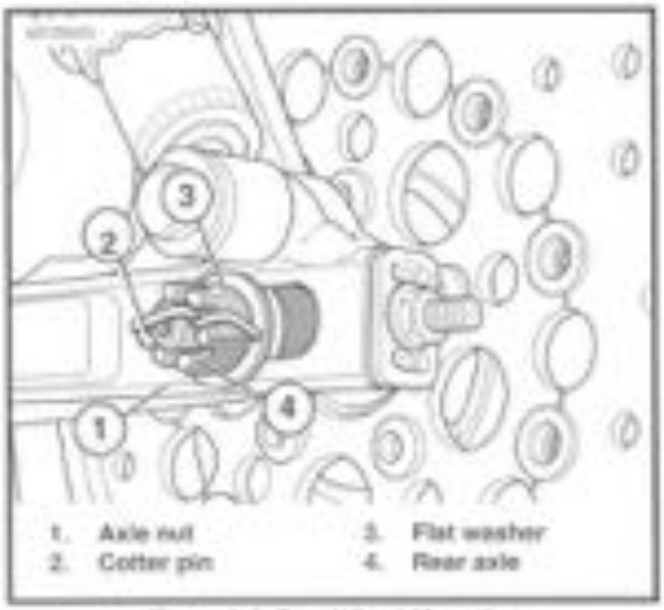
REAR WHEEL

REMOVAL

1. Raise rear end of motorcycle high enough to permit wheel removal. Support motorcycle with suitable blocking underneath frame.

2. Loosen axle, slide wheel forward and slip belt off sprocket.

3. See Figure 2-8. Remove cotter pin (2), axle nut (1) and flat washer (3).



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

Figure 2-8. Rear Wheel Mounting

4. Gently tap end of axle (4) with a soft hammer to loosen. Pull axle free of frame assembly.

NOTE

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

5. Remove spacer (16, Figure 2-9; 18, Figure 2-10) and rear wheel assembly.

DISASSEMBLY

Cast Wheel (Figure 2-9)

1. Move wheel to bench area. On the sprocket side of the wheel, remove external spacer (4) from hub. Pry out oil seal (3). Remove bearing inner race (5) and spacer sleeve (7). Discard oil seal.

2. On brake disc side of wheel, remove external spacer (4) from hub. Remove oil seal (3), bearing inner race (5), spacer washer (11) and shim pack (15). Discard oil seal.

3. Using a TORX T-45 driver, remove the T-45 TORX screws (9) to remove the brake disc (10).

NOTE

TORX screws (9) have a thread lock patch that provides fastener locking for three removal and installation cycles. Always replace screws after three use cycles or fastening integrity may be compromised.

4. Remove five bolts (18) with flat washers (17). Remove belt sprocket (13).

5. If bearing replacement is necessary, remove the outer bearing races (6) using WHEEL BEARING RACE REMOVER/INSTALLER (Part No. HD-33071A).

Laced Wheel (Figure 2-10)

1. Move wheel to bench area. On the sprocket side of the wheel, remove external spacer (4) from hub. Pry out oil seal (3). Remove bearing inner race (5) and spacer sleeve (7). Discard oil seal.

2. On brake disc side of wheel, remove external spacer (4) from hub. Remove oil seal (3), bearing inner race (5), spacer washer (12) and shim pack (8). Discard oil seal.

3. Using a TORX T-45 driver, remove the T-45 TORX screws (9) and locknuts (10) to remove the brake disc (11).

NOTE

TORX screws (9) have a thread lock patch that provides fastener locking for three removal and installation cycles (or remakes). Always replace screws after three use cycles or fastening integrity may be compromised.

4. Remove five bolts (20) with washers (19) and locknuts (14). Remove belt sprocket (15).

5. If bearing replacement is necessary, remove the outer bearing races (6) from hub using WHEEL BEARING RACE REMOVER/INSTALLER (Part No. HD-33071A).

6. If it is necessary to remove the hub from the wheel, loosen all spoke nipples and remove the rim and spokes.

CLEANING, INSPECTION, AND REPAIR

1. Thoroughly clean all parts in solvent.

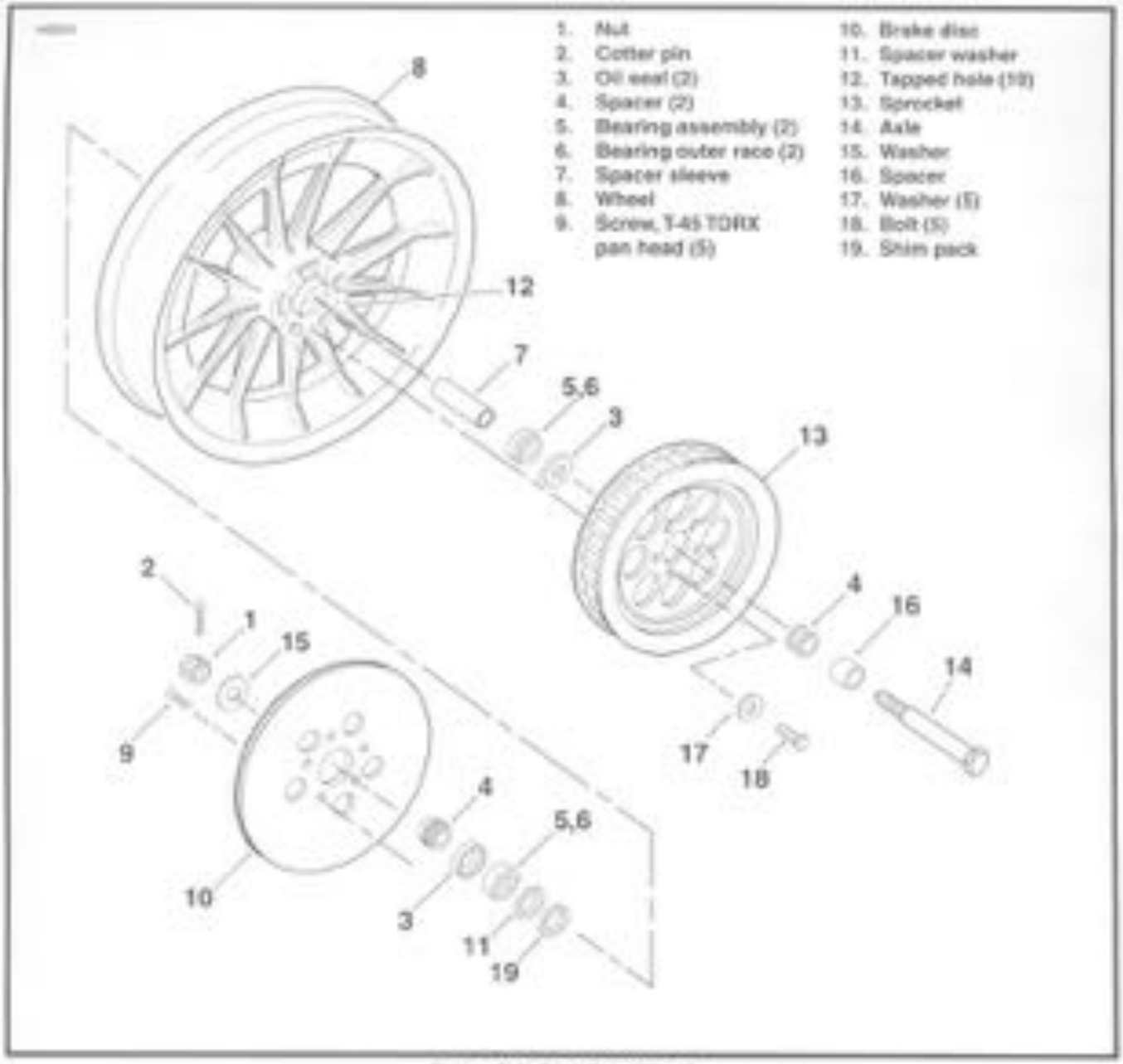


Figure 2-9. Cast Rear Wheel

⚠WARNING

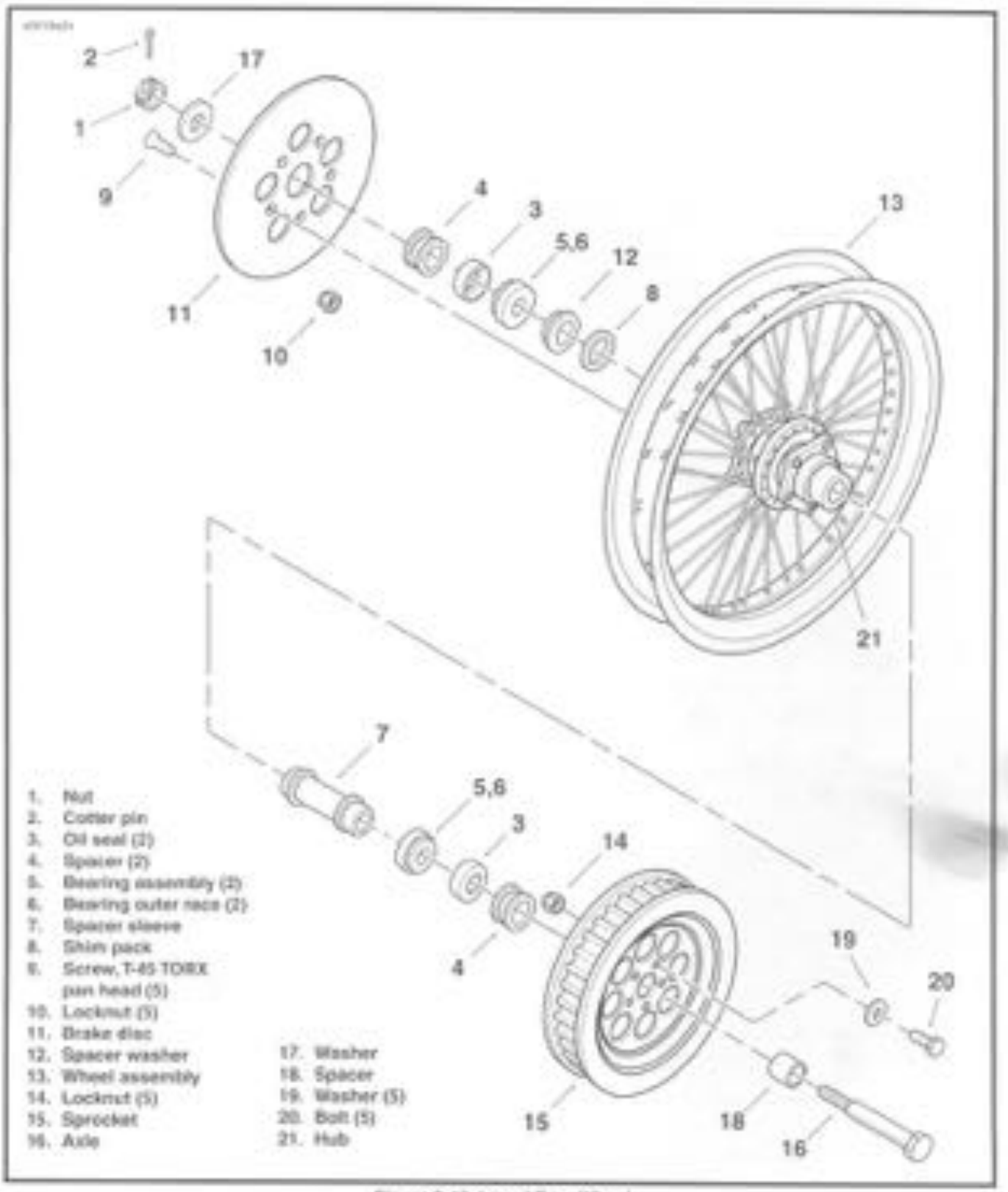
- **Never use compressed air to "spin-dry" bearings. Very high bearing speeds can damage unlubricated bearings. Spinning bearings with compressed air can also cause a bearing to fly apart, which may result in personal injury.**
- **ALWAYS wear safety glasses when using solvent to clean parts.**

2. Inspect all parts for damage or excessive wear. Inspect bearing races for scoring, discoloration, casing cracks and other damage.
3. Always replace bearing assemblies as a complete set- both bearings, inner and outer races.
4. Inspect shims for tears, dents or kinks. Replace as necessary.
5. Inspect brake disc. Replace disc if warped or badly scored. Measure disc thickness for excessive wear. Minimum acceptable thickness is stamped on side of disc.
6. Obtain a set of **new** oil seals. Use **new** T-45 TORX screws after three use cycles. See NOTE under Disassembly, Cast Wheel.
7. On laced wheels, replace spokes, rim or hub, if damaged.

ASSEMBLY

Cast Wheel (Figure 2-9)

1. If removed, press outer races (6) into each side of hub using WHEEL BEARING RACE REMOVER/ INSTALLER (Part No. HD-33071A). Apply a liberal amount of bearing grease to bearing outer races after installation.



1. Nut
2. Cotter pin
3. Oil seal (2)
4. Spacer (2)
5. Bearing assembly (2)
6. Bearing outer race (2)
7. Spacer sleeve
8. Shim pack
9. Screw, T-45 TORX pan head (5)
10. Locknut (5)
11. Brake disc
12. Spacer washer
13. Wheel assembly
14. Locknut (5)
15. Sprocket
16. Axle
17. Washer
18. Spacer
19. Washer (5)
20. Bolt (5)
21. Hub

Figure 2-10. Laced Rear Wheel

⚠WARNING

Do not allow brake fluid, bearing grease, lubricants, etc. to contact brake disc or reduced braking ability will occur, possibly resulting in personal injury.

2. Verify that brake disc (10) is thoroughly clean. Secure disc to hub with T-45 TORX screws (9). Use **new** T-45 TORX screws after three use cycles. Tighten screws to 30-45 ft-lbs (41-61 Nm) torque.
3. Apply two drops of LOCTITE THREADLOCKER 271 (red) to threads of each sprocket bolt (18). Install bolt

sprocket (13) using bolts and washers (17). Tighten bolts to 55-65 ft-lbs (75-88 Nm) torque.

4. Apply a liberal amount of bearing grease to bearing inner races (5). Pack grease into cavities around rollers.

NOTE

Use a good quality wheel bearing grease, such as H-D Part No. 99855-89.

5. Insert shim pack (19) into brake disc side of hub until it contacts counterbore. With the shoulder facing outside, insert spacer washer (17) into hub until it seats against the shims. Insert tapered end of bearing inner race (5) into hub until it contacts shoulder of spacer washer.

6. Lightly coat outside lip of **new** oil seal (3) with clean engine oil. With the open side in, press in oil seal until recessed 0.31 in. (7.9 mm) from hub face.

7. Pack cavity between oil seal and bearing with bearing grease.

8. With the chamfer facing inward, install external spacer (4) in oil seal I.D.

9. On the sprocket side of the wheel, insert spacer sleeve (7) into hub until it seats in bore on brake disc side. Spacer sleeve must not be cocked or tilted in bore. Insert tapered end of bearing inner race (5) into hub until it contacts end of spacer sleeve.

10. Lightly coat outside lip of **new** oil seal (3) with clean engine oil. With the open side in, press in oil seal until recessed 0.31 in. (7.9 mm) from hub face.

11. Pack cavity between oil seal and bearing with bearing grease.

12. With the chamfer facing inward, install external spacer (4) in oil seal I.D.

13. Install tire, if removed. Verify that wheel and tire are true. See CHECKING CAST RIM RUNOUT.

Laced Wheel (Figure 2-10)

1. If the hub and rim were disassembled, assemble the hub, spokes and rim. See LACING WHEELS.

2. If removed, press outer races (6) into each side of hub using WHEEL BEARING RACE REMOVER/INSTALLER (Part No. HD-33671A). Apply a liberal amount of bearing grease to bearing outer races after installation.

⚠WARNING

Do not allow brake fluid, bearing grease, lubricants, etc. to contact brake disc or reduced braking ability will occur, possibly resulting in personal injury.

3. Verify that brake disc (11) is thoroughly clean. Secure disc to hub with T-45 TORX screws (9) and locknuts (10). Use **new** T-45 TORX screws after three use cycles. Tighten screws to 30-45 ft-lbs (41-61 Nm) torque.

4. Apply two drops of LOCTITE THREADLOCKER 271 (red) to threads of each sprocket bolt (20). Install the belt sprocket (15) using bolts, washers (18) and locknuts (14). Tighten bolts to 45-55 ft-lbs (61-75 Nm) torque.

5. Apply a liberal amount of bearing grease to bearing inner races (5). Pack grease into cavities around rollers. Use of HD-33067 Wheel Bearing Packer is recommended.

NOTE

Use a good quality wheel bearing grease, such as H-D Part No. 99855-89.

6. Insert shim pack (8) into brake disc side of hub until it contacts counterbore. With the shoulder facing outside, insert spacer washer (12) into hub until it seats against the shims. Insert tapered end of bearing inner race (5) into hub until it contacts shoulder of spacer washer.

7. Lightly coat outside lip of **new** oil seal (3) with clean engine oil. With the open side in, press in oil seal until recessed 0.26-0.28 in. (6.6-7.1 mm) from hub face.

8. Pack cavity between oil seal and bearing with bearing grease.

9. With the chamfer facing inward, install external spacer (4) in oil seal I.D.

10. On the sprocket side of the wheel, insert spacer sleeve (6) into hub until it seats in bore on brake disc side. Spacer sleeve must not be cocked or tilted in bore. Insert tapered end of bearing inner race (5) into hub until it contacts end of spacer sleeve.

11. Lightly coat outside lip of **new** oil seal (3) with clean engine oil. With the open side in, press in oil seal until recessed 0.26-0.28 in. (6.6-7.1 mm) from hub face.

12. Pack cavity between oil seal and bearing with bearing grease.

13. With the chamfer facing inward, install external spacer (4) in oil seal I.D.

14. Install inner tube and tire, if removed.

15. Verify that wheel and tire are true. See TRUING LACED WHEEL.

INSTALLATION

1. Place wheel centrally in the rear fork (swingarm) with the brake disc in the caliper. Slide wheel far enough forward to slip belt over sprocket and then slide the wheel back.
2. Apply LOCTITE ANTI-SEIZE LUBRICANT to axle (14, Figure 2-9; 16, Figure 2-10). Insert axle through right side of rear fork, spacer (16, Figure 2-9; 18, Figure 2-10), wheel assembly, rear caliper bracket and left side of rear fork.
3. See Figure 2-8. Install flat washer (3) and nut (1) on end of axle (4). Tighten axle nut to 60-65 ft-lbs (81-88 Nm) torque.

⚠WARNING

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

4. See Figure 2-9 and Figure 2-10. Mount a magnetic base dial indicator on the brake disc. Set the indicator contact point on the end of the axle. Move the wheel back as far as it will go. Holding the wheel in position, zero the dial indicator gauge. Move the wheel forward as far as it will go. Note the reading of the dial indicator. The lateral movement or end play must fall between 0.002 and 0.006 in. (0.05-0.15 mm). Repeat the procedure to verify the reading.
5. Remove the wheel and substitute thicker spacer shim(s) (19, Figure 2-9; 8, Figure 2-10) if the end play must be increased. Use thinner spacer shim(s) to reduce the end play. See the following table for the available spacer shim thicknesses.

Rear Wheel Bearing Spacer Shims

Thickness		Part Number
in.	mm	
0.030 to 0.033	0.76 to 0.84	43290-82
0.015 to 0.017	0.38 to 0.43	43291-82
0.0075 to 0.0085	0.190 to 0.216	43292-82
0.0035 to 0.0045	0.089 to 0.114	43293-82
0.0015 to 0.0025	0.038 to 0.064	43294-82

6. Check for proper belt tension (see SECONDARY DRIVE BELT in Section 6 DRIVE/TRANSMISSION). Align wheel (see TIRES, INSTALLATION, WHEEL ALIGNMENT in this section).
7. See Figure 2-8. Install cotter pin (2) onto rear axle nut.

16 INCH WHEEL LACING

General

T-30 I.P. (Torx Plus) head spokes are shown below.

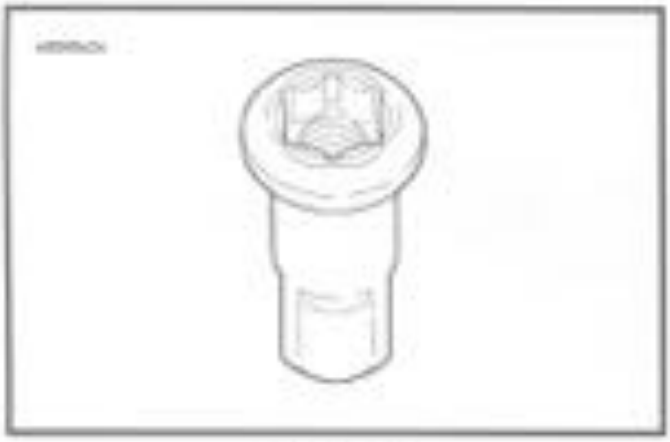


Figure 2-11

The 16 inch laced wheel hub is shown below.

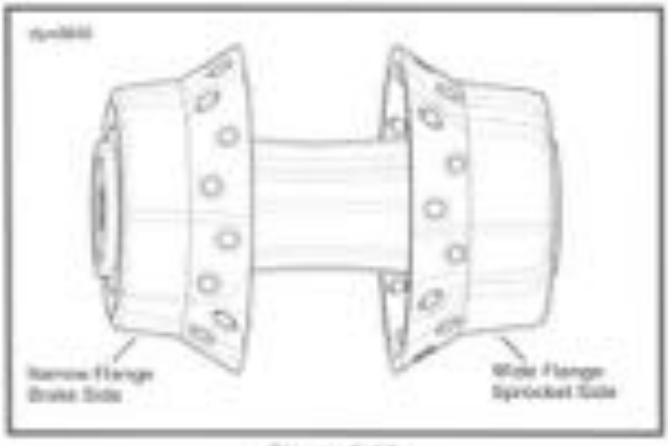


Figure 2-12

The new 16 inch laced wheel rim is shown below. New rims can be identified by the "half moon" shape around the valve stem hole.

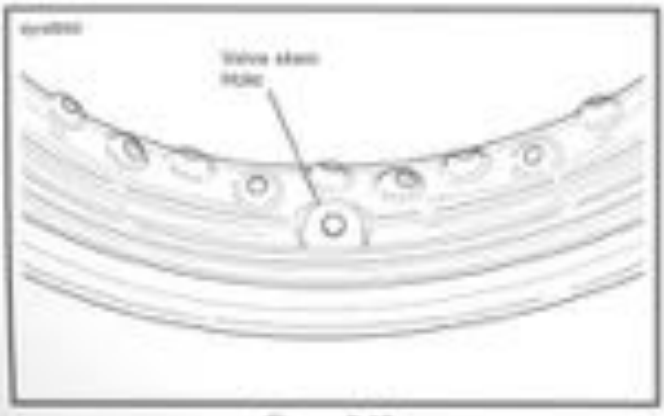


Figure 2-13

Lacing Wheel

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

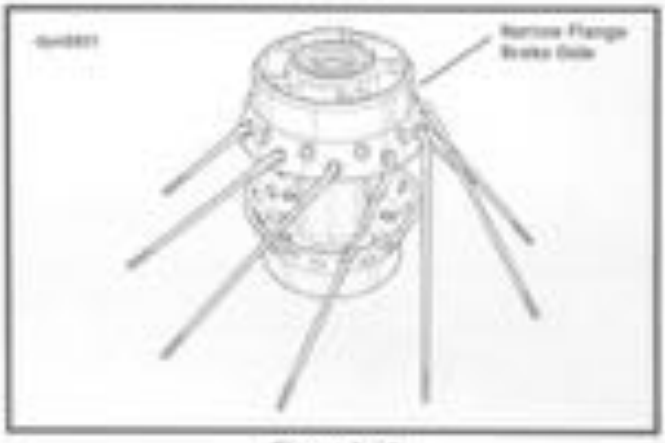


Figure 2-14

2. Position rim over the hub and spokes with valve stem hole up. Using any lower row spoke, place the first spoke into the rim hole to the left of the valve stem hole on the upper half of the rim centerline.

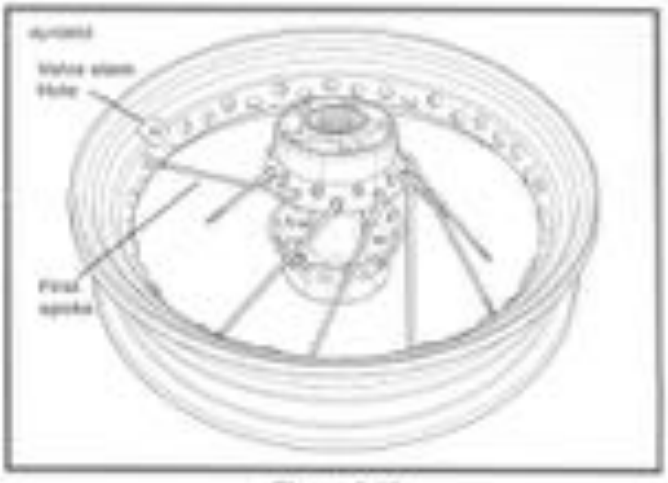


Figure 2-15

3. Install remaining lower row spokes in every fourth hole.

Figure 2-16

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

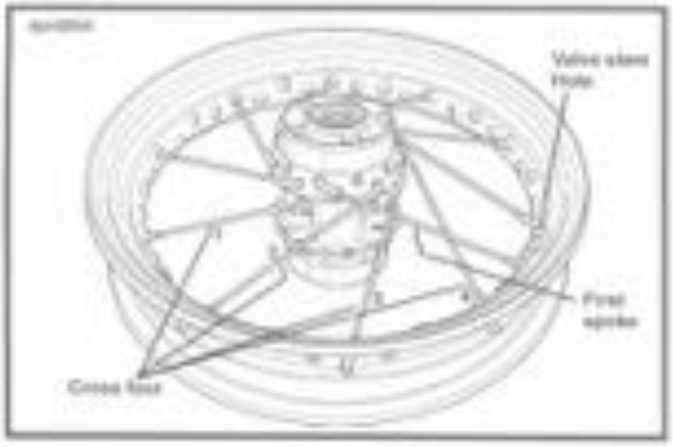


Figure 2-17

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

Figure 2-18

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

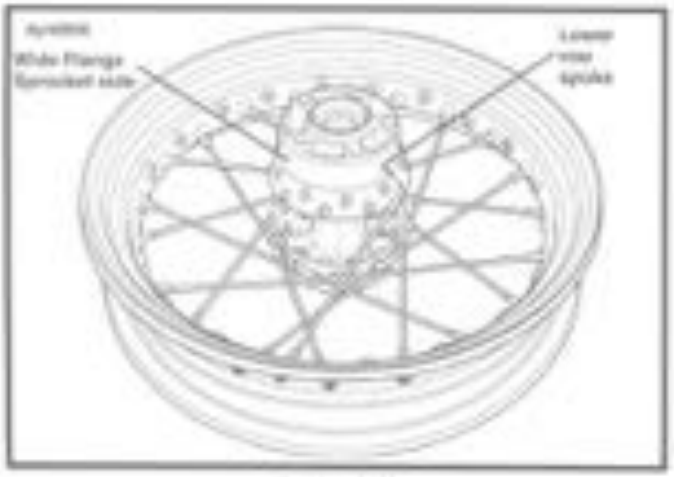


Figure 2-19

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

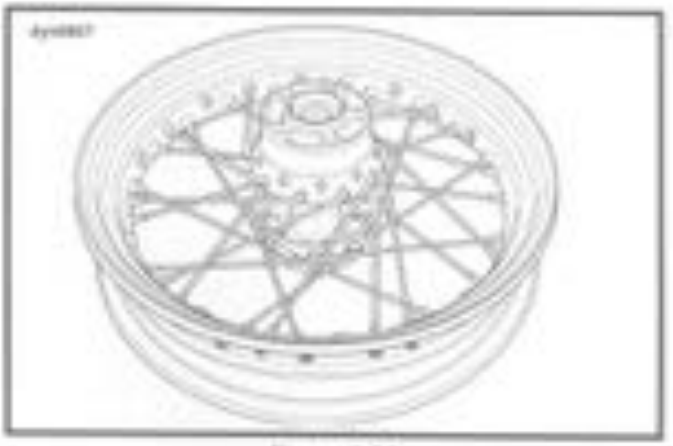


Figure 2-20

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

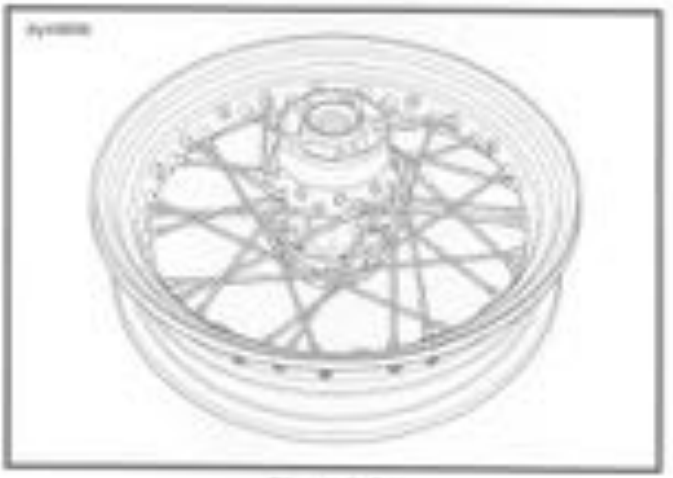


Figure 2-21

9. Install remaining nine upper row spokes. This completes spoke installation. Proceed to wheel truing section, page 2-20.

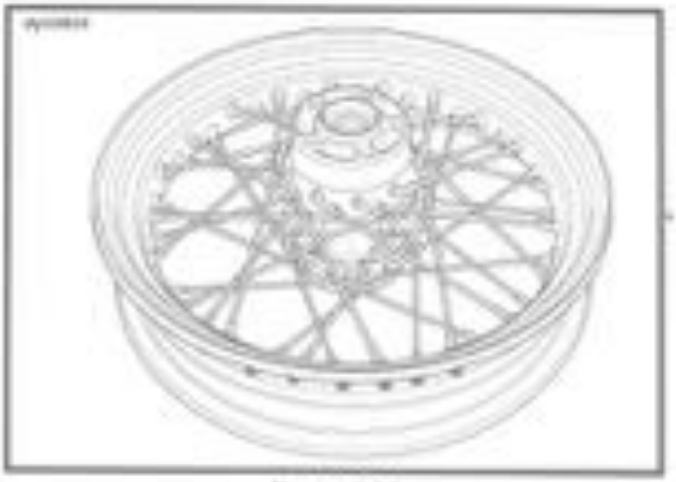


Figure 2-22

19-INCH WHEELS

1. See Figure 2-23. Divide spokes into two groups. Inner spokes have long heads; outer spokes have short heads. There are also fine- and coarse-threaded spokes and nipples. Match up fine-threaded spokes with fine-threaded nipples, and coarse-threaded spokes with coarse-threaded nipples. Do not intermix the thread patterns.

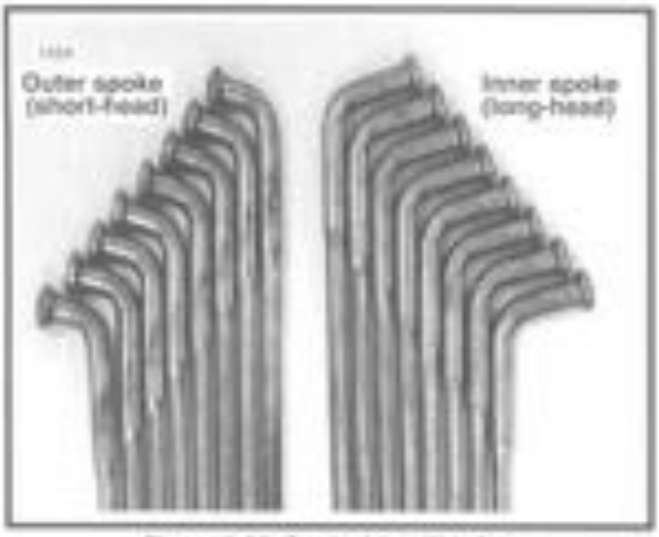


Figure 2-23. Spoke Identification

⚠WARNING

Exercise caution to avoid using oils that attack or contribute to the deterioration of rubber materials. Use of unsuitable oils may lead to premature tire failure, possibly resulting in personal injury and/or property damage.

2. Lubricate spoke threads and nipple shoulders with tire mounting lubricant.

3. See Figure 2-24. Place hub on bench either 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.

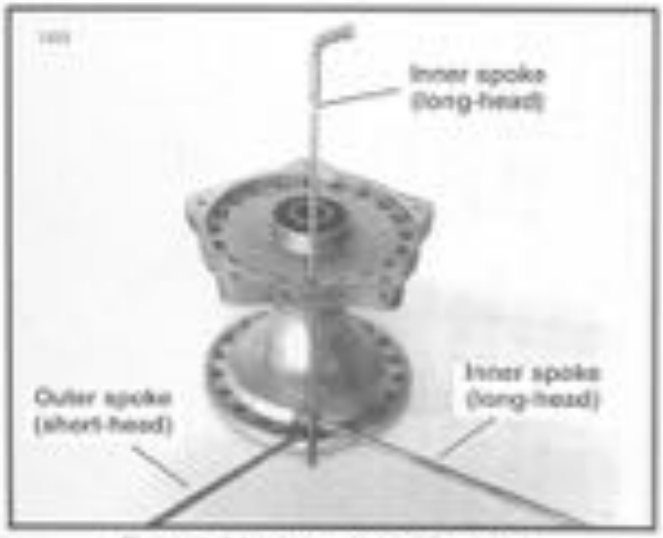


Figure 2-24. Lacing 19-in. Wheel Hub

4. Insert an inner spoke into the hole on the top flange that directly bisects the two spokes in the bottom flange. (Insert all remaining spokes in both hub flanges alternating the inner and outer spokes.

5. See Figure 2-25. With all forty spokes inserted in hub, group all spokes on top flange into two bundles. Secure each group with throttle grips or tape to keep the spokes together.

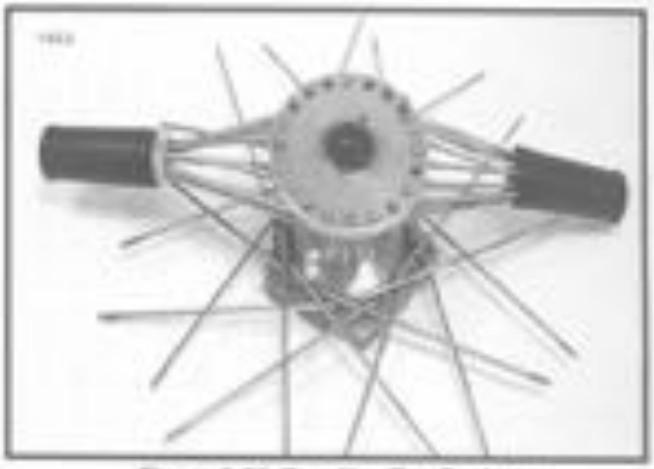


Figure 2-25. Bundling Top Spokes

6. Swing all bottom flange outer spokes (short-head) clockwise. Swing the inner spokes (long-head) counterclockwise, crossing over the outer spokes. Angle all spokes as far as they will go without overlapping the next LIKE spoke. For instance, swing an outer spoke (short-head) clockwise as far as it will go before crossing another outer spoke.

7. Center the rim over the hub assembly. Undo each top bundle and fan the spokes out around the top rim edge.

8. See Figure 2-26. The rim is divided into ten groups of spoke holes, four holes to a group. Each group has two holes on the left and two holes on the right, angled inward towards each other. Only one hole in each group will be angled toward the bottom flange inner spoke (long-head). Lace all bottom flange inner spokes into these holes. Secure each spoke with a nipple screwed on the end about three turns.

NOTE

Hub and spoke assembly may have to be spun slightly within the rim to allow proper spoke-to-rim alignment. Keep the bottom flange spokes crossed in correct position when spinning the hub. Also, keep the top flange spokes tensed around the rim. If they fall off the rim and become tangled in the bottom flange spokes, the hub will not rotate and it might be necessary to unlace the wheel to untangle them.

9. Lace the ten bottom flange outer spokes (short-head). Only one hole in each group of rim spoke holes will be angled toward these spokes. Secure each spoke with a nipple screwed on about three turns.

10. Lace all the top flange inner spokes, one at a time leaving the outer spokes resting on the rim. Swing the top flange inner spokes clockwise.

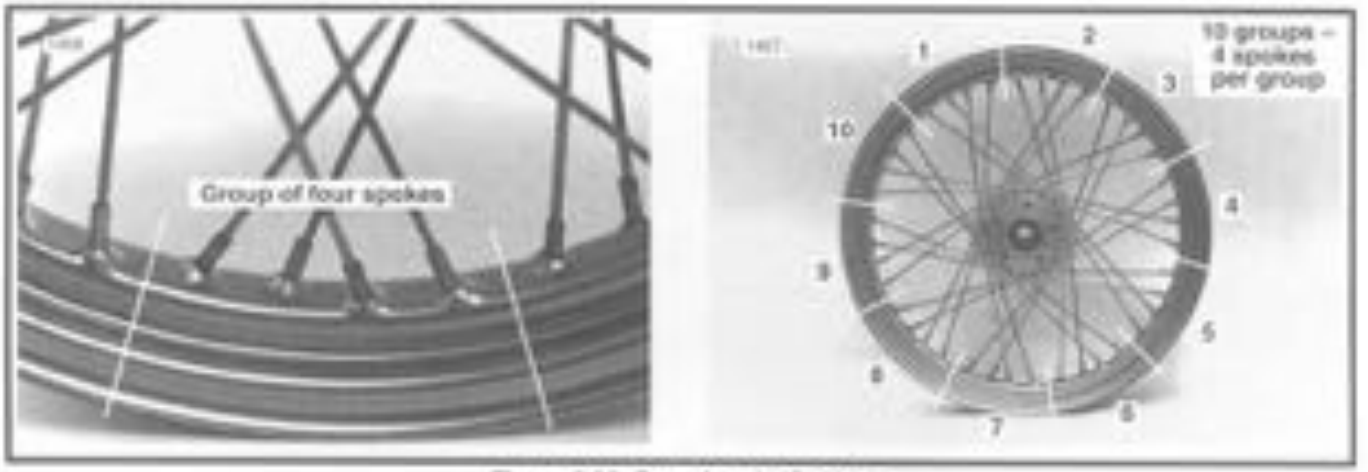


Figure 2-25. Grouping the Spokes

11. Lace the top flange outer spokes. Swing them counterclockwise and make sure each one crosses four inner spokes before securing it to the rim.

12. True the wheel. See TRUING LACED WHEEL.

TRUING LACED WHEEL

1. See Figure 2-27. 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.

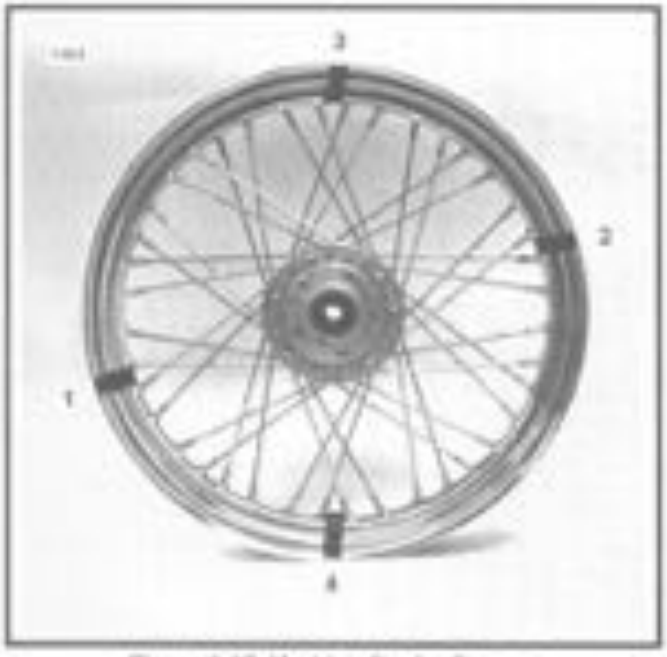


Figure 2-27. Marking Spoke Groups

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-99500-86). Tighten arbor nuts so hub will turn on its bearings.
4. See Figure 2-28. and Figure 2-29. The hub must be centered sideways with the rim. Lay a straightedge across the hub brake disc flange and one of the marked spoke groups. Measure the distance from the straightedge to the rim as shown. If this dimension is not equal on both sides of the wheel, loosen and tighten the four spokes accordingly. Use SPOKE WRENCH (Part No. HD-94681-80).

NOTE

See Figure 2-28. and Figure 2-29. Dimension "A" must be maintained to ensure centering of wheel on motorcycle.

EXAMPLE

If the measurement on the rim right side is greater than the left side, loosen the two spokes attached to the hub left side and tighten the two spokes attached to the hub right side. Turn all four spokes an equal number of turns until dimension is equal to within 0.040 in. (1.02 mm) for both sides.

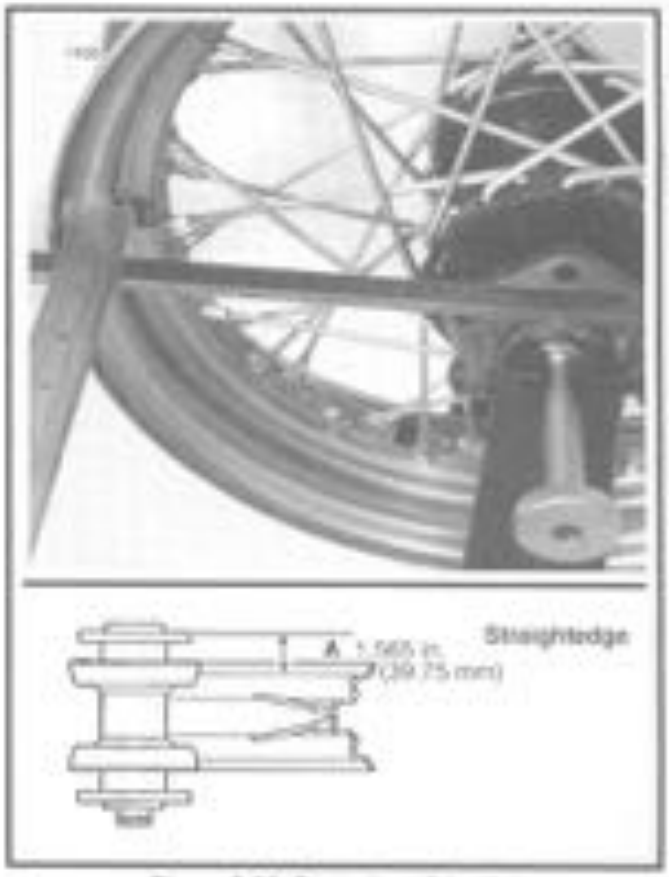


Figure 2-28. Centering 16-in. Hub

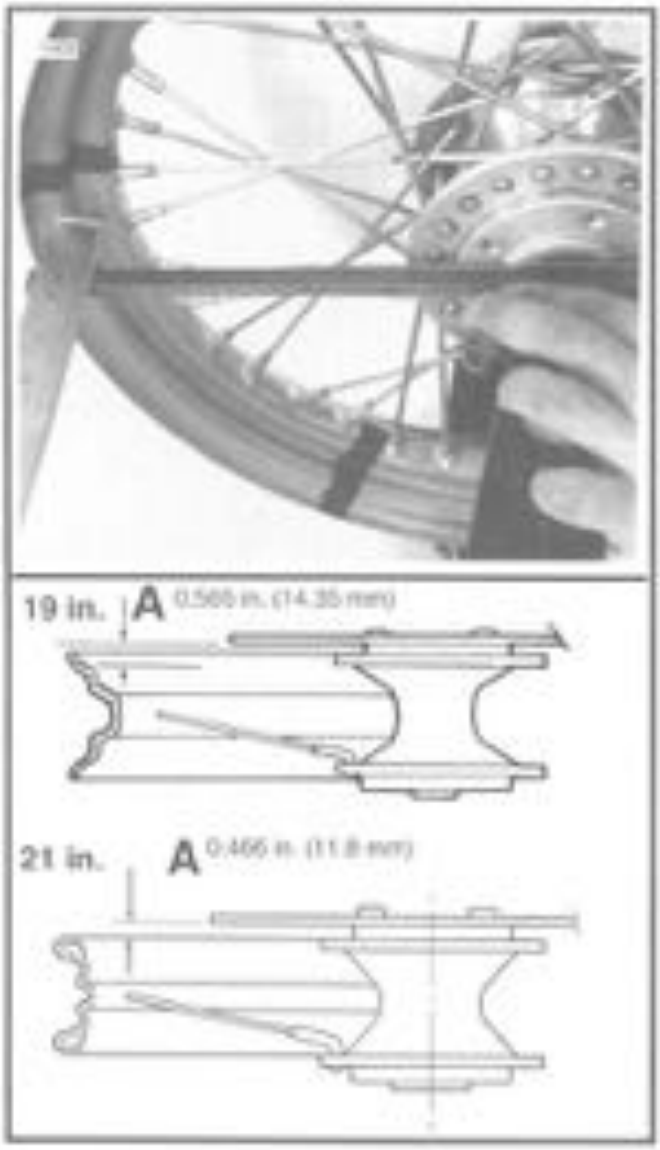


Figure 2-29. Centering 19-in and 21-in Hub

CAUTION

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

Repeat Step 4 for all four groups on the wheel.

5. See Figure 2-30. After rim has been centered sideways it must be checked and trued radially. Adjust truing stand gauge to the rims tire bead seat as shown. The rim should be trued within 0.030 in. (0.76 mm).

6. Spin the rim slowly. If the rim contacts the gauge on or near a marked group of spokes, loosen the spokes in the marked group on the opposite side of the rim. Now tighten the spokes in the group where the rim makes contact. Loosen and tighten spokes an equal number of turns.

   If the rim contacts the gauge between two marked groups, loosen the spokes in both opposite groups and tighten the spoke groups on the side of the rim that makes contact.

7. When the wheel is centered and trued, start at the valve hole and tighten the rest of the spoke nipples one turn at a time alternately until they are snug.

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

CAUTION

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

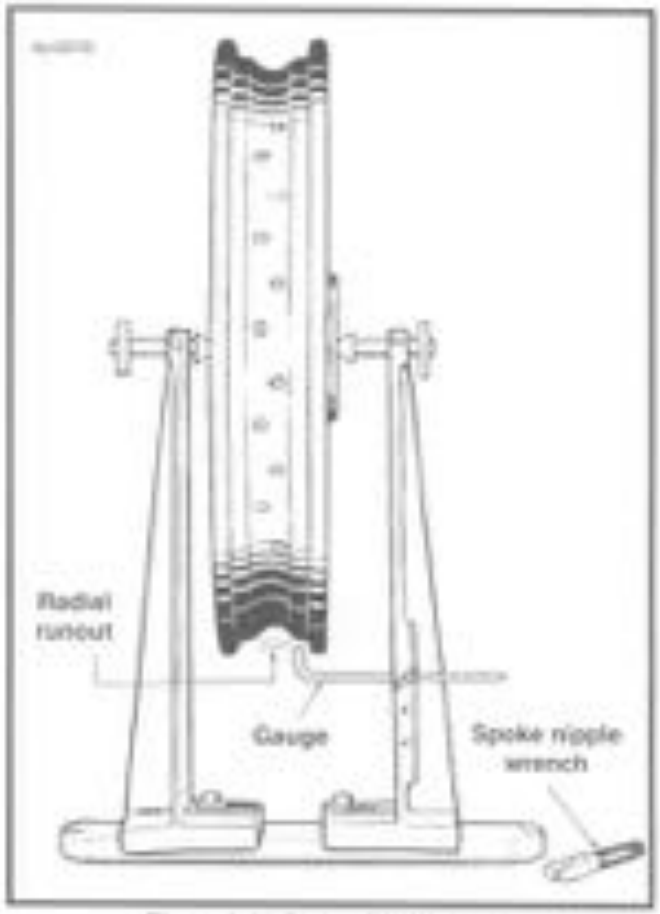


Figure 2-30. Truing Rim Radially

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

10. See Figure 2-28 and Figure 2-29. Check dimension A and retrue wheel if not within specifications.

CHECKING CAST RIM RUNOUT

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

1. See Figure 2-31. Install truing arbor in wheel hub and place wheel in WHEEL TRUING STAND (Part No. HD-99500-80). Tighten arbor nuts so hub will turn on its bearings. To check rim lateral runout, place a gauge rod or dial indicator near the rim bead. If lateral runout exceeds 0.040 in. (1.02 mm), replace the wheel.

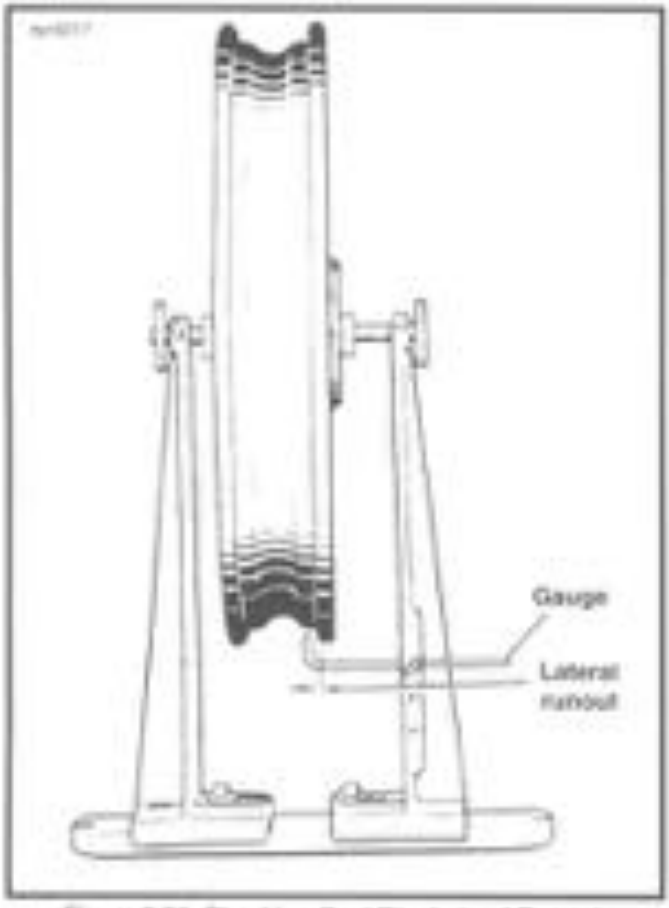


Figure 2-31. Checking Cast Rim Lateral Runout.

2. See Figure 2-32. Check for radial runout as shown. Replace the wheel if runout exceeds 0.030 in. (0.76 mm).

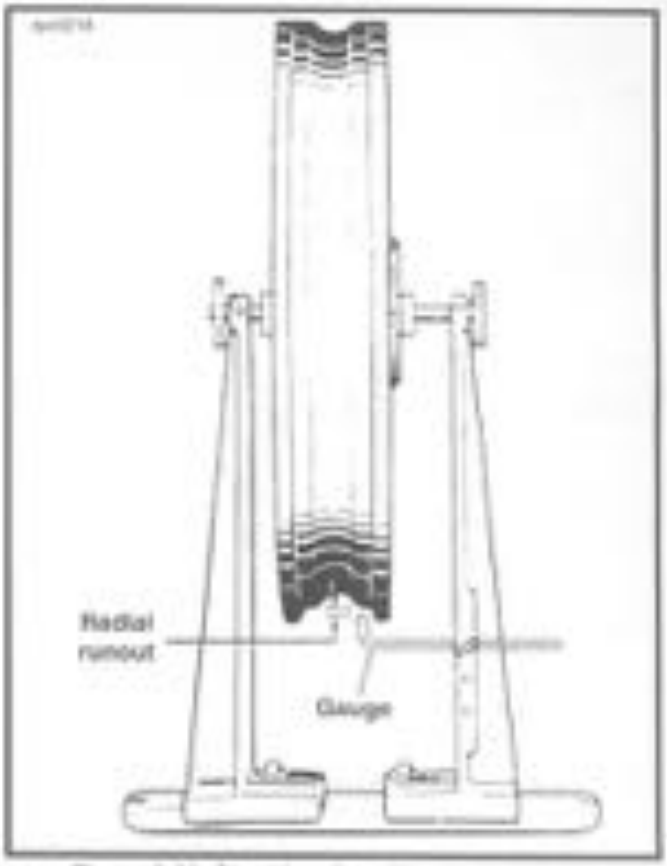


Figure 2-32. Checking Cast Rim Radial Runout

TIRES

GENERAL

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

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

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

⚠WARNING

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

Figure 2-33. Starting Tire Off Rim

REMOVAL

1. Remove wheel from motorcycle. See FRONT or REAR WHEELS.
2. Deflate 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. See Figure 2-33. Attach RIM PROTECTORS (Part No. HD-01269) to the rim. Using tire tools (not sharp instruments), start upper bead over edge of rim at valve. Repeat all around rim until first bead is over rim. Remove the tube on tube type wheels.

⚠CAUTION

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

5. Push lower bead into rim well on one side and insert tire tool underneath bead from opposite side. Pry bead over rim edge. Remove tire from rim.
6. On tubeless tire rims, remove the valve stem if it is damaged or leaks.

NOTE

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

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

CLEANING, INSPECTION, AND REPAIR

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

INSTALLATION

Tube Type Tires

⚠WARNING

Use the correct inner tube and tire as specified. See TIRE DATA in SPECIFICATIONS. Failure to do so could result in tire failure, causing personal injury.

1. See Figure 2-34. On laced wheels, install a rim strip into the rim well. Make sure no spokes protrude through nipples, and be sure to align the valve stem hole in rim strip with hole in rim.

Figure 2-34. Installing Rim Strip

2. Thoroughly lubricate the rim flanges and both beads of the tire with tire lubricant.
3. See Figure 2-35. Starting at the valve stem hole, start the first bead into the rim well. Work the bead on as far as possible by hand. Use the tire tool to pry the remaining bead over the rim flange.
4. Inflate tube just enough to round it out. Lubricate thoroughly 360° around the tube base. Insert tube in tire with valve stem in hole.
5. See Figure 2-36. Starting 180° from valve stem, start the second bead onto the rim. Work the bead onto the rim with tire tools, working toward valve in both directions. Remove the valve core from valve stem before prying the remaining bead over the rim flange.
6. Make sure valve stem moves in and out freely, then inflate the tire to recommended pressure to seat the bead. See SPECIFICATIONS. Then deflate tire to allow inner tube to smooth out. Install the valve core, then inflate to recommended pressure.

Figure 2-35. Starting Bead on Rim

Figure 2-36. Starting Second Bead on Rim

Tubeless Tires

⚠WARNING

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

Also, aftermarket valve caps that are heavier than the stock cap may have clearance at slow speeds; but, at high speed the valve/cap will be moved outward by centrifugal force. This outward movement could cause the valve/cap to strike the adjacent components, damage the valve and cause rapid tire deflation. Rapid tire deflation could cause loss of control and personal injury.

1. See Figure 2-37. On tubeless wheels, damaged or leaking valve stems must be replaced. Place rubber grommet on valve stem with shoulder in recess of the valve stem head.

1. **Tubeless tire valve stem – 19-inch wheel**
2. **Tubeless tire valve stem – 16-inch wheel**

Figure 2-37. Tubeless Tire Valve Stem

2. Insert valve stem into rim hole, and install metal washer with raised center facing away from rim. Install first hex nut, and tighten to 20-25 **in-lbs** (2.3-2.8 Nm) torque. Tire valves for 19-inch rims have only one nut that must be tightened to 35-40 **in-lbs** (4.0-4.5 Nm) torque.
3. Install second hex nut. While holding first nut with a wrench, tighten second nut to 40-60 **in-lbs** (4.5-6.8 Nm) torque.
4. Thoroughly lubricate the rim flanges and both beads of the tire with tire lubricant.
5. See Figure 2-35. Starting at the valve stem, start the first bead into the rim well. Work the bead on as far as possible by hand. Use a tire tool to pry the remaining bead over the rim flange.
6. See Figure 2-36. Start 180° from the valve stem hole and start the second bead on the rim. Work the bead onto the rim with tire tools, working toward the valve in both directions.
7. Apply air to the stem to seat the beads on the rim. It may be necessary to use a BEAD EXPANDER, Part No. HD-28700 on the tire until the beads seat on the rim.

⚠WARNING

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

Checking Tire Lateral Runout (Figure 2-38)

1. Turn wheel on axle and measure amount of displacement from a fixed point to tire sidewall.
2. Tire tread lateral runout should be no more than 0.080 in. (2.03 mm). If runout is more than 0.080 in. (2.03 mm), remove tire from rim, and check rim bead side runout to see if rim is at fault.

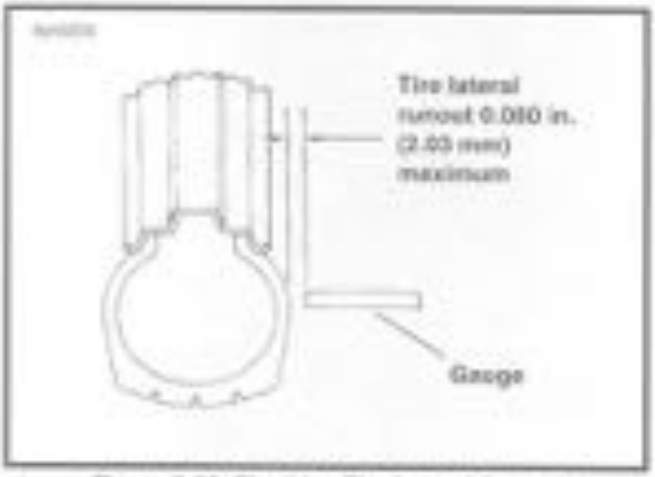


Figure 2-38. Checking Tire Lateral Runout

Checking Tire Radial Runout (Figure 2-39)

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

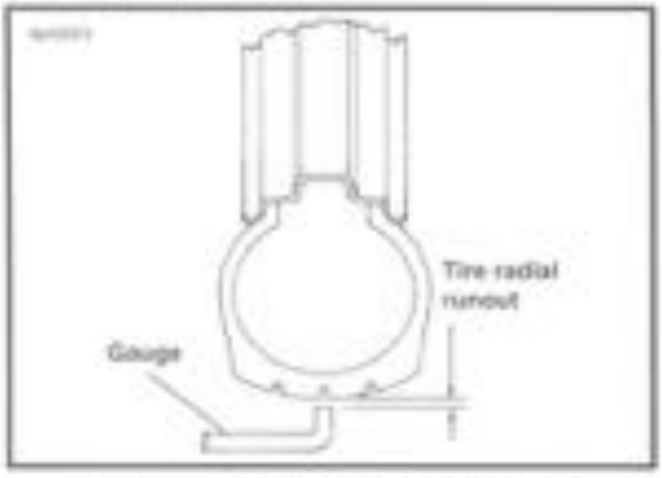


Figure 2-39. Checking Tire Radial Runout

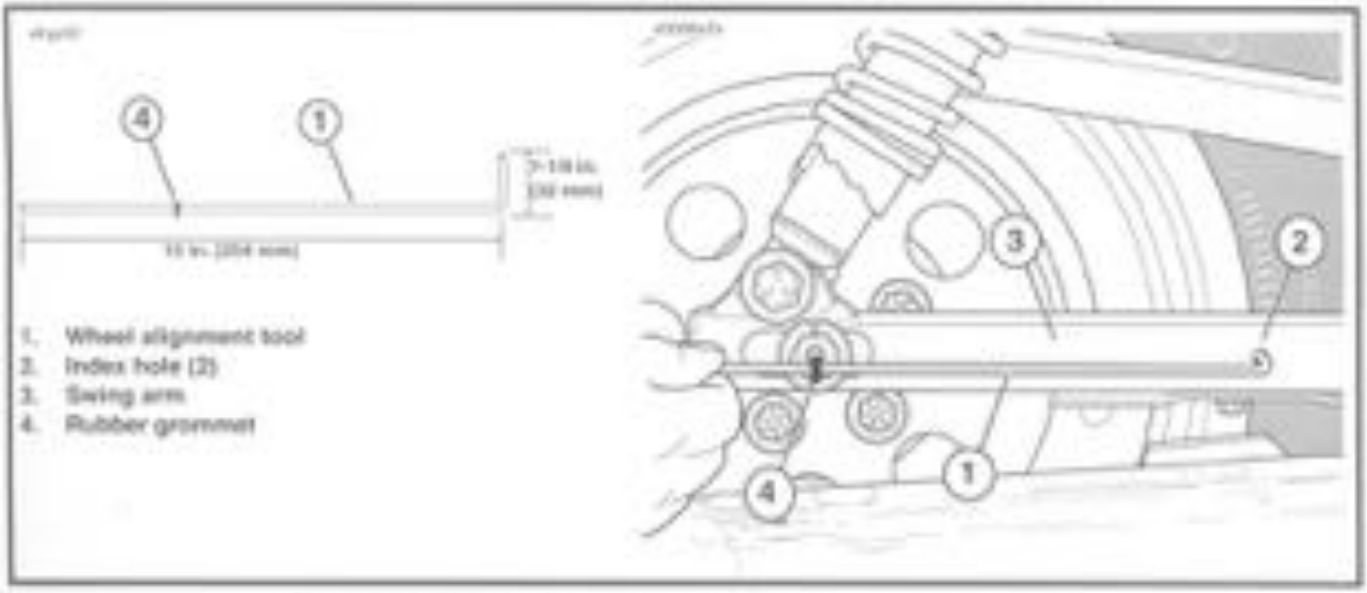
Wheel Alignment

CHECKING WHEEL ALIGNMENT (FIGURE 2-40)

⚠WARNING

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

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

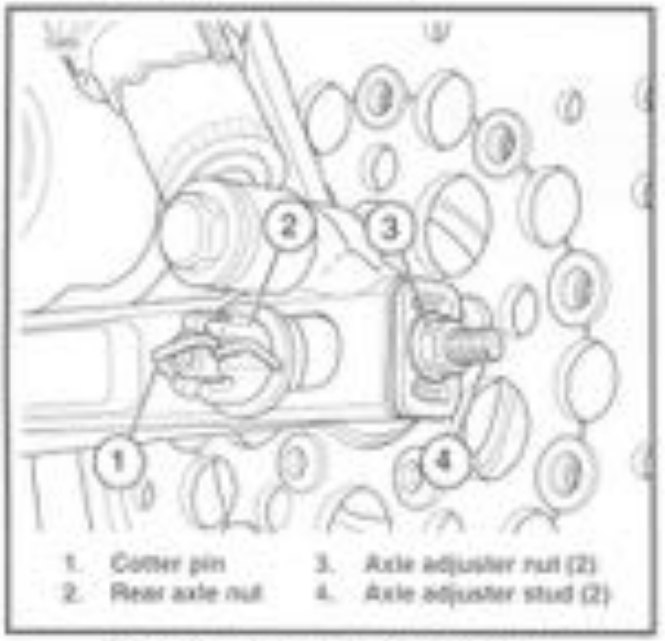


1. Wheel alignment tool
2. Index hole (2)
3. Swing arm
4. Rubber grommet

Figure 2-40. Checking Wheel Alignment Using Wheel Alignment Tool

ADJUSTING WHEEL ALIGNMENT (FIGURE 2-41)

1. Remove and discard cotter pin (1).



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

Figure 2-41. Adjusting Wheel Alignment

2. Loosen rear axle nut (2).

3. On side of rear fork which has longer distance from index hole to axle center, turn nut (3) on axle adjuster stud (4) counterclockwise to shorten distance. Adjust axle until left and right side alignment measurements are equal.

NOTE

- *Keep axle adjuster mechanisms firmly seated (under tension) on each side of rear fork during wheel alignment procedures above. Do so by applying moderate upward force on lower span of rear belt. This tensions rear belt, which holds rear axle forward against both adjuster mechanisms.*

- *Do not tighten rear axle nut (2) or install cotter pin (1) until after checking rear drive belt tension.*

4. Check rear drive belt tension after aligning rear wheel; adjust if required. See DRIVE/TRANSMISSION, SECONDARY DRIVE BELT, ADJUSTMENT.

5. If not yet performed, tighten axle nut (2) to 60-65 ft-lbs (81-88 Nm) torque, and install **new** cotter pin (1).

Wheel Balancing

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

In most cases, static balancing using WHEEL TRUING STAND (Part No. HD-96500-80) 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. (666 g) total weight applied to the rim(s). 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.

Laced Wheel Balance Weights

Weight (Mass)		HD Part Number
1/2 oz. (U.S.)	14 g	95578-41
3/4 oz. (U.S.)	21 g	95581-47
1 oz. (U.S.)	28 g	95582-47

WEIGHTS FOR CAST WHEELS

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

Cast Wheel Balance Weights

Weight (Mass) oz. (U.S.)	grams	Finish	HD Part Number
1/4	7	black	95594-84
1/4	7	silver	95595-84

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

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

NOTE

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

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

3. Allow eight hours for adhesive to cure completely before using wheel.

BRAKES

GENERAL

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

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

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

⚠WARNING

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

- **Always test motorcycle brakes at low speed after servicing or bleeding system. Harley-Davidson recommends that all brake repairs be performed by a Harley-Davidson dealer or other qualified mechanic.**

- **Exercise caution when handling brake fluid. Brake fluid can cause irritation of eyes and skin and may be harmful or fatal if swallowed. If swallowed, administer two tablespoons of salt in a glass of warm water to induce vomiting. Call a doctor immediately. In case of contact with skin or eyes, flush with plenty of water. Get medical attention for eyes. KEEP BRAKE FLUID OUT OF THE REACH OF CHILDREN.**

TROUBLESHOOTING

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

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

FRONT BRAKE MASTER CYLINDER

GENERAL

Master cylinders designed for dual disc (two caliper) operation have an 11/16 inch (17.5 mm) bore, while those that are designed for single disc (one caliper) operation have a 9/16 inch (14.3 mm) bore. The bore size is stamped on the master cylinder assembly inboard of the handlebar clamp bracket. See Figure 2-42.

⚠WARNING

Do not use a 9/16 inch bore master cylinder assembly on dual disc (two caliper) models. Likewise, do not use an 11/16 inch bore master cylinder assembly on single disc (one caliper) models. These master cylinder assemblies are not interchangeable. Using the wrong assembly can adversely affect braking efficiency or result in brake failure causing personal injury.

REMOVAL/DISASSEMBLY

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

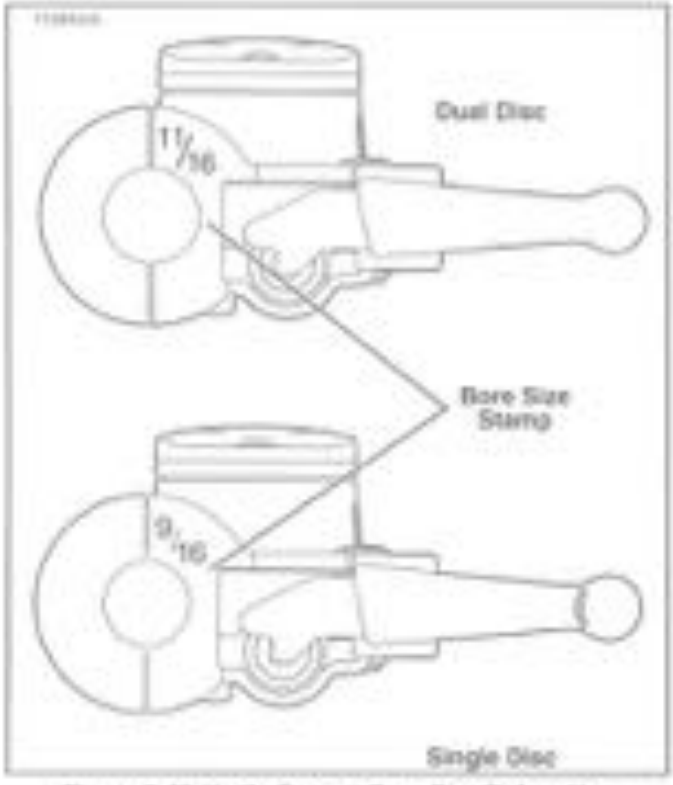


Figure 2-42. Verify Correct Bore Size Before Use

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

⚠CAUTION

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

NOTE

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

3. Place the cardboard insert between the brake lever and lever bracket. See Figure 2-43.

4. 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. See Figure 2-44.

⚠WARNING

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

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

Figure 2-43. Install Cardboard Insert Before Removing Master Cylinder Assembly

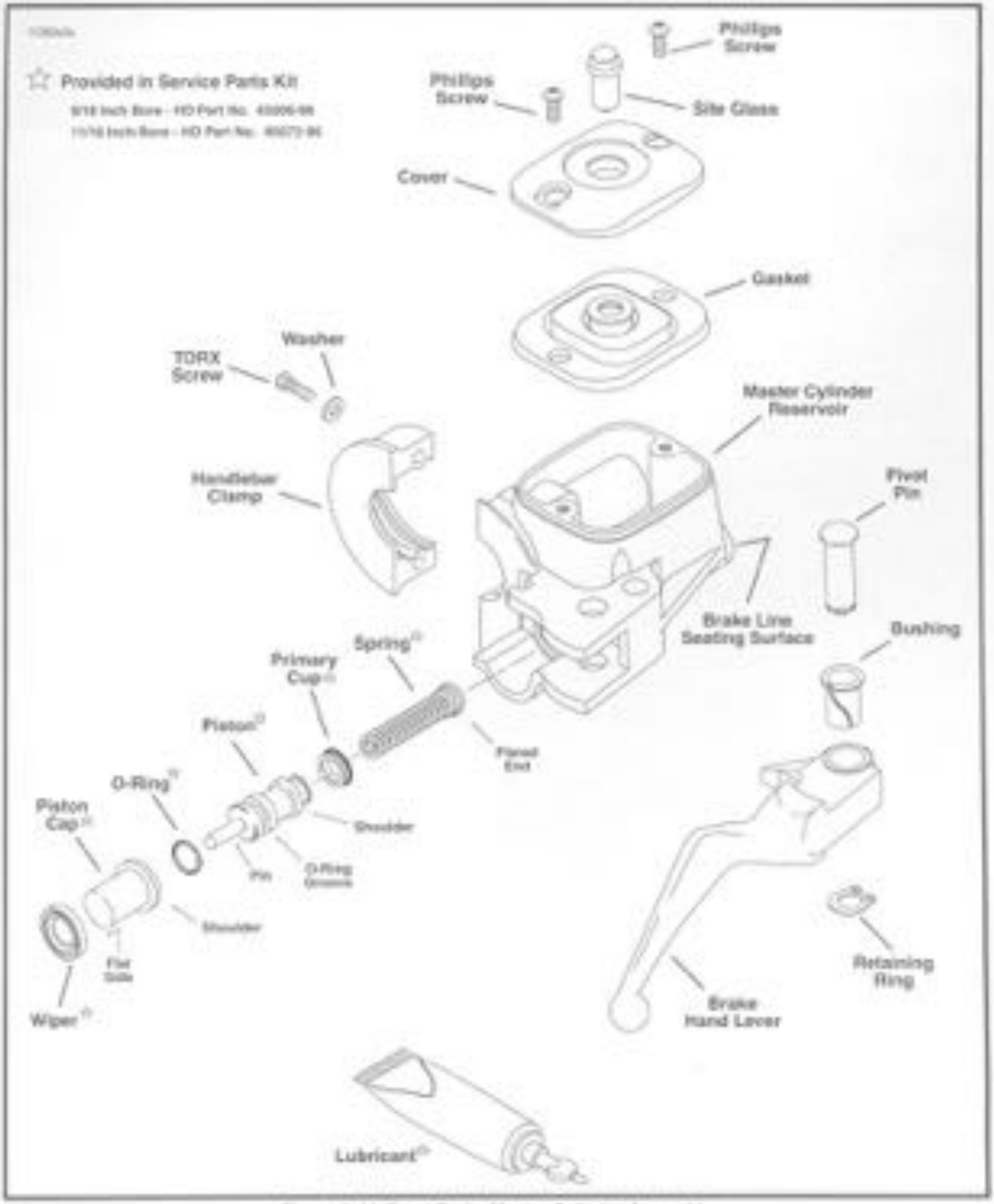


Figure 2-44. Front Brake Master Cylinder Assembly

1. Remove pivot pin and brake hand lever from master cylinder assembly.
2. Carefully remove wiper with pick or similar tool.
3. Remove piston cap.
4. Remove piston with O-ring and primary cup.
5. Remove spring.

⚠CAUTION

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

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

CLEANING, INSPECTION AND REPAIR

⚠WARNING

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

1. Always reassemble the master cylinder using **new** parts from the correct repair kit (9/16 inch bore- HD Part No. 45006-96; 11/16 inch bore- HD Part No. 45072-96).

2. Clean all parts with denatured alcohol or D.O.T. 5 BRAKE FLUID. Do not contaminate with mineral oil or other solvents. Wipe dry with a clean, lint free cloth. Blow out drilled passages and bore with a clean air supply. Do not use a wire or similar instrument to clean drilled passages in bottom of reservoir.

⚠WARNING

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

3. Carefully inspect all parts for wear or damage and replace as necessary.

4. Inspect the piston bore in the master cylinder housing for scoring, pitting or corrosion. Replace the housing if any of these conditions are found.

5. Inspect the outlet port that mates with the brake line fitting. As a critical sealing surface, replace the housing if any scratches, dents or other damage is noted.

6. Inspect the cover gasket for cuts, tears or general deterioration. Replace as necessary.

ASSEMBLY/INSTALLATION

1. Fit O-ring into groove at front of piston (pin side). See Figure 2-44.

2. Fit primary cup over lip at back of piston so that closed side (smaller OD) contacts shoulder.

3. Coat piston bore of housing with special lubricant supplied in the service parts kit. Also apply the lubricant to OD of installed O-ring and primary cup.

4. Insert flared end of spring into master cylinder bore so that it seats against the counterbore (recess) at bottom.

5. Slide piston over spring.

6. Fit wiper over piston cap so that the flat side of wiper contacts cap shoulder.

7. Fit piston cap over piston pin.

8. Press down on wiper until it contacts the counterbore. Larger OD of wiper must be completely seated in groove on outlet side of piston bore.

9. Install the cover (with gasket) on the master cylinder reservoir. Install two Phillips screws to fasten the cover to the reservoir, but do not tighten at this time.

10. Align hole in brake hand lever with hole in master cylinder bracket. From the top of the assembly, slide pivot pin through bracket and hand lever.

⚠WARNING

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

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

⚠CAUTION

See Figure 2-45. Do not install the master cylinder assembly without first placing the 5/32 inch cardboard insert (or cable strap eyelet) between the brake lever and lever bracket. Installation without the insert may result in damage to the rubber boot and plunger of the Front Stoplight Switch.

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

13. Align the holes in the handlebar clamp with those in the master cylinder housing and start the two screws (with flat washers). Position for rider comfort. Beginning with the top screw, tighten the screws to 70-80 **in-lbs** (7.9-9.0 Nm) torque using a T27 TORX drive head.

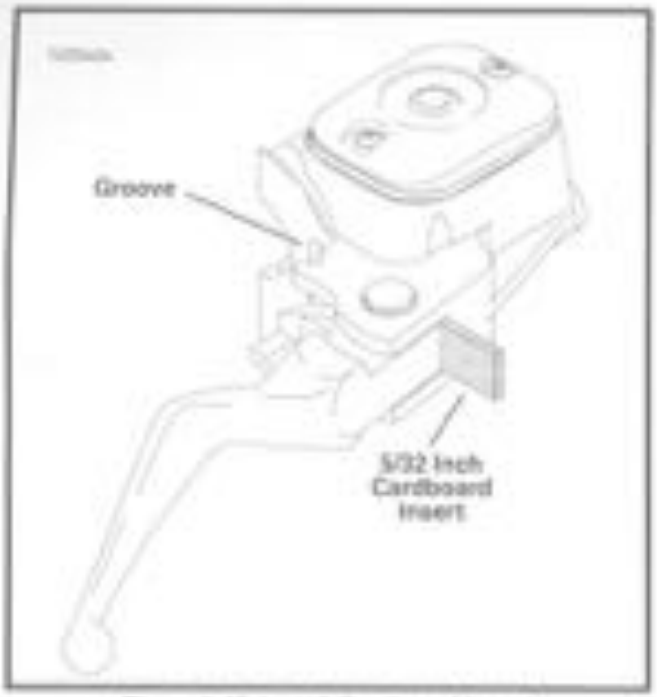


Figure 2-45. Install Cardboard Insert Before Installing Master Cylinder Assembly

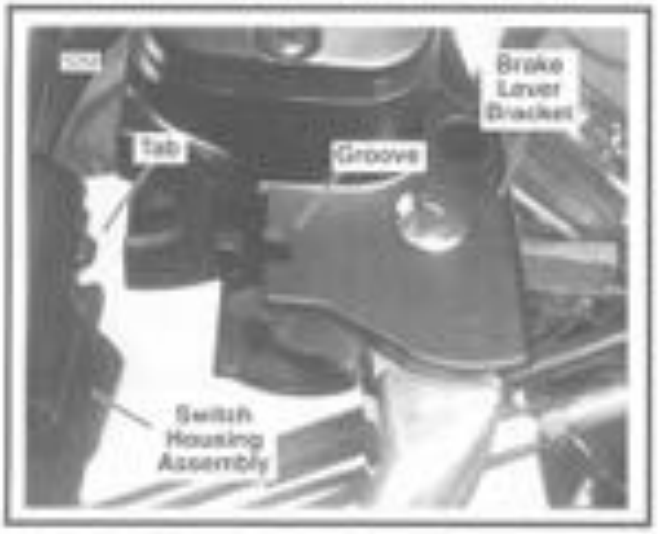


Figure 2-46. Fit Brake Lever/Master Cylinder to Right Handlebar Switch Housings

⚠CAUTION

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

1. Position **new** steel/rubber washers on each side of hydraulic brake line fitting. Insert bolt through washers and fitting. Thread bolt into master cylinder housing and tighten to 17-22 ft-lbs (23-30 Nm) torque.
2. Install length of clear plastic tubing over caliper bleeder valve, if removed. Place free end of tube in a clean container.
3. Remove the master cylinder cover. Stand the motorcycle upright so that the master cylinder is in a level position.
4. Add D.O.T. 5 SILICONE HYDRAULIC BRAKE FLUID to the master cylinder reservoir until the fluid level is 1/8 inch (3.2 mm) from the top. Do not reuse old brake fluid. Use only D.O.T. 5 fluid from a sealed container.

⚠WARNING

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

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

⚠WARNING

Always test motorcycle brakes at low speed after completing repairs or bleeding the system. Failure to do so may result in personal injury.

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

REAR BRAKE MASTER CYLINDER

ADJUSTMENT

Brake Pedal

See Figure 2-47. Loosen locknut (20). With motorcycle on level surface, adjust push rod (1) so that brake pedal is parallel with floor (see Figure 2-46). Tighten locknut.

REMOVAL/DISASSEMBLY (Figure 2-47)

NOTE

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

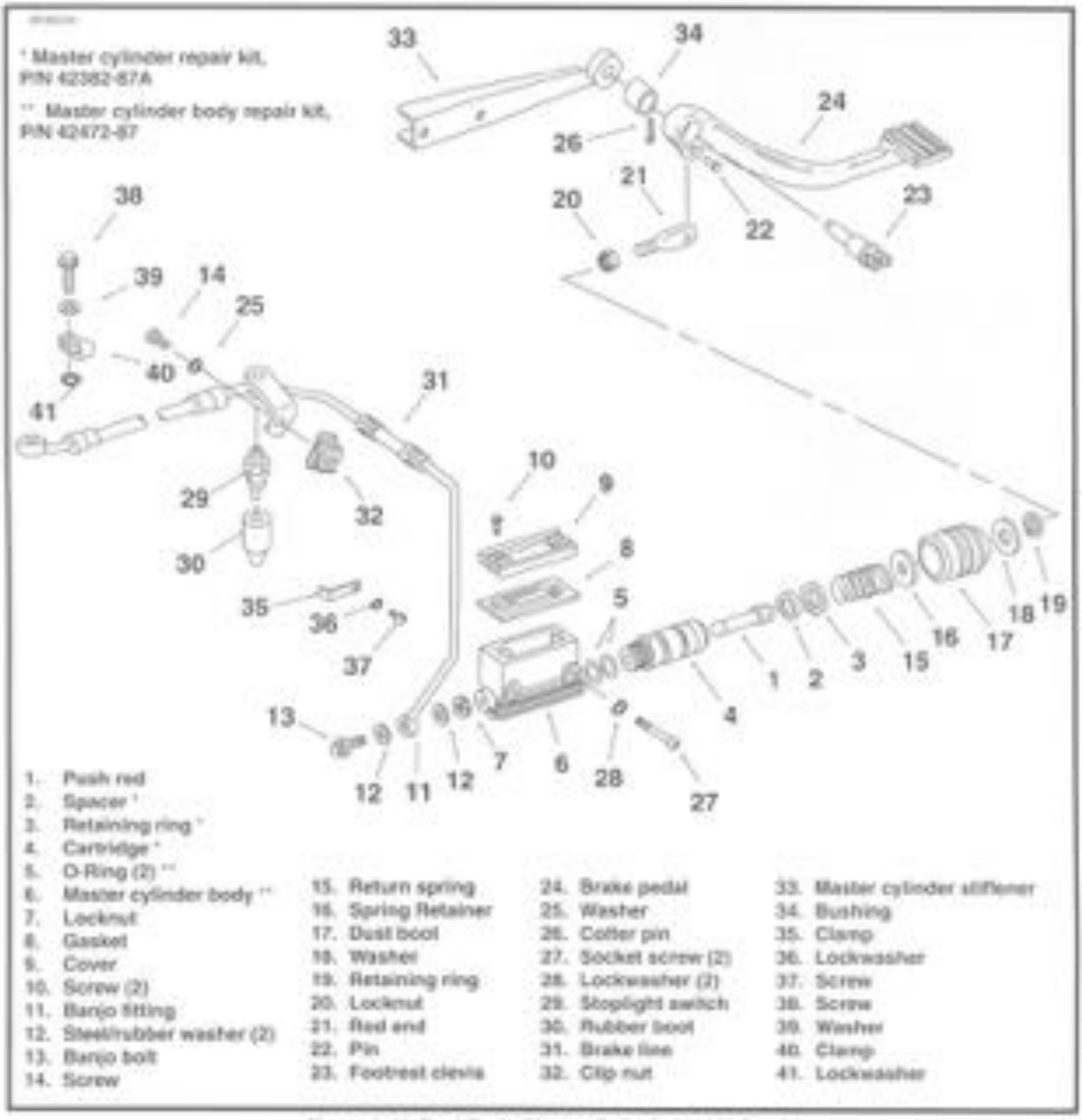


Figure 2-47. Rear Brake Master Cylinder and Linkage

1. Open bleeder nipple cap on rear caliper. Install end of a length of plastic tubing over caliper bleeder valve, while placing free end in a suitable container. Open bleeder valve about 1/2 turn. Pump brake pedal (24) to drain brake fluid.
2. Remove screw (37) and lockwasher (36) to detach brake line clamp (35) from sprocket cover. Remove banjo fitting bolt (13) and steel/rubber washers (12). Discard washers.
3. Lift banjo fitting (11) away from master cylinder (6). Remove two socket screws (27) and lockwashers (28) holding master cylinder to sprocket cover. Loosen locknut (20). Turn push rod (1) at flats until free of rod end (21).

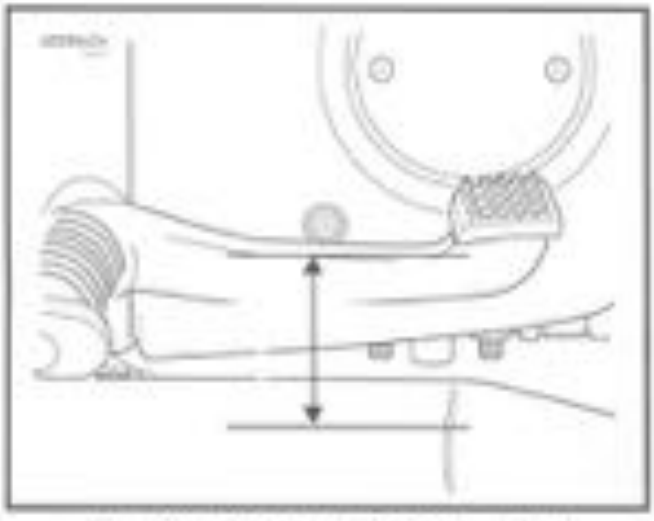


Figure 2-48. Rear Brake Pedal Adjustment

⚠CAUTION

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

4. Press down on large washer (18) to compress return spring (15). While spring is compressed, remove retaining ring (19) from push rod (1). Carefully release spring.
5. Remove washer (18), dust boot (17), spring retainer (16) and return spring (15).
6. Remove locknut (7). Pull cartridge and push rod assembly from master cylinder body (6). Remove retaining ring (3) from bore of cartridge (4). Pull the push rod (1) with spacer (2) free of cartridge. Remove two O-rings (5) from external grooves on cartridge; discard O-rings.

⚠CAUTION

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

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

CLEANING, INSPECTION AND REPAIR (Figure 2-47)

⚠WARNING

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

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

ASSEMBLY/INSTALLATION

1. See Figure 2-47. Insert original push rod (1) into bore at unthreaded end of cartridge (4). Install spacer (2) over end of push rod. Install retaining ring (3) in groove next to spacer inside cartridge bore. Slide two **new** O-rings (5) into external grooves on cartridge (4). Insert cartridge into master cylinder body (6). Align slot at top of cartridge with key in master cylinder body. Push cartridge through master cylinder body until cartridge bottoms in bore. Install locknut (7). Tighten locknut to 30-40 ft-lbs (41-54 Nm) torque.
2. Place protective shields over vise jaws and lightly clamp master cylinder body in vise with push rod (1) upright.
3. Place return spring (15) over push rod (1). Place spring retainer (16) on top of spring. Slip large I.D. end of dust boot (17) over retainer and spring. Seat the small I.D. end of boot against spring retainer (16). Be sure vent drain hole in boot is at the bottom.
4. Place washer (18) on top of boot. Push down on washer to compress spring (15). With spring compressed, install **new** retaining ring (19) in groove of push rod (1).

⚠CAUTION

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

5. Position master cylinder next to sprocket cover. Position **new** steel/rubber washers (12) on each side of banjo fitting (11). Insert bolt (13) through washers and banjo fitting. Thread bolt into cartridge and tighten to 17-22 ft-lbs (23-30 Nm) torque.
6. Position large I.D. end of dust boot (17) into groove in master cylinder body (6).

7. Install clamp (35), screw (37) and lockwasher (36) to secure rear brake line (31) to sprocket cover. Tighten clamp screw to 45-65 **in-lbs** (5-7 Nm) torque.

8. Install exhaust pipes. Install **new** locknut at exhaust support bracket. Tighten to 20-40 ft-lbs (27-54 Nm) torque.

9. Turn push rod (1) at flats to thread on rod end (21).

10. Position master cylinder body (6) over mounting holes in sprocket cover. Secure with screws (27) and lockwashers (26). Tighten screws to 155-190 **in-lbs** (17.5-21.5 Nm) torque.

11. Install footrest assembly.

12. Adjust push rod until brake pedal is parallel with floor, as shown in Figure 2-48. Tighten locknut (20).

13. With the master cylinder in a level position, verify that the brake fluid level in the reservoir is 1/8 in. (3.2 mm) from the top. Add D.O.T. 5 SILICONE HYDRAULIC BRAKE FLUID if necessary.

⚠WARNING

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

14. Verify proper operation of the master cylinder relief port. Actuate the brake pedal with the reservoir cover removed. A slight spurt of fluid will break the surface if all internal components are working properly.

15. Install cover gasket (8), cover (9) and screws (10).

16. Bleed brake system. See BLEEDING HYDRAULIC SYSTEM in this section.

17. Remove master cylinder cover (9). Verify proper fluid level- see Step 12.

18. Reinstall master cylinder cover. Tighten screws to 10-15 **in-lbs** (1.1-1.7 mm) torque.

19. Test operation of brake lamp with the rear brake applied and the ignition/light switch turned ON.

REAR BRAKE LINKAGE AND SPROCKET COVER

REMOVAL (Figure 2-49)

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

INSTALLATION (Figure 2-49)

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

⚠WARNING

Footrest mount must be installed in the orientation which allows footrest to fold up at a 45° angle (from vertical) toward rear of motorcycle. This angle allows footrest to fold up if it accidently strikes the ground when making a sharp turn. Failure to set footrest to the proper fold-up angle could result in personal injury.

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

1. Bolt
2. Nut
3. Wave washer
4. Footrest
5. Socket screw (2)
6. Lockwasher (2)
7. Push rod
8. Locknut
9. Screw
10. Clip
11. Socket screw (3)
12. Washer (3)
13. Cotter pin
14. Nut
15. Footrest mount
16. Rear brake pedal
17. Master cylinder stiffener
18. Sprocket cover
19. Rod end

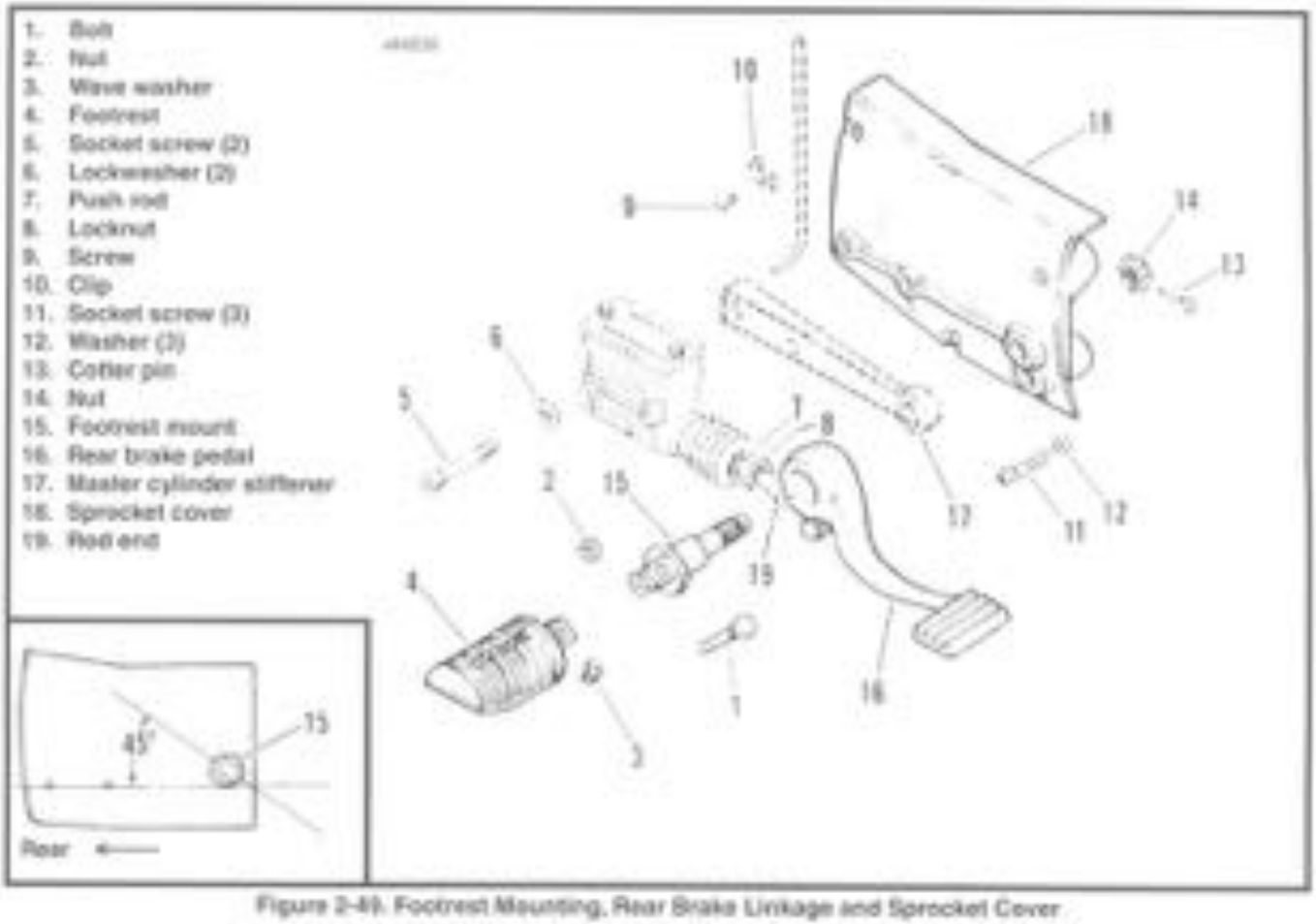


Figure 2-49. Footrest Mounting, Rear Brake Linkage and Sprocket Cover

FRONT BRAKE CALIPER

REMOVAL/DISASSEMBLY (Figure 2-50)

1. Remove upper mounting screw (1) and lower mounting pin (2) to release caliper assembly (16).
2. Remove banjo fitting bolt and steel/rubber washers to disconnect brake line from caliper. Discard washers.
3. Move caliper assembly to bench area. Remove retainer screw (15), pad retainer (14) and inboard pad (9).
4. Remove pad holder (7) with attached outboard pad (9) and spring clip (8). Push pad free from pad hold-down spring clip (8) to remove pad (9) from pad holder (7).
5. Insert a small screwdriver into notched groove at bottom of piston bore to pry out retaining wire (13). Remove dust boot (12) and discard.

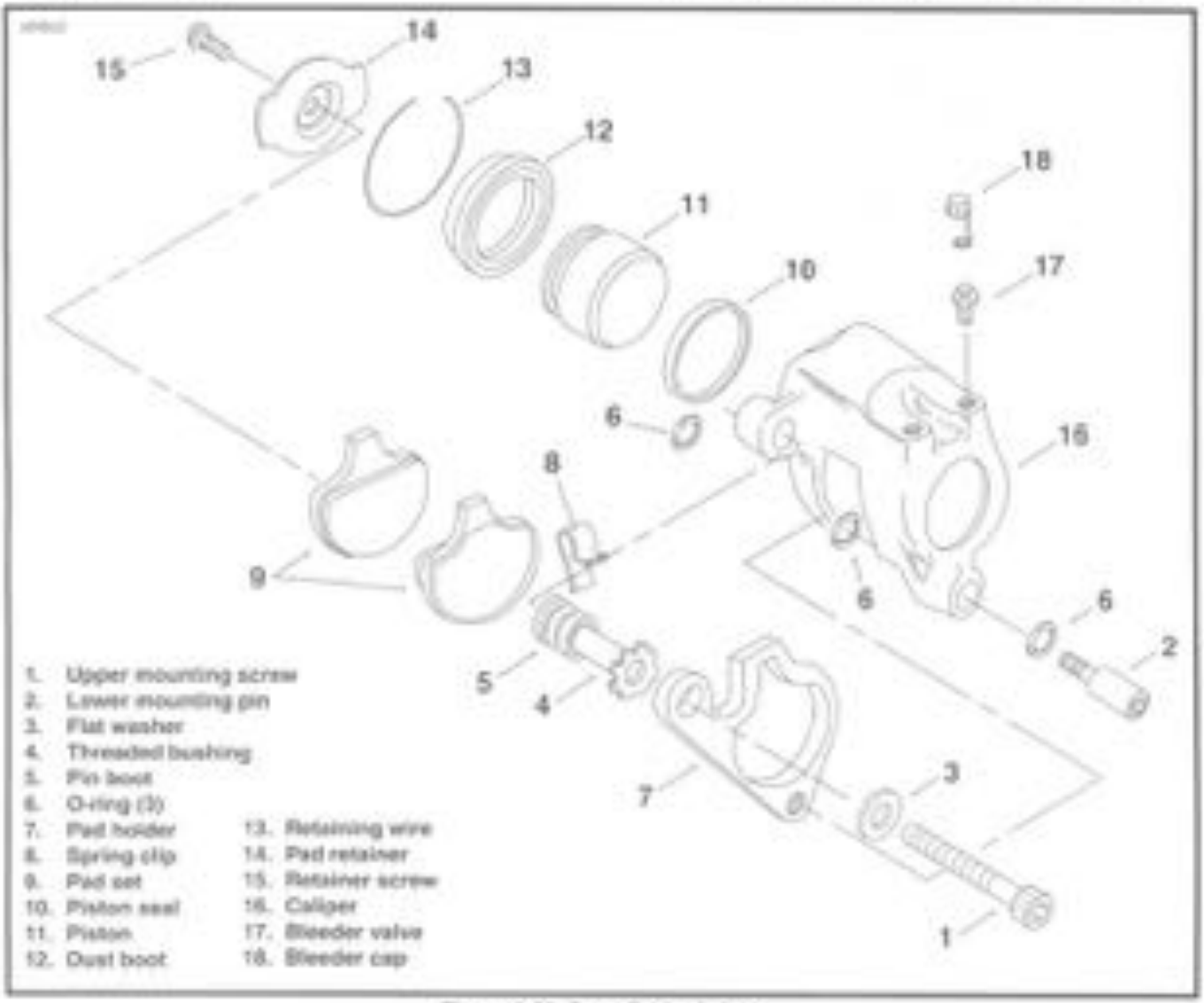
⚠WARNING

Wear safety glasses when removing piston from caliper using air pressure, piston may be ejected with considerable force. Wear heavy gloves or hold piston with heavy towel to prevent personal injury.

⚠CAUTION

Exercise care to avoid dropping piston on hard surface. Damage to surface may result in a sticking piston or fluid leakage.

6. Apply low air pressure to hydraulic brake line inlet to remove piston.
7. Pull threaded bushing (4) out of bushing bore. Remove pin boot (5) from groove in caliper.
8. Pry piston seal (10) and three O-rings (6) out of their respective grooves. Discard piston seal and O-rings.



1. Upper mounting screw
2. Lower mounting pin
3. Flat washer
4. Threaded bushing
5. Pin boot
6. O-ring (3)
7. Pad holder
8. Spring clip
9. Pad set
10. Piston seal
11. Piston
12. Dust boot
13. Retaining wire
14. Pad retainer
15. Retainer screw
16. Caliper
17. Bleeder valve
18. Bleeder cap

Figure 2-50. Front Brake Caliper

CLEANING, INSPECTION AND REPAIR (Figure 2-50)

⚠WARNING

- **Clean brake system components using denatured alcohol. Do not use mineral-base cleaning solvents such as gasoline or paint thinner. Use of mineral-base solvents causes deterioration of the rubber parts that continues after assembly and can result in improper and unsafe brake operation leading to personal injury. Do not allow brake fluid, solvents, lubricants, etc. to contact brake disc or brake pad friction material; reduced vehicle braking ability will otherwise occur, possibly resulting in personal injury. Thoroughly clean any foreign substances from brake disc. Replace brake pads (in sets only) which have been exposed to substances such as brake fluid, solvents, lubricants, etc.**
- **ALWAYS wear safety glasses when cleaning with solvents or using compressed air to blow dry components.**

1. Thoroughly clean brake system components using denatured alcohol. Blow dry using compressed air. Carefully inspect all components. Replace any parts that appear damaged or worn. Do not hone caliper piston bore.
2. Inspect brake disc. Replace if warped or badly scored. Minimum acceptable disc thickness is stamped on disc.
3. Inspect brake pads for damage or wear. Replace both pads as a set if the friction material of either pad is worn to 1/16 in. (1.6 mm) or less.

⚠WARNING

Always replace brake pads in complete sets for correct and safe brake operation. Never replace just one pad. Inconsistent brake operation may result, leading to personal injury.

ASSEMBLY

1. See Figure 2-50. Install **new** seal (16) in groove of caliper piston bore (16). Install **new** O-ring (6) in groove of threaded bushing bore. Install **new** O-rings (6) in each groove of lower mounting pin bore. Apply DOW CORNING 44 GREASE (tube marked "PIN LUBE" in service parts kit) to interior cavity of pin boot (5). Insert flanged end of pin boot in groove of threaded bushing bore.
2. Install dust boot (12), with its concave side facing piston (11), over top of piston. Seat the inner lip of dust boot in groove at top of piston.
3. Apply light coat of NovaGard silicone grease (marked "PISTON LUBE" in service parts kit) to piston O.D., including chamfer. Apply a light coat to caliper piston bore (16) and I.D. of installed piston seal (16). Install piston (with dust boot) into caliper piston bore. Use a "C" clamp to press in piston, if necessary.

NOTE

To ensure proper brake pad-to-brake disc clearance when the caliper is installed, piston must be pressed all the way into the bore whenever new brake pads are used.

4. Install outer lip of dust boot (12) into caliper piston bore (16). With the gap at the top, compress and install retainer wire (13) within caliper piston bore. Press retainer wire firmly against piston dust boot.
5. Apply light coat of DOW CORNING 44 GREASE (marked "PIN LUBE" in service parts kit) to the following:
   - I.D. of caliper (16) threaded bushing bore (upper)
   - O.D. of threaded bushing (4)
   - I.D. of caliper (16) mounting pin bore (lower)
6. Insert threaded bushing (4) through the installed pin boot (5) and O-ring (6) of the caliper threaded bushing bore. Press threaded bushing into bore until free end of pin boot seats in groove next to flanged head of threaded bushing.

⚠WARNING

Wear safety glasses when installing the spring clip. The spring clip can fly outward with great force resulting in personal injury.

7. See Figure 2-50 and 2-51. Lay down pad holder (7) on a firm flat surface with upper mounting screw (threaded bushing) hole positioned at the upper right.
8. Hook lip on looped end of clip (9) under inside edge of pad holder at top. Holding pad holder down, raise clip to snap in place on pad holder. Pick up pad holder to verify that clip is firmly attached. Lay pad holder back down in the same orientation.
9. With black insulator backing facing pad holder, center outboard pad (9) within pad holder. In this position, tang of pad rests on clip loop while bottom of pad slightly enters opening of pad holder. Push down on tang until pad lies flat. Pick up pad holder to verify that pad is firmly attached. One lip on clip should be caught on pad holder, the other on tang of pad.

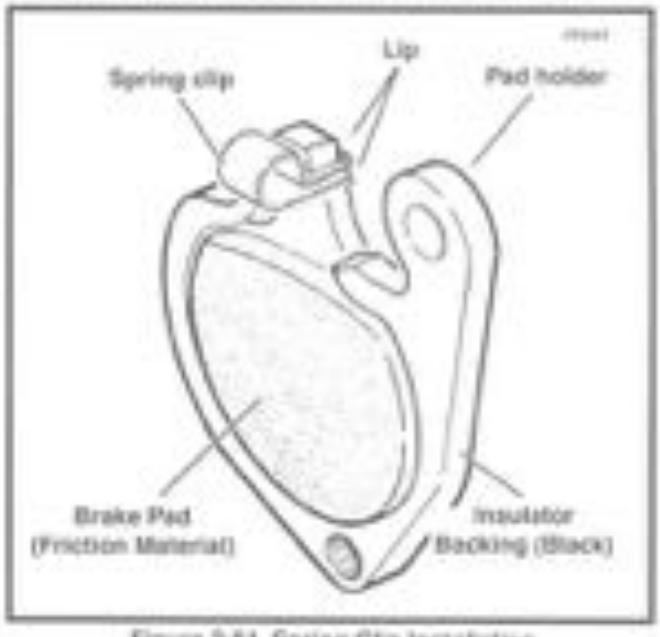


Figure 2-51. Spring Clip Installation

10. See Figure 2-50. Insert the assembly (outboard pad, pad holder and spring clip) into place on caliper (16) with insulator side of pad against face of piston (11).

NOTE

The spring clip loop and friction material must face away from the piston. If it is not, then remove the pad holder and reassemble the parts correctly.

11. Place inboard pad (9) (pad without insulator) in recessed seat machined into caliper (16).

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

INSTALLATION

1. See Figure 2-50. Apply light coat of DOW CORNING 44 GREASE (marked "PIN LUBE" in service parts kit) to O.D. of lower mounting pin (2).

2. See Figure 2-52. Position caliper (4) so that brake disc is situated between friction pads and lower mounting hole in caliper is aligned with lower mounting lug on front fork.

1. Upper mounting screw
2. Lower mounting pin
3. Banjo bolt
4. Caliper
5. Upper mounting lug
6. Brake line

Figure 2-52. Front Brake Caliper Mounting

⚠WARNING

Verify that caliper bushings are installed in the mounting lugs on the fork. Installing caliper without bushings will result in improper caliper location and possible locked brake leading to personal injury.

⚠CAUTION

See Figure 2-53. Position the flange of the threaded bushing beneath the rivet on the pad holder. The rivet body must engage one of the U-shaped notches on the edge of the flange. If the bushing is not properly positioned, damage to the rivet will occur when the caliper mounting fasteners are tightened.

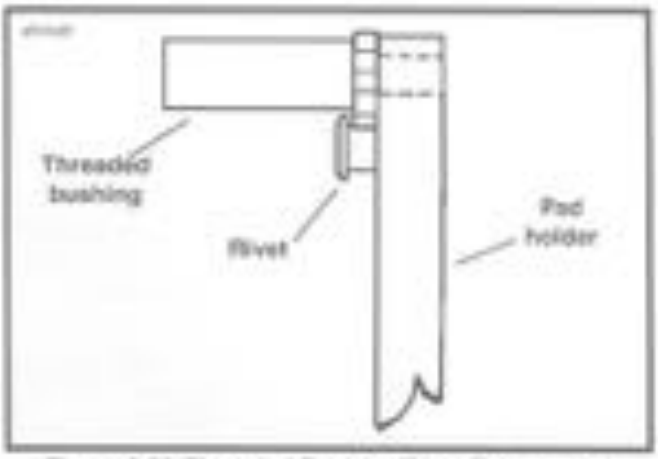


Figure 2-53. Threaded Bushing/Rivet Engagement

3. See Figure 2-50. Insert lower mounting pin (2) through caliper (16) and front fork lower mounting lug. Thread pin into tapped hole at lower end of pad holder (7). Tighten pin to 25-30 ft-lbs (34-41 Nm) torque.

4. Align upper mounting hole in caliper (with threaded bushing) with front fork upper mounting lug.

5. Install upper mounting screw (1) with spacer washer (3) through front fork upper mounting lug and pad holder (7). Thread the screw into threaded bushing (4). Tighten screw to 25-30 ft-lbs (34-41 Nm) torque.

6. Install bleeder valve (17) and valve cap (18), if removed. Tighten valve to 80-100 **in-lbs** (9.0-11.3 Nm) torque.

7. See Figure 2-52. Connect brake line (6) to caliper using **new** steel/rubber banjo washers. Tighten banjo fitting bolt (3) to 17-22 ft-lbs (23-30 Nm) torque.

8. With the master cylinder in a level position, verify that the brake fluid level in the reservoir is 1/8 in. (3.2 mm) from the top. Add D.O.T. 5 SILICONE HYDRAULIC BRAKE FLUID if necessary.

⚠WARNING

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

9. Verify proper operation of the master cylinder relief port. Actuate the brake lever with the reservoir cover removed. A slight spurt of fluid will break the surface if all internal components are working properly.

10. Install cover gasket, cover and screws.

11. Depress front brake lever several times to set brake pads to proper operating position within caliper. Bleed brake system. See BLEEDING HYDRAULIC SYSTEM in this section.

12. Remove master cylinder cover. Verify proper fluid level - see Step 8. Reinstall master cylinder cover. Tighten screws to 10-15 **in-lbs** (1.1-1.7 mm) torque.

13. Test operation of brake lamp with the front brake applied and the ignition/light switch turned ON.

NOTE

To allow new brake pads to "wear in" properly with the brake disc, avoid making hard stops for the first 100 miles (160 km).

REAR BRAKE CALIPER

REMOVAL/DISASSEMBLY (Figure 2-54)

1. Remove pin bolts (11). Retract piston (6) slightly within bore of caliper (10) by pushing caliper inward toward wheel. Carefully lift caliper (10) off brake disc and brake pads (4).
2. Remove retainer clip (2). Slide outside brake pad outboard toward shock absorber and off mounting bracket (1). Slide inside brake pad inboard toward wheel and off mounting bracket.
3. Remove pad shims (3).

NOTE

Do not remove pistons from caliper unless there are signs of hydraulic fluid leakage or piston is not operating properly. If piston must be removed, proceed to steps 4 and 5.

4. Pump brake lever until piston reaches its full travel. Remove banjo fitting bolt and steel/rubber washers to disconnect brake line from caliper. Discard washers.
5. Remove retaining ring (8), dust boot (7), piston (6) and seal (5). Discard dust boot and seal. If piston will not come loose, proceed to step 6.

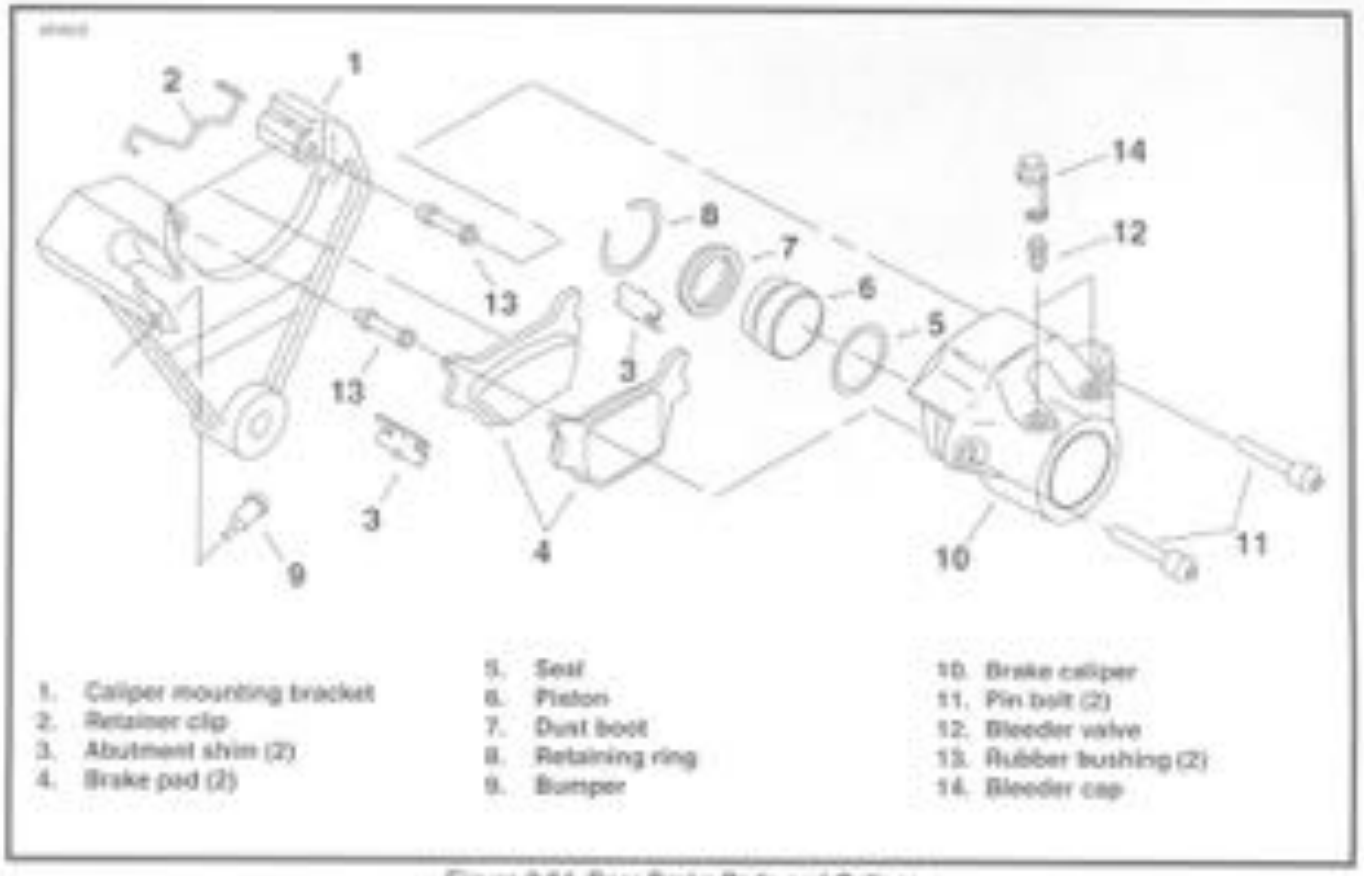
⚠WARNING

Always wear safety glasses when air pressure is used to remove piston from caliper, piston may be ejected with considerable force. Wear heavy gloves or hold piston with heavy towel to prevent personal injury.

⚠CAUTION

Exercise care to avoid dropping piston on hard surface. Damage to the piston surface may result in a sticking piston or fluid leakage.

6. Hold caliper with piston facing downward. Place a clean shop towel under piston. Apply low air pressure to hydraulic brake line inlet hole until piston is forced out caliper bore. If piston is tight in bore, tap lightly around caliper while applying air pressure.



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

Figure 2-54. Rear Brake Pads and Caliper

CLEANING, INSPECTION AND REPAIR (Figure 2-54)

⚠WARNING

- **Clean brake system components using denatured alcohol. Do not use mineral-base cleaning solvents such as gasoline or paint thinner. Use of mineral-base solvents causes deterioration of rubber parts that continues after assembly and can result in improper and unsafe brake operation leading to personal injury. Do not allow brake fluid, solvents, lubricants, etc. to contact brake disc or brake pad friction material or reduced vehicle braking ability will occur, possibly resulting in personal injury. Thoroughly clean all foreign substances from brake disc. Discard brake pads if they have been exposed to brake fluid, solvents, lubricants or similar substances.**
- **ALWAYS wear safety glasses when cleaning with solvents or using compressed air to blow dry components.**

1. Clean brake system components using denatured alcohol. Blow dry using compressed air. Carefully inspect all components. Replace any parts that appear damaged or worn. Replace rubber bushings (13) if damaged or worn. Do not hone caliper piston bore.
2. Inspect brake disc. Replace disc if warped or badly scored. Measure disc thickness for excessive wear. Minimum acceptable thickness is stamped on side of disc.
3. Inspect brake pads for damage or excessive wear. Replace both pads as a set if friction material of either pad is worn to 1/16 in. (1.6 mm) or less.

⚠WARNING

Always replace brake pads in complete sets for correct and safe brake operation. Never replace just one brake pad. Improper or unsafe brake operation could result in personal injury.

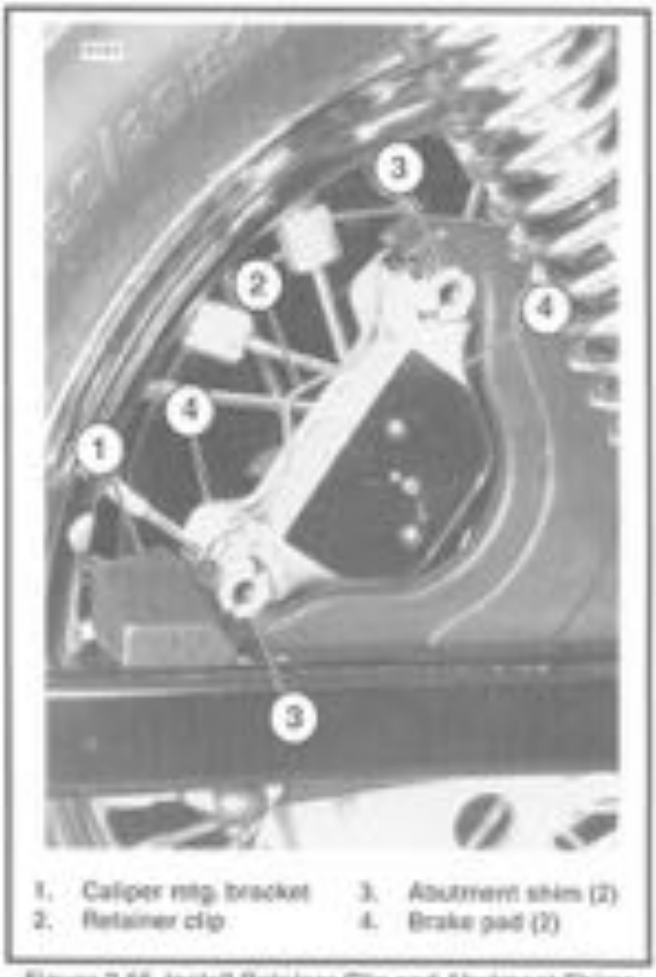
ASSEMBLY (Figure 2-54)

1. Install **new** seal (5) within groove in piston bore of caliper (10).
2. Install **new** dust boot (7), with its concave side facing piston (6), over top of piston. Seat the inner lip of dust boot in groove at top of piston.
3. Apply light coat of NeverSeez silicone grease (marked "PISTON LUBE" in service parts kit) to piston O.D., including chamfer. Apply a light coat to caliper piston bore (10) and I.D. of installed piston seal (5). Install piston (with dust boot) into caliper piston bore. Use a "C" clamp to press in piston, if necessary.

NOTE

To ensure proper brake pad to brake disc clearance when the caliper is installed, piston must be pressed all the way into the bore whenever new brake pads are used.

4. Install outer lip of dust boot (7) into caliper piston bore (10). With the gap at the top, compress and install retainer wire (8) within caliper piston bore. Press retainer wire firmly against piston dust boot.
5. Apply light coat of DOW CORNING 44 GREASE (marked "PIN LUBE" in service parts kit) to I.D. of rubber bushings (13).



1. Caliper mtg. bracket
2. Retainer clip
3. Abutment shim (2)
4. Brake pad (2)

Figure 2-55. Install Retainer Clip and Abutment Shims

INSTALLATION (Figures 2-54 and 2-55)

1. Position abutment shims (3) onto upper and lower rails of caliper mounting bracket (1). Position retaining loops of shims against outboard side of mounting bracket rails. Hold both shims in place.
2. With friction material facing brake rotor, install rear brake pads (4) onto abutment shims (3) on mounting bracket (one pad against outboard side of brake rotor, the other pad against inboard side).

⚠CAUTION

Both shims must be correctly positioned on mounting bracket and both rear brake pads must be correctly installed onto abutment shims or rear brake pad drag, uneven pad wear and/or damage to mounting bracket can result.

3. Position rear brake caliper (10) onto mounting bracket (1) so that caliper straddles brake pads (4). Align mounting holes in caliper with mounting holes in bracket. Apply light coat of DOW CORNING 44 GREASE (marked "PIN LUBE" in service parts kit) to O.D. of two pin bolts (11). Insert pin bolts into mounting holes of caliper and mounting bracket. Tighten pin bolts to 15-20 ft-lbs (20-27 Nm) torque.
4. Install bleeder valve (12) if removed. Tighten valve to 80-100 **in-lbs** (9.0-11.3 Nm) torque. Install bleeder cap (14).
5. Position **new** steel/rubber washers on each side of banjo fitting. Insert bolt through washers and banjo fitting into caliper. Tighten banjo fitting bolt to 17-22 ft-lbs (23-30 Nm) torque.
6. With the master cylinder in a level position, add brake fluid until the fluid level in the reservoir is 1/8 in. (3.2 mm) from the top. Use D.O.T. 5 SILICONE HYDRAULIC BRAKE FLUID.

⚠WARNING

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

7. Verify proper operation of the master cylinder relief port. Actuate the brake pedal with the reservoir cover removed. A slight spurt of fluid will break the surface if all internal components are working properly.
8. Install master cylinder cover gasket, cover and screws.
9. Depress rear brake pedal several times to set brake pads to proper operating position within caliper. Bleed brake system. See BLEEDING HYDRAULIC SYSTEM in this section.
10. Remove master cylinder cover. Verify proper fluid level, see Step 7.
11. Reinstall master cylinder cover. Tighten screws to 10-15 **in-lbs** (1.1-1.7 nm) torque.
12. Turn ignition/light switch to ON and apply rear brake to test operation of brake lamp.

NOTE

To allow new brake pads to "wear in" properly with the brake disc, avoid making hard stops for the first 100 miles (160 km).

FRONT BRAKE LINE (Figure 2-56)

1. Open bleeder nipple cap on front brake caliper. Install end of a length of plastic tubing over caliper bleeder valve, while placing free end in a suitable container. Open bleeder valve about 1/2-turn. Pump brake lever to drain brake fluid.
2. Remove screw (1) and lockwasher (2) to detach brake line clamp (3) from front fork upper bracket (right side).
3. Remove socket head screw (4), flat washer (5), clamp (6) and wire form (7) to detach brake line from stem at bottom of front fork lower bracket.
4. Remove banjo fitting bolt (8) and steel/rubber washers (9) to detach brake line from master cylinder body. Discard washers.
5. Remove banjo fitting bolt (8) and steel/rubber washers (9) to detach brake line from front brake caliper. Discard washers.
6. Carefully inspect the brake line for dents, cuts or other defects. Replace the brake line if any damage is noted.
7. Note that one end of the brake line is mostly thin tube construction, while the other end is flexible hose. Position **new** steel/rubber washers (9) on each side of the banjo fitting on the tube side. Insert bolt (8) through washers and banjo fitting. Loosely install bolt into master cylinder.
8. From the master cylinder, the brake line runs downward in front of the right handlebar, where it turns inboard at the front fork upper bracket. Loosely install clamp (3), lockwasher (2) and screw (1) to attach front brake line to right side of front fork upper bracket.
9. Continue running the brake line downward crossing to the left side of the vehicle under the front fork lower bracket (triple tree).
10. Loosely install wire form (7), clamp (6), flat washer (5) and socket head screw (4) to attach brake line to stem at bottom of front fork lower bracket.
11. Position **new** steel/rubber washers (9) on each side of banjo fitting at free end of brake line. Insert bolt (8) through washers and banjo fitting. Loosely install bolt into caliper.
12. Tighten clamp screw (4) at bottom of front fork lower bracket to 4-10 ft-lbs (5-14 Nm) torque.
13. Tighten banjo fitting bolt (8) into master cylinder to 17-22 ft-lbs (23-30 Nm) torque.
14. Tighten banjo fitting bolt into brake caliper to 17-22 ft-lbs (23-30 Nm) torque.
15. Tighten clamp screw (1) to front fork upper bracket to 15-21 **in-lbs** (1.7-2.4 Nm) torque.

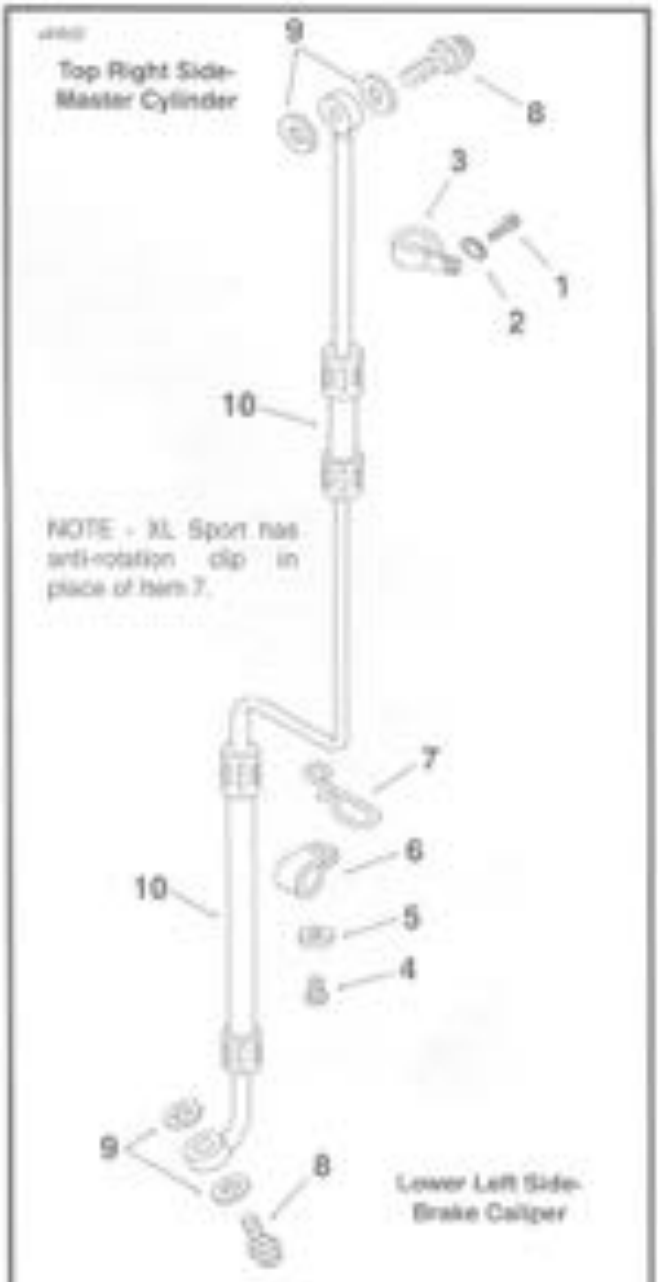
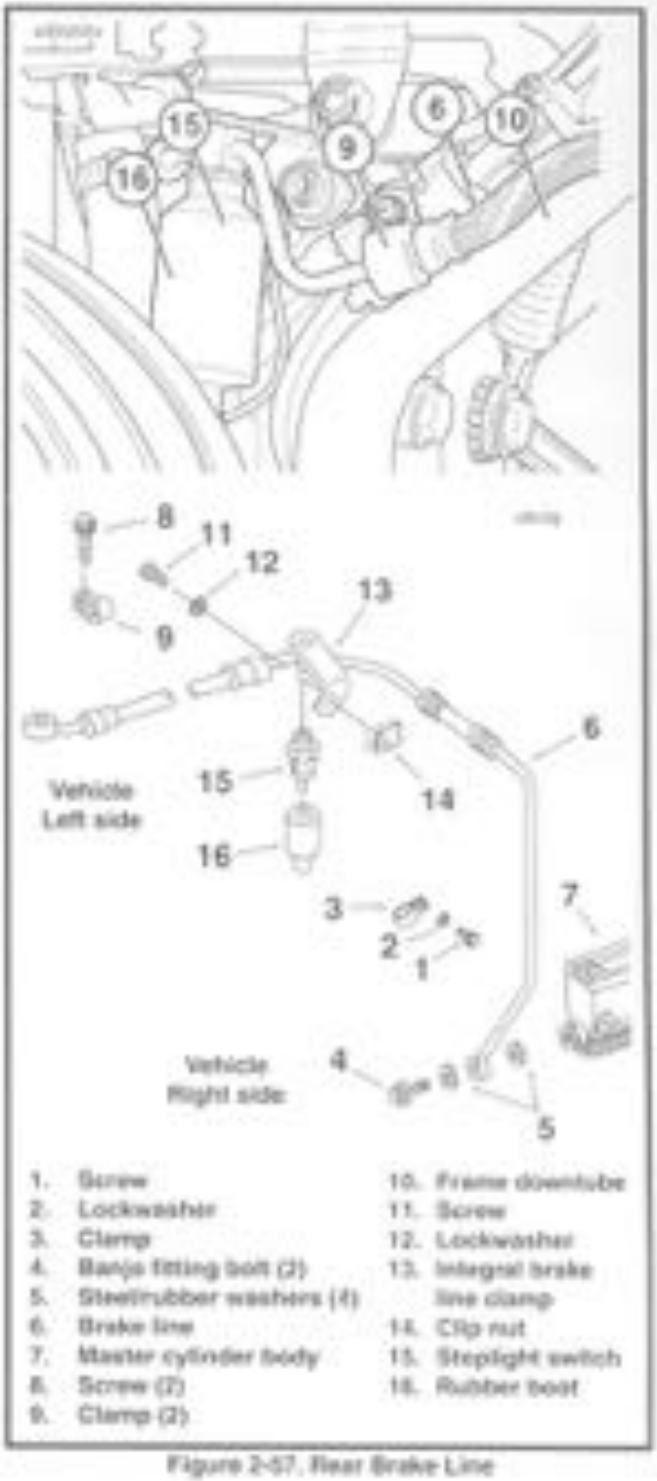


Figure 2-56. Front Brake Line

16. Install bleeder valve if removed. Refill master cylinder and bleed brakes. See BLEEDING HYDRAULIC SYSTEM in this section. Test operation of brake lever.
17. Tighten bleeder valve to 60-100 **in-lbs** (9.0-11.3 Nm) torque. Install bleeder cap.
18. Test operation of brake lamp with the front brake applied and the ignition/light switch turned ON.

REAR BRAKE LINE
(Figure 2-57)

1. Open bleeder nipple cap on rear caliper. Install end of a length of plastic tubing over caliper bleeder valve, while placing free end in a suitable container. Open bleeder valve about 1/2 turn. Pump brake pedal to drain brake fluid.
2. Remove screw (1) and lockwasher (2) to detach brake line clamp (3) from sprocket cover. Remove banjo fitting bolt (4) and steel/rubber washers (5) to detach brake line (6) from master cylinder body (7). Discard washers.
3. Remove banjo fitting bolt and steel/rubber washers to detach brake line from rear brake caliper. Discard washers.
4. Remove screws (8) to detach brake line clamps (9) from swing arm and frame downtube (10).
5. Remove screw (11) and lockwasher (12) securing integral brake line clamp (13) to clip nut (14) on flange of frame downtube. Pull terminal sockets from spade connections at bottom of stoplight switch. Unthread switch from tee nut. Remove rubber boot (16).
6. From left side of vehicle, feed **new** brake line beneath oil feed hose, left (forward) of negative battery cable and right (rearward) of positive battery cable to right side of vehicle.
7. Thread stoplight switch (15) to tee nut of brake line. Tighten switch assembly to 7-10 ft-lbs (9-14 Nm) torque. Install boot (16) on stoplight switch. Install terminal sockets on switch spade connectors.
8. Install clamp (3), screw (1) and lockwasher (2) to secure rear brake line (6) to sprocket cover. Tighten clamp screw to 45-65 **in-lbs** (5-7 Nm) torque.
9. Install clamps (9), screws (8), to secure rear brake line to swing arm and frame downtube (10). Tighten clamp screws to 15-21 **in-lbs** (1.7-2.4 Nm) torque.
10. Install clip nut (14) on flange of frame downtube. Install screw (11) and lockwasher (12) to secure integral brake line clamp (13) to frame downtube flange. Tighten screw to 5-10 ft-lbs (7-14 Nm) torque.
11. Position **new** steel/rubber washers (5) on each side of banjo fitting. Insert bolt (4) through washers and banjo fitting. Thread bolt into master cylinder and tighten to 17-22 ft-lbs (23-30 Nm) torque.
12. Position **new** steel/rubber washers on each side of banjo fitting. Insert bolt through washers and banjo fitting into caliper. Tighten banjo fitting bolt to 17-22 ft-lbs (23-30 Nm) torque.
13. Install bleeder valve if removed. Refill master cylinder and bleed brakes. See BLEEDING HYDRAULIC SYSTEM in this section. Test operation of rear brake.
14. Tighten bleeder valve to 80-100 **in-lbs** (9.0-11.3 Nm) torque. Install bleeder cap.
15. Test operation of brake lamp with the rear brake applied and the ignition/light switch turned ON.



1. Screw
2. Lockwasher
3. Clamp
4. Banjo fitting bolt (2)
5. Steel/rubber washers (4)
6. Brake line
7. Master cylinder body
8. Screw (2)
9. Clamp (2)
10. Frame downtube
11. Screw
12. Lockwasher
13. Integral brake line clamp
14. Clip nut
15. Stoplight switch
16. Rubber boot

Figure 2-57. Rear Brake Line

BLEEDING HYDRAULIC SYSTEM

GENERAL (Figure 2-58)

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

⚠WARNING

- **Harley-Davidson recommends all brake service be performed by a Harley-Davidson dealer or other qualified mechanic.**

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

NOTE

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

1. Install end of a length of plastic tubing over caliper bleeder valve. Place free end of tube in a clean container. Stand motorcycle upright.

2. Add D.O.T. 5 SILICONE HYDRAULIC BRAKE FLUID to master cylinder reservoir until the fluid level is 1/8 in. (3.2 mm) from the top. Do not reuse brake fluid.

3. Depress and hold brake lever/pedal to build up hydraulic pressure.

4. Open bleeder valve about 1/2-turn. Brake fluid will flow from bleeder valve through tubing. Close bleeder valve when brake lever/pedal has moved 1/2 to 3/4 of its full range of travel. Allow brake lever/pedal to return slowly to its released position.

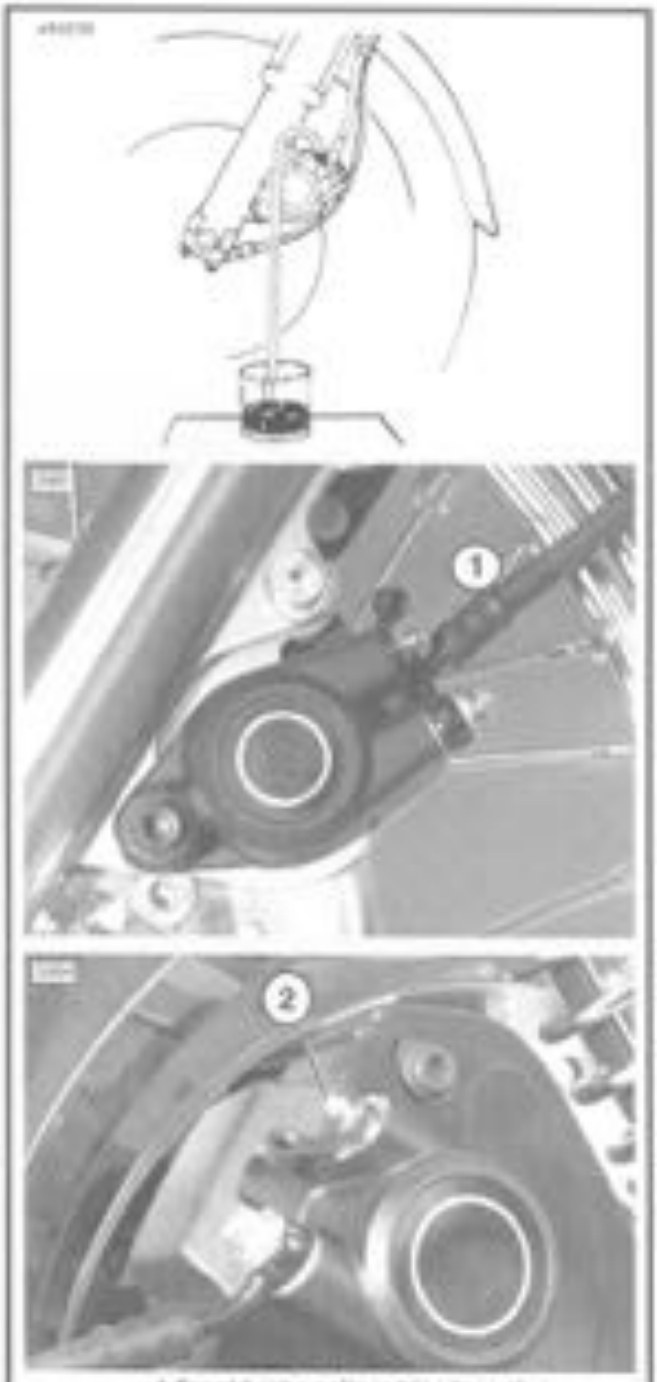
5. Repeat Steps 2-4 until all air bubbles are purged.

6. Final tighten bleeder valve to 80-100 **in-lbs** (9.0-11.3 Nm) torque. Install bleeder cap. Add brake fluid to master cylinder reservoir until fluid level is about 1/8 in. (3.2 mm) from the top. Do not reuse brake fluid. Final tighten master cylinder reservoir cover screws to 10-15 **in-lbs** (1.1-1.7 Nm) torque.

⚠WARNING

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

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



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

Figure 2-58. Bleeding Hydraulic System

FRONT FORK

GENERAL

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

Changing the Fork Oil (Figure 2-59)

1. Remove drain screw/washer (4) from bottom of one slider (2). Drain fork oil by repeatedly compressing front suspension.

NOTE

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

2. Repeat Step 1 for opposite side fork.
3. Block motorcycle under frame so that the front wheel is raised off the ground slightly; this enables front fork to extend fully and allows most of spring (10) preload (compression force) to be relieved.

⚠ WARNING

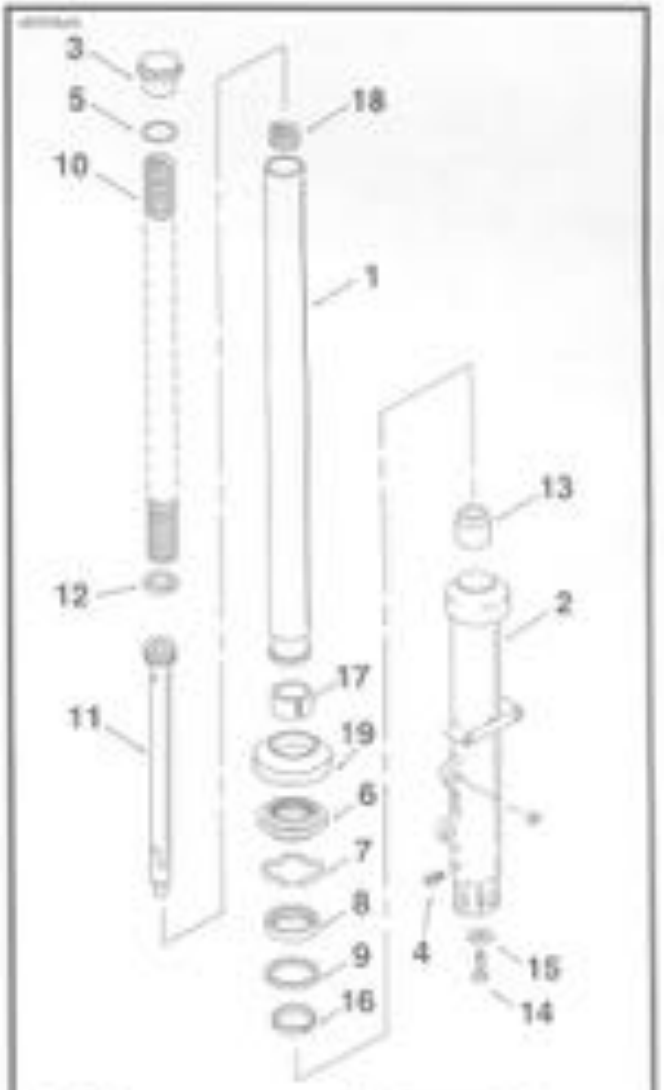
Always wear safety glasses when servicing fork assemblies. Do not attempt to remove tube caps (3) from slider tubes (1) without first relieving spring (10) preload in the manner specified or tube caps and springs might fly outward with great force, possibly resulting in personal injury.

4. Remove tube cap (3) with O-ring (5) from each slider tube (1). Replace the O-ring if damaged or worn.

NOTE

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

5. On all models, except XLH 883 Hugger and XL1200S Sport fill each slider tube/slider assembly with 9.0 fl oz. (269 ml) (WET fork) or 10.2 fl oz. (302 ml) (DRY fork) of TYPE "E" FORK OIL. On XLH 883 Hugger models only, fill each slider tube/slider assembly with 10.7 fl oz. (317 ml) (WET fork) or 12.1 fl oz. (358 ml) (DRY fork) of TYPE "E" FORK OIL.
6. Install each slider tube cap (3) with O-ring (5).
7. Lower motorcycle to the ground.

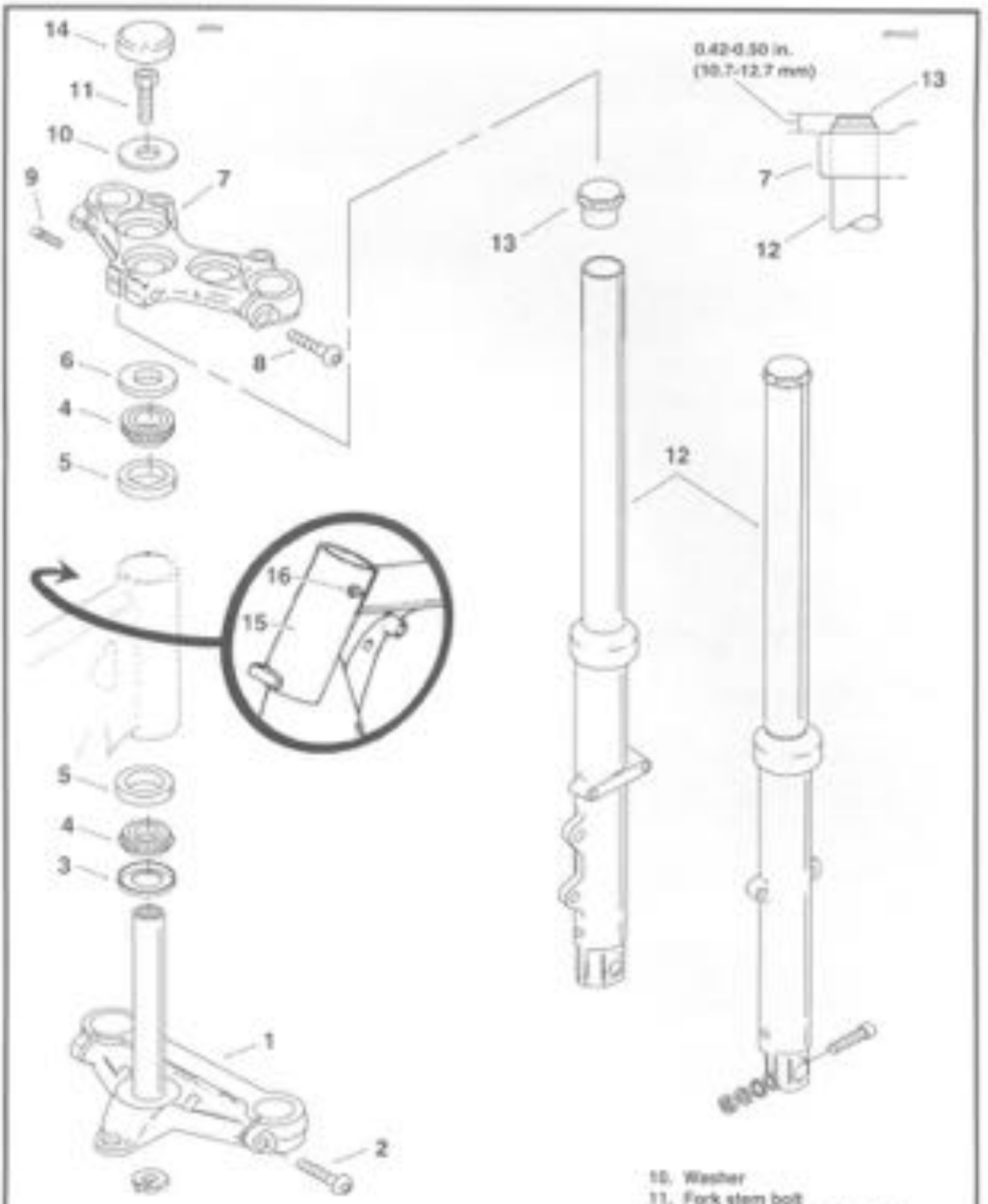


1. Tube
2. Slider
3. Tube cap
4. Drain screw/washer
5. O-ring
6. Dust seal
7. Internal circle clip
8. Oil seal
9. Spacer
10. Spring
11. Damper tube
12. Ring
13. Sleeve
14. Screw
15. Washer
16. Upper bushing
17. Lower bushing
18. Rebound spring
19. Cover

Figure 2-59. Front Slider Tube/Slider Assembly

REMOVAL

1. Remove front wheel assembly and front brake caliper. See FRONT WHEEL in this section.
2. Remove front fender mounting screws and locknuts. Remove fender.
3. See Figure 2-60. Loosen front fork upper and lower bracket pinch screws (8 and 2).
4. Slide fork sides (12) downward to remove from front fork brackets (7 and 1).



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

Figure 2-60. Front Fork Assembly

DISASSEMBLY (Figure 2-59)

1. Remove drain screw/washer (4) from slider (2). Remove tube cap (3) from slider tube (1). Drain fork oil. Remove O-ring (5) from tube cap (3). Remove spring (10) from slider tube (1).
2. Remove cover (19) and dust seal (8). Compress internal circle clip (7). Remove clip from groove in top of slider (2) bore.
3. Remove screw (14) and washer (15) from bottom of slider.

NOTE

Since there is little resistance to damper tube (11) rotation within slider tube (1) when removing screw (14), use an air impact wrench for best results.

4. Withdraw slider tube (1) from slider (2) until lower bushing (17) on slider tube contacts upper bushing (16) in slider. Use lower bushing on slider tube in a "slide hammer motion" to gently tap out oil seal (8), spacer (9) and upper bushing from slider bore.
5. Remove sleeve (13). Sleeve will be found within slider (2) or on bottom end of damper tube (11).
6. Insert a small diameter rod through opening in bottom of slider tube (1) to remove damper tube (11) assembly.
7. Remove rebound spring (18) from damper tube (11). Remove damper tube ring(s) (12) from damper tube. Remove lower bushing (17) from damper tube only if replacement is necessary.

CLEANING, INSPECTION, AND REPAIR (Figure 2-59)

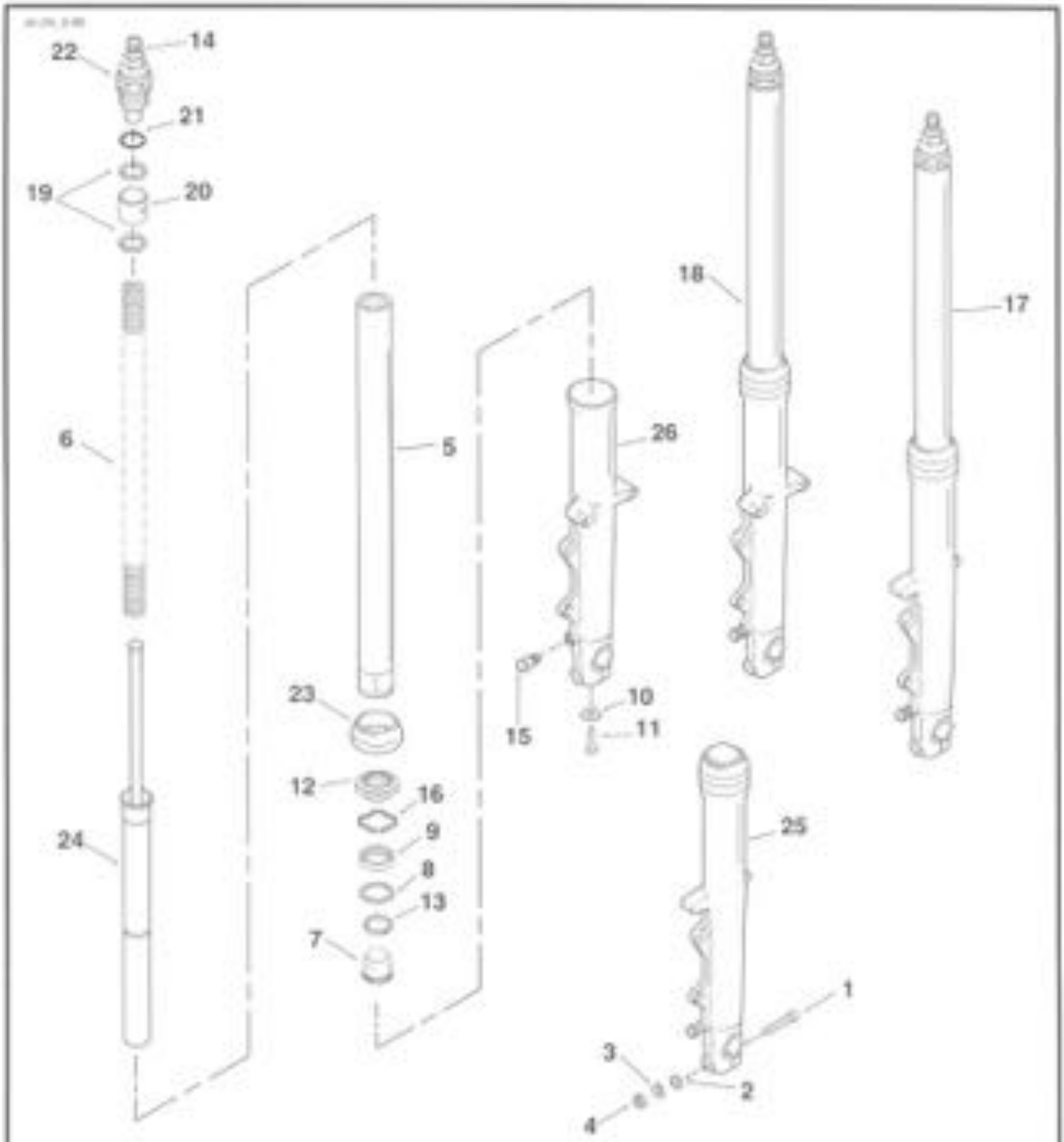
1. Thoroughly clean and inspect all parts. Replace any parts that are bent, broken or damaged.
2. Inspect the O-ring (5) for damage, wear or general deterioration; replace as necessary. Replace all other removed seals.
3. Inspect damper tube ring(s) (12). Replace ring(s) if damaged or excessively worn.
4. Check dust seal (8) where it contacts slider tube (1). 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 (Figure 2-59)

1. Install new lower bushing (17) in groove of slider tube (1), if removed. Expand bushing only enough to fit over tube.
2. Install damper tube ring(s) (12) into groove(s) of damper tube (11). Place rebound spring (18) over damper tube. Insert damper tube into slider tube (1).
3. Insert spring (10) into slider tube (1) with the tapered end down. Push damper tube (11) through opening at bottom of slider tube using spring (10). Place sleeve (13) over end of damper tube.
4. Install slider tube (1) assembly into slider (2). Install screw (14) with washer (15) 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 (10), final tighten screw (14).
5. Place upper bushing (16), spacer (9) (concave side downward), oil seal (8) (lettering side upward) and FORK SEAL AND BUSHING INSTALLATION TOOL (Part No. HD-39583) over slider tube (1). Install bushing, spacer and seal into slider (2) bore by tapping components downward with the installation tool. Install internal circle clip (7) into groove in top of slider bore.
6. Install dust seal (8) and cover (19) at top of slider (2). Install drain screw/washer (4) into lower end of slider.
7. Pour 10.2 fl oz. (302 ml) (all models except XLH 883 Hugger) or 12.1 fl oz. (358 ml) (XLH 883 Hugger models only) of TYPE "E" FORK OIL into top end of slider tube (1). Install slider tube cap (3) with O-ring (5).

INSTALLATION (Figure 2-60)

1. Insert fork slider (12) through front fork lower (1) and upper (7) brackets. Position slider tubes so that top of each tube cap (13) extends 0.42-0.50 in. (10.7-12.7 mm) above top surface of front fork upper bracket.
2. On models with directional lamps mounted to front fork bracket, hold directional lamp mounting brackets upright. On all models, tighten front fork upper and lower bracket pinch screws (8 and 2) to 30-35 ft-lbs (41-47 Nm) torque.
3. Install front fender using original fasteners. Tighten fasteners to 9-13 ft-lbs (12-18 Nm) torque.
4. Install front wheel assembly and front brake caliper. See FRONT WHEEL in this section.

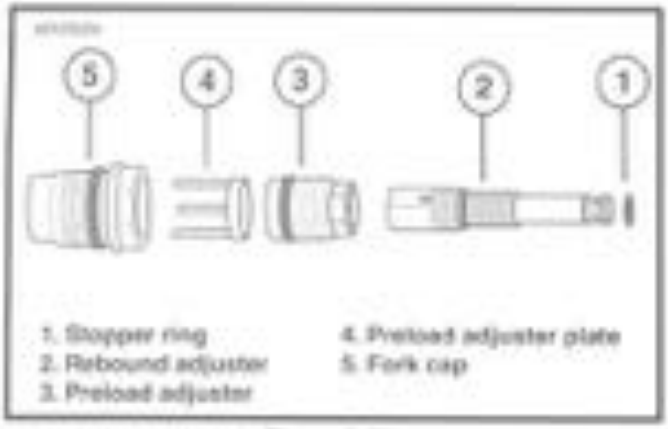


1. Screw
2. Washer
3. Lockwasher
4. Nut
5. Slider tube
6. Spring
7. Lower stop
8. Spacer
9. Oil seal
10. Washer
11. Screw
12. Seal
13. Bushing
14. Rebound adjuster
15. Compression adjuster
16. Retaining ring
17. Fork slider - right
18. Fork slider - left
19. Spacer
20. Spring collar
21. O ring
22. Cap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

Figure 3-61. XL1200 Sport Front Fork Assembly

DISASSEMBLY - XL 1200S

1. *See Figure 2-62.* Remove the stopper ring (1).



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

Figure 2-62.

2. Remove the spring preload adjuster (3).

NOTE

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

3. Unthread the fork cap (5) from the fork tube and allow the fork leg to drop, exposing the spring.

4. See Figure 2-63. Set the Fork Spring Compression tool (HD-41549A) on the spring collar. Turn screws in to engage holes in collar. Compress the spring until the Spring Plate tool (HD-41351) can be positioned between the spacer and the spring collar.

Figure 2-63.

5. See Figure 2-64. Hold the fork bolt and compression adjuster. Remove the fork bolt from the compression adjuster. Remove the spring adjuster plate from the fork bolt.

6. Remove spacer, spring collar and spring.

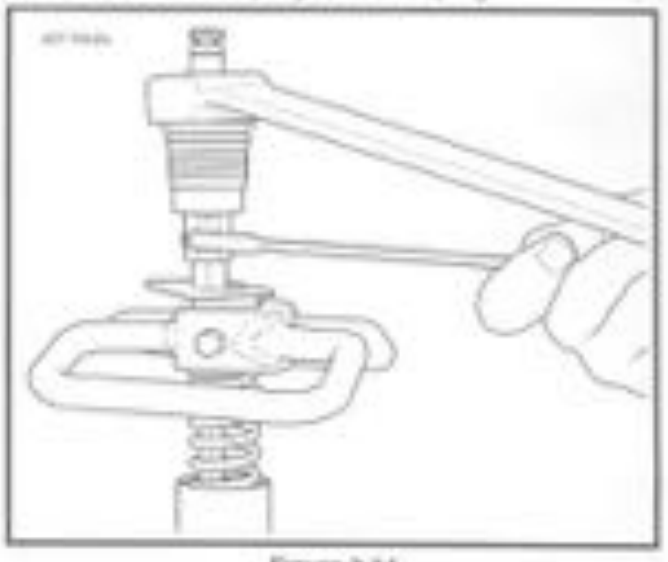


Figure 2-64.

7. Pour out the fork oil by pumping the fork leg and rod 8-10 times until rod moves freely.

8. See Figure 2-65 and 2-66. Position fork slider in vise using fork tube holder (HD-41177) to avoid damage.

9. See Figure 2-66. Remove the socket head bolt.

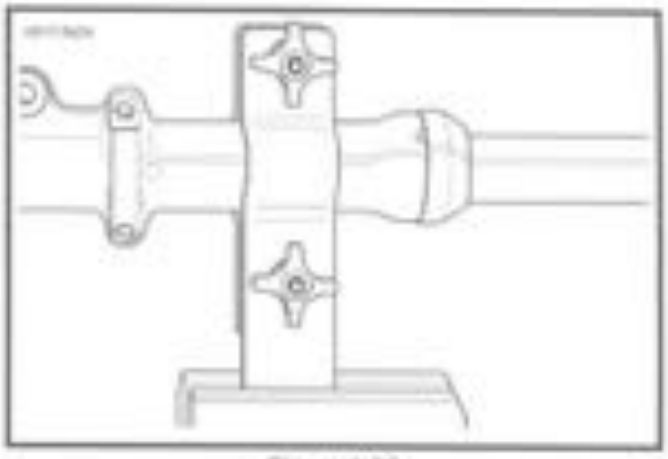


Figure 2-65.

10. Remove damper from fork tube.

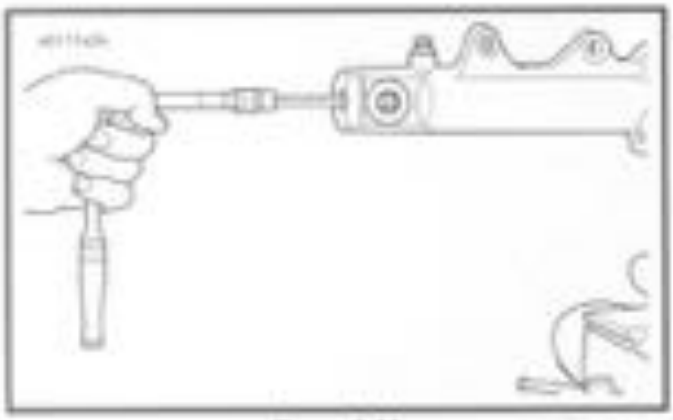


Figure 2-66.

11. See Figure 2-67 and 2-68. Remove the cover from the slider. Remove seal and stopper ring.

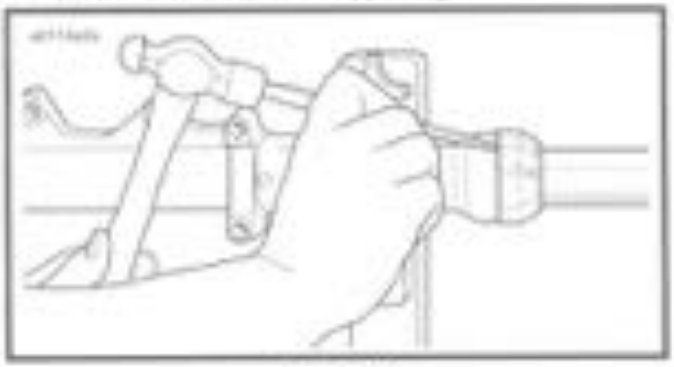


Figure 2-67.

12. Pull the fork tube out of the slider.

13. Remove the oil seal, spacer and guide bushing from the fork tube.

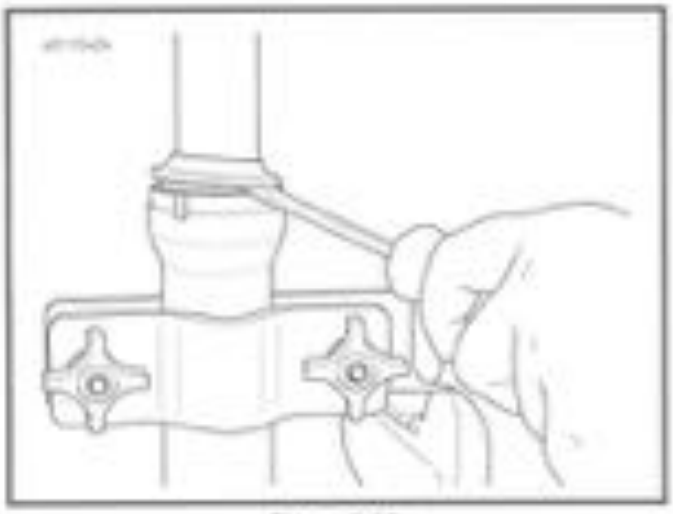


Figure 2-68.

INSPECTION - XL 1200S

1. Measure fork spring free length. Replace spring if it is shorter than 16.02 in (407 mm).
2. Check the fork tube and slider for score marks, scratches or abnormal wear.
3. Check the slide and guide bushings for excessive wear or scratches.
4. Set the fork tube on V-blocks and measure runout. Runout should not exceed .008 in. (0.2 mm).

ASSEMBLY - XL 1200S

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

NOTE

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

4. Slip the slider into the fork tube.
5. Place the slide bushing over the fork tube until it rests on the slider.
6. See Figure 2-69. Drive the guide bushing with the spacer seal into the slider.
7. Lubricate new oil seal with TYPE "E" FORK OIL.
8. Drive the oil seal into the slider using Fork Seal Installer, HD-35583.

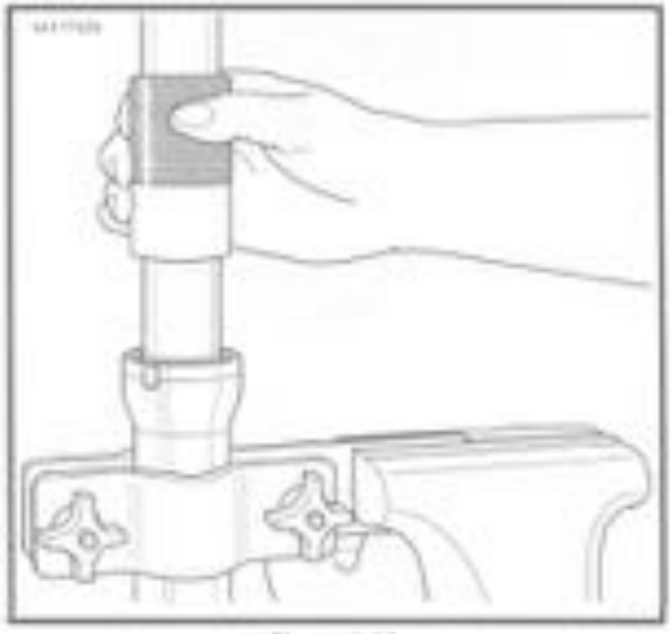


Figure 2-69.

9. Install the stopper ring and dust seal.

NOTE

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

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

b. See Figure 2-70. Holding thumb on detent spring and ball, back out (turn counterclockwise) rebound adjuster to last "click." Turn down (clockwise) 13 "clicks"

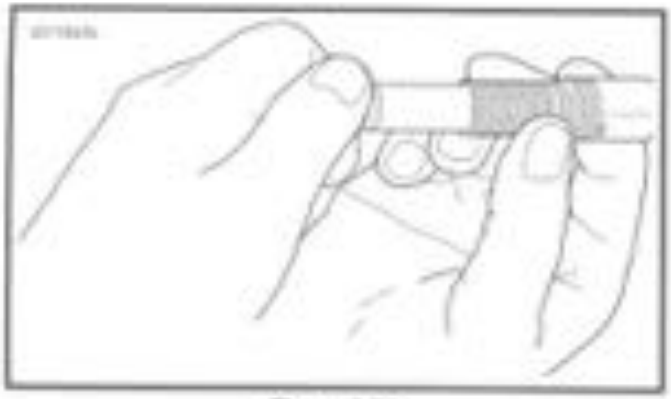


Figure 2-70

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

d. See Figure 2-71. Thread locknut on damper rod up to contact base of rebound adjuster and tighten in place.

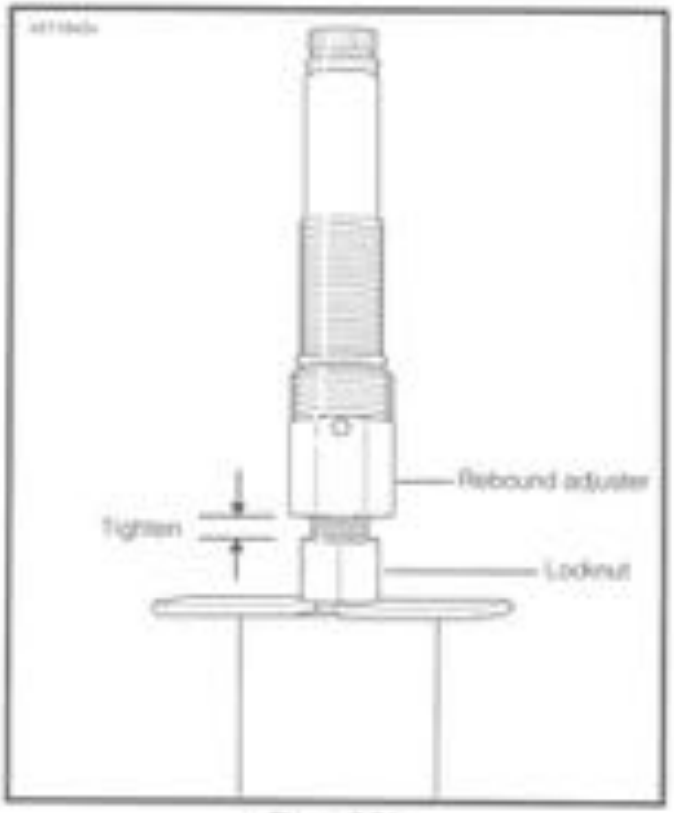


Figure 2-71

10. Hold slider in vise taking precautions to avoid damage. Install damper tube into the fork tube. Tighten socket screw and washer. Torque to 22 - 29 ft.lbs (29.8-39.3 Nm).

11. Pour half the TYPE "E" FORK OIL into fork tube.

12. See Figure 2-72. Slowly pump the damper rod 10 or more times.

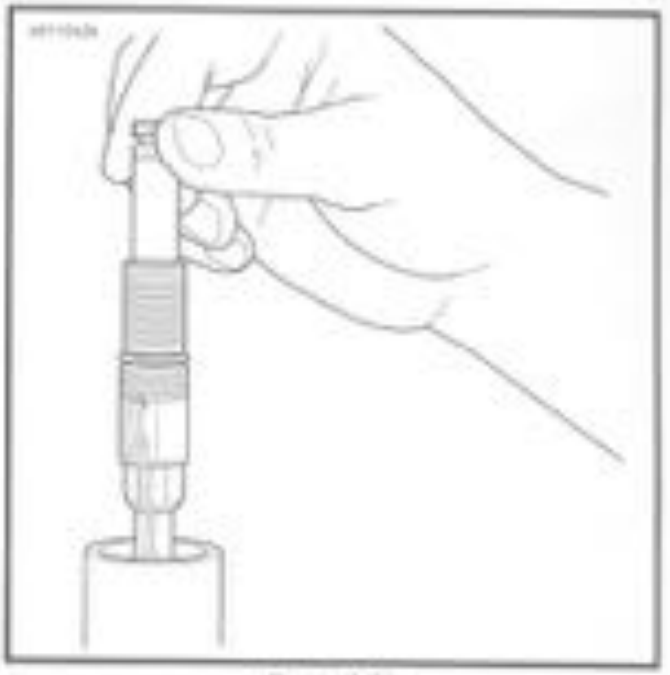


Figure 2-72.

13. Position the damper rod in the fully bottomed position.

14. Pour the remaining amount of TYPE "E" FORK OIL into the fork tube.

15. See Figure 2-73. Using the Pro-Level Oil Gauge (HD-59000A) adjust oil level to 5.6 in. (144 mm).

16. Carefully clean and install the spring, spring collar, and spacers.

NOTE

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

17. See Figure 2-74. Using Fork Spring Compression Tool (HD-41549A) push spring collar down and place Spring Plate (HD-41551) between spacer and spring collar.

18. Install fork cap and tighten against rebound adjuster.

19. Torque to 22 - 29 ft.lbs (29.8-39.3 Nm).

20. Tighten fork cap on fork tube. Torque to 11 - 22 ft.lb.

21. Install the spring adjuster plate.

22. Replace O-rings on spring preload adjuster and lubricate with fork oil.

23. Install the spring preload adjuster.

24. Install the stopper ring.

25. Carefully drive slider cover into slider.

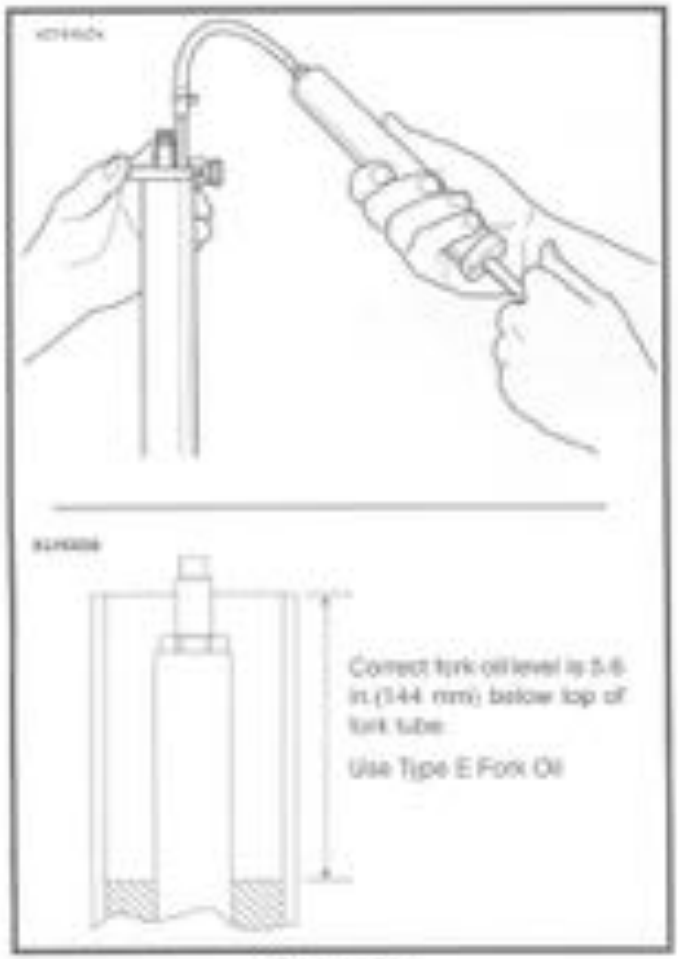


Figure 2-73.

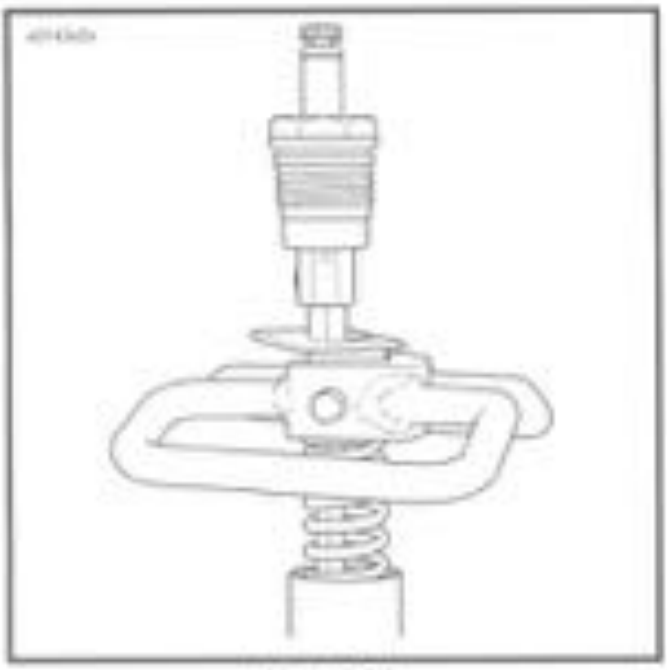


Figure 2-74.

INSTALLATION

NOTE

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

1. Insert fork sides through front fork lower and upper brackets. See Figure 2-75. Position slider tubes so that top of each tube cap extends 1.735-1.745 in. (44.1-44.3 mm) above top surface of front fork upper bracket.
2. On models with directional lamps mounted to front fork bracket, hold directional lamp mounting brackets upright. On all models, tighten front fork upper and lower bracket pinch screws to 30-35 ft-lbs (41-47 Nm) torque.
3. Install front fender using original fasteners. Tighten fasteners to 9-13 ft-lbs (12-18 Nm) torque.
4. Install front wheel assembly and front brake caliper. See FRONT WHEEL in this section.

NOTE

XL Sport suspension adjustment procedures, setting recommendations and troubleshooting information may be found in the 1998 Harley-Davidson Owner's Manual pages 110-115.

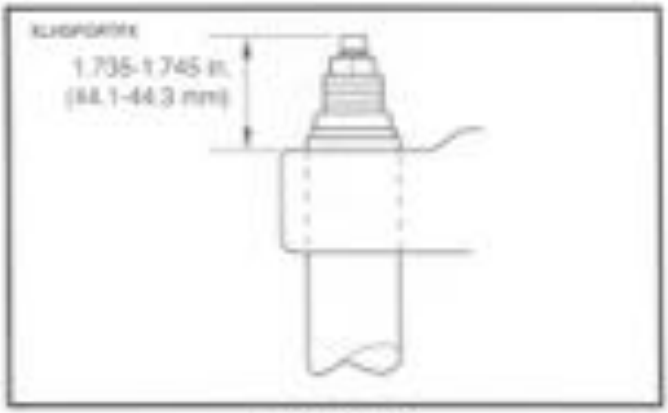


Figure 2-75.

FORK STEM AND BRACKET ASSEMBLY

ADJUSTMENT (Figure 2-60)

1. Place suitable blocking under frame to raise front wheel several inches off floor.
2. Remove all items that could interfere with front end swing momentum. If clutch control cable inhibits front end swing, disconnect it.
3. Place a strip of masking tape over tip of front fender.
4. Install a pointer mounted to a floor stand. The pointer is positioned at the center of the fender with the front wheel pointed straight ahead.
5. Repeatedly nudge the fender a short distance on one side until the front end begins to "fall-away" (i.e., pivot about its steering head center) by itself. Mark the point on the tape where the front end begins to "fall-away." Repeat this procedure in the opposite direction.
6. Measure the distance between the two "fall-away" marks. The distance must be 1-2 in. (25-50 mm) for proper bearing adjustment.
7. If the distance is not correct, loosen the lower bracket pinch screws (2) and the fork stem clamp screw (9). Remove cap (14). Loosen or tighten the fork stem bolt (11) until the "fall-away" distance is 1 to 2 inches (25-50 mm).

NOTE

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

8. Tighten fork stem clamp screw (9) to 30-35 ft-lbs (41-47 Nm) torque. Tighten lower bracket pinch screws (2) to 30-35 ft-lbs (41-47 Nm) torque.
9. Recheck "fall-away."

LUBRICATION (Figure 2-60)

All XLH models are equipped with a grease fitting (16) on the left side of the steering head (15). This fitting allows greasing of the steering head bearings (4) without disassembly.

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

REMOVAL/DISASSEMBLY (Figure 2-60)

1. Remove the fork assemblies. See FRONT FORK, REMOVAL.
2. Remove stem bolt cap (14), fork stem bolt (11) and washer (10). Loosen fork stem clamp screw (9). Lift handlebar assembly from steering head with fork upper bracket (7) attached. Carefully position assembly away from work area. Exercise caution to avoid bending control wires.

NOTE

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

3. Remove upper dust shield (6) and upper bearing cone (4). Lower the fork stem and bracket assembly (1). The lower bearing cone is a press fit on fork stem. Chisel through outer bearing cage to allow rollers to fall free. Apply heat to remove the remaining portion of bearing cone. Continuously move flame around its entire circumference until bearing falls free. Remove lower dust shield (3).
4. If replacement of bearing cups (5) is necessary, drive cups from steering head using STEERING HEAD BEARING RACE REMOVAL TOOL (Part No. HD-39951A) and UNIVERSAL DRIVER HANDLE (Part No. HD-33416).

CLEANING, INSPECTION, AND REPAIR (Figure 2-60)

Clean the dust shields (6 and 3), bearing cones (4), fork stem and bracket (1) and frame with solvent. Carefully inspect bearing races and assemblies for pitting, scoring, wear and other damage. Replace damaged bearing as a set. Check the fork stem and bracket (1) for damage. Replace damaged fork stem.

ASSEMBLY/INSTALLATION (Figure 2-60)

1. If removed, install new bearing cups (5) into frame steering head using STEERING HEAD BEARING RACE INSTALLATION TOOL (Part No. HD-39952).
2. Liberally coat the bearing cones (4) with grease. Work the grease into the rollers.
3. Place lower bearing dust shield (3) over fork stem. Find a section of pipe having an inside diameter slightly larger than the outside diameter of the fork stem. Press bearing cone (4) onto fork stem and bracket (1) using the pipe as a press on tool.
4. Insert fork stem and bracket (1) through the steering head. Install the upper bracket bearing (4) and dust shield (6) onto the stem.
5. Install the upper bracket (7) including the handlebar assembly and loosely install fork stem bolt (11) with washer (10).
6. Install fork assemblies (12). See FRONT FORK, INSTALLATION in this section.
7. Tighten the fork stem bolt (11) until the bearings have no free play. Make sure the fork stem turns freely, then tighten the fork stem clamp screw (9). Check bearing adjustment. See FORK STEM AND BRACKET ASSEMBLY, ADJUSTMENT.

REAR FORK

REMOVAL/DISASSEMBLY (Figure 2-76)

NOTE

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

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

⚠CAUTION

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

NOTE

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

7. Carefully press bearing outer races (8) from fork. Remove lock ring (9).

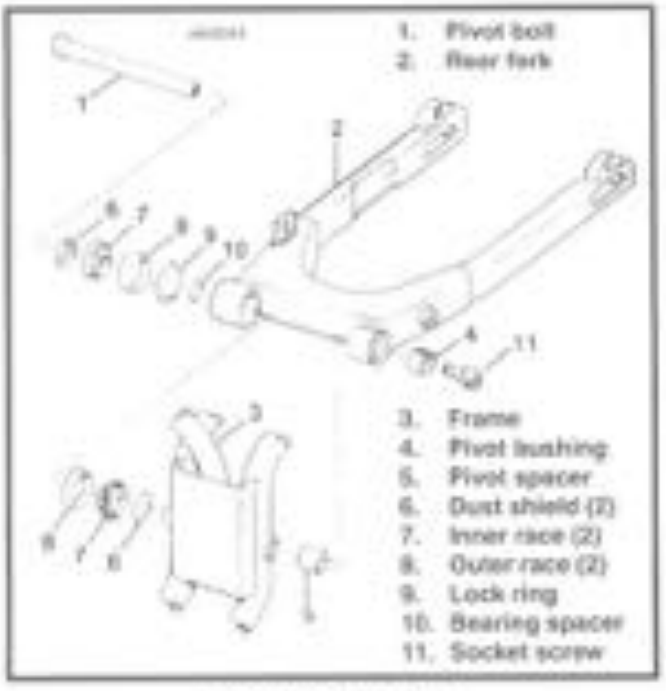


Figure 2-76.Rear Fork

8. Remove pivot spacer (5). Press pivot bushing (4) from fork assembly.

CLEANING AND INSPECTION

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

ASSEMBLY (Figure 2-76)

1. If necessary, install new lock ring (9) and press new outer races (8) into position.

NOTE

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

2. Coat bearing components with bearing grease and assemble.

⚠CAUTION

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

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

⚠WARNING

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

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

INSTALLATION (Figure 2-76)

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

REAR SHOCK ABSORBER

ADJUSTMENT (Figure 2-77, 2-78)

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

To adjust the compression of the rear shock absorber spring, turn spring adjusting cam (10) using SPANNER TOOL (Part No. HD-94820-75A). Adjust spring adjusting cams on both shock absorbers to the same position.

⚠WARNING

Both shock absorber spring adjusting cams must be adjusted to the same position or vehicle handling may be adversely affected, resulting in possible personal injury and/or vehicle damage.

REMOVAL (Figure 2-78)

1. Raise rear end of motorcycle with stand or suitable blocking underneath frame. If blocking is not available, remove one shock absorber at a time. The remaining shock absorber will hold the rear fork and frame in place.
2. Remove acorn nut (4), one washer (3), stud cover (14) and second washer (3) from end of upper mounting bolt (7). Remove bottom locknut (5), bolt (1) and washer (2). Remove shock absorber assembly.

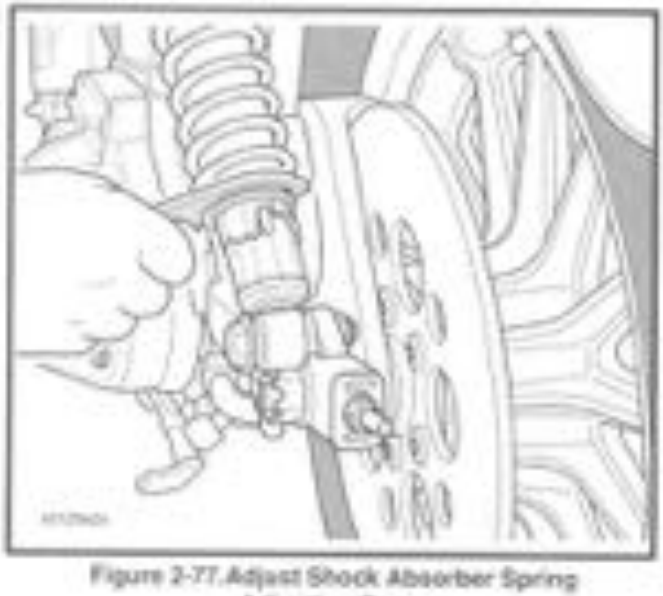


Figure 2-77.Adjust Shock Absorber Spring Adjusting Cams

DISASSEMBLY (Figure 2-78)

1. Note the position of the spring adjusting cam for proper reassembly.
2. With spring seat (8) facing up, place shock absorber in SHOCK ABSORBER TOOL (Part No. HD-97016-52A) or suitable shock or spring compressing tool. Compress spring far enough to remove spring seat (8).
3. Carefully release spring compression. Remove shock absorber from tool. Remove cover (15), spring, spring guide (9) and adjusting cam (10).

CLEANING AND INSPECTION

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

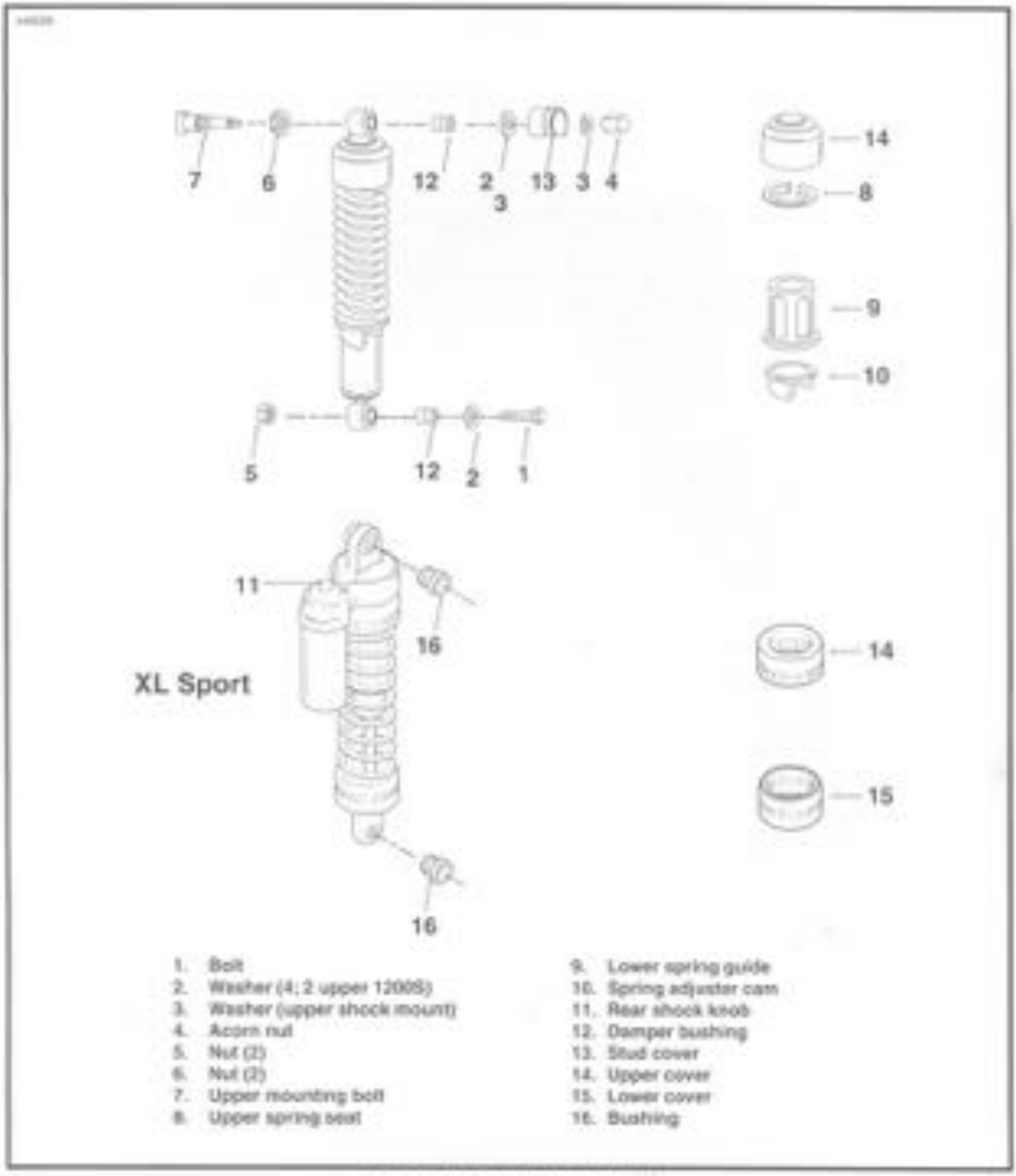
ASSEMBLY (Figure 2-78)

Assemble the components in the reverse order of the DISASSEMBLY procedures.

Apply a thin coat of grease to each cam surface. Place assembly in tool and compress spring enough to insert spring seat (8). Slowly release spring compression. Be sure to place the spring adjusting cam (10) in the same adjustment position on both shock absorbers.

INSTALLATION (Figure 2-78)

1. Install shock absorber upper end over upper mounting bolt (7). Locknut (6) secures mounting bolt to frame.
2. Position bottom end of shock absorber against outboard side of rear fork mount. Insert bolt (1) with washer (2) through shock bottom bushing (12) and rear fork mount flange. Install locknut (5) on end of bolt.
3. Apply 2-3 drops of LOCTITE Threadlocker 242 (blue) to threads of upper mounting bolt (7). Install washer (3), stud cover (14), second washer (3) and acorn nut (4) onto upper mounting bolt. Tighten acorn nut to 21-35 ft-lbs (28-47 Nm) torque.
4. Tighten locknut (5) to 30-50 ft-lbs (41-68 Nm) torque.



1. Bolt
2. Washer (4; 2 upper 1200S)
3. Washer (upper shock mount)
4. Acorn nut
5. Nut (2)
6. Nut (2)
7. Upper mounting bolt
8. Upper spring seat
9. Lower spring guide
10. Spring adjuster cam
11. Rear shock knob
12. Damper bushing
13. Stud cover
14. Upper cover
15. Lower cover
16. Bushing

Figure 2-78. Rear Shock Absorbers

THROTTLE CONTROL

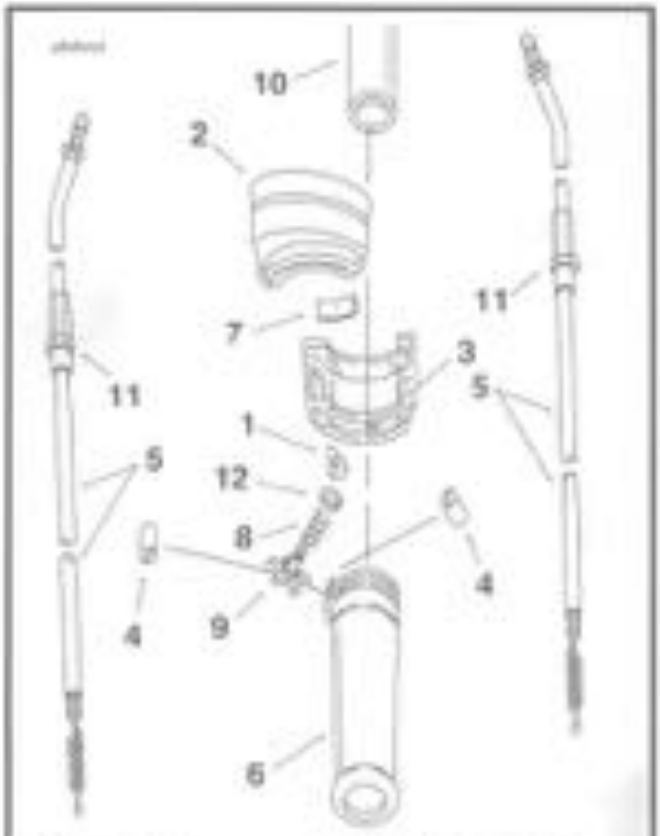
ADJUSTMENT

⚠WARNING

The throttle control MUST operate freely without binding. Irregular or sticking throttle response could result in loss of control of the vehicle and possible personal injury.

See Figure 2-79. With throttle friction screw (9) backed off, the carburetor throttle must return to the closed (idle) position. Check control cable adjustment. With engine running, turn handlebars through full range of travel. If engine speed changes during this maneuver, adjust control cables according to the following procedure.

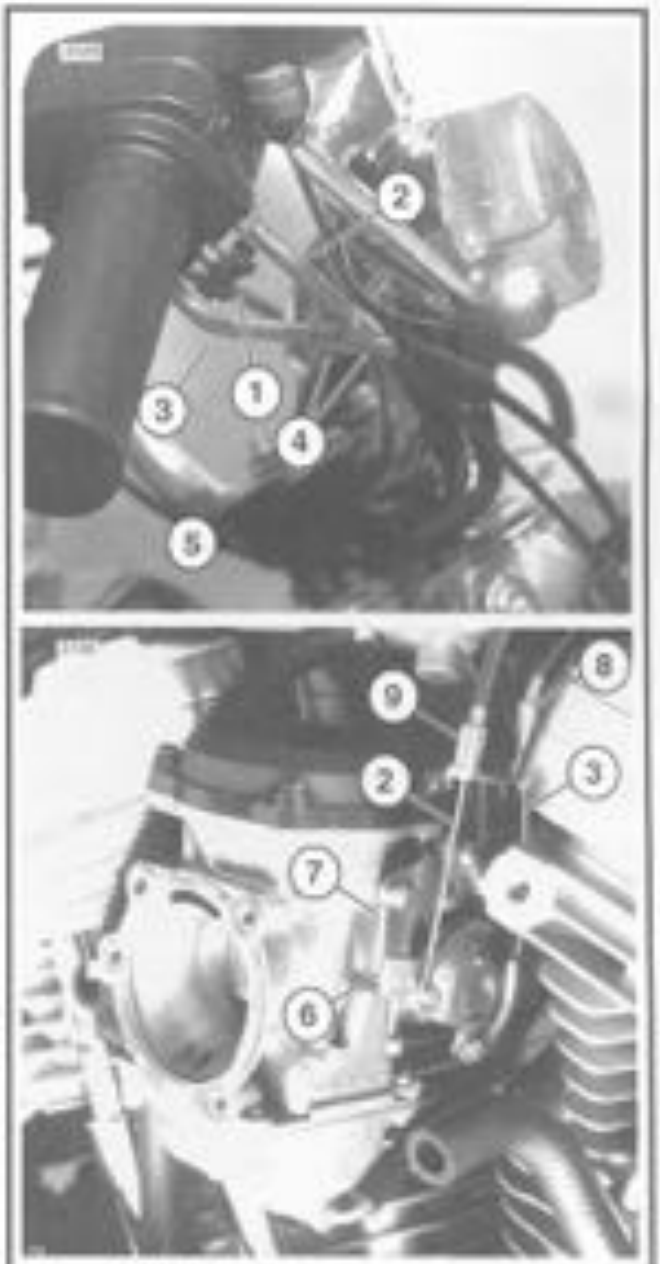
1. See Figure 2-80. Loosen throttle friction screw (1).
2. Slide rubber boot off each cable adjuster (4).
3. Loosen jam nut on each adjuster.
4. Turn adjusters in direction which will shorten cable housings to minimum length.



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

Figure 2-79. Throttle Control – Right Handlebar

5. Point front wheel straight ahead. Twist throttle control grip (5) to fully open position and hold.



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

Figure 2-80. Throttle Control Cable/Idle Control Cable

6. Turn adjuster (4) on throttle control cable (2) until throttle cam stop (6) touches carburetor stop plate (7). Tighten jam nut on throttle control cable adjuster (4). Release throttle control grip (5).

7. Turn handlebars fully to right. Turn adjuster (4) on idle control cable (3) until end of cable housing just touches spring within carburetor cable guide (8).

8. With throttle friction screw (9) loosened, twist and release throttle control grip (5) a few times. Carburetor throttle must return to idle position each time throttle grip is released. If this is not the case, turn adjuster (4) on idle control cable (3) (shortening cable housing) until throttle control functions properly.

9. Tighten jam nut on idle control cable adjuster (4). Recheck operation of throttle control (Step 8).

10. Slide rubber boot over each cable adjuster (4). Recheck engine slow idle speed. Adjust if required.

REMOVAL/DISASSEMBLY (Figure 2-79)

1. Slide rubber boot off each cable adjuster (11). Loosen jam nut on each adjuster. Turn adjusters in direction which will shorten cable housings to minimum length.

2. Remove two screws (1) and separate upper housing (2) from lower housing (3).

3. Unhook ferrules (4) and cables (5) from throttle control grip (6) and lower housing (3).

4. Remove air cleaner assembly. See AIR CLEANER, REMOVAL in Section 4.

5. Disconnect cables from carburetor.

6. Remove friction spring (7), throttle friction screw (9) and spring (8) from lower housing (3).

CLEANING, INSPECTION, AND REPAIR

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

ASSEMBLY/INSTALLATION (Figure 2-79)

1. Apply a light coating of graphite to the handlebar (10) and the inside surface of the switch housings (2 and 3).

2. Install throttle spring (8), throttle friction screw (9) and friction spring (7) in lower housing (3).

3. Attach cable assemblies (5) to lower housing (3). See Figure 2-80. Throttle control cable (2) has a 5/16 in. (7.9 mm) fitting end and is positioned to front of lower housing. Idle control cable (3) has a 1/4 in. (6.3 mm) fitting end and is positioned to rear of lower housing.

4. See Figure 2-79. Install throttle control grip (6) over end of right handlebar (10). Position lower housing (3) onto right handlebar, engaging lower housing with throttle control grip. Position ferrules (4) over cable (5) ball ends, then seat ferrules (with cables attached) in their respective notches of the throttle control grip.

5. Install upper housing (2) over right handlebar (10) and secure to lower housing (3) using screws (1). Tighten screws to 18-24 ft-lbs (24-33 Nm) torque.

6. See Figure 2-81. Route control cables forward from throttle control grip, forward of front fork upper bracket, downward between right slider tube and headlamp, rearward along right side of frame steering head, rearward along right side of frame backbone into retaining clip on ignition switch housing, downward to carburetor.

Figure 2-81. Control Cable Routing

7. See Figure 2-80. Install idle control cable (3) housing and spring into longer, inboard cable guide (8) on carburetor.

8. Install throttle control cable (2) housing into shorter, outboard cable guide (9) on carburetor.

⚠WARNING

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

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

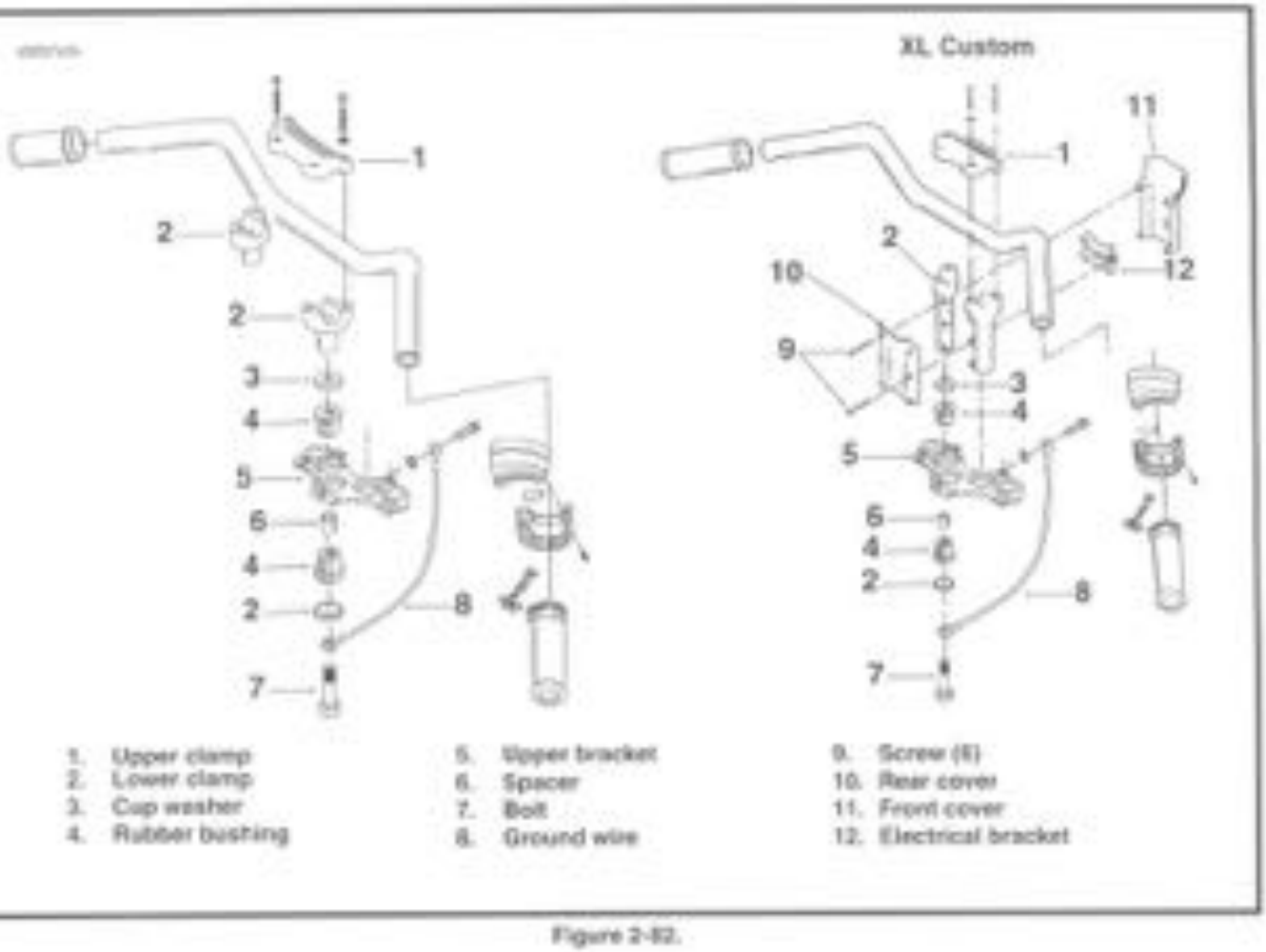
HANDLEBARS

REMOVAL

1. Disconnect battery negative cable.
2. See Figure 2-82. Remove left hand controls and switches. Let wires carefully support the switches.
3. Remove left handlebar grip.
4. Remove right side master cylinder. Loosen switch housing screws but do not remove.
5. Remove instrument cluster and screws.
6. Remove remaining two screws holding upper clamp.
7. Right hand control assembly may now be removed from detached handlebar.
8. On XL Custom
   - Remove riser cover screws (9) and front and rear covers (10 and 11).
   - Detach indicator lamp socket from bezel.
9. Loosen riser bolts (7). Remove cup washers (3), rubber bushings (4) and spacers (6).
10. Remove ground wire (8) from triple clamp.

INSTALLATION

1. See Figure 2-82. Install cup washers (3), rubber bushings (4) and spacers (6).
2. Insert riser bolts (7) (Finger tight only).
3. Slide right handlebar switch housing onto right handlebar end.
4. Position handlebar on lower riser clamp (2).
5. Place upper riser clamp in position and thread the two rear (front on XL Custom) screws in place.
6. Using the remaining two screws, install instrument bracket.
7. See Figure 2-83. Adjust the handlebars to the desired position and torque rear screws (front screws on XL Custom) to 12-15 ft-lbs (16-20 Nm) until cast-in spacers of upper clamp contact the lower clamp.
8. See Figure 2-83. Final tighten front screws (rear screws on XL Custom) to 12-15 ft-lbs (16-20 Nm).
9. Torque lower riser bolts (7) to 25-30 ft-lbs (34-41 Nm).



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

Figure 2-82.

10. On XL Custom:
    - Position indicator lamp socket and clip in position under bezel.
    - Install front and rear rear covers (10 and 11) and torque screws (9) to 8-12 **in-lbs** (.9-1.4 Nm).
11. Install new left hand grip in place as follows:
    - Using a piece of emery cloth, rough grip end of left handlebar.

NOTE

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

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

NOTE

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

12. Position left hand control and loosly install hand control clamp screws.
13. Attach clutch control and torque fastener. Torque hand control in position.
14. Push new wire harness retainers in handlebar holes.
15. Attach brake hand control in place and tighten torx screws to.
16. Push new wire harness retainers in handlebar holes.
17. Connect negative battery cable.
18. Verify the following:
    - cable adjustment operation.
    - proper throttle cable operation.
    - all electrical switch functions.
    - proper brake operation and brake light function.

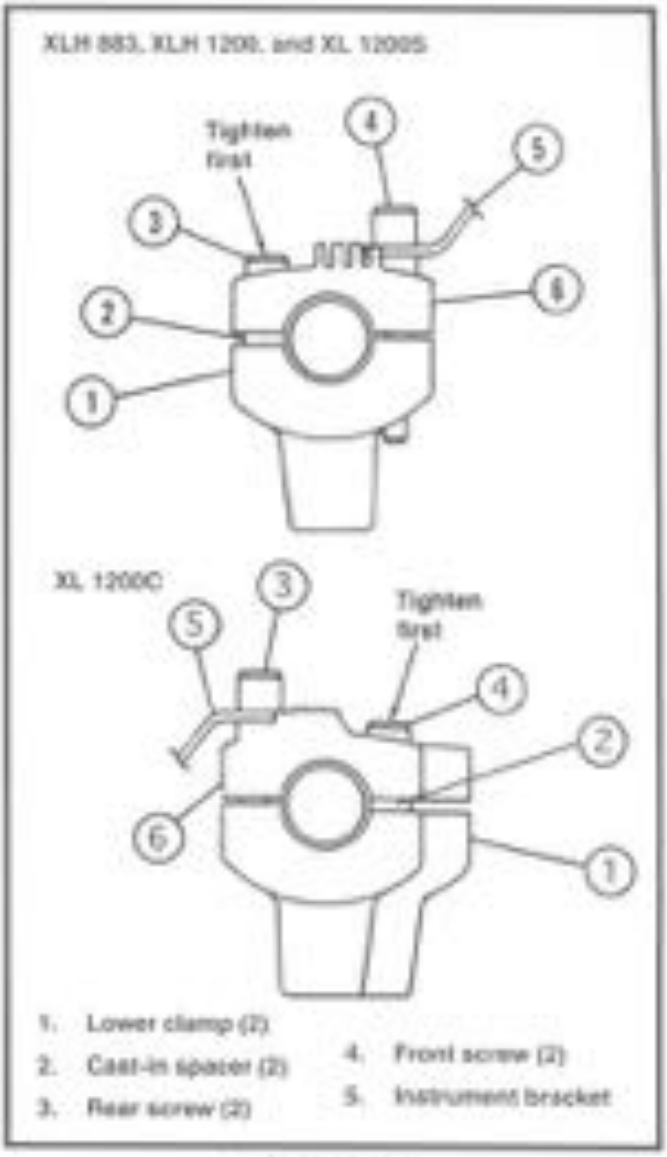


Figure 2-83.

Figure 2-64. Clutch Cable and Front Brake Line Routings – Left Side

CLUTCH CONTROL

ADJUSTMENT

Refer to CLUTCH RELEASE MECHANISM, ADJUSTMENT in Section 6.

REMOVAL/DISASSEMBLY

Clutch Cable – Lower (Figure 2-85)

1. Using T-27 TORX driver, remove four TORX screws (1) with washers to remove clutch inspection cover (2). Exercise caution to avoid damaging or dislodging quad ring (14) in primary cover (11).
2. Slide spring (3) with attached hex lockplate (4) from flats of adjusting screw (12).
3. Turn adjusting screw clockwise to release ramp and coupling mechanism. As the adjusting screw is turned, ramp assembly moves forward. Unscrew nut (5) from end of adjusting screw.
4. Remove hook of ramp (6) from button at the rear of cable end coupling (16). Remove cable end (10) from slot in coupling.
5. Turn cable end fitting (9) counterclockwise to remove clutch cable lower section from primary cover (11). Remove O-ring (8) from cable end fitting.

Clutch Lever and Clutch Cable – Upper (Figure 2-86)

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

Clutch Hand Control (Figure 2-86)

1. Remove two screws and washers (8) from clutch control clamp (7).
2. Remove clutch control clamp (7) and assembly of clutch cable (1) upper section, clutch lever (3) and clutch lever bracket (6) from left handlebar.

NOTE

You may need to loosen two screws at left handlebar switch housing to remove clutch control clamp (7) and assembly of clutch cable (1) upper section, clutch lever (3) and clutch lever bracket (6) from left handlebar.

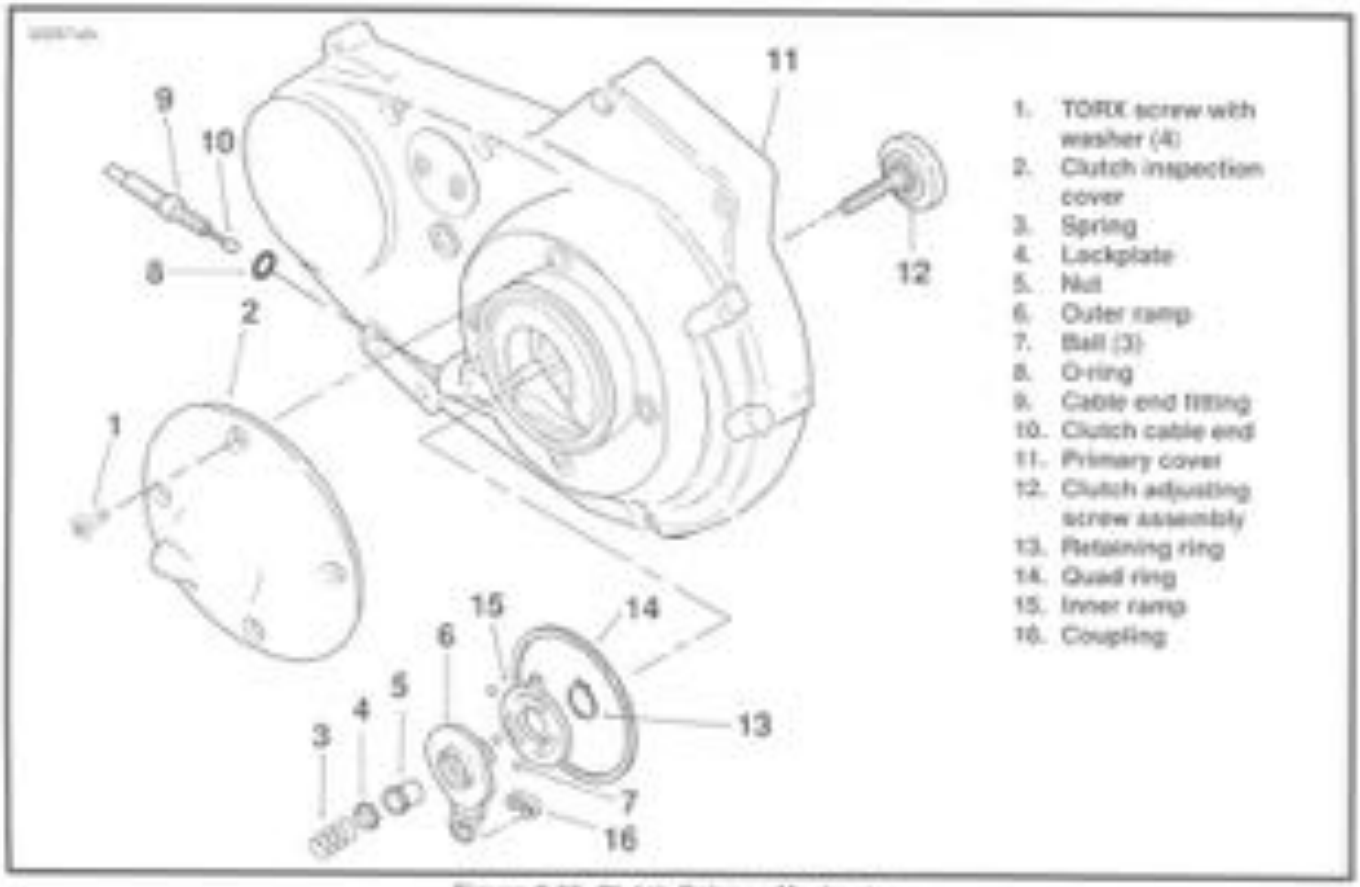


Figure 2-85. Clutch Release Mechanism

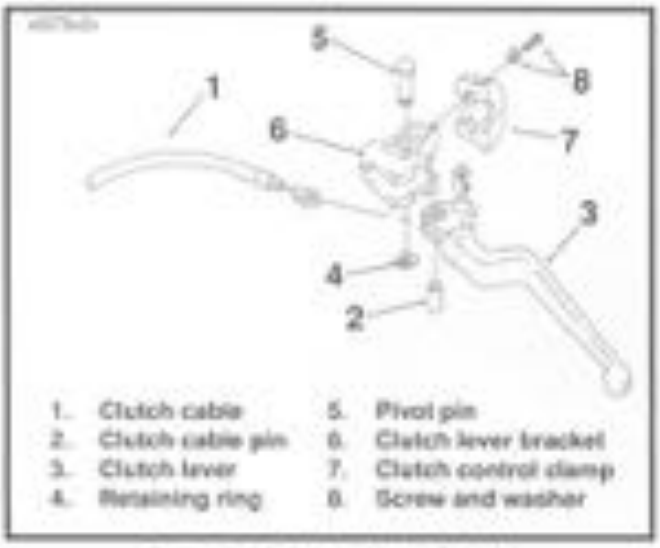


Figure 2-86. Clutch Hand Control

ASSEMBLY/INSTALLATION

Clutch Cable – Lower

1. See Figure 2-85. Install O-ring (8) over cable end fitting (9) of clutch cable lower section. Turn fitting clockwise to install into primary cover (11). Tighten fitting to 3-5 ft-lbs (4-7 Nm) torque.
2. Fit coupling (15) over cable end with the rounded side inboard, the ramp connector button outboard. With retaining ring side of ramp assembly facing inward, place hook of ramp around coupling button and rotate assembly counter-clockwise until tang on inner ramp (15) fits in slot of primary cover (11).
3. Thread nut (5) on adjusting screw (12) until slot of screw is accessible with a screwdriver. Fit nut hex into recess of outer ramp (6) and turn adjusting screw counter-clockwise.
4. See Figure 2-84. If not yet performed, route clutch cable (3) forward from primary cover (6), upward through clip (4) on lower left front engine mount to outboard side of left front slider tube, and then rearward to clutch lever (1).

Clutch Lever and Clutch Cable – Upper (Figure 2-86)

1. Connect end of clutch cable (1) upper section to clutch lever (3) using clutch cable pin (2).
2. Position lever within clutch lever bracket (6).

Clutch Hand Control (Figure 2-86)

1. Position clutch control clamp (7) and assembly of clutch cable (1) upper section, clutch lever (3) and clutch lever bracket (6) onto left handlebar. Hold assembly and bracket firmly against left handlebar switch housing.
2. Secure components to left handlebar using two screws and washers (8). Tighten screws to 70-80 **in-lbs** (7.9-9.0 Nm) torque.

NOTE

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

EXHAUST SYSTEM

REMOVAL (Figure 2-87)

1. Remove heat shields (12, 18 and 19) by opening worm drive clamps (6 and 7).
2. Remove nuts (4) from front and rear cylinder head exhaust studs.
3. To access locknut (5), remove master cylinder mounting bolts and lift brake pedal upward. Remove locknut to detach front muffler (16) from sprocket cover stud.
4. Remove locknut (3) and bolt (2) to detach rear muffler (17) from muffler support (15).
5. Remove exhaust system assembly.

DISASSEMBLY (Figure 2-87)

1. Remove Torca clamp assemblies (8) from front and rear mufflers (16 and 17). Discard Torca clamp assemblies-one time usage only.

NOTE

New Torca muffler clamps have eliminated the need for silicone or graphite tape during assembly. To ensure sealing integrity of muffler clamps and prevent the possibility of leakage, Harley-Davidson recommends that muffler clamp assemblies be discarded and replaced each time they are removed.

2. Remove front and rear mufflers (16 and 17) from exhaust pipes (13 and 14).
3. Separate front and rear exhaust pipes (13 and 14) at crossover pipe.

ASSEMBLY (Figure 2-87)

1. Insert **new** gasket (20) and washer (21) into crossover pipe on rear exhaust pipe (13). Connect rear exhaust pipe (13) to front exhaust pipe (14) at crossover pipe.
2. Place clamp (11), retaining ring (10) and new gasket (9) over front end of each exhaust pipe (front and rear). Position clamp so that inside counterbore faces cylinder head exhaust port.

INSTALLATION (Figure 2-87)

1. Position front ends of front and rear exhaust pipes (14, 13) into front and rear cylinder heads, respectively. Position holes in clamps (11) over mounting studs and loosely install nuts (4).
2. Place **new** Torca clamps (8) over slotted end of each muffler. Install each muffler (16 and 17) onto the end of its respective exhaust pipe. Front and rear mufflers can be identified by their tabs. Both sides of tab on rear muffler are of equal length (symmetrical) and the hole is smaller; on the front muffler, one side of tab is angular and the hole is larger.
3. Rotate front muffler (16) until tab is at top. Place tab over stud at sprocket cover. Loosely install nut (5) on stud.
4. Rotate rear muffler (17) until tab is at bottom. Align tab with hole in muffler support (15). Insert bolt (2) through holes in muffler support and muffler tab. Loosely install locknut (3) on end of bolt.
5. Tighten nuts (4) at cylinder head exhaust studs to 6-8 ft-lbs (8-11 Nm) torque. Tighten Torca clamps to 35-40 ft-lbs (47-54 Nm) torque. Tighten locknut (5) at sprocket cover stud to 20-40 ft-lbs (27-54 Nm) torque. Tighten locknut (3) at muffler support (15) to 10-15 ft-lbs (14-20 Nm) torque. Install master cylinder mounting bolts, and tighten to 155-190 **in-lbs** (17.5-21.5 Nm) torque.
6. Open worm drive clamps (6) and install heat shields (12, 18 and 19) on exhaust pipes. Position clamp so that screw is on the outboard side in the most accessible position.

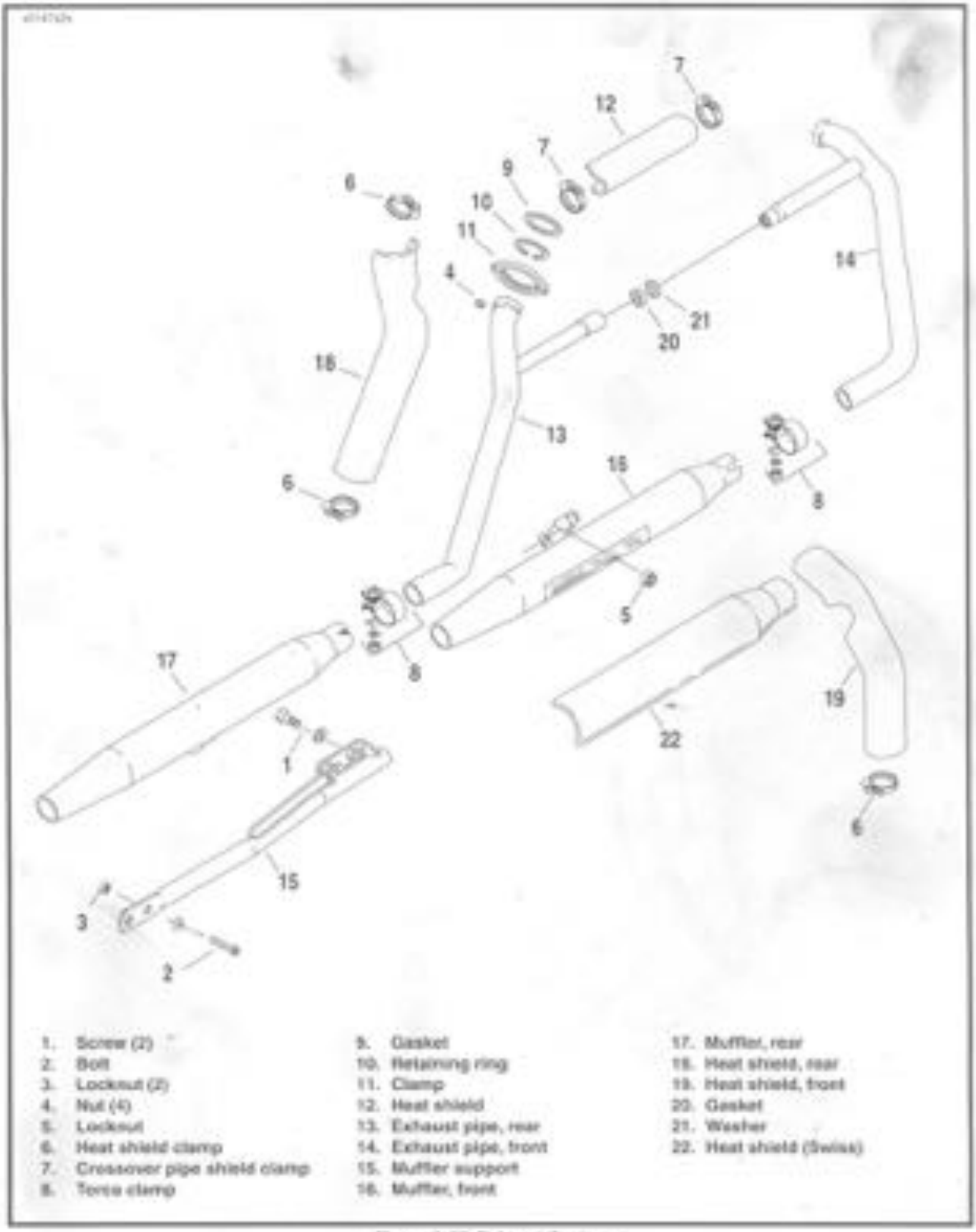


Figure 2-67. Exhaust System

FRONT FENDER

REMOVAL (Figure 2-88)

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

INSTALLATION (Figure 2-88)

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

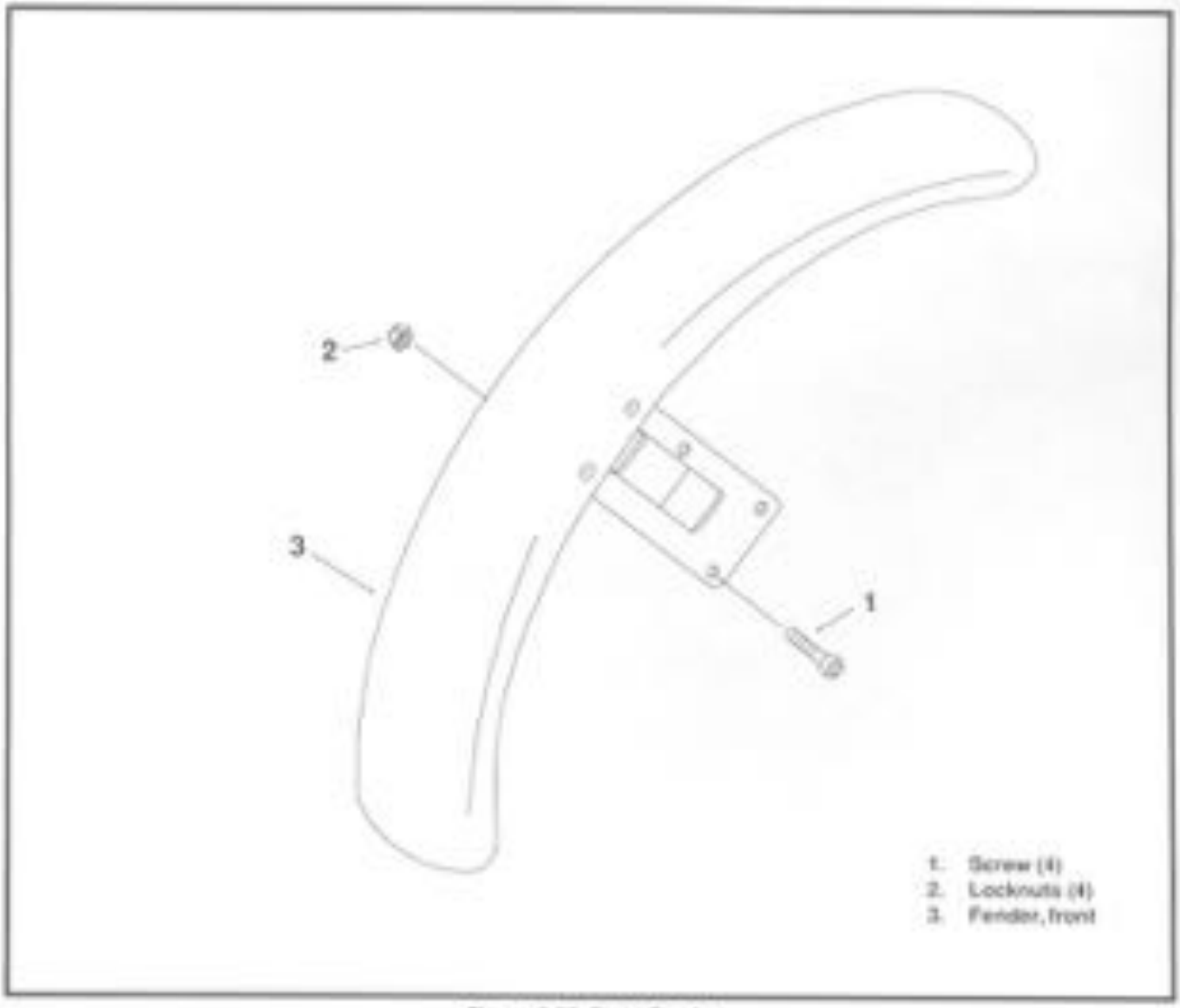
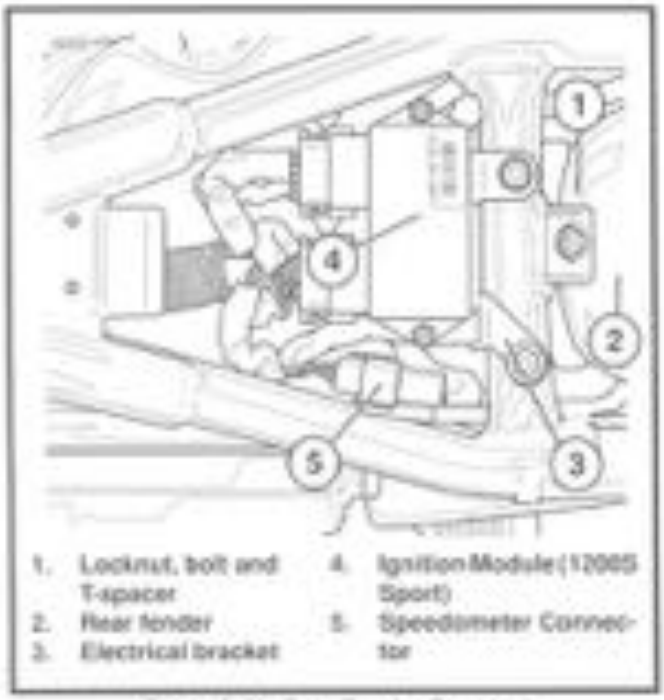


Figure 2-88. Front Fender

REAR FENDER

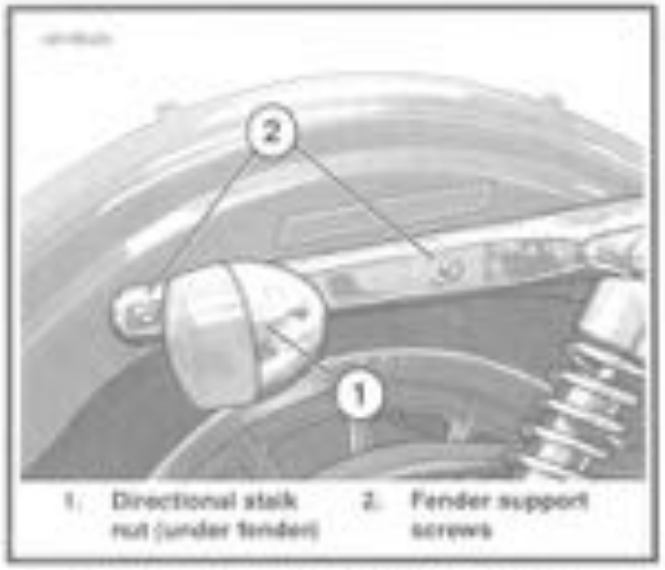
REMOVAL

1. Remove seat. See SEAT, REMOVAL in this Section.
2. See Figure 2-89. Remove locknut, bolt and T-spacer to detach top of rear fender from tab on frame cross member.
3. See Figure 2-90. Remove rear directional stalk nut and T-spacer from inside rear fender (both sides). Remove two fender support nuts, screws and T-spacers (both sides). Move chrome steel strut covers away from rear fender.



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

Figure 2-89. Rear Fender Removal



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

Figure 2-90 Rear Fender, Strut Cover and Directional Lamp Assembly

4. See Figure 2-89. Note the three electrical connectors taped together in the seat area. Connector # 5 houses the terminal connections for the right rear directional, #6 for the left rear directional while the 4-pin connector #4 in the middle houses the tail/brake light connections.
5. Remove tape from connector bundle. Depress latch on connectors to separate pin and socket housings.
6. See Figure 2-89. Remove two bolts to detach electrical bracket from frame cross member. Slightly move electrical bracket to draw socket side of connector out of seat area.
7. See Figure 2-91. Disassemble socket housing following procedure in Chapter 7 page 7-62.
8. Feed tail/brake light leads back through hole in plastic fender extension. Carefully remove rear fender with attached tail/brake light assembly from motorcycle.
9. Unclip tail/brake light lead from clamps spot welded to right inside fender at 8 locations. Remove speed nuts from tapered studs on tail light assembly. Discard speed nuts.
10. Remove tail/brake light fixture from fender.
11. Inspect rubber grommets for cuts, tears or general deterioration; replace as necessary.

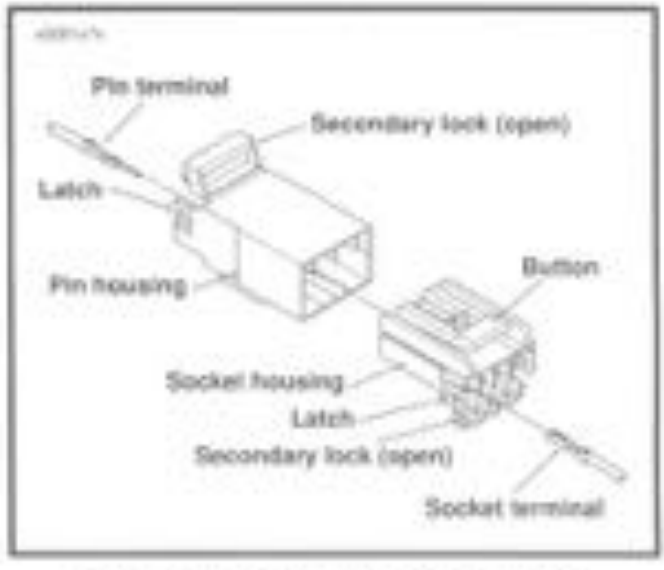
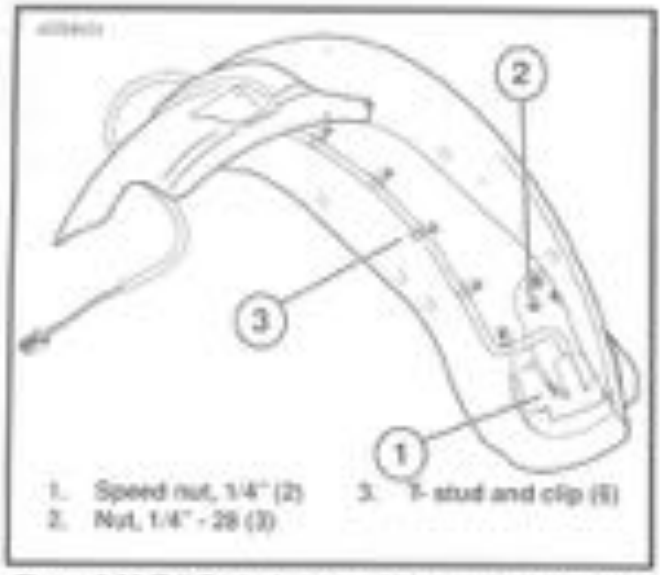


Figure 2-91. 4-Pin Amp Multilock Connector



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

Figure 2-92. Tail/Brake Lamp and License Plate Bracket Removal

INSTALLATION

NOTE

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

1. Remove passenger strap from old fender, if provided. Install passenger strap on new fender. See SEAT, REMOVAL in this Section for more information.
2. See Figure 2-92. Remove three 1/4"-28 nuts securing license plate bracket. Position assembly on new fender. Tighten screws to 6 ft-lbs (8 Nm) torque.
3. Carefully drill out pop rivets securing plastic fender extension with a 1/4 in. (6.35 mm) diameter drill bit. Rivet fender extension to new fender.
4. Insert tapered studs at back of tail/brake light fixture through fender bracket holes. Install **new** speed nuts and tighten.
5. Secure wire lead under clips attached to T-studs welded to underside of fender at 6 locations. Feed tail/brake light lead through hole in plastic fender extension.
6. Verify that grommets are installed at all 7 mounting points- 3 on each side, one at the top. Install grommets so that metal of fender is completely seated in groove on grommet O.D.
7. Install T-spacers in grommets (inboard side).
8. Carefully align holes in fender with those in strut.
9. Where the tail/brake light leads exit the plastic fender extension, run the wires upward and then forward beneath the electrical bracket to the Amp connector in the area of the right side frame rail.
10. Fit rear wire seal into back of socket housing, if removed. Gently push sockets through holes in wire seal into their respective numbered chambers. See Figure 2-93 for wire color locations. Feed socket into chamber until it snaps in place. Slightly tug wire to verify that socket will not back out. (See AMP MULTILOCK ELECTRICAL CONNECTORS, Section 7 for more information.)
11. Install internal seal on taped side of socket housing. Insert tapered end of secondary locking wedge into socket housing and press down until it snaps in place.
12. Press socket housing into pin housing until it snaps in place. Place large end of slot on attachment clip over T-stud on frame; push assembly forward to engage small end of slot.
13. See Figure 2-89. Align holes in electrical bracket with weldnuts in cross member of motorcycle frame. Install two bolts and tighten to 6-9 **in-lbs** (0.7-1.0 Nm) torque.

⚠CAUTION

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

14. Install top fender bolt. Hold bolt head at underside of fender and install nut topside. Tighten top fender nut to 10 ft-lbs (14 Nm) torque.
15. Align holes in chrome strut cover with those in strut. Verify that directional light leads are positioned under strut cover so that they are not pinched when cover is tightened.
16. See Figure 2-90. Slide directional stalk stud through holes in strut cover, strut and fender. Install nut.
17. Install fender support screws through strut cover, strut and fender. Install nuts.
18. Tighten directional stalk and fender support nuts to 8-13 ft-lbs (11-18 Nm) torque.

⚠CAUTION

Check for proper tail lamp operation before riding motorcycle.

19. Install seat. See SEAT INSTALLATION in this Section.

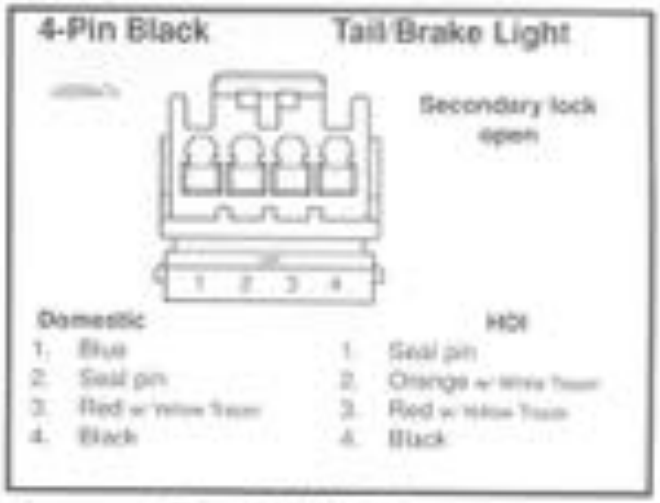


Figure 2-93. Amp Connector

JIFFY STAND

GENERAL

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

⚠WARNING

- **Without the weight of the motorcycle resting on the jiffy stand, any vehicle movement could cause the jiffy stand to retract slightly from the full forward position. If the jiffy stand is not in the full forward or lock position when vehicle weight is rested on it, the vehicle could fall over, possibly causing personal injury and/or vehicle damage.**
- **Always park the vehicle on a firm, level surface. The weight of the vehicle can cause it to fall over, possibly causing personal injury and/or vehicle damage.**
- **Be sure jiffy stand is fully retracted before riding. If jiffy stand is not fully retracted during vehicle operation, unexpected contact with the road surface can distract the rider. While the jiffy stand will retract upon contact, the momentary disturbance and/or rider distraction can lead to loss of vehicle control resulting in personal injury and/or vehicle damage.**

REMOVAL

⚠WARNING

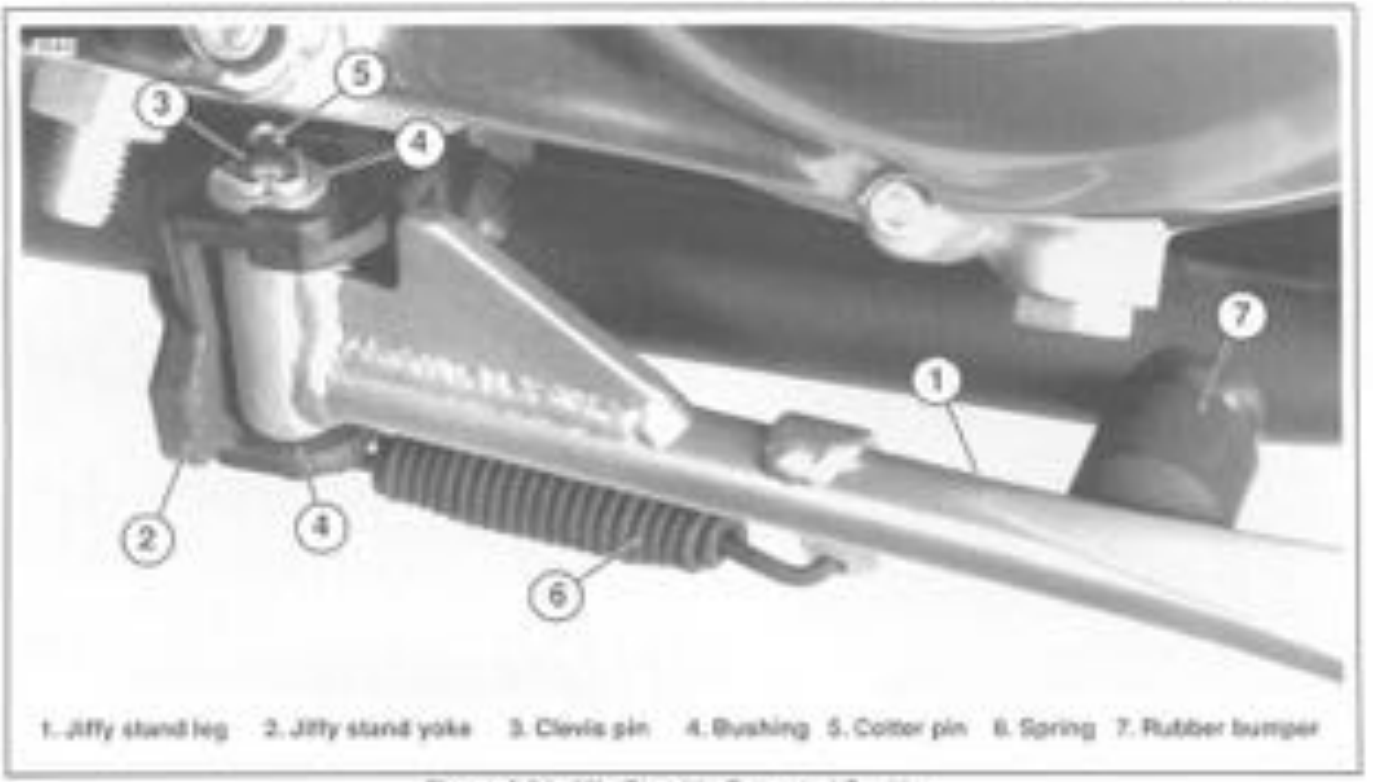
Wear gloves and protective eyeglasses (or face shield) when performing the following procedure. The jiffy stand spring tension could cause the spring, attached components and/or hand tools to fly outward at great speed and could cause personal injury.

1. Block motorcycle under frame so that motorcycle is securely upright and jiffy stand may be moved through its full range of travel.
2. See Figure 2-94. Remove rubber bumper (7) from frame to permit further retraction of jiffy stand leg (1). Additional spring tension relief allows for easier spring removal.
3. Place jiffy stand leg (1) in retracted position. Remove and discard cotter pin (5).
4. See Figure 2-95. While firmly holding jiffy stand leg (1) in fully retracted position, withdraw clevis pin (3) until it disengages with the upper pivot hole of jiffy stand yoke (2).
5. Detach spring (6) from anchor pin using pliers. Unhook other end of spring from jiffy stand leg (1).
6. Remove clevis pin (3) from lower pivot hole of jiffy stand yoke (2). Remove jiffy stand leg (1). Remove upper and lower bushings (4).

CLEANING AND LUBRICATION (Figure 2-95)

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

1. Refer to JIFFY STAND, REMOVAL to remove jiffy stand from motorcycle frame.
2. Thoroughly clean all jiffy stand components, including frame-mounted anchor pin and jiffy stand yoke (2).



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

Figure 2-94. Jiffy Stand in Retracted Position

3. Apply a small amount of wheel bearing grease to pivot holes of jiffy stand leg (1) and yoke (2), groove of anchor pin (3) and O.D. of clevis pin (5).

4. Refer to JIFFY STAND, INSTALLATION to install jiffy stand to motorcycle frame.

INSTALLATION

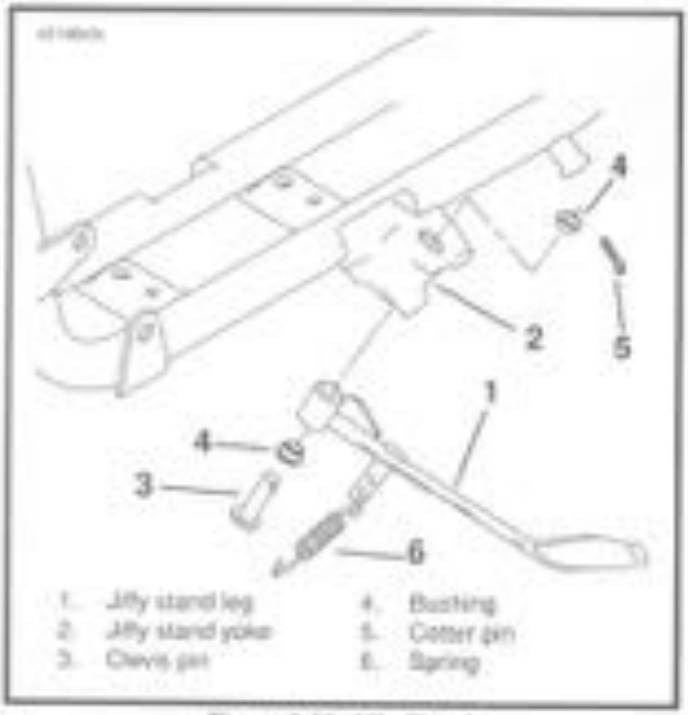
⚠WARNING

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

1. Clean and lubricate jiffy stand components according to procedure listed in JIFFY STAND, CLEANING AND LUBRICATION.

2. See Figure 2-95. Hook either end of spring (6) into spring mounting hole on jiffy stand leg (1). Install loose end of spring over anchor pin.

3. While holding end of spring (6) in groove of anchor pin and holding jiffy stand leg (1) in its retracted position, position pivot end of jiffy stand leg within yoke (2) on motorcycle frame. Insert clevis pin (3) through lower pivot hole of yoke and halfway into pivot hole of jiffy stand leg.



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

Figure 2-95. Jiffy Stand

4. See Figure 2-94. Lift jiffy stand leg (1) upward, aligning pivot hole of jiffy stand leg with slotted upper hole of yoke (2). With shoulder down, position bottom bushing (4) over clevis pin (3). Insert clevis pin (3) through holes in jiffy stand leg and yoke.

5. Install upper bushing (4) over end of clevis pin (3) and against upper surface of yoke (2). Insert **new** cotter pin (5) through hole in end of clevis pin. Bend ends of cotter pin apart to secure.

6. Press rubber bumper (7) onto mounting stud on motorcycle frame.

7. Extend and retract jiffy stand leg several times to check for proper operation. In retracted position (up), jiffy stand leg should be securely seated against frame-mounted rubber bumper (7).

8. Place jiffy stand in its full forward position (down). Carefully remove support blocking from beneath motorcycle frame. Rest motorcycle on jiffy stand.

SEAT

REMOVAL (Figure 2-97)

1. Remove screw (1) to detach seat from rear fender.
2. Slide seat rearward to remove from frame.
3. If dual seat, inspect passenger strap (3) for damage or excessive wear. Remove bolt (4) and flat washer (5) to detach passenger strap from rear fender, if necessary.

INSTALLATION (Figure 2-97)

1. Install passenger strap if mounting dual seat. Align holes on each end of strap with forward hole in rear fender. With concave side up, align hole in flat washer (5) with those in strap (3). Install bolt (4) and tighten to 8-13 ft lbs (11-18 Nm) torque.

⚠WARNING

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

2. Verify that rectangular metal plate is tightly secured to seat bottom and that no rivets are loose or missing. Position seat (4) on frame with mounting bracket (3) at rear.
3. See Figure 2-96. Slide seat forward until the tongue welded to center frame support fits snugly in groove at bottom of seat. The groove is formed where the contoured ribs are bridged by the metal plate.
4. Pull up on seat to verify that it is locked in place.
5. See Figure 2-97. Install screw (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.
6. Tighten mounting bracket screw (1).
7. Pull up on seat again to verify that it is properly secured, front and rear.

Figure 2-96. Seat Installation (1200S shown)

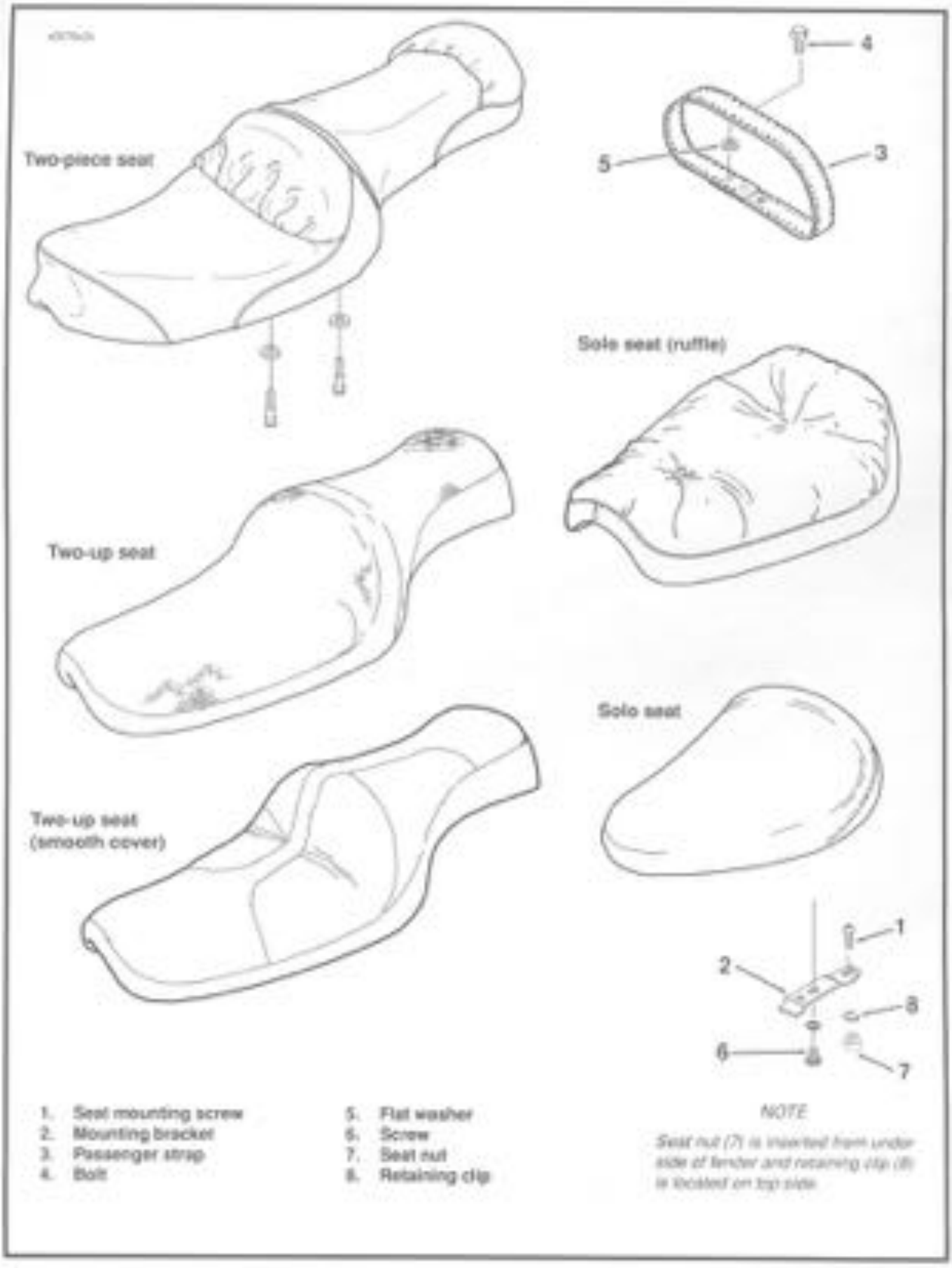


Figure 2-97. Seat

ENGINE 3

SUBJECT	PAGE NO.
1. Specifications	3-1
2. Engine	3-5
3. Stripping Motorcycle for Engine Repair	3-8
4. Installing the Engine	3-11
5. Cylinder Head	3-13
6. Cylinder and Piston	3-24
7. Engine Lubrication System	3-31
8. Oiling System	3-39
9. Valve Tappets	3-44
10. Gearcase Cover and Cam Gears	3-46
11. Crankcase	3-54

SPECIFICATIONS

NOTE

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

General	883	1200	1200S Sport
Number of cylinders	2	2	2
Type	4-cycle, 45°V	4-cycle, 45°V	4-cycle, 45°V
Horsepower	57 @ 6,000 rpm	66 @ 5,200 rpm	69 @ 5,500 rpm
Bore (inches)	3.000 in.	3.466	3.438
(mm)	76.20 mm	88.85 mm	88.85 mm
Stroke (inches)	3.812	3.812	3.812
(mm)	96.82 mm	96.82 mm	96.82 mm
Piston displacement (cubic inches)	53.9	73.3	73.3
(cc)	883 cc.	1201 cc.	1201 cc.
Torque (foot-pounds)	53 @ 4,500 rpm	72 @ 4,000 rpm	76 @ 4,000 rpm
(Nm)			
Compression ratio	9.0 to 1	9.0 to 1	10.0 to 1
Oil tank capacity with filter (U.S. quarts)	3	3	3
(liters)	2.8 liters	2.8 liters	2.8 liters

ITEM	NEW COMPONENTS		SERVICE WEAR LIMITS
	883cc	1200cc	
Valve			
Fit in guide			
Exhaust	0.0015-0.0033 in.	*	0.0040 in.
	0.038-0.084 mm	*	0.102 mm
Intake	0.0008-0.0026 in.	*	0.0035 in.
	0.020-0.066 mm	*	0.089 mm
Seat width	0.040-0.062 in.	*	0.090 in.
	1.02-1.57 mm	*	2.29 mm
Stem protrusion from cylinder valve pocket	1.975-2.011 in.	*	2.031 in.
	50.17-51.08	*	51.59 mm
Outer spring – free length	2.105-2.177 in.	*	2.105 in. (min.)
	53.47-55.30 mm	*	53.47 mm
Intake			
1.751-1.848 in. (closed)	72-92 lbs	*	
	32.6 kg.-41.7 kg.	*	
1.286 - 1.383 in. (open)	183-207 lbs	*	
	82.9-93.8 kg	*	
Exhaust			
1.751-1.848 in. (closed)	72-92 lbs	*	1.926 in. (min.)
	32.6-41.7 kg	*	48.92 mm
1.332 - 1.429 in. (open)	171-195 lbs	*	
	77.5-88.3 kg	*	
Inner spring – free length	1.929-1.996 in.	*	
	48.92-50.70 mm	*	
Intake			
1.577-1.683 in. (closed)	38-49 lbs	*	
	17.2-22.2 kg	*	
1.112-1.218 in. (open)	98-112 lbs	-	
	44.4-50.7 kg	*	
Exhaust			
1.577-1.683 in. (closed)	38-49 lbs	*	
	17.2-22.2 kg	*	
1.158-1.264 in. (open)	91-106 lbs	*	
	41.2-48.0 kg	*	

* Same as 883 cc

SPECIFICATIONS (CONTINUED)

ITEM	NEW COMPONENTS		SERVICE WEAR LIMITS
	883cc	1200cc	
Rocker Arm			
Shaft fit in bushing (loose)	0.0005-0.0020 in. 0.013-0.051 mm	* *	0.0035 in. 0.089 mm
End clearance	0.003-0.013 in. 0.08-0.33 mm	* *	0.025 in. 0.64 mm
Bushing fit in rocker arm (tight)	0.004-0.002 in. 0.10-0.05 mm	* *	
Rocker Arm Shaft			
Shaft fit in rocker cover (loose)	0.0007-0.0022 in. 0.018-0.056 mm	* *	0.0035 in. 0.089 mm
Piston			
Compression ring gap (top & 2nd)	0.010-0.023 in. 0.25-0.58 mm	0.007-0.020 in. 0.18-0.51 mm	0.032 in. 0.81 mm
Oil control ring rail gap	0.0013-0.053 in 0.25-1.35 mm	0.009-0.052 in. 0.23-1.32 mm	0.065 in. 1.65 mm
Compression ring side clearance			
Top	0.0020-0.0045 in. 0.051-0.114 mm	0.0020-0.0045 in. 0.051-0.114 mm	0.0065 in. 1.65 mm
2nd	0.0020-0.0045 in. 0.051-0.114 mm	0.0016-0.0041 in. 0.041-0.104 mm	0.0065 in. 1.65 mm
Oil control ring side clearance	0.0014-0.0074 in. 0.036-0.188 mm	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	*	0.00100 in. 0.0254 mm
Cylinder Head			
Valve guide in head (tight)	0.0033-0.0020 in. 0.084-0.051 mm	* *	
Valve seat in head (tight)	0.0035-0.0010 in. 0.089-0.025 mm	* *	
Head gasket surface (flatness)	0.006 in. total 0.15 mm	* *	0.006 in. total 0.15 mm
Cylinder			
Taper			0.002 in. 0.05 mm
Out of round			0.003 in. 0.08 mm
Warpage (gasket surfaces)			
Top			0.006 in. .15 mm
Base			0.008 in. 0.20 mm
Bore diameter ± 0.0002 in.			
			883cc **1200cc**
Standard	3.0005 in. 76.213 mm	3.4978 in. 88.844 mm	3.0035 in. 3.5008 in. 76.289 mm 88.920 mm
0.005 Oversize (O.S.)	3.0048 in. 76.323 mm	3.502 in. 88.95 mm	3.0078 in. 3.505 in. 76.398 mm 89.03 mm
0.010 O.S. Bore	3.0098 in. 76.449 mm	3.507 in. 89.08 mm	3.0128 in. 3.510 in. 76.525 mm 89.15 mm
0.020 O.S. Bore	3.0198 in. 76.703 mm	3.517 in. 89.33 mm	3.0228 in. 3.520 in. 76.779 mm 89.41 mm
0.030 O.S. Bore	3.0298 in. 76.957 mm	3.527 in. 89.59 mm	3.0328 in. 3.530 in. 77.033 mm 89.66 mm
0.040 O.S. Bore	3.0398 in. 77.211 mm	—	3.0428 in. — 77.287 mm

* Same as 883 cc

SPECIFICATIONS (CONTINUED)

ITEM	NEW COMPONENTS		SERVICE WEAR LIMITS
	883cc	1200cc	
Connecting Rod			
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. 0.13-0.64 mm	* *	0.030 in.
Fit on crankpin (loose)	0.0004-0.0017 in. 0.010-0.043 mm	* *	0.0027 in. 0.069 mm
Tappet			
Fit in guide	0.0008-0.0023 in. 0.020-0.058 mm	* *	0.003 in. 0.08 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
Oil Pump			
Oil pressure at normal operating temperature (pressure reading taken at oil pressure switch fitting)			
with engine speed of 1000 rpm	7-12 psi. 0.5-0.8 kN/cm^2	* *	
with engine speed of 2500 rpm	10-17 psi. 0.7-1.2 kN/cm^2	* *	
Feed scavenge inner/outer gerotor clearance	0.003 in. 0.08 mm	* *	0.004 in. 0.10 mm
Shaft to pump clearance	0.0025 in. 0.064 mm	* *	
Gearcase			
Cam gear shaft in bushing (loose)	0.0007-0.0022 in. 0.018-0.056 mm	* *	0.003 in. 0.08 mm
Cam gear shaft end play (mm) (except rear intake)	0.005-0.024 in. 0.13-0.61 mm	* *	0.025 in. 0.64 mm
Rear intake cam gear shaft end play (mm)	0.006-0.024 in. 0.15-0.61 mm	* *	0.040 in. 1.02 mm
Flywheel			
Runout (flywheels at rim)	0.000-0.010 in. 0.00-0.25 mm	* *	0.010 in. 0.25 mm
Runout (shaft at flywheel end)	0.000-0.002 in. 0.00-0.05 mm	* *	0.002 in. 0.05 mm
End play	0.001-0.005 in. 0.025-0.13 mm	* *	0.005 in. 0.13 mm
Sprocket Shaft Bearing			
Outer race fit in crankcase (tight)	0.0004-0.0024 in. 0.010-0.061 mm	* *	
Bearing inner race fit on shaft (tight)	0.0002-0.0015 in. 0.005-0.038 mm	* *	
Pinion Shaft Bearings			
Pinion shaft journal diameter	1.2500-1.2496 in. 31.750-31.740 mm	* *	1.2494 in. (min) 31.735 mm
Outer race diameter in right crankcase	1.5646-1.5652 in. 39.741-39.756 mm	* *	1.5672 in. (max) 39.807 mm
Bearing running-clearance	0.00012-0.00088 in. 0.0030-0.0224 mm	* *	
Fit in cover bushing fit (loose)	0.0023-0.0043 in. 0.058-0.109 mm	* *	0.0050 in. 0.127 mm

* Same as 883 cc

SPECIFICATIONS (CONTINUED)

ITEM	NEW COMPONENTS		SERVICE WEAR LIMITS
	883cc (HDI)	1200cc	
Ignition System			
Timing during engine cranking	5° BTDC (0° BTDC)	*	
Timing with engine speed at 950-1050	20° BTDC	*	
Spark plug gap (6R12)	0.038-0.043 in. 0.97-1.09 mm	* *	
Engine Speed			
Slow idle	950-1050 rpm	*	
Setting ignition timing	1650-1950 rpm	*	
Torque Values			
Crank pin nut	150-185 ft-lbs 203-251 Nm	* *	
Pinion gear nut	35-45 ft-lbs 47-61 Nm	* *	
Oil tank mounting locknuts	3-5 ft-lbs 4.7 Nm	* *	
Oil pump mounting screws	125-150 **in-lbs** 14.1-17.0 Nm	* *	
Push rod tube seal plate bolts	15-18 **ft-lbs** 20-24 Nm	* *	
Gearcase cover fasteners	80-110 **in-lbs** 9.0-12.4 Nm	* *	
Rocker cover			
5/16 in. bolts	15-18 ft-lbs 20-24 Nm	* *	
1/4 in. bolts	10-13 ft-lbs 14-18 Nm	* *	
1 Rear engine mount fasteners			
Frame to crankcase	25-30 ft-lbs 34-41 Nm	* *	
Negative cable nut	65-80 **in-lbs** 7-10 Nm	* *	
2 Lower front engine bracket fasteners			*NOTE*
Crankcase	25-30 ft-lbs 34-41 Nm	* *	*Torque engine mount fasteners in the numerical sequence shown in bold.*
Frame	25-30 ft-lbs 34-41 Nm	* *	
3 Upper front engine bracket fasteners			
Cylinder head	25-30 ft-lbs 34-41 Nm	* *	
Frame	30-35 ft-lbs 41-47 Nm	* *	
4 Top center engine bracket fasteners			
Cylinder head	25-30 ft-lbs 34-41 Nm	* *	
Frame	30-35 ft-lbs 41-47 Nm	* *	
Timer screws (inner cover & sensor plate)	15-20 **in-lbs** 1.7-2.3 Nm	* *	
Spark plug	11-18 ft-lbs 15-24 Nm	* *	
Rotor bolt	42-48 **in-lbs** 4.9-5.4 Nm	* *	
Tappet plate screws	80-11 **in-lbs** 9.0-12.4 Nm	* *	

* Same as 883 cc

ENGINE

GENERAL

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

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 from cylinder connecting rod, allowing a single connecting rod crank pin connection to the flywheel.

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

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

The trigger rotor has two openings which time the cylinders.

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

XL Sport

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

The trigger rotor has six openings which time the cylinders.

Fuel

Gasoline/alcohol Blends

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

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

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

Lubrication

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

ADJUSTMENT/TESTING

General

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

Most commonly, only cylinder head and cylinder repair is

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

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

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

⚠CAUTION

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

Symptoms indicating a need for engine repair are often misleading; but generally, if more than one symptom is present, possible causes can be narrowed down to make at least a partial diagnosis. An above-normal consumption of oil, for example, could be caused by several mechanical faults. See TROUBLESHOOTING, Section 1. However, when accompanied by blue-gray exhaust smoke and low engine compression, it indicates the piston rings need replacing. Low compression by itself, however, may indicate improperly seated valves, in addition to or in lieu of worn piston rings.

Piston slap is a condition where piston and/or cylinder are worn out-of-round and are loose fitting, allowing the piston to slap from front to rear of the cylinder as it moves up and down.

Most frequently, valves, rings, pins, bushings, and bearings need attention at about the same time. If the possible causes can be narrowed down through the process of elimination to indicate any one of the above components is worn, it is best to give attention to all of the cylinder head and cylinder parts.

Compression Test Procedure

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

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

⚠CAUTION

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

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

Diagnosis	Test Results
Ring trouble.	Compression low on first stroke; tends to build up on the following strokes but does not reach normal; improves considerably when oil is added to cylinder.
Valve trouble.	Compression low on first stroke; does not build up much on following strokes; does not improve considerably with the addition of oil.
Head gasket leak.	Same reaction as valve trouble.

Cylinder Leakage Test

The cylinder leakage test pinpoints engine problems including leaking valves, worn, broken or stuck piston rings and blown head gaskets. The cylinder leakage tester applies compressed air to the cylinder at a controlled pressure and volume, and measures the percent of leakage from the cylinder.

Use a CYLINDER LEAKDOWN TESTER (Part No. HD-35667A) and follow the specific instructions supplied with the tester.

The following are some general instructions that apply to Harley-Davidson V-twin engines:

1. Run engine until it reaches normal operating temperature.
2. Stop engine. Clean dirt from around spark plugs, and remove spark plugs.
3. Remove air cleaner, and set carburetor throttle in wide open position.
4. Remove timing inspection plug from crankcase.
5. The piston, in cylinder being tested, must be at top dead center of compression stroke during test.
6. To keep engine from turning over when air pressure is applied to cylinder, engage transmission in fifth gear and lock the rear brake.
7. Following the manufacturer's instructions, perform a cylinder leakage test on the front cylinder. Make a note of the percent leakdown. Any cylinder with 12% leakdown, or more, requires further attention.
8. Listen for air leaks at carburetor intake, exhaust, head gasket and timing inspection hole.

NOTE

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

Air Leak Location	Possible Causes
Carburetor intake.	Intake valve leaking.
Exhaust pipe.	Exhaust valve leaking.
Timing inspection hole.	Piston rings leaking. Worn or broken piston. Worn cylinder.
Head gasket.	Leaking gasket.

9. Repeat procedure on rear cylinder.

⚠CAUTION

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

Diagnosing Smoking Engine or High Oil Consumption

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

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

STRIPPING MOTORCYCLE FOR ENGINE REPAIR

Remove seat.

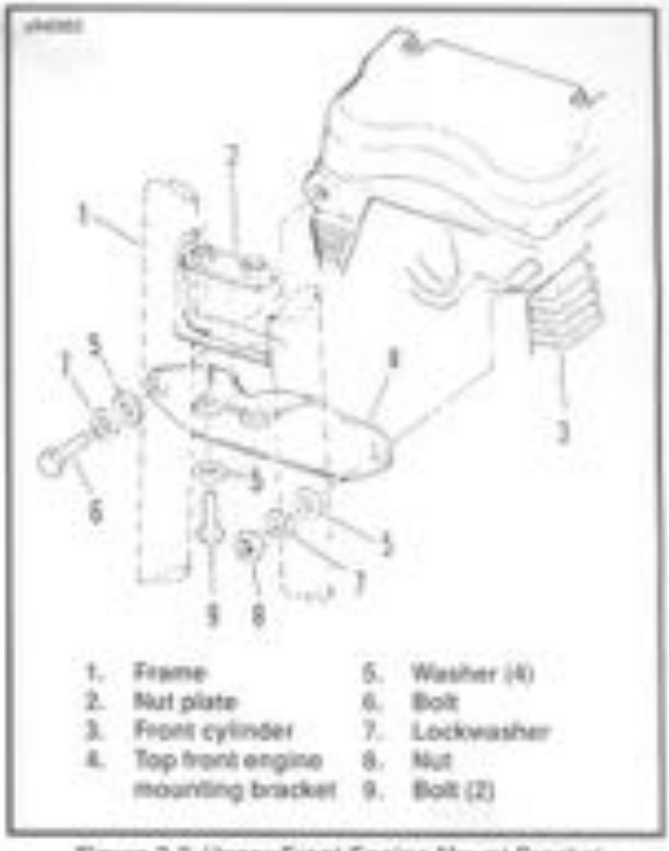
⚠WARNING

To prevent accidental starter operation and possible personal injury, disconnect battery cables (negative first) before doing any work on the engine, drive or electrical system.

Remove air cleaner assembly and backplate.

Disconnect spark plug wires. Remove horn, ignition coil, bracket, and throttle cable clip.

Drain gasoline. Remove fuel tank.



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

Figure 3-2. Upper Front Engine Mount Bracket

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

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

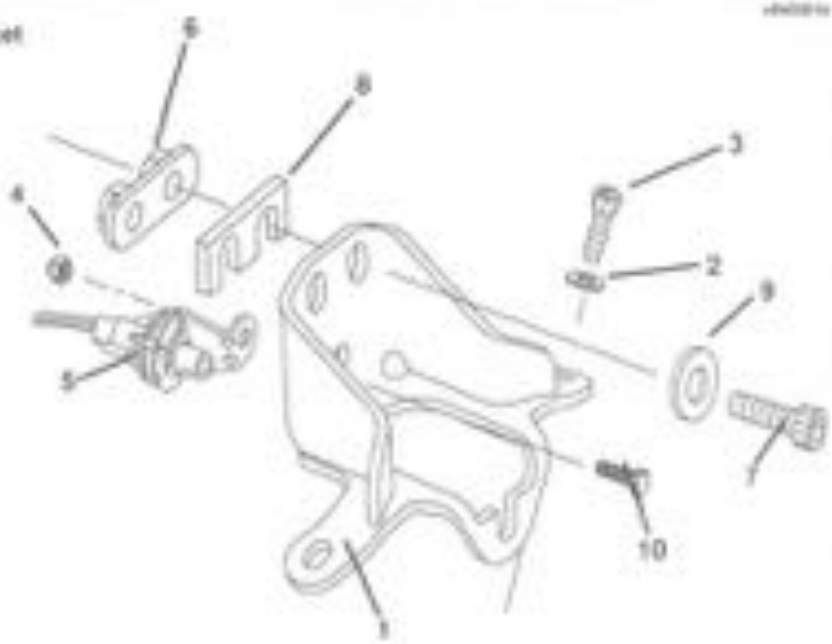


Figure 3-1. Top Center Engine Mount Bracket

⚠WARNING

Gasoline is flammable and fumes are explosive. To avoid possible personal injury, drain gasoline in well-ventilated area away from fire, flame or spark hazard. Drain gasoline into approved gasoline container only.

Free enricherer control-Disconnect V.O.E.S./ MAP hose at carburetor and V.O.E.S. wire from ignition module.

Remove carburetor with intake manifold.

Remove exhaust system.

Drain primary chaincase/transmission lubricant.

See Figure 3-1. Remove top center engine mounting bracket and shim(s).

See Figure 3-2. Remove top front engine mounting bracket.

NOTE

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

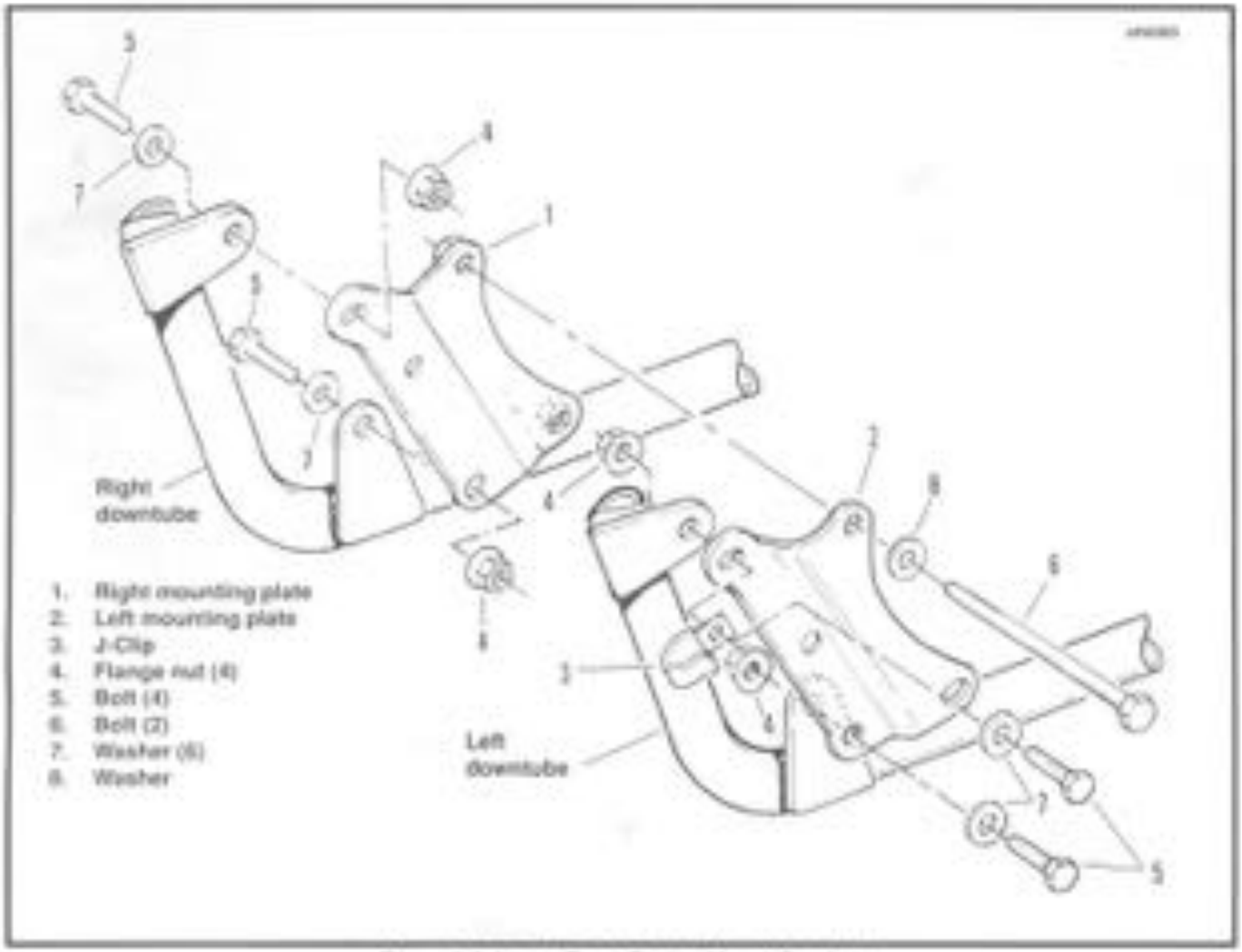


Figure 3-3. Lower Front Engine Mount Brackets

Remove rear brake master cylinder mounting bolts. Disconnect brake linkage from master cylinder.

Remove rear belt sprocket cover with brake pedal and linkage.

Remove rear belt.

Disconnect wire to oil pressure switch.

Disconnect neutral switch wire.

Unplug ignition timer plate wires from wiring harness.

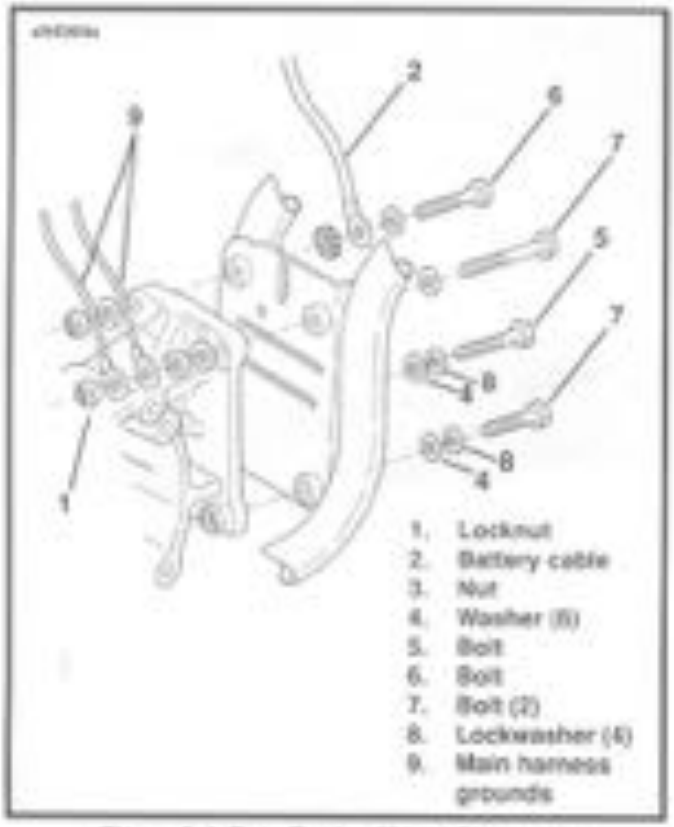


Figure 3-4. Rear Engine Mount Fasteners

Disconnect positive battery cable from battery. Disconnect 18-gauge green wire from starter motor.

Remove battery. Remove battery tray.

Disconnect the regulator/rectifier from the alternator stator at the plug beneath the regulator.

Disconnect battery grounding cable attached to rear crankcase bolt.

Detach clutch cable. Remove clutch handlever from handlebar.

Drain engine oil. Remove oil feed, return, and vent lines at oil tank.

See Figure 3-3. Remove hardware attaching lower front engine mounting plates.

See Figure 3-4. Remove bolts (5, 6, and 7) attaching rear of engine to frame.

Lift engine up off the mounting pad. Slip engine from right side while tipping top of engine slightly off center of chassis.

⚠CAUTION

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

INSTALLING THE ENGINE

Place engine in frame from right side of motorcycle.

See Figure 3-4. Install four rear engine mounting bolts (5, 6, and 7), washers (4) and nuts (3 and 1). Tighten fasteners to 25-30 ft-lbs (34-41 Nm) torque.

See Figure 3-3. Install lower front engine mounting brackets with bolts (6) and washers (8). Secure plates to lower front engine frame mounts with bolts (5), washers (7) and nuts (4). Tighten engine bolts to 25-30 ft-lbs (34-41 Nm) torque. Tighten frame bolts to 25-30 ft-lbs (34-41 Nm) torque.

See Figure 3-2. Install upper front engine mounting bracket, loosely attach hardware. Tighten engine bolts to 25-30 ft-lbs (34-41 Nm) torque. Tighten frame bolts to 30-35 ft lbs (41-47 Nm) torque.

See Figure 3-1. Install top center engine mounting bracket, loosely attach hardware. Connect V.O.E.S./ MAP and ignition switch. Tighten engine bolts to 25-30 ft-lbs (34-41 Nm) torque. Tighten frame bolts to 30-35 ft-lbs (41-47 Nm) torque.

See ENGINE LUBRICATION SYSTEM in this section, and connect feed, return, and vent lines to oil tank. Use new hose clamps.

Connect battery ground wire to crankcase bolt.

Connect battery positive cable and 18-gauge green wire to starter motor.

Plug regulator rectifier into stator connection. Attach sensor to wire harness. Connect neutral switch.

Connect oil pressure switch wire.

Attach clutch cable lever & bracket to handlebar.

Install carburetor with intake manifold.

NOTE
Use air cleaner backplate as guide to align carburetor manifold assembly.

Attach throttle and enricherer cables to carburetor.

Slide enricherer control into slot of mounting bracket. Tighten nut at backside of bracket.

Install rear belt.

Install rear belt sprocket cover with brake pedal and linkage.

Install right footrest and master cylinder assembly. Connect brake linkage to master cylinder.

Install exhaust system.

Install fuel tank, fuel lines, horn (if applicable), throttle cable clip, ignition coil, and bracket.


Install air cleaner assembly.
Install battery tray and battery.
Install new oil filter, engine oil, and primary chain case transmission lubricant.
Connect spark plug cables.
Connect battery cables, positive cable first.
Install seat.

CYLINDER HEAD

REMOVAL

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

1. See Figure 3-5. Remove four bolts (1) and fiber seals (2). Discard fiber seals.

⚠CAUTION

All washers and fasteners used in the V-Twin engine are hardened. Do not mix or replace hardened washers and fasteners with unhardened parts. Do not reuse fiber cover seals. Engine damage may result.

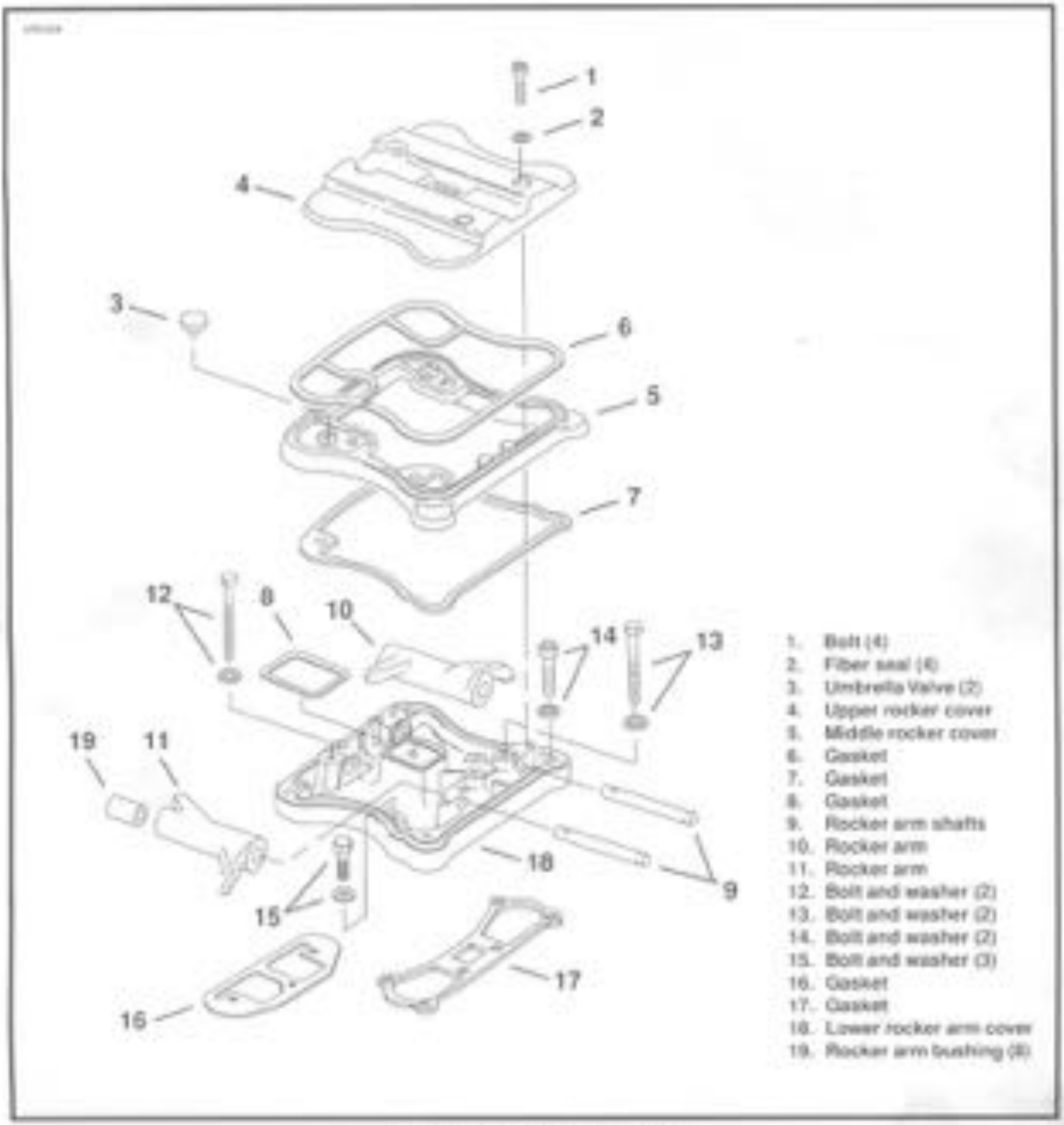


Figure 3-5. Rocker Arm Cover

2. Remove top (4) and middle (5) sections of rocker box. Remove gaskets (6, 7, 8) and discard.

3. Rotate crankshaft until both valves are closed on head being repaired.

4. Remove two 5/16 in. rocker arm retaining bolts (12) at push rod end.

5. Remove remaining fasteners and washers (13, 14, 15) holding lower rocker arm cover to cylinder head.

6. Remove lower rocker cover (16).

NOTE

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

⚠CAUTION

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

7. See Figure 3-6. Remove rocker arm shafts by tapping them out using a hammer and a soft metal punch.

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

Figure 3-6. Removing Rocker Arm Shafts

8. See Figure 3-5. Remove rocker arms (10, 11); mark them for reassembly in their original locations.

⚠CAUTION

Distortion to the head, cylinder, and crankcase studs may result if head screws are not loosened (or tightened) gradually in the sequence shown in Figure 3-7.

9. See Figure 3-7. Loosen each head screw 1/8 turn following the sequence shown.

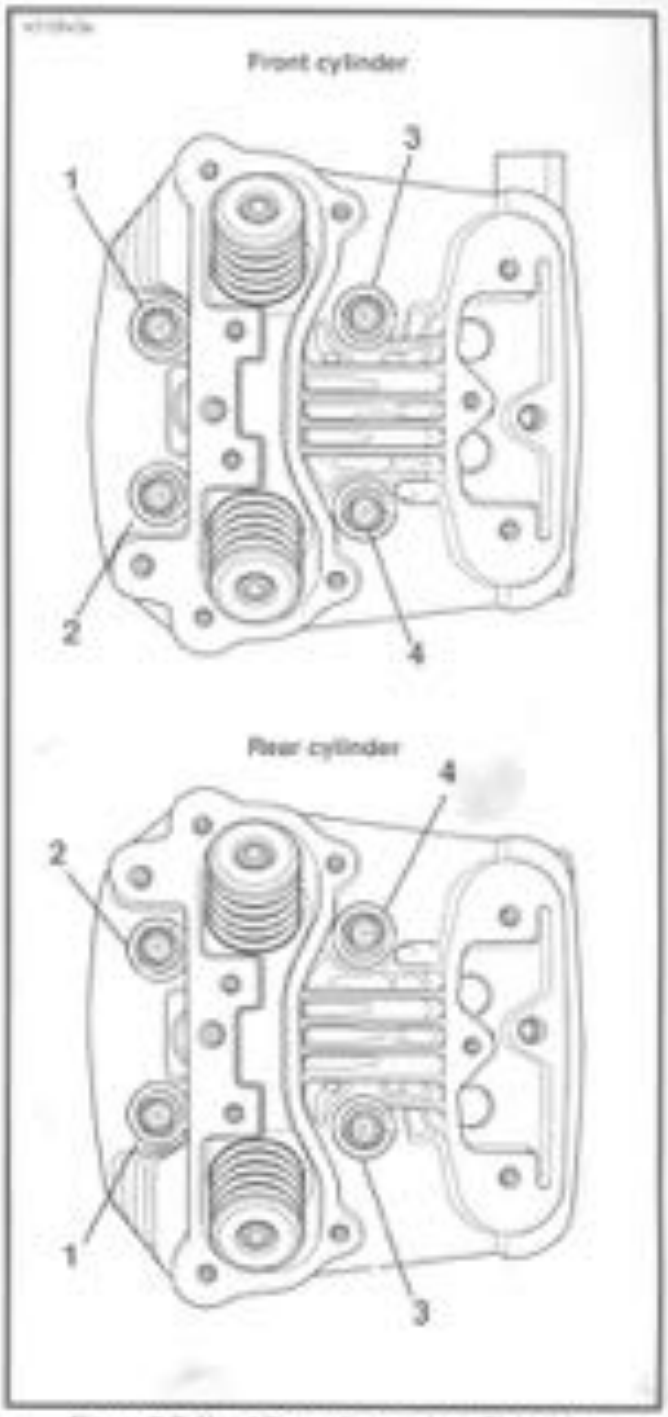


Figure 3-7. Head Screw Loosening / Tightening Sequence

10. Continue loosening in 1/8-turn increments until screws are loose. Remove screws and thick washers.

11. See Figure 3-8. Remove cylinder head (18), head gasket (4), and O-rings (14).

12. See Figure 3-9. Remove socket screws (11), washers (13), and retainers (9). Remove push rod covers (7), seals (8), O-rings (10), and push rods (12). Mark the location and orientation (top and bottom) of each push rod.

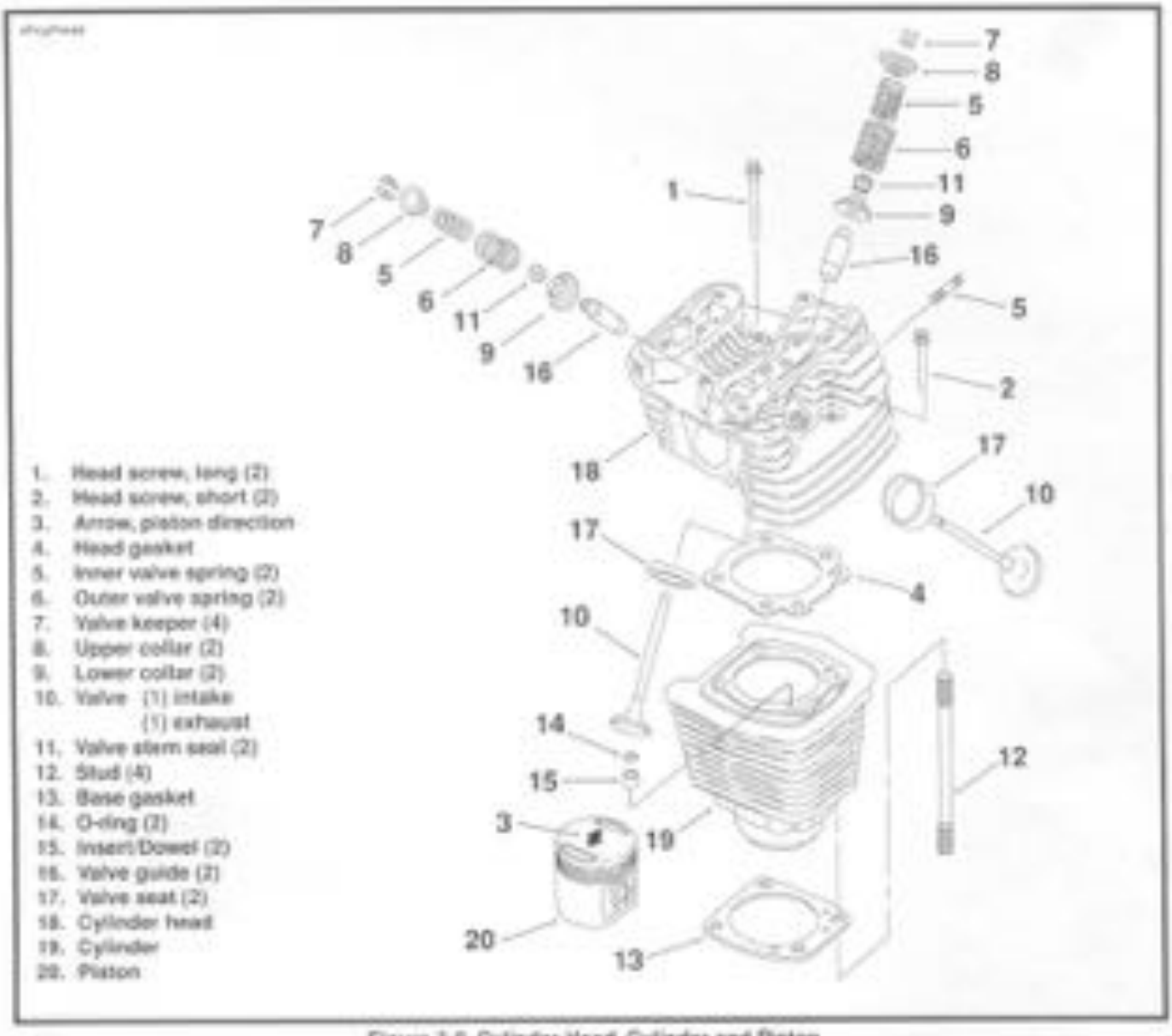


Figure 3-8. Cylinder Head, Cylinder and Piston

13. Remove socket screw (3), washer (14) and plate (4). Remove O-rings (2) from ends of pins (2). Grasp pins (2) and pull from crankcase. Use a pliers if necessary. Lift lifter out of crankcase bore.

14. Repeat Steps 1-13 for the other head.

DISASSEMBLY

1. See Figure 3-8. Compress valve springs (5 and 6) with VALVE SPRING COMPRESSOR (Part No. HD-34736B) (as shown in Figure 3-10).

2. See Figure 3-8. Remove keepers (7), upper collar (8) and springs (5 and 6). Mark keepers for reassembly in original position.

3. Use a fine tooth file to remove any burrs on the valve stem at the keeper groove.

4. Mark valve to ensure that it will be reassembled in the same head.

5. Remove valve (10), valve stem seal (11) and lower collar (9).

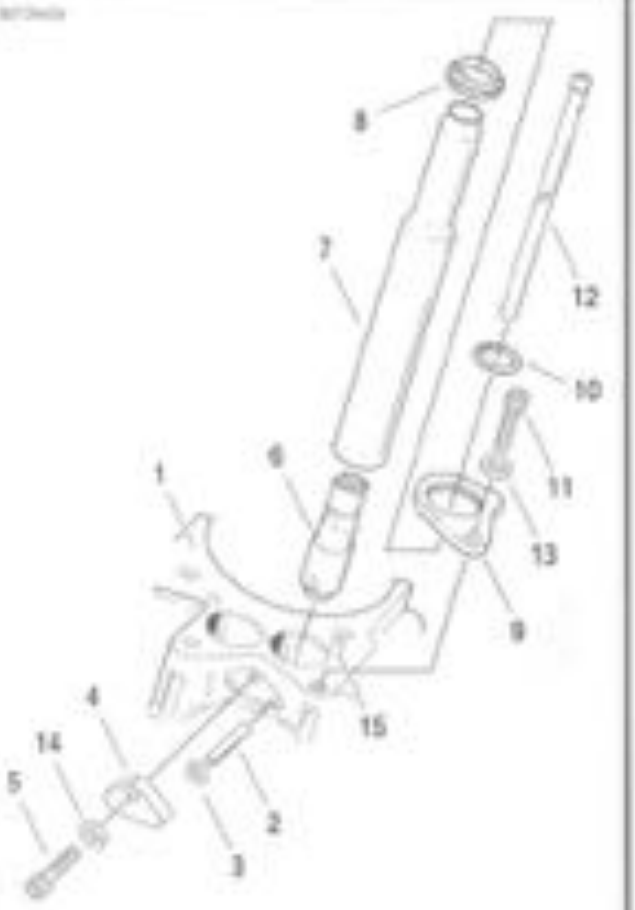
6. Repeat Steps 1-5 for the other valve.

7. Disassemble the other head following Steps 1-6.

CLEANING, INSPECTION, AND REPAIR

1. Bead blast or scrape carbon from head, top of cylinder and valve ports. Be careful to avoid scratching or nicking cylinder head and cylinder joint faces. Blow off loosened carbon or dirt with compressed air.

2. Soak cylinder head in an aluminum-compatible cleaner/solvent to loosen carbon deposits.



1. Right crankcase half
2. Pin (2)
3. O-ring (2)
4. Plate
5. Screw
6. Tappet (2)
7. Push rod cover (2)
8. Seal (2)
9. Retainer (2)
10. O-ring (2)
11. Screw (2)
12. Push rod (2)
13. Washer (2)
14. Washer
15. Locating pin (2)

Figure 3-9. Middle Valve Train Components (Quantities per Engine Cylinder)

3. Wash all parts in non-flammable solvent, followed by a thorough washing with hot, soapy water. Blow out oil passages in head. Be sure they are free of sludge and carbon particles. Remove loosened carbon from valve head and stem using a wire wheel. Never use a file or other hardened tool which could scratch or nick valve. Polish valve stem with very fine emery cloth or steel wool.

4. Check each rocker arm, at pad end and push rod end, for uneven wear or pitting. Replace rocker arm if either condition exists.

5. See Figures 3-11 and 3-12. Measure rocker arm shaft diameter at the positions where shaft fits in lower rocker arm cover and where rocker arm bushings ride. Record the measurements.

Figure 3-10. Compressing Valve Springs

Figure 3-11. Measuring Rocker Arm Shaft Diameter (Rocker Cover Position)

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

Figure 3-12. Measuring Rocker Arm Shaft Diameter (Rocker Arm Bushing Position)

Figure 3-14. Measuring Rocker Arm Bushing Inner Diameter

6. See Figures 3-13 and 3-14. Measure rocker arm shaft bore diameter in lower rocker cover and rocker arm bushing inner diameter. Record the measurements.

7. Check the clearances and measurements obtained in Steps 5 and 6 against the SERVICE WEAR LIMITS.

8. Repair or replace parts exceeding the SERVICE WEAR LIMITS.

9. Assemble rocker arms and rocker arm shafts into lower rocker cover.

10. Check end play of rocker arm with feeler gauge.

11. Replace rocker arm or cover or both if end play exceeds 0.025 in. (0.63 mm).

12. Valve heads should have a sealing surface width of 0.040-0.062 in. (1.02-1.57 mm), and should be free of pit marks and burn spots. The color of carbon on exhaust valves should be black or dark brown. White or light buff carbon indicates excessive heat and burning.

13. Valve seats are also subject to wear, pitting, and burning. They should be resurfaced whenever valves are refinished.

14. Clean valve guides by lightly honing with VALVE GUIDE HONE (Part No. HD-34723).

15. Scrub guides with VALVE GUIDE BRUSH (Part No. HD-34751) and hot soapy water. Measure valve stem outer diameter and valve guide inner diameter. Check measurements against SERVICE WEAR LIMITS.

16. Inspect spark plug threads for damage. If threads in head are damaged, a special plug type insert can be installed using a 12mm spark plug repair kit.

17. Inspect valve springs for broken or discolored coils.

18. See Figure 3-15. Check free length and compression force of each spring. Compare with ENGINE SPECIFICATIONS. If spring length is shorter than specification, or if spring compression force is below specification, replace spring.

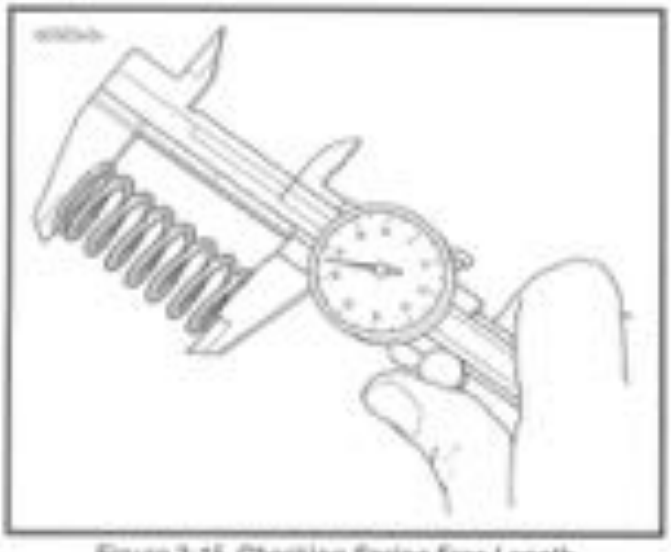


Figure 3-15. Checking Spring Free Length

19. Examine push rods, particularly the ball ends. Replace any rods that are bent, worn, discolored, or broken.

20. See Figure 3-16. Check head gasket surface on head for flatness. Machine or replace any head which exceeds SERVICE WEAR LIMIT of 0.006 in. (0.15 mm).

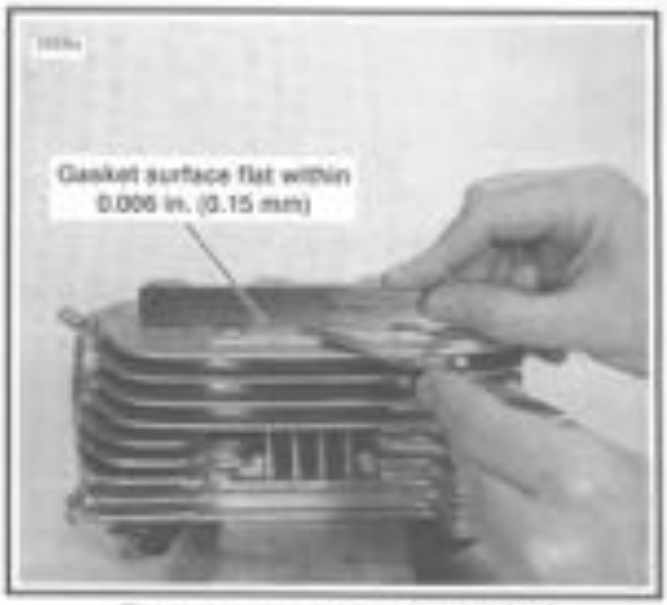


Figure 3-16. Checking Gasket Surface

Rocker Arms and Bushings

1. See Figure 3-17. To replace worn bushings, press or drive them from the rocker arm. If bushing is difficult to remove, turn a 9/16-18 tap into bushing. From opposite side of rocker arm, press out bushing and tap.

2. Press replacement bushing into rocker arm, flush with arm end, and split portion of bushing towards tap of arm.

3. Using remaining old bushing as a pilot, line ream new bushing with Harley-Davidson ROCKER ARM BUSHING REAMER (Part No. HD-94804-57).

4. Repeat for other end of rocker arm.

Replacing Valve Guides

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

Figure 3-17. Removing Rocker Arm Bushing

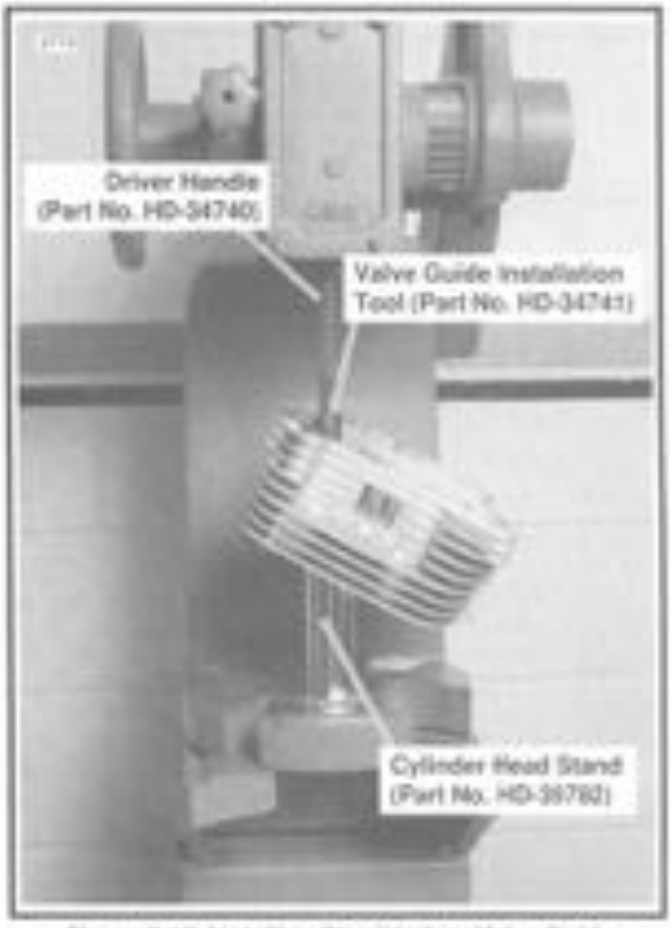


Figure 3-18. Installing Shoulderless Valve Guide

VALVE STEM CLEARANCES AND SERVICE WEAR LIMITS

Valve	Clearance	Service Wear Limit
Exhaust	0.0015-0.0033 in.	0.0040 in.
Intake	0.0010-0.0026 in.	0.0035 in.

1. To remove shoulderless guides, press or tap guides toward combustion chamber using DRIVER HANDLE AND REMOVER (Part No. HD-34740).
2. Clean and measure valve guide bore in head.
3. Measure outer diameter of a new standard valve guide. The guide diameter should be 0.0020-0.0033 in. (0.051-0.084 mm), larger than bore in head. If it is not, select one of the following oversizes: +0.001 in., +0.002 in., or +0.003 in. (+0.025, +0.05 +0.08 mm) (intake and exhaust).
4. See Figure 3-18. Install shoulderless guides using VALVE GUIDE INSTALLATION TOOL (Part No. HD-34731) and DRIVER HANDLE (Part No. HD-34740). Press or drive guide until the tool touches the machined surface surrounding the guide. At this point, the correct guide height has been reached.
5. Ream guides to final size or within 0.0010 in. (0.025 mm) of final size using VALVE GUIDE REAMER: Part No. HD-39932 (Steel) or Part No. HD-39932-CAR (Carbide). Use REAMER LUBRICANT (Part No. HD-39964) or liberal amounts of suitable cutting oil to prevent reamer chatter.
6. See Figure 3-19. Apply the proper surface finish to the valve guide bores using the VALVE GUIDE HONE (Part No. HD-34723). Lubricate hone with honing oil. Driving hone with an electric drill, work for a crosshatch pattern with an angle of approximately 60°.

NOTE

The hone is not intended for the removal of material.

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

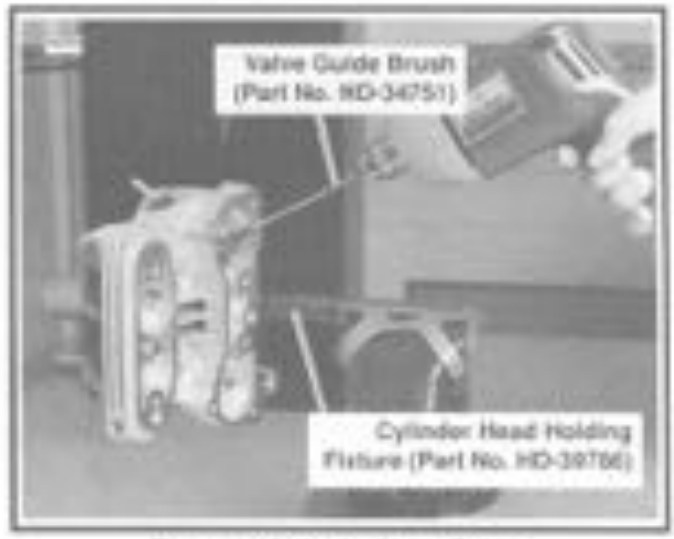


Figure 3-19. Honing Valve Guides

Grinding Valve Faces and Seats

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

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

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

See Figure 3-20. Correct 3-angle valve seat angles are shown. Use NEWAY VALVE SEAT CUTTERS, which are part of NEWAY VALVE SEAT CUTTER SET, (Part No. HD-36758) to cut the seats. Always grind valves before cutting seats.

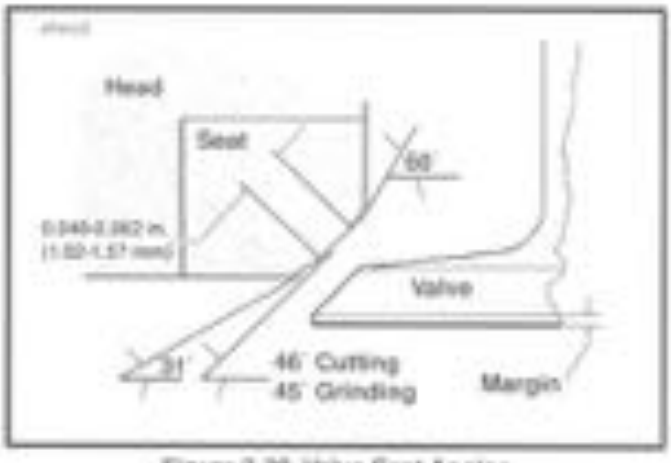


Figure 3-20. Valve Seat Angles

1. Using the #622 cutter, cut 46° (or grind 45°) valve seat angle first. Use cutting oil to avoid chatter marks. Cut or grind only enough to clean up the seat.

2. Apply a small amount of lapping compound to the valve face. Rotate valve against seat using VALVE LAPPING TOOL (Part No. HD-96550-36A).

3. See Figure 3-20. Check the contact pattern on valve face. It should be 0.040-0.062 in. (1.02-1.57 mm) wide, and its center should be positioned 2/3 of the way toward the outside edge of face.

4. If valve seat pattern is too close to the stem side of valve face, use the #605 cutter to cut the 60° angle to raise the seat. If pattern is too close to the edge of valve face, use cutter #622 to cut a 31° angle to lower the seat.

5. After cutting either or both 31° or 60° angles to position seat, final cut 46° (or grind 45°) seat angle to obtain proper 0.040-0.062 in. (1.02-1.57 mm) width.

6. Recheck valve seat width and location with lapping compound as described in Step 2.

7. To achieve a smooth even finish, place a piece of 280 grit emery paper under the cutter head and rotate cutter.

8. See Figure 3-21. Wipe valve seats and valve faces clean. Measure valve stem protrusion. If valve stem protrudes more than 2.034 in. (51.66 mm), valve seat or cylinder head must be replaced. If valve stem protrusion is within the acceptable range, valves and seats are ready for lapping.

⚠CAUTION

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

Figure 3-21. Measuring Valve Stem Protrusion

Replacing Valve Seats

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

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

Lapping Valve Faces and Seats (Figure 3-22)

NOTE

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

1. Apply a light coat of fine lapping compound to valve face. Insert valve in guide. Position one rubber cup end of VALVE LAPPING TOOL (Part No. HD-96556-36A) onto head of valve. Holding lapping tool as shown, apply only very light pressure against valve head, and rotate lapping tool and valve alternately clockwise and counterclockwise a few times.

Figure 3-22. Lapping Valves

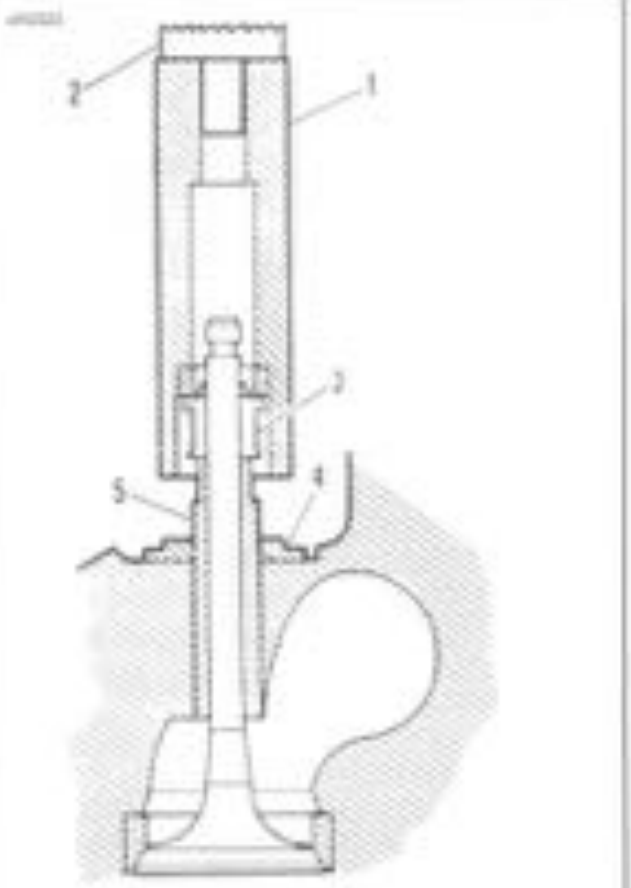
2. Lift valve and rotate it about 1/3 of a turn clockwise. Repeat lapping procedure in Step 1.
3. Repeat Step 2. Then, remove valve.
4. Wash valve face and seat; dry with a new, clean cloth or towel.
5. If inspection shows an unbroken lapped finish of uniform width around both valve and seat, valve is well seated. If lapped finish is not complete, further lapping (or grinding and lapping) is necessary.

ASSEMBLY

⚠CAUTION

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

1. Wash cylinder head and valves in warm, soapy water to remove all lapping compound.
2. Scrub valve guide bores with VALVE GUIDE BRUSH (Part No. HD-34751) and hot, soapy water.
3. Blow dry with compressed air.
4. Apply a liberal amount of engine oil to the valve stem.
5. See Figure 3-23. Insert valve into guide and install lower collar (4).



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

Figure 3-23. Valve Seal Installation

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

⚠CAUTION

- **Always use a protective sleeve on the valve stem keeper groove when installing valve stem seal. If the seal is installed without using the protective sleeve, the seal will be damaged.**
- **Do not remove valve after seal is installed. Otherwise, sharp edges on keeper groove will damage seal.**

7. See Figure 3-23. Tap the seal onto the guide using the VALVE SEAL INSTALLATION TOOL (Part No. HD-34643A) and DRIVER HANDLE (Part No. HD-34740). The seal is completely installed when the tool touches the lower collar (4).
8. See Figure 3-8. Install valve springs (5 and 6) and upper collar (8).
9. Compress springs with VALVE SPRING COMPRESSOR (Part No. HD-34736B).

Figure 3-24. Valve Guide Seal Protector Sleeve

10. Insert keepers (7) into upper collar (8), making sure they engage groove in valve stem. The keeper gaps should be equal.

11. Release and remove VALVE SPRING COMPRESSOR.

12. Repeat Steps 4 - 11 for the remaining valve(s).

INSTALLATION

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

1. See Figure 3-8. Coat mating surfaces of cylinder studs (12) and head screws (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 screws from studs. Wipe or blow dry thread surfaces.

4. Apply oil to stud threads and to the underside of the head screw shoulder.

⚠CAUTION

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

5. Blow or wipe off excess oil from head screws.

6. Thoroughly clean and dry the gasket surfaces of cylinder (19) and cylinder head (18).

7. Install a new O-ring (14) on each dowel (15).

⚠CAUTION

O-rings (14) help to properly position the head gasket (4). O-rings must be installed before the head gasket.

8. Install a new head gasket (4) to cylinder.

9. Carefully lower cylinder head over studs and position on dowels. Use great care so as not to disturb head gasket.

10. Install head screws (1 and 2) finger tight.

⚠CAUTION

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

11. See Figure 3-7. For each cylinder head, start with screw numbered one, as shown. In increasing numerical sequence (i.e. – 1, 2, 3, 4), tighten head screws in the following steps:

FIRST STEP:	Tighten each screw to 7-9 ft-lbs (9-12 Nm) torque.
SECOND STEP:	Tighten each screw to 12-14 ft-lbs (16-19 Nm) torque.
THIRD STEP:	**Loosen all screws**
FORTH STEP:	Tighten each screw to 7-9 ft-lbs (9-12 Nm) torque.
FIFTH STEP:	Tighten each screw to 12-14 ft-lbs (16-19 Nm) torque.
SIXTH STEP:	SeeFigure 3-25. Mark cylinder head and head screw shoulder with a line as shown (View A). Tighten each screw a quarter turn (90°) (View B).

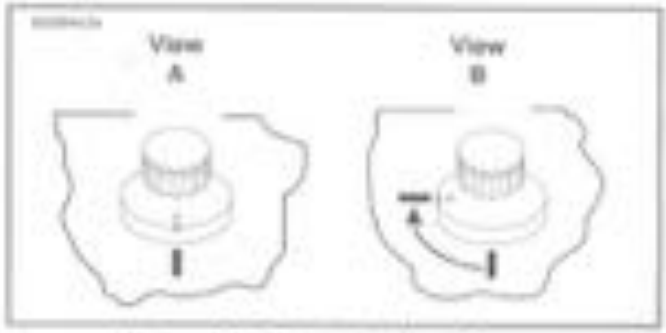


Figure 3-25. Tightening Head Screws

12. See Figure 3-9. Rotate engine so that both tappets (6), from the cylinder being serviced, will be installed on the base circle (lowest position) of the cam.

13. Apply a liberal amount of engine oil to tappet assembly (especially roller needles), to ensure smooth initial operation.

14. Insert tappet (6) into bore in crankcase (1). Rotate tappet so that flats at upper end of tappet face the front and rear of the engine. If the tappet is installed incorrectly, pins (2) cannot be inserted.

15. Insert pins (2) in the holes in crankcase. Place new O-rings (3) over ends of pins. Install plate (4) using screw (5) with washer (14). Tighten screw (5) to 80-110 in-lbs. (9.0-12.4 Nm).

16. Slide new seal (8), and place retainer (9), over top of push rod cover (7). Position new O-ring (10) at top of push rod cover. Hold cover at an angle and insert top through hole in cylinder head. Push up on cover while aligning bottom of cover with tappet bore in crankcase. Lower retainer (9) with seal (8) onto crankcase, aligning locating pin (15) with hole in retainer.

17. Insert screw (11) with washer (13) through hole in retainer (9), and thread into tapped hole in crankcase. Tighten screw (11) to 15-18 ft-lbs (20-24 Nm) torque.

18. Identify push rod color coding and length, and respective push rod positions in engine (see Push Rod Selection Table below). Place intake and exhaust push rods (12) onto seat at top of tappet (6).

Push Rod Selection Table

Position	Color Code, Part Number, Length
Exhaust (Front & Rear)	3 Band - Pink, 17904-89, 18.800 in.
Intake (Front & Rear)	1 Band - Brown, 17897-89, 18.746 in.

19. See Figure 3-5. Install new gaskets (16 and 17), with the bead facing up. Place lower rocker box assembly (with rocker arms and shafts) into position. Place push rods in rocker arm sockets.

⚠CAUTION

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

20. Install bolts (12), (13), (14), and (15). Slowly snug all fasteners in small increments (one turn at a time). Use a cross pattern on the four large bolts that fasten the lower rocker box to head. This will bleed the lifters. Tighten bolts (14) to 90-120 in-lbs (10.2-13.6 Nm) torque. Tighten bolts (15) to 10-13 ft-lbs (14-18 Nm) torque. Tighten bolts (12) and (13) to 15-18 ft lbs (20-24 Nm) torque.

21. Place new gasket (7), middle rocker cover (5), (with breather valve on intake side) new gasket (6) and upper rocker cover (4) on lower rocker box. Install bolts (1) with new fiber seals (2). Tighten bolts (1) to 10-13 ft-lbs (14-18 Nm) torque.

22. Repeat above procedures for other cylinder.

CYLINDER AND PISTON

REMOVAL/DISASSEMBLY (Figure 3-26)

1. Strip motorcycle as described under STRIPPING MOTORCYCLE FOR ENGINE REPAIR in this section.

2. Remove cylinder head as described under CYLINDER HEAD, REMOVAL in this section.

3. Clean crankcase around base of cylinder to prevent dirt and debris from entering crankcase while removing cylinder.

4. Turn engine over until one piston (3) is at bottom of its stroke.

5. Carefully raise cylinder (1) just enough to permit placing clean towel under piston to prevent any foreign matter from falling into crankcase.

NOTE

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

6. Carefully lift cylinder (1) over piston (3) and studs (4). Do not allow piston (3) to fall against cylinder studs. Discard cylinder base gasket (5).

⚠CAUTION

With cylinder removed, be careful not to bend the studs. The slightest bend could cause a stress riser and could lead to stud failure.

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

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

Figure 3-26. Cylinder and Piston

⚠WARNING

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

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

⚠CAUTION

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

NOTE

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

Figure 3-27. Piston Pin and Piston Identification

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

⚠CAUTION

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

10. Spread piston rings (6) outward until they clear grooves in piston (3) and lift off.

CLEANING, INSPECTION, AND REPAIR

1. Soak cylinder and piston in an aluminum-compatible cleaner/solvent until deposits are soft, then clean with a brush. Blow off loosened carbon and dirt particles and wash in solvent.
2. Clean oil passage in cylinder with compressed air.
3. Clean piston ring grooves with a piece of compression ring ground to a chisel shape.
4. Examine piston pin to see that it is not pitted or scored.
5. Check piston pin bushing to see that it is not loose in connecting rod, grooved, pitted or scored. A piston pin properly fitted to upper connecting rod bushing has a 0.00125 to 0.00175 in. (0.0317-0.0444 mm) clearance in bushing. If piston pin-to-bushing clearance exceeds 0.00200 in. (0.0508 mm), replace worn parts. See CONNECTING ROD BUSHINGS.
6. Clean piston pin retaining ring grooves.
7. Examine piston and cylinder for cracks, burnt spots, grooves and gouges.
8. Check connecting rod for up and down play in lower bearings. When up and down play is detected, lower bearing should be refitted. This requires removing and disassembling engine crankcase.

Checking Gasket Surface (Figure 3-28)

⚠CAUTION

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

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

Figure 3-28. Checking Gasket Surfaces

Measuring Cylinder Bore (Figure 3-29)

1. Remove any burrs from the cylinder gasket surfaces.
2. Install a head and base gasket, and CYLINDER TORQUE PLATES (Part No. HD-33440) and TORQUE PLATE BOLTS (Part No. HD-33446-66). Tighten the bolts using the same method used when installing the cylinder head screws. See INSTALLATION, CYLINDER HEAD earlier in this Section.

NOTE

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

3. Take cylinder bore measurement in ring path, starting about 1/2 in. (13 mm) from top of cylinder, measuring from front to rear, and then side to side. Record readings.
4. Repeat measurement at center, and then at bottom of ring path. Record readings. This process will determine if cylinder is out-of-round (or "egged") and will also show any cylinder taper or bulge. See cylinder bore service wear limits chart. If cylinder is not scuffed or scored and is within service limit, see Fitting Cylinder to Piston.

Figure 3-29. Measuring Cylinder Bore

Cylinder Bore Service Wear Limits

Bore Sizes	883cc	1200cc
Standard Bore	3.0035 in. 76.289 mm	3.5009 in. 88.920 mm
0.005 O.S. bore 0.13 mm	3.0078 in. 76.398 mm	3.5050 in. 89.027 mm
0.010 O.S. bore 0.25 mm	3.0128 in. 76.525 mm	3.5100 in. 89.154 mm
0.020 O.S. bore 0.51 mm	3.0228 in. 76.779 mm	3.5200 in. 89.408 mm
0.030 O.S. bore 0.76 mm	3.0328 in. 77.033 mm	3.5300 in. 89.662 mm
0.040 O.S. bore 1.02 mm	3.0428 in. 77.287 mm	–

NOTE

If piston clearance exceeds service limit, cylinders should be rebored 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 SPECIFICATIONS.

Measuring Piston

Because of their complex shape, the pistons cannot be accurately measured with standard measuring instruments.

The pistons have the typical elliptical shape when viewed from the top. However, they also are barrel-shaped when viewed from the side. This barrel shape is not symmetrical.

Any damage to the piston will change its shape, which will lead to problems.

Fitting Cylinder to Piston

Since pistons cannot be accurately measured with standard measuring instruments, the bore sizes, given in Step 2 under Boring and Honing Cylinder, must be observed. Example: A 0.005 in. (0.13 mm) oversize piston will have the proper clearance with a bore size of 3.0048 in. ± 0.0002 in. (76.322 mm ± 0.005 mm) for the 883cc engine.

Boring and Honing Cylinder

1. The cylinder must be bored with gaskets and torque plates attached. Bore the cylinder to 0.003 in. (0.08 mm) under the desired finished size.
2. Hone the cylinder to its finished size using a 280 grit rigid hone followed by a 240 grit flexible ball hone. Honing must be done with the torque plates attached. All honing must be done from the bottom (crankcase) end of the cylinder. Work for a 60° crosshatch pattern.

Final cylinder bore sizes, after honing are as follows:

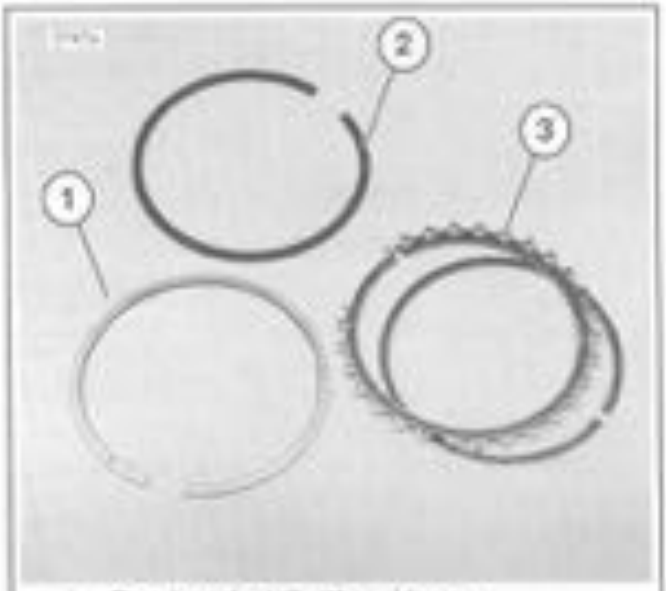
Bore Sizes	883cc	1200cc
Standard bore*	3.0005 in. 76.213 mm	3.4978 in. 88.844 mm
0.005 O.S. bore	3.0049 in. 76.323 mm	3.502 in. 88.95 mm
0.010 O.S. bore	3.0098 in. 76.449 mm	3.507 in. 89.08 mm
0.020 O.S. bore	3.0198 in. 76.793 mm	3.517 in. 89.33 mm
0.030 O.S. bore	3.0298 in. 76.957 mm	3.527 in 89.59 mm
0.040 O.S. bore	3.0398 in. 77.211 mm	–

*All bore sizes ± 0.0002 in.

When cylinder requires oversize reboring to beyond 0.040 in. (1.02 mm) on 883cc engines, or 0.30 in. (7.6 mm) on 1200cc engines, the oversize limit has been exceeded and cylinder must be replaced.

NOTE

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 hone to facilitate ring seating.



1. **Top ring – Install either side up**
2. **Second ring – Install dot toward top**
3. **Oil control rings**

Figure 3-30. Piston Rings

Fitting Piston Rings

NOTE

Ring sets and pistons, 0.040 in. (1.02 mm) oversize, are not available on 1200cc engines.

See Figure 3-30. Piston rings are of two types: compression and oil control. The two compression rings are positioned in the two upper piston ring grooves. The dot on the second compression ring must face upward. Ring sets are available to fit standard and oversize pistons.

Piston ring sets must be properly fitted to piston and cylinder:

1. See Figure 3-31. Place piston in cylinder about 1/2 in. (13 mm) from top. Set ring to be checked squarely against piston as shown. Check end gap with thickness gauge. See SPECIFICATIONS for tolerance.

NOTE

See SERVICE WEAR LIMITS for end gap dimensions. Do not file rings to obtain proper gap.

2. See Figure 3-32. Apply engine oil to piston grooves. Use a piston ring expander tool to slip compression rings over piston into their respective grooves. Be extremely careful not to over expand, twist rings, or damage piston surface when installing rings.

NOTE

Install second ring with dot towards top.

Figure 3-31. Measuring Ring End Gap

Figure 3-32. Installing Piston Rings

See Figure 3-33. Install rings so end gaps of adjacent rings are a minimum of 90° apart. Ring gaps are not to be within 10° of the thrust face centerline.

3. See Figure 3-34. Check for proper side clearance with thickness gauge, as shown. See SPECIFICATIONS for clearance.

NOTE

If the ring grooves are clean, and the side play is still not correct, replace the rings, the piston, or both.

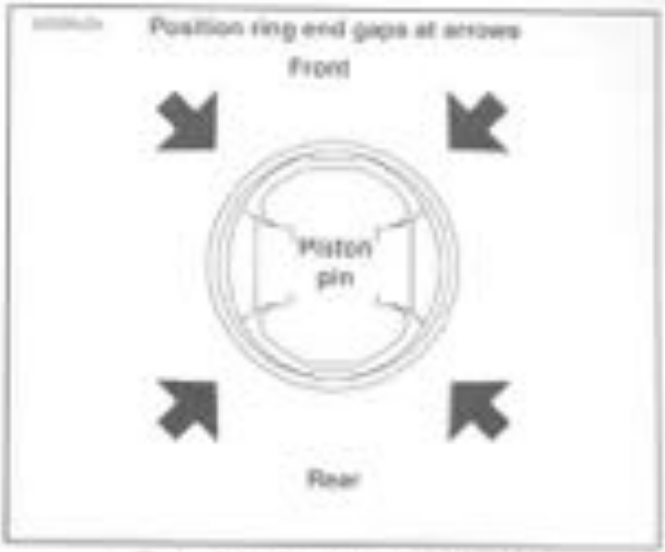


Figure 3-33. Ring End Gap Position

Figure 3-34. Measuring Ring Clearance in Groove

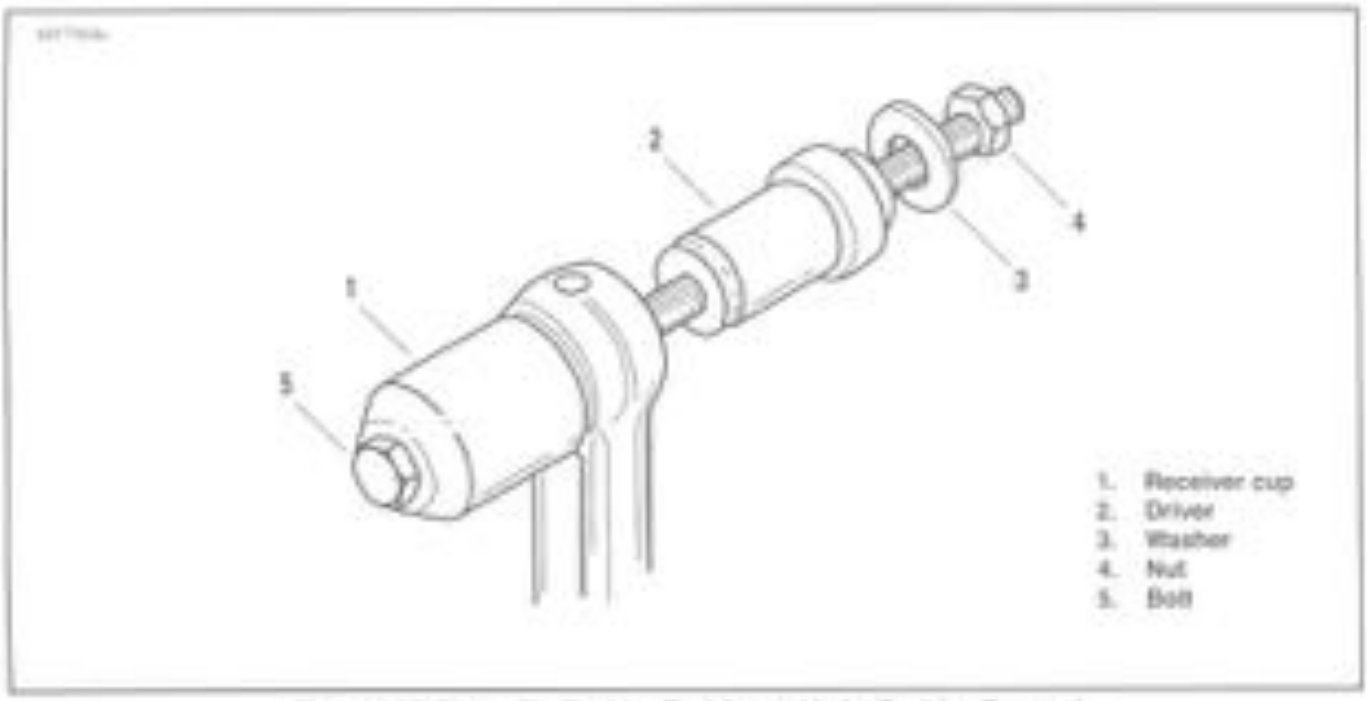


Figure 3-35. Piston Pin Bushing Tool Assembly for Bushing Removal

Connecting Rod Bushing

REMOVAL/INSTALLATION

When connecting rod bushing is worn to excessive pin clearance (0.002 in. or more) (0.05 mm) it must be replaced.

1. See Figure 3-36. Install plastic hoses over studs.
2. Secure connecting rod with ROD CLAMPING FIXTURE (Part No. HD-95952-33A).

NOTE

If CONNECTING ROD CLAMPING TOOL holes are too small, enlarge the holes in the tool.

3. See Figure 3-35. Attach PISTON PIN BUSHING TOOL (Part No. HD-95984-32C) to the connecting rod (receiver cup on one side of the rod and the driver on the opposite side) as shown.
4. Use two box wrenches and push the worn bushing from the connecting rod.
5. Remove the piston pin bushing tool from the connecting rod.
6. Remove the bushing from the receiver cup.
7. See Figure 3-36. Attach the PISTON PIN BUSHING TOOL (Part No. HD-95984-32C) to the connecting rod; place the new bushing between the connecting rod and the driver.

NOTE

The driver must be attached facing the opposite direction as it was for removal of the bushing.

8. Clean up and size bushing to .0013-0.0005 in. (0.025-0.013 mm) undersize using REAMER (Part No. HD-94600-26A).

   Sizing bushing with less than 0.00125 in. (0.0317 mm) clearance can result in a bushing loosening and/or seized pin in rod.

Figure 3-36. Installing New Piston Pin Bushing

9. Hone bushing to final size using CONNECTING ROD BUSHING HONE (Part No. HD-35102). Use a liberal amount of honing oil to prevent damage to hone or bushing. Use care to prevent foreign material from falling into the crankcase.

REPAIR

⚠CAUTION

Replace bent rods. Do not attempt to straighten. Straightening rods by bending will damage the bearing on the crank pin and the piston pin bushing.

ASSEMBLY/INSTALLATION

1. Install the piston assembly over connecting rod.

NOTE

New 1200cc and 883cc pistons must be installed with the arrow at the top of the piston, pointing towards the front of the engine.

2. Install piston pin.
3. See Figure 3-37. Install new piston pin retaining rings with the PISTON PIN RETAINING RING INSTALLER (Part No. HD-34623A). Make sure the ring groove is clean and that the ring is fully seated in the groove with the gap away from the slot at the bottom.

Figure 3-37. Installing Piston Retaining Rings

⚠CAUTION

Always use new retaining ring. Make sure retaining ring groove is clean and that ring seats firmly in groove. If it does not, discard the ring. Never install a used retaining ring or a new one if it has been installed and then removed for any reason. A loosely installed ring will come out of the piston groove and damage cylinder and piston beyond repair.

4. See Figure 3-39. Make sure the piston ring end gaps are properly positioned as shown.
5. Lubricate cylinder wall, piston, pin and rod bushing with engine oil.

Figure 3-38. Installing Cylinder Over Piston

6. Turn engine until piston is at top dead center.
7. See Figure 3-38. Compress the piston rings using PISTON RING COMPRESSOR (Part No. HD-96333-51B).
8. Remove cylinder stud sleeves. Install a new cylinder base gasket. Make sure the piston does not bump the studs or crankcase.
9. Install the cylinder over the piston as shown.
10. Remove the piston ring compressor.
11. Assemble and install cylinder head. See CYLINDER HEAD, ASSEMBLY/INSTALLATION in this section.
12. Install assembled engine to motorcycle. See INSTALLING THE ENGINE in this section.

ENGINE LUBRICATION SYSTEM

CHECKING AND ADDING OIL

Check engine oil level in oil tank at least once every 500 miles (800 km). Check level more frequently if engine uses more oil than normal or if vehicle is operated under harsh conditions. Oil tank capacity is three quarts (U.S.) (2.8 liters). Check table in ENGINE LUBRICATION SYSTEM, CHANGING OIL AND FILTER for recommended engine oil viscosity.

1. Run engine until engine oil is at normal operating temperature. Turn engine off.
2. Hold motorcycle upright so that it is not leaning on jiffy stand. Remove filler cap from oil tank on right side of vehicle. Wipe attached dipstick clean.
3. Install filler cap onto oil tank. Make sure cap is fully seated on tank.
4. See Figure 3-39. Remove filler cap and check warm oil level on dipstick. Dipstick has two marks. If oil level in tank is at or below lower mark, add one quart (0.946 liter) of Harley-Davidson oil to tank.
5. Repeat Steps 3-4 to verify correct engine oil level in oil tank. Do not fill oil tank to the level above upper mark on dipstick.

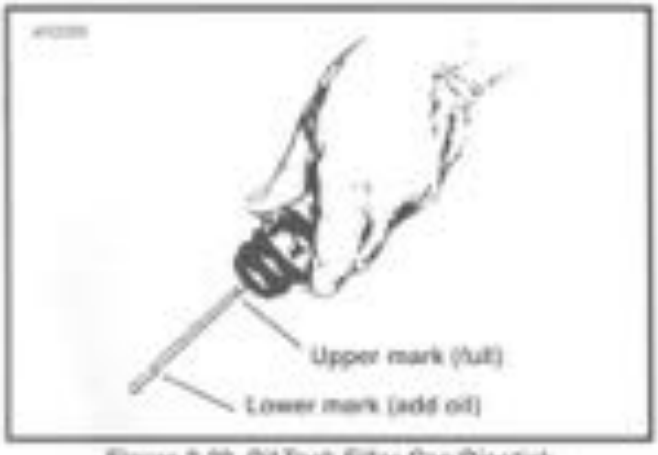


Figure 3-39. Oil Tank Filler Cap/Dipstick

CHANGING OIL AND FILTER

General

After a new engine has run its first 500 miles (806 km), and at 5000 mile (8000 km) intervals or annually thereafter, completely drain oil tank of used oil. Refill with fresh oil. If vehicle is driven extremely hard, used in competition, or driven on dusty roads, change engine oil at shorter intervals. Always change oil filter when changing engine oil. Proceed as follows:

Removal

1. Run engine until engine oil has reached normal operating temperature.
2. Place a suitable container under the engine crankcase. The container must be able to hold approximately three U.S. quarts (2.8 liters).
3. Locate the oil tank drain hose (see Figure 3-40). The drain hose is secured to a lug on the rear muffler mount.
4. Remove the Corbin clamp, pull the drain hose from the lug and insert the free end into the container. Completely drain engine oil from oil tank. It is not necessary to drain engine crankcase.

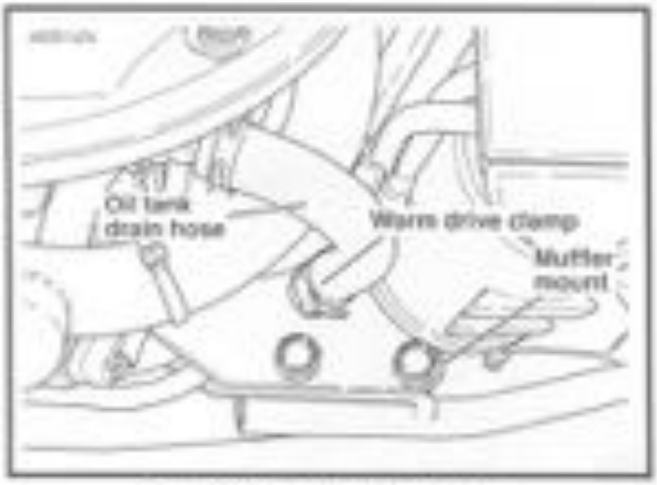


Figure 3-40. Oil Tank Drain Hose

NOTE

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

5. Move drain pan beneath front of engine crankcase.
6. Turn oil filter counterclockwise to remove from filter mount (see Figure 3-41). Discard oil filter.

Figure 3-41. Oil Filter

Recommended Engine Oil Viscosity

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

Installation

1. Pour about 4 fluid ounces (U.S.) (120 ml) of fresh, clean engine oil into **new** oil filter. Allow time for oil to soak into filter element.

NOTE

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

2. Wipe filter gasket contact surface of oil filter mount with a clean cloth. Coat filter gasket with clean engine oil.

3. Install oil filter. Hand tighten filter 1/2 to 3/4-turn after gasket contacts filter mount surface.

4. See Figure 3-40. Use Corbin clamp to secure oil tank drain hose to lug on muffler mount.

5. Install 3 quarts (U.S.) (2.8 liters) to engine oil tank minus the 4 fl. oz. (120 ml) added in step 1. Always use the proper grade of oil for the lowest expected air temperature before the next regularly scheduled oil change.

⚠CAUTION

Remove Corbin clamp and drain hose from rear muffler mount lug. Allow a small amount of oil to flow from hose before reconnection. This action removes air from the drain hose and prevents the possibility of oil pump cavitation.

6. Install filler cap onto oil tank. Make sure cap is fully seated.

7. Start engine. Verify that oil pressure signal light turns off when engine speed is 1000 rpm or above.

8. Check for oil leaks at oil filter and oil tank drain hose. Turn engine off.

WINTER LUBRICATION

Normal fuel combustion in a gasoline engine produces water vapor and carbon dioxide along with other gases and particulates. When first starting and warming an engine, some of the water vapor that gets into the engine crankcase condenses to form liquid water. If the engine is driven long enough to thoroughly warm the crankcase, most of this liquid water is again vaporized and exhausted through the crankcase breather system.

A moderately driven vehicle making short runs may not be able to vacate water vapors allowing liquid water to accumulates in the oil tank. This is especially true if the vehicle is operated in cold weather. In freezing weather, an accumulation of water in the engine oil may become slush or ice, which can block oil lines and lead to severe engine damage. Water remaining in the engine oil for long periods of time can form an acidic sludge that is corrosive to metal engine parts and causes accelerated wear of moving components.

In winter the oil change interval should be shorter than normal. The colder the weather, the shorter the recommended oil change interval. A vehicle used only for short runs in cold weather must have the engine oil drained frequently.

OIL HOSE ROUTING

The feed, vent and return ports are located on the bottom of the oil tank to reduce under seat congestion (see Figures 3-42). A short hose routes the oil from the feed port at the lower front corner (inboard side) to a pipe elbow. The elbow ensures that the hose does not become crimped or kinked, thereby depriving the engine of oil during operation (oil starvation). The elbow routes the oil flow straight down to a pipe tee. The short hose (oil drain) from the pipe tee goes to the rear muffler mount lug where it is held in place by a worm drive clamp. From the other port of the pipe tee the oil flow crosses to the right side of the vehicle where the hose runs forward to the oil pump inlet. From the feed section of the oil pump, another feed hose directs the flow up to the oil filter mount (see page 3-35 for further description). Eventually, oil drains to the sump where it collects in the scavenge section of the oil pump. The return hose, which is tie-wrapped to the feed hose, routes the oil back to the tank where the cycle is repeated.

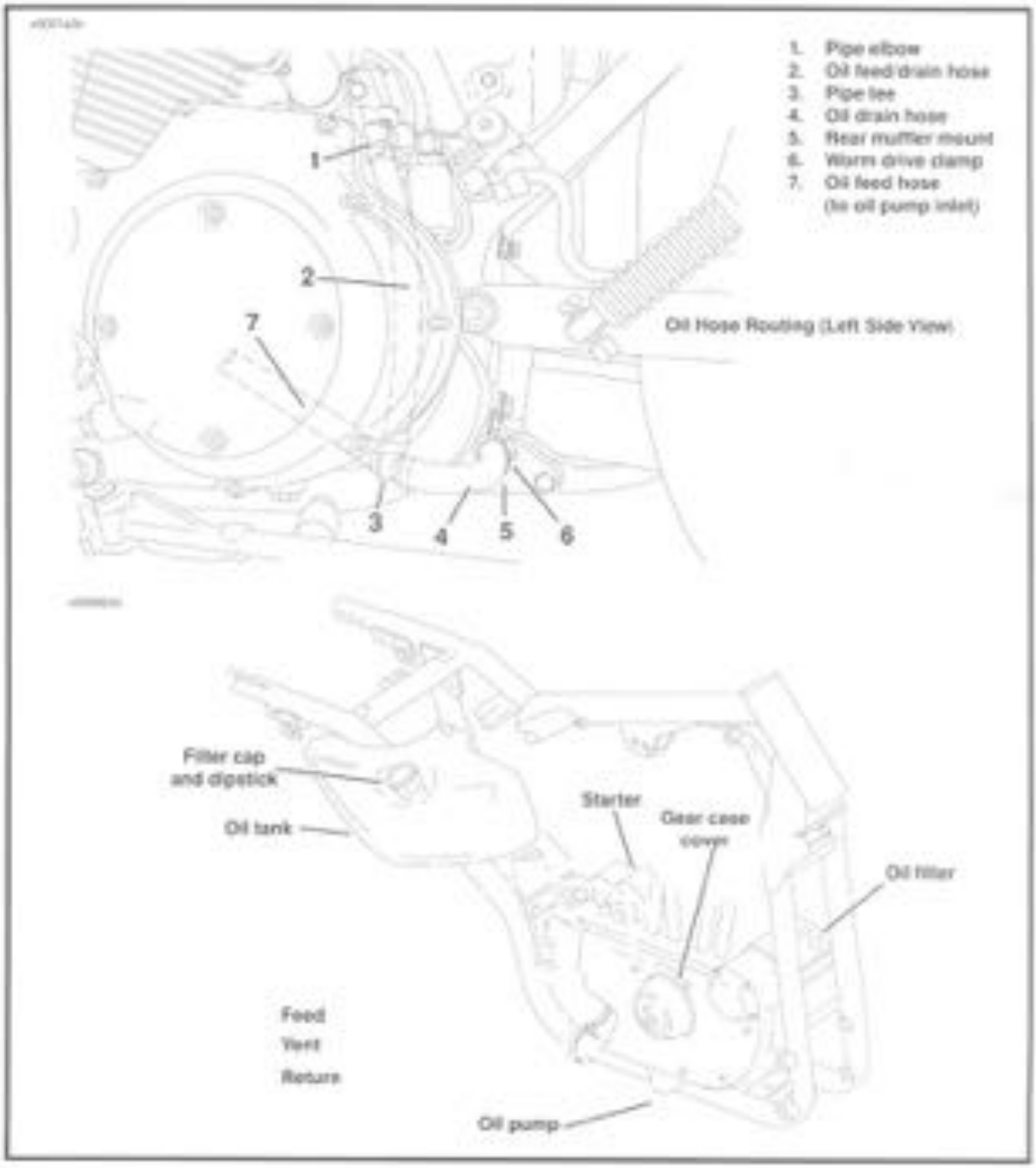


Figure 3-42. Engine Oil Tank, Oil Filter and Hose Routing Locations

OIL TANK

Removal and Disassembly

1. Remove seat. See SEAT, REMOVAL in Section 2.

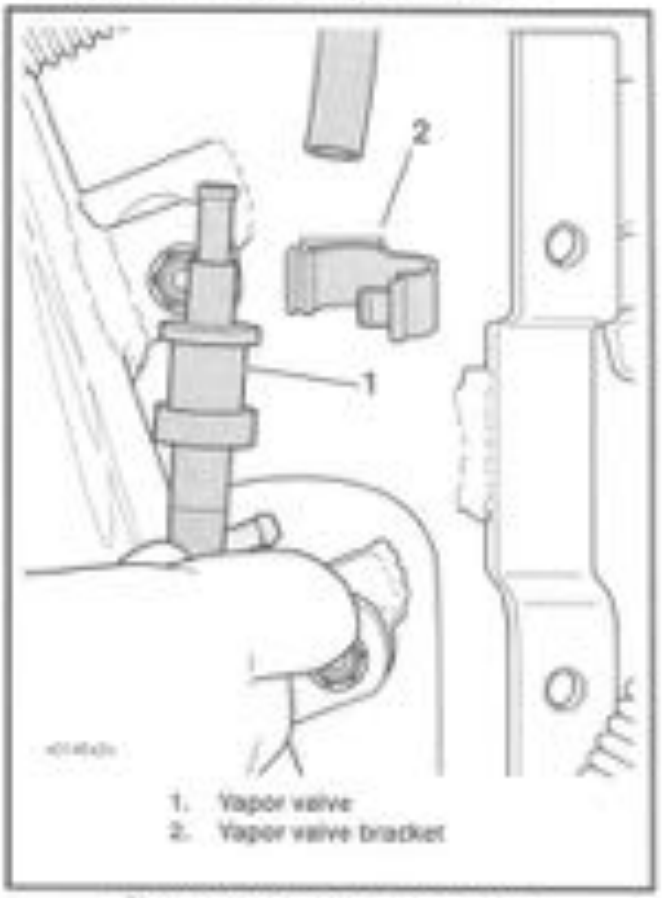
⚠ WARNING

If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion resulting in personal injury and/or property damage.

2. Disconnect battery cables, negative cable first. See BATTERY, DISCONNECTION AND REMOVAL in Section 7.
3. Remove battery from battery tray. Push ignition module connector on rear side plate of battery tray upward to unsnap attachment clip from T-stud. Lift connector off T-stud.
4. Drain oil tank. See ENGINE LUBRICATION SYSTEM, CHANGING OIL AND FILTER, REMOVAL. The oil filter need not be removed unless it is due to be replaced. Leave oil tank drain hose disconnected from lug on muffler mount.
5. Remove locknut securing tab at bottom of battery tray to frame-mounted rubber mount stud. Remove bolts and washers securing three corners of tray to oil tank brackets. Note that wire form retainer for positive battery cable is secured under front bolt. Remove battery tray.
6. Remove two bolts to detach electrical bracket from motorcycle frame. Remove rubber weltnuts from frame. Inspect for cuts, tears or general deterioration. Replace as necessary.
7. See Figure 3-43. Remove vapor valve assembly from inboard side of oil tank. Insert thin blade of screwdriver into slot of vapor valve bracket. Turn screwdriver gently to unsnap clip. Remove vapor valve body from bracket. Remove hose connection from neck of vapor valve. (On California models, remove carbon canister-to-carburetor purge hose from groove of vapor valve bracket.)
8. Cut cable strap securing wire harness to bracket welded next to top inboard seam of oil tank.
9. Slightly move electrical bracket to access upper rear rubber mount on oil tank. Remove locknuts from three oil tank rubber mount studs. Lift oil tank slightly away from motorcycle frame to access oil hoses. All hose connections are on the bottom of the tank.
10. For ease of assembly, mark oil tank hoses for identification: oil feed, vent and return. The straight tube on inboard side of tank next to lower front rubber mount is the feed port. Vent and return tubes can be identified by their 90 degree bends: the smaller O.D. tube is the vent fitting, the larger O.D. tube is the return oil fitting. Disconnect hoses from oil tank.
11. Remove oil tank from motorcycle. Remove vapor valve bracket from T-stud on inboard side of oil tank.
12. See Figure 3-44. Remove three rubber mounts from oil tank. Inspect rubber mounts for cuts, tears or general deterioration. Replace as necessary.
13. Mark position of trim strips on upper and lower inboard seams of oil tank. Remove trim strips.

Assembly and Installation

1. See Figure 3-45. Install three rubber mounts (12) onto oil tank (9). Note that washers are **not** used.
2. Install trim strips (7) in marked positions on upper and lower inboard seams of oil tank (9). Apply upper trim strips to seams on each side of battery tray bracket (8). Use a rubber mallet to seat strips on seams, if necessary. Verify that strips butt up against bracket.



1. Vapor valve
2. Vapor valve bracket

Figure 3-43. Vapor Valve and Bracket

3. Install vapor valve bracket on T-stud on inboard side of oil tank. Position oil tank near its installed location on motorcycle.
4. Install marked oil feed, drain, vent and return hoses in their proper locations on oil tank fittings. See Figures 3-41 and 3-45. Be sure that installed hoses (and battery cables) do not touch brake line.
5. Position oil tank (9) in its installed location on motorcycle. Align studs on inboard side of rubber mounts with flanges welded to frame members. See Figure 3-45. Install locknuts to secure oil tank to frame. Tighten locknuts to 3-5 ft-lbs (4-7 Nm) torque.
6. See Figure 3-43. Hold fuel tank vapor valve in an upright position with the long necked end at the top. Insert neck of vapor valve into hose until hose end contacts shoulder. Position body of vapor valve in bracket. Snap bracket closed. (On California models, install carbon

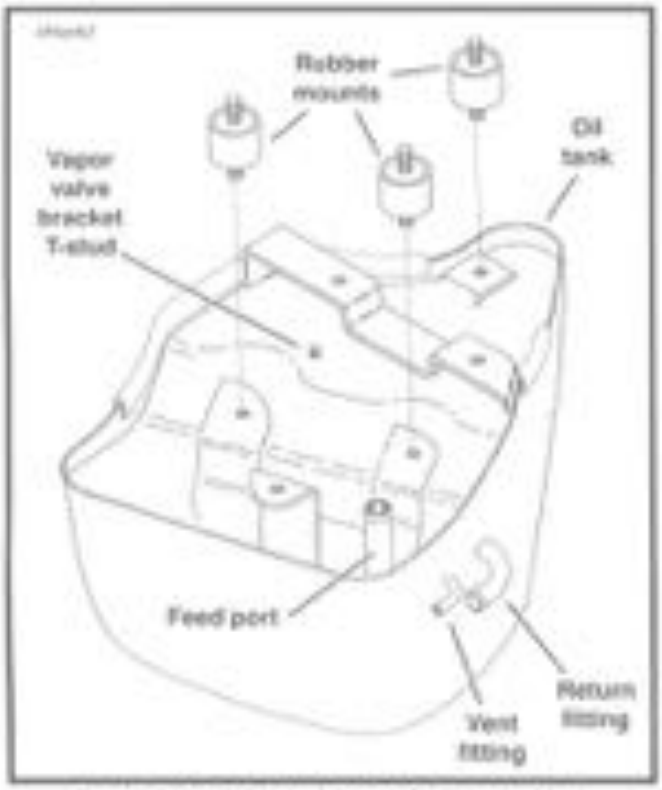


Figure 3-44. Remove/Inspect Rubber Mounts

canister-to-carburetor purge hose in groove of vapor valve bracket.)

7. Align holes in electrical bracket with weltnuts in cross member of motorcycle frame. Install two bolts. Tighten bolts to 6-9 **in-lbs** (0.7-1.0 Nm) torque. See Figure 3-47.

8. Secure wire harness to bracket welded next to top inboard seam of oil tank. Cable strap should pull harness onto trim strip and off unprotected metal seam of oil tank.

9. See Figure 3-48. Position battery tray onto motorcycle fitting tab at bottom of tray over frame-mounted rubber mount stud. Secure three corners of battery tray to brackets on oil tank using bolts and washers. Position wire form retainer for positive battery cable under front bolt. Install locknut on frame-mounted rubber mount stud. Tighten three bolts to 12-15 ft-lbs (16.20 Nm) torque. Tighten locknut on rubber mount stud to 36-60 **in-lbs** (4.1-6.8 Nm) torque.

10. Use worm drive clamp to secure free end of oil tank drain hose to rear muffler mount lug. See Figure 3-49.

11. Fill oil tank. See ENGINE LUBRICATION SYSTEM, CHANGING OIL AND FILTER, INSTALLATION.

1. Pipe tee
2. Hose clamp
3. Pipe elbow
4. Feed/drain hose, 3 inch
5. Feed/drain hose, 8 inch
6. Drain hose, 4-1/4 inch
7. Trim strip (3)
8. Battery tray bracket
9. Oil tank
10. Rear muffler mount
11. Worm drive clamp
12. Rubber mount (3)
13. Feed hose

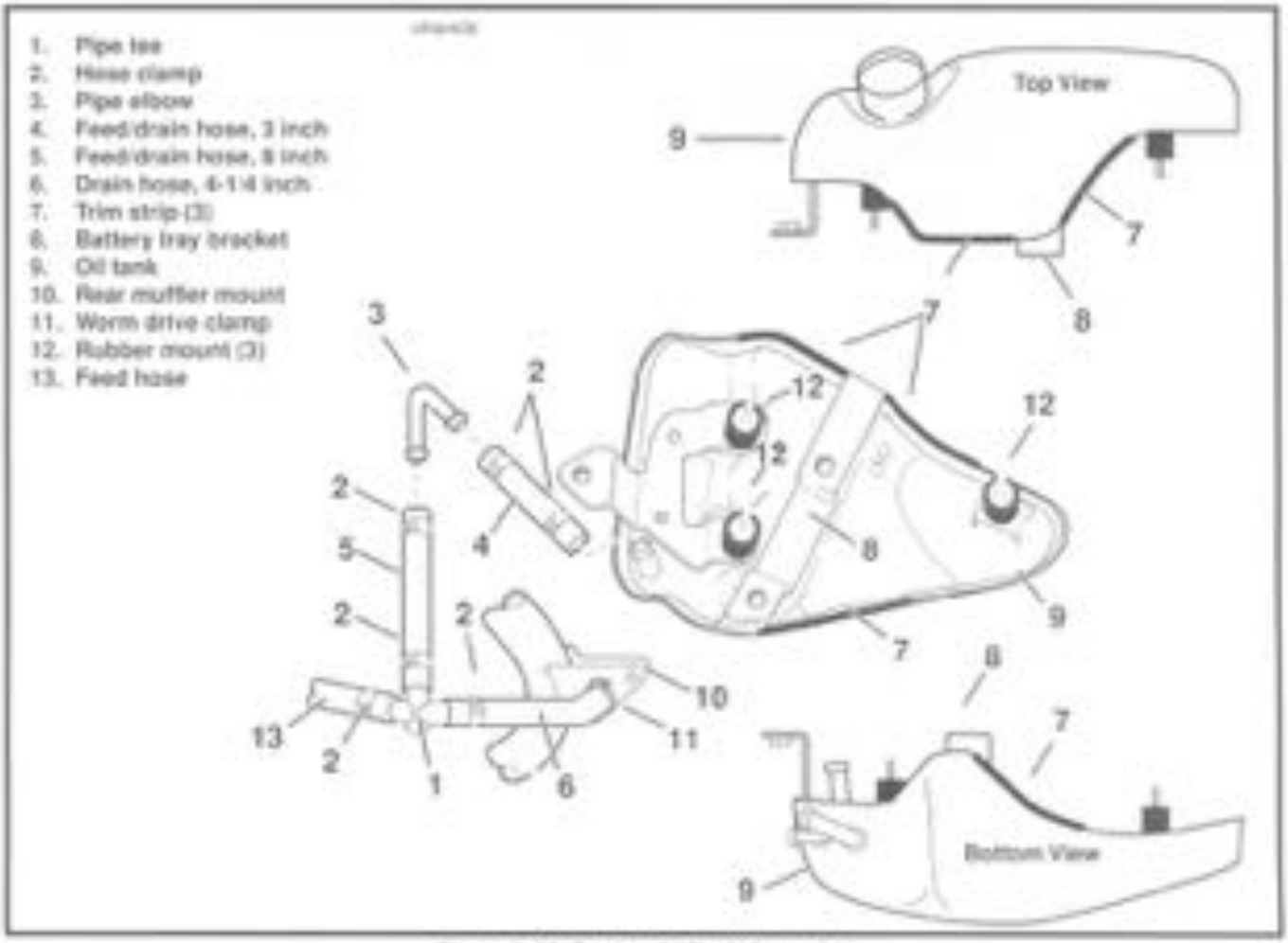


Figure 3-45. Engine Oil Tank Assembly

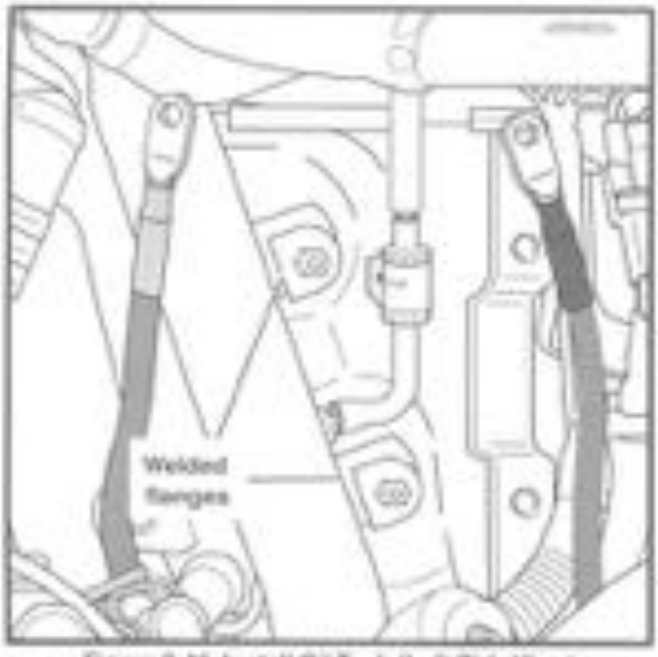


Figure 3-46. Install Oil Tank (Left Side View)


Figure 3-48. Install Battery Tray (Left Side View)

⚠CAUTION

Remove worm drive clamp and drain hose from rear muffler mount lug. Allow a small amount of oil to flow from hose before reconnection. This action removes air from the hose and prevents the possibility of oil pump cavitation.

12. Place large end of slot on attachment clip (of ignition module connector) over T-stud on rear side plate of battery tray; push connector assembly to engage small end of slot. Install battery pad and battery onto battery tray.

13. Install battery cables, positive cable first. See BATTERY INSTALLATION AND CONNECTION in Section 7.

14. Install seat. See SEAT, INSTALLATION in Section 2.

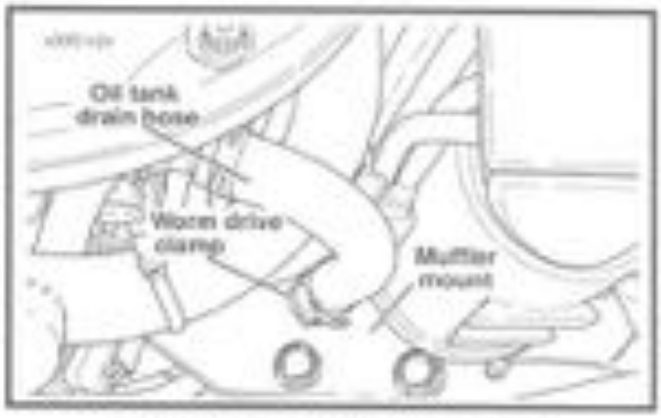


Figure 3-49. Secure Oil Tank Drain Hose

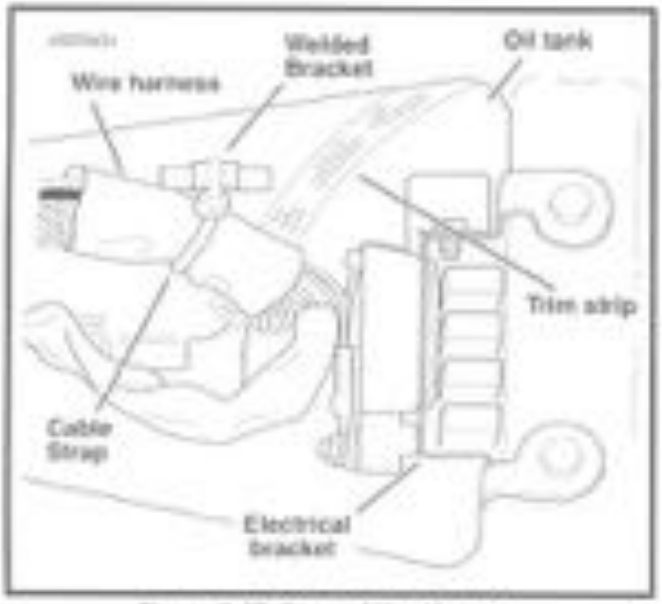


Figure 3-47. Secure Wire Harness

OIL PRESSURE SIGNAL LIGHT SWITCH (FIGURE 3-50)

The oil pressure signal light switch is a pressure-actuated diaphragm-type switch. When oil is not circulating through the system or when oil pressure is abnormally low, spring tension holds the switch contacts closed, thereby completing the signal light circuit and causing the indicator lamp to illuminate.

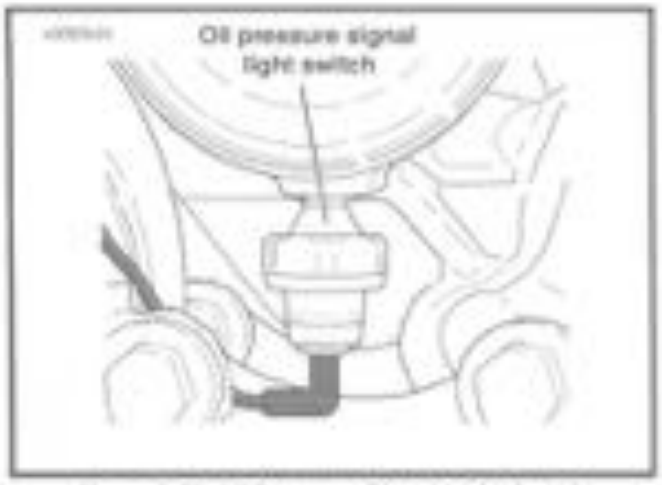


Figure 3-50. Oil Pressure Signal Light Switch

OIL PRESSURE SIGNAL LIGHT

The oil pressure signal light turns ON when:

- Ignition switch is turned on prior to starting engine.
- Oil is not circulating through the running engine.
- Oil pressure is abnormally low on the running engine.
- Engine is idling (or below 1000 rpm).

The oil pressure signal light turns OFF when:

- Oil is circulating with adequate pressure through the engine running at 1000 rpm or greater.

NOTE

If the ignition is turned back on immediately after the engine is stopped, the oil light may not turn on right away because of oil pressure retained in the filter housing.

Oil Pressure Signal Light	Probable Causes
Stays on at speeds above idle	• Empty oil tank. • Clogged feed line (ice and sludge, freezing temperatures). • Air bound oil line. • Grounded oil switch wire. • Malfunctioning signal switch. • Diluted oil. • Malfunctioning check valve (see OIL FILTER MOUNT).
Flickers at idle	• Incorrect idle speed. Malfunctioning or improperly installed check valve (see OIL FILTER MOUNT).
Does not glow when ignition is turned on (prior to operating engine).	• Malfunctioning signal switch. • Malfunction in wiring. • Burned-out signal bulb. • Dead battery (see NOTE above).

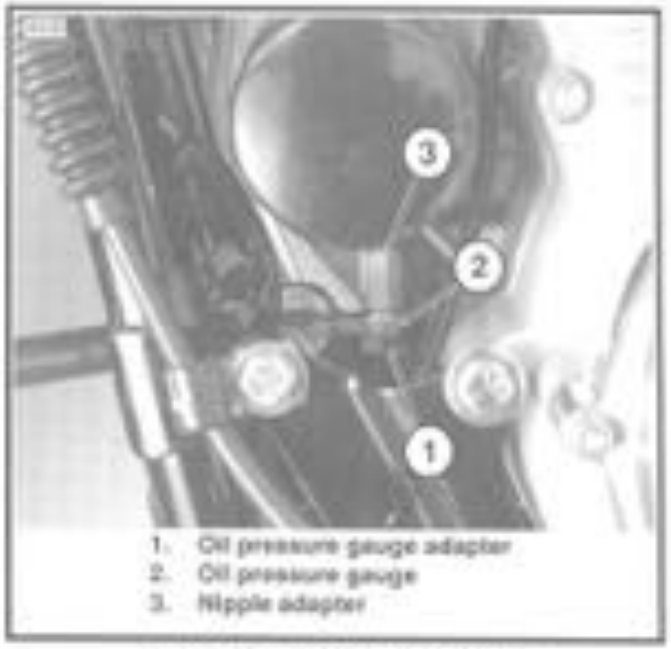
OIL PRESSURE (FIGURE 3-51)

The oil pump is nonregulatory and delivers its entire volume of oil under pressure to the oil filter mount. When an engine is cold, the engine oil will be more viscous (i.e., thicker). During start-up of a cold engine, oil pressure will be higher than normal and oil circulation will be somewhat restricted within the oiling system. As the engine warms to normal operating temperature, the engine oil will warm up and become less viscous — oil pressure decreases.

When an engine is operated at high speeds, the volume of oil circulated through the oiling system increases, resulting in higher oil pressure. As engine speed is reduced, the volume of oil pumped is also reduced, resulting in lower oil pressure.

To check oil pressure, use OIL PRESSURE GAUGE (Part No. HD-96921-52A) and OIL PRESSURE GAUGE ADAPTER (Part No. HD-96940-52A). Remove oil pressure switch and insert pressure gauge fitting.

Run the engine until oil reaches normal operating temperature (motorcycle should be driven at least 20 miles (32 km) at or above 50 mph (80 km/h)). At 2500 rpm, oil pressure will vary from 10-17 psi (69-117 kN/m^2). At idle speed (950-1050 rpm), oil pressure will vary from 7-12 psi (48-83 kN/m^2).



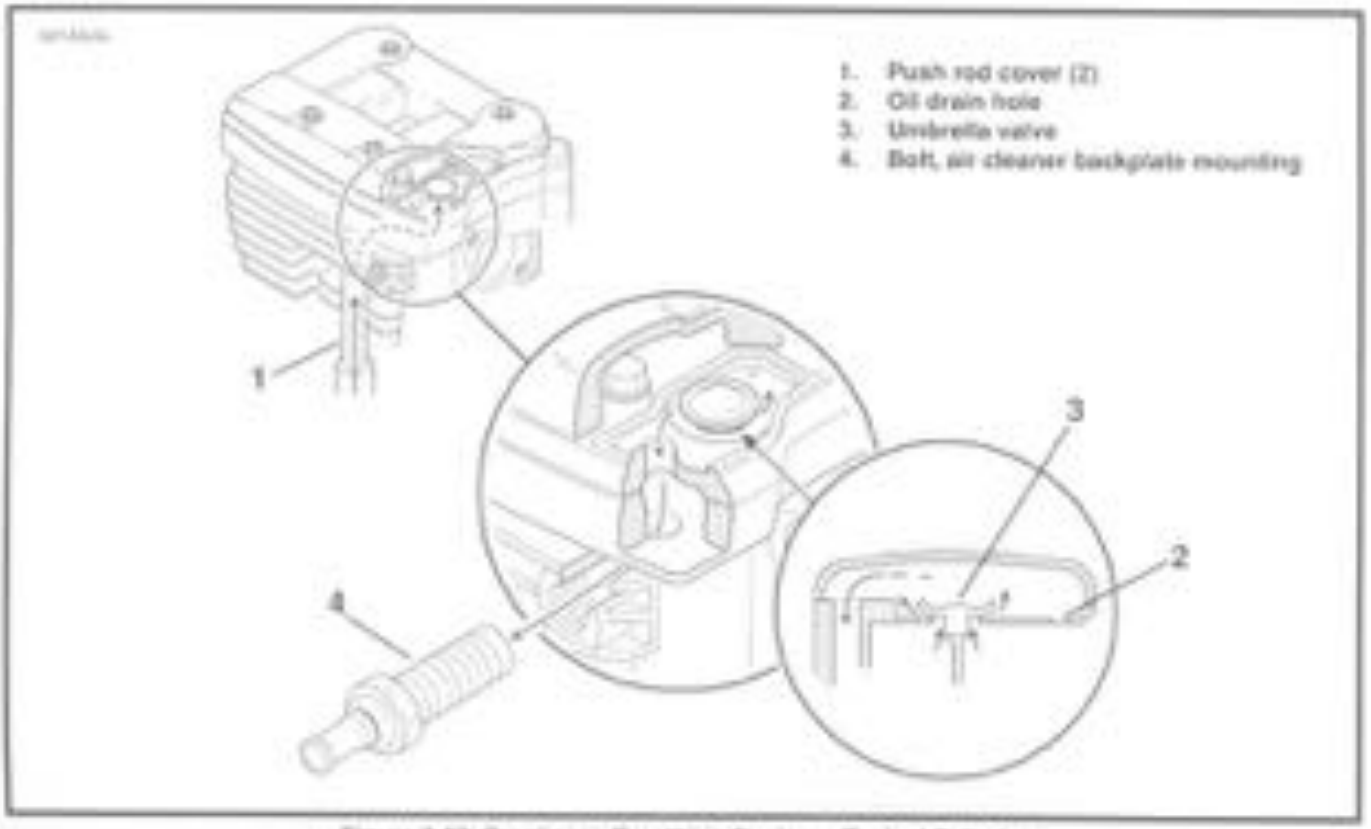
1. Oil pressure gauge adapter
2. Oil pressure gauge
3. Nipple adapter

Figure 3-51. Checking Oil Pressure

CRANKCASE BREATHING SYSTEM (Figure 3-52)

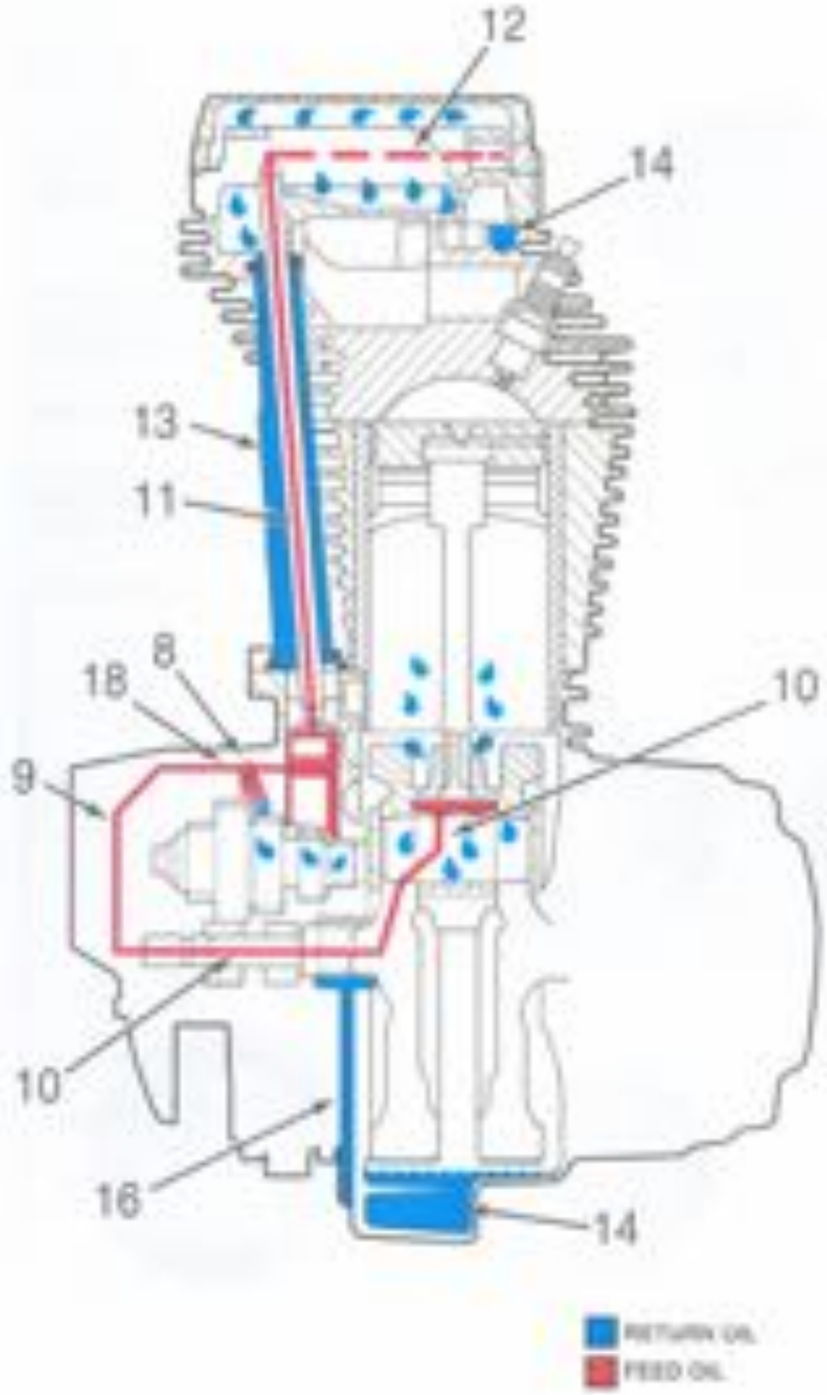
On piston downstroke, a mixture of crankcase air and oil mist is vented up the push rod covers (1) through an umbrella valve (3) in each middle rocker box section.

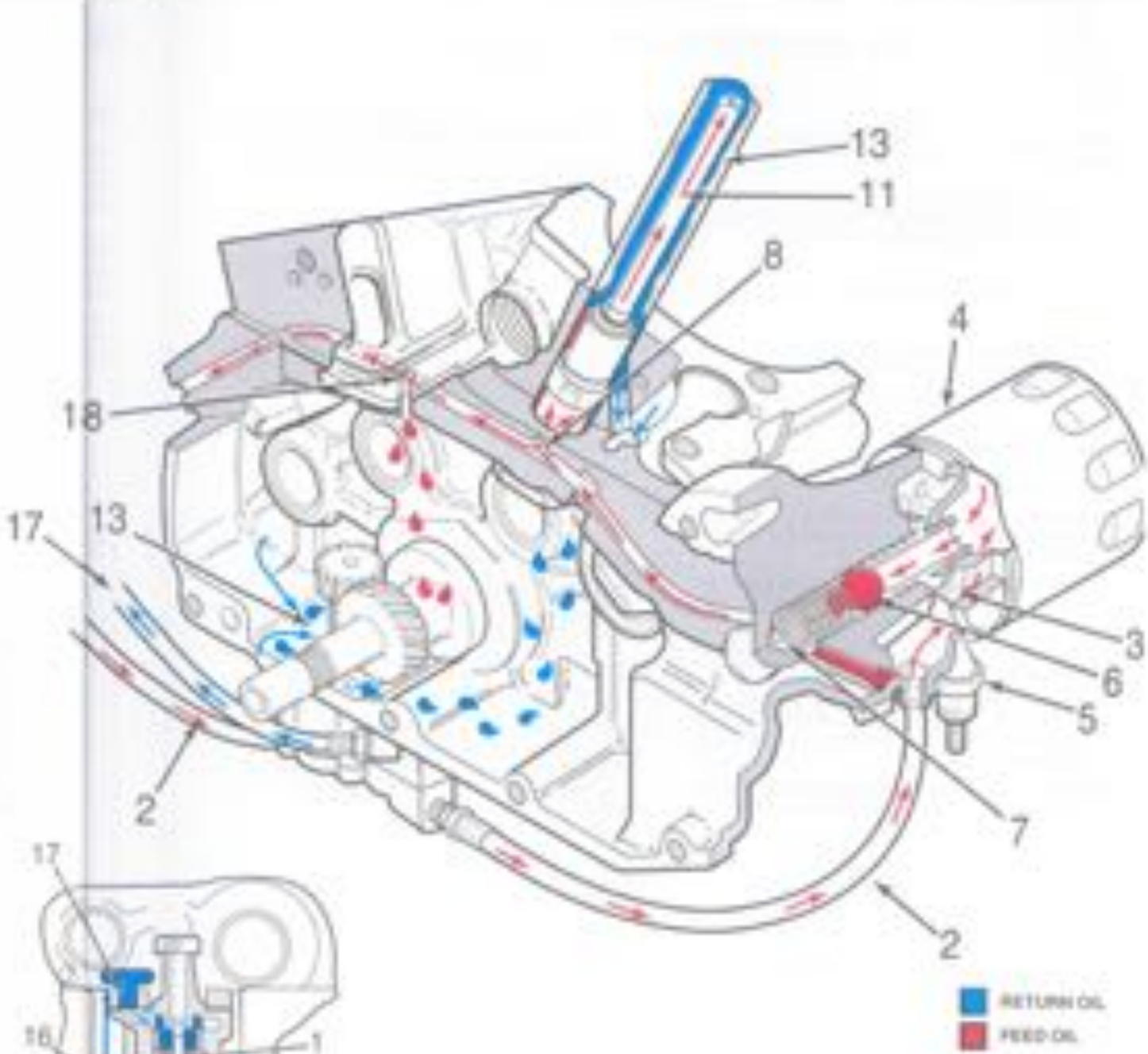
The oil mist separates from the crankcase air, collects and passes through a small drain hole (2) where it eventually returns to the crankcase. The crankcase air is routed through a passage in each cylinder head. The crankcase air then travels through each air cleaner backing plate mounting bolt (4) into the filtered side of the air cleaner.



1. Push rod cover (2)
2. Oil drain hole
3. Umbrella valve
4. Bolt, air cleaner backplate mounting

Figure 3-52. Crankcase Breathing System – Typical Cylinder





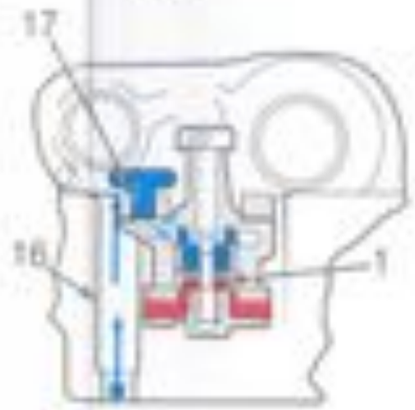


Figure 3-23. Lubrication Diagram

OILING SYSTEM (FIGURE 3-53)

NOTE

The following paragraph numbers correspond with the numbered callouts in Figure 3-53.

1. Oil is gravity-fed from the oil tank to the gerotor style oil pump through a **feed hose.** Oil enters the **feed section** and fills a cavity located under the feed pump.

NOTE

A complete explanation of the gerotor pump is given under OIL PUMP.

2. The feed pump transfers oil from the inlet cavity through the **feed hose** to the oil filter mount.
3. Oil flows through the **filter mount cavity** to the oil filter.
4. Oil enters the peripheral cavity of the **oil filter,** passes through the filtering medium into the central cavity of the oil filter, and flows into the filter adapter (fitting which connects filter to filter mount).
5. Adequate oil pressure in the filter mount cavity activates the **oil pressure signal light switch** and shuts off the oil pressure signal light.
6. Oil flowing from the filter adapter opens the **check ball.** The check ball opens at 4-6 psi (28-41 kN/m²) oil pressure.
7. With the check ball open, oil flows into the **crankcase feed gallery.**
8. Oil flows through the feed gallery in the crankcase to the tappet blocks and hydraulic lifters. **Cross-drilled passages** intersect the main feed gallery and carry oil to each hydraulic lifter.
9. Oil also enters an **intersecting passage** in the gearcase cover. Oil flow is then routed to the crankshaft area.
10. Oil enters a hole in the end of the **pinion gear shaft** and travels to the right flywheel where it is routed through the flywheel to the **crankpin.** Oil is forced through the crankpin to properly lubricate the rod bearing assembly.
11. Oil flows up passages in the **push rods** to the rocker arm shafts and bushings.
12. The valve stems are lubricated by oil supplied through drilled oil holes in the **rocker arms.**
13. Oil collected in the push rod areas of the cylinder heads flows down the **push rod covers,** through drain holes in the **tappet blocks** and into the gearcase. After providing lubrication to the gearcase components the oil flows to the return side of the oil pump.
14. Feed oil to the rocker area is returned to the crankcase through a **passage** in the head and cylinder.
15. Oil collected in the **sump** is splash-fed to the pistons, cylinder walls and flywheel components.
16. Oil collected in the sump area returns to the scavenge section of the oil pump through a **passage** located in the rear section of the sump. Oil flow to the pump is accomplished by the scavenging effect of the pump and by the pressure created by the downward stroke of the pistons.
17. Return oil fills a **cavity** above the pump's return gears. The return gears pump oil back to the oil tank.
18. A small amount of oil flows from the feed gallery in the right crankcase half through a **restricted orifice,** which sprays the oil onto the rear intake cam gear in the gearcase. Oil is transferred to the teeth of all the cam gears through the gear meshing action.

General

See Figure 3-54. The oil pump consists of two gerotor gear sets, feed and scavenge (return), housed in one pump body. The feed pump distributes oil to the engine; the scavenge pump returns oil to the tank.

A gerotor-type gear set has two parts — an inner and an outer gerotor. The inner gerotor has one less teeth than the outer gerotor. Both gerotors have fixed centers which are offset to each other.

In a gerotor gear set, oil is transferred from inlet to outlet as it is trapped between the rotating inner and outer gerotors. The illustration shows the principle of gerotor operation:

1. During the first 180° of rotation, the cavity between inner and outer gerotors gradually increases in size until it reaches its maximum size, equivalent to the full volume of the "missing tooth." The gradually enlarging cavity creates a vacuum into which oil flows from the inlet.
2. During the next 180° of rotation, the size of the cavity decreases forcing oil into the outlet. See Figure 3-55.

Gravity-fed oil from the oil tank enters the pump through fitting (5). It is forced by gerotor set (7) through a hose to the oil filter.

Return oil from the flywheel compartment is drawn back into the pump. Returning oil from the gearcase compartment drains directly into the pump and is forced by gerotor set (9) back to the oil tank.

See Figure 3-53 for oil passages within the engine.

The oil pump seldom needs servicing. Before you disassemble an oil pump suspected of not producing adequate oil pressure, be absolutely certain that all possible related malfunctions have been eliminated:

1. Make sure all oil line clamps are tight and fuel lines are not pinched or damaged.
2. Check oil level and condition of oil in tank. Pressure will be affected if oil is diluted. In freezing weather, proper circulation of oil can be affected if the oil feed line becomes clogged with ice and sludge.

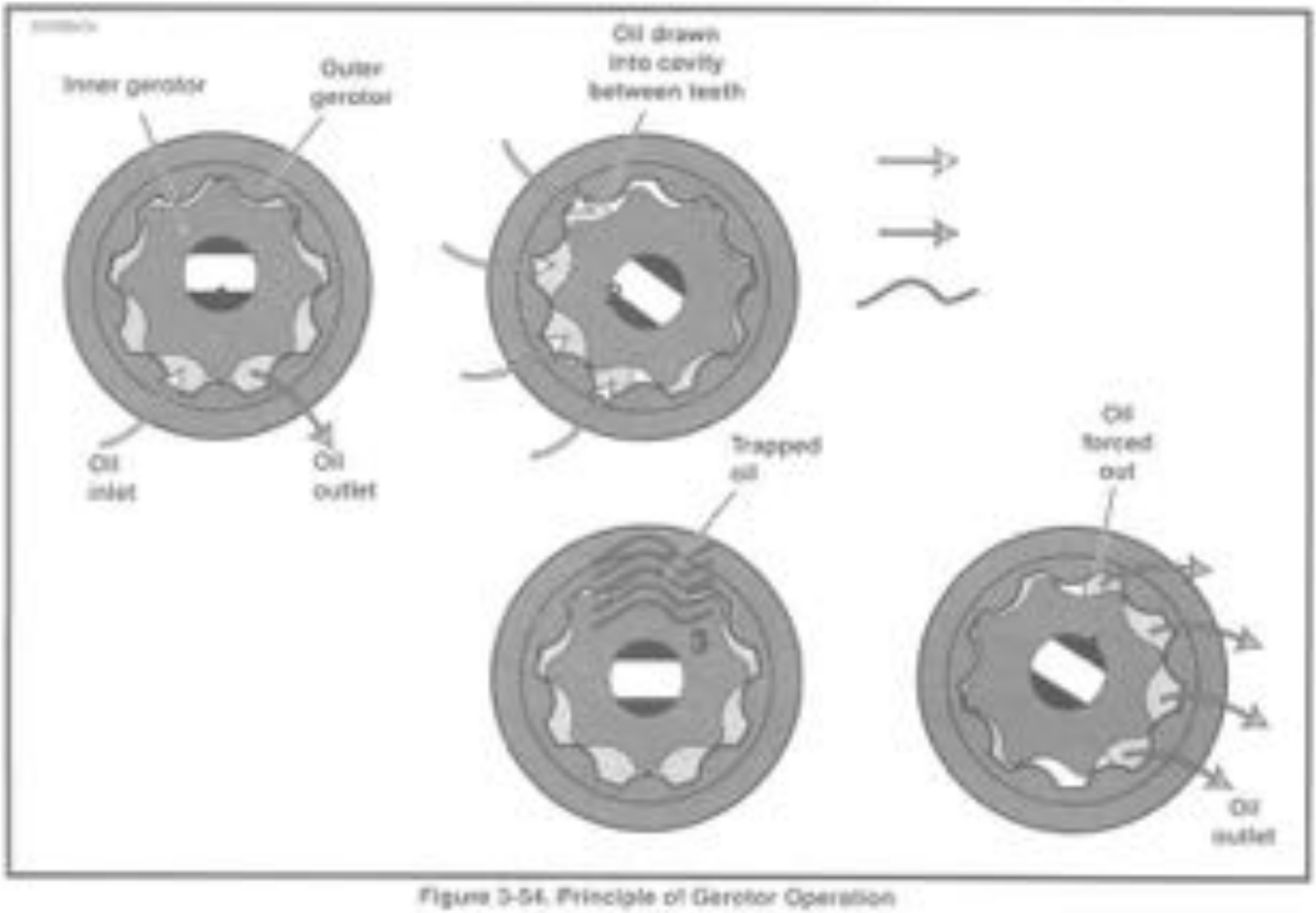
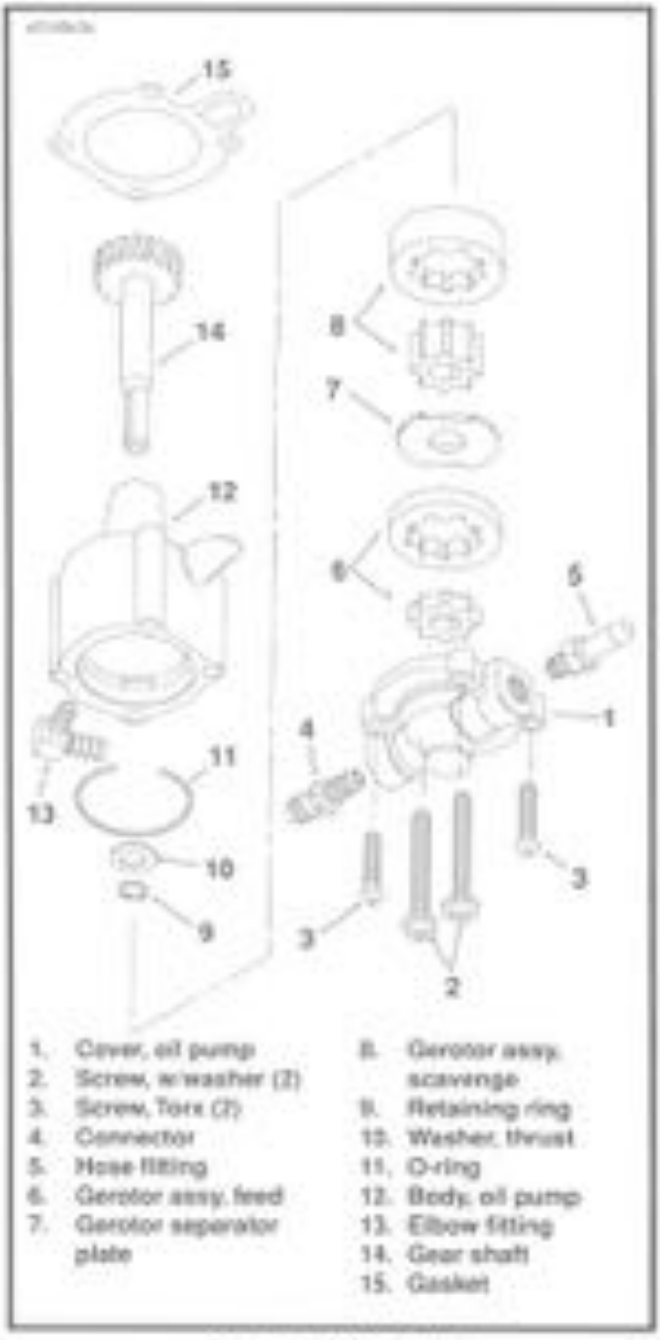


Figure 3-54. Principle of Gerotor Operation

3. Check for a grounded oil pressure switch wire or a faulty switch if oil indicator light fails to go out with engine running.

4. See ENGINE: LUBRICATION for additional information.



1. Cover, oil pump
2. Screw, w/washer (2)
3. Screw, Torx (2)
4. Connector
5. Hose fitting
6. Gerotor assy, feed
7. Gerotor separator plate
8. Gerotor assy, scavenge
9. Retaining ring
10. Washer, thrust
11. O-ring
12. Body, oil pump
13. Elbow fitting
14. Gear shaft
15. Gasket

Figure 3-55. Oil Pump

Removal/Disassembly

NOTE

Oil pump can be removed with engine in frame and without removing gearcase cover.

1. Drain oil from oil tank.
2. See Figure 3-45. Disconnect and tag the three oil hoses from the pump as shown.

NOTE

Do not remove feed hose fitting from the pump. Loosen large nut connected to fitting and then remove pressurized feed hose.

3. See Figure 3-55. Carefully remove two screws (2) that secure pump to crankcase. Pump will drop with screws removed. Discard mounting gasket (16).
4. Remove two Torx screws (3). Lift cover (1) off body (12). Remove and discard O-ring (11).
5. Slide both pieces of feed gerotor set (6), separator plate (7) and both pieces of scavenge gerotor set (8) off gear shaft (14).
6. Remove and discard retaining ring (9). Remove thrust washer (10) and gear shaft (14).

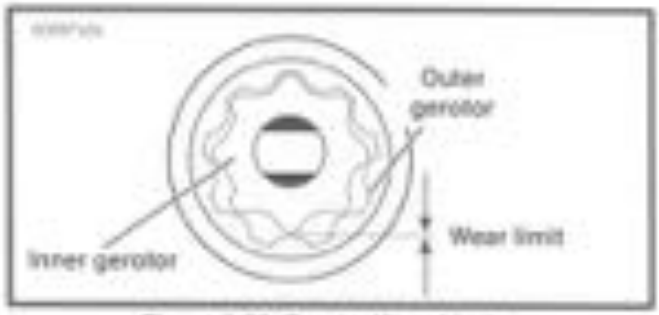


Figure 3-56. Gerotor Wear Limits

Cleaning, Inspection, and Repair

1. Clean all parts in cleaning solvent. Blow out holes and oil passages with compressed air.
2. See Figure 3-56. Inspect both gerotor sets for wear. Mesh pieces of each set together as shown. Use a feeler gauge to determine clearance.

The maximum allowable clearance between gerotors is 0.004 in. (0.10 mm). Replace gerotors as a set if clearance exceeds this dimension.

3. Measure thickness of feed gerotors with a micrometer. If they are not the same thickness, replace as a set.
4. Check gear shaft (14) teeth for damage or wear. Replace if necessary.

Assembly

1. See Figure 3-55. Install gear shaft (14) through body (12). Position thrust washer (10) over end of shaft. Install **new** retaining ring (9) into groove in shaft.

NOTE

Liberally coat all moving parts with clean engine oil to ensure easy assembly and smooth operation at start-up.

2. Insert inner gerotor of the scavenge gerotor set (8) over gear shaft.
3. Place outer gerotor over inner to complete scavenge set (8).
4. Position separator plate (7) into case and line up slots on perimeter with tabs inside oil pump body (12).
5. Place feed gerotor set (6) over gear shaft (14).
6. Install a **new** O-ring (11) into groove in cover (1). Place cover onto pump body. Install two Torx cover screws (3). Tighten screws (3) to 125-150 **in-lbs** (14.1-16.9 Nm) torque.
7. Place new mounting gasket (16) in position.
8. Secure pump to crankcase with two screws (2). Tighten screws to 125-150 in-lbs (14.1-16.9 Nm) torque.
9. See Figure 3-41. Install oil pump hoses at pump.

NOTE

Use new hose clamps. If fittings were removed, use TEFLON® PIPE SEALANT or HYLOMAR® on fitting threads.

OIL FILTER MOUNT

General (Figure 3-57)

Oil is pressure fed from the oil pump to the oil filter mount (2) via a hose connection (6). Oil travels through the filter mount into the filter via outer filter holes.

Adequate oil pressure activates the oil pressure signal light switch (5) in the filter mount, which turns off the oil pressure indicator lamp.

The check ball (3) in the filter adapter (1) "opens" at 4-6 psi (28-41 kN/m²) oil pressure. Filtered oil leaves the filter, flowing past the check ball.

Disassembly (Figure 3-57)

1. Remove oil filter adapter (1) from oil filter mount (2). Remove check ball (3) and spring (4).
2. Remove oil pressure signal light switch (5).

Cleaning and Inspection (Figure 3-57)

Thoroughly clean all parts in cleaning solvent. Blow out holes and passages using compressed air.

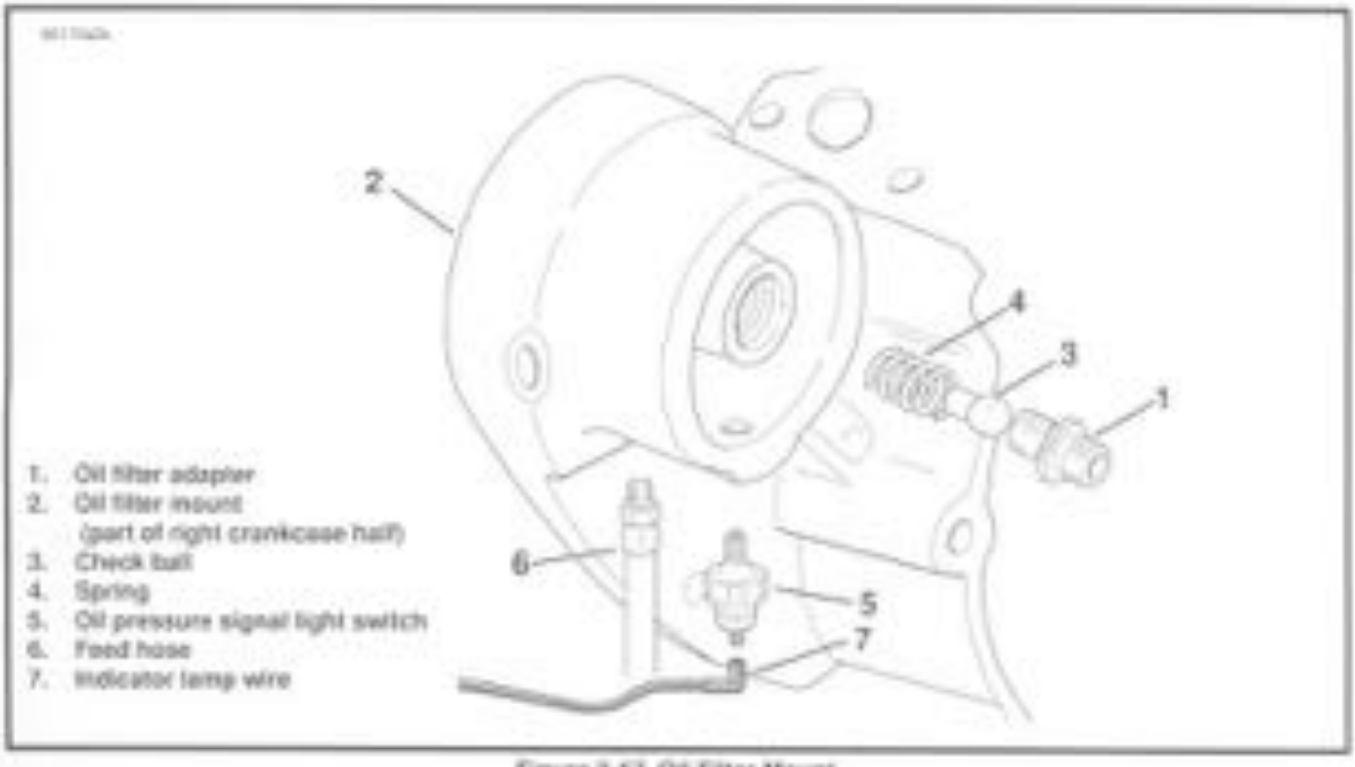


Figure 3-57. Oil Filter Mount

Assembly (Figure 3-57)

NOTE

Use TEFLON® PIPE SEALANT or HYLOMAR® on all fittings installed to oil filter mount.

1. Install oil pressure signal light switch (5). Tighten to 5-7 ft-lbs (7-9 Nm) torque.
2. Apply LOCTITE® THREADLOCKER 242 (blue) to the threads on that end of the adapter (1) which is installed into oil filter mount (2). Do not apply LOCTITE to adapter threads on oil filter element side.

NOTE

The oil filter adapter has identical ends; either end may be installed into the oil filter mount.

3. Place spring (4) and check ball (3) into threaded hole at center of mount (2). Push adapter (1) against ball to compress spring. Install threaded end (with LOCTITE) into threaded hole at center of mount (2). Tighten adapter to 8-12 ft-lbs (11-16 Nm) torque.
4. Connect pressure switch wire.
5. Pour about 4 fl oz. (120 ml) of clean engine oil into filter. Apply a light coat of oil to oil filter gasket. Install oil filter onto oil filter mount/adapter assembly; tighten filter an additional 1/2 to 3/4 turn after gasket contacts filter mount surface.
6. Fill oil tank with proper oil. See LUBRICATION.

VALVE TAPPETS

GENERAL

See Figures 3-9 and 3-58. The tappet assembly consists of tappet and roller. The tappet and roller, under compression force from valve spring, follow the surface of the revolving cam. The up-and-down motion produced is transmitted to the valve by the push rod and rocker arm. The tappet contains a piston (or plunger) and cylinder; it also contains a check valve, which allows the unit to fill with engine oil, thereby reducing clearance in the valve train.

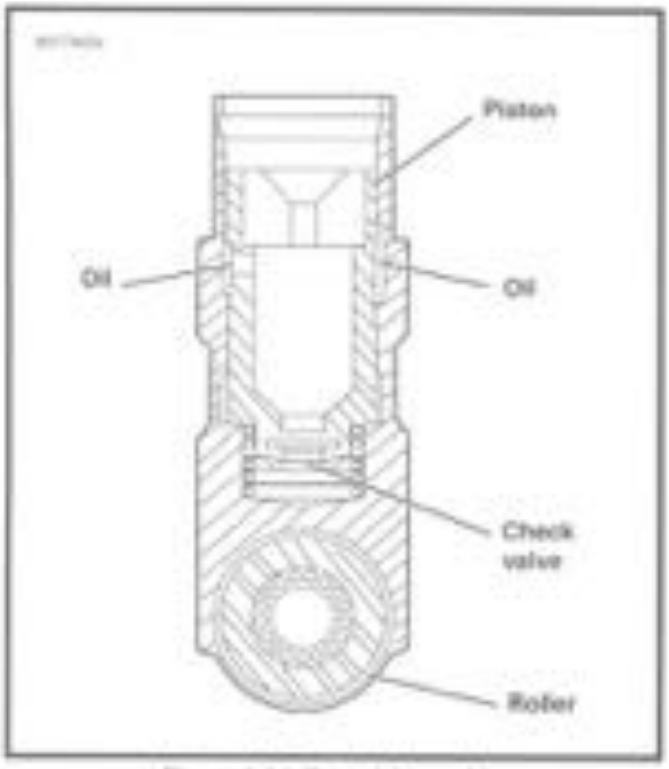


Figure 3-58. Tappet Assembly

When a tappet is functioning properly, the assembly operates with minimal tappet clearance. The unit automatically compensates for heat expansion to maintain a no-clearance condition.

It is normal for tappets to click when engine is started after standing for some time. Tappets have a definite leakdown rate which permits the oil in the tappets to escape. This is necessary to allow units to compensate for various expansion conditions of parts and still maintain correct clearance operation. Tappets are functioning properly if they become quiet after a few minutes of engine operation.

REMOVAL (FIGURE 3-9)

1. Clean all dirt from around crankcase, and blow loose particles from area with compressed air.
2. Remove the upper, middle, and lower rocker covers. See CYLINDER HEAD earlier in this section. Pull the push rod upward through top of cylinder head.
3. Remove socket screw (11) and washer (13). Lift retainer plate (9) and seal (8) upward a few inches on push rod cover (7). Push upward on push rod cover while pulling bottom of cover (7) clear of crankcase. Remove cover (7).
4. Remove socket screw (3), washer (14), and plate (4). Pull O-rings (3) off ends of pins (2) and discard. Grasp ends of pins (2) and pull outward free of crankcase. A pliers is a handy tool to free pins (2). With a thin-bladed screwdriver in the retainer groove at the top of the tappet, pry upward on the tappet until it extends above the gearcase and can be pulled out by hand.

CLEANING AND INSPECTION

1. Clean all parts, except roller tappet assembly, thoroughly in solvent. Blow dry with compressed air.
2. Inspect valve tappets for excessive clearance in guide. Clearance should be 0.0008-0.0020 in. (0.020-0.051 mm).
   Accurately measure tappet bore inner diameter with a gauge. Service wear limit is 0.0030 in. (0.076 mm). Excessive tappet guide clearance is corrected by fitting a new tappet and/or replacing crankcases.

   NOTE

   Inside and outside micrometers used for measuring tappets and tappet guides must be calibrated to ensure accurate readings.
3. Check tappet roller free play. Roller clearance on pin should be within 0.0006-0.0010 in. (0.015-0.025 mm). Recommended service practice is tappet replacement. Service wear limit is 0.0015 in. (0.038 mm).
4. Check tappet roller end clearance. Clearance should be 0.008-0.022 in. (0.203-0.559 mm). Service wear limit is 0.026 in. (0.660 mm).
5. Tappets should be soaked in clean engine oil and kept covered until assembly.

INSTALLATION (Figure 3-9)

1. Rotate engine so that both tappets (6), from the cylinder being serviced, will be installed on the base circle (lowest position) of the cam.
2. Apply a liberal amount of engine oil to tappet assembly (especially roller needles), to ensure smooth initial operation.
3. Insert tappet (6) into bore in crankcase (1). Rotate tappet so that flats at upper end of tappet face the front and rear of the engine. If the tappet is installed incorrectly, pins (2) cannot be inserted.
4. Insert pins (2) in the holes in crankcase. Place new O-rings (3) over ends of pins. Install plate (4) using screw (5) with washer (14). Tighten screw (5) to 80-110 in-lbs (9.0-12.4 Nm).
5. Slide new seal (8), and place retainer (9), over top of push rod cover (7). Position new O-ring (10) at top of push rod cover. Hold cover at an angle and insert top through hole in cylinder head. Push up on cover while aligning bottom of cover with tappet bore in crankcase. Lower retainer (9) with seal (8) onto crankcase, aligning locating pin (15) with hole in retainer.
6. Insert screw (11) with washer (13) through hole in retainer (9), and thread into tapped hole in crankcase. Tighten screw (11) to 15-18 ft-lbs (20-24 Nm) torque.
7. Install rocker covers. See CYLINDER HEAD earlier in this section.

GEARCASE COVER AND CAM GEARS

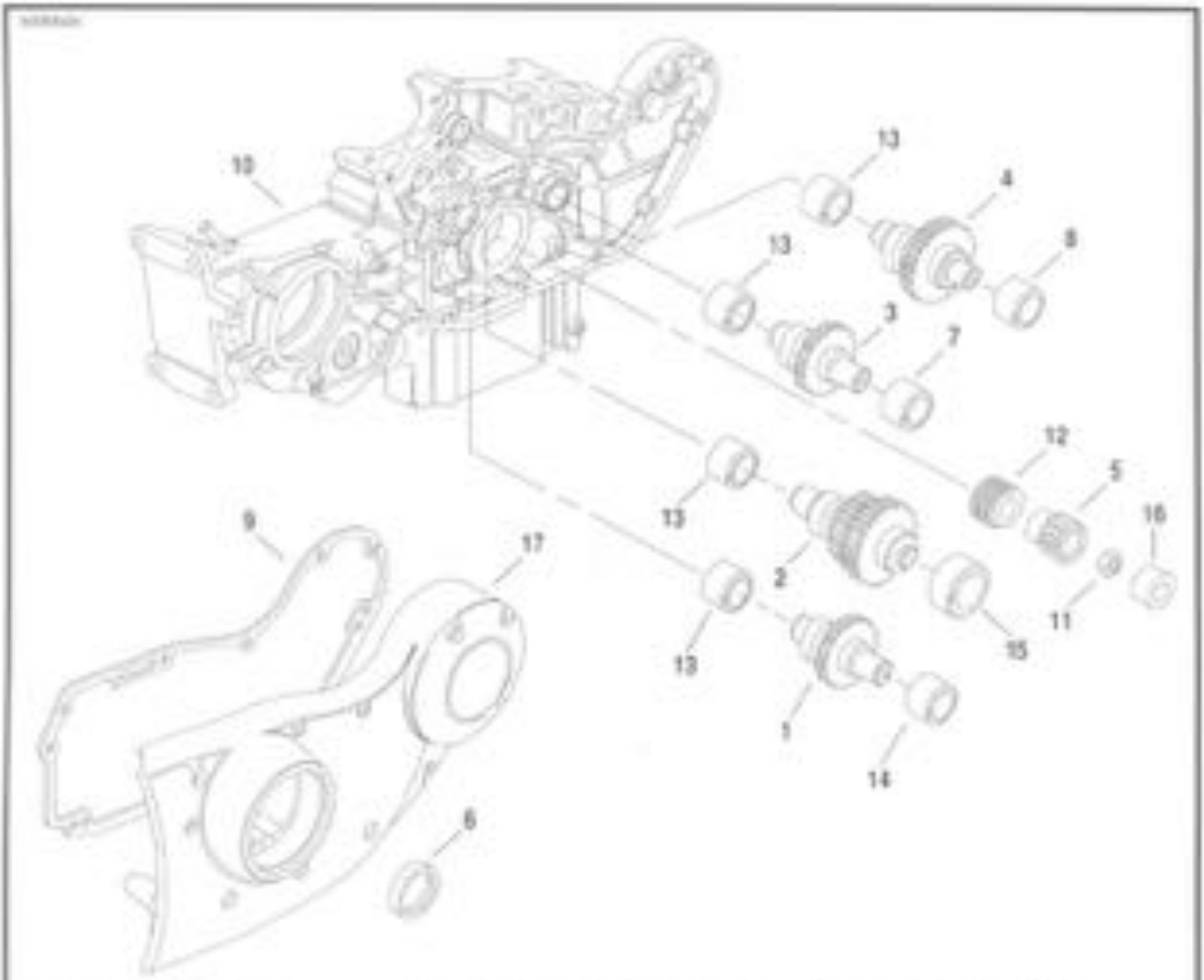
GENERAL

Read the complete gearcase section carefully before you begin any service work.

For the gearcase components to operate at their optimum, all components must be properly fitted and matched. Changing one component can affect many others. It is important to know and understand all inspection procedures and how components interact.

REMOVAL/DISASSEMBLY (Figure 3-59)

1. Thoroughly clean area around gearcase cover (17) and tappets. Blow loose dirt from crankcase with compressed air.
2. Remove any parts that will interfere with gearcase disassembly (i.e., exhaust pipe, footrest, air cleaner, brake pedal, etc.).
3. Remove push rods; see CYLINDER HEAD.
4. Remove tappets; see VALVE TAPPETS.



1. Rear exhaust cam gear
2. Rear intake cam gear
3. Front intake cam gear
4. Front exhaust cam gear
5. Pinion gear
6. Seal
7. Front intake cam gear bushing
8. Front exhaust cam gear bushing
9. Gearcase cover gasket
10. Right crankcase half
11. Nut
12. Oil pump drive gear
13. Cam gear bushing (4)
14. Rear exhaust cam gear bushing
15. Rear intake cam gear bushing
16. Pinion shaft bushing
17. Gearcase cover

Figure 3-59. Gearcase and Valve Train Components

5. Check for minimum cam gear end play; see ASSEMBLY procedure. Record readings.
6. Remove cam position sensor and rotor; see Section 7.
7. Place a pan under gearcase to collect oil. Remove cover screws. Carefully remove gearcase cover. Discard old gasket (9).

NOTE

If cover does not come loose on removal of screws, tap lightly with a rawhide hammer. Never pry cover off.

8. Remove cam gears (1, 2, 3, and 4). Carefully mark each component to ensure correct installation.

NOTE

Nut (11) is secured by Loctite-262 on the nut threads.

9. Remove nut (11). Slide pinion gear (5) and oil pump drive gear (12) off pinion shaft.

CLEANING, INSPECTION, AND REPAIR

1. Thoroughly clean gearcase compartment, gearcase cover, and gears in solvent to remove oil and carbon deposits.
2. Blow out all cover oil passages and bushings with compressed air.
3. Clean old gasket material from gearcase and cover faces with cleaning solvent.

Cam and Pinion Gear Identification, Inspection, and Selection

See Figure 3-60. Cam lobes are stamped with a number (1, 2, 3, or 4) followed by letter "D" or "W." The number identifies the cam location/function; the letter "D" or "W" indicates model year application:

1D (or W) = rear exhaust
2D (or W) = rear intake
3D (or W) = front intake
4D (or W) = front exhaust

Use only "W" cams on 1998 XL Sport models. "D" cams are used on all other models.

See Figure 3-61. Measure the gear diameter with a micrometer over 0.109 in. (2.74 mm) diameter gauge pins on opposite sides of the gear. The pins are of the proper size to fit between the contacting surfaces of the gear teeth. Gear diameter should be measured in at least two places 90° apart. Use GAUGE PIN SET (Part No. HD-39361) when measuring pinion and cam gear sizes.

Cam and pinion gears are individually selected for each specific gear cover through sophisticated computer aided measuring techniques in a controlled environment. Each gear is assigned an individual color code based on its diameter (measured with gauge pins). When cam and/or pinion gears

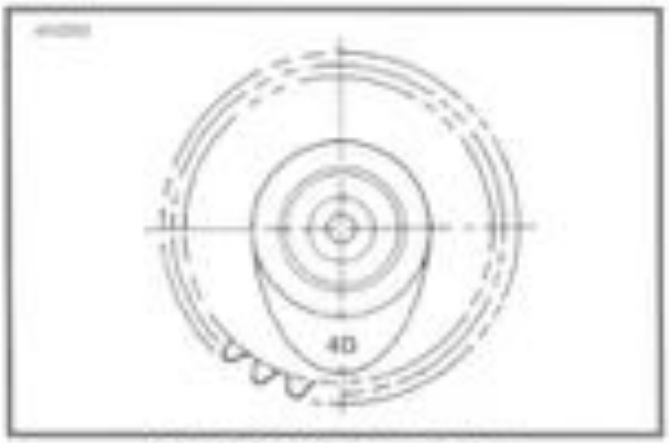


Figure 3-60. Cam Identification

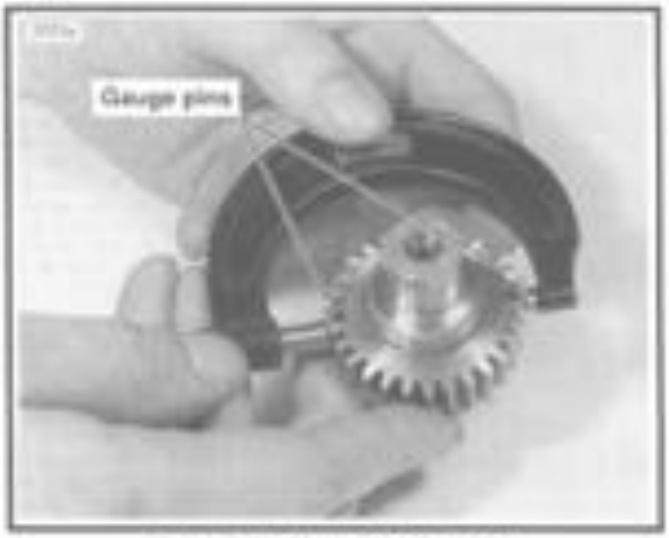


Figure 3-61. Measuring Gear Size

are replaced, always use the same color code as found on gears being replaced to ensure that the gear operation remains as quiet as possible. See Figure 3-62 for location of cam and pinion gear color codes.

NOTE

On flywheel pinion shaft, a paint dot is located on the shaft perimeter near the centerline of the keyway. This dot identifies the pinion shaft inner race size. Do not use this dot to select pinion gear size.

See the CAM AND PINION GEAR COLOR CODE AND DIAMETER table which follows. Compare the previously measured diameter of each gear with the specifications (listed in inches) shown in the table to determine amount of wear on gear teeth.

NOTE

Prior to changing any cam gears, check gear shaft fit within corresponding bushings. Worn bushings can cause excessive backlash.

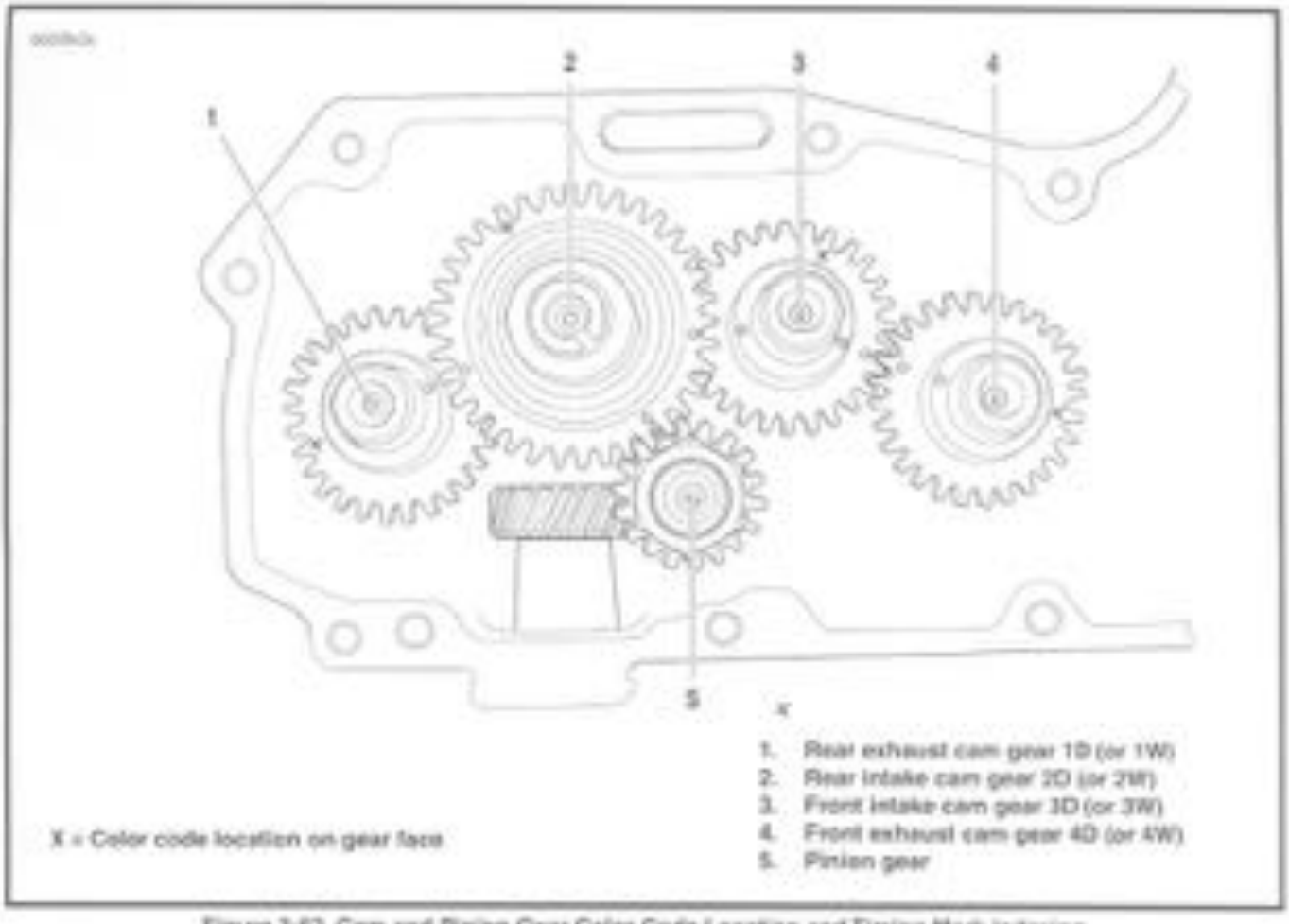


Figure 3-62. Cam and Pinion Gear Color Code Location and Timing Mark Indexing

CAM AND PINION GEAR COLOR CODE AND DIAMETER

GEAR NO. & POSITION	1	2 INBOARD	2 OUTBOARD	3	4	5
COLOR CODE (1 paint dot)	Rear Exhaust	Rear Intake	Rear Intake	Front Intake	Front Exhaust	Pinion
BROWN	1.9810-1.9814 (48.255-48.296)	1.9040-1.9044 (48.362-48.372)	2.4025-2.4030 (61.026-61.038)	1.9810-1.9814 (48.255-48.296)	1.9040-1.9044 (48.362-48.372)	1.2758-1.2761 (32.405-32.413)
BLUE	1.9815-1.9819 (48.258-48.308)	1.9035-1.9039 (48.349-48.359)	2.4031-2.4035 (61.039-61.049)	1.9815-1.9819 (48.258-48.308)	1.9039-1.9039 (48.349-48.359)	1.2754-1.2757 (32.395-32.403)
RED	1.9820-1.9824 (48.311-48.321)	1.9030-1.9034 (48.208-48.346)	2.4036-2.4040 (61.051-61.062)	1.9820-1.9824 (48.311-48.321)	1.9030-1.9034 (48.334-48.346)	1.2753-1.2756 (32.390-32.398)
WHITE	1.9025-1.9029 (48.323-48.334)	1.9025-1.9029 (48.323-48.334)	2.4041-2.4045 (61.064-61.074)	1.9825-1.9829 (48.323-48.334)	1.9025-1.9029 (48.323-48.334)	1.2744-1.2749 (32.375-32.382)
GREEN	1.9830-1.9834 (48.336-48.346)	1.9825-1.9829 (48.311-48.321)	2.4046-2.4050 (61.077-61.087)	1.9830-1.9834 (48.336-48.346)	1.9829-1.9834 (48.311-48.321)	1.2743-1.2746 (32.369-32.372)
YELLOW	1.9835-1.9839 (48.349-48.359)	1.9815-1.9819 (48.258-48.308)	2.4051-2.4055 (61.089-61.100)	1.9835-1.9839 (48.349-48.359)	1.9819-1.9819 (48.258-48.308)	1.2738-1.2741 (32.354-32.362)
BLACK	1.9840-1.9844 (48.362-48.372)	1.9810-1.9814 (48.255-48.296)	2.4056-2.4060 (61.102-61.112)	1.9840-1.9844 (48.362-48.372)	1.9810-1.9814 (48.255-48.296)	1.2734-1.2737 (32.344-32.352)

Bushing Inspection and Removal

1. See Figure 3-59. Bushings (7, 8, 13, 14, 15, and 16) are press fit in gearcase cover (17) and crankcase. Inspect each bushing against its corresponding cam gear shaft or pinion gear shaft.

Gear Shaft	Correct Clearance	Service Wear Limit
Cam	0.0017-0.0032 in. 0.018-0.056 mm	0.003 in. 0.08 mm
Pinion	0.0023-0.0043 in. 0.059-0.109 mm	0.005 0.13 mm

2. See Figure 3-63. Use a BUSHING AND BEARING PULLER (Part No. HD-95760-65A) to remove bushings from gearcase cover and crankcase.

Figure 3-63. Removing Bushing

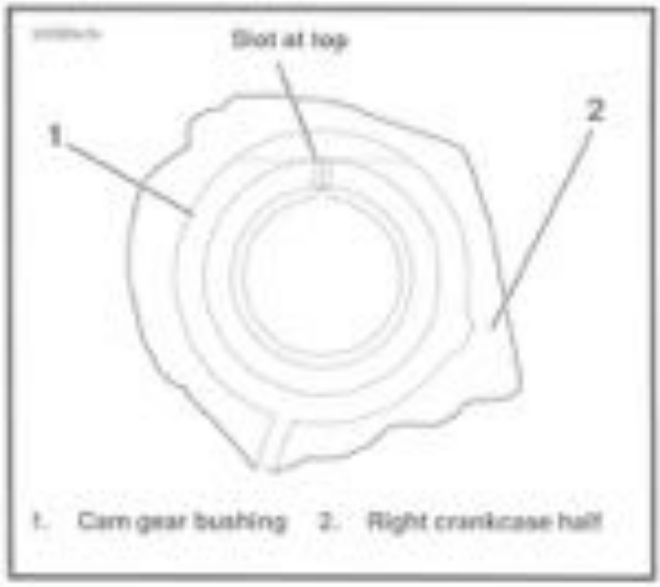
Bushing Installation

NOTE

Installing and reaming crankcase and gearcase cover bushings may alter the center distances between mating gears and may result in an increase in gear noise. For quiet-running gears, the gears should be matched to the center distances.

CAM GEAR BUSHINGS IN RIGHT CRANKCASE HALF

1. See Figure 3-64. Each cam gear bushing (1), to be installed in right crankcase half (2), must be positioned in crankcase bore with its oiling slot at exact top of bore (12 o'clock position).



1. Cam gear bushing 2. Right crankcase half

Figure 3-64. Cam Gear Bushing Installed in Crankcase

2. Using an arbor press, install each bushing in its crankcase bore so that bushing shoulder contacts crankcase boss.

3. After you install a new bushing in right crankcase half, ream the bushing to correct size. See BUSHING REAMING.

CAM GEAR BUSHINGS (EXCEPT REAR INTAKE BUSHING) IN GEARCASE COVER

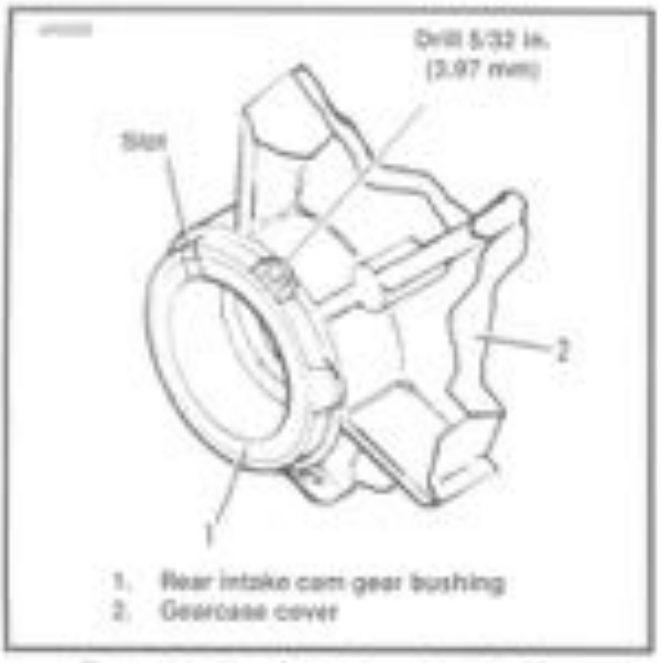
1. See Figure 3-59. Using an arbor press, install each bushing (7, 8, and 14) in its gearcase cover (17) bore so that bushing shoulder contacts cover boss. There is no need to orient these particular bushings in any specific position of rotation within gearcase cover bores.

2. After you install a new bushing in gearcase cover, ream the bushing to correct size. See BUSHING REAMING.

REAR INTAKE CAM GEAR BUSHING IN GEARCASE COVER

1. See Figure 3-59. Rear intake cam gear bushing (15) must be installed in its gearcase cover (17) bore using an arbor press. You will need to orient the bushing in a specific position of rotation within the cover bore, and will need to drill a lubrication hole in the bushing, according to the following procedures.

2. See Figure 3-65. 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.



1. Rear intake cam gear bushing
2. Gearcase cover

Figure 3-65. Rear Intake Cam Gear Bushing Installed in Gearcase Cover

3. Drill a 5/32 in. (3.97 mm) diameter hole through bushing using existing hole in gearcase cover as a guide.
4. After you install a new bushing in gearcase cover, line-ream the bushing to the correct size. See BUSHING REAMING.

PINION SHAFT BUSHING IN GEARCASE COVER

1. See Figure 3-59. Using an arbor press, install pinion shaft bushing (18) in its 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. 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. See Figure 3-66. 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 BUSHING REAMING.

Bushing Reaming

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.*

Figure 3-66. Drilling Dowel Pin Hole

- *Bushings in right crankcase half serve as pilots for reaming gearcase cover bushings and must, therefore, be reamed to size first.*
- *After reaming any bushing, check shaft fit in the bushing. It may be necessary to make a second pass with reamer to attain proper fit.*

CAM GEAR BUSHINGS IN RIGHT CRANKCASE HALF

1. Separate two halves of crankcase, if not already accomplished. Place right crankcase half on flat surface with gearcase side upward. Bushing to be reamed must be oriented as shown in Figure 3-64.
2. See Figure 3-67. Position CAMSHAFT BUSHING REAMER PILOT (Part No. HD-38871) into gearcase side of crankcase half; upper right and lower left indexing holes in pilot must be placed over dowels in crankcase half. Insert two bolts (supplied with pilot) through two remaining holes in pilot, and into threaded holes of crankcase half. Tighten bolts securely.
3. Insert the 11/16-in. diameter reamer through pilot hole and into bushing while turning reamer clockwise. Continue turning reamer clockwise through bushing until smooth shank of reamer passes through hole in pilot.
4. Detach reamer from handle. Pull reamer out opposite side of crankcase half.
5. Thoroughly clean right crankcase half, removing all metal chips/shavings. Blow out all oil passages using compressed air.

CAM GEAR BUSHINGS (EXCEPT REAR INTAKE BUSHING) IN GEARCASE COVER

NOTE

Newly installed cam gear bushings in the gearcase cover must be line reamed, using the right crankcase half as a pilot for the reamer, to establish correct clearance and to ensure perfect alignment. If crankcase halves are not separated on your motorcycle, use a spare right crankcase half to perform the following line reaming procedure.

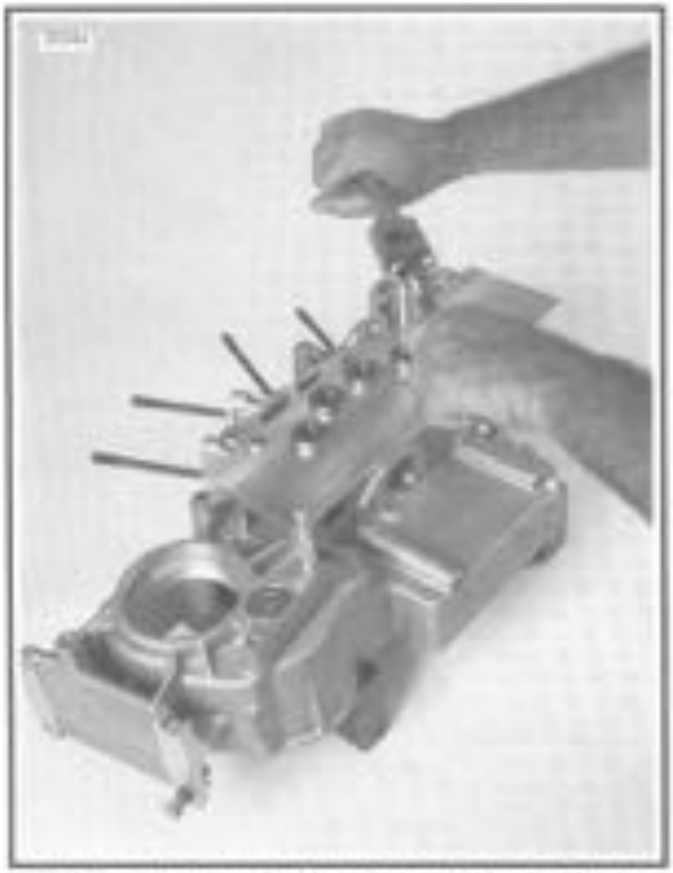


Figure 3-67. Reaming Cam Gear Bushing in Right Crankcase Half

1. See Figure 3-59. Bushings (7, 8, and 14) to be reamed must be installed in gearcase cover (17) as described in BUSHING INSTALLATION. Attach gearcase cover to right crankcase half (10), which has been disassembled from left crankcase half, securing with a minimum of three mounting screws.
2. Insert a standard 11/16-in. diameter reamer through the previously reamed cam gear bushing (13) in right crankcase half, which is in line with one of the bushings to be reamed in gearcase cover.
3. Turn reamer clockwise through bushing in cover until reamer bottoms. Then give reamer one complete clockwise turn to size the bushing. Continue turning reamer clockwise while extracting reamer from bushing.
4. Repeat Steps 2 and 3 for remaining two cam gear bushings (except rear intake bushing) in gearcase cover, if required.
5. Separate gearcase cover from right crankcase half. Inspect bushings for proper cam gear shaft fit. Repeat line reaming operation if necessary.
6. Thoroughly clean gearcase cover, removing all metal chips/shavings. Blow out all oil passages using compressed air.

REAR INTAKE CAM GEAR 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 half as a pilot for the reamer, to establish correct clearance and to ensure perfect alignment. If crankcase halves are not separated on your motorcycle, use a spare right crankcase half to perform the following line reaming procedure.

1. See Figure 3-59. Rear intake cam gear bushing (15) must be installed in gearcase cover (17) as described in BUSHING INSTALLATION.
2. Identify the previously reamed rear intake cam gear bushing (13) in right crankcase half (10), which has been disassembled from left crankcase half. Insert the shank end of REAR INTAKE CAM GEAR BUSHING REAMER (Part No. HD-94883-67) through gearcase side of this bushing.
3. With reamer inserted into bushing in right crankcase half, attach gearcase cover to right crankcase half, securing with a minimum of three mounting screws.
4. Turn reamer clockwise through bushing in gearcase cover until reamer bottoms. Then give reamer one complete clockwise turn to size the bushing. Continue turning reamer clockwise while extracting reamer from bushing.
5. Separate gearcase cover from right crankcase half. Inspect bushing for proper cam gear shaft fit. Repeat line reaming operation if necessary.
6. Thoroughly clean gearcase cover, removing all metal chips/shavings. Blow out all oil passages using compressed air.

PINION SHAFT BUSHING IN GEARCASE COVER

NOTE

A newly installed pinion shaft bushing in the gearcase cover must be line reamed, using both the right crankcase half and Part No. HD-94812-87 as pilots for the reamer, to establish correct clearance and to ensure proper alignment. If crankcase halves are not separated on your motorcycle, use a spare right crankcase half to perform the following line reaming procedures.

1. See Figure 3-59. Pinion shaft bushing (16) must be installed in gearcase cover (17) as described in BUSHING INSTALLATION. Attach gearcase cover to right crankcase half (10), which has been disassembled from left crankcase half, securing with a minimum of three mounting screws.

2. See Figure 3-68. 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.

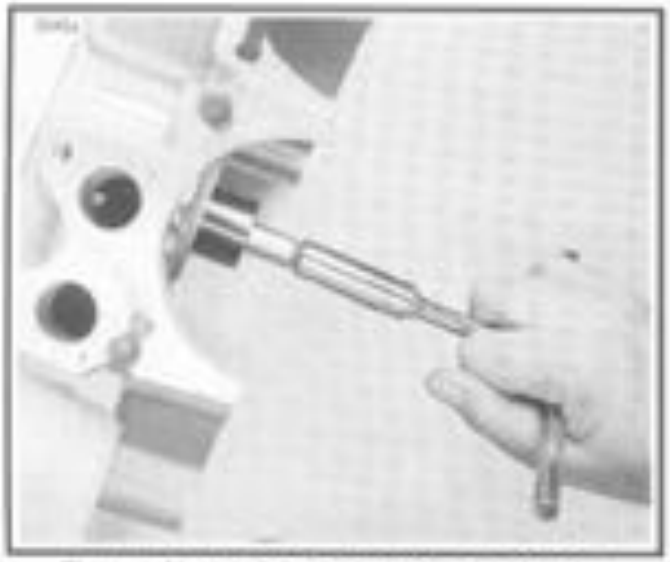


Figure 3-68. Line Reaming Pinion Shaft Bushing

3. Turn reamer clockwise through bushing in gearcase cover until reamer bottoms. Then give reamer one complete clockwise turn to size the bushing. Continue turning reamer clockwise while extracting reamer from bushing.

4. Separate gearcase cover from right crankcase half. Inspect bushing for proper pinion shaft fit. Repeat line reaming operation if necessary.

5. Remove pilot from right crankcase roller race. Thoroughly clean gearcase cover, removing all metal chips/shavings. Blow out all oil passages using compressed air.

ASSEMBLY/INSTALLATION

1. See Figure 3-59. Install oil pump drive gear (12) and pinion gear (5) to pinion shaft. Note that timing mark on pinion gear tooth is aligned with keyway in I.D. of pinion gear, as shown in Figure 3-69. See Figure 3-70. The timing mark will allow you to easily position pinion gear (1) over shaft key (2) and against oil pump drive gear (3) on pinion shaft (4).

2. See Figure 3-59. Clean pinion shaft threads and nut (11) threads. Apply several drops of LOCTITE® Threadlocker 262 (red) to threads of nut.

3. See Figure 3-71. Install CRANKSHAFT LOCKING TOOL (Part No. HD-41500) over pinion shaft. Install nut to pinion shaft, tightening to 35-45 ft-lbs (47-61 Nm) torque.

4. See CAM AND PINION GEAR IDENTIFICATION, INSPECTION, AND SELECTION, and Figures 3-60 and 3-62. Liberally apply engine oil to bushings, shafts, and gears. Install all cam gears into bushings of right crankcase half, properly aligning timing marks of cam gears and pinion gear as shown in Figure 3-62.

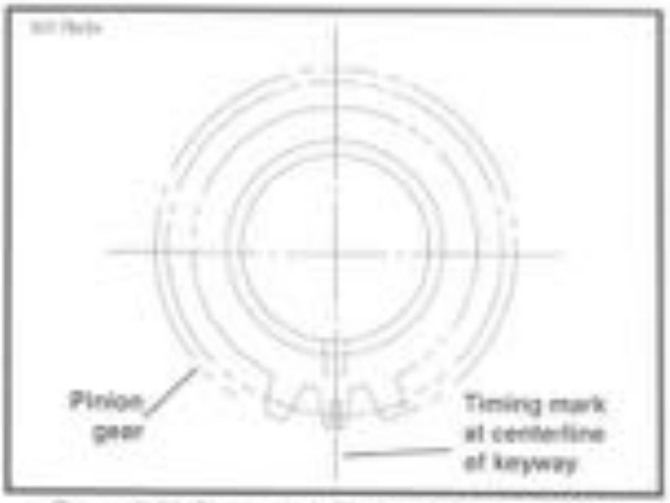


Figure 3-69. Pinion Gear Timing Mark and Keyway

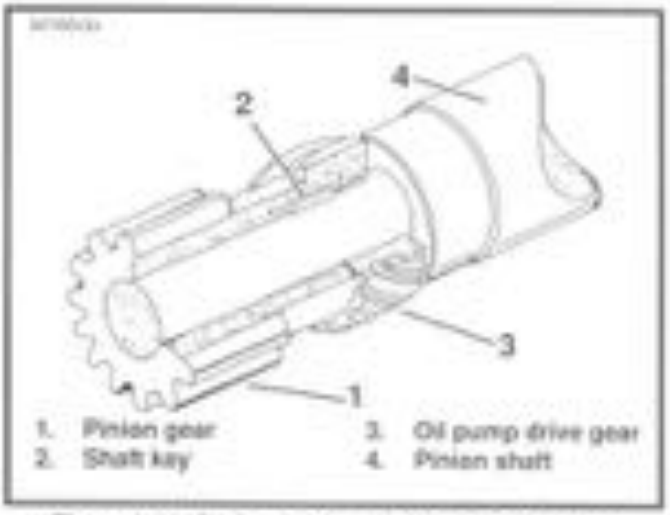


Figure 3-70. Oil Pump Drive Gear and Pinion Gear Installed on Pinion Shaft

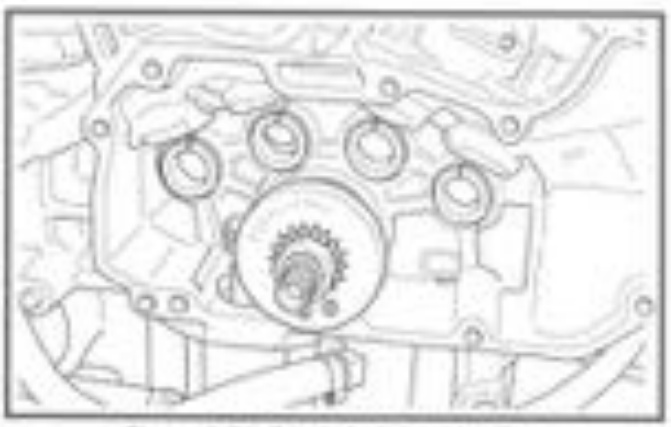


Figure 3-71. Crankshaft Locking Tool

NOTE

Because of the larger diameter additional gear (which meshes with the pinion gear) on the outboard end of the rear intake (2D) cam gear, the rear exhaust (1D) and front intake (3D) cam gears must both be installed before the rear intake (2D) cam gear is installed.

4. See Figure 3-59. Install a new seal (8) and new dry gasket (9) on gearcase cover (17).

5. Install gearcase cover over all gears and onto right crankcase half (10). Secure cover to crankcase half with 11 socket head screws. Tighten screws evenly to 80-110 **in-lbs** (9.0-12.4 Nm) torque according to the torque sequence shown in Figure 3-72.

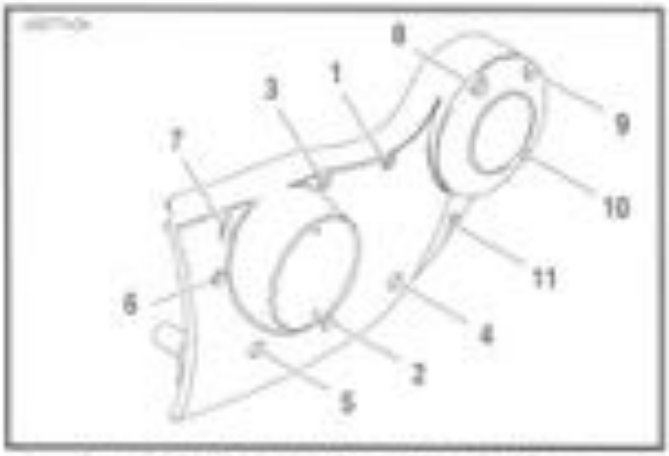


Figure 3-72. Gearcase Cover Mounting Screw Torque Sequence

6. Check cam gear end play for each cam gear as follows:

   - Turn engine over until lobe of cam gear being checked is pointing toward its respective tappet guide hole.
   - Using a flat blade screwdriver, gently pry the cam gear toward gearcase cover.
   - Using a feeler gauge, measure gap between bushing (in crankcase half) and cam gear shaft thrust face (shoulder). This is cam gear end play.
   - Compare your cam gear end play measurements with the SPECIFICATIONS at the beginning of this section. Make repairs as required if end gap is less than the minimum specified, or greater than the maximum specified (Service Wear Limits).

7. Install valve tappets and push rods (see VALVE TAPPETS).

8. Install cam position sensor and rotor. Static time or align scribed marks with sensor screws (see Section 7).

9. Install any components removed to gain access to gearcase (i.e. exhaust system components, footrest, air cleaner).

CRANKCASE

GENERAL

When rod bearings, pinion shaft bearing, or sprocket shaft bearing are in need of repair, the engine must be removed from the chassis; see STRIPPING MOTORCYCLE FOR ENGINE REPAIR in this section. It is recommended procedure to check and make repairs to cylinder heads, cylinders, gearcase and transmission at the same time (perform entire engine overhaul).

⚠CAUTION

Laying engine on primary side will damage clutch cable end fitting.

ADJUSTMENT/TESTING

Flywheel End Play

See Figure 3-73. Before completely disassembling crankcases, check flywheel end play.

Figure 3-73. Checking Flywheel End Play

1. After engine has been removed from chassis, securely fasten it to a stand or workbench.
2. Remove gearcase cover. Attach a dial indicator to gear side crankcase with indicator stem on end of gearshaft.
3. Sprocket shaft bearings must be preloaded to obtain an accurate flywheel end play reading. A suitable tool can be made by welding two handles to an old sprocket shaft nut. Install the nut and sprocket. Tighten nut to 150-165 ft-lbs (203-224 Nm) torque.
4. Rotate and push on sprocket shaft while reading dial indicator. Then rotate and pull on sprocket shaft while reading dial indicator. If difference (end play) in indicator readings is not 0.001-0.005 in. (0.025-0.13 mm), bearing inner spacer (shim) (item 6, Figure 3-75) must be replaced. Choose spacer from following table. Use a thinner spacer for less end play; use a thicker spacer for more end play.

Flywheel End Play Spacers (Shims)

Part Number	Thickness	
	inches	mm
9138	0.0975-0.0985	2.476-2.502
9142	0.0995 - 0.1005	2.527-2.553
9143	0.1015-0.1025	2.578-2.603
9144	0.1035 - 0.1045	2.629-2.654
9145	0.1055 - 0.1065	2.680-2.705
9146	0.1075 - 0.1085	2.730-2.756
9147	0.1095 - 0.1105	2.781-2.807
9148	0.1115 - 0.1125	2.832-2.857
9149	0.1135 - 0.1145	2.883-2.908

DISASSEMBLY

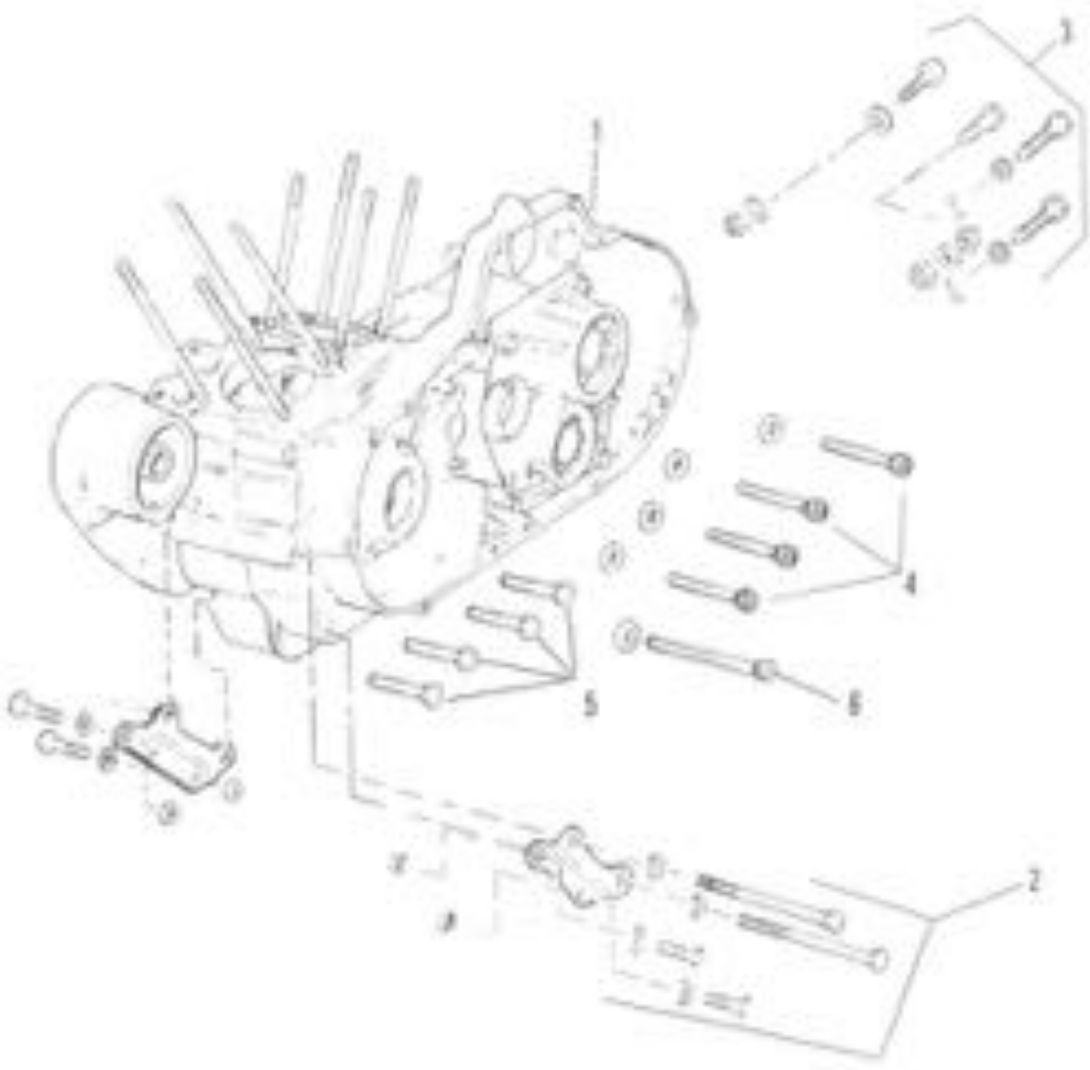
Crankcase Halves

1. Remove cylinder heads; see CYLINDER HEAD, REMOVAL in this section.
2. Remove cylinders and pistons; see CYLINDER AND PISTON, REMOVAL in this section.

⚠CAUTION

After removing cylinders, install plastic or rubber hose over cylinder studs. Never lift or move crankcase by grasping cylinder studs.

3. Remove oil pump and gearcase components; see ENGINE LUBRICATION SYSTEM, OIL PUMP, REMOVAL and GEARCASE COVER AND CAM GEARS, REMOVAL in this section.



1. Crankcase
2. Engine front mounting hardware
3. Engine rear mounting hardware
4. Upper case hex socket head screw – 2-1/2 in. long (4)
5. Bottom case hex head bolt – 3/4 in. long (4)
6. Access door hex socket head screw – 3-3/4 in. long

Figure 3-74. Crankcase Hardware

4. Remove clutch and primary drive components; see PRIMARY DRIVE / CLUTCH, REMOVAL in Section 6.

5. Remove starter motor; see ELECTRIC STARTER, STARTER, REMOVAL in Section 5.

6. Remove transmission; see TRANSMISSION CASE, REMOVAL in Section 6.

7. See Figure 3-74. Remove screws (4) and rear engine mount bolt securing crankcase halves together.

8. Position crankcase on work bench, gearcase side up. Tap crankcase with rawhide mallet to loosen top half and separate the halves.

⚠WARNING

The following step requires using a press. Wear eye protection and make certain set-up is stable. The force involved could cause parts to "fly out" and cause bodily injury.

9. See Figure 3-75. Mount the left case half and flywheel assembly on a press table, supporting crankcase on parallel bars. Press on end of sprocket shaft with arbor press until flywheel assembly is free from case half. Do not drive flywheel assembly from case half as flywheels may be knocked out of alignment.

Figure 3-75. Pressing Flywheel from Crankcase

NOTE

See Figure 3-76. If it is necessary to remove either the pinion shaft bearing (11) or sprocket shaft bearing (4 and 9), proceed as follows:

10. Pinion bearing (11) will remain on pinion shaft. Remove retaining ring (13), and bearing (11) may be slipped off pinion shaft.

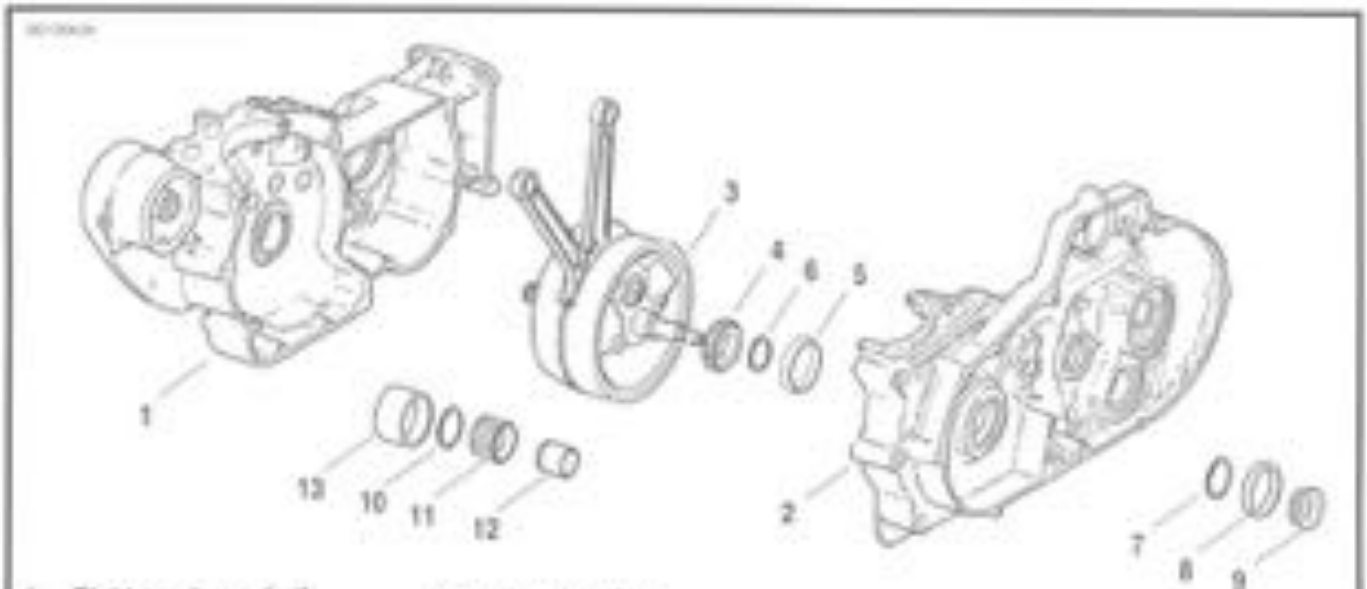
11. See Figure 3-76. Pull sprocket shaft bearing with WEDGE ATTACHMENT FOR CLAW PULLER (Part No. HD-95637-46) and TWO JAW PULLER (Part No. HD-97252-61) using bolts in place of jaws.

12. See Figure 3-77. Use CRANKSHAFT BEARING TOOL (Part No. HD-94547-80) to remove sprocket shaft outer races.

Figure 3-77. Sprocket Shaft Outer Race Removal

NOTE

See Figure 3-76. Do not remove retaining ring (7); the crankcase can easily be damaged during the removal process. Removal of the retaining ring is not necessary for the removal or installation of the outer bearing races.



1. Right crankcase half
2. Left crankcase half
3. Connecting rod and flywheel assembly
4. Sprocket right bearing
5. Sprocket right outer race
6. Spacer
7. Retaining ring
8. Sprocket left outer race
9. Sprocket left bearing
10. Retaining ring
11. Pinion shaft bearing
12. Pinion shaft bearing inner race
13. Pinion shaft bearing outer race

Figure 3-76. Crankcase and Flywheel Assembly

Flywheels (Figure 3-79)

1. Place flywheel assembly in holding fixture. Remove crank pin nut (1). Strike left flywheel with soft metal mallet at about 90 degrees from crank pin hole on wheel periphery to loosen. Lift left flywheel (2) off crank pin.
2. Hold down crank pin bearing assembly (4) with a short length of pipe or tubing so connecting rods (3) may be slipped off bearings, then remove bearing assembly. Secure bearings (4) together in set until they are washed and refitted to crank pin.
3. Remove crank pin nut (9), then tap crank pin (6) out of flywheel and remove key (7).

Figure 3-78. Removing Sprocket Shaft Roller Bearing

CLEANING AND INSPECTION

1. Wash all parts in solvent and blow dry with compressed air. Examine crank pin for wear, grooving and pitting. If the surface is at all worn, replace with new pin. Examine flywheel washers. If either washer is worn or grooved, it should be replaced. See REPLACING FLYWHEEL WASHERS.
2. Examine connecting rod lower races. If they appear slightly grooved or shouldered where edge of bearing rollers ride, they may be lapped out, and an oversize crank pin and new bearing installed. If they appear badly worn, grooved or pitted, new rods should be installed, preferably as an assembly with new bearings and crank pin.
3. Inspect bearing for wear, pitting and heat discoloration; replace as required.
4. Inspect crank pin, crank pin roller and connecting rods for correct free play.

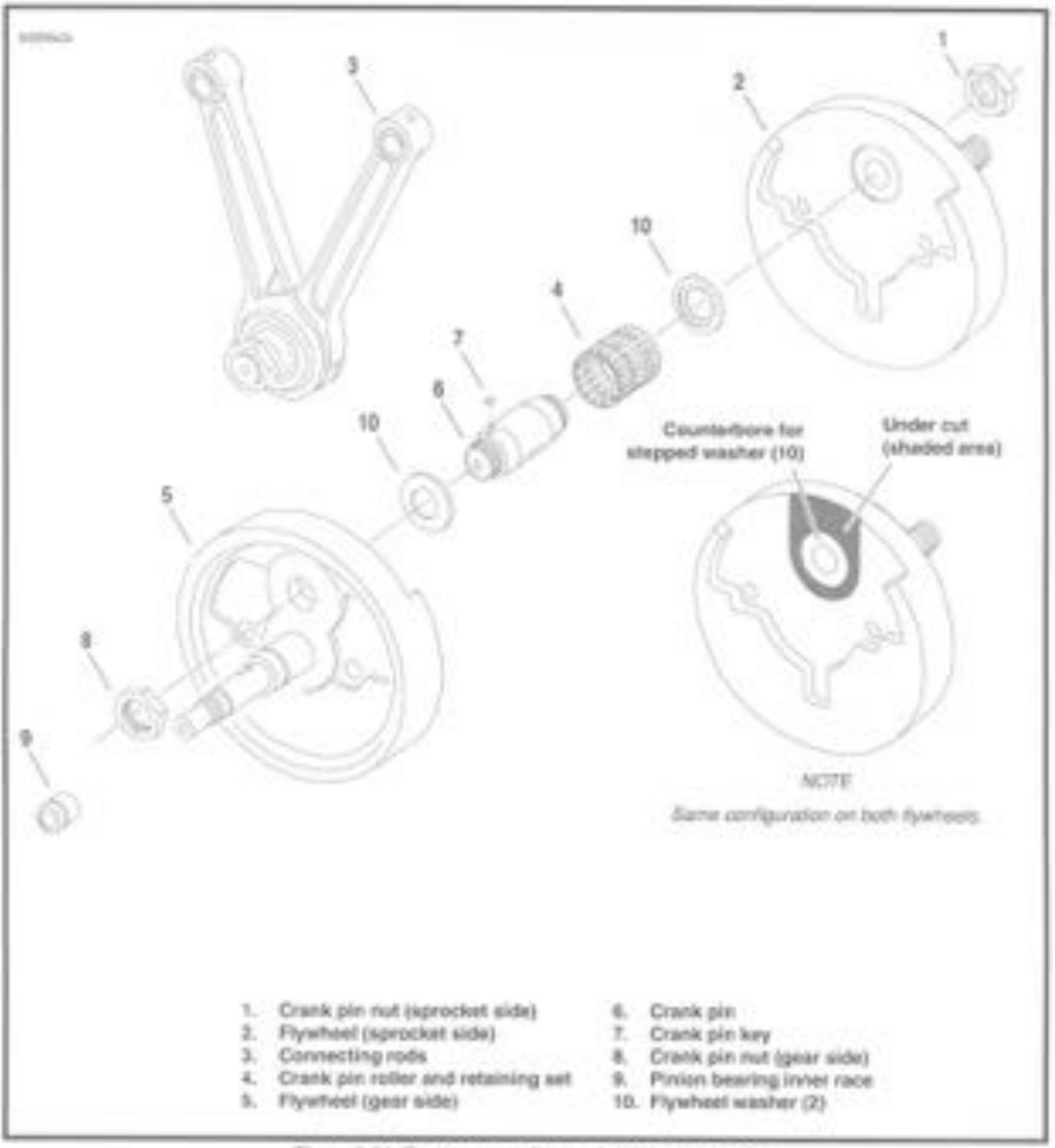
REPLACING FLYWHEEL WASHERS (FIGURE 3-79)

Replace worn flywheel washers (10) as follows:

1. The washer is a close fit in flywheel recess and is secured originally by punching flywheel metal tight against the washer at several points. It is usually necessary to drill a small hole (1/8 in. (3.2 mm)) or smaller) at the outer edge of the washer to permit prying with a pointed tool.

NOTE

Drill hole only slightly deeper than thickness of washer. Avoid removing more material than necessary.



1. Crank pin nut (sprocket side)
2. Flywheel (sprocket side)
3. Connecting rods
4. Crank pin roller and retaining set
5. Flywheel (gear side)
6. Crank pin
7. Crank pin key
8. Crank pin nut (gear side)
9. Pinion bearing inner race
10. Flywheel washer (2)

Figure 3-79. Flywheel and Connecting Rod Assembly

2. Before installing a new washer, scribe outer edge of recess, where metal was punched against original washer, so new washer will seat fully against recess bottom. If washer does not seat fully, forked rod will not have necessary clearance (side play).

⚠CAUTION

Be sure stepped thrust washers are installed with step facing crank pin bearing. Incorrect assembly may damage components.

3. Carefully tap new washers into place and using a punch, peen metal over edge to retain washer.

LAPPING CONNECTING ROD RACES (Figure 3-80)

Connecting rod lower races that are likely to clean up within range of oversize bearing rollers and are otherwise in serviceable condition, should be trued and sized with CONNECTING ROD LAPPING ARBOR (Part No. HD-56740-36).

Figure 3-80. Lapping Connecting Rod Races

1. Clean lap before using.
2. Clamp lap into lathe chuck, carefully load lap with #220 grit grinding compound, mixed with oil. Adjust lathe to turn at approximately 150-200 rpm.
3. Carefully slide connecting rod over lap. Adjust lap to a dragging, but free, fit in rod race.

NOTE

A loose lap will BELL MOUTH bearing races, so lap must be kept adjusted at all times.

4. Start lathe and work rod back and forth, over full length of lap. Hold rod as near race end as possible.
5. Check rod frequently. When rod is lapped true and all traces of pit marks or grooves are cleaned up, wash and blow rod dry.
6. Repeat lapping procedure for other rod race.
7. Bearing races should have a soft velvety appearance and be free of shiny spots.

FITTING ROD BEARINGS

See Figure 3-81. The new crank pin bearing set packages are color coded with either a red or blue identification. This color coding is used by the bearing manufacturer only. The color coding DOES NOT indicate size selection for crank pin bearing replacement.

⚠CAUTION

Either a red or a blue coded bearing set may be used. DO NOT intermix bearings from a red and a blue bearing set because this may cause excessive loading on one bearing, resulting in premature bearing failure.

The bearings consist of rollers retained in steel cages. The wide bearing (male/front rod) retains rollers both internally and externally. The two narrow bearings (female/rear rod) only retain the rollers externally, so care must be taken to slide the bearing set directly from the inner sleeve onto the crank pin; this will prevent the rollers from dropping out of the cage.

Only one size replacement bearing set (standard, either red or blue coding) is sold. Oversize bearings are not available. Bearing clearance or fit is controlled by the connecting rod race inside diameters and the crank pin diameter. Two oversize crank pins are available.

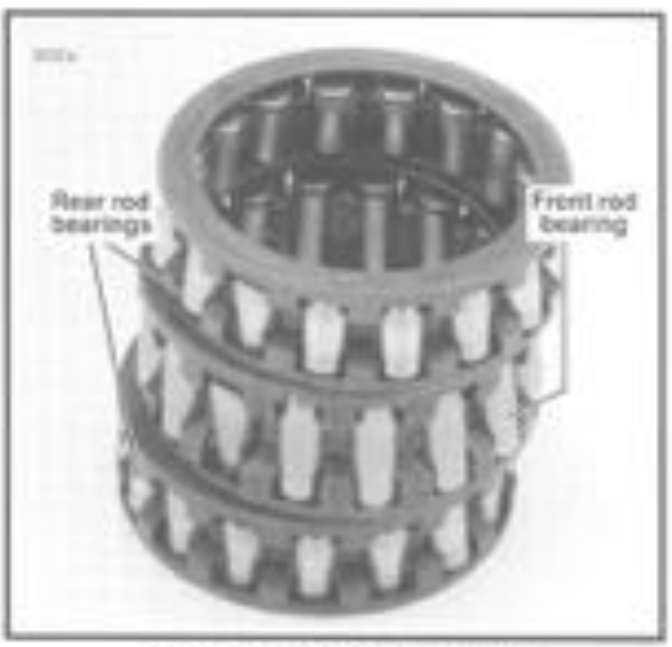


Figure 3-81. Crankpin Bearing Set

1. See Figure 3-82. Measure inside diameter (ID) of lapped connecting rod races with a dial bore gauge that has 0.0001 in. (0.0025 mm) graduations. Measure the ID at four places as shown. Record the four measurements. If any race ID exceeds Service Wear Limit of 1.6275 in. (41.326 mm), replace races or connecting rod set. If race ID measurements are less than 1.6270 in. (41.326 mm), continue procedure as follows.

Figure 3-82. Measuring Connecting Rod Race Inside Diameter

2. Compare the measurements recorded in Step 1 with the ranges given in the following table. If the four measurements taken in each race differ, use the smallest measurements.

NOTE

Front and rear rod race ID must be within the same tolerance range given in the above table. The following example will illustrate the procedure necessary if the lapped connecting rod races on both rods do not fall in the same range.

RACE DIAMETER AND CRANK PIN SIZE

CONNECTING ROD RACE ID REQUIRED	CRANK PIN REQUIRED
1.6245-1.6250 in. 41.262-41.275 mm	Standard
1.6255-1.6260 in. 41.288-41.300 mm	0.0010 in. oversize 0.025 mm
1.6265-1.6270 in. 41.313-41.326 mm	0.0020 in. oversize 0.051 mm
Greater than 1.6270 in. 41.326 mm	Service wear limit exceeded. Replace races or rods.

3. As an example, assign the following values to the measurements taken in Step 1.

Front connecting rod race diameter: 1.6255 in.
41.288 mm

Rear connecting rod race diameter: 1.6250 in.
41.275 mm

For the above example measurements, the RACE DIAMETER AND CRANK PIN SIZE table specifies that the front connecting rod would require a 0.0010 in. (0.025 mm) oversize crank pin, while the rear connecting rod could use the standard sized crank pin. The rear connecting rod races must be lapped so they have the same ID (within 0.0002 in. (0.005 mm)) as the front rod.

4. See Figure 3-83. Oversize (OS) crank pins are available in two oversizes: 0.0010 and 0.0020 in. (0.025 and 0.051 mm) OS crank pins will have a blue or red paint dot applied to the ends of the pins. A blue dot indicates 0.0010 in. (0.025 mm) OS; a red dot indicates 0.0020 in. (0.051 mm) OS. Standard size crank pins will not be marked.

5. Before assembling the flywheel assembly, recheck connecting rods as follows:

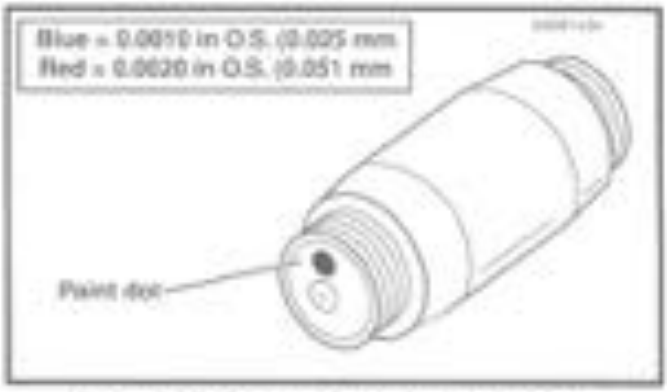


Figure 3-83. Oversize Crank Pin Identification

⚠CAUTION

After the appropriate connecting rod race ID range specified in RACE DIAMETER AND CRANK PIN SIZE table has been achieved, verify that the following specifications are also met:

CONNECTING ROD	SPECIFICATION
Rear	Difference in ID of two races must not exceed 0.0001 in. (0.0025 mm).
Front and rear	Difference in ID of races in front and rear connecting rods must not exceed 0.0002 in. (0.005 mm).
Front and rear	Races must be round within 0.00025 in. (0.0064 mm). (Difference between largest and smallest ID measurement in any race must not exceed 0.00025 in. (0.0064 mm)).

NOTE

Always use new bearings and crank pin after resizing (lapping) connecting rods to insure proper running clearance.

⚠CAUTION

Fitting components tighter than recommended may result in seizing and bearing damage when heat expands parts.

FITTING SPROCKET BEARINGS

If flywheel end play is within tolerance, and if tapered roller bearings and races pass visual check and have no apparent wear, the same set may be reinstalled. Make certain all parts of bearing are installed in exactly the same order in which they were removed. If any part of bearing assembly is worn, entire assembly should be replaced.

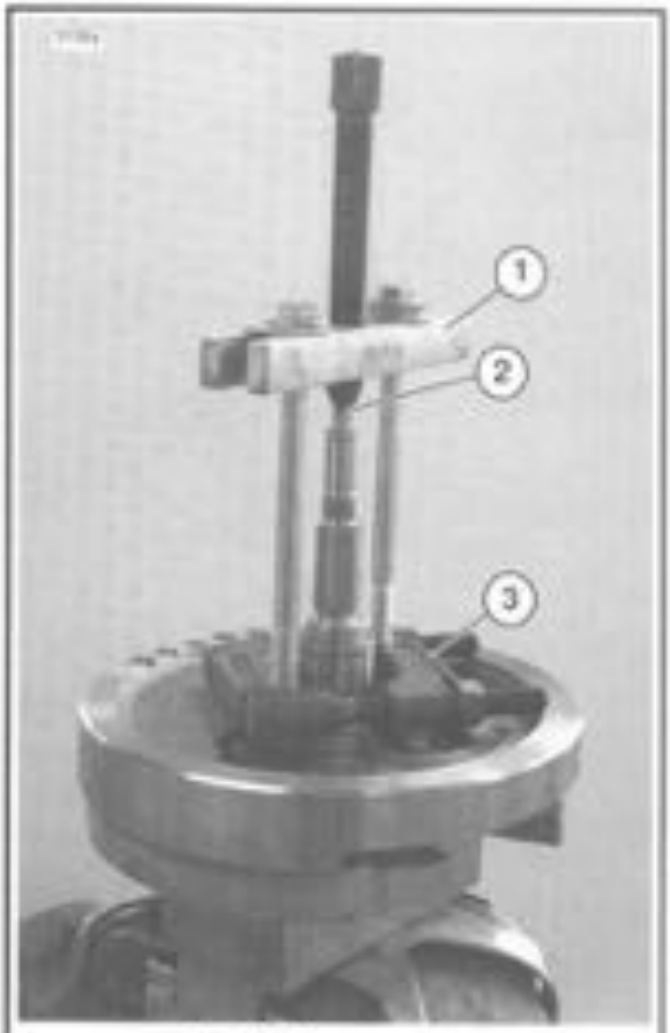
FITTING PINION BEARINGS

See Figure 3-76. A pressed-in bushing in the right crankcase half is the outer race (13). The inner race (12) is pressed on the pinion shaft.

See Figure 3-84. To remove pinion shaft inner race, use PULLER (Part No. HD-97292-61), CENTER CAP (Part HD-95652-43A), and BEARING SEPARATOR (Snap-on Tools Stock No. CJ950). Apply heat to race to aid removal. Four sizes of pinion bearings are available.

Pinion bearing selection at the factory, during engine rebuild, or replacement of crankcase set or flywheel assembly is based on the largest measured outside diameter (OD) of the inner race and the smallest measured inside diameter (ID) of the outer race (crankcase bushing).

A running clearance of 0.0002-0.0008 in. (0.005-0.020 mm) is established during crankcase set or flywheel assembly replacement and engine rebuild.



1. Puller
2. Center cap
3. Bearing separator

Figure 3-84. Pulling Pinion Shaft Inner Race

See Figure 3-85. Installed inner races are identified at the factory as shown.

See Figure 3-86. Outer races are identified at the factory as shown.

NOTE

The different sizes of crankcase sets and flywheel assemblies will not have separate part numbers. That is, a replacement crankcase set may have a class 1, 2 or 3 pinion outer race. Replacement flywheel assemblies will have either a class A or B inner race.

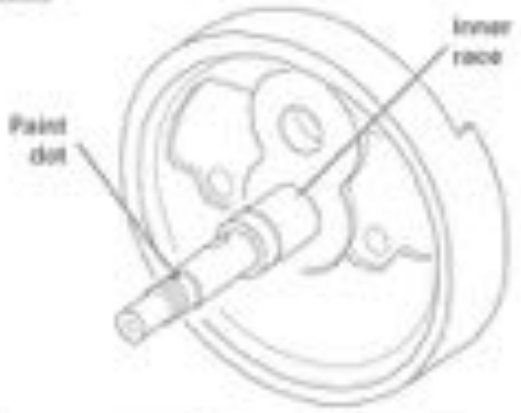
See Figure 3-87. Pinion bearings are identified as shown.

Bearing Selection

Select bearings using the identification information given for inner and outer races and bearings. See Pinion Shaft Bearing Selection table.

NOTE

If either inner or outer race show wear, measure both races to confirm correct bearing fit.

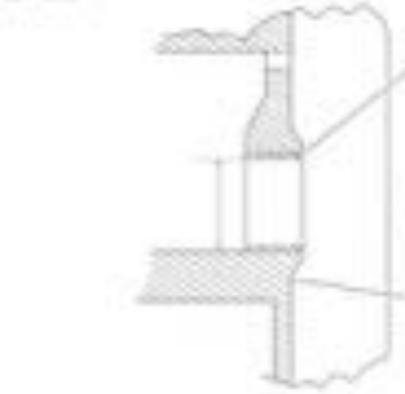


RACE OD	CLASS	IDENTIFICATION*
1.2498-1.2500 in. 31.745-31.750 mm	A	White
1.2496-1.2498 in. 31.740-31.745 mm	B	Green

* Paint dot on end of spline

Service wear limit: 1.2492 in.

Figure 3-85. Factory Inner Race Sizes



RACE ID	CLASS NO.	STAMPED IDENTIFICATION*
1.5646-1.5648 in. 39.741-39.746 mm	1	1
1.5648-1.5650 in. 39.746-39751 mm	2	2
1.5650-1.5652 in. 39.751-39756 mm	3	3

* Stamped number inside crankcase near race

Service wear limit: 1.5672 in.

Figure 3-86. Factory Outer Race Sizes

ROLLER OD (A)	IDENTIFICATION (Package color)
Largest	Red
	Blue
	White (Grey)
Smallest	Green

Figure 3-87. Bearing Identification

Pinion Shaft Bearing Selection

FACTORY STAMPED NUMBER	OUTER RACE ID	BEARING SIZE AS IDENTIFIED BY COLOR CODING										
	Over 1.5672 in. 39.807 mm	Serious Wear Limit Exceeded - Replace Outer Race and Rollers										
	[illegible]											Red
	[illegible]										Red	Blue
	[illegible]									Red	Blue	White-Gray
	[illegible]								Red	Blue	White-Gray	Green
	[illegible]							Red	Blue	White-Gray	Green	
	[illegible]						Red	Blue	White-Gray	Green		
	[illegible]					Red	Blue	White-Gray	Green			
	[illegible]				Red	Blue	White-Gray	Green				
	[illegible]			Red	Blue	White-Gray	Green					
	[illegible]		Red	Blue	White-Gray	Green						
3	1.5650-1.5652 in. 39.751-39.756 mm	Red	Blue	White-Gray	Green							
2	1.5648-1.5650 in. 39.746-39.751 mm	Blue	White-Gray	Green								
1	1.5646-1.5648 in. 39.741-39.746 mm	White-Gray	Green									
INNER RACE OD (in)		1.2496-1.2498 in.	1.2498-1.2500 in.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FACTORY COLOR CODE		Green	White									

1. Measure ID of outer race at four places with a dial bore gauge. Take measurement on ID where bearing rollers ride. Record the four measurements.
2. If the largest measurement is larger than 1.5672 in. (39.807 mm) or the required lapping to remove wear marks would enlarge bore beyond 1.5672 in., continue at Step 8.
3. If the largest measurement is 1.5672 in. (39.807 mm) or less, cover the cam bearings with masking tape to prevent debris from entering bearings. Assemble crankcase halves.

NOTE

The next step requires lapping the outer race. To keep sprocket shaft and pinion shaft bearings aligned the lap must be supported by an adaptor or pilot in the left crankcase half.

4. See CRANKCASE, LAPPING ENGINE MAIN BEARING RACES in this section. Race must be lapped until all wear marks are removed.
5. Measure ID of race at four places and record the measurements.
6. Check measurements against these specifications:

   Largest I.D. measured: 1.5672 in. (39.807 mm) or less

   Roundness of I.D.: within 0.0002 in. (0.005 mm)

   Taper: within 0.0002 in. (0.005)
7. If lapping increased bore ID to larger than 1.5672 in. (39.807 mm), go to Step 8. If roundness or taper do not meet specifications, continue lapping until specifications are met. If all specifications are met, continue at Step 10 to remove and size inner race.
8. Press the outer race from the right crankcase. Press new outer race into crankcase flush with inside edge of cast-in insert.

   See Figure 3-88; dimensions are shown for fabrication of tools used in pressing the outer race into or out of crankcase.

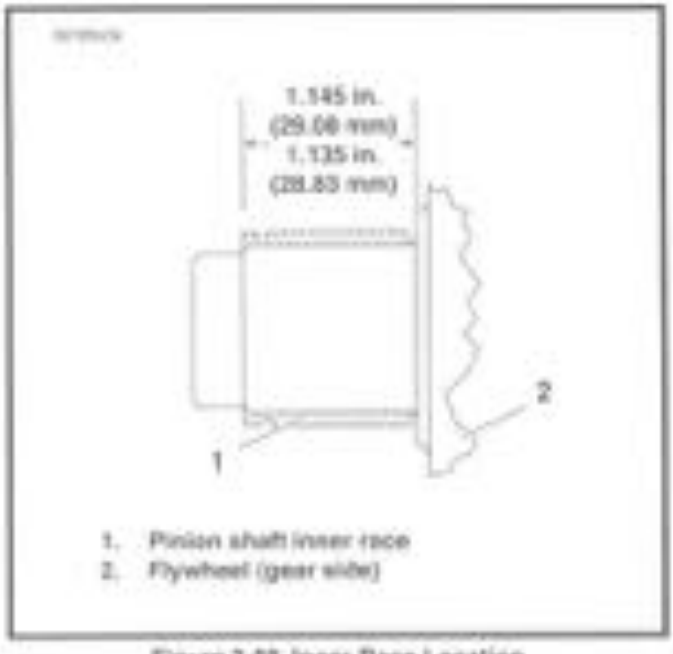
9. The new outer race must be lapped slightly to true and align with left case bearing and to meet the following specifications; see CRANKCASE, LAPPING ENGINE MAIN BEARING RACES in this section.

   I.D.: 1.5646 - 1.5652 in. (39.741 - 39.756 mm)
   Roundness: within 0.0002 in. (0.005 mm)
   Taper: within 0.0002 in. (0.005 mm)
   Surface finish: 16 RMS

10. See Figure 3-84. Pull inner race from pinion shaft using PULLER (Part No. HD-97292-61), CENTER CAP (Part No. HD-95652-43A), and BEARING SEPARATOR (Snap-on Tools Stock No. CJ990). Apply heat to race to aid removal.

11. See Figure 3-88. Press new inner race on pinion shaft as shown. The new inner race must be ground by a machinist to OD dimension range given in Pinion Shaft Bearing Selection table for the finished lapped ID of the outer race. The finished inner race must meet these specifications.

    See Figure 3-89 for necessary dimensions for constructing a press-on tool. When the tool bottoms against the flywheel, correct inner race location is automatically established.



1. Pinion shaft inner race
2. Flywheel (gear side)

Figure 3-88. Inner Race Location

   Roundness: within 0.0002 in.
   Taper: within 0.0002 in. (0.005 mm)
   Surface finish: 16 RMS

12. The following example illustrates how to determine the required inner race OD.

    EXAMPLE:

    A. If smallest measured ID of outer race is 1.5551 in. (39.754 mm) the Pinion Shaft Bearing Selection table indicates an inner race OD range of 1.2496-1.2504 in. (31.740 - 31.760 mm) is required.

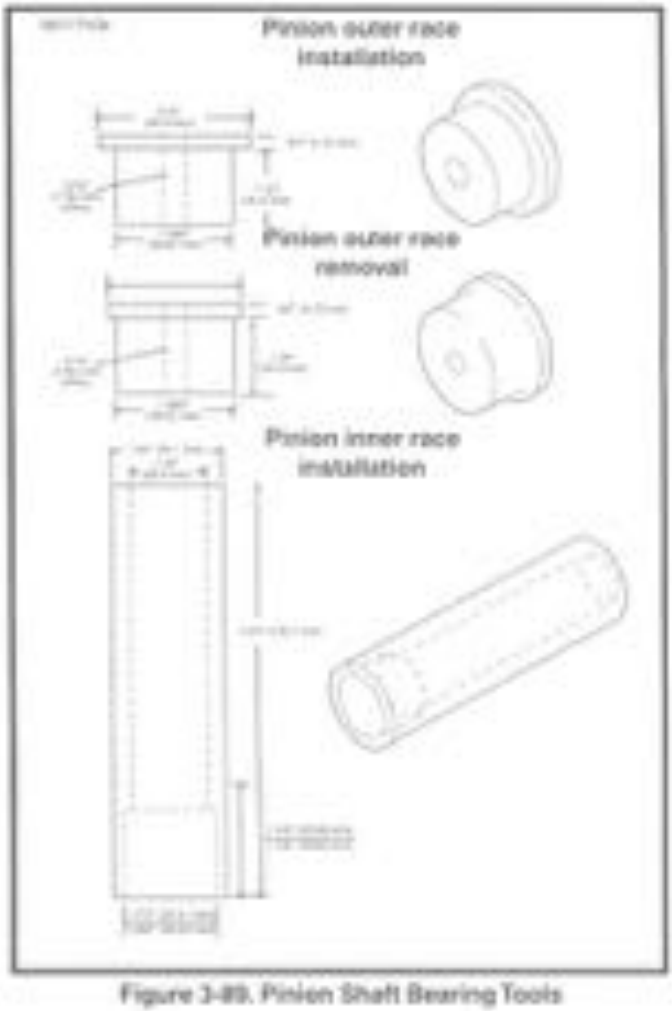


Figure 3-89. Pinion Shaft Bearing Tools

NOTE

Have machinist grind outer race to center or middle of required OD range. This will prevent grinding outer race undersize and gives a more easily achieved tolerance range.

A. Grind inner race. Measure OD at four places and check that specifications in Step 11 are met.

B. For example purposes, the largest measured OD of inner race after grinding is 1.2489 in. (31.747 mm) OD.

C. See Pinion Shaft Bearing Selection table. With a 1.5651 in. ID outer race and a 1.2499 in. (31.747 mm) OD inner race, a blue bearing is required.

NOTE

Always use the smallest outer race ID measurement and the largest OD inner race measurement when selecting bearings.

LAPPING ENGINE MAIN BEARING RACES (FIGURE 3-90)

1. Secure right and left crankcase halves with three crankcase stud bolts (top center and bottom left and right). The sprocket shaft bearing outer races and large spacer must be installed in left crankcase.

2. Obtain CRANKCASE MAIN BEARING LAPPING TOOL (Part No. HD-96710-40B). Assemble CRANKCASE MAIN BEARING LAP (Part No. HD-96716-87) to lapping handle. Assemble guide sleeve to sprocket shaft bearing bushing. Sleeves, for use with tapered bearing, are assembled to case with bearings and small spacer collar. Finger-tighten the sleeve parts.

3. Insert lap shaft with arbor assembled through pinion bearing bushing and into guide sleeve. Tighten arbor expansion collars using a length of 0.156 in. (3.96 mm) rod as spanner until arbor begins to drag. Do not adjust arbor snug in bushing or bushing will "bell," a condition where hole is larger at ends than it is in the center.

Figure 3-90. Lapping Pinion Shaft Main Bearing

4. Withdraw arbor bar enough to coat lightly with 220 grit lapping compound. Do not apply a heavy coat. Reposition lap in bushing and turn handle at moderate hand speed. Work lap back and forth in bushing, as it is revolved, to avoid grooving and tapering.

5. At frequent intervals, remove lap from crankcase wash and inspect bushing. Lapping is completed when entire bushing surface has a dull, satin finish rather than a glossy, smooth appearance. If necessary, flush off lap in cleaning solvent, air dry and apply fresh, light coat of fine lapping compound.

ASSEMBLY

Flywheels

After correct connecting rod bearing fit has been attained, clean and assemble parts as follows:

1. Carefully clean all flywheel components using a non-petroleum-based solvent, such as LOCTITE CLEANING SOLVENT or electrical contact cleaner. Thoroughly dry all components.
2. See Figure 3-79. Apply two drops of PERMABOND® HM-161 to the crank pin threads, and apply no more than two drops to the nut bearing faces.

⚠CAUTION

Do not apply any PERMABOND HM-161 Compound or Retaining Compound to shaft tapers.

3. Assemble crank pin (6) to gear-side flywheel (5) making sure that key (7) is in proper position. Tighten crank pin nut. See ENGINE, SPECIFICATIONS for proper torque.
4. Position gear-side flywheel assembly in a flywheel fixture with crank pin pointing up. Wipe crank pin taper clean.
5. See Figure 3-91. Slip bearings, and connecting rods over crank pin. Assemble angular boss of the female rod adjacent to large radius side of the male rod as shown. The side of the male rod with the larger radius is narrower in the area where it fits between the forks of the female rod.
6. Verify that oil passages through pinion shaft, gear-side flywheel, and crank pin are clear by blowing compressed air into oil galley at end of pinion shaft.
7. Install sprocket-side flywheel. Lightly tighten nut.
8. See Figure 3-92. Hold steel straightedge along outer face of wheel rims at 90° from crank pin as shown. Tap outer rim of top wheel until wheels are concentric. Tighten nut, recheck with straightedge at frequent intervals.

NOTE

Use soft metal hammer to realign wheels.

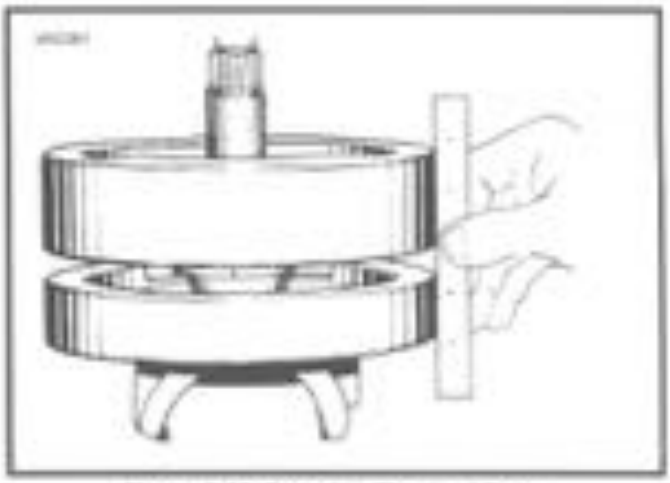


Figure 3-92. Squaring Flywheel Faces

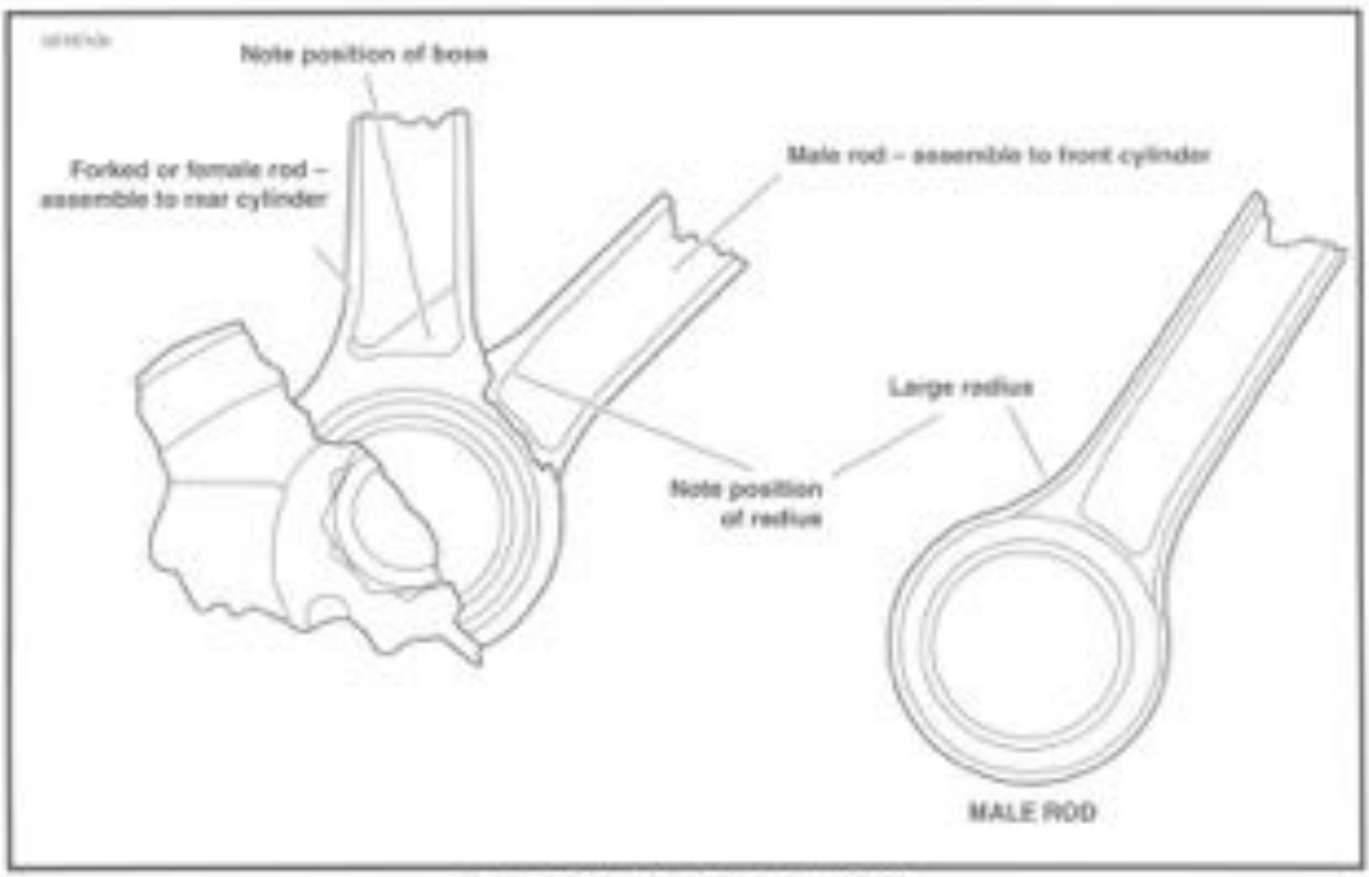


Figure 3-91. Installing Connecting Rods

9. Tighten crank pin nut to 150-185 ft-lbs (203-251 Nm) torque. See Figure 3-93. Install flywheel assembly in Harley-Davidson FLYWHEEL TRUING DEVICE (Part No. HD-96650-80) as shown. Adjust so centers are snug. Wheels must turn freely; however, shafts must not be loose in centers. If flywheel assembly is either loose or squeezed, indicators will not indicate accurately. Adjust indicators to take reading as near to flywheels as possible, so pointers read at about the middle of the scales.

10. Turn flywheels slowly and observe the movement of indicator pointers. Movement toward flywheels indicate high points of shafts. Find highest point of each shaft and chalk-mark flywheel rims at those points. Remove flywheel from stand and make corrections as follows.

11. See Figure 3-92. Flywheel may be out of true three ways, A, B and C or a combination of two of the three ways.

12. When wheels are both out of true as indicated in A, tighten C-clamp on rims or wheels opposite crank pin and lightly tap the rim at the crank pin with lead or copper mallet.

13. When wheels are both out of true as indicated in B, drive a hardwood wedge between the wheels opposite the crank pin and lightly tap the rims near the crank pin with a lead or copper mallet.

14. When wheels are out of true as indicated in C, strike the rim of the wheel a firm blow at about 90° from crank pin on high side.

15. When wheels are out of true in a combination of any of the conditions shown, correct C first, tapping rim of offending wheel only, and then correct condition A or B.

NOTE

The number of blows required and how hard they should be struck depends on how far shafts are out of true and how tight nuts are drawn. Always remove the flywheels from the stand and strike the flywheel rim only at 90° to the crank pin. Use only a soft metal mallet. Never strike wheels a hard blow near crank pin. This could result in a broken crank pin.

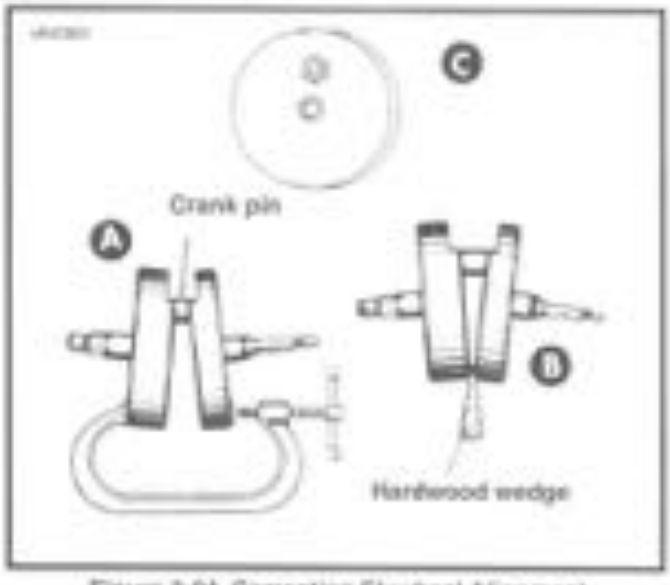


Figure 3-94. Correcting Flywheel Alignment

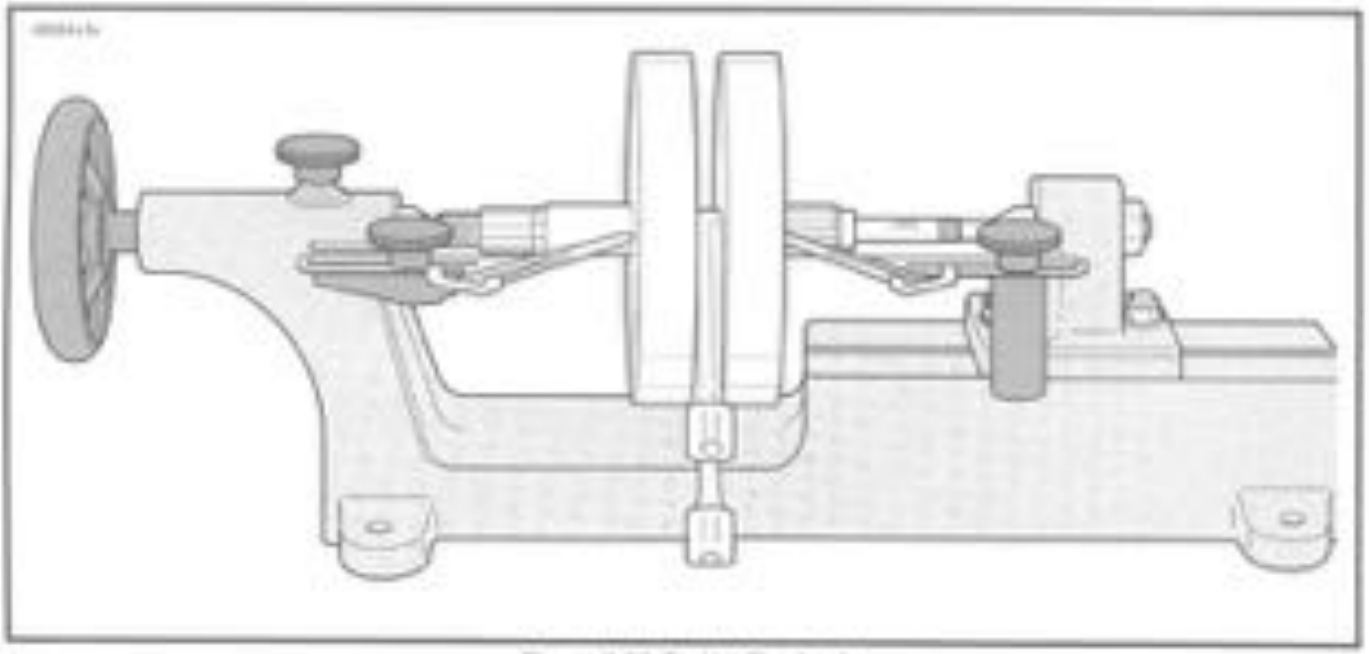


Figure 3-93. Truing Flywheel

16. See Figure 3-93. Readjust centers, revolve wheels and take reading from indicator. Repeat truing operation until indicated shaft runout does not exceed 0.001 in. (0.025 mm) (each graduation on indicator is 0.002 in. (0.05 mm)).

17. If it is impossible to true wheels, check for a cracked flywheel, damaged or enlarged tapered hole, or a sprocket or pinion shaft worn out-of-round at surface where indicator reading is being taken.

18. See Figure 3-95. When wheels are true, check connecting rod side play with thickness gauge as shown. If it is greater than tolerance shown in engine SPECIFICATIONS, draw up crank pin nuts until within tolerance. Insufficient play between rods and flywheel face is caused by one of the following conditions:

    A. Flywheels and crank pin assembled with oil on tapers and nut over-tightened. Disassemble, clean and reassemble.

    B. New flywheel washers installed and not fully seated. Disassemble, inspect, replace deepest seating flywheel or crank pin. As last resort, grind down width of forked rod.

    C. Taper holes enlarged as a result of having been taken apart several times. Replace deepest seating wheel.

    D. Cracked flywheel at tapered hole. Replace flywheel.

19. After rod side play is checked and adjusted, check that crank pin nut is tightened to specified torque, again check wheel trueness on truing device. Correct any runout as above.

Crankcase Halves

Lubricate all parts with Harley-Davidson 20W50 engine oil, and proceed as follows:

1. See Figure 3-96. The original retaining ring (1) is left in place to avoid damaging the bearing bore of the left crankcase half. Verify that gap in retaining ring (1) is aligned with oil supply hole (2) in left crankcase half bearing bore.

NOTE

See Figure 3-97. Use SPROCKET SHAFT BEARING OUTER RACE INSTALLATION TOOL (1, 2) (Part No. HD-39458) to install left and right outer races (4, 5) of sprocket shaft tapered roller bearings into left crankcase half (6). Always install left outer race (4) prior to installing right outer race (5) because the installer base (1) is usable only when you follow this sequence of race installation.

2. Insert "SPORTSTER" end of installer base (1) into inboard side of left crankcase half (6) bearing bore until base contacts installed retaining ring (3).

3. Position left outer race (4) over bearing bore on outboard side of left crankcase half (6).

4. Insert shaft of installer plug (2) through left outer race (4) and into installer base (1). Press race into bore until firmly seated against retaining ring (3).

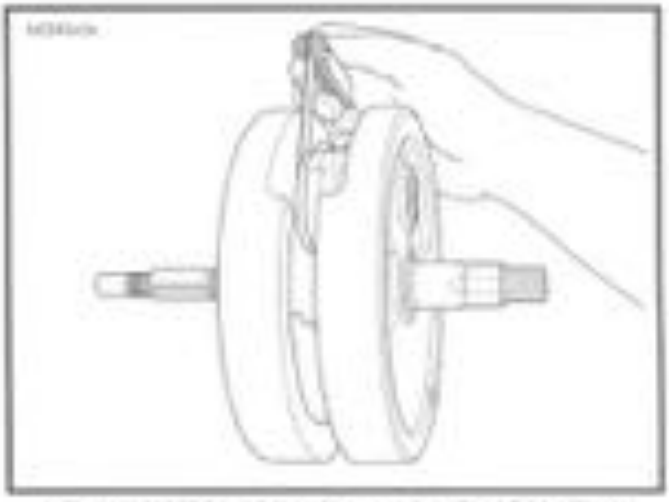
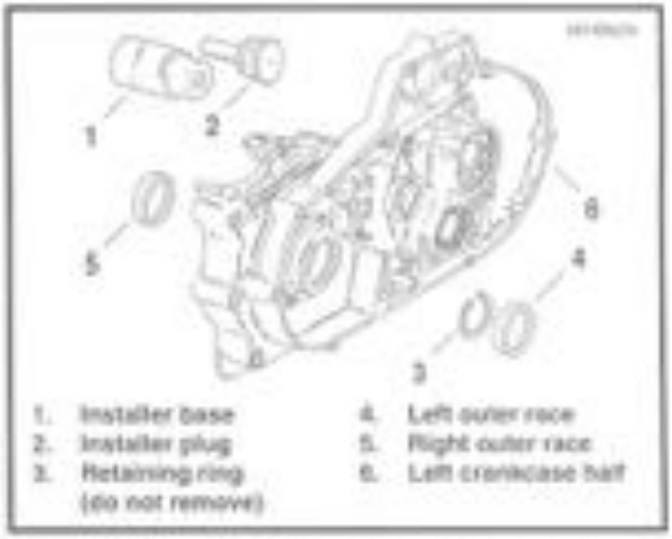


Figure 3-95. Checking Connecting Rod Side Play

1. Retaining ring
2. Oil supply hole
3. Oil supply channel

Figure 3-96. Retaining Ring



1. Installer base
2. Installer plug
3. Retaining ring (do not remove)
4. Left outer race
5. Right outer race
6. Left crankcase half

Figure 3-97. Installing Sprocket Shaft Bear Outer Races

5. Insert "SPORTSTER" end of installer base (1) into outboard side of left crankcase half (6) bearing bore until base contacts outboard surface of installed left outer race (4).

6. Position right outer race (5) over bearing bore on inboard side of left crankcase half (6).

7. Insert shaft of installer plug (2) through right outer race (5) and into installer base (1). Press race into bore until firmly seated against retaining ring (3).

NOTE

See Figure 3-98. Use SPROCKET SHAFT BEARING/SEAL INSTALLATION TOOL (Part No. HD-42578) to install sprocket shaft tapered roller bearings and seal.

8. Install inner bearing (6).

   a. Place **new** bearing, small end upward, over end of sprocket shaft.

   b. Thread pilot (1) onto sprocket shaft until pilot bottoms on sprocket shaft shoulder.

   c. Sparingly apply graphite lubricant to threads of pilot shaft to ensure smooth operation.

   d. Slide sleeve (5) over pilot (1) until sleeve contacts inner bearing race. Install Nice bearing (4), washer (3) and handle (2) on top of sleeve.

   e. Rotate handle clockwise until bearing (6) contacts flywheel shoulder. Remove tool from sprocket shaft.

9. See Figure 3-76. Install spacer (8) and outer bearing (9).

   a. See Figure 3-99. Carefully place crankcase half over sprocket shaft so that it rests flat on inner bearing.

   b. Slide **new** inner spacer over sprocket shaft until it contacts inner bearing race.

   c. Place **new** outer bearing, small end downward, over sprocket shaft.

   d. Assemble SPROCKET SHAFT BEARING/SEAL INSTALLATION TOOL (Part No. HD-42578) onto sprocket shaft. Follow procedure in Step 8.

   e. Rotate handle clockwise until bearing firmly contacts inner spacer. Inner and outer bearings must be tight against inner spacer for correct bearing clearance. Remove tool from sprocket shaft.

   f. Spin crankcase half to verify that flywheel assembly is free.

1. Pilot
2. Handle
3. Washer
4. Nice bearing
5. Sleeve
6. Inner bearing

Figure 3-98. Inner Bearing Installation

Figure 3-99. Installing Flywheel Spacer and Outer Bearing

10. See Figure 3-100. Install **new** spacer in seal ID. With the open (lipped) side facing outward, center seal/spacer assembly over bearing bore.

⚠CAUTION

Do not remove the spacer after installation or the new seal will have to be discarded and the procedure repeated.

11. See Figure 3-101. Install bearing seal and spacer.
    a. Center seal/spacer driver (2) over seal, so that the sleeve (smaller OD) seats between seal wall and garter spring.
    b. Assemble SPROCKET SHAFT BEARING/SEAL INSTALLATION TOOL (1) (Part No. HD-42579) and SPROCKET SHAFT SEAL/SPACER INSTALLER (Part No. HD-42774) onto sprocket shaft. Follow procedure in Step 8.
    c. Rotate handle clockwise until the spacer makes contact with the bearing. Remove tool from sprocket shaft.
12. See Figure 3-102. Install pinion shaft bearing.
    a. Lubricate pinion shaft bearing with engine oil.
    b. Slip bearing on pinion shaft.
    c. Install **new** retaining ring in groove of pinion shaft bearing inner race.
13. Assemble crankcase halves together.
    a. Apply a thin coat of DOW CORNING SILASTIC or 3-M 800 sealant to crankcase joint faces.
    b. Slide pinion shaft through outer race in right crankcase.
    c. Attach crankcase halves using hardware shown in Figure 3-71.
    d. Tighten 1/4-in. fasteners to 70-110 **in-lbs** (7.9-12.4 Nm).
    e. Tighten 5/16-in. fasteners to 15-18 ft-lbs (20.3-24.4 Nm).
14. See Figure 3-103. Install cylinder studs.
    a. Pack clean towels into crankcase opening.
    b. Place a steel ball into a head screw (1).
    c. The cylinder studs (2) have a shoulder (3) at the lower end. Place the end of the stud without the shoulder into the head screw.
    d. Install the stud in the crankcase with the shoulder end down. Use an air gun (4) to drive the stud until the shoulder reaches the crankcase.
    e. Remove air gun. Use a torque wrench to tighten stud to 10 ft-lbs (13.6 Nm).
15. Install pistons and cylinders. See CYLINDER AND PISTON, INSTALLATION in this Section.
16. Install oil pump. See ENGINE LUBRICATION SYSTEM, OIL PUMP, INSTALLATION in this section.
17. Install cam gears, gearcase cover, tappet guides and tappets. See GEARCASE COVER AND CAM GEARS, INSTALLATION.
18. Install cylinder heads. See CYLINDER HEAD, INSTALLATION in this Section.

Figure 3-100. Install Spacer in Seal

1. Bearing/seal installer (Part No. HD-42579)
2. Seal/spacer installer (Part No. 42774)

Figure 3-101. Install Bearing Seal/Spacer

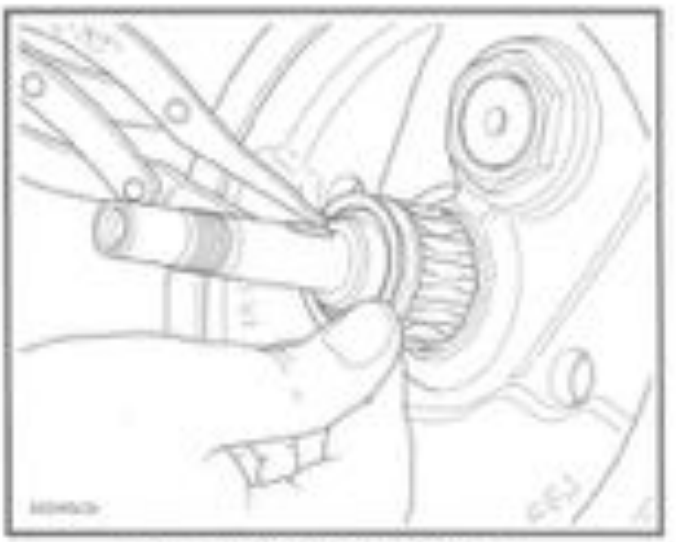


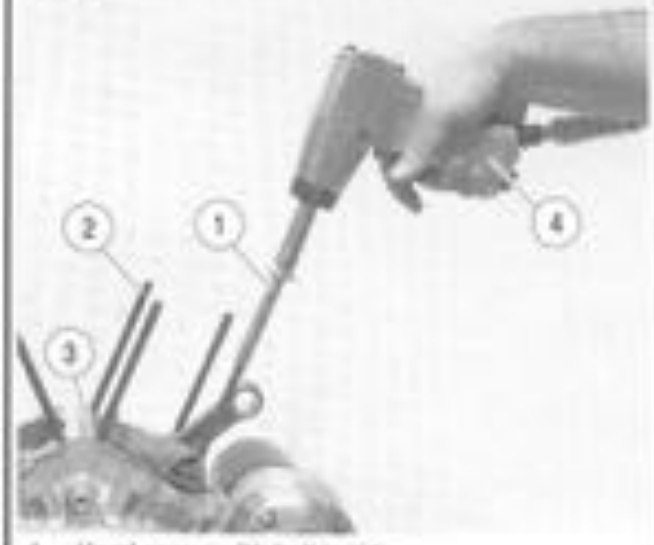
Figure 3-102. Pinion Shaft Bearing

19. Install starter. See ELECTRIC STARTER, STARTER, INSTALLATION in Section 5.
20. Install transmission. See TRANSMISSION INSTALLATION AND SHIFTER PAWL ADJUSTMENT in Section 6.
21. Install all primary drive components. This includes engine sprocket, primary chain, complete clutch assembly, engine sprocket nut and mainshaft nut. See PRIMARY DRIVE/CLUTCH, INSTALLATION in Section 6.
22. Install primary cover. See PRIMARY COVER under PRIMARY DRIVE/CLUTCH, INSTALLATION in Section 6.

NOTE

Be sure to refill transmission to proper level with fresh lubricant. See TRANSMISSION, LUBRICATION in Section 6.

23. See INSTALLING THE ENGINE and perform the applicable steps.



1. Head screw with ball inside
2. Cylinder stud
3. Shoulder on cylinder stud
4. Air gun

Figure 3-103. Cylinder Studs

FUEL SYSTEM 4

SUBJECT PAGE NO.

1. Specifications 4-1
2. Carburetor 4-2
3. Air Cleaner 4-18
4. Fuel Supply Valve 4-20
5. Fuel Tank 4-21
6. Evaporative Emissions Control, California Models 4-24

SPECIFICATIONS

	XLH 883			XLH 1200 / 1200S Sport		
	49 State	Calif.	HDI, Swiss	49 State	Calif.	HDI, Swiss
Carburetor Jet Sizes Main jet Slow jet	160 42	170 42	190 42	178/195 42	185/195 42	190/195 42
Carburetor Adjustments Engine slow idle speed Engine speed for setting ignition timing	1050 rpm 1050-1500 rpm					
Fuel Tank Capacity Total Reserve	3.30 gallons (U.S.) 12.5 liters 0.50 gallon (U.S.) 1.9 liters					
Torque Values Intake manifold flange bolts Air cleaner backplate to cylinder bolts Air cleaner backplate to carburetor bolts Fuel tank mounting bolts Air cleaner cover screws	6-10 ft-lbs 8-14 Nm 10-20 ft-lbs 14-27 Nm 3-5 ft-lbs 4-7 Nm 8-16 ft-lbs 11-22 Nm 3-5 ft-lbs 4-7 Nm					

CARBURETOR

GENERAL (Figure 4-1)

The carburetor is a constant-velocity, gravity-fed type with a float-operated inlet valve, a variable venturi, a throttle stop screw (for idle speed adjustment) and a fuel enrichment system (for starting).

1. Vacuum piston chamber
2. Float chamber
3. Accelerator pump
4. Idle speed adjusting screw

Figure 4-1. Carburetor

Idle and transfer ports provide a balanced fuel mixture during the transition period from stop to mid-range. A vacuum piston controls venturi opening.

The carburetor is specifically designed to control exhaust emissions. All jets are fixed. The idle mixture has been pre-set at the factory. The idle mixture screw is recessed in the carburetor casting. The opening is sealed with a plug because it is intended that the idle mixture be non-adjustable.

NOTE

Adjusting mixture setting by procedures other than specified in this section may be in violation of Federal or State regulations.

This system partially compensates for changes in the mixture that are normally caused by changes in altitude. Because atmospheric pressures drop as altitude increases, the pressure difference in the upper and lower chambers is reduced; this results in less fuel being delivered to the engine, thereby maintaining the correct air/fuel ratio for better engine performance and reduced exhaust emissions.

All models except the 1200S have a drain for emptying the float chamber during seasonal or extended periods of storage.

NOTE

The XL1200S Sport model does NOT have a drain for emptying the float chamber.

The carburetor is equipped with an accelerator pump. The accelerator pump system uses sudden throttle openings (rapid accelerations) to quickly inject raw fuel into the carburetor venturi; this provides extra fuel for smooth acceleration.

TROUBLESHOOTING

OVERFLOW

Check for:	Remedy:
1. Restricted fuel tank vent system.	1. Correct restricted hose. Replace vapor valve.
2. Loose float bowl screws.	2. Tighten screws.
3. Damaged float bowl O-ring.	3. Replace O-ring.
4. Damaged or leaking float assembly.	4. Replace float assembly.
5. Particle contamination in fuel inlet fitting cavity.	5. Clean and clear cavity and fuel supply tract.
6. Worn or dirty inlet valve or seat.	6. Clean or replace valve and clean seat.
7. Improper fuel level in float bowl.	7. Adjust float tab for correct fuel level.

POOR IDLING

Check for:	Remedy:
1. Idle speed improperly adjusted.	1. Adjust operating idle speed.
2. Inlet system air leak (faster idling).	2. Correct as required.
3. Loose low speed jet.	3. Tighten jet.
4. Contaminated or plugged low speed system.	4. Clean contaminants and clear passages.
5. Enrichener valve not seated or leaking.	5. Adjust, clean or replace.
6. Leaking accelerator pump.	6. Repair.

POOR FUEL ECONOMY

Check for:	Remedy:
1. Excessive use of enrichener system.	1. Limit system use.
2. Enrichener valve not seated or leaking.	2. Adjust, clean or replace.
3. Dirty air cleaner element.	3. Clean or replace as required.
4. Restricted fuel tank vent system.	4. Correct restricted hose. Replace vapor valve.
5. High speed riding style.	5. Modify riding habits.
6. Idle speed improperly adjusted.	6. Adjust operating idle speed.
7. Loose jets.	7. Tighten jets.
8. Fuel level too high.	8. Adjust float level.
9. Plugged or restricted bowl vent.	9. Clean and clear passages.
10. Worn or damaged needle or needle jet.	10. Replace needle or needle jet.
11. Vacuum piston assembly malfunction.	11. See Vacuum Piston Troubleshooting.
12. Plugged air jets or passages.	12. Clean and clear passages.
13. Excessive accelerator pump output.	13. Check and clean accelerator pump bypass orifice.

POOR ACCELERATION

Check for:	Remedy:
1. Throttle cables misaligned.	1. Adjust throttle cables.
2. Inlet system air leak.	2. Correct as required.
3. Restricted fuel tank vent system.	3. Correct restricted hose. Replace vapor valve.
4. Restricted fuel supply passages.	4. Correct and clear restriction.
5. Plugged bowl vent or overflow.	5. Clean and clear passages.
6. Enrichener valve not seated or leaking.	6. Adjust, clean or replace.
7. Worn or damaged needle or needle jet.	7. Replace assembly.
8. Vacuum piston malfunction.	8. See Vacuum Piston Troubleshooting.
9. Plugged jets or passages.	9. Clean and clear as required.
10. Fuel level (float chamber) too low.	10. Adjust float level.
11. Accelerator pump leaking or no output.	11. Repair as necessary.

HARD STARTING	
Check for:	**Remedy:**
1. Enrichener system plugged, not properly functioning or improperly operated.	1. Clean, adjust, or replace, or read Owner's Manual.
2. Inlet system air leak.	2. Correct as required.
3. Restricted fuel supply.	3. Correct fuel supply or passages.
4. Fuel overflow.	4. See Overflow Troubleshooting.
5. Plugged slow jet or passages.	5. Clean and clear jet or passages.
POOR PERFORMANCE ON ROAD	
Check for:	**Remedy:**
1. Idle speed improperly adjusted.	1. Adjust operating idle speed.
2. Inlet system air leak.	2. Correct as required.
3. Restricted fuel tank vent system.	3. Correct restricted hose. Replace vapor valve.
4. Dirty or damaged air cleaner element.	4. Clean or replace.
5. Enrichener valve not seated or leaking.	5. Adjust, clean or replace.
6. Restricted fuel supply tract.	6. Correct and clear restriction.
7. Plugged bowl vent or overflow.	7. Clean and clear passages.
8. Loose or plugged fuel and air jets or passages.	8. Clean, clear and correct as required.
9. Worn or damaged needle or needle jet.	9. Replace assembly.
10. Vacuum piston assembly malfunction.	10. See Vacuum Piston Troubleshooting.
11. Accelerator pump inoperative.	11. Repair as required.
POOR HIGH-SPEED PERFORMANCE	
Check for:	**Remedy:**
1. Inlet system air leak.	1. Clean or replace.
2. Enrichener valve not seated or leaking.	2. Adjust, clean or replace.
3. Restricted fuel tank vent system.	3. Correct restricted hose. Replace vapor valve.
4. Restricted fuel supply tract.	4. Correct and clean restriction.
5. Dirty or damaged air cleaner element.	5. Clean or replace.
6. Plugged bowl, vent or overflow.	6. Clean and clear passages.
7. Worn or damaged needle or needle jet.	7. Replace assembly.
8. Vacuum piston assembly malfunction.	8. See Vacuum Piston Troubleshooting.
9. Loose or plugged main jets or passages.	9. Tighten, clean, clear as required.
10. Improper fuel level.	10. Adjust float level.
11. Accelerator pump inoperative.	11. Repair as required.

VACUUM PISTON ASSEMBLY TROUBLESHOOTING

PISTON DOES NOT RISE PROPERLY	
Check for:	**Remedy:**
1. Piston atmosphere vent blocked. 2. Diaphragm cap loose, damaged or leaking. 3. Spring binding. 4. Diaphragm pinched at lip groove. 5. Torn diaphragm. 6. Piston binding. 7. Piston vacuum passage plugged.	1. Clear vent. 2. Tighten or replace cap. 3. Correct or replace spring. 4. Reposition diaphragm lip. 5. Replace piston diaphragm assembly. 6. Clean piston slides and body or replace piston. 7. Clean and clear passage.
PISTON DOES NOT CLOSE PROPERLY	
Check for:	**Remedy:**
1. Spring damaged. 2. Piston binding. 3. Piston diaphragm ring dirty or damaged.	1. Replace spring. 2. Clean piston slides and body or replace piston. 3. Clean or replace piston.

OPERATION

Enrichener

The enrichener knob, next to the ignition switch, controls the opening and closing of the enrichener valve at the carburetor.

COOL ENGINE

BE SURE THROTTLE IS CLOSED. Pull enrichener knob fully out. Turn the ignition switch on and press starter switch to operate the electric starter.

⚠CAUTION

You must pay close attention to a C. V. carburetor equipped vehicle's warm-up time. Both excessive use and insufficient use of the enrichener may cause poor performance, erratic idle, poor fuel economy and spark plug fouling.

OUTSIDE TEMPERATURE LESS THAN 50˚F (10˚C)

The vehicle should be allowed to warm up for only 15-30 seconds before being driven. Initial warm-up periods longer than 30 seconds are not recommended. For temperatures well below 50˚F (10˚C), you may need to twist the throttle once or twice immediately before attempting engine start-up. This will add extra fuel from the carburetor accelerator pump to assist the start-up.

1. If the outside temperature is less than 50˚ F (10˚C), ride for five minutes or three miles (5 km) with enrichener knob fully out.
2. Push the enrichener knob in to approximately 1/2 way. Ride another two minutes or two miles (3 km).
3. See Figure 4-2. Then push enrichener knob fully in. If engine will not idle at specified rpm, pull out enrichener knob enough to allow correct idle speed. Ride another two minutes or two miles (3 km), then push enrichener knob fully in.

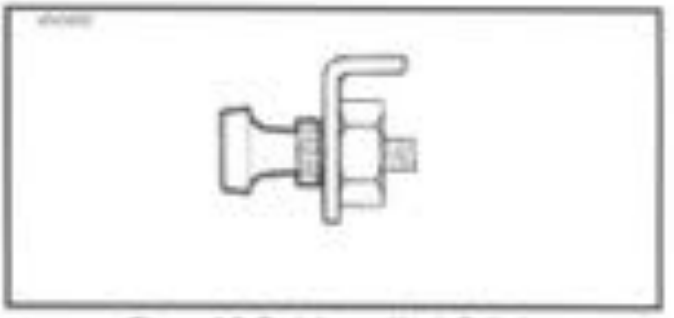


Figure 4-2. Enrichener Knob Fully In

OUTSIDE TEMPERATURE GREATER THAN 50˚F (10˚C)

The vehicle should be allowed to warm up for only 15-30 seconds before being driven. Initial warm-up periods longer than 30 seconds are not recommended.

1. If the outside temperature is greater than 50˚F (10˚C), ride for three minutes or two miles (3 km) with enrichener knob fully out.
2. Push the enrichener knob in to approximately 1/2 way. Ride another two minutes or two miles (3 km).
3. Then push enrichener knob fully in. If engine will not idle at specified rpm, pull out enrichener knob enough to allow correct idle speed. Ride another two minutes or two miles (3 km), then push enrichener knob fully in.

WARM OR HOT ENGINE

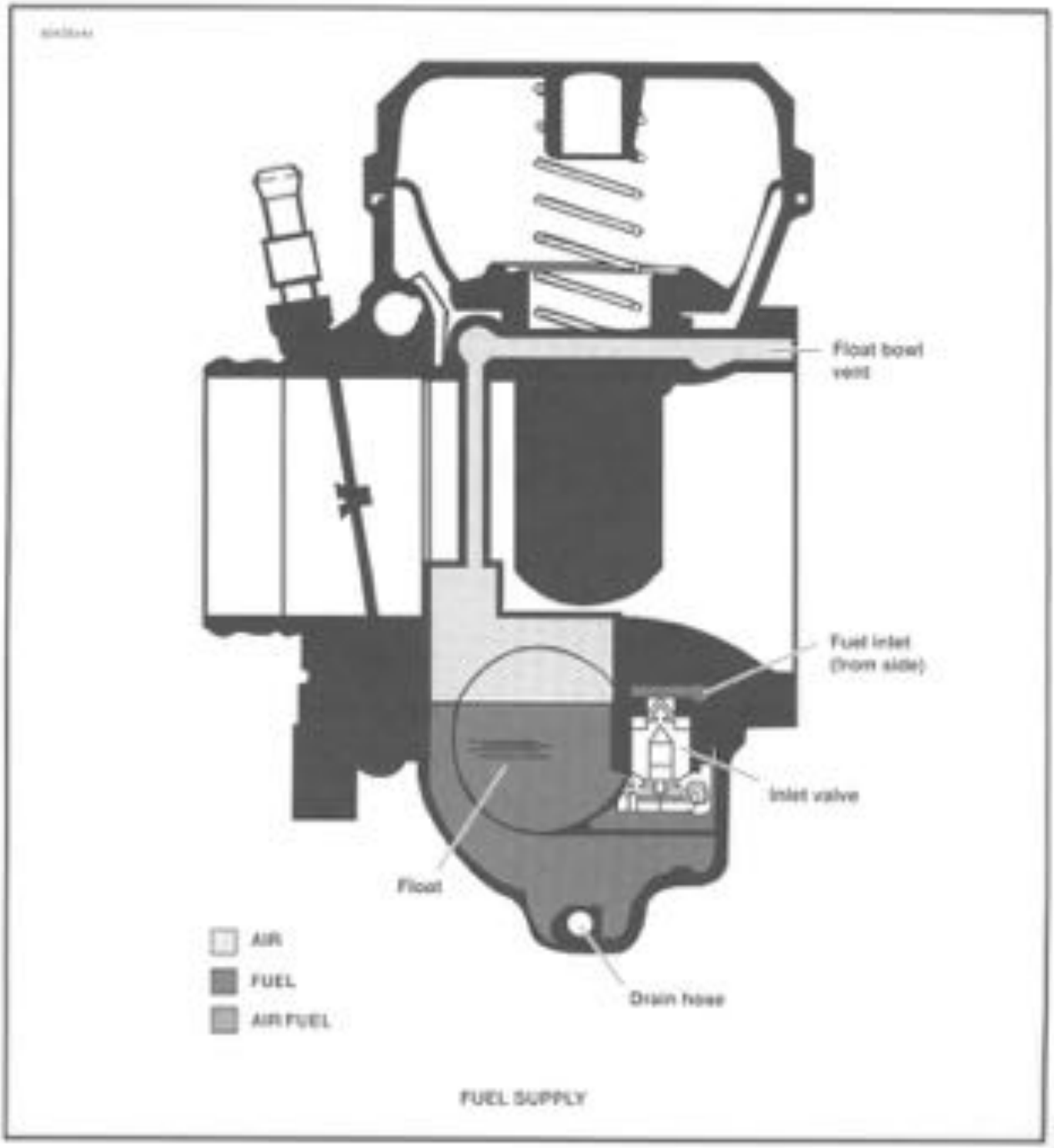
Open throttle 1/8-1/4 of full travel. Turn on ignition switch and operate electric starter. See Figure 4-2. DO NOT USE ENRICHENER, unless engine will not idle at specified rpm. If engine will not idle at specified rpm, pull out enrichener knob enough to allow correct idle speed. Ride two minutes or two miles (3 km), then push enrichener knob fully in.

Fuel Supply System

Fuel from the fuel tank passes through the carburetor inlet valve into the carburetor float chamber. The rising fuel level in the float chamber lifts the float, which in turn lifts the attached inlet valve closer to the valve seat. When the fuel reaches the level predetermined by the float level setting, the float will lift the inlet valve into its seated position, thereby closing the valve and stopping fuel flow to the float chamber.

When fuel is used by the running engine, the fuel level in the float chamber drops; this lowers the float and inlet valve, thereby causing the valve to open and the fuel flow to resume.

The float chamber is vented to atmosphere through an air passage in the carburetor body. The opening for the float chamber vent passage is next to the carburetor main venturi inlet, on the carburetor body surface to which the air cleaner backplate is mounted.



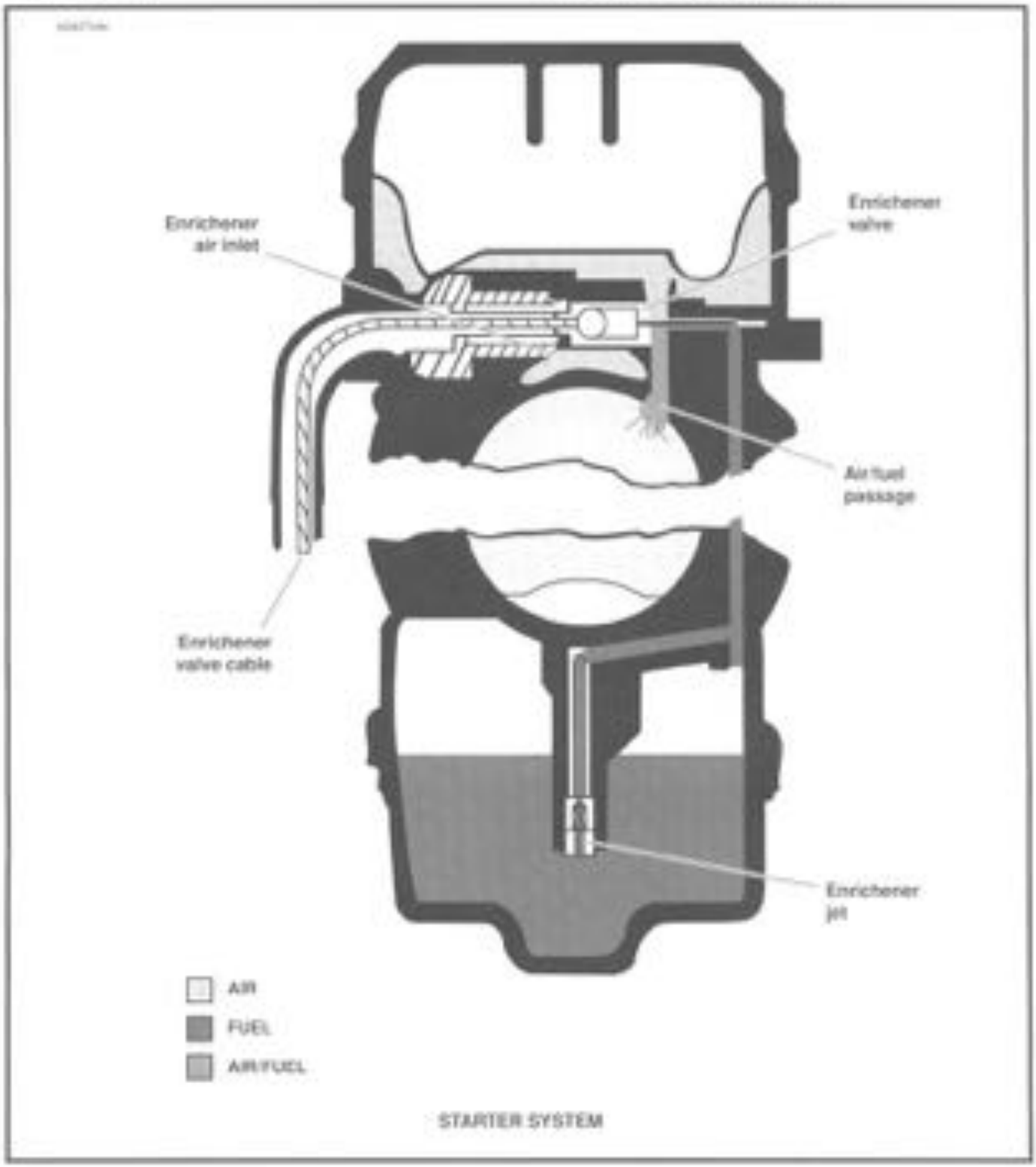
FUEL SUPPLY

Starter System

The starting circuit consists of a cable actuated enrichener valve and converging fuel and air passages in the carburetor body.

The enrichener air/fuel passage opens to the carburetor venturi, where low pressure exists when the engine is running. Fuel in the carburetor float bowl and air in the enrichener air inlet are vented to atmosphere and are at atmospheric pressure (greater pressure than in the carburetor venturi).

When the enrichener knob is pulled outward, the enrichener valve opens the air/fuel passage to the low pressure carburetor venturi. Fuel in the float bowl, at atmospheric pressure, flows upward through a metering enrichener jet and then through a passage to the lower pressure enrichener valve chamber. Air in the enrichener air inlet, at atmospheric pressure, also flows into the lower pressure enrichener valve chamber and mixes with the incoming fuel. The resulting air/fuel mixture flows through the air/fuel passage into the carburetor venturi, effectively increasing the amount of fuel delivered to the combustion chambers.



STARTER SYSTEM

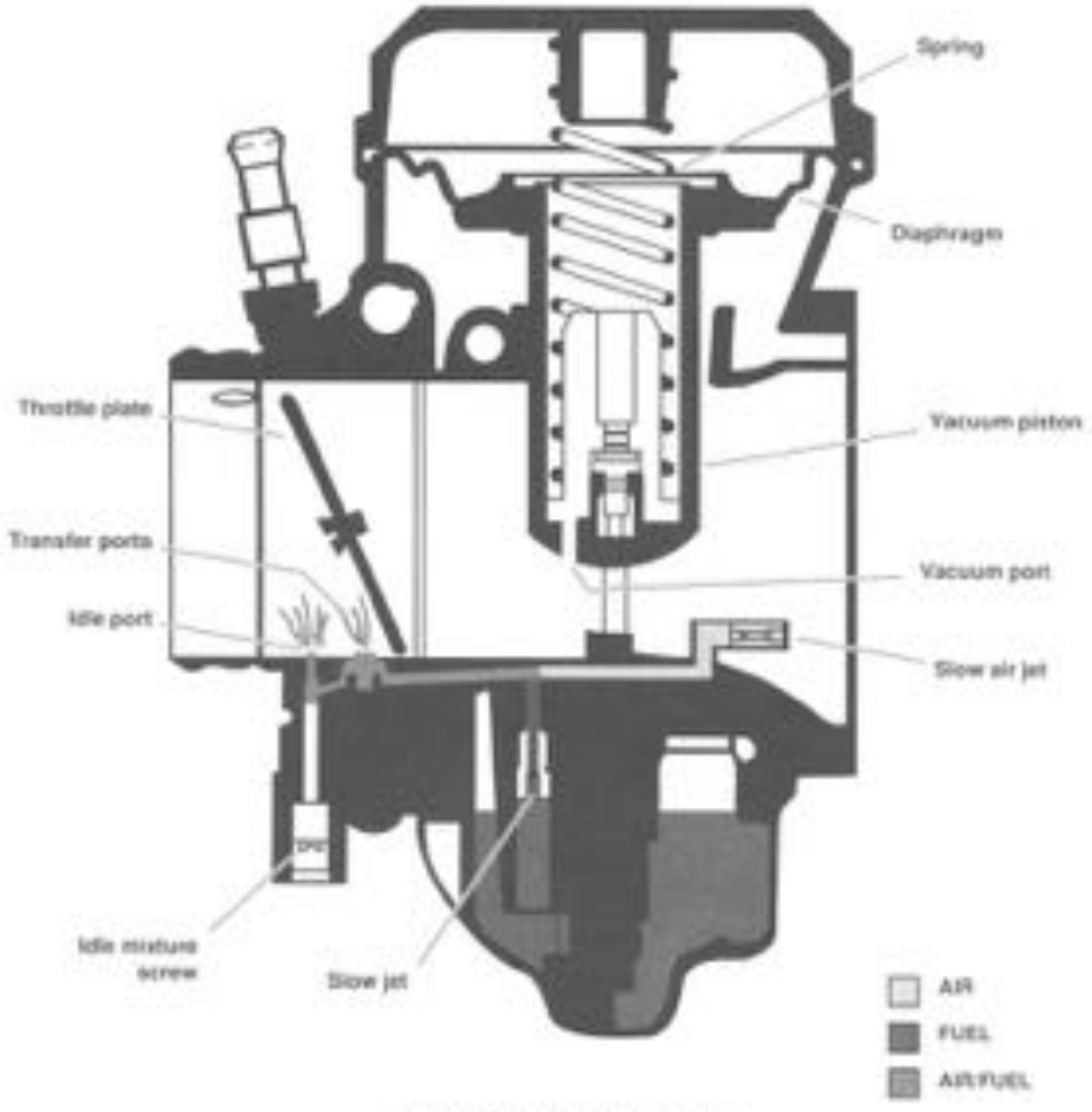
Idle- and Low-Speed Circuit

At idle (with the throttle plate closed and the main air stream obstructed), engine idle speed is maintained by fuel metered through the slow jet. Air from the slow air jet mixes with the fuel and is delivered to the idle port at the low pressure side of the throttle plate.

At low speed (with the throttle plate slightly open), the transfer ports are exposed to the low pressure side of the throttle plate, and additional fuel is directed to the barrel of the carburetor.

During the transition period from idle speed to mid-range, the idle and transfer ports also supply some fuel to the carburetor barrel; this allows for a smoother transition.

The venturi opening is reduced by the low position of the vacuum piston. This enables initial air stream velocities to be higher than normally attainable with fixed-venturi carburetors. The higher air stream velocities provide improved atomization of fuel necessary for good acceleration and driveability.



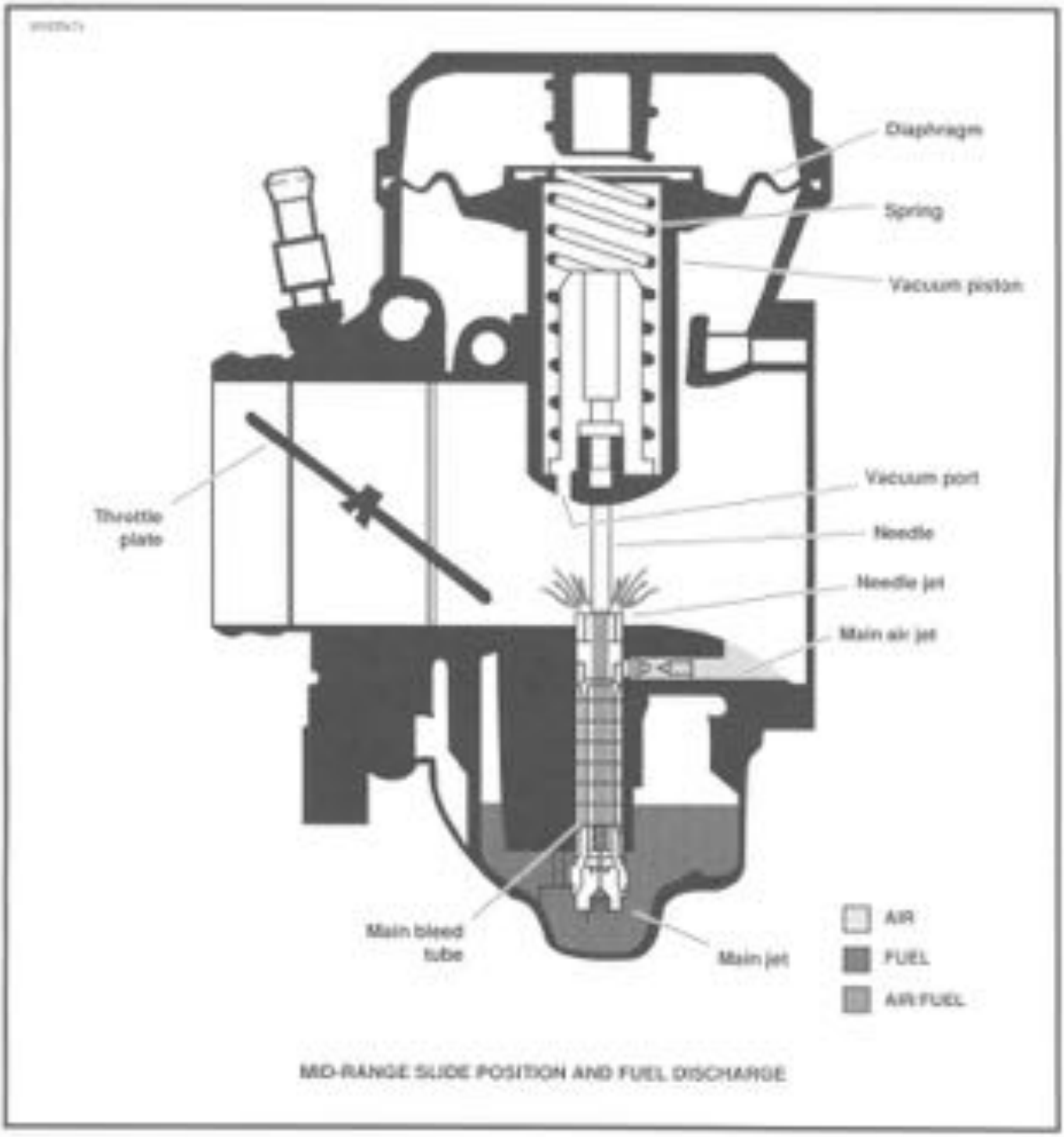
IDLE AND LOW SPEED CIRCUIT

Mid Range Slide Position and Fuel Discharge

As the throttle plate is opened, air flow increases through the carburetor, this causes air pressure to decrease in the carburetor venturi (near the needle jet) and in the chamber above the diaphragm (which is vented to the venturi through a vacuum port and passage in the vacuum piston).

The chamber beneath the diaphragm is vented to higher atmospheric pressure by a passage to the carburetor inlet. The higher air pressure at the underside of the diaphragm overcomes spring pressure and moves the vacuum piston upward in proportion to the pressure difference between the chambers.

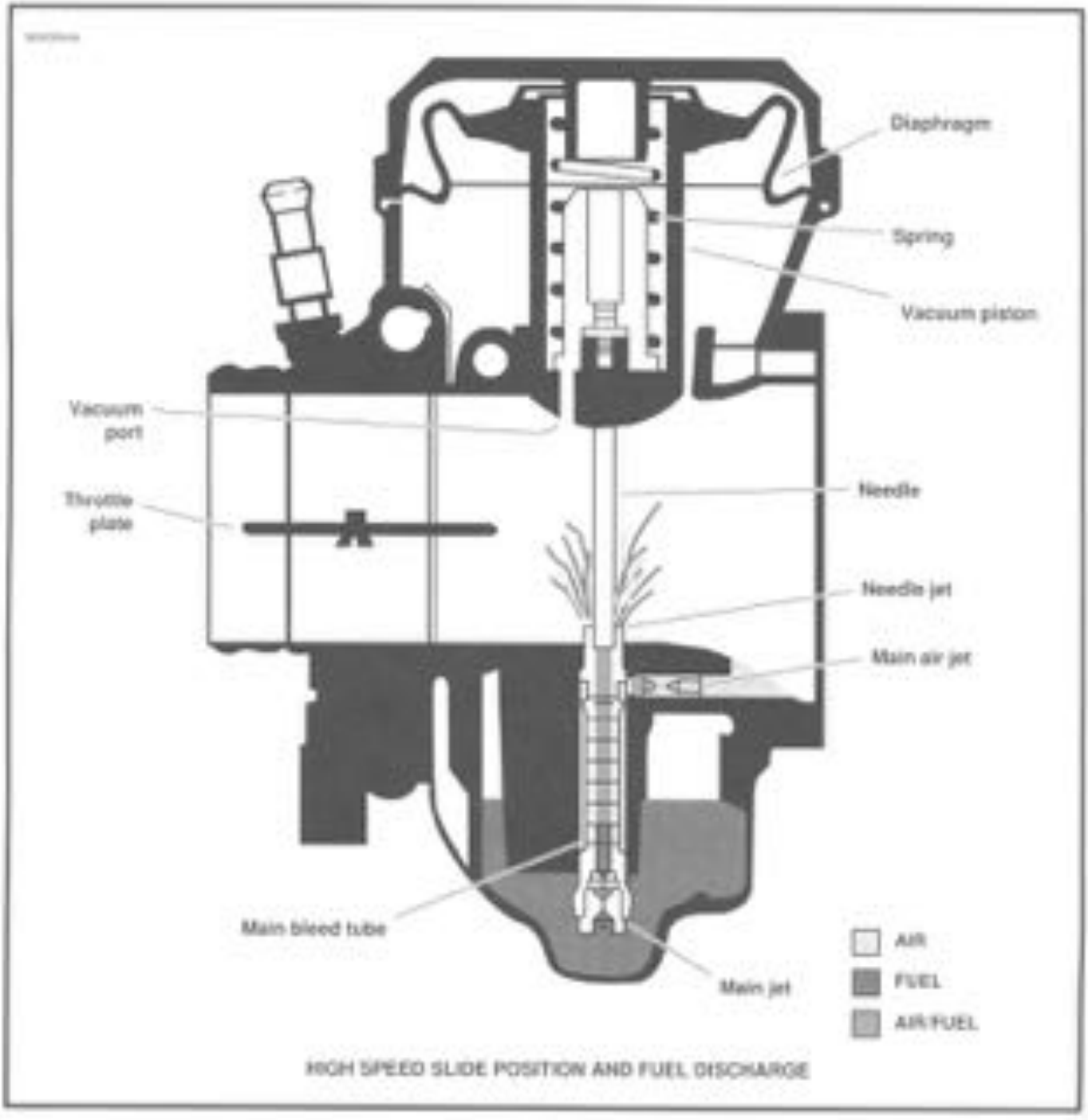
The tapered needle moves upward with the vacuum piston, thereby opening the needle jet. With the needle jet open, the main bleed tube is exposed to the lower pressure of the carburetor venturi. This causes fuel in the float bowl (at atmospheric pressure) to flow through the main jet and into the main bleed tube. Air from the main air jet (at atmospheric pressure) flows through the main bleed tube openings and mixes with the incoming fuel. The air/fuel mixture is then delivered through the needle jet into the main air stream of the venturi.



MID-RANGE SLIDE POSITION AND FUEL DISCHARGE

High-Speed Circuit Slide Position and Fuel Discharge

As the throttle plate is opened, the pressure difference between the chambers above and below the diaphragm increases and the vacuum piston moves further upward. The venturi opening increases and the needle is lifted further out of the needle jet. The quantity of fuel and the volume of air are simultaneously increased and metered to the proportions of engine demand by the variable venturi and needle lift. With the vacuum piston fully upward, the venturi opening is fully enlarged and the needle jet opening exposure to the air stream is at its maximum. Air and fuel supplies are now available in quantities sufficient to meet maximum engine demand.

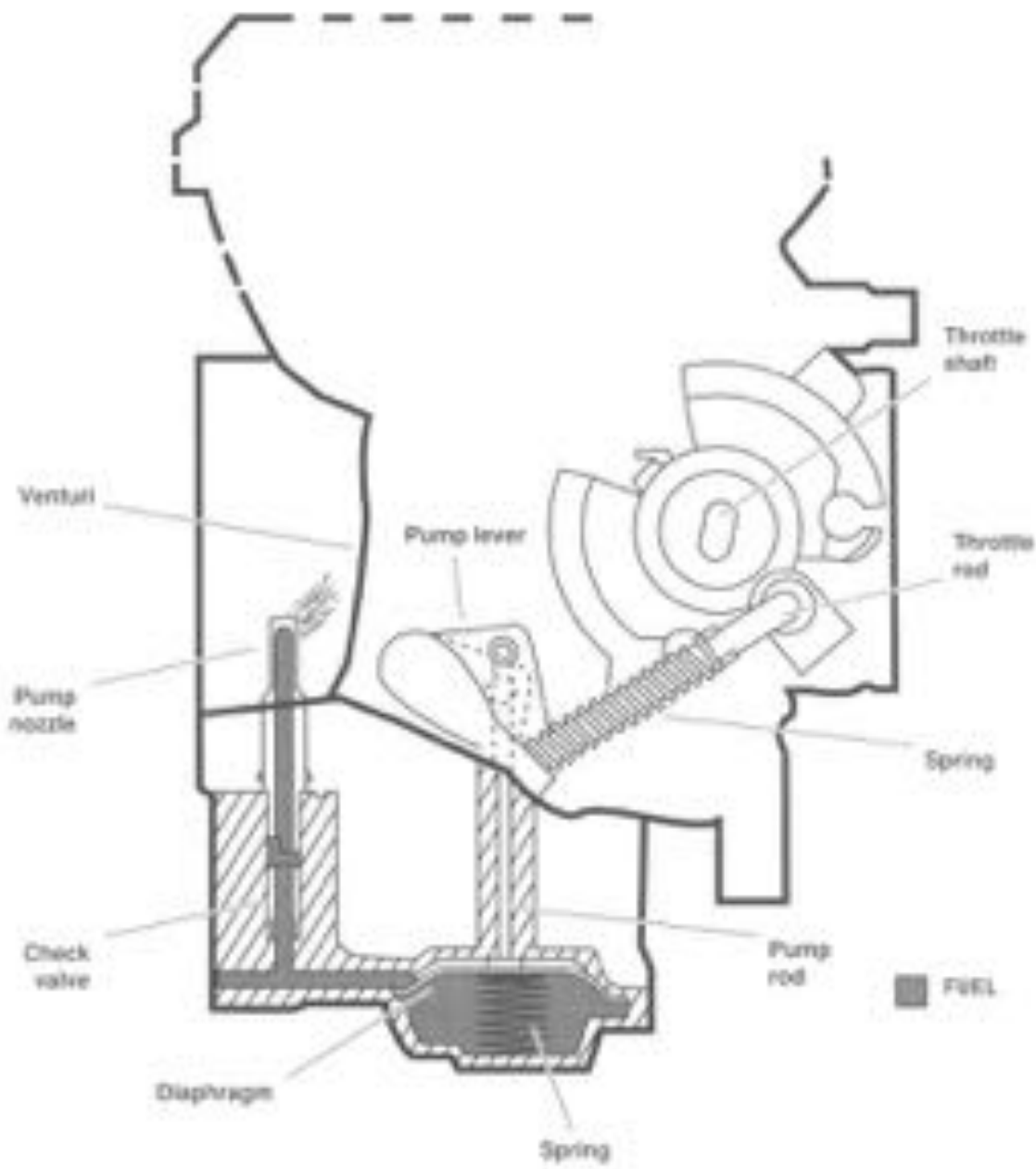


HIGH SPEED SLIDE POSITION AND FUEL DISCHARGE

Accelerator Pump System

The accelerator pump system uses sudden throttle openings (rapid acceleration) to quickly inject fuel into the carburetor venturi; the extra fuel provides for smooth acceleration. This fuel also assists engine operation during cold engine warm-up when the enricherer is turned off prematurely.

Rapid throttle action, during the first third of throttle travel, causes the accelerator pump rod to depress the accelerator pump diaphragm. This forces fuel in the pump to flow through a fuel passage (which has a "one-way" check valve), through the pump nozzle, and then into the venturi. When the throttle closes, the pump rod lifts up and away from the pump diaphragm; a spring below the diaphragm pushes the diaphragm upward, thereby causing the lower pump cavity to refill with fuel from the float bowl. The check valve prevents backflow of fuel from the pump nozzle/fuel passage during this refilling phase.



ACCELERATOR PUMP SYSTEM

ADJUSTMENT

Slow Idle

NOTE

Make certain enrichener knob is pushed in all the way before adjusting engine idle. The CV carburetor enrichener circuit will cause engine idle speed to increase to approximately 2000 rpm with enrichener knob pulled out fully and engine running at normal operating temperature. With enrichener knob pulled out partially, and engine running at normal operating temperature, engine idle speed will also increase above normal idle speed. The increase in idle speed is intended to alert the rider that engine is warmed up, and that enrichener knob should be pushed in all the way. Continued use of enrichener, after engine is at normal operating temperature, may cause fouled spark plugs.

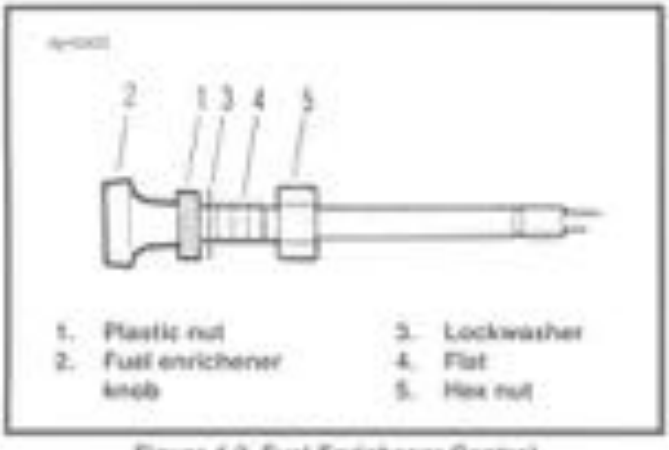
See Figure 4-1. With engine at normal operating temperature and enrichener pushed in all the way (enrichener valve closed), adjust idle speed adjusting screw (4) so engine idles at 950-1050 rpm.

NOTE

Use a test tachometer, connected to negative ignition coil terminal, to measure engine rpm on XLH 883 models.

Enrichener Control (Figure 4-3)

Check fuel enrichener operation. Fuel enrichener knob (2) should open (and remain open) and close without binding. Plastic nut (1), next to the enrichener knob, controls the sliding resistance of the enrichener control cable within the cable conduit. If adjustment is needed, perform the following:



1. Plastic nut
2. Fuel enrichener knob
3. Lockwasher
4. Flat
5. Hex nut

Figure 4-3. Fuel Enrichener Control

1. Loosen hex nut (5) at backside of mounting bracket.
2. Move cable assembly free of slot in mounting bracket.
3. Hold cable assembly at flats (4) with a wrench. Turn plastic nut (1) by hand counterclockwise (reducing sliding resistance) until knob slides inward unaided.
4. Turn plastic nut clockwise (increasing sliding resistance) until knob remains fully open without holding, and closes with relative ease.
5. Position cable assembly into slot in mounting bracket. Tighten hex nut at backside of bracket.

NOTE

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

Float Level (Figure 4-4)

1. Place carburetor on a flat, clean surface on engine manifold side. This is the "base" Tilt carburetor counterclockwise 15° to 20° from base until float comes to rest.

NOTE

If carburetor is tilted less than 15° or more than 20°, your measurements will be inaccurate.

2. Use a vernier or dial caliper depth gauge to measure from the carburetor flange face to the perimeter of the float. Be careful not to push on float while measuring. The measurement must be 0.413-0.453 in. (10.49-11.51 mm). If measurement is not within given dimension, remove float and carefully bend tab in order to reposition float at proper level.
3. Install float, and recheck setting.
4. Install float bowl. Install carburetor as described in CARBURETOR INSTALLATION.

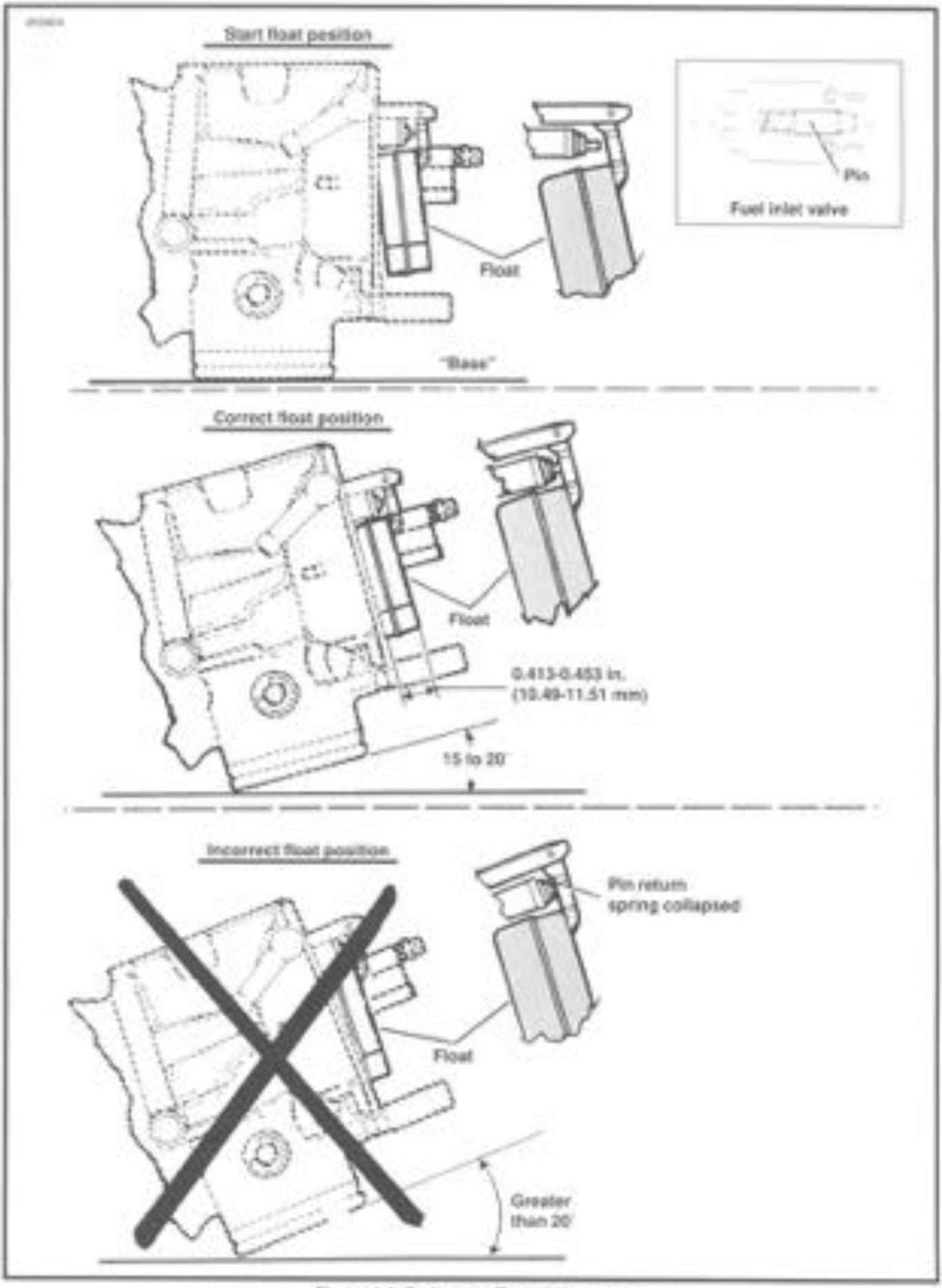


Figure 4-4. Carburetor Float Adjustment

OPERATION CHECK – VACUUM PISTON (Figure 4-5)

Opening Malfunction

⚠WARNING

While observing piston slide movement, be sure to maintain a safe distance from the carburetor and to wear suitable eye protection. An unexpected engine backfire could cause burns or eye injury.

1. With air cleaner cover off and engine running, twist throttle control partially open and closed several times while observing whether or not vacuum piston (4) has upward movement. If piston does not rise, see VACUUM PISTON.
2. With engine not running, lift vacuum piston (4) with finger. Feel whether piston lifts fully and smoothly or whether there is a binding condition.

Closing Malfunction

1. With engine not running, lift vacuum piston (4) to full open position, then release. Observe whether piston slides downward smoothly and fully to stop.
2. Observe position of piston slide at its lowest downward point. Lower edge of slide should rest at horizontal groove at lower end of slide track. See VACUUM PISTON TROUBLESHOOTING if problems are noted.

REMOVAL

⚠WARNING

Gasoline can be extremely flammable and highly explosive. Do not smoke or allow open flame or sparks when refueling or servicing the fuel system. Inadequate safety precautions may result in personal injury and/or property damage.

1. Turn the fuel supply valve to OFF.
2. Remove the air cleaner and backplate. See AIR CLEANER, REMOVAL in this section.

⚠WARNING

A small amount of gasoline may drain from the fuel hose when disconnected from the carburetor. Thoroughly wipe up any spilt fuel immediately and dispose of rags in a suitable manner. Gasoline can be extremely flammable and highly explosive. Inadequate safety precautions may result in personal injury and/or property damage.

3. See Figure 4-6. Disconnect fuel hose (1) and throttle cables (2) from carburetor.
4. See Figure 4-5. Disconnect fuel overflow/drain hose (31) from fuel overflow fitting (except XL-Sport). Disconnect vacuum hose (58) from V.O.E.S. fitting (7). Disconnect enrichener valve assembly (19, 20, 21, 22, and 23).

   On California models only, disconnect canister purge hose from fitting on carburetor body. See EVAPORATIVE EMISSIONS CONTROL – CALIFORNIA MODELS in this section.
5. Remove the fuel tank. See FUEL TANK, REMOVAL in this section.
6. See Figure 4-7. Pull carburetor free of intake manifold (5). If removing intake manifold, remove four manifold mounting screws (4). Remove intake manifold, seal ring (6), mounting flanges (1 and 2) and two intake manifold seals (3).

DISASSEMBLY (Figure 4-5)

Vacuum Piston Chamber

1. Remove screws (26, 25) and bracket (24).
2. Remove three screws and washers (2). Remove cover (1) and spring (3).
3. Lift out vacuum piston (4) with needle (6) and spring seat (5). Remove loose parts from vacuum piston.

Carburetor Body

1. Remove four screws and washers (18). Remove float bowl assembly (38).
2. Remove pin (14), float (15) and fuel inlet valve (13).
3. Back out main jet (11) and needle jet holder (10). Needle jet (9) is free to be removed from bottom end of passage.
4. Insert thin-bladed screwdriver into slow jet passage to remove slow jet (12).

Accelerator Pump

1. Remove three screws (49), lockwashers (48), accelerator pump housing (42), spring (43) and diaphragm (44). Remove O-ring (45) from housing.

CLEANING, INSPECTION AND REPAIR (Figure 4-5)

Vacuum Piston Components

1. Hold vacuum piston up to strong light. Examine diaphragm at top of vacuum piston (4) for evidence of pinching, holes or tears. Replace if damaged.
2. Examine vacuum passage through bottom of piston (4). Clean passage if restricted.
3. Examine spring (3) for stretching, crimping, distortion or damage. Replace if necessary.
4. Examine side on sides of piston (4) to be sure surface is smooth and clean. Clean or buff out any rough surfaces.
5. Examine needle for evidence of bending or damage. Needle should be straight; surface of taper should be smooth and even.

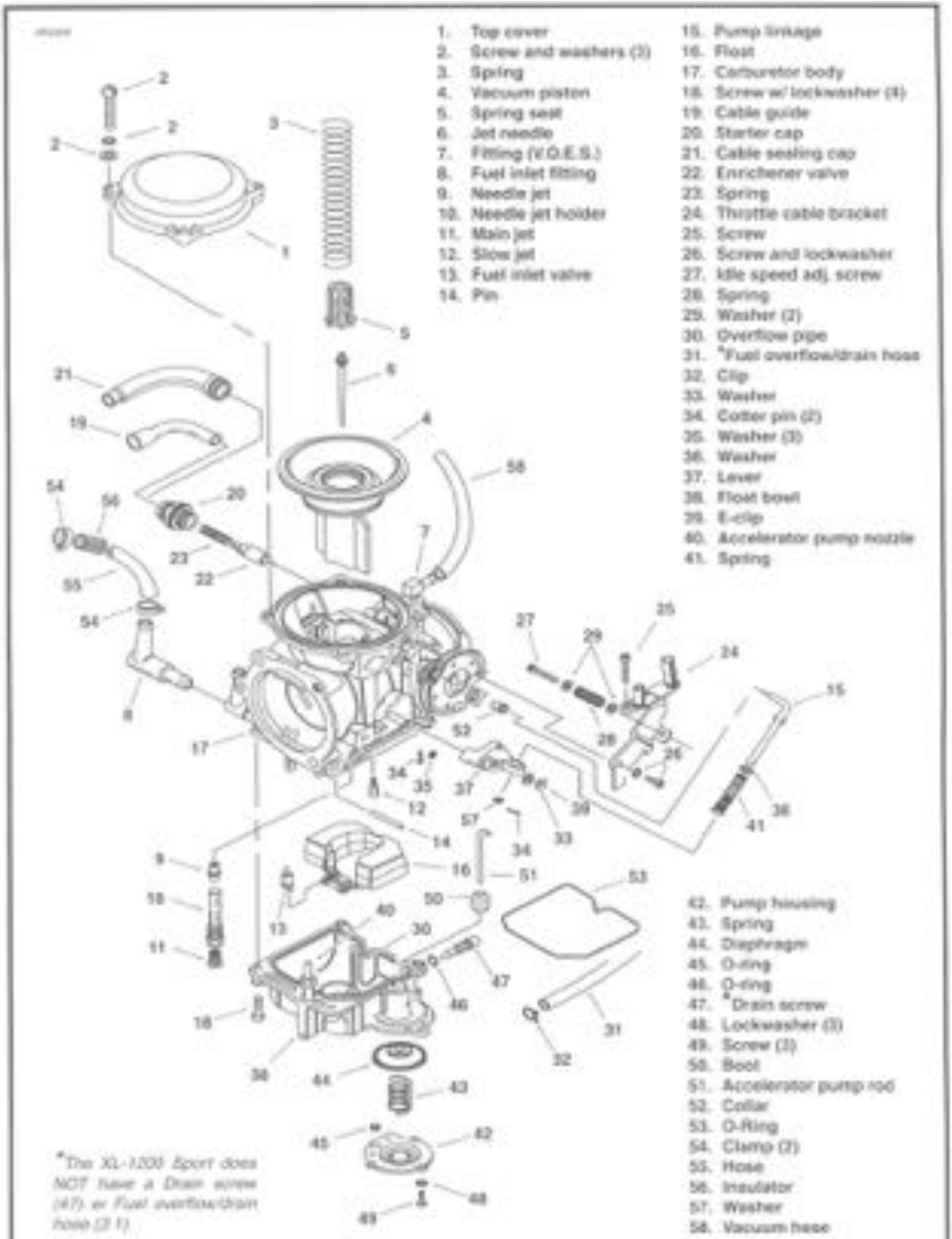
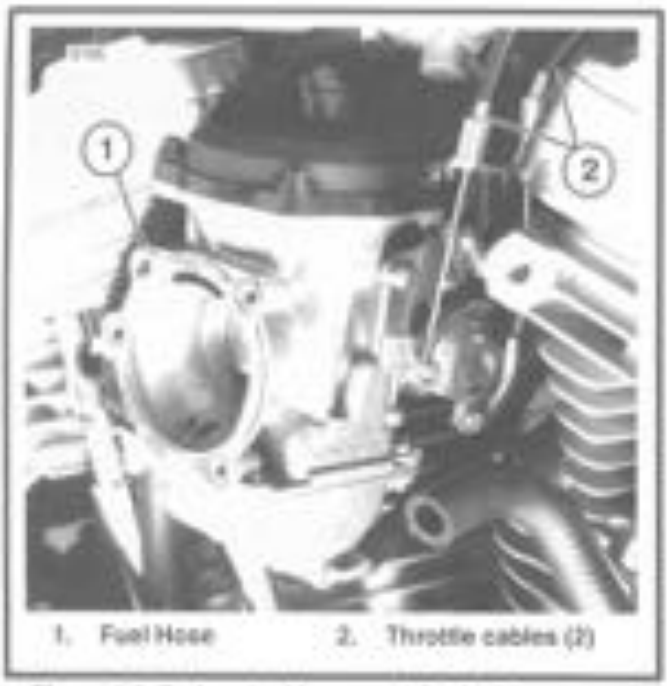
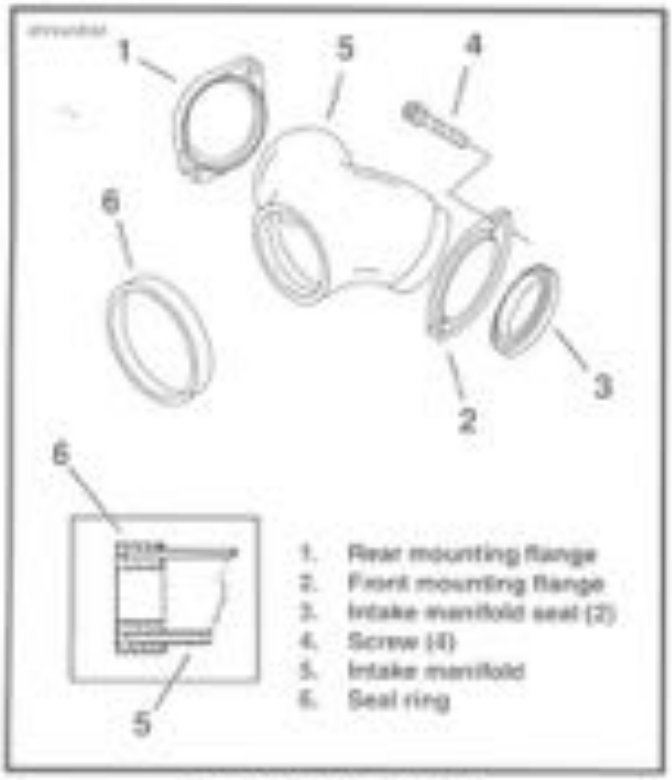


Figure 4-5. Constant-Velocity (CV) Carburetor



1. Fuel Hose
2. Throttle cables (2)

Figure 4-6. Carburetor Hoses and Cable Connections



1. Rear mounting flange
2. Front mounting flange
3. Intake manifold seal (2)
4. Screw (4)
5. Intake manifold
6. Seal ring

Figure 4-7. Intake Manifold

Carburetor Body Components

1. Check float bowl O-ring (53) for any distortion or damage. Replace if sealing surfaces are damaged.
2. Examine fuel inlet valve (13) and inlet valve seat. Clean with carburetor cleaner. Replace if seating surfaces are damaged.
3. Clean slow jet (12) with carburetor cleaner. Check to be sure all orifices are open.
4. Check enrichener valve (22). Be sure needle guide is clean, straight and undamaged. Check composition seating surface for wear or damage. Replace if damaged.
5. Check enrichener valve chamber. Clean with carburetor cleaner. Check that all passages are open and free of obstruction.
6. Clean needle jet (9). Replace if damaged.
7. Clean all internal fuel/air passages and jets. Check that all passages and jets are open and free of obstruction.
8. Check needle jet holder (10). Clean bleed tube orifices. Replace holder if damaged.
9. Check float (16) for cracks or other leaks. Replace if damaged.
10. Clean main jet (11) with carburetor cleaner and inspect for damage. Replace if damaged.

Accelerator Pump

1. Inspect the accelerator pump diaphragm (44) for holes, cracks or deformation. Replace as necessary.
2. Replace the pump rod (51) if it is bent; replace the boot (50) if it is cracked.

ASSEMBLY (Figure 4-5)

Vacuum Piston Chamber

1. Place needle (8) through center hole in vacuum piston (4). Place spring seat (3) over top of needle.
2. Insert vacuum piston into carburetor body. The slides on the piston are off-center and the piston will fit into the slide track grooves one way only. If piston does not fit, rotate 180 degrees.
3. Check to be sure diaphragm is seated evenly into groove at top of carburetor body. Place spring (3) over spring seat (5), and carefully lower top cover (1). Keep spring straight while lowering top cover.
4. After top cover is seated, hold top cover while lifting vacuum piston upward. Piston should raise to top smoothly. If piston movement is restricted, spring is cocked; lift up top cover, then lower carefully, keeping spring coils straight.
5. Once top cover is installed correctly, install screws and washers (2). Place bracket (24) in position with idle screw (27), resting on top of throttle cam stop. Install body screw and washer (26) first, then top screw (25) to prevent bending bracket or throttle cam.

Carburetor Body

⚠CAUTION

Slow jets from fixed-venturi carburetors look the same as the slow jet of the CV carburetor. However, the air bleed hole sizes are different on fixed-venturi carburetors, and they must not be installed on CV carburetors.

1. Thread slow jet (12) into slow jet passage with narrow-bladed screwdriver.

2. Turn carburetor upside down. Place needle jet (9) in main jet passage with needle passing through center hole. Be sure end of jet with larger opening and chamfered surface enters passage first.

3. Insert needle jet holder (10) into main jet passage with needle inserted into center of holder. Thread holder into passage and tighten. Thread and tighten main jet (11) in tapped hole in holder (10).

4. Place float assembly (16) into position with fuel inlet valve (13) inserted into valve seat and with pivot arm aligned with holes in mounting posts (at bottom of carburetor body). Insert pin (14) through float pivot arm and float mounting posts.

5. Check float level setting and adjust if necessary. See CARBURETOR, ADJUSTMENT, FLOAT LEVEL in this section.

6. Place float bowl (36) over float and onto carburetor body flange. Bowl will only fit in one position. Install and tighten screws and washers (18).

Accelerator Pump

Install diaphragm (44), spring (43), O-ring (45) and pump housing (42). Secure with three screws (49) and lockwashers (48).

INSTALLATION

Carburetor

1. See Figure 4-7. Place flanges (1 and 2) onto aluminum manifold (5).

2. Place intake manifold seals (3) onto each spigot of manifold with chamfered edge against flanges (1 and 2).

3. Place channel of seal ring (6) over inlet end of manifold.

4. Position manifold against intake ports of cylinder head, with slotted and round holes in flanges (1 and 2) aligned with holes in cylinder head. Insert screws (4) through manifold flanges and loosely thread into tapped holes in cylinder head.

NOTE

The fit between the carburetor and the seal ring is tight. For ease of installation, lubricate the mating surfaces, carburetor body and seal ring with liquid dish soap or live mounting lube prior to assembly.

5. Lubricate only the inside surface of seal ring (6) that will be in contact with the carburetor. Also apply a light coat of lubricant to the spigot of the carburetor body. Push carburetor body into seal ring (6).

6. Install air cleaner backplate and air cleaner. See AIR CLEANER, INSTALLATION in this section.

7. See Figure 4-7. Final tighten intake manifold screws (4) to 6-10 ft-lbs (8-14 Nm) torque.

8. Install fuel tank. See FUEL TANK, INSTALLATION in this section.

9. On California models only, connect canister purge hose onto fitting on carburetor body. See EVAPORATIVE EMISSIONS CONTROL – CALIFORNIA MODELS in this section.

10. See Figure 4-5. Connect fuel overflow/drain hose (31) to fuel overflow fitting. Connect vacuum hose (58) to V.O.E.S. fitting (7). Connect enrichener valve assembly (19, 20, 21, 22, 23) to carburetor body.

11. See Figure 4-6. Install throttle cables (2) and fuel hose (1) onto carburetor.

Carburetor Fuel Overflow / Drain Hose Routing (Figure 4-5)

On non-California models, route fuel overflow/drain hose (31) from the carburetor fuel overflow fitting downward and forward through the space between the engine front cylinder and the front cylinder push rod covers (intake and exhaust), and then downward through the space between the engine crankcase and the oil filter.

On all California models, route the fuel overflow/drain (vent) hose (31) from the carburetor fuel overflow fitting forward, along the inboard side of the carburetor float bowl (36), to a plastic fitting on the inboard side of the air cleaner backplate. Refer to EVAPORATIVE EMISSIONS CONTROL – CALIFORNIA MODELS and AIR CLEANER, INSTALLATION in this section.

AIR CLEANER

GENERAL

The air cleaner prevents foreign material from entering the carburetor and engine, trapping airborne dust and dirt in the filter element. Service the air cleaner filter element every 5,000 miles (8,000 km), or more often if the motorcycle is run in a dusty environment.

REMOVAL (Figure 4-8)

1. Remove two screws (1) from air cleaner cover (2). Remove cover [and air cleaner trim (8) on XLH 1200 models] from backplate (4).
2. Remove filter element (3) from backplate (4). If filter element is being removed for cleaning only, proceed to CLEANING, INSPECTION, AND REPAIR.
3. Remove two cylinder head screws (5) from backplate.

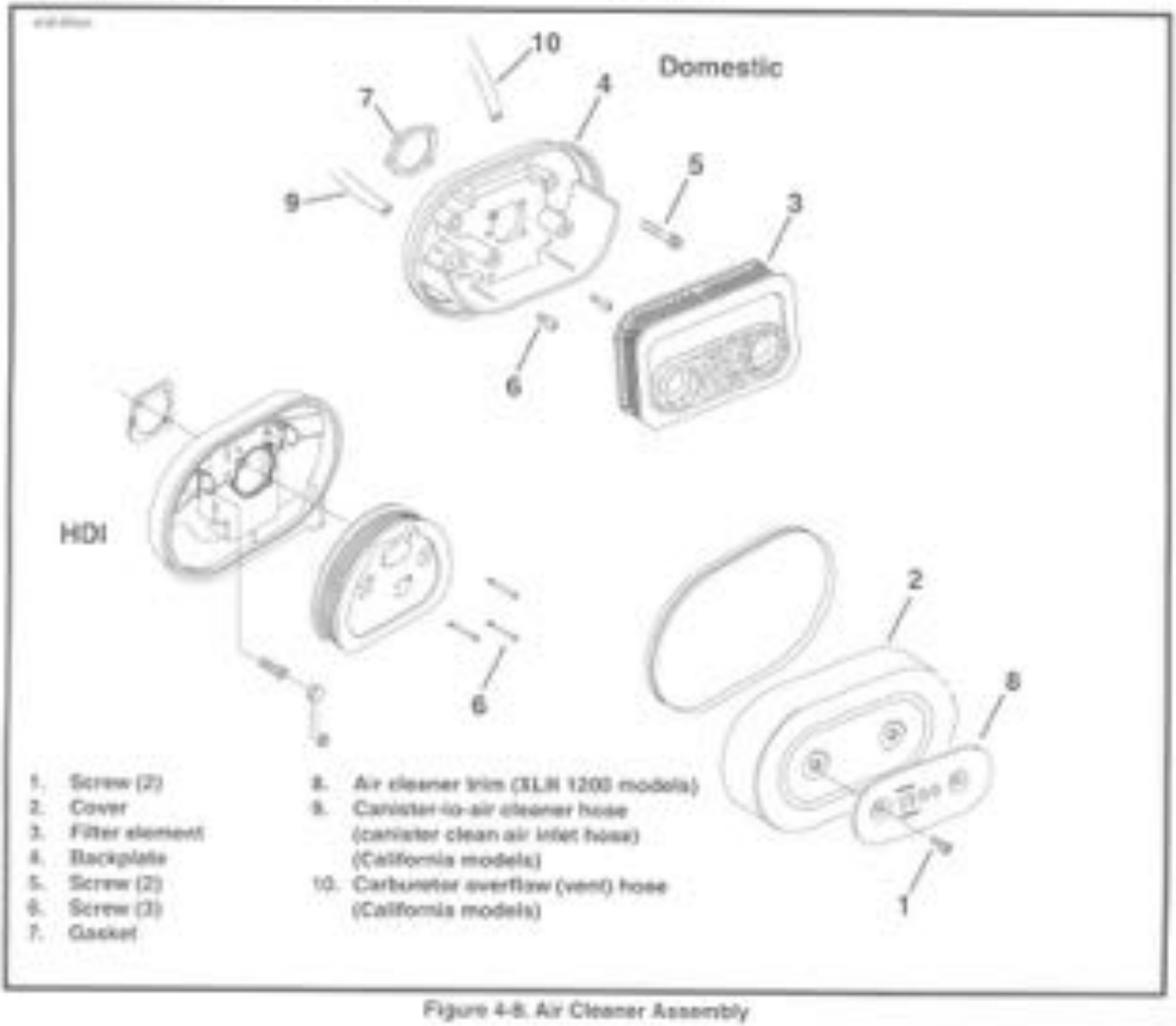
⚠CAUTION

To prevent damage to backplate during removal of captive screws (6), do not allow threads of screws to engage threads of backplate insert sleeves.

4. Alternately loosen each of three captive screws (6) a couple of turns while pulling backplate away from carburetor. Repeat this loosening procedure until all screws disengage from threaded holes in carburetor. Lift backplate (with screws) away from carburetor.

NOTE

Remove captive screws (6) from original backplate only if backplate is damaged and is to be replaced by a new backplate.



1. Screw (2)
2. Cover
3. Filter element
4. Backplate
5. Screw (2)
6. Screw (3)
7. Gasket
8. Air cleaner trim (XLH 1200 models)
9. Canister-to-air cleaner hose (canister clean air inlet hose) (California models)
10. Carburetor overflow (vent) hose (California models)

Figure 4-8. Air Cleaner Assembly

5. On California models, disconnect clean air inlet hose (9) and carburetor overflow (vent) hose (10) from backplate assembly (4). Disconnect solenoid wiring at 4-pin connector.

6. Remove backplate (4) and gasket (7).

CLEANING, INSPECTION AND REPAIR (Figure 4-8)

1. Remove filter element (3) from backplate (4).

⚠CAUTION

Do not run engine with air cleaner filter element removed. Engine damage may result.

2. Thoroughly clean backplate (4) and inside of cover (2).

3. Replace filter element (3) if damaged or if filter media cannot be adequately cleaned.

⚠WARNING

Do not use gasoline or solvents to clean the filter element. Volatile / flammable cleaning agents may cause an intake system fire, which can result in personal injury and vehicle damage.

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

5. Dry the filter element using low-pressure (32 psi/221 kPa maximum) compressed air. Rotate element while moving air nozzle up and down the element interior. Do not rap the element on a hard surface.

6. Hold filter element up to strong light source. The element can be considered sufficiently clean if light is uniformly visible through the element.

INSTALLATION (Figure 4-8)

⚠CAUTION

If installing a new backplate (4), thread captive screws (6) all the way into backplate prior to installation. This will reduce the possibility of cross-threading the screws into the carburetor.

1. On California models, connect butterfly valve solenoid wiring (11) at 4-pin connector. Connect carburetor overflow (vent) hose (10), and clean air inlet hose (9) to backplate assembly (4).

2. Position gasket (7) and backplate (4) at carburetor air inlet. Start each captive screw (6) into threaded holes of carburetor. Alternately tighten each screw a couple of turns until backplate is drawn to a loose fit at carburetor mounting surface.

3. Loosely install screws (5) through backplate (4) into cylinder heads.

4. Tighten three captive screws (6) to 3-5 ft-lbs (4-7 Nm) torque. On HD6 model torque to 20 **in-lbs** (2.26 Nm).

5. Tighten two cylinder head screws (5) to 10-20 ft-lbs (14-27 Nm) torque.

6. Service the air cleaner filter element, if necessary. See CLEANING, INSPECTION AND REPAIR.

7. Install air cleaner filter element (3) onto backplate (4). The words "This Side Out" should be readable on the upper edge of the filter element when installed.

8. Fit air cleaner cover (2) onto backplate (4) and install screws (1) [with air cleaner tool (8) on 3LH 1200 models]. Tighten screws to 3-5 ft-lbs (4-7 Nm) torque.

FUEL SUPPLY VALVE

GENERAL (Figure 4-9)

The fuel supply valve is located on the left side, below the fuel tank. The gasoline supply to the carburetor is shut off when the handle is in the horizontal position. For gasoline main supply, turn the handle clockwise until it stops in the vertical position. For gasoline reserve supply, turn the handle counterclockwise until it stops in the vertical position. Valve should always be in the OFF position when engine is not running.

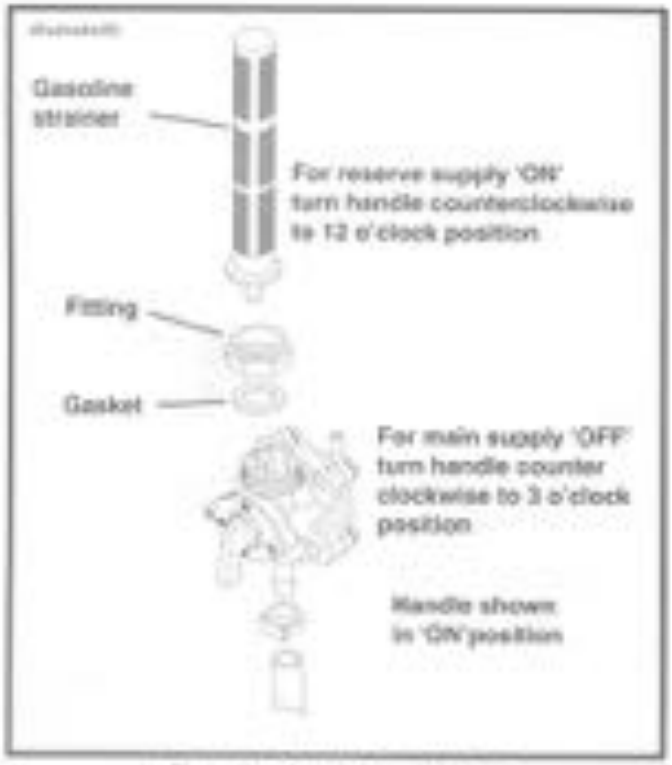


Figure 4-9. Fuel Supply Valve

REMOVAL (Figure 4-9)

⚠WARNING

Gasoline can be extremely flammable and highly explosive. Do not smoke or allow open flame or sparks when refueling or servicing the fuel system. Inadequate safety precautions may result in personal injury and/or property damage.

1. Turn the fuel supply valve to OFF.

⚠WARNING

A small amount of gasoline may drain from the fuel hose when disconnected from the carburetor. Thoroughly wipe up any spilt fuel immediately and dispose of rags in a suitable manner. Gasoline can be extremely flammable and highly explosive. Inadequate safety precautions may result in personal injury and/or property damage.

2. Remove fuel hose from carburetor.
3. Place end of fuel hose into a proper, clean container of adequate size.
4. Turn supply valve to reserve (RES). Drain gasoline from tank into container.

⚠WARNING

Even with the fuel tank completely drained, a small amount of gasoline may leak from the bore when the fuel supply valve is loosened or removed. Thoroughly wipe up any spilt fuel immediately and dispose of rags in a suitable manner. Gasoline can be extremely flammable and highly explosive. Inadequate safety precautions may result in personal injury and/or property damage.

5. Turn fitting and remove fuel supply valve assembly.

CLEANING, INSPECTION, AND REPAIR (Figure 4-9)

1. Clean or replace filter strainer (located inside fuel tank above fuel supply valve).
2. Flush fuel tank to remove all dirt.

INSTALLATION (Figure 4-9)

1. Coat supply valve threads with Loctite Pipe Sealant with Teflon and securely install fitting onto fuel tank.
2. Connect fuel hose to carburetor.

FUEL TANK

GENERAL

See Figure 4-10. The fuel tank is a one-piece welded tank. Although the tank interior is treated to resist rusting, further protection is required if the motorcycle is to be placed in storage. Drain the tank completely and apply a one-to-one oil/fuel mixture (or a commercially available fuel tank rust preventative) to the tank interior.

NOTE

Turn the filler cap until at least three clicks are heard in order to verify that it is securely fastened to the tank.

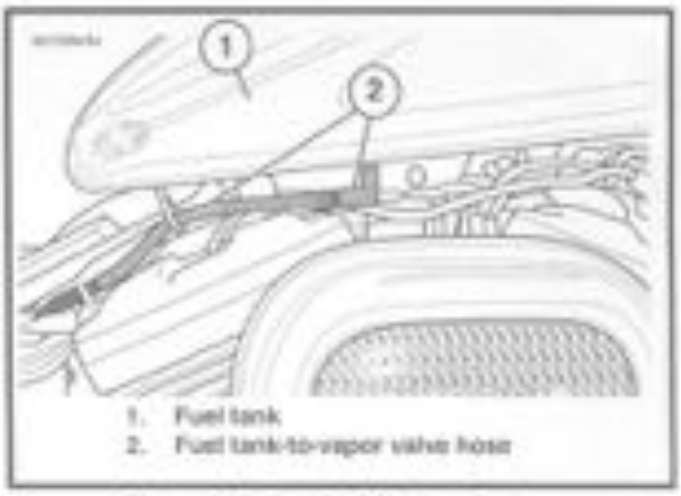
To reduce the level of vibration transmitted to the fuel tank through the vehicle frame, the tank is isolated by rubber grommets (8) at its front and rear mounting points.

See Figure 4-11. The fuel tank (1) is vented through a standpipe (vent tube) within the tank. A hose (2) at the base of the fuel tank is connected to the standpipe.

⚠WARNING

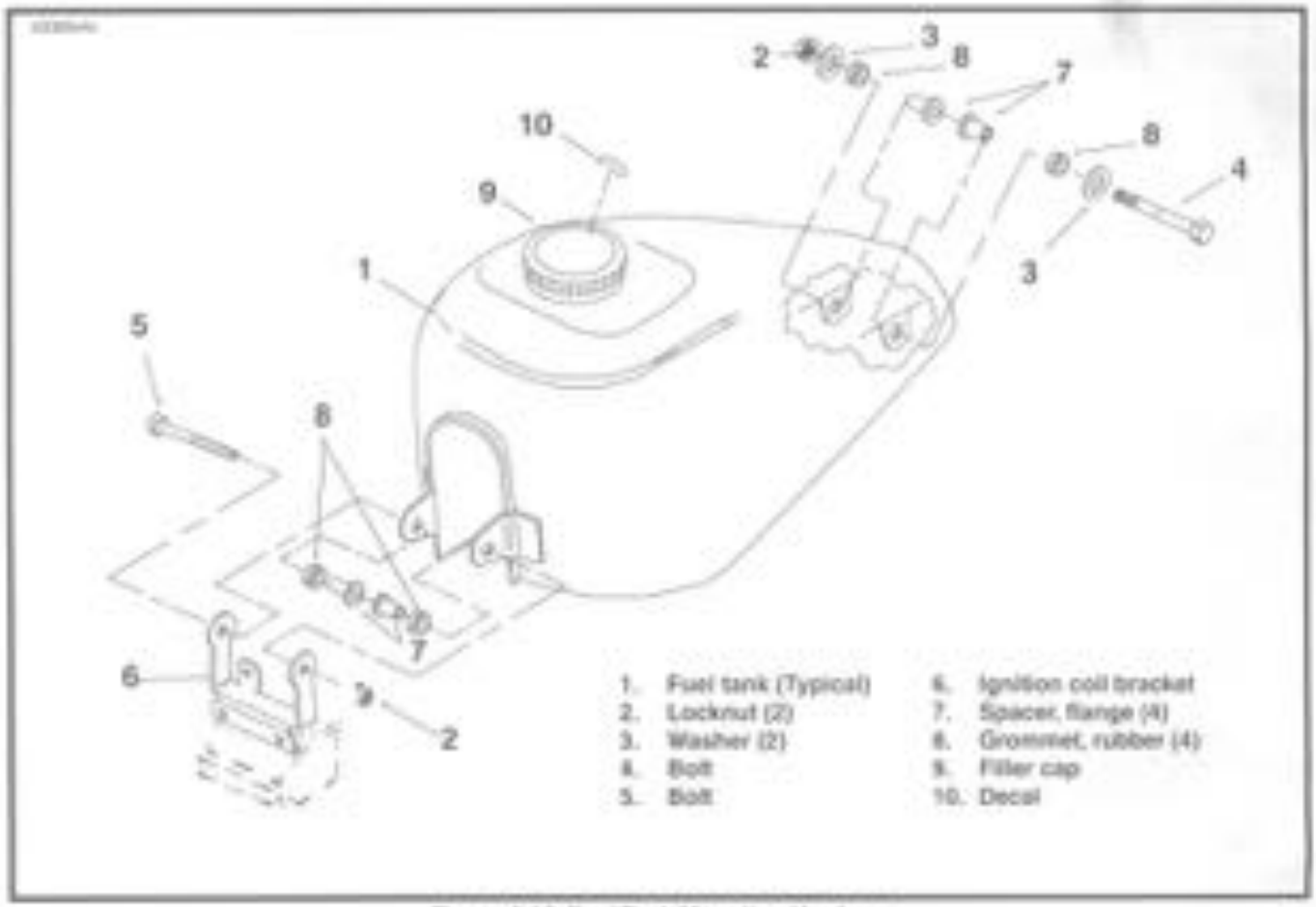
Verify that the fuel tank vapor hoses do not contact hot exhaust or engine parts. The hoses contain flammable vapors that can be ignited if damaged, thereby resulting in personal injury and/or vehicle damage.

See Figure 4-12. The fuel tank vapor hose is connected to a vapor valve (3) located beneath the seat between the oil tank and the battery tray. On non-California models, another hose (4) connects the vapor valve bottom fitting to a hollow frame member (5). On California models, the bottom hose is routed to the carbon canister (See EVAPORATIVE EMISSIONS CONTROL–CALIFORNIA MODELS).



1. Fuel tank
2. Fuel tank-to-vapor valve hose

Figure 4-11. Fuel Tank Venting System (Right Side View with Seat Removed)



1. Fuel tank (Typical)
2. Locknut (2)
3. Washer (2)
4. Bolt
5. Bolt
6. Ignition coil bracket
7. Spacer, flange (4)
8. Grommet, rubber (4)
9. Filler cap
10. Decal

Figure 4-10. Fuel Tank Mounting Hardware

CAUTION

See Figure 4-13. Mount the vapor valve (1) in an upright position with the longer fitting positioned at the top or excessive fuel vapor pressure may build up within the fuel tank.

REMOVAL

WARNING

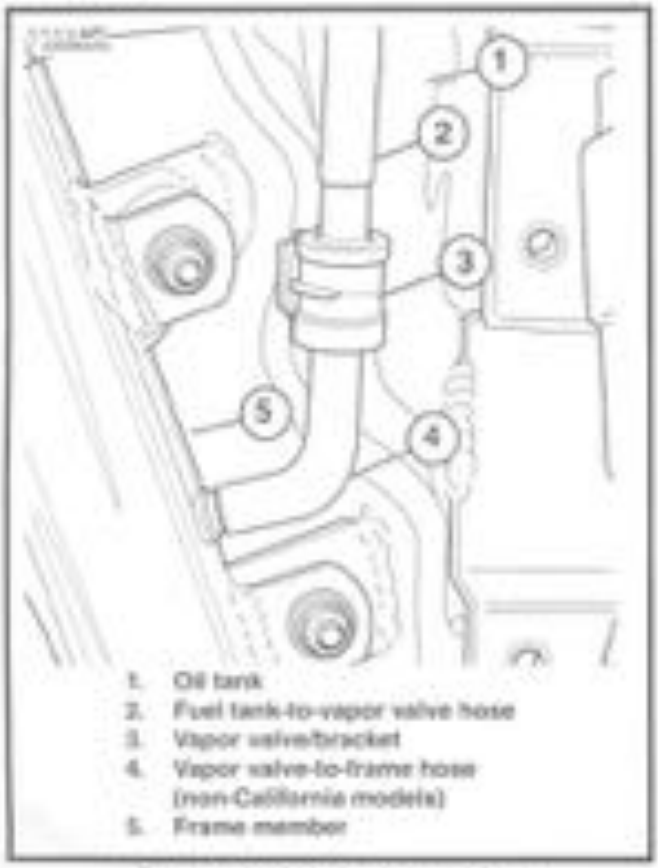
Gasoline can be extremely flammable and highly explosive. Do not smoke or allow open flame or sparks when refueling or servicing the fuel system. Inadequate safety precautions may result in personal injury and/or property damage.

1. See Figure 4-9. Turn fuel supply valve to OFF.

WARNING

A small amount of gasoline may drain from the fuel hose when disconnected from the carburetor. Thoroughly wipe up any spilt fuel immediately and dispose of rags in a suitable manner. Gasoline can be extremely flammable and highly explosive. Inadequate safety precautions may result in personal injury and/or property damage.

2. Remove fuel supply hose from carburetor fitting. Place free end of fuel hose into a suitable, clean container. Turn supply valve to "RESERVE." Drain gasoline from tank.
3. See Figure 4-10. Remove mounting hardware from front and rear of fuel tank.
4. See Figure 4-11. Disconnect fuel tank-to-vapor valve hose (2) from fitting at base of fuel tank. Lift fuel tank off motorcycle.



1. Oil tank
2. Fuel tank-to-vapor valve hose
3. Vapor valve/bracket
4. Vapor valve-to-frame hose (non-California models)
5. Frame member

Figure 4-12. Vapor Valve Assembly

WARNING

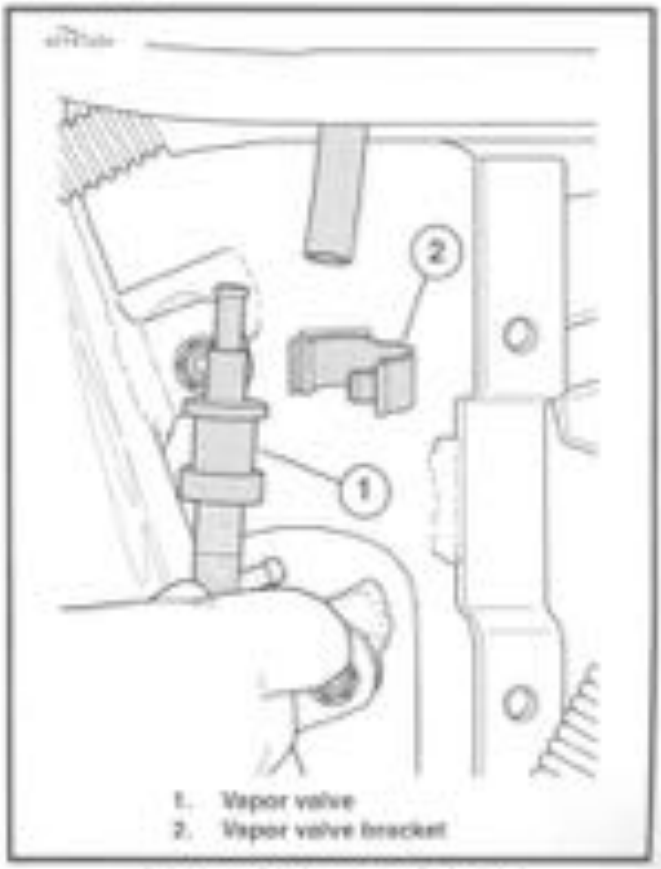
Even with the fuel tank completely drained, a small amount of gasoline may leak from the bore when the fuel supply valve is loosened or removed. Thoroughly wipe up any spilt fuel immediately and dispose of rags in a suitable manner. Gasoline can be extremely flammable and highly explosive. Inadequate safety precautions may result in personal injury and/or property damage.

5. See Figure 4-9. If the fuel supply valve requires cleaning or repair, turn the valve fitting counter-clockwise to remove it from the fuel tank.

CLEANING, INSPECTION AND REPAIR

WARNING

- An open flame or spark may cause a fuel tank explosion if all traces of fuel are not purged from the tank. Use extreme caution when servicing fuel tanks. Inadequate safety precautions may result in personal injury and/or property damage.
- To assist in loosening deposits, use only non-ferrous metal balls (such as lead pellets) with fuel tank cleaning solutions. The use of ferrous materials may cause a spark, which can then ignite fuel vapors inside the tank. The resulting flames or explosion could cause serious personal injury and/or property damage.



1. Vapor valve
2. Vapor valve bracket

Figure 4-13. Vapor Valve Mounting

Clean the tank interior with commercial cleaning solvent or a soap and water solution. Plug fuel tank openings. Shake the tank to agitate the cleaning agent. If necessary, non-ferrous metallic balls or pellets may be added to the tank to help loosen deposits. Thoroughly flush the fuel tank after cleaning. Allow tank to air dry. Carefully inspect fuel line for damage, wear or general deterioration. Replace as necessary.

INSTALLATION

1. If removed, install fuel supply valve onto fuel tank. See FUEL SUPPLY VALVE, INSTALLATION.

⚠CAUTION

Be sure that wiring harness does not get pinched between fuel tank and frame during tank installation.

2. See Figure 4-11. Install fuel tank to vapor valve hose (2) onto fitting at base of fuel tank (1). Position fuel tank on motorcycle.
3. See Figure 4-10. Install front and rear mounting hardware. Tighten fasteners to 8-15 ft-lbs (11-22 Nm) torque.

NOTE

On XLH 883, position horn so that it does not contact ignition coil bracket or frame.

4. Connect fuel supply hose to carburetor using a **new** clamp.
5. Fill the fuel tank with fuel supply valve turned OFF.
6. Open the fuel supply valve and carefully inspect for leaks. Turn the valve OFF after the inspection is performed.

EVAPORATIVE EMISSIONS CONTROL CALIFORNIA MODELS

GENERAL (Figure 4-14)

Harley-Davidson motorcycles sold in the state of California are equipped with an evaporative (EVAP) emissions control system. The EVAP system prevents fuel hydrocarbon vapors from escaping into the atmosphere and is designed to meet the California Air Resource Board (CARB) regulations in effect at the time of manufacture.

The EVAP functions in the following manner:

- Hydrocarbon vapors in the fuel tank are directed through the vapor valve and stored in the charcoal canister. If the vehicle is tipped at an abnormal angle, the vapor valve closes to prevent liquid gasoline from leaking out of the fuel tank through the vent hose.
- When the engine is not running and the ignition/light switch is OFF, the air cleaner's solenoid-operated butterfly valve is closed to seal the inlet port of the air cleaner backplate. This prevents hydrocarbon vapors emanating from the carburetor throat and from the float bowl overflow (vent) hose from escaping into the atmosphere.
- When the ignition/light switch is ON, the hold-in winding of the air cleaner butterfly valve solenoid is energized with 12 volts DC current. The solenoid will open the butterfly valve when the pull-in winding is energized with 12 volts DC from the start switch. The hold-in winding keeps the butterfly valve open until the ignition/light switch is turned OFF.
- When the engine is running, carburetor venturi negative pressure (vacuum) slowly draws off the hydrocarbon vapors from the carbon canister through the canister-to-carburetor purge hose. These vapors pass through the carburetor and are burned as part of normal combustion in the engine. The large diameter canister-to-air cleaner hose (canister clean air inlet hose) supplies the canister with fresh air from the air cleaner.

⚠WARNING

Verify that the evaporative emissions vent hoses do not contact hot exhaust or engine parts. The hoses contain flammable vapors that can be ignited if damaged, thereby resulting in personal injury and/or vehicle damage.

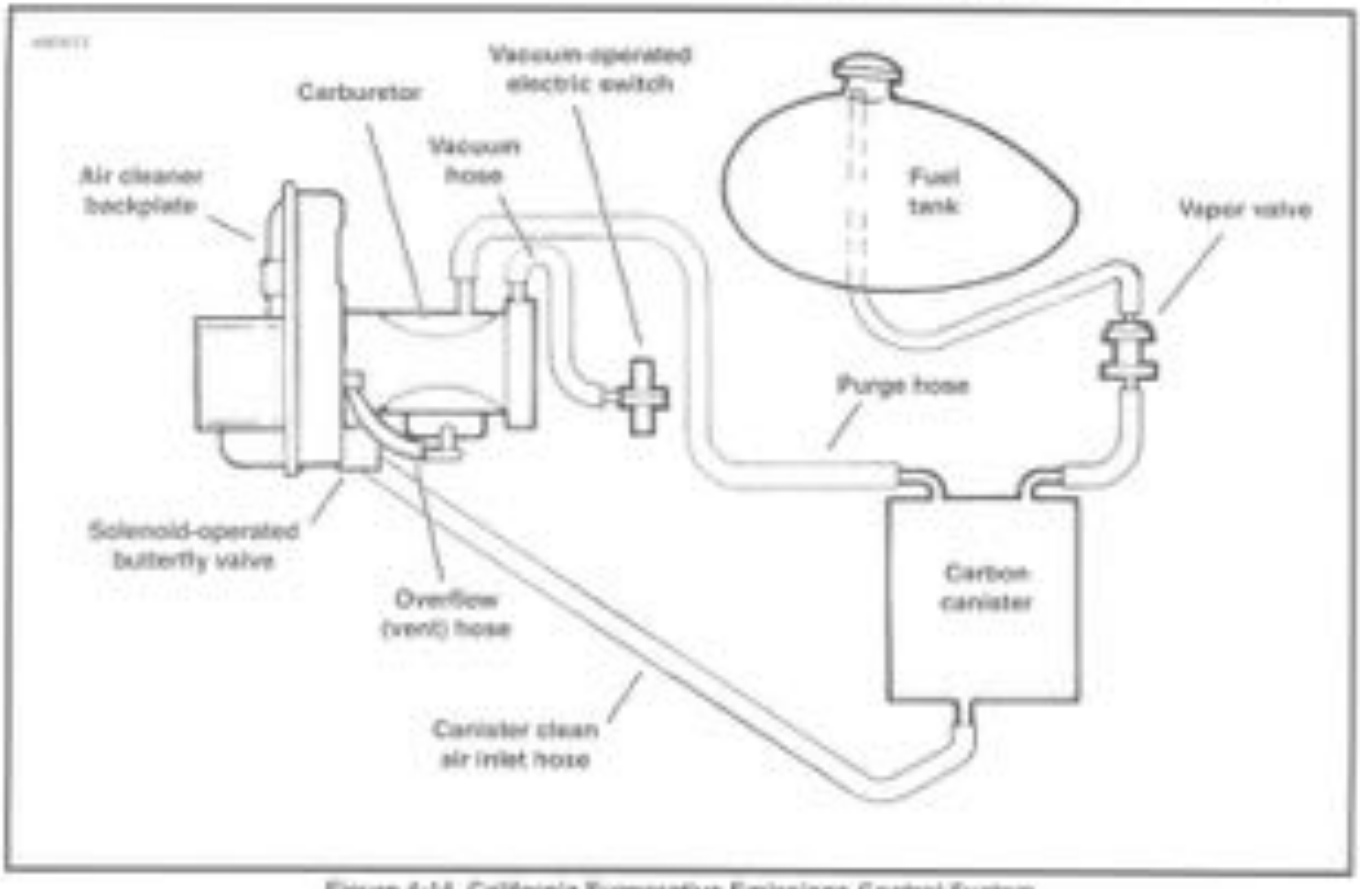


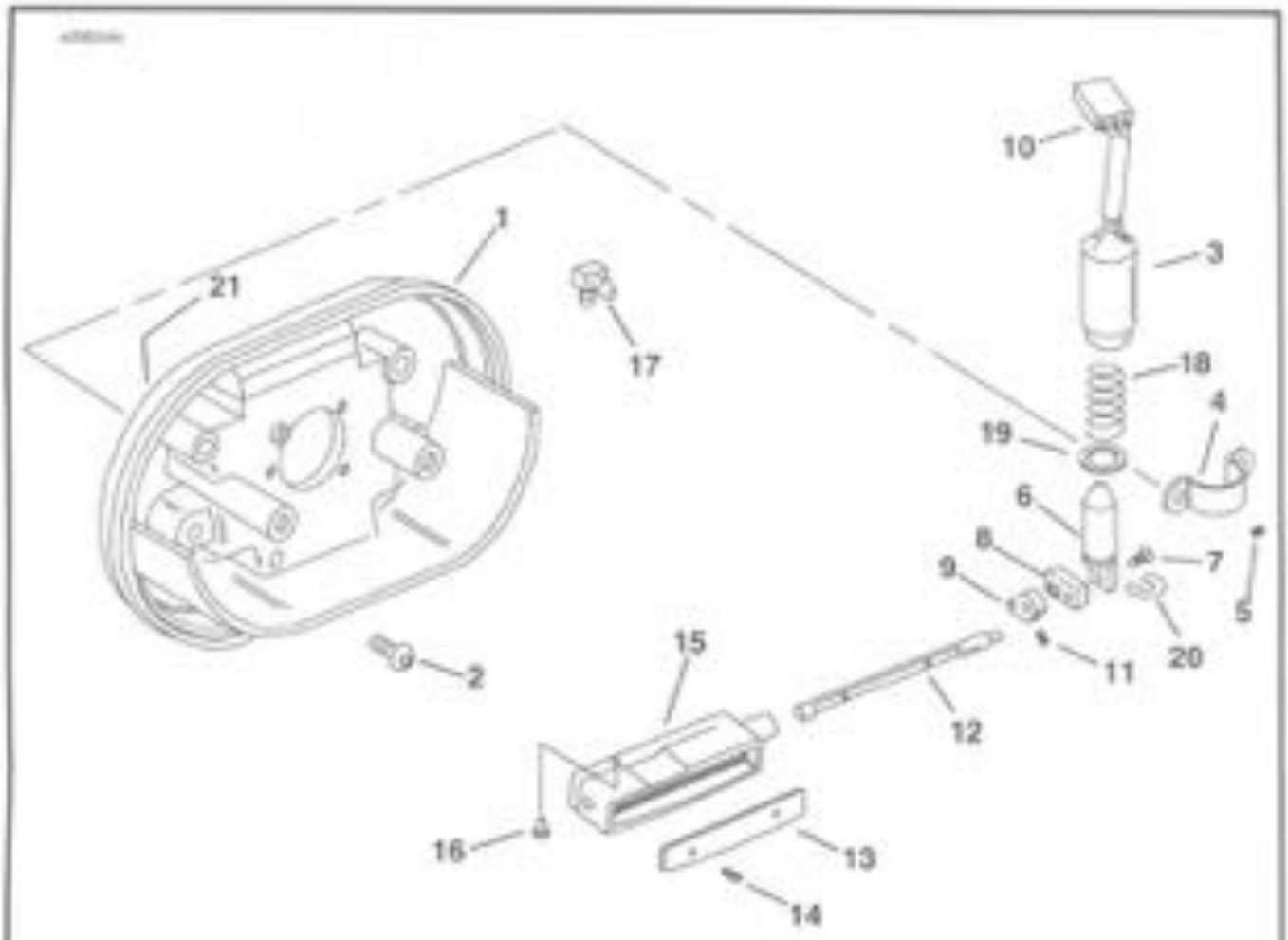
Figure 4-14. California Evaporative Emissions Control System

TROUBLESHOOTING

The EVAP system has been designed to operate with a minimum of maintenance. Check that all hoses are properly connected, are not pinched or kinked, and are routed properly. The solenoid troubleshooting procedure is shown in the following chart.

Troubleshooting Solenoid-Operated Butterfly Valve

Problem	Cause	Solution
1. Motorcycle acceleration is sluggish and top speed is approximately 40 mph (64 km/h).	1.1. Butterfly valve is not opening due to electrical malfunction.	1.1.1 See Figure 4-15. Check that connector (10) is connected. If unplugged, connect and check for proper operation by starting engine. If butterfly valve is still inoperative, proceed to 1.1.2.
		1.1.2 Perform the SOLENOID ELECTRICAL TESTS which follow this troubleshooting chart.
	1.2. Rider started engine without using starter by coasting downhill and engaging clutch with transmission in gear (Bump starting.)	1.2.1 Instruct rider to use starter or press start button momentarily with ignition switch ON before starting in the manner described in 1.2. Explain that the start switch input to the starter relay is also required to energize the pull-in winding and open the butterfly valve. **⚠WARNING** **Do not bump start with transmission in 1st gear or rear wheel may skid. Do not use more than 1/4 throttle or motorcycle may lurch forward. Both conditions can cause loss of vehicle control resulting in personal injury and/or property damage.**
	1.3. Butterfly valve is not opening or closing because mechanical linkage connecting butterfly valve to solenoid plunger is broken or missing. A broken solenoid spring (Item 18, Figure 4-13) will prevent butterfly valve closure.	1.3.1 See Figure 4-15. Check that all linkage parts are properly assembled and functioning. A broken solenoid spring will require replacing the solenoid. See REMOVAL and INSTALLATION AND ADJUSTMENT, BUTTERFLY VALVE SOLENOID.



1. Backplate (carburetor side)
2. Screw (2)
3. Solenoid assembly
4. Clamp
5. Set screw
6. Plunger
7. Screw
8. Link (plastic)
9. Lever arm
10. Connector
11. Set screw
12. Shaft
13. Butterfly plate
14. Screw (2)
15. Housing
16. Rivet (2)
17. Fitting, overflow (vent) hose
18. Spring
19. Plastic washer
20. E-clip
21. Nipple, canister clean air inlet hose

Figure 4-15. Air Cleaner Backplate – California Models

SOLENOID ELECTRICAL TESTS – AIR CLEANER BUTTERFLY VALVE

See Figure 4-16. Fabricate the solenoid test harness as shown. The harness allows the following tests to performed without removing the air cleaner backplate.

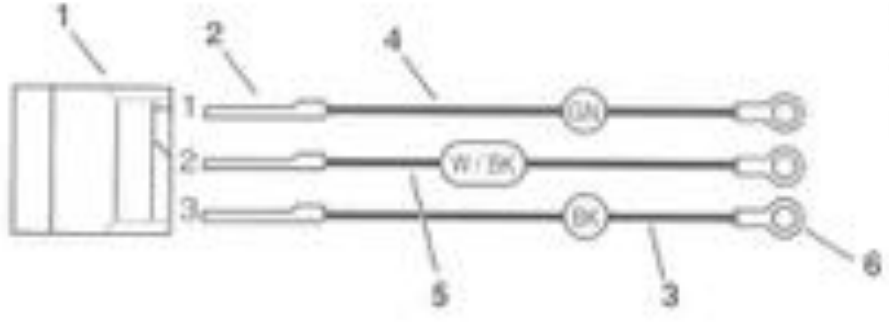
Winding Resistance Test

1. See Figure 4-15. Unplug 3-place connector (10) from solenoid.
2. See Figure 4-17. Connect the test harness to the solenoid as shown.
3. Use an ohmmeter to measure the resistance of the pull-in and hold-in windings. See the following table for probe placement instructions and resistance specifications.

Solenoid Winding Resistance Specifications

TEST	POSITIVE PROBE	NEGATIVE PROBE	WINDING RESISTANCE
Pull-in	Green	Black	4-6 Ohms
Hold-in	White/Black	Black	21-27 Ohms

4. If the resistance measurements are not within specification, the solenoid must be replaced. Refer to REMOVAL and INSTALLATION AND ADJUSTMENT, BUTTERFLY VALVE SOLENOID.
5. If winding resistance measurements are within specification, perform the following PULL-IN COIL TEST.



NOTE

The ring terminals (6) will ensure good connections for test probes. Blade or spade terminals may also be used.

1. Pin housing, Part No. 73103-96BK
2. Pin terminal (4), Part No. 73190-96
3. Black (BK) 18 gauge wire, 6 in. (152 mm) long
4. Green (GN), 18 gauge wire, 6 in. (152 mm) long
5. White/Black stripe, 18 gauge wire, 6 in. (152 mm) long
6. Ring terminal, Part No. 9858 or similar (4)

TEST HARNESS

Figure 4-16. Solenoid Test Harness

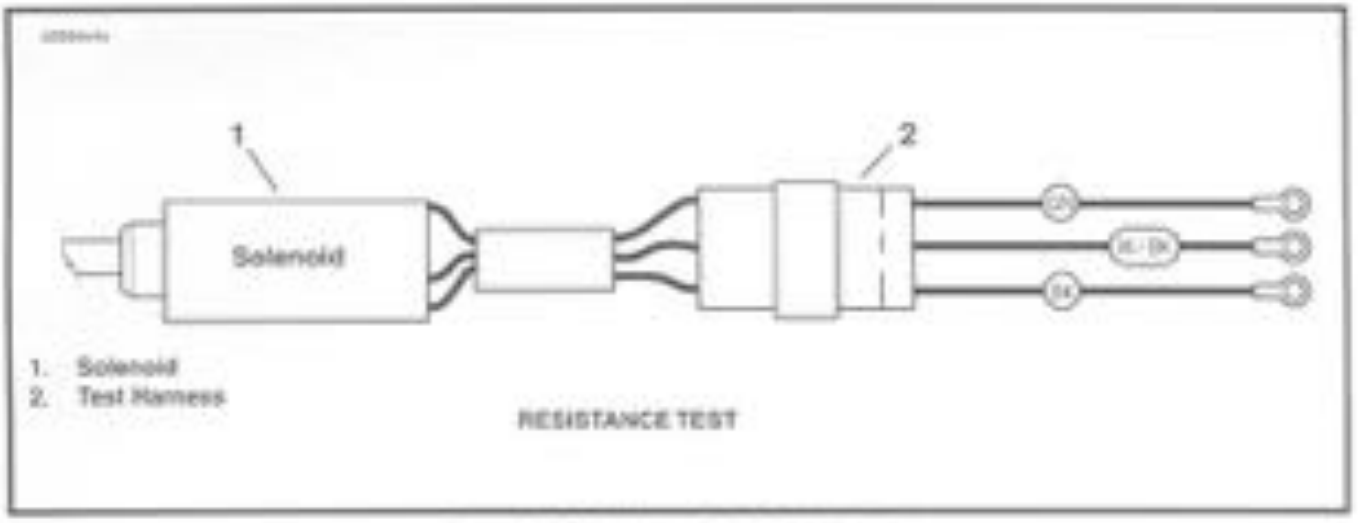


Figure 4-17. Resistance Test Connections

Pull-In Coil Test

1. See Figure 4-18. Connect a 12-volt battery to the solenoid test harness as shown. The butterfly valve must open.
2. If the butterfly valve opens, but does not open with solenoid connected to motorcycle harness, refer to applicable wiring diagram and check for the following:
   A. A good ground (1 Ohm or less) at BK wire in the 3-place mating connector (item 3, Figure 4-17).
   B. Connect the positive probe of a voltmeter to the GN wire in the 3-place mating connector. Connect the negative probe to a good ground. Press the START switch and verify that 12 VDC is indicated on the voltmeter.
3. If a good ground and/or 12 VDC are not present in the above tests, use continuity or voltage tests to isolate and correct the problem.
4. If both a good ground and 12 VDC are measured in Steps 2A and 2B, check the hold-in coil.

Hold-In Coil Test

1. See Figure 4-19. Connect a 12-volt battery to the solenoid test harness as shown.
2. Using a screwdriver, open the butterfly valve by gently pushing inward on the top side of the butterfly plate (item 13, Figure 4-15).
3. The butterfly valve must remain open with the hold-in coil energized.

4. Disconnect the negative battery cable. The butterfly valve should close.

5. If butterfly valve remains open in Step 3 and closes in Step 4, then the hold-in coil is functioning properly.

6. If butterfly valve does not remain open in Step 3, check that a good ground exists on the BK lead of the 3-place mating connector.

7. If there is not a good ground at the BK lead, refer to the applicable wiring diagram and correct the high-resistance ground.

8. Using a voltmeter, verify that W/BK wire at the 3-place mating connector has 12VDC when the ignition/light switch is ON.

9. If 12 VDC is not present when the ignition/light switch is ON, refer to the applicable wiring diagram and look for a broken wire, corroded connection or other malfunction causing the no power condition. Correct the problem as required.

10. If the solenoid is functioning properly, but butterfly valve is not opening and closing as it should, then refer to 12 in the table titled TROUBLESHOOTING SOLENOID-OPERATED BUTTERFLY VALVE.

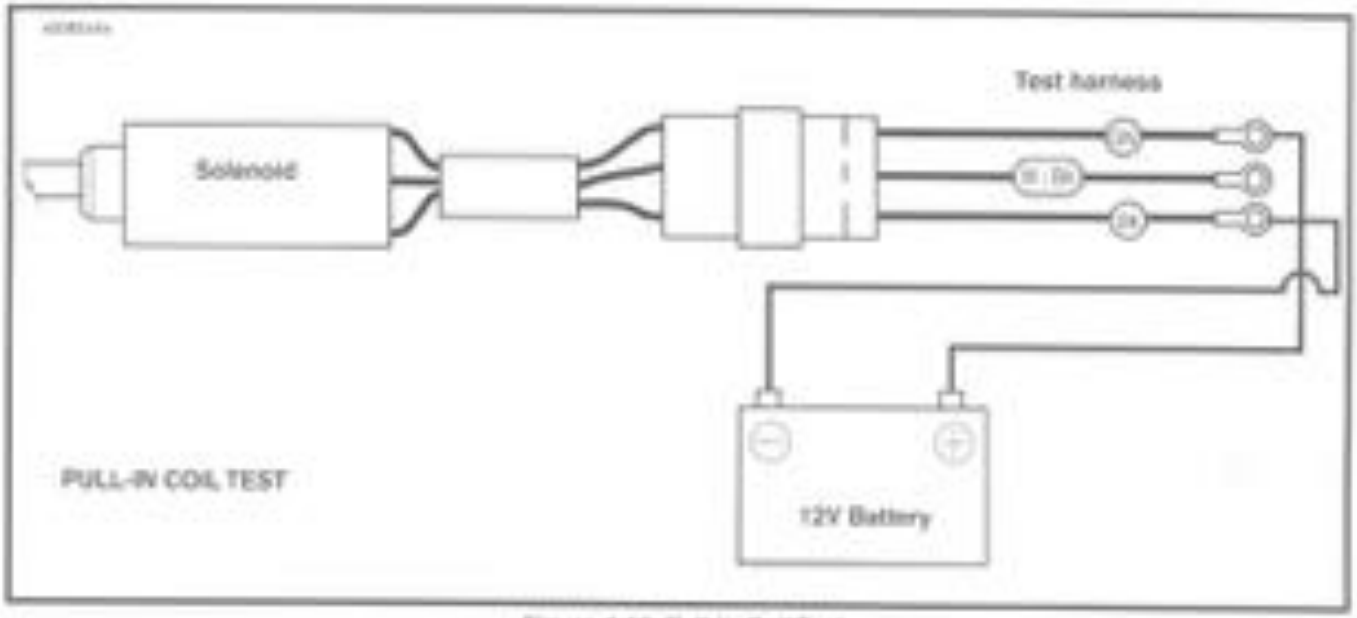


Figure 4-18. Pull-in Coil Test

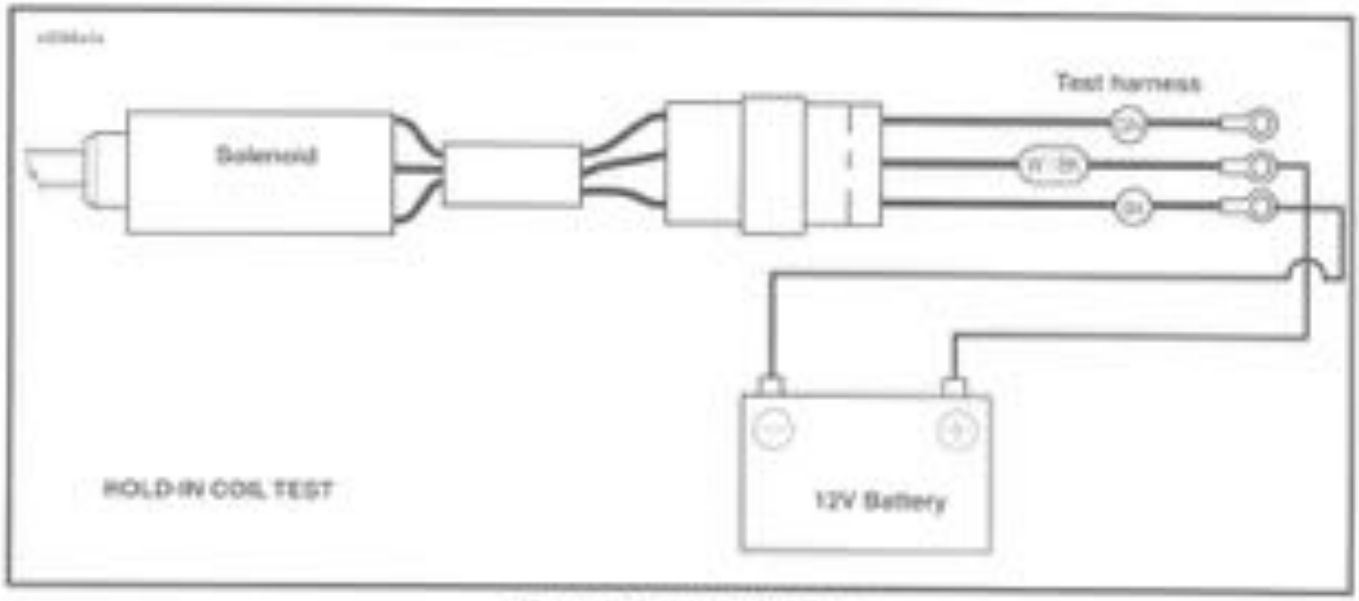


Figure 4-19. Hold-in Coil Test

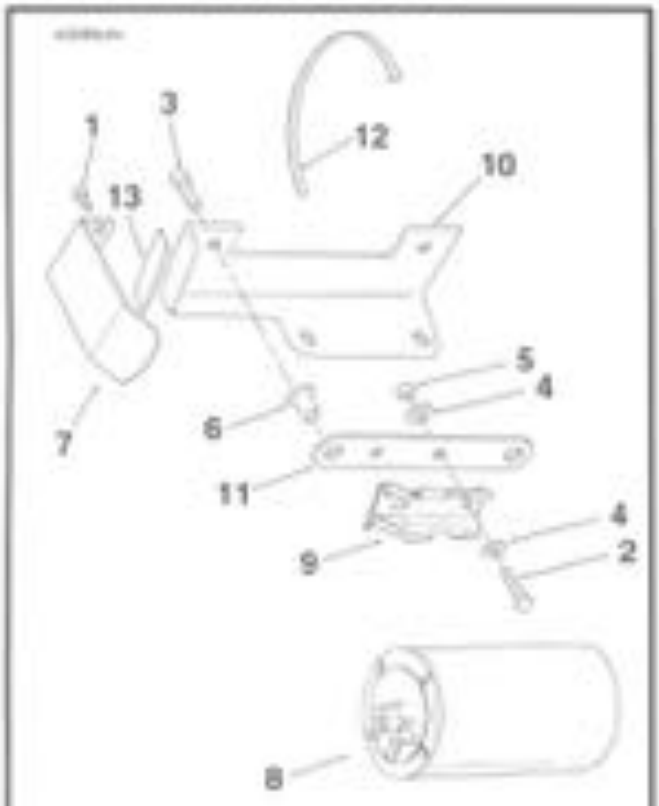
REMOVAL

Butterfly Valve Solenoid (Figure 4-15)

1. Remove air cleaner and backplate. See AIR CLEANER, REMOVAL.
2. Remove screw (7). Loosen set screw (5).
3. Slide solenoid (3) upward until free of clamp (4).

Canister (Figure 4-20)

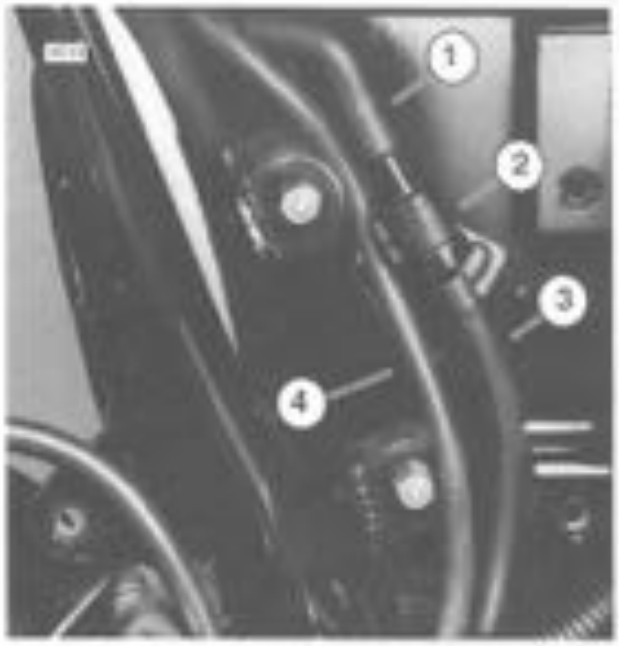
1. The canister (8) is mounted to the underside of the rear fork. Remove screws (1) and guard (7).



1. Self-tapping screw (2)
2. Bolt, 1/4 - 20 x 5/8 in. (2)
3. Bolt, 1/4 - 20 x 7/8 in. (2)
4. Washer (4)
5. Locknut (2)
6. Weilnut (2)
7. Canister guard
8. Canister
9. Canister bracket
10. Mounting bracket
11. Mounting plate
12. Cable strap
13. Foam pad

Figure 4-20. Carbon Canister Mounting

2. Mark the three hoses connected to the canister (8). Disconnect hoses from canister.
3. Depress locking tab at left end of canister bracket (9). Slide canister (8) towards the left side of the vehicle until it disengages from bracket.
4. Remove bolts (3) to detach mounting plate assembly (11) from mounting bracket (10). Remove weil nuts (6) from mounting plate (11).
5. Remove locknuts (5), washers (4) and bolts (2) to detach canister bracket (9) from mounting plate (11).



1. Fuel tank-to-vapor valve hose
2. Vapor valve
3. Vapor valve-to-canister hose
4. Canister-to-carburetor purge hose

Figure 4-21. Vapor Valve and Hose Routing - California

Vapor Valve (Figure 4-21)

1. The vapor valve (2) is located beneath the seat between the oil tank and the battery tray. Remove battery to gain access to valve. See ELECTRICAL, BATTERY, GENERAL.
2. The vapor valve assembly is attached to inboard side of oil tank. Remove carbon canister-to-carburetor purge hose from groove of vapor valve bracket. Insert thin blade of screwdriver into slot of bracket. Turn screwdriver gently to unsnap clip. Remove vapor valve body from bracket.
3. Mark the two hoses connected to upper and lower fittings of vapor valve. Remove hoses from fittings.

CLEANING, INSPECTION, REPAIR, AND LUBRICATION

Butterfly Valve / Solenoid (Figure 4-15)

1. At 2,500 miles (4,000 km), and at every 2,500 miles (4,000 km) thereafter, inspect butterfly valve and solenoid for proper operation.
2. At 5,000 miles (8,000 km), and at every 5,000 miles (8,000 km) thereafter, clean butterfly valve linkage and plunger using carburetor cleaner. After cleaning, lubricate linkage and plunger using a thin-film spray lubricant (such as TRI-FLOW™ or equivalent).

Butterfly Valve Solenoid (Figure 4-15)

1. Slide solenoid assembly (3) downward into clamp (4) on inboard side of air cleaner backplate (1).

2. Apply one to two drops of LOCTITE Threadlocker 222 (purple) to threads of screw (7) and set screw (5). Attach plunger (6) to plastic link (8) using screw (7). Tighten screw (7) to 5-7 **in-lbs** (0.6-0.8 Nm) torque.

NOTE

Slot in link (8) must face pin on lever arm (9). Link (8) must be attached to deep, flat side of plunger (6).

3. With solenoid set screw (5) loose, push upward on bottom of plunger (6) until butterfly valve plate (13) fully opens; solenoid body (3) may slide upward within clamp (4) during this procedure.

4. While firmly lifting upward on bottom of plunger, and maintaining a fully open butterfly valve, press downward on top of solenoid body (3) until bottom of solenoid body just touches plastic washer (19). Tighten set screw (5) firmly.

5. Release plunger and verify that solenoid spring (18) closes butterfly valve plate (13).

Electrical Connections

1. See Figure 4-22. Replacement solenoids do not include pin housing (1), pin terminals (2) and conduit (3).

2. Install pin terminals (Part No. 72030-71) on solenoid wires and reuse conduit and pin housing removed from old solenoid.

⚠CAUTION

Make certain solenoid wires are installed in pin housing as shown in Figure 4-22.

Canister (Figure 4-20)

1. Attach canister bracket (9) to mounting plate (11) using bolts (2), washers (4), and locknuts (5). Tighten locknuts to 3-5 ft-lbs (4-7 Nm) torque.

2. Insert weil nuts (6) into holes in mounting plate (11). Install mounting plate assembly onto bracket (10) by securing bolts (3) through mounting plate and into weil nuts. Tighten bolts to 5-8 **in-lbs** (0.6-0.8 Nm) torque.

3. Starting at the left side of canister bracket (9), slide canister (8) to the right and into locked position on canister bracket. Clip at left end of canister bracket must engage top left side of canister mount; bend clip outward somewhat if canister is not held securely.

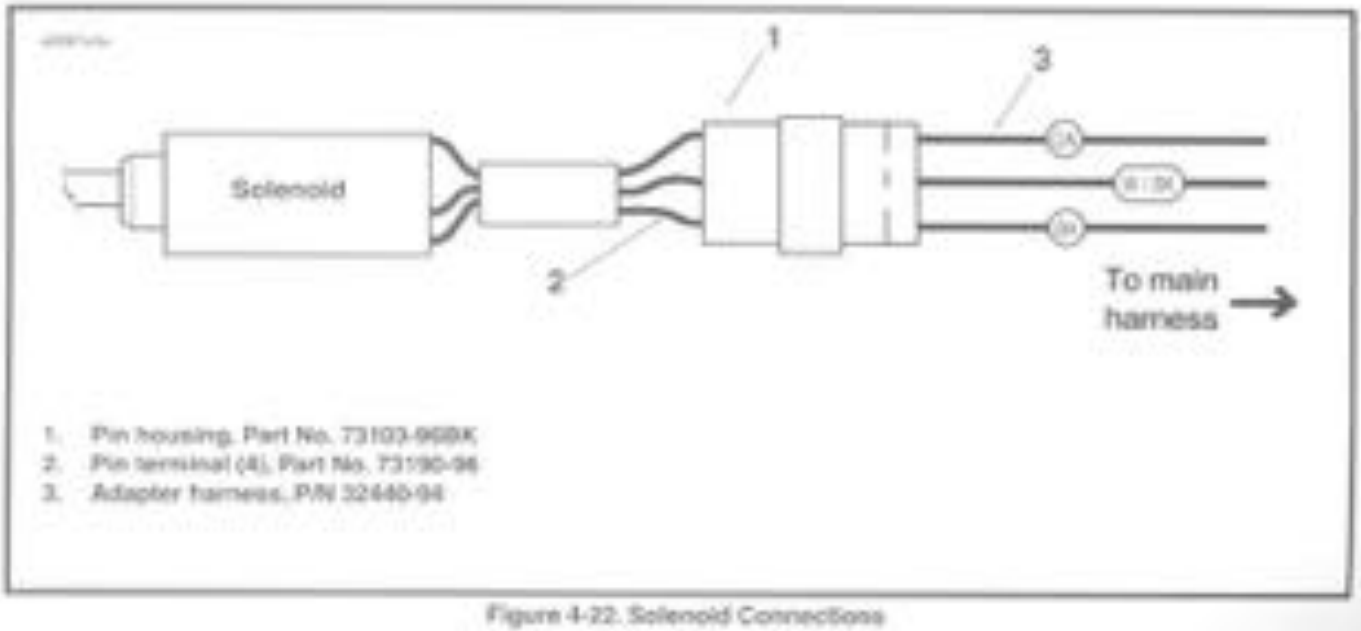
4. Connect three marked hoses to their proper fittings on canister (8).

5. Install canister guard (7) using self-tapping screws (6). Tighten screws to 15-21 **in-lbs** (1.7-2.4 Nm) torque.

Vapor Valve (Figure 4-21)

⚠WARNING

Verify that the fuel tank vapor valve hoses do not contact hot exhaust or engine parts. The hoses contain flammable vapors that can be ignited if damaged, thereby resulting in personal injury and/or vehicle damage.



1. Pin housing, Part No. 73103-968K
2. Pin terminal (4), Part No. 73190-96
3. Adapter harness, P/N 32440-94

Figure 4-22. Solenoid Connections

⚠CAUTION

See Figure 4-13. Mount the vapor valve in an upright position with the longer fitting positioned at the top or excessive fuel vapor pressure may build up within the fuel tank. Mounting the vapor valve upside down will result in fuel flow problems.

1. Hold vapor valve in an upright position with the long necked end at the top. Insert neck of vapor valve into hose from fuel tank. Install lower hose to carbon canister.
2. Position body of vapor valve in bracket attached to T-stud on inboard side of oil tank. Snap bracket closed. Install carbon canister-to-carburetor purge hose in groove of vapor valve bracket.

NOTE

On non-California models, the carbon canister is absent and the bottom hose of the vapor valve is connected to a fitting in the hollow frame member. See Figure 4-12.

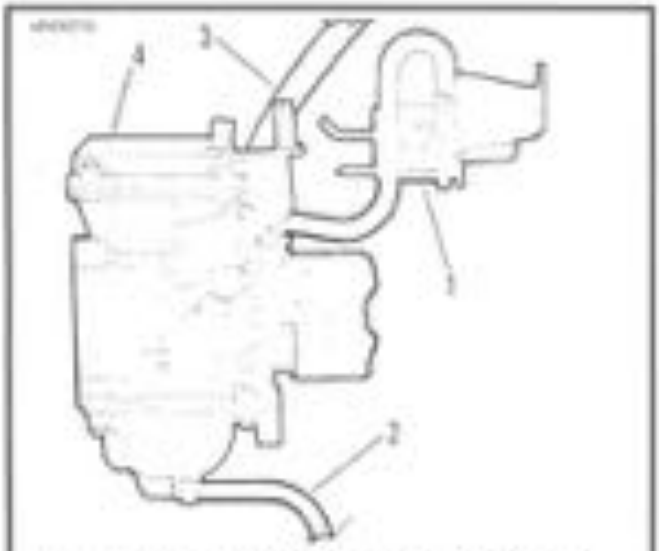
3. Install battery. See ELECTRICAL, BATTERY, GENERAL.

HOSE ROUTING

See Figure 4-14, California Evaporative Emissions Control System schematic, and then see Canister Hose Routings.

Carburetor (Figure 4-23)

Route the evaporative emissions control hoses at the carburetor as shown. To gain access to the V.O.E.S. and hoses, remove the fuel tank and/or air cleaner / backplate assembly if necessary.

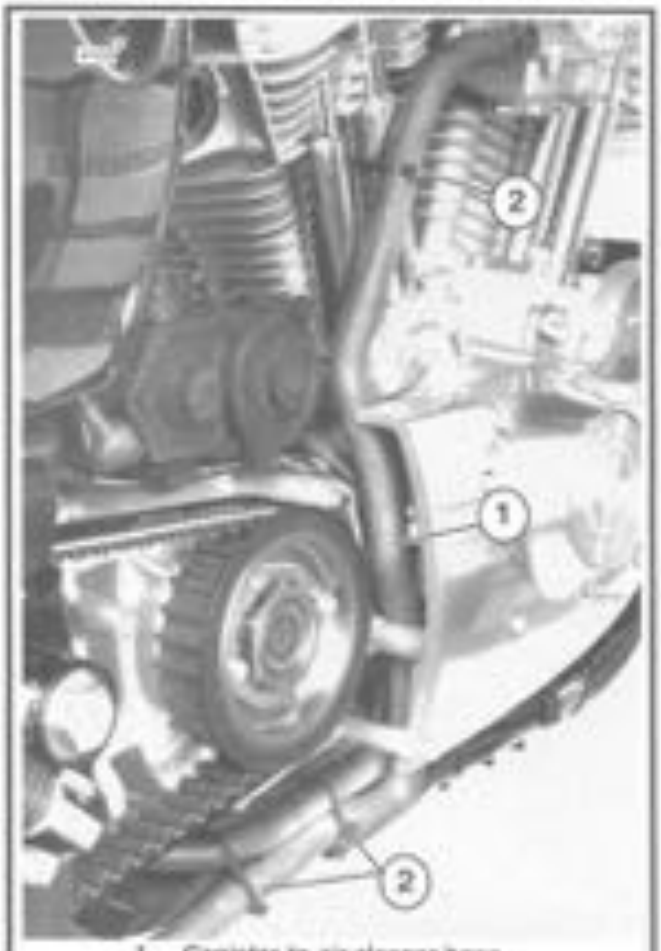


1. Vacuum-operated electric switch (V.O.E.S.)
2. Overflow (vent) hose (to air cleaner backplate)
3. Purge hose (to canister)
4. Carburetor

Figure 4-23. Emissions Hose Routing at Carburetor

Canister Hose Routings

1. See Figure 4-24. Connect one end of the canister-to-air cleaner hose (canister clean air inlet hose) to the fitting on the right side of the carbon canister. Route the hose forward along the right frame bottom tube and then upward through the rear section of the gearcase cover. Continue running the hose upward along the starter motor (right front side) and rear exhaust push rod cover before routing it forward to the air cleaner backplate fitting. Secure the hose at three points using cable straps.



1. Canister-to-air cleaner hose
2. Cable straps (3)

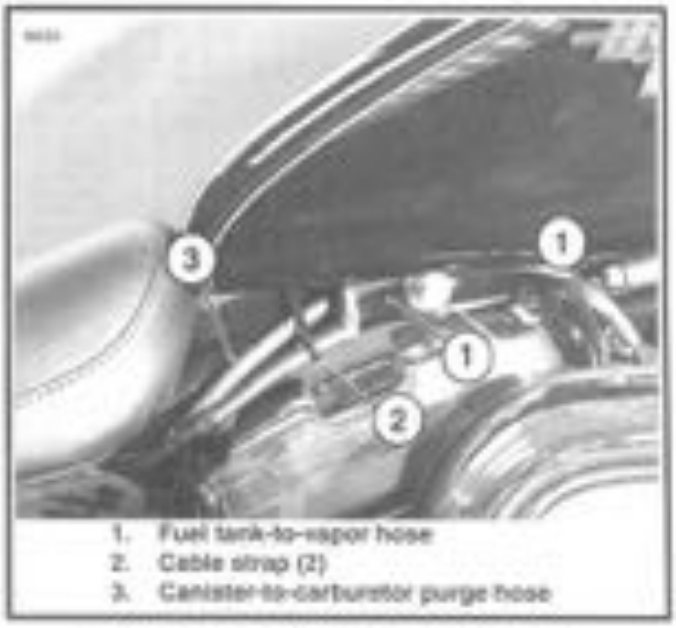
Figure 4-24. Canister-to-Air Cleaner Hose

2. See Figure 4-21. Connect the vapor valve-to-canister hose (3) and the canister-to-carburetor purge hose to fittings on the left side of the carbon canister. Route both hoses forward through the clip on the left frame bottom tube. After running the hoses forward and then upward along the inboard side of the primary chaincase, route the hoses between the oil tank and battery tray. Connect the vapor valve-to-canister hose (3) to the bottom of the vapor valve (2). Connect the fuel tank-to-vapor valve hose (1) at the top.

3. See Figure 4-25. Route both the canister-to-carburetor purge hose (3) and the fuel tank-to-vapor valve hose (1) forward along the right side of the frame backbone.

   Connect the canister-to-carburetor purge hose (3) to the vacuum fitting on the carburetor. Connect the fuel tank-to-vapor valve hose (1) to the fitting under the fuel tank.

   Secure the hoses to the vehicle frame using two cable straps (2).



1. Fuel tank-to-vapor hose
2. Cable strap (2)
3. Canister-to-carburetor purge hose

Figure 4-25. Emissions Control Hose Routing

ELECTRIC STARTER 5

SUBJECT PAGE NO.

1. Specifications 5-1
2. Electric Starter System 5-1
3. Troubleshooting 5-4
4. Starter System Testing 5-10
5. Starter 5-11
6. Starter Solenoid 5-18

SPECIFICATIONS

STARTER

Free (no load) speed	3000 rpm (min.) @ 11.5 V
Free (no load) current	90 amp (max.) @ 11.5 V
Stall torque	8.1 ft-lbs (11.0 Nm) (min.) @ 2.4

SERVICE WEAR LIMITS

Brush length minimum	0.433 in.
	11.0 mm
Commutator diameter minimum	1.141 in.
	28.96 mm

TORQUE VALUES

Thru-bolts	39-65 in-lbs
	4.4-7.3 Nm
Cable terminal nuts	69-80 in-lbs
	7.3-9.0 Nm
Starter to crankcase mounting bolts	13-20 ft-lbs
	18-27 Nm
Hose clamp mounting nut	50-60 in-lbs
	5.6-6.8 Nm

ELECTRIC STARTER SYSTEM

GENERAL

The starter is made up of an armature, field winding assembly, solenoid, drive assembly, idler gear and drive housing.

The starter motor torque is increased through gear reduction. The gear reduction consists of the drive pinion on the armature, an idler gear and a clutch gear in the drive housing. The idler gear is supported by rollers. The clutch gear is part of the overrunning clutch/drive assembly.

The overrunning clutch is the part which engages and drives the clutch ring gear. It also prevents the starter from overrunning. The field windings are connected in series with the armature through brushes and commutator segments.

Wiring Diagrams

For additional information concerning the starting system circuit, see the wiring diagrams at the end of Section 7, ELECTRICAL.

Starter Relay

The starter relay is a non-repairable part that must be replaced as a unit if it fails.

Operation (Figure 5-1)

The starter relay is activated when the starter switch is pushed. This allows battery current to flow into the pull-in winding and also into the hold-in winding to ground. The magnetic forces of the pull-in and hold-in windings in the solenoid push the plunger causing it to shift to the left. This action engages the pinion gear with the clutch ring gear. At the same time, the main solenoid contacts are closed, so battery current flows directly through the field windings to the armature and to ground. Simultaneously, the pull-in winding is shorted. The current continues flowing through the hold-in winding keeping the main solenoid contacts closed. At this point, the starter begins to crank the engine. After the engine has started, the pinion gear turns freely on the pinion shaft through the action of the overrunning clutch. The overrunning clutch prevents the clutch ring gear (which is now rotating under power from the engine) from turning the armature too fast.

When the starter switch is released, the current at the hold-in winding is fed through the main solenoid contacts and the direction of the current in the pull-in winding is reversed. The solenoid plunger is returned to its original position by the return spring, which causes the pinion gear to disengage from the clutch ring gear.

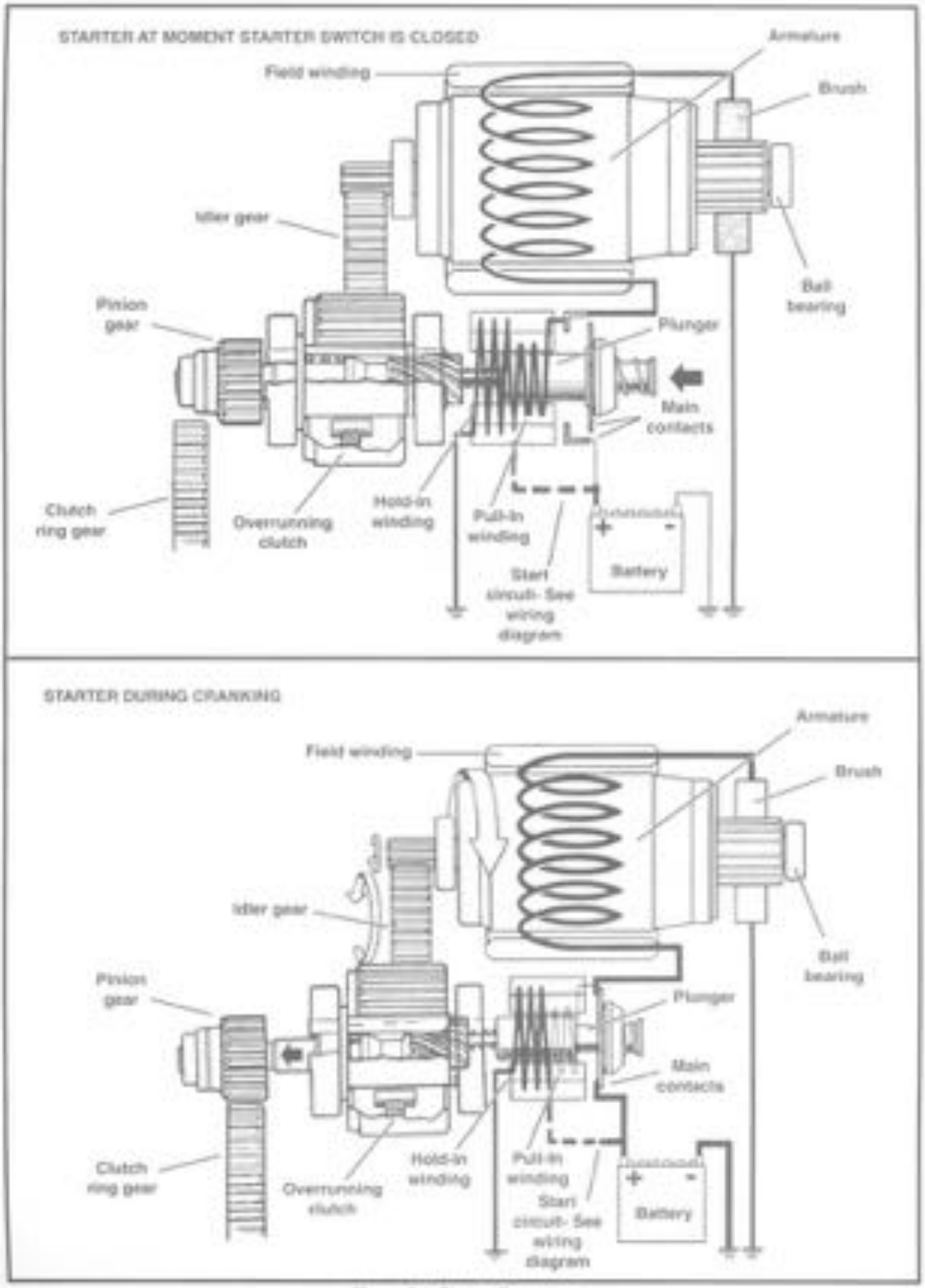
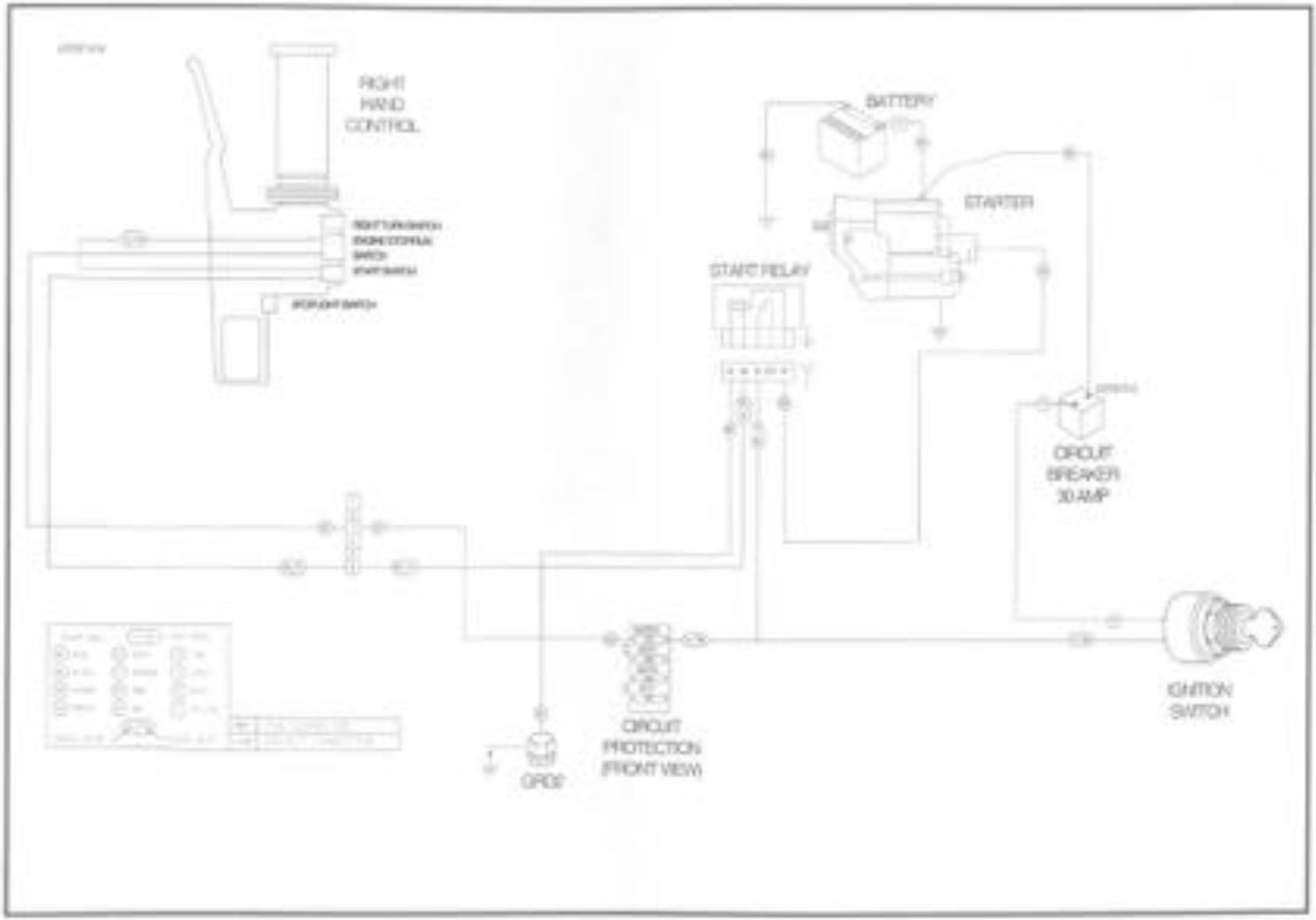


Figure 5-1. Starter Operation



Starting System Circuit

TROUBLESHOOTING

PROBLEM	SOURCE OF PROBLEM	PROBABLE CAUSE	SOLUTION
1. Starter does not run, or runs at very low speeds.	1.1 Battery.	1.1.1 Voltage drop due to discharged battery.	1.1.1 Charge battery.
		1.1.2 Worn or defective battery.	1.1.2 Replace battery.
		1.1.3 Poor contact condition of battery terminal(s).	1.1.3 Clean and retighten.
	1.2 Wiring.	1.2.1 Open or poor connection in starter circuit wiring.	1.2.1 Repair connection or replace wire.
	1.3 Starting switch or starter relay.	1.3.1 Poor contact condition or poor connection.	1.3.1 Replace.
	1.4 Solenoid.	1.4.1 Poor contact condition caused by burnt contact.	1.4.1 Rebuild solenoid assembly. See NOTE below.
		1.4.2 Pull-in winding open or short-circuited.	1.4.2 Replace solenoid assembly.
		1.4.3 Hold-in winding open.	1.4.3 Replace solenoid assembly.
	1.5 Starting motor.	1.5.1 Poor contact condition of brushes.	1.5.1 Check brush spring tension.
		1.5.2 Commutator burnt.	1.5.2 Correct on lathe or replace.
		1.5.3 Commutator high mica.	1.5.3 Correct by undercutting.
		1.5.4 Field winding grounded.	1.5.4 Replace.
		1.5.5 Armature winding grounded or short-circuited.	1.5.5 Replace.
		1.5.6 Reduction gears damaged.	1.5.6 Replace.
		1.5.7 Insufficient brush spring tension.	1.5.7 Replace.
		1.5.8 Disconnected lead wire between solenoid and field windings.	1.5.8 Repair or replace lead wire.
		1.5.9 Bad bearing sticks.	1.5.9 Replace bearing.

NOTE

A solenoid repair kit is available from your Harley-Davidson dealer. Follow the repair procedure given in the Instruction Sheet included with the repair kit.

TROUBLESHOOTING (CONT)

PROBLEM	SOURCE OF PROBLEM	PROBABLE CAUSE	SOLUTION
2. Pinion does not engage with ring gear while starter is running or engine cannot be cranked.	2.1 Battery.	2.1.1 Voltage drop due to discharged battery.	2.1.1 Charge battery.
		2.1.2 Worn or defective battery.	2.1.2 Replace battery.
		2.1.3 Poor contact condition of battery terminal(s).	2.1.3 Clean and retighten.
	2.2 Wiring.	2.2.1 Poor connection between battery, relay, and solenoid terminal.	2.2.1 Repair or replace wire.
	2.3 Overrunning clutch.	2.3.1 Overrunning clutch malfunction (rollers or compression spring).	2.3.1 Replace overrunning clutch.
		2.3.2 Pinion teeth worn out.	2.3.2 Replace overrunning clutch.
		2.3.3 Pinion does not run in overrunning direction.	2.3.3 Replace overrunning clutch.
		2.3.4 Poor sliding condition of spline teeth.	2.3.4 Remove foreign materials, dirt, or replace overrunning clutch.
		2.3.5 Reduction gears damaged.	2.3.5 Replace overrunning clutch and idler gear.
	2.4 Ring gear.	2.4.1 Excessively worn teeth.	2.4.1 Replace ring gear.
3. Starter does not stop running.	3.1 Solenoid.	3.1.1 Return spring worn.	3.1.1 Replace solenoid.
		3.1.2 Coil layer shorted.	3.1.2 Replace solenoid.
		3.1.3 Contact plate melted and stuck.	3.1.3 Replace solenoid.
	3.2 Starting switch or starter relay.	3.2.1 Unopened contacts.	3.3.1 Replace starting switch or starter relay.
		3.2.2 Poor returning.	3.3.1 Replace starting switch or starter relay.

STARTING SYSTEM DIAGNOSIS

— BATTERY TESTS —
• VISUAL • VOLTAGE • LOAD

Check Connections at Battery and Starter Components.

Continued on Next Page

INOPERATIVE

Solenoid Clicks.

Nothing Clicks.

Relay Clicks

Perform Voltage Drop Tests Between Battery and "Relay" Terminal on Solenoid. Less Than 1 Volts.

YES

NO

Perform Voltage Drop Tests from Battery (Pos. +) to Starter "Motor" Terminal. Crank Engine. Is Voltage Greater than 1 Volt?

Backtrack to Pinpoint Poor Connections at Relay Contact Problems Using Voltage Drop Tests.

YES

NO

Perform Voltage Drop Tests from Battery (Pos. +) to Starter Motor "Battery" Terminal. Crank Engine. Is Voltage Greater than 1 Volt?

Perform Voltage Drop Test Between Battery (Neg. -) and Starter Shells or Bolts. Is Voltage Greater than 1 Volt?

YES

NO

Repair Connection Between Battery and Starter.

Repair or Replace Solenoid (Contacts).

Clean Ground Connections.

Does Starter Motor Turn If Jumped?

YES

NO

Replace Solenoid.

Test Starter Motor for Opens, Shorts or Grounds.

Test for Voltage at Solenoid Terminal. Is 12V Present When Starter Button is Pressed?

YES

NO

Test for Voltage to Relay. Is 12V Present on Relay Terminal 30?

YES

NO

Test for Voltage from Relay. Is 12V Present on Relay Terminal 87 When Starter Button is Pressed?

Repair Open on R/BK Wire Feeding Terminal 30 on Starter Relay.

YES

NO

Repair Open on GN Wire Between Relay and Solenoid.

Replace Starter Relay.

Check for Battery Voltage at Relay Terminal 86 From Starter Button. Battery Voltage Present?

YES

NO

Check for Ground at Relay Terminal 85. Ground Present?

Check for Battery Voltage from Starter Button (BK/R Wire at Connector [22], BK Wire on 95 FX). Battery Voltage Present With Starter Button Pressed?

YES

NO

YES

NO

Substitute Good Relay or Test Relay.

Correct Relay Ground.

Repair Wiring From Starter Button to Relay.

Check for Battery Voltage to Starter Button (W/BK Wire at Connector [22]). Battery Voltage Present?

YES

NO

Replace Starter Button.

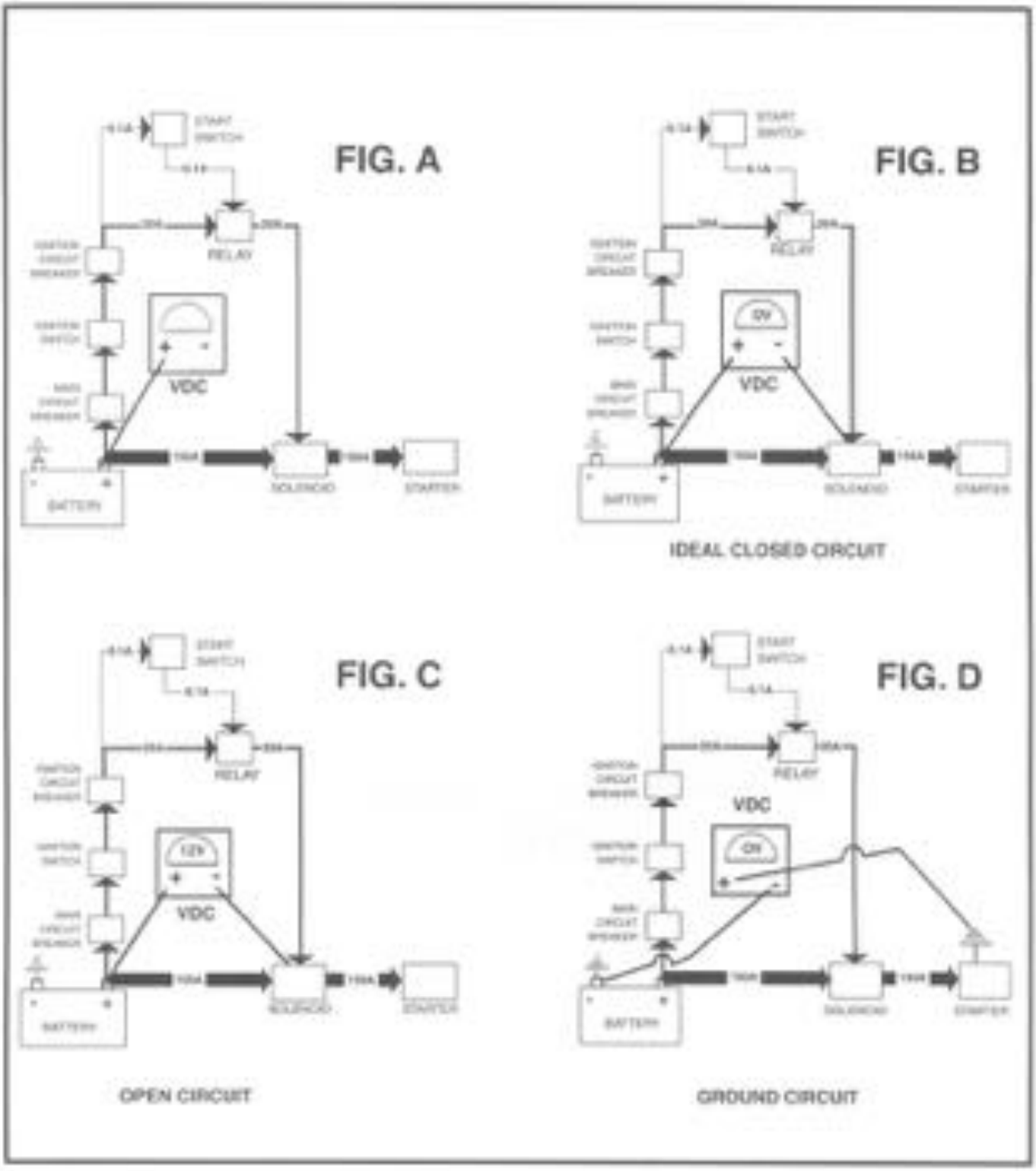
Repair Wiring to Starter Button.

STARTING SYSTEM DIAGNOSIS-continued

NOTES

1. Remove starter motor and connect jumper wires as described in Free Running Current Draw Test.
2. See Troubleshooting/Diagnostics- Voltage drops.
3. See Starter Current Draw Test.
4. See Free Running Current Draw Test.

STARTING ACTIVATION CIRCUITS



Typical Circuitry. Refer to wiring diagrams for specific vehicles.

GENERAL

Follow the STARTING SYSTEM DIAGNOSIS chart to diagnose starting system problems. The VOLTAGE DROPS procedure will help you to locate poor connections or components with excessive voltage drops. The TROUBLESHOOTING charts contain detailed procedures to solve and correct problems.

VOLTAGE DROPS

OBJECTIVE: To check the integrity of all wiring, switches, circuit breakers and connectors between the source and destination.

The voltage drop test measures the difference in potential or the actual voltage dropped between the source and destination.

1. See Figure A on the opposite page. Attach your red meter lead to the most positive part of the circuit, which in this case would be the positive post of the battery.
2. See Figure B. Attach the black meter lead to the final destination or component in the circuit (solenoid terminal from relay).
3. Activate the starter and observe the meter reading. The meter will read the voltage dropped or the difference in potential between the source and destination.
4. An ideal circuit's voltage drop would be 0 volts or no voltage dropped, meaning no difference in potential.
5. See Figure C. An open circuit should read 12 volts, displaying all the voltage dropped, and the entire difference in potential displayed on the meter.
6. Typically, a good circuit will drop less than 1 volt.
7. If the voltage drop is greater, back track through the connections until the source of the potential difference is found.

The benefit of doing it this way is speed.

A. Your readings aren't as sensitive to real battery voltage.

B. Your readings show the actual voltage dropped, not just the presence of voltage.

C. This tests the system as it is actually being used. It is more accurate and will display hard to find poor connections.

D. This approach can be used on lighting circuits, ignition circuits, etc. Start from most positive and go to most negative (the destination or component).

8. See Figure D. The negative or ground circuit can be checked as well. Place the negative lead on the most negative part of the circuit (or the negative battery post). Remember, there is nothing more negative than the negative post of the battery. Place the positive lead to the ground you wish to check.
9. Activate the circuit. This will allow you to read the potential difference or voltage dropped on the negative or ground circuit. This is very effective for identifying poor grounds due to powdered paint. Even the slightest connection may cause an ohmmeter to give a good reading. However, when sufficient current is passed through, the resistance caused by the powdered paint will cause a voltage drop, or potential difference in the ground circuit.

STARTER SYSTEM TESTING

"ON-MOTORCYCLE" TESTS

Starter Relay

1. Remove seat. See SEAT, REMOVAL in Section 2.
2. See Figure 5-2. Locate the starter relay. The relay is located on the ignition bracket behind the left side cover. Unplug the relay connector.
3. To install a new starter relay, refer to ELECTRICAL BRACKET, REPLACE STARTER RELAY in Section 7. To test the relay, proceed to step 4.
4. See Figure 5-3. Obtain a 12 volt battery and a continuity tester or ohmmeter. Connect the battery leads to the 86 and 85 terminals to energize the relay. Check for continuity between the 30 and 87 terminals. A 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 the starter relay is functioning properly, proceed to the STARTER CURRENT DRAW TEST.

Figure 5-2. Starter Relay Location

Starter Current Draw Test (Figure 5-4)

Check starter current draw with an induction ammeter before disconnecting the battery. Proceed as follows:

- Engine temperature should be stable and at room temperature.
- Battery should be fully charged.

1. Verify that transmission is in neutral. Disconnect spark plug wires from spark plug terminals.
2. Clamp induction ammeter over the positive battery cable next to starter.
3. With the ignition switch ON, turn engine over by pressing starter switch while taking a reading on the ammeter. Disregard initial high current reading which is normal when the engine is first turned over.
   - Typical starter current draw will range between 140 and 180 amperes.
4. If starter current draw exceeds 180 amperes, then the problem may be in the starter or starter drive. Remove the starter for further tests. See REMOVAL.

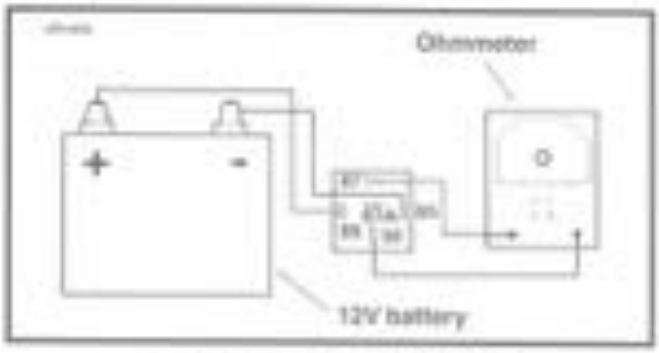


Figure 5-3. Starter Relay Test

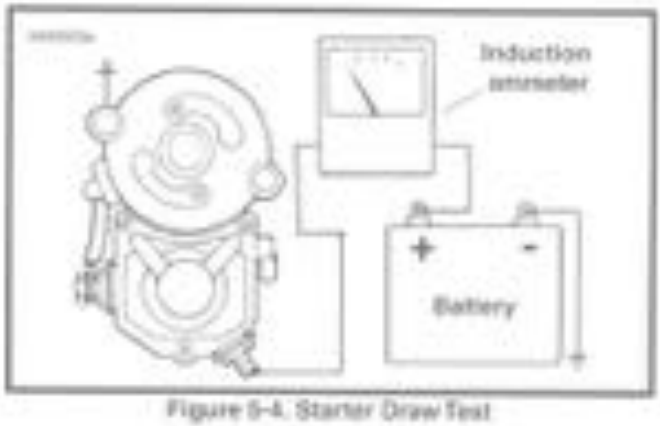


Figure 5-4. Starter Draw Test

STARTER

REMOVAL

⚠WARNING

To avoid accidental start-up of vehicle and possible personal injury, disconnect the battery cables before proceeding. Always disconnect the negative cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion producing personal injury.

1. Remove primary cover. See PRIMARY CHAIN, REMOVAL, PRIMARY COVER in Section 6.
2. Remove the two starter mounting bolts and washers. See Figure 5-5.

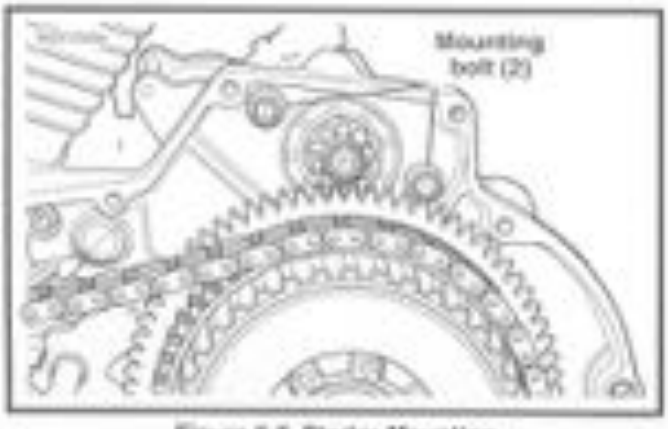


Figure 5-5. Starter Mounting

NOTE

A ball hex driver may be required to gain access to the starter mounting bolts.

3. Remove rear exhaust pipe.
4. Remove positive battery lead and solenoid wire from starter.
5. Remove starter and gasket from right side of motorcycle.

TESTING ASSEMBLED STARTER

Starter Solenoid

NOTE

Do not disassemble solenoid. Before testing, disconnect field wire from "Motor" terminal as shown in Figure 5-6.

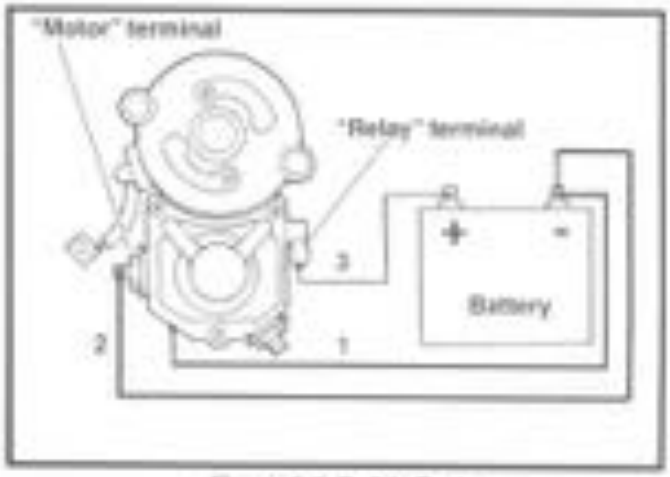


Figure 5-6. Pull-In Test

⚠CAUTION

Each test should be performed for only 3 to 5 seconds to prevent damage to solenoid.

NOTE

The solenoid Pull-in, Hold-in, and Return tests must be performed together in one continuous operation. All three tests are conducted one after the other in the sequence given without interruption.

SOLENOID PULL-IN TEST (FIGURE 5-6)

Using a 12 volt battery, connect three separate test leads as follows:

1) **solenoid housing to battery negative.**
2) **solenoid "Motor" terminal to battery negative.**
3) **solenoid "Relay" terminal to battery positive.**

Starter pinion should pull in strongly if solenoid is working properly. If pinion does not pull in, solenoid should be replaced.

SOLENOID HOLD-IN TEST (FIGURE 5-7)

With test leads still connected in the manner specified in the previous SOLENOID PULL-IN TEST, **disconnect solenoid "Motor" terminal/battery negative test lead at battery negative end only; reconnect loose end of this test lead to battery positive, instead.** If pinion remains in pull-in position, solenoid is working properly. If pinion does not remain in pull-in position, solenoid should be replaced.

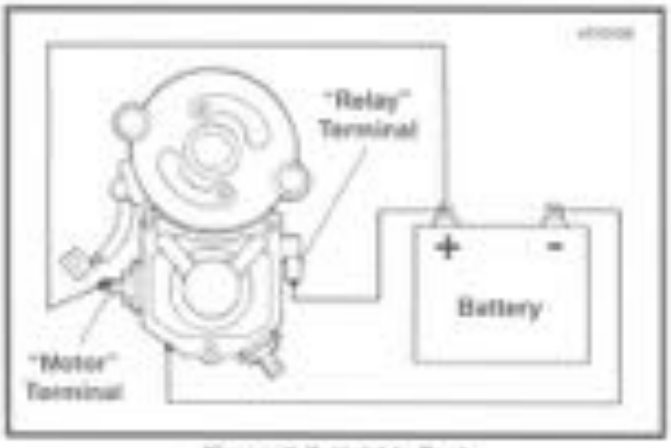


Figure 5-7. Hold-In Test

SOLENOID RETURN TEST (FIGURE 5-8)

With test leads still connected in the manner specified at the end of the previous SOLENOID HOLD-IN TEST, **disconnect solenoid "Relay" terminal/battery positive test lead at either end.** If pinion returns to its original position, the solenoid is working properly. If pinion does not return to its original position, solenoid should be replaced.

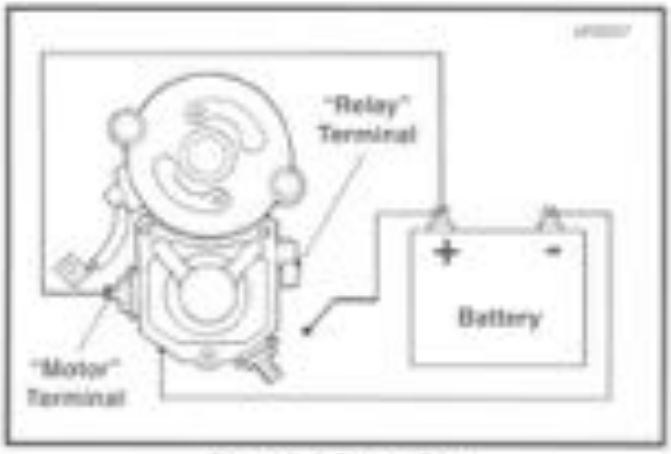


Figure 5-8. Return Test

DISASSEMBLY, INSPECTION, AND REPAIR

1. See Figure 5-11. Remove field wire (22).
2. See Figure 5-9. Remove thru-bolts.

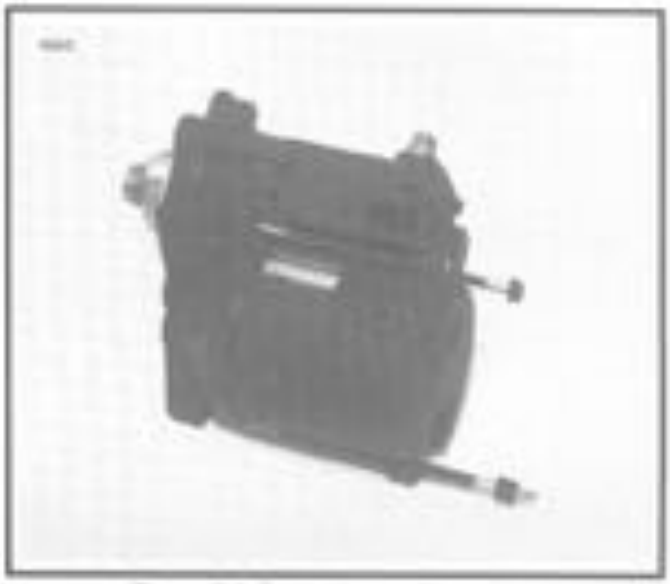


Figure 5-9. Removing the Thru-Bolts

3. See Figure 5-10. Remove two cover screws, O-rings, and cover.

Figure 5-10. Removing End Cover

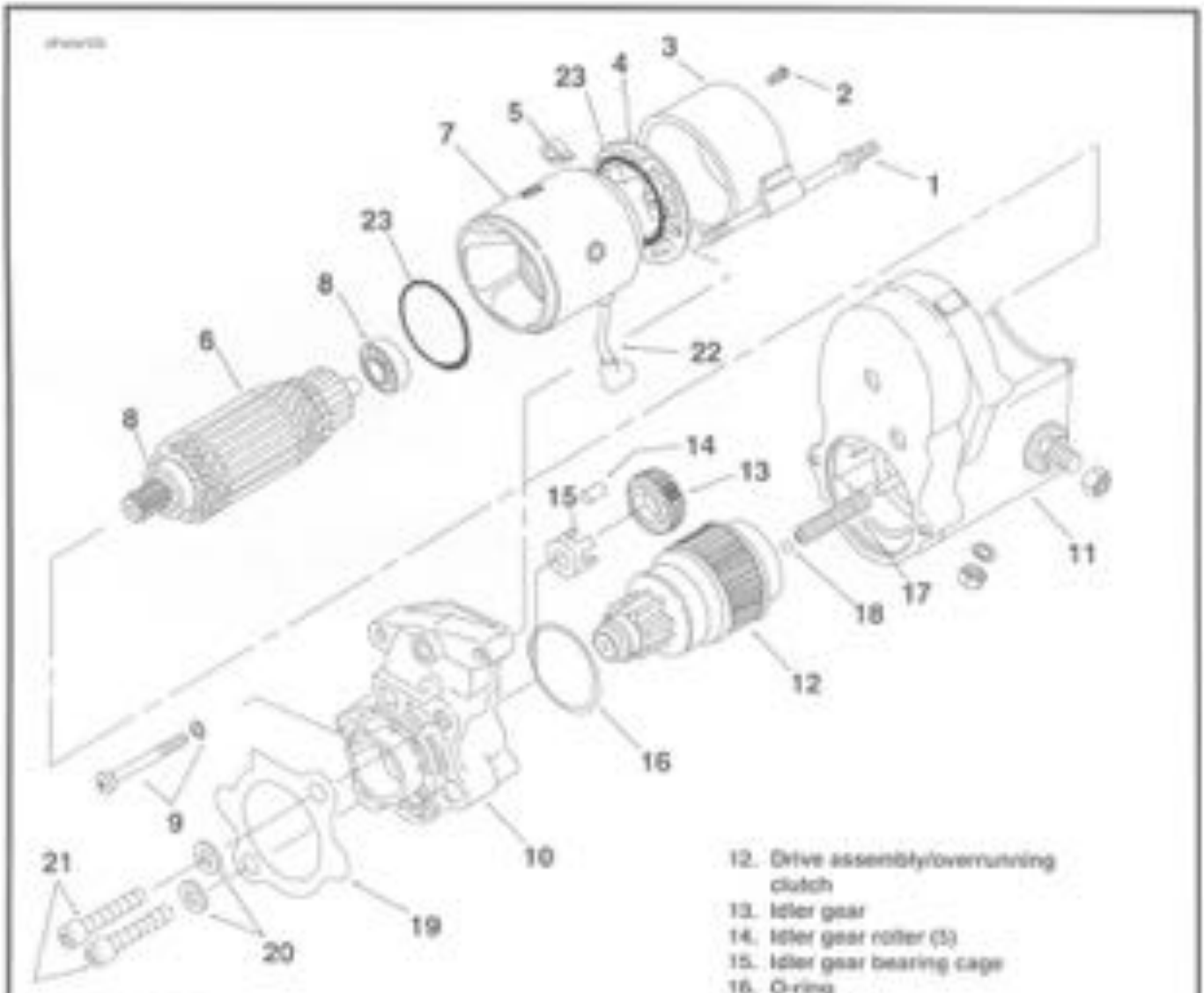


Figure 5-11. Starter Assembly

4. See Figure 5-12. Use a wire hook to pull upward on brush springs, and lift brushes out of holder. Remove brush holder.

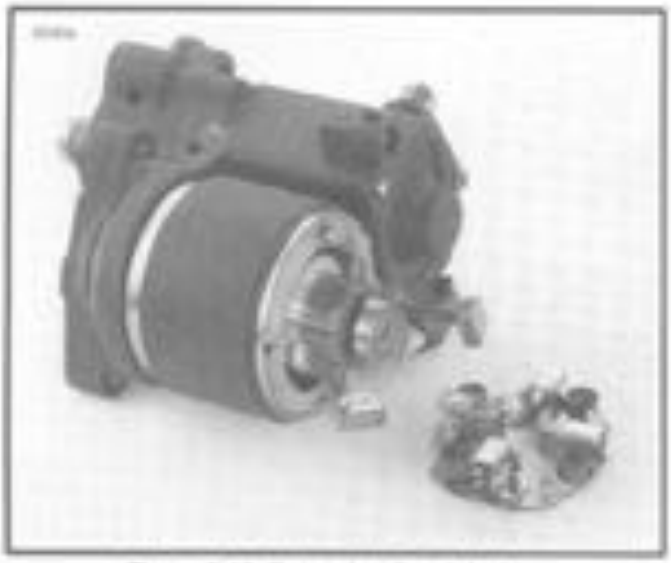


Figure 5-12. Removing Brush Holder

5. Check brush length. Replace all four brushes if length of any one brush is less than 0.433 in. (11.0 mm). Replace brushes in sets of four only.

6. See Figure 5-11. Remove armature (6) and field frame (7).

7. Place armature in lathe or truing stand and check runout of commutator. Commutators with more than 0.016 in. (0.41 mm) of runout should be replaced, or machined on a lathe. Commutators should be replaced when diameter is less than 1.141 in. (28.98 mm).

⚠CAUTION

Do not use sandpaper or emery cloth to remove burrs on commutator. Otherwise, abrasive grit may remain on commutator segments; this could lead to excessive brush wear. Use only the recommended crocus cloth.

8. Check depth of mica on commutator. If undercut is less than 0.008 in. (0.20 mm) , use an undercutting machine to undercut the mica to 1/32 in. (0.79 mm) deep. The slots should then be cleaned to remove any dirt or copper dust. See Figure 5-13. If an undercutting machine is not available, undercutting can be done satisfactorily using a thin hacksaw blade. After undercutting, lightly sand the commutator with crocus cloth to remove any burrs.

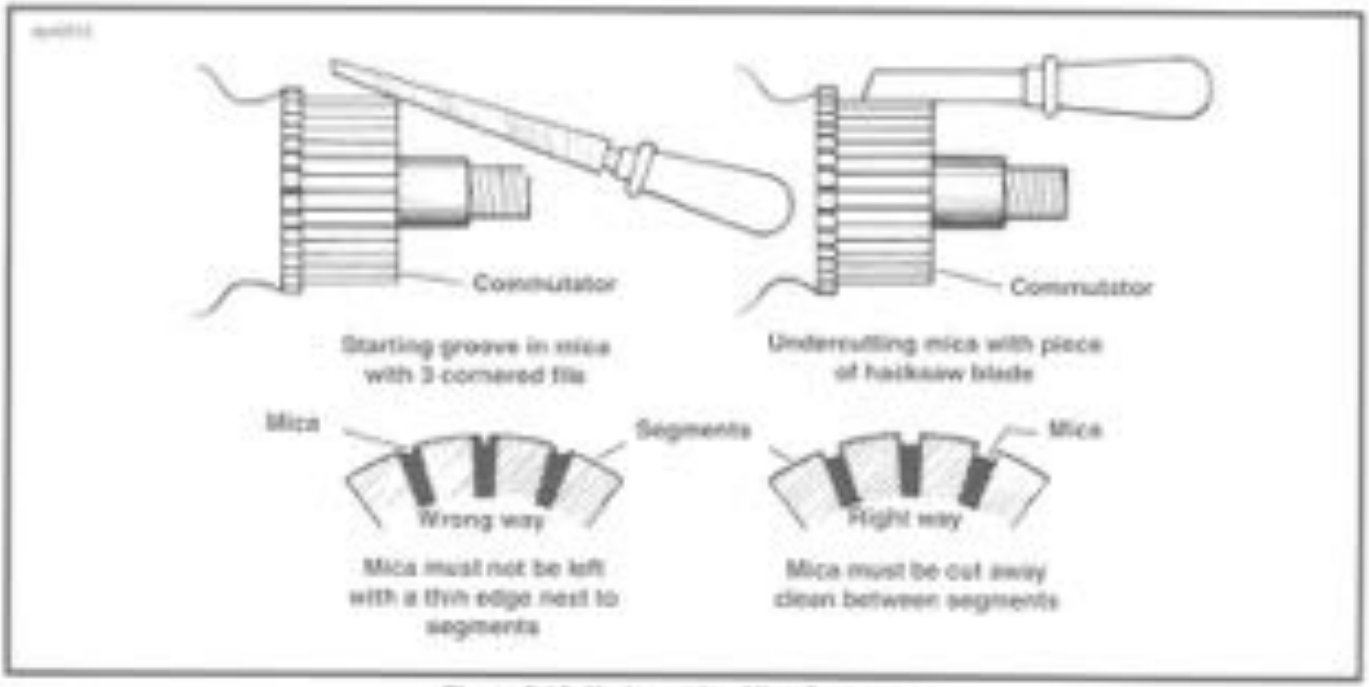


Figure 5-13. Undercutting Mica Separators

9. See Figure 5-14. Check for SHORTED ARMATURE with a growler. Place armature on growler. Hold a thin steel strip (hacksaw blade) against armature core and slowly turn armature. A shorted armature will cause the steel strip to vibrate and be attracted to the core. Replace armatures if shorted.

Figure 5-14. Shorted Armature Test Using Growler

10. See Figure 5-15. Check for a GROUNDED ARMATURE with an ohmmeter or continuity tester. Touch one probe to any commutator segment. Touch the other probe to the armature core. There should be no continuity (infinite ohms). If there is continuity, then the armature is grounded. Replace a grounded armature.

11. See Figure 5-16. Check for OPEN ARMATURE with an ohmmeter or continuity tester. Check for continuity between all commutator segments. There should be continuity (0 ohms) at all test points. No continuity at any test point indicates armature is open and must be replaced.

Figure 5-15. Grounded Armature Test

Figure 5-16. Open Armature Test

12. See Figure 5-17. Check for GROUNDED FIELD WINDING with an ohmmeter or continuity tester. Touch one probe to the frame. Touch the other probe to each of the brushes attached to the field winding. There should be no continuity (infinite ohms). If there is any continuity at either brush, then the field winding(s) are grounded and the field frame must be replaced.

Figure 5-17. Grounded Field Test

13. See Figure 5-18. Check for OPEN FIELD WINDING with an ohmmeter or continuity tester. Touch one probe to the field wire. Touch the other probe to each of the brushes attached to the field coils. There should be continuity. If there is no continuity at either brush, then the field winding(s) are open and the field frame must be replaced.

14. See Figure 5-19. Test BRUSH HOLDER INSULATION with an ohmmeter or continuity tester. Touch one probe to holder plate. Touch the other probe to each of the positive (insulated) brush holders. There should be no continuity (infinite ohms). If there is continuity at either brush holder, replace the brush holder assembly.

15. See Figure 5-11. Check armature bearings (8) and replace if necessary.

Figure 5-18. Open Field Test

Figure 5-19. Brush Holder Insulation Test

16. Figure 5-20. Remove two drive housing mounting screws (with washers and lockwashers). Remove drive housing from solenoid housing.

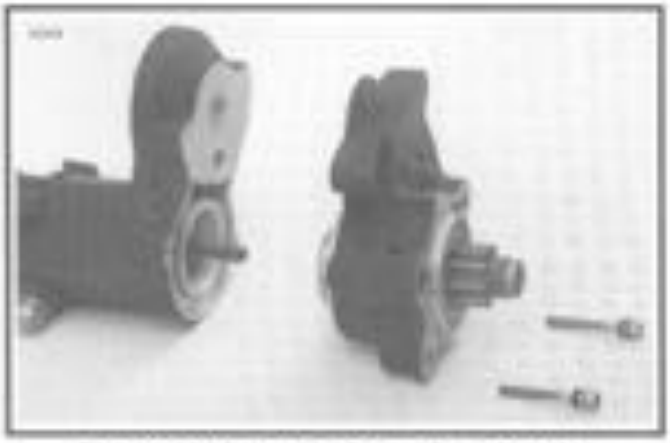


Figure 5-20. Removing Starter Drive Housing

17. See Figure 5-21. Remove drive, idler gear, idler gear bearing, and O-ring from drive housing (O-ring is located in drive housing groove).

Figure 5-21. Starter Drive Assembly

ASSEMBLY

1. See Figure 5-21. Clean, inspect, and lubricate drive assembly components. Lubricate parts with high temperature grease, such as LUBRIPLATE 110.

2. See Figure 5-11. When installing drive assembly components, open end of idler bearing cage (15) faces toward solenoid.

3. When installing drive housing (10) to solenoid housing (11), use new O-rings (16). Be sure to install return spring (17) and ball (18).

4. Lubricate armature bearings (8) and felt washer (20) (883 only) with high temperature grease, such as LUBRIPLATE 110. Install armature (6) and frame (7) to solenoid housing (11).

5. Install brushes and brush holder (4).

6. Install end cover (3) with screws (2) and O-rings (1200 only).

7. Install bolts (1).

8. Install solenoid wire to terminal.

INSTALLATION

1. Install starter and starter gasket from right side of motorcycle.

2. Install positive battery cable and solenoid wire to solenoid.

3. See Figure 5-5. Install the two starter mounting bolts and washers. Tighten mounting bolts to 15-20 ft-lbs (18-27 Nm) torque.

4. Install primary cover. See PRIMARY CHAIN, INSTALLATION, PRIMARY COVER in Section 6.

5. Fill primary chaincase / transmission with proper lubricant, refer to PRIMARY CHAIN, INSTALLATION, PRIMARY COVER in Section 6 for details.

6. Install rear exhaust pipe.

7. Connect battery cables, positive cable first.

STARTER SOLENOID

GENERAL (Figure 5-22)

The starter solenoid is a switch that is designed to open and close the starting circuit electromagnetically. The switch consists of contacts and a winding around a hollow cylinder containing a movable plunger.

DISASSEMBLY (Figure 5-22)

1. Remove screws/washers (1) and clip (2).
2. Remove cover (3) and gasket (4); discard gasket.
3. Remove plunger (5) from solenoid housing (6).

ASSEMBLY (Figure 5-22)

1. Replace wire connection hardware as necessary.
2. Install plunger (5) in solenoid housing (6).
3. Install new gasket (4) onto cover (3).
4. Position cover with gasket onto solenoid housing. Install clip (2) and screws/washers (1).

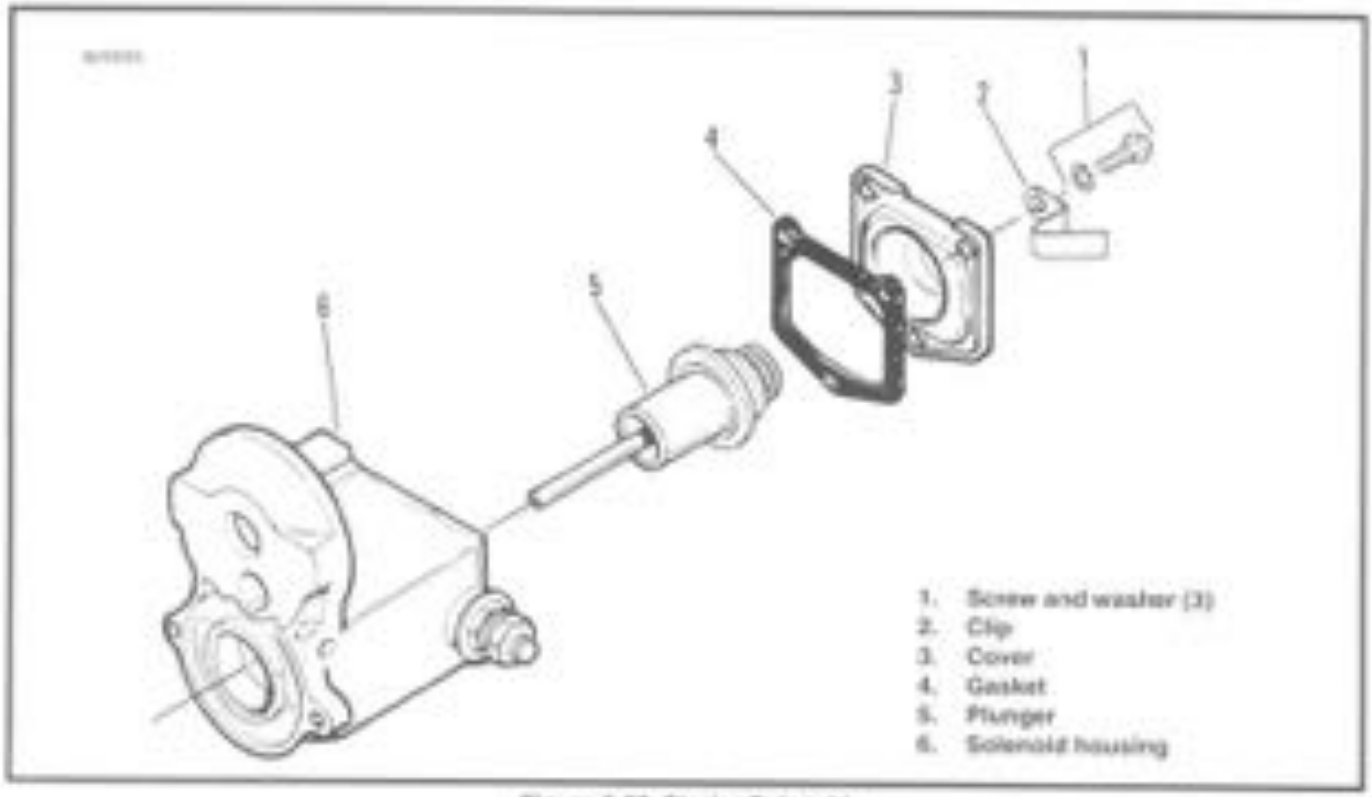


Figure 5-22. Starter Solenoid

DRIVE/TRANSMISSION 6

SUBJECT	PAGE NO.
1. Specifications	6-1
2. Primary Chain	6-3
3. Secondary Drive Belt	6-7
4. Clutch	6-9
5. Clutch Release Mechanism	6-10
6. Primary Drive/Clutch	6-12
7. Transmission	6-16
8. Transmission Case	6-18
9. Shifter Forks and Drum	6-20
10. Mainshaft and Countershaft	6-23
11. Main Drive Gear	6-30
12. Access Door Bearings	6-32
13. Right Transmission Case Bearings	6-33
14. Transmission Installation and Shifter Pawl Adjustment	6-34

SPECIFICATIONS

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.

ITEM	NEW COMPONENTS	SERVICE WEAR LIMITS
Primary Drive (Engine-to-Transmission)		
Engine sprocket – number of teeth	35	
Clutch sprocket – number of teeth	56	
Ratio*	1.60 : 1	
Final Drive (Transmission-to-Rear Wheel)		
Transmission sprocket – number of teeth		
883 cc engine	27	
1200 cc engine	29	
Rear wheel sprocket – number of teeth	61	
Secondary drive belt – number of teeth (orange color code)	128	
Ratio		
883 cc engine	2.26:1	
1200 cc engine	2.10:1	
Transmission		
Primary drive / transmission lubricant capacity	32 U.S. fl oz. (946 ml)	
Overall gear ratios** – Domestic & HDI	**883 cc** **1200 cc**	
First gear (low)	9.71 9.04	
Second gear	7.12 6.62	
Third gear	5.18 4.82	
Fourth gear	4.26 3.97	
Fifth gear (high)	3.61 3.36	

*Internal gear ratios indicate number of mainshaft revolutions required to drive output sprocket one revolution.
**Overall gear ratios indicate number of engine revolutions required to drive rear wheel one revolution.

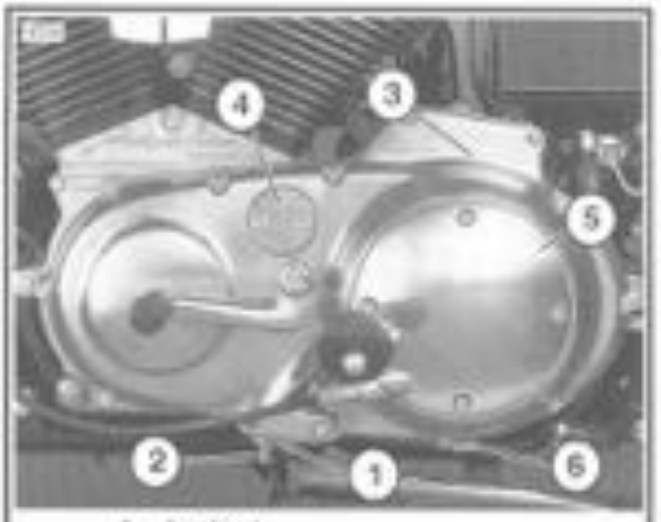
SPECIFICATIONS (CONTINUED)

ITEM	NEW COMPONENTS	SERVICE WEAR LIMITS
Clutch		
Type	Wet – multiple disc	
Clutch plate thickness		
Friction plate (fiber)	0.0866 in. ± 0.0031 in. 2.200 mm ± 0.079 mm	
Steel plate	0.0629 in. ± 0.0020 in. 1.598 mm ± 0.051 mm	
Clutch pack		0.6618 in. (minimum) (16.787 mm)
Maximum allowable warpage		
Friction plate (fiber)		0.0059 in. 0.150 mm
Steel plate		0.0059 in. 0.150 mm
Torque Values		
Transmission sprocket nut lockplate screws	90-110 **in-lbs** 10.2-12.4 Nm	
Transmission sprocket nut **(left-hand threads)**	See page 6-35	
Transmission access door bolts	13-17 ft-lbs 18-23 Nm	
Drain plug	14-21 ft-lbs 19-28 Nm	
Primary cover fasteners	90-110 **in-lbs** 9.9-12.4 Nm	
Primary drive / transmission lubricant level screw	90-110 **in-lbs** 10.2-12.4 Nm	
Chain tensioner stud nut	20-25 ft-lbs 27-34 Nm	
Torx fasteners (stator)	30-40 **in-lbs** 3.4-4.5 Nm	
Engine sprocket nut	190-210 ft-lbs 258-285 Nm	
Sprocket cover screws	90-110 **in-lbs** 10.2-12.4 Nm	
Shift lever pinch bolt	90-110 **in-lbs** 10.2-12.4 Nm	
Footrest fasteners	16-28 ft-lbs 22-38 Nm	
Clutch release mechanism screws	22-30 **in-lbs** 2.5-3.4 Nm	
Inspection cover screws	40-60 **in-lbs** 4.5-6.8 Nm	
Clutch hub nut **(left-hand threads)**	70-80 ft-lbs 95-108 Nm	
Countershaft retaining screw	13-17 ft-lbs 18-23 Nm	

PRIMARY CHAIN

GENERAL

See Figure 6-1. Check the primary chain for correct tension by measuring its vertical free play through the primary chain inspection cover (4) opening located near the top of the primary cover (3).



1. Locknut
2. Chain adjuster screw
3. Primary cover
4. Primary chain inspection cover
5. Clutch inspection cover
6. Drain plug

Figure 6-1. Primary Cover

See Figure 6-2. 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.

NOTE

- *Always measure vertical free play with the sprockets rotated to several different positions. The tightest measurement observed must be within the specifications shown in Figure 6-2.*

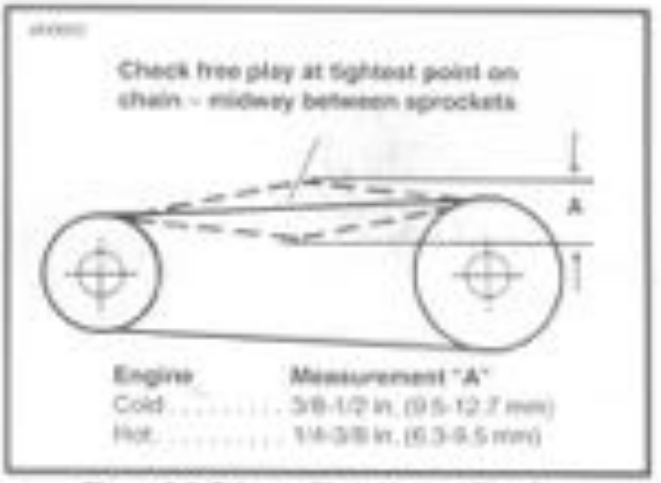


Figure 6-2. Primary Chain Vertical Free Play

- *The initial primary chain vertical free play specification used at the Harley-Davidson assembly plant is 1/4 -1/2 in. (6.3-12.7 mm) with a cold engine. The 1/4 in. (6.3 mm) minimum is only allowed at the absolute tightest point in the drive, as measured with specialized factory equipment. If a chain has less than 1/4 in. vertical free play (with a cold engine), adjust free play to the "field" specification of 3/8-1/2 in. (9.5-12.7 mm). The looser specification will avoid overtightening, which might otherwise occur during adjustment using "non-factory" equipment and methods.*

An opening between the primary drive and transmission compartments allows the same lubricant supply to lubricate moving parts in both compartments. For complete lubrication service on the primary chain, see TRANSMISSION, LUBRICATION in this section.

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 PRIMARY DRIVE/ CLUTCH, REMOVAL.

ADJUSTMENT

⚠WARNING

To avoid accidental start-up of vehicle and possible personal injury, disconnect the battery cables before proceeding. Always disconnect the negative cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion producing personal injury.

See Figure 6-1. The primary chain can be adjusted without removing the primary cover (3). Proceed as follows:

1. Remove the two hex socket screws which secure primary chain inspection cover (4).
2. Rotate sprockets to find tightest point on primary chain.
3. Loosen locknut (1). Turn chain adjuster screw (2) clockwise (inward) to reduce free play or counterclockwise (outward) to increase free play. Vertical free play must fall within the limits specified in Figure 6-2.

NOTE

If vertical free play cannot be set within the limits specified in Figure 6-2, then primary chain and/or chain adjuster are worn beyond adjustment limits. Replace parts as necessary.

4. See Figure 6-1. When tension is set correctly, tighten locknut (1) to 20-25 ft-lbs (27-34 Nm) torque.
5. Install primary chain inspection cover (4). Tighten hex socket screws to 40-60 **in-lbs** (4.5-6.8 Nm) torque.

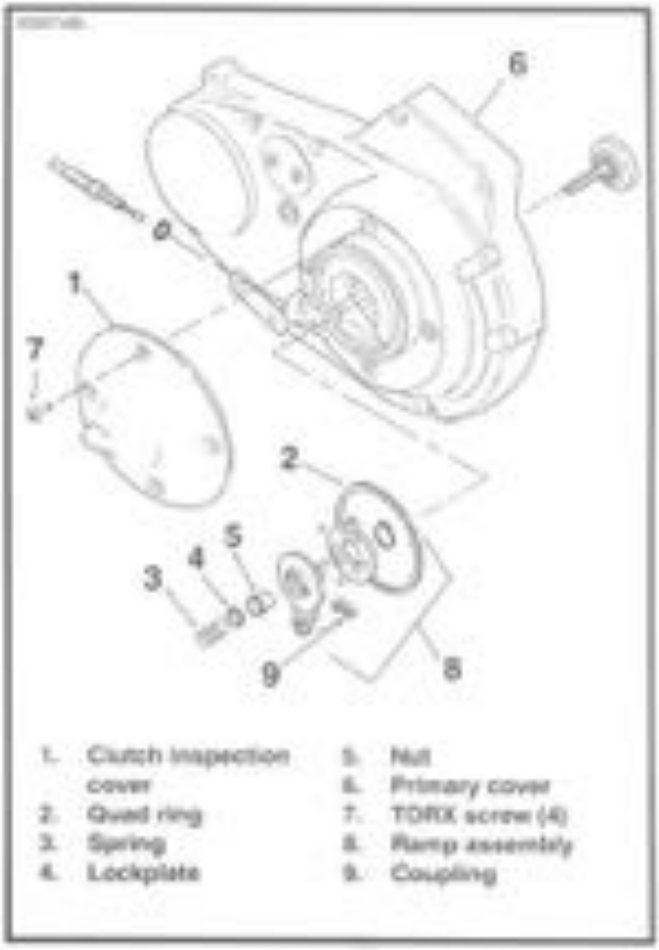
REMOVAL

Primary Cover

⚠WARNING

To avoid accidental start-up of vehicle and possible personal injury, disconnect the battery cables before proceeding. Always disconnect the negative cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion producing personal injury.

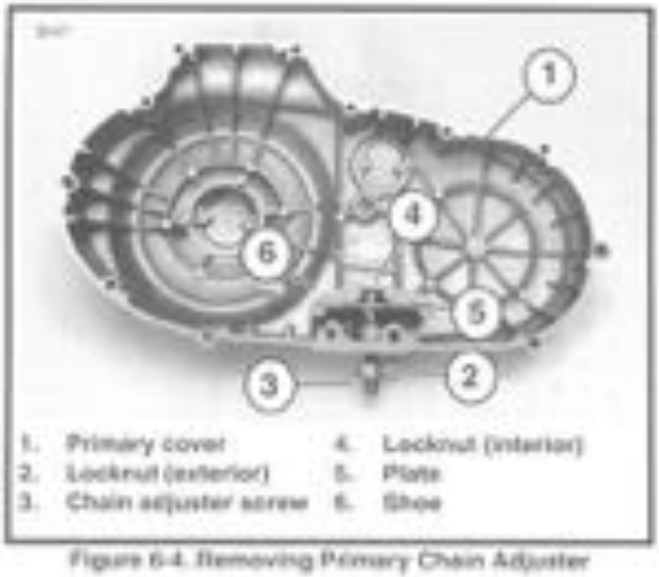
1. See Figure 6-1. Place a drain pan under the engine. Remove drain plug (6) and drain lubricant from primary drive.
2. Remove gear shifter lever and left footrest assembly.
3. Loosen locknut (1). Turn chain adjuster screw (2) counter-clockwise to relax primary chain tension.
4. See Figure 6-3. Remove clutch inspection cover (1). Remove quad ring (2) from groove in primary cover.
5. Slide spring (3) with attached hex lockplate (4) from flats of adjusting screw.



1.	Clutch inspection cover	5.	Nut
2.	Quad ring	6.	Primary cover
3.	Spring	7.	TORX screw (4)
4.	Lockplate	8.	Ramp assembly
		9.	Coupling

Figure 6-3. Clutch Inspection Cover

6. Turn adjusting screw clockwise to release ramp and coupling mechanism. As the adjusting screw is turned, ramp assembly (8) moves forward. Unscrew nut (5) from end of adjusting screw.
7. Remove hook of ramp from button to the rear of cable end coupling (9). Remove cable end from slot in coupling. Remove coupling and ramp assembly.
8. Remove screws which secure primary cover. Remove cover and gasket.
9. Remove and discard shifter shaft oil seal.



1. Primary cover
2. Locknut (exterior)
3. Chain adjuster screw
4. Locknut (interior)
5. Plate
6. Shoe

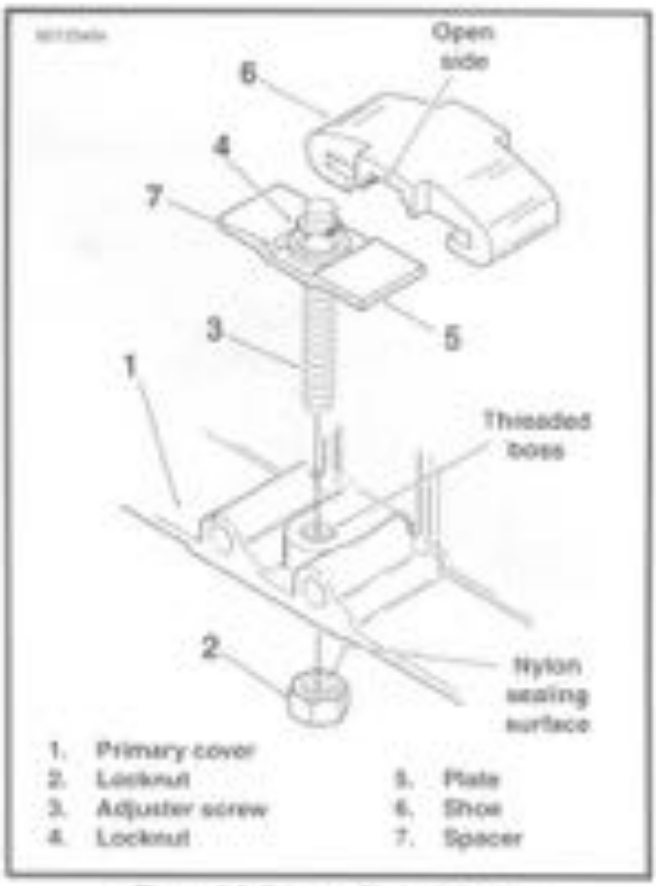
Figure 6-4. Removing Primary Chain Adjuster

Primary Chain Adjuster (Figure 6-4)

1. Remove primary cover (1). See REMOVAL, PRIMARY COVER.

2. Remove locknut (2) from adjuster screw (3). Turn adjuster screw out of threaded boss in primary cover.

3. Slide shoe (6) off plate (5) (shoe must be slid off plate toward closed or blind side of shoe). Remove locknut (4) and plate (5).



1. Primary cover
2. Locknut
3. Adjuster screw
4. Locknut
5. Plate
6. Shoe
7. Spacer

Figure 6-5. Primary Chain Adjuster

INSTALLATION

Primary Chain Adjuster (Figure 6-5)

1. If shoe (6) is badly worn, replace it or adjuster assembly.

2. Install plate (5) over top of adjuster screw (3). Place spacer (7) over top of adjuster screw next to plate. Secure plate and spacer to adjuster screw by threading on locknut (4). Tighten locknut to 10-12 ft-lbs (14-16 Nm) torque.

3. Place plate into slots at open end of shoe (6). Slide shoe over plate until locknut at top end of adjuster screw is against closed (blind) side of shoe.

4. Position adjuster inside primary cover (1) with closed side of shoe against cover. Thread adjuster screw into tapped boss at bottom of primary cover. At outside of cover, install locknut (2) onto adjuster screw with nylon sealing surface toward cover.

5. Install primary cover. See PRIMARY CHAIN INSTALLATION, PRIMARY COVER.

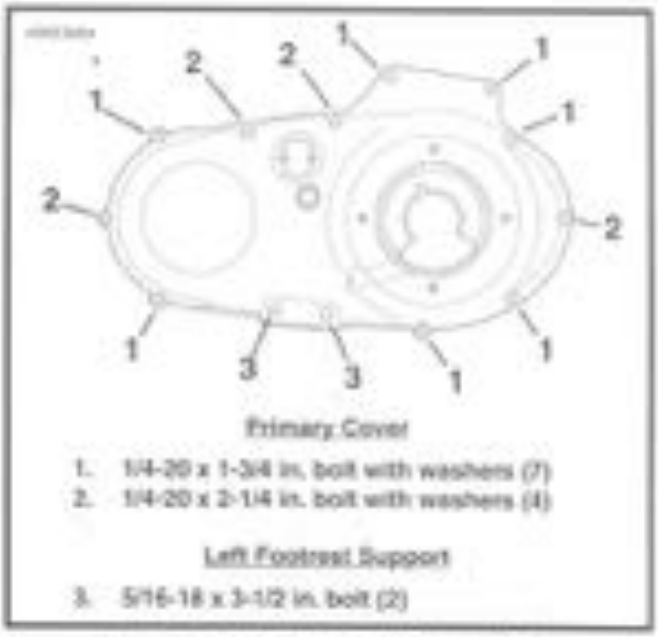
Primary Cover

1. Remove foreign material from magnetic drain plug. Install plug and tighten to 14-21 ft-lbs (19-28 Nm) torque.
2. Install a new gasket on primary cover.
3. See Figure 6-6. Install primary cover and gasket onto left crankcase half using mounting screws. Tighten screws to 80-110 **in-lbs** (9.0-12.4 Nm) torque.
4. Install new shifter shaft oil seal.
5. Fit coupling over cable end with the rounded side inboard, the ramp connector button outboard. With retaining ring side of ramp assembly facing inward, place hook of ramp around coupling button and rotate assembly counter-clockwise until tang on inner ramp fits in slot of primary cover.
6. See Figure 6-3. Thread nut on adjusting screw until slot of screw is accessible with a screwdriver. Fit nut hex into recess of outer ramp and turn adjusting screw counter-clockwise.
7. Adjust clutch. See CLUTCH RELEASE MECHANISM, ADJUSTMENT in this section, steps 1-2 and 5-9.
8. Adjust primary chain tension. See PRIMARY CHAIN, ADJUSTMENT.
9. Add transmission fluid. See TRANSMISSION, LUBRICATION in this section, steps 6-8.
10. Install the gear shift lever. Tighten pinch bolt to 80-110 **in-lbs** (9.0-12.4 Nm) torque.
11. Install left footrest. Tighten footrest mounting bolts to 16-26 ft-lbs (22-38 Nm) torque.

⚠WARNING

Always connect positive battery cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion producing personal injury.

12. Connect battery cables, positive cable first.



Primary Cover

1. 1/4-20 x 1-3/4 in. bolt with washers (7)
2. 1/4-20 x 2-1/4 in. bolt with washers (4)

Left Footrest Support

3. 5/16-18 x 3-1/2 in. bolt (2)

Figure 6-6. Install Primary Cover Bolts

SECONDARY DRIVE BELT

GENERAL (Figure 6-7)

The secondary drive belt should be checked for unusual wear, cracking, or loss of teeth. Check the belt sprocket for unusual wear, broken teeth, or damaged flange.

Check belt deflection with no rider or cargo on motorcycle, with transmission in neutral, with belt and sprockets at ambient temperature (cold engine), and with motorcycle resting on side stand. At position "A," midway between transmission sprocket and rear wheel sprocket, apply 10 lbs of upward force on lower span of rear belt using BELT TENSION GAUGE (Part No. HD-35381). Measure belt deflection "B" several times, each time with belt moved (by rotating rear wheel) to a different position on sprockets. With sprockets rotated to the tightest belt position, belt deflection "B" should be 9/16 in. to 11/16 in. (14.3-17.5 mm) (measured at position "A").

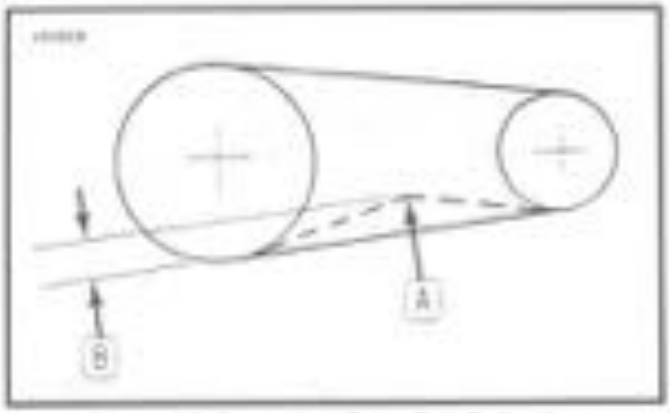


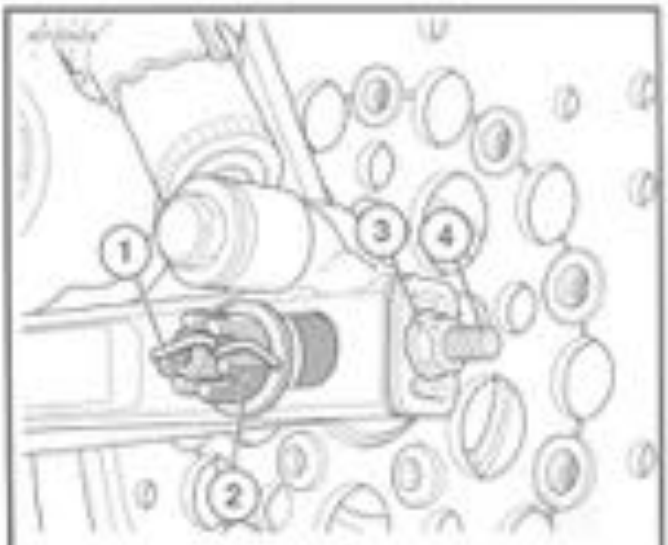
Figure 6-7. Secondary Drive Belt Deflection

ADJUSTMENT

1. Determine belt deflection in manner specified in GENERAL above. See Figure 6-7. If belt deflection "B" is not 9/16-11/16 in. (14.3-17.5 mm) (measured at position "A"), adjust per the following procedures.
2. See Figure 6-11. Remove cotter pin (1) and loosen rear axle nut (2). Turn axle adjuster nuts (3) (on each side of rear fork) clockwise to decrease belt deflection (increase tension), or counterclockwise to increase belt deflection (decrease tension). Turn each adjuster nut exactly the same number of turns in order to maintain alignment of rear wheel.
3. Check rear wheel alignment. Wheel must be centered between swing arm. See TIRES, WHEEL ALIGNMENT in Section 2.
4. After belt deflection is properly adjusted, tighten axle nut (2) to 60-65 ft-lbs (81-88 Nm) torque. Install cotter pin (1).

CLEANING

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

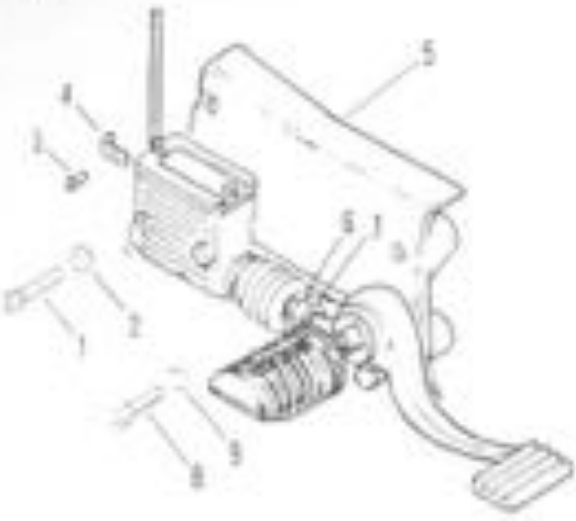


1. Cotter pin
2. Axle nut
3. Axle adjuster nut (2)
4. Axle adjuster (2)

Figure 6-8. Secondary Drive Belt Adjustment

REMOVAL AND INSTALLATION

1. Raise rear of vehicle off the floor using a center stand beneath frame.
2. Remove exhaust system. See EXHAUST SYSTEM, REMOVAL in Section 2.
3. See Figure 6-9. Remove screw (3) and clip (4) which secure rear brake line to sprocket cover (5).
4. Remove two socket head screws (1) and lockwashers (2) which secure rear brake master cylinder to sprocket cover.
5. At rear brake linkage, loosen locknut (7). Turn push rod (6) at flats until rod end is free of push rod.
6. Remove three sprocket cover screws (8) and washers (9). Remove sprocket cover (5).



1. Socket screw (2)
2. Lockwasher (2)
3. Screw
4. Clip
5. Sprocket cover
6. Push rod
7. Locknut
8. Socket screw (3)
9. Washer (3)

Figure 6-9. Sprocket Cover

7. See Figure 6-8. Remove cotter pin (1) and loosen rear axle nut (2). Decrease belt tension by turning the axle adjuster nut (3) on each side of rear fork an equal number of turns counterclockwise.

⚠CAUTION

Do not bend secondary belt backwards or into loops smaller than 5 inches (130 mm) in diameter. Damage to belt cords will otherwise result.

8. Remove right lower shock absorber bolt and belt guard. Remove belt.

9. See Figure 6-9. Install belt. Reinstall removed components in reverse order of removal procedures.
   - Tighten sprocket cover screws (8) to 90-110 **in-lbs** (10.2-12.4 Nm) torque.
   - Tighten master cylinder screws (1) to 155-190 **in-lbs** (17.5-21.5 Nm) torque.
   - Install exhaust system. See EXHAUST SYSTEM, INSTALLATION in Section 2.
   - Adjust brake pedal, see REAR BRAKE MASTER CYLINDER, ADJUSTMENT, BRAKE PEDAL.
   - Adjust belt tension; see SECONDARY DRIVE BELT, ADJUSTMENT.

CLUTCH

GENERAL (Figure 6-13)

The purpose of the clutch is to smoothly disengage and engage the engine from the rear wheel for starting, stopping, and shifting gears.

The clutch is a wet, multiple-disc clutch with six steel plates (18), one spring plate (19), and eight fiber (friction) plates (17) stacked alternately in the clutch shell (25). The order of plate assembly, from inboard to outboard, is as follows:

F - St - F - St - F - St - F - **Sp** - F - St - F - St - F - St - F

(F = Friction plate, St = Steel plate, **Sp** = Spring plate)

The friction plates (clutch driving plates) are keyed to the clutch shell (25), which is driven by the engine through the primary chain. The steel plates (clutch driven plates) and the centrally located spring plate (also a clutch driven plate) are keyed to the clutch hub (22), which drives the rear wheel through the transmission and secondary drive belt.

When the clutch is engaged (clutch lever released), the diaphragm spring (10) applies strong inward force against the pressure plate (16); the pressure plate then presses the clutch plates (17, 18, and 19) together, allowing no slippage between the plates and causing the plates to turn as a single unit. The result is that the rotational force of the clutch shell (25) is fully transmitted through the "locked" clutch plates to the clutch hub (22). 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 (16) is pulled outward (by clutch cable action) against the diaphragm spring (10), thereby compressing the diaphragm spring. With the pressure plate retracted, strong inward force no longer squeezes the clutch plates (17, 18, and 19) together. The friction plates (17) are now free to rotate at a different relative speed than that of the steel and spring plates (18 and 19) (i.e. – slippage between the clutch plates occurs). The result is that the rotational force of the clutch shell (25) is no longer fully transmitted through the "unlocked" clutch plates to the clutch hub (22). The engine is free to rotate at a different speed than the rear wheel.

TROUBLESHOOTING

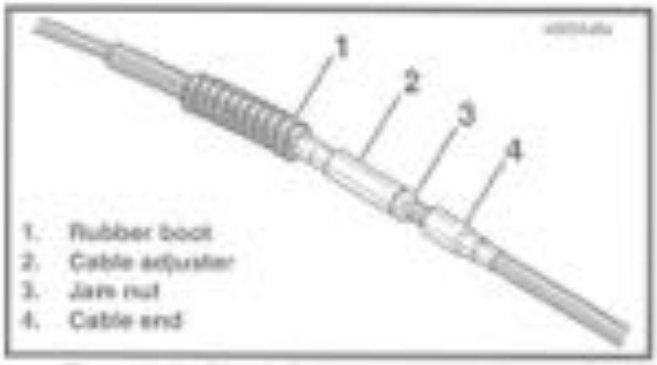
Symptom	Cause (Check in following order)	Remedy
Clutch slips.	Incorrect clutch release adjustment. Worn clutch plates.	Check and adjust clutch release mechanism. Check service wear limits. Replace plates.
Clutch drags.	Incorrect clutch release adjustment. Worn clutch release ramps or balls. Warped clutch steel plates. Blade worn or damaged clutch gear splines. Overfilled primary.	Check and adjust clutch release mechanism. Replace release ramps and/or balls. Replace clutch steel plates. Replace clutch gear or hub as required. Drain lubricant to correct level.

CLUTCH RELEASE MECHANISM

ADJUSTMENT

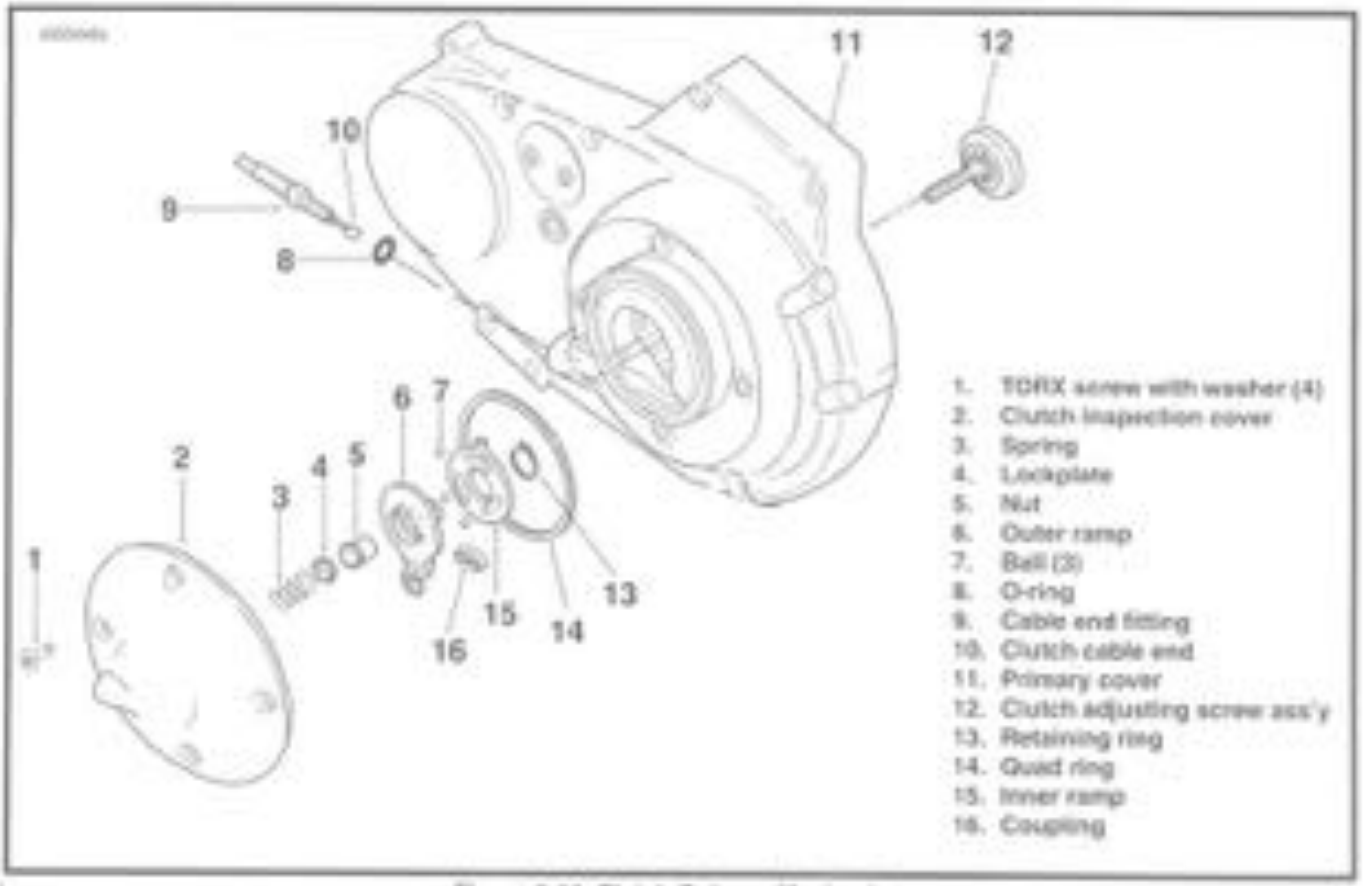
All models feature a new primary cover and a quick-release clutch cable to simplify both clutch service and adjustment.

1. See Figure 6-10. Slide rubber boot off cable adjuster.
2. Holding cable adjuster with 1/2 inch wrench, loosen jam nut using a 9/16 inch wrench. Back jam nut away from cable adjuster. Move adjuster toward jam nut to introduce a large amount of free play at hand lever.
3. Remove locknut and bolt to free left side footrest from footrest support. Remove footrest and spring washer.
4. Using T-27 TORX driver, remove four TORX screws with washers to remove clutch inspection cover. Exercise caution to avoid damaging or dislodging quad ring in primary cover. See Figure 6-11.
5. Slide spring with attached hex lockplate from flats of adjusting screw. Turn adjusting screw counter-clockwise until resistance is felt. Back off adjusting screw 1/4 turn.
6. Slide spring with hex lockplate onto flats of adjusting screw. If necessary, turn adjusting screw clockwise slightly so that lockplate slides onto flats while also fitting within recess of outer ramp.
7. Verify that quad ring is fully seated in groove of primary cover. Using T-27 TORX driver, install four TORX screws with washers to secure clutch inspection cover. Tighten screws in a crosswise pattern to 7-9 ft-lbs (9-12 Nm) torque.
8. Turn cable adjuster clockwise away from jam nut until slack is eliminated. Pull clutch cable ferrule away from clutch lever bracket to check free play. Turn cable adjuster as necessary to obtain 1/16 to 1/8 inch free play between end of cable ferrule and clutch lever bracket, as shown in Figure 6-12.
9. Hold adjuster with 1/2 inch wrench. Using 9/16 inch wrench, tighten jam nut against cable adjuster. Cover cable adjuster mechanism with rubber boot.
10. Position spring washer over lower inside hole of left footrest support. The concave side of the spring washer



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

Figure 6-10. Clutch Cable Adjuster Mechanism



1. TORX screw with washer (4)
2. Clutch inspection cover
3. Spring
4. Lockplate
5. Nut
6. Outer ramp
7. Ball (3)
8. O-ring
9. Cable end fitting
10. Clutch cable end
11. Primary cover
12. Clutch adjusting screw ass'y
13. Retaining ring
14. Quad ring
15. Inner ramp
16. Coupling

Figure 6-11. Clutch Release Mechanism

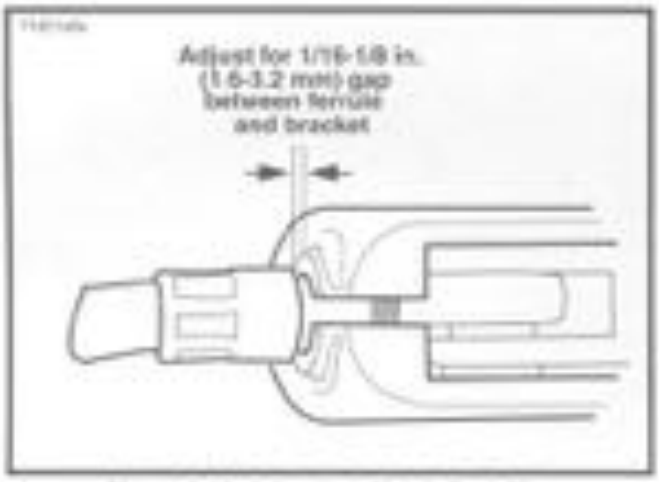


Figure 6-12. Adjusting Clutch Free Play

should face the support flange. Align holes in footrest with those in support and spring washer. Install bolt and locknut. Tighten locknut to 8-16 ft-lbs (11-22 Nm) torque.

DISASSEMBLY

⚠WARNING

To avoid accidental start-up of vehicle and possible personal injury, disconnect the battery cables before proceeding. Always disconnect the negative cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion producing personal injury.

1. See Clutch Release Mechanism, Adjustment, steps 1-4.
2. Slide spring with attached hex lockplate from flats of adjusting screw. See Figure 6-11.
3. Turn adjusting screw clockwise to release ramp and coupling mechanism. As the adjusting screw is turned, ramp assembly moves forward. Unscrew nut from end of adjusting screw.
4. Remove hook of ramp from button to the rear of cable end coupling. Remove cable end from slot in coupling.
5. Remove retaining ring from ramp assembly to separate inner and outer halves. Remove balls from ramp sockets.

CLEANING, INSPECTION, AND REPAIR (Figure 6-11)

1. Thoroughly clean all parts in cleaning solvent.
2. Inspect three balls of release mechanism and ball socket surfaces of inner and outer ramps for wear, pitting, surface breakdown and other damage. Replace parts as necessary.
3. Check hub fit of inner and outer ramps. Replace ramps if excessively worn.
4. Check clutch cable for frayed or worn ends. Replace cable if damaged or worn.
5. Change or add transmission fluid if necessary. See TRANSMISSION, LUBRICATION in this section.

ASSEMBLY (Figure 6-11)

1. Apply multi-purpose grease to balls and ramps. Insert balls in sockets of outer ramp. Install inner ramp on hub of outer ramp with tang 180° from hook of outer ramp. Install retaining ring in groove of outer ramp hub.
2. Fit coupling over cable end with the rounded side inboard, the ramp connector button outboard. With retaining ring side of ramp assembly facing inward, place hook of ramp around coupling button and rotate assembly counter-clockwise until tang on inner ramp fits in slot of primary cover.
3. Thread nut on adjusting screw until slot of screw is accessible with a screwdriver. Fit nut hex into recess of outer ramp and turn adjusting screw counter clockwise until resistance is felt. Back off adjusting screw 1/4 turn.
4. See Clutch Release Mechanism, Adjustment, steps 6-10.

REMOVAL (Figure 6-13)

⚠WARNING

To avoid accidental start-up of vehicle and possible personal injury, disconnect the battery cables before proceeding. Always disconnect the negative cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion producing personal injury.

NOTE

If replacement of clutch pack (friction plates [17], steel plates [18], and spring plate [19]) is the only service work to be performed, perform REMOVAL Step 1 only, and then proceed to DISASSEMBLY. NOTE

1. Remove primary cover, as described under PRIMARY CHAIN, REMOVAL, PRIMARY COVER.
2. Install SPROCKET LOCKING LINK (Part No. HD-38362). Remove the engine sprocket nut. Loosen, but do not remove, engine sprocket. If necessary, use the slotted portion of PULLER (Part No. HD-97292-61) and two bolts to loosen the engine sprocket.
3. Remove retaining ring (13). Remove adjusting screw assembly (12, 13, 14, and 15) from pressure plate (16).

⚠CAUTION

Clutch hub nut (22) has left-hand threads. Turn nut clockwise to loosen and remove from mainshaft.

4. Remove nut (20) and washer (21). Remove the clutch assembly, primary chain, and engine sprocket as an assembly from the vehicle.
5. If primary chain is damaged or excessively worn, remove it from engine sprocket and clutch assembly; replace original primary chain with a new one.

DISASSEMBLY

NOTE

See Figure 6-13. If replacement of clutch pack (friction plates [17], steel plates [18], and spring plate [19]) is the only service work to be performed, perform DISASSEMBLY Steps 2, 3, 4, 5, and 7 only, and then proceed to INSPECTION AND REPAIR. NOTE. ***Observe all ⚠WARNING and ⚠CAUTION statements which apply to the steps specified.***

1. See Figure 6-13. With clutch assembly removed from primary chaincase, reinstall adjusting screw assembly (12, 13, 14, and 15) into pressure plate (16), noting that two tabs on perimeter of release plate (12) must be inserted into corresponding recesses in pressure plate (16). Secure the adjusting screw assembly with retaining ring (13).

⚠WARNING

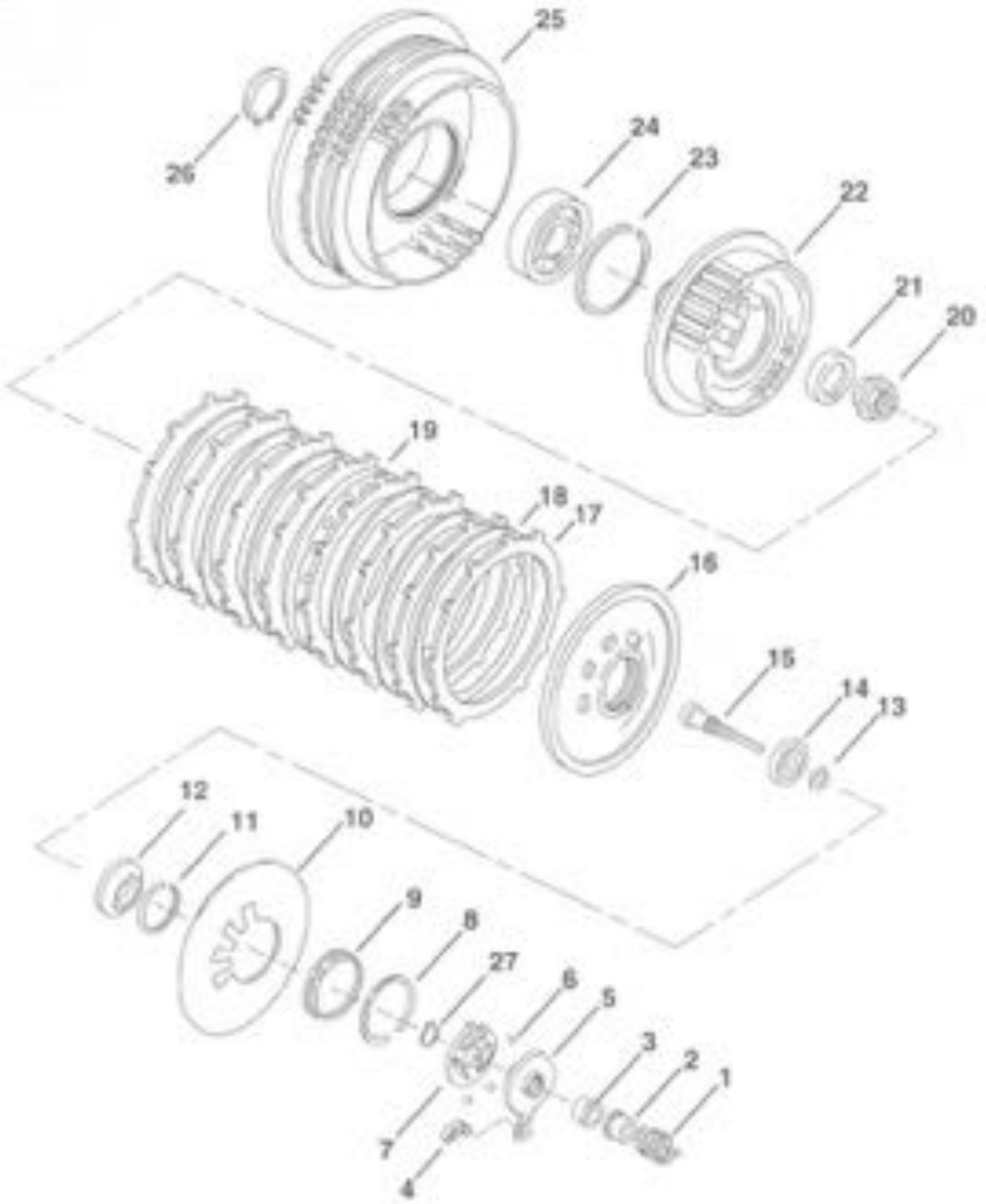
See Figure 6-14. Do not attempt to disassemble the clutch without SPRING COMPRESSING TOOL (Part No. HD-38515A) and CLUTCH SPRING FORCING SCREW (Part No. HD-38515-91). Otherwise, the highly compressed diaphragm spring could fly out with great force, possibly causing personal injury.

2. Thread the CLUTCH SPRING FORCING SCREW (Part No. HD-38515-91) (item 1, Figure 6-14) onto the clutch adjusting screw (item 15, Figure 6-13). Place the bridge (item 2, Figure 6-14) of SPRING COMPRESSING TOOL (Part No. HD-38515A) against diaphragm spring (item 10, Figure 6-13). Thread the tool handle (item 3, Figure 6-14) onto end of forcing screw.

⚠CAUTION

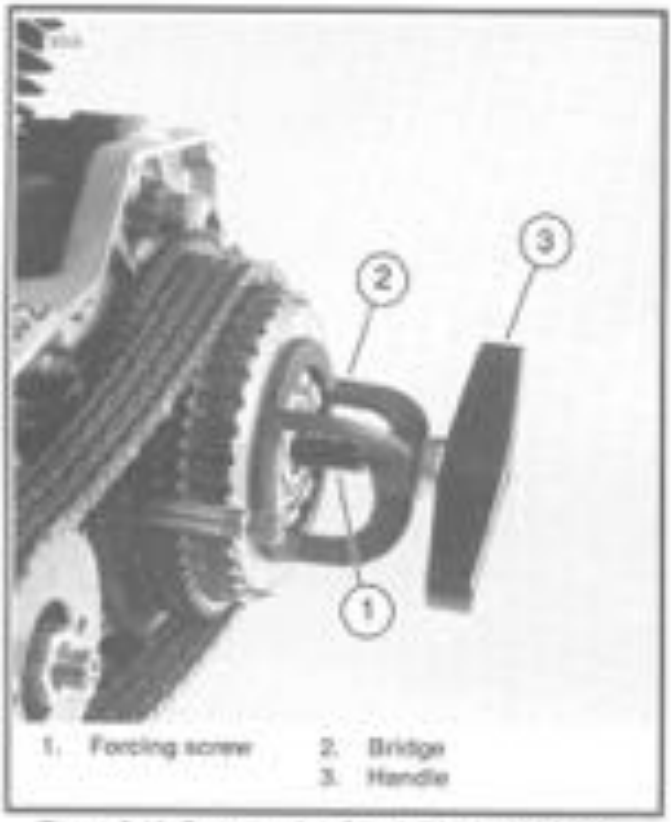
See Figure 6-13. Turn compressing tool handle only the amount required to remove spring seat (9) and snap ring (8). Excessive compression of diaphragm spring could damage clutch pressure plate.

3. See Figure 6-13. With a wrench on the clutch spring forcing screw flats to prevent the forcing screw from turning, turn handle clockwise until tool relieves pressure on snap ring (8) and spring seat (9).
4. Remove snap ring (8) and spring seat (9) from the groove in clutch hub (22) prongs. Remove the assembly of diaphragm spring (10), pressure plate (16), adjusting screw components, and compressing tool.
5. Turn the compressing tool handle counterclockwise until the clutch spring forcing screw disconnects from the clutch adjusting screw (15). Remove snap ring (8), spring seat (9), and diaphragm spring (10) from pressure plate (16) assembly.
6. Remove retaining ring (13) and adjusting screw assembly (12, 13, 14, and 15) from pressure plate (16). If necessary, disassemble adjusting screw assembly by removing retaining ring (13), and then separating the remaining adjusting screw components (12, 14, and 15).
7. Remove the clutch pack, which consists of eight friction plates (17), six steel plates (18), and a spring plate (19), from the clutch hub (22).



1. Spring
2. Locking plate
3. Nut
4. Coupling
5. Outer ramp
6. Ball (3)
7. Inner ramp
8. Snap ring
9. Spring seat
10. Diaphragm spring
11. Retaining ring
12. Release plate
13. Retaining ring
14. Bearing
15. Adjusting screw
16. Pressure plate
17. Friction plate (8)
18. Steel plate (8)
19. Spring plate
20. Nut mainshaft
21. Washer
22. Clutch hub
23. Retaining ring
24. Bearing
25. Clutch shell
26. Retaining ring
27. Retaining ring

Figure 6-13. Clutch Assembly



1. Forcing screw
2. Bridge
3. Handle

Figure 6-14. Compressing Clutch Diaphragm Spring

⚠CAUTION

See Figure 6-13. Due to the possible damage to the bearing (24), the clutch hub (22) and shell (25) 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. See Figure 6-13. Remove retaining ring (23) from inboard end of clutch hub (22). Using an arbor press, separate clutch hub (22) from assembly of clutch shell (25), bearing (24), and retaining ring (23).
9. See Figure 6-13. Remove retaining ring (23) from groove in clutch shell (25). Press on the inboard side of bearing (24) outer race to remove bearing from clutch shell.

INSPECTION AND REPAIR (Figure 6-13)

NOTE

If replacement of clutch pack friction plates (17), steel plates (18), and spring plate (19) is the only service work to be performed, perform all INSPECTION AND REPAIR steps (except Step 5), and then proceed to ASSEMBLY, NOTE.

Wash all parts, except the friction (driven) plates (17) and bearing (24), in cleaning solvent. Blow dry with compressed air. Examine the clutch components as follows:

1. Check for worn lining surface.
2. Inspect for cracked or chipped lining.
3. Inspect each steel (drive) plate (18) for grooves. Also, check each steel plate for flatness in several places using a feeler gauge; the plate must be placed on a surface plate or flat surface. Replace any plates that are damaged or that are warped more than 0.006 in. (0.15 mm).
4. Wipe the lubricant from the eight friction plates, and stack them on top of each other. Measure the thickness of the eight stacked friction plates with a dial caliper or micrometer. The minimum thickness must be 0.661 in. (16.79 mm). If the thickness is less than specified, the friction plates and steel plates must be discarded, and a new set of both friction and steel plates must be installed.
5. Check the bearing (24) for smoothness by rotating the clutch shell while holding the clutch hub. If bearing is rough or binds, it must be replaced.
6. Check the primary chain sprocket and the starter ring gear on the clutch shell (25). If either sprocket or ring gear are badly worn or damaged, replace the clutch shell.
7. Check the slots that mate with the clutch plates on both clutch shell and hub. If slots are worn or damaged, replace shell and/or hub.
8. Check the diaphragm spring (10) for cracks or bent tabs. Install a new spring if either condition exists.

ASSEMBLY

NOTE

See Figure 6-13. If replacement of clutch pack (friction plates [17], steel plates [18], and spring plate [19]) is the only service work to be performed, perform ASSEMBLY Steps 2, 5, 6, 7, and 8 only, and then proceed to INSTALLATION. NOTE. ***Observe all ⚠WARNING and ⚠CAUTION statements which apply to the steps specified.***

1. See Figure 6-13. If the assembly of the clutch hub (22) and shell (25) was disassembled, press **new** bearing (24) in clutch shell; secure bearing with a **new** retaining ring (23). Press inboard end of clutch hub into shell bearing; secure with **new** retaining ring (26) on end of hub.
2. Install the clutch pack, which consists of eight friction plates (17), six steel plates (18), and a spring plate (19), into the clutch hub (22). 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

INBOARD ..... OUTBOARD

F = Friction plate
St = Steel plate
Sp = Spring plate

3. If disassembled, assemble bearing (14) and adjusting screw (15) in release plate (12); secure with **new** retaining ring (13).

4. Install adjusting screw assembly (12, 13, 14, and 15) into pressure plate (16), noting that two tabs on perimeter of release plate (12) must be inserted into corresponding recesses in pressure plate (16). Secure the adjusting screw assembly with retaining ring (11).

5. Position diaphragm spring (10), with its concave side facing inboard (toward pressure plate), onto pressure plate (16) assembly. Position spring seat (9), with its flat, larger O.D. side facing inboard (toward diaphragm spring), and a **new** snap ring (8) onto convex (outboard) side of diaphragm spring (10).

6. Thread the CLUTCH SPRING FORCING SCREW (Part No. HD-38515-91) (item 1, Figure 6-14) onto the clutch adjusting screw (item 15, Figure 6-13). Place the bridge (item 2, Figure 6-14) of SPRING COMPRESSING TOOL (Part No. HD-38515A) against diaphragm spring (item 10, Figure 6-13). Thread the tool handle (item 3, Figure 6-14) onto end of forcing screw. Do not tighten compressing tool against diaphragm spring at this time.

7. See Figure 6-13. Align square openings of pressure plate (16) and diaphragm spring (10) so that the assembly can be installed over prongs of clutch hub (22). Place assembly of spring seat, snap ring, diaphragm spring, pressure plate, adjusting screw components, and compressing tool onto clutch hub (22), and against clutch pack.

⚠CAUTION

Turn compressing tool handle only the amount required to install spring seat (9) and snap ring (8). Excessive compression of diaphragm spring (10) could damage clutch pressure plate.

8. Place a wrench on the clutch spring forcing screw flats to prevent the forcing screw from turning. Turn compressing tool handle clockwise until diaphragm spring (10) compresses just enough to install spring seat (9) and snap ring (8) into the groove in clutch hub (22) prongs. With snap ring positioned against flange face (outboard side) of spring seat, and fully seated in groove of clutch hub, carefully loosen and remove compression tool.

9. Remove retaining ring (11). Remove adjusting screw assembly (12, 13, 14, and 15) from pressure plate (16).

INSTALLATION (Figure 6-13)

NOTE

If replacement of clutch pack (friction plates [17], steel plates [18], and spring plate [19]) was the only service work performed, perform INSTALLATION Step 5 only.

1. Install the engine sprocket, clutch assembly, and primary chain as a unit into primary chaincase.

2. Install SPROCKET LOCKING LINK (Part No. HD-36962). Apply two or three drops of LOCTITE Threadlocker 262 (red) onto threads of sprocket shaft. Install the engine sprocket nut. Tighten nut to 190 - 210 ft-lbs (258-285 Nm) torque.

⚠CAUTION

Washer (21) must be installed with the word "out" facing the mainshaft nut (20). Incorrect assembly can result in clutch and/or transmission failure.

3. Apply two or three drops of LOCTITE Threadlocker 262 (red) onto threads on end of mainshaft. Install washer (21) and nut (20) **(left-hand threads)** on mainshaft. Tighten nut (20) to 70-80 ft-lbs (95-108 Nm) torque.

4. Install adjusting screw assembly (12, 13, 14, and 15) in the pressure plate (16), noting that two tabs on perimeter of release plate (12) must be inserted into corresponding recesses in pressure plate (16). Secure assembly with a **new** retaining ring (11).

5. Install primary cover as described under PRIMARY CHAIN, INSTALLATION, PRIMARY COVER. Connect battery cables (positive cable first).

GENERAL (Figure 6-17)

The transmission is a five-speed constant-mesh type housed in an extension of the crankcase. The transmission permits the rider to vary the ratio of engine speed-to-rear driving wheel speed in order to meet the varying conditions of operation.

The transmission is foot-operated by the gear shifter lever, which transmits the force through a gear shifter shaft. The shifter shaft actuates a pawl and a shifter fork drum. The shifter fork drum moves shifter forks, which slide a series of shifter clutch gears, on the mainshaft and countershaft, into and out of mesh with the other gears.

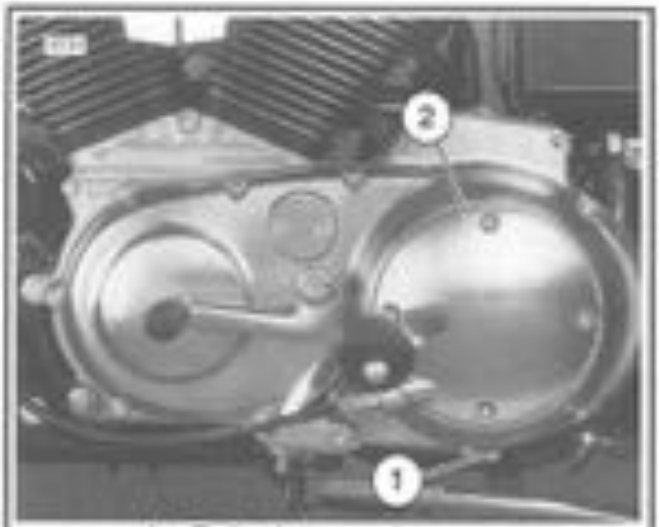
LUBRICATION

Drain transmission and refill to correct level with fresh, clean lubricant at least once each year or every 5000 miles (8000 km), whichever comes first. For best results, drain lubricant while hot. Proceed as follows:

⚠CAUTION

Do not overfill the primary chaincase with lubricant. Overfilling may cause rough clutch engagement and incomplete disengagement (or clutch drag).

1. On level surface, stand vehicle upright (not leaning on jiffy stand) to prevent chaincase lubricant from draining out of clutch cover opening when refilled.
2. See Figure 6-15. Position a suitable container under transmission lubricant drain plug (1). Remove drain plug and drain lubricant.



1. Drain plug
2. Clutch inspection cover

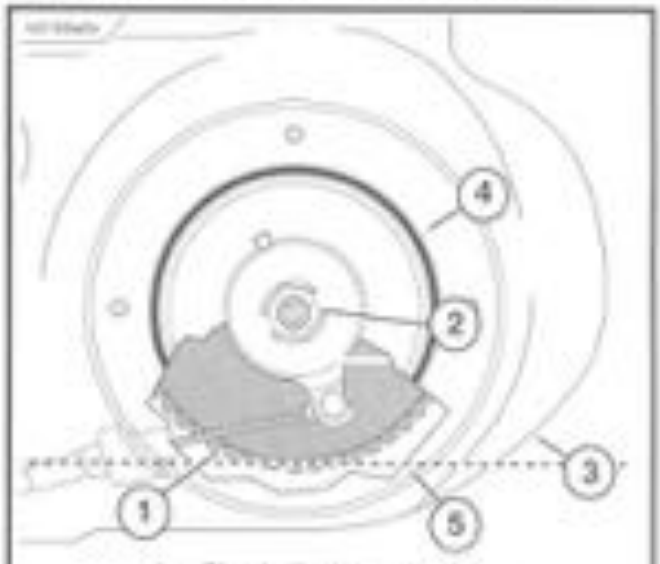
Figure 6-15. Primary Cover

3. Remove foreign material from magnetic drain plug. Reinstall plug and tighten to 14-21 ft-lbs (19-28 Nm) torque.
4. Using a T-27 TORX driver, remove screws with washers from clutch inspection cover (2). Remove clutch inspection cover from primary cover. Exercise caution to avoid damaging or dislodging quad ring on primary cover.

⚠CAUTION

Do not overfill the primary chaincase with lubricant. Overfilling may cause rough clutch engagement and incomplete disengagement (or clutch drag).

5. Add 32 fluid ounces (946 ml) of Harley-Davidson Sport-Trans Fluid (Part No. 98854-96 quart size; Part No. 98855-96 gallon size) through clutch inspection cover opening.
6. See Figure 6-16. Verify that lubricant level (5) is even with bottom of clutch diaphragm spring (1).
7. Install clutch inspection cover on primary cover using T-27 TORX screws with washers. Tighten screws in a crisscross pattern to 7-9 ft-lbs (9-12 Nm) torque.



1. Clutch diaphragm spring
2. Clutch adjusting screw
3. Primary cover
4. Quad ring
5. Chaincase lubricant level

Figure 6-16. Chaincase Lubricant Level

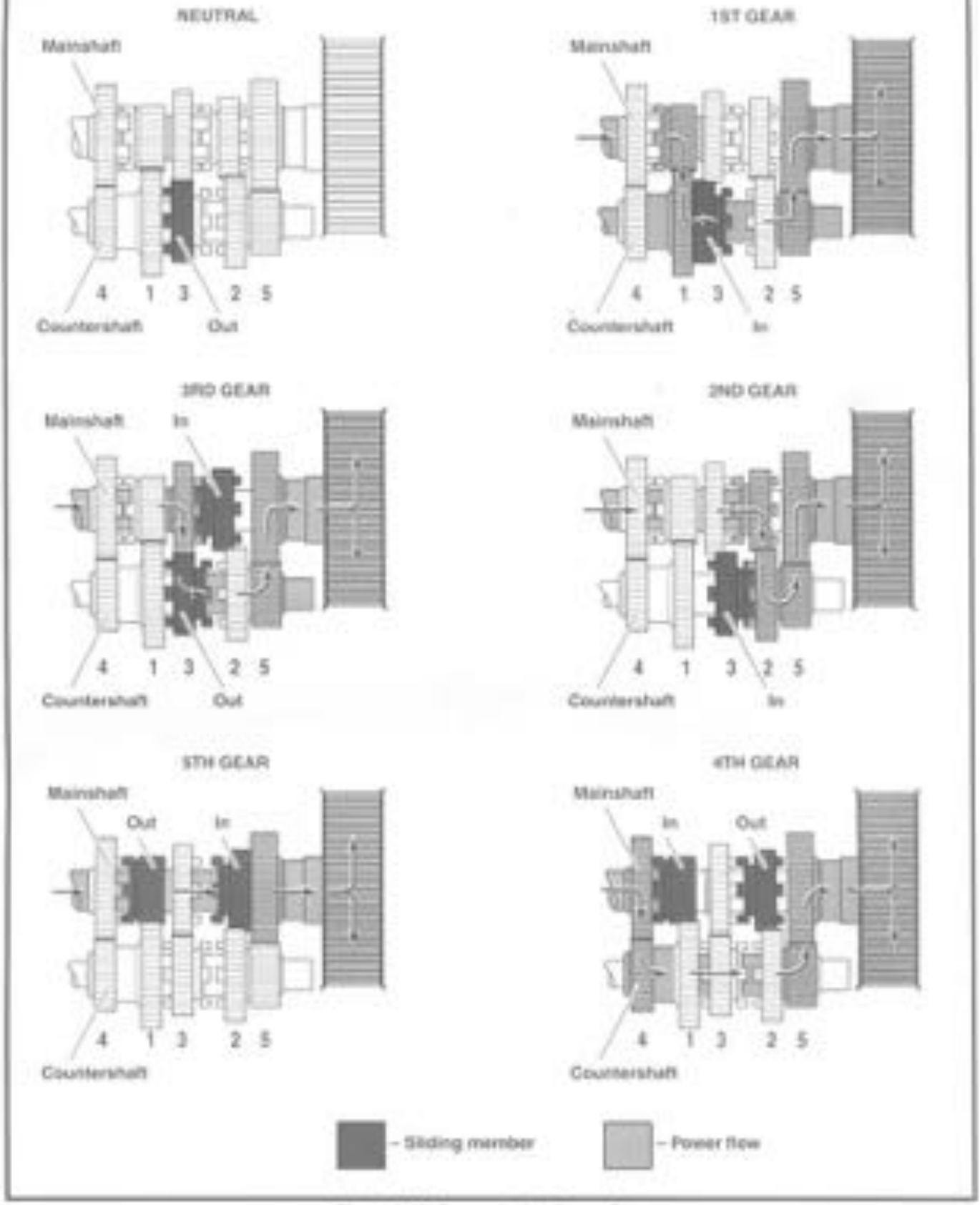


Figure 6-17. Transmission Power Flow

TRANSMISSION CASE

GENERAL

The rear compartment of the left and right crankcase halves form the transmission case. An access cover (door) allows removal of transmission components without removing the engine or disassembling (splitting) the crankcase.

REMOVAL

1. Remove exhaust system. See EXHAUST SYSTEM, REMOVAL in Section 2.
2. See Figure 6-18. Remove footrest, brake pedal, sprocket cover (5), and rear brake master cylinder from right side of motorcycle.

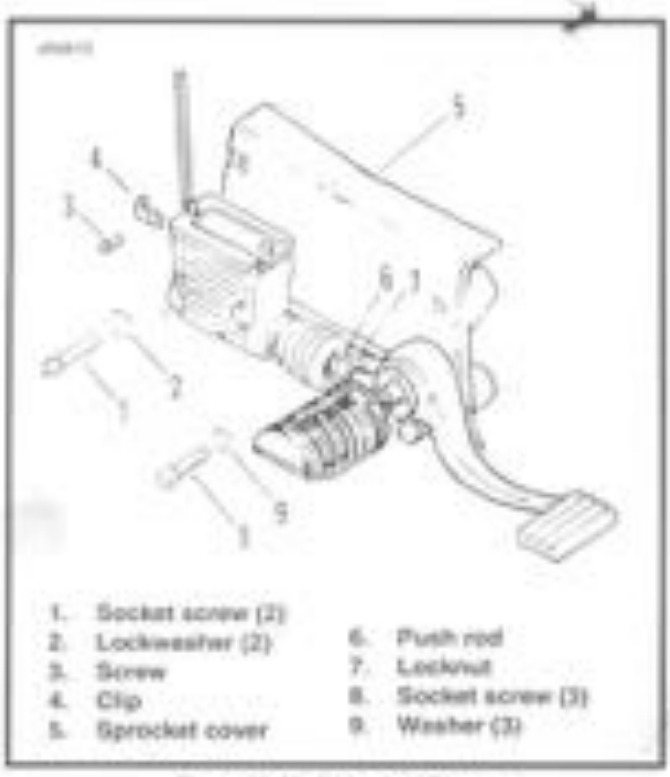


Figure 6-18. Sprocket Cover

3. Place a drain pan under the engine. Remove drain plug, and drain lubricant from primary drive/transmission.
4. See Figure 6-19. Place transmission in first gear. Remove two socket head screws (5) and lockplate (4).

⚠CAUTION

Transmission sprocket nut has left-hand threads. Turn nut clockwise to loosen and remove from main drive gear shaft.

5. Remove transmission sprocket nut (3) from main drive gear shaft (1).
6. See Figure 6-20. Remove cotter pin (1) and loosen rear axle nut (2). Release tension on secondary drive belt by turning axle adjuster nuts (3), on each side of rear fork, an equal number of turns counterclockwise.

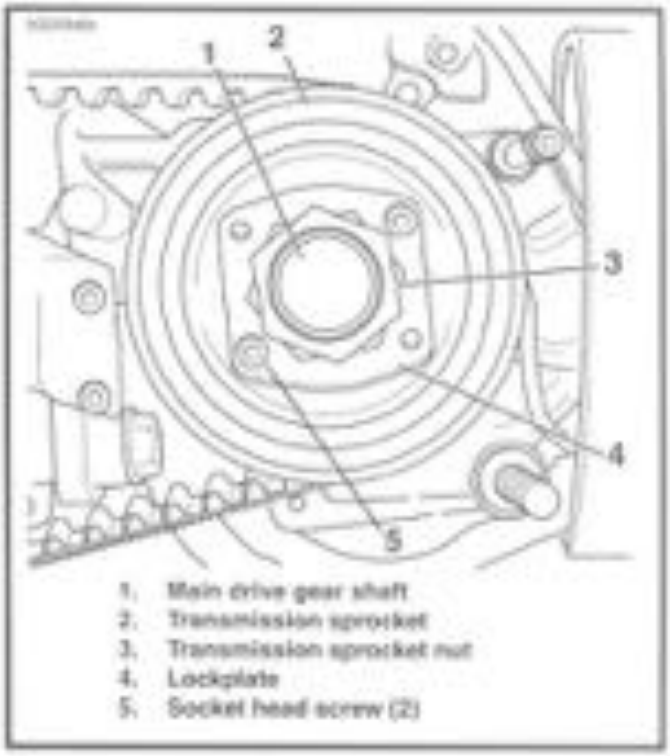


Figure 6-19. Transmission Sprocket

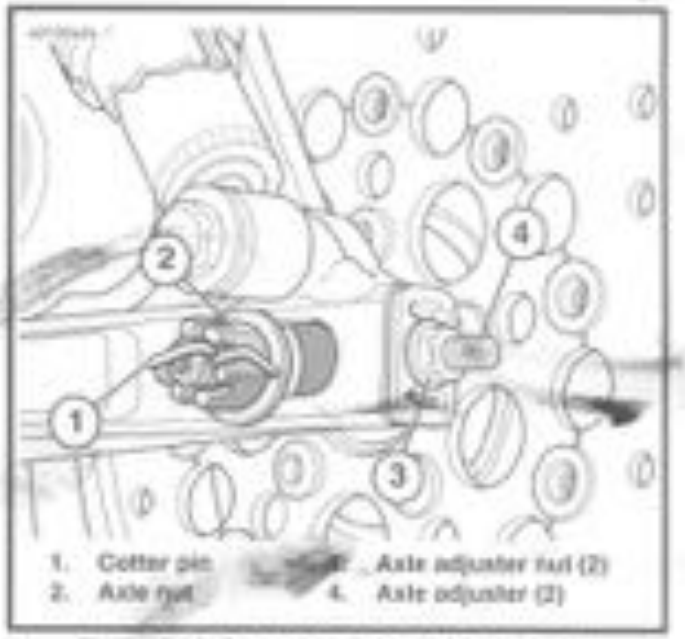


Figure 6-20. Secondary Drive Belt Adjustment

7. See Figure 6-19. Remove secondary drive belt from transmission sprocket (2). Remove transmission sprocket from main drive gear shaft (1).
8. Remove primary cover; see PRIMARY CHAIN, REMOVAL, PRIMARY COVER.
9. Remove clutch assembly, primary chain, and engine sprocket as described under PRIMARY DRIVE/CLUTCH, REMOVAL.

10. See Figure 6-21. Lock transmission in gear. Remove countershaft Torx screw and retainer.

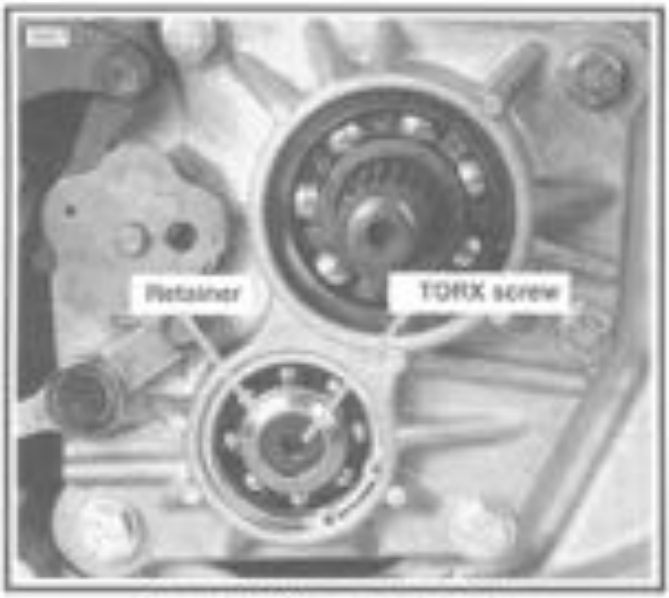


Figure 6-21. Countershaft Retainer

11. See Figure 6-22. Detach spring (1) from groove in post (2).

12. Remove retaining ring (10) and detent plate (9). You will need to use a new retaining ring for installation.

13. Remove two locknuts (3) and washers (11) which attach shifter shaft assembly (6) to studs at transmission case. Remove shifter shaft assembly.

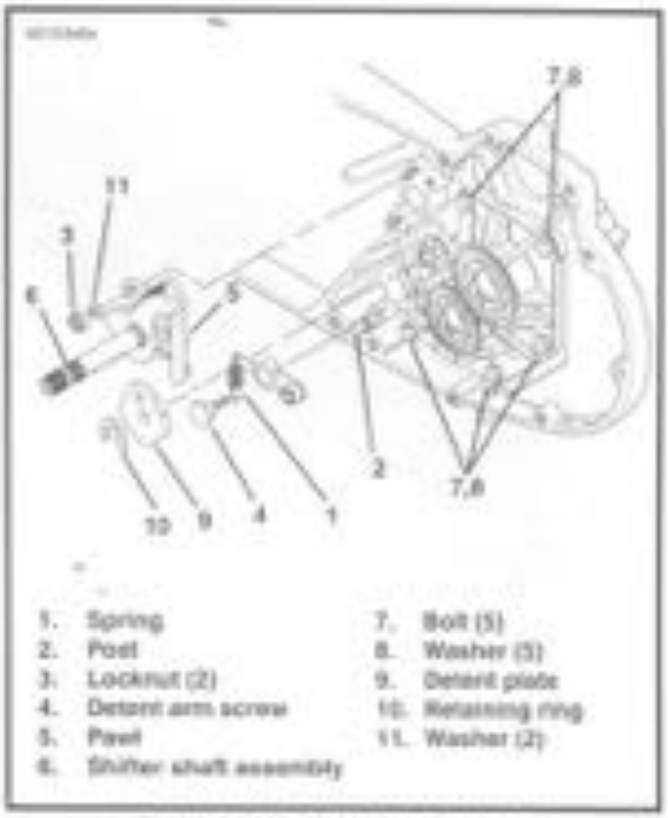
14. Remove five access door bolts (7) and washers (8). Remove transmission assembly by pulling it straight outward, away from transmission case.

CLEANING, INSPECTION AND REPAIR

Thoroughly clean transmission compartment with cleaning solvent. Blow parts dry with compressed air. Inspect parts to determine if any must be replaced. Replace all parts that are badly worn or damaged.

Neutral Indicator Switch (Figure 6-23)

The neutral indicator switch is threaded into the transmission portion of the right crankcase half. See NEUTRAL INDICATOR SWITCH in Section 7 for testing, removal, and installation procedures.



1. Spring
2. Post
3. Locknut (2)
4. Detent arm screw
5. Pawl
6. Shifter shaft assembly
7. Bolt (5)
8. Washer (5)
9. Detent plate
10. Retaining ring
11. Washer (2)

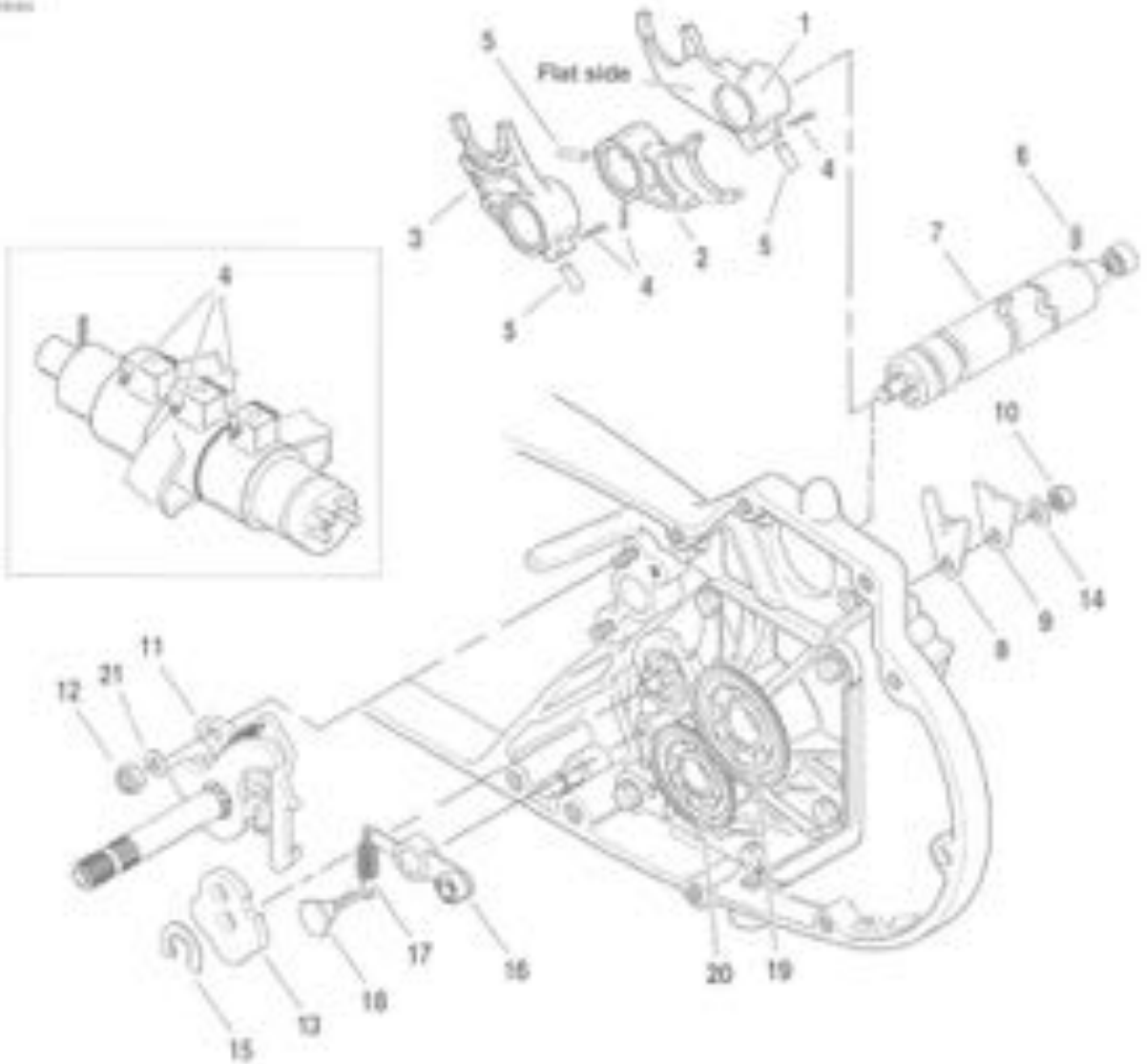
Figure 6-22. Shifter Shaft Assembly

Figure 6-23. Neutral Indicator Switch

SHIFTER FORKS AND DRUM

DISASSEMBLY

1. Remove the transmission assembly as described under TRANSMISSION CASE. Mount transmission assembly in vise with protective jaws.
2. See Figure 6-24. Remove nut (10), washer (14), screw(18), drum lock plates (8, 9), detent arm (16), and spring (17).
3. Remove and discard the three fork cotter pins (4).



1. Shifter fork 3rd and 5th gear
2. Shifter fork 1st and 2nd gear
3. Shifter fork 4th gear
4. Cotter pin
5. Pin, shifter fork
6. Pin, neutral indicator
7. Shifter fork drum
8. Plate, shifter drum locating
9. Plate, reinforcing
10. Nut (2)
11. Shifter shaft assembly
12. Nut
13. Plate, detent
14. Washer
15. Bowed snap ring
16. Detent arm
17. Spring
18. Screw, detent
19. Bearing, mainshaft
20. Bearing countershaft
21. Washer

Figure 6-24. Shifter Mechanism

4. Remove three shift fork pins (3). A small magnet is useful in freeing the fork pins (3).

5. Slide shift drum (7) away from access door, through shifter forks. The neutral switch pin prevents removal in the other direction.

6. Remove shift forks (3, 2, 1).

CLEANING, INSPECTION AND REPAIR

1. See Figure 6-24. Clean all parts except bearings (19, 20) with solvent.

2. Inspect bearings (19 and 20) and shifter drum ends. If ends of shifter drum are pitted or grooved, replace the shifter drum and bearings. If replacing bearings, see ACCESS DOOR BEARINGS later in this section.

3. Inspect shifter drum (1) for cracks or wear; replace if necessary.

ASSEMBLY

1. See Figure 6-25 for shifter fork identification. See Figure 6-24. Lubricate the shaft bore in fork (1) with Sport Transmission Lube. Place 3rd and 5th gear shifter fork (1) in the fork groove of mainshaft 2nd gear. Be sure the flat side of fork is facing the access cover.

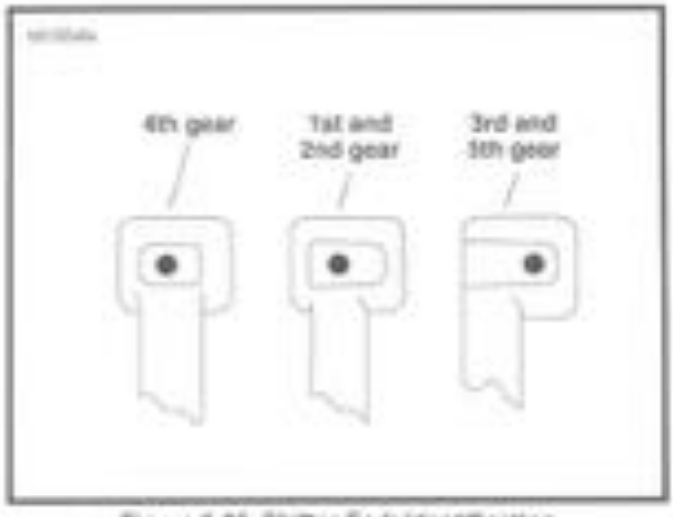


Figure 6-25. Shifter Fork Identification

2. Lubricate the shaft bore in fork (2) with Sport Transmission Lube. Place 1st and 2nd gear shifter fork (2) in the fork groove of countershaft 3rd gear. Be sure the flat side of fork is facing away from the access door.

3. Lubricate the shaft bore in fork (3) with Sport Transmission Lube. Place 4th gear shifter fork (3) in the fork groove of mainshaft 1st gear. Be sure the flat side of fork is facing away from the access door.

4. See Figure 6-24. Position the shifter drum shaft so that the neutral indicator switch activator pin (8) is upward. The shaft is then in the neutral position. Insert the pin end of drum shaft (7) through the hubs of shifter forks (1), (2) and (3) and through the bearing in access cover.

5. Align the hole through the top of each shifter fork with the appropriate cam groove in the shifter drum. Lubricate pins (5) with Sport Transmission Lube. Drop pins (5) through the holes in shifter forks. With a small screwdriver press on the pins while manipulating the forks back and forth until the pin seats in the drum groove. Secure pins in place with new cotter pins (4).

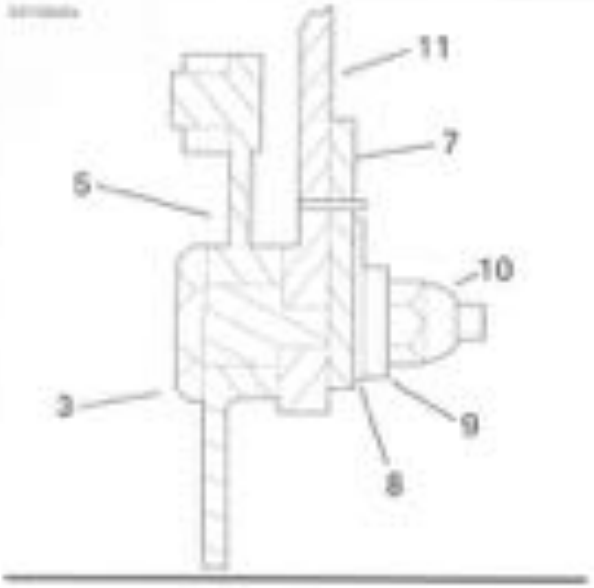
⚠CAUTION

To prevent possible cotter pin damage, the pins must be inserted through the shifter forks as shown in the inset of Figure 6-24.

NOTE

See Figure 6-26. Detent plate (2) and bowed snap ring (1) are not installed at this time. These parts are installed during transmission installation after the final shifter pawl adjustment is completed. See TRANSMISSION INSTALLATION AND SHIFTER PAWL ADJUSTMENT later in this section.

6. See Figure 6-26. At the inside of the access door (11), place the shifter drum retention plate (7) in the groove of the drum shaft. Take care to correctly align the shifter drum retention plate (7) and drum reinforcement plate (8) with the retaining pin pressed in the retention plate (7). Insert detent screw (3) through detent arm (5), transmission access door (11), shifter drum retention plate (7), drum reinforcement plate (8) and washer (9). Thread nut (10) on detent screw (3) and tighten to 13-17 ft-lbs (18-23 Nm) torque.



1. Retainer
2. Detent plate
3. Detent screw
4. Spring
5. Detent
6. Post
7. Shifter drum retention plate/ pin assembly
8. Reinforcement plate
9. Washer
10. Nut
11. Transmission access door

Figure 6-26. Detent Plate Mounting

DISASSEMBLY

1. See Figure 6-27. Clamp transmission assembly in vise, with protective jaws, as shown, to work on disassembly.

2. Remove transmission assembly as described under TRANSMISSION CASE, remove shifter forks and drum as described under SHIFTER FORKS AND DRUM.

Figure 6-27.

NOTE

As the transmission runs, each part develops a certain wear pattern and a kind of "set" with its mating parts. For this reason, it is important that each component be reinstalled in its original location and facing its original direction.

3. See Figure 6-28. As each component is removed, place it on a clean surface in the exact order of removal.

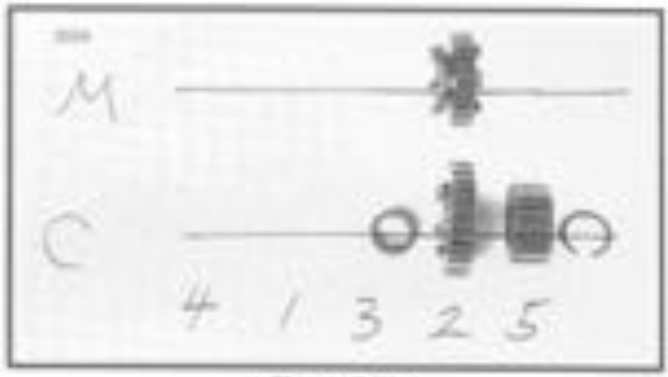


Figure 6-28.

See Figure 6-29. Using retaining ring pliers Part No. J5586 remove and discard retaining ring (5) next to countershaft 5th gear (12). Slide countershaft 5th (12), mainshaft 2nd (22) and countershaft 2nd (11) off end of shafts.

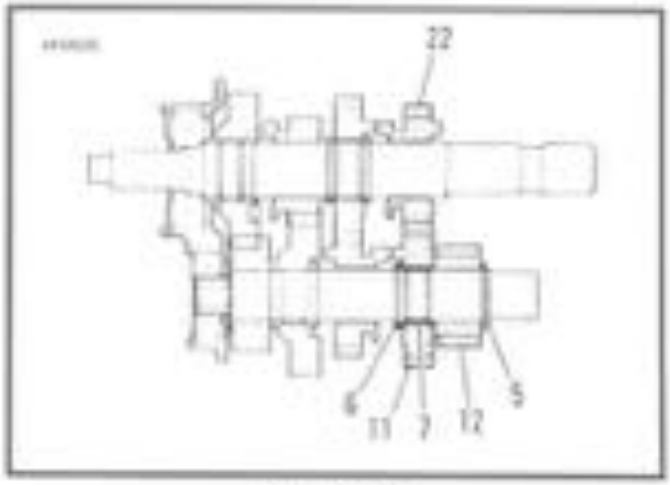


Figure 6-29.

4. Remove split bearing (7) that was under gear (11) and thrust washer (6) on the countershaft.

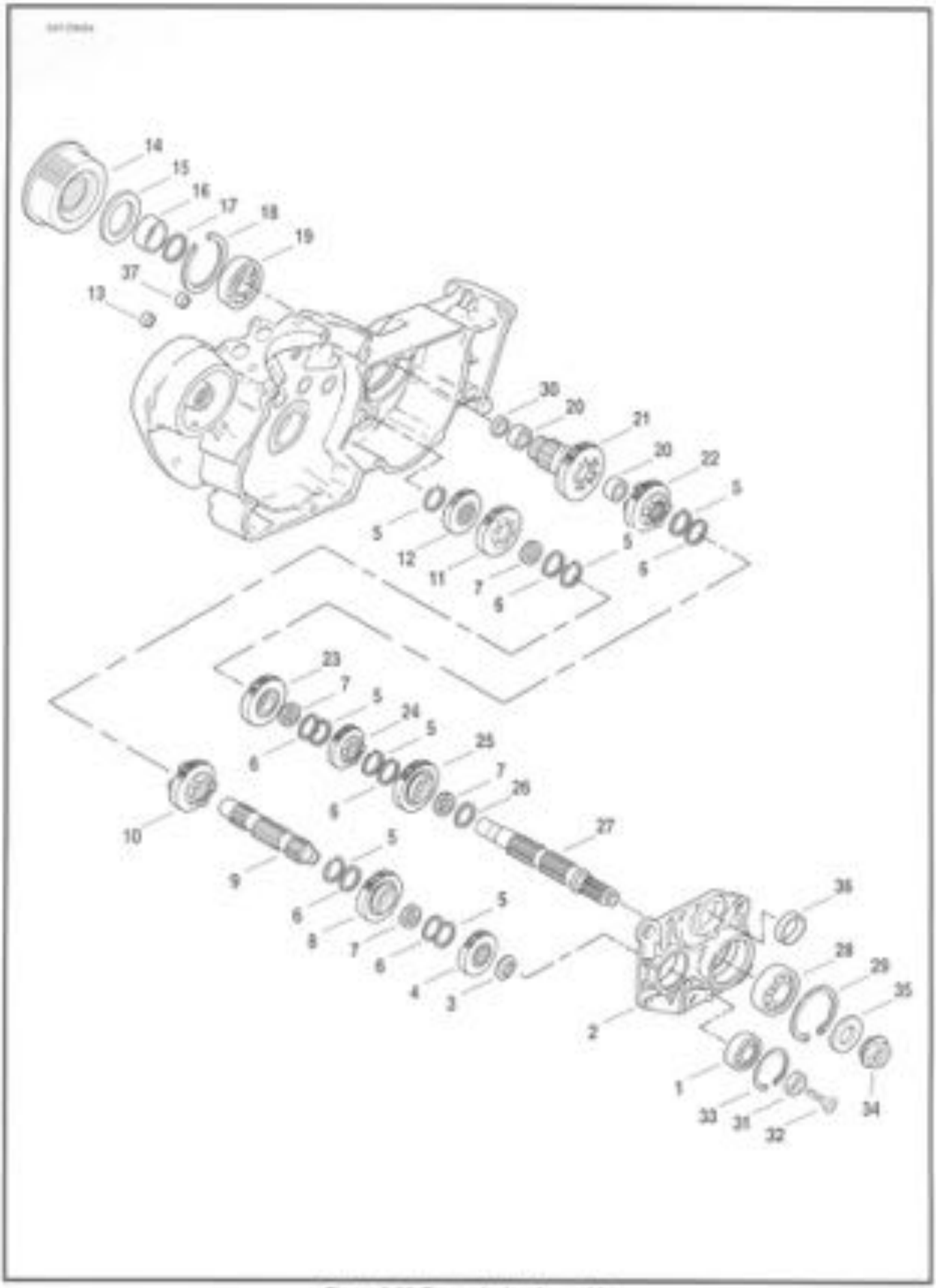


Figure 6-30. Transmission Assembly

1. Bearing
2. Door, access
3. Spacer, bevel
4. Gear, countershaft 4th
5. Ring, retaining (7)
6. Washer, thrust (6)
7. Bearing, split (4)
8. Gear, countershaft 1st
9. Countershaft
10. Gear, countershaft 3rd
11. Gear, countershaft 2nd
12. Gear, countershaft 5th
13. Bearing, closed (countershaft)
14. Sprocket, chain/belt
15. Seal, oil
16. Spacer (belt drive)
17. Ring, quad
18. Ring, retaining
19. Bearing, ball
20. Bearing, needle
21. Gear, mainshaft 5th
22. Gear, mainshaft 2nd
23. Gear, mainshaft 3rd
24. Gear, mainshaft 1st
25. Gear, mainshaft 4th
26. Spacer
27. Mainshaft
28. Bearing
29. Ring, retaining
30. Seal
31. Retention collar
32. Torx screw
33. Ring, retaining
34. Nut, mainshaft
35. Washer, spring
36. Bushing
37. Bearing closed (shifter shaft)

Figure 6-36. Transmission Assembly (cont'd)

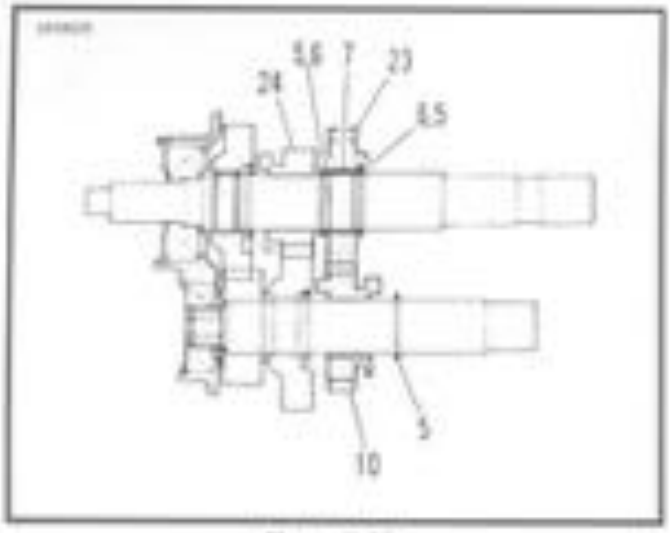


Figure 6-32.

5. See Figure 6-32. Remove retaining ring (5) next to countershaft 3rd gear (10). Slide countershaft 3rd gear (10) off free end of shaft.

6. At mainshaft, between mainshaft 1st gear (24) and mainshaft 3rd gear (23), expand retaining ring (5) and move next to mainshaft 1st gear along with thrust washer (6). Move mainshaft 3rd gear as far as possible toward mainshaft 1st gear (24). Expand retaining ring (5) at opposite side of mainshaft 3rd gear and slide off end of shaft. Remove mainshaft 3rd gear (23) and its split bearing (7).

7. Slide thrust washer (6) off end of mainshaft. Expand retaining ring (5), which is next to mainshaft 1st gear (24), and slide off end of shaft.

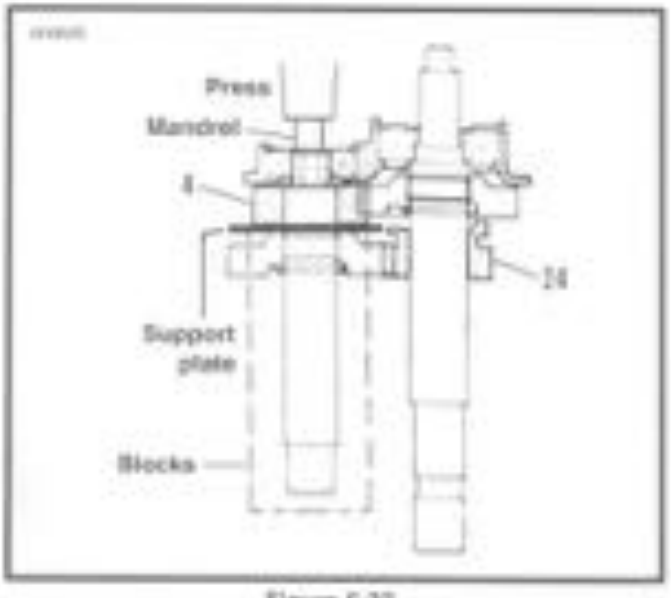


Figure 6-33.

8. See Figure 6-33. Place COUNTERSHAFT GEAR SUPPORT PLATE (Part No. HD-37404) under countershaft 4th gear (4). Place assembly on press with suitable metal blocks under the support plate. Place a socket or mandrel, smaller than inside diameter of bearing, and press countershaft free of access cover. Slide mainshaft 1st gear (24) off mainshaft.

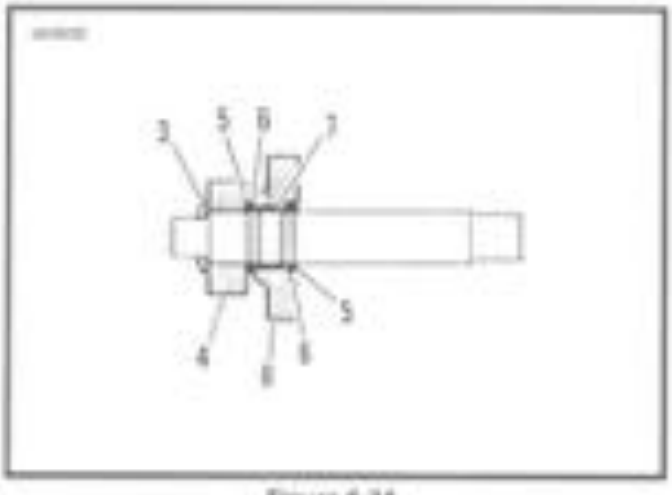


Figure 6-34.

9. See Figure 6-34. Remove beveled spacer (3) and countershaft 4th gear (4).

10. Expand retaining ring (5) located next to countershaft 1st gear (6). Remove retaining ring (5) and thrust washer (6). Slide countershaft 1st gear off end of shaft. Remove split bearing (7).

11. Remove thrust washer (6). Expand remaining retaining ring (5) and slide off shaft. This completes disassembly of countershaft.

12. See Figure 6-35. Place mainshaft and access door assembly on arbor press with support under mainshaft 4th gear (25). Press on end of shaft until mainshaft is free of access door bearing. Remove spacer (26), mainshaft 4th gear (25) and split bearing (7).

13. Remove thrust washer (6). Expand and remove remaining retaining ring (5).

CLEANING, INSPECTION AND REPAIR

1. Clean all parts (except bearings) in cleaning solvent, and blow dry with compressed air.

2. Check gear teeth for damage. If gears are pitted, scored, rounded, cracked, or chipped, they should be replaced.

3. Inspect the engaging dogs on the gears. Replace the gears if dogs are rounded, cracked, battered, chipped, or dimpled.

4. Discard all retaining rings that were removed.

ASSEMBLY

⚠CAUTION

During assembly, the split bearings (7) and the internal bores of the gears must be lubricated with SPORT TRANSMISSION FLUID prior to assembly. Leaving these parts dry could accelerate wear at start-up.

1. Find a section of pipe that matches the inner race of bearing (28).

2. See Figure 6-36. Place the door assembly outside downward, on a press with the inner race of bearing (28) resting on the section of pipe. Insert the splined end of the shaft through the bearing and hold in a vertical position. Press the shaft into the bearing until the bearing bottoms against the shaft shoulder.

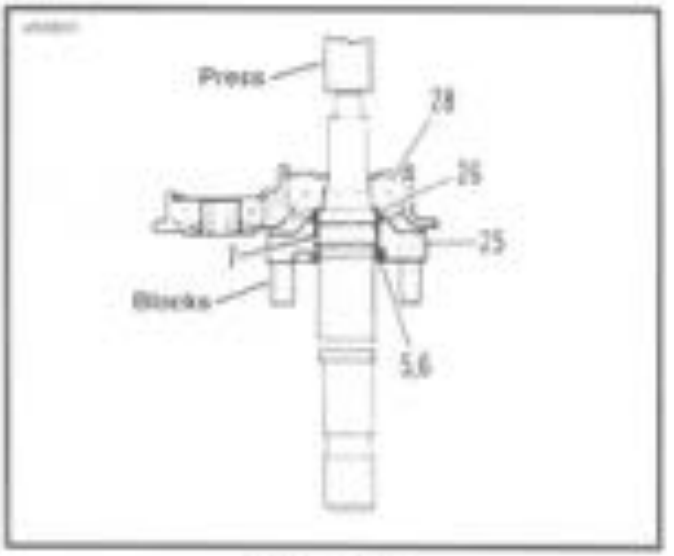


Figure 6-35.

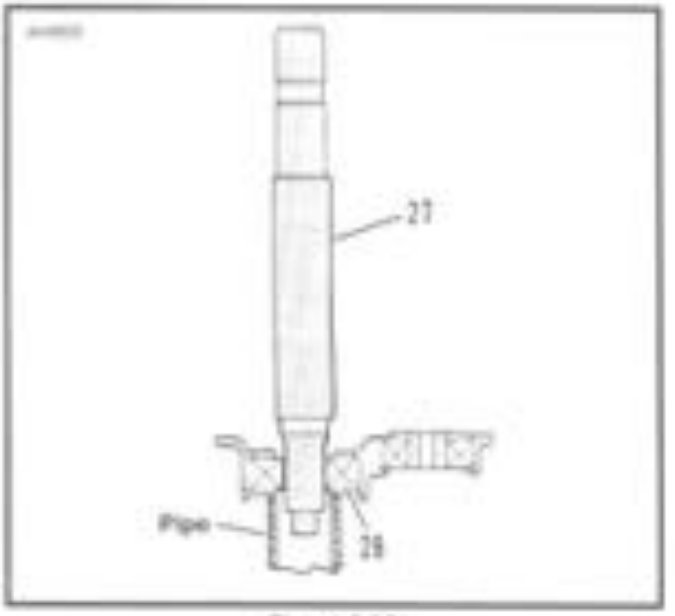


Figure 6-36.

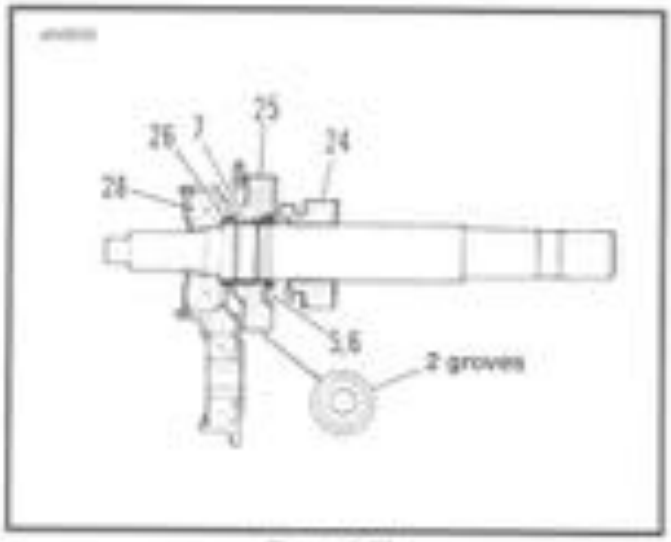


Figure 6-37.

3. See Figure 6-37. Place spacer (26) over mainshaft and position next to bearing (28). Position split bearing (7) into machined seat next to spacer (26). Locate mainshaft 4th gear (25), which can be identified by the two radial grooves at one side. Slide gear (25) onto shaft with radial grooves facing door. Position gear over bearing next to spacer (26).

4. Install thrust washer (6) and retaining ring (5) next to gear (25). It will be necessary to push the retaining ring into final position with a screwdriver.

5. Slide mainshaft 1st gear (24) onto mainshaft with the locking dogs facing gear (25).

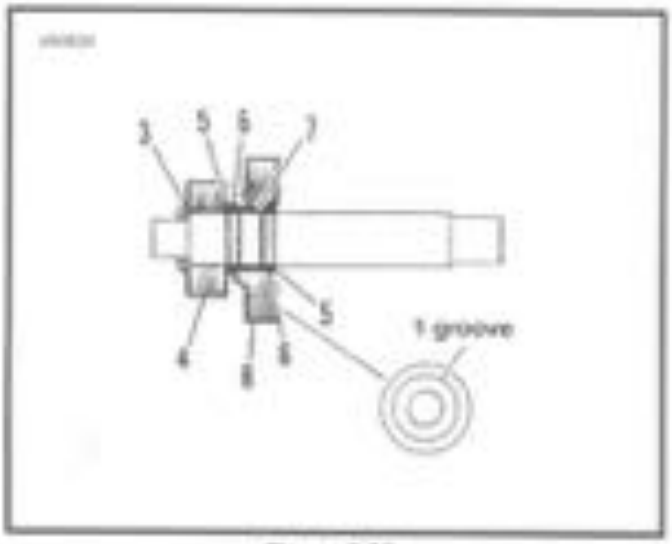


Figure 6-38.

6. See Figure 6-38. Install retaining ring (5). Position retaining ring in the second ring groove from the end with internal threads. Install thrust washer (6) next to retaining ring. Install split bearing (7) in seat next to washer (6).

7. Locate countershaft first gear (8). Gear (8) has a ring groove at one side of the gear. Install gear (8) over split bearing (7).

8. Install thrust washer (6) and retaining ring (5) next to gear (8).

9. Locate countershaft 4th gear (4). This gear is splined and has a single radial groove at one side. Position gear next to snap ring (5). Place beveled washer (3) over end of shaft with beveled side away from gear (4).

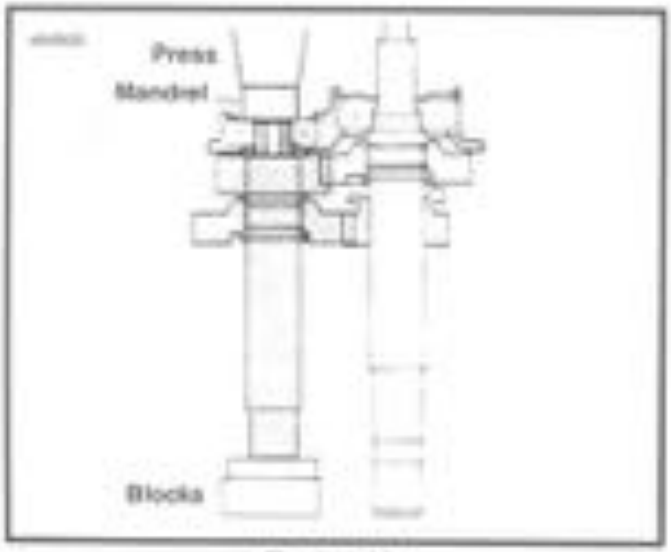


Figure 6-39.

10. See Figure 6-39. Stand countershaft assembly on press with small end (end with threaded hole) upward. Place access cover and mainshaft assembly on top of countershaft with bearing (1) in access cover over end of countershaft. Place a socket or section of pipe on inner race of bearing (1). Hold assembly straight, making sure gear teeth on countershaft are engaged with gear teeth on mainshaft, and press bearing onto shaft until beveled spacer bottoms against bearing.

NOTE

When correctly installed, countershaft 4th gear should have zero end play.

11. See Figure 6-40. At mainshaft, install retaining ring (5) and thrust washer (6). Install split bearing (7) in seat next to thrust washer (6).

12. Install mainshaft 3rd gear (23) onto shaft over bearing (7).

13. Install thrust washer (6) and retaining ring (5) next to gear (23).

14. Install countershaft 3rd gear (10) onto shaft.

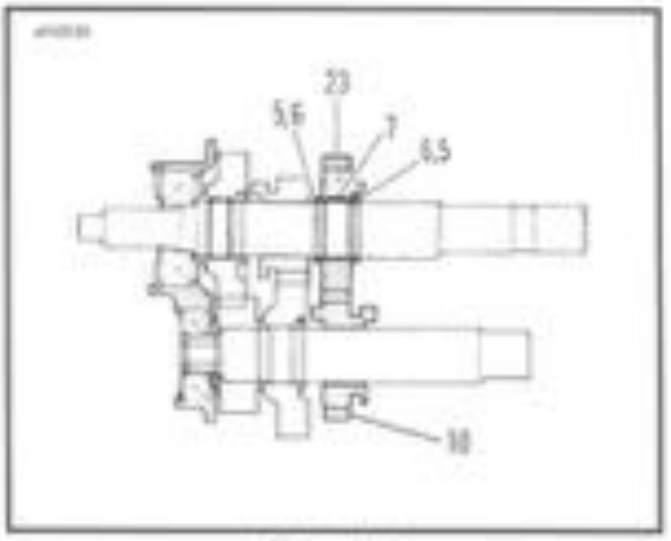


Figure 6-40.

15. See Figure 6-41. Install retaining ring (5) and thrust washer (6). Install split bearing (7) into seat next to thrust washer (6).

16. Install countershaft 2nd gear (11) over bearing (7).

17. Install mainshaft 2nd gear (22) onto shaft.

18. Install countershaft 5th gear (12).

19. Expand retaining ring (5) and slide into groove next to countershaft 5th gear (12).

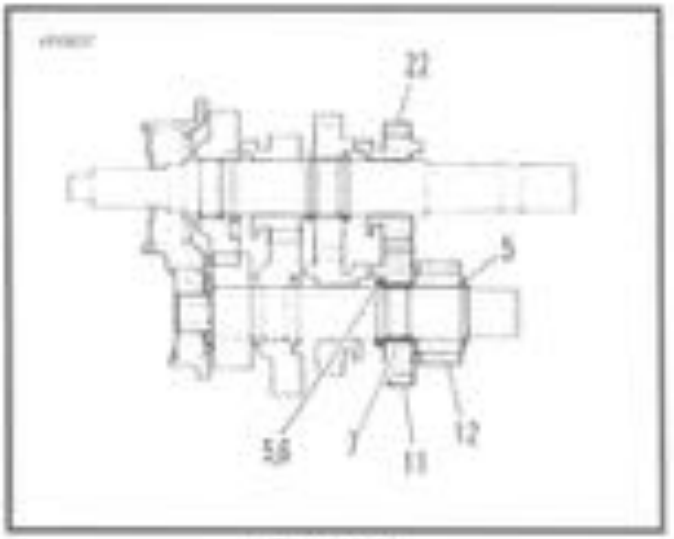


Figure 6-41.

20. See Figure 6-42. At outside of access door, position retention collar (31) next to end of countershaft with beveled side facing outward. Apply a few drops of Loctite 242 blue to the threads of screw (32). Insert screw (32) through retention collar, and thread into end of shaft. Place transmission in gear, and tighten TORX screw to 13-17 ft-lbs (18-23 Nm) torque.

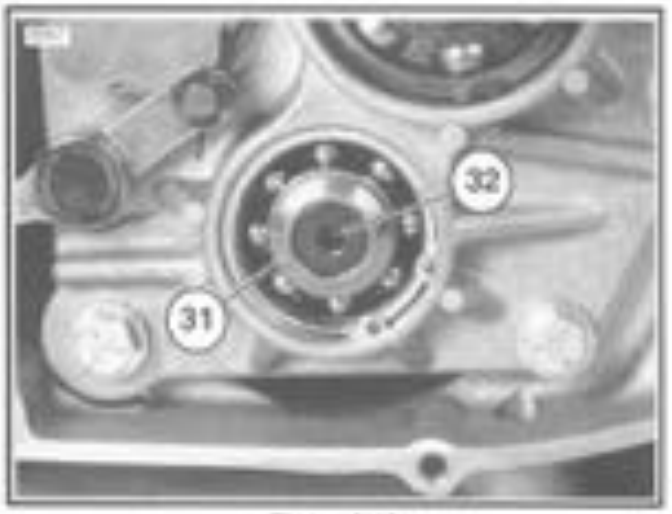
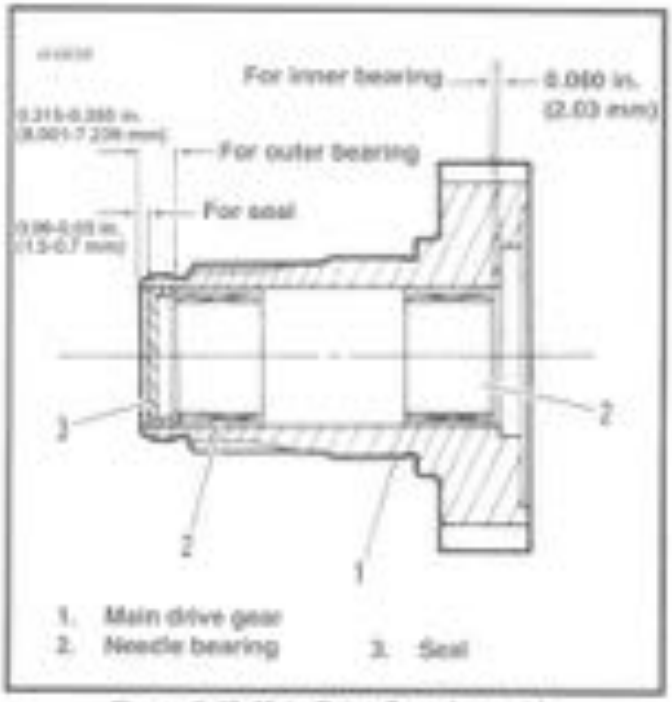


Figure 6-42.

MAIN DRIVE GEAR

REMOVAL

1. Remove transmission as described under TRANSMISSION CASE earlier in this section.
2. See Figure 6-43. From inside case tap out seal (3) at end of mainshaft 5th gear (1). Discard seal (3).
3. See Figure 6-44. Use MAIN DRIVE GEAR REMOVER AND INSTALLER (Part No. HD-35316A) with CROSS PLATE (Part No. HD-35316-91). Take support bracket (1) and insert pins, at one side, into holes which are now exposed under access cover.
4. See Figure 6-45. Insert bolt (2) through support bracket (1) and 5th gear (3).
5. At outside of case, place driver (4) and thrust washer (5) over end of bolt (2). Install and tighten nut (6) until 5th gear (3) is free.



1. Main drive gear
2. Needle bearing
3. Seal

Figure 6-43. Main Drive Gear Assembly

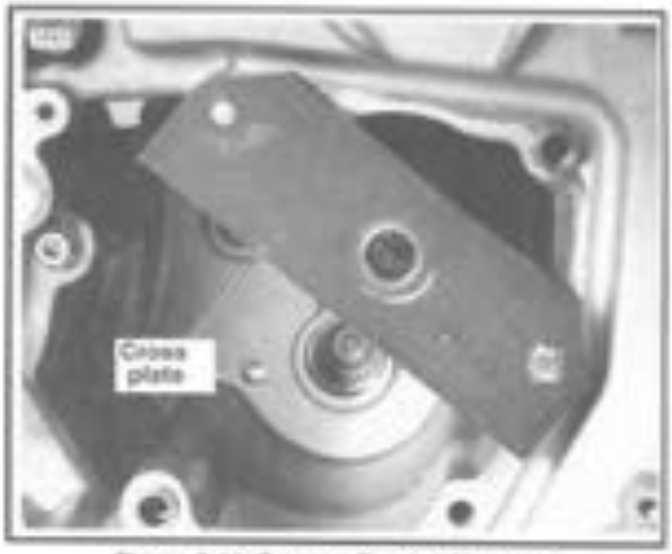
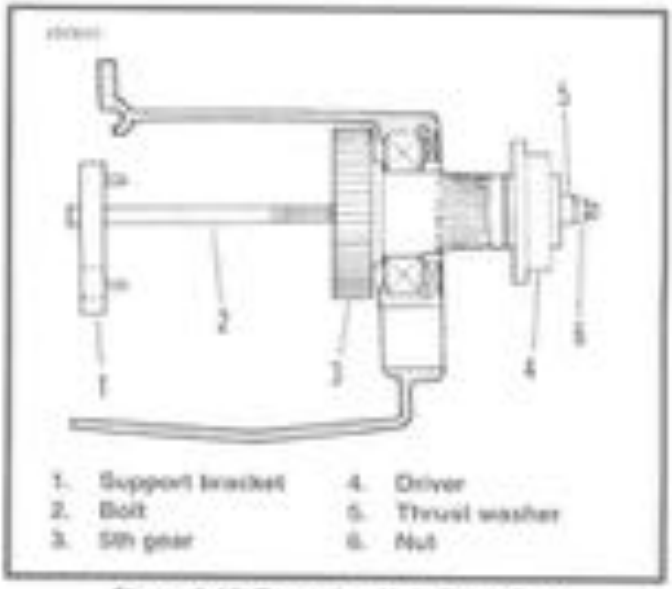


Figure 6-44. Support Bracket Mounting



1. Support bracket
2. Bolt
3. 5th gear
4. Driver
5. Thrust washer
6. Nut

Figure 6-45. Removing Main Drive Gear

⚠CAUTION

When removing the main drive gear, the gear is pressed out against the resistance of the bearing inner race. Without any support at the inner race, the bearing is destroyed. Whenever the main drive gear is removed the main drive gear bearing will also have to be replaced.

DISASSEMBLY

Drive out needle bearings, from inside bore of main drive gear. Do not reuse bearings after removal.

ASSEMBLY

1. Use INNER/OUTER MAIN DRIVE GEAR NEEDLE BEARING INSTALLATION TOOL (Part No. HD-37842A). See Figure 6-46. The tool is stamped 0.080 in. (2.032 mm) for the end of the tool to be used for driving the bearing into the inner end and 0.315 (8.001 mm) for the outer end bearing.

2. Place main drive gear on a press. With the bearing installation tool, press in the outer bearing to a depth of 0.315-0.285 in. (8.001-7.239 mm). Press in the inner bearing to a depth of 0.080 in. (2.032 mm). The installation tool will automatically bottom on the gear when the correct depth is reached.

INSTALLATION

1. Replace main drive gear bearing as instructed under RIGHT CRANKCASE BEARINGS.

2. Use Main Drive Gear Remover and Installer Tool. See Figure 6-47. Take bolt (2) and place washer (5) followed by main drive gear (4) over end of bolt. From inside of case insert bolt and main drive gear through inner race of ball bearing.

3. Insert threaded end of bolt (2) through installer cup (3) and thrust washer (1). Thread nut (6) onto end of bolt (2). Tighten nut (6) until shoulder on gear (4) bottoms against inner race of bearing.

4. See Figure 6-43. Tap in new seal (2) at threaded end of 5th gear.

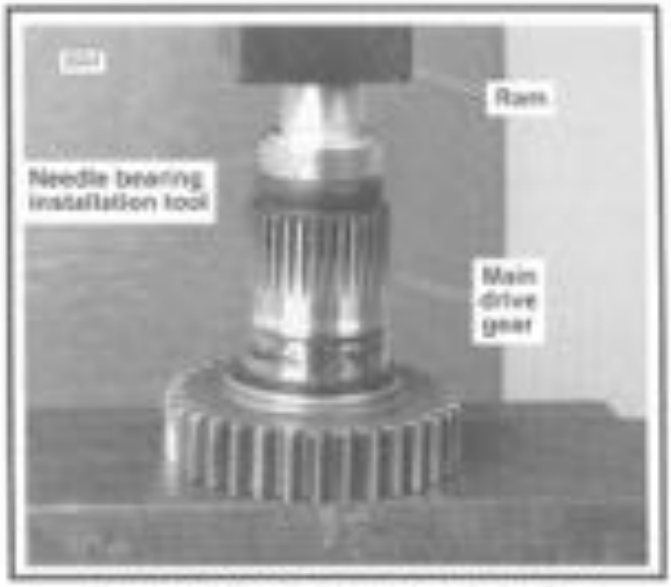


Figure 6-46. Needle Bearing Installation Tool

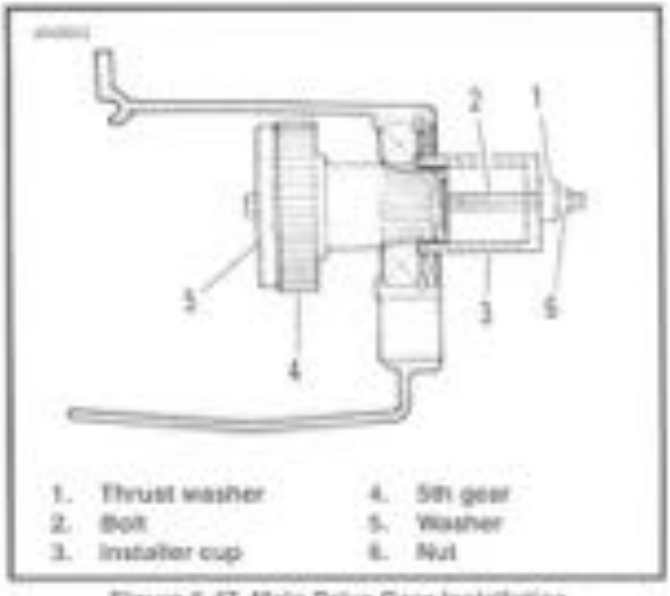


Figure 6-47. Main Drive Gear Installation

ACCESS DOOR BEARINGS

REMOVAL

Mainshaft and Countershaft Bearings

1. Remove transmission assembly as described under TRANSMISSION CASE. Remove shifter forks and drum as described under SHIFTER FORKS AND DRUM. Remove countershaft and mainshaft as described under MAINSHAFT AND COUNTERSHAFT. All the aforementioned procedures can be found earlier in this section.
2. Inspect the mainshaft and countershaft ball bearings for pitting, scoring, discoloration, or other damage.
3. See Figure 6-48. If bearing replacement is required, remove retaining rings (1) and (2). Press out bearings (3) and (4) from the inside of the door.

Shift Drum Bushing

1. Inspect the shifter drum bushing for pitting, scoring, discoloration, or excessive wear.

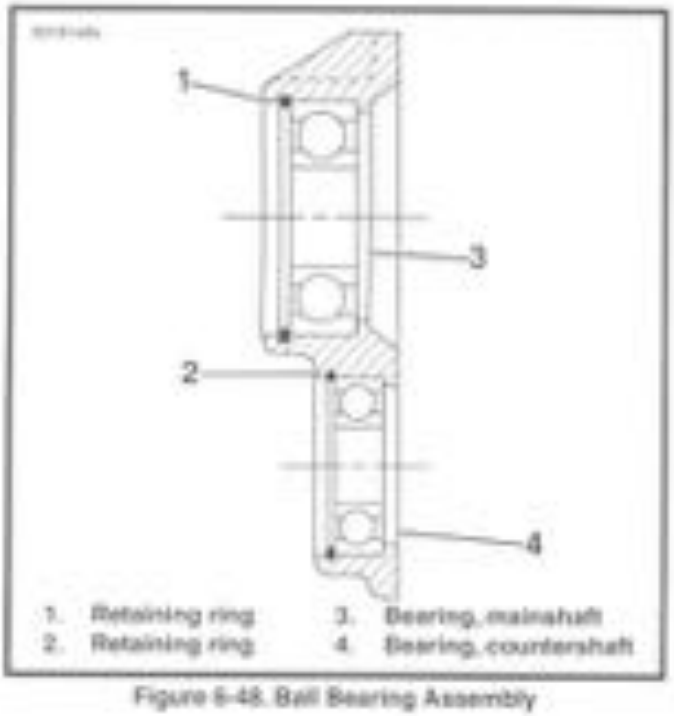


Figure 6-48. Ball Bearing Assembly

If bushing requires replacement press bushing out of door from either side.

INSTALLATION

Mainshaft and Countershaft Bearings

1. Lay access door on press with inside surface of door downward.

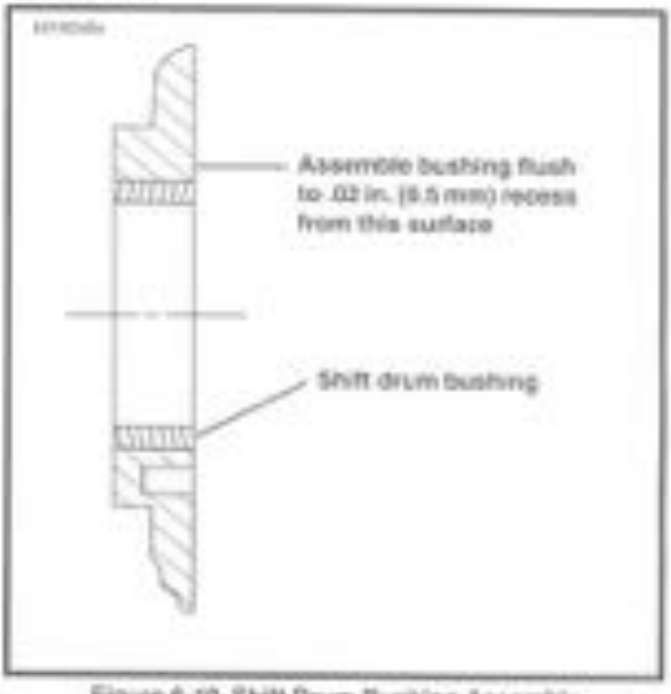


Figure 6-49. Shift Drum Bushing Assembly

2. Lay bearing squarely over bore with printed side of bearing upward. Place section of pipe or tubing (slightly smaller than outside diameter of bearing) against outer race. Press bearing into bore until bearing bottoms against shoulder.
3. Install new retaining ring with beveled side facing away from bearing.

Shift Drum Bushing

1. Lay access door on press with outside surface of door downward.
2. See Figure 6-49. Lay bushing squarely over bore. Locate socket or pipe that is slightly larger than diameter of bushing. Place socket or pipe on bushing and press into bore until bushing is flush with or 0.020 in. (0.51 mm) below inside surface. If using a pressing tool larger than diameter of bushing, the pressing tool will bottom against door when bushing is flush with top surface.

RIGHT TRANSMISSION CASE BEARINGS

REMOVAL

1. Remove transmission assembly as described under TRANSMISSION CASE earlier in this section. Remove main drive 5th Gear as described under MAIN DRIVE GEAR earlier in this section.
2. At outside of case remove seal next to 5th gear bearing retainer. Remove retaining ring.
3. From inside transmission case drive bearings (5th gear, countershaft or shifter shaft) out of bores. Carefully tap bearings free by working around bearing diameter to keep bearing from skewing.

INSTALLATION

Mainshaft 5th Gear Ball Bearing

1. Locate Main Drive Gear Remover and Installer Tool. See Figure 6-50. Place support bracket pins in appropriate holes in transmission case.
2. See Figure 6-51. Insert bolt (2) through cross plate (1), new bearing (3), driver (4) and thrust washer (5). Thread nut (6) on end of bolt. Tighten nut carefully until bearing is started in bore squarely. Tighten nut (6) until bearing is seated against shoulder in bore.
3. At outside of case install beveled retaining ring in groove inside bearing bore with beveled side facing outside of case.
4. Lubricate bearing with Sport Transmission Lube.

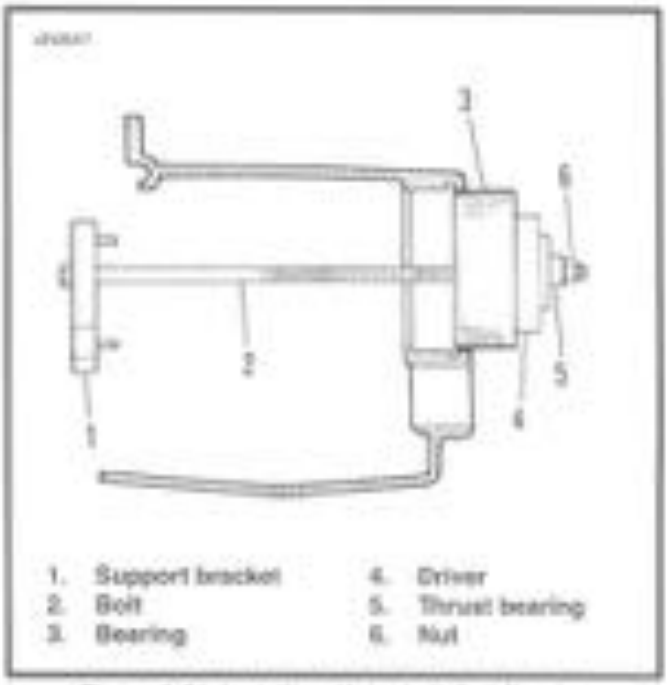
Countershaft Needle Bearing

1. Find a suitable bearing driver 1-1/4 in. (31.75 mm) in diameter.
2. From the outside of the case place the needle bearing open end first next to the bearing bore. Hold the driver squarely against the closed end of the bearing and tap the bearing into place. The bearing is properly positioned when it is driven inward flush or 0.030 in. (0.76 mm) below the outside surface of the case.
3. Lubricate bearing with Sport Transmission Lube.

Shift Drum Needle Bearing

1. Find a suitable bearing driver 13/16 in. (20.64 mm) in diameter.
2. From the outside of the case place the needle bearing, open end first, next to the bearing bore. Hold the driver squarely against the closed end of the bearing and tap the bearing into place. The bearing is properly positioned when driven inward flush or 0.030 in. (0.76 mm) below the outside surface.
3. Lubricate bearing with Sport Transmission Lube.

Figure 6-50. Cross Plate Mounting



1. Support bracket
2. Bolt
3. Bearing
4. Driver
5. Thrust bearing
6. Nut

Figure 6-51. Installing Mainshaft Ball Bearing

TRANSMISSION INSTALLATION AND SHIFTER PAWL ADJUSTMENT

Verify that all parts have been properly installed, as described earlier in this section under RIGHT TRANSMISSION CASE BEARINGS, MAIN DRIVE GEAR, MAINSHAFT AND COUNTERSHAFT, and SHIFTER FORKS AND DRUM.

1. Carefully insert transmission into case opening. Position the assembly so that the mainshaft enters 5th gear, and so that the countershaft and drum shifter shaft enter their respective bearings.
2. See Figure 6-22. Apply a few drops of LOCTITE Threadlocker 242 (blue) to the threads of the five access door mounting bolts (7). Insert the bolts with washers (8) through holes in access door, and thread into tapped holes in right transmission case. Tighten bolts to 13-17 ft-lbs (18-23 Nm) torque.
3. Lift pawl (5) over drum pins, and place shifter shaft assembly (6) on studs at transmission case. Loosely install a washer (11) and locknut (3) on each stud.
4. Attach the loop of spring (1) over and into groove in post (2).
5. Place detent plate (9) over drum pins. Rotate plate until blind holes in plate align with pins in end of drum shaft. Install new retaining ring (10) using TRANSMISSION SNAP RING TOOL (Part No. HD-39151). Verify that retaining ring is fully engaged with drum groove.
6. See Figure 6-52. Place transmission in third gear. Place a No. 32 drill bit (0.116 in. dia.) through hole in detent plate (3), and between pawl (2) and drive pin at end of shifter drum shaft. Push down top of crank (4) to remove all clearance between pawl and drill bit; this will correctly align pawl to shift drum pins (do not push down with too great a force, as this might cause the shifter drum to rotate). With bit in place, tighten shifter shaft assembly bottom nut (1) first to 90-110 **in-lbs** (10.2-12.4 Nm) torque. Then, tighten shifter shaft assembly top nut (1) to the same torque. **Remove drill bit.**
7. See Figure 6-30. Place new quad ring (17) over threaded end of 5th gear (21), and position next to the gear taper. Install spacer (16) over threaded end of 5th gear with chamfered end toward quad ring. Slide spacer up against bearing (19).
8. Coat lips of seal (15) with SPORT TRANS FLUID. Position seal over spacer (16) with lips of seal toward case. Gently tap seal into bore of case until the outside of seal is flush with outer edge of bore. It is acceptable to recess seal to about 0.030 in. (0.76 mm) below outer edge of bore; seal recession will be limited by seal bottoming against retaining ring (18).

Transmission Sprocket Installation

1. See Figure 6-53. Install transmission sprocket (2) with secondary drive belt onto main drive gear shaft (1).
2. Place transmission in neutral. Apply a few drops of LOCTITE THREADLOCKER 262 (red) to the **left-hand threads** of transmission sprocket nut (3). Position nut with washer-faced side facing transmission sprocket.

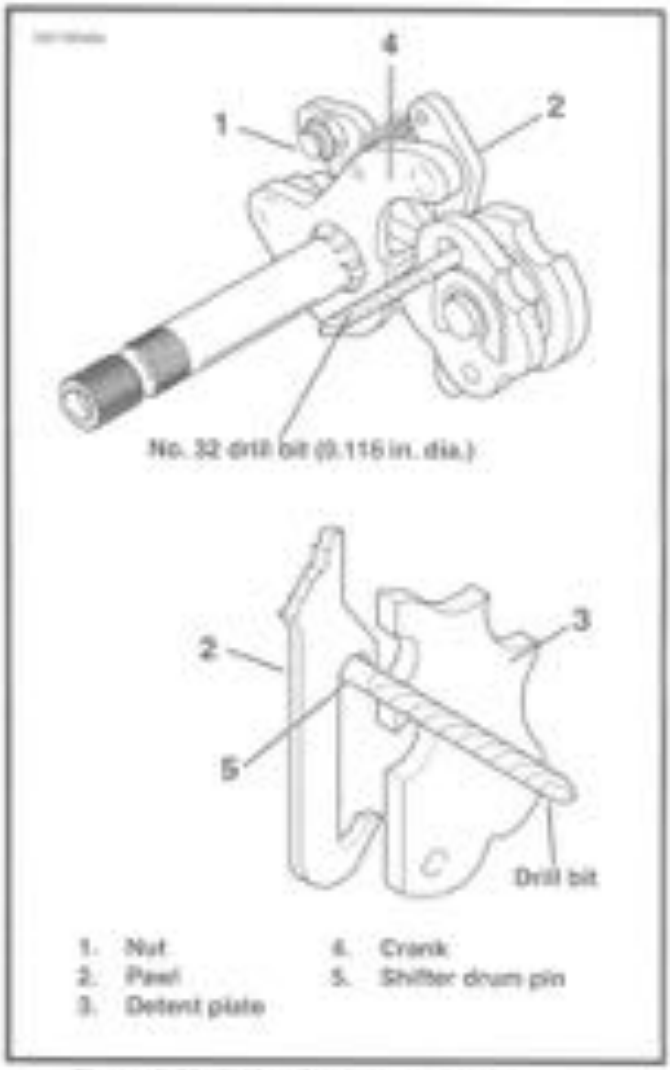


Figure 6-52. Shifter Shaft Assembly Alignment

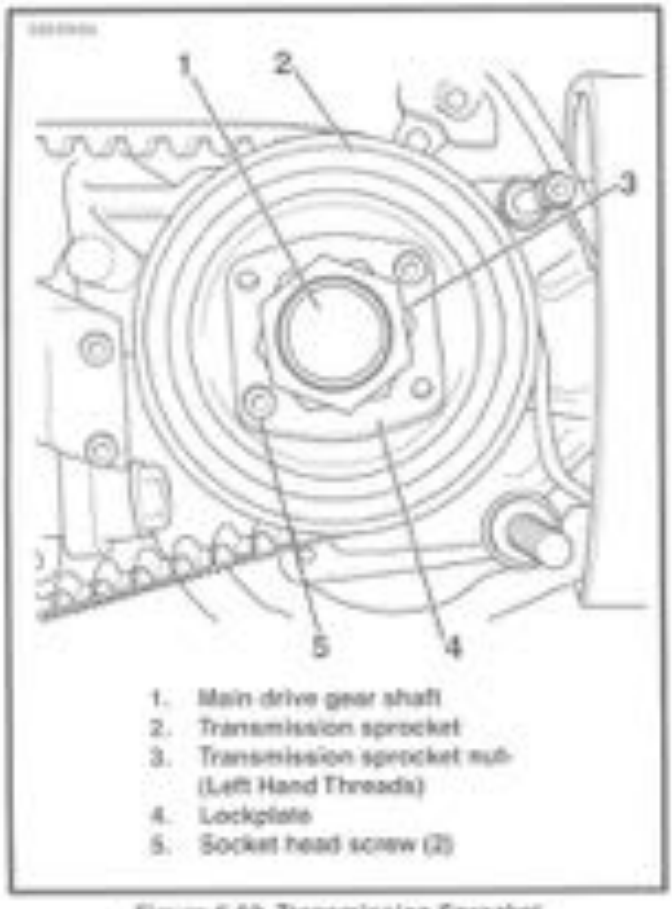
Turn the nut **counterclockwise** to install it onto main drive gear shaft.

a. Use TRANSMISSION SPROCKET HOLDING TOOL, HD-41321 and MAINSHAFT LOCKNUT WRENCH, Part No. HD-94660-37B, and a torque wrench. Tighten nut to 50 ft-lbs (67.8 Nm) **initial** torque, ONLY.

b. See Figure 6-54. Scribe a line on the transmission sprocket nut and continue the line on the transmission sprocket as shown.

c. Tighten the transmission sprocket nut an additional 30° - 40°.

d. See Figure 6-53. 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.



1. Main drive gear shaft
2. Transmission sprocket
3. Transmission sprocket nut (Left Hand Threads)
4. Lockplate
5. Socket head screw (2)

Figure 6-53. Transmission Sprocket

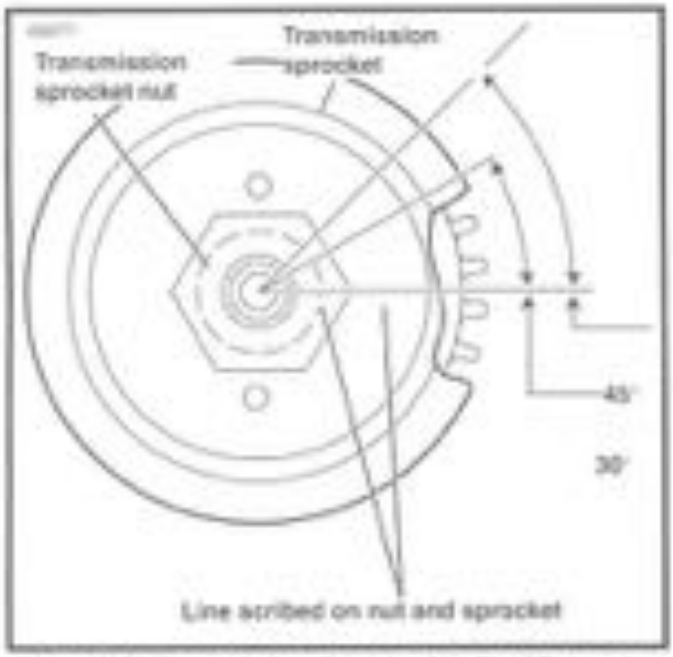


Figure 6-54. Transmission Sprocket Nut Final Tightening Procedure

NOTE

The lockplate has 4 screw holes and can be turned to either side, so you should be able to find a position without having to additionally tighten the nut. If you cannot align the screw holes properly, the nut may be additionally TIGHTENED until the screw holes line up, but do not exceed 45° as specified above. Never LOOSEN nut to align the screw holes.

e. If lockplate will not align with holes, tighten nut to 45° maximum as shown in Figure 6-54.

⚠CAUTION

Maximum allowable tightening of sprocket nut is 45° of counterclockwise rotation, after initially tightening to 50 ft-lbs torque. Do not loosen sprocket nut while attempting to align the screw holes. If you cannot align lockplate and sprocket screw holes, nut may be additionally tightened until screw holes line up, but do not exceed 45° as specified above. Tightening too much or little may cause the nut to come loose during vehicle operation.

f. Install socket head screws through two of the four holes in lockplate (4), then into two corresponding tapped holes in sprocket.

⚠CAUTION

To ensure the lockplate's security, you must use BOTH screws when you install the lockplate.

3. Tighten socket head screws (5) to 7-9 ft-lbs (9-12 Nm) torque.

NOTE

The socket head screws have Loctite patches and can be reused 3 - 5 times.

4. Install primary chain and chaincase as described under PRIMARY CHAINCASE, ASSEMBLY later in this section.

5. Align vehicle and adjust belt tension. See VEHICLE ALIGNMENT, Section 2.

SUBJECT PAGE NO.

1. Specifications 7-1
2. Electrical Bracket 7-2
3. Ignition System 7-4
4. Bank Angle Sensor 7-47
5. MAP (Manifold Absolute Pressure) - 1200S 7-48
6. Vacuum Operated Electric Switch (V.O.E.S) 7-49
7. Ignition/Light Switch 7-51
8. Ignition Module - 1290S 7-53
9. Cam Position Sensor and Rotor - 1200S 7-54
10. Ignition Module - All except 1200S 7-55
11. Spark Plugs 7-57
12. Spark Plug Cables 7-58
13. Ignition Coil 7-59
14. Charging System 7-61
15. Alternator 7-67
16. Voltage Regulator 7-69
17. Battery 7-70
18. Lamps 7-75
19. Rear Brake Switch 7-80
20. Handlebar Switches 7-81
21. Horn 7-92
22. Neutral Indicator Switch 7-94
23. Directional (Turn Signal) Canceller 7-95
24. Fuses and Main Circuit Breaker 7-102
25. Electronic Speedometer and Tachometer 7-104
26. Deutsch Electrical Connectors 7-111
27. AMP Multilock Electrical Connectors 7-116
28. Packard Electrical Connectors 7-120
29. Sealed Butt Connectors 7-122
30. Crimp Tables 7-123
31. Wiring Diagrams 7-127

SPECIFICATIONS

IGNITION

Spark Plugs

Size ..... 12 mm

Gap ..... 0.038-0.043 in.
0.97-1.09 mm

Type HD-6R12

Torque Value ..... 11-18 ft-lbs
15-24 Nm

Ignition Coil Resistance

Resistance	Primary	Secondary
All except 1200S	2.5 - 3.1 Ohms	10,800 - 12,500 Ohms
1200S	.4 - .6 Ohms	11,500 - 12,700 Ohms

Ignition Timing Spark Occurrence

Idle	V.O.E.S.	
	Connected	Disconnected
All models except 1200S Normal 1000 -1050 RPM*	20° BTDC	Approximately 7.5° BTDC

*Set timing at 1000-1050 RPM with V.O.E.S. connected.

XL1200S Sport - set timing at 1000-1050 RPM - 20° BTDC

ALTERNATOR

AC Voltage Output ..... 19-26 VAC per 1000-engine RPM
Stator Coil Resistance ..... 0.2-0.4 Ohms

REGULATOR

Voltage output @ 75°F ..... 14.3-14.7 VDC
Amperes @ 3600 engine RPM ..... 22 Amps

BATTERY

All Models ..... 12 volt, 18 Ampere Hours

FUSES

	Amp Rating
Ignition	15
Lights	15
Accessory	15
Instruments	15

MAIN CIRCUIT BREAKER

All Models ..... 30 Amps

BULB CHART

Refer to the table below for information regarding bulbs and lamps used on the Harley-Davidson XL/H motorcycle.

Bulb Chart

LAMP DESCRIPTION (ALL LAMPS 12 V)	NUMBER OF BULBS REQUIRED	CURRENT DRAW (Amperes)	HARLEY-DAVIDSON PART NUMBER
Headlamp – H4 Bulb Element High Beam/Low Beam	1	 5.00/4.58	67697-81
Position Lamp (HDI)	1	.32	53438-92
Indicator Lamps High Beam Oil Pressure Neutral Directional	 1 1 1 2	 0.15 0.15 0.15 0.15	 68024-94 68024-94 68024-94 68024-94
Directional Running Lamps Front Directional Running Lamps Rear Directional Front/Rear (HDI)	 2 2 2	 2.25/0.59 2.25 1.75	 68168-89 68572-94B 68163-94
Tail/Stop Lamp Tail/Stop Lamp (HDI)	1 1	0.59/2.25 .42/1.75	68168-89 68169-90
Speedometer Lamp Tachometer Lamp (if applicable)	1 1	0.30 0.35	53439-79 52441-94
Odometer	1	0.19	67136-85

ELECTRICAL BRACKET

See Figure 7-1. To provide for easy access and servicing, the electrical bracket is located under the left side cover and includes the following electrical components:

- Main circuit breaker (30 Amp)
- Fuse Block (under starter relay and data port)
- Starter relay
- Data link (12005 only)

REMOVAL

⚠WARNING

To avoid accidental start-up of vehicle and possible personal injury, disconnect the battery cables before proceeding. Always disconnect the negative cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion producing personal injury.

1. If necessary, disconnect battery cables, negative cable first. See BATTERY, DISCONNECTION AND REMOVAL.
2. Gently pull side cover away from frame tubes (no tools required).

INSTALLATION

1. Align barbed studs in side cover with grommets in frame and push firmly onto place (no tools required).

⚠WARNING

Always connect the positive battery cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion producing personal injury.

2. If necessary, install battery cables, positive cable first. See BATTERY, INSTALLATION AND CONNECTION in this section.

REPLACE FUSE(S)

Removal

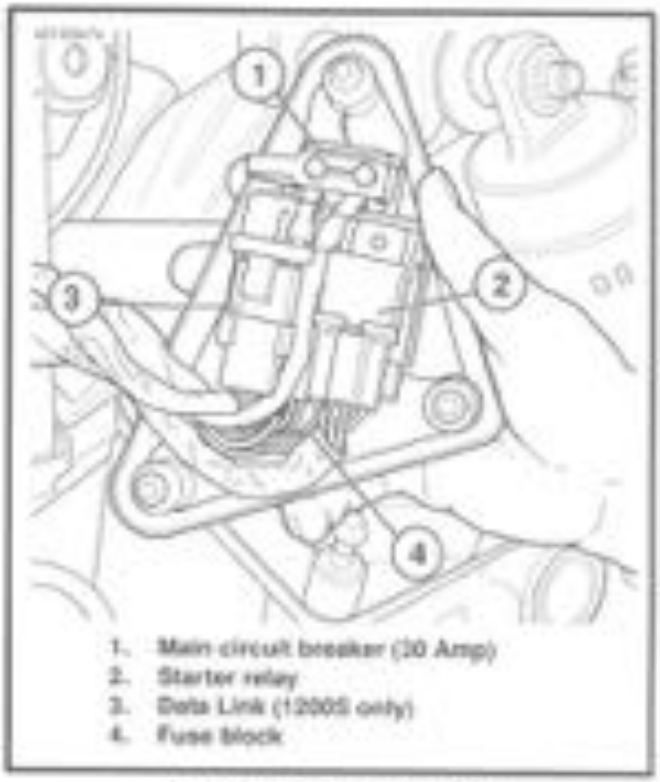
1. Remove side cover.
2. See Figure 7-2. Pull up on latch to release fuse block and slide fuse block from electrical bracket.
3. Pull fuses from slots in fuse holder and inspect for damage. Replace as necessary.

NOTE

A fuse puller tool and two spare 15 amp fuses are located in the base of the electrical bracket under the fuse block.

Installation

1. Insert fuse(s) (15 amp) in appropriate slot.



1. **Main circuit breaker (30 Amp)**
2. **Starter relay**
3. **Data Link (12005 only)**
4. **Fuse block**

Figure 7-1. Electrical Bracket

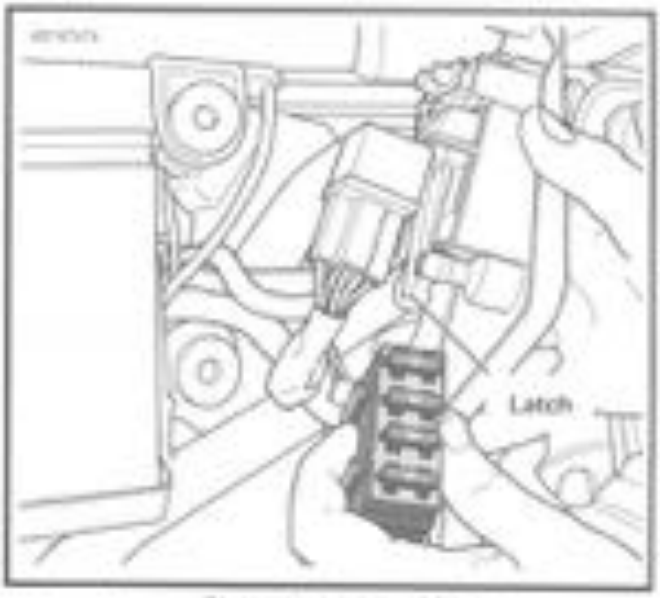


Figure 7-2. Fuse Block

⚠CAUTION

Always use replacement fuses that are of the correct type and value. Use of incorrect fuses can result in damage to the electrical system.

2. Align fuse block so guides engage slots in bracket assembly.
3. Slide fuse block into bracket assembly until latch engages.
4. Install side cover.

REPLACE MAIN CIRCUIT BREAKER

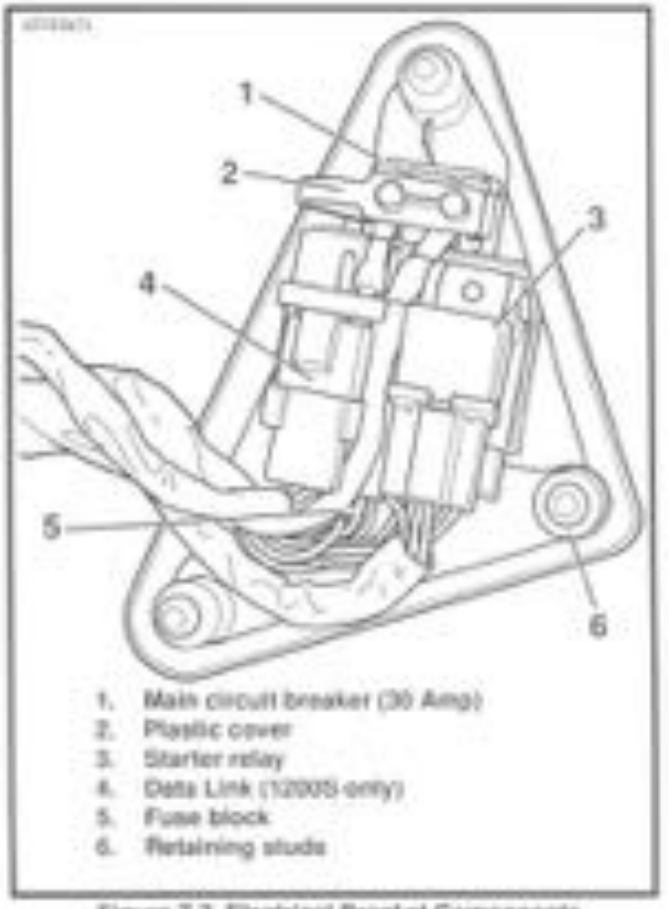
1. Remove left side cover.
2. Disconnect battery cables, negative cable first. See BATTERY, DISCONNECTION AND REMOVAL.
3. See Figure 7-3. Remove plastic cover (2) from terminal studs of main circuit breaker (1). Remove hex nuts from terminals. Remove ring connectors.
4. Gently pry up latch holding main breaker and remove.
5. Obtain new main circuit breaker.
6. Install single black lead on copper terminal. Install double red lead on remaining terminal. Install and tighten terminal nuts. Install plastic cover on terminal studs.
7. Push main circuit breaker into clip on electrical bracket.
8. Install electrical bracket. See ELECTRICAL BRACKET, INSTALLATION.

REPLACE STARTER RELAY

1. Remove left side cover.
2. See Figure 7-3. Unplug starter relay (3).
3. Lift gently on the connector end to release tab and free relay.
4. See Figure 7-4. Position locating hole in relay over raised tab on electrical bracket and push into position.
5. Connect plug to new relay.
6. Install electrical bracket. See ELECTRICAL BRACKET, INSTALLATION.

REPLACE ELECTRICAL BRACKET

1. Disconnect battery cables, negative cable first. See BATTERY, DISCONNECTION AND REMOVAL.
2. Access electrical bracket. See ELECTRICAL BRACKET, REMOVAL.
3. See Figure 7-3. Remove main breaker (1).
4. Remove fuse block (5).
5. Remove starter relay (3).
6. On 12005 - remove Data Link.
7. Remove the three screws holding the bracket to the side cover.
8. Position new electrical bracket in place and fasten with three screws.
9. Install main breaker, fuse block, starter relay and, on 12005 models, the data link.
10. Install side cover.



1. Main circuit breaker (30 Amp)
2. Plastic cover
3. Starter relay
4. Data Link (12005 only)
5. Fuse block
6. Retaining studs

Figure 7-3. Electrical Bracket Components

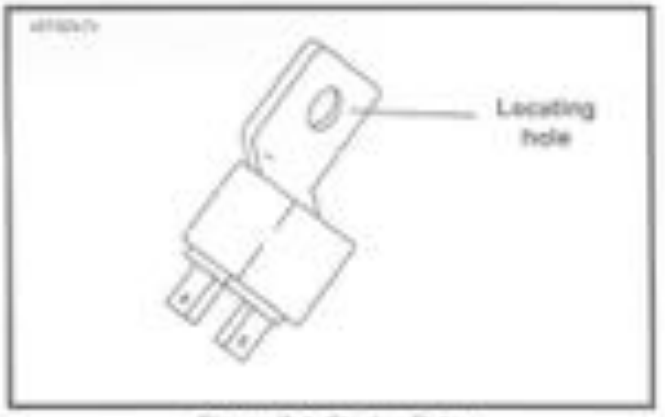


Figure 7-4. Starter Relay

IGNITION SYSTEM

GENERAL (Figures 7-5 or 7-6)

The vehicle is provided with a breakerless inductive-discharge ignition system. The system has both a primary and secondary circuit. The primary circuit consists of the battery, ignition switch, primary coil winding, computerized ignition timer and associated wiring. The secondary circuit consists of the secondary coil, spark plugs and associated wiring.

The computerized ignition system contains of four assemblies – the computerized ignition module, vacuum-operated electric switch (V.O.E.S.), the bank angle sensor and the rotor.

The ignition module is mounted in the gear case cover. The ignition module has two functions. First, it computes the spark advance for proper ignition timing. Second, it opens and closes the low-voltage circuits between the battery and ignition coil to produce high-voltage discharge to the spark plugs.

The vacuum-operated electric switch (V.O.E.S.) is attached to the top center engine mounting bracket above the intake manifold. The V.O.E.S. senses intake passage vacuum through a carburetor hose connection. The switch is open during acceleration and high engine load conditions (low vacuum) and is closed during deceleration and low engine load conditions (high vacuum). The ignition module is programmed with two spark advance curves to meet varying engine loads.

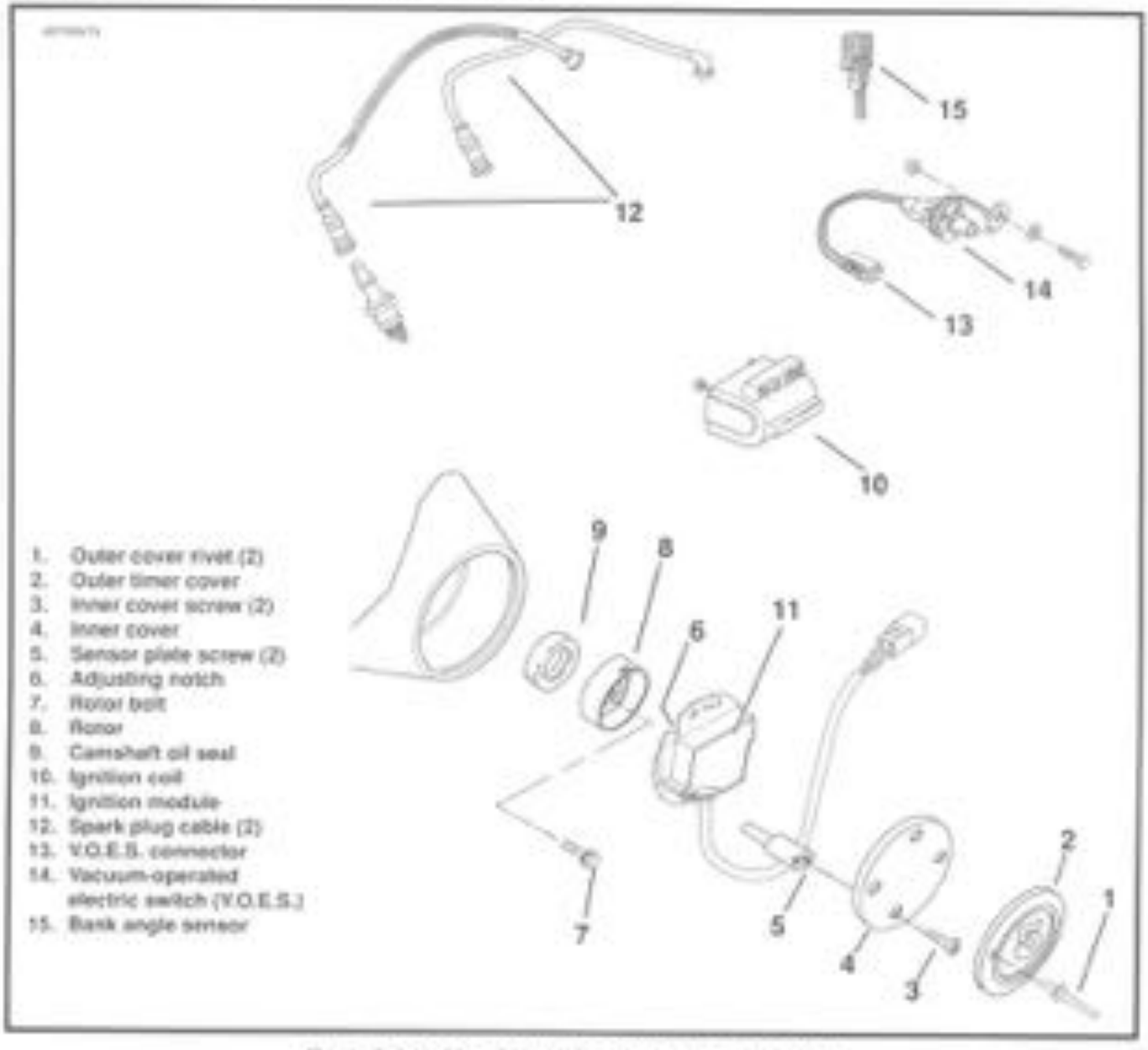
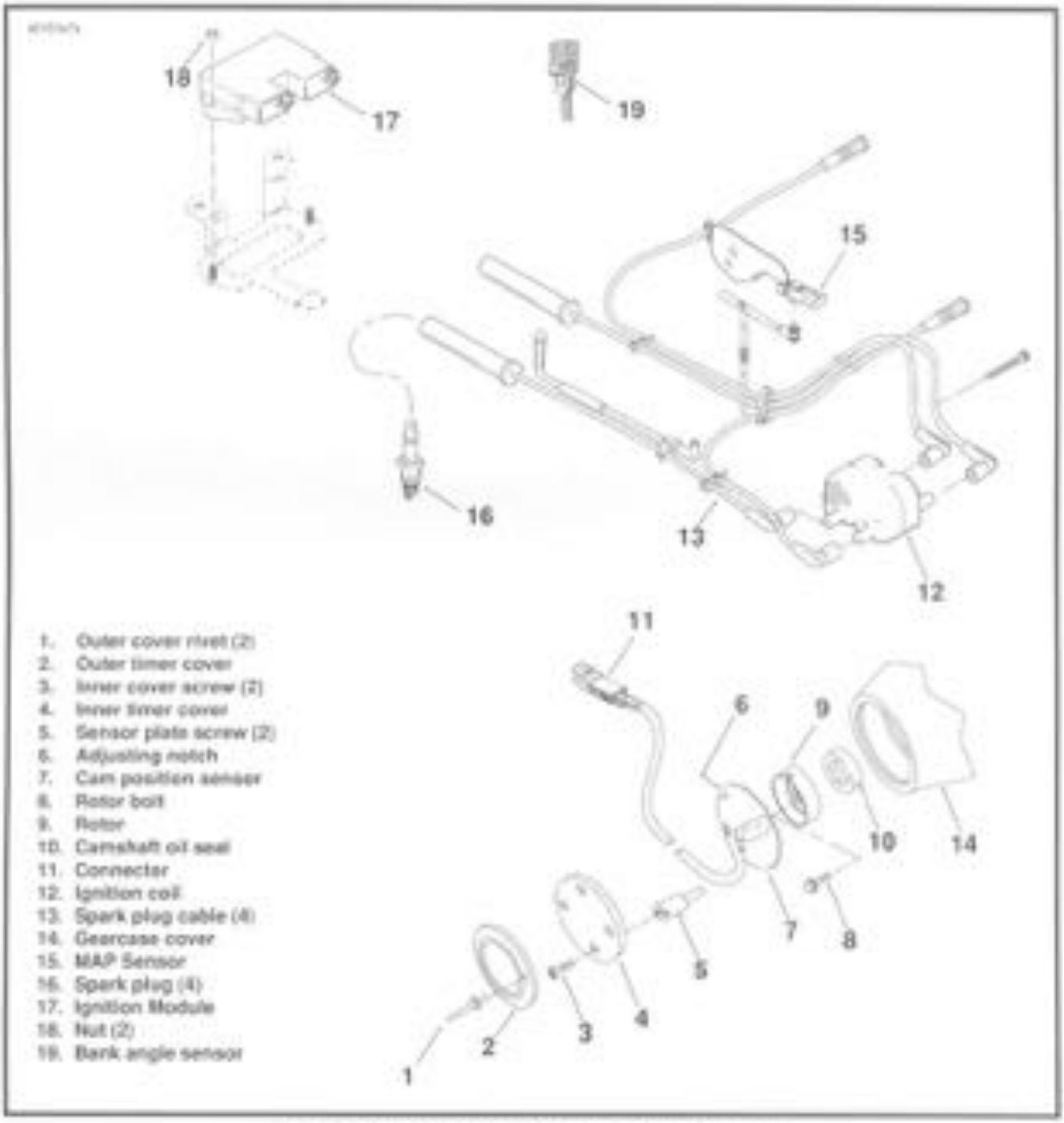


Figure 7-5. Ignition System Components (except 1200S)

The high-vacuum curve, selected for maximum spark advance under normal light-load cruising conditions, provides improved fuel economy and performance. The low-vacuum curve (retarded spark) minimizes spark knock while maintaining performance under high-load conditions (acceleration and highway driving).

The ignition module selects the proper curve when it receives an open or closed electrical signal from the V.O.E.S. This system ensures correct timing to suit starting and low- and high-speed requirements.

The bank angle sensor is attached to the side of the battery tray. The sensor consists of a magnet that rides in a channel filled with fluid. If the vehicle lean angle exceeds 50°, the magnet moves to create an open circuit. The open circuit is detected by the ignition module and the ignition system is shut off.



1. Outer cover rivet (2)
2. Outer timer cover
3. Inner cover screw (2)
4. Inner timer cover
5. Sensor plate screw (2)
6. Adjusting notch
7. Cam position sensor
8. Rotor bolt
9. Rotor
10. Camshaft oil seal
11. Connector
12. Ignition coil
13. Spark plug cable (4)
14. Gearcase cover
15. MAP Sensor
16. Spark plug (4)
17. Ignition Module
18. Nut (2)
19. Bank angle sensor

Figure 7-6. Ignition System Components - 1200S Sport

A single ignition coil fires both spark plugs simultaneously. The spark plug in the front cylinder fires at the end of that cylinder's compression stroke, thereby igniting the air/fuel mixture. At the same instant, the spark in the rear cylinder fires ineffectually during the end of that cylinder's exhaust stroke. During the next engine revolution, the simultaneous firing of the spark plugs will occur during the middle of the front cylinder's exhaust stroke and at the end of the rear cylinder's compression stroke (thereby igniting the air/fuel mixture in the rear cylinder).

The rotor and cam position sensor (integrated with the Ignition Module) are located in the gearcase cover on the right side of the motorcycle. The rotor is mounted on the camshaft and operates at one-half crankshaft speed. As the rotor turns, slots in its outside diameter break the magnetic field of a Hall-effect device in the ignition module. The output of the Hall-effect device is a logic-type signal that corresponds to the timing information from the spinning rotor. This technique gives accurate timing information down to "0" speed.

The ignition system produces a spark near top dead center (TDC) for starting. At rpm's and loads above this, the system produces a spark 0° to 45° before TDC on 883 and 1200 models. The whole timing program can be shifted by mechanical rotation of the cam position sensor. See ADJUSTMENT/TESTING, IGNITION TIMING, CHECK.

The ignition module contains all the solid-state components used in the ignition system. The dwell time for the ignition coil is also calculated by the microprocessor and is dependent upon engine speed. The programmed dwell is an added feature to keep battery drain to a minimum and to adequately charge the coil at all speeds. The ignition module has added protection against transient voltages, continuous reverse voltage protection and damage due to jump starts. The system will operate down to 5.7 volts DC. The ignition module is fully enclosed in a "potting" material to protect it from vibration, dust, water and oil. The unit is not repairable –it must be replaced if it fails.

See the wiring diagrams at the end of this section for additional information on ignition system circuits.

1200 Sport

The XL Sport ignition differs from other Sportsters. The ignition system consists of five assemblies, the ignition module, cam position sensor, rotor, Bank angle sensor, and the MAP (Manifold Absolute Pressure) sensor.

The ignition module is located under the seat. It computes the spark advance for proper ignition timing and regulates the low voltage circuits between battery and ignition coil.

The ignition timer includes a rotor, cam position sensor, ignition module and MAP sensor. A twin coil fires each pair of spark plugs in single fire mode (i.e. both spark plugs fire in one cylinder but not the other - no wasted spark).

The MAP sensor is located on a bracket along the frame backbone under the fuel tank. The sensor monitors the intake manifold pressure and adjusts the advance curve for optimum performance.

The bank angle sensor is attached to the side of the battery tray. The sensor consists of a magnet that rides in a channel filled with fluid. If the vehicle lean angle exceeds 59°, the magnet moves to create an open circuit. The open circuit is detected by the ignition module and the ignition system is shut off.

TROUBLESHOOTING

Perform the following tests if the engine will not start, or if hard starting or missing indicates a faulty operating ignition system.

Check for Ignition Spark

1. Disconnect spark plug cables from spark plugs. Check condition of plugs and cables. Clean or replace as necessary.
2. Insert a conductive adapter into spark plug cable end and establish a 3/16 inch (4.8 mm) gap between adapter and cylinder head. Turn on ignition and "engine stop" switches. With transmission in neutral, press "engine start" button. Check for a spark across plug electrode gap. If a spark is produced, problem is not in electronic system or coil – check carburetion, enricherer and spark plugs. If no spark is produced, check battery voltage and battery connection condition. Battery voltage must be 11-13 vdc. Charge battery if voltage is low.
3. Verify that the ground wire from battery to frame is in good condition.If there is still no spark, then perform the tests under NO IGNITION SPARK.

No Ignition Spark

See Figure 7-7. To conduct the following tests, it will be necessary to assemble a set of jumper wires. Cut two wires of ample length to reach from a good ground connection to the negative terminal of the coil primary. If a suitable capacitor is not available, use a condenser (such as the type used in earlier breaker point ignition systems). When conducting Steps 3 and 5 of the following spark tests, connect a spare spark plug to one of the plug wires and lay the spark plug on the engine cylinder head. During the testing procedures, check for spark across the spark plug electrodes.

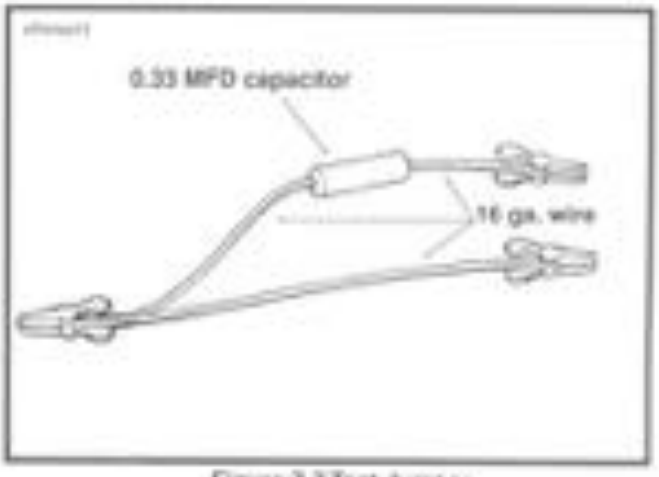
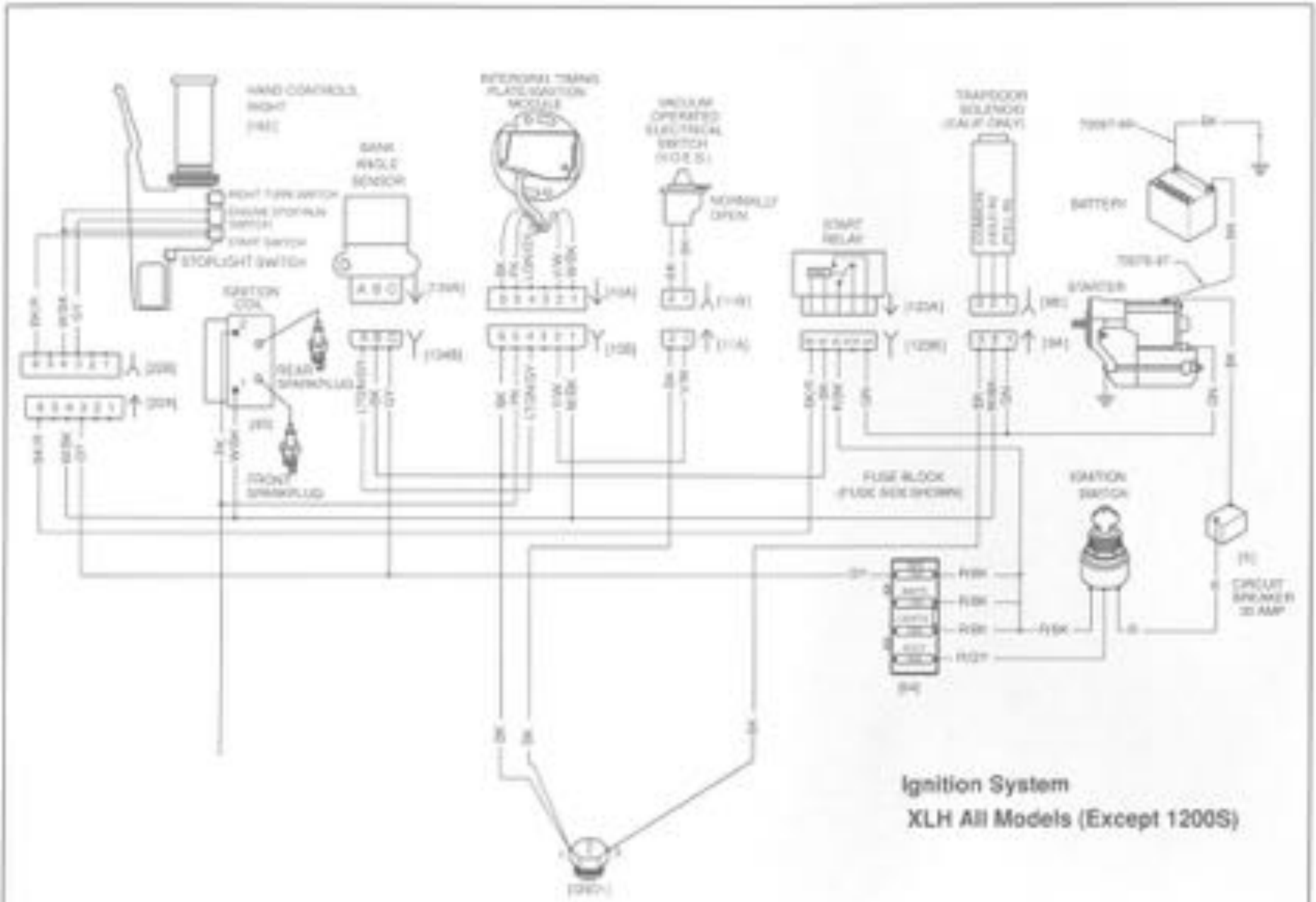
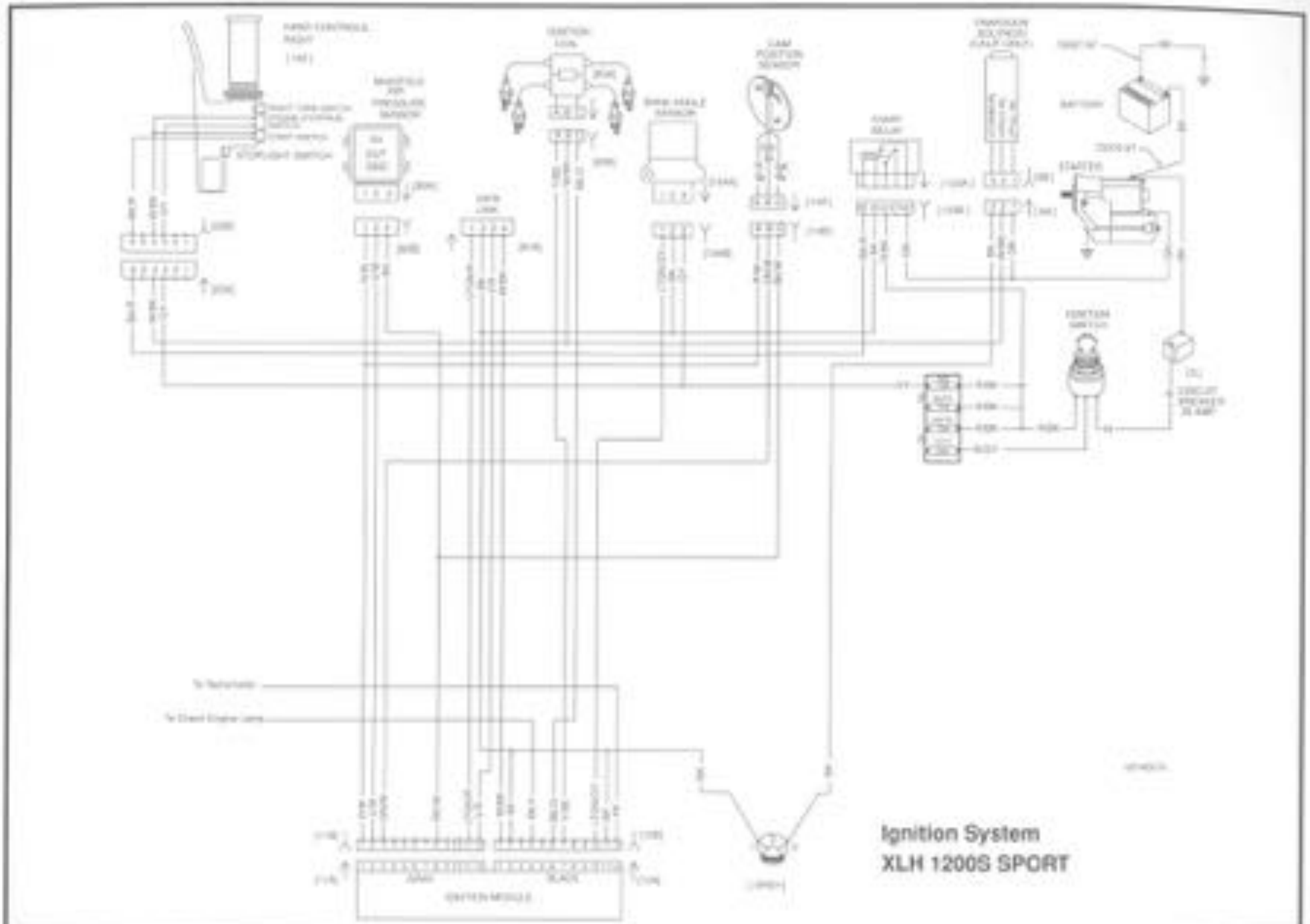


Figure 7-7 Test Jumper

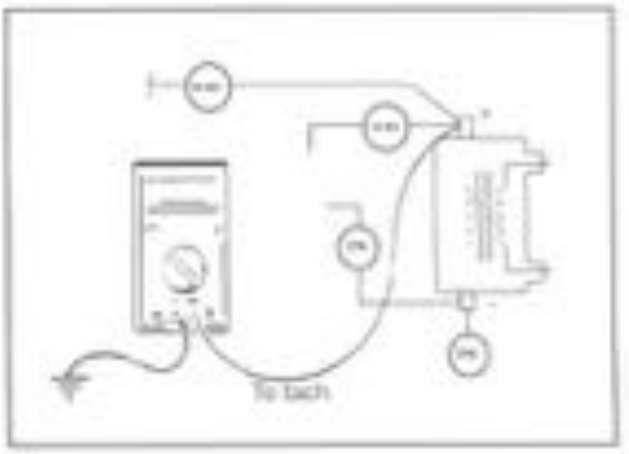


Ignition System
XLH All Models (Except 1200S)



Ignition System
XLH 1200S SPORT

Continuous Or No Spark At Spark Plug



-Ignition On.
-Multimeter Red Wire To White/black Wire On Coil, Black Wire To Ground.
-Meter Should Register 12v ± One Volt.

YES

Go To Next Page

NO

Check Ign. Fuse
Is Fuse Ok?

YES

Power To Gray Wire In Fuseblock?

NO

Replace - Find Source Of Fault

YES

Measure Voltage At Connector [22A] Pin 3 (GY). Battery Voltage Present?

NO

Check For 12VDC Between Battery, Main Breaker, Ignition Switch And Fuse Block. Repair As Necessary

YES

With Connector [22] Mated And Ignition On, Measure Voltage At Connector [22A], Pin 5 (W/BK). Battery Voltage Present?

NO

Repair Open (GY) Wire Between [22] and Fuse.

YES

Repair Open (W/BK) Wire Between Coil and [22A].

NO

Repair / Replace Engine Stop Switch or Wiring.

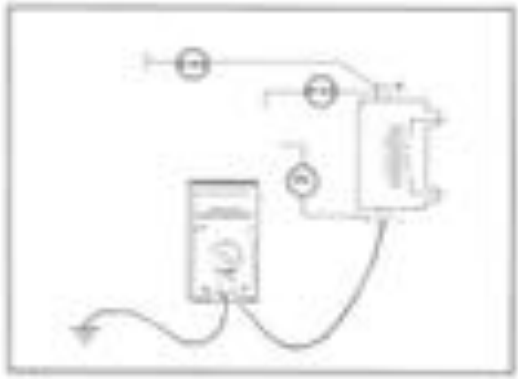
Wire Harness Connectors

No.	Description	Type	Location
[22]	RT Handlebar Switch	6 - Place Deutsch (DRC)	In Headlight

YES

•Remove Pink (Module) Wire From Coil Terminal.
•Ignition Switch On.
•Multimeter Red Lead Alternately To White/Black Wire Terminal And To (PK) Wire Terminal.

12VDC at both terminals?

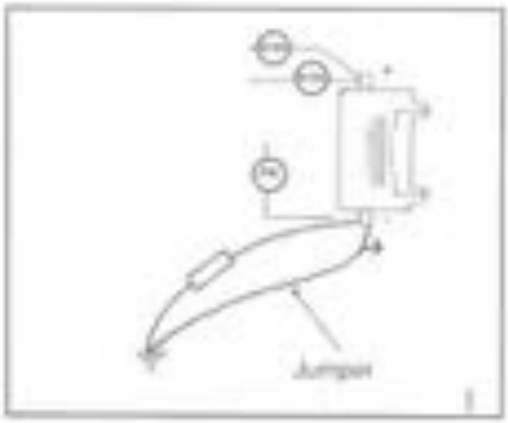


YES

NO

Replace coil.

• Pink (Module) Wire Disconnected.
• Ignition On.
• Jumper Wire – Connect Capacitor Wire To Pink Wire Terminal.*
• Connect Both Wires To Common Ground.
• Momentarily Touch Ground Wire To Pink Wire Terminal.
Is There A Spark At Plug When You Remove The Wire?



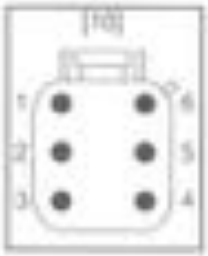
*Perform Coil Resistance Check If Capacitor Is Not Available

YES

NO

Replace Coil.

• Reconnect (PK) Wire
• Disconnect 6-pin Connector [10].
• Ignition Switch On.
• Multimeter Red Lead To (W/BK) Wire (Pin 1) Terminal.
• Multimeter Black Lead To BK (Pin 6) On [10B].
• Multimeter Should Register 12VDC ± 1.0 VDC.



NO

YES

Check Continuity Between Pin 1 W/bk [10B] And Coil W/BK Wire. Continuity Present?

Go To Next Page

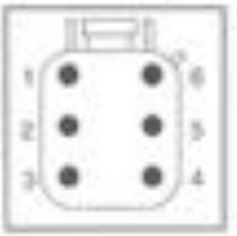
YES

NO

Repair Open Between [10B] Pin 6 (BK) And Ground.

Repair Open in W/BK Wire.

Continuous Or No Spark At Spark Plug - All Models Except 1200 Sport



+ Ignition On
+ Measure Voltage At Connector [109] - Multimeter Red Lead To Pin 5 (PK) And Black Lead To Pin 6 (BK)
Is 12VDC ± 1.0 VDC Present?

YES

NO

Check Wire Continuity Between Connector [108] Pin 5 (PK) And Coil Terminal (PK)
Continuity Present?

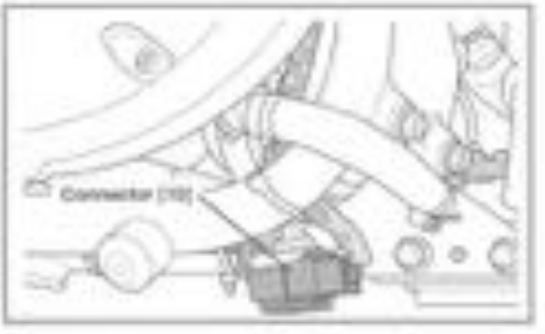
YES

NO

Locate And Repair Short To Ground On (PK) Wire

Repair Open (PK) Wire

Install 6-pin Harness Adapter (HD-42982) and Breakout Box using Black connectors Between Connectors [10A] And [10B]
Measure Voltage Between LTGN/GY (Pin 4) And BK (Pin 6).
Is Voltage 0.6-1.1 VDC ?



YES

NO

See Next Page.

Remove Timer Cover. Crank Engine. Is Led Flashing?

YES

NO

Replace Ignition Module.

Is Rotor Cup Rotating?

YES

NO

Replace Ignition Module.

Remove Gearcase Cover. Inspect For Mechanical Failure. Repair.

Harness Adapters (HD-42982)

Continuous Or No Spark At Spark Plug - All Models Except 1200 Sport

Is Bank Angle Sensor Connected?

NO → Reconnect.

YES →

* Remove Bank Angle Sensor. Disconnect Connector [134]. Measure Voltage On [134B] Between Socket A, LT GN/GY And Socket B, Bk

* To avoid damage to terminals, remove Bank Angle Sensor before disconnecting connector [134]. Use Harness Connector Adapter Kit HD-41509 (Gray male probe and patch cord)

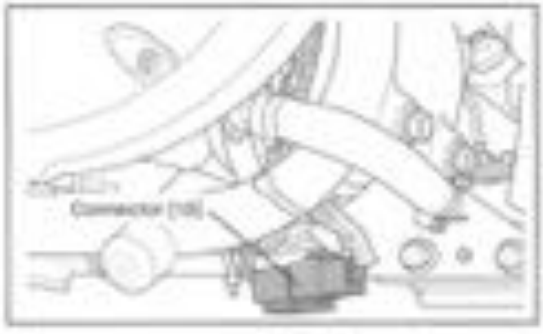
3.0-3.5 VDC → See Next Page

11-13 VDC → Repair Short On LT GN/GY

0 VDC → Disconnect Connector [10]. Check Continuity Between Socket A, LT GN/GY On Connector [134B] And Socket 5, LT GN/GY On Connector [108]. Continuity Present?

NO → Repair Open In LT GN/GY Wire

YES →



Check *Continuity To Ground On BK Wire, Socket B, Connector [134B]. Is Continuity Present?

NO → Repair Open Ground Wire

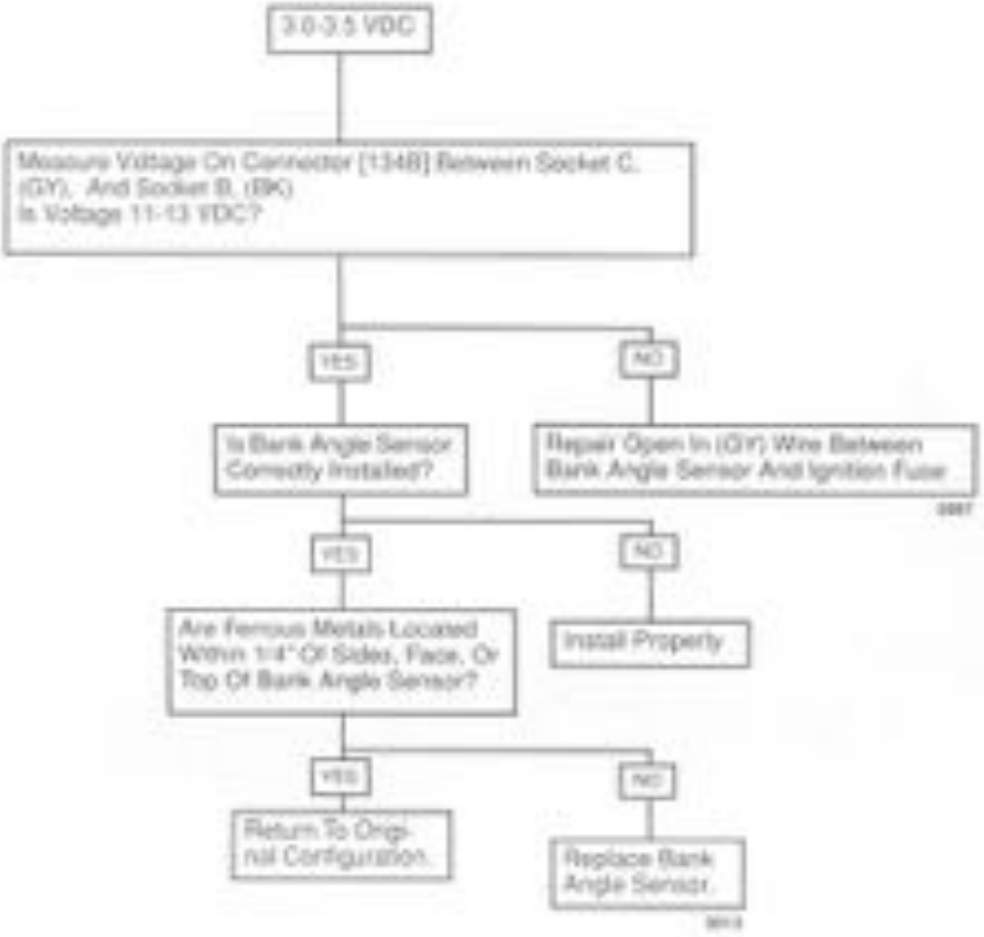
YES →

Check Continuity To Ground On LT GN/GY Wire, Socket A, Connector [134B] Or [108]. Is Continuity Present?

YES → Repair Short To Ground On LT GN/GY

NO → Inspect Module Harness For Damage. Repair If Necessary. If Harness Is Not Damaged, Replace Ignition Module.

Continuous Or No Spark At Spark Plug - All Models Except 1200 Sport



Check Engine Lamp

To diagnose system problems, start by observing the behavior of the Check Engine Lamp.
When the Ignition Switch is turned ON (Key ON) after being off for 10 seconds or more, the Check Engine Lamp will illuminate for approximately four seconds and then turn off.

NOTE

- *"Key ON" means only that the ignition Key Switch is turned to ON and the handlebar Engine Stop Switch is in the RUN position (although the engine is NOT running).*

- *If the Check Engine Lamp is not illuminated at Key ON or if it fails to go OFF after the initial four second ON period, then a problem exists in the lamp circuit. See DIAGNOSTIC FLOW CHARTS in XL Service Manual for procedure to correct problem.*

When the lamp turns off after being illuminated for the first four second period, it will remain off if there are no fault conditions or trouble codes currently detected by the ignition module.
However, if the Check Engine Lamp stays off for only 4 seconds and then comes back on for an 8 second period, then a functional error is stored (although no current trouble code exists).
If the Check Engine Lamp remains on beyond the 8 second period, then a current trouble code exists.

NOTE

Trouble codes relating to the ignition coil can only be fully diagnosed during actuation. For example, a problem with an ignition coil will be considered a current fault even after the problem is corrected, since the ignition module will not know of its resolution until after the coil is exercised by a vehicle start sequence. In this manner, there may sometimes be a false indication of a current trouble code.

If a particular problem happens to resolve itself, the active status is dropped and it becomes a "historic," rather than a "current" fault. Historic trouble codes are stored for a length of time to assist in the diagnosis of intermittent faults. The Check Engine Lamp will not indicate the existence of only historic trouble codes.
While the trouble codes are stored (whether current, historic or functional), they can be read by either the Scanalyzer or the Check Engine Lamp. All trouble codes reside in the memory of the ignition module until the code is cleared by use of the Scanalyzer or a total of 50 trips has elapsed. A "trip" consists of a start and run cycle, the run cycle lasting at least 30 seconds. After the 50 trip retention period, the trouble code is automatically erased from memory (that is, assuming no subsequent faults of the same type are detected in that period).

IMPORTANT NOTE

It is important to note that historic trouble codes may also be present whenever the system indicates the existence of a CURRENT fault.

Retrieving Trouble Codes

Data Link Connector

The behavior of the Check Engine Lamp as described under CHECKING FOR TROUBLE CODES indicates the existence of a fault condition. Turn the Ignition/Light Key Switch to OFF and proceed as follows:

Diagnostic Modes

The XL 1200S Ignition System provides two levels of system diagnostics.

In the more sophisticated mode, a portable Scan Tool called a "Scanalyzer" (HD-41325) plugs into the Data Link Connector and facilitates the diagnosis of system problems through a direct interface with the ignition module. Using a special programmable application cartridge, the Scanalyzer offers data displays and menu selections that allow for quick and easy retrieval of data and enables the user to perform a variety of diagnostic tests while monitoring inputs and outputs.

Figure 7-10. Scanalyzer (HD-41325)

At the second level, the Check Engine Lamp is observed by the user after being placed in the diagnostic mode. The lamp blinks a code which correlates to a particular problem area.

Scanalyzer

1. Gently pull left side cover from frame downtubes (no tools required).
2. See Figure 7-11. Note the Data Link connector (pin side of 4-place Deutsch) on the side cover.
3. Remove rubber protective plug from open end of Data Link connector.

Figure 7-11. Data Link Connector

4. Plug the Scanalyzer (HD-41325) into the Data Link Connector.
5. Turn the Ignition/Light Key Switch to IGNITION. Turn the handlebar mounted Engine Stop Switch to the RUN position (but do not start the engine).
6. Insert the diagnostic application cartridge HD-41325-95A, into the Scanalyzer. During the next few seconds, the Scanalyzer sequences through a series of screens that reflect a power-on self test, the system copyright, and then an attempt at communications with the ignition module. Once communications is established with the ignition module, the Diagnostic Menu appears. See Figure 7-12.
7. The Diagnostic Menu, which consists of seven items, is the primary system menu (main menu) through which all other secondary menus and displays are accessed. Since the screen may not be large enough to display all line items at any given time, use the up and down arrow keys to scroll through the list.
8. From the Diagnostic Menu, press the number "2" to access the Trouble Codes Menu. At this point, the unit allows the operator to display current trouble codes (by pressing the number "1"), display historic codes (number "2") or clear trouble codes (number "3"). Unlike the Check Engine Lamp Diagnostics, note that the Scanalyzer does allow the operator to clear trouble codes from memory as well as differentiate between current and historic codes.
9. After reading trouble codes, simply press the Mode key to return to the Trouble Codes Menu. Press the Mode key again to return to the Diagnostic Menu. In this manner, regardless of where the operator is in the program, the Mode key need only be pressed once or twice to return to the main menu.

NOTE

For more detailed instructions, refer to the literature provided with the Scanalyzer.

10. Write down all trouble codes on a piece of paper. If a current trouble code exists, place it at the top of the list.
11. If trouble codes are present, refer to the applicable flow chart. A Scanalyzer icon appears at those points in the flow chart where use of the Scanalyzer would be most convenient or desirable.
12. If trouble codes are NOT present, but starting or driveability problems are evident, see the Symptoms Chart under DIAGNOSTIC CHECK.
13. After correcting system problems, clear trouble codes using the Trouble Codes Menu of the Scanalyzer.

NOTE

Trouble codes cannot be cleared while the engine is running. Turn the engine off, but leave the Ignition/Light Key Switch in the IGNITION position and return the handlebar Engine Stop Switch to RUN.

14. Turn the Ignition/Light Key Switch to OFF. Turn the handlebar mounted Engine Stop Switch to the OFF position.
15. Unplug the Scanalyzer from the Data Link Connector. Install protective plug over pin side of Data Link Connector.
16. Place Data Link Connector in clip on left side cover.
17. Align barbed studs in side cover with grommets in frame downtubes and push firmly into place (no tools required).
18. Road test the vehicle and observe the Check Engine Lamp to confirm proper operation without the reoccurrence of trouble codes.

Diagnostic Codes for XL1200S		
Code	**Description**	**Ref. Page**
12	MAP Sensor	7-33
16	Battery Voltage	7-35
24	Front Coil	7-37
25	Rear Coil	7-37
86	Tachometer	7-40
41	Cam Sync Failure	7-41
44	Bank Angle Sensor	7-42
52	PAM/ROM Failure	7-43
54	EEPROM Failure	7-44
55	Module Failure	7-44

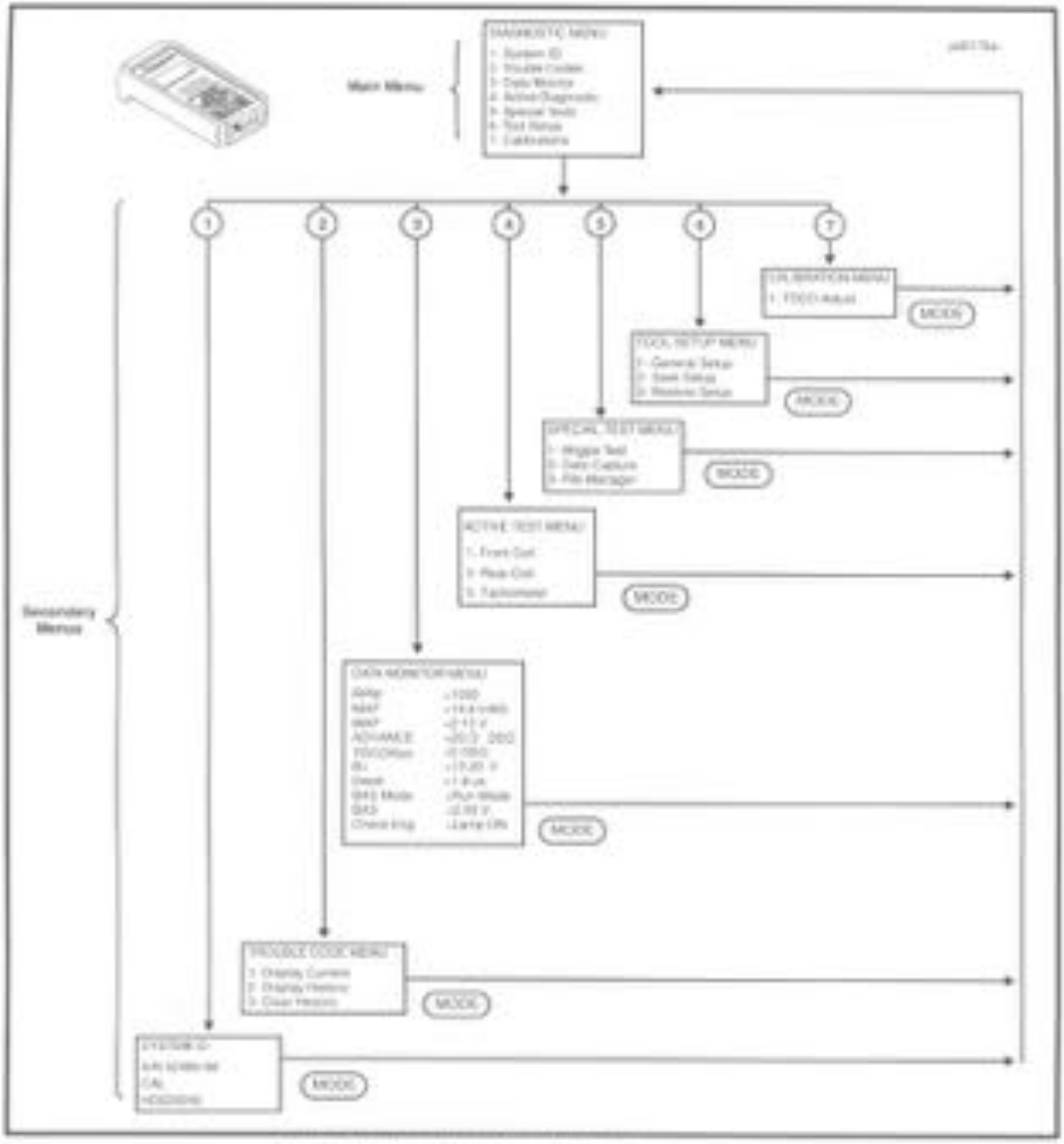


Figure 7-12. Scanalyzer Menu Selections

NOTE

Use of the Check Engine Lamp Diagnostics assumes that the Scanalyzer (HD-41325) is not available.

1. To activate the diagnostic feature of the Check Engine Lamp, proceed as follows:
   A. Install diagnostic test wire across pins 1 and 2 on Data Link connector [91A].
   B. Turn the Ignition/Light Key Switch to IGNITION and wait approximately eight seconds for the Check Engine Lamp to start flashing.

Figure 7-13. Diagnostic Test Wire

2. All trouble codes are sent out as a series of flashes.

   The transmission of a trouble code is always preceded by a series of rapid flashes (about 3 per second). This "intermission" is followed by a 2 second pause in which the lamp is off. The lamp will then flash one or more times to indicate the first digit of the trouble code. The length of time the lamp is illuminated and the length of time in which it is off are each about 1 second in duration. Simply count the number of times the lamp flashes in order to retrieve the first digit of the trouble code.

3. Following transmission of the first digit, there is another 2 second pause in which the lamp is off. The lamp will then flash one or more times to indicate the second digit of the trouble code. Count the number of times the lamp flashes to retrieve the second digit.

   Following transmission of the second digit, there is a third 2 second pause in which the lamp is off. After the pause comes the intermission, which is followed by transmission of the next recorded trouble code. All subsequent codes are sent in the same manner, each separated from the next by the intermission.

4. Write down the trouble codes on a piece of paper. Once all codes have been sent, the data string is repeated. When you have recorded the same trouble code twice, it is an indication that the transmission has been restarted and that all trouble codes have been retrieved.

NOTE

If the lamp flashes at a rate faster than normal, then you are observing the "intermission" only, which means that no trouble codes are present.

5. If trouble codes are present, refer to the applicable flow chart in the XLH Service Manual.

   If trouble codes are NOT present, but starting or driveability problems are evident, see the XLH Service Manual, DIAGNOSTIC CHECK, for help in diagnosing system problems.

6. Turn the Ignition/Light Key Switch to OFF. Remove diagnostic test wire from Data Link Connector.

IMPORTANT NOTE

If Diagnostic Test Wire is installed across Pins 1 and 2 on connector [91A] in lieu of Scanalyzer, the Ignition Module is placed in a Diagnostics Mode and engine will start. The test wire must be removed from the Data Link Connector and the Ignition Switch turned to OFF or the Check Engine lamp will continue to flash codes.

7. After correcting system problems, clear trouble codes. If the Scanalyzer is not available, perform 50 start and run cycles. To execute one run cycle, start the vehicle, let it run for at least 30 seconds and then turn the engine off for a minimum of 10 seconds.

8. Road test the vehicle and observe the Check Engine Lamp to confirm proper operation without the reoccurrence of trouble codes.

Breakout Box (HD-42682) Installation

General

The breakout box splices into the main harness of the Sportster. Used in conjunction with a DVOM, it allows circuit diagnosis of the wiring harness and connectors without having to probe with sharp objects.

The unit connects at the ignition module and allows the vehicle to run during testing.

The Breakout Box may be connected directly to the 1200S ignition module. On all other models, Breakout Box harness adapters (HD-42962) must be installed at connector [10] to connect the Breakout Box.

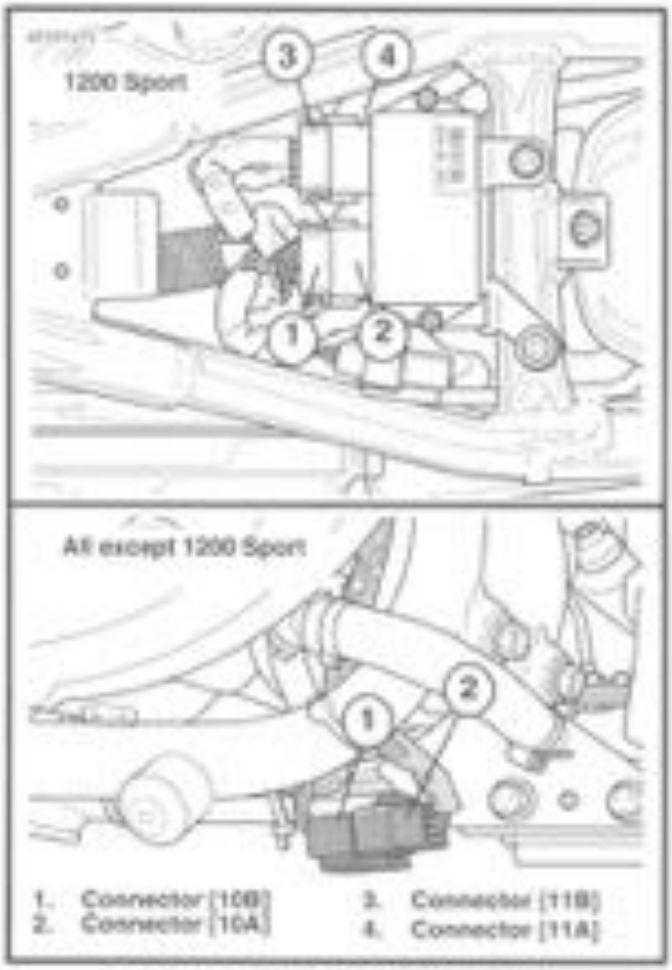


Figure 7-14. Breakout Box Connection

Installation

1. On 1200S: Remove seat. See SEAT, REMOVAL in Section 2.
2. On 1200S: Depress the latches on the side of the connectors [10] Black and [11] Gray and seperate with a gentle rocking motion.
3. On all other models seperate six pin connector [10], under engine on left frame tube.
4. On all except 1200S Sport, connect Harness Adapters (HD-42962) to connector [10].

Figure 7-15. Breakout Box connections (1200S)

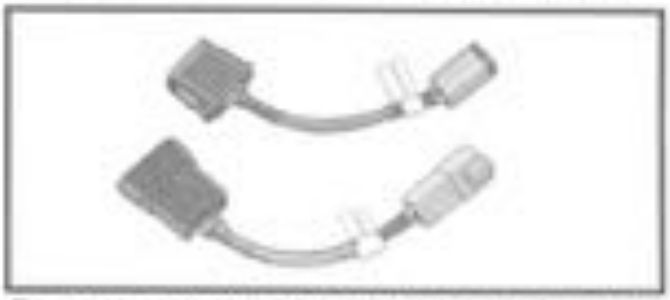


Figure 7-16. Breakout Box Harness Adapters - All except 1200S.

5. See Figure 7-14 and 7-15. On 1200S models, connect the Black male connector from the Breakout Box to ignition module connector [10B] and connector [10A] from the harness to the black female connector on the breakout box.
6. On all other models except 1200S, connect Black connectors from breakout box to Harness Adapters installed in step 4.
7. On 1200S Models, Connect the gray male connector from the Breakout Box to ignition module connector [11B] and connector [11A] from the harness to the gray female connector on the breakout box.

Circuit Diagnostics may now be performed.

GENERAL

The diagnostic check is an organized approach to identifying a problem caused by an electronic control system malfunction. If no problems are found after completion of the Diagnostic Check, a comparison of Scanalyzer parameters may be used to help locate intermittents and out-of-specification sensors. See TYPICAL SCAN VALUES table.

If the Scanalyzer is not working properly, check operation on another vehicle. If OK, check Data Link Connector for 12 volts and proper ground. If Scanalyzer reads 'No Response' with the Ignition Switch turned to ON (Engine Stop Switch at RUN with the engine off), check serial data wire for an open or short to ground between Data Link terminal "1" and Ignition Module. Also check for an open diagnostic test terminal between Data Link terminal "3" and Ignition Module. With Ignition Switch turned to ON, Transmit Data and Receive Data line should have 5 volts.

NOTE

If Diagnostic Test Wire (see below) is installed across Pins 1 and 2 on connector [91A] in lieu of Scanalyzer, the Ignition Module is placed in a Diagnostics Mode and engine will start. The test wire must be removed from the Data Link Connector and the Ignition Switch turned to OFF or the Check Engine lamp will still flash codes.

Wire Harness Connectors

No.	Description	Type	Location
[10]	Ign. Module	10 - Place Deutsch (Black)	Under Seat
[11]	Ign. Module	12 - Place Deutsch (Gray)	Under Seat
[91]	Data Link	4 - Place Deutsch	Under Left Side Cover

Figure 7-18. Data Link Connector [91A]

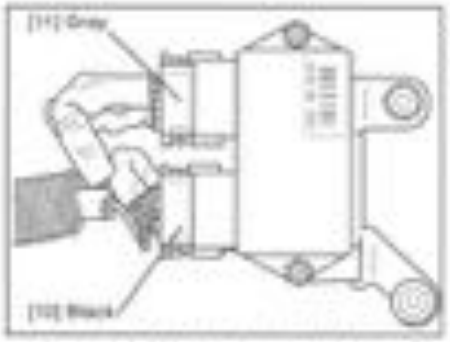
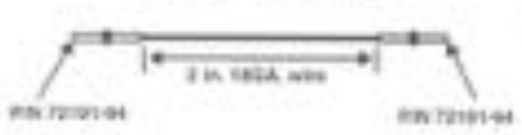


Figure 7-17. 1200S Ignition Module

Diagnostic Test Wire



DIAGNOSTIC NOTES

The reference numbers below correlate with those on the diagnostic flow chart.

① See Retrieving Trouble Codes page 7-14.

② See Typical Scan Values Chart Below.

SCAN VALUES			
Component	**Minimum**	**Maximum**	**Hot Idle**
MAP Sensor	0.1 V	4.95 V	1.5-3 V
Spark Advance (While Running)	0°	35°	20°
RPM	0	3500	1000
Bank Angle Sensor	Run Mode	Disable	Run Mode
Dwell	2.36 mSec	8.1 mSec	1.8-3 mSec

③ Wiggle Test. Shake or wiggle harness with DVOM or Scanalyzer connected. Radical voltage changes on the DVOM will indicate the presence of intermittents, while the Scanalyzer (in Wiggle Test Mode) will beep, light the four corner LEDs and display a minus sign when a current trouble code is detected. (If a current trouble code is present when the wiggle test is entered, the Scanalyzer will respond as described immediately upon entering the wiggle test mode. With Key On and engine off, clear trouble codes and then perform wiggle test with vehicle running.)

④ See Symptoms Chart Below.

SYMPTOMS	
STARTS HARD	
Battery Discharged	See Charging System Troubleshooting in Section 7 of this Service Manual.
Spark Plugs	See CHART C, Page 7-31
Ignition Coil	See CHART C, Page 7-31
Plug Wires	See CHART C, Page 7-31
Valve Sticking	See Section 3 of this Service Manual.
Water or Dirt in Fuel System	Drain and Refill With Fresh Fuel

SYMPTOMS (Cont.'d)	
HESITATES, STUMBLES, SURGES, MISFIRES AND OR SLUGGISH PERFORMANCE	
Manifold Leak	Spray Water Around Intake manifold Seals While Idling Engine. If RPM Changes, Replace Seals.
MAP Sensor or Hose Plugged or Not Operating Properly	See TROUBLE CODE 12.
Water or Dirt in Fuel System	Drain and Refill With Fresh Fuel.
Spark Plugs	See CHART C.
EVAP Hose Disconnected From Carburetor (Cold Models)	Connect.
Throttle Plates Not Opening Fully	See Throttle Cable Adjustment in Section 2 of this Service Manual.
ENGINE EXHAUST EMITS BLACK SMOKE OR FOULS PLUGS	
Clogged Air Filter	See Air Cleaner.
MAP Sensor or Hose Plugged or Not Operating Properly	See TROUBLE CODE 12.

⑤ Use Harness Connector Test Kit (HD-41404), black socket probes and patch cord.

⑥ See Ignition Module, Removal/Installation, page 7-52.

Diagnostic Codes for XL1200S		
Code	**Description**	**Ref. Page**
12	MAP Sensor	7-38
16	Battery Voltage	7-35
24	Front Coil	7-37
25	Rear Coil	7-37
33	Tachometer	7-44
41	Cam Sync Failure	7-41
44	Bank Angle Sensor	7-42
52	HAM/ROM Failure	7-40
54	EEPROM Failure	7-40
55	Module Failure	7-40

CHART A-1, CHECK ENGINE LAMP NOT ILLUMINATED at KEY ON

GENERAL

When the Ignition Switch is turned to ON (Engine Stop Switch at RUN with the engine off), the Check Engine Lamp should illuminate for 4 seconds. Battery voltage is supplied to the lamp bulb. The lamp bulb is grounded by the Ignition Module through the BK/Y wire. A lack of power to the Ignition Module will cause the Check Engine Lamp to be inoperative and also create a no start situation.

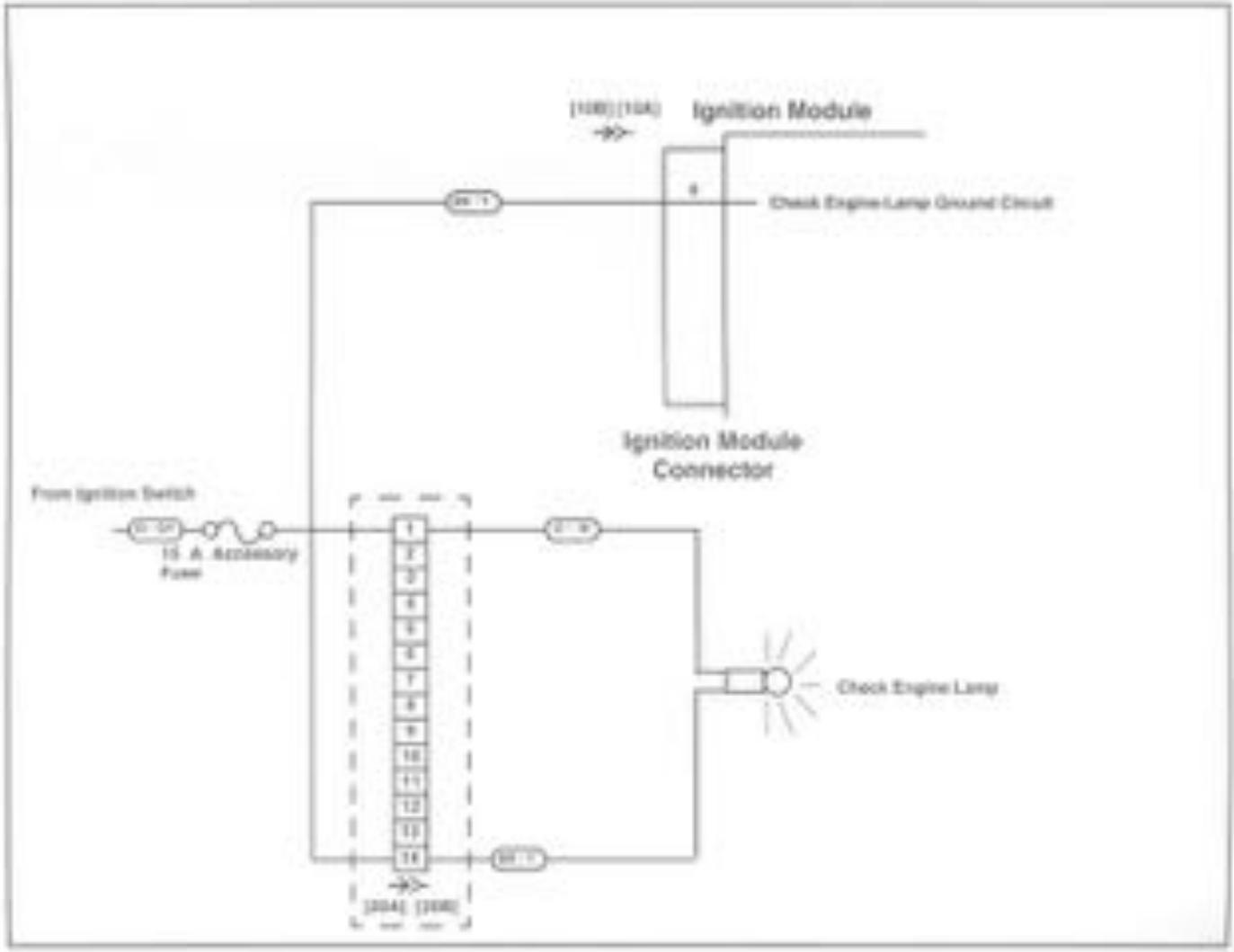
DIAGNOSTIC TIPS

- Check for open in BK/Y wire.
- Check for blown Accessory fuse.

DIAGNOSTIC NOTES

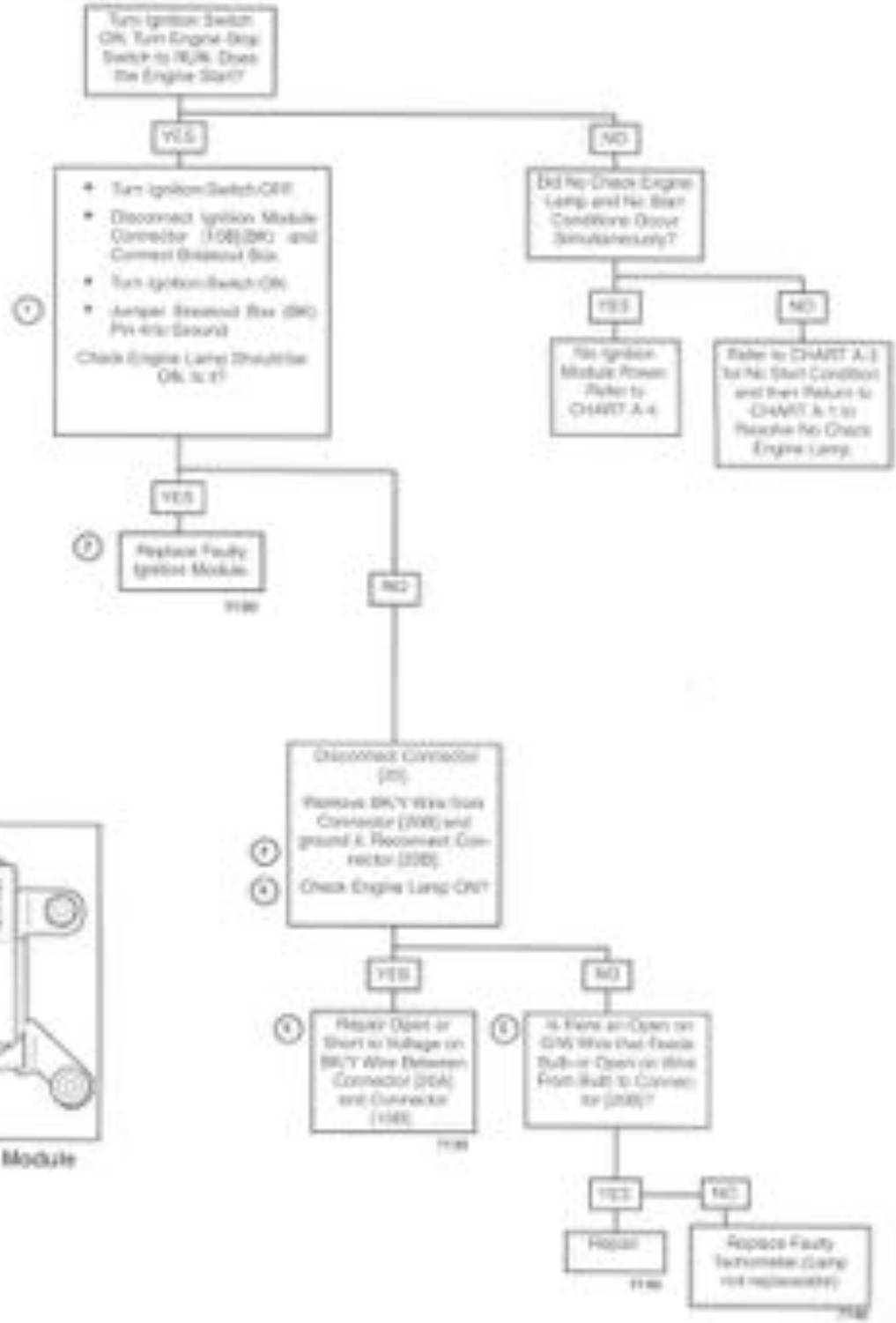
The reference numbers correlate with those on the diagnostic flow chart.

1. Use Harness Connector Test Kit (HD-41404), black pin probe and patch cord.
2. Inspect Connector [10] (BK) for contamination or corrosion. If connection is good, Ignition Module requires replacement, see Ignition Module, Removal/Installation, page .
3. Use special pick (Snap-On Tool T3600-3) as described under Amp Multilock Electrical Connectors in Section 7 of this Service Manual.
4. Use Harness Connector Test Kit (HD-41404), gray socket probe and patch cord.
5. Check continuity. If continuity present, then most likely short to voltage; if no continuity, then open.
6. LED failure requires tachometer replacement.



Check Engine Lamp Circuit Diagram

Chart A-1, No Check Engine Lamp at Key On



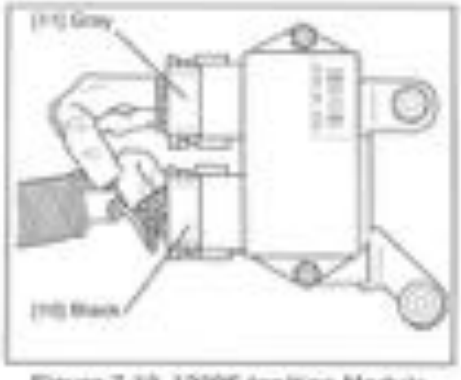


Figure 7-19. 12005 Ignition Module

Wire Harness Connectors

No.	Description	Type	Location
[20]	Main Harness to Instruments	19 - Place Multilock	Under Headlamp bracket
[10]	Ignition Module	12 - Place Deutsch (BK)	Under seat

CHART A-2, CHECK ENGINE LAMP ON CONTINUOUSLY

The Check Engine Lamp should illuminate for 4 seconds when the Ignition Switch is turned to ON (with the Engine Stop Switch at RUN and the engine off). Following the initial period of illumination, the lamp should go off for 4 seconds. It may then come back on for an 8 second period (for a stored functional error) or remain on continuously (current error).

Battery voltage is supplied to the lamp bulb. The lamp bulb is grounded by the Ignition Module through the BK/Y wire. A steady light may indicate a short to ground on the BK/Y wire.

DIAGNOSTIC NOTES

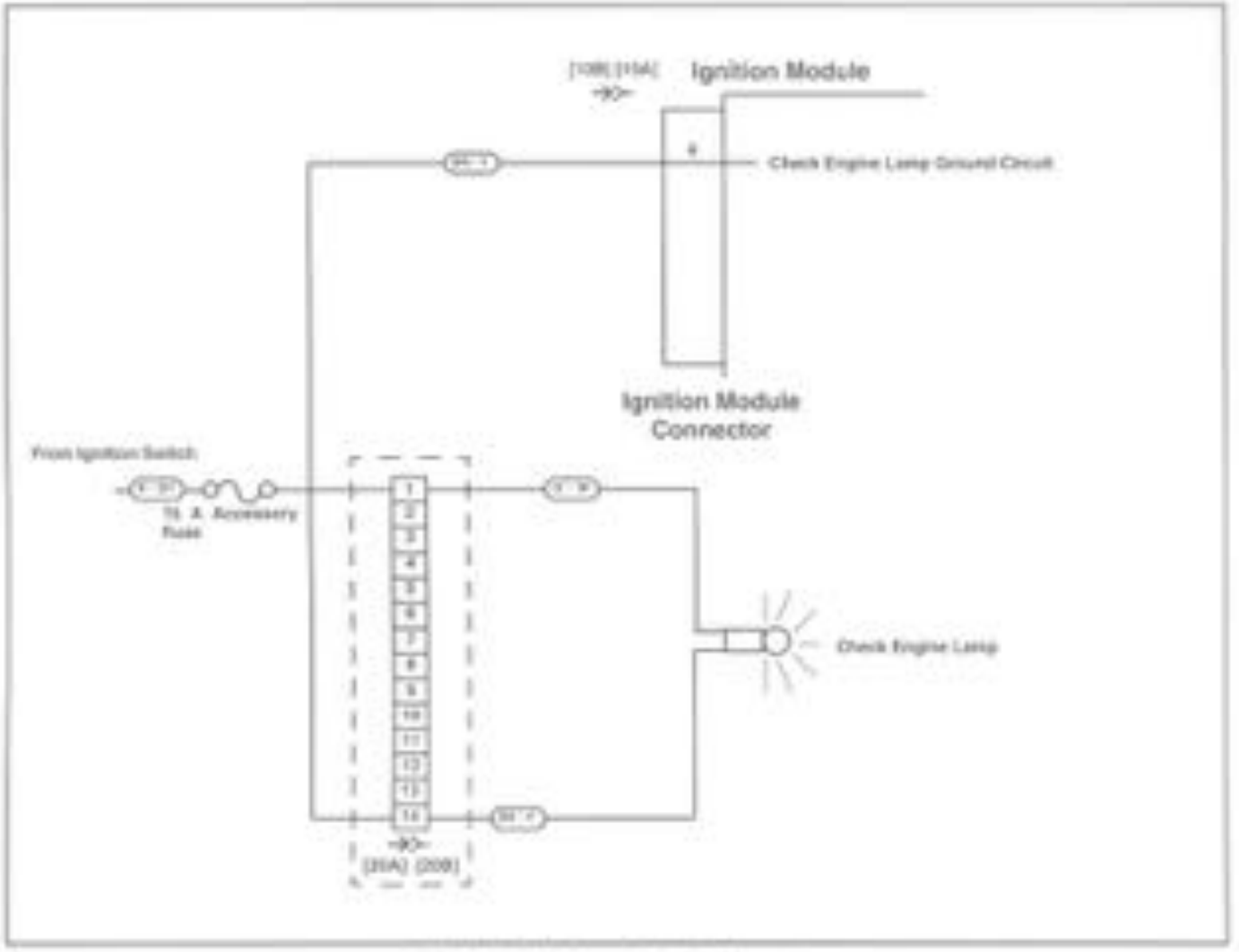
The reference numbers below correlate with those on the diagnostic flow chart.

① If the lamp goes off when Ignition Module connector is unplugged, BK/Y wire is not shorted to ground.

② See Retrieving Trouble Codes.

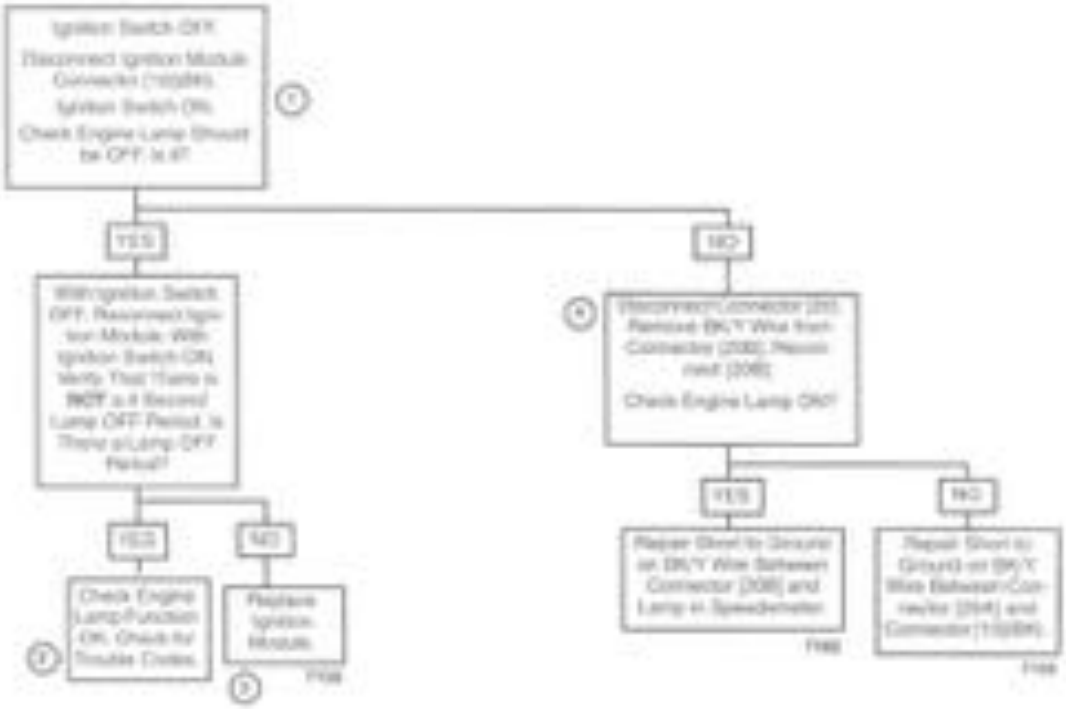
③ See Ignition Module, Removal/Installation.

④ Use special pick (Snap-On Tool TT600-3) as described under Amp Multilock Electrical Connectors in Section 7 of this Service Manual.



Check Engine Lamp Circuit Diagram

Chart A-2. Check Engine Lamp On Continuously



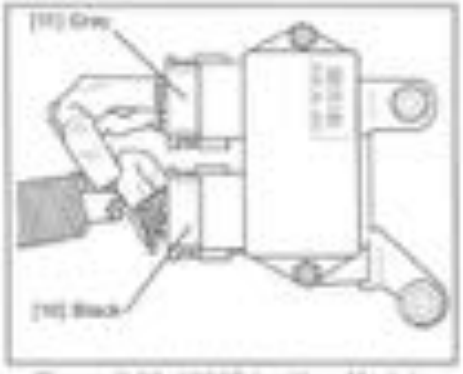


Figure 7-20. 1200S Ignition Module

Wire Harness Connectors

No.	Description	Type	Location
[20]	Main Harness to Instruments	12 - Place Multilock	Under Headlamp Bracket
[11]	Ignition Module	12 - Place Deutsch	Under Seat

CHART A-3, ENGINE CRANKS BUT WILL NOT START

GENERAL

NOTE

If starter will not crank engine, the problem is ***not*** *ignition related. Refer to Section 3 of this Service Manual, Electric Starter.*

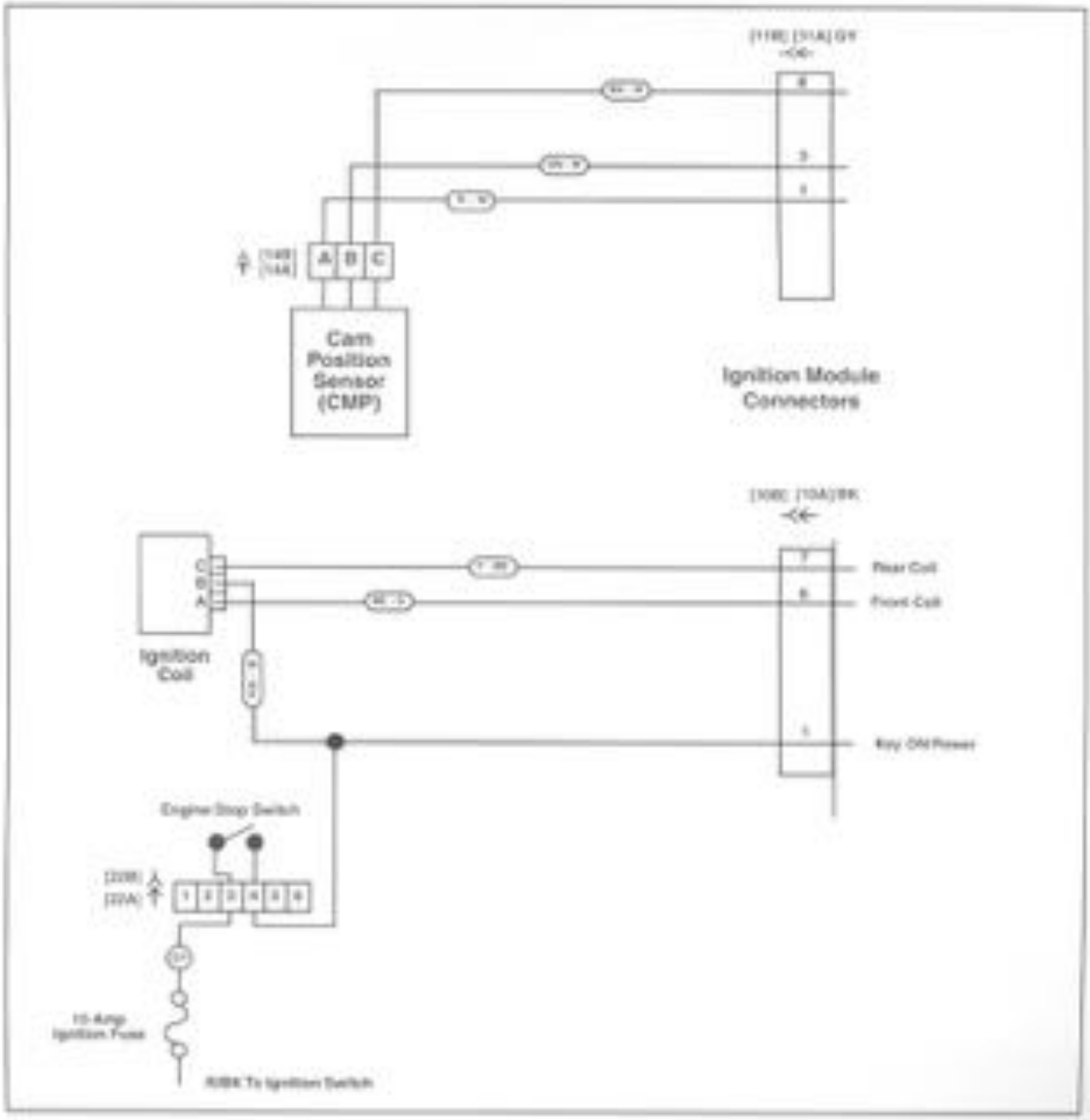
NOTE

Engine can be started with Diagnostics Test wire installed or if Receive Data Line is grounded. Ignition/Light Key Switch must be turned to OFF after test wire is removed or check engine lamp will continue to flash stored codes.

DIAGNOSTIC NOTES

The reference numbers below correlate with those on the diagnostic flow chart.

1. See Retrieving Trouble Codes, page 7-14.
2. Check the condition of the battery. Perform a voltage test and recharge if below 12.80. Check battery connections and perform load test. Replace the battery if necessary. See Section 7 of this Service Manual for detailed information.



Ignition Circuit Diagram

Chart A-3, Engine Cranks But Will Not Start (1 of 3)

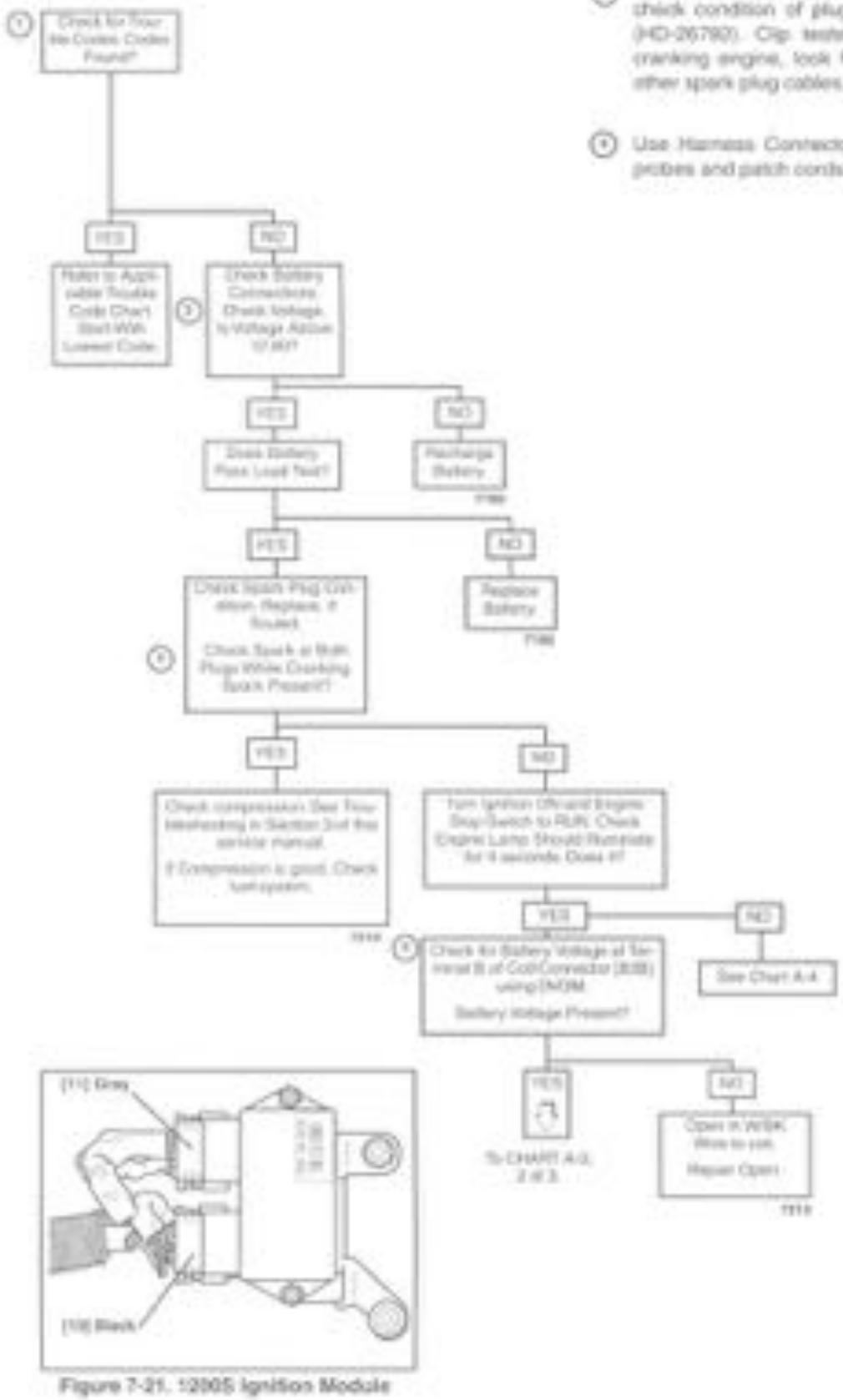
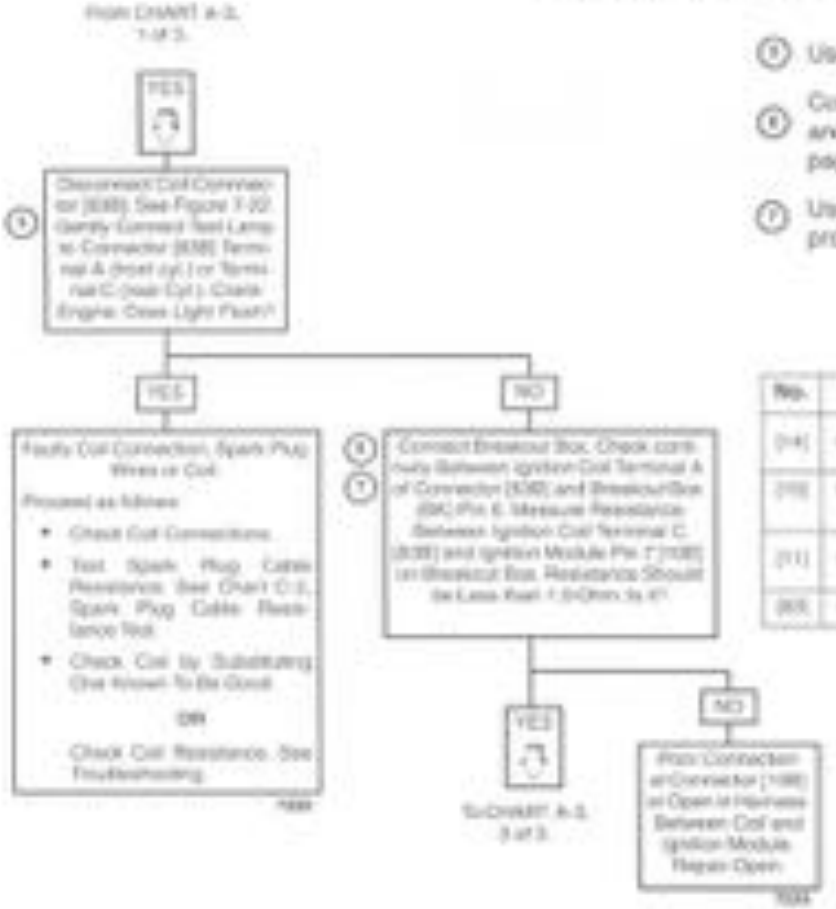


Figure 7-21. 12005 Ignition Module

1. Remove spark plug cable from spark plug. Visually check condition of plug. Attach cable to Spark Tester (HD-26792). Clip tester to cylinder head bolt. While cranking engine, look for spark. Repeat procedure on other spark plug cables.

3. Use Harness Connector test Kit (HD-41404) gray pin probes and patch cords.

Chart A-3, Engine Cranks But Will Not Start (2 of 3)



5 Use Test lamp as shown in Figure 7-22.

6 Connect Breakout Box (HD-42682) between harness and Ignition Module. See Breakout Box Installation, page7-18.

7 Use Harness Connector Test Kit (HD-41404), gray pin probe and patch cord.

Wire Harness Connectors

No.	Description	Type	Location
[14]	CMP Sensor	3 - Place Deutsch	Bottom Frame Cross Member (Right Side)
[10]	Ignition Module	12 - Place Deutsch (BK)	Under Seat
[11]	Ignition Module	12 - Place Deutsch (GY)	Under Seat
[E8]	Ignition Coil	3 - Place Packard	Below Fuel Tank

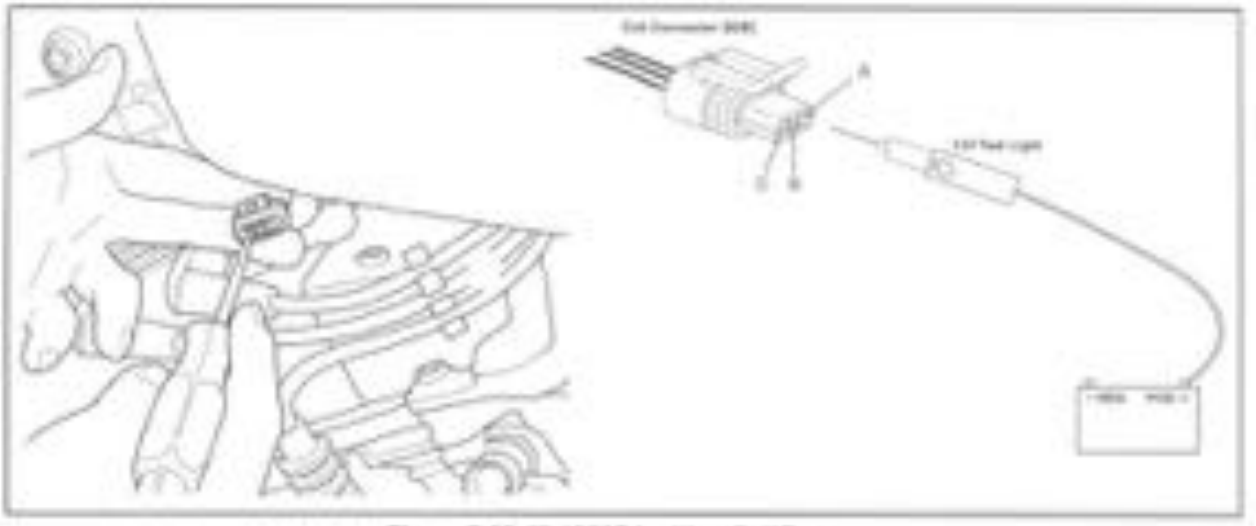


Figure 7-22. XL1200S Ignition Coil Test

Chart A-3, Engine Cranks But Will Not Start (3 of 3)

④ Use Harness Connector Test Kit (HD-41404), black pin probe and patch cord.

⑤ See Camshaft Position Sensor, Removal/Installation, page 7-53.

CHART A-4, NO SPARK, NO CHECK ENGINE LAMP AT KEY ON

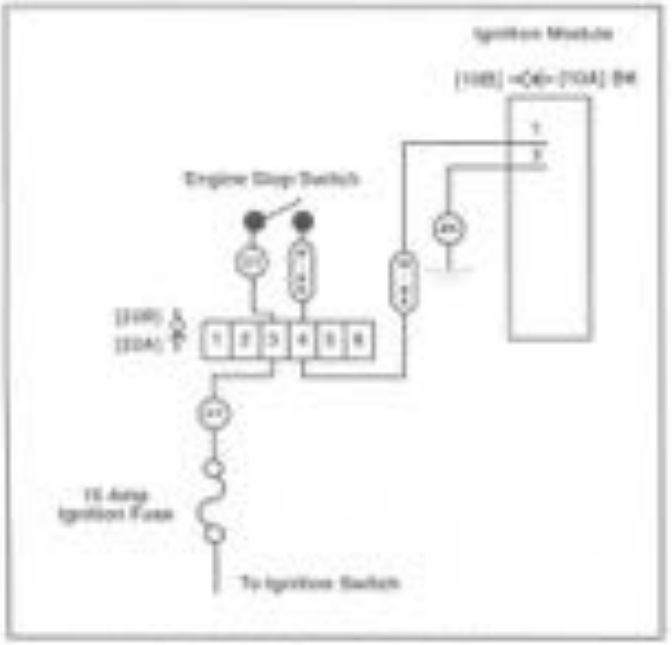
The Ignition Module turns on when power is applied to Pin 1 of [10], the black connector. The Ignition Module goes through an initialization sequence every time power is removed and re-applied to Pin 1. The only visible part of this sequence is the Check Engine Lamp. Upon starting, the Check Engine Lamp will illuminate for 4 seconds and then (if parameters are normal) go out.

DIAGNOSTIC NOTES

The reference numbers which follow correlate with those on the diagnostic flow chart.

(1) See Fuses, Removal/Installation, page 7-2.

(2) Use Harness Connector Test Kit (HD-41404), black pin probe and patch cord.



Ignition Module Power Circuit Diagram

Wire Harness Connectors

No.	Description	Type	Location
[10]	Ignition Module	12 - Place Deutsch (BK)	Under Seat
[22]	RT Handlebar Switch	6 - Place Deutsch (BK)	In Headlight

Chart A-4, No Spark, No Check Engine Lamp at Key On

NOTE

With one exception (noted in this chart), always turn Key ON prior to probing terminals with test lamp.

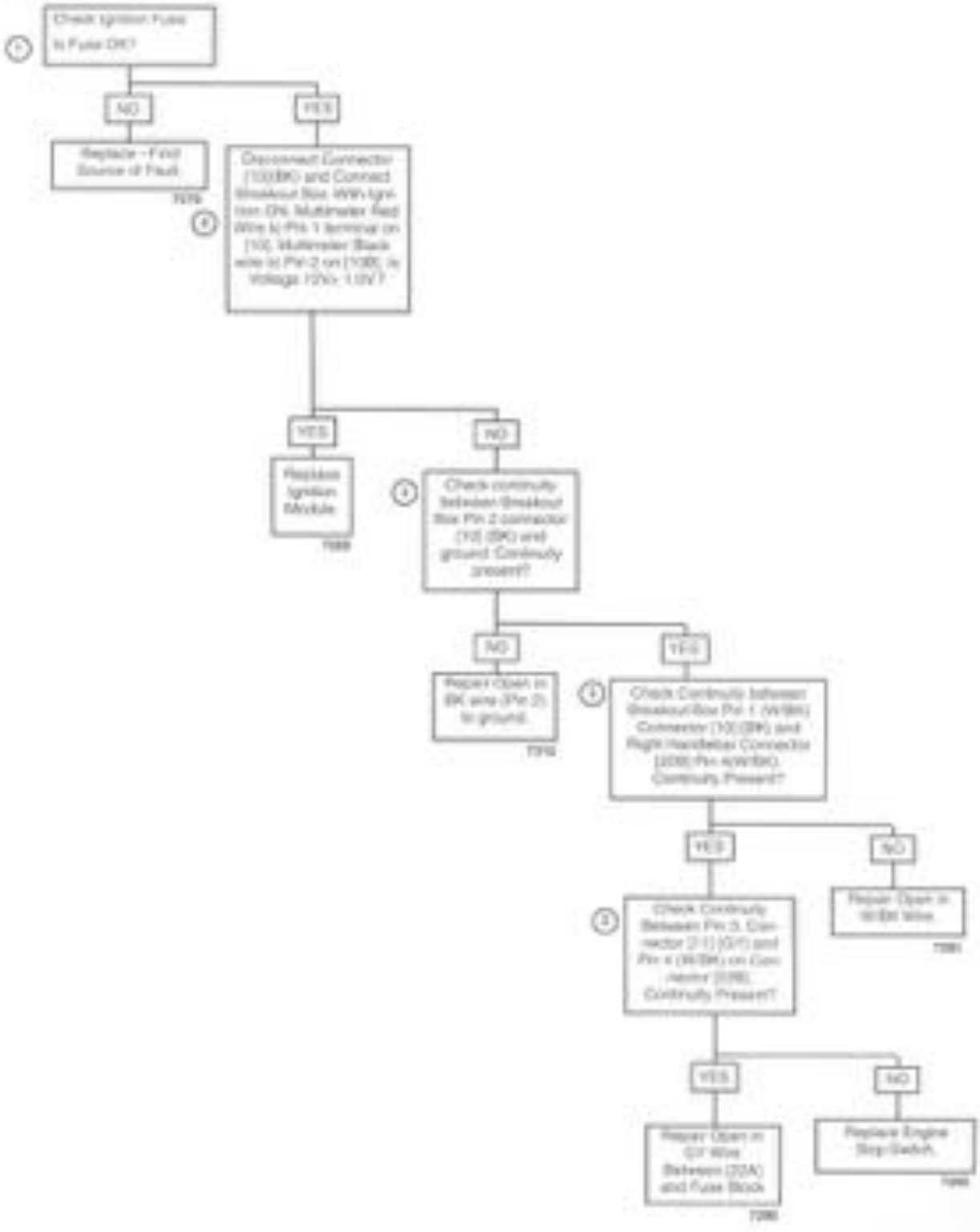


CHART C, MISFIRE

GENERAL

Battery condition and connections may also cause misfires. See Battery in Section 8 of this Service Manual for more information.

DIAGNOSTIC NOTES

The reference numbers below correlate with those on the diagnostic flow chart.

⚠WARNING

Any open spark around gasoline or other combustibles may result in fire or explosion causing personal injury and/or property damage. Thoroughly wipe up any spilt fuel and dispose of rags in a suitable manner.

1. A Spark Tester (HD-26792) must be used to verify adequate available secondary voltage at the spark plug (25,000 volts). Remove spark plug cable from spark plug. Visually check condition of plug. Attach cable to Spark Tester (HD-26792). Clip tester to cylinder head bolt. While cranking engine, look for spark. Repeat procedure on other spark plug cable.

2. **SPARK PLUG CABLE RESISTANCE TEST:** Remove spark plug cable from spark plug and ignition coil. Using an ohmmeter, touch probes to terminals on each end of plug wire. Resistance must be within values shown in Table below. Reinstall and repeat on other cable. For best results, use a needle nose pliers for removal and installation on coil. Gently grasp cable as close to terminals as possible.

3. If carbon tracking is evident, replace the ignition coil and be sure spark plug wire to that coil is clean and tight. Excessive wire resistance or faulty connections can cause coil damage. See Ignition Coil, Removal/Installation.

4. See Ignition Coil, Removal/Installation. This test can also be performed by substituting a known good coil for the one causing the no spark condition. The coil does not require full installation to be functional. Verify faulty coil by performing resistance test (see Troubleshooting).

5. Use Harness Connector Test Kit (HD-41404), GY pin probe and patch-cord to the coil connector [83B].

6. Inspect for corrosion at battery terminals, main circuit breakers, ignition fuse terminals (GY and R/BK), right handlebar connector [22] and coil connector.

NOTE

Fuel system problems may also cause misfires. Refer to SYMPTOMS chart.

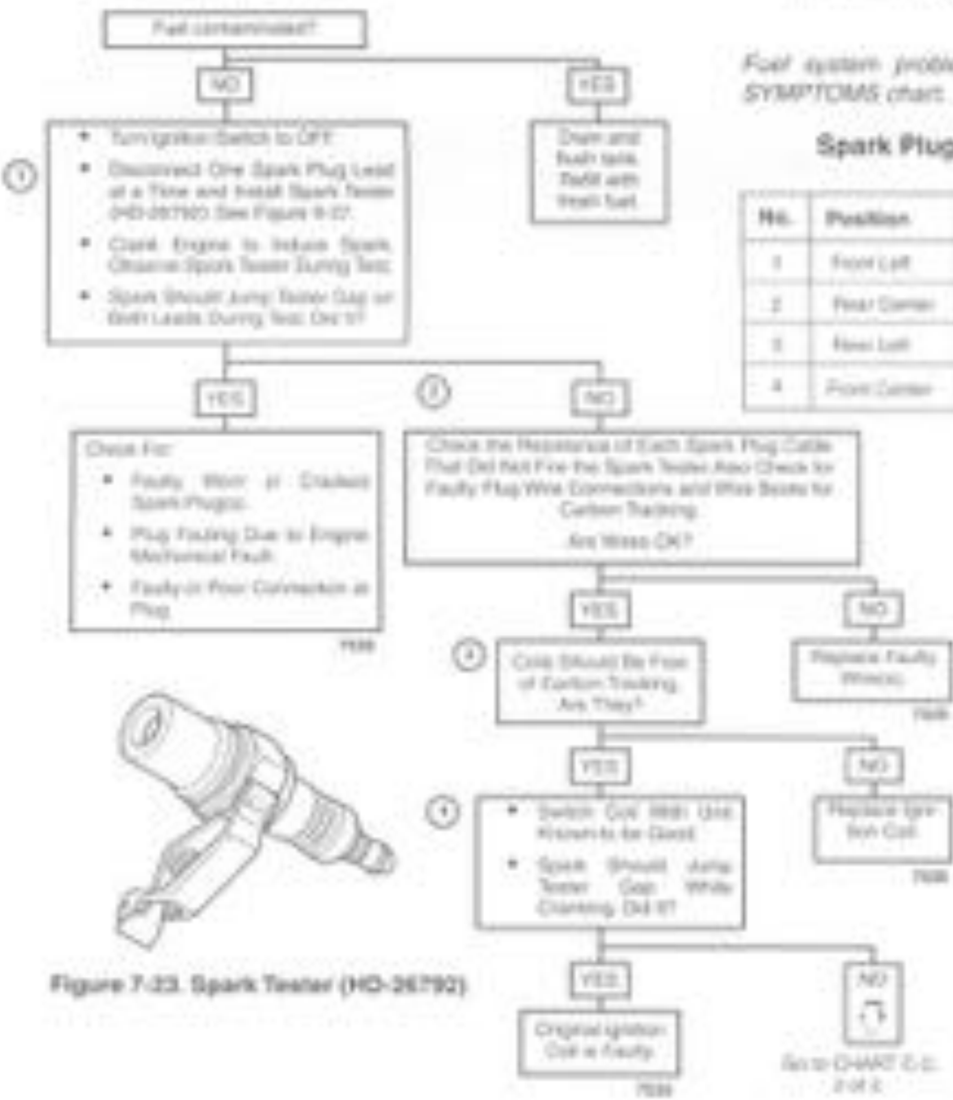
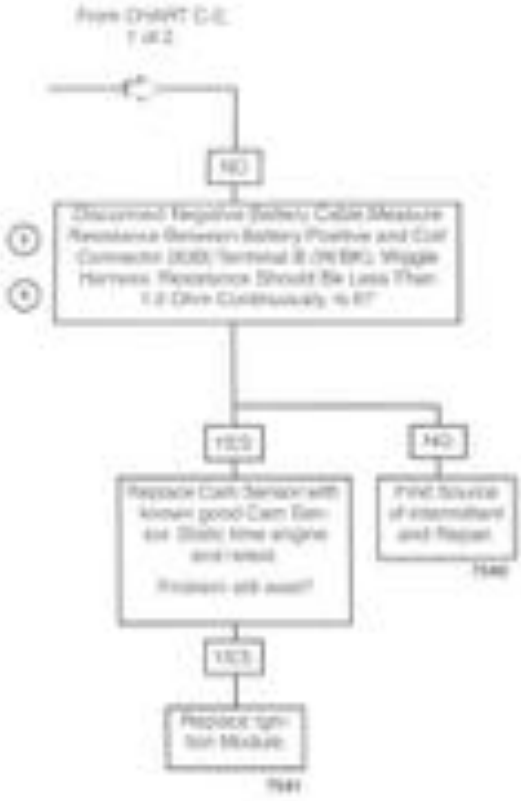


Figure 7-23. Spark Tester (HD-26792)

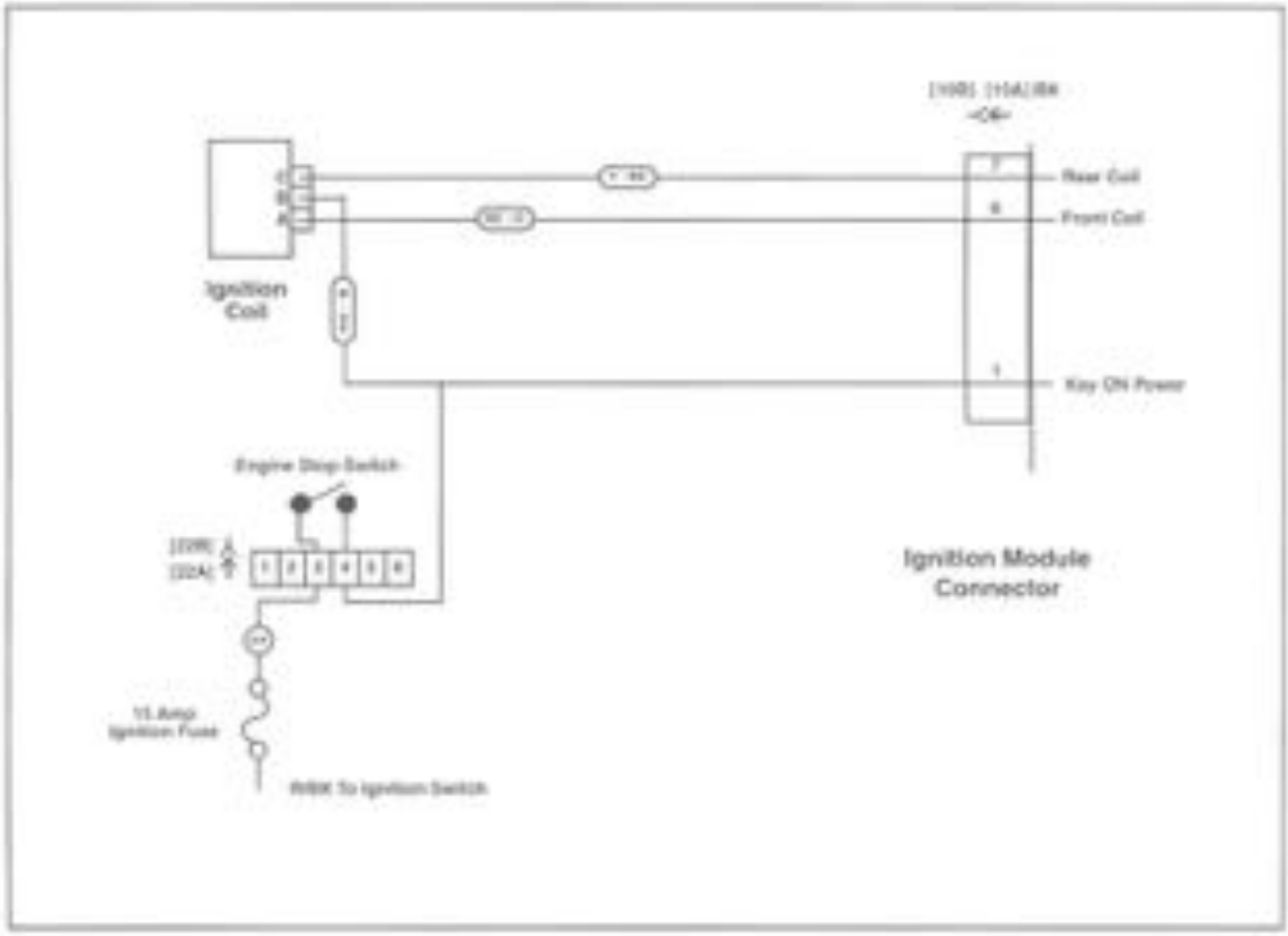
Spark Plug Cables Length / Resistance

No.	Position	Length in. (mm)	Resistance (ohms)
1	Front Left	20.2 (512)	[illegible]
2	Rear Center	18.7 (474)	[illegible]
3	Rear Left	23.1 (586)	[illegible]
4	Front Center	19.5 (496)	[illegible]



Wire Harness Connectors

No.	Description	Type	Location
(10)	Ignition Module	12 - Place Deutsch (DRC)	Under Seat
(23)	RT Handlebar Switch	6 - Place Deutsch (DRC)	In Headlight
(83)	Coil	3 - Place Packard	Under Fuel Tank



Ignition Coil Circuit Diagram

TROUBLE CODE 12 MAP SENSOR

The Manifold Absolute Pressure Sensor (MAP Sensor) is supplied 5 volts from the Ignition Module and sends a signal back to the Ignition Module which varies in accordance with engine vacuum and atmospheric barometric pressure. Changes in barometric pressure are influenced by weather and altitude.

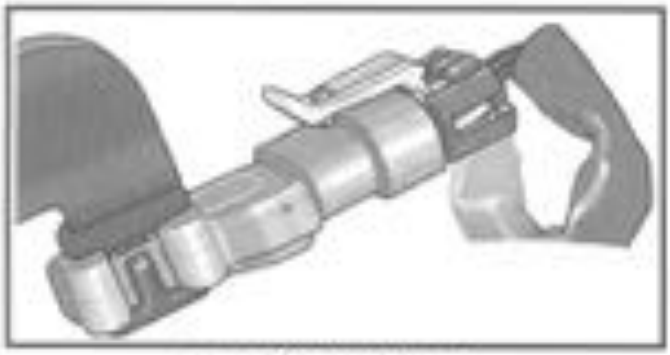


Figure 7-24. MAP Sensor

DIAGNOSTIC TIPS

- Code 12 will set if the MAP Sensor signal is out of range or fluctuates faster than normal operation.
- With the MAP Sensor disconnected, the Ignition Module and Scanalyzer should recognize a low voltage. If low voltage is observed, the Ignition Module and harness are not at fault.
- Gently place a jumper wire across MAP Sensor connector [3686] terminals 1 and 2 using Harness Connector Test Kit (HD-41404), purple male probes and patch cord. With the MAP Sensor connector jumper in place, the Ignition Module and Scanalyzer should recognize a high voltage. MAP Sensor Output Check. Using the vacuum pump (HD-23738A), apply a vacuum to the pressure port of the MAP Sensor. The signal voltage should lower as the vacuum is applied.

DIAGNOSTIC NOTES

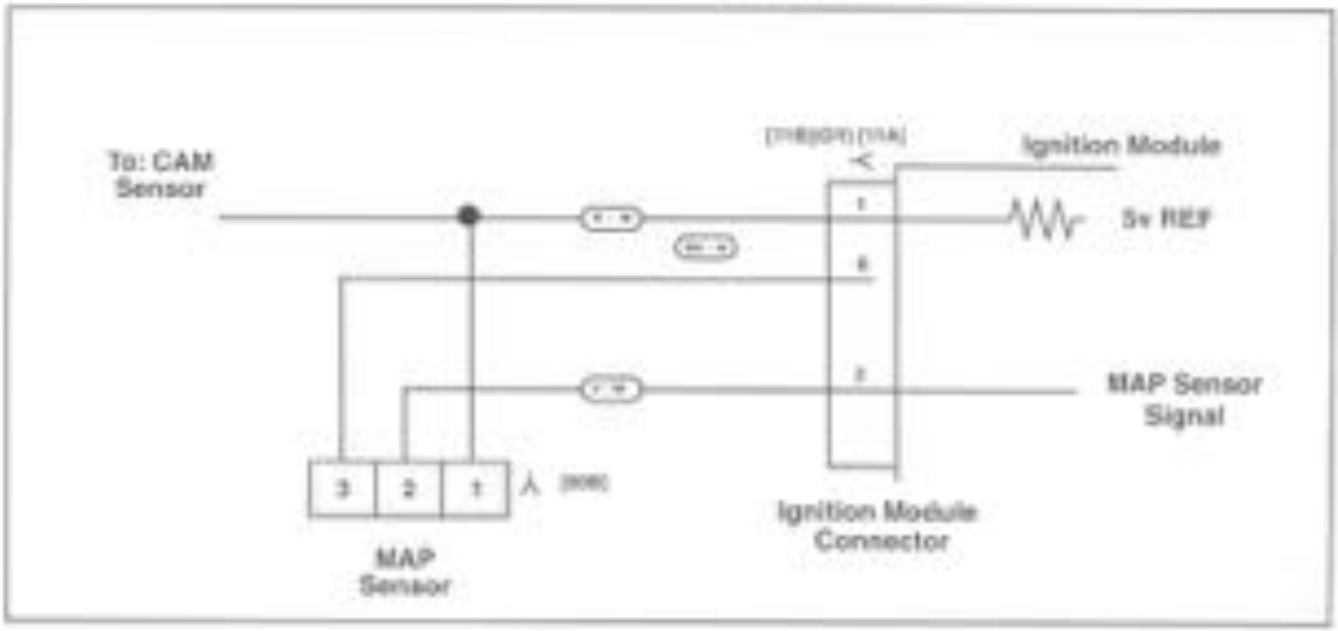
The reference numbers below correlate with those on the diagnostic flow chart.

① Connect Breakout Box (HD-42682) between wire harness and Ignition Module. See Breakout Box Installation page 7-18.

NOTE

Engine must be running for scanalyzer to work properly.

② Shake or wiggle harness with DVOM or Scanalyzer connected. Radical voltage changes on the DVOM will indicate the presence of intermittents, while the Scanalyzer (in Wiggle Test Mode) will beep, light the four corner LEDs and display a minus sign when a current trouble code is detected. (If a current trouble code is present when the wiggle test is entered, the Scanalyzer will respond as described immediately upon entering the wiggle test mode. With Key On and engine off, clear trouble codes and then perform wiggle test with vehicle running.)



MAP Sensor Circuit Diagram

Code 12, MAP Sensor

NOTE

The **Scanalyzer** *icon appears at those points in the flow chart where the Scanalyzer may be used.*

1. See MAP Sensor, Removal/Installation, page 7-47.
2. See Ignition Module Removal/Installation, page 7-52.
3. Use Harness Connector Test Kit (HD-41404), purple pin probes and patch cords.

Wire Harness Connectors

No.	Description	Type	Location
[60]	MAP Sensor	3 - Place Amp	Under Fuel Tank
[10]	Ign. Module	12 - Place Deutsch (BK)	Under Seat
[11]	Ign. Module	12 - Place Deutsch (GY)	Under Seat

Clear Codes and Confirm Proper Operation with No Check Engine Lamp.

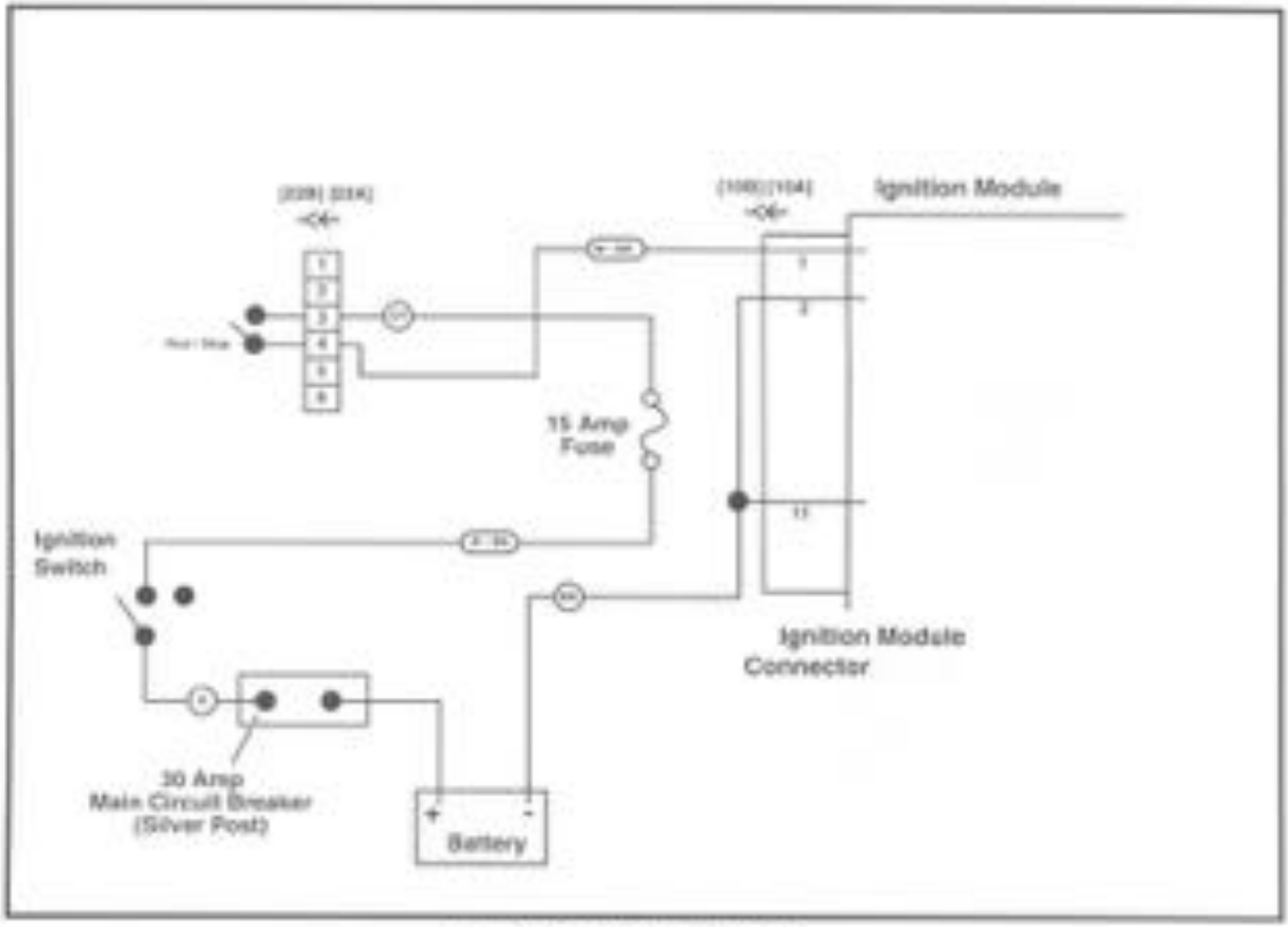
TROUBLE CODE 16, BATTERY VOLTAGE

A Code 16 is set if the Ignition Module sees battery positive voltage less than 8 or greater than 16 volts. Low voltage generally indicates loose wire and/or corroded connections or a charging system problem. A high voltage condition may be caused by a faulty voltage regulator.

DIAGNOSTIC NOTES

The reference numbers below correlate with those on the diagnostic flow chart.

1. Was battery allowed to discharge? Was battery drawn down by starting problem? Yes, Charge battery. No - See Charging System Troubleshooting in Section 7 of this Service Manual.
2. Connect Breakout Box (HD-42582) between wire harness and Ignition Module. See Breakout Box Installation, page 7-18.
3. The Ignition Module is monitoring voltage at Ignition Module connector (10)(BK) Pin1.
4. This checks for voltage drops in the Ignition Module power circuit.
5. Perform Wiggle Test. Shake or wiggle harness with DVOM or Scanalyzer connected. Radical voltage changes on the DVOM will indicate the presence of intermittence, while the Scanalyzer (in Wiggle Test Mode) will beep, light the four corner LEDs and display a minus sign when a current trouble code is detected. (If a current trouble code is present when the wiggle test is entered, the Scanalyzer will respond as described immediately upon entering the wiggle test mode. With Key On and engine off, clear trouble codes and then perform wiggle test with vehicle running.)
6. See Fuses, Removal/Installation.



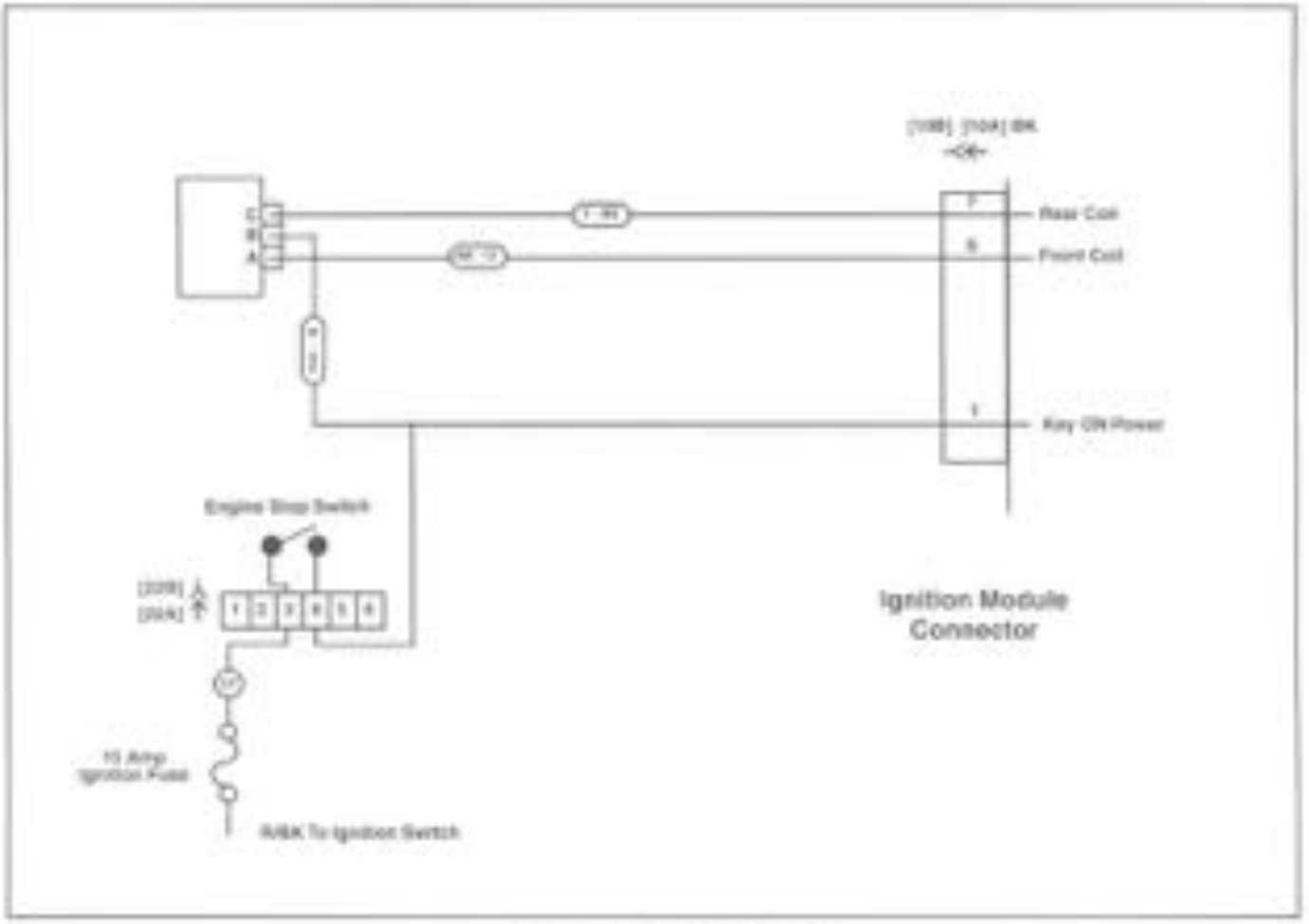
Battery Voltage Circuit Diagram


Perform Charging System Tests. Charging System OK?
YES
NO
Repair Charging System.
Remove Spark Plug Cables. Connect Breakout Box. Measure Voltage on Breakout Box (BK) Between Pin 1 and Pin 11 while Cranking Engine. Disregard Reading During First 2 Seconds of Cranking. Is Voltage Above 8 Volts? Reconnect plug cables.
YES
NO
NOTE
The Scanalyzer symbol appears at those points in the flow chart where the Scanalyzer may be used.
System OK.
With ignition On, Measure Voltage Drop Between Battery Positive Terminal and Breakout Box connector (10)(BK) Pin 1, is Voltage Drop Greater than 0.5 Volt?
NO
YES
NO
With ignition On, Measure Voltage Drop Between Battery Positive Terminal (+) and Fuse (BK) Terminal on 15 Amp Ignition Module Fuse (-), is Voltage Drop Greater than 0.5 Volt?
With ignition On, Measure Voltage Drop Between Battery Positive Terminal (+) and Connector (22A), Pin 4, is Voltage Drop Greater than 0.3 Volt?
Check for Voltage Drop between Battery Negative Terminal (-) and Breakout Box connector (10)(BK)Pin (2)(-), is Voltage Drop Greater than 0.5 VOLT?
YES
NO
Locate and Repair Bad Connection
Problem is Intermittent. Perform Wiggle Test.
NO
YES
NO
YES
Replace Fuse or Fuse Terminals
Replace 6(BK) Wire or Terminals.
With ignition On, Measure Voltage Drop Between Battery Positive Terminal (+) and Copper Post on Main Circuit Breaker (-), is Voltage Drop Greater than 0.3 Volt?
With ignition On, Measure Voltage Drop Between Battery Positive Terminal (+) and Copper Post on Main Circuit Breaker (-), is Voltage Drop Greater than 0.5 Volt?
NO
YES
NO
YES
Inspect (22) for Corrosion or loose wires. If not present replace Right Hand Run/Start Switches.
With ignition On, Measure Voltage Drop Between Battery Positive Terminal (+) and G(Y Terminal on 15 Amp Fuse (-), is Voltage Drop Greater than 0.5 Volt?
Replace ignition switch or Terminals.
With ignition On, Measure Voltage Drop Between Battery Positive Terminal (+) and Copper Post on Main Circuit Breaker (-), is Voltage Drop Greater than 0.5 Volt?
NO
YES
NO
YES
Replace G1 Wire or Terminals
Replace Circuit Breaker
High Resistance Between 30 Amp Circuit Breaker and Battery. Replace Wire or Terminals.
Clear Codes and Confirm Proper Operation with No Check Engine Lamp.

TROUBLE CODE 24 and 25, IGNITION COIL

Code 24 = Front Coil **Code 25 = Rear Coil**

A Code 24 or 25 will set if the ignition coil voltage is out of range. This could occur if there is an open coil or loss of power to the coil. The coil receives power from the Run/Stop Switch.
The Ignition Module is responsible for turning the coils on by providing the ground to activate the coils, which in turn powers the coils. If both codes are set, it is likely a coil power failure or a coil failure.



Ignition Coil Circuit Diagram

Codes 24 and 25, Ignition Coil

DIAGNOSTIC NOTES

The reference numbers below correlate with those on the diagnostic flow chart.

1. Use Test Lamp as shown in Figure 7-25.
2. See Ignition Coil, Removal/Installation.
3. Use Harness Connector Test Kit (HD-41404), gray pin probe and patch cord.
4. Connect Breakout Box (HD-42682) between wire harness and Ignition Module. See Breakout Box Installation.
5. Shake or wiggle harness with DVOM or Scanalyzer (Engine running) connected. Radical voltage changes on the DVOM will indicate the presence of intermittents, while the Scanalyzer (in Wiggle Test Mode) will beep, light the four corner LEDs and display a minus sign when a current trouble code is detected. (If a current trouble code is present when the wiggle test is entered, the Scanalyzer will respond as described immediately upon entering the wiggle test mode. With Key On and engine off, clear trouble codes and then perform wiggle test with vehicle running.)
6. See Ignition Module, Removal/Installation, page 7-57.

SCANALYZER NOTES

The ***Scanalyzer icon*** *appears at those points in the flow chart where the Scanalyzer may be used. If a number is printed next to the icon, then refer to the* ***Scanalyzer Notes*** *which follow.*

With the engine off, Scanalyzer (Active Diagnostic Test Mode) can be used to energize either the front or rear coil once each second for a total of 5 seconds.

Wire Harness Connectors

No.	Description	Type	Location
[60]	Ignition Coil	3 - Place Amp	Below Fuel Tank
[22]	RH Handlebar Switch	6 - Place Deutsch (DK)	Inside Headlamp Housing

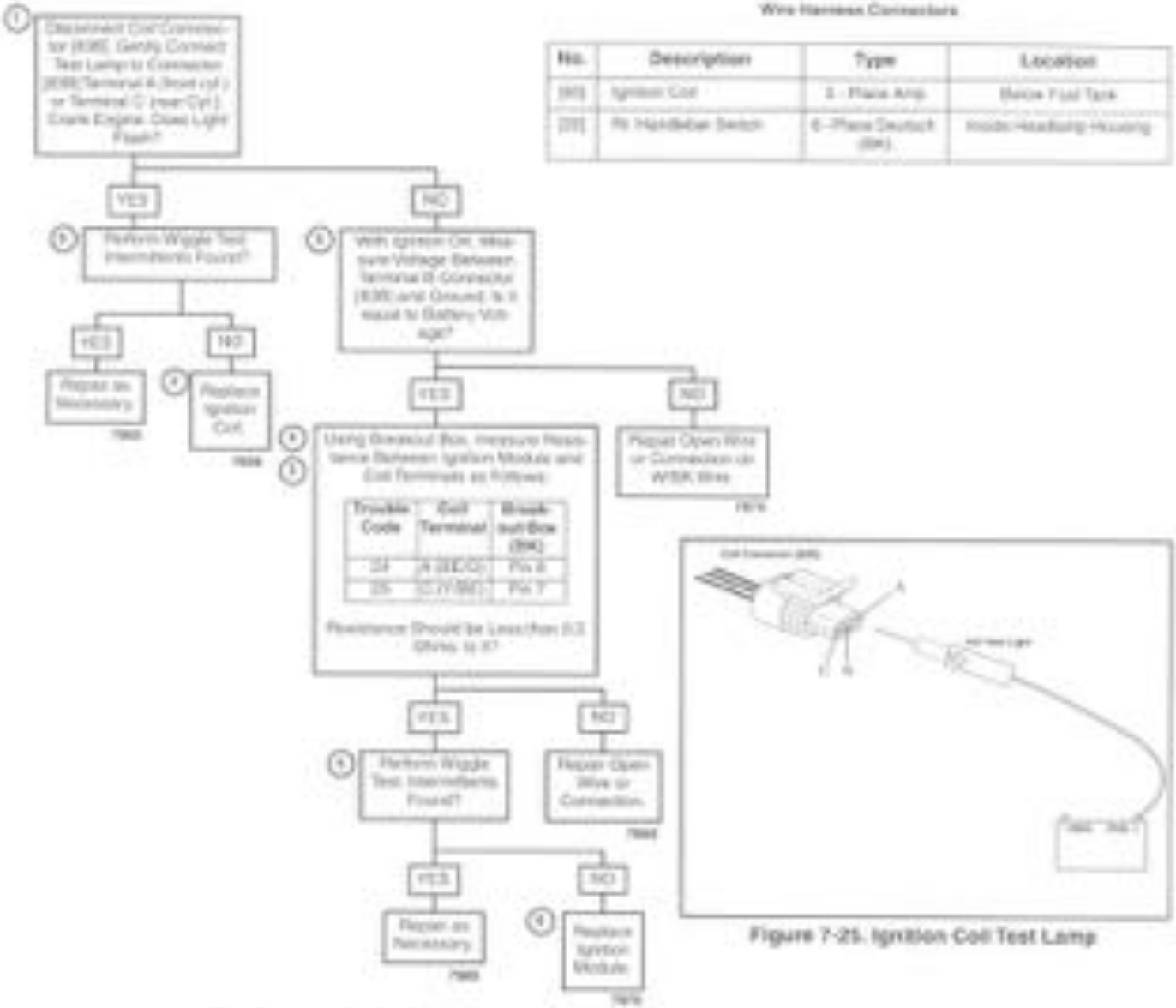


Figure 7-25. Ignition Coil Test Lamp

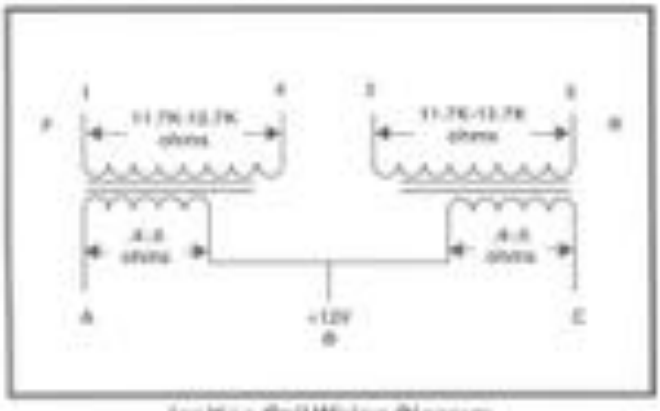
GENERAL

The ignition coil is a pulse type transformer that transforms or steps up low battery voltage to the high voltage necessary to jump the electrode at the spark plug in the cylinder head. Internally the coil consists of primary and secondary windings with a laminated iron core and sealed in waterproof insulating compound. The ignition coil cannot be taken apart or repaired. If the ignition coil is faulty it must be replaced.

Troubleshooting

When the engine will not start or when hard starting or missing indicates a faulty ignition system, see CHART C in this section. If the condition persists, check primary and secondary resistance of ignition coil with an ohmmeter. See Wiring Diagram below.

Resistances should be within the following limits: primary resistance 0.4-0.6 ohms, secondary resistance 11.7-12.7K ohms. Check ignition coil with a coil tester.



Ignition Coil Wiring Diagram

If a coil tester is not available, temporarily substitute a new ignition coil by attaching it at any convenient point near the old coil (coil will function without being secured). Transfer terminal wires to new coil.

Attach new spark plug cables to coil and plugs. If ignition trouble is eliminated by the temporary installation of new coil, carefully inspect old coil for damaged cables and insulation. The insulation on cables may be cracked or otherwise damaged allowing high tension current to short to metal parts. This is most noticeable in wet weather or after motorcycle has been washed.

TROUBLE CODE 35, TACHOMETER

Code 35 will set if the PK wire is shorted to power or ground.

DIAGNOSTIC NOTES

The reference numbers which follow correlate with those on the diagnostic flow chart.

① See page 7-18, Install Breakout Box HD-42682

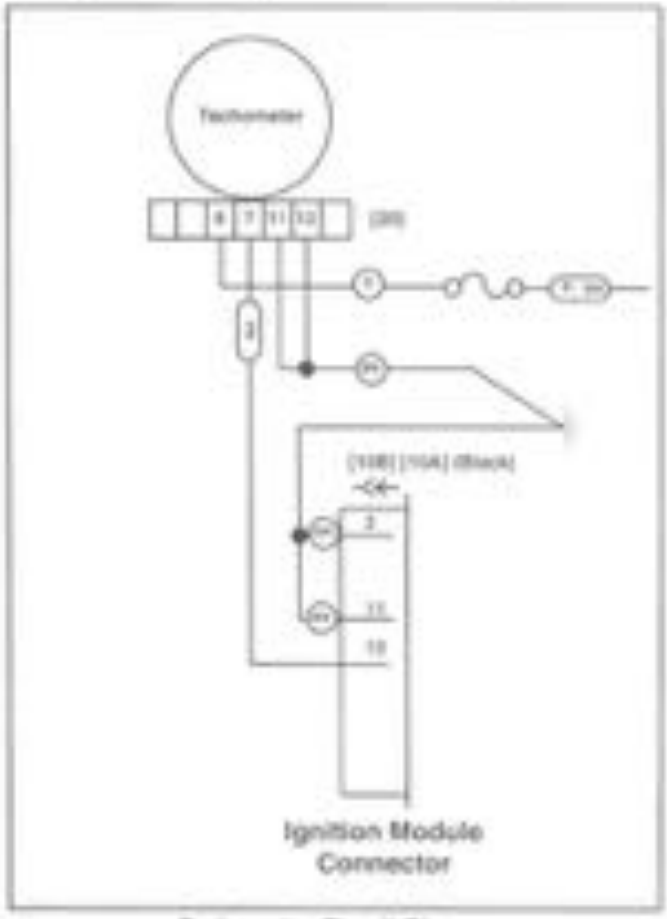
② Shake or wiggle harness with DVOM or Scanalyzer (Engine running) connected. Radical voltage changes on the DVOM will indicate the presence of intermittents, while the Scanalyzer (in Wiggle Test Mode) will beep, light the four corner LEDs and display a minus sign when a current trouble code is detected. (If a current trouble code is present when the wiggle test is entered, the Scanalyzer will respond as described immediately upon entering the wiggle test mode. With Key On and engine off, clear trouble codes and then perform wiggle test with vehicle running).

④ See Tachometer Remove and Replace

⑤ See Ignition Module Remove and Replace

Wire Harness Connectors

No.	Description	Type	Location
[10]	Ignition Module	12 - Place Oval with (BK)	Below Fuel Tank
[20]	Instruments	14 - Place Multi-wide	Under Headlamp Bracket



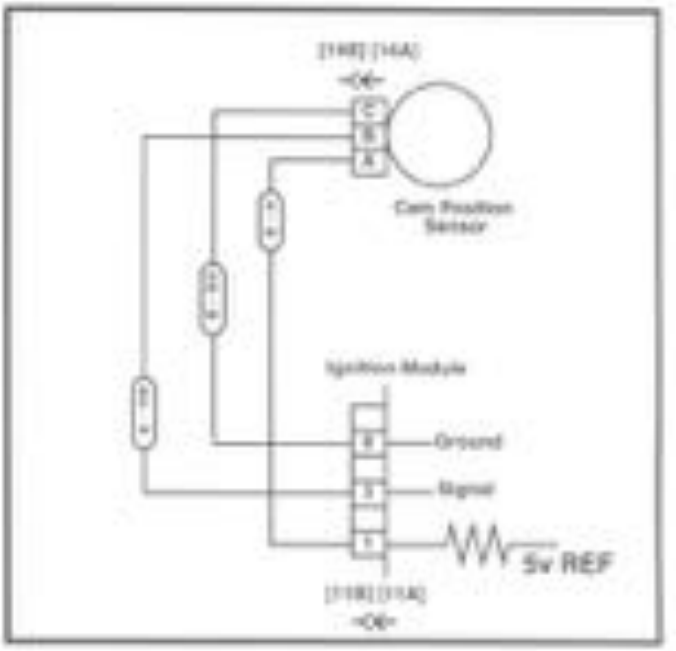
Tachometer Circuit Diagram

TROUBLE CODE 41, CAM SYNC FAILURE

GENERAL

This code occurs only when the engine is running if the ignition module either does not receive a signal from the timing plate or receives an unexpected signal. The motorcycle may continue to run, run poorly, or stop running altogether.

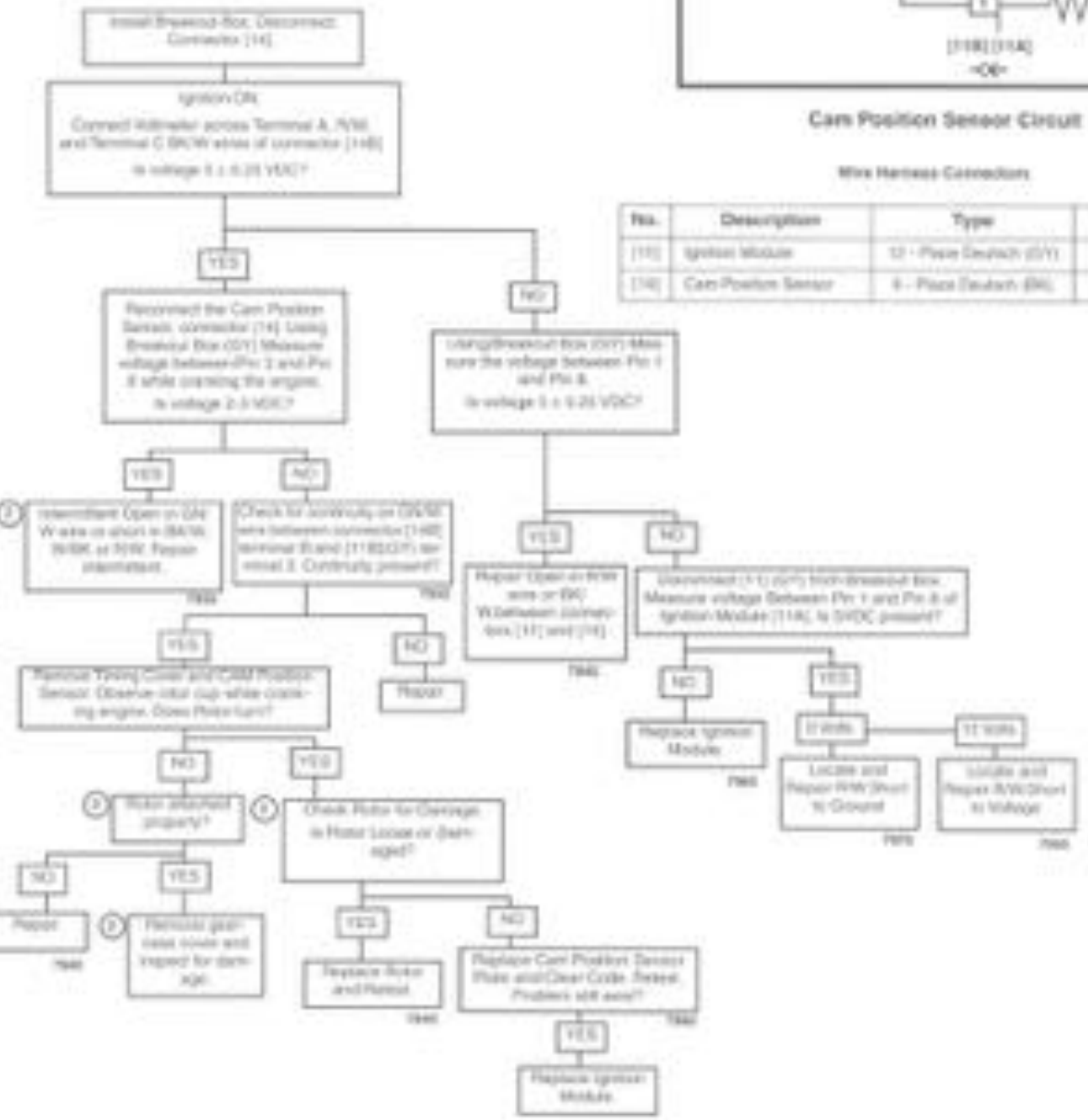
1. Install Breakout Box HD-42682.
2. Perform Wiggle Test (Engine Running).
3. Refer to appropriate section of Service Manual and job time code for operation.



Cam Position Sensor Circuit

Wire Harness Connectors

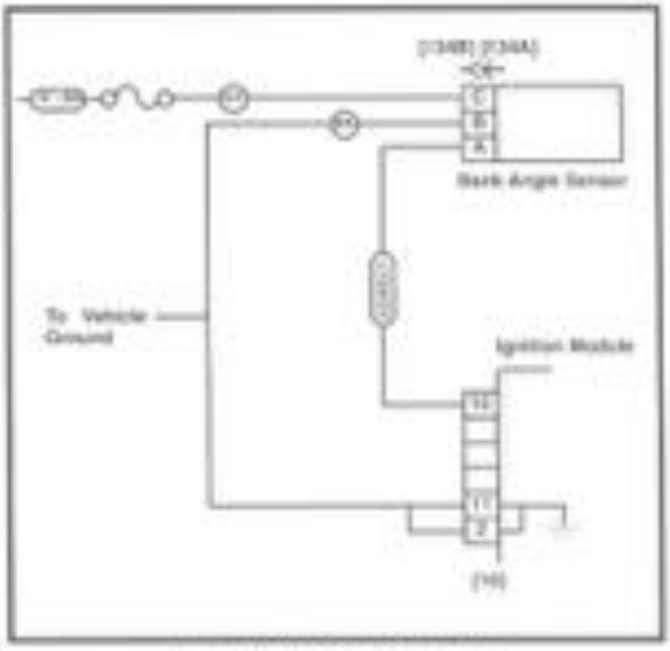
No.	Description	Type	Location
[11]	Ignition Module	12 - Place Deutsch (GY)	Below Seat
[14]	Cam Position Sensor	4 - Place Deutsch (BK)	Under Crankcase



TROUBLE CODE 44, Bank Angle Sensor

GENERAL

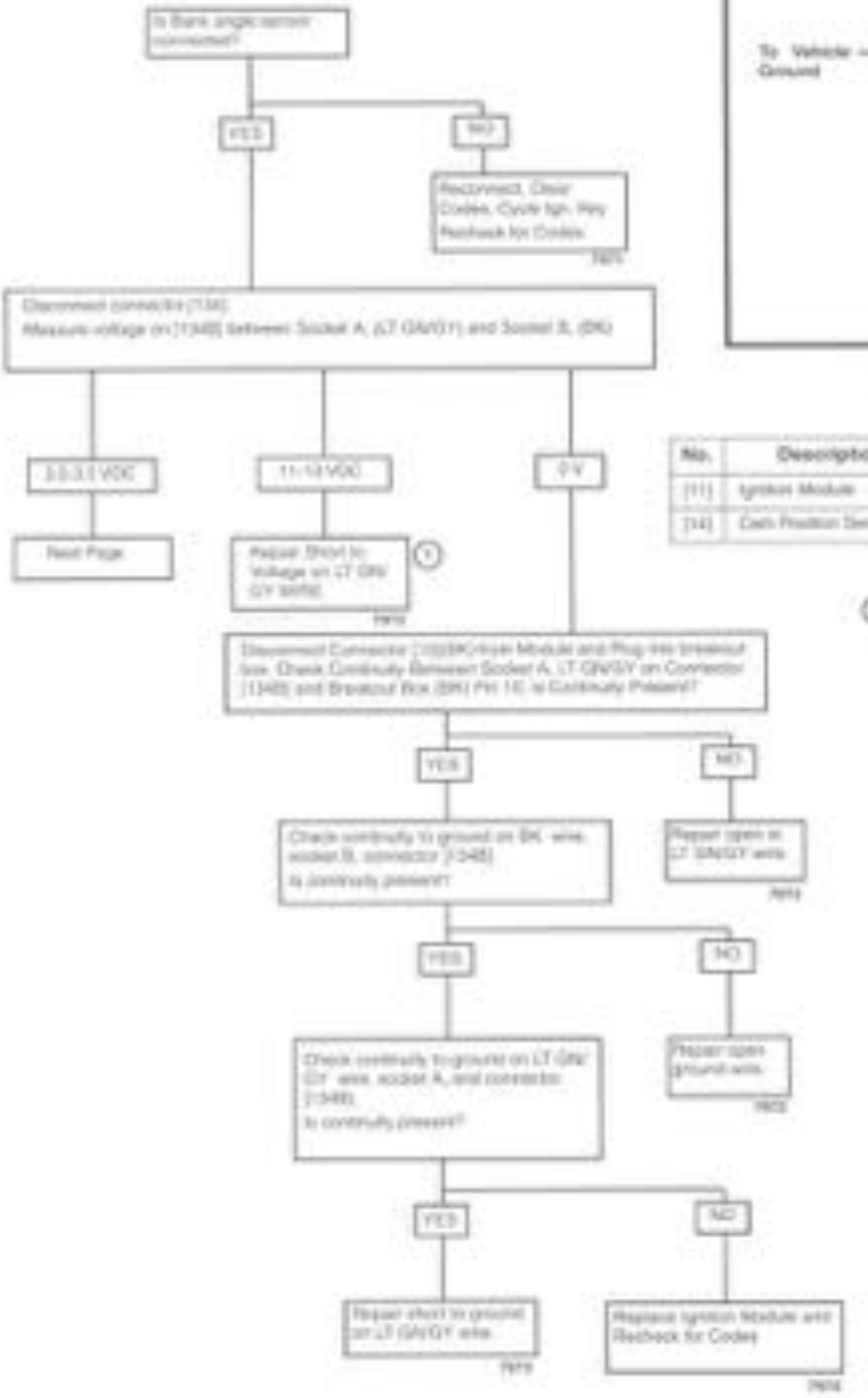
This code occurs when the Bank Angle Sensor voltage is outside of the normal operating range. This may be caused by a short to ground, or voltage in the harness between the ignition module and the Bank Angle Sensor, or a failed Bank Angle Sensor. If this code occurs, the engine may stop running. The engine may still be restarted and ridden to the dealership for repair.



Bank Angle Sensor Circuit

Wire Harness Connectors

No.	Description	Type	Location
[11]	Ignition Module	12 - Place Deutsch (BK)	Below Fuel Tank
[14]	Cam Position Sensor	6 - Place Deutsch (BK)	Under Crankcase



1 See page 7-18, Install Breakout Box HD-42682


Measure Voltage Between Socket C, GY, and Socket B, BK.
Is Voltage 11-12 VDC?
YES
NO
Is Bank Angle Sensor Correctly Installed?
Repair Open in GY and Between J134 and Harness
7972
YES
NO
Install Properly
Are Ferrous Metals Located Within 1/4" of Sides, Face, or Top of Bank Angle Sensor?
YES
NO
Return to Original Configuration
Replace Bank Angle Sensor
7974

TROUBLE CODES 52, 54 and 55, IGNITION MODULE FAILURE

GENERAL

All of the following codes indicate an internal failure which requires replacement of the Ignition Module.

- Code 52 - RAM/ROM Failure
- Code 54 - EE PROM Failure
- Code 55 - Module Microprocessor Malfunction

See Ignition Module Removal/Installation page 7-52.

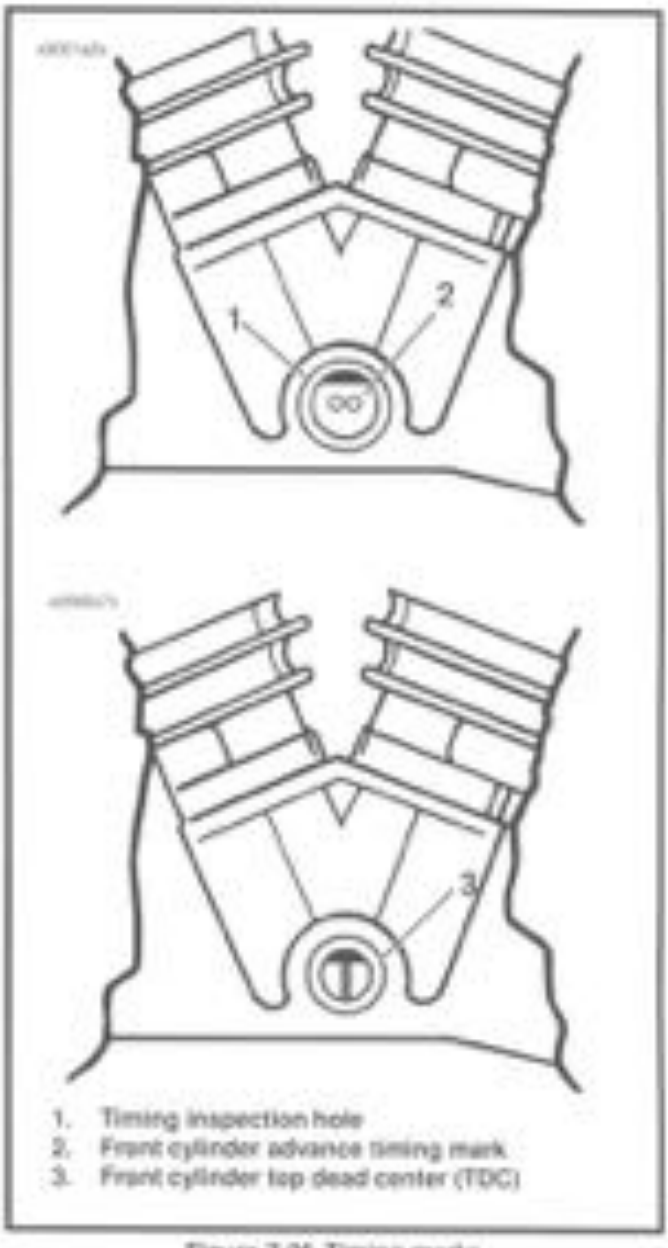
Static Timing - 1200S

1. See Figure 7-8. Locate outer timer cover (2) at bottom of gearcase cover (15) on right side of vehicle.

⚠WARNING

Always wear proper eye protection when drilling. Flying debris may result in eye injury.

2. Drill off heads of outer timer cover rivets (1) using a 1/8-inch drill bit. Use a punch to tap rivet shafts inboard through holes in outer timer cover. Remove outer timer cover (2).
3. Remove two Phillips screws (3) to free inner timer cover (4). If necessary, tap remaining rivet shafts through holes in inner timer cover.
4. Carefully check the gearcase cover timer bore for any rivet fragments.
5. Depress external latch on Cam position sensor connector (31) and use a rocking motion to separate pin and socket halves.
6. Remove the timing plug from the timing inspection hole centered below the cylinders on the right side of the crankcase.
7. Remove the spark plugs.
8. Jack up vehicle to allow rotation of the rear wheel.
9. Shift transmission into fifth gear, and standing on left side of vehicle, slowly rotate rear wheel in a counter-clockwise direction until front intake valve opens and closes (as viewed through spark plug holes).
10. Rotate rear wheel until TDC mark (vertical line, see lower frame Figure 7-10) is centered in timing inspection hole.
11. See page 7-18. Connect Breakout Box (HD-42682). Connect DVOM Red (+) lead to Pin 1 (Gray) [11] and Black lead to Pin 8 (Gray) [11].
12. Turn the Ignition/Light Key Switch to IGNITION.
13. Loosen two screws and rotate the cam position sensor plate just until the voltmeter registers the change from 5 VDC (+)- 0.5 volts) to 0-1.0 VDC.
14. Tighten sensor plate screws to 15-30 **in-lbs** (1.7-3.4 Nm).
15. Install spark plugs, shift transmission into Neutral and remove jack.
16. Remove test harness and mate pin and socket halves of Cam position sensor connector (14). Place large end of slot on attachment clip over T-stud. Push connector assembly forward to engage small end of slot.
17. Proceed to DYNAMIC TIMING. Begin at step 2.



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

Figure 7-26. Timing marks.

Adjust Timing using Scanalyzer (HD-41325) - 1200S only

1. Gently pull left side cover from frame downtubes (no tools required).
2. See Figure 7-27. Note the Data Link connector (pin side of 4-place Deutsch) on the side cover.
3. Remove rubber protective plug from open end of Data Link connector.
4. Plug the Scanalyzer (HD-41325) into the Data Link Connector.
5. Turn the Ignition/Light Key Switch to IGNITION. Turn the handlebar mounted Engine Stop Switch to the RUN position (but do not start the engine).

Figure 7-27. Data Link Connector - 1200S

6. Insert the diagnostic application cartridge HD-41325-95A, into the Scanalyzer. Once communications is established with the ignition module, the DIAGNOSTIC MENU appears. See Figure 7-12.
7. Select item 7- CALIBRATION from the DIAGNOSTIC MENU.
8. Press 1. TDCO Adjust on the key pad.
9. Connect Timing light (See Dynamic Timing) and observe timing mark.
10. Timing may be electronically adjusted by pressing the up arrow key to advance the timing offset or the down arrow key to retard the timing offset. Each press of the arrow key will change the timing one degree.
11. Press MODE to exit.

Static Timing - All except 1200S

1. Follow steps 1 - 12 on page 7-45.
2. Slowly rotate module plate until red LED illuminates. Tighten in position.
3. Proceed to DYNAMIC TIMING. Begin at step 2.

Dynamic Timing

1. Remove hex socket timing plug from timing inspection hole, which is located on right crankcase half and centered below engine cylinders. Install TIMING MARK VIEW PLUG (Part No. HD-96295-65D) into timing inspection hole. Make sure view plug does not touch flywheel.
2. Connect leads of INDUCTIVE TIMING LIGHT (Part No. HD-33813) to front spark plug cable, battery positive (+) terminal, and suitable ground.
3. Make sure vacuum hose is properly installed at carburetor and V.O.E.S. (MAP sensor on 1200S). Start engine.

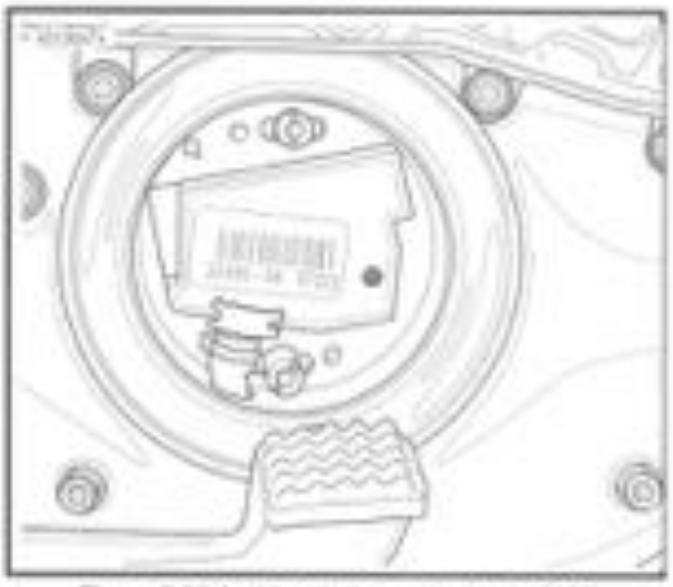


Figure 7-28. Ignition timing - all except 1200S

Set engine speed to 1,000-1,050 rpm on all models.

⚠CAUTION

When checking ignition timing, always check V.O.E.S. operation (see VACUUM-OPERATED ELECTRIC SWITCH). Failure to do so may result in running engine with too much spark advance, and may cause extreme engine knock and engine failure.

4. See Figure 7-10. Timing light will flash each time an ignition system spark occurs. Aim timing light into timing inspection hole. Front cylinder advance timing mark (2) should be centered in timing inspection hole. If this is the case, ignition timing is properly adjusted. Remove TIMING MARK VIEW PLUG from timing inspection hole and install hex socket timing plug. If timing mark is not centered or is not visible in the timing inspection hole, proceed to Step 5.
5. See Figure 7-8. Remove outer cover rivets (1), outer cover (2), inner cover screws (3), and inner cover (4).
6. Loosen cam position sensor screws (5) just enough to allow sensor plate (7) to be rotated using a screwdriver in the plate's notch (6).
7. With timing light aimed into inspection hole, rotate cam position sensor (7) until front cylinder advance timing mark is centered in timing inspection hole (as shown in Figure 7-10).
8. See Figure 7-8. Tighten cam position sensor screws (5).
9. Install inner cover (4), inner cover screws (3), outer cover (2) and new outer cover rivets (1).
10. Remove TIMING MARK VIEW PLUG from timing inspection hole. Install hex socket timing plug.

BANK ANGLE SENSOR

General

The Bank Angle Sensor turns off the ignition system if the motorcycle lean angle exceeds 60 degrees.

Bank Angle Sensor operation may be verified by placing a magnet at top of switch - Engine will stop if switch is operating correctly. Remove magnet and turn ignition switch OFF to reset.

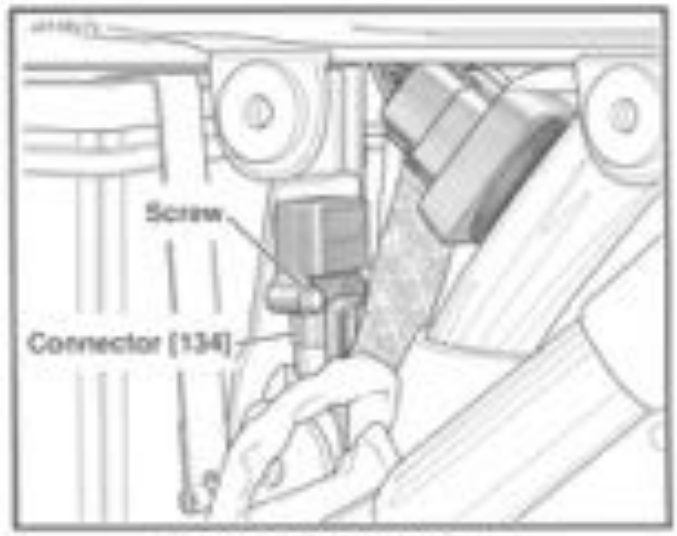


Figure 7-29. Bank Angle Sensor

Removal

1. Gently pull left side cover from frame downtubes (no tools required).

2. See Figure 7-29. Locate Bank Angle Sensor on battery box. Remove screw.

NOTE

To avoid damage to terminals, remove Bank Angle Sensor from side of battery box before disconnecting connector [134].

3. Carefully un-plug connector [134].

Installation

1. Plug-in new sensor.

2. Install new sensor - make sure locating pin on sensor body is positioned in hole.

3. Install sensor screw. Torque to 15-20 in. lbs (1.7-2.3 Nm).

4. Install left side cover.

MAP (Manifold Absolute Pressure) Sensor - 1200S

1. Loosen fuel tank rear mounting bolt.
2. Remove fuel tank front mounting bolt. Carefully pivot tank upward and prop in position to allow access to the MAP sensor.
3. Remove vacuum hose from bottom of MAP sensor.
4. See Figure 7-28. Using appropriate tool gently release tang holding sensor - Push sensor down.
5. Remove connector [80].
6. Plug connector [80] into new MAP sensor.
7. Slide MAP Sensor upward onto holding bracket until tang is engaged.
8. Attach vacuum hose to MAP Sensor.
9. Lower fuel tank into position and install front mounting bolt.
10. Tighten fuel tank rear mounting bolt.

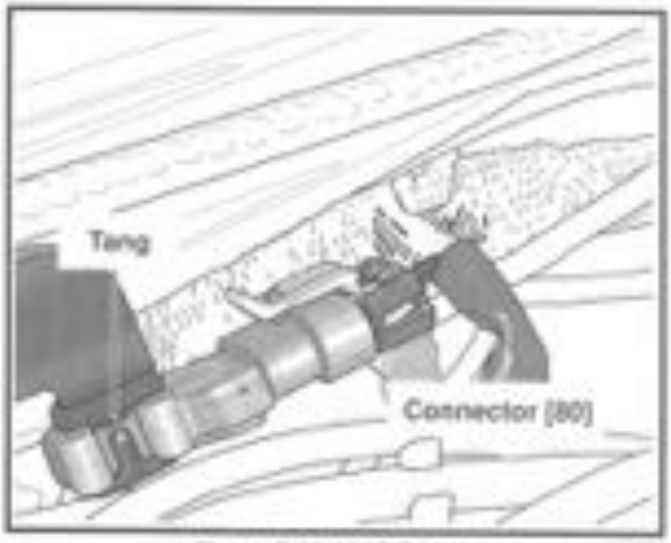


Figure 7-28. MAF Sensor

ADJUSTMENT/TESTING

Timing Mark Method

Verify engine ignition timing. See IGNITION SYSTEM, ADJUSTMENT-TESTING, IGNITION TIMING. Adjust ignition timing, if necessary, and then perform the following V.O.E.S. check:

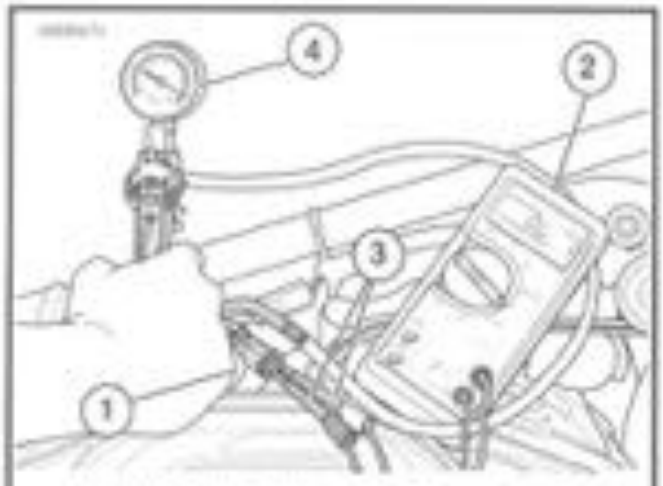
1. With engine running at 1000-1050 rpm, disconnect V.O.E.S. vacuum hose from carburetor fitting.
2. Temporarily plug the open carburetor fitting. Ignition timing should retard (front cylinder advance timing mark disappears from view in timing inspection hole) and engine rpm should decrease.
3. Connect V.O.E.S. vacuum hose to carburetor fitting. Timing mark should reappear and engine speed should increase to previous rpm.

If speed does not first decrease and then increase as described, check V.O.E.S. wire connection to ignition module.

Ohmmeter and Vacuum Pump Method

The V.O.E.S. can also be checked using an ohmmeter, a Harley-Davidson VACUUM PUMP (Part No. HD-23738) and Harness Connector Test Kit (HD-41404).

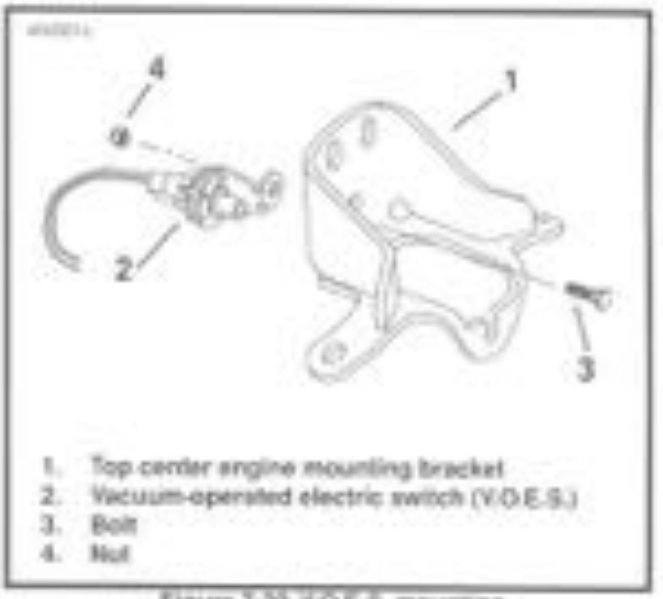
1. Disconnect V.O.E.S. Deutsch connector.
2. Insert black male probes in socket terminals of 2-place Deutsch connector.
3. Disconnect vacuum hose and connect vacuum pump to V.O.E.S. vacuum fitting.



1. V.O.E.S. Deutsch connector
2. Ohmmeter
3. Ohmmeter probes
4. Vacuum pump

Figure 7-29. Checking V.O.E.S. Using Ohmmeter and Vacuum Pump

4. Slowly squeeze vacuum pump handle. Observe vacuum gauge and ohmmeter readings. Ohmmeter should indicate switch closed (zero ohms) with an applied vacuum of 3.5-4.5 inches (89-114 mm) mercury (Hg). If a vacuum reading of more than 4.5 in. (114 mm) Hg or less than 3.5 in. (89 mm) Hg is required to close the switch, then the switch must be replaced.



1. Top center engine mounting bracket
2. Vacuum-operated electric switch (V.O.E.S.)
3. Bolt
4. Nut

Figure 7-30. V.O.E.S. mounting

REMOVAL

1. Remove air cleaner. See AIR CLEANER, REMOVAL in Section 4.
2. Remove rear mounting bolt, locknut and 2 flat washers to free fuel tank from frame member.
3. Standing on vehicle right side, raise rear of fuel tank slightly and push 2-pin Deutsch connector on top motor mount rearward to unsnap attachment clip from T-stud.
4. Depress latch on connector to separate pin and socket housings. For best results, use a rocking motion while pulling the halves apart.
5. Remove bolt and nut attaching V.O.E.S. to top center engine mounting bracket.
6. Pull V.O.E.S. assembly out of cavity and disconnect hose from V.O.E.S. fitting. Note the blue mark on hose fitting.

INSTALLATION

⚠CAUTION

Verify that V.O.E.S. switch, wiring and hose connection do not contact engine rocker box. Normal engine vibration and heat can damage V.O.E.S. assembly if it is mounted in contact with the engine.

NOTE

The correct V.O.E.S. for XLH Sportster models is identified by a blue paint mark on the hose fitting.

1. Install hose on V.O.E.S. fitting.
2. Insert bolt through hole in back of top center engine mounting bracket. Mount tab of V.O.E.S. on bolt and Rotate V.O.E.S. so that rounded edge of bracket faces upward toward fuel tank. Install nut to secure V.O.E.S. to top-center engine mounting bracket. Tighten locknut to 5-12 ft-lbs (7-16 Nm) torque.
3. Press socket housing into pin housing until it snaps in place. Place large end of slot on attachment clip over T-stud on right side of top motor mount; push assembly forward to engage small end of slot.
4. Slide flat washer on rear fuel tank mounting bolt. Insert bolt through grommet of right fuel tank flange, frame member and grommet of left fuel tank flange. Install flat washer and locknut on end of bolt. Tighten bolt to 8-16 ft-lbs (11-22 Nm) torque.
5. Install air cleaner. See AIR CLEANER, INSTALLATION in Section 4.

IGNITION/LIGHT SWITCH

GENERAL (Figure 7-31)

The ignition/light switch is not repairable and must be replaced as a unit if it fails.

⚠WARNING

DO NOT modify the ignition/light switch wiring to circumvent the automatic-on headlight feature. High visibility is an important safety consideration for motorcycle riders.

The vehicle is provided with a three-position combination ignition/light switch. The three positions are as follows:

OFF - ignition locked, lights off, key removable.

ACC(ESSORY) - Ignition locked, instrument lights on, key removable (HDI- position lamp and tail lamp on).

IGNITION - Ignition unlocked, lights on, key not removable.

Note that the key locks the ignition system and is removable in both the OFF and ACC(ESSORY) positions. The accessory position is located between the OFF and IGNITION positions and allows the rider to remove the key while leaving the instrument lights on. In this position, the instrument (con) lamps, 4-way flashers (front and rear directionals) and tail/ brake light are on or can be activated. On HDI vehicles the position lamp and taillight are on.

⚠CAUTION

When turning off the ignition, verify that the key is removed in the OFF position or that the lights are not left on. If the rider stops the engine and inadvertently removes the key in the ACC(ESSORY) position, the battery will be drained of its charge if the vehicle is left standing too long.

REMOVAL (Figure 7-32)

⚠WARNING

To avoid accidental start-up of vehicle and possible personal injury, disconnect the battery cables before proceeding. Always disconnect the negative cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion producing personal injury.

1. Remove seat.
2. Disconnect battery cables, negative cable first. See BATTERY, DISCONNECTION AND REMOVAL in this section.
3. Remove ignition switch face nut.
4. Remove Fuel tank. See FUEL TANK REMOVAL, Section 4.
5. Remove mounting screw. Remove switch cover. Remove switch from switch cover.
6. Remove harness covering and cut switch wires 3 inches from switch.

1. OFF position
2. ACC(ESSORY) position
3. IGNITION position
4. Face nut
5. Switch cover
6. Mounting screw

Figure 7-31. Ignition/Light Switch

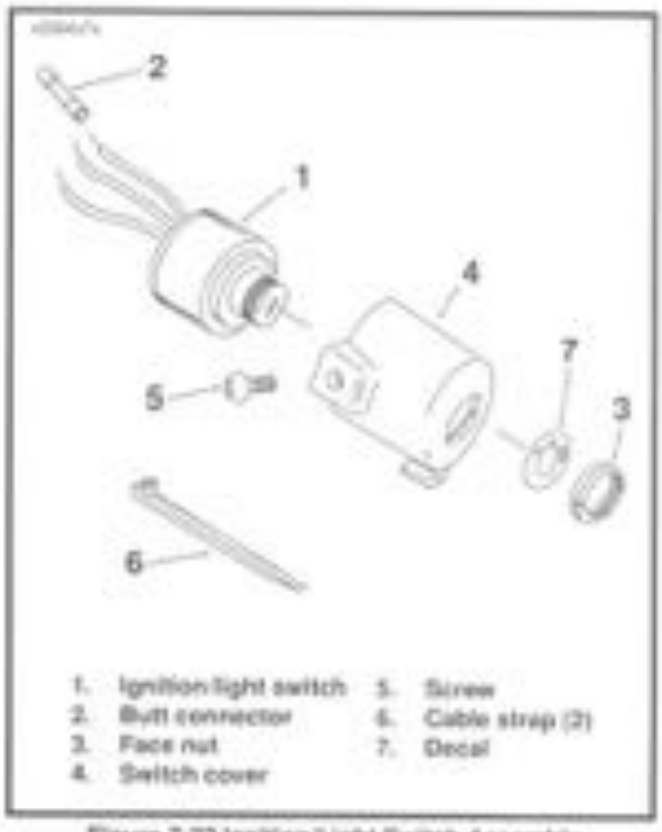
INSTALLATION (Figure 7-32)

1. Slide replacement conduit on harness wires.
2. Observing color codes, install butt connectors to harness wires. Complete butt splice to **new** ignition switch. Seal butt splice connectors using UltraTorch UT-100 or other radiant heating device. See SEALED BUTT CONNECTORS in this section for more detailed information.
3. Slide conduit over butt splice connectors.
4. Insert ignition switch into hole of switch cover. The word "TOP" stamped on the switch body should face upward toward the lettering on the switch position decal. Loosely install face nut.
5. Install and tighten mounting screw to 3-7 ft-lbs (4-9 Nm) torque.
6. Tighten face nut to secure switch within cover.
7. Using two **new** cable straps, secure main harness to frame backbone.

⚠WARNING

Always connect the positive battery cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion producing personal injury.

8. Install battery cables, positive cable first. See BATTERY, INSTALLATION AND CONNECTION in this section.
9. Check ignition/light switch for proper operation.



1. Ignition/light switch
2. Butt connector
3. Face nut
4. Switch cover
5. Screw
6. Cable strap (2)
7. Decal

Figure 7-32 Ignition/Light Switch Assembly

IGNITION MODULE - 1200S

GENERAL

See Figure 7-33. The ignition module is mounted to a bracket located under the seat.

Refer to IGNITION SYSTEM in this section for information on the function and testing of the ignition module. The ignition module is not repairable and must be replaced if defective.

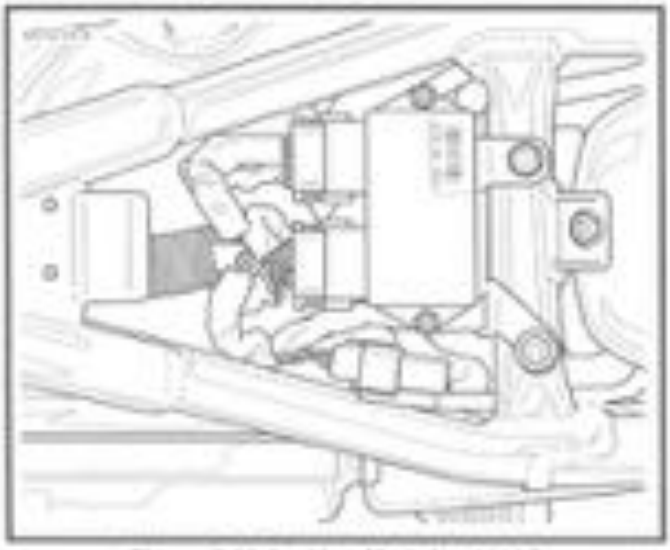


Figure 7-33. Ignition Module - 1200S

REMOVAL

1. Remove seat. See SEAT REMOVAL in Section 2.

⚠WARNING

To avoid accidental start-up of vehicle and possible personal injury, disconnect the battery cables before proceeding. Always disconnect the negative cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion producing personal injury.

2. Disconnect battery cables, negative cable first. See BATTERY, DISCONNECTION AND REMOVAL.
3. See Figure 7-6. Disconnect ignition module (17) from wiring harness at Deutsch connectors.
4. Depress external latches on socket housing side and use a rocking motion to separate pin and socket halves.
5. Remove screws (18) to free the ignition module (17) from the frame-mounted bracket.

INSTALLATION

1. See Figure 7-6. Align holes in ignition module with those in frame-mounted bracket.
2. Secure module to bracket using screws (18). Tighten screws to 15-21 **in-lbs** (1.7-2.4 Nm) torque.
3. Connect ignition module (17) Deutsch connectors [13] and [11] to module.

   Align tabs on socket housing with grooves on pin housing. Push connector halves together until latches "click." If latches do not click (latch), press on one side of the connector until that latch engages, then press on opposite side to engage other latch.

   Fit attachment clip to pin housing, if removed. Place large end of slot on attachment clip over T-stud on battery tray. Push assembly toward plug end (socket side) to engage small end of slot.

⚠WARNING

Always connect the positive battery cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion producing personal injury.

4. Install battery cables, positive cable first. See BATTERY, INSTALLATION AND CONNECTION in this Section.
5. Install seat. See SEAT INSTALLATION in Section 2.
6. Test engine for proper ignition system operation.

CAM POSITION SENSOR AND ROTOR - 1200S

GENERAL (Figure 7-6)

The cam position sensor (7) and rotor (9) are located in the gearcase cover (14) on the right side of the vehicle. The rotor is mounted on the camshaft and operates at one-half crankshaft speed. The cam position sensor wiring is connected to the ignition module (12) wiring harness. Refer to IGNITION TIMING in this Section for information on the function, testing and adjustment of the cam position sensor and rotor assembly.

REMOVAL (Figure 7-6)

⚠WARNING

To avoid accidental start-up of vehicle and possible personal injury, disconnect the battery cables before attempting any service procedure.

1. Disconnect battery cables, negative cable first. See BATTERY, DISCONNECTION AND REMOVAL.
2. Disconnect cam position sensor (7) wiring at connector (11) located on left frame tube under motor.
3. Note position of each cam position sensor wiring terminal in plug end of connector (11).
4. Remove terminals following procedure outlined under DEUTSCH ELECTRICAL CONNECTORS at the end of this section.
5. Drill off heads of outer timer cover rivets (1) using a 1/8-inch drill bit. Tap remaining rivet shafts inboard through holes in outer timer cover (2) and inner timer cover (4). Remove outer cover.
6. Remove inner cover screws (3) and inner cover (4). Carefully remove any remaining pieces of rivets from gearcase cover timer bore.
7. To obtain approximate ignition timing during installation, mark position of cam position sensor screws (5) on cam position sensor (7).
8. Remove cam position sensor screws. Carefully remove cam position sensor. Remove rotor bolt (8) and rotor (9).
9. Carefully remove camshaft oil seal (10) if damaged or if there is any evidence of oil leakage past the seal.

INSTALLATION (Figure 7-6)

1. With the tpoed side facing inboard, install **new** camshaft oil seal (10) into gearcase cover (14), if removed. Press seal into position until flush with surface of timer bore.
2. Position rotor (9) onto end of camshaft aligning notch with camshaft slot. Apply LOCTITE THREADLOCKER 242 (blue) to rotor bolt (8). Install bolt to secure rotor. Tighten bolt to 43-53 **in-lbs** (4.9-6 Nm) torque.
3. Install cam position sensor (7) and cam position sensor screws (5). Rotate sensor plate to its previously marked position to obtain approximate ignition timing.
4. Route cam position sensor wiring leads downward through hole (7 o'clock position) in timer bore of gearcase cover (15). Route leads upward through bottom opening between right crankcase half and rear of gearcase cover.

⚠CAUTION

Route cam position sensor wires about 1-1/2 inches (38 mm) forward of gearcase cover rear edge. If wires are routed too far to the rear of this position, they could contact the moving secondary drive belt and/or sprocket resulting in damage to cam position sensor wiring.

5. Install cam position sensor wiring terminals into correct positions in plug end of connector (11). Red, green and black wires of plug end (from cam position sensor) must match same color wires in receptacle end of connector (from ignition module wiring harness). Install terminals following procedure outlined under DEUTSCH ELECTRICAL CONNECTORS at the end of this section.

   Connect cam position sensor (7) wiring to ignition module (12) at wiring harness connector (11).
6. Check ignition timing as described under IGNITION TIMING, Static Timing if cam position sensor has been replaced or proceed to Dynamic Timing Pages 14 in this Section if aligning marks on original sensor. Final tighten cam position sensor screws (5) to 12-20 **in-lbs** (1.4-2.3 Nm) torque.
7. Install inner cover (4) using screws (3). Tighten screws to 12-20 **in-lbs** (1.4-2.3 Nm) torque.
8. Secure outer cover (2) to inner cover using **new** rivets.

⚠CAUTION

Use only H-D Part No. 8699 rivets to secure outer timing cover. These rivets are specially designed so that no rivet end falls off into the timing compartment. Use of regular rivets can damage ignition system components and may allow water to enter the timing compartment.

9. Install battery cables, positive cable first. See BATTERY, INSTALLATION AND CONNECTION in this Section.

IGNITION MODULE - All except 1200S

GENERAL (Figure 7-8)

The cam position sensor (7) and rotor (9) are located in the gearcase cover (15) on the right side of the vehicle. The rotor is mounted on the camshaft and operates at one-half crankshaft speed. The cam position sensor wiring is connected to the ignition module (12) wiring harness. Refer to IGNITION TIMING in this Section for information on the function, testing and adjustment of the cam position sensor and rotor assembly.

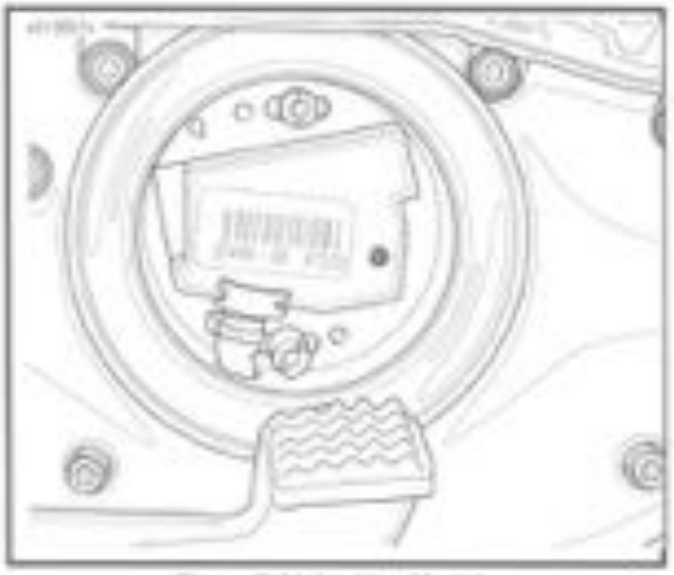


Figure 7-34. Ignition Module

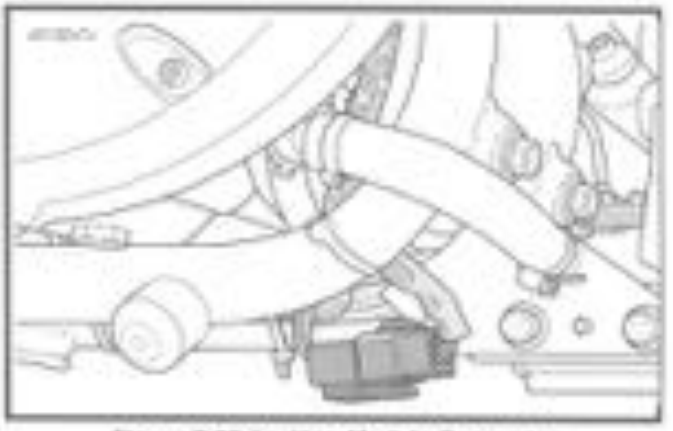


Figure 7-35. Ignition Module Connector

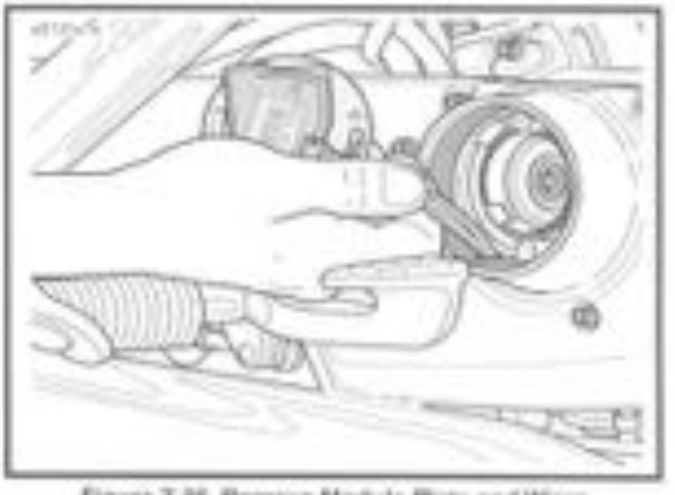


Figure 7-36. Remove Module Plate and Wires

REMOVAL (Figure 7-8)

⚠WARNING

To avoid accidental start-up of vehicle and possible personal injury, disconnect the battery cables before attempting any service procedure.

1. Disconnect battery cables, negative cable first. See BATTERY, DISCONNECTION AND REMOVAL.
2. Drill off heads of outer timer cover rivets (1) using a 3/8-inch (9.525 mm) drill bit. Tap remaining rivet shafts inboard through holes in outer timer cover (2) and inner timer cover (4). Remove outer cover.
3. Remove inner cover screws (3) and inner cover (4). Carefully remove any remaining pieces of rivets from gearcase cover timer bore.
4. To obtain approximate ignition timing during installation, mark position of cam position sensor screws (5) on cam position sensor (7).
5. Remove cam position sensor screws. Carefully remove cam position sensor. If oil leak is present inside timer cover, remove rotor bolt (8) and rotor (9).
6. Carefully remove camshaft oil seal (10) if damaged or if there is any evidence of oil leakage past the seal.

INSTALLATION (Figure 7-8)

1. If the camshaft oil seal was removed, install as follows: With the lipped side facing inboard, install **new** camshaft oil seal (12) into gearcase cover (15), if removed. Press seal into position until flush with surface of timer bore.

2. Position rotor (9) onto end of camshaft aligning notch with camshaft slot. Apply LOCTITE THREADLOCKER 242 (blue) to rotor bolt (8). Install bolt to secure rotor. Tighten bolt to 43-50 **in-lbs** (4.9-6 Nm) torque.

3. Install cam position sensor (7) and cam position sensor screws (5). Rotate sensor plate to its previously marked position to obtain approximate ignition timing.

4. Route cam position sensor wiring leads downward through hole (7 o'clock position) in timer bore of gearcase cover (15). Route leads upward through bottom opening between right crankcase half and rear of gearcase cover.

⚠CAUTION

Route cam position sensor wires about 1-1/2 inches (38 mm) forward of gearcase cover rear edge. If wires are routed too far to the rear of this position, they could contact the moving secondary drive belt and/or sprocket resulting in damage to cam position sensor wiring.

5. Install cam position sensor wiring terminals into correct positions in plug end of connector (11). Red, green and black wires of plug end (from cam position sensor) must match same color wires in receptacle end of connector (from ignition module wiring harness). Install terminals following procedure outlined under DEUTSCH ELECTRICAL CONNECTORS at the end of this section.

   Connect cam position sensor (7) wiring to ignition module (12) at wiring harness connector (11).

6. Check ignition timing as described under IGNITION TIMING, Static Timing if cam position sensor has been replaced or proceed to Dynamic Timing Pages14 in this Section if aligning marks on original sensor. Final tighten cam position sensor screws (5) to 12-20 **in-lbs** (1.4-2.3 Nm) torque.

7. Install inner cover (4) using screws (3). Tighten screws to 12-20 **in-lbs** (1.4-2.3 Nm) torque.

8. Secure outer cover (2) to inner cover using **new** rivets.

⚠CAUTION

Use only H-D Part No. 9699 rivets to secure outer timing cover. These rivets are specially designed so that no rivet end falls off into the timing compartment. Use of regular rivets can damage ignition system components and may allow water to enter the timing compartment.

9. Install battery cables, positive cable first. See BATTERY, INSTALLATION AND CONNECTION in this Section.

SPARK PLUGS

GENERAL

Harley Davidson 6R12 spark plugs have a resistor element to reduce the radio interference which originates in the motorcycle ignition system. Spark plugs should be replaced every 10,000 miles (16,000 km). Use only the resistor-type spark plugs specified.

ADJUSTMENT

Spark plug gap is 0.038-0.043 in. (0.96-1.09 mm). Use only a wire type feeler gauge. Bend the outside electrode so a slight drag on the gauge is felt when passing it between electrodes. Never make adjustments by bending the center electrode.

CLEANING AND INSPECTION

Inspection

Examine spark plugs as soon as they have been removed. The deposits on the plug base are an indication of the plug efficiency and are a guide to the general condition of pistons, piston rings, valves, valve guides, valve seals, carburetor and ignition system.

Spark Plug Condition

Compare your observations of the plug deposits with the descriptions provided below.

A. A wet, black and shiny deposit on plug base, electrodes and ceramic insulator tip indicates an oil fouled plug. The condition may be caused by one or more of the following: worn pistons, worn piston rings, worn valves, worn valve guides, worn valve seals, a weak battery or a faulty ignition system.

B. A dry, fluffy or sooty black deposit indicates a carburetor air-fuel mixture that is too rich, engine idling for excessive periods of time and/or enricherier usage for excessive periods of time.

C. A light brown, glassy deposit indicates an overheated plug. This condition may be accompanied by cracks in the insulator or by erosion of the electrodes and is caused by an air-fuel mixture that is too lean, a hot running engine, valves not seating or improper ignition timing. The glassy deposit on the spark plug is a conductor when hot and may cause high-speed misfiring. A plug with eroded electrodes, heavy deposits or a cracked insulator must be replaced.

D. A plug with a white, yellow, tan or rusty brown powdery deposit indicates balanced combustion. Clean off spark plug deposits at regular intervals. See CLEANING.

Cleaning

Inspect spark plugs every 5,000 miles (8047 km). Replace spark plugs every 10,000 miles (16,093 km). If the plugs require cleaning between tune-ups, proceed as follows:

1. Degrease firing end of spark plug using ELECTRICAL CONTACT CLEANER. Dry spark plug with compressed air.
2. Use a thin file to flatten spark plug electrodes. A spark plug with sharp edges on its electrodes requires 25%-40% less firing voltage than one with rounded edges.
3. Adjust spark plug gap. See ADJUSTMENT in this section.

INSTALLATION

1. Before installing spark plugs, check condition of threads in cylinder head and on plug. If necessary, soften deposits with penetrating oil and clean out with a thread chaser.
2. Apply a very light coating of ANTISEIZE LUBRICANT to spark plug threads. Install spark plug. Tighten spark plug to 11-18 ft-lbs (15-24 Nm) torque.

   If a torque wrench is not available, finger-tighten spark plug and then using a spark plug wrench, tighten plug an additional 1/4 turn.
3. Check engine idle speed. Adjust as necessary.

SPARK PLUG CABLES

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

Never disconnect a spark plug cable with the engine running. If you disconnect a spark plug cable with the engine running, you may receive a potentially fatal electric shock from the ignition system.

⚠CAUTION

When disconnecting each spark plug cable from its spark plug terminal, always grasp and pull on the rubber boot at the end of the cable assembly (as close as possible to the spark plug terminal). Do not pull on the cable portion itself. Pulling on the cable will damage the cable's carbon core.

Disconnect spark plug cables from ignition coil and spark plug terminals.

INSPECTION

Check cables for cracks or loose terminals.

Check spark plug cable resistance with an ohmmeter. Resistance must be 1,625-3,796 ohms for 6-1/2-in. (165 mm) cable, and 5,000-11,680 ohms for 20-in. (508 mm) cable. For 1200S resistance values see chart on page 7-31.

Replace cables that are worn/damaged or that do not meet resistance specifications. Check cable boots/caps for cracks or tears; also check for loose fit on ignition coil and spark plugs. Replace boots/caps if you find any of the detrimental conditions mentioned above.

INSTALLATION

Connect spark plug cables to ignition coil and spark plugs. Make sure boots/caps are secured properly; this will provide the necessary moisture-proof environment for the ignition coil and spark plug terminals.

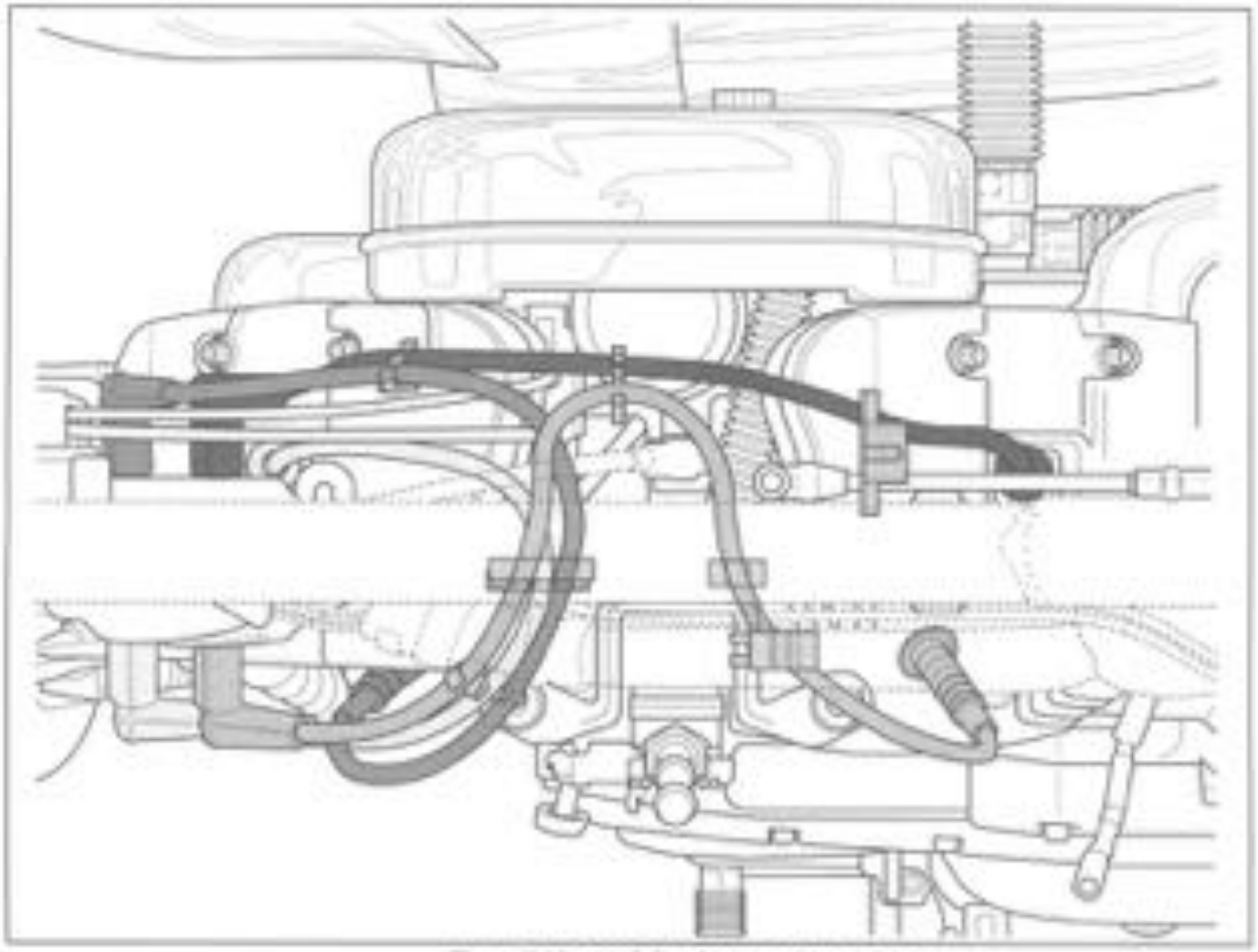


Figure 7-37. 1200S Spark plug cable routing

IGNITION COIL

GENERAL

The ignition coil is attached to a mounting bracket secured by the fuel tank front mounting bolt.

See Figure 7-5 or 7-6. The ignition coil is a pulse-type transformer. Internally, the coil consists of primary and secondary windings with a laminated iron core. The contents are sealed in a waterproof insulating compound. The ignition coil is not repairable. Replace the ignition coil if it is not functioning properly.

The low-voltage ignition primary circuit consists of the coil primary winding, ignition module and battery. When the circuit is closed, current flows through the coil primary winding creating a strong magnetic field in the iron core of the ignition coil.

When the ignition module receives a signal from the ignition sensor plate and rotor, the ignition module interrupts (opens) the ignition primary circuit, which causes the magnetic field in the coil core to collapse suddenly.

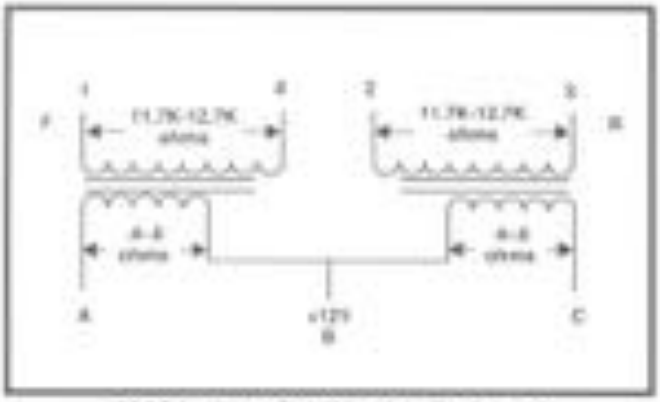
The collapsing magnetic field induces a high-voltage electrical discharge in the ignition secondary circuit, which consists of the coil secondary winding, spark plug cables and spark plugs. The high-voltage discharge produces a spark to bridge the electrode gap of each spark plug.

The ignition coil fires both spark plugs simultaneously. In one spark plug, the spark jumps from the center electrode to the outer electrode, but on the other plug, the spark jumps in the reverse direction (from the outer electrode to the center electrode).

TROUBLESHOOTING

Follow the troubleshooting procedures listed under IGNITION SYSTEM if the engine will not start, is difficult to start or runs roughly. Also check condition of spark plug cables. Insulation on cables may be cracked or damaged allowing high tension current to short to metal parts. This problem is most noticeable when cables are wet.

If poor starting/running condition persists, check resistance of ignition coil primary and secondary windings using an ohmmeter. See Figure 7-38. Resistance values should be within the limits shown in the following table:



1200S Ignition Coil Winding Resistance

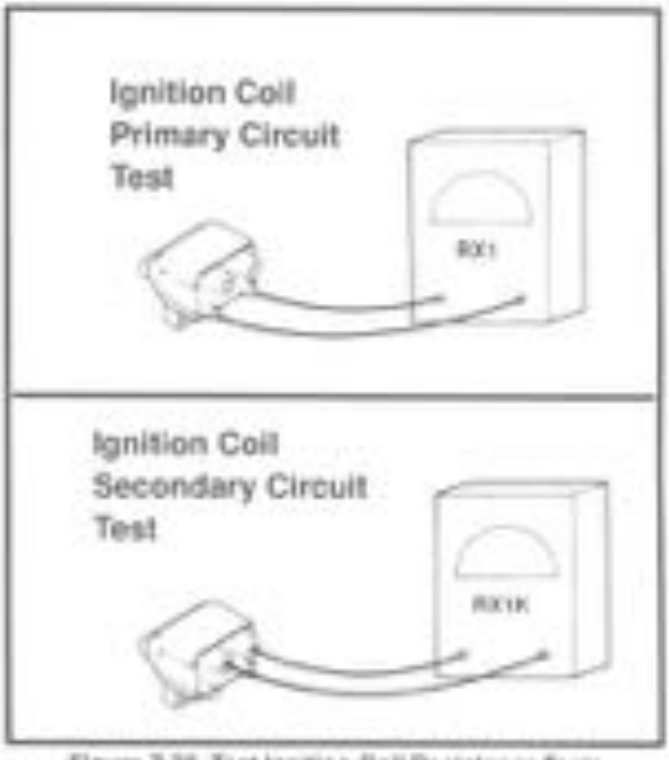


Figure 7-38. Test Ignition Coil Resistance Tests

Ignition Coil Winding Resistance - All except 1200S

Ignition Coil Winding	Ohmmeter Scale	Normal Resistance Range (in Ohms)
Primary	R x 1	2.5-3.1
Secondary	R x 1K	10,000-12,500

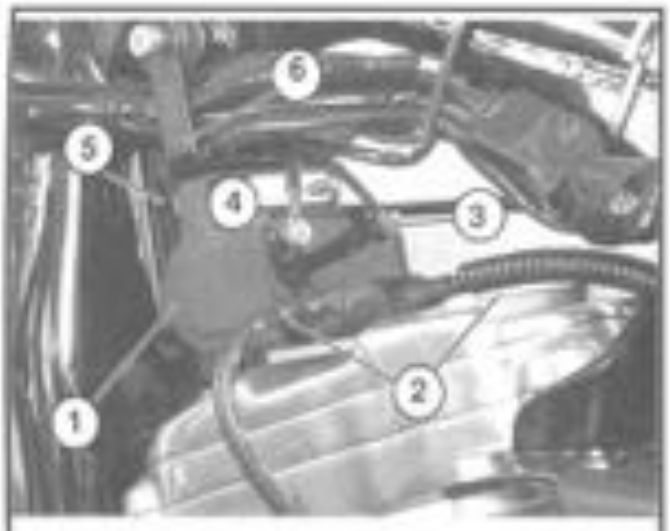
- A low resistance value indicates a short in the coil winding; replace coil.
- A high resistance value might indicate that there is some corrosion/oxidation of the coil terminals; clean terminals, and repeat resistance test. If resistance is still high after cleaning terminals, replace coil.
- An infinite ohms (no continuity) resistance value indicates an open circuit – a break in the coil winding – replace coil.

REMOVAL - ALL EXCEPT 1200S (Figure 7-39)

⚠WARNING

To avoid accidental start-up of vehicle and possible personal injury, disconnect the battery cables before proceeding. Always disconnect the negative cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion producing personal injury.

1. Disconnect battery cables, negative cable first. See BATTERY, DISCONNECTION AND REMOVAL in this section.



1. Ignition coil
2. Spark plug cables
3. Positive terminal (white with black tracer)
4. Negative terminal (pink)
5. Bolt and lockwasher (2)
6. Ignition coil mounting bracket

Figure 7-39. Coil Mounting- All except 1200S

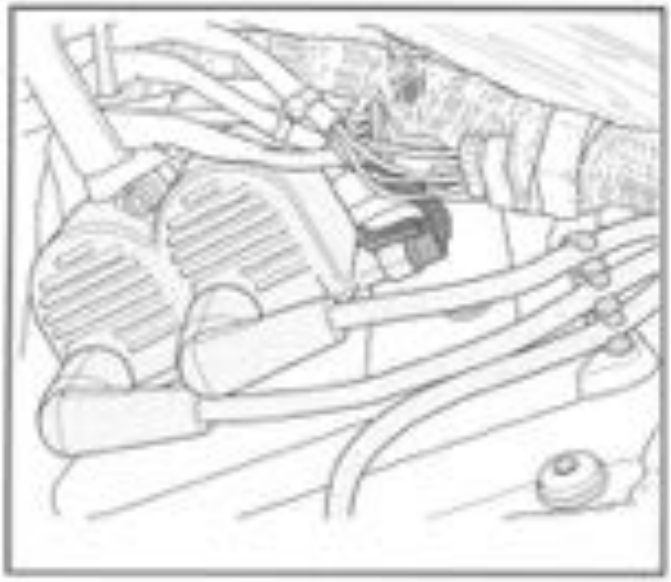


Figure 7-40. Coil Mounting - 1200S

2. Disconnect spark plug cables (2) from ignition coil (1).

3. Disconnect ring terminals of white with black tracer from coil positive terminal (3). Disconnect ring terminal of pink wires from coil negative terminal (4).

4. Remove two bolts and lockwashers (5). Remove nut plate (6) and ignition coil.

INSTALLATION - ALL EXCEPT 1200S (Figure 7-39)

1. Position ignition coil (1) onto ignition coil mounting bracket (6).

2. Secure ignition coil using nut plate and two bolts and lockwashers (5). Tighten bolts to 2-6 ft-lbs (3-8 Nm) torque.

3. Connect ring terminal of pink wires to coil negative terminal (4). Connect ring terminals of white with black tracer wires to coil positive terminal (3).

4. Connect spark plug cables (2) to ignition coil (1).

⚠WARNING

Always connect the positive battery cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion producing personal injury.

5. Install battery cables, positive cable first. See BATTERY INSTALLATION AND CONNECTION in this Section.

REMOVAL - 1200S (Figure 40)

1. Disconnect battery cables, negative cable first. See BATTERY, DISCONNECTION AND REMOVAL in this section.

2. Remove fuel tank front mounting bolt and raise tank.

3. Remove plug wires from coil towers (note location see Figure 7-37).

4. Disconnect primary wires connector (838).

5. Remove mounting bolt to free coil.

INSTALLATION - 1200S (Figure 40)

1. Position coil under mounting bracket and install bolt.

2. Torque coil mounting bolt to 2-6 ft-lbs (2.7-8.1 Nm).

3. Connect primary wire connector (838).

4. Attach plug wires to coil towers (see Figure 7-37).

5. Lower fuel tank into position and install bolt.

CHARGING SYSTEM

GENERAL

The charging system consists of the alternator and regulator. See pages 7-62 for charging system circuits.

Alternator

The alternator consists of two main components: the rotor which is mounted on the engine sprocket shaft, and the stator, which is bolted to the engine crankcase.

Regulator

The regulator is a series regulator with shunt control. The circuit combines the functions of rectifying and regulating.

TROUBLESHOOTING

Special Tools	Torque Values
Ammeter Load tester Ohmmeter AC voltmeter	None

Preliminary Checks

When the charging system fails or does not charge at a satisfactory rate, it is recommended that the following checks be made:

Battery

Check for a weak or dead battery. See the BATTERY section. Battery must be fully charged in order to perform any electrical tests.

Wiring

Check for corroded or loose connections in the charging circuit.

Regulator Inspection

The regulator base must have a clean, tight connection for proper grounding. Check by using an ohmmeter with one lead on a known good ground, such as battery ground cable, and the other on the regulator base.

The stator connector plug located on the right front downtube must be clean and tight.

Regulator Bleed Test

Be sure regulator is connected to battery. See Figure 7-28. Unplug two-pin stator connector. Use a trouble light and touch one probe to a known good ground and the other to the regulator pins, one at a time. If light glows, replace regulator.

MILLIAMP DRAW TEST

NOTE

Be sure accessories are not wired so they stay on at all times. Check for this by connecting ammeter between negative battery terminal and battery.

See Figure 7-18. Connect ammeter between negative battery terminal and battery. With this arrangement, you will also pick up any regulator drain. With ignition switch and all lights and accessories turned to OFF, amperage reading should be 3 milliamperes maximum. A higher reading indicates excessive current draw.

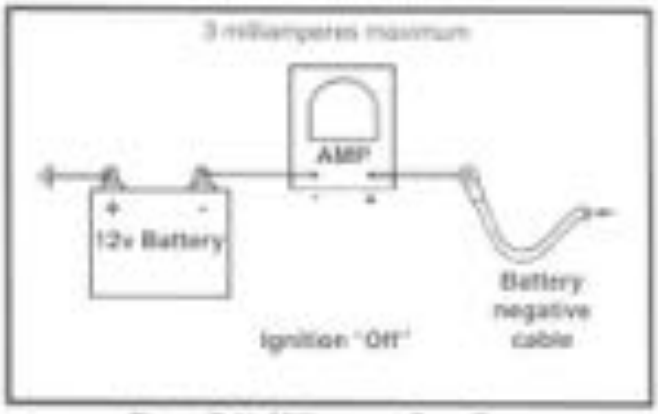


Figure 7-41. Milliampere Draw Test

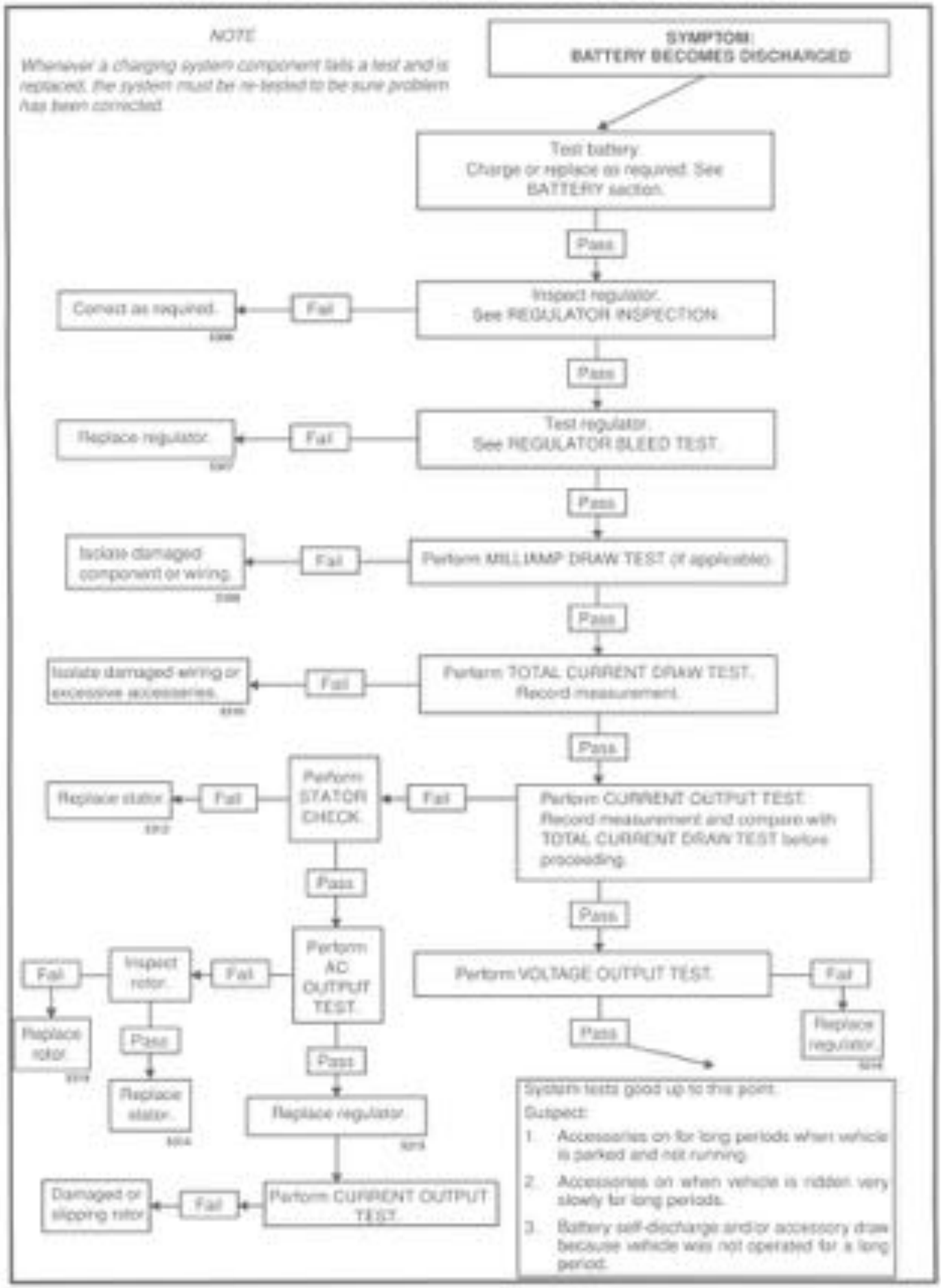
Any accessories must be considered and checked for excessive drain. Isolate the source of the excessive current draw by disconnecting regulator or accessories until current draw is reduced.

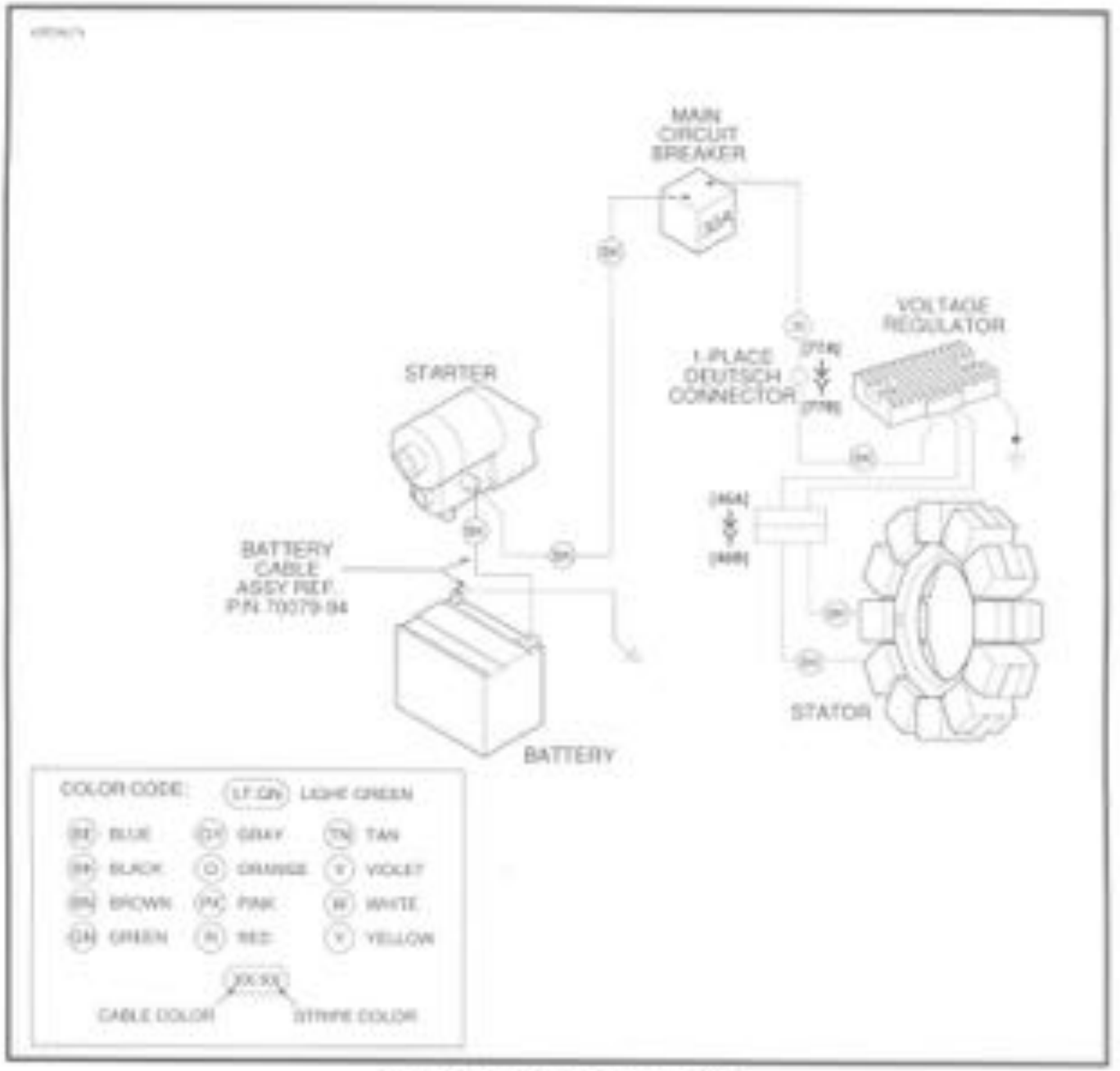
This condition could drain battery completely if vehicle is parked for a long time.

NOTE

A battery with surface discharge condition could cause a static drain. Correct by cleaning battery case.

CHARGING SYSTEM TROUBLESHOOTING





XLH Models Charging System Circuit

Total Current Draw Test

See Figure 7-42. If battery runs down during use, the current draw of the motorcycle components and accessories may exceed output of the charging system. To check for this condition, place load tester induction pickup or current probe pickup, over battery negative cable as shown below.

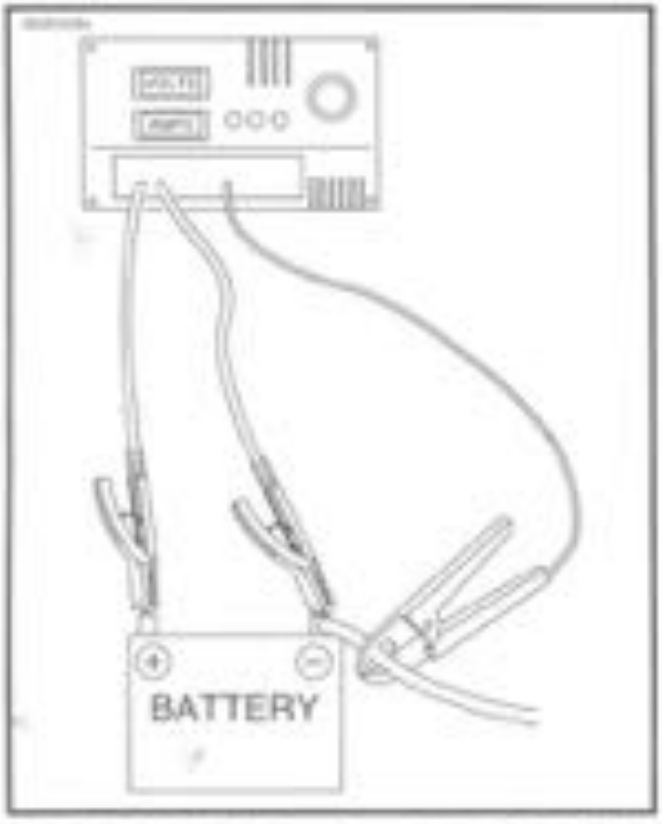


Figure 7-42. Check Current Draw (Ignition Switch On)

Disconnect the regulator from the stator at the connector on the right front downtube (see Figure 7-28) and start the motorcycle. Start engine and run 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 in CURRENT AND VOLTAGE OUTPUT TEST. The current output should exceed current draw by 3.5 amps, minimum. If not, there may be too many accessories for the charging system to handle.

Reconnect the regulator after the test.

NOTE

Rider's habits may require output test at lower RPM.

Current and Voltage Output Test

1. Connect load tester negative and positive leads to battery terminals and place load tester induction pickup over positive regulator cable as shown in Figure 7-21.
2. Run the engine at 2,000 R.P.M. Increase the load as required to obtain a constant 13.0 volts.
3. The current output should be 19-23 amps. Make note of measurement.

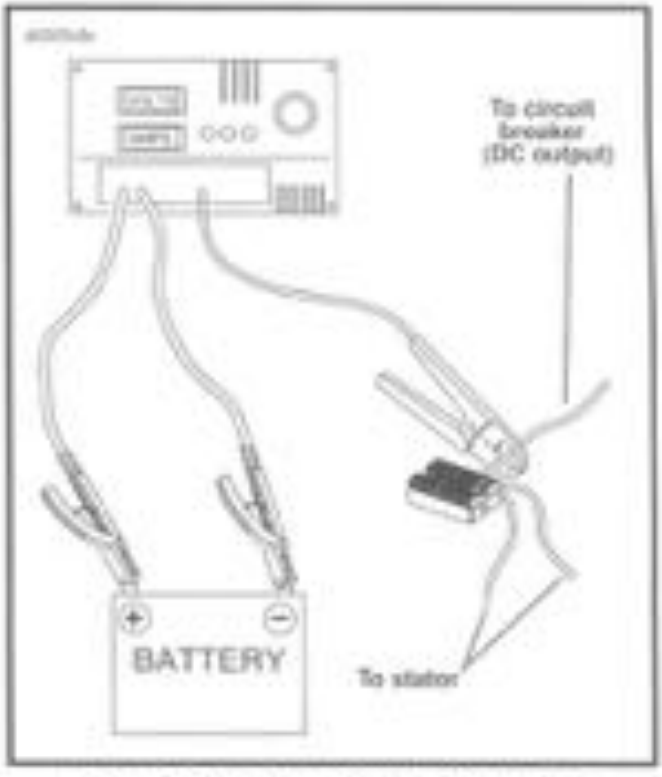


Figure 7-43. Current and Voltage Output Test

Voltage Output Test

See Figure 7-43. After removing the load, read the load tester voltage meter. Voltage to the battery must not be more than 15 volts. If voltage is higher, regulator is not functioning properly or connections are loose or dirty.

⚠CAUTION

Do not leave any load switch turned on for more than 20 seconds or overheating and tester damage are possible.

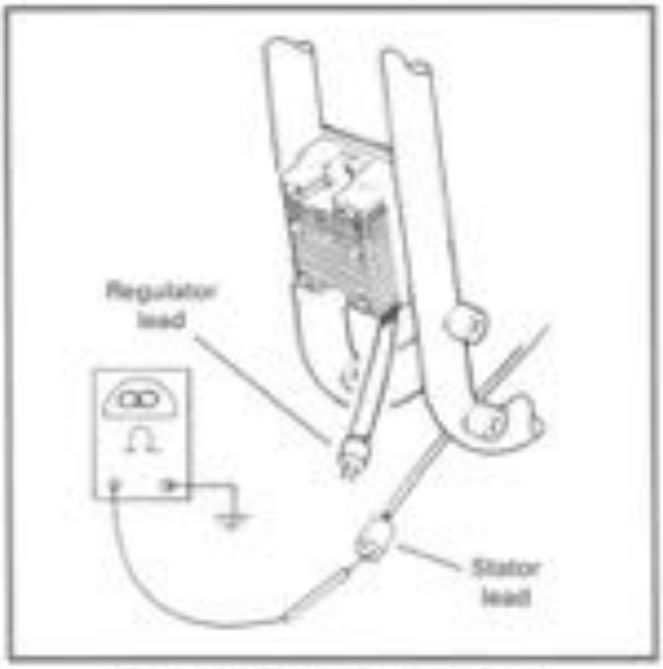


Figure 7-44. Test for Grounded Stator

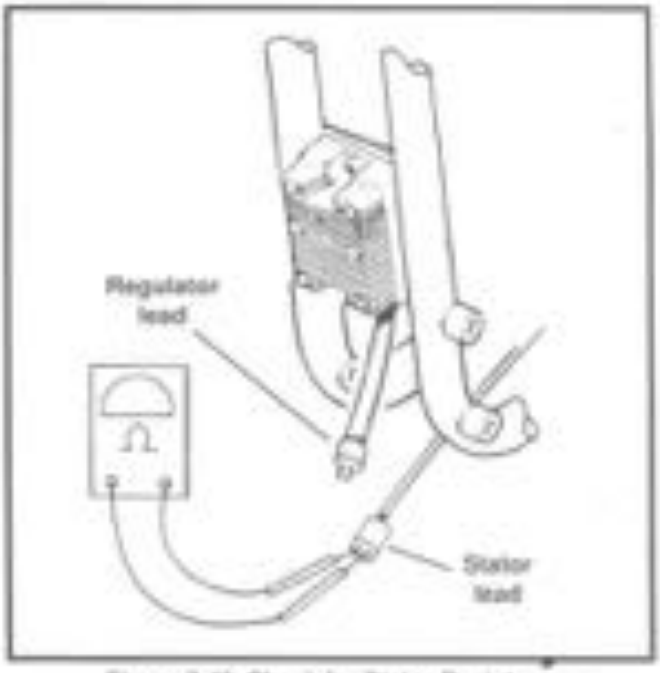


Figure 7-45. Check for Stator Resistance

Stator Check

1. To check for a grounded stator, turn off ignition and disconnect the regulator from the stator at the connector on the right front frame downtube (see Figure 7-28).
2. See Figure 7-44. Connect an ohmmeter on the RX1 scale between crankcase and either stator socket. There should be no continuity (∞ ohms) across either test point. Any other reading indicates a grounded stator which must be replaced.
3. See Figure 7-45. Check the resistance using an ohmmeter set on the RX1 scale. Resistance across the stator sockets or pins should be 0.2-0.4 ohms. If the resistance is lower, the stator is damaged and must be replaced.

AC Output Check

1. See Figure 7-46. To test AC output, disconnect the regulator and connect an AC voltmeter across both stator sockets. Run the engine at 2000 R.P.M. The AC output should be 38-52 volts AC.
2. If the output is below specifications, charging problem could be a faulty rotor or stator. If output is good, charging problem might be faulty regulator-rectifier. Replace as required.
3. Check the output again as described under CURRENT AND VOLTAGE OUTPUT TEST.

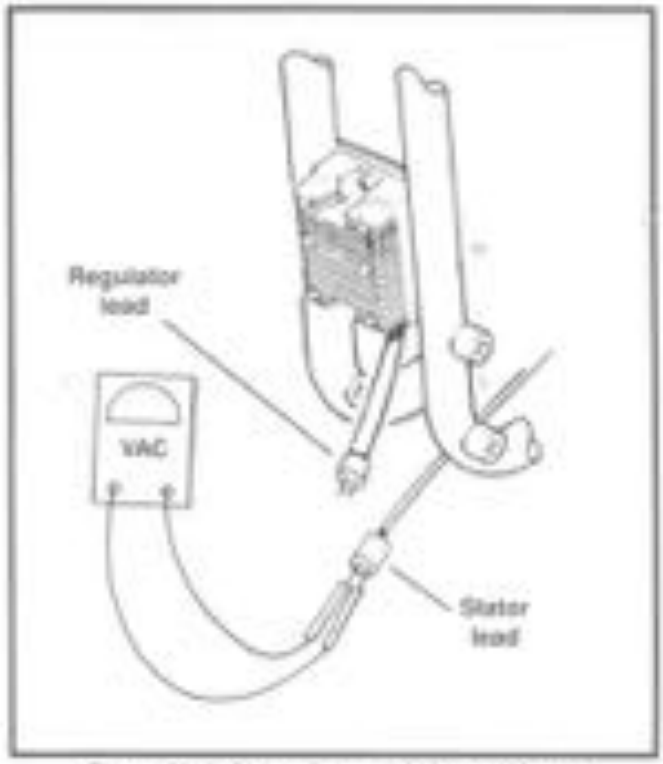


Figure 7-46. Check Stator AC Voltage Output

REMOVAL AND DISASSEMBLY

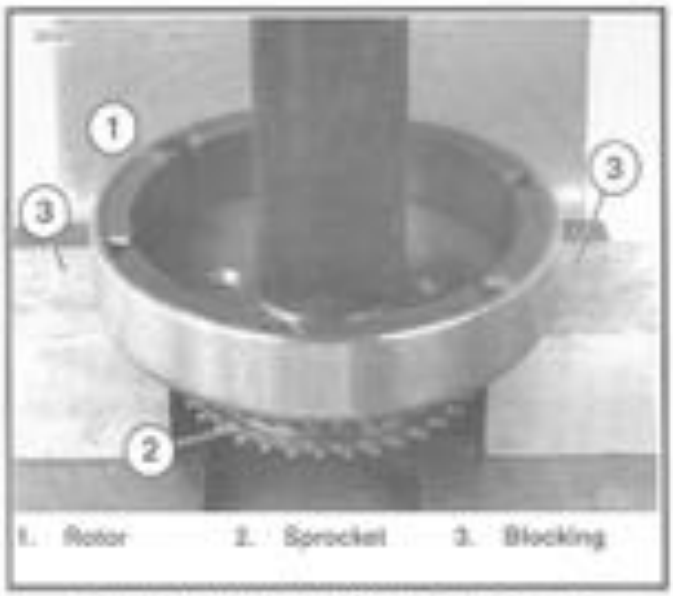
⚠WARNING

To avoid accidental start-up of vehicle and possible personal injury, disconnect the battery cables (negative cable first) before performing any of the following procedures.

1. Remove primary cover. See PRIMARY CHAIN, REMOVAL, PRIMARY COVER in Section 6.
2. Remove clutch assembly, primary chain and engine sprocket/rotor assembly as a unit. Refer to PRIMARY DRIVE/CLUTCH, REMOVAL in Section 6. Remove/ disassemble rotor and/or stator, as required. Refer to the following procedures.

Rotor (Figure 7-47)

1. Remove bolts which secure alternator rotor (1) to engine sprocket (2).



1. Rotor 2. Sprocket 3. Blocking

Figure 7-47. Removing Rotor From Sprocket

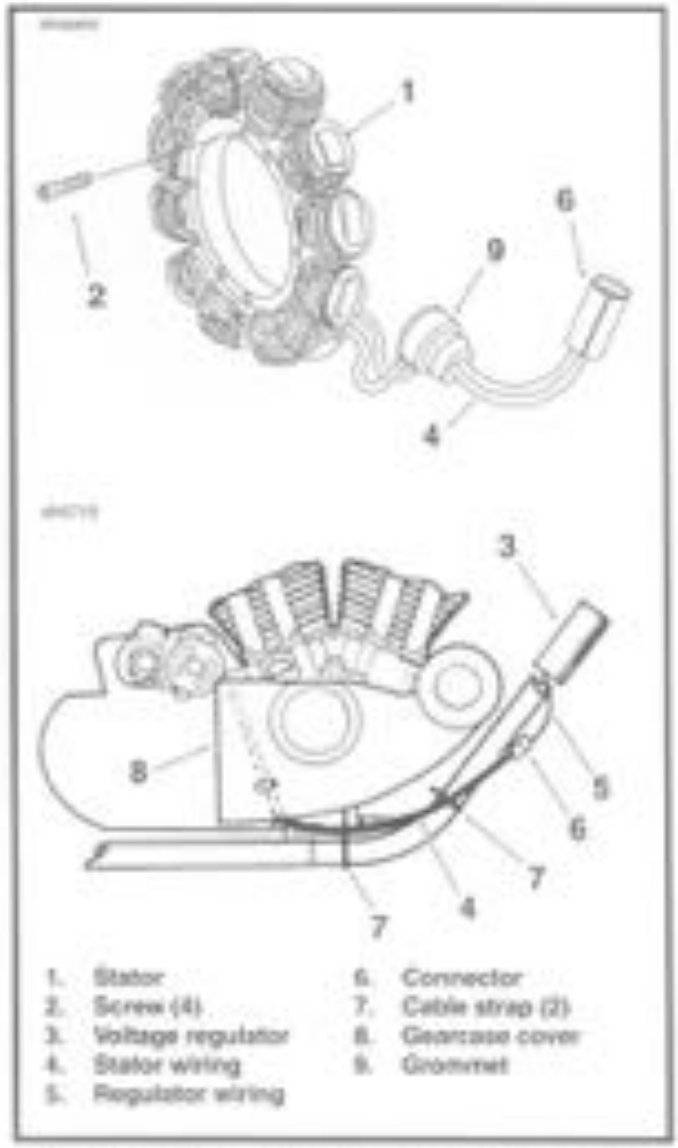
2. Position blocking (3) under rotor (1). Press sprocket (2) free of rotor.

NOTE

Resistance to sprocket/rotor disassembly is due in part to the magnetic force of the permanent rotor magnets.

Stator (Figure 7-48)

1. Disconnect stator wiring (4) from voltage regulator wiring (5) at connector (6).
2. Remove cable straps (7).
3. Withdraw stator wiring (4) from opening between right crankcase half and gearcase cover (8).
4. Using a T-27 TORX driver, remove and discard screws (2) which secure stator (1) to left crankcase half.



1. Stator
2. Screw (4)
3. Voltage regulator
4. Stator wiring
5. Regulator wiring
6. Connector
7. Cable strap (2)
8. Gearcase cover
9. Grommet

Figure 7-48. Stator Assembly and Stator Cable Routing

⚠CAUTION

Stator TORX screws contain a thread locking compound. Do not reuse existing screws. Always use new screws with the proper thread locking compound. Loss of torque on TORX fasteners could result in alternator damage.

5. Remove stator wiring grommet (9) from left crankcase half.
6. Withdraw stator wiring (4) from grommet hole in left crankcase half. Remove stator (1).

CLEANING, INSPECTION AND REPAIR

⚠CAUTION

Do not strike or drop alternator rotor or damage to magnet adhesive may occur. Magnet adhesive damage can result in rotor failure.

1. Clean rotor with a petroleum-base solvent. Remove all foreign material from rotor magnets. Replace rotor if rotor magnets are cracked or loose.
2. Clean stator by wiping with a clean cloth.
3. Examine stator leads for cracked or damaged insulation.

NOTE

The rotor and stator can be replaced individually if either is damaged.

ASSEMBLY AND INSTALLATION

Depending on whether the rotor, the stator, or both the rotor and stator were removed/disassembled, perform the applicable procedures which follow:

1. See Figure 7-48. Feed stator wiring (4) with attached grommet (9) into open grommet hole in left crankcase half.
2. Apply a light coating of clean engine oil or chaincase lubricant to grommet (9). Install grommet into hole in left crankcase half.

⚠CAUTION

Stator TORX screws contain a thread locking compound. Do not reuse existing screws. Always use new screws with the proper thread locking compound. Loss of torque on TORX fasteners can result in alternator damage.

3. Position stator (1) on left crankcase half. Secure stator using **new** Torx screws (2). Use a T-27 TORX driver to tighten screws to 30-40 **in-lbs** (3.4-3.5 Nm) torque.

⚠CAUTION

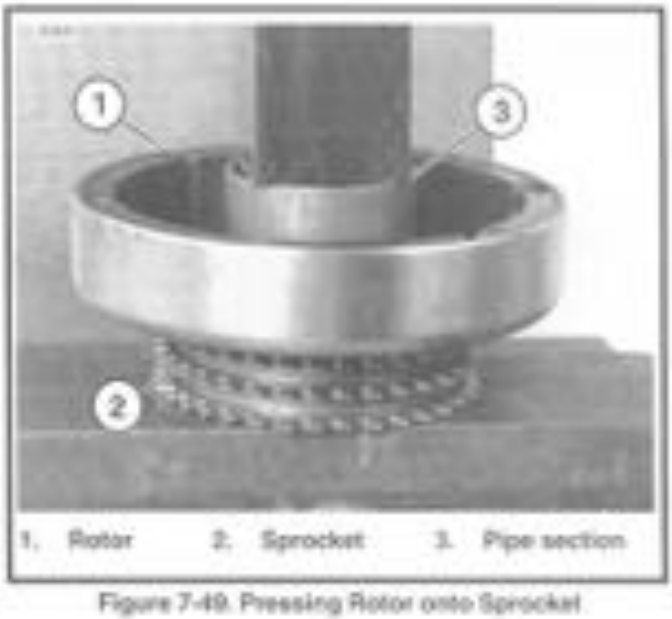
Make sure stator wiring is routed about 1-1/2 in. (38 mm) forward of gearcase cover rear edge. If routed too far to the rear of this position, wiring could contact the moving secondary drive belt and/or sprocket, resulting in damage to stator wiring and charging system.

4. Route stator wiring (4) across top of crankcase halves to right side of engine. Route stator wiring downward through opening between right crankcase half and gearcase cover (8).

NOTE

Temporarily attach a thin flexible "feed" or mechanic's wire to the connector end of the stator wiring to assist in the routing of the wiring.

5. Route stator wiring (4) forward and then upward along inboard side of right frame downtube. Connect stator wiring (4) to voltage regulator wiring (5) at connector (6).
6. Secure stator wiring (4), along with any other wires and hoses routed in the same location, to right frame downtube using cable straps (7).
7. See Figure 7-49. Position rotor (1) on sprocket (2). Align holes in sprocket with holes in rotor. Apply a drop of LOCTITE THREADLOCKER 242 (blue) to threads of each mounting bolt. Insert mounting bolts through rotor and start bolts into tapped holes in sprocket. Position a section of pipe (3) with an inside diameter larger than the sprocket mounting hub over center of rotor. Press rotor onto sprocket. Tighten bolts to 90-110 **in-lbs** (10.2-12.4 Nm) torque.



1. Rotor 2. Sprocket 3. Pipe section

Figure 7-49. Pressing Rotor onto Sprocket

8. Install clutch assembly, primary chain and engine sprocket/rotor assembly as a unit. See PRIMARY DRIVE/CLUTCH, INSTALLATION in Section 6.
9. Install primary cover, left footrest assembly and gear shift lever. See PRIMARY CHAIN, INSTALLATION, PRIMARY COVER in Section 6.
10. Connect battery cables to battery (positive cable first).
11. Test charging system. See CHARGING SYSTEM, ADJUSTMENT/TESTING in this section.

VOLTAGE REGULATOR

GENERAL

The voltage regulator is not repairable. The unit must be replaced if it fails.

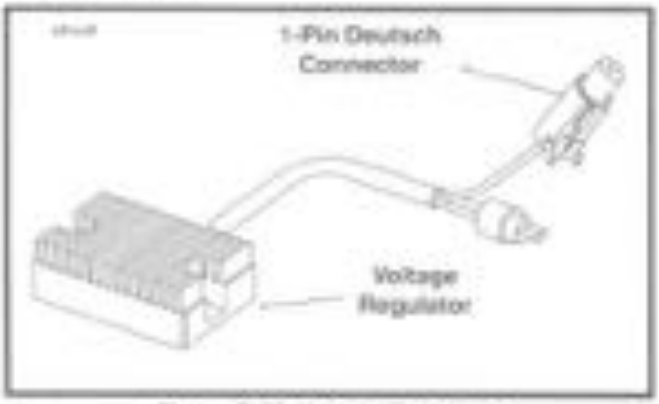


Figure 7-50. Voltage Regulator

REMOVAL (Figure 7-51)

⚠WARNING

To avoid accidental vehicle start-up and possible personal injury, disconnect the battery cables (negative cable first) before proceeding.

⚠CAUTION

When disconnecting the alternator stator wiring, pull apart the connector by firmly grasping both connector halves. Do not pull on leads or damage to the wires and/or terminals may result.

1. Locate the voltage regulator (2) between the right and left frame downtubes at the front of the vehicle.
2. Disconnect voltage regulator wiring to alternator stator wiring at 2-pin connector (7).
3. Disconnect voltage regulator charging wire to 50 amp main circuit breaker at 1-pin Deutsch connector (6). Depress the external latch on the socket housing side and use a rocking motion to separate the pin and socket halves.
4. Cut upper cable strap (5) which secures voltage regulator wiring to right side motorcycle frame downtube.
5. Remove bolts (3) and lockwashers (4) to free voltage regulator from frame downtubes.
6. Discard voltage regulator.

INSTALLATION (Figure 7-51)

1. Install **new** voltage regulator (2) between frame downtubes using mounting bolts (3) and lockwashers (4). Tighten locknuts or bolts to 36-60 **in-lbs** (4.1-6.8 Nm) torque.
2. Connect voltage regulator charging wire to 50 amp main circuit breaker at 1-pin Deutsch connector (6). Insert socket housing into pin housing until it snaps in place.
3. Connect voltage regulator wiring to alternator stator wiring at 2-pin connector (7).
4. Secure voltage regulator wiring to right side motorcycle frame downtube using **new** cable strap (5).
5. Connect battery cables to battery (positive cable first). Test charging system. See CHARGING SYSTEM, ADJUSTMENT/TESTING.

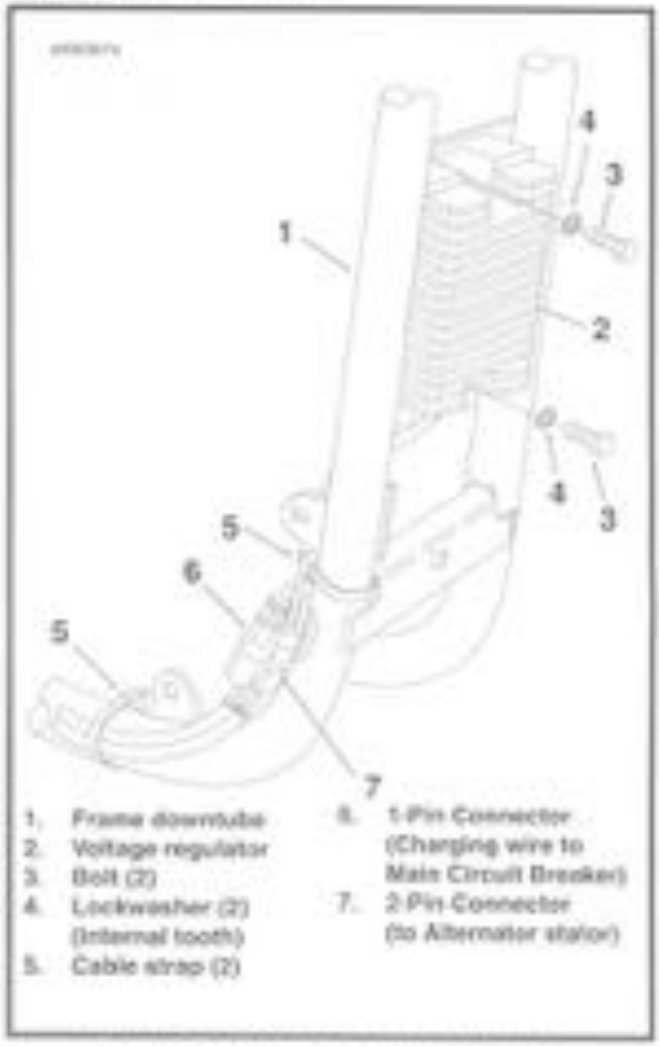


Figure 7-51. Voltage Regulator Mounting

BATTERY

GENERAL (Figure 7-52)

The battery (1) is located below the seat on the left side of the vehicle. The battery stores electrical energy for the purposes of starting the motorcycle, operating accessories when the engine is not running and providing additional current (above that generated by the alternator) when required. The battery will remain in good condition if the current draw is balanced by the current input.

The YTX20L-BS battery installed in 1996 XLH Sportster motorcycles is a permanently sealed, maintenance-free, lead/calcium and sulfuric acid battery. Do not remove the cap strip to add water, or when charging the battery.

1. Battery
2. Battery tray
3. Battery cover
4. Battery strap

Figure 7-52. Battery assembly

⚠DANGER – EXPLOSIVE GASES

Cigarettes, flames, or sparks could cause battery to explode. Always shield eyes and face from battery. Do not charge without proper instruction and training. Securely connect cables to the proper terminals.

POISON – CAUSES SEVERE BURNS

Contains sulfuric acid. Avoid contact with skin, eyes, and clothing. In event of accident, flush with water and call a physician immediately.

KEEP OUT OF REACH OF CHILDREN

⚠WARNING

Batteries contain sulfuric acid which is highly corrosive and can cause chemical burns. Avoid contact with skin, eyes or clothing. Always wear approved eye protection when working around batteries. Battery electrolyte is poisonous. Keep children away from battery.

ANTIDOTE

External – Flush with water.

Internal – Drink large quantities of milk or water, followed by Milk of Magnesia, vegetable oil or beaten eggs. Call doctor immediately.

Eyes – Flush with water, get immediate medical attention.

Figure 7-53. Maintenance-free battery

ACTIVATION/TESTING

Maintenance-free batteries are shipped pre-charged, however a voltage check should be performed before putting the battery into service.

Voltmeter Test

The voltmeter test provides a general indicator of battery condition. Check the voltage of the battery to make sure it is in a 100% charged condition. If the open circuit voltage (no loads applied) reading is below 12.6 V, charge battery and recheck voltage after battery has sat 1-2 hours. If battery reads below 12.6 Volts, after 10 hours of charging using a constant current charger (set at 1.8 amps), replace the battery. Tapered-rate chargers or trickle chargers will require longer charge times.

State of Charge	Voltage
100%	13.8 V
75%	12.8 V
50%	12.5 V
25%	12.2 V

Load Test

The load test measures battery performance under full current load and is the best indicator of battery condition.

⚠CAUTION

Fully charge the battery before testing. If battery is not fully charged, test readings will be incorrect.

Load battery to three times amp hour rating using the load tester. See Figure 7-54. Connect tester leads to battery posts and place induction pickup over negative (black) cable. The Harley-Davidson 18 amp-hour battery should be loaded to three times its amp-hour rating, or 54 amps for 15 seconds. Voltage reading throughout the test should be 9.6V or more at 70°F (21°C).

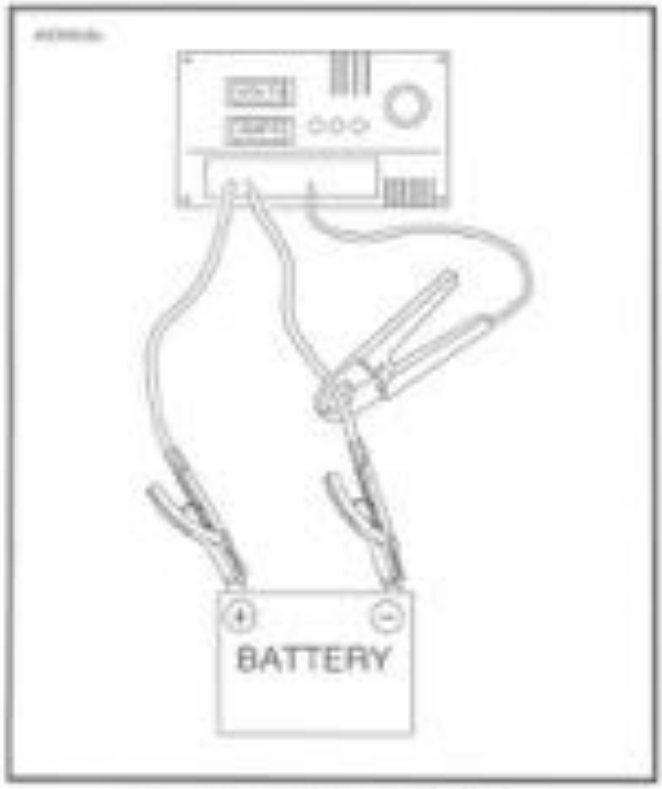


Figure 7-54. Battery Load Test

CLEANING AND INSPECTION

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

CHARGING BATTERY

⚠WARNING

Always unplug or turn battery charger OFF before connecting or disconnecting charger clamps from battery. Connecting or disconnecting clamps with charger ON could cause a spark and a possible battery explosion. A battery explosion may rupture the battery case and spray sulfuric acid resulting in personal injury.

⚠CAUTION

Never add water to the maintenance free battery, and never remove the sealed caps on top of the battery. Never allow a battery to stand in a discharged condition.

1. Remove battery from motorcycle and place battery on a level surface.

⚠CAUTION

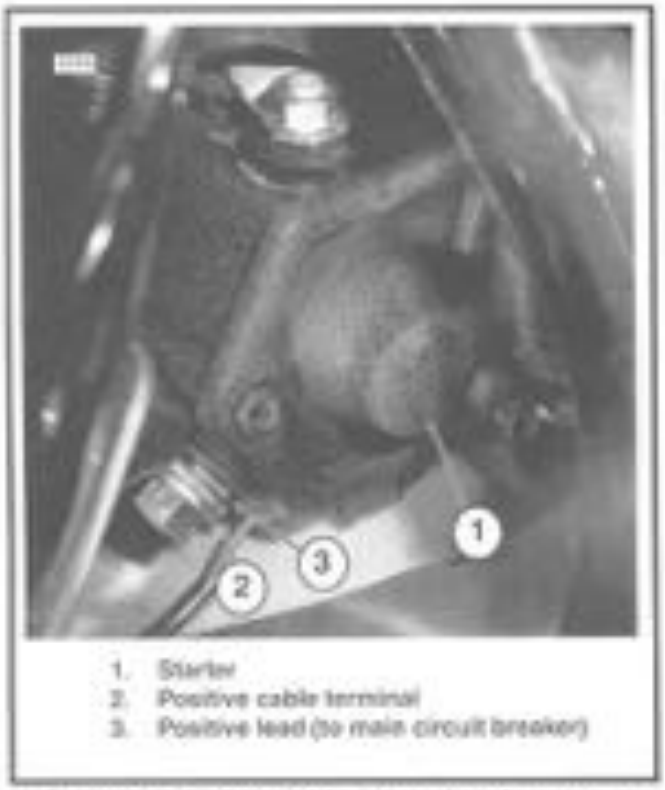
Refer to the charging instructions on the top of the battery. Do not reverse the charger connections described in the next step, or the charging system of the motorcycle could be damaged.

2. Connect the red battery charger lead to the positive terminal of the battery and the black charger lead to the negative terminal. With a constant current charger, charge for the recommended times shown below. Tapered-rate chargers or trickle chargers will require longer charge times.

State of Charge	Voltage	Charge Period (using a constant current charger @ 1.8 amps)
100%	13.8 V	NONE
75%	12.8 V	3-5 hours
50%	12.5 V	4-7 hours
25%	12.2 V	10 hours

3. If battery gets hot, over 110°F (44°C) (warm to the touch), discontinue charging and let battery cool down.

3. Tighten starter post nut (positive battery cable) to 60-85 **in-lbs** (7-10 Nm) torque. Bias negative battery cable toward center of vehicle (to compensate for opposite torque reaction) and tighten bolt on rear engine mount bolt to 25-30 ft-lbs (34-41 Nm) torque.
4. Install screws, flat washers and lockwashers to secure rear brake line clamps to left rear fork and frame down-tube. Tighten clamp screws to 15-21 **in-lbs** (1.7-2.4 Nm) torque.
5. Install battery onto battery tray. Install battery cables, positive cable first. See BATTERY, INSTALLATION AND CONNECTION in this section.
6. Install seat. See SEAT, INSTALLATION in Section 2.



1. Starter
2. Positive cable terminal
3. Positive lead (to main circuit breaker)

Figure 7-55. Positive Cable Starter Post Connection (Right Side View)

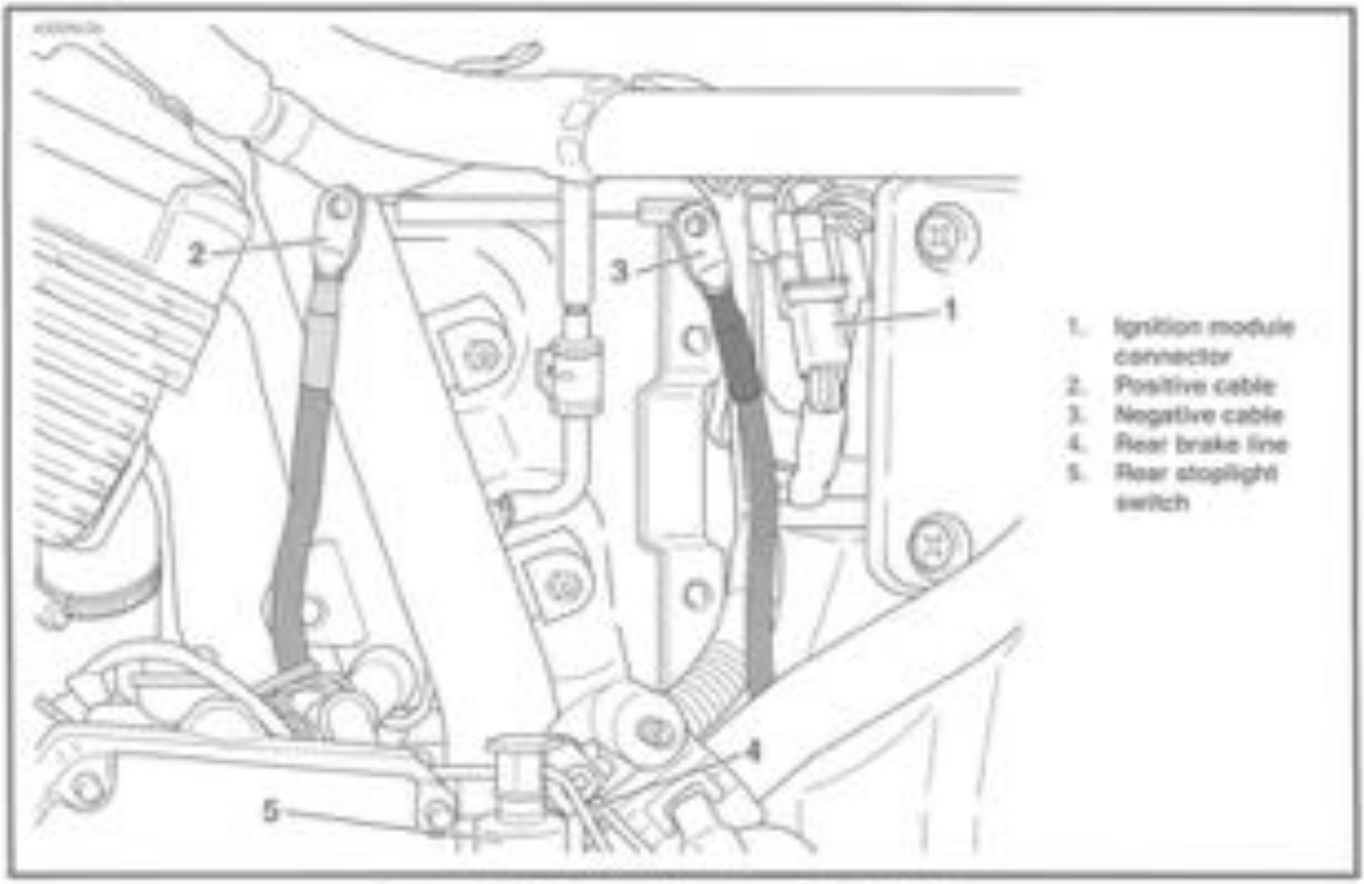


Figure 7-56. Battery cable routing (Left Side View)

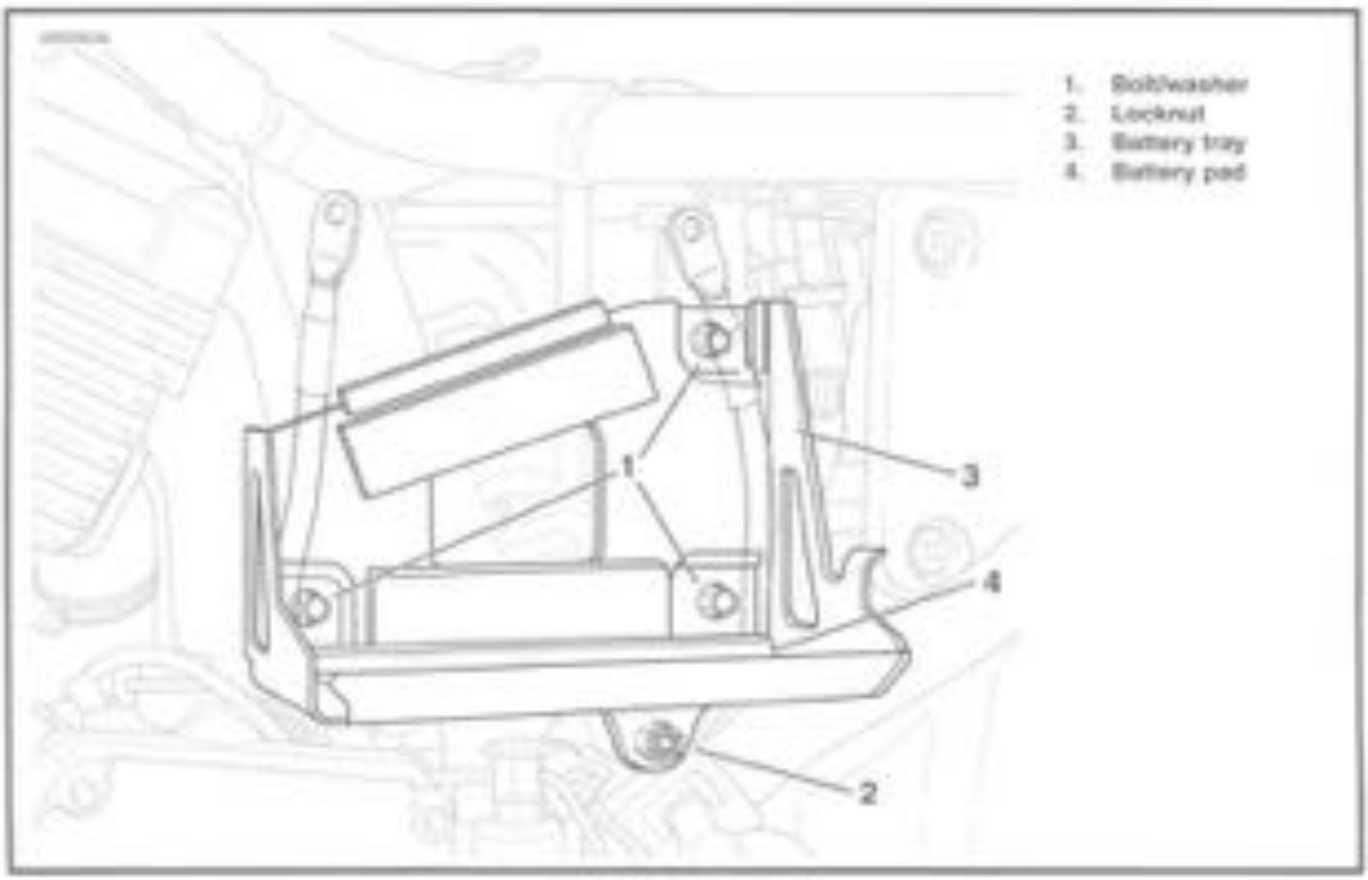


Figure 7-57 Battery tray

GENERAL

The headlamp is a replaceable bulb (element) type. When bulb replacement is required, use only the specified "H4" halogen bulb (Part No. 67697-81).

The high beam, oil pressure, neutral, and turn signal indicator lamps do not have replaceable bulbs; the entire unit must be replaced if faulty.

The speedometer has two illumination lamps; the tachometer has one. See SPEEDOMETER AND TACHOMETER, REMOVAL/INSTALLATION in Section 2 for bulb replacement instructions.

Domestic front directional/running lamps have double-filament bulbs. HDI front directional and all rear directional lamps have single-filament bulbs.

The tail lamp uses a double-filament bulb.

ADJUSTMENT

Headlamp (Figure 7-58)

⚠WARNING

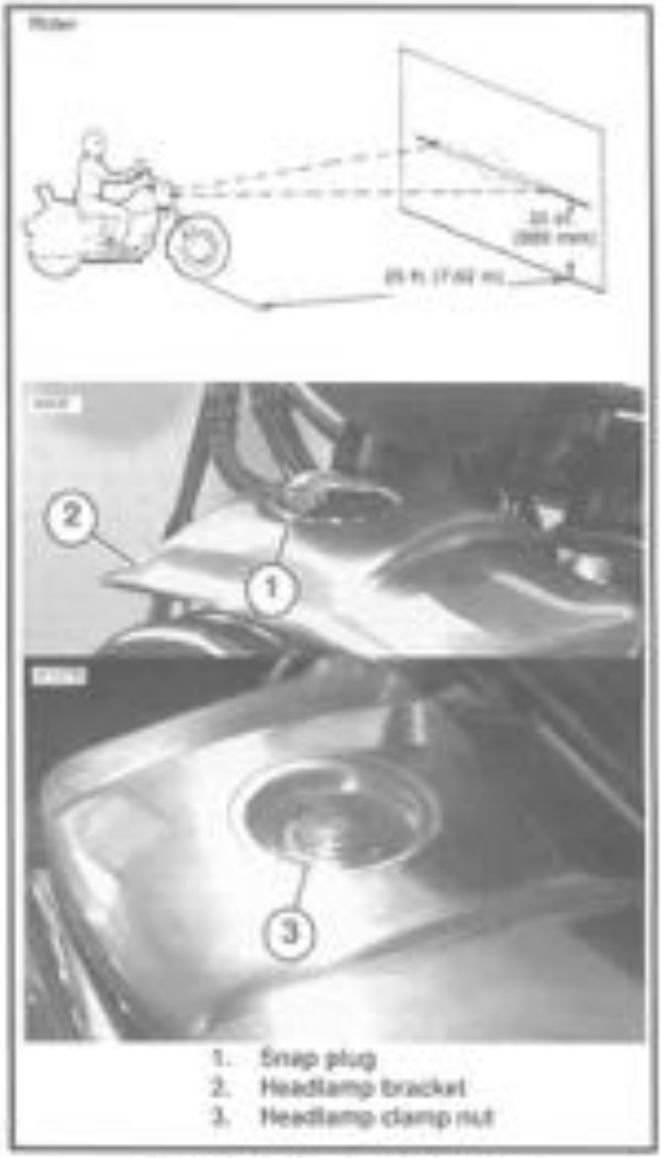
Do not modify ignition wiring to permit motorcycle operation with headlamp off. Operation without headlamp reduces your visibility to other motorists and may lead to an accident.

Check headlamp beam for proper height and lateral alignment. Proceed as follows:

1. Verify correct front and rear tire inflation pressure.
2. Place motorcycle on level floor (or pavement) in an area with minimum light.
3. Point front of motorcycle toward a screen or wall which is 25 ft (7.62 m) away from front tire contact patch on floor (i.e. directly below front axle).
4. Draw a horizontal line, on screen or wall, which is 35 in (889 mm) above floor.
5. Have a person, whose weight is roughly the same as that of the principal rider, sit on motorcycle seat. Weight of rider will compress vehicle suspension slightly.
6. Stand motorcycle upright with both tires resting on floor and with front wheel held in straight alignment (directly forward).
7. Turn ignition/light switch to "IGNITION" position. Set handlebar switch to high beam position.
8. Check light beam for proper height alignment. Main beam of light (broad, flat pattern of light) should be centered on horizontal line of screen or wall (i.e. equal area of light above and below line).
9. Check light beam for proper lateral alignment. Main beam of light should be directed straight ahead (i.e. equal area of light to right and left of center).

   Adjust headlamp alignment, if necessary.

1. Remove snap plug (1) on top of headlamp bracket (2). Loosen headlamp clamp nut (3).
2. 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.
3. Tighten headlamp clamp nut to 10-20 ft-lbs (14-27 Nm) torque after lamp is properly positioned. Install snap plug in headlamp bracket.



1. Snap plug
2. Headlamp bracket
3. Headlamp clamp nut

Figure 7-58. Headlamp Alignment

REMOVAL/INSTALLATION

Headlamp and Bulb (Element)

1. See Figure 7-59. Remove screw (1) and outer molding ring (2). Pry headlamp assembly (4) from rubber mounting.
2. See Figure 7-60. Firmly depress lock release tabs (3) on left and right sides of locking connector (2). While holding both lock release tabs down, carefully pull connector from headlamp (1) terminals.
3. Remove rubber boot (4) from back of headlamp assembly (1).
4. See Figure 7-61. Depress ends (3) of retaining clip (4) to unhook them from slots in headlamp assembly (1).

⚠CAUTION

Do not touch glass bulb portion of headlamp bulb with bare hands. Oil from your skin deposited on the bulb will create temperature variances in the glass during normal lamp operation; this can cause the bulb to fracture. When removing or installing any halogen bulb, touch only the terminal side or metal base of the bulb. Keep glass bulb clean and free of any foreign material.

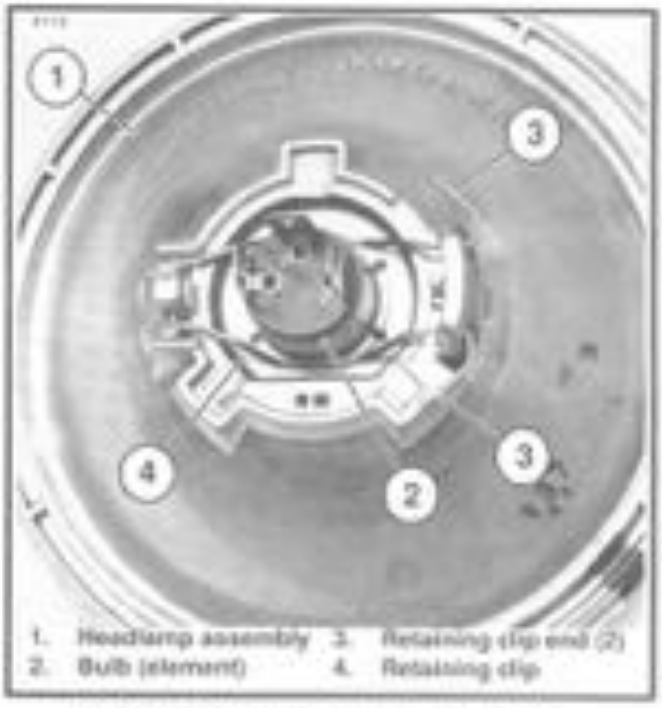
5. Pivot wire retaining clip (4) away from bulb (2). Remove bulb from headlamp assembly (1).
6. See Figure 7-37. Installation is the reverse order of removal. When installing rubber boot (4), position vent/drain holes (5) to the bottom. Be sure headlamp and connector block terminals are clean to ensure a good electrical contact.
7. After final assembly, align headlamp as described under LAMPS, ADJUSTMENT, HEADLAMP in this section.

1. Screw
2. Molding ring
3. Headlamp bracket
4. Headlamp assembly

Figure 7-59. Headlamp Assembly

1. Headlamp assembly
2. Locking connector
3. Lock release tab (2)
4. Rubber boot
5. Vent/drain hole

Figure 7-60. Headlamp Locking Wiring Harness Connector



1. Headlamp assembly
2. Bulb (element)
3. Retaining clip end (2)
4. Retaining clip

Figure 7-61. Replaceable Headlamp Bulb

Indicator Lamp socket

Replace indicator assemblies as follows:

1. Remove two bolts with lockwashers to remove headlamp bracket (with attached headlamp assembly) from upper stem bracket.
2. See Figure 7-62. On XL Custom remove top and bottom pair of screws from the rear of the riser cover. See Figure 7-64 and 7-65. Remove front of riser cover to expose electrical bracket. Slide electrical bracket off center screws. Indicator lamp socket is on backside of bracket.

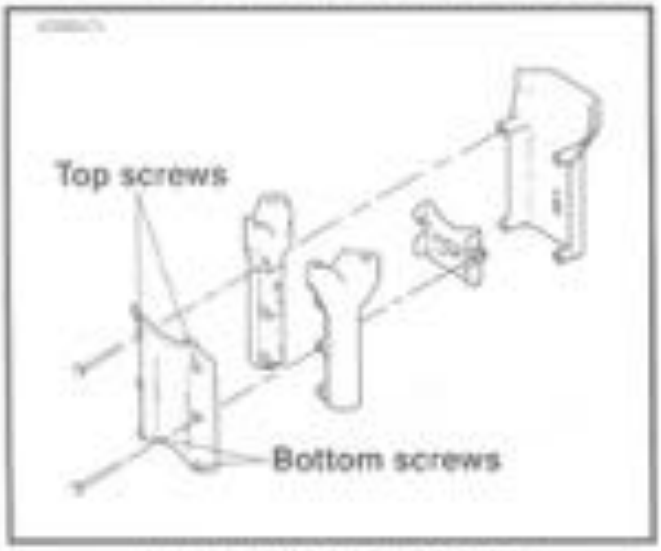


Figure 7-62. XL Custom riser cover

3. Locate the black 14-pin Multilock connector located between the headlamp bracket and element housing. Depress the button and separate pin and socket halves.
4. Open the secondary lock from the socket side (plug end of connector). See AMP MULTILOCK ELECTRICAL CONNECTORS in this section.
5. Gently depress terminal latches inside socket housing and back out all sockets through holes in rear wire seal.
6. Cut cable strap on wire bundle leading to Multilock connector and remove conduit.
7. Use a rocking motion while pulling on indicator lamp to remove indicator lamp from housing.
8. See Figure 7-63. Cut wire from bulb assembly approximately 1-1/2 inches before the splices (this leaves the splice as well as the other bulb connections intact). The neutral and oil lamps lead to a 3-wire splice on 883 and Custom, 4-wire on 1200S. The turn signal and high beam lamps lead to the 4-wire splice.
9. Push on bulb socket to move bulb assembly out through the front of indicator lamp housing. Discard.
10. Trim wires of replacement bulb assembly to proper lengths. Install new Multilock socket terminal to lead of replacement bulb assembly. The correct lead can be identified by the colored tape. If necessary, see AMP MULTILOCK ELECTRICAL CONNECTORS, CRIMPING INSTRUCTIONS in this section.

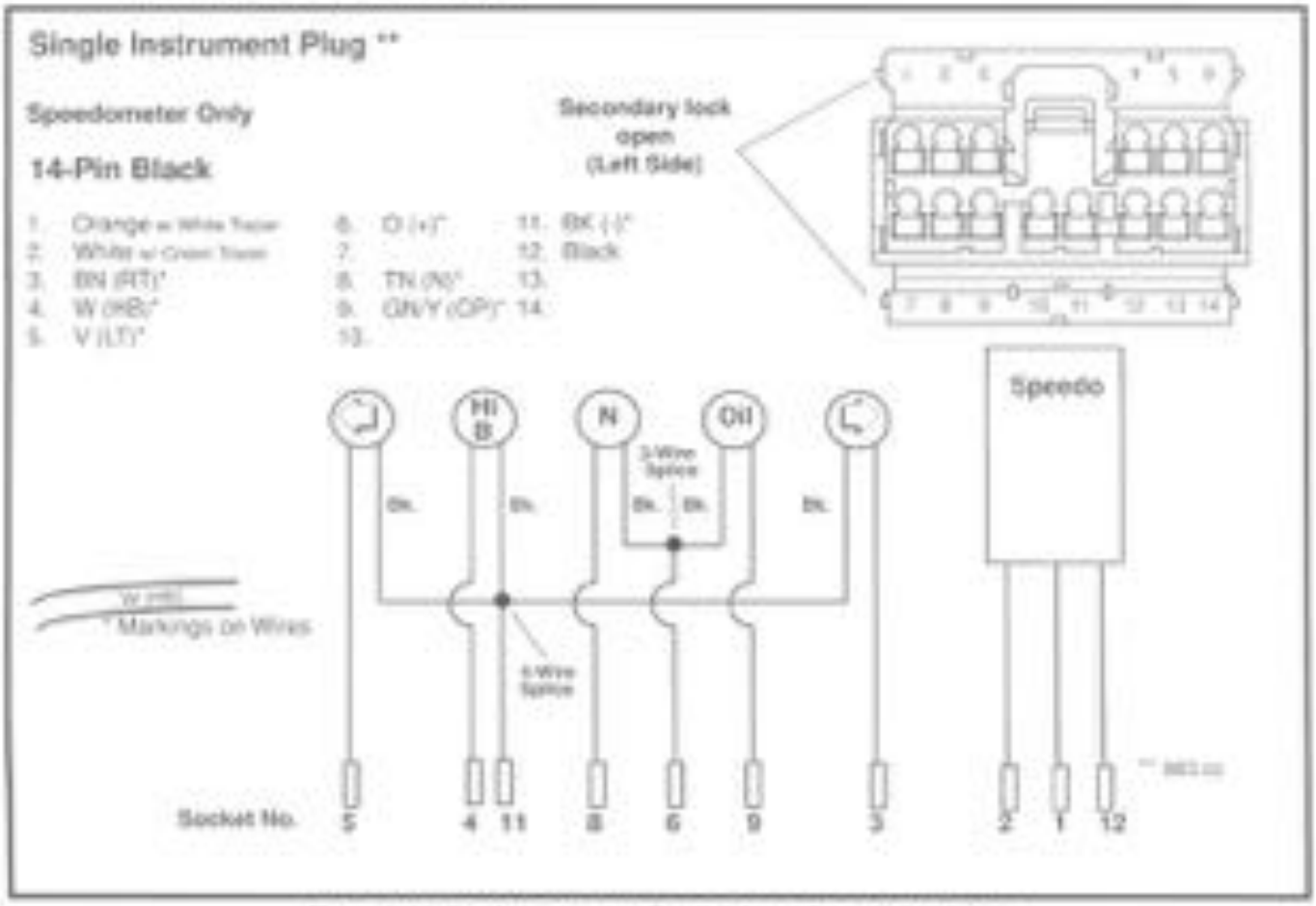


Figure 7-63. Single Instrument Plug- Schematic and Wire Colors

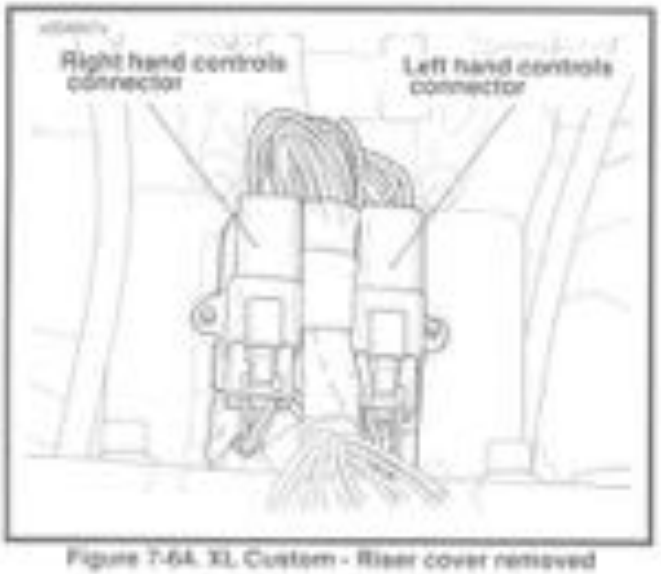


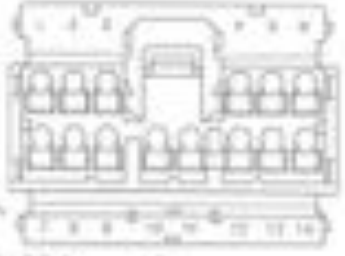
Figure 7-64. XL Custom - Riser cover removed

Figure 7-65. XL Custom - Electrical bracket removed

Dual Instrument Plug **

Speedometer and Tachometer

14-Pin Black



1.	Orange w/ White Tracer	5.	V (LT)*	9.	GN/Y (OP)*	13.	
2.	White w/ Green Tracer	6.	O (+)*	10.		14.	BK/Y***
3.	BN (RT)*	7.	Pink	11.	BK (-)*		
4.	W (HB)*	8.	TN (N)*	12.	Black		

* Markings on Wires

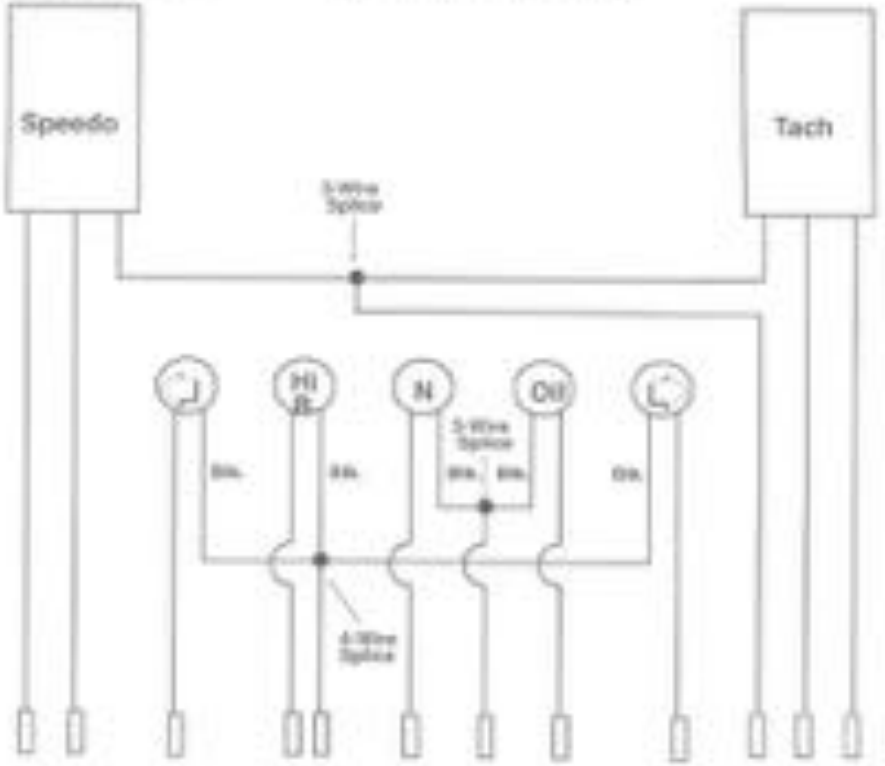
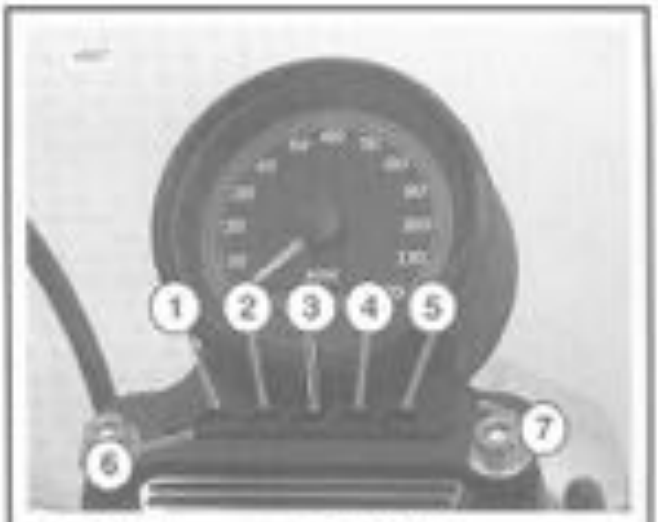


Figure 7-66. Dual Instrument Plug- Schematic and Wire Colors

11. Socket end first, insert replacement bulb back into housing.
12. Install butt connector to remaining wire (black, untaped) of replacement bulb assembly. Complete butt splice to 1-1/2 inch lead remaining from old bulb assembly. See SEALED BUTT CONNECTORS in this section.
13. Slide conduit over butt splices and wire crimps. Install **new** cable strap to secure conduit to wire bundle.
14. Fit rear wire seal into back of socket housing, if removed. Grasp sockets approximately 1 inch (25.4 mm) behind contact barrel. Push sockets into their respective chambers. For correct wire color locations, see Figure 7-63 (no tachometer) or Figure 7-66 (tachometer). Feed each socket into chamber until it "clicks" in place. Verify that socket will not back out of chamber; a slight tug on the wire will confirm that it is locked in place.
15. Push on secondary lock of socket housing and press down until it snaps in place.
16. Align the tabs on the socket housing with the grooves on the pin housing. Push the connector halves together until the latch "clicks".
17. Position Multilock connector beneath bracket at back of headlamp assembly (inside rear cover on XL 1200C).
18. Align holes in headlamp bracket with holes in upper stem bracket. Install two bolts with lockwashers. Tighten bolts to 16-16 ft-lbs (14-22 Nm) torque. On XL 1200C, install rear covers.



1. Left turn
2. High beam
3. Neutral
4. Oil pressure
5. Right turn
6. Trim cover
7. Instrument bracket

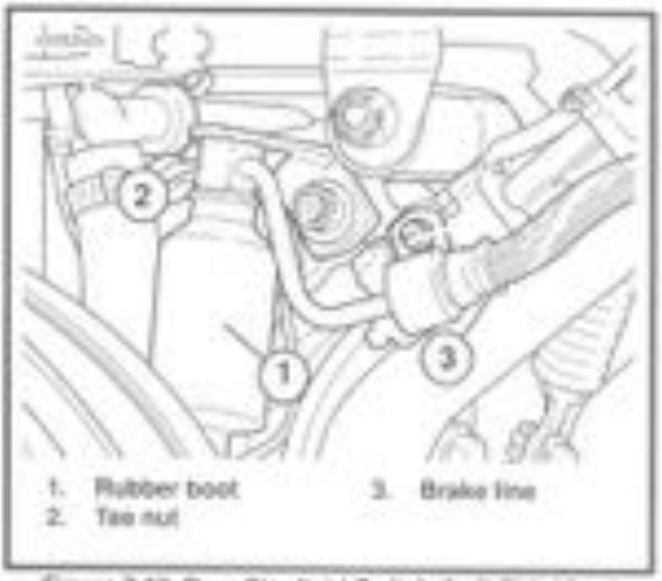
Figure 7-67. Indicator Lamp Assembly

REAR BRAKE SWITCH

The rear stoplight switch is threaded into a tee in the rear brake line. A protective rubber boot keeps out dust and dirt.

The stoplight switch is an open type switch which closes with hydraulic pressure. The individual parts of the switch are not serviceable, so the unit must be replaced if it fails.

1. Pull terminal sockets from spade connections at bottom of stoplight switch.
2. Stretch rubber boot (1) to remove from switch body. Unthread switch from tee nut (2) on rear brake line (3).
3. Thread **new** stoplight switch to tee nut (2) on brake line (3). Tighten switch assembly to 7-10 ft-lbs (9-14 Nm) torque.
4. Install boot (1) on stoplight switch.
5. Install terminal sockets on switch spade connections.
6. Refill master cylinder and bleed brakes. See BLEEDING HYDRAULIC SYSTEM. Test operation of rear brake.
7. Test operation of brake lamp with the rear brake applied and the ignition/light switch turned ON.



1. Rubber boot
2. Tee nut
3. Brake line

Figure 7-68. Rear Stoplight Switch (Left Side View)

HANDLEBAR SWITCHES

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.

NOTE

To replace or repair individual switches in either the right or left handlebar switch assemblies, see SWITCH REPAIR/REPLACEMENT following the REMOVAL/INSTALLATION procedures.

The following removal and installation steps apply when replacing the entire switch assembly, switch housing, or handlebars.

REMOVAL

Right Handlebar Controls

⚠CAUTION

Do not remove the switch housing assembly without first placing a 5/32 inch cardboard insert between the brake lever and lever bracket. Removing the assembly without the insert in place may result in damage to the rubber boot and plunger of the front stoplight switch.

1. See Figure 7-69. Place the cardboard insert between the brake lever and lever bracket.

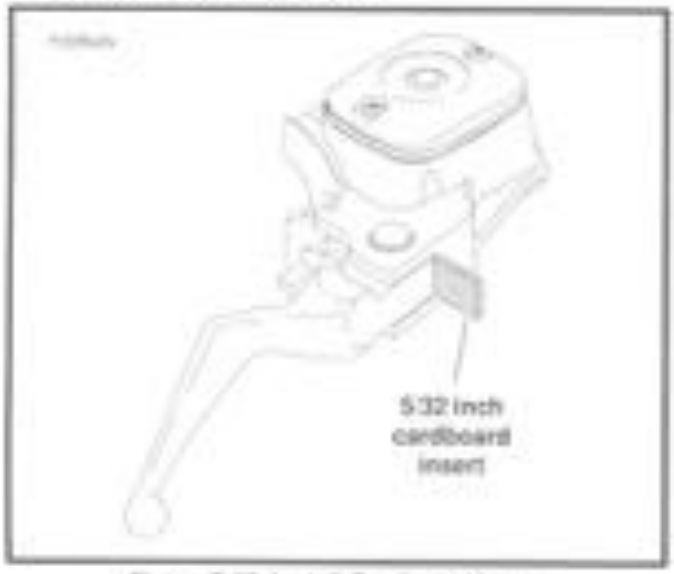


Figure 7-69. Install Cardboard Insert

2. Using a T27 TORX drive head, remove the two screws with flat washers securing the handlebar clamp to the master cylinder housing. Remove the brake lever/master cylinder assembly and clamp from the handlebar.
3. Using a T25 TORX drive head, remove the upper and lower switch housing screws.
4. Remove the friction shoe from the end of the tension adjuster screw.

NOTE

The friction screw is a loose fit and may fall out or become dislodged if the lower switch housing is turned upside down or shaken.

5. Remove the brass ferrules from the notches on the inboard side of the throttle control grip. Remove the ferrules from the cable end fittings.
6. Remove the throttle control grip from the end of the handlebar.
7. Pull the crimped inserts at the end of the throttle and idle control cable housings from the lower switch housing. For best results, use a rocking motion while pulling. Place a drop of light oil on the retaining rings, if necessary. Remove the cables from the switch housing.

Left Handlebar Controls

1. Using a T27 TORX drive head, remove the two screws with flat washers securing the handlebar clamp to the clutch lever bracket. Remove the clutch hand lever assembly and clamp from the handlebar.
2. Using a T25 TORX drive head, remove the upper and lower switch housing screws.
3. Remove the grip sleeve from the end of the handlebar if damaged.

INSTALLATION

Right Handlebar Controls

1. With the concave side facing upward, install the friction shoe so that the pin hole is over the point of the adjuster screw.

NOTE

The friction screw is a loose fit and may fall out or become dislodged if the lower switch housing is turned upside down or shaken.

2. Push the throttle and idle control cables into the lower switch housing until they snap in place. Proceed as follows:

   Note the different diameter inserts crimped into the end of the throttle and idle cable housings. See Figure 7-70.

   Push the larger diameter insert (silver colored, 5/16 inch; 7.9 mm) of the throttle cable housing into the larger hole in front of the tension adjuster screw.

   Push the smaller diameter insert (gold colored,1/4 inch; 6.3 mm) of the idle cable housing into the smaller hole at the rear of the tension adjuster screw.

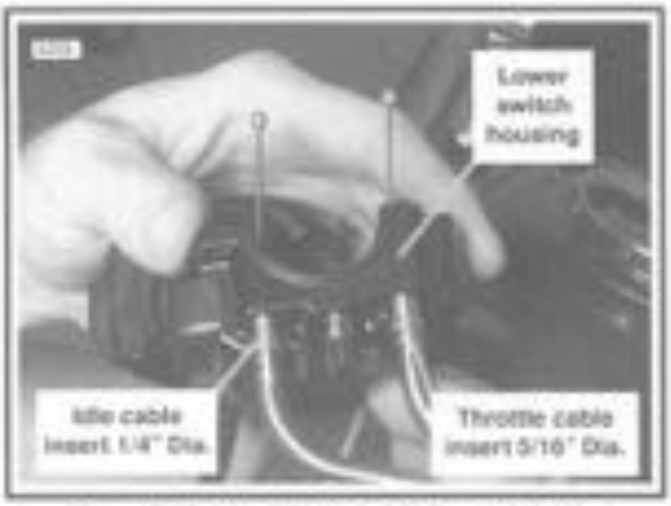


Figure 7-70. Install Throttle/Idle Control Cables In Lower Switch Housing

NOTE:

To aid assembly, place a drop of light oil on the retaining rings of the crimped inserts. Always replace the retaining rings if damaged or distorted.

3. See Figure 7-71. Route the cable to the upper switch housing as shown.

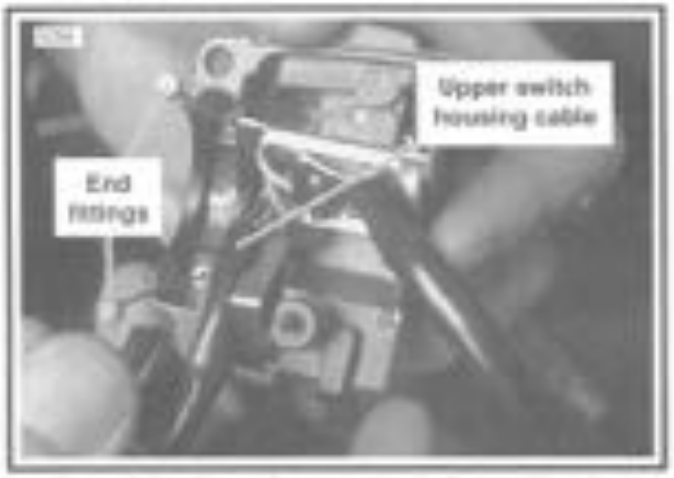


Figure 7-71. Route Cable to Upper Switch Housing

4. Slide the throttle control grip over the end of the right handlebar until it bottoms against the closed end. Rotate the grip so that the ferrule notches are at the top. To prevent binding, pull the grip back about 1/8 inch (3.2 mm).

5. See Figure 7-72. Position the lower switch housing beneath the throttle control grip. Install the brass ferrules onto the cable so that the end fittings seat in the ferrule recess. Seat the ferrules in their respective notches on the throttle control grip. Verify that the cables are captured in the grooves molded into the grip.

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.

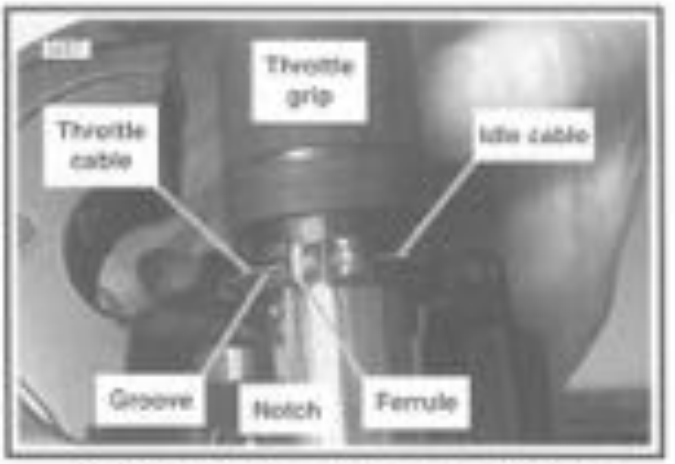


Figure 7-72. Install Throttle Idle Control Cables on Throttle Control Grip

8. Start the upper and lower switch housing screws, but do not tighten.

CAUTION

See Figure 7-73. Do not remove the 5/32 inch cardboard insert wedged between the brake lever and lever bracket. Removal will result in damage to the rubber boot and plunger of the front stoplight switch during installation of the master cylinder assembly.

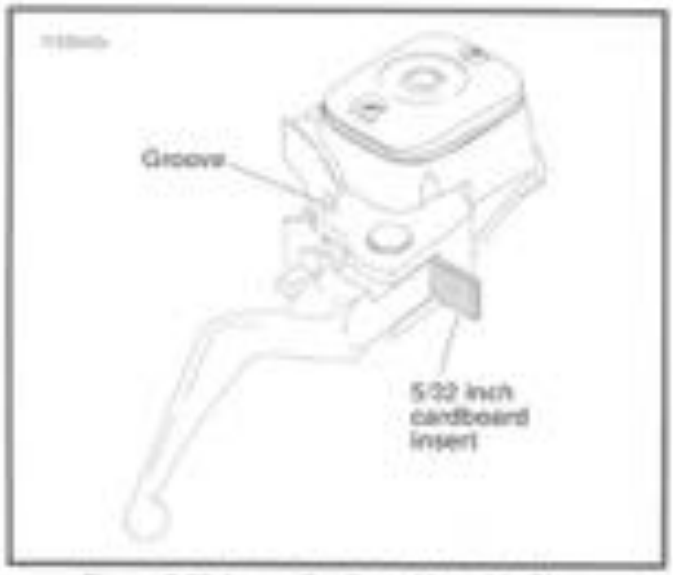


Figure 7-73. Leave Cardboard Insert in Place

9. See Figure 7-74. Position the brake lever/master cylinder assembly inboard of the switch housing assembly, engaging the tab on the lower switch housing in the groove at the top of the brake lever bracket.

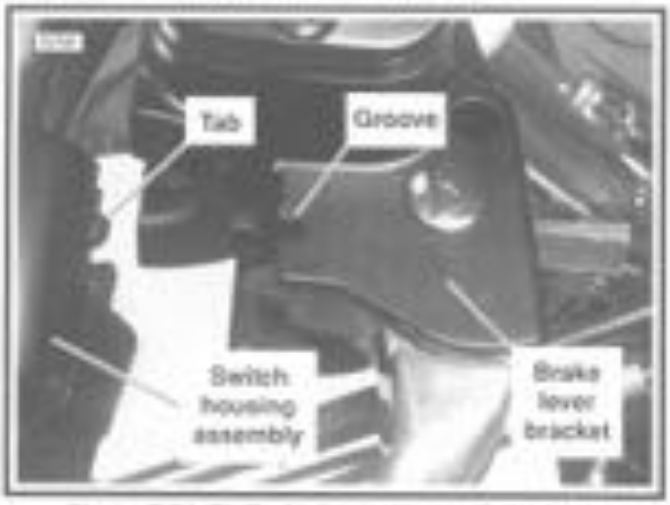


Figure 7-74. Fit Brake Lever/Master Cylinder to Right Handlebar Switch Housings

10. Align the holes in the handlebar clamp with those in the master cylinder housing and start the two screws (with flat washers). Position for rider comfort. Beginning with the top screw, tighten the screws to 60-80 **in-lbs** (6.8-9.0 Nm) using a T27 TORX drive head.

11. Using a T25 TORX drive head, tighten the lower and upper switch housing screws to 35-45 **in-lbs** (3.4-4.5 Nm).

NOTE

Always tighten the lower switch housing screw first so that any gap between the upper and lower housings is at the front of the switch.

12. Remove the cardboard insert between the brake lever and lever bracket.

13. Test the switches for proper operation.

14. If necessary, secure wire harness conduit to handlebar using **new** cable strap. Position cable strap approximately 4-5 inches from handlebar clamp. Cut any excess cable strap material.

Left Handlebar Controls

1. If the grip sleeve was removed, thoroughly clean handlebar to remove all adhesive residue.

   a. Using a piece of emery cloth, rough grip end of left side of handlebar.

NOTE

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

   b. Apply LOCTITE PRISM PRIMER (770) to inside of handgrip. Remove any excess PRISM PRIMER. Wait two minutes for PRISM PRIMER to set before beginning the next step.

   c. Apply LOCTITE PRISM SUPERBONDER (411) to inside of handgrip. Place new handgrip on left buckhorn handlebar.

NOTE

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

   Roll grip to evenly distribute adhesive on inside surfaces. Install grip on handlebar with a twisting motion.

2. See Figure 7-75. Install upper and lower switch housings on handlebar. Be sure that ribs on outboard side of switch housings fit in grooves molded into grip.

Figure 7-75. Install Left Handlebar Switch Housings

⚠CAUTION

See Figure 7-73. Do not remove the 5/32 inch cardboard insert wedged between the brake lever and lever bracket. Removal will result in damage to the rubber boot and plunger of the front stoplight switch during installation of the master cylinder assembly.

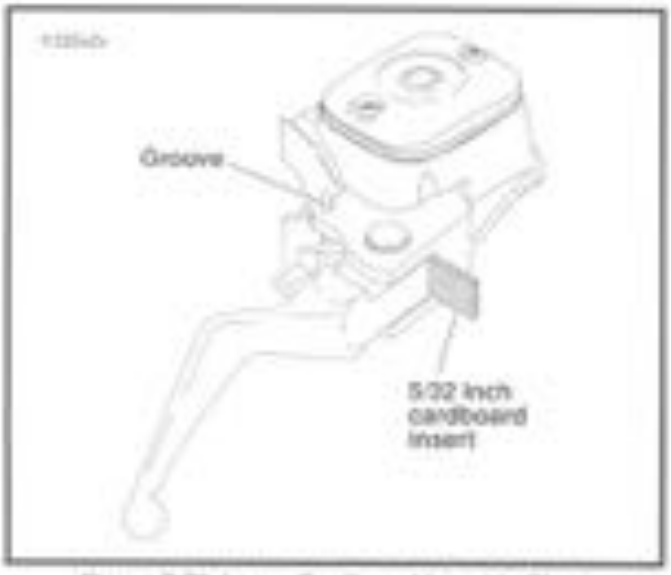


Figure 7-73. Leave Cardboard Insert in Place

8. See Figure 7-74. Position the brake lever/master cylinder assembly inboard of the switch housing assembly, engaging the tab on the lower switch housing in the groove at the top of the brake lever bracket.

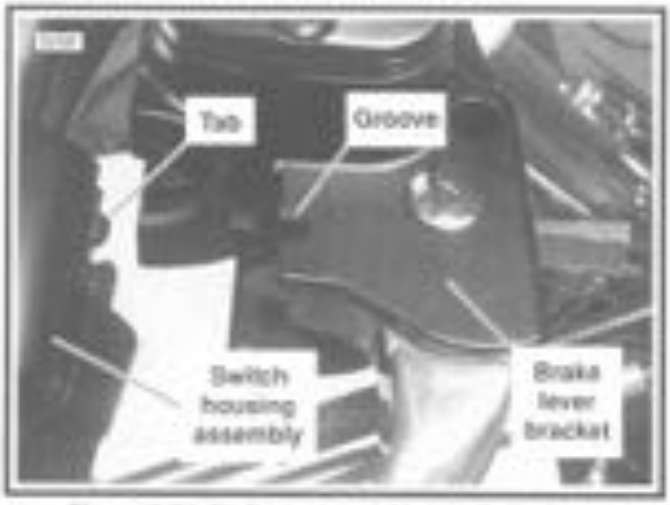


Figure 7-74. Fit Brake Lever/Master Cylinder to Right Handlebar Switch Housings

10. Align the holes in the handlebar clamp with those in the master cylinder housing and start the two screws (with flat washers). Position for rider comfort. Beginning with the top screw, tighten the screws to 60-80 **in-lbs** (6.8-9.0 Nm) using a T27 TORX drive head.

11. Using a T25 TORX drive head, tighten the lower and upper switch housing screws to 35-45 **in-lbs** (3.4-4.5 Nm).

NOTE

Always tighten the lower switch housing screw first so that any gap between the upper and lower housings is at the front of the switch.

12. Remove the cardboard insert between the brake lever and lever bracket.

13. Test the switches for proper operation.

14. If necessary, secure wire harness conduit to handlebar using **new** cable strap. Position cable strap approximately 4-5 inches from handlebar clamp. Cut any excess cable strap material.

Left Handlebar Controls

1. If the grip sleeve was removed, thoroughly clean handlebar to remove all adhesive residue.

   a. Using a piece of emery cloth, rough grip end of left side of handlebar.

NOTE

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

   b. Apply LOCTITE PRISM PRIMER (770) to inside of handgrip. Remove any excess PRISM PRIMER. Wait two minutes for PRISM PRIMER to set before beginning the next step.

   c. Apply LOCTITE PRISM SUPERBONDER (411) to inside of handgrip. Place new handgrip on left buckhorn handlebar.

NOTE

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

   Roll grip to evenly distribute adhesive on inside surfaces. Install grip on handlebar with a twisting motion.

2. See Figure 7-75. Install upper and lower switch housings on handlebar. Be sure that ribs on outboard side of switch housings fit in grooves molded into grip.

Figure 7-75. Install Left Handlebar Switch Housings

3. Verify that the wire harness conduit runs in the groove at the bottom of the handlebar. Be sure that the upper switch housing harness will not be pinched under the handlebar when the switch housing screws are tightened.
4. Start the upper and lower switch housing screws, but do not Tighten.
5. See Figure 7-76. Position the clutch hand lever assembly inboard of the switch housing assembly, engaging the tab on the lower switch housing in the groove at the bottom of the clutch lever bracket.

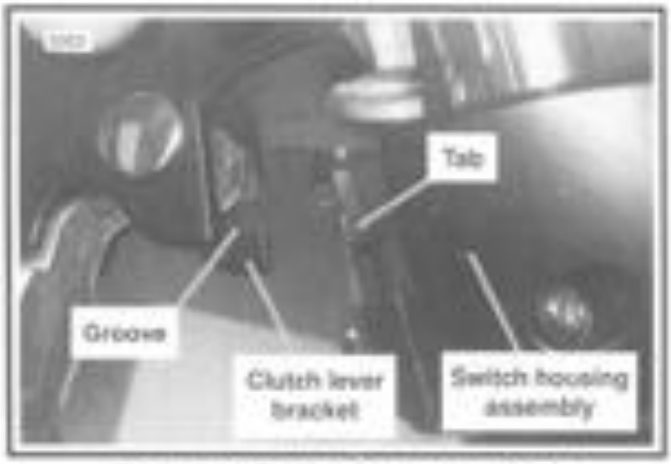


Figure 7-76. Fit Clutch Lever Bracket to Left Handlebar Switch Housings

6. Align the holes in the handlebar clamp with those in the clutch lever bracket and start the two screws (with flat washers). Position for rider comfort. Beginning with the top screw, tighten the screws to 60-80 **in-lbs** (6.8-9.0 Nm) using a T27 TORX drive head.
7. Using a T25 TORX drive head, tighten the lower and upper switch housing screws to 35-45 **in-lbs** (3.4-4.5 Nm).

NOTE

Always tighten the lower switch housing screw first so that any gap between the upper and lower housings is at the front of the switch.

8. Test the switches for proper operation.
9. If necessary, secure wire harness conduit to handlebar using **new** cable strap. Position cable strap approximately 4-5 inches from handlebar clamp. Cut any excess cable strap material.

SWITCH REPAIR/REPLACEMENT

Right Handlebar Switches–Disassembly

⚠CAUTION

See Figure 7-76. Do not remove the switch housing assembly without first placing a 5/32 inch cardboard insert between the brake lever and lever bracket. Removing the assembly without the insert in place may result in damage to the rubber boot and plunger of the front stoplight switch.

1. Place the cardboard insert between the brake lever and lever bracket.
2. Using a T25 TORX drive head, remove the upper and lower switch housing screws.
3. If replacing lower housing switches, perform steps 4 through 7 before continuing to repair section. If replacing upper housing switches, proceed directly to repair section.
4. Using a T27 TORX drive head, loosen the upper screw securing the handlebar clamp to the master cylinder housing. Remove the lower clamp screw with flat washer.
5. Remove the brass ferrules from the notches on the inboard side of the throttle control grip. Remove the ferrules from the cable end fittings.
6. Remove the friction shoe from the end of the tension adjuster screw.

NOTE

The friction shoe is a loose fit and may fall out or become dislodged if the lower switch housing is turned upside down or shaken.

7. Remove the throttle control grip from the end of the handlebar.

Right Handlebar Upper Switch Housing Repair

NOTE

Replace the engine stop and engine start switches as a single assembly even if only one switch is determined to be faulty.

1. See Figure 7-77. From inside the switch housing, remove the Phillips screw with lockwasher to release the bracket. Remove the bracket and switch assembly from the housing.

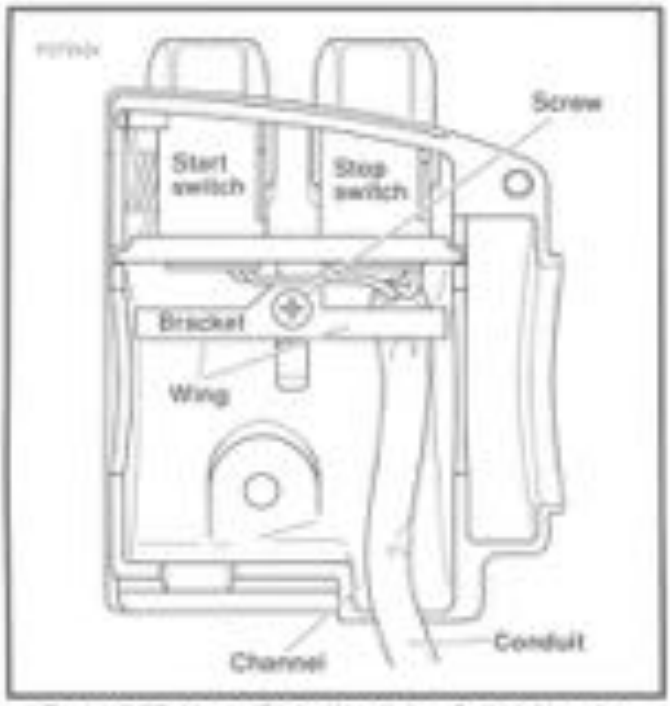


Figure 7-77. Upper Right Handlebar Switch Housing (Without Splices)

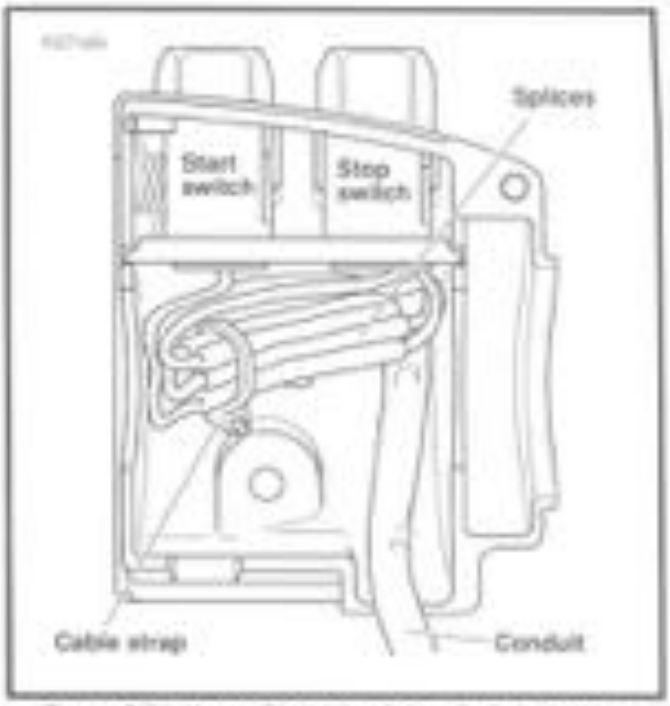


Figure 7-78. Upper Right Handlebar Switch Housing (With Splices)

2. Move cable conduit from beneath wing of bracket. Cut wires 1/4 inch from old switches. Discard old switch and bracket assembly.

3. Slide conduit forward over cut ends of switch wires and cut off 1/2 inch of conduit material. Push conduit back to access switch wires.

4. Separate **new** engine stop switch and engine start switch wires into two bundles.

NOTE

Replacement stop switch and start switch wires are cut to length (2-1/2 inches and 2 inches, respectively) and partially stripped.

5. See the last part of switch repair/replacement, GENERAL REPAIR PROCEDURES for information on repair practices.

6. Loop switch wires so that spliced lengths are positioned as shown in Figure 7-78. Route wires downstream of splices beneath wing on engine stop switch side of bracket as seen in Figure 7-76.

7. Install a **new** 7 inch cable strap beneath wing on engine start switch side of bracket and capture wire splices.

8. Place switch assembly into upper housing aligning hole in bracket with threaded hole in boss. Be sure that bracket is fully seated. The step at the edge of the boss captures the bottom edge of the bracket, while tabs on each side of the bracket fit in slots cast into the housing.

9. Install Phillips screw (with lockwasher) to secure bracket inside housing. Verify that wing on engine stop switch side of bracket captures edge of conduit as shown in Figure 7-77.

10. Securely tighten cable strap to draw splices to bracket. Remove any excess cable strap material.

11. See RIGHT HANDLEBAR SWITCHES–ASSEMBLY.

Right Handlebar Lower Switch Housing Repair

1. From inside the switch housing, carefully cut cable strap to free conduit from the turn signal switch bracket.

2. Remove the Phillips screw with lockwasher to release the turn signal switch bracket. Remove the bracket and switch assembly from the housing.

TURN-RIGHT SIGNAL SWITCH

1. Cut wire 1-1/2 inches from old switch. Discard old switch assembly.

NOTE

Replacement turn right signal switch wires are cut to length (1-1/2 inches) and partially stripped.

2. See the last part of switch repair/replacement, GENERAL REPAIR PROCEDURES for information on repair practices.

3. See RIGHT HANDLEBAR SWITCHES–ASSEMBLY.

FRONT STOPLIGHT SWITCH

1. Carefully remove the wedge between the switch and switch housing, if present. To remove the switch from the housing, depress the plunger and slowly rotate switch upward while rocking slightly.

2. Cut wires 1 inch from old switch. Discard old switch.

NOTE

Replacement stoplight switch wires are cut to length (2-1/2 inches) and partially stripped.

3. See the last part of switch repair/replacement, GENERAL REPAIR PROCEDURES for information on repair practices.

4. Carefully depress plunger against inside wall of switch housing. With thumb over plunger bore, move switch into the installed position in the switch housing cavity. When plunger is positioned against thumb, slowly rotate switch downward while rocking slightly. Release the plunger only after switch is properly positioned in the cavity.

5. Verify that the plunger is square in the bore and that the boot is not compressed, collapsed, or torn. If necessary, gently work the plunger in and out until boot is fully extended.

6. See Figure 7-79. Push down on switch so that it bottoms against housing and wires run in groove at base of cavity. With the concave side facing outward, insert wedge between switch and outboard side of switch housing.

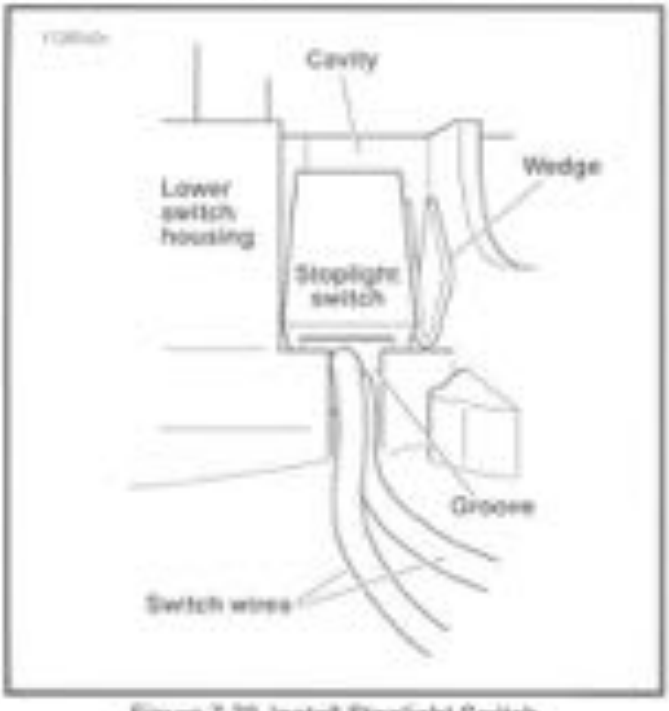


Figure 7-79. Install Stoplight Switch

7. Push wedge down until it also bottoms against housing. Verify that the plunger is still square in the bore and then place a drop of RTV Silicone Sealant on upper corner of wedge.

8. See RIGHT HANDLEBAR SWITCHES–ASSEMBLY.

Right Handlebar Switches–Assembly

1. See Figure 7-80. Insert tapered end of **new** 7 inch cable strap into round hole in turn signal switch bracket and then feed back through using the adjacent hole. Reserve the oblong hole for the bracket screw.

Figure 7-80. Insert Cable Strap in Switch Bracket

NOTE

Be sure that all splices are positioned above the turn signal switch bracket.

2. Place the turn signal switch assembly into the housing, aligning the oblong hole in the bracket with the threaded hole in the boss. Be sure that the bracket is fully seated. Tabs on each side of bracket are captured in slots cast into switch housing.

3. Start Phillips screw (with lockwasher) to secure bracket inside housing.

⚠CAUTION

If routed incorrectly, wires may be pinched by casting or handlebar resulting in switch failure.

4. Loop switch wires so that spliced lengths are positioned as shown.

5. Capturing conduit about 1/4 inch from end, securely tighten cable strap to draw conduit to bracket. Remove any excess cable strap material.

6. Install second 7 inch cable strap capturing conduit and wire splices. Securely tighten cable strap to draw splices to conduit. Remove any excess cable strap material.

7. Tighten Phillips screw to secure bracket inside housing.

8. Route wire bundle to upper switch housing by gently pressing conduit into channel next to angular arm of bracket. Secure bundle to arm using third cable strap. Cut any excess cable strap material. If necessary, bend angular arm of bracket downward to firmly secure front stoplight switch in position.

9. If lower housing switches were replaced, proceed to step 10. If upper housing switches were replaced, proceed to step 17.

10. With the concave side facing upward, install the friction shoe so that the pin hole is over the point of the adjuster screw.

NOTE

The friction shoe is a loose fit and may fall out or become dislodged if the lower switch housing is turned upside down or shaken.

11. Slide the throttle control grip over the end of the right handlebar until it bottoms against the closed end. Rotate the grip so that the ferrule notches are at the top. To prevent binding, pull the grip back about 1/8 inch.

12. Position the lower switch housing beneath the throttle control grip. Install the brass ferrules onto the cables so that the end fittings seat in the ferrule recess. Seat the ferrules in their respective notches on the throttle control grip. Verify that the cables are captured in the grooves molded into the grip.

13. Position the upper switch housing over the handlebar and lower switch housing. Verify that the wire harness conduit runs in the depression at the bottom of the handlebar.

14. Start the upper and lower switch housing screws, but do not tighten.

15. Position the brake lever/master cylinder assembly inboard of the switch housing assembly engaging the tab on the lower switch housing in the groove at the top of the brake lever bracket.

16. Align the holes in the handlebar clamp with those in the master cylinder housing and start the lower screw (with flat washer). Position for rider comfort. Beginning with the top screw, tighten the screws to 60-80 **in-lbs** (6.8-9.0 Nm) using a T27 TORX drive head.

17. Using a T25 TORX drive head, tighten the lower and upper switch housing screws to 35-45 **in-lbs** (3.4-4.5 Nm).

NOTE

Always tighten the lower switch housing screw first so that any gap between the upper and lower housings is at the front of the switch.

18. Remove the cardboard insert between the brake lever and lever bracket.

19. Test the switches for proper operation.

Left Handlebar Switches–Disassembly

1. Using a T25 TORX drive head, remove the upper and lower switch housing screws.

2. If replacing lower housing switches, perform step 3 before continuing to repair section. If replacing upper housing switches, proceed directly to repair section.

3. Using a T27 TORX drive head, loosen the upper screw securing the handlebar clamp to the clutch lever bracket. Remove the lower clamp screw with flat washer.

Left Handlebar Upper Switch Housing Repair

NOTE

Replace the horn switch and high/low beam switch as a single assembly even if only one switch is determined to be faulty.

1. See Figure 7-81. From inside the switch housing, remove the Phillips screw and lockwasher to release the bracket. Remove the bracket and switch assembly from the housing.

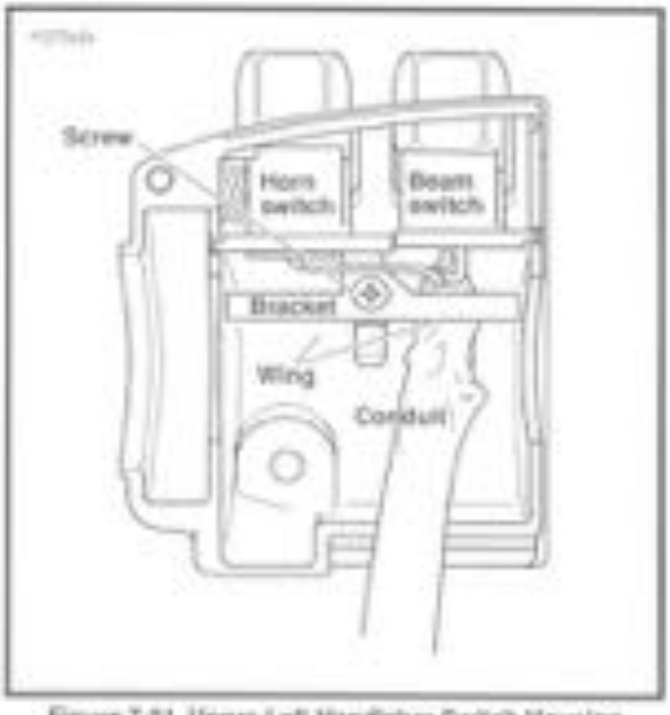


Figure 7-81. Upper Left Handlebar Switch Housing (Without Splices)

2. Move cable conduit from beneath wing of bracket. Cut wires 1/4 inch from old switches. Discard old switch and bracket assembly.
3. Slide conduit forward over cut ends of switch wires and cut off 1/2 inch of conduit material. Push conduit back to access switch wires.
4. Separate new horn switch and high/low beam switch wires into two bundles.

NOTE

Replacement high/low beam switch wires and horn switch wires are cut to length (2-1/2 inches and 2 inches, respectively) and partially stripped.

5. See the last part of switch repair/replacement, GENERAL REPAIR PROCEDURES for information on repair practices.
6. Loop switch wires so that spliced lengths are positioned as shown in Figure 7-82. Route wires downstream of splices beneath wing on high/low beam switch side of bracket as seen in Figure 7-81.

Figure 7-82. Upper Left Handlebar Switch Housing (With Splices)

7. Install a new 7 inch cable strap beneath wing on horn switch side of bracket and capture wire splices.
8. Place switch assembly into upper housing aligning hole in bracket with threaded hole in boss. Be sure that bracket is fully seated. The step at the edge of the boss captures the bottom edge of the bracket, while tabs on each side of the bracket fit in slots cast into the housing.
9. Install Phillips screw (with lockwasher) to secure bracket inside housing. Verify that wing on high/low beam switch side of bracket captures edge of conduit as shown in Figure 7-81.
10. Securely tighten cable strap to draw splices to bracket. Remove any excess cable strap material.
11. See LEFT HANDLEBAR SWITCHES-ASSEMBLY.

Left Handlebar Lower Switch Housing Repair

1. From inside the switch housing, carefully cut cable strap to free conduit from the turn signal switch bracket.
2. Remove the Phillips screw with lockwasher to release the turn signal switch bracket. Remove the bracket and switch assembly from the housing.
3. Cut wires 1-1/2 inches from old switch (Turn-Left) Signal Switch). Discard switch assembly.
4. See the last part of switch repair/replacement, GENERAL REPAIR PROCEDURES for information on repair practices.
5. See LEFT HANDLEBAR SWITCHES-ASSEMBLY.

Left Handlebar Switches–Assembly

1. See Figure 7-83. Insert tapered end of **new** 7 inch cable strap into round hole in turn signal switch bracket and then feed back through using the adjacent hole. Reserve the oblong hole for the bracket screw.

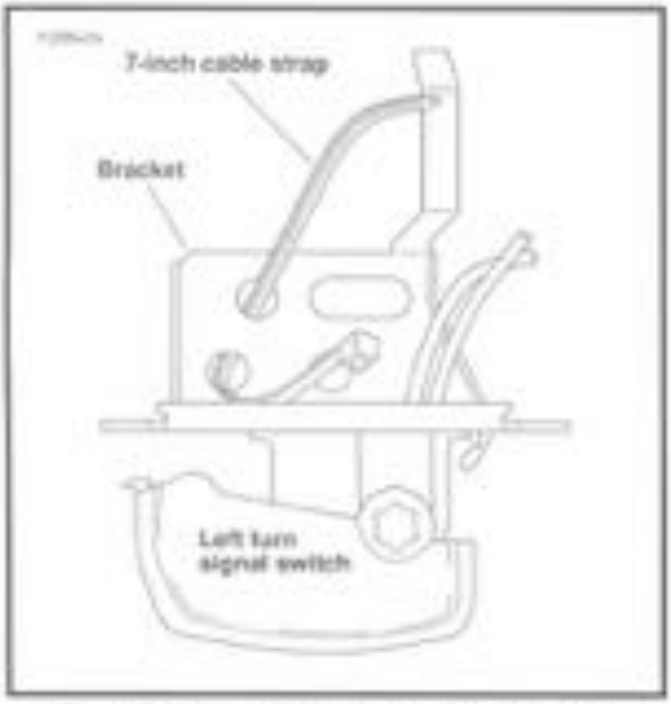


Figure 7-83. Insert Cable Strap in Switch Bracket

NOTE

Be sure that all splices are positioned above the turn signal switch bracket.

2. Place the turn signal switch assembly into the housing, aligning the oblong hole in the bracket with the threaded hole in the boss. Be sure that the bracket is fully seated. Tabs on each side of bracket are captured in slots cast into switch housing.
3. Start Phillips screw (with lockwasher) to secure bracket inside housing.
4. See Figure 7-81. Loop switch wires so that spliced lengths are positioned as shown.
5. Capturing conduit about 1/4 inch from end, securely tighten cable strap to draw conduit to bracket. Remove any excess cable strap material.
6. Tighten Phillips screw to secure bracket inside housing.
7. Route wire bundle to upper switch housing below and then forward of the main wire harness, positioning conduit in channel next to angular arm of bracket. Secure bundle to arm using **new** cable strap. Cut any excess cable strap material.
8. If lower housing switches were replaced, proceed to step 9. If upper housing switches were replaced, proceed to step 13.
9. Install upper and lower switch housing on handlebar. Be sure that ribs on outboard side of switch housings fit in grooves molded into grip. Verify that the wire harness conduit runs in the depression at the bottom of the handlebar.
10. Start the upper and lower switch housing screws, but do not tighten.
11. Position the clutch hand lever assembly inboard of the switch housing assembly, engaging the tab on the lower switch housing in the groove at the bottom of the clutch lever bracket.
12. Align the holes in the handlebar clamp with those in the clutch lever bracket and start the lower screw (with flat washer). Position for rider comfort. Beginning with the top screw, tighten the screws to 60-80 **in-lbs** (6.8-9.0 Nm) using a T27 TORX drive head.
13. Using a T27 TORX drive head, tighten the lower and upper switch housing screws to 35-45 **in-lbs** (3.4-4.5 Nm).

NOTE

Always tighten the lower switch housing screw first so that any gap between the upper and lower housings is at the front of the switch.

14. Test the switches for proper operation.

General Repair Procedures

1. To better access wires and avoid damaging conduit with radiant heating device, push conduit back and secure with extra 7 inch cable strap in kit.
2. Strip 1/2 inch of insulation off switch wires. Twist stripped ends of switch wires until all strands are tightly coiled.
3. Cut dual wall heat-shrink tubing (supplied in kit) into one-inch segments. Slide tubing over each wire of new switch assembly.
4. Splice existing and new switch wires, matching wire colors. Solder the spliced connections. For best results, do one wire at a time.
5. Center the heat shrink tubing over the soldered splices.

⚠WARNING

Use caution when operating the UltraTorch UT-100, or any other radiant heating device. Read the manufacturer's instructions carefully before use. Improper handling can result in personal injury. Always keep hands away from tool tip area and heat shrink attachment. Avoid directing the heat towards any fuel system component. Extreme heat can cause fuel ignition or explosion.

6. Using the UltraTorch UT-100 Robinair Heat Gun with heatshrink attachment, or other suitable radiant heating device, uniformly heat the heat-shrink tubing to insulate and seal the soldered connections. Apply heat just until the meltable sealant exudes out both ends of tubing and it assumes a smooth cylindrical appearance.

⚠CAUTION

Electrically connected solder outside the tubing may cause a short to ground.

7. Inspect the melted sealant for solder beads. Excess solder or heat may force some solder out with the melted sealant. Use a small needle nose pliers to remove any solder found. Briefly heat the connection to reseal the tubing if solder beads were removed. Use less solder or reduce heating time or intensity when doing subsequent splices.

HORN

GENERAL

XLH-883 See Figure 7-84

Removal

1. Turn wheel to the right to access horn area. The horn is located between the front downtubes.
2. Remove terminal clips from horn spade connections.
3. Remove the two screws (2) threaded into weil nuts (10) on horn bracket.

Installation

1. Thread two screws (2) into weil-nuts (10) and torque to 6-9 in/lbs (.7-1 Nm).
2. Install harness terminal clips on horn spade connections. Attach the yellow wire with black tracer to rear terminal, black wire to front terminal.

XLH 1200/S See Figure 7-84

Removal

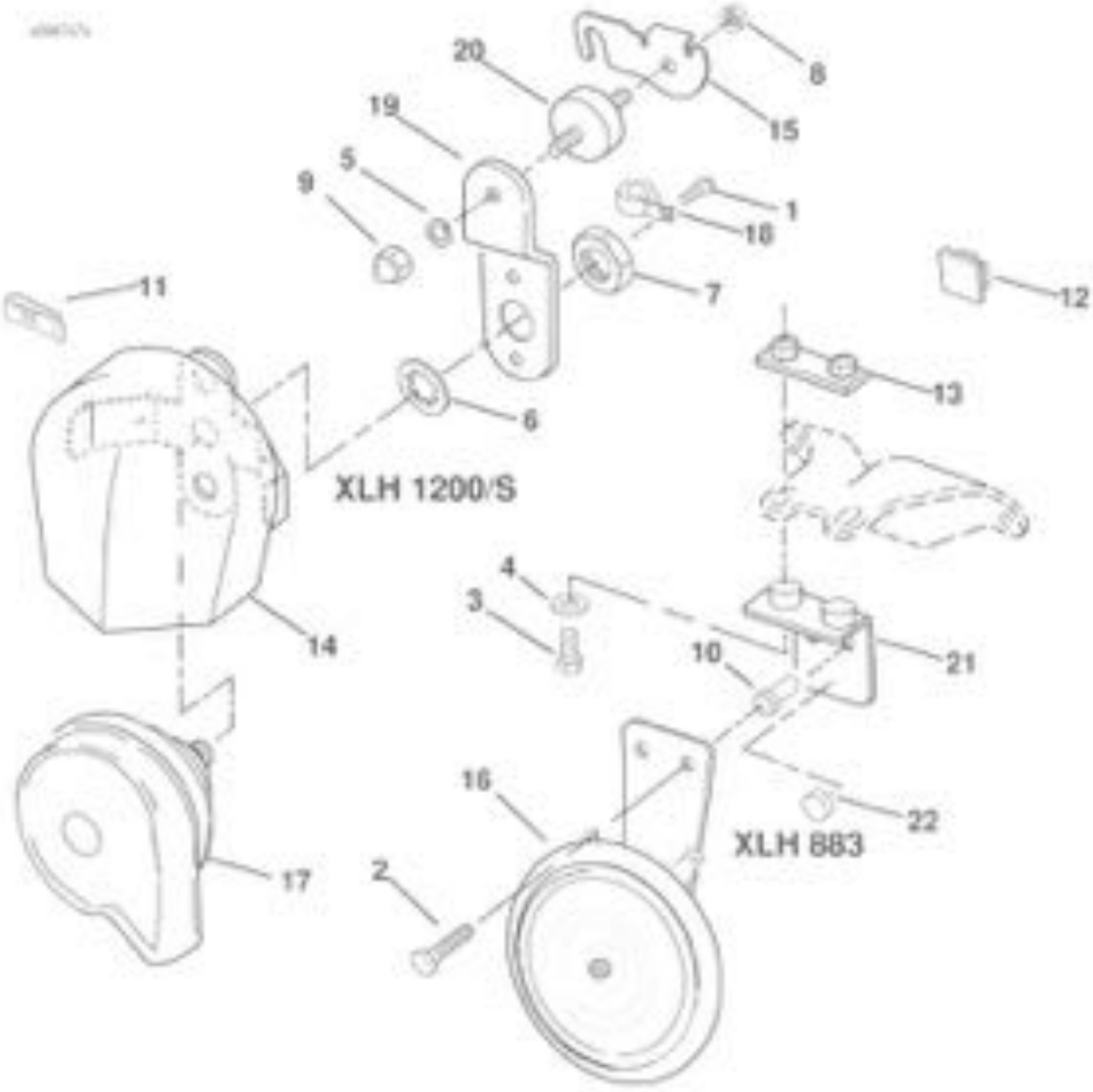
1. Locate the horn on the left side of the vehicle.
2. Remove terminal clips from horn spade connections.
3. Remove acorn nut (9) and lockwasher (5) to free horn assembly from rubber mount stud (22).
4. Remove wire conduit from clamp (18) at back of horn bracket (19).
5. Remove locknut (7) from circular recess at back of horn bracket. Remove horn (17) from chrome horn cover (14). Remove internal tooth lockwasher (6) from horn stud.

Installation

1. Install internal teeth lockwasher (6) on horn stud.
2. Slide horn (17) into chrome cover (14) pushing stud at back of horn assembly through hole in horn bracket (19). Apply two drops of LOCTITE THREADLOCKER 222 (purple) to threads of locknut (7). Install locknut on horn stud and tighten to 110 in/lbs (7-14 Nm) torque.
3. Install harness terminal clips on horn spade connections. Attach the yellow wire with black tracer to front terminal, black wire to rear terminal. Push wire conduit into clip at back of horn bracket.
4. Install horn on rubber mount stud (20) of frame mounting bracket. Install lock washer (5) and acorn nut (9) on rubber mount stud. Tighten acorn nut to 5-15 ft-lbs (7-20 Nm) torque.

TROUBLESHOOTING

1. If the horn does not sound or fails to function satisfactorily, check for the following conditions.
   - Discharged battery
   - Loose, frayed or damaged wiring leading to horn terminal
2. If battery has a satisfactory charge and wiring appears to be in good condition, check for the following:
   - Poor ground to frame through mounting hardware or ground wire (see Steps 3-6 below)
   - Inoperative horn switch (see Steps 3-6 below)
3. Remove terminal clips from horn spade connections.
4. Connect a voltmeter as follows:
   - Positive (+) lead to wire terminal
   - Negative (–) lead to ground
5. Turn ignition switch ON. Depress horn switch. If battery voltage is present, horn or horn grounding is faulty. If battery voltage is not present, either horn switch or wiring to horn is faulty.
6. If the horn is faulty, then it must be replaced as an assembly. The horn is not repairable. If the horn switch is faulty, replace the switch according to the procedures outlined in Section 2, HANDLEBAR SWITCHES, REMOVAL AND INSTALLATION.



1. Screw
2. Screw
3. Bolt
4. Washer
5. Lockwasher
6. Lockwasher
7. Nut
8. Locknut
9. Acorn nut
10. Well nut
11. Clip nut
12. Clip
13. Nut plate
14. Cover
15. Support bracket
16. Horn
17. Horn
18. Clamp
19. Horn bracket
20. Rubber mount
21. Horn bracket
22. Bumper

Figure 7-64. Horn assemblies

NEUTRAL INDICATOR SWITCH

GENERAL (Figure 7-85)

The neutral indicator switch (1) is threaded into the transmission portion of the right crankcase half (2). It is immediately forward of the main drive gear shaft (3). The sprocket cover must be removed to test the switch. If switch requires replacement, secondary drive belt and transmission sprocket must also be removed; there is not enough clearance to allow the removal of the switch without first removing the transmission sprocket.

A pin on the shifter drum contacts the neutral indicator switch plunger, completing the neutral indicator circuit. The switch is not repairable; if it malfunctions, it must be replaced.

1. Neutral indicator switch
2. Right crankcase half
3. Main drive gear shaft
4. Transmission sprocket
5. Transmission sprocket nut (LH threads)
6. Lockplate
7. Socket head screw (2)

Figure 7-85. Neutral Indicator Switch

TESTING (Figure 7-85)

1. Remove sprocket cover; see REAR BRAKE LINKAGE AND SPROCKET COVER, REMOVAL in Section 2.
2. Disconnect wire lead from neutral indicator switch (1).
3. With ignition switch ON, touch the neutral indicator wire lead to a suitable ground.
   - If indicator lamp lights, then problem is at indicator switch. Replace switch.
   - If indicator lamp does not light, then problem is elsewhere in circuit (i.e. indicator lamp burned out, loose connection, or faulty wiring).
4. After testing, connect wire lead to indicator switch (1). Install sprocket cover and any other removed components; see REAR BRAKE LINKAGE AND SPROCKET COVER, INSTALLATION in Section 2.

REMOVAL AND INSTALLATION (Figure 7-85)

1. Verify that the ignition/light switch is turned to OFF.
2. Remove sprocket cover; see REAR BRAKE LINKAGE AND SPROCKET COVER, REMOVAL in Section 2.
3. Place transmission in first gear. Remove two socket head screws (7) and lockplate (6).

⚠ CAUTION

Transmission sprocket nut has left-hand threads. Turn nut clockwise to loosen and remove from main drive gear shaft.

4. Remove transmission sprocket nut (5) from main drive gear shaft (3).
5. Decrease secondary drive belt tension according to the applicable procedures listed in SECONDARY DRIVE BELT, REMOVAL in Section 6. Remove transmission sprocket (4) (with secondary drive belt) from main drive gear shaft (3).
6. Remove wire lead from neutral indicator switch (1). Remove switch from right crankcase half (2).
7. Apply a light coating of LOCTITE THREADLOCKER 242 (blue) to new neutral indicator switch (1) threads. Install switch in crankcase (2), and tighten switch to 3.5 ft-lbs (4.7 Nm) torque. Connect wire lead to switch.
8. Install transmission sprocket (4) (with secondary drive belt) onto main drive gear shaft (3) according to applicable procedures listed in TRANSMISSION INSTALLATION AND SHIFTER PAWL ADJUSTMENT in Section 6.
9. Install sprocket cover and any other removed components; see REAR BRAKE LINKAGE AND SPROCKET COVER, INSTALLATION in Section 2.
10. Adjust secondary drive belt tension; see SECONDARY DRIVE BELT, ADJUSTMENT in Section 6.

DIRECTIONAL (TURN SIGNAL) CANCELLER

OPERATION (Figure 7-86)

General

Both the directionals (turn signals) and 4-way flashers are controlled by an electronic module (self-canceller).

The module is secured to the rear fender, under the seat.

The canceller contains circuitry to generate pulses for "flashing" the appropriate directional lamps, thereby eliminating the previously used directional and hazard flashers. Steps 1 and 2 below explain canceller operation when a rider signals for a left turn; step 3 explains canceller operation when a right turn is signalled.

1. Pressing and releasing the left turn signal switch causes a momentary 12 vdc to be applied to Pin 8. The module sends a series of 12 vdc pulses (Pin 4) to flash the left directional lamps (front and rear).

2. The module monitors the number of vehicle speed sensor pulses from the speedometer at Pin 5. The switch closures indicate vehicle distance traveled. When the number of switch closure pulses equals a quantity preset in the self-canceling module, the left turn signal is automatically canceled.

3. Pressing and releasing the right turn signal switch causes a momentary 12 vdc to be applied to Pin 7 and an output at Pin 3 identical to that just described for a left turn signal.

Manual or Rider Control

Directionals may be cancelled by pressing the turn signal switch a second time. Pressing the left turn signal switch while the right turn signal lamps are flashing will cancel the right turn lamps and activate the left turn lamps (and vice versa).

Hazard Flasher (4-Way)

To activate the hazard flashers, simultaneously press and hold both right and left turn signal switches for 1-1/2 seconds. To cancel hazard flashers, momentarily press and release right and left turn signal switches simultaneously.

DISTANCE TEST

Directionals cancel after rear wheel travels a certain distance at a specific speed. Turn signal module begins measuring the distance traveled immediately upon release of the turn signal switch button.

Directionals will remain flashing for the following distances within the speed ranges specified:

Speed range #1	0-34 mph 0-48 km/h	221 ft. (0.04 mi.) 67 m
Speed range #2	35-44 mph 56-71 km/h	339 ft. (0.06 mi.) 103 m
Speed range #3	45-60 mph 74-97 km/h	680 ft. (0.13 mi.) 207 m
Speed range #4	61+ mph 98+ km/h	1051 ft. (0.20 mi.) 320 m

Pin Number	Wire Color	DESCRIPTION/FUNCTION
1	BK	Module ground to motorcycle
2		12vdc input from accessory circuit breaker
3		Pulsed 12vdc for flashing right turn signal lights
4		Pulsed 12vdc for flashing left turn signal lights
5		Vehicle speed sensor input
6	-	Not used
7		12vdc from right turn signal switch (when pressed)
8		12vdc from left turn signal switch (when pressed)

Figure 7-86. Turn Signal Module Pinout

NOTE

Distance test and time test can also be performed using the speedometer tester (MD-41354) as an input device.

To check module operation, proceed as follows:

1. Operate the motorcycle at 15 mph (24 km/h), which is the midpoint of speed range #1.
2. Press and release right turn switch button. Closely monitor vehicle speed and odometer reading. Measure the distance traveled from the time the button is released to the time the directional cancels.
3. Repeat steps 1 and 2 for left turn.

NOTE

Since the odometer's smallest unit-of-measure for distance (0.1 mile) is larger than the distance you will be measuring for speed range #1 (0.04 mile), you will need to release the turn signal switch button when a number is completely centered on the odometer's tenths wheel and watch for the point where the tenths wheel has rotated 4/10 of the way toward the next number.

4. Repeat steps 2 and 3 for right and left turns at midpoint of speed ranges 2 through 4.
5. If the distances observed in Steps 1 through 4 are not correct, check the following:
   a. Turn signal module ground and module pin connections.
   b. Vehicle speed sensor operation, connections and grounds.
   c. Replace module with one known to be good and repeat DISTANCE TEST.

NOTE

Turn signal module and turn signal lamps must have the same ground potential; grounds for both module and lamps must have good continuity to one another.

ALTERNATE TIME TEST

Another way of checking the self-cancelling turn signal module is to measure the length of time the directional operates at a constant vehicle speed. From the instant the turn signal switch button is released, measure the number of seconds that elapse before the directional cancels.

The approximate elapsed times at four constant speeds should be as follows:

CONSTANT SPEED	TURN SIGNAL ELAPSED TIME (in seconds)
25 mph (40 km/h)	5-7
38 mph (61 km/h)	5-7
52 mph (84 km/h)	8-10
65 mph (105 km/h)	10-12

RIDER PREFERENCE AND CONTROL

To extend the distance/time that directionals flash, simply press and hold the turn signal switch button. Since the module does not begin to measure distance traveled and time elapsed until the switch button is released, the flashing sequence is prolonged.

To shorten the distance/time that directionals flash, press the turn signal switch button a second time while the directionals are still flashing. This procedure immediately cancels the turn signal.

TROUBLESHOOTING

See the following chart for troubleshooting procedures.

⚠CAUTION

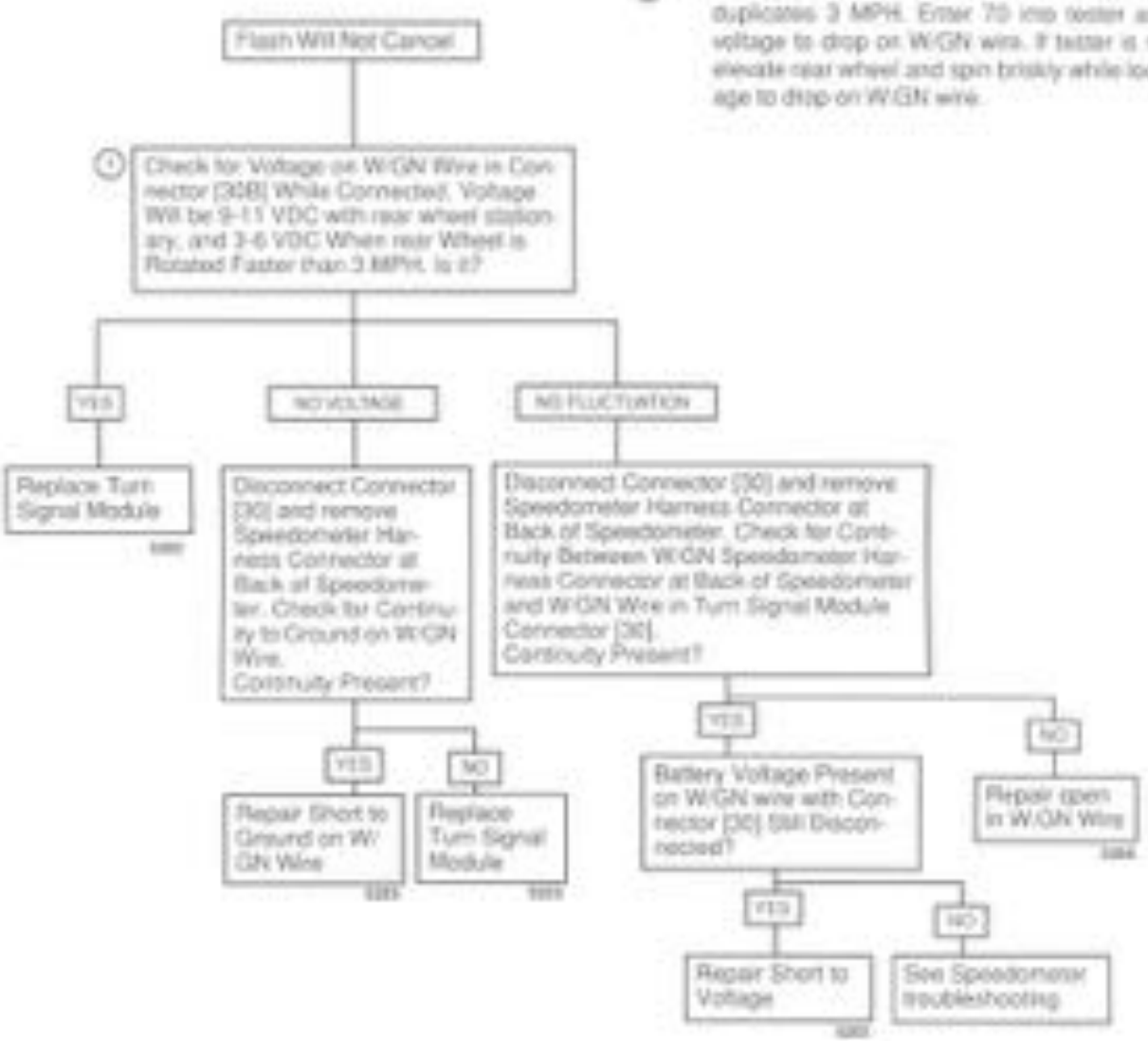
Do not apply 12 vdc to self-cancelling module without pin 1 connected to ground or module will be damaged.

Use this chart for Speedometer trouble codes 9 (speed output shorted high) and 10 (speed output shorted low or open).

DIAGNOSTIC NOTES

The reference numbers below correlate with those on the diagnostic flow chart.

① Use Speedometer tool HD-41354 to input a signal which duplicates 3 MPH. Enter 70 into tester and watch for voltage to drop on W/GN wire. If tester is not available, elevate rear wheel and spin briskly while looking for voltage to drop on W/GN wire.



Numbers below leave refer to the Warranty Code

Turn Signal Troubleshooting -1200 Models

Chart 1: Turn Signals Will Not Cancel.

Numbers below boxes refer to the Warranty Code.

Turn Signal Troubleshooting - 1200 Models

Chart 2: Turn SignalsWill Not Flash Right, Will Not Flash Left.

Numbers below boxes refer to the Warranty Code

Chart 3: Turn Signals Will Not Flash, 4-Way Flashers Inoperable.

REMOVAL/INSTALLATION - DIRECTIONAL CANCELLER

1. Remove seat. See SEAT, REMOVAL in Section 2.
2. Verify that the ignition/light switch is turned to OFF.
3. On 1200S models:
   - Remove two bolts to detach electrical bracket from frame cross member.
   - Lift up electrical bracket.
4. Disconnect connector [308]. Simultaneously depress the two external latches and use a rocking motion to separate pin and socket halves of directional canceller connector.
5. Remove screw securing module to rear fender. Remove module.
6. Align new self-cancelling turn signal module and insert screw. Tighten screw to 3-5 **in-lbs** (.3-.6 Nm).
7. Align tabs on socket housing with grooves on socket plug of module. Push connector until latches "click."
8. On 1200S models:
   - Align holes in electrical bracket with weldnuts in cross member of motorcycle frame.
   - Install two bolts in electrical bracket.
   - Tighten bolts to 6-9 **in-lbs** (0.7-1.0 Nm) torque.
9. Test all turn signal functions. See DISTANCE TEST OR ALTERNATE TIME TEST in this section.
10. Install seat. See SEAT INSTALLATION in Section 2.

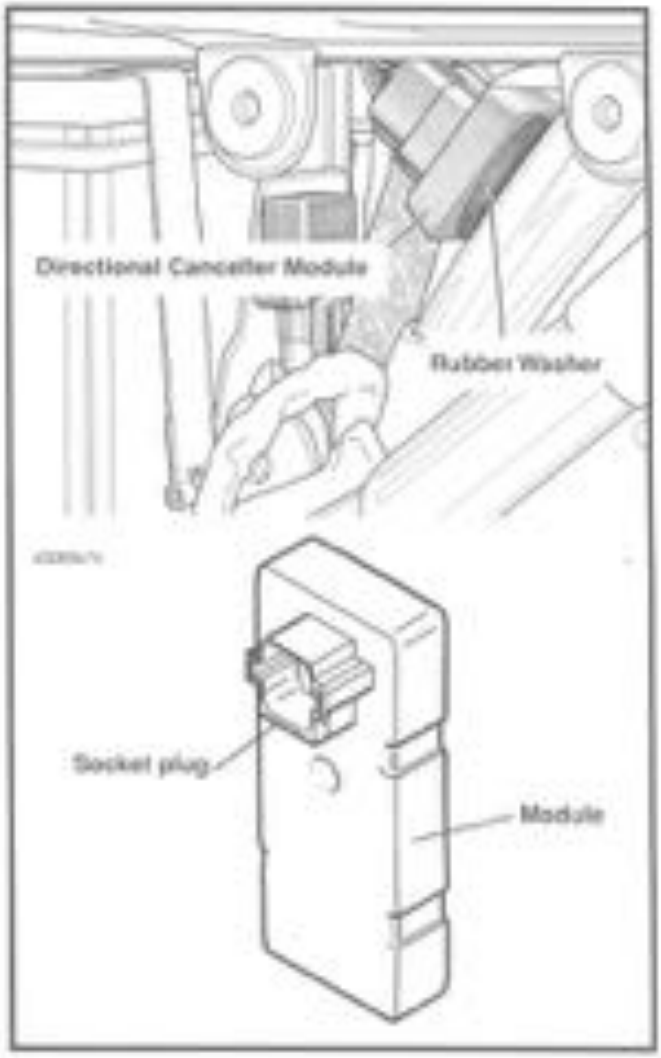


Figure 7-67. Directional Canceller

FUSES and MAIN CIRCUIT BREAKER

GENERAL (Figure 7-88)

Fuses function to prevent electrical overload of a circuit. The fuse completes the circuit as long as current (amperage) flowing through the fuse does not exceed the ampere rating of the fuse. If the circuit current happens to exceed the fuse ampere rating, the fuse opens and the current flow in the circuit is interrupted.

The Main circuit breaker is the automatic-reset type, the bimetallic breaker contact automatically closes (completing the circuit) once it has cooled down from the initial overload. If the overload condition still exists, the breaker contact will again open to interrupt current flow. This "cycling effect" (opening and closing) of the breaker contact continues as long as the current circuit overload condition exists.

Figure 7-88. Main Circuit Breaker

⚠WARNING

To prevent accidental start-up of vehicle and possible personal injury, disconnect battery cables (negative cable first) before performing any electrical work.

XLH models have 4 fuses and one circuit breaker, all of which are installed on the electrical bracket (under side cover). The fuses are all rated at 15 amperes. The main circuit breaker is rated at 30 amperes.

- See ELECTRICAL BRACKET, REPLACE FUSES in this section.
- See ELECTRICAL BRACKET, REPLACE MAIN CIRCUIT BREAKER in this section.

Figure 7-89. Fuse Block

ELECTRONIC SPEEDOMETER - HOW IT WORKS

The electronic speedometer consists of a speed sensor, function switch and the speedometer. The speed sensor is mounted on the right side of transmission case below the starter. The sensor circuitry is that of a Hall-Effect sensor that is triggered by the gear teeth of 5th gear on the transmission mainshaft. The output from the sensor is a series of pulses that are interpreted by speedometer circuitry to control the position of the speedometer needle and the liquid crystal display (LCD) odometer display. The odometer mileage is permanently stored and will not be lost when electrical power is turned off or disconnected. The function switch allows switching or "toggling" between the odometer and trip odometer displays. To zero the trip odometer, have the odometer display visible, press and keep the function switch depressed. The trip odometer mileage will be displayed for 2-3 seconds and then the mileage will return to zero miles.

The odometer can display seven numbers to indicate a maximum of 999999.9 miles. The trip odometer can display five numbers for a maximum of 9999.9 miles.

Circuitry in the speedometer also conditions the sensor input to provide an input to the turn signal canceller.

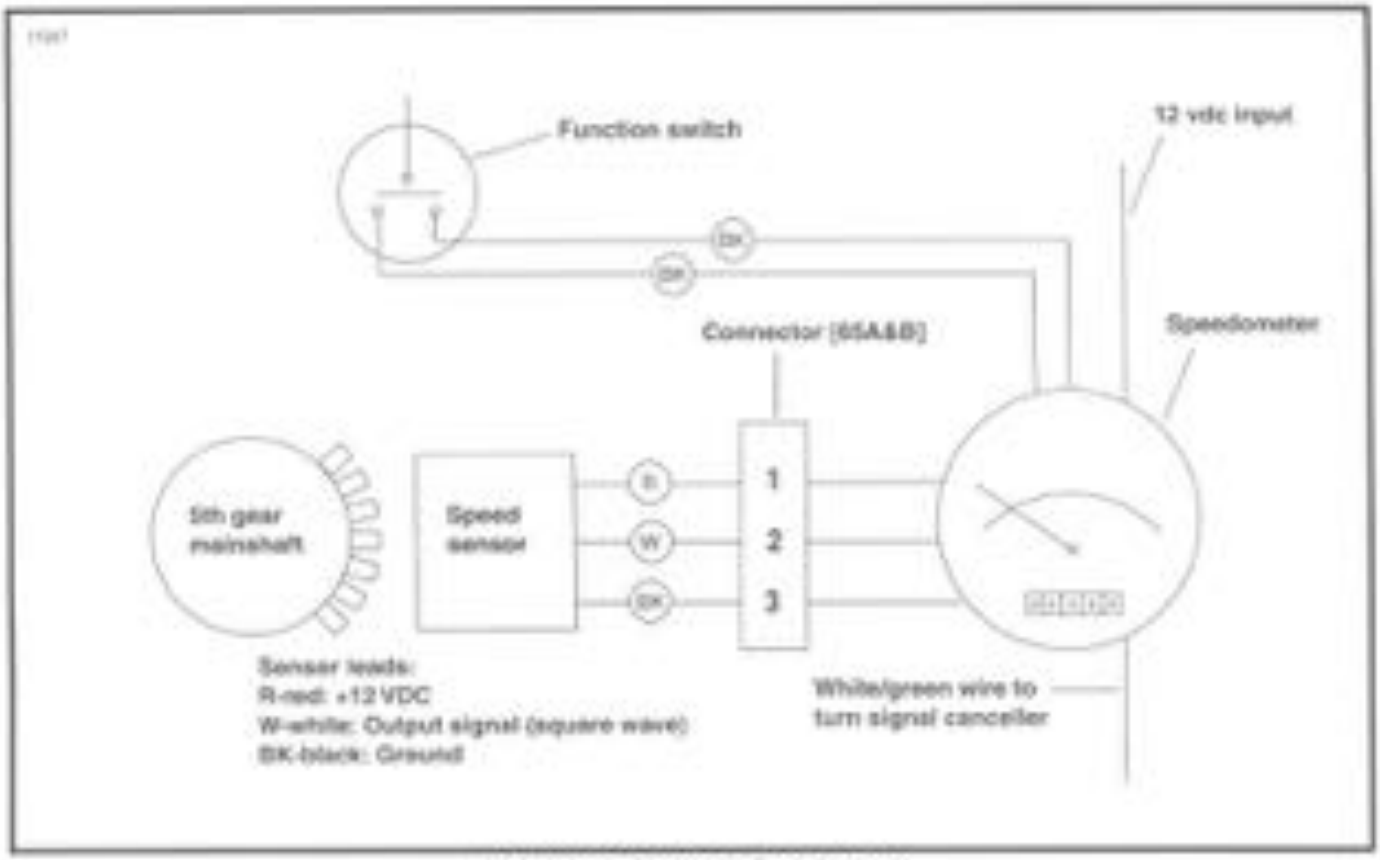


Figure 7-90. Electronic Speedometer

ELECTRONIC SPEEDOMETER AND TACHOMETER

Speedometer Removal - 1200 models

1. Remove seat and fuel tank. Detach speedometer sensor plug from frame T-stud. Unplug connector [65]. Cut cable straps holding sensor harness. Free harness from battery area and allow to hang free from front of motorcycle.
2. Detach headlight assembly from top of fork bracket to allow removal of speedometer sensor harness. On 1200 Custom remove fork bracket cover and riser cover.
3. Remove odometer reset boot from back of housing.
4. Remove socket head screws holding back of speedometer housing.
5. See Figure 7-92. Remove nuts from terminal studs 1, 2, and 4. Remove wires from studs. On vehicles where speedometer wires may have been wired directly into the speedometer, cut the wire approximately 1" from the speedometer. Strip 3/16" off of end of wire and crimp the ring terminal from the new speedometer kit onto the wire using the Packard crimper 115 (HD-38125-6) using the 20-16 crimping die for the core crimp.
6. Loosen back gasket and push instrument through front of housing toward rear of motorcycle. Remove gasket from instrument.

Speedometer Installation - 1200 models

1. Install gasket removed in Step 6, above.
2. Slide speedometer into instrument housing and press firmly until fully seated.
3. See Figure 7-92. Install wires back on terminals 1, 2, and 4.
4. Route wires through slot in back of instrument housing. Install gasket on back of housing.
5. Position reset switch in squared boss on back of speedometer housing.
6. Align back cover. Install back cover screws and tighten. Replace rubber boot on odometer reset switch.
7. Route speedometer sensor cable along main wiring harness. Route connector behind battery up through frame. Reconnect sensor.

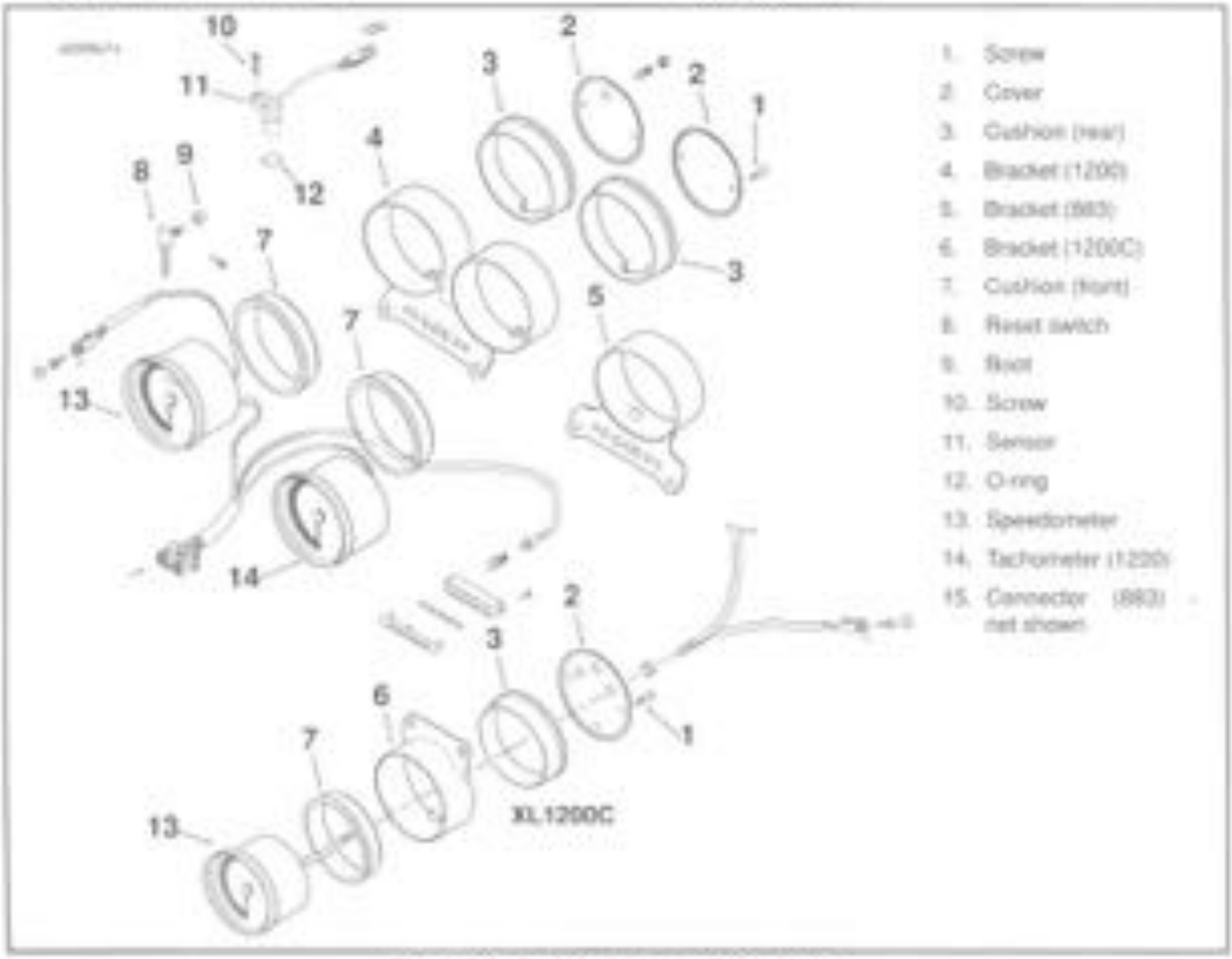


Figure 7-91. Speedometer and Tachometer

8. Position toward frame away from spark plug cable. Replace cable straps.
9. Install headlamp bracket to top fork bracket.
10. On 1200 Custom install rear and fork bracket cover.
11. Install fuel tank.
12. Install seat.
13. Check headlamp alignment.
14. Check speedometer for proper operation.

Speedometer Removal - 883 models

1. Remove odometer reset boot from back of housing.
2. Remove socket head screws holding back of speedometer housing.
3. Depress tab and remove connector.
4. Loosen back gasket and push instrument through front of housing toward rear of motorcycle. Remove gasket from instrument.

Speedometer Installation - 883 models

1. Install gasket removed in Step 4, above.
2. Slide speedometer into instrument housing and press firmly until fully seated.
3. Insert connector.
4. Route wires through slot in back of instrument housing. Install gasket on back of housing.
5. Position reset switch in squared boss on back of speedometer housing.
6. Align back cover. Install back cover screws and tighten. Replace rubber boot on odometer reset switch.

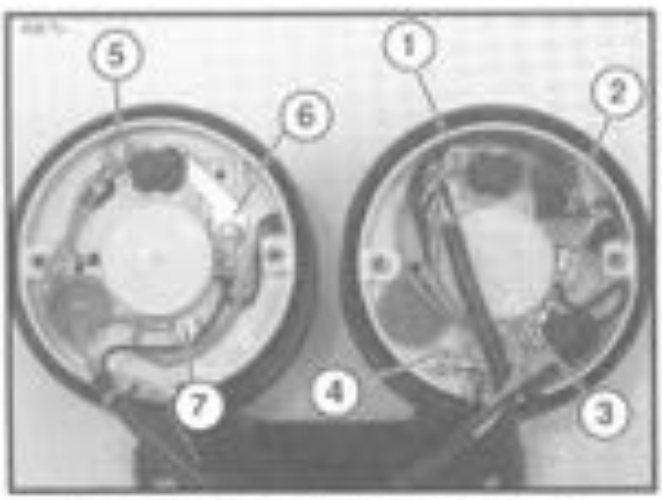


Figure 7-92. Speedometer and Tachometer

Tachometer Replacement

Removal

1. Remove socket head screws holding back of tachometer housing.
2. See Figure 7-92. Remove 9/32" nuts from terminal studs 5, 6, and 7. Remove wires from studs.
3. Loosen back gasket and push instrument through front of housing toward rear of motorcycle. Remove gasket from instrument.

Installation

1. Install gasket removed in Step 3, above.
2. Slide Tachometer into instrument housing and press firmly until fully seated.
3. See Figure 7-92. Install wires back on terminals 5, 6, and 7.
4. Route wires through slot in back of instrument housing. Install gasket on back of housing.
5. Align back cover. Install back cover screws and tighten.

Speedometer Sensor Replacement

Removal

1. Remove seat. See SEAT, REMOVAL in Section 2.
2. Disconnect battery cables, negative cable first. See BATTERY, DISCONNECTION AND REMOVAL. Remove battery from tray.
3. See Figure 7-93. Push the 3-place connector [S5] located on the frame underneath the seat forward to dislodge connector from U-stud and disconnect the connector. Cut the cable straps that retain sensor wires to main harness bundle.
4. Remove sensor mounting screw using allen socket tool (Snap-On P/N TMAX56) and lift sensor from crankcase.

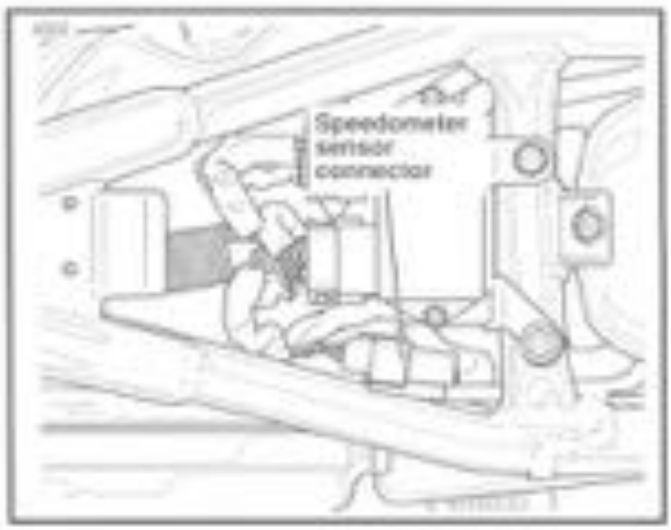


Figure 7-93. Speedometer sensor connector (1200S shown

Remove assembly from left side by lifting the transmission vent hose up far enough to allow the sensor to pass and then remove it.

Installation

1. Route the speedometer sensor underneath the transmission vent hose from left and install sensor into crankcase from right side of vehicle. Install sensor mounting screw and torque to 80-100 in/lbs (9-11 Nm).
2. Route the sensor cable back into position along main wiring harness bundle and retain with cable straps.
3. Check speedometer for proper operation.

Reset switch Replacement

Removal

1. Remove odometer reset boot from back of housing.
2. Remove socket head screws holding back of speedometer housing.
3. Cut wires from switch.

Installation

1. Follow instructions for installing SEALED WIRE SPLICES.
2. Position reset switch in squared boss on back of speedometer housing.
3. Align back cover. Install back cover screws and tighten. Replace rubber boot on odometer reset switch.

883 Speedometer (Late Model)

Late model 1998 XLH-883 Models have a speedometer with self-diagnostic capabilities.

A "late-model" Speedometer can be identified by the following means:

- Amber backlight.
- At power up the Speedometer will "over drive" at zero momentarily and the needle will "quiver" or "vibrate" visibly.
- Removing cover will show 12 pin connector.
- Press and hold in odometer reset at "key ON" will enable diagnostic mode.

General

The reset switch is used to change the odometer display between mileage and trip values and to reset the trip odometer. It is also used to identify the speedometer calibration and to enter the diagnostic mode, clear diagnostic codes and exit diagnostic mode.

Diagnostic Mode

The diagnostic mode is entered by turning the ignition from OFF to ON while holding the reset switch in. The normal power-up sequence will occur before entering the diagnostic mode. Diagnostic codes set during this power up sequence will be stored as well.

IMPORTANT NOTE

Be sure no Diagnostic codes are indicated before reset is held in for more than 5 seconds or diagnostic information will be lost.

When in the diagnostic mode the odometer will display the first diagnostic code. When the trip switch is pressed again the next code will be shown. If the trip switch is pressed for more than 5 seconds at any time while in the diagnostic mode, **all of the diagnostic codes will be erased whether they have been displayed or not.**

There are 7 different diagnostic codes available. They are as follows:

d01 - Speed sensor power output shorted low

d02 - Speed sensor power output shorted high or open

d03 - Not used

d04 - Not used

d05 - Speed sensor return shorted high

d06 - Speed sensor return shorted low

d07 - Not used

d08 - Speedometer power overvoltage

d09 - Speed output shorted high

d10 - Speed output shorted low or open

CAL XX - Speedometer application calibration number:

14 = Domestic

15 = HDI

When in the diagnostic mode, all codes are displayed in sequence from d01 to d10.

As a code appears in the display (for instance d02), it will read "d02SE" if set or "d02CU" if clear.

The diagnostic mode is exited either by turning ignition from ON to OFF to ON again without depressing the reset switch or if a speed signal greater than 5 MPH is detected.

Diagnostics cannot be performed if system voltage is less than 9 VDC or greater than 16 VDC. The only exception is **d08** which is set when system voltage is greater than 16VDC.

After all the diagnostic codes are displayed, the speedometer calibration number is displayed (**CAL 14** for example).

SPEEDOMETER/TACHOMETER PERFORMANCE CHECK

GENERAL

The performance (proper operation and sweeping action) of the speedometer and tachometer (if equipped) can be evaluated with the speedometer tester, HD-41354. This tester generates a signal that simulates the signal from the speedometer sensor for checking speedometer operation. The tester can also be connected to the cam position sensor connector to introduce a signal to the ignition module that simulates the signal from the cam position sensor. This configuration is used to test tachometer performance.

Also, the signal generated by the speedometer tester can be used to simulate running engine conditions for ignition system troubleshooting. See IGNITION SYSTEM for more information on performing tests.

NOTE

Use the following procedures in conjunction with the manual supplied with the speedometer tester.

SPEEDOMETER TESTS

NOTE

The speedometer tester, HD-41354, cannot be used to verify the calibration of a speedometer and it will not verify the speedometer's function to support legal proceedings. It's purpose is to verify speedometer function when performing service diagnosis or repair, and to assist in determining if speedometer replacement is necessary.

Operation Test

1. See Figure 7-94. Disconnect speedometer sensor connector [60]. Install speedometer tester connector into speedometer sensor connector [60B] as shown.

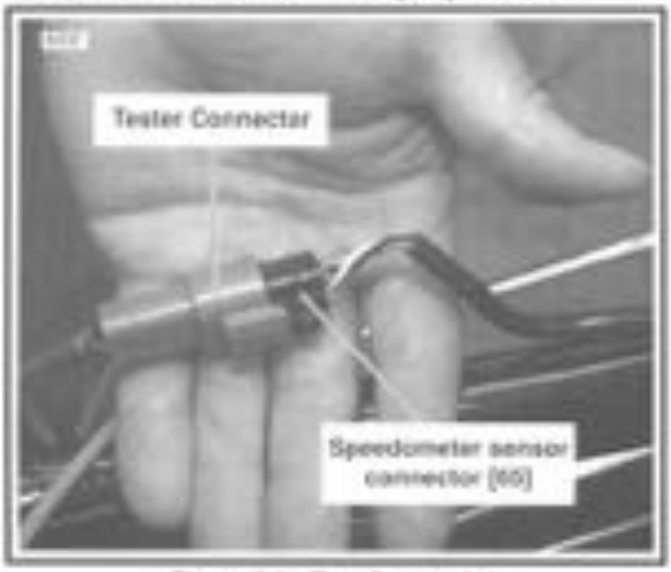


Figure 7-94. Test Connection

2. See Figure 7-71. Place speedometer tester power switch in the "ON" position, and the signal switch in the "OUT" position.

Figure 7-95. Speedometer Tester

3. Turn the ignition switch "ON". Press "ENTER" on the tester keypad. Enter the frequency shown on the table below, press "ENTER", then check that the speedometer reads the corresponding speed. To change the frequency, press "CLEAR" to cancel, and enter the new frequency, and press "ENTER" to begin. The speedometer should be accurate within -0 mph to +4 mph (-0 kph to +6.5 kph).

Model (units)	Tester Frequency (in Hz) Corresponding to-			
	20 mph (30 kph)	40 mph (60 kph)	60 mph (100 kph)	80 mph (130 kph)
1200 DOM & CB	408	814	1216	1613
1200 HDI	381	760	1259	1629
883 DOM & CB	439	874	1306	1733
883 HDI	408	815	1353	1792

Sweep Test

The tester's sweep function moves the speedometer needle through the full range of needle movement to allow testing for smoothness of operation, hesitancy, or needle sticking.

1. With tester connected as in operation test, place speedometer tester power switch in the "ON" position, and the signal switch in the "OUT" position.
2. Turn the ignition switch "ON". Press 0, then press "ENTER" on the tester keypad. The tester will scan for two seconds, then the tester will put out 1 Hz.
3. Use the 2, 5, and 8 keys to select one of three ranges. LO (1-20 Hz), CEN (21-999 Hz), or HI (1000-20,000 Hz).
4. After selecting a range, use the corresponding arrow keys to accelerate through the range. For example keys 1 and 3 move through the LO range. As you move through the speed range, check for smooth needle movement.

TACHOMETER TEST

Operation Test

1. Connect the speedometer tester to the cam position sensor Deutsch socket housing [14B]. The tester frequency you enter will now travel to the ignition module and the module will open and close circuits to fire the spark plugs. This allows you to simulate engine running and generate tachometer readings.
2. Because tester frequency is in Hertz, and you will be interested in measuring rpm on the tachometer being tested, convert the tachometer reading you want to Hz, then enter the frequency just as you did in the speedometer operation test above.

   For example:

   2000 rpm (tachometer reading) ÷ **60**
   = **33.3** (enter 33 into tester)

   In this example, entering 33 Hz into the tester should result in an rpm reading of 2000 on the tachometer. Test the tachometer at several different rpm readings to verify proper operation.

Tachometer Accuracy Tolerances at 68°-77°F (20°-25°C)				
Indication (rpm)	2000	4000	6000	7500
Tolerance (rpm)	±100	±120	±210	±320

Sweep Test

Just as in the speedometer sweep test above, variable frequency signals can be generated by the speedometer tester to help verify proper tachometer sweep operation. With the speedometer tester installed at the cam position sensor connector [14B], perform the tachometer sweep test following the speedometer sweep test steps described above.

SPEEDOMETER SENSOR TEST

If the speedometer is inoperative, but backlighting and odometer work, the speedometer sensor may not be working.

To test the speedometer sensor as described below, as well as the cam position sensor test using the tachometer tester (described in IGNITION SYSTEM), a test harness is required. Fabricate the test harness by splicing together two Deutsch 3-place socket housings (72113-94BK) and one Deutsch 3-place pin housing (72103-94BK). Use six inch lengths of 18 gage wire. Install the test harness at the cam position sensor connector [14].

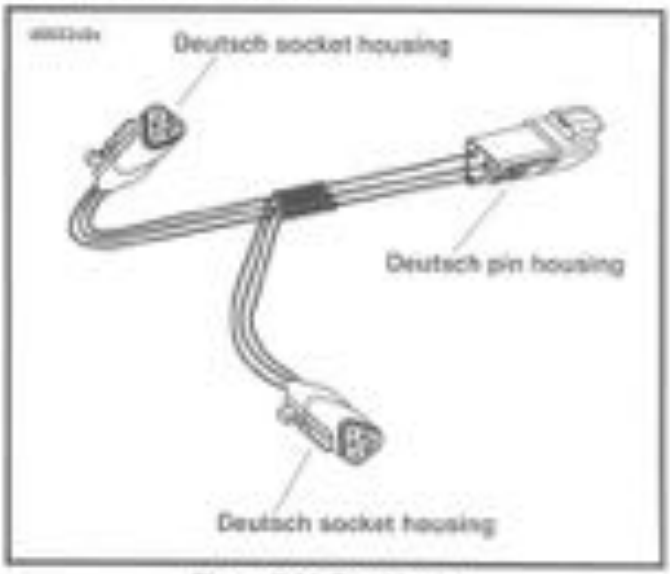


Figure 7-96. Test Harness

To diagnose the speedometer sensor, first test for voltage to sensor by checking for 8-12 VDC on Red wire in connector [65B]. Then check for continuity to ground on Black wire in connector [65B]. The following test will only work if voltage and proper ground are present at speedometer sensor.

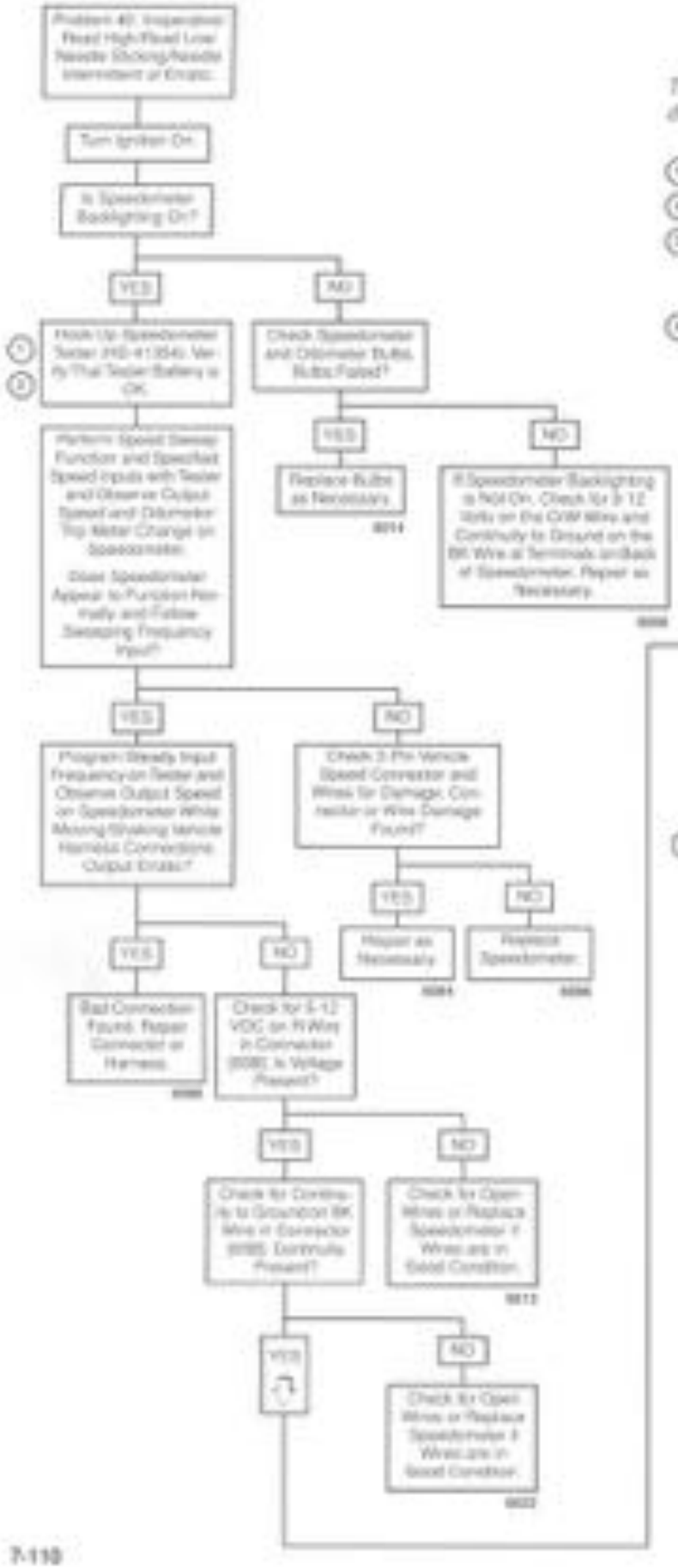
Install the test harness between the speedometer sensor connectors [65A & B]. Turn tester power switch to ON, and place signal switch in the IN position. Plug the speedometer tester into the test harness and turn the ignition ON. Press ENTER on the keypad. Rotate the motorcycle's rear wheel. The numbers on the speedometer tester readout should change with changes in wheel speed. If the readout doesn't change, the speedometer sensor is suspect. Install a known, good speedometer sensor and test again for proper operation.

Chart 1: Odometer, Trip Odometer and Reset Switch

Numbers below boxes refer to the Warranty Code.

Speedometer Troubleshooting

Chart 2: Inoperative, Inaccurate or Erratic Speedometer.



DIAGNOSTIC NOTES

The reference numbers below correlate with those on the diagnostic flow chart.

1. Remove seat. See Seat, Removal, in Section 2.
2. Test results may be inaccurate if tester battery is low.
3. Sensor can also be tested with Speedometer Tester (HD-41354) and Test Harness. See Speedometer Sensor Test.
4. Remove sensor and check for accumulation of debris on sensor; if debris is not present, replace sensor. If debris is present, clean sensor and repeat test. Replace if necessary.

Numbers below boxes refer to the Warranty Code.

DEUTSCH ELECTRICAL CONNECTORS

The XLH models utilize Deutsch DT Series Electrical Connectors. The Deutsch Connector features a superior seal to protect electrical contacts from dirt and moisture in harsh environments. The connector also provides better pin retention than previous connectors.

A 12-pin connector is illustrated in Figure 7-98 to show the various parts of the Deutsch connector. The following instructions may be followed for all 2-pin through 12-pin Deutsch connectors.

Socket housing: alignment tabs and/or external latch, secondary locking wedge, internal seal, wire seal, seal pin.

NOTE

Seal pins or plugs are installed in the wire seals of unused pin and socket locations. If removed, seal pins must be replaced to maintain the integrity of the environmental seal.

Pin housing: alignment grooves and/or external latch cover, attachment clip, secondary locking wedge, wire seal, seal pin.

REMOVING/DISASSEMBLING

Attachment clips are attached to the pin housings of most connectors. The clips are then attached to T-studs on the motorcycle frame. T-studs give positive location to electrical connectors and wire harness. Consistent location reduces electrical problems and improves serviceability.

1. Push the connector toward the rear to disengage small end of slot on attachment clip from T-stud. Lift connector off T-stud.
2. Depress the external latch(es) on the socket housing side and use a rocking motion to separate the pin and socket halves. Two-, three-, four- and six-pin Deutsch connectors have one external latch, while eight- and twelve-pin connectors have two, both of which must be pressed simultaneously to separate the connector halves.

NOTE

With one exception (see number 10 in Figure 7-55), the socket housing can always be found on the accessory side, while the pin side of the connector is plumbed to the wiring harness.

REMOVING/INSTALLING SOCKETS

1. See Figure 7-99. Remove the secondary locking wedge. Insert the blade of a small screwdriver between the socket housing and locking wedge inline with the groove (inline with the pin holes if the groove is absent). Turn the screwdriver 90 degrees to pop the wedge up.
2. Gently depress terminal latches inside socket housing and back out sockets through holes in rear wire seal.

NOTE

An Electrical Terminal Crimp Tool (Part No. HD-39965) is used to install Deutsch pin and socket terminals on wires. If new terminals must be installed, follow the instructions included with the crimping tool or see Crimping Instructions in this section.

3. Fit rear wire seal into back of socket housing, if removed. Grasp socket approximately 1 inch (25.4 mm) behind the contact barrel. Gently push sockets through holes in wire seal into their respective chambers (see Figure 7-77 for wire color locations). Feed socket into chamber until it "clicks" in place. Verify that socket will not back out of chamber; a slight tug on the wire will confirm that it is properly locked in place.

4. Install internal seal on lip of socket housing, if removed. Insert tapered end of secondary locking wedge into socket housing and press down until it snaps in place. The wedge fits into the center groove within the socket housing and holds the terminal latches tightly closed.

NOTE

While rectangular wedges do not require a special orientation, the conical secondary locking wedge of the 3-pin connector must be installed with the arrow pointing toward the external latch. See Figure 7-98.

NOTE

If the secondary locking wedge does not slide into the installed position easily, verify that all terminals are fully installed in the socket housing. The lock indicates when terminals are not properly installed by not entering its fully installed position.

Figure 7-98. Remove Secondary Locking Wedge

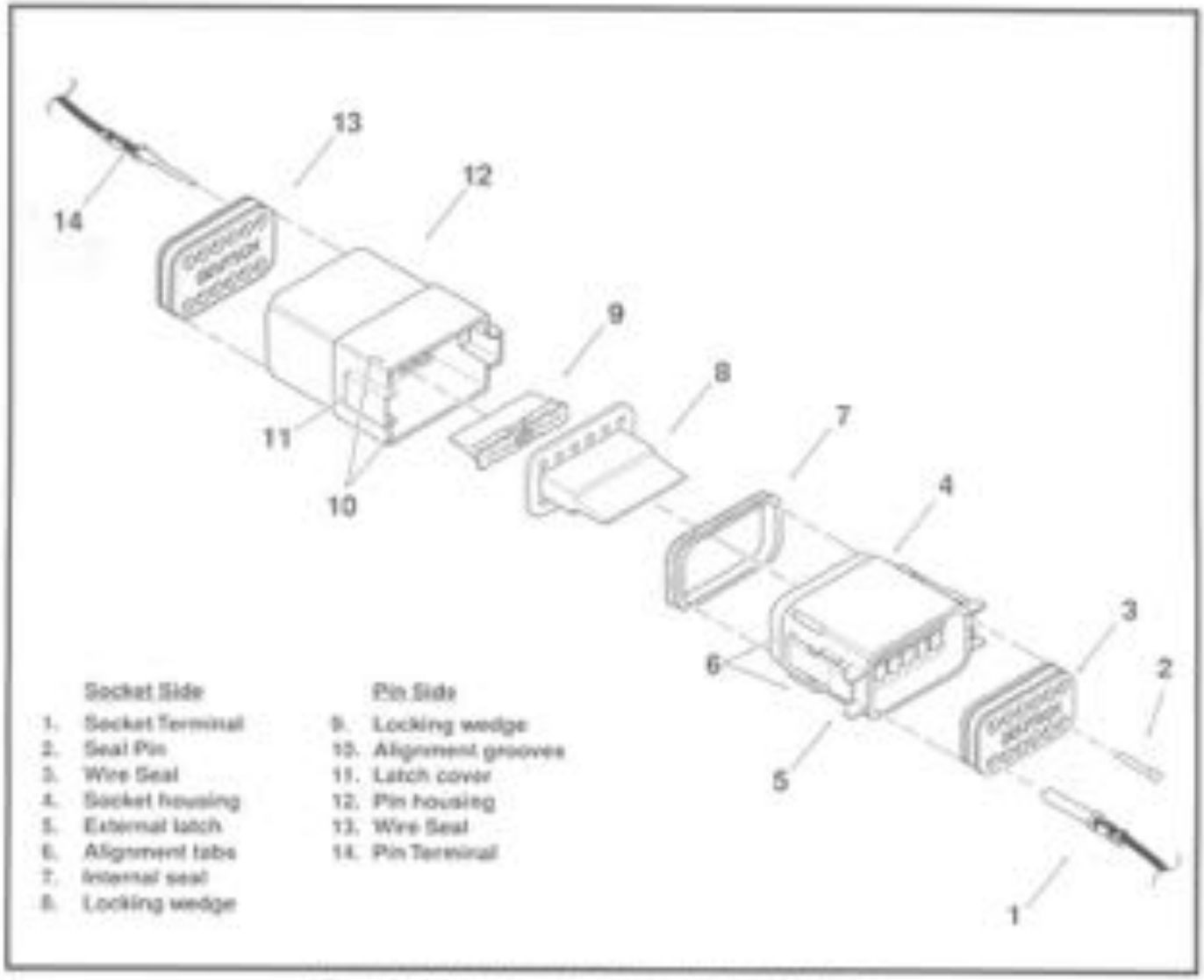


Figure 7-97. 12-pin Deutsch Connector (Exploded View)

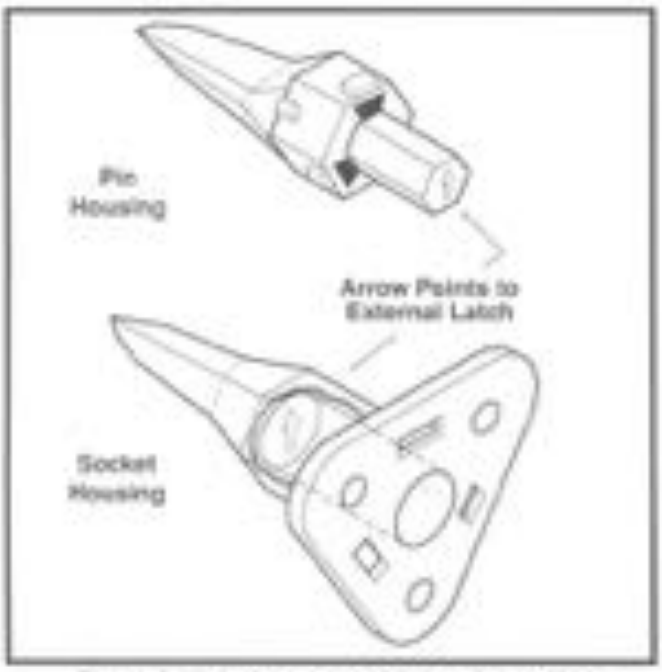


Figure 7-99. 3-pin Locking Wedge Orientation

REMOVING/INSTALLING PINS

1. Remove the secondary locking wedge. Use the hooked end of a stiff piece of mechanics wire or a needle nose pliers, whichever is most suitable.

2. Gently depress terminal latches inside pin housing and back out pins through holes in wire seal.

NOTE

An Electrical Terminal Crimp Tool (Part No. AD-29965) is used to install Deutsch pin and socket terminals on wires. If new terminals must be installed, see Crimping Instructions in this section.

3. Fit wire seal into back of pin housing. Grasp crimped pin approximately 1 inch (25.4 mm) behind the contact barrel. Gently push pins through holes in wire seal into their respective numbered locations. Feed pin into chamber until it "clicks" in place. Verify that pin will not back out of chamber; a slight tug on the wire will confirm that it is properly locked in place.

4. Insert tapered end of secondary locking wedge into pin housing and press down until it snaps in place. The wedge fits in the center groove within the pin housing and holds the terminal latches tightly closed.

NOTE

While rectangular wedges do not require a special orientation, the conical secondary locking wedge of the 3-pin connector must be installed with the arrow pointing toward the external latch. See Figure 7-99.

NOTE

If the secondary locking wedge does not slide into the installed position easily, verify that all terminals are fully installed in the pin housing. The lock indicates when terminals are not properly installed by not entering its fully installed position.

ASSEMBLING/INSTALLING

1. Insert socket housing into pin housing until it snaps in place. Two-, three-, four- and six-pin Deutsch connectors have one external latch on the socket half of the connector. To fit the halves of the connector together, the latch on the socket side must be aligned with the latch cover on the pin side.

   For those connectors with two external latches (8-pin and 12-pin), a different system is used to prevent improper assembly. Align the tabs on the socket housing with the grooves on the pin housing. Push the connector halves together until the latches "click." If latches do not click (latch), press on one side of the connector until that latch engages, then press on the opposite side to engage the other latch.

NOTE

*Deutsch connectors are colored coded for location purposes. Those connectors associated with **left** side accessories, such as the front and rear **left** turn signals, are **gray**. All other connectors, including those associated with right side accessories, are black.*

If it should become necessary to replace a plug or receptacle, please note that the 8-pin and 12-pin gray and black connectors are not interchangeable. Since location of the alignment tabs differ between the black and gray connectors, plugs or receptacles must be replaced by those of the same color. If replacing both the socket and pin halves, then the black may be substituted for the gray, and vice versa. The socket and pin halves of all other connectors are interchangeable, that is, the black may be mated with the gray, since the alignment tabs are absent and the orientation of the external latch is the same.

2. Fit the attachment clip to the pin housing, if removed. Place large end of slot on attachment clip over T-stud on frame; push assembly forward to engage small end of slot.

CRIMPING INSTRUCTIONS (Figure 7-100)

1. Squeeze the handles to cycle the crimp tool to the fully open position.

2. Raise locking bar by pushing up on bottom flange. With the crimp tails facing upward and the rounded side of the contact barrel resting on the concave split level area of the crimp tool, insert contact (socket/pin) through middle hole of locking bar.

3. Release locking bar to lock position of contact. If the crimp tails are slightly out of vertical alignment, the crimp tool automatically rotates the contact so that the tails face straight upward. When correctly positioned, the locking bar fits snugly in the space between the contact barrel and the core crimp tails.

4. Strip lead removing 5/32 inch (3.96 mm) of insulation. Insert wires between crimp tails until ends make contact with locking bar. Verify that wire is positioned so that short pair of crimp tails squeeze bare wire strands, while long pair folds over insulation material.

5. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete. Raise up locking bar and remove contact.
6. Inspect the quality of the core and insulation crimps. Distortion should be minimal.

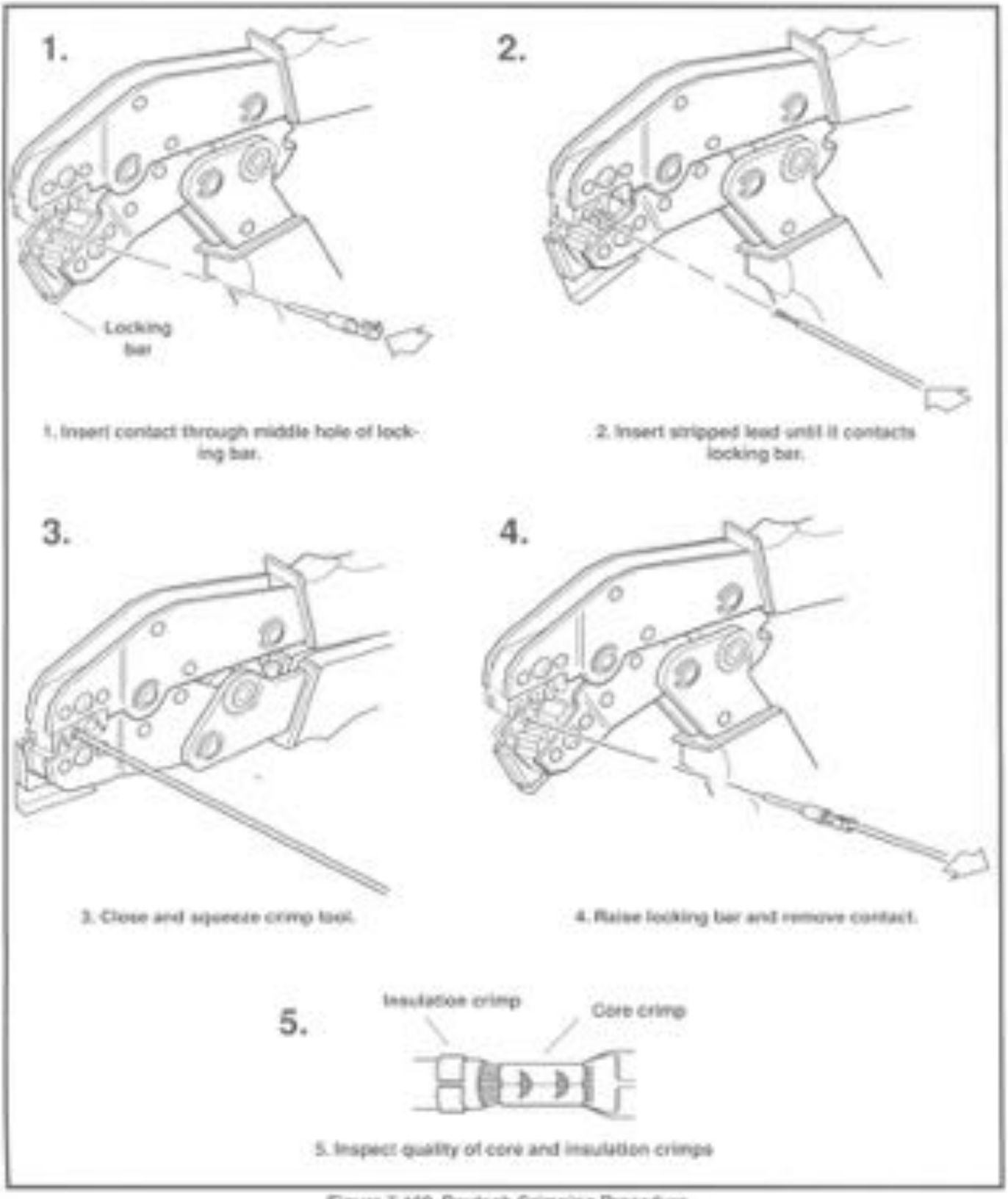


Figure 7-150. Deutsch Crimping Procedure

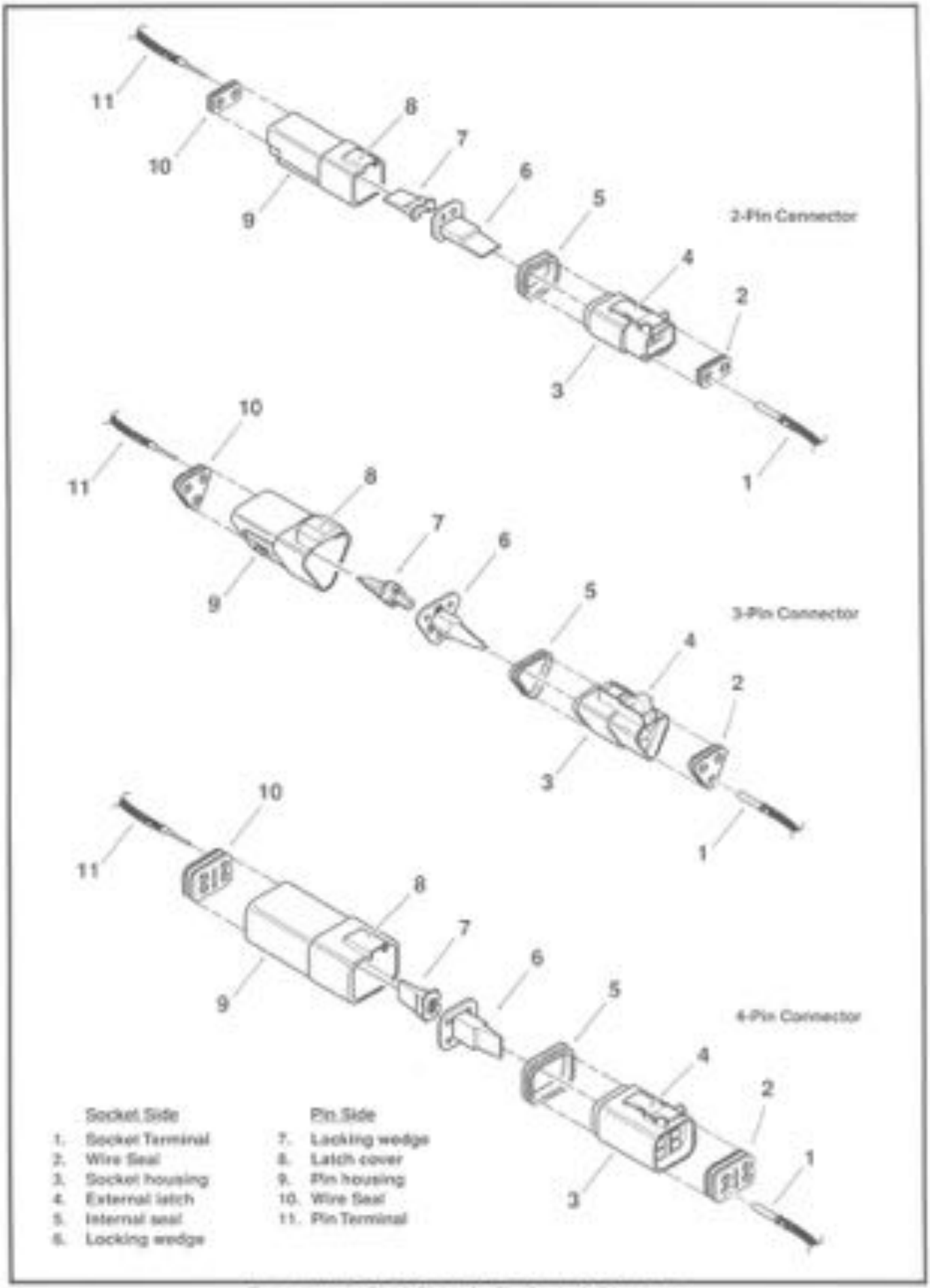


Figure 7-101. 2-Pin, 3-Pin and 4-Pin Deutsch Connectors

AMP MULTILOCK ELECTRICAL CONNECTORS

REMOVING SOCKET/PIN TERMINALS

1. Remove connector from the retaining device, either attachment or rosebud clip.

2. Depress the button on the socket terminal side of the connector (plug) and pull apart the pin and socket halves.

3. Bend back the latch slightly and free one side of secondary lock, then repeat the step to release the other side. Rotate the secondary lock outward on hinge to access terminals in chambers of connector housing.

4. Looking in the terminal side of the connector (opposite the secondary lock), take note of the cavity next to each terminal.

5. See Figure 7-103. With the flat side against the terminal, insert the pick tool (Snap-On TT600-3) into the cavity until it stops. Pivot the end of the pick away from the terminal and gently tug on wire to pull terminal from chamber. Do not tug on the wire until the tang is released or the terminal will be difficult to remove. A "click" is heard if the tang is engaged but then inadvertently released. Repeat the step without releasing the tang.

NOTE

An Electrical Terminal Crimp Tool (Part No. HD-41609) is used to install Amp Multilock pin and socket terminals on wires. If new terminals must be installed, see Crimping Instructions on the next page.

INSTALLING SOCKET/PIN TERMINALS

NOTE

For wire location purposes, numbers are stamped into the secondary locks of both the socket and pin housings. See Figure 7-104.

1. From the secondary lock side of the connector, insert the terminal into its respective numbered chamber until it snaps in place. For proper fit, the slot in the terminal must face the tang in the chamber.

NOTE

The tang in the chamber engages the slot to lock the terminal in position. On the pin side of the connector, tangs are positioned at the bottom of each chamber, so the slot in the pin terminal (on the side opposite the crimp tails) must face downward. On the socket side, tangs are at the top of

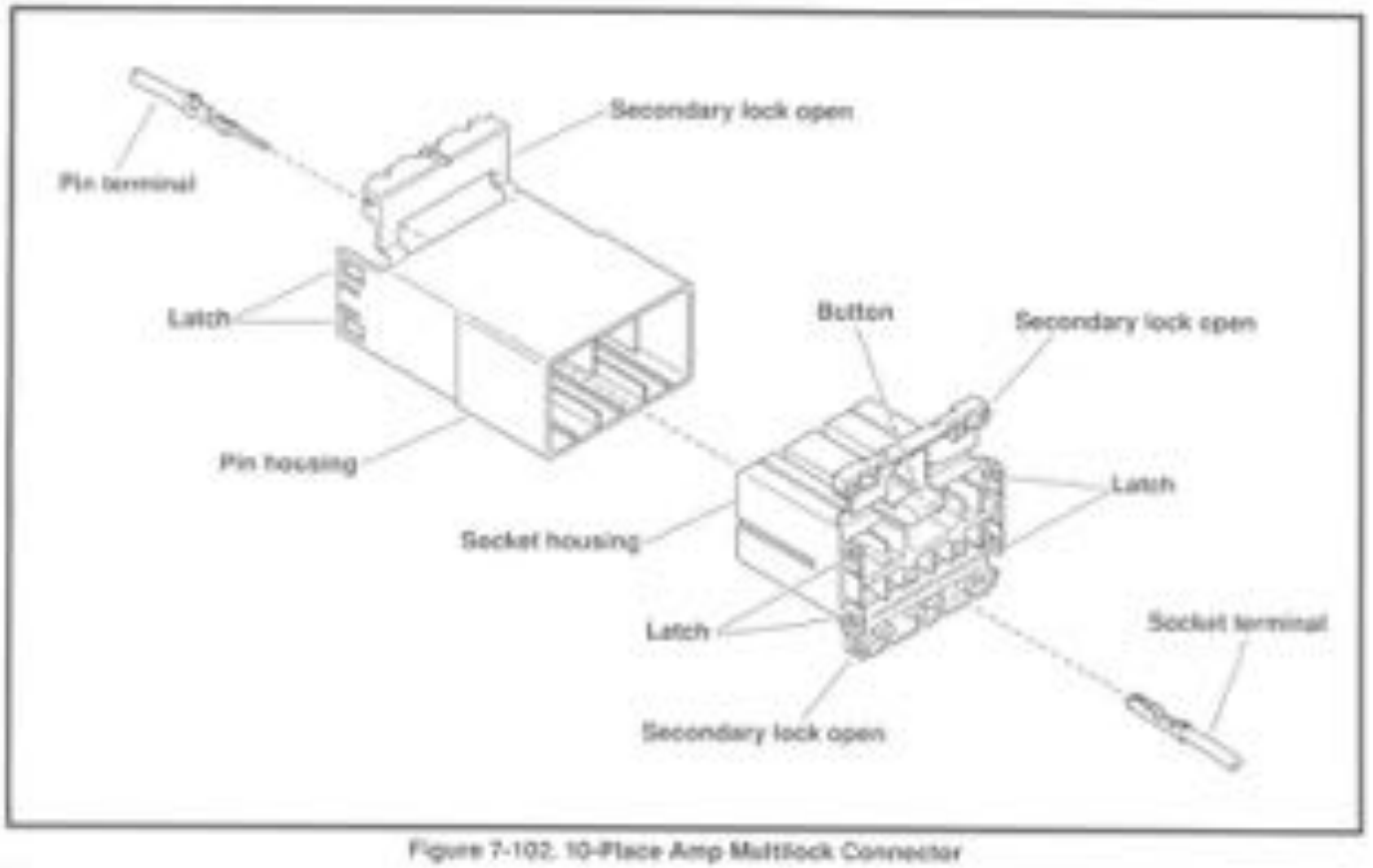


Figure 7-102. 10-Place Amp Multilock Connector

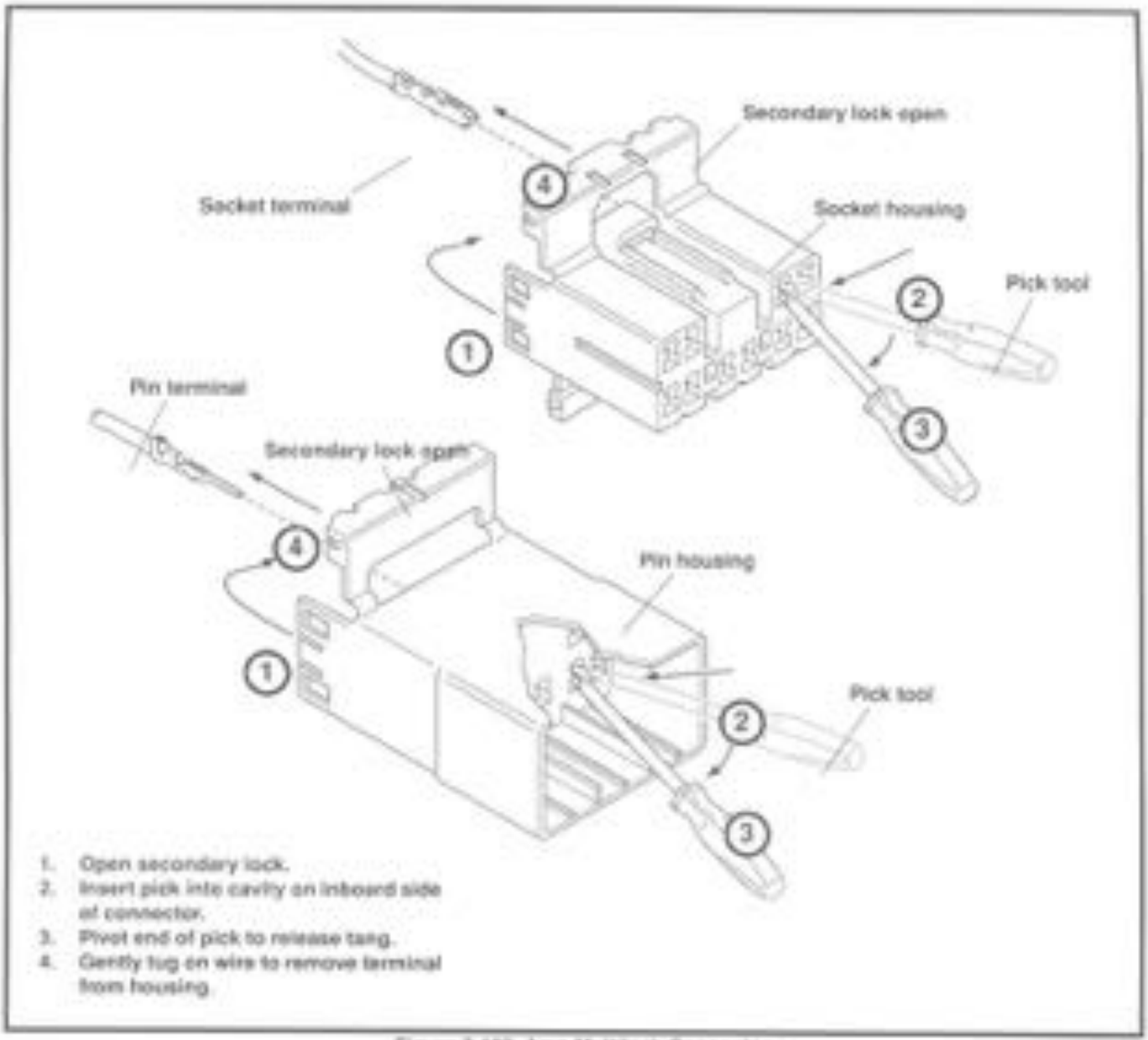


Figure 7-183. Amp Multilock Connector

each chamber, so the socket terminal slot (on the same side as the crimp tabs) must face upward. Up and down can be determined by the position of the release button (used to separate the pin and socket halves); the button always being the top of the connector.

2. Gently tug on wire and to verify that the terminal is locked in place and will not back out of chamber.

3. Rotate the hinged secondary lock inward until tabs fully engage latches on both sides of connector.

4. Insert the socket housing (plug) into the pin housing (receptacle) until it snaps in place.

5. Install connector on retaining device, either attachment or rosebud clip.

CRIMPING INSTRUCTIONS

1. Squeeze the handles to cycle the crimp tool (Part No. HD-41609) to the fully open position.

2. Raise locking bar by pushing up on bottom flange. With the crimp tails facing upward, insert contact (socket/pin) through locking bar, so that the closed side of the contact rests on the front rest (concave split level area of the crimp tool). See Figure 7-185.

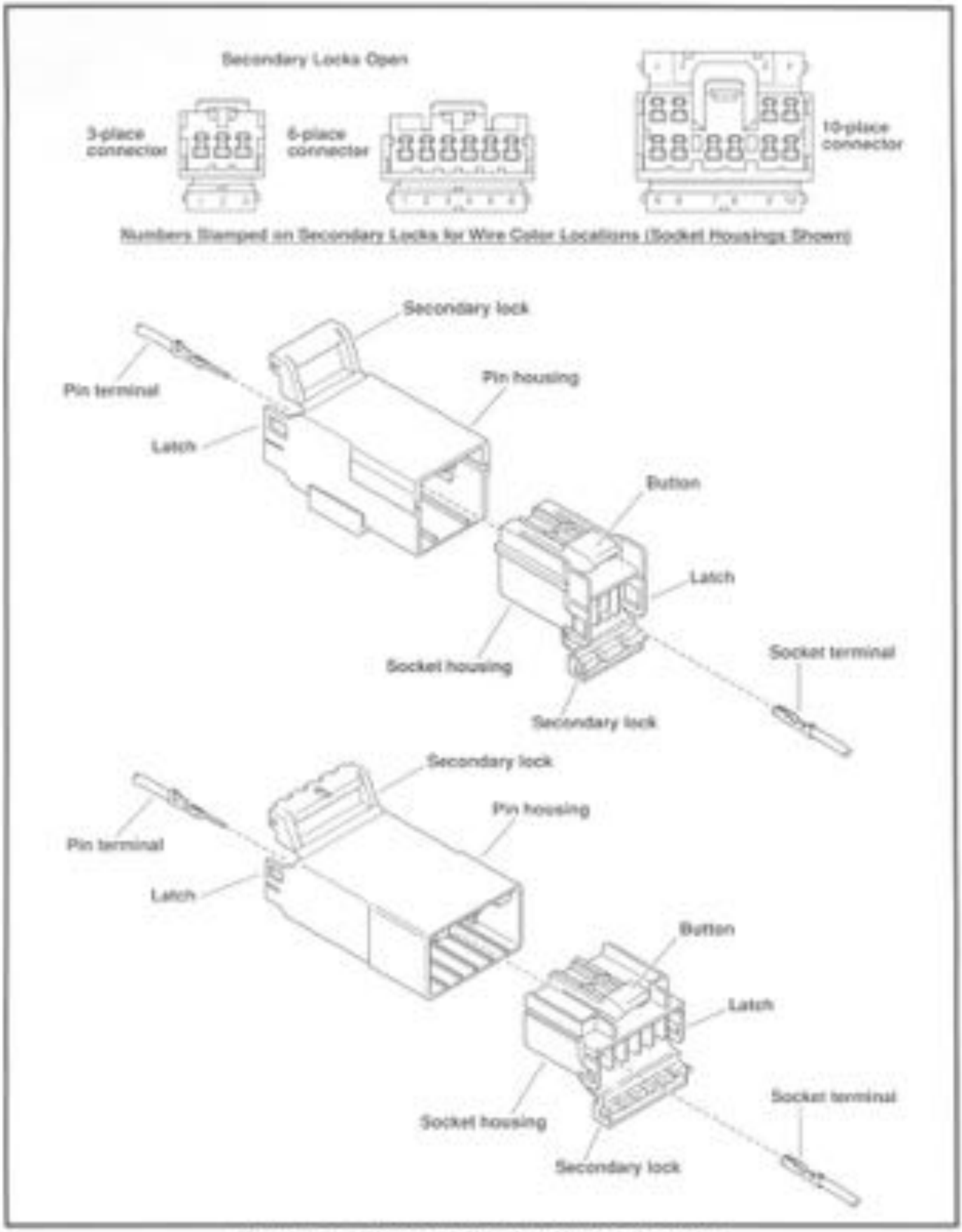


Figure 7-104. 3-Place and 6-Place Amp Multilock Connectors

3. Release locking bar to lock position of contact. When correctly positioned, the locking bar fits snugly in the space at the front of the core crimp tails.

4. Strip lead removing 5/32 inch (4 mm) of insulation. Insert wires between crimp tails until ends make contact with locking bar. Verify that wire is positioned so that short pair of crimp tails squeeze bare wire strands, while long pair folds over insulation material.

5. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete. Raise up locking bar and remove contact.

6. Inspect the quality of the core and insulation crimps. Distortion should be minimal.

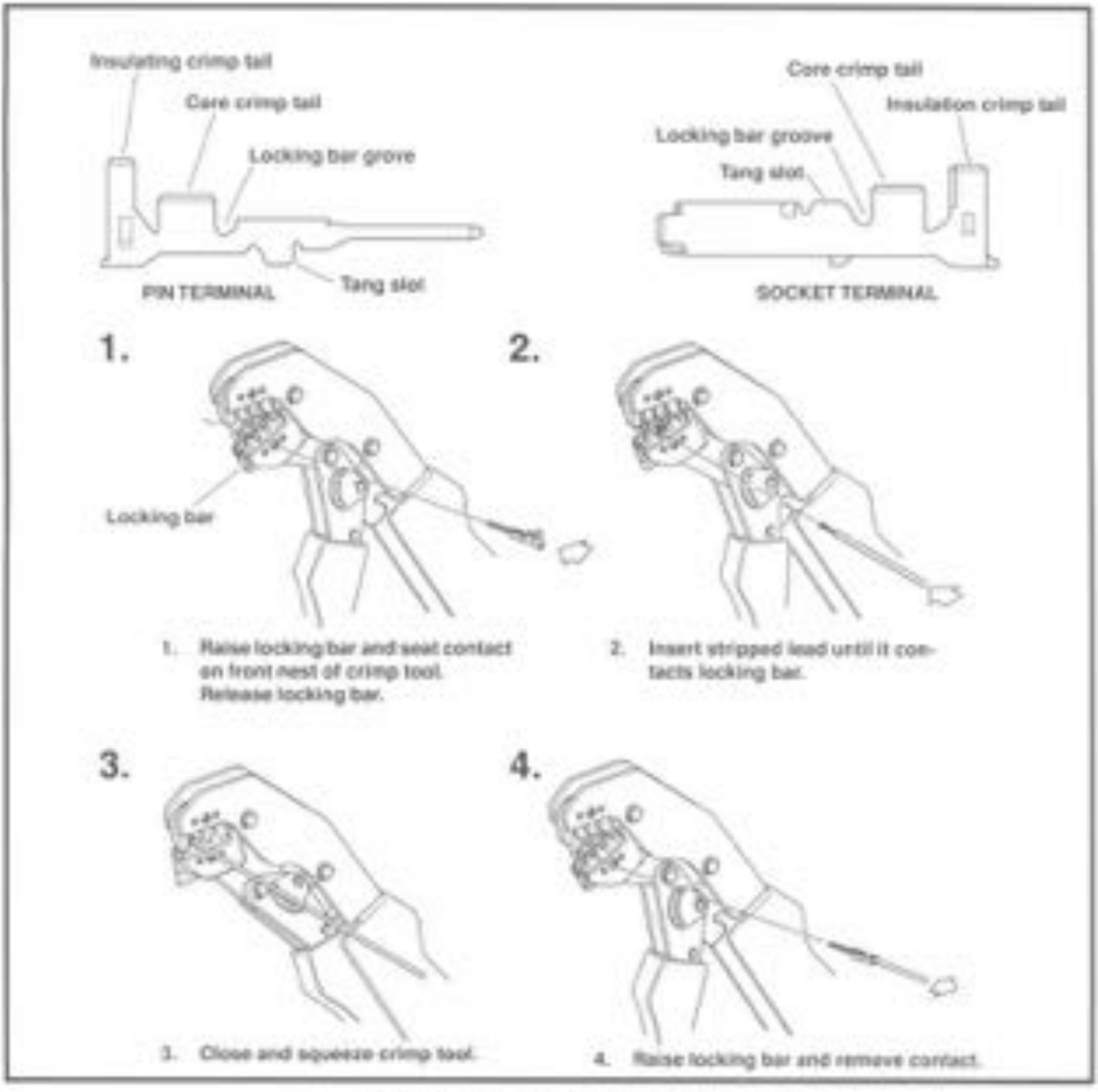


Figure 7-105. Amp Multilock Crimping Procedure

GENERAL

From a servicing standpoint, there are two basic types of Packard electrical connectors, those with pull-to-seat terminals and those with push-to-seat terminals.

Look into the mating end of the connector. If it appears that the terminal can be extracted from this side, then it is probably the pull-to-seat type.

At least one Packard pull-to-seat terminal can be easily recognized by the presence of a locking ear. The ear engages a slot in the connector housing and prevents the terminal from being removed from the wire end side of the connector. The ear also acts as a strain relief in the event that the wires are pulled and further inhibits movement of the terminal inside the chamber. PULL-TO-SEAT TERMINALS)

Unlike most connectors, where the terminals are pulled out the wire end of the connector, to remove the terminals from the pull-to-seat connectors, the terminal is pushed out the mating end of the connector. Once a new terminal is crimped onto the end of the wire, the wire is pulled to draw the terminal back inside the chamber of the connector housing.

The Packard pull-to-seat terminal connectors found on XL model vehicles are listed below.

- Bank Angle Sensor [134]
- 12005 Coil [80]
- MAP Sensor [80]

Packard pull-to-seat electrical connectors have an external latch to lock the pin and socket halves together.

Removing Pull-to-seat Terminals External Latch Type

To remove a pull-to-seat terminal from connectors with external latches, proceed as follows:

1. Remove the connector from the retaining device, if present.
2. Bend back the external latch(es) slightly and separate the pin and socket halves of the connector.
3. To free a pull-to-seat terminal from the connector housing, first look into the mating end of the connector to find the locking tang. See A in Figure 110. The tangs are always positioned in the middle of the chamber and are on the same side as the external latch. On those connectors with locking ears, the tang is on the side opposite the ear.
4. At a slight angle, gently insert the point of a one inch safety pin down the middle of the chamber (about 1/8 inch) and pivot the end of the pin toward the terminal body. When a click is heard, remove the pin and repeat the procedure. See B in Figure 110. The click is the sound of the tang returning to the locked position as it slips from the pairs of the pin. Pick at the tang in this manner until the clicking stops and the pin seems to slide in at a slightly greater depth than it had previously. This is an indication that the tang has been depressed.

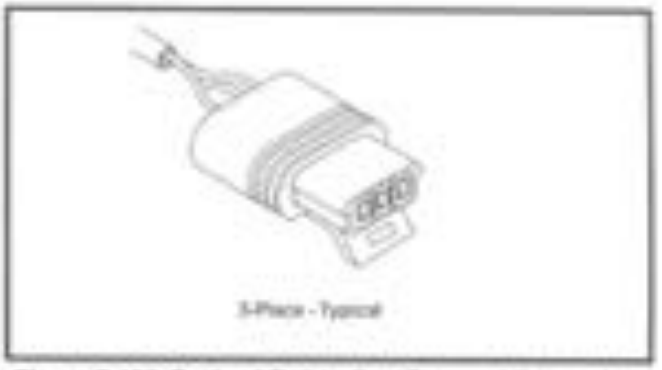


Figure 7-106. Packard Pull-to-Seat Terminal Connectors (Socket Sides)

NOTE

On those terminals that have been extracted on a previous occasion, no clicking sound may be heard when the pin is pivoted to depress the tang, but proceed as if the clicking is audible and then push on the wire end of the lead to check if the terminal is free.

NOTE

When picking multiple terminals, the end of the pin may become malleable. For best results, continue the procedure with a new safety pin.

5. Remove the pin and push on the wire end of the lead to extract the terminal from the mating end of the connector. See C in Figure 110. If necessary, pull back the conduit and remove the wire seal at the back of the connector to introduce some slack in the wires.

NOTE

A series of Packard Electrical Terminal Crimp Tools are available to install Packard pin and socket terminals on wires. If new terminals must be installed, see Crimping Instructions on page 7-121.

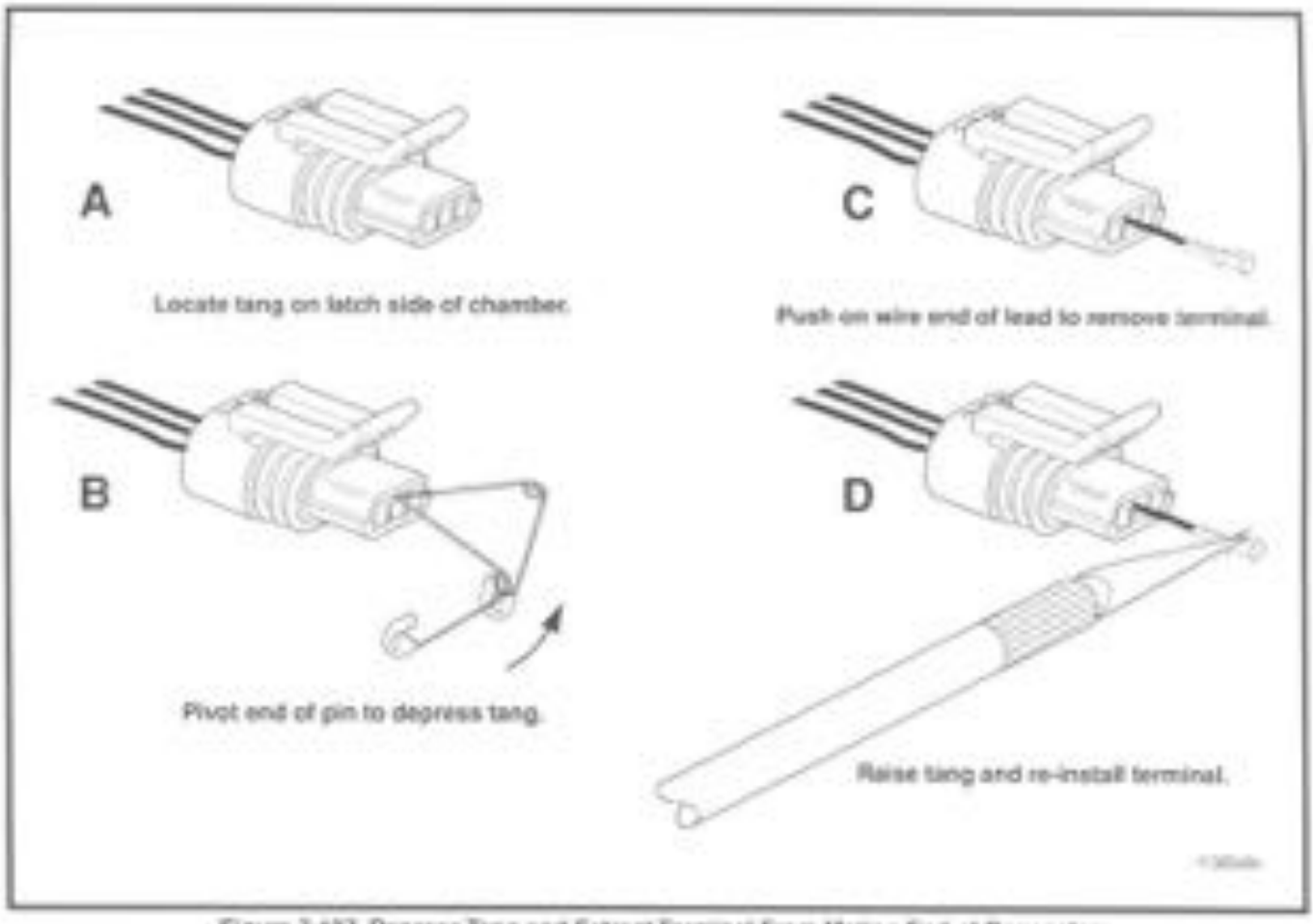


Figure 7-127. Depress Tang and Extract Terminal From Mating End of Connector

Installing Pull-to-seat Terminals External Latch Type

NOTE

For wire location purposes, alpha characters are stamped into the socket housings.

1. To install a terminal back into the chamber of the connector housing, use a thin flat blade, like that on an X-Acto knife, and carefully bend the tang outward away from the terminal body. See D in Figure 1-D.
2. Gently pull on the lead at the wire end of the connector to draw the terminal back into the chamber. A click is heard when the terminal is properly seated.
3. Push on the lead to verify that the terminal is locked in place.
4. Push the pin and socket halves of the connector together until the latches "click."

CRIMPING INSTRUCTIONS

1. Strip wire lead removing 5/32 inch (4 mm) of insulation.
2. Compress handles until ratchet automatically opens.

NOTE

Always perform core crimp before insulation/seal crimp.

3. Determine the correct dye or nest for the core crimp based on the information presented in the Crimp Tables.

INSTALLING SEALED BUTT CONNECTORS

Butt splicing is a necessary procedure for replacement of several components. These components are:

- Ignition switch
- Indicator (icon) lamps

Proceed as follows:

1. Strip 3/8 inch of insulation off the ends of the wires.
2. Insert wires into opposite ends of the butt splice connector (see Figure 7-108). Feed the wires into the connector until the stripped ends are housed within the metal insert. Since the size of the connectors vary with the gauge of the wire, reference the following table to ensure properly sealed splices.
3. Crimp the wires within the connector using the Packard Crimp Tool (HD-38125-B). Be sure to match the color or gauge wire marked on the butt splice connector with the corresponding crimp cavity on the crimp tool (see Figure 7-85).

NOTE

If adjacent wires are being spliced, stagger the splices so that the butt splice connectors are spaced at different positions along the length of the wires.

⚠WARNING

Use extreme caution when operating the UltraTorch UT-100 or any other radiant heating device. Read the manufacturers instructions carefully before use. Improper handling can result in personal injury and/or vehicle damage. Always keep hands aways from tool tip area and heat shrink attachment. Avoid directing the heat toward any fuel system component. Extreme heat can cause fuel ignition/explosion. Avoid directing heat toward any electrical system component other than the connectors on which heat shrink work is being performed. Be sure to turn the "ON/OFF" switch to the "OFF" position after use.

4. Using the UltraTorch UT-100 (HD-39969), Robinair Heat Gun (HD-25070) with heatshrink attachment (HD 41182) or other suitable radiant heating device, heat the crimped splice to encapsulate the butt splice connection. Apply heat from the center of the crimp out to each end until the meltable sealant exudes out both ends of the connector (see Figure 7-108).

NOTE

It is acceptable for the splice to rest against the heat shrink tool attachment.

5. Heat the center of the splice until the crimp indentations disappear and the tubing assumes a smooth cylindrical appearance.

Gauge Wire	Connector Color	Part Number
18-20	Red	P/N 70585-93
14-16	Blue	P/N 70586-93
10-12	Yellow	P/N 70587-93

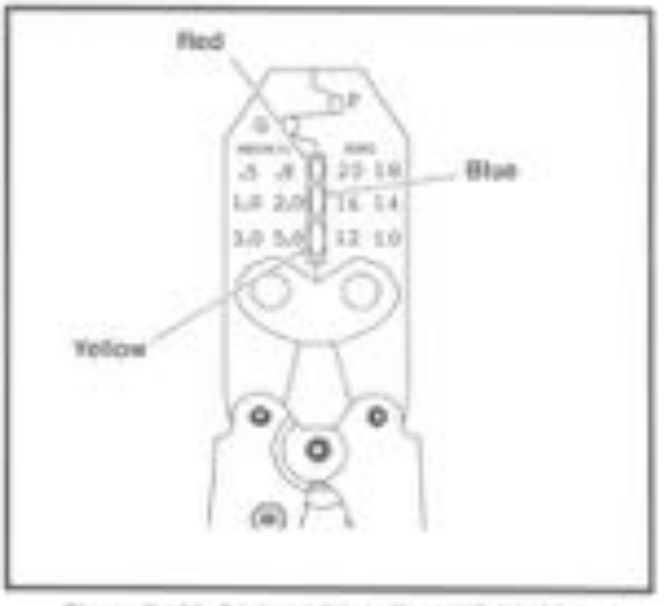


Figure 7-109. Packard Crimp Tool (HD-38125-B)

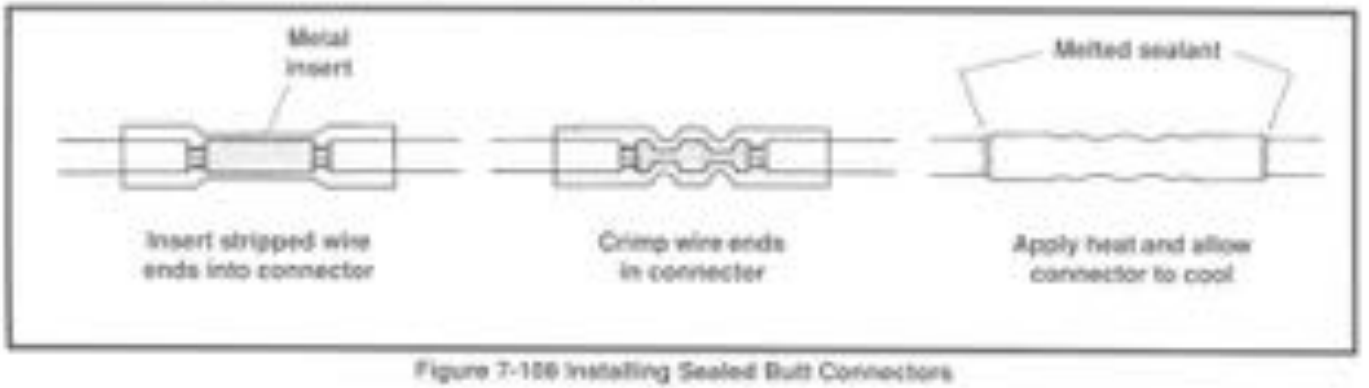


Figure 7-108 Installing Sealed Butt Connectors

CRIMP TABLES

Table 1. 1998 Components

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
IGNITION MODULE (14C) [illegible]	ALL	72190-94	DTT 16-00	18	CENTER POSITION	CENTER POSITION
CAM POSITION SENSOR (14A) [illegible]	ALL	72190-94	DTT 16-00	18	CENTER POSITION	CENTER POSITION
TRAP DOOR SOLENOID (14A)	ALL	[illegible]	PACKARD [illegible]	20	E	E
REAR LIGHTING (7B)	ALL	72191-98	HD-41609	18	REAR POSITION	REAR POSITION
REAR DIRECTIONALS (18B, 19B)	ALL	72191-98	HD-41609	18	REAR POSITION	REAR POSITION
V.O.E.S. (11B)	ALL	72191-94	DTT 16-00	18	CENTER POSITION	CENTER POSITION
FRONT DIRECTIONALS (31B)	ALL	72191-98	HD-41609	18	REAR POSITION	REAR POSITION
HEADLAMP (XL CUSTOM ONLY) (38B)	ALL	72191-98	HD-41609	18	MIDDLE POSITION	MIDDLE POSITION
INSTRUMENT CLUSTER (20B)	ALL	72191-98	HD-41609	18	REAR POSITION	REAR POSITION
LEFT HANDLEBAR CONTROL (24B)	ALL	72191-94	DTT 16-00	18	CENTER POSITION	CENTER POSITION
RIGHT HANDLEBAR CONTROL (22B)	ALL	72191-94	DTT 16-00	18	CENTER POSITION	CENTER POSITION
SPEED SENSOR (65A)	ALL	72190-94	DTT 16-00	20 (a)	CENTER POSITION	CENTER POSITION
SPEED SENSOR (65B)	ALL	72191-94	DTT 16-00	20 (a)	CENTER POSITION	CENTER POSITION
SPEEDOMETER TERMINALS		72191-94 (a)	PACKARD 271	18	C	A
POSITION LAMP		9868	PACKARD 271		TIP	
POSITION LAMP		9868	PACKARD 115		TIP	
HEADLAMP 68733-93A	ALL	70896-93 (j)	PACKARD 115	16	16-14 GA.	
REGULATOR (77B)		72197-94	HD-42879	12	12	

Table 2. 1998 XL Custom Main Wiring Harness, Part No. 70153-98

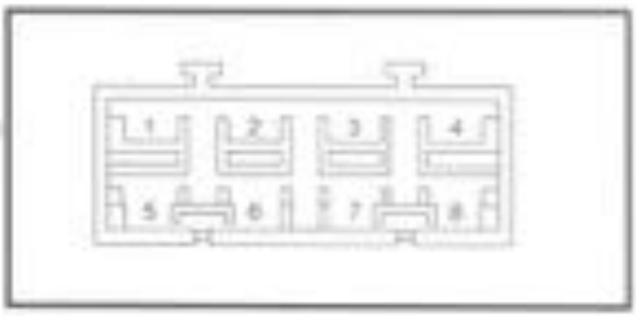
CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
STARTER TERMINAL		9867 (a)	PACKARD 275,271	12	A	3
CIRCUIT BREAKER TERMINAL (BK)		9863 (a)	PACKARD 275,271	14	B	3
CIRCUIT BREAKER TERMINAL (2-R)		9868 (h)	PACKARD 115	12/14	12-10 GA. (h)	12-10 GA. (h)
STARTER RELAY (86,86 R)	85,86	9907	PACKARD 271	18	C	3
STARTER RELAY (5/BK)	30	9907	PACKARD 271	12	C	4
STARTER RELAY (2-GN)	87	9907 (h)	PACKARD 271	14/16	C (h)	A (h)
FUSE BLOCK (2-GY)	1	72019-94 (h)	PACKARD 271	16, 18	[illegible] (h)	B (h)
FUSE BLOCK (2)	2	72017-94	PACKARD 271	18	E	4
FUSE BLOCK (2-BE)	3	72033-94 (h)	PACKARD 271	16	A (h)	G (h)
FUSE BLOCK (2-GN)	4	72033-94 (h)	PACKARD 271	16	A (h)	G (h)
FUSE BLOCK (2-R/BK)	5	72033-94 (h)	PACKARD 271, 115	14	A (h)	G (h)
FUSE BLOCK (2-W/BK)	6	72033-94 (h)	PACKARD 271, 115	14	A (h)	G (h)
FUSE BLOCK (R/BK)	7	72018-94	PACKARD 271	14	C	4
FUSE BLOCK (R/GY)	8	72018-94	PACKARD 271	14	C	4
OIL PRESSURE SENDING UNIT		72[illegible]-94 (a) (e)	PACKARD 271	18	C	4
REAR STOP LIGHT SWITCH (O/W)		9907 (b)	PACKARD 271	18	F	D
REAR STOP LIGHT SWITCH (V/W)		9907 (b)	PACKARD 271	18	C (h)	F (h)
MAIN GROUND-CHASSIS		9865	PACKARD 115	14	16-14 GA.	16-14 GA.
MAIN GROUND-CHASSIS (2-BK)		72242-94 (a)	PACKARD 115,275	14/16 (h)	G (h)	3 (h)
SOLENOID		72091-94	PACKARD 271, 115	16	E	G
HORN		9868	PACKARD 271	18	TIP	4
HORN		9866	PACKARD 115	18	TIP	4
NEUTRAL SWITCH		9865	PACKARD 115	18	20-18 GA.	20-18 GA.
OIL (W/BK)		72041-94 (a)	PACKARD 271	18	C (a)	4
TAIL LIGHT (7A)	ALL	72190-98	HD-41609	18	REAR POSITION	REAR POSITION
EVAP SOLENOID (CAL) [illegible]	B,C	72190-98	DTT 16-00	18	REAR POSITION	REAR POSITION
EVAP SOLENOID (CAL) [illegible]	A	72190-98	DTT 16-00	18	CENTER POSITION	CENTER POSITION
TO V.O.E.S. (11A)	ALL	72190-94	DTT 16-00	18	CENTER POSITION	CENTER POSITION
TO IGNITION MODULE (14B)	EXCEPT 8	72191-94	DTT 16-00	18	CENTER POSITION	CENTER POSITION
TO IGNITION MODULE (14B)	8	72191-94	DTT 16-00	18	CENTER POSITION	CENTER POSITION
TO REAR DIRECTIONALS (18A, 19A)	ALL	72190-98	DTT 16-00	18	REAR POSITION	REAR POSITION
INSTRUMENT CLUSTER (20A)	EXCEPT 1	72190-98	HD-41609	18	REAR POSITION	REAR POSITION
INSTRUMENT CLUSTER (20A)	1	72190-98	HD-41609		CENTER POSITION	CENTER POSITION
TO RIGHT HAND CONTROLS (22A)	EXCEPT 3	72190-94	DTT 16-00	18	CENTER POSITION	CENTER POSITION
TO RIGHT HAND CONTROLS (22A)	3	72190-94	DTT 16-00	18	CENTER POSITION	CENTER POSITION
TO LEFT HAND CONTROLS (24A)	1,3,6	72190-94	DTT 16-00	18	CENTER POSITION	CENTER POSITION
TO LEFT HAND CONTROLS (24A)	2,5,4	72190-94	DTT 16-00	18	CENTER POSITION	CENTER POSITION
TO TURN SIGNAL MODULE (30A)	EXCEPT 2	72190-94	DTT 16-00	18	CENTER POSITION	CENTER POSITION
TO TURN SIGNAL MODULE (30A)	2	72190-94	DTT 16-00	18	CENTER POSITION	CENTER POSITION
HEADLAMP (38A)	1	72190-98	HD-41609	18	REAR POSITION	REAR POSITION
HEADLAMP (38A)	2,3,4	72190-98	HD-41609	18	CENTER POSITION	CENTER POSITION
FRONT TURN SIGNALS (31A)	ALL	72190-98	HD-41609	18	REAR POSITION	REAR POSITION
HEADLAMP 68733-93A	ALL	70896-93 (j)	PACKARD 115	16	16-14 GA.	
IGNITION SWITCH/KEY [illegible]	ALL	70896-93 (j)	PACKARD 115	14	16-14 GA.	
BANK ANGLE SENSOR (134B)	All	72033-95	PACKARD 271	18	E	G
REGULATOR (77A)		72198-94	HD-42879	12	12	

CRIMP TABLES

Table 3. 1998 XL Main Wiring Harness, Part No. 70135-98

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
STARTER TERMINAL		9947 (z)	PACKARD 272,271	10	B	3
CIRCUIT BREAKER TERMINAL (BK)		9940 (z)	PACKARD 272,271	10	B	3
CIRCUIT BREAKER TERMINAL (2 R)		9886 (h)	PACKARD 115	12,14	12-13 GA (h)	13-14 GA (h)
STARTER RELAY (BK,BK/R)	85,86	9937	PACKARD 271	18	C	D
STARTER RELAY (R/BK)	30	9937	PACKARD 271	18	C	A
STARTER RELAY (2 GA)	87	9937 (h)	PACKARD 271	14,18	C (h)	B (h)
FUSE BLOCK (2 GY)	1	72219-94 (h)	PACKARD 271	16, 18	C (h)	B (h)
FUSE BLOCK (O)	2	72217-94	PACKARD 271	18	E	A
FUSE BLOCK (2 BE)	3	72220-94 (h)	PACKARD 271	18	A (h)	D (h)
FUSE BLOCK (2 O/W)	4	72220-94 (h)	PACKARD 271	18	A (h)	D (h)
FUSE BLOCK (2 R/BK)	5	72220-94 (h)	PACKARD 271,115	18	A (h)	D (h)
FUSE BLOCK (2 R/BK)	6	72220-94 (h)	PACKARD 271,115	16	A (h)	D (h)
FUSE BLOCK (R/BK)	7	72218-94	PACKARD 271	16	C	A
FUSE BLOCK (R/GY)	8	72218-94	PACKARD 271	16	C	A
OIL PRESSURE SENDING UNIT		72041-94 (a) (z)	PACKARD 271	18	C	A
REAR STOP LIGHT SWITCH (2 R)		9937 (b)	PACKARD 271	18	C	C
REAR STOP LIGHT SWITCH (2 R/Y)		9937 (b)	PACKARD 271	18	C (h)	D (h)
MAIN GROUND CHASSIS		9893	PACKARD 115	16	16-14 GA	16-14 GA
MAIN GROUND CHASSIS (2 BK)		72042-96 (q)	PACKARD 115,270	14,18 (h)	D (h)	3 (h)
SOLENOID		72091-94	PACKARD 271,115	14	A	C
HORN		9868	PACKARD 271	18	TW	A
HORN		9858	PACKARD 115	16	TM	A
NEUTRAL SWITCH		9403	PACKARD 115	16	20-16 GA	20-16 GA
COIL		72041-94 (q)	PACKARD 271	14	D (q)	A
COIL (2 PK)		72041-94 (h)(q)	PACKARD 271	18	A (h)	B (h)
TAIL LIGHT (7A)	ALL	72133-94	HD-41609	18	REAR POSITION	REAR POSITION
EVAP SOLENOID (CAL.) (6A)	B-C	72190-94	DTT 16-20	18	REAR POSITION	REAR POSITION
EVAP SOLENOID (CAL.) (6A)	A	72190-94	DTT 16-20	18	CENTER POSITION	CENTER POSITION
TO V.O.E.S. (11A)	ALL	72190-94	DTT 16-20	18	CENTER POSITION	CENTER POSITION
TO IGNITION MODULE (14B)	EXCEPT 6	72191-94	DTT 16-20	18	CENTER POSITION	CENTER POSITION
TO IGNITION MODULE (14B)	6	72191-94	DTT 16-20	18	CENTER POSITION	CENTER POSITION
TO REAR DIRECTIONALS (18A,19A)	ALL	72190-94	DTT 16-20	18	REAR POSITION	REAR POSITION
INSTRUMENT CLUSTER (20A)	EXCEPT 1	72190-94	HD-41609	18	REAR POSITION	REAR POSITION
INSTRUMENT CLUSTER (20A)	1	72190-94	HD-41609		CENTER POSITION	CENTER POSITION
TO RIGHT HAND CONTROLS (22A)	EXCEPT 3	72190-94	DTT 16-20	18	CENTER POSITION	CENTER POSITION
TO RIGHT HAND CONTROLS (22A)	3	72190-94	DTT 16-20	18	CENTER POSITION	CENTER POSITION
TO LEFT HAND CONTROLS (24A)	1,5,6	72190-94	DTT 16-20	18	CENTER POSITION	CENTER POSITION
TO LEFT HAND CONTROLS (24A)	2,3,4	72190-94	DTT 16-20	18	CENTER POSITION	CENTER POSITION
TO TURN SIGNAL MODULE (30A)	EXCEPT 3	72190-94	DTT 16-20	18	CENTER POSITION	CENTER POSITION
TO TURN SIGNAL MODULE (30A)	3	72145-94	DTT 16-20	18	CENTER POSITION	CENTER POSITION
FRONT TURN SIGNALS (31A)	ALL	72190-94	HD-41609	18	REAR POSITION	REAR POSITION
HEADLAMP W/TO 93A	Y	72588-93 (j)	PACKARD 115	16	14-16 GA	
HEADLAMP W/TO 93A	W,BK	72588-93 (j)	PACKARD 115	16,18	14-16 GA	
IGNITION SWITCH KIT 71441-99	ALL	70685-93 (j)(h)	PACKARD 115	14	14-16 GA	
BANK ANGLE SENSOR (134B)	All	72023-93	PACKARD 271	18	E	C
REGULATOR (77A)		72198-94	HD-42879	12	12	

Crimp Table Legend
(a) - requires solder after crimping
(b) - 9937 terminals require use of 72249-94 heat shrink tubing
(h) - double lug crimp
(j) - heat sealed butt splice connector
(q) - requires use of 72249-94 heat shrink tube
(z) - use with 7629 nut



The cavity numbers or positions in the fuse block are identified in the above illustration.

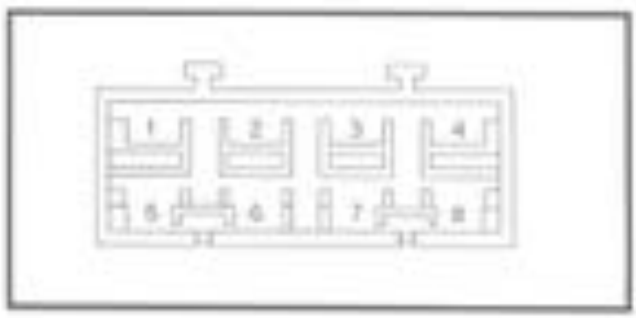
CRIMP TABLES

Table 4. 1997 XL Sport Main Wiring Harness, Part No. 70139-98

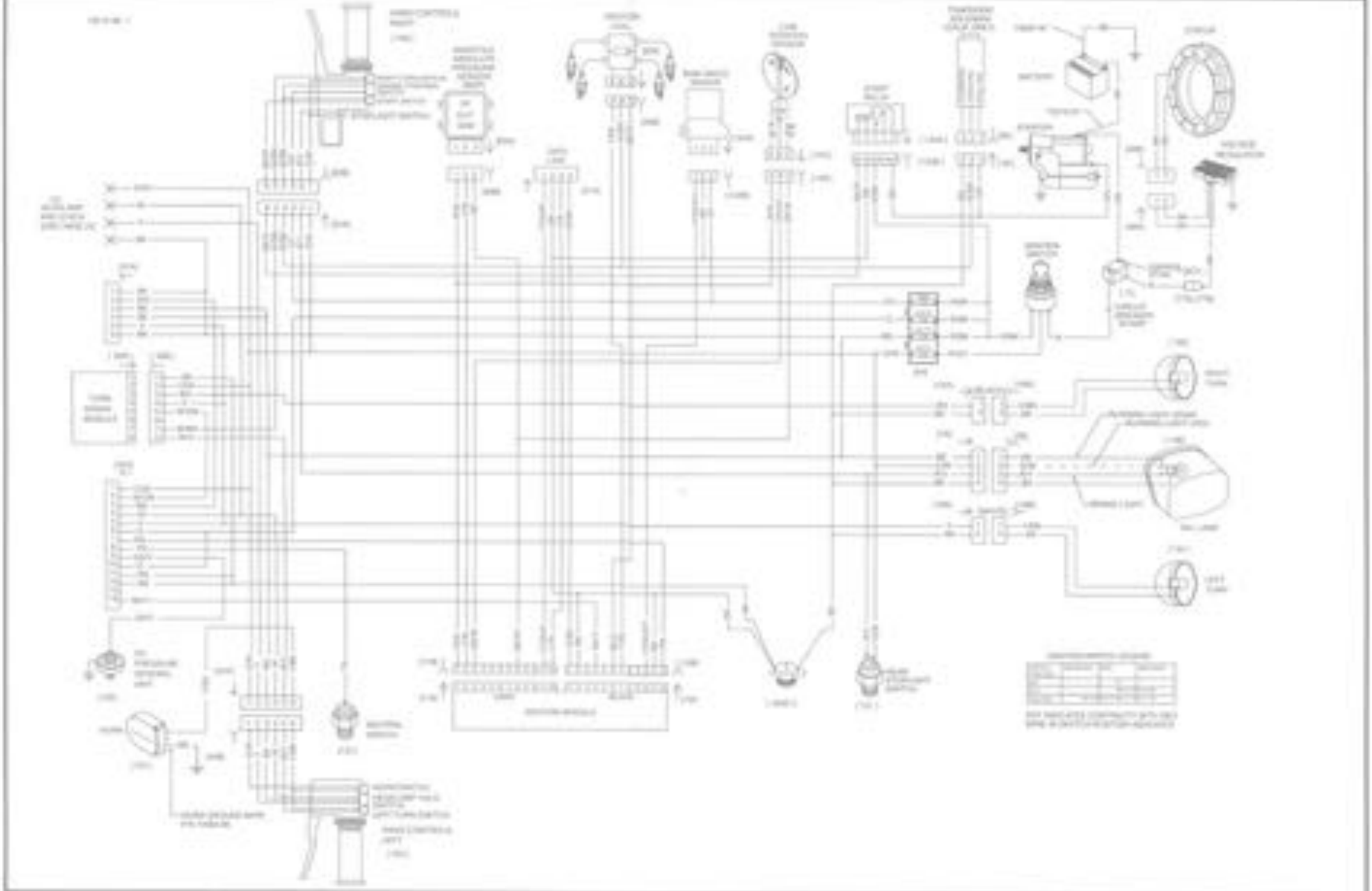
CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
STARTER TERMINAL		8942 (a)	PACKARD 270,271	12	8	3
CIRCUIT BREAKER TERMINAL (8K)		9840 (a)	PACKARD 270,271	14	8	3
CIRCUIT BREAKER TERMINAL (2-R)		9865	PACKARD 115	12-14	12-10 GA	12-10 GA (h)
STARTER RELAY (85,86,R)	85,86	9937	PACKARD 271	18	C	D
STARTER RELAY (R/BK)	30	9937	PACKARD 271	14	C	A
STARTER RELAY (2-[illegible])	87	9937	PACKARD 271	12,18	E (h)	A (b)
FUSE BLOCK (2-O/Y)	1	72217-94	PACKARD 271	14,18	C (h)	B (h)
FUSE BLOCK (2-O)	2	72218-94	PACKARD 271	14	C (h)	B (h)
FUSE BLOCK (2-R)	3	72218-94	PACKARD 271	14	C (h)	B (h)
FUSE BLOCK (2-O/W)	4	72218-94	PACKARD 271	14	E (h)	B (h)
FUSE BLOCK (2-[illegible]/BK)	5	72220-94	PACKARD 271,115	12	E (h)	D (h)
FUSE BLOCK (2-[illegible]/BK)	6	72220-94	PACKARD 271,115	14	E (h)	D (h)
FUSE BLOCK (R/BK)	7	72218-94	PACKARD 271	14	C	A
FUSE BLOCK (R/GY)	8	72218-94	PACKARD 271	14	C	A
OIL PRESSURE SENDING UNIT		9887 (x)	PACKARD 114	18	C	A
REAR STOP LIGHT SWITCH (2-W)		9937 (b)	PACKARD 271	18	C	D
REAR STOP LIGHT SWITCH (1-R/Y)		9937 (b)	PACKARD 271	18	C (h)	D (h)
MAIN GROUND CHASSIS		9863	PACKARD 115	14	16-14 GA	16-14 GA
MAIN GROUND CHASSIS (2-BK)		72241-94 (a)	PACKARD 115,270	14,10(h)	D (h)	A (h)
NO RADIO		72201-94	PACKARD 271,115	16	B	D
HORN		9856	PACKARD 271	16	TIP	A
HORN		9808	PACKARD 114	16	TIP	A
NEUTRAL SWITCH		9905	PACKARD 115	16	20-18 GA	20-18 GA
VSS (130B)	ALL	72228-93	PACKARD 271	16	E	C
TAIL LIGHT (7A)	ALL	72198-96	HD 41609	16	REAR POSITION	REAR POSITION
EVAP SOLENOID (CAL.) ([illegible])	B,D	72198-96	DTT 16-00	18	REAR POSITION	REAR POSITION
EVAP SOLENOID (CAL.) ([illegible])	B	72190-96	DTT 16-00	18	CENTER POSITION	CENTER POSITION
CAM POSITION SENSOR (14B)	ALL	72191-94	DTT 16-00	18	CENTER POSITION	CENTER POSITION
MAP SENSOR (80B)	ALL	72113-94 (x)	PACKARD 271, 270	18	E	1
IGNITION MODULE (10B, 28L)	EXCEPT 2,11	72191-94	DTT 16-00	18	CENTER POSITION	CENTER POSITION
IGNITION MODULE (10B, 28L)	2,11	72191-94	DTT 16-00	18	REAR POSITION	REAR POSITION
IGNITION MODULE ([illegible])	ALL	72191-9[illegible]	DTT 16-00	18	REAR POSITION	REAR POSITION
REAR DIRECTIONALS (18A, 19A)	ALL	72190-94	DTT 16-00	18	CENTER POSITION	CENTER POSITION
INSTRUMENT CLUSTER (20A)	EXCEPT 1	72190-94	HD 41609	18	CENTER POSITION	CENTER POSITION
INSTRUMENT CLUSTER (20A)	1	72189-94	HD 41609	18	CENTER POSITION	CENTER POSITION
RIGHT HAND CONTROLS (22A)	EXCEPT 2	72190-94	DTT 16-00	18	CENTER POSITION	CENTER POSITION
RIGHT HAND CONTROLS (22A)	2	72190-94	DTT 16-00	18	CENTER POSITION	CENTER POSITION
LEFT HAND CONTROLS (24A)	1,5,6	72189-94	DTT 16-00	18	CENTER POSITION	CENTER POSITION
LEFT HAND CONTROLS (24A)	2,3,4	72190-94	DTT 16-00	18	CENTER POSITION	CENTER POSITION
TURN SIGNAL MODULE (30A)	EXCEPT 2	72190-94	DTT 16-00	18	CENTER POSITION	CENTER POSITION
TURN SIGNAL MODULE (30A)	2	72190-94	DTT 16-00	16	CENTER POSITION	CENTER POSITION
FRONT TURN SIGNALS	ALL	72190-94	HD 41609	18	REAR POSITION	REAR POSITION
HEADLAMP 68725-93A	7	70586-93 (l)	PACKARD 115	12	14-16 GA	
HEADLAMP 68725-93A	W,BK	70586-93 (l)	PACKARD 115	14-16	14-16 GA	
IGNITION SWITCH KIT 71441-[illegible]	ALL	70586-93 (l)	PACKARD 115	14	14-16 GA	
BANK ANGLE SENSOR (134B)	ALL	72223-93	PACKARD 271	18	E	C
REGULATOR (77A)		72199-94	HD 42879	12	12	

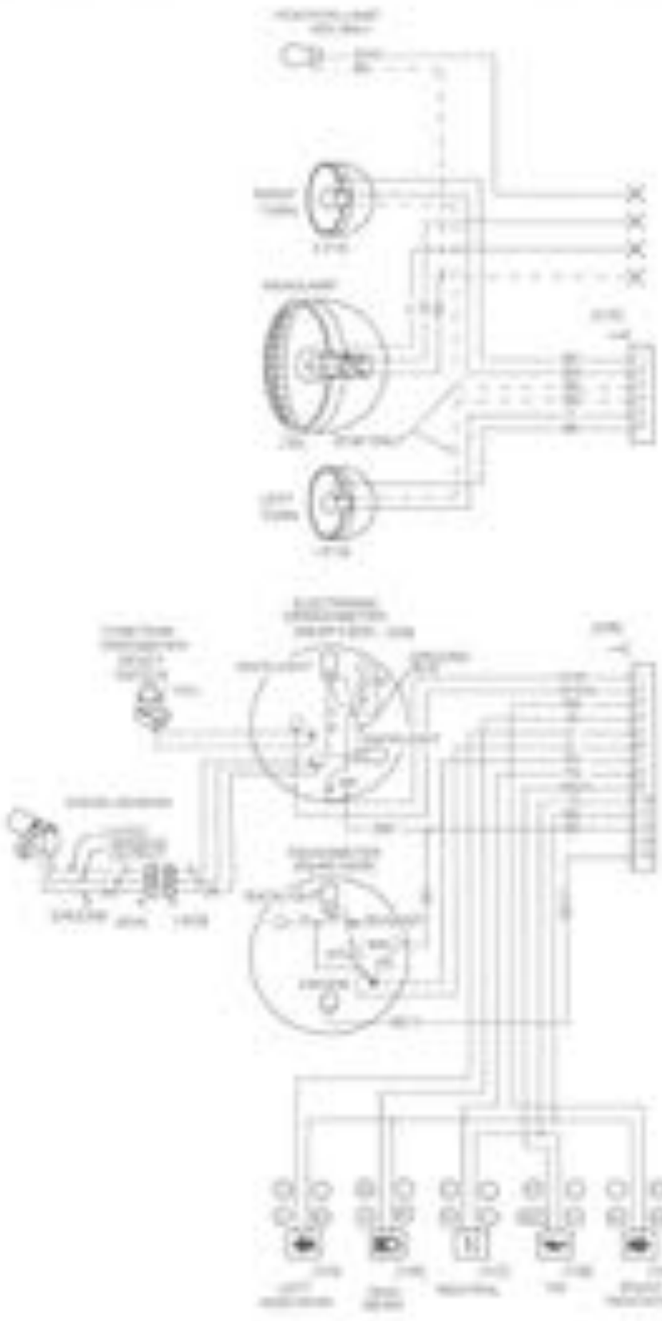
Crimp Table Legend

(a) - requires solder after crimping
(b) - 9937 terminals require use of 72249-94 heat shrink tubing
(h) - double lug crimp
(j) - heat sealed butt splice connector
(q) - requires use of 72249-94 heat shrink tube
(x) - use 72214-94 seal
(l) - use with 7629 nut



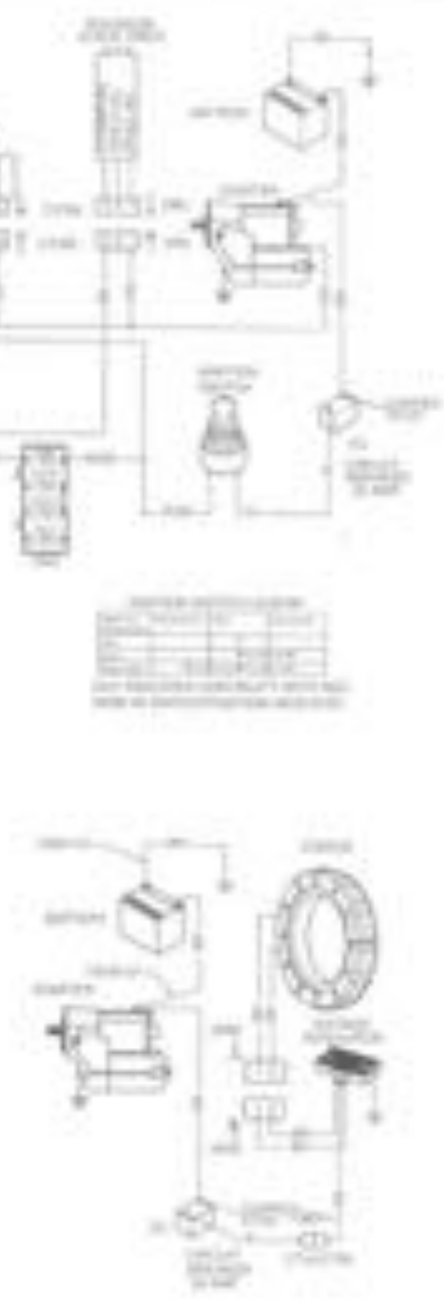
The cavity numbers or positions in the fuse block are identified in the above illustration.



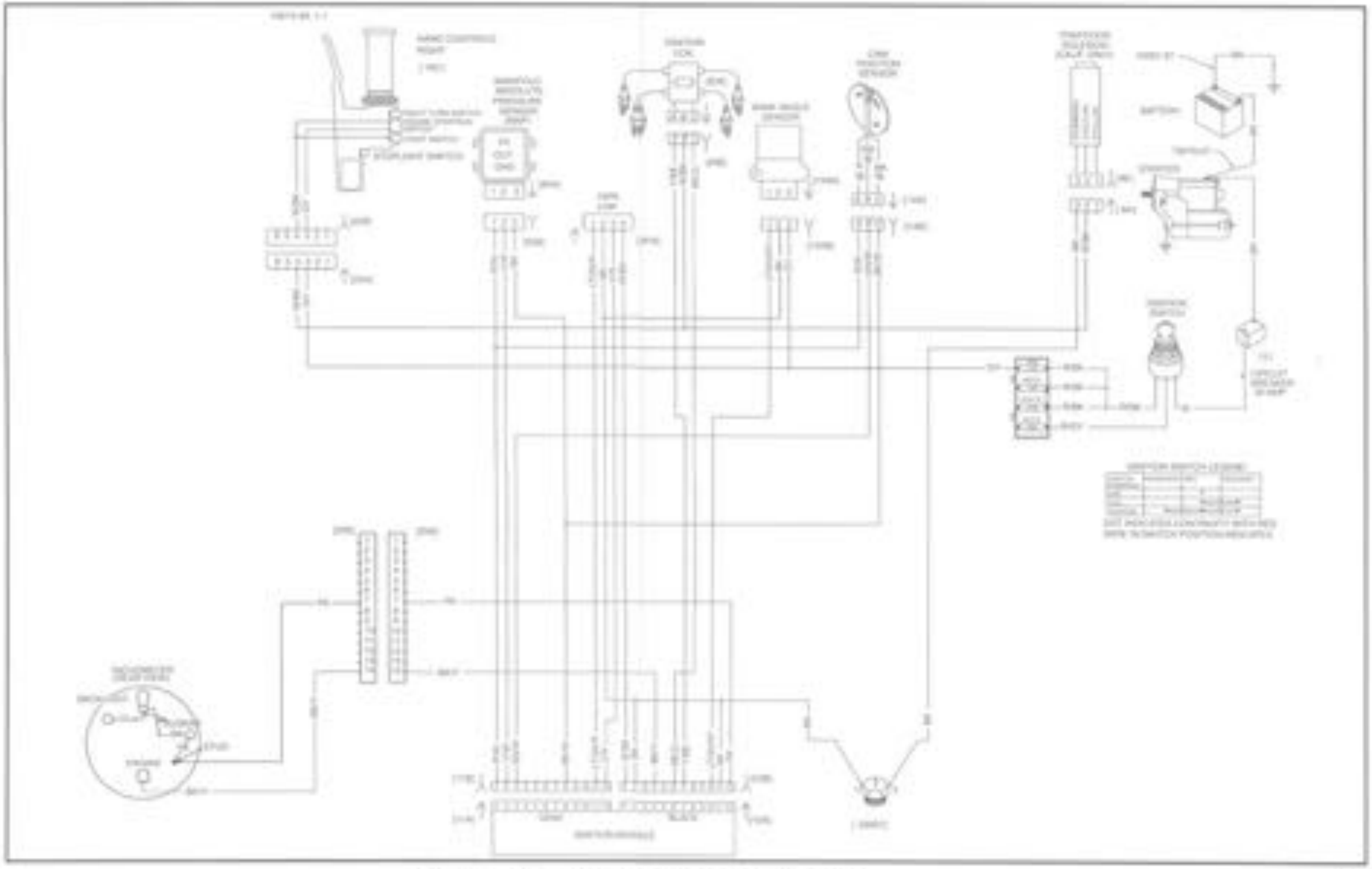


XL 1200S Front Lamps

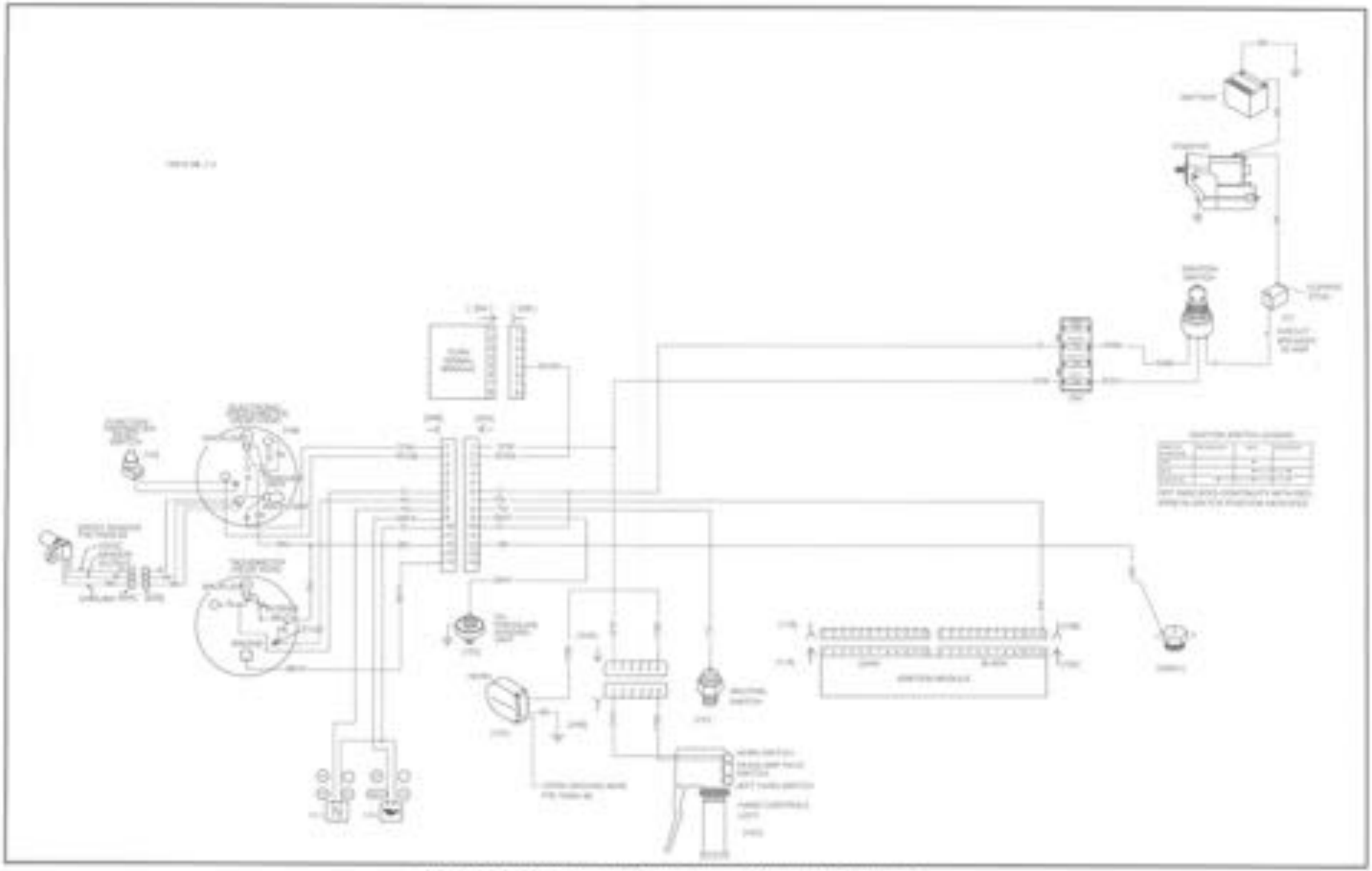
STARTING CIRCUIT
(Same on all Sportsters)



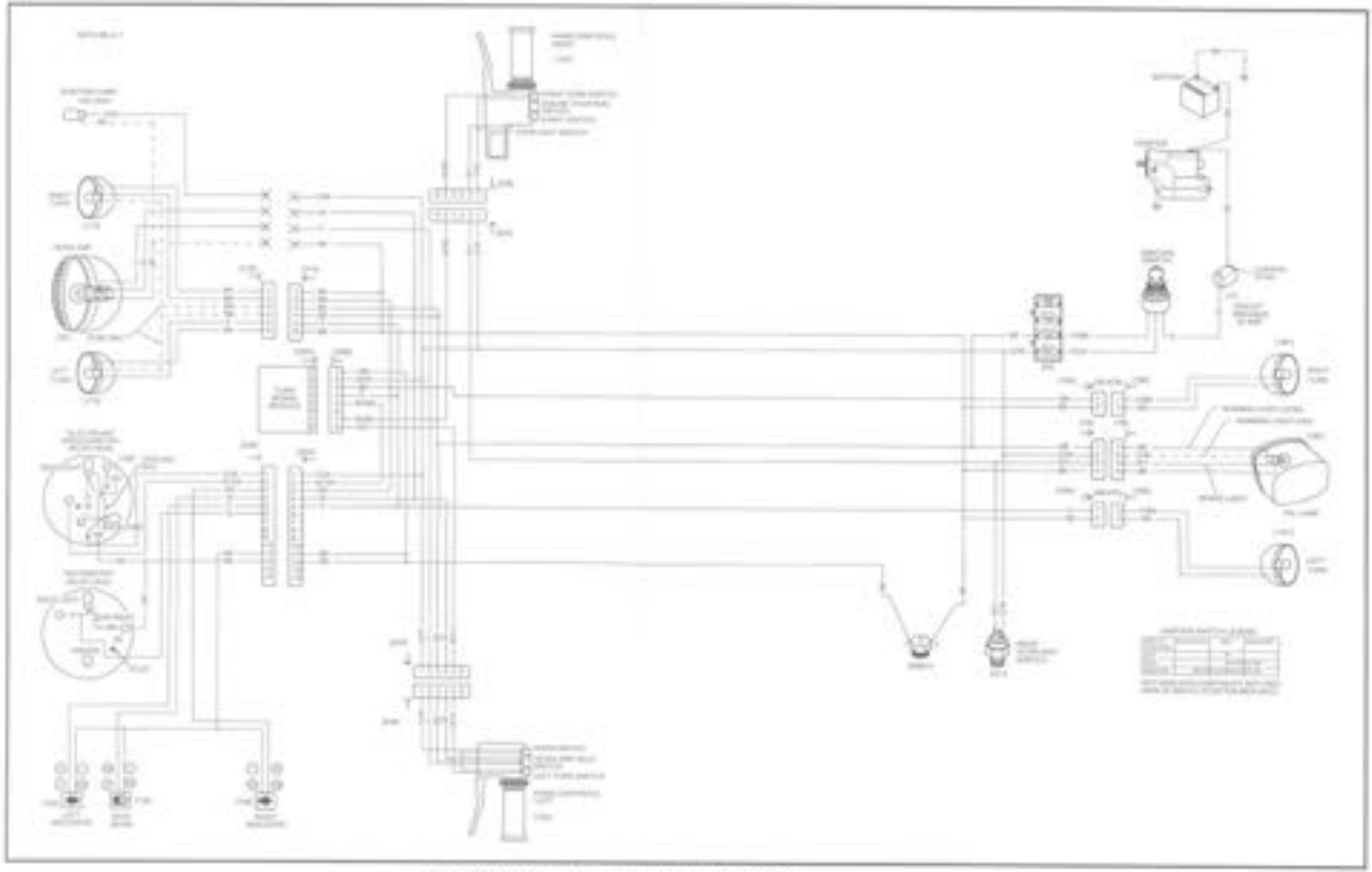
CHARGING CIRCUIT
(Same on all Sportsters)

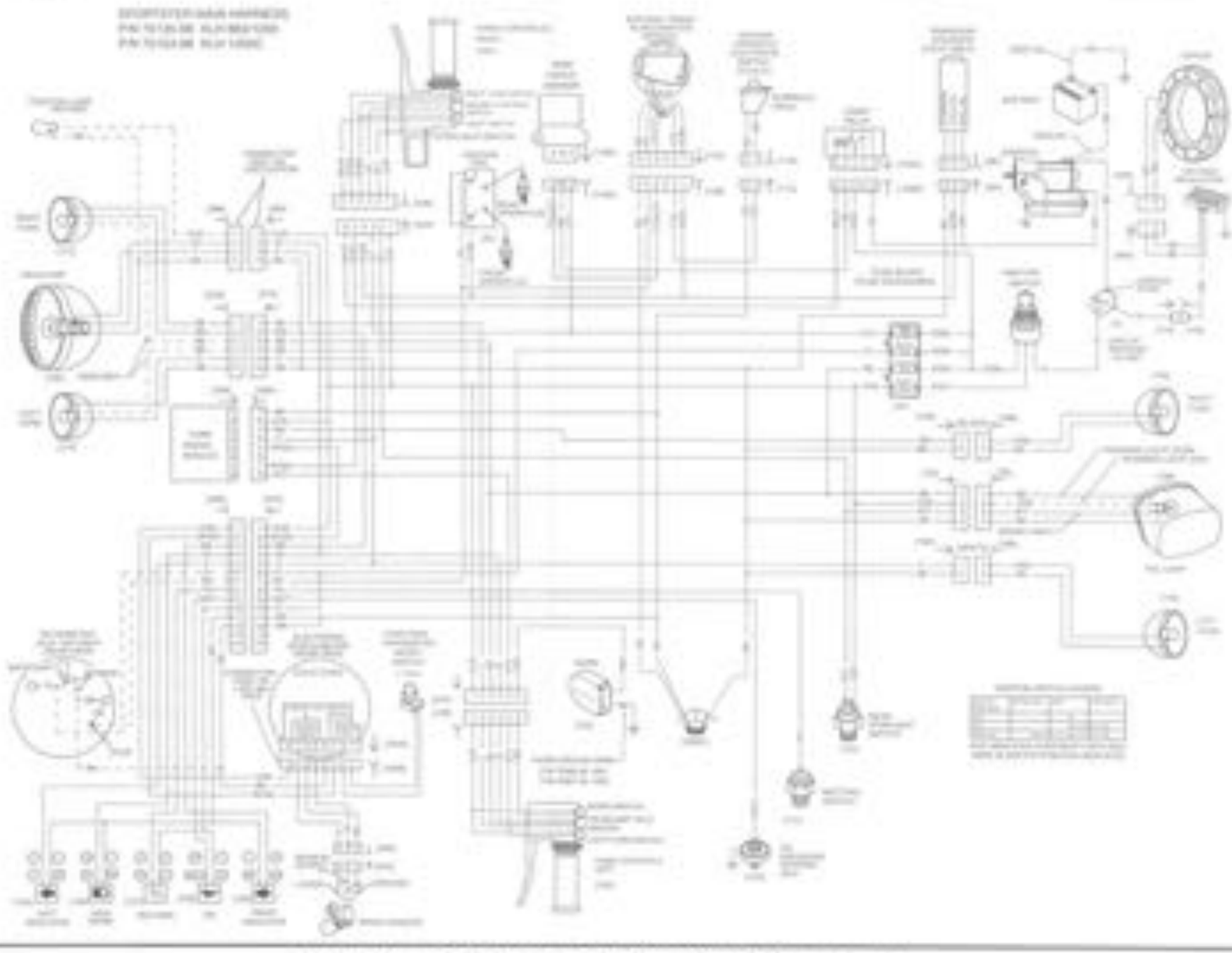


XLH 1200S Domestic and International - Ignition Circuit

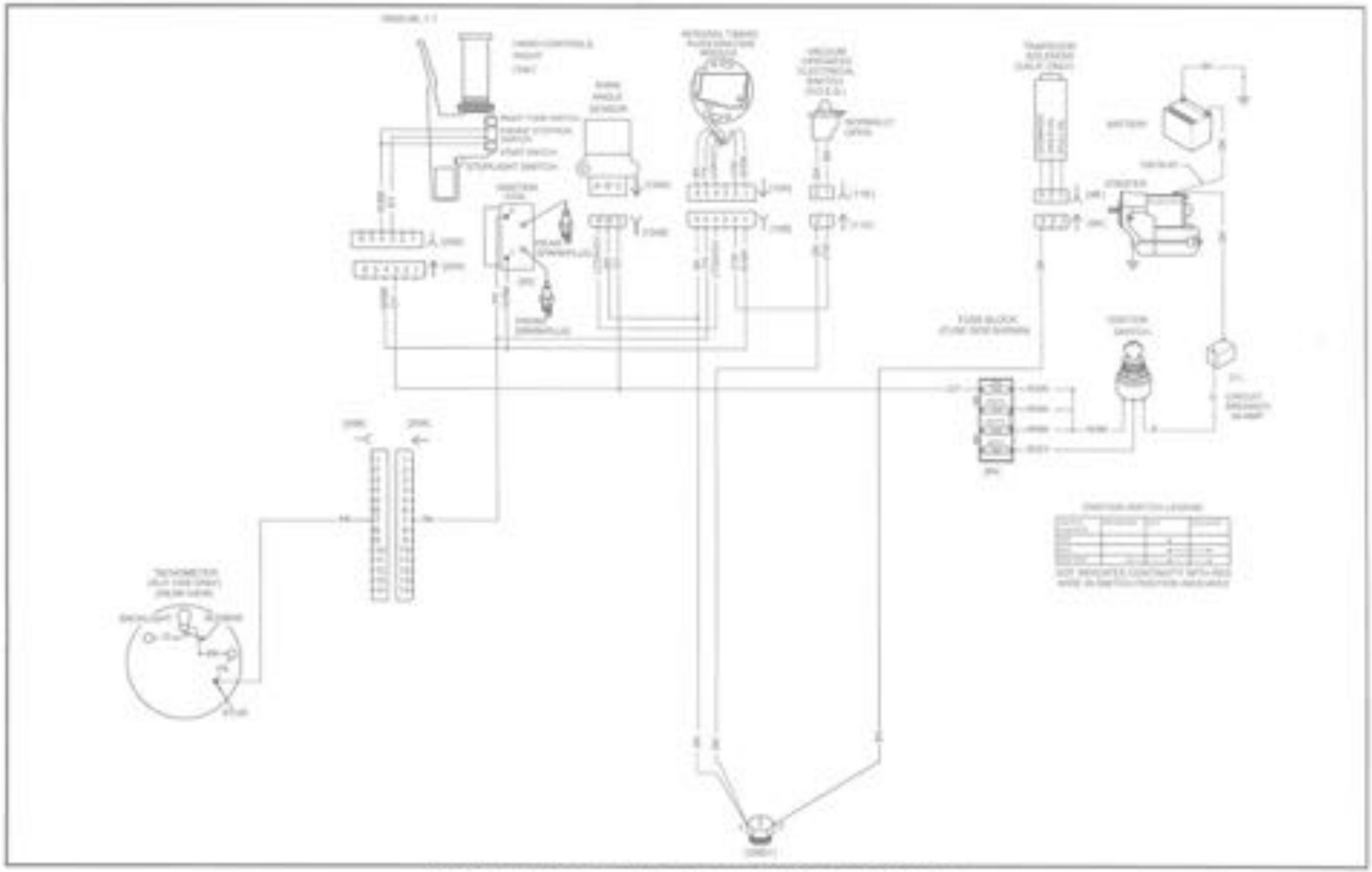


XLH 1200S Domestic and International - Horn and Instruments

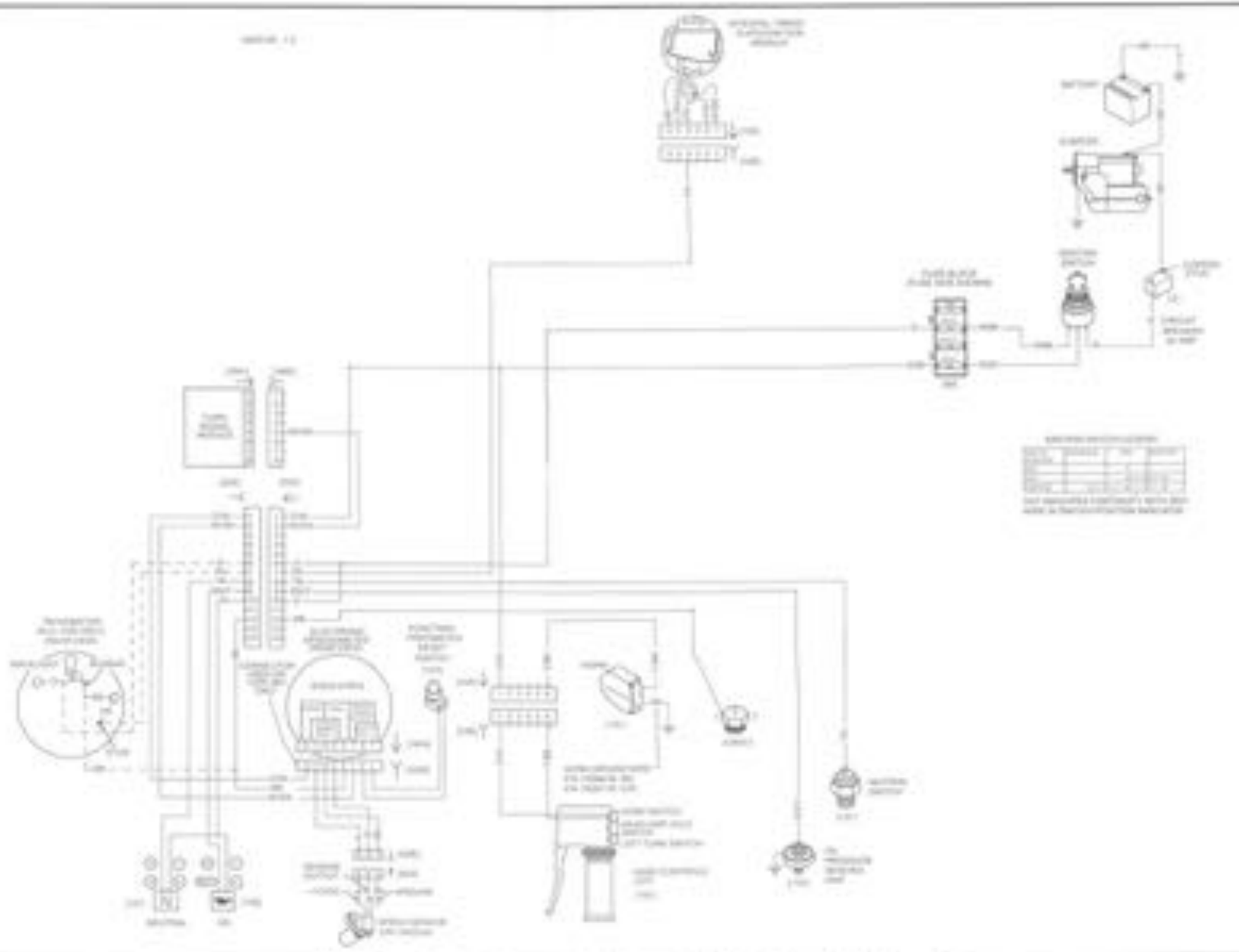




All XL Domestic and International (Except 1200S) - Main Harness



All XL Domestic and Interrational (Except 1200S) - Ignition Circuit



INDEX

INDEX

Page No.

A

Adding Engine Oil ... 3-31
Air Cleaner ... 4-18
Air Cleaner Cleaning, Inspection and Repair ... 4-19
Air Cleaner Installation ... 4-19
Air Cleaner Removal ... 4-18
Air Cleaner Solenoid Electrical Tests, Calif. EVAP ... 4-27
Air Tools ... 1-15
Alignment, Headlamp ... 7-75
Alignment, Wheel ... 2-26
Alternator Assembly and Installation ... 7-68
Alternator Cleaning, Inspection and Repair ... 7-68
Alternator Removal and Disassembly ... 7-67
AMP Multilock Connectors ... 7-116

B

Balancing, Wheel ... 2-27
Bank Angle Sensor ... 7-47
Battery ... 7-70
Battery Activating / Testing ... 7-70
Battery Cleaning and Inspection ... 7-71
Battery Disconnection and Removal ... 7-72
Battery Installation and Connection ... 7-72
Battery Charging ... 7-71
Battery Storage ... 7-72
Battery Testing ... 7-70
Bearings, Piston ... 3-62
Bearings, Rod ... 3-60
Bearings, Sprocket ... 3-62
Bearing Grease, Wheel ... 1-8
Bearing Races, Lapping Engine Main ... 3-66
Bleeding Hydraulic System ... 2-45
Brakes ... 2-28
Brake Caliper, Front ... 2-37
Brake Caliper, Rear ... 2-40
Brake Fluid ... 1-8
Brake Line, Front ... 2-43
Brake Line, Rear ... 2-44
Brake Linkage, Rear ... 2-36
Brake Master Cylinder, Front ... 2-29
Brake Master Cylinder, Rear ... 2-33
Brake Switch, Front ... 7-86
Brake Switch, Rear ... 7-80
Breaker, Main Circuit ... 7-102
British Imperial System – Fluid Measurement ... 1-8
Butt Connectors ... 7-122
Butterfly Valve, Solenoid-Operated ... 4-27

C

Cable, Clutch ... 2-64
Cables, Spark Plug ... 7-58
Cables, Throttle Control ... 2-58

Page No.

Caliper, Front Brake ... 2-37
Caliper, Rear Brake ... 2-40
Cam Gears ... 3-48
Cam Gear Cleaning, Inspection and Repair ... 3-47
Cam Gear Installation ... 3-52
Cam Gear Removal ... 3-46
Cam Position Sensor (1200S) ... 7-54
Canceller, Directional ... 7-95
Carburetor ... 4-2
Carburetor Adjustment ... 4-12
Carburetor Assembly ... 4-15
Carburetor Cleaning, Inspection and Repair ... 4-14
Carburetor Disassembly ... 4-14
Carburetor Fuel Supply System ... 4-6
Carburetor High-Speed Circuit ... 4-10
Carburetor Idle and Low-Speed Circuit ... 4-8
Carburetor Installation ... 4-17
Carburetor Mid-Range Slide Position ... 4-9
Carburetor Removal ... 4-14
Carburetor Starting Circuit ... 4-7
Cast Rim Runout ... 2-22
Chain, Primary ... 6-3
Chain Lubricant, Primary Drive ... 1-8
Changing Engine Oil and Filter ... 3-31
Charging Battery ... 7-71
Chassis Specifications ... 2-1
Checking and Adding Engine Oil ... 3-31
Chokes ... 1-13
Circuit Breaker, Main ... 7-102
Cleaning – Shop Practices ... 1-13
Clutch ... 6-9, 6-12
Clutch Assembly ... 6-14
Clutch Cable ... 2-64, 2-65
Clutch Control Assembly Installation ... 2-65
Clutch Control Removal/Disassembly ... 2-64
Clutch Disassembly ... 6-12
Clutch Hand Control ... 2-64, 2-65
Clutch Inspection and Repair ... 6-14
Clutch Installation ... 6-15
Clutch Release Mechanism Adjustment ... 6-10, 6-12
Clutch Release Mechanism Assembly ... 6-11, 6-13
Clutch Release Mechanism Clean, Insp. Repair ... 6-11, 6-13
Clutch Release Mechanism Disassembly ... 6-11, 6-13
Clutch Removal ... 6-12
Clutch Troubleshooting ... 6-9
Codes (1200S), Diagnostic:
- Code 12 ... 7-33
- Code 16 ... 7-35
- Code 24 ... 7-37
- Code 35 ... 7-40
- Code 41 ... 7-41
- Code 44 ... 7-42
- Code 52 ... 7-44
- Code 54 ... 7-44
- Code 55 ... 7-44

Coil, Ignition ... 7-59
Connecting Rod Race Lapping ... 3-60
Control, Clutch ... 2-64

Page No.

Control, Throttle 2-58
Conversion Table, Metric Dimension 1-9
Countershaft Disassembly, Transmission 6-23
Countershaft Clean, Insp. and Repair, Transmission 6-27
Countershaft Assembly, Transmission 6-27
Cover, Gearcase 3-46
Cover, Primary 6-4
Cover, Sprocket 2-36
Crankcase 3-54
Crankcase Adjustment/Testing 3-54
Crankcase Assembly 3-67
Crankcase Breathing System 3-38
Crankcase Disassembly 3-54
Cutaway 1-15
Cylinder, Engine 3-24
Cylinder, Front Brake Master 2-29
Cylinder, Rear Brake Master 2-33
Cylinder Assembly, Engine 3-30
Cylinder Cleaning, Inspection, and Repair, Engine 3-25
Cylinder Head 3-13
Cylinder Head Assembly 3-21
Cylinder Head Cleaning, Inspection, and Repair 3-15
Cylinder Head Disassembly 3-15
Cylinder Head Installation 3-22
Cylinder Head Removal 3-13
Cylinder Removal/Disassembly, Engine 3-24

D

Deutsch Electrical Connectors 7-111
Diagnostic Codes (12003)
- Code 12 7-33
- Code 16 7-35
- Code 24 7-37
- Code 35 7-40
- Code 41 7-41
- Code 44 7-42
- Code 52 7-44
- Code 54 7-44
- Code 55 7-44

Diagram – Charging System Wiring 7-63
Diagram – Ignition System All Except 12005 7-7
Diagram – Ignition System 12005 7-8
Diagram – Starting System Wiring 5-3
Dimension Conversion Table, Metric 1-9
Directional Canceller Operation 7-95
Directional Canceller Removal/Installation 7-101
Directional Canceller Testing 7-95
Directional Canceller Troubleshooting 7-95
Directional Switches 7-95
Drain Hose, Engine Oil 3-31

E

Electrical Bracket 7-2
Engine 3-5
Engine Adjustment/Testing 3-5
Engine Idle Speed Adjustment 4-12
Engine Installation 3-11
Engine Lubrication System 3-31
Engine Oil 3-31
Engine Oil Tank 3-34

Page No.

Engine Oiling System 3-33
Engine Repair, Stripping Motorcycle for 3-8
Engine Specifications 3-1
Engine Start Switch 7-81
Engine Stop Switch 7-81
Evaporative Emissions Control – California 4-24
Exhaust System 2-66

F

Fastener Torque Values 1-10
Fender, Front 2-68
Fender, Rear 2-69
Filter, Engine Air 4-16
Filter, Engine Oil 3-31
Filter Mount, Engine Oil 3-42
Fluid, Brake 1-8
Fluid, Primary Drive/Transmission 1-8
Fluid Measurement Systems 1-8
Fluid Requirements 1-8
Flywheel Assembly 3-67
Flywheel Cleaning and Inspection 3-58
Flywheel Disassembly 3-54
Flywheel Washers, Replacing 3-58
Fork, Front 2-46
Fork, Rear 2-55
Fork Lower Bracket and Stem, Front 2-54
Fork Oil, Front 1-8
Fork Stem and Bracket Assembly 2-54
Front Brake Caliper 2-37
Front Brake Caliper Assembly 2-38
Front Brake Caliper Clean, Insp. and Repair 2-36
Front Brake Caliper Installation 2-39
Front Brake Caliper Removal/Disassembly 2-37
Front Brake Master Cylinder 2-29
Front Brake Master Cyl Assembly/Install 2-31
Front Brake Master Cyl Clean, Insp, Repair 2-31
Front Brake Master Cyl Removal/Disassembly 2-29
Front Brake Switch 7-86
Front Fender 2-68
Front Fork 2-46
Front Fork Assembly 2-48
Front Fork Cleaning, Inspection, and Repair 2-48
Front Fork Disassembly 2-48
Front Fork Installation 2-49
Front Fork Lower Bracket and Stem 2-54
Front Fork Removal 2-46
Front Wheel 2-7
Front Wheel Assembly 2-8
Front Wheel Cleaning, Inspection, and Repair 2-7
Front Wheel Disassembly 2-7
Front Wheel Installation 2-10
Front Wheel Removal 2-7
Fuel 1-8
Fuel Supply Valve 4-20
Fuel System Troubleshooting 4-3
Fuel Tank 4-21
Fuel Tank Cleaning, Inspection, and Repair 4-22
Fuel Tank Installation 4-23
Fuel Tank Removal 4-22

G

Gasoline 1-8
Gear, Cam 3-46
Gear, Pinion 3-47
Gearcase Cover 3-46
Gearcase Cover Assembly/Installation 3-52
Gearcase Cover Cleaning, Inspection, and Repair 3-47
Gearcase Cover Removal/Disassembly 3-46
General (Motorcycle) 1-1
Grease, Wheel Bearing 1-9

H

Hammers 1-15
Handlebar Switches 7-81
Head, Engine Cylinder 3-13
Headlamp Adjustment 7-75
Headlamp Removal/Installation 7-76
Horn 7-92
Horn Switch 7-88
Hose Routing, California EVAP 4-32
Hose Routing, Carburetor Fuel Overflow/Drain 4-17
Hose Routing, Engine Oil 3-33
Hydraulic Lifters, Valve 3-44
Hydraulic System, Bleeding 2-45

I

Identification Number (V.I.N.), Vehicle 2-4
Ignition Coil 7-59
Ignition Coil Installation 7-59
Ignition Coil Removal 7-59
Ignition Coil Troubleshooting 7-59
Ignition/Light Switch 7-51
Ignition Module - 1200S 7-53
Ignition Module - All except 1200S 7-55
Ignition System 7-5
Ignition System Troubleshooting 7-7
Ignition Timing Check 7-45
Imperial System – Fluid Measurement 1-8
Indicator Switch, Neutral 7-94
Intervals, Regular Maintenance 1-2

J

Jiffy Stand (Side Stand) 2-71
Jiffy Stand Cleaning and Lubrication 2-71
Jiffy Stand Installation 2-72
Jiffy Stand Removal 2-71

K

Kent-Moore Tools 8, 1-17

L

Laced Wheel, Truing 2-30
Lacing 16-Inch Wheels 2-16
Lacing 19-Inch Wheels 2-18
Lamps 7-75
Lamp Adjustment 7-75
Lamp Removal/Installation 7-76
Lifters, Valve 3-44
Light, Oil Pressure Signal 3-37
Light/Ignition Switch 7-51
Linkage, Rear Brake 2-36
Lower Bracket and Stem, Front Fork 2-54
Lubricant, Engine 1-8
Lubricant, Front Fork 1-8
Lubricant, Primary Drive 1-8
Lubricant, Transmission 1-8
Lubricant, Wheel Bearing 1-8
Lubrication, Winter 3-32
Lubrication System, Engine 3-31

M

Main Bearing Races, Lapping 3-66
Main Circuit Breaker 7-102
Main Drive Gear Assembly 5-30
Main Drive Gear Installation 5-31
Main Drive Gear Disassembly 5-31
Main Drive Gear Removal 5-30
Mainshaft Assembly 5-27
Mainshaft Clean, Insp, and Repair 5-27
Mainshaft Disassembly 5-23
Maintenance Intervals, Regular 1-2
MAP Sensor (1200S) 7-48
Master Cylinder, Front Brake 2-39
Master Cylinder, Rear Brake 2-33
Metric Conversion Table 1-9
Metric System – Fluid Measurement 1-8
Module, Directional (Turn Signal) Canceller 7-95
Module, Ignition 7-55
Mount, Engine Oil Filter 3-42
Muffler, Exhaust System 2-66

N

Neutral Indicator Switch 7-94
Number (V.I.N.), Vehicle Identification 2-4

Page No.

O

Oil, Changing Engine 3-31
Oil, Checking and Adding Engine 3-31
Oil, Engine 1-8
Oil, Front Fork 1-8
Oil, Primary Drive 1-8
Oil, Transmission 1-8
Oiling System, Engine 3-39
Oil Filter Mount, Engine 3-42
Oil Hose Routing, Engine 3-33
Oil Pressure, Engine 3-38
Oil Pressure Signal Light 3-37
Oil Pressure Signal Light Switch 3-37
Oil Pump, Engine 3-40
Oil Tank, Engine 3-34

P

Pinion Bearings, Fitting 3-62
Pinion Gear 3-47
Pinion Gear Cleaning, Inspection and Repair 3-47
Pinion Gear Installation 3-52
Pinion Gear Removal 3-46
Pinion Shaft Bearing Selection 3-64
Pipe, Exhaust System 2-66
Piston, Engine 3-24
Piston Assembly/Installation, Engine 3-30
Piston Cleaning, Inspection and Repair, Engine 3-25
Piston Removal/Disassembly, Engine 3-24
Pliers 1-15
Plug Cables, Spark 7-58
Plugs, Spark 7-57
Primary Chain 6-3
Primary Chain Adjustment 6-4
Primary Chain Installation 6-5
Primary Chain Removal 6-4
Primary Cover Installation 6-6
Primary Cover Removal 6-4
Primary Drive/Clutch Assembly 6-14
Primary Drive/Clutch Disassembly 6-12
Primary Drive/Clutch Inspection and Repair 6-14
Primary Drive/Clutch Installation 6-15
Primary Drive/Clutch Removal 6-12
Primary Drive/Transmission Lubricant 1-6, 6-16
Prybars 1-15
Pump, Engine Oil 3-40
Punches 1-15

R

Ratchets and Handles 1-15
Rear Brake Caliper 2-40
Rear Brake Caliper Assembly 2-41
Rear Brake Caliper Clean, Insp, and Repair 2-41
Rear Brake Caliper Installation 2-41
Rear Brake Caliper Removal/Disassembly 2-40
Rear Brake Linkage 2-38
Rear Brake Master Cylinder 2-33

Page No.

Rear Brake Master Cyl. Adjustment 2-33
Rear Brake Master Cyl. Assembly 2-34
Rear Brake Master Cyl. Clean, Insp, and Repair 2-34
Rear Brake Master Cyl. Removal/Disassembly 2-33
Rear Brake Switch 7-88
Rear Fender 2-69
Rear Fork 2-55
Rear Fork Assembly 2-55
Rear Fork Cleaning and Inspection 2-55
Rear Fork Installation 2-55
Rear Fork Removal/Disassembly 2-55
Rear Shock Absorber 2-56
Rear Wheel 2-11
Rear Wheel Assembly 2-12
Rear Wheel Cleaning, Inspection, and Repair 2-11
Rear Wheel Disassembly 2-11
Rear Wheel Installation 2-14
Rear Wheel Removal 2-11
Regular Maintenance Intervals 1-2
Regulator, Voltage 7-69
Removal from Storage 1-7
Repair and Replacement Procedures, Shop 1-13
Repair Notes, Shop 1-13
Rotor, Alternator 7-67

S

Safe Operating Maintenance 1-1
Scanalyzer 7-15
Scanalyzer, Adjust Timing using (1200S only) 7-45
Screwdrivers 1-15
Secondary Drive Belt 6-7
Sensor
- Bank Angle 7-47
- Cam Position (1200S) 7-54
- MAP (1200S) 7-48

Serial Number (V.I.N.) 2-4
Service Intervals, Regular 1-2
Servicing a New Motorcycle 1-1
Shifter Forks and Drum Assembly 6-20
Shifter Forks and Drum Clean, Insp, and Repair 6-21
Shifter Forks and Drum Disassembly 6-20
Shifter Pawl Adjustment 6-34
Shock Absorber, Rear 2-56
Shop Practices 1-13
Side Stand Liftly Stand) 2-71
Signal Canceller, Turn 7-95
Signal Light, Oil Pressure 3-37
Signal Light Switch, Oil Pressure 3-37
Sockets 1-16
Solenoid-Operated Butterfly Valve 4-27
Solenoid, Starter 5-18
Spark Coil 7-59
Spark Plug Cables 7-58
Spark Plugs 7-57
Special Tools 1-17
Specifications, Chassis 2-1
Specifications, Drive 6-1
Specifications, Electrical 7-1
Specifications, Engine 3-1
Specifications, Fuel System 4-1
Specifications, Starter 5-1

Page No.

Specifications, Tire 2-3
Specifications, Transmission 6-1
Speedometer, Electronic 7-103
Sport Trans Fluid 1-8
Sprocket Cover 2-36
Stand, Jiffy (Side) 2-71
Start Switch, Engine 7-84
Starter, Testing Assembled 5-11
Starter Assembly 5-17
Starter Disassembly, Inspection, and Repair 5-12
Starter Installation 5-17
Starter On-Motorcycle Tests 5-10
Starter Removal 5-11
Starter Solenoid 5-18
Starter System, Electric 5-1
Starter System Testing 5-10
Starter Troubleshooting 5-4
Stop Switch, Engine 7-84
Stoplight Switche 7-80
Storage, Motorcycle 1-7
Storage, Removal from 1-7
Storage Units, Shop 1-16
Stripping Motorcycle for Engine Repair 3-8
Switch, Neutral Indicator 7-84
Switch, Oil Pressure Signal Light 3-37
Switch, Handlebar 7-81
Switch, Ignition/Light 7-51
Switch, Stoplight (Brake) 7-80
Switch, Vacuum-Operated Electric (V.O.E.S.) 7-49

T

Tachometer, Electronic 7-105
Tank, Engine Oil 3-34
Tank, Fuel 4-21
Throttle Control 2-58
Throttle Control Adjustment 2-58
Throttle Control Assembly/Installation 2-59
Throttle Control Cleaning, Inspection and Repair 2-59
Throttle Control Removal/Disassembly 2-59
Timing, Ignition System 7-45
Tires 2-23
Tire Cleaning, Inspection and Repair 2-23
Tire Installation 2-24
Tire Removal 2-23
Tire Specifications 2-3
Tools 1-17
Tool Safety 1-15
Torque Values, Fastener 1-10
Transmission 6-16
Transmission Case 6-18
Transmission Case Removal 6-18
Transmission Case Cleaning, Inspection and Repair 6-19

Page No.

Transmission Lubrication 1-8, 6-16
Trouble Codes (1200S):
- Code 12 7-33
- Code 16 7-35
- Code 24 7-37
- Code 35 7-43
- Code 41 7-41
- Code 44 7-42
- Code 52 7-44
- Code 54 7-44
- Code 55 7-44

Troubleshooting, General 1-11
Troubleshooting Brakes 2-28
Troubleshooting Wheels 2-5
Truing Laced Wheel 2-29
Tube, Carburetor Fuel Overflow/Drain 4-17
Turn Signal Canceller 7-95
Turn Signal Lamps 7-95

U

United States System – Fluid Measurement 1-8

V

Vacuum Piston, Operation Check 4-14
Vacuum-Operated Electric Switch (V.O.E.S.) 7-49
Valve, Fuel Supply 4-20
Valve Hydraulic Lifters, Engine 3-43
Valve Hydraulic Lifter Cleaning and Inspection 3-44
Valve Hydraulic Lifter Installation 3-45
Valve Hydraulic Lifter Removal 3-44
Valve Stem, Tubeless Tire 2-25
Vapor Valve, Fuel Tank 4-21
Vehicle Identification Number (V.I.N.) 2-4
Voltage Regulator 7-60

W

Wheels 2-5
Wheel, Front 2-7
Wheel, Rear 2-11
Wheels, Lacing 16-Inch 2-16
Wheels, Lacing 19-Inch 2-18
Wheels, Truing Laced 2-20
Wheel Alignment 2-26
Wheel Balancing 2-27
Wheel Bearing Grease 1-8
Winter Lubrication 3-32
Wiring Diagrams 7-127
Wiring Diagram – Charging System 7-63
Wiring Diagram – Ignition System 7-7, 7-8
Wiring Diagram – Starting System 5-3
Wrenches 1-15