1993 Volkswagen EuroVan All Categories All Sections
Title List for Volkswagen Technical Site

Saturday, March 18, 2000 10:41PM

* A/C-HEATER SYSTEM UNIFORM INSPECTION GUIDELINES *
* ANTI-LOCK BRAKES UNIFORM INSPECTION GUIDELINE *
* AUTO TRANS DIAGNOSIS MENU - VOLKSWAGEN
* BRAKE SYSTEM UNIFORM INSPECTION GUIDELINES *
* ELECTRICAL SYSTEM UNIFORM INSPECTION GUIDELINES *
* ENGINE SYSTEMS UNIFORM INSPECTION GUIDELINES *
* EXHAUST SYSTEM UNIFORM INSPECTION GUIDELINES *
* STEERING UNIFORM INSPECTION GUIDELINES *
* SUSPENSION UNIFORM INSPECTION GUIDELINES *
* SYMPTOM CHECK LIST *
2.5L 5-CYL
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A/C COMPRESSOR OIL CHECKING
A/C COMPRESSOR SERVICING
A/C SYSTEM GENERAL DIAGNOSTIC PROCEDURES
A/C SYSTEM GENERAL SERVICING
A/C-HEATER SYSTEM - MANUAL
AA - USING THIS SECTION (GENERAL HELP INFORMATION)
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ANTI-LOCK BRAKE SAFETY PRECAUTIONS
ANTI-LOCK BRAKE SYSTEM
AXLE SHAFTS
BRAKE SYSTEM
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MAINTENANCE INFORMATION
MAINTENANCE REMINDER LIGHT RESET PROCEDURES
METRIC CONVERSIONS
N - REMOVE/INSTALL/OVERHAUL
P - EGR FUNCTION TESTING
PRE-ALIGNMENT CHECKS
RIDING HEIGHT ADJUSTMENT
SCHEDULED SERVICES
SPECIFICATIONS & ELECTRIC COOLING FANS
STARTER
STEERING COLUMN
STEERING COLUMN SWITCHES
STEERING GEAR - POWER RACK & PINION
STEERING LOSS: NEW U-JT. UPPER LOCKING BOLT
SUN ROOF - POWER
SUSPENSION - FRONT
SUSPENSION - REAR
SYSTEM WIRING DIAGRAMS
TRANSMISSION REMOVAL & INSTALLATION - A/T
TRANSMISSION REMOVAL & INSTALLATION - M/T
TRANSMISSION SERVICING - A/T
TRANSMISSION SERVICING - M/T
TROUBLE SHOOTING - BASIC PROCEDURES
WAVEFORMS - INJECTOR PATTERN TUTORIAL
WHEEL ALIGNMENT SPECIFICATIONS & PROCEDURES
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WIPER/WASHER SYSTEM
WIRING DIAGRAM SYMBOLS
WIRING DIAGRAMS

* A/C-HEATER SYSTEM UNIFORM INSPECTION GUIDELINES *

Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:02PM

ARTICLE BEGINNING

GENERAL INFORMATION
A/C-Heater System Motorist Assurance Program
Standards For Automotive Repair

All Makes and Models

INTRODUCTION TO MOTORIST ASSURANCE PROGRAM (MAP)

The Motorist Assurance Program was formed in 1992 by forty (40) companies who were concerned about the image of automotive service establishments. Today, MAP is an industry-wide association dedicated to strengthening consumer satisfaction with the automotive repair industry. MAP's participants represent the majority of the nation's multi-bay retail automotive outlets, their parts and equipment suppliers, independent repair shops, industry associations, car companies, manufacturers representatives, and the trade press. MAP is developing standards of service, uniform inspection procedures and other programs to assure consumers of the industry's professionalism and the commitment to excellence shared by MAP's sponsoring companies.

MAP's achievements to date include production and distribution (over 280,000) of the consumer brochure "How to Find Your Way Under the Hood and Around Your Car", development of a Pledge of Satisfaction to Consumers and Standards of Service and establishment of relationships with regulatory agencies.

As auto repair becomes an issue for federal and state regulators, MAP is working to educate government leaders on the dynamics of automotive service and the self-monitoring efforts MAP has undertaken on the industry's behalf. MAP's sponsoring companies are becoming well-known to government representatives as exemplary businesses working to improve the industry. Media sources also look to MAP to provide information and advice to consumers and on working with automotive technicians and repair establishments.

In the next few months, MAP plans to assist member repair facilities in implementing the MAP Pledge to Customers, establishing an alternate dispute resolution system to help resolve customer complaints within the industry, and developing a shop accreditation program to encourage policies in concert with the MAP Standards of Service and Inspection Guidelines.

MAP has united the aftermarket behind its consumer-oriented goals and has established itself both within and outside of the industry. We welcome you to join us as MAP continues its outreach. With your support, both the automotive repair industry and your customers will reap the benefits. Please contact MAP at:

808 17th Street, NW
Suite 200
Washington, D.C. 20006
202 466 7050

* A/C-HEATER SYSTEM UNIFORM INSPECTION GUIDELINES *

Article Text (p. 2)

1993 Volkswagen EuroVan

For Volkswagen Technical Site

Saturday, March 18, 2000 10:02PM

MAP UNIFORM INSPECTION GENERAL GUIDELINES

OVERVIEW OF SERVICE REQUIREMENTS & SUGGESTIONS

It is MAP policy that all exhaust, brake, ABS, steering and suspension, wheel alignment, tires and wheels, driveline, engine performance and maintenance and heating, ventilation and air conditioning services be offered and performed under the guidelines and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be required or suggested. In addition, suggestions may be made to satisfy the needs expressed by the customer.

This section lists the various parts and conditions that indicate required or suggested service or part replacement. Although this list is extensive, it is not inclusive. In addition to this list, a technician may make a suggestion. This suggestion must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

* Example: An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.
* Example: A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or to address a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may only be to suggest service.

* Example: An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.
* Example: The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may

not be sold as a requirement.

A customer, of course, has the choice of whether or not a Shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. The following reasons may be used for required and suggested services:

Reasons to Require Repair or Replacement:

* component no longer performs intended purpose
* component does not meet a design specification (regardless of performance)
* component is missing.

Reasons to Suggest Repair or Replacement

* component is close to the end of its useful life (just above discard specifications or weak; failure likely to occur soon, etc.)
* address a customer need, convenience or request (stiffen ride, enhance performance, eliminate noise, etc.)
* comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM)
* technician's recommendation based on substantial and informed experience.

HEATING, VENTILATION & AIR CONDITIONING GUIDELINES

* PLEASE READ THIS FIRST *

NOTE: When servicing R-12 Systems it is suggested to use "O" rings, seals and hose materials which are also compatible with R-134a in case the vehicle requires retrofitting later in its life.

COMPRESSOR & CLUTCH ASSEMBLY

COMPRESSOR

Condition	Procedure	Note
Seized	Requires replacement	
Inoperative	Further inspection required.	Check/service state of charge following the manufacturer's recommended service procedures. If the compressor is still inoperative, require repair or replacement.
Noisy	Further inspection	Check/service oil level and

	required.	state of charge following manufacturer's recommended service procedures. If the compressor is still noisy, suggest repair or replacement. Compressor may be near the end of its useful life.
Damaged housing	Suggest repair or replacement.	If damage affects proper operation of system require replacement.
Leaks	Require repair or replacement.	
Missing or damaged mounting brackets/hardware	Require repair or replacement.	

CLUTCH ASSEMBLY

Condition	Procedure	Note
Inoperative/slips	Further inspection required.	Check air gap, belt tension, system pressure, electrical system. Require repair or replacement according to manufacturer's specifications.
Noisy	Suggest repair or replacement.	
Seized bearing	Require replacement of bearing.	
Burnt coil	Require replacement of coil.	
Damaged connector	Require repair or replacement.	
Damaged hub	Require repair or replacement of hub.	
Will not disengage	Further inspection required.	Check air gap & electrical system. Suggest repair or replacement.

* A/C-HEATER SYSTEM UNIFORM INSPECTION GUIDELINES *

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EVAPORATOR

EVAPORATOR

Condition	Procedure	Note
Leaking	Require repair or replacement.	
Internal restriction	Require replacement.	
Air flow obstruction	Further inspection required.	If fins cannot be cleaned or straightened, require replacement.
Damaged connections or fittings	Require replacement.	

ACCUMULATOR/DRIER

ACCUMULATOR/DRIER

Condition	Procedure	Note
Leaking	Require replacement.	
Restricted	Require replacement.	
Desiccant bag deterioration	Require replacement.	
Moisture in system	Require replacement.	
System has been exposed to air	Suggest replacement.	
Missing, damaged mounting hardware or brackets	Require repair or replacement of hardware or brackets	

HOSES/LINES/FITTINGS

HOSES/LINES/FITTINGS

Condition	Procedure
Blistered hose	Suggest repair or replacement.

Damaged	Require repair or replacement.
Routed incorrectly	Suggest re-routing.
Leaking	Require repair or replacement.
Restricted	Require repair or replacement.
Outer covering is cracked to the extent inner fabric of hose is visible	Require repair or replacement.
Crimped	Require repair or replacement.
Missing/damaged mounting hardware or brackets	Require repair or replacement of hardware or brackets.

EVAPORATOR FILTER (IF APPLICABLE)

EVAPORATOR FILTER (IF APPLICABLE)

Condition	Procedure	Note
Air flow obstruction	Further inspection required.	If filter cannot be cleaned, require replacement.
Missing	Require replacement.	

EXPANSION VALVE/ORIFICE TUBE

EXPANSION VALVE/ORIFICE TUBE

Condition	Procedure	Note
Leaking	Require replacement.	
Restricted	Require repair or replacement.	
Filter screen torn	Require replacement.	
Inoperative expansion valve	Further inspection required.	Inspect capillary tube and ensure proper positioning. Re-check system performance. If still inoperative require replacement of expansion valve.

PRESSURE CONTROL VALVES

NOTE: Includes Evaporator Pressure Regulator (EPR), Pilot Operated Absolute (POA), Suction Throttling Valve (STV), Valves In Receiver (VIR).

PRESSURE CONTROL VALVES

Condition	Procedure
Leaking	Require repair or replacement.
Restriction	Require repair or replacement.
Stuck open or closed	Require repair or replacement.
Damaged connections or fittings	Require repair or replacement.

SERVICE PORTS

SERVICE PORTS

Condition	Procedure
Leaking	Require repair or replacement.
Sticking valve core	Require repair or replacement
Missing valve cap	Require replacement of valve cap.
Damaged threads	Require repair or replacement.

DRIVE BELTS

DRIVE BELTS

Condition	Procedure	Note
Missing	Require replacement.	
Improper tension	Require adjustment.	
Improper alignment	Further inspection required.	Check alignment of pulleys and proper belt installation. Suggest repair or replacement.
Damaged	Require replacement.	Damaged conditions may include but are not limited to: teeth missing,

		chunking or excessive
		cracking, missing rib,
		broken or cut, ply
		separation.
Noisy	Suggest replacement.	
Worn	Suggest replacement.	Worn conditions may include: belt worn narrower than original width, bottom and side-wall cracks, protruding edge cords.

DRIVE PULLEYS

DRIVE PULLEYS

Condition	Procedure
Damaged	Require replacement.
Improper alignment	Require repair.
Missing, damaged mounting hardware	Require repair or replacement of bracket of hardware or bracket.

TENSIONERS

TENSIONERS

Condition	Procedure
Missing	Require replacement.
Noisy	Suggest replacement.
Damaged	Suggest replacement.
Improper adjustment	Require adjustment or repair.

CONDENSER

CONDENSER

Condition	Procedure	Note
Leaking	Require repair or replacement.	

Damaged connections or fittings	Require replacement.	
Internal restriction Air flow obstruction	Require replacement. Further inspection required.	If fins cannot be cleaned or straightened, require replacement.
Missing/damaged mounting hardware/ brackets	Require repair or replacement of hardware or brackets.	

"O" RINGS/GASKETS/SEALS/SPRING LOCKS

"O" RINGS/GASKETS/SEALS/SPRING LOCKS

Condition	Procedure
Leaking	Require repair or replacement.

IN-LINE FILTER

IN-LINE FILTER

Condition	Procedure
Leaking	Require repair or replacement.
Restricted	Require replacement.
Damaged connections or fittings	Require repair or replacement.

REFRIGERANT OIL

REFRIGERANT OIL

Condition	Procedure	Note
Overcharge/ undercharge	Require service to manufacturer's specifications.	
Contaminated	Suggest replacement.	Particulate material (contaminants) may indicate a need for additional service. Determine cause of contamination and repair or replace affected

³	³ components as necessary.
³	³ Discoloration of oil does not
³	³ necessarily indicate a system
³	³ problem.

REFRIGERANT

REFRIGERANT

Condition	Procedure
Overcharge/undercharge	Require service to manufacturer's specifications.
Cross-contamination Different types of refrigerants in the same system	Require service following manufacturer's procedures and specifications.
Incompatible refrigerants mixed together	

AIR DISTRIBUTION

PLENUM/EVAPORATOR CASE/HEATER CASE

Condition	Procedure	Note
Cracked	Suggest repair or replacement.	
Air leaks	Require repair or replacement	
Restricted	Suggest cleaning, repair or replacement.	
Odor	Further inspection required.	Identify source. Suggest cleaning or repair.
Noisy	Further inspection required.	Identify source. Suggest cleaning or repair.
Cold water leak in passenger compartment	Further inspection required.	Determine source of leak. Leak may be caused due to restricted drain tube, cracked evaporator case, leaking seal or gasket. Require repair or replacement.

ELECTRICAL/VACUUM ACTUATORS (MOTORS)

ELECTRICAL/VACUUM ACTUATORS (MOTORS)

Condition	Procedure
Leaking vacuum	Require replacement.
Inoperative	Require replacement
Damaged	Suggest replacement.
Missing	Require replacement.
Missing, damaged mounting hardware	Require repair of mounting hardware or bracket.
Corroded, loose terminals	Require repair or replacement.

LINKAGE

LINKAGE

Condition	Procedure
Broken/damaged or binding	Require repair or replacement.
Missing or disconnected	Require repair or replacement.
Out of adjustment	Require adjustment.

CABLES

CABLES

Condition	Procedure
Binding	Suggest repair or replacement.
Out of adjustment	Require adjustment.
Broken or seized	Require replacement.
Disconnected	Require repair.

VACUUM HOSES/TUBES

VACUUM HOSES/TUBES

Condition	Procedure
Missing	Require replacement.
Damaged	Suggest repair or replacement.
Leaking/restricted	Require repair or replacement.
Routed incorrectly	Suggest re-routing.

EVAPORATOR DRAIN TUBE

EVAPORATOR DRAIN TUBE

Condition	Procedure
Disconnected	Require repair.
Missing	Require replacement.
Damaged/leaking	Require replacement.
Restricted	Require repair or replacement.

CONTROLS

FUNCTION SELECTORS

Condition	Procedure
Inoperative	Require repair or replacement.
Malfunctioning	Suggest repair or replacement.
Damaged	Suggest replacement.
Missing	Require replacement.
Missing, damaged mounting hardware	Require repair of mounting hardware or bracket.
Corroded, loose terminals	Require repair or replacement.

BLOWER SWITCH

Condition	Procedure
Inoperative	Require replacement.

Malfunctioning	³ Suggest repair or replacement.
Damaged	³ Suggest replacement.
Missing	³ Require replacement.
Missing, damaged mounting hardware	³ Require repair of mounting ³ hardware or bracket.
Corroded, loose terminals	³ Require repair or replacement.

BLOWER MOTOR

BLOWER MOTOR	
Condition	³ Procedure
Inoperative	³ Require replacement.
Noisy	³ Suggest replacement.
Damaged	³ Suggest replacement.
Missing	³ Require replacement.
Missing, damaged mounting hardware	³ Require repair of mounting ³ hardware or bracket.
Corroded, loose terminals	³ Require repair or replacement.

BLOWER FAN

BLOWER FAN	
Condition	³ Procedure
Damaged	³ Require replacement.
Noisy	³ Suggest replacement.

BLOWER RESISTOR

BLOWER RESISTOR	
Condition	³ Procedure
Inoperative	³ Require replacement.
Malfunctioning	³ Suggest replacement.

*** A/C-HEATER SYSTEM UNIFORM INSPECTION GUIDELINES ***
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Damaged	³ Suggest replacement.
Missing	³ Require replacement.
Missing, damaged mounting hardware	³ Require repair of mounting ³ hardware or bracket.
Corroded, loose terminals	³ Require repair or replacement.

SWITCHES

NOTE: Includes, but not limited to: High Pressure Cut-Off, Low Pressure Cut-Off, Thermostatic Fan Control, Ambient, Pressure Cycling, etc.

SWITCHES

Condition	³ Procedure
Inoperative/intermittent	³ Require replacement.
Malfunctioning	³ Suggest replacement.
Leaking	³ Require repair or replacement.
Damaged	³ Suggest replacement.
Missing	³ Require replacement.
Missing, damaged mounting hardware	³ Require repair of mounting ³ hardware or bracket.
Corroded, loose terminals	³ Require repair or replacement.

THERMISTOR/SENSORS

NOTE: Includes, but not limited to: In-car Temperature, Ambient Air Temperature, Sun Load Sensor, etc.

THERMISTOR/SENSORS

Condition	³ Procedure
Inoperative	³ Require replacement.
Malfunctioning	³ Suggest replacement.
Damaged	³ Suggest replacement.

Missing	Require replacement.
Missing, damaged mounting hardware	Require repair of mounting hardware or bracket.
Corroded, loose terminals	Require repair or replacement.

RELAYS

RELAYS	
Condition	Procedure
Inoperative	Require replacement.
Malfunctioning	Suggest replacement.
Damaged	Suggest replacement.
Missing	Require replacement.
Missing, damaged mounting hardware	Require repair or replacement of hardware.
Corroded, loose terminals	Require repair or replacement.

FUSE/FUSIBLE LINK/CIRCUIT BREAKER

FUSE/FUSIBLE LINK/CIRCUIT BREAKER		
Condition	Procedure	Note
Inoperative/intermittent	Require replacement. Further inspection required.	Determine cause of condition & correct prior to replacement.
Damaged	Suggest repair or replacement.	
Open	Require replacement.	
Missing	Require replacement.	Refer to OEM owner's manual for proper amperage & location.

WIRING HARNESS/CONNECTORS

WIRING HARNESS/CONNECTORS		
Condition	Procedure	Note
Damaged	Suggest repair or	

	³ replacement.	³
Routed incorrectly	³ Suggest rerouting of ³ of wiring.	³
Open fusible link	³ Require replacement of fusible link.	³ Determine cause of condition and repair prior to replacement.
Shorted/open	³ Require repair or replacement.	³
Connector terminal bent, broken, corroded or loose	³ Require repair or replacement	³
Excessive resistance	³ Require repair or replacement	³
Poor ground	³ Require repair.	³

CONTROL MODULE

NOTE: Includes, but not limited to: BOM (Body), ECM (Electronic), PCM (Power), etc.

CONTROL MODULE

Condition	Procedure	Note
Inoperative	³ Require replacement.	³
Malfunctioning	³ Suggest replacement.	³
Code set	³ Further inspection required.	³ Refer to manufacturer's diagnostic trouble code procedure and repair or replace affected component(s) as necessary.
Damaged/cracked housing	³ Suggest replacement.	³ If moisture enters the module it can reduce life expectancy or impair function.
Damaged	³ Suggest replacement.	³
Missing	³ Require replacement.	³
Missing, damaged mounting hardware	³ Require repair of mounting hardware or bracket.	³

Corroded, loose terminals	Require repair or replacement.	

CONTROLLERS

NOTE: Includes, but not limited to: IRCM, Coolant Fan Control Module (CFCM), AC Controller, Amplifier, Programmers, Control Heads, Power Modules, etc.

CONTROLLERS

Condition	Procedure	Note
Inoperative	Require replacement.	
Malfunctioning	Suggest replacement.	
Damaged/cracked housing	Suggest replacement.	If moisture enters the controller it can reduce life expectancy or impair function.
Damaged	Suggest replacement.	
Missing	Require replacement.	
Missing, damaged mounting hardware	Require repair of mounting hardware or bracket.	
Corroded, loose terminals	Require repair or replacement.	

HEATER CORE

HEATER CORE

Condition	Procedure	Note
Leaking	Require repair or replacement.	
Damaged fins, tubes, fittings	Suggest repair or replacement.	
Internal restrictions	Require repair or replacement	
Missing/by-passed	Suggest repair or replacement	

Air flow obstruction	Further inspection required.	If fins cannot be cleaned or straightened, require replacement.

HEATER CONTROL VALVE

HEATER CONTROL VALVE

Condition	Procedure
Coolant leak	Require replacement.
Vacuum leak	Require replacement.
Inoperative	Require replacement.
Malfunctioning	Suggest replacement.
Restricted	Suggest repair or replacement.

MIX/AIR CONTROL DOORS

MIX/AIR CONTROL DOORS

Condition	Procedure
Broken/damaged/binding	Require repair or replacement.
Disconnected	Require repair or replacement.

REQUEST FOR MAP MEMBERSHIP INFORMATION

NOTE: To print membership information request form, print portion of article between dashed lines.

MAP

Request for Membership Information

I want to be a part of the automotive maintenance and repair industry's move to improve the level of Customer satisfaction.

Please send me information on how I can become a member of MAP.

Name _____

*** A/C-HEATER SYSTEM UNIFORM INSPECTION GUIDELINES ***
Article Text (p. 19)
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For Volkswagen Technical Site

Saturday, March 18, 2000 10:02PM

Company/Organization _____

Address _____

_____

_____

Phone _____ FAX _____

****

MAP

808 17th STREET, NW
Suite 200
Washington, D.C 20006

Phone 202 466 7050
Fax 202 223 9569

END OF ARTICLE

* ANTI-LOCK BRAKES UNIFORM INSPECTION GUIDELINE *

Article Text

1993 Volkswagen EuroVan

For Volkswagen Technical Site

Saturday, March 18, 2000 10:03PM

ARTICLE BEGINNING

GENERAL INFORMATION
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* Example: An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.

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but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

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* component no longer performs intended purpose
* component does not meet a design specification (regardless of performance)
* component is missing.

Reasons to Suggest Repair or Replacement

* component is close to the end of its useful life (just above discard specifications or weak; failure likely to occur soon, etc.)
* address a customer need, convenience or request (stiffen ride, enhance performance, eliminate noise, etc.)
* comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM)
* technician's recommendation based on substantial and informed experience.

BRAKE SERVICE PROCEDURES REQUIRED AND SUGGESTED FOR PROPER VEHICLE OPERATION

ANTI-LOCK BRAKE SYSTEMS: GENERAL

Anti-lock brake systems are considered an essential part of brake systems on which they are found .

Anti-lock brake systems are commonly referred to as "ABS" and will be referred to as "ABS" throughout these guidelines. Some ABS components also function as part of a traction control system (TCS). Inspection, diagnostic and service procedures vary. Refer to appropriate service manuals for vehicle's specific requirements.

WARNING: When diagnosing and servicing high pressure components, observe safety procedures and equipment requirements established by the vehicle manufacturer to reduce the possibility of serious personal injury.

CAUTION: Most manufacturers prohibit the use of DOT 5 brake fluid in a system equipped with ABS.

NOTE: Intermittent electrical conditions are often caused by a loss of ground, poor connection, or water intrusion into

the wiring harness.
Electro-magnetic interference (EMI) may be caused by incorrect installation of accessories or components which can result in improper system operation.

ABS: WHEEL SPEED OR VEHICLE SPEED SENSORS

ABS: WHEEL SPEED OR VEHICLE SPEED SENSORS

Condition	Procedure	Note
Improper output signal	Further inspection required.	Component failure may be caused by water intrusion into the wiring harness.
Internal resistance does not meet specifications	Require replacement.	Always check insulation for damage and wiring for excessive resistance.
Cracked sensor housing	Require replacement.	
Improper routing of lead	Require re-routing according to vehicle manufacturer's specifications.	
Damaged wire lead	Require replacement.	
Contamination of surface	Suggest cleaning; identify and correct source.	
Damaged or missing tip or sensor	Require replacement.	
Loose	Require adjustment to vehicle manufac-turer's specifications.	Some integral bearing assemblies with sensors may require replacement.
Improper air gap	Require adjustment to vehicle manufac-turer's specifications.	If a sensor is not adjustable further inspection is required to identify and correct cause.

ABS: TOOTHED RING (TONE WHEEL)

ABS: TOOTHED RING (TONE WHEEL)

Condition	Procedure	Note

Teeth damaged	Further inspection required.	No action required unless ABS system performance is affected. If performance is affected, require replacement.
Cracked	Require replacement.	
Teeth missing or broken	Require replacement.	
Loose	Require replacement of worn parts.	
Contaminated	Suggest cleaning, identify and correct cause.	
Missing	Require replacement.	
Improper alignment	Require repair or replacement.	
Bent	Require replacement.	
Incorrect	Require replacement.	If the toothed ring requires replacement and cannot be replaced as a separate component, replace the assembly of which the ring is a part.

ABS: FLUID LEVEL SENSOR SWITCH

ABS: FLUID LEVEL SENSOR SWITCH

Condition	Procedure
Saturated float	Require replacement.
Improper output	Require replacement.

ABS: PRESSURE SWITCHES

ABS: PRESSURE SWITCHES

Condition	Procedure
Leaks	Require tightening or replacement as necessary.

Improper output	Require replacement.
Damaged housing	Require replacement.
Loose connector	Require repair or replacement.

ABS: PARKING BRAKE, STOP LIGHT, PEDAL TRAVEL OR IGNITION DISABLE SWITCH

ABS: PARKING BRAKE, STOP LIGHT, PEDAL TRAVEL

Condition	Procedure
Out of adjustment	Require adjustment or replacement.
Bent or broken	Require replacement.
Improper output	Require replacement.
Contaminated	Suggest cleaning or replacement as necessary.
Saturated float	Require replacement.
Improper output	Require replacement.

ABS: FOUR WHEEL DRIVE SWITCH

ABS: FOUR WHEEL DRIVE SWITCH

Condition	Procedure
Broken	Require replacement.
Missing	Require replacement.
Improper output	Require replacement.
Leaking	Require repair or replacement.
Loose	Require repair or replacement.

ABS: ACCELEROMETER (G SENSOR OR LATERAL)

ABS: ACCELEROMETER (G SENSOR OR LATERAL)

Condition	Procedure
Out of position	Require re-positioning to vehicle manufacturer's

	³	specifications.
Improper output	³	Require replacement.
Loose	³	Require repair or replacement.
Broken	³	Require replacement.

ABS: DIGITAL RATIO AXLE CONTROLLER/BUFFER (DRAC OR DRAB)

ABS: DIGITAL RATIO AXLE CONTROLLER/BUFFER (DRAC OR DRAB)

Condition	³	Procedure
Improper calibration	³	Require repair or replacement.
No output	³	Require replacement.

ABS: HYDRAULIC MODULATORS

NOTE: Many modulators can only be replaced as complete assemblies. Whenever possible, replace the failed component part. If replacement of the failed part is not possible then replace the modulator assembly.

ABS: HYDRAULIC MODULATORS

Condition	³	Procedure
Internal leak	³	Require repair or replacement.
External leak	³	Require repair or replacement.
Stuck valve	³	Require repair or replacement.
Electrical failure	³	Require repair or replacement.
Cracked housing	³	Require repair or replacement.
Missing or by-passed	³	Require repair or replacement.
Improper calibration	³	Require repair or replacement.

ABS: ELECTRONIC CONTROLLER

ABS: ELECTRONIC CONTROLLER

Condition	³	Procedure	³	Note

Inoperative	Require replacement.	
Cracked housing	Suggest replacement.	If moisture enters the controller it can reduce life expectancy or impair function.

ABS: WIRING HARNESS

NOTE: Component failure may be caused by water intrusion into the wiring harness. Always check insulation for damage and wiring for excessive resistance.

ABS: WIRING HARNESS

Condition	Procedure
Mis-routed	Require re-routing to vehicle manufacturer specifications.
Shorted or open	Require repair or replacement.
Damaged (cut, burned or chaffed)	Require repair or replacement.
Connector and/or terminal problem (bent, broken, corroded or loose)	Require repair or replacement.
Excessive resistance	Require repair or replacement.
Poor ground	Require repair or replacement.
Blown fuse/fusible link or diode	Require identification and correct cause; then replace component.

ABS:ELECTRICAL PUMP & MOTORS

ABS:ELECTRICAL PUMP & MOTORS

Condition	Procedure	Note
Inoperative	Require replacement.	
Leaking	Require repair or replacement.	
Excessive run time	Further inspection required.	If excessive run time or failure to build pressure

Does not build pressure	is traced to the pump, require replacement.

ABS: ACCUMULATORS

ABS: ACCUMULATORS

Condition	Procedure
Incorrect pre-charge	Require replacement.
Leaking	Require replacement.

ABS: RELAYS

ABS: RELAYS

Condition	Procedure	Note
Open	Require replacement.	
Shorted	Require replacement.	
Intermittent	Require replacement.	
Missing	Require replacement.	
Cracked housing	Suggest replacement.	If moisture enters the relay it can reduce life expectancy or impair function.

ABS: TIRES AND WHEELS

ABS: TIRES AND WHEELS

Condition	Procedure
Incorrect size, diameter or pressure may affect the operation of ABS and traction control systems.	Consult the vehicle owner's manual or vehicle placard for correct size, speed ratings and inflation pressure of the original tires. Do not exceed the maximum load or inflation capacity of the tire specified by OE.

*** ANTI-LOCK BRAKES UNIFORM INSPECTION GUIDELINE ***
Article Text (p. 10)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:03PM

NOTE: To print membership information request form, print portion of article between dashed lines.

MAP

Request for Membership Information

I want to be a part of the automotive maintenance and repair industry's move to improve the level of Customer satisfaction.

Please send me information on how I can become a member of MAP.

Name _____

Company/Organization _____

Address _____

_____

_____

Phone _____ FAX _____

****

MAP

808 17th STREET, NW
Suite 200
Washington, D.C 20006

Phone 202 466 7050
Fax 202 223 9569

END OF ARTICLE

* AUTO TRANS DIAGNOSIS MENU - VOLKSWAGEN

Article Text

1993 Volkswagen EuroVan

For Volkswagen Technical Site

Saturday, March 18, 2000 10:03PM

ARTICLE BEGINNING

AUTOMATIC TRANSMISSION DIAGNOSIS
ARTICLE SEARCH BY TRANSMISSION - IMPORTS

*** PLEASE READ THIS FIRST ***

The menu in this article pertains to articles that are specifically written for the Electronically-Controlled transmission/ transaxle systems.

AUTO TRANS MENU - ALPHABETICAL - VOLKSWAGEN

VOLKSWAGEN

VOLKSWAGEN TRANSMISSIONS

TRANSMISSION	GO TO:
010	AUTO TRANS DIAGNOSIS - 010
096	AUTO TRANS DIAGNOSIS - 096
098	AUTO TRANS DIAGNOSIS - 098

END OF ARTICLE

* BRAKE SYSTEM UNIFORM INSPECTION GUIDELINES *

Article Text

1993 Volkswagen EuroVan

For Volkswagen Technical Site

Saturday, March 18, 2000 10:03PM

ARTICLE BEGINNING

GENERAL INFORMATION
Brake Systems - Motorist Assurance Program
Standards For Automotive Repair

All Makes & Models

INTRODUCTION TO MOTORIST ASSURANCE PROGRAM (MAP)

OVERVIEW OF MOTORIST ASSURANCE PROGRAM

The Motorist Assurance Program (MAP) is the consumer outreach effort of the Automotive Maintenance and Repair Association, Inc. (AMRA). Participation in the Motorist Assurance Program is drawn from retailers, suppliers, independent repair facilities, vehicle manufacturers and industry associations.

The Motorist Assurance Program was established as an industry-wide effort to address concerns raised by regulators, the media and consumers questioning our ethics and methods of doing business. The automotive repair industry had been bombarded by months of negative stories in the media and scrutiny from state and federal regulators who focused on how the need for repairs is determined. MAP was formed as an industry response to this issue.

Our mission is to strengthen the relationship between the consumer and the auto repair industry. We produce materials that give motorists the information and encouragement to take responsibility for their vehicles - through proper, manufacturer-recommended, maintenance. We encourage participatinf service and repair shops (including franchisees and dealers) to adopt a Pledge to their Customers and the Motorist Assurance Program developed Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service which demonstrates to their customers that they are serious about customer satisfaction.

These Standards of Service require that an inspection of the vehicle's (problem) system be made according to industry guidelines. After learning that neither the car manufacturers nor any other source had complete guidelines, leading industry organizations, along with other industry participants banded together to address this challenging task. During the past two and a half years, they successfully developed industry inspection guidelines for the following systems: Exhaust, Brakes, ABS, Steering and Suspension, Engine Maintenance and Performance, HVAC, and Electrical systems. Guidelines for Drive Train and Transmision are currently being promulgated. Revisions to the inspection guidelines for Exhaust, Brakes/ABS and Steering and Suspension Systems, which were issued two years ago, are now being published for implementation beginning spring 1997. Participating shops utilize these Uniform Inspection Guidelines as part of the inspection process and for communicating their findings to their customers.

The Motorist Assurance Program continues to work

cooperatively and proactively with government agencies and consumer groups toward solutions that both benefit the customer and are mutually acceptable to both regulators and industry. We maintain the belief that industry must retain control over how we conduct our business, and we must be viewed as part of the solution and not part of the problem. Meetings with state and other government officials concerned with auto repair and/or consumer protection are conducted. Feedback from these representatives are brought back to members, and the program adjusted as needed.

To assure auto repair customers recourse if they were not satisfied with a repair transaction, the Motorist Assurance Program offers arbitration through MAP/BBB-CARE in cooperation with the Council of Better Business Bureaus and individual participating Bureaus. MAP "piloted" in Indianapolis and Pittsburgh during spring, 1996 - and publicized "roll-outs" in New Jersey, Detroit (MI), Chicago (IL) and Richmond (VA) were conducted. To put some "teeth" in the program, and accreditation requirement for shops was initiated. The requirements are stringent and a self-policing method has been incorporated which includes the "mystery shopping" of outlets. In addition, a committee of service providers had been working diligently developing standards for newspaper, television and Internet advertising.

We welcome you to join us as we continue our outreach ... with your support, both the automotive repair industry and your customers will reap the benefits. Please visit MAP at our Internet site: www.hunter.com/map.htm or contact us at:

808 17th Street, NW Suite 200
Washington, D.C. 20006
Ph. (202) 466-7050 Fax (202) 223-9569

The Motorist Assurance Program was formed in 1992 by forty (40) companies who were concerned about the image of automotive service establishments. Today, MAP is an industry-wide association dedicated to strengthening consumer satisfaction with the automotive repair industry. MAP's participants represent the majority of the nation's multi-bay retail automotive outlets, their parts and equipment suppliers, independent repair shops, industry associations, car companies, manufacturers representatives, and the trade press. MAP is developing standards of service, uniform inspection procedures and other programs to assure consumers of the industry's professionalism and the commitment to excellence shared by MAP's sponsoring companies.

MAP's achievements to date include production and distribution (over 280,000) of the consumer brochure "How to Find Your Way Under the Hood and Around Your Car", development of a Pledge of Satisfaction to Consumers and Standards of Service and establishment of relationships with regulatory agencies.

As auto repair becomes an issue for federal and state regulators, MAP is working to educate government leaders on the dynamics of automotive service and the self-monitoring efforts MAP has undertaken on the industry's behalf. MAP's sponsoring companies are becoming well-known to government representatives as exemplary

businesses working to improve the industry. Media sources also look to MAP to provide information and advice to consumers and on working with automotive technicians and repair establishments.

In the next few months, MAP plans to assist member repair facilities in implementing the MAP Pledge to Customers, establishing an alternate dispute resolution system to help resolve customer complaints within the industry, and developing a shop accreditation program to encourage policies in concert with the MAP Standards of Service and Inspection Guidelines.

MAP has united the aftermarket behind its consumer-oriented goals and has established itself both within and outside of the industry. We welcome you to join us as MAP continues its outreach. With your support, both the automotive repair industry and your customers will reap the benefits. Please contact MAP at:

808 17th Street, NW Suite 200
Washington, D.C. 20006
Ph. (202) 466-7050 Fax (202) 223-9569

MAP UNIFORM INSPECTION GENERAL GUIDELINES

OVERVIEW OF SERVICE REQUIREMENTS & SUGGESTIONS

It is MAP policy that all exhaust, brake, ABS, steering and suspension, wheel alignment, tires and wheels, driveline, engine performance and maintenance and heating, ventilation and air conditioning services be offered and performed under the guidelines and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be required or suggested. In addition, suggestions may be made to satisfy the needs expressed by the customer.

This section lists the various parts and conditions that indicate required or suggested service or part replacement. Although this list is extensive, it is not inclusive. In addition to this list, a technician may make a suggestion. This suggestion must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

* Example: An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.

* Example: A brake rotor has been worn to the point where it

measures less than the vehicle manufacturer's specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or to address a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may only be to suggest service.

* Example: An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.

* Example: The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a customer declines to authorize a service or repair indicated in the MAP Uniform Inspection Guidelines as "required," a MAP shop may refuse service on that system, if proceeding with the work could create or continue an unsafe or unsatisfactory condition.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the Uniform Inspection Guidelines that follow.

PART REPLACEMENT CODE IDENTIFICATION

NOTE: Refer to the following tables for definitions of the codes listed in the condition/procedure tables for the specific components that may need to be replaced.

A - PART NO LONGER PERFORMS INTENDED PURPOSE

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
A - Part no longer performs intended purpose	1 - Part is close to the end of its useful life (just above discard specifications, or weak; failure likely to occur soon, etc.)

B - PART DOES NOT MEET DESIGN SPEC., REGARDLESS OF PERFORMANCE

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
B - Part does not meet a design specification (regardless of performance)	2 - To address a customer need, convenience, or request (to stiffen ride, enhance performance, eliminate noise etc.)

C - PART IS MISSING

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
C - Part is missing	3 - To comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM)
	4 - Technician's recommendation based on substantial and informed experience

BRAKES

SERVICE PROCEDURES REQUIRED & SUGGESTED FOR PROPER VEHICLE OPERATION

The brake system is the single most important safety feature of any passenger vehicle. It is absolutely vital that proper procedures and preventive maintenance are offered and suggested to consumers to prevent very costly, and in some cases, catastrophic brake system failure.

NOTE: Some states may have specifications that differ from OEM. Check your local/state regulations. Where state or local laws are stricter, they take precedence over these guidelines.

ANTI-LOCK BRAKE SYSTEMS: GENERAL

Anti-lock brake systems are considered an essential part of brake systems on which they are found.

Anti-lock brake systems are commonly referred to as "ABS" and will be referred to as "ABS" throughout these guidelines. Some ABS components also function as part of a traction control system (TCS). Inspection, diagnostic, and service procedures vary. Refer to appropriate service manuals for vehicle's specific requirements.

WARNING: When diagnosing and servicing high pressure components,

observe safety procedures and equipment requirements established by the vehicle manufacturer to reduce the possibility of serious personal injury.

CAUTION: Most manufacturers prohibit the use of DOT 5 brake fluid in a system equipped with ABS.

NOTE: Intermittent electrical conditions are often caused by a loss of ground, poor connection, or water intrusion into the wiring harness.

Electro-magnetic interference (EMI) may be caused by incorrect installation of accessories or components. EMI can result in improper system operation.

ACCELEROMETERS (G SENSOR OR LATERAL)

Condition	Code	Procedure
Broken	A	Require replacement.
Connector loose	A	Require repair or replacement.
Loose	A	Require repair or replacement.
Missing	A	Require replacement.
Out of position	A	Require re-positioning to vehicle manufacturer's specifications.
Output signal incorrect	A	Require replacement.

ACCUMULATORS - BRAKE

Condition	Code	Procedure
Leaking	A	Require replacement.
Missing	A	Require replacement.
Pre-charge incorrect	A	Require replacement.

BACKING PLATES OR ANCHOR PINS

Condition	Code	Procedure
Anchor pin bent	A	Require repair or replacement.
Anchor pin broken	A	Require replacement.

Anchor pin worn, affecting structural integrity	A	Require replacement.
Backing plate bent	A	Require repair or replacement.
Backing plate cracked	A	Require repair or replacement.
Backing plate broken	A	Require replacement.
Corroded, affecting structural integrity	A	Require repair or replacement.
Loose	A	Require repair or replacement.
Missing	A	Require replacement.
Shoe lands worn	A	Require repair or replacement.

BRAKE FLUID

DOT 3 and DOT 4 brake fluids are clear or light amber in color. DOT 5 brake fluid is violet in color. Correct fluid required for the brake system is stamped on the master cylinder cover.

It is suggested that the system should be flushed and refilled with correct brake fluid when performing hydraulic brake service.

BRAKE FLUID

Condition	Code	Procedure
Beyond service interval	C,3	Suggest replacement.
Brake fluid incorrect	A	Require service. See note (1) below.
Contaminated, e.g. fluid other than brake fluid present	A or A	Require service. See note (2) below.
Rubber master cylinder cover gasket distorted and gummy	A	Require service. See note (2) below.

NOTE: (1) If a fluid other than specification brake fluid is present in the brake system, the required service is to flush and fill with the correct brake fluid.

(2) If a fluid other than brake fluid is present in the brake system which DOES affect the rubber parts, the required service is to: a) remove all components having rubber parts from the system, b) flush lines with denatured alcohol or

brake cleaner, c) repair or replace all components having rubber parts, and d) bleed and flush with correct brake fluid. (Code A)
If a fluid other than brake fluid is present in the brake system which DOES NOT affect the rubber parts, the required service is to flush and fill with the correct brake fluid. (Code A)

BRAKE FRICTION MATERIAL

NOTE: Original Equipment Manufacturer (OEM) specifications designate replacement at different thicknesses.

CAUTION: It is required that friction material be matched in axle sets for consistent braking characteristics.

BRAKE FRICTION MATERIAL

Condition	Code	Procedure
Contaminated, e.g. fluid that leaked from caliper, wheel cylinder or axle seal	A	Require replacement.
Cracked through	A	Require replacement.
Flaking or chunking	A	Require replacement.
Glazed (shiny)		No service suggested or required.
Grooves or ridges	B,2	No service suggested or required. See note (1) below.
Permanently attached hardware bent	A	Require replacement.
Permanently attached hardware broken	A	Require replacement.
Permanently attached hardware loose	A	Require replacement.
Permanently attached hardware missing	A	Require replacement.
Permanently attached hardware seized	A	Require repair or replacement.
Rivets loose	A	Require replacement.
Separating from backing	A	Require replacement.

*** BRAKE SYSTEM UNIFORM INSPECTION GUIDELINES ***

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1993 Volkswagen EuroVan

For Volkswagen Technical Site

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Shoe table or web bent	A	Require replacement.
Shoe table or web cracked	A	Require replacement.
Shoe table or web worn affecting performance	A	Require replacement.
Surface cracking		No service suggested or required. Further inspection may be necessary.
Tapered wear	A	Further inspection required. See note (2) below.
Thickness of one pad is greater than opposite pad in the same caliper (uneven wear)	B,2	Suggested minimum service is to lubricate caliper anchor and hardware. However, caliper may need to be rebuilt or replaced. See note (3) below.
Wear indicator device (electronic) contacts rotor	A	Require replacement of appropriate parts. See caution below.

CAUTION: The pad wear indicator light may come on due to other electrical problems.

Wear indicator device (mechanical) bent	B,2	Further inspection required. See note (4) below.
Wear indicator device (mechanical) broken	B,2	Further inspection required. See note (4) below.
Wear indicator device (mechanical) contacts rotor	B,2	Further inspection required. See note (4) below.
Worn to minimum specification	A	Suggest replacement.
Worn below minimum specification	A	Require replacement.
Worn close to, but above, minimum specification	A	Suggest repair or replacement.

NOTE: (1) When reconditioning or replacing drums or rotors, replacement of friction material may be suggested depending on the severity of the grooves or ridges.

(2) This type of wear is normal on some vehicles. Refer to specific vehicle application. If not normal, require

replacement of pads and correction of cause.
(3) Uneven pad thickness is normal on some vehicles. Refer to specific vehicle applications.
(4) Explain to the customer that the purpose of the wear indicator is to alert him or her to check for friction wear. Wear indicators may be bent or broken. Therefore, the friction material must be measured. Friction material replacement is determined based upon the conditions stated in this section. Periodic inspection suggested.

BRAKE SHOE HARDWARE

BRAKE SHOE HARDWARE

Condition	Code	Procedure
Broken	A	Require replacement.
Distorted	A	Require replacement.
Missing	A	Require replacement.
Surfaces are rust-pitted	A	Suggest replacement.

BRAKE STOPLIGHT SWITCHES

BRAKE STOPLIGHT SWITCHES

Condition	Code	Procedure
Bent	A	Require replacement.
Broken	A	Require replacement.
Missing	A	Require replacement.
Out of adjustment	A	Require adjustment or replacement.
Output signal incorrect	A	Require replacement.

CALIPER HARDWARE

CALIPER HARDWARE

Condition	Code	Procedure
Bent	A	Require repair or replacement.
Broken	A	Require repair or replacement.

Corroded, affecting performance	A	Require repair or replacement.
Dust boots on slider pin (bolt) are missing	B,2	Suggest replacement of boots.
Dust boots on slider pin (bolt) are torn	B,2	Suggest replacement of boots.
Missing	A	Require replacement.
Shims bent	A	Require removal or replacement.
Shims (OE standard) missing	A	Require replacement. See note (1) below.
Shims out of position	A	Require removal or replacement.
Shims worn	A	Require removal or replacement.
Slider pin (bolt) bent	A	Require repair or replacement of slider pin or bolt & lubricants.
		slider pin or bolt & lubricants.
Slider pin (bolt) rust-pitted	A	Require repair or replacement of slider pin or bolt & lubricants.
Slider pin (bolt) worn	A	Require repair or replacement of slider pin or bolt & lubricants.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Worn, affecting performance	A	Require replacement.

NOTE: (1) Aftermarket shims may be suggested to reduce noise.

CALIPERS

You are not required to replace or rebuild calipers in axle sets. However, when replacing or rebuilding a caliper due to the conditions that follow, you may suggest servicing, rebuilding, or replacement of the other caliper (on the same axle) for improved performance and preventive maintenance (for example, the part is close to the end of its useful life, replacing the caliper may extend pad life, or contribute to more balanced braking).

*** BRAKE SYSTEM UNIFORM INSPECTION GUIDELINES ***
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For Volkswagen Technical Site

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CAUTION: When installing calipers (loaded or unloaded), it is required that friction material be matched in axle sets for consistent braking characteristics.

Determine the need to replace or rebuild based upon the individual caliper conditions that follow.

CALIPERS

Condition	Code	Procedure
Bleeder port damaged (if non-repairable)	A	Require replacement of caliper.
Bleeder screw plugged	A	Require repair or replacement of bleeder screw. See note (1) below.
Bleeder screw broken off in caliper (if non-repairable)	A	Require replacement of caliper. See note (1) below.
Bleeder screw seized	A	Require replacement of caliper. See note (2) below.
Casting damaged - heavy corrosion affecting structural integrity	A	Require replacement of caliper.
Casting damaged - worn by rotor or wheel, affecting structural integrity	A	Require replacement of caliper.
Dust boot around caliper is torn	B,2	Suggest rebuilding or replacement of caliper.
Leaking	A	Require rebuilding or replacement of caliper.
Mounting pin threads damaged	A	Require repair or replacement of component with damaged threads.
Mounting pin threads stripped (threads missing)	A	Require repair or replacement of component with stripped threads.
Mounting pin threads stripped in caliper bracket (threads missing)	A	Require repair or replacement of caliper bracket.
Mounting pin threads stripped in steering knuckle (threads missing)	A	Require repair or replacement of steering knuckle.

*** BRAKE SYSTEM UNIFORM INSPECTION GUIDELINES ***
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Pad thickness is greater than opposite pad in the same caliper (uneven wear)	A	Require lubrication of caliper anchor and hardware. However, caliper and/or hardware may need to be rebuilt or replaced. See note (3) below.
Pads in one caliper are thinner than pads in the other caliper on the same axle	A	Further inspection required. See note (4) below.
Parking brake cable support, lever, or return spring bent	A	Require replacement of parts.
Parking brake cable support, lever, or return spring broken	A	Require replacement of parts.
Parking brake mechanism in caliper inoperative	A	Require repair or replacement.
Piston anodized finish worn off	A	Require replacement of piston and rebuilding or replacement of caliper.
Piston corroded (pitted or peeling chrome plating)	A	Require replacement of piston and rebuilding or replacement of caliper.
Piston face damaged (small scratches, chips acceptable)	A	Require replacement of piston and rebuilding or replacement of caliper.
Piston face scored by rotor (small scratches, chips acceptable)	A	Require replacement of piston and rebuilding or replacement of caliper.
Piston sealing surface damaged	A	Require replacement of piston and rebuilding or replacement of caliper.
Piston sticking	A	Require rebuilding or replacement of caliper.

NOTE: (1) Only required if the hydraulic system must be opened.
(2) Seized is defined as a bleeder screw that cannot be removed after a practical attempt at removing. Only required if the hydraulic system must be opened.
(3) Some vehicles are designed with inner and outer pads of different thicknesses. Refer to specific vehicle applications.

(4) If all other causes have been eliminated, suggest repair or replacement of the caliper(s).

DIGITAL RATIO AXLE CONTROLLERS & BUFFERS (DRAC & DRAB)

DIGITAL RATIO AXLE CONTROLLERS & BUFFERS (DRAC & DRAB)

Condition	Code	Procedure
Missing	A	Require replacement.
Output signal incorrect	A	Require repair or replacement.

DRUMS

Determine the need to recondition based upon individual drum conditions that follow. Friction material replacement does not require drum reconditioning unless other justifications exist. DO NOT recondition new drums unless they are being pressed or bolted onto an existing hub. It is not necessary to replace drums in axle sets. However, when replacing or reconditioning a drum due to the conditions that follow, you may suggest reconditioning of the other drum on the same axle to eliminate uneven braking behavior. Determine the need to replace based upon the individual drum conditions that follow. Always wash drums after servicing or before installing.

DRUMS

Condition	Code	Procedure
Balance weight missing		No service suggested or required.
Bell-mouthed	B,2	Suggest reconditioning or replacement.
Cooling fin broken		No service suggested or required.
Cracked	A	Require replacement.
Drum diameter will exceed OEM "machine to" specs after required reconditioning	A	Require replacement. See note (1) below.
Hard-spotted	A	Suggest reconditioning or replacement.
Measured diameter is greater than OEM discard specifications	A	Require replacement.

Out-of-round (wobbles)	B,2	Suggest reconditioning or replacement.
Scored	A	Require reconditioning or replacement.
Surface is threaded due to improper machining	A	Require reconditioning or replacement.
Tapered	B,2	Suggest reconditioning or replacement.

NOTE: (1) If OEM does not supply "machine to" specifications, you may machine to the discard specifications.

ELECTRICAL PUMPS & MOTORS - BRAKE

ELECTRICAL PUMPS & MOTORS - BRAKE

Condition	Code	Procedure
Does not build pressure	A	Further inspection required. See note (1) below.
Excessive run time	A	Further inspection required. See note (2) below.
Inoperative	A	Require replacement.
Leaking	A	Require repair or replacement.
Missing	A	Require replacement.

NOTE: (1) If failure to build pressure is traced to the pump or motor, require replacement.
(2) If excessive run time is traced to the pump or motor, require replacement.

ELECTRONIC CONTROLLERS BRAKE

ELECTRONIC CONTROLLERS BRAKE

Condition	Code	Procedure
Housing cracked	B,2	Suggest repair or replacement. See note (1) below.
Inoperative	A	Require replacement.

Missing	A	Require replacement.

NOTE: (1) If moisture enters the controller, it can reduce life expectancy or impair function.

FLUID LEVEL SENSOR SWITCHES BRAKE

FLUID LEVEL SENSOR SWITCHES BRAKE

Condition	Code	Procedure
Connector loose	A	Require repair or replacement.
Float saturated	A	Require replacement.
Missing	A	Require replacement.
Output signal incorrect	A	Require replacement.

FOUR WHEEL DRIVE SWITCHES

FOUR WHEEL DRIVE SWITCHES

Condition	Code	Procedure
Broken	A	Require replacement.
Connector loose	A	Require repair or replacement.
Leaking	A	Require repair or replacement.
Loose	A	Require repair or replacement.
Missing	A	Require replacement.
Output signal incorrect	A	Require replacement.

HOSES

HOSES

Condition	Code	Procedure
Blistered	A	Require replacement.
Fitting threads damaged	A	Require repair or replacement.
Fitting threads stripped (threads missing)	A	Require replacement.

Incorrectly secured	A	Require repair.
Inner fabric (webbing) cut	A	Require replacement.
Leaking	A	Require replacement.
Mounting hardware damaged	A	Require repair or replacement.
Mounting hardware missing	A	Require replacement.
Outer covering is cracked to the extent that inner fabric of hose is visible	A	Require replacement.
Restricted	A	Require replacement.
Routed incorrectly	A	Require routing correction.

HYDRAULIC MODULATORS BRAKE

Many modulators can only be replaced as complete assemblies. Whenever possible, replace the failed component part. If replacement of the failed part is not possible, then replace the modulator assembly.

HYDRAULIC MODULATORS BRAKE

Condition	Code	Procedure
Disabled	A	Require repair or replacement.
Electrical failure	A	Require repair or replacement.
External leak	A	Require repair or replacement.
Housing cracked	A	Require repair or replacement.
Internal leak	A	Require repair or replacement.
Missing	A	Require replacement.
Valve stuck	A	Require repair or replacement.

HYDRO-BOOSTERS

Conditions listed assume that the problem has been isolated to the specific component by proper testing procedures.

HYDRO-BOOSTERS

Condition	Code	Procedure
Does not apply assist, or inadequate assist	A	Require repair or replacement.
Leaks fluid at fitting	A	Require tightening or replacement.
Leaks fluid at unit	A	Require repair or replacement. See note (1) below.
Leaks fluid from pressure hose(s)	A	Require replacement of hose(s).
Leaks fluid into passenger compartment	A	Require repair or replacement.
Wires corroded	A	Require repair or replacement.
Wires have exposed conductors	A	Require repair or replacement.
Wires burned	A	Require repair or replacement.

NOTE: (1) Follow diagnostic procedures as outlined in service manual to determine cause of leak and if unit can be repaired.

HYDRO-ELECTRIC BOOSTERS (POWERMASTER)

Conditions listed assume that the problem has been isolated to the specific component by proper testing procedures.

HYDRO-ELECTRIC BOOSTERS (POWERMASTER)

Condition	Code	Procedure
Connector bent	A	Require repair or replacement.
Connector broken	A	Require repair or replacement.
Connector loose	A	Require repair or replacement.
Does not apply assist, or inadequate assist	A	Require repair or replacement.
Leaks fluid at fitting	A	Require tightening or replacement.
Leaks fluid at unit	A	Require repair or replacement. See note (1) below.

Leaks fluid from pressure hose(s)	A	Require replacement of hose(s).
Leaks fluid into passenger compartment	A	Require repair or replacement.

NOTE: (1) Follow diagnostic procedures as outlined in service manual to determine cause of leak and if unit can be repaired.

IGNITION DISABLE SWITCHES

IGNITION DISABLE SWITCHES

Condition	Code	Procedure
Bent	A	Require replacement.
Broken	A	Require replacement.
Corroded	B,2	Suggest repair or replacement.
Missing	A	Require replacement.
Out of adjustment	A	Require adjustment or replacement.
Output signal incorrect	A	Require replacement.

LIGHTS - BRAKE

LIGHTS - BRAKE

Condition	Code	Procedure
Brake stoplights inoperable	A	Further inspection required to determine cause. See note (1).
Bulb burned out	A	Require replacement.
Warning light does not come on during bulb check		Further inspection required to determine cause. See note (1).
Warning light flashes		Further inspection required to determine cause. See note (1).
Warning light is intermittent		Further inspection required to determine cause. See note (1).
Warning light stays on after initial bulb check		Further inspection required to determine cause. See note (1).

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NOTE: (1) Follow appropriate procedure for determined cause.

MASTER CYLINDERS - BRAKE

MASTER CYLINDERS - BRAKE

Condition	Code	Procedure
Brake fluid leaking from rear of master cylinder bore	A	Further inspection required. See note (1) below.
Brake pedal drops intermittently	A	Further inspection required. See note (2) below.
Fluid level low		Further inspection required. See caution below.
CAUTION: DO NOT TOP OFF. Look for disc pad wear or fluid leak. Refer to OEM procedures for adjusting low fluid level.		
Internal valve failure	A	Require repair or replacement. See note (3) below.
Master cylinder has residue in reservoir	B,2	Further inspection required. See note (4) below.
Master cylinder leaking brake fluid internally	A	Require repair or replacement. See note (5) below.
Piston does not return	A	Require repair or replacement.
Ports plugged	A	Require repair or replacement.
Rubber master cylinder cover gasket distorted and gummy	A	Require replacement of the gasket. See note (6) below.

NOTE: (1) Check for possible vacuum leak at booster input seal and/or push rod misalignment as possible causes. If neither is the cause, require repair or replacement of master cylinder.
(2) This condition may be normal on some vehicles equipped with anti-lock brakes. If all other possible causes have been eliminated, require repair or replacement of master cylinder.
(3) Require repair or replacement of valve if possible. If not possible, require replacement of the master cylinder.
(4) DO NOT replace master cylinder unless it exhibits conditions listed for replacement. You may suggest fluid change according to OEM service intervals.
(5) Use hose clamp test to determine this condition. Use an

approved brake hose clamp to avoid damage to the hose.
(6) This condition may indicate contaminated brake fluid. See Brake Fluid section of the Uniform Inspection Guidelines.

PARKING BRAKE SWITCHES

PARKING BRAKE SWITCHES

Condition	Code	Procedure
Bent	A	Require replacement.
Broken	A	Require replacement.
Corroded	B,2	Suggest repair or replacement as necessary.
Missing	A	Require replacement.
Out of adjustment	A	Require adjustment or replacement.
Output signal incorrect	A	Require replacement.

PARKING BRAKE SYSTEMS

The parking brake is an integral part of the brake system. It is important that the parking brake function properly when brake service is performed.

PARKING BRAKE SYSTEMS

Condition	Code	Procedure
Cable improperly adjusted	A	Require cable adjustment.
Cable sticking	A	Require cable lubrication.
Cable stuck inside conduit and cannot be lubricated so that parking brake functions properly	A	Require replacement of cable assembly.
Cable or individual wires in the cable are broken	A	Require replacement of cable assembly.
Parking brake parts are inoperative	A	Require replacement of inoperative parts.
Parking brake parts are missing	A	Require replacement of missing parts.

Parking brake parts are broken	A	Require replacement of broken parts.
Parking brake parts bent	A	Require replacement of bent parts.

PEDAL TRAVEL SWITCHES

PEDAL TRAVEL SWITCHES

Condition	Code	Procedure
Bent	A	Require replacement.
Broken	A	Require replacement.
Corroded	B,2	Suggest repair or replacement.
Missing	A	Require replacement.
Out of adjustment	A	Require adjustment or replacement.
Output signal incorrect	A	Require replacement.

PRESSURE DIFFERENTIAL SWITCHES

PRESSURE DIFFERENTIAL SWITCHES

Condition	Code	Procedure
Bent	A	Require replacement.
Broken	A	Require replacement.
Corroded	B,2	Suggest repair or replacement.
Missing	A	Require replacement.
Output signal incorrect	A	Require replacement.
Leaking	A	Require repair or replacement.

PRESSURE SWITCHES

PRESSURE SWITCHES

Condition	Code	Procedure
Connector loose	A	Require repair or replacement.

Housing damaged	A	Require replacement.
Leaking	A	Require repair or replacement.
Loose	A	Require repair or replacement.
Missing	A	Require replacement.
Output signal incorrect	A	Require replacement.

RELAYS - BRAKE

RELAYS - BRAKE

Condition	Code	Procedure
Housing cracked	B,2	Suggest replacement. See note (1) below.
Intermittent	A	Require replacement.
Missing	A	Require replacement.
Output signal incorrect	A	Require repair or replacement.

NOTE: (1) If moisture enters the relay, it can reduce life expectancy or impair function.

ROTORS

Determine the need to recondition based upon individual rotor conditions that follow. Friction material replacement does not require rotor reconditioning unless other justifications exist. DO NOT recondition new rotors unless they are being pressed or bolted onto an existing hub. It is not necessary to replace rotors in axle sets. However, when replacing or reconditioning a rotor due to the conditions that follow, you may suggest reconditioning of the other rotor on the same axle to eliminate uneven braking behavior.

Determine the need to replace based upon the individual rotor conditions that follow. Reconditioning is defined as machining and block sanding, or block sanding only. Block sanding is defined as using 120-150 grit sandpaper with moderate to heavy force for 60 seconds per side. Always wash rotors after servicing or before installing.

ROTORS

Condition	Code	Procedure

Corrosion affecting structural integrity	A	Require replacement. See (1) note below.
Cracked	A	Require replacement.
Hard spots	A	Suggest reconditioning or replacement of rotor according to OEM specs.
Lateral runout (wobble) exceeds OEM specs	A	Require re-indexing, reconditioning, or replacement according to specs.
Measured thickness is less than OEM discard specifications	A	Require replacement.
Rotor thickness will be less than OEM "machine to" specifications after required reconditioning	A	Require replacement. See note (2) below.
Surface is rust-pitted	A	Require reconditioning or replacement of rotor according to OEM specs.
Surface is scored	A	Require reconditioning or replacement of rotor according to OEM specs. See note (3) below.
Thickness variation (parallelism) exceeds OEM specifications	A	Require reconditioning or replacement of rotor according to OEM specs.

NOTE: (1) Examples of severe corrosion are: composite plate separated from friction surfaces and cooling fins cracked or missing.
(2) If OEM does not supply "machine to" specifications, you may machine to discard specifications.
(3) Scoring is defined as grooves or ridges in the friction contact surface. Some vehicle manufacturers require machining when scoring exceeds their allowable specifications.

SELF-ADJUSTING SYSTEMS

SELF-ADJUSTING SYSTEMS

Condition	Code	Procedure
Inoperative	A	Require repair or replacement of inoperative parts.
Missing	A	Require replacement.

Star wheel does not turn freely	A	Require repair or replacement.

STEEL BRAKE LINES

CAUTION: When replacing steel brake lines, replacement product must meet or exceed OEM design specifications.

STEEL BRAKE LINES

Condition	Code	Procedure
Fitting incorrect (e.g. compression fitting)	A	Require replacement.
Flare type incorrect	A	Require replacement.
Leaking	A	Require tightening or replacement.
Line material incorrect (copper, etc.)	A	Require replacement.
Mounting hardware damaged	A	Require repair or replacement.
Mounting hardware missing	A	Require replacement.
Restricted	A	Require replacement.
Routed incorrectly	A	Require routing correction.
Rust-pitted	A	Suggest replacement.

TIRES & WHEELS

Incorrect tire size, diameter, or pressure may affect the operation of ABS, traction control, and braking systems.

Consult the vehicle owner's manual or vehicle placard for correct size, speed ratings, and inflation pressure of the original tires.

TOOTHED RINGS (TONE WHEEL)

If the toothed ring requires replacement and cannot be replaced as a separate component, replace the assembly of which the ring is a part.

TOOTHED RINGS (TONE WHEEL)

Condition	Code	Procedure

Alignment incorrect	A	Require repair or replacement.
Bent	A	Require replacement.
Contaminated	B,2	Suggest cleaning; identify and correct cause.
Cracked	A	Require replacement.
Incorrect number of teeth	A	Require replacement.
Loose	A	Require replacement of worn parts.
Missing	A	Require replacement.
Teeth broken	A	Require replacement.
Teeth distorted	A	Further inspection required. See note (1) below.
Teeth missing	A	Require replacement.

NOTE: (1) No action required unless ABS system performance is affected. If performance is affected, require replacement.

VACUUM BOOSTERS

VACUUM BOOSTERS

Condition	Code	Procedure
Auxiliary vacuum pump inoperative	A	Require repair or replacement.
Vacuum booster applies too much assist (oversensitive)	A	Require replacement.
Vacuum booster check valve grommet deteriorated	A	Suggest replacement of grommet.
Vacuum booster check valve leaking	A	Require replacement of check valve.
Vacuum booster check valve missing	A	Require replacement of check valve.
stuck closed		valve.
Vacuum booster check valve stuck open	A	Require replacement of check valve.

Vacuum booster does not apply enough assist	A	Require replacement.
Vacuum booster does not release	A	Require replacement.
Vacuum booster fails to store or maintain vacuum	A	Require replacement.
Vacuum hose filter restricted	A	Require replacement of filter.
Vacuum hose filter leaking	A	Require replacement of filter.
Vacuum hoses collapsed	A	Require repair or replacement of hose.
Vacuum hoses leaking	A	Require repair or replacement of hose.
Vacuum hoses missing	A	Require replacement of hose.
Vacuum hoses restricted	A	Require repair or replacement of hose.

VALVES - BRAKE

VALVES - BRAKE

Condition	Code	Procedure
Leaking	A	Require repair or replacement.
Linkage bent (rear load valves)	A	Require repair or replacement.
Linkage broken (rear load valves)	A	Require repair or replacement.
Linkage disconnected (rear load valves)	A	Require repair or replacement.
Pressure incorrect	A	Require adjustment. If not possible, require replacement.
Seized	A	Require replacement.
Sticking	A	Require replacement.

WHEEL ATTACHING HARDWARE

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For conditions noted below, also check conditions of wheel stud holes.

CAUTION: Proper lug nut torque is essential. Follow manufacturer's torque specifications and tightening sequence. DO NOT lubricate threads unless specified by the vehicle manufacturer.

WHEEL ATTACHING HARDWARE

Condition	Code	Procedure
Bent	A	Require replacement.
Broken	A	Require replacement. See note (1) below.
Loose	A	Require repair or replacement of affected component.
Lug nut installed backward	A	Require repair.
Lug nut mating type incorrect	A	Require replacement of nut.
Lug nut mating surface dished	A	Require replacement of nut.
Lug nut flats rounded	A	Require replacement of nut. See note (2)
Lug nut seized	A	Require replacement of nut and/or stud. See note (2) below.
Stud incorrect	A	Require replacement of stud.
Threads damaged	A	Require repair or replacement of component with damaged threads.
Threads stripped (threads missing)	A	Require replacement of component with stripped threads.

NOTE: (1) Some manufacturers require replacement of all studs on that wheel if two or more studs or nuts on the same wheel are broken or missing.
(2) Only required if removing wheel.

WHEEL BEARINGS, RACES, & SEALS

NOTE: When repacking or replacing wheel bearings, grease seal replacement is required. You are not required to replace these components in axle sets. Determine the need to replace based

upon the individual component conditions that follow.

WHEEL BEARINGS, RACES, AND SEALS

Condition	Code	Procedure
Rear axle seal on rear-wheel drive leaking	A	Require replacement of seal and inspection of axle, bearing, housing, and vent tube.
Seal leaking	A	Require replacement of seal and inspection of bearings.
Spindle worn	A	Require replacement of spindle and bearings.
Wheel bearing assembly feels rough when rotated	A	Require replacement of bearing assembly.
Wheel bearing balls are pitted	A	Require replacement of bearing assembly.
Wheel bearing balls are worn	A	Require replacement of bearing assembly.
Wheel bearing end-play exceeds manufacturer's specifications	A	Require adjustment of bearing, if possible. If proper adjustment cannot be obtained, require repair or replacement of worn component.
Wheel bearing race is loose in the hub bore	A	Require replacement of hub assembly and wheel bearings.
Wheel bearing races are pitted	A	Require replacement of bearing assembly.
Wheel bearing races are worn	A	Require replacement of bearing assembly.
Wheel bearing rollers are pitted	A	Require replacement of bearing assembly.
Wheel bearing rollers are worn	A	Require replacement of bearing assembly.

WHEEL CYLINDERS

You are not required to replace or rebuild wheel cylinders in axle sets. However, when rebuilding or replacing a wheel cylinder due to the conditions that follow, you may suggest rebuilding or replacement of the other wheel cylinder (on the same axle) for

preventive maintenance, for example, the part is close to the end of its useful life.

Determine the need to rebuild or replace based upon the individual wheel cylinder conditions that follow.

WHEEL CYLINDERS

Condition	Code	Procedure
Attaching hardware bent	A	Require replacement of bent parts.
Attaching hardware broken	A	Require replacement of broken parts.
Attaching hardware corroded affecting structural integrity	A	Require replacement of corroded parts.
Attaching hardware loose	A	Require repair or replacement.
Attaching hardware missing	A	Require replacement of missing parts.
Bleeder port damaged (if non-repairable)	A	Require replacement.
Bleeder screw plugged	A	Require repair or replacement of bleeder screw. See note (1) below.
Bleeder screw broken off in wheel cylinder (if non-repairable)	A	Require replacement. See note (1) below.
Bleeder screw seized	A	Require replacement. See note (2) below.
Bore corroded (pitted)	A	Require replacement.
Bore grooved	A	Require replacement.
Bore oversized	A	Require replacement.
Casting mounting threads damaged	A	Require repair or replacement.
Casting mounting threads stripped (threads missing)	A	Require replacement.
Dust boot damaged	A	Require replacement of dust boot. See note (3) below.
Dust boot missing	A	Require replacement of dust boot.

			See note (3) below.
Leaking		A	Require rebuilding or replacement. See note (4) below.
Piston anodized finish worn off		A	Require replacement of piston and rebuilding or replacement of wheel cylinder.
Piston corroded (pitted)		A	Require replacement of piston and rebuilding or replacement of wheel cylinder.
Piston stuck in bore		A	Require replacement of wheel cylinder.
Wheel cylinder loose		A	Require repair. See note (5) below

NOTE: (1) Only required if the hydraulic system must be opened.
(2) Seized is defined as bleeder screw that cannot be removed after a practical attempt at removing. Only required if the hydraulic system must be opened.
(3) Inspect for related conditions to wheel cylinder.
(4) Leaking is defined as a drop or almost a drop. Dampness is normal.
(5) Further inspection is required to determine whether the attaching hardware may be reused or replaced. This may include screws, clips, rings, or backing plate, depending upon the design.

WHEEL SPEED & VEHICLE SPEED SENSORS

WHEEL SPEED & VEHICLE SPEED SENSORS

Condition	Code	Procedure
Air gap incorrect	A	Require adjustment to vehicle manufacturer's specifications. See note (1) below.
Broken	A	Require replacement.
Housing cracked	A	Require replacement.
Internal resistance does not meet specifications	A	Require replacement. See note (2) below.
Lead routing incorrect	A	Require re-routing according to vehicle manufacturer's specs.
Loose	A	Require adjustment to vehicle

		manufacturer's specifications.
		See note (3) below.
Missing	A	Require replacement.
Output signal incorrect	A	Require repair or replacement. See note (2) below.
Surface contaminated	B,2	Suggest cleaning; identify and correct source.
Tip bent	A	Require replacement.
Tip broken	A	Require replacement.
Tip missing	A	Require replacement.
Wire lead burned	A	Require replacement.
exposed		
Wire lead corroded	A	Require replacement.
Wire lead open	A	Require replacement.
Wire lead shorted	A	Require replacement.

NOTE: (1) If a sensor is not adjustable, further inspection is required to identify and correct cause.
(2) Component failure may be caused by water intrusion into the wiring harness. Always check insulation for damage and wiring for excessive resistance.
(3) Some integral bearing assemblies with sensors may require replacement.

WIRING HARNESSES - BRAKE

NOTE: Component failure may be caused by water intrusion into the wiring harness. Always check insulation for damage and wiring for excessive resistance.

WIRING HARNESSES - BRAKE

Condition	Code	Procedure
Burned	A	Require repair or replacement.
Connector bent	A	Require repair or replacement.
Connector broken	A	Require repair or replacement.

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Connector burned	A	Require repair or replacement.
Connector loose	A	Require repair or replacement.
Connector melted	A	Require repair or replacement.
Conductors exposed	A	Require repair or replacement.
Diode open	A	Require replacement.
Diode shorted	A	Require replacement.
Excessive resistance	A	Require repair or replacement.
Fuse blown	A	Require replacement.
Fusible link blown	A	Require replacement.
Mis-routed	A	Require re-routing to vehicle manufacturer's specifications.
Open	A	Require repair or replacement.
Poor ground	A	Require repair or replacement.
Shorted	A	Require repair or replacement.
Socket bent	A	Require repair or replacement.
Socket broken	A	Require repair or replacement.
Socket burned	A	Require repair or replacement.
Socket corroded	A	Require repair or replacement.
Socket loose	A	Require repair or replacement.
Socket melted	A	Require repair or replacement.
Terminal bent	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal corroded	A	Require repair or replacement.
Terminal loose	A	Require repair or replacement.

END OF ARTICLE

* ELECTRICAL SYSTEM UNIFORM INSPECTION GUIDELINES *

Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:05PM

ARTICLE BEGINNING

GENERAL INFORMATION
Electrical System Motorist Assurance Program
Standards For Automotive Repair

All Makes and Models

INTRODUCTION TO MOTORIST ASSURANCE PROGRAM (MAP)

The Motorist Assurance Program was formed in 1992 by forty (40) companies who were concerned about the image of automotive service establishments. Today, MAP is an industry-wide association dedicated to strengthening consumer satisfaction with the automotive repair industry. MAP's participants represent the majority of the nation's multi-bay retail automotive outlets, their parts and equipment suppliers, independent repair shops, industry associations, car companies, manufacturers representatives, and the trade press. MAP is developing standards of service, uniform inspection procedures and other programs to assure consumers of the industry's professionalism and the commitment to excellence shared by MAP's sponsoring companies.

MAP's achievements to date include production and distribution (over 280,000) of the consumer brochure "How to Find Your Way Under the Hood and Around Your Car", development of a Pledge of Satisfaction to Consumers and Standards of Service and establishment of relationships with regulatory agencies.

As auto repair becomes an issue for federal and state regulators, MAP is working to educate government leaders on the dynamics of automotive service and the self-monitoring efforts MAP has undertaken on the industry's behalf. MAP's sponsoring companies are becoming well-known to government representatives as exemplary businesses working to improve the industry. Media sources also look to MAP to provide information and advice to consumers and on working with automotive technicians and repair establishments.

In the next few months, MAP plans to assist member repair facilities in implementing the MAP Pledge to Customers, establishing an alternate dispute resolution system to help resolve customer complaints within the industry, and developing a shop accreditation program to encourage policies in concert with the MAP Standards of Service and Inspection Guidelines.

MAP has united the aftermarket behind its consumer-oriented goals and has established itself both within and outside of the industry. We welcome you to join us as MAP continues its outreach. With your support, both the automotive repair industry and your customers will reap the benefits. Please contact MAP at:

808 17th Street, NW
Suite 200
Washington, D.C. 20006
202 466 7050

* ELECTRICAL SYSTEM UNIFORM INSPECTION GUIDELINES *

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Saturday, March 18, 2000 10:05PM

PLEDGE TO CUSTOMERS

1. That recommendations will be clearly explained and based on system failure, improved system performance or preventive maintenance according to accepted industry standards.
2. That personnel will be properly trained and qualified to identify and perform an accurate and complete inspection and service of vehicle systems.
3. That a written estimate will be provided and no work will be performed without a prior authorization.
4. That a written limited warranty will be included at no additional cost.

STANDARDS OF SERVICE

I. Our recommendations are based upon the following definitions.

A. System Failure - Parts/system indicated are out of manufacturers' specifications, have failed, or are unable to perform their normal function as intended or designed by the manufacturers. Service/replacement is needed now.

B. Preventive/Schedule Maintenance - Parts/system are scheduled for service/replacement per industry standards or are near the end of their useful life and repair/replacement is recommended in advance of parts/system failure. Service/replacement is optional.

C. Improved System Performance (Performance Improvement) - Parts/system indicated are recommended for repair/replacement to enhance/improve the vehicle's ability to perform as intended or designed by the manufacturer, or as requested by the customer. Service/replacement is optional.

II. Training/Criteria

A. Our personnel have acquired auto repair expertise through formal education or work experience.

B. Where appropriate, personnel are moving toward certification (e.g. vehicle manufacturers, ASE, etc.) for the services performed.

C. Continuing education will be supported by all MAP participants.

III. Appropriate Company Approved Inspection - We will perform an appropriate inspection based on MAP Uniform Inspection Guidelines.

IV. Written Estimates - Written estimates based on our inspection, in compliance with state and local regulations, will include parts (dollar amount), labor (dollar amount), and the total

estimate.

V. Work Authorization - No work will be performed without the customer's prior approval.

VI. Limited Warranty - A minimum limited warranty will be offered of 90 days or 4,000 miles, whichever comes first, covering parts and labor.

VII. Returned Parts - All customers will be entitled to the return of old parts, or if they choose, they may examine the parts prior to leaving the store. Where failed parts are required to be returned to the manufacturer in order to honor the warranty, the customer will be allowed to examine the parts.

VIII. Classification of Parts - Replaced parts will be identified as new, remanufactured, rebuilt or used. MAP participants will inform the customer and indicate on the estimate and invoice whether a part is new, remanufactured, rebuilt or used.

MAP UNIFORM INSPECTION GENERAL GUIDELINES

OVERVIEW OF SERVICE REQUIREMENTS & SUGGESTIONS

It is MAP policy that all exhaust, brake, ABS, steering and suspension, wheel alignment, tires and wheels, driveline, engine performance and maintenance and heating, ventilation and air conditioning services be offered and performed under the guidelines and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be required or suggested. In addition, suggestions may be made to satisfy the needs expressed by the customer.

This section lists the various parts and conditions that indicate required or suggested service or part replacement. Although this list is extensive, it is not inclusive. In addition to this list, a technician may make a suggestion. This suggestion must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

* Example: An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.

* Example: A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or to address a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may only be to suggest service.

* Example: An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.

* Example: The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

A customer, of course, has the choice of whether or not a Shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. The following reasons may be used for required and suggested services:

Reasons to Require Repair or Replacement:

* component no longer performs intended purpose
* component does not meet a design specification (regardless of performance)
* component is missing.

Reasons to Suggest Repair or Replacement

* component is close to the end of its useful life (just above discard specifications or weak; failure likely to occur soon, etc.)
* address a customer need, convenience or request (stiffen ride, enhance performance, eliminate noise, etc.)
* comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM)
* technician's recommendation based on substantial and informed experience.

ELECTRICAL SYSTEMS

NOTE: When working on electrical systems, if a potentially hazardous condition is observed, require repair or

replacement of affected components.

BATTERY PREFACE COVER PAGE

Proper operation of any electrical system component can be affected by battery condition. The battery(ies) must meet or exceed minimum specification for vehicle as equipped and test to that specific battery's CCA. Before condemning any component, test vehicle following OEM test and diagnostic procedures.

A battery should meet or exceed the intended vehicle's OEM (Original Equipment Manufacturer) specifications with regard to Cold Cranking Amps for that specific vehicle. A battery should be tested using the test procedures outlined by Battery Council International (BCI) - an association of battery industry companies whose members establish policy and standards for the industry and/or the manufacturer of the battery,

DEFINITION OF TERMS

Cold Cranking Amp (CCA) Rating - The number of amperes a new, fully charged battery at 0øF (-17.8øC) can deliver for 30 seconds and maintain at least a voltage of 1.2 volts per cell (7.2 volts for a 12 volt battery).

Cranking Amps (CA) - The number of amps a new, fully charged battery, typically at 32øF (0øC), can deliver for 30 seconds and maintain at least a voltage of 1.2 volts per cell (7.2 volts for a 12 volt battery).

Hot Cranking Amps - A rating (non-recognized by BCI) used by some battery manufacturers for testing purposes based on 80øF (26.7ø C).

OEM Cranking Amps - A number indicating the amount of amps (current) at 0ø recommended by the vehicle manufacturer intended to meet the starting requirements for a specific vehicle.

Fails to Accept and Hold a Charge - This term refers a battery that fails to either accept and/or retain a charge using appropriate times listed in the Battery Charging Guide section of the BCI Technical Service Manual or battery manufacturer's specifications.

BATTERY LOAD TESTING

* Battery Load Testing requirements should be tested at vehicle OEM specifications or battery CCA specifications for pass/fail criteria using the highest rating.

* Battery Load Testing and OEM specifications are based on testing at the CCA level only. When a battery is rated at any other given temperature (32øF or 80øC), the battery rating should be converted to a corresponding CCA for testing

purposes.

BATTERY

NOTE: Must meet or exceed OE specs for intended vehicle and component manufacturer's specifications for specific battery.

BATTERY

Condition	Procedure	Note
Fails to accept and hold charge	Require replacement.	
Discharged battery/ open circuit voltage low/ low specific gravity	Further inspection required.	Recharge and retest to manufacturer's specifications if battery fails load test or fails to accept or hold a charge - replacement required.
Corroded posts/ terminals	Require repair.	
Burned, melted posts/terminals	Require repair or replacement.	
Loose posts/ terminals	Require replacement.	
Loose or missing vent caps	Require repair or replacement of vent caps.	
Case leaking	Require replacement.	
Low fluid level	Further inspection required.	Determine cause of low fluid level, refill to proper level with water (distilled water preferred). If level was below top of plates, recharge and retest to manufacturer's specifications to verify condition. If battery does not meet specifications, require replacement. If battery is sealed type (non-removable filler caps) and the eye color

		indicates low fluid level
		require replacement.
Swollen casing	Further inspection required.	No service suggested or required unless the battery fails load test
Electrolyte discoloration/ contamination		or fails to accept or hold a charge - replacement required.
Wet/dirty top	Clean battery using BCI procedures. Further inspection required.	Check fluid level and adjust to manufacturer's specification. Check charging system for proper operation.
Frozen battery	Further inspection required.	Do not attempt to charge a frozen battery. Allow battery to warm and then recharge and test to manufacturer's specifications.

BATTERY TRAY/HOLD DOWN HARDWARE

BATTERY TRAY/HOLD DOWN HARDWARE

Condition	Procedure	Note
Missing	Require replacement.	
Damaged/corroded	Suggest repair or replacement.	If battery tray/hold down hardware no longer performs intended purpose require repair or replacement.

CHARGING SYSTEM

NOTE: Inoperative means output does not meet OE specs for the intended vehicle. If components have been added that increase vehicle electrical load requirement (e.g., sound systems, air conditioning, alarm systems, etc.) charging system output must meet the increased demand.

ALTERNATOR/GENERATOR

ALTERNATOR/GENERATOR

Condition	Procedure

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Inoperative/intermittent	Require repair or replacement.
Missing, damaged mounting hardware	Require repair or replacement of mounting hardware.
Corroded, loose terminals	Suggest repair or replacement.
Noisy	Suggest repair or replacement.
Cracked/broken housing	Suggest repair or replacement.
Defective diodes	Require repair or replacement.

BELTS

BELTS

Condition	Procedure	Note
Missing	Require replacement.	
Out of adjustment	Further inspection required.	Follow manufacturer's recommended adjustment procedures. Require replacement if unable to meet OE specifications.
Improper alignment	Further inspection required.	Check alignment of pulleys, components, and proper belt installation. Service as necessary.
Damaged	Require replacement.	Damaged conditions may include: teeth missing, chunking or excessive cracking, missing rib, broken or cut, ply separation.
Noisy	Suggest replacement.	
Worn	Suggest replacement.	Worn conditions may include: Belt worn narrower than original width, bottom and sidewall cracks, protruding edge cords.

PULLEYS

PULLEYS

Condition	Procedure
Improper alignment	Require repair or replacement.
Missing, damaged mounting hardware	Require repair or replacement of mounting hardware.
Damaged	Require replacement.

TENSIONERS

TENSIONERS

Condition	Procedure	Note
Missing	Require replacement.	
Noisy	Suggest replacement.	
Damaged	Suggest replacement.	
Improper tension	Further inspection required.	Follow manufacturer's recommended adjustment procedures. Suggest replacement if unable to meet OE specifications.

VOLTAGE REGULATOR

VOLTAGE REGULATOR

Condition	Procedure
Inoperative/Intermittent	Require replacement.
Output outside of OEM specifications	Require repair or replacement.
Corroded, loose terminal ends	Suggest repair or replacement.
Noisy	Suggest repair or replacement.
Missing, damaged mounting hardware	Require repair or replacement of mounting hardware.
Damaged	Suggest replacement.

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WIRING HARNESS/CONNECTORS

VOLTAGE REGULATOR

Condition	Procedure
Routed incorrectly	Suggest repair.
Shorted/open	Require repair or replacement.
Connector terminal problem (e.g., bent, corroded, loose)	Suggest repair or replacement.
Excessive resistance	Require repair or replacement.
Poor ground	Require repair.
Damaged	Suggest repair or replacement.

FUSE BOX/BLOCK

FUSE BOX/BLOCK

Condition	Procedure	Note
Burned/melted	Further inspection required.	Determine cause and correct prior to repair or replacement of fuse box.
Connector, terminal problem (e.g., bent, corroded, loose)	Suggest repair or replacement.	
Missing, damaged mounting hardware	Require replacement of mounting hardware.	

SYSTEM INDICATOR LIGHTS

SYSTEM INDICATOR LIGHTS

Condition	Procedure	Note
Light does not come on during bulb check	Further inspection required.	See service manual for further information
Fail to function properly during test mode		

On constantly or intermittently below.		

SYSTEM GAUGE

Condition	Procedure	Note
Inoperative/ intermittent	Further inspection required.	See service manual for further information
Indicating out of OEM's specification		
Missing, damaged mounting hardware	Require replacement of mounting hardware.	

GROUND STRAP

Condition	Procedure
High resistance/open	Require repair or replacement.
Missing	Require replacement.
Corroded	Require repair or replacement.
Loose	Require repair.
Missing, damaged mounting hardware	Require replacement of mounting hardware.
Damaged	Suggest repair or replacement.

STARTER SYSTEMS

To prevent misdiagnosis, care should be taken to eliminate the possibilities of mechanical problems or high resistance in power and/or ground circuits.

Condition	Procedure	Note
Inoperative/	Require repair or	

intermittent	replacement.	
Excessive resistance/ open	Require repair or replacement.	
Amperage does not meet OEM specifications	Require repair or replacement.	
Missing, damaged mounting hardware/ brackets	Require repair or replacement of mounting hardware.	
Noisy	Further inspection required.	Identify source of noise, suggest repair or replacement.
Damaged drive gear	Require repair or replacement.	Inspect ring gear and service as needed.
Corroded, loose terminals	Require repair or replacement.	
Cracked/broken housing	Suggest repair or replacement.	

SOLENOID

SOLENOID

Condition	Procedure	Note
Inoperative/ intermittent	Require repair or replacement.	
Excessive resistance/ open	Require repair or replacement.	
Noisy	Further inspection required.	Identify source of noise, suggest repair or replacement.
Missing, damaged mounting hardware/ brackets	Require repair or replacement of mounting hardware.	
Fails to disengage	Further inspection required.	See service manual for further information.
Damaged	Suggest replacement.	

RELAYS

RELAYS

Condition	Procedure
Inoperative/intermittent	Require replacement.
Missing	Require replacement.
Missing, damaged mounting hardware	Require replacement of mounting hardware.
Corroded, loose terminals	Suggest repair or replacement.
Damaged	Suggest replacement.

IGNITION SWITCH

IGNITION SWITCH

Condition	Procedure
Inoperable	Require replacement.
Intermittent	Suggest replacement.
Malfunctioning (e.g., binding, worn, won't return, etc.)	Suggest repair or replacement.
Missing, damaged mounting hardware	Require replacement of mounting hardware.
Corroded, loose terminals	Suggest repair or replacement.
Damaged (e.g., melted, burned, cracked, etc.)	Suggest replacement.

NEUTRAL SAFETY SWITCH/CLUTCH SWITCH

NEUTRAL SAFETY SWITCH/CLUTCH SWITCH

Condition	Procedure	Note
Inoperative	Require replacement.	
Intermittent	Suggest replacement.	
Malfunctioning (e.g.,	Suggest repair or	

binding, worn, won't return, etc.)	replacement	
Missing	Require replacement	
Missing, damaged mounting hardware	Require repair or replacement of mounting hardware.	
Corroded, loose terminals	Suggest repair or replacement.	
Out of adjustment	Further inspection required.	Follow OEM recommended adjustment procedures. Repair or replace if out of specification.
Damaged	Suggest replacement.	

STARTER WIRING HARNESS/CONNECTORS
BATTERY CABLES/WIRES/CONNECTORS

NOTE: Cable/wires includes all wires and terminals connected to the battery.

STARTER WIRING HARNESS/CONNECTORS

Condition	Procedure
Routed incorrectly	Suggest repair.
Shorted/open	Require repair or replacement.
Connector terminal problem (e.g., bent, corroded, loose)	Suggest repair or replacement.
Excessive resistance	Require repair or replacement.
Poor ground	Require repair.
Missing, damaged mounting hardware or brackets	Require repair or replacement mounting hardware or brackets.
Damaged (e.g., melted, burned, cracked, etc.	Suggest repair or replacement.

LIGHTS (BULBS/SEALED BEAM/LED's)

LIGHTS (BULBS/SEALED BEAM/LED's)

Condition	Procedure	Note
Out of adjustment	Further inspection required.	Follow OEM recommended adjustment procedures. Repair or replace if out of specification.
Inoperative	Require replacement.	
Intermittent	Require replacement.	
Corroded, loose terminals	Suggest repair or replacement.	
Missing, damaged mounting hardware	Require repair or replacement of mounting hardware.	
Damaged	Suggest replacement.	

BULB SOCKETS

BULB SOCKETS

Condition	Procedure	Note
Missing, damaged mounting hardware	Require repair or replacement of mounting hardware.	
Burned/melted	Further inspection required.	Determine cause and correct prior to repair or replacement of socket(s).
Corroded, loose terminals	Suggest repair or replacement.	
Inoperative/ intermittent	Require repair or replacement.	
Damaged	Suggest repair or replacement.	

WIRING HARNESS/CONNECTORS

WIRING HARNESS/CONNECTORS

Condition	Procedure

Routed incorrectly	Suggest repair.
Shorted/open	Require repair or replacement.
Connector terminal problem (e.g., bent, corroded, loose)	Suggest repair or replacement.
Excessive resistance	Require repair or replacement.
Poor ground	Require repair.
Damaged	Suggest repair or replacement.

FUSE/FUSIBLE LINK/CIRCUIT BREAKER

FUSE/FUSIBLE LINK/CIRCUIT BREAKER

Condition	Procedure	Note
Inoperative/ intermittent	Require replacement. Further inspection required.	Determine cause of condition and correct prior to replacement.
Corroded, loose terminals	Suggest repair or replacement.	
Missing	Require replacement.	Refer to OEM owner's manual for proper amperage and location.
Damaged (e.g., melted, burned, cracked, etc.)	Suggest repair or replacement.	

SWITCHES/DIMMERS/TIMERS/DELAYS

SWITCHES/DIMMERS/TIMERS/DELAYS

Condition	Procedure
Inoperative/intermittent	Require replacement.
Missing	Require replacement.
Malfunctioning (e.g., binding, worn, won't return, etc.)	Suggest repair or replacement.
Missing, damaged mounting hardware/ adjusters	Require repair or replacement of mounting hardware/adjusters.

Corroded, loose terminals	Suggest repair or replacement.
Damaged (e.g., melted, burned, cracked, etc.)	Suggest replacement.

LENSES

Condition	Procedure
Missing	Require replacement.
Missing, damaged mounting hardware/ adjusters	Require repair or replacement of mounting hardware/adjusters.
Broken	Require replacement.
Damaged	Suggest replacement.

ACTUATOR MOTOR/DOOR ASSEMBLY

Condition	Procedure	Note
Inoperative/ intermittent	Require replacement.	
Malfunctioning (e.g. binding, worn, won't return, etc.)	Suggest repair or replacement.	
Missing	Require replacement.	
Out of adjustment	Further inspection required.	Follow OEM recommended adjustment procedures. Repair or replace if out of specification.
Leaking (vacuum)	Suggest repair or replacement.	
Noisy		
Missing, damaged mounting hardware	Require repair or replacement of mounting hardware.	
Corroded, loose	Suggest replacement.	

terminals		
Damaged		

VEHICLE ACCESSORIES

Vehicle accessories refers to OEM installed equipment, including but not limited to power windows, locks, seats, roof/top, antennas, heated seats, mirrors, windshield/window defrosters, trunk pull down/release, keyless entry, tire pressure monitors, electric mirrors, etc.

POWER LOCKS, WINDOWS, SEATS, MIRRORS, ROOF/TOPS, ANTENNAS, SLIDING DOORS

SWITCHES

Condition	Procedure
Inoperable	Require replacement.
Intermittent	Suggest replacement.
Malfunctioning (e.g.,binding, worn, won't return, etc.)	Suggest repair or replacement.
Missing	Require replacement.
Missing, damaged mounting hardware	Require repair or replacement of mounting hardware.
Corroded, loose terminals	Suggest repair or replacement.
Damaged (e.g., melted, burned, cracked, etc.)	Suggest replacement.

ACTUATORS/MOTORS/SOLENOIDS/TRANSDUCERS

ACTUATORS/MOTORS/SOLENOIDS/TRANSDUCERS

Condition	Procedure	Note
Inoperative/ intermittent	Require replacement.	
Malfunctioning (e.g. binding, worn, won't return, etc.)	Suggest repair or replacement.	
Missing	Require replacement.	

Out of adjustment	Further inspection required.	Follow OEM recommended adjustment procedures. Repair or replace if out of specification.
Leaking (vacuum/ fluid/air)	Suggest repair or replacement.	
Noisy		
Corroded, loose terminals		
Missing, damaged mounting hardware	Require repair or replacement of mounting hardware.	
Damaged	Suggest repair or replacement.	

WIRING HARNESS/CONNECTORS

WIRING HARNESS/CONNECTORS

Condition	Procedure
Routed incorrectly	Suggest repair.
Shorted/open	Require repair or replacement.
Connector terminal problem (e.g., bent, corroded, loose)	Suggest repair or replacement.
Excessive resistance	
Poor ground	Suggest repair.
Damaged	Suggest repair or replacement.

FUSE BOX/BLOCK

FUSE BOX/BLOCK

Condition	Procedure	Note
Burned/melted	Require replacement. Further inspection required.	Determine cause and correct prior to repair or replacement of fuse box.

Connector, terminal problem (e.g., bent, corroded, loose)	Suggest repair or replacement.
Loose terminals/ connectors	
Missing, damaged mounting hardware	Require replacement of mounting hardware.

FUSE/FUSIBLE LINK/CIRCUIT BREAKER

FUSE/FUSIBLE LINK/CIRCUIT BREAKER

Condition	Procedure	Note
Inoperative, intermittent	Require replacement. Further inspection required.	Determine cause of condition and correct prior to replacement.
Corroded, loose terminals	Suggest repair or replacement.	
Missing	Require replacement.	Refer to OEM owner's manual for proper amperage and location.
Damaged (e.g., melted, burned, cracked, etc.)	Suggest repair or replacement.	

RELAYS

RELAYS

Condition	Procedure
Inoperative, intermittent	Require replacement.
Missing	Require replacement.
Missing, damaged mounting hardware	Require repair or replacement of mounting hardware.
Corroded, loose terminals	Suggest repair or replacement.
Damaged	Suggest replacement.

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CONTROL MODULE

CONTROL MODULE

Condition	Procedure	Note
Inoperative/ intermittent	Require replacement.	
Malfunctioning (i.e., consistent with expected operations)	Suggest replacement.	
Code set (if applicable)	Further inspection required.	Refer to manufacturer's diagnostic trouble code procedure and repair or replacement of affected component(s).
Damaged	Suggest replacement.	
Corroded, loose terminals		
Missing, damaged mounting hardware	Require replacement of mounting hardware.	

ELECTROCHROMATIC MIRROR

ELECTROCHROMATIC MIRROR

Condition	Procedure
Inoperative, intermittent	Require replacement.
Corroded, loose terminals	Suggest repair or replacement.
Malfunctioning	Suggest replacement.
Missing, damaged mounting hardware	Require repair or replacement of mounting hardware.
Missing	Require replacement.
Damaged	Suggest replacement.

HEATING ELEMENTS (DEFROSTER/DEFOGGER - ELECTRIC HEATERS, MIRRORS, SEATS. ETC.)

HEATING ELEMENTS (DEFROSTER/DEFOGGER - ELECTRIC HEATERS, ETC.)

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Condition	Procedure
Inoperative, intermittent	Require repair or replacement.
Corroded, loose terminals	Suggest repair or replacement.
Damaged	Suggest repair or replacement.

CLOCK

CLOCK

Condition	Procedure
Inoperative, intermittent	Require repair or replacement.
Missing, damaged mounting hardware	Require repair or replacement of mounting hardware.
Corroded, loose terminals	Suggest repair or replacement.
Damaged (e.g., melted, burned, cracked, etc.)	Suggest repair or replacement.

CIGARETTE LIGHTER/SOCKET/ELEMENT

CIGARETTE LIGHTER/SOCKET/ELEMENT

Condition	Procedure
Inoperative, intermittent	Require repair or replacement.
Corroded, loose terminals	Suggest repair or replacement.
Missing	Suggest replacement.
Missing, damaged mounting hardware	Require repair or replacement of mounting hardware.
Damaged	Suggest repair or replacement.

CRUISE CONTROL/LINKAGE/CABLES

CRUISE CONTROL/LINKAGE/CABLES

Condition	Procedure	Note
Missing	Require replacement.	

Out of adjustment	Further inspection required.	Follow OEM recommended adjustment procedures. Repair or replace if out of specification.
Disconnected	Further inspection required.	CAUTION: Reconnect and check for proper operation.
Binding/seized	Further inspection required.	Determine cause of binding. Require repair or replacement.
Broken	Require replacement.	
Damaged	Suggest replacement.	
Missing, damaged mounting hardware or brackets	Require repair or replacement of mounting hardware or brackets.	
Routed incorrectly	Suggest repair.	

VACUUM HOSES/TUBES/RESERVOIRS

VACUUM HOSES/TUBES/RESERVOIRS

Condition	Procedure
Missing	Require replacement.
Leaking	Require repair or replacement.
Restricted	Require repair or replacement.
Routed incorrectly	Suggest repair.
Damaged	Suggest repair or replacement.
Missing, damaged mounting hardware or brackets	Require repair or replacement of mounting hardware or brackets.

VEHICLE SPEED SENSORS

VEHICLE SPEED SENSORS

Condition	Procedure	Note

Improper output signal	Further inspection required.	Follow OEM recommended service procedures.
Internal resistance does not meet specifications		Component failure may be caused by water intrusion into the wiring harness. Always check insulation for damage and wiring for excessive resistance. Require repair or replacement of affected component(s).
Cracked sensor housing	Require replacement.	
Lead routed incorrectly	Require re-routing according to vehicle manufacturer's specifications.	
Damaged wire lead	Require repair or replacement.	
Contamination of surface	Further inspection required.	Identify and correct source of contamination. Suggest repair (cleaning).
Missing sensor/tip	Require replacement.	
Loose	Require repair or replacement.	
Damaged	Suggest replacement.	
Missing, damaged mounting hardware or brackets	Require repair or replacement of mounting hardware or brackets.	

BRAKE/CLUTCH SWITCH

BRAKE/CLUTCH SWITCH

Condition	Procedure	Note
Inoperative	Require replacement.	
Intermittent		

Malfunctioning (e.g., binding, worn, won't return, etc.)	Suggest repair or replacement.	
Out of adjustment	Further inspection required.	Follow OEM recommended adjustment procedure. Require repair or replacement if out of specification.
Leaking	Suggest replacement.	
Missing	Require replacement.	
Missing, damaged mounting hardware	Require repair or replacement of mounting hardware.	
Corroded, loose terminals	Suggest repair or replacement.	
Damaged	Suggest replacement.	

VACUUM DUMP RELEASE VALVE

VACUUM DUMP RELEASE VALVE

Condition	Procedure	Note
Inoperative	Require replacement.	
Intermittent		
Out of adjustment required.	Further inspection required.	Follow OEM recommended adjustment procedure. Require repair or replacement if out of specification.
Leaking	Suggest replacement.	
Missing, damaged mounting hardware	Require repair or replacement of mounting hardware.	
Damaged	Suggest replacement.	

CELLULAR PHONES/ANTENNA

CELLULAR PHONES/ANTENNA

Condition	Procedure
Inoperative/intermittent	Require replacement.
Broken	
Missing	
Corroded, loose terminals	Suggest repair or replacement.
Missing, damaged mounting hardware	Require repair or replacement of mounting hardware.
Damaged	Suggest repair or replacement.

TRANSCEIVER/EXTERNAL SPEAKER/MICROPHONE

TRANSCEIVER/EXTERNAL SPEAKER/MICROPHONE

Condition	Procedure	Note
Inoperative/ intermittent	Require repair or replacement	
Malfunctioning	Suggest repair or replacement.	
Missing	Require replacement.	
Missing, damaged mounting hardware	Require replacement of mounting hardware.	
Corroded, loose terminals	Suggest repair or replacement.	
Poor sound quality	Further inspection required.	Make sure poor sound is not caused by ignition/ charging system or other forms of electrical interference.
Damaged	Suggest repair or replacement.	

HORNS/SIRENS

HORNS/SIRENS

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Condition	Procedure
Inoperative	Require repair or replacement.
Intermittent	Suggest repair or replacement.
Malfunctioning	
Missing	Require replacement.
Missing, damaged mounting hardware	Require repair or replacement of mounting hardware.
Corroded, loose terminals	Suggest repair or replacement.
Damaged	

SECURITY/ALARM SYSTEM/SENSORS

SECURITY/ALARM SYSTEM/SENSORS

Condition	Procedure
Inoperative	Require repair or replacement.
Intermittent	Suggest repair or replacement.
Malfunctioning	
Missing	Require replacement.
Missing, damaged mounting hardware	Require repair or replacement of mounting hardware.
Corroded, loose terminals	Suggest repair or replacement.
Damaged	

KEYLESS ENTRY/KEY PAD/TRANSMITTER

KEYLESS ENTRY/KEY PAD/TRANSMITTER

Condition	Procedure
Inoperative/intermittent	Require repair or replacement.
Malfunctioning	Suggest repair or replacement.
Missing	Require replacement.

Missing, damaged mounting hardware	Require repair or replacement of mounting hardware.
Corroded, loose terminals	Suggest repair or replacement.
Damaged	Suggest replacement.

SOUND SYSTEMS/WIRING HARNESS/CONNECTORS

SOUND SYSTEMS/WIRING HARNESS/CONNECTORS

Condition	Procedure
Routed incorrectly	Suggest repair.
Shorted/open	Require repair or replacement.
Connector terminal problem (e.g., bent, broken, corroded, loose)	Suggest repair or replacement.
Excessive resistance	
Poor ground	Suggest repair.
Damaged	Suggest repair or replacement.

RECEIVER/AMPLIFIER/SPEAKERS/EQUALIZER
SUB-WOOFER VOLUME CONTROL

RECEIVER/AMPLIFIER/SPEAKERS/EQUALIZER/SUB-WOOFER VOLUME CONTROL

Condition	Procedure	Note
Inoperative	Require repair or replacement	
Intermittent		
Malfunctioning	Suggest repair or replacement.	
Missing	Require replacement.	
Missing, damaged mounting hardware	Require replacement of mounting hardware.	
Poor sound quality	Further inspection required.	Make sure poor sound is not caused by ignition/ charging system or other forms of electrical interference.

Corroded, loose terminals	Suggest repair or replacement.	
Damaged	Suggest replacement.	

TAPE/CD PLAYER

TAPE/CD PLAYER

Condition	Procedure	Note
Inoperative	Require repair or replacement	
Intermittent	Suggest repair or replacement.	
Malfunctioning		
Missing	Require replacement.	
Missing, damaged mounting hardware	Require replacement of mounting hardware.	
Poor sound quality	Further inspection required.	Make sure poor sound is not caused by ignition/ charging system or other forms of electrical interference.
Corroded, loose terminals	Suggest repair or replacement.	
Skips		
Incorrect speed		
Damaged	Suggest replacement.	

WIPER SYSTEMS/MOTOR

WIPER SYSTEMS/MOTOR

Condition	Procedure	Note
Inoperative/ intermittent	Require repair or replacement.	
Malfunctioning (e.g. binding, worn, won't	Suggest repair or replacement.	

return, etc.)		
Missing	Require replacement.	
Out of adjustment	Further inspection required.	Follow OEM recommended adjustment procedures. Repair or replace if out of specification.
Leaking (vacuum/ fluid/air)	Suggest repair or replacement.	
Noisy		
Corroded, loose terminals		
Missing, damaged mounting hardware	Require repair or replacement of mounting hardware.	
Damaged	Suggest repair or replacement.	

LINKAGE/ARMS/BLADES

LINKAGE/ARMS/BLADES		
Condition		Procedure
Inoperative	Require replacement.	
Malfunctioning	Suggest repair or replacement.	
Missing	Require replacement.	
Missing, damaged mounting hardware	Require repair or replacement of mounting hardware.	
Loose		
Noisy	Suggest repair or replacement.	
Damaged		

PUMP RESERVOIR

PUMP RESERVOIR		
Condition		Procedure

Leaks	Require repair or replacement.
Missing	Require replacement.
Missing, damaged mounting hardware	Require repair or replacement of mounting hardware.
Damaged	Suggest repair or replacement.

HOSES/NOZZLES

HOSES/NOZZLES

Condition	Procedure
Leaks	Require repair or replacement.
Missing	Require replacement.
Missing, damaged mounting hardware	Require repair or replacement of mounting hardware.
Incorrect spray pattern	Suggest repair or replacement.
Blocked	Require repair or replacement.
Damaged	Suggest repair or replacement.

PASSIVE RESTRAINT SYSTEMS

FOR ALL SIR COMPONENTS AND CONDITIONS, CUSTOMER MUST BE REFERRED TO DIAGNOSIS AND PART REPLACEMENT.

FACILITY ACCREDITATION PROGRAM

The mission of the Motorist Assurance Program (MAP) is ... To promote trust and the assurance of customer satisfaction in the vehicle repair industry through education and the creation of industry guidelines. In continuing to fulfill its mission, MAP will be establishing a facility accreditation procedure to provide customers with some assurance that standards of service are being followed throughout the industry, and that when those standards are not met, there is a method for the customer to achieve satisfaction.

A repair facility which commits to participate in the program will be permitted to display the MAP Facility Accreditation Program sign. Display of the sign will notify the consuming public that they can have confidence in the inspection performed at the facility, and that any dispute over repairs or service will be resolved fairly.

Facilities participating in the MAP Accreditation Program

must adopt and diligently adhere to MAP's Pledge to Customers and MAP's Standards of Service.

If you are interested in obtaining more information about the Accreditation Program when it is issued, please complete the form below and then FAX it to MAP headquarters at (202) 223 9569.

Please send me information about MAP's accreditation program as soon as it is available.

NOTE: To print information request for Facilities Accreditation Program, print portion of article between dashed lines.

MAP FACILITIES ACCREDITATION PROGRAM

Please send me information about MAP's accreditation program as soon as possible.

Name _____

Company _____

Address _____

_____

_____

Phone _____ FAX _____

END OF ARTICLE

* ENGINE SYSTEMS UNIFORM INSPECTION GUIDELINES *

Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:06PM

ARTICLE BEGINNING

GENERAL INFORMATION
Engine Maintenance & Performance
Uniform Inspection Guidelines

All Makes & Models

Last Updated: December, 1994

MAP UNIFORM INSPECTION GENERAL GUIDELINES

OVERVIEW OF MOTORIST ASSURANCE PROGRAM

The Motorist Assurance Program (MAP) is the consumer outreach effort of the Automotive Maintenance and Repair Association, Inc. (AMRA). Participation in the Motorist Assurance Program is drawn from retailers, suppliers, independent repair facilities, vehicle manufacturers and industry associations.

The Motorist Assurance Program was established as an industry-wide effort to address concerns raised by regulators, the media and consumers questioning our ethics and methods of doing business. The automotive repair industry had been bombarded by months of negative stories in the media and scrutiny from state and federal regulators who focused on how the need for repairs is determined. MAP was formed as an industry response to this issue.

Our mission is to strengthen the relationship between the consumer and the auto repair industry. We produce materials that give motorists the information and encouragement to take responsibility for their vehicles - through proper, manufacturer-recommended, maintenance. We encourage participatinf service and repair shops (including franchisees and dealers) to adopt a Pledge to their Customers and the Motorist Assurance Program developed Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service which demonstrates to their customers that they are serious about customer satisfaction.

These Standards of Service require that an inspection of the vehicle's (problem) system be made according to industry guidelines. After learning that neither the car manufacturers nor any other source had complete guidelines, leading industry organizations, along with other industry participants banded together to address this challenging task. During the past two and a half years, they successfully developed industry inspection guidelines for the following systems: Exhaust, Brakes, ABS, Steering and Suspension, Engine Maintenance and Performance, HVAC, and Electrical systems. Guidelines for Drive Train and Transmision are currently being promulgated. Revisions to the inspection guidelines for Exhaust, Brakes/ABS and Steering and Suspension Systems, which were issued two years ago, are now being published for implementation beginning spring 1997. Participating shops utilize these Uniform Inspection Guidelines as part of the inspection process and for communicating their findings

to their customers.

The Motorist Assurance Program continues to work cooperatively and proactively with government agencies and consumer groups toward solutions that both benefit the customer and are mutually acceptable to both regulators and industry. We maintain the belief that industry must retain control over how we conduct our business, and we must be viewed as part of the solution and not part of the problem. Meetings with state and other government officials concerned with auto repair and/or consumer protection are conducted. Feedback from these representatives are brought back to members, and the program adjusted as needed.

To assure auto repair customers recourse if they were not satisfied with a repair transaction, the Motorist Assurance Program offers arbitration through MAP/BBB-CARE in cooperation with the Council of Better Business Bureaus and individual participating Bureaus. MAP "piloted" in Indianapolis and Pittsburgh during spring, 1996 - and publicized "roll-outs" in New Jersey, Detroit (MI), Chicago (IL) and Richmond (VA) were conducted. To put some "teeth" in the program, and accreditation requirement for shops was initiated. The requirements are stringent and a self-policing method has been incorporated which includes the "mystery shopping" of outlets. In addition, a committee of service providers had been working diligently developing standards for newspaper, television and Internet advertising.

We welcome you to join us as we continue our outreach ... with your support, both the automotive repair industry and your customers will reap the benefits. Please visit MAP at our Internet site: www.hunter.com/map.htm or contact us at:

808 17th Street, NW Suite 200
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OVERVIEW OF SERVICE REQUIREMENTS & SUGGESTIONS

It is MAP policy that all exhaust, brake, ABS, steering and suspension, wheel alignment, tires and wheels, driveline, engine performance and maintenance and heating, ventilation and air conditioning services be offered and performed under the guidelines and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be required or suggested. In addition, suggestions may be made to satisfy the needs expressed by the customer.

This section lists the various parts and conditions that indicate required or suggested service or part replacement. Although this list is extensive, it is not inclusive. In addition to this list, a technician may make a suggestion. This suggestion must be based on substantial and informed experience or the vehicle manufacturer's

recommended service interval.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

* Example: An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.

* Example: A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or to address a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may only be to suggest service.

* Example: An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.

* Example: The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a customer declines to authorize a service or repair indicated in the MAP Uniform Inspection Guidelines as "required," a MAP shop may refuse service on that system, if proceeding with the work could create or continue an unsafe or unsatisfactory condition.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the Uniform Inspection Guidelines that follow.

ENGINE PERFORMANCE & MAINTENANCE

ENGINE: MISCELLANEOUS

ENGINE OIL
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÂÄÄ

*** ENGINE SYSTEMS UNIFORM INSPECTION GUIDELINES ***

Article Text (p. 4)

1993 Volkswagen EuroVan

For Volkswagen Technical Site

Saturday, March 18, 2000 10:06PM

Condition	Procedure
Contaminated	Require replacement of oil and filter. See NOTE: (1) below.
High level	Determine source of incorrect level and suggest correction.
Low level	
Maintenance intervals	Suggest replacement to comply with vehicles OEM recommended service intervals.

NOTE: (1) Determine source of contamination, i.e., engine coolant, fuel, metal particles, when changing oil.

ENGINE OIL FILTER/CANISTER

Condition	Procedure
Contaminated	Require replacement of oil and filter. See NOTE: (1) below.
Damaged	Suggest replacement. Furtherinspection required. See NOTE: (2) below.
Leaking	Require repair or replacement.
Maintenance intervals	Suggest replacement to comply with vehicles OEM recommended service intervals.

NOTE: (1) Determine cause of contamination, i.e., engine coolant, fuel, metal particles, when changing oil.
(2) Determine cause, i.e., broken motor mount.

ENGINE GASKETS/SEALS

Condition	Procedure
Leaking	Tighten or suggest replacement as necessary.

ENGINE OIL DRAIN PLUG/GASKET

Condition	Procedure
Leaking	Require repair or replacement.
Damagend threads	Require repair or replacement.

NOTE: Some OEMs require replacement of drain plug gasket. Inspect

threads in oil pan for damage.

ENGINE OIL WARNING LIGHTS

Condition	Procedure
Light not on during bulb check	Further inspection required. See NOTE: below.
Light stays on or intermittent while engine is running	Further inspection required. See NOTE: below.

NOTE: Light may indicate problem with contaminated oil, level, pressure, temperature or problem with circuit.

ENGINE OIL PRESSURE GAUGE

Condition	Procedure
Inoperative	Further inspection required. See note.
Indicates out of range	Further inspection required. See note.

NOTE: Gauge may indicate problem with contaminated oil, level, pressure, temperature or problem with gauge.

OIL PRESSURE SENDING UNIT

Condition	Procedure
Leaking	Require replacement.
Connector or terminal bent, broken, or loose	Require repair or replacement.
Inoperative/inaccurate	Require repair or replacement.

POWER STEERING FLUID

Condition	Procedure
See Steering and Suspension Uniform Inspection Guidelines	

TIMING BELT

Condition	Procedure

Missing	Require replacement. See note.
Damaged	Suggest replacement. See note.
Maintenance intervals	Suggest replacement to comply with vehicle OEM recommended service intervals.
Oil soaked	Suggest adjustment. Further inspection required.
Improper adjustment/ noisy	Suggest adjustment. See note.

NOTE: Inspect belt tensioners, pulleys and cover.

TIMING BELT TENSIONERS

Condition	Procedure
Missing	Require replacement.
Noisy	Suggest replacement.
Damaged	Require replacement.
Improper adjustment	Adjust to OEM specifications.

MOTOR MOUNTS

Condition	Procedure
Broken	Require replacement.
Oil soaked (rubber mount)	Suggest replacement.
Leaking (hydraulic mount)	Require replacement.
Missing or broken fasteners	Require repair or replacement of fasteners

TORQUE STRUT

Condition	Procedure
Worn or damaged bushings	Requirement replacement.
Damaged or missing fasteners	Require repair or replacement of fasteners.

Leaking	³ Suggest replacement.
Missing	³ Require replacement

INDICATOR LIGHTS & GUAGES (TEMPERATURE, BRAKE, ENGINE OIL, CHARGING)

Condition - Lights	³ Procedure
Light doesn't come on during bulb check	³
Fail to function properly during test mode	³ Further inspection required. ³ See note.
On constantly or intermittently	³

NOTE: See service manual for further information.

Condition - Guages	³ Procedure
Inoperative	³
	´ Further inspection required.
Indicating out of manufacturer's recommended range	³ See note. ³

NOTE: See service manual for further information.

DIP STICKS/TUBES

Condition	³ Procedure
Missing	³ Require replacement.
Incorrect application	³ Require replacement.
Modified	³ Suggest replacement.
Broken/damaged	³ Suggest replacement.
Leaking	³ Suggest repair or replacement.

COOLERS (TRANSMISSION) EXTERNAL; ENGINE OIL; POWER STEERING

Condition	³ Procedure
Leaking	³ Require repair or replacement.
Damaged fins, tubes or fittings	³ Suggest repair or replacement.
Internal restrictions	³ Require repair or replacement.

Missing/by-passed	Further inspection required.
Air flow restriction	Suggest repair.
Missing, damaged, deteriorated mounting hardware and bushings	Require repair or replacement of hardware and/or bushings.

ENGINE COOLING SYSTEM

RADIATOR & RADIATOR CAP

Condition - Radiator	Procedure
Leaking	Require repair or replacement.
Damaged fins, tubes or fittings	Suggest repair or replacement.
Internal restrictions	Require repair or replacement.
Air flow restriction	Suggest repair.
Missing, damaged, deteriorated mounting hardware and bushings	Require repair or replacement of hardware and/or bushings.
Leaking internal trans cooler	Require repair or replacement.
Corroded	Suggest repair or replacement.

Condition - Radiator Cap	Procedure
Missing	Require replacement.
Fails to maintain proper pressure	Require replacement.
Damaged/bent or corroded	Suggest replacement.
Missing gaskets/seals	Require replacement.
Coolant recovery check valve inoperative	Require replacement.
Improper application	Require replacement.

THERMOSTAT/HOUSING

Condition	Procedure
Improper installation	Require repair or replacement.
Missing/damaged/corroded thermostat	Require replacement of

	³ thermostat
Improper application	³ Require replacement.
Inoperative	³ Require replacement.
Damaged/corroded housing	³ Suggest replacement of housing.

COOLANT HOSES/TUBES (RADIATOR, BY-PASS, HEATER, RECOVERY TANK)

Condition	³ Procedure
Leaking	³ Require repair or replacement.
Britlle, hard, cracked, corroded, spongy, soft, oil soaked, collapsed, swollen, non-automotive	³ Suggest repair or replacement. ³ ³
Improper routing	³ Suggest repair or replacement.
Restricted	³ Suggest repair or replacement.
Missing/damaged protective sleeves	³ Suggest replacement of sleeves.
Maintenance intervals	³ Suggest replacement to comply ³ with vehicle's OEM recommended ³ service intervals.

CLAMPS

Condition	³ Procedure
Missing/damaged	³ Require replacement.
Loose	³ Require repair or replacement.
Corroded	³ Suggest replacement.

NOTE: Be sure to inspect hoses for deterioration.

COOLANT RECOVERY TANK/CAP

Condition	³ Procedure
Missing	³ Require replacement.
Leaking	³ Require repair or replacement.
Damaged	³ Suggest repair or replacement.

Missing, damaged mounting hardware	Suggest repair or replacement of hardware.

COOLANT

Condition	Procedure
Contaminated	Require replacement. Further inspection required. See NOTE: (1).
Low level	Require filling to proper level. See NOTE: (2).
Improper mixture/type	Require correction or replacement.
Improper acidity (pH)	Suggest correction or replacement.
Maintenance intervals	Suggest replacement. See NOTE: (3).

NOTE: (1) Determine source of contamination and suggest correction prior to coolant replacement.
(2) Determine source of incorrect level and suggest repair.
(3) The system should be drained and/or flushed and refilled with correct coolant according to OEM Recommended Service Interval and procedure.

WATER PUMP

Condition	Procedure
Leaking, damaged	Require replacement.
Noisy	Suggest replacement.
Inoperative	Require replacement.
Broken, missing fasteners	Require replacement of fasteners.

SHROUD/BAFFLES/DEFLECTORS

Condition	Procedure
Missing/damaged	Require replacement.
Missing/damaged mounting hardware	Require replacement of hardware.

RADIATOR FAN BLADE & FAN CLUTCH

Condition - Fan Blade	Procedure
Damaged	Require replacement.
Loose	Require repair or replacement.

Condition - Fan Clutch	Procedure
Seized	Require replacement.
Noisy/worn bearing	Suggest replacement.
Leaking	Suggest replacement.
Slips (insufficient fan speed)	Require replacement.
Damaged	Suggest replacement.
Loose fasteners	Require repair or replacement of fasteners.

NOTE: Some lateral movement, measured at the fan blade tip, is normal.

RADIATOR FAN MOTOR

Condition	Procedure
Vibration/noisy	Suggest replacement.
Intermittent/inoperative	Require replacement. See note.
Missing	Require replacement.
Missing, damaged mounting hardware	Require replacement of hardware.

NOTE: Check fan motor/controls.

RADIATOR FAN MOTOR RELAY/MODULE & FAN MOTOR RESISTOR

Condition - Fan Motor Relay/Module	Procedure
Missing	Require replacement.
Damaged	Suggest replacement.
Intermittent/inoperative	Require replacement.
Missing, damaged mounting hardware	Require replacement of hardware.

Condition - Fan Motor Resistor	Procedure
Leaking	Require repair or replacement.
Contaminated/corroded	Suggest repair or replacement.
Intermittent/inoperative	Require replacement.
Damaged	Suggest replacement.

ACCESSORY BELTS

Condition	Procedure
Missing	Require replacement.
Improper tension	Require adjustment or repair.
Improper alignment	Further inspection required. See note.
Damaged	Require replacement.
Noisy	Suggest replacement.

NOTE: Check alignment of pulleys and proper belt installation.

ACCESSORY PULLEYS & TENSIONERS

Condition - Pulleys	Procedure
Damaged	Require replacement.
Improper alignment	Require repair.
Missing, damaged mounting hardware	Require repair or replacement of hardware.
Condition - Tensioners	Procedure
Missing	Require replacement
Noisy	Suggest replacement.
Damaged	Suggest replacement.
Improper adjustment	Require adjustment or repair.

GASKETS

Condition	Procedure
Leaking	Tighten or suggest replacement as necessary.

HEATER CORE

Condition	Procedure
Leaking	Require repair or replacement.
Damaged fins, tubes, fittings	Suggest repair or replacement.
Internal restrictions	Suggest repair or replacement.
Missing/by-passed	Suggest repair or replacement.
Air flow restriction	Suggest repair or replacement.
Missing, damaged deteriorated mounting hardware/bushing	Suggest repair or replacement of hardware/bushing
Corroded	Suggest repair or replacement.

HEATER CONTROL VALVE

Condition	Procedure
Missing/by-passed	Suggest repair or replacement.
Leaking	Require replacement.
Inoperative	Suggest replacement.
Damaged valve/bracket	Suggest repair or replacement of valve/bracket

ENGINE COOLING PASSAGES

Condition	Procedure
External/internal leak	Require repair or replacement.
Restricted cooling passage	Require repair.

CASTING CORE/EXPANSION PLUGS

Condition	Procedure

Leaking	Require replacement.
Improper type	Suggest replacement.

AIR INDUCTION SYSTEM

AIR DUCT/TUBES

Condition	Procedure
Missing	Require replacement.
Damaged	Suggest repair or replacement.
Leaking	Require repair or replacement.

AIR FILTER HOUSING/GASKETS

Condition	Procedure
Missing	Require replacement.
Damaged	Suggest repair or replacement.
Leaking	Require repair or replacement.
Missing/damaged mounting hardware	Require repair or replacement of hardware.

AIR FILTER ELEMENT

Condition	Procedure
Missing	Require replacement.
Damaged	Suggest replacement.
Restricted	Suggest replacement.
Maintenance intervals	Suggest replacement to comply with vehicle's OEM recommended service intervals.

PCV BREATHER ELEMENT

Condition	Procedure
Missing	Require replacement.

Damaged	³ Suggest replacement.
Restricted	³ Suggest replacement.
Maintenance intervals	³ Suggest replacement to comply with vehicle's ³ OEM recommended service intervals.

THERMOSTATIC AIR DOOR ASSEMBLY

Condition	³ Procedure
Missing	³ Require replacement.
Damaged	³ Suggest repair or replacement.
Inoperative	³ Require repair or replacement.

SUPER CHARGER

Condition	³ Procedure
Inoperative	³ Require repair or replacement.
Noisy	³ Suggest repair or replacement.

TURBO CHARGER

Condition	³ Procedure
Missing	³ Require repair or replacement.
Damaged	³ Suggest repair or replacement.
Leaking	³ Require repair or replacement.
Missing/damaged mounting hardware	³ Require repair or replacement of ³ hardware.

WASTE GATE/CONTROL MECHANISM & CONTROL SOLENOID

Condition - Control³ Mechanism	³ Procedure
Inoperative	³ Require repair or replacement. Further ³ inspection required. See NOTE: below.
Leaking	³ Require repair or replacement.

Condition - Control Solenoid	Procedure
Inoperative	Require repair or replacement. Further inspection required. See NOTE: below.
Leaking	Require repair or replacement.

NOTE: Inoperative includes intermittent operation or out of OEM specification.

IDLE AIR CONTROL (IAC)

Condition	Procedure
Missing	Require replacement.
Inoperative	Require repair or replacement. Further inspection required. See NOTE: below.
Damaged	Suggest replacement.
Missing/damaged mounting hardware	Require repair or replacement of hardware.

NOTE: Inoperative includes intermittent operation or out of OEM specifications. Some components may be serviceable; check for accepted cleaning procedure.

CHARGE AIR COOLER "INTERCOOLER" (CAC)

Condition	Procedure
Missing	Require replacement.
Leaking	Require repair or replacement
Damaged	Suggest repair or replacement.
Missing/damaged mounting hardware	Require repair or replacement of hardware.

INTAKE AIR TEMP SENSOR (IAT)

Condition	Procedure
Missing	Require replacement.
Inoperative	Require repair or replacement. Further inspection

	³	required. See NOTE: below.
Damaged	³	Suggest replacement.
Missing/damaged mounting hardware	³	Require repair or replacement of hardware.

NOTE: Inoperative includes intermittent operation or out of OEM specifications. Some components may be serviceable; check for accepted cleaning procedure.

VOLUME AIR FLOW (VAF)

Condition	³	Procedure
Missing	³	Require replacement.
Inoperative	³	Require repair or replacement. Further inspection
	³	required. See NOTE: below.
Damaged	³	Suggest replacement.
Missing/damaged mounting hardware	³	Require repair or replacement of hardware.

NOTE: Inoperative includes intermittent operation or out of OEM specification.

MASS AIR FLOW (MAF)

Condition	³	Procedure
Missing	³	Require replacement.
Inoperative	³	Require repair or replacement. See NOTE: below.
Damaged	³	Suggest replacement.
Missing/damaged mounting hardware	³	Require repair or replacement of hardware.

NOTE: Inoperative includes intermittent operation or out of OEM specification.

AIR PLENUM/INTAKE MANIFOLD

Condition	³	Procedure
Leaking	³	Require repair or replacement.

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1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:06PM

Restricted	³ Require repair or replacement. See NOTE: below.

NOTE: Refer to accepted service procedure.

CARBURETOR/CHOKE (SEE NOTE:)

Condition	³	Procedure
Improper operation	³	Require repair or replacement.
Missing, damaged, binding mounting hardware and other components	³	Require repair or replacement.

NOTE: Proper operation of a carburetor includes the ability to control fuel mixtures during all phases of driving operation to comply with all federal and local emission standards. Adjustments are to be considered repairs.

THROTTLE BODY

Condition	³	Procedure
Leaking	³	Require repair or replacement.
Restricted/contaminated	³	Require repair. See NOTE: below.
Damaged	³	Require repair or replacement.

NOTE: Some components may be serviceable; check for accepted cleaning procedure.

VACUUM HOSES/TUBES

Condition	³	Procedure
Missing	³	Require replacement.
Leaking/restricted	³	Require repair or replacement.

EARLY FUEL EVAPORATION (EFE)

Condition	³	Procedure

Refer to Early Fuel Evaporation Heater/Grid.

POWERTRAIN CONTROL MODULE (PCM)

Condition	Procedure
Inoperative	Require repair or replacement.
Damaged	Suggest repair or replacement.

SENSORS/ACTUATORS DEFINITIONS

NOTE: The conditions and procedures apply to, but are not limited to the following list of components (SAE J1930 Terminology).

SENSORS/ACTUATORS DEFINITIONS

Sensor	Abbreviation
02 Sensor	02S
Intake Air Temperature Sensor	IAT
Manifold Absolute Pressure Sensor	MAP
Engine Coolant Temperature Sensor	ECT
Barometric Pressure Sensor	BARO
Crankshaft Position Sensor	CKP
Throttle Positon Sensor	TPS
Camshaft Position Sensor	CMP
Park Neutral Position	PNP
Clutch Pedal Position Switch	CPP
Wide Open Throttle Switch	WOT Switch
Exhaust Gas Recirculation Valve Position Sensor	EGR Valve Position Sensor
Mass Air Flow Sensor	MAF
Volume Air Flow Sensor	VAF
Power Steering Pressure Sensor	PSP
Vehicle Speed Sensor	VSS
Fan Control Sensor	FS
Knock Sensor	KS
Air Conditioning Cycling Switch	AC
Exhaust Gas Recirculating Temperature Sensor	EGRT
Transmission Range Switch	TR Switch

Actuators	Abbreviation
Idle Speed Control Actuator	ISC
Idle Air Control	IAC
Exhaust Gas Recirculation Solenoid	EGR Solenoid
Vacuum Regulator Solenoid	...
Mix Control Solenoid	MC Solenoid
Torque Converter Clutch	TCC
Fuel Injector	...

Evaporative Emission Canister Purge Valve ..... EVAP
Secondary Air Injection By-Pass ..... Air By-Pass
Secondary Air Injection Diverter ..... Air Diverter
Waste Gate Control Solenoid ....

Condition	Procedure
Missing	Require replacement.
Inoperative	Require repair or replacement. Further inspection required. See NOTE: below.
Damaged	Suggest replacement.
Missing/damaged mounting hardware	Require repair or replacement of hardware.

NOTE: Inoperative includes intermittent operation or out of OEM specifications. Contaminated components may be serviceable; check for accepted cleaning procedure.

POSITIVE CRANKCASE VENTILATION SYSTEM (PCV)

POSITIVE CRANKCASE VENNTILATlON VALVE (PCV VALVE)

Condition	Procedure
Missing	Require replacement.
Damaged	Suggest repair or replacement.
Restricted	Suggest replacement.
Maintenance intervals	Suggest replacement to comply with vehicle's OEM recommended service intervals.

PCV BREATHER ELEMENT

Condition	Procedure
Missing	Require replacement.
Damaged	Suggest repair or replacement.
Restricted	Suggest replacement.
Maintenance intervals	Suggest replacement to comply with vehicle's OEM recommended service intervals.

TUBES, HOSES, CLAMPS & GROMMETS

Condition	Procedure
Missing	Require replacement.
Damaged	Require repair or replacement.
Leaking	Require repair or replacement.
Restricted	Require repair or replacement.

ORIFICE

Condition	Procedure
Missing	Require replacement.
Restricted	Require repair or replacement.
Maintenance intervals	Suggest replacement to comply with vehicle's OEM recommended service intervals.

OIL SEPARATOR/FILTER

Condition	Procedure
Missing	Require replacement.
Restricted	Require repair or replacement.
Damaged	Suggest repair or replacement.
Maintenance intervals	Suggest replacement to comply with vehicle's OEM recommended service intervals.

IGNITION SYSTEM

BATTERY

Condition	Procedure
Refer to Starting/Charging System information.	

BATTERY CABLES/WIRES/CONNECTORS (SEE NOTE:)

Condition	Procedure

Damaged	³ Suggest repair or replacement.
Corroded	³ Suggest repair or replacement.
High resistance	³ Require repair or replacement.
Loose	³ Require repair or replacement.
Missing, damaged, deteriorated mounting hardware	³ Require repair or replacement. ³

NOTE: Cable/wires includes all wires and terminals connected to the battery.

BATTERY TRAY/HOLD DOWN HARDWARE

Condition	³	Procedure
Missing	³	Require replacement.
Damaged/corroded	³	Suggest repair or replacement. See NOTE: ³ below.

NOTE: If battery tray/hold down hardware no longer performs intended purpose, reauire repair or replacement.

FUSIBLE LINK

Condition	³	Procedure
Damaged	³	Suggest repair or replacement.
Open	³	Require replacement.

IGNITION SWITCH

Condition	³	Procedure
Damaged	³	Suggest replacement.
Inoperable/intermittent	³	Require replacement.

PARK NEUTRAL SWITCH (PNP)

Condition	³	Procedure
Inoperable/intermittent	³	Require replacement.

Damaged	³ Suggest repair or replacement
Loose	³ Suggest repair or replacement.

BALLAST RESISTOR/RESISTOR WIRE

Condition	³ Procedure
Inoperable	³ Require replacement.
Damaged	³ Suggest replacement.

IGNITION COIL(S)

Condition	³ Procedure
Damaged	³ Suggest replacement.
Arcing	³ Require replacement.
Out of specification	³ Require replacement.
Leaking oil	³ Require replacement.
Damaged/missing mounting hardware	³ Require repair or replacement of ³ hardware.
Distorted	³ Further inspection required. See ³ NOTE: below.

NOTE: Distortion may be the result of overheating; coil should be tested.

IGNITION CONTROL MODULE (ICM)

Condition	³ Procedure
Damaged	³ Suggest replacement.
Inoperative	³ Require replacement. See NOTE: below.

NOTE: Inoperative includes intermittent operation or out of OEM specification.

PICK-UPS (INCLUDES MAGENTIC, HAL EFFECT, OPTICAL)

Condition	³ Procedure

Damaged	Suggest replacement.
Out of specification	Require replacement.
Oil soaked	Further inspection required. See NOTE: below.
Inoperative	Require replacement. See NOTE: below.

NOTE: Inoperative includes intermittent operation or out of OEM specification. Refer to OEM recommended service procedures.

STATOR/RELUCTOR

Condition	Procedure
Damaged	Require replacement.

CRANK SENSOR (CKP)

Condition	Procedure
Missing	Require replacement.
Inoperative	Require repair or replacement. Further inspection required. See NOTE: below.
Damaged	Suggest replacement.
Missing/damaged mounting hardware	Require repair or replacement of hardware.

NOTE: Inoperative includes intermittent operation or out of OEM specifications.

CAM SENSOR (CMP)

Condition	Procedure
Missing	Require replacement.
Inoperative	Require repair or replacement. Further inspection required. See NOTE: below.
Damaged	Suggest replacement.
Missing/damaged mounting hardware	Require repair or replacement of hardware.

NOTE: Inoperative includes intermittent operation or out of OEM

specifications.

IGNITION HARNESS (PRIMARY)

Condition	Procedure
Damaged	Suggest repair or replacement.
Mis-routed	Suggest repair.
Open fusible link	Require replacement.
Shorted/open	Require repair or replacement.
Connector terminal problem (bent, broken, corroded or loose)	Require repair or replacement.
Excessive resistance	Require repair or replacement.
Poor ground	Require repair.

DISTRIBUTOR

Condition	Procedure
Bent shaft, worn bushings and/or cam lobe	Further inspection required. See NOTE: below.
Damaged	Suggest repair or replacement.
Missing, damaged mounting hardware	Require repair or replacement of hardware.
Worn gear	Suggest replacement of gear.
Broken gear	Require replacement of gear.
Oil soaked	Further inspection required. See NOTE: below.

NOTE: Refer to OEM recommended service procedures.

DISTRIBUTOR CAP

Condition	Procedure
Damaged	Suggest replacement.
Corroded/eroded terminals	Suggest replacement.

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1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:07PM

Burned/carbon tracked/arcing	Require replacement.
Missing carbon button	Require replacement.
Loose	Suggest repair or replacement.

DISTRIBUTOR ROTOR

Condition	Procedure
Damaged	Suggest replacement.
Corroded/eroded	Require replacement.
Loose	Suggest repair or replacement.
Missing, damaged hold down fastener	Require repair or replacement of fastener
Burned/carbon tracked	Require replacement.

IGNITION WIRES/BOOTS/TERMINAL (SECONDARY - SEE NOTE: (1))

Condition	Procedure
Damaged	Suggest repair or replacement.
Oil soaked	Suggest replacement.
Open/shorted	Require repair or replacement.
Mis-routed	Suggest repair. See NOTE: (2).
Missing/damaged mounting	Suggest repair or replacement of hardware. See NOTE: (2).
Loose terminal	Suggest repair or replacement.
Corroded	Suggest repair or replacement.
High/Low resistance	Require repair or replacement.

NOTE: (1) It is not required to replace ignition wires in sets. However, you may suggest replacement of the entire secondary wire set for preventive maintenance.
(2) Proper routing, hardware, heat shields, etc. are intended to prevent premature failure of secondary ignition components.

SPARK PLUGS (SEE NOTE: (1))

Condition	Procedure
Damaged	Require replacement.
Shorted	Require replacement.
Fouled	Require repair or replacement. See NOTE: (2).
Maintenance interval	Suggest replacement. See NOTE: (3).
Eroded electrode	Suggest replacement.
Incorrect gap	Require repair or replacement.

NOTE: (1) It is not required to replace spark plugs in sets. However, you may suggest replacement of the other plugs for preventive maintenance.
(2) Determine cause of fouling and suggest repair.
(3) Suggest replacement to comply with vehicle's OEM recommended service intervals.

DISTRIBUTOR ADVANCE/RETARD (MECHANICAL/VACUUM)

Condition	Procedure
Damaged	Suggest repair or replacement.
Inoperative	Require repair or replacement.
Out of specification	Require repair or replacement.

ELECTRONIC SPARK CONTROL MODULE

Condition	Procedure
Damaged	Suggest replacement.
Inoperative	Require repair or replacement. Further inspection required. See NOTE: below.

NOTE: Inoperative includes intermittent operation, out of OEM specifications.

GAS CAP

Condition	Procedure

Missing	Require replacement.
Leaking	Require replacement.
Damaged	Suggest replacement.

FUEL FILLER NECK/HOSES/CLAMPS/RESTRICTOR

Condition	Procedure
Missing	Require replacement.
Leaking	Require repair or replacement.
Damaged	Suggest repair or replacement.
Missing, damaged mounting hardware	Require repair or replacement of hardware.

FUEL TANK/CELL

Condition	Procedure
Leaking	Require repair or replacement.
Loose baffles	Require repair or replacement.
Damaged	Suggest repair or replacement.
Missing, damaged mounting hardware	Require repair or replacement of hardware.
Contaminated	Suggest repair. Further inspection required. See NOTE: below.

NOTE: Some components may be serviceable; check for accepted cleaning procedure.

FUEL LEVEL SENDER

Condition	Procedure
Inoperative	Suggest repair or replacement.
Leaking	Require repair or replacement.
Damaged	Suggest repair or replacement.

FUEL PUMP (IN TANK/EXTERNAL - ELECTRICAL OR MECHANICAL)

Condition	Procedure
Inoperative	Require repair or replacement.
Noisy	Suggest replacement.
Leaking	Require repair or replacement.
Damaged	Suggest repair or replacement.
Missing, damaged mounting hardware	Requires repair or replacement of hardware

ELECTRIC FUEL PUMP CONTROL CIRCUIT

Condition	Procedure
See Electrical Uniform Inspection Guidelines.	

LIQUID VAPOR SEPARATOR

Condition	Procedure
Missing	Require replacement.
Leaking	Require replacement.
Damaged	Suggest repair or replacement.
Inoperative	Require repair or replacement

ROLL-OVER VALVE

Condition	Procedure
Missing	Require replacement.
Damaged	Suggest repair or replacement.
Inoperative	Require replacement.
Leaking	Require replacement.

INERTIA FUEL SHUT OFF SWITCH

*** ENGINE SYSTEMS UNIFORM INSPECTION GUIDELINES ***
Article Text (p. 30)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:07PM

Condition	Procedure
Inoperative	Require repair or replacement.
Missing	Require replacement.
Damaged	Suggest replacement.

FUEL LINES/CLAMPS/O-RINGS/CONNECTORS (SEE NOTE)

Condition	Procedure
Missing	Require replacement.
Leaking	Require repair or replacement.
Restricted	Require repair or replacement.
Routed incorrectly	Suggest repair.
Damaged	Suggest repair or replacement.

NOTE: When replacing fuel lines/hoses, replace with products that meet(s) or exceed(s) OEM design specifications.

FUEL FILTER & IN-TANK FUEL STRAINER

Condition - External Filter	Procedure
Missing	Require replacement.
Restricted/contaminated	Require replacement.
Leaking	Require repair or replacement.
Damaged	Suggest replacement.
Maintenance interval	Suggest replacement to comply with OEM recommended service interval.
Missing, damaged mounting hardware	Suggest repair. Further inspection required.

Condition - In-Tank	Procedure
Missing	Require replacement.
Damaged	Require replacement.
Restricted	Require repair or replacement.

FUEL ACCUMULATOR/DAMPENER

Condition	Procedure
Inoperative	Require replacement.
Leaking	Require replacement.
Damaged	Suggest replacement.

FUEL PRESSURE REGULATOR

Condition	Procedure
Inoperative	Require repair or replacement.
Leaking	Require repair or replacement.
Damaged	Suggest replacement.
Restricted/contaminated	Suggest repair. Further inspection required. See NOTE: below.

NOTE: Some components may be serviceable; check for accepted cleaning procedure.

FUEL RAIL

Condition	Procedure
Restricted	Require repair or replacement.
Leaking	Require repair or replacement.
Damaged	Suggest replacement.

FUEL DISTRIBUTOR

Condition	Procedure
Inoperative	Require repair or replacement. Further inspection required. See NOTE: below.
Out of specification	Require repair or replacement.
Leaking	Requires repair or replacement.

Damaged	Suggest replacement.
Restricted/contaminated	Suggest repair. Further inspection required. See NOTE: below.

NOTE: Some components may be serviceable; check for accepted cleaning procedure.

FUEL/COLD START INJECTORS (SEE NOTE: (1))

Condition	Procedure
Inoperative	Require repair or replacement. Further inspection required. See NOTE: (2) below.
Damaged	Suggest repair or replacement.
Missing, damaged mounting hardware	Require repair or replacement of hardware.
Leaking	Require repair or replacement.

NOTE: (1) It is not required to replace injectors in sets. However, you may suggest replacement of all injectors for preventive maintenance.
(2) Inoperative included intermittent operations out of OEM specifications. Some components may be serviceable; check for accepted cleaning procedure.

THROTTLE BODY

Condition	Procedure
Leaking	Require repair or replacement.
Restricted/contaminated	Require repair. See NOTE: below.
Damaged	Require repair or replacement.

NOTE: Some components may be serviceable; check for accepted cleaning procedure.

CARBURETOR/CHOKE

Condition	Procedure
Improper air/fuel control	Require repair or replacement.
Missing, damaged hardware	Require repair or replacement of

	³	hardware.
Leaking	³	Require repair or replacement.
Contaminated	³	Require repair or replacement. Further ³ inspection required. See NOTE: below.
Improper mechanical operation	³	Require repair or replacement.

NOTE: Some components may be serviceable; check for accepted cleaning procedure.

EARLY FUEL EVAPORATION VALVE (HEAT RISER ASSEMBLY)

Condition	³	Procedure
Inoperative, binding	³	Require repair or replacement.
Leaking exhaust	³	Require repair or replacement.
Noisy	³	Suggest repair or replacement.

EARLY FUEL EVAPORATION, HEATER/GRID (EFE)

Condition	³	Procedure
Inoperative	³	Require repair or replacement.
Restricted	³	Require repair or replacement.
Damaged	³	Suggest repair or replacement.

EXHAUST GAS RECIRCULATION SYSTEM (EGR)

EGR VALVE

Condition	³	Procedure
Missing	³	Require replacement.
Inoperative	³	Require repair or replacement.
Leaking	³	Require repair or replacement.
Restricted passage	³	Require repair or replacement.
Damaged	³	Suggest repair or replacement.
Maintenance interval	³	Suggest repair or replacement to comply with

	³	OEM recommended service intervals.

EGR PIPE/PLATE/COOLER

Condition	³	Procedure
Missing	³	Require replacement.
Leaking	³	Require repair or replacement.
Restricted	³	Require repair or replacement.
Damaged	³	Suggest repair or replacement.

EGR CONTROLS (ELECTRICAL/VACUUM)

Condition	³	Procedure
Missing	³	Require replacement.
Inoperative	³	Require repair or replacement.
Damaged	³	Suggest repair or replacement.
Leaking	³	Require repair or replacement.
Restricted	³	Require repair or replacement.

EGR INTAKE/EXHAUST MANIFOLD PASSAGES

Condition	³	Procedure
Leaking	³	Require repair or replacement.
Restricted	³	Require repair or replacement.

AIR INJECTION SYSTEM

AIR PUMP

Condition	³	Procedure
Missing	³	Require replacement.
Damaged	³	Suggest repair or replacement.
Inoperative	³	Require repair or replacement.

Noisy	³	Suggest repair or replacement.

AIR PUMP BELT

Condition	³	Procedure
Missing	³	Require replacement.
Improper tension	³	Require adjustment or repair.
Improper alignment	³	Further inspection required. See NOTE: below.
Damaged	³	Require replacement.
Noisy	³	Suggest replacement.

AIR CONTROL VALVE (DIVERTER/BY-PASS)

Condition	³	Procedure
Missing	³	Require replacement.
Damaged	³	Suggest replacement.
Inoperative	³	Require repair or replacement.
Missing, damaged mounting hardware	³	Require repair or replacement of hardware.

ASPIRATOR, CHECK/DECEL VALVE

Condition	³	Procedure
Missing	³	Require replacement.
Damaged	³	Suggest replacement.
Inoperative	³	Require repair or replacement.
Missing, damaged mounting hardware	³	Require repair or replacement of hardware.

AIR MAIFOLD/PIPE

Condition	³	Procedure
Missing	³	Require replacement.

Damaged	³	Suggest repair or replacement.
Restricted	³	Require repair or replacement.
Leaking	³	Require repair or replacement.
Missing, damaged mounting hardware	³ ³	Suggest repair or replacement of hardware.

CONTROL SOLENOID

Condition	³	Procedure
Missing	³	Require replacement.
Damaged	³	Suggest replacement.
Inoperative	³	Require replacement.

EVAPORATIVE SYSTEMS

EVAPORATIVE EMISSION CANISTER (EVAP)

Condition	³	Procedure
Damaged	³	Suggest replacement.
Missing	³	Require replacement.
Leaking	³	Require replacement.
Saturated	³	Require replacement.
Inoperative	³	Require repair or replacement.

EVAPORATIVE EMISSION CANISTER FILTER (EVAP FILTER)

Condition	³	Procedure
Missing	³	Require replacement.
Restricted	³	Suggest replacement.
Maintenance interval	³ ³	Suggest repair or replacement to comply with OEM recommended service interval.

HOSES/CLAMPS/TUBES

*** ENGINE SYSTEMS UNIFORM INSPECTION GUIDELINES ***
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1993 Volkswagen EuroVan
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Saturday, March 18, 2000 10:07PM

Condition	Procedure
Missing	Require replacement.
Damaged	Suggest replacement.
Leaking	Require repair or replacement.
Restricted	Require repair or replacement.

EVAPORATIVE EMISSION CANISTER PURGE VALVE (ELECTRICAL/VACUUM)

Condition	Procedure
Missing	Require replacement.
Damaged	Suggest replacement.
Inoperative	Require replacement.
Leaking	Require replacement.

GAS CAP

Condition	Procedure
Missing	Require replacement.
Leaking	Require replacement.
Damaged	Suggest replacement.

LIQUID/VAPOR SEPARATOR

Condition	Procedure
Missing	Require replacement.
Leaking	Require replacement.
Damaged	Suggest repair or replacement.
Inoperative	Require repair or replacement.

ROLL OVER VALVE

Condition	Procedure

Missing	Require replacement.
Damaged	Suggest repair or replacement.
Inoperative	Require replacement.
Leaking	Require replacement.

TRANSMISSION & CLUTCH RELATED INSPECTION INFORMATION

AUTOMATIC TRANSMISSION FILTER

Condition	Procedure
Contaminated	Require replacement of fluid and filter.
Maintenance intervals	Suggest replacement to comply with OEM recommended service intervals.

TRANSMISSION FLUID

Condition	Procedure
See * TRANSMISSION UNIFORM INSPECTION GUIDELINES *. (1)	

(1) - TRANSMISSION UNIFORM INSPECTION GUIDELINES article is not available at this time.

CLUTCH FLUID

Condition	Procedure
See * TRANSMISSION UNIFORM INSPECTION GUIDELINES *. (1)	

(1) - TRANSMISSION UNIFORM INSPECTION GUIDELINES article is not available at this time.

END OF ARTICLE

* EXHAUST SYSTEM UNIFORM INSPECTION GUIDELINES *

Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:07PM

ARTICLE BEGINNING

GENERAL INFORMATION
Exhaust Systems

All Makes & Models

Updated: September, 1996

MAP UNIFORM INSPECTION GENERAL GUIDELINES

OVERVIEW OF MOTORIST ASSURANCE PROGRAM

The Motorist Assurance Program (MAP) is the consumer outreach effort of the Automotive Maintenance and Repair Association, Inc. (AMRA). Participation in the Motorist Assurance Program is drawn from retailers, suppliers, independent repair facilities, vehicle manufacturers and industry associations.

The Motorist Assurance Program was established as an industry-wide effort to address concerns raised by regulators, the media and consumers questioning our ethics and methods of doing business. The automotive repair industry had been bombarded by months of negative stories in the media and scrutiny from state and federal regulators who focused on how the need for repairs is determined. MAP was formed as an industry response to this issue.

Our mission is to strengthen the relationship between the consumer and the auto repair industry. We produce materials that give motorists the information and encouragement to take responsibility for their vehicles - through proper, manufacturer-recommended, maintenance. We encourage participatinf service and repair shops (including franchisees and dealers) to adopt a Pledge to their Customers and the Motorist Assurance Program developed Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service which demonstrates to their customers that they are serious about customer satisfaction.

These Standards of Service require that an inspection of the vehicle's (problem) system be made according to industry guidelines. After learning that neither the car manufacturers nor any other source had complete guidelines, leading industry organizations, along with other industry participants banded together to address this challenging task. During the past two and a half years, they successfully developed industry inspection guidelines for the following systems: Exhaust, Brakes, ABS, Steering and Suspension, Engine Maintenance and Performance, HVAC, and Electrical systems. Guidelines for Drive Train and Transmision are currently being promulgated. Revisions to the inspection guidelines for Exhaust, Brakes/ABS and Steering and Suspension Systems, which were issued two years ago, are now being published for implementation beginning spring 1997. Participating shops utilize these Uniform Inspection Guidelines as part of the inspection process and for communicating their findings to their customers.

* EXHAUST SYSTEM UNIFORM INSPECTION GUIDELINES *

Article Text (p. 2)

1993 Volkswagen EuroVan

For Volkswagen Technical Site

Saturday, March 18, 2000 10:07PM

The Motorist Assurance Program continues to work cooperatively and proactively with government agencies and consumer groups toward solutions that both benefit the customer and are mutually acceptable to both regulators and industry. We maintain the belief that industry must retain control over how we conduct our business, and we must be viewed as part of the solution and not part of the problem. Meetings with state and other government officials concerned with auto repair and/or consumer protection are conducted. Feedback from these representatives are brought back to members, and the program adjusted as needed.

To assure auto repair customers recourse if they were not satisfied with a repair transaction, the Motorist Assurance Program offers arbitration through MAP/BBB-CARE in cooperation with the Council of Better Business Bureaus and individual participating Bureaus. MAP "piloted" in Indianapolis and Pittsburgh during spring, 1996 - and publicized "roll-outs" in New Jersey, Detroit (MI), Chicago (IL) and Richmond (VA) were conducted. To put some "teeth" in the program, and accreditation requirement for shops was initiated. The requirements are stringent and a self-policing method has been incorporated which includes the "mystery shopping" of outlets. In addition, a committee of service providers had been working diligently developing standards for newspaper, television and Internet advertising.

We welcome you to join us as we continue our outreach ... with your support, both the automotive repair industry and your customers will reap the benefits. Please visit MAP at our Internet site: www.hunter.com/map.htm or contact us at:

808 17th Street, NW Suite 200
Washington, D.C. 20006
Ph. (202) 466-7050 Fax (202) 223-9569

OVERVIEW OF SERVICE REQUIREMENTS & SUGGESTIONS

It is MAP policy that all exhaust, brake, ABS, steering and suspension, wheel alignment, tires and wheels, driveline, engine performance and maintenance and heating, ventilation and air conditioning services be offered and performed under the guidelines and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be required or suggested. In addition, suggestions may be made to satisfy the needs expressed by the customer.

This section lists the various parts and conditions that indicate required or suggested service or part replacement. Although this list is extensive, it is not inclusive. In addition to this list, a technician may make a suggestion. This suggestion must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

* Example: An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.

* Example: A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or to address a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may only be to suggest service.

* Example: An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.

* Example: The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a customer declines to authorize a service or repair indicated in the MAP Uniform Inspection Guidelines as "required," a MAP shop may refuse service on that system, if proceeding with the work could create or continue an unsafe or unsatisfactory condition.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the Uniform Inspection Guidelines that follow.

PART REPLACEMENT CODE IDENTIFICATION

NOTE: Refer to the following tables for definitions of the codes listed in the condition/procedure tables for the specific components that may need to be replaced.

A - PART NO LONGER PERFORMS INTENDED PURPOSE

*** EXHAUST SYSTEM UNIFORM INSPECTION GUIDELINES ***
Article Text (p. 4)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:07PM

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
A - Part no longer performs intended purpose	1 - Part is close to the end of its useful life (just above discard specifications, or weak; failure likely to occur soon, etc.)

B - PART DOES NOT MEET DESIGN SPEC., REGARDLESS OF PERFORMANCE

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
B - Part does not meet a design specification (regardless of performance)	2 - To address a customer need, convenience, or request (to stiffen ride, enhance performance, eliminate noise etc.)

C - PART IS MISSING

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
C - Part is missing	3 - To comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM)
	4 - Technician's recommendation based on substantial and informed experience

EXHAUST

SERVICE PROCEDURES REQUIRED & SUGGESTED FOR PROPER VEHICLE OPERATION

WARNING: Federal EPA rules prohibit altering an exhaust system in any way that defeats the emission reduction components of a vehicle. Be sure to review and adhere to EPA policy on removing and replacing catalytic converters. Where state or local laws are stricter, they take precedence over these guidelines.

Some exhaust systems are of a welded design. It is not required that the entire system be replaced. Determine the need to replace individual components based on conditions of component.

*** EXHAUST SYSTEM UNIFORM INSPECTION GUIDELINES ***
Article Text (p. 5)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:07PM

CATALYTIC CONVERTERS

CAUTION: Before working on an exhaust system, review EPA regulations on removing and replacing catalytic converters.

NOTE: Any time a converter has failed, further diagnosis is required to determine the reason(s) for converter failure. Advise customer of cause(s).

CATALYTIC CONVERTERS

Condition	Code	Procedure
Air injection tube broken	A	
Air injection tube burnt	A	
Air injection tube damaged	B	
Air injection tube leaking	A	
Air injection tube loose	A	Require repair or replacement of injection tube or replacement of catalytic converter.
Air injection tube restricted	A	
Air injection tube threads damaged	B	
Air injection tube threads stripped (threads missing)	A	
Body cracked	B	
Converter empty	A	Require repair or replacement.
Converter fill plug missing	C	
Converter missing	C	Require replacement.
Exhaust gases leaking	A	Require repair or replacement.
Flanges leaking	A	Require repair or replacement of flanges.
Inlet pipes cracked	B	Require repair or replacement.
Internal rattle (except pellet-type)	B,2	Further inspection required. See note (1) below.
Mounting brackets that are	A	Require repair or replacement.

part of converter broken		
Obvious overheating		Further inspection required. See note (2) below.
Outlet pipes cracked	B	Require repair or replacement.
Pieces of catalyst material found downstream	A,1	Suggest replacement.
Plugged	A	Require replacement. See note (3)
Testing has determined that existing converter has been lead-poisoned, contaminated or failed testing	A	Require repair or replacement.

NOTE: (1) If the converter is breaking up, suggest converter replacement. If an object has fallen into the converter, remove the object.
(2) Further diagnosis is required to determine the cause of the overheating. Replacement of the converter may not be necessary.
(3) Determine cause and correct to ensure that new converter will not become plugged.

EXHAUST & TAIL PIPES

NOTE: For pipes with resonators, also refer to the section on Mufflers and Resonators.

EXHAUST & TAIL PIPES

Condition	Code	Procedure
Bracket broken	A	
Pipe bent out of position	B	Require repair or replacement.
Pipe broken	A	
Pipe cracked	B	
Pipe leaking	A	
Pipe missing	C	Require replacement.
Pipe plugged	A	
Pipe weak due to corrosion, but no leaks present	A,1	Suggest replacement.

Weld(s) broken	A	Require repair or replacement.

EXHAUST CONNECTIONS

EXHAUST CONNECTIONS

Condition	Code	Procedure
Attaching hardware incorrect	B	Require replacement of hardware.
Corroded, affecting structural integrity	A,1	Suggest replacement.
Incorrect type (i.e. flange, ball & socket etc.)	B	Require replacement.
Leaking	A	Require repair.
Loose	A	Require repair.

HANGERS

HANGERS

Condition	Code	Procedure
Broken	A	Require replacement.
Corroded, affecting structural integrity	A,1	Suggest replacement.
Incorrect type	B	Require replacement.
Loose	A	Require repair or replacement.
Missing	C	Require replacement.
Out of position	B	Require repair or replacement.
Rubber deteriorated	A,1	Suggest replacement.

HEAT RISERS

HEAT RISERS

Condition	Code	Procedure

Broken	A	Require replacement of affected parts.
Diaphragm inoperative	A	Further inspection required. See note (1) below.
Leaking	A	Require repair or replacement.
Rattles	B,2	Suggest replacement of affected parts.
Seized	A	Require replacement of affected parts.
Spring(s) broken	B	Require replacement of spring(s).
Spring(s) inoperative	A	Require replacement of spring(s).

NOTE: (1) If the inoperative diaphragm is separate from the heat riser, then require replacement of the inoperative diaphragm. If the inoperative diaphragm is part of the heat riser, then replace the heat riser.

HEAT SHIELDS

HEAT SHIELDS

Condition	Code	Procedure
Bent	B	Require repair or replacement.
Broken	A	Require replacement.
Corroded, affecting structural integrity	A,1	Suggest replacement.
Loose	A	Require repair.
Missing	C	Require replacement.

MANIFOLDS: CAST & TUBE TYPE

MANIFOLDS: CAST & TUBE TYPE

Condition	Code	Procedure
Air injection tube in manifold broken	A	Require repair of injection tube or replacement of manifold.
Air injection tube in	A,1	Suggest replacement of injection

manifold corroded, affecting structural integrity	A	Require repair of injection tube or manifold.
Air injection tube in manifold leaking	A	Require repair of injection tube or replacement of manifold.
Air injection tube in manifold loose	A	Require repair.
Air injection tube in manifold restricted	A	Require replacement of injection tube or manifold.
Air injection tube in manifold threads damaged	A	Require repair of injection tube manifold.
Air injection tube in manifold threads stripped (threads missing)	A	Require replacement of injection tube or manifold.
Bolt(s) broken	A	Require replacement.
Bolt(s) loose	A	Require tightening or replacement of bolts.
Bolt(s) missing	C	Require replacement.
Gasket leaking	A	Require tightening or replacement of gasket.
Heat stove bent	B	Require repair or replacement of stove. See note (1) below.
Heat stove broken	A	Require replacement of stove. See note (1) below.
Heat stove corroded, affecting structural integrity	A,1	Suggest replacement of stove. See note (1) below.
Heat stove missing	C	Require replacement of stove. See note (1) below.
Manifold broken	A	Require repair or replacement.
Manifold cracked	B	Require repair or replacement.
Manifold warped	A	Require replacement.
Stud(s) broken	A	Require replacement of stud.
Stud(s) missing	C	Require replacement of stud.

*** EXHAUST SYSTEM UNIFORM INSPECTION GUIDELINES ***
Article Text (p. 10)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:07PM

Stud(s) threads damaged	A	Require repair/replacement of stud
Stud(s) threads stripped (threads missing)	A	Require replacement of stud.

NOTE: (1) Stove may not be available separately; this may require replacement of manifold.

MUFFLERS & RESONATORS

MUFFLERS & RESONATORS

Condition	Code	Procedure
Body shell distorted, affecting performance or structural integrity	A	
Corrosion hole	A	Require replacement.
Missing	C	
Mounting bracket(s) broken	A	
Mounting bracket(s) cracked	B	Require repair or replacement.
Nipple cracked	A	
Nipple loose	B	Require replacement.
Outer wrap peeling (exhaust not leaking)	A,1	Suggest replacement.
Plugged	A	
Puncture (other than a drain hole)	A	Require replacement.
Rattling or knocking noise from muffler	B	
Seam(s) open (exhaust leaking)	A	
Sound quality unsatisfactory	B,2	Suggest replacement to address customer need and/or request.
Split (exhaust leaking)	A	Require replacement.
Weak due to corrosion, but no leaks present	A,1	Suggest replacement.

END OF ARTICLE

* STEERING UNIFORM INSPECTION GUIDELINES *

Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:08PM

ARTICLE BEGINNING

GENERAL INFORMATION
Steering & Suspension Systems - (Including Wheels & Tires)

All Makes & Models

Updated: January, 1997

MAP UNIFORM INSPECTION GENERAL GUIDELINES

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* STEERING UNIFORM INSPECTION GUIDELINES *

Article Text (p. 2)

1993 Volkswagen EuroVan

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PART REPLACEMENT CODE IDENTIFICATION

NOTE: Refer to the following tables for definitions of the codes listed in the condition/procedure tables for the specific components that may need to be replaced.

A - PART NO LONGER PERFORMS INTENDED PURPOSE

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Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
A - Part no longer performs intended purpose	1 - Part is close to the end of its useful life (just above discard specifications, or weak; failure likely to occur soon, etc.)

B - PART DOES NOT MEET DESIGN SPEC., REGARDLESS OF PERFORMANCE

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
B - Part does not meet a design specification (regardless of performance)	2 - To address a customer need, convenience, or request (to stiffen ride, enhance performance, eliminate noise etc.)

C - PART IS MISSING

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
C - Part is missing	3 - To comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM)
	4 - Technician's recommendation based on substantial and informed experience

STEERING & SUSPENSION

SERVICE PROCEDURES REQUIRED & SUGGESTED FOR PROPER VEHICLE OPERATION

Steering and suspension are complex systems made up of a variety of interdependent components. For proper vehicle handling, ride, and tire wear, a thorough inspection is required whenever suspension work is being performed.

Conditions listed assume that the problem has been isolated to the specific component by proper testing procedures.

NOTE: When replacing steering and/or suspension components which may affect an alignment angle, you are required to check and adjust alignment as needed. Refer to the OEM specifications.

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CAUTION: DO NOT use ride height altering or load compensating components, such as variable rate springs and coil over shocks, on vehicles with height or load sensing proportioning valve-equipped braking systems, unless these components are original equipment.

AIR RIDE SUSPENSION

NOTE: Depending on the air suspension design, there are some aftermarket products available to eliminate the air ride suspension on certain vehicles. If the system has been eliminated with one of these products, then no service is suggested or required.

AIR RIDE SUSPENSION - AIR SHOCKS & AIR STRUTS

NOTE: This section covers the air spring portion of the air shock or strut. For dampening portion of shock or strut conditions and procedures, refer to the "Shock Absorbers, Strut Cartridges, and Strut Assemblies" section.

AIR RIDE SUSPENSION - AIR SHOCKS & AIR STRUTS

Condition	Code	Procedure
Inner fabric of air bag damaged	A	Require replacement.
Leaking	A	Require repair or replacement.
Outer covering of air bag is cracked to the extent that inner fabric of air bag is visible	A,1	Suggest replacement.

AIR RIDE SUSPENSION - AIR SPRING VALVES

AIR RIDE SUSPENSION - AIR SPRING VALVES

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.

Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Blocked	A	Require repair or replacement.
Connector bent	A	Require repair or replacement.
Connector broken	A	Require replacement.
Connector loose	A	Require repair or replacement.
Inoperative	A	Require repair or replacement.
Leaking	A	Require repair or replacement.
Restricted	A	Require repair or replacement.

AIR RIDE SUSPENSION - AIR SPRINGS

AIR RIDE SUSPENSION - AIR SPRINGS

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware incorrect	A	Require replacement of incorrect part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Collar cracked	A	Require replacement.
End cap cracked	A	Require replacement.
Inner fabric of bag damaged	A	Require replacement.
Leaking	A	Require repair or replacement.

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Outer covering of air bag is cracked to the extent that inner fabric of air bag is visible	A,1	Suggest replacement.
Piston cracked	A	Require replacement.

AIR RIDE SUSPENSION - COMPRESSORS

AIR RIDE SUSPENSION - COMPRESSORS

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part.
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Connector bent	A	Require repair or replacement.
Connector broken	A	Require replacement.
Connector loose	A	Require repair or replacement.
Does not build pressure	A	Further inspection required. See note (1) below.
Excessive run time	B	Further inspection required. See note (2) below.
Inoperative	A	Require replacement.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.

NOTE: (1) If failure to build pressure is traced to the compressor,

require replacement.
(2) If excessive run time is traced to the compressor, require replacement.

AIR RIDE SUSPENSION - HEIGHT SENSORS

AIR RIDE SUSPENSION - HEIGHT SENSORS

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part.
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware corroded affecting structural integrity	A	Require replacement of corroded part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)		Require replacement of part with stripped threads.
Dust boot missing	B,2	Suggest replacement. See note (1).
Dust boot split	B,2	Suggest replacement. See note (1).
Dust boot torn	B,2	Suggest replacement. See note (1).
Housing cracked	A	Require replacement.
Lead routing incorrect	B	Require re-routing according to vehicle manufacturer's specs.
Loose	B	Require adjustment to vehicle manufacturer's specifications.
Missing	C	Require replacement.
Output signal incorrect	A	Require repair or replacement.
Wire lead damaged	A	Require repair or replacement.

NOTE: (1) This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.

AIR RIDE SUSPENSION - MODULES

AIR RIDE SUSPENSION - MODULES

Condition	Code	Procedure
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Housing cracked	B,2	Suggest repair or replacement.
Inoperative	A	Require replacement.
Missing	C	Require replacement.

AIR RIDE SUSPENSION - RELAYS (COMPRESSOR)

AIR RIDE SUSPENSION - RELAYS (COMPRESSOR)

Condition	Code	Procedure
Housing cracked	B,2	Suggest replacement. See note (1).
Intermittent	A	Require replacement.
Missing	C	Require replacement.
Output signal incorrect	A	Require replacement.

NOTE: (1) If moisture enters the relay, it can reduce life expectancy or impair function.

AIR RIDE SUSPENSION - SWITCHES (ON/OFF)

AIR RIDE SUSPENSION - SWITCHES (ON/OFF)

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Condition	Code	Procedure
Broken	A	Require replacement.
Missing	C	Require replacement.
Output signal incorrect	A	Require replacement.

AIR RIDE SUSPENSION - TORSION SPRINGS (COUNTER BALANCING)

AIR RIDE SUSPENSION - TORSION SPRINGS (COUNTER BALANCING)

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part.
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware incorrect	A	Require replacement of incorrect part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Broken	A	Require replacement.
Missing	C	Require replacement.

AIR RIDE SUSPENSION - TUBING

AIR RIDE SUSPENSION - TUBING

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part.
Attaching hardware loose	A	Require repair or replacement of loose part.

Attaching hardware missing	C	Require replacement of missing part.
Blocked	A	Require repair or replacement.
Fitting incorrect	B	Require replacement.
Leaking	A	Require repair or replacement.
Line type incorrect	B	Require replacement.
Missing	C	Require replacement.
Restricted	A	Require repair or replacement.
Routed incorrectly	B	Require routing correction.

AIR RIDE SUSPENSION - WARNING LAMPS

AIR RIDE SUSPENSION - WARNING LAMPS

Condition	Code	Procedure
Bulb burned out	A	Require replacement.
Warning light does not come on during bulb check		
Warning light flashes		
Warning light is intermittent		Further inspection required to determine cause.
Warning light stays on after initial bulb check		

AIR RIDE SUSPENSION - WIRING HARNESSES

AIR RIDE SUSPENSION - WIRING HARNESSES

Condition	Code	Procedure
Connector bent	A	
Connector broken	A	
Connector loose	A	Require repair or replacement.
Damaged (cut, burned, or chafed)	A	

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Excessive resistance	B	
Fuse blown	A	Require replacement.
Fusible link blown	A	
Open	A	Require repair or replacement.
Poor ground	A	
Routed incorrectly	B	Require re-routing according to vehicle manufacturer's specs.
Shorted	A	
Terminal bent	A	
Terminal broken	A	Require repair or replacement.
Terminal corroded	A	
Terminal loose	A	

BALL JOINTS

Before requiring or suggesting ball joint replacement, the approved OEM procedure must be used to measure ball joint wear. The measurement(s) obtained, along with the vehicle manufacturer's specifications, must be noted on the inspection report. Some states require that these measurements also appear on the invoice.

NOTE: The term "perceptible movement," defined as any visible movement in any direction, has been the industry standard for determining the need for replacement of follower ball joints. Some vehicle manufacturers are now publishing specifications for follower ball joints that were previously diagnosed by the "perceptible movement" standard. Before requiring or suggesting any parts be replaced based on "perceptible movement," consult your repair manual to determine if OEM specifications exist.

You are not required to replace ball joints in axle sets. However, when replacing a ball joint due to wear exceeding manufacturer's specification, you may suggest replacement of the other ball joint if its measurement shows it is close to the end of its useful life, for preventive maintenance.

BALL JOINTS

Condition	Code	Procedure

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Attaching hardware bent	B	Require repair or replacement of bent part if available; otherwise, replace ball joint.
Attaching hardware broken	A	Require replacement of broken part if available; otherwise, replace ball joint.
Attaching hardware corroded affecting structural integrity	A	Require replacement of broken part if available; otherwise, replace ball joint.
Attaching hardware incorrect	A	Require replacement of incorrect part if available; otherwise, replace ball joint.
Attaching hardware loose	A	Require repair or replacement of loose part if available; otherwise, replace ball joint.
Attaching hardware missing	C	Require replacement of missing part if available; otherwise, replace ball joint.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads if available; otherwise, replace ball joint.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads if available; otherwise, replace ball joint.
Binding	A	Further inspection required. See note (1) below.
Grease boot cracked	B,2	Suggest replacement. See note (2).
Grease boot missing	B,2	Suggest replacement. See note (3).
Grease boot torn	B,2	Suggest replacement. See note (4).
Grease fitting broken	A	Require replacement of grease fitting.
Grease fitting missing	C	Require replacement of grease fitting.
Grease fitting won't seal	A	Require replacement of grease fitting.

Greaseable ball joint will not take grease	B,2	Suggest replacement of grease fitting. See note (5) below.
Nut on ball joint loose	A	Require repair or replacement. See note (6) below.
Pre-load adjustment incorrect	B	Require repair or replacement.
Seized	A	Require replacement.
Stud bent	B	Require replacement. See note (7).
Stud broken	A	Require replacement. See note (7).
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement. See note (7).
Wear exceeds manufacturer's specifications	B	Require replacement.

NOTE: (1) If greaseable, grease ball joint. If problem persists or joint is non-greaseable, require replacement.
(2) Cracked grease boot will allow contaminants to enter the ball joint and will accelerate wear.
(3) Lack of grease boot will allow contaminants to enter the ball joint and will accelerate wear.
(4) Torn grease boot will allow contaminants to enter the ball joint and will accelerate wear.
(5) If the greaseable ball joint still will not take grease after replacing the grease fitting, suggest replacement of ball joint.
(6) Check for bent stud or damaged taper hole.
(7) Check for damaged taper hole.

BUSHINGS

BUSHINGS

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part if available; otherwise, replace bushing.
Attaching hardware broken	A	Require replacement of broken part if available; otherwise, replace bushing.

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Attaching hardware corroded affecting structural integrity	A	Require replacement of corroded part if available; otherwise, replace bushing.
Attaching hardware incorrect	A	Require replacement of incorrect part if available; otherwise, replace bushing.
Attaching hardware loose	A	Require repair or replacement of loose part if available; otherwise, replace bushing.
Attaching hardware missing	C	Require replacement of missing part if available; otherwise, replace bushing.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads if available; otherwise, replace bushing.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads if available; otherwise, replace bushing.
Binding	A	Require repair or replacement.
Deteriorated, affecting performance	A	Require repair or replacement.
Distorted, affecting performance	A	Require repair or replacement.
Leaking (fluid-filled type)	A	Require replacement.
Missing	A	Require replacement.
Noisy	B,2	Further inspection required. See note (1) and caution below.
Rubber separating from internal metal sleeve on bonded bushing	A	Require replacement.
Seized	A	Require replacement.
Shifted (out of position)	B	Require repair or replacement.
Split	A	Require replacement.
Surface cracking (weather-checked)		No service suggested or required.

NOTE: (1) If noise isolated to bushing, suggest repair or replacement.

CAUTION: Use only approved lubricant on rubber bushings. Petroleum-based lubricants may damage rubber bushings.

CENTER LINKS

CENTER LINKS

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace center link.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace center link.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace center link.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace center link.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace center link.
Bent	B	Require replacement.
Binding	A	Further inspection required. See note (1) below.
Grease boot cracked	B,2	Suggest replacement. See note (2).
Grease boot missing	B,2	Suggest replacement. See note (3).
Grease boot torn	B,2	Suggest replacement. See note (4).
Grease fitting broken	A	Require replacement of grease fitting.
Grease fitting missing	C	Require replacement of grease fitting.
Grease fitting won't seal	A	Require replacement of grease

			fitting.
Grease seal missing		B,2	Suggest replacement. See note (5).
Grease seal torn		B,2	Suggest replacement. See note (6).
Looseness (perceptible horizontal movement)		A,1	Suggest replacement. See note (7).

CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.

Looseness that is excessive		B	Require replacement. See notes (8) and (9), caution below.

CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.

Seized		A	Require replacement.
Stud bent		B	Require replacement. See note (10)
Stud broken		A	Require replacement. See note (10)
Stud loose in taper hole		A	Require repair or replacement. See note (10) below.
Taper hole elongated		A	Require replacement. See note (11)
Threads damaged		A	Require repair or replacement.
Threads stripped (threads missing)		A	Require replacement. See note (10)
Wear exceeds manufacturer's specifications		B	Require replacement.

NOTE: (1) If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.
(2) Cracked grease boot will allow contaminants to enter the joint and will accelerate wear.
(3) Lack of grease boot will allow contaminants to enter the joint and will accelerate wear.
(4) Torn grease boot will allow contaminants to enter the joint and will accelerate wear.
(5) Lack of grease seal will allow contaminants to enter the joint and will accelerate wear.
(6) Torn grease seal will allow contaminants to enter the joint and will accelerate wear.
(7) If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.

(8) Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity.
(9) If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.
(10) Check for damaged taper hole.
(11) Check for damaged stud.

CONTROL ARM SHAFTS

CONTROL ARM SHAFTS

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace shaft.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace shaft.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace shaft.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace shaft.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace shaft.
Bent	B	Require replacement.
Shaft bushing surface undersized (worn)	B	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

CONTROL ARMS

CONTROL ARMS

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part, if available; otherwise, replace control arm.
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace control arm.

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Attaching hardware corroded affecting structural integrity	A	Require replacement of corroded part, if available; otherwise, replace control arm.
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace control arm.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace control arm.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace control arm.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace control arm.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace control arm.
Bent	B	Require replacement.
Bushing hole oversized	B	Require replacement.
Ball joint hole oversized (loose interference or press fit)	B	Further inspection required. See note (1) below.
Corroded, affecting structural integrity	A	Require replacement.
Holes distorted	A	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

NOTE: (1) If oversized ball joint is available, require replacement of ball joint. If oversized ball joint is not available, require replacement of control arm.

DRAG LINKS

DRAG LINKS

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Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace drag link.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace drag link.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace drag link.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace drag link.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace drag link.
Bent	B	Require replacement.
Binding	A	Further inspection required. See note (1) below.
Grease boot cracked	B,2	Suggest replacement. See note (2).
Grease boot missing	B,2	Suggest replacement. See note (3).
Grease boot torn	B,2	Suggest replacement. See note (4).
Grease fitting broken	A	Require replacement of grease fitting.
Grease fitting missing	C	Require replacement of grease fitting.
Grease fitting won't seal	A	Require replacement of grease fitting.
Grease seal missing	B,2	Suggest replacement. See note (5).
Grease seal torn	B,2	Suggest replacement. See note (4).
Looseness (perceptible horizontal movement)	A,1	Suggest replacement. See note (6).

CAUTION: DO NOT use pliers or pry bar to check ball and socket

movement. Use only moderate hand pressure.

Looseness that is excessive	B	Require replacement. See notes (6) and (7), caution below.

CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.

Seized	A	Require replacement.
Stud bent	B	Require replacement. See note (8).
Stud broken	A	Require replacement. See note (8).
Stud loose in taper hole	A	Require repair or replacement. See note (8) below.
Taper hole elongated	A	Require replacement. See note (9).
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement. See note (8).
Wear exceeds manufacturer's specifications	B	Require replacement.

NOTE: (1) If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.
(2) Cracked grease boot will allow contaminants to enter the joint and will accelerate wear.
(3) Lack of grease boot will allow contaminants to enter the joint and will accelerate wear.
(4) Torn grease boot will allow contaminants to enter the joint and will accelerate wear.
(5) Missing grease seal will allow contaminants to enter the joint and will accelerate wear.
(6) If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.
(7) Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity.
(8) Check for damaged taper hole.
(9) Check for damaged stud.

ELECTRONIC RIDE CONTROL SHOCKS & STRUTS

NOTE: This section covers the electronic damping control portion of the electronic shock or strut. For dampening portion of shock or strut conditions and procedures, refer to the "Shock Absorbers, Strut Cartridges, and Strut Assemblies" section.

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ELECTRONIC RIDE CONTROL SHOCKS & STRUTS

Condition	Code	Procedure
Connector bent	A	Require repair or replacement.
Connector broken	A	Require repair or replacement.
Connector loose	A	Require repair or replacement.
Electronic valve control inoperative	B,2	Suggest replacement. See note (1).
Terminal bent	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal corroded	A	Require repair or replacement.
Terminal loose	A	Require repair or replacement.

NOTE: (1) It is acceptable to replace with a non-electronically controlled unit, where available.

IDLER ARMS

IDLER ARMS

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace idler arm.
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace idler arm.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace idler arm.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace idler arm.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace idler arm.

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Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace idler arm.
Binding	A	Further inspection required. See note (1) below.
Grease boot cracked	B,2	Suggest replacement. See note (2).
Grease boot missing	B,2	Suggest replacement. See note (3).
Grease boot torn	B,2	Suggest replacement. See note (4).
Grease fitting broken	A	Require replacement of grease fitting.
Grease fitting missing	C	Require replacement of grease fitting.
Grease fitting won't seal	A	Require replacement of seal.
Grease seal missing	B,2	Suggest replacement. See note (5).
Grease seal torn	B,2	Suggest replacement. See note (4).
Greaseable joint will not take grease	B,2	Suggest replacement of grease fitting. See note (6) below.
Looseness at frame bracket end	B	Require repair or replacement. See notes (7) and (8) below.
Looseness at link end (perceptible horizontal movement)	A,1	Suggest replacement. See note (7).

CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.

Looseness at link end that is excessive	B	Require replacement. See notes (7) and (9) and caution below.

CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.

Mounted out of position (center link not parallel)	B	Require repositioning.
Nut on stud loose	A	Require repair or replacement. See note (10) below.
Seized	A	Require replacement.

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Stud bent	B	Require replacement. See note (11)
Stud broken	A	Require replacement. See note (11)
Taper hole elongated	A	Require replacement. See note (12)
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement. See note (11)
Wear exceeds manufacturer's specifications	B	Require replacement.

NOTE: (1) If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.
(2) Cracked grease boot will allow contaminants to enter joint and will accelerate wear.
(3) Lack of grease boot will allow contaminants to enter joint and will accelerate wear.
(4) Torn grease boot will allow contaminants to enter joint and will accelerate wear.
(5) Missing grease seal will allow contaminants to enter joint and will accelerate wear.
(6) If greaseable joint will not take grease after replacing the grease fitting, suggest replacement of idler arm.
(7) If manufacturer's procedures and specifications exist, use those procedures and specifications; otherwise, use an approved inspection method such as the dry park check.
(8) Looseness is defined as movement that creates excessive toe change.
(9) Excessive looseness is defined as significant enough to affect vehicle handling or structural integrity.
(10) Check for bent stud or damaged taper hole.
(11) Check for damaged taper hole.
(12) Check for damaged stud.

KING PINS

You are not required to replace king pins in axle sets. However, when replacing a king pin due to wear exceeding manufacturer's specifications, you may suggest replacement of the other king pin on the axle if its measurement shows it is close to the end of its useful life.

KING PINS

Condition	Code	Procedure
Bearing balls pitted	A	Require replacement.

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Bearing balls worn	A	Require replacement.
Bearing races pitted	A	Require replacement.
Bearing races worn	A	Require replacement.
Bearing rollers pitted	A	Require replacement.
Bearing rollers worn	A	Require replacement.
Bearing seal bent	B,2	Suggest replacement of seal or bearing.
Bearing seal missing	B,2	
Bearing seal torn	B,2	
Binding	A	Require repair or replacement of affected parts.
End caps missing	C	Require replacement of missing part, if available; otherwise, replace king pin.
End play exceeds specifications	B	Require repair.
Grease fitting broken	A	
Grease fitting missing	C	Require replacement of grease fitting.
Grease fitting won't seal	A	
Locating pins missing	C	Require replacement of missing part, if available; otherwise, replace king pin.
Looseness exceeds manufacturer's specs	B	Require replacement of worn parts.
Seized	A	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Will not take grease	B,2	Suggest replacement of grease fitting. See note (1) below.

NOTE: (1) If king pin will not take grease after replacement of grease fitting, suggest replacement of king pin.

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PITMAN ARMS

PITMAN ARMS

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace pitman arm.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace pitman arm.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace pitman arm.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace pitman arm.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace pitman arm.
Bent	B	Require replacement.
Binding	A	Further inspection required. See note (1) below.
Grease boot cracked	B,2	Suggest replacement. See note (2).
Grease boot missing	B,2	Suggest replacement. See note (3).
Grease boot torn	B,2	Suggest replacement. See note (4).
Grease fitting broken	A	Require replacement grease fitting.
Grease fitting missing	C	
Grease fitting won't seal	A	
Grease seal missing	B,2	Suggest replacement of seal. See note (5) below.
Grease seal torn	B,2	Suggest replacement of seal. See note (6) below.

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Looseness (perceptible horizontal movement)	A,1	Suggest replacement. See note (7)
CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.		
Looseness that is excessive	B	Require replacement. See notes (7) and (8), caution below.
CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.		
Nut on stud loose	A	Require repair or replacement. See note (9) below.
Seized	A	Require replacement.
Splines damaged	A	Require repair or replacement.
Splines stripped (splines missing)	A	Require replacement.
Stud bent	B	Require replacement. See note (10)
Stud broken	A	Require replacement. See note (10)
Stud loose in taper hole	A	Require repair or replacement. See note (10) below.
Taper hole elongated	A	Require replacement. See note (11)
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement. See note (10)

NOTE: (1) If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.
(2) Cracked grease boot will allow contaminants to enter joint and will accelerate wear.
(3) Lack of grease boot will allow contaminants to enter joint and will accelerate wear.
(4) Torn grease boot will allow contaminants to enter joint and will accelerate wear.
(5) Lack of grease seal will allow contaminants to enter joint and will accelerate wear.
(6) Torn grease seal will allow contaminants to enter joint and will accelerate wear.
(7) If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.
(8) Excessive looseness is defined as being significant enough

to affect vehicle handling or structural integrity.
(9) Check for bent stud of damaged taper hole.
(10) Check for damaged taper hole.
(11) Check for damaged stud.

POWER STEERING HOSES

POWER STEERING HOSES

Condition	Code	Procedure
Blistered	B	Require replacement.
Blocked	A	Require repair or replacement.
Fitting threads damaged	A	Require repair or replacement.
Fitting threads stripped (threads missing)	A	Require replacement.
Inner fabric (webbing) cut	A	Require replacement.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Outer covering is cracked to the extent that the inner fabric of hose is visible	B	Require replacement.
Restricted	A	Require repair or replacement.

POWER STEERING (HYDRAULIC) PUMPS

If diagnosis has determined that complete disassembly is necessary to determine the extent of the system failure, the suggestion may be made to rebuild or replace the power steering pump. Repair or replacement of the following components may be required if performed as part of a power steering pump overhaul or rebuild service to meet a minimum rebuild standard.

POWER STEERING (HYDRAULIC) PUMPS

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part.
Attaching hardware broken	A	Require replacement of broken

			part.
Attaching hardware loose	A	Require repair or replacement of	loose part.
Attaching hardware missing	C	Require replacement of missing	part.
Attaching hardware threads damaged	A	Require repair or replacement of	part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with	stripped threads.
Belt alignment incorrect	B	Further inspection required.	See note (1) below.
Belt cracked	A,1	Suggest replacement.	
Belt frayed	A,1	Suggest replacement.	
Belt missing	C	Require replacement.	
Belt noisy	B,2	Further inspection required.	See note (2) below.
Belt plies separated	A	Require replacement.	
Belt tension out of spec	B	Require adjustment or replacement.	
Belt worn beyond adjustment range	B	Require replacement.	
Belt worn so it contacts bottom of pulley	A	Require replacement.	
Binding	A	Require repair or replacement.	
Fluid at or beyond service interval	C,3	Suggest fluid change.	
Fluid contaminated	B	Require flushing and refilling of	the system. See note (3) below.
Fluid level incorrect	B	Require adjustment of fluid level.	
Inadequate assist	A	Further inspection required.	See note (4) below.
Leaking	A	Require repair or replacement.	
Noise	B,2	Further inspection required.	

			See note (5) below.
Pulley bent		A	Require repair or replacement of pulley.
Pulley missing		C?	Require replacement of pulley.
Remote reservoir leaking		A	Require replacement of reservoir.
Reservoir cap broken		A	Require replacement of cap.
Reservoir cap missing		C	Require replacement of cap.
Seized		A	Require replacement.
Threads damaged		A	Require repair or replacement.
Threads stripped (threads missing)		A	Require replacement.

NOTE: (1) Determine cause of incorrect alignment and require repair.
(2) Determine cause of noise and suggest repair.
(3) Determine and correct source of contamination. OEM specifications must be followed for fluid type.
(4) If pump is source of inadequate assist, require repair or replacement.
(5) If noise is isolated to pump, suggest repair or replacement.

RADIUS ARMS

RADIUS ARMS

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware incorrect	A	Require replacement of incorrect part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.

Bent	B	Require replacement.
Corroded, affecting structural integrity	A	Require replacement.
Holes distorted	A	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

RELAY RODS

RELAY RODS

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace relay rod.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace relay rod.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace relay rod.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace relay rod.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace relay rod.
Bent	B	Require replacement.
Binding	A	Further inspection required. See note (1) below.
Grease boot cracked	B,2	Suggest replacement. See note (2).
Grease boot missing	B,2	Suggest replacement. See note (3).
Grease boot torn	B,2	Suggest replacement. See note (4).

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Grease fitting broken	A	
Grease fitting missing	C	Require replacement grease fitting.
Grease fitting won't seal	A	
Grease seal missing	B,2	Suggest replacement. See note (5).
Grease seal torn	B,2	Suggest replacement. See note (6).
Looseness (perceptible horizontal movement)	A,1	Suggest replacement. See note (7).
CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.		
Looseness that is excessive	B	Require replacement. See notes (7) and (8) and caution below.
CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.		
Seized	A	Require replacement.
Stud bent	B	Require replacement. See note (9).
Stud broken	A	Require replacement. See note (9).
Stud loose in taper hole	A	Require repair or replacement. See note (9).
Taper hole elongated	A	Require replacement. See note (10)
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement. See note (9).
Wear exceeds manufacturer's specifications	B	Require replacement.

NOTE: (1) If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.
(2) Cracked grease boot will allow contaminants to enter the joint and will accelerate wear.
(3) Lack of grease boot will allow contaminants to enter the joint and will accelerate wear.
(4) Torn grease boot will allow contaminants to enter the joint and will accelerate wear.
(5) Lack of grease seal will allow contaminants to enter joint and will accelerate wear.
(6) Torn grease seal will allow contaminants to enter joint and

will accelerate wear.
(7) If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.
(8) Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity.
(9) Check for damaged taper hole.
(10) Check for damaged stud.

SHOCK ABSORBERS, STRUT CARTRIDGES, & STRUT ASSEMBLIES

You are not required to replace shocks or struts in axle sets. However, when replacing a shock or strut due to the conditions that follow, you may suggest replacement of the other shock or strut on the same axle for improved performance and preventive maintenance.

* part is close to the end of its useful life
* to extend tire life
* to balance ride and handling
* to improve stopping distance

When replacing steering and/or suspension components which may affect an alignment angle, you are required to check and adjust alignment as needed. Refer to the OEM specifications.

Under no circumstances should a technician bend struts or strut housings.

A vehicle's load-carrying and handling abilities are limited by its suspension, tires, brakes, and driveline. Installing coil over shocks or any other load assist device does not increase the vehicle's load capacity. See the vehicle owner's manual for more details.

NOTE: If vehicle is equipped with original equipment coil over shocks, apply the conditions for coil springs from the "Springs: Coil, Leaf, and Torsion Bar" section of the Steering and Suspension guidelines. If the vehicle is equipped with add-on coil over shocks, you may suggest replacing the shocks with standard shocks for any spring-related condition.

SHOCK ABSORBERS, STRUT CARTRIDGES, & STRUT ASSEMBLIES

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part, if available; otherwise, replace shock or strut.
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace shock or strut.

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Attaching hardware corroded affecting structural integrity	A	Require replacement of corroded part, if available; otherwise, replace shock or strut.
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace shock or strut.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace shock or strut.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace shock or strut.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace shock or strut.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace shock or strut.
Binding	A	Require replacement.
Body dented	A	Further inspection required. See note (1) below.
Body punctured	A	Require replacement.
Brake hose bracket bent	B	Require repair or replacement.
Brake hose bracket missing	C	Require replacement.
Brake hose bracket threads damaged	C	Require repair or replacement.
Brake hose bracket threads stripped (threads missing)	C	Require replacement.
Compression bumper missing	C	Require replacement of compression bumper.
Compression bumper split	A,1	Suggest replacement of compression bumper.
Damping (none)	A	Require replacement.
Dust boot (bellows) split	B,2	Suggest replacement of boot. See note (2) below.

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Dust boot (bellows) missing	B,2	Suggest replacement of boot. See (3) note below.
Dust boot (bellows) torn	B,2	Suggest replacement of boot. See note (4) below.
Dust shield broken	B,2	Suggest replacement. See note (4).
Dust shield missing	B,2	Suggest replacement. See note (4).
Gland nut (strut housing cap) is not removable using appropriate tool	A	Require replacement of nut and/or housing. See note (5) below.
Gland nut (strut housing cap) threads damaged	A	Require repair or replacement of nut.
Gland nut (strut housing cap) threads stripped (threads missing)	A	Require replacement of nut.
Housing dented	A	Further inspection required. See note (6) below.
Housing punctured	A	Require replacement.
Jounce bumper missing	C	Require replacement of jounce bumper.
Jounce bumper split	1?	Suggest replacement of jounce bumper.
Leaking oil, enough for fluid to be running down the body	A	Require replacement. See caution below.

CAUTION: If the strut cartridge has been replaced previously, the oil on the strut housing may be filler oil. The technician must identify the source of the oil.

Noise	B,2	Further inspection required. See note (7) below.
Piston rod bent	A	Require replacement.
Piston rod broken	A	Require replacement.
Piston rod has surface defect	B,2	Suggest replacement.
Piston rod threads damaged	A	Require repair or replacement.

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Piston rod threads stripped (threads missing)	A	Require replacement.
Seized	A	Require replacement.
Shock missing	C	Require replacement.
Strut housing bent	A	Require replacement.
Strut housing cap (gland nut) is not removable using appropriate tool	A	Require replacement of nut and/or housing. See note (5) below.
Strut housing cap (gland nut) threads damaged	A	Require repair or replacement of nut.
Strut housing cap (gland nut) threads stripped (threads missing)	A	Require replacement of nut.
Strut housing severely corroded, affecting structural integrity	A	Require replacement.
Strut housing threads damaged	A	Require repair or replacement.
Strut housing threads stripped (threads missing)	A	Require replacement.
Tire cupping	A	Further inspection required. See note (8) below

NOTE: (1) Require replacement of units where dents restrict shock or strut piston rod movement. If dents don't restrict movement, no service is suggested or required. Especially critical on mono-tube shocks.

(2) This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.

(3) This condition can lead to damage of the piston rod, which causes piston rod seal wear.

(4) This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.

(5) Only required if replacing cartridge.

(6) Require replacement of units where dents restrict shock or strut piston rod movement. If dents don't restrict movement, no service is suggested or required. Especially critical on mono-tube shocks.

(7) If noise is isolated to shock or strut, suggest replacement.

(8) Although shocks or struts may have contributed to tire cupping, an inspection is needed of the entire suspension

system. If the shock or strut is found to be contributing to the tire cupping, require replacement.

SPINDLES

SPINDLES

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Bent	B	Require replacement.
Broken	A	Require replacement.
Race seat area undersized	B	Require replacement.
Scored	A	Require repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

SPRINGS: COIL, LEAF, & TORSION BAR

When springs are replaced, it is suggested, but not required, that both springs on an axle be replaced to maintain equal height from side to side and to provide a balanced ride and proper handling.

When variable rate springs are installed in place of conventional coil springs, they must be installed in axle sets to ensure proper handling, uniform ride, and proper chassis height.

Erroneous height measurements may result from: improper tire inflation, non-standard tire or wheel size, and heavy load in vehicle or trunk.

SPRINGS: COIL, LEAF, & TORSION BAR

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Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part.
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware corroded affecting structural integrity	A	Require replacement of corroded part.
Attaching hardware incorrect	A	Require replacement of incorrect part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Broken (all springs except secondary leave(s) on multi-leaf springs)	A	Require replacement.
Coil clash		Require ride height check. See note (1) below.
Coil spring insulator deteriorated	B,2	Suggest replacement of insulator.
Coil spring insulator missing	B,2	Suggest replacement of insulator.
Coil spring insulator split	B,2	Suggest replacement of insulator.
Coil spring plastic coating deteriorated - rust present	A	Refer to manufacturer's service requirements. See note (2) below.
Composite spring damaged	A	Further inspection required. See note (3) below.
Cracked (all springs except composite leaf and secondary leave(s) on	A	Require replacement.

multi-leaf springs)		
Installed incorrectly	B	Require repair.
Leaf spring insulators missing	B,2	Suggest replacement of insulators.
Secondary leaf on multi-leaf spring broken	A,1	Suggest repair or replacement
Secondary leaf on multi-leaf spring cracked	A,1	Suggest repair or replacement
Torsion bar adjuster bent	A	Require repair or replacement of adjuster. See note (4) below.
Torsion bar adjuster seized	A	Require repair or replacement of adjuster. See note (4) below.
Torsion bar adjuster threads damaged	A	Require repair or replacement of part with damaged threads. See note (4) below.
Torsion bar adjuster threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Vehicle suspension height not within OEM specs	B	Require adjustment or replacement.

NOTE: (1) If vehicle is within manufacturer's height specifications, no service is suggested or required.
(2) Some manufacturers require replacement under these conditions.
(3) Check vehicle ride height. If ride height is OK, no service is suggested or required.
(4) Only required if ride height needs to be adjusted.

STEEL POWER STEERING LINES

CAUTION: When replacing steel power steering lines, be sure to use a replacement product that meets or exceeds OEM design specifications.

STEEL POWER STEERING LINES

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part.

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Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Blocked	A	Require repair or replacement.
Fitting incorrect (such as compression fitting)	B	Require replacement.
Flare type incorrect	B	Required replacement.
Leaking	A	Require tightening or replacement.
Line type incorrect	B	Require replacement.
Restricted	A	Require replacement.
Routed incorrectly	B	Require routing correction.
Rust-pitted	A,1	Suggest replacement.
Rust pitted affecting structural integrity	A	Require replacement.

STEERING ARMS

STEERING ARMS

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part.
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware incorrect	A	Require replacement of incorrect part.
Attaching hardware loose	A	Require repair or replacement of

	³	³ loose part.
Attaching hardware missing	³ C	³ Require replacement of missing
	³	³ part.
Attaching hardware threads damaged	³ A	³ Require repair or replacement of
	³	³ part with damaged threads.
Attaching hardware threads stripped (threads missing)	³ A	³ Require replacement of part with
	³	³ stripped threads.
Bent	³ B	³ Require replacement.
Broken	³ A	³ Require replacement.
Taper hole elongated	³ A	³ Require replacement. See note (1).
Threads damaged	³ A	³ Require repair or replacement.
Threads stripped (threads missing)	³ A	³ Require replacement.
	³	³

NOTE: (1) Check for damaged stud.

STEERING DAMPERS

The following procedures are only required if the vehicle was originally equipped from the factory with a steering damper. If the steering damper is an add-on unit, then the unit may be removed instead of repairing or replacing.

STEERING DAMPERS

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part, if available; otherwise, replace steering damper.
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace steering damper.
Attaching hardware corroded affecting structural integrity	A	Require replacement of corroded part, if available; otherwise, replace steering damper.
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace steering damper.

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Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace steering damper.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace steering damper.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace steering damper.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace steering damper.
Binding	A	Require replacement.
Damper body dented	A	Further inspection required. See note (1) below.
Damper body punctured	A	Require replacement.
Damping (none)	A	Require replacement.
Dust boot (bellows) missing	B,2	Suggest replacement of boot. See note (2) below.
Dust boot (bellows) split	B,2	Suggest replacement of boot. See note (2) below.
Dust shield broken	B,2	Suggest replacement. See note (2).
Dust shield missing	B,2	Suggest replacement. See note (2).
Leaking oil, enough for fluid to be running down the body	A	Require replacement.
Loose	A	Require repair or replacement.
Missing	C	Require replacement.
Noise	B,2	Further inspection required. See note (3) below.
Piston rod bent	A	Require replacement.

Piston rod broken	A	Require replacement.
Piston rod has surface defect	B,2	Suggest replacement.
Piston rod threads stripped (threads missing)	A	Require replacement.
Piston rod threads damaged	A	Require repair or replacement.
Seized	A	Require replacement.

NOTE: (1) Require replacement of units where dents restrict damper piston rod movement. If dents don't restrict movement, no service is suggested or required. Especially critical on mono-tube dampers.
(2) This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.
(3) If noise is isolated to damper, suggest replacement.

STEERING GEARS (EXCEPT RACK & PINION)

If diagnosis has determined that complete disassembly is necessary to determine the extent of the system failure, the suggestion may be made to rebuild or replace the power steering pump. Repair or replacement of the following components may be required, if performed as part of a power steering pump overhaul or rebuild service to meet a minimum rebuild standard.

STEERING GEARS (EXCEPT RACK & PINION)

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Binding	A	Require repair or replacement
Flex coupler binding	A	Require repair or replacement of

		coupler.
Flex coupler loose	A	Require repair or replacement of coupler.
Flex coupler missing parts	A	Require repair or replacement of coupler.
Flex coupler soft/spongy	A	Require replacement of coupler.
Flex coupler torn	A	Require replacement of coupler.
Fluid contaminated	B	Require flushing and refilling of the system. See note (1) below.
Gasket leaking	A	Require repair or replacement of gasket.
Housing leaking	A	Require replacement.
Hydraulic fittings leaking	A	Require repair or replacement of fittings.
Inadequate power assist	A	Further inspection required. See note (2) below.
Lash exceeds manufacturer's specifications	B	Require repair or replacement.
Seal leaking	A	Require repair or replacement of seal and/or mating part.
Splines damaged	A	Require repair or replacement of splines.
Splines stripped	A	Require replacement of splines.
Steering coupler shield cracked	B,2	Suggest replacement.
Steering coupler shield missing	C	Require replacement.
Threads damaged	A	Require repair or replacement of part with damaged threads.
Threads stripped (threads missing)	A	Require replacement of part with stripped threads.
U-joint binding	A	Require repair or replacement of joint.

U-joint loose	A	Require repair or replacement of joint.
Unequal power assist	A	Require repair or replacement.

NOTE: (1) Determine and correct source of contamination. OEM specifications must be followed for fluid type.
(2) If steering gear is source of inadequate assist, require repair or replacement.

STEERING GEARS: RACK & PINION

If diagnosis has determined that complete disassembly is necessary to determine the extent of the system failure, the suggestion may be made to rebuild or replace the power steering pump. Repair or replacement of the following components may be required, if performed as part of a power steering pump overhaul or rebuild service to meet a minimum rebuild standard.

STEERING GEARS: RACK & PINION

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Balance tube blocked	A	Require repair or replacement of balance tube.
Balance tube missing	C	Require replacement of balance tube.
Balance tube restricted	A	Require repair or replacement of balance tube.
Bellows boot clamp missing	C	Require replacement of clamp.
Bellows boot cracked (not through)	B,2	Suggest replacement of bellows boot.

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Bellows boot missing	C	Require replacement of bellows boot.
Bellows boot not sealing	A	Require repair or replacement of bellows boot.
Bellows boot torn	A	Require replacement of bellows boot.
Bellows boot twisted (from toe adjustment)	B	Require repair.
Fitting leaking	A	Require repair or replacement.
Fitting missing	A	Require replacement of fitting.
Fitting threads damaged	A	Require repair or replacement of part with damaged threads.
Fitting threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Flex coupler binding	A	Require repair or replacement of coupler.
Flex coupler loose	A	Require repair or replacement of coupler.
Flex coupler missing parts	A	Require repair or replacement of coupler.
Flex coupler soft/spongy	A	Require replacement of coupler.
Flex coupler torn	A	Require replacement of coupler.
Fluid contaminated	B	Require flushing and refilling of the system. See note (1) below.
Gasket leaking	A	Require repair or replacement.
Hard steering on cold start-up	A,1	Suggest repair or replacement. See note (2) below.
Housing cracked, affecting structural integrity	B	Require replacement.
Housing leaking	A	Require replacement.
Inadequate power assist	A	Further inspection required. See note (3) below.

Lash exceeds manufacturer's specifications	B		Require repair or replacement.
Seal leaking	A		Require repair or replacement.
Splines damaged	A		Require repair or replacement.
Splines stripped (splines missing)	A		Require replacement.
Steel line blocked	A		Require repair or replacement of line.
Steel line leaking	A		
Steel line missing	C		Require replacement of line.
Steel line restricted	A		Require repair or replacement of line.
Steering coupler shield cracked	B,2		Suggest replacement.
Steering coupler shield missing	C		Require replacement.
Steering coupler shield torn	B,2		Suggest replacement.
Threads damaged	A		Require repair or replacement of part with damaged threads.
Threads stripped (threads missing)	A		Require replacement of part with stripped threads.
U-joint binding	A		Require repair or replacement of joint.
U-joint loose	A		Require repair or replacement of joint.
Unequal power assist	A		Require repair or replacement.

NOTE: (1) Determine and correct source of contamination. Follow OE specifications for fluid type.
(2) Indicates internal wear.
(3) If steering gear is source of inadequate assist, require repair or replacement.

STEERING KNUCKLES

STEERING KNUCKLES

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Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part.
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware incorrect	A	Require replacement of incorrect part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Bent	B	Require replacement.
Broken	A	Require replacement.
Pinch bolt incorrect	B	Require replacement with bolt that meets OE design.
Pinch bolt loose	B	Require repair.
Pinch bolt missing	B	Require replacement.
Pinch bolt tabs deformed (pinched together), .032" or more before clamping	B	Require replacement. See note (1) below.
Taper hole elongated	A	Require replacement. See note (2).
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require repair or replacement.

NOTE: (1) Steering knuckle deformation can cause pinch bolt breakage.
(2) Check for damaged stud.

STRIKE OUT BUMPERS

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STRIKE OUT BUMPERS

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware corroded affecting structural integrity	A	Require replacement of corroded part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Missing	C	Require replacement.
Split	A,1	Suggest replacement.

STRUT RODS

STRUT RODS

Condition	Code	Procedure
Adjusting nut seized	A	Require repair or replacement. See note (1) below.
Attaching hardware bent	B	Require repair or replacement of bent part, if available; otherwise, replace strut rod.
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace strut rod.
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace strut rod.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace strut rod.

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Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace strut rod.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace strut rod.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace strut rod.
Attaching (mating) hole oversized	A	Require repair or replacement of frame.
Attaching point on frame corroded, affecting structural integrity	A	Require repair of frame.
Bent	A	Require replacement.
Mating (attaching) hole oversized	A	Require repair or replacement of frame.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

NOTE: (1) Only required if an alignment is being performed.

STRUT UPPER BEARING PLATE ASSEMBLIES

NOTE: When the following guidelines indicate replacement of bearing, only the bearing should be replaced if it is available separately; otherwise, replace the bearing plate assembly.

STRUT UPPER BEARING PLATE ASSEMBLIES

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace bearing plate assembly.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace bearing plate

		assembly.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace bearing plate assembly.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace bearing plate assembly.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace bearing plate assembly.
Bearing axial or radial movement exceeds vehicle manufacturer's specs	B	Require replacement of bearing.
Bearing binding	A	Require replacement of bearing.
Bearing missing	C	Require replacement of bearing.
Bearing seized	A	Require replacement of bearing.
Bent	B	Require replacement.
Holes distorted	A	Require replacement.
Missing	C	Require replacement.
Severely corroded, affecting structural integrity	A	Require replacement.

SWAY BAR LINKS

SWAY BAR LINKS

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace link.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace link.
Attaching hardware missing	C	Require replacement of missing

		part, if available; otherwise, replace link.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace link.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace link.
Ball and socket has looseness (perceptible vertical movement)	A,1	Suggest replacement. See note (1).

CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.

Ball and socket has looseness that is excessive	B	Require replacement. See notes (1) and (2) and caution.
Bent	B	Require replacement.
Broken	A	Require replacement.
Corroded, affecting structural integrity	A	Require replacement.
Grease boot cracked	B,2	Suggest replacement. See note (3).
Grease boot missing	B,2	Suggest replacement. See note (4).
Grease boot torn	B,2	Suggest replacement. See note (5).
Missing	C	Require replacement.
Nut on stud loose	A	Require repair. See note (6).
Stud bent	B	Require replacement. See note (7).
Stud broken	A	Require replacement. See note (7).
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement. See note (7).

NOTE: (1) If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.

(2) Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity.
(3) Cracked grease boot will allow contaminants to enter the joint and will accelerate wear.
(4) Lack of grease boot will allow contaminants to enter the joint and will accelerate wear.
(5) Torn grease boot will allow contaminants to enter the joint and will accelerate wear.
(6) Check for bent stud or damaged taper hole.
(7) Check for damaged taper hole.

SWAY BARS

SWAY BARS

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace sway bar.
Attaching hardware corroded affecting structural integrity	A	Require replacement of corroded part, if available; otherwise, replace sway bar.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace sway bar.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace sway bar.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace sway bar.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace sway bar.
Bent	B	Require replacement.
Broken	A	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

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TIE ROD ENDS (INNER & OUTER)

TIE ROD ENDS (INNER & OUTER)

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace tie rod end.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace tie rod end.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace tie rod end.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace tie rod end.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace tie rod end.
Adjusting sleeve bent	B	Require replacement of sleeve or tie rod end.
Adjusting sleeve clamps out of position	B	Require repair.
Adjusting sleeve corroded, affecting structural integrity	A	Require replacement of sleeve or tie rod end.
Adjusting sleeve missing	C	Require replacement of sleeve or tie rod end.
Adjusting sleeve seized	A	Require repair or replacement. See note (1) below.
Adjusting sleeve threads damaged	A	Require repair or replacement of sleeve or tie rod end.
Adjusting sleeve threads stripped (threads missing)	A	Require replacement of sleeve or tie rod end.
Binding	A	Further inspection required. See note (2) below.

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Grease boot cracked		Suggest replacement. See note (3).
Grease boot missing		Suggest replacement. See note (4).
Grease boot torn		Suggest replacement. See note (5).
Grease fitting broken	A	Require replacement of grease fitting.
Grease fitting missing	C	Require replacement of grease fitting.
Grease fitting won't seal	A	Require replacement of grease fitting.
Grease seal missing	B,2	Suggest replacement of seal. See note (4) below.
Grease seal torn	B,2	Suggest replacement of seal. See note (5) below.
Greaseable tie rod end will not take grease	B,2	Suggest replacement of grease fitting. See note (6) below.
Looseness (perceptible horizontal movement)	A,1	Suggest replacement. See note (7).
CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.		
Looseness exceeds manufacturer's specs	B	Require replacement.
Looseness that is excessive	B	Require replacement. See notes (7) and (8), caution.
Nut on stud loose	A	Require repair or replacement of nut. See note (9) below.
Seized	A	Require replacement
Stud bent	B	Require replacement. See note (10)
Stud broken	A	Require replacement. See note (10)
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement. See note (10)

NOTE: (1) Only required if toe needs to be adjusted.

(2) If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.
(3) Cracked grease boot will allow contaminants to enter joint and will accelerate wear.
(4) Lack of grease boot will allow contaminants to enter joint and will accelerate wear.
(5) Torn grease boot will allow contaminants to enter joint and will accelerate wear.
(6) If greaseable tie rod end will not take grease after replacing the grease fitting, suggest replacement of tie rod end.
(7) If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.
(8) Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity.
(9) Check for bent stud or damaged taper hole.
(10) Check for damaged taper hole.

TRACK BARS

TRACK BARS

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace track bar.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace track bar.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace track bar.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace track bar.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace track bar.
Bent	B	Require replacement.
Corroded, affecting structural integrity	A	Require replacement.

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Grease boot cracked	B,2	Suggest replacement. See note (1).
Grease boot missing	B,2	Suggest replacement. See note (2).
Grease boot torn	B,2	Suggest replacement. See note (3).
Holes distorted	A	Require replacement.
Looseness (perceptible horizontal movement)	A,1	Suggest replacement. See note (4) below.

CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.

Looseness that is excessive	B	Require replacement. See notes (4) and (5), caution.
Nut on stud loose	A	Require repair or replacement of nut. See note (6) below.
Seized	A	Require replacement.
Stud bent	B	Require replacement. See note (7).
Stud broken	A	Require replacement. See note (7).
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement. See note (7).
Wear exceeds manufacturer's specifications	B	Require replacement.

NOTE: (1) Cracked grease boot will allow contaminants to enter joint and will accelerate wear.
(2) Lack of grease boot will allow contaminants to enter joint and will accelerate wear.
(3) Torn grease boot will allow contaminants to enter joint and will accelerate wear.
(4) If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.
(5) Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity.
(6) Check for bent stud or damaged taper hole.
(7) Check for damaged taper hole.

TRAILING ARMS

TRAILING ARMS

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Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace trailing arm.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace trailing arm.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace trailing arm.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace trailing arm.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace trailing arm.
Bent	B	Require replacement.
Bushing hole oversized	B	Require replacement.
Corroded, affecting structural integrity	A	Require replacement.
Holes distorted	A	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

WHEEL ALIGNMENT

WHEEL ALIGNMENT

Wheel alignment is defined as the measurement, analysis, and adjustment of steering and suspension angles to conform to OEM specifications. These angles usually include, but are not limited to: caster, camber, toe, and thrust angle. Where these angles are not adjustable and not in specification, component replacement or correction kits may be required. Errors in set-back and steering axis inclination (SAI) are often attributable to failed or damaged components and must be corrected prior to performing an alignment.

Failure to replace or correct suggested or required parts or

service may prevent a proper alignment.

Before performing an alignment check, inspect and verify the following:

* Tire pressure and size
* Vehicle loading
* Ride height
* Steering and suspension parts

Only if the inspection reveals that all the above are within published specifications, should a wheel alignment check and an alignment, if needed, be performed.

CAUTION: Under no circumstances should a technician bend or heat any steering or suspension component, unless specified by the vehicle manufacturer, for example, Ford forged twin "I" beam axles. All measurements and suggestions must be noted on the inspection report.

WHEEL ALIGNMENT

Condition	Code	Procedure
Dog tracking, shown to be caused by faulty alignment	B,2	Suggest repair.
Lead, shown to be caused by faulty alignment	B	Require alignment.
Part has been changed that may affect alignment	B	Require alignment check.
Pull, shown to be caused by faulty alignment	B	Require alignment.
Steering wheel off-center	B,2	Suggest alignment.
Tire wear, shown to be caused by faulty alignment	B	Require alignment.
Wander, shown to be caused by faulty alignment	B	Require alignment.

WHEEL BEARINGS, RACES, & SEALS

NOTE: When replacing or repacking wheel bearings, grease seal replacement is required. You are not required to replace these components in axle sets. Determine the need to replace based upon the individual component conditions that follow.

WHEEL BEARINGS, RACES, & SEALS

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Condition	Code	Procedure
Rear axle seal on rear-wheel drive leaking	A	Require replacement of seal and inspection of axle, bearing, housing, and vent tube
Seal bent	A,1	Suggest replacement.
Seal leaking	A	Require replacement of seal and inspection of bearings.
Seal missing	C	Require replacement.
Seal torn	A	Require replacement.
Wheel bearing assembly feels rough when rotated	A	Require replacement of bearing assembly.
Wheel bearing balls are pitted	A	Require replacement of bearing assembly.
Wheel bearing balls are worn	A	Require replacement of bearing assembly.
Wheel bearing end-play exceeds vehicle manufacturer's specs	A	Require adjustment of bearing, if possible. If proper adjustment cannot be obtained, require repair or replacement of worn component.
Wheel bearing race is loose in the hub bore	A	Require replacement of hub assembly and wheel bearings.
Wheel bearing races are pitted	A	Require replacement of bearing assembly.
Wheel bearing races are worn	A	Require replacement of bearing assembly.
Wheel bearing rollers are pitted	A	Require replacement of bearing assembly.
Wheel bearing rollers are worn	A	Require replacement of bearing assembly.

WHEELS & TIRES

TIRES

WARNING: These guidelines do not apply to split rims.

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Some vehicle manufacturers restrict replacement of tires to specific brands, types, or sizes.

High pressure temporary compact spare tires should not be used with any other rims or wheels, nor should standard tires, snow tires, wheel covers, or trim rings be used with high pressure compact spare rims or wheels.

Attempting to mount a tire of one diameter on a wheel of a different diameter or flange type may result in serious injury or death.

Only specially trained persons should de-mount or mount tires. Explosions of tire and wheel assembly can result from improper mounting, possibly causing serious injury or death.

Consult the vehicle owner's manual or vehicle placard for correct size, speed rating, designation, and cold inflation pressure of the original tires. DO NOT exceed the maximum load or inflation capacity of the tire specified by the Tire and Rim Association

When replacing tires, it is suggested that the replacement tires match or exceed the OEM speed rating designation. If tires of different speed rating designations are mixed on the same vehicle, the tires may vary in handling characteristics. DO NOT mix different speed rating designations on the same axle.

DO NOT mix radials with non-radial tires on the same axle, as this may affect vehicle handling and stability. If radial tires and bias or bias-belted ply tires are mixed on the same vehicle, the radials must be on the rear. High-pressure temporary compact spare tires are exempt from this rule.

DO NOT mix size or type (all season, performance, mud and snow) of tires on the same axle.

TIRES

Condition	Code	Procedure
Air pressure incorrect	B	Require repair
Bead broken	A	Require replacement.
Bead leaking, caused by tire	A	Require repair or replacement.
Bead wire/cord exposed	A	Require replacement.
Cord or belt material exposed	A	Require replacement.
Cord ply separations	A	Require replacement.
Directional/asymmetrical tires mounted incorrectly	B	Require remounting and/or repositioning.
Irregular tread wear, affecting performance	A	Suggest replacement. See note (1) below.
Load ratings less than OEM	B	Require replacement.

specifications		
Mixed tire size designations on same axle	A	Require rotation or replacement.
Mixed tread types (all season, performance, mud and snow) on same axle	A	Require rotation or replacement.
Number of punctures exceeds manufacturer's limit	B	Require replacement.
Out of balance	B	Require rebalance of tire/wheel assembly.
Ply separation	A	Require replacement.
Pull or lead, caused by tire	A	Require rotation or replacement.
Radial and bias or bias-belted ply tires on same axle	B	Require rotation or replacement.
Radials are on the front and not on the rear	B	Require rotation or replacement. See note (2).
Run flat damage	A	Require replacement.
Shoulder cut	A	Require replacement.
Shoulder puncture	A	Require replacement.
Shoulder with plug	A	Require replacement.
Sidewall bulge	A	Require replacement.
Sidewall cut	A	Require replacement.
Sidewall indentation		No service required/suggested.
Sidewall puncture	A	Require replacement.
Sidewall with plug	A	Require replacement.
Speed rating designations different on same axle	B	Suggest rotation or replacement.
Tire and wheel assembly has excessive run-out	B	Require repair or replacement of appropriate part. See note (3) below.
Tires with more than 1/4"	B	Require replacement.

diameter difference on a four-wheel drive vehicle		
Tread area puncture larger in diameter than tire manufacturer's specifications	B	Require replacement.
Tread missing pieces (chunking), exposing cord	A	Require replacement.
Tread missing pieces (chunking), not exposing cord	A	Suggest replacement.
Tread separations	A	Require replacement.
Tube in tubeless tire	C,3	Suggest removal of tube. See note (4) below.
Weather-checking		No service required/suggested.
Worn to tread wear indicators	B	Require replacement.

NOTE: (1) Determine and correct cause of irregular tire wear.
(2) If radials and bias or bias-belted ply tires are on the same vehicle, the radials must be on the rear axle, except for high-pressure temporary spares.
(3) Excessive is defined as enough to contribute to performance problems. Match mounting may correct run-out. If not, require replacement of appropriate part. Refer to manufacturer's specifications.
(4) Most manufacturers do not recommend tubes in tubeless tires. Inspect tire and wheel assembly to determine the reason for a tube in tubeless tire. Recommendation for repair or replacement should be based upon condition of tires and/or wheel listed in these guidelines.

VALVE STEMS

VALVE STEMS

Condition	Code	Procedure
Bent	A,1	Suggest replacement.
Broken	A	Require replacement.
Cut, but not leaking	A,1	Suggest replacement.
Deteriorated (cracking, dry rot)	A,1	Suggest replacement.
Leaking	A	Require repair/replacement.

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Missing	C	Require replacement.
Threads damaged	A	Require repair/replacement.
Threads stripped (threads missing)	A	Require replacement.
Valve cap missing	C	Require replacement of cap.
Weather-checking	A,1	Suggest replacement.
Won't take air	A	Require repair/replacement.

WHEEL ATTACHMENT HARDWARE

For conditions noted below, also check conditions of wheel stud holes.

CAUTION: Proper lug nut torque is essential. Follow manufacturer's torque specifications and tightening sequence. DO NOT lubricate threads unless specified by the vehicle manufacturer.

WHEEL ATTACHMENT HARDWARE

Condition	Code	Procedure
Bent	A	Require replacement.
Broken	A	Require replacement. See note (1) below.
Loose	B	Require repair or replacement of affected component.
Lug nut installed backward	B	Require repair.
Lug nut mating type incorrect	B	Require replacement of nut.
Lug nut mating surface dished	A	Require replacement of nut.
Lug nut flats rounded	A	Require replacement of nut. See note (2) below.
Lug nut seized	A	Require replacement of nut and/or stud. See note (2) below.
Stud incorrect	B	Require replacement of stud.
Threads damaged	A	Require repair or replacement of component with damaged threads.

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Threads stripped (threads missing)	A	Require replacement of component with stripped threads.

NOTE: (1) Some manufacturers require replacement of all studs on that wheel if two or more studs or nuts on the same wheel are broken or missing.
(2) Only required if removing wheel.

WHEELS

WARNING: Mounting a regular tire on a high-pressure compact spare wheel is not permitted. Attempting to mount a tire of one diameter on a wheel of a different diameter or flange type may result in serious injury or death. If the wheel identification stamp is not legible, or cannot be found, DO NOT use the wheel until the size and type have been properly identified. Wheels of different diameter, offset, or width cannot be mixed on the same axle. Bead seat tapers cannot be interchanged.

WHEELS

Condition	Code	Procedure
Bead leaking, caused by wheel rim flange	A	Require repair or replacement. See caution below.
Bent wheel hub mounting surface	A	Require replacement.
Bent wheel rim, causing vibration	B,2	Suggest replacement. See caution above.
Broken	A	Require replacement.
Cast wheel porous, causing a leak	A	Require repair or replacement.
Clip-on balance weight is incorrect type for wheel rim flange	B,2	Suggest replacement.
Corrosion, affecting structural integrity	A	Require replacement.
Corrosion build-up on wheel hub mounting surface	A	Require repair.

CAUTION: DO NOT attempt to correct a bent wheel rim.

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Cracked	A	Require replacement.
Directional/asymmetrical wheels mounted incorrectly	B	Require remounting and/or repositioning.
Load capacity less than OEM specifications	B	Require replacement.
Offset mismatched on same axle	B	Require replacement.
Rivets leaking	A	Require replacement.
Run-out beyond OEM specs	B	Require replacement.
Stud holes elongated	A	Require replacement. See note (1)
Welded or brazed repair	B,2	Suggest replacement.
Welds leaking	A	Require replacement.
Wheel hub centering (pilot) hole incorrect	B	Require replacement.

NOTE: (1) Inspect wheel attaching hardware for damage.

END OF ARTICLE

* SUSPENSION UNIFORM INSPECTION GUIDELINES *

Article Text

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For Volkswagen Technical Site

Saturday, March 18, 2000 10:16PM

ARTICLE BEGINNING

GENERAL INFORMATION
Steering & Suspension Systems - (Including Wheels & Tires)

All Makes & Models

Updated: January, 1997

MAP UNIFORM INSPECTION GENERAL GUIDELINES

OVERVIEW OF MOTORIST ASSURANCE PROGRAM

The Motorist Assurance Program (MAP) is the consumer outreach effort of the Automotive Maintenance and Repair Association, Inc. (AMRA). Participation in the Motorist Assurance Program is drawn from retailers, suppliers, independent repair facilities, vehicle manufacturers and industry associations.

The Motorist Assurance Program was established as an industry-wide effort to address concerns raised by regulators, the media and consumers questioning our ethics and methods of doing business. The automotive repair industry had been bombarded by months of negative stories in the media and scrutiny from state and federal regulators who focused on how the need for repairs is determined. MAP was formed as an industry response to this issue.

Our mission is to strengthen the relationship between the consumer and the auto repair industry. We produce materials that give motorists the information and encouragement to take responsibility for their vehicles - through proper, manufacturer-recommended, maintenance. We encourage participatinf service and repair shops (including franchisees and dealers) to adopt a Pledge to their Customers and the Motorist Assurance Program developed Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service which demonstrates to their customers that they are serious about customer satisfaction.

These Standards of Service require that an inspection of the vehicle's (problem) system be made according to industry guidelines. After learning that neither the car manufacturers nor any other source had complete guidelines, leading industry organizations, along with other industry participants banded together to address this challenging task. During the past two and a half years, they successfully developed industry inspection guidelines for the following systems: Exhaust, Brakes, ABS, Steering and Suspension, Engine Maintenance and Performance, HVAC, and Electrical systems. Guidelines for Drive Train and Transmision are currently being promulgated. Revisions to the inspection guidelines for Exhaust, Brakes/ABS and Steering and Suspension Systems, which were issued two years ago, are now being published for implementation beginning spring 1997. Participating shops utilize these Uniform Inspection Guidelines as part of the inspection process and for communicating their findings to their customers.

* SUSPENSION UNIFORM INSPECTION GUIDELINES *

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The Motorist Assurance Program continues to work cooperatively and proactively with government agencies and consumer groups toward solutions that both benefit the customer and are mutually acceptable to both regulators and industry. We maintain the belief that industry must retain control over how we conduct our business, and we must be viewed as part of the solution and not part of the problem. Meetings with state and other government officials concerned with auto repair and/or consumer protection are conducted. Feedback from these representatives are brought back to members, and the program adjusted as needed.

To assure auto repair customers recourse if they were not satisfied with a repair transaction, the Motorist Assurance Program offers arbitration through MAP/BBB-CARE in cooperation with the Council of Better Business Bureaus and individual participating Bureaus. MAP "piloted" in Indianapolis and Pittsburgh during spring, 1996 - and publicized "roll-outs" in New Jersey, Detroit (MI), Chicago (IL) and Richmond (VA) were conducted. To put some "teeth" in the program, and accreditation requirement for shops was initiated. The requirements are stringent and a self-policing method has been incorporated which includes the "mystery shopping" of outlets. In addition, a committee of service providers had been working diligently developing standards for newspaper, television and Internet advertising.

We welcome you to join us as we continue our outreach ... with your support, both the automotive repair industry and your customers will reap the benefits. Please visit MAP at our Internet site: www.hunter.com/map.htm or contact us at:

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Washington, D.C. 20006
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OVERVIEW OF SERVICE REQUIREMENTS & SUGGESTIONS

It is MAP policy that all exhaust, brake, ABS, steering and suspension, wheel alignment, tires and wheels, driveline, engine performance and maintenance and heating, ventilation and air conditioning services be offered and performed under the guidelines and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be required or suggested. In addition, suggestions may be made to satisfy the needs expressed by the customer.

This section lists the various parts and conditions that indicate required or suggested service or part replacement. Although this list is extensive, it is not inclusive. In addition to this list, a technician may make a suggestion. This suggestion must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

* Example: An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.

* Example: A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or to address a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may only be to suggest service.

* Example: An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.

* Example: The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a customer declines to authorize a service or repair indicated in the MAP Uniform Inspection Guidelines as "required," a MAP shop may refuse service on that system, if proceeding with the work could create or continue an unsafe or unsatisfactory condition.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the Uniform Inspection Guidelines that follow.

PART REPLACEMENT CODE IDENTIFICATION

NOTE: Refer to the following tables for definitions of the codes listed in the condition/procedure tables for the specific components that may need to be replaced.

A - PART NO LONGER PERFORMS INTENDED PURPOSE

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
A - Part no longer performs intended purpose	1 - Part is close to the end of its useful life (just above discard specifications, or weak; failure likely to occur soon, etc.)

B - PART DOES NOT MEET DESIGN SPEC., REGARDLESS OF PERFORMANCE

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
B - Part does not meet a design specification (regardless of performance)	2 - To address a customer need, convenience, or request (to stiffen ride, enhance performance, eliminate noise etc.)

C - PART IS MISSING

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
C - Part is missing	3 - To comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM)
	4 - Technician's recommendation based on substantial and informed experience

STEERING & SUSPENSION

SERVICE PROCEDURES REQUIRED & SUGGESTED FOR PROPER VEHICLE OPERATION

Steering and suspension are complex systems made up of a variety of interdependent components. For proper vehicle handling, ride, and tire wear, a thorough inspection is required whenever suspension work is being performed.

Conditions listed assume that the problem has been isolated to the specific component by proper testing procedures.

NOTE: When replacing steering and/or suspension components which may affect an alignment angle, you are required to check and adjust alignment as needed. Refer to the OEM specifications.

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CAUTION: DO NOT use ride height altering or load compensating components, such as variable rate springs and coil over shocks, on vehicles with height or load sensing proportioning valve-equipped braking systems, unless these components are original equipment.

AIR RIDE SUSPENSION

NOTE: Depending on the air suspension design, there are some aftermarket products available to eliminate the air ride suspension on certain vehicles. If the system has been eliminated with one of these products, then no service is suggested or required.

AIR RIDE SUSPENSION - AIR SHOCKS & AIR STRUTS

NOTE: This section covers the air spring portion of the air shock or strut. For dampening portion of shock or strut conditions and procedures, refer to the "Shock Absorbers, Strut Cartridges, and Strut Assemblies" section.

AIR RIDE SUSPENSION - AIR SHOCKS & AIR STRUTS

Condition	Code	Procedure
Inner fabric of air bag damaged	A	Require replacement.
Leaking	A	Require repair or replacement.
Outer covering of air bag is cracked to the extent that inner fabric of air bag is visible	A,1	Suggest replacement.

AIR RIDE SUSPENSION - AIR SPRING VALVES

AIR RIDE SUSPENSION - AIR SPRING VALVES

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.

Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Blocked	A	Require repair or replacement.
Connector bent	A	Require repair or replacement.
Connector broken	A	Require replacement.
Connector loose	A	Require repair or replacement.
Inoperative	A	Require repair or replacement.
Leaking	A	Require repair or replacement.
Restricted	A	Require repair or replacement.

AIR RIDE SUSPENSION - AIR SPRINGS

AIR RIDE SUSPENSION - AIR SPRINGS

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware incorrect	A	Require replacement of incorrect part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Collar cracked	A	Require replacement.
End cap cracked	A	Require replacement.
Inner fabric of bag damaged	A	Require replacement.
Leaking	A	Require repair or replacement.

Outer covering of air bag is cracked to the extent that inner fabric of air bag is visible	A,1	Suggest replacement.
Piston cracked	A	Require replacement.

AIR RIDE SUSPENSION - COMPRESSORS

AIR RIDE SUSPENSION - COMPRESSORS

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part.
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Connector bent	A	Require repair or replacement.
Connector broken	A	Require replacement.
Connector loose	A	Require repair or replacement.
Does not build pressure	A	Further inspection required. See note (1) below.
Excessive run time	B	Further inspection required. See note (2) below.
Inoperative	A	Require replacement.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.

NOTE: (1) If failure to build pressure is traced to the compressor,

require replacement.
(2) If excessive run time is traced to the compressor, require replacement.

AIR RIDE SUSPENSION - HEIGHT SENSORS

AIR RIDE SUSPENSION - HEIGHT SENSORS

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part.
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware corroded affecting structural integrity	A	Require replacement of corroded part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)		Require replacement of part with stripped threads.
Dust boot missing	B,2	Suggest replacement. See note (1).
Dust boot split	B,2	Suggest replacement. See note (1).
Dust boot torn	B,2	Suggest replacement. See note (1).
Housing cracked	A	Require replacement.
Lead routing incorrect	B	Require re-routing according to vehicle manufacturer's specs.
Loose	B	Require adjustment to vehicle manufacturer's specifications.
Missing	C	Require replacement.
Output signal incorrect	A	Require repair or replacement.
Wire lead damaged	A	Require repair or replacement.

NOTE: (1) This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.

AIR RIDE SUSPENSION - MODULES

AIR RIDE SUSPENSION - MODULES

Condition	Code	Procedure
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Housing cracked	B,2	Suggest repair or replacement.
Inoperative	A	Require replacement.
Missing	C	Require replacement.

AIR RIDE SUSPENSION - RELAYS (COMPRESSOR)

AIR RIDE SUSPENSION - RELAYS (COMPRESSOR)

Condition	Code	Procedure
Housing cracked	B,2	Suggest replacement. See note (1).
Intermittent	A	Require replacement.
Missing	C	Require replacement.
Output signal incorrect	A	Require replacement.

NOTE: (1) If moisture enters the relay, it can reduce life expectancy or impair function.

AIR RIDE SUSPENSION - SWITCHES (ON/OFF)

AIR RIDE SUSPENSION - SWITCHES (ON/OFF)

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Condition	Code	Procedure
Broken	A	Require replacement.
Missing	C	Require replacement.
Output signal incorrect	A	Require replacement.

AIR RIDE SUSPENSION - TORSION SPRINGS (COUNTER BALANCING)

AIR RIDE SUSPENSION - TORSION SPRINGS (COUNTER BALANCING)

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part.
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware incorrect	A	Require replacement of incorrect part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Broken	A	Require replacement.
Missing	C	Require replacement.

AIR RIDE SUSPENSION - TUBING

AIR RIDE SUSPENSION - TUBING

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part.
Attaching hardware loose	A	Require repair or replacement of loose part.

Attaching hardware missing	C	Require replacement of missing part.
Blocked	A	Require repair or replacement.
Fitting incorrect	B	Require replacement.
Leaking	A	Require repair or replacement.
Line type incorrect	B	Require replacement.
Missing	C	Require replacement.
Restricted	A	Require repair or replacement.
Routed incorrectly	B	Require routing correction.

AIR RIDE SUSPENSION - WARNING LAMPS

AIR RIDE SUSPENSION - WARNING LAMPS

Condition	Code	Procedure
Bulb burned out	A	Require replacement.
Warning light does not come on during bulb check		
Warning light flashes		
Warning light is intermittent		Further inspection required to determine cause.
Warning light stays on after initial bulb check		

AIR RIDE SUSPENSION - WIRING HARNESSES

AIR RIDE SUSPENSION - WIRING HARNESSES

Condition	Code	Procedure
Connector bent	A	
Connector broken	A	
Connector loose	A	Require repair or replacement.
Damaged (cut, burned, or chafed)	A	

Excessive resistance	B	
Fuse blown	A	
Fusible link blown	A	Require replacement.
Open	A	
Poor ground	A	Require repair or replacement.
Routed incorrectly	B	Require re-routing according to vehicle manufacturer's specs.
Shorted	A	
Terminal bent	A	
Terminal broken	A	Require repair or replacement.
Terminal corroded	A	
Terminal loose	A	

BALL JOINTS

Before requiring or suggesting ball joint replacement, the approved OEM procedure must be used to measure ball joint wear. The measurement(s) obtained, along with the vehicle manufacturer's specifications, must be noted on the inspection report. Some states require that these measurements also appear on the invoice.

NOTE: The term "perceptible movement," defined as any visible movement in any direction, has been the industry standard for determining the need for replacement of follower ball joints. Some vehicle manufacturers are now publishing specifications for follower ball joints that were previously diagnosed by the "perceptible movement" standard. Before requiring or suggesting any parts be replaced based on "perceptible movement," consult your repair manual to determine if OEM specifications exist.

You are not required to replace ball joints in axle sets. However, when replacing a ball joint due to wear exceeding manufacturer's specification, you may suggest replacement of the other ball joint if its measurement shows it is close to the end of its useful life, for preventive maintenance.

BALL JOINTS

Condition	Code	Procedure

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Attaching hardware bent	B	Require repair or replacement of bent part if available; otherwise, replace ball joint.
Attaching hardware broken	A	Require replacement of broken part if available; otherwise, replace ball joint.
Attaching hardware corroded affecting structural integrity	A	Require replacement of broken part if available; otherwise, replace ball joint.
Attaching hardware incorrect	A	Require replacement of incorrect part if available; otherwise, replace ball joint.
Attaching hardware loose	A	Require repair or replacement of loose part if available; otherwise, replace ball joint.
Attaching hardware missing	C	Require replacement of missing part if available; otherwise, replace ball joint.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads if available; otherwise, replace ball joint.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads if available; otherwise, replace ball joint.
Binding	A	Further inspection required. See note (1) below.
Grease boot cracked	B,2	Suggest replacement. See note (2).
Grease boot missing	B,2	Suggest replacement. See note (3).
Grease boot torn	B,2	Suggest replacement. See note (4).
Grease fitting broken	A	Require replacement of grease fitting.
Grease fitting missing	C	Require replacement of grease fitting.
Grease fitting won't seal	A	Require replacement of grease fitting.

Greaseable ball joint will not take grease	B,2	Suggest replacement of grease fitting. See note (5) below.
Nut on ball joint loose	A	Require repair or replacement. See note (6) below.
Pre-load adjustment incorrect	B	Require repair or replacement.
Seized	A	Require replacement.
Stud bent	B	Require replacement. See note (7).
Stud broken	A	Require replacement. See note (7).
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement. See note (7).
Wear exceeds manufacturer's specifications	B	Require replacement.

NOTE: (1) If greaseable, grease ball joint. If problem persists or joint is non-greaseable, require replacement.
(2) Cracked grease boot will allow contaminants to enter the ball joint and will accelerate wear.
(3) Lack of grease boot will allow contaminants to enter the ball joint and will accelerate wear.
(4) Torn grease boot will allow contaminants to enter the ball joint and will accelerate wear.
(5) If the greaseable ball joint still will not take grease after replacing the grease fitting, suggest replacement of ball joint.
(6) Check for bent stud or damaged taper hole.
(7) Check for damaged taper hole.

BUSHINGS

BUSHINGS

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part if available; otherwise, replace bushing.
Attaching hardware broken	A	Require replacement of broken part if available; otherwise, replace bushing.

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Attaching hardware corroded affecting structural integrity	A	Require replacement of corroded part if available; otherwise, replace bushing.
Attaching hardware incorrect	A	Require replacement of incorrect part if available; otherwise, replace bushing.
Attaching hardware loose	A	Require repair or replacement of loose part if available; otherwise, replace bushing.
Attaching hardware missing	C	Require replacement of missing part if available; otherwise, replace bushing.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads if available; otherwise, replace bushing.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads if available; otherwise, replace bushing.
Binding	A	Require repair or replacement.
Deteriorated, affecting performance	A	Require repair or replacement.
Distorted, affecting performance	A	Require repair or replacement.
Leaking (fluid-filled type)	A	Require replacement.
Missing	A	Require replacement.
Noisy	B,2	Further inspection required. See note (1) and caution below.
Rubber separating from internal metal sleeve on bonded bushing	A	Require replacement.
Seized	A	Require replacement.
Shifted (out of position)	B	Require repair or replacement.
Split	A	Require replacement.
Surface cracking (weather-checked)		No service suggested or required.

NOTE: (1) If noise isolated to bushing, suggest repair or replacement.

CAUTION: Use only approved lubricant on rubber bushings. Petroleum-based lubricants may damage rubber bushings.

CENTER LINKS

CENTER LINKS

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace center link.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace center link.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace center link.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace center link.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace center link.
Bent	B	Require replacement.
Binding	A	Further inspection required. See note (1) below.
Grease boot cracked	B,2	Suggest replacement. See note (2).
Grease boot missing	B,2	Suggest replacement. See note (3).
Grease boot torn	B,2	Suggest replacement. See note (4).
Grease fitting broken	A	Require replacement of grease fitting.
Grease fitting missing	C	Require replacement of grease fitting.
Grease fitting won't seal	A	Require replacement of grease

	³	³	fitting.
Grease seal missing	³	B,2 ³	Suggest replacement. See note (5).
Grease seal torn	³	B,2 ³	Suggest replacement. See note (6).
Looseness (perceptible horizontal movement)	³	A,1 ³	Suggest replacement. See note (7).

CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.

Looseness that is excessive	³	B ³	Require replacement. See notes (8) and (9), caution below.

CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.

Seized	³	A ³	Require replacement.
Stud bent	³	B ³	Require replacement. See note (10)
Stud broken	³	A ³	Require replacement. See note (10)
Stud loose in taper hole	³	A ³	Require repair or replacement. See note (10) below.
Taper hole elongated	³	A ³	Require replacement. See note (11)
Threads damaged	³	A ³	Require repair or replacement.
Threads stripped (threads missing)	³	A ³	Require replacement. See note (10)
Wear exceeds manufacturer's specifications	³	B ³	Require replacement.

NOTE: (1) If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.
(2) Cracked grease boot will allow contaminants to enter the joint and will accelerate wear.
(3) Lack of grease boot will allow contaminants to enter the joint and will accelerate wear.
(4) Torn grease boot will allow contaminants to enter the joint and will accelerate wear.
(5) Lack of grease seal will allow contaminants to enter the joint and will accelerate wear.
(6) Torn grease seal will allow contaminants to enter the joint and will accelerate wear.
(7) If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.

(8) Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity.
(9) If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.
(10) Check for damaged taper hole.
(11) Check for damaged stud.

CONTROL ARM SHAFTS

CONTROL ARM SHAFTS

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace shaft.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace shaft.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace shaft.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace shaft.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace shaft.
Bent	B	Require replacement.
Shaft bushing surface undersized (worn)	B	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

CONTROL ARMS

CONTROL ARMS

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part, if available; otherwise, replace control arm.
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace control arm.

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Attaching hardware corroded affecting structural integrity	A	Require replacement of corroded part, if available; otherwise, replace control arm.
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace control arm.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace control arm.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace control arm.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace control arm.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace control arm.
Bent	B	Require replacement.
Bushing hole oversized	B	Require replacement.
Ball joint hole oversized (loose interference or press fit)	B	Further inspection required. See note (1) below.
Corroded, affecting structural integrity	A	Require replacement.
Holes distorted	A	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

NOTE: (1) If oversized ball joint is available, require replacement of ball joint. If oversized ball joint is not available, require replacement of control arm.

DRAG LINKS

DRAG LINKS

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Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace drag link.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace drag link.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace drag link.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace drag link.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace drag link.
Bent	B	Require replacement.
Binding	A	Further inspection required. See note (1) below.
Grease boot cracked	B,2	Suggest replacement. See note (2).
Grease boot missing	B,2	Suggest replacement. See note (3).
Grease boot torn	B,2	Suggest replacement. See note (4).
Grease fitting broken	A	Require replacement of grease fitting.
Grease fitting missing	C	Require replacement of grease fitting.
Grease fitting won't seal	A	Require replacement of grease fitting.
Grease seal missing	B,2	Suggest replacement. See note (5).
Grease seal torn	B,2	Suggest replacement. See note (4).
Looseness (perceptible horizontal movement)	A,1	Suggest replacement. See note (6).

CAUTION: DO NOT use pliers or pry bar to check ball and socket

movement. Use only moderate hand pressure.

Looseness that is excessive	B	Require replacement. See notes (6) and (7), caution below.

CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.

Seized	A	Require replacement.
Stud bent	B	Require replacement. See note (8).
Stud broken	A	Require replacement. See note (8).
Stud loose in taper hole	A	Require repair or replacement. See note (8) below.
Taper hole elongated	A	Require replacement. See note (9).
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement. See note (8).
Wear exceeds manufacturer's specifications	B	Require replacement.

NOTE: (1) If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.
(2) Cracked grease boot will allow contaminants to enter the joint and will accelerate wear.
(3) Lack of grease boot will allow contaminants to enter the joint and will accelerate wear.
(4) Torn grease boot will allow contaminants to enter the joint and will accelerate wear.
(5) Missing grease seal will allow contaminants to enter the joint and will accelerate wear.
(6) If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.
(7) Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity.
(8) Check for damaged taper hole.
(9) Check for damaged stud.

ELECTRONIC RIDE CONTROL SHOCKS & STRUTS

NOTE: This section covers the electronic damping control portion of the electronic shock or strut. For dampening portion of shock or strut conditions and procedures, refer to the "Shock Absorbers, Strut Cartridges, and Strut Assemblies" section.

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ELECTRONIC RIDE CONTROL SHOCKS & STRUTS

Condition	Code	Procedure
Connector bent	A	Require repair or replacement.
Connector broken	A	Require repair or replacement.
Connector loose	A	Require repair or replacement.
Electronic valve control inoperative	B,2	Suggest replacement. See note (1).
Terminal bent	A	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal corroded	A	Require repair or replacement.
Terminal loose	A	Require repair or replacement.

NOTE: (1) It is acceptable to replace with a non-electronically controlled unit, where available.

IDLER ARMS

IDLER ARMS

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace idler arm.
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace idler arm.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace idler arm.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace idler arm.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace idler arm.

Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace idler arm.
Binding	A	Further inspection required. See note (1) below.
Grease boot cracked	B,2	Suggest replacement. See note (2).
Grease boot missing	B,2	Suggest replacement. See note (3).
Grease boot torn	B,2	Suggest replacement. See note (4).
Grease fitting broken	A	Require replacement of grease fitting.
Grease fitting missing	C	Require replacement of grease fitting.
Grease fitting won't seal	A	Require replacement of seal.
Grease seal missing	B,2	Suggest replacement. See note (5).
Grease seal torn	B,2	Suggest replacement. See note (4).
Greaseable joint will not take grease	B,2	Suggest replacement of grease fitting. See note (6) below.
Looseness at frame bracket end	B	Require repair or replacement. See notes (7) and (8) below.
Looseness at link end (perceptible horizontal movement)	A,1	Suggest replacement. See note (7).

CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.

Looseness at link end that is excessive	B	Require replacement. See notes (7) and (9) and caution below.

CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.

Mounted out of position (center link not parallel)	B	Require repositioning.
Nut on stud loose	A	Require repair or replacement. See note (10) below.
Seized	A	Require replacement.

Stud bent	B	Require replacement. See note (11)
Stud broken	A	Require replacement. See note (11)
Taper hole elongated	A	Require replacement. See note (12)
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement. See note (11)
Wear exceeds manufacturer's specifications	B	Require replacement.

NOTE: (1) If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.
(2) Cracked grease boot will allow contaminants to enter joint and will accelerate wear.
(3) Lack of grease boot will allow contaminants to enter joint and will accelerate wear.
(4) Torn grease boot will allow contaminants to enter joint and will accelerate wear.
(5) Missing grease seal will allow contaminants to enter joint and will accelerate wear.
(6) If greaseable joint will not take grease after replacing the grease fitting, suggest replacement of idler arm.
(7) If manufacturer's procedures and specifications exist, use those procedures and specifications; otherwise, use an approved inspection method such as the dry park check.
(8) Looseness is defined as movement that creates excessive toe change.
(9) Excessive looseness is defined as significant enough to affect vehicle handling or structural integrity.
(10) Check for bent stud or damaged taper hole.
(11) Check for damaged taper hole.
(12) Check for damaged stud.

KING PINS

You are not required to replace king pins in axle sets. However, when replacing a king pin due to wear exceeding manufacturer's specifications, you may suggest replacement of the other king pin on the axle if its measurement shows it is close to the end of its useful life.

KING PINS

Condition	Code	Procedure
Bearing balls pitted	A	Require replacement.

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Bearing balls worn	A	Require replacement.
Bearing races pitted	A	Require replacement.
Bearing races worn	A	Require replacement.
Bearing rollers pitted	A	Require replacement.
Bearing rollers worn	A	Require replacement.
Bearing seal bent Bearing seal missing	B,2	Suggest replacement of seal or bearing.
Bearing seal torn	B,2	
Binding	A	Require repair or replacement of affected parts.
End caps missing	C	Require replacement of missing part, if available; otherwise, replace king pin.
End play exceeds specifications	B	Require repair.
Grease fitting broken	A	
Grease fitting missing	C	Require replacement of grease fitting.
Grease fitting won't seal	A	
Locating pins missing	C	Require replacement of missing part, if available; otherwise, replace king pin.
Looseness exceeds manufacturer's specs	B	Require replacement of worn parts.
Seized	A	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.
Will not take grease	B,2	Suggest replacement of grease fitting. See note (1) below.

NOTE: (1) If king pin will not take grease after replacement of grease fitting, suggest replacement of king pin.

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PITMAN ARMS

PITMAN ARMS

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace pitman arm.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace pitman arm.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace pitman arm.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace pitman arm.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace pitman arm.
Bent	B	Require replacement.
Binding	A	Further inspection required. See note (1) below.
Grease boot cracked	B,2	Suggest replacement. See note (2).
Grease boot missing	B,2	Suggest replacement. See note (3).
Grease boot torn	B,2	Suggest replacement. See note (4).
Grease fitting broken	A	Require replacement grease fitting.
Grease fitting missing	C	
Grease fitting won't seal	A	
Grease seal missing	B,2	Suggest replacement of seal. See note (5) below.
Grease seal torn	B,2	Suggest replacement of seal. See note (6) below.

Looseness (perceptible horizontal movement)	A,1	Suggest replacement. See note (7)
CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.		
Looseness that is excessive	B	Require replacement. See notes (7) and (8), caution below.
CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.		
Nut on stud loose	A	Require repair or replacement. See note (9) below.
Seized	A	Require replacement.
Splines damaged	A	Require repair or replacement.
Splines stripped (splines missing)	A	Require replacement.
Stud bent	B	Require replacement. See note (10)
Stud broken	A	Require replacement. See note (10)
Stud loose in taper hole	A	Require repair or replacement. See note (10) below.
Taper hole elongated	A	Require replacement. See note (11)
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement. See note (10)

NOTE: (1) If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.
(2) Cracked grease boot will allow contaminants to enter joint and will accelerate wear.
(3) Lack of grease boot will allow contaminants to enter joint and will accelerate wear.
(4) Torn grease boot will allow contaminants to enter joint and will accelerate wear.
(5) Lack of grease seal will allow contaminants to enter joint and will accelerate wear.
(6) Torn grease seal will allow contaminants to enter joint and will accelerate wear.
(7) If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.
(8) Excessive looseness is defined as being significant enough

to affect vehicle handling or structural integrity.
(9) Check for bent stud of damaged taper hole.
(10) Check for damaged taper hole.
(11) Check for damaged stud.

POWER STEERING HOSES

POWER STEERING HOSES

Condition	Code	Procedure
Blistered	B	Require replacement.
Blocked	A	Require repair or replacement.
Fitting threads damaged	A	Require repair or replacement.
Fitting threads stripped (threads missing)	A	Require replacement.
Inner fabric (webbing) cut	A	Require replacement.
Leaking	A	Require repair or replacement.
Missing	C	Require replacement.
Outer covering is cracked to the extent that the inner fabric of hose is visible	B	Require replacement.
Restricted	A	Require repair or replacement.

POWER STEERING (HYDRAULIC) PUMPS

If diagnosis has determined that complete disassembly is necessary to determine the extent of the system failure, the suggestion may be made to rebuild or replace the power steering pump. Repair or replacement of the following components may be required if performed as part of a power steering pump overhaul or rebuild service to meet a minimum rebuild standard.

POWER STEERING (HYDRAULIC) PUMPS

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part.
Attaching hardware broken	A	Require replacement of broken

		part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Belt alignment incorrect	B	Further inspection required. See note (1) below.
Belt cracked	A,1	Suggest replacement.
Belt frayed	A,1	Suggest replacement.
Belt missing	C	Require replacement.
Belt noisy	B,2	Further inspection required. See note (2) below.
Belt plies separated	A	Require replacement.
Belt tension out of spec	B	Require adjustment or replacement.
Belt worn beyond adjustment range	B	Require replacement.
Belt worn so it contacts bottom of pulley	A	Require replacement.
Binding	A	Require repair or replacement.
Fluid at or beyond service interval	C,3	Suggest fluid change.
Fluid contaminated	B	Require flushing and refilling of the system. See note (3) below.
Fluid level incorrect	B	Require adjustment of fluid level.
Inadequate assist	A	Further inspection required. See note (4) below.
Leaking	A	Require repair or replacement.
Noise	B,2	Further inspection required.

		See note (5) below.
Pulley bent	A	Require repair or replacement of pulley.
Pulley missing	C?	Require replacement of pulley.
Remote reservoir leaking	A	Require replacement of reservoir.
Reservoir cap broken	A	Require replacement of cap.
Reservoir cap missing	C	Require replacement of cap.
Seized	A	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

NOTE: (1) Determine cause of incorrect alignment and require repair.
(2) Determine cause of noise and suggest repair.
(3) Determine and correct source of contamination. OEM specifications must be followed for fluid type.
(4) If pump is source of inadequate assist, require repair or replacement.
(5) If noise is isolated to pump, suggest repair or replacement.

RADIUS ARMS

RADIUS ARMS

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware incorrect	A	Require replacement of incorrect part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.

Bent	B	Require replacement.
Corroded, affecting structural integrity	A	Require replacement.
Holes distorted	A	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

RELAY RODS

RELAY RODS

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace relay rod.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace relay rod.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace relay rod.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace relay rod.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace relay rod.
Bent	B	Require replacement.
Binding	A	Further inspection required. See note (1) below.
Grease boot cracked	B,2	Suggest replacement. See note (2).
Grease boot missing	B,2	Suggest replacement. See note (3).
Grease boot torn	B,2	Suggest replacement. See note (4).

Grease fitting broken	A	
Grease fitting missing	C	Require replacement grease fitting.
Grease fitting won't seal	A	
Grease seal missing	B,2	Suggest replacement. See note (5).
Grease seal torn	B,2	Suggest replacement. See note (6).
Looseness (perceptible horizontal movement)	A,1	Suggest replacement. See note (7).
CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.		
Looseness that is excessive	B	Require replacement. See notes (7) and (8) and caution below.
CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.		
Seized	A	Require replacement.
Stud bent	B	Require replacement. See note (9).
Stud broken	A	Require replacement. See note (9).
Stud loose in taper hole	A	Require repair or replacement. See note (9).
Taper hole elongated	A	Require replacement. See note (10)
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement. See note (9).
Wear exceeds manufacturer's specifications	B	Require replacement.

NOTE: (1) If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.
(2) Cracked grease boot will allow contaminants to enter the joint and will accelerate wear.
(3) Lack of grease boot will allow contaminants to enter the joint and will accelerate wear.
(4) Torn grease boot will allow contaminants to enter the joint and will accelerate wear.
(5) Lack of grease seal will allow contaminants to enter joint and will accelerate wear.
(6) Torn grease seal will allow contaminants to enter joint and

will accelerate wear.
(7) If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.
(8) Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity.
(9) Check for damaged taper hole.
(10) Check for damaged stud.

SHOCK ABSORBERS, STRUT CARTRIDGES, & STRUT ASSEMBLIES

You are not required to replace shocks or struts in axle sets. However, when replacing a shock or strut due to the conditions that follow, you may suggest replacement of the other shock or strut on the same axle for improved performance and preventive maintenance.

* part is close to the end of its useful life
* to extend tire life
* to balance ride and handling
* to improve stopping distance

When replacing steering and/or suspension components which may affect an alignment angle, you are required to check and adjust alignment as needed. Refer to the OEM specifications.

Under no circumstances should a technician bend struts or strut housings.

A vehicle's load-carrying and handling abilities are limited by its suspension, tires, brakes, and driveline. Installing coil over shocks or any other load assist device does not increase the vehicle's load capacity. See the vehicle owner's manual for more details.

NOTE: If vehicle is equipped with original equipment coil over shocks, apply the conditions for coil springs from the "Springs: Coil, Leaf, and Torsion Bar" section of the Steering and Suspension guidelines. If the vehicle is equipped with add-on coil over shocks, you may suggest replacing the shocks with standard shocks for any spring-related condition.

SHOCK ABSORBERS, STRUT CARTRIDGES, & STRUT ASSEMBLIES

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part, if available; otherwise, replace shock or strut.
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace shock or strut.

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Attaching hardware corroded affecting structural integrity	A	Require replacement of corroded part, if available; otherwise, replace shock or strut.
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace shock or strut.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace shock or strut.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace shock or strut.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace shock or strut.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace shock or strut.
Binding	A	Require replacement.
Body dented	A	Further inspection required. See note (1) below.
Body punctured	A	Require replacement.
Brake hose bracket bent	B	Require repair or replacement.
Brake hose bracket missing	C	Require replacement.
Brake hose bracket threads damaged	C	Require repair or replacement.
Brake hose bracket threads stripped (threads missing)	C	Require replacement.
Compression bumper missing	C	Require replacement of compression bumper.
Compression bumper split	A,1	Suggest replacement of compression bumper.
Damping (none)	A	Require replacement.
Dust boot (bellows) split	B,2	Suggest replacement of boot. See note (2) below.

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Dust boot (bellows) missing	B,2	Suggest replacement of boot. See (3) note below.
Dust boot (bellows) torn	B,2	Suggest replacement of boot. See note (4) below.
Dust shield broken	B,2	Suggest replacement. See note (4).
Dust shield missing	B,2	Suggest replacement. See note (4).
Gland nut (strut housing cap) is not removable using appropriate tool	A	Require replacement of nut and/or housing. See note (5) below.
Gland nut (strut housing cap) threads damaged	A	Require repair or replacement of nut.
Gland nut (strut housing cap) threads stripped (threads missing)	A	Require replacement of nut.
Housing dented	A	Further inspection required. See note (6) below.
Housing punctured	A	Require replacement.
Jounce bumper missing	C	Require replacement of jounce bumper.
Jounce bumper split	1?	Suggest replacement of jounce bumper.
Leaking oil, enough for fluid to be running down the body	A	Require replacement. See caution below.

CAUTION: If the strut cartridge has been replaced previously, the oil on the strut housing may be filler oil. The technician must identify the source of the oil.

Noise	B,2	Further inspection required. See note (7) below.
Piston rod bent	A	Require replacement.
Piston rod broken	A	Require replacement.
Piston rod has surface defect	B,2	Suggest replacement.
Piston rod threads damaged	A	Require repair or replacement.

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Piston rod threads stripped (threads missing)	A	Require replacement.
Seized	A	Require replacement.
Shock missing	C	Require replacement.
Strut housing bent	A	Require replacement.
Strut housing cap (gland nut) is not removable using appropriate tool	A	Require replacement of nut and/or housing. See note (5) below.
Strut housing cap (gland nut) threads damaged	A	Require repair or replacement of nut.
Strut housing cap (gland nut) threads stripped (threads missing)	A	Require replacement of nut.
Strut housing severely corroded, affecting structural integrity	A	Require replacement.
Strut housing threads damaged	A	Require repair or replacement.
Strut housing threads stripped (threads missing)	A	Require replacement.
Tire cupping	A	Further inspection required. See note (8) below

NOTE: (1) Require replacement of units where dents restrict shock or strut piston rod movement. If dents don't restrict movement, no service is suggested or required. Especially critical on mono-tube shocks.
(2) This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.
(3) This condition can lead to damage of the piston rod, which causes piston rod seal wear.
(4) This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.
(5) Only required if replacing cartridge.
(6) Require replacement of units where dents restrict shock or strut piston rod movement. If dents don't restrict movement, no service is suggested or required. Especially critical on mono-tube shocks.
(7) If noise is isolated to shock or strut, suggest replacement.
(8) Although shocks or struts may have contributed to tire cupping, an inspection is needed of the entire suspension

system. If the shock or strut is found to be contributing to the tire cupping, require replacement.

SPINDLES

SPINDLES

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Bent	B	Require replacement.
Broken	A	Require replacement.
Race seat area undersized	B	Require replacement.
Scored	A	Require repair or replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

SPRINGS: COIL, LEAF, & TORSION BAR

When springs are replaced, it is suggested, but not required, that both springs on an axle be replaced to maintain equal height from side to side and to provide a balanced ride and proper handling.

When variable rate springs are installed in place of conventional coil springs, they must be installed in axle sets to ensure proper handling, uniform ride, and proper chassis height.

Erroneous height measurements may result from: improper tire inflation, non-standard tire or wheel size, and heavy load in vehicle or trunk.

SPRINGS: COIL, LEAF, & TORSION BAR

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Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part.
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware corroded affecting structural integrity	A	Require replacement of corroded part.
Attaching hardware incorrect	A	Require replacement of incorrect part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Broken (all springs except secondary leave(s) on multi-leaf springs)	A	Require replacement.
Coil clash		Require ride height check. See note (1) below.
Coil spring insulator deteriorated	B,2	Suggest replacement of insulator.
Coil spring insulator missing	B,2	Suggest replacement of insulator.
Coil spring insulator split	B,2	Suggest replacement of insulator.
Coil spring plastic coating deteriorated - rust present	A	Refer to manufacturer's service requirements. See note (2) below.
Composite spring damaged	A	Further inspection required. See note (3) below.
Cracked (all springs except composite leaf and secondary leave(s) on	A	Require replacement.

multi-leaf springs)		
Installed incorrectly	B	Require repair.
Leaf spring insulators missing	B,2	Suggest replacement of insulators.
Secondary leaf on multi-leaf spring broken	A,1	Suggest repair or replacement
Secondary leaf on multi-leaf spring cracked	A,1	Suggest repair or replacement
Torsion bar adjuster bent	A	Require repair or replacement of adjuster. See note (4) below.
Torsion bar adjuster seized	A	Require repair or replacement of adjuster. See note (4) below.
Torsion bar adjuster threads damaged	A	Require repair or replacement of part with damaged threads. See note (4) below.
Torsion bar adjuster threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Vehicle suspension height not within OEM specs	B	Require adjustment or replacement.

NOTE: (1) If vehicle is within manufacturer's height specifications, no service is suggested or required.
(2) Some manufacturers require replacement under these conditions.
(3) Check vehicle ride height. If ride height is OK, no service is suggested or required.
(4) Only required if ride height needs to be adjusted.

STEEL POWER STEERING LINES

CAUTION: When replacing steel power steering lines, be sure to use a replacement product that meets or exceeds OEM design specifications.

STEEL POWER STEERING LINES

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part.

Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Blocked	A	Require repair or replacement.
Fitting incorrect (such as compression fitting)	B	Require replacement.
Flare type incorrect	B	Required replacement.
Leaking	A	Require tightening or replacement.
Line type incorrect	B	Require replacement.
Restricted	A	Require replacement.
Routed incorrectly	B	Require routing correction.
Rust-pitted	A,1	Suggest replacement.
Rust pitted affecting structural integrity	A	Require replacement.

STEERING ARMS

STEERING ARMS

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part.
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware incorrect	A	Require replacement of incorrect part.
Attaching hardware loose	A	Require repair or replacement of

		loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Bent	B	Require replacement.
Broken	A	Require replacement.
Taper hole elongated	A	Require replacement. See note (1).
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

NOTE: (1) Check for damaged stud.

STEERING DAMPERS

The following procedures are only required if the vehicle was originally equipped from the factory with a steering damper. If the steering damper is an add-on unit, then the unit may be removed instead of repairing or replacing.

STEERING DAMPERS

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part, if available; otherwise, replace steering damper.
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace steering damper.
Attaching hardware corroded affecting structural integrity	A	Require replacement of corroded part, if available; otherwise, replace steering damper.
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace steering damper.

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Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace steering damper.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace steering damper.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace steering damper.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace steering damper.
Binding	A	Require replacement.
Damper body dented	A	Further inspection required. See note (1) below.
Damper body punctured	A	Require replacement.
Damping (none)	A	Require replacement.
Dust boot (bellows) missing	B,2	Suggest replacement of boot. See note (2) below.
Dust boot (bellows) split	B,2	Suggest replacement of boot. See note (2) below.
Dust shield broken	B,2	Suggest replacement. See note (2).
Dust shield missing	B,2	Suggest replacement. See note (2).
Leaking oil, enough for fluid to be running down the body	A	Require replacement.
Loose	A	Require repair or replacement.
Missing	C	Require replacement.
Noise	B,2	Further inspection required. See note (3) below.
Piston rod bent	A	Require replacement.

Piston rod broken	A	Require replacement.
Piston rod has surface defect	B,2	Suggest replacement.
Piston rod threads stripped (threads missing)	A	Require replacement.
Piston rod threads damaged	A	Require repair or replacement.
Seized	A	Require replacement.

NOTE: (1) Require replacement of units where dents restrict damper piston rod movement. If dents don't restrict movement, no service is suggested or required. Especially critical on mono-tube dampers.
(2) This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.
(3) If noise is isolated to damper, suggest replacement.

STEERING GEARS (EXCEPT RACK & PINION)

If diagnosis has determined that complete disassembly is necessary to determine the extent of the system failure, the suggestion may be made to rebuild or replace the power steering pump. Repair or replacement of the following components may be required, if performed as part of a power steering pump overhaul or rebuild service to meet a minimum rebuild standard.

STEERING GEARS (EXCEPT RACK & PINION)

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Binding	A	Require repair or replacement
Flex coupler binding	A	Require repair or replacement of

		coupler.
Flex coupler loose	A	Require repair or replacement of coupler.
Flex coupler missing parts	A	Require repair or replacement of coupler.
Flex coupler soft/spongy	A	Require replacement of coupler.
Flex coupler torn	A	Require replacement of coupler.
Fluid contaminated	B	Require flushing and refilling of the system. See note (1) below.
Gasket leaking	A	Require repair or replacement of gasket.
Housing leaking	A	Require replacement.
Hydraulic fittings leaking	A	Require repair or replacement of fittings.
Inadequate power assist	A	Further inspection required. See note (2) below.
Lash exceeds manufacturer's specifications	B	Require repair or replacement.
Seal leaking	A	Require repair or replacement of seal and/or mating part.
Splines damaged	A	Require repair or replacement of splines.
Splines stripped	A	Require replacement of splines.
Steering coupler shield cracked	B,2	Suggest replacement.
Steering coupler shield missing	C	Require replacement.
Threads damaged	A	Require repair or replacement of part with damaged threads.
Threads stripped (threads missing)	A	Require replacement of part with stripped threads.
U-joint binding	A	Require repair or replacement of joint.

U-joint loose	A	Require repair or replacement of joint.
Unequal power assist	A	Require repair or replacement.

NOTE: (1) Determine and correct source of contamination. OEM specifications must be followed for fluid type.
(2) If steering gear is source of inadequate assist, require repair or replacement.

STEERING GEARS: RACK & PINION

If diagnosis has determined that complete disassembly is necessary to determine the extent of the system failure, the suggestion may be made to rebuild or replace the power steering pump. Repair or replacement of the following components may be required, if performed as part of a power steering pump overhaul or rebuild service to meet a minimum rebuild standard.

STEERING GEARS: RACK & PINION

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Balance tube blocked	A	Require repair or replacement of balance tube.
Balance tube missing	C	Require replacement of balance tube.
Balance tube restricted	A	Require repair or replacement of balance tube.
Bellows boot clamp missing	C	Require replacement of clamp.
Bellows boot cracked (not through)	B,2	Suggest replacement of bellows boot.

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Bellows boot missing	C	Require replacement of bellows boot.
Bellows boot not sealing	A	Require repair or replacement of bellows boot.
Bellows boot torn	A	Require replacement of bellows boot.
Bellows boot twisted (from toe adjustment)	B	Require repair.
Fitting leaking	A	Require repair or replacement.
Fitting missing	A	Require replacement of fitting.
Fitting threads damaged	A	Require repair or replacement of part with damaged threads.
Fitting threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Flex coupler binding	A	Require repair or replacement of coupler.
Flex coupler loose	A	Require repair or replacement of coupler.
Flex coupler missing parts	A	Require repair or replacement of coupler.
Flex coupler soft/spongy	A	Require replacement of coupler.
Flex coupler torn	A	Require replacement of coupler.
Fluid contaminated	B	Require flushing and refilling of the system. See note (1) below.
Gasket leaking	A	Require repair or replacement.
Hard steering on cold start-up	A,1	Suggest repair or replacement. See note (2) below.
Housing cracked, affecting structural integrity	B	Require replacement.
Housing leaking	A	Require replacement.
Inadequate power assist	A	Further inspection required. See note (3) below.

Lash exceeds manufacturer's specifications	B		Require repair or replacement.
Seal leaking	A		Require repair or replacement.
Splines damaged	A		Require repair or replacement.
Splines stripped (splines missing)	A		Require replacement.
Steel line blocked	A		Require repair or replacement of line.
Steel line leaking	A		
Steel line missing	C		Require replacement of line.
Steel line restricted	A		Require repair or replacement of line.
Steering coupler shield cracked	B,2		Suggest replacement.
Steering coupler shield missing	C		Require replacement.
Steering coupler shield torn	B,2		Suggest replacement.
Threads damaged	A		Require repair or replacement of part with damaged threads.
Threads stripped (threads missing)	A		Require replacement of part with stripped threads.
U-joint binding	A		Require repair or replacement of joint.
U-joint loose	A		Require repair or replacement of joint.
Unequal power assist	A		Require repair or replacement.

NOTE: (1) Determine and correct source of contamination. Follow OE specifications for fluid type.
(2) Indicates internal wear.
(3) If steering gear is source of inadequate assist, require repair or replacement.

STEERING KNUCKLES

STEERING KNUCKLES

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Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part.
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware incorrect	A	Require replacement of incorrect part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Bent	B	Require replacement.
Broken	A	Require replacement.
Pinch bolt incorrect	B	Require replacement with bolt that meets OE design.
Pinch bolt loose	B	Require repair.
Pinch bolt missing	B	Require replacement.
Pinch bolt tabs deformed (pinched together), .032" or more before clamping	B	Require replacement. See note (1) below.
Taper hole elongated	A	Require replacement. See note (2).
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require repair or replacement.

NOTE: (1) Steering knuckle deformation can cause pinch bolt breakage.
(2) Check for damaged stud.

STRIKE OUT BUMPERS

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STRIKE OUT BUMPERS

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part.
Attaching hardware corroded affecting structural integrity	A	Require replacement of corroded part.
Attaching hardware loose	A	Require repair or replacement of loose part.
Attaching hardware missing	C	Require replacement of missing part.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads.
Missing	C	Require replacement.
Split	A,1	Suggest replacement.

STRUT RODS

STRUT RODS

Condition	Code	Procedure
Adjusting nut seized	A	Require repair or replacement. See note (1) below.
Attaching hardware bent	B	Require repair or replacement of bent part, if available; otherwise, replace strut rod.
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace strut rod.
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace strut rod.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace strut rod.

Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace strut rod.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace strut rod.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace strut rod.
Attaching (mating) hole oversized	A	Require repair or replacement of frame.
Attaching point on frame corroded, affecting structural integrity	A	Require repair of frame.
Bent	A	Require replacement.
Mating (attaching) hole oversized	A	Require repair or replacement of frame.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

NOTE: (1) Only required if an alignment is being performed.

STRUT UPPER BEARING PLATE ASSEMBLIES

NOTE: When the following guidelines indicate replacement of bearing, only the bearing should be replaced if it is available separately; otherwise, replace the bearing plate assembly.

STRUT UPPER BEARING PLATE ASSEMBLIES

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace bearing plate assembly.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace bearing plate

		assembly.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace bearing plate assembly.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace bearing plate assembly.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace bearing plate assembly.
Bearing axial or radial movement exceeds vehicle manufacturer's specs	B	Require replacement of bearing.
Bearing binding	A	Require replacement of bearing.
Bearing missing	C	Require replacement of bearing.
Bearing seized	A	Require replacement of bearing.
Bent	B	Require replacement.
Holes distorted	A	Require replacement.
Missing	C	Require replacement.
Severely corroded, affecting structural integrity	A	Require replacement.

SWAY BAR LINKS

SWAY BAR LINKS

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace link.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace link.
Attaching hardware missing	C	Require replacement of missing

		part, if available; otherwise, replace link.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace link.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace link.
Ball and socket has looseness (perceptible vertical movement)	A,1	Suggest replacement. See note (1).

CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.

Ball and socket has looseness that is excessive	B	Require replacement. See notes (1) and (2) and caution.
Bent	B	Require replacement.
Broken	A	Require replacement.
Corroded, affecting structural integrity	A	Require replacement.
Grease boot cracked	B,2	Suggest replacement. See note (3).
Grease boot missing	B,2	Suggest replacement. See note (4).
Grease boot torn	B,2	Suggest replacement. See note (5).
Missing	C	Require replacement.
Nut on stud loose	A	Require repair. See note (6).
Stud bent	B	Require replacement. See note (7).
Stud broken	A	Require replacement. See note (7).
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement. See note (7).

NOTE: (1) If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.

(2) Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity.
(3) Cracked grease boot will allow contaminants to enter the joint and will accelerate wear.
(4) Lack of grease boot will allow contaminants to enter the joint and will accelerate wear.
(5) Torn grease boot will allow contaminants to enter the joint and will accelerate wear.
(6) Check for bent stud or damaged taper hole.
(7) Check for damaged taper hole.

SWAY BARS

SWAY BARS

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace sway bar.
Attaching hardware corroded affecting structural integrity	A	Require replacement of corroded part, if available; otherwise, replace sway bar.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace sway bar.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace sway bar.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace sway bar.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace sway bar.
Bent	B	Require replacement.
Broken	A	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

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TIE ROD ENDS (INNER & OUTER)

TIE ROD ENDS (INNER & OUTER)

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace tie rod end.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace tie rod end.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace tie rod end.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace tie rod end.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace tie rod end.
Adjusting sleeve bent	B	Require replacement of sleeve or tie rod end.
Adjusting sleeve clamps out of position	B	Require repair.
Adjusting sleeve corroded, affecting structural integrity	A	Require replacement of sleeve or tie rod end.
Adjusting sleeve missing	C	Require replacement of sleeve or tie rod end.
Adjusting sleeve seized	A	Require repair or replacement. See note (1) below.
Adjusting sleeve threads damaged	A	Require repair or replacement of sleeve or tie rod end.
Adjusting sleeve threads stripped (threads missing)	A	Require replacement of sleeve or tie rod end.
Binding	A	Further inspection required. See note (2) below.

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Grease boot cracked		Suggest replacement. See note (3).
Grease boot missing		Suggest replacement. See note (4).
Grease boot torn		Suggest replacement. See note (5).
Grease fitting broken	A	Require replacement of grease fitting.
Grease fitting missing	C	Require replacement of grease fitting.
Grease fitting won't seal	A	Require replacement of grease fitting.
Grease seal missing	B,2	Suggest replacement of seal. See note (4) below.
Grease seal torn	B,2	Suggest replacement of seal. See note (5) below.
Greaseable tie rod end will not take grease	B,2	Suggest replacement of grease fitting. See note (6) below.
Looseness (perceptible horizontal movement)	A,1	Suggest replacement. See note (7).
CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.		
Looseness exceeds manufacturer's specs	B	Require replacement.
Looseness that is excessive	B	Require replacement. See notes (7) and (8), caution.
Nut on stud loose	A	Require repair or replacement of nut. See note (9) below.
Seized	A	Require replacement
Stud bent	B	Require replacement. See note (10)
Stud broken	A	Require replacement. See note (10)
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement. See note (10)

NOTE: (1) Only required if toe needs to be adjusted.

(2) If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.
(3) Cracked grease boot will allow contaminants to enter joint and will accelerate wear.
(4) Lack of grease boot will allow contaminants to enter joint and will accelerate wear.
(5) Torn grease boot will allow contaminants to enter joint and will accelerate wear.
(6) If greaseable tie rod end will not take grease after replacing the grease fitting, suggest replacement of tie rod end.
(7) If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.
(8) Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity.
(9) Check for bent stud or damaged taper hole.
(10) Check for damaged taper hole.

TRACK BARS

TRACK BARS

Condition	Code	Procedure
Attaching hardware incorrect	A	Require replacement of incorrect part, if available; otherwise, replace track bar.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace track bar.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace track bar.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace track bar.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace track bar.
Bent	B	Require replacement.
Corroded, affecting structural integrity	A	Require replacement.

Grease boot cracked	B,2	Suggest replacement. See note (1).
Grease boot missing	B,2	Suggest replacement. See note (2).
Grease boot torn	B,2	Suggest replacement. See note (3).
Holes distorted	A	Require replacement.
Looseness (perceptible horizontal movement)	A,1	Suggest replacement. See note (4) below.
CAUTION: DO NOT use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.		
Looseness that is excessive	B	Require replacement. See notes (4) and (5), caution.
Nut on stud loose	A	Require repair or replacement of nut. See note (6) below.
Seized	A	Require replacement.
Stud bent	B	Require replacement. See note (7).
Stud broken	A	Require replacement. See note (7).
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement. See note (7).
Wear exceeds manufacturer's specifications	B	Require replacement.

NOTE: (1) Cracked grease boot will allow contaminants to enter joint and will accelerate wear.
(2) Lack of grease boot will allow contaminants to enter joint and will accelerate wear.
(3) Torn grease boot will allow contaminants to enter joint and will accelerate wear.
(4) If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.
(5) Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity.
(6) Check for bent stud or damaged taper hole.
(7) Check for damaged taper hole.

TRAILING ARMS

TRAILING ARMS

Condition	Code	Procedure
Attaching hardware broken	A	Require replacement of broken part, if available; otherwise, replace trailing arm.
Attaching hardware loose	A	Require repair or replacement of loose part, if available; otherwise, replace trailing arm.
Attaching hardware missing	C	Require replacement of missing part, if available; otherwise, replace trailing arm.
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads, if available; otherwise, replace trailing arm.
Attaching hardware threads stripped (threads missing)	A	Require replacement of part with stripped threads, if available; otherwise, replace trailing arm.
Bent	B	Require replacement.
Bushing hole oversized	B	Require replacement.
Corroded, affecting structural integrity	A	Require replacement.
Holes distorted	A	Require replacement.
Threads damaged	A	Require repair or replacement.
Threads stripped (threads missing)	A	Require replacement.

WHEEL ALIGNMENT

WHEEL ALIGNMENT

Wheel alignment is defined as the measurement, analysis, and adjustment of steering and suspension angles to conform to OEM specifications. These angles usually include, but are not limited to: caster, camber, toe, and thrust angle. Where these angles are not adjustable and not in specification, component replacement or correction kits may be required. Errors in set-back and steering axis inclination (SAI) are often attributable to failed or damaged components and must be corrected prior to performing an alignment.

Failure to replace or correct suggested or required parts or

service may prevent a proper alignment.

Before performing an alignment check, inspect and verify the following:

* Tire pressure and size
* Vehicle loading
* Ride height
* Steering and suspension parts

Only if the inspection reveals that all the above are within published specifications, should a wheel alignment check and an alignment, if needed, be performed.

CAUTION: Under no circumstances should a technician bend or heat any steering or suspension component, unless specified by the vehicle manufacturer, for example, Ford forged twin "I" beam axles. All measurements and suggestions must be noted on the inspection report.

WHEEL ALIGNMENT

Condition	Code	Procedure
Dog tracking, shown to be caused by faulty alignment	B,2	Suggest repair.
Lead, shown to be caused by faulty alignment	B	Require alignment.
Part has been changed that may affect alignment	B	Require alignment check.
Pull, shown to be caused by faulty alignment	B	Require alignment.
Steering wheel off-center	B,2	Suggest alignment.
Tire wear, shown to be caused by faulty alignment	B	Require alignment.
Wander, shown to be caused by faulty alignment	B	Require alignment.

WHEEL BEARINGS, RACES, & SEALS

NOTE: When replacing or repacking wheel bearings, grease seal replacement is required. You are not required to replace these components in axle sets. Determine the need to replace based upon the individual component conditions that follow.

WHEEL BEARINGS, RACES, & SEALS

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Condition	Code	Procedure
Rear axle seal on rear-wheel drive leaking	A	Require replacement of seal and inspection of axle, bearing, housing, and vent tube
Seal bent	A,1	Suggest replacement.
Seal leaking	A	Require replacement of seal and inspection of bearings.
Seal missing	C	Require replacement.
Seal torn	A	Require replacement.
Wheel bearing assembly feels rough when rotated	A	Require replacement of bearing assembly.
Wheel bearing balls are pitted	A	Require replacement of bearing assembly.
Wheel bearing balls are worn	A	Require replacement of bearing assembly.
Wheel bearing end-play exceeds vehicle manufacturer's specs	A	Require adjustment of bearing, if possible. If proper adjustment cannot be obtained, require repair or replacement of worn component.
Wheel bearing race is loose in the hub bore	A	Require replacement of hub assembly and wheel bearings.
Wheel bearing races are pitted	A	Require replacement of bearing assembly.
Wheel bearing races are worn	A	Require replacement of bearing assembly.
Wheel bearing rollers are pitted	A	Require replacement of bearing assembly.
Wheel bearing rollers are worn	A	Require replacement of bearing assembly.

WHEELS & TIRES

TIRES

WARNING: These guidelines do not apply to split rims.

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Some vehicle manufacturers restrict replacement of tires to specific brands, types, or sizes.

High pressure temporary compact spare tires should not be used with any other rims or wheels, nor should standard tires, snow tires, wheel covers, or trim rings be used with high pressure compact spare rims or wheels.

Attempting to mount a tire of one diameter on a wheel of a different diameter or flange type may result in serious injury or death.

Only specially trained persons should de-mount or mount tires. Explosions of tire and wheel assembly can result from improper mounting, possibly causing serious injury or death.

Consult the vehicle owner's manual or vehicle placard for correct size, speed rating, designation, and cold inflation pressure of the original tires. DO NOT exceed the maximum load or inflation capacity of the tire specified by the Tire and Rim Association

When replacing tires, it is suggested that the replacement tires match or exceed the OEM speed rating designation. If tires of different speed rating designations are mixed on the same vehicle, the tires may vary in handling characteristics. DO NOT mix different speed rating designations on the same axle.

DO NOT mix radials with non-radial tires on the same axle, as this may affect vehicle handling and stability. If radial tires and bias or bias-belted ply tires are mixed on the same vehicle, the radials must be on the rear. High-pressure temporary compact spare tires are exempt from this rule.

DO NOT mix size or type (all season, performance, mud and snow) of tires on the same axle.

TIRES

Condition	Code	Procedure
Air pressure incorrect	B	Require repair
Bead broken	A	Require replacement.
Bead leaking, caused by tire	A	Require repair or replacement.
Bead wire/cord exposed	A	Require replacement.
Cord or belt material exposed	A	Require replacement.
Cord ply separations	A	Require replacement.
Directional/asymmetrical tires mounted incorrectly	B	Require remounting and/or repositioning.
Irregular tread wear, affecting performance	A	Suggest replacement. See note (1) below.
Load ratings less than OEM	B	Require replacement.

specifications		
Mixed tire size designations on same axle	A	Require rotation or replacement.
Mixed tread types (all season, performance, mud and snow) on same axle	A	Require rotation or replacement.
Number of punctures exceeds manufacturer's limit	B	Require replacement.
Out of balance	B	Require rebalance of tire/wheel assembly.
Ply separation	A	Require replacement.
Pull or lead, caused by tire	A	Require rotation or replacement.
Radial and bias or bias-belted ply tires on same axle	B	Require rotation or replacement.
Radials are on the front and not on the rear	B	Require rotation or replacement. See note (2).
Run flat damage	A	Require replacement.
Shoulder cut	A	Require replacement.
Shoulder puncture	A	Require replacement.
Shoulder with plug	A	Require replacement.
Sidewall bulge	A	Require replacement.
Sidewall cut	A	Require replacement.
Sidewall indentation		No service required/suggested.
Sidewall puncture	A	Require replacement.
Sidewall with plug	A	Require replacement.
Speed rating designations different on same axle	B	Suggest rotation or replacement.
Tire and wheel assembly has excessive run-out	B	Require repair or replacement of appropriate part. See note (3) below.
Tires with more than 1/4"	B	Require replacement.

diameter difference on a four-wheel drive vehicle		
Tread area puncture larger in diameter than tire manufacturer's specifications	B	Require replacement.
Tread missing pieces (chunking), exposing cord	A	Require replacement.
Tread missing pieces (chunking), not exposing cord	A	Suggest replacement.
Tread separations	A	Require replacement.
Tube in tubeless tire	C,3	Suggest removal of tube. See note (4) below.
Weather-checking		No service required/suggested.
Worn to tread wear indicators	B	Require replacement.

NOTE: (1) Determine and correct cause of irregular tire wear.
(2) If radials and bias or bias-belted ply tires are on the same vehicle, the radials must be on the rear axle, except for high-pressure temporary spares.
(3) Excessive is defined as enough to contribute to performance problems. Match mounting may correct run-out. If not, require replacement of appropriate part. Refer to manufacturer's specifications.
(4) Most manufacturers do not recommend tubes in tubeless tires. Inspect tire and wheel assembly to determine the reason for a tube in tubeless tire. Recommendation for repair or replacement should be based upon condition of tires and/or wheel listed in these guidelines.

VALVE STEMS

VALVE STEMS

Condition	Code	Procedure
Bent	A,1	Suggest replacement.
Broken	A	Require replacement.
Cut, but not leaking	A,1	Suggest replacement.
Deteriorated (cracking, dry rot)	A,1	Suggest replacement.
Leaking	A	Require repair/replacement.

Missing	C	Require replacement.
Threads damaged	A	Require repair/replacement.
Threads stripped (threads missing)	A	Require replacement.
Valve cap missing	C	Require replacement of cap.
Weather-checking	A,1	Suggest replacement.
Won't take air	A	Require repair/replacement.

WHEEL ATTACHMENT HARDWARE

For conditions noted below, also check conditions of wheel stud holes.

CAUTION: Proper lug nut torque is essential. Follow manufacturer's torque specifications and tightening sequence. DO NOT lubricate threads unless specified by the vehicle manufacturer.

WHEEL ATTACHMENT HARDWARE

Condition	Code	Procedure
Bent	A	Require replacement.
Broken	A	Require replacement.
		See note (1) below.
Loose	B	Require repair or replacement
		of affected component.
Lug nut installed backward	B	Require repair.
Lug nut mating type incorrect	B	Require replacement of nut.
Lug nut mating surface dished	A	Require replacement of nut.
Lug nut flats rounded	A	Require replacement of nut.
		See note (2) below.
Lug nut seized	A	Require replacement of nut
		and/or stud. See note (2) below.
Stud incorrect	B	Require replacement of stud.
Threads damaged	A	Require repair or replacement of
		component with damaged threads.

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Threads stripped (threads missing)	A	Require replacement of component with stripped threads.

NOTE: (1) Some manufacturers require replacement of all studs on that wheel if two or more studs or nuts on the same wheel are broken or missing.
(2) Only required if removing wheel.

WHEELS

WARNING: Mounting a regular tire on a high-pressure compact spare wheel is not permitted. Attempting to mount a tire of one diameter on a wheel of a different diameter or flange type may result in serious injury or death. If the wheel identification stamp is not legible, or cannot be found, DO NOT use the wheel until the size and type have been properly identified. Wheels of different diameter, offset, or width cannot be mixed on the same axle. Bead seat tapers cannot be interchanged.

WHEELS

Condition	Code	Procedure
Bead leaking, caused by wheel rim flange	A	Require repair or replacement. See caution below.
Bent wheel hub mounting surface	A	Require replacement.
Bent wheel rim, causing vibration	B,2	Suggest replacement. See caution above.
Broken	A	Require replacement.
Cast wheel porous, causing a leak	A	Require repair or replacement.
Clip-on balance weight is incorrect type for wheel rim flange	B,2	Suggest replacement.
Corrosion, affecting structural integrity	A	Require replacement.
Corrosion build-up on wheel hub mounting surface	A	Require repair.

CAUTION: DO NOT attempt to correct a bent wheel rim.

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Cracked	A	Require replacement.
Directional/asymmetrical wheels mounted incorrectly	B	Require remounting and/or repositioning.
Load capacity less than OEM specifications	B	Require replacement.
Offset mismatched on same axle	B	Require replacement.
Rivets leaking	A	Require replacement.
Run-out beyond OEM specs	B	Require replacement.
Stud holes elongated	A	Require replacement. See note (1)
Welded or brazed repair	B,2	Suggest replacement.
Welds leaking	A	Require replacement.
Wheel hub centering (pilot) hole incorrect	B	Require replacement.

NOTE: (1) Inspect wheel attaching hardware for damage.

END OF ARTICLE

* SYMPTOM CHECK LIST *
Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:18PM

ARTICLE BEGINNING

SYMPTOM CHECK LIST WORKSHEETS

*** PLEASE READ THIS FIRST ***

NOTE: This article is intended for general information purposes only. It does not apply specifically to one make or model.

PURPOSE

Why Use the Symptom Check List Worksheets?

One of the most difficult and critical lines of communication is between the service customer and the technician. The clearer the technician understands the customer's concerns, the more likely the problem will be "fixed right the first time".

The Symptom Check List Worksheets in this article are designed to improve this communication. When used consistently, they can be helpful in reducing shop comebacks, increasing technician productivity, and producing satisfied customers. They also provide other benefits:

* Reduce "No Trouble Found" problems
* Increase customer involvement
* Customer perceive that "they really care and listen"
* Save time during peak write-up periods
* Reduce recontacting customers for additional information
* Improve night drop information
* Insure all the right questions are asked at write-up

Making the Worksheets a Part of Your Normal Routine

The following information contains ideas that may be helpful in forming habits that promote daily use of the Symptom Check Lists:

* HAVE THE SERVICE ADVISER FILL OUT THE FORM(S) WITH THE CUSTOMER WHENEVER POSSIBLE.
* Place them in your night drop for the customer to fill out, along with an instruction sheet to help them understand what to do.
* Hand out the worksheets to customers while they wait in line during the peak morning rush and ask them to fill it out. It will save time for all concerned and improve the quality of information received from the customer.
* Make sure it is attached to the hard copy when it goes to the technician.
* Place a copy with the final repair papers and review it with the customer at delivery.
* Put a new worksheet in the glovebox of all departing customers.
* Require that you personally see a copy of all worksheets filled out for shop comebacks.

* Hold a shop meeting to get employee buy-in and their ideas on how to make it effective in your shop.

There are many other ways to utilize the concept, but as with every other idea, successful implementation depends on employee involvement and buy-in.

SYMPTOM CHECK LIST WORKSHEETS

CONDENSED VERSION - ALL ON ONE PAGE

NOTE: Have the service adviser fill out this form with the customer whenever possible.

*** SYMPTOM CHECK LIST ***
Article Text (p. 3)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:18PM

DRIVEABILITY WORKSHEET

(To Be Filled Out By Vehicle Owner)

Name: _____ **Date:** _____ **Make:** _____

Model: _____ **Year:** _____ **Engine:** _____ **Mileage:** _____

FAULT CHARACTERISTICS – SYMPTOMS – DESCRIPTION OF PROBLEM	(Please Check All That Apply In All Categories)
Starting Problems	☐ Will Not Crank ☐ Cranks, But Won't Start ☐ Starts, But Takes A Long Time
Engine Quits/ Running Problems	**Quits:** ☐ Right After Starting ☐ When Put Into Gear ☐ Right After Vehicle Comes To A Stop ☐ During Steady Speed Driving ☐ While Idling ☐ During Acceleration ☐ When Parking
Poor Idling Conditions	**Idle Speed:** ☐ Is Too Slow At All Times ☐ Is Too Slow With A/C On ☐ Is Too Fast ☐ Is Rough Or Uneven ☐ Fluctuates Up and Down
Poor Running Conditions	☐ Runs Rough ☐ Lacks Power ☐ Hesitates Or Stumbles On Acceleration ☐ Bucks and Jerks ☐ Engine Knocks, Pings, Rattles ☐ Backfires ☐ Poor Fuel Economy ☐ Misfires or Cuts Out ☐ Surges and/or Chuggles ☐ Dieseling or Run-On ☐ Engine Light Always On ☐ Engine Light On Sometimes ☐ Fuel, Gas, or Sulfur Smell
Auto. Transmission Problems	☐ Improper Shifting (early/late) ☐ Changes Gear Randomly On Its Own ☐ Vehicle Does Not Move When In Gear
Poor Handling	☐ Pulls To One Side ☐ Hard Steering ☐ Vehicle Shakes and/or Vibrates While Moving
Noise Problems	**Explain:**
Odor Problems	**Explain:**
Problem Frequency	☐ Always ☐ Often ☐ Occasionally
Usually Occurs	☐ Morning ☐ Afternoon ☐ Anytime
Engine Temp.	☐ Cold ☐ Warm ☐ Hot
Vehicle Speed	☐ Low ☐ Cruising ☐ High
Driving Conditions During Occurrence	☐ Short – Less Than 2 Miles ☐ 2-10 Miles ☐ Long – More Than 10 Miles ☐ Stop & Go ☐ While Turning ☐ While Braking ☐ At Gear Engagement ☐ With A/C Operating ☐ With Headlights On ☐ During Acceleration ☐ During Deceleration ☐ Mostly Downhill ☐ Mostly Uphill ☐ Mostly Level ☐ Mostly Curvy ☐ Rough Road
Driving Habits	☐ Drive Hard Before Engine Is Warmed ☐ Allow Engine To Warm ☐ Mostly City Driving ☐ Highway ☐ Park Vehicle Inside ☐ Outside **Drive Per Day:** ☐ Less Than 10 Miles ☐ 10-50 ☐ More Than 50 **Fuel Octane:** ☐ 87 ☐ 89 ☐ 91 ☐ More Than 91 **Brand:** _____ ☐ Gasohol ☐ Propane Conversion
Outside Weather	☐ Cold ☐ Warm ☐ Hot ☐ Wet/Rainy ☐ Fog ☐ Snow/Hail ☐ Dust/Dirt ☐ Dry ☐ Humid

Fig. 1: Entire Vehicle - Symptom Check List For Customer

FULL VERSION - ALL ON FOUR PAGES

NOTE: Have the service adviser fill out these forms with the customer whenever possible.

Dear Valued Customer:
Our goal is to fix your problem correctly and get you back on the road as soon as possible in the unlikely event you experience a problem with your vehicle. Help us identify the exact nature of the concern by taking a few moments to complete the appropriate section of this diagnostic worksheet. Thank you.

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO.:**

DIAGNOSTIC WORKSHEET

DRIVEABILITY - ENGINE - AUTOMATIC TRANSMISSION

SYMPTOM (CHECK ALL THAT APPLY)
ENGINE

- ☐ "Service Engine Soon"/"Malfunction Indicator Light" on
- ☐ Hard start/no start (cranks OK)
- ☐ Won't crank
- ☐ Engine stalls
- ☐ Engine miss
- ☐ Miss while driving
- ☐ Hesitates, stumbles or sags
- ☐ Rough idle
- ☐ Idle is too high ☐ Idle is too low
- ☐ Poor power/performance
- ☐ Surge or chuggle, buck - jerk - skip
- ☐ Poor gas mileage ☐ Highway ☐ City
- ☐ Pings, detonates
- ☐ Suphur, rotten egg odor
- ☐ Backfires (popping noise) - underhood/tailpipe
- ☐ Exhaust smoke ☐ Increased oil consumption
- ☐ Runs on after key is turned off
- ☐ Speed fluctuates without moving accelerator
- ☐ Engine noise (explain): _____

_____
_____
(whine, rattle, groan, clunk, etc.)

- ☐ Other: _____

_____
_____

TRANSMISSION

- ☐ Does not shift properly ☐ Hard shift
- ☐ Will not shift ☐ Up ☐ Down
- ☐ Will not shift into overdrive
- ☐ Engine starts in other than "P" or "N"
- ☐ Noise (describe): _____

_____
_____
(whine, rattle, groan, clunk, buzz, etc.)

- ☐ Shifts into gear too early
- ☐ Overdrive doesn't work with speed control, but is otherwise OK
- ☐ Highway speed - shudder, surge, etc.
- ☐ Other: _____

_____
_____

EXPLAIN: _____

_____
_____

OPERATING CONDITIONS (CHECK ALL THAT APPLY)
HOW OFTEN DOES IT OCCUR? (Engine and/or Transmission)

- ☐ Always ☐ Few seconds ☐ Few minutes
- ☐ Few hours ☐ Few days ☐ Few weeks
- ☐ Few months ☐ Variable ☐ Only during event
- ☐ Every _____ to ___ miles ☐ Unknown
- ☐ Other (explain): _____
- ☐ Just started ☐ Getting better ☐ Getting worse
- ☐ Since new

WHEN DOES IT OCCUR? (Engine and/or Transmission)
When Engine Temperature is:

- ☐ Cold ☐ Warm ☐ Hot
- ☐ All the time ☐ Only during warmup

Weather Conditions:

- ☐ Very cold - below 0 degrees F ☐ Cold - 0 to 32 degrees F
- ☐ Cool - 32 to 60 degrees F ☐ Warm - 60 to 80 degrees F
- ☐ Hot - Above 80 degrees F ☐ Any environment
- ☐ Raining ☐ Dry ☐ Humid
- ☐ Snow/ice ☐ Wet roads ☐ Other (explain below)

Driving Conditions:

- ☐ Light throttle ☐ Medium throttle ☐ Hard throttle
- ☐ Starting ☐ At idle ☐ Decelerating
- ☐ Over bumps ☐ When shifting ☐ While turning
- ☐ Cruising steady at _____ MPH ☐ While braking
- ☐ Anytime ☐ Uphill ☐ Downhill
- ☐ Highway ☐ City/town ☐ Stop and go
- ☐ Between _____ MPH and _____ MPH
- ☐ Only with A/C or Defrost on

What Type of Fuel? **What Brand?** _____

- ☐ Regular UL ☐ Mid range UL ☐ Premium Unleaded
- ☐ Gasohol ☐ Ethanol ☐ Methanol
- ☐ Diesel #1 ☐ Diesel #2 ☐ Various brands

When Gear Selector is in:

- ☐ Park/Neutral ☐ Reverse ☐ Overdrive
- ☐ Drive/3 ☐ Drive/2 ☐ Drive/1

Between Gears:

- ☐ Park to R or D ☐ Rev/Drive ☐ First/Second
- ☐ Second/Third ☐ Third/Overdrive

50G15061

Fig. 2: Symptom Check List - Page 1

* SYMPTOM CHECK LIST *
Article Text (p. 5)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:18PM

BRAKES - STEERING - SUSPENSION

SYMPTOM

- ☐ Vehicle pulls right - When _____
- ☐ Vehicle pulls left - When _____
- ☐ Steering wheel vibrates at ____ MPH
- ☐ Excessive play in steering
- ☐ Erratic steering when braking
- ☐ Poor steering wheel return after cornering
- ☐ Suspension bottoms out
- ☐ Leans or sways in corners
- ☐ Brake light on
- ☐ Traction control light on
- ☐ Uneven tire wear
- ☐ Sits uneven
- ☐ "Dog" tracks
- ☐ ABS light on
- ☐ Soft ride

Hard to steer

- ☐ Effort
- ☐ Wanders
- ☐ Steering wheel off center

Shimmy/vibration (check box below for location)

- ☐ Front
- ☐ Rear
- ☐ Don't know
- ☐ Seat
- ☐ Floor
- ☐ Other _____

Brake pedal

- ☐ Noise
- ☐ Pulses
- ☐ Squeaks
- ☐ Hard
- ☐ Mushy
- ☐ Excessive travel

WHEN DOES IT OCCUR?

- ☐ Cold days
- ☐ Hot days
- ☐ Wet/rain
- ☐ All the time
- ☐ Intermittent
- ☐ Parking manuevers
- ☐ At road speed
- ☐ Accelerating
- ☐ Decelerating

EXPLAIN: _____

SQUEAK - RATTLE - NOISE CONDITIONS

AREA OF NOISE

☐ Engine Compartment	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Front Suspension	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Rear Suspension	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Passenger Compartment	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Instrument Panel	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Doors	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Rear seat area	☐ Console	☐ Other _____		

NOISE SOUNDS LIKE

- ☐ Knocks
- ☐ Hard metal
- ☐ Light metal
- ☐ Roars
- ☐ Ticking
- ☐ Whine
- ☐ Squeaks
- ☐ Rattles
- ☐ Scraping
- ☐ Other _____

HOW OFTEN DOES IT OCCUR?

- ☐ Continuous
- ☐ Often
- ☐ Intermittent
- ☐ Just started
- ☐ Since new

WHEN DOES IT OCCUR?

- ☐ All the time
- ☐ Speed
- ☐ RPM
- ☐ Only moving
- ☐ On turns
- ☐ Braking
- ☐ Hard throttle
- ☐ Light throttle
- ☐ Decelerate
- ☐ Steady speed
- ☐ Idle in gear
- ☐ Idle out of gear
- ☐ Hot days
- ☐ Cold days
- ☐ Humid or rainy
- ☐ Temperature _____
- ☐ Heavy bumps
- ☐ Light bumps
- ☐ Smooth pavement

EXPLAIN: _____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50H15062

Fig. 3: Symptom Check List - Page 2

* SYMPTOM CHECK LIST *
Article Text (p. 6)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:18PM

AIR CONDITIONING - HEATER - VENTILATION

SYSTEM OR AREA AFFECTED

☐ Air conditioner ☐ Heater ☐ Defroster ☐ Vent ☐ Bi-Level ☐ Fan/blower
☐ Max A/C ☐ Automatic Temperature Control ☐ Mix/blend ☐ Economy ☐ All

SYMPTOM

☐ Does not work ☐ Blows wrong temperature air ☐ No air comes out of vents ☐ Rapid cycling
☐ Noisy (explain) ☐ Broken ☐ Odor ☐ Air comes from wrong outlets ☐ Blows fuse
☐ Leaks ☐ Insufficient heat or cool ☐ Other (explain below)

WHEN DOES IT OCCUR?

☐ All the time ☐ Hot ☐ Cold ☐ Intermittent ☐ Right after startup
☐ When change controls only ☐ Other (explain below) ☐ Fan blower speed High / Med / Low

EXPLAIN: _____

ELECTRICAL - RADIO - TAPE/CD PLAYER

SYMPTOM - MUSIC SYSTEM

☐ Does not work ☐ Noisy ☐ Static ☐ Won't load ☐ Won't eject ☐ Poor reception
☐ Controls do not work ☐ Blows fuse ☐ Other (explain below)

SYSTEM AFFECTED

☐ Radio only ☐ AM ☐ FM ☐ FM stereo ☐ Graphic equalizer
☐ Tape player ☐ CD player ☐ Whole system ☐ Steering wheel buttons ☐ Phone
☐ Speakers ☐ Front ☐ Rear ☐ Left ☐ Right
☐ Antenna ☐ Clock ☐ Radio or player controls ☐ Rear seat controls

ALL OTHER ELECTRICAL ITEMS OR ACCESSORIES
Please list the complaint accessory or item and check any applicable symptom(s) from the list that follows:

_____ ☐ Inoperable ☐ Noisy ☐ No control ☐ Erratic
☐ Check light on or flashing ☐ Works improperly (explain below)
☐ Blows fuse ☐ Intermittent ☐ Related system affected (explain below)

_____ ☐ Inoperable ☐ Noisy ☐ No control ☐ Erratic
☐ Check light on or flashing ☐ Works improperly (explain below)
☐ Blows fuse ☐ Intermittent ☐ Related system affected (explain below)

_____ ☐ Inoperable ☐ Noisy ☐ No control ☐ Erratic
☐ Check light on or flashing ☐ Works improperly (explain below)
WHEN DOES IT OCCUR? ☐ Blows fuse ☐ Intermittent ☐ Related system affected (explain below)

☐ All the time ☐ Hot ☐ Cold ☐ Just after starting - malfunctions for a while
☐ Intermittent ☐ After runs for _____ minutes ☐ Rough roads or bumps only
☐ Other (explain below)

EXPLAIN: _____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50115063

Fig. 4: Symptom Check List - Page 3

* SYMPTOM CHECK LIST *
Article Text (p. 7)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:18PM

WATER LEAK - WINDNOISE

WATER LEAK
Leak Occurs When?

☐ Setting level ☐ Any time it rains ☐ While driving in the rain ☐ Car wash only
☐ Back lower than front (facing uphill) ☐ Front lower than back (facing downhill)

Location of Leak (where water appears):

☐ LF Door ☐ RF Door ☐ LR Door ☐ RR Door ☐ Windshield ☐ Rear window
☐ LF window ☐ RF window ☐ LR window ☐ RR window ☐ Side door ☐ Sunroof/T-Top
☐ Under instrument panel ☐ Rear door/rear hatch

WINDNOISE:
Location:

☐ LF Door ☐ RF Door ☐ LR Door ☐ RR Door ☐ Windshield ☐ Rear window
☐ LF window ☐ RF window ☐ LR window ☐ RR window ☐ Side door ☐ Sunroof/T-Top
☐ Under instrument panel ☐ Rear door/rear hatch

EXPLAIN: _____

MANUAL TRANSMISSION - CLUTCH

SYMPTOM - MANUAL GEAR SHIFT

☐ Hard to shift ☐ Doesn't shift
☐ Grinds going into____ gear
☐ Noisy when in _____ gear or neutral ____
☐ Slips/pops out of gear
☐ Noise (describe): _____
☐ Upshift light stays on
☐ Upshift light doesn't light

WHEN DOES IT OCCUR?

☐ All the time ☐ Light load
☐ Heavy load

SYMPTOM - CLUTCH

☐ Hard to push ☐ Fail to release
☐ Noise when pressing pedal down (describe): _____
☐ Slips ☐ Chattering (grabbing)
☐ Odor present ☐ Pedal stays on the floor
☐ Squealing sound

WHEN DOES IT OCCUR?
When Engine Temperature is:

☐ Cold ☐ Hot
☐ Accelerating ☐ Decelerating

EXPLAIN: _____

COMMENTS:

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50J15064

Fig. 5: Symptom Check List - Page 4

* SYMPTOM CHECK LIST *
Article Text (p. 8)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:18PM

NOTE: Have the service adviser fill out these forms with the customer whenever possible.

DRIVEABILITY - ENGINE - AUTOMATIC TRANSMISSION

SYMPTOM (CHECK ALL THAT APPLY)
ENGINE

- ☐ "Service Engine Soon"/Malfunction Indicator Light" on
- ☐ Hard start/no start (cranks OK)
- ☐ Won't crank
- ☐ Engine stalls
- ☐ Engine miss
- ☐ Miss while driving
- ☐ Hesitates, stumbles or sags
- ☐ Rough idle
- ☐ Idle is too high ☐ Idle is too low
- ☐ Poor power/performance
- ☐ Surge or chuggle, buck - jerk - skip
- ☐ Poor gas mileage ☐ Highway ☐ City
- ☐ Ping, detonates
- ☐ Sulphur/rotten egg odor
- ☐ Backfires (popping noise) - underhood/tailpipe
- ☐ Exhaust smoke ☐ Increased oil consumption
- ☐ Runs on after key is turned off
- ☐ Speed fluctuates without moving accelerator
- ☐ Engine noise (explain): _____

(whine, rattle, groan, clunk, etc.)

- ☐ Other: _____

TRANSMISSION

- ☐ Does not shift properly ☐ Hard shift
- ☐ Will not shift ☐ Up ☐ Down
- ☐ Will not shift into overdrive
- ☐ Engine starts in other than "P" or "N"
- ☐ Noise (describe): _____

(whine, rattle, groan, clunk, buzz, etc.)

- ☐ Shifts into next gear too early
- ☐ Overdrive doesn't work with speed control, but is otherwise OK
- ☐ Highway speed - shudder, surge, etc.
- ☐ Other: _____

EXPLAIN: _____

OPERATING CONDITIONS (CHECK ALL THAT APPLY)
HOW OFTEN DOES IT OCCUR? (Engine &/or Transmission)

- ☐ Always ☐ Few Seconds ☐ Few minutes
- ☐ Few hours ☐ Few days ☐ Few weeks
- ☐ Few months ☐ Variable ☐ Only during event
- ☐ Every _____ to ____ miles ☐ Unknown
- ☐ Other (explain): _____
- ☐ Just started ☐ Getting better ☐ Getting worse
- ☐ Since new

WHEN DOES IT OCCUR? (Engine and/or Transmission)
When Engine Temperature is:

- ☐ Cold ☐ Warm ☐ Hot
- ☐ All the time ☐ Only during warmup

Weather Conditions:

- ☐ Very cold - below 0°F ☐ Cold - 0 to 32°F
- ☐ Cool - 32 to 60°F ☐ Warm - 60 to 80°F
- ☐ Hot - above 80°F ☐ Any environment
- ☐ Raining ☐ Dry ☐ Humid
- ☐ Snow/Ice ☐ Wet roads
- ☐ Other (explain): _____

Driving Conditions:

- ☐ Light throttle ☐ Medium throttle ☐ Hard throttle
- ☐ Starting ☐ At idle ☐ Decelerating
- ☐ Over bumps ☐ When shifting ☐ While turning
- ☐ Cruising - steady at MPH ☐ While braking
- ☐ Anytime ☐ Uphill ☐ Downhill
- ☐ Highway ☐ City/town ☐ Stop and go
- ☐ Between ___ MPH and ___ MPH
- ☐ Only with A/C or Defrost on

What Type of Fuel? **What Brand?**

- ☐ Regular UL ☐ Midrange UL ☐ Premium UL
- ☐ Gasohol ☐ Ethanol ☐ Methanol
- ☐ Diesel #1 ☐ Diesel #2 ☐ Various brands

When Gear Selector is in:

- ☐ Park/Neutral ☐ Reverse ☐ Overdrive
- ☐ Drive/3 ☐ Drive/2 ☐ Drive/1

Between Gears:

- ☐ Park to R or D ☐ Reverse/Drive ☐ First/Second
- ☐ Second/Third ☐ Third/Overdrive

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50H15054

Fig. 6: Engine Driveability & Automatic Transmission

* SYMPTOM CHECK LIST *
Article Text (p. 9)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:18PM

BRAKES - STEERING - SUSPENSION

SYMPTOM

- ☐ Vehicle pulls right - When _____
- ☐ Vehicle pulls left - When _____
- ☐ Steering wheel vibrates at ____ MPH
- ☐ Excessive play in steering
- ☐ Erratic steering when braking
- ☐ Poor steering wheel return after cornering
- ☐ Suspension bottoms out
- ☐ Leans or sways in corners
- ☐ Brake light on
- ☐ Traction control light on
- ☐ Uneven tire wear
- ☐ Sits uneven
- ☐ "Dog" tracks
- ☐ ABS light on
- ☐ Soft ride

Hard to steer

- ☐ Effort
- ☐ Wanders
- ☐ Steering wheel off center

Shimmy/vibration (check box below for location)

- ☐ Front
- ☐ Rear
- ☐ Don't know
- ☐ Seat
- ☐ Floor
- ☐ Other _____

Brake pedal

- ☐ Noise
- ☐ Pulses
- ☐ Squeaks
- ☐ Hard
- ☐ Mushy
- ☐ Excessive travel

WHEN DOES IT OCCUR?

- ☐ Cold days
- ☐ Hot days
- ☐ Wet/rain
- ☐ All the time
- ☐ Intermittent
- ☐ Parking manuevers
- ☐ At road speed
- ☐ Accelerating
- ☐ Decelerating

EXPLAIN: _____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50C15059

Fig. 7: Brakes, Steering, & Suspension

*** SYMPTOM CHECK LIST ***
Article Text (p. 10)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:18PM

AIR CONDITIONING - HEATER - VENTILATION

SYSTEM OR AREA AFFECTED

☐ Air conditioner ☐ Heater ☐ Defroster ☐ Vent ☐ Bi-Level ☐ Fan/blower
☐ Max A/C ☐ Automatic Temperature Control ☐ Mix/blend ☐ Economy ☐ All

SYMPTOM

☐ Does not work ☐ Blows wrong temperature air ☐ No air comes out of vents ☐ Rapid cycling
☐ Noisy (explain) ☐ Broken ☐ Odor ☐ Air comes from wrong outlets ☐ Blows fuse
☐ Leaks ☐ Insufficient heat or cool ☐ Other (explain below)

WHEN DOES IT OCCUR?

☐ All the time ☐ Hot ☐ Cold ☐ Intermittent ☐ Right after startup
☐ When change controls only ☐ Other (explain below) ☐ Fan blower speed High / Med / Low

EXPLAIN: _____

_____

_____

_____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50A15057

Fig. 8: Air Conditioning, Heater & Ventilation

* SYMPTOM CHECK LIST *
Article Text (p. 11)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:18PM

ELECTRICAL - RADIO - TAPE/CD PLAYER

SYMPTOM - MUSIC SYSTEM

☐ Does not work ☐ Noisy ☐ Static ☐ Won't load ☐ Won't eject ☐ Poor reception
☐ Controls do not work ☐ Blows fuse ☐ Other (explain below)

SYSTEM AFFECTED

☐ Radio only ☐ AM ☐ FM ☐ FM stereo ☐ Graphic equalizer
☐ Tape player ☐ CD player ☐ Whole system ☐ Steering wheel buttons ☐ Phone
☐ Speakers ☐ Front ☐ Rear ☐ Left ☐ Right
☐ Antenna ☐ Clock ☐ Radio or player controls ☐ Rear seat controls

ALL OTHER ELECTRICAL ITEMS OR ACCESSORIES
Please list the complaint accessory or item and check any applicable symptom(s) from the list that follows:

_____ ☐ Inoperable ☐ Noisy ☐ No control ☐ Erratic
☐ Check light on or flashing ☐ Works improperly (explain below)
☐ Blows fuse ☐ Intermittent ☐ Related system affected (explain below)

_____ ☐ Inoperable ☐ Noisy ☐ No control ☐ Erratic
☐ Check light on or flashing ☐ Works improperly (explain below)
☐ Blows fuse ☐ Intermittent ☐ Related system affected (explain below)

_____ ☐ Inoperable ☐ Noisy ☐ No control ☐ Erratic
☐ Check light on or flashing ☐ Works improperly (explain below)
☐ Blows fuse ☐ Intermittent ☐ Related system affected (explain below)

WHEN DOES IT OCCUR?

☐ All the time ☐ Hot ☐ Cold ☐ Just after starting - malfunctions for a while
☐ Intermittent ☐ After runs for _____ minutes ☐ Rough roads or bumps only
☐ Other (explain below)

EXPLAIN: _____
_____
_____
_____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50B15058
Fig. 9: Electrical, Radio & Tape/CD Player

*** SYMPTOM CHECK LIST ***
Article Text (p. 12)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:18PM

MANUAL TRANSMISSION - CLUTCH

SYMPTOM - MANUAL GEAR SHIFT

☐ Hard to shift ☐ Doesn't shift
☐ Grinds going into_____ gear
☐ Noisy when in _____ gear or neutral _____
☐ Slips/pops out of gear
☐ Noise (describe): _____
_____
_____
☐ Upshift light stays on
☐ Upshift light doesn't light

WHEN DOES IT OCCUR?

☐ All the time ☐ Light load
☐ Heavy load

SYMPTOM - CLUTCH

☐ Hard to push ☐ Fail to release
☐ Noise when pressing pedal down (describe): _____
_____
_____
☐ Slips ☐ Chattering (grabbing)
☐ Odor present ☐ Pedal stays on the floor
☐ Squealing sound

WHEN DOES IT OCCUR?
When Engine Temperature is:

☐ Cold ☐ Hot
☐ Accelerating ☐ Decelerating

EXPLAIN: _____
_____
_____
_____
_____
_____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50J15056
Fig. 10: Manual Transmission & Clutch

* SYMPTOM CHECK LIST *
Article Text (p. 13)

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:18PM

SQUEAK - RATTLE - NOISE CONDITIONS

AREA OF NOISE

☐ Engine Compartment	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Front Suspension	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Rear Suspension	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Passenger Compartment	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Instrument Panel	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Doors	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Rear seat area	☐ Console	☐ Other _____		

NOISE SOUNDS LIKE

☐ Knocks	☐ Hard metal	☐ Light metal	☐ Roars	☐ Ticking	☐ Whine
☐ Squeaks	☐ Rattles	☐ Scraping	☐ Other _____		

HOW OFTEN DOES IT OCCUR?

☐ Continuous	☐ Often	☐ Intermittent	☐ Just started	☐ Since new

WHEN DOES IT OCCUR?

☐ All the time	☐ Speed	☐ RPM	☐ Only moving	☐ On turns	☐ Braking
☐ Hard throttle	☐ Light throttle	☐ Decelerate	☐ Steady speed	☐ Idle in gear	☐ Idle out of gear
☐ Hot days	☐ Cold days	☐ Humid or rainy	☐ Temperature _____		
☐ Heavy bumps	☐ Light bumps	☐ Smooth pavement			

EXPLAIN: _____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50F15060

Fig. 11: Squeak, Rattle, & Noise Conditions

* SYMPTOM CHECK LIST *
Article Text (p. 14)

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:18PM

WATER LEAK - WINDNOISE

WATER LEAK
Leak Occurs When?

☐ Setting level ☐ Any time it rains ☐ While driving in the rain ☐ Car wash only
☐ Back lower than front (facing uphill) ☐ Front lower than back (facing downhill)

Location of Leak (where water appears):

☐ LF Door ☐ RF Door ☐ LR Door ☐ RR Door ☐ Windshield ☐ Rear window
☐ LF window ☐ RF window ☐ LR window ☐ RR window ☐ Side door ☐ Sunroof/T-Top
☐ Under instrument panel ☐ Rear door/rear hatch

WINDNOISE:
Location:

☐ LF Door ☐ RF Door ☐ LR Door ☐ RR Door ☐ Windshield ☐ Rear window
☐ LF window ☐ RF window ☐ LR window ☐ RR window ☐ Side door ☐ Sunroof/T-Top
☐ Under instrument panel ☐ Rear door/rear hatch

EXPLAIN: _____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50I15055
Fig. 12: Water Leak & Wind Noise

END OF ARTICLE

ARTICLE BEGINNING

1993 VOLKSWAGEN ENGINES
2.5L 5-Cylinder

EuroVan

*** PLEASE READ THIS FIRST ***

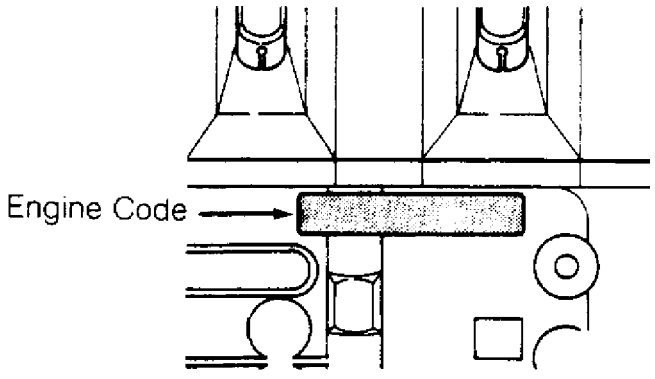
NOTE: For engine repair procedures not covered in this article, see ENGINE OVERHAUL PROCEDURES - GENERAL INFORMATION article in the GENERAL INFORMATION section.

ENGINE IDENTIFICATION

Engine identification number is stamped on a machined pad, between No. 3 and 5 cylinders. See Fig. 1. The engine code is also listed on a sticker attached to the timing belt cover.

ENGINE IDENTIFICATION CODES TABLE

Application	Engine Code
EuroVan	
2.5L 5-Cylinder 10-Valve	AAF



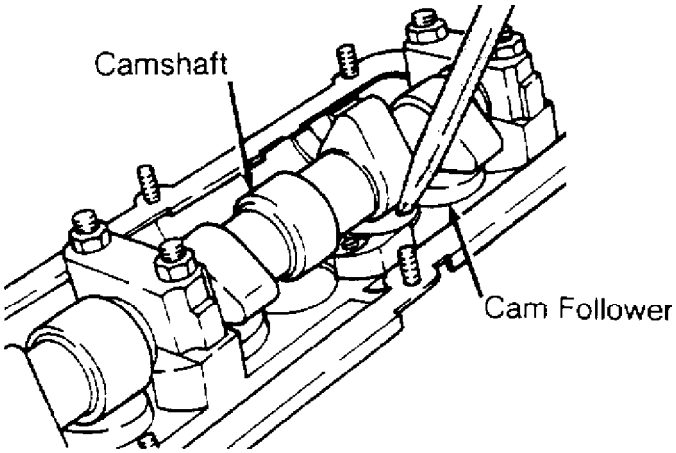
93F83001
Fig. 1: Locating Engine Identification Number
Courtesy of Volkswagen United States, Inc.

ADJUSTMENTS

HYDRAULIC LIFTER (CAM FOLLOWER) TEST

To determine weak or noisy lifter, position camshaft lobe high point upward. Using a piece of wood, push cam follower down. See

Fig. 2. If cam follower moves down more than .004" (.10 mm), replace cam follower. If cam follower moves less than .004" (.10 mm), cam follower is okay. Repeat procedure for remaining cam followers.



93G83002

Fig. 2: Measuring Cam Follower Clearance
Courtesy of Volkswagen United States, Inc.

REMOVAL & INSTALLATION

NOTE: The engine must be removed from below vehicle with transaxle attached. Match mark engine mounts to ensure original alignment position after installation.

FUEL PRESSURE RELEASE

Remove fuel pump relay (located in fuse/relay panel). Crank engine for 5 seconds. Reinstall fuel pump relay.

ENGINE

Removal

1) Obtain radio code. Disconnect negative battery cable. Support upper control arms with Wedge (3250). Drain cooling system. Disconnect cooling fan and thermoswitch.

2) Label and disconnect electrical wiring and vacuum hoses. Disconnect throttle, cruise and kickdown linkage. Remove air duct from intake manifold. Remove shifting linkage clevis, and pry up on shift lever. See Fig. 3.

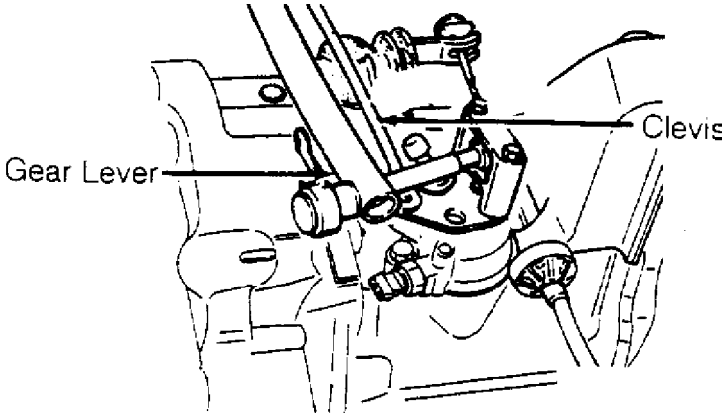
3) Disconnect shift rod. Disconnect power steering hoses and allow to drain. Remove left drive axle and disconnect right drive axle. See FWD AXLE SHAFTS article in DRIVE AXLES. Disconnect exhaust pipe from exhaust manifold.

4) Bolt Adapter Bracket (3227) to cylinder block. Raise transaxle slightly using Transaxle Jack (1383A). See Fig. 4. Remove 2 engine and transaxle mount bolts. Lower engine and transaxle out of

vehicle.

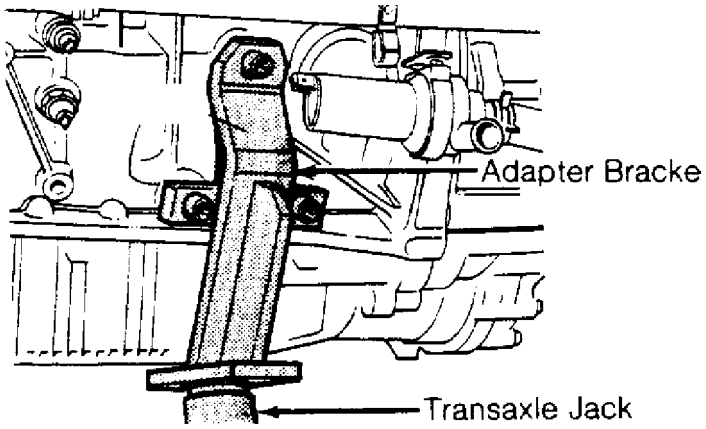
Installation

Reverse removal procedure to complete installation. Use NEW self-locking nuts. Ensure engine mounts are installed to original location. Tighten engine mount bolts to specification with engine running at idle. See TORQUE SPECIFICATIONS table.



93H83003

Fig. 3: Removing Shift Linkage
Courtesy of Volkswagen United States, Inc.



93I83004

Fig. 4: Raising Transaxle
Courtesy of Volkswagen United States, Inc.

INTAKE MANIFOLD

Removal and installation procedure is not available from manufacturer. See TORQUE SPECIFICATIONS table.

EXHAUST MANIFOLD

Removal and installation procedure is not available from manufacturer. See TORQUE SPECIFICATIONS table.

CYLINDER HEAD

Removal

1) Removal and installation procedure is not available from manufacturer. Cylinder head may be removed with engine in vehicle. Match mark all components for installation reference.

2) Remove timing belt. See TIMING BELT under REMOVAL & INSTALLATION. Remove cylinder head bolts in reverse sequence of installation. See Fig. 6. Replace cylinder head bolts after loosening or removing.

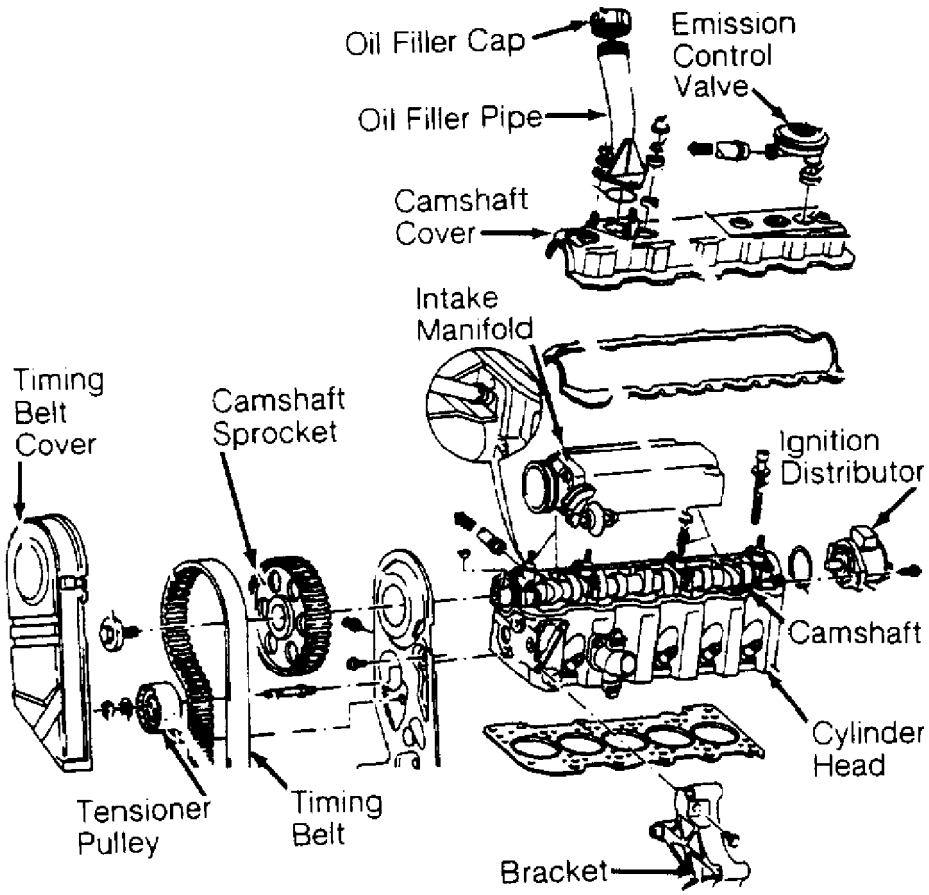


Fig. 5: Identifying 2.5L Cylinder Head (10-Valve)
Courtesy of Volkswagen United States, Inc.

Inspection

Thoroughly clean all gasket mating surfaces. Check cylinder head for warpage. Maximum warpage is .004" (.10 mm). Check minimum

cylinder head height and replace cylinder head (if necessary).

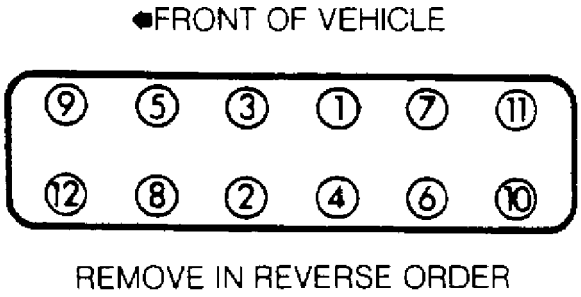
NOTE: DO NOT reuse antifreeze after replacing cylinder block, cylinder head, head gasket, radiator and/or heater core.

Installation

1) Ensure OBEN marking on cylinder head gasket faces up. Install Guide Pins (3070) into cylinder head bolts holes No. 9 and 10. See Fig. 6. Install gasket onto guide pins.

2) Install cylinder head onto cylinder block. Do not use any type of sealant. Install remaining head bolts and tighten by hand. Remove Guide Pins (3070) and install head bolts No. 9 and 10.

3) Tighten cylinder head bolts (in 3 steps) in sequence to specification. See Fig. 6. See the TORQUE SPECIFICATIONS table.



93A83006

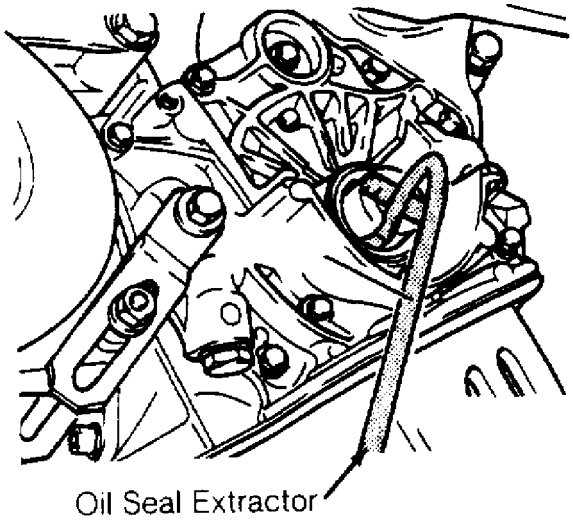
Fig. 6: Cylinder Head Bolts Tightening Sequence
Courtesy of Volkswagen United States, Inc.

FRONT COVER OIL SEAL

Removal

1) Remove timing belt. Remove vibration damper and crankshaft sprocket. Using Oil Seal Extractor (2086), remove front cover seal. See Fig. 7.

2) Lubricate threaded area of extractor and push in as far as possible. Loosen set screw and turn inner part of extractor until oil seal is removed.

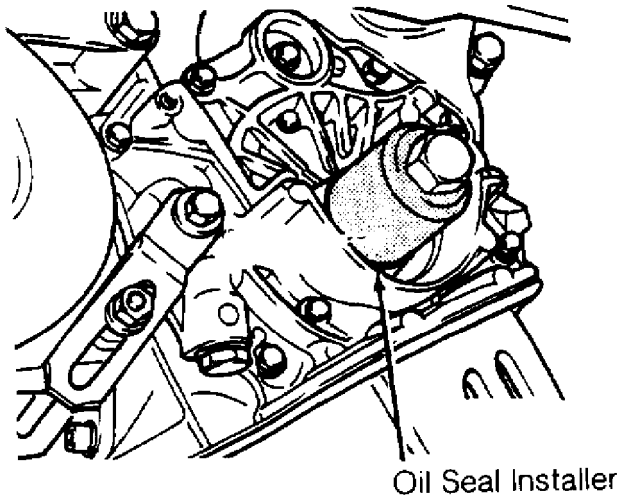


93B83007

Fig. 7: Removing Front Cover Oil Seal
Courtesy of Volkswagen United States, Inc.

Installation

Lubricate outer edge and lip of new seal. Use bolt and Oil Seal Installer (2080A) to install oil seal. See Fig. 8. Insert bolt through oil seal installer and thread bolt all the way into crankshaft. Press seal completely into position. To complete installation, reverse removal procedure.



93C83008

Fig. 8: Installing Front Cover Oil Seal
Courtesy of Volkswagen United States, Inc.

TIMING BELT

Removal

1) Match mark all components to ensure reassembly in original position. Loosen tensioner and remove accessory drive belt. Remove vibration damper and timing belt cover.

2) Set crankshaft sprocket at TDC position and mark for reassembly reference. DO NOT turn crankshaft with belt removed. Loosen tensioner pulley and water pump. Remove timing belt. See Fig. 9.

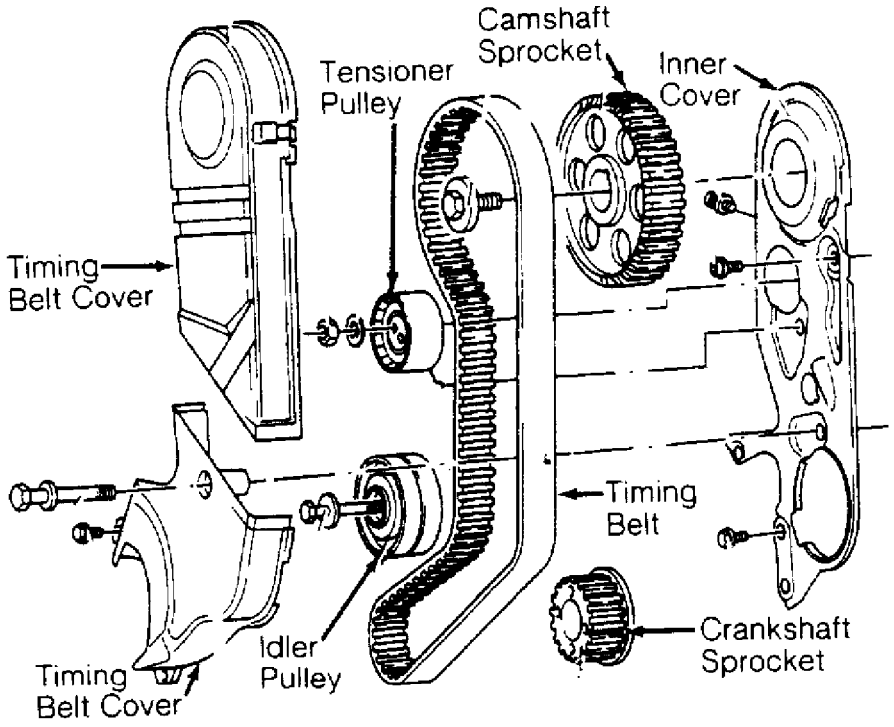


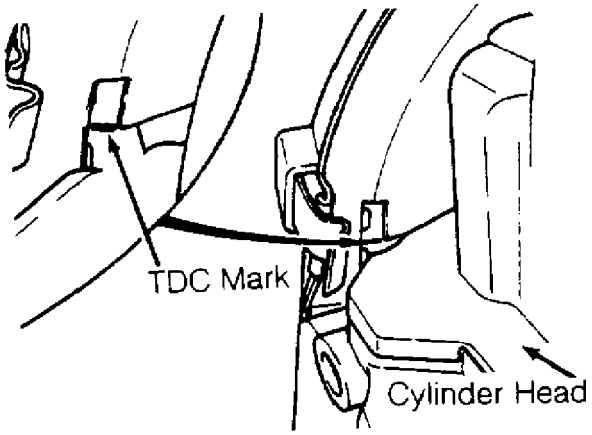
Fig. 9: Exploded View Of Timing Belt & Related Components
Courtesy of Volkswagen United States, Inc.

Installation

1) Ensure crankshaft is aligned at TDC. Align camshaft sprocket timing marks. See Fig. 10. Install timing belt on camshaft sprocket and crankshaft sprocket.

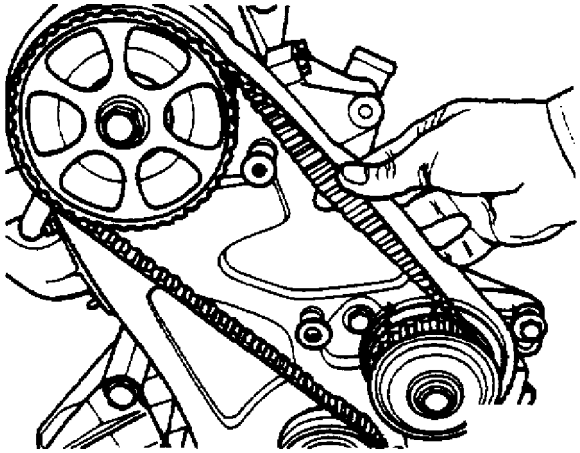
2) On models equipped with tensioner, loosen tensioner nut. Rotate tensioner clockwise to tighten belt and install lock nut. By hand, rotate crankshaft 2 turns and check timing mark alignment.

3) On models not equipped with tensioner, loosen water pump and move upward until slack in timing belt is eliminated. On all models, proper deflection is achieved when longest span of belt between sprockets can be twisted 90 degrees. See Fig. 11. To complete installation, reverse removal procedure.



93G83010

Fig. 10: Aligning Camshaft Timing Marks
Courtesy of Volkswagen United States, Inc.



93H83011

Fig. 11: Checking Timing Belt Tension
Courtesy of Volkswagen United States, Inc.

CAMSHAFT

Removal

1) Remove upper timing belt cover. Remove valve cover and camshaft cover. Place camshaft at TDC. See Fig. 10. Remove timing belt from camshaft sprocket.

2) Use puller to remove camshaft sprocket. Remove Woodruff key from camshaft. Remove distributor. Remove bearing caps No. 1 and 3. Loosen bearing caps No. 2 and 4 alternately in a diagonal sequence. Remove camshaft.

Inspection

Check camshaft bearing oil clearance. See CAMSHAFT table under ENGINE SPECIFICATIONS. If oil clearance exceeds specification, install new camshaft and recheck clearance. If clearance still exceeds specification, replace cylinder head.

Installation

1) Lubricate all contact surfaces. Place camshaft in cylinder head with both high points of lobes for No. 1 cylinder facing upward. Install bearing caps.

2) Tighten bearing caps No. 2 and 4 alternately in a diagonal sequence to 15 ft. lbs. (20 N.m). Repeat procedure for bearing caps No. 1 and 3. Install Woodruff key in camshaft.

3) To complete installation, reverse removal procedure. Ensure timing marks are properly aligned. Before starting engine, allow 30 minutes for cam followers to bleed down.

REAR CRANKSHAFT OIL SEAL

Removal & Installation

Remove flywheel/flexplate, and discard bolts. Remove retaining flange. Using Oil Seal Extractor (10-221), remove oil seal. See Fig. 12. Use Seal Installer (2003/1) to install seal. See Fig. 13. To complete installation, reverse removal procedure. Install new flywheel/flex plate bolts.

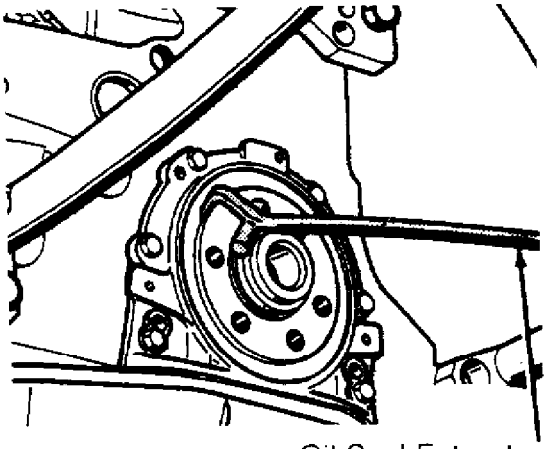


Fig. 12: Removing Rear Crankshaft Oil Seal
Courtesy of Volkswagen United States, Inc.

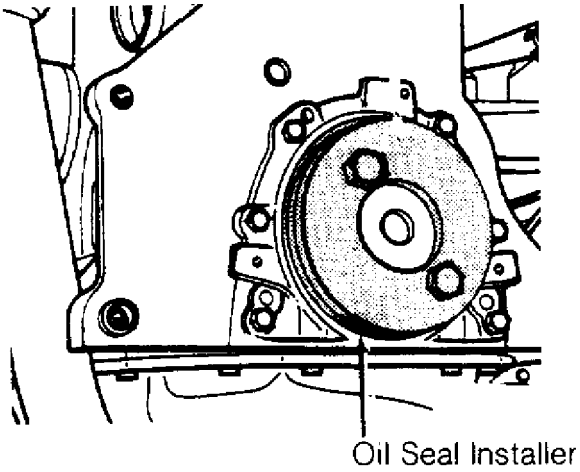


Fig. 13: Installing Crankshaft Rear Oil Seal
Courtesy of Volkswagen United States, Inc.

WATER PUMP

CAUTION: Coolant/water mixture should be used at all times.

Removal & Installation

1) Disconnect negative battery cable. Turn heater control to hot. Drain cooling system. Remove accessories and brackets (as necessary).

2) Label and remove coolant hoses from water pump. Remove water pump pulley. Remove bolts and remove water pump assembly. To install, reverse removal procedure.

OIL PAN

Oil pan can be removed and installed with engine in vehicle. No further information is available from manufacturer.

OVERHAUL

CYLINDER HEAD

Cylinder Head

Clean all gasket mating surfaces. Check cylinder head for warpage. Ensure warpage does not exceed .004" (0.1 mm).

Valve Stem Oil Seals

Install seals using Valve Seal Replacer/Sleeve (10-204). DO NOT install valve seal without using sleeve.

Valve Guides

1) Check valve-to-guide clearance specification. See CYLINDER HEAD table under ENGINE SPECIFICATIONS. To replace valve guide, press guide out from combustion chamber side.

2) Press guide in cold cylinder head (from camshaft side) until shoulder makes contact. DO NOT exceed one ton pressure. Ream guides to proper valve-to-guide clearance. See CYLINDER HEAD table under ENGINE SPECIFICATIONS.

Valve Seats

1) Check valve seats before any other cylinder head service. Insert the valve and hold firmly against the valve seat. Measure valve stem tip-to-cylinder head distance. See Fig. 14.

2) Valve stem tip-to-cylinder head distance determines installed valve height. Subtract measured distance from minimum specification. See MINIMUM VALVE INSTALLED HEIGHT table.

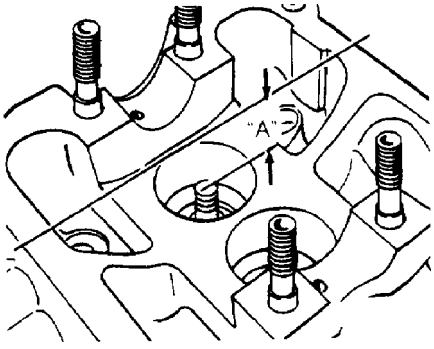
MINIMUM VALVE INSTALLED HEIGHT SPECIFICATIONS TABLE

Application	In. (mm)
Intake Valve	1.33 (33.8)
Exhaust Valve	1.34 (34.1)

3) The difference is maximum refacing allowable for valve and seat. If valve installed height is too high, replace cylinder head assembly. If valve installed height is too low or too high, cam followers will not work correctly.

Valves

Measure valve stem diameter and valve margin. If not within specification, replace valves. Lap valves by hand or replace as necessary. See VALVES & VALVE SPRINGS table under ENGINE SPECIFICATIONS.



"A" = Valve Stem-To-Cylinder Head Measurement

93A83014

Fig. 14: Measuring Valve Installed Height
Courtesy of Volkswagen United States, Inc.

CYLINDER BLOCK ASSEMBLY

Piston & Rod Assembly

1) Make sure piston, rod and rod caps are marked with matching cylinder number prior to removal. Ensure arrow on top of piston points toward pulleys.

2) Ensure marks exists on rod and cap are positioned correctly. See Fig. 15. Rod cap bolts and nuts must be replaced after removing or loosening. Mark piston in relation to pin. Remove circlips from ends of pin bore.

3) Use Piston Pin Replacer/Installer (VW 222A) to remove and install piston pin. If pin is too tight, heat piston to 140øF (60øC). Ensure rod is properly positioned with piston. See Fig. 15.

Fitting Pistons

Measure clearances with cylinder block supported on work bench. Check clearance of piston-to-cylinder bore. Piston diameter is stamped on top of piston in millimeters.

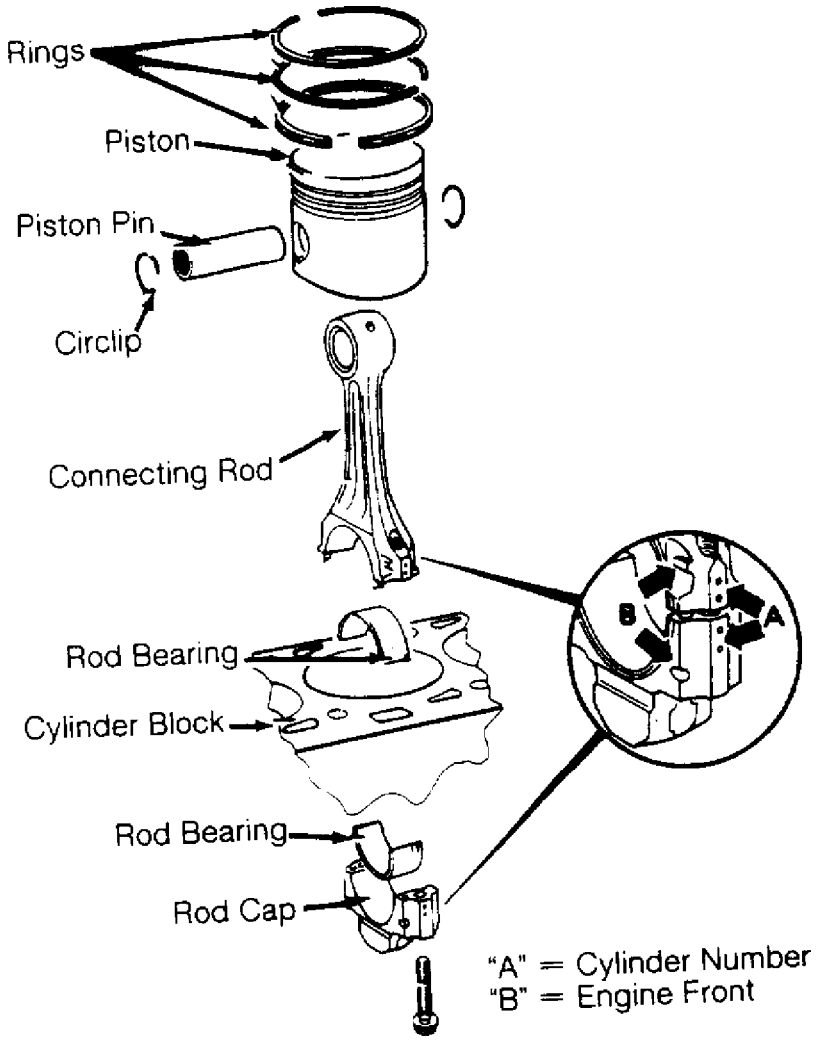
PISTON-TO-CYLINDER BORE DIMENSIONS TABLE

Size	Piston Diameter In. (mm)	Cylinder Bore In. (mm)
Standard	3.188 (80.98)	3.189 (81.01)
1st Over	3.198 (81.23)	3.199 (81.26)
2nd Over	3.208 (81.48)	3.209 (81.51)

Piston Rings

1) Measure ring end gap. Measure ring side clearance with piston. If not within specification, replace as necessary. See PISTONS, PINS & RINGS table under ENGINE SPECIFICATIONS.

2) Install rings on piston with OBEN mark facing upward. Recessed edge on outside of center ring must face piston pin (down). Position ring gaps on piston at 120 degree intervals.



93B83015

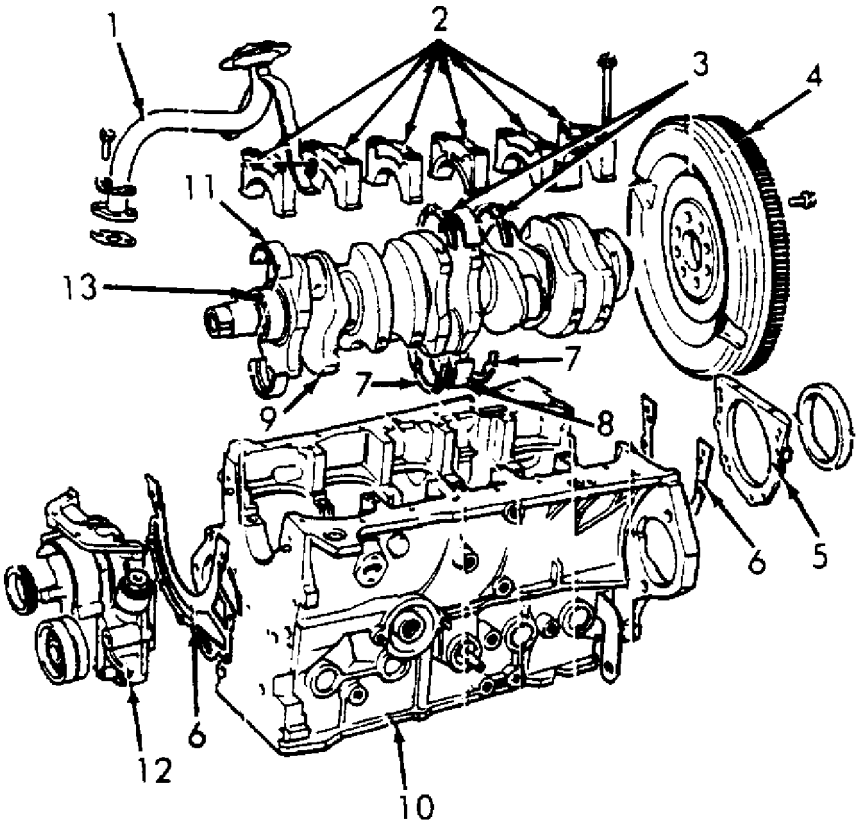
Fig. 15: Assembling Piston & Rod
Courtesy of Volkswagen United States, Inc.

Rod Bearings

Mark rod caps for reinstallation. Use Plastigage to measure bearing clearances. Measure connecting rod side play. Replace or machine as necessary. See CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS table under ENGINE SPECIFICATIONS. Tighten evenly to specification in several steps. See TORQUE SPECIFICATIONS table.

Crankshaft & Main Bearings

Main bearing caps are marked with matching journal for installation in original position. See Fig. 16. Measure crankshaft end play. See THRUST BEARING.



1. Intake Tube
2. Bearing Caps
3. Thrust Washer
4. Flywheel
5. Oil Seal Mounting Flange
6. Gasket
7. Thrust Washer
8. Bearing Shell No. 4
9. Crankshaft
10. Cylinder Block
11. Bearing Shells
12. Oil Pump
13. Oil Pump Drive

93C83016

Fig. 16: Exploded View Of Crankshaft Assembly
Courtesy of Volkswagen United States, Inc.

Thrust Bearing

Insert feeler gauge between No. 4 main bearing and crankshaft thrust face to measure end play. See Fig. 16. Replace thrust bearing as necessary. See CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS table under ENGINE SPECIFICATIONS.

Cylinder Block

Check cylinder bore for wear, out-of-round and taper. Check cylinder block for warpage. See CYLINDER BLOCK table under ENGINE SPECIFICATIONS.

ENGINE OILING

ENGINE LUBRICATION SYSTEM

Crankcase Capacity
See CRANKCASE CAPACITY table.

CRANKCASE CAPACITY TABLE

Model	With Filter Replacement	Without Filter Replacement
2.5L	5.8 Qts. (5.5L)	5.3 Qts. (5.0L)

Oil Pressure
Check oil pressure with engine at warm operating temperature. Minimum oil pressure at 2000 RPM is 29 psi (2.0 kg/cmý). If oil pressure is incorrect, check oil pump and oil pressure relief valve. See Fig. 17.

OIL PUMP

Removal & Installation
Remove oil pan. Remove oil pump attaching bolts and remove oil pump assembly. To install, reverse removal procedure.

Inspection
Check oil pump housing, gears and pressure relief valve for damage or excessive wear. Repair or replace as necessary.

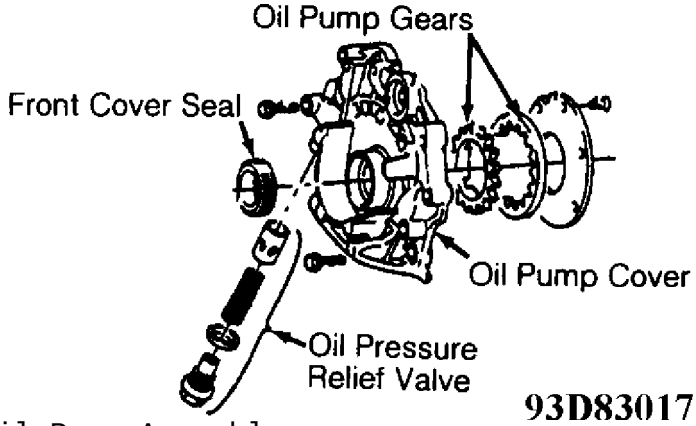


Fig. 17: Oil Pump Assembly
Courtesy of Volkswagen United States, Inc.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS TABLE

Application	Ft. Lbs. (N.m)
A/C Bracket-To-Engine Bolt	22 (30)

```
Axle Shaft-To-Transaxle Drive Flange Bolt  ........  33 (45)
Camshaft Bearing Cap Bolt  .......................  11 (15)
Camshaft Drive Gear Bolt
  8.8  ...........................................  63 (85)
  10.9  ........................................  74 (100)
Clutch Cover Bolt  ...............................  15 (20)
Connecting Rod Bolt  ..................  22 (30) + 1/4 Turn
Crankshaft Main Bearing Cap Bolt  ................  50 (65)
Crankshaft Timing Sprocket Bolt  .................  66 (90)
Cylinder Head Nut
  Step 1  ........................................  30 (40)
  Step 2  ........................................  44 (60)
  Step 3  ......................  Additional 1/4 (90ø) Turn
  Step 4  ......................  Additional 1/4 (90ø) Turn
Engine Bracket-To-Hydraulic Mount Bolt  ..........  44 (60)
Engine-To-Transaxle 10-mm Bolt  ..................  33 (45)
Engine-To-Transaxle 12-mm Bolt  ..................  41 (55)
Exhaust Manifold-To-Cylinder Head Bolt & Nut  .....  18 (25)
Exhaust Pipe-To-Manifold Nut  ....................  22 (30)
Exhaust Pipe-To-Support Bracket Bolt  ............  18 (25)
Flywheel or Pressure Plate-To-Crankshaft  .........  22 (30)
Front Exhaust Pipe-To-Manifold Bolt  .............  30 (40)
Intake Manifold  .................................  18 (25)
Intermediate Shaft Sprocket Bolt  ................  59 (80)
Lower Pulley Bolt  ...............................  15 (20)
Oil Pan Bolt  ....................................  15 (20)
Oil Pan Drain Plug  ..............................  22 (30)
Oil Pump Cover Short Bolt  ........................  7 (10)
Oil Pump Cover Long Bolt  ........................  15 (20)
Rod Bearing Cap Nut  ..................  22 (30) + 1/4 Turn
Starter Mount Bolt  ..............................  18 (25)
Timing Belt Tensioner Nut  .......................  15 (20)
Torque Converter-To-Carrier Plate Bolt  ..........  22 (30)
Vibration Damper Bolt  ..........................  339 (460)
Water Pump Pulley Bolt  ..........................  15 (20)
Water Pump Housing-To-Engine Bolt  ...............  15 (20)

                                             INCH Lbs. (N.m)

Timing Belt Idler Bolt  ..........................  82 (10)
Transaxle/Engine Cover Plate Bolt  ...............  89 (11)
Valve Cover Retaining Nut  .......................  89 (11)
Water Pump-To-Housing  ...........................  89 (11)
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ENGINE SPECIFICATIONS

GENERAL ENGINE SPECIFICATIONS

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GENERAL ENGINE SPECIFICATIONS TABLE
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Application                                      Specification
```

Displacement	153 Cu. In.
Bore	3.19" (81.0 mm)
Stroke	3.76" (95.5 mm)
Compression Ratio	8.5:1
Fuel System	Digifant II PFI
Horsepower @ RPM	121 @ 4500
Torque Ft. Lbs @ RPM	190 @ 2200

CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS SPECS

CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS SPECS TABLE

Application	In. (mm)
Crankshaft	
End Play	
Standard	.003-.007 (.07-.17)
Service Limit	.010 (.25)
Runout	.001 (.03)
Main Bearings	
Journal Diameter	2.275-2.300 (57.78-58.42)
Journal Out-Of-Round	.001 (.03)
Journal Taper	.001 (.03)
Oil Clearance	
Standard	.001-.003 (.03-.08)
Service Limit	.007 (.17)
Connecting Rod Bearings	
Journal Diameter	1.880-1.881 (47.58-48.22)
Journal Out-Of-Round	.001 (.03)
Journal Taper	.001 (.03)
Oil Clearance	.0004-.002 (.01-.06)

PISTONS, PINS & RINGS SPECIFICATIONS

PISTONS, PINS & RINGS SPECIFICATIONS TABLE

Application	In. (mm)
Pistons	
Clearance	.0016 (.040)
Diameter	3.189 (80.99)
Pins	
Diameter	(1)
Piston Fit	Interference
Rod Fit	Interference
Rings	
No. 1	
End Gap	
Standard	.008-.016 (.20-.40)

```
    Service Limit  ..........................  .039 (1.0)
  Side Clearance
    Standard  ......................  .001-.002 (.02-.05)
    Service Limit  ..........................  .006 (.15)
 No. 2
  End Gap
    Standard  ......................  .008-.016 (.20-.40)
    Service Limit  ..........................  .039 (1.0)
  Side Clearance  ..................  .001-.002 (.02-.05)
 No. 3 (Oil)
  End Gap
   Standard  ......................  .010-.020 (.25-.50)
   Service Limit  ..........................  .039 (1.0)
  Side Clearance  ..................  .001-.002 (.02-.05)

(1) - Information not available from manufacturer.
```

CYLINDER BLOCK SPECIFICATIONS

CYLINDER BLOCK SPECIFICATIONS TABLE

Application	In. (mm)
Cylinder Bore	
Standard Diameter	3.189 (81.01)
Maximum Taper	.0032 (.08)
Maximum Out-of-Round	.001 (.03)

VALVES SPECIFICATIONS

VALVES SPECIFICATIONS TABLE

Application	Specification
Intake Valves	
Face Angle	45ø
Head Diameter	1.574" (40.00 mm)
Length	3.583" (91.00 mm)
Minimum Margin (1)	(2)
Stem Diameter	.314" (7.97 mm)
Exhaust Valves	
Face Angle	45ø
Head Diameter	1.299" (33.00 mm)
Length	3.575" (90.80 mm)
Minimum Margin (1)	(2)
Stem Diameter	.313" (7.95 mm)

(1) - DO NOT machine valves; hand lap only.
(2) - Information not available from manufacturer.

CYLINDER HEAD SPECIFICATIONS

CYLINDER HEAD SPECIFICATIONS TABLE

Application	Specification
Cylinder Head Height	(1)
Maximum Warpage	.039" (1.00 mm)
Valve Seats	
Intake Valve	
Seat Angle	45ø
Seat Width	(2)
Exhaust Valve	
Seat Angle	45ø
Seat Width	(2)
Valve Guides	
Intake Valve	
Valve Guide Installed Height	(3)
Oil Clearance	(2) .039" (1.0 mm)
Exhaust Valve	
Valve Guide Installed Height	(1)
Valve Stem-to-Guide	
Oil Clearance	(4) .051" (1.30 mm)

(1) - Cylinder Head Height determined by measuring distance between valve stem tip and cylinder head surface. See CYLINDER HEAD under OVERHAUL.
(2) - Information not available from manufacturer.
(3) - Valve guide shoulder flush with cylinder head.
(4) - New valve installed in cylinder head. Dial indicator used to measure valve rock in guide.

CAMSHAFT SPECIFICATIONS

CAMSHAFT SPECIFICATIONS TABLE

Application	In. (mm)
End Play	.006 (.15)
Oil Clearance	.004 (.10) Maximum

END OF ARTICLE

A - ENGINE/VIN ID
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:19PM

ARTICLE BEGINNING

1993 ENGINE PERFORMANCE
Volkswagen Introduction

All Models

MODEL COVERAGE

MODEL COVERAGE TABLE

Model	Body Code	Engine	Engine ID	Fuel System	Ignition System
Cabriolet	15	1.8L 8-Valve	2H	Digifant II MFI (1)	Hall Effect
Corrado SLC	50	2.8L VR6 (2)	AAA	Motronic MFI (3)	Hall Effect
EuroVan	70	2.5L 10-Valve	AAF	Digifant MFI	Hall Effect
Fox	30	1.8L 8-Valve	ABG	Digifant II MFI (1)	Hall Effect
Golf	1H	2.0L 8-Valve	ABA	Motronic MFI (3)	Hall Effect
GTI	1H	2.0L 8-Valve	ABA	Motronic MFI (3)	Hall Effect
Jetta	1H	2.0L 8-Valve	ABA	Motronic MFI (3)	Hall Effect
Passat GL	31	2.0L 16-Valve	9A	CIS-E Motronic	Hall Effect
Passat GLX	31	2.8L VR6 (2)	AAA	Motronic MFI (3)	Hall Effect

(1) - California vehicles are equipped with Digifant I.
(2) - The VR6 is a combination "Vee" and "Rheihenmotor" (German). The combination can be roughly described as an "In-Line vee". For practical purposes, engine has 6 in-line but slightly staggered cylinders.
(3) - Sequential Multiport Fuel Injection.

VIN DEFINITION

Numbers preceding the explanations in the legend below refer to the sequence of characters as listed on VIN identification label.

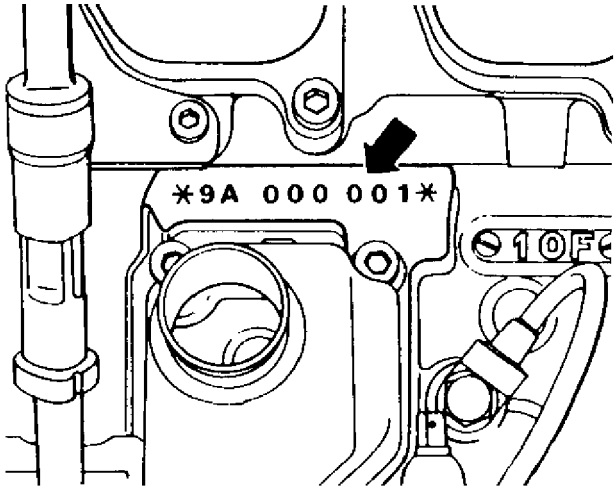
(VIN)	W	V	W	C	B	5	1	5	2	P	C	0	0	0	0	0	1
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

1-3 Indicates Nation of Origin.
4 Indicates Series.
5 Indicates Engine Type.
6 Indicates Restraint System.
7-8 Indicates Body Code.
9 Indicates Check Digit.
10 Indicates Model Year.
11 Indicates Assembly Plant.
12-17 Indicates Production Sequence.

MODEL YEAR VIN CODE APPLICATION TABLE

VIN Code	Model Year
L	1990
M	1991
N	1992
P	1993

ENGINE CODE LOCATION



STAMPED ON ENGINE BLOCK, JUST BELOW CYLINDER HEAD.

93B79450

Fig. 1: Engine Code Location (4-Cylinder & 5-Cylinder)
Courtesy of Volkswagen United States, Inc.

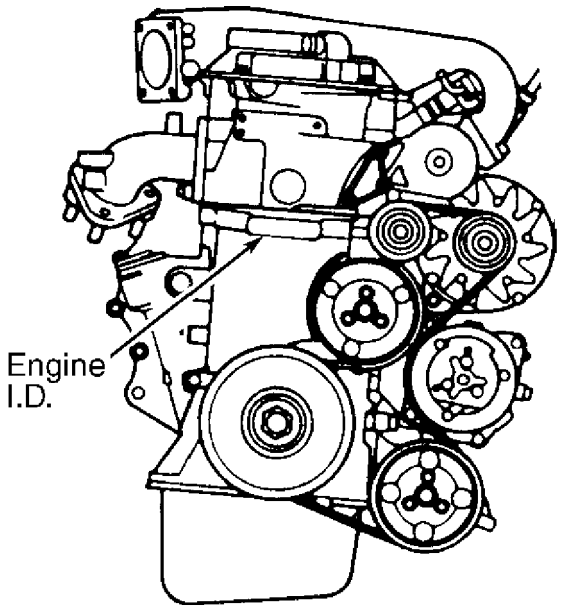


Fig. 2: Engine Code Location (V6)
Courtesy of Volkswagen United States, Inc.

END OF ARTICLE

A/C COMPRESSOR OIL CHECKING

Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:20PM

ARTICLE BEGINNING

1993 GENERAL SERVICING
Compressor Refrigerant Oil Checking

*** PLEASE READ THIS FIRST ***

NOTE: For compressor applications, see COMPRESSOR APPLICATIONS TABLE below. DO NOT exceed A/C system refrigerant oil capacity, when servicing system. See REFRIGERANT OIL & REFRIGERANT SPECIFICATIONS TABLE.

COMPRESSOR APPLICATION

NOTE: Due to late changes, always refer to underhood A/C specification label in engine compartment or A/C compressor label while servicing A/C system. If A/C Specification label and specifications in this article differ, always use label specifications.

COMPRESSOR APPLICATION TABLE

Application	Compressor
Acura	Nippondenso 10-Cyl.
Audi	
90	Zexel 6-Cyl.
100	Zexel 6-Cyl.
BMW	Nippondenso Or Seiko-Seiki
Chrysler Motors/Eagle	
Colt & Summit	Sanden FX105V Scroll
Colt Vista & Summit Wagon	Nippondenso 10PA15 10-Cyl.
Stealth	Sanden FX105VS Scroll
Ram-50	Sanden FX80 Scroll
Ford Motor Co.	
Capri	Nippondenso 10-Cyl.
Festiva	Nippondenso 6-Cyl.
General Motors & Geo	
LeMans	Harrison V5 5-Cyl.
Metro & Tracker	Nippondenso 10-Cyl.
Prizm	Nippondenso 10PA15 10-Cyl.
Storm	Diesel Kiki KC-50 Rotary Vane
Honda	
Accord	Nippondenso 10-Cyl. Or Hadsys RC-17S 7-Cyl.
Civic	Sanden Scroll
Civic Del Sol	Sanden Scroll
Prelude	Sanden Scroll
Hyundai	
Elantra	Sanden TRF-090 Scroll

Excel ..... Sanden SD-709 7-Cyl.
Scoupe ..... Nippondenso 10PA15C 10-Cyl.
Sonata ..... Ford FX-15 10-Cyl.
Infiniti
G20 ..... Atsugi NVR 140S Rotary Vane
J30 ..... Calsonic V6 6-Cyl.
Q45 ..... Calsonic V5 5-Cyl.
Isuzu (R-12)
Amigo ..... Diesel Kiki DKS-13CH 6-Cyl.
Pickup
4-Cylinder ..... Diesel Kiki DKS-13CH 6-Cyl.
V6 ..... Harrison R4 4-Cyl. Radial
Stylus ..... Diesel Kiki DKV-14D Rotary Vane
Rodeo
4-Cylinder ..... Diesel Kiki DKS-17CH 6-Cyl.
V6 ..... Diesel Kiki DKV-14D Rotary Vane
Trooper ..... Diesel Kiki DKV-14D Rotary Vane
Isuzu (R-134a Option) (1)
Amigo, Pickup, Rodeo & Trooper
2.3L & 2.6L Engine ..... Zexel R-134a 6-Cyl.
3.1L Engine ..... Harrison R-134a R-4 4-Cyl. Radial
3.2L Engine ..... Zexel R-134a Rotary Vane
Jaguar
XJS ..... Sanden SD-709 7-Cyl.
XJ6 ..... Sanden SD-7H15 7-Cyl.
Lexus ..... Nippondenso 10PA20 10-Cyl.
Mazda
B2200 & B2600i ..... Sanden 5-Cyl.
Miata ..... Nippondenso TV12 Rotary Vane
MPV ..... Nippondenso 10-Cyl.
MX-6 & 626 ..... Panasonic Rotary Vane
Navajo ..... Ford FX-15 10-Cyl.
MX-3, Protege & 323 ..... Panasonic Rotary Vane
929 ..... Panasonic Rotary Vane
RX7 ..... Nippondenso TV12 Rotary Vane
Mercedes-Benz
190E ..... Nippondenso 10PA15 10-Cyl.
300D/E, 400E & 500E ..... Nippondenso 10PA17 10-Cyl.
300SE/SD, 400SE & 500SEL ..... Nippondenso 10PA20 10-Cyl.
Mitsubishi
Diamante
R-12 ..... Sanden FX105VS Scroll
R-134a ..... Sanden MSC105
Diamante Wagon ..... Nippondenso 10PA17C 10-Cyl.
Galant & Mirage ..... Sanden FX105V Scroll
Eclipse ..... Nippondenso 10PA17 10-Cyl.
Expo/Expo LRV ..... Nippondenso 10PA17C 10-Cyl.
Pickup ..... Sanden FX80 Scroll
Montero ..... Nippondenso 10PA15 10-Cyl.
Precis ..... Sanden SD-709 7-Cyl.
3000GT
R-12 ..... Sanden FX105VS Scroll

R-134a	Sanden MSC105
Nissan	
Altima	Zexel DKV-14C Rotary Vane
Maxima & 300ZX	Zexel DKS-16H 6-Cyl.
Quest	Ford FX-15 10-Cyl.
Pathfinder & Pickup	Zexel DKV-14C Rotary Vane
Sentra & NX	Zexel DKV-14D Rotary Vane
240SX	Calsonic V5 5-Cyl.
Porsche	
911 America Roadster, RS America & Carrera 2/4	Nippondenso 10-Cyl.
Saab	
900	Sanden 5-Cyl.
9000	Seiko-Seiki SS121 DN1 Rotary Vane
Subaru	
Impreza	Zexel Rotary Vane
Legacy	Zexel DKS-15CH 5-Cyl. Calsonic V5-15C 5-Cyl.
Loyale	Hitachi MJS170-5DP 6-Cyl.
SVX	Calsonic V5 5-Cyl.
Suzuki	Nippondenso 10-Cyl.
Toyota	
Camry	Nippondenso 10PA17C 10-Cyl.
Celica	
4A-FE Engine	Nippondenso 10PA15C 10-Cyl.
3S-GTE & 5S-FE Engine	Nippondenso 10PA17C/VC 10-Cyl.
Corolla	Nippondenso 10PA15 10-Cyl.
Land Cruiser	Nippondenso 10PA17 10-Cyl.
MR2	Nippondenso 10P13C 10-Cyl.
Paseo	Matsushita Rotary Vane
Pickup & 4Runner	Nippondenso 10-Cyl.
Previa	Nippondenso 10PA17E 10-Cyl.
Supra	Nippondenso 10-Cyl.
Tercel	Matsushita TV10B Rotary Vane
T100	Nippondenso 10PA15 10-Cyl.
Volkswagen	
Cabriolet	Sanden SD-508 5-Cyl. Or SD-709 7-Cyl.
Corrado SLC	Sanden SD-709 7-Cyl.
EuroVan	Sanden SD7H15 7-Cyl.
Golf, GTI & Jetta	Sanden SD7-V16/SD7-V16L 7-Cyl.
Fox	Nippondenso 6-Cyl.
Passat	Sanden SD7-V16/SD7-V16L 7-Cyl.
Volvo	
240	Seiko-Seiki SS-121DS5
850	Zexel DKS-15CH 6-Cyl.
940 & 960	Sanden SD-510 5-Cyl., Sanden SD-709 7-Cyl. Or Seiko-Seiki SS-121DS5

(1) - Standard equipment on some models built after 5/1/93.

A/C COMPRESSOR OIL CHECKING

Article Text (p. 4)

1993 Volkswagen EuroVan

For Volkswagen Technical Site

Saturday, March 18, 2000 10:20PM

REFRIGERANT OIL & REFRIGERANT CAPACITY

REFRIGERANT OIL & REFRIGERANT CAPACITY (ACURA THROUGH INFINITI)

Application	(1) Oil Ounces	Refrigerant Ounces
Acura		
Integra	(2) 2.0-3.4	32-34
Legend		
Sedan	(2) (3) 4.7	(4) 24.7-26.5
Coupe	(3) 4.7	24.7-26.5
Vigor	(2) 4.7-4.9	26.5-28.0
Audi		
90	7.8-9.2	(5) 23.0-24.8
100	7.8-9.2	(5) 21.0-22.8
BMW		
318 & 325 Series	3.4-4.8	(6) 35-36
525i & 535i	4.7-6.1	(6) 53.0-55.5
740i & 740iL	4.7-6.1	(6) 53.0-55.5
Chrysler Motors/Eagle		
Colt & Summit	(2) 4.4-5.1	26-30
Colt Vista & Summit		
Wagon	(2) 2.0-3.4	30
Ram-50	(2) 4.4-5.1	30
Stealth	(2) 4.6-6.0	29
Ford Motor Co.		
Capri	2.4-3.0	23-27
Festiva	10	25
General Motors & Geo		
LeMans	8.0	35
Metro	2.7	18
Prizm & Prizm LSi	6.0	25
Storm	5.1	21
Tracker	2.7	21
Honda		
Accord		
Nippondenso	3.0-4.1	28-30
Hadsys	4.1-4.3	28-30
Civic	4.0-4.7	21-23
Civic Del Sol	4.0-4.7	21-23
Prelude	(7) 4.3-5.0	21-23
Hyundai		
Excel	8.1	30-32
Scoupe	2-3	28-32
Elantra	4.0	32
Sonata	6.9-7.7	30-32
Infiniti		
G20	6.8	24-29
J30	8.5	(8) 24-26
Q45	9.7	38-42

(1) - Total system capacity, unless otherwise noted.
(2) - Compressor refrigerant oil capacity.
(3) - Capacity revised by manufacturer in Acura Service News bulletin number ASN 0793-02.
(4) - Use R-134a refrigerant and ND-Oil 8 (Part No. 38899-PR7-003).
(5) - Use R-134a refrigerant and Polyalkylene Glycol (PAG) oil.
(6) - Use R-134a and Poyalkylene Glycol Oil (Part No. 81-22-9-407-724).
(7) - Use R-134a refrigerant and PAG Refrigerant Oil (Part No. 38899-P13-003).
(8) - Use R-134a refrigerant and Type "S" Oil (Part No. KLH00-PAGS0).

REFRIGERANT OIL & REFRIGERANT CAPACITY (ISUZU THROUGH MERCEDES)

Application	(1) Oil Ounces	Refrigerant Ounces
Isuzu (R-12)		
Amigo	5.0	26
Pickup		
2.3L & 2.6L Engine	5.0	26
3.1L Engine	6.0	26
Rodeo		
2.6L Engine	5.0	26
3.2L Engine	5.0	26
Stylus	5.0	21
Trooper	5.0	30
Isuzu (R-134a Option) (3)		
Amigo & Pickup		
2.3L & 2.6L Engine	5.0	23
3.1L Engine	7.5-8.5	23
Rodeo	5.0	23
Trooper	5.0	26
Jaguar		
XJS	(2) 4.6	40
XJ6	(2) 4.5	(4) 40
Lexus		
ES300	(2) 3.5	32-35
GS300	(2) 4.0	(5) 28-32
LS400	(2) 2.8-3.5	(5) 32
SC300 & SC400	(2) 4.0	32-35
Mazda		
B2200 & B2600i	(2) 4.5	28
Miata	(2) 2.7-3.3	28
MPV		
Dual Unit	(2) 2.7-3.3	51
Single Unit	(2) 2.7-3.3	37
MX-3	(2) 5.0	28

MX-6 & 626	(2) 4.3	26
Protege & 323	(2) 3.9-4.6	28
Navajo	7.0	28-29
929	3.6	28
RX7	3.4-4.7	21
Mercedes-Benz		
190E	(2) 4.0	36
300D/E, 400E & 500E	(2) 5.4	(6) 36
300SE/SD, 400SE & 500SEL	(2) 5.4	(7) 43

(1) - Total system capacity, unless otherwise noted.
(2) - Compressor refrigerant oil capacity.
(3) - Standard equipment on some models built after 5/1/93. Use R-134a Swash Plate Compressor Oil (Part No. 2-90188-300-0)on 2.3L and 2.6L engine. Use R-134a R-4 Compressor Oil (Part No. 2-90222-320-0) on 3.1L engine. Use R-134a Rotary Vane Compressor Oil (Part No. 2-90188-301-0) on 3.2L engine.
(4) - Use R-134a refrigerant and PAG SP20 refrigerant oil.
(5) - Use R-134a refrigerant and ND-Oil 8 (Part No. 38899-PR7-003).
(6) - Use R-134a refrigerant and Densooil 8 (Part No. A 001 989 08 03).
(7) - Use R-134a refrigerant and Densooil 8 (Part No. A 001 989 08 03).Use 50 ounces if equipped with rear passenger compartment A/C-heater system.

REFRIGERANT OIL & REFRIGERANT CAPACITY (MITSUBISHI THRU SUBARU)

Application	(1) Oil Ounces	Refrigerant Ounces
Mitsubishi		
Diamante		
R-12	5.4-6.0	34-38
R-134a	(3) 5.7-6.4	26-28
Diamante Wagon	5.4	28
Eclipse	(2) 2.0-3.4	33
Expo/Expo LRV		
1.8L	(2) 3.4-4.0	30
2.4L	(2) 2.0-3.4	30
Galant	(2) 5.0-5.7	33
Mirage	(2) 4.4-5.1	26-30
Pickup	(2) 4.4-5.1	30
Montero	(2) 2.0-3.4	28
Precis	8.1	30-32
3000GT		
R-12	4.7-6.0	29
R-134a	(3) 4.7-6.0	26-28
Nissan		

Altima	(4) 6.8	25-28
Maxima	(5) 6.8	30-33
Pathfinder & Pickup	(4) 6.8	26-30
Quest		
Front A/C	7.0	36
Front & Rear A/C	10	56
Sentra & NX	6.8	23-26
240SX	8.0	29-32
300ZX	6.8	26-30
Porsche		
911 America Roadster, RS America & Carrera 2/4	4.6	(6) 29.5
Saab		
900	5.9	34-36
9000	6.6	(3) 33-34
Subaru		
Impreza	6.1	23-26
Legacy		
Zexel	(2) 2.4	29-32
Calsonic	(2) 3.2	29-32
Loyale	(2) 2.4	26-28
SVX	(2) 2.4	(7) 22-23

(1) - Total system capacity, unless otherwise noted.
(2) - Compressor refrigerant oil capacity.
(3) - Use SUN PAG 56 refrigerant oil.
(4) - Use R-134a refrigerant and Type "R" Oil (Part No. KLH00-PAGR0).
(5) - Use R-134a refrigerant and Type "S" Oil (Part No. KLH00-PAGS0).
(6) - Use R-134a refrigerant and Nippondenso ND8 refrigerant oil.
(7) - Use R-134a refrigerant and ZXL100 PG (DH-PS) Type "S"Oil (Part No. K0010PS000).

REFRIGERANT OIL & REFRIGERANT CAPACITY (SUZUKI THROUGH VOLVO)

Application	(1) Oil Ounces	Refrigerant Ounces
Suzuki		
Samurai	2.0-3.4	18
Sidekick	2.0-3.4	21-23
Swift	2.0-3.4	18
Toyota		
Camry	(2) 3.5	32-35
Celica	3.4-4.1	24-27
Corolla	3.4-4.1	25-28
Land Cruiser	3.4-4.1	30-34
MR2	3.4-4.1	28-32
Paseo	3.4-4.1	25-28
Pickup	3.4-4.1	24-29

Previa		
Without Rear A/C	3.4-4.7	32-35
With Rear A/C	3.4-4.7	41-44
Supra	(2) 4.1	(3) 23-27
Tercel	3.4-4.1	25-28
T100	3.4-4.1	(3) 21-25
4Runner	3.4-4.1	27-30
Volkswagen		
Cabriolet	4.6	30.0-31.8
Corrado SLC	3.9-4.4	35.0-36.8
EuroVan		
Without Rear A/C	4.6	(4) 34-35
With Rear A/C	8.2	(4) 48-49
Fox	5.7	41-42
Golf, GTI & Jetta	3.9	(4) 28-30
Passat	3.9-4.4	(4) 41.0-42.8
Volvo		
240	7.4	(5) 26
850		
Cold Climates	7.0	(5) 29
Hot Climates	7.0	(5) 26
940 & 960		
Sanden SD-510	4.8	(6) 32-34
Sanden SD-709	8.5	(6) 32-34
Seiko-Seiki	7.8	(6) 32-34

(1) - Total system capacity, unless otherwise noted.
(2) - Compressor refrigerant oil capacity.
(3) - Use R-134a refrigerant and ND-Oil 8 (Part No. 38899-PR7-003).
(4) - Use R-134a refrigerant and SP-10 PAG Oil (Part No. G 052 154 A2).
(5) - Use R-134a refrigerant and ZXL 100 PG Oil (Part No. 8708581-7).
(6) - Use R-134a refrigerant and PAG Oil (Part No. 8708581-9).
ÄÄÄ

REFRIGERANT OIL

Only NEW, moisture-free refrigerant oil should be used in the air conditioning system. This oil is highly refined and dehydrated so moisture content is less than 10 parts per million. The oil container must be tightly closed at all times when not in use, or moisture from the air will be absorbed into the refrigerant oil.

SERVICING PRECAUTIONS

DISCHARGING SYSTEM

Discharge A/C system using approved refrigerant recovery/recycling equipment. Always follow recovery/recycling equipment manufacturer's instructions. After refrigerant recovery

process is completed, the amount of compressor oil removed must be measured and the same amount added to A/C system.

DISCONNECTING LINES & FITTINGS

After system is discharged, carefully clean area around all fittings to be opened. Always use 2 wrenches when tightening or loosening fittings. Some refrigerant lines are connected with a coupling. Special tools may be required to disconnect lines. Cap or plug all openings as soon as lines are removed. DO NOT remove caps until connections of lines and fittings are completed.

CONNECTING LINES & FITTINGS

NOTE: All R-134a based systems use 1/2-16 ACME threaded fittings. Ensure all replacement parts match the connections of the system being worked on.

Always use a new gasket or "O" ring when connecting lines or fittings. Coat "O" ring with refrigerant oil and ensure it is not twisted during installation. Always use 2 wrenches to prevent damage to lines and fittings.

PLACING SYSTEM IN OPERATION

After component service or replacement has been completed and all connections have been made, evacuate system thoroughly with a vacuum pump. Charge system with proper amount of refrigerant and perform leak test. See REFRIGERANT OIL & REFRIGERANT SPECIFICATIONS article in GENERAL SERVICING for system capacities. Check all fittings that have been opened. After system has been leak tested, check system performance.

NOTE: Most compressors are pre-charged with a fixed amount of refrigerant (shipping) oil. Drain compressor oil from new compressor and add refrigerant oil to new compressor according to amount removed from old compressor. Always refer to underhood A/C specification label or A/C compressor label while servicing A/C system.

ATSUGI

ROTARY VANE

1) Before checking and adjusting oil level, operate engine at 1200 RPM. Set controls at maximum cooling and high blower motor speed for 10 minutes to return oil to compressor.
2) Stop engine. Discharge refrigerant and remove compressor from vehicle. See SERVICING PRECAUTIONS. Drain compressor oil through compressor discharge port and measure oil amount.
3) If amount drained is less than 3 ounces, conduct leak tests at system connections. Repair or replace faulty parts as

necessary. Check purity of oil and adjust oil level as follows.

4) If amount drained is 3 ounces or more, oil level is okay. Fill with same amount drained, using new oil. If amount drained is less than 3 ounces, pour in 3 ounces of new refrigerant oil.

COMPONENT REFRIGERANT OIL CAPACITIES (ATSUGI ROTARY VANE)

Component	Ounces
Condenser	1.0-1.7
Evaporator	1.5-2.5
Receiver-Drier	0.5-0.8
Refrigerant Lines (1)	1.0-1.7

(1) - Add only if a refrigerant oil leak is indicated.

BOSCH

6-CYLINDER

1) Before checking and adjusting oil level, operate compressor at engine idle speed, and set controls at maximum cooling and high blower motor speed for 20-30 minutes to return oil to compressor.

2) Stop engine and discharge refrigerant. See SERVICING PRECAUTIONS. Remove refrigerant oil level inspection plug on side of compressor. Oil should be at lower lip of threaded hole. If oil level is low, add new refrigerant oil as necessary. Replace inspection plug and tighten to 10-12 ft. lbs. (14-16 N.m).

CALSONIC

V5 5-CYLINDER & V6 6-CYLINDER

Infiniti & Nissan

1) Before checking and adjusting oil level, operate engine at 1200 RPM. Set controls at maximum cooling and high blower motor speed for 10 minutes to return oil to compressor.

2) Stop engine. Discharge refrigerant. See SERVICING PRECAUTIONS. Measure the amount of oil drained/discharged into refrigerant recovery/recycling equipment.

3) Remove compressor from vehicle. Drain compressor oil from compressor drain plug and measure oil amount. Add this amount to amount drained in step 2), to obtain total amount drained.

4) Fill compressor with total amount drained, using new oil. If any major components of the system were also replaced, determine the amount of additional oil needed. See appropriate COMPONENT REFRIGERANT OIL CAPACITIES table for specified amount.

COMPONENT REFRIGERANT OIL CAPACITIES (CALSONIC V5)

A/C COMPRESSOR OIL CHECKING

Article Text (p. 11)

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:20PM

Component	Ounces
Condenser	1.0-1.7
Evaporator	1.5-2.5
Receiver-Drier	0.5-0.8
Refrigerant Lines (1)	1.0-1.7

(1) - Add only if a refrigerant oil leak is indicated.

COMPONENT REFRIGERANT OIL CAPACITIES (CALSONIC V6)

Component	Ounces
Condenser	2.5
Evaporator	2.5
Receiver-Drier	0.2
Refrigerant Lines (1)	1.0

(1) - Add only if a refrigerant oil leak is indicated.

Subaru

1) Before checking and adjusting oil level, operate engine at 1000-1500 RPM. Set controls at maximum cooling and high blower motor speed for 20 minutes to return oil to compressor.

2) Stop engine. Discharge refrigerant and remove compressor from vehicle. See SERVICING PRECAUTIONS. Drain compressor oil from compressor drain plug and measure oil amount.

3) Fill compressor with total amount drained, using new oil. If any major components of the system were also replaced, determine the amount of additional oil needed. See appropriate SUBARU COMPONENT REFRIGERANT OIL CAPACITIES table for specified amount.

SUBARU COMPONENT REFRIGERANT OIL CAPACITIES (LEGACY)

Component	Ounces
Compressor	2.4
Condenser	1.7
Evaporator	2.4
Refrigerant Lines (1)	1.7

(1) - Add only if a refrigerant oil leak is indicated.

SUBARU COMPONENT REFRIGERANT OIL CAPACITIES (SVX)

Component	Ounces
Compressor	2.4
Condenser	1.7

Evaporator	2.4
Refrigerant Lines (1)	1.7

(1) - Add only if a refrigerant oil leak is indicated.

DIESEL KIKI

ROTARY VANE

1) Before checking and adjusting oil level, operate engine at 800-1000 RPM. Set controls at maximum cooling and high blower motor speed for 20 minutes to return oil to compressor.
2) Stop engine. Discharge refrigerant and remove compressor from vehicle. See SERVICING PRECAUTIONS. Remove oil drain plug and measure amount of oil drained.
3) If amount drained is less than 3 ounces (1.7 ounces on Geo Storm), conduct leak tests at system connections. Repair or replace faulty parts as necessary.
4) If amount drained is more 3 ounces (1.7 ounces on Geo Storm), oil level is okay. Fill compressor with same amount drained, using new oil. If amount drained is less than 3 ounces (1.7 ounces on Geo Storm), pour in 3 (1.7) ounces of new refrigerant oil.
5) When replacing other A/C system components, add the following amount(s) of refrigerant oil. See COMPONENT REFRIGERANT OIL CAPACITIES (DIESEL KIKI ROTARY VANE) table.

COMPONENT REFRIGERANT OIL CAPACITIES (DIESEL KIKI ROTARY VANE)

Component	Ounces
Condenser	1.7
Evaporator	1.0
Receiver-Drier	1.0
Refrigerant Lines	0.3

5 & 6-CYLINDER

1) Before checking and adjusting oil level, operate engine at 800-1000 RPM. Set controls at maximum cooling and high blower motor speed for 20 minutes to return oil to compressor.
2) Stop engine. Discharge refrigerant and remove compressor from vehicle. See SERVICING PRECAUTIONS. Remove oil drain plug and measure amount of oil drained.
3) If amount drained is less than 3 ounces, conduct leak tests at system connections. Repair or replace faulty parts as necessary.
4) If amount drained is more 3 ounces, oil level is okay. Fill compressor with same amount drained, using new oil.
5) When replacing other A/C system components, add the following amount(s) of refrigerant oil. See COMPONENT REFRIGERANT OIL

CAPACITIES (DIESEL KIKI 5 & 6-CYLINDER) table.

COMPONENT REFRIGERANT OIL CAPACITIES (DIESEL KIKI 5 & 6-CYLINDER)

Component	Ounces
Condenser	1.0
Evaporator	1.7
Receiver-Drier	1.0
Refrigerant Lines	0.3

FORD

FX-15 10-CYLINDER

1) Slowly discharge system. See SERVICING PRECAUTIONS. Remove A/C compressor. Drain compressor oil from suction and discharge ports. Measure amount drained and discard oil.
2) If amount drained from removed (old) compressor is between 3 and 5 ounces, add drained amount of new refrigerant oil into the NEW compressor through suction port.
3) If amount drained is less than 3 ounces, add 3 ounces to the NEW compressor. If amount drained is more than 5 ounces, add 5 ounces. Use new "O" rings on refrigerant lines. Install A/C compressor. Evacuate and recharge system. Perform leak test.
4) When replacing other A/C system components, add the following amount(s) of refrigerant oil. See COMPONENT REFRIGERANT OIL CAPACITIES (FX-15 10-CYLINDER) table.

COMPONENT REFRIGERANT OIL CAPACITIES (FX-15 10-CYLINDER)

Component	Ounces
Condenser	1.0
Evaporator	3.0
Receiver-Drier	(1) 2.0
Refrigerant Lines	(2) 1.0

(1) - On Hyundai Sonata and Mazda Navajo, drain oil from old receiver-drier. Add amount drained to amount specified.
(2) - Add only if a large oil leak is indicated.

HADSYS

7-CYLINDER

Honda (Accord)
1) Discharge system. See SERVICING PRECAUTIONS. Remove compressor from vehicle. Drain all oil from NEW compressor and fill compressor with 4 ounces of clean refrigerant oil.

2) Add one ounce of refrigerant oil when replacing evaporator. Add1/2 ounce when replacing condenser. When replacing receiver-drier or hoses, add 1/3 ounce per component replaced.

HARRISON

R4 4-CYLINDER

1) Before checking and adjusting oil level, operate engine at 800-1000 RPM. Set controls at maximum cooling and high blower motor speed for 20 minutes to return oil to compressor.
2) Stop engine. Discharge refrigerant and remove compressor from vehicle. See SERVICING PRECAUTIONS. Remove oil drain plug and measure amount of oil drained.
3) If amount drained is less than one ounce, conduct leak tests at system connections. Repair or replace faulty parts as necessary. Fill compressor with 2 ounces, using new refrigerant oil.
4) If amount drained is more one ounce, oil level is okay. Fill compressor with same amount drained, using new oil.
5) When replacing other A/C system components, add the following amount(s) of refrigerant oil. See COMPONENT REFRIGERANT OIL CAPACITIES (HARRISON R4 4-CYLINDER) table.

COMPONENT REFRIGERANT OIL CAPACITIES (HARRISON R4 4-CYLINDER)

Component	Ounces
Condenser	1.0
Evaporator	1.7
Receiver-Drier	1.0
Refrigerant Lines	0.3

V5 5-CYLINDER

1) If system is operable, run A/C system for several minutes to stabilize system. Turn off engine. Discharge system and remove compressor. See SERVICING PRECAUTIONS. Remove drain plug and measure oil.
2) If one ounce or more is drained, add same amount. If less than one ounce is drained, add 2 ounces of new refrigerant oil to compressor.
3) If condenser is replaced, add one ounce. Add 3.5 ounces if accumulator is replaced. If evaporator is replaced or if a large refrigerant leak occurred, add 3 ounces of new refrigerant oil.

HITACHI

6-CYLINDER

1) Before checking and adjusting oil level, operate compressor at 1000-1500 engine RPM, and set controls at maximum

cooling and high blower motor speed for about 10 minutes to return oil to compressor.

2) Stop engine. Discharge refrigerant and remove compressor from vehicle. See SERVICING PRECAUTIONS. Drain oil from compressor through suction port. Measure amount of oil drained.

3) If amount drained is 2.4 ounces or more, fill with same amount using new oil. If amount drained is less than 2.4 ounces, fill with 2.4 ounces. Install compressor and recharge.

4) If A/C components are replaced, add refrigerant oil to system. Add 1.7 ounces if condenser is replaced. Add 2.4 ounces if evaporator is replaced. Oil does not need to be added if receiver-drier is replaced. Add 1.7 ounces of refrigerant oil only if a refrigerant oil leak is indicated.

MATSUSHITA

ROTARY VANE

Geo (Prizm)

1) If system is operable, run A/C system for several minutes to stabilize system. Turn off engine. Discharge system and remove compressor. See SERVICING PRECAUTIONS. Remove drain plug and measure oil.

2) If one ounce or more is drained, add same amount. If less than one ounce is drained, add 2 ounces of new refrigerant oil to compressor.

3) If condenser is replaced, add one ounce. Add 3.5 ounces if receiver-drier is replaced. If evaporator is replaced or if a large refrigerant leak occurred, add 3 ounces of new refrigerant oil.

Toyota

Discharge system. See SERVICING PRECAUTIONS. Remove compressor from vehicle. Drain oil from compressor through inlet and outlet ports. Fill compressor with 3.4-4.1 ounces of oil through suction port. Add 0.7 ounces if receiver-drier was replaced. When replacing condenser or evaporator, add 1.4-1.7 ounces of refrigerant oil.

NIPPONDENSO

ROTARY VANE

1) Before checking and adjusting oil level, operate compressor at engine idle speed, and set controls at maximum cooling and high blower motor speed for 20-30 minutes to return oil to compressor.

2) Stop engine. Discharge refrigerant and remove compressor from vehicle. See SERVICING PRECAUTIONS. Drain compressor oil through compressor intake and discharge ports. Measure amount drained.

3) Fill compressor with same amount as drained, plus one ounce. When replacing condenser, add one ounce. When replacing evaporator, add 1 1/2 ounces. When replacing receiver-drier, add 1/3

ounce of new refrigerant oil.

6 & 10-CYLINDER

NOTE: Porsche and Suzuki compressor oil checking procedures are not available from manufacturer.

Acura & Honda

1) Discharge system. See SERVICING PRECAUTIONS. Remove compressor from vehicle. Drain all oil from NEW compressor and fill compressor with 3-4 ounces of clean refrigerant oil.

2) On Accord, add 5/6 ounce of refrigerant oil when replacing evaporator. Add 1/3 ounce when replacing condenser. When replacing receiver-drier or hoses, add 1/3 ounce per component replaced.

3) On Legend, add 2 ounces of refrigerant oil when replacing evaporator. Add one ounce when replacing condenser. When replacing receiver-drier or hoses, add 1/3 ounce per component replaced.

4) On Integra, add one ounce of refrigerant oil when replacing evaporator. When replacing condenser, receiver-drier or hoses, add 1/3 ounce per component replaced.

5) On Vigor, add 1/2 ounce of refrigerant oil when replacing evaporator. Add 2/3 ounce when replacing condenser. When replacing receiver-drier or hoses, add 1/3 ounce per component replaced.

Chrysler Corp. (Colt Vista/Summit Wagon)

Add 2 ounces of refrigerant oil when replacing evaporator. Add one ounce when replacing condenser. When replacing receiver-drier or hoses, add 1/3 ounce per component replaced.

Ford Motor Co.

On Capri, add 2-3 ounces when replacing compressor. Add one ounce of refrigerant oil when replacing condenser or evaporator. When replacing receiver-drier, add 1/2 ounce. On Festiva, drain and measure oil from receiver-drier. Add the amount drained plus one ounce. Add one ounce when replacing condenser. Add 3 ounces of refrigerant oil when replacing evaporator.

Geo, Hyundai & Mazda

Add one ounce of refrigerant oil when replacing condenser. Add 1-1 1/2 ounce when replacing evaporator. When replacing receiver-drier or hoses, add 1/3 ounce per component replaced.

Lexus & Toyota

The use of refrigerant recovery/recycling is recommended by manufacturer. After refrigerant recovery process is completed, the amount of compressor oil removed must be measured and the same amount added to A/C system. Add 1 1/2 ounces of refrigerant oil when replacing condenser. Add 1 1/2 ounces when replacing evaporator. When replacing receiver-drier or hoses, add1/2 ounce per component replaced.

Mercedes-Benz

Add 2/3 ounce of refrigerant oil when replacing condenser. Add 1 1/3 ounces when replacing evaporator. When replacing receiver-drier or hoses, add 1/3 ounce per component replaced. If A/C system line has broken (sudden discharge), add1 1/3 ounces of refrigerant oil.

NOTE: On Mercedes-Benz vehicles with rear A/C, add 2/3 ounce of refrigerant oil when replacing rear condenser. When replacing rear A/C lines, add 1/3 ounce per line replaced.

Mitsubishi

1) On Eclipse, add 2/3 ounce of refrigerant oil when replacing condenser. Add one ounce when replacing evaporator. When replacing receiver-drier or hoses, add 1/3 ounce per component replaced.

2) On Expo/Expo LRV and Montero, add one ounce of refrigerant oil when replacing condenser. Add 2 ounces when replacing evaporator. When replacing receiver-drier or hoses, add 1/3 ounce per component replaced.

Volkswagen (Fox)

1) The use of refrigerant recovery/recycling is recommended by manufacturer. After refrigerant recovery process is completed, the amount of compressor oil removed must be measured and the same amount added to A/C system.

2) Add 1 1/2 ounce of refrigerant oil when replacing evaporator. When replacing condenser, add 1 1/3 ounce of refrigerant oil. Add one ounce of refrigerant oil when replacing receiver-drier (1 1/2 ounces if relief valve on receiver-drier has burst).

PANASONIC

ROTARY VANE

Mazda

Add 1 1/3 ounce of refrigerant oil when replacing condenser (1/2 ounce on MX-6 and 626). Add 2 ounces when replacing evaporator. When replacing receiver-drier or hoses, add 1/3 ounce of refrigerant oil.

SANDEN

SCROLL

Chrysler/Mitsubishi

1) On Colt, Galant, Mirage, Pickup, Ram-50 and Summit, add 1/2 ounce of refrigerant oil when replacing condenser. Add 1 1/2 ounces when replacing evaporator. When replacing receiver-drier or hoses, add 1/3 ounce per component replaced.

2) On Stealth and 3000GT, add 1/2 ounce of refrigerant oil when replacing condenser. Add 2 ounces when replacing evaporator. When replacing receiver-drier or low-pressure hose, add 1/3 ounce per

component replaced.

Honda
1) Discharge system. See SERVICING PRECAUTIONS. Remove compressor from vehicle. Drain all oil from NEW compressor and fill compressor with 4 ounces of clean refrigerant oil.
2) On Civic and Civic Del Sol, add 1 1/2 ounce of refrigerant oil when replacing evaporator. Add 2/3 ounce when replacing condenser. When replacing receiver-drier or hoses, add 1/3 ounce per component replaced.
3) On Prelude, add one ounce of refrigerant oil when replacing evaporator. When replacing other A/C components, add 1/3 ounce per component replaced (including hoses).

Hyundai
Add 1 1/2 ounces of refrigerant oil when replacing evaporator. Add one ounce when replacing condenser. When replacing receiver-drier, add 1/3 ounce of refrigerant oil.

5-CYLINDER

Mazda
Add one ounce of refrigerant oil when replacing condenser. Add 1 2/3 ounce when replacing evaporator. When replacing receiver-drier, add 1/2 ounce of refrigerant oil.

NOTE: Saab and Volvo (Sanden 5 or 7-cylinder) compressor oil checking procedures are not available from manufacturer.

7-CYLINDER

Hyundai & Mitsubishi (Excel & Precis)
1) Before checking and adjusting oil level, operate compressor at engine idle speed, and set controls at maximum cooling and high blower motor speed for 20-30 minutes to return oil to compressor.
2) Stop engine. Discharge refrigerant and remove compressor from vehicle. See SERVICING PRECAUTIONS. Remove oil drain plug and drain oil. Measure amount of oil drained. Install drain plug with new "O" ring.
3) If amount drained is 2.3 ounces or more, fill compressor with same amount using new oil. If amount drained is less than 2.3 ounces, fill with 2.3 ounces. Install filler plug. Install compressor and recharge system.

COMPONENT REFRIGERANT OIL CAPACITIES (SANDEN 7-CYLINDER)

Component	Ounces
Condenser	1.0
Evaporator	3
Receiver-Drier	1

A/C COMPRESSOR OIL CHECKING

Article Text (p. 19)

1993 Volkswagen EuroVan

For Volkswagen Technical Site

Saturday, March 18, 2000 10:20PM

Jaguar (XJS)

1) Operate engine at idle speed for 10 minutes, to return refrigerant oil to compressor. Stop engine. Discharge refrigerant. See SERVICING PRECAUTIONS. Clean area around compressor filler plug and remove plug slowly.

2) Determine angle at which compressor is mounted. Insert compressor dipstick diagonally until stop on dipstick contacts filler plug surface. See Fig. 1. Remove dipstick and note oil fill level. Each increment on dipstick represents one ounce of oil.

3) Determine amount of oil needed according to mounting angle. See COMPRESSOR OIL CAPACITIES (JAGUAR XJS) table for specified amount.

4) If necessary, correct compressor oil level. Install compressor oil plug, and tighten it to 72-108 INCH lbs. (8-12 N.m). Evacuate and recharge A/C system. Perform leak test.

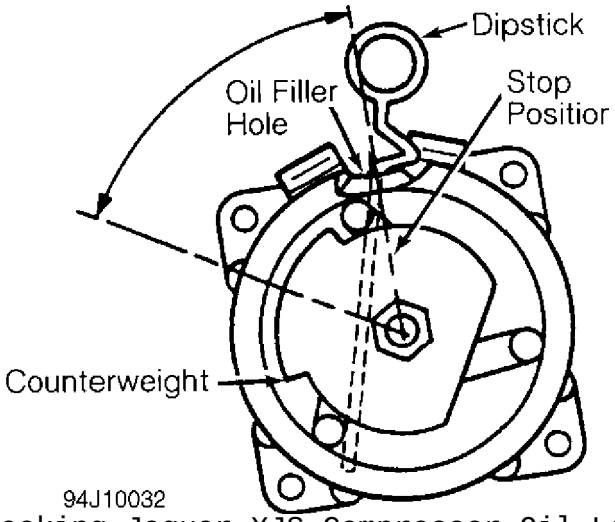


Fig. 1: Checking Jaguar XJS Compressor Oil Level (Sanden 7-Cylinder) Courtesy of Jaguar Cars, Inc.

COMPRESSOR OIL CAPACITIES (JAGUAR XJS)

Mounting Angle (In Degrees)	Oil Level In Increments
0	3-5
10	4-6
20	5-7
30	6-8
40	7-9
50	8-10
60	9-11
90	10-12

Volkswagen

1) The use of refrigerant recovery/recycling is recommended

by manufacturer. After refrigerant recovery process is completed, the amount of compressor oil removed must be measured and the same amount added to A/C system.

2) On Cabriolet, add 2/3 ounce of refrigerant oil when replacing evaporator. When replacing condenser or receiver-drier, add 1/3 ounce of refrigerant oil per component replaced.

3) On Corrado SLC, Golf, GTI, Jetta and Passat, add 2/3 ounce of refrigerant oil when replacing evaporator. When replacing condenser or receiver-drier, add 1/3 ounce of refrigerant oil per component replaced.

4) On EuroVan, add one ounce of refrigerant oil when replacing evaporator. Add 1/2 ounce when replacing condenser (2/3 ounce on vehicles with rear A/C). When replacing receiver-drier, add 1/3 ounce (2/3 ounce on vehicles with rear A/C).

SEIKO-SEIKI

ROTARY VANE

Saab (9000)

The A/C system is filled with 6.6 ounces of compressor oil. The compressor must be topped off with the specified amount. See COMPONENT REFRIGERANT OIL CAPACITIES (SEIKO-SEIKI ROTARY VANE) table. Topping off should be carried out on the high pressure side of the compressor.

COMPONENT REFRIGERANT OIL CAPACITIES (SEIKO-SEIKI ROTARY VANE)

Component	Ounces
Compressor	(1) 2.3
Condenser	1.3
Expansion Valve	0.6
Evaporator	1.3
Receiver-Drier	1.3
Refrigerant Lines	0.6

(1) - To avoid an excessive amount of oil in the A/C system, oil must be drained from the compressor before it is installed.

ZEXEL

NOTE: Isuzu and Subaru compressor oil checking procedures are not available from manufacturer.

ROTARY VANE

Nissan

1) Before checking and adjusting oil level, operate engine at 1200 RPM. Set controls at maximum cooling and high blower motor speed for 10 minutes to return oil to compressor.

2) Stop engine. Discharge refrigerant. See SERVICING PRECAUTIONS. Measure the amount of oil drained/discharged into refrigerant recovery/recycling equipment.
3) Remove compressor from vehicle. Drain compressor oil from compressor drain plug and measure oil amount. Add this amount to amount drained in step 2), to obtain total amount drained.
4) Fill compressor with total amount drained, using new oil. If any major components of the system were also replaced, determine the amount of additional oil needed. See COMPONENT REFRIGERANT OIL CAPACITIES (ZEXEL ROTARY VANE & 6-CYLINDER) table for specified amount.

COMPONENT REFRIGERANT OIL CAPACITIES (ZEXEL ROTARY VANE & 6-CYLINDER)

Component	Ounces
Condenser	
Altima & Maxima	2.5
NX, Pickup, Sentra & 300ZX	1.0-1.7
Evaporator	
Altima & Maxima	2.5
NX, Pickup, Sentra & 300ZX	1.5-2.5
Receiver-Drier	
Altima & Maxima	0.2
NX, Pickup, Sentra & 300ZX	0.5-0.8
Refrigerant Lines (1)	1.0

(1) - Add only if a refrigerant oil leak is indicated.

6-CYLINDER

Audi
1) The use of refrigerant recovery/recycling is recommended by manufacturer. After refrigerant recovery process is completed, the amount of compressor oil removed must be measured and the same amount added to A/C system.
2) Add one ounce of refrigerant oil when replacing accumulator. When replacing condenser, add amount drained from condenser plus 1/3 ounce of refrigerant oil. When replacing evaporator, add amount drained from evaporator plus 2/3 ounce of refrigerant oil.

Nissan
1) Before checking and adjusting oil level, operate engine at 1200 RPM. Set controls at maximum cooling and high blower motor speed for 10 minutes to return oil to compressor.
2) Stop engine. Discharge refrigerant. See SERVICING PRECAUTIONS. Measure the amount of oil drained/discharged into refrigerant recovery/recycling equipment.
3) Remove compressor from vehicle. Drain compressor oil from compressor drain plug and measure oil amount. Add this amount to

amount drained in step 2), to obtain total amount drained.

4) Fill compressor with total amount drained, using new oil. If any major components of the system were also replaced, determine the amount of additional oil needed. See COMPONENT REFRIGERANT OIL CAPACITIES (ZEXEL ROTARY VANE & 6-CYLINDER) table for specified amount.

Volvo (850)

1) Discharge refrigerant. See SERVICING PRECAUTIONS. Remove compressor from vehicle. Drain compressor oil from compressor drain plug and measure oil amount. Add the same amount of oil as was drained from the old compressor.

2) Add 1 2/3 ounce of refrigerant oil when replacing evaporator. When replacing condenser or hoses, add 2/3 ounce of refrigerant oil per component replaced. Add 3 ounce of refrigerant oil when replacing receiver-drier.

END OF ARTICLE

A/C COMPRESSOR SERVICING
Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:20PM

ARTICLE BEGINNING

1993 AIR CONDITIONING & HEAT
Compressor Servicing

READ THIS FIRST

NOTE: The purpose of this article is to provide GENERAL servicing overview. For more specific information, refer to the AUTO A/C-HEAT SYSTEM, MANUAL A/C-HEAT SYSTEM, or HEATER SYSTEM articles in this section.

NOTE: Due to variety of clutch and shaft seal configurations, obtain appropriate A/C compressor service tools for compressor being serviced.

ATSUGI ROTARY VANE CLUTCH COIL R & I

Removal

When replacing compressor clutch, be careful not to scratch shaft or bend pulley. When removing center bolt, hold clutch disc with Clutch Holder (KV99231010). Using Hub Puller (KV998VR001), remove clutch disc. When removing pulley, remove lock nut with Hub Socket (KV99235160).

Installation

1) Tighten center bolt to 81-104 INCH lbs. (9.1-11.8 N.m). Tighten lock nut to 21-29 ft. lbs. (29-39 N.m). Using feeler gauge, ensure clearance between clutch disc and pulley is .012-.024" (.30-.60 mm).

2) If clearance is not correct, replace adjustment shim(s). See Fig. 1. Break-in clutch by engaging and disengaging clutch about 30 times.

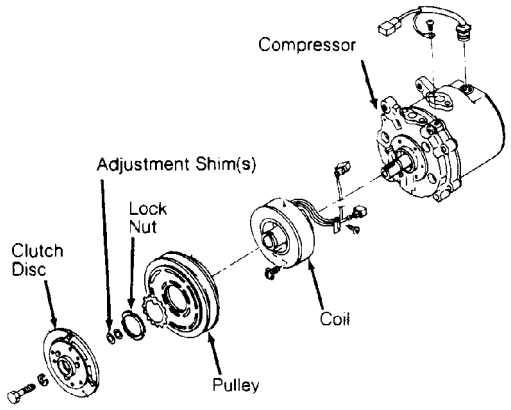


Fig. 1: Exploded View Of Compressor (Atsugi Rotary Vane)
Courtesy of Nissan Motor Co., U.S.A.

BOSCH 6-CYLINDER CLUTCH COIL R & I

Removal

1) Hold clutch plate and remove shaft nut. Using Clutch Plate Remover (64 5 00), remove clutch plate. Using snap ring pliers, remove circlip and remove pulley assembly.

2) If pulley bearing is being replaced, remove circlip at rear of pulley. Press bearing and spacer from pulley. Press in new bearing with spacer and replace circlip.

Installation

1) Clean all surfaces. Install pulley assembly on compressor and install circlip. Ensure clutch plate shim is in place on shaft. Install clutch plate and nut. Tighten nut to 13-15 ft. lbs. (18-20 N. m).

2) Using a feeler gauge, check clutch plate-to-pulley clearance. Clearance should be .028-.051" (.7-1.3 mm). If clearance is not correct, remove clutch plate and replace clutch plate shim. See Fig. 2.

BOSCH 6-CYLINDER SHAFT SEAL R & I

Removal

Remove clutch plate. Remove shaft key and circlip. Using Seal Seat Remover/Installer (64 5 030), remove seal seat. Using Seal Remover/Installer (64 5 040), turn seal slightly clockwise to disengage tangs and pull out shaft seal. Remove "O" ring seal.

Installation

1) Coat new "O" ring seal with refrigerant oil and install. Coat new shaft seal with refrigerant oil and install seal on Seal Remover/Installer(64 5 040). Ensure shaft seal and shaft machine surfaces align. Insert shaft seal and turn slightly counterclockwise to secure on shaft.

2) Using sleeve from Seal Seat Remover/Installer (64 5 030), push seal seat into compressor and install circlip. Install shaft key and clutch plate. Check compressor oil level before charging system.

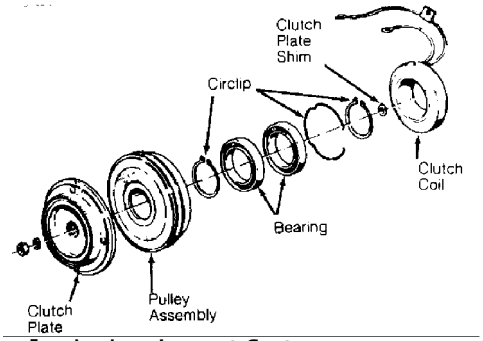


Fig. 2: Exploded View Of Compressor Clutch (Bosch 6-Cylinder)
Courtesy of BMW of North America, Inc.

CALSONIC V5 & V6 CLUTCH COIL R & I

NOTE: Calsonic V6 compressor servicing procedure is not available from manufacturer.

Removal

1) Remove shaft nut while holding clutch plate with Clutch Disc Wrench (J-39072). Install clutch disc Puller Set (J-39073-4, J-33013-1, J-33013-3) and remove clutch plate.

2) Remove snap ring. Use a universal gear puller to remove clutch pulley. See Fig. 3. Remove screw from clutch coil lead. Use puller to remove clutch coil.

Installation

1) To install clutch coil, reverse removal procedure. Ensure coil lead is installed in original position. Using puller set and Coil Jig (J-39073-1), carefully press clutch coil into place.

2) Install a new clutch pulley snap ring, being careful not to damage shaft seal. Press clutch plate into place. Install shaft nut and torque to 89-106 INCH lbs. (10-12 N.m).

3) Use a feeler gauge to check clutch plate-to-pulley clearance. Clearance should be .012-.024" (.30-.60 mm). If clearance is too large, remove shaft nut and again press in clutch plate. If clearance is too small, increase gap by pulling up clutch plate. DO NOT remove shaft nut.

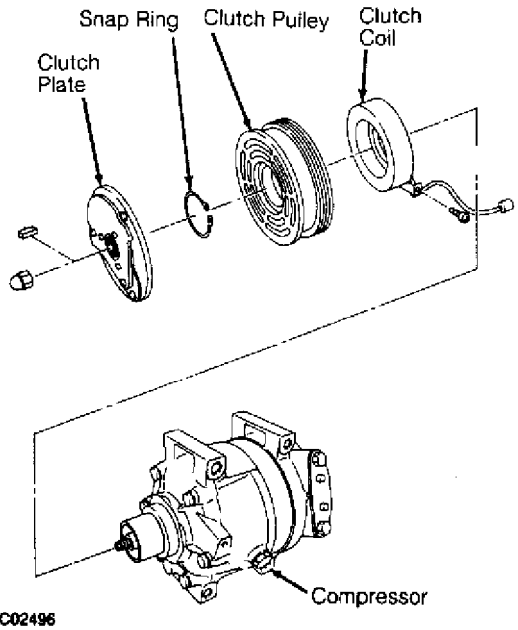


Fig. 3: Exploded View Of Compressor Clutch (Calsonic V5)
Courtesy of Nissan Motor Co., U.S.A.

DIESEL KIKI ROTARY VANE CLUTCH COIL R & I

Removal

1) Hold clutch disc using Clutch Holder (J-33939) and remove center bolt. Using Puller (J-33944-A) and Forcing Bolt (J-33944-4), remove clutch disc. Remove adjustment shim(s) and snap ring.

2) Remove pulley using Pilot (J-38424) and universal puller. Remove coil lead screw, clutch coil screws and coil. Remove snap ring and bearing if necessary.

Installation

1) Ensure coil lead is installed in original position. Install and tighten coil screws to 35-53 INCH lbs. (4-6 N.m). Press pulley onto compressor using Pulley Installer (J-33940). Install snap ring and adjustment shim(s).

2) Install clutch disc and tighten center bolt to 106-133 INCH lbs. (12-15 N.m). Using feeler gauge, ensure clearance between clutch disc and pulley is .012-.024" (.30-.60 mm). If clearance is incorrect, add or remove shim(s) as necessary. Break-in clutch by engaging and disengaging clutch 30 times.

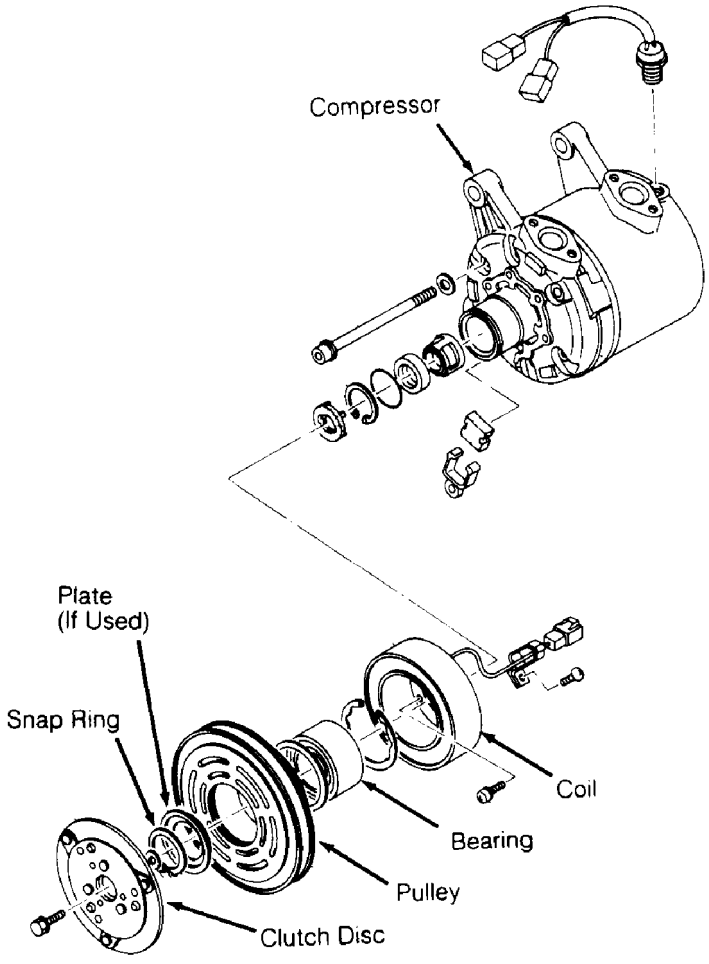


Fig. 4: Exploded View Of Compressor (Diesel Kiki Rotary Vane)
Courtesy of Nissan Motor Co., U.S.A.

DIESEL KIKI 6-CYLINDER CLUTCH COIL R & I

NOTE: Due to variety of clutch and shaft seal configurations, obtain appropriate A/C compressor service tools for compressor being serviced.

Removal & Installation

1) Using Clutch Holder (J-33939) to prevent clutch disc from rotating, remove shaft bolt. Using Clutch Disc Puller (J-33944-A) and Forcing Bolt (J-33944-4), remove clutch disc. Remove shim(s) from compressor drive shaft or clutch disc. See Fig. 5.

2) Remove snap ring, cover and pulley. With Puller Guide (J-33943-A) in center of pulley, attach Crossbar (J-8433) to outside diameter of pulley. Tighten crossbar bolt against puller guide to remove pulley. Remove coil lead, screws, and coil.

3) To install, reverse removal procedure. Install cover snap ring with beveled side facing out. Install clutch disc and tighten center bolt to 133 INCH lbs. (15 N.m).

4) Using feeler gauge, ensure clearance between clutch disc and pulley is .012-.024" (.30-.60 mm). If clearance is incorrect, add or remove shim(s) as necessary.

DIESEL KIKI SHAFT SEAL R & I

Removal & Installation

1) Remove clutch coil. Remove and discard felt. Using Shaft Seal Cover Remover/Installer (J-33942), push down and turn remover clockwise to engage tangs to cover. Slowly remove seal cover from bore.

2) Remove shaft seal snap ring. Use Shaft Seal Remover (J-33942-B) to remove seal. Remove compressor through bolts, front head and "O" ring. If necessary, replace front and rear valve plates, reed valves, and "O" rings.

3) To install, reverse removal procedure. Coat "O" ring, shaft seal and seal seat with refrigerant oil. Place Shaft Seal Guide (J-34614) over end of compressor shaft. Ensure chamfered portion of shaft seal retainer aligns with chamfered portion on compressor shaft.

4) Install front head and tighten compressor through bolts, in a crisscross pattern, to 16 ft. lbs. (22 N.m). Install shaft seal cover and felt. See Fig. 5. Rotate compressor drive shaft 2-3 times to ensure compressor operates smoothly.

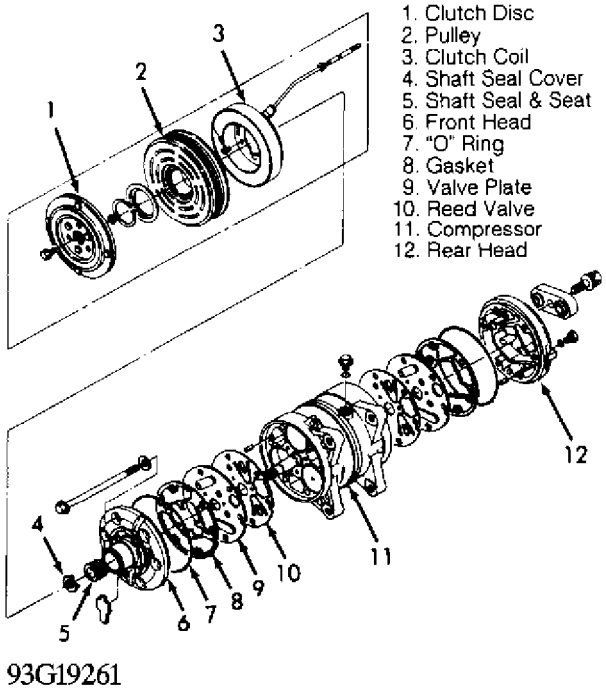


Fig. 5: Exploded View Of Compressor (Diesel Kiki 6-Cylinder)
Courtesy of Isuzu Motor Co.

FORD FX-15 CLUTCH COIL R & I

Removal

1) Using Clutch Holder (000 41 0812 05), remove clutch plate bolt. Using an 8-mm bolt threaded into clutch plate, remove clutch plate and shim(s). See Fig. 6.

2) Remove snap ring and pulley assembly. Install Shaft Protector (49 UN01 047) over shaft seal opening. Use a 2-jaw puller to remove clutch coil from compressor.

Installation

1) Ensure clutch coil mounting surface is clean. Use Coil Installer (49 UN01 046) and 2-jaw puller engaged to rear side of compressor front mounts to press coil into place.

2) Install pulley assembly. Install pulley assembly snap ring with bevel side of snap ring facing out. Install shim(s) and clutch plate. Install a new clutch plate bolt and tighten to 97-115 INCH lbs. (11-13 N.m).

3) Use a feeler gauge to check clearance between clutch plate and pulley assembly. Clearance should be .018-.033" (.46-.84 mm). If clearance is incorrect, add or remove shims as necessary.

FORD FX-15 SHAFT SEAL R & I

Removal

1) Using Clutch Holder (000 41 0812 05), remove clutch plate bolt. Using an 8-mm bolt threaded into clutch plate, remove clutch plate and shim(s). See Fig. 6.

2) Remove shaft felt seal. Thoroughly clean seal area of compressor. Remove shaft seal snap ring. Position Shaft Seal Remover (49 UN01 044) over compressor shaft.

3) Push shaft seal remover downward against seal. Ensure end of shaft seal remover is engaged with inside of seal. Rotate shaft seal remover clockwise to expand remover tip inside seal. Pull shaft seal from compressor.

Installation

1) Lubricate shaft seal protector and shaft seal with refrigerant oil. Install shaft seal on shaft seal protector so lip seal is toward compressor (large end of shaft seal protector).

2) Install shaft seal protector on compressor shaft. Using Shaft Seal Installer (49 UN01 043), push shaft seal down seal protector until seal is seated.

3) Remove shaft seal installer and protector. Install a new shaft seal retaining snap ring and shaft seal felt. Install shim(s) and clutch plate. Install a new clutch plate retaining bolt and tighten to 97-115 INCH lbs. (11-13 N.m).

4) Use a feeler gauge to check clearance between clutch plate and pulley assembly. Clearance should be .018-.033" (.46-.84 mm). If clearance is incorrect, add or remove shims as necessary.

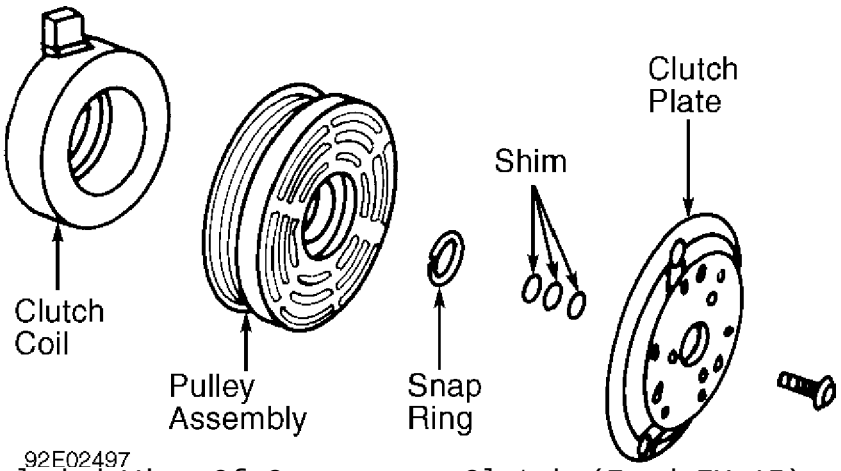


Fig. 6: Exploded View Of Compressor Clutch (Ford FX-15)
Courtesy of Mazda Motors Corp.

HADSYS 7-CYLINDER CLUTCH COIL R & I

Removal

Using Clutch Holder (J-37872), hold pressure plate and remove shaft bolt. Remove pressure plate and adjustment shim(s). See Fig. 7. Remove snap ring. Using universal puller, remove compressor pulley. Remove clutch coil.

Installation

Install clutch coil in reverse order of removal. Ensure snap ring is properly seated. Apply locking compound to shaft bolt and tighten it to 62 INCH lbs. (7 N.m). Ensure clearance between pressure plate and pulley is 0.012-0.024" (.30-.60 mm). If clearance is incorrect, add or remove shim(s) as necessary.

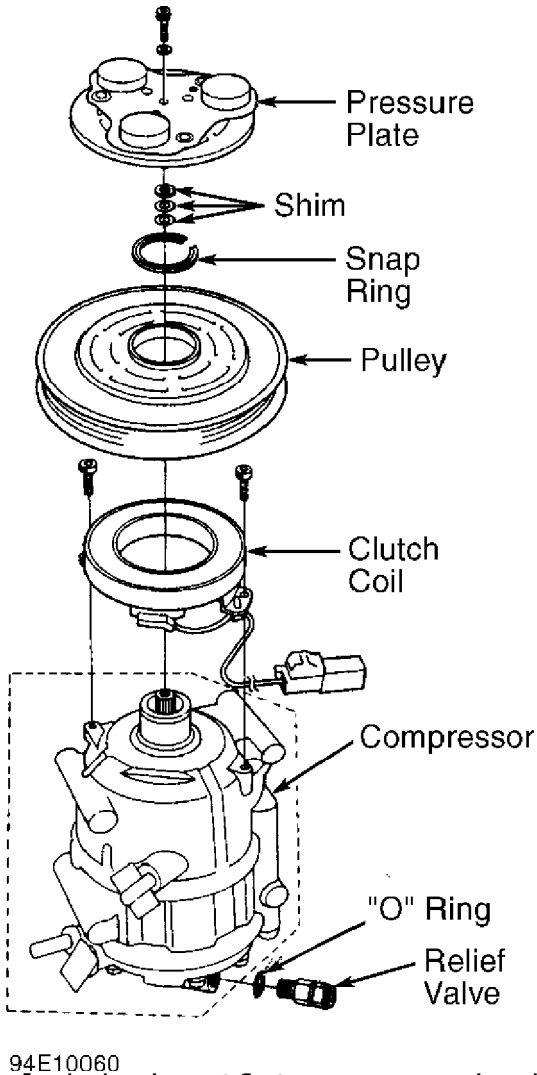


Fig. 7: Exploded View Of Compressor (Hadsys 7-Cylinder)
Courtesy of American Honda Motor Co., Inc.

HARRISON R4 4-CYLINDER CLUTCH COIL AND BEARING R & I

Removal

1) Clamp Holding Fixture (J-25008-A) in vise. Attach compressor to holding fixture. Use Clutch Hub Holder (J-33027) to hold clutch and remove shaft nut.

2) Thread Hub and Drive Plate Assembly Remover/Installer (J-37707) into hub. Hold body of remover with wrench and turn center bolt

into remover body to remove clutch plate and hub assembly. Remove shaft key and save for installation.

3) Remove snap ring. Place Puller Guide (J-25031-1) in center of pulley housing. Engage universal puller to outer diameter of pulley (clutch rotor). See Fig. 8. Hold puller and tighten screw to remove pulley.

4) Invert pulley and place on work bench. Press out rotor bearing using handle and Bearing Remover (J-9398-A). Attach universal puller to outside diameter of clutch coil. Tighten bolt against puller guide to remove clutch coil.

CAUTION: DO NOT drive or pound on clutch hub or shaft.

Installation

1) Ensure clutch coil is installed in original position. Press pulley onto compressor using Installer (J-9481-A) and handle. Install shaft key into hub key groove. Allow key to project approximately 3/16" (4.8 mm) out of keyway.

2) Ensure frictional surface of clutch plate and clutch rotor are clean before installing clutch plate and hub assembly. Align shaft key with shaft keyway and place clutch plate and hub assembly onto compressor shaft.

3) Hold hub and drive plate remover/installer with wrench and tighten nut to press hub into shaft until there is a .020-.040" (.5-1.0 mm) air gap between plate and clutch rotor. Install a new shaft nut and tighten to 10 ft. lbs. (14 N.m). Ensure rotor is not rubbing on clutch plate.

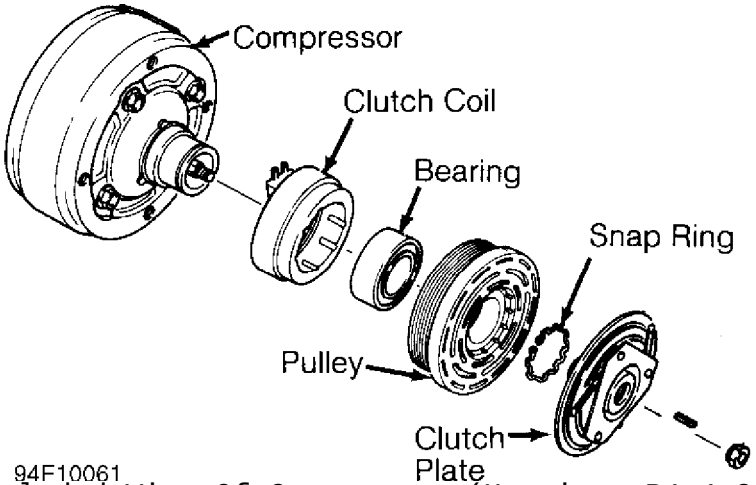


Fig. 8: Exploded View Of Compressor (Harrison R4 4-Cylinder) Courtesy of Isuzu Motor Co.

HARRISON V5 5-CYLINDER CLUTCH COIL AND BEARING R & I

Removal

1) Clamp Holding Fixture (J-34992) in vise. Attach compressor to holding fixture. Use Clutch Hub Holder (J-33027-A) to hold clutch. Remove shaft nut using Socket (J-33022). See Fig. 9.

2) Thread Clutch Plate and Hub Assembly Remover (J-33013-B) into hub. Hold body of remover with wrench and turn center bolt to remove clutch plate and hub assembly. Remove snap ring. Remove shaft key and save for installation.

3) Place Puller Guide (J-33023-A) in center of pulley housing. Engage Rotor/Bearing Puller (J-33020) to inner circle of slots in pulley (rotor). Hold rotor/bearing puller in place and tighten screw to remove pulley.

4) Remove screw from rotor/bearing puller. Invert assembly and place on work bench with rotor/bearing puller still engaged. Remove hub bearing using handle and Bearing Remover (J-9398-A).

5) With puller guide in place, attach Crossbar (J-8433-1) and Puller (J-33025) to outside diameter of clutch coil. Tighten crossbar Bolt (J-8433-3) against puller guide to remove clutch coil.

Installation

1) Ensure clutch coil is installed in original position. Press coil into position using crossbar, clutch Coil Installer (J-33024) and Through Bolts (J-34992-2). Stake compressor housing 120 degrees apart to secure coil.

2) Position Rotor/Bearing Installer (J-33017) and puller guide over inner race of bearing. Using through bolts, assemble crossbar over puller pilot and tighten through bolts onto holding fixture. Tighten crossbar bolt to press pulley/bearing assembly onto compressor.

3) Install shaft key into hub key groove. Allow key to project approximately 1/8" (3.2 mm) out of keyway. Align shaft key with shaft keyway and place clutch plate and hub assembly onto compressor shaft.

CAUTION: Do not drive or pound on clutch hub or compressor shaft, as compressor could be damaged internally.

4) Hold hex portion of Hub Installer (J-33013) with a wrench. Tighten center screw to press hub into shaft until there is .020-.030" (.50-.76 mm) air gap between frictional plate and clutch rotor.

5) Install new shaft nut with small diameter boss of nut against crankshaft shoulder. Use Socket (J-33022) and Clutch Hub Holder (J-33027-A). Tighten shaft nut to 12 ft. lbs. (16 N.m). Ensure pulley does not rub on clutch plate. See Fig. 9.

HARRISON V5 5-CYLINDER SHAFT SEAL R & I

Removal

Remove clutch plate and hub assembly. Remove shaft seal snap ring. Thoroughly clean inside of compressor neck area around shaft and seal. Engage tangs of Seal Remover/Installer (J-23128-A) into recessed portion of seal and remove seal. Remove and discard "O" ring from compressor neck. Thoroughly clean inside of compressor neck and "O" ring groove.

Installation

1) Coat new "O" ring with refrigerant oil and install on "O" Ring Installer (J-33011). Install "O" ring into groove in compressor neck. Attach new seal to seal remover/installer. Dip shaft seal in clean refrigerant oil.

2) Place Seal Protector (J-34614) over compressor shaft. Push new seal over shaft protector. Install new seal snap ring with flat side against seal. Install clutch plate assembly.

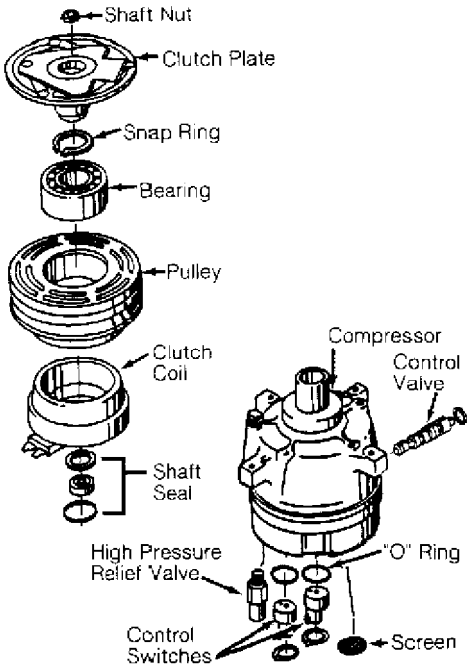


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Fig. 9: Exploded View Of Compressor (Harrison V5 5-Cylinder) Courtesy of General Motors Corp.

HITACHI 6-CYLINDER CLUTCH COIL AND SEAL R & I

Removal

1) Hold clutch hub with Clutch Tightener (925770000). Remove shaft nut from shaft. Using Clutch Hub Remover (926130000), remove clutch hub. Use snap ring pliers to remove inner snap ring.

2) Remove pulley and bearing assembly. Remove screws securing clutch coil lead. Remove inner snap ring from clutch coil. Remove clutch coil from front cover.

3) Remove shaft key. Use snap ring pliers to remove shaft seal snap ring. Wrap a rag around compressor shaft. Using Injector Needle (92619000) and refrigerant can, slowly pressurize compressor at low pressure (suction) service port. See Fig. 10. Catch shaft seal seat in rag.

4) Insert Shaft Seal Remover/Installer (926120000) through

open end of front cover. Slowly pull out remover/installer to remove shaft seal.

Installation

1) Ensure shaft seal contact surface is free of dirt. Lubricate with refrigerant oil. Using shaft seal remover/installer, insert shaft seal.

2) To install clutch coil and hub, reverse removal procedure. Tighten shaft nut to 14-15 ft. lbs. (19-21 N.m). Ensure clearance between pressure plate and pulley is 0.020-0.031" (.50-.80 mm).

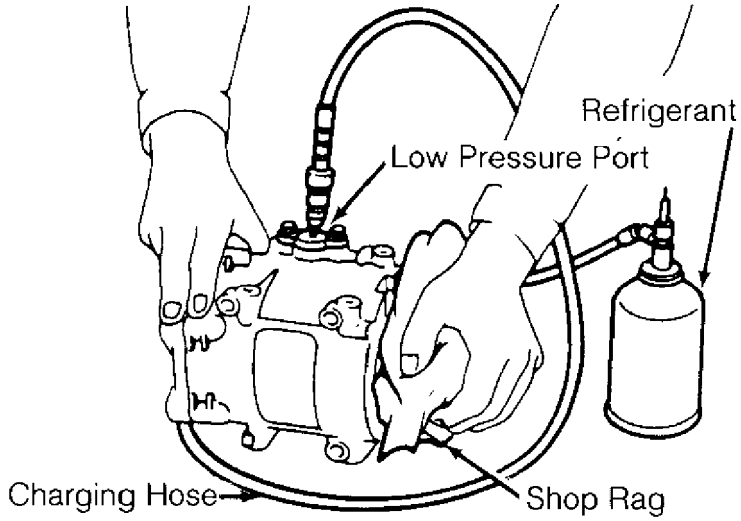

Fig. 10: Removing Compressor Shaft Seal Seat (Hitachi 6-Cylinder) Courtesy of Subaru of America, Inc.

MATSUSHITA ROTARY VANE CLUTCH COIL R & I

Removal & Installation

1) Using Pressure Plate Holder (J-7624) and socket, remove center bolt. Thread Puller (J-34878) onto pressure plate. Hold pressure plate with pressure plate holder and tighten puller to remove pressure plate.

2) Remove shim(s) from shaft. Remove snap ring and, using a plastic hammer, tap pulley off. Remove screw for clutch coil lead. Remove snap ring and clutch coil. See Fig. 11.

3) To install, reverse removal procedure. Tighten shaft bolt to 10 ft. lbs (14 N.m). Using feeler gauge, ensure clearance between pressure plate and pulley is .014-.026" (.35-.65 mm). If clearance is incorrect, add or remove shim(s) as necessary.

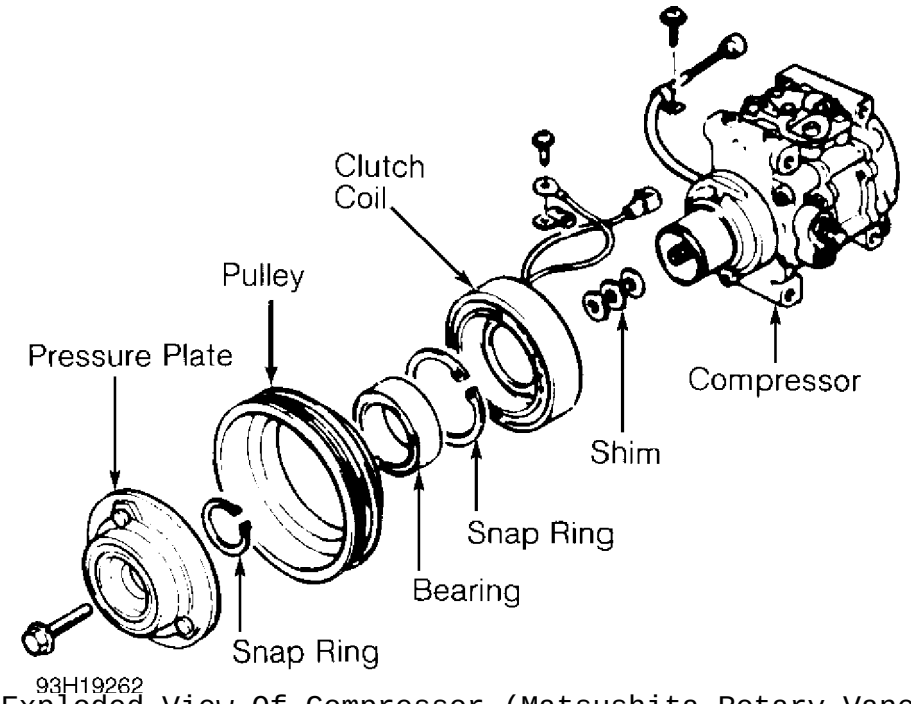

Fig. 11: Exploded View Of Compressor (Matsushita Rotary Vane)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

NIPPONDENSO TV12 ROTARY VANE CLUTCH COIL R & I

Removal

1) Hold clutch disc with Clutch Holder (00007-10331) and remove shaft nut. Install Clutch Disc Remover (4992-02-020) and remove clutch disc and shims. See Fig. 12.

2) Remove pulley snap ring and tap pulley (with bearing) off of compressor with plastic hammer. Remove screw for clutch coil lead. Remove snap ring and clutch coil.

Installation

To install, reverse removal procedure. Ensure pulley-to-clutch disc clearance is .016-.024" (.40-.60 mm). If clearance is incorrect, add or remove shim(s) as necessary.

NIPPONDENSO TV12 DISCHARGE VALVE & SHAFT SEAL R & I

Removal

1) Drain and measure compressor oil in compressor. Remove discharge valve body through bolts. Remove discharge valve body bolts and body. Remove discharge valve plate and discharge valve.

2) Remove compressor through bolts and front and rear housing (oil separator case). Remove pins and gaskets. Remove shaft seal from shaft. Press shaft seal plate off of front housing (head cover).

Installation

To install components, reverse removal procedure. Tighten

compressor through bolts to 19 ft. lbs. (26 N.m). Tighten discharge valve bolts to 41 INCH lbs. (4.6 N.m). Tighten discharge valve body and body through bolts to 96 INCH lbs. (10.8 N.m).

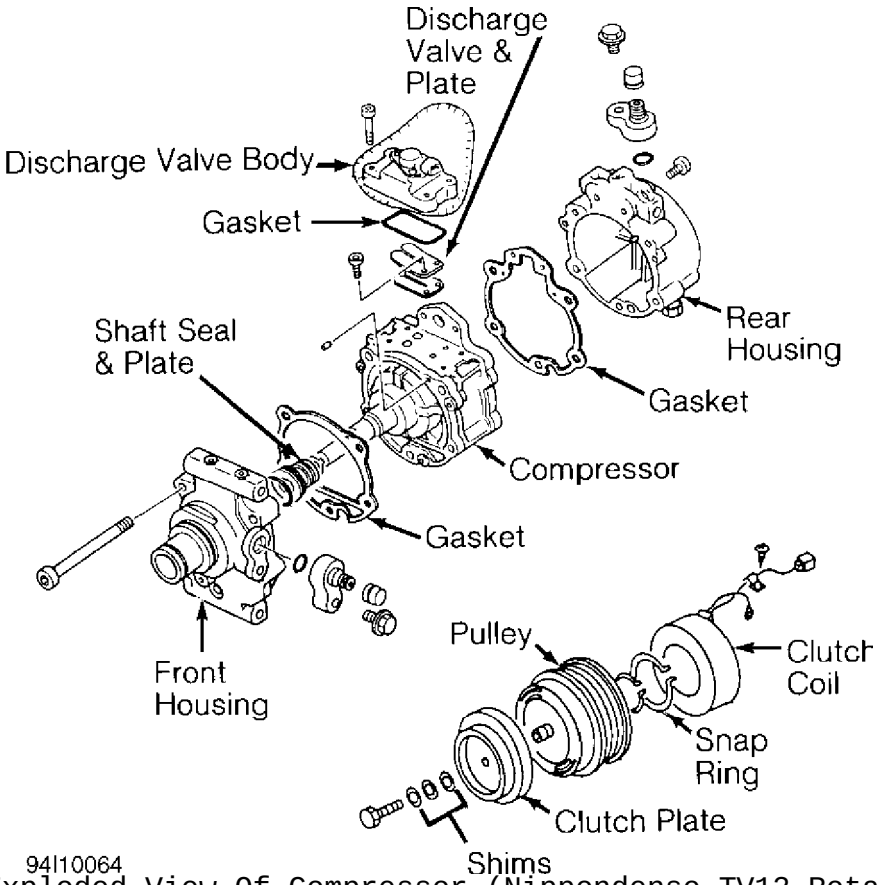

Fig. 12: Exploded View Of Compressor (Nippondenso TV12 Rotary Vane) Courtesy of Mazda Motors Corp.

NIPPONDENSO 6 & 10-CYLINDER CLUTCH COIL AND BEARING R & I

NOTE: Due to variety of clutch and shaft seal configurations, obtain appropriate A/C compressor service tools for compressor being serviced.

Removal

1) Hold clutch plate stationary and remove shaft bolt (or nut). Remove clutch plate using puller. Remove shim(s) from shaft and snap ring. Tap pulley off shaft with plastic hammer. If pulley cannot be removed by hand, use commercially available puller.

2) Remove snap ring, bearing, and seal (if equipped) from pulley. See Fig. 13. Remove screw for clutch coil lead. Remove snap ring and clutch coil.

Installation

To install, reverse removal procedure. Ensure snap rings are installed with beveled side facing out. Tighten shaft bolt (or nut) to

13-14 ft. lbs. (17-19 N.m) on Fox, MR2 and Scoupe; 10-13 ft. lbs. (14-17 N.m) on all others. Ensure air gap between clutch plate and pulley is .024-.040" (.60-1.00 mm) on Fox and MR2; .014-.026" (.36-.66 mm) on all others. If air gap is incorrect, add or remove shim(s) as necessary.

NOTE: To check air gap, place a dial indicator on clutch plate. Apply voltage to clutch coil. Check air gap between clutch plate and drive pulley. Ensure air gap is as specified.

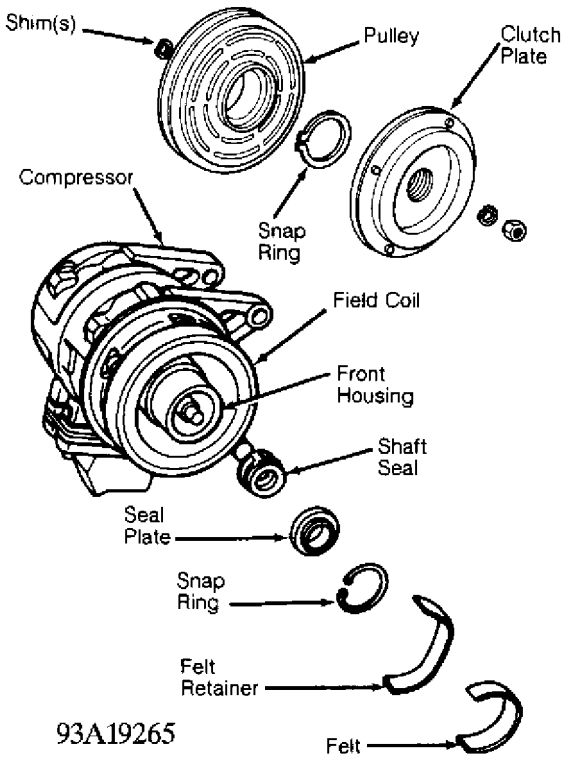

Fig. 13: Exploded View Of Compressor (Nippondenso 10-Cylinder) Courtesy of Ford Motor Co.

NIPPONDENSO 6 & 10-CYLINDER SHAFT SEAL R & I

NOTE: On Chrysler and Mitsubishi, remove compressor through bolts and front housing to remove shaft seal. See Fig. 14. Alternately tighten through bolts to 18-21 ft. lbs. (24-28 N.m).

Removal

1) Remove clutch plate and pulley. Remove shim(s) from shaft. Remove clutch coil if necessary. Remove felt and felt retainer (if equipped). Place shaft key remover on shaft and turn to remove key.

2) Remove seal plate snap ring. Engage plate remover on seal plate and pull up to remove seal plate. Engage shaft seal remover/installer to shaft seal and pull up to remove shaft seal from front housing.

Installation

1) Apply clean refrigerant oil to compressor housing bore. Lubricate shaft seal with refrigerant oil and install in front housing. Lubricate seal plate and install in front housing.

2) Install shaft key, snap ring, felt retainer and felt. With clutch plate installed, ensure air gap between clutch plate and pulley is .024-.040" (.60-1.00 mm) on Fox and MR2; .014-.026" (.36-.66 mm) on all others. If air gap is incorrect, add or remove shim(s) as necessary.

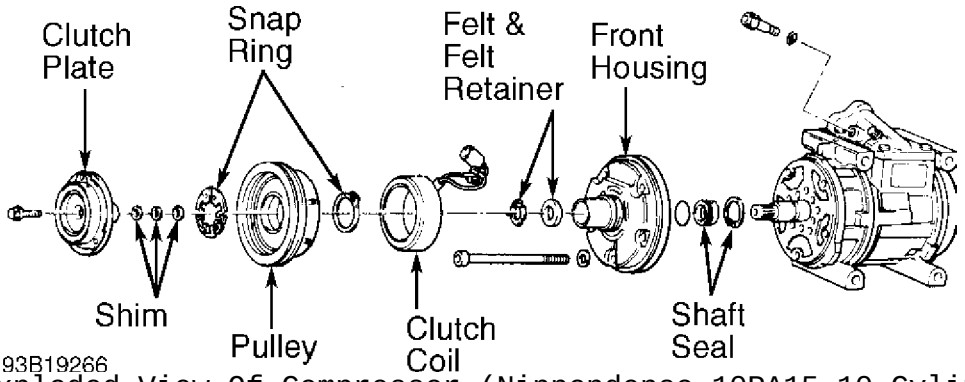

Fig. 14: Exploded View Of Compressor (Nippondenso 10PA15 10-Cylinder) Courtesy of Chrysler Corp.

PANASONIC ROTARY VANE CLUTCH COIL R & I

Removal

Hold clutch disc stationary and remove shaft bolt. Remove clutch disc and shim(s) from shaft. Remove snap ring. Using a puller, remove pulley. Remove screw from clutch coil lead. Remove screws and field coil.

Installation

To install, reverse removal procedure. Tighten field coil screws to 30-57 INCH lbs. (3.4-6.4 N.m). Ensure pulley-to-armature gap is .016-.020" (.40-.50 mm). If air gap is incorrect, add or remove shim(s) as necessary. Tighten shaft bolt to 97-115 INCH lbs. (11-13 N. m).

PANASONIC ROTARY VANE DISCHARGE VALVE R & I

Removal & Installation

Remove compressor head cover. Remove discharge valve stopper and discharge valve. See Fig. 15. Install replacement discharge valve and stopper, reversing removal procedure. Tighten discharge valve bolts to 27-34 INCH lbs. (3.0-3.8 N.m). Tighten compressor head cover

bolts to 89 INCH lbs. (10 N.m).

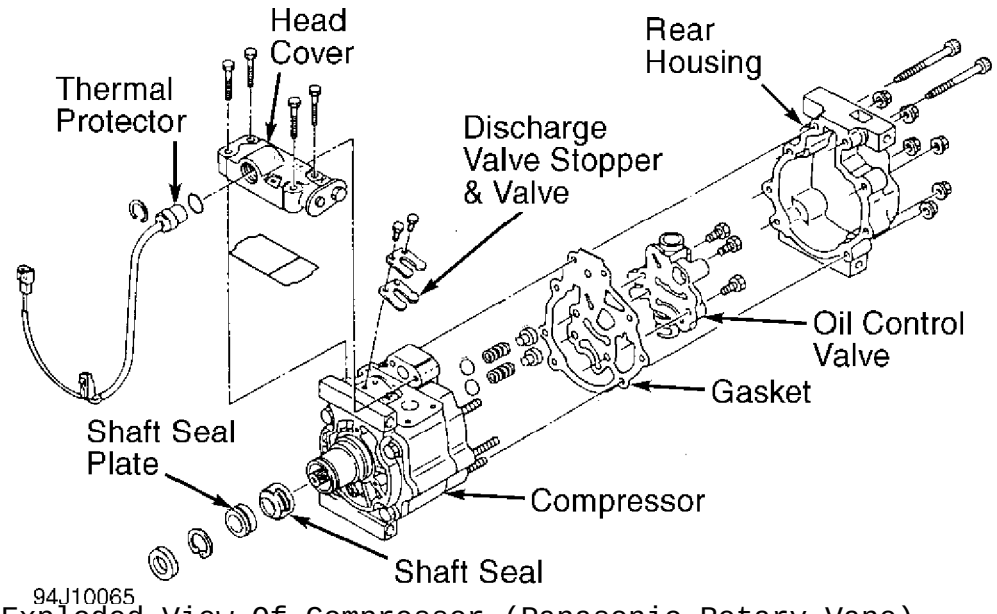

Fig. 15: Exploded View Of Compressor (Panasonic Rotary Vane) Courtesy of Mazda Motors Corp.

PANASONIC ROTARY VANE OIL CONTROL VALVE R & I

Removal & Installation

Remove compressor rear cover. Remove oil control valve. Remove springs, valve, and rear cover seal. To install components, reverse removal procedure. Tighten oil control valve bolts to 89 INCH lbs. (10 N.m). Tighten rear cover nuts to 21 ft. lbs. (29 N.m) and bolts to 89 INCH lbs. (10 N.m).

PANASONIC ROTARY VANE SHAFT SEAL R & I

Removal & Installation

Remove clutch disc and shim(s). Remove felt seal and snap ring. Using Seal Plate Remover (49 B061 005), engage and remove shaft seal plate. Remove shaft seal with Seal Remover/Installer (49 B061 006). To install, reverse removal procedure. Coat new seal plate and seal with clean refrigerant oil. DO NOT touch seal surfaces with fingers.

SANDEN SCROLL CLUTCH COIL AND SHAFT SEAL R & I

NOTE: Due to variety of clutch and shaft seal configurations, obtain appropriate A/C compressor service tools for compressor being serviced.

Removal (Chrysler & Mitsubishi Except Galant & Mirage)

1) Remove drive belt pulley (if equipped). Hold clutch plate

using Pliers (MB991367) and Bolts (MB991386). Use a ratchet and socket to remove clutch hub nut.

2) Remove clutch plate. Remove snap ring with internal snap ring pliers. Remove clutch hub (rotor). Remove snap ring and clutch coil.

3) Using an awl, remove bearing cover and retainer. Using Bearing Remover (MB991456), engage bearing grooves. Place base of bearing remover over remover arms and tighten nut.

4) Tighten bearing remover bolt to withdraw bearing from compressor. Engage grooves of Shaft Seal Remover/Installer (MB991458) and pull straight up on shaft seal.

Installation (Chrysler & Mitsubishi Except Galant & Mirage)

1) To install shaft seal, ensure front housing is free of foreign objects. Lubricate Shaft Seal Protector (MB991459) and place over compressor shaft. Lubricate shaft seal and install using shaft seal remover/installer. Remove shaft seal protector.

2) Using a 21 mm socket or Drift (MB991301), carefully press bearing onto compressor shaft. Install clutch coil so that alignment pin is engaged. Install clutch coil snap ring with tapered side facing out.

3) Align armature plate with crankshaft spline. Tighten shaft nut to 12 ft. lbs (16 N.m). Using feeler gauge, ensure clearance between pressure plate and pulley is .016-.024" (.40-0.60 mm). If clearance is incorrect, add or remove shim(s) as necessary.

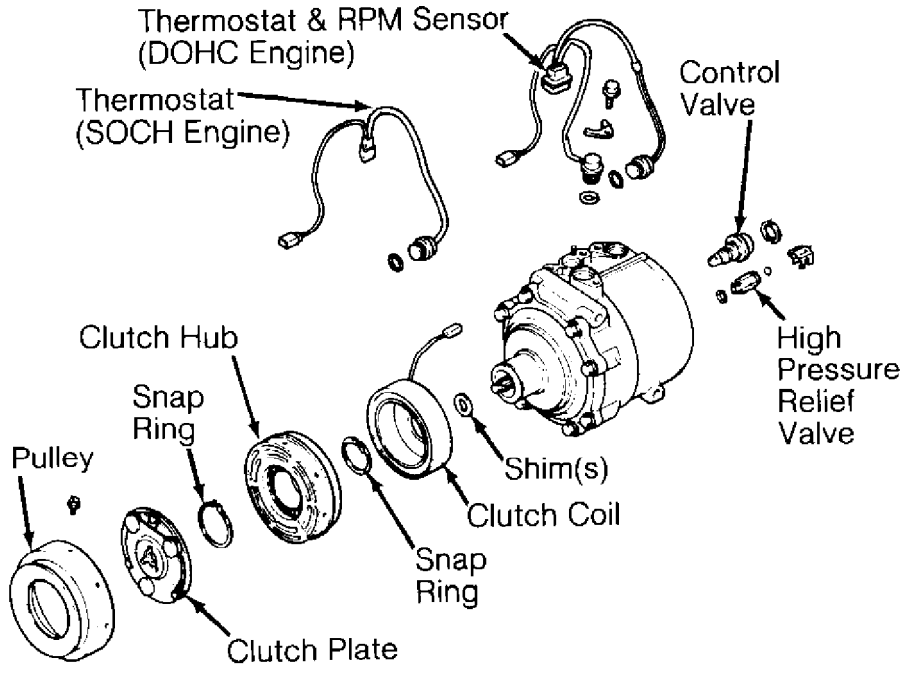

Fig. 16: Exploded View Of Compressor (Sanden Scroll)
Courtesy of Chrysler Corp.

Removal (Chrysler & Mitsubishi Galant & Mirage)

1) Hold clutch plate by securing 2 box-end wrenches with two 6-mm bolts, 1" (25 mm) or longer. Holding bow-end wrenches, use a ratchet and socket to remove clutch hub nut.

2) Remove clutch plate. See Fig. 17. Remove snap ring with internal snap ring pliers. Remove clutch hub. Remove snap ring and clutch coil.

3) Remove front housing bolts. Remove front housing and "O" ring from compressor. Remove shaft seal from shaft. Remove snap ring from back side of front housing. Remove seal plate. Use brass drift and hammer to lightly tap shaft bearing from front housing. Remove felt seal.

NOTE: DO NOT touch sealing surfaces of shaft seal carbon ring and shaft seal plate.

Installation (Chrysler & Mitsubishi Galant & Mirage)

1) Lubricate shaft seal with compressor oil. Align notches on shaft seal with notches on shaft. Install shaft seal plate on front housing. Install front seal housing to compressor.

2) Use Drift (MB991301) to install felt into front housing. Ensure metal ring on felt faces up. Use drift to press bearing into front housing.

3) Align and install clutch coil. Install snap ring so tapered surface faces outward. Install clutch hub. Install snap ring. Align clutch plate mark with shaft; where there are no splines on shaft.

4) Tighten clutch hub nut to 12 ft. lbs. (16 N.m). Using feeler gauge, measure clutch plate-to-clutch hub gap. If gap is not .012-.024" (.30-.60 mm), remove clutch assembly and add or remove shim(s).

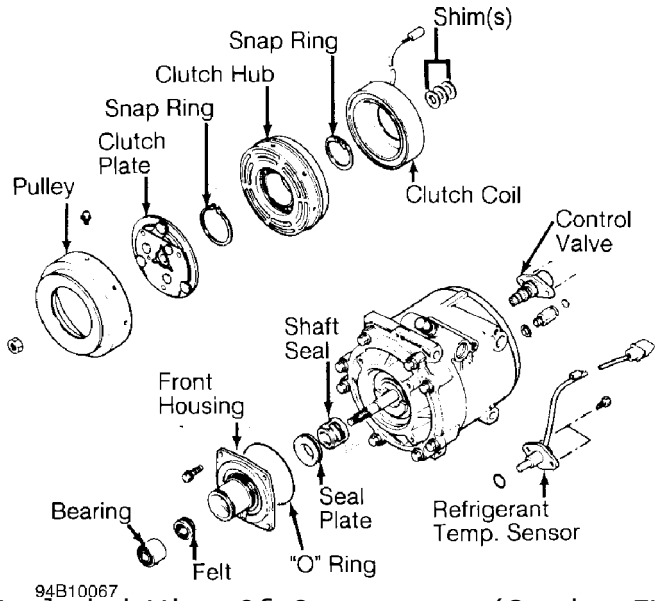

Fig. 17: Exploded View Of Compressor (Sanden FX105V Scroll) Courtesy of Chrysler Corp.

Removal & Installation (Honda & Hyundai)

1) Remove shaft nut while holding clutch plate with Armature Holder (J-37872). Using Puller (07935-8050003), remove pressure plate and shim(s). See Fig. 16. Remove snap ring.

2) Place Seal Driver (07945-4150200) in center of pulley. Engage universal puller to outer diameter of pulley. DO NOT engage puller on belt area. Hold puller in place and tighten screw to remove pulley. Remove screw for clutch coil lead. Remove snap ring and clutch coil.

3) To install clutch coil, reverse removal procedure. Align lug on clutch coil with hole in compressor. Install snap rings with chamfered side facing out. Tighten shaft nut to 12-14 ft. lbs. (16-19 N.m). Using feeler gauge, ensure clearance between pressure plate and pulley is .014-.026" (.35-.65 mm). If clearance is incorrect, add or remove shim(s) as necessary.

NOTE: Shaft seal removal and installation procedures not available from Honda or Hyundai.

SANDEN 5-CYLINDER CLUTCH COIL R & I

Removal

1) Hold clutch plate, using Holder (0000-41-0809-01), and remove shaft nut. Remove clutch plate using Puller (0000-41-0809-02). Remove shaft key and shim(s). Remove external front housing snap ring and internal bearing snap ring (if used).

2) Install Clutch Pilot (0000-41-0810-77), Pulley/Clutch Remover (0000-41-0810-76), and Puller (0000-41-0804-51/57) to remove pulley assembly. Remove snap ring and drive bearing out of pulley. Remove screw for clutch coil lead. Remove snap ring and clutch coil.

Installation

1) Install new bearing, ensuring Bearing Installer (000-41-0804-43) contacts outer race of bearing. Install snap ring and ensure bearing turns freely.

2) Install clutch coil, ensuring lug on coil aligns with hole in front housing. Support compressor on rear mounting ears. Align rotor on front housing hub. Use bearing installer and Driver (0000-41-0810-59) to install pulley. With pulley seated, install snap ring(s). Install shim(s) and shaft key.

3) Place clutch plate over shaft and, using Shaft Protector (0000-41-0809-10), tap clutch plate into place. Install and tighten shaft nut to 25-32 ft. lbs. (34-44 N.m). Using feeler gauge, ensure clearance between clutch plate and pulley is .016-.032" (.40-.80 mm). If clearance is incorrect, add or remove shim(s) as necessary.

SANDEN 5-CYLINDER CYLINDER HEAD & VALVE PLATE R & I

Removal & Installation

Remove compressor cylinder head (rear cover) bolts. Carefully pry cylinder head of compressor. Remove reed valve plate and gasket. To install components, reverse removal procedure. Tighten compressor

cylinder head bolts, in a crisscross pattern, to 21-29 ft. lbs. (29-39 N.m).

SANDEN 5-CYLINDER SHAFT SEAL R & I

Removal

Remove shaft nut and clutch plate. Remove shaft key and shim(s). Carefully remove felt ring. Remove shaft seal seat snap ring. Using Seal Seat Remover/Installer (0000-41-0810-73), carefully remove seal seat. Using Shaft Seal Remover/Installer (0000-41-0812-11), carefully remove shaft seal.

Installation

1) Install Seal Protector (0000-41-0812-13) over shaft. Place new seal on remover/installer. DO NOT touch carbon sealing surface with fingers. Dip seal in refrigerant oil and install. Remove seal installer by turning counterclockwise.

2) Coat seal seat with refrigerant oil. Install seal seat using remover/installer. Install seal seat snap ring (with flat side down). Install shim(s), felt ring and shaft key. Install shaft nut and clutch plate. Ensure clearance between clutch plate and pulley is .016-.032" (.40-.80 mm). If clearance is incorrect, add or remove shim(s) as necessary.

SANDEN 7-CYLINDER CLUTCH COIL AND BEARING R & I

NOTE: Due to variety of clutch and shaft seal configurations, obtain appropriate A/C compressor service tools for compressor being serviced.

Removal

1) Install two 6-mm bolts, 1" (25 mm) or longer, in clutch plate holes. Using 2 box-end wrenches to hold bolts and to prevent clutch plate from turning, remove shaft nut.

2) Remove clutch plate using Clutch Plate Puller (09977-21100). Remove clutch shim(s) and bearing dust cover. Remove external front housing snap ring. See Fig. 18.

3) Remove pulley using universal puller. Detach clutch coil lead from compressor housing. Remove clutch coil snap ring and clutch coil. If necessary, remove snap ring and bearing.

Installation

1) Align clutch coil lug with hole in compressor housing, and install clutch coil. Install clutch coil snap ring. Install drive pulley using Drive Pulley Installer (09977-21811).

2) Install external bearing snap ring. Using Seal Installer (09977-21800), install bearing dust cover. After dust cover installation, ensure there is no contact between cover and front housing.

3) Install clutch shim(s) and clutch plate. Tighten shaft nut to 13-14 ft. lbs. (17-19 N.m). Using a dial indicator, check air gap between clutch plate and drive pulley. Apply voltage to clutch coil.

Ensure air gap is .016-.032" (.40-.80 mm). If clearance is incorrect, add or remove shim(s) as necessary.

NOTE: If compressor valve plate is serviced, tighten compressor cylinder head bolts to 25-26 ft. lbs. (34-35 N.m).

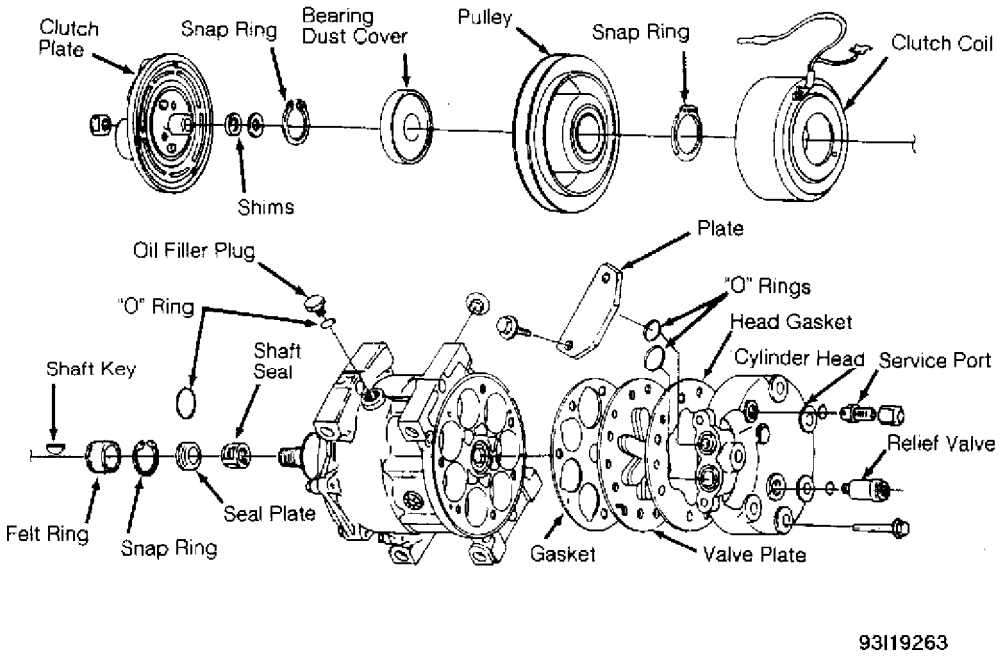

Fig. 18: Exploded View Of Compressor (Sanden 7-Cylinder) Courtesy of Hyundai Motor Co.

SANDEN 7-CYLINDER SHAFT SEAL R & I

NOTE: Check compressor refrigerant oil level when replacing seals. See COMPRESSOR OIL CHECKING article in GENERAL SERVICING.

Removal

1) Remove clutch plate, shim(s) and bearing dust cover. Tap shaft key out of slot in compressor shaft. Remove seal retainer felt ring.

2) Remove shaft seal seat snap ring. Insert Seal Seat Remover/Installer (09977-21400) into front housing and turn to engage tangs on seat. Lift seal seat out.

3) Insert Seal Remover/Installer (09977-21510) into front housing and turn to engage tangs on seal. Carefully lift shaft seal out without scratching compressor shaft.

Installation

1) Install Shaft Seal Guide Sleeve (09977-21700) over compressor shaft. Dip seal in refrigerant oil and install seal on sleeve. Using seal remover/installer, rotate seal clockwise until seal is engaged. Remove seal remover/installer by turning it

counterclockwise.

2) Coat seal seat with refrigerant oil and install seal with seal seat remover/installer. Remove shaft seal guide sleeve. Install snap ring with beveled edge facing out. Install seal retainer felt ring using seal seat remover/installer.

3) Install shaft key and clutch plate. Tighten shaft nut to 13-14 ft. lbs. (17-19 N.m). Using a dial indicator, check air gap between clutch plate and drive pulley. Apply voltage to clutch coil. Ensure air gap is .016-.032" (.40-.80 mm). If clearance is incorrect, add or remove shim(s) as necessary.

SEIKO-SEIKI ROTARY VANE

NOTE: Volvo Seiko-Seiki compressor servicing procedure is not available from manufacturer.

ZEXEL ROTARY VANE CLUTCH COIL AND BEARING R & I

Removal

1) Hold clutch disc using Clutch Disc Wrench (KV99231260) and remove center bolt. Using Clutch Disc Puller (KV99232340), remove drive plate and adjustment shim(s).

2) Remove snap ring. Remove pulley using Pilot (J-39023) and universal puller. Remove clutch coil. If necessary, remove snap ring and bearing. See Fig. 19.

Installation

1) Ensure coil lead is installed in original position. Install and tighten coil screws. Press pulley onto compressor using Pulley Installer (J-33940). Install snap ring and adjustment shim(s).

2) Install clutch disc and tighten center bolt to 11-13 ft. lbs. (15-18 N.m). Using feeler gauge, ensure clearance between clutch disc and pulley is .012-.024" (.30-.60 mm). If clearance is incorrect, add or remove shim(s) as necessary. Break-in clutch by engaging and disengaging clutch 30 times.

NOTE: Shaft seal assembly servicing procedure is not available from manufacturer. Use exploded view as a guide. See Fig. 19. Tighten thermal protector, if removed, to 11-13 ft.lbs. (15-18 N.m).

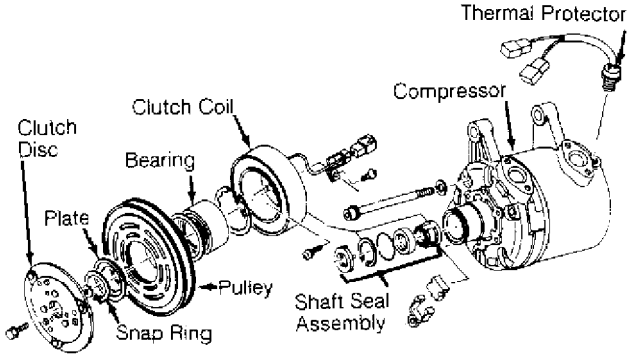

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Fig. 19: Exploded View Of Compressor (Zexel Rotary Vane)
Courtesy of Nissan Motor Co., U.S.A.

ZEXEL 6-CYLINDER CLUTCH COIL AND BEARING R & I

NOTE: Volvo Zexel compressor servicing procedure is not available from manufacturer.

Removal (Audi)

1) Using Spanner Wrench (44-4), hold clutch hub stationary and remove shaft bolt. Remove clutch plate and shim(s) using Puller (VAG 1719) and Spanner Wrench (3212). See Fig. 20. Remove snap ring.

2) Place Spacer (VAG 1719/1) in center of pulley cavity. Attach Puller (US 1078) to outer diameter of pulley and remove pulley. Remove snap ring, bearing, and clutch coil as necessary.

Installation (Audi)

Ensure clutch coil lug fits into hole on compressor housing. Using Installer (VAG 1719/2), press on pulley and install snap ring. Install shim(s) and clutch plate. Tighten shaft bolt to 11 ft. lbs. (15 N.m). Using feeler gauge, ensure air gap between pulley and clutch disc is .012-.024" (.30-.60 mm). If clearance is incorrect, add or remove shim(s) as necessary.

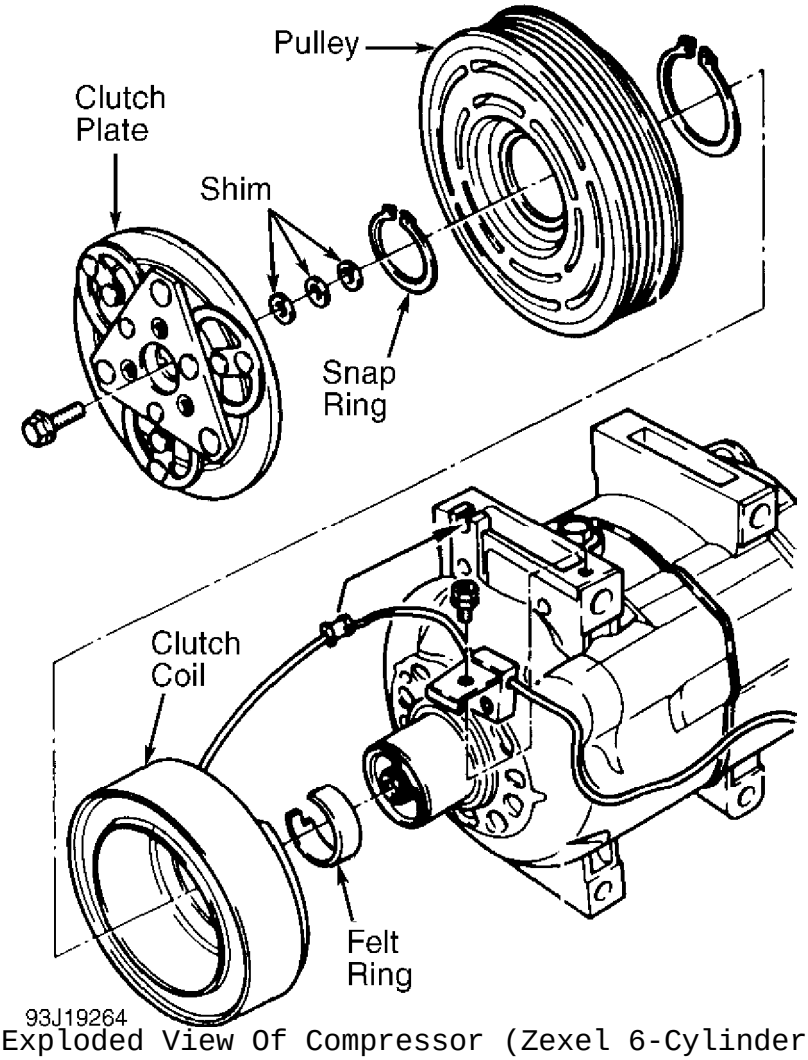


Fig. 20: Exploded View Of Compressor (Zexel 6-Cylinder)
Courtesy of Audi of America, Inc.

Removal (Nissan)

1) Using Clutch Disc Wrench (J-37877), hold clutch hub stationary and remove shaft nut. Remove adjustment shim(s) and clutch disc using Clutch Disc Puller (J-26571-A).

2) Bend lock washer away from lock nut. See Fig. 21. Remove lock nut with Wrench (J-37882). Remove pulley by hand or, if difficult to remove, use Pilot (J-26720-A) and universal puller. Remove snap ring, bearing, and clutch coil as necessary.

Installation (Nissan)

1) Ensure key is installed in compressor shaft keyway. Install pulley, lock washer and pulley. Tighten lock nut to 25-29 ft. lbs. (34-39 N.m). Bend lock washer against lock nut.

2) Install clutch disc and tighten shaft nut to 10-12 ft. lbs (14-16 N.m). Using feeler gauge, ensure air gap between pulley and clutch disc is .012-.024" (.30-.60 mm). If clearance is incorrect, add or remove shim(s) as necessary. Break-in compressor clutch assembly by

engaging and disengaging clutch 30 times.

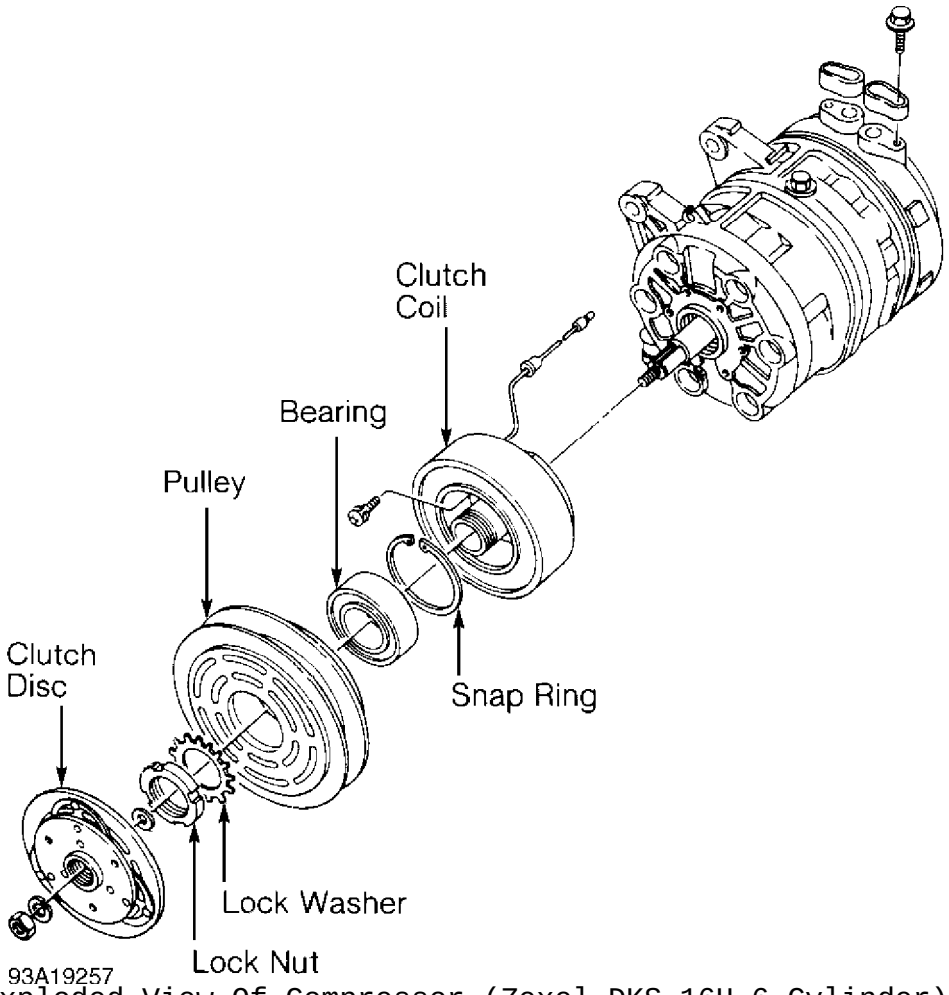


Fig. 21: Exploded View Of Compressor (Zexel DKS-16H 6-Cylinder) Courtesy of Nissan Motor Co., U.S.A.

END OF ARTICLE

A/C SYSTEM GENERAL DIAGNOSTIC PROCEDURES
Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:20PM

ARTICLE BEGINNING

1993 AIR CONDITIONING & HEAT
A/C General Diagnostic Procedures

Diagnosis is an important first step in A/C system servicing. To save time and effort, systems should be carefully checked to identify the causes of poor performance. By using the following diagnostic charts, defective components or system problems can be quickly located. To identify problems that are specific to one system, refer to the repair section of this manual. The charts in this section apply to all systems.

PREPARATION FOR TESTING

1) Attach Low and High pressure gauges.
2) Start engine and allow to warm up.
3) Set system to COOL and blower to HIGH.
4) Open car doors and hood.
5) Run engine at fast idle for 2-3 minutes.

AIR CONDITIONING SYSTEM PERFORMANCE CHECK

AIR CONDITIONING SYSTEM PERFORMANCE CHECK TABLE

PERFORM TESTS:	SHOULD BE:	IF:
Temperature Check		Temperature Check Is:
* Switch to LOW blower. * Close doors. * Check outlet temperature.	35-45ø F	Too warm - Check control lever operation, heater water valve, cooling system and gauge readings.
PERFORM TESTS:	SHOULD BE:	IF:
Visual Check		Visual Check Shows:
* Compressor	Quiet with no leaks	Noisy - Check belts, oil level, seals, gaskets, reed valves.
* Condenser	Free of obstructions	Blocked - Clean off. Plugged - Flush or replace.
* Receiver-Drier	Dry and warm to touch	Frosty - Check for restriction, replace desiccant.

* Sight Glass	Clear or few bubbles	Bubbly, foamy or streaks - Check gauge readings.
* High Side Lines	Dry and warm to touch	Frosty or very hot - Check for restriction or overcharge.
* Low Side Lines	Dry and cool to touch	Frosty or warm - Check for restriction, low charge or bad valve.
* Expansion Valve	Dry	Frosty - Check for moisture or restriction. Check sensing bulb.
* STV	Dry and cool to touch	Frosty or warm - Check gauge readings for valve malfunction.
* Evaporator	Dry and cold to touch	Freezing or warm - Check expansion valve, STV or thermoswitch.

PERFORM TESTS:	SHOULD BE:	IF:
Gauge Readings		Gauge Readings are:
* High Side Gauge	See Pressure Chart	Above or below normal - See A/C Diagnosis.
* Low Side Gauge	See Pressure Chart	Above or below normal

AMBIENT TEMPERATURE/PRESSURE

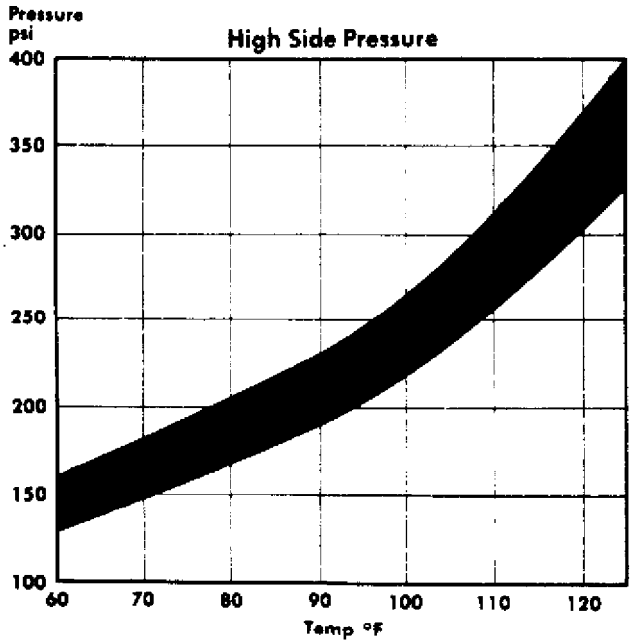


Fig. 1: Ambient Temperature/Pressure (R-12)

EVAPORATOR TEMPERATURE/PRESSURE

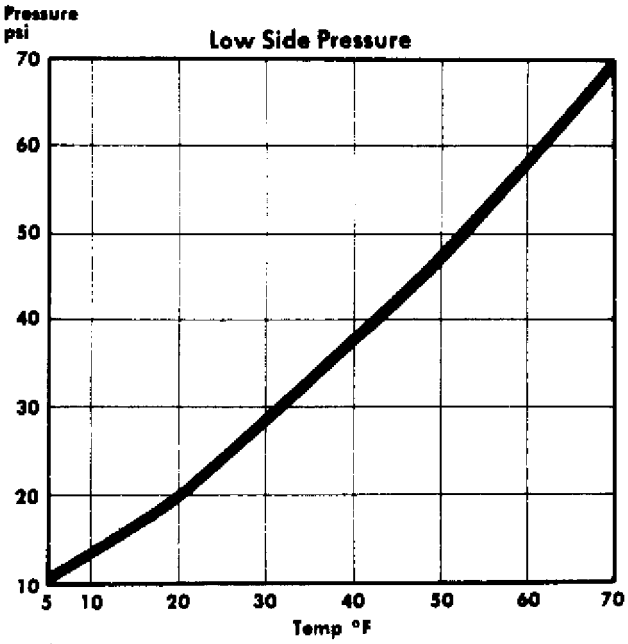


Fig. 2: Evaporator Temperature/Pressure (R-12)

A/C DIAGNOSIS W/GAUGES FOR SYS. W/INSUFFICIENT OR NO COOLING

A/C DIAGNOSIS W/GAUGES FOR SYS. W/INSUFFICIENT OR NO COOLING TABLE

A/C SYSTEM GENERAL DIAGNOSTIC PROCEDURES

Article Text (p. 4)

1993 Volkswagen EuroVan

For Volkswagen Technical Site

Saturday, March 18, 2000 10:20PM

Low Side Gauge	High Side Gauge	Other Symptoms (1)	Diagnosis
NORMAL	NORMAL	No or few bubbles in sight glass. High side gauge may go high. Low side gauge does not fluctuate with compressor on/off cycle.	Some Air & Moisture in System
NORMAL	NORMAL	Cools okay in morning but not during hot part of day. Bubbles in sight glass. Discharge air warm when low side gauge drops into vacuum.	Excessive Moisture in System
NORMAL	NORMAL	Thermostatic sw. sys. only- compressor cycles off & on too rapidly.	Defective Thermostatic Sw.
NORMAL to HIGH	NORMAL	Cycling clutch sys only - compressor doesn't turn on soon enough. Discharge air becomes warm as low side pressure rises.	Misadjusted Thermostatic Sw. or Defective Pressure Sensing Switch
LOW	LOW	Bubbles in sight glass. Outlet air slightly cool.	Low R-12 Charge
LOW	LOW	Sight glass clear. Outlet air very warm.	Excessively Low R-12 Charge
LOW	LOW	Outlet air slightly cool. Sweating or frost at expansion valve.	Expansion Valve Stuck Closed Screen Plugged or Sensing Bulb Malfunction
LOW	LOW	Outlet air slightly cool. High side line cool to touch. Sweating or frost on high side.	Restriction on High Side
LOW	HIGH	Evaporator outlet pipe cold. Low side goes into vacuum when blower is disconnected.	STV Stuck Open
HIGH	LOW	Evaporator outlet pipe warm. Outlet air warm.	STV Stuck Closed
HIGH	LOW	Noise from compressor.	Compressor Malfunction

HIGH	HIGH	Outlet air warm. Liquid line very hot. Bubbles in sight glass.	Compressor Malfunction or R-12 Overcharge
HIGH	HIGH	Outlet air slightly cool. Bubbles in sight glass.	Large Amount of Air of Air & Moisture in System
HIGH	HIGH	Outlet air warm. Evaporator outlet sweating and frost.	Expansion Valve Stuck Open

(1) - If equipped with a low refrigerant charge protection system, compressor operation may have stopped.

AIR CONDITIONING GENERAL TROUBLE SHOOTING

CONDITION & POSSIBLE CAUSE

Compressor Not Working
* Compressor clutch circuit open.
* Compressor clutch coil inoperative.
* Poor clutch ground connection.
* Fan belts loose.
* Thermostatic switch inoperative.
* Thermostatic switch not adjusted.
* Ambient temperature switch open.
* Superheat fuse blown.

Excessive Noise or Vibration
* Missing or loose mounting bolts.
* Bad idler pulley bearings.
* Fan belts not tightened correctly.
* Compressor clutch contacting body.
* Excessive system pressure.
* Compressor oil level low.
* Damaged clutch bearings.
* Damaged reed valves.
* Damaged compressor.

Insufficient or No Cooling; Compressor Working
* Expansion valve inoperative.
* Heater control valve stuck open.
* Low system pressure.
* Blocked condenser fins.
* Blocked evaporator fins.
* Vacuum system leak.
* Vacuum motors inoperative.
* Control cables improperly adjusted.

* Restricted air inlet.
* Mode doors binding.
* Blower motor inoperative.
* Temperature above system capacity.

HEATING GENERAL TROUBLE SHOOTING

CONDITION & POSSIBLE CAUSE

Insufficient, Erratic, or No Heat
* Low coolant level.
* Incorrect thermostat.
* Restricted coolant flow through heater core.
* Heater hoses plugged.
* Misadjusted control cable.
* Sticking heater control valve.
* Vacuum hose leaking.
* Vacuum hose blocked.
* Vacuum motors inoperative.
* Blocked air inlet.
* Inoperative heater blower motor.
* Oil residue on heater core fins.
* Dirt on heater core fins.

Too Much Heat
* Improperly adjusted cables.
* Sticking heater control valve.
* No vacuum to heater control valve.
* Temperature door stuck open.

Airflow Changes During Acceleration
* Vacuum system leak.
* Bad check valve or reservoir.

Air From Defroster At All Times
* Vacuum system leak.
* Improperly adjusted control cables.
* Inoperative vacuum motor.

Blower Does Not Operate Correctly
* Blown fuse.
* Blower motor windings open.
* Resistors burned out.
* Motor ground connection loose.
* Wiring harness connections loose.
* Blower motor switch inoperative.
* Blower relay inoperative.
* Fan binding or foreign object in housing.
* Fan blades broken or bent.

END OF ARTICLE

A/C SYSTEM GENERAL SERVICING
Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:29PM

ARTICLE BEGINNING

1993 GENERAL SERVICING
General Servicing Procedures

USING R-12 & R-134a REFRIGERANT

HANDLING/SAFETY PRECAUTIONS

1) Always work in a well-ventilated, clean area. Refrigerant R-134a is colorless and is invisible as a gas. Refrigerant (R-12 or R-134a) is heavier than oxygen and will displace oxygen in a confined area. Avoid breathing refrigerant vapors. Exposure may irritate eyes, nose and throat.

2) The system's high pressure can cause severe injury to eyes and skin if a hose were to burst. Always wear eye protection when working around A/C system and refrigerant. If necessary, wear rubber gloves or other protective clothing.

3) Refrigerant evaporates quickly when exposed to atmosphere, freezing anything it contacts. If liquid refrigerant contacts eyes or skin, DO NOT rub eyes or skin. Immediately flush affected area with cool water for 15 minutes and consult a doctor or hospital.

4) Never use R-134a in combination with compressed air for leak testing. Pressurized R-134a in the presence of oxygen (air concentrations greater than 60% by volume) may form a combustible mixture. DO NOT introduce compressed air into R-134a containers (full or empty), A/C system components or service equipment.

5) DO NOT expose A/C system components to high temperatures, steam cleaning for example, as excessive heat will cause refrigerant/system pressure to increase. Never expose refrigerant directly to open flame. If refrigerant needs to be warmed, place bottom of refrigerant tank in warm water. Water temperature MUST NOT exceed 125øF (52øC).

6) Use care when handling refrigerant containers. DO NOT drop, strike, puncture or incinerate containers. Use Department Of Transportation (DOT) approved, DOT 4BW or DOT 4BA, refrigerant containers.

7) Never overfill refrigerant containers. The safe filling level of a refrigerant container MUST NOT exceed 60% of the container's gross weight rating. Store refrigerant containers at temperature less than 125øF (52øC).

8) R-12 refrigerant (Freon) will be sold and stored in White containers, while R-134a refrigerant will be sold and stored in 30 or 50-pound Light Blue containers.

9) R-12 and R-134a refrigerants must never be mixed, as their desiccants and lubricants are not compatible. If the refrigerants are mixed, system cross-contamination or A/C system component failure may occur. Always use separate servicing and refrigerant recovery/recycling equipment.

10) Follow equipment manufacturer instructions of all service equipment to be used. The Material Safety Data Sheet (MSDS), provided by refrigerant manufacturer/suppliers, contains valuable information

regarding the safe handling of R-12 or R-134a refrigerants.

IDENTIFYING R-134a SYSTEMS & COMPONENTS

To prevent refrigerant cross-contamination, use following methods to identify R-134a based systems and components.

Fittings & "O" Rings

All R-134a based A/C systems use 1/2" - 16" ACME threaded fittings (identifiable by square threads) and quick-connect service couplings. See Fig. 1. Besides the use of these fittings, most manufacturers will use Green colored "O" rings in R-134a systems.

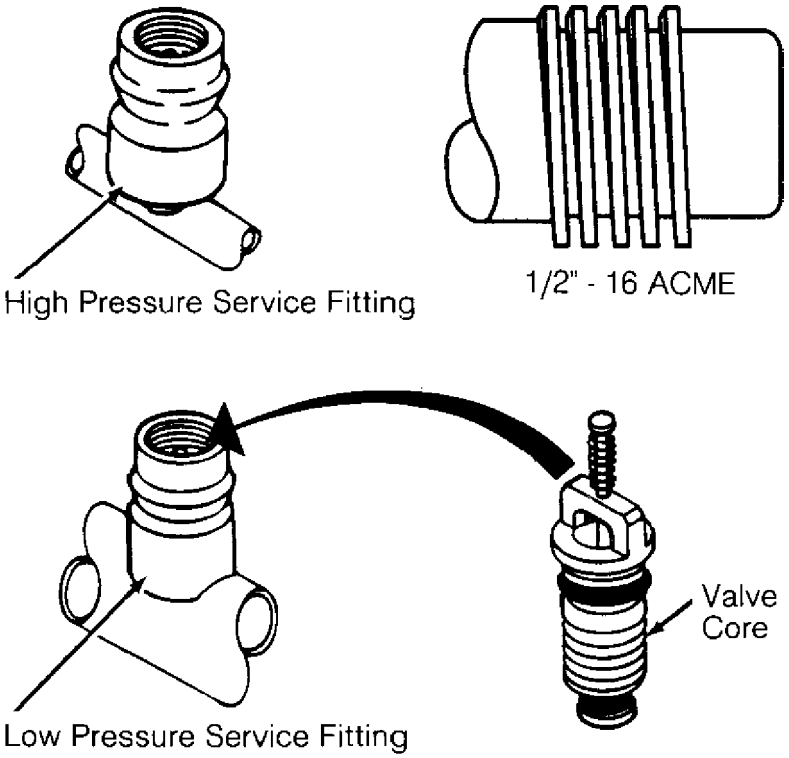


Fig. 1: R-134a Fittings & Quick Connect Service Couplings ID
Courtesy of Audi of America, Inc.

Underhood A/C Specification Labels

Most R-134a based systems will be identified through the use of Green or Light Blue underhood labels, or with R-134a refrigerant clearly printed on labels. See Fig. 2. Some manufacturers will identify R-12 based systems with White, Red, Silver or Gold underhood labels. Before servicing an A/C system, always determine which refrigerant is being used.

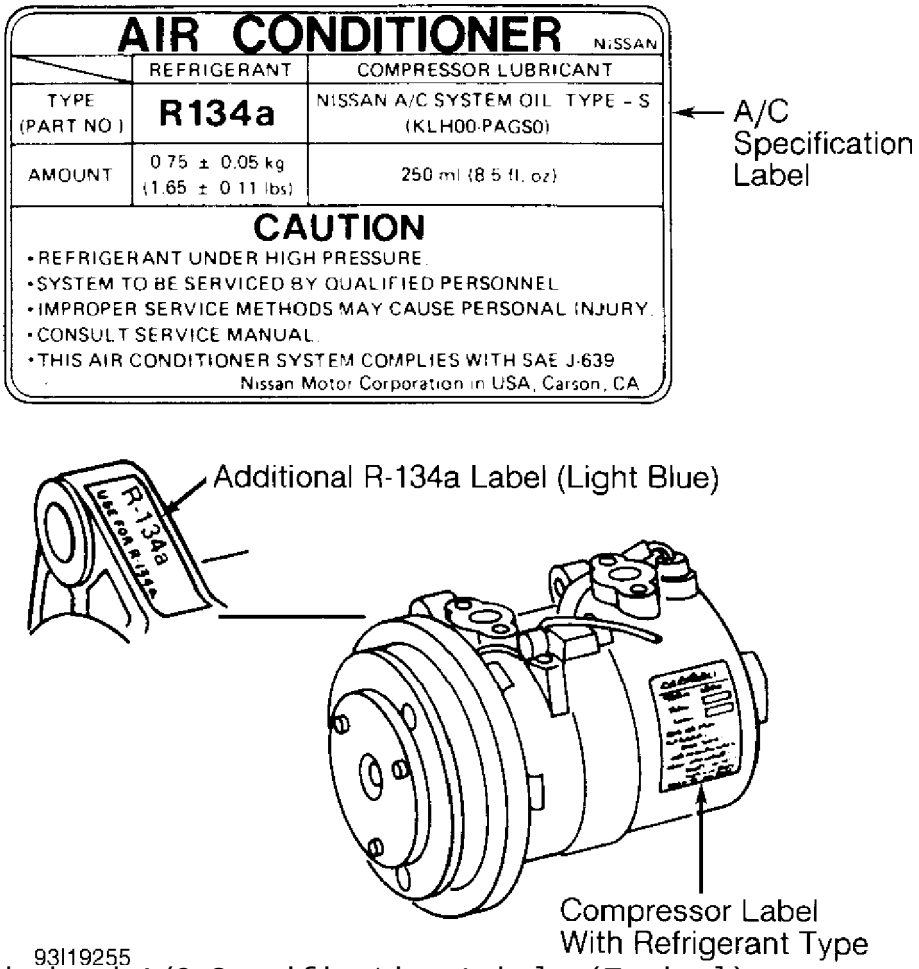


Fig. 2: Underhood A/C Specification Labels (Typical)
Courtesy of Nissan Motor Co., U.S.A.

Other Means Of Identification

Refrigerant R-134a, when viewed through a sight glass, may have a "milky" appearance due to the mixture of refrigerant and lubricating oil. As the refrigerant and oil DO NOT exhibit a "clear" sight glass on a properly charged A/C system, R-134a systems have no sight glass.

Audi, Mercedes-Benz and Volkswagen use Green bands/labels on condenser, refrigerant lines, receiver-drier and expansion valve. Lexus A/C system hoses and line connectors have a groove, a White line and "R-134a" marked on them. See Fig. 3.

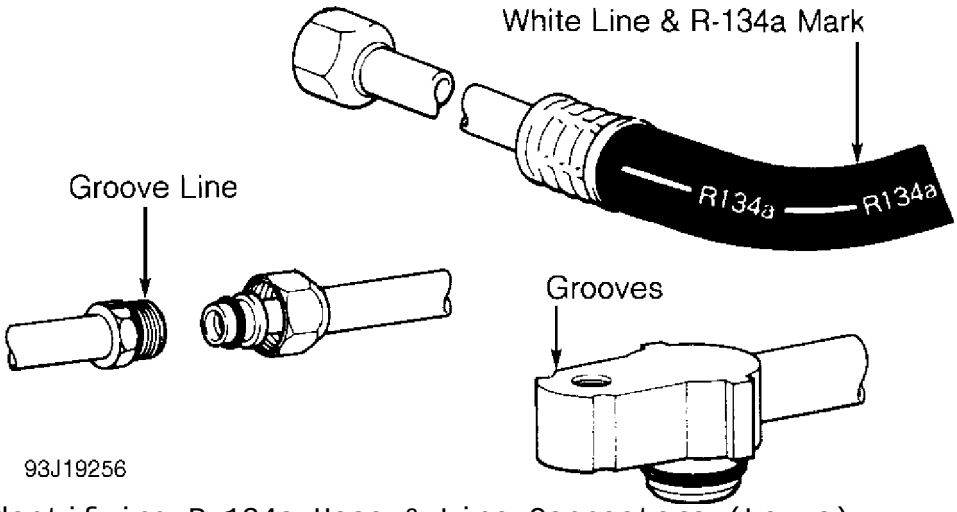


Fig. 3: Identifying R-134a Hose & Line Connectors (Lexus)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

REFRIGERANT OILS

Refrigerant R-12 based systems use mineral oil, while R-134a systems use synthetic/Polyalkylene Glycol (PAG) oils. Using a mineral oil based lubricant with R-134a will result in A/C compressor failure due to lack of proper lubrication.

Use ONLY specified oil for the appropriate system and A/C compressor. Always check the underhood A/C specification label or A/C compressor label before adding refrigerant oil to A/C compressor/system. See Fig. 2. The following R-134a refrigerant oils are currently available.

Lexus
PAG Refrigerant Oil (ND-OIL 8) with 10P/10PA swashplate (piston) compressor. Synthetic Refrigerant Oil (ND-OIL 9) with through-vane (rotary vane) compressor.

Mercedes-Benz
PAG Refrigerant Oil (001 989 08 03).

Nissan
PAG Refrigerant Oil (KLH00-PAGR0) with rotary vane compressor. PAG Refrigerant Oil (KLH00-PAGS0) with piston (swashplate) compressor.

Saab
PAG Refrigerant Oil (40 74 787).

NOTE: Synthetic/PAG oils absorb moisture very rapidly, 2.3-5.6% by weight, as compared to a mineral oil absorption rate of .005% by weight.

SERVICE EQUIPMENT

Because R-134a is not interchangeable with R-12, separate sets of hoses, manifold gauge set and recovery/recycling equipment are required to service vehicles. This is necessary to avoid cross-contaminating and damaging system.

All equipment used to service systems using R-134a must meet SAE standard J1991. The service hoses on the manifold gauge set must have manual (turn wheel) or automatic back-flow valves at the service port connector ends. This will prevent refrigerant from being released into the atmosphere.

For identification purposes, R-134a service hoses must have a Black stripe along its length and be clearly labeled SAE J2196/R-134a. The low pressure test hose is Blue with a Black stripe. The high pressure test hose is Red with a Black stripe, and the center test hose is Yellow with a Black stripe.

NOTE: Refrigerant R-12 service hoses will ONLY be labeled SAE J2196.

R-134a manifold gauge sets can be identified by one or all of the following:

* Labeled FOR USE WITH R-134a on set
* Labeled HFC-134 or R-134a on gauge face
* Light Blue color on gauge face

In addition, pressure/temperature scales on R-134a gauge sets are different from R-12 manifold gauge sets.

SYSTEM SERVICE VALVES

SCHRADER-TYPE VALVES

NOTE: Although similar in construction and operation to a tire valve, NEVER replace a Schrader-type valve with a tire valve.

Schrader valve is similar in construction and operation to a tire valve. When a test gauge hose with built-in valve core depressor is attached, Schrader stem is pushed inward to the open position and allows system pressure to reach gauge.

If test hose does not have a built-in core depressor, an adapter must be used. Never attach hose or adapter to Schrader valve unless it is first connected to manifold gauge set.

Refrigerant R-12 Schrader-type valve cores have TV5 thread size. Refrigerant R-134a Schrader-type valve cores use M6 (Metric) threads. R-134a valve cores can be easily identified by use of "O" rings and external spring. See Fig. 1.

SERVICE VALVE LOCATIONS

SERVICE VALVE LOCATIONS TABLE

Vehicle	High	Low

Audi	(1)(2)		(1)(3)
Acura	(2)		(3)
BMW	(4)		(5)
Chrysler, Eagle & Mitsubishi			
Colt, Mirage & Summit	(1)(0)		(5)
Colt Vista & Summit Wagon	(1)(0)		(1)(1)
Diamante	(4)		(5)
Eclipse & Expo	(1)(0)		(1)(1)
Galant	(1)(0)		(1)(1)
Montero	(1)(1)		(1)(1)
Pickup & Ram-50	(1)(0)		(1)(1)
Precis	(1)(0)		(1)(0)
Stealth & 3000GT			
R-12	(1)		(1)
R-134a	(1)		(5)
Ford Motor Co.	(4)		(5)
General Motors	(1)(2)		(1)(2)
Geo	(4)		(5)
Honda	(4)		(5)
Hyundai			
Elantra & Scoupe	(4)		(5)
Excel & Sonata	(1)(0)		(1)(0)
Infiniti	(4)		(5)
Isuzu	(4)		(5)
Jaguar	(4)		(5)
Lexus	(4)		(5)
Mazda			
B2200 & B2600i	(8)		(8)
Miata, MPV Protege & 323	(4)		(5)
Navajo	(6)		(7)
All Others	(1)		(1)
Mercedes-Benz	(4)		(5)
Nissan	(4)		(5)
Porsche	(8)		(8)
Saab	(8)		(8)
Subaru			
Impreza	(1)		(1)
Legacy & Loyale	(4)		(5)
SVX	(9)		(9)
Suzuki	(4)		(5)
Toyota			
Pickup & 4Runner	(1)(1)		(1)(1)
All Others	(4)		(5)
Volkswagen	(4)		(5)
Volvo			
240, 940 & 960	(4)		(5)
850	(1)		(5)

(1) - Information is not available from manufacturer.
(2) - On high pressure line (near top of condenser on Integra; near receiver-drier on Legend; on receiver-drier on

Vigor). Use High-Side Adapter (J-25498).
(3) - On low pressure line (near battery on Integra; near right rear of engine on Legend; near compressor on Vigor).
(4) - On high pressure (discharge) hose/line.
(5) - On low pressure (suction) hose/line.
(6) - On high pressure line, between compressor and condenser.
(7) - On suction accumulator/drier.
(8) - On low and high pressure hoses, behind compressor.
(9) - On receiver/drier and low pressure hose (near compressor).
(1)(0) - On compressor discharge hose and accumulator.
(1)(1) - On compressor discharge and suction ports.
(1)(2) - Front of condenser on right side.
(1)(3) - Towards rear of compressor.

REFRIGERANT RECOVERY/RECYCLING

Refrigerant recovery/recycling equipment is used to remove refrigerant from vehicle's A/C system without polluting atmosphere. To remove and recycle refrigerant, connect the recovery/recycling system and follow instructions provided with the system.

The removed refrigerant is filtered, dried and stored in a tank within the recovery/recycling system until it is ready to be pumped back into the vehicle's A/C system. With refrigerant stored in the recovery/recycling system, A/C system can be opened without polluting atmosphere.

NOTE: Separate sets of hoses, gauges and refrigerant recovery/recycling equipment MUST be used for R-12 and R-134a based systems. DO NOT mix R-12 and R-134a refrigerants, as their refrigerant oils and desiccants are not compatible. On systems with R-134a refrigerant, use Polyalkylene Glycol (PAG) wax-free refrigerant oil.

END OF ARTICLE

A/C-HEATER SYSTEM - MANUAL
Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:29PM

ARTICLE BEGINNING

1993 MANUAL A/C-HEATER SYSTEMS
Volkswagen United States, Inc.

EuroVan

SPECIFICATIONS

SPECIFICATIONS TABLE

Application	Specification
Compressor Type	Sanden SD7H15 7-Cyl.
Compressor Belt Tension (1)	
System Oil Capacity (2)	
Without Rear A/C	4.6 ozs.
With Rear A/C	8.2 ozs.
Refrigerant (R-134a) Capacity	
Without Rear A/C	34-35 ozs.
With Rear A/C	48-49 ozs.
System Operating Pressures	
High Side	203 psi (14.3 kg/cmý)
Low Side	17-26 psi (1.2-1.8 kg/cmý)

(1) - Serpentine belt tension is automatically adjusted by tensioner pulley.
(2) - Use SP-10 PAG Oil (Part No. G 052 154 A2).

WARNING: To avoid injury from accidental air bag deployment, read and carefully follow all SERVICE PRECAUTIONS and DISABLING & ACTIVATING AIR BAG SYSTEM procedures.

AIR BAG SYSTEM PRECAUTIONS

SYSTEM OPERATION CHECK

Two lights pertaining to air bag system are located directly above air bag symbol in instrument cluster. Control light is used to indicate readiness of system. With ignition on, control light comes on for about 5-8 seconds then goes out, while diagnosis unit in air bag control unit performs an electronic test cycle of system.

If control light does not function as described, a fault probably exists in system. If fault occurs while ignition is on, it will be stored in fault memory. Warning light will then come on, and air bag system will be switched off. If warning light comes on or flickers while driving, air bag system should be tested.

SERVICE PRECAUTIONS

Observe these precautions when working with air bag systems:

* DO NOT use computer memory saver tool. Using computer memory tool will keep air bag system active and may cause accidental deployment of air bag unit.
* Disable air bag system before servicing any air bag system or steering column component. See DISABLING & ACTIVATING AIR BAG SYSTEM.
* Because of critical operating requirements of system, DO NOT attempt to service any air bag system component.
* DO NOT leave air bag parts unattended. Install parts in vehicle immediately after obtaining.
* DO NOT use air bag components that have been dropped from height of more than 18 inches.
* DO NOT allow chemical cleaners, oil and grease to contact vinyl covering on air bag unit.
* DO NOT place stickers or covers on steering wheel.
* Always disable air bag system before performing electric welding on vehicle.
* Air bag system can only be tested using Diagnostic Tester (VAG 1551) and Multimeter (US-1119). Never use test light on air bag system.
* DO NOT expose air bag unit to temperatures greater than 194øF (90øC).

DISABLING & ACTIVATING AIR BAG SYSTEM

WARNING: System voltage is retained for about 20 MINUTES after system is deactivated. Wait about 20 MINUTES after system is disabled before servicing, as air bag may accidentally deploy, causing personal injury.

Disabling & Activating System

To disable system, disconnect negative battery cable. Wait 20 MINUTES before working on vehicle. To activate system, reconnect negative battery cable. Verify system is functioning properly. See SYSTEM OPERATION CHECK.

CAUTION: When battery is disconnected, radio will go into anti-theft protection mode. Obtain radio anti-theft protection code from owner prior to servicing vehicle.

DESCRIPTION

This vehicle uses a flow-through ventilation, blend air-type A/C-heating system. Air flows through grille below engine compartment hood and into passenger compartment. See Fig. 1. Interior compartment air is drawn out of vehicle through vents at rear of vehicle. The vents are located at bottom of each "D" pillar.

OPERATION

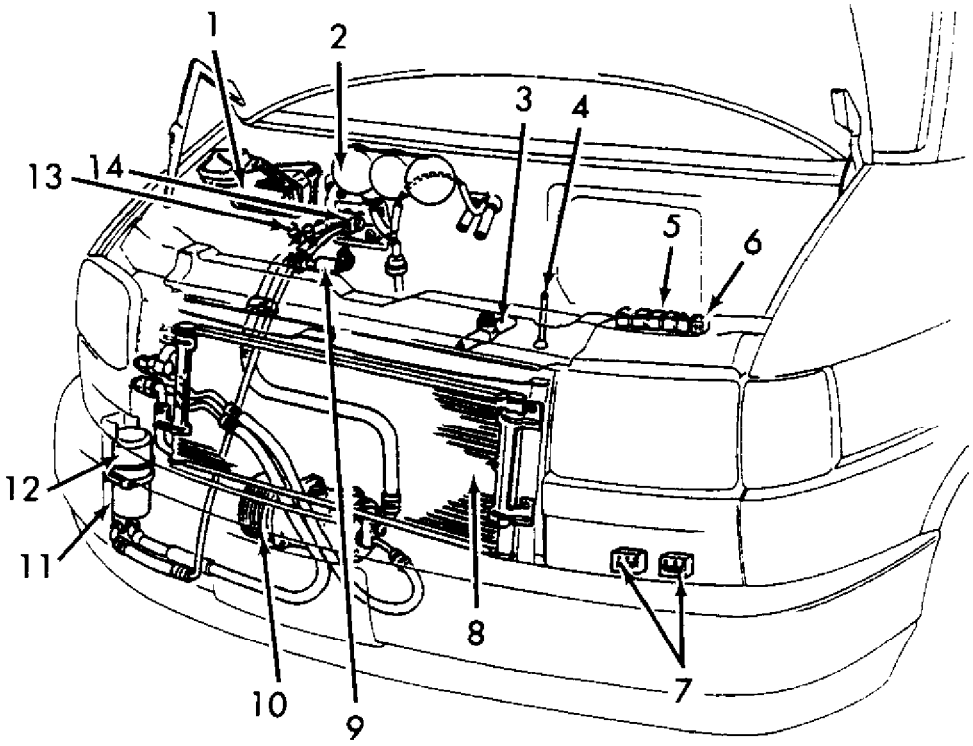
A/C-HEATER CONTROL PANEL/SYSTEM

Front

The front A/C-heater system is of the blend-air type design. Heated coolant flows through the heater core at all times. Interior temperature is controlled by a temperature regulation flap which regulates the amount or air being passed through or around heater core. A heater control valve is not used.

Bottom lever on A/C-heater control panel controls temperature regulation flap. The top lever on A/C-heater control panel determines mode of operation and air distribution.

This lever operates a combination vacuum/electrical switch. The vacuum portion of the switch determines air distribution. the electrical portion supplies power to the A/C compressor clutch, blower motor, and evaporator fan for the rear A/C-heater system.



1. Air Intake Duct
2. Vacuum Reservoir
3. A/C Thermoswitch
4. Drain Tube
5. Relays
6. Cooling Fan Fuses
7. Cooling Fan Resistors
8. Condenser
9. A/C Pressure Switch
10. A/C Compressor
11. Pressure Relief Valve
12. Receiver-Drier
13. Service Valves
14. Expansion Valve

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Fig. 1: Identifying A/C-Heater System Components (Engine Compartment) Courtesy of Volkswagen United States, Inc.

Rear

The rear A/C-heater system only works when the main (front)

A/C-heater system is switched on. The temperature of the rear A/C-heater system is independent of the main A/C-heater system. Air distribution is accomplished through 6 vents in headliner. The vents are located above each rear seat and are individually adjustable.

A temperature control knob is located next to fan switch rotary knob. To prevent windows from fogging, the rear blower motor will not operate when A/C or defrost modes are selected.

A potentiometer inside rear A/C-heater control panel supplies a pulsed voltage signal to the electrically controlled heater control valve. The heater control valve supplies heated engine coolant to rear heater core. See Fig. 2.

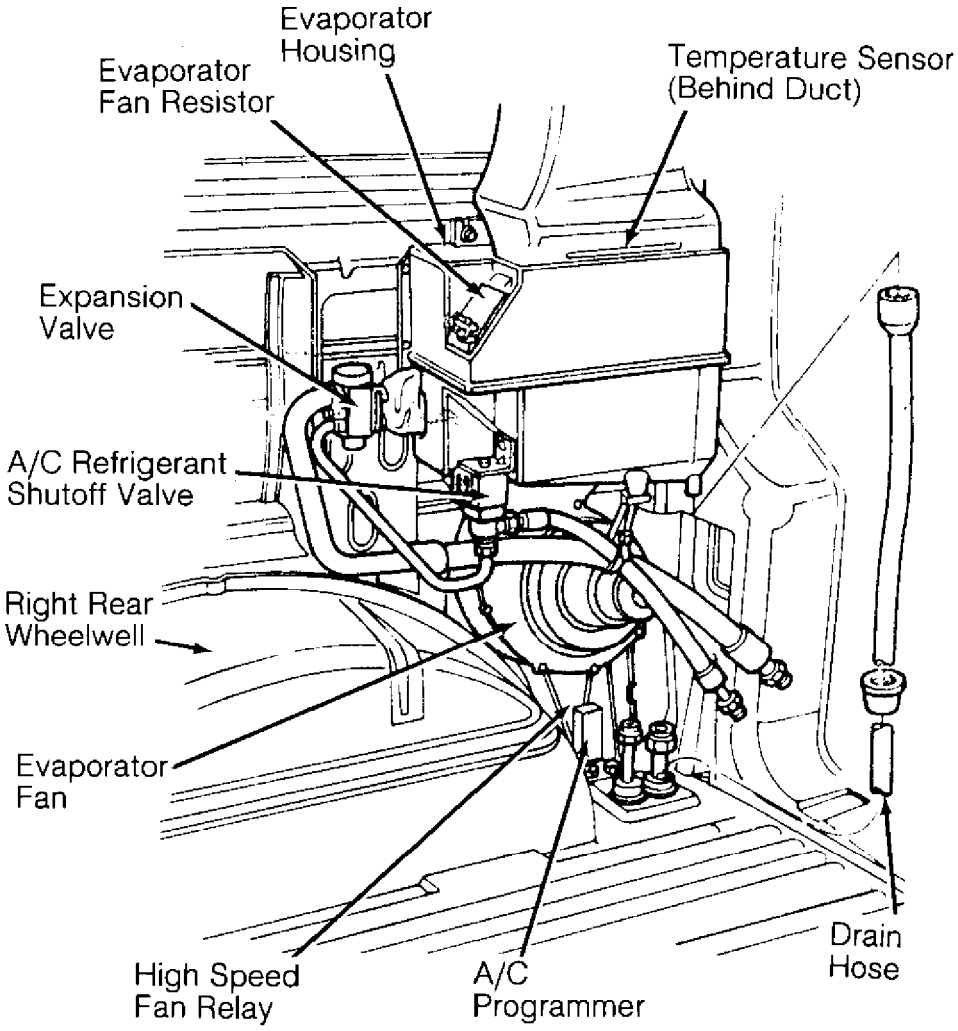


Fig. 2: Identifying Rear A/C-Heater System Components
Courtesy of Volkswagen United States, Inc.

A/C PRESSURE SWITCH

The A/C pressure switch is a triple-pressure type. Switch is located on refrigerant line, near expansion valve. See Fig. 1.

If refrigerant pressure is too low, the A/C compressor is

turned off (low pressure cutout). Switch opens when system pressure is less than 29.0 psi (2.0 kg/cmý). Switch closes when system pressure is more than 43.5 psi (3.1 kg/cmý).

If refrigerant pressure is too high, the A/C compressor is turned off (high pressure cutout). Switch opens when system pressure is more than 464 psi (32.6 kg/cmý). Switch closes when system pressure is less than 348 psi (24.5 kg/cmý).

The high pressure portion of A/C pressure switch controls cooling fan high speed operation. Switch closes, and cooling fan operates on second speed, when system pressure is more than 232 psi (16.3 kg/cmý). The switch opens when system pressure is less than 181 psi(12.7 kg/cmý).

A/C PROGRAMMER

The A/C programmer (temperature control unit) is located at bottom brace of rear evaporator (if equipped). See Fig. 2. The A/C programmer receives inputs from rear temperature control potentiometer and temperature sensor located at rear evaporator.

Depending on the temperature selected and the temperature of the air at rear evaporator, the A/C programmer will either open or close the A/C refrigerant shutoff valve.

A/C REFRIGERANT SHUTOFF VALVE

This valve, as controlled by A/C programmer, controls refrigerant flow to rear evaporator. See Fig. 2. The A/C programmer controls A/C refrigerant shutoff valve when evaporator temperature drops to 32øF (0øC) to prevent rear evaporator freeze-up.

AIR RECIRCULATION SWITCH

A rotary knob air recirculation switch is located above heater control panel. This switch, through a solenoid and vacuum servo, opens and closes a flap that is located in air inlet duct. When flap is open, outside air enters vehicle. When flap is closed, the vehicle's interior compartment air is recirculated to help prevent exhaust or harmful fumes from entering vehicle.

A/C THERMOSWITCH

The A/C thermoswitch (evaporator temperature switch) senses front evaporator temperature. See Fig. 1. Thermoswitch turns off A/C compressor when evaporator temperature drops to 32øF (0øC) to prevent evaporator freeze-up.

EXPANSION VALVES

An "H" type expansion valve is used for both front and rear evaporator. See Fig. 1. The rear A/C lines are connected to the front expansion valve. The rear A/C lines are routed under right side of vehicle and are attached to frame. The service ports and sight glass

are also located near the expansion valve.

HEATER CONTROL VALVE

The electrically controlled heater control valve is located on left side of engine compartment, below brake booster. The valve is controlled by a pulsed voltage signal which closes or opens valve plunger. The higher the selected temperature, the longer the plunger stays open.

PRESSURE RELIEF VALVE

Pressure relief valve is located on refrigerant line fitting at bottom of receiver-drier. See Fig. 1. If system pressure reaches 580 psi (40.8 kg/cmý), the pressure relief valve will briefly open, then close when pressure has dropped. The system is not completely discharged. If an excessive system pressure is reached, the plastic washer on pressure relief valve breaks. Check system for cause of excessive pressure.

ADJUSTMENTS

TEMPERATURE FLAP CABLE

1) Attach temperature flap cable to lower control lever of A/C-heater control panel. Position cable sleeve on stop of A/C-heater control panel and secure with clip. Install A/C-heater control panel.
2) Slide temperature control lever fully left (cool position). Connect other end of temperature flap cable to temperature flap lever. Push lever away from cable until it stops. See Fig. 3.
3) Hold temperature flap lever in this position and secure cable with retaining clip. To check adjustment, slide temperature control lever back and forth from stop to stop. Temperature flap must audibly contact stops.

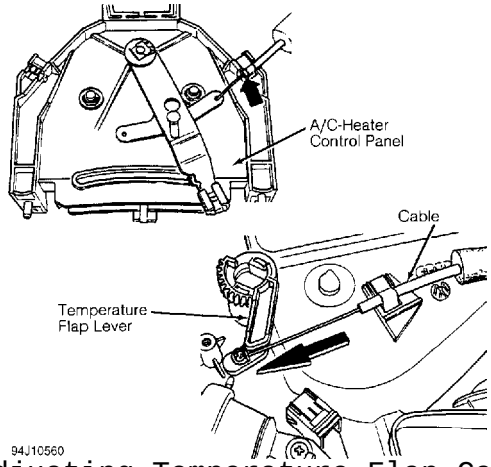


Fig. 3: Adjusting Temperature Flap Cable
Courtesy of Volkswagen United States, Inc.

TESTING

WARNING: To avoid injury from accidental air bag deployment, read and carefully follow all SERVICE PRECAUTIONS and DISABLING & ACTIVATING AIR BAG SYSTEM procedures.

A/C SYSTEM PERFORMANCE

Park vehicle out of direct sunlight. Attach manifold gauge set to service valves. Start and run engine at 1500 RPM. Set A/C switch for maximum cooling. Set blower fan on high speed. Note low-side and high-side pressure readings. Service refrigerant system as necessary.

A/C PRESSURE SWITCH

NOTE: A/C pressure switch may be removed without discharging A/C system.

High Pressure (Condenser Fan) Circuit

1) Locate A/C pressure switch on refrigerant line, near expansion valve. See Fig. 1. Cycling of high pressure (condenser fan) circuit occurs between Red and Black wires.

2) Ensure switch closes, and cooling fan operates on second speed, when system pressure is more than 232 psi (16.3 kg/cmý). Ensure switch opens when system pressure is less than 181 psi (12.7 kg/cmý). Replace switch if necessary.

High Pressure Cut-Out Circuit

Cycling of high pressure cut-out circuit occurs between Blue wires. Ensure switch opens when system pressure is more than 464 psi (32.6 kg/cmý). Ensure switch closes when system pressure is less than 348 psi (24.5 kg/cmý). Replace switch if necessary.

Low Pressure Cut-Out Circuit

Cycling of low pressure cut-out circuit occurs between Blue wires. Ensure switch opens when system pressure is less than 29.0 psi (2.0 kg/cmý). Ensure switch closes when system pressure is more than 43.5 psi (3.1 kg/cmý). Replace switch if necessary.

NOTE: Additional testing information is not available from manufacturer. Use wiring diagram as a guide. See WIRING DIAGRAMS.

REMOVAL & INSTALLATION

WARNING: To avoid injury from accidental air bag deployment, read and carefully follow all SERVICE PRECAUTIONS and DISABLING & ACTIVATING AIR BAG SYSTEM procedures.

NOTE: For removal and installation procedures not covered in this article, see HEATER SYSTEM article.

A/C COMPRESSOR

Removal & Installation

1) Mark rotation direction of serpentine belt for installation reference. Using Lever (3299), loosen serpentine belt tensioner pulley. Remove serpentine belt.

2) Discharge A/C system using approved refrigerant recovery/recycling equipment. Detach refrigerant lines from A/C compressor. Remove A/C compressor bracket and/or A/C compressor as necessary. To install A/C compressor, reverse removal procedure.

CONDENSER

Removal & Installation

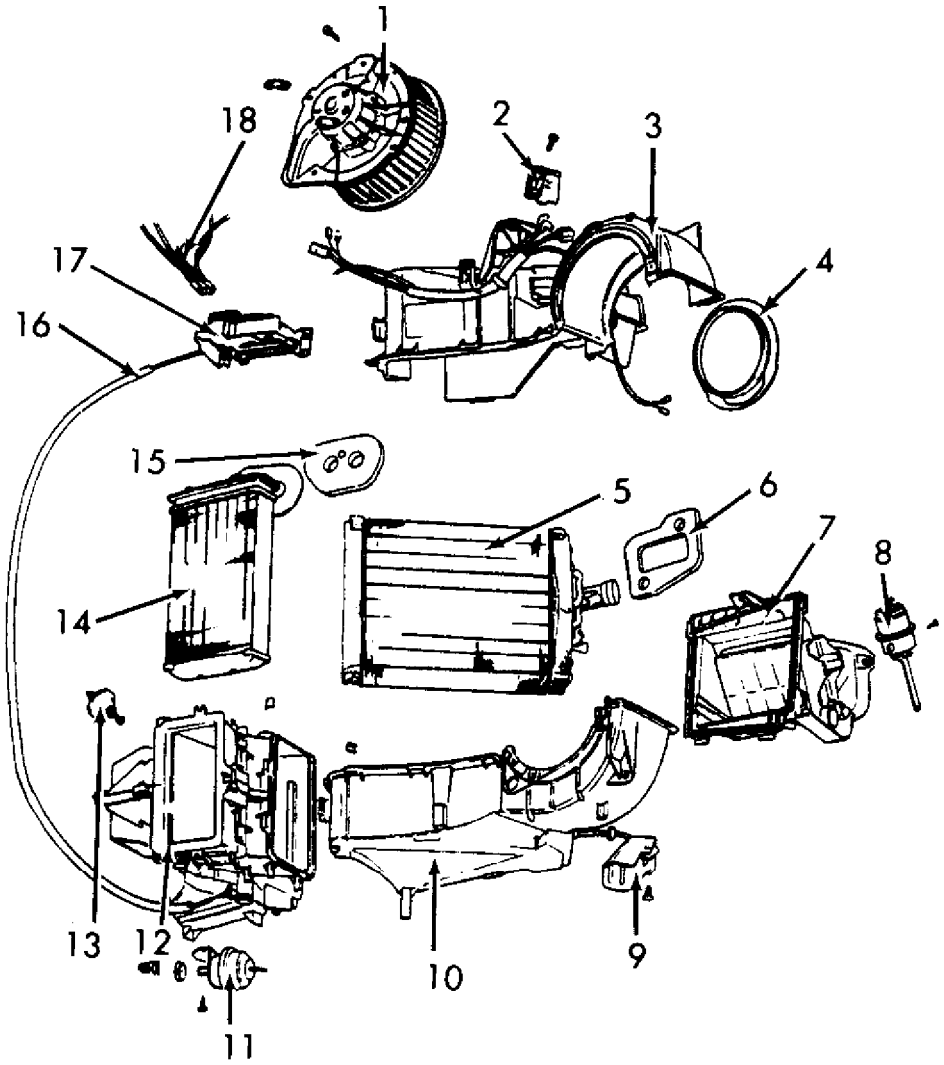
Discharge A/C system using approved refrigerant recovery/recycling equipment. Remove front radiator grille. Detach refrigerant lines from condenser. Remove condenser. To install condenser, reverse removal procedure.

EVAPORATOR & HEATER CORE

Removal & Installation

1) Evaporator and heater core removal and installation procedure is not available from manufacturer. If it is necessary to remove instrument panel, see INSTRUMENT PANEL.

2) Discharge A/C system using approved refrigerant recovery/recycling equipment. Use exploded view of evaporator assemblies as a guide. See Figs. 4 and 5. Manufacturer recommends that rear evaporator not be disassembled further than shown.



1. Blower Motor
2. Blower Motor Resistor
3. Upper Evaporator Housing
4. Air Intake Ring
5. Evaporator
6. Seal
7. Air Intake Duct
8. Fresh/Recirculated Air Flap Vacuum Servo
9. A/C Thermoswitch
10. Lower Evaporator Housing
11. Central Flap Vacuum Servo
12. Air Distribution Case
13. Footwell/Defroster Flap Vacuum Servo
14. Heater Core
15. Grommet
16. Temperature Flap Cable
17. A/C-Heater Control Panel
18. Vacuum Hoses

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Fig. 4: Exploded View Of Front Evaporator Assembly
Courtesy of Volkswagen United States, Inc.

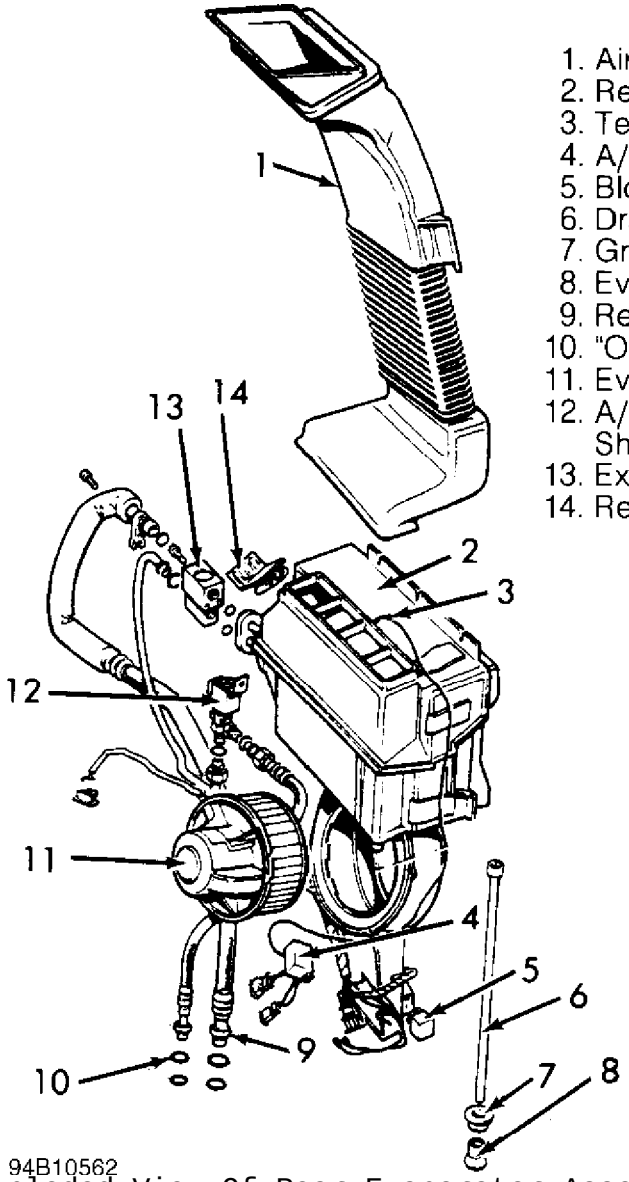
EVAPORATOR TEMPERATURE SWITCH

Removal & Installation

1) Locate evaporator temperature switch along bottom of evaporator housing. Remove screw(s) and evaporator temperature switch

from evaporator housing.

2) When installing evaporator temperature switch, apply tape 13" (330 mm) from end of sensor tube and install sensor tube into evaporator up to tape. DO NOT bend sensor tube.



1. Air Duct
2. Rear Evaporator
3. Temperature Sensor
4. A/C Programmer
5. Blower Motor Relay
6. Drain Hose
7. Grommet
8. Evaporator Drain Valve
9. Refrigerant Lines
10. "O" Rings
11. Evaporator Fan
12. A/C Refrigerant Shutoff Valve
13. Expansion Valve
14. Resistor

Fig. 5: Exploded View Of Rear Evaporator Assembly
Courtesy of Volkswagen United States, Inc.

FRESH/RECIRCULATING AIR FLAP VACUUM SERVO

Removal & Installation

Remove glove box. Remove screws, and rotate vacuum servo to disengage it from arm and lever. Remove vacuum servo. To install vacuum servo, reverse removal procedure.

INSTRUMENT PANEL

Removal

1) Obtain radio anti-theft protection code from owner prior to servicing vehicle. Disconnect negative battery cable. Open engine compartment hood. Remove bolt from air duct and cross panel. Bolt is located on engine compartment side of firewall, near windshield wiper linkage.

2) Mark position of steering wheel for installation reference. Remove steering wheel. Remove steering column trim and combination switch. Remove instrument cluster trim. Disconnect speedometer cable from instrument cluster.

3) Carefully remove vent from left and right air outlets. Remove screw, and carefully pry out left and right air outlets. Remove switch panel located below air outlet on driver's side. Disconnect wiring from speakers.

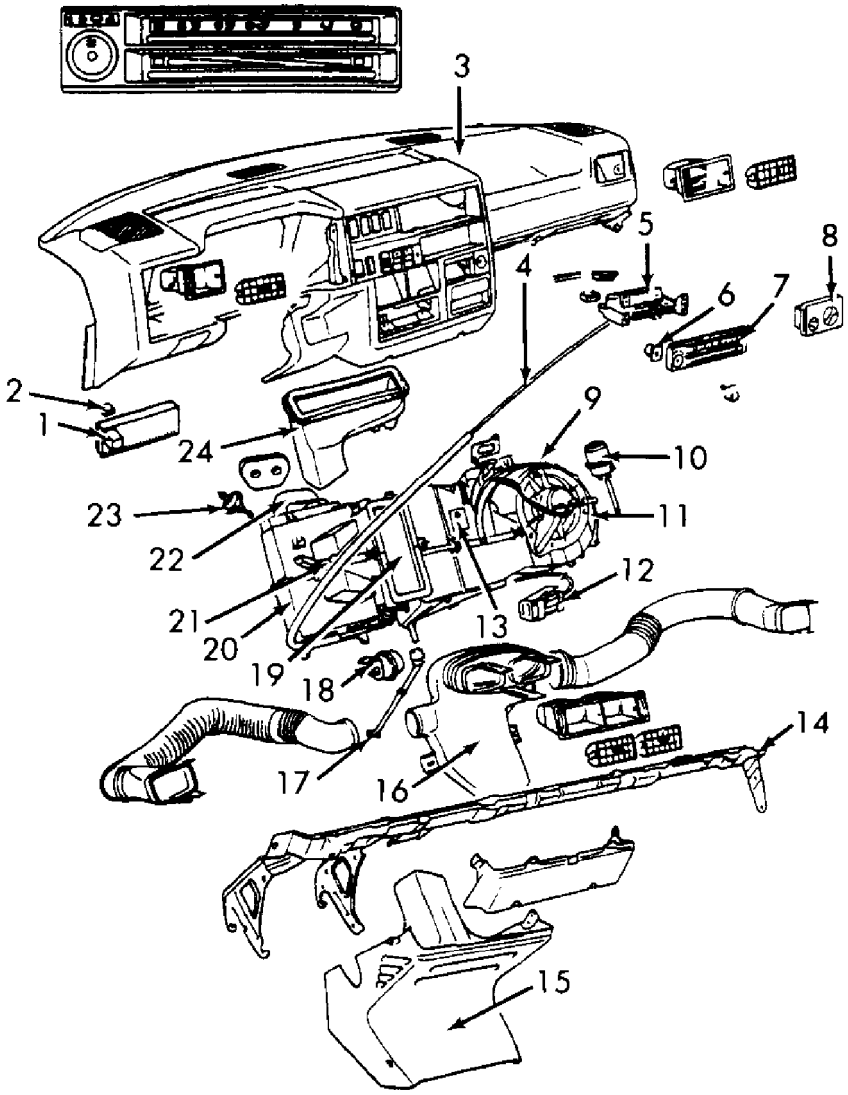
4) Rotate knob on center of storage bin (fuse/relay panel cover) and open bin. Carefully disengage storage bin from pivot points and remove bin. Carefully remove vent from center air outlet. Remove screws and carefully pry out center air outlet.

5) Remove A/C-heater control panel. See Fig. 6. Remove radio. Disconnect antenna, switches, and cigarette lighter wiring harness. Ensure all switches and/or harnesses are disconnected from center part of instrument panel.

6) Open glove box. Remove glove box light, and disconnect wiring harness. Remove 7 screws and glove box. Remove covers and bolts from ends of instrument panel. Remove remove instrument panel.

Installation

To install instrument panel, reverse removal procedure. Ensure wiring harnesses are not pinched during installation.



1. A/C Relay
2. A/C-Heater System Fuse
3. Instrument Panel
4. Temperature Flap Cable
5. A/C-Heater Control Panel
6. Blower Motor Switch (Front)
7. Trim Panel
8. Blower Motor Switch (Rear)
9. Air Intake Duct & Fresh/ Recirculated Air Flap
10. Fresh/Recirculated Air Flap Vacuum Servo
11. Blower Motor
12. A/C Thermoswitch
13. Blower Motor Resistor
14. Bracket
15. Footwell Air Outlet Console
16. Center Air Duct
17. Drain Hose
18. Center Flap Vacuum Servo
19. Center Flap
20. Heater/Evaporator Housing
21. Footwell/Defroster Flap
22. Heater Core
23. Footwell/Defroster Flap Vacuum Servo
24. Defroster Duct

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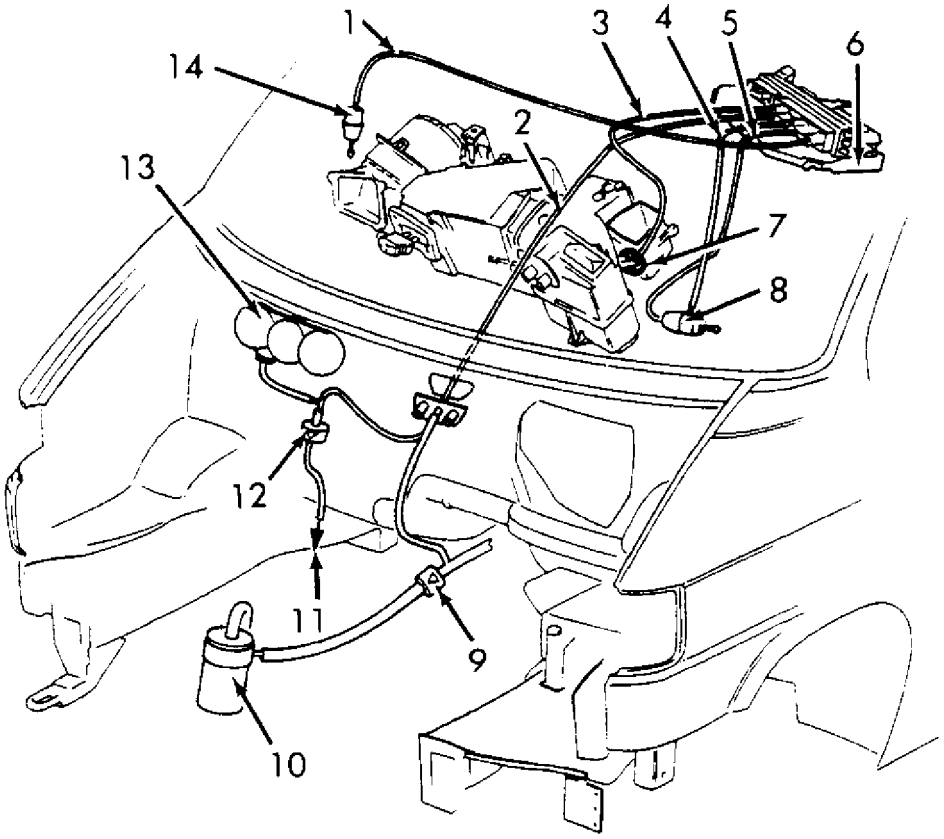
Fig. 6: A/C-Heater System Component ID (Passenger Compartment)
Courtesy of Volkswagen United States, Inc.

VACUUM DIAGRAM



1. Vacuum Hose (White)
2. Vacuum Hose (Black)
3. Vacuum Hose (Red)
4. Vacuum Hose (Green)
5. Vacuum Hose (Yellow)
6. A/C-Heater Control Panel
7. Footwell/Defroster Flap Vacuum Servo
8. Central Flap Vacuum Servo
9. Check Valve (If Equipped)
10. Vacuum Pump (If Equipped)
11. Engine Vacuum Supply Hose
12. Check Valve
13. Vacuum Reservoir
14. Fresh/Recirculated Air Flap Vacuum Servo

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Fig. 7: Vacuum Diagram
Courtesy of Volkswagen United States, Inc.

WIRING DIAGRAMS

A/C-HEATER SYSTEM - MANUAL

Article Text (p. 14)

1993 Volkswagen EuroVan

For Volkswagen Technical Site

Saturday, March 18, 2000 10:29PM

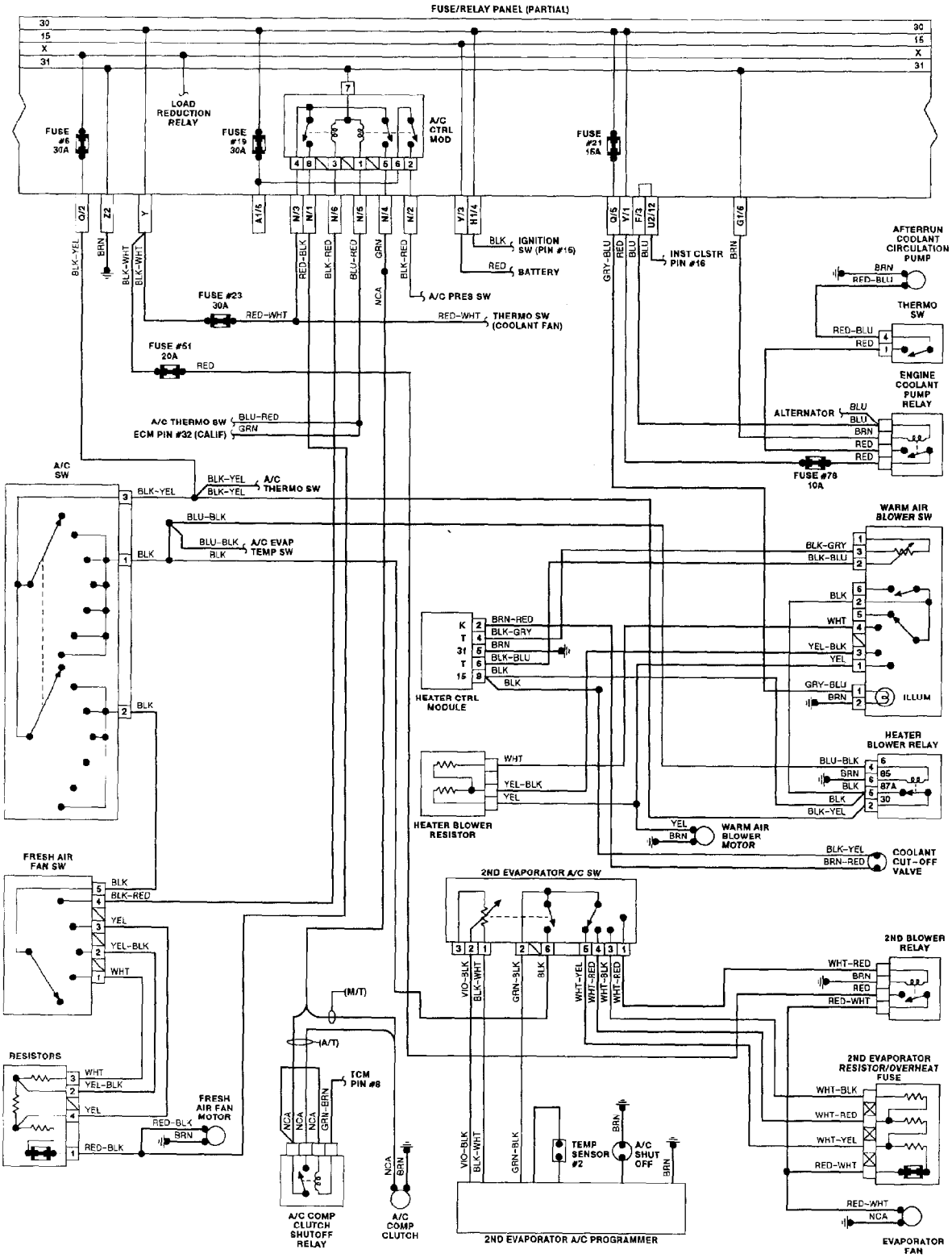

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Fig. 8: Manual A/C-Heater System Wiring Diagram (1 Of 2)

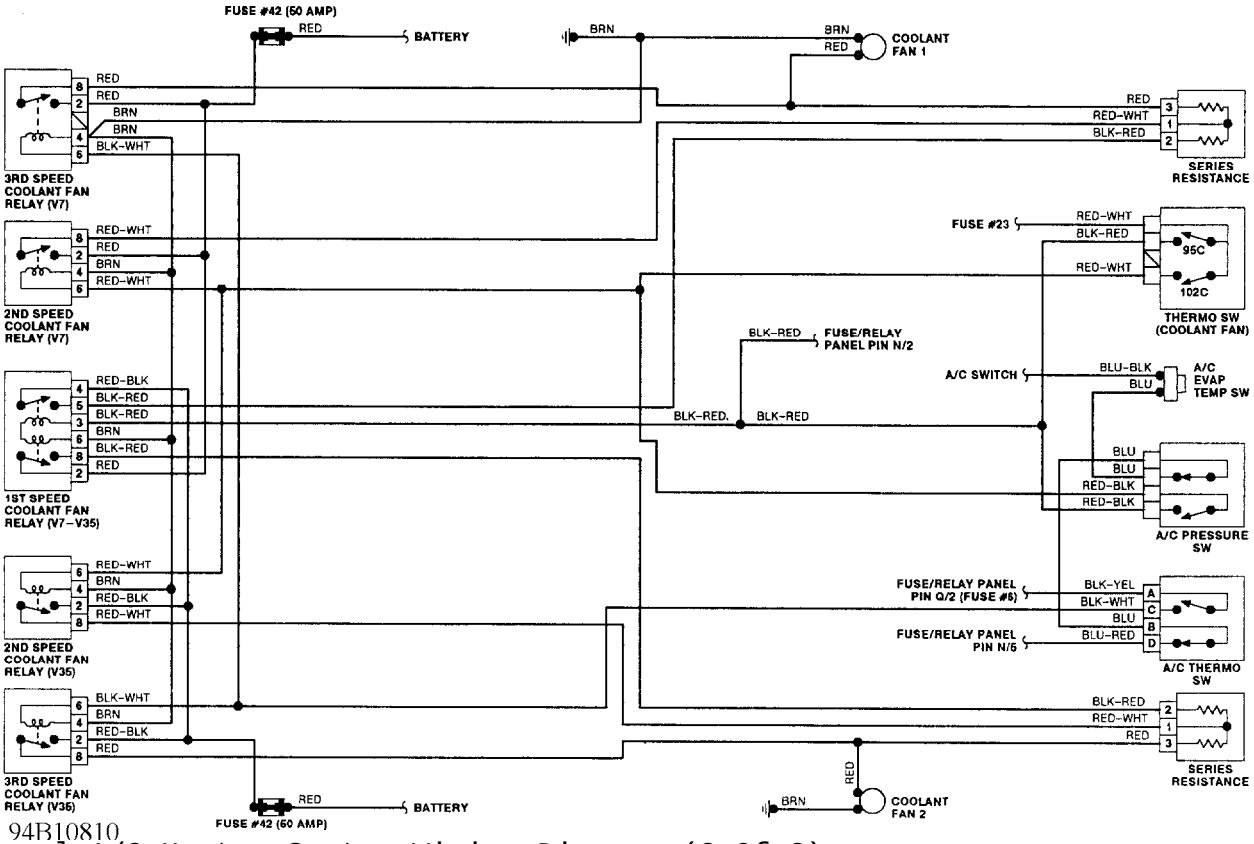

Fig. 9: Manual A/C-Heater System Wiring Diagram (2 Of 2)

END OF ARTICLE

AA - USING THIS SECTION (GENERAL HELP INFORMATION)
Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:29PM

ARTICLE BEGINNING

ENGINE PERFORMANCE
How To Use This Section

INTRODUCTION

NOTE: Because there are so many possible combinations of articles for the different manufacturers and models, the new hyper-text capabilities built into this product DO NOT apply to this article.

It is the purpose of this repair information system to help professional automotive technicians maintain top vehicle performance and correct driveability problems related to today's high tech vehicles.

Because of the limited amount of space allowable for the this product, our titles have been condensed to fit into the menus. An alphabetical designation has been added to the front of each title to allow the titles to be displayed in a way that reflects their respective order of use. References to the titles in some of the diagnostic flow charts sometimes will not correlate with the titles in the this product menu. If not, refer to the MENU CROSS-REFERENCE table below.

MENU CROSS-REFERENCE TABLE

Title	Associate Print (Book) Title:
A - ENGINE/VIN I D	Introduction
B - EMISSION APPLICATION	Emission Applications
C - TUNE-UP SPECS	Service & Adjustment Specifications
C - SPECIFICATIONS	Service & Adjustment Specifications
D - ADJUSTMENTS	On-Vehicle Adjustments
E - THEORY/OPERATION	Theory & Operation
F - BASIC TESTING	Basic Diagnostic Procedures
G - TESTS W/ CODES	Self-Diagnostics
H - TESTS W/O CODES	Trouble Shooting - No Codes
I - SYS/COMP TESTS	Systems & Component Testing
J - PIN VOLTAGE CHARTS	Pin Voltage Charts
K - SENSOR RANGE CHARTS	Sensor Operating Range Charts
L - WIRING DIAGRAMS	Wiring Diagrams
M - VACUUM DIAGRAMS	Vacuum Diagrams
N - REMOVE/INSTALL/OHAUL	Removal, Overhaul & Installation

Because of this we recommend that you read the rest of these INTRODUCTION paragraphs to better understand why the information is presented in this new format.

The A - ENGINE/VIN I D article will help you identify the vehicle and its systems. It will also explain the VIN code and in many cases, show its location.

AA - USING THIS SECTION (GENERAL HELP INFORMATION)
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If you want "TUNE-UP" type information, see D - ADJUSTMENTS for the adjustment procedures. If you are familiar with the procedures, but need a quick way to find the specification, go to C - TUNE-UP SPECS or C - SPECIFICATIONS for the specifications pertaining to the vehicle.

When diagnosing driveability problems, first go to F - BASIC TESTING. This article is here to help eliminate wasted diagnostic time. If the basic systems are working properly, go to G - TESTS W/ CODES.

If the vehicle still is having a driveability problem or if the vehicle has no self-diagnostic system, go to H - TESTS W/O CODES. This article will help you diagnose the problem by symptom, locate the symptom exhibited by the vehicle, and inspect or test the items which may be causing the problem.

After finding which specific system or component requires testing, use the I - SYS/COMP TESTS article to tests the systems and components. We have also included (when available) pin voltage charts and sensor range charts. These can be found in J - PIN VOLTAGE CHARTS and K - SENSOR RANGE CHARTS.

Also included in this section are wiring diagrams and vacuum diagrams. These can be found in L - WIRING DIAGRAMS and M - VACUUM DIAGRAMS.

When all diagnostic tests have been performed and the problem has been discovered, it may be necessary to replace or overhaul the defective part. This information can be found in N - REMOVE/INSTALL/OHAUL.

The content of each of these articles is outlined below. As a summary of the driveability diagnosis, see ROUTINE OUTLINE in this article.

A - ENGINE/VIN ID

This article shows how to identify the model and engine by its Vehicle Identification Number (VIN). A model coverage chart shows each model and engine, the fuel system, ignition system and engine code. The engine serial number locations are also included in this article.

B - EMISSION APPLICATION

These charts identify the emission systems and sub-systems applicable to each model and engine combination.

C - TUNE-UP SPECS

This is a collection of quick-reference type specifications. This article is helpful when you are familiar with proper adjustment procedures and only need specifications. Included in this section are:

* Battery specifications.
* Fluid capacities.

* Replacement intervals.
* Belt adjustment.
* Engine Compression.
* Valve clearance.
* Valve Arrangement.
* Ignition coil specifications.

* High tension wire resistance.
* Spark plug type and gap.
* Firing order.
* Ignition timing.
* Fuel pump performance and injector resistance specifications
* Slow and fast idle speed and mixture specifications.
* Carbon monoxide (CO) level specifications.
* Throttle position sensor/switch specifications.

C - SPECIFICATIONS

This is a collection of quick-reference type specifications. This article is helpful when you are familiar with proper adjustment procedures and only need specifications. Included in this section are:

* Battery specifications.
* Fluid capacities.
* Replacement intervals.
* Belt adjustment.
* Engine Compression.
* Valve clearance.
* Valve Arrangement.
* Ignition coil specifications.

* High tension wire resistance.
* Spark plug type and gap.
* Firing order.
* Ignition timing.
* Fuel pump performance and injector resistance specifications
* Slow and fast idle speed and mixture specifications.
* Carbon monoxide (CO) level specifications.
* Throttle position sensor/switch specifications.

D - ADJUSTMENTS

This article contains the information that use to be included in the TUNE-UP section. Checking and adjusting valves, spark plugs, spark plug wires, base ignition timing and idle speed are found in this section. Use this article for routine maintenance. Also, if you have a driveability problem, ensure all on-vehicle adjustments are correct before proceeding with any diagnosis.

E - THEORY/OPERATION

AA - USING THIS SECTION (GENERAL HELP INFORMATION)

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For Volkswagen Technical Site

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This article covers basic theory and operation of engine performance-related systems and components. Before diagnosing vehicles or systems with which you are not completely familiar, read this article.

F - BASIC TESTING

When diagnosing driveability problems, there are certain "BASIC DIAGNOSTIC PROCEDURES" which must FIRST be performed. It is necessary to perform a careful, complete check of basic engine mechanical and electrical conditions, and verify spark availability and adequate fuel supply.

The procedures apply to both computerized and non-computerized systems. If all systems are okay, go to G - TESTS W/ CODES for vehicles with self-diagnostic systems or H - TESTS W/O CODES for diagnosis by symptom.

G - TESTS W/ CODES

Use this article to retrieve and interpret trouble codes from the engine computer self-diagnostic system. Once information is retrieved, diagnostic procedures are given to help pinpoint and repair computer system/component faults. Necessary steps for clearing trouble codes are also given. If faults indicated by trouble codes are not present at time of testing, proceed to TESTS W/O CODES for intermittent testing procedures.

H - TESTS W/O CODES

This article helps trouble shoot driveability problems based upon available "SYMPTOMS" and "INTERMITTENT TESTING" procedures. Procedures in this section should lead you to specific component or system tests which may or may not be computer monitored/controlled.

I - SYS/COMP TESTS

In this article, you will find tests for systems and components related to air induction systems (turbochargers), fuel control, ignition control, and emissions control systems.

J - PIN VOLTAGE CHARTS

PIN VOLTAGE CHARTS are supplied (where available) to speed up the diagnostic process. By checking pin voltages at the electronic control unit, it is possible to determine if the control unit is receiving and transmitting proper voltage signals.

K - SENSOR RANGE CHARTS

Use the SENSOR OPERATING RANGE CHARTS to determine if a

sensor is out of calibration. A sensor that is out of calibration may not set a trouble code, but it will cause driveability problems.

L - WIRING DIAGRAMS

Use these WIRING DIAGRAMS to identify and trace component circuits, locate shorts and opens in circuits, and understand how individual circuits function as part of a system. The diagrams in this article are only for fuel, ignition and emission systems

M - VACUUM DIAGRAMS

The VACUUM DIAGRAMS will assist you in finding incorrectly routed vacuum hoses which may cause driveability problems or computer indicated malfunctions.

N - REMOVE/INSTALL/OHAUL

N - REMOVE/INSTALL/OHAUL contains information found in the sub-headings of REMOVAL, OVERHAUL & INSTALLATION. These are procedures and specifications required to remove, overhaul (if possible) and install components related to engine performance.

WHERE TO START

PERFORM BASIC INSPECTION

1) Verify customer complaint.
2) Perform visual inspection. See F - BASIC TESTING.
3) Test engine sub-system to determine that the following systems are functioning properly. See F- BASIC TESTING.

* Mechanical conditions (compression)
* Ignition output
* Fuel Delivery

4) Check air induction system for leaks.
5) Check & adjust basic engine settings listed below to ensure they are to specification. See D - ADJUSTMENTS.

* Ignition timing
* Idle speed

CHECK FOR TROUBLE CODES

1) If equipped with self-diagnostics, check for trouble codes. Refer to G - TESTS W/ CODES.
2) Repair causes of trouble code(s).
3) Clear control unit memory.

SYMPTOM DIAGNOSIS

1) If no self-diagnostics available, or no trouble codes present, identify symptom.
2) See trouble shooting procedure to repair complaint. See H - TESTS W/O CODES

TEST SYSTEM

1) Perform necessary systems and component tests. See I - SYS/COMP TESTS.
2) Verify that complaint is repaired.

SAFETY PRECAUTIONS

* Always refer to Engine Tune-Up Decal in engine compartment before performing tune-up. If manual and decal differ, always use decal specifications.
* DO NOT allow or create a condition of misfire in more than one cylinder for an extended period of time. Damage to converter may occur due to loading converter with unburned air/fuel mixture.
* Always turn ignition off and disconnect negative battery cable BEFORE disconnecting or connecting computer or other electrical components.

* DO NOT drop or shock electrical components such as computer, airflow meter, etc.
* DO NOT use fuel system cleaning compounds that are not recommended by the manufacturer. Damage to gaskets, diaphragm materials and catalytic converter may result.
* Before performing a compression test or cranking engine using a remote starter switch, disconnect coil wire from distributor and secure it to a good engine ground, or disable ignition.
* Before disconnecting any fuel system component, ensure fuel system pressure is released.

* Use a shop towel to absorb any spilled fuel to prevent fire.
* DO NOT create sparks or have an open flame near battery.
* If any EFI components such as hoses or clamps are replaces, ensure they are replaced with components designed for EFI use.
* Always reassemble throttle body components with new gaskets, "O" rings and seals.
* If equipped with an inertia switch, DO NOT reset switch until fuel system has been inspected for leaks.
* Wear safety goggles when drilling or grinding.
* Wear proper clothing which protects against chemicals and other hazards.

END OF ARTICLE

ABBREVIATIONS
Article Text
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ARTICLE BEGINNING

GENERAL INFORMATION

COMMONLY USED ABBREVIATION

"A" ABBREVIATION TABLE

"A" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
A	Amperes
A/C	Air Conditioning
A/T	Automatic Transmission/Transaxle
AAP	Auxiliary Accelerator Pump
AB	Air Bleed
ABCV	Air Bleed Control Valve
ABDC	After Bottom Dead Center
ABRS	Air Bag Restraint System
ABS	Anti-Lock Brake System
AC	Alternating Current
ACC	A/C Clutch Compressor
ACCS	A/C Cycling Switch
ACCUM	Accumulator
ACCY	Accessory
ACT	Air Charge Temperature Sensor
ACV	Thermactor Air Control Valve
ADJ	Adjust or Adjustable
ADV	Advance
AFS	Airflow Sensor
AI	Air Injection
AIR or A.I.R.	Air Injection Reactor
AIS	Air Injection System
ALCL	Assembly Line Communications Link
ALDL	Assembly Line Diagnostic Link
ARC	Automatic Ride Control
ASCD	Automatic Speed Control Device
ASCS	Air Suction Control Solenoid
ASD	Auto Shutdown
ASDM	Air Bag System Diagnostic Module
ASV	Air Suction Valve
ATC	Automatic Temperature Control
ATDC	After Top Dead Center
ATF	Automatic Transmission Fluid
ATS	Air Temperature Sensor
AXOD	Automatic Transaxle Overdrive
Abs.	Absolute
Accy.	Accessory
Alt.	Alternator or Altitude
Amp.	Ampere

³Assy.	³Assembly ³
³Auto.	³Automatic ³
³Aux.	³Auxiliary ³
³Avg.	³Average ³

"B" ABBREVIATION TABLE

"B" ABBREVIATION TABLE

³ABBREVIATION	³DEFINITION ³
³B/P	³Backpressure ³
³BAC	³By-Pass Air Control ³
³BAP	³Barometric Absolute Pressure Sensor ³
³BARO	³Barometric ³
³BBDC	³Before Bottom Dead Center ³
³BCM	³Body Control Module ³
³BDC	³Bottom Dead Center ³
³BHP	³Brake Horsepower ³
³BLK	³Black ³
³BLU	³Blue ³
³BMAP	³Barometric & Manifold Absolute Pressure Sensor ³
³BOO	³Brake On-Off Switch ³
³BP	³Barometric Pressure sensor ³
³BPS	³Barometric Pressure Sensor ³
³BPT	³Backpressure Transducer ³
³BRN	³Brown ³
³BTDC	³Before Top Dead Center ³
³BTU	³British Thermal Unit ³
³BVSV	³Bimetallic Vacuum Switching Valve ³
³Baro.	³Barometric ³
³Batt.	³Battery ³
³Bbl.	³Barrel (Example: 4-Bbl.) ³
³Blst.	³Ballast ³
³Blwr.	³Blower ³
³Brkr.	³Breaker ³

"C" ABBREVIATION TABLE

"C" ABBREVIATION TABLE

³ABBREVIATION	³DEFINITION ³
³ø C	³Celsius (Degrees) ³
³C(3) I	³Computer Controlled Coil Ignition ³
³C(4)	³Computer Controlled Catalytic Converter ³
³CANP	³Canister Purge solenoid ³
³CARB	³California Air Resources Board ³
³CAT	³Catalytic Converter ³
³CB	³Circuit Breaker ³

³CBD	³Closed Bowl Distributor ³
³CBVV	³Carburetor Bowl Vent Valve ³
³cc	³Cubic Centimeter ³
³CCC	³Computer Command Control ³
³CCD	³Computer Controlled Dwell ³
³CCM	³Central Control Module ³
³CCO	³Converter Clutch Override ³
³CCOT	³Cycling Clutch Orifice Tube ³
³CCW	³Counterclockwise ³
³CDI	³Capacitor Discharge Ignition ³
³CEC	³Computerized Engine Control ³
³CFI	³Central Fuel Injection ³
³CID	³Cubic Inch Displacement ³
³CID	³Cylinder Identification sensor ³
³CIS	³Continuous Injection System ³
³CIS-E	³Continuous Injection System-Electronic ³
³CKT	³Circuit ³
³CLR	³Clear ³
³CNG	³Compressed Natural Gas ³
³CO	³Carbon Monoxide ³
³CO2	³Carbon Dioxide ³
³CONV	³Convertible ³
³CP	³Canister Purge ³
³CPA	³Connector Position Assurance ³
³CPS	³Crank Position Sensor ³
³CTS	³Coolant Temperature Sensor ³
³CV	³Check Valve or Constant Velocity ³
³CVC	³Constant Vacuum Control ³
³CW	³Clockwise ³
³CYL or Cyl.	³Cylinder ³
³Calif.	³California ³
³Carb.	³Carburetor ³
³Chrg.	³Charging ³
³Circ.	³Circuit ³
³Cntrl.	³Control ³
³Comp.	³Compressor or Compartment ³
³Conn.	³Connector ³
³Cont.	³Continued ³
³Conv.	³Convertible or Converter ³
³Cu. In.	³Cubic Inch ³
³Cyl.	³Cylinder ³

"D" ABBREVIATION TABLE

"D" ABBREVIATION TABLE

³ABBREVIATION	³DEFINITION ³
³"D"	³Drive ³
³DBC	³Dual Bed Catalyst ³
³DC	³Direct Current or Discharge ³

³DDD	³Dual Diaphragm Distributor ³
³DERM	³Diagnostic Energy Reserve Module ³
³DFI	³Digital Fuel Injection ³
³DIC	³Driver Information Center ³
³DIS	³Direct Ignition System ³
³DIS	³Distributorless Ignition System ³
³DIST	³Distribution ³
³DISTR	³Distributor ³
³DK BLU	³Dark Blue ³
³DK GRN	³Dark Green ³
³DME	³Digital Motor Electronics (Motronic System) ³
³DOHC	³Double Overhead Cam ³
³DOT	³Department of Transportation ³
³DP	³Dashpot ³
³DRB-II	³Diagnostic Readout Box ³
³DVOM	³Digital Volt/Ohm Meter (see VOM) ³
³Def.	³Defogger or Defroster ³
³Def.	³Defrost ³
³Defog.	³Defogger ³
³Diag.	³Diagnostic ³
³Dist.	³Distributor or Distribution ³
³Dr.	³Door ³

"E" ABBREVIATION TABLE

"E" ABBREVIATION TABLE

³ABBREVIATION	³DEFINITION ³
³EAC	³Electric Assist Choke ³
³EACV	³Electric Air Control Valve ³
³EBCM	³Electronic Brake Control Module ³
³ECA	³Electronic Control Assembly ³
³ECAT	³Electronically Controlled Automatic Transaxle ³
³ECM	³Electronic Control Module ³
³ECT	³Engine Coolant Temperature Sensor ³
³ECU	³Electronic Control Unit or Engine Control Unit ³
³EDF	³Electric Drive Fan relay assembly ³
³EDIS	³Electronic Distributorless Ignition System ³
³EEC	³Electronic Engine Control ³
³EECS	³Evaporative Emission Control System ³
³EEPROM	³Electronically Erasable PROM ³
³EFE	³Early Fuel Evaporation ³
³EFI	³Electronic Fuel Injection ³
³EGO	³Exhaust Gas Oxygen sensor (see HEGO) ³
³EGR	³Exhaust Gas Recirculation system ³
³EGRC	³EGR Control solenoid or system ³
³EGRV	³EGR Vent solenoid or system ³
³EMR	³Emission Maintenance Reminder Module ³
³ESA	³Electronic Spark Advance ³
³ESC	³Electronic Spark Control ³

³EST	³Electronic Spark Timing ³
³ETR	³Emergency Tensioning Retractor ³
³EVAP	³Fuel Evaporative System ³
³EVIC	³Electronic Vehicle Information Center ³
³EVO	³Electronic Variable Orifice ³
³EVP	³EGR Valve Position Sensor ³
³EVR	³EGR Valve Regulator ³
³EVRV	³Electronic Vacuum Regulator Valve ³
³Elect.	³Electronic ³
³Eng.	³Engine ³
³Evap.	³Evaporative ³
³Exc.	³Except ³

"F" ABBREVIATION TABLE

"F" ABBREVIATION TABLE

³ABBREVIATION	³DEFINITION ³
³ø F	³Fahrenheit (Degrees) ³
³F/B	³Fuse Block ³
³FBC	³Feedback Carburetor ³
³FI	³Fuel Injector or Fuel Injection ³
³FICD	³Fast Idle Control Device ³
³FIPL	³Fuel Injector Pump Lever ³
³FP	³Fuel Pump ³
³FPM	³Fuel Pump Monitor ³
³FPR-VSV	³Fuel Pressure Regulator Vacuum Switching Valve ³
³FWD	³Front Wheel Drive ³
³Fed.	³Federal ³
³Ft. Lbs.	³Foot Pounds ³

"G" ABBREVIATION TABLE

"G" ABBREVIATION TABLE

³ABBREVIATION	³DEFINITION ³
³g	³grams ³
³GND or GRND	³Ground ³
³GRN	³Green ³
³GRY	³Gray ³
³Ga.	³Gauge ³
³Gals.	³gallons ³
³Gov.	³Governor ³

"H" ABBREVIATION TABLE

"H" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
H/D	Heavy Duty
HAC	High Altitude Compensation
HC	Hydrocarbons
HEDF	High Speed Electro Drive Fan relay or circuit
HEGO	Heated Exhaust Gas Oxygen Sensor
HEGOG	HEGO Ground circuit
HEI	High Energy Ignition
HLDT	Headlight
HO	High Output
HP	High Performance
HSC	High Swirl Combustion
HSO	High Specific Output
HTR	Heater
HVAC	Heating
Headlt.	Headlight
Hg	Mercury
Hgt.	Height
Htr.	Heater
Hz	Hertz (Cycles Per Second)

"I" ABBREVIATION TABLE

"I" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
I.D.	Inside Diameter
IAC	Idle Air Control
IACV	Idle Air Control Valve
IC	Integrated Circuit
ID	Identification
IDM	Ignition Diagnostic Monitor
IGN	Ignition system or circuit
ILC	Idle Load Compensator
In. Hg	Inches of Mercury
INCH Lbs.	Inch Pounds
INFL REST	Inflatable Restraint
INJ	Injector or Injection
IP	Instrument Panel
IPC	Instrument Panel Cluster
ISA	Idle Speed Actuator
ISC	Idle Speed Control
ISS	Idle Stop Solenoid
ITS	Idle Tracking Switch
IVSV	Idle Vacuum Switching Valve
Ign.	Ignition
In.	Inches

Inj.	Injector

"J" ABBREVIATION TABLE

"J" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
J/B	Junction Block

"K" ABBREVIATION TABLE

"K" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
k/ohms	1000 ohms (kilo as in k/ohms)
kg	Kilograms (weight)
kg/cmý	Kilograms Per Square Centimeter
KAM	Keep Alive Memory
KAPWR	Keep Alive Power
KM/H	Kilometers Per Hour
KOEO	Key On Engine Off
KOER	Key On Engine Running
KS	Knock Sensor

"L" ABBREVIATION TABLE

"L" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
L	Liter(s)
L/D	Light Duty
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LH	Left Hand
LOS	Limited Operation Strategy
LT BLU	Light Blue
LT GRN	Light Green
LUS	Lock-Up Solenoid
Lbs.	Pounds
Lt(s).	Light(s)
Lugg.	Luggage

"M" ABBREVIATION TABLE

ABBREVIATIONS
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"M" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
mA	Milliamps
mV	Millivolts
mfd.	Microfarads
mm	Millimeters
M/T	Manual Transaxle or Transmission
MA PFI	Mass Air Sequential Port Fuel Injection system
MA or MAF	Mass Airflow
MAF	Mass Air Flow sensor
MAFS	Mass Airflow Sensor
MAP	Manifold Absolute Pressure sensor
MAT	Manifold Air Temperature
MCU	Microprocessor Control Unit
MCV	Mixture Control Valve
MEM-CAL	Memory Calibration Chip
MFI	Multiport Fuel Injection
MIL	Malfunction Indicator Light
MLP	Manual Lever Position
MPFI	Multi Point Fuel Injection
MPH	Miles Per Hour
MPI	Multi-Point (Fuel) Injection
Man.	Manual
Mech.	Mechanical
Mem.	Memory
Mtr.	Motor

"N" ABBREVIATION TABLE

"N" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
N.m	Newton-Meter
NA	Not Available
NDS	Neutral Drive Switch
NGS	Neutral Gear Switch
NOx	Oxides of Nitrogen
NPS	Neutral Pressure Switch
No.	Number
Nos.	Numbers

"O" ABBREVIATION TABLE

"O" ABBREVIATION TABLE

ABBREVIATION	DEFINITION

³O	³Oxygen ³
³O.D.	³Outside Diameter ³
³O/S	³Oversize ³
³O2	³Oxygen ³
³OC	³Oxidation Catalyst ³
³OCC	³Output Circuit Check ³
³OD	³Overdrive ³
³ODO	³Odometer ³
³OHC	³Overhead Camshaft ³
³ORG	³Orange ³
³OSC	³Output State Check ³
³Opt.	³Option or Optional ³
³oz.	³Ounce ³
³ozs.	³Ounces ³

"P" ABBREVIATION TABLE

"P" ABBREVIATION TABLE

³ABBREVIATION	³DEFINITION ³
³"P"	³Park ³
³P/C	³Printed Circuit ³
³P/N	³Park/Neutral ³
³P/S	³Power Steering ³
³PAV	³Pulse Air Valve ³
³PC-SOL	³Purge Control Solenoid ³
³PCM	³Powertrain Control Module ³
³PCS	³Purge Control Solenoid ³
³PCSDM	³Passenger Compartment Sensor/Diagnostic Module ³
³PCV	³Positive Crankcase Ventilation ³
³PFE	³Pressure Feedback EGR sensor or circuit ³
³PFI	³Port Fuel Injection (see MA SEFI) ³
³PGM-CARB	³Programmed Carburetor ³
³PGM-FI	³Programmed Fuel Injection ³
³PIP	³Profile Ignition Pickup ³
³PNK	³Pink ³
³PPL	³Purple ³
³PRNDL	³Park Reverse Neutral Drive Low ³
³PROM	³Programmable Read-Only Memory ³
³psi	³Pounds Per Square Inch ³
³PSPS	³Power Steering Pressure Switch ³
³PTC	³Positive Temperature Coefficient ³
³PTO	³Power Take-Off ³
³PWR GND	³Power Ground circuit ³
³Pkg.	³Package ³
³Press.	³Pressure ³
³Prog.	³Programmed or Programmable ³
³Pts.	³Pints ³
³Pwr.	³Power ³

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"Q" ABBREVIATION TABLE

"Q" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
Qts.	Quarts

"R" ABBREVIATION TABLE

"R" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
RABS	Rear Anti-Lock Brake System
RAC	Remote Accessory Control
RAM	Random Access Memory
RAP	Retained Accessory Power
RECIRC	Recirculation
RED	Red
RH	Right Hand
ROM	Read Only Memory
RPM	Revolutions Per Minute
RVB	Rear Vacuum Break
RWAL	Rear Wheel Anti-Lock Brake
RWD	Rear Wheel Drive
Recirc.	Recirculate or Recirculation
Reg.	Regulator
Rly.	Relay

"S" ABBREVIATION TABLE

"S" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
SBC	Single Bed Converter
SBEC	Single Board Engine Controller
SC	Super Charged
SCC	Spark Control Computer
SCS	Air Suction Control Solenoid
SDM	Supplemental Restraint System Diagnostic Module
SDU	SRS Diagnostic Unit
SEN	Sensor
SES	Service Engine Soon
SFI	Sequential (Port) Fuel Injection
SIG RTN	Signal Return circuit
SIL	Shift Indicator Light

³SIR	³Supplemental Inflatable Restraint ³
³SMEC	³Single Module Engine Controller ³
³SOHC	³Single Overhead Cam ³
³SOL or Sol.	³Solenoid ³
³SPFI	³Sequential Port Fuel Injection ³
³SPK	³Spark Control ³
³SPOUT	³Spark Output Signal ³
³SRS	³Supplemental Restraint System (Air Bag) ³
³SS 3/4-4/3	³Shift Solenoid circuit ³
³SSI	³Solid State Ignition ³
³STAR	³Self-Test Automatic Readout ³
³STI	³Self Test Input circuit ³
³STO	³Self-Test Output ³
³SUB-O2	³Sub Oxygen Sensor ³
³Sen. or Sens.	³Sensor ³
³Sol.	³Solenoid ³
³Sprchg.	³Supercharger ³
³Strg.	³Steering ³
³Susp.	³Suspension ³
³Sw.	³Switch ³
³Sys.	³System ³

"T" ABBREVIATION TABLE

"T" ABBREVIATION TABLE

³ABBREVIATION	³DEFINITION ³
³T.V.	³Throttle Valve ³
³TAB	³Thermactor Air By-Pass ³
³TAC	³Thermostatic Air Cleaner ³
³TAD	³Thermactor Air Diverter ³
³TAN	³Tan ³
³TBI	³Throttle Body Injection ³
³TCC	³Torque Converter Clutch ³
³TCCS	³Toyota Computer Control System ³
³TDC	³Top Dead Center ³
³TDCL	³Total Diagnostic Communication Link ³
³TFI	³Thick Film Ignition system ³
³TGS	³Top Gear Switch (cancels SIL in top gear) ³
³THERMAC	³Thermostatic Air Cleaner ³
³THS	³Transmission Hydraulic Switch ³
³TP/TPS	³Throttle Position Sensor ³
³TPI	³Tuned Port Injection ³
³TPS	³Throttle Position Sensor/Switch ³
³TS	³Temperature Sensor ³
³TSB	³Technical Service Bulletin ³
³TTS	³Transmission Temperature Switch ³
³TV	³Thermovalve ³
³TWC	³Three-Way Catalyst ³
³Temp.	³Temperature ³

Trans.	Transaxle/Transmission

"V" ABBREVIATION TABLE

"V" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
V	Valve
VAF	Vane Air Flow sensor or circuit
VAPS	Variable Assist Power Steering
VAT	Vane Air Temperature
VATS	Vehicle Anti-Theft System
VBATT	Vehicle Battery Voltage
VCC	Viscous Converter Clutch
VIN	Vehicle Identification Number
VIO	Violet
VLR	Volt Loop Reserve
VM	Vacuum Modulator
VM	Vane Meter
VOM	Volt-Ohmmeter (Analog)
VPWR	Vehicle Power supply voltage (10-14 volts)
VREF	Voltage Reference (ECA supplied reference voltage
VRV	Vacuum Regulator Valve
VSC	Vehicle Speed Control sensor or signal
VSS	Vehicle Speed Sensor or signal
VSV	Vacuum Switching Valve
Vac.	Vacuum
Volt.	Voltage

"W" ABBREVIATION TABLE

"W" ABBREVIATION TABLE

ABBREVIATION	DEFINITION
W/	With
W/O	Without
WAC	WOT A/C Cut-off switch or circuit
WAC	Wide Open Throttle A/C Switch
WHT	White
WOT	Wide Open Throttle
YEL	Yellow

END OF ARTICLE

ALTERNATOR & REGULATOR
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:30PM

ARTICLE BEGINNING

1993 ELECTRICAL
Volkswagen Alternators & Regulators - Bosch

Volkswagen; Cabriolet, Corrado SLC, EuroVan, Fox, Golf, GTI, Jetta, Passat

DESCRIPTION

Bosch alternators are conventional 3-phase, self-rectifying type alternators. Bosch 65 to 75-amp alternators use 3 positive and 3 negative diodes connected to stator windings to rectify current. Bosch 90-amp alternators use 14 diodes.

All alternators use 3 exciter diodes connected to stator windings. These diodes turn off the alternator indicator light and supply power to the voltage regulator while the engine is running. Bosch regulators are transistorized and integral with alternator.

TROUBLE SHOOTING

NOTE: See TROUBLE SHOOTING - BASIC PROCEDURES article in GENERAL INFORMATION.

ADJUSTMENTS

BELT TENSION

BELT ADJUSTMENT TABLE

Application	Specification
A/C Compressor	
Cabriolet	
New	(1) 54 INCH Lbs. (6 N.m)
Used	(1) 36 INCH Lbs. (4 N.m)
Fox	13/64-3/8" (5-10 mm)
Passat GL	
New	(1) 72 INCH Lbs. (8 N.m)
Used	(1) 36 INCH Lbs. (4 N.m)
Alternator	
Cabriolet	
New	5/16" (8 mm)
Used	5/32" (4 mm)
Fox	3/8-9/16" (10-15 mm)
Passat GL	(1) (2) 72 INCH Lbs. (8 N.m)
Power Steering	
Passat GL	13/64" (5 mm)
Serpentine Belt	
Corrado SLC, EuroVan, Golf, GTI, Jetta & Passat GLX	(3)

(1) - Turn tensioning nut on toothed rack with Torque Wrench (VAG1410) and Ring Insert (SW VAG 1410-2).
(2) - Start engine and let it idle for 5 minutes. Loosen bolts and retighten belt to specification.
(3) - Serpentine belt tension automatically adjusted by tensioner.
ÄÄÄ

ON-VEHICLE TESTING

WIRING CONTINUITY TEST

1) With ignition off, connect a voltmeter between alternator B+ terminal and ground. Voltmeter should indicate battery voltage. If battery voltage is not present, check wiring between alternator and battery.

2) Turn ignition on and ensure alternator indicator light comes on. If light does not come on, check wiring between alternator and warning light, including indicator bulb.

OUTPUT TEST

CAUTION: DO NOT load electrical system for more than 15-20 seconds during output test or possible system damage may occur.

1) Ensure connections at battery, alternator, and starter (most vehicles) are clean and tight. Ensure alternator, engine and body are properly grounded. Ensure alternator drive belt is tight and in good condition.

2) Turn off all accessories. Start engine and allow to idle. Connect ammeter following manufacturer's instructions. Run engine at 2000 RPM. Adjust carbon pile on tester to obtain maximum alternator output. DO NOT allow battery voltage to drop to less than 12.6 volts.

3) Alternator output should equal alternator rated output, minus 16-20 amps. If reading is more than 20 amps less than alternator rating, replace regulator and retest. If output is still low, repair or replace alternator.

REGULATOR CONTROL VOLTAGE TEST

1) Connect ammeter following manufacturer's instructions. Connect voltmeter leads to battery terminals. Start engine and run at 3000 RPM.

2) Run engine until voltage stops rising. Voltage should be 13.5-14.5 volts. If reading is incorrect, remove regulator and ensure brushes are longer than 3/16" (5 mm). Replace if necessary.

3) If brushes are okay and regulator fails to keep voltage within specified limits, replace regulator and retest. If voltage is still incorrect, repair or replace alternator.

BENCH TESTING

DIODE ASSEMBLY

1) Place ohmmeter on X 100 scale. Connect ohmmeter leads across B+ terminal and 3 stator terminals one at a time. Reverse leads. Ohmmeter should indicate continuity in one direction only.
2) Connect ohmmeter leads across negative plate and 3 stator terminals one at a time. See Fig. 1. Reverse leads. Ohmmeter should indicate continuity in one direction only.
3) Connect ohmmeter leads across D+ terminal and 3 stator terminals one at a time. Reverse leads. Ohmmeter should indicate continuity in one direction only. Replace diode assembly if defective.

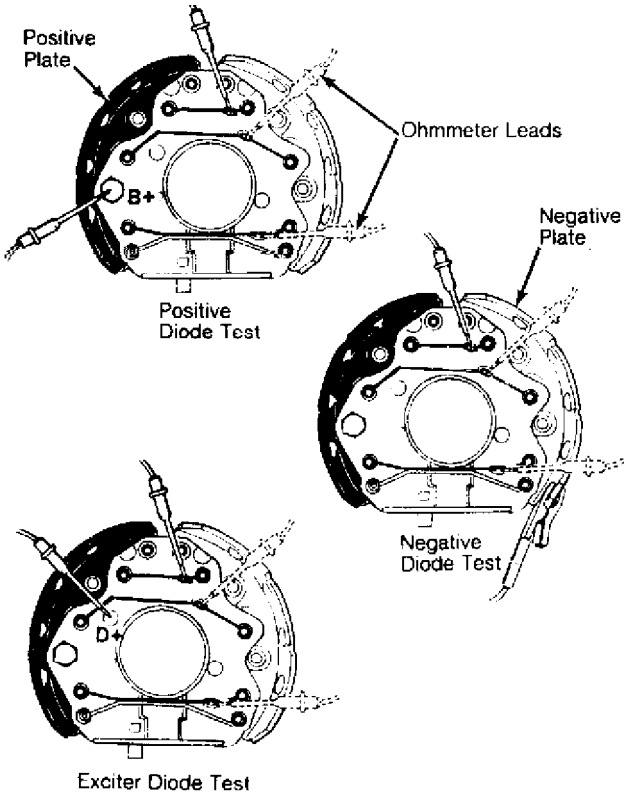

Fig. 1: Testing Diode Assembly
Courtesy of Volkswagen United States, Inc.

STATOR

1) Place ohmmeter on lowest scale. Connect ohmmeter across stator leads. Resistance should be approximately .09-.10 ohms. If resistance is incorrect, stator has open or shorted windings and must be replaced.
2) Place ohmmeter on X 1000 scale. Connect ohmmeter between stator core and stator lead. No continuity should exist. If continuity exists, stator is grounded and must be replaced.

ROTOR

1) Place ohmmeter on lowest scale. Connect ohmmeter across slip rings. Resistance should be 2.8-3.1 ohms.

2) If resistance is too low, rotor has short circuit and must be replaced. If resistance is infinity (no continuity), rotor has open circuit and must be replaced.

3) Place ohmmeter on X 1000 scale. Connect ohmmeter between either slip ring and rotor core. No continuity should exist. If continuity exists, rotor is grounded and must be replaced.

4) Clean slip rings using fine sandpaper. Rings which are worn or pitted should be turned on lathe. Minimum ring diameter is 1 1/16".

5) If slip rings are beyond repair, remove rear bearing from slip ring end of rotor. Unsolder wires from slip rings and bend up ends of rotor winding. Pull off slip rings. Ensure ends of rotor winding are not damaged.

6) Insert ends of rotor winding into slip ring and press new slip ring onto rotor. Slip ring end must be 9/64" from end of collar. Solder rotor winding to slip ring terminals. Turn rings on lathe and retest rotor. Maximum slip ring runout is .0012" (.03 mm).

BEARINGS

Always replace bearings. If replacement front bearing is sealed on one side only, open side must face rotor. If replacement rear bearing is sealed on one side only, open side must face away from rotor.

BRUSHES

Ensure brushes are longer than 7/32". Replace if necessary. Unsolder brushes from voltage regulator. Solder new brushes. DO NOT allow solder to run into strands of brush leads. Brushes must be free to slide in brush holder with normal spring tension of 10-14 ozs. (283-397 g).

OVERHAUL

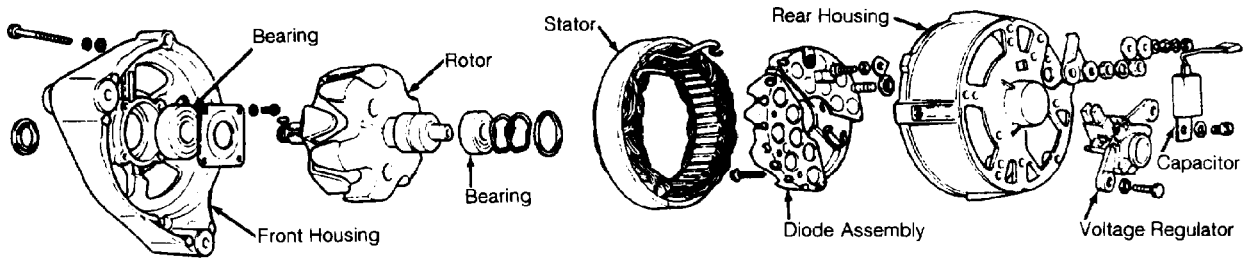

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Fig. 2: Exploded View Of Bosch Alternator (Typical)
Courtesy of Volkswagen United States, Inc.

END OF ARTICLE

ANTI-LOCK BRAKE SAFETY PRECAUTIONS
Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:30PM

ARTICLE BEGINNING

GENERAL INFORMATION
Anti-Lock Brake Safety Precautions

*** PLEASE READ THIS FIRST ***

This article is intended for general information purposes only. This information may not apply to all makes and models. If vehicle is equipped with Anti-Lock Brake System (ABS), refer to appropriate ANTI-LOCK BRAKE SYSTEM article in the BRAKES section for description, operation, depressurizing, testing, system bleeding, trouble shooting and servicing of specific system.

WARNING: Failure to depressurize ABS could lead to physical injury.

ANTI-LOCK BRAKE SAFETY PRECAUTIONS

WARNING: Failure to depressurize ABS could lead to physical injury.

* NEVER open a bleeder valve or loosen a hydraulic line while ABS is pressurized.
* NEVER disconnect or reconnect any electrical connectors while ignition is on. Damage to ABS control unit may result.
* DO NOT attempt to bleed hyudarulic system without first referring to the appropriate ANTI-LOCK BRAKE SYSTEM article in the BRAKES section.
* Only use specially designed brake hoses/lines on ABS equipped vehicles.
* DO NOT tap on speed sensor components (sensor, sensor rings). Sensor rings must be pressed into hubs, NOT hammered into hubs. Striking these components can cause demagnetization or a loss of polarization, affecting the accuracy of the speed signal returning to the ABS control unit.
* DO NOT mix tire sizes. Increasing the width, as long as tires remain close to the original diameter, is acceptable. Rolling diameter must be identical for all 4 tires. Some manufacturers recommend tires of the same brand, style and type. Failure to follow this precaution may cause inaccurate wheel speed readings.
* DO NOT contaminate speed sensor components with grease. Only use recommended coating, when system calls for an anti-corrosion coating.
* When speed sensor components have been removed, ALWAYS check sensor-to-ring air gaps when applicable. These specifications can be found in each appropriate article.
* ONLY use rocommended brake fluids. DO NOT use silicone brake fluids in an ABS equipped vehicle.
* When instlling transmittion devices (CB's, telephones, etc.) on ABS equipped vehicles, DO NOT locate the antenna near the ABS control unit (or any control unit).

* Disconnect all on-board computers, when using electric welding equipment.
* DO NOT expose the ABS control unit to prolonged periods of high heat (185 øF/85øC for 2 hours is generally considered a maximum limit).

END OF ARTICLE

ANTI-LOCK BRAKE SYSTEM
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:30PM

ARTICLE BEGINNING

1993 BRAKES
Volkswagen Anti-Lock

EuroVan

ANTI-LOCK BRAKE SAFETY PRECAUTIONS

* NEVER open a bleeder valve or loosen a hydraulic line while ABS is pressurized
* NEVER disconnect or reconnect any electrical connectors while ignition is on. Damage to ABS control unit may result.
* DO NOT attempt to bleed hydraulic system without first referring to the appropriate article.
* Only use specially designed brake hoses/lines on ABS-equipped vehicles.
* DO NOT tap on speed sensor components (sensor, sensor rings). Speed rings must be pressed, NOT hammered into hubs. Striking these components can cause demagnetization or a loss of polarization, affecting the accuracy of the speed signal returning to the ABS control unit.
* DO NOT mix tire sizes. Increasing the width, as long as tires remain close to the original diameter, is acceptable. Rolling diameter must be identical for all 4 tires. Some manufacturers recommend tires of the same brand, style and type. Failure to follow this precaution may cause inaccurate wheel speed readings.
* DO NOT contaminate speed sensor components with grease. Only use recommended anti-corrosion coating.
* When speed sensor components have been removed, ALWAYS check sensor-to-ring air gaps when applicable. These specifications can be found in each appropriate article.
* ONLY use recommended brake fluids. DO NOT use silicone brake fluids in an ABS-equipped vehicle.
* When installing transmitting devices (CB's, telephones, etc.) on ABS-equipped vehicles, DO NOT locate the antenna near the ABS control unit (or any control unit).
* Disconnect all on-board computers, when using electric welding equipment.
* DO NOT expose the ABS control unit to prolonged periods of high heat (185øF/85øC for 2 hours is generally considered a maximum limit).

DESCRIPTION

A Teves Anti-Lock Brake System (ABS) is used. See Fig. 1. This system reduces the chance of wheel lock-up during heavy braking. The system consists of 4 wheel speed sensors, Electronic Control Unit (ECU), hydraulic modulator/pump and solenoid valves, ANTILOCK and BRAKE warning lights. There are 2 relays located at fuse/relay panel,

to protect the hydraulic modulator and ECU.

NOTE: For more brake system information, see BRAKE SYSTEM article in the BRAKES section.

OPERATION

When pressure is applied to brake pedal, ECU monitors input signals from each wheel speed sensor. If ECU measures a rate of reduction greater than what is programmed in ECU, the ECU will output a signal to appropriate solenoid valve. Each solenoid valve allows hydraulic pressure to increase or decrease to the appropriate wheel cylinder.

If a system failure occurs, ANTILOCK warning light, located on instrument panel, will come on. System will be deactivated, but conventional brake system will still operate. If brake fluid level drops too low, BRAKE warning light, located on instrument panel, will come on.

CAUTION: See ANTI-LOCK BRAKE SAFETY PRECAUTIONS in this article.

CAUTION: The ABS system is under extremely high pressure. Depressurize the brake system before loosening or removing any hydraulic component.

DEPRESSURIZING BRAKE SYSTEM

Turn ignition off. Depress and release brake pedal 25-35 times, or until there is a noticeable increase in the effort to depress the brake pedal. DO NOT turn ignition on until all hydraulic lines and components are fully tighten.

BLEEDING BRAKE SYSTEM

FRONT BRAKES

Depressurize brake system. See DEPRESSURIZING BRAKE SYSTEM. Connect a container with hose to left front bleeder screw. Have assistant depress and release brake pedal a few times. Holding brake pedal down, open bleeder screw and allow fluid to enter container. Close bleeder screw and then release brake pedal. Continue this method until no air is present in fluid. Check master cylinder fluid level to make sure it does not go below minimum level mark. Use same procedure for right front brake.

REAR BRAKES

CAUTION: When bleeding rear brakes, accumulator pressure (about 3100 psi) is used to assist in procedure. Use eye protection when performing this procedure. DO NOT allow pump to run longer than 2 minutes. See ANTI-LOCK BRAKE SAFETY PRECAUTIONS in

this article.

Attach hose and container to right rear bleeder screw. Position actuator lever on load-sensing pressure regulator toward rear of vehicle. Depress brake pedal and turn ignition on. Open bleeder screw and allow fluid to exit until no air is present in fluid. Close bleeder screw. Turn ignition off and release brake pedal. Perform same procedure for left rear brake. Ensure fluid level does not go below minimum level mark.

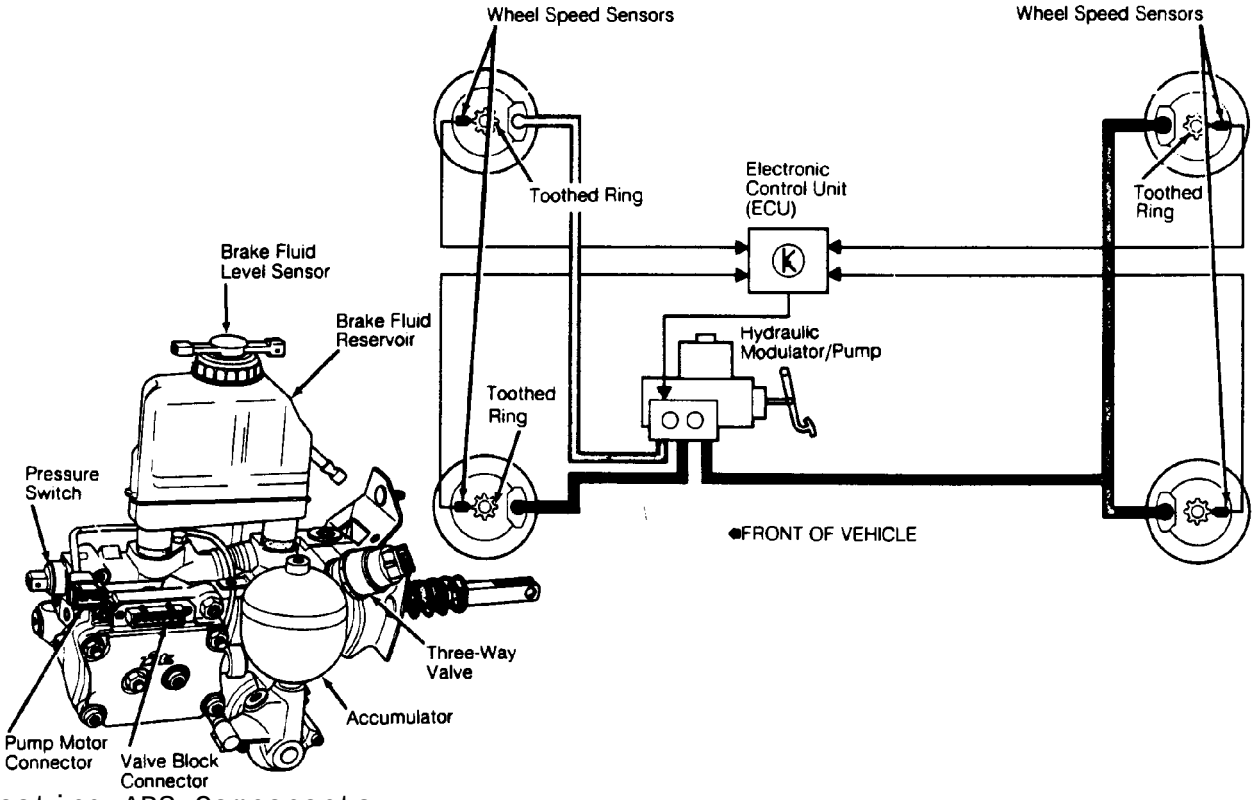


Fig. 1: Locating ABS Components
Courtesy of Volkswagen United States, Inc.

ADJUSTMENTS

PARKING BRAKE

Raise vehicle and support securely. Release parking brake lever. Apply brake pedal once. Loosen lock nuts. Tighten each adjusting nut until lever on respective caliper lifts off stop. Measure gap between stop and lever. Do not move lever off stop more than .040" (1 mm). Tighten lock nuts. Ensure wheels lock at 3 notches.

NOTE: No other information on adjustments is available from manufacturer.

TROUBLE SHOOTING

HYDRAULIC MODULATOR/PUMP

Depressurize brake system. See DEPRESSURIZING BRAKE SYSTEM. Turn ignition on. Hydraulic modulator/pump should operate for 60 seconds maximum and then stop. Depress brake pedal a few times; pump should operate again for a few seconds. If pump motor does not operate, check electrical system. If pump motor operates for more than 60 seconds, internal or external hydraulic leak may be indicated. Check for external leaks. If external leak is not found, further testing may be needed to check for internal leaks.

ANTILOCK WARNING LIGHT

Start engine. ANTILOCK warning light should come on, then turn off after a few seconds. If light does not come on when engine is started, check electrical system. If light comes on and stays on, fault has been detected by the ECU and testing will be needed. See SYSTEM TESTING under DIAGNOSIS & TESTING.

DIAGNOSIS & TESTING

SYSTEM TESTING

NOTE: Check battery condition, brake fluid level, electrical connections and wiring for damage. If fluid level is incorrect or battery and/or electrical connections are faulty, correct problem before preceding. Perform each step, in sequence, to test entire system, except for ECU. If faulty ECU is suspected, replace with a known good one, and retest system. Unplug ECU connector for all test steps.

Power-To-ECU Test

Turn ignition off. Unplug ECU connector. Turn ignition on. Using a voltmeter, check voltage between ECU connector terminals No. 1 and 2. See Fig. 2. If voltage is 10 volts or more, go to next test. If voltage is less than 10 volts, check battery, ground, ABS fuse, relay and wiring. Repair as necessary.

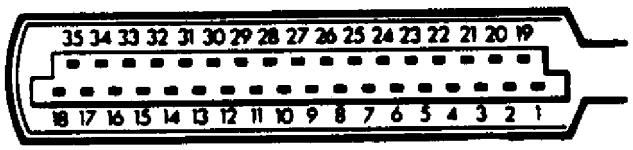


Fig. 2: Identifying ECU Connector Terminals
Courtesy of Volkswagen United States, Inc.

ECU Relay Voltage Test

Connect a jumper wire between ECU connector terminals No. 2 and 8. See Fig. 2. Turn ignition on. Using a voltmeter, check voltage between ECU connector terminals No. 1 and 3. If voltage is 10 volts or more, go to next test. If voltage is less than 10 volts, check ABS

fuse. If fuse is faulty, replace and retest. If fuse is okay, check wiring. If wiring is faulty, repair and retest. If wiring is okay, replace relay and retest.

Brakelight Switch

Turn ignition on. Apply brakes. Check for 12 volts between terminals No. 12 and 1. If 12 volts are present, brakelight switch is okay. If 12 volts are not present, check fuse, brakelight switch and Black/Red wire from brakelight switch to ECU.

Hydraulic Modulator/Pump Relay Voltage Test

1) Turn ignition off. Unplug hydraulic modulator/pump connector. Depress brake pedal 25 times. Turn ignition on. Using a voltmeter, measure voltage between ECU connector terminals No. 1 and 32. See Fig. 2. If voltage is 10 volts or more, go to RIGHT REAR WHEEL SPEED SENSOR VOLTAGE TEST under SYSTEM TESTING.

2) If voltage is less than 10 volts, check hydraulic modulator/pump fuse. If fuse is okay, check wiring between ECU connector terminal No. 32 and hydraulic modulator/pump connector terminal No. 1 (large gauge Red/Black wire). See Figs. 2 and 4. If wiring is not okay, repair wiring, and retest. If wiring is okay, replace relay, and retest.

Right Rear Wheel Speed Sensor Voltage Test

Connect an AC voltmeter between ECU connector terminals No. 4 and 22. See Fig. 2. Rotate right rear wheel at one revolution per second. Measure voltage with wheel rotating. If voltage is 0.075 volt or more, go to next test. If voltage is less than 0.075 volt, check wheel speed sensor and/or toothed ring for damage, wear and proper installation. If damage or wear is found, replace faulty component and retest. If components are not properly installed, reposition and retest. If components are okay, replace wheel speed sensor and retest.

Left Rear Wheel Speed Sensor Voltage Test

Connect an AC voltmeter between ECU connector terminals No. 6 and 24. See Fig. 2. Rotate left rear wheel at one revolution per second. Measure voltage with wheel rotating. If voltage is 0.075 volt or more, go to next test. If voltage is less than 0.075 volt, check wheel speed sensor and/or toothed ring for damage, wear and proper installation. If damage or wear is found, replace faulty component and retest. If components are not properly installed, reposition and retest. If components are okay, replace wheel speed sensor and retest.

Right Front Wheel Speed Sensor Voltage Test

Connect an AC voltmeter between ECU connector terminals No. 7 and 25. See Fig. 2. Rotate right front wheel at one revolution per second. Measure voltage with wheel rotating. If voltage is 0.075 volt or more, go to next test. If voltage is less than 0.075 volt, check wheel speed sensor and/or toothed ring for damage, wear and improper installation. If damage or wear is found, replace faulty component, and retest. If components are improperly installed, reposition component, and retest. If components are okay, replace wheel speed

sensor, and retest.

Left Front Wheel Speed Sensor Voltage Test

Connect an AC voltmeter between ECU connector terminals No. 5 and 23. See Fig. 2. Rotate left front wheel at one revolution per second. Measure voltage with wheel rotating. If voltage is 0.075 volt or more, go to next test. If voltage is less than 0.075 volt, check wheel speed sensor and/or toothed ring for damage, wear and proper installation. If damage or wear is found, replace faulty component and retest. If components are not properly installed, reposition and retest. If components are okay, replace wheel speed sensor and retest.

ECU Relay Continuity Test

Turn ignition off. Using an ohmmeter, check for continuity between ECU connector terminals No. 1 and 3, and between terminals No. 1 and 20. See Fig. 2. If there is continuity at both test points, go to next test. If there is no continuity at either or both test points, check wiring. If wiring is faulty, repair and retest. If wiring is okay, replace relay and retest.

Solenoid Valves Ground Circuit Continuity Test

1) Turn ignition off. Remove jumper wire from previous test. Using an ohmmeter, check for continuity between ECU connector terminals No. 1 and 11. See Fig. 2. If there is continuity, go to step 3).

2) If continuity does not exist, check for continuity between ECU connector terminal No. 1 and valve block housing and between hydraulic modulator and valve block housing. If continuity does not exist between ECU connector terminal No. 1 and valve block housing, repair wiring, and retest. If continuity does not exist between housings, repair as necessary.

3) Reconnect jumper wire between ECU connector terminals No. 1 and 11. Check for continuity between ECU connector terminal No. 11 and valve block connector terminal No. 1 (Brown wire). See Figs. 2 and 4. If there is no continuity, repair wiring and retest.

Hydraulic Modulator/Pump Relay Ground Circuit Test

Turn ignition off. Reconnect pressure switch connector. Depress brake pedal 20 times. Using an ohmmeter, check for continuity between ECU connector terminals No. 1 and 14. If continuity exists, go to next test. If continuity does not exist, check for continuity between pressure switch terminals No. 1 (Brown wire) and No. 4 (Red/Yellow or White wire). See Fig. 1 and 4. If continuity does not exist, replace pressure switch, and retest. If continuity exists, check wiring between ECU terminal No. 14 and pressure switch terminal No. 4. Repair wiring, and retest.

Low Pressure Warning Switch Test

Turn ignition off. Ensure brake fluid level is okay and fluid level sensor switch float is in correct position (switch is in closed position). Ensure accumulator is fully charged and pump is not operating. Using an ohmmeter, check for continuity between ECU

connector terminals No. 9 and 10. See Fig. 2. If there is continuity, switch is okay. If continuity does not exist, check wiring. If wiring is okay, replace switch, and retest.

Right Rear Wheel Speed Sensor Resistance Test

Turn ignition off. Using an ohmmeter, measure resistance between ECU connector terminals No. 4 and 22. See Fig. 2. If resistance is 800-1400 ohms, go to next test. If resistance is not as specified, check resistance at right rear wheel speed sensor. If resistance is correct, repair wiring and retest. If resistance is not correct, replace wheel speed sensor and retest.

Left Rear Wheel Speed Sensor Resistance Test

Using an ohmmeter, measure resistance between ECU connector terminals No. 6 and 24. See Fig. 2. If resistance is 800-1400 ohms, go to next test. If resistance is not as specified, check resistance at left rear wheel speed sensor. If resistance is correct, repair wiring and retest. If resistance is not correct, replace wheel speed sensor, and retest.

Right Front Wheel Speed Sensor Resistance Test

Using an ohmmeter, measure resistance between ECU connector terminals No. 7 and 25. See Fig. 2. If resistance is 800-1400 ohms, go to next test. If resistance is not as specified, check resistance at right front wheel speed sensor. If resistance is correct, repair wiring and retest. If resistance is not correct, replace wheel speed sensor and retest.

Left Front Wheel Speed Sensor Resistance Test

Using an ohmmeter, measure resistance between ECU connector terminals No. 5 and 23. See Fig. 2. If resistance is 800-1400 ohms, go to next test. If resistance is not as specified, check resistance at left front wheel speed sensor. If resistance is correct, repair wiring, and retest. If resistance is not correct, replace wheel speed sensor, and retest.

Right Rear Wheel Speed Sensor Shielding Resistance Test

Using an ohmmeter, measure resistance between ECU connector terminals No. 1 and 4. See Fig. 2. If resistance is 20,000 ohms or more, go to next test. If resistance is less than 20,000 ohms, check shielding wire for damage. Replace harness if damage is found and retest.

Left Rear Wheel Speed Sensor Shielding Resistance Test

Using an ohmmeter, measure resistance between ECU connector terminals No. 1 and 6. See Fig. 2. If resistance is 20,000 ohms or more, go to next test. If resistance is less than 20,000 ohms, check shielding wire for damage. Replace harness if damage is found and retest.

Right Front Wheel Speed Sensor Shielding Resistance Test

Using an ohmmeter, measure resistance between ECU connector

terminals No. 1 and 7. See Fig. 2. If resistance is 20,000 ohms or more, go to next test. If resistance is less than 20,000 ohms, check shielding wire for damage. Replace harness if damaged, and retest.

Left Front Wheel Speed Sensor Shielding Resistance Test

Using an ohmmeter, measure resistance between ECU connector terminals No. 1 and 5. See Fig. 2. If resistance is 20,000 ohms or more, go to next test. If resistance is less than 20,000 ohms, check shielding wire for damage. Replace harness if damaged, and retest.

ECU Relay Resistance Test

Using an ohmmeter, measure resistance between ECU connector terminals No. 1 and 8. See Fig. 2. If resistance is 50-100 ohms, go to next test. If resistance is not as specified, check wiring. If wiring is faulty, repair and retest. If wiring is okay, replace relay and retest. See Fig. 3.

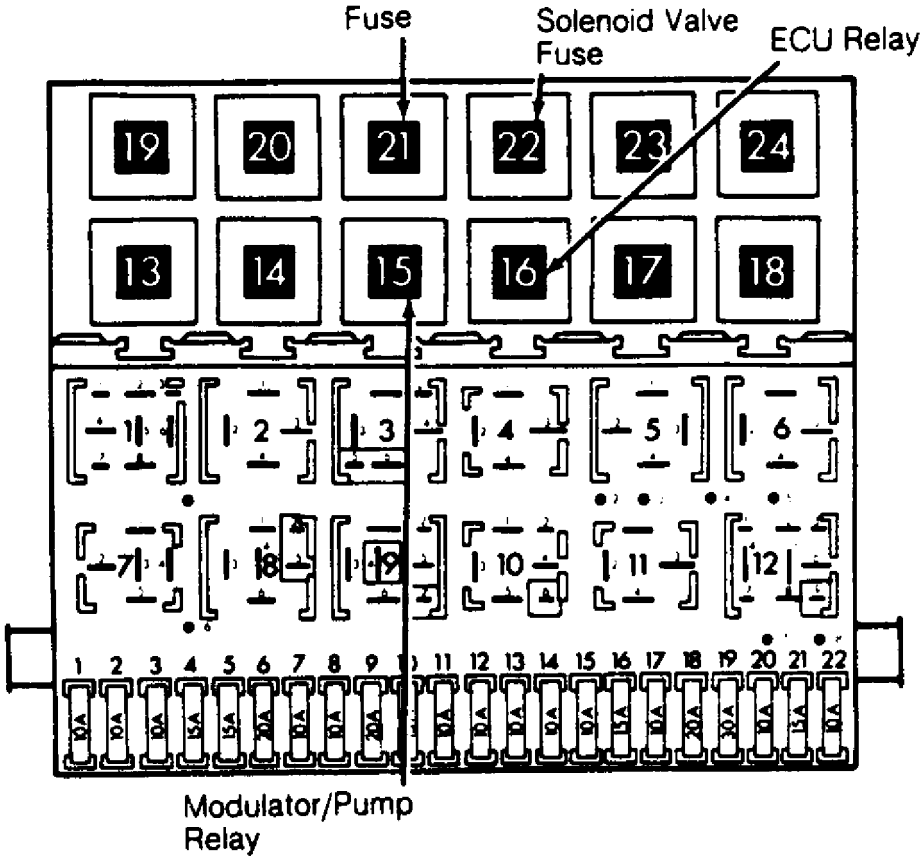


Fig. 3: Locating Relays
Courtesy of Volkswagen United States, Inc.

ABS Main Valve Resistance Test

Using an ohmmeter, measure resistance between terminals at ABS main valve terminals. See Figs. 1 and 4. If resistance is 2-5 ohms, ABS main valve is okay. If resistance is not 2-5 ohms, replace hydraulic modulator.

ABS Main Valve Continuity Test

Using an ohmmeter, check for continuity between ABS main valve terminal No. 1 (Black wire) and ECU connector terminal No. 18, and between ABS main valve terminal No. 2 (Brown wire) and ground. There should be continuity at both test points. If there is no continuity at both test points, repair wiring and retest.

Rear Hydraulic Modulator Inlet Valve Resistance Test

Using an ohmmeter, measure resistance between ECU connector terminals No. 11 and 17. See Fig. 2. If resistance is 5-7 ohms, go to next test. If resistance is not 5-7 ohms, measure between hydraulic modulator block terminals No. 1 (Brown wire) and No. 5 (Gray wire). See Fig. 4. If resistance is 5-7 ohms, check wiring between hydraulic modulator and ECU for open circuit. If resistance is not 5-7 ohms, replace hydraulic modulator.

Right Front Hydraulic Modulator Inlet Valve Resistance Test

Using an ohmmeter, measure resistance between ECU connector terminals No. 11 and 15. See Fig. 2. If resistance is 5-7 ohms, go to next test. If resistance is not 5-7 ohms, measure between hydraulic modulator terminals No. 1 (Brown wire) and No. 2 (Yellow wire). See Fig. 4. If resistance is 5-7 ohms, check wiring between hydraulic modulator and ECU for open circuit. If resistance is not 5-7 ohms, replace hydraulic modulator.

Left Front Hydraulic Modulator Inlet Valve Resistance Test

Using an ohmmeter, measure resistance between ECU connector terminals No. 11 and 35. See Fig. 2. If resistance is 5-7 ohms, go to next test. If resistance is not 5-7 ohms, measure between hydraulic modulator terminals No. 1 (Brown wire) and No. 7 (Blue or Black/Green wire). See Fig. 4. If resistance is 5-7 ohms, check wiring between valve block and ECU for open circuit. If resistance is not 5-7 ohms, replace hydraulic modulator.

Rear Hydraulic Modulator Outlet Valve Resistance Test

Using an ohmmeter, measure resistance between ECU connector terminals No. 11 and 33. See Fig. 2. If resistance is 3-5 ohms, go to next test. If resistance is not 3-5 ohms, measure between valve block terminals No. 1 (Brown wire) and No. 4 (White wire). See Fig. 4. If resistance is 3-5 ohms, check wiring between hydraulic modulator and ECU for open circuit. If resistance is not 3-5 ohms, replace hydraulic modulator.

Right Hydraulic Modulator Block Outlet Valve Resistance Test

Using an ohmmeter, measure resistance between ECU connector terminals No. 11 and 34. See Fig. 2. If resistance is 3-5 ohms, go to next test. If resistance is not 3-5 ohms, measure between hydraulic modulator terminals No. 1 (Brown wire) and No. 3 (Green wire). See Fig. 4. If resistance is 3-5 ohms, check wiring between hydraulic modulator and ECU for open circuit. If resistance is not 3-5 ohms, replace hydraulic modulator.

Left Front Hydraulic Modulator Outlet Valve Resistance Test

Using an ohmmeter, measure resistance between ECU connector terminals No. 11 and 16. See Fig. 2. If resistance is 3-5 ohms, go to next test. If resistance is not 3-5 ohms, measure between hydraulic modulator terminals No. 1 (Brown wire) and No. 6 (Black/Blue wire). See Fig. 4. If resistance is 3-5 ohms, check wiring between hydraulic modulator and ECU for open circuit. If resistance is not 3-5 ohms, replace hydraulic modulator.

Hydraulic Modulator/Pump Relay Resistance Test

Turn ignition off. Unplug pressure switch connector from hydraulic modulator. Using an ohmmeter, measure resistance between ECU connector terminals No. 2 and 14. See Fig. 2. If resistance is 50-100 ohms, go to next test. If resistance is not 50-100 ohms, check wiring. If wiring is faulty, repair wiring and retest. If wiring is okay, replace relay and retest.

ABS Main Valve Function Test

Connect a jumper wire between ECU connector terminals No. 2 and 18. See Fig. 2. Depress brake pedal. Turn ignition on. Brake pedal should rise slightly. If brake pedal did not rise slightly, check wiring between terminals and hydraulic modulator. If wiring is okay, replace hydraulic modulator.

Hydraulic Modulator/Pump Test

Turn ignition off. Depress brake pedal 25 times. Turn ignition on. BRAKE and ANTILOCK lights should come on for 2-60 seconds. Pump should operate for 2-60 seconds, then turn off. If lights do not come on, check wiring and warning light bulbs, and retest. Also check bulb(s). If lights come on, then turn off, and pump operates for 60 seconds maximum, then turns off, go to next test. If pump does not operate and all other preceding tests have been performed, replace hydraulic modulator/pump.

CAUTION: During VALVE BLOCK FUNCTION TESTS, DO NOT turn ignition on longer than 60 seconds during any test.

Rear Valve Block Function Test

Connect a jumper wire ECU between ECU connector terminals No. 2, 17 and 33. See Fig. 2. Depress brake pedal. Rear wheels should be locked up. Turn ignition on. Rear wheels should rotate. If wheels do not rotate, replace hydraulic modulator. Turn ignition off.

Right Front Valve Block Function Test

Connect a jumper wire ECU between ECU connector terminals No. 2, 15 and 34. See Fig. 2. Depress brake pedal. Right front wheel should be locked up. Turn ignition on. Right front wheel should rotate. If wheel does not rotate, replace hydraulic modulator. Turn ignition off.

Left Front Valve Block Function Test

Connect a jumper wire ECU between ECU connector terminals No. 2, 16 and 35. See Fig. 2. Depress brake pedal. Left front wheel should be locked up. Turn ignition on. Left front wheel should rotate. If wheel does not rotate, replace hydraulic modulator. Turn ignition off.

REMOVAL & INSTALLATION

HYDRAULIC MODULATOR/PUMP

Removal & Installation

1) Depressurize brake system. See DEPRESSURIZING BRAKE SYSTEM. Disconnect negative battery cable. Unplug all electrical connectors from hydraulic modulator/pump. Identify and disconnect all hydraulic lines from hydraulic modulator/pump. Plug all line openings.

2) From inside passenger compartment, remove push rod clevis pin. Remove hydraulic modulator/pump retaining nuts. Remove hydraulic modulator/pump. To install, reverse removal procedure. Tighten all fittings to specification. See TORQUE SPECIFICATIONS table. Bleed brake system. See BLEEDING BRAKE SYSTEM.

WHEEL SPEED SENSORS

NOTE: To protect magnetic part of sensor, always leave new wheel speed sensor in special packaging until ready for installation.

Removal & Installation

Remove bolt retaining wheel speed sensor. Unplug connector. Remove wheel speed sensor. To install, apply Lubricant (G-000-650) to sensor. Install sensor, and tighten retaining bolt to 84 INCH lbs. (10 N.m).

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS TABLE

Applications	Ft. Lbs. (N.m)
Brake Lines-To-Hydraulic Modulator/Pump	11 (15)
Hydraulic Modulator/Pump Retaining Nuts	18 (25)
	INCH Lbs. (N.m)
Wheel Sensor Retaining Bolt	89 (10)

WIRING DIAGRAMS

ANTI-LOCK BRAKE SYSTEM
Article Text (p. 12)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:30PM

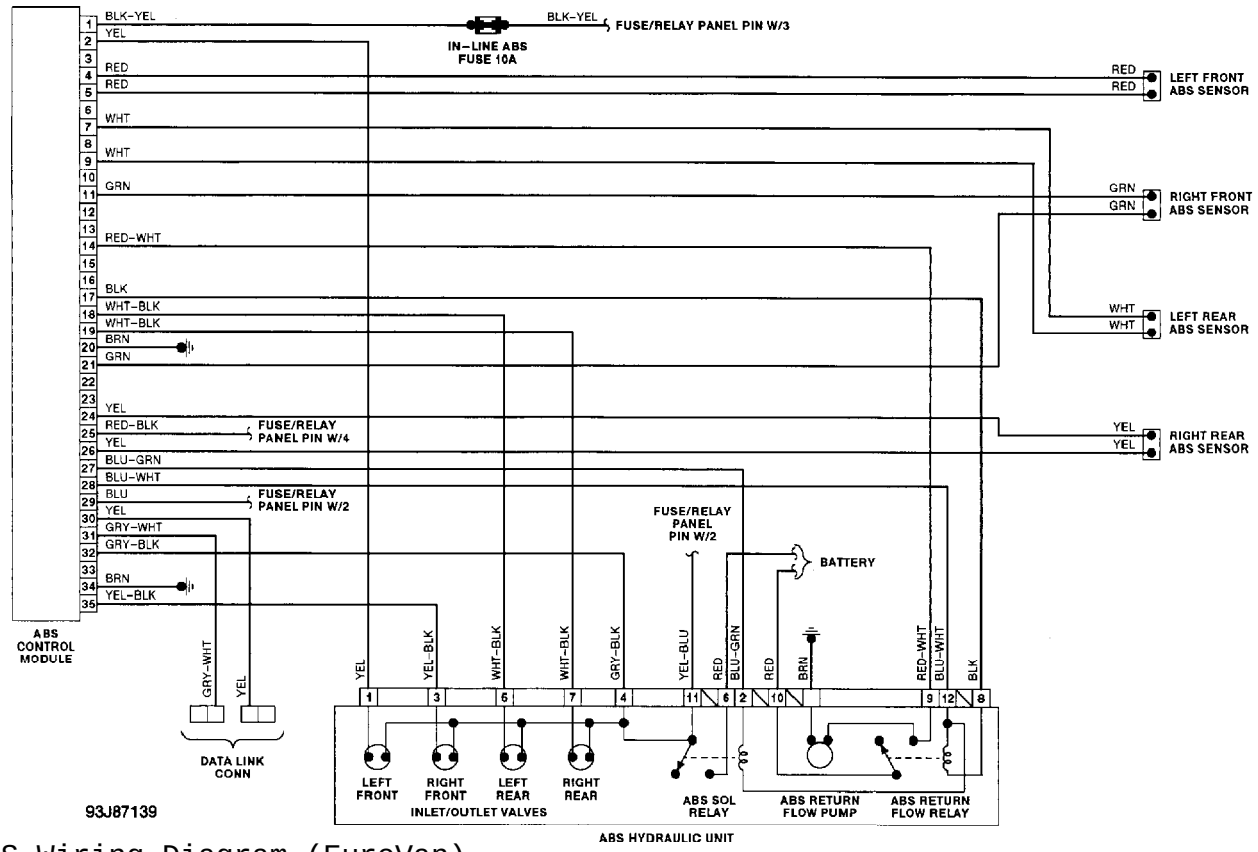


Fig. 4: ABS Wiring Diagram (EuroVan)

END OF ARTICLE

AXLE SHAFTS
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:30PM

ARTICLE BEGINNING

DRIVE AXLES
Volkswagen Axle Shafts - FWD

EuroVan

TROUBLE SHOOTING

Refer to TROUBLE SHOOTING - BASIC PROCEDURES article in the GENERAL TROUBLE SHOOTING section.

REMOVAL, DISASSEMBLY, REASSEMBLY & INSTALLATION

NOTE: Clean bolts and nuts to ensure tightening torque is correct.

AXLE SHAFT

Removal
1) Remove axle shaft nut. Remove wheel. Remove brake caliper and secure aside. Remove inner CV joint flange bolts. Loosen inner CV joint from transaxle flange.
2) Mark ball joint position on control arm. Remove ball joint from control arm. On models with manual transaxle, compress shock absorber. On models with automatic transaxle, remove plug from multifunction switch. On all models, pull axle shaft out of wheel bearing housing. See Fig. 1.

NOTE: Models with automatic transaxle use a tripod designed inner CV joint. CV joint boot may be replaced. No other information is available.

Disassembly & Reassembly (Exc. Tripot Designed Inner CV Joint)
1) Remove axle shaft boot(s). Using a drift, remove protective cap from CV joint. Remove circlip from inner CV joint.
2) Support CV joint with axle assembly on Support Stand (VW 402). Using Driver (VW 408A), press inner CV joint from axle shaft. DO NOT disassemble inner CV joint, replace as complete unit.
3) To remove outer CV joint, use a drift and hammer to drive CV joint off axle shaft. Rotate inner race and remove balls. Inspect for galling or wear. Cover balls with grease and reinstall in race. To reassemble, reverse disassembly procedure. See AXLE SHAFT LENGTH table. Use new circlips and boot clamps during assembly.

Installation
1) Apply locking compound around splines, not more than 1/4" wide. Install axle shaft. Bring ball joint into same position as marked before removal. Tighten ball joint. See TORQUE SPECIFICATIONS.
2) Install new axle shaft nut. Check camber, and adjust as necessary. Install wheel assembly. Allow locking compound to dry one

hour before driving vehicle.

NOTE: Models with automatic transaxle use a tripod designed inner CV joint. CV joint boot may be replaced. No other service information is available.

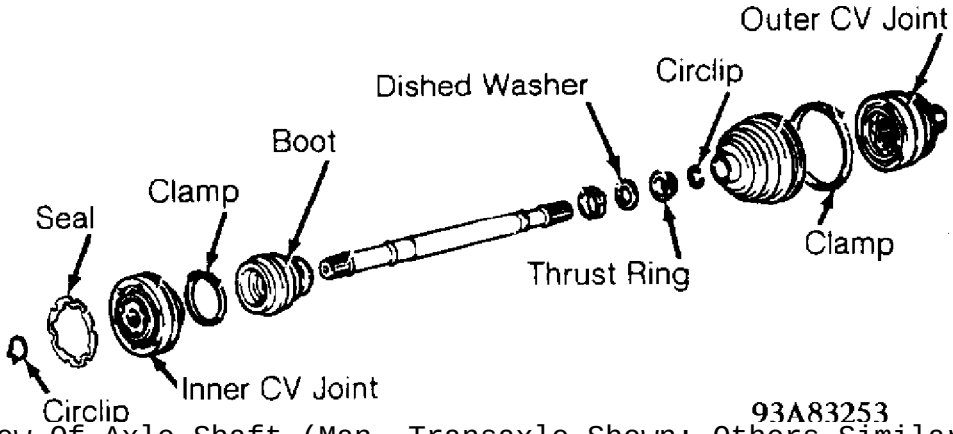


Fig. 1: View Of Axle Shaft (Man. Transaxle Shown; Others Similar)
Courtesy of Volkswagen United States, Inc.

AXLE SHAFT LENGTH TABLE

Application	In. (mm)
EuroVan	(1)

(1) - Information not available from manufacturer.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS TABLE

Application	Ft. Lbs. (N.m)
Axle Shaft Bolt	148 (200)
Brake Caliper Bolt	199 (270)
Inner CV Joint-To-Transaxle Bolt	41 (55)
Lower Ball Joint Nut	41 (55)
Spindle Assembly-To-Strut Nut	69 (94)
Subframe Mount Bolt	33 (45)
Tie Rod End Nut	22 (30)

END OF ARTICLE

BRAKE SYSTEM
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:30PM

ARTICLE BEGINNING

1993 BRAKES
Volkswagen Disc & Drum

EuroVan

DESCRIPTION

All models are equipped with front disc brakes. Rear brakes are either disc or drum. Parking brake acts on rear brakes and is cable-actuated. All models use pressure regulator between front and rear brake circuits to avoid rear wheel lock-up during hard braking.

A vacuum power-assist servo is used to ease brake pedal application. A vacuum check valve, located in vacuum supply hose, prevents vacuum leakdown when engine is off.

SERVICING

Manufacturer recommends replacing brake fluid every 2 years.

BLEEDING BRAKE SYSTEM

CAUTION: Ensure fluid level in master cylinder is adequate at all times during bleeding procedure. Use only DOT 4 brake fluid. DO NOT use DOT 5 silicone brake fluid.

BLEEDING PROCEDURES

NOTE: Manufacturer recommends bleeding brake system using Pressure Bleeder (US 1116). If a pressure bleeder is not available, use standard bleeding procedure.

1) Exhaust vacuum reserve from power unit by depressing brake pedal several times. On ABS-equipped vehicles, depress brake pedal at least 20 times to relieve system pressure.

2) Fill master cylinder with clean brake fluid. If master cylinder was replaced, bleed master cylinder before bleeding wheel calipers. Connect bleeder hose to appropriate caliper bleeder valve. See BRAKELINE BLEEDING SEQUENCE table.

BRAKELINE BLEEDING SEQUENCE TABLE

Application (1)	Sequence
EuroVan	RR, LR, RF, LF

(1) - Push lever of pressure regulator in direction of rear axle when bleeding rear brakes.

3) Submerge other end of hose in clean glass jar partially filled with clean brake fluid. Pump brake pedal several times, then hold down. Open bleeder valve. Holding pedal down, close bleeder valve. Release brake pedal.

4) Repeat procedure until brake fluid shows no signs of air bubbles. When bleeding rear brakes, push lever of pressure regulator in direction of rear axle.

5) After bleeding ABS vehicles, turn ignition on. Allow pump to run until it shuts off. If pump runs longer than 2 minutes, allow pump to cool for 10 minutes. On all vehicles, ensure master cylinder reservoir is full.

ADJUSTMENTS

BRAKE PRESSURE REGULATOR

CAUTION: On all models, DO NOT adjust pressure regulator with brake pedal depressed.

1) Raise and support vehicle. Attach Pressure Gauges (VAG 1310) to right front brake caliper and left rear brake cylinder. Bleed pressure gauge and hoses through valve on gauges.

2) Press on brake pedal until reading on front gauge shows pressure given for first reading in BRAKE PRESSURES table. Hold brake pressure to specification. Rear gauge reading should be within specification given for first reading in BRAKE PRESSURES table.

NOTE: A .039" (1 mm) adjustment of slide mounting will change brake system pressure approximately 58 psi (4 kg/cmý)

3) If pressure is not within specification, loosen spring sliding mounting bolt. See Fig. 1. Move slide mounting downward to increase pressure and upward to decrease pressure. Ensure that horizontal beam remains within .16" (4 mm) of being level. Tighten bolts and repeat step 2).

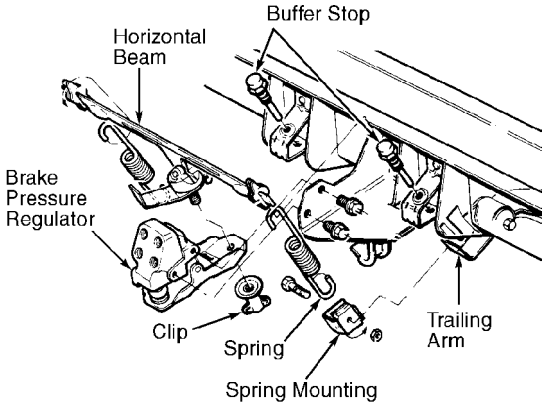


Fig. 1: Identifying Brake Pressure Regulator Components
Courtesy of Volkswagen United States, Inc.

BRAKE PRESSURES TABLE

Application	Front Gauge psi (kg/cmý)	Rear Gauge psi (kg/cmý)
EuroVan (1)		
1st Reading	725 (51)	261-319 (18-22)

(1) - On EuroVan, 2nd reading is not used.

STOPLIGHT SWITCH

NOTE: Stoplight switches mounted on master cylinder are nonadjustable.

Adjustable stoplight switch is located above brake pedal. See Fig. 2. To adjust, loosen lock nut. Turn switch until distance between brake pedal arm and first thread on switch body is .20-.24" (5-6 mm). Tighten lock nut.

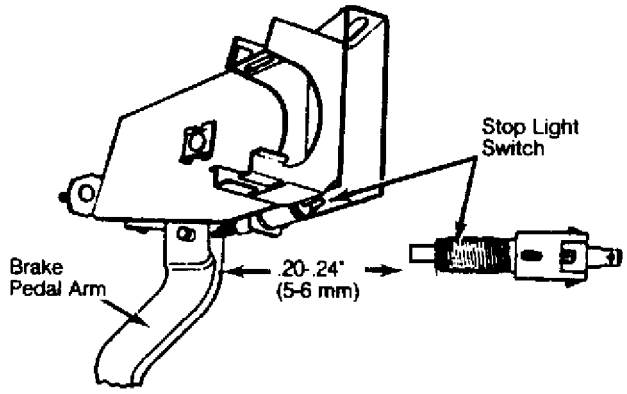


Fig. 2: Adjusting Stoplight Switch
Courtesy of Volkswagen United States, Inc.

PARKING BRAKE

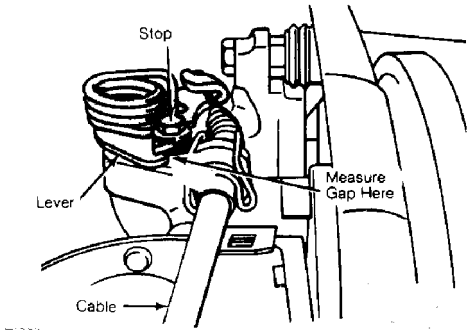


Fig. 3: Adjusting Rear Disc Parking Brake
Courtesy of Volkswagen United States, Inc.

Disengage parking brake. Raise and support vehicle. Remove brake drums. Tighten parking brake cable adjusting nut until parking brake lever moves .08" (2 mm) away from inner brake shoe. Install brake drum and ensure both wheels rotate freely.

WHEEL BEARINGS

NOTE: Front wheel bearings, also called hub or axle bearings, are sealed units with 1-piece outer race. Bearings are not adjustable.

Rear Wheel Bearings

Tighten adjusting nut snugly while turning drum or rotor. Back off and retighten nut just until axial movement is eliminated. Install locking cap and NEW cotter key. Install dust cap.

REMOVAL & INSTALLATION

FRONT & REAR BRAKE CALIPER

Removal & Installation

1) Raise and support vehicle. Remove wheels. Disconnect brakeline from caliper, and plug openings. Bend back locking tabs (if equipped) on mounting bolts. If removing rear brake calipers, disconnect parking brake cables.

2) On all calipers, remove caliper mounting bolts. See Fig. 5. Remove caliper assembly from wheel bearing housing. To install, reverse removal procedure. Use NEW lock plates (if equipped) and mounting bolts. Bleed hydraulic brake system. See BLEEDING PROCEDURES under BLEEDING BRAKE SYSTEM.

FRONT & REAR BRAKE ROTOR

Removal

Raise and support vehicle. Remove wheels. Remove caliper and suspend from frame with wire. Remove countersunk screw that holds rotor to hub. Pull rotor off hub.

Installation

To install, reverse removal procedure. Adjust wheel bearings (if necessary). See WHEEL BEARINGS under ADJUSTMENTS.

REAR BRAKE DRUM

CAUTION: ALWAYS loosen or tighten castellated axle nuts with wheels on ground.

Removal

Release parking brake. Raise and support vehicle. Remove wheel. Remove brake drum attaching screw. Remove brake drum. If necessary, use screwdriver, inserted through backing plate hole, to back off brake shoe adjustment.

Installation

To install, reverse removal procedure. Apply brake pedal firmly several times to set self-adjusting mechanism.

REAR BRAKE SHOES

Removal

1) Remove brake drum. See REAR BRAKE DRUM under REMOVAL & INSTALLATION. After removing drum, remove retainer clips, hold-down springs and anchor pins. Remove lower return spring. Disconnect parking brake cable from lever. See Fig. 4.

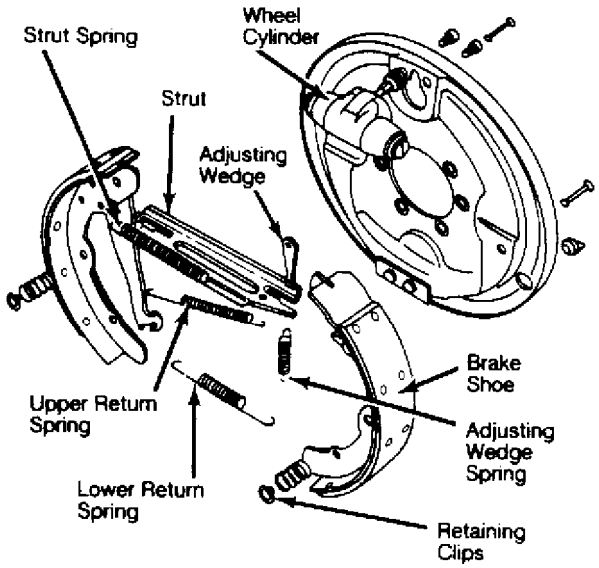


Fig. 4: Identifying Rear Brake Components (Typical)
Courtesy of Volkswagen United States, Inc.

2) Disconnect adjusting wedge spring and upper return spring. Remove brake shoes together with push rod and tensioning spring. Place push rod and shoes in vise. Remove tension spring. Separate shoes from push rod.

Installation

To install, reverse removal procedure. Ensure lug on adjusting wedge faces backing plate. Adjust wheel bearings (if necessary). See WHEEL BEARINGS under ADJUSTMENTS. Apply brake firmly to set self-adjusting mechanism.

MASTER CYLINDER

Removal

1) Drain master cylinder reservoir. Remove cover plate (if equipped). Disconnect brakelines and wiring at master cylinder.

2) On models without power assist servo, disconnect brake push rod at brake pedal. On models equipped with power assist servo,

remove master cylinder from servo. Be careful to keep any spacers used on attaching bolts for proper installation.

Installation

To install, reverse removal procedure. Always use NEW "O" ring between master cylinder and power assist servo. Bleed hydraulic system.

VACUUM POWER ASSIST SERVO

Removal

Remove master cylinder from power assist servo. Disconnect brake push rod from brake pedal. Disconnect vacuum hose from servo. Remove servo from vehicle.

NOTE: Not all vehicles have all components.

Installation

To install, reverse removal procedure. Before attaching brake push rod to brake pedal, check and adjust push rod length. See MASTER CYLINDER PUSH ROD under ADJUSTMENTS. Always use NEW damping ring, washer, filter and "O" ring (as equipped). Slots in damping washer and filter must be offset 180 degrees (if equipped). Complete installation, and bleed hydraulic system.

OVERHAUL

NOTE: Black staining from piston seal wear may show on caliper bore walls and piston. This staining is normal. DO NOT disassemble power assist servo as parts are not available.

Refer to appropriate illustration for caliper and master cylinder overhaul. See Figs. 5 and 6.

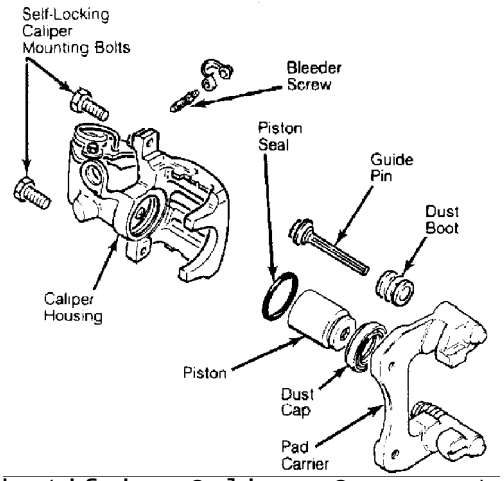


Fig. 5: Identifying Caliper Components (Typical)
Courtesy of Volkswagen United States, Inc.

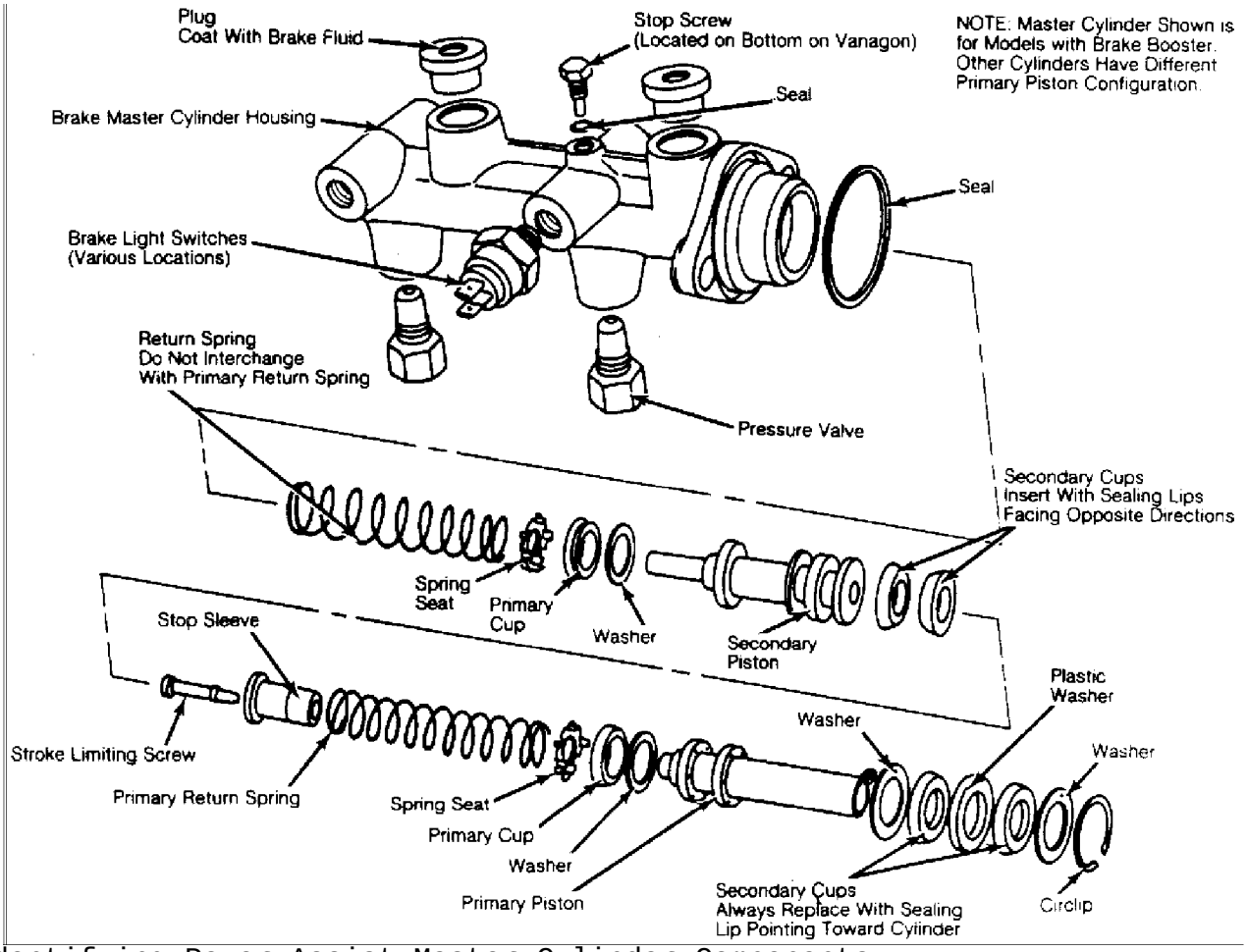


Fig. 6: Identifying Power Assist Master Cylinder Components
Courtesy of Volkswagen United States, Inc.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS TABLE

Application	Ft. Lbs. (N.m)
Caliper Mounting Bolts (1)	53 (70)
Rear Backing Plate-To-Flange Bolt	44 (60)
Wheel Lug Nut	118 (160)
	INCH Lbs. (N.m)
Wheel Cylinder Bolt	80 (9)

(1) - Always replace all self-locking bolts.

DISC BRAKE SPECIFICATIONS

DISC BRAKE SPECIFICATIONS TABLE (1)

Application	In. (mm)
Front	
Disc Diameter	(2)
Original Thickness	(2)
Wear Limit	.787 (20)
Rear	
Original Thickness	.394 (10)
Wear Limit	.315 (8)

(1) - Lateral runout is .002" (.05 mm).
(2) - Information not available from manufacturer.

DRUM BRAKE SPECIFICATIONS

DRUM BRAKE SPECIFICATIONS TABLE

Application	In. (mm)
Drum Diameter	(1)
Maximum Drum Refinish Diameter	(1)
Wear Limit	10.610 (269.5)

(1) - Information not available from manufacturer.

END OF ARTICLE

C - SPECIFICATIONS
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:31PM

ARTICLE BEGINNING

1993 ENGINE PERFORMANCE
Service & Adjustment Specifications

EuroVan

INTRODUCTION

Use this article to quickly find specifications related to servicing and on-vehicle adjustments. This is a quick-reference article to use when you are familiar with an adjustment procedure and only need a specification.

CAPACITIES

BATTERY SPECIFICATIONS

Application	Amp Hr. Rating
Primary Battery	63
Secondary Battery	92

FLUID CAPACITIES

Application	Quantity
Auto. Trans. (Dexron-II)	
Dry Fill	5.9 Qts. (5.6L)
Refill (Oil Change)	3.2 Qts. (3.0L)
Auto. Trans. Final Drive (SAE 75W-90, G50 Synthetic Gear Oil) (1)	1.2 Qts. (1.15L)
Cooling System (Includes Heater)	12.2 Qts. (11.5L)
Crankcase (Includes Filter)	4.8 Qts. (4.5L)
Man. Transaxle (SAE 75-80/API GL-4 Or SAE 75W-90, G50 Synthetic Gear Oil)	3.2 Qts. (3.0L)

(1) - Dry fill capacity given. Use ONLY synthetic oil specified (Part No. G-052-145-A2). No oil change is required.

QUICK-SERVICE

SERVICE INTERVALS & SPECIFICATIONS

REPLACEMENT INTERVALS

Component	Miles

Air Filter	30,000
Coolant	30,000
Fuel Filter (1)	15,000
Oil & Filter	7500
Spark Plugs	30,000

(1) - Discard mini-fuel filter at 1000-mile maintenance interval. Install new copper gaskets.

BELT ADJUSTMENT

Application	Specification
Serpentine Belt	(1)

(1) - Serpentine belt tension is automatically adjusted by the tensioner.

MECHANICAL CHECKS

ENGINE COMPRESSION

COMPRESSION SPECIFICATIONS

Application	Specification
Compression Ratio	8.5:1
Compression Pressure	128-170 psi (9.0-12.0 kg/cmý)
Minimum Compression Pressure	100 psi (7.0 kg/cmý)
Maximum Variation Between Cylinders	43 psi (3.0 kg/cmý)

VALVE CLEARANCE

NOTE: All models are equipped with hydraulic lifters. No adjustments are required.

IGNITION SYSTEM

IGNITION COIL

IGNITION COIL RESISTANCE - Ohms @ 68øF (20øC)

Application	Primary	Secondary
EuroVan	0.5-0.7	3000-4000

HIGH TENSION WIRE RESISTANCE

HIGH TENSION WIRE RESISTANCE

Application	Ohms
Cap & Coil Suppressors	600-1400
Spark Plug Connector Suppressors	4000-6000

SPARK PLUGS

SPARK PLUG TYPE

Application	Bosch
EuroVan	(1) N9BMC

(1) - As per Volkswagen Technical Service Bulletin No. 92-03, Group 28, the spark plugs listed in the owner's manual are incorrect. Use only the N9BMC Champion spark plugs listed in this table.

SPARK PLUG SPECIFICATIONS

Application	Gap In. (mm)	Torque Ft. Lbs. (N.m)
EuroVan	.028-.035 (.70-.90)	18 (25)

FIRING ORDER & TIMING MARKS

NOTE: To identify firing order and distributor rotation, see Fig. 1.

Timing mark location is on flywheel. Timing pointer is on timing hole on transaxle bellhousing.

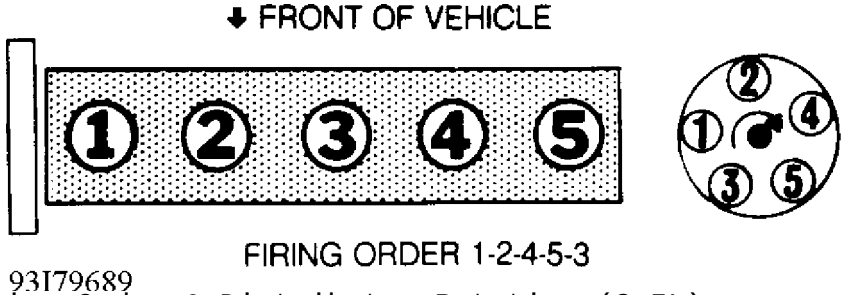


Fig. 1: Firing Order & Distributor Rotation (2.5L)
Courtesy of Volkswagen United States, Inc.

IGNITION TIMING

NOTE: Always refer to underhood label for latest specifications.

IGNITION TIMING (Degrees BTDC @ RPM)

Application	Checking	Adjusting
EuroVan (1)	4-8 @ 2000-2500	4-8 @ 2000-2500

(3) - Using Scan Tester (VAG 1551) in BASIC ADJUSTMENT mode, engine oil temperature 176øF (80øC), and Blue engine coolant temperature sensor disconnected.

IGNITION TIMING ADVANCE (Degrees BTDC @ RPM)

Application	Specification
California	(1) 15-38 @ 2200
Other 49 States	(1) 26-36 @ 2200

(1) - Vehicle NOT in BASIC ADJUSTMENT mode, engine oil temperature 176øF (80øC) and Blue engine coolant temperature sensor connected.

FUEL SYSTEM

FUEL PUMP

NOTE: Fuel pump performance measures fuel pressure and volume availability, not regulated fuel pressure.

FUEL PUMP PERFORMANCE

Application	Pressure psi (kg/cm(ý)	Min. Vol. In 30 Sec. Pts. (L)
EuroVan (1)	43 (3.0)	1.0-1.4 (0.5-0.7)

(1) - Using Adapter Cable (VAG 1348/3-2) between battery positive terminal and terminal No. 4 of fuel pump relay socket. Fuel pump energized, with 10-12 volts at fuel pump and engine off.

REGULATED FUEL PRESSURE

Application	At Idle w/Vacuum psi (kg/cmý)	At Idle w/o Vacuum (1) psi (kg/cmý)

EuroVan ..... 36 (2.5) 43 (3.0)

(1) - With vacuum hose disconnected from fuel pressure regulator.

INJECTOR RESISTANCE

INJECTOR RESISTANCE SPECIFICATIONS

Application	Ohms
EuroVan	
With 2-Pin Connector	(1) 15.20.0
With 6-Pin Connector	12.0-18.0

(1) - Resistance is 3.0-4.0 ohms for all 5 injectors.

IDLE SPEED & MIXTURE

IDLE SPEED & CO LEVEL

Application	Idle RPM	CO Level %
EuroVan (1)	775-825	0.3-1.2

(1) - Idle speed and fuel mixture (CO level) are not adjustable.

DASHPOT SPECIFICATION

Gap between limiter (stop) screw and throttle lever must be 0.06-0.10" (1.5-2.5 mm).

END OF ARTICLE

CLUTCH
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:31PM

ARTICLE BEGINNING

1993 CLUTCHES
Volkswagen FWD - EuroVan

Volkswagen; EuroVan

DESCRIPTION

The hydraulically operated clutch is a single dry disc type, which uses a diaphragm spring-type pressure plate. The clutch is hydraulically operated. Master cylinder is mounted in the clutch pedal bracket housing and slave cylinder is mounted on the clutch housing.

ADJUSTMENTS

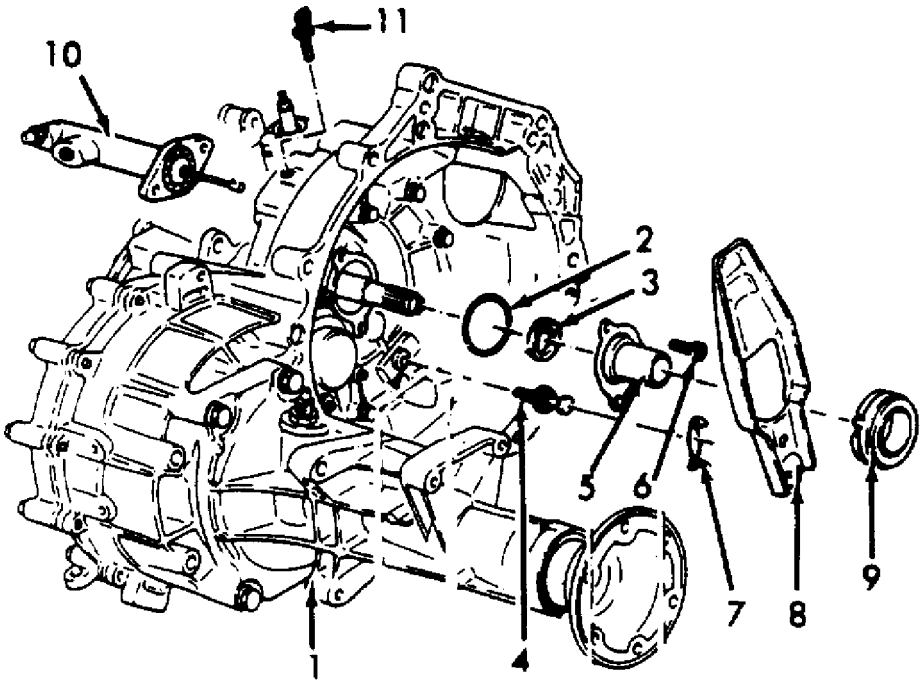
CLUTCH PEDAL

Clutch is automatically adjusted and requires no manual adjustment. If clutch pedal does not operate clutch or return properly, check hydraulic system for leaking fluid or air in system.

REMOVAL & INSTALLATION

CLUTCH ASSEMBLY

Removal
1) Obtain radio code. Disconnect negative battery cable. Remove radiator. Disconnect all wiring harness connectors from transaxle and starter. Remove shift linkage from transaxle.
2) Remove slave cylinder from transaxle. Disconnect speedometer. Remove all necessary brackets and cooling lines. Remove upper engine-to-transaxle mounting bolts. Remove brake booster and vacuum hose.
3) Measure protrusion of torsion bar adjusting nut. Release tension from torsion bar. Loosen drive shaft/wheel hub bolt. Remove wheel bearing housing. Disconnect shock absorber. Remove drive axle.
4) Remove starter and alternator. Disconnect tranaxle carrier from bearing housing. Remove A/C compressor (if equipped). Disconnect front exhaust pipe. Using tranaxle jack, support tranaxle. Support engine and remove remaining engine-to-transaxle mounting bolts. Lower transaxle out of vehicle.
5) Using Flywheel Lock (3067) or similar device, hold engine from turning. Remove pressure plate bolts. Remove pressure plate and clutch disk. If flywheel needs repair or replacement, remove flywheel from engine.



1. Transaxle
2. Input Shaft "O" Ring
3. Input Shaft Seal
4. Ball Stud
5. Guide Sleeve
6. Guide Sleeve Bolt
7. Retaining Spring
8. Release Lever
9. Release Bearing
10. Slave Cylinder
11. Assembly Pin

93F83233

Fig. 1: Exploded View Of Clutch Assembly Components
Courtesy of Volkswagen United States, Inc.

Inspection

Inspect pressure plate springs ends for damage or scoring. Scores up to .12" (3mm) deep are acceptable. Replace pressure plate if:

* Contact Surface Has Burns, Cracks Or Chatter Marks
* Contact Surface Has Grooves Or Defective Spring Connections
* Diaphragm Spring Has Deep Scores Or Damaged Pointed Tips
* Pressure Plate Housing Is Distorted Or Broken
* Pressure Plate Housing Spring Connections Are Defective
* Pressure Plate Housing Dowel Pin Bores Are Deformed
* Pressure Plate Housing Rivets Are Damaged Or Loose

Replace friction disk if;

* Worn To Surface Of Rivet Heads
* Rivets Are Loose, Missing Or Damaged
* Friction Material Is Oil Or Grease Soaked
* Friction Material Is Loose, Cracked Or Grooved
* Hub Is Rusted Or Damaged
* Springs Are Rusted Solid, Broken, Cracked Or Loose

NOTE: Pressure plate has a protective grease coating. Remove contact surface grease only. Service life will be shortened if remaining portions of pressure plate protective grease are removed.

Installation

1) Replace input shaft seal. See Fig. 1. Ensure friction disk slides on input shaft spines. Splines may be lightly greased. Wipe off excess grease. If flywheel was removed, reinstall on engine. Using flywheel lock or similar device, hold engine from turning. Tighten flywheel bolts to specification. See TORQUE SPECIFICATIONS table at end of article.

2) Mount friction disk and pressure plate on engine. Install pressure plate bolts finger tight. Using Clutch Centering Plug (3190), align friction disk and pilot bushing holes. Tighten pressure plate bolts to specification using a crisscross pattern.

3) To complete installation, reverse removal procedure. Plug transaxle openings to prevent contamination or fluid loss. Push clutch release lever rearward and temporarily install mounting pin or an 8 x 22 mm bolt through pivot arm. Remove pin or bolt after installation is complete. Tighten nuts and bolts to specification. See TORQUE SPECIFICATIONS table.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS TABLE

Application	Ft. Lbs. (N.m)
Drive Axle-To-Flange Bolt	33 (45)
Flywheel Bolt	22 (30) + 1/4 Turn
Front Transaxle Mount Nut	44 (60)
Gearshift Cable Bolt	18 (25)
Gearshift Cable Support Bolt	18 (25)
Left Transaxle Mount	
Bracket-To-Mount Bolt	44 (60)
Bracket-To-Transaxle Bolt	18 (25)
Pressure Plate Bolt	15 (20)
Right Rear Transaxle Mount Bolt	18 (25)
Slave Cylinder Bolt	18 (25)
Starter Bolt	44 (60)
Transaxle Support-To-Transaxle Bolt	44 (60)
Transaxle-To-Engine Bolt	59 (80)

END OF ARTICLE

COMPUTER RELEARN PROCEDURES
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:31PM

ARTICLE BEGINNING

GENERAL INFORMATION
Computer Relearn Procedures

All Models

*** PLEASE READ THIS FIRST ***

The following general procedures are to be used if driveability problems are encountered after power loss or battery has been disconnected. These procedures may provide an aid in eliminating these problems.

To reduce the possibility of complaints, after any service which requires battery power to be disconnected, vehicle should be road tested.

COMPUTER RELEARN PROCEDURES

Vehicles equipped with engine or transmission computers may require a relearn procedure after vehicle battery is disconnected. Many vehicle computers memorize and store vehicle operation patterns for optimum driveability and performance. When vehicle battery is disconnected, this memory is lost. The computer will use default data until new data from each key start is stored. As computer memorizes vehicle operation for each new key start, driveability is restored. Vehicle computers may memorize vehicles operation patterns for 40 of more key starts.

Customers often complain of driveability problems during relearn stage because vehicle acts differently then before being serviced. Depending on type and make of vehicle and how it is equipped, the following complaints (driveability problems) may exist:

* Harsh Or Poor Shift Quality
* Rough Or Unstable Idle
* Hesitation Or Stumble
* Rich Or Lean Running
* Poor Fuel Mileage

These symptoms and complaints should disappear after a number of drive cycles have been memorized. To reduce the possibility of complaints, after any service which requires battery power to be disconnected, vehicle should be road tested. If a specific relearn procedure is not available, the following procedure may be used:

Automatic Transmission

* Set parking brake, start engine in "P" or "N" position. Warm-up vehicle to normal operating temperature or until cooling fan cycles.
* Allow vehicle to idle for one minute in "N" position. Select

"D" and allow engine to idle for one minute.

* Accelerate at normal throttle position (20-50%) until vehicle shifts into top gear.
* Cruise at light to medium throttle.
* Decelerate to a stop, allowing vehicle to downshift, and use brakes normally.
* Process may be repeated as necessary.

Manual Transmission

* Place transmission in Neutral position.
* Ensure emergency brake has been set and all accessories are turned off.
* Start engine and bring to normal operating temperature.
* Allow vehicle to idle in Neutral for one minute.
* Initial relearn is complete: process will be completed during normal driving.

Some manufacturers identify a specific relearn procedure which will help establish suitable driveability during relearn stage. These procedures are especially important if vehicle is equipped with and electronically controlled automatic transmission or transaxle. Always complete procedure before returning vehicle to customer.

END OF ARTICLE

CRUISE CONTROL SYSTEM
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:31PM

ARTICLE BEGINNING

1993 ACCESSORIES & EQUIPMENT
Volkswagen Cruise Control Systems

Volkswagen; Corrado SLC, EuroVan, Passat

DESCRIPTION & OPERATION

The cruise control system allows driver to maintain a constant cruising speed above 22 MPH without depressing the accelerator pedal. The cruise control system consists of a vacuum pump, vacuum servo unit, vent valves and a control module. See Fig. 1 and 2.

The cruise control system is operated by placing RES/ON/OFF switch in the ON position. Accelerate to desired speed and press the SET button. This sets the cruising speed and stores it in memory. Pushing the SET button again will increase the previous set speed until the button is released.

Cruise control system will disengage temporarily when the brake or clutch pedal is depressed. To reactivate system, slide the RES/ON/OFF button to RESUME. The vehicle will automatically accelerate to the previous set speed. To erased set speed from memory, slide the RES/ON/OFF button to OFF.

WARNING: DO NOT shift into Neutral when cruise control system is switched on.

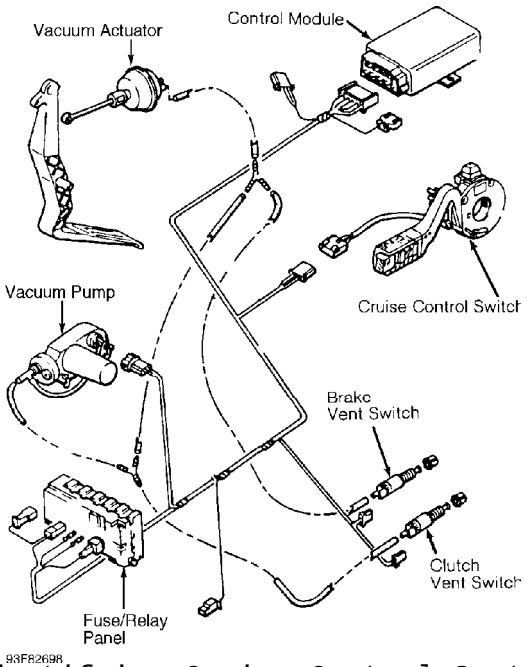


Fig. 1: Identifying Cruise Control System Components (Corrado SLC Is Shown; Passat Is Similar)
Courtesy of Volkswagen United States, Inc.

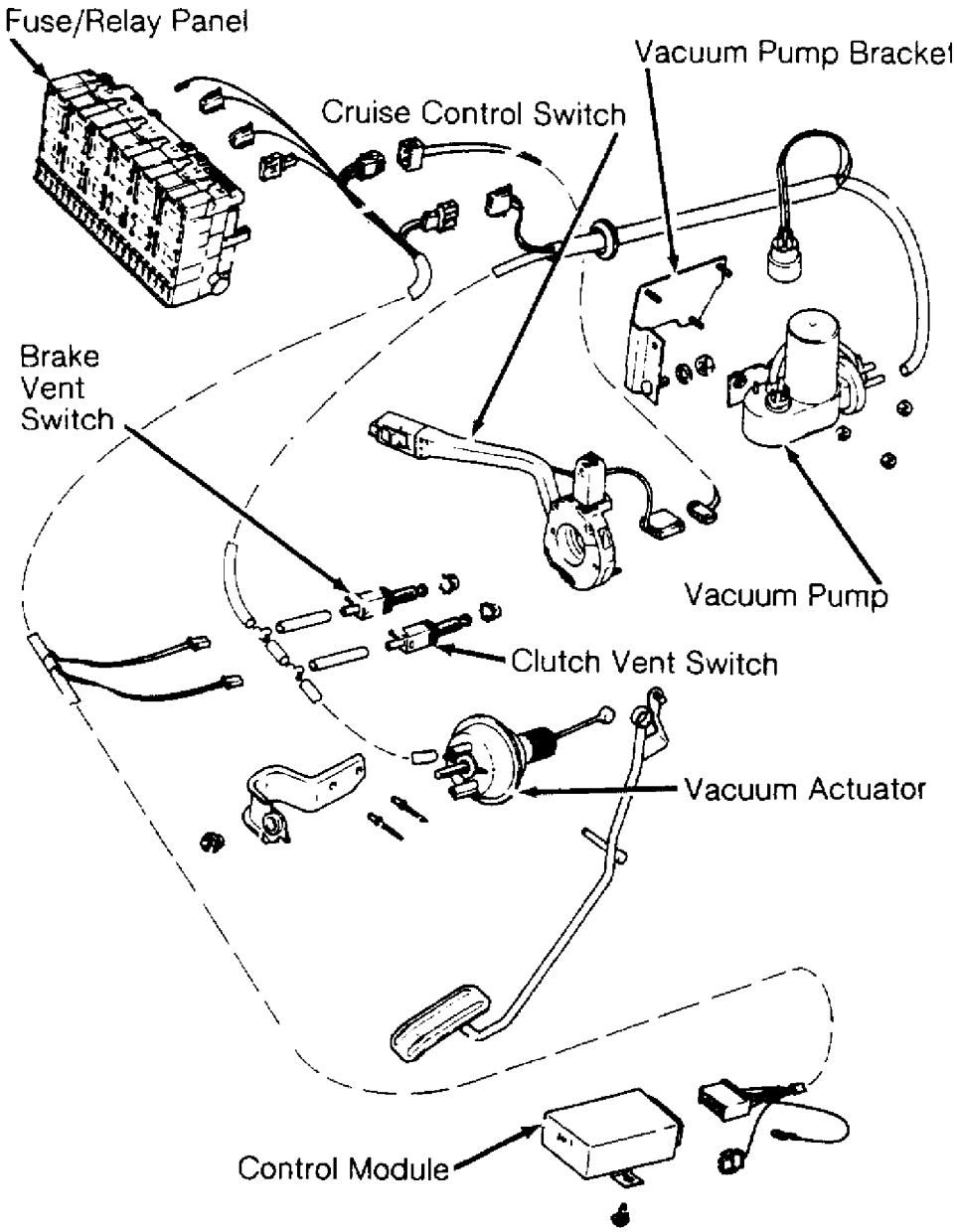


Fig. 2: Identifying Cruise Control System Components (EuroVan)
Courtesy of Volkswagen United States, Inc.

ADJUSTMENTS

VACUUM ACTUATOR

Corrado SLC & Passat
Loosen vacuum actuator adjustment sleeve and push forward.

See Fig. 3. Adjust cable as necessary. Pull adjustment sleeve toward rear until .14" (3.5 mm) of play is obtained at pedal plate. Check accelerator pedal clearance.

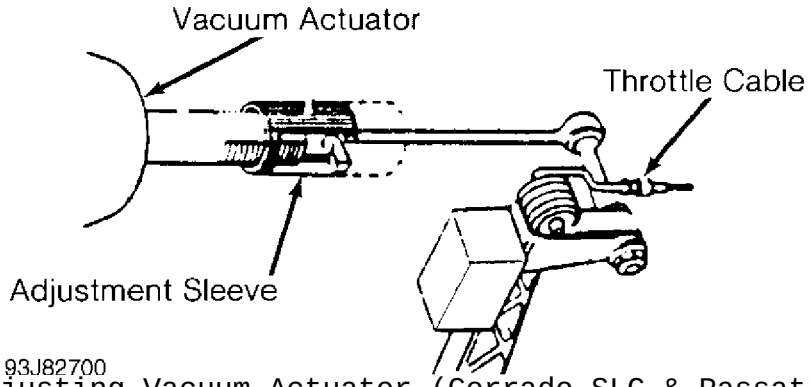


Fig. 3: Adjusting Vacuum Actuator (Corrado SLC & Passat)
Courtesy of Volkswagen United States, Inc.

VACUUM SERVO LINKAGE

EuroVan

Ensure throttle linkage is fully released. Push adjustment sleeve and linkage forward. See Fig. 4. Turn adjusting linkage to lock. Ensure throttle linkage operates freely.

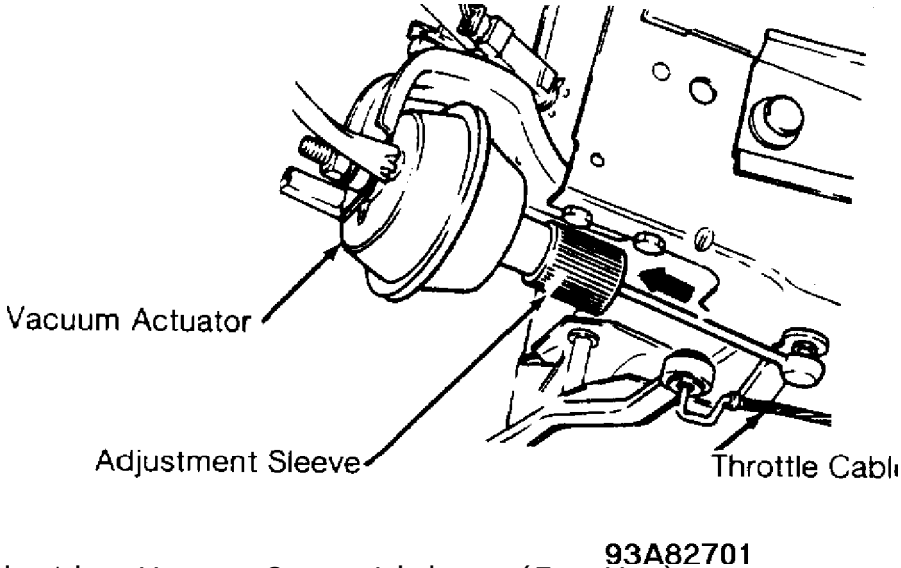


Fig. 4: Adjusting Vacuum Servo Linkage (EuroVan)
Courtesy of Volkswagen United States, Inc.

REMOVAL & INSTALLATION

BRAKE & CLUTCH VENT VALVES

Removal

Remove trim panel and vent duct from beneath left side of

instrument panel. Brake and clutch switches are located on a bracket in front of associated pedal. See Fig. 5 or 6. Disconnect wiring and vacuum hose from valve. Rotate vent valve out of bracket.

Installation

Install brake or clutch vent valve into bracket until valve is seated. Pull back pedal as far as it will go. Slowly release pedal to adjust switch.

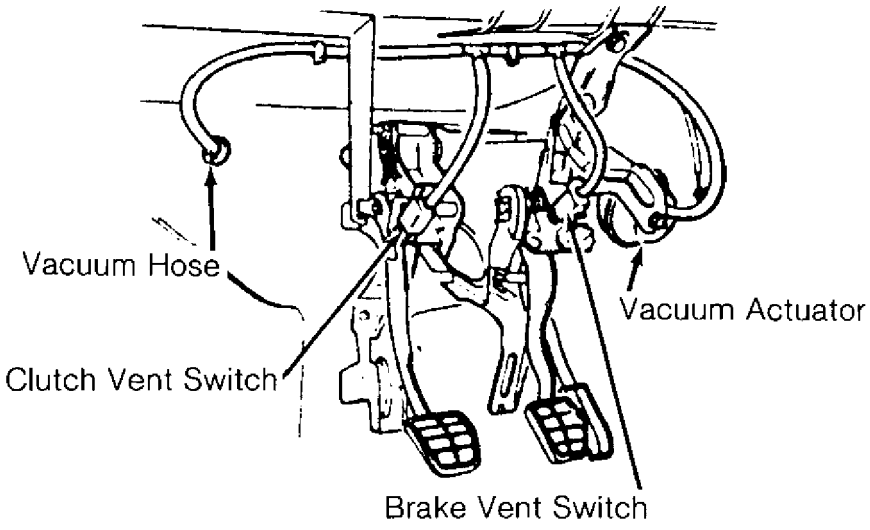


Fig. 5: Identifying Brake & Clutch Vent Valves System Components (Corrado SLC & Passat)
Courtesy of Volkswagen United States, Inc.

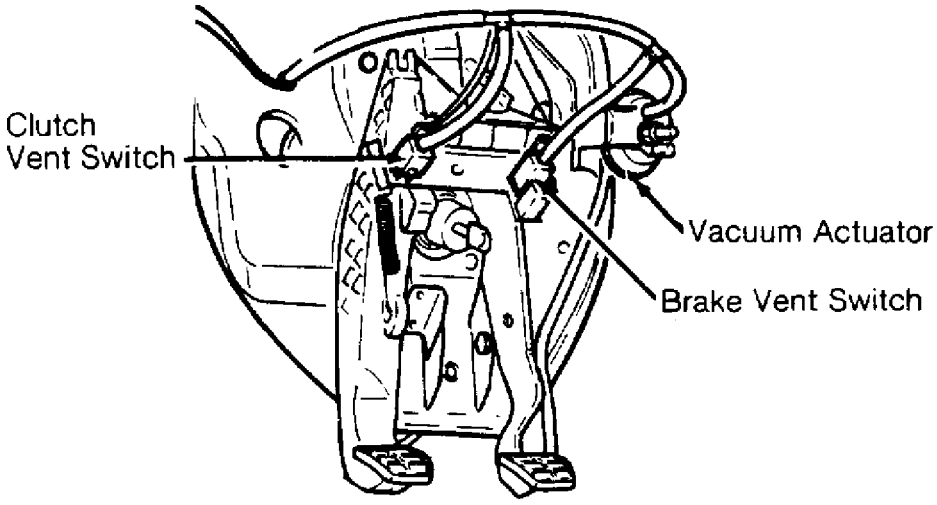


Fig. 6: Identifying Brake & Clutch Vent Valves System Components (EuroVan)
Courtesy of Volkswagen United States, Inc.

CONTROL UNIT

Removal & Installation

Remove glove compartment. Remove control module mounting bracket. Remove control unit wiring harness connectors. Remove control module. To install, reverse removal procedure.

STEERING COLUMN CONTROL SWITCH

Removal & Installation

Remove steering wheel. Loosen steering column switch clamp and pull up steering column switch. Disconnect electrical connector and remove steering column control switch. To install, reverse removal procedure.

VACUUM PUMP

Removal & Installation

On Corrado SLC and Passat models, remove windshield washer mounting bracket. Remove battery. On all models, remove screws and vacuum pump fender. See Fig. 7 or 8. To install, reverse removal procedure.

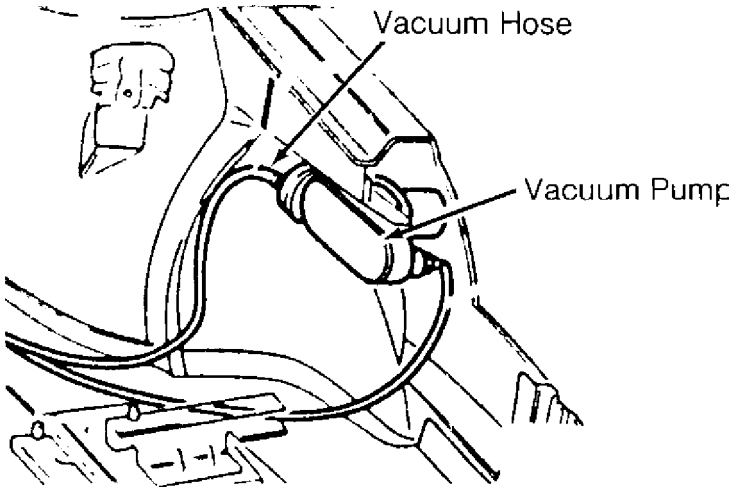


Fig. 7: Identifying Vacuum Pump Components (Corrado SLC & Passat)
Courtesy of Volkswagen United States, Inc.

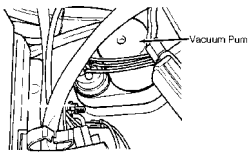


Fig. 8: Identifying Vacuum Pump Components (EuroVan)
Courtesy of Volkswagen United States, Inc.

VACUUM SERVO

Removal & Installation

1) Detach linkage and remove vacuum hose from vacuum servo. Remove nut and servo from bracket. To install, reverse removal procedure. Adjust linkage as necessary.

TESTING

VACUUM CHECK

Locate vacuum pump. See Fig. 7 or 8. Remove vacuum line from vacuum pump. Push vacuum actuator diaphragm inward. Apply brake pedal by hand until pressure is felt. Release brake pedal. If diaphragm moves, repair or replace as necessary.

WIRING DIAGRAMS

See appropriate chassis wiring diagram in WIRING DIAGRAMS.

END OF ARTICLE

D - ADJUSTMENTS
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:31PM

ARTICLE BEGINNING

1993 ENGINE PERFORMANCE
On-Vehicle Adjustments

EuroVan

ENGINE MECHANICAL

Before performing any on-vehicle adjustments to fuel or ignition systems, ensure engine mechanical condition is okay.

VALVE CLEARANCE

NOTE: All models use hydraulic lifters. No adjustments are required.

IGNITION TIMING

NOTE: See ENTERING SELF-DIAGNOSTICS in the G - TESTS W/CODES article in this section for additional scan tester operating instructions.

5-CYLINDER IGNITION TIMING

1) Start and warm engine to normal operating temperature. Ensure engine oil temperature is at least 176øF (80øC). Ensure A/C and electrical loads are off, including cooling fan.
2) Remove splash shield from distributor. Connect Engine Analyzer (VAG 1367) and Inductive Pick-Up (VAG 1367/8) to engine. Connect Scan Tester (VAG 1551) to Data Link Connectors (DLC) located in fold-down storage shelf in front of relay panel.
3) Ensure no Diagnostic Trouble Codes (DTC) are stored. Ensure throttle cable and closed throttle position switch are properly adjusted. Ensure idle air control valve is okay. Valve must vibrate or hum. Ensure exhaust system has no leaks.

NOTE: Some EuroVan engines require the use of TDC sensor and Adapter (VAG 1367/9). On engines having crankshaft position sensor, Ignition Tester (VAG 1367) and Adapter (VAG 1367/9) can be connected to these engines without removing distributor cap.

4) Start engine and let it run at closed throttle (less than 1500 RPM). Operate scan tester and observe display. Press "1" button to select RAPID DATA TRANSFER function.
5) Press "0" and "1" buttons to select ENGINE ELECTRONICS function. Press "Q" button to enter input. Press right arrow button, then "0" and "4" buttons to select BASIC ADJUSTMENT function. The Engine Control Module (ECM) should control idle speed.
6) Press "0" button TWICE to select INDICATOR GROUP NUMBER

input. Press "Q" button to enter input. Scan tester will display SYSTEM IN BASIC ADJUSTMENT 1 through 10 or FUNCTION UNKNOWN/OR CANNOT BE CONDUCTED AT THIS TIME.

7) If the latter is displayed, ensure coolant temperature is 185øF (85øC). Check for idle speed in excess of 1500 RPM. Basic adjustment function using scan tester is not possible. Correct condition(s) as necessary.

8) If scan tester enters basic adjustment function, disconnect Blue Engine Coolant Temperature (ECT) sensor. Check ignition timing. Timing mark is on flywheel. Timing pointer is on timing hole on transaxle bellhousing.

9) If necessary, adjust ignition timing by rotating distributor. Ensure radiator cooling fan is not running during adjustment. After adjustment, press right arrow button to end basic adjustment.

10) Using scan tester, activate and erase DTCs. This will erase stored DTC set when ECT sensor was disconnected. Check and adjust idle speed if necessary. See IDLE SPEED & MIXTURE.

11) After adjustments, press "0" and "6" buttons to select END DATA TRANSFER function. Press "Q" button to enter input. Allow engine to cool. Disconnect test equipment. Install distributor splash shield. Remove TDC sensor and adapter from bellhousing (if installed).

NOTE: To check ignition timing advance on EuroVan, ensure ignition timing is correctly set. With vehicle/scan tester NOT in basic adjustment function, increase engine speed to slightly over 2200 RPM. See IGNITION TIMING ADVANCE table.

IGNITION TIMING ADVANCE (Degrees BTDC @ RPM)

Application	Specification
EuroVan	
California	(1) 15-38 @ 2200
Other 49 States	(1) 26-36 @ 2200

(1) - Vehicle NOT in BASIC ADJUSTMENT mode, engine oil temperature 176øF (80øC) and Blue engine coolant temperature sensor connected.

IDLE SPEED & MIXTURE

NOTE: Mixture adjustment is NOT a part of normal tune-up procedure and should not be performed unless mixture control unit is replaced or vehicle fails emissions testing.

NOTE: Ensure fuel system pressure is correct before attempting idle speed or mixture adjustment.

5-CYLINDER IDLE SPEED & MIXTURE ADJUSTMENT

1) Adjust ignition timing. See 4-CYLINDER IGNITION TIMING under IGNITION TIMING. Connect CO tester using Adapter (VAG 1363/3) on CO tap tube. DO NOT remove oxygen sensor.
2) Disconnect crankcase breather hose from emission control valve. Position hose so that only fresh air is drawn. With engine in BASIC ADJUSTMENT function, disconnect Blue Engine Coolant Temperature (ECT) sensor.
3) Check idle speed and CO level (fuel mixture). Ensure radiator cooling fan is not running during measurement. After checking idle speed and fuel mixture, press right arrow button to end basic adjustment.
4) Using scan tester, activate and erase DTCs. This will erase stored DTC set when ECT sensor was disconnected. Press "0" and "6" buttons to select END DATA TRANSFER function. Press "Q" button to enter input. Allow engine to cool. Disconnect test equipment.

THROTTLE BODY

THROTTLE BODY ADJUSTMENT

CAUTION: Throttle limiting (stop) screw is set by manufacturer and should NOT be moved. If screw is accidentally turned, perform throttle body adjustment.

1) Turn throttle stop screw until there is a gap between stop lever and screw. Turn in stop screw until it just touches lever. Place a thin piece of paper between stop screw and lever.
2) Slide paper back and forth until resistance is felt. The stop point will become obvious. After determining stop point, turn stop screw in 1/2 turn. check dashpot, throttle position sensor, and idle speed adjustments.

AIRFLOW SENSOR

DASHPOT

Ensure THROTTLE BODY adjustment is correct. Open and close throttle until dashpot piston contacts roller. With throttle in this position, check gap between limiter (stop) screw and throttle. Gap between limiter (stop) screw and throttle lever must be 0.06-0.10" (1.5-2.5 mm). If gap is not as specified, adjust dashpot.

IDLE & FULL THROTTLE SWITCHES

CLOSED THROTTLE POSITION (CTP) SWITCH ADJUSTMENT

Ensure throttle body adjustment is correct. Loosen CTP switch screws. Ensure throttle stop lever contact limiter (stop) screw. Slightly tighten CTP switch screws. Tightly press throttle lever and CTP switch. Fully tighten CTP switch screws. Open throttle and listen for click from CTP switch.

THROTTLE POSITION (TP) SENSOR ADJUSTMENT

1) Connect Scan Tester (VAG 1551) to Data Link Connectors (DLC) located in fold-down storage shelf in front of relay panel. Turn ignition on. Operate scan tester until READ BLOCK MEASUREMENT function appears on display. See appropriate G - TESTS W/CODES article.

2) Slowly open throttle, while observing display in channel 3, until throttle is wide open. Numerical value must increase uniformly over entire opening range. Reading should be 0 or greater than zero at idle. Reading should be 80 or greater at full throttle stop.

3) If readings are correct, press right arrow button. Press "0" and "6" to select END DATA TRANSFER function. Press "Q" button to enter input. If readings are incorrect, check TP sensor circuit or replace TP sensor as necessary. After replacing TP sensor, check idle speed.

END OF ARTICLE

DEFOGGER - REAR WINDOW
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:31PM

ARTICLE BEGINNING

1993 ACCESSORIES & EQUIPMENT
Volkswagen Rear Window Defoggers

Volkswagen; Cabriolet, Corrado SLC, EuroVan, Fox, Golf, GTI, Jetta, Passat

DESCRIPTION & OPERATION

Ignition must be on for rear window defogger to operate. Power to control switch is applied through fuse in fuse block. An indicator light in the control switch comes on when the defogger is turned on. Control switch also provides power to heating element in both outside mirrors.

TROUBLE SHOOTING

DEFOGGER DOES NOT WORK

Check for blown fuse, defective defogger switch, open wiring or poor connections. Check for breaks in rear window defogger grid. See FILAMENT TEST under TESTING.

INDICATOR LIGHT DOES NOT WORK

Check for burned bulb, blown fuse, open wiring or poor connection.

TESTING

SYSTEM TEST

Ensure and control switch are okay. Turn ignition and control switch on. After a few minutes, feel glass for warmth. If glass is not warm, use a test light to check for battery voltage at grid feed wire. If no voltage is present, check control switch.

FILAMENT TEST

1) To locate breaks in grid filaments, connect test light negative lead to ground side of grid. Touch opposite (positive) side of grid with test light probe. If test light glows, grid line is okay. Test light will glow dimmer as probe is moved toward ground side of grid.
2) If test light does not glow, grid line is broken. To locate break, move probe along grid line toward ground side of heat grid until test light glows, indicating area of damage.

WIRING DIAGRAMS

See appropriate chassis wiring diagram in WIRING DIAGRAMS.

END OF ARTICLE

E - THEORY/OPERATION
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:31PM

ARTICLE BEGINNING

1993 ENGINE PERFORMANCE
Volkswagen Theory & Operation - Digifant

EuroVan

INTRODUCTION

This article covers basic description and operation of engine performance-related systems and components. Read this article before diagnosing vehicles or systems with which you are not completely familiar.

COMPUTERIZED ENGINE CONTROLS

The Bosch AFC Digifant system is a computer-controlled fuel injection system. The system does not use cold start injector or thermo time switch for cold start enrichment. Different sensors and switches, along with Electronic Control Unit (ECU) or Engine Control Module (ECM), regulate fuel injection and ignition timing. See Fig. 1.

ELECTRONIC CONTROL UNIT

The ECU/ECM controls all engine operations and limits maximum engine speed. It receives information from various input devices and cannot be repaired.

ECU/ECM LOCATION

Application	Location
EuroVan	In Left Side Of Engine Compartment, Behind Headlight

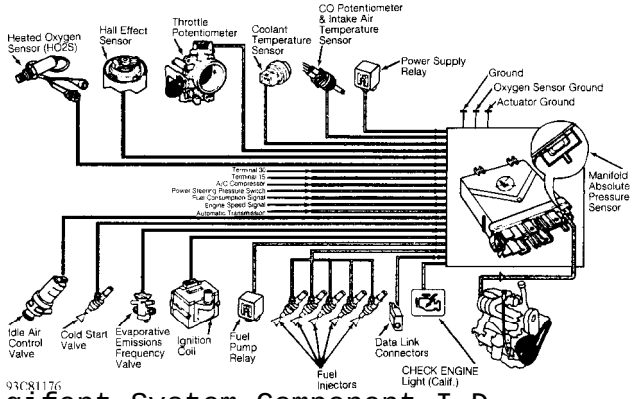


Fig. 1: Digifant System Component I.D.
Courtesy of Volkswagen United States, Inc.

NOTE: Components are grouped into 2 categories. The first category covers INPUT DEVICES, which control or produce voltage signals monitored by the control unit/module. The second category covers OUTPUT SIGNALS, which are components controlled by the control unit/module.

INPUT DEVICES

Coolant Temperature Sensor

Sensor is a temperature sensitive variable resistor (less resistance as temperature increases). This sensor returns signals to the ECM to determine amount of cold start enrichment, acceleration enrichment, after-start enrichment, deceleration fuel cut-off and idle air control during cold start.

Hall Effect Sensor

See ELECTRONIC IGNITION SYSTEM under IGNITION SYSTEM.

Intake Air Temperature Sensor

Intake air temperature sensor is a thermistor-type variable resistor (resistance decreases with increase of temperature). This sensor voltage signal varies to ECU/ECM in relation to engine air temperature. The ECU/ECM uses this signal to control fuel injection duration.

Manifold Absolute Pressure (MAP) Sensor

MAP sensor is located inside the ECM. The MAP sensor signal is used by ECM to determine engine load. This signal along with RPM is used to calculate ignition timing and fuel injection quantity.

Oxygen (O2) Sensor

The O2 sensor detects oxygen content in the exhaust gas and sends this information to the ECU/ECM. In operation, the ECU/ECM receives signals from the O2 sensor and varies the duration during which fuel is injected. A high voltage signal indicates a rich mixture. A low voltage signal indicates a lean mixture.

The O2 sensor is heated electrically for rapid warm-up and constant operating temperature. Power to the heating element is supplied whenever ignition switch is turned to ON position.

Throttle Potentiometer

Throttle potentiometer is used by ECM to sense throttle position. This signal is also used for activation of idle air control, deceleration fuel shut-off and full throttle enrichment. On vehicles equipped with a manual transmission, a dashpot delays throttle valve closing just before idle.

OUTPUT SIGNALS

NOTE: Each vehicle may be equipped with different combinations of computer controlled components. The following listed components may NOT be used on all models. For theory and

operation on each output component, refer to the system indicated to right of each component.

Auxiliary Air Regulator
See IDLE SPEED.

Cold Start Valve
See FUEL CONTROL.

Fuel Injectors
See FUEL CONTROL.

Fuel Pump Relay
See FUEL DELIVERY.

Idle Air Control Valve
See IDLE SPEED.

Ignition Coil Control
See IGNITION SYSTEM.

FUEL SYSTEM

FUEL DELIVERY

Electric Fuel Pump
The fuel pump provides fuel under pressure to the fuel pressure regulator. Power for operation during cranking mode is provided from starter relay via fuel pump relay. After engine has started, control of fuel pump is through the ignition signal. The fuel pump is sealed unit.

Fuel Pump Relay
When energized by ignition switch and grounded by ECU/ECM, fuel pump relay provides battery voltage to the fuel pumps, injectors, idle stabilization control unit, oxygen sensor heating element and the power steering pressure switch.

Fuel Pressure Regulator
The fuel pressure regulator is a sealed, spring loaded diaphragm with connection for intake manifold vacuum. Fuel pressure is maintained at about 36 psi (2.5 kg/cmý) pressure.
A connection for intake manifold vacuum provides a constant pressure differential which ensures that the amount of fuel injected is solely dependent upon injector open ON time. Excess fuel is returned to fuel tank. No service of pressure regulator is required. The pressure regulator is located on or near fuel rail.

FUEL CONTROL

Data on engine temperature, engine speed, intake air volume, throttle position, exhaust oxygen content and intake air temperature

are used by ECU/ECM to determine injection pulse width.

Cold Start Valve

Cold start valve, mounted on intake manifold, sprays fuel to enrich mixture during starting so engine will start easily. The cold start valve is electronically controlled. The engine coolant temperature sensor with a signal supplied to ECM determines the opening time of the valve.

Fuel Injectors

A fuel rail links the fuel pressure regulator with the fuel injectors. Each cylinder is provided with a solenoid-operated injector which sprays fuel toward backside of each inlet valve. Each injector is energized through the ignition coil and grounded through the ECU/ECM to complete the circuit.

Each injector is linked to a resistor (resistor may be external or integral with injector or ECU/ECM) to reduce operating voltage to 3 volts and to protect injectors from power surges. The ECU/ECM controls length of time each injector is open. The ON time of the injector governs the amount of fuel delivered. The injector delivers 1/2 the amount of fuel required for an operating cycle each time they open (twice per cycle).

IDLE SPEED

Idle Air Control Valve

The idle air control valve is attached to intake manifold and adjusts the amount of air to engine to control engine idle speed when throttle valve is closed. The control valve receives signals from ECM. The control valve supplies additional air to engine when A/C is on.

IGNITION SYSTEM

ELECTRONIC IGNITION SYSTEM

The Hall Effect sensor in the distributor uses a shutter window wheel, mounted on the distributor shaft. The shutter blades pass in and out of the air gap of the Hall Effect sensor, resulting in signal pulses. There is one shutter window for each engine cylinder.

Signals from distributor Hall Effect sensor are sent to the ECU/ECM. The ECU/ECM sends a switching voltage signal to the ignition coil primary circuit to discharge secondary spark voltage.

IGNITION TIMING CONTROL SYSTEM

Ignition Timing Control

Signals from distributor Hall Effect sensor are sent to the ECU/ECM, which produces a pulsating signal to the ignition coil. This computed signal from ECU/ECM to ignition coil controls ignition timing according to engine load (airflow sensor signal), engine speed (Hall Effect signal) and engine coolant temperature.

EMISSION SYSTEMS

Evaporative Emissions System

Fuel vapors are collected in the expansion tank. Liquid gasoline collects in expansion tank and flows back to the fuel tank through vent lines. See Fig. 2. When engine is not running, fuel vapors are drawn from tops of the expansion tanks, and flow into carbon canister, where vapors are stored.

After engine is started, the control valve is opened by throttle vacuum. Fresh air is drawn into bottom of the canister. Fuel vapors from the canister are drawn into the intake manifold. On EuroVan, fuel vapor flow is further regulated by an ECM-controlled evaporative emissions frequency valve.

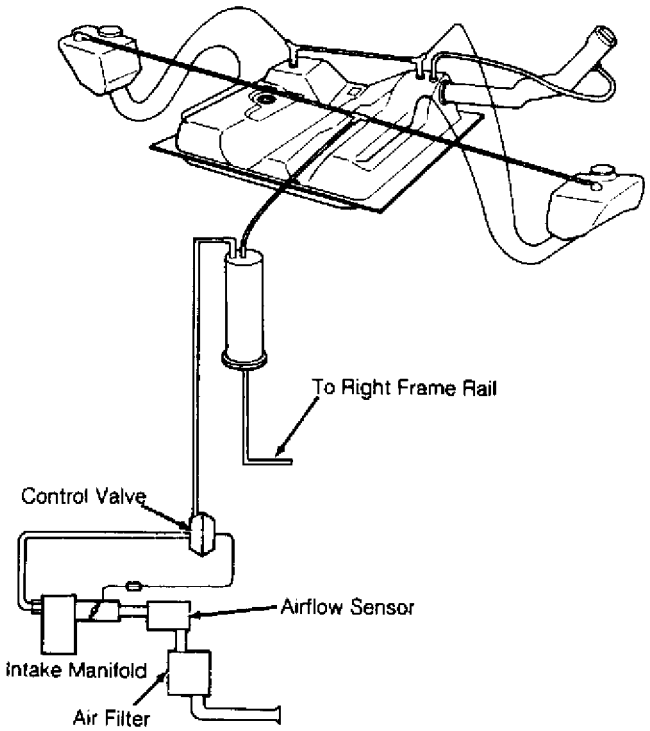


Fig. 2: Identifying Evaporative Emissions System Components
Courtesy of Volkswagen United States, Inc.

Thermostatic Air Cleaner

During cold engine operation, a regulator flap located inside air cleaner assembly is opened so engine can draw warmed air from around exhaust system. Vacuum from throttle valve operates regulator flap. The regulator flap is controlled by a temperature regulator valve located in upper part of air cleaner assembly. When engine warms up, temperature regulator valve closes causing regulator flap to close, blocking warm air flow from around exhaust.

SELF-DIAGNOSTIC SYSTEM

O2 SENSOR WARNING LIGHT

All vehicles are equipped with an O2 sensor warning light, located on the instrument panel. The light illuminates when a mileage counter reaches 60,000 miles, indicating recommended O2 sensor replacement and mileage counter reset.

MISCELLANEOUS CONTROLS

NOTE: Although not considered true engine performance-related systems, some controlled devices may affect driveability if they malfunction.

COOLING FAN

Cooling Fan Motor

The cooling fan is either a 1 or 2-speed motor. For specific On-Off operating temperatures of the different fans, see the COOLING FAN OPERATIONAL SPECIFICATIONS table below.

COOLING FAN OPERATIONAL SPECIFICATIONS

Application	Fan Turns ON at: øF (øC)	Fan Turns OFF at: øF (øC)
Single-Speed Fan	198-207 (92-97)	183-196 (84-91)
Dual-Speed Fan		
Low-Speed		
Without A/C	198-208 (92-98)	183-196 (99-108)
With A/C	183-207 (84-97)	183-196 (99-108)
High-Speed		
Without A/C	210-226 (99-108)	196-220 (91-104)
With A/C	201-220 (91-104)	196-220 (91-104)

After-Run Thermoswitch

An after-run switch is used to help prevent fuel vaporization. The thermoswitch turns cooling fan on when temperatures in engine compartment exceeds 230øF (110øC), and turns it off at 217øF (103øC).

END OF ARTICLE

ELECTRICAL COMPONENT LOCATOR
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:31PM

ARTICLE BEGINNING

1993 ELECTRICAL COMPONENT LOCATION
Volkswagon Electrical Components

EuroVan

BUZZERS, RELAYS & TIMERS

Component	Component Location
ABS Relays	On top of ABS pump.
A/C Clutch Relay	On fuse/relay block.
A/C Control Module Relay	On fuse/relay block.
Blower Fan Relay	On fuse/relay block.
Coolant Pump After-Run Relay	On fuse/relay block.
ECM Relay	On fuse/relay block.
Foglight/Parking Light Relay	On fuse/relay block.
Fuel Pump Relay	On fuse/relay block.
Hazard Flasher Relay	On fuse/relay block.
Heater Control Module Relay	On fuse/relay block.
Horn Relay	On fuse/relay block.
Load Reduction Relay	On fuse/relay panel.
Radiator Fan Relays	On left front of engine compartment.
Rear Window Defroster & Heated Mirror Relay	On fuse/relay panel.
Rear A/C Fan High Speed Relay	Behind right rear wheelwell, under blower motor housing.
Seat Belt Warning Relay	On fuse/relay block.
Starter Interlock & Back-Up Light Relay	On fuse/relay block.
Wiper/Washer Relay (Front & Rear)	On fuse/relay block.

ELECTRICAL COMPONENT LOCATOR
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CIRCUIT PROTECTION DEVICES

Component	Component Location
Auxiliary Heater Fuses (Canada)	On fuse holder, behind right kick panel.
Fuse/Relay Block	Behind left side of dash.

CONTROL UNITS

Component	Component Location
ABS Control Module	Behind left kick panel.
Auxiliary Heater Control Module (Canada)	Behind right kick panel.
Cruise Control Module	Behind right side of dash, behind glove box.
Digifant Control Module	Behind left headlight.
Transmission Control Module (TCM)	Behind right kick panel.

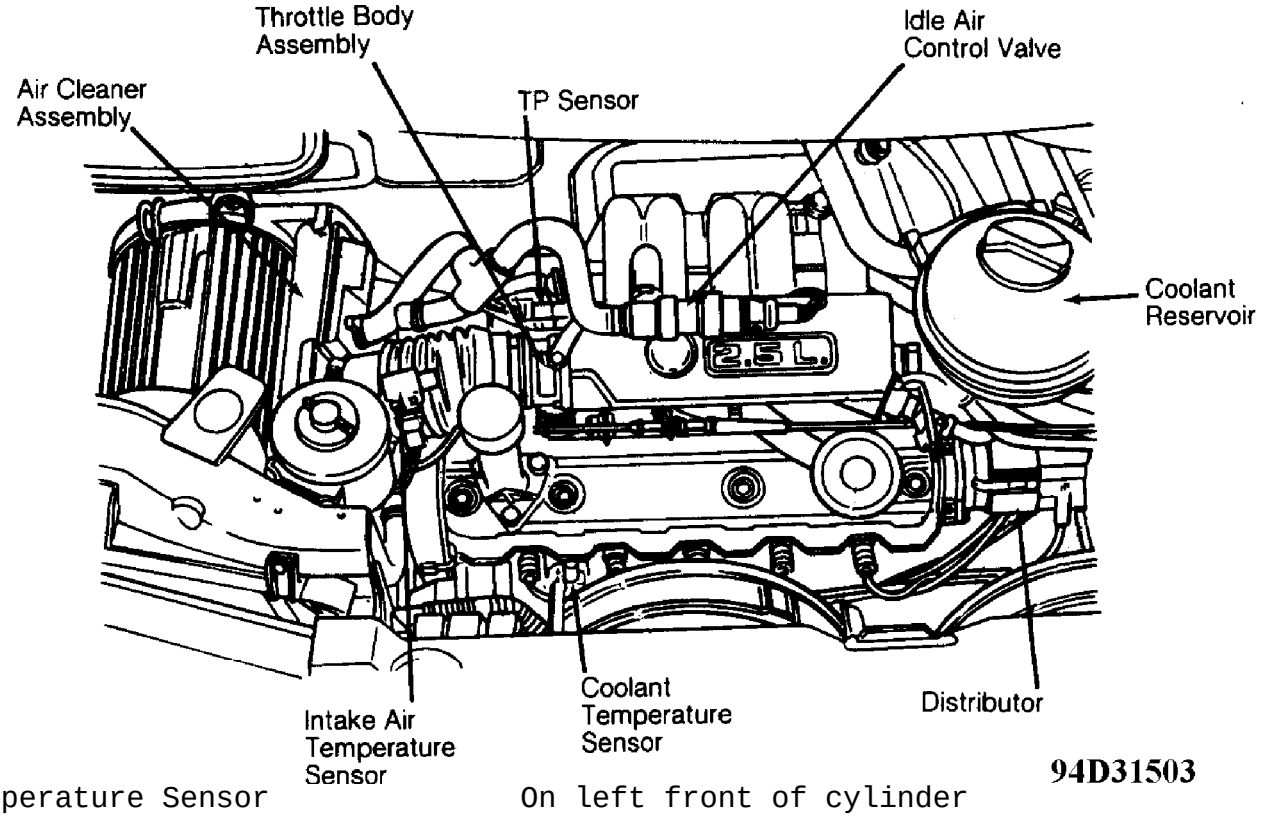
MOTORS

Component	Component Location
Blower Fan Motor	
Front	Under left side of dash.
Rear	
A/C Unit	On right rear of vehicle.
Heater Unit	Under rear of vehicle.
Coolant Circulation Pump	On left rear bottom of engine.
Fuel Pump	In fuel tank.
Washer Pump (Headlight/Windshield)	In washer fluid reservoir, behind right headlight.
Wiper Motors	
Front	On center of firewall.
Rear	Behind panel on each rear swing door or liftgate (if

equipped).

SENDING UNITS & SENSORS

Component	Component Location
ABS Wheel Speed Sensors	On each wheel spindle or hub assembly.



Coolant Temperature Sensor	On left front of cylinder head.

ELECTRICAL COMPONENT LOCATOR

Article Text (p. 4)

1993 Volkswagen EuroVan

For Volkswagen Technical Site

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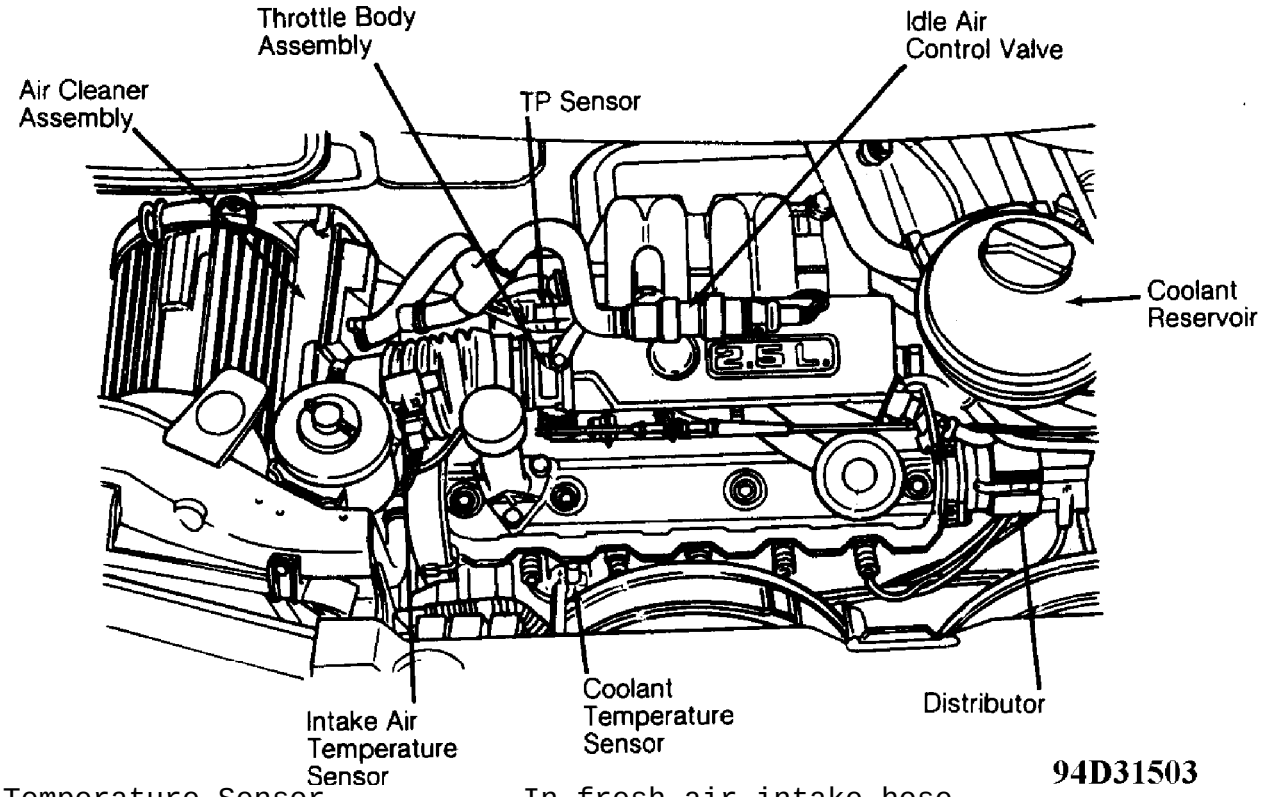
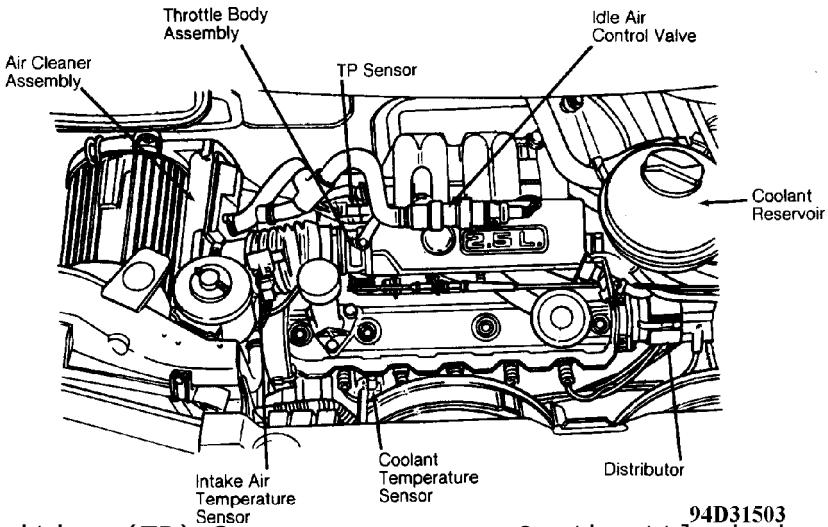


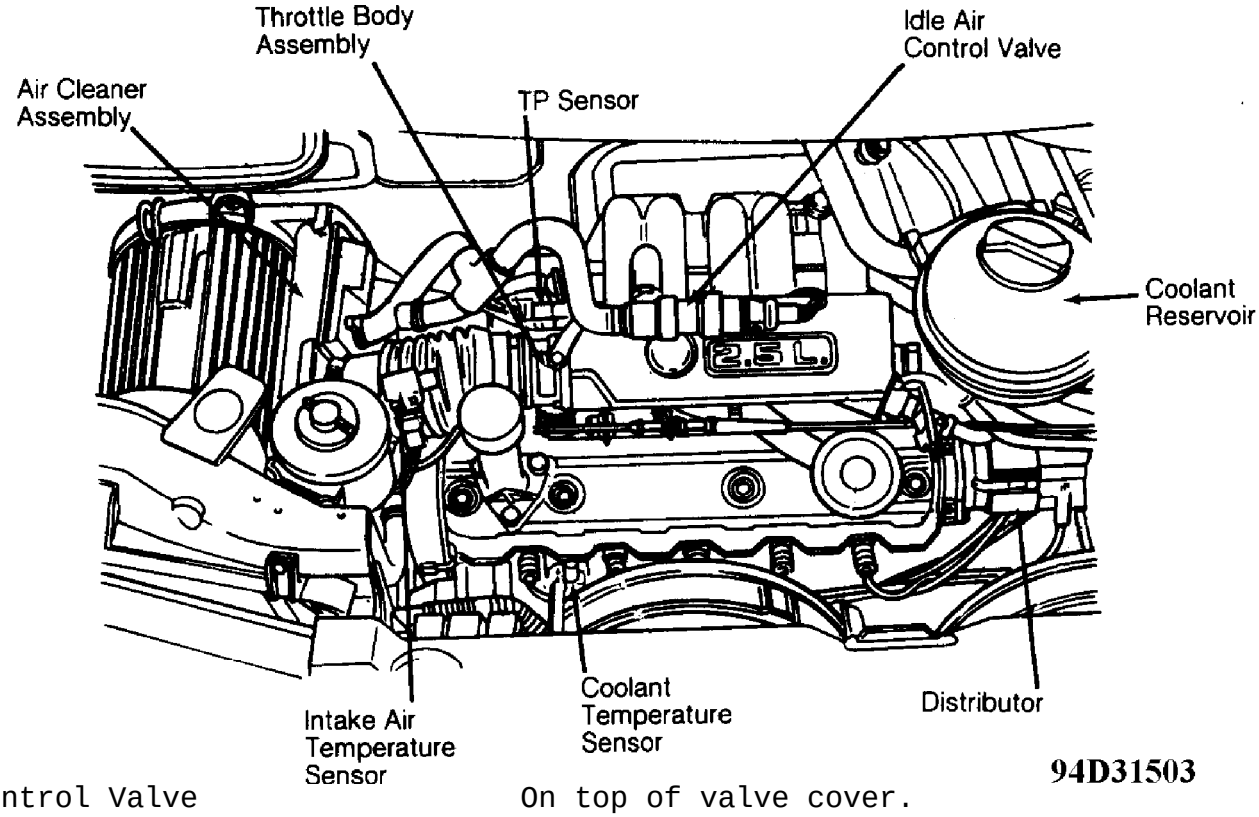
Intake Air Temperature Sensor	In fresh air intake hose, before throttle body.
MAP Sensor	Inside of digifant control module.
Rear A/C Temperature Sensor	Inside duct, above rear blower motor.



Throttle Position (TP) Sensor	On throttle body assembly.
Vehicle Speed Sensor	On speedometer assembly.

SOLENOIDS & SOLENOID VALVES

Component	Component Location
ABS Solenoids	On top of ABS pump.
Cold Start Injector Valve	In front of intake manifold.



Idle Air Control Valve	On top of valve cover.

SWITCHES

Component	Component Location
Back-Up Light Switch	On side of transaxle.
Brake/Cruise/Stoplight Switch	On bracket, above brake pedal.
Clutch/Cruise Switch	On bracket, above clutch pedal.
Coolant Temp. Thermal Switch	On left top of cylinder head.
Parking Brake Switch	On base of parking brake

	lever.
Power Steering Pressure Switch	On pressure hose, near power steering pump.

MISCELLANEOUS

Component	Component Location
Data Link Connector (DLC)	Behind left side of dash.
Cooling Fan Series Resistors	Under left headlight.
Evaporator Fan Series Resistors	On each evaporator housing (front & rear A/C unit).
Voltage Stabilizer	Attached to rear of instrument panel.

END OF ARTICLE

ELECTROSTATIC DISCHARGE WARNING - BASIC INFORMATION

Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:32PM

ARTICLE BEGINNING

GENERAL INFORMATION
Electrostatic Discharge (ESD) Warning - Basic Information

All Makes amd Models

*** PLEASE READ THIS FIRST ***

NOTE: This article is intended for general information purposes only.

INTRODUCTION

All Electrostatic Discharge (ESD) sensitive components contain solid state circuits (transistors, diodes, semiconductors) that may become damaged when contacted with an electrostatic charge. The following information applies to all ESD sensitive devices. The ESD symbol shown in Fig. 1 may be used on schematics to indicate which components are ESD sensitive. See Fig. 1. Although different manufactures may display different symbols to represent ESD sensitive devices, the handling and measuring precautions and procedures are the same.

Fig. 1: Sample ESD Symbol

HANDLING STATIC-SENSITIVE CIRCUITS/DEVICES

When handling an electronic part that is ESD sensitive, the technician should follow these guidelines to reduce any possible electrostatic charge build-up on the technician's body and the electronic part.

1) Always touch a known good ground source before handling the part. This should be repeated while handling the part and more frequently after sitting down from a standing position, sliding across the seat or walking a distance.
2) Avoid touching electrical terminals of the part, unless instructed by a diagnostic procedure.
3) DO NOT open the package of a new part until it is time to install the part.
4) Before removing the part from its package, ground the package to a known good ground source.

CHECKING STATIC-SENSITIVE CIRCUITS/DEVICES

1) Solid State circuits in electronic devices are shown greatly simplified in schematics. See Fig. 2. Due to the simplification of the electronic devices on the schematic, resistance measurements could be misleading or could lead to an electrostatic discharge. Always follow the recommended diagnostic procedure.

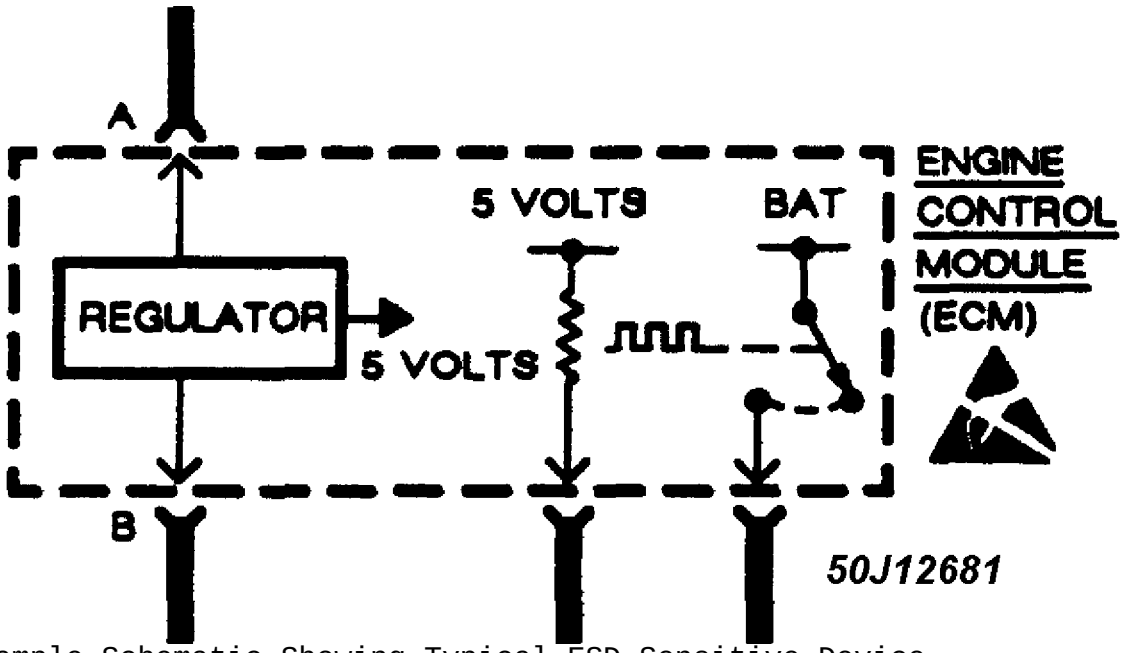


Fig. 2: Sample Schematic Showing Typical ESD Sensitive Device

2) Only measure resistance at the terminals of the devices when instructed by the recommended diagnostic procedure.
3) When using a voltmeter, be sure to connect the ground lead first.

END OF ARTICLE

EMERGENCY BRAKE DOES NOT HOLD: NEW TORSION SPRING

Article Text

1993 Volkswagen EuroVan

For Volkswagen Technical Site

Saturday, March 18, 2000 10:32PM

ARTICLE BEGINNING

NHTSA RECALL BULLETIN

Model(s):	1993 Volkswagen EuroVan
Campaign No:	93V138000
Number of Affected Vehicles:	2400
Beginning Date of Manufacture:	1992 JUL
Ending Date of Manufacture:	1992 NOV

VEHICLE DESCRIPTION:

Passenger van.

DESCRIPTION OF DEFECT:

The handle of the emergency brake contains a torsion spring which is designed to ensure that the locking mechanism remains firmly engaged upon application of the emergency brake. Some of these springs may have been improperly installed.

FAULT:

Assembly, Improperly installed, Location, Preparation

SYSTEM:

Emergency brakes.

CONSEQUENCE OF DEFECT:

An improperly installed spring can cause the emergency brake to release. If the vehicle is not properly secured, it could set itself in motion and cause an accident.

CORRECTIVE ACTION:

Dealers will install a longer tension spring to provide sufficient tension.

ADDITIONAL INFORMATION:

The National Highway Traffic Safety Administration operates Monday through Friday from 8:00 AM to 4:00 PM, Eastern Time. For more information call (800) 424-9393 or (202) 366-0123. For the hearing impaired, call (800) 424-9153.

END OF ARTICLE

ENGINE OVERHAUL PROCEDURES - GENERAL INFORMATION

Article Text

1993 Volkswagen EuroVan

For Volkswagen Technical Site

Saturday, March 18, 2000 10:32PM

ARTICLE BEGINNING

Engine Overhaul Procedures - General Information
ALL PISTON ENGINES

*** PLEASE READ THIS FIRST ***

Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

ENGINE IDENTIFICATION

The engine may be identified from its Vehicle Identification Number (VIN) stamped on a metal tab. Metal tab may be located in different locations depending on manufacturer. Engine identification number or serial number is located on cylinder block. Location varies with manufacturer.

INSPECTION PROCEDURES

* PLEASE READ THIS FIRST *

NOTE: Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

GENERAL

Engine components must be inspected to meet manufacturer's specifications and tolerances during overhaul. Proper dimensions and tolerances must be met to obtain proper performance and maximum engine life.

Micrometers, depth gauges and dial indicator are used for checking tolerances during engine overhaul. Magnaflux, Magnaglo, dye-check, ultrasonic and x-ray inspection procedures are used for parts inspection.

MAGNETIC PARTICLE INSPECTION

Magnaflux & Magnaglo

Magnaflux is an inspection technique used to locate material flaws and stress cracks. The part in question is subjected to a strong magnetic field. The entire part, or a localized area, can be magnetized. The part is coated with either a wet or dry material that contains fine magnetic particles.

Cracks which are outlined by the particles cause an interruption in the magnetic field. The dry powder method of Magnaflux can be used in normal light. A crack will appear as an obvious bright line.

Fluorescent liquid is used in conjunction with a blacklight in a second Magnaflux system called Magnaglo. This type of inspection demands a darkened room. The crack will appear as a glowing line in this process. Both systems require complete demagnetizing upon completion of the inspection. Magnetic particle inspection applies to ferrous materials only.

PENETRANT INSPECTION

Zyglo

The Zyglo process coats the material with a fluorescent dye penetrant. The part is often warmed to expand cracks that will be penetrated by the dye. When the coated part is subjected to inspection with a blacklight, a crack will glow brightly. Developing solution is often used to enhance results. Parts made of any material, such as aluminum cylinder heads or plastics, may be tested using this process.

Dye Check

Penetrating dye is sprayed on the previously cleaned component. Dye is left on component for 5-45 minutes, depending upon material density. Component is then wiped clean and sprayed with a developing solution. Surface cracks will show up as a bright line.

ULTRASONIC INSPECTION

If an expensive part is suspected of internal cracking, Ultrasonic testing is used. Sound waves are used for component inspection.

X-RAY INSPECTION

This form of inspection is used on highly stressed components. X-ray inspection maybe used to detect internal and external flaws in any material.

PRESSURE TESTING

Cylinder heads can be tested for cracks using a pressure tester. Pressure testing is performed by plugging all but one of the holes in the head and injecting air or water into the open passage. Leaks are indicated by the appearance of wet or damp areas when using water. When air is used, it is necessary to spray the head surface with a soap solution. Bubbles will indicate a leak. Cylinder head may also be submerged in water heated to specified temperature to check for cracks created during heat expansion.

CLEANING PROCEDURES

ENGINE OVERHAUL PROCEDURES - GENERAL INFORMATION

Article Text (p. 3)

1993 Volkswagen EuroVan

For Volkswagen Technical Site

Saturday, March 18, 2000 10:32PM

* PLEASE READ THIS FIRST *

NOTE: Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

GENERAL

All components of an engine do not have the same cleaning requirements. Physical methods include bead blasting and manual removal. Chemical methods include solvent blast, solvent tank, hot tank, cold tank and steam cleaning of components.

BEAD BLASTING

Manual removal of deposits may be required prior to bead blasting, followed by some other cleaning method. Carbon, paint and rust may be removed using bead blasting method. Components must be free of oil and grease prior to bead blasting. Beads will stick to grease or oil soaked areas causing area not to be cleaned.

Use air pressure to remove all trapped residual beads from components after cleaning. After cleaning internal engine parts made of aluminum, wash thoroughly with hot soapy water. Component must be thoroughly cleaned as glass beads will enter engine oil resulting in bearing damage.

CHEMICAL CLEANING

Solvent tank is used for cleaning oily residue from components. Solvent blasting sprays solvent through a siphon gun using compressed air.

The hot tank, using heated caustic solvents, is used for cleaning ferrous materials only. DO NOT clean aluminum parts such as cylinder heads, bearings or other soft metals using the hot tank. After cleaning, flush parts with hot water.

A non-ferrous part will be ruined and caustic solution will be diluted if placed in the hot tank. Always use eye protection and gloves when using the hot tank.

Use of a cold tank is for cleaning of aluminum cylinder heads, carburetors and other soft metals. A less caustic and unheated solution is used. Parts may be lift in the tank for several hours without damage. After cleaning, flush parts with hot water.

Steam cleaning, with boiling hot water sprayed at high pressure, is recommended as the final cleaning process when using either hot or cold tank cleaning.

COMPONENT CLEANING

* PLEASE READ THIS FIRST *

NOTE: Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and

specifications for the vehicle being repaired.

SHEET METAL PARTS

Examples of sheet metal parts are the rocker covers, front and side covers, oil pan and bellhousing dust cover. Glass bead blasting or hot tank may be used for cleaning.

Ensure all mating surfaces are flat. Deformed surfaces should be straightened. Check all sheet metal parts for cracks and dents.

INTAKE & EXHAUST MANIFOLDS

Using solvent cleaning or bead blasting, clean manifolds for inspection. If the intake manifold has an exhaust crossover, all carbon deposits must be removed. Inspect manifolds for cracks, burned or eroded areas, corrosion and damage to fasteners.

Exhaust heat and products of combustion cause threads of fasteners to corrode. Replace studs and bolts as necessary. On "V" type intake manifolds, the sheet metal oil shield must be removed for proper cleaning and inspection. Ensure that all manifold parting surfaces are flat and free of burrs.

CYLINDER HEAD REPLACEMENT

* PLEASE READ THIS FIRST *

NOTE: Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

REMOVAL

Remove intake and exhaust manifolds and valve cover. Cylinder head and camshaft carrier bolts (if equipped), should be removed only when the engine is cold. On many aluminum cylinder heads, removal while hot will cause cylinder head warpage. Mark rocker arm or overhead cam components for location.

Remove rocker arm components or overhead cam components. Components must be installed in original location. Individual design rocker arms may utilize shafts, ball-type pedestal mounts or no rocker arms. For all design types, wire components together and identify according to the corresponding valve. Remove cylinder head bolts. Note length and location. Some applications require cylinder head bolts be removed in proper sequence to prevent cylinder head damage. See Fig. 1. Remove cylinder head.

ENGINE OVERHAUL PROCEDURES - GENERAL INFORMATION

Article Text (p. 5)

1993 Volkswagen EuroVan

For Volkswagen Technical Site

Saturday, March 18, 2000 10:32PM

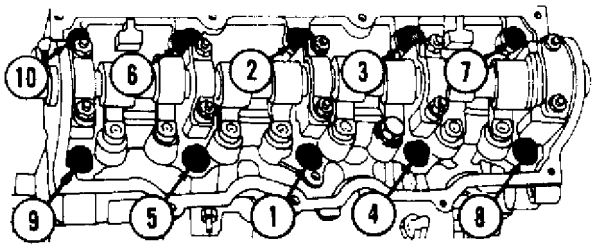


Fig. 1: Typical Cylinder Head Tightening or Loosening Sequence
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INSTALLATION

Ensure all surfaces and head bolts are clean. Check that head bolt holes of cylinder block are clean and dry to prevent block damage when bolts are tightened. Clean threads with tap to ensure accurate bolt torque.

Install head gasket on cylinder block. Some manufacturer's may recommend sealant be applied to head gasket prior to installation. Note that all holes are aligned. Some gasket applications may be marked so certain area faces upward. Install cylinder head using care not to damage head gasket. Ensure cylinder head is fully seated on cylinder block.

Some applications require head bolts be coated with sealant prior to installation. This is done if head bolts are exposed to water passages. Some applications require head bolts be coated with light coat of engine oil.

Install head bolts. Head bolts should be tightened in proper steps and sequence to specification. See Fig. 1. Install remaining components. Tighten all bolts to specification. Adjust valves if required. See VALVE ADJUSTMENT in this article.

NOTE: Some manufacturers require that head bolts be retightened after specified amount of operation. This must be done to prevent head gasket failure.

VALVE ADJUSTMENT

Engine specifications will indicate valve train clearance and temperature at which adjustment is to be made on most models. In most cases, adjustment will be made with a cold engine. In some cases, both a cold and a hot clearance will be given for maintenance convenience.

On some models, adjustment is not required. Rocker arms are tightened to specification and valve lash is automatically set. On some models with push rod actuated valve train, adjustment is made at push rod end of rocker arm while other models do not require adjustment.

Clearance will be checked between tip of rocker arm and tip of valve stem in proper sequence using a feeler gauge. Adjustment is made by rotating adjusting screw until proper clearance is obtained. Lock nut is then tightened. Engine will be rotated to obtain all valve adjustments to manufacturer's specifications.

Some models require hydraulic lifter to be bled down and clearance measured. Different length push rods can be used to obtain proper clearance. Clearance will be checked between tip of rocker arm and tip of valve stem in proper sequence using a feeler gauge.

On overhead cam engines designed without rocker arms actuate valves directly on a cam follower. A hardened, removable disc is installed between the cam lobe and lifter. Clearance will be checked between cam heel and adjusting disc in proper sequence using a feeler gauge. Engine will be rotated to obtain all valve adjustments.

On overhead cam engines designed with rocker arms, adjustment is made at push rod end of rocker arm. Ensure that the valve to be adjusted is riding on the heel of the cam on all engines. Clearance will be checked between tip of rocker arm and tip of valve stem in proper sequence using a feeler gauge. Adjustment is made by rotating adjusting screw until proper clearance is obtained. Lock nut is then tightened. Engine will be rotated to obtain all valve adjustments to manufacturer's specifications.

CYLINDER HEAD OVERHAUL

* PLEASE READ THIS FIRST *

NOTE: Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

DISASSEMBLY

Mark valves for location. Using valve spring compressor, compress valve springs. Remove valve locks. Carefully release spring compressor. Remove retainer or rotator, valve spring, spring seat and valve. See Fig. 2.

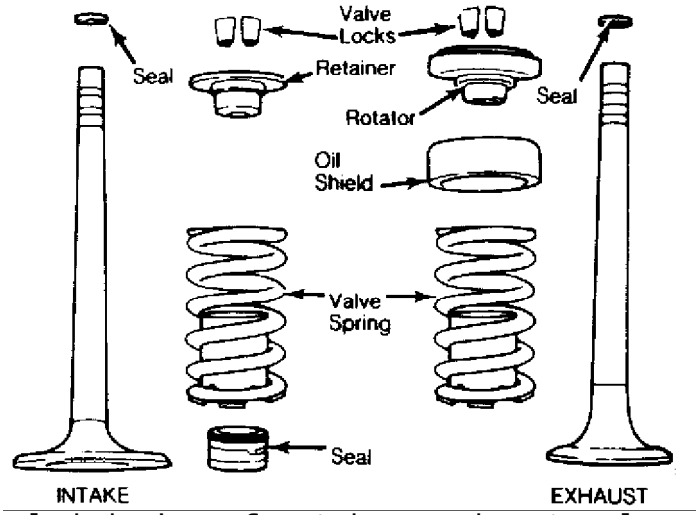

Fig. 2: Exploded View of Intake & Exhaust Valve Assemblies - Typical This Graphic For General Information Only

CLEANING & INSPECTION

Clean cylinder head and valve components using approved cleaning methods. Inspect cylinder head for cracks, damage or warped gasket surface. Place straightedge across gasket surface. Determine clearance at center of straightedge. Measure across both diagonals, longitudinal centerline and across the head at several points. See Fig. 3.

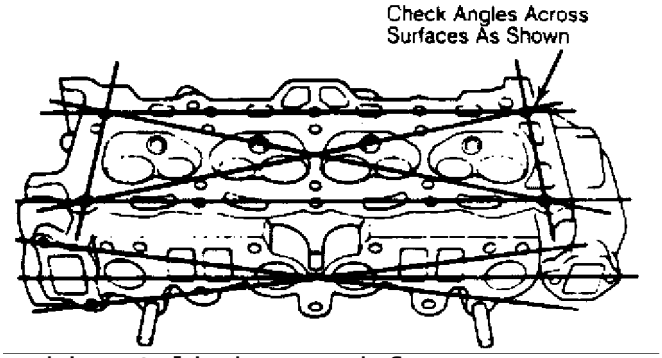

Fig. 3: Checking Cylinder Head for Warpage - Typical
This Graphic For General Information Only

On cast cylinder heads, if warpage exceeds .003" (.08 mm) in a 6" span, or .006" (.15 mm) over total length, cylinder head must be resurfaced. On most aluminum cylinder heads, if warpage exceeds .002" (.05 mm) in any area, cylinder head must be resurfaced. Warpage specification may vary with manufacturer.

Cylinder head thickness should be measured to determine amount of material which can be removed before replacement is required. Cylinder head thickness must not be less than manufacturer's specifications.

If cylinder head required resurfacing, it may not align properly with intake manifold. On "V" type engines, misalignment is corrected by machining intake manifold surface that contacts cylinder head. Cylinder head may be machined on surface that contacts intake manifold.

Using oil stone, remove burrs or scratches from all sealing surfaces.

VALVE SPRINGS

Inspect valve springs for corroded or pitted valve spring surfaces which may lead to breakage. Polished spring ends caused by a rotating spring, indicates that spring surge has occurred. Replace springs showing evidence of these conditions.

Inspect valve springs for squareness using a 90 degree straightedge. See Fig. 4. Replace valve spring if out-of-square exceeds manufacturer's specification.

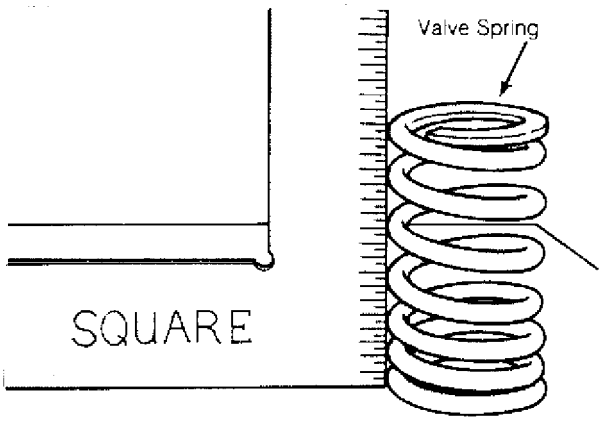

Fig. 4: Checking Valve Spring Squareness - Typical
This Graphic For General Information Only

Using vernier caliper, measure free length of all valve springs. Replace springs if not within specification. Using valve spring tester, test valve spring pressure at installed and compressed heights. See Fig. 5.

Usually compressed height is installed height minus valve lift. Replace valve spring if not within specification. It is recommended to replace all valve springs when overhauling cylinder head.

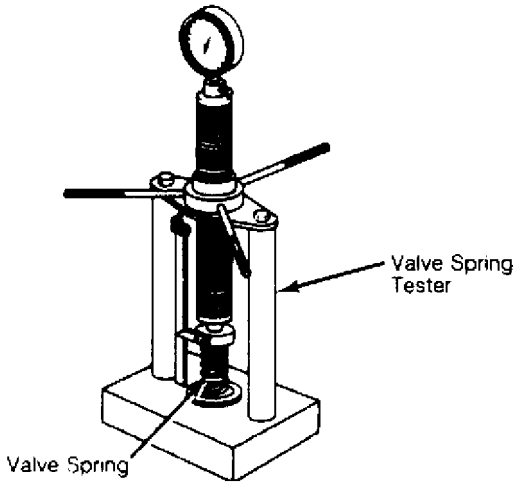

Fig. 5: Checking Valve Spring Pressure - Typical
This Graphic For General Information Only

VALVE GUIDE

Measuring Valve Guide Clearance

Check valve stem-to-guide clearance. Ensure valve stem diameter is within specifications. Install valve in valve guide. Install dial indicator assembly on cylinder head with tip resting against valve stem just above valve guide. See Fig. 6.

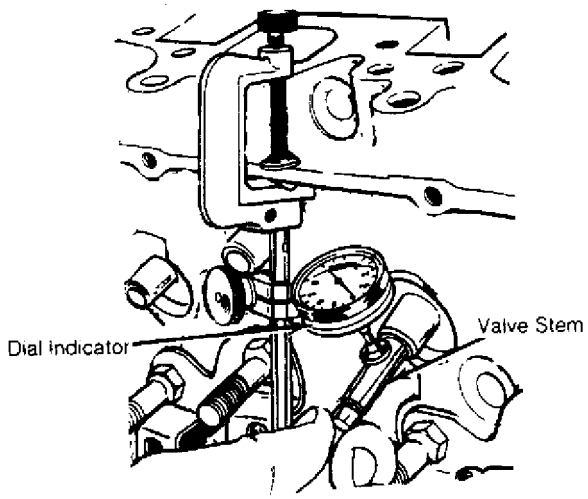

Fig. 6: Measuring Valve Stem-to-Guide Clearance - Typical
This Graphic For General Information Only

Lower valve approximately 1/16" below valve seat. Push valve stem against valve guide as far as possible. Adjust dial indicator to zero. Push valve stem in opposite direction and note reading. Clearance must be within specification.

If valve guide clearance exceeds specification, valves with oversize stems may be used or valve guide must be replaced. On some applications, a false guide is installed, then reamed to proper specification. Valve guide reamer set is used to ream valve guide to obtain proper clearance for new valve.

Reaming Valve Guide

Select proper reamer for valve stem. Reamer must be of proper length to provide clean cut through entire length of valve guide. Install reamer in valve guide and rotate to cut valve guide. See Fig. 7.

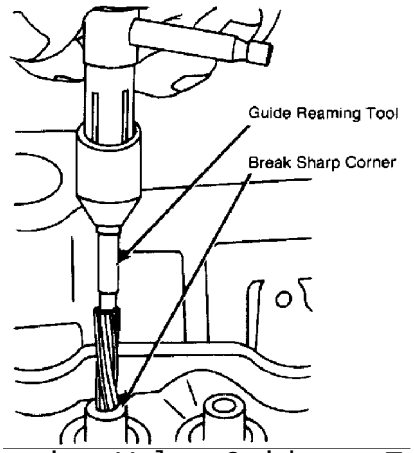

Fig. 7: Reaming Valve Guides - Typical
This Graphic For General Information Only

Replacing Valve Guide

Replace valve guide if clearance exceeds specification. Valve guides are either pressed, hammered or shrunk in place, depending upon cylinder head design and type of metal used.

Remove valve guide from cylinder head by pressing or tapping on a stepped drift. See Fig. 8. Once valve guide is installed, distance from cylinder head to top of valve guide must be checked. This distance must be within specification.

Aluminum heads are often heated before installing valve guide. Guide is sometimes chilled in dry ice before installation. Combination of a heated head and chilled guide insures a tight guide fit upon assembly. The new guide must be reamed to specification.

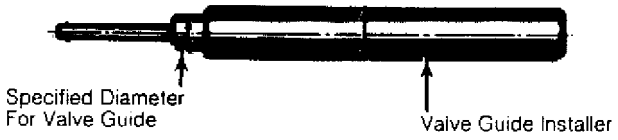

Fig. 8: Typical Valve Guide Remover & Installer
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VALVES & VALVE SEATS

Valve Grinding

Valve stem O.D. should be measured in several areas to indicate amount of wear. Replace valve if not within specification. Valve margin area should be measured to ensure that valve can be grounded. See Fig. 9.

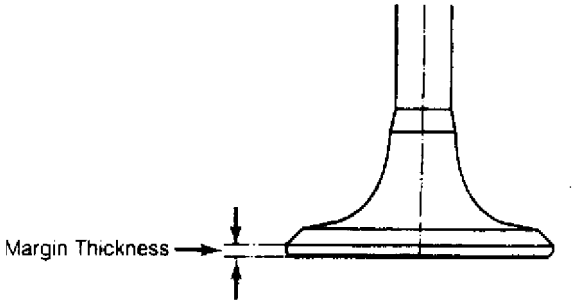

Fig. 9: Measuring Valve Head Margin - Typical
This Graphic For General Information Only

If valve margin is less than specification, this will burn the valves. Valve must be replaced. Due to minimum margin dimensions during manufacture, some new type valves cannot be reground.

Resurface valve on proper angle specification using valve grinding machine. Follow manufacturer's instructions for valve grinding machine. Specifications may indicate a different valve face angle than seat angle.

Measure valve margin after grinding. Replace valve if not within specification. Valve stem tip can be refinished using valve

grinding machine.

Valve Lapping

During valve lapping of recent designed valves, be sure to follow manufacturers recommendations. Surface hardening and materials used with some valves do not permit lapping. Lapping process will remove excessive amounts of the hardened surface.

Valve lapping is done to ensure adequate sealing between valve face and seat. Use either a hand drill or lapping stick with suction cup attached.

Moisten and attach suction cup to valve. Lubricate valve stem and guide. Apply a thin coat of fine valve grinding compound between valve and seat. Rotate lapping tool between the palms or with hand drill.

Lift valve upward off the seat and change position often. This is done to prevent grooving of valve seat. Lap valve until a smooth polished seat is obtained. Thoroughly clean grinding compound from components. Valve to valve seat concentricity should be checked. See VALVE SEAT CONCENTRICITY.

CAUTION: Valve guides must be in good condition and free of carbon deposits prior to valve seat grinding. Some engines contain an induction hardened valve seat. Excessive material removal will damage valve seats.

Valve Seat Grinding

Select coarse stone of correct size and angle for seat to be ground. Ensure stone is true and has a smooth surface. Select correct size pilot for valve guide dimension. Install pilot in valve guide. Lightly lubricate pilot shaft. Install stone on pilot. Move stone off and on the seat approximately 2 times per second during grinding operation.

Select a fine stone to finish grinding operation. Grinding stones with 30 and 60 degree angles are used to center and narrow the valve seat as required. See Fig. 10.

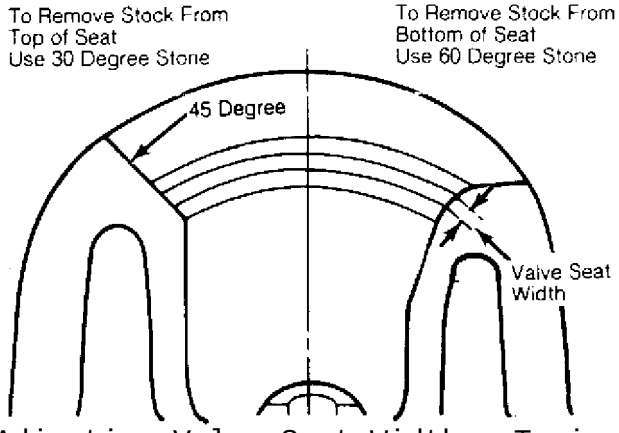

Fig. 10: Adjusting Valve Seat Width - Typical
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Valve Seat Replacement

Replacement of valve seat inserts is done by cutting out the old insert and machining an oversize insert bore. Replacement oversize insert is usually chilled and the cylinder head is sometimes warmed. Valve seat is pressed into the head. This operation requires specialized machine shop equipment.

Valve Seat Concentricity

Using dial gauge, install gauge pilot in valve guide. Position gauge arm on the valve seat. Adjust dial indicator to zero. Rotate arm 360 degrees and note reading. Runout should not exceed specification.

To check valve-to-valve seat concentricity, coat valve face lightly with Prussian Blue dye. Install valve and rotate it on valve seat. If pattern is even and entire seat is coated at valve contact point, valve is concentric with the seat.

REASSEMBLY

Valve Stem Installed Height

Valve stem installed height must be checked when new valves are installed or when valves or valve seats have been ground. Install valve in valve guide. Measure distance from tip of valve stem to spring seat. See Fig. 11. Distance must be within specifications.

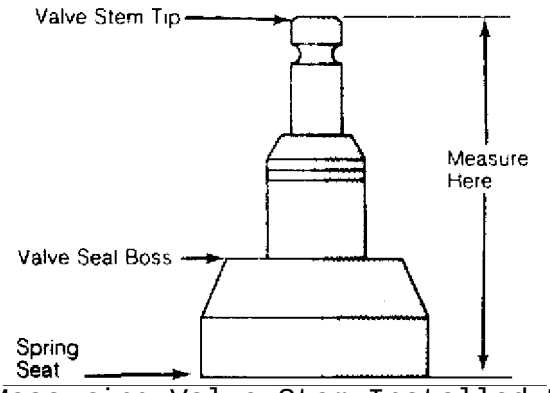

Fig. 11: Measuring Valve Stem Installed Height - Typical
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Remove valve and grind valve stem tip if height exceeds specification. Valve tips are surface hardened. DO NOT remove more than .010" (.25 mm) from tip. Chamfer sharp edge of reground valve tip. Recheck valve stem installed height.

VALVE STEM OIL SEALS

Valve stem oil seals must be installed on valve stem. See Fig. 2. Seals are needed due to pressure differential at the ends of valve guides. Atmospheric pressure above intake guide, combined with manifold vacuum below guide, causes oil to be drawn into the cylinder.

Exhaust guides also have pressure differential created by

exhaust gas flowing past the guide, creating a low pressure area. This low pressure area draws oil into the exhaust system.

Replacement (On Vehicle)

Mark rocker arm or overhead cam components for location. Remove rocker arm components or overhead cam components. Components must be installed in original location. Remove spark plugs. Valve stem oil seals may be replaced by holding valves against seats using air pressure.

Air pressure must be installed in cylinder using an adapter for spark plug hole. An adapter can be constructed by welding air hose connection to spark plug body with porcelain removed.

Install adapter in spark plug hole. Apply a minimum of 140 psi (9.8 kg/cmý) to adapter. Air pressure should hold valve closed. If air pressure does not hold valve closed, check for damaged or bent valve. Cylinder head must be removed for service.

Using valve spring compressor, compress valve springs. Remove valve locks. Carefully release spring compressor. Remove retainer or rotator and valve spring. Remove valve stem oil seal.

If oversized valves have been installed, oversized oil seals must be used. Coat valve stem with engine oil. Install protective sleeve over end of valve stem. Install new oil seal over valve stem and seat on valve guide. Remove protective sleeve. Install spring seat, valve spring and retainer or rotator. Compress spring and install valve locks. Remove spring compressor. Ensure valve locks are fully seated.

Install rocker arms or overhead cam components. Tighten all bolts to specification. Adjust valves if required. Remove adapter. Install spark plugs, valve cover and gasket.

VALVE SPRING INSTALLED HEIGHT

Valve spring installed height should be checked during reassembly. Measure height from lower edge of valve spring to the upper edge. DO NOT include valve spring seat or retainer. Distance must be within specifications. If valves and/or seats have been ground, a valve spring shim may be required to correct spring height. See Fig. 12.

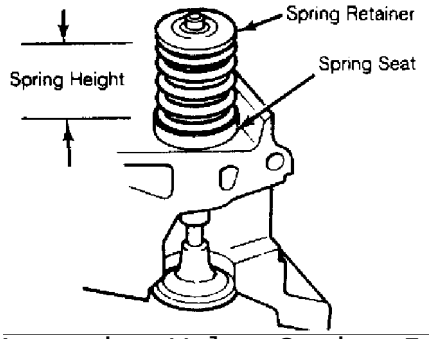

Fig. 12: Measuring Valve Spring Installed Height - Typical
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ROCKER ARMS & ASSEMBLIES

Rocker Studs

Rocker studs are either threaded or pressed in place. Threaded studs are removed by locking 2 nuts on the stud. Unscrew the stud by turning the jam nut. Coat the stud threads with Loctite and install. Tighten to specification.

Pressed in stud can be removed using a stud puller. Ream the stud bore to proper specification and press in a new oversize stud. Pressed in studs are often replaced by cutting threads in the stud bore to accept a threaded stud.

Rocker Arms & Shafts

Mark rocker arms for location. Remove rocker arm retaining bolts. Remove rocker arms. Inspect rocker arms, shafts, bushings and pivot balls (if equipped) for excessive wear. Inspect rocker arms for wear in valve stem contact area. Measure rocker arm bushing I.D. Replace bushings if excessively worn.

The rocker arm valve stem contact point can be reground, using special fixture for valve grinding machine. Remove minimum amount of material as possible. Ensure all oil passages are clear. Install rocker arms in original locations. Ensure rocker arm is properly seated in push rod. Tighten bolts to specification. Adjust valves if required. See VALVE ADJUSTMENT in this article.

Pushrods

Remove rocker arms. Mark push rods for location. Remove push rods. Push rods can be steel or aluminum, solid or hollow. Hollow pushrods must be internally cleaned to ensure oil passage to the rocker arms is cleaned. Check the pushrod for damage, such as loose ends on steel tipped aluminum types.

Check push rod for straightness. Roll push rod on a flat surface. Using feeler gauge, check clearance at center. Replace push rod if bent. The push rod can also be supported at each end and rotated. A dial indicator is used to detect bends in the push rod.

Lubricate ends of push rod and install push rod in original location. Ensure push rod is properly seated in lifter. Install rocker arm. Tighten bolts to specification. Adjust valves if required. See VALVE ADJUSTMENT in this article.

LIFTERS

Hydraulic Lifters

Before replacing a hydraulic lifter for noisy operation, ensure noise is not caused by worn rocker arms or valve tips. Hydraulic lifter assemblies must be installed in original locations. Remove the rocker arm assembly and push rod. Mark components for location. Some applications require intake manifold, or lifter cover removal. Remove lifter retainer plate (if used). To remove lifters, use a hydraulic lifter remover or magnet. Different type lifters are used. See Fig. 13.

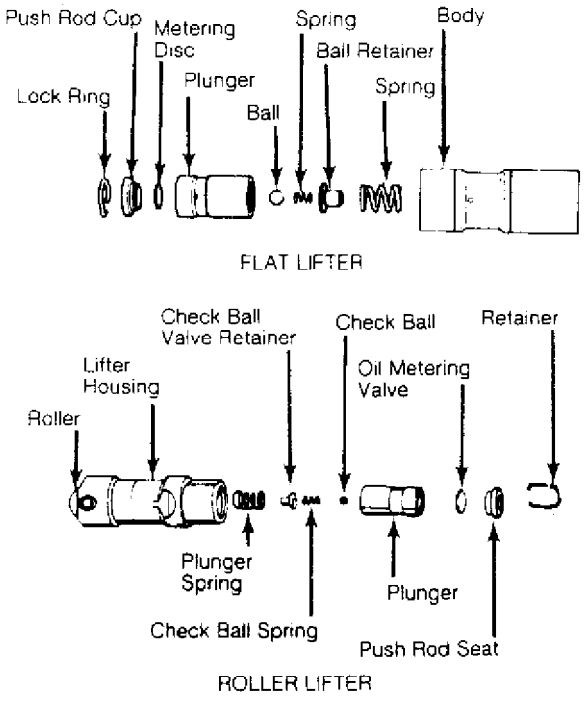

Fig. 13: Typical Hydraulic Valve Lifter Assemblies - Typical
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On sticking lifters, disassemble and clean lifter. DO NOT mix lifter components or positions. Parts are select-fitted and are not interchangeable. Inspect all components for wear. Note amount of wear in lifter body-to-camshaft contact area. Surface must have smooth and convex contact face. If wear is apparent, carefully inspect cam lobe.

Inspect push rod contact area and lifter body for scoring or signs of wear. If body is scored, inspect lifter bore for damage and lack of lubrication. On roller type lifters, inspect roller for flaking, pitting, loss of needle bearings and roughness during rotation.

Measure lifter body O.D. in several areas. Measure lifter bore I.D. of cylinder block. Some models offer oversized lifters. Replace lifter if damaged.

If lifter check valve is not operating, obstructions may be preventing it from closing or valve spring may be broken. Clean or replace components as necessary.

Check plunger operation. Plunger should drop to bottom of the body by its own weight when assembled dry. If plunger is not free, soak lifter in solvent to dissolve deposits.

Lifter leak-down test can be performed on lifter. Lifter must be filled with special test oil. New lifters contain special test oil. Using lifter leak-down tester, perform leak-down test following manufacturer's instructions. If leak-down time is not within specifications, replace lifter assembly.

Lifters should be soaked in clean engine oil several hours prior to installation. Coat lifter base, roller (if equipped) and lifter body with ample amount of Molykote or camshaft lubricant. See

Fig. 13. Install lifter in original location. Install remaining components. Valve lash adjustment is not required on most hydraulic lifters. Preload of hydraulic lifter is automatic. Some models may require adjustment.

Mechanical Lifters

Lifter assemblies must be installed in original locations. Remove rocker arm assembly and push rod. Mark components for location. Some applications require intake manifold or lifter cover removal. Remove lifter retainer plate (if used). To remove lifters, use lifter remover or magnet.

Inspect push rod contact area and lifter body for scoring or signs of wear. If body is scored, inspect lifter bore for damage and lack of lubrication. Note amount of wear in lifter body-to-camshaft contact area. Surface must have smooth and convex contact face. If wear is apparent, carefully inspect cam lobe.

Coat lifter base, roller (if equipped) and lifter body with ample amount of Molykote or camshaft lubricant. Install lifter in original location. Install remaining components. Tighten bolts to specification. Adjust valves. See VALVE ADJUSTMENT in this article.

PISTONS, CONNECTING RODS & BEARINGS

* PLEASE READ THIS FIRST *

NOTE: Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

RIDGE REMOVAL

Ridge in cylinder wall must be removed prior to piston removal. Failure to remove ridge prior to removing pistons will cause piston damage in piston ring locations.

With the piston at bottom dead center, place a rag in the bore to trap metal chips. Install ridge reamer in cylinder bore. Adjust ridge reamer using manufacturer's instructions. Remove ridge using ridge reamer. DO NOT remove an excessive amount of material. Ensure ridge is completely removed.

PISTON & CONNECTING ROD REMOVAL

Note top of piston. Some pistons may contain a notch, arrow or be marked "FRONT". Piston must be installed in proper direction to prevent damage with valve operation.

Check that connecting rod and cap are numbered for cylinder location and which side of cylinder block the number faces. Proper cap and connecting rod must be installed together. Connecting rod cap must be installed on connecting rod in proper direction to ensure bearing lock procedure. Mark connecting rod and cap if necessary. Pistons must be installed in original location.

Remove cap retaining nuts or bolts. Remove bearing cap.

Install stud protectors on connecting rod bolts. This protects cylinder walls from scoring during removal. Ensure proper removal of ridge. Push piston and connecting rod from cylinder. Connecting rod boss can be tapped with a wooden dowel or hammer handle to aid in removal.

PISTON & CONNECTING ROD

Disassembly

Using ring expander, remove piston rings. Remove piston pin retaining rings (if equipped). On pressed type piston pins, special fixtures and procedures according to manufacturer must be used to remove piston pins. Follow manufacturer's recommendations to avoid piston distortion or breakage.

Cleaning

Remove all carbon and varnish from piston. Pistons and connecting rods may be cleaned in cold type chemical tank. Using ring groove cleaner, clean all deposits from ring grooves. Ensure all deposits are cleaned from ring grooves to prevent ring breakage or sticking. DO NOT attempt to clean pistons using wire brush.

Inspection

Inspect pistons for nicks, scoring, cracks or damage in ring areas. Connecting rod should be checked for cracks using Magnaflux procedure. Piston diameter must be measured in manufacturers specified area.

Using telescopic gauge and micrometer, measure piston pin bore of piston in 2 areas, 90 degrees apart. This is done to check diameter and out-of-round.

Install proper bearing cap on connecting rod. Ensure bearing cap is installed in proper location. Tighten bolts or nuts to specification. Using inside micrometer, measure inside diameter in 2 areas, 90 degrees apart.

Connecting rod I.D. and out-of-round must be within specification. Measure piston pin bore I.D. and piston pin O.D. All components must be within specification. Subtract piston pin diameter from piston pin bore in piston and connecting rod to determine proper fit.

Connecting rod length must be measured from center of crankshaft journal inside diameter to center of piston pin bushing using proper caliper. Connecting rods must be the same length. Connecting rods should be checked on an alignment fixture for bent or twisted condition. Replace all components which are damaged or not within specification.

PISTON & CYLINDER BORE FIT

Ensure cylinder is checked for taper, out-of-round and properly honed prior to checking piston and cylinder bore fit. See CYLINDER BLOCK in this article. Using dial bore gauge, measure cylinder bore. Measure piston at right angle to piston pin in center

of piston skirt area. Subtract piston diameter from cylinder bore diameter. The difference is piston-to-cylinder clearance. Clearance must be within specification. Mark piston for proper cylinder location.

ASSEMBLING PISTON & CONNECTING ROD

Install proper fitted piston on connecting rod for proper cylinder. Ensure piston marking on top of piston marked is in correspondence with connecting rod and cap number. See Fig. 14.

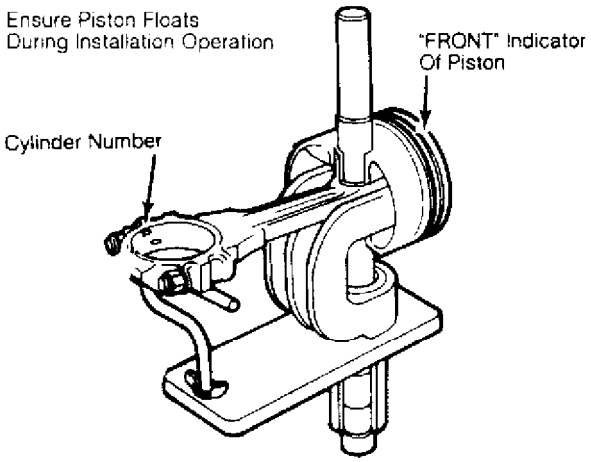

Fig. 14: Piston Pin Installation - Typical
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Lubricate piston pin and install in connecting rod. Ensure piston pin retainers are fully seated (if equipped). On pressed type piston pins, follow manufacturer's recommended procedure to avoid distortion or breakage.

CHECKING PISTON RING CLEARANCES

Piston rings must be checked for side clearance and end gap. To check end gap, install piston ring in cylinder which it is to be installed. Using an inverted piston, push ring to bottom of cylinder in smallest cylinder diameter.

Using feeler gauge, check ring end gap. See Fig. 15. Piston ring end gap must be within specification. Ring breakage will occur with insufficient ring end gap.

On some manufacturers, insufficient ring end gap may be corrected by using a fine file while other manufacturers recommend using another ring set. Mark rings for proper cylinder installation after checking end gap.

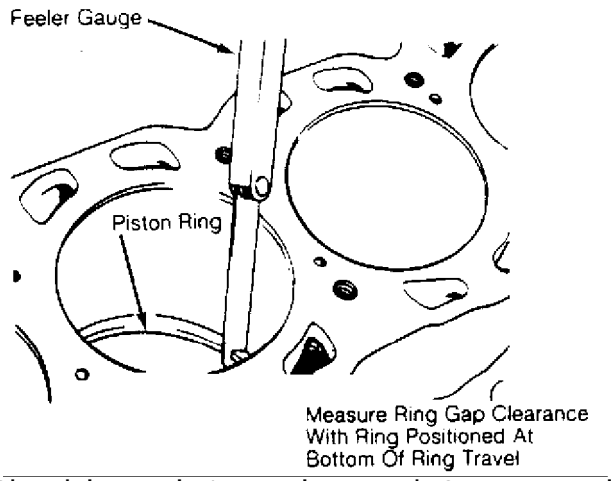

Fig. 15: Checking Piston Ring End Gap - Typical
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For checking side clearance, install rings on piston. Using feeler gauge, measure clearance between piston ring and piston ring land. Check side clearance in several areas around piston. Side clearance must be within specification.

If side clearance is excessive, piston ring grooves can be machined to accept oversized piston rings (if available). Normal practice is to replace piston.

PISTON & CONNECTING ROD INSTALLATION

Cylinders must be honed prior to piston installation. See CYLINDER HONING under CYLINDER BLOCK in this article.

Install upper connecting rod bearings. Lubricate upper bearings with engine oil. Install lower bearings in rod caps. Ensure bearing tabs are properly seated. Position piston ring gaps according to manufacturers recommendations. See Fig. 16. Lubricate pistons, rings and cylinder walls.

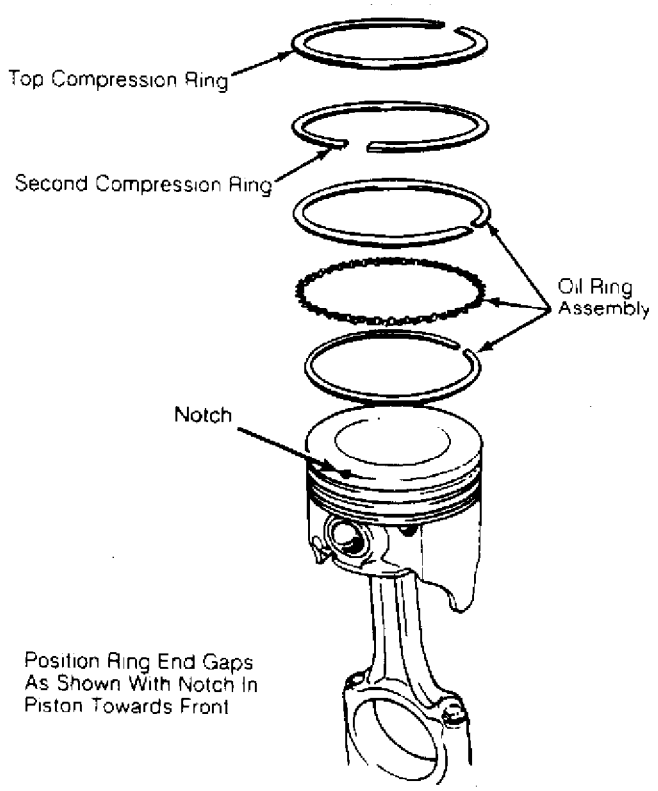

Fig. 16: Typical Piston Ring End Gap Positioning - Typical
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Install ring compressor. Use care not to rotate piston rings. Compress rings with ring compressor. Install plastic tubing protectors over connecting rod bolts. Install piston and connecting rod assembly. Ensure piston notch, arrow or "FRONT" mark is toward front of engine. See Fig. 17.

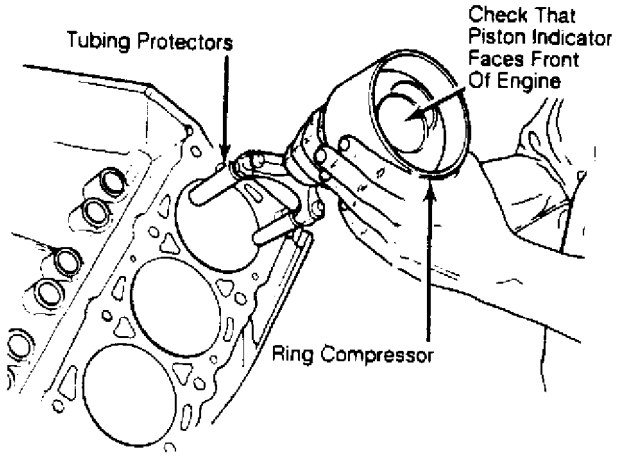

Fig. 17: Installing Piston & Connecting Rod Assembly - Typical
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Carefully tap piston into cylinder until rod bearing is

seated on crankshaft journal. Remove protectors. Install rod cap and bearing. Lightly tighten connecting rod bolts. Repeat procedure for remaining cylinders. Check bearing clearance. See MAIN & CONNECTING ROD BEARING CLEARANCE in this article.

Once clearance is checked, lubricate journals and bearings. Install bearing caps. Ensure marks are aligned on connecting rod and cap. Tighten rod nuts or bolts to specification. Ensure rod moves freely on crankshaft. Check connecting rod side clearance. See CONNECTING ROD SIDE CLEARANCE in this article.

CONNECTING ROD SIDE CLEARANCE

Position connecting rod toward one side of crankshaft as far as possible. Using feeler gauge, measure clearance between side of connecting rod and crankshaft. See Fig. 18. Clearance must be within specifications.

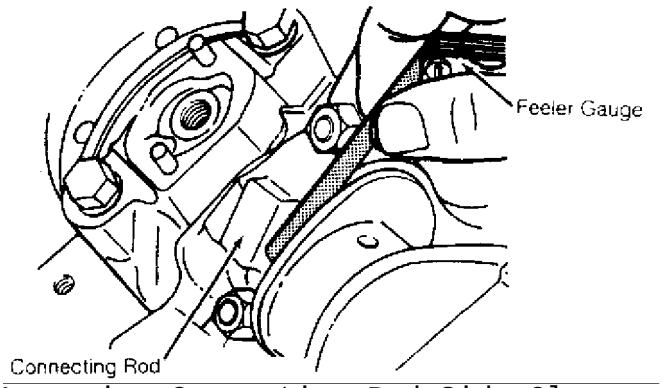

Fig. 18: Measuring Connecting Rod Side Clearance - Typical
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Check for improper bearing installation, wrong bearing cap or insufficient bearing clearance if side clearance is insufficient. Connecting rod may require machining to obtain proper clearance. Excessive clearance usually indicates excessive wear at crankshaft. Crankshaft must be repaired or replaced.

MAIN & CONNECTING ROD BEARING CLEARANCE

Plastigage Method

Plastigage method may be used to determine bearing clearance. Plastigage can be used with an engine in service or during reassembly. Plastigage material is oil soluble.

Ensure journals and bearings are free of oil or solvent. Oil or solvent will dissolve material and false reading will be obtained. Install small piece of Plastigage along full length of bearing journal. Install bearing cap in original location. Tighten bolts to specification.

CAUTION: DO NOT rotate crankshaft while Plastigage is installed.
Bearing clearance will not be obtained if crankshaft is

rotated.

Remove bearing cap. Compare Plastigage width with scale on Plastigage container to determine bearing clearance. See Fig. 19. Rotate crankshaft 90 degrees. Repeat procedure. this is done to check journal eccentricity. This procedure can be used to check oil clearance on both connecting rod and main bearings.

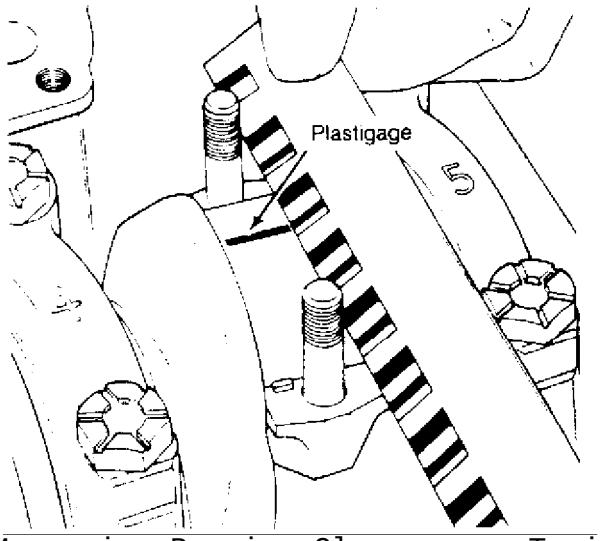

Fig. 19: Measuring Bearing Clearance - Typical
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Micrometer & Telescopic Gauge Method

A micrometer is used to determine journal diameter, taper and out-of-round dimensions of the crankshaft. See CLEANING & INSPECTION under CRANKSHAFT & MAIN BEARINGS in this article.

With crankshaft removed, install bearings and caps in original location on cylinder block. Tighten bolts to specification. On connecting rods, install bearings and caps on connecting rods. Install proper connecting rod cap on corresponding rod. Ensure bearing cap is installed in original location. Tighten bolts to specification.

Using a telescopic gauge and micrometer or inside micrometer measure inside diameter of connecting rod and main bearings bores. Subtract each crankshaft journal diameter from the corresponding inside bore diameter. This is the bearing clearance.

CRANKSHAFT & MAIN BEARINGS

* PLEASE READ THIS FIRST *

NOTE: Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

REMOVAL

Ensure all main bearing caps are marked for location on cylinder block. Some main bearing caps have an arrow stamped on it which must face front of engine. Remove main bearing cap bolts. Remove main bearing caps. Carefully remove crankshaft. Use care not to bind crankshaft in cylinder block during removal.

CLEANING & INSPECTION

Thoroughly clean crankshaft using solvent. Dry with compressed air. Ensure all oil passages are clear and free of sludge, rust, dirt, and metal chips.

Inspect crankshaft for scoring and nicks. Inspect crankshaft for cracks using Magnaflux procedure. Inspect rear seal area for grooving or damage. Inspect bolt hole threads for damage. If pilot bearing or bushing is used, check pilot bearing or bushing fit in crankshaft. Inspect crankshaft gear for damaged or cracked teeth. Replace gear if damaged. Check that oil passage plugs are tight (if equipped).

Using micrometer, measure all journals in 4 areas to determine journal taper, out-of-round and undersize. See Fig. 20. Some crankshafts can be reground to the next largest undersize, depending on the amount of wear or damage. Crankshafts with rolled fillet cannot be reground and must be replaced.

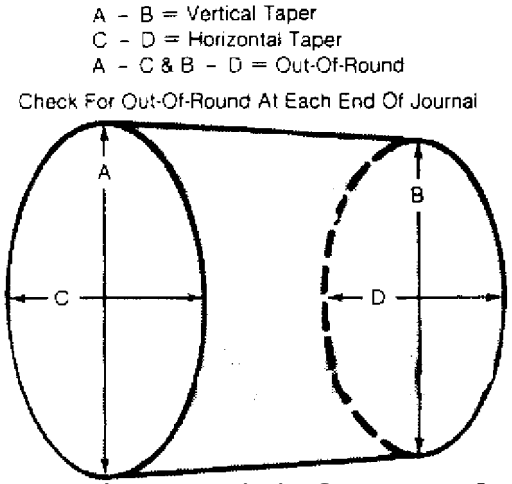

Fig. 20: Measuring Crankshaft Journal - Typical
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Crankshaft journal runout should be checked. Install crankshaft in "V" blocks or bench center. Position dial indicator with tip resting on the main bearing journal area. See Fig. 21. Rotate crankshaft and note reading. Journal runout must not exceed specification. Repeat procedure on all main bearing journals. Crankshaft must be replaced if runout exceeds specification.

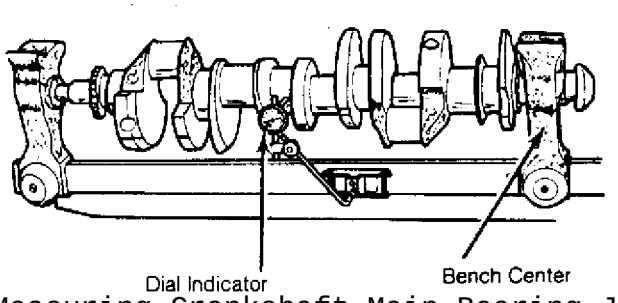

Fig. 21: Measuring Crankshaft Main Bearing Journal Runout - Typical This Graphic For General Information Only

INSTALLATION

Install upper main bearing in cylinder block. Ensure lock tab is properly located in cylinder block. Install bearings in main bearing caps. Ensure all oil passages are aligned. Install rear seal (if removed).

Ensure crankshaft journals are clean. Lubricate upper main bearings with clean engine oil. Carefully install crankshaft. Check each main bearing clearance using Plastigage method. See MAIN & CONNECTING ROD BEARING CLEARANCE in this article.

Once clearance is checked, lubricate lower main bearing and journals. Install main bearing caps in original location. Install rear seal in rear main bearing cap (if removed). Some rear main bearing caps require sealant to be applied in corners to prevent oil leakage.

Install and tighten all bolts except thrust bearing cap to specification. Tighten thrust bearing cap bolts finger tight only. Thrust bearing must be aligned. On most applications, crankshaft must be moved rearward then forward. Procedure may vary with manufacturer. Thrust bearing cap is then tighten to specification. Ensure crankshaft rotates freely. Crankshaft end play should be checked. See CRANKSHAFT END PLAY in this article.

CRANKSHAFT END PLAY

Dial Indicator Method

Crankshaft end play can be checked using dial indicator. Mount dial indicator on rear of cylinder block. Position dial indicator tip against rear of crankshaft. Ensure tip is resting against flat surface.

Pry crankshaft rearward. Adjust dial indicator to zero. Pry crankshaft forward and note reading. Crankshaft end play must be within specification. If end play is not within specification, check for faulty thrust bearing installation or worn crankshaft. Some applications offer oversized thrust bearings.

Feeler Gauge Method

Crankshaft end play can be checked using feeler gauge. Pry crankshaft rearward. Pry crankshaft forward. Using feeler gauge, measure clearance between crankshaft and thrust bearing surface. See Fig. 22.

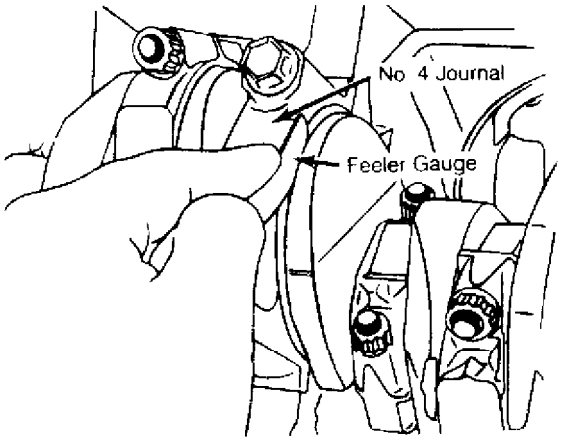

Fig. 22: Checking Crankshaft End Play - Typical
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Crankshaft end play must be within specification. If end play is not within specification, check for faulty thrust bearing installation or worn crankshaft. Some applications offer oversized thrust bearings.

CYLINDER BLOCK

* PLEASE READ THIS FIRST *

NOTE: Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

BLOCK CLEANING

Only cast cylinder blocks should be hot tank cleaned. Aluminum cylinder blocks should be cleaned using cold tank method. Cylinder block is cleaned in order to remove carbon deposits, gasket residue and water jacket scale. Remove oil galley plugs, freeze plugs and cam bearings prior to block cleaning.

BLOCK INSPECTION

Visually inspect the block. Check suspected areas for cracks using the Dye Penetrant inspection method. Block may be checked for cracks using the Magnaflux method.

Cracks are most commonly found at the bottom of the cylinders, the main bearing saddles, near expansion plugs and between the cylinders and water jackets. Inspect lifter bores for damage. Inspect all head bolt holes for damaged threads. Threads should be cleaned using tap to ensure proper head bolt torque. Consult machine shop concerning possible welding and machining (if required).

CYLINDER BORE INSPECTION

Inspect the bore for scuffing or roughness. Cylinder bore is dimensionally checked for out-of-round and taper using dial bore gauge. For determining out-of-round, measure cylinder parallel and perpendicular to the block centerline. Difference in the 2 readings is the bore out-of-round. Cylinder bore must be checked at top, middle and bottom of piston travel area.

Bore taper is obtained by measuring bore at the top and bottom. If wear has exceeded allowable limits, block must be honed or bored to next available oversize piston dimension.

CYLINDER HONING

Cylinder must be properly honed to allow new piston rings to properly seat. Cross-hatching at correct angle and depth is critical to lubrication of cylinder walls and pistons.

A flexible drive hone and power drill are commonly used. Drive hone must be lubricated during operation. Mix equal parts of kerosene and SAE 20w engine oil for lubrication.

Apply lubrication to cylinder wall. Operate cylinder hone from top to bottom of cylinder using even strokes to produce 45 degree cross-hatch pattern on the cylinder wall. DO NOT allow cylinder hone to extend below cylinder during operation.

Recheck bore dimension after final honing. Wash cylinder wall with hot soapy water to remove abrasive particles. Blow dry with compressed air. Coat cleaned cylinder walls with lubricating oil.

DECK WARPAGE

Check deck for damage or warped head sealing surface. Place a straightedge across gasket surface of the deck. Using feeler gauge, measure clearance at center of straightedge. Measure across width and length of cylinder block at several points.

If warpage exceeds specifications, deck must be resurfaced. If warpage exceeds manufacturer's maximum tolerance for material removal, replace block.

DECK HEIGHT

Distance from the crankshaft centerline to the block deck is termed the deck height. Measure and record front and rear main journals of crankshaft. To compute this distance, install crankshaft and retain with center main bearing and cap only. Measure distance from the crankshaft journal to the block deck, parallel to the cylinder centerline.

Add one half of the main bearing journal diameter to distance from crankshaft journal to block deck. This dimension should be checked at front and rear of cylinder block. Both readings should be the same.

If difference exceeds specifications, cylinder block must be repaired or replaced. Deck height and warpage should be corrected at

the same time.

MAIN BEARING BORE & ALIGNMENT

For checking main bearing bore, remove all bearings from cylinder block and main bearing caps. Install main bearing caps in original location. Tighten bolts to specification. Using inside micrometer, measure main bearing bore in 2 areas 90 degrees apart. Determine bore size and out-of-round. If diameter is not within specification, block must be align-bored.

For checking alignment, place a straightedge along centerline of main bearing saddles. Check for clearance between straightedge and main bearing saddles. Block must be align-bored if clearance is present.

EXPANSION PLUG REMOVAL & INSTALLATION

Removal

Drill a hole in the center of expansion plug. Remove with screwdriver or punch. Use care not to damage sealing surface.

Installation

Ensure sealing surface is free of burrs. Coat expansion plug with sealer. Use a wooden dowel or pipe of slightly smaller diameter, install expansion plug. Ensure expansion plug is evenly located.

OIL GALLERY PLUG REMOVAL & INSTALLATION

Removal

Remove threaded oil gallery plugs using the appropriate wrench. Soft, press-in plugs are removed by drilling into plug and installing a sheet metal screw. Remove plug with slide hammer or pliers.

Installation

Ensure threads or sealing surface is clean. Coat threaded oil gallery plugs with sealer and install. Replacement soft press-in plugs are driven in place with a hammer and drift.

CAMSHAFT

* PLEASE READ THIS FIRST *

NOTE: Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

CLEANING & INSPECTION

Clean camshaft with solvent. Ensure all oil passages are clear. Inspect cam lobes and bearing journals for pitting, flaking or scoring. Using micrometer, measure bearing journal O.D.

Support camshaft at each end with "V" blocks. Position dial indicator with tip resting on center bearing journal. Rotate camshaft and note reading. If reading exceeds specification, replace camshaft.

Check cam lobe lift by measuring base circle of camshaft using micrometer. Measure again at 90 degrees to tip of cam lobe. Cam lift can be determined by subtracting base circle diameter from tip of cam lobe measurement.

Different lift dimensions are given for intake and exhaust cam lobes. Reading must be within specifications. Replace camshaft if cam lobes or bearing journals are not within specifications.

Inspect camshaft gear for chipped, eroded or damaged teeth. Replace gear if damaged. On camshafts using thrust plate, measure distance between thrust plate and camshaft shoulder. Replace thrust plate if not within specification.

CAMSHAFT BEARINGS

Removal & Installation

Remove the camshaft rear plug. The camshaft bearing remover is assembled with its shoulder resting on the bearing to be removed according to manufacturer's instructions. Tighten puller nut until bearing is removed. Remove remaining bearings, leaving front and rear bearings until last. These bearings act as guide for camshaft bearing remover.

To install new bearings, puller is rearranged to pull bearings toward the center of block. Ensure all lubrication passages of bearing are aligned with cylinder block. Coat new camshaft rear plug with sealant. Install camshaft rear plug. Ensure plug is even in cylinder block.

CAMSHAFT INSTALLATION

Lubricate bearing surfaces and cam lobes with ample amount of Molykote or camshaft lubricant. Carefully install camshaft. Use care not to damage bearing journals during installation. Install thrust plate retaining bolts (if equipped). Tighten bolts to specification. On overhead camshafts, install bearing caps in original location. Tighten bolts to specification. Check end play.

CAMSHAFT END PLAY

Using dial indicator, check end play. Position dial indicator on front of engine block. Position indicator tip against camshaft. Push camshaft toward rear of engine and adjust indicator to zero.

Move camshaft forward and note reading. Camshaft end play must be within specification. End play may be adjusted by relocating gear, shimming thrust plate or replacing thrust plate depending on manufacturer.

TIMING CHAINS & BELTS

* PLEASE READ THIS FIRST *

NOTE: Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

TIMING CHAINS

Timing chains will stretch during operation. Limits are placed upon amount of stretch before replacement is required. Timing chain stretch will alter ignition timing and valve timing.

To check timing chain stretch, rotate crankshaft to eliminate slack from one side of timing chain. Mark reference point on cylinder block. Rotate crankshaft in opposite direction to eliminate slack from remaining side of timing chain. Force other side of chain outward and measure distance between reference point and timing chain. See Fig. 23. Replace timing chain and gears if not within specification.

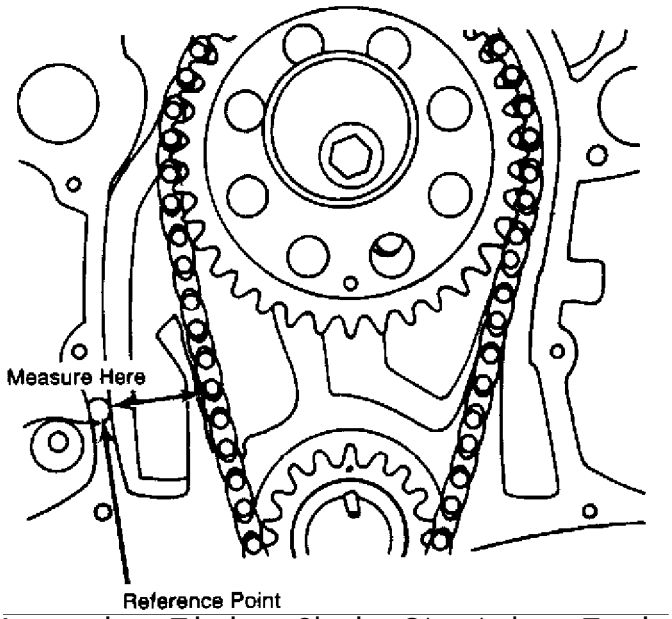

Fig. 23: Measuring Timing Chain Stretch - Typical
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Timing chains must be installed so that timing marks on camshaft gear and crankshaft gear are aligned according to manufacturer. See Fig. 24.

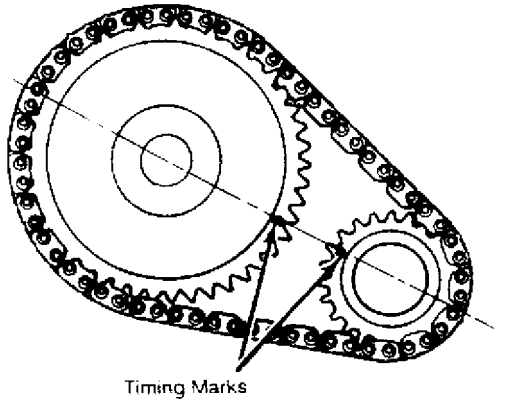

Fig. 24: Timing Gear Mark Alignment - Typical
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TIMING BELTS

Cogged tooth belts are commonly used on overhead cam engines. Inspect belt teeth for rounded corners or cracking. Replace belt if cracked, damaged, missing teeth or oil soaked.

Used timing belt must be installed in original direction of rotation. Inspect all sprocket teeth for wear. Replace all worn sprockets. Sprockets are marked for timing purposes. Engine is positioned so that crankshaft sprocket mark will be upward. Camshaft sprocket is aligned with reference mark on cylinder head and timing belt is installed. See Fig. 25.

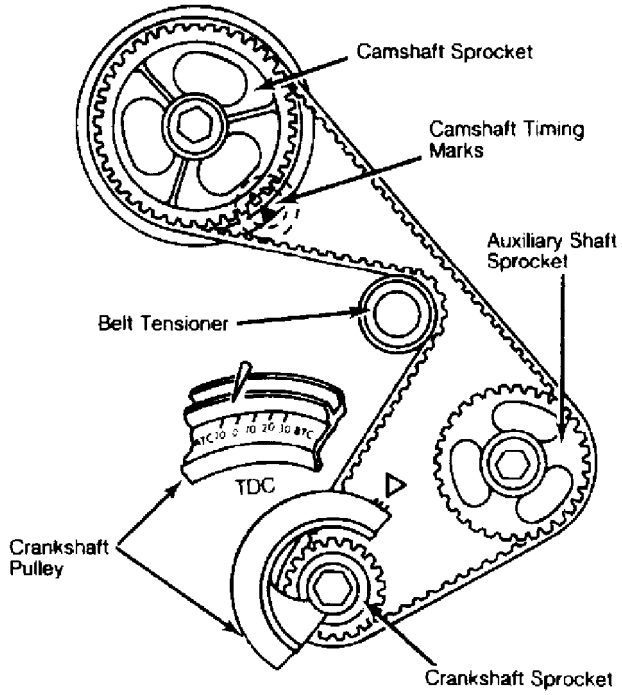

Fig. 25: Timing Belt Sprocket Alignment - Typical
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TENSION ADJUSTMENTS

If guide rails are used with spring loaded tensioners, ensure at least half of original rail thickness remains. Spring loaded tensioner should be inspected for damage.

Ensure all timing marks are aligned. Adjust belt tension using manufacturer's recommendations. Belt tension may require checking using tension gauge. See Fig. 26.

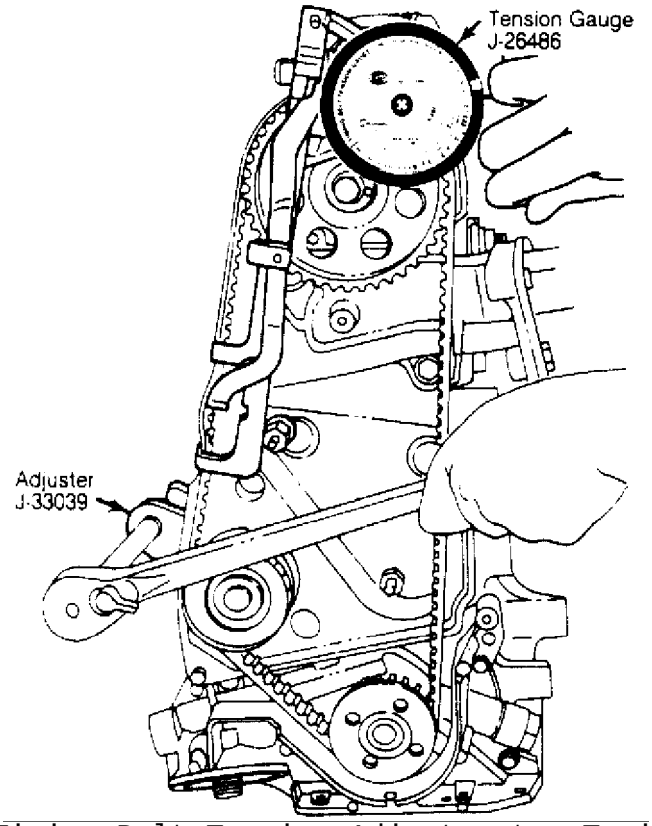

Fig. 26: Timing Belt Tension Adjustment - Typical
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TIMING GEARS

* PLEASE READ THIS FIRST *

NOTE: Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

TIMING GEAR BACKLASH & RUNOUT

On engines where camshaft gear operates directly on crankshaft gear, gear backlash and runout must be checked. To check backlash, install dial indicator with tip resting on tooth of camshaft gear. Rotate camshaft gear as far as possible. Adjust indicator to

zero. Rotate camshaft gear in opposite direction as far as possible and note reading.

To determine timing gear runout, mount dial indicator with tip resting on face edge of camshaft gear. Adjust indicator to zero. Rotate camshaft gear 360 degrees and note reading. If backlash or runout exceed specifications, replace camshaft and/or crankshaft gear.

REAR MAIN OIL SEAL

* PLEASE READ THIS FIRST *

NOTE: Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

INSTALLATION

One-Piece Type Seal

For one-piece type oil seal installation, coat block contact surface of seal with sealer if seal is not factory coated. Ensure seal surface is free of burrs. Lubricate seal lip with engine oil and press seal into place using proper oil seal installer. See Fig. 27.

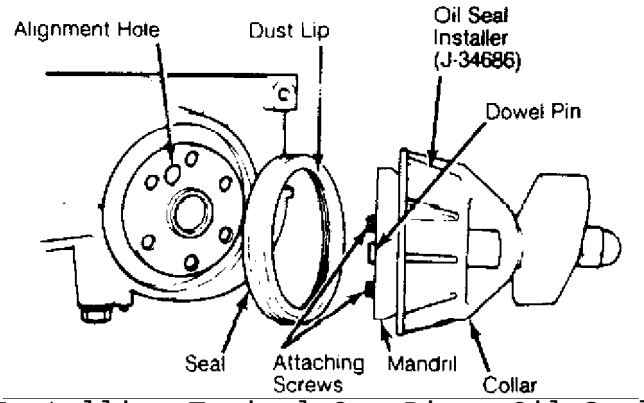

Fig. 27: Installing Typical One-Piece Oil Seal
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Rope Type Seal

For rope type rear main oil seal installation, press seal lightly into its seat. Using seal installer, fully seat seal in bearing cap or cylinder block.

Trim seal ends even with block parting surface. Some applications require sealer to be applied on main bearing cap prior to installation. See Fig. 28.

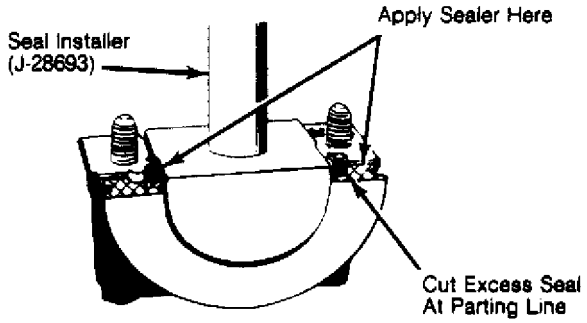

Fig. 28: Typical Rope Seal Installation
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Split-Rubber Type Seal

Follow manufacturers procedures when installing split-rubber type rear main oil seals. Installation procedures vary with engine type. See appropriate ENGINE article in this section. See Fig. 29.

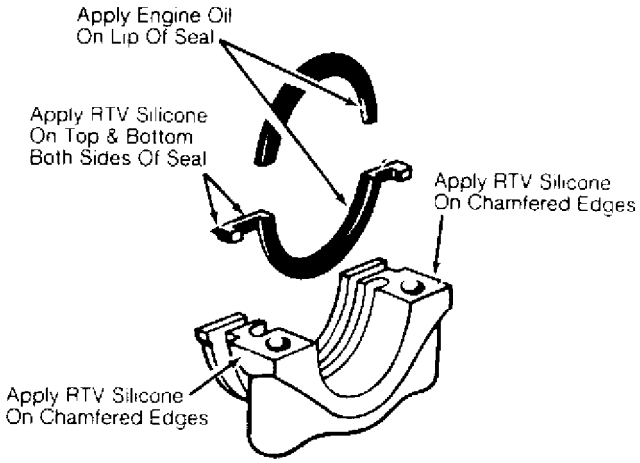

Fig. 29: Typical Split-Rubber Seal Installation
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OIL PUMP

* PLEASE READ THIS FIRST *

NOTE: Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

ROTOR-TYPE

Oil pump rotors must be marked for location prior to removal. See Fig. 30. Remove outer rotor and measure thickness and diameter. Measure inner rotor thickness. Inspect shaft for scoring or wear. Inspect rotors for pitting or damage. Inspect cover for grooving or wear. Replace components if worn or damaged.

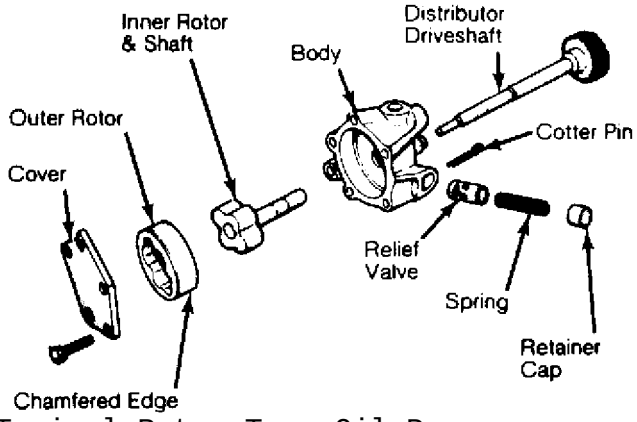

Fig. 30: Typical Rotor Type Oil Pump
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Measure outer rotor-to-body clearance. Replace pump assembly if clearance exceeds specification. Measure clearance between rotors. See Fig. 31. Replace shaft and both rotors if clearance exceeds specifications.

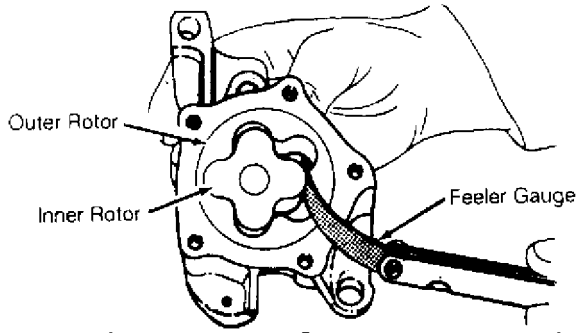

Fig. 31: Measuring Rotor Clearance - Typical
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Install rotors in pump body. Position straightedge across pump body. Using feeler gauge, measure clearance between rotors and straightedge. Pump cover wear is measured using a straightedge and feeler gauge. Replace pump if clearance exceeds specification.

GEAR TYPE

Oil pump gears must be marked for location prior to removal. See Fig. 32. Remove gears from pump body. Inspect gears for pitting or damage. Inspect cover for grooving or wear.

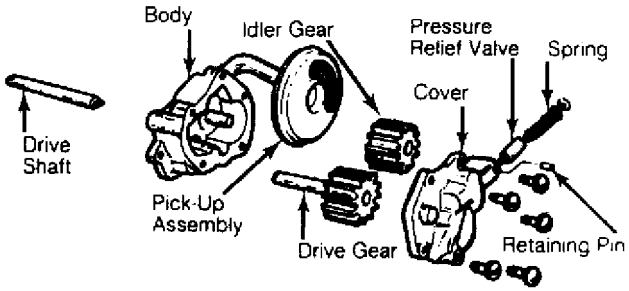

Fig. 32: Typical Gear Type Oil Pump
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Measure gear diameter and length. Measure gear housing cavity depth and diameter. See Fig. 33. Replace components if worn or damaged.

Pump cover wear is measured using a straightedge and feeler gauge. Pump is to be replaced if warpage or wear exceeds specifications or mating surface of pump cover is scratched or grooved.

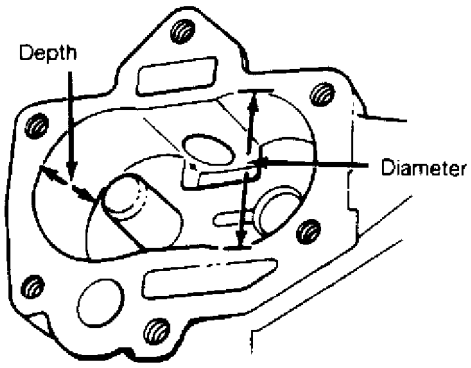

Fig. 33: Measuring Oil Pump Gear Cavity - Typical
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BREAK-IN-PROCEDURE

* PLEASE READ THIS FIRST *

NOTE: Always refer to appropriate engine overhaul article in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

ENGINE PRE-OILING

Engine pre-oiling should be done prior to operation to prevent engine damage. A lightly oiled pump will cavitate unless oil pump cavities are filled with engine oil or petroleum jelly.

Engine pre-oiling can be done using pressure oiler (if available). Connect pressure oiler to cylinder block oil passage such as oil pressure sending unit. Operate pressure oiler long enough

to ensure correct amount of oil has filled crankcase. Check oil level while pre-oiling.

If pressure oiler is not available, disconnect ignition system. Remove oil pressure sending unit and replace with oil pressure test gauge. Using starter motor, rotate engine starter until gauge shows normal oil pressure for several seconds. DO NOT crank engine for more than 30 seconds to avoid starter motor damage.

Ensure oil pressure has reached the most distant point from the oil pump. Reinstall oil pressure sending unit. Reconnect ignition system.

INITIAL START-UP

Start the engine and operate engine at low speed while checking for coolant, fuel and oil leaks. Stop engine. Recheck coolant and oil level. Adjust if necessary.

CAMSHAFT

Break-in procedure is required when a new or reground camshaft has been installed. Operate and maintain engine speed between 1500-2500 RPM for approximately 30 minutes. Procedure may vary due to manufacturers recommendations.

PISTON RINGS

Piston rings require a break-in procedure to ensure seating of rings to cylinder walls. Serious damage may occur to rings if correct procedures are not followed.

Extremely high piston ring temperatures are produced obtained during break-in process. If rings are exposed to excessively high RPM or high cylinder pressures, ring damage can occur. Follow piston ring manufacturer's recommended break-in procedure.

FINAL ADJUSTMENTS

Check or adjust ignition timing and dwell (if applicable). Adjust valves (if necessary). Adjust carburetion or injection idle speed and mixture. Retighten cylinder heads (if required). If cylinder head or block is aluminum, retighten bolts when engine is cold. Follow the engine manufacturer's recommended break-in procedure and maintenance schedule for new engines.

NOTE: Some manufacturer's require that head bolts be retightened after specified amount of operation. This must be done to prevent head gasket failure.

END OF ARTICLE

F - BASIC TESTING
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:32PM

ARTICLE BEGINNING

1993 ENGINE PERFORMANCE
Volkswagen Basic Diagnostic Procedures

Cabriolet, Corrado SLC, EuroVan, Fox, Golf, GTI, Jetta, Passat GL, Passat GLX

INTRODUCTION

The following diagnostic steps will help prevent overlooking a simple problem. This is also where to begin diagnosis for a no-start condition.

The first step in diagnosing any driveability problem is verifying the customer's complaint with a test drive under the conditions the problem reportedly occurred.

Before entering self-diagnostics (if equipped), perform a careful and complete visual inspection. Most engine control problems result from mechanical breakdowns, poor electrical connections, or damaged/misrouted vacuum hoses. Before condemning the computerized system, perform each test listed in this article.

NOTE: Perform all voltage tests with a Digital Volt-Ohmmeter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure.

PRELIMINARY INSPECTION & ADJUSTMENTS

VISUAL INSPECTION

Visually inspect all electrical wiring, looking for chafed, stretched, cut or pinched wiring. Ensure electrical connectors fit tightly and are not corroded. Ensure vacuum hoses are properly routed and are not pinched or cut. See M - VACUUM DIAGRAMS article in this section to verify routing and connections (if necessary). Inspect air induction system for possible vacuum leaks.

MECHANICAL INSPECTION

Compression

Check engine mechanical condition with a compression gauge, vacuum gauge, or an engine analyzer. See engine analyzer manual for specific instructions.

WARNING: DO NOT use ignition switch during compression tests on fuel injected vehicles. Use a remote starter to crank engine. Fuel injectors on many models are triggered by ignition switch during cranking mode, which can create a fire hazard or contaminate the engine's oiling system.

COMPRESSION SPECIFICATION TABLE

Application	Compression Pressure psi (kg/cmý)	Compression Ratio
Cabriolet	131-174 (9.2-12.2)	10.0:1
Corrado SLC	157-186 (11.0-13.0)	10.0:1
EuroVan	128-170 (9.0-12.0)	8.5:1
Fox	128-170 (9.0-12.0)	9.0:1
Golf & GTI	142-186 (10.0-13.0)	10.0:1
Jetta	142-186 (10.0-13.0)	10.0:1
Passat GL (2.0L)	142-186 (10.0-13.0)	10.8:1
Passat GLX (2.8L)	142-186 (10.0-13.0)	10.0:1

Exhaust System Backpressure

The exhaust system can be checked with a vacuum or pressure gauge. Remove O2 sensor or air injection check valve (if equipped). Connect a 0-5 psi pressure gauge and operate engine at 2500 RPM. If exhaust system backpressure is greater than 2 psi, exhaust system or catalytic converter is plugged.

If a vacuum gauge is used, connect vacuum gauge hose to intake manifold vacuum port and start engine. Observe vacuum gauge. Open throttle part way and hold steady. If vacuum gauge reading slowly drops after stabilizing, check exhaust system for restriction.

FUEL SYSTEM

FUEL SYSTEM APPLICATION

FUEL SYSTEM APPLICATION TABLE

Model	Engine	Engine ID	Fuel System
Cabriolet	1.8L 8-Valve	2H (1)	Digifant II MFI
Corrado SLC	2.8L VR6	AAA	Motronic MFI (2)
EuroVan	2.5L 10-Valve	AAF	Digifant MFI
Fox	1.8L 8-Valve	ABG (1)	Digifant II MFI
Golf	2.0L 8-Valve	ABA	Motronic MFI (2)
GTI	2.0L 8-Valve	ABA	Motronic MFI (2)

Jetta	2.0L 8-Valve	ABA	Motronic MFI (2)
Passat GL	2.0L 16-Valve	9A	CIS-E Motronic MFI (2)
Passat GLX	2.8L VR6	AAA	Motronic MFI (2)

(1) - California vehicles are equipped with Digifant I.
(2) - Sequential Multiport Fuel Injection.

FUEL PRESSURE

Basic diagnosis of fuel system should begin with determining fuel system pressure.

WARNING: ALWAYS relieve fuel pressure before disconnecting any fuel injection-related component. DO NOT allow fuel to contact engine or electrical components.

CIS-E Motronic

1) Ensure ignition is off. Wrap a cloth around fuel distributor port near cold start valve. Slowly loosen distributor port near cold start valve to release fuel pressure. Connect fuel pressure gauge between fuel distributor port and end of fuel line to cold start valve. Disconnect differential pressure regulator harness connector.

2) Start engine and let it run. System fuel pressure should 89-96 psi (6.3-6.7 kg/cm**ý**). If system fuel pressure is lower than specification, perform fuel volume check. If fuel volume is okay, replace fuel pressure regulator.

3) If fuel pressure is greater than specification, remove return hose from pressure regulator and place in a container. Repeat test. If system pressure is okay, check for restricted fuel return line. If pressure is incorrect, replace fuel pressure regulator.

4) Turn ignition off. After 10 minutes, residual pressure should be 48 psi (3.4 kg/cm**ý**). After 20 minutes, residual pressure should be 46 psi (3.2 kg/cm**ý**). If system fuel pressure is low, check fuel pump check valve, sensor plate free play, fuel distributor "O" rings and seats. Replace if necessary. If these components are okay, replace fuel pressure regulator.

Digifant

1) Ensure ignition is off. Wrap a cloth around service port on fuel plenum. Slowly loosen service port on fuel plenum to release fuel pressure. Install fuel pressure gauge at service port on fuel plenum. Fuel pressure gauge must have reading range of 0-50 psi. Start engine and allow it to idle. System fuel pressure should be approximately 36 psi (2.5 kg/cm**ý**).

2) Disconnect vacuum hose from top of fuel pressure regulator. Fuel pressure should increase to approximately 44 psi (3

kg/cmý). Turn engine off. After 10 minutes, residual pressure should be 29 psi (2 kg/cmý). If system pressure is too high, replace fuel pressure regulator.

3) If residual pressure is too low, operate engine until system pressure builds up, then pinch off Blue fuel return line. If pressure holds, replace the fuel regulator. If fuel pressure is low, check for leaks at fuel lines, fuel injectors and fuel pump check valve

TRANSFER PUMP CHECK

Transfer Pump Fuel Volume Check

1) Turn ignition off. To check transfer pump (in tank), remove rear seat. Remove fuel sending unit access cover. Disconnect ignition coil secondary wire and jumper to ground.

2) With transmission in Neutral, crank engine for 3-4 seconds. While starter is turning and for a few seconds afterwards, an audible sound should be heard at the pump. If sound is not heard, go to next step. If sound is heard, go to step 5).

3) Remove fuel pump relay from relay panel. On Corrado and Passat, activate fuel pumps using Remote Control (VAG 1348/3A). On all other models, activate fuel pumps using Remote Control (US 4480/3). On all models, if pump does not operate, remove transfer pump wire harness connector. See Fig. 1.

4) Using test light, check voltage between middle wire and outer Brown wire of fuel pump connector for Digifant fuel system, or between Brown wire and Red/Yellow wire for CIS-E fuel system. If voltage is present, replace transfer pump. If voltage is not present, repair open or short circuit in wiring.

5) Remove fuel pump relay jumper wire. Disconnect and plug transfer pump output hose. Attach a hose to pump outlet connector and place other end of hose in a graduated container. Activate fuel pump for 10 seconds.

6) Minimum fuel flow should be 10 ounces (.3 liter). If fuel flow is low, check fuel tank filter for restriction. If fuel tank filter is okay, replace transfer pump.

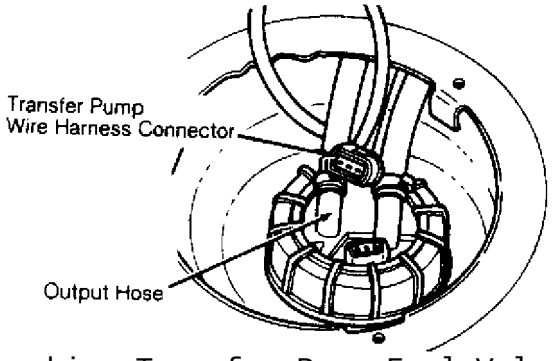

Fig. 1: Checking Transfer Pump Fuel Volume (Typical)
Courtesy of Volkswagen United States, Inc.

MAIN FUEL PUMP VOLUME CHECK

NOTE: Before testing main fuel pump, check transfer pump. See TRANSFER PUMP CHECK.

Cabriolet, Fox, Golf & Jetta

Remove fuel pump relay from relay panel. Activate fuel pumps using Remote Control (US 4480/3). Activate fuel pumps for 30 seconds. Compare fuel volume with values in FUEL PUMP PERFORMANCE table.

Corrado, GTI & Passat

1) Remove fuel pump relay from relay panel. On Corrado and Passat, activate fuel pumps using Remote Control (VAG 1348/3A). On GTI, activate fuel pumps using Remote Control (US 4480/3). On all models, measure voltage being applied to fuel pump when activating with remote control. Record voltage.

2) Fuel volume is relative to voltage applied to fuel pumps. Activate fuel pumps for 30 seconds. Compare volume with values in FUEL PUMP PERFORMANCE table.

FUEL PUMP PERFORMANCE

Application	Pressure psi (kg/cm²)	Min. Vol. In 30 Sec. Pts. (L)
Cabriolet	43 (3.0)	1.4 (0.7)
Corrado SLC (1)	58 (4.0)	1.0-1.4 (0.5-0.7)
Golf, GTI & Jetta (1)	43 (3.0)	1.0-1.4 (0.5-0.7)
EuroVan (1)	43 (3.0)	1.0-1.4 (0.5-0.7)
Fox (2)	36 (2.5)	1.4 (0.7)
Passat GL	(3) 87-94 (6.1-6.6)	1.0-1.4 (0.5-0.7)
Passat GLX (1)	58 (4.0)	1.0-1.4 (0.5-0.7)

(1) - Using Adapter Cable (VAG 1348/3-2) between battery positive terminal and terminal No. 4 of fuel pump relay socket. Fuel pump energized, with 10-12 volts at fuel pump and engine off.
(2) - Using Remove Control Switch (US 4480/3) in place of fuel pump relay.
(3) - Briefly operate starter and ensure fuel pump runs for at least one second. Alternate method is to disconnect Electronic Control Module (ECM) and ground terminal No. 12 using Remove Control Switch (VAG 1348/3A).

REGULATED FUEL PRESSURE

Application	At Idle w/Vacuum psi (kg/cm²)	At Idle w/o Vacuum (1) psi (kg/cm²)
Cabriolet & Fox	36 (2.5)	43 (3.0)
Corrado SLC	50 (3.5)	58 (4.0)
Golf, GTI & Jetta	36 (2.5)	43 (3.0)

EuroVan	36 (2.5)	43 (3.0)
Passat GL	(2) 87-94 (6.1-6.6)	(3) 87-94 (6.1-6.6)
Passat GLX	50 (3.5)	58 (4.0)

(1) - With vacuum hose disconnected from fuel pressure regulator.
(2) - Approximately 4.3-7.2 psi (0.3-0.5 kg/cmý) below system pressure, with differential pressure regulator disconnected.
(3) - Approximately 18.5-23.0 psi (1.3-1.6 kg/cmý) below system pressure, with differential pressure regulator connected.

IGNITION CHECKS

NOTE: Ignition checks are divided according to fuel system.

SPARK TEST

1) Using an ohmmeter, check resistance of each spark plug wire. See HIGH TENSION WIRE RESISTANCE table. Check for a strong Blue spark at coil wire and at each spark plug wire by holding wire terminal 5/16" from ground while cranking engine.
2) Disconnect and inspect all related ignition system connectors and harness. Clean or repair if necessary. If related connectors and harness are okay, remove negative battery cable. Disconnect secondary and primary leads from ignition coil.
3) Using ohmmeter, check primary resistance between primary terminals of coil. Check secondary resistance between coil secondary terminal and primary positive terminal. Replace coil if readings are not within specifications. See IGNITION COIL RESISTANCE table.

HIGH TENSION WIRE RESISTANCE TABLE

Application	Ohms
Coil Wire Only	(1)
Coil Wire With Connector	1600-2400
Spark Plug Wire Connector	4000-6000
Suppressor (2)	600-1400

(1) - Check for continuity.
(2) - Suppressor is located between ignition coil wire and distributor cap.

IGNITION COIL

IGNITION COIL RESISTANCE - Ohms @ 68øF (20øC)

Application	Primary	Secondary
Cabriolet		
Digifant I	0.5-0.7	3000-4000

Digifant II	0.52-0.76		2400-3500
Corrado SLC (1)			
Fox			
Digifant I	0.5-0.7		3000-4000
Digifant II	0.6-0.7		2500-3500
Golf, GTI & Jetta	0.5-0.7		3000-4000
Passat GL	0.6-0.8		6500-8500
Passat GLX (1)			

(1) - Ignition coil pack, new for 1993, is located on left side of cylinder head. When ignition coil is triggered, spark is supplied to 2 spark plugs at one time. One spark plug fires during compression stroke and the other plug fires during exhaust stroke (waste spark). Ignition coil specifications are not available from manufacturer.

DISTRIBUTOR

Hall Effect Sender

1) Remove coil secondary wire and attach to ground. Disconnect Hall Effect sender harness connector at distributor. Using an LED Test Light (US 1115), check for voltage between outer terminals of connector. See Figs. 2 and 3. With ignition on, light should be on. If light is on, go to next step. If light is not on, check wiring for short or open circuit. If wiring is okay, replace ignition control unit.

2) Reconnect Hall Effect sender harness connector. Pull back Hall Effect sender boot to expose contact terminals. Connect LED Test Light (US 1115) probe to center contact and battery positive terminal. See Fig. 2. Observe test light while cranking engine. If test light blinks, Hall Effect sender is okay. If light does not blink, replace Hall Effect sender.

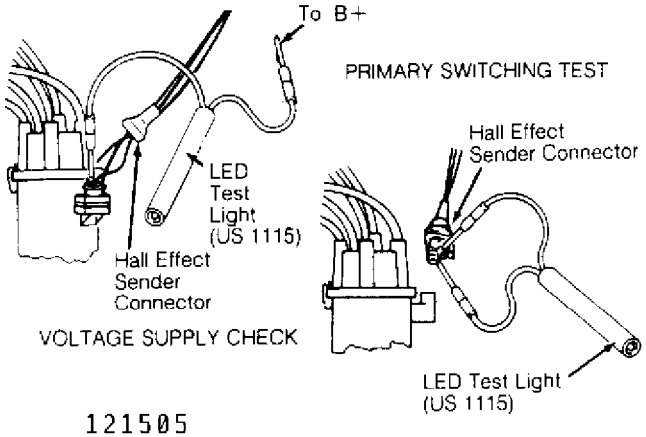

Fig. 2: Testing Hall Effect Sender (Typical)
Courtesy of Volkswagen United States, Inc.

Voltage Supply & Ground To Hall Effect Sender

1) With ignition off, disconnect Hall Effect sender harness connector. Using a voltmeter, check for voltage between outer terminals No. 1 and No. 3. See Fig. 3. Turn ignition on. There should be a minimum of 9 volts on vehicles with CIS-E fuel system, or 10 volts on vehicles with Digifant fuel system.

2) If there is no voltage, check for open wire between terminal No. 3 of Hall Effect sender connector and ECU. Also check for voltage between terminal No. 1 of Hall Effect sender and ground. Repair open and recheck.

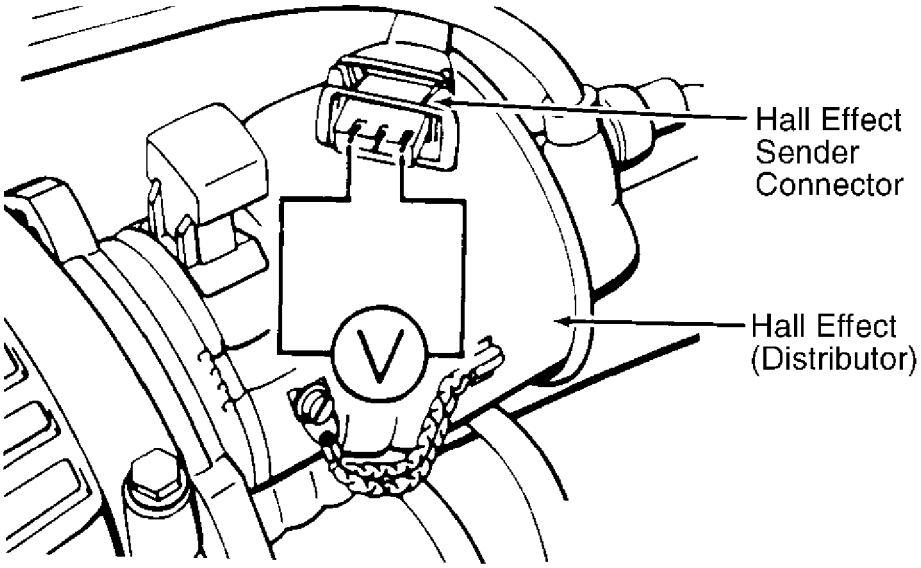

Fig. 3: Testing Hall Effect Sender Connector (Typical)
Courtesy of Volkswagen United States, Inc.

POWER STAGE

Voltage Supply & Ground To Power Stage

1) Turn ignition off. Disconnect coil power stage harness connector. Connect a voltmeter to terminals No. 1 and No. 3. See Fig. 4.

2) Turn ignition on. Ensure battery voltage is present. Turn ignition off. If voltage is not present, check for open wire from fuse box to terminal No. 1, or open from terminal No. 3 to ground. Repair open wire and recheck.

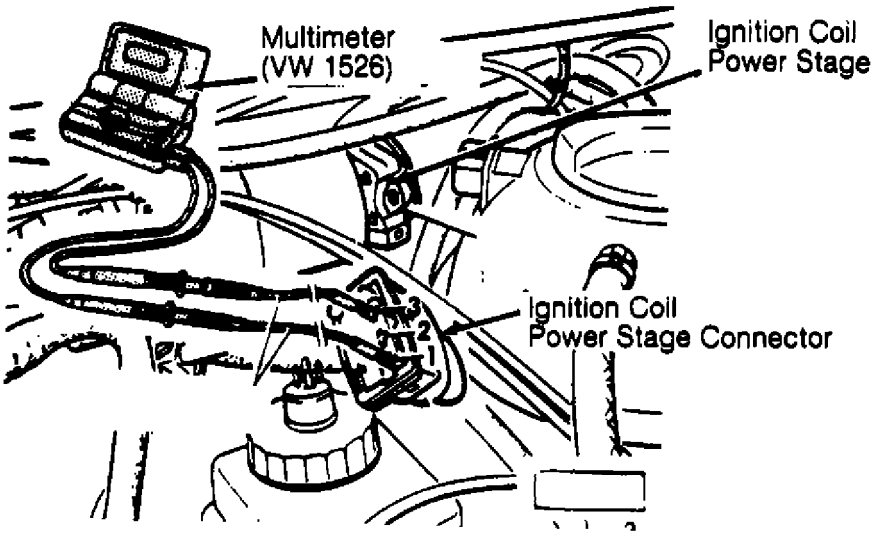

Fig. 4: Testing Ignition Coil Power Stage (Typical)
Courtesy of Volkswagen United States, Inc.

HALL CONTROL UNIT

Cabriolet, Fox, Golf, Jetta & GTI With Digifant II

1) Perform spark test. See SPARK TEST under IGNITION CHECKS. If secondary spark is present, ignition control unit is okay. If secondary spark is not present, turn ignition off. Disconnect ignition control unit wire harness connector. Turn ignition on. Using a voltmeter, measure voltage between terminal No. 2 (-) and terminal No. 4 (+) of connector. See Fig. 5.

2) Battery voltage should be present. If battery voltage is not present, ensure continuity exists between terminal No. 2 and ground. Continuity must also exist between terminal No. 4 and ignition coil positive terminal. Repair wiring if necessary. If wiring is okay, replace ignition control unit.

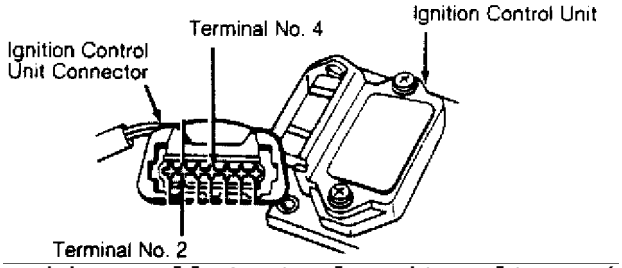

Fig. 5: Checking Hall Control Unit Voltage (Typical)
Courtesy of Volkswagen United States, Inc.

IDLE SPEED, CO LEVEL & IGNITION TIMING

Ensure idle speed, CO level and base ignition timing are set

to specification. If necessary, see the appropriate D - ADJUSTMENTS article in this section. Refer to the following menu:

NOTE: For the appropriate D - ADJUSTMENTS article, go to:

* For Cabriolet, see: D - ADJUSTMENTS
* For Corrado SLC, see: D - ADJUSTMENTS
* For EuroVan, see: D - ADJUSTMENTS
* For Fox, see: D - ADJUSTMENTS
* For Golf, GTI, Jetta, see: D - ADJUSTMENTS
* For Passat GL 2.0L 4-Cylinder, see: D - ADJUSTMENTS - 4-CYL
* For Passat GLX 2.8L VR6, see: D - ADJUSTMENTS - VR6

IDLE SPEED & CO LEVEL

Application	Idle RPM	CO Level %
Cabriolet (1)		
Digifant I	750-850	0.3-1.2
Digifant II	750-850	0.3-1.1
Corrado SLC (2)	650-750	0.3-1.5
Fox	(3) 875-925	0.3-1.2
Golf, Jetta & GTI (2)	800-880	0.3-1.2
Passat GL	(4) 800-1000	0.2-1.2
Passat GLX (2)	650-750	0.3-1.5

(1) - With engine running, after reconnecting Blue coolant temperature sensor. See the D - ADJUSTMENTS article in this section for more information. See menu above.
(2) - Idle speed and fuel mixture (CO level) are not adjustable.
(3) - If A/C equipped, disconnect idle speed boost valve harness connector when checking idle speed. Clamp crankcase breather hose near emission control valve when checking CO level.
(4) - Idle speed is not adjustable.

IGNITION TIMING (Degrees BTDC @ RPM)

Application	Checking	Adjusting
Cabriolet (1)	4-8 @ 2000-2500	5-7 @ 2000-2500
Corrado SLC	(2)	(2)
Fox (1)	4-8 @ 2000-2500	5-7 @ 2000-2500
Golf, GTI & Jetta	(3) 12 @ 800-880	
Passat GL	4-8 @ 800-1000	5-7 @ 800-1000
Passat GLX	(2)	(2)

(1) - On Digifant I systems, ensure engine oil temperature

is 176øF (80øC) and Blue engine coolant temperature sensor is disconnected.
(2) - Ignition timing is computer controlled. Information is not available from manufacturer.
(3) - Using Scan Tester (VAG 1551) in START BASIC SETTING mode. Ignition timing is not adjustable.

IGNITION TIMING ADVANCE (Degrees BTDC @ RPM)

Application	Specification
Cabriolet	
Digifant I (California)	(1) 27-33 @ 4500
Digifant II (Other 49 States)	(1) 20-30 @ 2300
Fox	
Digifant I (California)	(1) 27-33 @ 4500
Digifant II (Other 49 States)	(1) 20-30 @ 2300
All Other Models	(2)

(1) - With Blue engine coolant temperature sensor connected. Specification is in addition to the initial setting.
(2) - Ignition timing advance is computer controlled. Information is not available from manufacturer.

SUMMARY

If no faults were found while performing the tests in this article, see H - TESTS W/O CODES article in this section for diagnosis by symptom (i.e., ROUGH IDLE, NO START, etc.) or intermittent diagnostic procedures.

END OF ARTICLE

FUSES & CIRCUIT BREAKERS
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:32PM

ARTICLE BEGINNING

Fuses & Circuit Breakers
1993-95 Volkswagen

Euro Van CL
GL
MV (Camper)

FUSES & CIRCUIT BREAKERS

Fuses are located to right side of steering wheel behind storage compartment. Fuses are numbered from left to right.

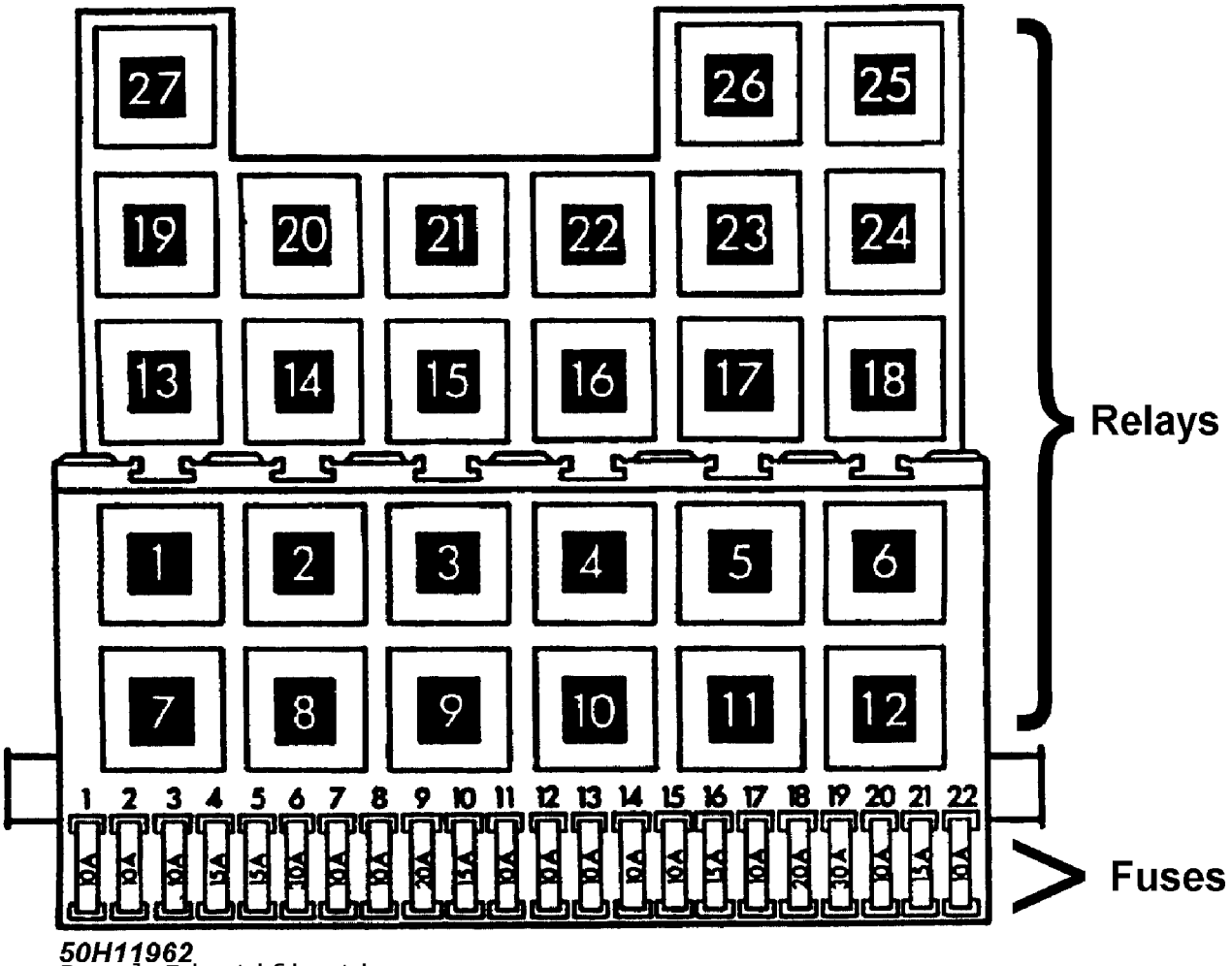

Fig. 1: Fuse Panel Identification
Courtesy of Volkswagen United States, Inc.

Fuse & Circuit Breaker Identification

1 - 10 Amp (Red)
Left Headlight Low Beam

2 - 10 Amp (Red)
Right Headlight Low Beam
3 - 10 Amp (Red)
Instrument & License Lights
4 - 15 Amp (Blue)
Rear Window Wiper/Washer, Heated Front Seats
5 - 15 Amp (Blue)
Windshield Wiper/Washer, Rear Window Washer, Heated Washer Jets
6 - 30 Amp (Green)
A/C, Fresh Air Fan
7 - 10 Amp (Red)
Right Tail Light & Side Marker Light, Engine Compartment Lamp
8 - 10 Amp (Red)
Left Taillight & Side Marker Light
9 - 20 Amp (Yellow)
Rear Window & Mirror Heater
10 - 15 Amp (Blue)
Fog Lamps
11 - 10 Amp (Red)
Left Headlight High Beam & High Beam Indicator
12 - 10 Amp (Red)
Right Headlight High Beam
13 - 10 Amp (Red)
Horn, Radiator Cooling Fan
14 - 10 Amp (Red)
Backup Lights, Electric Mirrors, Heated Front Seats, Windshield Washer Jets, Cruise Control, Power Roof
15 - 10 Amp (Red)
Engine Electronics
16 - 15 Amp (Blue)
Warning/Indicator Lights, Multi-Function Indicator, Glove Box Light, ABS
17 - 10 Amp (Red)
Turn Signals
18 - 20 Amp (Yellow)
Fuel Pump
19 - 30 Amp (Green)
A/C, Radiator Cooling Fan
20 - 10 Amp (Red)
Brake Lights
21 - 15 Amp (Blue)
Dome & Luggage Lamps, Clock, Radio, Central Locking System, Multi-Function Indicator, Vanity Mirror, OBD Diagnostic
22 - 10 Amp (Red)
Cigarette Lighter

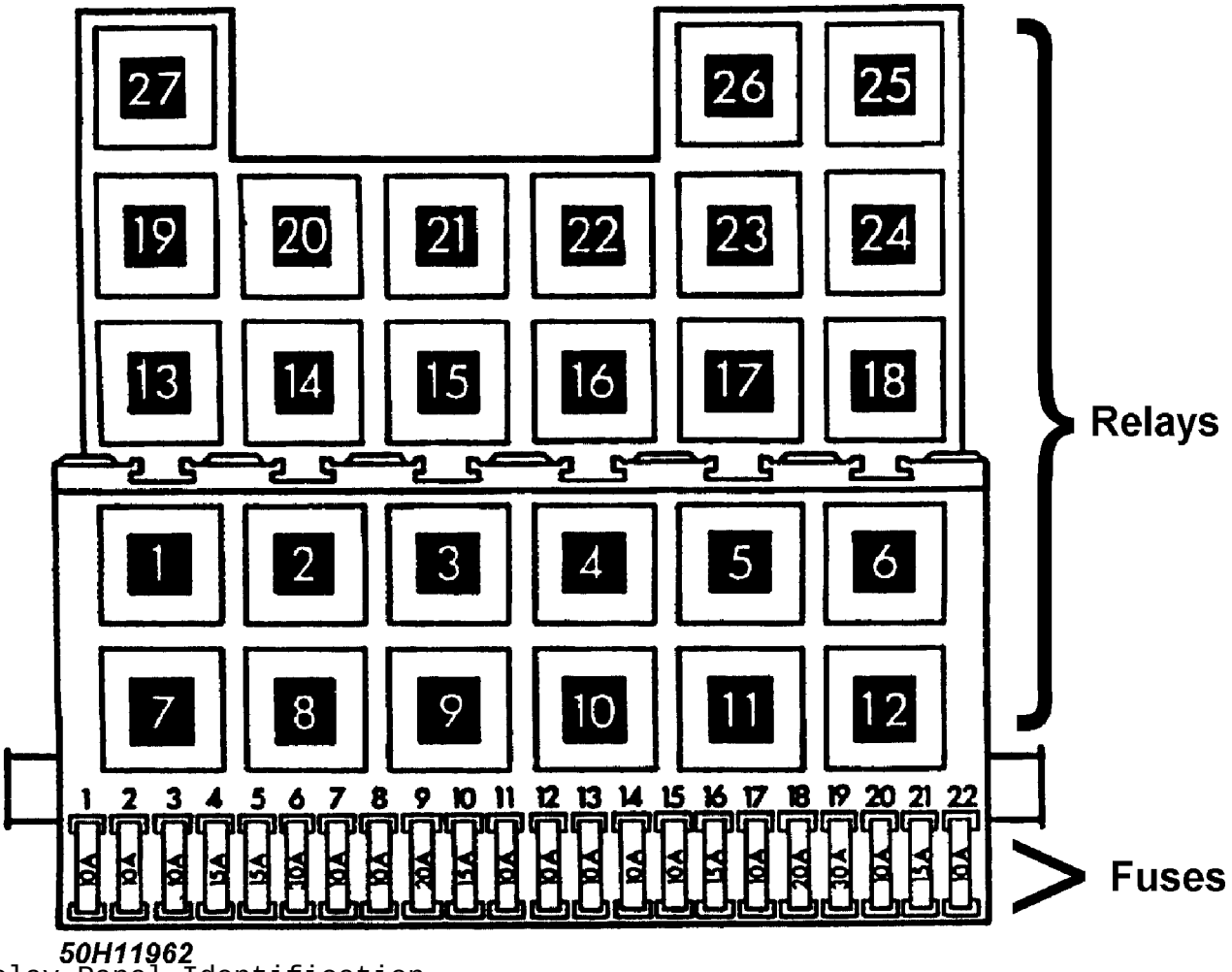

Fig. 2: Relay Panel Identification
Courtesy of Volkswagen United States, Inc.

Fuse, Relay & Circuit Breaker Identification

1 - A/C Control Module Relay
2 - Rear Window Wiper/Washer Relay
3 - ECM Power Supply Relay
4 - Load Reduction Relay
5 - Open
6 - Emergency Flasher Relay
7 - Headlight Washer Relay
8 - Washer/Wiper Intermittent Relay
9 - Seat Belt Warning Relay
10 - Fog Lamp/Parking Lamp Relay
11 - Dual Horn Relay
12 - Fuel Pump Relay
13 - Heater Control Module Relay
14 - Coolant Pump After-Run Relay
15 - Open
16 - Open
17 - Open

18 - Fuse
Roof Ventilator Fan
19 - Heater Air Blower Relay
20 - Starter Interlock/Back-up Light Relay
21 - 5 Amp Fuse
Back-up Lights, Cruise Control
22 - 20 Amp Fuse
A/C (Second Evaporator)
23 - Rear Window Defroster/Heated Mirror Relay
24 - 20 Amp (Circuit Breaker)
Power Windows, Central Locking System
25 - 10 Amp Fuse
ABS System
26 - 15 Amp (Blue)
Rear Window Defroster, Heated Mirrors
27 - A/C Compressor Clutch Relay

Additional Fuse Identification

WARNING: Always disconnect battery ground cable before servicing "high-current fuses. It is recommended that "high-current" fuses be replaced by a qualified technician.

NOTE: Located on left side of engine compartment, above battery.

1 - 50 Amp
Radiator Fan

NOTE: Located in the engine compartment, above the brake booster.

1 - 50 Amp (1995 Diesel)
Glow Plugs (1995 Diesel Models Only)

NOTE: Located under drivers seat.

1 - 25 Amp (Clear)
Auxiliary HVAC Fan
2 - 20 Amp (Yellow)
Blower for Auxiliary Heater
3 - 30 Amp (Green) (MV Camper Models Only)
Refrigerator Socket, Socket below Folding Table (MV Models)
4 - 5 Amp (Lt. Brown) (MV Camper Models Only)
Fluorescent Light (MV Models)

BATTERY SPECIFICATIONS

CAUTION: When battery is disconnected, vehicles equipped with computers may lose memory data. When battery power is restored, driveability problems may exist on some vehicles. These vehicles may require a relearn procedure. See COMPUTER RELEARN PROCEDURES article in the GENERAL INFORMATION section.

AUXILIARY BATTERY - CAMPER MODELS

All models use a battery located under the hood. Some models have an optional second battery located under the left front seat. This battery is conected to the electrical system with a relay and supplies power to the interior accessories (refrigerator, flourescent light and power socket) when the engine is off. Replacement batteries should always have the same specifications and dimensions as shown on the battery housing.

CAUTIONS & WARNINGS

SUPPLEMENTAL RESTRAINT SYSTEM (AIR BAG)

NOTE: See the AIR BAGS article in the ACCESSORIES/SAFETY EQUIPMENT Section.

Modifications or improper maintenance, including incorrect removal and installation of the Supplemental Restraint System (SRS), can adversely affect system performance. DO NOT cover, obstruct or change the steering wheel horn pad in any way, as such action could cause improper function of the system. Use only plain water when cleaning the horn pad. Solvents or cleaners could adversely affect the air bag cover and cause improper deployment of the system.

WARNING: To avoid injury from accidental air bag deployment, read and carefully follow all warnings and service precautions. See appropriate AIR BAGS article in ACCESSORIES/SAFETY EQUIPMENT.

CAUTION: Disconnect negative battery cable before servicing any air bag system, steering column or passenger side dash component. After any repair, turn ignition key to the ON position from passenger's side of vehicle in case of accidental air bag inflation

SUPPLEMENTAL RESTRAINT SYSTEM (SRS) AIR BAR WARNING

NOTE: For information on air bag DIAGNOSIS & TESTING or DISPOSAL PROCEDURES, see AIR BAGS article in the ACCESSORIES/SAFETY EQUIPMENT Section.

System circuit is grounded by 2 screws beneath the driver's seat. DO NOT use these screws to ground any other accessory. DO NOT ground any other components near this system.

AIR CONDITIONING SERVICING (1993 MODELS)

CAUTION: Avoid breathing R-134a refrigerant and PAG lubricant vapors, exposure may irritate eyes, nose and throat. To remove R-134a from system use R-134a recycling equipment that meets SAE J2210 specifications. If accidental system discharge

occurs, ventilate work area before resuming service.

WARNING: R-134a service equipment or vehicle A/C systems SHOULD NOT be pressure tested or leak tested with compressed air. Some mixtures of air/R134a have shown to be combustible at elevated pressures. These mixtures are dangerous and may cause fire and/or explosions. See AIR CONDITIONING SERVICE article in GENERAL INFORMATION section.

ANTI-LOCK BRAKE SYSTEM

The anti-lock brake system contains electronic equipment that can be susceptible to interference caused by improperly installed or high output radio transmitting equipment. Since this interference could cause the possible loss of the anti-lock braking capability, such equipment should be installed by qualified professionals.

On models equipped with anti-lock brake systems, ALWAYS observe the following cautions:

* DO NOT attempt to bleed hydraulic system without first referring to the appropriate ANTI-LOCK BRAKE SYSTEM article in the BRAKES Section.
* DO NOT mix tire sizes. As long as tires remain close to the original diameter, increasing the width is acceptable. Rolling diameter must be identical for all 4 tires. Some manufacturers recommend tires of the same brand, style and type. Failure to follow this precaution may cause inaccurate wheel speed readings.
* Use ONLY recommended brake fluids. DO NOT use silicone brake fluids in an ABS-equipped vehicle.

BATTERY WARNING

WARNING: When battery is disconnected, vehicles equipped with computers may lose memory data. When battery power is restored, driveability problems may exist on some vehicles. These vehicles may require a relearn procedure. See COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION section.

REPLACING BLOWN FUSES

Before replacing a blown fuse, remove ignition key, turn off all lights and accessories to avoid damaging the electrical system. Be sure to use fuse with the correct indicated amperage rating. The use of an incorrect amperage rating fuse may result in a dangerous electrical system overload.

BRAKE PAD REPLACEMENT

WARNING: Use caution when checking and/or changing brake pads, some pads may contain asbestos which can irritate eyes and may

cause other health hazards. A water based solution should be used to clean brake dust from wheel and brake components. DO NOT use compressed air to blow off brake dust.

BRAKE SYSTEM

CAUTION: Extreme brake pedal pressure is required if the engine is not running.

CAUTION: If brake warning light comes on while driving it indicates a low fluid level or failure in one of the braking circuits. If the brake pedal can be depressed further than normal it is an indication that one of the brake circuits is not functioning. Stop vehicle and check brake reservoir fluid level. If level is below MIN mark, DO NOT drive vehicle. Have it towed to a repair shop. If level is between the MIN and MAX marks, proceed cautiously to a repair shop.

BRAKE PAD WEAR INDICATOR

Indicator will cause a squealing or scraping noise, warning that brake pads need replacement.

CATALYTIC CONVERTER

Continued operation of vehicle with a severe malfunction could cause converter to overheat, resulting in possible damage to converter and vehicle.

Any modification to the exhaust system on turbo models, which reduces exhaust backpressure, will lead to lean fuel mixtures and excessive spark advance. This could cause serious engine damage.

COOLANT (PROPYLENE-GLYCOL FORMULATIONS)

To avoid possible damage to vehicle use only ethylene-glycol based coolants with a mixture ratio from 44-68% anti-freeze. DO NOT use 100% anti-freeze as it will cause the formation of cooling system deposits. This results in coolant temperatures of over 300ø F (149øC) which can melt plastics. 100% anti-freeze has a freeze point of only -8ø F (-22øC).

CAUTION: Propylene-Glycol Mixtures has a smaller temperature range than Ethylene-Glycol. The temperature range (freeze-boil) of a 50/50 Anti-Freeze/Water Mix is as follows:
Propylene-Glycol -26ø F (-32øC) - 257ø F (125øC)
Ethylene-Glycol -35ø F (-37øC) - 263ø F (128øC)

CAUTION: Propylene-Glycol/Ethylene-Glycol Mixtures can cause the destabilization of various corrosion inhibitors. Also Propylene-Glycol/Ethylene-Glycol has a different specific gravity than Ethylene-Glycol coolant, which will result in

inaccurate freeze point calculations.

DIESEL FUEL ANTI-FUNGAL ADDITIVES

CAUTION: If fuel contamination due to fungi or other microorganisms is suspected a fuel additive with a biocide may be used. Follow the manufacturers dosage as recommended on product label. Use biocides ONLY when necessary, excessive use can may cause other fuel system problems.

DIESEL FUEL CONTAMINATION

WARNING: Diesel fuel system may be contaminated with fungi or other microorganisms. Keep contaminated fuel away from open skin cuts or sores to prevent skin irritation or infection.

DIESEL FUEL REQUIREMENTS

CAUTION: All diesel engines are to use Diesel Fuel #2 when the outside temperature is above 20øF (-7øC). In temperatures that are below 20øF (-7øC) use Diesel Fuel #1, this will reduce the chance of the fuel thickening and forming wax.

Note: A Diesel Fuel #1 & #2 combination (Blended Fuel) may be used, and is recommended for mild winter driving.

STARTING FLUID USE (DIESEL)

WARNING: DO NOT USE starting fluids (ether) or flammable liquids to aid the starting of a Diesel engine. NEVER pour diesel fuel, flammable liquids or starting fluids into the air cleaner canister, air intake or turbocharger housing in an attempt to start the vehicle. A flash fire may result causing personal injury.

ELECTRICAL SHOCK

WARNING: Contact with live components of ignition system while engine is running could lead to a fatal electric shock.

ELECTROSTATIC DISCHARGE SENSITIVE (ESD) PARTS

WARNING: Many solid state electrical components can be damaged by static electricity (ESD). Some will display a warning label, but many will not. Discharge personal static electricity by touching a metal ground point on the vehicle prior to servicing any ESD sensitive component.

ENGINE OIL

CAUTION: Never use non-detergent or straight mineral oil.

FUEL SYSTEM SERVICE

WARNING: Relieve fuel system pressure prior to servicing any fuel system component (fuel injection models).

HALOGEN BULBS

Halogen bulbs contain pressurized gas which may explode if overheated. DO NOT touch glass portion of bulb with bare hands. Eye protection should be worn when handling or working around halogen bulbs.

RADIATOR CAP

CAUTION: Always disconnect the fan motor when working near the radiator fan. The fan is temperature controlled and could start at any time even when the ignition key is in the OFF position. DO NOT loosen or remove radiator cap when cooling system is hot.

RADIATOR FAN

WARNING: Keep hands away from radiator fan. Fan is controlled by a thermostatic switch which may come on or run for up to 15 minutes even after engine is turned off.

END OF ARTICLE

G - TESTS W/CODES
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:32PM

ARTICLE BEGINNING

1993 ENGINE PERFORMANCE
Volkswagen Self-Diagnostics

EuroVan

INTRODUCTION

If no faults were found while performing preliminary inspection procedures, proceed with self-diagnostics. If no fault codes or only pass codes are present after entering self-diagnostics, proceed to H - TESTS W/O CODES article for diagnosis by symptom (i.e., ROUGH IDLE, NO START, etc.).

NOTE: Scan Tester (VAG 1551) must be used to make full use of the self-diagnostic system capabilities.

SELF-DIAGNOSTIC SYSTEM DESCRIPTION

Hard Failures

Hard failures of monitored sensors and/or components, cause Malfunction Indicator Light (MIL) to come on and remain on until problem is repaired. If malfunction indicator CHECK ENGINE light comes on and remains on during vehicle operation, cause of malfunction must be determined.

If malfunctions are present for more than 5 seconds, they are stored as Diagnostic Trouble Codes (DTCs) and will be displayed as a permanent malfunction even though the malfunction is not occurring at the time DTCs are displayed. Malfunctions that affect oxygen sensor control can only be read accurately after a test drive of at least 5 minutes.

Intermittent Failures

If a malfunction occurs for a maximum of 5 seconds, they are stored and considered to be "sporadic" (intermittent failures). When displayed on scan tester, malfunctions will have "SP" (sporadic) code.

RETRIEVING CODES

NOTE: See ENTERING SELF-DIAGNOSTICS for additional scan tester operating instructions.

EuroVan (2.5L)

1) Connect Scan Tester (VAG 1551) to Data Link Connectors (DLC) located below A/C-heater control panel (in fold-down storage shelf in front of relay panel on EuroVan). See Fig. 1. Attach Black connector first, wait for VAG ON-BOARD DIAGNOSTIC display (VAG SELF-DIAGNOSIS on EuroVan), then connect White connector. DO NOT connect scan tester Blue connector.

2) Turn ignition on. Operate scan tester and observe display.

Press "1" button to select RAPID DATA TRANSFER function. Press PRINT button to turn on printer. Indicator light on button should come on.

3) Press "0" and "1" buttons to select ENGINE ELECTRONICS function. Press "Q" button to enter input. Press right arrow button, then "0" and "2" buttons to select READ DTC MEMORY function. Press "Q" button to enter input.

4) Scan tester will display malfunction numbers (if any). If NO FAULTS (DTCs) RECOGNIZED is displayed, press right arrow button to return to RAPID DATA TRANSFER function.

5) If one or more DTCs are stored, look up DTCs and repair as necessary. After repairs, press "0" and "5" buttons to select ERASE DTC MEMORY function. Press "Q" button to enter input. After DTCs are erased, press right arrow button.

NOTE: On EuroVan, if ignition is turned off between reading and erasing DTC memory, DTC memory (fault codes) will not be erased.

6) Press "0" and "6" buttons to select END DATA TRANSFER function. Press "Q" button to enter input. Enter RAPID DATA TRANSFER function and test drive vehicle for at least 10 minutes (5 minutes on EuroVan).

7) During test drive, ensure that engine coolant temperature reaches 185øF (85øC). Ensure that accelerator pedal is momentarily, but completely pushed down (wide open throttle) at least once.

8) Ensure engine speed reaches at least 4600 RPM (3000 RPM on EuroVan). On Golf, GTI and Jetta, accelerate vehicle for 4 seconds with accelerator pedal pushed halfway down (transmission in 4th gear). On all models, select READ DTC MEMORY function once again to ensure DTCs (malfunctions) have been cleared (corrected).

ECM LOCATION

ECU/ECM LOCATION

Application	Location
EuroVan	In Left Side Of Engine Compartment, Behind Headlight

TROUBLE CODE IDENTIFICATION

TROUBLE CODE IDENTIFICATION (EUROVAN) (1)

DTC (2) (Blink) Code	System/ Affected Circuit	Possible Cause/Repair
65535 (4444)	No Fault	
00518 (2212)	Throttle Position Sensor	Open Ckt; Open/Short Ckt To Ground Or Battery

		Voltage
00519 (2222)	MAP Sensor	No Vacuum To ECM Or Faulty ECM
00521 (2242) (3)	Throttle Valve Potentiometer	Open Ckt; Open/Short Ckt To Ground Or Battery Voltage
00522 (2312)	Coolant Temp. Sensor	Open Ckt Or Short To Battery Voltage
00523 (2322)	Intake Air Temp. Sensor	Open Ckt; Open/Short Ckt To Ground Or Battery Voltage
00525 (2342)	Oxygen (O2) Sensor (Heated)	Open Ckt Or Short Ckt To Battery Voltage
00537 (2341)	Oxygen (O2) Sensor Control	Intake System Leaks Or Short Ckt To Battery Voltage
00545 (2142)	Transmission Control Module	Open Ckt (No Signal to ECM)
00532 (2234)	System Voltage	Battery Voltage Less Than 6.1 Volts Or More Than 15.5 Volts
01249 (4411)	Injector Drive Ckt	Open/Short Ckt To Ground Or Battery Voltage
65535 (1111)	Electronic Control Module	Replace Faulty ECM

(1) - For testing information, see J - PIN VOLTAGE CHARTS article.
(2) - Blink code is 4-digit malfunction indicator light code.
(3) - Code not applicable to California vehicles.

ÄÄ

ENTERING SELF-DIAGNOSTICS

VAG ON-BOARD DIAGNOSTICS

NOTE: If VAG SELF-DIAGNOSIS (VAG ON-BOARD DIAGNOSTIC) display does not appear on scan tester, check DLC terminals for battery voltage and ground. Upper terminal should have battery voltage, bottom terminals serve as ground.

EuroVan (2.5L)

1) Ensure battery voltage and fuse No. 22 are okay (fuses No. 15, 18 and 21 on EuroVan). Ensure engine/transmission ground connections are okay. Ground lead is located near or below intake manifold.

2) Connect Scan Tester (VAG 1551) to Data Link Connectors (DLC) located below A/C-heater control panel (in fold-down storage

shelf in front of relay panel on EuroVan). See Fig. 1. Attach Black connector first, wait for VAG ON-BOARD DIAGNOSTIC display (VAG SELF-DIAGNOSIS on EuroVan), then connect White connector. DO NOT connect scan tester Blue connector.

3) Turn ignition on or start engine depending on function being selected. See appropriate SELECTABLE FUNCTIONS table. Press "1" button to select RAPID DATA TRANSFER function.

4) Press "0" and "1" buttons to select ENGINE ELECTRONICS function. Press "Q" button to enter input. Electronic Control Module (ECM) identification will be displayed on scan tester.

5) If CONTROL MODULE DOES NOT ANSWER (RESPOND) message is displayed, press HELP button to print a list of possible causes. With scan tester in RAPID DATA TRANSFER function, press right arrow button. Press "00" to "09" buttons to select desired function. Press "Q" button to enter input.

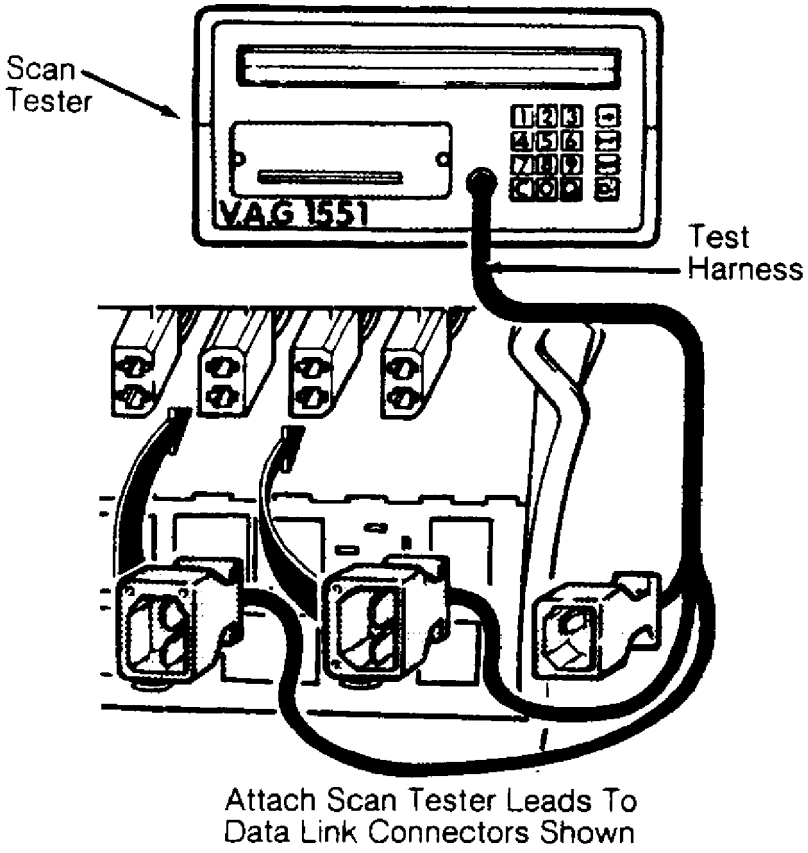

Fig. 1: Connecting Scan Tester To Data Link Connectors (EuroVan)
Courtesy of Volkswagen United States, Inc.

SELECTABLE FUNCTIONS (EUROVAN) (1)

Function	Ignition On	Engine On
02 (Read DTC Memory)	X	

03 (Output Diagnostic Test Mode)	X	.....	.....
04 (Initiate Basic Setting) ..	.....	.....	X
05 (Erase DTC Memory)	X	.....	.....
06 (End Data Transfer)	X	.....	X
08 (Read Measurement Block)	X	.....	X
09 (Read Individual 09 Measurements)	X	.....	X

(1) - Press HELP button at any time to obtain additional scan tester operating instructions.

OUTPUT CHECK DIAGNOSIS (OUTPUT DIAGNOSTIC TEST MODE)

NOTE: See ENTERING SELF-DIAGNOSTICS for additional scan tester operating instructions.

EuroVan (2.5L)

1) Connect Scan Tester (VAG 1551) to Data Link Connectors (DLC) located in fold-down storage shelf in front of relay panel. With scan tester in OUTPUT DIAGNOSTIC TEST MODE, the fuel pump relay, Idle Air Control (IAC) valve, and evaporative frequency (solenoid) valve may be actuated.

2) Press right arrow button to actuate fuel pump relay. Relay must click until test mode is switched to next output test by pressing the right arrow button. When actuating fuel pump relay, the fuel pump must also be running. If fuel pump relay does not actuate, test circuit using the J - PIN VOLTAGE CHARTS article in this section.

3) If fuel pump relay operates properly, press right arrow button to actuate IAC valve. IAC valve must click until test mode is switched to next output test by pressing the right arrow button.

4) If IAC valve does not actuate, connect Test Harness (VAG 1501) between IAC valve and wiring harness connector. See Fig. 2. Connect LED Tester (US 1115) between terminals No. 1 and 3 using jumper wires from Adapter Kit (VW 1594).

5) If LED tester blinks, replace IAC valve. If LED does not blink, test circuit using the J - PIN VOLTAGE CHARTS article in this section. If IAC valve and circuit are okay, replace ECM.

6) If IAC valve operates properly, press right arrow button to actuate evaporative frequency (solenoid) valve. If valve does not actuate, disconnect wiring harness connector from valve.

7) Connect LED tester between wiring harness connector terminals. If LED blinks, replace evaporative frequency (solenoid) valve. If LED does not blink, test circuit using the J - PIN VOLTAGE CHARTS article in this section. If evaporative frequency solenoid and circuit are okay, replace ECM.

8) With OUTPUT DIAGNOSTIC TEST MODE completed, select END DATA TRANSFER FUNCTION on scan tester. Turn ignition off. Disconnect scan tester. If ignition is not turned off before trying to re-start engine, the engine will not start, as the injectors and ignition transformer will not be actuated.

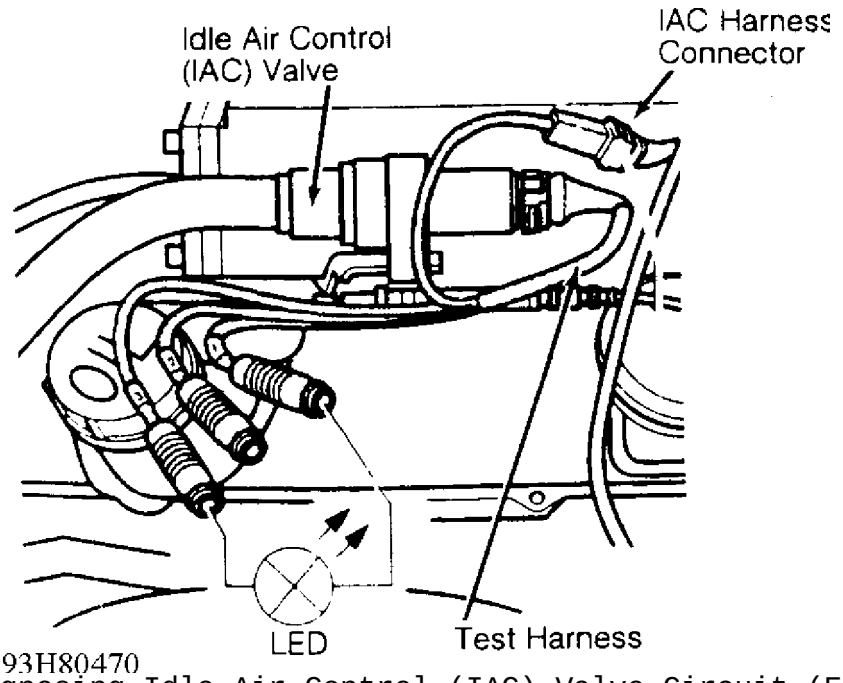

Fig. 2: Diagnosing Idle Air Control (IAC) Valve Circuit (EuroVan)
Courtesy of Volkswagen United States, Inc.

READ MEASUREMENT & READ MEASURING (TEST) VALUE BLOCK

NOTE: See ENTERING SELF-DIAGNOSTICS for additional scan tester operating instructions.

EuroVan (2.5L)

1) Connect Scan Tester (VAG 1551) to Data Link Connectors (DLC) located below A/C-heater control panel (in fold-down storage shelf in front of relay panel on EuroVan). With scan tester in READ MEASUREMENT (MEASURING VALUE) BLOCK function, press "00" to "06" buttons to select desired display group. See appropriate DISPLAY GROUP table.

2) When display group "00" is selected, only READ MEASUREMENT BLOCK is shown on display (the zeros do not appear on display). With READ MEASUREMENT BLOCK function completed, select END DATA TRANSFER function on scan tester. Turn ignition off. Disconnect scan tester.

DISPLAY GROUP (EUROVAN)

Display Group Number & Channel Number	Display Parameters
00	..... Used Only For Testing Vehicle At the Factory
01	
1	..... Engine Coolant Temperature
2	..... Engine Speed
3	..... Oxygen Sensor Signal Voltage
4	..... Ignition Timing
02	

```
 1  ......................  Engine Coolant Temperature
 2  ....................................  Engine Speed
 3  .................................  Throttle Angle
 4  ....................................  Engine Load
03
 1  ......................  Engine Coolant Temperature
 2  ....................................  Engine Speed
 3  ..........................  Intake Air Temperature
 4  .................................  Battery Voltage
04
 1  ......................  Engine Coolant Temperature
 2  ....................................  Engine Speed
 3  .................................  Ignition Timing
 4  ....................................  Engine Load
05
 1  ......................  Engine Coolant Temperature
 2  ....................................  Engine Speed
 3  .................................  Throttle Angle
 4  .................................  Battery Voltage
```

CLEARING CODES

See RETRIEVING CODES.

ECM LOCATION

ECU/ECM LOCATION

Application	Location
EuroVan	In Left Side Of Engine Compartment, Behind Headlight

SUMMARY

If no hard fault codes (only "sporadic" codes) are present, driveability symptoms exist or intermittent codes exist, proceed to the H - TESTS W/O CODES article for diagnosis by symptom (i.e., ROUGH IDLE, NO START, etc.) or intermittent diagnostic procedures.

END OF ARTICLE

GEAR TOOTH CONTACT PATTERNS
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:33PM

ARTICLE BEGINNING

GENERAL INFORMATION
Gear Tooth Contact Patterns

*** PLEASE READ THIS FIRST ***

The following article is for GENERAL INFORMATION purposes only. Information does not SPECIFICALLY apply to all years, makes and models, but is to be used as a general reference guide.

INSPECTION

PRELIMINARY INSPECTION

Wipe lubricant from internal parts. Rotate gears and inspect for wear or damage. Mount dial indicator to housing, and check backlash at several points around ring gear. Backlash must be within specifications at all points. If no defects are found, check gear tooth contact pattern.

GEAR TOOTH CONTACT PATTERN

NOTE: Drive pattern should be well centered on ring gear teeth. Coast pattern should be centered, but may be slightly toward toe of ring gear teeth.

1) Paint ring gear teeth with marking compound. Wrap cloth or rope around drive pinion flange to act as brake. Rotate ring gear until clear tooth contact pattern is obtained.
2) Contact pattern will indicate whether correct pinion bearing mounting shim has been installed and if drive gear backlash has been set properly. Backlash between drive gear and pinion must be maintained within specified limits, until correct tooth pattern is obtained.

GEAR TOOTH CONTACT PATTERNS

Article Text (p. 2)

1993 Volkswagen EuroVan

For Volkswagen Technical Site

Saturday, March 18, 2000 10:33PM

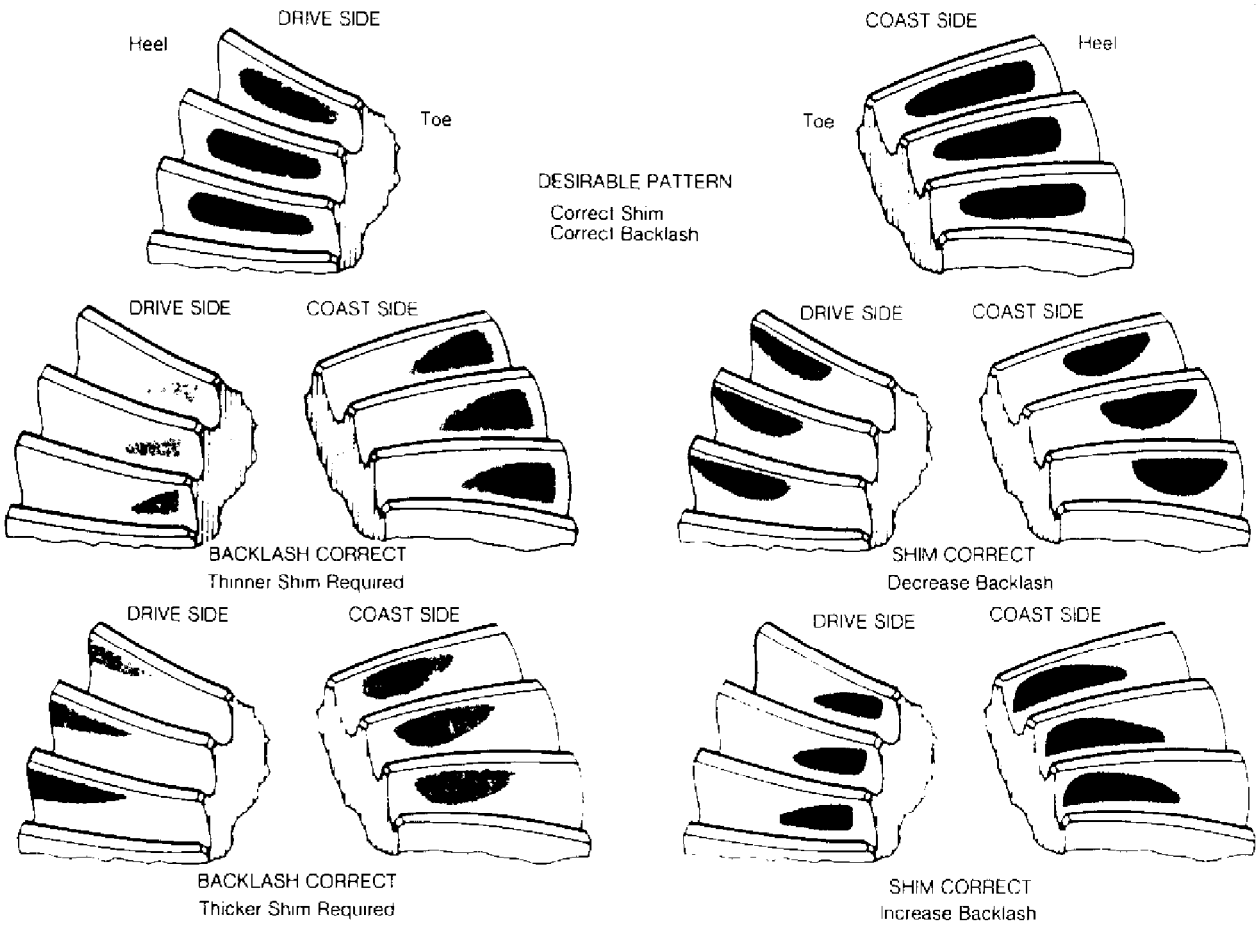

Fig. 1: Drive Axle Gear Tooth Patterns

ADJUSTMENTS

GEAR BACKLASH & PINION SHIM CHANGES

NOTE: Backlash is adjusted by either moving shims from one side of differential case to the other or by turning adjusting nuts on which side bearing races ride. Changing of pinion shims alters the distance from face of pinion of centerline of ring gear.

1) With no change in backlash, moving pinion further from ring gear moves drive pattern toward heel and top of tooth, and moves coast pattern toward toe and top of tooth.

2) With no change in backlash, moving pinion closer to ring gear moves drive pattern toward toe and bottom of tooth, and moves coast pattern toward heel and bottom of tooth.

3) With no change in pinion shim thickness, an increase in backlash moves ring gear further from pinion. Drive pattern moves toward heel and top of tooth, and coast pattern moves toward heel and top of tooth.

4) With no change in pinion shim thickness, decrease in backlash moves ring gear closer to pinion gear. Drive pattern moves toward toe and bottom of tooth, and coast pattern moves toward toe and bottom of tooth.

END OF ARTICLE

GENERAL COOLING SYSTEM SERVICING
Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:33PM

ARTICLE BEGINNING

GENERAL INFORMATION
General Cooling System Servicing

*** PLEASE READ THIS FIRST ***

The following article is for general information only. Information may not apply to all years, makes and models. See specific article in the ENGINE COOLING section.

DESCRIPTION

The basic liquid cooling system consists of a radiator, water pump, thermostat, electric or belt-driven cooling fan, pressure cap, heater, and various connecting hoses and cooling passages in the block and cylinder head.

MAINTENANCE

DRAINING

Remove radiator cap and open heater control valve to maximum heat position. Open drain cocks or remove plugs in bottom of radiator and engine block. In-line engines usually have one plug or drain cock, while "V" type engines will have 2, one in each bank of cylinders.

CLEANING

A good cleaning compound removes most rust and scale. Follow manufacturer's instructions in the use of cleaner. If considerable rust and scale has to be removed, cooling system should be flushed. Clean radiator air passages with compressed air.

FLUSHING

CAUTION: Some manufacturers use an aluminum and plastic radiator. Flushing solution must be compatible with aluminum.

Back Flushing
Back flushing is an effective means of removing cooling system rust and scale. The radiator, engine and heater core should be flushed separately.

Radiator
To flush radiator, connect flushing gun to water outlet of radiator and disconnect water inlet hose. To prevent flooding engine, use a hose connected to radiator inlet. Use air in short bursts to prevent damage to radiator. Continue flushing until water runs clear.

Engine

To flush engine, remove thermostat and replace housing. Connect flushing gun to water outlet of engine. Flush using short air bursts until water runs clean.

Heater Core

Flush heater core as described for radiator. Ensure heater control valve is set to maximum heat position before flushing heater.

REFILLING

To prevent air from being trapped in engine block, engine should be running when refilling cooling system. After system is full, continue running engine until thermostat is open, then recheck fill level. Do not overfill system.

TESTING

THERMOSTAT

1) Visually inspect thermostat for corrosion and proper sealing of valve and seat. If okay, suspend thermostat and thermometer in a 50/50 mixture of coolant and water. See Fig. 1. Do not allow thermostat or thermometer to touch bottom of container. Heat water until thermostat just begins to open.

2) Read temperature on thermometer. This is the initial opening temperature and should be within specification. Continue heating water until thermostat is fully open and note temperature. This is the fully opened temperature. If either reading is not to specification, replace thermostat.

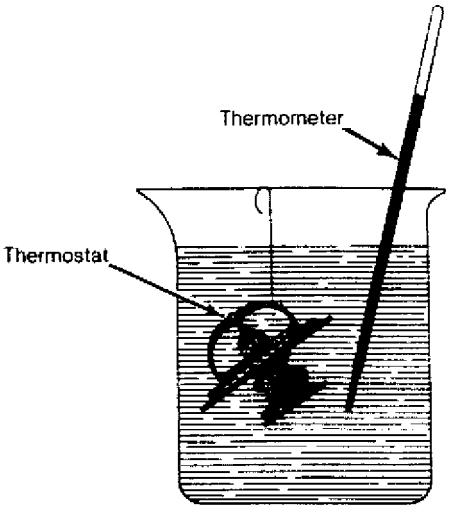

Fig. 1: Testing Thermostat in Anti-Freeze/Water Solution

PRESSURE TESTING

A pressure tester is used to check both radiator cap and complete cooling system. Test components as follows, following tool

manufacturer's instructions.

Radiator Cap

Visually inspect radiator cap, then dip cap into water and connect to tester. Pump tester to bring pressure to upper limit of cap specification. If cap fails to hold pressure, replace cap.

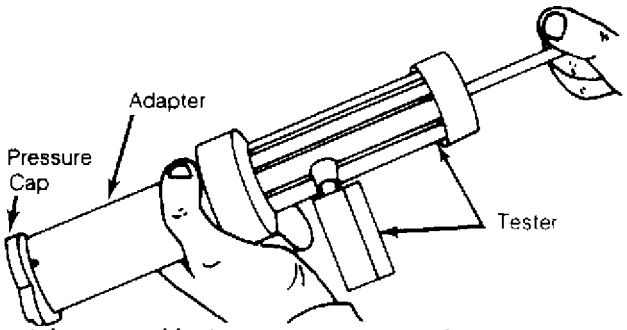

Fig. 2: Testing Radiator Pressure Cap

Cooling System

1) With engine off, wipe radiator filler neck seat clean. Fill radiator to correct level. Attach tester to radiator and pump until pressure is at upper level of radiator rating.

2) If pressure drops, inspect for external leaks. If no leaks are apparent, detach tester and run engine until normal operating temperature is reached. Reattach tester and observe. If pressure builds up immediately, a possible leak exists from a faulty head gasket or crack in head or block.

NOTE: Pressure may build up quickly. Release any excess pressure or cooling system damage may result.

3) If there is no immediate pressure build up, pump tester to within system pressure range (on radiator cap). Vibration of gauge pointer indicates compression or combustion leak into cooling system. Isolate leak by shorting each spark plug wire to cylinder block. Gauge pointer should stop or decrease vibration when leaking cylinder is shorted.

END OF ARTICLE

H - TESTS W/O CODES
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:33PM

ARTICLE BEGINNING

1993 ENGINE PERFORMANCE
Volkswagen Trouble Shooting - No Codes

Cabriolet, Corrado SLC, EuroVan, Fox
Golf, GTI, Jetta, Passat GL, Passat GLX

INTRODUCTION

PRELIMINARY INFORMATION

Before diagnosing symptoms or intermittent faults, perform steps in the F - BASIC TESTING article in this section. Use this article to diagnose driveability problems existing when a hard fault code is not present or vehicle is not equipped with a self-diagnostic system.

NOTE: Some driveability problems may have been corrected by manufacturer with a revised computer calibration chip or computer control unit. Check with manufacturer for latest chip or computer application.

Symptom checks can direct the technician to malfunctioning component(s) for further diagnosis. A symptom should lead to a specific component, system test or an adjustment.
Use intermittent test procedures to locate driveability problems that DO NOT occur when the vehicle is being tested. These test procedures should also be used if a soft (intermittent) trouble code was present, but no problem was found during self-diagnostic testing.

NOTE: For specific test procedures, see the I - SYS/COMP TESTS article in this section. For adjustment procedures, see the appropriate D - ADJUSTMENTS article. For Engine Performance related specifications, see appropriate C - SPECIFICATIONS article in this section. See the following menus:

C - SPECIFICATIONS ARTICLES MENU

NOTE: For the appropriate C - SPECIFICATIONS article, go to:

* For Cabriolet, see: C - SPECIFICATIONS
* For Corrado SLC, see: C - SPECIFICATIONS
* For EuroVan, see: C - SPECIFICATIONS
* For Fox, see: C - SPECIFICATIONS
* For Golf, GTI, Jetta, see: C - SPECIFICATIONS
* For Passat, see: C - SPECIFICATIONS

D - ADJUSTMENTS ARTICLES MENU

NOTE: For the appropriate D - ADJUSTMENTS article, go to:

* For Cabriolet, see: D - ADJUSTMENTS
* For Corrado SLC, see: D - ADJUSTMENTS
* For EuroVan, see: D - ADJUSTMENTS
* For Fox, see: D - ADJUSTMENTS
* For Golf, GTI, Jetta, see: D - ADJUSTMENTS
* For Passat GL 2.0L 4-Cylinder, see: D - ADJUSTMENTS - 4-CYL
* For Passat GLX 2.8L VR6, see: D - ADJUSTMENTS - VR6

I - SYS/COMP TESTS ARTICLES MENU

NOTE: For the appropriate I - SYS/COMP TESTS article, go to:

* For Cabriolet, see: I - SYSTEM/COMPONENT TESTS
* For Corrado SLC, see: I - SYSTEM/COMPONENT TESTS
* For EuroVan, see: I - SYSTEM/COMPONENT TESTS
* For Fox, see: I - SYSTEM/COMPONENT TESTS
* For Golf, GTI, Jetta, see: I - SYSTEM/COMPONENT TESTS
* For Passat GL 2.0L 4-Cylinder, see: I - SYSTEM/COMPONENT TESTS - 4-CYL
* For Passat GLX 2.8L VR6, see: I - SYSTEM/COMPONENT TESTS - VR6

SYMPTOMS

SYMPTOM DIAGNOSIS

Symptom checks cannot be used properly unless the problem is actually happening while the vehicle is being tested. To reduce diagnostic time, ensure battery voltage is okay and starter motor turns engine over before attempting to diagnose a symptom.

Check engine mechanical condition (compression pressure, valve timing, etc.), wiring harness and connections (terminals not corroded or pushed back), and vacuum hose (not disconnected or leaking).

Also check for correct tire sizes, as recommended by manufacturer. Ensure wheels rotate freely (brake drag or bad wheel bearings). Ensure no speed reducing accessories are installed. Symptoms available for diagnosis include the following.

* Engine Does Not Start Or Is Difficult To Start When Cold
* Engine Does Not Start Or Is Difficult To Start When Warm
* Uneven Idle Or No Idle With Cold Engine Or During Warm-Up
* Engine Starts But Stalls
* Idle Speed Exceeds Specification
* Poor Acceleration With Cold Engine Or During Warm-Up
* Engine Stalls While Driving
* Poor Performance
* Engine Run-On (Dieseling)
* High Fuel Consumption
* Engine Knock
* Engine Runs Unevenly Over Entire Speed Range

NOTE: Symptoms listed are for CIS-E Motronic system. When working on Digifant and Motronic systems, use symptoms listed only as a diagnostic guide. A list of specific symptoms for Digifant and Motronic systems is not available from manufacturer.

ENGINE DOES NOT START OR IS DIFFICULT TO START WHEN COLD

* Check for insufficient fuel in tank.
* Check fuel pump relay and fuel pump.
* Check fuel system for leaks.
* Check auxiliary air intake system.
* Check fuel system after-start, acceleration enrichment and warm-up circuits.
* Check cold-start valve.
* Check airflow sensor lever adjustment and control plunger.
* Check sensor plate rest position and idle circuit.
* Check fuel system differential and residual pressures.
* Check fuel injection volume.
* Check engine coolant temperature sensor.
* Check ignition timing, spark plugs, distributor, secondary ignition wiring and coil.
* Check Hall Effect sensor.
* Check ignition coil power output stage.

ENGINE DOES NOT START OR IS DIFFICULT TO START WHEN WARM

* Check radiator cooling fan after-run circuit.
* Check fuel pump check valve.
* Check fuel evaporative frequency solenoid(s).
* Check fuel system for leaks.
* Check auxiliary air intake system.
* Check idle speed.
* Check fuel system after-start, acceleration enrichment and warm-up circuits.
* Check cold-start valve.
* Check injector fuel pressure and volume.
* Check sensor plate rest position and idle circuit.
* Check sealing ring under control plunger.
* Check fuel system differential and residual pressures.
* Check engine coolant temperature sensor.
* Check ignition timing, spark plugs, distributor, secondary ignition wiring and coil.

UNEVEN IDLE OR NO IDLE WITH COLD ENGINE OR DURING WARM-UP

* Check fuel evaporative frequency solenoid(s).
* Check fuel system for leaks.
* Check auxiliary air intake system.
* Check idle speed.
* Check oxygen sensor control circuit.

* Check cold-start valve.
* Check injector fuel pressure and volume.
* Check throttle potentiometer.
* Check fuel system differential and residual pressures.
* Check idle switch.
* Check engine coolant temperature sensor.
* Check exhaust system.
* Check ignition timing and spark plugs.

ENGINE STARTS BUT STALLS

* Check fuel pump relay and fuel pump.
* Check auxiliary air intake system.
* Check idle speed.
* Check fuel system after-start, acceleration enrichment and warm-up circuits.
* Check airflow sensor lever adjustment and control plunger.
* Check sensor plate rest position and idle circuit.
* Check fuel system differential and residual pressures.
* Check idle switch.
* Check engine coolant temperature sensor.

IDLE SPEED EXCEEDS SPECIFICATION

* Check throttle cable adjustment.
* Check fuel evaporative frequency solenoid(s).
* Check auxiliary air intake system.
* Check idle speed.
* Check throttle potentiometer.
* Check idle switch.
* Check engine coolant temperature sensor.
* Check throttle body basic adjustment.
* Check ignition timing.

POOR ACCELERATION WITH COLD ENGINE OR DURING WARM-UP

* Check fuel pump.
* Check auxiliary air intake system.
* Check oxygen sensor control circuit.
* Check fuel system after-start, acceleration enrichment and warm-up circuits.
* Check airflow sensor lever adjustment and control plunger.
* Check throttle potentiometer.
* Check fuel system differential and residual pressures.
* Check injector fuel pressure and volume.
* Check idle switch.
* Check engine coolant temperature sensor.
* Check throttle body basic adjustment.
* Check exhaust system.
* Check ignition timing, spark plugs, distributor, secondary ignition wiring and coil.

ENGINE STALLS WHILE DRIVING

* Check fuel pump.
* Check auxiliary air intake system.
* Check injector fuel pressure and volume.
* Check idle and full throttle switches.
* Check intake air preheating system.
* Check ignition timing, spark plugs, distributor, secondary ignition wiring and coil.

POOR PERFORMANCE

* Check fuel pump.
* Check throttle cable adjustment.
* Check auxiliary air intake system.
* Check airflow sensor lever adjustment and control plunger.
* Check throttle potentiometer.
* Check fuel system differential and residual pressures.
* Check injector fuel pressure and volume.
* Check full throttle switch.
* Check mass airflow sensor (if equipped).
* Check intake air preheating system.
* Check catalytic converter.
* Check ignition timing.

ENGINE RUN-ON (DIESELING)

* Check fuel evaporative frequency solenoid(s).
* Check fuel system for leaks.
* Check cold-start valve.
* Check injector fuel pressure and volume.
* Check airflow sensor lever adjustment and control plunger.

HIGH FUEL CONSUMPTION

* Check fuel system for leaks.
* Check oxygen sensor control circuit.
* Check cold-start valve.
* Check injector fuel pressure and volume.
* Check airflow sensor lever adjustment and control plunger.
* Check throttle potentiometer.
* Check injector fuel pressure and volume.
* Check full throttle switch.
* Check mass airflow sensor (if equipped).
* Check intake air preheating system.
* Check exhaust system for leaks (between cylinder and oxygen (O2) sensor).
* Check ignition timing.

ENGINE KNOCK

* Check knock sensors (if equipped).

* Check full throttle switch.
* Check ignition timing.

ENGINE RUNS UNEVENLY OVER ENTIRE SPEED RANGE

* Check auxiliary air intake system.
* Check injector fuel pressure and volume.
* Check ignition timing, spark plugs, distributor, secondary ignition wiring and coil.

INTERMITTENTS

INTERMITTENT PROBLEM DIAGNOSIS

Intermittent fault testing requires duplicating circuit or component failure to identify the problem. These procedures may lead to the computer setting a fault code (on some systems) which may help in diagnosis.

If problem vehicle does not produce fault codes, monitor voltage or resistance values using a DVOM while attempting to reproduce conditions causing intermittent fault. A status change on DVOM indicates a fault has been located.

Use a DVOM to pinpoint faults. When monitoring voltage, ensure ignition switch is in ON position or engine is running. Ensure ignition switch is in OFF position or negative battery cable is disconnected when monitoring circuit resistance. Status changes on DVOM during test procedures indicate area of fault.

TEST PROCEDURES

Intermittent Simulation

To reproduce the conditions creating an intermittent fault, use the following methods:

* Lightly vibrate component.
* Heat component.
* Wiggle or bend wiring harness.
* Spray component with water.
* Remove/apply vacuum source.

Monitor circuit/component voltage or resistance while simulating intermittent. If engine is running, monitor for self-diagnostic codes. Use the test results to identify a faulty component or circuit. For system or component testing refer to the appropriate I - SYS/COMP TESTS article in this section. See the menu below:

* For Cabriolet, see: I - SYSTEM/COMPONENT TESTS
* For Corrado SLC, see: I - SYSTEM/COMPONENT TESTS
* For EuroVan, see: I - SYSTEM/COMPONENT TESTS
* For Fox, see: I - SYSTEM/COMPONENT TESTS
* For Golf, GTI, Jetta, see: I - SYSTEM/COMPONENT TESTS
* For Passat GL 2.0L 4-Cylinder, see:

```
   I - SYSTEM/COMPONENT TESTS - 4-CYL
*  For Passat GLX 2.8L VR6, see:
   I - SYSTEM/COMPONENT TESTS - VR6
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END OF ARTICLE

HEATER SYSTEM
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:33PM

ARTICLE BEGINNING

1993 HEATER SYSTEMS
Volkswagen United States, Inc.

EuroVan

NOTE: The gas-fired auxiliary heater is not covered in this article.

DESCRIPTION

This vehicle uses a flow-through ventilation and heating system. Air flows through grille below engine compartment hood and into passenger compartment. Interior compartment air is drawn out of vehicle through vents at rear of vehicle. The vents are located at bottom of each "D" pillar.

CAUTION: When battery is disconnected, radio will go into anti-theft protection mode. Obtain radio anti-theft protection code from owner prior to servicing vehicle.

AIR BAG SYSTEM PRECAUTIONS

SYSTEM OPERATION CHECK

Two lights pertaining to air bag system are located directly above air bag symbol in instrument cluster. Control light is used to indicate readiness of system. With ignition on, control light comes on for about 5-8 seconds then goes out, while diagnosis unit in air bag control unit performs an electronic test cycle of system.

If control light does not function as described, a fault probably exists in system. If fault occurs while ignition is on, it will be stored in fault memory. Warning light will then come on, and air bag system will be switched off. If warning light comes on or flickers while driving, air bag system should be tested.

SERVICE PRECAUTIONS

Observe these precautions when working with air bag systems:

* DO NOT use computer memory saver tool. Using computer memory tool will keep air bag system active and may cause accidental deployment of air bag unit.
* Disable air bag system before servicing any air bag system or steering column component. See DISABLING & ACTIVATING AIR BAG SYSTEM.
* Because of critical operating requirements of system, DO NOT attempt to service any air bag system component.
* DO NOT leave air bag parts unattended. Install parts in vehicle immediately after obtaining.

* DO NOT use air bag components that have been dropped from height of more than 18 inches.
* DO NOT allow chemical cleaners, oil and grease to contact vinyl covering on air bag unit.
* DO NOT place stickers or covers on steering wheel.
* Always disable air bag system before performing electric welding on vehicle.
* Air bag system can only be tested using Diagnostic Tester (VAG 1551) and Multimeter (US-1119). Never use test light on air bag system.
* DO NOT expose air bag unit to temperatures greater than 194øF (90øC).

DISABLING & ACTIVATING AIR BAG SYSTEM

WARNING: System voltage is retained for about 20 MINUTES after system is deactivated. Wait about 20 MINUTES after system is disabled before servicing, as air bag may accidentally deploy, causing personal injury.

Disabling & Activating System

To disable system, disconnect negative battery cable. Wait 20 MINUTES before working on vehicle. To activate system, reconnect negative battery cable. Verify system is functioning properly. See SYSTEM OPERATION CHECK.

OPERATION

AIR RECIRCULATION SWITCH

A rectangular air recirculation switch is located above heater control panel. This switch, through a solenoid and vacuum servo, opens and closes a flap that is located in air inlet duct. See Fig. 3. When flap is open, outside air enters vehicle. When flap is closed, the vehicle's interior compartment air is recirculated to help prevent exhaust or harmful fumes from entering vehicle.

HEATER CONTROL PANEL

Three slide levers and a fan switch rotary knob are used on control panel. Top left lever is used to control airflow to footwells. Top right lever is used to control airflow to head (upper body) area.

Bottom slide lever controls temperature. Depending on position of levers, fresh (cool) air or heated air flows out of vents.

A rear heater blower motor switch, located above heater control panel, has 3 fan speeds. See Fig. 1. Temperature setting for front heater is also the temperature setting for the rear heater.

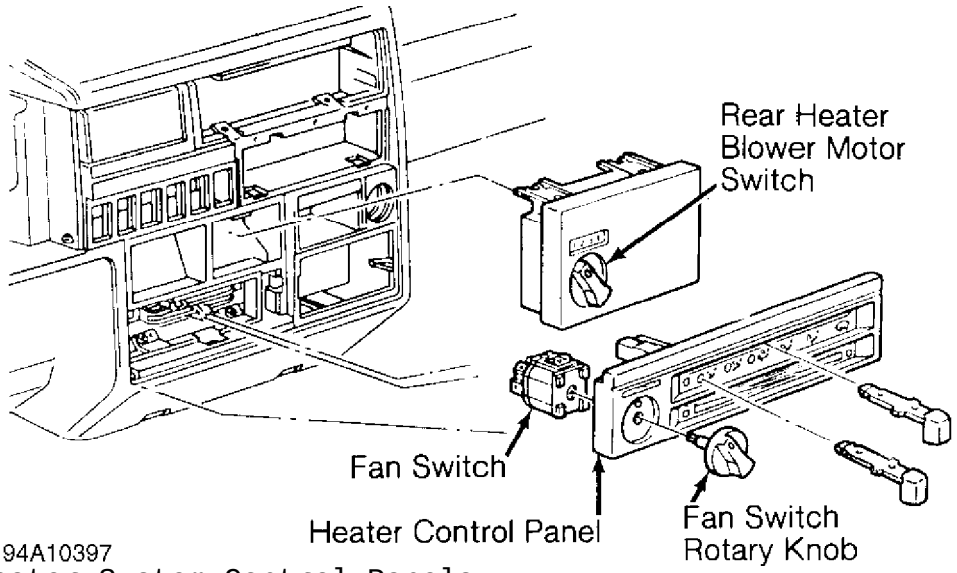


Fig. 1: Heater System Control Panels
Courtesy of Volkswagen United States, Inc.

HEATER SYSTEM

Front

The front heater system uses a heater control valve and is cable operated. The heater control valve is located on left side of engine compartment, below brake booster. See Fig. 2.

The cable-actuated heater control valve, controls temperature for both front and rear heater systems. Air distribution is controlled by defroster flap and footwell flap cables.

Rear

The rear heater, located underneath vehicle, is standard equipment on all models. Engine coolant is supplied to rear heater core by 2 heater hoses. The intake for the rear heater is located in the sliding door footwell, allows interior air to be recirculated through the heater core for greater efficiency.

A blower motor forces air through heater core, and out of an adjustable vent. On EuroVan CL, rear air outlet vent is located between middle row of seats. On EuroVan MV, rear air outlet vent is located underneath right jump seat.

ADJUSTMENTS

COOLING SYSTEM BLEEDING

1) Place heater control panel to maximum heat position. Remove cap from coolant expansion tank. Open cooling system bleed screw (on heater hose to heater control valve). See Fig. 2.

2) Fill coolant expansion tank to MAX line. Close bleed screw. Run engine at fast idle speed. Check coolant level and add as necessary. Install cap on coolant expansion tank. Run engine until cooling fan comes on.

3) Check coolant level once again and add coolant as necessary. With engine at operating temperature, coolant level must be slightly above MAX line. With engine cold, level must fall between MAX and MIN lines.

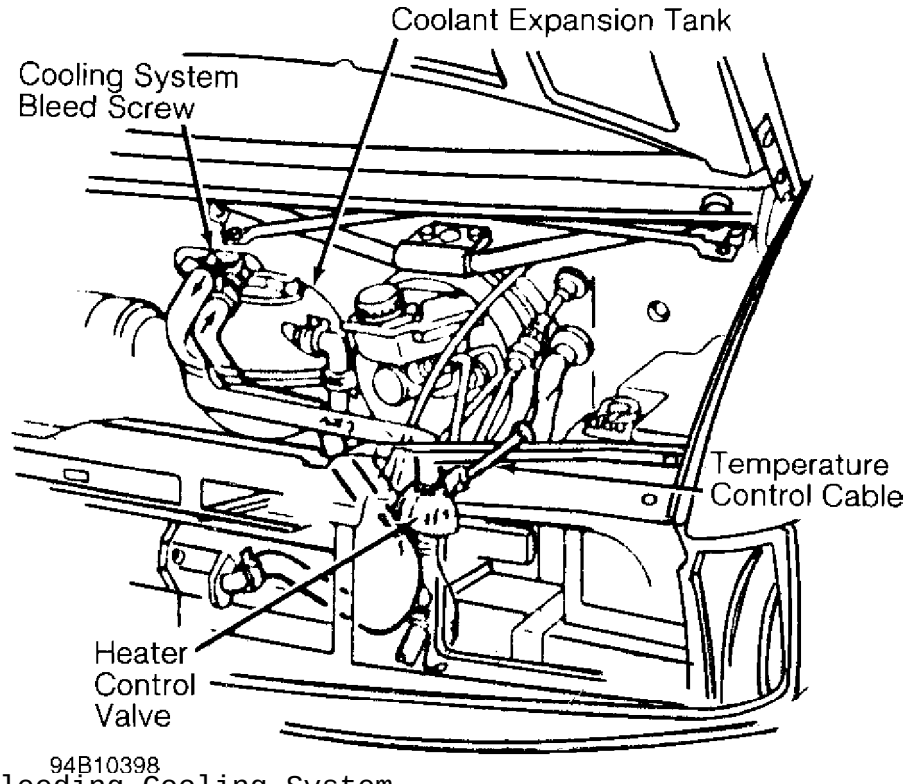


Fig. 2: Bleeding Cooling System
Courtesy of Volkswagen United States, Inc.

HEATER CONTROL PANEL CABLES

1) Before installing heater control panel, attach cables onto panel. Position cable sleeves on stops, and secure cables with clips.

2) Push temperature control cable through firewall and into engine compartment. See Fig. 2. Slide temperature control lever to left stop. Slide control lever on heater control valve away from cable retaining clip (no coolant flow). Hold heater control valve lever in this position, and attach cable.

3) Slide defroster (top right) lever to left stop. Slide defroster flap lever toward cable retaining clip. Hold defroster flap lever in this position and attach cable.

4) Slide footwell (top left) lever to right stop. Slide footwell flap lever away from cable retaining clip. Hold footwell flap lever in this position and attach cable.

5) To complete adjustment, move control lever(s) from stop to stop. The cables for the defroster and footwell flaps are self-adjusting. See Fig. 3.

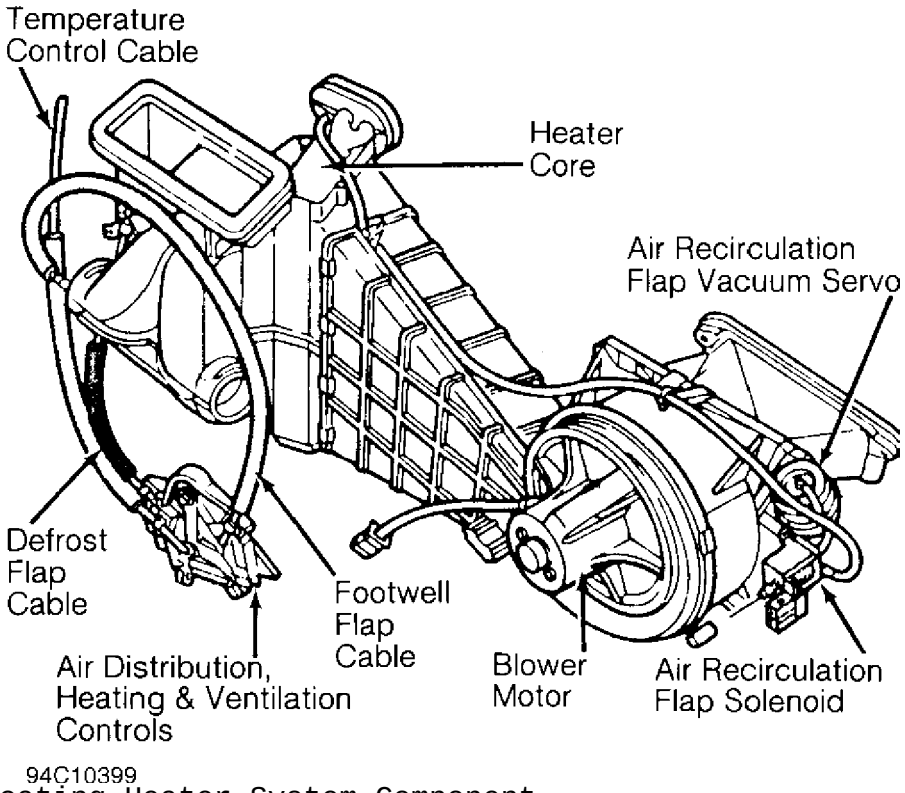


Fig. 3: Locating Heater System Component
Courtesy of Volkswagen United States, Inc.

TESTING

Testing information is not available from manufacturer. Use wiring diagram as a guide. See WIRING DIAGRAM.

REMOVAL & INSTALLATION

WARNING: To avoid injury from accidental air bag deployment, read and carefully follow all SERVICE PRECAUTIONS and DISABLING & ACTIVATING AIR BAG SYSTEM procedures.

BLOWER MOTOR & RESISTOR

Removal & Installation (Front)

1) Open glove box. Remove glove box light, and disconnect wiring harness. Remove 7 screws and glove box. Disconnect wiring harness from blower motor resistor. Remove blower motor resistor (if necessary).

2) Disengage locking tab, and rotate blower motor clockwise. To remove blower motor, pull blower motor toward center of instrument panel. To install blower motor or resistor, reverse removal procedure. See Fig. 4.

Removal & Installation (Rear)

Raise and support vehicle. Locate rear heater housing underneath vehicle. Disconnect wiring harness from rear blower motor. Remove rear blower motor. To install rear blower motor, reverse removal procedure.

NOTE: Rear blower motor resistor removal and installation procedure is not available from manufacturer. Rear blower motor resistor is located on left side of engine compartment.

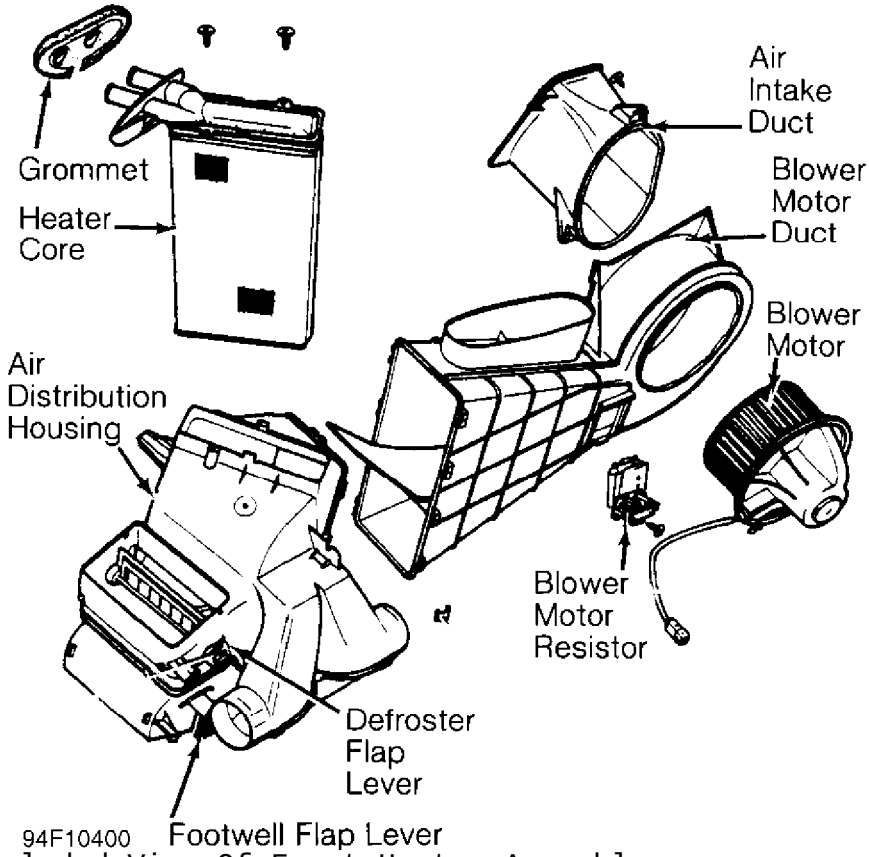


Fig. 4: Exploded View Of Front Heater Assembly
Courtesy of Volkswagen United States, Inc.

BLOWER MOTOR SWITCH

Removal & Installation (Rear Heater)

Using a screwdriver, carefully pry blower motor switch (located above heater control panel) from instrument panel. Disconnect wiring harness and remove switch. To install switch, reverse removal procedure.

HEATER CONTROL PANEL

Removal

Remove fan switch rotary knob. See Fig. 1. Remove air distribution/temperature control levers. Remove heater control panel screws. Pull heater control panel away from instrument panel. Detach

heater control panel cables.

Installation

Attach and adjust heater control cables. See HEATER CONTROL PANEL CABLES under ADJUSTMENTS. To complete installation, reverse removal procedure.

FRONT HEATER CORE

Removal (Front)

1) Obtain radio anti-theft protection code from owner prior to servicing vehicle. Open hood. Disconnect negative battery cable. Remove 3 screws and air intake duct from engine compartment side of firewall.

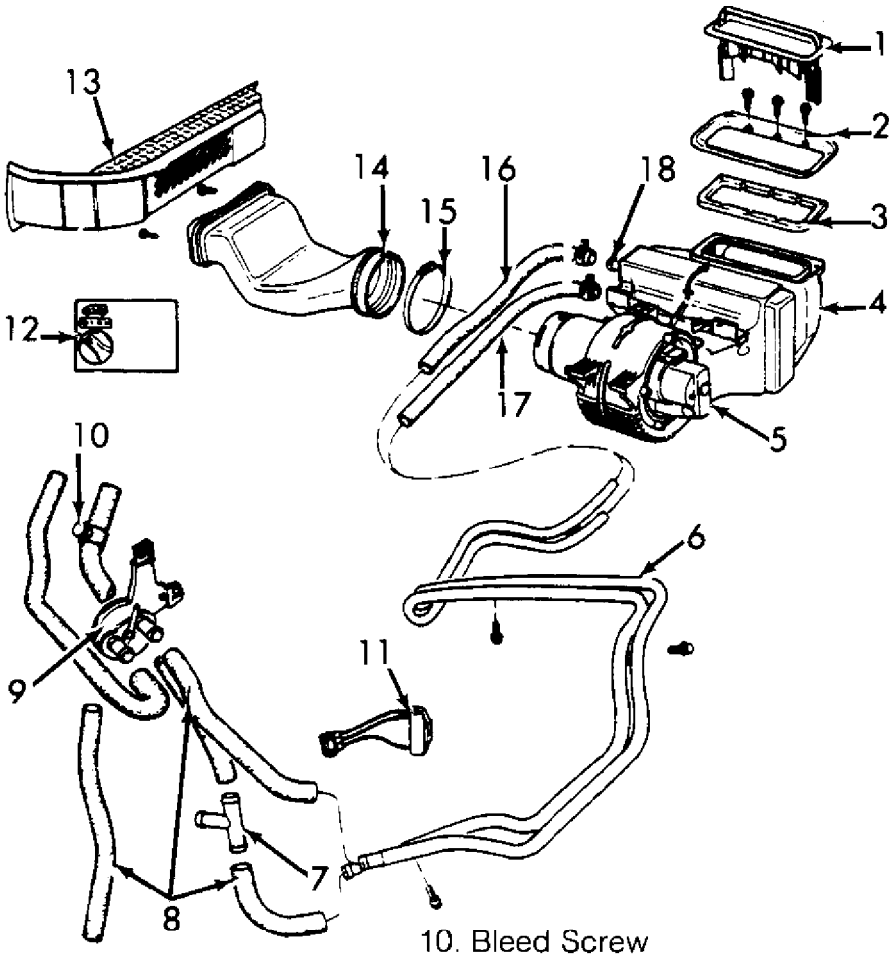
2) Open glove box. Remove glove box light, and disconnect wiring harness. Remove 7 screws and glove box. Remove right air duct. Carefully remove vent from center air outlet. Remove screws, and carefully pry out center air outlet.

3) Remove center air duct (if equipped). Detach control cables from heater housing. Disconnect wiring harness form blower motor resistor. Remove footwell air outlet console and cover.

4) Disconnect temperature control cable from heater control valve (in engine compartment). Disconnect heater hoses, and plug openings. Remove screws, on engine compartment side of firewall, and remove heater assembly. Disassemble air distribution housing to remove heater core. See Fig. 4.

Installation (Front)

To install, reverse removal procedure. Install seal around entire circumference of heater core so there are no gaps.



1. Air Outlet Vent
2. Cover Plate
3. Seal
4. Air Distribution Housing
5. Blower Motor
6. Coolant Pipes
7. "T" Fitting
8. Coolant Hoses (In Engine Compartment)
9. Heater Control Valve
10. Bleed Screw
11. Blower Motor Resistor (In Engine Compartment)
12. Blower Motor Switch
13. Sliding Door Footwell Insert
14. Air Intake Duct
15. Clamp
16. Coolant Return Hose
17. Coolant Supply Hose
18. Heater Core

Fig. 5: Identifying Rear Heater Components (EuroVan CL)
Courtesy of Volkswagen United States, Inc.

REAR HEATER CORE

Removal

1) On EuroVan CL, locate rear air outlet vent between middle row of seats. Pull up on rear air outlet vent to remove. Remove rear air outlet vent cover plate.

2) On EuroVan MV, locate rear air outlet vent underneath right jump seat. Remove screws from top of rear air outlet vent. Using a screwdriver, carefully unlock latch from bottom edge of rear air

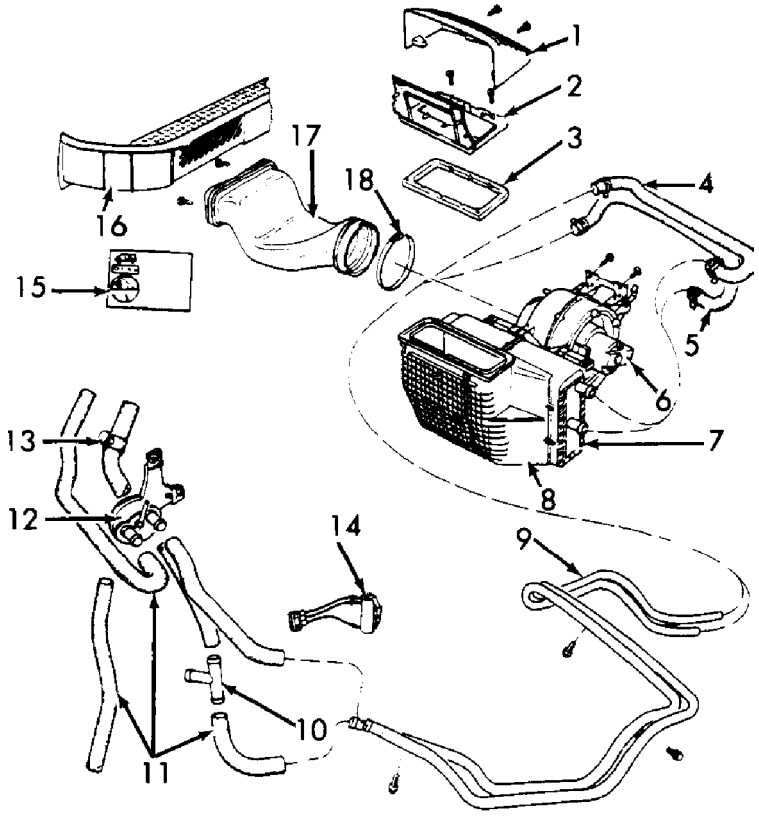
outlet vent. Remove rear air outlet vent bracket.

3) On all models, raise and support vehicle. Locate rear heater housing underneath vehicle. Disconnect wiring harness from rear heater housing. Detach heater hoses from heater core. See Fig. 5 or 6. Remove rear heater housing or heater core as necessary.

4) If air duct removal is necessary, remove sliding door footwell insert. Remove air duct screws. Loosen air duct clamp and remove air duct. If rear heater hose removal is necessary, remove fuel tank. Remove torsion bar. Remove rear heater hoses.

Installation

To install, reverse removal procedure. Install seal around entire circumference of heater core so there are no gaps.



1. Air Outlet Vent
2. Air Outlet Vent Bracket
3. Seal
4. Coolant Return Hose
5. Coolant Supply Hose
6. Blower Motor
7. Heater Core
8. Air Distribution Housing
9. Coolant Pipes
10. "T" Fitting
11. Coolant Hoses (In Engine Compartment)
12. Heater Control Valve
13. Bleed Screw
14. Blower Motor Resistor (In Engine Compartment)
15. Blower Motor Switch
16. Sliding Door Footwell Insert
17. Air Intake Duct
18. Clamp

Fig. 6: Identifying Rear Heater Components (EuroVan MV)
Courtesy of Volkswagen United States, Inc.

HEATER CONTROL VALVE

Removal & Installation (Front)

Detach temperature control cable from heater control valve. Clamp shut heater hoses at heater control valve. Detach hoses, and remove heater control valve. To install, reverse removal procedure.

Removal & Installation (Rear)

Detach temperature control cable from heater control valve. Clamp shut heater hoses at heater control valve. Detach hoses and remove heater control valve from expansion tank. To install, reverse removal procedure.

WIRING DIAGRAM

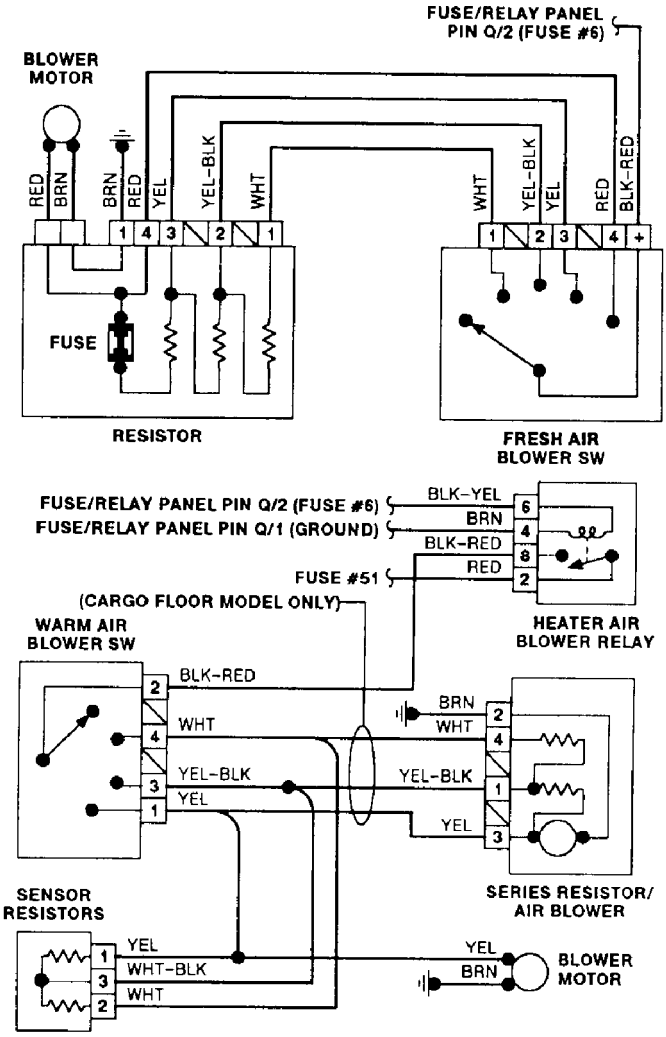


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Fig. 7: Heater System Wiring Diagram

END OF ARTICLE

HOW TO USE SYSTEM WIRING DIAGRAMS
Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:33PM

ARTICLE BEGINNING

GENERAL INFORMATION
Using Wiring Diagrams

All Models

INTRODUCTION

Mitchell obtains wiring diagrams and technical service bulletins, containing wiring diagram changes from the domestic and import manufacturers. These are checked for accuracy and are all redrawn into a consistent format for easy use.

In the past, when cars were simpler, diagrams were simpler. All components were connected by wires and diagrams seldom exceeded 4 pages in length. Today, some wiring diagrams require more than 16 pages. It would be impractical to expect a service technician to trace a wire from page 1 across every page to page 16.

Removing some of the wiring maze reduces eyestrain and time wasted searching across several pages. Today the majority of Mitchell diagrams follow a much improved format, which permits space for internal switch details.

Wiring diagrams are drawn in a "top-down" format. The diagrams are drawn with the power source at the top of the diagram and the ground point at the bottom of the diagram. Components locations are identified on the wiring diagrams. Any wires that don't connect directly to a component are identified on the diagram to indicate where they go.

COLOR ABBREVIATIONS

COLOR ABBREVIATIONS TABLE

Color	Normal	Optional
Black	BLK	BK
Blue	BLU	BU
Brown	BRN	BN
Clear	CLR	CR
Dark Blue	DK BLU	DK BU
Dark Green	DK GRN	DK GN
Green	GRN	GN
Gray	GRY	GY
Light Blue	LT BLU	LT BU
Light Green	LT GRN	LT GN
Orange	ORG	OG
Pink	PNK	PK
Purple	PPL	PL
Red	RED	RD
Tan	TAN	TN

Violet	VIO		VI
White	WHT		WT
Yellow	YEL		YL

IDENTIFYING WIRING DIAGRAM ABBREVIATIONS

NOTE: Abbreviations used on Mitchell diagrams are normally self-explanatory. If necessary see ABBREVIATIONS article in GENERAL INFORMATION.

IDENTIFYING WIRING DIAGRAM SYMBOLS

NOTE: Standard wiring symbol are used in Mitchell diagrams. The illustration below will help clarify any symbols that are not easily understood at a glance. Most components are labeled "Motor", "Switch" or "Relay" in addition to being drawn with the standard symbol.

HOW TO USE SYSTEM WIRING DIAGRAMS
Article Text (p. 3)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:33PM

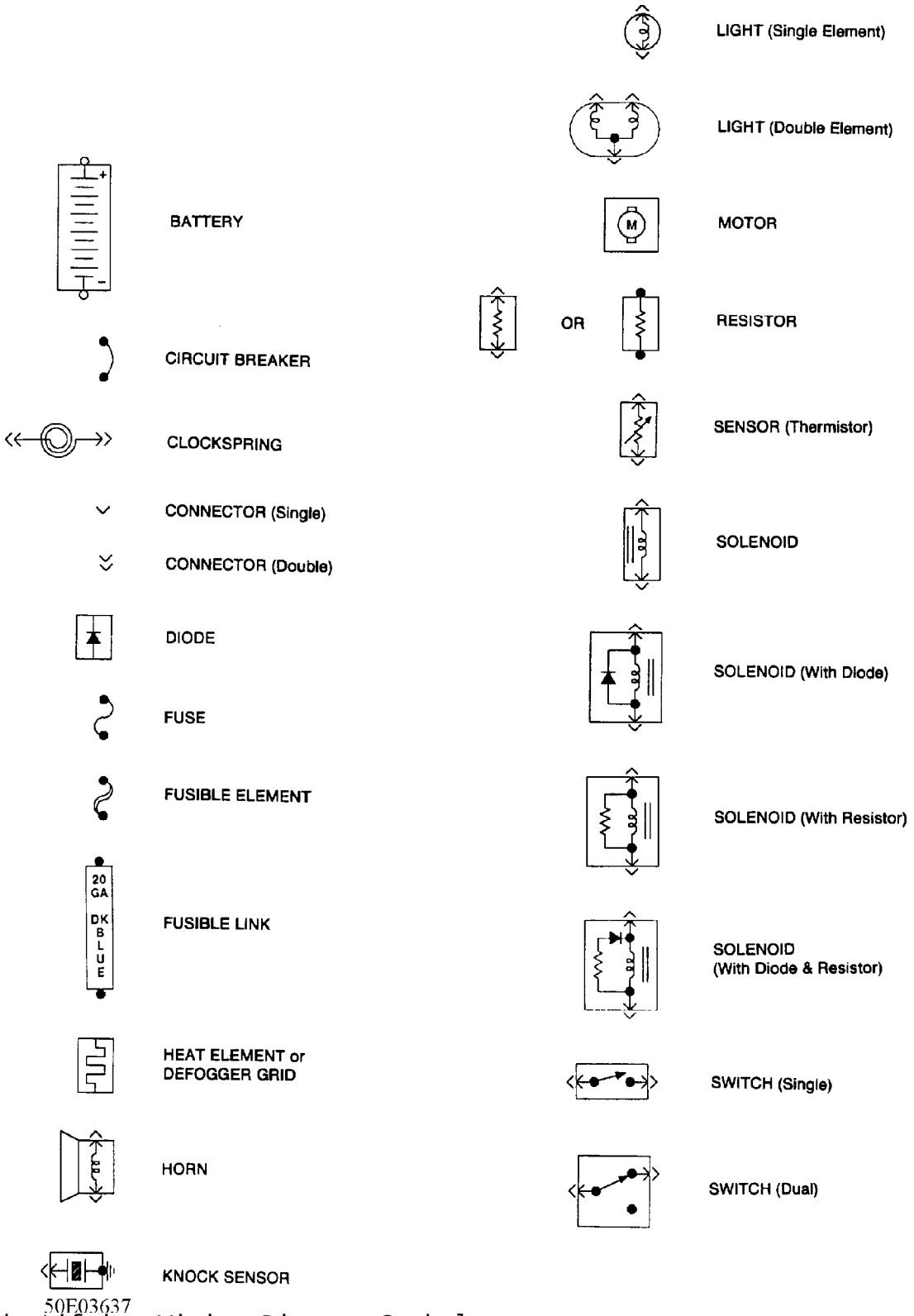

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Fig. 1: Identifying Wiring Diagram Symbols

WIRING DIAGRAM COMPONENT LOCATIONS

HOW TO USE SYSTEM WIRING DIAGRAMS

Article Text (p. 4)

1993 Volkswagen EuroVan

For Volkswagen Technical Site

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When trying to locate a component in a wiring diagram and you don't know the specific system where it is located, use this handy component locator to find the system wiring diagram in which the component is located. Then, go to that system and locate the component within the wiring diagram.

For example, if you don't know the specific system in which the ignition switch is located, look up ignition switch in the wiring diagram component location tables and go to the appropriate wiring diagram(s) which contain either full or partial views of the ignition switch. The full view of the ignition switch is located in Power Distribution.

The first listing for the component will be the full or most complete view of the component. Additional listings will be partial views of the component. Not all components are used on all models.

All components will have a partial view in Ground Distribution and Power Distribution. Data Link Connectors show connecting circuits between modules. Alternate names for components may be listed in wiring diagram component locations tables.

WIRING DIAGRAM COMPONENT LOCATIONS TABLE

Component	Wiring Diagram
ABS Electronic Control Unit	Anti-Lock Brakes
	Data Link Connectors
ABS Hydraulic Unit	Anti-Lock Brakes
Acceleration Sensor	Anti-Lock Brakes
Accessory Delay Relay	Power Windows
A/C Compressor Clutch Relay	Engine Performance
A/C Sensor	Engine Performance
A/C Pressure Switch	Engine Performance
Adaptive Lamp Control Module	Exterior Lights
Air Bag(s)	Air Bag Restraint System
Air Bag Module	Air Bag Restraint System
Air Bag Sensor(s)	Air Bag Restraint System
Air Injection Pump Relay	Engine Performance
Air Temperature Sensor	Overhead Console
Alternator (Generator)	Generators & Regulators
Anti-Theft Control Module	Anti-Theft System
	Starters
Autolamp Control Relay	Headlight Systems
	Daytime Running Lights
Automatic Shutdown (ASD) Relay	Engine Performance
	Generators & Regulators
Autostick Switch	Engine Performance
Auxiliary Battery Relay	Generators & Regulators
Back-Up Lights	Back-Up Lights
	Exterior Lights
Barometric (BARO) Pressure Sensor	Engine Performance
Battery	Power Distribution
Battery Temperature Sensor	Engine Performance

Body Control Module ..... Body Control Computer
Anti-Theft System
Daytime Running Lights
Engine Performance
Headlight Systems
Warning Systems
Boost Control Solenoid ..... Engine Performance
Boost Sensor ..... Engine Performance
Brake Fluid Level Switch ..... Analog Instrument Panels
Brake On/Off (BOO) Switch ..... Cruise Control Systems
Engine Performance
Shift Interlock Systems
Buzzer Module ..... Warning Systems
Camshaft Position (CMP) Sensor ..... Engine Performance
Central Control Module ..... Anti-Theft System
Clockspring ..... Air Bag Restraint System
Cruise Control Systems
Steering Column Switches
Clutch Pedal Position Switch ..... Starters
Clutch Start Switch ..... Starters
Combination Meter ..... Analog Instrument Panels
Constant Control Relay Module (CCRM) ..... Engine Performance
Electric Cooling Fans
Convenience Center ..... Power Distribution
Illumination/Interior Lights
Convertible Top Motor ..... Power Convertible Top
Convertible Top Switch ..... Power Convertible Top
Crankshaft Position (CKP) Sensor ..... Engine Performance
Cruise Control Module ..... Cruise Control Systems
Cruise Control Switch ..... Cruise Control Systems
Condenser Fan Relay(s) ..... Electric Cooling Fans
Data Link Connector (DLC) ..... Engine Performance
Daytime Running Lights Module ..... Daytime Running Lights
Exterior Lights
Defogger Relay ..... Rear Window Defogger
Diagnostic Energy Reserve Module (DERM) ... Air Bag Restraint System
Discriminating Sensor (Air Bag) ..... Air Bag Restraint System
Distributor ..... Engine Performance
Door Lock Actuators ..... Power Door Locks
Remote Keyless Entry
Door Lock Relay(s) ..... Power Door Locks
Electrochromic Mirror ..... Power Mirrors
Electronic Level Control (ELC)
Height Sensor ..... Electronic Suspension
Electronic Level Control (ELC) Module ..... Electronic Suspension
Engine Coolant Temperature (ECT)
Sending Unit ..... Analog Instrument Panels
Engine Coolant Temperature (ECT) Sensor ..... Engine Performance
Engine Control Module ..... Engine Performance
Generators & Regulators
Starters
ETACS ECU ..... Warning Systems

Power Windows
Remote Keyless Entry
Evaporative (EVAP) Emissions Canister ..... Engine Performance
EVAP Canister Purge Solenoid ..... Engine Performance
EVAP Canister Vent Solenoid ..... Engine Performance
Exhaust Gas Recirculation (EGR) Valve ..... Engine Performance
Fuel Tank Vacuum Sensor ..... Engine Performance
Fog Lights ..... Headlight Systems
Daytime Running Lights
Fog Light Relay ..... Headlight Systems
Daytime Running Lights
Fuel Door Release Solenoid ..... Power Fuel Door Release
Fuel Gauge Sending Unit ..... Analog Instrument Panels
Fuel Injectors ..... Engine Performance
Fuel Pump ..... Engine Performance
Fuel Pump Relay ..... Engine Performance
Power Distribution
Fuse/Relay Block ..... Power Distribution
Fusible Links ..... Power Distribution
Generators & Regulators
Starters
Generator ..... Generators & Regulators
Engine Performance
Power Distribution
Generic Electronic Module (GEM) ..... Body Control Modules
Electronic Suspension
Glow Plug Relay ..... Engine Performance
Glow Plugs ..... Engine Performance
Grounds ..... Ground Distribution
Headlight Door Module ..... Headlight Doors
Headlight Relay ..... Headlight Systems
Daytime Running Lights
Headlights ..... Headlight Systems
Daytime Running Lights
Heated Oxygen Sensor(s) (HO2S) ..... Engine Performance
Heated Windshield Control Module ..... Heated Windshields
Height Sensor ..... Electronic Suspension
Horns ..... Steering Column Switches
Horn Relay ..... Steering Column Switches
Idle Air Control (IAC) Motor/Valve ..... Engine Performance
Ignition Coil(s) ..... Engine Performance
Ignition Key Lock Cylinder ..... Anti-Theft System
Ignition Module ..... Engine Performance
Ignition Switch ..... Power Distribution
Engine Performance
Generators & Regulators
Starters
Illuminated Entry Module ..... Illumination/Interior Lights
Illumination Lights ..... Illumination/Interior Lights
Impact Sensor ..... Air Bag Restraint System
Inertia Fuel Shutoff Switch ..... Engine Performance
Inhibit Relay ..... Starters

Instrument Cluster ..... Analog Instrument Panels
Intake Air Temperature (IAT) Sensor ..... Engine Performance
Interior Lights ..... Illumination/Interior Lights
Interlock Switch ..... Starters
Junction Block ..... Power Distribution
Keyless Entry Receiver ..... Remote Keyless Entry
Key Reminder Switch ..... Starters
Knock Sensor ..... Engine Performance
Lamp Control Module ..... Exterior Lights
License Plate Lamp ..... Exterior Lights
Lighting Control Module ..... Lighting Control Modules
Anti-Theft System
Daytime Running Lights
Headlight Systems
Lower Relay ..... Power Convertible Top
Malfunction Indicator Light (MIL) ..... Engine Performance
Instrument Panels
Manifold Absolute Pressure (MAP) Sensor ..... Engine Performance
Mass Airflow (MAF) Sensor ..... Engine Performance
Mega Fuse ..... Generators & Regulators
Memory Seat/Mirror Module ..... Memory Systems
Mirror Defogger ..... Rear Window Defogger
Moon Roof Motor ..... Power Moon Roof
Moon Roof Relay ..... Power Moon Roof
Multi-Function Control Module ..... Warning Systems
Neutral Safety Switch ..... Starters
Oil Level Switch ..... Engine Performance
Oil Pressure Switch/Sending Unit ..... Analog Instrument Panels
Engine Performance
Overhead Console ..... Overhead Console
Oxygen Sensor(s) (O2S) ..... Engine Performance
Parking Brake Switch ..... Analog Instrument Panels
Park Lights ..... Exterior Lights
Park/Neutral Position Switch ..... Starters
Engine Performance
Anti-Theft System
Body Control Module
Perimeter Lighting Control Relay ..... Exterior Lights
Power Amplifier ..... Power Antennas
Power Antenna Module ..... Power Antennas
Power Antenna Motor ..... Power Antennas
Power Distribution Center ..... Power Distribution
Generators & Regulators
Starters
Power Door Lock Motors ..... Power Door Locks
Power Mirror Motors ..... Power Mirrors
Memory Systems
Power Sliding Door Controller ..... Power Sliding Side Door
Power Seat Motors ..... Power Seats
Memory Systems
Power Steering Pressure Switch ..... Engine Performance
Power Top Motor ..... Power Convertible Top

Power Top Relay(s) ..... Power Convertible Top
Powertrain Control Module ..... Engine Performance
Analog Instrument Panels
Cruise Control Systems
Data Link Connectors
Generators & Regulators
Starters
Power Window Motors ..... Power Windows
Power Window Relay(s) ..... Power Windows
Radiator Fan Motor(s) ..... Electric Cooling Fans
Radiator Fan Relay(s) ..... Engine Performance
Electric Cooling Fans
Rainsense Module ..... Wiper/Washer Systems
Raise Relay ..... Power Convertible Top
Remote Anti-Theft Personality (RAP) Module ..... Anti-Theft System
Starters
Warning Systems
Seat Belt Pretensioners ..... Air Bag Restraint System
Seat Belt Retractor Solenoid ..... Passive Restraints
Seat Belt Switch ..... Air Bag Restraint System
Passive Restraints
Shift Interlock Solenoid ..... Shift Interlock Systems
Shift Lock Actuator ..... Shift Interlock Systems
Side Marker Lights ..... Exterior Lights
SIR Coil Assembly (Clockspring) ..... Air Bag Restraint System
Slip Ring (Clockspring) ..... Air Bag Restraint System
Steering Column Switches
SRS Control Module ..... Air Bag Restraint System
Starter Motor ..... Starters
Starter Interrupt Relay ..... Starters
Starter Solenoid ..... Starters
Starter Relay ..... Starters
Steering Wheel Position Sensor ..... Anti-Lock Brakes
Stoplights ..... Exterior Lights
Stoplight Switch ..... Engine Performance
Cruise Control Systems
Anti-Lock Brakes
Sun Roof ECU ..... Power Sun Roof
Sun Roof Motor ..... Power Sun Roof
Sun Roof Position Sensor ..... Power Sun Roof
Taillights ..... Exterior Lights
Throttle Position (TP) Sensor ..... Engine Performance
Torque Converter Clutch Solenoid/Switch ..... Engine Performance
Traction Control Switch ..... Anti-Lock Brakes
Trailer Tow Connector ..... Exterior Lights
Trailer Tow Relay ..... Exterior Lights
Transmission/Transaxle ..... Engine Performance
Transmission Control Module (TCM) ..... Engine Performance
Starters
Transmission Range Sensor ..... Starters
Back-Up Lights
Engine Performance

Transmission Range Switch ..... Back-Up Lights
Engine Performance
Anti-Theft System
Turn Signal Flasher ..... Exterior Lights
Turn Signal Lights ..... Exterior Lights
Twilight Sentinel Switch ..... Headlight Systems
Daytime Running Lights
Vapor Canister Leak Detection Pump ..... Engine Performance
Vehicle Control Module (VCM) ..... Engine Performance
Vehicle Dynamic Module ..... Electronic Suspension
Vehicle Speed Control Servo ..... Cruise Control Systems
Vehicle Speed Sensor ..... Data Link Connectors
Analog Instrument Panels
Cruise Control Systems
Electronic Suspension
Voltage Regulator ..... Generators & Regulators
Water-In-Fuel Sensor ..... Engine Performance
Analog Instrument Panels
Wheel Speed Sensors ..... Anti-Lock Brakes
Window Timer Module ..... Power Convertible Top
Windshield Intermittent Wiper Relay ..... Wiper/Washer Systems
Windshield Washer Motor ..... Wiper/Washer Systems
Wiper Motor ..... Wiper/Washer Systems

END OF ARTICLE

I - SYSTEM/COMPONENT TESTS
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:33PM

ARTICLE BEGINNING

1993 ENGINE PERFORMANCE
Volkswagen System & Component Testing - Digifant

EuroVan

INTRODUCTION

Since many computer-controlled and monitored components set a trouble code if they malfunction, also perform procedures in the G - TESTS W/ CODES article. In most instances, Scan Tester (VAG 1551) must be used to test systems and/or components. See ENTERING SELF-DIAGNOSTICS in the appropriate G - TESTS W/CODES article for additional scan tester operating instructions.

AIR INDUCTION SYSTEMS

INTAKE AIR PREHEATING

EuroVan (2.5L)
1) Ensure control flap vacuum motor is air tight. Remove air cleaner housing and remove air filter. Remove hose from stove hot air pipe.
2) Disconnect vacuum hose from temperature regulator. Connect hand-held vacuum pump to control valve vacuum motor. Control flap must close cold air intake.
3) Reconnect vacuum hose to temperature regulator. Start engine and allow it to idle. Check position of control flap after 20 seconds. Replace temperature regulator if position of control flap is not as specified in TEMPERATURE REGULATOR table.

TEMPERATURE REGULATOR

Regulator Temperature øF (øC)	Control Flap Position
Less Than 68 (20)	Cold Air Intake Closed
Between 68-86 (20-30)	Open To Both Hot & Cold Air Intake
More Than 86 (30)	Hot Air Intake Closed

COMPUTERIZED ENGINE CONTROLS

ELECTRONIC CONTROL MODULE (ECM)

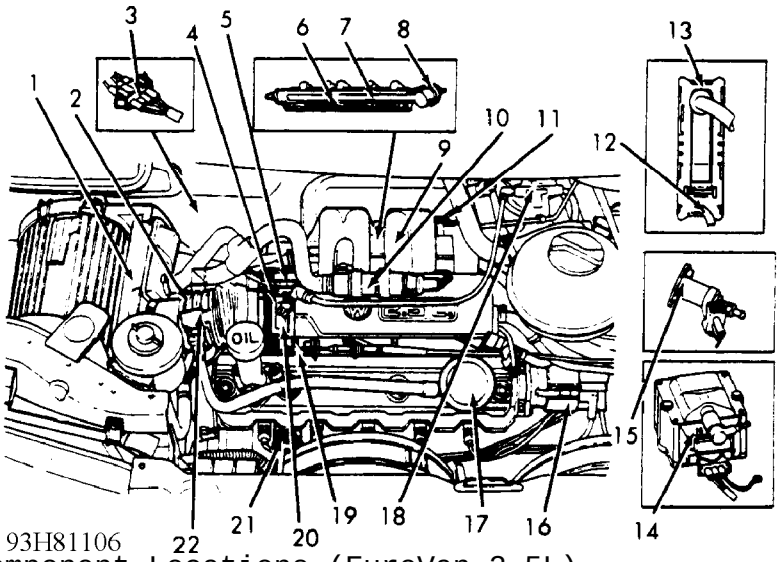
Ground & Power Circuits
Check ECM ground and power circuits. Refer to the appropriate J - PIN VOLTAGE CHARTS article in this section.

ECM REFERENCE SETTING (ECM RELEARN PROCEDURE)

NOTE: The Electronic Control Module (ECM) must be reset if Blue engine coolant temperature sensor has been disconnected while the engine is running or if throttle body, throttle valve potentiometer, airflow sensor or ECM have been replaced. This procedure is not necessary on Digifant II systems.

ENGINE SENSORS & SWITCHES

NOTE: For engine sensors and switches not covered in this article, see the D - ADJUSTMENTS article. For component locations, see Fig. 1.



1. Air Cleaner
2. Air Intake Duct
3. Oxygen Sensor Connector
4. Throttle Body
5. Throttle Position Sensor
6. Fuel Injector
7. Fuel Rail
8. Fuel Pressure Regulator
9. Intake Manifold
10. Intake Air Control (IAC) Valve
11. CO Tap Tube
12. Vacuum Hose
13. Electronic Control Module (ECM)
14. Ignition Coil
15. Cold-Start Injector
16. Distributor
17. Emission Control Valve
18. Fuel Evaporative Solenoid (Frequency) Valve
19. Closed Throttle Position Switch
20. Idle Speed Adjustment Screw (If Equipped)
21. Engine Coolant Temp. Sensor (Blue
22. Intake Air Temp. Sensor

Fig. 1: Component Locations (EuroVan 2.5L)
Courtesy of Volkswagen United States, Inc.

INTAKE AIR TEMPERATURE SENSOR

EuroVan (2.5L)
1) Connect Scan Tester (VAG 1551) to Data Link Connectors (DLC) located in fold-down storage shelf in front of relay panel. Remove intake air temperature sensor from air intake duct.
2) With scan tester in READ MEASUREMENT BLOCK function, read intake air temperature sensor value as displayed in channel No. 3 of scan tester. Spray sensor with cooling spray and observe value on scan tester.
3) Scan tester value must drop. If temperature value does not change, repair intake air temperature sensor circuit or replace sensor as necessary. After repairs, erase Diagnostic Trouble Code (DTC) memory (if applicable) and select END DATA TRANSFER function.

HALL EFFECT SENSOR

EuroVan (2.5L)
1) Disconnect Hall Effect sensor wiring harness connector at

ignition distributor. Connect DVOM, using test leads from Adapter Kit (VW 1594), to outer terminals of connector.

2) Turn ignition on. DVOM reading must be 10 volts minimum. If voltage is not okay, repair open Hall Effect sensor voltage supply circuit. If circuit is okay, replace ECM. If voltage is okay, reconnect Hall Effect sensor.

3) Turn ignition off. Disconnect cold-start injector and fuel injector wiring harness at fuel rail. Use LED Tester (US 1115) to backprobe center and Brown/White outer wire at Hall Effect sensor connector. Crank engine and observe LED tester. If LED tester does not flicker, replace Hall Effect sensor.

COOLANT TEMPERATURE SENSOR

EuroVan (2.5L)

1) Ensure engine is cold. Connect Scan Tester (VAG 1551) to Data Link Connectors (DLC) located in fold-down storage shelf in front of relay panel. With scan tester in READ MEASUREMENT BLOCK function, read coolant temperature value in channel No. 1 of scan tester.

2) Temperature value must increase uniformly without interruption. If coolant temperature value does not change, test circuit using J - PIN VOLTAGE CHARTS article. If necessary, replace engine coolant temperature sensor. After repairs, erase DTC memory (if applicable) and select END DATA TRANSFER function.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

EuroVan (2.5)

1) Connect Scan Tester (VAG 1551) to Data Link Connectors (DLC) located in fold-down storage shelf in front of relay panel. With scan tester in READ MEASUREMENT BLOCK function, ensure coolant temperature is more than 185øF (85øC) as displayed in channel No. 1 of scan tester.

2) With scan tester still in READ MEASUREMENT BLOCK function, read MAP sensor value in channel No. 4 of scan tester. Value must be 20-40 percent and fluctuating.

3) If a constant value of roughly 90 percent is displayed, check for leaks in vacuum hose to ECM or replace ECM as necessary. After repairs, erase DTC memory (if applicable) and select END DATA TRANSFER function.

FUEL SYSTEM

ACCELERATION/FULL THROTTLE ENRICHMENT & DECELERATION FUEL CUT-OFF

EuroVan (2.5L)

1) Connect Scan Tester (VAG 1551) to Data Link Connectors (DLC) located in fold-down storage shelf in front of relay panel. With scan tester in READ MEASUREMENT BLOCK function, ensure coolant temperature is more than 185øF (85øC) as displayed in channel No. 1 of scan tester.

2) Allow engine to run 2 minutes at idle. Read and record closed throttle position value in channel No. 4 of scan tester. Check full throttle load enrichment by gradually pressing down accelerator to 3000 RPM and then releasing it.

3) Display value must increase, drop down to 0 milliseconds, then return to value recorded at closed throttle. If specified values are not obtained, check idle speed. Also check THROTTLE POSITION (TP) SENSOR ADJUSTMENT in ON-VEHICLE ADJUSTMENTS article.

COLD-START INJECTOR

EuroVan (2.5L)

1) Disconnect main fuel injector wiring harness from fuel rail. Disconnect cold-start injector. See Fig. 2. Connect LED Tester (US 1115) to wiring harness connector using test leads from Adapter Kit (VW 1594).

2) Disconnect Blue Engine Coolant Temperature (ECT) sensor. Crank engine and observe LED tester. LED tester must light up for 1-4 seconds. If LED tester does not light up, check cold-start injector voltage supply circuit using J - PIN VOLTAGE CHARTS article or replace ECM as necessary.

3) If LED tester lights up (voltage supply circuit okay), remove cold-start injector and reconnect cold-start injector to wiring harness. Place cold-start injector in container and crank engine.

4) Cold-start injector must spray uniformly for 1-4 seconds. Wipe off cold-start injector nozzle and observe tip. No drips or dampness may occur within one minute. Replace cold-start injector if it does not operate as specified.

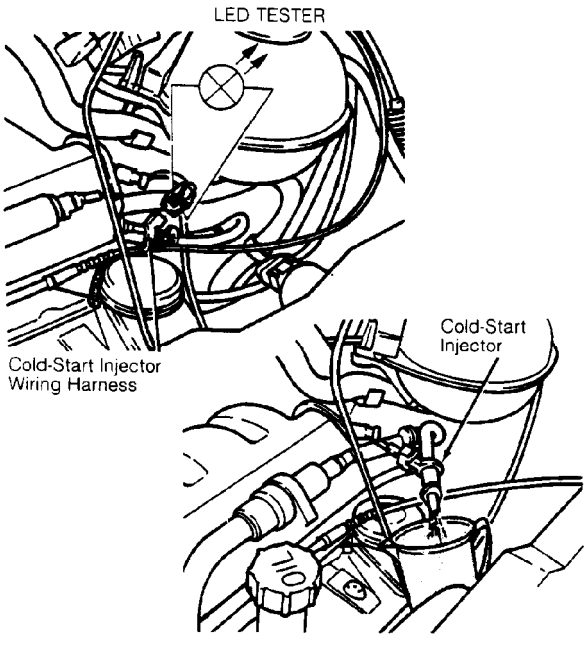


Fig. 2: Testing Cold-Start Injector (EuroVan)
Courtesy of Volkswagen United States, Inc.

FUEL INJECTORS & CIRCUIT

EuroVan (2.5L)

1) Ensure Hall Effect sensor and its circuit is okay. Disconnect fuel injector wiring harness. Using test leads from Adapter Kit (VW 1594), connect LED Tester (US 1115) to fuel injector wiring harness connector terminals No. 1 and 6. See Fig. 3.

NOTE: Connect LED tester to terminals No. 1 and 2 on models with 2-pin connector.

2) Crank engine and observe LED tester. LED tester must light up. Repeat injector circuit test using terminals No. 2 and 6, No. 3 and 6, No. 4 and 6, and terminals No. 5 and 6 (skip this test on 2-pin connector).

3) If LED lights up continuously, repair ground wire between battery and transmission or replace ECM as necessary. If LED flickers but DOES NOT light up, test fuel injector voltage supply circuit(s) using J - PIN VOLTAGE CHARTS article or replace ECM as necessary.

4) On models with 2-pin connector, connect Digital Volt-Ohmmeter (DVOM) between fuel injector wiring harness connector terminals No. 1 and 2. Injector resistance should be 3.0-4.0 ohms. If resistance is incorrect, remove fuel rail and test individual injectors (12.0-18.0 ohms).

5) On models with 6-pin connector, check individual fuel injector resistance between terminals No. 1 and 6, No. 2 and 6, No. 3 and 6, No. 4 and 6, and terminals No. 5 and 6. See Fig. 3. Individual injector resistance must be 12.0-18.0 ohms.

6) On all models, disconnect cold-start injector and Engine Coolant Temperature (ECT) sensor. Adjust Digital Potentiometer (VAG 1630) to 15000 ohms and connect potentiometer to ECT sensor using test leads from Adapter Kit (VW 1594).

7) Remove fuel rail, leaving fuel lines and injectors attached. Use test leads and fuel rail hose extensions if necessary. Place injectors in Fuel Analyzer (VAG 1602). Crank engine and observe injectors.

8) Injectors must spray uniformly while pulsating. Turn ignition off and disconnect fuel rail wiring harness. Turn ignition on for 5 seconds and check fuel injectors for leaks. No more than 2 drops are permissible per minute. When reinstalling fuel rail, ensure "O" rings are not damaged.

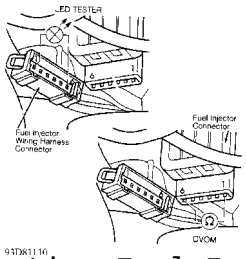


Fig. 3: Testing Fuel Injectors & Circuit (EuroVan)
Courtesy of Volkswagen United States, Inc.

OXYGEN (O2) SENSOR CONTROL

EuroVan (2.5L)

1) Ensure engine idle speed is okay. Ensure there are no exhaust system leaks between catalytic converter and cylinder head. Connect Scan Tester (VAG 1551) to Data Link Connectors (DLC) located in fold-down storage shelf in front of relay panel. Refer to the appropriate G - TESTS W/CODES article in this section.

2) With scan tester in READ MEASUREMENT BLOCK function, ensure coolant temperature is more than 185øF (85øC) as displayed in channel No. 1 of scan tester. Allow engine to run for 2 minutes at idle.

3) Connect CO tester using Adapter (VAG 1363/3) on CO tap tube. DO NOT remove oxygen (O2) sensor. Measure CO level (0.3-1.2%), then read oxygen (O2) sensor factor (signal) in channel No. 3 of scan tester. Display value must fluctuate between 0.0-0.75 volts.

4) If value in channel No. 3 does not fluctuate, disconnect vacuum hose from fuel pressure regulator. Value must increase then drop back to original value. If value does not change, check voltage supply to oxygen (O2) sensor heater, repair oxygen (O2) sensor circuit or replace oxygen (O2) sensor as necessary. After repairs, erase DTC memory (if applicable) and select END DATA TRANSFER function.

IDLE CONTROL SYSTEM

IDLE AIR CONTROL (IAC) VALVE

EuroVan (2.5L)

1) Check Idle Air Control (IAC) valve using OUTPUT DIAGNOSTIC TEST MODE. See the G - TESTS W/CODES article. Turn ignition on. IAC valve must vibrate or hum. If IAC valve does not vibrate or hum, turn ignition off and disconnect IAC valve.

2) Connect Digital Volt-Ohmmeter (DVOM) to IAC valve using test leads from Adapter Kit (VW 1594). IAC valve resistance should be 2-10 ohms. If resistance is incorrect, replace IAC valve.

NOTE: IAC valve control current amperage may vary between 400-1000 milliamps depending on engine load (A/C on, power steering at full lock, incorrect ignition timing).

3) If IAC valve is working properly, ensure engine coolant temperature is at least 176øF (80øC). Ensure idle speed is correctly set and no air leaks exist in air intake system.

4) With IAC valve disconnected, install Test Harness (VAG 1315A/2) between IAC valve and wiring harness connector. See Fig. 4. Using test leads from adapter kit, connect DVOM to test harness.

5) Start engine and allow it to idle. With engine at 775-825 RPM, IAC valve control current must be 500-600 milliamps. With throttle closed, disconnect Blue Engine Coolant Temperature (ECT) sensor.

6) With ECT sensor disconnected, IAC valve control current must remain at 500-600 milliamps. If IAC valve control current is not

as specified, repair circuit or replace ECM as necessary.

NOTE: If engine stalls, reconnect ECT before re-starting engine. This will prevent ECM from entering "limp home" mode, making IAC control current measurements inaccurate.

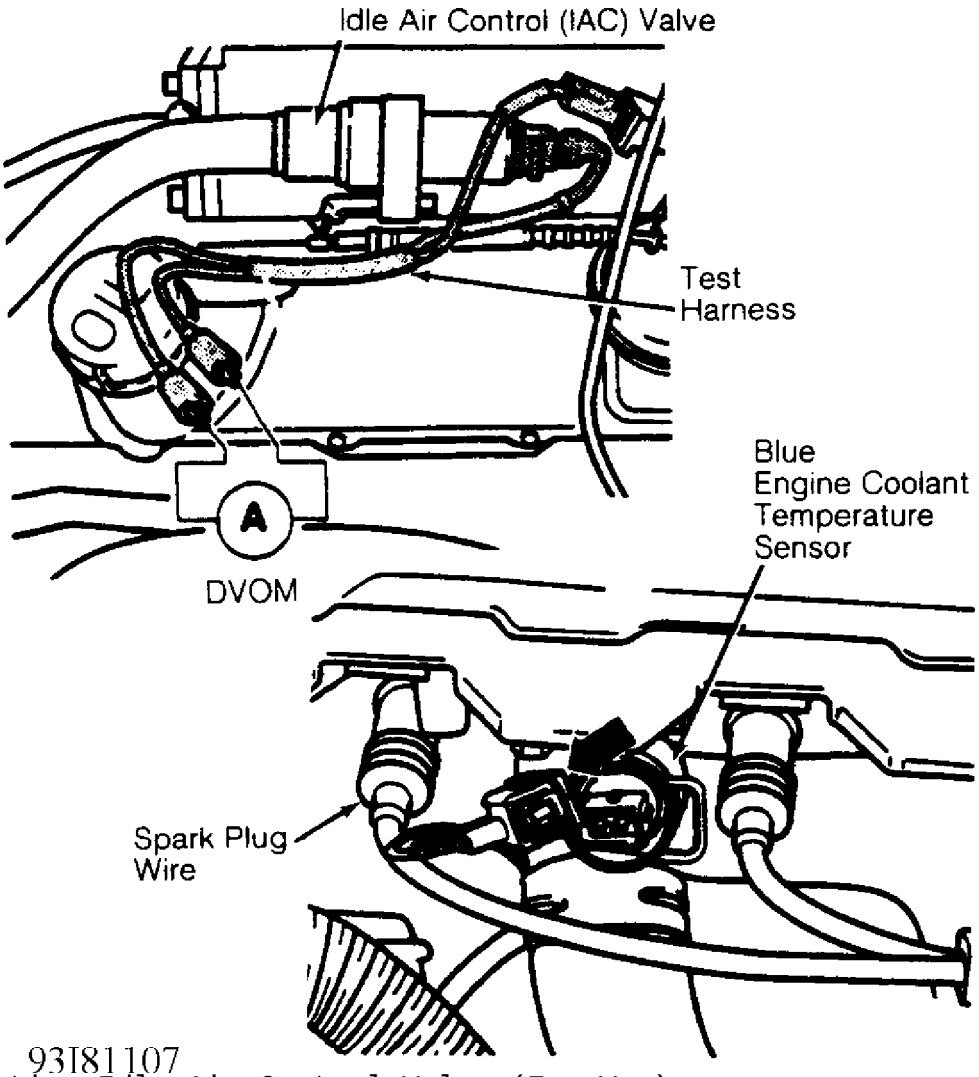


Fig. 4: Testing Idle Air Control Valve (EuroVan)
Courtesy of Volkswagen United States, Inc.

IGNITION SYSTEM

IGNITION COIL

EuroVan 2.5L (Primary & Secondary Windings)

1) Connect Digital Volt-Ohmmeter (DVOM) between coil terminals No. 1 and 15. See Fig. 5. Primary coil resistance should be 0.5-0.7 ohms.

2) Connect DVOM between coil tower and terminal No. 15. Secondary coil resistance should be 3000-4000 ohms. If resistance

values are incorrect, remove ignition coil. Remove ignition coil power output stage from coil and repeat test.

EuroVan 2.5L (Ignition Coil Power Output Stage)

1) Ensure Hall Effect sensor and ignition coil are okay. Disconnect 3-pin connector from ignition coil. Connect DVOM to ignition coil wiring harness terminals No. 1 and 3. See Fig. 5.

2) Turn ignition on. Battery (system) voltage should be indicated on DVOM. If battery voltage is not indicated, repair supply voltage circuit as necessary. If battery voltage is indicated, supply voltage circuit is okay.

3) Turn ignition off. Disconnect cold-start injector (EuroVan only) and fuel injector wiring harness at fuel rail. Connect LED Tester (US 1115) to ignition coil wiring harness terminals No. 2 and 3 using test leads from Adapter Kit (VW 1594).

4) Crank engine and check for ignition signal from Electronic Control Module (ECM). If LED tester does not flicker, repair ignition signal circuit or replace ECM as necessary. If LED tester flickers, ignition signal circuit is okay.

5) Turn ignition off. Reconnect ignition wire and 3-pin connector to ignition coil. Connect LED tester between coil terminals No. 1 and 15. Turn ignition on. LED tester must light up for 1-2 seconds.

6) Crank engine and ensure LED tester flickers. If LED tester flickers, power output stage is okay. If LED tester does not flicker, replace power output stage.

NOTE: A DVOM may also be used in step 5). With ignition on, voltage should be 2 volts minimum and then drop to zero volts after 1-2 seconds.

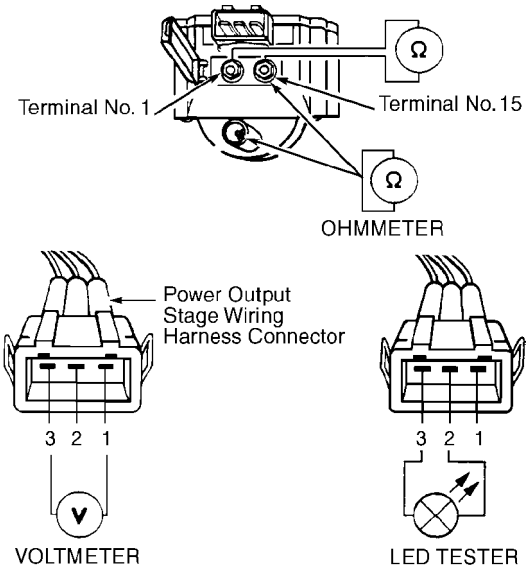


Fig. 5: Testing Ignition Coil & Power Output Stage
Courtesy of Volkswagen United States, Inc.

EMISSION SYSTEMS & SUB-SYSTEMS

NOTE: Other than EuroVan fuel evaporation system, additional emission systems and sub-system component testing information not available from manufacturer.

FUEL EVAPORATION

EuroVan (2.5L)

1) Ensure engine coolant temperature is at least 176øF (80øC). Ensure oxygen (O2) sensor and fuel/ignition system is operating properly.

2) Disconnect hose from fuel evaporative canister frequency solenoid valve (on left side of engine compartment firewall). Start engine and allow it to idle. Valve must not operate and no vacuum should be felt at valve connection.

3) Increase engine speed. Valve must open and close and vacuum must be felt at connection. If fuel evaporative canister frequency solenoid valve does not operate, perform OUTPUT DIAGNOSTIC TEST mode. See the G - TESTS W/CODES article.

4) If necessary, turn ignition off. Disconnect fuel evaporative canister frequency solenoid valve wiring harness connector. Using test leads from adapter kit, connect LED tester between wiring harness connector terminals. Start engine and increase engine speed. LED tester must briefly flicker.

5) If LED tester flickers, replace fuel evaporative canister frequency solenoid valve. If LED tester does not flicker, check wiring harness for an open circuit. If wiring harness is okay, replace Electronic Control Module (ECM).

END OF ARTICLE

INSTRUMENT PANEL
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:33PM

ARTICLE BEGINNING

1993 ACCESSORIES & EQUIPMENT
Volkswagen Instrument Panels

Volkswagen; EuroVan, Passat

DESCRIPTION & OPERATION

Instrument cluster for most models includes speedometer, fuel gauge and temperature gauge. Optional instruments include clock, tachometer, voltmeter and oil temperature gauge. See Figs. 3 and 4.

Printed circuit provides voltage to gauges. A voltage regulator attached to printed circuit controls voltage to fuel and temperature gauges. Most warning lights are a Light Emitting Diode (LED). To replace diode, pull from printed circuit socket.

TESTING

VOLTAGE REGULATOR TEST

1) If only one gauge is inoperative, regulator is not defective. Remove instrument cluster trim, leaving multi-point connector attached. Remove tachometer/clock. Connect positive (+) lead to terminal "A". See Fig. 1 or 2. Connect voltmeter negative (-) lead to terminal "B". Turn ignition on. If battery voltage is present, go to next step. If battery voltage is not present, repair wiring harness.

2) Turn ignition off. Connect positive (+) lead to terminal "C". See Fig. 1 or 2. Connect voltmeter negative (-) lead to terminal "B". Meter reading should be 9.5-10.5 volts. If voltage is incorrect, replace voltage regulator.

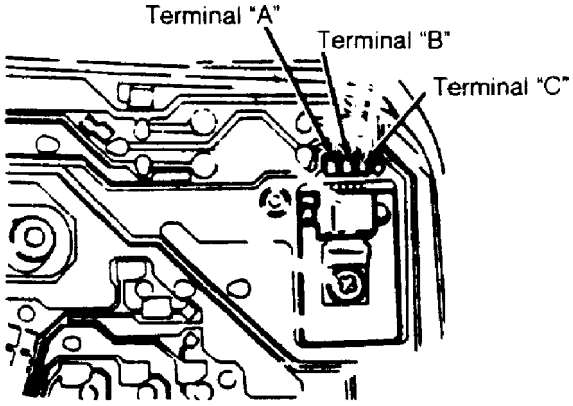


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Fig. 1: Testing Voltage Regulator (Analog Gauges)
Courtesy of Volkswagen United States, Inc.

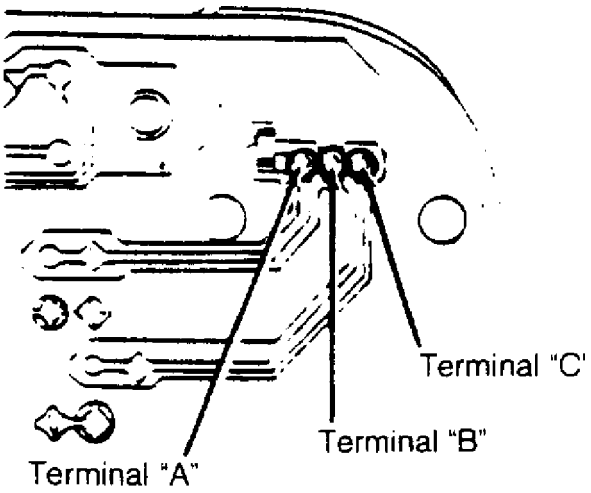

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Fig. 2: Testing Voltage Regulator (Passat With Electronic Gauges) Courtesy of Volkswagen United States, Inc.

FUEL & TEMPERATURE GAUGE TEST

NOTE: Volkswagen Tester (VW 1301) is required for resistance tests. Tester settings are numerical. Settings do not indicate resistance in ohms. Manufacturer does not supply resistance values in ohms.

1) Disconnect wire from fuel tank or temperature sending unit. Connect VW Tester (VW 1301) between wire and ground. Turn ignition on and allow 2 minutes for gauge reading to stabilize. Use FUEL GAUGE TESTING or TEMPERATURE GAUGE TESTING table to compare gauge reading. Gauge should be within one pointer width of specification.

2) If gauge needle does not move, check continuity between sender wire and gauge. If needle moves but does not match specifications, replace gauge. If gauge works correctly with tester but not sending unit, replace sending unit.

FUEL GAUGE TESTING (1) TABLE

Application	Dial Setting	Indicator
Passat	50	Full

(1) - Information for EuroVan not available from manufacturer.

TEMPERATURE GAUGE TESTING (1) TABLE

Application	Dial Setting	Indicator

Passat	80	Normal
	50	(2) Hot

(1) - Information for EuroVan not available from manufacturer.
(2) - With Red LED flashing.

REMOVAL & INSTALLATION

CAUTION: DO NOT damage printed circuit when installing instruments.

INSTRUMENT CLUSTER

Removal & Installation (EuroVan)

1) Obtain radio code. Remove negative battery cable. Remove instrument cluster trim. Remove instrument cluster trim cover. For tachometer and combination gauge, carefully pull gauge from housing and connector. Remove speedometer mounting screws and carefully pull speedometer from housing.

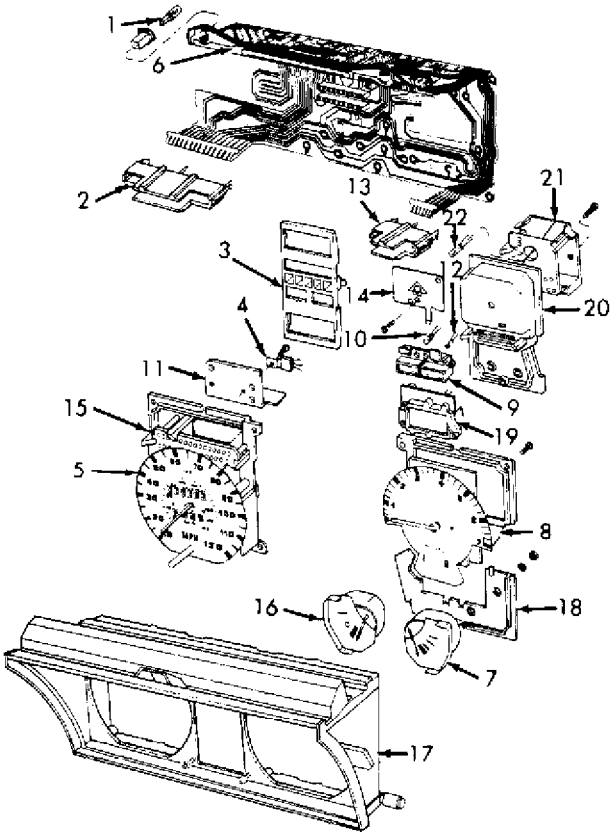
2) To install, reverse removal procedure. Carefully guide plugs on rear of instruments into connector on printed circuit board.

Removal & Installation (Passat)

1) Obtain radio code. Remove negative battery cable. Remove instrument cluster trim. Remove instrument cluster trim cover.

2) For tachometer and combination gauge, carefully pull gauge from housing and connector. For mechanical speedometer, remove mounting screws and carefully pull speedometer from housing.

3) To install, reverse removal procedure. Carefully guide plugs on rear of instruments into connector on printed circuit board.

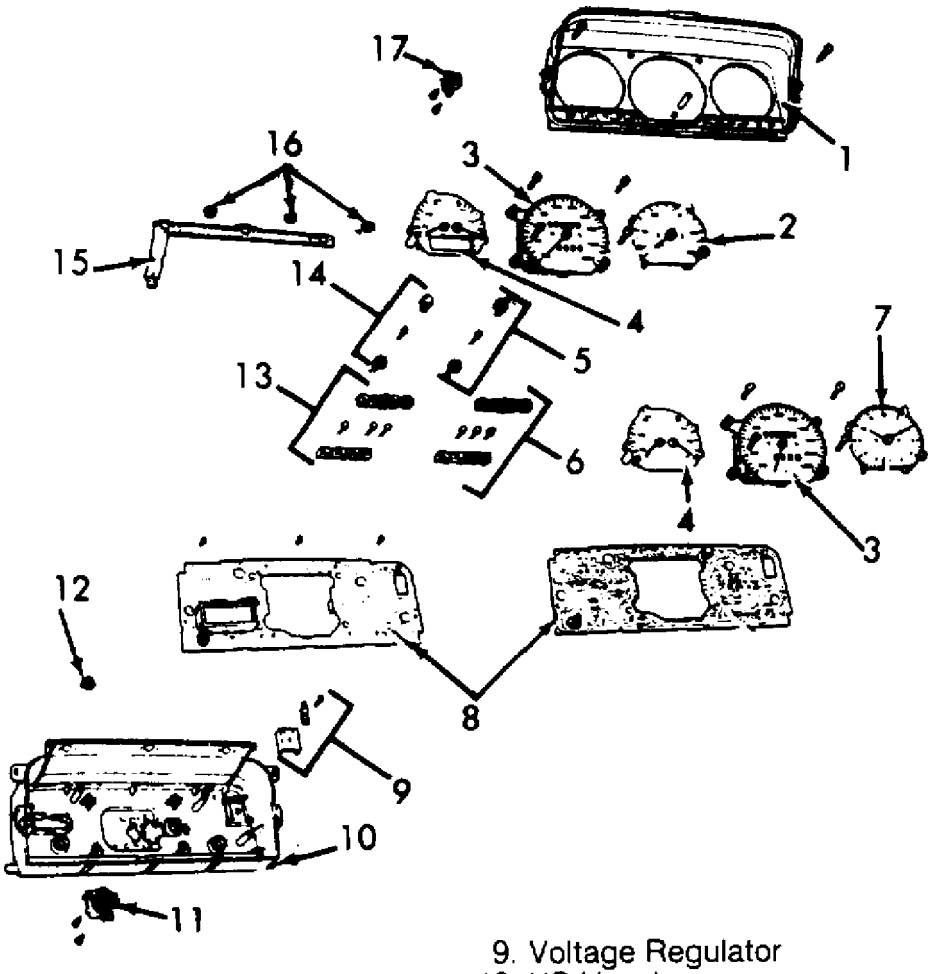


1. Instrument Cluster Light Bulb
2. Wire Terminal Housing
3. Trim
4. Voltage Regulator
5. Speedometer
6. Flexible Printed Circuit
7. Fuel Gauge
8. Tachometer
9. LED Holder
10. LED Indicator Light
11. Voltage Regulator Heat Shield
12. Warning LED
13. Wire Terminal Housing
14. Upshift Indicator (If Equipped)
15. Oil Pressure Warning System Control Unit
16. Coolant Temperature Gauge
17. Instrument Cluster Insert
18. Support Plate For Gauges
19. Digital Clock
20. Instrument Cluster Housing Cover
21. Parking Brake/Brake Fluid Level Warning Light Printed Circuit
22. Upshift Indicator LED (If Equipped)

Fig. 3: Exploded View Of Instrument Cluster (Jetta Is Similar)
Courtesy of Volkswagen United States, Inc.

INSTRUMENT PANEL
Article Text (p. 5)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:34PM



1. Frame
2. Tachometer
3. Speedometer
4. Fuel/Coolant Temp. Gauge
5. Right Indiactor Light
6. Warning/Indicator Light
7. Clock
8. Printed Circuit Board
9. Voltage Regulator
10. I/C Housing
11. Vehicle Speed Sensor Plate
12. Digital Clock Light
13. Warning/Indicator Light
14. Warning/Indicator Light
15. Printed Circuit Board
16. Instrument Cluster Light
17. Vehicle Speed Sensor

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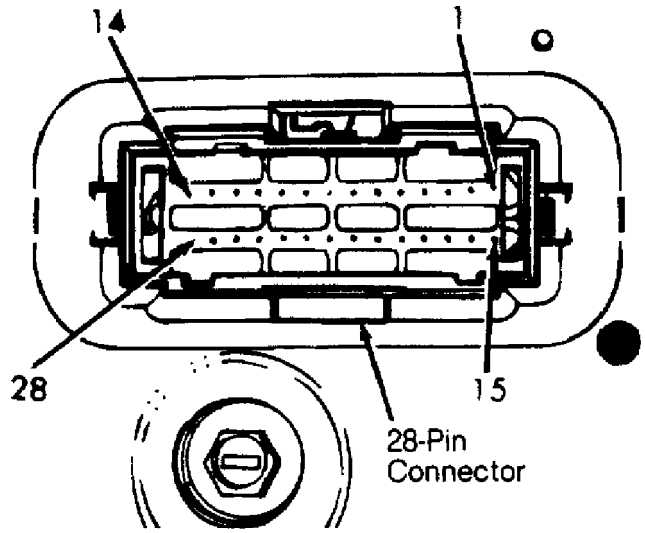
Fig. 4: Exploded View Of Instrument Cluster (EuroVan Is Similar)
Courtesy of Volkswagen United States, Inc.

PRINTED CIRCUIT CONNECTORS



1. Outside Temperature Sensor Ground (If Equipped)
2. To Coolant Low Level Sensor
3. Ground (Terminal No. 31)
4. Multifunction Indicator Memory Reset Switch (If Equipped)
5. Ground (Terminal No. 31)
6. Multifunction Indicator Memory Reset Switch (If Equipped)
7. Vehicle Speed Sensor Signal
8. From Oil Pressure Switch (High Side)
9. From Oil Pressure Switch (Low Side)
10. Tachometer Input Signal (Terminal 1/W)
11. Battery Voltage (Terminal No. 30)
12. Battery Voltage For Instrument Lighting (Terminal 58b
13. Battery Voltage (Terminal No. 15)
14. (Not Used)
15. To MFI Mode Switch (If Equipped)
16. Alternator Warning Light (Terminal No. 61)
17. From Oil Temperature Sensor (If Equipped)
18. To Seat Belt Warning Light/Brake Warning Light (If Equipped)
19. Outside Temperature Sensor Signal (If Equipped)
20. MIL Or Glow Plug (Diesel Only)
21. Fuel Gauge
22. Left Turn Signal
23. Coolant Temperature Gauge
24. Right Turn Signal
25. High Beam Indicator
26. Fuel Consumption Indicator (If Equipped)
27. Signal From Speedometer Sensor (If Equipped)
28. A/T Selector Display (If Equipped)

93H82757

Fig. 5: Identifying Printed Circuit 28-Pin Connector (Passat)
Courtesy of Volkswagen United States, Inc.

WIRING DIAGRAMS

See appropriate chassis wiring diagram in WIRING DIAGRAMS.

END OF ARTICLE

INTERFERENCE VERIFICATION CHECK FOR OHC ENGINE

Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:34PM

ARTICLE BEGINNING

Maintenance & Service Information
1974-96 Volkswagen - Timing Belt Information

Cabrio, Cabriolet, Corrado, Dasher, Eurovan (Canadian), Fox, Golf, Golf (Canadian), GTI, GTI (Canadian), Jetta, Jetta GLI, Passat, Passat (Canadian), Pickup, Quantum, Rabbit, Scirocco, Scirocco (Canadian), Transporter (Canadian), Vanagon

TIMING BELT INTERFERENCE VERIFICATION INFORMATION

TIMING BELT INTERFERENCE CAUTION

NOTE: CAMSHAFT DRIVE BELTS OR TIMING BELTS - The condition of camshaft drive belts should always be checked on vehicles which have more than 50,000 miles. Although some manufacturers do not recommend replacement at a specified mileage, others require it at 60,000-100,000 miles. A camshaft drive belt failure may cause extensive damage to internal engine components on most engines, although some designs do not allow piston-to-valve contact. These designs are often called "Free Wheeling". Many manufacturers changed their maintenance and warranty schedules in the mid-1980's to reflect timing belt inspection and/or replacement at 50,000-60,000 miles. Most service interval schedules shown in this section reflect these changes. Belts or components should be inspected and replaced if any of the following conditions exist:

* Crack Or Tears In Belt Surface
* Missing, Damaged, Cracked Or Rounded Teeth
* Oil Contamination
* Damaged Or Faulty Tensioners
* Incorrect Tension Adjustment

TIMING BELT INTERFERENCE CHECK MENU

TIMING BELT INTERFERENCE VERIF. TABLE - PASSENGER CARS (1)

Application	Engine	Replacement Interval (Miles)
Cabrio		
1995-96	2.0L 4-Cyl.	(3) 60,000
Cabriolet		
1985-89	1.8L 4-Cyl. (DOHC)	(3) 60,000
	1.8L 4-Cyl. (SOHC)	(3) 60,000
1990-93	1.8L 4-Cyl.	(3) 60,000
Corrado		
1990-92	1.8L 4-Cyl.	(3) 60,000
Dasher		

1976-80	(2) 1.5L 4-Cyl. Diesel	(3) 60,000
1974-80	1.6L 4-Cyl.	(3) 60,000
1981-80	(2) 1.6L 4-Cyl. Diesel & Turbo Diesel	(3) 60,000
Fox		
1987-93	1.8L 4-Cyl.	(3) 60,000
Golf		
1985-88	(2) 1.6L 4-Cyl. Diesel	(3) 60,000
1985-89	1.8L 4-Cyl. (DOHC)	(3) 60,000
1985-93	1.8L 4-Cyl. (SOHC)	(3) 60,000
1990-92	1.8L 4-Cyl.	(3) 60,000
1993-96	2.0L 4-Cyl.	(3) 60,000
Golf (Canadian)		
1985-92	(2) 1.6L 4-Cyl. Diesel	(3) 60,000
1993	1.8L 4-Cyl.	(3) 60,000
GTI		
1983-84	(2) 1.6L 4-Cyl. Diesel	(3) 60,000
	(2) 1.6L 4-Cyl. Turbo Diesel	(3) 60,000
	1.7L 4-Cyl.	(3) 60,000
	1.8L 4-Cyl.	(3) 60,000
1985-89	1.8L 4-Cyl. (DOHC)	(3) 60,000
1983-92	1.8L 4-Cyl. (SOHC)	(3) 60,000
1990-92	1.8L 4-Cyl.	(3) 60,000
1990-96	2.0L 4-Cyl.	(3) 60,000
GTI (Canadian)		
1993	2.0L 4-Cyl.	(3) 60,000
Jetta		
1980	1.6L 4-Cyl.	(3) 60,000
1981-92	(2) 1.6L 4-Cyl. Diesel & Turbo Diesel	(3) 60,000
1983-84	1.7L 4-Cyl.	(3) 60,000
	1.8L 4-Cyl.	(3) 60,000
1985-89	1.8L 4-Cyl. (DOHC)	(3) 60,000
1983-92	1.8L 4-Cyl. (SOHC)	(3) 60,000
1990-92	1.8L 4-Cyl.	(3) 60,000
1993-96	2.0L 4-Cyl.	(3) 60,000
Jetta GLI		
1990-92	2.0L 4-Cyl.	(3) 60,000
Passat		
1990-96	2.0L 4-Cyl.	(3) 60,000
Passat (Canadian)		
1993	1.8L 4-Cyl.	(3) 60,000
Quantum		
1981-86	(2) 1.6L 4-Cyl. Diesel & Turbo Diesel	(3) 60,000
1981-84	1.7L 4-Cyl.	(3) 60,000
1984-85	2.1L 5-Cyl.	(3) 60,000
1983-88	2.2L 5-Cyl.	(3) 60,000
1985-86	1.8L 4-Cyl.	(3) 60,000
Rabbit		
1974-79	1.5L 4-Cyl.	(3) 60,000
	1.6L 4-Cyl.	(3) 60,000

1976-80	(2) 1.5L 4-Cyl. Diesel		(3) 60,000
1981-84	(2) 1.6L 4-Cyl. Diesel & Turbo Diesel		(3) 60,000
1983-84	1.7L 4-Cyl.		(3) 60,000
	1.8L 4-Cyl.		(3) 60,000
Scirocco			
1976-79	1.5L 4-Cyl.		(3) 60,000
1976-80	1.6L 4-Cyl.		(3) 60,000
1983-84	1.7L 4-Cyl.		(3) 60,000
	1.8L 4-Cyl.		(3) 60,000
1985-89	1.8L 4-Cyl. (DOHC)		(3) 60,000
	1.8L 4-Cyl. (SOHC)		(3) 60,000
Scirocco (Canadian)			
1989	1.8L 4-Cyl. (DOHC)		(3) 60,000
	1.8L 4-Cyl. (SOHC)		(3) 60,000

(1) - Other interference engine applications may exist which are not indicated here.
(2) - Interference engine. Check for possible damage to piston(s) or valve(s) if there has been a timing belt failure.
(3) - Although the vehicle manufacturer does not recommend a specific scheduled maintenance interval, aftermarket belt manufacturers suggest the belt be replaced at 60,000 mile intervals.
(4) - Vehicle manufacturer recommends replacing all belts at the same time.

TIMING BELT INTERFERENCE VERIF. TABLE - LIGHT TRUCKS (1)

Application	Engine	Replacement Interval (Miles)
Eurovan (Canadian)		
1992-96	2.5L 5-Cyl.	(3) 60,000
Pickup		
1980	(2) 1.5L 4-Cyl. Diesel	(3) 60,000
1980-83	1.6L 4-Cyl.	(3) 60,000
1981-83	(2) 1.6L 4-Cyl. Diesel	(3) 60,000
	1.7L 4-Cyl.	(3) 60,000
Transporter (Canadian)		
1992-96	2.5L 5-Cyl.	(3) 60,000
Vanagon		
1981-82	(2) 1.6L 4-Cyl. Diesel	(3) 60,000

(1) - Other interference engine applications may exist which are not indicated here.
(2) - Interference engine. Check for possible damage to piston(s) or valve(s) if there has been a timing belt failure.
(3) - Although the vehicle manufacturer does not recommend a

specific scheduled maintenance interval, aftermarket belt manufacturers suggest the belt be replaced at 60,000 mile intervals.

(4) - Vehicle manufacturer recommends replacing all belts at the same time.

END OF ARTICLE

J - PIN VOLTAGE CHARTS
Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:34PM

ARTICLE BEGINNING

1993 ENGINE PERFORMANCE
Volkswagen Pin Voltage Charts

EuroVan

INTRODUCTION

Pin voltage charts are supplied to reduce diagnostic time. Checking pin voltages at ECU/ECM determines whether ECU/ECM is receiving and transmitting proper voltage signals. Charts may also help determine if ECU/ECM harness has an electrical short or open.

NOTE: Unless stated otherwise in testing procedures, perform all voltage tests using a Digital Volt-Ohmmeter (DVOM) with a minimum 10-megohm input impedance. Voltage readings may vary slightly due to battery condition or charging rate.

ECU PIN VOLTAGES (EUROVAN DIGIFANT - CALIFORNIA)

ECU PIN VOLTAGES (EUROVAN DIGIFANT - CALIFORNIA)

Component/Circuit (VAG 1598 Terminal No.)	(1) Test Conditions & Additional Steps	Specified Value Or Test Result
ECU NOT CONNECTED TO VAG 1598		
Voltage Supply - Control Unit (7 & 11)	Ignition On	Battery Voltage
Voltage Supply - Control Unit (19 & 35)	Ignition On	Battery Voltage
Wiring From Starter Term. 50 (25 & 35)	Operate Starter Then Turn Ignition Off	8 Volts Min.
Wiring To Fuel Pump Relay (24 & 35 - Jumper)	Ignition On	Fuel Pump Must Operate
Wiring To Fuel Injector (EV11 & 20)	(2) Ignition On	Battery Voltage
Wiring To Fuel Injector (EV21 & 21)	(2) Ignition On	Battery Voltage
Wiring To Fuel Injector (EV31 & 3)	(2) Ignition On	Battery Voltage
Wiring To Fuel Injector (EV41 & 2)	(2) Ignition On	Battery Voltage
Wiring To Fuel Injector (EV51 & 22)	(2) Ignition On	Battery Voltage
Cold Start Valve Ckt (5 & 35)	Ignition On	Battery Voltage

IAC Valve Ckt (23 & 35)	Ignition On	Battery Voltage
Wiring To A/C Compressor (32 & Green Wire)	Disconnect Connector ...	1.5 Ohms Max. (Continuity)
Wiring To Hall Effect Sensor (1 & 28) (3)	Disconnect Sensor Connector	1.5 Ohms Max. (Continuity)
Wiring To Hall Effect Sensor (2 & 27) (3)	Disconnect Sensor Connector	1.5 Ohms Max. (Continuity)
Wiring To Hall Effect Sensor (3 & 38) (3)	Disconnect Sensor Connector	1.5 Ohms Max. (Continuity)
Coolant Temperature Sensor (11 & 28)	(4)	(4)
Intake Air Temperature Sensor (28 & 30)	(4)	(4)
Closed Throttle Position Switch (1 & 28)	Throttle Fully Closed ...	1.5 Ohms Max. (Continuity)
Wiring To TPS (1 & 34) (3)	Disconnect Sensor Connector	1.5 Ohms Max. (Continuity)
Wiring To TPS (2 & 33) (3)	Disconnect Sensor Connector	1.5 Ohms Max. (Continuity)
Wiring To TPS (3 & 28) (3)	Disconnect Sensor Connector	1.5 Ohms Max. (Continuity)
Wiring To Heated O2 Sensor (2 & 1) (3)	Disconnect Sensor Connector	1.5 Ohms Max. (Continuity)
Wiring To Heated O2 Sensor (3 & 16) (3)	Reconnect Sensor Connector	Infinity (Open)
Wiring To Heated O2 Sensor (9 & 16)	Reconnect Sensor Connector	Infinity (Open)
Wiring To Heated O2 Sensor (16 & 35)	Reconnect Sensor Connector	Infinity (Open)
White DLC Connector Gray/White Wire (2 & 36) (3)	Ignition Off	1.5 Ohms Max. (Continuity)

White DLC Connector			
Yellow/White Wire			
(1 & 17) (3)	Ignition Off		1.5 Ohms Max. (Continuity)
ECU CONNECTED TO VAG 1598			
Throttle Potentiometer -			
Power (33 & 34)	Disconnect Sensor Connector		3.5-5.0 Volts
Throttle Potentiometer -			
Power (28 & 34)	Ignition On		4.5-5.0 Volts
Throttle Potentiometer -			
(28 & 33)	Reconnect Sensor, Throttle Setting:		
	Idle		0.3-1.7 Volts
	Full Throttle		3-5 Volts
Hall Effect Sensor -			
Power (28 & 38)	Ignition On		10 Volts Minimum
Hall Effect Sensor -			
Signal (28 & 37) (5)	Operate Starter		LED Must Flicker
Ignition Signal			
Function (1 & 6) (5)	Operate Starter		LED Must Flicker
RPM Signal Function			
(18 & 28) (5)	Operate Starter		LED Must Flicker

(1) - TESTING CONDITIONS: Disconnect harness connector from ECM. Connect Test Box (VAG 1598) to ECM harness connector using Adaptor Cable (VAG 1598/9), leaving ECM disconnected. Set multimeter to 20-volt DC scale.
(2) - With ignition on and fuse No. 18 removed, jumper terminals No. 24 and No. 35.
(3) - These are terminal connectors at sensor or data link connector.
(4) - Refer to I - SYS/COMP TESTS article.
(5) - Perform test only if engine will not start. Turn ignition off. Instead of using multimeter, connect LED Tester (US 1115) with Adapter Kit(VAG 1594/15). Disconnect wiring harness from cold start valve and fuel distributor (main injector connector).

ECU PIN VOLTAGES (EUROVAN DIGIFANT - FEDERAL)

ECU PIN VOLTAGES (EUROVAN DIGIFANT - FEDERAL)

Component/Circuit (VAG 1598 Terminal No.)	(1) Test Conditions & Additional Steps	Specified Value Or Test Result
ECU NOT CONNECTED TO VAG 1598		
Voltage Supply -		
Control Unit (20 & 36)	Ignition On	Battery Voltage
Voltage Supply -		
Control Unit (29 & 38)	Ignition On	Battery Voltage
Wiring From Starter		

Term. 50 (26 & 29)	Operate Starter Then Turn Ignition Off	8 Volts Min.
Wiring To Fuel Pump (7 & 29 - Jumper)	Ignition On	Fuel Pump Must Operate
Wiring To Fuel Injectors (2 & 20)	(2) Ignition On	Battery Voltage
EVAP Frequency Valve Ckt (4 & 29)	Ignition On	Battery Voltage
Wiring To Ignition Coil (20 & 27)	Ignition On	Battery Voltage
Cold Start Valve Ckt (3 & 29)	Ignition On	Battery Voltage
IAC Valve Ckt (25 & 29)	Ignition On	Battery Voltage
Wiring To A/C Compressor (37 & Green Wire)	Disconnect Connector	1.5 Ohms Max. (Continuity)
Wiring To Hall Effect Sensor (1 & 13) (3)	Disconnect Sensor Connector	1.5 Ohms Max. (Continuity)
Wiring To Hall Effect Sensor (2 & 11) (3)	Disconnect Sensor Connector	1.5 Ohms Max. (Continuity)
Wiring To Hall Effect Sensor (3 & 30) (3)	Disconnect Sensor Connector	1.5 Ohms Max. (Continuity)
Coolant Temperature Sensor (13 & 14)	(4)	(4)
Intake Air Temperature Sensor (13 & 15)	(4)	(4)
CO Potentiometer (13 & 35)	Ignition Off	0-2000 Ohms
Closed Throttle Position Switch (13 & 35)	Throttle Fully Closed	1.5 Ohms Max. (Continuity)
Closed Throttle Position Switch (13 & 35)	Throttle Wide Open	Infinity (Open)
Wiring To TPS Sensor (1 & 1) (3)	Disconnect Sensor Connector	1.5 Ohms Max. (Continuity)
Wiring To TPS Sensor (2 & 12) (3)	Disconnect Sensor Connector	1.5 Ohms Max. (Continuity)
Wiring To TPS Sensor (3 & 13) (3)	Disconnect Sensor Connector	1.5 Ohms Max. (Continuity)

Wiring To Heated O2 Sensor (2 & 20) (3)	....	Disconnect Sensor Connector	..... 1.5 Ohms Max. (Continuity)
Wiring To Heated O2 Sensor (3 & 8) (3)	.....	Reconnect Sensor Connector	..... Infinity (Open)
Wiring To Heated O2 Sensor (8 & 20) (3)	....	Reconnect Sensor Connector	..... Infinity (Open)
White DLC Connector Gray/White Wire (2 & 32) (3)	.....	Ignition Off	..... 1.5 Ohms Max. (Continuity)

ECU CONNECTED TO VAG 1598

Throttle Position Sensor - Power (1 & 12)	.....	Disconnect Sensor Connector	..... 3.5-5.0 Volts
Throttle Position Sensor - Power (1 & 13)	.....	Ignition On	..... 4.5-5.0 Volts
Throttle Position Sensor (12 & 13)	.....	Reconnect Sensor, Throttle Setting: Idle	..... 0.3-1.7 Volts
		Full Throttle	..... 3-5 Volts
Hall Effect Sensor - Power (13 & 30)	.....	Ignition On	..... 10 Volts Minimum
Hall Effect Sensor - Signal (11 & 13) (5)	..	Operate Starter	..... LED Must Flicker
Ignition Signal Function (20 & 27) (5)	.....	Operate Starter	..... LED Must Flicker
RPM Signal Function (10 & 13) (5)	.....	Operate Starter	..... LED Must Flicker

(1) - TESTING CONDITIONS: Disconnect harness connector from ECM. Connect Test Box (VAG 1598) to ECM harness connector using Adaptor Cable (VAG 1598/9), leaving ECM disconnected. Set multimeter to 20-volt DC scale.
(2) - With ignition on and fuse No. 18 removed, jumper terminals No. 7 and No. 29.
(3) - These are terminal connectors at sensor or data link connector.
(4) - Refer to I - SYS/COMP TESTS article.
(5) - Perform test only if engine will not start. Turn ignition off. Instead of using multimeter, connect LED Tester (US 1115) with Adapter Kit(VAG 1594/15). Disconnect wiring harness from cold start valve and fuel distributor (main injector connector).

END OF ARTICLE

L - WIRING DIAGRAMS
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

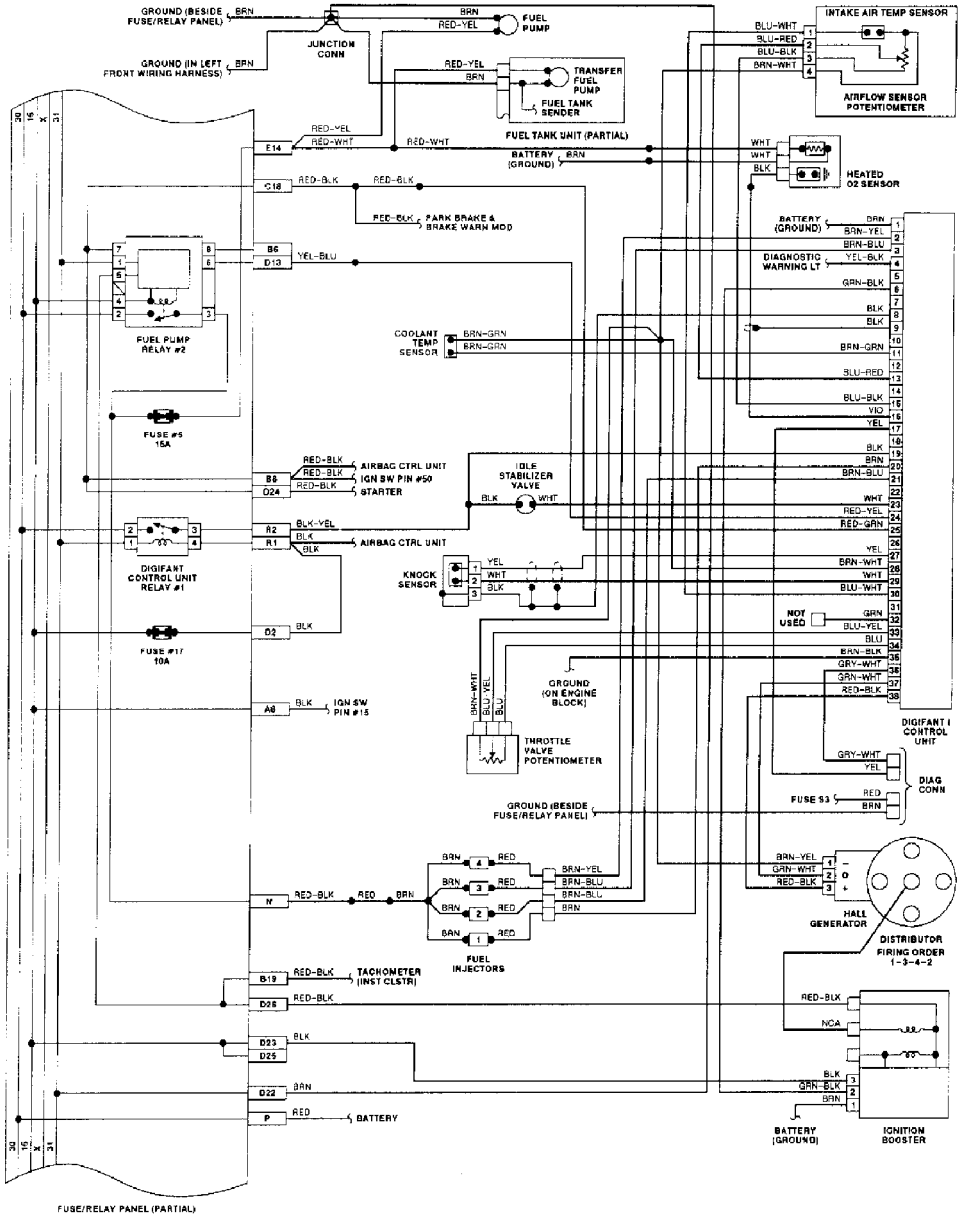
Saturday, March 18, 2000 10:34PM

ARTICLE BEGINNING

1993 ENGINE PERFORMANCE
Volkswagen Wiring Diagrams

Cabriolet, Corrado, EuroVan, Fox, Golf, GTI, Jetta, Passat

WIRING DIAGRAMS



92A25510

Fig. 1: Wiring Diagram (Cabriolet 1.8L Digifant I - California)

L - WIRING DIAGRAMS
Article Text (p. 2)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:34PM

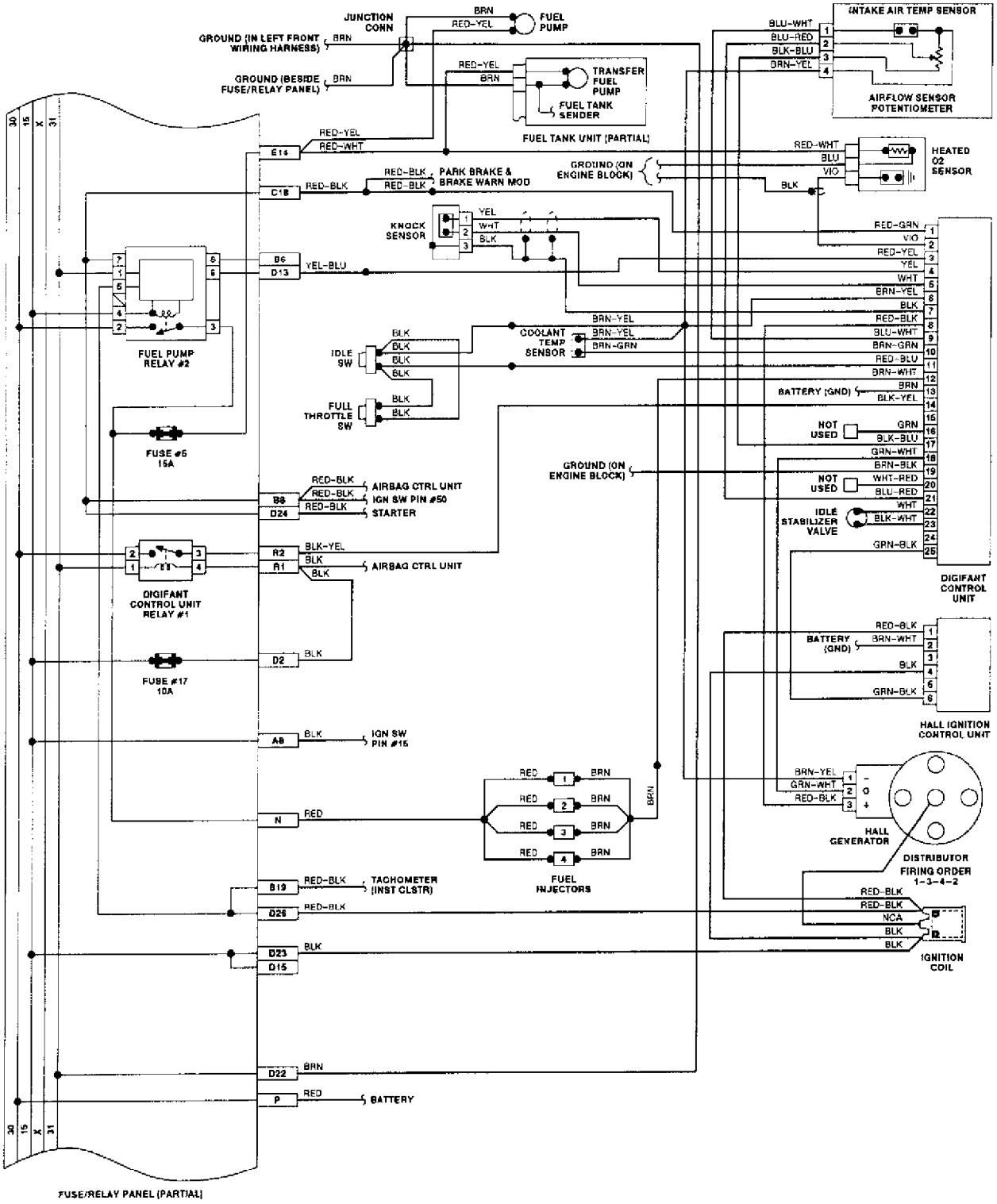


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Fig. 2: Wiring Diagram (Cabriolet 1.8L Digifant II)

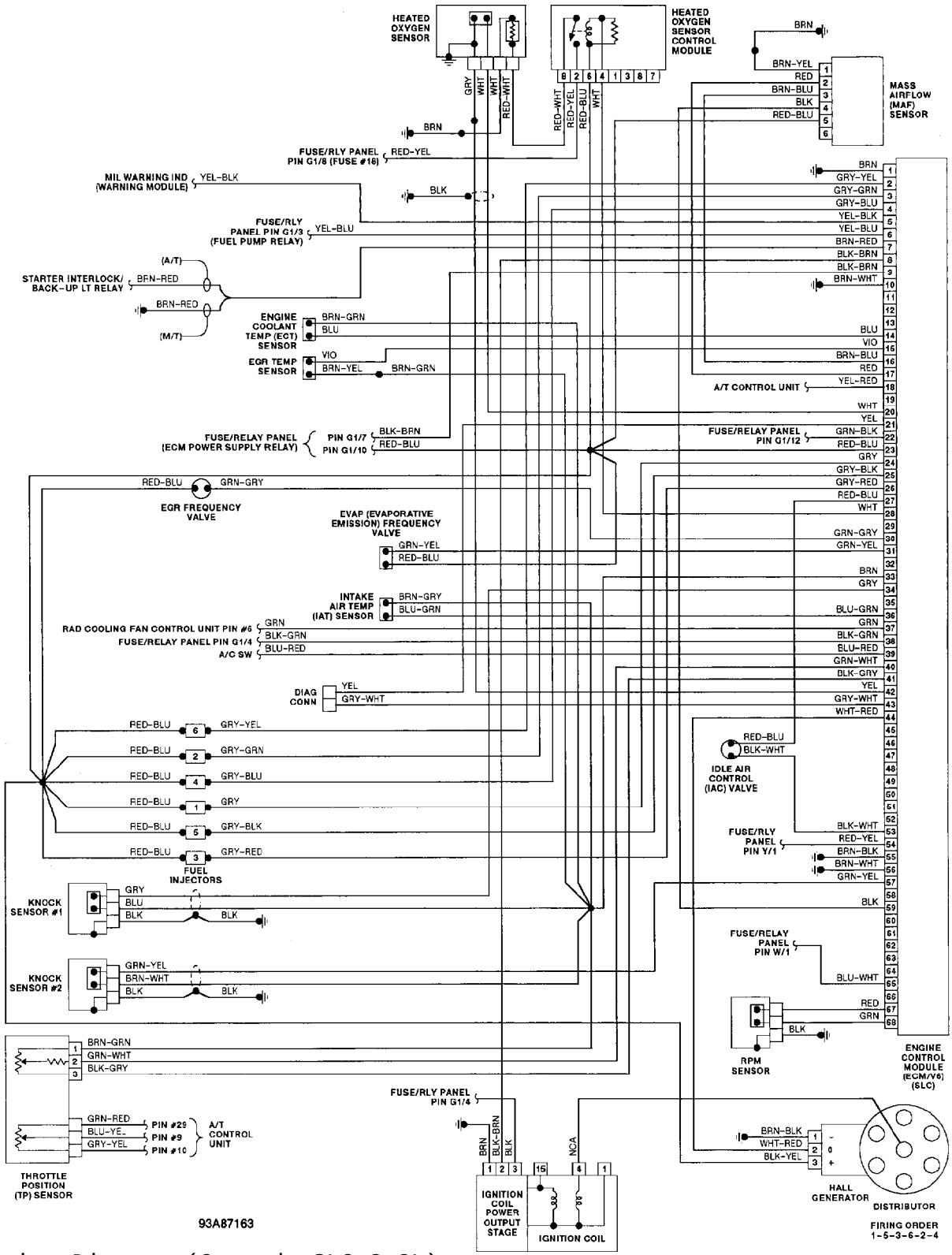


Fig. 3: Wiring Diagram (Corrado SLC 2.8L)

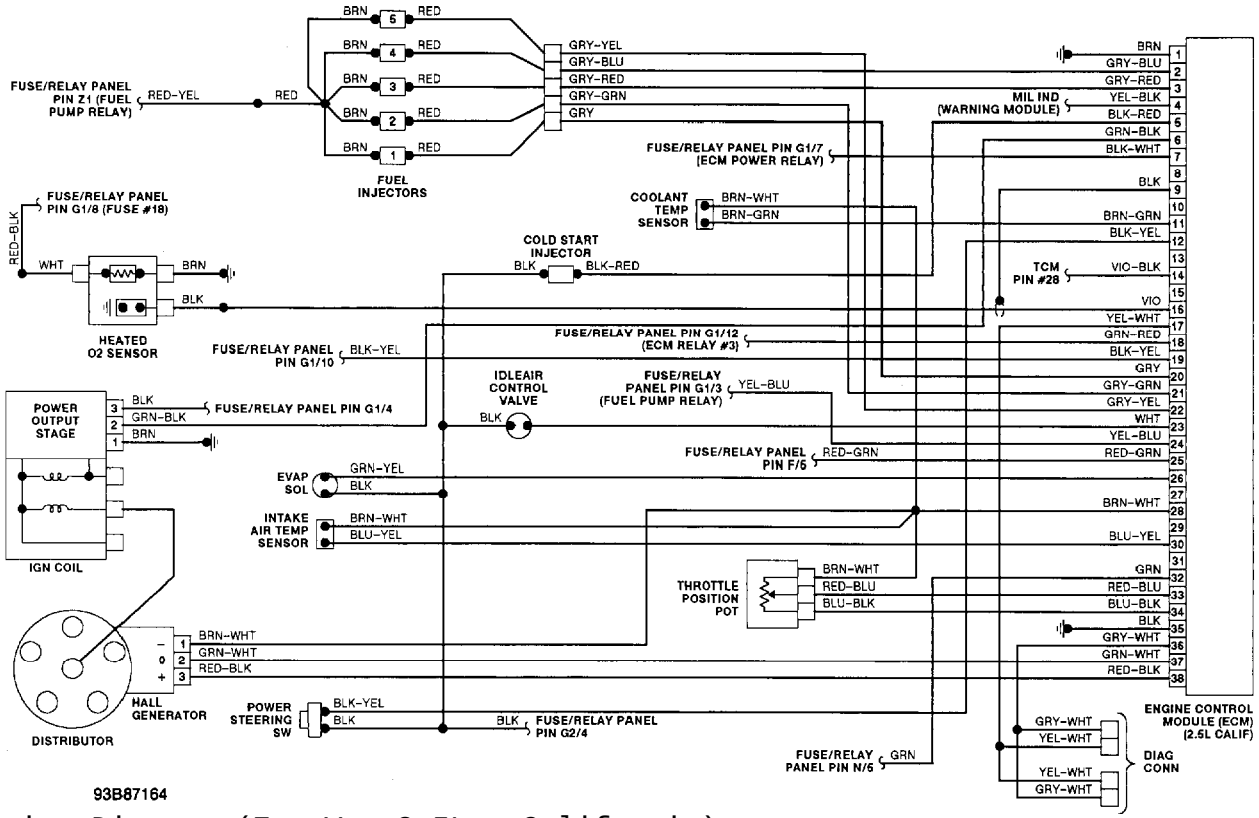


Fig. 4: Wiring Diagram (EuroVan 2.5L - California)

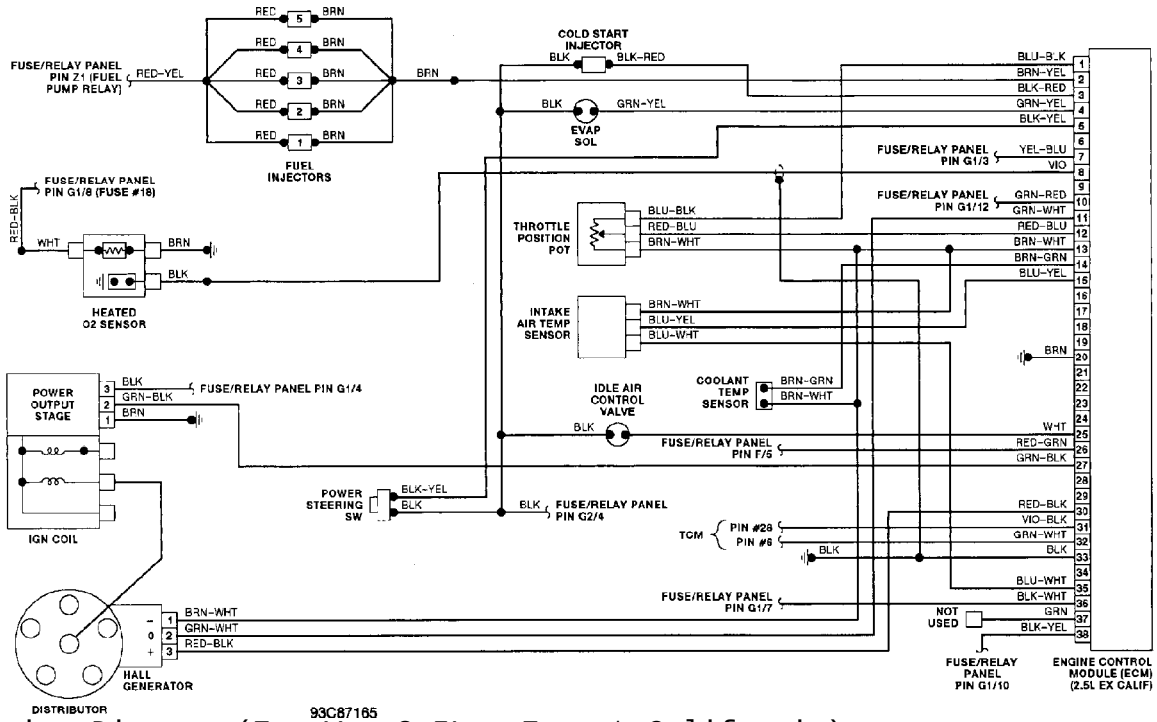
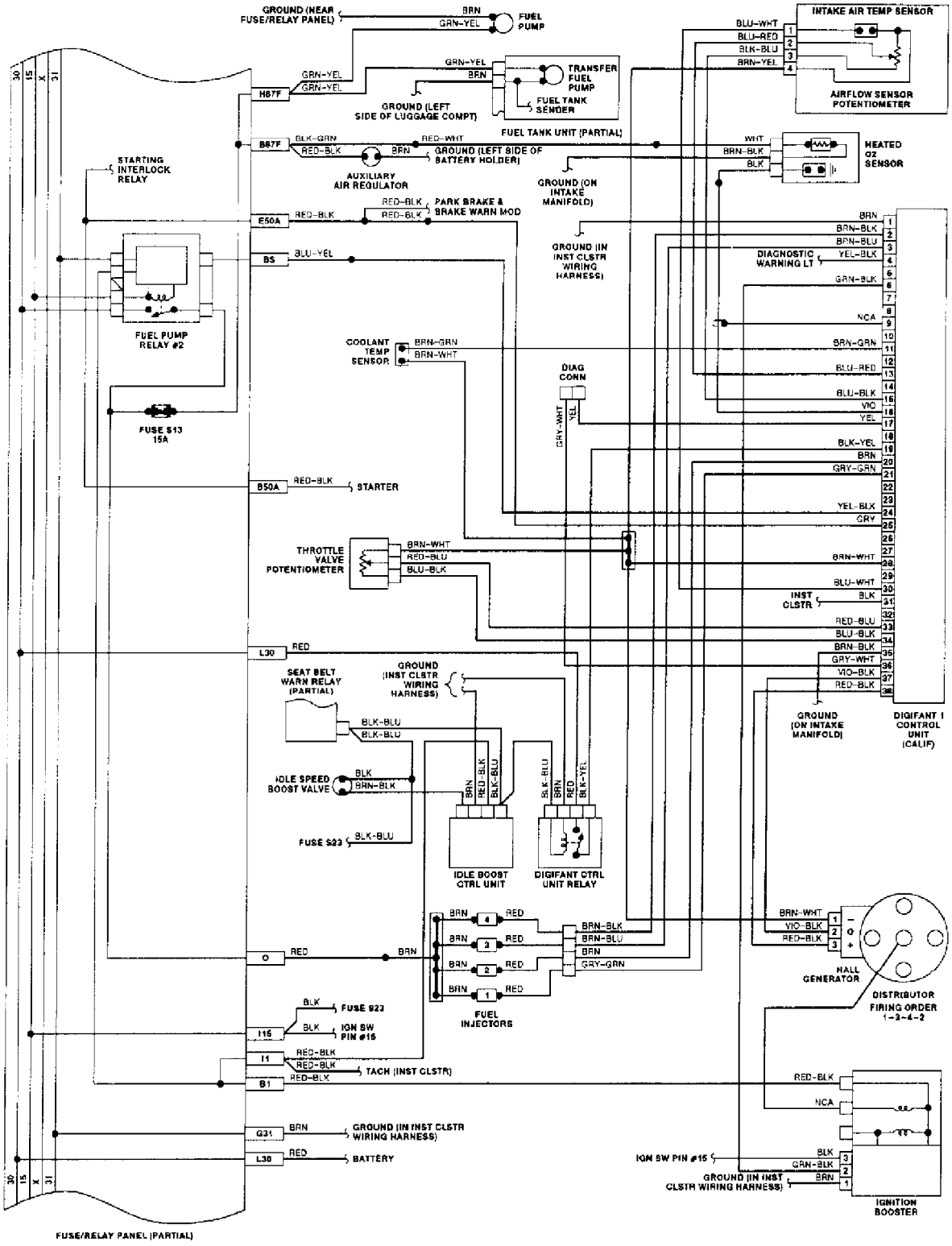
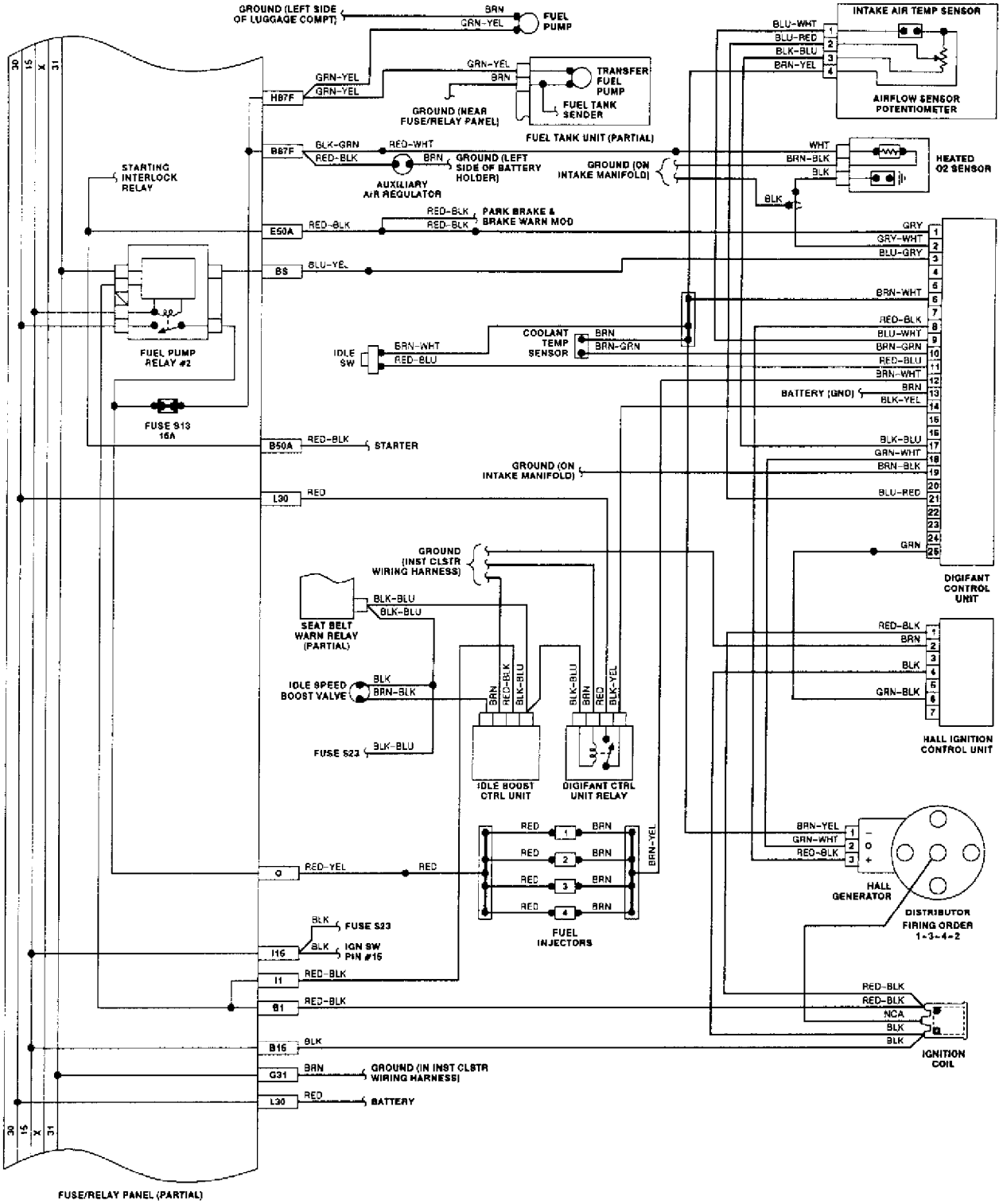


Fig. 5: Wiring Diagram (EuroVan 2.5L - Except California)



92F25515

Fig. 6: Wiring Diagram (Fox 1.8L Digifant I - California)



92G25516

Fig. 7: Wiring Diagram (Fox 1.8L Digifant II)

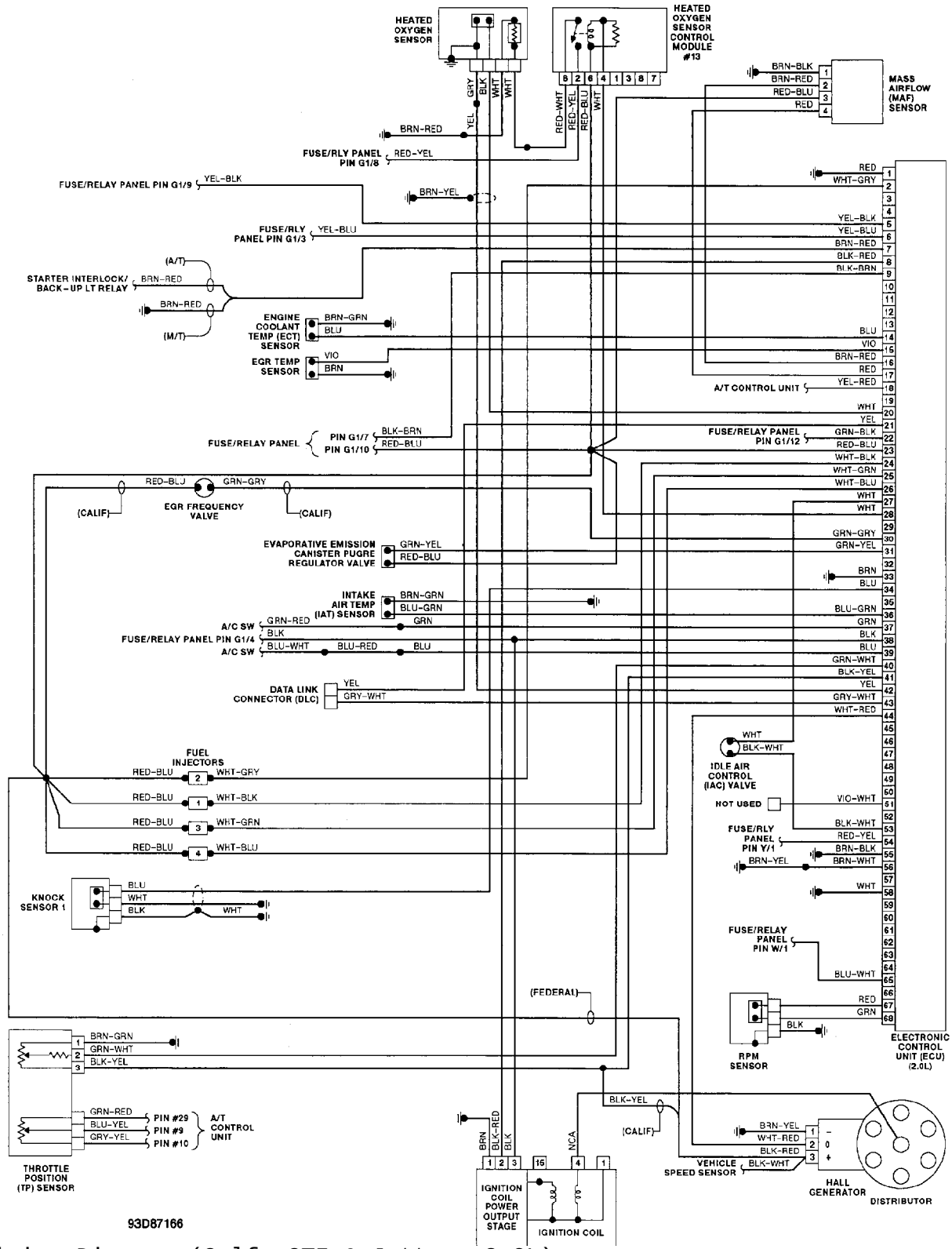


Fig. 8: Wiring Diagram (Golf, GTI & Jetta - 2.0L)

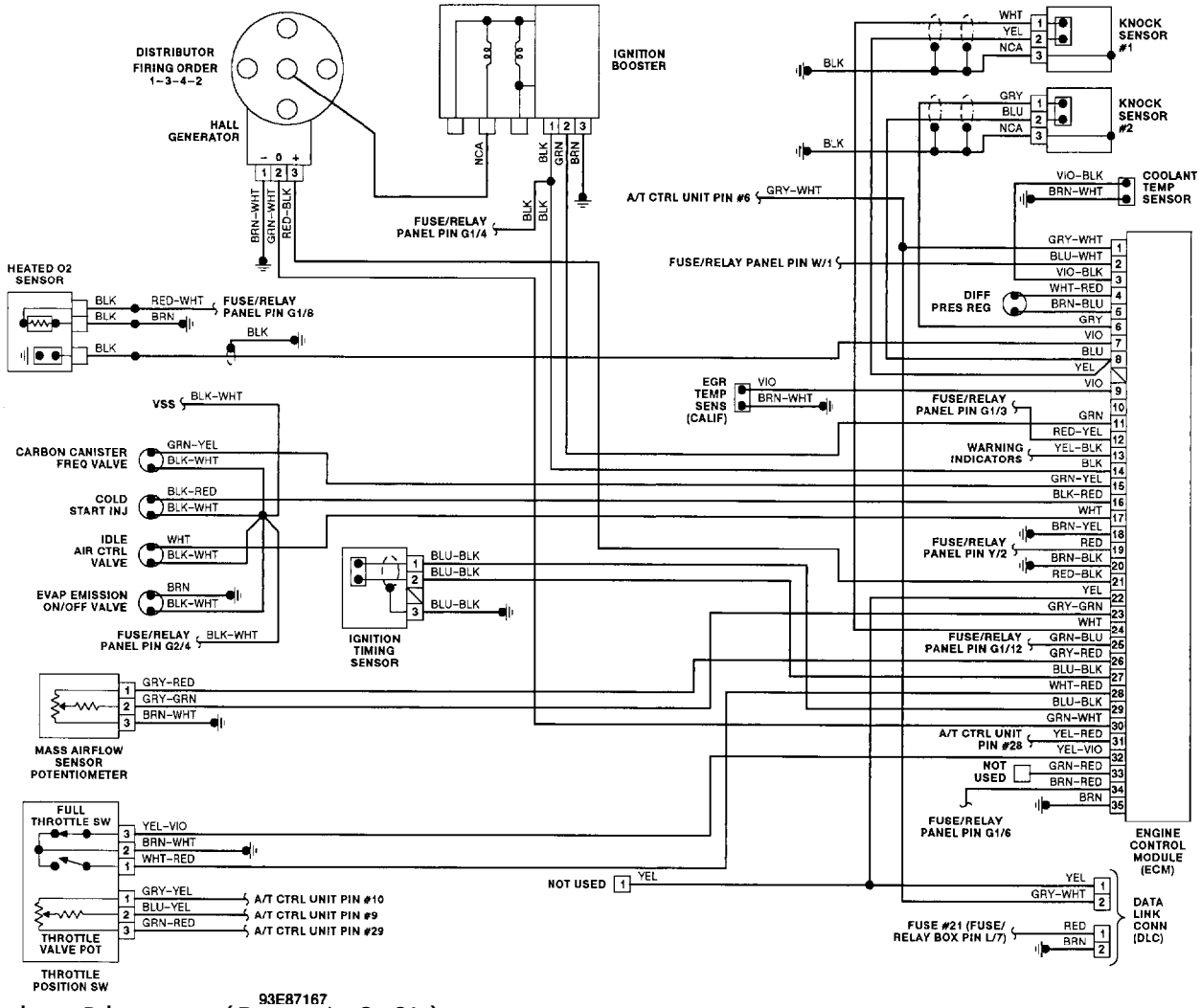


Fig. 9: Wiring Diagram (Passat 2.0L)

L - WIRING DIAGRAMS
Article Text (p. 9)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:34PM

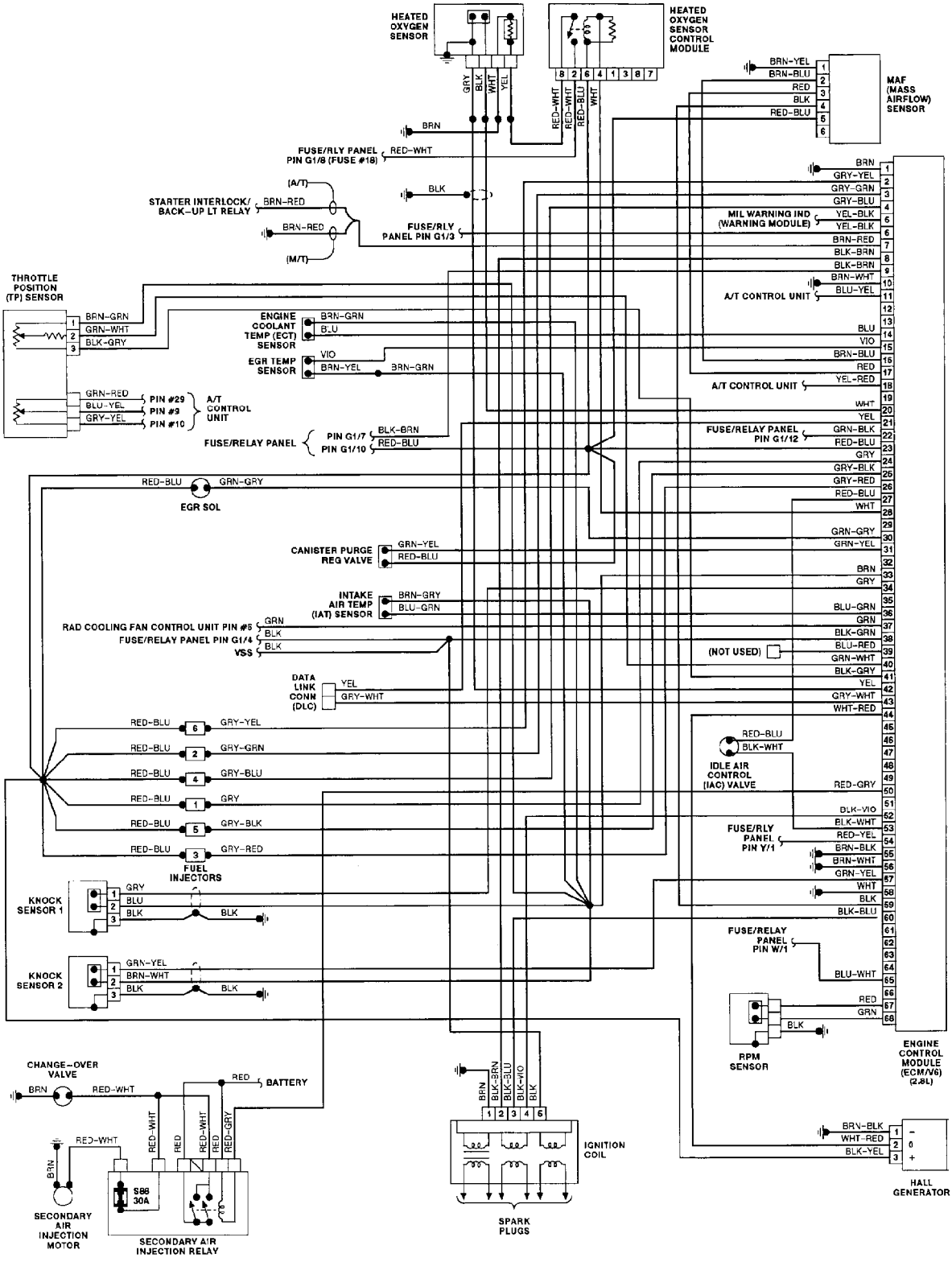


Fig. 10: Wiring Diagram (Passat 2.8L)

END OF ARTICLE

M - VACUUM DIAGRAMS
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:34PM

ARTICLE BEGINNING

1993 ENGINE PERFORMANCE
Vacuum Diagrams

Cabriolet, Corrado SLC, EuroVan,
Fox, Golf, GTI, Jetta, Passat

INTRODUCTION

This article contains underhood views or schematics of vacuum hose routing. Use these vacuum diagrams during visual inspection. This will assist in identifying improperly routed vacuum hoses which cause driveability and/or computer-indicated malfunctions.

CABRIOLET & FOX VACUUM DIAGRAMS

NOTE: Vacuum diagrams are not available for Cabriolet or Fox.

EUROVAN VACUUM DIAGRAMS

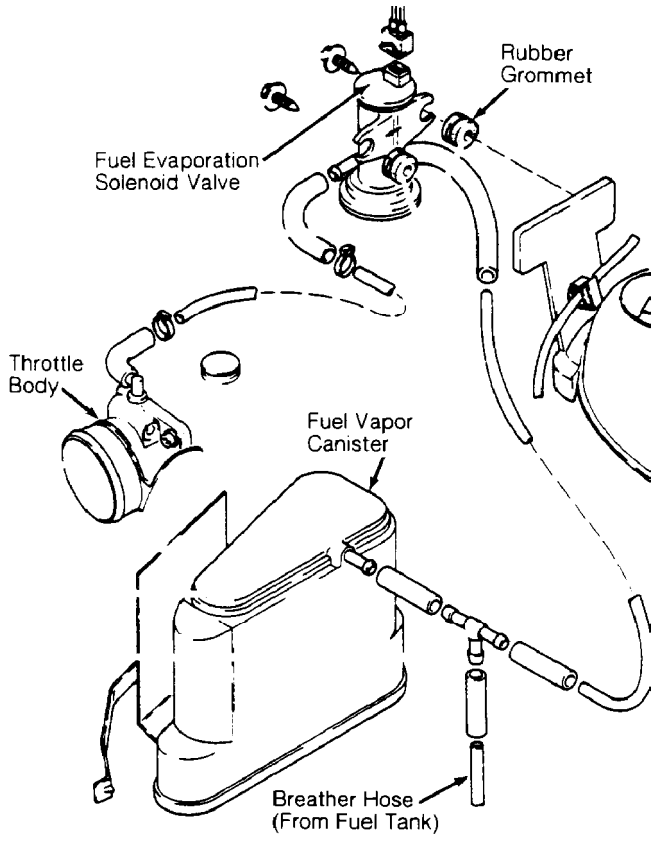


Fig. 1: Fuel Evaporation System Vacuum Diagram (EuroVan)
Courtesy of Volkswagen United States, Inc.

GOLF, GTI & JETTA VACUUM DIAGRAMS

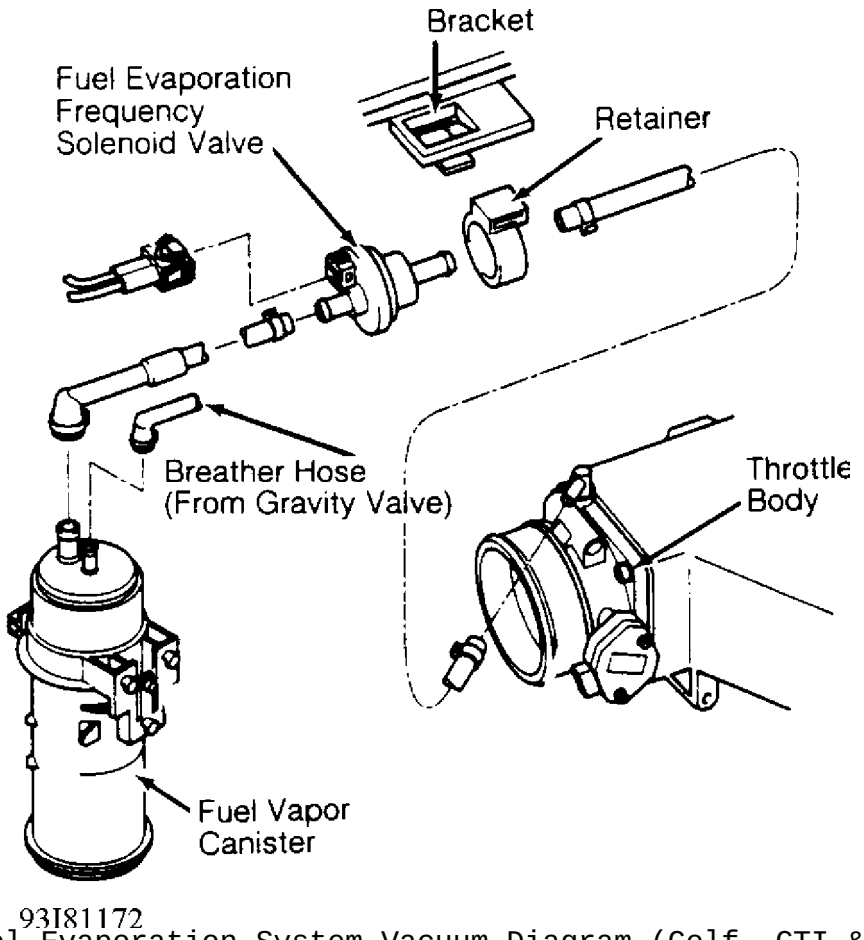


Fig. 2: Fuel Evaporation System Vacuum Diagram (Golf, GTI & Jetta)
Courtesy of Volkswagen United States, Inc.

PASSAT GL VACUUM DIAGRAMS

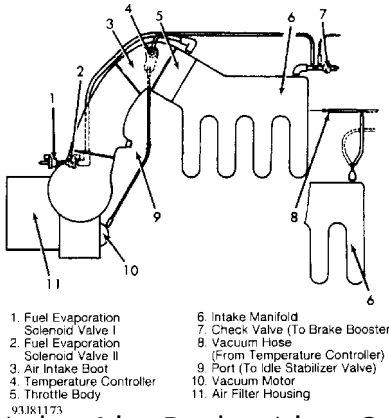


Fig. 3: Intake Air Preheating System Vacuum Diagram (Passat GL)
Courtesy of Volkswagen United States, Inc.

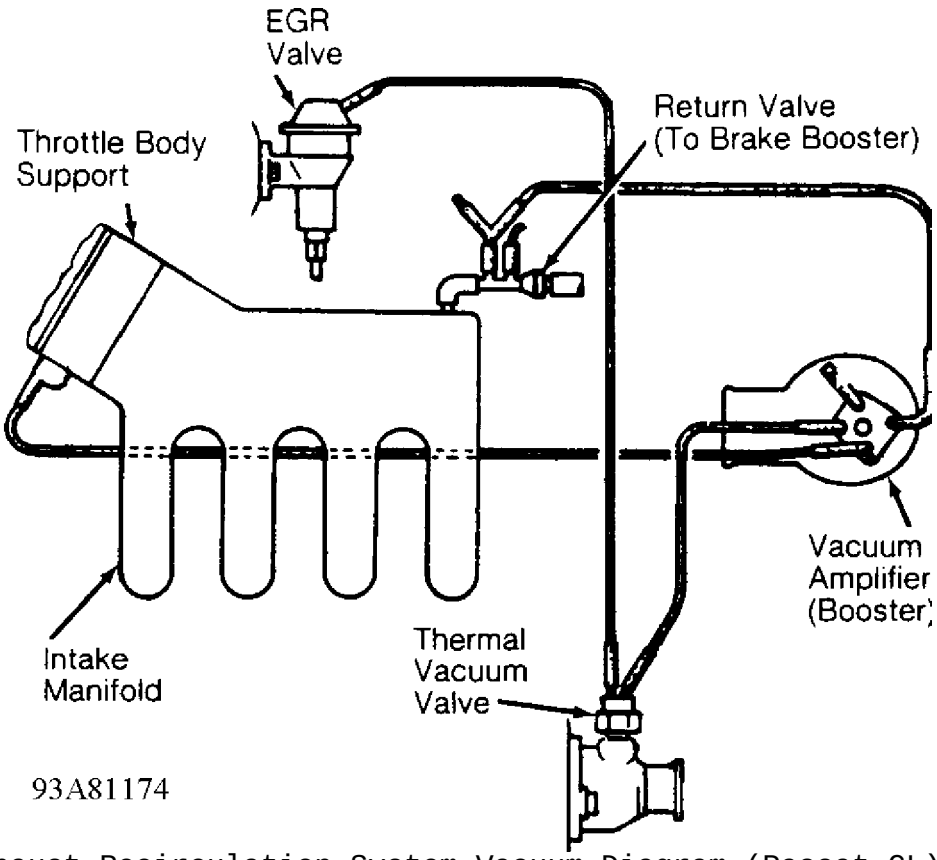


Fig. 4: Exhaust Recirculation System Vacuum Diagram (Passat GL)
Courtesy of Volkswagen United States, Inc.

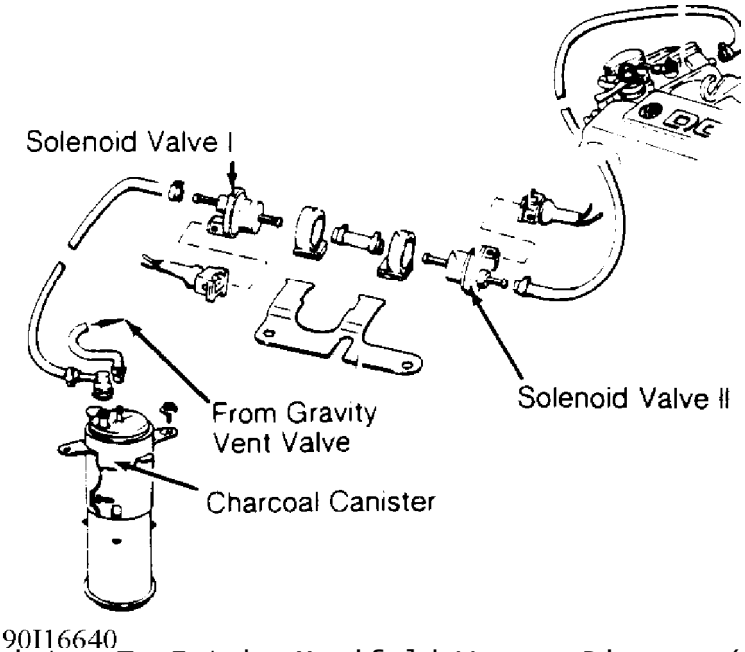


Fig. 5: Canister-To-Intake Manifold Vacuum Diagram (Passat GL)
Courtesy of Volkswagen United States, Inc.

CORRADO SLC & PASSAT GLX VACUUM DIAGRAMS

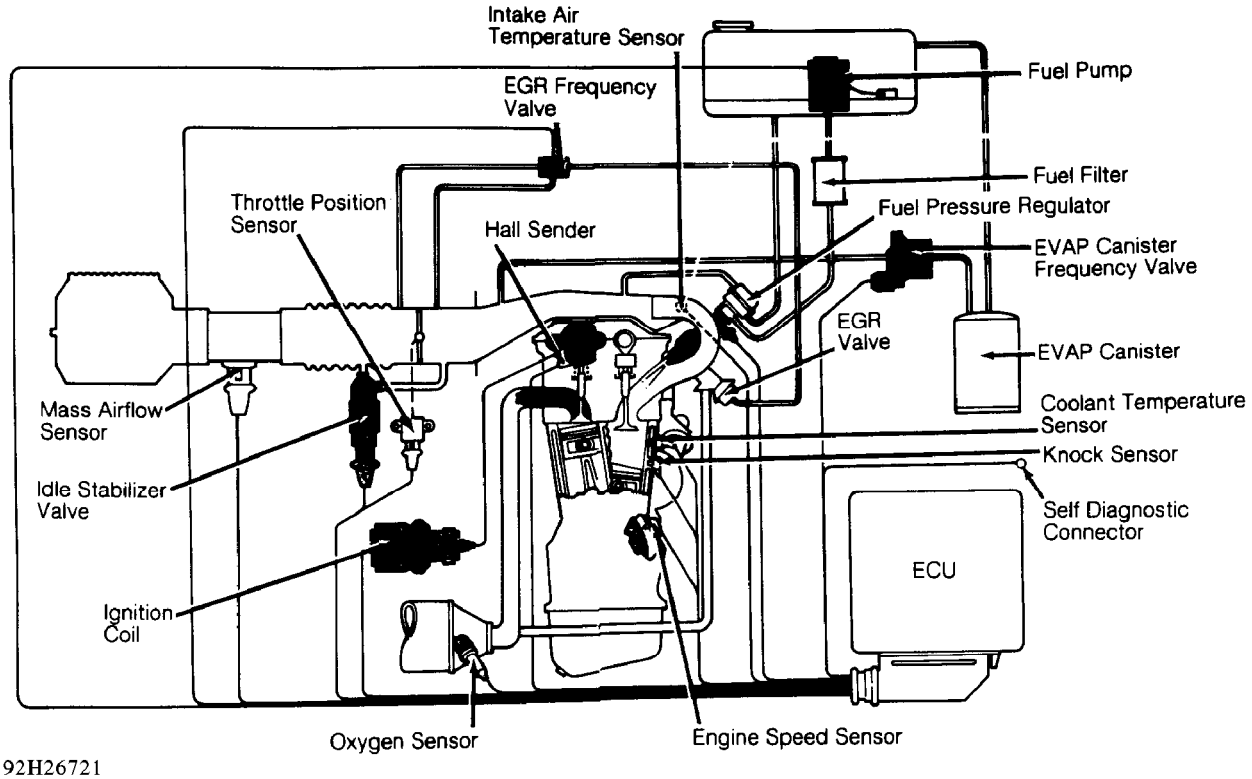


Fig. 6: Motronic System & Vacuum Diagram (Corrado SLC/Passat GLX)
Courtesy of Volkswagen United States, Inc.

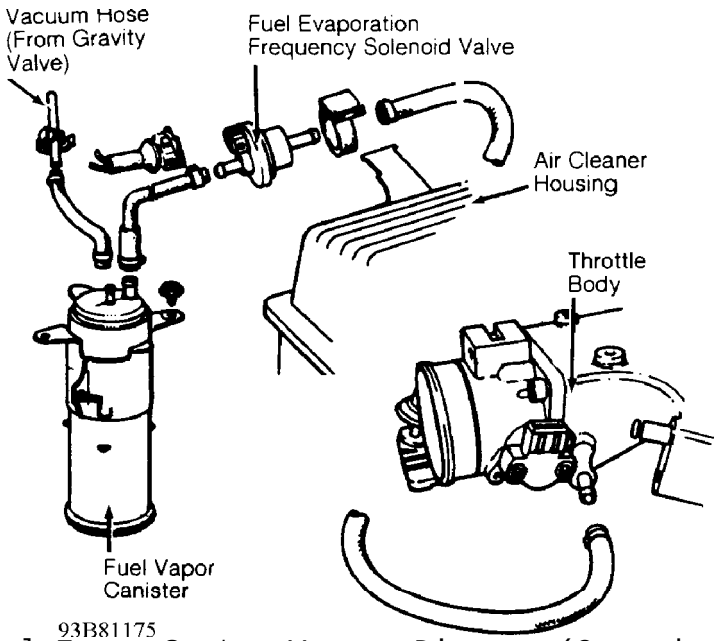


Fig. 7: Fuel Evap. System Vacuum Diagram (Corrado SLC/Passat GLX)
Courtesy of Volkswagen United States, Inc.

END OF ARTICLE

ARTICLE BEGINNING

1993-95 MAINTENANCE
Volkswagen Maintenance Information

Euro Van CL
GL
MV (Camper)

* PLEASE READ THIS FIRST *

NOTE: For scheduled maintenance intervals and the related fluid capacities, fluid specifications and labor times for major service intervals, see SCHEDULED SERVICES article in this section. Warranty information and specifications for fluid capacities, lubrication specifications, wheel and tire size, and battery type are covered in this article.

MODEL IDENTIFICATION

NOTE: All 1994 models are carryover 1993 models. The 1995 models have standard dual air bags and are 1995 models.

VIN LOCATION

The Vehicle Identification Number (VIN) is located on the left side of the dash panel at the base of the windshield. The VIN chart explains the code characters.

VIN CODE ID EXPLANATION

Numbers preceding the explanations in the legend below refer to the sequence of characters as listed on VIN identification label. See VIN example below.

(VIN)	W	V	2	H	D	0	7	0	5	P	H	0	2	7	5	8	2
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

1 - Manufacturing Country
W * Germany

2 - Manufacturer
V * Volkswagen

3 - Vehicle Type
2 * MPV (Multi-Purpose Vehicle)

4 - Series
H * Euro Van (CL)

```
  K  *  Euro Van (GL)
  M  *  Camper (MV)

5 - Engine
  D  *  2.5L 5-Cylinder (1993-95)
  D  *  2.4L Diesel 5-Cylinder (1995)

6 - Restraint System
  0  *  Active
  9  *  Passive - Driver and Passenger Air Bag (1995)

7-8 - Model
 70  *  Euro Van

9 - VIN Check Digit
  2  *  Computer Selected Check Number

10 - Vehicle Model Year
  P  *  1993
  R  *  1994
  S  *  1995

11 - Assembly Plant
  G  *  Graz
  H  *  Hannover
  K  *  Osnabruk
  N  *  Neckarsulm
  S  *  Stuttgart
  W  *  Wolfsburg

12-17 - Serial Number
     *  Sequential Production Number
```

MAINTENANCE SERVICE INFORMATION

SEVERE & NORMAL SERVICE DEFINITIONS

NOTE: Use the Severe Service schedule if the vehicle to be serviced is operated under ANY (one or more) of these conditions:

Service is recommended at mileage intervals based on vehicle operation. Service schedules are based on the following primary operating conditions:

Normal Service

- Driven More Than 10 Miles Daily
- No Operating Conditions From Severe Service Schedule

Severe Service (Unique Driving Conditions)

- Short Trips (10 Miles) In Freezing Temperatures

* Towing or Heavily Loaded
* Severe Dust Conditions
* Hot Weather, Stop-and-Go Driving
* Extensive Idling Conditions (Taxi or Delivery)

CAMSHAFT TIMING BELT

CAUTION: Failure to replace a faulty camshaft timing belt may result in serious engine damage.

The condition of camshaft drive belts should always be checked on vehicles which have more than 50,000 miles. Although some manufacturers do not recommend belt replacement at a specified mileage, others require it at 60,000-100,000 miles. A camshaft drive belt failure may cause extensive damage to internal engine components on most engines, although some designs do not allow piston-to-valve contact. These designs are often called "Free Wheeling".

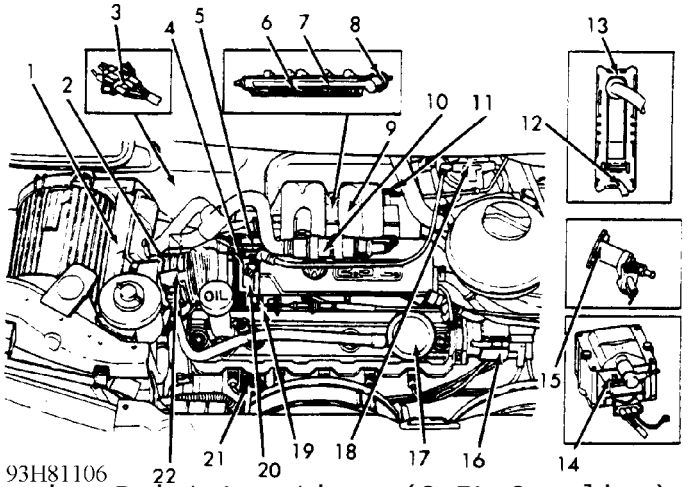
Many manufacturers changed their maintenance and warranty schedules in the mid-1980's to reflect timing belt inspection and/or replacement at 50,000-60,000 miles. Most service interval schedules in this manual reflect these changes.

Belts or components should be inspected and replaced if any of the following conditions exist:

* Cracks Or Tears In Belt Surface
* Missing, Damaged, Cracked Or Rounded Teeth
* Oil Contamination
* Damaged Or Faulty Tensioners
* Incorrect Tension Adjustment

Replace timing belt every 36,000 miles or 36 months.

SERVICE POINT LOCATIONS



1. Air Cleaner
2. Air Intake Duct
3. Oxygen Sensor Connector
4. Throttle Body
5. Throttle Position Sensor
6. Fuel Injector
7. Fuel Rail
8. Fuel Pressure Regulator
9. Intake Manifold
10. Intake Air Control (IAC) Valve
11. CO Tap Tube
12. Vacuum Hose
13. Electronic Control Module (ECM)
14. Ignition Coil
15. Cold-Start Injector
16. Distributor
17. Emission Control Valve
18. Fuel Evaporative Solenoid (Frequency) Valve
19. Closed Throttle Position Switch
20. Idle Speed Adjustment Screw (If Equipped)
21. Engine Coolant Temp. Sensor (Blue
22. Intake Air Temp. Sensor

Fig. 1: Service Point Locations (2.5L Gasoline)
Courtesy of Volkswagen United States, Inc.

ADDITIONAL SERVICE INFORMATION

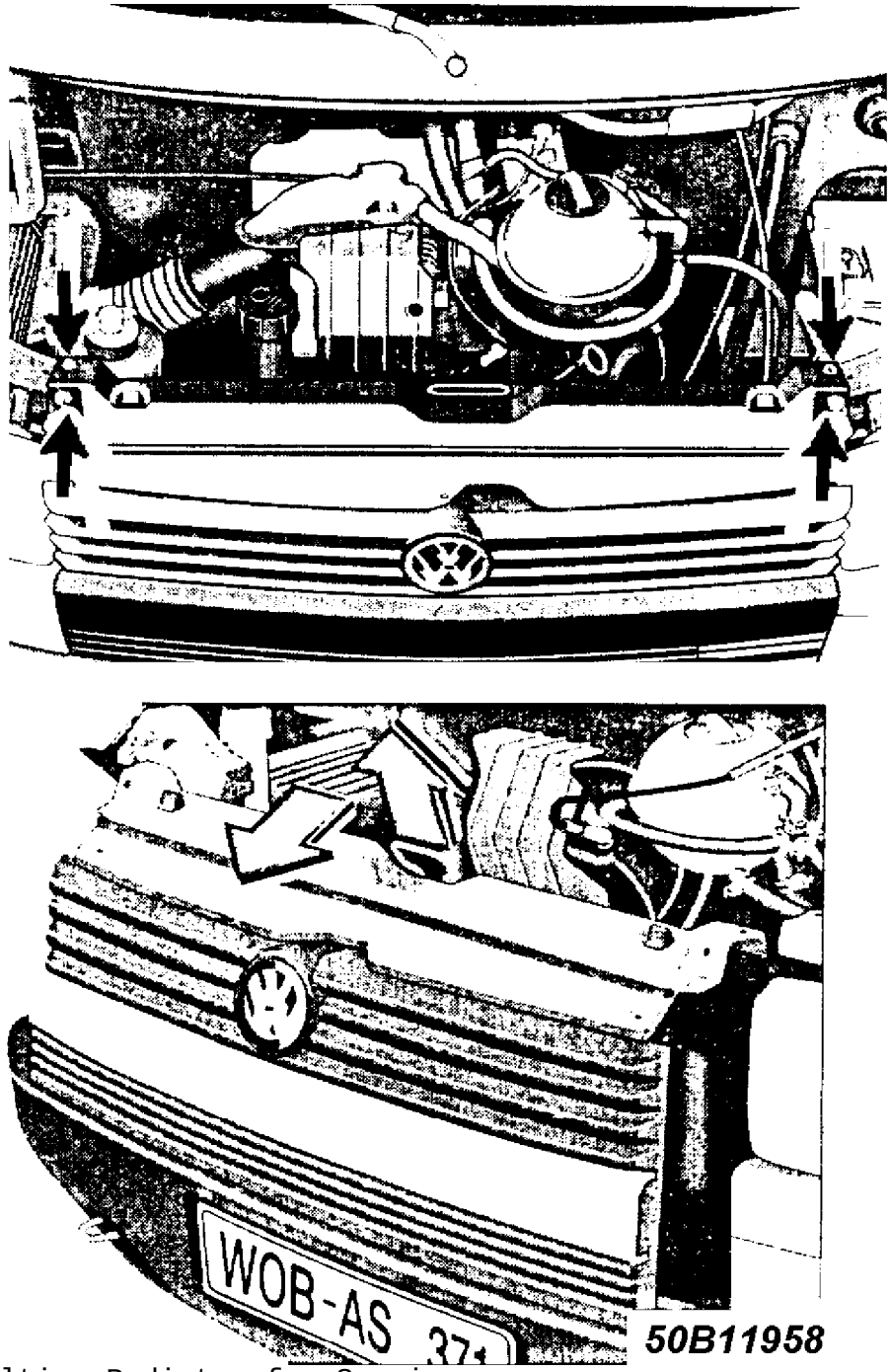


Fig. 2: Tilting Radiator for Service
Courtesy of Volkswagen United States, Inc.

1) With gear selector in Park, depress brake pedal.
2) Move gear selector to desired position.
3) If gear selector DOES NOT MOVE, check fuse #12.
4) TO MANUALLY RELEASE gear selector, push finger between

brushes at base of shifter and push catch to the left. (See Fig. 2).
5) Select a gear.

NOTE: It may not be possible to move the radiator on some 1995 models (models with one piece lower grille sections).

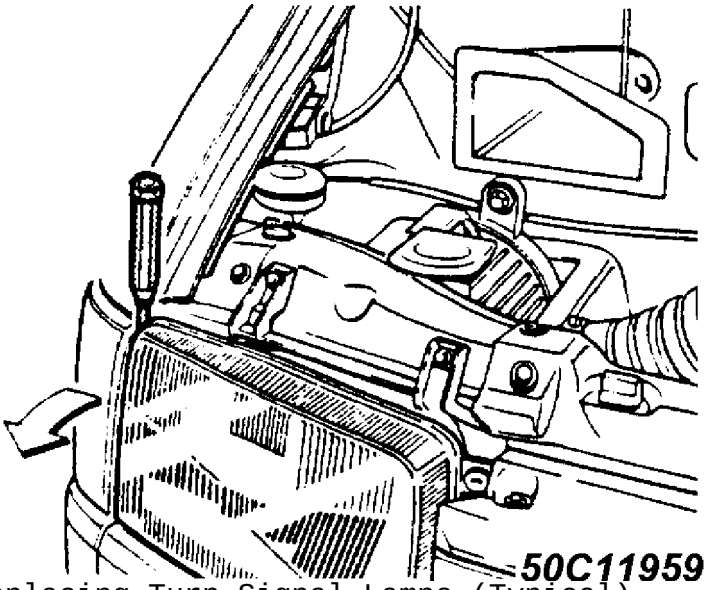


Fig. 3: Replacing Turn Signal Lamps (Typical)
Courtesy of Volkswagen United States, Inc.

ALIGNING CAMSHAFT TIMING MARKS

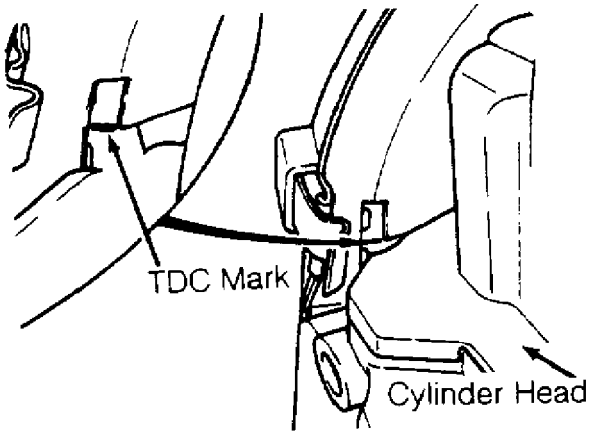


Fig. 4: Aligning Camshaft & Crankshaft Timing Marks
Courtesy of Volkswagen United States, Inc.

NOTE: For more information regarding camshaft timing belt service refer to the 2.5L 5-CYLarticle in the ENGINE MECHANICAL section.

BODY SERVICE POINTS

PASSENGER COMPARTMENT FILTER REPLACEMENT

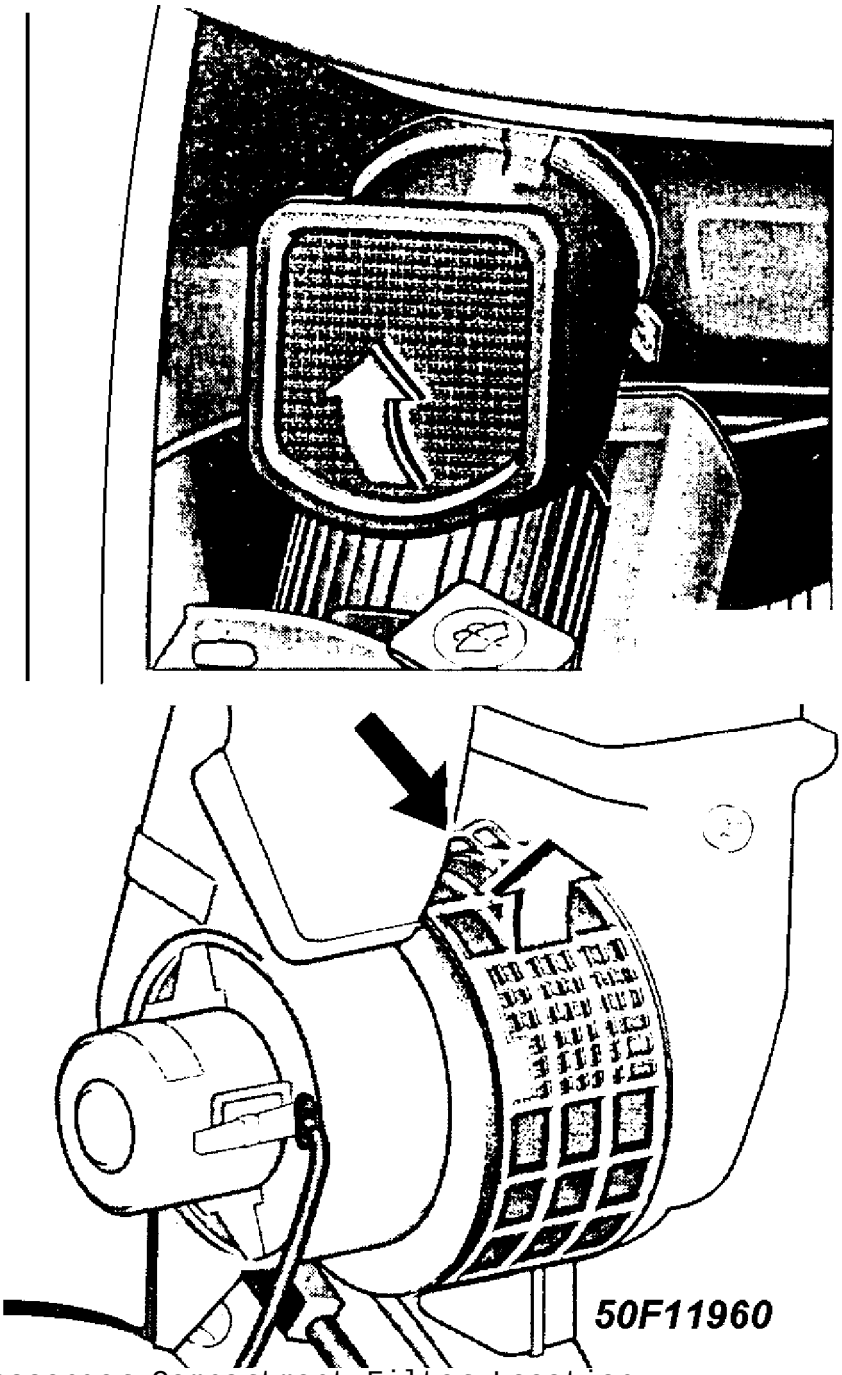


Fig. 5: Passenger Compartment Filter Location
Courtesy of Volkswagen United States, Inc.

DIESEL FUEL FILTER MAINTENANCE

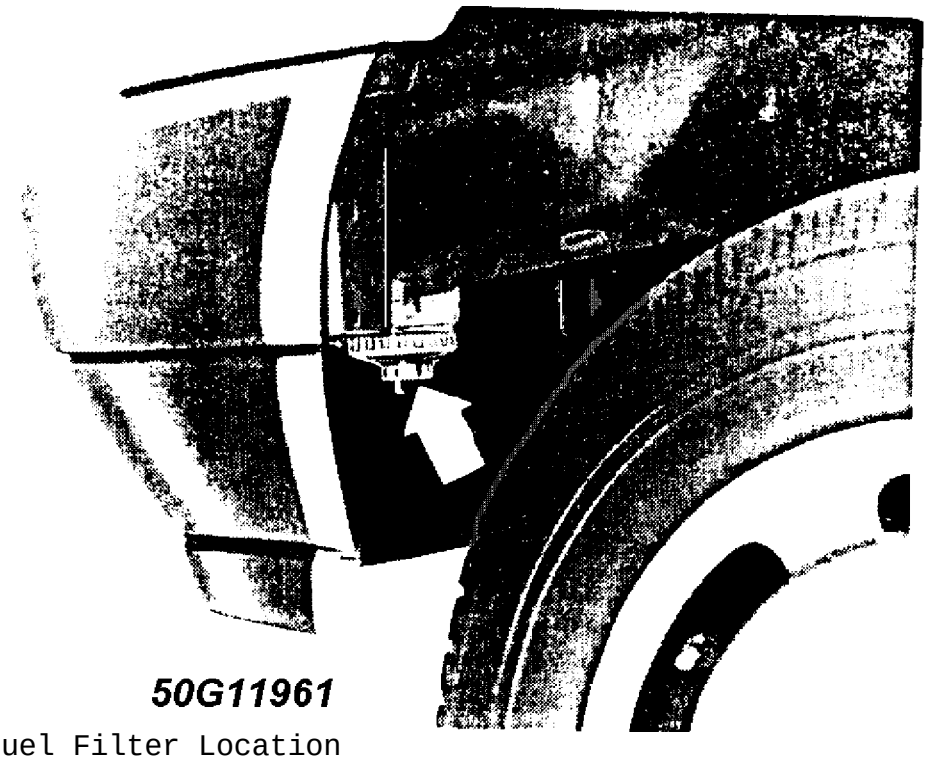


Fig. 6: Fuel Filter Location
Courtesy of Volkswagen United States, Inc.

SERVICE LABOR TIMES

SERVICE LABOR TIMES TABLE (HOURS)

Application (1)(2)(3)	15,000/45,000 Mile Service	30,000 (60,000) Mile Service
Automatic Transmission	1.6	3.4 (4.3)
Manual Transmission	1.8	2.8 (3.7)

(1) - Add .2 hr. if equipped with A/C.
(2) - Add .1 hr. if equipped with cruise control.
(3) - Add 2.0 hrs. to replace camshaft timing belt.

LUBRICATION SPECIFICATIONS

LUBRICATION SPECIFICATIONS TABLE

Application	Fluid Specifications
Automatic Transmission	Dexron-IIE ATF
Brake Fluid	SAE J1703 Or DOT 4 Brake Fluid
Coolant	50/50 Mix Water & Ethylene Glycol
Engine Oil (1)	

```
  Ambient Temperatures
   Greater Than 14ø F (-10øC)  ..  SAE 15W-40 Or 20W-50 API SG/CD
   14ø-50øF (-10ø To +10øC)  ....  SAE 10W-30 Or 10W-40 API SG/CD
   Less Than 50øF (10øC)  .......... SAE 5W-30 Or 5W-40 API SG/CD
Manual Transaxle  ..........................  SAE 80W API GL-4 Or
                                SAE 75W-90 (G50 Synthetic Gear Oil)
Power Steering Fluid  ..............  VW Hydraulic Oil G-002-000
Final Drive (A/T & M/T)
  (Differential)  ..........  SAE 75W-90 (G50 Synthetic Gear Oil)
Wheel Bearings  ....................  NLGI Grade 2 Category GC-LB
Steering Linkage (2)(3)  ...........  NLGI Grade 2 Category GC-LB
Ball Joints (2)(4)  ................  NLGI Grade 2 Category GC-LB
Weatherstrip  ......................  Dielectric Silicone Grease

(1) - SAE 15W-40 or 20W-40 engine oil is recommended for extreme
      conditions or extended highway operation.
(2) - Use low pressure grease gun to prevent seal damage.
(3) - Fill until lubricant squeezes out from the base of seals.
(4) - Fill ball joint until seal starts to swell.
```

FLUID CAPACITIES

FLUID CAPACITIES TABLE

Application	Quantity (1)
A/C R-134a Refrigerant (2)	
Front A/C	32-35 Ozs.
Front & Rear A/C	46-49 Ozs.
Cooling System	18.6 Qts (17.5L)
Engine Oil (3)	
1993-94	
2.5L Gasoline	4.8 Qts. (4.5L)
1995	
2.4L Diesel	6.0 Qts. (5.5L)
2.5L Gasoline	6.0 Qts. (5.5L)
Fuel Tank	21.1 Gals. (60L)
Automatic Transmission	
Fluid Change	3.2 Qts. (3.0L)
Dry Fill	5.9 Qts. (5.6L)
Final Drive (Differential)	
A/T (4)	0.8 Qt. (.75L)
Manual Transmission (5)	2.1 Qts. (2.0L)

```
(1) - Capacities are recommended or calculated levels. Always use
      dipstick (if available) to measure level.
(2) - Use of R-12 in a R134a system will result in SEVERE DAMAGE.
(3) - Includes filter change.
(4) - Lifetime fill.
(5) - One piece case, includes transmission and final drive.
```

WHEEL & TIRE SPECIFICATIONS

TIRE SPECIFICATION LABEL

Tire specification label is located on the inside of the driver's door jamb. When replacing tires always refer to label for correct tire and wheel specifications.

WHEEL & TIRE SPECIFICATIONS TABLE

Wheel Size	Tire Size
15 Inch	205/65R 15
16 Inch	215/65R 16

NOTE: Snow chains must be used on front wheels only.

BATTERY SPECIFICATIONS

CAUTION: When battery is disconnected, vehicles equipped with computers may lose memory data. When battery power is restored, driveability problems may exist on some vehicles. These vehicles may require a relearn procedure. See COMPUTER RELEARN PROCEDURES article in the GENERAL INFORMATION section.

AUXILIARY BATTERY - CAMPER MODELS

All models use a battery located under the hood. Some models have an optional second battery located under the left front seat. This battery is conected to the electrical system with a relay and supplies power to the interior accessories (refrigerator, flourescent light and power socket) when the engine is off. Replacement batteries should always have the same specifications and dimensions as shown on the battery housing.

CAUTIONS & WARNINGS

SUPPLEMENTAL RESTRAINT SYSTEM (AIR BAG)

NOTE: See the AIR BAGS article in the ACCESSORIES/SAFETY EQUIPMENT Section.

Modifications or improper maintenance, including incorrect removal and installation of the Supplemental Restraint System (SRS), can adversely affect system performance. DO NOT cover, obstruct or change the steering wheel horn pad in any way, as such action could cause improper function of the system. Use only plain water when cleaning the horn pad. Solvents or cleaners could adversely affect the

air bag cover and cause improper deployment of the system.

WARNING: To avoid injury from accidental air bag deployment, read and carefully follow all warnings and service precautions. See appropriate AIR BAGS article in ACCESSORIES/SAFETY EQUIPMENT.

CAUTION: Disconnect negative battery cable before servicing any air bag system, steering column or passenger side dash component. After any repair, turn ignition key to the ON position from passenger's side of vehicle in case of accidental air bag inflation

SUPPLEMENTAL RESTRAINT SYSTEM (SRS) AIR BAR WARNING

NOTE: For information on air bag DIAGNOSIS & TESTING or DISPOSAL PROCEDURES, see AIR BAGS article in the ACCESSORIES/SAFETY EQUIPMENT Section.

System circuit is grounded by 2 screws beneath the driver's seat. DO NOT use these screws to ground any other accessory. DO NOT ground any other components near this system.

AIR CONDITIONING SERVICING (1993 MODELS)

CAUTION: Avoid breathing R-134a refrigerant and PAG lubricant vapors, exposure may irritate eyes, nose and throat. To remove R-134a from system use R-134a recycling equipment that meets SAE J2210 specifications. If accidental system discharge occurs, ventilate work area before resuming service.

WARNING: R-134a service equipment or vehicle A/C systems SHOULD NOT be pressure tested or leak tested with compressed air. Some mixtures of air/R134a have shown to be combustible at elevated pressures. These mixtures are dangerous and may cause fire and/or explosions. See AIR CONDITIONING SERVICE article in GENERAL INFORMATION section.

ANTI-LOCK BRAKE SYSTEM

The anti-lock brake system contains electronic equipment that can be susceptible to interference caused by improperly installed or high output radio transmitting equipment. Since this interference could cause the possible loss of the anti-lock braking capability, such equipment should be installed by qualified professionals.

On models equipped with anti-lock brake systems, ALWAYS observe the following cautions:

* DO NOT attempt to bleed hydraulic system without first referring to the appropriate ANTI-LOCK BRAKE SYSTEM article in the BRAKES Section.
* DO NOT mix tire sizes. As long as tires remain close to the

original diameter, increasing the width is acceptable. Rolling diameter must be identical for all 4 tires. Some manufacturers recommend tires of the same brand, style and type. Failure to follow this precaution may cause inaccurate wheel speed readings.

* Use ONLY recommended brake fluids. DO NOT use silicone brake fluids in an ABS-equipped vehicle.

BATTERY WARNING

WARNING: When battery is disconnected, vehicles equipped with computers may lose memory data. When battery power is restored, driveability problems may exist on some vehicles. These vehicles may require a relearn procedure. See COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION section.

REPLACING BLOWN FUSES

Before replacing a blown fuse, remove ignition key, turn off all lights and accessories to avoid damaging the electrical system. Be sure to use fuse with the correct indicated amperage rating. The use of an incorrect amperage rating fuse may result in a dangerous electrical system overload.

BRAKE PAD REPLACEMENT

WARNING: Use caution when checking and/or changing brake pads, some pads may contain asbestos which can irritate eyes and may cause other health hazards. A water based solution should be used to clean brake dust from wheel and brake components. DO NOT use compressed air to blow off brake dust.

BRAKE SYSTEM

CAUTION: Extreme brake pedal pressure is required if the engine is not running.

CAUTION: If brake warning light comes on while driving it indicates a low fluid level or failure in one of the braking circuits. If the brake pedal can be depressed further than normal it is an indication that one of the brake circuits is not functioning. Stop vehicle and check brake reservoir fluid level. If level is below MIN mark, DO NOT drive vehicle. Have it towed to a repair shop. If level is between the MIN and MAX marks, proceed cautiously to a repair shop.

BRAKE PAD WEAR INDICATOR

Indicator will cause a squealing or scraping noise, warning that brake pads need replacement.

CATALYTIC CONVERTER

Continued operation of vehicle with a severe malfunction could cause converter to overheat, resulting in possible damage to converter and vehicle.

Any modification to the exhaust system on turbo models, which reduces exhaust backpressure, will lead to lean fuel mixtures and excessive spark advance. This could cause serious engine damage.

COOLANT (PROPYLENE-GLYCOL FORMULATIONS)

To avoid possible damage to vehicle use only ethylene-glycol based coolants with a mixture ratio from 44-68% anti-freeze. DO NOT use 100% anti-freeze as it will cause the formation of cooling system deposits. This results in coolant temperatures of over 300ø F (149øC) which can melt plastics. 100% anti-freeze has a freeze point of only -8ø F (-22øC).

CAUTION: Propylene-Glycol Mixtures has a smaller temperature range than Ethylene-Glycol. The temperature range (freeze-boil) of a 50/50 Anti-Freeze/Water Mix is as follows:
Propylene-Glycol -26ø F (-32øC) - 257ø F (125øC)
Ethylene-Glycol -35ø F (-37øC) - 263ø F (128øC)

CAUTION: Propylene-Glycol/Ethylene-Glycol Mixtures can cause the destabilization of various corrosion inhibitors. Also Propylene-Glycol/Ethylene-Glycol has a different specific gravity than Ethylene-Glycol coolant, which will result in inaccurate freeze point calculations.

DIESEL FUEL ANTI-FUNGAL ADDITIVES

CAUTION: If fuel contamination due to fungi or other microorganisms is suspected a fuel additive with a biocide may be used. Follow the manufacturers dosage as recommended on product label. Use biocides ONLY when necessary, excessive use can may cause other fuel system problems.

DIESEL FUEL CONTAMINATION

WARNING: Diesel fuel system may be contaminated with fungi or other microorganisms. Keep contaminated fuel away from open skin cuts or sores to prevent skin irritation or infection.

DIESEL FUEL REQUIREMENTS

CAUTION: All diesel engines are to use Diesel Fuel #2 when the outside temperature is above 20øF (-7øC). In temperatures that are below 20øF (-7øC) use Diesel Fuel #1, this will reduce the chance of the fuel thickening and forming wax.

Note: A Diesel Fuel #1 & #2 combination (Blended Fuel) may be

used, and is recommended for mild winter driving.

STARTING FLUID USE (DIESEL)

WARNING: DO NOT USE starting fluids (ether) or flammable liquids to aid the starting of a Diesel engine. NEVER pour diesel fuel, flammable liquids or starting fluids into the air cleaner canister, air intake or turbocharger housing in an attempt to start the vehicle. A flash fire may result causing personal injury.

ELECTRICAL SHOCK

WARNING: Contact with live components of ignition system while engine is running could lead to a fatal electric shock.

ELECTROSTATIC DISCHARGE SENSITIVE (ESD) PARTS

WARNING: Many solid state electrical components can be damaged by static electricity (ESD). Some will display a warning label, but many will not. Discharge personal static electricity by touching a metal ground point on the vehicle prior to servicing any ESD sensitive component.

ENGINE OIL

CAUTION: Never use non-detergent or straight mineral oil.

FUEL SYSTEM SERVICE

WARNING: Relieve fuel system pressure prior to servicing any fuel system component (fuel injection models).

HALOGEN BULBS

Halogen bulbs contain pressurized gas which may explode if overheated. DO NOT touch glass portion of bulb with bare hands. Eye protection should be worn when handling or working around halogen bulbs.

RADIATOR CAP

CAUTION: Always disconnect the fan motor when working near the radiator fan. The fan is temperature controlled and could start at any time even when the ignition key is in the OFF position. DO NOT loosen or remove radiator cap when cooling system is hot.

RADIATOR FAN

WARNING: Keep hands away from radiator fan. Fan is controlled by a thermostatic switch which may come on or run for up to

15 minutes even after engine is turned off.

WARRANTY INFORMATION

CAUTION: Due to the different warranties offered in various regions and the variety of after-market extended warranties available, please refer to the warranty package that came with the vehicle to verify all warranty options.

BASIC NEW CAR WARRANTY

Manufacturer warrants to the original retail customer, and any subsequent purchaser, that every vehicle imported and sold as a new vehicle to a retail customer will be free of defects in material and workmanship for 2 years or 24,000 miles after date of delivery to the first retail customer, or after vehicle was first placed in service.

LIMITED WARRANTY

Warrants vehicle to be free of defects in materials or workmanship for a period of 2 years or 24,000 miles, whichever occurs first.

LIMITED POWER TRAIN WARRANTY

Covers engine, transmission and drivetrain for a period of 5 years or 50,000 miles, whichever occurs first.

ANTI-CORROSION

Covers holes caused by corrosion in body sheet metal for 6 years, without respect to mileage, so long as inspection and maintenance services are performed.

EMISSION CONTROL SYSTEM

Manufacturer warrants to the initial purchaser and each subsequent purchaser that this vehicle is designed, built, and equipped so as to conform at time of sale with all U.S. and California Air Resources Board emission regulations applicable at time of manufacture and that this vehicle is free from defects in materials and workmanship which cause it to fail to conform with applicable regulations within the first 5 years or 50,000 miles, whichever occurs first.

FUSES & CIRCUIT BREAKERS

Fuses are located to right side of steering wheel behind storage compartment. Fuses are numbered from left to right.

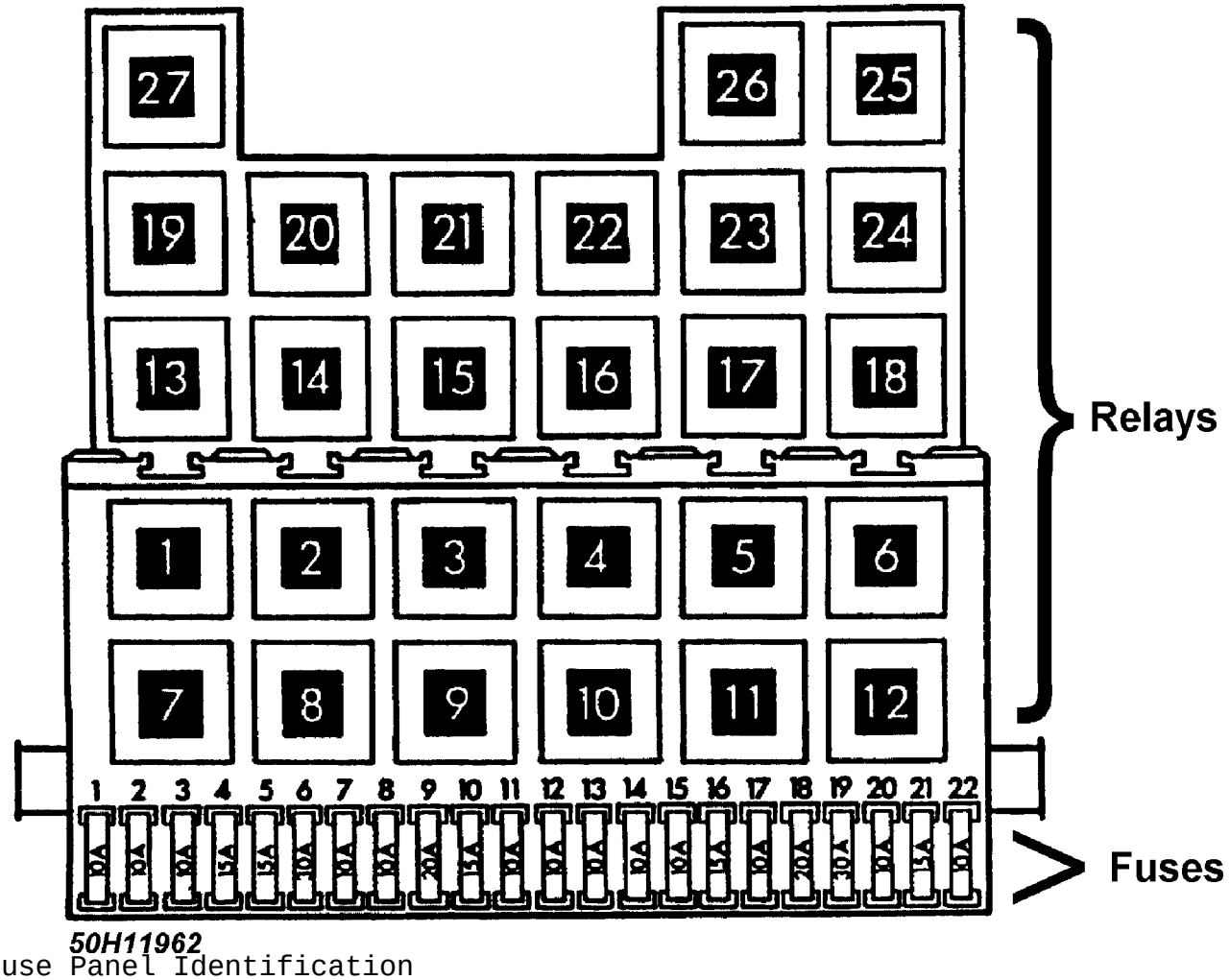


Fig. 7: Fuse Panel Identification
Courtesy of Volkswagen United States, Inc.

Fuse & Circuit Breaker Identification

1 - 10 Amp (Red)
Left Headlight Low Beam
2 - 10 Amp (Red)
Right Headlight Low Beam
3 - 10 Amp (Red)
Instrument & License Lights
4 - 15 Amp (Blue)
Rear Window Wiper/Washer, Heated Front Seats
5 - 15 Amp (Blue)
Windshield Wiper/Washer, Rear Window Washer, Heated Washer Jets
6 - 30 Amp (Green)
A/C, Fresh Air Fan
7 - 10 Amp (Red)
Right Tail Light & Side Marker Light, Engine Compartment Lamp
8 - 10 Amp (Red)
Left Taillight & Side Marker Light

9 - 20 Amp (Yellow)
Rear Window & Mirror Heater
10 - 15 Amp (Blue)
Fog Lamps
11 - 10 Amp (Red)
Left Headlight High Beam & High Beam Indicator
12 - 10 Amp (Red)
Right Headlight High Beam
13 - 10 Amp (Red)
Horn, Radiator Cooling Fan
14 - 10 Amp (Red)
Backup Lights, Electric Mirrors, Heated Front Seats, Windshield Washer Jets, Cruise Control, Power Roof
15 - 10 Amp (Red)
Engine Electronics
16 - 15 Amp (Blue)
Warning/Indicator Lights, Multi-Function Indicator, Glove Box Light, ABS
17 - 10 Amp (Red)
Turn Signals
18 - 20 Amp (Yellow)
Fuel Pump
19 - 30 Amp (Green)
A/C, Radiator Cooling Fan
20 - 10 Amp (Red)
Brake Lights
21 - 15 Amp (Blue)
Dome & Luggage Lamps, Clock, Radio, Central Locking System, Multi-Function Indicator, Vanity Mirror, OBD Diagnostic
22 - 10 Amp (Red)
Cigarette Lighter

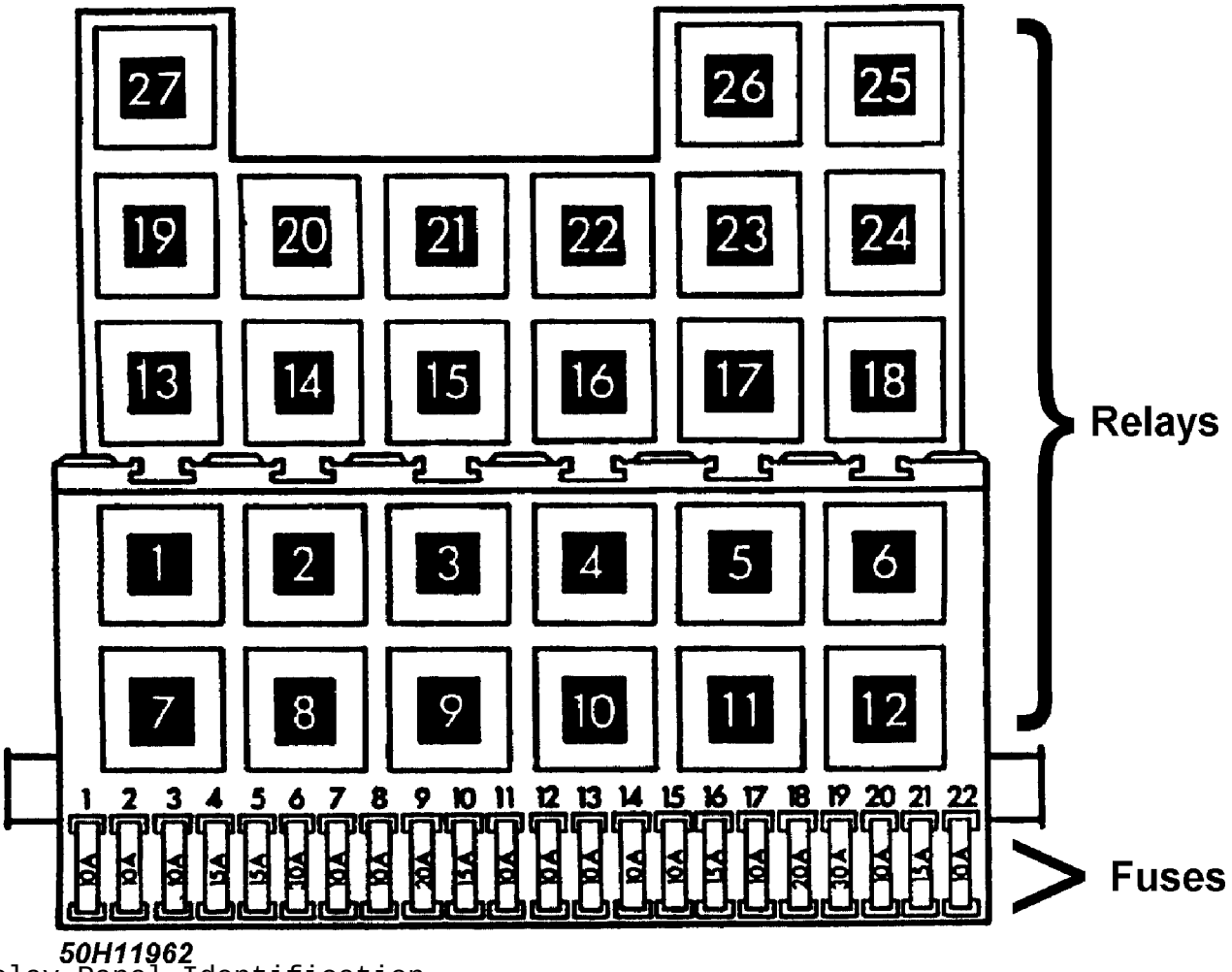


Fig. 8: Relay Panel Identification
Courtesy of Volkswagen United States, Inc.

Fuse, Relay & Circuit Breaker Identification

1 - A/C Control Module Relay
2 - Rear Window Wiper/Washer Relay
3 - ECM Power Supply Relay
4 - Load Reduction Relay
5 - Open
6 - Emergency Flasher Relay
7 - Headlight Washer Relay
8 - Washer/Wiper Intermittent Relay
9 - Seat Belt Warning Relay
10 - Fog Lamp/Parking Lamp Relay
11 - Dual Horn Relay
12 - Fuel Pump Relay
13 - Heater Control Module Relay
14 - Coolant Pump After-Run Relay
15 - Open
16 - Open
17 - Open

18 - Fuse
Roof Ventilator Fan
19 - Heater Air Blower Relay
20 - Starter Interlock/Back-up Light Relay
21 - 5 Amp Fuse
Back-up Lights, Cruise Control
22 - 20 Amp Fuse
A/C (Second Evaporator)
23 - Rear Window Defroster/Heated Mirror Relay
24 - 20 Amp (Circuit Breaker)
Power Windows, Central Locking System
25 - 10 Amp Fuse
ABS System
26 - 15 Amp (Blue)
Rear Window Defroster, Heated Mirrors
27 - A/C Compressor Clutch Relay

Additional Fuse Identification

WARNING: Always disconnect battery ground cable before servicing "high-current fuses. It is recommended that "high-current" fuses be replaced by a qualified technician.

NOTE: Located on left side of engine compartment, above battery.

1 - 50 Amp
Radiator Fan

NOTE: Located in the engine compartment, above the brake booster.

1 - 50 Amp (1995 Diesel)
Glow Plugs (1995 Diesel Models Only)

NOTE: Located under drivers seat.

1 - 25 Amp (Clear)
Auxiliary HVAC Fan
2 - 20 Amp (Yellow)
Blower for Auxiliary Heater
3 - 30 Amp (Green) (MV Camper Models Only)
Refrigerator Socket, Socket below Folding Table (MV Models)
4 - 5 Amp (Lt. Brown) (MV Camper Models Only)
Fluorescent Light (MV Models)

END OF ARTICLE

MAINTENANCE REMINDER LIGHT RESET PROCEDURES

Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:34PM

ARTICLE BEGINNING

1983-96 MAINTENANCE
Volkswagen Maintenance Reminder Light Reset Procedures

EGR MAINTENANCE LIGHT (IF EQUIPPED)

EGR light comes on at 15,000 mile intervals to indicate EGR servicing is required. After checking EGR system, reset mileage counter. See RESETTING MILEAGE COUNTER.

OXYGEN SENSOR WARNING LIGHT (IF EQUIPPED)

Oxygen sensor (OXS) light comes on at 30,000 mile intervals to indicate oxygen sensor replacement. After installing new sensor, reset mileage counter. See RESETTING MILEAGE COUNTER.

RESETTING MILEAGE COUNTER (IF EQUIPPED)

1) On some Rabbit and Pickup models, remove instrument panel cover plate. Reach into opening at top left corner of speedometer and pull release arm to reset counter. See Fig. 1. Left arm resets EGR counter, right arm resets oxygen sensor.
2) On Vanagon models, locate mileage counter under spare tire or under driver's floorboard (in-line with speedometer cable). Using a pointed instrument, depress reset button. Ensure light is out.
3) On all other models, locate mileage counter (in-line with speedometer cable) and push White reset button. See Fig. 1. Ensure light is out.

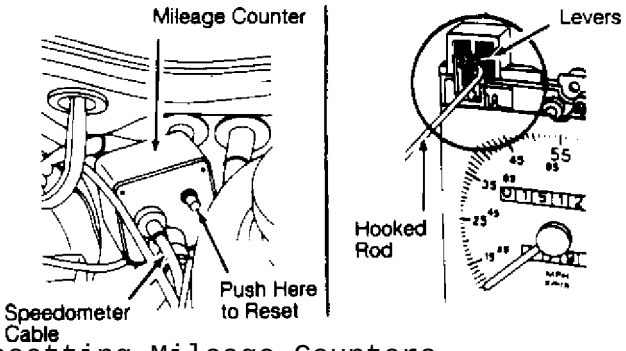


Fig. 1: Resetting Mileage Counters
Courtesy of Volkswagen United States, Inc.

SERVICE REMINDER INDICATOR (SRI) DISPLAY

CABRIO, GOLF III, GTI, JETTA III (1993-95) JETTA (1996)

1) One of four service codes may be displayed on instrument cluster according to mileage driven. Each service code displayed determines type or level of maintenance required. Service code will

flash for approximately 3 seconds in odometer display window as ignition is turned on. When servicing becomes due (every 7500 miles), appropriate service code will flash for approximately 60 seconds. The four service codes available for display are as follows:

* IN 00 (No Service Necessary)
* OEL (Oil Change Service) Every 7500 Miles
* IN 01 (Inspection Service) Every 15,000 Miles
* IN 02 (Additional Servicing Work) Every 30,000 Miles

2) After performing required maintenance, each effected service code displayed must be reset individually. For example, at 15, 000 miles service codes OEL and IN 01 will both need to be reset.

3) To reset service codes, turn ignition on. Press and hold odometer reset button located below speedometer. While holding button, press clock reset button (lower button for digital clock) located to left of fuel gauge. Release buttons. Programming mode is now activated. Service code OEL1.S (distance counter) should be displayed.

4) Press clock reset button once more. 7500 miles should now be indicated on display. Desired mileage for reset may be attained by pressing clock reset button. Mileage displayed will decrease in increments of 500 miles each time button is pressed. This feature should only be used to calibrate mileage when instrument cluster is replaced. When desired mileage is displayed, press odometer reset button.

5) Service code OEL2.S (time counter) should be displayed. Press clock reset button. 6 (months) will be indicated on display. Time counter for next oil change may be set by pressing clock reset button if instrument cluster was replaced. When desired time is displayed, press odometer reset button.

6) Service code IN 01.S (time counter) should be displayed. Press clock reset button. 12 (months) will be indicated on display. Time counter for next maintenance interval may be set by pressing clock reset button if instrument cluster was replaced. When desired time is displayed, press odometer reset button.

7) Service code IN 02.S (distance counter) should be displayed. Press clock reset button. 30,000 (miles) will be indicated on display. Desired mileage for reset may be attained by pressing clock reset button. Mileage displayed will decrease in increments of 500 miles each time button is pressed. This feature should only be used to calibrate mileage when instrument cluster is replaced. When desired mileage is displayed, turn ignition off. Programming is now stored in memory.

END OF ARTICLE

METRIC CONVERSIONS
Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:35PM

ARTICLE BEGINNING

GENERAL INFORMATION

METRIC CONVERSIONS

METRIC CONVERSIONS

Metric conversions are making life more difficult for the mechanic. In addition to doubling the number of tools required, metric-dimensioned nuts and bolts are used alongside English components in many new vehicles. The mechanic has to decide which tool to use, slowing down the job. The tool problem can be solved by trial and error, but some metric conversions aren't so simple. Converting temperature, lengths or volumes requires a calculator and conversion charts, or else a very nimble mind. Conversion charts are only part of the answer though, because they don't help you "think" metric, or "visualize" what you are converting. The following examples are intended to help you "see" metric sizes:

LENGTH

Meters are the standard unit of length in the metric system. The smaller units are 10ths (decimeter), 100ths (centimeter), and 1000ths (millimeter) of a meter. These common examples might help you to visualize the metric units:

* A meter is slightly longer than a yard (about 40 inches).
* An aspirin tablet is about one centimeter across (.4 inches).
* A millimeter is about the thickness of a dime.

VOLUME

Cubic meters and centimeters are used to measure volume, just as we normally think of cubic feet and inches. Liquid volume measurements include the liter and milliliter, like the English quarts or ounces.

* One teaspoon is about 4 cubic centimeters.
* A liter is about one quart.
* A liter is about 61 cubic inches.

WEIGHT

The metric weight system is based on the gram, with the most common unit being the kilogram (1000 grams). Our comparable units are ounces and pounds:

* A kilogram is about 2.2 pounds.
* An ounce is about 28 grams.

TORQUE

METRIC CONVERSIONS
Article Text (p. 2)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:35PM

Torque is somewhat complicated. The term describes the amount of effort exerted to turn something. A chosen unit of weight or force is applied to a lever of standard length. The resulting leverage is called torque. In our standard system, we use the weight of one pound applied to a lever a foot long, resulting in the unit called a foot-pound. A smaller unit is the inch-pound (the lever is one inch long).

Metric units include the meter kilogram (lever one meter long with a kilogram of weight applied) and the Newton-meter (lever one meter long with force of one Newton applied). Some conversions are:

* A meter kilogram is about 7.2 foot pounds.
* A foot pound is about 1.4 Newton-meters.
* A centimeter kilogram (cmkg) is equal to .9 inch pounds.

PRESSURE

Pressure is another complicated measurement. Pressure is described as a force or weight applied to a given area. Our common unit is pounds per square inch. Metric units can be expressed in several ways. One is the kilogram per square centimeter (kg/cmý). Another unit of pressure is the Pascal (force of one Newton on an area of one square meter), which equals about 4 ounces on a square yard. Since this is a very small amount of pressure, we usually see the kiloPascal, or kPa (1000 Pascals). Another common automotive term for pressure is the bar (used by German manufacturers), which equals 10 Pascals. Thoroughly confused? Try the examples below:

* Atmospheric pressure at sea level is about 14.7 psi.
* Atmospheric pressure at sea level is about 1 bar.
* Atmospheric pressure at sea level is about 1 kg/cmý.
* One pound per square inch is about 7 kPa.

CONVERSION FACTORS

CONVERSION FACTORS

TO CONVERT	TO	MULTIPLY BY
LENGTH		
Millimeters (mm)	Inches	.03937
Inches	Millimeters	25.4
Meters (M)	Feet	3.28084
Feet	Meters	.3048
Kilometers(Km)	Miles	.62137
AREA		
Square Centimeters (cmý)	Square Inches	.155
Square Inches	Square Centimeters	6.45159
VOLUME		
Cubic Centimeters	Cubic Inches	.06103

METRIC CONVERSIONS
Article Text (p. 3)

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:35PM

³Cubic Inches	³Cubic Centimeters	³ 16.38703	³
³Liters	³Cubic Inches	³ 61.025	³
³Cubic Inches	³Liters	³ .01639	³
³Liters	³Quarts	³ 1.05672	³
³Quarts	³Liters	³ .94633	³
³Liters	³Pints	³ 2.11344	³
³Pints	³Liters	³ .47317	³
³Liters	³Ounces	³ 33.81497	³
³Ounces	³Liters	³ .02957	³
³WEIGHT	³	³	³
³Grams	³Ounces	³ .03527	³
³Ounces	³Grams	³ 28.34953	³
³Kilograms	³Pounds	³ 2.20462	³
³Pounds	³Kilograms	³ .45359	³
³WORK	³	³	³
³Centimeter Kilograms	³Inch Pounds	³ .8676	³
³Pounds/Sq. Inch	³Kilograms/Sq.Centimeter	³ .07031	³
³Bar	³Pounds/Sq. Inch	³ 14.504	³
³Pounds/Sq. Inch	³Bar	³ .06895	³
³Atmosphere	³Pounds/Sq. Inch	³ 14.696	³
³Pounds/Sq. Inch	³Atmosphere	³ .06805	³
³TEMPERATURE	³	³	³
³Centigrade Degrees	³Fahrenheit Degrees	³(øCx(9)/5)+32	³
³Fahrenheit Degrees	³Centigrade Degrees	³(øF-32)x(5)/9	³

CONVERSION FACTORS (Cont.)

³INCHES	DECIMALS	mm ³
³		³
³1/64	.016	.397 ³
³1/32	.031	.794 ³
³3/64	.047	1.191 ³
³1/16	.063	1.588 ³
³5/64	.078	1.984 ³
³3/32	.094	2.381 ³
³7/64	.109	2.778 ³
³1/8	.125	3.175 ³
³9/64	.141	3.572 ³
³5/32	.156	3.969 ³
³11/64	.172	4.366 ³
³3/16	.188	4.763 ³
³13/64	.203	5.159 ³
³7/32	.219	5.556 ³
³15/64	.234	5.953 ³
³1/4	.250	6.350 ³
³17/64	.266	6.747 ³
³9/32	.281	7.144 ³

19/64	.297	7.541
5/16	.313	7.938
21/64	.328	8.334
11/32	.344	8.731
23/64	.359	9.128
3/8	.375	9.525
25/64	.391	9.992
13/32	.406	10.319
27/64	.422	10.716
7/16	.438	11.113
29/64	.453	11.509
15/32	.469	11.906
31/64	.484	12.303
1/2	.500	12.700
33/64	.516	13.097
17/32	.531	13.494
35/64	.547	13.891
9/16	.563	14.288
37/64	.578	14.684
19/32	.594	15.081
39/64	.609	15.478
5/8	.625	15.875
41/64	.641	16.272
21/32	.656	16.669
43/64	.672	17.066
11/16	.687	17.463
45/64	.703	17.859
23/32	.719	18.256
47/64	.734	18.653
3/4	.750	19.050
49/64	.766	19.447
25/32	.781	19.844
51/64	.797	20.241
13/16	.813	20.638
53/64	.828	21.034
27/32	.844	21.431
55/64	.859	21.828
7/8	.875	22.225
57/64	.891	22.622
29/32	.906	23.019
59/64	.922	23.416
15/16	.938	23.813
61/64	.953	24.209
31/32	.969	24.606
63/64	.984	25.003
1	1.000	25.400

END OF ARTICLE

N - REMOVE/INSTALL/OVERHAUL
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:35PM

ARTICLE BEGINNING

1993 ENGINE PERFORMANCE
Removal, Overhaul & Installation

EuroVan

CAUTION: When battery is disconnected, vehicle computer and memory systems may lose memory data. Driveability problems may exist until computer systems have completed a relearn cycle. See the COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION before disconnecting battery.

INTRODUCTION

Removal, overhaul and installation procedures are covered in this article. If component removal and installation is primarily an unbolt and bolt-on procedure, only a torque specification may be furnished.

CAUTION: When disconnecting battery, obtain and record radio anti-theft code. If wrong code is entered into radio after power is restored, radio will become inoperable.

IGNITION SYSTEM

DISTRIBUTOR

Removal & Installation (EuroVan)

1) Distributor removal procedure is not available from manufacturer. To install distributor, ensure cylinder No. 1 is at TDC of compression stroke. See Fig. 1.

2) Align mark on camshaft sprocket with mark on rear toothed belt guard. Turn rotor so that it points to cylinder No. 1 mark on distributor housing. Insert distributor into engine. Check ignition timing.

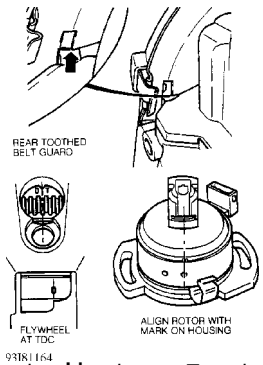


Fig. 1: Distributor Installation (EuroVan)
Courtesy of Volkswagen United States, Inc.

FUEL SYSTEM

FUEL SYSTEM PRESSURE RELEASE

To relieve fuel system pressure, remove fuel pump fuse (No. 5, 13 or 18) or fuel pump relay to deactivate fuel pump. Place a clean shop rag around fuel line fitting and slowly loosen fitting.

WARNING: Fuel system pressure release procedure is not available from manufacturer. Fuel will discharge when disconnecting fuel system components. Disconnect ignition coil output stage wiring harness to deactivate ignition. DO NOT smoke or work near heaters or other fire hazards. Keep a fire extinguisher handy.

FUEL PUMP

Removal & Installation (EuroVan)

1) Obtain and record radio anti-theft code. Disconnect negative battery cable. Pull out carpeting from around access cover just right of parking brake lever. Remove access cover.

2) Disconnect wiring harness and fuel lines from fuel pump. Using Wrench (3217), loosen fuel pump screw cap. Remove flange and sealing ring from fuel tank opening. Loosen fuel pump by twisting it to left. Remove fuel pump from fuel tank.

3) When installing fuel pump, ensure that fuel gauge sending unit is installed with a frontal angle of 30 degrees and is not bent. Align mark on flange with fuel tank. To complete installation, reverse removal procedure.

FUEL RAIL & INJECTORS

Removal & Installation (EuroVan)

1) Remove air cleaner housing and filter. Remove air intake hose. Disconnect wiring harness connector at fuel rail.

2) Disconnect crankcase breather hose. Disconnect fuel lines from fuel rail. Disconnect vacuum hose from fuel pressure regulator. Using a 1/8" drive ratchet and Attachment (SW5 3249), remove fuel rail bolts.

3) Remove fuel rail, toward front of vehicle, with fuel injectors on right. Remove bolt near center of fuel rail and separate upper and lower fuel rail sections.

4) Install a bolt in vise, threaded side in jaws. Press out fuel injectors against bolt head. To install injectors, lubricate "O" rings with fuel. To complete installation, reverse removal procedure.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS (EUROVAN)

Application	Ft. Lbs. (N.m)

Hot Air Stove Nuts	18 (25)
Throttle Body Bolts (M8)	15 (20)
Oxygen Sensor	37 (50)

	INCH Lbs. (N.m)
Distributor Hold-Down Bolts	84 (10)
Fuel Rail-To-Intake Manifold Bolts	84 (10)
Fuel Rail Upper/Lower Section Bolt	84 (10)
Throttle Body Bolts (M6)	84 (10)

END OF ARTICLE

P - EGR FUNCTION TESTING
Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:35PM

ARTICLE BEGINNING

1989-95 ENGINE PERFORMANCE
Volkswagen EGR Function Testing

All Models

EGR VALVE (EXCEPT DIESEL)

1) Run engine at idle speed. Using a hand-held vacuum pump, apply 12 in. Hg to EGR valve. Engine should run rough or stall. If not, check EGR valve pintle for movement. If EGR pintle is moving, EGR port is plugged. If EGR valve does not function, replace EGR valve.

2) To check EGR port vacuum supply, connect vacuum gauge to EGR vacuum line using a "T" fitting. Start engine and increase engine speed to about 3000 RPM. Vacuum gauge should indicate vacuum. If vacuum is not present, vacuum source is plugged. Repair as necessary and repeat test.

END OF ARTICLE

PRE-ALIGNMENT CHECKS
Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:35PM

ARTICLE BEGINNING

Wheel Alignment
PRE-ALIGNMENT INSPECTION PROCEDURES

PRE-ALIGNMENT CHECKS

Before making wheel alignment adjustment, perform the following checks:

1) Tires should be equal in size and runout must not be excessive. Tires and wheels should be in balance, and inflated to manufacturer's specifications.
2) Wheel bearings must be properly adjusted. Steering linkage and suspension must not have excessive looseness. Check for wear in tie rod ends and ball joints.
3) Steering gear box must not have excessive play. Check and adjust to manufacturer's specifications.
4) Vehicle must be at curb height with full fuel load and spare tire in vehicle. No extra load should be on vehicle.
5) Vehicle must be level with floor and with suspension settled. Jounce front and rear of vehicle several times and allow it to settle to normal curb height.
6) If steering wheel is not centered with front wheels in straight-ahead position, correct by shortening one tie rod adjusting sleeve and lengthening opposite sleeve equal amounts.
7) Ensure wheel lug nuts are tightened to torque specifications.

END OF ARTICLE

RIDING HEIGHT ADJUSTMENT
Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:35PM

ARTICLE BEGINNING

1993 WHEEL ALIGNMENT
Volkswagen Specifications & Procedures

All Models

*** PLEASE READ THIS FIRST ***

NOTE: Prior to performing wheel alignment, perform preliminary visual and mechanical inspection of wheels, tires and suspension components. See PRE-ALIGNMENT INSTRUCTIONS in WHEEL ALIGNMENT THEORY/OPERATION article in the GENERAL INFORMATION section.

RIDING HEIGHT ADJUSTMENT

NOTE: On vehicles with electronic chassis controls, all systems should be functional before attempting riding height or wheel alignment adjustment.

Before adjusting alignment, ensure difference in riding height between left and right sides of vehicle is less than 1" (25.4 mm). Riding height must be checked with vehicle on level floor and tires properly inflated. Bounce vehicle several times and allow suspension to settle.

Visually inspect vehicle for signs of abnormal height from front to rear or side to side. Check passenger and luggage compartments for extra heavy items and remove if present. If difference in riding height between left and right sides of vehicle is NOT less than 1" (25.4 mm), check suspension components and repair or replace as necessary.

On EuroVan models, measure the distance between bolt head of upper shock absorber mounting and center of bolt head of lower shock absorber mounting. If distance measured is not 10.9-11.1" (278-280 mm) turn torsion bar adjustment bolt until correct riding height is obtained.

END OF ARTICLE

SCHEDULED SERVICES
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:35PM

ARTICLE BEGINNING

1993-95 MAINTENANCE
Volkswagen Maintenance & Service Intervals

Euro Van CL
GL
MV (Camper)

*** PLEASE READ THIS FIRST ***

NOTE: All SERVICE SCHEDULES are listed for normal service vehicles. If vehicle is operated under severe service conditions, see SEVERE SERVICE REQUIREMENTS (PERFORM W/SERVICE SCHEDULES) for items requiring additional maintenance.

NOTE: This article contains scheduled maintenance service information. Fluid types and capacities listed with each service in this article are only those necessary to perform that scheduled service. For specifications pertaining to fluid capacities for the entire vehicle, fuse and circuit breaker identification, wheel and tire size, battery type, warranty information, or model identification refer to the MAINTENANCE INFORMATION article in this section.

NOTE: All 1994 models are carryover 1993 models. The 1995 models have standard dual air bags and are 1995 models.

CAUTIONS & WARNINGS

SUPPLEMENTAL RESTRAINT SYSTEM (AIR BAG)

NOTE: See the AIR BAGS article in the ACCESSORIES/SAFETY EQUIPMENT Section.

Modifications or improper maintenance, including incorrect removal and installation of the Supplemental Restraint System (SRS), can adversely affect system performance. DO NOT cover, obstruct or change the steering wheel horn pad in any way, as such action could cause improper function of the system. Use only plain water when cleaning the horn pad. Solvents or cleaners could adversely affect the air bag cover and cause improper deployment of the system.

WARNING: To avoid injury from accidental air bag deployment, read and carefully follow all warnings and service precautions. See appropriate AIR BAGS article in ACCESSORIES/SAFETY EQUIPMENT.

CAUTION: Disconnect negative battery cable before servicing any air bag system, steering column or passenger side dash component. After any repair, turn ignition key to the ON

position from passenger's side of vehicle in case of accidental air bag inflation

SUPPLEMENTAL RESTRAINT SYSTEM (SRS) AIR BAR WARNING

NOTE: For information on air bag DIAGNOSIS & TESTING or DISPOSAL PROCEDURES, see AIR BAGS article in the ACCESSORIES/SAFETY EQUIPMENT Section.

System circuit is grounded by 2 screws beneath the driver's seat. DO NOT use these screws to ground any other accessory. DO NOT ground any other components near this system.

AIR CONDITIONING SERVICING (1993 MODELS)

CAUTION: Avoid breathing R-134a refrigerant and PAG lubricant vapors, exposure may irritate eyes, nose and throat. To remove R-134a from system use R-134a recycling equipment that meets SAE J2210 specifications. If accidental system discharge occurs, ventilate work area before resuming service.

WARNING: R-134a service equipment or vehicle A/C systems SHOULD NOT be pressure tested or leak tested with compressed air. Some mixtures of air/R134a have shown to be combustible at elevated pressures. These mixtures are dangerous and may cause fire and/or explosions. See AIR CONDITIONING SERVICE article in GENERAL INFORMATION section.

ANTI-LOCK BRAKE SYSTEM

The anti-lock brake system contains electronic equipment that can be susceptible to interference caused by improperly installed or high output radio transmitting equipment. Since this interference could cause the possible loss of the anti-lock braking capability, such equipment should be installed by qualified professionals.

On models equipped with anti-lock brake systems, ALWAYS observe the following cautions:

* DO NOT attempt to bleed hydraulic system without first referring to the appropriate ANTI-LOCK BRAKE SYSTEM article in the BRAKES Section.
* DO NOT mix tire sizes. As long as tires remain close to the original diameter, increasing the width is acceptable. Rolling diameter must be identical for all 4 tires. Some manufacturers recommend tires of the same brand, style and type. Failure to follow this precaution may cause inaccurate wheel speed readings.
* Use ONLY recommended brake fluids. DO NOT use silicone brake fluids in an ABS-equipped vehicle.

BATTERY WARNING

WARNING: When battery is disconnected, vehicles equipped with computers may lose memory data. When battery power is restored, driveability problems may exist on some vehicles. These vehicles may require a relearn procedure. See COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION section.

REPLACING BLOWN FUSES

Before replacing a blown fuse, remove ignition key, turn off all lights and accessories to avoid damaging the electrical system. Be sure to use fuse with the correct indicated amperage rating. The use of an incorrect amperage rating fuse may result in a dangerous electrical system overload.

BRAKE PAD REPLACEMENT

WARNING: Use caution when checking and/or changing brake pads, some pads may contain asbestos which can irritate eyes and may cause other health hazards. A water based solution should be used to clean brake dust from wheel and brake components. DO NOT use compressed air to blow off brake dust.

BRAKE SYSTEM

CAUTION: Extreme brake pedal pressure is required if the engine is not running.

CAUTION: If brake warning light comes on while driving it indicates a low fluid level or failure in one of the braking circuits. If the brake pedal can be depressed further than normal it is an indication that one of the brake circuits is not functioning. Stop vehicle and check brake reservoir fluid level. If level is below MIN mark, DO NOT drive vehicle. Have it towed to a repair shop. If level is between the MIN and MAX marks, proceed cautiously to a repair shop.

BRAKE PAD WEAR INDICATOR

Indicator will cause a squealing or scraping noise, warning that brake pads need replacement.

CATALYTIC CONVERTER

Continued operation of vehicle with a severe malfunction could cause converter to overheat, resulting in possible damage to converter and vehicle.

Any modification to the exhaust system on turbo models, which reduces exhaust backpressure, will lead to lean fuel mixtures and excessive spark advance. This could cause serious engine damage.

COOLANT (PROPYLENE-GLYCOL FORMULATIONS)

To avoid possible damage to vehicle use only ethylene-glycol based coolants with a mixture ratio from 44-68% anti-freeze. DO NOT use 100% anti-freeze as it will cause the formation of cooling system deposits. This results in coolant temperatures of over 300ø F (149øC) which can melt plastics. 100% anti-freeze has a freeze point of only -8ø F (-22øC).

CAUTION: Propylene-Glycol Mixtures has a smaller temperature range than Ethylene-Glycol. The temperature range (freeze-boil) of a 50/50 Anti-Freeze/Water Mix is as follows:
Propylene-Glycol -26ø F (-32øC) - 257ø F (125øC)
Ethylene-Glycol -35ø F (-37øC) - 263ø F (128øC)

CAUTION: Propylene-Glycol/Ethylene-Glycol Mixtures can cause the destabilization of various corrosion inhibitors. Also Propylene-Glycol/Ethylene-Glycol has a different specific gravity than Ethylene-Glycol coolant, which will result in inaccurate freeze point calculations.

DIESEL FUEL ANTI-FUNGAL ADDITIVES

CAUTION: If fuel contamination due to fungi or other microorganisms is suspected a fuel additive with a biocide may be used. Follow the manufacturers dosage as recommended on product label. Use biocides ONLY when necessary, excessive use can may cause other fuel system problems.

DIESEL FUEL CONTAMINATION

WARNING: Diesel fuel system may be contaminated with fungi or other microorganisms. Keep contaminated fuel away from open skin cuts or sores to prevent skin irritation or infection.

DIESEL FUEL REQUIREMENTS

CAUTION: All diesel engines are to use Diesel Fuel #2 when the outside temperature is above 20øF (-7øC). In temperatures that are below 20øF (-7øC) use Diesel Fuel #1, this will reduce the chance of the fuel thickening and forming wax.

Note: A Diesel Fuel #1 & #2 combination (Blended Fuel) may be used, and is recommended for mild winter driving.

STARTING FLUID USE (DIESEL)

WARNING: DO NOT USE starting fluids (ether) or flammable liquids to aid the starting of a Diesel engine. NEVER pour diesel fuel, flammable liquids or starting fluids into the air cleaner canister, air intake or turbocharger housing in an attempt to start the vehicle. A flash fire may result causing

personal injury.

ELECTRICAL SHOCK

WARNING: Contact with live components of ignition system while engine is running could lead to a fatal electric shock.

ELECTROSTATIC DISCHARGE SENSITIVE (ESD) PARTS

WARNING: Many solid state electrical components can be damaged by static electricity (ESD). Some will display a warning label, but many will not. Discharge personal static electricity by touching a metal ground point on the vehicle prior to servicing any ESD sensitive component.

ENGINE OIL

CAUTION: Never use non-detergent or straight mineral oil.

FUEL SYSTEM SERVICE

WARNING: Relieve fuel system pressure prior to servicing any fuel system component (fuel injection models).

HALOGEN BULBS

Halogen bulbs contain pressurized gas which may explode if overheated. DO NOT touch glass portion of bulb with bare hands. Eye protection should be worn when handling or working around halogen bulbs.

RADIATOR CAP

CAUTION: Always disconnect the fan motor when working near the radiator fan. The fan is temperature controlled and could start at any time even when the ignition key is in the OFF position. DO NOT loosen or remove radiator cap when cooling system is hot.

RADIATOR FAN

WARNING: Keep hands away from radiator fan. Fan is controlled by a thermostatic switch which may come on or run for up to 15 minutes even after engine is turned off.

CAMSHAFT TIMING BELT REPLACEMENT INFORMATION

CAUTION: Failure to replace a faulty camshaft timing belt may result in serious engine damage.

The condition of camshaft drive belts should always be checked on vehicles which have more than 50,000 miles. Although some

manufacturers do not recommend belt replacement at a specified mileage, others require it at 60,000-100,000 miles. A camshaft drive belt failure may cause extensive damage to internal engine components on most engines, although some designs do not allow piston-to-valve contact. These designs are often called "Free Wheeling".

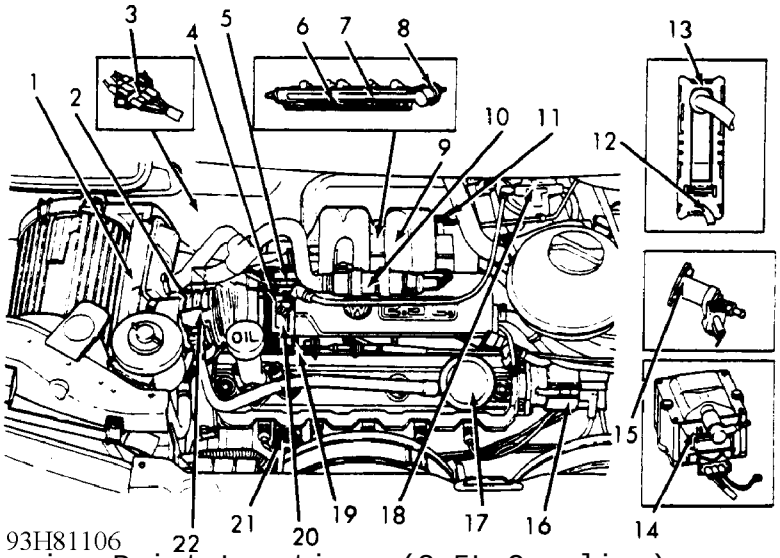
Many manufacturers changed their maintenance and warranty schedules in the mid-1980's to reflect timing belt inspection and/or replacement at 50,000-60,000 miles. Most service interval schedules in this manual reflect these changes.

Belts or components should be inspected and replaced if any of the following conditions exist:

* Cracks Or Tears In Belt Surface
* Missing, Damaged, Cracked Or Rounded Teeth
* Oil Contamination
* Damaged Or Faulty Tensioners
* Incorrect Tension Adjustment

Replace timing belt every 36,000 miles or 36 months.

SERVICE POINT LOCATIONS



1. Air Cleaner
2. Air Intake Duct
3. Oxygen Sensor Connector
4. Throttle Body
5. Throttle Position Sensor
6. Fuel Injector
7. Fuel Rail
8. Fuel Pressure Regulator
9. Intake Manifold
10. Intake Air Control (IAC) Valve
11. CO Tap Tube
12. Vacuum Hose
13. Electronic Control Module (ECM)
14. Ignition Coil
15. Cold-Start Injector
16. Distributor
17. Emission Control Valve
18. Fuel Evaporative Solenoid (Frequency) Valve
19. Closed Throttle Position Switch
20. Idle Speed Adjustment Screw (If Equipped)
21. Engine Coolant Temp. Sensor (Blue
22. Intake Air Temp. Sensor

Fig. 1: Service Point Locations (2.5L Gasoline)
Courtesy of Volkswagen United States, Inc.

ADDITIONAL SERVICE INFORMATION

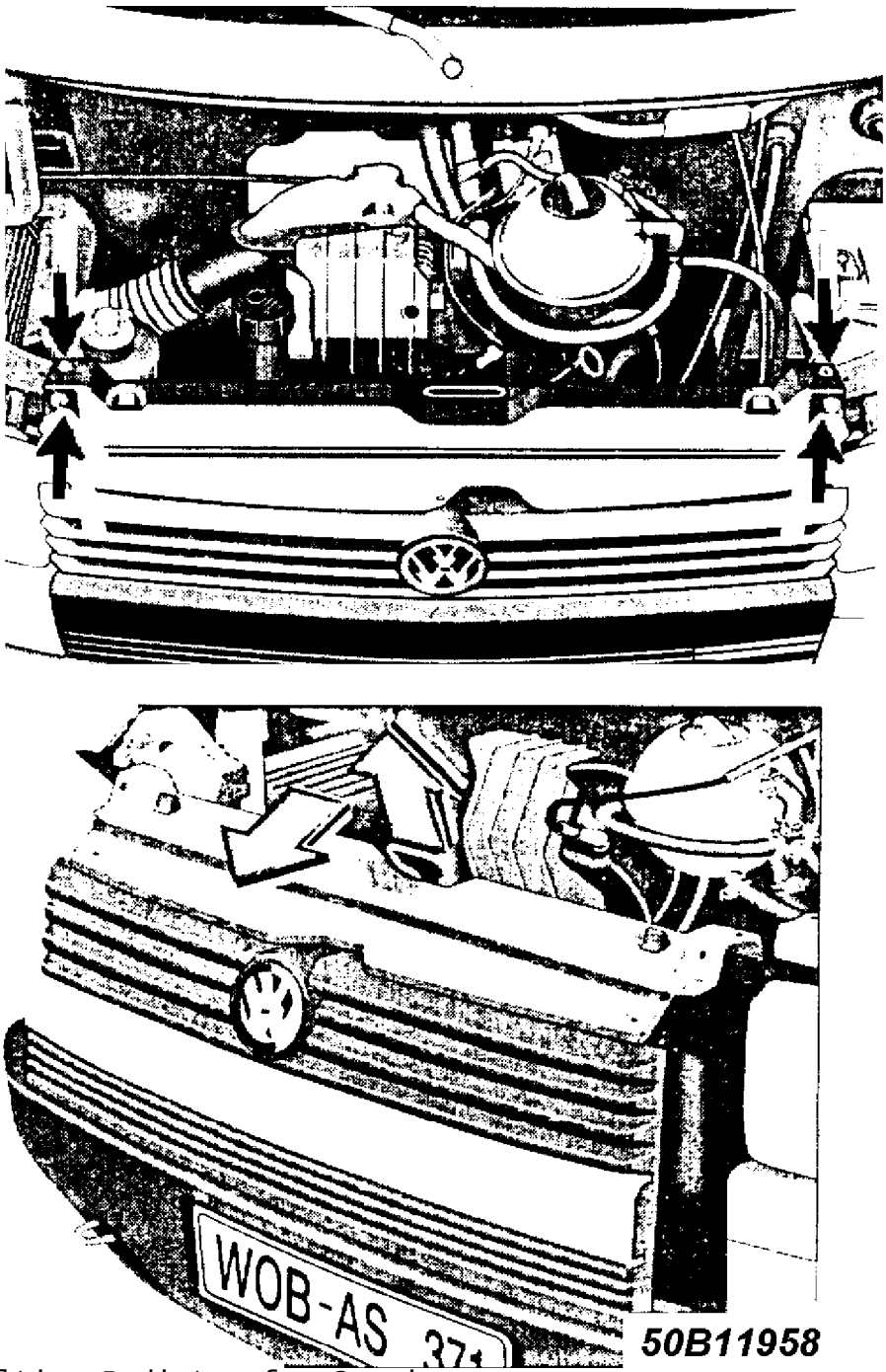


Fig. 2: Tilting Radiator for Service
Courtesy of Volkswagen United States, Inc.

1) With gear selector in Park, depress brake pedal.
2) Move gear selector to desired position.
3) If gear selector DOES NOT MOVE, check fuse #12.
4) TO MANUALLY RELEASE gear selector, push finger between brushes at base of shifter and push catch to the left. (See Fig. 2).
5) Select a gear.

NOTE: It may not be possible to move the radiator on some 1995 models (models with one piece lower grille sections).

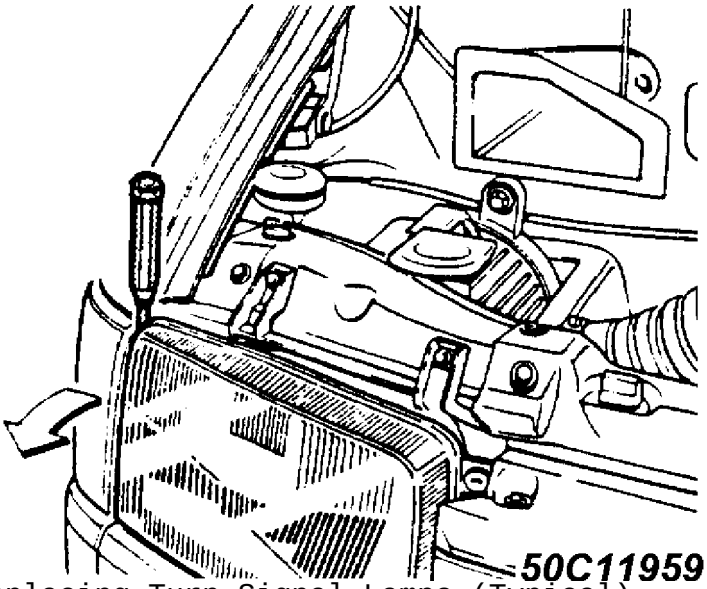


Fig. 3: Replacing Turn Signal Lamps (Typical)
Courtesy of Volkswagen United States, Inc.

ALIGNING CAMSHAFT TIMING MARKS

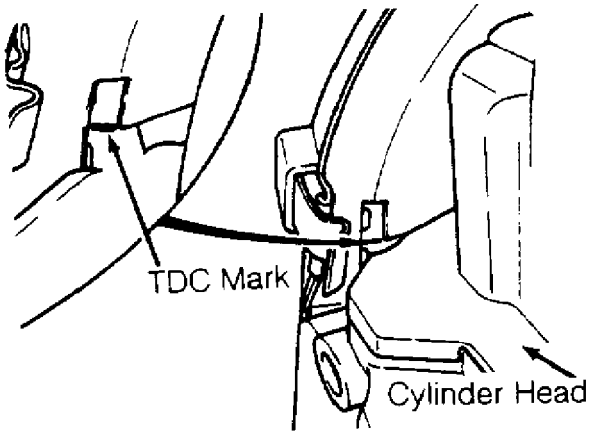


Fig. 4: Aligning Camshaft & Crankshaft Timing Marks
Courtesy of Volkswagen United States, Inc.

NOTE: For more information regarding camshaft timing belt service refer to the 2.5L 5-CYLarticle in the ENGINE MECHANICAL section.

BODY SERVICE POINTS

PASSENGER COMPARTMENT FILTER REPLACEMENT

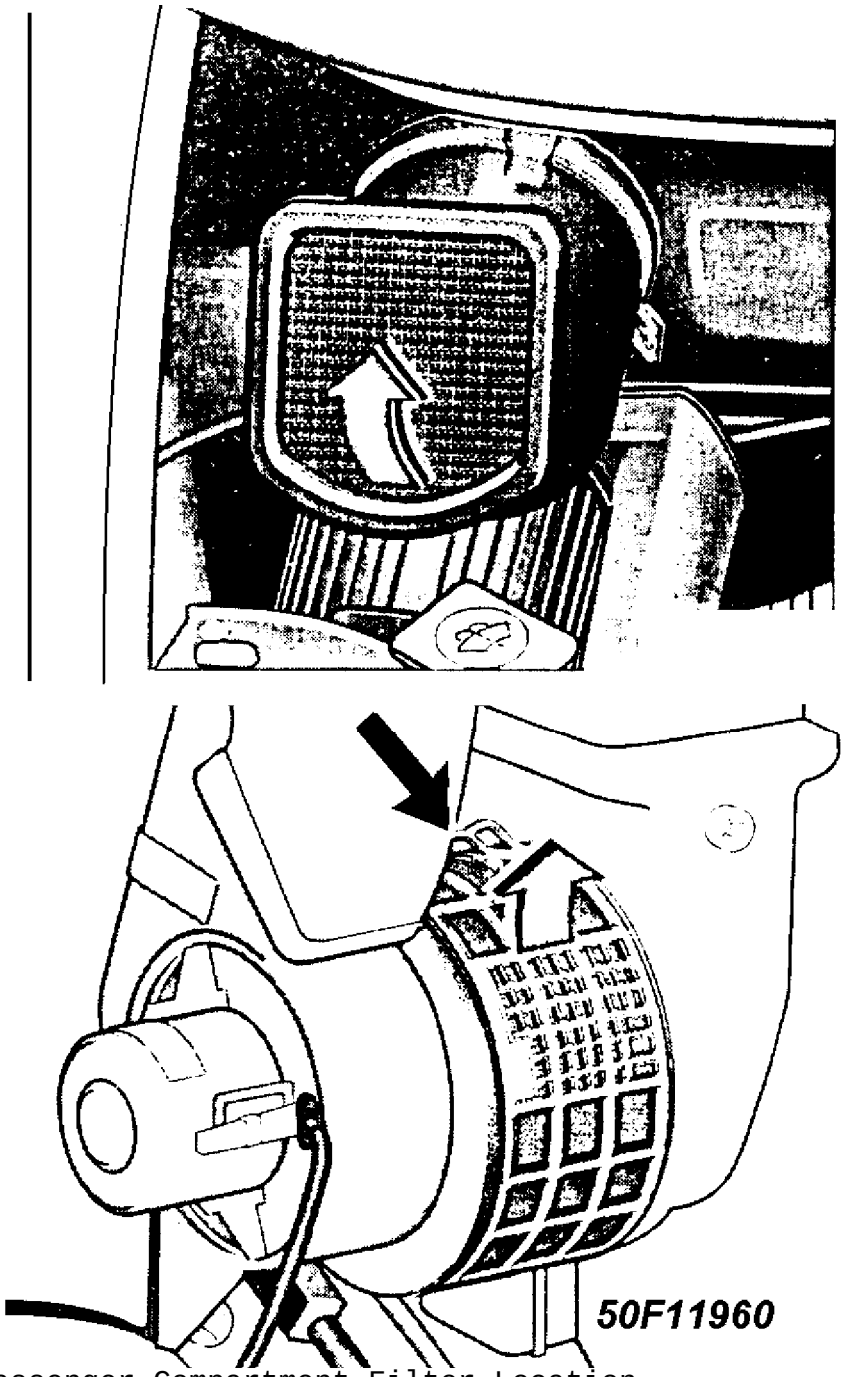


Fig. 5: Passenger Compartment Filter Location
Courtesy of Volkswagen United States, Inc.

DIESEL FUEL FILTER MAINTENANCE

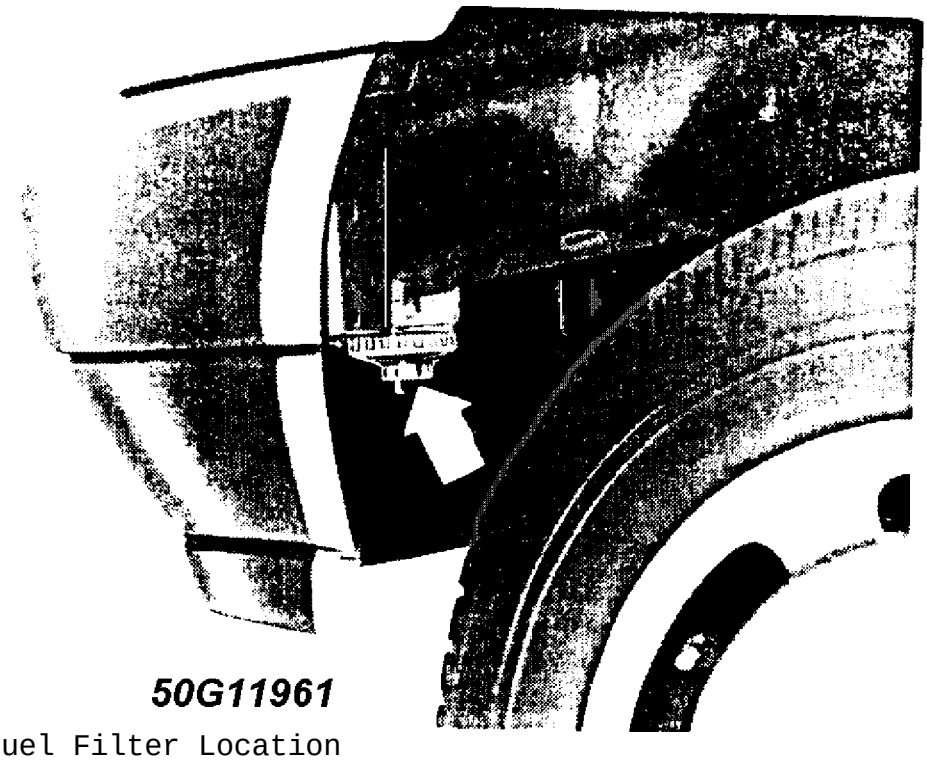


Fig. 6: Fuel Filter Location
Courtesy of Volkswagen United States, Inc.

SEVERE & NORMAL SERVICE DEFINITIONS

NOTE: Use the Severe Service schedule if the vehicle to be serviced is operated under ANY (one or more) of these conditions:

Service is recommended at mileage intervals based on vehicle operation. Service schedules are based on the following primary operating conditions:

Normal Service

* Driven More Than 10 Miles Daily
* No Operating Conditions From Severe Service Schedule

Severe Service (Unique Driving Conditions)

* Short Trips (10 Miles) In Freezing Temperatures
* Towing or Heavily Loaded
* Severe Dust Conditions
* Hot Weather, Stop-and-Go Driving
* Extensive Idling Conditions (Taxi or Delivery)

SEVERE SERVICE REQUIREMENTS (PERFORM W/SERVICE SCHEDULES)

NOTE: The following services are to be performed on vehicles subjected to severe service. See SEVERE & NORMAL SERVICE

SCHEDULED SERVICES
Article Text (p. 11)

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:35PM

DEFINITIONS. This service is to be performed in addition to the normal services listed in the NORMAL MAINTENANCE SERVICE SCHEDULES.

SEVERE SERVICE CONDITIONS/ACTIONS TABLE

Condition	Action	Item	Perform Every (1)
Short Trips (10 Miles) In Freezing Temperatures	Replace	Engine Oil & Filter	3,750 Miles or 3 Months
	Replace	A/T Fluid	30,000 Miles
	Service	A/T: Clean Pan & Strainer	30,000 Miles
Towing Or Heavily Loaded	Replace	Engine Oil & Filter	3,750 Miles or 3 Months
	Replace	A/T Fluid	30,000 Miles
	Service	A/T: Clean Pan & Strainer	30,000 Miles
Severe Dust Conditions	Replace	Engine Oil & Filter	3,750 Miles or 3 Months
	Replace	A/T Fluid	30,000 Miles
	Service	A/T: Clean Pan & Strainer	30,000 Miles
Hot Weather, Stop-And-Go Driving	Replace	Engine Oil & Filter	3,750 Miles or 3 Months
	Replace	A/T Fluid	30,000 Miles
	Service	A/T: Clean Pan & Strainer	30,000 Miles
Extensive Idling Conditions (Taxi or Delivery)	Replace	Engine Oil & Filter	3,750 Miles or 3 Months
	Replace	A/T Fluid	30,000 Miles
	Service	A/T: Clean Pan & Strainer	30,000 Miles

(1) - Perform these services at the mileage or number of months (since the last time), whichever comes first.

NORMAL MAINTENANCE SERVICE SCHEDULES

CAUTION: The following service schedules refer to vehicles driven under normal operating conditions. For vehicles driven under severe conditions, additional services may be necessary. See SEVERE SERVICE REQUIREMENTS (PERFORM W/SERVICE SCHEDULES) above in this article for additional service requirements.

7,500 MILE (12,000 KM) SERVICE

7,500 MILE (12,000 KM) SERVICE

Service Or Inspect
Check Fluid Levels
Inspect Coolant Hoses and Clamps
Inspect Brake System
Inspect Exhaust System
Inspect C/V Joint boots
Inspect Steering Linkage/Front Suspension
Lubricate Chassis
Replace
Engine Oil
Oil Filter
Lubrication Specifications

Application	Specification
Engine Oil	
Ambient Temperatures	
Greater Than 14ø F (-10øC) ...	SAE 20W-40 Or 20W-50 API SG/CD
14ø-50øF (-10ø To +10øC)	SAE 10W-30 Or 10W-40 API SG/CD
Less Than 50øF (10øC)	SAE 5W-30 Or 5W-40 API SG/CD

Fluid Capacities

SCHEDULED SERVICES
Article Text (p. 13)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:35PM

Application	(1) Quantity
Engine Oil (2)	
1993-94	
2.5L Gasoline	4.8 Qts. (4.5L)
1995	
2.4L Diesel	6.0 Qts. (5.5L)
2.5L Gasoline	6.0 Qts. (5.5L)

(1) - Capacities are recommended or calculated levels. Always use dipstick (if available) to measure level.
(2) - Includes filter change.

15,000 MILE (24,000 KM) SERVICE

15,000 MILE (24,000 KM) SERVICE

Service Or Inspect
Verify Last Major Service Was Performed
Diagnostic System Read Out
Check Fluid Levels
Check Cooling System Hoses and Clamps
Check Coolant Strength
Inspect For Fluid Leaks
Inspect/Adjust Accessory Drive Belts (Replace if Required)
A/C Cooling & Heating System
Crankcase Ventilation System
Intake Air System
Throttle Linkage
Inspect Brake System
Check Exhaust System & Heat Shielding
Clean Battery and Battery Terminals
Inspect Fuel/Tank/Cap/Lines
Check Operation of Horn, Wipers/Washers & All Exterior Lights

- Inspect Condition of Wiper Blades
- Check Headlight Alignment
- Lubricate Weatherstripping with Silicone
- Door/Hood/Trunk Stops, Hinges & Locks
- Check Body Drain Holes
- Check Seat Belt Webbing and Release Mechanisms
- Windshield Washer System
- Parking Brake Adjustment
- Clutch Adjustment
- Clutch Hydraulic System
- Suspension & Wheel Bearings
- Check Shift Interlock Operation
- Inspect Steering Linkage/Front Suspension
- Lubricate Chassis
- Inspect Brake Pads, Rotors and Calipers
- Inspect Brake System Hoses & Lines
- Inspect Shocks/Struts for Leakage
- Inspect Tire Wear and Condition
- Rotate Tires and Adjust Air Pressure (Including Spare)
- Replace
- Engine Oil
- Oil Filter
- Drain, Refill and Bleed Brake System Fluid
- Lubrication Specifications

Application	Specification
Automatic Transaxle	Dexron-IIE ATF
Brake Fluid	SAE J1703 Or DOT 4 Brake Fluid

Coolant	50/50 Mix Ethylene Glycol/Water
Engine Oil	
Ambient Temperatures	
Greater Than 14ø F (-10øC)	SAE 20W-40 Or 20W-50 API SG/CD
14ø-50øF (-10ø To +10øC)	SAE 10W-30 Or 10W-40 API SG/CD
Less Than 50øF (10øC)	SAE 5W-30 Or 5W-40 API SG/CD
Wheel Bearings	NLGI Grade 2 Category GC-LB
Steering Linkage (1)(2)	NLGI Grade 2 Category GC-LB
Ball Joints (1)(3)	NLGI Grade 2 Category GC-LB
Manual Transaxle	SAE 80W API GL-4 Or SAE 75W-90 Synthetic Transmission Oil G 50
Power Steering Fluid	VW Hydraulic Oil G-002-000
Weatherstrip	Dielectric Silicone Grease
Final Drive (Differential)	Synthetic Transmission Oil G 50 SAE 75W-90

(1) - Use low pressure grease gun to prevent seal damage.
(2) - Fill until lubricant squeezes out from the base of seals.
(3) - Fill ball joint until seal starts to swell.

Fluid Capacities

Application	(1) Quantity
Automatic Transmission	3.2 Qts. (3.0L)
Cooling System	18.6 Qts (17.5L)
Engine Oil (2)	
1993-94	
2.5L Gasoline	4.8 Qts. (4.5L)
1995	
2.4L Diesel	6.0 Qts. (5.5L)
2.5L Gasoline	6.0 Qts. (5.5L)

(1) - Capacities are recommended or calculated levels. Always use dipstick (if available) to measure level.
(2) - Includes filter change.

Service Labor Times

Application	(1)(2)(3) Hours
2.5L 5-Cylinder	
Automatic Transmission	1.6
Manual Transmission	1.8

(1) - Add .2 hr. if equipped with A/C.
(2) - Add .1 hr. if equipped with cruise control.
(3) - Add 2.0 hrs. to replace camshaft timing belt.

22,500 MILE (36,000 KM) SERVICE

22,500 MILE (36,000 KM) SERVICE

Service Or Inspect	
Verify Last Major Service Was Performed	
Check Fluid Levels	
Inspect Coolant Hoses and Clamps	
Inspect Brake System	
Inspect Exhaust System	
Inspect C/V Joint boots	
Inspect Steering Linkage/Front Suspension	
Lubricate Chassis	
Replace	
Engine Oil	
Oil Filter	

Lubrication Specifications

Application	Specification
Engine Oil	
Ambient Temperatures	
Greater Than 14ø F (-10øC) ...	SAE 20W-40 Or 20W-50 API SG/CD
14ø-50øF (-10ø To +10øC)	SAE 10W-30 Or 10W-40 API SG/CD
Less Than 50øF (10øC)	SAE 5W-30 Or 5W-40 API SG/CD

Fluid Capacities

Application	(1) Quantity
Engine Oil (2)	
1993-94	
2.5L Gasoline	4.8 Qts. (4.5L)
1995	
2.4L Diesel	6.0 Qts. (5.5L)
2.5L Gasoline	6.0 Qts. (5.5L)

(1) - Capacities are recommended or calculated levels. Always use dipstick (if available) to measure level.
(2) - Includes filter change.

30,000 MILE (48,000 KM) SERVICE

30,000 MILE (48,000 KM) SERVICE

Service Or Inspect
Verify Last Major Service Was Performed
Diagnostic System Read Out
Check Fluid Levels
Check Cooling System Hoses and Clamps
Check Coolant Strength
Inspect For Fluid Leaks
Inspect/Adjust Accessory Drive Belts (Replace if Required)
A/C Cooling & Heating System
Crankcase Ventilation System
Intake Air System
Throttle Linkage
Inspect Brake System
Check Exhaust System & Heat Shielding
Clean Battery and Battery Terminals
Inspect Fuel/Tank/Cap/Lines
Check Operation of Horn, Wipers/Washers & All Exterior Lights
Inspect Condition of Wiper Blades
Check Headlight Alignment
Lubricate Weatherstripping with Silicone
Door/Hood/Trunk Stops, Hinges & Locks
Check Body Drain Holes
Check Seat Belt Webbing and Release Mechanisms
Windshield Washer System

- Parking Brake Adjustment
- Clutch Adjustment
- Clutch Hydraulic System
- Suspension & Wheel Bearings
- Check Shift Interlock Operation
- Inspect Steering Linkage/Front Suspension
- Lubricate Chassis
- Inspect Brake Pads, Rotors and Calipers
- Inspect Brake System Hoses & Lines
- Inspect Shocks/Struts for Leakage
- Inspect Tire Wear and Condition
- Rotate Tires and Adjust Air Pressure (Including Spare)
- Replace
- Engine Oil
- Oil Filter
- Spark Plugs
- Air Filter Element
- Replace (2) Passenger HVAC Air Filters
- Replace Automatic Transmission Fluid and Clean ATF Strainer
- Drain, Refill and Bleed Brake System Fluid
- Drain, Flush and Refill Engine Coolant

Lubrication Specifications

Application	Specification
Automatic Transaxle	Dexron-IIE ATF
Brake Fluid	SAE J1703 Or DOT 4 Brake Fluid
Coolant	50/50 Mix Ethylene Glycol/Water
Engine Oil	
Ambient Temperatures	
Greater Than 14ø F (-10øC)	SAE 20W-40 Or 20W-50 API SG/CD

14ø-50øF (-10ø To +10øC)	SAE 10W-30 Or 10W-40 API SG/CD
Less Than 50øF (10øC)	SAE 5W-30 Or 5W-40 API SG/CD
Wheel Bearings	NLGI Grade 2 Category GC-LB
Steering Linkage (1)(2)	NLGI Grade 2 Category GC-LB
Ball Joints (1)(3)	NLGI Grade 2 Category GC-LB
Manual Transaxle	SAE 80W API GL-4 Or SAE 75W-90 Synthetic Transmission Oil G 50
Power Steering Fluid	VW Hydraulic Oil G-002-000
Weatherstrip	Dielectric Silicone Grease
Final Drive (Differential)	Synthetic Transmission Oil G 50 SAE 75W-90

(1) - Use low pressure grease gun to prevent seal damage.
(2) - Fill until lubricant squeezes out from the base of seals.
(3) - Fill ball joint until seal starts to swell.

Fluid Capacities

Application	(1) Quantity
Automatic Transmission	3.2 Qts. (3.0L)
Cooling System	18.6 Qts (17.5L)
Engine Oil (2)	
1993-94	
2.5L Gasoline	4.8 Qts. (4.5L)
1995	
2.4L Diesel	6.0 Qts. (5.5L)
2.5L Gasoline	6.0 Qts. (5.5L)

(1) - Capacities are recommended or calculated levels. Always use dipstick (if available) to measure level.
(2) - Includes filter change.

Service Labor Times

Application	(1)(2)(3) Hours
2.5L 5-Cylinder	
Automatic Transmission	3.4
Manual Transmission	2.8

(1) - Add .2 hr. if equipped with A/C.
(2) - Add .1 hr. if equipped with cruise control.
(3) - Add 2.0 hrs. to replace camshaft timing belt.

36,000 MILE (57,600 KM) SERVICE

36,000 MILE (57,600 KM) SERVICE

Service Or Inspect

	Verify Last Major Service Was Performed
	Check Fluid Levels
	Inspect Coolant Hoses and Clamps
	Inspect C/V Joint boots
	Lubricate Chassis
Replace	
	Camshaft Timing Belt

Lubrication Specifications

Application	Specification
Engine Oil	
Ambient Temperatures	
Greater Than 14ø F (-10øC) ...	SAE 20W-40 Or 20W-50 API SG/CD
14ø-50øF (-10ø To +10øC)	SAE 10W-30 Or 10W-40 API SG/CD
Less Than 50øF (10øC)	SAE 5W-30 Or 5W-40 API SG/CD

Fluid Capacities

Application	(1) Quantity
Engine Oil (2)	
1993-94	
2.5L Gasoline	4.8 Qts. (4.5L)
1995	
2.4L Diesel	6.0 Qts. (5.5L)
2.5L Gasoline	6.0 Qts. (5.5L)

(1) - Capacities are recommended or calculated levels. Always use dipstick (if available) to measure level.
(2) - Includes filter change.

Service Labor Times

Application	(1)(2)(3) Hours
2.5L 5-Cylinder	
Automatic Transmission	3.4
Manual Transmission	2.8

(1) - Add .2 hr. if equipped with A/C.
(2) - Add .1 hr. if equipped with cruise control.
(3) - Add 2.0 hrs. to replace camshaft timing belt.

37,500 MILE (60,000 KM) SERVICE

37,500 MILE (60,000 KM) SERVICE

Service Or Inspect
Verify Last Major Service Was Performed
Check Fluid Levels
Inspect Coolant Hoses and Clamps
Inspect Brake System
Inspect Exhaust System
Inspect C/V Joint boots
Inspect Steering Linkage/Front Suspension
Lubricate Chassis
Replace
Engine Oil
Oil Filter

Lubrication Specifications	
Application	Specification
Engine Oil	
Ambient Temperatures	
Greater Than 14ø F (-10øC) ...	SAE 20W-40 Or 20W-50 API SG/CD
14ø-50øF (-10ø To +10øC)	SAE 10W-30 Or 10W-40 API SG/CD
Less Than 50øF (10øC)	SAE 5W-30 Or 5W-40 API SG/CD

Fluid Capacities	
Application	(1) Quantity
Engine Oil (2)	
1993-94	
2.5L Gasoline	4.8 Qts. (4.5L)
1995	
2.4L Diesel	6.0 Qts. (5.5L)
2.5L Gasoline	6.0 Qts. (5.5L)

(1) - Capacities are recommended or calculated levels. Always use dipstick (if available) to measure level.
(2) - Includes filter change.

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45,000 MILE (72,000 KM) SERVICE

45,000 MILE (72,000 KM) SERVICE

Service Or Inspect
Verify Last Major Service Was Performed
Diagnostic System Read Out
Check Fluid Levels
Check Cooling System Hoses and Clamps
Check Coolant Strength
Inspect For Fluid Leaks
Inspect/Adjust Accessory Drive Belts (Replace if Required)
A/C Cooling & Heating System
Crankcase Ventilation System
Intake Air System
Throttle Linkage
Inspect Brake System
Check Exhaust System & Heat Shielding
Clean Battery and Battery Terminals
Inspect Fuel/Tank/Cap/Lines
Check Operation of Horn, Wipers/Washers & All Exterior Lights
Inspect Condition of Wiper Blades
Check Headlight Alignment
Lubricate Weatherstripping with Silicone
Door/Hood/Trunk Stops, Hinges & Locks
Check Body Drain Holes
Check Seat Belt Webbing and Release Mechanisms

³ ³ Windshield Washer System	³
³ ³ Parking Brake Adjustment	³
³ ³ Clutch Adjustment	³
³ ³ Clutch Hydraulic System	³
³ ³ Suspension & Wheel Bearings	³
³ ³ Check Shift Interlock Operation	³
³ ³ Inspect Steering Linkage/Front Suspension	³
³ ³ Lubricate Chassis	³
³ ³ Inspect Brake Pads, Rotors and Calipers	³
³ ³ Inspect Brake System Hoses & Lines	³
³ ³ Inspect Shocks/Struts for Leakage	³
³ ³ Inspect Tire Wear and Condition	³
³ ³ Rotate Tires and Adjust Air Pressure (Including Spare)	³
³ Replace	³
³ ³ Engine Oil	³
³ ³ Oil Filter	³
³ ³ Drain, Refill and Bleed Brake System Fluid	³
³ Lubrication Specifications	³

³ Application	Specification ³
³	³
³ Automatic Transaxle	Dexron-IIE ATF ³
³ Brake Fluid	SAE J1703 Or DOT 4 Brake Fluid ³
³ Coolant	50/50 Mix Ethylene Glycol/Water ³
³ Engine Oil	³
³ Ambient Temperatures	³
³ Greater Than 14ø F (-10øC) ...	SAE 20W-40 Or 20W-50 API SG/CD ³
³ 14ø-50øF (-10ø To +10øC)	SAE 10W-30 Or 10W-40 API SG/CD ³
³ Less Than 50øF (10øC)	SAE 5W-30 Or 5W-40 API SG/CD ³
³ Wheel Bearings	NLGI Grade 2 Category GC-LB ³
³ Steering Linkage (1)(2)	NLGI Grade 2 Category GC-LB ³
³ Ball Joints (1)(3)	NLGI Grade 2 Category GC-LB ³
³ Manual Transaxle	SAE 80W API GL-4 Or SAE 75W-90 ³
³	Synthetic Transmission Oil G 50 ³
³ Power Steering Fluid	VW Hydraulic Oil G-002-000 ³

Weatherstrip	Dielectric Silicone Grease
Final Drive (Differential)	Synthetic Transmission Oil G 50 SAE 75W-90

(1) - Use low pressure grease gun to prevent seal damage.
(2) - Fill until lubricant squeezes out from the base of seals.
(3) - Fill ball joint until seal starts to swell.

Fluid Capacities

Application	(1) Quantity
Automatic Transmission	3.2 Qts. (3.0L)
Cooling System	18.6 Qts (17.5L)
Engine Oil (2)	
1993-94	
2.5L Gasoline	4.8 Qts. (4.5L)
1995	
2.4L Diesel	6.0 Qts. (5.5L)
2.5L Gasoline	6.0 Qts. (5.5L)

(1) - Capacities are recommended or calculated levels. Always use dipstick (if available) to measure level.
(2) - Includes filter change.

Service Labor Times

Application	(1)(2)(3) Hours
2.5L 5-Cylinder	
Automatic Transmission	1.6
Manual Transmission	1.8

(1) - Add .2 hr. if equipped with A/C.
(2) - Add .1 hr. if equipped with cruise control.
(3) - Add 2.0 hrs. to replace camshaft timing belt.

52,500 MILE (84,000 KM) SERVICE

52,500 MILE (84,000 KM) SERVICE

Service Or Inspect

- Verify Last Major Service Was Performed
- Check Fluid Levels
- Inspect Coolant Hoses and Clamps
- Inspect Brake System

	Inspect Exhaust System
	Inspect C/V Joint boots
	Inspect Steering Linkage/Front Suspension
	Lubricate Chassis
	Replace
	Engine Oil
	Oil Filter

Lubrication Specifications

Application	Specification
Engine Oil	
Ambient Temperatures	
Greater Than 14ø F (-10øC) ...	SAE 20W-40 Or 20W-50 API SG/CD
14ø-50øF (-10ø To +10øC)	SAE 10W-30 Or 10W-40 API SG/CD
Less Than 50øF (10øC)	SAE 5W-30 Or 5W-40 API SG/CD

Fluid Capacities

Application	(1) Quantity
Engine Oil (2)	
1993-94	
2.5L Gasoline	4.8 Qts. (4.5L)
1995	
2.4L Diesel	6.0 Qts. (5.5L)
2.5L Gasoline	6.0 Qts. (5.5L)

(1) - Capacities are recommended or calculated levels. Always use dipstick (if available) to measure level.
(2) - Includes filter change.

60,000 MILE (96,000 KM) SERVICE

60,000 MILE (96,000 KM) SERVICE

	Service Or Inspect
	Verify Last Major Service Was Performed
	Diagnostic System Read Out
	Check Fluid Levels

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Check Cooling System Hoses and Clamps
Check Coolant Strength
Inspect For Fluid Leaks
Inspect/Adjust Accessory Drive Belts (Replace if Required)
A/C Cooling & Heating System
Crankcase Ventilation System
Intake Air System
Throttle Linkage
Inspect Brake System
Check Exhaust System & Heat Shielding
Clean Battery and Battery Terminals
Inspect Fuel/Tank/Cap/Lines
Check Operation of Horn, Wipers/Washers & All Exterior Lights
Inspect Condition of Wiper Blades
Check Headlight Alignment
Lubricate Weatherstripping with Silicone
Door/Hood/Trunk Stops, Hinges & Locks
Check Body Drain Holes
Check Seat Belt Webbing and Release Mechanisms
Windshield Washer System
Parking Brake Adjustment
Clutch Adjustment
Clutch Hydraulic System
Suspension & Wheel Bearings
Check Shift Interlock Operation
Inspect Steering Linkage/Front Suspension

Lubricate Chassis	
Inspect Brake Pads, Rotors and Calipers	
Inspect Brake System Hoses & Lines	
Inspect Shocks/Struts for Leakage	
Inspect Tire Wear and Condition	
Rotate Tires and Adjust Air Pressure (Including Spare)	
Replace	
Engine Oil	
Oil Filter	
Spark Plugs	
Air Filter Element	
Replace (2) Passenger HVAC Air Filters	
Replace Automatic Transmission Fluid and Clean ATF Strainer	
Manual Transmission Fluid	
A/T Differential Oil	
Oxygen Sensor	
Drain, Refill and Bleed Brake System Fluid	
Drain, Flush and Refill Engine Coolant	

Lubrication Specifications

Application	Specification
Automatic Transaxle	Dexron-IIE ATF
Brake Fluid	SAE J1703 Or DOT 4 Brake Fluid
Coolant	50/50 Mix Ethylene Glycol/Water
Engine Oil	
Ambient Temperatures	
Greater Than 14ø F (-10øC)	SAE 20W-40 Or 20W-50 API SG/CD
14ø-50øF (-10ø To +10øC)	SAE 10W-30 Or 10W-40 API SG/CD
Less Than 50øF (10øC)	SAE 5W-30 Or 5W-40 API SG/CD
Wheel Bearings	NLGI Grade 2 Category GC-LB
Steering Linkage (1)(2)	NLGI Grade 2 Category GC-LB
Ball Joints (1)(3)	NLGI Grade 2 Category GC-LB
Manual Transaxle	SAE 80W API GL-4 Or SAE 75W-90

	Synthetic Transmission Oil G 50
Power Steering Fluid	VW Hydraulic Oil G-002-000
Weatherstrip	Dielectric Silicone Grease
Final Drive (Differential)	Synthetic Transmission Oil G 50 SAE 75W-90

(1) - Use low pressure grease gun to prevent seal damage.
(2) - Fill until lubricant squeezes out from the base of seals.
(3) - Fill ball joint until seal starts to swell.

Fluid Capacities

Application	(1) Quantity
Automatic Transmission	3.2 Qts. (3.0L)
Cooling System	18.6 Qts (17.5L)
Engine Oil (2)	
1993-94	
2.5L Gasoline	4.8 Qts. (4.5L)
1995	
2.4L Diesel	6.0 Qts. (5.5L)
2.5L Gasoline	6.0 Qts. (5.5L)

(1) - Capacities are recommended or calculated levels. Always use dipstick (if available) to measure level.
(2) - Includes filter change.

Service Labor Times

Application	(1)(2)(3) Hours
2.5L 5-Cylinder	
Automatic Transmission	4.3
Manual Transmission	3.7

(1) - Add .2 hr. if equipped with A/C.
(2) - Add .1 hr. if equipped with cruise control.
(3) - Add 2.0 hrs. to replace camshaft timing belt.

67,500 MILE (108,000 KM) SERVICE

67,500 MILE (108,000 KM) SERVICE

Service Or Inspect

- Verify Last Major Service Was Performed
- Check Fluid Levels
- Inspect Coolant Hoses and Clamps

³ ³ Inspect Brake System	³
³ ³ Inspect Exhaust System	³
³ ³ Inspect C/V Joint boots	³
³ ³ Inspect Steering Linkage/Front Suspension	³
³ ³ Lubricate Chassis	³
³ Replace	³
³ ³ Engine Oil	³
³ ³ Oil Filter	³

³ Lubrication Specifications ³

Application	Specification
Engine Oil	
Ambient Temperatures	
Greater Than 14ø F (-10øC) ...	SAE 20W-40 Or 20W-50 API SG/CD
14ø-50øF (-10ø To +10øC)	SAE 10W-30 Or 10W-40 API SG/CD
Less Than 50øF (10øC)	SAE 5W-30 Or 5W-40 API SG/CD

³ Fluid Capacities ³

Application	(1) Quantity
Engine Oil (2)	
1993-94	
2.5L Gasoline	4.8 Qts. (4.5L)
1995	
2.4L Diesel	6.0 Qts. (5.5L)
2.5L Gasoline	6.0 Qts. (5.5L)

(1) - Capacities are recommended or calculated levels. Always use dipstick (if available) to measure level.
(2) - Includes filter change.

72,000 MILE (115,200 KM) SERVICE

72,000 MILE (115,200 KM) SERVICE

³ Service Or Inspect	³
³ ³ Verify Last Major Service Was Performed	³
³ ³ Check Fluid Levels	³

- Inspect Coolant Hoses and Clamps
- Inspect C/V Joint boots
- Lubricate Chassis

Replace

- Camshaft Timing Belt

Lubrication Specifications

Application	Specification
Engine Oil	
Ambient Temperatures	
Greater Than 14ø F (-10øC) ...	SAE 20W-40 Or 20W-50 API SG/CD
14ø-50øF (-10ø To +10øC)	SAE 10W-30 Or 10W-40 API SG/CD
Less Than 50øF (10øC)	SAE 5W-30 Or 5W-40 API SG/CD

Fluid Capacities

Application	(1) Quantity
Engine Oil (2)	
1993-94	
2.5L Gasoline	4.8 Qts. (4.5L)
1995	
2.4L Diesel	6.0 Qts. (5.5L)
2.5L Gasoline	6.0 Qts. (5.5L)

(1) - Capacities are recommended or calculated levels. Always use dipstick (if available) to measure level.
(2) - Includes filter change.

Service Labor Times

Application	(1)(2)(3) Hours
2.5L 5-Cylinder	
Automatic Transmission	4.3
Manual Transmission	3.7

(1) - Add .2 hr. if equipped with A/C.
(2) - Add .1 hr. if equipped with cruise control.
(3) - Add 2.0 hrs. to replace camshaft timing belt.

75,000 MILE (120,000 KM) SERVICE

75,000 MILE (120,000 KM) SERVICE

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Service Or Inspect
Verify Last Major Service Was Performed
Diagnostic System Read Out
Check Fluid Levels
Check Cooling System Hoses and Clamps
Check Coolant Strength
Inspect For Fluid Leaks
Inspect/Adjust Accessory Drive Belts (Replace if Required)
A/C Cooling & Heating System
Crankcase Ventilation System
Intake Air System
Throttle Linkage
Inspect Brake System
Check Exhaust System & Heat Shielding
Clean Battery and Battery Terminals
Inspect Fuel/Tank/Cap/Lines
Check Operation of Horn, Wipers/Washers & All Exterior Lights
Inspect Condition of Wiper Blades
Check Headlight Alignment
Lubricate Weatherstripping with Silicone
Door/Hood/Trunk Stops, Hinges & Locks
Check Body Drain Holes
Check Seat Belt Webbing and Release Mechanisms
Windshield Washer System
Parking Brake Adjustment
Clutch Adjustment

- Clutch Hydraulic System
- Suspension & Wheel Bearings
- Check Shift Interlock Operation
- Inspect Steering Linkage/Front Suspension
- Lubricate Chassis
- Inspect Brake Pads, Rotors and Calipers
- Inspect Brake System Hoses & Lines
- Inspect Shocks/Struts for Leakage
- Inspect Tire Wear and Condition
- Rotate Tires and Adjust Air Pressure (Including Spare)
- Replace
- Engine Oil
- Oil Filter
- Drain, Refill and Bleed Brake System Fluid

Lubrication Specifications

Application	Specification
Automatic Transaxle	Dexron-IIE ATF
Brake Fluid	SAE J1703 Or DOT 4 Brake Fluid
Coolant	50/50 Mix Ethylene Glycol/Water
Engine Oil	
Ambient Temperatures	
Greater Than 14ø F (-10øC)	SAE 20W-40 Or 20W-50 API SG/CD
14ø-50øF (-10ø To +10øC)	SAE 10W-30 Or 10W-40 API SG/CD
Less Than 50øF (10øC)	SAE 5W-30 Or 5W-40 API SG/CD
Wheel Bearings	NLGI Grade 2 Category GC-LB
Steering Linkage (1)(2)	NLGI Grade 2 Category GC-LB
Ball Joints (1)(3)	NLGI Grade 2 Category GC-LB
Manual Transaxle	SAE 80W API GL-4 Or SAE 75W-90 Synthetic Transmission Oil G 50
Power Steering Fluid	VW Hydraulic Oil G-002-000
Weatherstrip	Dielectric Silicone Grease
Final Drive (Differential)	Synthetic Transmission Oil G 50 SAE 75W-90

(1) - Use low pressure grease gun to prevent seal damage.
(2) - Fill until lubricant squeezes out from the base of seals.

³ (3) - Fill ball joint until seal starts to swell. ³

Fluid Capacities	
Application	(1) Quantity
Automatic Transmission	3.2 Qts. (3.0L)
Cooling System	18.6 Qts (17.5L)
Engine Oil (2)	
1993-94	
2.5L Gasoline	4.8 Qts. (4.5L)
1995	
2.4L Diesel	6.0 Qts. (5.5L)
2.5L Gasoline	6.0 Qts. (5.5L)

³ (1) - Capacities are recommended or calculated levels. Always use ³
³ dipstick (if available) to measure level. ³
³ (2) - Includes filter change. ³

Service Labor Times	
Application	(1)(2)(3) Hours
2.5L 5-Cylinder	
Automatic Transmission	1.6
Manual Transmission	1.8

³ (1) - Add .2 hr. if equipped with A/C. ³
³ (2) - Add .1 hr. if equipped with cruise control. ³
³ (3) - Add 2.0 hrs. to replace camshaft timing belt. ³

82,500 MILE (132,000 KM) SERVICE

82,500 MILE (132,000 KM) SERVICE

Service Or Inspect
³ Verify Last Major Service Was Performed
³ Check Fluid Levels
³ Inspect Coolant Hoses and Clamps
³ Inspect Brake System
³ Inspect Exhaust System
³ Inspect C/V Joint boots
³ Inspect Steering Linkage/Front Suspension

³ ³ Lubricate Chassis	³
³ Replace	³
³ ³ Engine Oil	³
³ ³ Oil Filter	³
³ Lubrication Specifications	³

³ Application	Specification ³
³	³
³ Engine Oil	³
³ Ambient Temperatures	³
³ Greater Than 14ø F (-10øC) ...	SAE 20W-40 Or 20W-50 API SG/CD ³
³ 14ø-50øF (-10ø To +10øC)	SAE 10W-30 Or 10W-40 API SG/CD ³
³ Less Than 50øF (10øC)	SAE 5W-30 Or 5W-40 API SG/CD ³

³ Fluid Capacities ³

³ Application	(1) Quantity ³
³	³
³ Engine Oil (2)	³
³ 1993-94	³
³ 2.5L Gasoline	4.8 Qts. (4.5L) ³
³ 1995	³
³ 2.4L Diesel	6.0 Qts. (5.5L) ³
³ 2.5L Gasoline	6.0 Qts. (5.5L) ³

³ (1) - Capacities are recommended or calculated levels. Always use ³
³ dipstick (if available) to measure level. ³
³ (2) - Includes filter change. ³

90,000 MILE (144,000 KM) SERVICE

90,000 MILE (144,000 KM) SERVICE

³ Service Or Inspect ³
³ ³ Verify Last Major Service Was Performed ³
³ ³ Diagnostic System Read Out ³
³ ³ Check Fluid Levels ³
³ ³ Check Cooling System Hoses and Clamps ³
³ ³ Check Coolant Strength ³
³ ³ Inspect For Fluid Leaks ³

Inspect/Adjust Accessory Drive Belts (Replace if Required)
A/C Cooling & Heating System
Crankcase Ventilation System
Intake Air System
Throttle Linkage
Inspect Brake System
Check Exhaust System & Heat Shielding
Clean Battery and Battery Terminals
Inspect Fuel/Tank/Cap/Lines
Check Operation of Horn, Wipers/Washers & All Exterior Lights
Inspect Condition of Wiper Blades
Check Headlight Alignment
Lubricate Weatherstripping with Silicone
Door/Hood/Trunk Stops, Hinges & Locks
Check Body Drain Holes
Check Seat Belt Webbing and Release Mechanisms
Windshield Washer System
Parking Brake Adjustment
Clutch Adjustment
Clutch Hydraulic System
Suspension & Wheel Bearings
Check Shift Interlock Operation
Inspect Steering Linkage/Front Suspension
Lubricate Chassis
Inspect Brake Pads, Rotors and Calipers
Inspect Brake System Hoses & Lines

- Inspect Shocks/Struts for Leakage
- Inspect Tire Wear and Condition
- Rotate Tires and Adjust Air Pressure (Including Spare)
- Replace
  - Engine Oil
  - Oil Filter
  - Drain, Refill and Bleed Brake System Fluid
  - Spark Plugs
  - Air Filter Element
  - Replace (2) Passenger HVAC Air Filters
  - Replace Automatic Transmission Fluid and Clean ATF Strainer
  - Drain, Refill and Bleed Brake System Fluid
  - Drain, Flush and Refill Engine Coolant

Lubrication Specifications

Application	Specification
Automatic Transaxle	Dexron-IIE ATF
Brake Fluid	SAE J1703 Or DOT 4 Brake Fluid
Coolant	50/50 Mix Ethylene Glycol/Water
Engine Oil	
Ambient Temperatures	
Greater Than 14ø F (-10øC)	SAE 20W-40 Or 20W-50 API SG/CD
14ø-50øF (-10ø To +10øC)	SAE 10W-30 Or 10W-40 API SG/CD
Less Than 50øF (10øC)	SAE 5W-30 Or 5W-40 API SG/CD
Wheel Bearings	NLGI Grade 2 Category GC-LB
Steering Linkage (1)(2)	NLGI Grade 2 Category GC-LB
Ball Joints (1)(3)	NLGI Grade 2 Category GC-LB
Manual Transaxle	SAE 80W API GL-4 Or SAE 75W-90
	Synthetic Transmission Oil G 50
Power Steering Fluid	VW Hydraulic Oil G-002-000
Weatherstrip	Dielectric Silicone Grease
Final Drive (Differential)	Synthetic Transmission Oil G 50
	SAE 75W-90

(1) - Use low pressure grease gun to prevent seal damage.
(2) - Fill until lubricant squeezes out from the base of seals.
(3) - Fill ball joint until seal starts to swell.

Fluid Capacities	
Application	(1) Quantity
Automatic Transmission	3.2 Qts. (3.0L)
Cooling System	18.6 Qts (17.5L)
Engine Oil (2)	
1993-94	
2.5L Gasoline	4.8 Qts. (4.5L)
1995	
2.4L Diesel	6.0 Qts. (5.5L)
2.5L Gasoline	6.0 Qts. (5.5L)

(1) - Capacities are recommended or calculated levels. Always use dipstick (if available) to measure level.
(2) - Includes filter change.

Service Labor Times	
Application	(1)(2)(3) Hours
2.5L 5-Cylinder	
Automatic Transmission	3.4
Manual Transmission	2.8

(1) - Add .2 hr. if equipped with A/C.
(2) - Add .1 hr. if equipped with cruise control.
(3) - Add 2.0 hrs. to replace camshaft timing belt.

97,500 MILE (156,000 KM) SERVICE

97,500 MILE (156,000 KM) SERVICE

Service Or Inspect
Verify Last Major Service Was Performed
Check Fluid Levels
Inspect Coolant Hoses and Clamps
Inspect Brake System
Inspect Exhaust System
Inspect C/V Joint boots
Inspect Steering Linkage/Front Suspension
Lubricate Chassis

Replace	
Engine Oil	
Oil Filter	

Lubrication Specifications	
Application	Specification
Engine Oil	
Ambient Temperatures	
Greater Than 14ø F (-10øC) ...	SAE 20W-40 Or 20W-50 API SG/CD
14ø-50øF (-10ø To +10øC)	SAE 10W-30 Or 10W-40 API SG/CD
Less Than 50øF (10øC)	SAE 5W-30 Or 5W-40 API SG/CD

Fluid Capacities	
Application	(1) Quantity
Engine Oil (2)	
1993-94	
2.5L Gasoline	4.8 Qts. (4.5L)
1995	
2.4L Diesel	6.0 Qts. (5.5L)
2.5L Gasoline	6.0 Qts. (5.5L)

(1) - Capacities are recommended or calculated levels. Always use dipstick (if available) to measure level.
(2) - Includes filter change.

105,000 MILE (168,000 KM) SERVICE

105,000 MILE (168,000 KM) SERVICE

Service Or Inspect
Verify Last Major Service Was Performed
Diagnostic System Read Out
Check Fluid Levels
Check Cooling System Hoses and Clamps
Check Coolant Strength
Inspect For Fluid Leaks
Inspect/Adjust Accessory Drive Belts (Replace if Required)

A/C Cooling & Heating System
Crankcase Ventilation System
Intake Air System
Throttle Linkage
Inspect Brake System
Check Exhaust System & Heat Shielding
Clean Battery and Battery Terminals
Inspect Fuel/Tank/Cap/Lines
Check Operation of Horn, Wipers/Washers & All Exterior Lights
Inspect Condition of Wiper Blades
Check Headlight Alignment
Lubricate Weatherstripping with Silicone
Door/Hood/Trunk Stops, Hinges & Locks
Check Body Drain Holes
Check Seat Belt Webbing and Release Mechanisms
Windshield Washer System
Parking Brake Adjustment
Clutch Adjustment
Clutch Hydraulic System
Suspension & Wheel Bearings
Check Shift Interlock Operation
Inspect Steering Linkage/Front Suspension
Lubricate Chassis
Inspect Brake Pads, Rotors and Calipers
Inspect Brake System Hoses & Lines
Inspect Shocks/Struts for Leakage

Inspect Tire Wear and Condition	
Rotate Tires and Adjust Air Pressure (Including Spare)	
Replace	
Engine Oil	
Oil Filter	
Drain, Refill and Bleed Brake System Fluid	

Lubrication Specifications

Application	Specification
Automatic Transaxle	Dexron-IIE ATF
Brake Fluid	SAE J1703 Or DOT 4 Brake Fluid
Coolant	50/50 Mix Ethylene Glycol/Water
Engine Oil	
Ambient Temperatures	
Greater Than 14ø F (-10øC)	SAE 20W-40 Or 20W-50 API SG/CD
14ø-50øF (-10ø To +10øC)	SAE 10W-30 Or 10W-40 API SG/CD
Less Than 50øF (10øC)	SAE 5W-30 Or 5W-40 API SG/CD
Wheel Bearings	NLGI Grade 2 Category GC-LB
Steering Linkage (1)(2)	NLGI Grade 2 Category GC-LB
Ball Joints (1)(3)	NLGI Grade 2 Category GC-LB
Manual Transaxle	SAE 80W API GL-4 Or SAE 75W-90
	Synthetic Transmission Oil G 50
Power Steering Fluid	VW Hydraulic Oil G-002-000
Weatherstrip	Dielectric Silicone Grease
Final Drive (Differential)	Synthetic Transmission Oil G 50
	SAE 75W-90

(1) - Use low pressure grease gun to prevent seal damage.
(2) - Fill until lubricant squeezes out from the base of seals.
(3) - Fill ball joint until seal starts to swell.

Fluid Capacities

Application	(1) Quantity
Automatic Transmission	3.2 Qts. (3.0L)
Cooling System	18.6 Qts (17.5L)
Engine Oil (2)	
1993-94	
2.5L Gasoline	4.8 Qts. (4.5L)
1995	
2.4L Diesel	6.0 Qts. (5.5L)
2.5L Gasoline	6.0 Qts. (5.5L)

(1) - Capacities are recommended or calculated levels. Always use

³ dipstick (if available) to measure level. ³
³ (2) - Includes filter change. ³

Service Labor Times	
Application	(1)(2)(3) Hours
2.5L 5-Cylinder	
Automatic Transmission	1.6
Manual Transmission	1.8

(1) - Add .2 hr. if equipped with A/C.
(2) - Add .1 hr. if equipped with cruise control.
(3) - Add 2.0 hrs. to replace camshaft timing belt.

108,000 MILE (172,800 KM) SERVICE

108,000 MILE (172,800 KM) SERVICE

³ Service Or Inspect ³
³ ³ Verify Last Major Service Was Performed ³
³ ³ Check Fluid Levels ³
³ ³ Inspect Coolant Hoses and Clamps ³
³ ³ Inspect C/V Joint boots ³
³ ³ Lubricate Chassis ³
³ Replace ³
³ ³ Camshaft Timing Belt ³

Lubrication Specifications	
Application	Specification
Engine Oil	
Ambient Temperatures	
Greater Than 14ø F (-10øC) ...	SAE 20W-40 Or 20W-50 API SG/CD
14ø-50øF (-10ø To +10øC)	SAE 10W-30 Or 10W-40 API SG/CD
Less Than 50øF (10øC)	SAE 5W-30 Or 5W-40 API SG/CD

Fluid Capacities	
Application	(1) Quantity
Engine Oil (2)	
1993-94	

2.5L Gasoline	4.8 Qts. (4.5L)
1995	
2.4L Diesel	6.0 Qts. (5.5L)
2.5L Gasoline	6.0 Qts. (5.5L)

(1) - Capacities are recommended or calculated levels. Always use dipstick (if available) to measure level.
(2) - Includes filter change.

Service Labor Times

Application	(1)(2)(3) Hours
2.5L 5-Cylinder	
Automatic Transmission	1.6
Manual Transmission	1.8

(1) - Add .2 hr. if equipped with A/C.
(2) - Add .1 hr. if equipped with cruise control.
(3) - Add 2.0 hrs. to replace camshaft timing belt.

112,500 MILE (180,000 KM) SERVICE

112,500 MILE (180,000 KM) SERVICE

Service Or Inspect
Verify Last Major Service Was Performed
Check Fluid Levels
Inspect Coolant Hoses and Clamps
Inspect Brake System
Inspect Exhaust System
Inspect C/V Joint boots
Inspect Steering Linkage/Front Suspension
Lubricate Chassis
Replace
Engine Oil
Oil Filter
Lubrication Specifications

Application	Specification
Engine Oil	
Ambient Temperatures	
Greater Than 14ø F (-10øC) ...	SAE 20W-40 Or 20W-50 API SG/CD
14ø-50øF (-10ø To +10øC)	SAE 10W-30 Or 10W-40 API SG/CD
Less Than 50øF (10øC)	SAE 5W-30 Or 5W-40 API SG/CD

Fluid Capacities

Application	(1) Quantity
Engine Oil (2)	
1993-94	
2.5L Gasoline	4.8 Qts. (4.5L)
1995	
2.4L Diesel	6.0 Qts. (5.5L)
2.5L Gasoline	6.0 Qts. (5.5L)

(1) - Capacities are recommended or calculated levels. Always use dipstick (if available) to measure level.
(2) - Includes filter change.

120,000 MILE (192,000 KM) SERVICE

120,000 MILE (192,000 KM) SERVICE

Service Or Inspect
Verify Last Major Service Was Performed
Diagnostic System Read Out
Check Fluid Levels
Check Cooling System Hoses and Clamps
Check Coolant Strength
Inspect For Fluid Leaks
Inspect/Adjust Accessory Drive Belts (Replace if Required)
A/C Cooling & Heating System
Crankcase Ventilation System
Intake Air System
Throttle Linkage

³ ³	Inspect Brake System ³
³ ³	Check Exhaust System & Heat Shielding ³
³ ³	Clean Battery and Battery Terminals ³
³ ³	Inspect Fuel/Tank/Cap/Lines ³
³ ³	Check Operation of Horn, Wipers/Washers & All Exterior Lights ³
³ ³	Inspect Condition of Wiper Blades ³
³ ³	Check Headlight Alignment ³
³ ³	Lubricate Weatherstripping with Silicone ³
³ ³	Door/Hood/Trunk Stops, Hinges & Locks ³
³ ³	Check Body Drain Holes ³
³ ³	Check Seat Belt Webbing and Release Mechanisms ³
³ ³	Windshield Washer System ³
³ ³	Parking Brake Adjustment ³
³ ³	Clutch Adjustment ³
³ ³	Clutch Hydraulic System ³
³ ³	Suspension & Wheel Bearings ³
³ ³	Check Shift Interlock Operation ³
³ ³	Inspect Steering Linkage/Front Suspension ³
³ ³	Lubricate Chassis ³
³ ³	Inspect Brake Pads, Rotors and Calipers ³
³ ³	Inspect Brake System Hoses & Lines ³
³ ³	Inspect Shocks/Struts for Leakage ³
³ ³	Inspect Tire Wear and Condition ³
³ ³	Rotate Tires and Adjust Air Pressure (Including Spare) ³
³	Replace ³
³ ³	Engine Oil ³

- Oil Filter
- Spark Plugs
- Air Filter Element
- Replace (2) Passenger HVAC Air Filters
- Replace Automatic Transmission Fluid and Clean ATF Strainer
- Manual Transmission Fluid
- A/T Differential Oil
- Oxygen Sensor
- Drain, Refill and Bleed Brake System Fluid
- Drain, Flush and Refill Engine Coolant

Lubrication Specifications

Application	Specification
Automatic Transaxle	Dexron-IIE ATF
Brake Fluid	SAE J1703 Or DOT 4 Brake Fluid
Coolant	50/50 Mix Ethylene Glycol/Water
Engine Oil	
Ambient Temperatures	
Greater Than 14ø F (-10øC)	SAE 20W-40 Or 20W-50 API SG/CD
14ø-50øF (-10ø To +10øC)	SAE 10W-30 Or 10W-40 API SG/CD
Less Than 50øF (10øC)	SAE 5W-30 Or 5W-40 API SG/CD
Wheel Bearings	NLGI Grade 2 Category GC-LB
Steering Linkage (1)(2)	NLGI Grade 2 Category GC-LB
Ball Joints (1)(3)	NLGI Grade 2 Category GC-LB
Manual Transaxle	SAE 80W API GL-4 Or SAE 75W-90
	Synthetic Transmission Oil G 50
Power Steering Fluid	VW Hydraulic Oil G-002-000
Weatherstrip	Dielectric Silicone Grease
Final Drive (Differential)	Synthetic Transmission Oil G 50
	SAE 75W-90

(1) - Use low pressure grease gun to prevent seal damage.
(2) - Fill until lubricant squeezes out from the base of seals.
(3) - Fill ball joint until seal starts to swell.

Fluid Capacities

Application	(1) Quantity
Automatic Transmission	3.2 Qts. (3.0L)
Cooling System	18.6 Qts (17.5L)

Engine Oil (2)	
1993-94	
2.5L Gasoline	4.8 Qts. (4.5L)
1995	
2.4L Diesel	6.0 Qts. (5.5L)
2.5L Gasoline	6.0 Qts. (5.5L)

(1) - Capacities are recommended or calculated levels. Always use dipstick (if available) to measure level.
(2) - Includes filter change.

Service Labor Times

Application	(1)(2)(3) Hours
2.5L 5-Cylinder	
Automatic Transmission	4.3
Manual Transmission	3.7

(1) - Add .2 hr. if equipped with A/C.
(2) - Add .1 hr. if equipped with cruise control.
(3) - Add 2.0 hrs. to replace camshaft timing belt.

LUBRICATION SPECIFICATIONS

LUBRICATION SPECIFICATIONS TABLE

Application	Fluid Specifications
Automatic Transaxle	Dexron-IIE ATF
Brake Fluid	SAE J1703 Or DOT 4 Brake Fluid
Coolant	50/50 Mix Water & Ethylene Glycol
Engine Oil	
Ambient Temperatures	
Greater Than 14ø F (-10øC)	SAE 15W-40 Or 20W-50 API SG/CD
14ø-50øF (-10ø To +10øC)	SAE 10W-30 Or 10W-40 API SG/CD
Less Than 50øF (10øC)	SAE 5W-30 Or 5W-40 API SG/CD
Manual Transaxle	SAE 80W API GL-4 Or SAE 75W-90 Synthetic Transmission Oil G 50
Power Steering Fluid	VW Hydraulic Oil G-002-000
Final Drive	
(Differential)	Synthetic Transmission Oil G 50 SAE 75W-90

FLUID CAPACITIES

FLUID CAPACITIES TABLE

Application	Quantity (1)

A/C R-134a Refrigerant
  Front A/C ..... 32-35 Ozs.
  Front & Rear A/C ..... 46-49 Ozs.
Cooling System ..... 18.6 Qts (17.5L)
Engine Oil (2)
  1993-94
    2.5L Gasoline ..... 4.8 Qts. (4.5L)
  1995
    2.4L Diesel ..... 6.0 Qts. (5.5L)
    2.5L Gasoline ..... 6.0 Qts. (5.5L)
Fuel Tank ..... 21.1 Gals. (60L)
Automatic Transmission ..... 3.2 Qts. (3.0L)

(1) - Capacities are recommended or calculated levels. Always use dipstick (if available) to measure level.
(2) - Includes filter change.

END OF ARTICLE

SPECIFICATIONS & ELECTRIC COOLING FANS
Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:36PM

ARTICLE BEGINNING

1993 ENGINE COOLING
Volkswagen Specifications & Electric Cooling Fans

Volkswagen; EuroVan

SPECIFICATIONS

BELT ADJUSTMENT

BELT ADJUSTMENT TABLE

Application	Specification
A/C Compressor	
EuroVan	(1)

(1) - Serpentine belt tension automatically adjusted by tensioner.

COOLING SYSTEM SPECIFICATIONS

COOLING SYSTEM SPECIFICATIONS (1)

Model	Specification
Coolant Replacement Interval	30,000 Miles
EuroVan	12.2 Qts. (11.5L)

(1) - Cooling system includes heater.

ELECTRIC COOLING FAN

NOTE: If detonation is a problem, it is possible that the cooling fan is not coming on at proper temperature and engine is overheating.

EuroVan

The cooling fan is either a 1 or 2-speed motor. If vehicle is equipped with single-speed motor, the fan comes on at 198-207øF (92-97øC) and turns off at 183-196øF (84-91øC). If equipped with a 2-speed motor, low speed of cooling fan should come on at 198-208øF (92-98øC) on vehicles without A/C, or 183-207øF (84-97øC) on vehicles with A/C. Low speed will shut off at 183-196øF (84-91øC) on all vehicles. High speed comes on at 210-226øF (99-108øC) on vehicles without A/C, or 201-226øF (94-108øC) on vehicles with A/C. High speed will shut off at 196-220øF (91-104øC) on all vehicles.

After-Run Thermoswitch

An after-run switch is used to help prevent fuel vaporization. The thermoswitch turns cooling fan on when temperatures in engine compartment exceeds 230øF (110øC), and turns it off at 217øF (103øC).

TROUBLE SHOOTING

NOTE: Trouble shooting information not available from manufacturer.

TESTING

ENGINE COOLANT TEMPERATURE (ECT) SENSOR

EuroVan (2.5L)

1) Ensure engine is cold. Connect Scan Tester (VAG 1551) to Data Link Connectors (DLC) located in fold-down storage shelf in front of relay panel. With scan tester in READ MEASUREMENT BLOCK function, read coolant temperature value in channel No. 1 of scan tester.

2) Temperature value must increase uniformly without interruption. If coolant temperature value does not change, test wiring harness for open or short circuit. See WIRING DIAGRAMS article. If circuit is okay, replace engine coolant temperature sensor. See ECT SENSOR LOCATION table. After repairs, erase DTC memory (if applicable) and select END DATA TRANSFER function.

ECT SENSOR RESISTANCE TABLE

Temperature øF (øC)	Ohms
68 (20)	3000-2000
86 (30)	2000-1500
104 (40)	1500-1000
122 (50)	1000-800
140 (60)	700-500
158 (70)	500-375
176 (80)	375-275
194 (90)	275-225

ECT SENSOR LOCATION TABLE

Model	Location
EuroVan	Below Spark Plug No. 1

SERPENTINE DRIVE BELT ROUTING

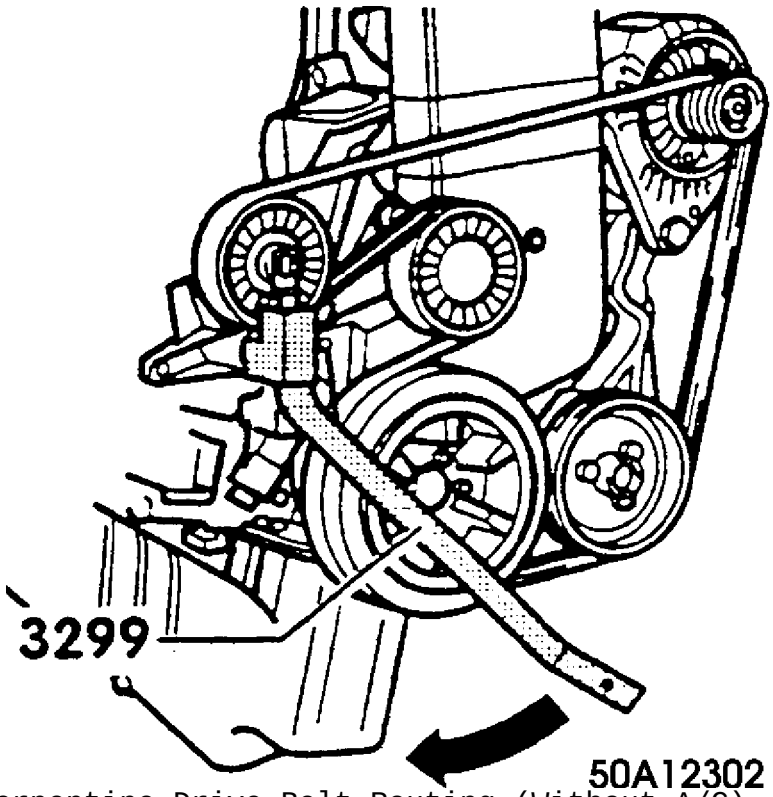

Fig. 1: Serpentine Drive Belt Routing (Without A/C)

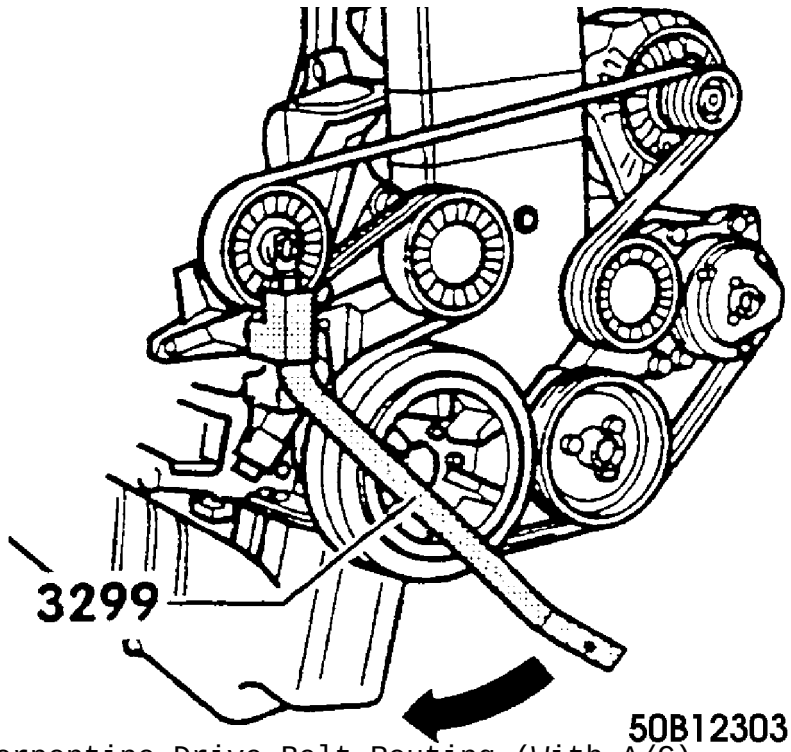

Fig. 2: Serpentine Drive Belt Routing (With A/C)

END OF ARTICLE

STARTER
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:37PM

ARTICLE BEGINNING

1993 ELECTRICAL
Volkswagen Starters - Bosch

Volkswagen; Cabriolet, EuroVan, Golf, GTI, Jetta

DESCRIPTION

Starter is a brush type, series-wound electric motor with an overrunning clutch. Field frame is enclosed by commutator end frame and drive bushing, and carries pole shoes and field coils. A splined armature shaft drive end carries drive assembly.

TROUBLE SHOOTING

NOTE: See TROUBLE SHOOTING - BASIC PROCEDURES article in GENERAL INFORMATION.

ON-VEHICLE TESTING

STARTER DOES NOT CRANK ENGINE

1) Ensure battery is fully charged. Make sure electrical and ground connections are clean and tight. With ignition switch in START position, measure voltage at spade terminal of starter solenoid. Reading should be at least 8 volts. If voltage is as specified, check engine for mechanical problems. If voltage is not as specified, go to next step.
2) Measure voltage at ignition switch. If reading is at least 8 volts, check wiring between ignition switch and starter solenoid. If voltage is not as specified, replace ignition switch.
3) Measure voltage at field (starter) terminal of starter solenoid. If reading is 8 volts or more, repair or replace starter. If reading is less than 8 volts, replace starter solenoid.

NOTE: On vehicles with automatic transmission, also check park/neutral switch.

STARTER CRANKS TOO SLOWLY

Ensure engine crankcase is filled with recommended viscosity oil. Check charging system to ensure battery is fully charged. Make sure electrical and ground connections are clean and tight. If starter still turns slowly, repair or replace starter.

VOLTAGE DROP TEST

Starter Main Terminal
Connect a voltmeter between starter main terminal and starter body. Disconnect ignition coil positive terminal and operate starter.

Voltage reading should not be more than one volt less than battery voltage. If a larger voltage drop is indicated, circuit between battery and starter terminal may be defective.

Main Starter Case

Connect a voltmeter between positive battery terminal and starter motor "M" terminal. With ignition off, operate starter for 2-3 seconds. Battery voltage should be present, then drop to less than one volt. If voltage is greater than specification, high resistance may be present in circuit. Go to ACROSS SOLENOID SWITCH test.

Across Solenoid Switch

Connect a voltmeter between 2 starter solenoid terminal stud connections. With ignition disconnected, operate starter for 2-3 seconds and note meter reading. Initially, battery voltage should be present, then voltage should drop to less than .5 volt. If voltage is not as specified, check for damaged switch or loose or dirty connections. If high resistance is present, terminal may be loose or corroded.

Ground Return Line

Connect a voltmeter between battery ground terminal and starter main housing. With ignition off, operate starter for 2-3 seconds. If ground is okay, voltage reading should be less than .5 volt. If reading is .6 volt or more, high resistance is present in ground return side of circuit.

BENCH TESTING

STARTER SOLENOID

1) Remove bridge strap connecting solenoid to motor. Check windings by connecting a 12-volt self-powered test light between solenoid main terminal STA and solenoid body. If light illuminates, both windings are satisfactory.

2) Ensure that contacts open and close satisfactorily by connecting a 12-volt self-powered test light between starter solenoid main terminals. Test light should not illuminate.

NOTE: Step 3) uses a non-powered (standard) test light.

3) Connect a test light to STARTER terminal of solenoid and ground. Apply voltage to STA and BAT terminals of solenoid. Solenoid should be heard to operate as contacts close and test light should illuminate. When voltage is removed from STA terminal of solenoid, test light should go out.

STARTER LOAD (LOCK) TEST

With starter on test bench, lock starter drive pinion. Voltmeter should read 4.5 volts and ammeter should read 700-800 amps.

STARTER NO-LOAD TEST

With starter on test bench, operate starter and check ammeter, voltage, and RPM. Readings should be within specification. See STARTER NO-LOAD TEST SPECIFICATIONS table.

STARTER NO-LOAD TEST SPECIFICATIONS TABLE

Volts	Amps	RPM
11.5	65-95	6500

REMOVAL & INSTALLATION

CABRIOLET, EUROVAN, GOLF, GTI & JETTA

Removal & Installation

Disconnect negative battery cable. Raise and support vehicle. Disconnect wiring and remove starter. To install, reverse removal procedure. Tighten starter mounting bolts/nuts to specification. See TORQUE SPECIFICATIONS table at end of article.

OVERHAUL

For overhaul, see exploded view of typical Bosch starter. See Fig. 1.

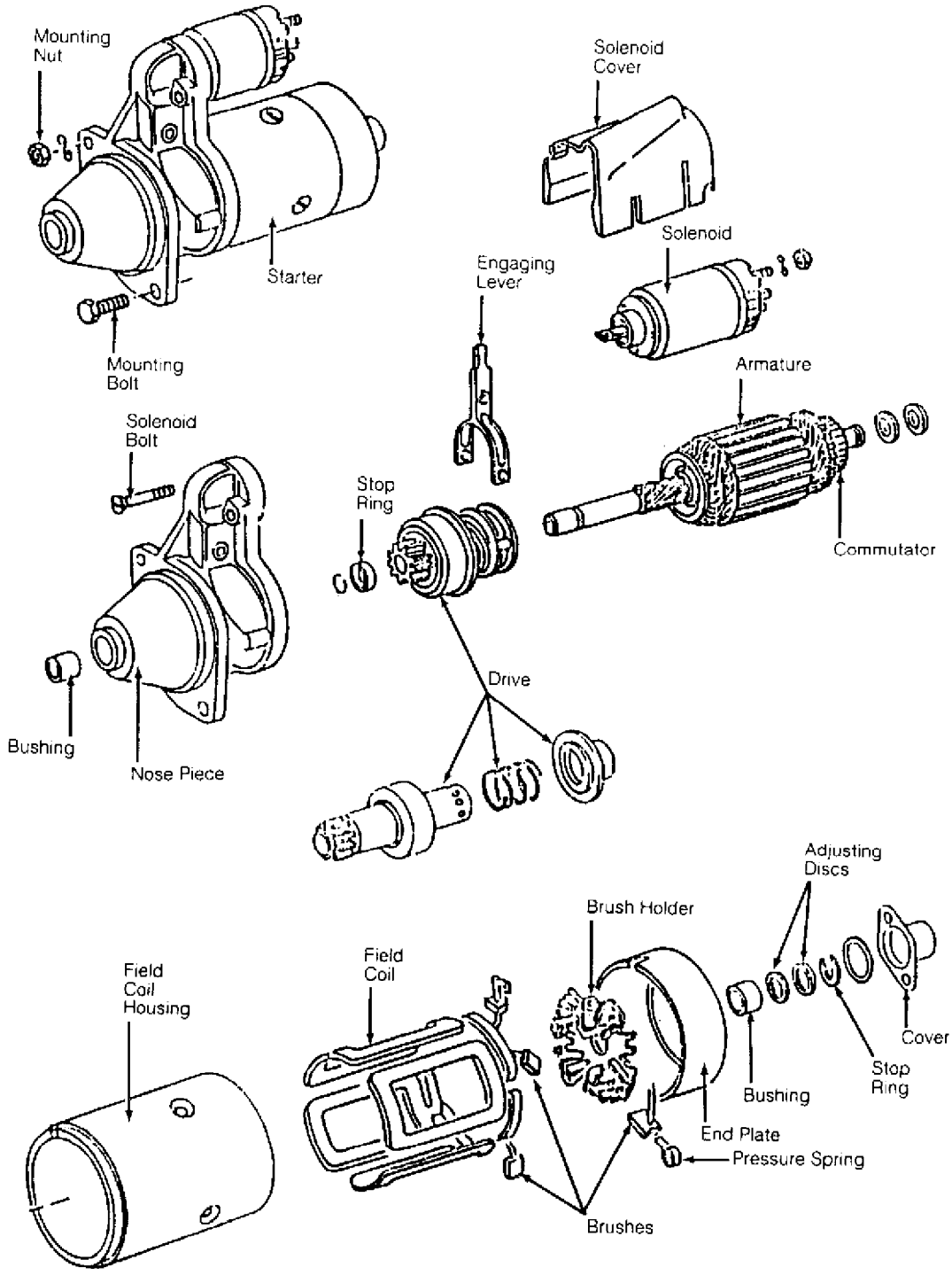

Fig. 1: Exploded View of Bosch Starter (Typical)
Courtesy of Volkswagen United States, Inc.

STARTER SPECIFICATIONS

STARTER
Article Text (p. 5)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:37PM

STARTER SPECIFICATIONS TABLE

Application	Specification
Armature	
Runout	.002" (.05 mm)
End Play	.002" (.05 mm)
Cold Cranking	
Test Voltage	12
Minimum Voltage	9
Amps	90
Minimum RPM	1500
Solenoid Hold-In Winding Voltage	4 Volts Minimum
Solenoid Pull-In Winding Voltage	7 Volts
Commutator Runout	.0004" (.01 mm)
Cranking Voltage	9 Volts Minimum
Starter Current Draw	170 Amps Maximum

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS TABLE

Application	Ft. Lbs. (N.m)
Starter-To-Block Bolt/Nut	
Cabriolet, Golf, GTI & Jetta	
A/T	14 (19)
M/T	43 (58)
EuroVan	15 (20)
	INCH Lbs. (N.m)
Solenoid Bolts	96 (11)
Through Bolts	54 (6)

END OF ARTICLE

STEERING COLUMN
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:37PM

ARTICLE BEGINNING

1993 STEERING
Volkswagen - Steering Columns

EuroVan

DESCRIPTION

Swing-away steering column is held by a clamp and leaf spring. On impact, the "U" joint shaft pushes steering column against the leaf spring. The spring allows the column to disengage and swing away.

REMOVAL & INSTALLATION

STEERING WHEEL & HORN PAD

Removal & Installation
1) Disconnect negative battery cable. Pry center cover from steering wheel.
2) Disconnect horn wiring. Ensure steering wheel is in straight-ahead position. Mark shaft and wheel for reassembly reference. Remove retaining nut and washer. Pull steering wheel from shaft. To install, reverse removal procedure.

TURN SIGNAL SWITCH

Removal & Installation
Remove steering wheel. See STEERING WHEEL & HORN PAD. Unplug harness connector. Remove turn signal switch. To install, reverse removal procedure.

WINDSHIELD WIPER SWITCH

Removal & Installation
Remove steering wheel. See STEERING WHEEL & HORN PAD. Remove turn signal switch. See TURN SIGNAL SWITCH. Unplug harness connector. Remove windshield wiper switch. To install, reverse removal procedure.

IGNITION SWITCH

Removal
1) Remove steering wheel. See STEERING WHEEL & HORN PAD. Remove lower cover from steering column.
2) Remove turn signal and windshield wiper switches. See TURN SIGNAL SWITCH and WINDSHIELD WIPER SWITCH. Remove lock washer, spring and horn contact ring. Remove bolt retaining steering column tube to steering column housing.
3) Disconnect wiring from ignition switch. Unlock steering with ignition key. Remove steering column housing, ignition lock and

upper half of steering column switch cover. Remove retaining screw and ignition switch.

Installation
To install ignition switch, reverse removal procedure.

STEERING COLUMN

NOTE: Refer to illustration for exploded view of steering column. See Fig. 1.

Removal
1) Disconnect negative battery cable. Remove steering wheel. Remove bolt and screw from switch housing recess. Tilt switch unit toward instrument panel. Pry spacer sleeve from column.
2) Pull up combination switch to disconnect wires. Remove combination switch. Disconnect steering shaft from "U" joint shaft. Disconnect brake pedal push rod.
3) Disconnect clutch cable from clutch pedal. Using a screwdriver, push down leaf spring retainer clip to disengage it from mounting slot.
4) Remove bolts that retain steering column under instrument panel. Drill out shear bolts. Remove column assembly from vehicle.

Installation
To install, reverse removal procedure. Place wheels in straight-ahead position. Tighten pinch bolt. Install spacer. See Fig. 1. Install combination switch and steering wheel. Adjust brake pedal and clutch pedal height.

OVERHAUL

STEERING COLUMN

NOTE: Refer to illustration for exploded view of steering column. See Fig. 1.

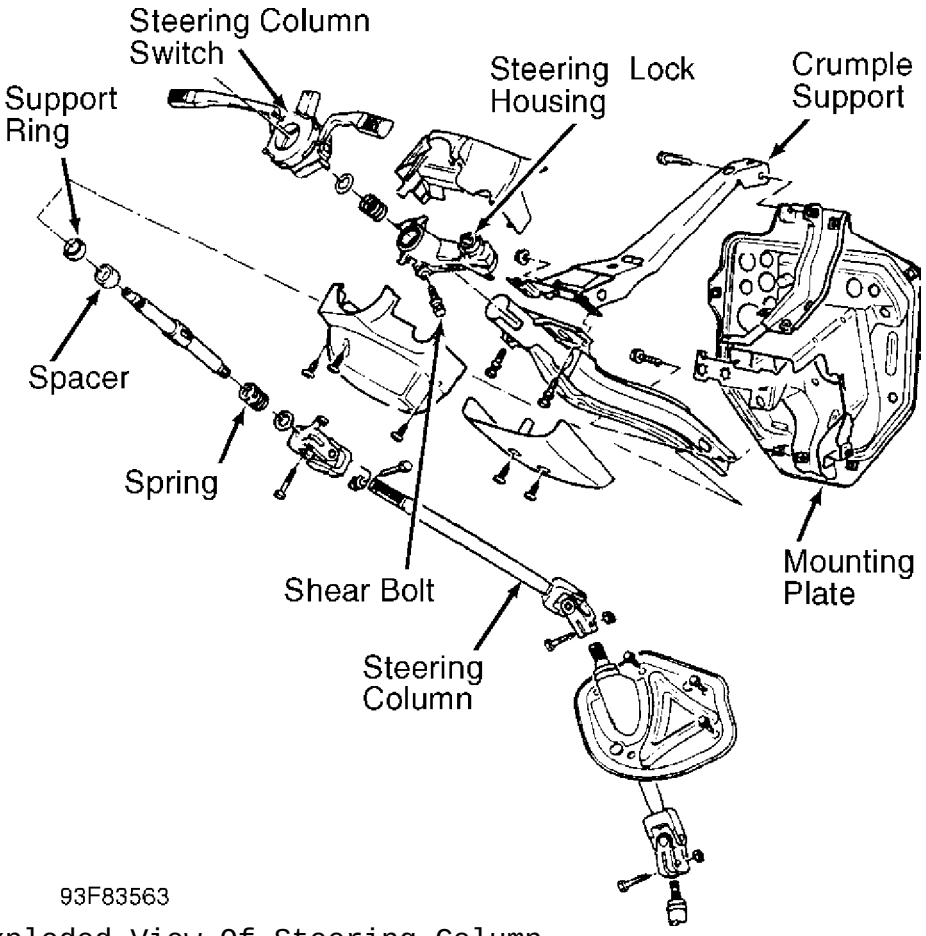

Fig. 1: Exploded View Of Steering Column
Courtesy of Volkswagen United States, Inc.

Disassembly
Press steering shaft from column. Remove bearings from steering column.

Inspection
Check upper bracket for damage and upper bearing for smooth rotation. Check shafts for signs of bending, damaged splines, or damaged "U" joints. Check column tube for bending or other damage. Repair or replace components as necessary.

Reassembly
Press in steering shaft and new bearings. DO NOT use more than 200 lbs. (90 kg) force to press shaft and bearings into column tube.

"U" JOINT SHAFT

Disassembly
1) Remove pinch bolt that connects lower end of "U" joint shaft to steering gear pinion shaft. Separate manual gearshift linkage from steering box. Remove steering gear retaining nuts.

2) Pull box down to separate from lower "U" joint. Remove rubber boot from lower "U" joint. Remove upper "U" joint pinch bolt. Pull down joint and remove shaft with "U" joints.

Inspection

Inspect "U" joints for wear or excessive play. If abnormal wear or play exists, replace as necessary.

Reassembly

1) Fit "U" joint to steering shaft. Align steering shaft notch with lower "U" joint slot. Install boot and damping grommet. Fit steering box to frame while guiding pinion shaft into lower "U" joint.

2) Hand-tighten steering gear retaining nuts. Place wheels in straight-ahead position. Align pinion shaft and "U" joint. Tighten pinch bolt. Tighten steering gear retaining nuts. Connect gearshift linkage. Check linkage for smooth operation.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS TABLE

Application	Ft. Lbs. (N.m)
Pinch Bolt	22 (30)
Steering Column-To-Instrument Panel	
Retaining Bolt	15 (20)
Shear Bolt	(1)
Steering Gear Retaining Nut	22 (30)
Steering Wheel Nut	30 (40)
	INCH Lbs. (N.m)
Air Bag Unit-To-Steering Wheel Screws	89 (10)

(1) - Tighten until bolt head snaps off.

END OF ARTICLE

STEERING COLUMN SWITCHES
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:37PM

ARTICLE BEGINNING

1993 ACCESSORIES & EQUIPMENT
Volkswagen Steering Column Switches

Cabriolet, Corrado SLC, EuroVan, Fox, Golf, GTI, Jetta, Passat

*** PLEASE READ THIS FIRST ***

CAUTION: Cabriolet is equipped with Supplemental Restraint System (SRS). SRS wiring harness is routed close to instrument cluster, steering wheel, and related components. Before working on steering column components, disable air bag system. See AIR BAG RESTRAINT SYSTEM article in the ACCESSORIES/SAFETY EQUIPMENT section.

WARNING: Wait about 20 minutes after disabling air bag system. Back-up power circuit, capacitor internal to SRS unit, maintains system voltage for up to 20 minutes after battery is disconnected. Servicing air bag system before 20 minutes may cause accidental air bag deployment and possible personal injury.

REMOVAL & INSTALLATION

COMBINATION SWITCH

Removal

Remove steering wheel. Remove upper and lower steering column covers. Disconnect combination switch harness connectors. Remove snap ring and washer from steering shaft (if equipped). Remove combination switch attaching screws. Remove combination switch.

Installation

To install, reverse removal procedure. Ensure all electrical connections are tight. Check canceling operation of turn signal switch.

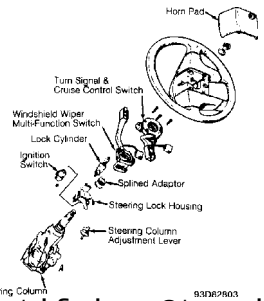

Fig. 1: Identifying Steering Wheel Components (Corrado SLC)
Courtesy of Volkswagen United States, Inc.

STEERING COLUMN SWITCHES
Article Text (p. 2)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:37PM

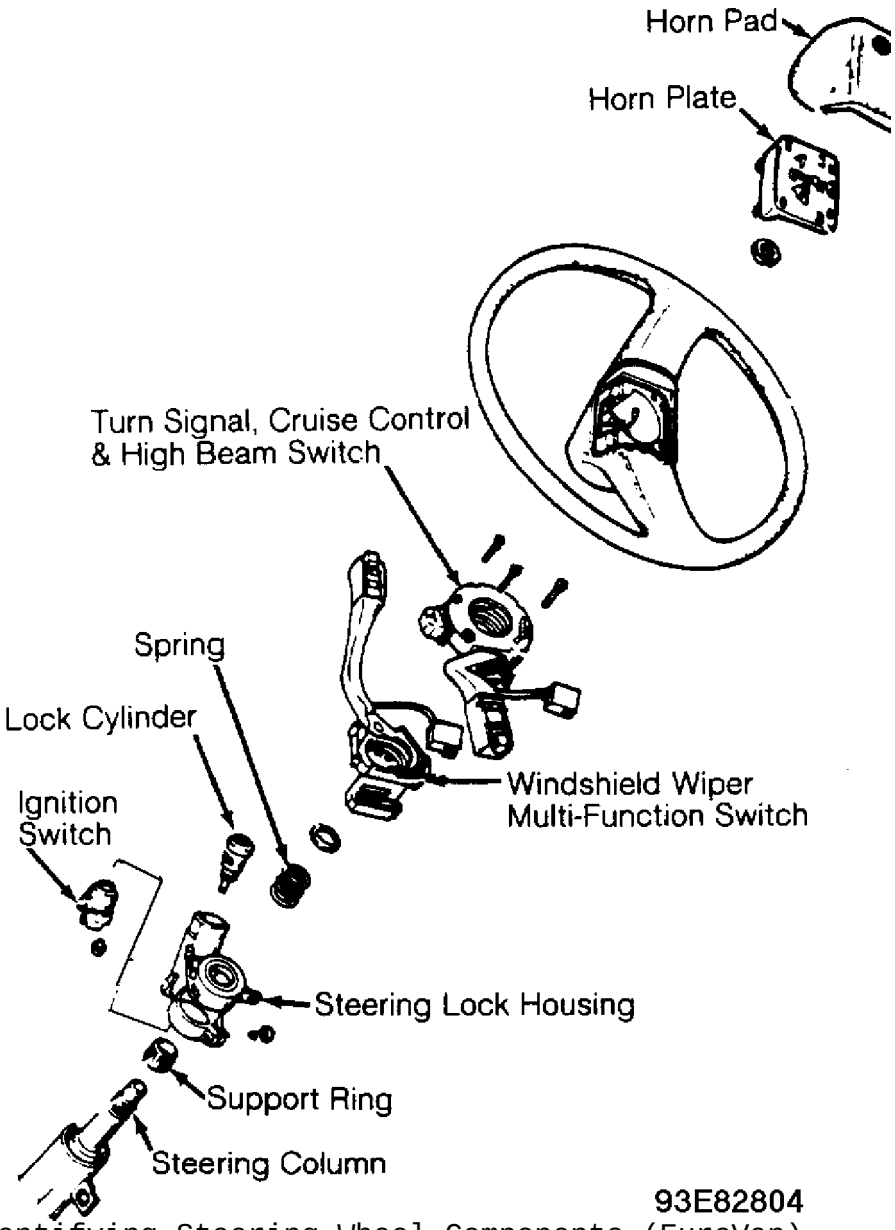

Fig. 2: Identifying Steering Wheel Components (EuroVan)
Courtesy of Volkswagen United States, Inc.

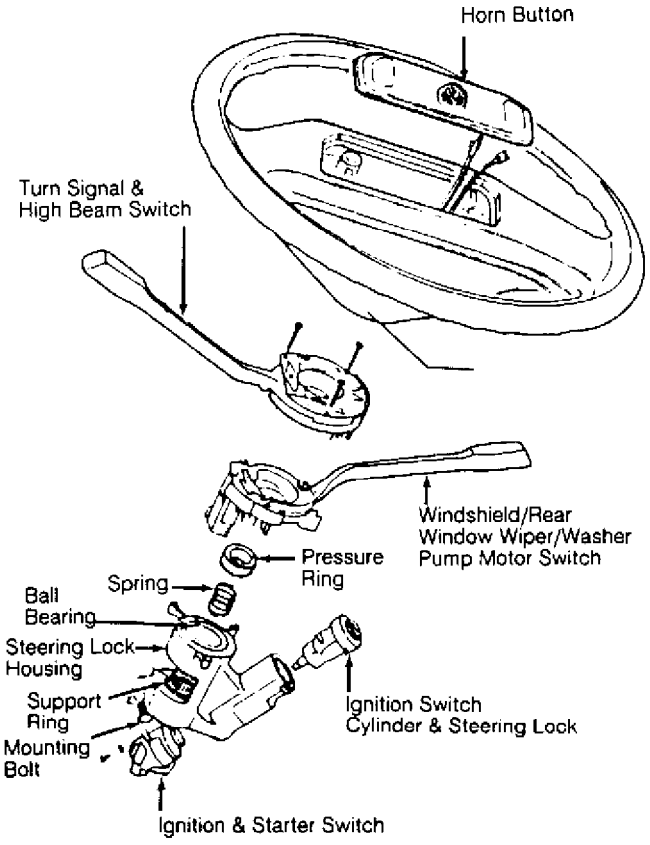

Fig. 3: Identifying Steering Wheel Components (Fox)
Courtesy of Volkswagen United States, Inc.

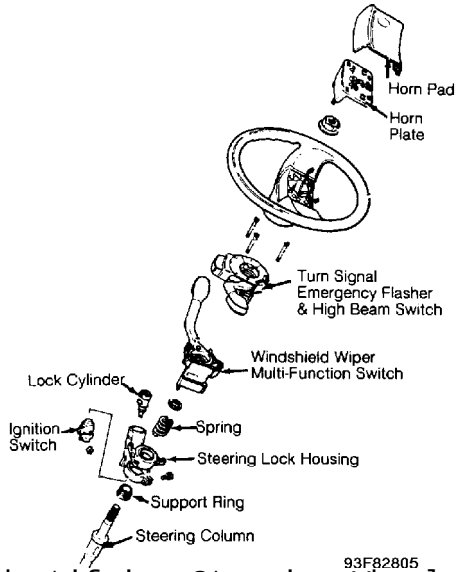

Fig. 4: Identifying Steering Wheel Components
(Golf, GTI & Jetta)
Courtesy of Volkswagen United States, Inc.

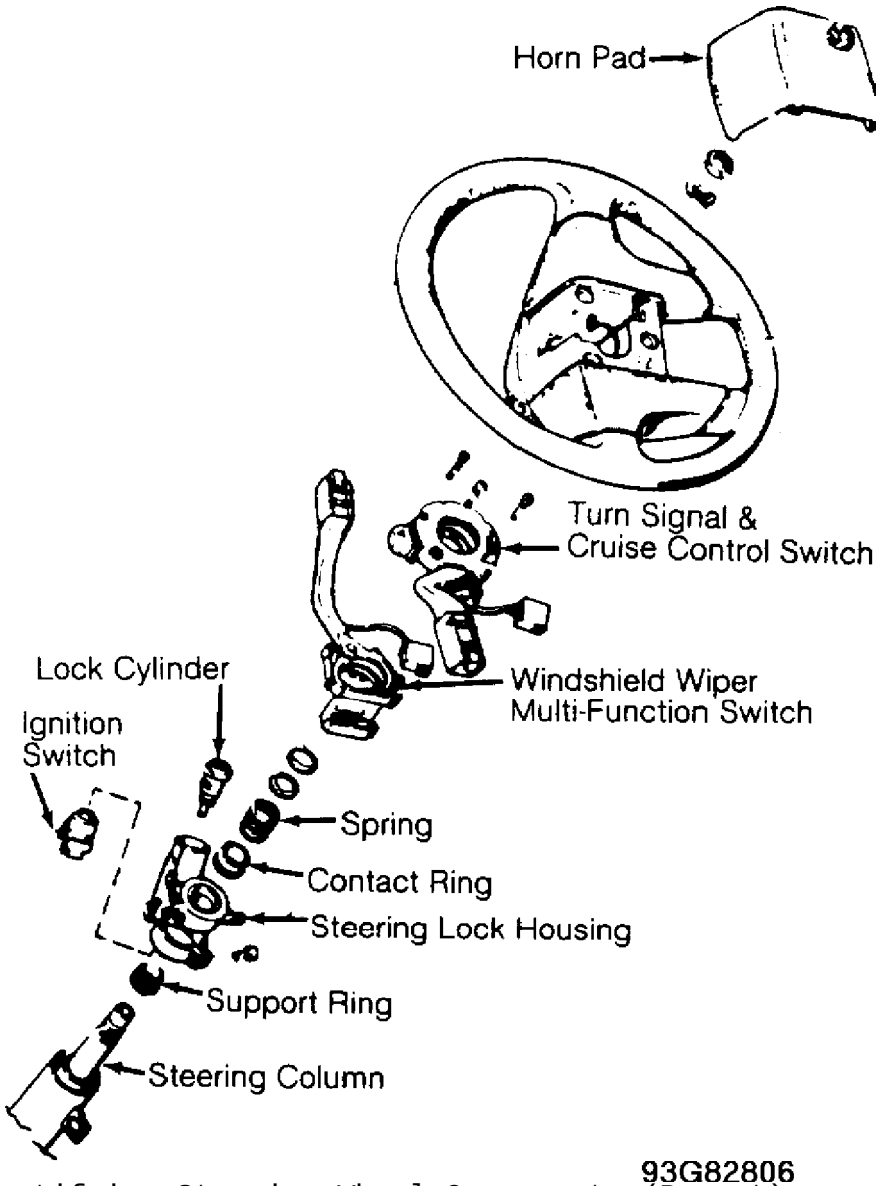

Fig. 5: Identifying Steering Wheel Components (Passat)
Courtesy of Volkswagen United States, Inc.

LOCK CYLINDER

Removal

1) Remove steering wheel. Remove combination switch and upper and lower steering wheel covers. Mark steering lock housing at intersection of "A" and "B" for hole. See Fig. 6. "A"=12 mm; "B"=10 mm.

2) Drill 3 mm hole into steering lock housing at mark until lock cylinder stop spring is visible. Hole depth will be approximately 3 mm. Compress stop spring with punch and pull lock cylinder out.

Installation

1) Insert lock cylinder into steering lock housing. Insert key into lock cylinder. Push lock cylinder fully into housing while gently turning key.

2) Install combination switch and upper and lower steering column covers. Install steering wheel and nut. Tighten steering wheel nut to specification. See TORQUE SPECIFICATIONS table.

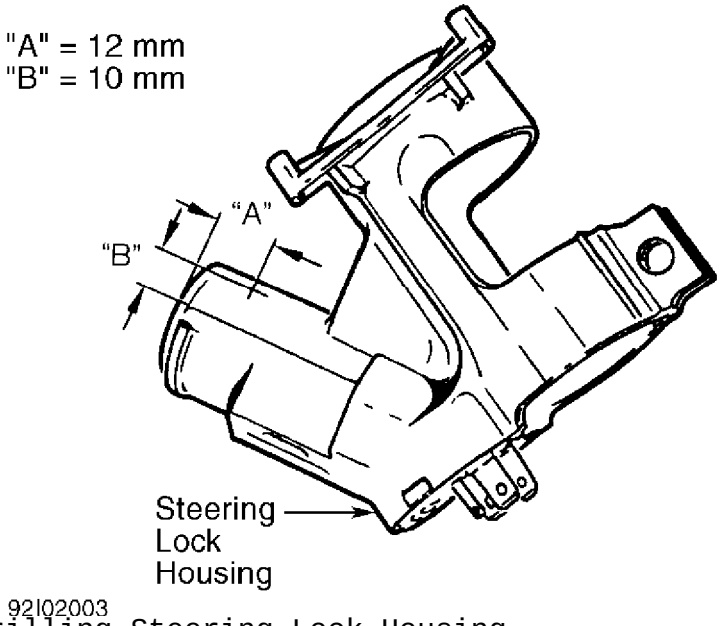

Fig. 6: Drilling Steering Lock Housing
Courtesy of Volkswagen United States, Inc.

SPIRAL SPRING

Removal (Cabriolet)

Before proceeding, follow air bag service precautions. See SERVICE PRECAUTIONS in AIR BAG RESTRAINT SYSTEM article in the ACCESSORIES/SAFETY EQUIPMENT section. Remove steering wheel. See STEERING WHEEL. Remove knee bar panel and steering column lower trim. Disconnect 2-pin wiring connector (Green/Black and Green/Red wires) at base of steering column. Remove 3 spiral spring retaining screws, and remove spiral spring. See Fig. 7.

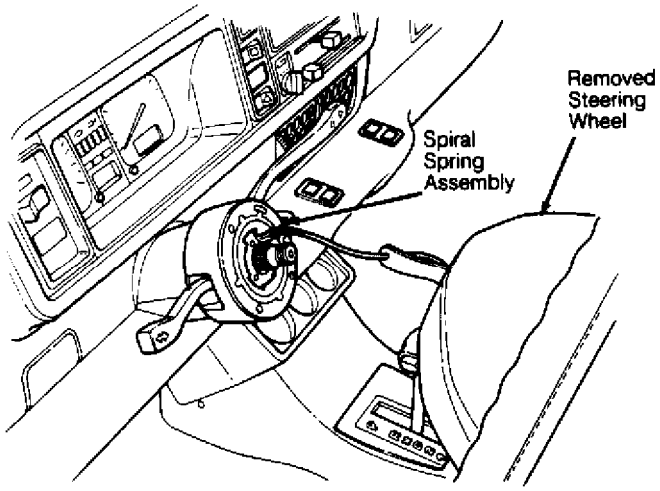

Fig. 7: Removing Spiral Spring Assembly
Courtesy of Volkswagen United States, Inc.

Installation

1) To install spiral spring assembly, reverse removal procedure. NEW spiral spring assemblies have a locking tab which locks assembly in its centered position. Locking tab must be removed before installing new spring assembly.

2) If a spiral spring assembly is reinstalled, it must be centered. To center, turn spring assembly 4 turns from stop, in either direction.

3) Reactivate air bag system. See DISABLING & ACTIVATING AIR BAG SYSTEM. Check air bag indicator lights to ensure system is functioning properly. See SYSTEM OPERATION CHECK.

STEERING WHEEL

Removal (Cabriolet)

1) Before proceeding, follow air bag service precautions. See SERVICE PRECAUTIONS in AIR BAG RESTRAINT SYSTEM article in the ACCESSORIES/SAFETY EQUIPMENT section. Disable air bag system. See DISABLING & ACTIVATING AIR BAG SYSTEM in AIR BAG RESTRAINT SYSTEM article in the ACCESSORIES/SAFETY EQUIPMENT section.

2) Turn front wheels to straight-ahead position. Remove air bag unit. See AIR BAG UNIT in AIR BAG RESTRAINT SYSTEM article in the ACCESSORIES/SAFETY EQUIPMENT section. Remove steering wheel nut and spring washer. Mark steering wheel and shaft for reassembly reference. Remove steering wheel.

Installation

To install, reverse removal procedure. Tighten steering wheel nut to specification. See TORQUE SPECIFICATIONS table. Check air bag indicator lights to ensure system is functioning properly.

STEERING WHEEL & HORN PAD

Removal (Except Cabriolet)

1) Disconnect negative battery cable. Remove screws attaching horn button assembly/center pad to steering wheel from behind steering wheel (if equipped).

2) Pull horn button assembly/center pad from steering wheel. Use a cloth covered screwdriver to pry off horn button assembly/center pad (if necessary). Disassemble horn button assembly (if necessary).

3) Place springs, contacts, horn or cruise control harness connectors and screws in order for reassembly reference. Place wheels in straight-ahead position.

4) Remove steering wheel retaining nut and washer. Mark steering wheel and shaft for reassembly reference. Using a steering wheel puller, remove steering wheel. See Fig. 8.

5) Place steering wheel, cruise control set/resume switch (if equipped), canceling cams, springs and slip rings in order for reassembly reference.

Installation

1) Coat slip ring contact surfaces with a light electrical grease. Assemble horn button assembly (if disassembled). Ensure wheels are in a straight-ahead position.

2) Aligning marks made during removal, place slip ring, springs, canceling cams, steering wheel, washer and steering wheel retaining nut on shaft.

3) Tighten steering wheel nut to specification. See TORQUE SPECIFICATIONS table. To complete installation, reverse removal procedure.

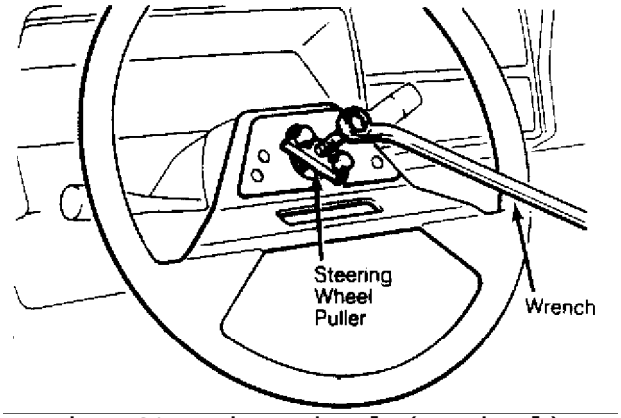

Fig. 8: Removing Steering Wheel (Typical)
Courtesy of Volkswagen United States, Inc.

STEERING LOCK & IGNITION SWITCH

Removal

1) Remove steering wheel, upper and lower steering column covers and combination switch. Disconnect ignition switch harness connectors.

2) Remove clamping washers, spring and contact ring from steering column. Remove steering lock housing mounting bolt. Remove steering lock housing from steering column.

Installation

1) To install, reverse removal procedure. Slide steering lock housing onto steering column. Install contact ring, spring and clamping washers onto steering column. Ensure proper operation of steering lock and ignition switch.

NOTE: On Corrado SLC, pull steering column upward from steering column tube as far as possible to ensure proper column position.

2) Install combination switch, upper and lower steering column covers and steering wheel. Tighten steering wheel nut to specification. See TORQUE SPECIFICATIONS table.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS TABLE

Application	Ft. Lbs. (N.m)
Steering Wheel Nut	30 (40)
	INCH Lbs. (N.m)
Air Bag Unit-To-Steering Wheel Screws	89 (10)

END OF ARTICLE

STEERING GEAR - POWER RACK & PINION
Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:37PM

ARTICLE BEGINNING

1993 STEERING
Volkswagen - Power Rack & Pinion

EuroVan

DESCRIPTION & OPERATION

System consists of a vane pump, rack and pinion steering gear, and an oil reservoir. Vane pump draws fluid from reservoir and supplies it to flow control valve. Control valve directs fluid to appropriate side of rack piston.

LUBRICATION

CAPACITY

Fluid capacity is approximately 1 qt. (.95L).

FLUID TYPE

Recommended fluid type is VW Hydraulic Oil No. G 002 000.

FLUID LEVEL CHECK

Remove reservoir cover. Start engine and let idle. Fluid level should be between MIN and MAX marks on reservoir.

HYDRAULIC SYSTEM BLEEDING

1) Start engine and let idle. Ensure fluid is at proper level. Turn steering wheel from lock to lock several times quickly.
2) Continue until fluid level remains at reservoir mark. Ensure no bubbles appear in reservoir when steering wheel is turned. Shut off engine. Ensure oil level does not rise more than 3/8" (10 mm).

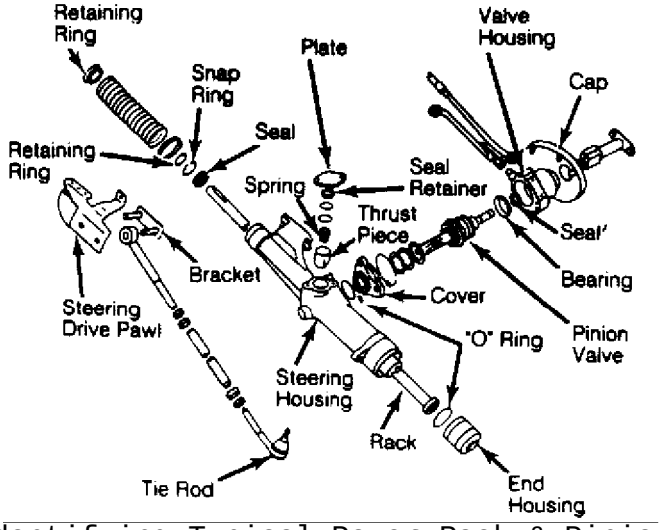

Fig. 1: Identifying Typical Power Rack & Pinion Components
Courtesy of Volkswagen United States, Inc.

ADJUSTMENTS

POWER STEERING PUMP BELT

Loosen nuts on pump mounting bracket. Turn adjuster bolt until belt deflection is 3/8" (10 mm) at center of belt. Tighten nuts to specification.

TESTING

HYDRAULIC SYSTEM INSPECTION

Ensure fluid level is okay. Check service belt condition and adjustment. Ensure hoses are not kinked or leaking.

PUMP PRESSURE TEST

Install Pressure Gauge (US 1074 B) between pressure hose and pressure line of valve housing. Start engine and let idle. Close valve. Leave valve closed for no longer than 5 seconds. Pressure should be within specification. See POWER STEERING SYSTEM PRESSURE table. If pump pressure is not within specification, replace pump.

POWER STEERING SYSTEM PRESSURE TABLE

Model	Pressure psi (bar)
EuroVan	1233-1378 (85-95)

STEERING GEAR INSPECTION

Remove rack and pinion assembly. See POWER RACK & PINION under REMOVAL & INSTALLATION. Loosen lock nut. Turn adjuster bolt until pinion shaft can be turned by hand without binding. Hold adjuster bolt in position while tightening lock nut.

REMOVAL & INSTALLATION

POWER STEERING PUMP

Removal

Remove alternator and pump belts. Disconnect hydraulic lines from pump. Cap lines to prevent contamination. Remove bracket bolts. Remove pump. See Fig. 2.

Installation

To install, reverse removal procedure. Adjust belt tension. See POWER STEERING PUMP BELT under ADJUSTMENTS. Tighten nuts and bolts to specification. See TORQUE SPECIFICATIONS table at end of article. Fill and bleed hydraulic system. See HYDRAULIC SYSTEM BLEEDING. Start engine and check for leaks.

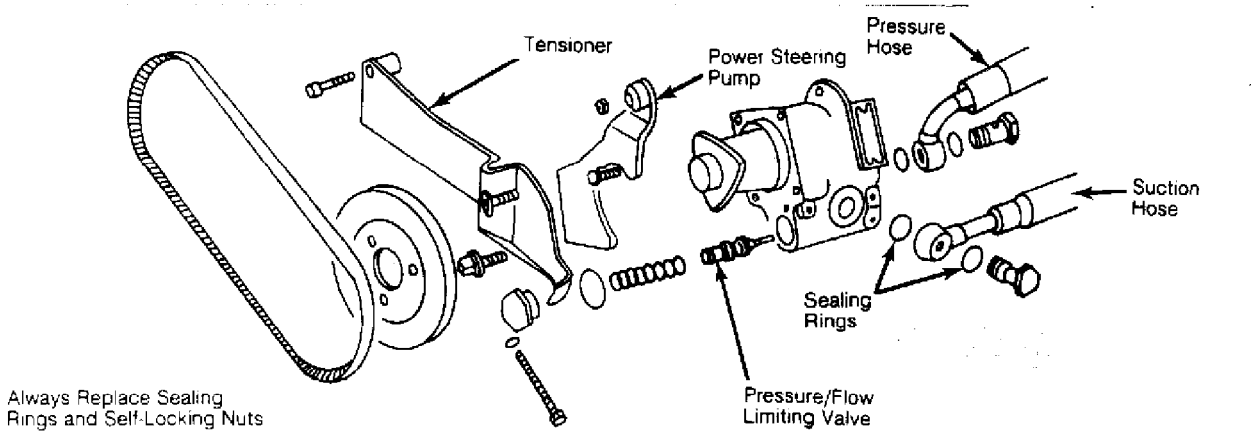

Fig. 2: Identifying Typical Power Steering Pump Components
Courtesy of Volkswagen United States, Inc.

POWER RACK & PINION

NOTE: Refer to illustration for exploded view of power rack and pinion components. See Fig. 1.

Removal

1) Remove lower insulation pan. Remove front exhaust pipe. Remove heat shield located above power steering gear (if equipped). Remove hoses from pump. Drain fluid from pump and hoses.

2) Disconnect tie rod ends from steering knuckles. Remove stabilizer clamps from subframe. Push stabilizer upward. Move rack toward right side to disengage pinion from "U" joint. Move rack left and then toward the rear of vehicle to remove.

Installation

To install, reverse removal procedure. Tighten nuts and bolts to specification. See TORQUE SPECIFICATIONS table at end of article. Fill and bleed hydraulic system. See HYDRAULIC SYSTEM BLEEDING. Check wheel alignment. See WHEEL ALIGNMENT SPECIFICATIONS & PROCEDURES article in the WHEEL ALIGNMENT section.

OVERHAUL

Manufacturer recommends that power steering pump and steering gear be replaced, rather than be repaired.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS TABLE

Application	Ft. Lbs. (N.m)
End Housing Bolt	37 (50)
Power Steering Pump Bolt	18 (25)
Pressure-Flow Limiting Valve Cap	42 (57)
Pressure Line Fitting	29 (39)
Return Line Fitting	
On Pump	29 (39)
On Valve Housing	22 (30)
Steering Gear Retaining Bolt	24 (33)
Subframe Bolt	
Long	96 (130)
Short	59 (80)
Tie Rod Lock Nut	42 (55)
Tie Rod-To-Steering Arm	32 (44)
Valve Housing Bolt	15 (20)

END OF ARTICLE

STEERING LOSS: NEW U-JT. UPPER LOCKING BOLT

Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:37PM

ARTICLE BEGINNING

NHTSA RECALL BULLETIN

Model(s):	1993 Volkswagen EuroVan
Campaign No:	94V058000
Number of Affected Vehicles:	8350
Beginning Date of Manufacture:	1992 JUL
Ending Date of Manufacture:	1993 JAN

VEHICLE DESCRIPTION:

Passenger vans equipped with impact collapsible steering wheel.

DESCRIPTION OF DEFECT:

These steering wheels and include a universal joint which is attached to steering shafts and secured by locking bolts. The universal joint's upper locking bolt was not sufficiently torqued during manufacture, and can eventually loosen.

FAULT:

Assembly, Improperly installed, Location, Preparation

SYSTEM:

Steering; wheel and column.

CONSEQUENCE OF DEFECT:

If the upper locking bolt holding the steering assembly's universal joint loosens, it can render the steering system inoperative and cause an accident.

CORRECTIVE ACTION:

Dealers will remove the present universal upper locking bolt, install a new one, and torque it to specifications.

NOTE:

If your vehicle is presented to an authorized dealer on an agreed upon service date and the remedy is not provided within a reasonable time and free of charge, or the remedy does not correct the defect or noncompliance, please contact Volkswagen at 1-800-822-8987. Also, contact the National Highway Traffic Safety Administration's auto safety hotline at 1-800-424-9393.

ADDITIONAL INFORMATION:

The National Highway Traffic Safety Administration operates Monday

through Friday from 8:00 AM to 4:00 PM, Eastern Time. For more information call (800) 424-9393 or (202) 366-0123. For the hearing impaired, call (800) 424-9153.

END OF ARTICLE

SUN ROOF - POWER
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:37PM

ARTICLE BEGINNING

1993 ACCESSORIES & EQUIPMENT
Volkswagen Power Sun Roof

Volkswagen; Corrado SLC, EuroVan, Golf, GTI, Jetta, Passat

DESCRIPTION & OPERATION

The power sun roof operates at all times when the ignition is in the on position. Power sun roof will operate after the ignition is turned off until driver's door is opened. Power sun roof can also be closed by inserting key in door lock and holding in the locked position. If power system fails, sun roof can be operated manually by removing control panel and rotating crank.

ADJUSTMENTS

NOTE: Adjustment information for EuroVan is not available.

PARALLEL ALIGNMENT

Corrado SLC, Golf, GTI, Jetta & Passat

1) Obtain radio code. Disconnect negative battery cable. Using Headliner Trim Remover (3195), disengage headliner trim frame from guide rails and push toward rear as far as possible. See Fig. 5 or 7.

2) Pry off interior light. Remove sun roof cable drive cover. Remove cable drive mounting screws. Lower pinion drive until drive pinion no longer meshes with cables.

3) Move rear guides with cables to rear. Ensure pivots position is correct. See Fig. 1. Engage locking levers into guide rails. Drive cable should be in the closed position.

4) Clean cable drive mounting screws and coat threads with locking compound. Install cable guide and interior light. Install headliner trim frame onto guides. Reconnect negative battery cable.

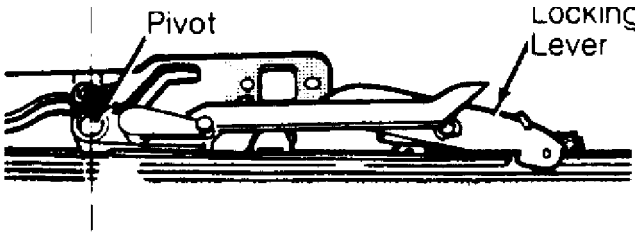

Fig. 1: Aligning Guide Rail Pivot Position
(Corrado SLC, Golf, GTI, Jetta & Passat)
Courtesy of Volkswagen United States, Inc.

SUN ROOF HEIGHT ADJUSTMENT

Corrado SLC, Golf, GTI, Jetta & Passat
Loosen adjustment screws. Adjust height by positioning sun roof panel at .01" (1 mm). See Fig. 2. Tighten adjustment screws to 48 Inch lbs (4.5 Nm).

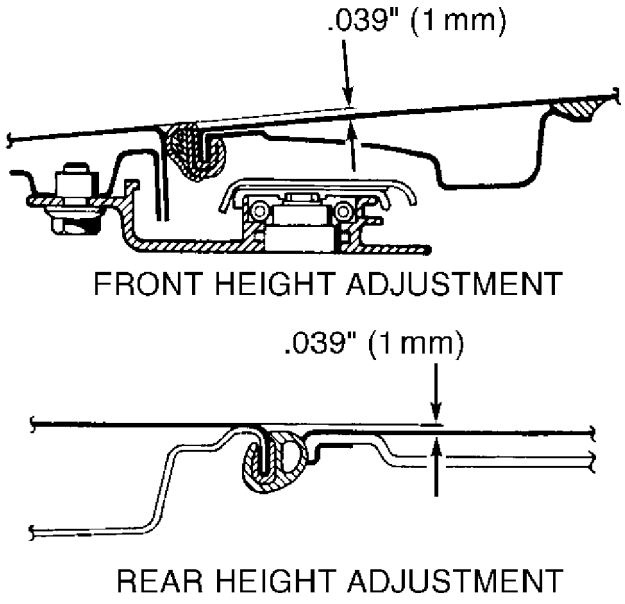

Fig. 2: Adjusting Sun Roof Panel
Courtesy of Volkswagen United States, Inc.

MAINTENANCE

DRAIN TUBES

Front drain tubes are routed through A pillars and discharge above front door hinge. Rear drain tubes are routed through D pillars and discharge behind rear wheel housing. Clean rear drain tubes through sun roof opening.

NOTE: Compressed air can be used to clean drain tubes

TESTING

NOTE: Test information is not available from manufacturer.

REMOVAL & INSTALLATION

CARRIER UNIT

Removal & Installation (Golf, GTI & Jetta)
1) Obtain radio code. Disconnect negative battery cable. Remove sliding glass panel. Remove molding from headliner cut-out. Remove electric drive motor cover.

2) Remove pillar trim and electric drive motor. Remove carrier unit attaching bolts. Remove carrier unit. See Fig. 7. To install, reverse removal procedure. Push sliding headliner to rear until both springs engage.

SLIDING SUN ROOF PANEL

Removal & Installation (Corrado SLC & Passat)

1) Slide headliner to rear. Tilt sun roof panel up. Install Sun Roof Remover (3195) into sun roof opening. See Fig. 3.

2) Pull sliding headliner and tilting frame down until sun roof remover engages headliner trim frame. See Fig. 5. Disengage headliner trim frame from guide rails by hitting sun roof remover toward rear.

3) Push back headliner trim frame until sun roof remover contacts edge of roof cutout. Remove adjusting plate Torx screws. Remove adjusting plate. Pull sun roof panel upward to remove. To install, reverse removal procedure.

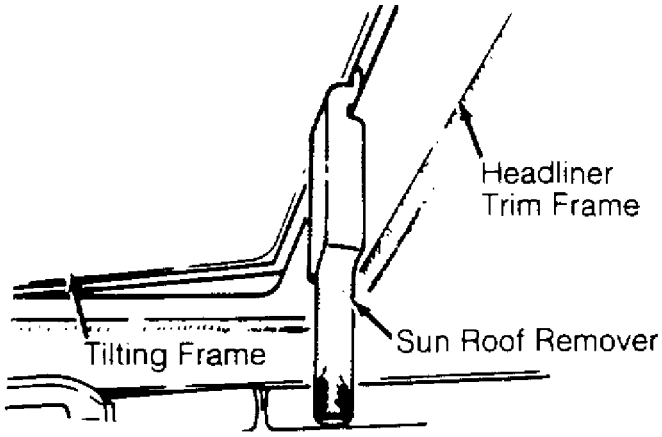

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Fig. 3: Installing Sun Roof Remover Into Sun Roof Opening
Courtesy of Volkswagen United States, Inc.

Removal & Installation (EuroVan)

1) Ensure sun roof panel is closed. Turn rotary handle screw about 1/4 turn until sun roof panel disengages from latch. See Fig. 4.

2) Turn rotary handle clockwise until sun roof is raised. Ensure sun roof panel does not engage latch. Press lock lever upward. Unlatch sun roof and remove from brackets. See Fig. 6. To install, reverse removal procedure.

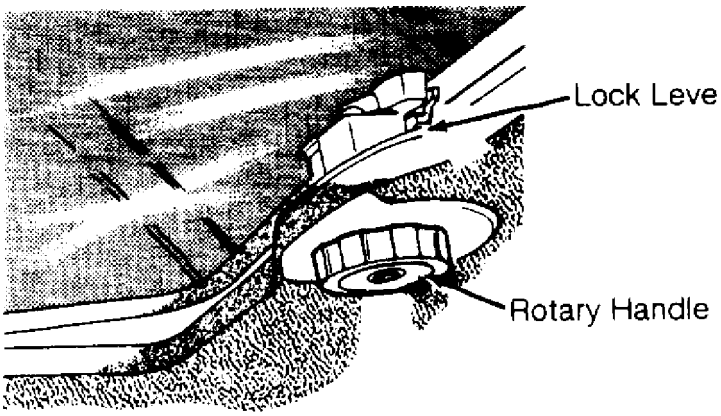


Fig. 4: Identifying Rotary Handle & Locking Lever
Courtesy of Volkswagen United States, Inc.

Removal & Installation (Golf, GTI & Jetta)

1) Slide headliner to rear. Tilt glass panel open. Unclip trim frame. Slide trim frame to rear. See Fig. 7.

2) Remove adjusting plate Torx screws. Remove adjusting plate. Pull glass panel upward to remove. To install, reverse removal procedure.

SLIDING HEADLINER

Removal & Installation (Golf, GTI & Jetta)

1) Remove sliding glass panel and move trim frame to rear. Using a small screwdriver, pry guide feet out of carrier guide by prying on one side while pressing sliding headliner into opposite guide channel.

2) Release spring and pull sliding headliner out of roof cut-out. See Fig. 7. To install, reverse removal procedure. Push sliding headliner to rear until both springs engage.

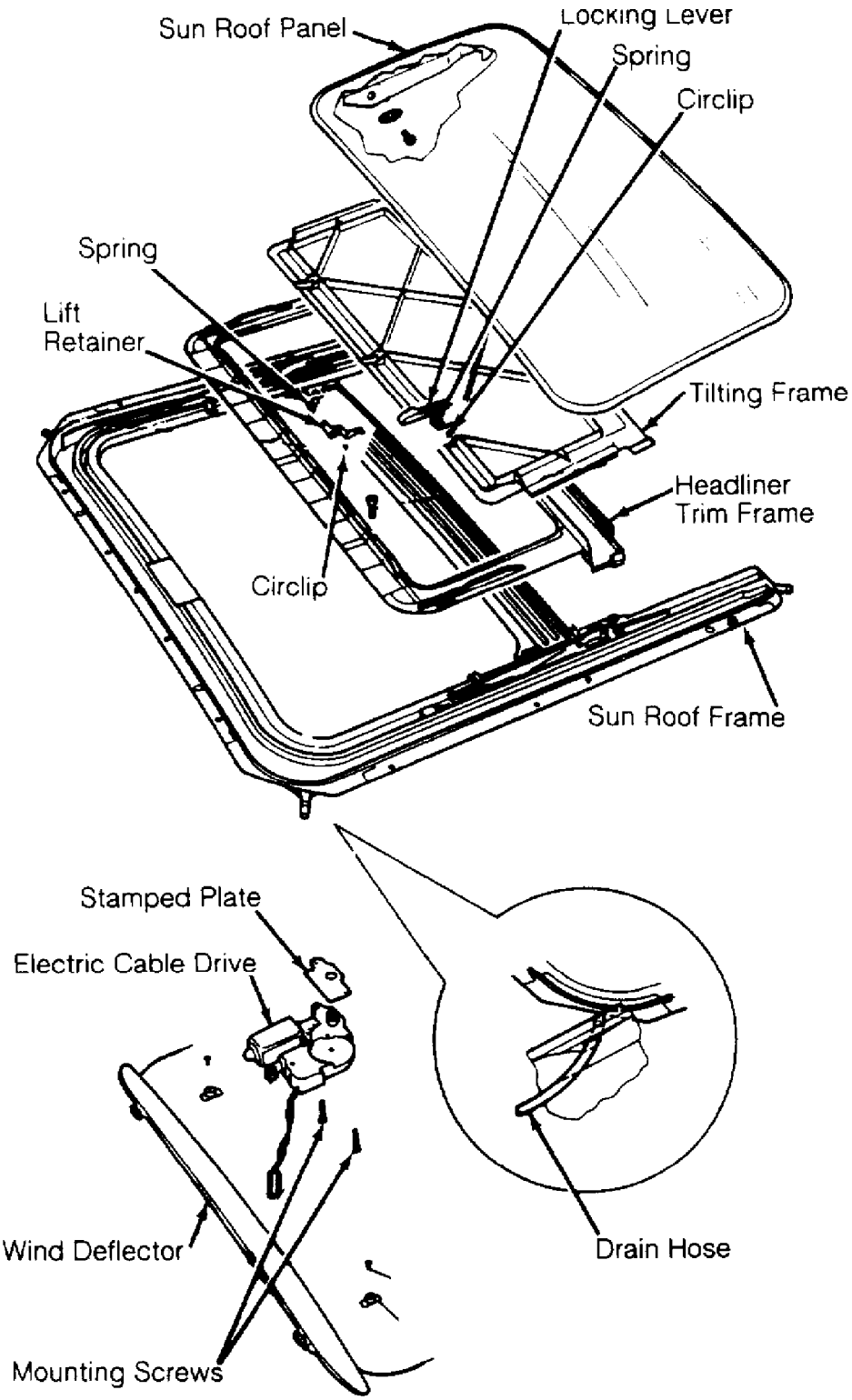


Fig. 5: Exploded View Of Power Sun Roof Assembly
(Corrado SLC & Passat)
Courtesy of Volkswagen United States, Inc.

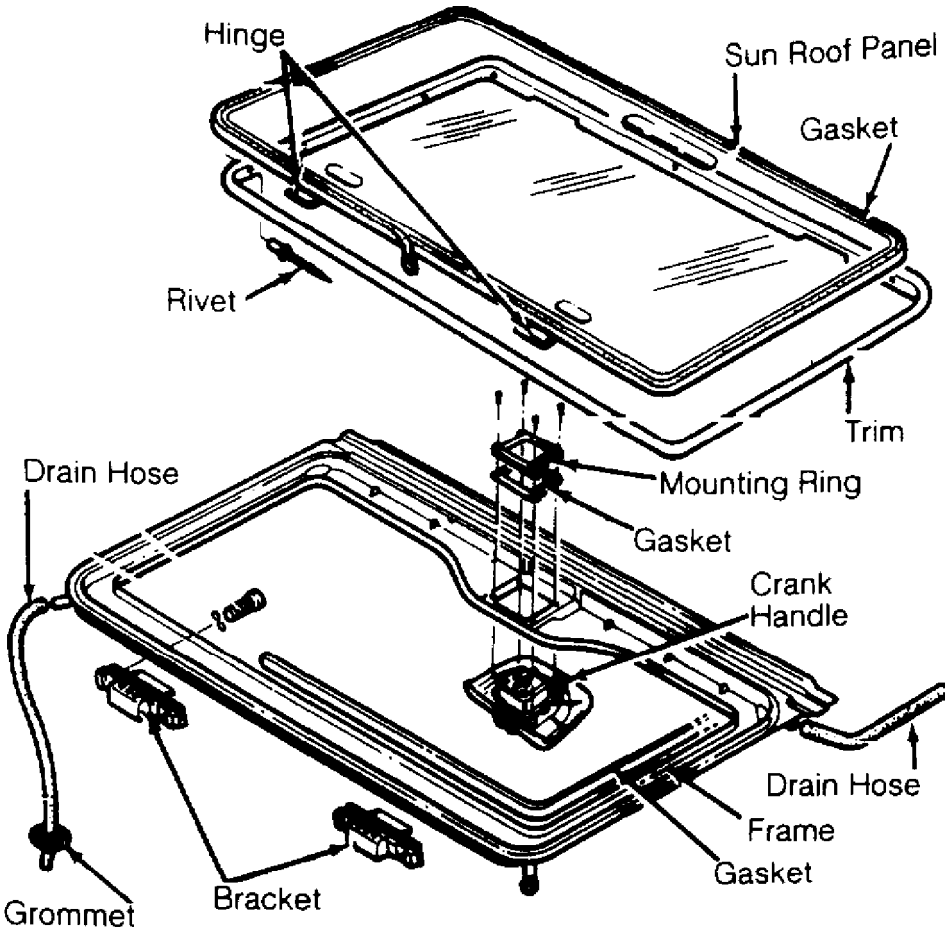


Fig. 6: Exploded View Of Power Sun Roof Assembly (EuroVan)
Courtesy of Volkswagen United States, Inc.

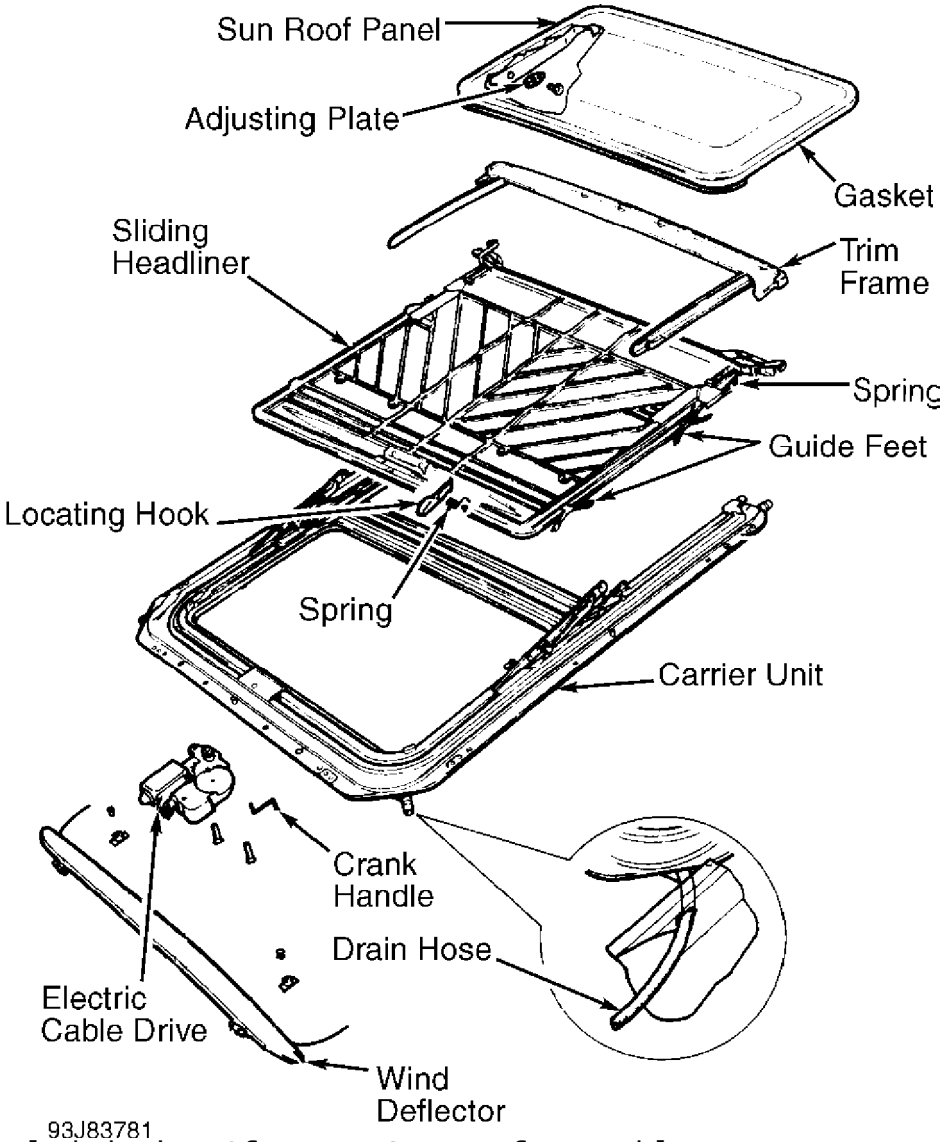


Fig. 7: Exploded View Of Power Sun Roof Assembly (Golf, Jetta & GTI)
Courtesy of Volkswagen United States, Inc.

WIRING DIAGRAMS

See appropriate chassis wiring diagram in WIRING DIAGRAMS.

END OF ARTICLE

SUSPENSION - FRONT
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:37PM

ARTICLE BEGINNING

1993 SUSPENSION
Volkswagen Front

EuroVan

DESCRIPTION

FWD independent suspension is an double-wishbone type with torsion bars mounted on upper control arm. Wheel is supported by a steering knuckle mounted between the upper and lower control arms. Torsion bars are mounted between the upper control arms and vehicle frame. Shock absorbers are mounted between the lower control arm and frame. See Fig. 1.

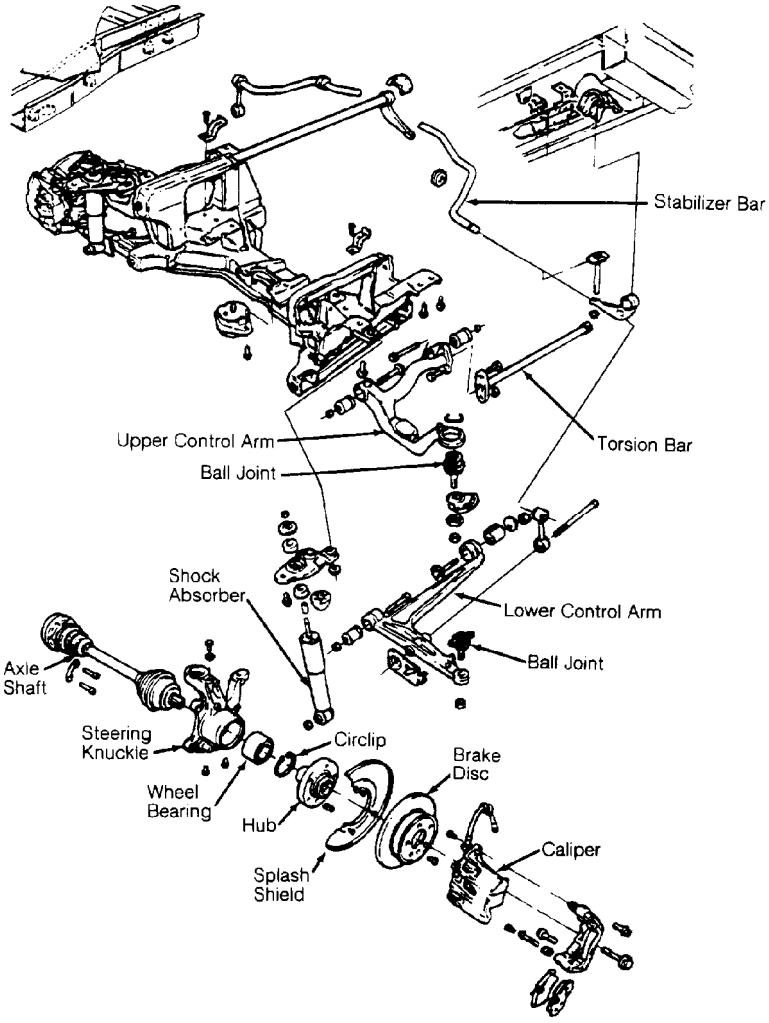


Fig. 1: Exploded View Of Front Suspension

ADJUSTMENTS & INSPECTION

WHEEL ALIGNMENT SPECIFICATIONS & PROCEDURES

NOTE: See WHEEL ALIGNMENT SPECIFICATIONS & PROCEDURES article in the WHEEL ALIGNMENT section.

WHEEL BEARING

No adjustment is required.

RIDING HEIGHT

Measure the distance between bolt head of upper shock absorber mounting and center of bolt head of lower shock absorber mounting. If distance measured is not 10.9-11.1" (278-280 mm) turn torsion bar adjustment bolt until correct riding height is obtained.

BALL JOINT CHECKING

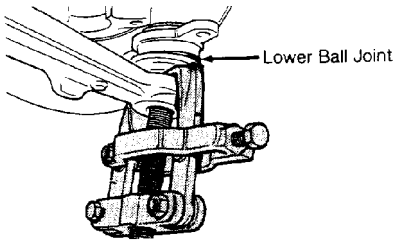
Raise and support vehicle. Inspect ball joints for excessive play and damaged rubber boots. There should be no vertical or horizontal ball joint play. Replace ball joint if any play is present.

REMOVAL & INSTALLATION

BALL JOINTS

Removal (Lower Ball Joint)
1) Install Control Arm Support (3250) between upper control arm and subframe. See Fig. 5. If control arm support is not available, release tension from torsion bar. Raise and support vehicle.
2) Remove steering knuckle. See STEERING KNUCKLE under REMOVAL & INSTALLATION. Using puller, remove lower ball joint from lower control arm. See Fig. 2.

Installation (Lower Ball Joint)
To install, reverse removal procedure. Ensure all nuts and bolts are tightened to specification. See TORQUE SPECIFICATIONS table at end of article.



93D83512

Fig. 2: Removing Lower Ball Joint

Removal (Upper Ball Joint)

1) Install Control Arm Support (3250) between upper control arm and subframe. See Fig. 5. If control arm support is not available, release tension from torsion bar. Raise and support vehicle.
2) Remove steering knuckle. See STEERING KNUCKLE under REMOVAL & INSTALLATION. Remove eccentric bushing See Fig. 7. Using puller, remove upper ball joint from upper control arm. See Fig. 3.

Installation (Upper Ball Joint)
Using Press (3111), install upper ball joint into upper control arm. See Fig. 4. Reverse removal procedure to complete installation. Ensure all nuts and bolts are tightened to specification. See TORQUE SPECIFICATIONS table at end of article.

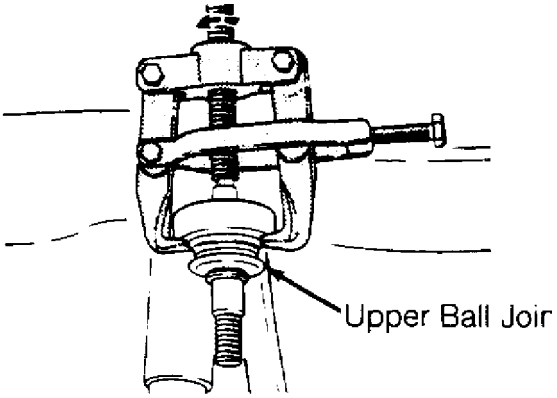


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Fig. 3: Removing Upper Ball Joint

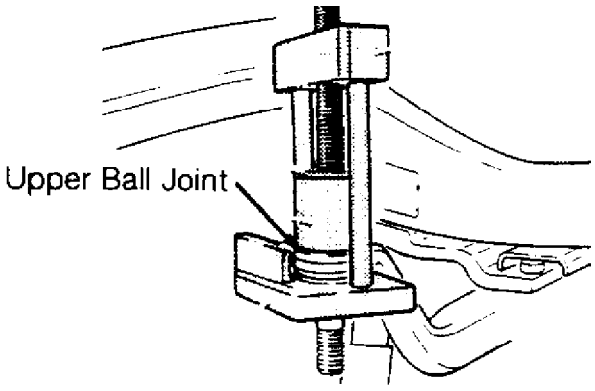

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Fig. 4: Installing Upper Ball Joint

HUB & KNUCKLE ASSEMBLY

Use exploded view illustration when removing or installing hub and knuckle assembly. See Fig. 1.

LOWER CONTROL ARM

Removal

1) Install Control Arm Support (3250) between upper control arm and subframe. See Fig. 5. If control arm support is not available, release tension from torsion bar. Raise and support vehicle.

2) Remove bolt retaining ball joint at steering knuckle. Separate ball joint from housing. Leave control arm hanging in mounts at subframe. If control arm is not to be removed and ball joint is riveted to control arm, drill out ball joint rivets using a 9/32" (7 mm) drill. If ball joint is bolted to control arm, remove bolts. Remove ball joint.

3) If control arm is to be removed from vehicle, remove stabilizer bar link rod nut, washers, and bushings. Remove pivot bolt and bracket housing inner pivot pin. Slide out control arm.

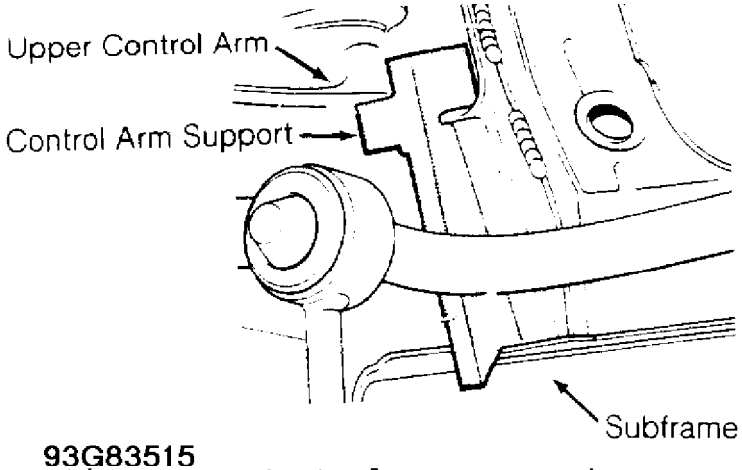


Fig. 5: Supporting Upper Control Arm & Torsion Bar

Inspection

Check lower control arm bushings for excessive wear, cracks or contamination. Replace bushings if necessary. To replace bushings, press out worn bushing. Select new bushing and press into position. Ensure bushing does not twist when seating into place.

Installation

1) Slide new ball joint into slot in control arm. Install and tighten ball joint retaining bolts. Install lower control arm to subframe. Install ball joint into steering knuckle. To complete installation, reverse removal procedure.

2) Tighten control arm bolts with vehicle on ground. Tighten all bolts and nuts to specification. See TORQUE SPECIFICATIONS table at end of article. Check wheel alignment. See WHEEL ALIGNMENT SPECIFICATIONS & PROCEDURES article in the WHEEL ALIGNMENT section.

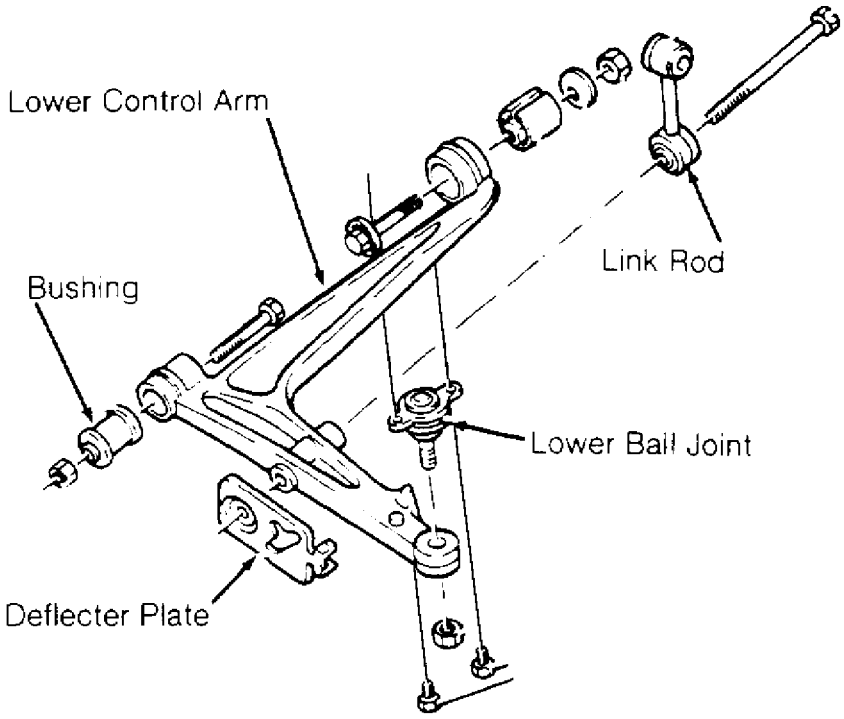


Fig. 6: Exploded View Of Lower Control Arm Assembly

SHOCK ABSORBER

Removal & Installation

1) Raise and support vehicle. Remove wheel assembly. Remove nuts retaining shock absorber to bracket. Remove washers and cushions from shaft of shock absorber.

2) Remove nuts and bolts securing shock absorber to lower control arm. Compress shock absorber and remove from vehicle. To install, reverse removal procedure.

TORSION BAR

Removal

Remove fuel tank. Remove exhaust system heat shield. Measure length of torsion bar stud thread below adjustment nut for installation reference. Loosen adjusting nut. Remove bolts attaching torsion bar to upper control arm. Remove torsion bar.

Installation

To install, reverse removal procedure. Tighten adjusting nut so stud protrusion is equal to original measurement.

UPPER CONTROL ARM

Removal

1) Remove torsion bar. See TORSION BAR under REMOVAL & INSTALLATION. Remove cotter pin and nut. Disconnect upper ball joint

from steering knuckle. Remove nut, cushion and retainer.

2) Disconnect shock absorber from frame. Do not disconnect shock absorber from lower control arm. Remove upper control arm shaft bolts and remove upper control arm from frame.

Bushing Replacement

Using Adapter (VW 519) and a press, remove bushings. Press in new bushing using Adapter (VW 454). Install upper control arm shaft. Press in new front bushing.

Installation

To install, reverse removal procedure. Tighten shaft nuts to specification with on ground. Tighten all nuts and bolts to specification. See TORQUE SPECIFICATIONS table at end of article.

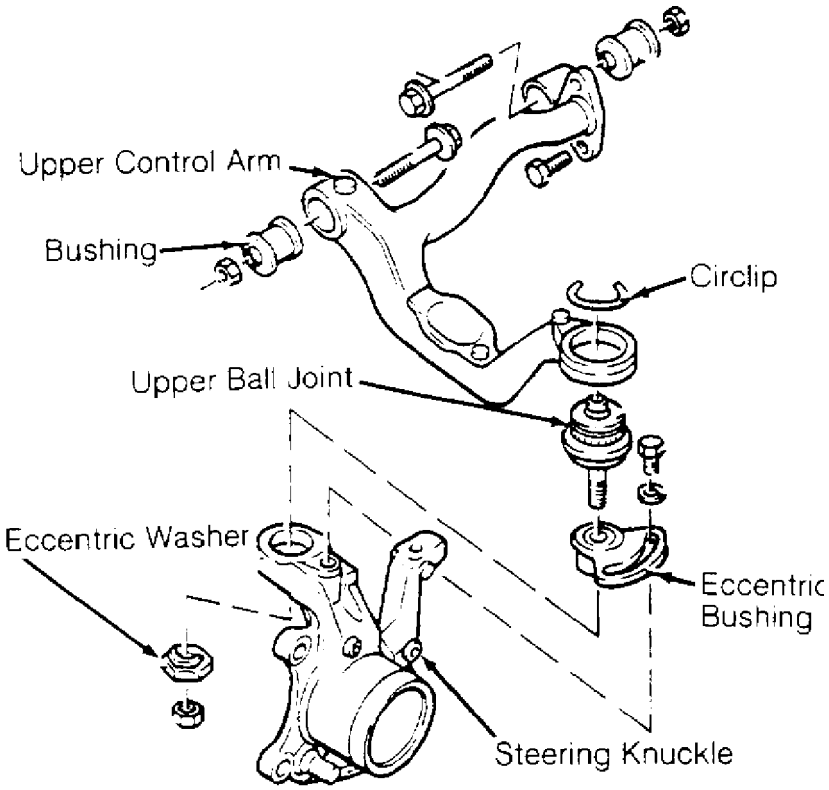


Fig. 7: Exploded View Of Upper Control Arm Assembly

WHEEL BEARING

Removal

1) Remove axle shaft nut with front wheels on ground. Install Control Arm Support between upper control arm and subframe. See Fig. 5. If control arm support is not available, release tension from torsion bar. Raise and support vehicle.

2) Remove wheel assembly. Remove brake caliper attaching bolts. Remove caliper and wire aside. Remove brake disc retaining

screw and remove disc. Disconnect tie rod ball joint from steering knuckle. Remove control arm ball joint clamp nut and bolt. Disconnect control arm ball joint from steering knuckle. Remove steering knuckle.

3) Remove wheel bearing circlip. Using Hub Remover (40-105), press wheel hub assembly out of steering knuckle. See Fig. 8. Using Bearing Remover (VW 442), press wheel bearing out of steering knuckle. See Fig. 9. Using a bearing puller, remove wheel bearing inner race from hub assembly. See Fig. 10.

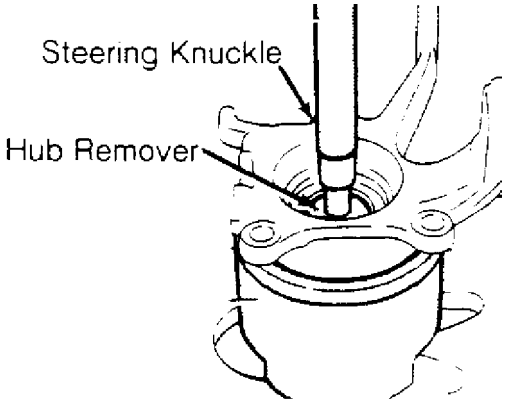


Fig. 8: Pressing Hub Assembly Out Of Steering Knuckle

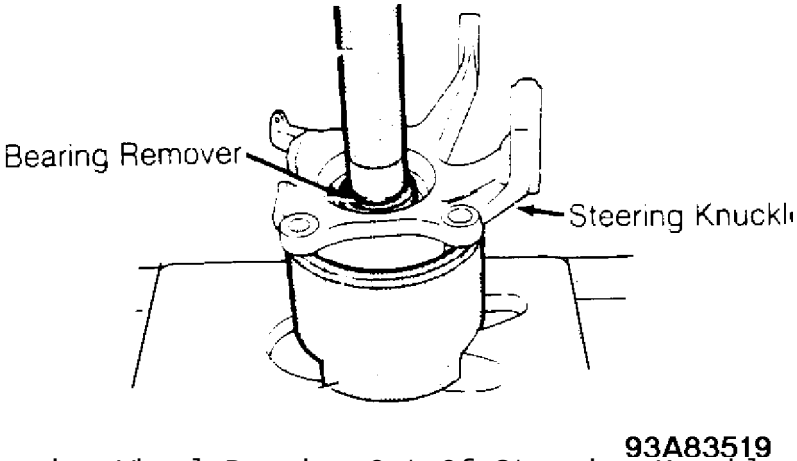


Fig. 9: Pressing Wheel Bearing Out Of Steering Knuckle

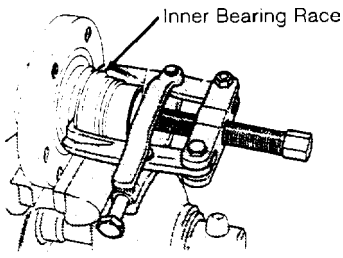


Fig. 10: Removing Wheel Bearing Inner Race

NOTE: When installing hub, ensure press adapter contacts inner

bearing race only.

Installation

1) Press new wheel bearing race onto hub. Using Bearing Installer (3253/7), press new bearing into steering knuckle from outboard side. Using Hub Installer (3074), press new bearing into steering knuckle. See Fig. 11.

2) To complete installation, reverse removal procedure. Always replace self-locking axle shaft bolt. Tighten bolts and nuts to specification. See TORQUE SPECIFICATIONS table. Check wheel alignment. See WHEEL ALIGNMENT SPECIFICATIONS & PROCEDURES article in the WHEEL ALIGNMENT section.

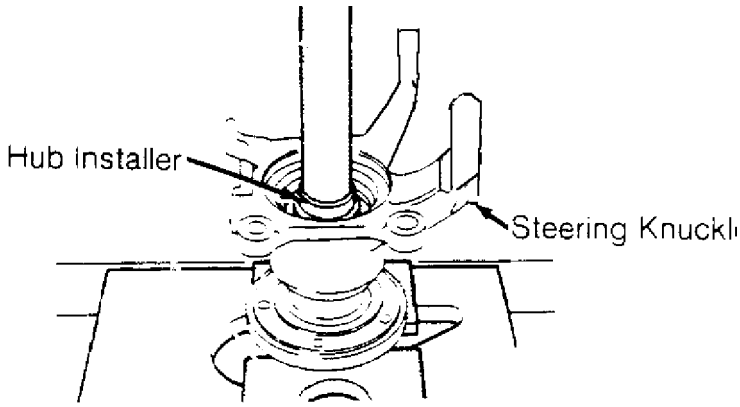


Fig. 11: Pressing Wheel Hub Into Steering Knuckle

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS TABLE

Application	Ft. Lbs. (N.m)
Axle Nut	195 (265)
Axle Shaft-To-Transaxle Bolt	33 (45)
Ball Joint Clamp Bolt	37 (50)
Ball Joint-To-Control Arm Bolt	18 (24)
Caliper Pin Bolt	18 (24)
Control Arm Pivot Bolt	
Lower	118 (160)
Upper	74 (116)
Ball Joint-To-Steering Knuckle Bolt	81 (110)
Tie Rod Castle Nut	26 (35)
Wheel Lug Bolt	81 (110)

END OF ARTICLE

SUSPENSION - REAR
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:38PM

ARTICLE BEGINNING

1993 SUSPENSION
Volkswagen Rear

EuroVan

DESCRIPTION

Suspension uses control arms and axle beam for stabilization. Control arms and axle beam are combined as one unit. Brake drums or discs rotate on stub axles bolted to control arms. See Fig. 1.

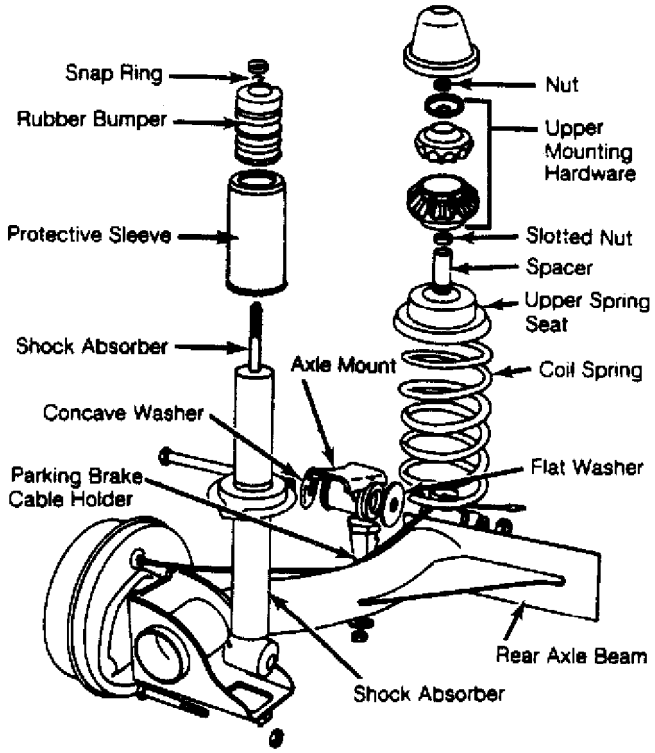


Fig. 1: Identifying Rear Suspension Components (Typical)
Courtesy of Volkswagen United States, Inc.

ADJUSTMENTS & INSPECTION

WHEEL ALIGNMENT SPECIFICATIONS & PROCEDURES

NOTE: See WHEEL ALIGNMENT SPECIFICATIONS & PROCEDURES article in the WHEEL ALIGNMENT section.

WHEEL BEARING

Tighten hub nut to 148 ft. lbs. (200 N.m). Insert tip of screwdriver between thrust washer and hub. Adjustment is correct when light finger pressure against screwdriver moves thrust washer. Turn

hub nut to adjust. Install NEW cotter pin.

REMOVAL & INSTALLATION

AXLE BEAM PIVOT BUSHING

NOTE: The following procedure is for replacing bushing with axle beam installed in vehicle.

Removal

Raise and support vehicle. With no pressure on beam, remove nuts which retain axle beam to body. Tap out pivot bolt. Using Bushing Remover (VW 3111), press out bushing. Press new bushing into place.

Installation

1) Loosely install mounting pad onto axle beam. Install bushing to a depth of 2.42-2.44" (61.5-62.0 mm). Concave washer and bolt head must face toward outside of vehicle. Bolt head must recess into washer.

2) Using Mounting Bracket Aligner (VW 261 or 3021), align mount. See Fig. 2. With vehicle on ground, tighten pivot bolt nut to specification.

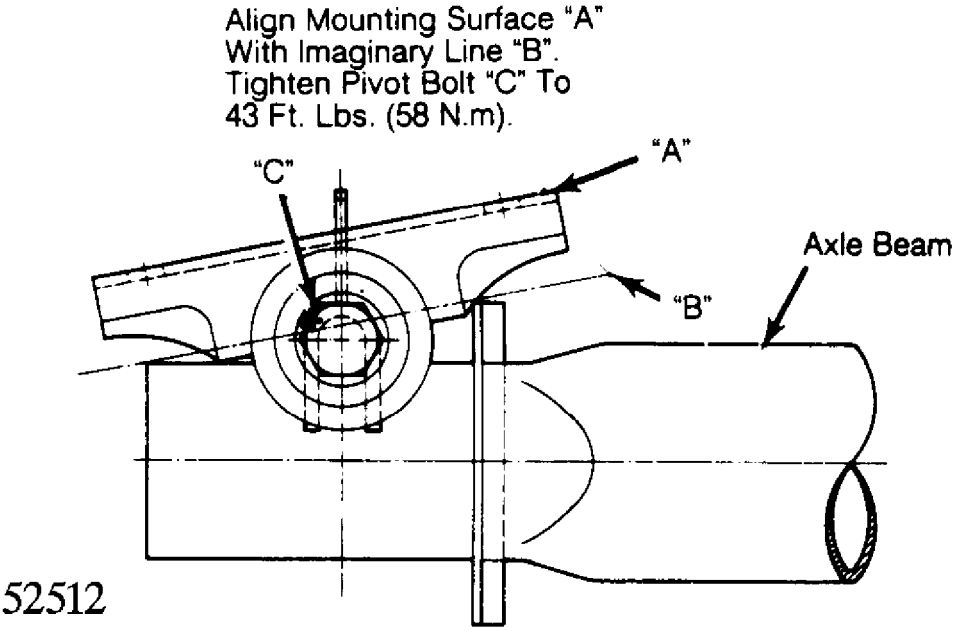


Fig. 2: Aligning Axle Beam Mounting Pad
Courtesy of Volkswagen United States, Inc.

STRUT/SHOCK ABSORBER

CAUTION: DO NOT remove both suspension strut/shock absorbers at same time.

Removal

1) With vehicle on floor, remove plastic cap which covers upper strut/shock retaining nuts. Remove strut/shock retaining nuts. Slowly raise vehicle until weight is off spring. Remove bolt which retains lower end of strut/shock absorber to axle beam mount. Raise vehicle until strut/shock can be removed. Place strut/shock assembly in vise.

2) Hold piston rod. Remove strut/shock retaining nut and related components. See Fig. 1. Remove slotted nut (some models). Remove spacer and coil spring. If coil spring is to be replaced, ensure paint stripe color on replacement spring matches original spring color stripe.

Installation

1) Install protective cap and tube onto shock absorber. Install rubber buffer with small end downward. Install snap ring and washer. Place spring into lower seat. Install upper retainer with spacer sleeve.

2) Tighten slotted nut (some models) which retains piston rod. Install upper mounting hardware. Tighten piston rod. To complete installation, reverse removal procedure. Tighten bolts and nuts to specification. See TORQUE SPECIFICATIONS table at end of article.

SUSPENSION ASSEMBLY

CAUTION: When removing suspension assembly, add weight to rear of vehicle to prevent tipping due to change in center of gravity.

Removal

1) With vehicle on floor, disconnect upper strut/shock mount. Raise and support vehicle. Disconnect parking brake at bracket near axle mount.

2) Disconnect and plug brakelines. Leave flex hose attached to suspension. Separate brake pressure regulator spring from axle beam (if equipped). Remove nuts which retain axle beam to body.

NOTE: DO NOT install bolts and nuts fouled with undercoating. With waxy coating on threads, true tightening torque cannot be measured. Clean or replace bolts and nuts.

Installation

1) If axle beam mounting has been removed, adjust mounting pad. See Fig. 2. If pad is not correctly aligned, torsional preload of mounting bushings will be incorrect.

2) Position rear suspension on body. Install nuts retaining axle beam to body. Raise wheel. Guide upper end of strut/shock into body mount.

3) Connect parking brake cables. Connect brakelines. Lower vehicle. Tighten upper strut/shock retaining nuts. Tighten all bolts and nuts to specification. Bleed brake system.

WHEEL BEARING

Removal (Disc Brakes)

Raise and support vehicle. Remove wheel assembly. Remove caliper assembly and support it out of work area. Remove dust cap, cotter pin, hub nut, and thrust washer. Remove brake disc. Using a long drift, tap bearings, races, and grease seal from disc hub.

Installation (Disc Brakes)

1) Clean hub cavity thoroughly. Using Bearing Race Installer (VW 432 and VW 411), press inner and outer bearing races into bore. Lubricate and install inner bearing. Using Seal Installer (VW 295 and 3074), tap grease seal into bore.

2) Install brake disc, outer bearing, thrust washer, and hub nut. Reverse removal procedure to complete installation. Adjust wheel bearing. See WHEEL BEARING under ADJUSTMENTS & INSPECTION. Install NEW cotter pin.

Removal (Drum Brakes)

Raise and support vehicle. Remove wheel assembly. Using transaxle jack, support transaxle. Remove brake drum. Using a hub puller, remove hub from control arm. Remove circlip. Using a bearing puller, remove wheel bearing from control arm. See Fig. 3.

Installation (Drum Brakes)

To install, reverse removal procedure. Clean hub cavity thoroughly. Lubricate and install inner bearing. Tighten all bolts and nuts to specification.

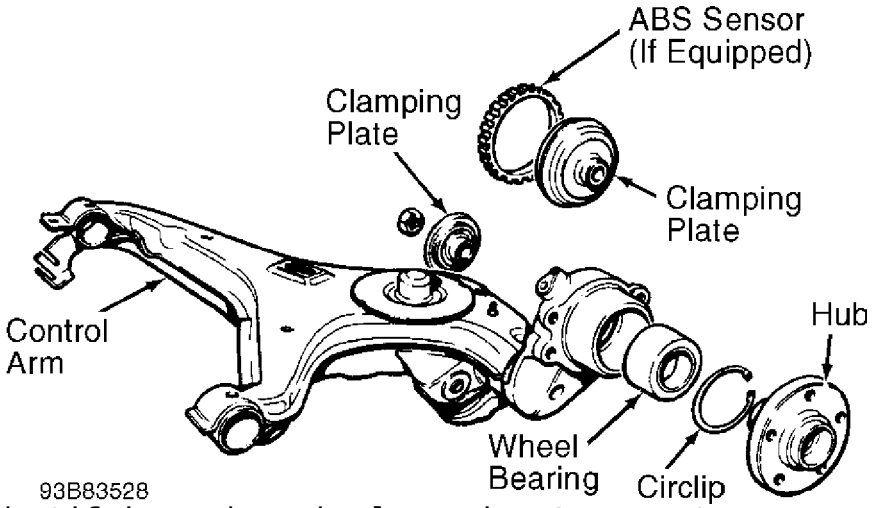


Fig. 3: Identifying Hub & Wheel Bearing Components
Courtesy of Volkswagen United States, Inc.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS TABLE

Application	Ft. Lbs. (N.m)

Brake Caliper Bolt	48 (65)
Coil Spring Retainer-To-Piston Rod Nut	11 (15)
Rear Axle Bolt	148 (200)
Rear Axle Beam Pivot Bushing Bolt	43 (58)
Rear Axle Mounting Pad-To-Body Bolt	63 (85)
Shock Absorber Slot Nut	15 (20)
Shock Absorber-To-Axle Beam Nut	52 (70)
Shock Absorber-To-Body Bolt	26 (35)
Stub Axle-To-Control Arm Bolt	44 (60)
Wheel Lug Bolt	81 (110)

END OF ARTICLE

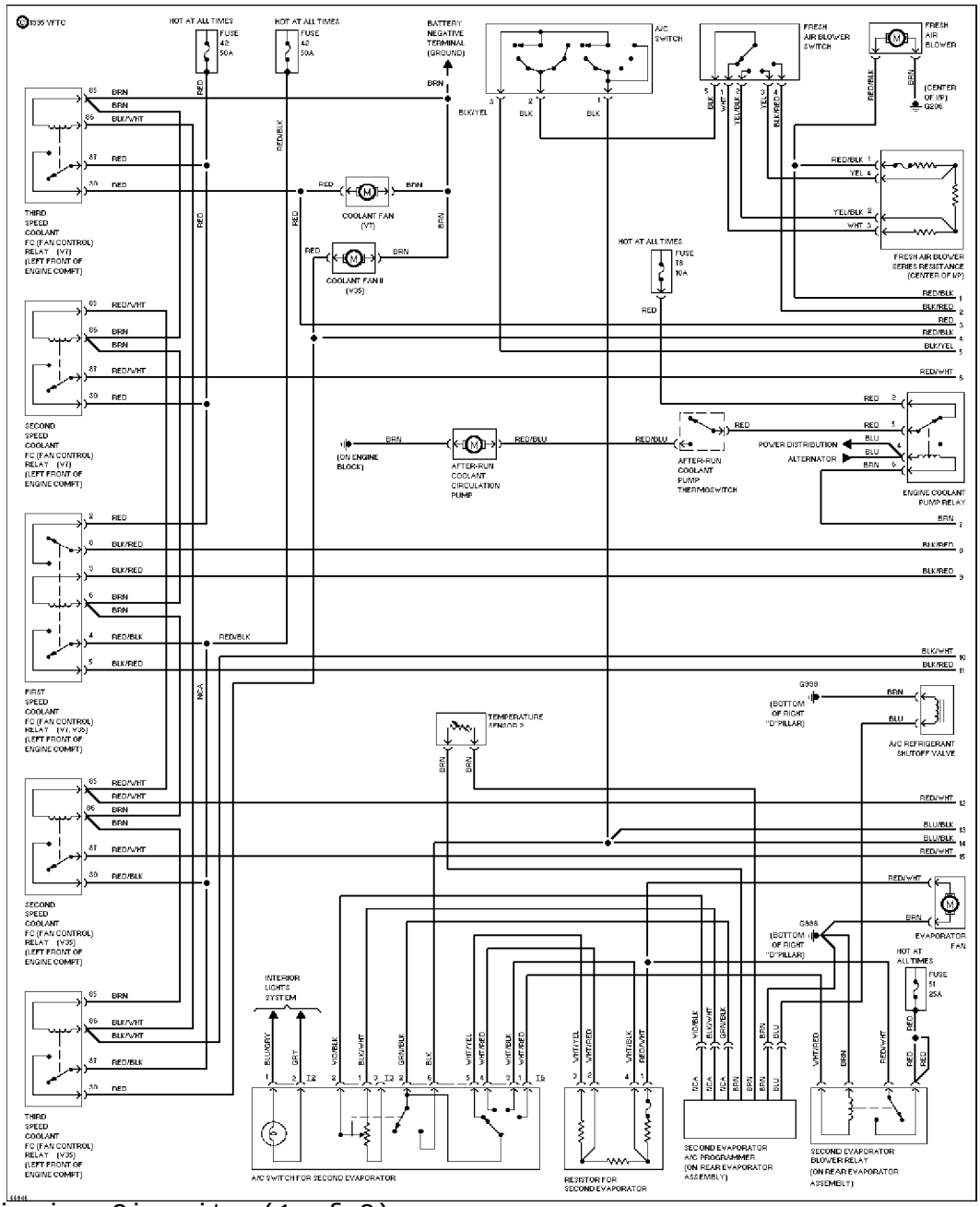
SYSTEM WIRING DIAGRAMS
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:38PM

ARTICLE BEGINNING

1993 System Wiring Diagrams
Volkswagen - EuroVan

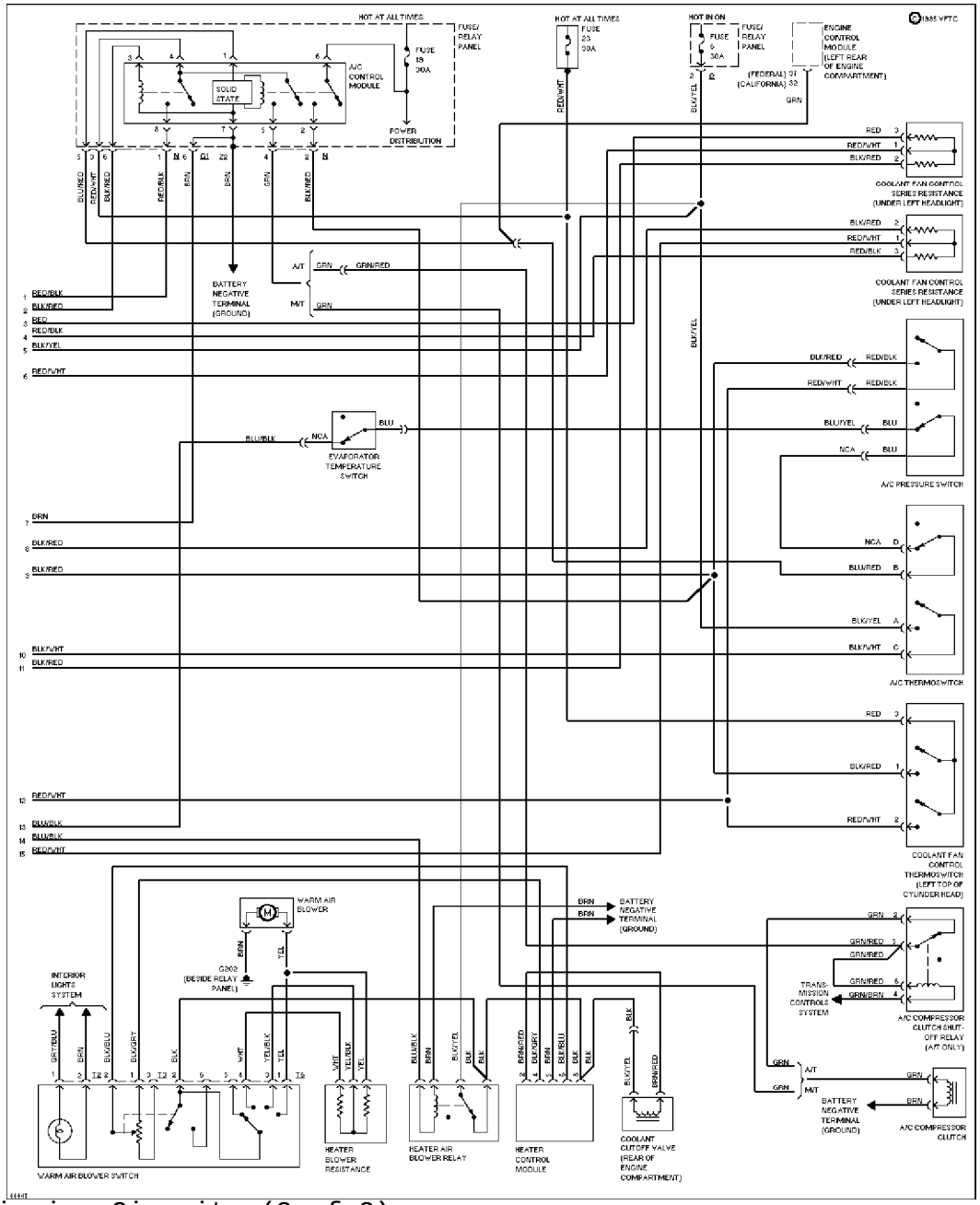
AIR CONDITIONING



Air Conditioning Circuits (1 of 2)

SYSTEM WIRING DIAGRAMS
Article Text (p. 2)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

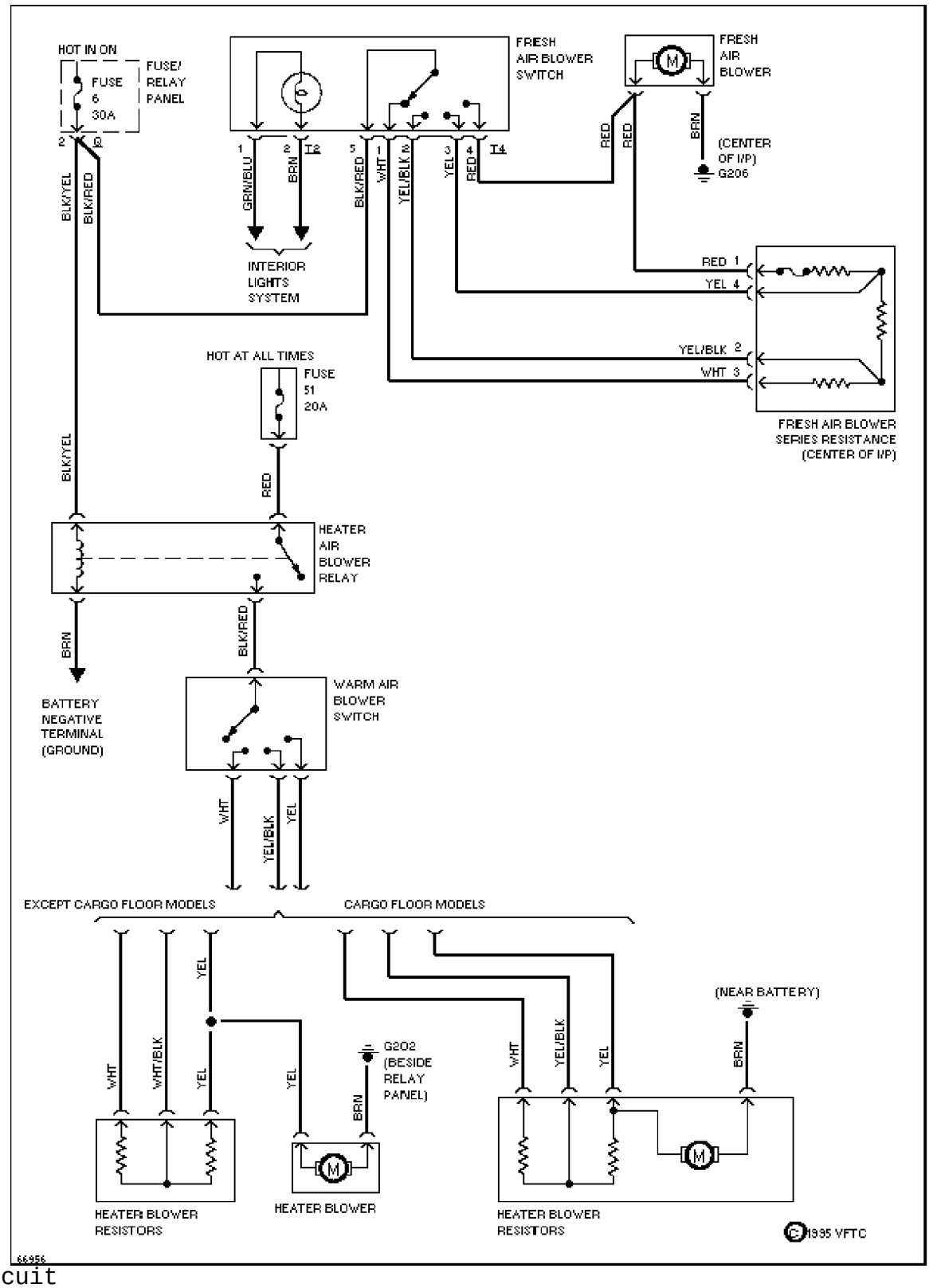
Saturday, March 18, 2000 10:38PM



Air Conditioning Circuits (2 of 2)

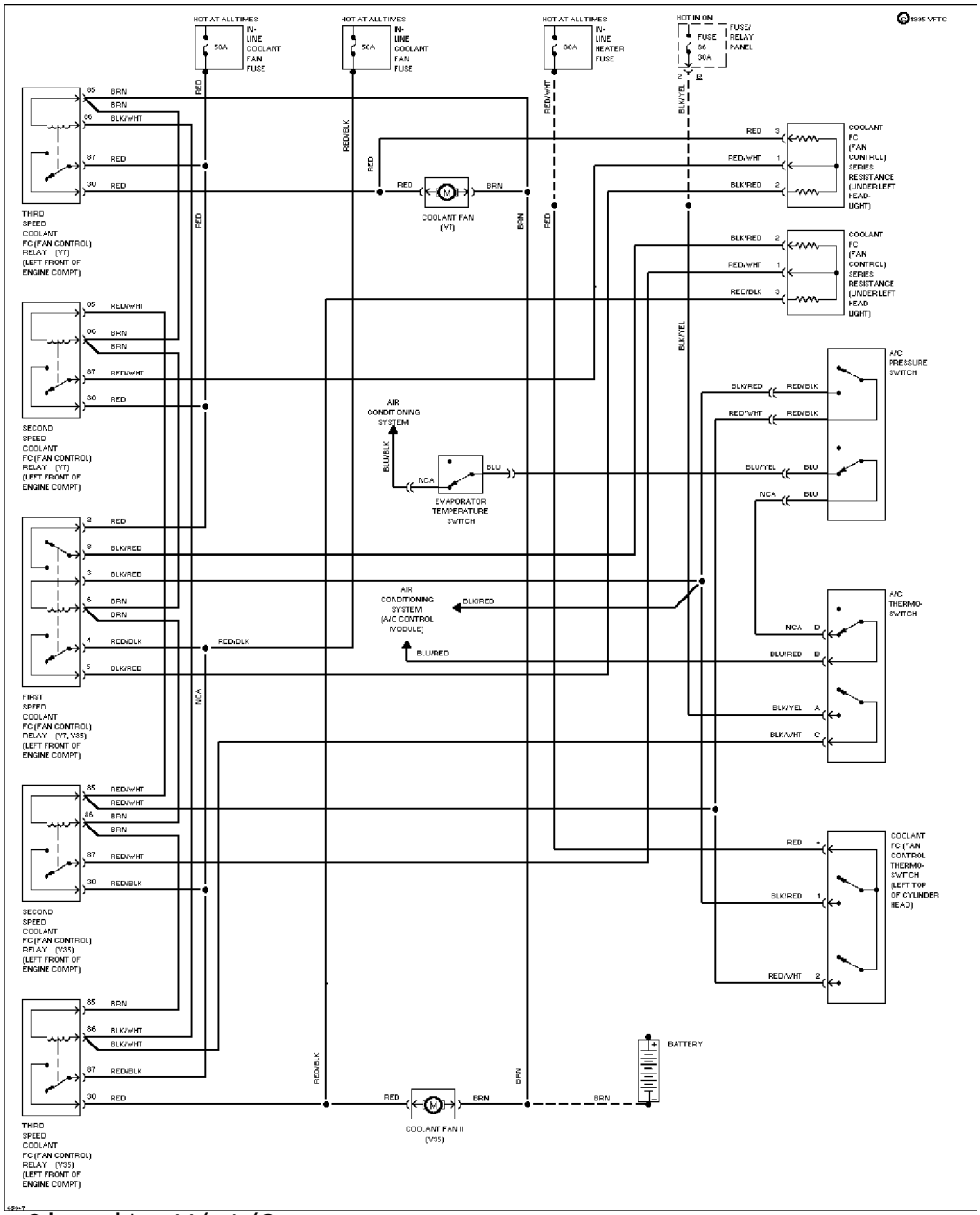
SYSTEM WIRING DIAGRAMS
Article Text (p. 3)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:38PM

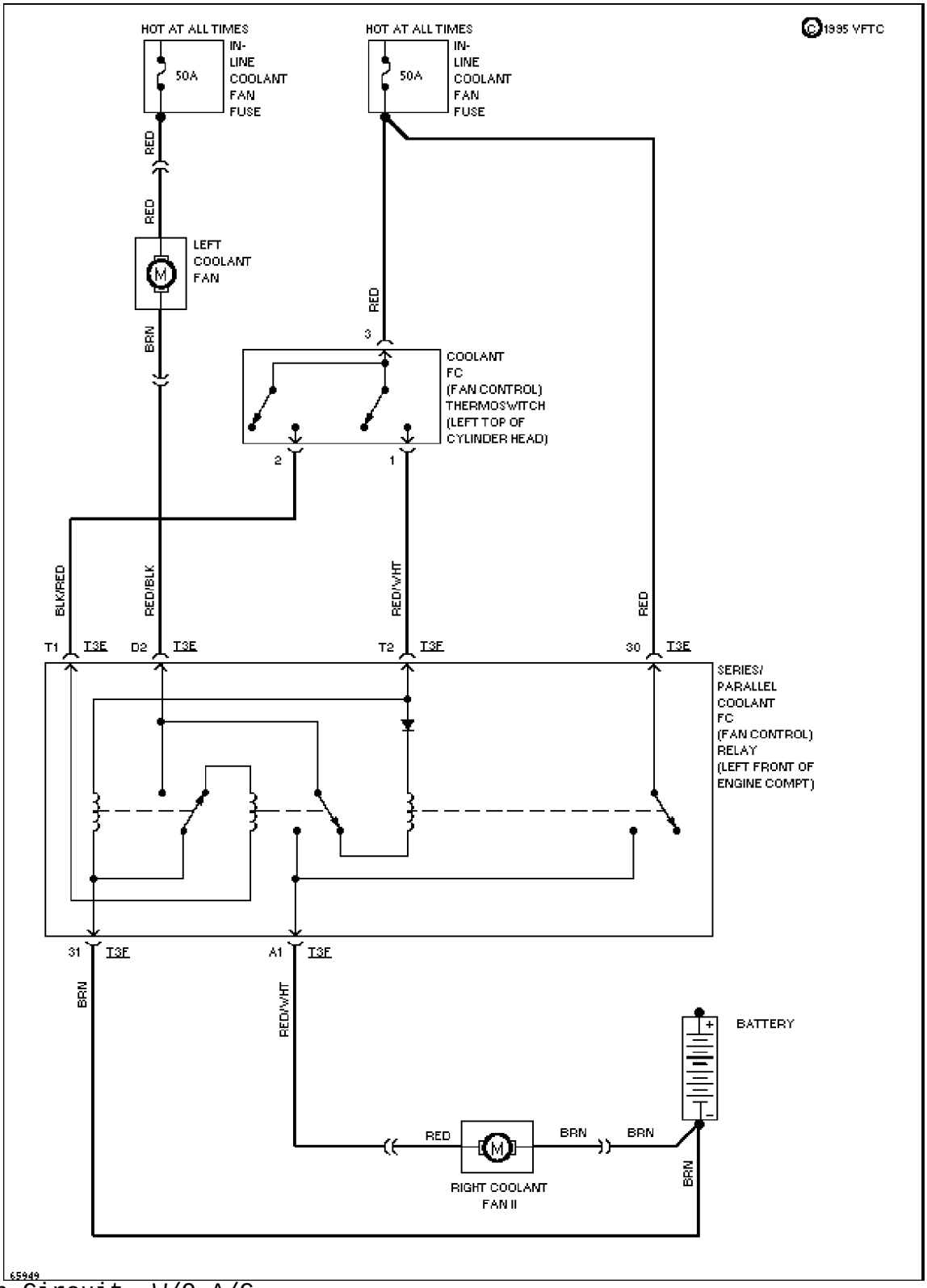


Heater Circuit

COOLING FAN



Cooling Fan Circuit, W/ A/C

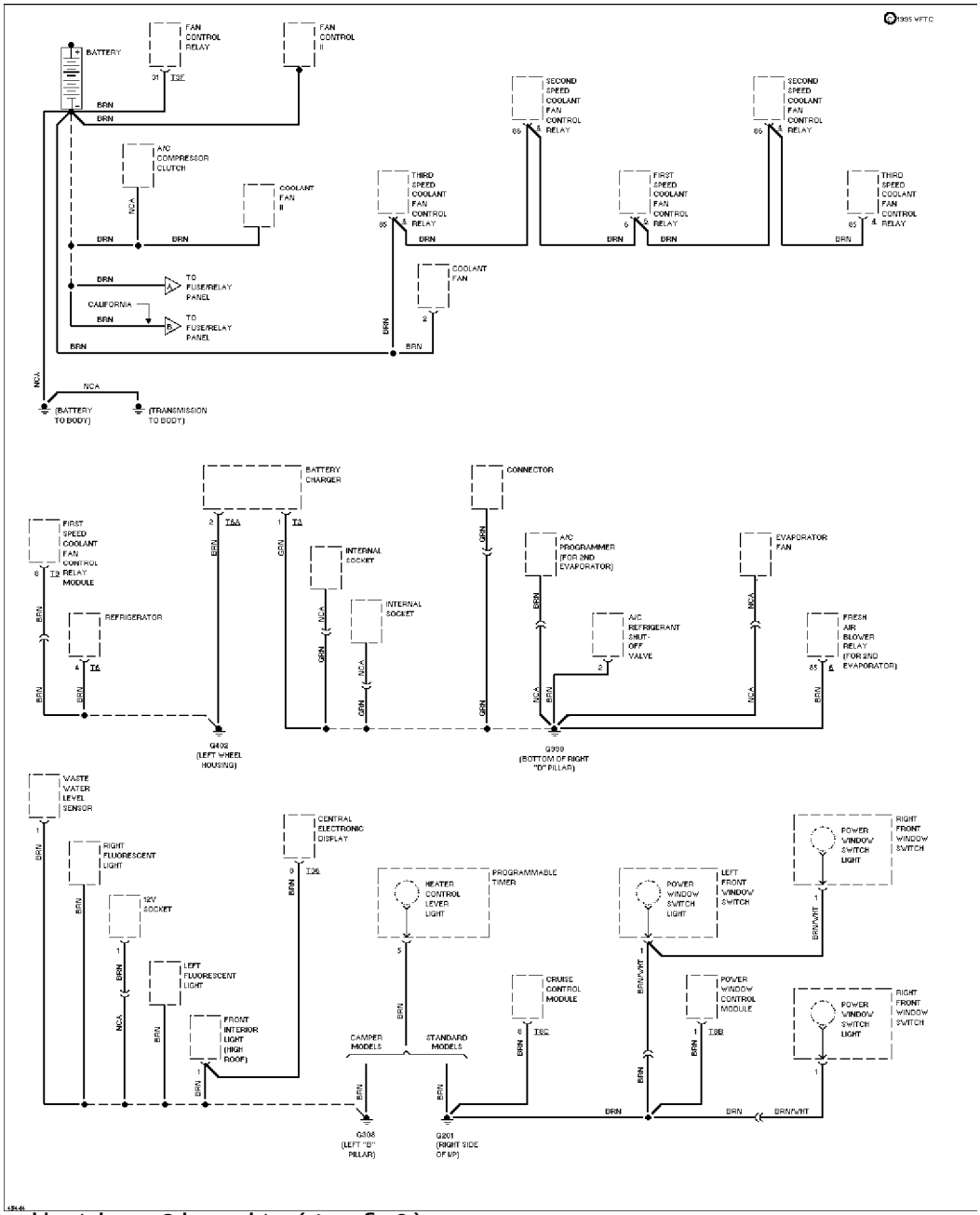


Cooling Fan Circuit, W/O A/C

SYSTEM WIRING DIAGRAMS
Article Text (p. 6)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:38PM

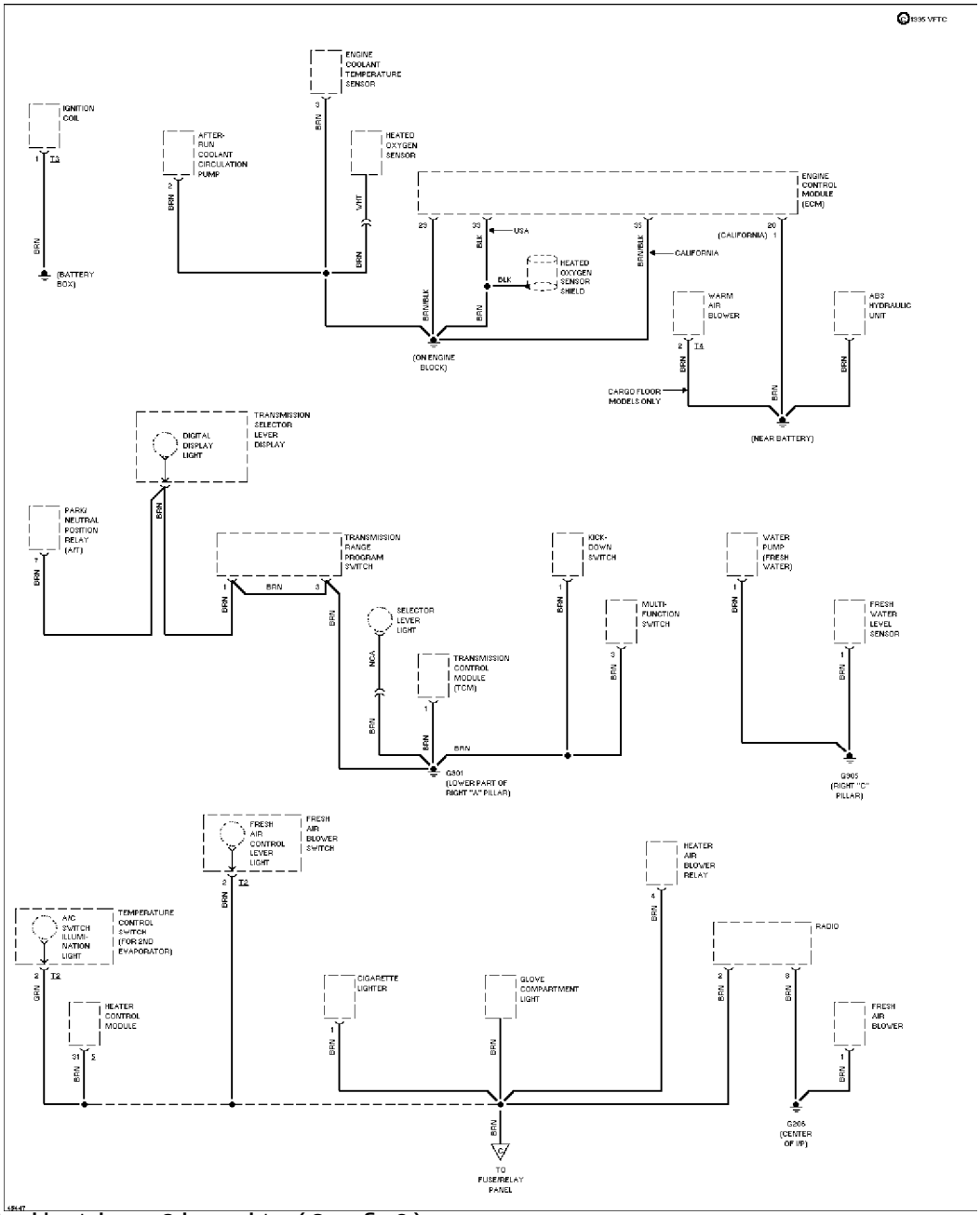
GROUND DISTRIBUTION



Ground Distribution Circuit (1 of 6)

SYSTEM WIRING DIAGRAMS
Article Text (p. 7)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

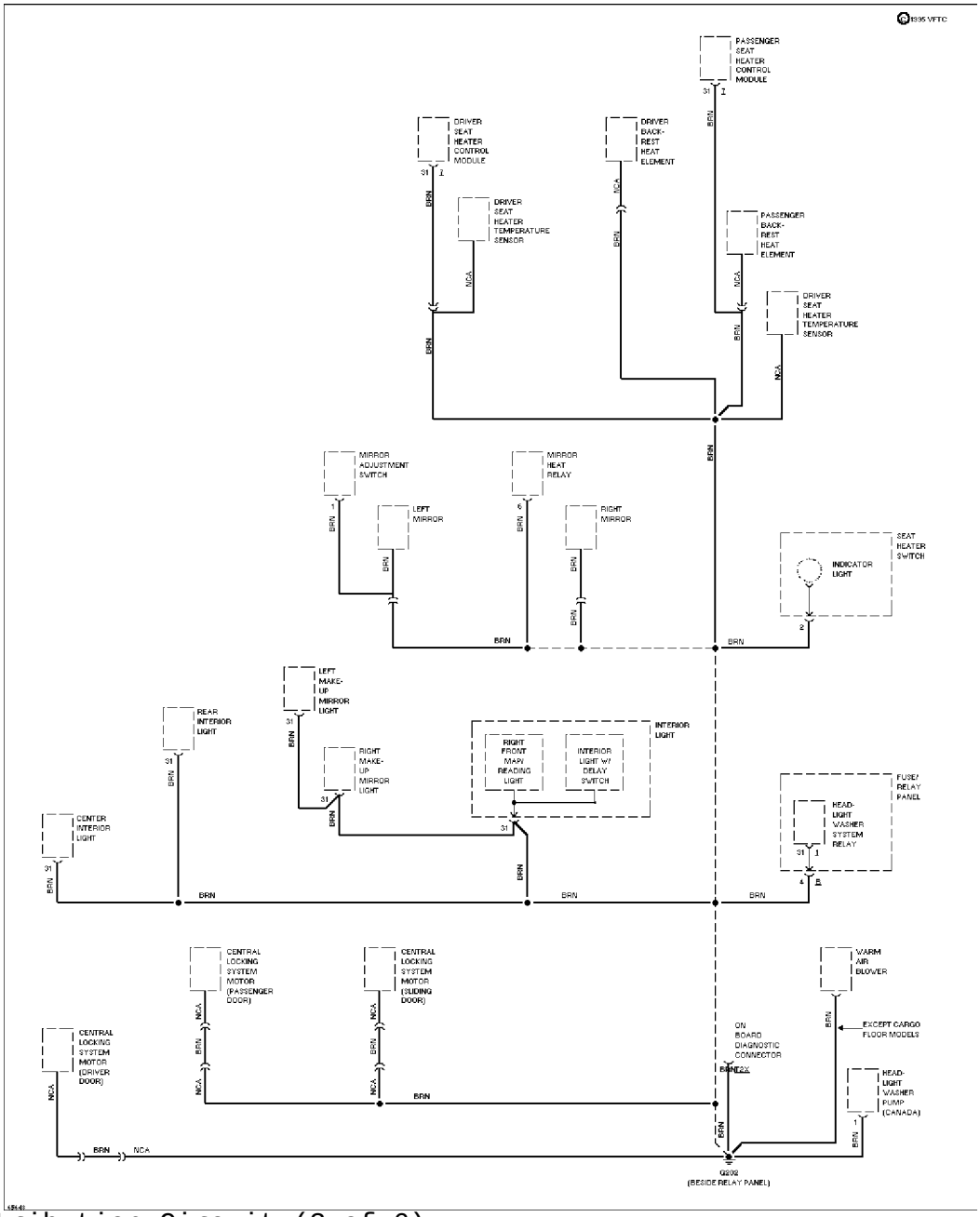
Saturday, March 18, 2000 10:38PM



Ground Distribution Circuit (2 of 6)

SYSTEM WIRING DIAGRAMS
Article Text (p. 8)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

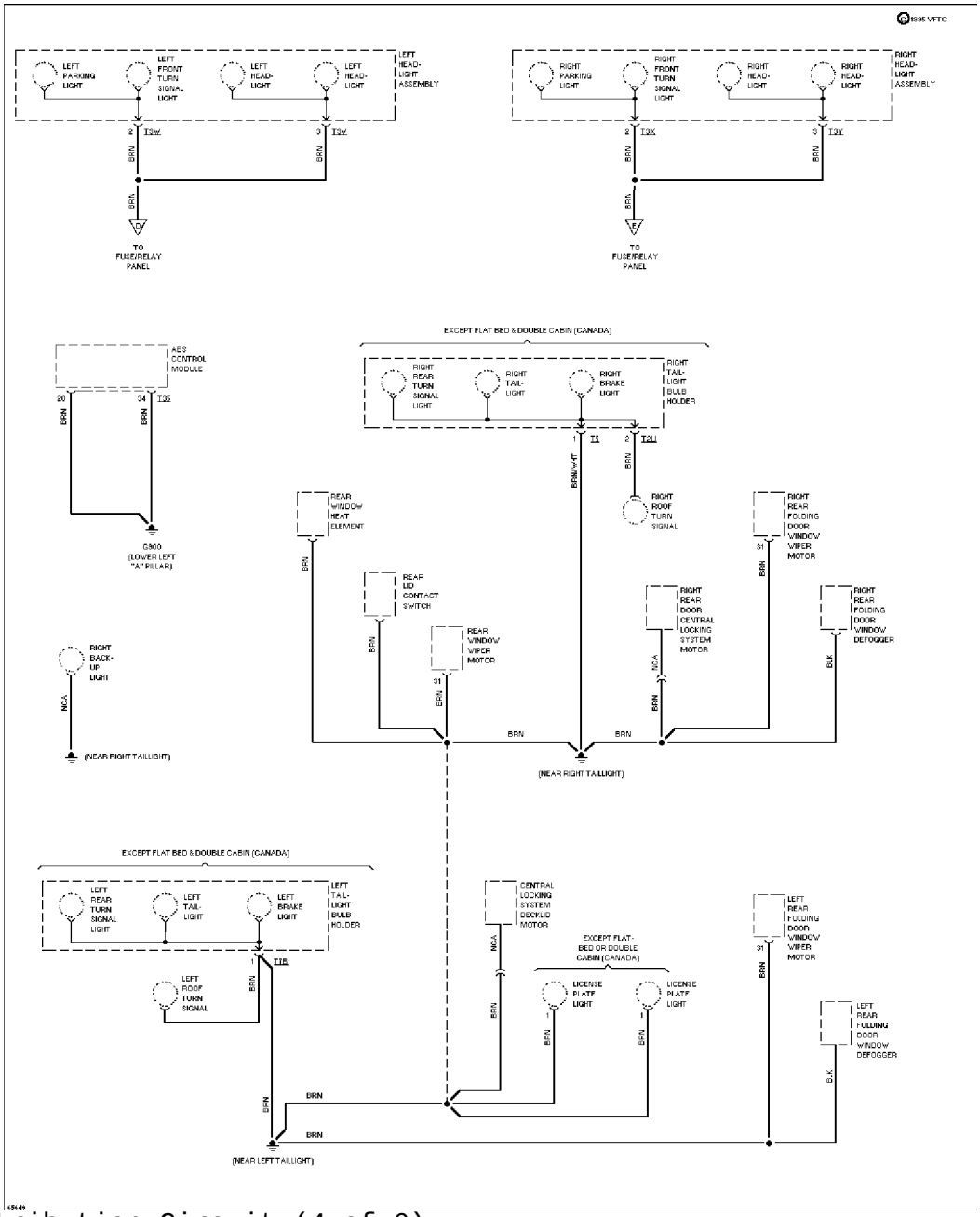
Saturday, March 18, 2000 10:38PM



Ground Distribution Circuit (3 of 6)

SYSTEM WIRING DIAGRAMS
Article Text (p. 9)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

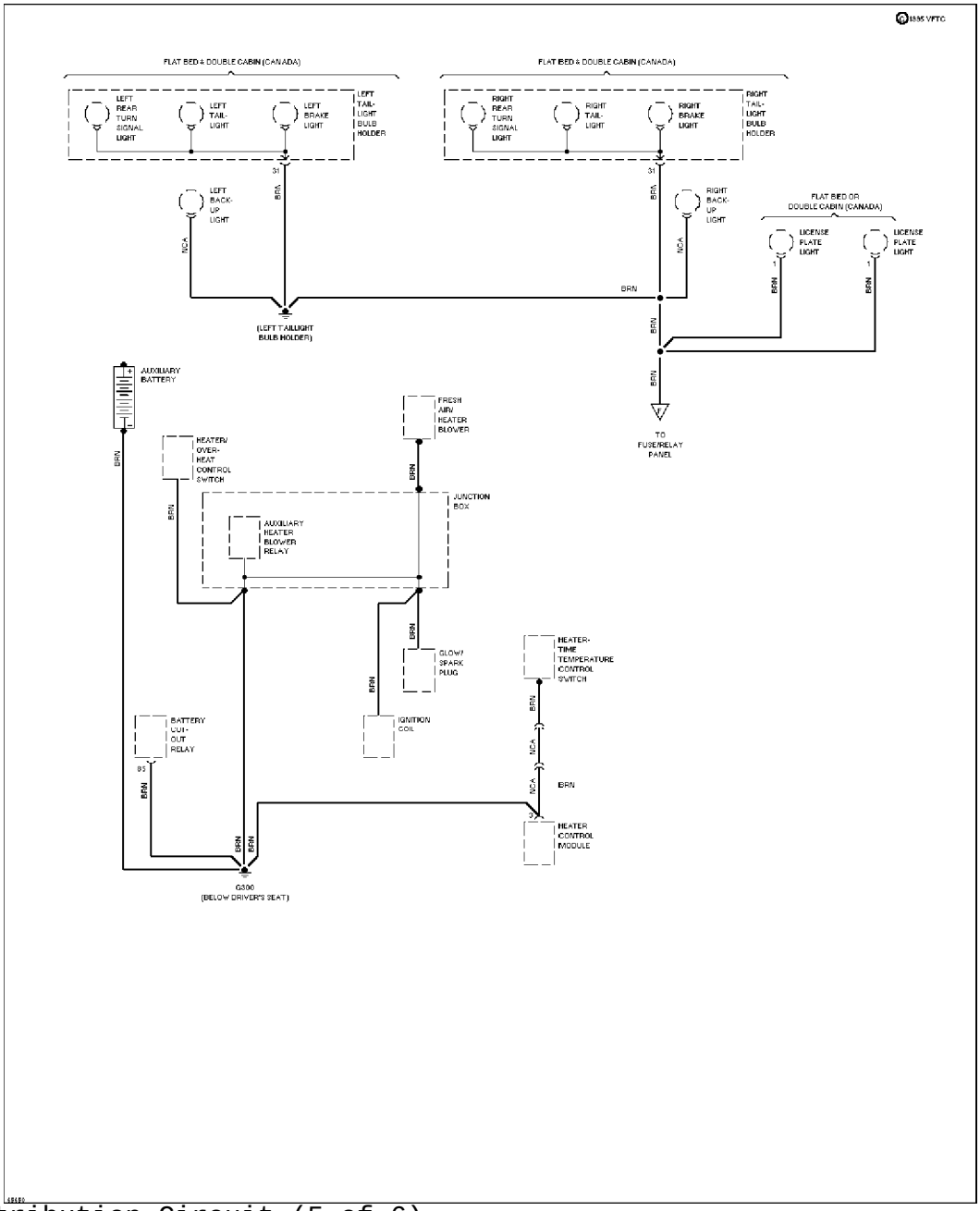
Saturday, March 18, 2000 10:38PM



Ground Distribution Circuit (4 of 6)

SYSTEM WIRING DIAGRAMS
Article Text (p. 10)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

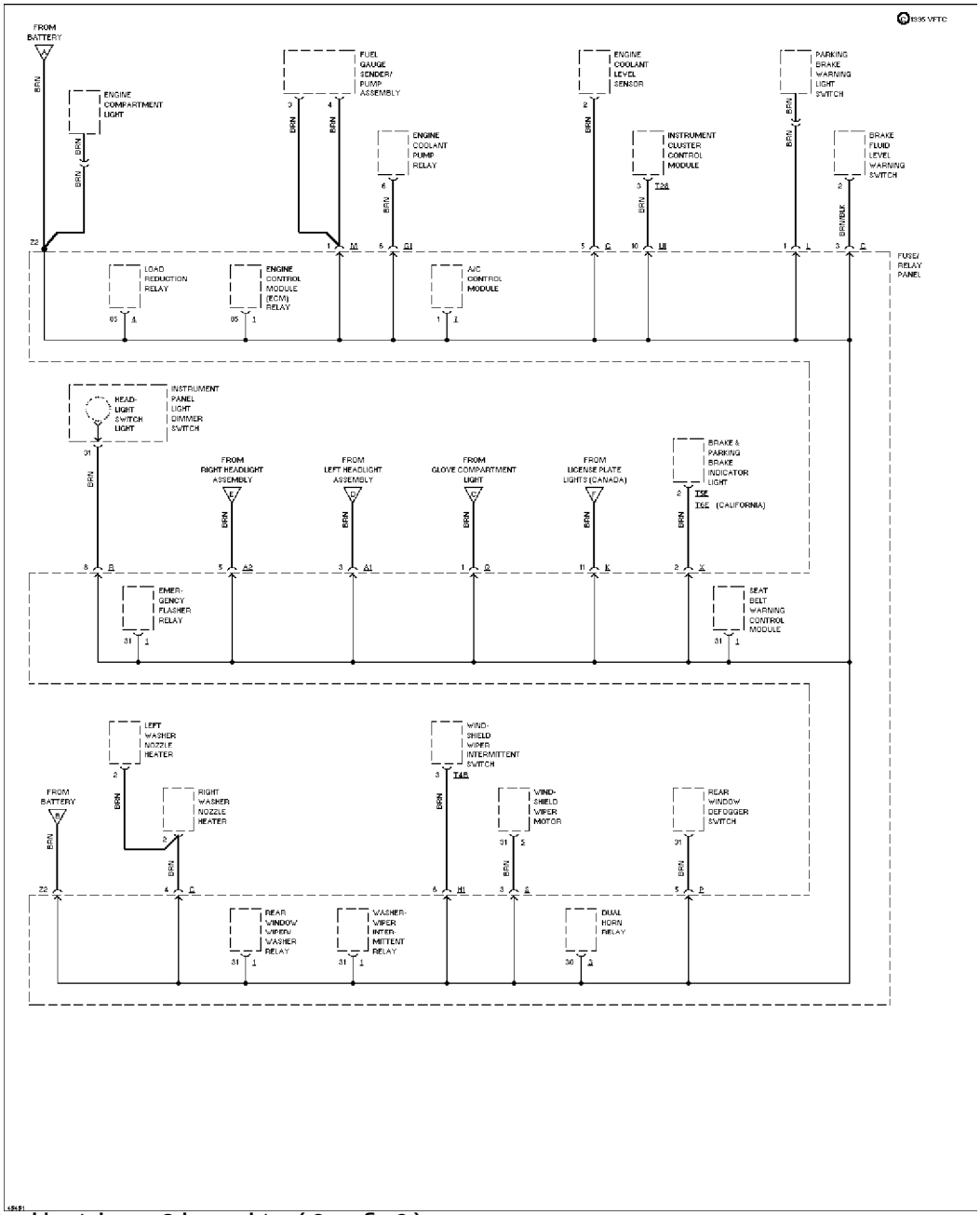
Saturday, March 18, 2000 10:38PM



Ground Distribution Circuit (5 of 6)

SYSTEM WIRING DIAGRAMS
Article Text (p. 11)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:38PM

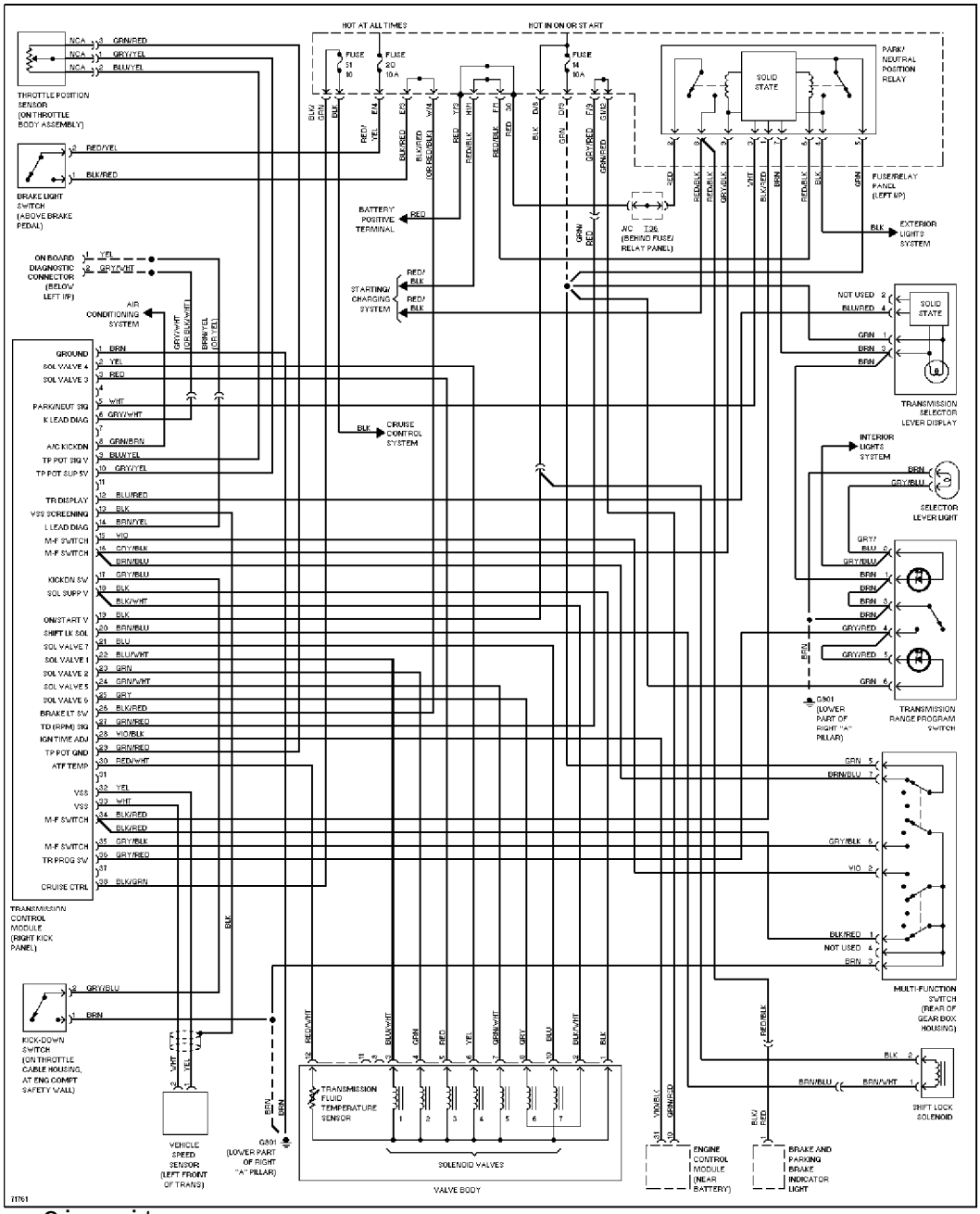


Ground Distribution Circuit (6 of 6)

TRANSMISSION

SYSTEM WIRING DIAGRAMS
Article Text (p. 12)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:38PM



Transmission Circuit

END OF ARTICLE

TRANSMISSION REMOVAL & INSTALLATION - A/T
Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:38PM

ARTICLE BEGINNING

1993-94 TRANSMISSION SERVICING
Volkswagen Transmission Removal & Installation - Automatic

EuroVan

REMOVAL & INSTALLATION

REMOVAL

1) Obtain radio code. Disconnect negative battery cable. Remove bolts and tilt radiator forward. Remove upper transaxle-to-engine mounting bolts.
2) Raise and support vehicle. Remove noise deadening panel and left horn cap. Remove all electrical connectors from transaxle. Disconnect oxygen sensor wiring harness connector.
3) Disconnect front exhaust pipe. Remove transaxle support from engine and bearing housing. Remove transaxle inspection plate cover. Remove torque converter-to-drive plate bolts.
4) Release tension from torsion bars. Disconnect left shock absorber from lower suspension link. Disconnect axle shafts from transaxle and support with wire. Loosen alternator mounting.
5) Support engine and transaxle with jack and raise slightly. Disconnect remaining engine/transaxle mounts. Remove lower engine-to-transaxle mounting bolts. Lower engine and transaxle out of vehicle as an assembly.

INSTALLATION

To install, reverse removal procedure. Adjust accelerator and selector cables if necessary. Use NEW self-locking nuts. Ensure engine mounts are installed to original location. Tighten engine mounting bolts to specification with engine running at idle. Refer to the TORQUE SPECIFICATIONS table.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS TABLE

Applications	Ft. Lbs. (N.m)
Axle Shaft-To-Flange Bolts	41 (55)
Bearing Housing	
Engine Mount Bolts	48 (65)
Inner Bracket	33 (45)
Outer Bracket	48 (65)
Torque Converter-To-Drive Plate Bolts	44 (60)
Transaxle-To-Engine Bolts	55 (75)
M8 Bolts	15 (20)
M10 Bolts	44 (60)

M12 Bolts 59 (80)

END OF ARTICLE

TRANSMISSION REMOVAL & INSTALLATION - M/T
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:38PM

ARTICLE BEGINNING

1993 TRANSMISSION SERVICING
Volkswagen Manual Transmission Removal & Installation

Volkswagen; EuroVan

REMOVAL & INSTALLATION

CLUTCH ASSEMBLY

Removal

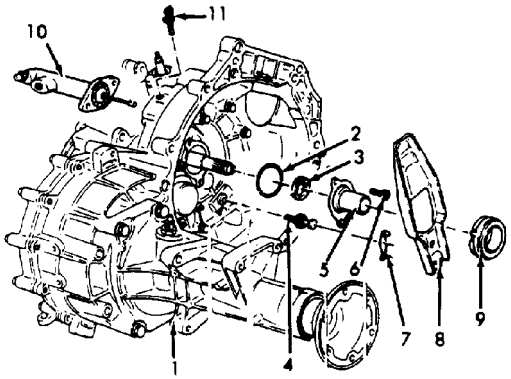
1) Obtain radio code. Disconnect negative battery cable. Remove radiator. Disconnect all wiring harness connectors from transaxle and starter. Remove shift linkage from transaxle.

2) Remove slave cylinder from transaxle. Disconnect speedometer. Remove all necessary brackets and cooling lines. Remove upper engine-to-transaxle mounting bolts. Remove brake booster and vacuum hose.

3) Measure protrusion of torsion bar adjusting nut. Release tension from torsion bar. Loosen drive shaft/wheel hub bolt. Remove wheel bearing housing. Disconnect shock absorber. Remove drive axle.

4) Remove starter and alternator. Disconnect tranaxle carrier from bearing housing. Remove A/C compressor (if equipped). Disconnect front exhaust pipe. Using tranaxle jack, support tranaxle. Support engine and remove remaining engine-to-transaxle mounting bolts. Lower transaxle out of vehicle.

5) Using Flywheel Lock (3067) or similar device, hold engine from turning. Remove pressure plate bolts. Remove pressure plate and clutch disk. If flywheel needs repair or replacement, remove flywheel from engine.



1. Transaxle
2. Input Shaft "O" Ring
3. Input Shaft Seal
4. Ball Stud
5. Guide Sleeve
6. Guide Sleeve Bolt
7. Retaining Spring
8. Release Lever
9. Release Bearing
10. Slave Cylinder
11. Assembly Pin

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Fig. 1: Exploded View Of Clutch Assembly Components
Courtesy of Volkswagen United States, Inc.

Installation

1) Replace input shaft seal. See Fig. 1. Ensure friction disk slides on input shaft spines. Splines may be lightly greased. Wipe off excess grease. If flywheel was removed, reinstall on engine. Using flywheel lock or similar device, hold engine from turning. Tighten flywheel bolts to specification. See TORQUE SPECIFICATIONS table at end of article.

2) Mount friction disk and pressure plate on engine. Install pressure plate bolts finger tight. Using Clutch Centering Plug (3190), align friction disk and pilot bushing holes. Tighten pressure plate bolts to specification using a crisscross pattern.

3) To complete installation, reverse removal procedure. Plug transaxle openings to prevent contamination or fluid loss. Push clutch release lever rearward and temporarily install mounting pin or an 8 x 22 mm bolt through pivot arm. Remove pin or bolt after installation is complete. Tighten nuts and bolts to specification. See TORQUE SPECIFICATIONS table.

END OF ARTICLE

TRANSMISSION SERVICING - A/T
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:38PM

ARTICLE BEGINNING

TRANSMISSION SERVICING
Volkswagen Transmission Servicing - Automatic

Corrado SLC, EuroVan, Passat

IDENTIFICATION

AUTOMATIC TRANSMISSION APPLICATIONS TABLE

Model	Transmission
Corrado SLC & Passat	Model 096
EuroVan	Model 098

LUBRICATION

SERVICE INTERVALS

Check fluid level at each oil change. Change fluid every 30,000 miles under severe driving conditions. On Corrado SLC and Passat, replace filter (if equipped) every 30,000 miles.

CHECKING FLUID LEVEL

Transmission
Park vehicle on level surface, with transmission at normal operating temperature. Set selector lever to Park or Neutral. Apply parking brake. Allow engine to idle. Remove dipstick, wipe clean, and reinsert. Remove dipstick. Fluid level should be between marks on dipstick.

Final Drive
Oil level in the final drive does not need to be checked.

RECOMMENDED FLUID

Transmission
Use Dexron or Dexron-II ATF.

Final Drive
Use G50 or SAE 75W-90.

FLUID CAPACITY

TRANSMISSION REFILL CAPACITIES TABLE

Application	Refill Qts. (L)	Dry Fill Qts. (L)

EuroVan, Corrado SLC & Passat	3.2 (3.0)	5.9 (5.6)	

FINAL DRIVE REFILL CAPACITIES TABLE

Model	Qts. (L)
All Models	.8 (.76)

DRAINING & REFILLING

1) Remove transmission protection plate (if necessary). Remove rear pan bolts. Loosen front pan bolts. Carefully lower pan to drain as much fluid as possible. Remove oil pan. Pour out remaining fluid.

2) Remove filter. Clean oil pan. Install new filter. Tighten filter retaining screws to 71 INCH lbs. (8 N.m). Install oil pan with new gasket. Tighten oil pan bolts to 89 INCH lbs. (10 N.m).

3) Install protection plate if it was removed. Tighten bolts to 18 ft. lbs. (25 N.m). Add 3.2 qts. (3.0L) transmission fluid. Check fluid level. Add if necessary.

ADJUSTMENTS

SELECTOR LEVER CABLE

Corrado SLC, EuroVan & Passat

Set transmission selector to Park. Loosen screw at gear lever shaft. Set gear lever in Park. Ensure detent engages parking lock. Tighten screw to 15 ft. lbs. (20 N.m) on Corrado SLC and EuroVan. Tighten screw to 18 ft. lbs. (25 N.m) on Passat.

NEUTRAL SAFETY SWITCH

Neutral safety switch is located in shift console. Remove console cover. Adjust switch so that engine starts in Park and Neutral positions only.

END OF ARTICLE

TRANSMISSION SERVICING - M/T
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:38PM

ARTICLE BEGINNING LOOSE

TRANSMISSION SERVICING
Volkswagen Manual Transmission

Volkswagen; EuroVan,

IDENTIFICATION

MANUAL TRANSAXLE APPLICATIONS TABLE

Model	Transaxle
EuroVan	5-Speed - 02B Transaxle

LUBRICATION

SERVICE INTERVALS

No oil changes are required.

CHECKING FLUID LEVEL

Manufacturer states that fluid level does not have to be checked, and does not specify a procedure for doing so.

RECOMMENDED FLUID

Use API GL-4, SAE 80W or 80W-90.

FLUID CAPACITIES

TRANSAXLE REFILL CAPACITIES TABLE

Transaxle	Qts. (L)
02A	2.1 (2.0)
02B	2.9 (3.1)
013 & 014	1.8 (1.7)
020	2.1 (2.0)

ADJUSTMENTS

GEARSHIFT LINKAGE

1) Place gearshift lever in Neutral position. Remove knob and boot. Loosen upper shift rod clamp bolt. Install Shift Linkage Gauge (3258). See Fig. 1.
2) With gauge tightly secured against gearshift lever,

tighten knurled head screw. Align gate selector console to move freely. Tighten upper shift rod clamp bolt. Remove shift linkage gauge.

3) Place gear selector in 1st position. Light pull gear selector toward left side of vehicle. Measure distance between gear lever stop and gear shift housing. See Fig. 2. If .05-.09" (1.3-2.3 mm) is not present, repeat steps 1) and 2).

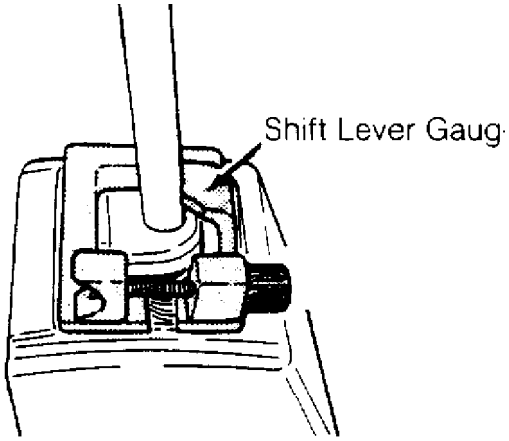

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Fig. 1: Adjusting Shift Rod End
Courtesy of Volkswagen United States, Inc.

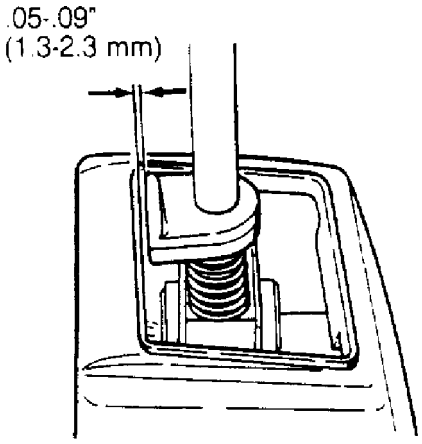

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Fig. 2: Checking Shift Linkage
Courtesy of Volkswagen United States, Inc.

END OF ARTICLE

TROUBLE SHOOTING - BASIC PROCEDURES

Article Text

1993 Volkswagen EuroVan

For Volkswagen Technical Site

Saturday, March 18, 2000 10:38PM

ARTICLE BEGINNING

GENERAL TROUBLE SHOOTING

AIR CONDITIONING TROUBLE SHOOTING

WARNING: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC AIR CONDITIONING TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE
Compressor Not Working	ù Compressor clutch circuit open. ù Compressor clutch coil inoperative. ù Poor clutch ground connection. ù Fan belts loose. ù Thermostatic switch inoperative. ù Thermostatic switch not adjusted. ù Ambient temperature switch open. ù Superheat fuse blown.
Excessive Noise or Vibration	ù Missing or loose mounting bolts. ù Bad idler pulley bearings. ù Fan belts not tightened correctly. ù Compressor clutch contacting body. ù Excessive system pressure. ù Compressor oil level low. ù Damaged clutch bearings. ù Damaged reed valves. ù Damaged compressor.
Insufficient or No Cooling; Compressor Working	ù Expansion valve inoperative. ù Heater control valve stuck open. ù Low system pressure. ù Blocked condenser fins. ù Blocked evaporator fins. ù Vacuum system leak. ù Vacuum motors inoperative. ù Control cables improperly adjusted. ù Restricted air inlet. ù Mode doors binding. ù Blower motor inoperative. ù Temperature above system capacity.

TROUBLE SHOOTING - BASIC PROCEDURES

Article Text (p. 2)

1993 Volkswagen EuroVan

For Volkswagen Technical Site

Saturday, March 18, 2000 10:38PM

BRAKE SYSTEM TROUBLE SHOOTING

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BRAKE SYSTEM TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Brakes Pull Left or Right	Incorrect tire pressure	Inflate tires to proper pressure
	Front end out of alignment	See WHEEL ALIGNMENT
	Mismatched tires	Check tires sizes
	Restricted brake lines or hoses	Check hose routing
	Loose or malfunctioning caliper	See DISC BRAKES or BRAKE SYSTEM
	Bent shoe or oily linings	See DRUM BRAKES or BRAKE SYSTEM
	Malfunctioning rear brakes	See DRUM, DISC BRAKES or BRAKE SYSTEM
	Loose suspension parts	See SUSPENSION
Noises Without Brakes Applied	Front linings worn out	Replace linings
	Dust or oil on drums or rotors	See DRUM, DISC BRAKES or BRAKE SYSTEM
Noises With Brakes Applied	Insulator on outboard shoe damaged	See DISC BRAKES or BRAKE SYSTEM
	Incorrect pads or linings	Replace pads or linings
Brake Rough, Chatters or Pulsates	Excessive lateral runout	Check rotor runout

	Parallelism not to specifications	Reface or replace rotor
	Wheel bearings not adjusted	See SUSPENSION
	Rear drums out-of-round	Reface or replace drums
	Disc pad reversed, steel against rotor	Remove and reinstall pad
Excessive Pedal Effort	Malfunctioning power unit	See POWER BRAKES or BRAKE SYSTEM
	Partial system failure	Check fluid and pipes
	Worn disc pad or lining	Replace pad or lining
	Caliper piston stuck or sluggish	See DISC BRAKES or BRAKE SYSTEM
	Master cylinder piston stuck	See MASTER CYLINDERS or BRAKE SYSTEM
	Brake fade due to incorrect pads for linings	Replace pads or linings
	Linings or pads glazed	Replace pads or linings
	Worn drums	Reface or replace drums
Excessive Pedal Travel	Partial brake system failure	Check fluid and pipes
	Insufficient fluid in master cylinder	See MASTER CYLINDERS or BRAKE SYSTEM
	Air trapped in system	See BRAKE BLEEDING or BRAKE SYSTEM
	Rear brakes not adjusted	See Adjustments in DRUM BRAKES or BRAKE SYSTEM
	Bent shoe or lining	See DRUM BRAKES or BRAKE SYSTEM
	Plugged master cylinder cap	See MASTER CYLINDERS or BRAKE SYSTEM

	Improper brake fluid	Replace brake fluid
Pedal Travel Decreasing	Compensating port plugged	See MASTER CYLINDERS or BRAKE SYSTEM
	Swollen cup in master cylinder	See MASTER CYLINDERS or BRAKE SYSTEM
	Master cylinder piston not returning	See MASTER CYLINDERS or BRAKE SYSTEM
	Weak shoe retracting springs	See DRUM BRAKES BRAKE SYSTEM
	Wheel cylinder piston sticking	See DRUM BRAKES or BRAKE SYSTEM
Dragging Brakes	Master cylinder pistons not returning	See MASTER CYLINDERS BRAKE SYSTEM
	Restricted brake lines or hoses	Check line routing
	Incorrect parking brake adjustment	See DRUM BRAKES BRAKE SYSTEM
	Parking Brake cables frozen	See DRUM BRAKES BRAKE SYSTEM
	Incorrect installation of inboard disc pad	Remove and replace correctly
	Power booster output rod too long	See POWER BRAKE UNITS BRAKE SYSTEM
	Brake pedal not returning freely	See DISC, DRUM BRAKES BRAKE SYSTEM
Brakes Grab or Uneven Braking Action	Malfunction of combination valve	See CONTROL VALVE or BRAKE SYSTEM
	Malfunction of power brake unit	See POWER BRAKE UNITS or BRAKE SYSTEM

	Binding brake pedal	See DISC, DRUM BRAKES or BRAKE SYSTEM
Pulsation or Roughness	Uneven pad wear caused by caliper	See DISC BRAKES or BRAKE SYSTEM
	Uneven rotor wear	See DISC BRAKES or BRAKE SYSTEM
	Drums out-of-round	Reface or replace drums

CARBURETOR TROUBLE SHOOTING:

READ THIS FIRST:

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COLD START SYMPTOMS

BASIC COLD START SYMPTOMS TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Won't Start	Choke not closing	Check choke operation, see FUEL SYSTEMS
	Choke linkage bent	Check linkage, see FUEL SYSTEM
Engine Starts, Then Dies	Choke vacuum kick setting too wide	Check setting and adjust see, FUEL SYSTEMS
	Fast idle RPM too low	Reset RPM to specif-ication, see TUNE-UP
	Fast idle cam index incorrect	Reset fast idle cam index, see FUEL SYSTEMS
	Vacuum leak	Inspect vacuum system for leaks

	Low fuel pump outlet	Repair or replace pump, see FUEL SYSTEMS
	Low carburetor fuel level	Check float setting see FUEL SYSTEM
Engine Quits Under Load	Choke vacuum kick setting incorrect	Reset vacuum kick setting,see FUEL SYSTEMS
	Fast idle cam index incorrect	Reset fast idle cam index, see FUEL SYSTEM
	Incorrect hot fast idle speed RPM	Reset fast idle RPM, see TUNE-UP
Engine Starts, Runs Up,Then Idles, Slowly With Black Smoke	Choke vacuum kick set too narrow	Reset vacuum kick, see FUEL SYSTEMS
	Fast idle cam index incorrect	Reset fast idle cam index, see FUEL SYSTEMS
	Hot fast idle RPM too low	Reset fast idle RPM, see TUNE-UP

HOT STARTING SYMPTOMS

BASIC HOT START SYMPTOMS TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Won't Start	Engine flooded	Allow fuel to evaporate

COLD ENGINE DRIVEABILITY SYMPTOMS

BASIC COLD ENGINE DRIVEABILITY SYMPTOMS TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Stalls in Gear	Choke vacuum kick setting incorrect	Reset choke vacuum kick, see FUEL SYSTEMS
	Fast idle RPM incorrect	Reset fast idle RPM, see TUNE-UP

	Fast idle cam index incorrect	Reset fast idle cam see FUEL SYSTEMS
Acceleration Sag or Stall	Defective choke control switch	Replace choke control switch
	Choke vacuum kick setting incorrect	Reset choke vacuum kick see, FUEL SYSTEMS
	Float level incorrect (too low)	Adjust float level, FUEL SYSTEMS
	Accelerator pump defective	Repair or replace pump see FUEL SYSTEMS
	Secondary throttles not closed	Inspect lockout adjustment,see FUEL SYSTEMS
Sag or Stall After Warmup	Defective choke control switch	Replace choke control switch, see FUEL SYSTEMS
	Defective accelerator pump	Replace pump, see FUEL SYSTEMS
	Float level incorrect (too low)	Adjust float level, see FUEL SYSTEMS
Backfiring & Black Smoke	Plugged heat crossover system	Remove restriction

WARM ENGINE DRIVEABILITY SYMPTOM

BASIC WARM ENGINE DRIVEABILITY SYMPTOMS TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Hesitation With Small Amount of Gas Pedal Movement	Vacuum leak	Inspect vacuum lines
	Accelerator pump weak or inoperable	Replace pump, see FUEL SYSTEMS
	Float level setting too low	Reset float level, see,FUEL SYSTEMS
	Metering rods sticking or binding	Inspect and/or replace rods, see

		FUEL SYSTEMS
	Carburetor idle or transfer system plugged	Inspect system and remove restriction
	Frozen or binding heated air inlet	Inspect heated air door for binding
Hesitation With Heavy Gas Pedal Movement	Defective accelerator pump	Replace pump, see FUEL SYSTEMS
	Metering rod carrier sticking or binding	Remove restriction
	Large vacuum leak	Inspect vacuum system and repair leak
	Float level setting too low	Reset float level, see FUEL SYSTEMS
	Defective fuel pump, lines or filter	Inspect pump, lines and filter
	Air door setting incorrect	Adjust air door setting, see FUEL

CHARGING SYSTEM TROUBLE SHOOTING

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BASIC CHARGING SYSTEM TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Vehicle Will Not Start	Dead battery	Check battery cells, alternator belt tension and alternator output
	Loose or corroded battery connections	Check all charging system connections
	Ignition circuit or switch	Check and replace as

	malfunction	necessary
Alternator Light Stays On With Engine Running	Loose or worn alternator drive belt	Check alternator drive tension and condition, See Belt Adjustment in TUNE-UP article in the TUNE-UP section
	Loose alternator wiring connections	Check all charging system connections
	Short in alternator light wiring	See Indicator Warning Lights in STANDARD INSTRUMENTS in the ACCESSORIES & EQUIPMENT section
	Defective alternator stator or diodes	See Bench Tests in ALTERNATOR article
	Defective regulator	See Regulator Check in ALTERNATOR article
Alternator Light Stays Off With Ignition Switch ON	Blown fuse	See WIRING DIAGRAMS
	Defective alternator	See Testing in ALTERNATOR article
	Defective indicator light bulb or socket	See Indicator Warning Lights in STANDARD INSTRUMENTS in the ACCESSORIES & EQUIPMENT section
Alternator Light Stays OFF With Ignition Switch ON	Short in alternator wiring	See On-Vehicle Tests in ALTERNATOR article
	Defective rectifier bridge	See Bench Tests in ALTERNATOR article
Lights or Fuses Burn Out Frequently	Defective alternator wiring	See On-Vehicle Tests in ALTERNATOR article
	Defective regulator	See Regulator Check in ALTERNATOR article

	Defective battery	Check and replace as necessary
Ammeter Gauge Shows Discharge	Loose or worn drive belt	Check alternator drive belt tension and condition. See Belt Adjustment in TUNE-UP article in the TUNE-UP section
	Defective wiring	Check all wires and wire connections
	Defective alternator or regulator	See Bench Tests and On-Vehicle Tests in ALTERNATOR article
	Defective ammeter, or improper ammeter wiring connection	See Testing in STANDARD INSTRUMENTS in the ACCESSORIES & EQUIPMENT section
Noisy Alternator	Loose drive pulley	Tighten drive pulley attaching nut
	Loose mounting bolts	Tighten all alternator mounting bolts
	Worn or dirty bearings	See Bearing Replacement ALTERNATOR article
	Defective diodes or stator	See Bench Test in ALTERNATOR article
Battery Does Stay Charged	Loose or worn drive belt	Check alternator drive belt tension and condition. See Belt Adjustment in appropriate TUNE-UP article in the TUNE-UP section
	Loose or corroded battery connections	Check all charging system connections
	Loose alternator connections	Check all charging system connections
	Defective alternator or battery	See On-Vehicle Tests and Bench Tests in

		ALTERNATOR article
	Add-on electrical accessories exceeding alternator capacity	Install larger alternator
Battery Overcharged-Uses Too Much Water	Defective battery	Check alternator output and repair as necessary
	Defective alternator	See On-Vehicle Test and Bench Tests in ALTERNATOR article
	Excessive alternator voltage	Check alternator output and repair as necessary

CLUTCH TROUBLE SHOOTING

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BASIC CLUTCH TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Chattering or Grabbing	Incorrect clutch adjustment	Adjust clutch
	Oil, grease or glaze on facings	Disassemble and clean or replace
	Loose "U" joint flange	See DRIVE AXLES article
	Worn input shaft spline	Replace input shaft
	Binding pressure plate	Replace pressure plate
	Binding release lever	See CLUTCH article
	Binding clutch disc hub	Replace clutch disc
	Unequal pressure plate contact	Replace worn/misaligned components
	Loose/bent clutch disc	Replace clutch disc

	Incorrect transmission alignment	Realign transmission
	Worn pressure plate, disc or flywheel	Replace damaged components
	Broken or weak pressure springs	Replace pressure plate
	Sticking clutch pedal	Lubricate clutch pedal & linkage
	Incorrect clutch disc facing	Replace clutch disc
	Engine loose in chassis	Tighten all mounting bolts
Failure to Release	Oil or grease on clutch facings	Clean or replace clutch disc
	Incorrect release lever or pedal adjustment	See CLUTCH article
	Worn or broken clutch facings	Replace clutch disc
	Bent clutch disc or pressure plate	Replace damaged components
	Clutch disc hub binding on input shaft	Clean or replace clutch disc and/or input shaft
	Binding pilot bearing	Replace pilot bearing
	Sticking release bearing sleeve	Replace release bearing and/or sleeve
	Binding clutch cable	See CLUTCH article
	Defective clutch master	Replace master cylinder
	Defective clutch slave	Replace slave cylinder
	Air in hydraulic system	Bleed hydraulic system
Rattling	Weak or broken release lever spring	Replace spring and check alignment
	Damaged pressure plate	Replace pressure plate

	Broken clutch return spring	Replace return spring
	Worn splines on clutch disc or input shaft	Replace clutch disc and/or input shaft
	Worn clutch release bearing	Replace release bearing
	Dry or worn pilot bearing	Lubricate or replace pilot bearing
	Unequal release lever contact	Align or replace release lever
	Incorrect pedal free play	Adjust free play
	Warped or damaged clutch disc	Replace damaged components
Slipping	Pressure springs worn or	Release pressure plate
	Oily, greasy or worn facings	Clean or replace clutch disc
	Incorrect clutch alignment	Realign clutch assembly
	Warped clutch disc or pressure plate	Replace damaged components
	Binding release levers or clutch pedal	Lubricate and/or replace release components
Squeaking	Worn or damaged release	Replace release bearing
	Dry or worn pilot or release bearing	Lubricate or replace assembly
	Pilot bearing turning in crankshaft	Replace pilot bearing and/or crankshaft
	Worn input shaft bearing	Replace bearing and seal
	Incorrect transmission alignment	Realign transmission
	Dry release fork between pivot	Lubricate release fork and pivot
Heavy and/or Stiff Pedal	Sticking release bearing sleeve	Replace release bearing and/or sleeve

	Dry or binding clutch pedal hub	Lubricate and align components
	Floor mat interference with pedal	Lay mat flat in proper area
	Dry or binding ball/fork pivots	Lubricate and align components
	Faulty clutch cable	Replace clutch cable
Noisy Clutch Pedal	Faulty interlock switch	Replace interlock switch
	Self-adjuster ratchet noise	Lubricate or replace self-adjuster
	Speed control interlock switch	Lubricate or replace interlock switch
Clutch Pedal Sticks Down	Binding clutch cable	See CLUTCH article
	Springs weak in pressure plate	Replace pressure plate
	Binding in clutch linkage	Lubricate and free linkage
Noisy	Dry release bearing	Lubricate or replace release bearing
	Dry or worn pilot bearing	Lubricate or replace bearing
	Worn input shaft bearing	Replace bearing
Transmission Click	Weak springs in pressure plate	Replace pressure plate
	Release fork loose on ball stud	Replace release fork and/or ball stud
	Oil on clutch disc damper	Replace clutch disc
	Broken spring in slave cylinder	Replace slave cylinder

COOLING SYSTEM TROUBLE SHOOTING

TROUBLE SHOOTING - BASIC PROCEDURES

Article Text (p. 15)

1993 Volkswagen EuroVan

For Volkswagen Technical Site

Saturday, March 18, 2000 10:38PM

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COOLING SYSTEM TROUBLE SHOOTING

CONDITION	POSSIBLE CAUSE	CORRECTION
Overheating	Coolant Leak	Fill/Pressure Test System
	A/C Condenser Fins Clogged	Remove/Clean Condenser
	Radiator Fins Clogged	Remove/Clean Radiator
	Thermostat Stuck Closed	Replace Thermostat
	Clogged Cooling System Passages	Clean/Flush Cooling System
	Water Pump Malfunction	Replace Water Pump
	Fan Clutch Malfunction	Replace Fan Clutch
	Retarded Ignition Timing	Reset Ignition Timing
	Cooling Fan Malfunction	Test Cooling Fan/ Circuit
	Cooling Fan Motor Malfunction	Test Fan Motor
	Cooling Fan Relay Malfunction	Test Fan Relay
	Faulty Radiator Cap	Replace Radiator Cap
	Broken/Slipping Fan Belt	Replace Fan Belt
	Restricted Exhaust	Repair Exhaust System
Corrosion	Impurities In Coolant	Clean/Flush System
Coolant Leakage	Damaged hose	Replace Hose
	Leaky Water Pump	Replace Water Pump
	Damaged Radiator Seam	Replace/Repair Radiator

	Leaky Thermostat Cover	Replace Thermostat Cover
	Cylinder Head Problem	Check Head/Head Gasket
	Leaky Freeze Plugs	Replace Freeze Plugs
Recovery System Inoperative		
	Loose and/or Defective Radiator Cap	Replace Radiator Cap
	Overflow Tube Clogged and/or Leaking	Repair Tube
	Recovery Bottle Vent Restricted	Clean Vent
No Heater Core Flow		
	Collapsed Heater Hose	Replace Heater Hose
	Plugged Heater Core	Clean/Replace Heater Core
	Faulty Heater Valve	Replace Heater Valve

DIESEL ENGINE TROUBLE SHOOTING

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NOTE: Diesel engines mechanical diagnosis is the same as gasoline engines for items such as noisy valves, bearings, pistons, etc. The following trouble shooting covers only items pertaining to diesel engines.

BASIC DIESEL ENGINE TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Won't Crank	Bad battery connections or dead batteries	Check connections and/or replace batteries
	Bad starter connections or bad starter	Check connections and/or replace batteries

Engine Cranks Slowly, Won't Start	Bad battery connections or dead batteries	Check connections and/or replace batteries
	Engine oil too heavy	Replace engine oil
Engine Cranks Normally, But Will Not Start	Glow plugs not functioning	Check glow plug system, see FUEL SYSTEMS
	Glow plug control not functioning	Check controller, see FUEL SYSTEMS
	Fuel not injected into cylinders	Check fuel injectors, see FUEL SYSTEMS
	No fuel to injection pump	Check fuel delivery system
	Fuel filter blocked	Replace fuel filter
	Fuel tank filter blocked	Replace fuel tank filter
	Fuel pump not operating	Check pump operation and/or replace pump
	Fuel return system blocked	Inspect system and remove restriction
	No voltage to fuel solenoid	Check solenoid and connections
	Incorrect or contaminated fuel	Replace fuel
	Incorrect injection pump timing	Re-adjust pump timing, see FUEL SYSTEMS
	Low compression	Check valves, pistons, rings, see ENGINES
	Injection pump malfunction	Inspect and/or replace injection pump
Engine Starts, Won't Idle	Incorrect slow idle adjustment	Reset idle adjustment, see TUNE-UP
	Fast idle solenoid malfunctioning	Check solenoid and connections
	Fuel return system blocked	Check system and remove restrictions
	Glow plugs go off too soon	See glow plug diagnosis in FUEL SYSTEMS
	Injection pump timing incorrect	Reset pump timing, see FUEL SYSTEMS
	No fuel to injection pump	Check fuel delivery system
	Incorrect or contaminated fuel	Replace fuel
	Low compression	Check valves, piston, rings, see ENGINES
	Injection pump malfunction	Replace injection pump, see FUEL SYSTEMS
	Fuel solenoid closes in RUN position	Check solenoid and connections

Engines Starts/ Idles Rough W/out Smoke or Noise	Incorrect slow idle adjustment	Reset slow idle, see TUNE-UP
	Injection line fuel leaks	Check lines and connections
	Fuel return system blocked	Check lines and connections
	Air in fuel system	Bleed air from system
	Incorrect or contaminated fuel	Replace fuel
	Injector nozzle malfunction	Check nozzles, see FUEL SYSTEMS
Engines Starts and Idles Rough W/out Smoke or Noise, But Clears After Warm-Up	Injection pump timing incorrect	Reset pump timing, see FUEL SYSTEMS
	Engine not fully broken in	Put more miles on engine
	Air in system	Bleed air from system
	Injector nozzle malfunction	Check nozzles, see FUEL SYSTEMS
Engine Idles Correctly, Misfires Above Idle	Blocked fuel filter	Replace fuel filter
	Injection pump timing incorrect	Reset pump timing, see FUEL SYSTEMS
	Incorrect or contaminated fuel	Replace fuel
Engine Won't Return To Idle	Fast idle adjustment incorrect	Reset fast idle, see TUNE-UP
	Internal injection pump malfunction	Replace injection pump, see FUEL SYSTEMS
	External linkage binding	Check linkage and remove binding
Fuel Leaks On Ground	Loose or broken fuel line	Check lines and connections
	Internal injection pump seal leak	Replace injection pump, see FUEL SYSTEMS
Cylinder Knocking Noise	Injector nozzles sticking open	Test injectors, see FUEL SYSTEMS
	Very low nozzle opening pressure	Test injectors and/or replace
Loss of Engine Power	Restricted air intake	Remove restriction
	EGR valve malfunction	Replace EGR valve
	Blocked or damaged exhaust system	Remove restriction and/or replace components
	Blocked fuel tank filter	Replace filter
	Restricted fuel filter	Remove restriction and/or replace filter

	Block vent in gas cap	Remove restriction and/or replace cap
	Tank-to-injection pump fuel supply blocked	Check fuel lines and connections
	Blocked fuel return system	Remove restriction
	Incorrect or contaminated fuel	Replace fuel
	Blocked injector nozzles	Check nozzle for blockage, see FUEL SYSTEMS
	Low compression	Check valves, rings, pistons, see ENGINES
Loud Engine Noise With Black Smoke	Basic timing incorrect	Reset timing, see FUEL SYSTEMS
	EGR valve malfunction	Replace EGR valve
	Internal injection pump malfunction	Replace injection pump, see FUEL SYSTEMS
	Incorrect injector pump housing pressure	Check pressure, see FUEL SYSTEMS
Engine Overheating	Cooling system leaks	Check cooling system and repair leaks
	Belt slipping or damaged	Check tension and/or replace belt
	Thermostat stuck closed	Remove and replace thermostat, see ENGINE COOLING
	Head gasket leaking	Replace head gasket
Oil Light on at Idle	Low oil pump pressure	Check oil pump operation, see ENGINES
	Oil cooler or line restricted	Remove restriction and/or replace cooler
Engine Won't Shut Off	Injector pump fuel solenoid does not return fuel valve to OFF position	Remove and check solenoid and replace if needed

VACUUM PUMP DIAGNOSIS

Excessive Noise	Loose pump-to-drive assembly screws	Tighten screws
	Loose tube on pump assembly	Tighten tube
	Valves not functioning properly	Replace valves
Oil Leakage	Loose end plug	Tighten end plug
	Bad seal crimp	Remove and re-crimp seal

DRIVE AXLE - NOISE DIAGNOSIS

UNRELATED NOISES

Some driveline trouble symptoms are also common to the engine, transmission, wheel bearings, tires, and other parts of the vehicle. Ensure cause of trouble actually is in the drive axle before adjusting, repairing, or replacing any of its parts.

NON-DRIVE AXLE NOISES

A few conditions can sound just like drive axle noise and have to be considered in pre-diagnosis. The 4 most common noises are exhaust, tires, CV/universal joints and wheel trim rings.

In certain conditions, the pitch of the exhaust gases may sound like gear whine. At other times, it may be mistaken for a wheel bearing rumble.

Tires, especially radial and snow, can have a high-pitched tread whine or roar, similar to gear noise. Also, some non-standard tires with an unusual tread construction may emit a roar or whine.

Defective CV/universal joints may cause clicking noises or excessive driveline play that can be improperly diagnosed as drive axle problems.

Trim and moldings also can cause a whistling or whining noise. Ensure none of these components are causing the noise before disassembling the drive axle.

GEAR NOISE

A "howling" or "whining" noise from the ring and pinion gear can be caused by an improper gear pattern, gear damage, or improper bearing preload. It can occur at various speeds and driving conditions, or it can be continuous.

Before disassembling axle to diagnose and correct gear noise, make sure that tires, exhaust, and vehicle trim have been checked as possible causes.

CHUCKLE

This is a particular rattling noise that sounds like a stick against the spokes of a spinning bicycle wheel. It occurs while decelerating from 40 MPH and usually can be heard until vehicle comes to a complete stop. The frequency varies with the speed of the vehicle.

A chuckle that occurs on the driving phase is usually caused by excessive clearance due to differential gear wear, or by a damaged tooth on the coast side of the pinion or ring gear. Even a very small tooth nick or a ridge on the edge of a gear tooth is enough the cause the noise.

This condition can be corrected simply by cleaning the gear tooth nick or ridge with a small grinding wheel. If either gear is damaged or scored badly, the gear set must be replaced. If metal has

broken loose, the carrier and housing must be cleaned to remove particles that could cause damage.

KNOCK

This is very similar to a chuckle, though it may be louder, and occur on acceleration or deceleration. Knock can be caused by a gear tooth that is damaged on the drive side of the ring and pinion gears. Ring gear bolts that are hitting the carrier casting can cause knock. Knock can also be due to excessive end play in the axle shafts.

CLUNK

Clunk is a metallic noise heard when an automatic transmission is engaged in Reverse or Drive, or when throttle is applied or released. It is caused by backlash somewhere in the driveline, but not necessarily in the axle. To determine whether driveline clunk is caused by the axle, check the total axle backlash as follows:

1) Raise vehicle on a frame or twinpost hoist so that drive wheels are free. Clamp a bar between axle companion flange and a part of the frame or body so that flange cannot move.
2) On conventional drive axles, lock the left wheel to keep it from turning. On all models, turn the right wheel slowly until it is felt to be in Drive condition. Hold a chalk marker on side of tire about 12" from center of wheel. Turn wheel in the opposite direction until it is again felt to be in Drive condition.
3) Measure the length of the chalk mark, which is the total axle backlash. If backlash is one inch or less, drive axle is not the source of clunk noise.

BEARING WHINE

Bearing whine is a high-pitched sound similar to a whistle. It is usually caused by malfunctioning pinion bearings. Pinion bearings operate at drive shaft speed. Roller wheel bearings may whine in a similar manner if they run completely dry of lubricant. Bearing noise will occur at all driving speeds. This distinguishes it from gear whine, which usually comes and goes as speed changes.

BEARING RUMBLE

Bearing rumble sounds like marbles being tumbled. It is usually caused by a malfunctioning wheel bearing. The lower pitch is because the wheel bearing turns at only about 1/3 of drive shaft speed.

CHATTER ON TURNS

This is a condition where the entire front or rear of vehicle vibrates when vehicle is moving. The vibration is plainly felt as well

as heard. Extra differential thrust washers installed during axle repair can cause a condition of partial lock-up that creates this chatter.

AXLE SHAFT NOISE

Axle shaft noise is similar to gear noise and pinion bearing whine. Axle shaft bearing noise will normally distinguish itself from gear noise by occurring in all driving modes (Drive, cruise, coast and float), and will persist with transmission in Neutral while vehicle is moving at problem speed.

If vehicle displays this noise condition, remove suspect axle shafts, replace wheel seals and install a new set of bearings. Re-evaluate vehicle for noise before removing any internal components.

VIBRATION

Vibration is a high-frequency trembling, shaking or grinding condition (felt or heard) that may be constant or variable in level and can occur during the total operating speed range of the vehicle.

The types of vibrations that can be felt in the vehicle can be divided into 3 main groups:

* Vibrations of various unbalanced rotating parts of the vehicle.
* Resonance vibrations of the body and frame structures caused by rotating of unbalanced parts.
* Tip-in moans of resonance vibrations from stressed engine or exhaust system mounts or driveline flexing modes.

DRIVE AXLE - RWD TROUBLE SHOOTING

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DRIVE AXLE (RWD) TROUBLE SHOOTING

CONDITION	POSSIBLE CAUSE	CORRECTION
Knocking or Clunking		
	Differential Side Gear Clearance	Check Clearance
	Worn Pinion Shaft	Replace Pinion Shaft
	Axle Shaft End Play	Check End Play

	Missing Gear Teeth	Check Differential/ Replace Gear
	Wrong Axle Backlash	Check Backlash
	Misaligned Driveline	Realign Driveline
Clinking During Engagement		
	Side Gear Clearance	Check Clearance
	Ring and Pinion Backlash	Check Backlash
	Worn/Loose Pinion Shaft	Replace Shaft/Bearing
	Bad "U" Joint	Replace "U" Joint
	Sticking Slip Yoke	Lube Slip Yoke
	Broken Rear Axle Mount	Replace Mount
	Loose Drive Shaft Flange	Check Flange
Click/Chatter On Turns		
	Differential Side Gear Clearance	Check Clearance
	Wrong Turn On Plates (1)	Replace Clutch Plates
	Wrong Differential Lubricant (1)	Change Lubricant
Knock Or Click	Flat Spot on Rear Wheel Bearing	Replace Wheel Bearing
Low Vibration At All Speeds		
	Faulty Wheel Bearing	Replace Wheel Bearing
	Faulty "U" Joint	Replace "U" Joint
	Faulty Drive Shaft	Balance Drive Shaft
	Faulty Companion Flange	Replace Flange
	Faulty Slip Yoke Flange	Replace Flange

(1) - Limited slip differential only.

FWD AXLE SHAFTS & CV JOINTS TROUBLE SHOOTING

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BASIC FWD AXLE SHAFTS & CV JOINTS TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE
Grease Leaks	CV boot torn or cracked
Clicking Noise on Cornering	Damaged outer CV
Clunk Noise on Acceleration	Damaged inner CV
Vibration or Shudder on Acceleration	Sticking, damaged or worn CV Misalignment or spring height

FUEL INJECTION TROUBLE SHOOTING

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BASIC FUEL INJECTION TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Won't Start (Cranks Normally)	Cold start valve inoperative	Test valve and circuit
	Poor connection;vacuum or wiring	Check vacuum and electrical connections
	Contaminated fuel	Test fuel for water or alcohol
	Defective fuel pump relay or circuit	Test relay and wiring
	Battery too low	Charge and test battery
	Low fuel pressure	Test pressure regul-

		ator and fuel pump, check for restricted lines and filters
	No distributor reference pulses	Repair ignition system as necessary
	Open coolant temperature sensor circuit	Test sensor and wiring
	Shorted W.O.T. switch in T.P.S.	Disconnect W.O.T. switch, engine should start
	Defective ECM	Replace ECM
	Fuel tank residual pressure valve leaks	Test for fuel pressure drop after shut down
Hard Starting	Disconnected hot air tube to air cleaner	Reconnect tube and test control valve
	Defective Idle Air Control (IAC) valve	Test valve operation and circuit
	Shorted, open or misadjusted T.P.S.	Test and adjust or replace T.P.S.
	EGR valve open	Test EGR valve and control circuit
	Poor Oxygen sensor signal	Test for shorted or circuit
	Incorrect mixture from PCV system	Test PCV for flow, check sealing of oil filter cap
Poor High Speed Operation	Low fuel pump volume	Faulty pump or restricted fuel lines or filters
	Poor MAP sensor signal	Test MAP sensor, vacuum hose and wiring
	Poor Oxygen sensor signal	Test for shorted or open sensor or circuit
	Open coolant temperature	Test sensor and

	sensor circuit	wiring
	Faulty ignition operation	Check wires for cracks or poor connections, test secondary voltage with oscilloscope
	Contaminated fuel	Test fuel for water or alcohol
	Intermittent ECM ground	Test ECM ground connection for resistance
	Restricted air cleaner	Replace air cleaner
	Restricted exhaust system	Test for exhaust manifold back pressure
	Poor MAF sensor signal	Check leakage between sensor and manifold
	Poor VSS signal	If tester for ALCL hook-up is available check that VSS reading matches speedometer
Ping or Knock on Acceleration	Poor Knock sensor signal	Test for shorted or open sensor or circuit
	Poor Baro sensor signal	Test for shorted or open sensor or circuit
	Improper ignition timing	See VEHICLE EMISSION CONTROL LABEL (where applicable)
	Check for engine overheating problems	Low coolant, loose belts or electric cooling fan inoperative

NOTE: For additional electronic fuel injection trouble shooting information, see the appropriate article in the ENGINE PERFORMANCE section (not all vehicles have Computer Engine

Control articles). Information is provided there for diagnosing fuel system problems on vehicles with electronic fuel injection.

GASOLINE ENGINE - MECHANICAL TROUBLE SHOOTING

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BASIC GASOLINE ENGINE - MECHANICAL TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Lopes At Idle	Intake manifold-to-head leaks	Replace manifold gasket, See ENGINES
	Blown head gasket	Replace head gasket, See ENGINES
	Worn timing gears, chain or sprocket	Replace gears, chain or sprocket
	Worn camshaft lobes	Replace camshaft, See ENGINES
	Overheated engine	Check cooling system, See COOLING
	Blocked crankcase vent valve	Remove restriction
	Leaking EGR valve	Repair leak and/or replace valve
	Faulty fuel pump	Replace fuel pump
Engine Has Low Power	Leaking fuel pump	Repair leak and/or replace fuel pump
	Excessive piston-to-bore clearance	Install larger pistons, See ENGINES
	Sticking valves or weak valve springs	Check valve train components, See ENGINES
	Incorrect valve timing	Reset valve timing, See ENGINES
	Worn camshaft lobes	Replace camshaft, See ENGINES
	Blown head gasket	Replace camshaft, See ENGINES
	Clutch slipping	Adjust pedal and/or replace components, See ENGINES
	Engine overheating	Check cooling system, See COOLING
	Auto. Trans. pressure	

	regulator valve faulty	Replace pressure regulator valve
	Auto. Trans. fluid level too low	Add fluid as necessary
	Improper vacuum diverter valve operation	Replace vacuum diverter valve
	Vacuum leaks	Inspect vacuum system and repair as required
	Leaking piston rings	Replace piston rings, See ENGINES
Faulty High Speed Operation	Low fuel pump volume	Replace fuel pump
	Leaking valves or worn	Replace valves and/or springs, See ENGINES
	Incorrect valve timing	Reset valve timing,See ENGINES
	Intake manifold restricted	Remove restriction
	Worn distributor shaft	Replace distributor
Faulty Acceleration	Improper fuel pump stroke	Remove pump and reset pump stroke
	Incorrect ignition timing	Reset ignition timing, See TUNE-UP
	Leaking valves	Replace valves, See ENGINES
	Worn fuel pump diaphragm or piston	Replace diaphragm or piston
Intake Backfire	Improper ignition timing	Reset ignition timing, See TUNE-UP
	Faulty accelerator pump discharge	Replace accelerator pump
	Improper choke operation	Check choke and adjust as required
	Defective EGR valve	Replace EGR valve
	Fuel mixture too lean	Reset air/fuel mixture, See TUNE-UP
	Choke valve initial clearance too large	Reset choke valve initial clearance
Exhaust Backfire	Vacuum leak	Inspect and repair vacuum system
	Faulty vacuum diverter valve	Replace vacuum diverter valve
	Faulty choke operation	Check choke and adjust as required
	Exhaust system leak	repair exhaust system leak
Engine	Ignition timing too far	Reset ignition timing,

Detonation	advanced	See TUNE-UP
	Faulty ignition system	Check ignition timing, See TUNE-UP
	Spark plugs loose or faulty	Retighten or replace plugs
	Fuel delivery system clogged	Inspect lines, pump and filter for clog
	EGR valve inoperative	Replace EGR valve
	PCV system inoperative	Inspect and/or replace hoses or valve
	Vacuum leaks	Check vacuum system and repair leaks
	Excessive combustion chamber deposits	Remove built-up deposits
	Leaking, sticking or broken valves	Inspect and/or replace valves
External Oil Leakage	Fuel pump improperly seated or worn gasket	Remove pump, replace gasket and seat properly
	Oil pan gasket broken or pan bent	Straighten pan and replace gasket
	Timing chain cover gasket broken	Replace timing chain cover gasket
	Rear main oil seal worn	Replace rear main oil seal
	Oil pan drain plug not seated properly	Remove and reinstall drain plug
	Camshaft bearing drain hole blocked	Remove restriction
	Oil pressure sending switch leaking	Remove and reinstall sending switch
Excessive Oil Consumption	Worn valve stems or guides	Replace stems or guides, See ENGINES
	Valve "O" ring seals damaged	Replace "O" ring seals, See ENGINES
	Plugged oil drain back holes	Remove restrictions
	Improper PCV valve operation	Replace PCV valve
	Engine oil level too high	Remove excess oil
	Engine oil too thin	Replace thicker oil
	Valve stem oil deflectors damaged	Replace oil deflectors
	Incorrect piston rings	Replace piston rings, See ENGINES
	Piston ring gaps not staggered	Reinstall piston rings, See ENGINES
	Insufficient piston ring tension	Replace rings, See ENGINES
	Piston ring grooves or oil	Replace piston rings,

	return slots clogged	See ENGINES
	Piston rings sticking in grooves	Replace piston rings, See ENGINES
	Piston ring grooves excessively worn	Replace piston and rings, See ENGINES
	Compression rings installed upside down	Replace compression rings correctly, See ENGINES
	Worn or scored cylinder walls	Rebore cylinders or replace block
	Mismatched oil ring expander and rail	Replace oil ring expander and rail, See ENGINES
	Intake gasket dowels too long	Replace intake gasket dowels
	Excessive main or connecting rod bearing clearance	Replace main or connecting rod bearings, See ENGINES
No Oil Pressure	Low oil level	Add oil to proper level
	Oil pressure sender or gauge broken	Replace sender or gauge
	Oil pump malfunction	Remove and overhaul oil pump, See ENGINES
	Oil pressure relief valve sticking	Remove and reinstall valve
	Oil pump passages blocked	Overhaul oil pump, See ENGINES
	Oil pickup screen or tube blocked	remove restriction
	Loose oil inlet tube	Tighten oil inlet tube
	Loose camshaft bearings	Replace camshaft bearings, See ENGINES
	Internal leakage at oil passages	Replace block or cylinder head
Low Oil Pressure	Low engine oil level	Add oil to proper level
	Engine oil too thin	Remove and replace with thicker oil
	Excessive oil pump clearance	Reduce oil pump clearance, See ENGINES
	Oil pickup tube or screen blocked	Remove restrictions
	Main, rod or cam bearing clearance excessive	Replace bearing to reduce clearance, See ENGINES
High Oil Pressure	Improper grade of oil	Replace with proper oil
	Oil pressure relief valve stuck closed	Eliminate binding
	Oil pressure sender or gauge faulty	Replace sender or gauge

Noisy Main Bearings	Inadequate oil supply	Check oil delivery to main bearings
	Excessive main bearing clearance	Replace main bearings, See ENGINES
	Excessive crankshaft end play	Replace crankshaft, See ENGINES
	Loose flywheel or torque converter	Tighten attaching bolts
	Loose or damaged vibration damper	Tighten or replace vibration damper
	Crankshaft journals out-of-round	Re-grind crankshaft journals
	Excessive belt tension	Loosen belt tension
Noisy Connecting Rods	Excessive bearing clearance or missing bearing	Replace bearing, See ENGINES
	Crankshaft rod journal out-of-round	Re-grind crankshaft journal
	Misaligned connecting rod or cap	Remove rod or cap and realign
	Incorrectly tightened rod bolts	Remove and re-tighten rod bolts
Noisy Pistons and Rings	Excessive piston-to-bore clearance	Install larger pistons, See ENGINES
	Bore tapered or out-of-round	Rebore block
	Piston ring broken	Replace piston rings, See ENGINES
	Piston pin loose or seized	Replace piston pin, See ENGINES
	Connecting rods misaligned	Realign connecting rods
	Ring side clearance too loose or tight	Replace with larger or smaller rings
	Carbon build-up on piston	Remove carbon
Noisy Valve Train	Worn or bent push rods	Replace push rods, See ENGINES
	Worn rocker arms or bridged pivots	Replace push rods, See ENGINES
	Dirt or chips in valve lifters	Remove lifters and remove dirt/chips
	Excessive valve lifter leak-down	Replace valve lifters, See ENGINES
	Valve lifter face worn	Replace valve lifters, See ENGINES
	Broken or cocked valve springs	replace or reposition springs
	Too much valve stem-to-guide clearance	Replace valve guides, See ENGINES
	Valve bent	Replace valve, See ENGINES

	Loose rocker arms	Retighten rocker arms, See ENGINES
	Excessive valve seat run-out	Reface valve seats, See ENGINES
	Missing valve lock	Install new valve lock
	Excessively worn camshaft lobes	Replace camshaft, See ENGINES
	Plugged valve lifter oil holes	Eliminate restriction or replace lifter
	Faulty valve lifter check ball	Replace lifter check ball, See ENGINES
	Rocker arm nut installed upside down	Remove and reinstall correctly
	Valve lifter incorrect for engine	Remove and replace valve lifters
	Faulty push rod seat or lifter plunger	Replace plunger or push rod
Noisy Valves	Improper valve lash	Re-adjust valve lash, See ENGINES
	Worn or dirty valve lifters	Clean and/or replace lifters
	Worn valve guides	Replace valve guides, See ENGINES
	Excessive valve seat or face run-out	Reface seats or valve face
	Worn camshaft lobes	Replace camshaft, See ENGINES
	Loose rocker arm studs	Re-tighten rocker arm studs, See ENGINES
	Bent push rods	Replace push rods, See ENGINES
	Broken valve springs	Replace valve springs, See ENGINES
Burned,Sticking or Broken Valves	Weak valve springs or warped valves	Replace valves and/or springs, See ENGINES
	Improper lifter clearance	Re-adjust clearance or replace lifters
	Worn guides or improper guide clearance	Replace valve guides, See ENGINES
	Out-of-round valve seats or improper seat width	Re-grind valve seats
	Gum deposits on valve stems, seats or guides	Remove deposits
	Improper spark timing	Re-adjust spark timing
Broken Pistons/Rings	Undersize pistons	Replace with larger pistons, See ENGINES
	Wrong piston rings	Replace with correct rings, See ENGINES
	Out-of-round cylinder bore	Re-bore cylinder bore

	Improper connecting rod alignment	Remove and realign connecting rods
	Excessively worn ring grooves	Replace pistons, See ENGINES
	Improperly assembled piston pins	Re-assemble pin-to -piston, See ENGINES
	Insufficient ring gap clearance	Install new rings, See ENGINES
	Engine overheating	Check cooling system
	Incorrect ignition timing	Re-adjust ignition timing, See TUNE-UP
Excessive Exhaust Noise	Leaks at manifold to head, or to pipe	Replace manifold or pipe gasket
	Exhaust manifold cracked or broken	Replace exhaust manifold, See ENGINES

HEATER SYSTEM TROUBLE SHOOTING

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BASIC HEATER SYSTEM TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE
Insufficient, Erratic, or No Heat	ù Low Coolant Level ù Incorrect thermostat. ù Restricted coolant flow through heater core. ù Heater hoses plugged. ù Misadjusted control cable. ù Sticking heater control valve. ù Vacuum hose leaking. ù Vacuum hose blocked. ù Vacuum motors inoperative. ù Blocked air inlet. ù Inoperative heater blower motor. ù Oil residue on heater core fins. ù Dirt on heater core fins.
Too Much Heat	ù Improperly adjusted cables. ù Sticking heater control valve. ù No vacuum to heater control valve. ù Temperature door stuck open.

TROUBLE SHOOTING - BASIC PROCEDURES

Article Text (p. 34)

1993 Volkswagen EuroVan

For Volkswagen Technical Site

Saturday, March 18, 2000 10:39PM

Air Flow Changes During Acceleration	ù Vacuum system leak. ù Bad check valve or reservoir.
Air From Defroster At All Times	ù Vacuum system leak. ù Improperly adjusted control cables. ù Inoperative vacuum motor.
Blower Does Not Operate Correctly	ù Blown fuse. ù Blower motor windings open. ù Resistors burned out. ù Motor ground connection loose. ù Wiring harness connections loose. ù Blower motor switch inoperative. ù Blower relay inoperative. ù Fan binding or foreign object in housing. ù Fan blades broken or bent.

IGNITION SYSTEM TROUBLE SHOOTING

PLEASE READ THIS FIRST:

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IGNITION SECONDARY TROUBLE SHOOTING CHART

START: Visually inspect Spark Plug Wires, Coil Wires, Plug Wire Boots, Rotor, and Distributor Cap for signs of damage.

- OK
  - * To test secondary ignition system, modify a Spark Plug by attaching a ground wire to the body of the plug and widening the gap to 1/4-3/8".
- NOT OK
  - * Repair or replace damaged components as necessary

Disconnect spark plug wire and insert test plug. Ground plug, crank engine, and check for spark.

GOOD SPARK	NO SPARK
* If plug sparks, driveability problem is most likely NOT in the ignition system.	* Remove coil wire from the distributor and attach the modified spark plug. Ground the plug and crank engine while checking for spark.

GOOD SPARK	NO SPARK
* If plug has a good spark, the problem is in the plug wires, distributor cap, or rotor. Replace components as necessary.	* Proceed to the IGNITION PRIMARY TROUBLE SHOOTING CHECK CHART below in this article.

IGNITION PRIMARY TROUBLE SHOOTING CHART

START: Visually inspect primary ignition wires for broken, frayed, split, or cut wires. Also check for loose, corroded, or disconnected connectors.

OK	NOT OK
* Check that battery voltage is at least 11.5 volts.	* Repair or replace damaged components as necessary.

NOT OK	OK
* Replace or recharge the battery.	* Check for battery voltage at the positive terminal of the coil.

TROUBLE SHOOTING - BASIC PROCEDURES

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For Volkswagen Technical Site

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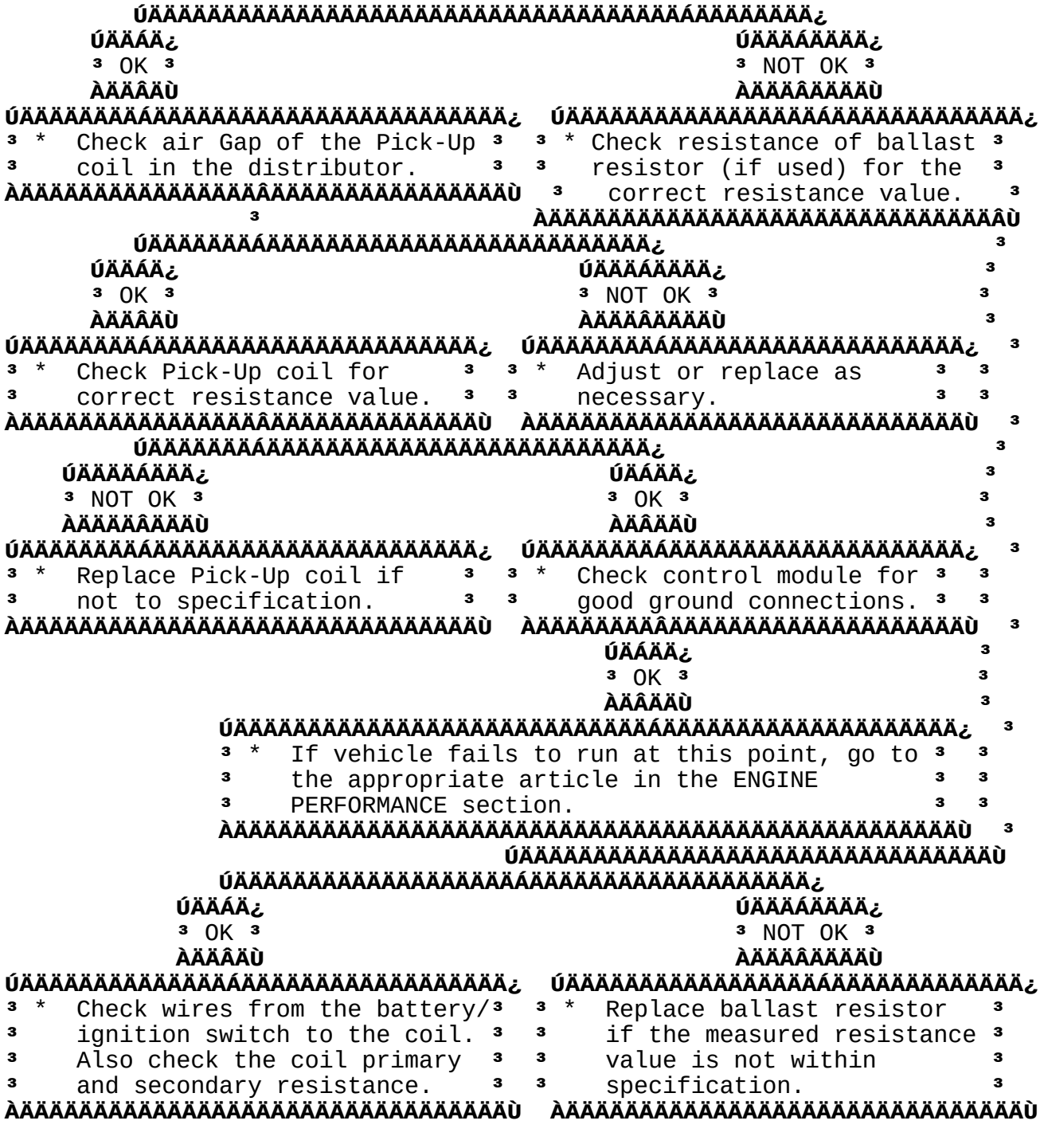

MANUAL STEERING GEAR TROUBLE SHOOTING

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BASIC MANUAL STEERING GEAR TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Rattle or Chucking Noise in Rack and Pinion	Rack and pinion mounting bracket loose	Tighten all mounting bolts
	Lack of/or incorrect lubricant	Correct as necessary
	Steering gear mounting bolts loose	Tighten all mounting bolts
Excessive Play	Front wheel bearing improperly adjusted	See FRONT SUSPENSION article
	Loose or worn steering linkage	See STEERING LINKAGE article
	Loose or worn steering gear shift	See MANUAL STEERING GEAR article
	Steering arm loose on gear shaft	See MANUAL STEERING GEAR article
	Steering gear housing bolts loose	Tighten all mounting bolts
	Steering gear adjustment too loose	See MANUAL STEERING GEAR article
	Steering arms loose on knuckles	Tighten and check steering linkage
	Rack and pinion mounting loose	Tighten all mounting bolts
	Rack and pinion out of adjustment	See adjustment in STEERING article
	Tie rod end loose	Tighten and check steering linkage
	Excessive Pitman shaft-to-ball nut lash	Repair as necessary
Poor Returnability	Lack of lubricant in ball joint or linkage	Lubricate and service systems

	Binding in linkage or ball joints	See STEERING LINKAGE and SUSPENSION article
	Improper front end alignment	See WHEEL ALIGNMENT article
	Improper tire pressure	Inflate to proper pressure
	Tie rod binding	Inflate to proper pressure
	Shaft seal rubbing shaft	See STEERING COLUMN article
Excessive Vertical Motion	Improper tire pressure	Inflate to proper pressure
	Tires, wheels or rotors out of balance	Balance tires then check wheels and rotors
	Worn or faulty shock absorbers	Check and replace if necessary
	Loose tie rod ends or steering	Tighten or replace if necessary
	Loose or worn wheel bearings	See SUSPENSION article
Steering Pulls to One Side	Improper tire pressure	Inflate to proper pressure
	Front tires are different sizes	Rotate or replace if necessary
	Wheel bearings not adjusted properly	See FRONT SUSPENSION article
	Bent or broken suspension components	See FRONT SUSPENSION article
	Improper wheel alignment	See WHEEL ALIGNMENT article
	Brakes dragging	See BRAKES article
Instability	Low or uneven tire pressure	Inflate to proper pressure

	Loose or worn wheel bearings	See FRONT SUSPENSION article
	Loose or worn idler arm bushing	See FRONT SUSPENSION article
	Loose or worn strut bushings	See FRONT SUSPENSION article
	Incorrect front wheel alignment	See WHEEL ALIGNMENT article
	Steering gear not centered	See MANUAL STEERING GEARS article
	Springs or shock	Check and replace if necessary
	Improper cross shaft	See MANUAL STEERING GEARS article

POWER STEERING TROUBLE SHOOTING

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BASIC POWER STEERING TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Rattle or Chucking Noise	Pressure hoses touching engine parts	Adjust to proper clearance
	Loose Pitman shaft	Adjust or replace if necessary
	Tie rods ends or Pitman arm loose	Tighten and check system
	Rack and pinion mounts loose	Tighten all mounting bolts
	Free play in worm and	See POWER STEERING GEAR article
	Loose sector shaft or	See POWER STEERING GEAR

	thrust bearing adjustment	
	Free play in pot coupling	See STEERING COLUMN article
	Worn shaft serrations	See STEERING COLUMN article
Growl in Steering Pump	Excessive pressure in hoses	Restricted hoses, see POWER STEERING GEAR article
	Scored pressure plates	See POWER STEERING GEAR article
	Scored thrust plates or rotor	See POWER STEERING GEAR article
	Extreme wear of cam ring	See POWER STEERING GEAR article
Rattle in Steering Pump	Vanes not installed	See POWER STEERING PUMP article
	Vanes sticking in rotor	See POWER STEERING PUMP article
Swish noise in Pump	Defective flow control valve	See POWER STEERING PUMP article
Groan in Steering Pump	Air in fluid	See POWER STEERING PUMP article
	Poor pressure hose connection	Tighten and check, replace if necessary
Squawk When Turning	Damper "O" ring on valve spool cut	See POWER STEERING PUMP article
Moan or Whine in Pump	Pump shaft bearing scored	Replace bearing and fluid
	Air in fluid or fluid level low	See POWER STEERING PUMP article
	Hose or column grounded	Check and replace if necessary
	Cover "O" ring missing or damaged	See POWER STEERING PUMP article
	Valve cover baffle	See POWER STEERING PUMP

	missing or damaged	article
	Interference of components in pump	See POWER STEERING PUMP article
	Loose or poor bracket alignment	Correct or replace if necessary
Hissing When Parking	Internal leakage in steering gear	Check valved assembly first
Chirp in Steering Pump	Loose or worn power steering belt	Adjust or replace if necessary
Buzzing When Not Steering	Noisy pump	See POWER STEERING PUMP article
	Free play in steering shaft bearing	See STEERING COLUMN article
	Bearing loose on shaft serrations	See STEERING COLUMN article
Clicking Noise in Pump	Pump slippers too long	See POWER STEERING PUMP article
	Broken slipper springs	See POWER STEERING PUMP article
	Excessive wear or nicked rotors	See POWER STEERING PUMP article
	Damaged cam contour	See POWER STEERING PUMP article
Poor Return of Wheel	Wheel rubbing against turn signal	See STEERING COLUMN SWITCHES article
	Flange rubbing steering gear adjuster	See STEERING COLUMN article
	Tight or frozen steering shaft bearing	See STEERING COLUMN article
	Steering gear out of adjustment	See POWER STEERING GEAR article
	Sticking or plugged spool valve	See POWER STEERING PUMP article
	Improper front end alignment	See WHEEL ALIGNMENT article

	Wheel bearings worn or loose	See FRONT SUSPENSION article
	Ties rods or ball joints binding	Check and replace if necessary
	Intermediate shaft joints binding	See STEERING COLUMN article
	Kinked pressure hoses	Correct or replace if necessary
	Loose housing head spanner nut	See POWER STEERING GEAR article
	Damaged valve lever	See POWER STEERING GEAR article
	Sector shaft adjusted too tight	See ADJUSTMENTS in POWER STEERING GEAR article
	Worm thrust bearing adjusted too tight	See ADJUSTMENTS in POWER STEERING GEAR article
	Reaction ring sticking in cylinder	See POWER STEERING GEAR article
	Reaction ring sticking in housing head	See POWER STEERING GEAR article
	Steering pump internal leakage	See POWER STEERING PUMP article
	Steering gear-to-column misalignment	See STEERING COLUMN article
	Lack of lubrication in linkage	Service front suspension
	Lack of lubrication in ball joints	Service front suspension
Increased Effort When Turning Wheel Fast Foaming, Milky Power Steering Fluid, Low Fluid Level or Low Pressure	High internal pump leakage	See POWER STEERING PUMP article
	Power steering pump belt slipping	Adjust or replace if necessary
	Low fluid level	Check and fill to proper level
	Engine idle speed to low	Adjust to correct

		setting
	Air in pump fluid system	See POWER STEERING PUMP article
	Pump output low	See POWER STEERING PUMP article
	Steering gear malfunctioning	See POWER STEERING GEAR article
Wheel Surges or Jerks	Low fluid level	Check and fill to proper level
	Loose fan belt	Adjust or replace if necessary
	Insufficient pump pressure	See POWER STEERING PUMP article
	Sticky flow control valve	See POWER STEERING PUMP article
	Linkage hitting oil pan at full turn	Replace bent components
Kick Back or Free Play	Air in pump fluid system	See POWER STEERING PUMP article
	Worn poppet valve in steering gear	See POWER STEERING PUMP article
	Excessive over center lash	See POWER STEERING GEAR article
	Thrust bearing out of adjustment	See POWER STEERING GEAR article
	Free play in pot coupling	See POWER STEERING PUMP article
	Steering gear coupling loose on shaft	See POWER STEERING PUMP article
	Steering disc mounting bolts loose	Tighten or replace if necessary
	Coupling loose on worm shaft	Tighten or replace if necessary
	Improper sector shaft adjustment	See POWER STEERING GEAR article

	Excessive worm piston side play	See POWER STEERING GEAR article
	Damaged valve lever	See POWER STEERING GEAR article
	Universal joint loose	Tighten or replace if necessary
	Defective rotary valve	See POWER STEERING GEAR article
No Power When Parking	Sticking flow control valve	See POWER STEERING PUMP article
	Insufficient pump pressure output	See POWER STEERING PUMP article
	Excessive internal pump leakage	See POWER STEERING PUMP article
	Excessive internal gear leakage	See POWER STEERING PUMP article
	Flange rubs against gear adjust plug	See STEERING COLUMN article
	Loose pump belt	Adjust or replace if necessary
	Low fluid level	Check and add proper amount of fluid
	Engine idle too low	Adjust to correct setting
	Steering gear-to-column misaligned	See STEERING COLUMN article
No Power, Left Turn	Left turn reaction seal "O" ring worn	See POWER STEERING GEAR article
	Left turn reaction seal damaged/missing	See POWER STEERING GEAR article
	Cylinder head "O" ring damaged	See POWER STEERING PUMP article
No Power, Right Turns	Column pot coupling bottomed	See STEERING COLUMN article

	Right turn reaction seal "O" ring worn	See POWER STEERING GEAR article
	Right turn reaction seal damaged	See POWER STEERING GEAR article
	Internal leakage through piston end plug	See POWER STEERING GEAR article
	Internal leakage through side plugs	See POWER STEERING GEAR article
Lack of Effort in Turning	Left and/or right reaction seal sticking in cylinder head	Replace, see POWER STEERING GEAR article
Wanders to One Side	Front end alignment incorrect	See WHEEL ALIGNMENT article
	Unbalanced steering gear valve	See POWER STEERING GEAR article
Low Pressure Due to Steering Pump	Flow control valve stuck or inoperative	See POWER STEERING PUMP article
	Pressure plate not flat against cam ring	See POWER STEERING PUMP article
	Extreme wear of cam ring	Replace and check adjustments
	Scored plate, thrust plate or rotor	See POWER STEERING PUMP article
	Vanes not installed properly	See POWER STEERING PUMP article
	Vanes sticking in rotor slots	See POWER STEERING PUMP article
	Cracked/broken thrust or pressure plate	See POWER STEERING PUMP article

STARTER TROUBLE SHOOTING

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BASIC STARTER TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Starter Fails to Operate	Dead battery or bad connections between starter and battery	Check battery charge and all wires and connections to starter
	Ignition switch faulty or misadjusted	Adjust or replace ignition switch
	Open circuit between starter switch ignition terminal on starter relay	Check and repair wires and connections as necessary
	Starter relay or starter defective	See Testing in STARTER article
	Open solenoid pull-in wire	See Testing in STARTER article
Starter Does Not Operate and Headlights Dim	Weak battery or dead cell	Charge or replace battery as necessary
	Loose or corroded battery connections	Check that battery connections are clean and tight
	Internal ground in starter windings	See Testing in STARTER article
	Grounded starter fields	See Testing in STARTERS
	Armature rubbing on pole shoes	See STARTER article
Starter Turns but Engine Does Not Rotate	Starter clutch slipping	See STARTER article
	Broken clutch housing	See STARTER article
	Pinion shaft rusted or dry	See STARTER article
	Engine basic timing incorrect	See Ignition Timing in TUNE-UP article
	Broken teeth on engine flywheel	Replace flywheel and check for starter pinion gear damage

Starter Will Not Crank Engine	Faulty overrunning clutch	See STARTER article
	Broken clutch housing	See STARTER article
	Broken flywheel teeth	Replace flywheel and check for starter pinion gear damage
	Armature shaft sheared or reduction gear teeth stripped	See STARTER article
	Weak battery	Charge or replace battery as necessary
	Faulty solenoid	See On-Vehicle Tests in STARTER article
	Poor grounds	Check all ground connections for tight and clean connections
	Ignition switch faulty or misadjusted	Adjust or replace ignition switch as necessary
Starter Cranks Engine Slowly	Battery weak or defective	Charge or replace battery as necessary
	Engine overheated	See ENGINE COOLING SYSTEM article
	Engine oil too heavy	Check that proper viscosity oil is used
	Poor battery-to-starter connections	Check that all between battery and starter are clean and tight
	Current draw too low or too high	See Bench Tests in STARTER article
	Bent armature, loose pole shoes screws or worn bearings	See STARTER article
	Burned solenoid contacts	Replace solenoid

	Faulty starter	Replace starter
Starter Engages Engine Only Momentarily	Engine timing too far advanced	See Ignition Timing in TUNE-UP article
	Overrunning clutch not engaging properly	Replace overrunning clutch. See STARTER article
	Broken starter clutch	See STARTER article
	Broken teeth on engine flywheel	Replace flywheel and check starter pinion gear for damage
	Weak drive assembly thrust spring	See STARTER article
	Weak hold-in coil	See Bench Tests in STARTER article
Starter Drive Will Not Engage	Defective point assembly	See Testing in STARTER article
	Poor point assembly ground	See Testing in STARTER article
	Defective pull-in coil	Replace starter solenoid
Starter Relay Does Not Close	Dead battery	Charge or replace battery as necessary
	Faulty wiring	Check all wiring and connections leading to relay
	Neutral safety switch faulty	Replace neutral safety switch
	Starter relay faulty	Replace starter relay
Starter Drive Will Not Disengage	Starter motor loose on mountings	Tighten starter attach bolts
	Worn drive end bushing	See STARTER article
	Damaged engine flywheel teeth	Replace flywheel and starter pinion gear for damage

	Drive yolk return spring broken or missing	Replace return spring
	Faulty ignition switch	Replace ignition switch
	Insufficient clearance between winding leads to solenoid terminal and main contact in solenoid	Replace starter solenoid
	Starter clutch not disengaging	Replace starter clutch
	Ignition starter switch contacts sticking	Replace ignition switch
Starter Relay Operates but Solenoid Does Not	Faulty solenoid switch, switch connections or	Check all wiring between relay and solenoid or replace relay or solenoid as necessary
	Broken lead or loose soldered connections	Repair wire or wire connections as necessary
Solenoid Plunger Vibrates When Switch is Engaged	Weak battery	Charge or replace battery as necessary
	Solenoid contacts corroded	Clean contacts or replace solenoid
	Faulty wiring	Check all wiring leading to solenoid
	Broken connections inside switch cover	Repair connections or replace solenoid
	Open hold-in wire	Replace solenoid
Low Current Draw	Worn brushes or weak	Replace brushes or brush springs as necessary
High Pitched Whine During Cranking Before Engine Fires but Engine Fires and Cranks Normally	Distance too great between starter pinion and flywheel	Align starter or check that correct starter and flywheel are being used
High Pitched	Distance too small between	

Whine After Engine Fires With Key released. Engine Fires and Cranks Normally	starter pinion and flywheel Flywheel runout contributes to the intermittent nature	

STEERING COLUMN TROUBLE SHOOTING

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BASIC STEERING COLUMN TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Noise in Steering	Coupling pulled apart	See STEERING COLUMNS article
	Column not correctly aligned	See STEERING COLUMNS article
	Broken lower joint	Replace joint
	Horn contact ring not	See STEERING COLUMN article
	Bearing not lubricated	See STEERING COLUMN article
	Shaft snap ring not properly seated	Reseat or replace snap ring
	Plastic spherical joint not lubricated	See STEERING COLUMN article
	Shroud or housing loose	Tighten holding screws
	Lock plate retaining ring not seated	See STEERING COLUMN article
	Loose sight shield	Tighten holding screws
High Steering Shaft Effort	Column assembly misaligned	See STEERING COLUMN article
	Improperly installed dust	Adjust or replace

	shield	
	Tight steering universal joint	See STEERING COLUMN article
High Shift Effort	Column is out of alignment	See STEERING COLUMN article
	Improperly installed dust shield	Adjust or replace
	Seals or bearings not lubricated	See STEERING COLUMNS article
	Mounting bracket screws too long	Replace with new shorter screws
	Burrs on shift tube	Remove burrs or replace tube
	Lower bowl bearing assembled wrong	See STEERING COLUMN article
	Shift tube bent or broken	Replace as necessary
	Improper adjustment of shift levers	See STEERING COLUMN article
Improper Trans. Shifting	Sheared shift tube joint	Replace as necessary
	Sheared lower shaft lever	Replace as necessary
	Improper shift lever adjustment	See STEERING COLUMN article
	Improper gate plate adjustment	See STEERING COLUMN article
Excess Play in Column	Instrument panel bracket bolts loose	Tighten bolts and check bracket
	Broken weld nut on jacket	See STEERING COLUMN article
	Instrument bracket capsule sheared	See STEERING COLUMN article
	Column bracket/jacket bolts loose	Tighten bolts and check bracket
Steering Locks in Gear	Release lever mechanism	See STEERING COLUMN article

TROUBLE SHOOTING - BASIC PROCEDURES
Article Text (p. 52)

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:39PM

SUSPENSION TROUBLE SHOOTING

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BASIC SUSPENSION TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Front End Noise	Loose or worn wheel	See Wheel Bearing Adjustment in SUSPENSION
	Worn shocks or shock mountings	Replace struts or strut mountings
	Worn struts or strut mountings	Replace struts or strut mountings
	Loose or worn lower control arm	See SUSPENSION
	Loose steering gear-to-frame bolts	See STEERING
	Worn control arm bushings	See SUSPENSION
	Ball joints not lubricated	Lubricate ball joints & see Ball Joint Checking in SUSPENSION
Front Wheel Shake, Shimmy, or Vibration	Tires or wheels out of balance	Check tire balance
	Incorrect wheel alignment	See WHEEL ALIGNMENT
	Drive shaft unbalanced	Check drive shaft balance
	Loose or worn wheel bearings	See WHEEL ALIGNMENT
	Loose or worn tie rod ends	See SUSPENSION
	Worn upper ball joints	See Ball Joint Checking

		in SUSPENSION
	Worn shock absorbers	Replace shock absorbers
	Worn strut bushings	Replace strut bushings
Car Pulls to One Side	Mismatched or uneven tires	Check tire condition
	Broken or sagging springs	See SUSPENSION
	Loose or worn strut bushings	See SUSPENSION
	Improper wheel alignment	See WHEEL ALIGNMENT
	Improper rear axle alignment	Check rear axle alignment
	Power steering gear unbalanced	See STEERING
	Front brakes dragging	See BRAKES
Abnormal Tire Wear	Unbalanced tires	Check tire balance & rotation
	Sagging or broken springs	See SUSPENSION
	Incorrect front end alignment	See WHEEL ALIGNMENT
	Faulty shock absorbers	Replace chock absorbers
Scuffed Tires	Toe-In incorrect	See WHEEL ALIGNMENT
	Suspension arm bent or twisted	See appropriate SUSPENSION article
Springs Bottom or Sag	Bent or broken springs	See SUSPENSION
	Leaking or worn shock absorbers	Replace shock absorbers
	Frame misalignment	Check frame for damage
Spring Noises	Loose "U" Bolts	See SUSPENSION
	Loose or worn bushings	See SUSPENSION
	Worn or missing interliners	See SUSPENSION
Shock Absorber	Loose shock mountings	Check & tighten

Noise		mountings
	Worn bushings	Replace bushings
	Air in system	Bleed air from system
	Undercoating on shocks	Remove undercoating
Car Leans or Sways on Corners	Loose stabilizer bar	See SUSPENSION
	Faulty shocks or mountings	Replace shocks or mountings
	Broken or sagging springs	See SUSPENSION
Shock Absorbers Leaking	Worn seals or reservoir tube crimped	See SUSPENSION
Broken Springs	Loose "U" bolts	See SUSPENSION
	Inoperative shock absorbers	Replace shock absorbers

TUNE-UP TROUBLE SHOOTING - GAS ENGINE VEHICLES

PLEASE READ THIS FIRST:

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SPARK PLUG DIAGNOSIS

BASIC SPARK PLUG TROUBLE SHOOTING CHARTS

CONDITION	POSSIBLE CAUSE	CORRECTION
Normal Spark Plug Condition	Light Tan or Gray deposits	No Action
	Electrode not burned or fouled	No Action
	Gap tolerance not changed	No Action
Cold Fouling or Carbon Deposits	Overrich air/fuel mixture	Adjust air/fuel mixture, see ENGINE PERFORMANCE section

	Faulty choke	Replace choke assembly, see ENGINE PERFORMANCE section
	Clogged air filter	Clean and/or replace air filter
	Incorrect idle speed or dirty carburetor	Reset idle speed and/ or clean carburetor
	Faulty ignition wires	Replace ignition wiring
	Prolonged operation at idle	Shut engine off during long idle
	Sticking valves or worn valve guide seals	Check valve train
Wet Fouling or Oil Deposits	Worn rings and pistons	Install new rings and pistons
	Excessive cylinder wear	Rebore or replace block
	Excessive valve guide clearance	Worn or loose bearing
Gap Bridged	Deposits in combustion chamber becoming fused to electrode	Clean combustion chamber of deposits
Blistered Electrode	Engine overheating	Check cooling system
	Wrong type of fuel	Replace with correct fuel
	Loose spark plugs	Retighten spark plugs
	Over-advanced ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Pre-Ignition or Melted Electrodes	Incorrect type of fuel	Replace with correct fuel
	Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
	Burned valves	Replace valves
	Engine Overheating	Check cooling system

	Wrong type of spark plug, too hot	Replace with correct spark plug, see ENGINE PERFORMANCE
Chipped Insulators	Severe detonation	Check for over-advanced timing or combustion
	Improper gapping procedure	Re-gap spark plugs
Rust Colored Deposits	Additives in unleaded fuel	Try different fuel brand
Water In Combustion Chamber	Blown head gasket or cracked head	Repair or replace head or head gasket

ELECTRONIC IGNITION DIAGNOSIS

NOTE: Before diagnosing an electronic ignition system, ensure that all wiring is connected properly between distributor, wiring connector and spark plugs. Ignition problem will show up either as: Engine Will Not Start or Engine Runs Rough.

BASIC ELECTRONIC IGNITION TROUBLE SHOOTING CHARTS

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Won't Start	Open circuit between distributor and bulkhead connector	Repair circuit
	Open circuit between bulkhead connector and ignition switch	Repair circuit
	Open circuit between ignition switch and starter solenoid	Repair circuit
Engine Runs Rough	Fuel lines leaking or clogged	Tighten fitting, remove restriction
	Initial timing incorrect	Reset ignition timing see ENGINE PERFORMANCE
	Centrifugal advance malfunction	Repair distributor advance
	Defective spark plugs or	Replace plugs or plug

	wiring	wiring
Component Failure	Spark arc-over on cap, rotor or coil	Replace cap, rotor or or coil
	Defective pick-up coil	Replace pick-up coil
	Defective ignition coil	Replace ignition coil
	Defective vacuum unit	Replace vacuum unit
	Defective control module	Replace control module

ELECTRONIC IGNITION DIAGNOSIS BY OSCILLOSCOPE PATTERN

BASIC ELECTRONIC IGNITION TROUBLE SHOOTING CHARTS - USING OSCILLOSCOPE PATTERNS

CONDITION	POSSIBLE CAUSE	CORRECTION
Firing Voltage Lines are the Same, but Abnormally High	Retarded ignition timing	Reset ignition timing, see ENGINE PERFORMANCE section
	Fuel mixture too lean	Readjust carburetor, see ENGINE PERFORMANCE
	High resistance in coil wire	Replace coil wire
	Corrosion in coil tower terminal	Clean and/or replace coil
	Corrosion in distributor coil terminal	Clean and/or replace distributor cap
Firing Voltage Lines are the Same but Abnormally Low	Fuel mixture too rich	Readjust carburetor, see ENGINE PERFORMANCE
	Breaks in coil wire causing arcing	Replace coil wire
	Cracked coil tower causing arcing	Replace coil
	Low coil output	Replace coil
	Low engine compression	Determine cause and repair
One or More, But	Carburetor idle mixture	Readjust carburetor,

Not All Firing Voltage Lines are Higher Than Others	not balanced	see ENGINE PERFORMANCE
	EGR valve stuck open	Clean and/or replace valve
	High resistance in spark plug wires	Replace spark plug wires
	Cracked or broken spark plug insulator	Replace spark plugs
	Intake vacuum leak	Repair leak
	Defective spark plugs	Replace spark plugs
	Corroded spark plug terminals	Replace spark plugs
One or More, But Not All Firing Voltage Lines Are Lower Than Others	Curb idle mixture not balanced	Readjust carburetor, see ENGINE PERFORMANCE
	Breaks in plug wires causing arcing	Replace plug wires
	Cracked coil tower causing arcing	Replace coil
	Low compression	Determine cause and repair
	Defective spark plugs	Replace spark plugs
	Corroded spark plugs	Replace spark plugs
Cylinders Not Firing	Cracked distributor cap terminals	Replace distributor cap
	Shorted spark plug wire	Determine cause and repair
	Mechanical problem in engine	Determine cause and repair
	Defective spark plugs	Replace spark plugs
	Spark plugs fouled	Replace spark plugs

DRIVEABILITY PROBLEMS TROUBLE SHOOTING

BASIC DRIVEABILITY PROBLEMS TROUBLE SHOOTING TABLE

TROUBLE SHOOTING - BASIC PROCEDURES
Article Text (p. 59)

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:39PM

CONDITION	POSSIBLE CAUSE	CORRECTION
Hard Starting	Binding carburetor linkage	Eliminate binding
	Binding choke linkage	Eliminate binding
	Binding choke piston	Eliminate binding
	Restricted choke vacuum	Check vacuum lines for blockage
	Worn or dirty needle valve and seat	Clean carburetor, see ENGINE PERFORMANCE
	Float sticking	Readjust or replace float see the ENGINE PERFORMANCE section
	Incorrect choke adjustment	Reset choke adjustment see ENGINE PERFORMANCE
	Defective coil	Replace coil
	Improper spark plug gap	Regap spark plugs
	Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Detonation	Over-advanced ignition timing	Reset ignition timing see ENGINE PERFORMANCE
	Defective spark plugs	Replace spark plugs
	Fuel lines clogged	Clean fuel lines
	EGR system malfunction	Check and repair EGR system
	PCV system malfunction	Repair PCV system
	Vacuum leaks	Check and repair vacuum system
	Loose fan belts	Tighten or replace fan belts, see ENGINE PERFORMANCE
	Restricted airflow	Remove restriction
	Vacuum advance malfunction	Check distributor operation

Dieseling	Binding carburetor linkage	Eliminate binding
	Binding throttle linkage	Eliminate blinding
	Binding choke linkage or fast idle cam	Eliminate binding
	Defective idle solenoid	Replace idle solenoid see ENGINE PERFORMANCE
	Improper base idle speed	Reset idle speed, see see ENGINE PERFORMANCE
	Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
	Incorrect idle mixture setting	Reset idle mixture, see ENGINE PERFORMANCE
Faulty Acceleration	Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
	Engine cold and choke too lean	Adjust choke and allow engine to warm-up
	Defective spark plugs	Replace spark plugs
	Defective coil	Replace coil
Faulty Low Speed Operation	Clogged idle transfer slots	Clean idle transfer slots, see FUEL
	Restricted idle air bleeds and passages	Disassemble and clean carburetor, see FUEL
	Clogged air cleaner	Replace air filter
	Defective spark plugs	Replace spark plugs
	Defective ignition wires	Replace ignition wire see ENGINE PERFORMANCE
	Defective distributor cap	Replace distributor cap
Faulty High Speed Operation	Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
	Defective distributor centrifugal advance	Replace advance mechanism

	Defective distributor vacuum advance	Replace advance unit
	Incorrect spark plugs or plug gap	Check gap and/or replace spark plugs
	Faulty choke operation	Check choke and repair as required
	Clogged vacuum passages	Remove restrictions
	Improper size or clogged main jet	Check jet size and clean, see FUEL
	Restricted air cleaner	Check filter and replace as necessary
	Defective distributor cap, rotor or coil	Replace cap, rotor or coil
Misfire at All Speeds	Defective spark plugs	Replace spark plugs
	Defective spark plug wires	Replace spark plug wires
	Defective distributor cap, rotor, or coil	Replace cap, rotor, or coil
	Cracked or broken vacuum hoses	Replace vacuum hoses
	Vacuum leaks	Repair vacuum leaks
	Fuel lines clogged	Remove restriction
Hesitation	Cracked or broken vacuum hoses	Replace vacuum hoses
	Vacuum leaks	Repair Vacuum leaks
	Binding carburetor linkage	Eliminate binding
	Binding throttle linkage	Eliminate binding
	Binding choke linkage or fast idle cam	Eliminate binding
	Improper float setting	Readjust float setting, see FUEL
	Cracked or broken ignition	Replace ignition

	wires	wires
Rough idle, Missing or Stalling	Incorrect curb idle or fast idle speed	Reset idle speed, see see ENGINE PERFORMANCE
	Incorrect basic timing	Reset ignition timing see ENGINE PERFORMANCE
	Improper idle mixture adjustment	Reset idle mixture, see ENGINE PERFORMANCE
	Improper feedback system operation	Check feedback system see ENGINE PERFORMANCE
	Incorrect spark plug gap	Reset spark plug gap, see ENGINE PERFORMANCE
	Moisture in ignition components	Dry components
	Loose or broken ignition wires	Replace ignition wires
	Damaged distributor cap or or rotor	Replace distributor cap or rotor
	Faulty ignition coil	Replace ignition coil
	Fuel filter clogged or worn	Replace fuel filter
	Damaged idle mixture screw	Replace idle mixture screw, see FUEL
	Improper fast idle cam adjustment	Reset fast idle cam adjustment, see TUNE- see ENGINE PERFORMANCE
	Improper EGR valve operation	Replace EGR valve
	Faulty PCV valve air flow	Replace PCV valve
	Choke binding or improper choke setting	Reset choke or eliminate binding
	Vacuum leak	Repair vacuum leak
	Improper float bowl fuel level	Reset float adjustment, see FUEL
	Clogged air bleed or idle passages	Clean carburetor passages, see FUEL

	Clogged or worn air cleaner filter	Replace air filter
	Faulty choke vacuum diaphragm	Replace diaphragm, see ENGINE PERFORMANCE
	Exhaust manifold heat valve inoperative	Replace heat valve
	Improper distributor spark advance	Check distributor operation
	Leaking valves or valve components	Check and repair valvetrain
	Improper carburetor mounting	Remove and remount carburetor
	Excessive play in distributor shaft	Replace distributor
	Loose or corroded wiring connections	Repair or replace as required
Engine Surges	Improper PCV valve airflow	Replace PCV valve
	Vacuum leaks	Repair vacuum leaks
	Clogged air bleeds	Remove restriction
	EGR valve malfunction	Replace EGR valve
	Restricted air cleaner filter	Replace air filter
	Cracked or broken vacuum hoses	Replace vacuum hoses
	Cracked or broken ignition wires	Replace ignition wires
	Vacuum advance malfunction	Check unit and replace as necessary
	Defective or fouled spark plugs	Replace spark plugs
Ping or Spark Knock	Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
	Distributor centrifugal or vacuum advance malfunction	Check operation and replace as necessary

	Carburetor setting too lean	Readjust mixture setting, see ENGINE PERFORMANCE
	Vacuum leak	Eliminate vacuum leak
	EGR valve malfunction	Replace EGR valve
Poor Gasoline Mileage	Cracked or broken vacuum hoses	Replace vacuum hoses
	Vacuum leaks	Repair vacuum leaks
	Defective ignition wires	Replace wires
	Incorrect choke setting	Readjust setting, see ENGINE PERFORMANCE
	Defective vacuum advance	Replace vacuum advance
	Defective spark plugs	Replace spark plugs
	Binding carburetor power piston	Eliminate binding
	Dirt in carburetor jets	Clean and/or replace jets
	Incorrect float adjustment	Readjust float setting, see FUEL
	Defective power valve	Replace power valve, see ENGINE PERFORMANCE
	Incorrect idle speed	Readjust idle speed
Engine Stalls	Improper float level	Readjust float level
	Leaking needle valve and seat	Replace needle valve and seat
	Vacuum leaks	Eliminate vacuum leaks

VACUUM PUMP - DIESEL TROUBLE SHOOTING

WARNING: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to

problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

NOTE: Diesel engines mechanical diagnosis is the same as gasoline engines for items such as noisy valves, bearings, pistons, etc. The following trouble shooting covers only items pertaining to diesel engines.

VACUUM PUMP (DIESEL) TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Excessive Noise	Loose pump-to-drive assembly screws	Tighten screws
	Loose tube on pump assembly	Tighten tube
	Valves not functioning properly	Replace valves
Oil Leakage	Loose end plug	Tighten end plug
	Bad seal crimp	Remove and re-crimp seal

WHEEL ALIGNMENT TROUBLE SHOOTING

WARNING: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC WHEEL ALIGNMENT TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Premature Tire Wear	Improper tire inflation	Check tire pressure
	Front alignment out of tolerance	See ALIGNMENT SPECS in WHEEL ALIGNMENT section
	Suspension components worn	See SUSPENSION section
	Steering system components worn	See STEERING section
	Improper standing height	See WHEEL ALIGNMENT
	Uneven or sagging springs	See SUSPENSION section

	Bent wheel	See WHEEL ALIGNMENT
	Improper torsion bar adjustment	See SUSPENSION section
	Loose or worn wheel bearings	See WHEEL BEARING ADJ. in SUSPENSION section
	Worn or defective shock	Replace shock absorbers
	Tires out of balance	Check tire balance
Pulls to One Side	Improper tire inflation	Check tire pressure
	Brake dragging	See BRAKE section
	Mismatched tires	See WHEEL ALIGNMENT
	Broken or sagging spring	See SUSPENSION section
	Broken torsion bar	See SUSPENSION section
	Power steering valve not centered	See STEERING section
	Front alignment out of tolerance	See WHEEL ALIGNMENT section
	Defective wheel bearing	See WHEEL BEARINGS in SUSPENSION section
	Uneven sway bar links	See SUSPENSION section
	Frame bent	Check for frame damage
	Steering system bushing worn	See STEERING section
Hard Steering	Idler arm bushing too tight	See STEERING LINKAGE in STEERING section
	Ball joint tight or seized	See SUSPENSION section
	Steering linkage too tight	See STEERING LINKAGE in STEERING section
	Power steering fluid low	Add proper amount of fluid
	Power steering drive belt loose	See STEERING section

	Power steering pump defective	See STEERING section
	Steering gear out of adjustment	See STEERING section
	Incorrect wheel alignment	See WHEEL ALIGNMENT
	Damaged steering gear	See STEERING section
	Damaged suspension	See SUSPENSION section
	Bent steering knuckle or supports	See SUSPENSION section
Vehicle "Wanders"	Strut rod or control arm bushing worn	See SUSPENSION section
	Loose or worn wheel bearings	See WHEEL BEARINGS in SUSPENSION section
	Improper tire inflation	Check tire pressure
	Stabilizer bar missing or defective	See SUSPENSION section
	Wheel alignment out of tolerance	See Adjustment in WHEEL ALIGNMENT section
	Broken spring	See SUSPENSION section
	Defective shock absorbers	Replace shock absorbers
	Worn steering & suspension components	See SUSPENSION section
Front End Shimmy	Tire out of balance/round	Check tire balance
	Excessive wheel runout	See WHEEL ALIGNMENT
	Insufficient or improper caster	See WHEEL ALIGNMENT section
	Worn suspension or steering components	See SUSPENSION section
	Defective shock absorbers	Replace shock absorber
	Wheel bearings worn or loose	See WHEEL BEARING ADJ. in SUSPENSION section
	Power steering reaction	See STEERING section

	Bracket loose	
	Steering gear box (rack) mounting loose	See STEERING section
	Steering gear adjustment loose	See STEERING section
	Worn spherical joints	See SUSPENSION section
Toe-In Not Adjustable	Lower control arm bent	See SUSPENSION section
	Frame bent	Check frame for damage
Camber Not Adjustable	Control arm bent	See SUSPENSION section
	Frame bent	Check frame for damage
	Hub & bearing not seated properly	See SUSPENSION section

END OF ARTICLE

WAVEFORMS - INJECTOR PATTERN TUTORIAL
Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:39PM

ARTICLE BEGINNING

GENERAL INFORMATION
Waveforms - Injector Pattern Tutorial

*** PLEASE READ THIS FIRST ***

NOTE: This article is intended for general information purposes only. This information may not apply to all makes and models.

PURPOSE OF THIS ARTICLE

Learning how to interpret injector drive patterns from a Lab Scope can be like learning ignition patterns all over again. This article exists to ease you into becoming a skilled injector pattern interpreter.

You will learn:

* How a DVOM and noid light fall short of a lab scope.
* The two types of injector driver circuits, voltage controlled & current controlled.
* The two ways injector circuits can be wired, constant ground/switched power & constant power/switched ground.
* The two different pattern types you can use to diagnose with, voltage & current.
* All the valuable details injector patterns can reveal.

SCOPE OF THIS ARTICLE

This is NOT a manufacturer specific article. All different types of systems are covered here, regardless of the specific year/make/model/engine.

The reason for such broad coverage is because there are only a few basic ways to operate a solenoid-type injector. By understanding the fundamental principles, you will understand all the major points of injector patterns you encounter. Of course there are minor differences in each specific system, but that is where a waveform library helps out.

If this is confusing, consider a secondary ignition pattern. Even though there are many different implementations, each still has a primary voltage turn-on, firing line, spark line, etc.

If specific waveforms are available in On Demand for the engine and vehicle you are working on, you will find them in the Engine Performance section under the Engine Performance category.

IS A LAB SCOPE NECESSARY?

INTRODUCTION

You probably have several tools at your disposal to diagnose injector circuits. But you might have questioned "Is a lab scope

necessary to do a thorough job, or will a set of noid lights and a multifunction DVOM do just as well?"

In the following text, we are going to look at what noid lights and DVOMs do best, do not do very well, and when they can mislead you. As you might suspect, the lab scope, with its ability to look inside an active circuit, comes to the rescue by answering for the deficiencies of these other tools.

OVERVIEW OF NOID LIGHT

The noid light is an excellent "quick and dirty" tool. It can usually be hooked to a fuel injector harness fast and the flashing light is easy to understand. It is a dependable way to identify a no-pulse situation.

However, a noid light can be very deceptive in two cases:

* If the wrong one is used for the circuit being tested. Beware: Just because a connector on a noid light fits the harness does not mean it is the right one.
* If an injector driver is weak or a minor voltage drop is present.

Use the Right Noid Light

In the following text we will look at what can happen if the wrong noid light is used, why there are different types of noid lights (besides differences with connectors), how to identify the types of noid lights, and how to know the right type to use.

First, let's discuss what can happen if the incorrect type of noid light is used. You might see:

* A dimly flashing light when it should be normal.
* A normal flashing light when it should be dim.

A noid light will flash dim if used on a lower voltage circuit than it was designed for. A normally operating circuit would appear underpowered, which could be misinterpreted as the cause of a fuel starvation problem.

Here are the two circuit types that could cause this problem:

* Circuits with external injector resistors. Used predominately on some Asian & European systems, they are used to reduce the available voltage to an injector in order to limit the current flow. This lower voltage can cause a dim flash on a noid light designed for full voltage.
* Circuits with current controlled injector drivers (e.g. "Peak and Hold"). Basically, this type of driver allows a quick burst of voltage/current to flow and then throttles it back significantly for the remainder of the pulse width duration. If a noid light was designed for the other type of driver (voltage controlled, e.g. "Saturated"), it will appear dim because it is expecting full voltage/current to flow for the entire duration of the pulse width.

Let's move to the other situation where a noid light flashes normally when it should be dim. This could occur if a more sensitive noid light is used on a higher voltage/amperage circuit that was weakened enough to cause problems (but not outright broken). A circuit with an actual problem would thus appear normal.

Let's look at why. A noid light does not come close to consuming as much amperage as an injector solenoid. If there is a partial driver failure or a minor voltage drop in the injector circuit, there can be adequate amperage to fully operate the noid light BUT NOT ENOUGH TO OPERATE THE INJECTOR.

If this is not clear, picture a battery with a lot of corrosion on the terminals. Say there is enough corrosion that the starter motor will not operate; it only clicks. Now imagine turning on the headlights (with the ignition in the RUN position). You find they light normally and are fully bright. This is the same idea as noid light: There is a problem, but enough amp flow exists to operate the headlights ("noid light"), but not the starter motor ("injector").

How do you identify and avoid all these situations? By using the correct type of noid light. This requires that you understanding the types of injector circuits that your noid lights are designed for. There are three. They are:

* Systems with a voltage controlled injector driver. Another way to say it: The noid light is designed for a circuit with a "high" resistance injector (generally 12 ohms or above).
* Systems with a current controlled injector driver. Another way to say it: The noid light is designed for a circuit with a low resistance injector (generally less than 12 ohms) without an external injector resistor.
* Systems with a voltage controlled injector driver and an external injector resistor. Another way of saying it: The noid light is designed for a circuit with a low resistance injector (generally less than 12 ohms) and an external injector resistor.

NOTE: Some noid lights can meet both the second and third categories simultaneously.

If you are not sure which type of circuit your noid light is designed for, plug it into a known good car and check out the results. If it flashes normally during cranking, determine the circuit type by finding out injector resistance and if an external injector resistor is used. You now know enough to identify the type of injector circuit. Label the noid light appropriately.

Next time you need to use a noid light for diagnosis, determine what type of injector circuit you are dealing with and select the appropriate noid light.

Of course, if you suspect a no-pulse condition you could plug in any one whose connector fit without fear of misdiagnosis. This is because it is unimportant if the flashing light is dim or bright. It is only important that it flashes.

In any cases of doubt regarding the use of a noid light, a lab scope will overcome all inherent weaknesses.

OVERVIEW OF DVOM

A DVOM is typically used to check injector resistance and available voltage at the injector. Some techs also use it check injector on-time either with a built-in feature or by using the dwell/duty function.

There are situations where the DVOM performs these checks dependably, and other situations where it can deceive you. It is important to be aware of these strengths and weaknesses. We will cover the topics above in the following text.

Checking Injector Resistance

If a short in an injector coil winding is constant, an ohmmeter will accurately identify the lower resistance. The same is true with an open winding. Unfortunately, an intermittent short is an exception. A faulty injector with an intermittent short will show "good" if the ohmmeter cannot force the short to occur during testing.

Alcohol in fuel typically causes an intermittent short, happening only when the injector coil is hot and loaded by a current high enough to jump the air gap between two bare windings or to break down any oxides that may have formed between them.

When you measure resistance with an ohmmeter, you are only applying a small current of a few milliamps. This is nowhere near enough to load the coil sufficiently to detect most problems. As a result, most resistance checks identify intermittently shorted injectors as being normal.

There are two methods to get around this limitation. The first is to purchase an tool that checks injector coil windings under full load. The Kent-Moore J-39021 is such a tool, though there are others. The Kent-Moore costs around $240 at the time of this writing and works on many different manufacturer's systems.

The second method is to use a lab scope. Remember, a lab scope allows you to see the regular operation of a circuit in real time. If an injector is having an short or intermittent short, the lab scope will show it.

Checking Available Voltage At the Injector

Verifying a fuel injector has the proper voltage to operate correctly is good diagnostic technique. Finding an open circuit on the feed circuit like a broken wire or connector is an accurate check with a DVOM. Unfortunately, finding an intermittent or excessive resistance problem with a DVOM is unreliable.

Let's explore this drawback. Remember that a voltage drop due to excessive resistance will only occur when a circuit is operating? Since the injector circuit is only operating for a few milliseconds at a time, a DVOM will only see a potential fault for a few milliseconds. The remaining 90+% of the time the unloaded injector circuit will show normal battery voltage.

Since DVOMs update their display roughly two to five times a

second, all measurements in between are averaged. Because a potential voltage drop is visible for such a small amount of time, it gets "averaged out", causing you to miss it.

Only a DVOM that has a "min-max" function that checks EVERY MILLISECOND will catch this fault consistently (if used in that mode). The Fluke 87 among others has this capability.

A "min-max" DVOM with a lower frequency of checking (100 millisecond) can miss the fault because it will probably check when the injector is not on. This is especially true with current controlled driver circuits. The Fluke 88, among others fall into this category.

Outside of using a Fluke 87 (or equivalent) in the 1 mS "min-max" mode, the only way to catch a voltage drop fault is with a lab scope. You will be able to see a voltage drop as it happens.

One final note. It is important to be aware that an injector circuit with a solenoid resistor will always show a voltage drop when the circuit is energized. This is somewhat obvious and normal; it is a designed-in voltage drop. What can be unexpected is what we already covered--a voltage drop disappears when the circuit is unloaded. The unloaded injector circuit will show normal battery voltage at the injector. Remember this and do not get confused.

Checking Injector On-Time With Built-In Function

Several DVOMs have a feature that allows them to measure injector on-time (mS pulse width). While they are accurate and fast to hookup, they have three limitations you should be aware of:

* They only work on voltage controlled injector drivers (e.g "Saturated Switch"), NOT on current controlled injector drivers (e.g. "Peak & Hold").
* A few unusual conditions can cause inaccurate readings.
* Varying engine speeds can result in inaccurate readings.

Regarding the first limitation, DVOMs need a well-defined injector pulse in order to determine when the injector turns ON and OFF. Voltage controlled drivers provide this because of their simple switch-like operation. They completely close the circuit for the entire duration of the pulse. This is easy for the DVOM to interpret.

The other type of driver, the current controlled type, start off well by completely closing the circuit (until the injector pintle opens), but then they throttle back the voltage/current for the duration of the pulse. The DVOM understands the beginning of the pulse but it cannot figure out the throttling action. In other words, it cannot distinguish the throttling from an open circuit (de-energized) condition.

Yet current controlled injectors will still yield a millisecond on-time reading on these DVOMs. You will find it is also always the same, regardless of the operating conditions. This is because it is only measuring the initial completely-closed circuit on-time, which always takes the same amount of time (to lift the injector pintle off its seat). So even though you get a reading, it is useless.

The second limitation is that a few erratic conditions can

cause inaccurate readings. This is because of a DVOM's slow display rate; roughly two to five times a second. As we covered earlier, measurements in between display updates get averaged. So conditions like skipped injector pulses or intermittent long/short injector pulses tend to get "averaged out", which will cause you to miss important details.

The last limitation is that varying engine speeds can result in inaccurate readings. This is caused by the quickly shifting injector on-time as the engine load varies, or the RPM moves from a state of acceleration to stabilization, or similar situations. It too is caused by the averaging of all measurements in between DVOM display periods. You can avoid this by checking on-time when there are no RPM or load changes.

A lab scope allows you to overcome each one of these limitations.

Checking Injector On-Time With Dwell Or Duty

If no tool is available to directly measure injector millisecond on-time measurement, some techs use a simple DVOM dwell or duty cycle functions as a replacement.

While this is an approach of last resort, it does provide benefits. We will discuss the strengths and weaknesses in a moment, but first we will look at how a duty cycle meter and dwell meter work.

How A Duty Cycle Meter and Dwell Meter Work

All readings are obtained by comparing how long something has been OFF to how long it has been ON in a fixed time period. A dwell meter and duty cycle meter actually come up with the same answers using different scales. You can convert freely between them. See RELATIONSHIP BETWEEN DWELL & DUTY CYCLE READINGS TABLE.

The DVOM display updates roughly one time a second, although some DVOMs can be a little faster or slower. All measurements during this update period are tallied inside the DVOM as ON time or OFF time, and then the total ratio is displayed as either a percentage (duty cycle) or degrees (dwell meter).

For example, let's say a DVOM had an update rate of exactly 1 second (1000 milliseconds). Let's also say that it has been measuring/tallying an injector circuit that had been ON a total of 250 mS out of the 1000 mS. That is a ratio of one-quarter, which would be displayed as 25% duty cycle or 15ø dwell (six-cylinder scale). Note that most duty cycle meters can reverse the readings by selecting the positive or negative slope to trigger on. If this reading were reversed, a duty cycle meter would display 75%.

Strengths of Dwell/Duty Meter

The obvious strength of a dwell/duty meter is that you can compare injector on-time against a known-good reading. This is the only practical way to use a dwell/duty meter, but requires you to have known-good values to compare against.

Another strength is that you can roughly convert injector mS on-time into dwell reading with some computations.

A final strength is that because the meter averages

everything together it does not miss anything (though this is also a severe weakness that we will look at later). If an injector has a fault where it occasionally skips a pulse, the meter registers it and the reading changes accordingly.

Let's go back to figuring out dwell/duty readings by using injector on-time specification. This is not generally practical, but we will cover it for completeness. You NEED to know three things:

* Injector mS on-time specification.
* Engine RPM when specification is valid.
* How many times the injectors fire per crankshaft revolution.

The first two are self-explanatory. The last one may require some research into whether it is a bank-fire type that injects every 360ø of crankshaft rotation, a bank-fire that injects every 720ø, or an SFI that injects every 720ø. Many manufacturers do not release this data so you may have to figure it out yourself with a frequency meter.

Here are the four complete steps to convert millisecond on-time:

1) Determine the injector pulse width and RPM it was obtained at. Let's say the specification is for one millisecond of on-time at a hot idle of 600 RPM.

2) Determine injector firing method for the complete 4 stroke cycle. Let's say this is a 360ø bank-fired, meaning an injector fires each and every crankshaft revolution.

3) Determine how many times the injector will fire at the specified engine speed (600 RPM) in a fixed time period. We will use 100 milliseconds because it is easy to use.

Six hundred crankshaft Revolutions Per Minute (RPM) divided by 60 seconds equals 10 revolutions per second.

Multiplying 10 times .100 yields one; the crankshaft turns one time in 100 milliseconds. With exactly one crankshaft rotation in 100 milliseconds, we know that the injector fires exactly one time.

4) Determine the ratio of injector on-time vs. off-time in the fixed time period, then figure duty cycle and/or dwell. The injector fires one time for a total of one millisecond in any given 100 millisecond period.

One hundred minus one equals 99. We have a 99% duty cycle. If we wanted to know the dwell (on 6 cylinder scale), multiple 99% times .6; this equals 59.4ø dwell.

Weaknesses of Dwell/Duty Meter

The weaknesses are significant. First, there is no one-to-one correspondence to actual mS on-time. No manufacturer releases dwell/duty data, and it is time-consuming to convert the mS on-time readings. Besides, there can be a large degree of error because the conversion forces you to assume that the injector(s) are always firing at the same rate for the same period of time. This can be a dangerous assumption.

Second, all level of detail is lost in the averaging process. This is the primary weakness. You cannot see the details you need to make a confident diagnosis.

Here is one example. Imagine a vehicle that has a faulty injector driver that occasionally skips an injector pulse. Every skipped pulse means that that cylinder does not fire, thus unburned O2 gets pushed into the exhaust and passes the O2 sensor. The O2 sensor indicates lean, so the computer fattens up the mixture to compensate for the supposed "lean" condition.

A connected dwell/duty meter would see the fattened pulse width but would also see the skipped pulses. It would tally both and likely come back with a reading that indicated the "pulse width" was within specification because the rich mixture and missing pulses offset each other.

This situation is not a far-fetched scenario. Some early GM 3800 engines were suffering from exactly this. The point is that a lack of detail could cause misdiagnosis.

As you might have guessed, a lab scope would not miss this.

RELATIONSHIP BETWEEN DWELL & DUTY CYCLE READINGS TABLE (1)

Dwell Meter (2)	Duty Cycle Meter
1ø	1%
15ø	25%
30ø	50%
45ø	75%
60ø	100%

(1) - These are just some examples for your understanding. It is okay to fill in the gaps.
(2) - Dwell meter on the six-cylinder scale.

THE TWO TYPES OF INJECTOR DRIVERS

OVERVIEW

There are two types of transistor driver circuits used to operate electric fuel injectors: voltage controlled and current controlled. The voltage controlled type is sometimes called a "saturated switch" driver, while the current controlled type is sometimes known as a "peak and hold" driver.

The basic difference between the two is the total resistance of the injector circuit. Roughly speaking, if a particular leg in an injector circuit has total resistance of 12 or more ohms, a voltage control driver is used. If less than 12 ohms, a current control driver is used.

It is a question of what is going to do the job of limiting the current flow in the injector circuit; the inherent "high" resistance in the injector circuit, or the transistor driver. Without some form of control, the current flow through the injector would cause the solenoid coil to overheat and result in a damaged injector.

VOLTAGE CONTROLLED CIRCUIT ("SATURATED SWITCH")

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The voltage controlled driver inside the computer operates much like a simple switch because it does not need to worry about limiting current flow. Recall, this driver typically requires injector circuits with a total leg resistance of 12 or more ohms.

The driver is either ON, closing/completing the circuit (eliminating the voltage-drop), or OFF, opening the circuit (causing a total voltage drop).

Some manufacturers call it a "saturated switch" driver. This is because when switched ON, the driver allows the magnetic field in the injector to build to saturation. This is the same "saturation" property that you are familiar with for an ignition coil.

There are two ways "high" resistance can be built into an injector circuit to limit current flow. One method uses an external solenoid resistor and a low resistance injector, while the other uses a high resistance injector without the solenoid resistor. See the left side of Fig. 1.

In terms of injection opening time, the external resistor voltage controlled circuit is somewhat faster than the voltage controlled high resistance injector circuit. The trend, however, seems to be moving toward use of this latter type of circuit due to its lower cost and reliability. The ECU can compensate for slower opening times by increasing injector pulse width accordingly.

NOTE: Never apply battery voltage directly across a low resistance injector. This will cause injector damage from solenoid coil overheating.

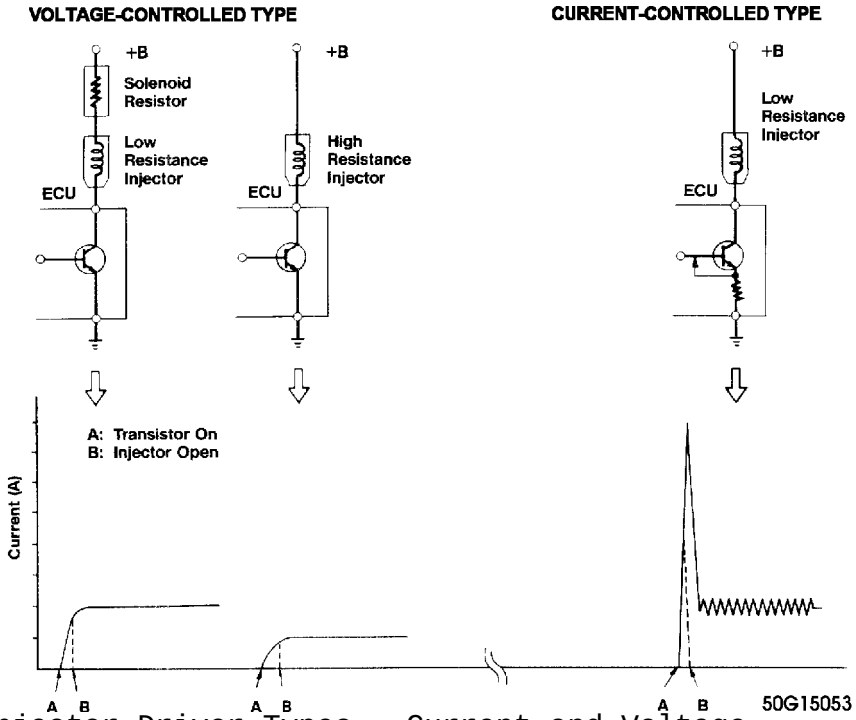

Fig. 1: Injector Driver Types - Current and Voltage

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CURRENT CONTROLLED CIRCUIT ("PEAK & HOLD")

The current controlled driver inside the computer is more complex than a voltage controlled driver because as the name implies, it has to limit current flow in addition to its ON-OFF switching function. Recall, this driver typically requires injector circuits with a total leg resistance of less than 12 ohms.

Once the driver is turned ON, it will not limit current flow until enough time has passed for the injector pintle to open. This period is preset by the particular manufacturer/system based on the amount of current flow needed to open their injector. This is typically between two and six amps. Some manufacturers refer to this as the "peak" time, referring to the fact that current flow is allowed to "peak" (to open the injector).

Once the injector pintle is open, the amp flow is considerably reduced for the rest of the pulse duration to protect the injector from overheating. This is okay because very little amperage is needed to hold the injector open, typically in the area of one amp or less. Some manufacturers refer to this as the "hold" time, meaning that just enough current is allowed through the circuit to "hold" the already-open injector open.

There are a couple methods of reducing the current. The most common trims back the available voltage for the circuit, similar to turning down a light at home with a dimmer.

The other method involves repeatedly cycling the circuit ON-OFF. It does this so fast that the magnetic field never collapses and the pintle stays open, but the current is still significantly reduced. See the right side of Fig. 1 for an illustration.

The advantage to the current controlled driver circuit is the short time period from when the driver transistor goes ON to when the injector actually opens. This is a function of the speed with which current flow reaches its peak due to the low circuit resistance. Also, the injector closes faster when the driver turns OFF because of the lower holding current.

NOTE: Never apply battery voltage directly across a low resistance injector. This will cause injector damage from solenoid coil overheating.

THE TWO WAYS INJECTOR CIRCUITS ARE WIRED

Like other circuits, injector circuits can be wired in one of two fundamental directions. The first method is to steadily power the injectors and have the computer driver switch the ground side of the circuit. Conversely, the injectors can be steadily grounded while the driver switches the power side of the circuit.

There is no performance benefit to either method. Voltage controlled and current controlled drivers have been successfully implemented both ways.

However, 95% percent of the systems are wired so the driver controls the ground side of the circuit. Only a handful of systems use the drivers on the power side of the circuit. Some examples of the

latter are the 1970's Cadillac EFI system, early Jeep 4.0 EFI (Renix system), and Chrysler 1984-87 TBI.

INTERPRETING INJECTOR WAVEFORMS

INTERPRETING A VOLTAGE CONTROLLED PATTERN

NOTE: Voltage controlled drivers are also known as "Saturated Switch" drivers. They typically require injector circuits with a total leg resistance of 12 ohms or more.

NOTE: This example is based on a constant power/switched ground circuit.

* See Fig. 2 for pattern that the following text describes.

Point "A" is where system voltage is supplied to the injector. A good hot run voltage is usually 13.5 or more volts. This point, commonly known as open circuit voltage, is critical because the injector will not get sufficient current saturation if there is a voltage shortfall. To obtain a good look at this precise point, you will need to shift your Lab Scope to five volts per division.

You will find that some systems have slight voltage fluctuations here. This can occur if the injector feed wire is also used to power up other cycling components, like the ignition coil(s). Slight voltage fluctuations are normal and are no reason for concern. Major voltage fluctuations are a different story, however. Major voltage shifts on the injector feed line will create injector performance problems. Look for excessive resistance problems in the feed circuit if you see big shifts and repair as necessary.

Note that circuits with external injector resistors will not be any different because the resistor does not affect open circuit voltage.

Point "B" is where the driver completes the circuit to ground. This point of the waveform should be a clean square point straight down with no rounded edges. It is during this period that current saturation of the injector windings is taking place and the driver is heavily stressed. Weak drivers will distort this vertical line.

Point "C" represents the voltage drop across the injector windings. Point "C" should come very close to the ground reference point, but not quite touch. This is because the driver has a small amount of inherent resistance. Any significant offset from ground is an indication of a resistance problem on the ground circuit that needs repaired. You might miss this fault if you do not use the negative battery post for your Lab Scope hook-up, so it is HIGHLY recommended that you use the battery as your hook-up.

The points between "B" and "D" represent the time in milliseconds that the injector is being energized or held open. This line at Point "C" should remain flat. Any distortion or upward bend indicates a ground problem, short problem, or a weak driver. Alert readers will catch that this is exactly opposite of the current

controlled type drivers (explained in the next section), because they bend upwards at this point.

How come the difference? Because of the total circuit resistance. Voltage controlled driver circuits have a high resistance of 12+ ohms that slows the building of the magnetic field in the injector. Hence, no counter voltage is built up and the line remains flat.

On the other hand, the current controlled driver circuit has low resistance which allows for a rapid magnetic field build-up. This causes a slight inductive rise (created by the effects of counter voltage) and hence, the upward bend. You should not see that here with voltage controlled circuits.

Point "D" represents the electrical condition of the injector windings. The height of this voltage spike (inductive kick) is proportional to the number of windings and the current flow through them. The more current flow and greater number of windings, the more potential for a greater inductive kick. The opposite is also true. The less current flow or fewer windings means less inductive kick. Typically you should see a minimum 35 volts at the top of Point "D".

If you do see approximately 35 volts, it is because a zener diode is used with the driver to clamp the voltage. Make sure the beginning top of the spike is squared off, indicating the zener dumped the remainder of the spike. If it is not squared, that indicates the spike is not strong enough to make the zener fully dump, meaning the injector has a weak winding.

If a zener diode is not used in the computer, the spike from a good injector will be 60 or more volts.

Point "E" brings us to a very interesting section. As you can see, the voltage dissipates back to supply value after the peak of the inductive kick. Notice the slight hump? This is actually the mechanical injector pintle closing. Recall that moving an iron core through a magnetic field will create a voltage surge. The pintle is the iron core here.

This pintle hump at Point "E" should occur near the end of the downward slope, and not afterwards. If it does occur after the slope has ended and the voltage has stabilized, it is because the pintle is slightly sticking because of a faulty injector

If you see more than one hump it is because of a distorted pintle or seat. This faulty condition is known as "pintle float".

It is important to realize that it takes a good digital storage oscilloscope or analog lab scope to see this pintle hump clearly. Unfortunately, it cannot always be seen.

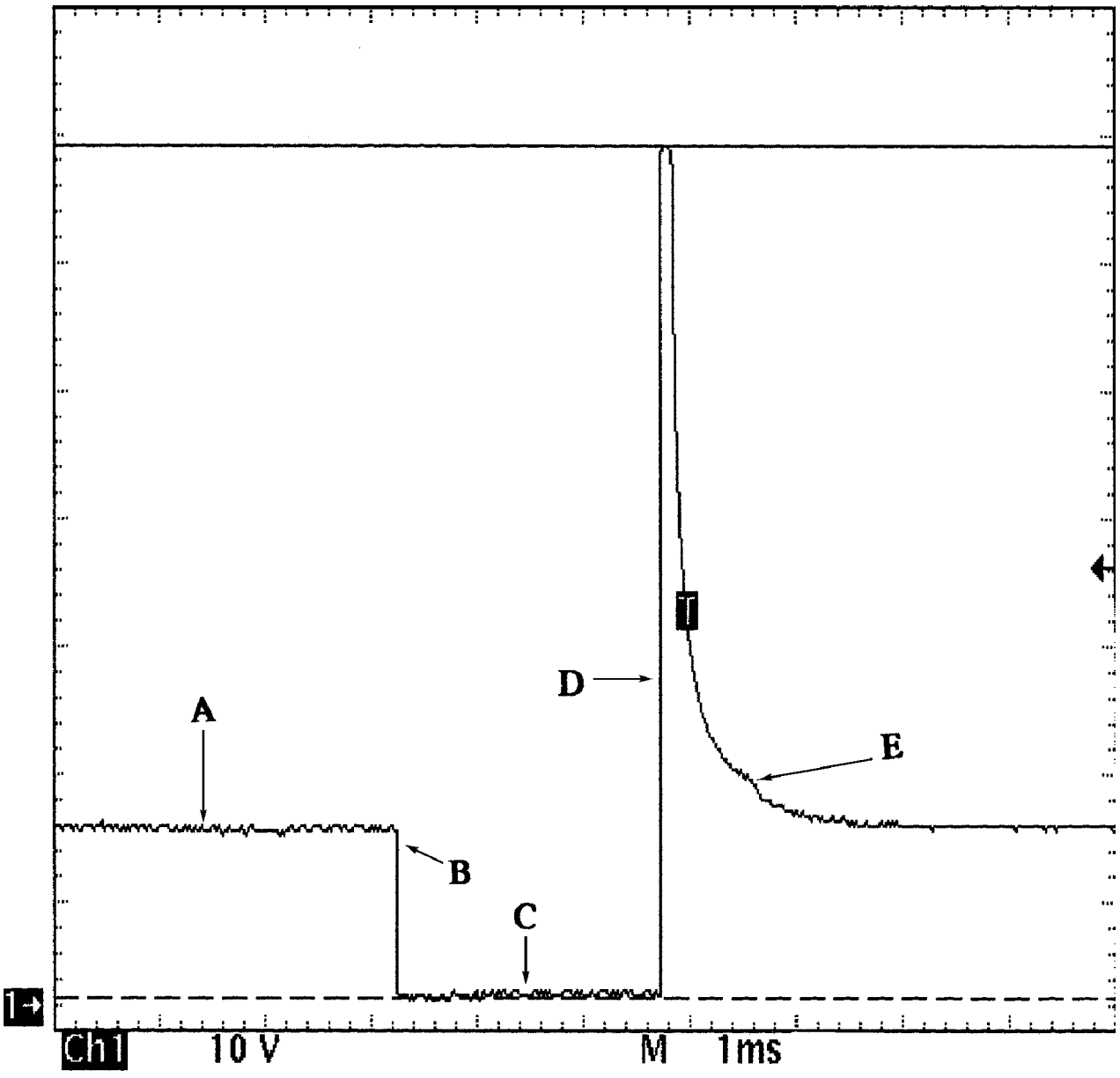

Fig. 2: Identifying Voltage Controlled Type Injector Pattern

INTERPRETING A CURRENT CONTROLLED PATTERN

NOTE: Current controlled drivers are also known as "Peak and Hold" drivers. They typically require injector circuits with a total leg resistance with less than 12 ohm.

NOTE: This example is based on a constant power/switched ground circuit.

* See Fig. 3 for pattern that the following text describes.

Point "A" is where system voltage is supplied to the

injector. A good hot run voltage is usually 13.5 or more volts. This point, commonly known as open circuit voltage, is critical because the injector will not get sufficient current saturation if there is a voltage shortfall. To obtain a good look at this precise point, you will need to shift your Lab Scope to five volts per division.

You will find that some systems have slight voltage fluctuations here. This could occur if the injector feed wire is also used to power up other cycling components, like the ignition coil(s). Slight voltage fluctuations are normal and are no reason for concern. Major voltage fluctuations are a different story, however. Major voltage shifts on the injector feed line will create injector performance problems. Look for excessive resistance problems in the feed circuit if you see big shifts and repair as necessary.

Point "B" is where the driver completes the circuit to ground. This point of the waveform should be a clean square point straight down with no rounded edges. It is during this period that current saturation of the injector windings is taking place and the driver is heavily stressed. Weak drivers will distort this vertical line.

Point "C" represents the voltage drop across the injector windings. Point "C" should come very close to the ground reference point, but not quite touch. This is because the driver has a small amount of inherent resistance. Any significant offset from ground is an indication of a resistance problem on the ground circuit that needs repaired. You might miss this fault if you do not use the negative battery post for your Lab Scope hook-up, so it is HIGHLY recommended that you use the battery as your hook-up.

Right after Point "C", something interesting happens. Notice the trace starts a normal upward bend. This slight inductive rise is created by the effects of counter voltage and is normal. This is because the low circuit resistance allowed a fast build-up of the magnetic field, which in turn created the counter voltage.

Point "D" is the start of the current limiting, also known as the "Hold" time. Before this point, the driver had allowed the current to free-flow ("Peak") just to get the injector pintle open. By the time point "D" occurs, the injector pintle has already opened and the computer has just significantly throttled the current back. It does this by only allowing a few volts through to maintain the minimum current required to keep the pintle open.

The height of the voltage spike seen at the top of Point "D" represents the electrical condition of the injector windings. The height of this voltage spike (inductive kick) is proportional to the number of windings and the current flow through them. The more current flow and greater number of windings, the more potential for a greater inductive kick. The opposite is also true. The less current flow or fewer windings means less inductive kick. Typically you should see a minimum 35 volts.

If you see approximately 35 volts, it is because a zener diode is used with the driver to clamp the voltage. Make sure the beginning top of the spike is squared off, indicating the zener dumped the remainder of the spike. If it is not squared, that indicates the spike is not strong enough to make the zener fully dump, meaning there

is a problem with a weak injector winding.

If a zener diode is not used in the computer, the spike from a good injector will be 60 or more volts.

At Point "E", notice that the trace is now just a few volts below system voltage and the injector is in the current limiting, or the "Hold" part of the pattern. This line will either remain flat and stable as shown here, or will cycle up and down rapidly. Both are normal methods to limit current flow. Any distortion may indicate shorted windings.

Point "F" is the actual turn-off point of the driver (and injector). To measure the millisecond on-time of the injector, measure between points "C" and "F". Note that we used cursors to do it for us; they are measuring a 2.56 mS on-time.

The top of Point "F" (second inductive kick) is created by the collapsing magnetic field caused by the final turn-off of the driver. This spike should be like the spike on top of point "D".

Point "G" shows a slight hump. This is actually the mechanical injector pintle closing. Recall that moving an iron core through a magnetic field will create a voltage surge. The pintle is the iron core here.

This pintle hump at Point "E" should occur near the end of the downward slope, and not afterwards. If it does occur after the slope has ended and the voltage has stabilized, it is because the pintle is slightly sticking. Some older Nissan TBI systems suffered from this.

If you see more than one hump it is because of a distorted pintle or seat. This faulty condition is known as "pintle float".

It is important to realize that it takes a good digital storage oscilloscope or analog lab scope to see this pintle hump clearly. Unfortunately, it cannot always be seen.

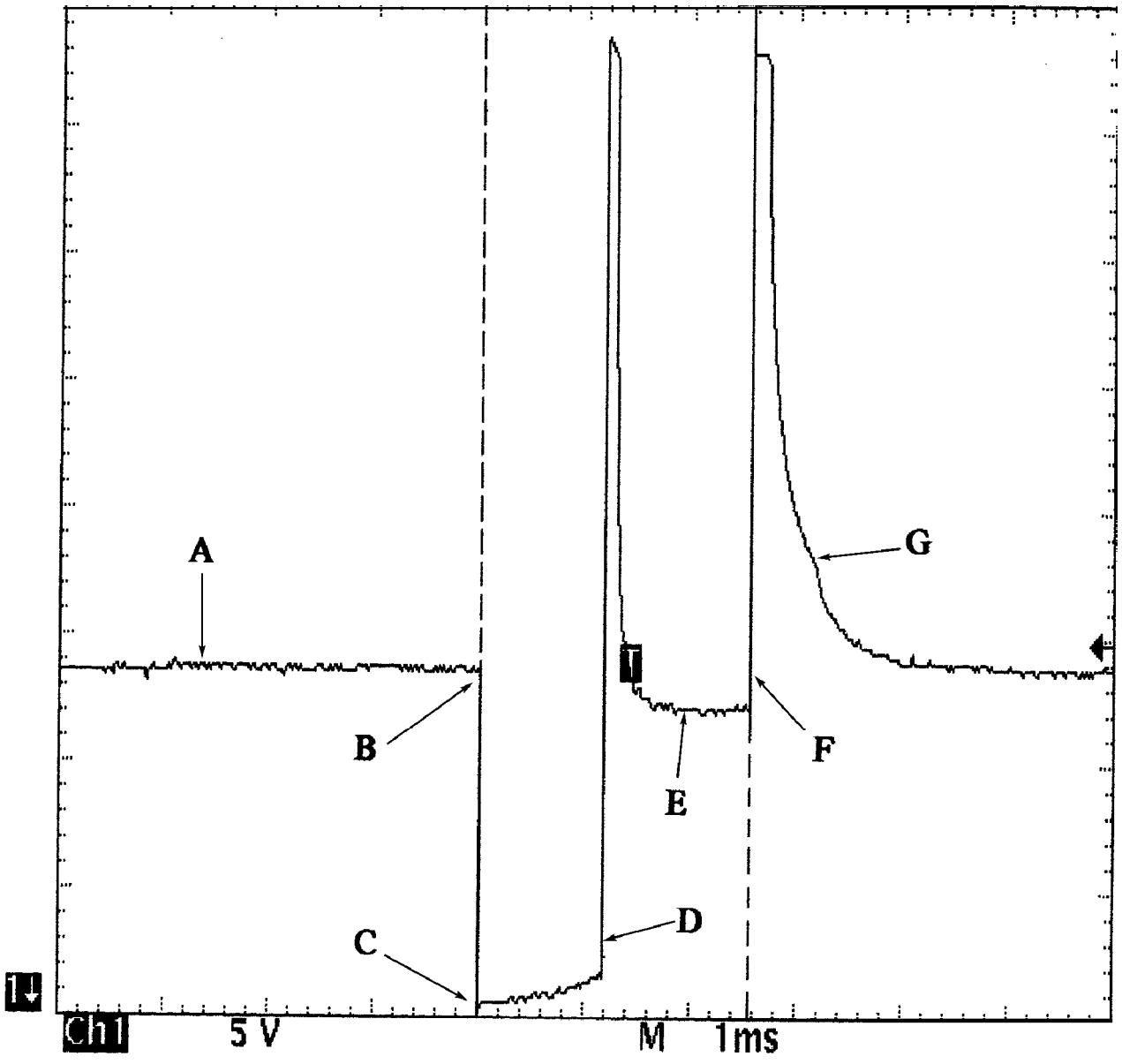

Fig. 3: Identifying Current Controlled Type Injector Pattern

CURRENT WAVEFORM SAMPLES

EXAMPLE #1 - VOLTAGE CONTROLLED DRIVER

The waveform pattern shown in Fig. 4 indicate a normal current waveform from a Ford 3.0L V6 VIN [U] engine. This voltage controlled type circuit pulses the injectors in groups of three injectors. Injectors No. 1, 3, and 5 are pulsed together and cylinders 2, 4, and 6 are pulsed together. The specification for an acceptable bank resistance is 4.4 ohms. Using Ohm's Law and assuming a hot run voltage of 14 volts, we determine that the bank would draw a current of 3.2 amps.

However this is not the case because as the injector windings become saturated, counter voltage is created which impedes the current flow. This, coupled with the inherent resistance of the driver's transistor, impedes the current flow even more. So, what is a known good value for a dynamic current draw on a voltage controlled bank of injectors? The waveform pattern shown below indicates a good parallel injector current flow of 2 amps. See Fig. 4.

Note that if just one injector has a resistance problem and partially shorts, the entire parallel bank that it belongs to will draw more current. This can damage the injector driver.

The waveform pattern in Fig. 5 indicates this type of problem with too much current flow. This is on other bank of injectors of the same vehicle; the even side. Notice the Lab Scope is set on a one amp per division scale. As you can see, the current is at an unacceptable 2.5 amps.

It is easy to find out which individual injector is at fault. All you need to do is inductively clamp onto each individual injector and compare them. To obtain a known-good value to compare against, we used the good bank to capture the waveform in Fig. 6. Notice that it limits current flow to 750 milliamps.

The waveform shown in Fig. 7 illustrates the problem injector we found. This waveform indicates an unacceptable current draw of just over one amp as compared to the 750 milliamp draw of the known-good injector. A subsequent check with a DVOM found 8.2 ohms, which is under the 12 ohm specification.

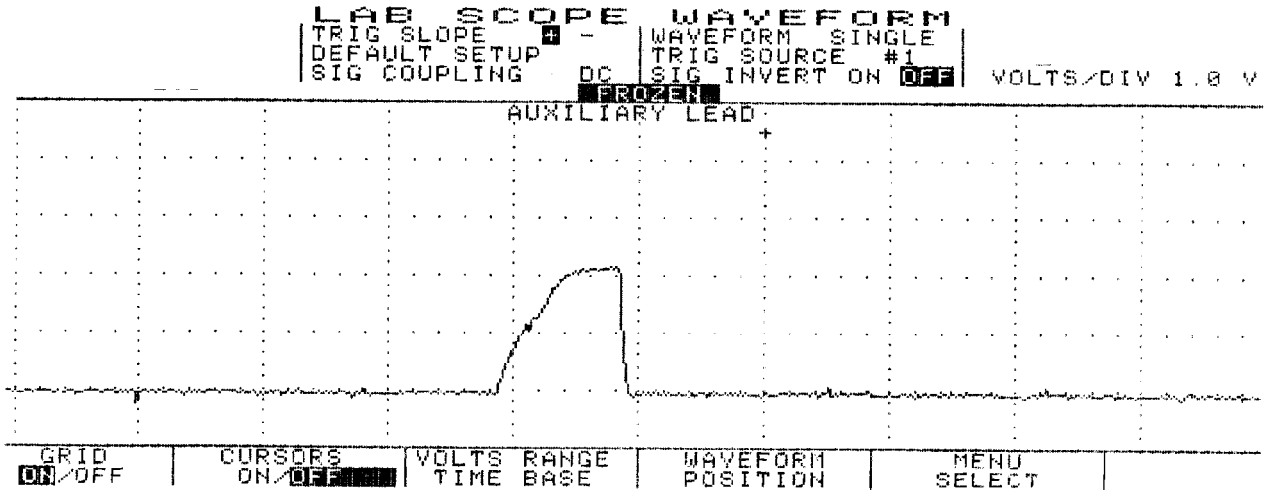

Fig. 4: Injector Bank w/Normal Current Flow - Current Pattern

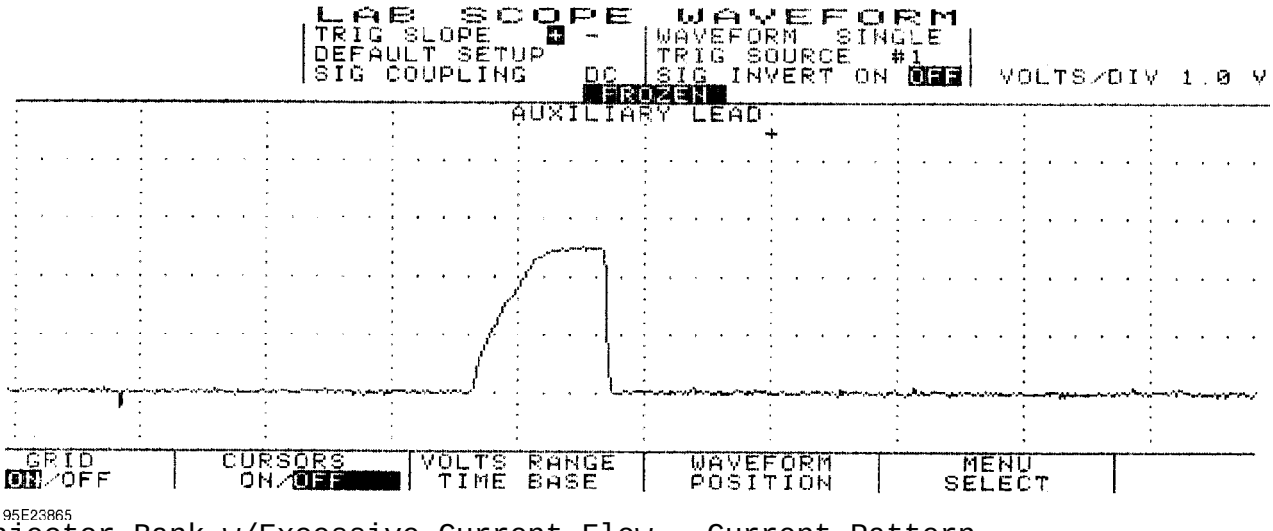

Fig. 5: Injector Bank w/Excessive Current Flow - Current Pattern

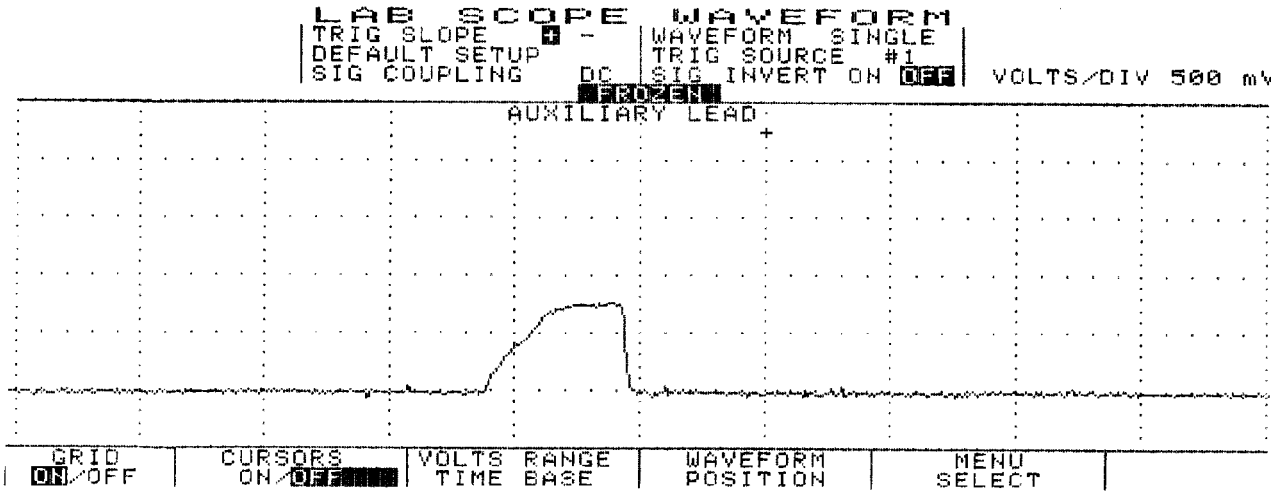

Fig. 6: Single Injector w/Normal Current Flow - Current Pattern

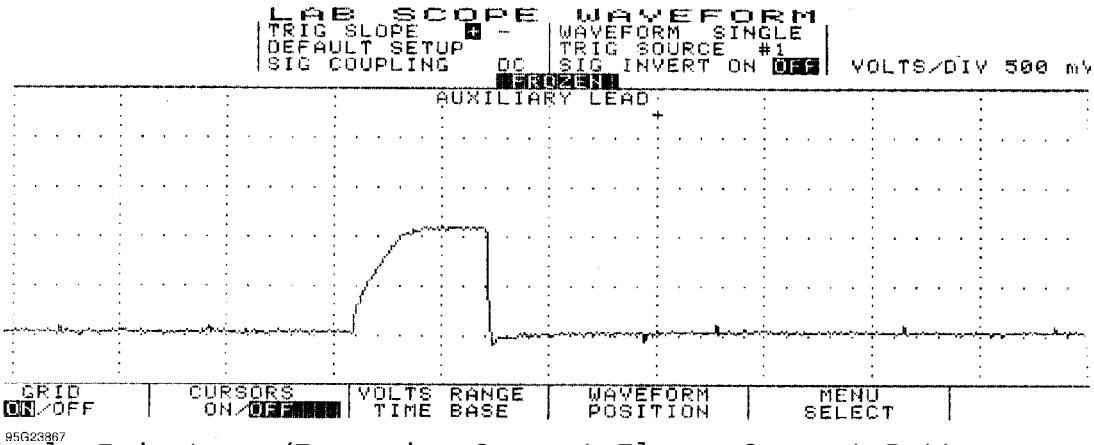

Fig. 7: Single Injector w/Excessive Current Flow - Current Pattern

EXAMPLE #2 - VOLTAGE CONTROLLED DRIVER

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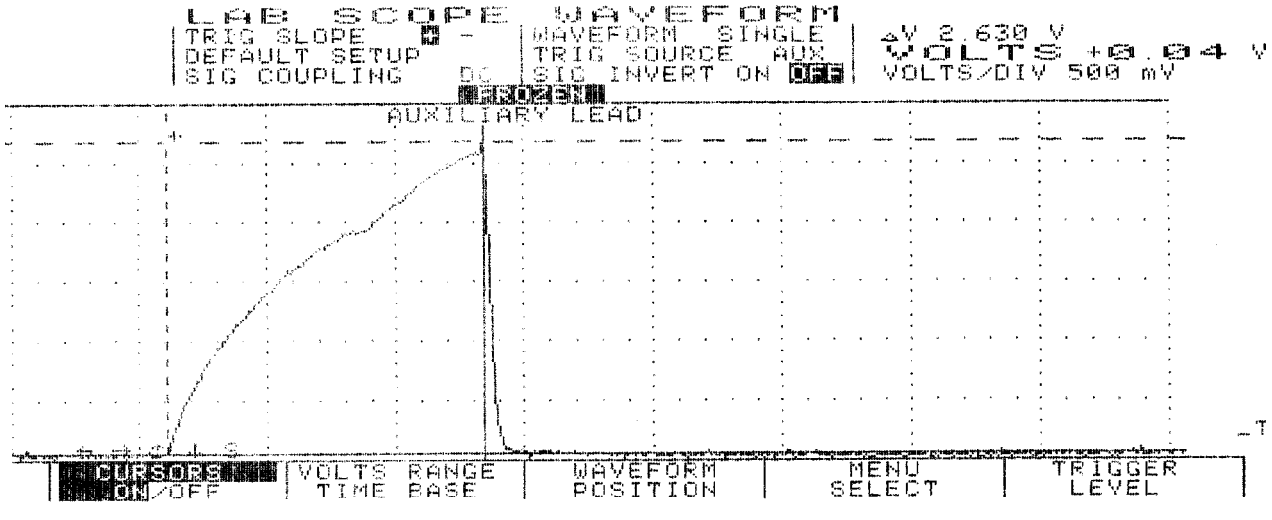
This time we will look at a GM 3.1L V6 VIN [T]. Fig. 8 shows the 1, 3, 5 (odd) injector bank with the current waveform indicating about a 2.6 amp draw at idle. This pattern, taken from a known good vehicle, correctly stays at or below the maximum 2.6 amps current range. Ideally, the current for each bank should be very close in comparison.

Notice the small dimple on the current flow's rising edge. This is the actual injector opening or what engineers refer to as the "set point." For good idle quality, the set point should be uniform between the banks.

When discussing Ohm's Law as it pertains to this parallel circuit, consider that each injector has specified resistance of 12.2 ohms. Since all three injectors are in parallel the total resistance of this parallel circuit drops to 4.1 ohms. Fourteen volts divided by four ohms would pull a maximum of 3.4 amps on this bank of injectors. However, as we discussed in EXAMPLE #1 above, other factors knock this value down to roughly the 2.6 amp neighborhood.

Now we are going to take a look at the even bank of injectors; injectors 2, 4, and 6. See Fig. 9. Notice this bank peaked at 1.7 amps at idle as compared to the 2.6 amps peak of the odd bank (Fig. 8). Current flow between even and odd injectors banks is not uniform, yet it is not causing a driveability problem. That is because it is still under the maximum amperage we figured out earlier. But be aware this vehicle could develop a problem if the amperage flow increases any more.

Checking the resistance of this even injector group with a DVOM yielded 6.2 ohms, while the odd injector group in the previous example read 4.1 ohms.



95E23873
Fig. 8: Injector Odd Bank w/Normal Current Flow - Current Pattern

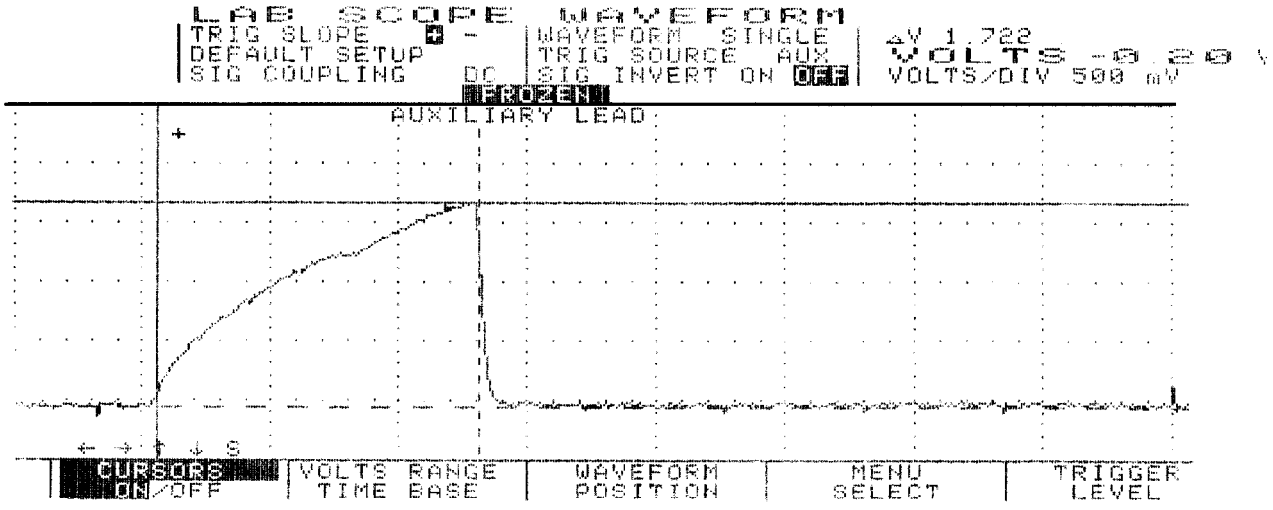


Fig. 9: Injector Even Bank w/Normal Current Flow - Current Pattern

EXAMPLE #3 - VOLTAGE CONTROLLED DRIVER

Example #3 is of a Ford 5.0L V8 SEFI. Fig. 10 shows a waveform of an individual injector at idle with the Lab Scope set on 200 milliamps per division. Notice the dimple in the rising edge. This dimple indicates the actual opening of the injector (set point) occurred at 400 milliamps and current peaked at 750 milliamps. This is a good specification for this engine.

The next waveform pattern in Fig. 11 shows an abnormality with another injector. With the Lab Scope set on 500 milliamps per division, you can see that the current waveform indicates a 1200 milliamp draw. This is a faulty injector.

Abnormally low resistance injectors create excessive current draw, causing rough idle, and possible computer driver damage.

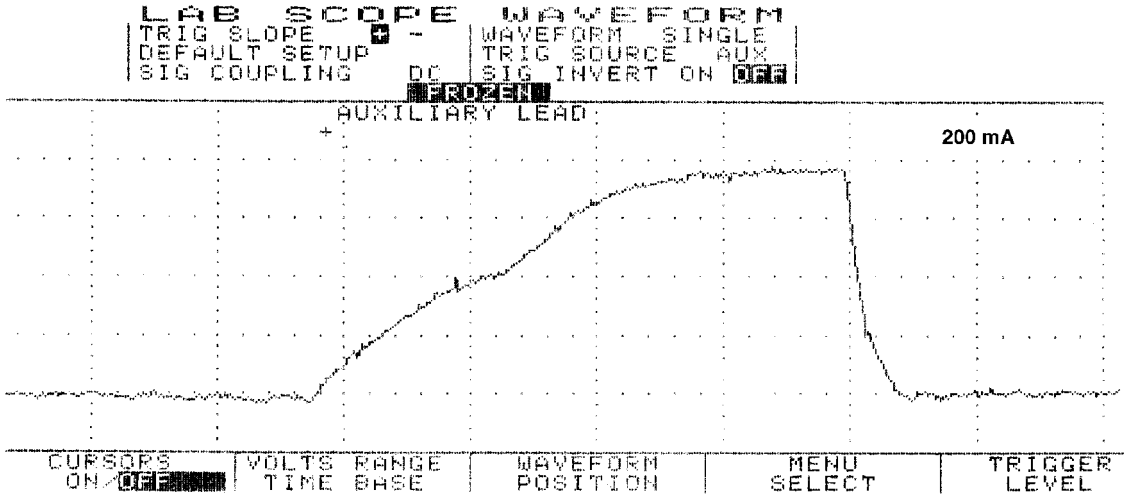
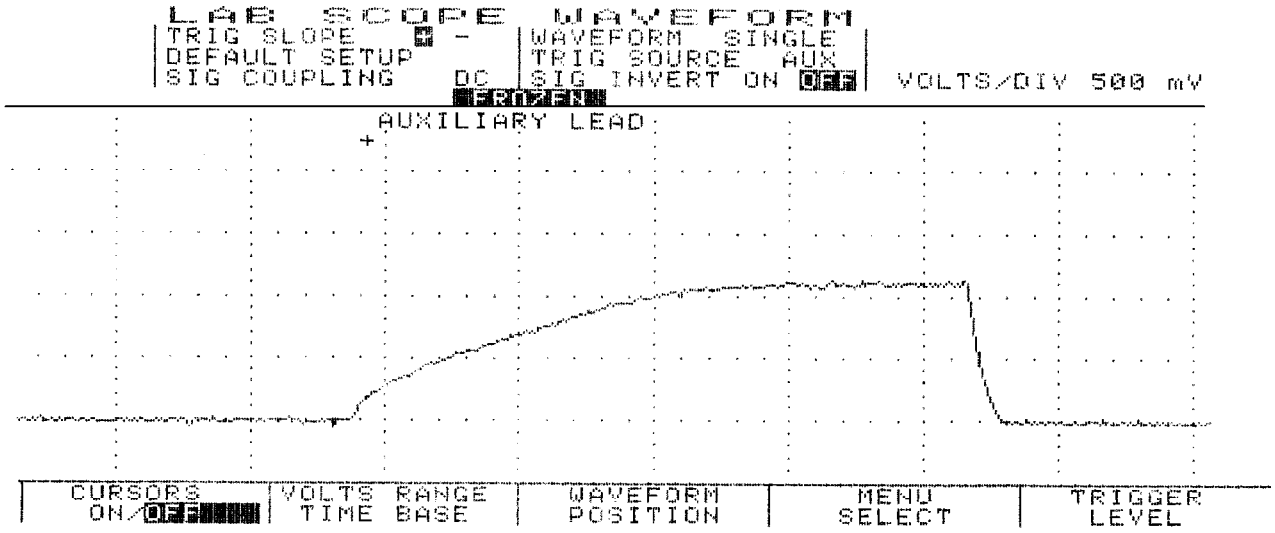


Fig. 10: Single Injector w/Normal Current Flow - Current Pattern

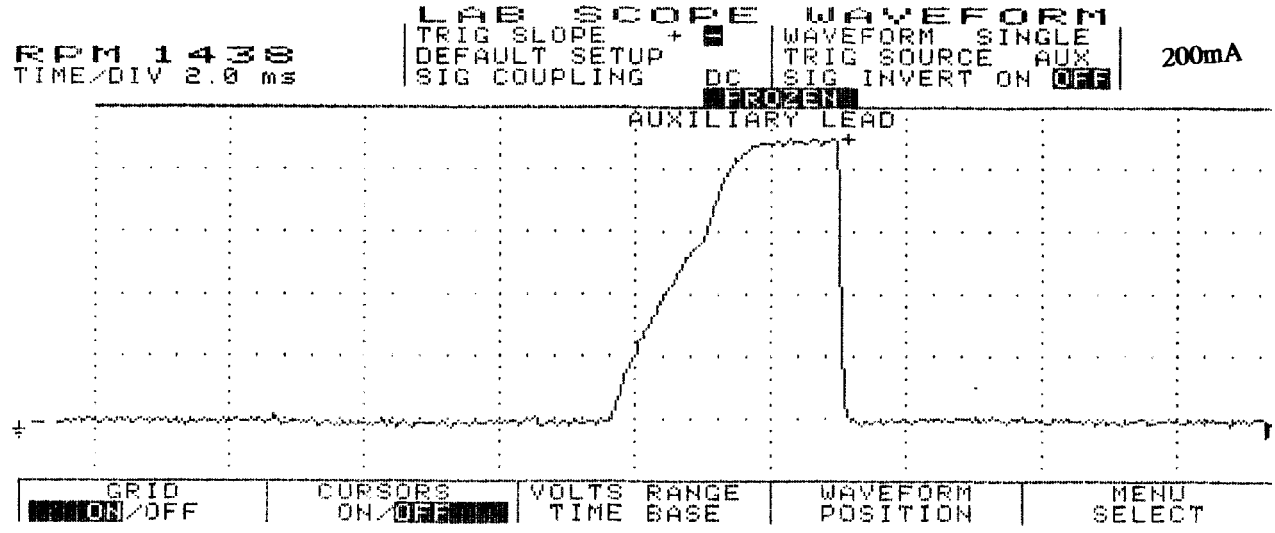


95H23876
Fig. 11: Single Injector w/Excessive Current Flow - Current Pattern

EXAMPLE #4 - CURRENT CONTROLLED DRIVER

Example #4 is of a Ford 4.6L SEFI VIN [W]. See Fig. 12 for the known-good waveform pattern. This Ford system is different from the one above in EXAMPLE #3 as it peaks at 900 milliamps and the actual opening of the injector (set point) is just below 600 milliamps.

This is offered as a comparison against the Ford pattern listed above, as they are both Ford SEFI injectors but with different operating ranges. The point is that you should not make any broad assumptions for any manufacturer.



95D23872
Fig. 12: Single Injector w/Normal Current Flow - Current Pattern

EXAMPLE #5 - CURRENT CONTROLLED DRIVER

The known-good waveform in Fig. 13 is from a Chrysler 3.0L V6 PFI VIN [3]. It is a perfect example of the peak and hold theory. The waveform shows a 1-amp per division current flow, ramping to 4 amps and then decreasing to 1-amp to hold the injector open.

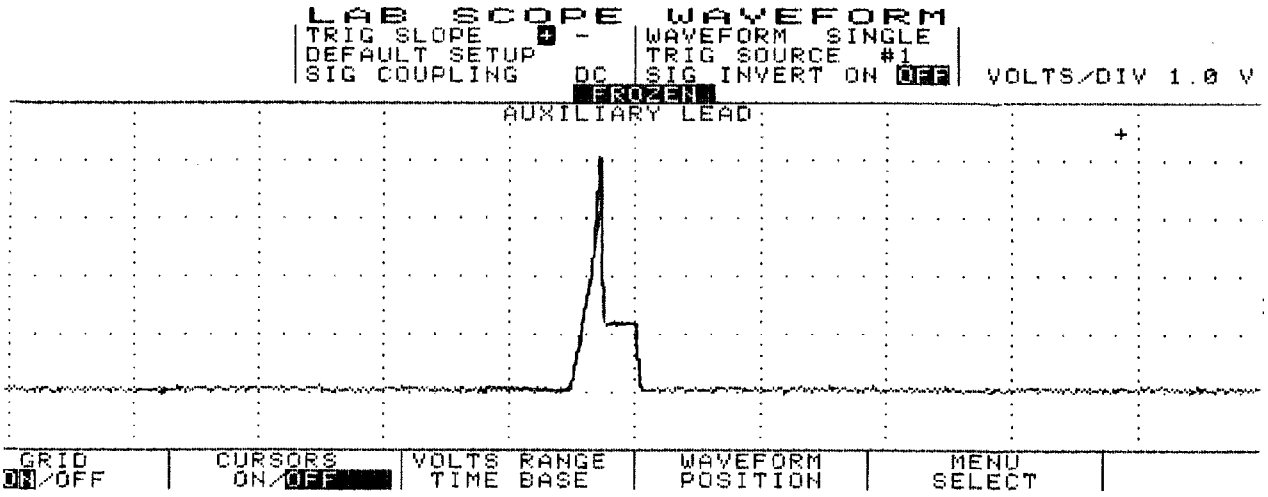


Fig. 13: Injector Bank w/Normal Current Flow - Current Pattern

EXAMPLE #6 - CURRENT CONTROLLED DRIVER

This next known-good waveform is from a Ford 5.0L V8 CFI VIN [F]. See Fig. 14. The pattern, which is set on a 250 milliamps scale, indicates a 1.25 amp peak draw and a hold at 350 milliamps.

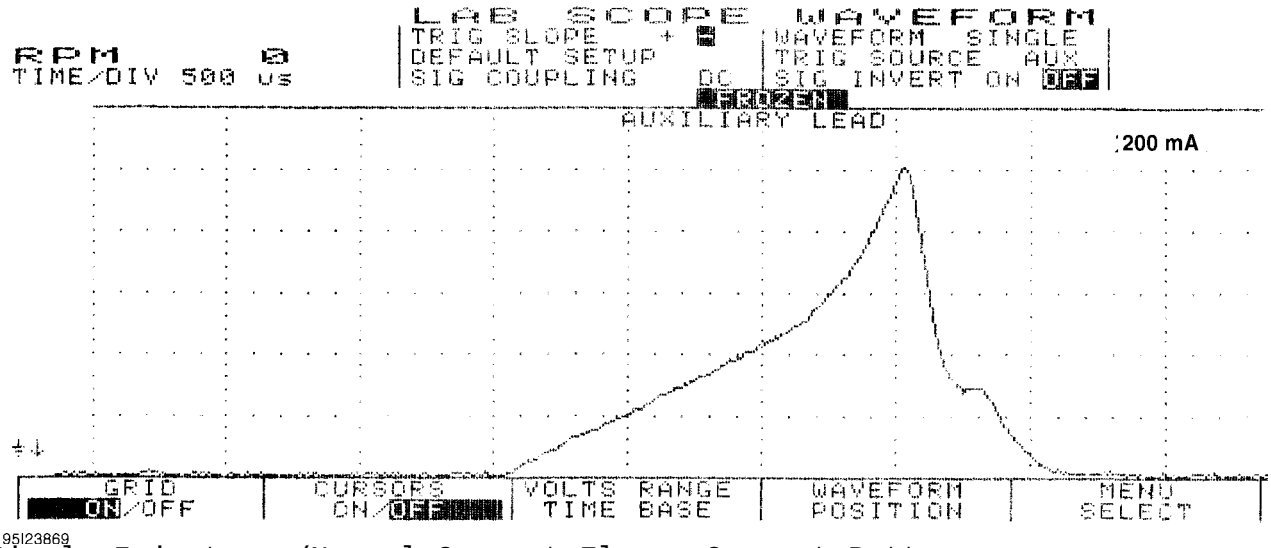


Fig. 14: Single Injector w/Normal Current Flow - Current Pattern

EXAMPLE #7 - CURRENT CONTROLLED DRIVER

The known-good current controlled type waveform in Fig. 15 is from a GM 2.0L TBI VIN [1]. With the lab scope set at 2 amps per division, notice that this system peaks at 4 amps and holds at 1 amp.

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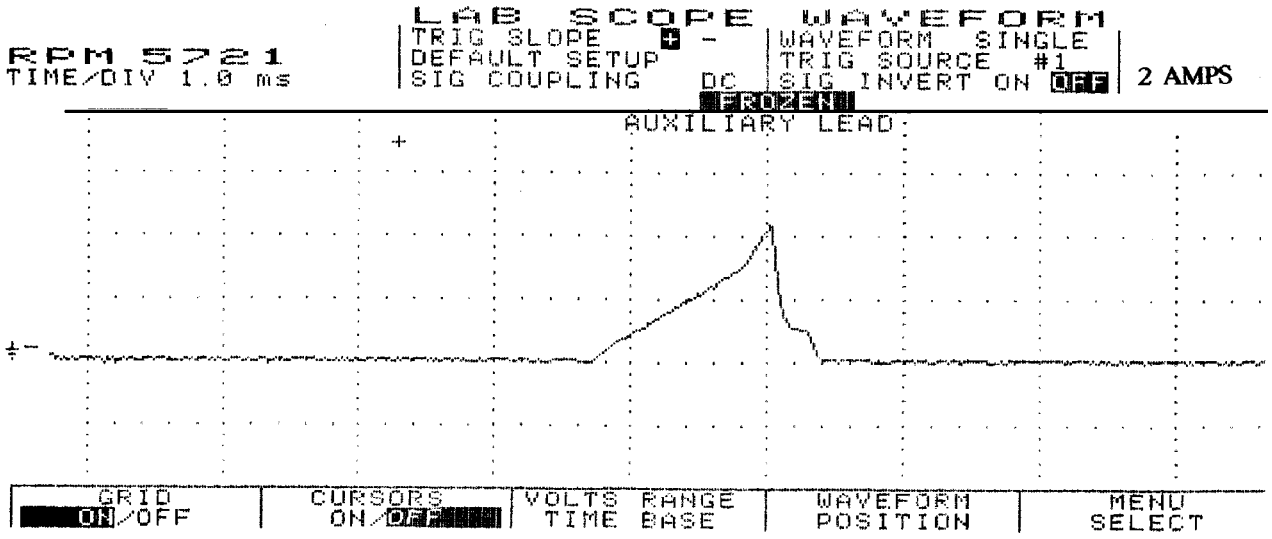
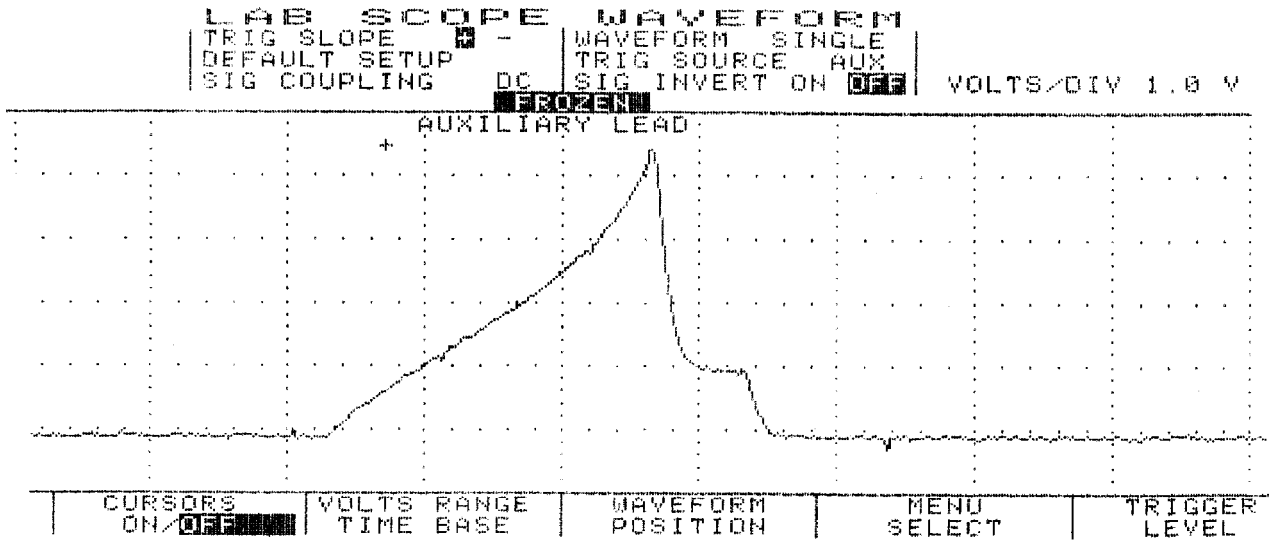
The next waveform is from the same type of engine, except that it shows a faulty injector. See Fig. 16. Notice that the current went to almost 5 amps and stayed at 1 amp during the hold pattern. Excessive amounts of current flow from bad injectors are a common source of intermittent computer shutdown. Using a current waveform pattern is the most accurate method of pinpointing this problem.



95C23871
Fig. 15: Single Injector w/Normal Current Flow - Current Pattern



95I23877
Fig. 16: Single Injector w/Excessive Current Flow - Current Pattern

EXAMPLE #8 - CURRENT CONTROLLED DRIVER

This known-good CPI system waveform from a GM 4.3L V6 CPI VIN [W] peaks at 4 amps and holds at 1-amp. See Fig. 17 for waveform.

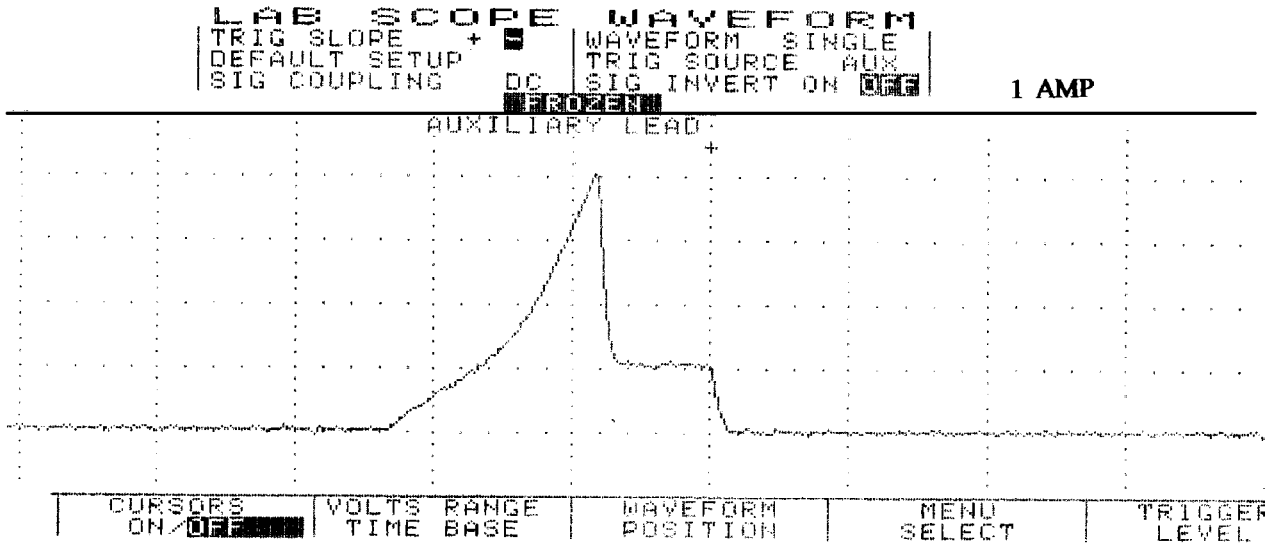


Fig. 17: Single Injector w/Normal Current Flow - Current Pattern

VOLTAGE WAVEFORM SAMPLES

EXAMPLE #1 - VOLTAGE CONTROLLED DRIVER

These two known-good waveform patterns are from a Ford 4.6L V8 VIN [W]. Fig. 18 illustrates the 64 volt inductive kick on this engine, indicating no clamping is occurring. The second pattern, Fig. 19, was taken during hot idle, closed loop, and no load.

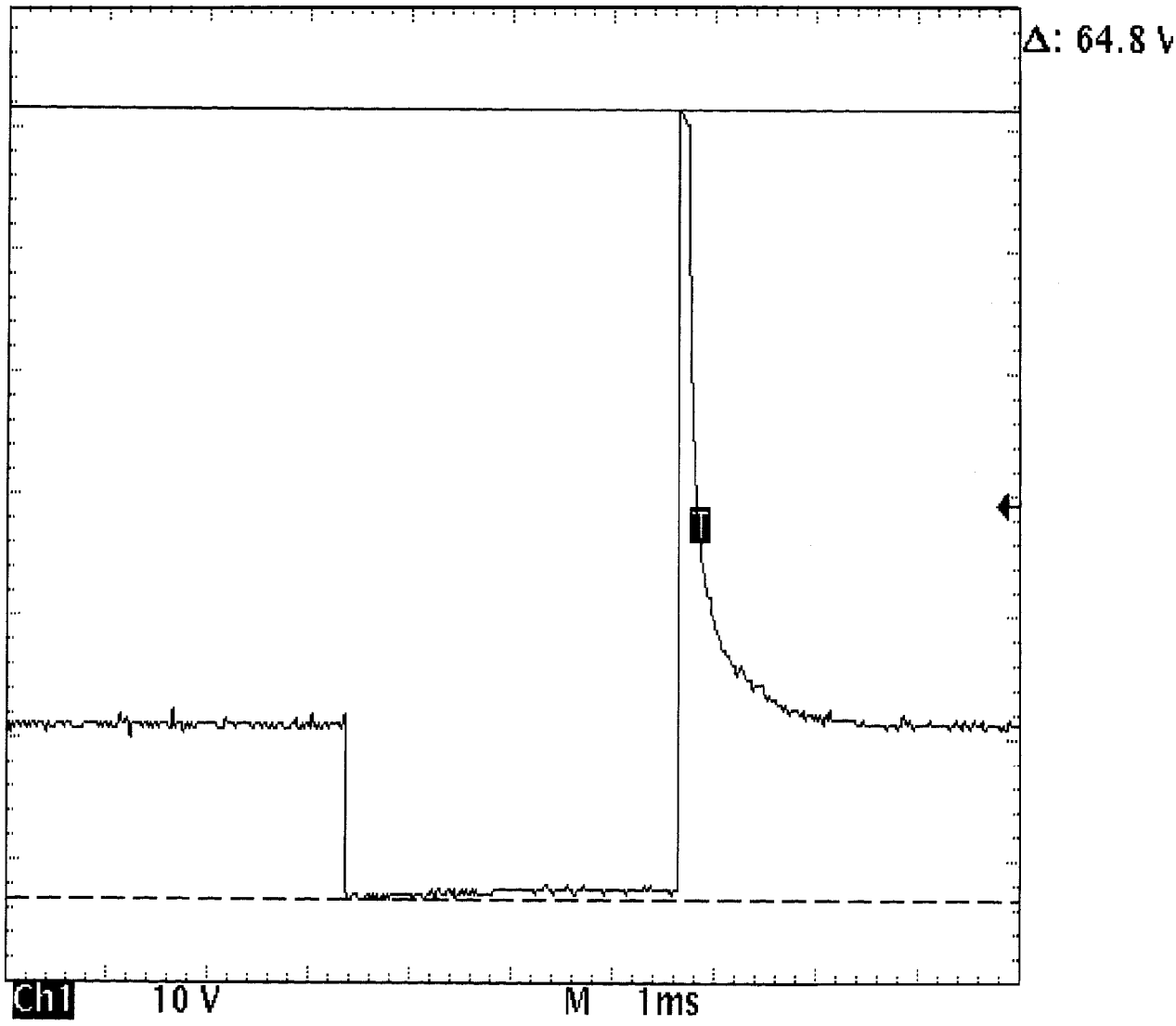


Fig. 18: Injector Bank - Known Good - Voltage Pattern

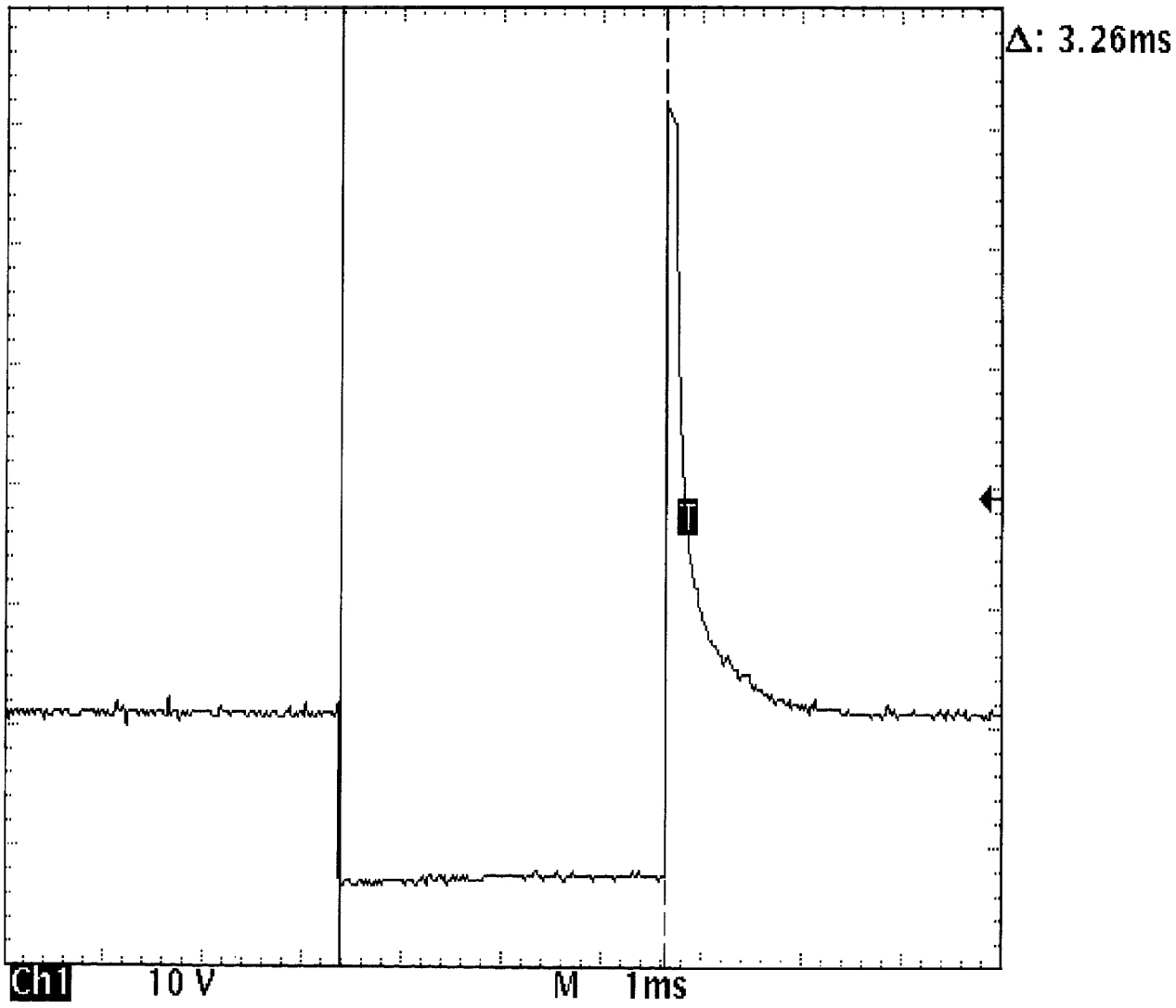


Fig. 19: Injector Bank - Known Good - Voltage Pattern

EXAMPLE #2 - VOLTAGE CONTROLLED DRIVER

The known-good waveform pattern in Fig. 20 is from a GM 3.8L V6 PFI VIN [3]. It was taken during hot idle, closed loop and no load.

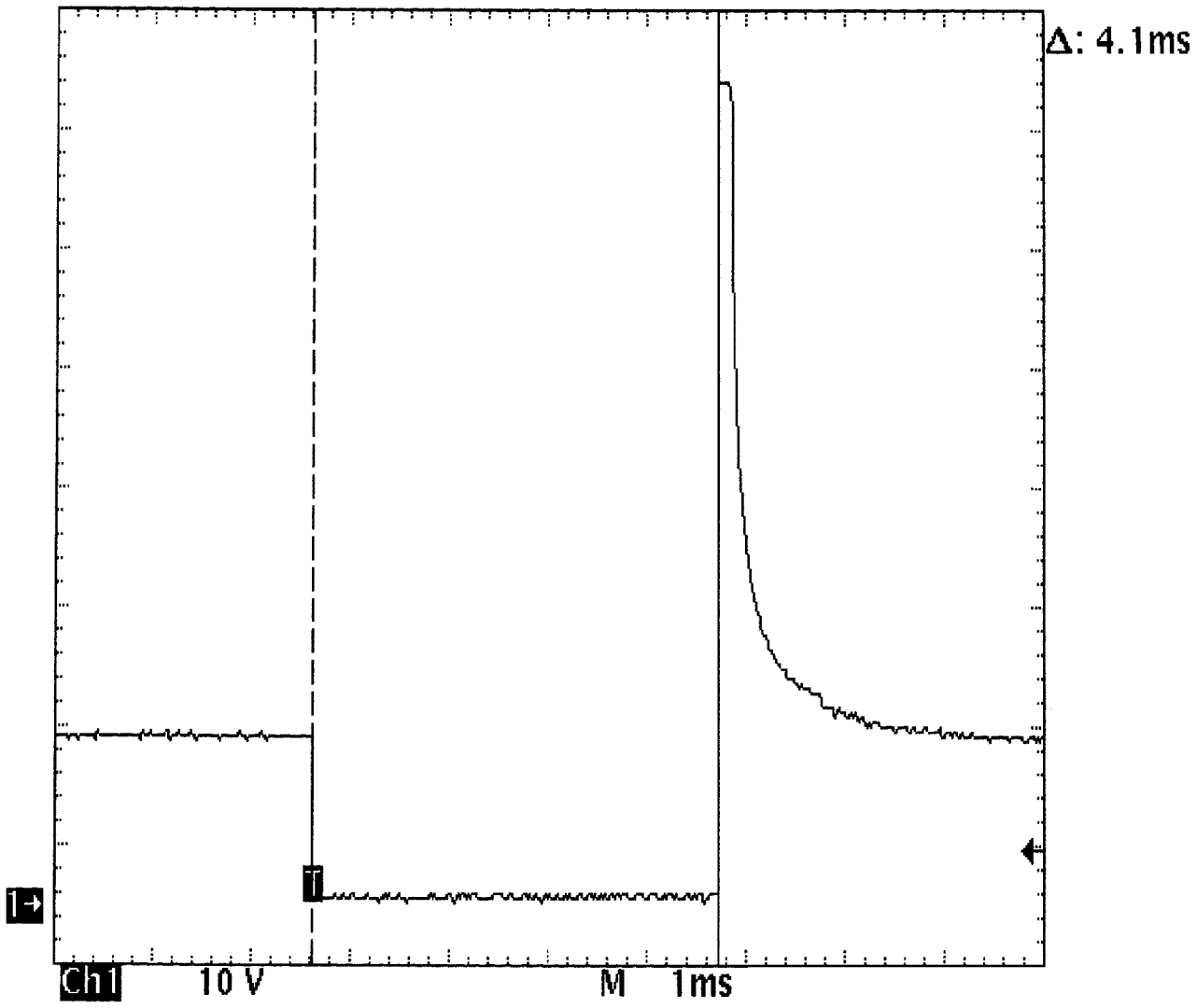


Fig. 20: Injector Bank - Known Good - Voltage Pattern

EXAMPLE #3 - VOLTAGE CONTROLLED DRIVER

This known-good waveform pattern, Fig. 21, is from a GM 5.0L V8 TPI VIN [F]. It was taken during hot idle, closed loop and no load.

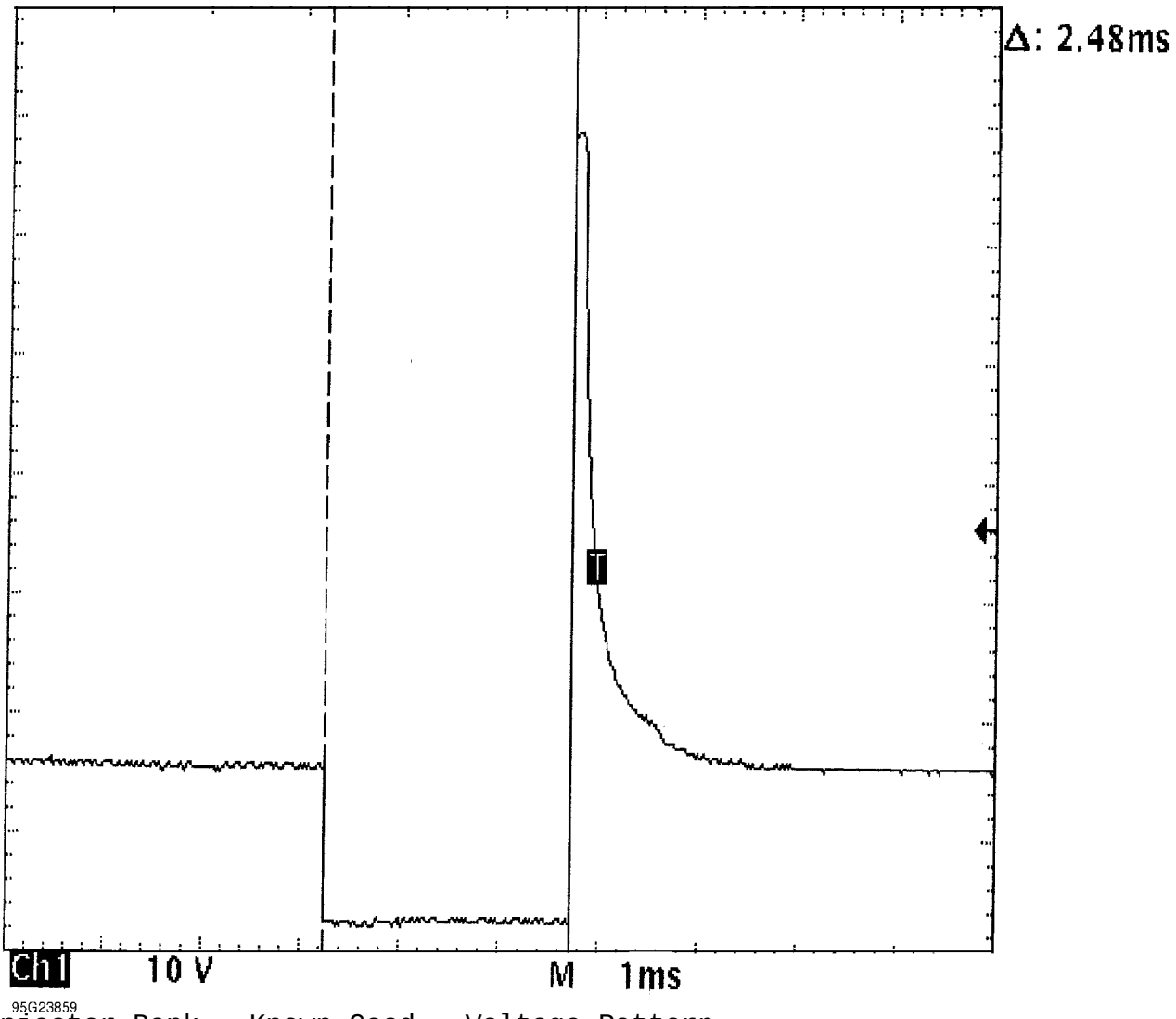
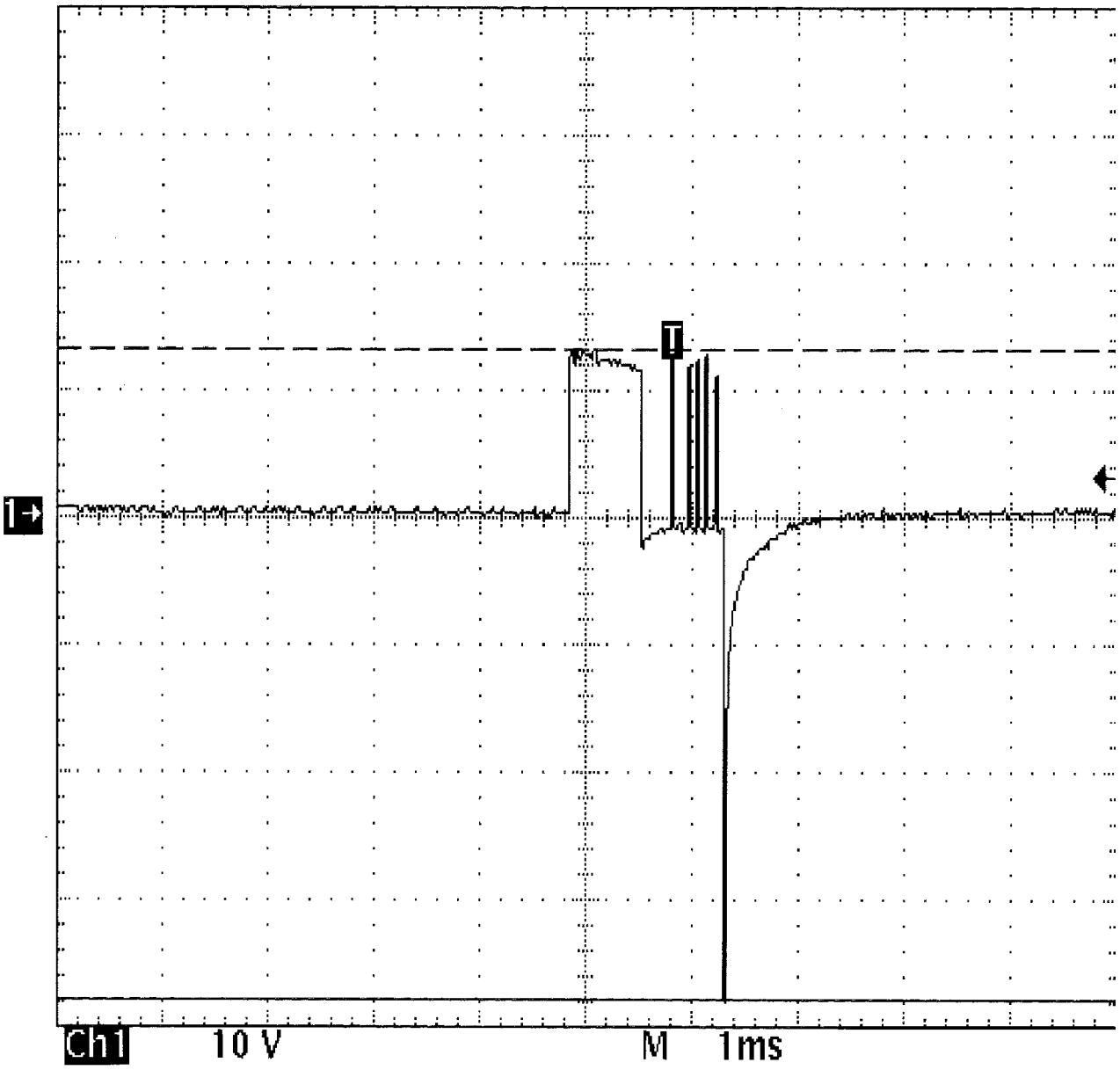


Fig. 21: Injector Bank - Known Good - Voltage Pattern

EXAMPLE #4 - CURRENT CONTROLLED DRIVER

From 1984 to 1987, Chrysler used this type injector drive on their TBI-equipped engines. See Fig. 22 for a known-good pattern. Instead of the ground side controlling the injector, Chrysler permanently grounds out the injector and switches the power feed side. Most systems do not work this way.

These injectors peak at 6 amps of current flow and hold at 1 amp.



95J23860

Fig. 22: Single Injector - Known Good - Voltage Pattern

EXAMPLE #5 - CURRENT CONTROLLED DRIVER

These two known-good waveform patterns are from a Chrysler 3. 0L V6 VIN [3]. The first waveform, Fig. 23, is a dual trace pattern that illustrates how Chrysler uses the rising edge of the engine speed signal to trigger the injectors. The second waveform, Fig. 24, was taken during hot idle, closed loop, and no load.

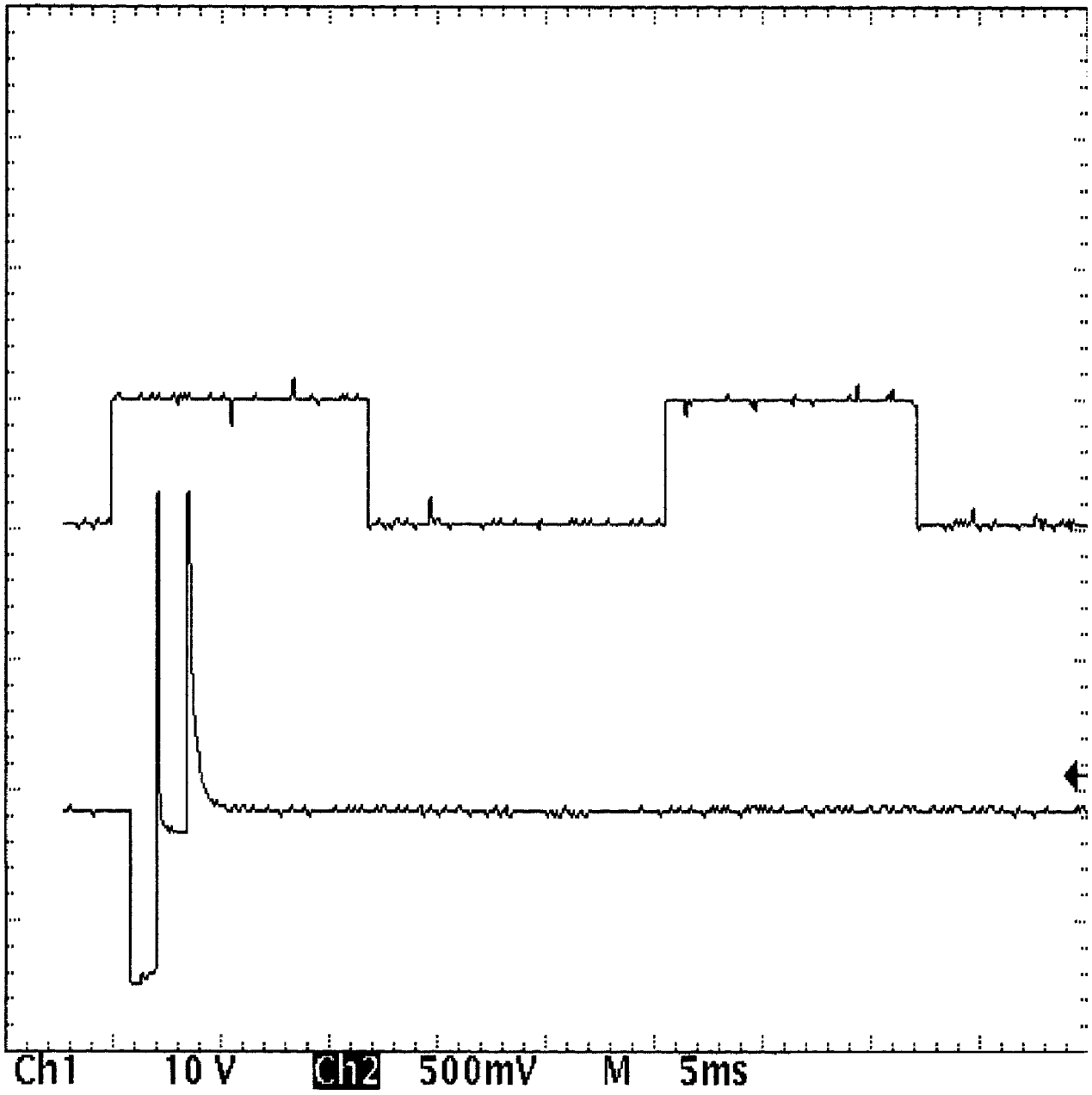
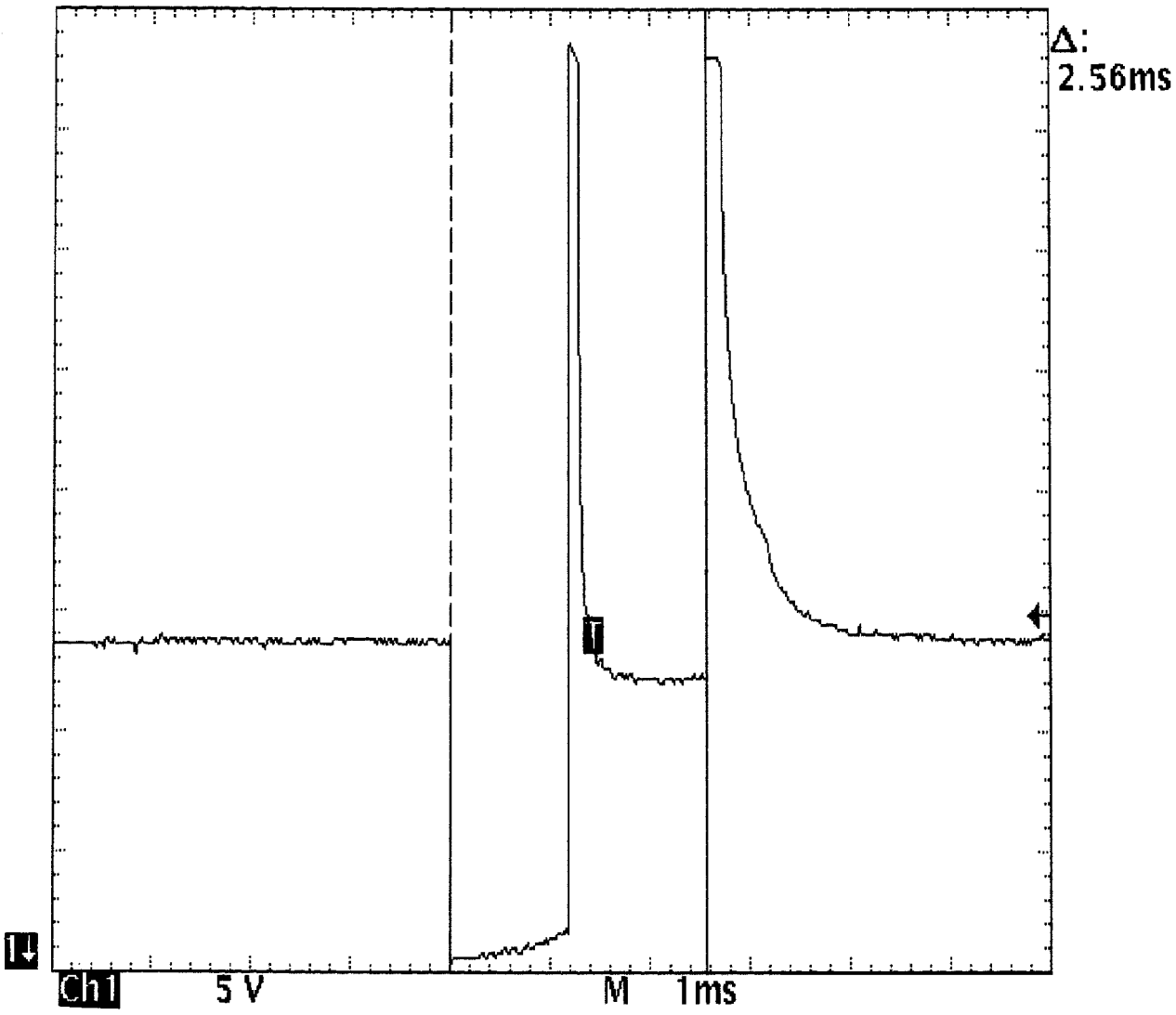


Fig. 23: Injector Bank - Known Good - Voltage Pattern



95B23854

Fig. 24: Injector Bank - Known Good - Voltage Pattern

EXAMPLE #6 - CURRENT CONTROLLED DRIVER

This known-good pattern from a Ford 3.0L V6 PFI VIN [U] illustrates that a zener diode inside the computer is used to clamp the injector's inductive kick to 35-volts on this system. See Fig. 25.

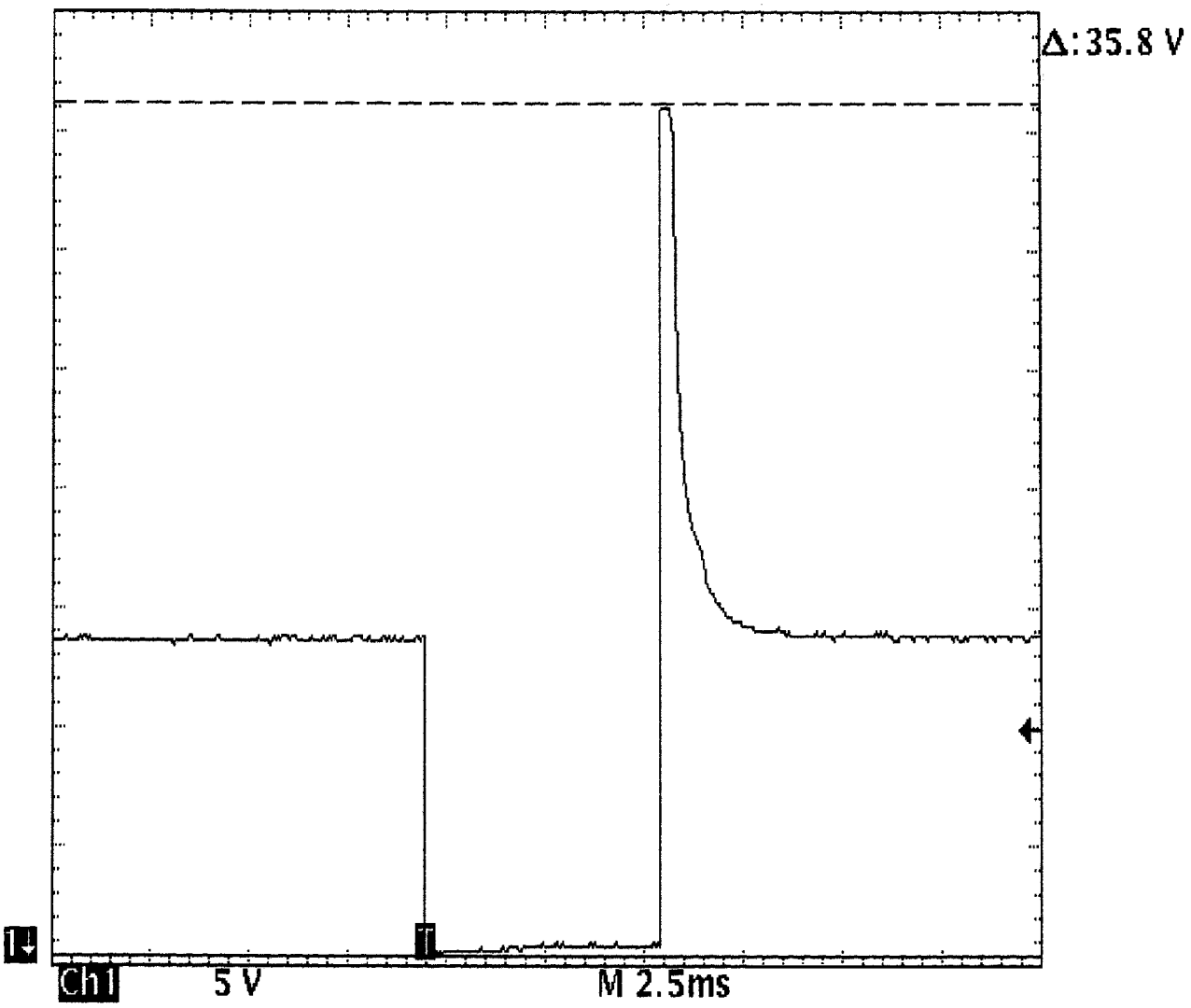


Fig. 25: Injector Bank - Known Good - Voltage Pattern

EXAMPLE #7 - CURRENT CONTROLLED DRIVER

This known-good waveform from a Ford 5.0L V8 CFI VIN [F] was taken during hot idle, closed loop, and no load. See Fig. 26.

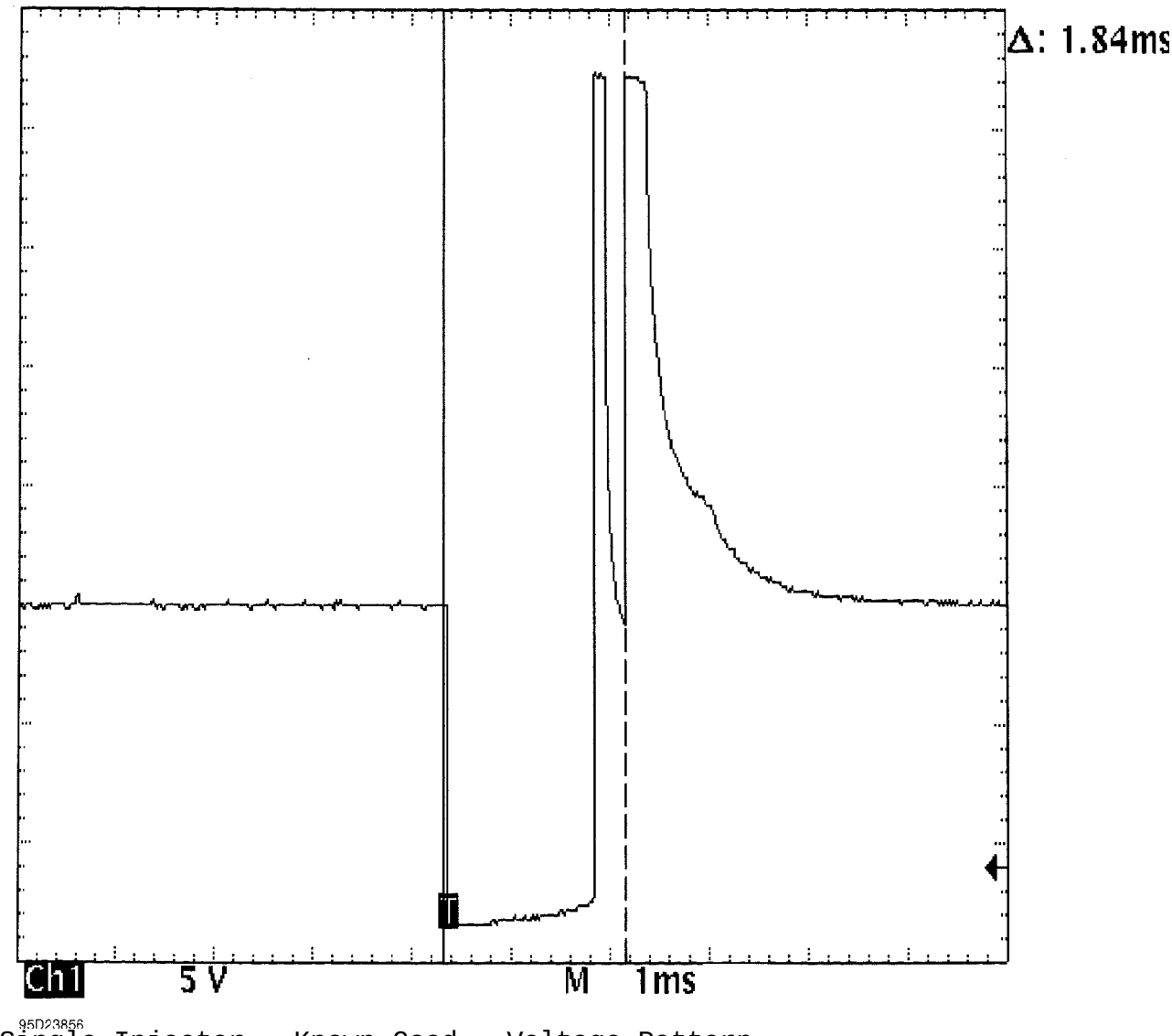


Fig. 26: Single Injector - Known Good - Voltage Pattern

EXAMPLE #8 - CURRENT CONTROLLED DRIVER

These two known-good waveform patterns are from a GM 2.0L In-Line 4 VIN [1]. Fig. 27 illustrates the 78 volt inductive spike that indicates a zener diode is not used. The second waveform, Fig. 28, was taken during hot idle, closed loop, and no load.

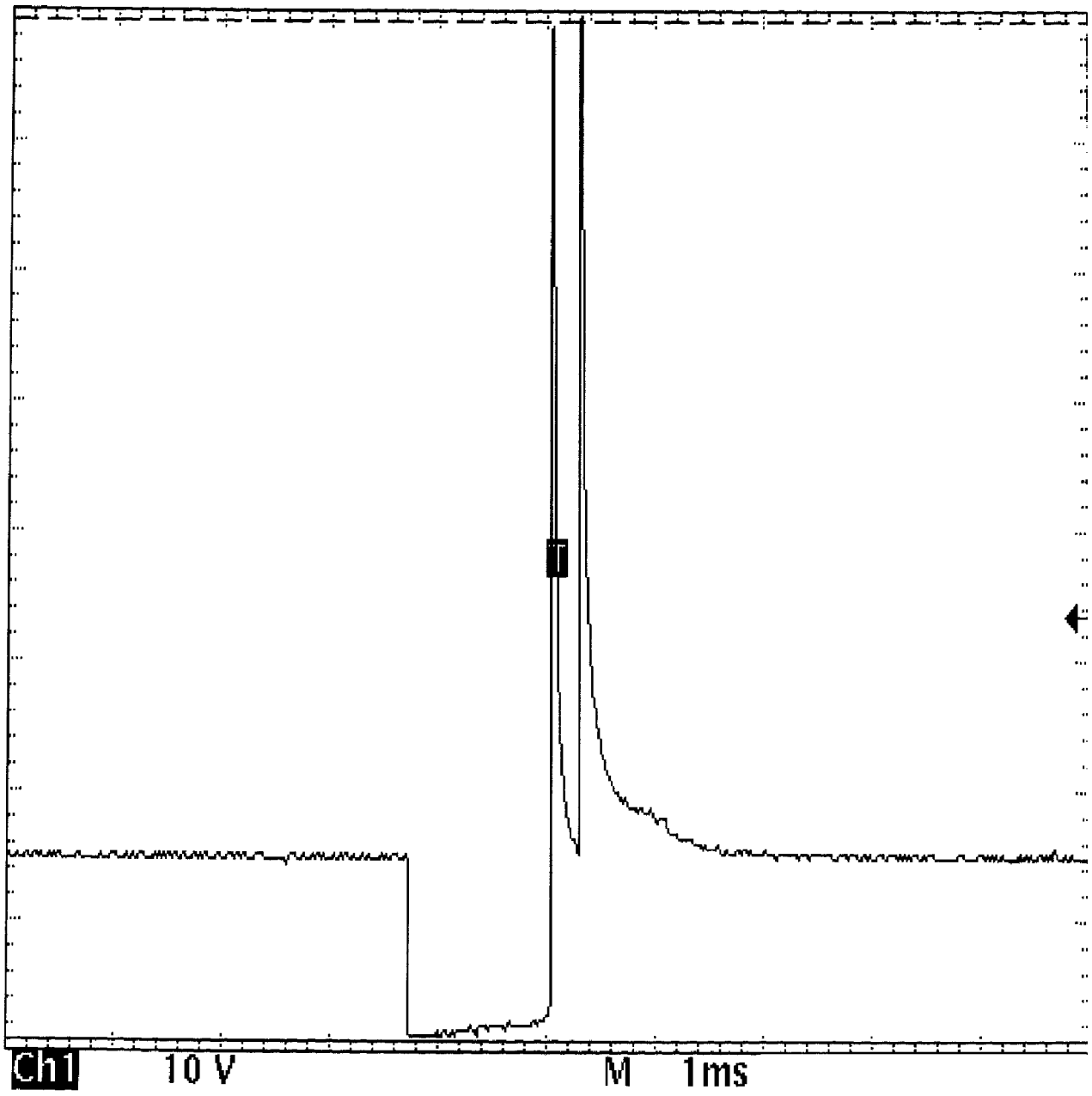


Fig. 27: Single Injector - Known Good - Voltage Pattern

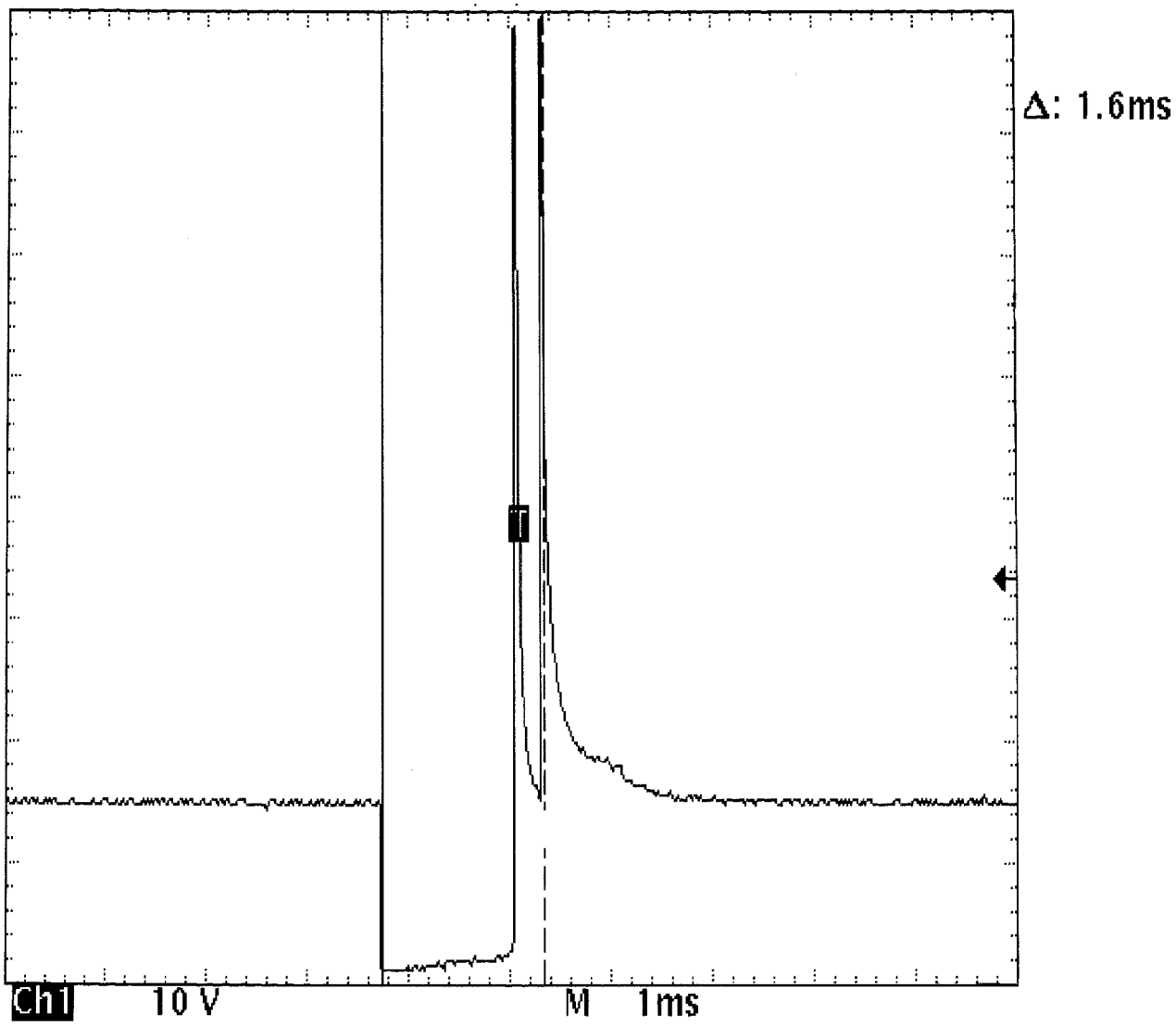


Fig. 28: Single Injector - Known Good - Voltage Pattern

END OF ARTICLE

WHEEL ALIGNMENT SPECIFICATIONS & PROCEDURES
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:39PM

ARTICLE BEGINNING

1993 WHEEL ALIGNMENT
Volkswagen Specifications & Procedures

EuroVan

*** PLEASE READ THIS FIRST ***

NOTE: Prior to performing wheel alignment, perform preliminary visual and mechanical inspection of wheels, tires and suspension components. See PRE-ALIGNMENT INSTRUCTIONS in WHEEL ALIGNMENT THEORY/OPERATION article in the GENERAL INFORMATION section.

WHEEL ALIGNMENT SPECIFICATIONS

WHEEL ALIGNMENT SPECIFICATIONS TABLE

Application	Preferred	Range
Camber (1)		
Front	1/8	0 To 1/4
Rear	-1/2	0 To -1
Caster (1)	1 5/8	1 1/8 To 2 1/8
Toe-In (2)		
Front	1/16	0 To 1/8 (0 To 3.2)
Rear	1/6 (2.8)	0 To 1/3 (0 To 5.6)
Toe-In (1)		
Front	1/8	0 To 1/4
Rear	1/3	0 To 2/3
Toe-Out On Turns (1)	-3/4	1/2 To 1 1/4

(1) - Measurement is in degrees.
(2) - Measurement is in inches (mm).

END OF ARTICLE

WHEEL ALIGNMENT THEORY/OPERATION
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:40PM

ARTICLE BEGINNING

GENERAL INFORMATION
Wheel Alignment Theory & Operation

ALL MODELS

*** PLEASE READ THIS FIRST ***

NOTE: This article is intended for general information purposes only. This information may not apply to all makes and models.

PRE-ALIGNMENT INSTRUCTIONS

GENERAL ALIGNMENT CHECKS

Before adjusting wheel alignment, check the following:

* Each axle uses tires of same construction and tread style, equal in tread wear and overall diameter. Verify that radial and axial runout is not excessive. Inflation should be at manufacturer's specifications.
* Steering linkage and suspension must not have excessive play. Check for wear in tie rod ends and ball joints. Springs must not be sagging. Control arm and strut rod bushings must not have excessive play. See Fig. 1.

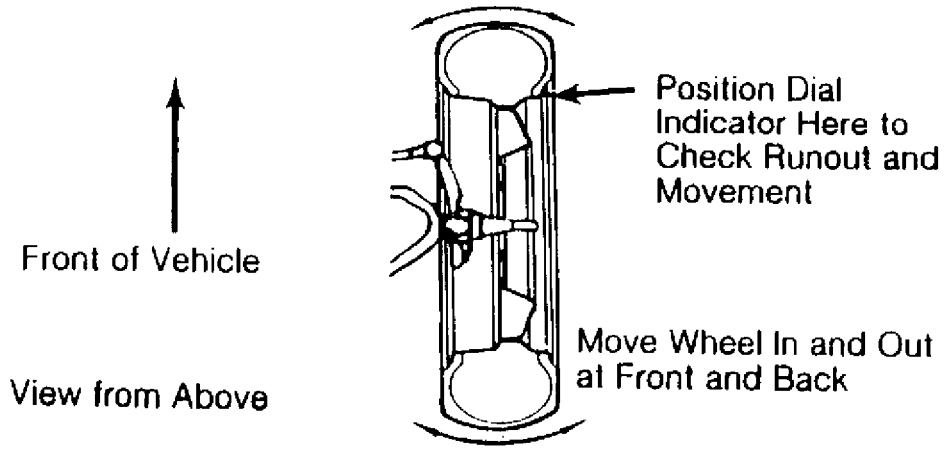


Fig. 1: Checking Steering Linkage

* Vehicle must be on level floor with full fuel tank, no passenger load, spare tire in place and no load in trunk. Bounce front and rear end of vehicle several times. Confirm vehicle is at normal riding height.

* Steering wheel must be centered with wheels in straight ahead position. If required, shorten one tie rod adjusting sleeve and lengthen opposite sleeve (equal amount of turns). See Fig. 2.
* Wheel bearings should have the correct preload and lug nuts must be tightened to manufacturer's specifications. Adjust camber, caster and toe-in using this sequence. Follow instructions of the alignment equipment manufacturer.

CAUTION: Do not attempt to correct alignment by straightening parts. Damaged parts must be replaced.

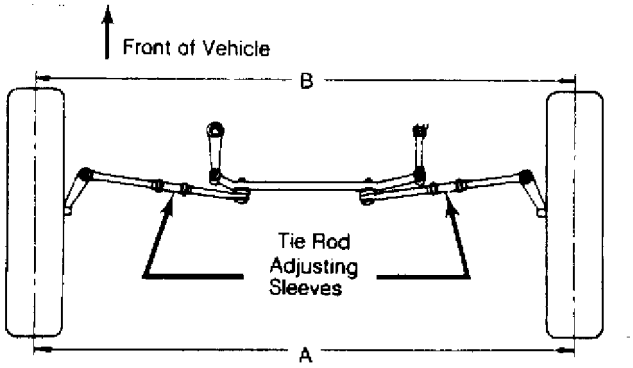


Fig. 2: Adjusting Tie Rod Sleeves (Top View)

CAMBER

1) Camber is the tilting of the wheel, outward at either top or bottom, as viewed from front of vehicle. See Fig. 3.
2) When wheels tilts outward at the top (from centerline of vehicle), camber is positive. When wheels tilt inward at top, camber is negative. Amount of tilt is measured in degrees from vertical.

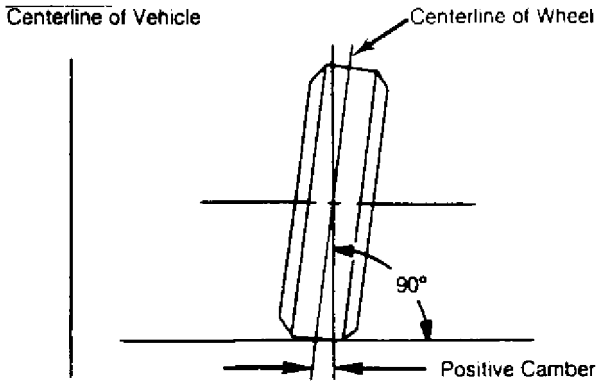


Fig. 3: Determining Camber Angle

CASTER

1) Caster is tilting of front steering axis either forward or backward from vertical, as viewed from side of vehicle. See Fig. 4.
2) When axis is tilted backward from vertical, caster is

positive. This creates a trailing action on front wheels. When axis is tilted forward, caster is negative, causing a leading action on front wheels.

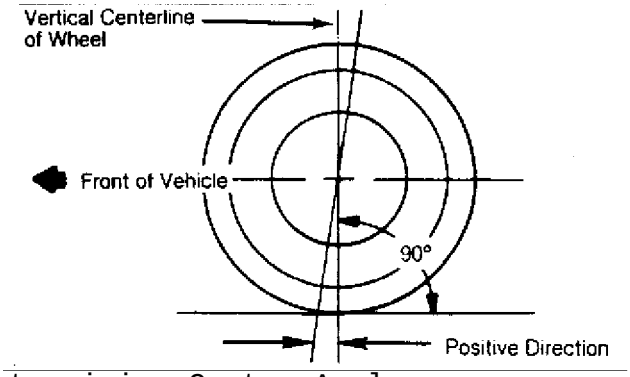


Fig. 4: Determining Caster Angle

TOE-IN ADJUSTMENT

Toe-in is the width measured at the rear of the tires subtracted by the width measured at the front of the tires at about spindle height. A positive figure would indicate toe-in and a negative figure would indicate toe-out. If the distance between the front and rear of the tires is the same, toe measurement would be zero. To adjust:

1) Measure toe-in with front wheels in straight ahead position and steering wheel centered. To adjust toe-in, loosen clamps and turn adjusting sleeve or adjustable end on right and left tie rods. See Figs. 2 and 5.

2) Turn equally and in opposite directions to maintain steering wheel in centered position. Face of tie rod end must be parallel with machined surface of steering rod end to prevent binding.

3) When tightening clamps, make certain that clamp bolts are positioned so there will be no interference with other parts throughout the entire travel of linkage.

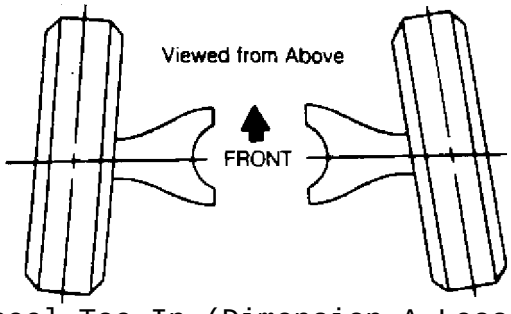


Fig. 5: Wheel Toe-In (Dimension A Less Dimension B)

TOE-OUT ON TURNS

1) Toe-out on turns (turning radius) is a check for bent or damaged parts, and not a service adjustment. With caster, camber, and

toe-in properly adjusted, check toe-out with weight of vehicle on wheels.

2) Use a full floating turntable under each wheel, repeating test with each wheel positioned for right and left turns. Incorrect toe-out generally indicates a bent steering arm. Replace arm, if necessary, and recheck wheel alignment.

STEERING AXIS INCLINATION

1) Steering axis inclination is a check for bent or damaged parts, and not a service adjustment. Vehicle must be level and camber should be properly adjusted. See Fig. 6.

2) If camber cannot be brought within limits and steering axis inclination is correct, steering knuckle is bent. If camber and steering axis inclination are both incorrect by approximately the same amount, the upper and lower control arms are bent.

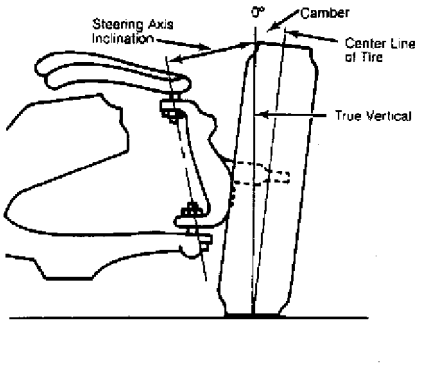


Fig. 6: Checking Steering Axis Inclination

END OF ARTICLE

WIPER/WASHER SYSTEM
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:40PM

ARTICLE BEGINNING

1993 ACCESSORIES & EQUIPMENT
Volkswagen Wiper/Washer Systems

Volkswagen; EuroVan

DESCRIPTION

All models are equipped with 2-speed wipers. A standard or optional intermittent feature is also available. The wiper control is the right lever on the steering column. Some models are equipped with a rear wiper/washer system.

ADJUSTMENTS

WIPER BLADE

To adjust wiper blade park position, ensure wiper motor is at park position. Locate wiper blade(s) above lower edge of windshield as specified. See WIPER BLADE PARK POSITION SPECIFICATION table. Secure wiper arm.

WIPER BLADE PARK POSITION SPECIFICATION TABLE

Application	In. (mm)
EuroVan	
Front	(2)
Rear	(1) 1.8 (45)

(1) - Measured from top of blade to left edge of glass.

TESTING

Testing information is not available from manufacturer.

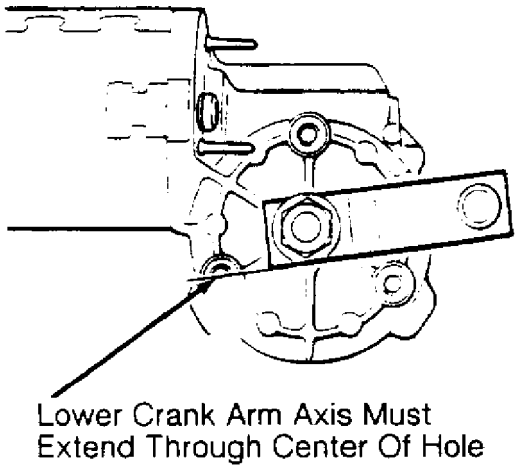
REMOVAL & INSTALLATION

FRONT WIPER MOTOR

Removal
Open hood, and unplug wiring connector. Pry linkage off motor crank arm. Remove mounting bolts and motor. DO NOT remove motor bracket when removing motor.

Installation
Check crank arm alignment by running motor and allowing arm to park. Ensure crank arm is properly aligned. See Fig. 1. To complete

installation, reverse removal procedure.



93F82854

Fig. 1: Aligning Front Wiper Motor Crank Arm)
Courtesy of Volkswagen United States, Inc.

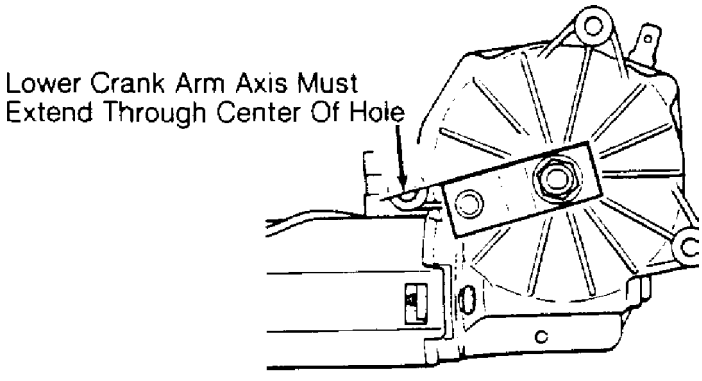
REAR WIPER MOTOR

Removal

Remove inner trim panel on rear hatch. Unplug wiring connector, and pry linkage off motor crank arm. Remove motor crank arm, motor bolts and motor.

Installation

Check crank arm alignment by running motor and allowing arm to park. Install crank arm in correct position. See Fig. 2. Ensure motor is in Park and install wiper blade arm. Reverse removal procedure to complete installation.



93I82857

Fig. 2: Aligning Rear Motor Crank Arm (EuroVan)
Courtesy of Volkswagen United States, Inc.

WIRING DIAGRAMS

See appropriate chassis wiring diagram in WIRING DIAGRAMS.

END OF ARTICLE

WIRING DIAGRAM SYMBOLS
Article Text

1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:40PM

ARTICLE BEGINNING

WIRING DIAGRAMS
How To Use The Wiring Diagrams

INTRODUCTION

The wiring diagrams and technical service bulletins, containing wiring diagram changes, are obtained from the domestic and import manufacturers. These are checked for accuracy and are all redrawn into a consistent format for easy use.

All diagrams are arranged with the front of the vehicle at the left side of the first page and the rear of the vehicle at the right side of the last page. Accessories are shown near the end of the diagram.

Components are shown in their approximate location on the vehicle. Due to the constantly increasing number of components on vehicles today, it is impossible to show exact locations.

In the past, when cars were simpler, diagrams were simpler. All components were connected by wires, and diagrams seldom exceeded 4 pages in length. Today some wiring diagrams require more than 16 pages. It would be impractical to expect a service technician to trace a wire from page 1 across every page to page 16.

Removing some of the wiring maze reduces eyestrain and time wasted searching across several pages. Today, the majority of diagrams now follow a much improved format, which permits space for internal switch details and connector shapes.

Any wires that don't connect directly to their components are identified on the diagram to indicate where they go. There is a legend on the first page of each diagram, detailing component location. It refers you to sub-systems, using grid NUMBERS at the top and bottom of the page and grid LETTERS on each side. This grid system works in a manner similar to that of a road map.

HOW TO USE THE WIRING DIAGRAMS

1) On the first page of the diagram, you will find a listing of major electrical components or systems. Locate the specific component or system you wish to trace. A grid number and letter will follow the component's name.

2) Use the grid NUMBERS (arranged horizontally across the top and bottom of each page) to find the page of the wiring diagram that contains the component you're seeking. When you reach this page, use the grid LETTERS on the side of the page to determine the component's vertical location.

3) Locate the circuit you need to service. The internals are shown for switches and relays to assist you in understanding how the circuit operates.

NOTE: In some of the newer wiring diagram articles in this product, there is a Legend for the wiring diagrams that has

been created to make locating components easier. For these articles, there will be a COMPONENT LOCATION MENU title in the article main menu. These articles will also have the original legend available on the first graphic.

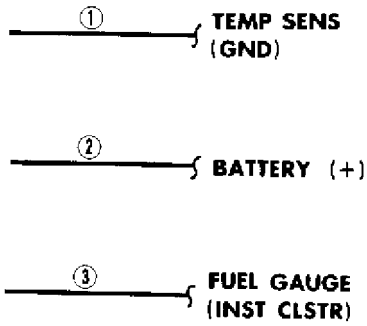


Fig. 1: Identifying Tie-Off Symbols

4) If the wires are not drawn all the way to another component (across several pages), a reference will tell you their final destination.

5) Again, use the legend on the first page of the wiring diagram to determine the grid number and letter of the referenced component. You can then turn directly to it without tracing wires across several pages.

6) The symbols shown in Fig. 1 are called tie-offs. The first tie-off shown indicates that the circuit goes to the temperature sensor, and is also a ground circuit.

7) The second symbol indicates that the circuit goes to a battery positive parallel circuit. The third symbol leads to a particular component and the location is also given.

8) The lines shown in Fig. 2 are called options. Which path or option to take depends on what engine or systems the vehicle has.

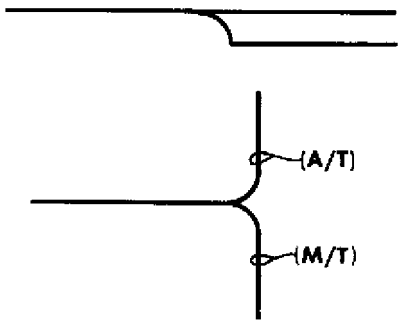


Fig. 2: Identifying Option Symbols

COLOR ABBREVIATIONS IDENTIFICATION

COLOR ABBREVIATIONS

Color	Normal	Optional
Black	BLK	BK

WIRING DIAGRAM SYMBOLS
Article Text (p. 3)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:40PM

Blue	BLU		BU
Brown	BRN		BN
Clear	CLR		CR
Dark Blue	DK BLU		DK BU
Dark Green	DK GRN		DK GN
Green	GRN		GN
Gray	GRY		GY
Light Blue	LT BLU		LT BU
Light Green	LT GRN		LT GN
Orange	ORG		OG
Pink	PNK		PK
Purple	PPL		PL
Red	RED		RD
Tan	TAN		TN
Voilet	VIO		VI
White	WHT		WT
Yellow	YEL		YL

WIRING DIAGRAM SYMBOL IDENTIFICATION

NOTE: Standard wiring symbols are used on diagrams. The list below will help clarify any symbols that are not easily understood at a glance. Most components are labeled "Motor", "Switch" or "Relay" in addition to being drawn with the standard symbol.

WIRING DIAGRAM SYMBOLS

Views of the symbols used in the WIRING DIAGRAM articles are in the following graphics. See Figs. 3 through 25.

Fig. 3: Circuit Breaker

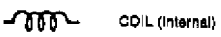


Fig. 4: Coil (Internal)

Fig. 5: Connector

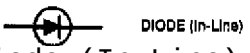


Fig. 6: Diode (In-Line)

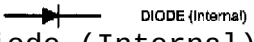


Fig. 7: Diode (Internal)

Fig. 8: Diode (Light Emitting)

WIRING DIAGRAM SYMBOLS
Article Text (p. 4)
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:40PM

Fig. 9: Defogger Grid

Fig. 10: Fuse

Fig. 11: Fusible Link

Fig. 12: Ground

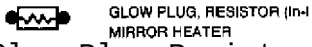


Fig. 13: Glow Plug Resistor (In-Line) or Mirror Heater

Fig. 14: Injector (Diesel) or Photocell (Gasoline)

Fig. 15: Internal Fuse, Thermal Limiter

Fig. 16: Lamp (Dual Element)

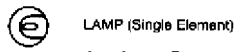


Fig. 17: Lamp (Single Element)

Fig. 18: Motor

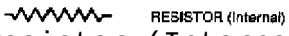


Fig. 19: Resistor (Internal)

Fig. 20: Sensor, Thermistor

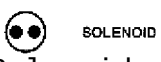


Fig. 21: Solenoid

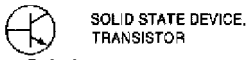


Fig. 22: Solid State Device, Transistor

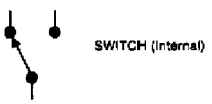


Fig. 23: Switch (Internal)

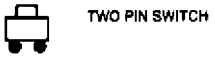


Fig. 24: Two Pin Switch

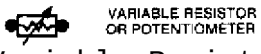


Fig. 25: Variable Resistor or Potentiometer

END OF ARTICLE

WIRING DIAGRAMS
Article Text
1993 Volkswagen EuroVan
For Volkswagen Technical Site

Saturday, March 18, 2000 10:40PM

ARTICLE BEGINNING

1993 WIRING DIAGRAMS
Volkswagen Wiring Diagrams

Volkswagen; EuroVan

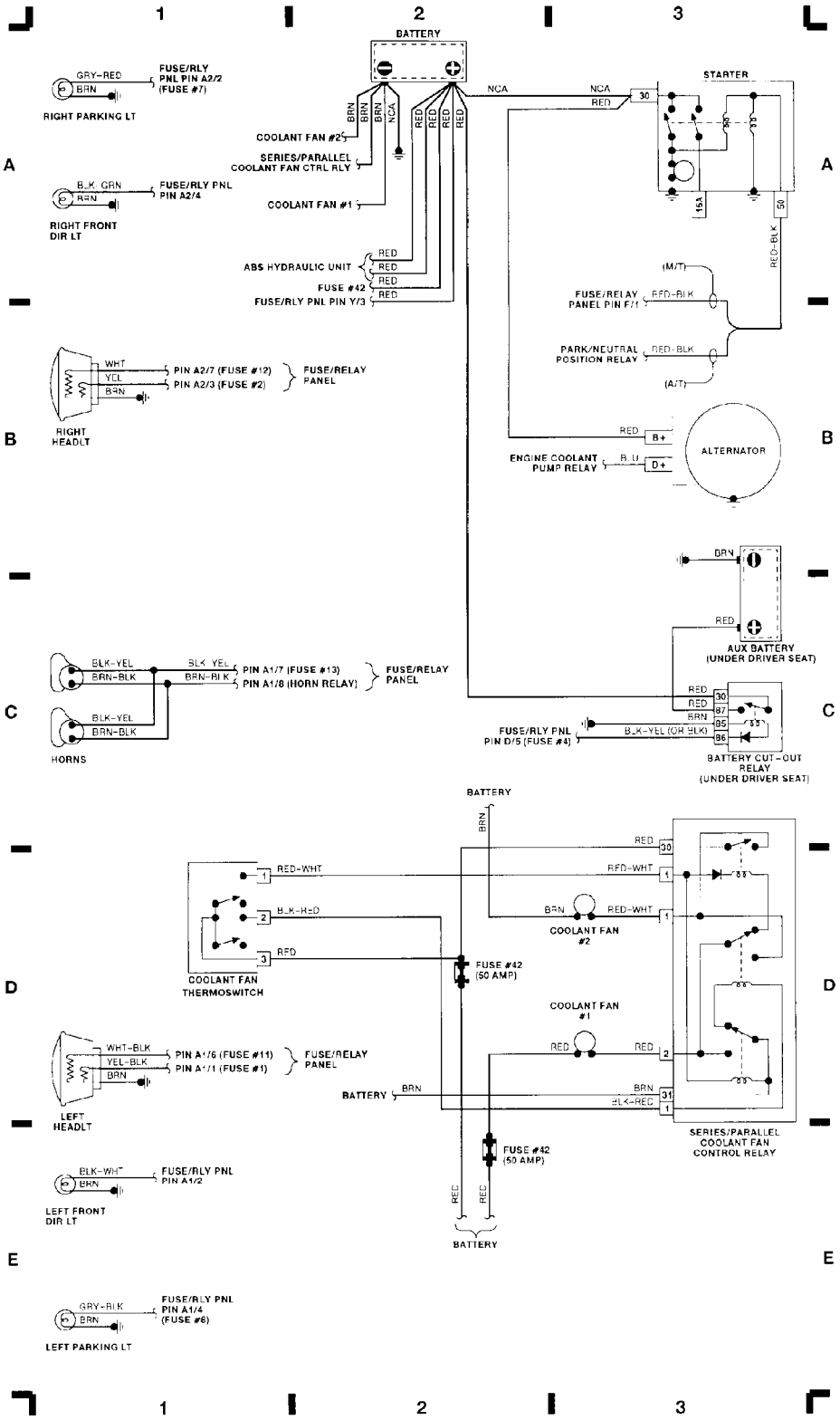
COMPONENT LOCATION MENU

COMPONENT LOCATIONS TABLE

Component	Figure No. (Location)
A/C COMPRESSOR CLUTCH	6 (D 22)
A/C COMP CLUTCH SHUTOFF RELAY	6 (D 23)
A/C SWITCH	6 (E 20-21)
ABS CONTROL UNIT	4 (A-B 12)
ABS HYDRAULIC UNIT	4 (C 13-14)
ALTERNATOR	1 (B 3)
AUXILIARY BATTERY	1 (C 3)
BACK-UP LIGHT SWITCH (M/T)	8 (E 28)
BATTERY	1 (A 2)
BATTERY CUT-OUT RELAY	1 (C 3)
CENTRAL LOCKING CB	10 (B 37)
CENTRAL LOCKING SYSTEM	10 (B-E 36-39)
CIGARETTE LIGHTER/LIGHT	8 (A 28)
COOLANT FANS (W/ A/C)	4 (C-E 12-15)
CRUISE CONTROL SWITCH	3 (E 11)
CRUISE CONTROL UNIT	3 (D-E 8)
DEFOGGER SWITCH	8 (E 29)
DIR SWITCH	6 (A 22)
DOOR SWITCHES	11 (E 43)
EMERGENCY FLASHER SWITCH	6 (A 20-22)
ENGINE CONTROL MODULE (ECM)	2 (A-B 7)
ENGINE CONTROL MODULE (CALIF)	2 (D-E 7)
ENGINE PUMP COOLANT RELAY	7 (A 26)
FRESH AIR SWITCH (W A/C)	6 (E 22)
FRESH AIR SWITCH (W/O A/C)	9 (E 32-33)
FRESH AIR SWITCH ILLUM LIGHT	6 (E 20)
FUEL INJECTORS	2 (A 5, C 5)
FUSE #23	6 (D 20)
FUSE #42 (W A/C)	4 (C 12, E 12)
FUSE #42 (W/O A/C)	1 (D 2, E 2)
FUSE #51	6 (D 20)
FUSE #78	7 (A 26)
FUSE #92	5 (E 17)
FUSE RELAY PANEL	5,6,7,8 (B-D 16-31)
HEATED O2 SENSOR	2 (A 4, D 4)
HEATED SEATS	11 (C-E 40-41)
HEATER AIR BLOWER RELAY	10 (D 39)
HEATER BLOWER RELAY	9 (E 35)
IGNITION COIL	2 (B 4, D-E 4)

IGNITION SWITCH ..... 5 (A 16-17)
IN-LINE ABS FUSE ..... 4 (A 13)
INSTRUMENT CLUSTER ..... 9 (A-D 32-33)
INTERIOR LIGHTS ..... 9 (B-C 33-35)
LIGHT SWITCH ..... 5 (A 18-19)
MAKE-UP MIRRORS ..... 11 (D-E 42)
MIRROR HEATER RELAY ..... 11 (D 41)
MULTI-FUNCTION SWITCH ..... 3 (C-D 11)
PARK/NEUTRAL POSITION RELAY ..... 3 (A 8)
POWER MIRROR SYSTEM ..... 11 (B-D 42)
POWER STEERING SWITCH ..... 2 (C 5, E 5)
POWER WINDOW CB ..... 10 (B 37)
POWER WINDOW SYSTEM ..... 10 (A-B 36-39)
PROGRAM SWITCH ..... 3 (A-B 8)
SERIES/PARALLEL COOLANT FAN CNTRL RLY (W/O A/C) ..... 1 (D 3)
STARTER ..... 1 (A 3)
STOP LIGHT SWITCH ..... 8 (A 29)
TRANSMISSION CONTROL MODULE ..... 3 (A-C 11)
VACUUM VENT VALVE ..... 3 (E 9)
WINDSHIELD WIPER SYSTEM ..... 7 (E 24-27)
WARM AIR BLOWER SWITCH ..... 9 (D-E 35)
WARNING MODULE ..... 8 (A 29-30)
2ND EVAPORATOR A/C SWITCH ..... 11 (A 40)

WIRING DIAGRAMS



94E30977

Fig. 1: Battery, Starter, Alternator (Grid 1-3)

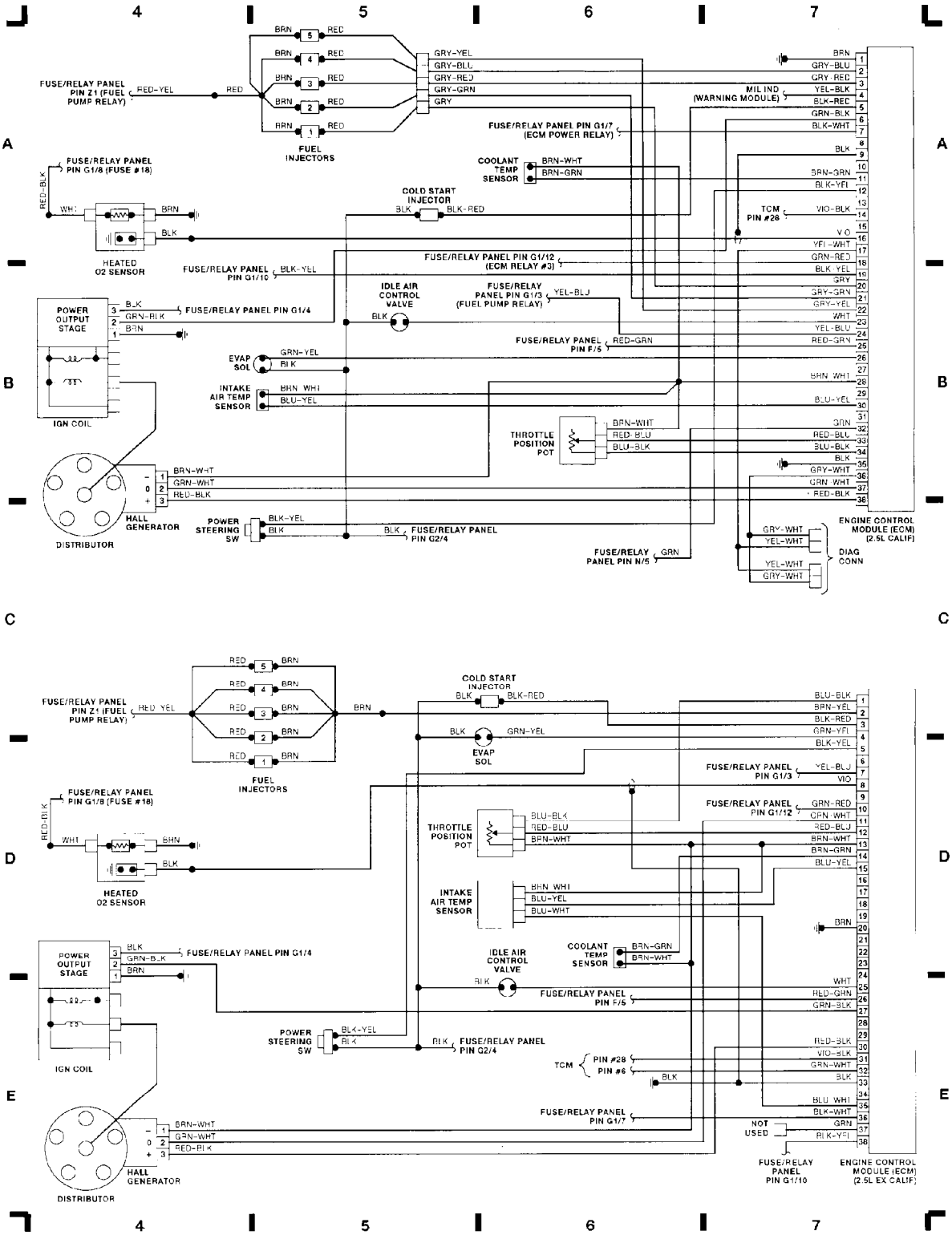


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Fig. 2: Engine Control Modules (Grid 4-7)

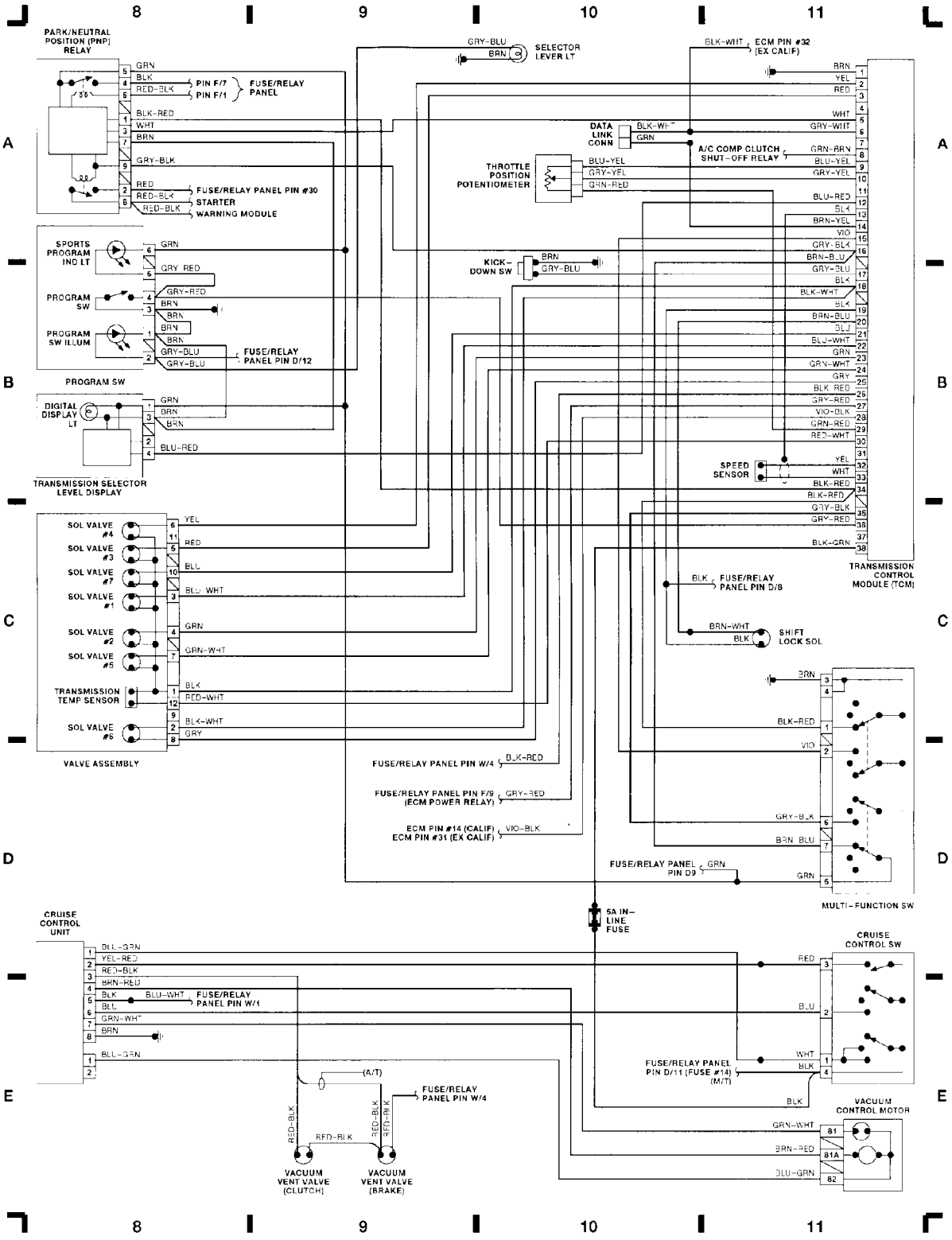

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Fig. 3: Transmission Cntrl Module, Valve Assy (Grid 8-11)

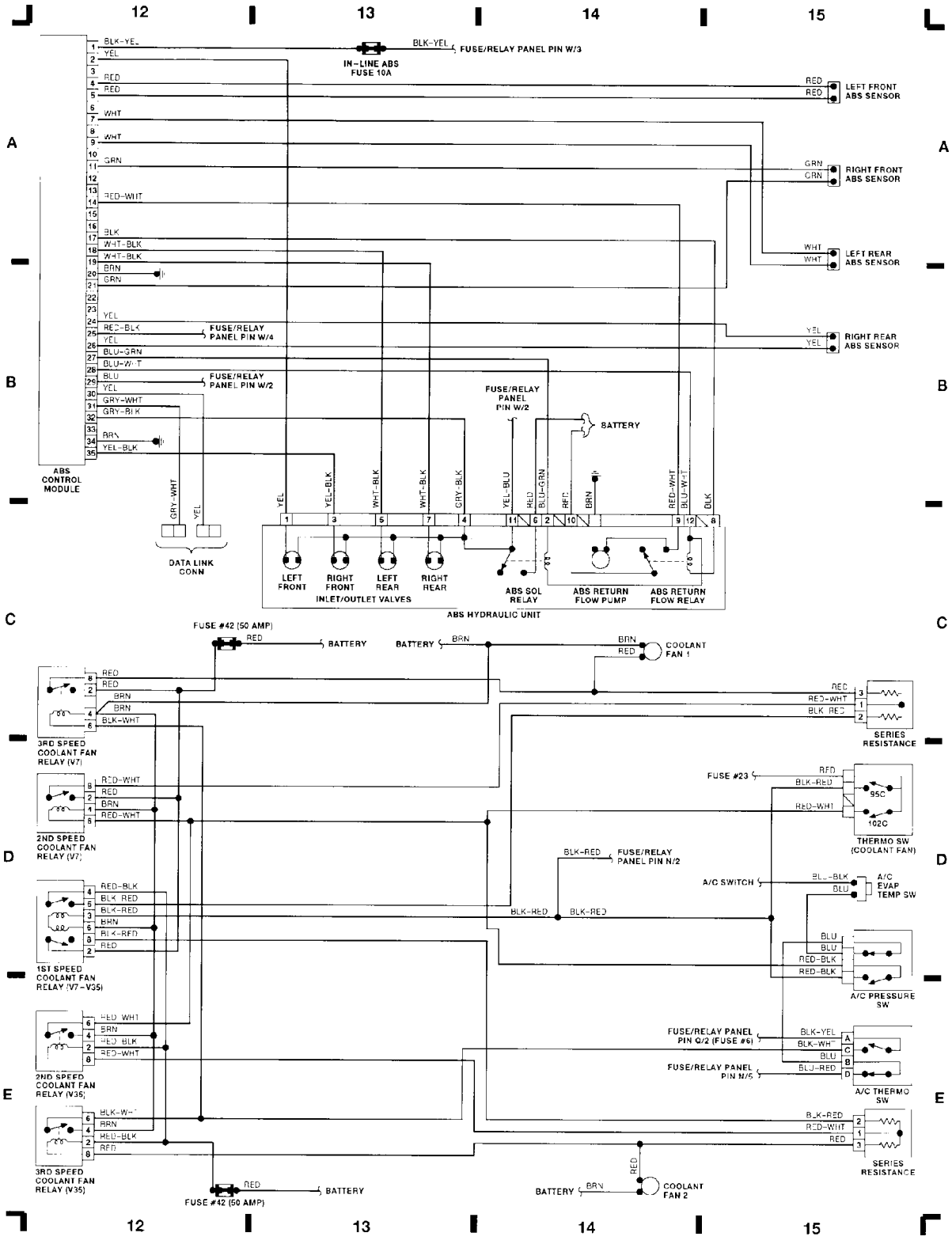

Fig. 4: ABS Control Module, ABS Hydraulic Unit (Grid 12-15)

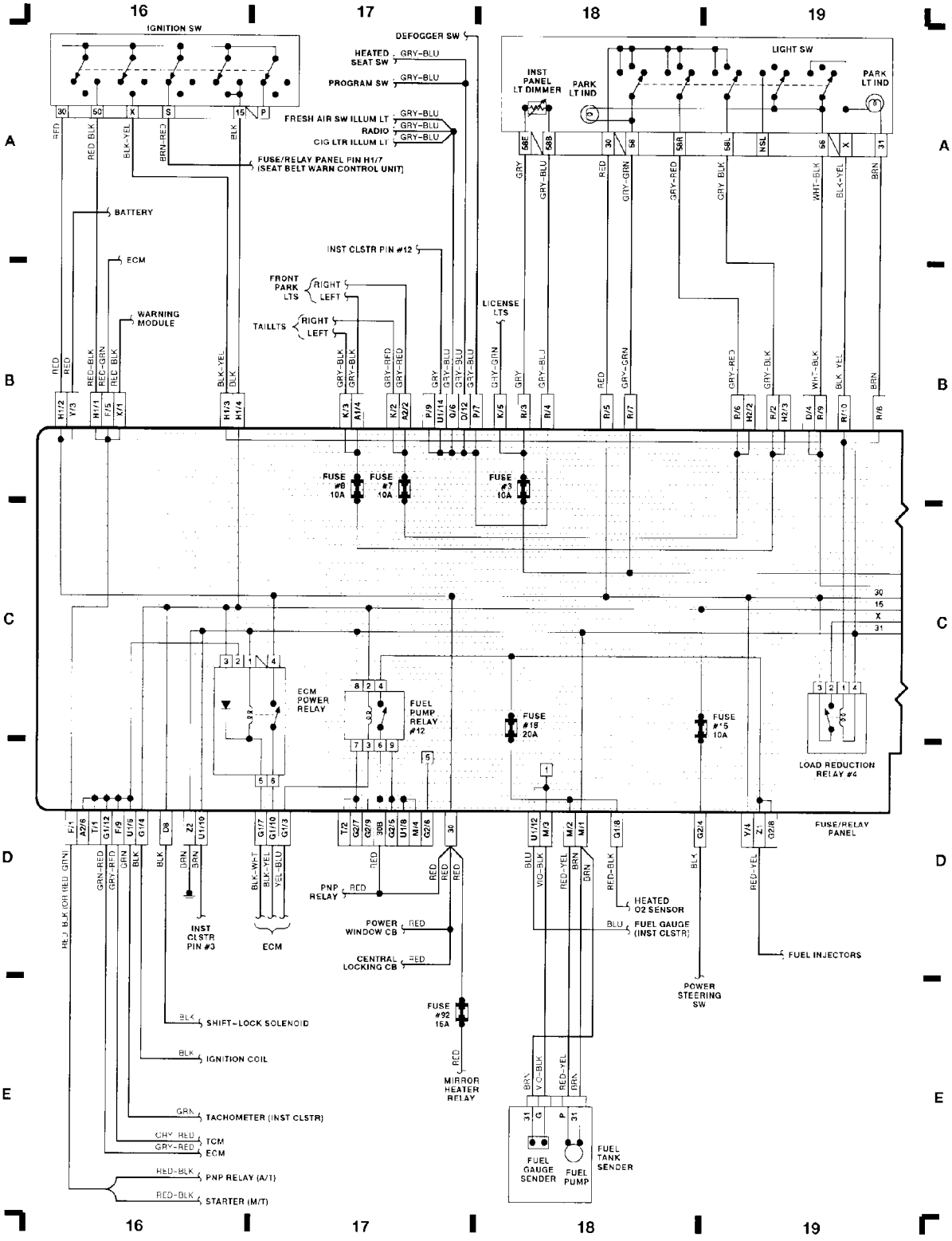

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Fig. 5: Ignition SW, Fuse Relay Panel (Grid 16-19)

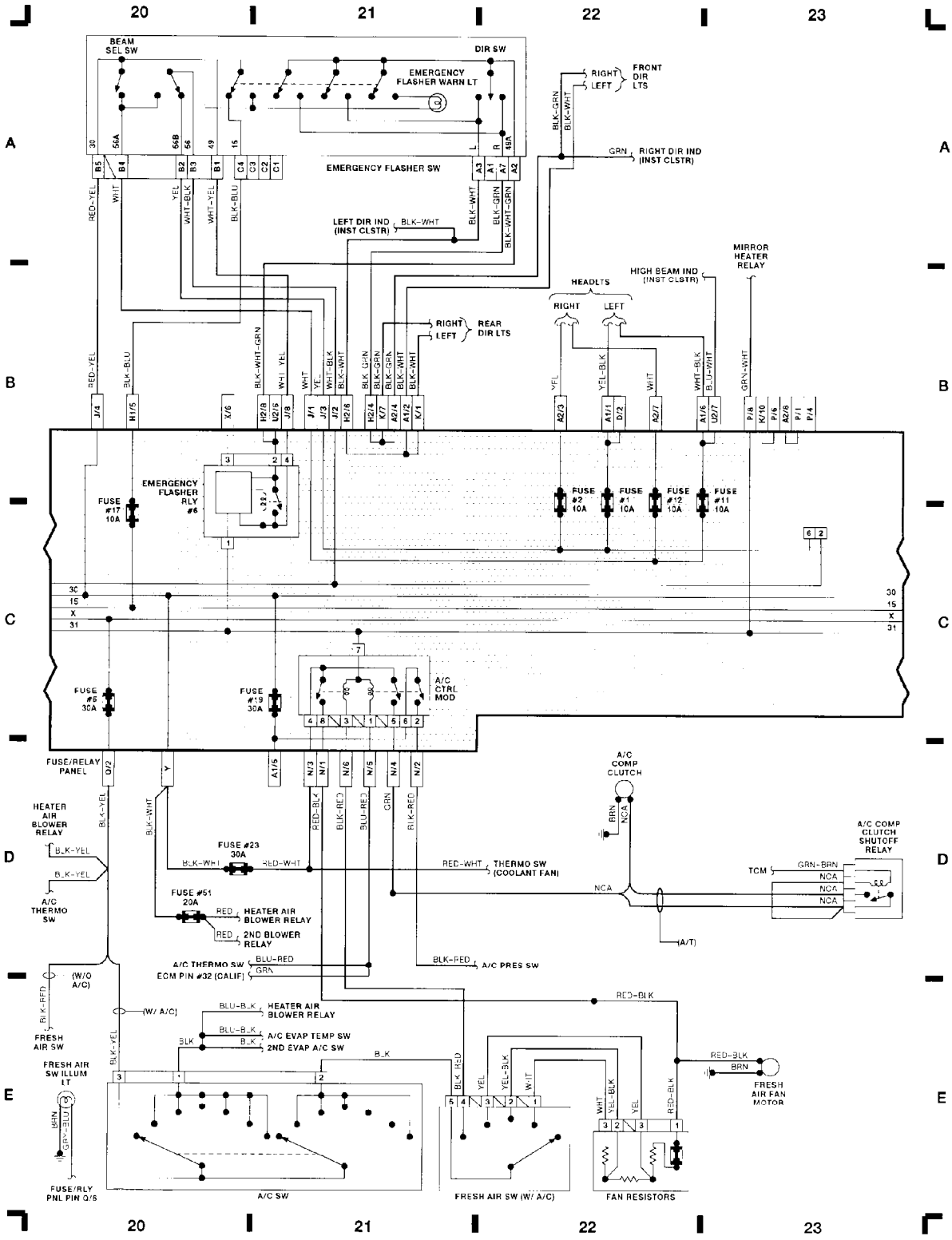

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Fig. 6: Emergency Flasher SW, Fuse/Relay Panel (Grid 20-23)

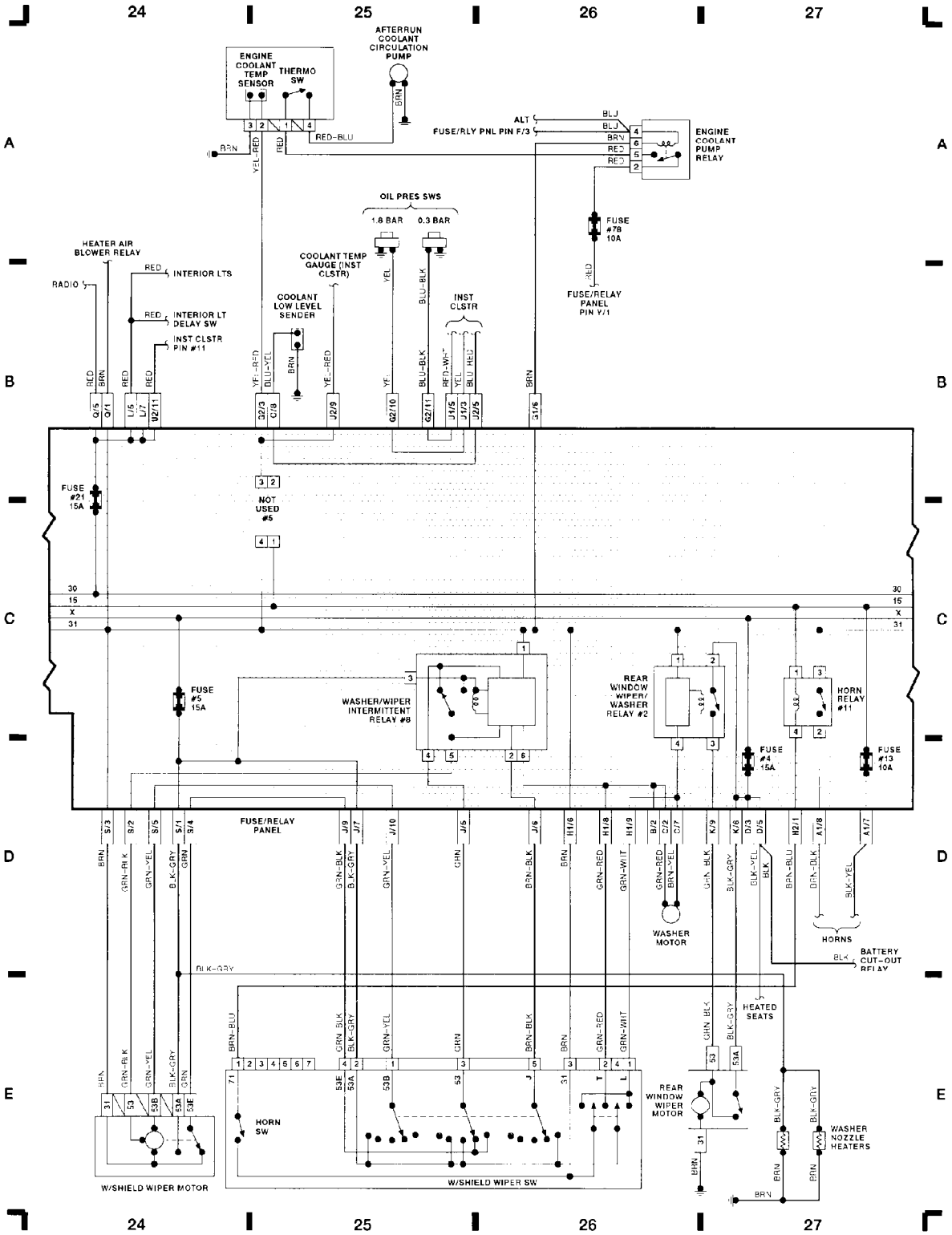

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Fig. 7: Windshield Wiper SW & Motor, Fuse/Relay Panel (Grid 24-27)

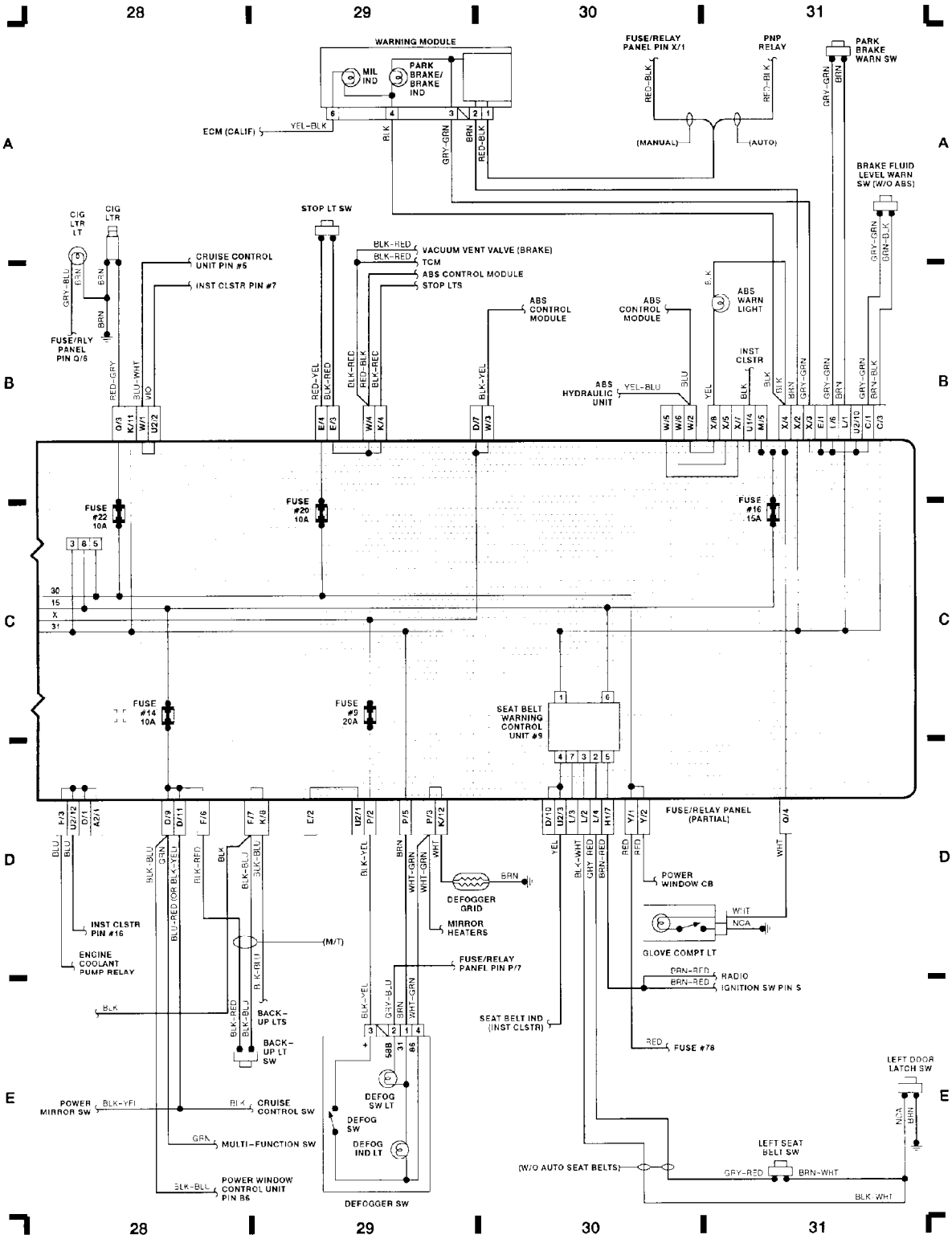

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Fig. 8: Fuse/Relay Panel, Warning Module, Defogger SW (Grid 28-31)

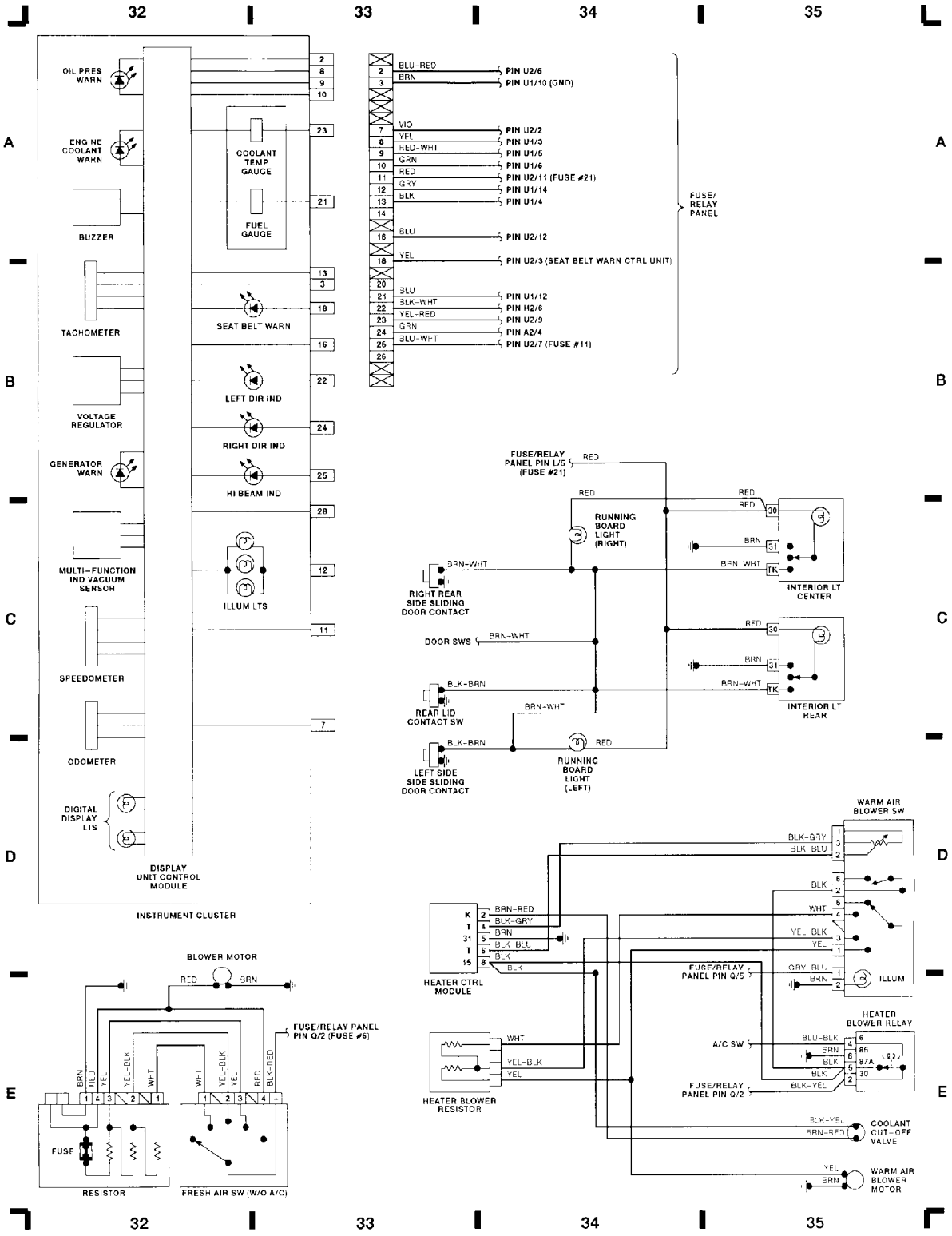

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Fig. 9: Instrument Cluster, Resistor (Grid 32-35)

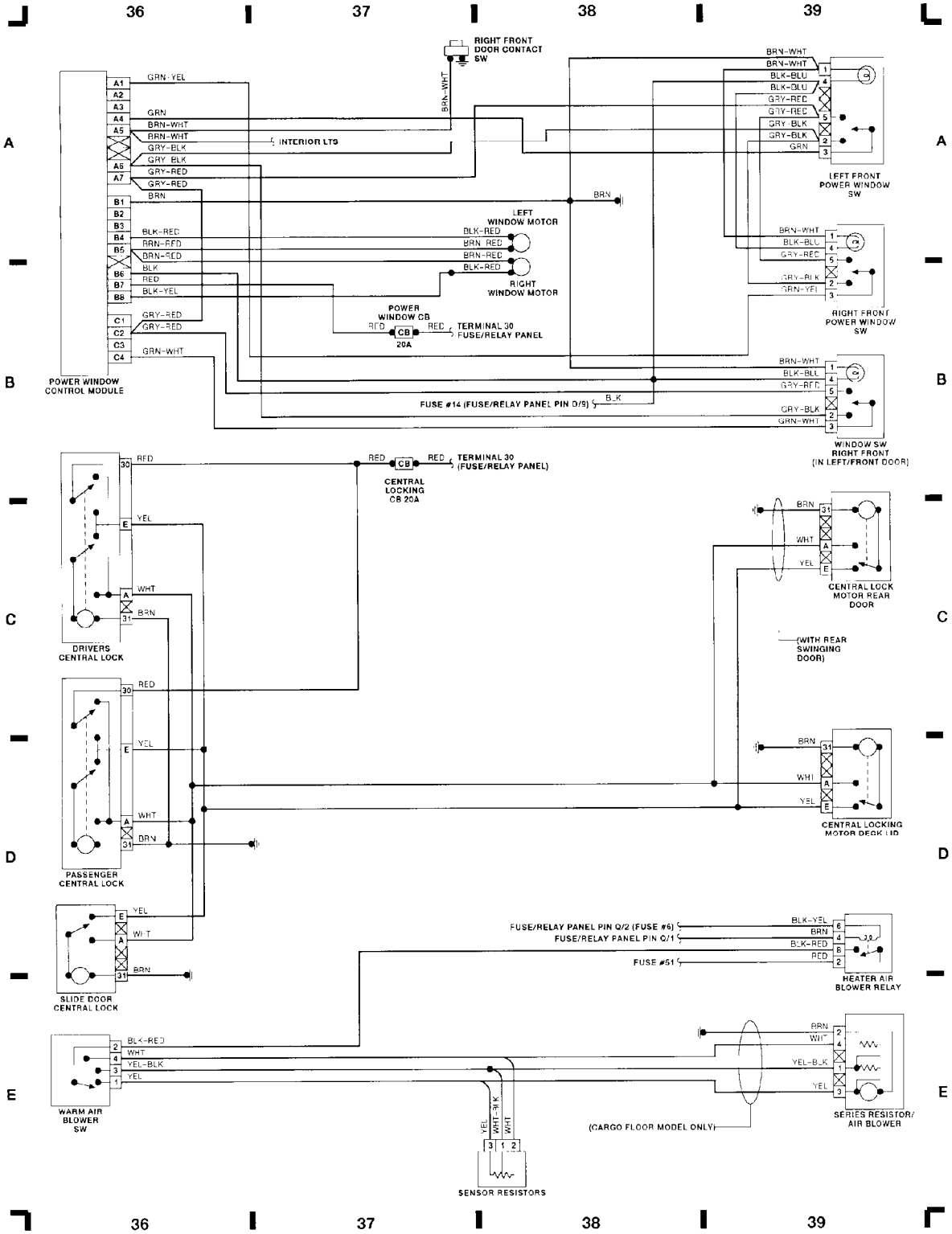

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Fig. 10: Power Window Cntrl Module, Driver Central Lock (Grid 36-39)

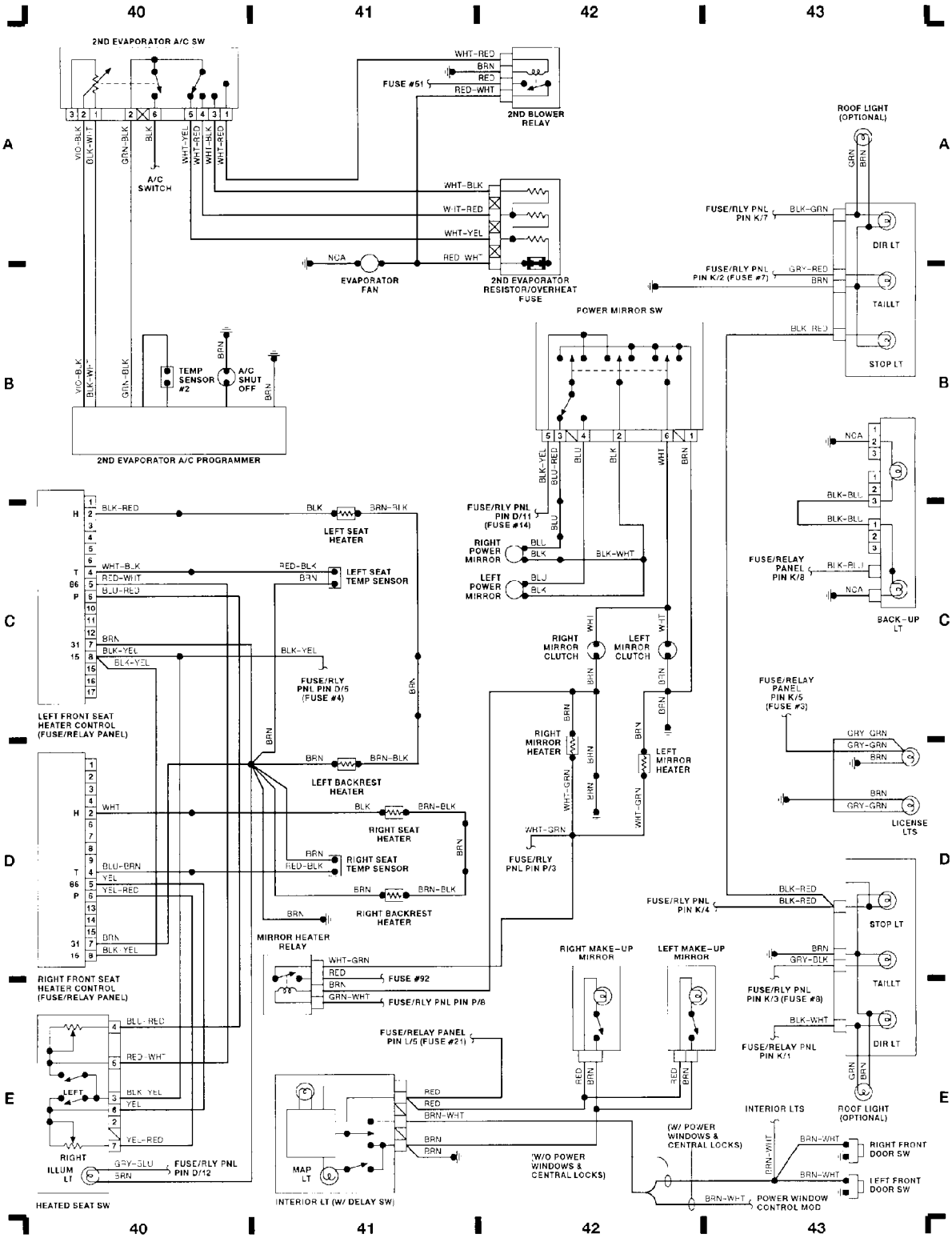

Fig. 11: 2nd Evaporator A/C SW & Programmer (Grid 40-43)

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