

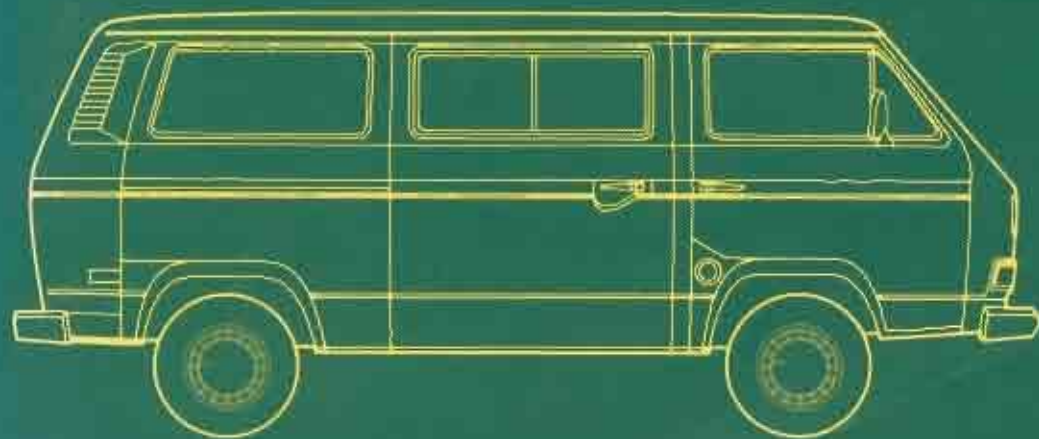
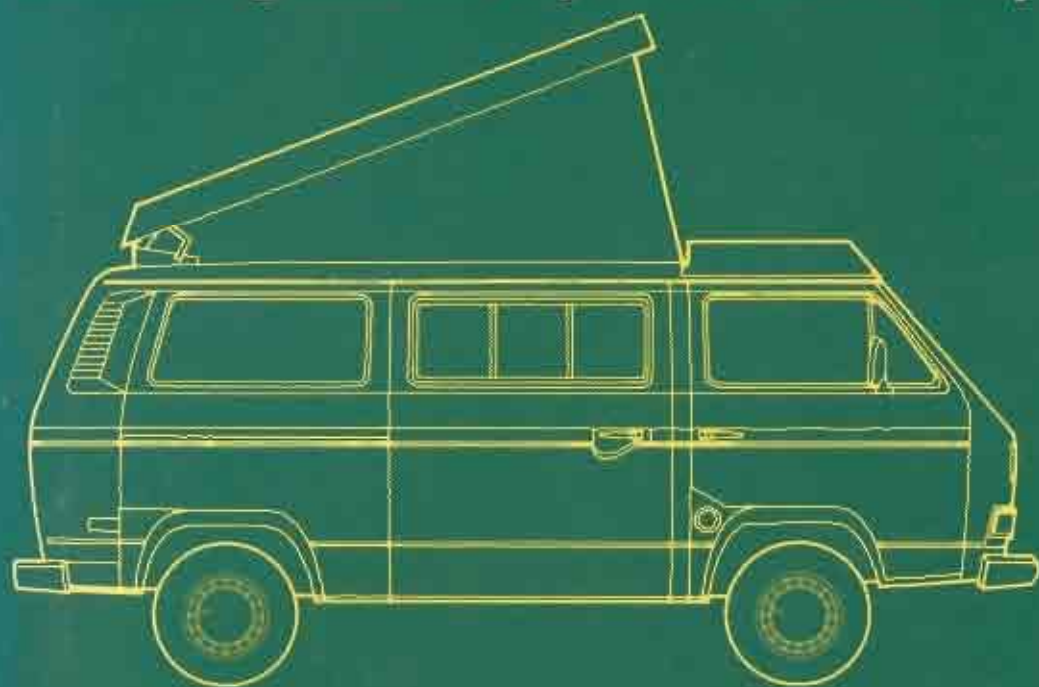


# VOLKSWAGEN VANAGON

## Official Factory Repair Manual

1980, 1981, 1982, 1983, 1984, 1985,  
1986, 1987, 1988, 1989, 1990, 1991

Including Diesel, Syncro and Camper



Robert Bentley



# **Volkswagen Vanagon**

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**Robert Bentley  
Cambridge, Massachusetts**





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**WARNING—Important Safety Notice**

Do not use this manual unless you are familiar with basic automotive repair procedures and safe workshop practices. This manual illustrates the workshop procedures required for most service work; it is not a substitute for full and up-to-date information from the vehicle manufacturer or for proper training as an automotive technician. Note that it is not possible for us to anticipate all of the ways or conditions under which vehicles may be serviced or to provide cautions as to all of the possible hazards that may result.

The vehicle manufacturer will continue to issue service information updates and parts retrofits after the editorial closing of this manual. Some of these updates and retrofits will apply to procedures and specifications in this manual. We regret that we cannot supply updates to purchasers of this manual.

We have endeavored to ensure the accuracy of the information in this manual. Please note, however, that considering the vast quantity and the complexity of the service information involved, we cannot warrant the accuracy or completeness of the information contained in this manual.

FOR THESE REASONS, NEITHER THE PUBLISHER NOR THE AUTHOR MAKES ANY WARRANTIES, EXPRESS OR IMPLIED, THAT THE INFORMATION IN THIS BOOK IS FREE OF ERRORS OR OMISSIONS AND WE EXPRESSLY DISCLAIM THE IMPLIED WARRANTIES OF MERCHANTABILITY AND OF FITNESS FOR A PARTICULAR PURPOSE, EVEN IF THE PUBLISHER OR AUTHOR HAVE BEEN ADVISED OF A PARTICULAR PURPOSE, AND EVEN IF A PARTICULAR PURPOSE IS INDICATED IN THE MANUAL. THE PUBLISHER AND AUTHOR ALSO DISCLAIM ALL LIABILITY FOR DIRECT, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES WHICH RESULT FROM ANY USE OF THE EXAMPLES, INSTRUCTIONS OR OTHER INFORMATION IN THIS BOOK. IN NO EVENT SHALL OUR LIABILITY WHETHER IN TORT, CONTRACT OR OTHERWISE EXCEED THE COST OF THIS MANUAL.

Your common sense and good judgment are crucial to safe and successful service work. Read procedures through before starting them. Think about whether the condition of your car, your level of mechanical skill, or your level of reading comprehension might result in or contribute in some way to an occurrence which might cause you injury, damage your car, or result in an unsafe repair. If you have doubts for these or other reasons about your ability to perform safe repair work on your car, have the work done at an authorized Volkswagen dealer or other qualified shop.

Part numbers listed in this manual are for identification purposes only, not for ordering. Always check with your authorized Volkswagen dealer to verify part numbers and availability before beginning service work that may require new parts.

Before attempting any work on your Volkswagen, read the warnings and cautions on pages ix and x and any warning or caution that accompanies a procedure in the service manual. Review the warnings and cautions on pages ix and x each time you prepare to work on your Volkswagen.

Special tools required to perform certain service operations are identified in the manual and are recommended for use. Use of tools other than those recommended in this service manual may be detrimental to the car's safe operation as well as the safety of the person servicing the car.

Copies of this manual may be purchased from authorized Volkswagen dealers, most automotive accessories and parts dealers specializing in Volkswagens, from selected booksellers, or directly from the publisher by mail.

The publisher encourages comments from the reader of this manual. These communications have been and will be carefully considered in the preparation of this and other manuals. Please write to Robert Bentley, Inc. at the address listed on the top of this page.

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Manufactured in the United States of America

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# Foreword

Service to Volkswagen owners is a top priority of Volkswagen organization and has always included the continuing development and introduction of new and expanded services. In line with this purpose, Volkswagen United States, Inc. has introduced this Volkswagen Official Factory Repair Manual.

This Vanagon manual covers the model years 1980 through 1991 including Air-cooled and Water-cooled Gasoline Engines, Diesel Engine, Syncro and Camper. This manual was specifically written to cover U.S. and Canada models only.

For the Volkswagen owner with basic mechanical skills and for independent garages, this manual gives all the specifications and procedures that were available in an authorized Volkswagen service department as this manual went to press. In addition, the Volkswagen owner who has no intention of working on his or her vehicle may find that reading and owning this manual will make it possible to be better informed and to discuss repairs more intelligently with a professional automotive technician.

This manual has been prepared from the repair information that the Volkswagen organization provides to its own factory-trained technicians and has been developed primarily with the professional automotive technician in mind. The aim throughout has been clarity and completeness with step-by-step procedures and accurate specifications.

The Volkswagen owner intending to do maintenance and repair should have a set of metric wrenches and sockets, a torque wrench, screwdrivers, and feeler gauges, since these basic hand tools will be used for a majority of the repairs described in this manual. Usually, the text will note when a repair requires special tools.

This manual is organized so that, whenever possible, when a change has been made within a model year, the vehicle identification number (VIN) of the first vehicle with this change is given. The digits you need to know for this parts and service information are taken from the seventeen digit VIN number. If, for example the VIN is WVVZZZ24ZBH000001, you will need only nine of the last eleven digits of this number—or, more specifically, the digits 24 B 000001. Your Volkswagen's VIN is found on the left doorjamb and on a plate mount-

ed on the driver's side of the instrument panel padding where the number can be seen through the windshield. The VINs assigned to Vanagon models for the years 1980 through 1991 which are covered by this manual are:

1980:	_____25_A_000001	to	_____25_A_999999
1981:	_____25_B_000001	to	_____25_B_999999
1982:	_____25_C_000001	to	_____25_C_999999
1983:	_____25_D_000001	to	_____25_D_999999
1984:	_____25_E_000001	to	_____25_E_999999
1985:	_____24_F_000001	to	_____24_F_999999
	_____25_F_000001	to	_____25_F_999999
1986:	_____24_G_000001	to	_____24_G_999999
	_____25_G_000001	to	_____25_G_999999
1987:	_____24_H_000001	to	_____24_H_999999
	_____25_H_000001	to	_____25_H_999999
1988:	_____24_J_000001	to	_____24_J_999999
	_____25_J_000001	to	_____25_J_999999
1989:	_____24_K_000001	to	_____24_K_999999
	_____25_K_000001	to	_____25_K_999999
1990:	_____24_L_000001	to	_____24_L_999999
	_____25_L_000001	to	_____25_L_999999
1991:	_____24_M_000001	to	_____24_M_999999
	_____25_M_000001	to	_____25_M_999999

We have endeavored to ensure the highest degree of accuracy possible. When the vast array of data presented in this manual is taken into account, however, no claim to infallibility can be made. We therefore cannot be responsible for the result of any errors that may have crept into the text. The Publisher encourages comments from the readers of this manual in regard to any errors and, also, suggestions for improvement in the presentation of the technical material. These communications have been and will be carefully considered in the preparation of this and other manuals. Please write to Robert Bentley, Inc., Cambridge, Massachusetts 02138.

Volkswagen offers extensive warranties, especially on components of the fuel delivery and emission control systems. Therefore, before deciding to repair a Volkswagen that may still be covered wholly or in part by any warranties issued by Volkswagen United States, Inc., consult your authorized Volkswagen dealer. You may find that he can make the repair either free or at minimum cost. Regardless of its age, or whether it is under warranty, your Volkswagen is both an easy vehicle to service and an easy vehicle to get serviced. So if at any time a repair is needed that you feel is too difficult to do yourself, a trained Volkswagen technician is ready to do the job for you.

**Robert Bentley**



# Please read these warnings and cautions before proceeding with maintenance and repair work.

## WARNING—

- Some repairs may be beyond your capability. If you lack the skills, tools and equipment, or a suitable workplace for any procedure described in this manual, we suggest you leave such repairs to an authorized Volkswagen dealer service department, or other qualified shop.
- Volkswagen is constantly improving its cars. Sometimes these changes, both in parts and specifications, are made applicable to earlier models. Therefore, before starting any major jobs or repairs to components on which passenger safety may depend, consult your authorized Volkswagen dealer about Technical Bulletins that may have been issued since the editorial closing of this manual.
- Do not re-use any fasteners that are worn or deformed in normal use. Many fasteners are designed to be used only once and become unreliable and may fail when used a second time. This includes, but is not limited to, nuts, bolts, washers, self-locking nuts or bolts, circlips and cotter pins. Always replace these fasteners with new parts.
- Never work under a lifted car unless it is solidly supported on stands designed for the purpose. Do not support a car on cinder blocks, hollow tiles or other props that may crumble under continuous load. Never work under a car that is supported solely by a jack. Never work under the car while the engine is running.
- If you are going to work under a car on the ground, make sure that the ground is level. Block the wheels to keep the car from rolling. Disconnect the battery negative (–) terminal (Ground strap) to prevent others from starting the car while you are under it.
- Never run the engine unless the work area is well ventilated. Carbon monoxide kills.
- Finger rings, bracelets and other jewelry should be removed so that they cannot cause electrical shorts, get caught in running machinery, or be crushed by heavy parts.
- Tie long hair behind your head. Do not wear a necktie, a scarf, loose clothing, or a necklace when you work near machine tools or running engines. If your hair, clothing, or jewelry were to get caught in the machinery, severe injury could result.
- Do not attempt to work on your car if you do not feel well. You increase the danger of injury to yourself and others if you are tired, upset or have taken medication or any other substance that may keep you from being fully alert.
- Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the car. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.
- Catch draining fuel, oil, or brake fluid in suitable containers. Do not use food or beverage containers that might mislead someone into drinking from them. Store flammable fluids away from fire hazards. Wipe up spills at once, but do not store the oily rags, which can ignite and burn spontaneously.
- Always observe good workshop practices. Wear goggles when you operate machine tools or work with battery acid. Gloves or other protective clothing should be worn whenever the job requires working with harmful substances.
- Friction materials such as brake or clutch discs may contain asbestos fibers. Do not create dust by grinding, sanding, or by cleaning with compressed air. Avoid breathing asbestos fibers and asbestos dust. Breathing asbestos can cause serious diseases such as asbestosis or cancer, and may result in death.
- Disconnect the battery negative (–) terminal (Ground strap) whenever you work on the fuel system or the electrical system. Do not smoke or work near heaters or other fire hazards. Keep an approved fire extinguisher handy.
- Batteries give off explosive hydrogen gas during charging. Keep sparks, lighted matches and open flame away from the top of the battery. If hydrogen gas escaping from the cap vents is ignited, it will ignite gas trapped in the cells and cause the battery to explode.
- Connect and disconnect battery cables, jumper cables or a battery charger only with the ignition switched off, to prevent sparks. Do not disconnect the battery while the engine is running.
- Do not quick-charge the battery (for boost starting) for longer than one minute. Wait at least one minute before boosting the battery a second time.
- Do not allow battery charging voltage to exceed 16.5volts. If the battery begins producing gas or boiling violently, reduce the charging rate. Boosting a sulfated battery at a high charging rate can cause an explosion.
- The air-conditioning system is filled with chemical refrigerant, which is hazardous. The A/C system should be serviced only by trained technicians using approved refrigerant recovery/recycling equipment, trained in related safety precautions, and familiar with regulations governing the discharging and disposal of automotive chemical refrigerants.
- Do not expose any part of the A/C system to high temperatures such as open flame. Excessive heat will increase system pressure and may cause the system to burst.
- Some aerosol tire inflators are highly flammable. Be extremely cautious when repairing a tire that may have been inflated using an aerosol tire inflator. Keep sparks, open flame or other sources of ignition away from the tire repair area. Inflate and deflate the tire at least four times before breaking the bead from the rim. Completely remove the tire from the rim before attempting any repair.
- Some cars covered by this manual are equipped with a supplemental restraint system (SRS), that automatically deploys an airbag in the event of a frontal impact. The airbag is inflated by an explosive device. Handled improperly or without adequate safeguards, it can be accidentally activated and cause serious injury.
- Greases, lubricants and other automotive chemicals contain toxic substances, many of which are absorbed directly through the skin. Read manufacturer's instructions and warnings carefully. Use hand and eye protection. Avoid direct skin contact.

continued on next page

# Please read these warnings and cautions before proceeding with maintenance and repair work.

## CAUTION—

- If you lack the skills, tools and equipment, or a suitable workshop for any procedure described in this manual, we suggest you leave such repairs to an authorized Volkswagen dealer or other qualified shop.
- Volkswagen offers extensive warranties, especially on components of fuel delivery and emission control systems. Therefore, before deciding to repair a Volkswagen that may still be covered wholly or in part by any warranties issued by Volkswagen United States, Inc., consult your authorized Volkswagen dealer. You may find that he can make the repair for free, or at minimal cost.
- Volkswagen part numbers listed in this manual are for identification purposes only, not for ordering. Always check with your authorized Volkswagen dealer to verify part numbers and availability before beginning service work that may require new parts.
- Before starting a job, make certain that you have all the necessary tools and parts on hand. Read all the instructions thoroughly, do not attempt shortcuts. Use tools appropriate to the work and use only replacement parts meeting Volkswagen specifications. Makeshift tools, parts and procedures will not make good repairs.
- Use pneumatic and electric tools only to loosen threaded parts and fasteners. Never use these tools to tighten fasteners, especially on light alloy parts. Always use a torque wrench to tighten fasteners to the tightening torque specification listed.
- Be mindful of the environment and ecology. Before you drain the crankcase, find out the proper way to dispose of the oil. Do not pour oil onto the ground, down a drain, or into a stream, pond or lake. Consult local ordinances that govern the disposal of wastes.
- On cars equipped with anti-theft radios, make sure you know the correct radio activation code before disconnecting the battery or removing the radio. If the wrong code is entered into the radio when power is restored, that radio may lock up and be rendered inoperable, even if the correct code is then entered.
- Connect and disconnect a battery charger only with the battery charger switched off.
- Do not quick-charge the battery (for boost starting) for longer than one minute. Wait at least one minute before boosting the battery a second time.
- Sealed or "maintenance free" batteries should be slow-charged only, at an amperage rate that is approximately 10% of the battery's ampere-hour (Ah) rating.
- Do not allow battery charging voltage to exceed 16.5 volts. If the battery begins producing gas or boiling violently, reduce the charging rate. Boosting a sulfated battery at a high charging rate can cause an explosion.

**WARNING —**

• *Automotive service and repair is serious business. You must be alert, use common sense, and exercise good judgement to prevent personal injury and complete the work safely.*

• *Before beginning any work on your Volkswagen, thoroughly read all the Cautions and Warnings listed near the front of this manual.*

• *Always read the complete procedure before you begin the work. Pay special attention to any Cautions and Warnings that accompany that procedure, or other information on a specific topic.*

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**WARNING —**

• *Automotive service and repair is serious business. You must be alert, use common sense, and exercise good judgement to prevent personal injury and complete the work safely.*

• *Before beginning any work on your Volkswagen, thoroughly read all the Cautions and Warnings listed near the front of this manual.*

• *Always read the complete procedure before you begin the work. Pay special attention to any Cautions and Warnings that accompany that procedure, or other information on a specific topic.*

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**WARNING —**

• *Automotive service and repair is serious business. You must be alert, use common sense, and exercise good judgement to prevent personal injury and complete the work safely.*

• *Before beginning any work on your Volkswagen, thoroughly read all the Cautions and Warnings listed near the front of this manual.*

• *Always read the complete procedure before you begin the work. Pay special attention to any Cautions and Warnings that accompany that procedure, or other information on a specific topic.*

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## Vehicle Identification Number (VIN)

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## Wiring Diagrams

- *See Electrical Wiring*



# Vanagon Quick Data 1980 through 1991



## Engine—Assembly Group 10

### Compression pressures

<b>Air-cooled—AFC</b>	
nominal	6-9 bar (87-131 psi)
minimum	5.0 bar (73 psi)
max. difference	
between cylinders	3.0 bar (44 psi)

### Water-cooled—Digijet/Digifant

nominal	10-13 bar (145-189 psi)
minimum	8 bar (116 psi)
max. difference	
between cylinders	3.0 bar (44 psi)

### Tightening torques (installing engine)

<b>Air-cooled—AFC</b>	
engine to trans	30 Nm (22 ft-lb)
engine carrier to mount	25 Nm (18 ft-lb)
trans. mount	30 Nm (22 ft-lb)
torque converter	
to drive plate	30 Nm (22 ft-lb)

### Diesel

engine to trans	
M10 fasteners	45 Nm (33 ft-lb)
M12 fasteners	80 Nm (59 ft-lb)
engine mounts	85 Nm (63 ft-lb)
support member	45 Nm (33 ft-lb)
fuel line unions	
to injection pump	22 Nm (16 ft-lb)

### Water-cooled—Digijet/Digifant

engine to trans	30 Nm (22 ft-lb)
engine carrier to body	25 Nm (18 ft-lb)
trans. mounts	30 Nm (22 ft-lb)
torque converter	
to drive plate	20 Nm (15 ft-lb)

## Crankshaft, Crankcase Group 13

### Air-cooled—AFC

<b>tightening torques</b>	
connecting rod	35 Nm (26 ft-lb)
case halves	
small	20 Nm (15 ft-lb)
large	30 Nm (22 ft-lb)
flywheel to crankshaft	60 Nm (44 ft-lb) plus 1/4 turn (90°)
torque converter drive plate	
to crankshaft	90 Nm (66 ft-lb)

### crankshaft end play

new	0.07-0.13 mm (0.003-0.005 in.)
wear limit	0.15 mm (0.006 in.)

### Diesel

<b>tightening torques</b>	
main bearing cap	65 Nm (47 ft-lb)
connecting rod	
two different types	see Repair Manual
flywheel to crankshaft	75 Nm (54 ft-lb)

### crankshaft end play

new	0.07-0.17 mm (0.003-0.007 in.)
wear limit	0.37 mm (0.015 in.)

### Water-cooled—Digijet/Digifant

<b>tightening torques</b>	
connecting rod	
1980-1985	45 Nm (33 ft-lb)
from 1986	30 Nm (22 ft-lb) plus 1/2 turn

### case halves

small	20 Nm (15 ft-lb)
up to engine # DH 027 404	35 Nm (26 ft-lb)
from engine # DH 027 404	45 Nm (33 ft-lb)
from engine # MV 041 599	50 Nm (37 ft-lb)
flywheel to crankshaft	60 Nm (44 ft-lb) plus 1/4 turn (90°)

torque converter drive plate to crankshaft	
1980-1985	90 Nm (66 ft-lb)
from 1986	110 Nm (81 ft-lb)

### crankshaft end play

new	0.07-0.13 mm (0.003-0.005 in.)
wear limit	0.35 mm (0.006 in.)

### connecting rod side clearance

wear limit	0.7 mm (0.028 in.)
------------	--------------------

## Cylinder Head Group 15

### Diesel

<b>valve clearance (engine warm)</b>	
intake	0.20-0.30 mm (0.008-0.012 in.)
exhaust	0.40-0.50 mm (0.016-0.020 in.)

### tightening torques

cam bearing cap	20 Nm (15 ft-lb)
-----------------	------------------

## Lubrication System Group 17

### Air-cooled—AFC

<b>oil capacity</b>	
with filter change	3.5 L (3.7 US qt.)
without filter change	3.0 L (3.2 US qt.)
<b>tightening torques</b>	
drain plug	25 Nm (18 ft-lb)

### Diesel

<b>oil capacity</b>	
with filter change	4.0 L (4.2 US qt.)
without filter change	3.5 L (3.7 US qt.)

### tightening torques

drain plug	25 Nm (18 ft-lb)
strainer plug (foot)	13 Nm (9 ft-lb)

### Water-cooled—Digijet/Digifant

<b>oil capacity</b>	
with filter change	4.5 L (4.7 US qt.)
without filter change	4.0 L (4.2 US qt.)
<b>tightening torques</b>	
drain plug	25 Nm (18 ft-lb)

## Cooling System Group 19

### Diesel

<b>coolant pump V-belt</b>	
deflection	10-15 mm (3/16-9/16 in.)
coolant capacity	16.0 L (16.9 US qt.)
coolant reservoir cap	
release pressure	1 bar (14 psi)
<b>tightening torques</b>	
coolant pump pulley	20 Nm (15 ft-lb)
thermostat housing	10 Nm (6 ft-lb)
thermoswitches	30 Nm (22 ft-lb)

### Water-cooled—Digijet/Digifant

<b>coolant pump V-belt</b>	
deflection	10-15 mm (3/16-9/16 in.)
coolant capacity	17.5 L (18.4 US qt.)
coolant reservoir cap	
release pressure	0.9-1.5 bar (13-17 psi)
<b>tightening torques</b>	
thermostat housing	10 Nm (6 ft-lb)

## Fuel Supply Group 20

<b>fuel tank capacity (including reserve)</b>	
Vanagon except Syncro	60 L (16 US gal.)
Syncro	70 L (18.6 US gal.)
reserve	10 L (2.5 US qt.)

## Diesel Fuel Injection Group 23

idle speed	800-850 rpm
maximum speed	
(no load)	4800 ± 50 rpm
<b>tightening torques</b>	
glow plugs	40 Nm (29 ft-lb)

## Exhaust/Emissions Group 26

### tightening torques

exhaust system	
fasteners (M8)	20 Nm (15 ft-lb)
oxygen sensor	
to 1985	55 Nm (40 ft-lb)
from 1986	50 Nm (37 ft-lb)

## Ignition System Group 28

iring order 1-4-3-2

### tightening torques

<b>spark plugs</b>	
air-cooled	30 Nm (22 ft-lb)
water-cooled	20 Nm (15 ft-lb)

## Clutch Group 30

clutch pressure plate	
to flywheel	25 Nm (18 ft-lb)

## Manual Trans. Groups 34/35

refer to Repair Manual for specifications

## Automatic Trans. Groups 37/38

ATF	Dexron or Dexron II
<b>ATF capacity</b>	
refill	3.0 L (3.2 US qt.)
dry fill	6.0 L (6.4 US qt.)

## Front Suspension Group 40

### tightening torques

axle nut	350 Nm (258 ft-lb)
brake caliper to steering knuckle (Vanagon)	
1980-1985	160 Nm (115 ft-lb)
from 1986	270 Nm (200 ft-lb)
brake caliper to wheel bearing housing	
Syncro	250 Nm (185 ft-lb)
wheel lug bolts	
1980 to Nov. 1984	170 Nm (125 ft-lb)
from Nov. 1984	180 Nm (133 ft-lb)

## Rear Suspension Group 42

<b>constant velocity (CV) joint lubricant</b>	
lubricant (per joint)	90 g
type	G6 grease
<b>tightening torques</b>	
CV joints	45 Nm (33 ft-lb)
rear axle nut	500 Nm (360 ft-lb)

## Brakes Group 46

brake caliper guide pin bolts (always replace)	
from 1986	35 Nm (26 ft-lb)
brake pad minimum thickness (without backing plate)	2 mm (0.079 in.)

## Heater Booster Group 82

refer to Repair Manual for specifications

## Air Conditioning Group 87

<b>From 1986</b>	
refrigerant capacity	1450 grams (50.75 oz.)
<b>refrigerant oil quantities</b>	
evaporator	2.02 oz.
accumulator	0.3 oz.
high-pressure hose	0.3 oz.
low-pressure hose	0.3 oz.
compressor	5.07 oz.

## Electrical System Groups 90-97

refer to Repair Manual for specifications

VW Part No. LPV 800 148

Bentley Stock No. VV91

ISBN 0-8376-0336-6

**Robert Bentley**

*Information that makes the difference.®*

<b>Index</b>		
<p><b>Identification (Numbers/Codes)</b></p> <ul style="list-style-type: none"> <li>— Automatic transmission 4</li> <li>— Compression pressure values 2a</li> <li>— Engine 2</li> <li>— Front final drive Syncro 3b</li> <li>— Manual transmission 3, 3a</li> <li>— Type/Model/Assemblies 2</li> <li>— VIN (Vehicle Identification Number) 2</li> </ul> <p><b>Lifting Vehicle</b></p> <ul style="list-style-type: none"> <li>— Hoist/Floor jack 5</li> </ul> <p><b>Towing</b></p> <ul style="list-style-type: none"> <li>— Procedure 6, 7</li> </ul>	<p><b>Ignition distributor and settings</b></p> <ul style="list-style-type: none"> <li>— Air-cooled AFC Can/USA, not Calif. 8 California 9</li> <li>— Water-cooled Digijet 10</li> <li>— Digifant 11</li> </ul> <p><b>Technical data</b></p> <ul style="list-style-type: none"> <li>— Digifant 12</li> </ul>	

# General

Type/model: Type: 25

Model: VANAGON/VANAGON SYNCRO

Assemblies	Code letters	BHP (SAE)	RPM
Engine (air-cooled) 2.0 Liter (AFC)	CV	70	4200
Manual Transmission - 4 speed (091)	DK	—	—
Automatic Transmission (090)	NG	—	—
Engine (Diesel) 1.6 Liter	CS	50	4200
Manual Transmission - 4 speed (091)	DM/DZ	—	—
Manual Transmission - 5 speed (094)	DX	—	—
Engine (water-cooled) 1.9 Liter (Digijet)	DH	80	4800
Manual Transmission - 4 speed (091/1)	DU/ABD	—	—
Automatic Transmission (090)	NH	—	—
Engine (water-cooled) 2.1 Liter (Digifant)	MV	95	4800
Manual Transmission - 4 speed (091/1)	ABD/ACW	—	—
Automatic Transmission (090)	NK	—	—
Manual Transmission - Syncro 5-speed (094-4WD)			
(with differential lock)	AAN/AVN	—	—
(without differential lock)	AAK/AVV	—	—

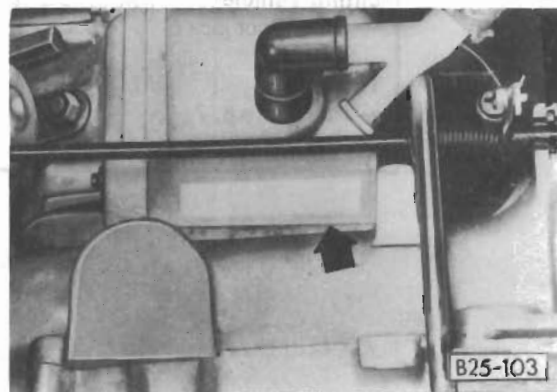
## CAUTION SYNCRO TRANSMISSIONS

When checking engine performance, only use dynamometer designed to brake all four wheels at the same time.

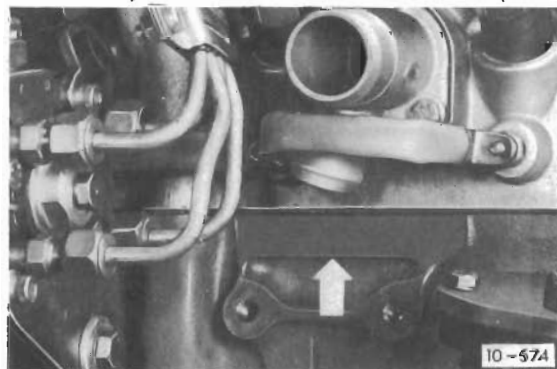
## Vehicle Identification



**Vehicle identification number (VIN)**  
• on dashboard on driver's side (arrow)



**Engine number (Gasoline)**  
• stamped on crankcase below breather (arrow)



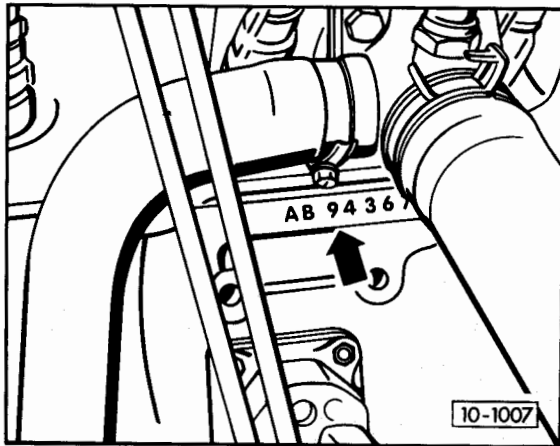
**Engine number (Diesel)**  
• on engine block (arrow) between injection pump  
an vacuum pump

Beginning May 1987, engine codes are now either a two letter combination or a combination of one number and one letter.

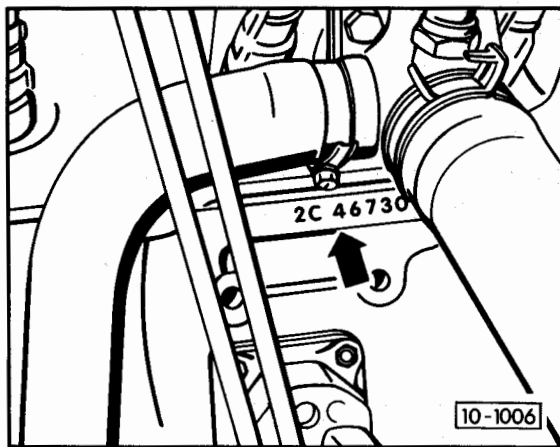
Engine code continues to precede the engine number.

**CAUTION**

Engines with identical code **DO NOT** necessarily have identical specifications.



old (water-cooled shown)



new (water-cooled shown)

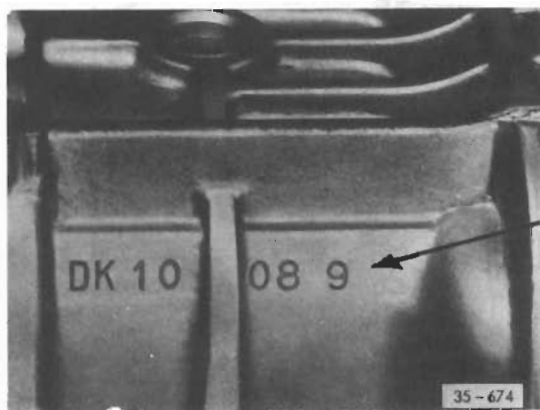
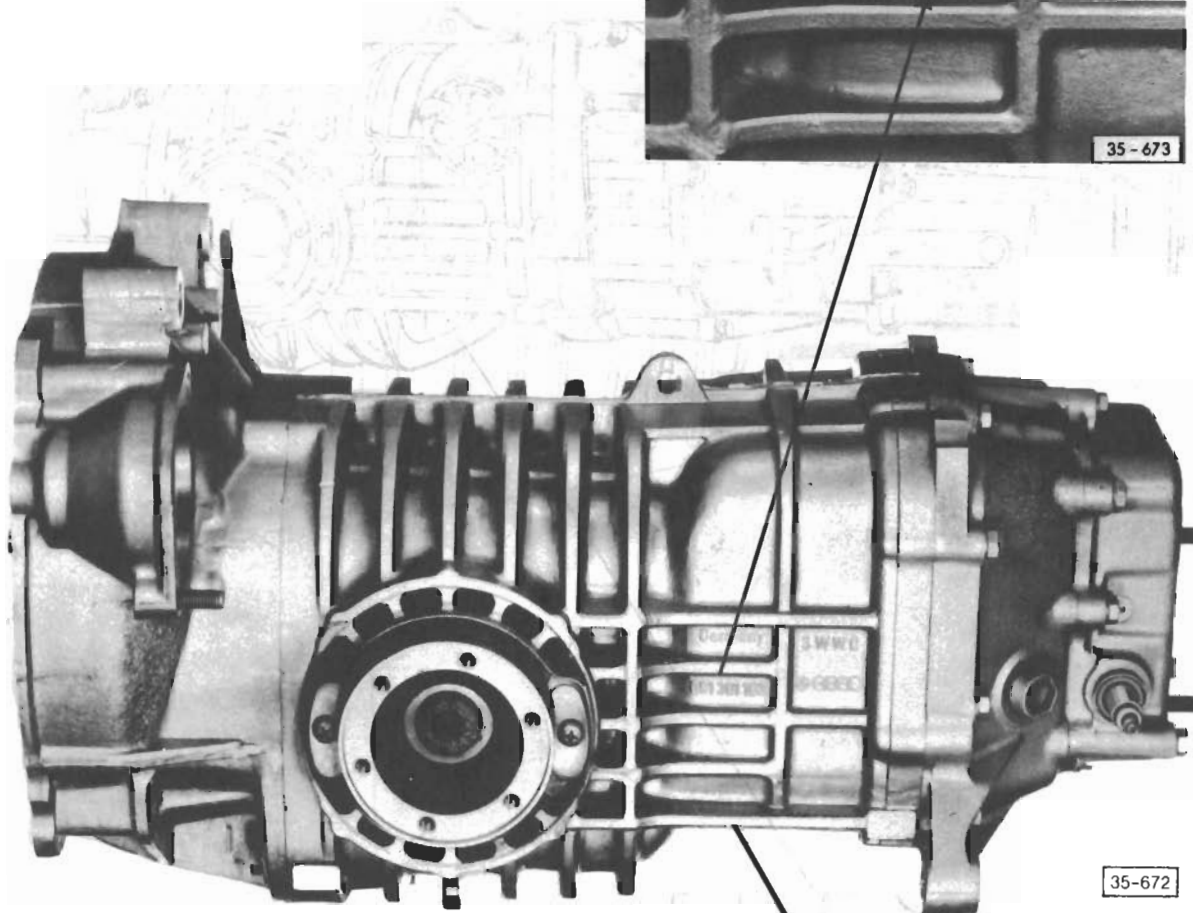
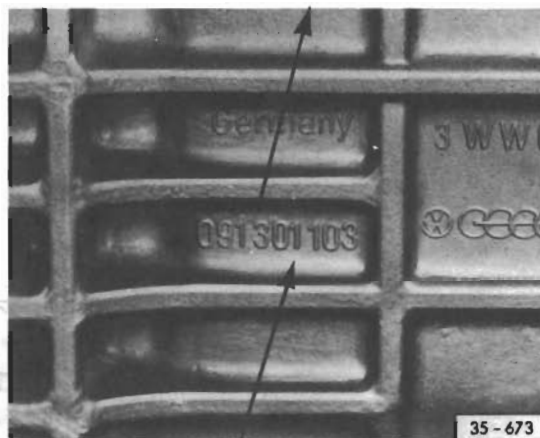
**Compression pressure values**

Engine codes	CV	DH, MV	CS
Compression pressure values bar (psi)	6 - 9 (87 - 131)	10 - 13 (145 - 190)	34 (493)
Wear limit bar (psi)	5 (73)	8 (116)	26 (377)
Maximum permissible difference between all four cylinders bar (psi)	3 (44)		5 (73)

From May 1987



Manual Transmission Type 091

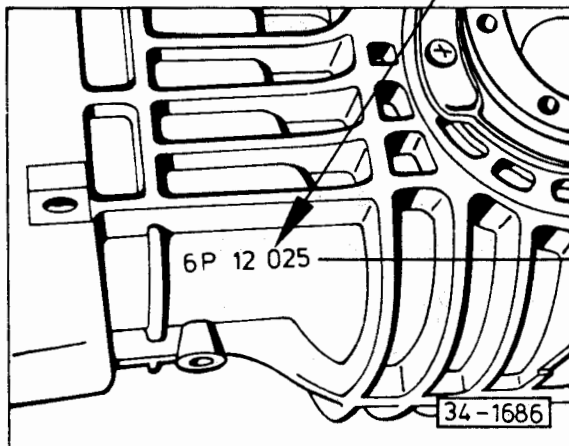
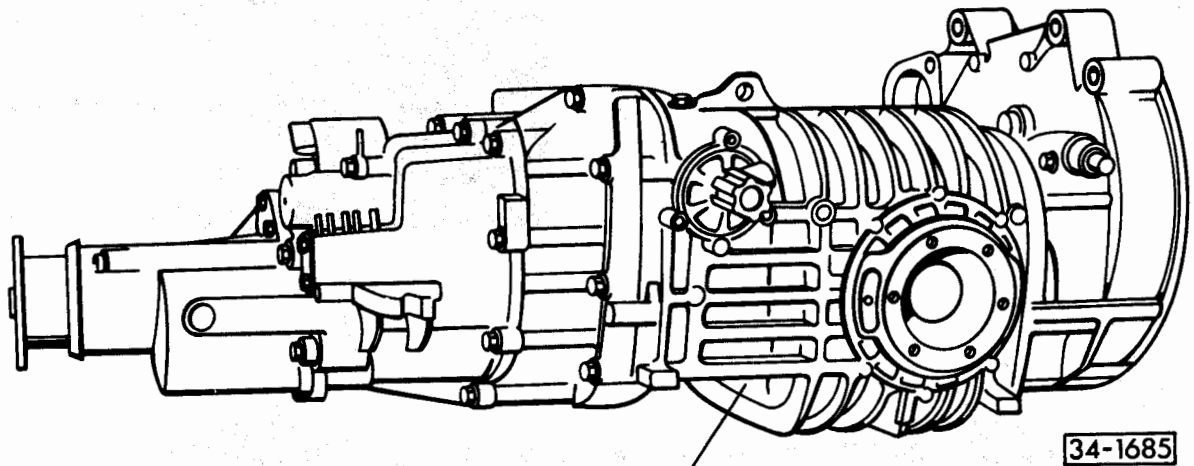


Code letters and date of manufacture

Example	DK	10	08	9
	code letters	day	month	year (79)
		of manufacture		

# General

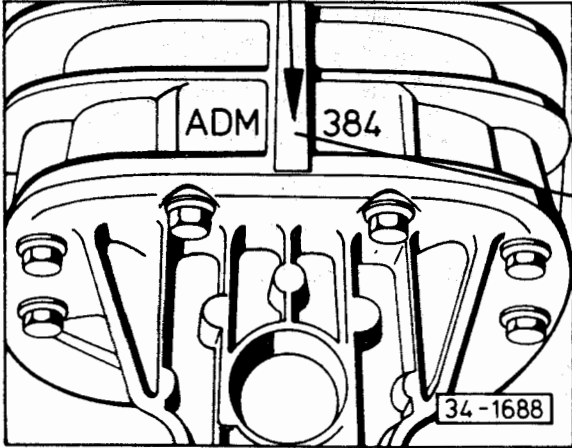
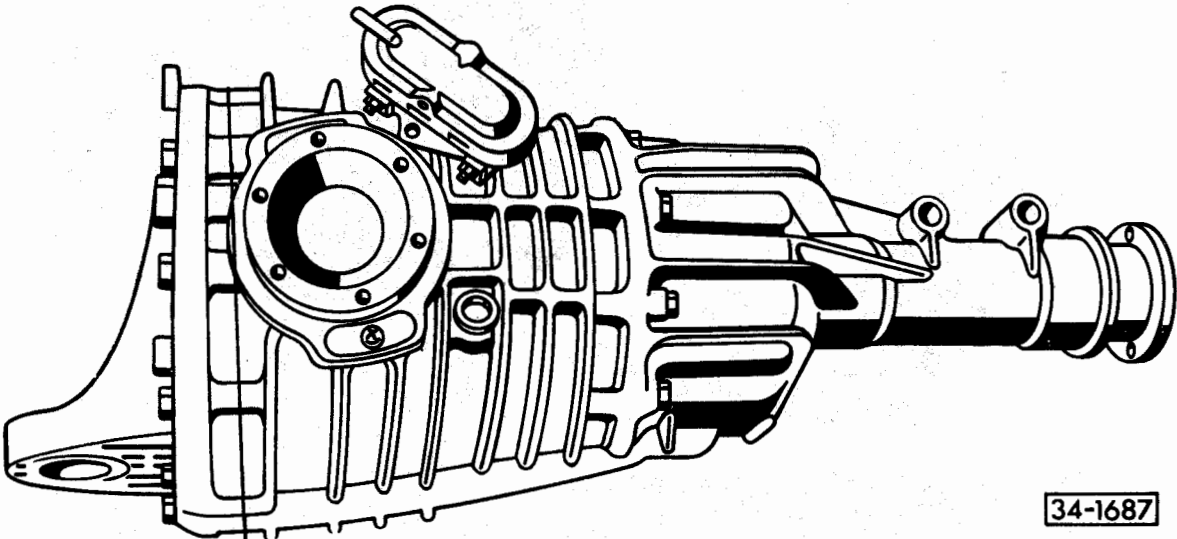
## Manual Transmission Type 094



Gearbox code letters and date of manufacture:

Example:      GP            12            02            5  
                  |                    |                    |                    |  
                  Code        Day of        Month        Year  
                  letters        manu-                       (85)  
                                  facture

Front Final Drive



Front final drive code letters and date of manufacture

Example:      ADM                      384

                         |    |

                         Code    Manufacturer's

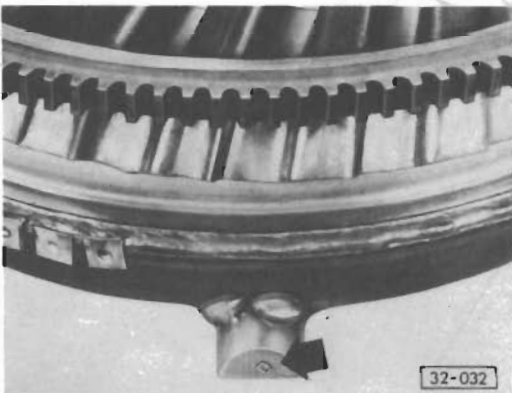
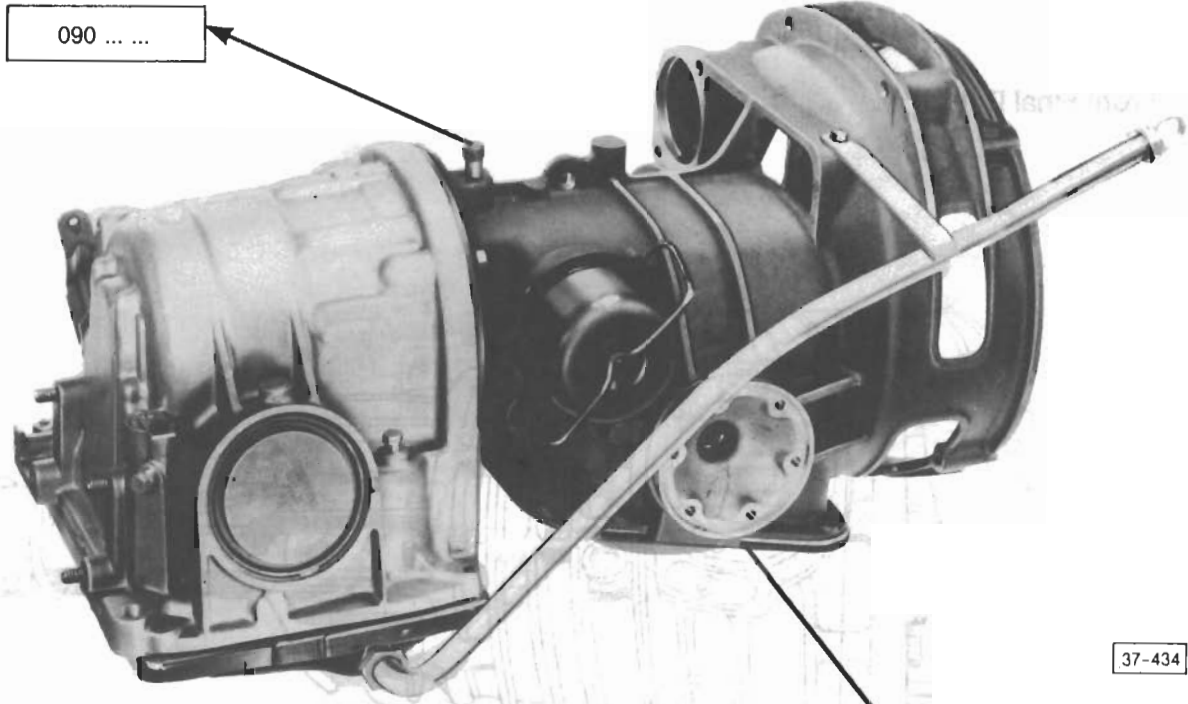
                         letters    consecutive

                            no.



# General

## Automatic Transmission Type 090

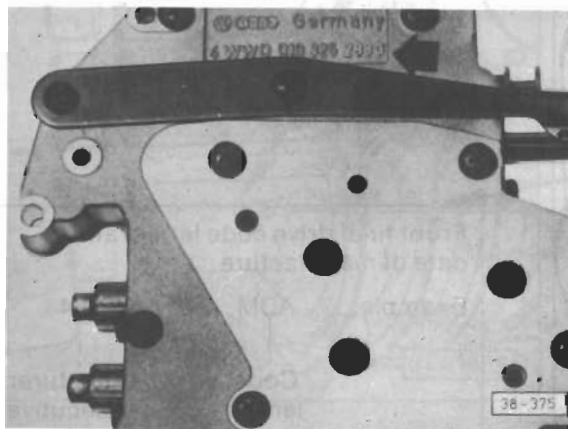


Code letters and date of manufacture

Example	NG	15	08	9
	code letters	day	month	year (79)
		of manufacture		

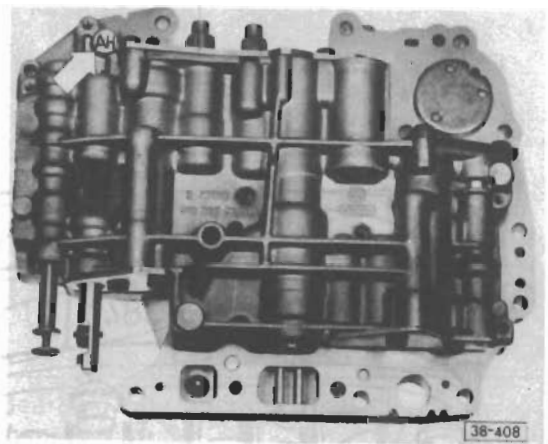
### Converter code letter

- letter D or Z on lug ( arrow )



### Transfer plate identification

- part number (arrow)



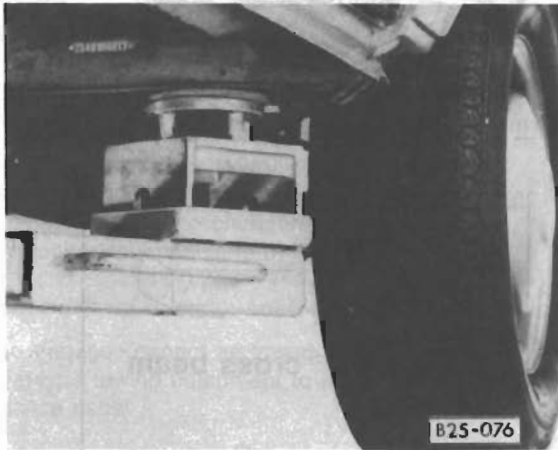
### Valve body code letters

- on boss (arrow)

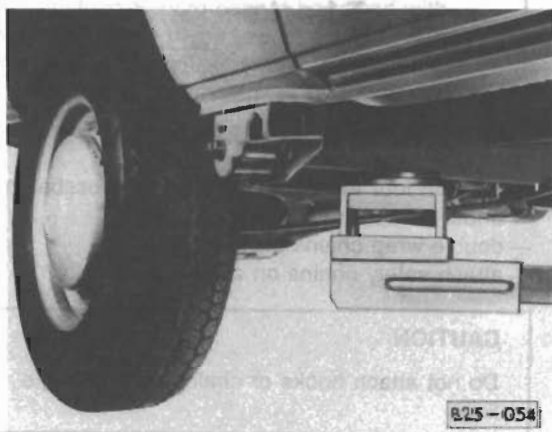
### Lifting vehicle with hoist/floor jack

**CAUTION**

Before driving onto lift, check for clearance between lifting arms and tires to avoid cutting sidewalls. Extend arms and check to see if arms are long enough to contact lifting points. Lift only at points shown



**Front**  
at crossmember next to jacking port



**Rear**  
at rear crossmember

**Note**

When lifting vehicle with floor jack, use same lifting points as with hoist

**CAUTION**

Do not lift vehicle by engine, transmission or front suspension. Doing so may result in damage to components



# General

## Emergency Towing

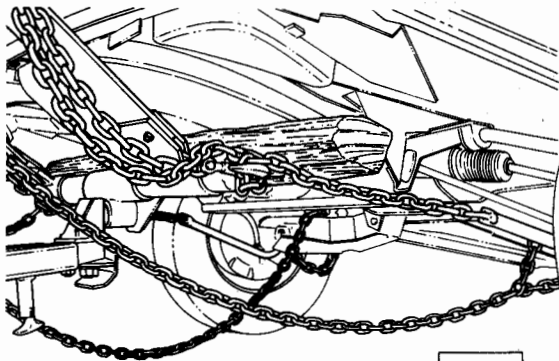
### Note

All towing procedures are based on use of typical sling-type tow truck equipment. If other types of towing equipment are used, these procedures may not apply

- whenever possible, tow with rear wheels off ground
- if car with **automatic transmission** must be towed with front wheels lifted because of extensive damage, dollies should be used under rear wheels if towing speed will exceed 30 mph or distance over 30 miles. Exceeding these limits will damage transmission
- selector lever must be in "N" position when moving car with automatic transmission with rear wheels on ground

### WARNING

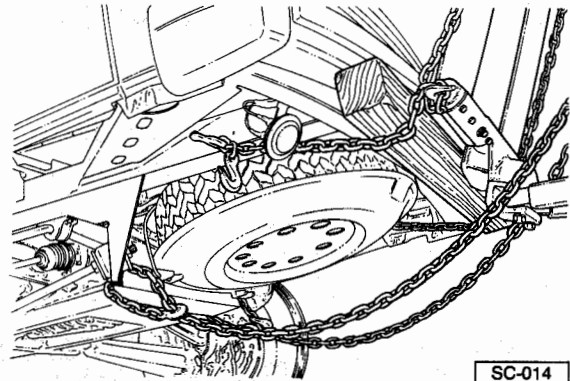
Always secure front wheels with an external steering wheel lock when towing with rear wheels off ground.  
Never use ignition steering lock to secure front wheels.  
Never allow passengers to ride in towed vehicle



00-A189

### Front hook-up — all models thru 1985

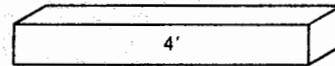
- attach grab hooks under lower control arms outboard of shock absorber mounts (as shown)
- place 4x4 wooden crossbeam under spare tire
- place tow bar under 4x4
- double wrap chains on tow bar
- attach safety chains to lower control arms (as shown)



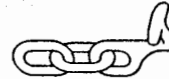
SC-014

### Front hook-up—From 1986 m.y.

- remove front license plate/bracket if interfere with front hook-up



**4 x 4 x 48'' cross beam**



**T-hooks**

00-A294

- attach T-hooks (above) to tie down slots in long members (as shown)
- position four foot long 4x4 wooden crossbeam under bumper (as shown)
- double wrap chains on tow bar
- attach safety chains on axle platform

### CAUTION

Do not attach hooks or chains around brake lines

- raise vehicle to allow four inches clearance between tires and road

## Towing speed/distance

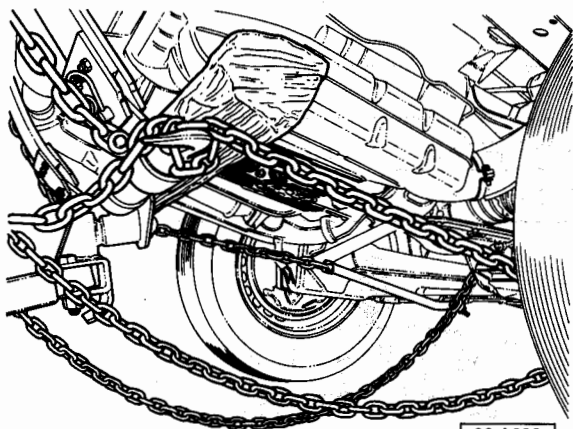
### Front tow — all models EXCEPT Syncro

#### Automatic transmission

30 mph (48 kmh) for up to 30 miles (48 km)

#### Manual transmission

50 mph (80 kmh) for up to 50 miles (80 km)



00-A293

### Rear hook-up — air cooled gasoline models only

- attach grab hooks to trailing arms
- place 4x4 under engine carrier to space tow bar away from heat exchangers
- attach safety chains to trailing arms

### Rear hook-up — water-cooled/diesel models

The Vanagon cannot be towed with conventional sling-type towing equipment to avoid damage to valance panel.

## Vanagon Syncro

### Front/rear hook-up

The Vanagon Syncro cannot be towed with conventional sling-type towing equipment nor with wheel lift equipment or wheel dollies to avoid damage to the all-wheel drive system.

- use flat-bed tow truck only.

## Flat Towing

Vehicles with **automatic transmission** may be towed forward (in driving direction) at speeds up to 30 mph for maximum of 30 miles

### CAUTION

Towing vehicles at more than 30 mph and/or for distance greater than 30 miles with rear wheels on ground will damage automatic transmission due to lack of lubrication

If towing speed will be greater than 30 mph or distance greater than 30 miles, temporary modifications to vehicle are required as follows:

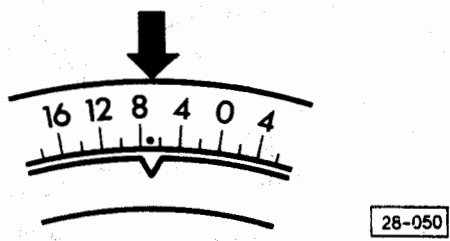
### Work sequence

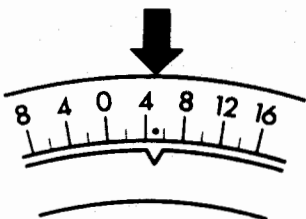
- remove drive shaft assemblies
- seal drive shaft flanges against water and dirt
- wrap drive shafts and store in vehicle

### Manual transmission (including Syncro)

There are no restrictions on speed or distance when towing manual transmission cars behind other vehicles

# General

Engine code letters	CV
Distributor (Part No.)	022 905 205S
Ignition timing	7.5° BTDC
Timing mark location: crankshaft pulley	
Idle speed manual automatic Vacuum hose disconnected	800- 950 rpm 850-1000 rpm
Dwell angle new points wear limit	44-50° 42-58°
Centrifugal advance (crankshaft degrees) start	1000-1200 rpm
	9-14° at 1600 rpm
end	21-25° at 3400 rpm
Vacuum advance start	107-147 mbar (80-110 mm Hg)
end	266 mbar (200 mm Hg) 8-12°
Spark plugs Bosch Beru Champion	W 145 M2. W 8 CO 145/14/3L N 288
Spark plug tightening torque	30 Nm (22 ft lb)
Spark plug gap	0.6-0.7 mm (0.023-0.028 in.)
Firing order	1-4-3-2

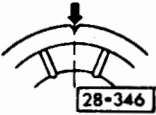
Engine code letters	CV	
Distributor (Part No.)	039 905 205C	
Ignition timing	5° ATDC	
Timing mark location: crankshaft pulley		
Idle adjustment Vacuum hoses connected Idle stabilizer plugs removed and connected together	850-950 rpm	
Dwell angle setting	not adjustable	
Centrifugal advance (crankshaft degrees)	start	1050-1300 rpm
	end	9-13° at 1600 rpm 21-25° at 3400 rpm
Vacuum advance	start	90-160 mbar (70-120 mm Hg)
	end	240-280 mbar (180-210 mm Hg) 9-12°
Vacuum retard	start	90-160 mbar (70-120 mm Hg)
	end	200-280 mbar (150-210 mm Hg) 11-13°
Spark plugs	Bosch Beru Champion	W 145 M2, W 8 CO 145/14/3L N 288
Spark plug gap		0.6-0.7 mm (0.023-0.028 in.)
Spark plug tightening torque		30 Nm (22 ft lb)
Firing order		1-4-3-2

### Transistorized ignition system cautions

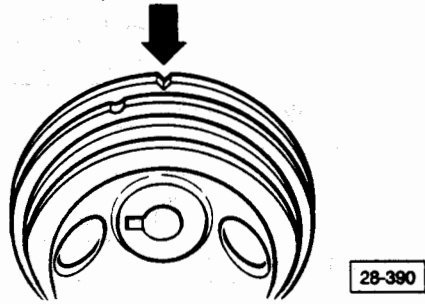
Do not connect any condenser/suppressor or test light to terminal 1. Do not connect test instruments with a 12 volt supply on terminal 15 of ignition coil. Do not crank engine before high tension wire of distributor cap (terminal 4) is connected to ground with jumper wire (example: compression check etc.). Do not replace installed coil—211 905 115 C—with conventional type. Do not leave battery connected when electric welding

on car. Do not start engine after heating up to more than 80°C (176°F), example: paint drying booth. Do not wash engine when it is running. Do not use battery booster longer than 15 sec. nor exceed 16.5 volts with booster. Allow 1 minute pause between boosting attempts. Do not disconnect battery while engine is running. Disconnect plug to ignition control unit when car has to be towed.

# General

Engine code letters	DH
Distributor (Part No.)	025 905 205 D
Ignition timing	$5 \pm 1^\circ$ ATDC
Timing mark location: crankshaft pulley	
Idle speed	$850 \pm 50$ rpm
Vacuum hoses connected	
Idle stabilizer control unit	electrical plugs disconnected from unit and connected together
Centrifugal advance (crankshaft degrees)	
start	1050–1150 rpm
	16–20° at 2400 rpm
end	21–25° at 3800 rpm
Vacuum advance	
start	190–230 mbar (14.0–17.0 cm Hg)
end	360 mbar (27.0 cm Hg) 12–16°
Vacuum retard	
start	100–220 mbar (7.5–16.5 cm Hg)
end	260–360 mbar (19.5–27.0 cm Hg) 9–11°
Spark plugs	Bosch Beru Champion W 7 C 0 14 L-7 C N 288
Spark plug gap	$0.7 + 0.1$ mm (0.028 + 0.004 in.)
Spark plug tightening torque	20 Nm (14 ft lb)
Firing order	1–4–3–2



Introduction		October 1985
Engine code		MV
Part no.:	Ignition distributor	025 905 205 M
	Digifant control unit***	025 906 022D old 025 906 022/022A new
Ignition timing	Checking value	3° - 7° before TDC
	Adjusting value	5° ± 1° before TDC
Timing mark location		
RPM*		2000 - 2500
Ignition adjustment** -- timing map --		
	RPM	Approx. 3000
	Degrees	35 ± 5°
RPM limit	Switch-off RPM of digifant control unit	RPM 5600
Firing order	CYL.	1 - 4 - 3 - 2
Spark plugs (tightening torque: 20 Nm (14 ft lb))	Bosch Beru Champion	W 7 CCO 14L-7CU, 14L-7C N 288
Spark plug gap	mm (in)	0.7 ± .1 mm (0.028 ± 0.003 in)

\*) Engine oil temperature 80° C, (176°F) connector of temperature sensor II disconnected with engine running.

\*\*) Engine oil temperature 80°C, connector of temperature sensor II connected.

\*\*\*) When replacing control unit always replace old control unit with newer version.

### CAUTION

Part numbers are for reference only. Always check with your parts department for latest part information.

## Technical data/specified values

Engine code		<b>MV</b>
Type		2.1 liter 70 kW, 90 SAE net HP
Introduction		October 1985
Part no.		
	Control unit	025 906 022
Ignition timing	checking spec.	3-7° before TDC
	adjusting spec.	5 ± 1° before TDC
• Test and adjustment conditions	no.	1 and 9
Idle adjustment	idle rpm	880 ± 50 rpm
	CO content	0.7 ± 0.4 Vol. %
• Test and adjustment conditions	no.	1 to 6, 7, 8

### Conditions and requirements:

- 1 — engine oil temperature min. 80°C (176°F)
- 2 — electrical consumers turned off
- 3 — crankcase breather hose on oil breather removed and closed tightly
- 4 — throttle valve switch turned on (continuity)
- 5 — idle stabilizer OK (valve vibrates and hums)
- 6 — ignition timing setting: OK
- 7 — connector (single connector) for idle stabilizer control valve disconnected
- 8 — with ignition OFF, disconnect connector (single connector) for oxygen sensor
- 9 — with engine running, double connector for temperature sender disconnected and rpm increased to 2000-2500 rpm by depressing throttle

# Engine Crankshaft Crankcase

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### Air-cooled

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### Diesel

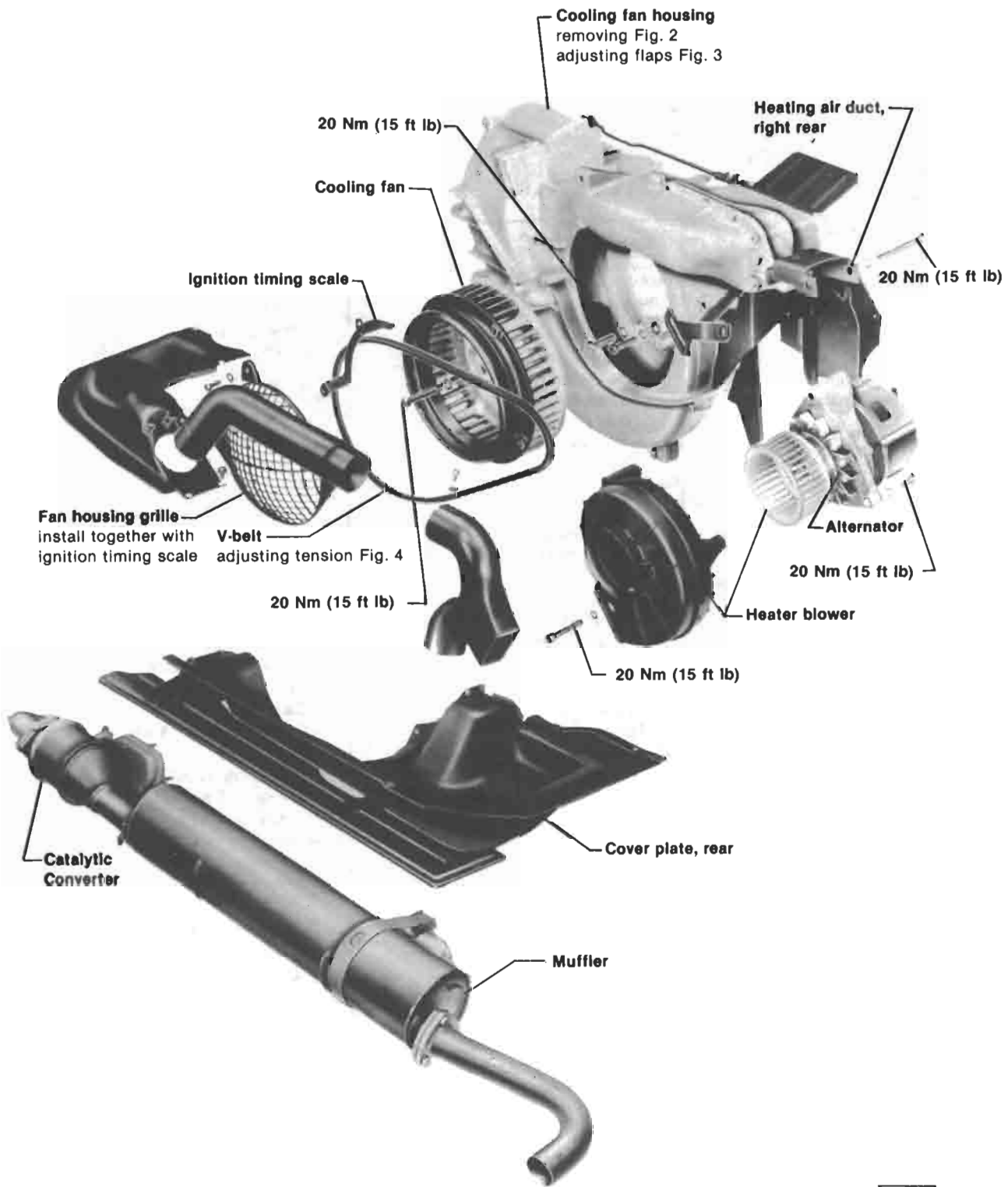
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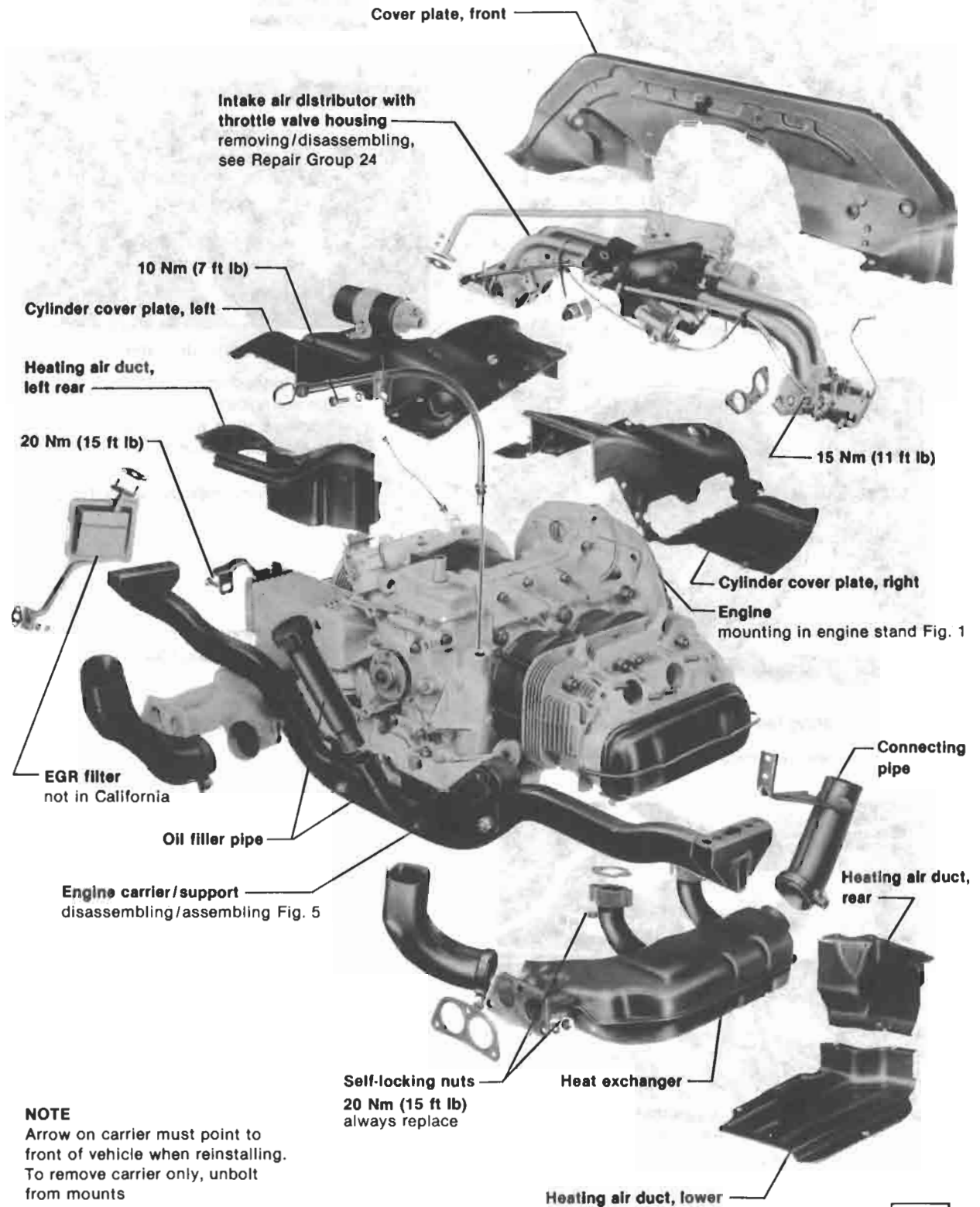
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# 13 Engine - Crankshaft, Crankcase

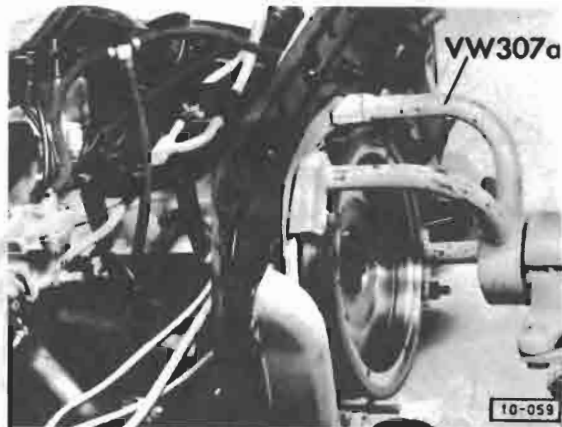


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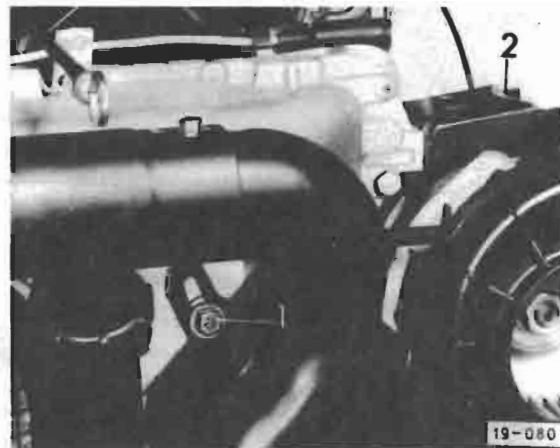


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# 13 Engine - Crankshaft, Crankcase

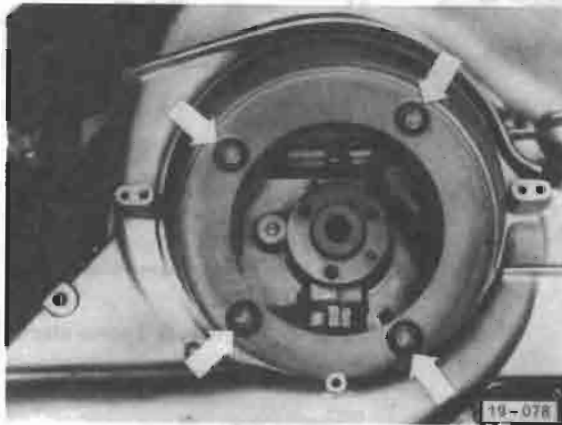


**Fig. 1** Engine, mounting in engine stand



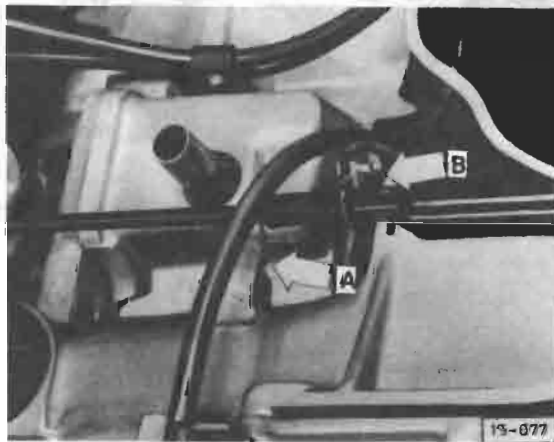
**Fig. 4** Alternator V-belt, adjusting

- after loosening bolts 1 and 2, move alternator to tension V-belt
- tighten bolts 1 and 2 to 20 Nm (15 ft lb)
- check belt tension by pressing belt firmly in center
  - deflection: approx. 10–15 mm (3/8–9/16 in.)



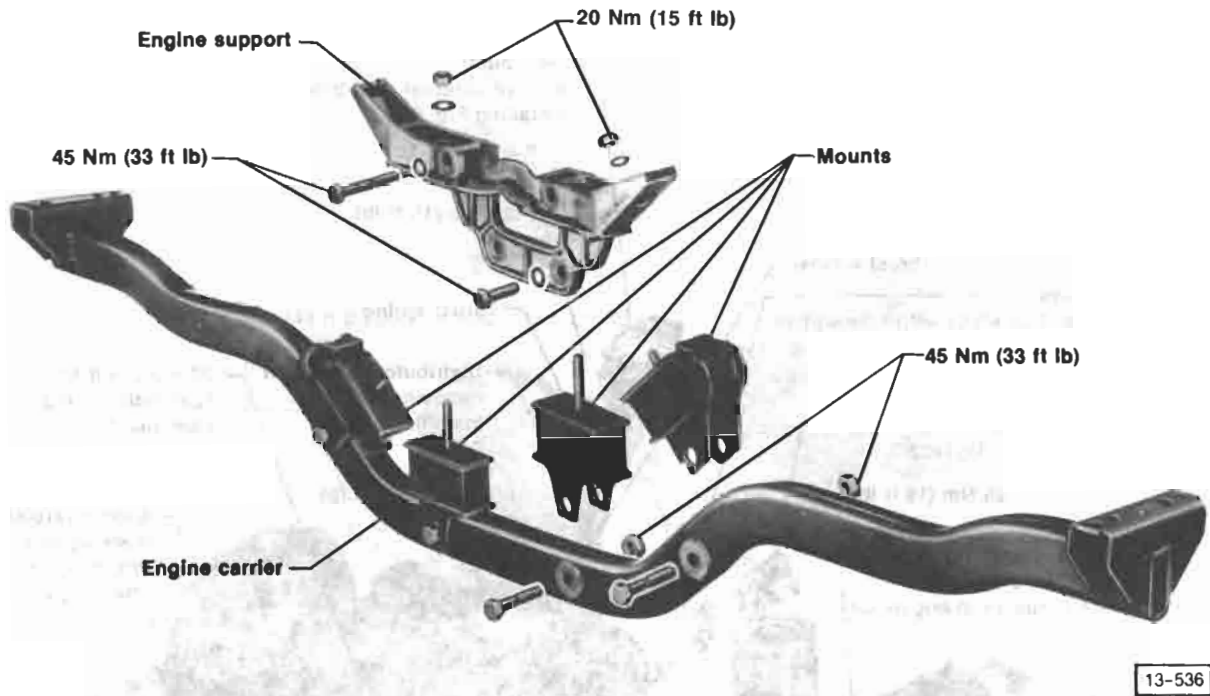
**Fig. 2** Cooling fan housing, removing

- remove bolts (arrows) and detach



**Fig. 3** Cooling air flaps, adjusting

- bent ends of return spring must rest on boss of cooling fan housing (arrow A) and on cable guide (arrow B)
- press flaps into closed position and tighten cable clamp

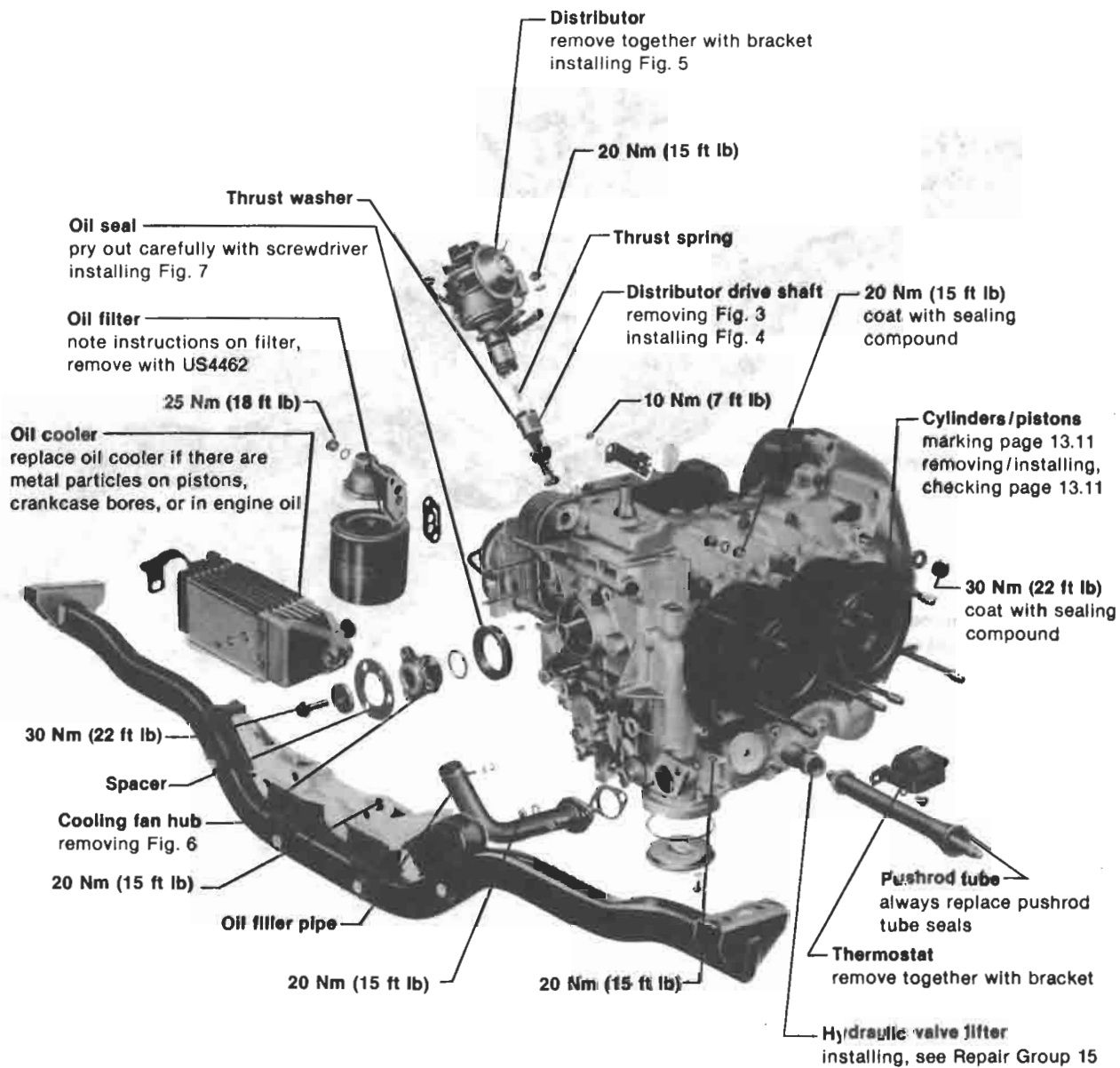


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**Fig. 5 Engine carrier/support, disassembling/assembling**



# 13 Engine - Crankshaft, Crankcase



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**WARNING**

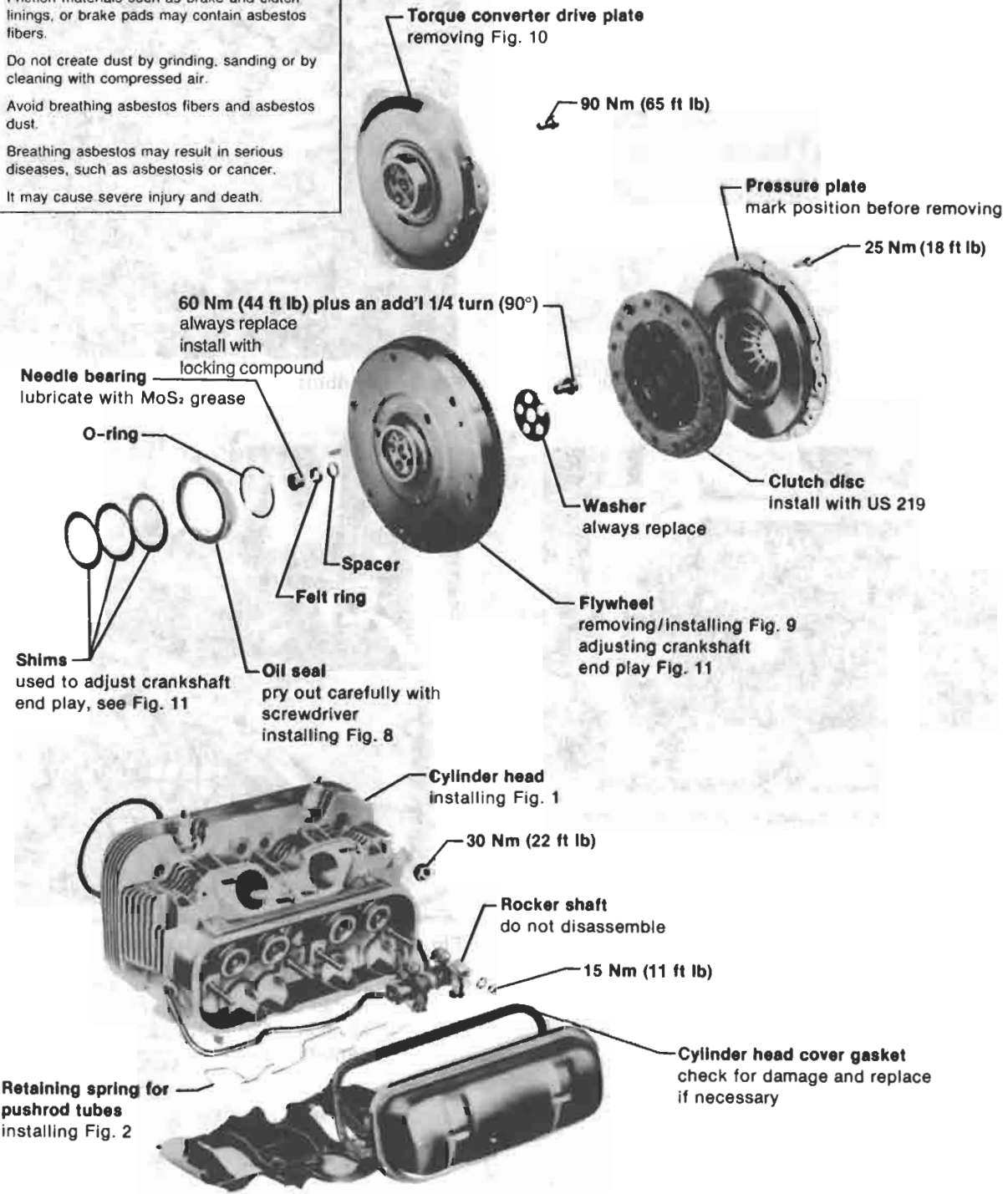
Friction materials such as brake and clutch linings, or brake pads may contain asbestos fibers.

Do not create dust by grinding, sanding or by cleaning with compressed air.

Avoid breathing asbestos fibers and asbestos dust.

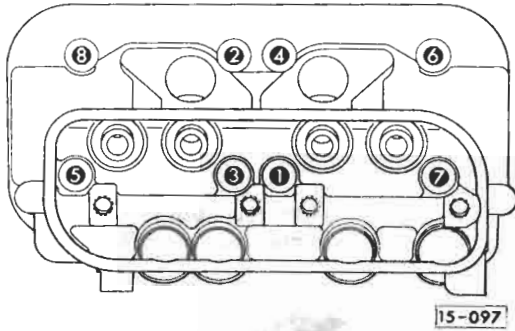
Breathing asbestos may result in serious diseases, such as asbestosis or cancer.

It may cause severe injury and death.



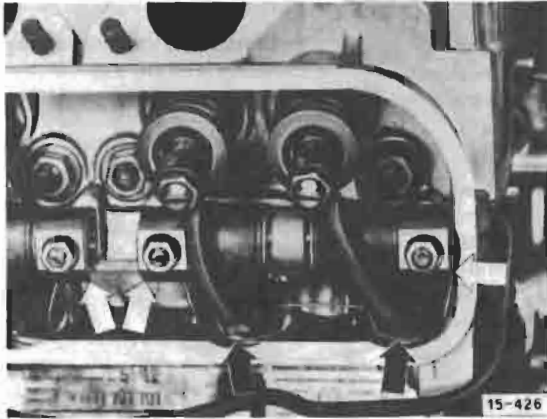
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# 13 Engine - Crankshaft, Crankcase



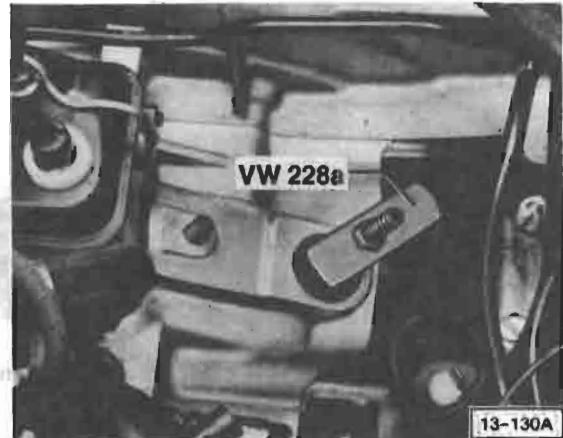
**Fig. 1 Cylinder head, installing**

- hand tighten nuts to align components, then torque to 30 Nm (22 ft lb) in sequence

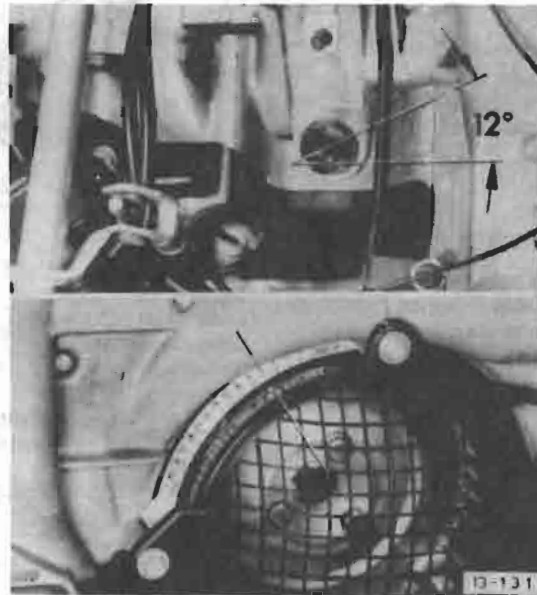


**Fig. 2 Retaining spring for push rod tubes, installing**

- spring must rest on tubes (black arrows) and engage supports (white arrows)

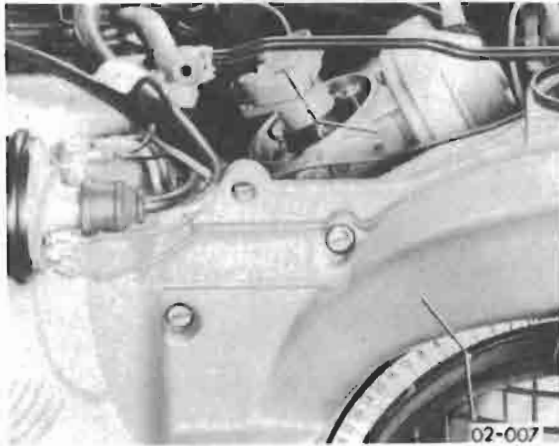


**Fig. 3 Distributor drive, removing**



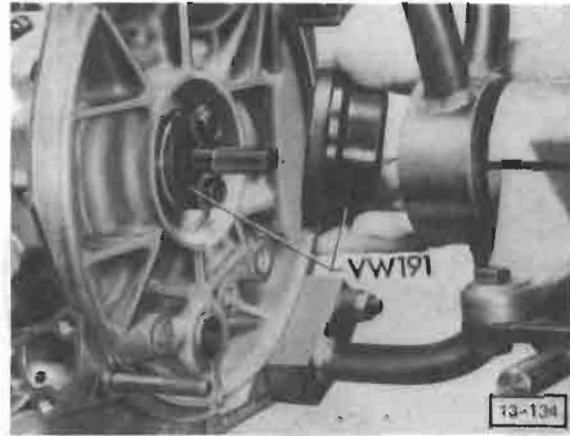
**Fig. 4 Distributor drive, installing**

- set crankshaft to TDC on cylinder No. 1
- install drive shaft so that offset slot is at an angle of about 12° to engine centerline (small segment to coil side)

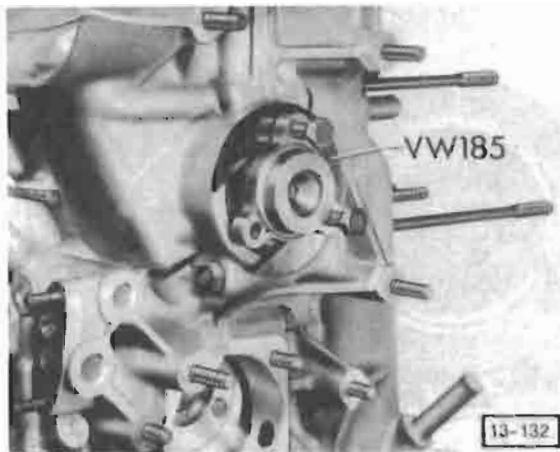


**Fig. 5 Distributor, installing**

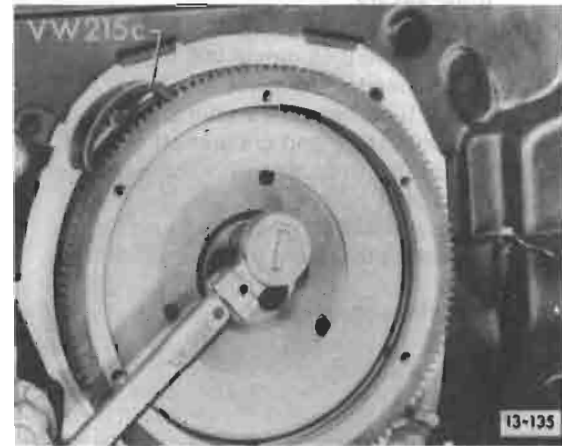
- set cylinder No. 1 to TDC
- turn rotor until mark on rotor is in line with mark on distributor housing (cylinder No. 1)



**Fig. 8 Crankshaft oil seal, flywheel side, installing**



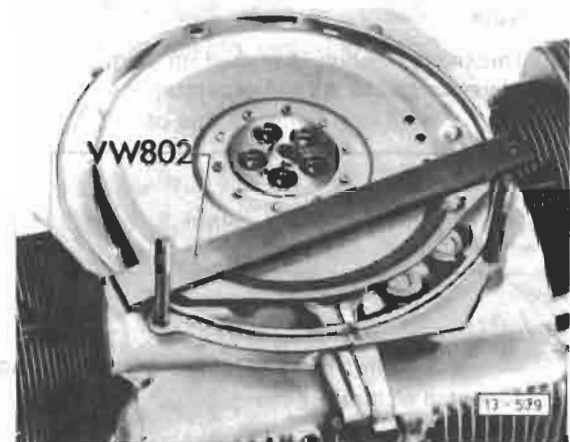
**Fig. 6 Cooling fan hub, removing**



**Fig. 9 Flywheel, removing/installing**



**Fig. 7 Crankshaft oil seal, cooling fan side, installing**



**Fig. 10 Torque converter drive plate, removing**

# 13 Engine - Crankshaft, Crankcase

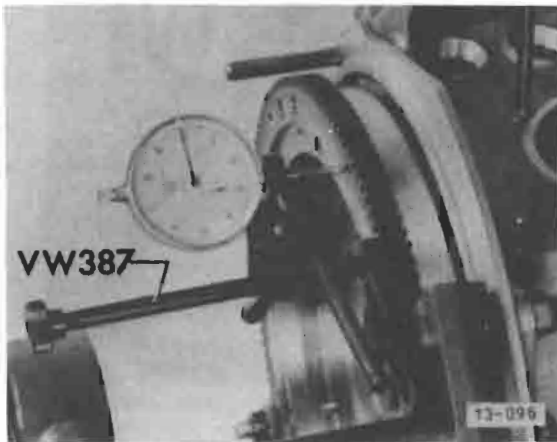


Fig. 11 Crankshaft end play, checking/adjusting

- check crankshaft end play and adjust if necessary

- new: 0.07–0.13 mm (0.003–0.005 in.)

- wear limit: 0.15 mm (0.006 in.)

if **NO**, proceed as follows:

- install flywheel with 2 shims but **without** O-ring and crankshaft oil seal
- mount dial indicator with bracket on crankcase
- move crankshaft in and out and measure movement (crankshaft end play)
- determine thickness of 3rd shim

### Example

dial indicator reading    0.44 mm (0.017 in.)

specified end play        – 0.10 mm (0.004 in.)

thickness of 3rd shim    0.34 mm (0.013 in.)

### Note

Thickness of shim is etched on shim.

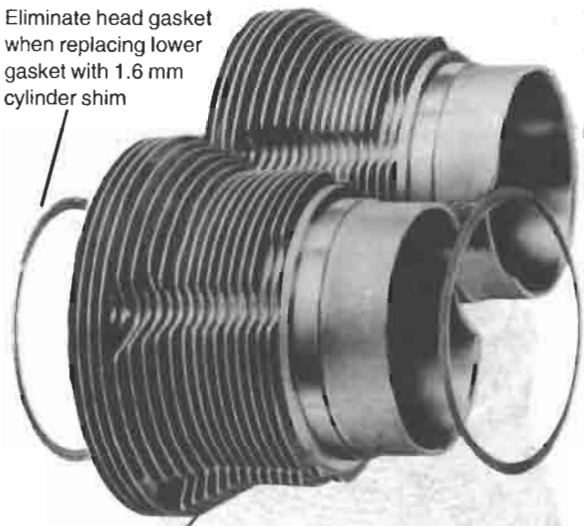
Always recheck with micrometer

### CAUTION

Always install **three** shims to obtain correct crankshaft end play

- remove flywheel
- install O-ring, crankshaft oil seal and felt ring
- install all three shims
- install flywheel
- tighten bolts to 110 Nm (80 ft lb)
- recheck crankshaft end play

Eliminate head gasket when replacing lower gasket with 1.6 mm cylinder shim

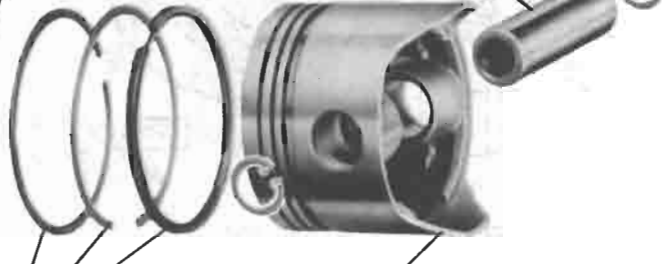


**Cylinder**  
mark before removing Fig. 1  
checking for wear Fig. 9  
Installing Fig. 11  
cylinder bore/piston  
diameter page 13.13

When installing new pistons and cylinders  
replace lower gasket with 1.6 mm cylinder shim part #071 101 341

**Circlip**  
removing/installing Fig. 2

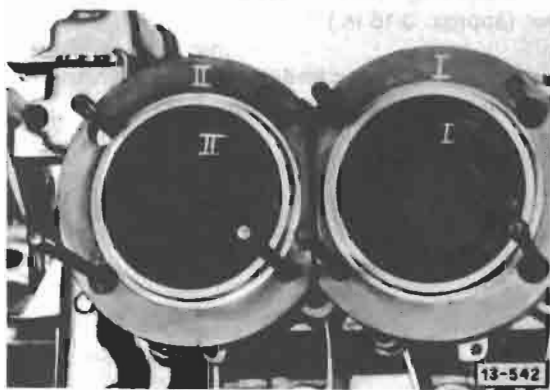
**Piston pin**  
removing/installing Fig. 3



**Piston**  
mark before removing Fig. 1  
classifications Fig. 6  
diameter/wear, checking Fig. 10  
piston diameter/cylinder  
bore page 13.13

**Piston rings**  
removing/installing Fig. 4  
positioning Fig. 5  
end gap, checking Fig. 7  
side clearance, checking Fig. 8

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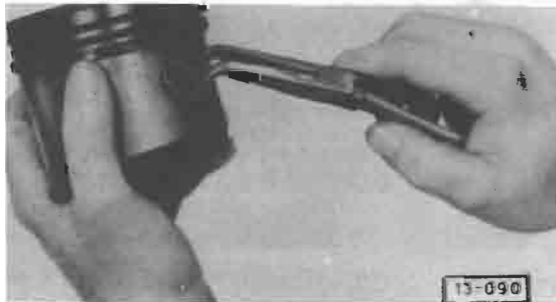


**Fig. 1** Pistons/cylinders, marking

- arrow points to flywheel

**Note**

Before removing, mark matching numbers on pistons and cylinders



**Fig. 2** Circlip, removing/installing



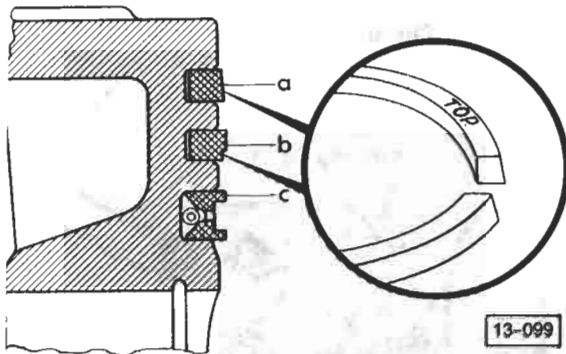
**Fig. 3** Piston pin, removing/installing

- if pin is too tight in piston, heat piston to approx. 60°C (140°F)



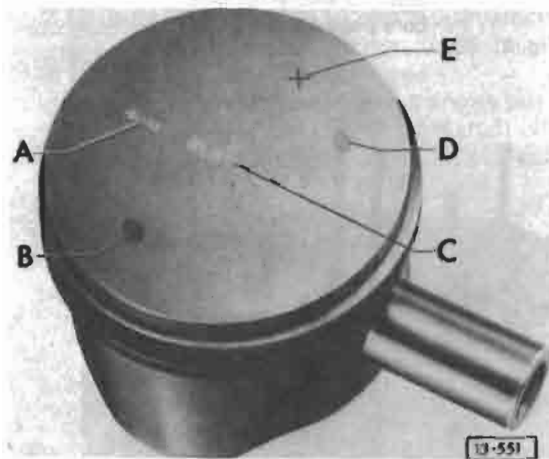
**Fig. 4** Piston rings, removing/installing

# 13 Engine - Crankshaft, Crankcase



**Fig. 5 Piston rings, positioning**

- TOP mark on piston rings must face top of piston
- a = top ring
- b = middle ring
- c = oil scraper ring



**Fig. 6 Piston, classifications**

- A = arrow must point toward flywheel when installing
- B and C = piston diameter in mm (blue or pink paint dot indicates matching size)
- D and E = weight group
  - (brown) = 474 - 482 grams
  - + (gray) = 482 - 490 grams



**Fig. 7 Piston ring end gap, checking**

— push ring into cylinder about 4-5 mm (approx. 3/16 in.)

	ring end gap	wear limit
upper/middle ring:	0.40-0.65 mm (0.016-0.026 in.)	0.90 mm (0.035 in.)
oil scraper ring:	0.25-0.40 mm (0.010-0.016 in.)	0.95 mm (0.037 in.)



**Fig. 8 Piston ring side clearance, checking**

	clearance	wear limit
upper/middle ring:	0.04-0.07 mm (0.002-0.003 in.)	0.12 mm (0.005 in.)
oil scraper ring:	0.02-0.05 mm (0.001-0.002 in.)	0.10 mm (0.004 in.)



## CAUTION

If measurement of piston/cylinder shows that clearance is close to 0.2 mm (0.008 in.), piston/cylinder should be replaced by set of same size group (standard or oversize). Weight difference of pistons must not exceed 10 grams.

If cylinder of damaged piston shows no wear, install new piston of appropriate matching size.

Cylinders/pistons must be of same size group.

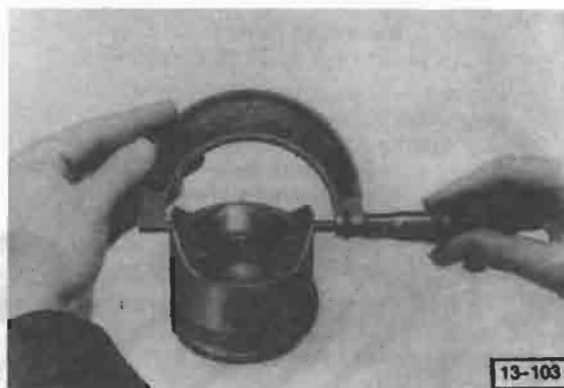
## Cylinder bore/Piston diameter

	Cylinder bore (mm)	Piston dia. (mm)
<b>Standard (94.0 mm)</b>		
blue	93.992-94.008	93.97
pink	94.002-94.018	93.98
<b>1st oversize (94.5 mm)</b>		
blue	94.492-94.508	94.47
pink	94.502-94.518	94.48
<b>2nd oversize (95.0 mm)</b>		
blue	94.992-95.008	94.97
pink	95.002-95.018	94.98



**Fig. 9 Cylinder, checking for wear**

— measure 10-16 mm (3/8-5/8 in.) from top

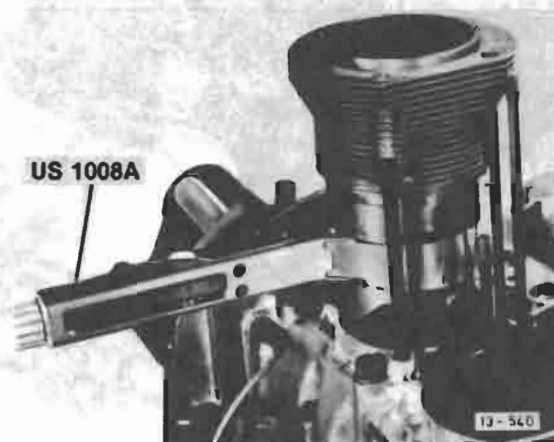


**Fig. 10 Piston, checking diameter/wear**

— measure at bottom of skirt approx. 16 mm (3/8 in.) from edge (diameter stamped in top of piston)

• clearance new: 0.02-0.05 mm (0.001-0.002 in.)

• wear limit: 0.2 mm (0.008 in.)



**Fig. 11 Cylinder, installing**

• piston ring end gaps must be offset 120°

**Index**

**Engine (Air-cooled AFC)**

- Removing 10.2
- Installing 10.5

**Engine (Diesel)**

- Removing 10.6
- Installing 10.7

**Engine (Water-cooled Syncro)**

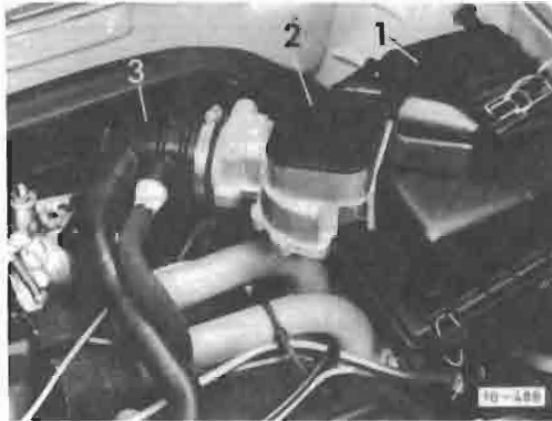
- Removing 10.8
- Installing 10.10

# 10 Engine-Assembly

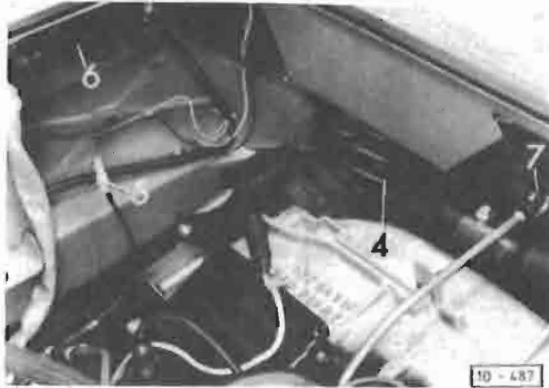
## Engine, removing (Air cooled-AFC)

### Work sequence

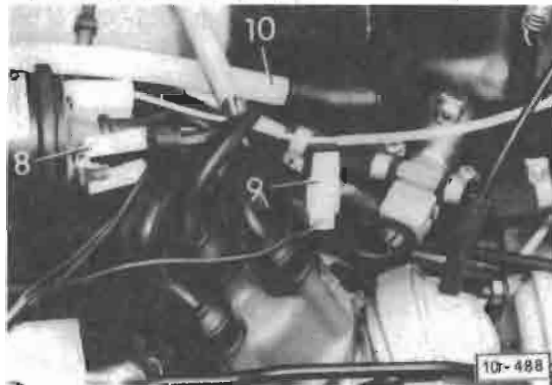
- disconnect ground cable from battery



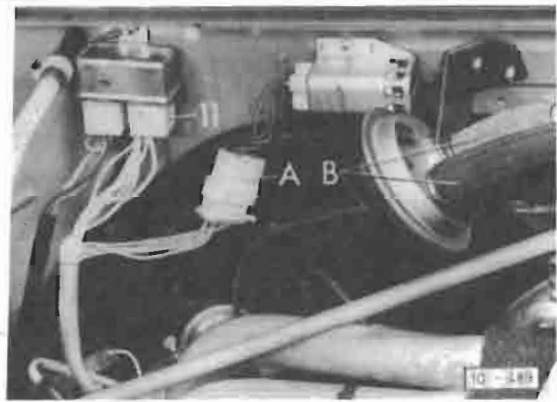
- detach air cleaner 1 with air flow sensor 2 and air intake duct 3



- remove rubber boot for heater booster 4
- disconnect wire for alternator 5
- disconnect plug 6 at control unit
- pull engine oil level dip stick 7

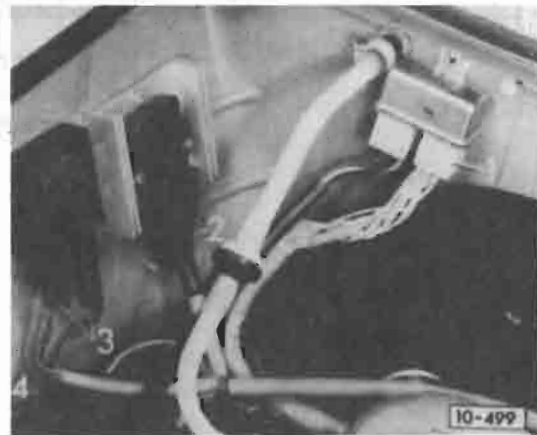


- disconnect wires at
  - ignition distributor 8
  - engine oil pressure switch 9
- disconnect vacuum hose 10 for brake booster

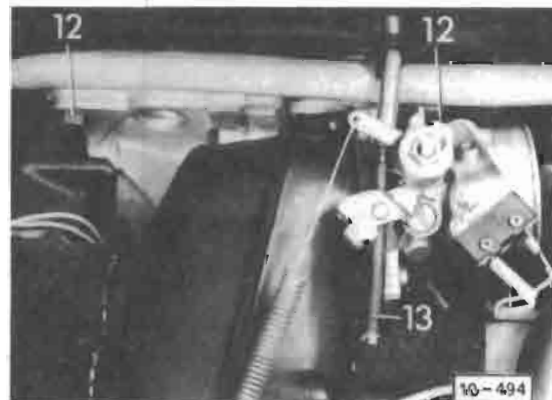


- disconnect following
  - plug 11 at double-relay
  - plug A for resistors
  - hoses B at deceleration valve

### California only

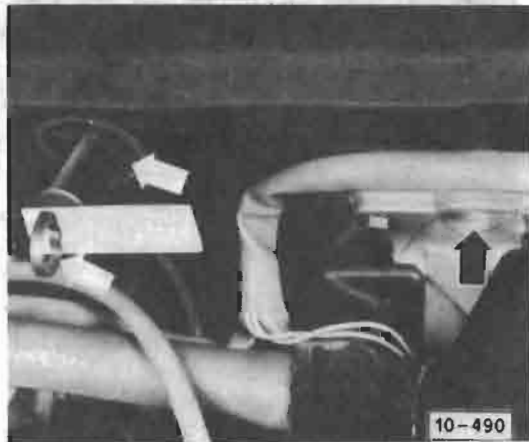


- disconnect following:
  - plug 1 at double-relay
  - plug 2 at Hall control unit
  - plugs 3 at idle stabilizer
  - wire connection 4 for oxygen sensor

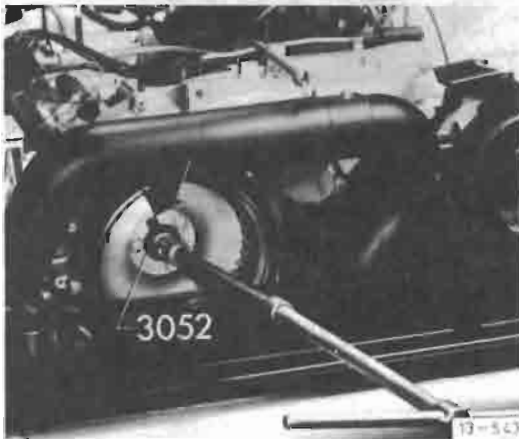


- remove nuts 12 of upper engine mounting bolts
- disconnect accelerator cable 13

## Automatic transmission



- remove plug (black arrow) on top of transmission housing
- pull ATF dip stick (lower white arrow)
- remove ATF filler tube grommet (upper white arrow)



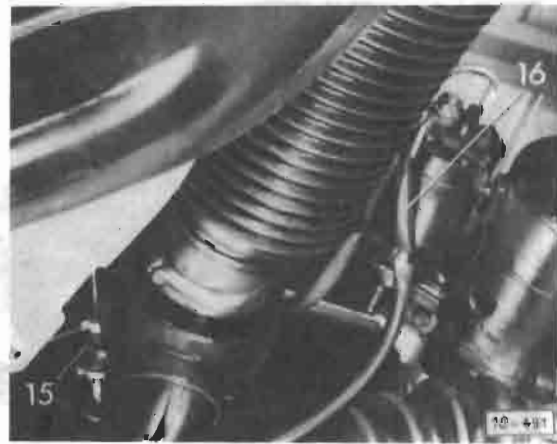
- remove three 8 mm bolts of torque converter through hole on top of transmission housing
  - use adaptor 3052, extension and T-handle to turn crankshaft of engine
  - make sure pin (arrow) engages in recess of cooling fan hub

### Note

To gain access to bolts of torque converter, engine must be rotated until each bolt appears in hole on top of transmission housing



- remove heater flap housing bolt 14

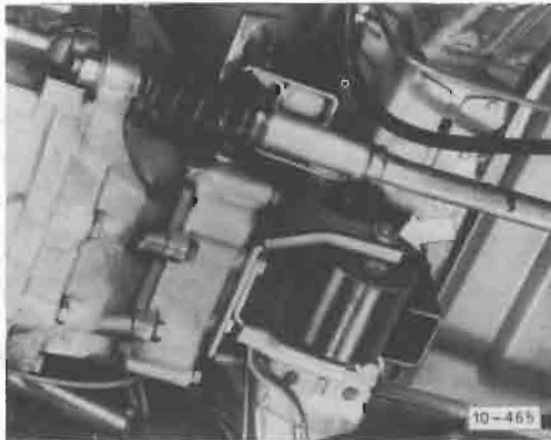


- block fuel line 15 with clamp
- disconnect wiring 16 on starter

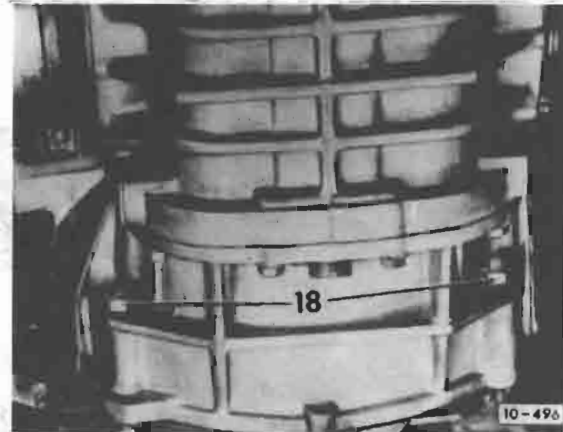


- block fuel line from pressure regulator 17 with clamp

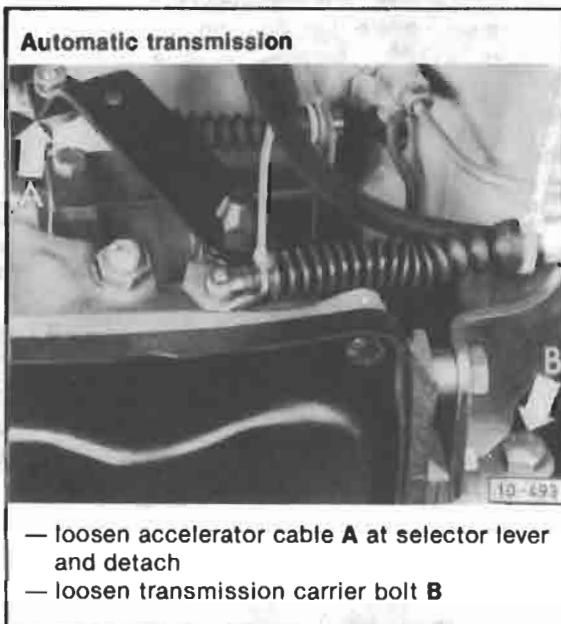
# 10 Engine - Assembly



— loosen transmission mount bolt (arrow)



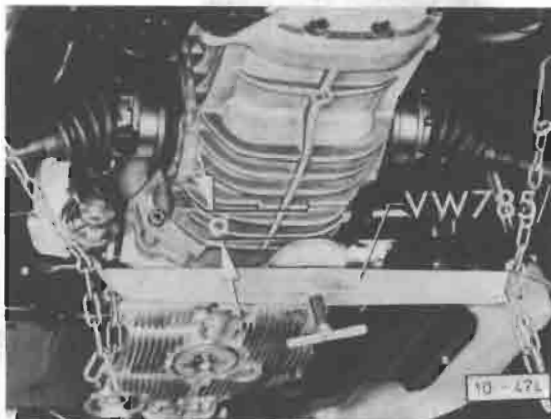
— remove nuts **18** from engine mounting bolts



— loosen accelerator cable **A** at selector lever and detach  
— loosen transmission carrier bolt **B**



— remove bolts **19** from engine carrier  
— lower engine/transmission assembly until transmission rests on support VW 785/1  
— remove engine from transmission  
— lower engine with floor jack



— support transmission with VW 785/1  
• when attaching keep distance  
a = 80 mm (3 1/4 in.)  
— support engine with floor jack  
• use adaptor VW 612/5

## Engine, installing

(Air cooled-AFC)

Proceed in reverse order of removing and note following:

- check clutch release bearing for wear, replace if necessary
- lightly lubricate splines on main drive shaft and contact points of clutch release bearing/ clutch release lever with MoS<sub>2</sub> grease
  - do not lubricate clutch release bearing guide sleeve
- always replace all self-locking nuts

### Manual transmission

- adjust accelerator cable at full throttle position

### Automatic transmission

- adjust accelerator cable

### Tightening torques:

- |                                   |                  |
|-----------------------------------|------------------|
| • engine to transmission          | 30 Nm (22 ft lb) |
| • engine carrier to mount         | 25 Nm (18 ft lb) |
| • transmission mount              | 30 Nm (22 ft lb) |
| • torque converter to drive plate | 30 Nm (18 ft lb) |

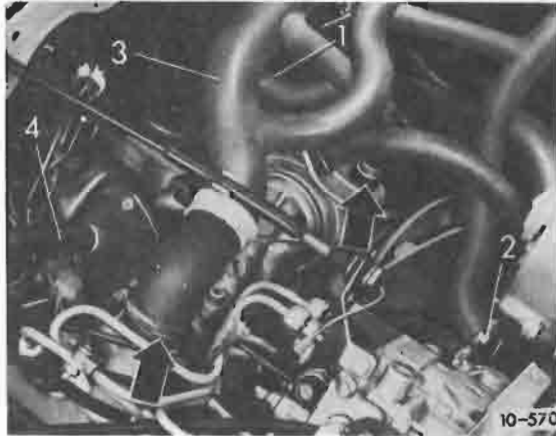
# 10 Engine - Assembly

## Engine, removing

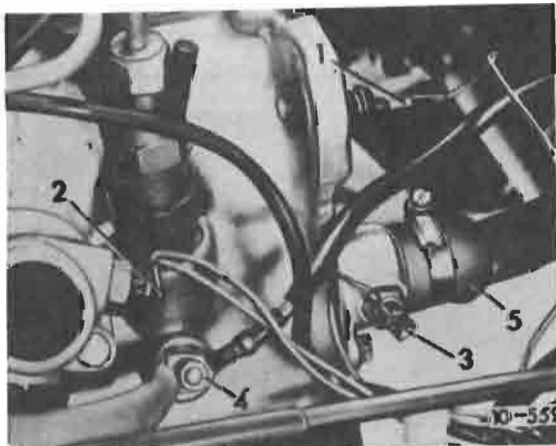
### CAUTION

Coolant/antifreeze **must not** be reused when replacing engine, cylinder head, cylinder head gasket, radiator and heater core.

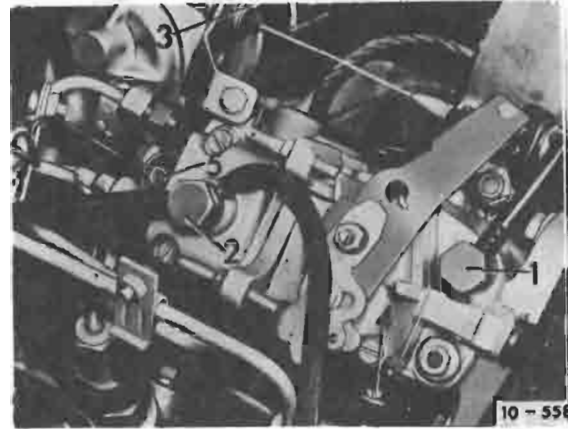
- disconnect battery ground cable
- remove top of air cleaner
- remove lower engine cover
- open coolant expansion tank cap



- disconnect lower hose from waterpump at connecting pipe 1 to radiator (see caution)
- disconnect center hose 2 from waterpump
- disconnect hose 3 from cylinder head (lower arrow) and from oil cooler (upper arrow) and move it to one side
- remove vacuum hose 4 from vacuum pump

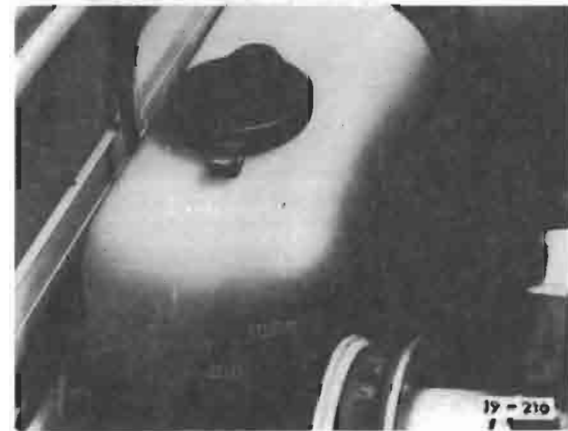


- disconnect wiring from:
  - oil pressure switch 1
  - temperature sensors 2 and 3
  - glow plugs 4
- remove coolant hose 5



- remove fuel supply line 1 and fuel return line 2 from injection pump
- disconnect accelerator cable from pump lever and remove retaining clip 3 at bracket and place cable to one side
- disconnect cold start cable at lock screw 4

- remove retaining clip at bracket and place cold start cable to one side
- disconnect wire 5 from fuel shut-off solenoid

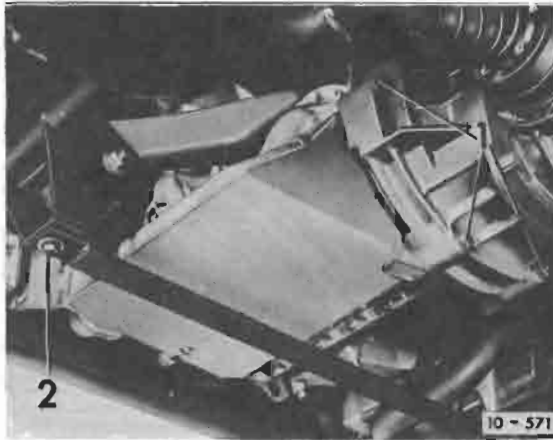


- remove coolant reservoir

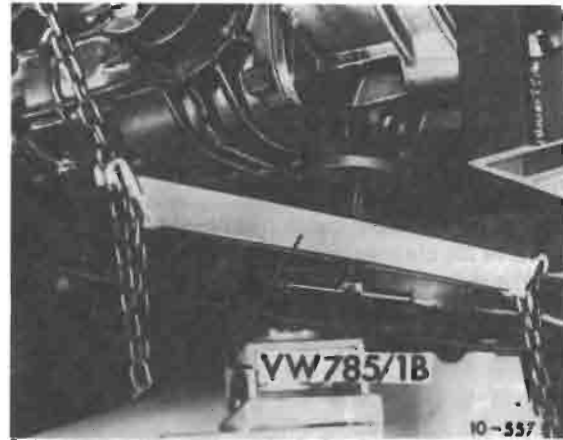


- remove cap with dipstick 1
- remove nuts 2 from rear engine mounts on left and right sides, but leave bolts in

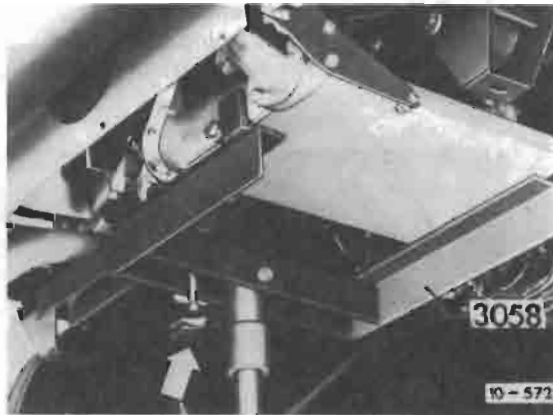




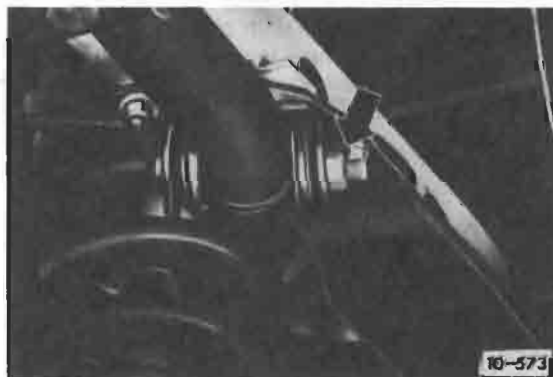
- remove all 7 engine/transmission mounting bolts 1
- remove support member bolts 2 and remove support member



- support transmission with VW 785/1B
- remove engine from transmission and lower it out of vehicle



- support engine with engine crane and adaptor 3058
  - angle of engine to transmission can be adjusted by turning knob (arrow)



- remove nuts (arrow) from front engine mounts on left and right sides
- remove bolts from both front and rear engine mounts
- lower engine/transmission assembly until engine can be separated from transmission

## Engine, installing

Proceed in reverse order of removing and note following:

- adjust angle of engine to transmission before joining engine and transmission

### CAUTION

Do not interchange fuel supply and fuel return pipe union screws. For identification, fuel return pipe union screw is marked with **OUT** on hex. head. Fuel return line also has smaller diameter than fuel supply line

- adjust cold start cable, see Repair Group 23
- refill coolant, see Repair Group 19

### Tightening torques:

- engine to transmission
 

M10 bolts	45 Nm (33 ft lb)
M12 bolts	80 Nm (59 ft lb)
- engine mounts 85 Nm (63 ft lb)
- support member 45 Nm (33 ft lb)
- fuel line union screws on injection pump 22 Nm (16 ft lb)

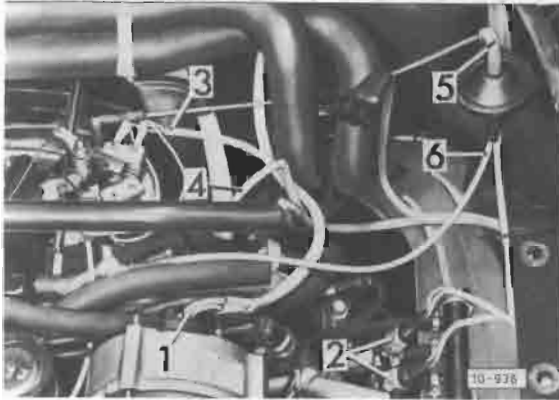
# 10 Engine - Assembly

## Engine, removing

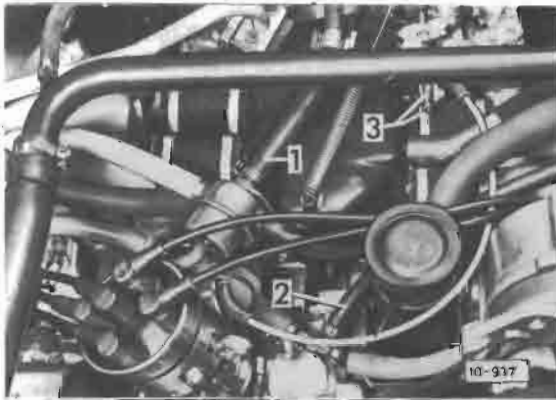
### CAUTION

Coolant/antifreeze **must not** be reused when replacing engine, cylinder head, cylinder head gasket, radiator and heater core.

- disconnect ground cable from battery
- remove air cleaner with air flow sensor and air intake duct



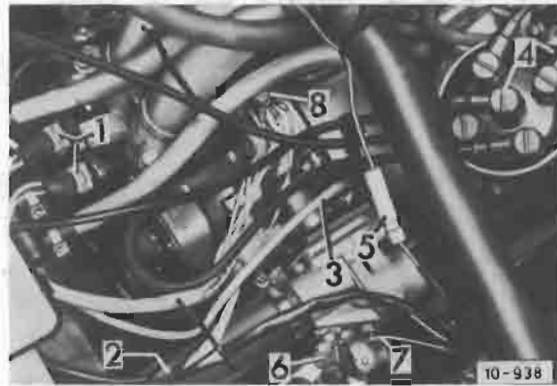
- disconnect wire 1 at alternator
- disconnect following:
  - plugs 2 at injectors
  - plug 3 at throttle valve switch
  - plug 4 at auxiliary air regulator
- disconnect hoses 5 and 6 at charcoal filter valve



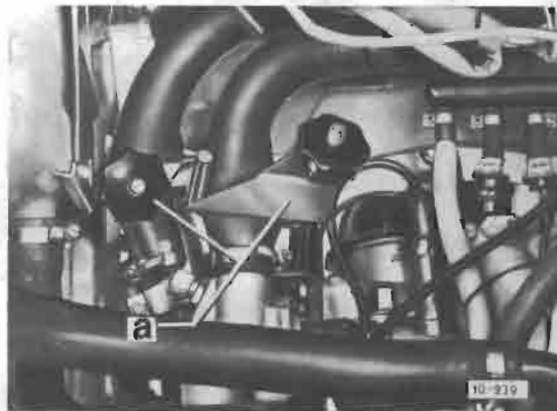
- disconnect and plug fuel hoses 1 and 2
- remove accelerator cable from throttle valve lever

### Automatic Transmission

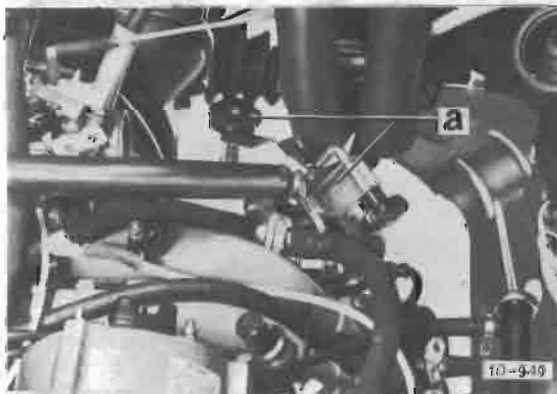
- remove circlip and spring 3 from accelerator rod



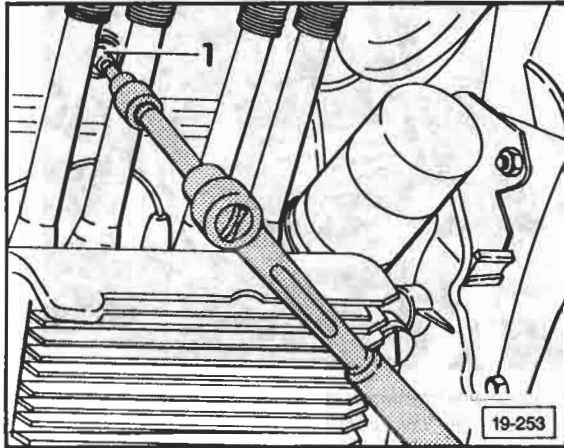
- disconnect following:
  - plugs 1 at injectors
  - plug 2 at oxygen sensor
  - plug 3 and 4 at ignition distributor
  - plug 5 at oil pressure switch
  - plug 6 at temperature sensor
  - plug 7 at temperature sender
  - plug at coolant level warning switch (not shown—located in coolant expansion tank)
- remove ground connectors 8



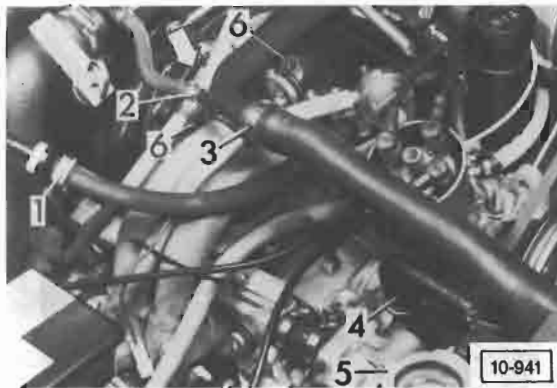
- block coolant hoses with clamps a
  - a = universal clamp—local supply



- block coolant hoses with clamps a
  - a = universal clamp—local supply
- open coolant expansion tank cap



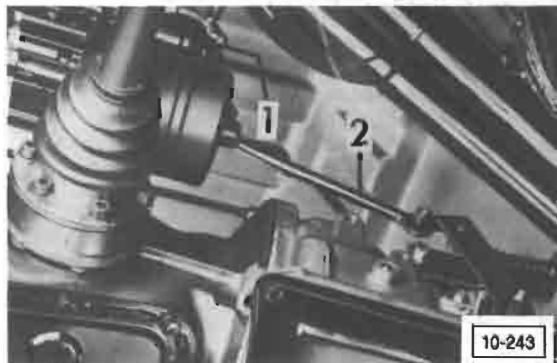
- remove drain plugs 1 at cylinder heads and drain coolant



- disconnect brake booster line 1
- disconnect coolant hoses 2, 3 and 4
- remove coolant expansion tank 5
- remove engine/transmission bolt/nut 6 on left and right sides

### Automatic Transmission

- remove three bolts which attach torque converter to drive plate through hole on top of trans. housing (arrow)



- disconnect wiring 1 at starter

### Automatic Transmission

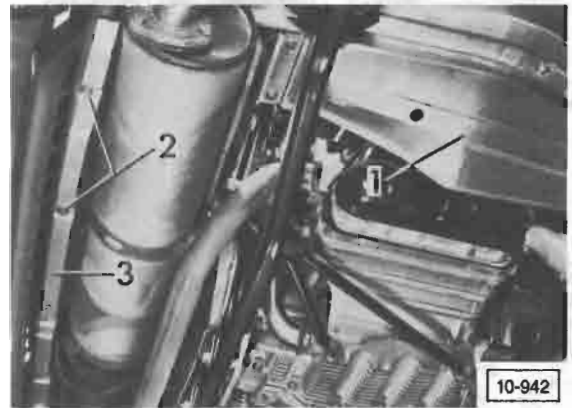
- remove accelerator rod 2

### Vehicles with power steering

- remove power steering pump with hose left attached, and place in engine compartment.

### Vehicles with air conditioning

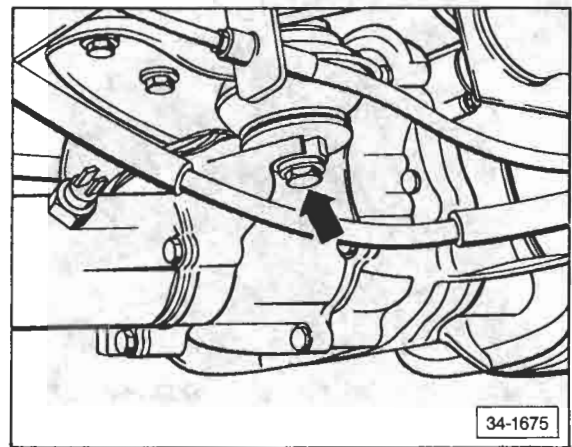
- remove compressor with hoses attached and place in engine compartment.



- remove plates 1 on left and right sides
- remove bolts, 2, do not remove plate 3

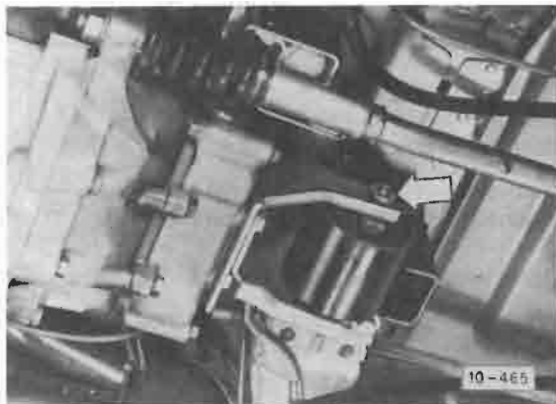
### Syncro only

- remove rear skid plate under engine/transmission



- loosen mounting bolts for front transmission bracket three turns (arrow)

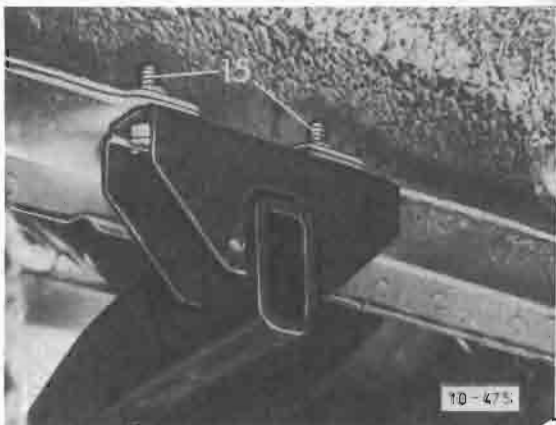
# 10 Engine-Assembly



— loosen transmission mount bolt (arrow)



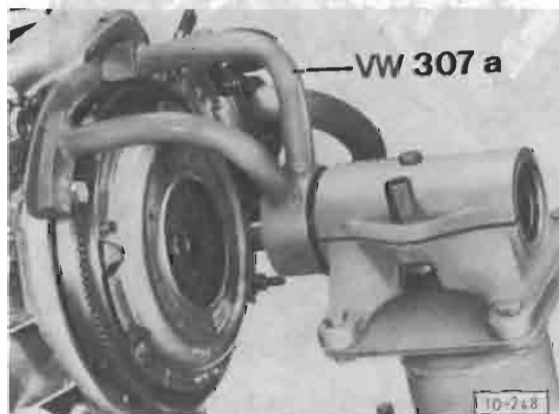
— attach VW 785/1B so that distance between support pad and transmission housing is about 120 mm (4 3/4 in.)  
— support engine with US 612/5 and floor crane



— remove engine carrier bolts 15



— lower engine/transmission assembly until transmission rests on VW 785/1B  
— when lowering, adjust angle of inclination on floor crane head and keep wiring harness aside so that it can pass oil filler tube  
— remove nuts 2 of lower engine mounting bolts  
— remove engine from transmission and lower it out of vehicle



— mount engine on repair stand with engine holder VW 307a

## Engine, installing

Proceed in reverse order of removing and note following:

— check clutch release bearing for wear and replace if necessary

### Syncro only

— clean joining faces of engine and transmission and lightly coat joining surface of engine with silicone adhesive seal Part No. AMV 176 000 05  
— lubricate clutch release bearing and main shaft splines lightly with MoS<sub>2</sub> grease (do not lubricate guide sleeve for release bearing)  
— replace all self-locking nuts on engine mounts  
— check and adjust, if necessary, accelerator cable/throttle controls, see Repair Group 20

### Tightening torques:

• engine to transmission	30 Nm (22 ft lb)
• engine carrier to body	25 Nm (18 ft lb)
• transmission mounts	30 Nm (22 ft lb)
• torque converter to drive place	20 Nm (15 ft lb)

# 13 Engine - Crankshaft, Crankcase

## Crankshaft oil seal (pulley side), removing/installing

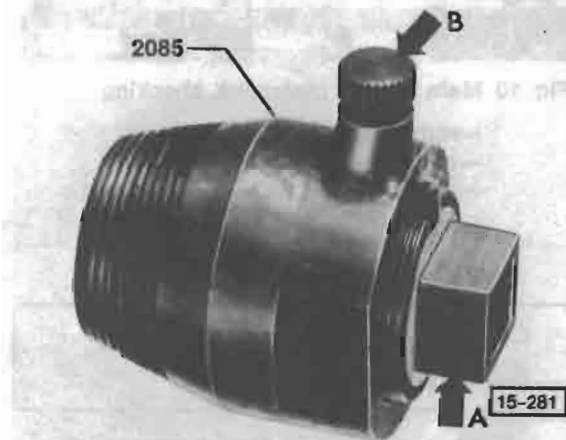
### Note

Puller 2002 may also be used

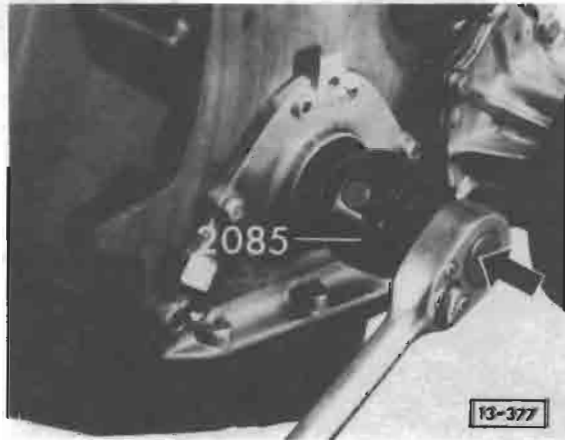
### Work sequence

#### Removing

- remove drive belt cover and drive belt
- remove drive belt sprocket on crankshaft
- remove woodruff key from crankshaft



- unscrew inner part (arrow A) of oil seal extractor 2085 2 turns (approx. 3mm/1/8 in.) out of outer part
- lock in position with knurled screw (arrow B)
- to guide extractor, screw sprocket bolt into crankshaft until it projects about 20 mm (3/4 in.)
- lubricate threads on tapered end of seal extractor

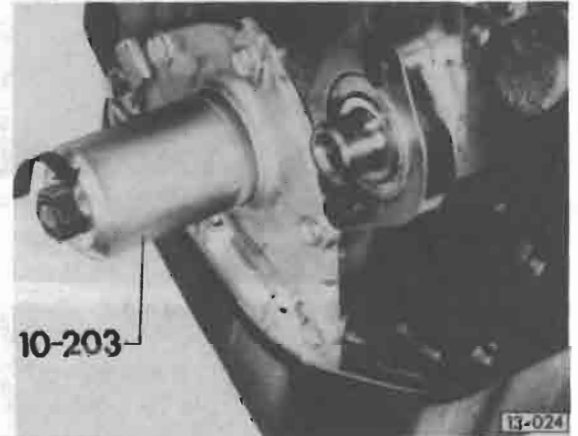


- position seal extractor and screw it into oil seal as far as possible by pushing firmly in direction of arrow

- loosen knurled screw and turn inner part in against crankshaft until oil seal is pulled out
- clamp extractor in vise and remove oil seal with pliers

#### Installing

- coat seal lips with oil



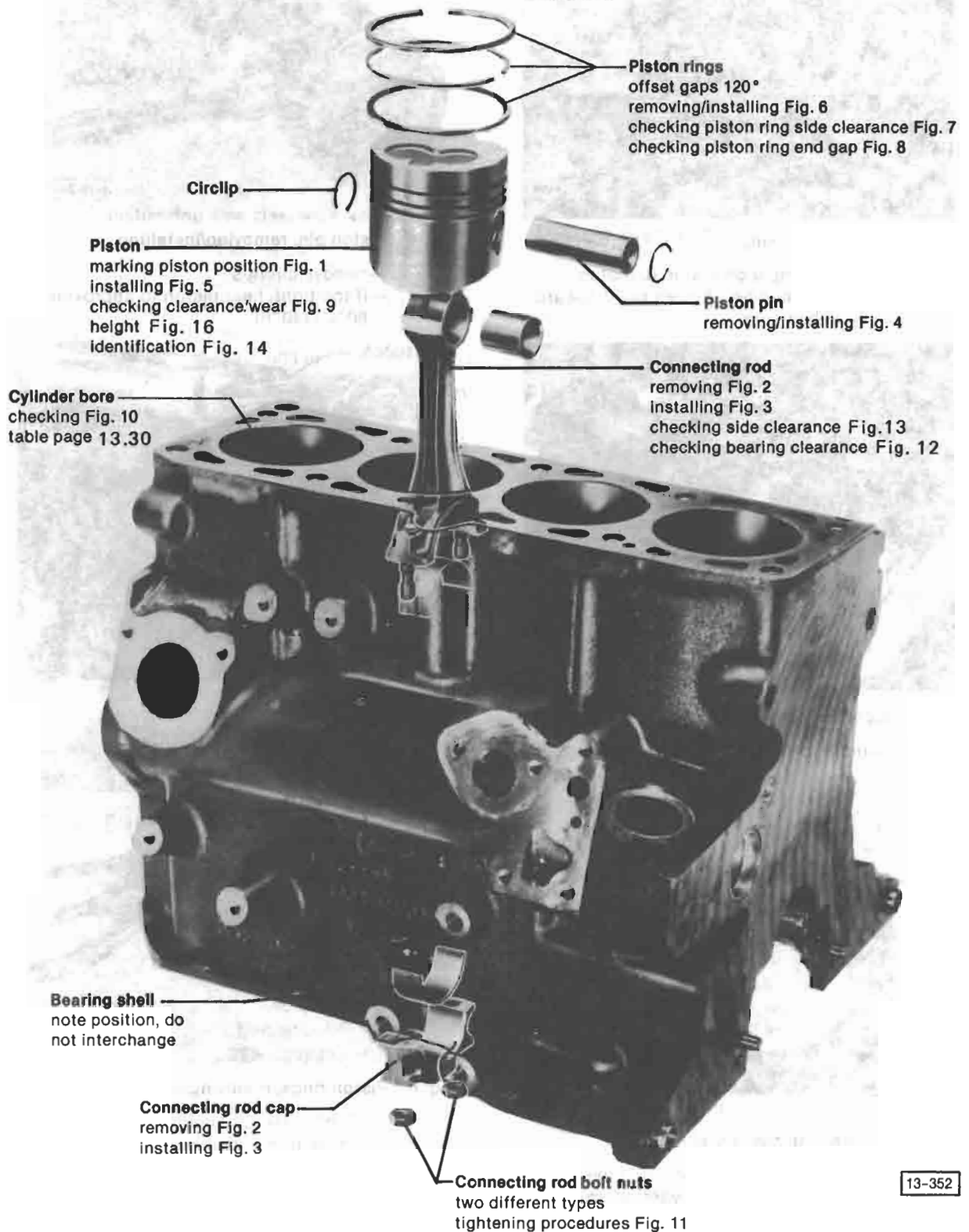
- press in seal to a depth of 2 mm (0.080 in.) below outer edge of cover
  - use washer from sprocket bolt between bolt head and tool



**Note**

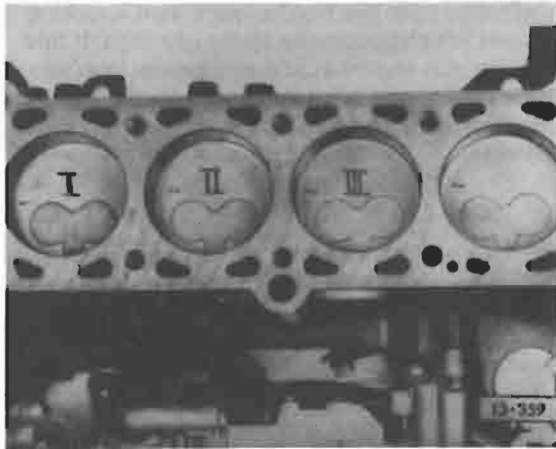
When installing new pistons or short block, check piston height to determine head gasket thickness, see Fig. 15 and Fig. 16

Defective injectors can cause violent knocking noises which sound like faulty bearings. If this occurs, run engine at idle and loosen injection pipe unions one after the other. If knocking stops when a union is loosened, that injector is defective



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# 13 Engine - Crankshaft, Crankcase



**Fig. 1** Pistons, marking

- mark number on piston to match cylinder number. Arrows point toward drive belt side



**Fig. 2** Connecting rod, removing

- mark rod and cap before removing



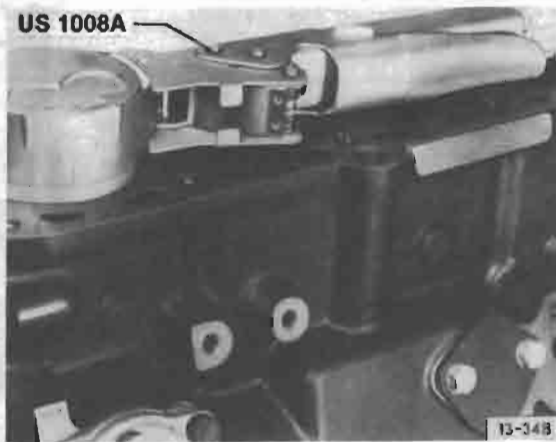
**Fig. 3** Connecting rod, installing

- casting marks and retaining lug for bearing shell face toward intermediate shaft (arrows)



**Fig. 4** Piston pin, removing/installing

- remove circlips
- if too tight, heat piston to approximately 60°C (140°F)



**Fig. 5** Pistons, installing



**Fig. 6** Piston rings, removing/installing

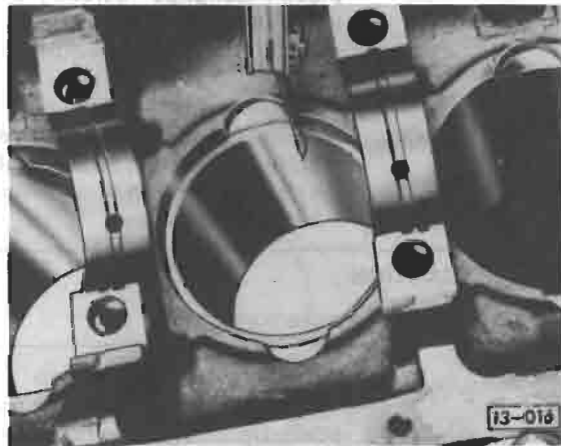
- “Top” marks on piston rings must face toward piston crown





**Fig. 7 Piston ring side clearance, checking**

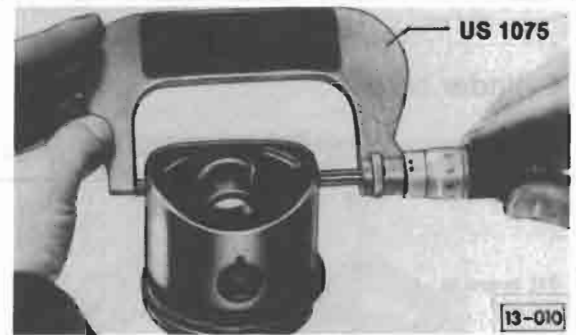
	Clearance	Wear limit
Upper ring	0.06-0.09 mm (0.002-0.004 in.)	0.2 mm (0.008 in.)
Lower ring	0.05-0.08 mm (0.002-0.003 in.)	0.2 mm (0.008 in.)
Oil scraper ring	0.03-0.06 mm (0.001-0.002 in.)	0.15 mm (0.006 in.)



**Fig. 8 Piston ring end gap, checking**

—push ring down squarely into cylinder until it is about 15 mm (9/16 in.) from top edge

	Ring gap	Wear limit
Upper and lower rings	0.3-0.5 (0.012-0.020 in.)	1 mm (0.039 in.)
Oil scraper ring	0.25-0.40 mm (0.010-0.016 in.)	1 mm (0.039 in.)

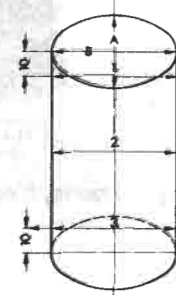


**Fig. 9 Piston, checking for wear**

—measure about 15 mm (9/16 in.) from lower edge

### Piston diameter

	Piston dia. (mm)	Cylinder bore (mm)
Standard	76.48	76.51
	76.49	76.52
	76.50	76.53
1st oversize	76.73	76.76
	76.74	76.77
	76.75	76.78
2nd oversize	76.98	77.01
	76.99	77.02
	77.00	77.03
3rd oversize	77.48	77.51
	77.49	77.52
	77.50	77.53



**Fig. 10 Cylinder clearance, checking**

—measure at points 1, 2 and 3 first in direction A then direction B  
 1 = 10 mm (3/8 in.) from top  
 2 = middle of cylinder wall  
 3 = 10 mm (3/8 in.) from bottom

- piston to cylinder clearance  
 new part: 0.03 mm (0.0011 in.)  
 wear limit: 0.07 mm (0.0027 in.)

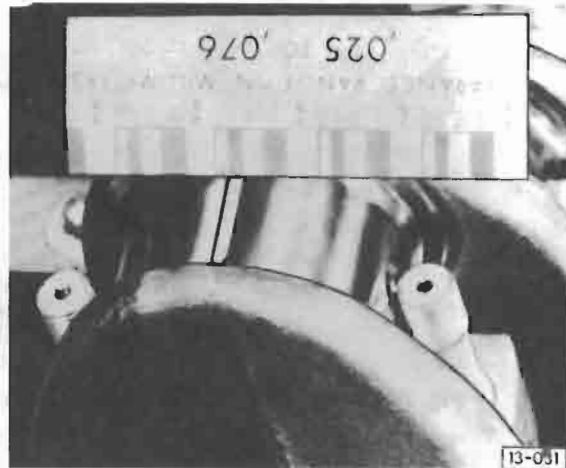
### Note

Do not measure when block is mounted in repair stand as measurements may be incorrect due to distortion

# 13 Engine - Crankshaft, Crankcase

## Cylinder bore

	Bore (mm)	Piston dia. (mm)
Standard	76.51	76.48
	76.52	76.49
	76.53	76.50
1st oversize	76.76	76.73
	76.77	76.74
	76.78	76.75
2nd oversize	77.01	76.98
	77.02	76.99
	77.03	77.00
3rd oversize	77.51	77.48
	77.52	77.49
	77.53	77.50



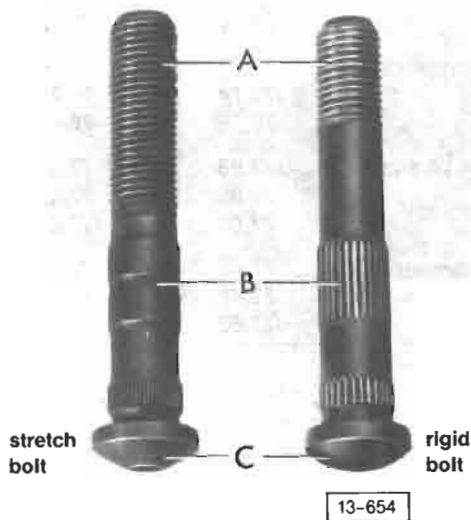
**Fig. 12** Connecting rod bearing clearance, checking

- remove connecting rod cap
- clean bearing shell and crankshaft journal
- place Plastigage® across journal
- install cap and tighten nuts
  - if rigid bolts, tighten nuts to 45 Nm (33 ft lb)
  - if stretch bolts, tighten nuts to 30 Nm (22 ft lb) (to avoid stretching bolts, do not turn stretch bolt nuts extra quarter turn when measuring bearing clearance)

### CAUTION

Do not turn crankshaft

- remove connecting rod cap
- compare width of strip with measuring scale; figure on scale gives bearing clearance
  - new part: 0.028–0.088 mm (0.0011–0.0034 in.)
  - wear limit: 0.12 mm (0.0047 in.)



**Fig. 11** Connecting rod bolts, identification/tightening procedure

stretch		rigid
25mm (1.0 in.)		15mm (9/16 in.)
smooth	<b>A</b> = thread length	serrated
conical	<b>B</b> = center part	half round
	<b>C</b> = bolt head	

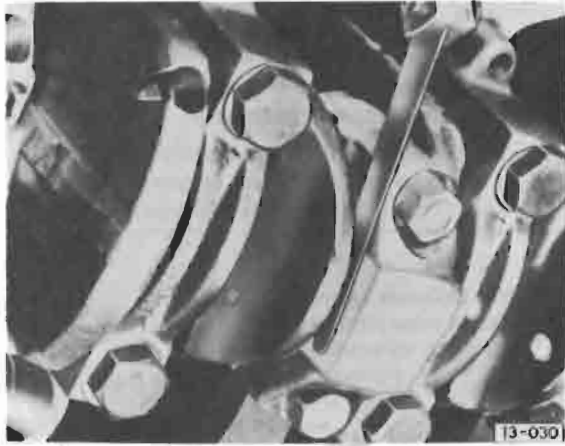
### Tightening procedure

#### stretch bolt:

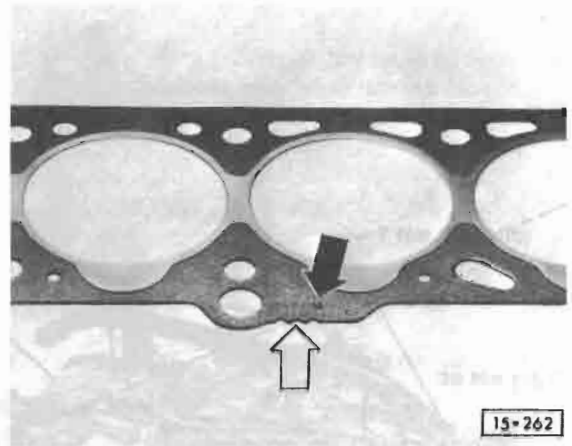
- lubricate contact face of nut
- tighten to 30 Nm (22 ft lb)
- then tighten nut 1/4 turn (90°) more

#### rigid bolt:

- lubricate contact face of nut
- tighten to 45 Nm (33 ft lb)



**Fig. 13** Connecting rod side clearance, checking  
wear limit: 0.37 mm (0.014 in)

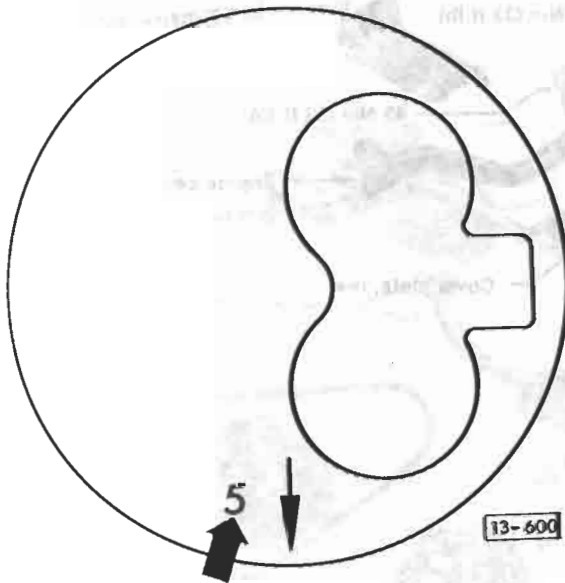


**Fig. 15** Cylinder head gasket, identification

white arrow = identification notches  
black arrow = part number

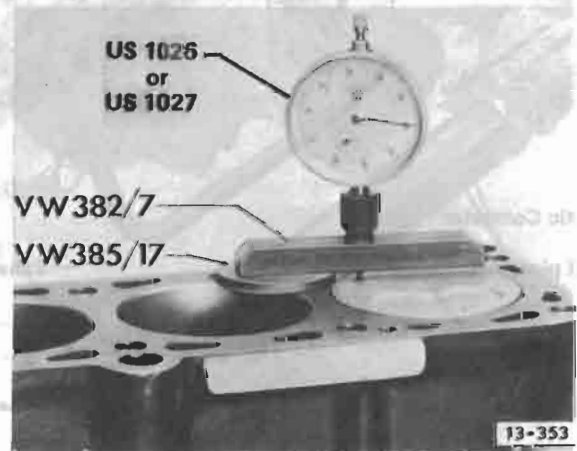
**Note**

Always select gasket thickness according to piston height above top of cylinder block



**Fig. 14** Piston Identification

- pistons are marked with figure 5 next to installation direction
- arrow must point to drive belt side



**Fig. 16** Piston height, checking

Piston height of **ALL** cylinders must be measured when installing new pistons or short block.

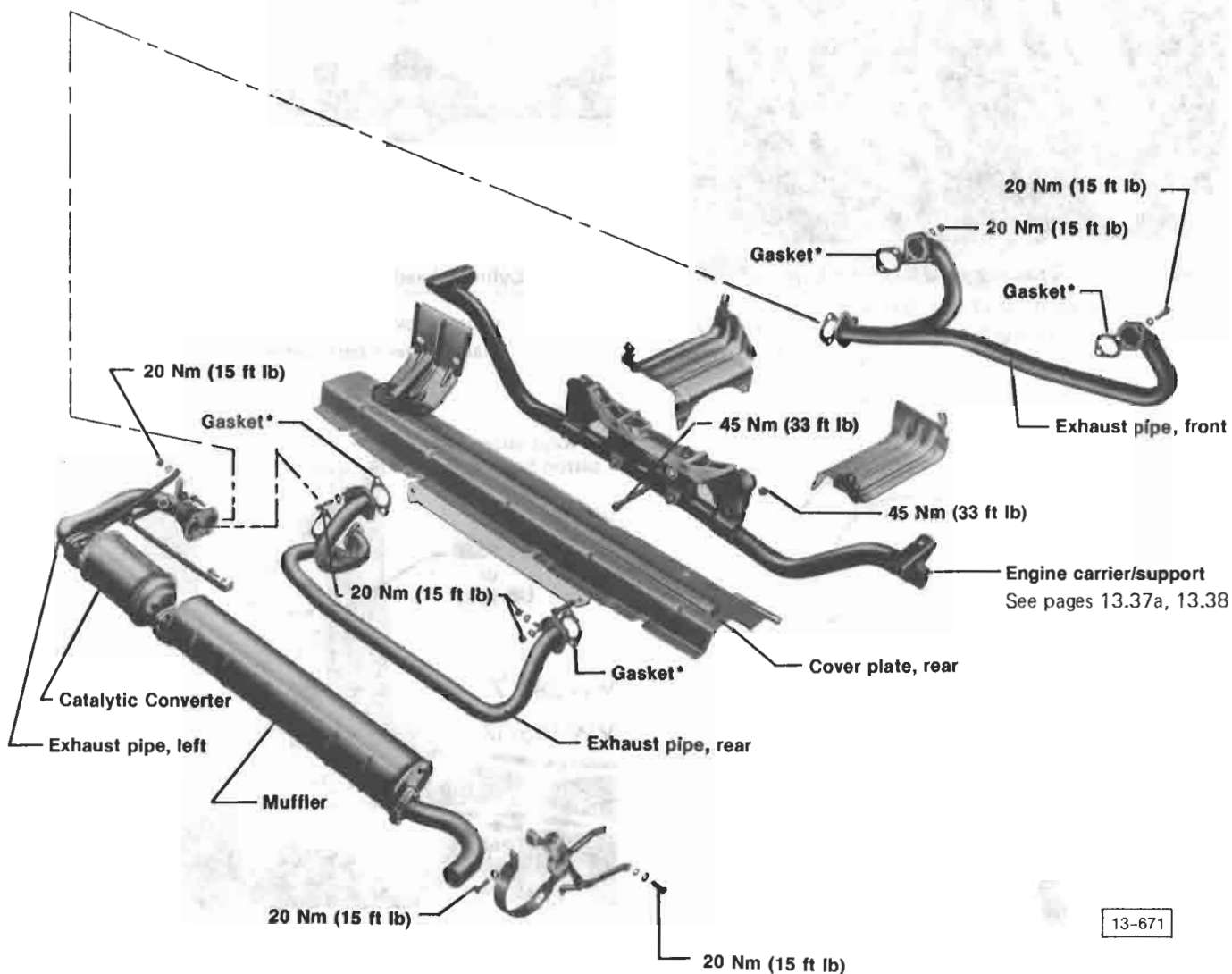
Head gasket is selected based on cylinder with **HIGHEST** piston height.

Thickness of gasket (mm/in.)	Piston height (mm/in.)	Identification notches in head gasket	Part No.
0.63-0.82 (0.025-0.032)	1.4 (0.055)	1	068 103 383 L
0.83-0.92 (0.033-0.036)	1.5 (0.059)	2	068 103 383 M
0.93-1.02 (0.037-0.040)	1.6 (0.063)	3	068 103 383 N

# 13 Engine-Crankshaft, Crankcase

## Note

Arrows on carrier must point to front of vehicle when reinstalling.  
Remove carrier as complete assembly



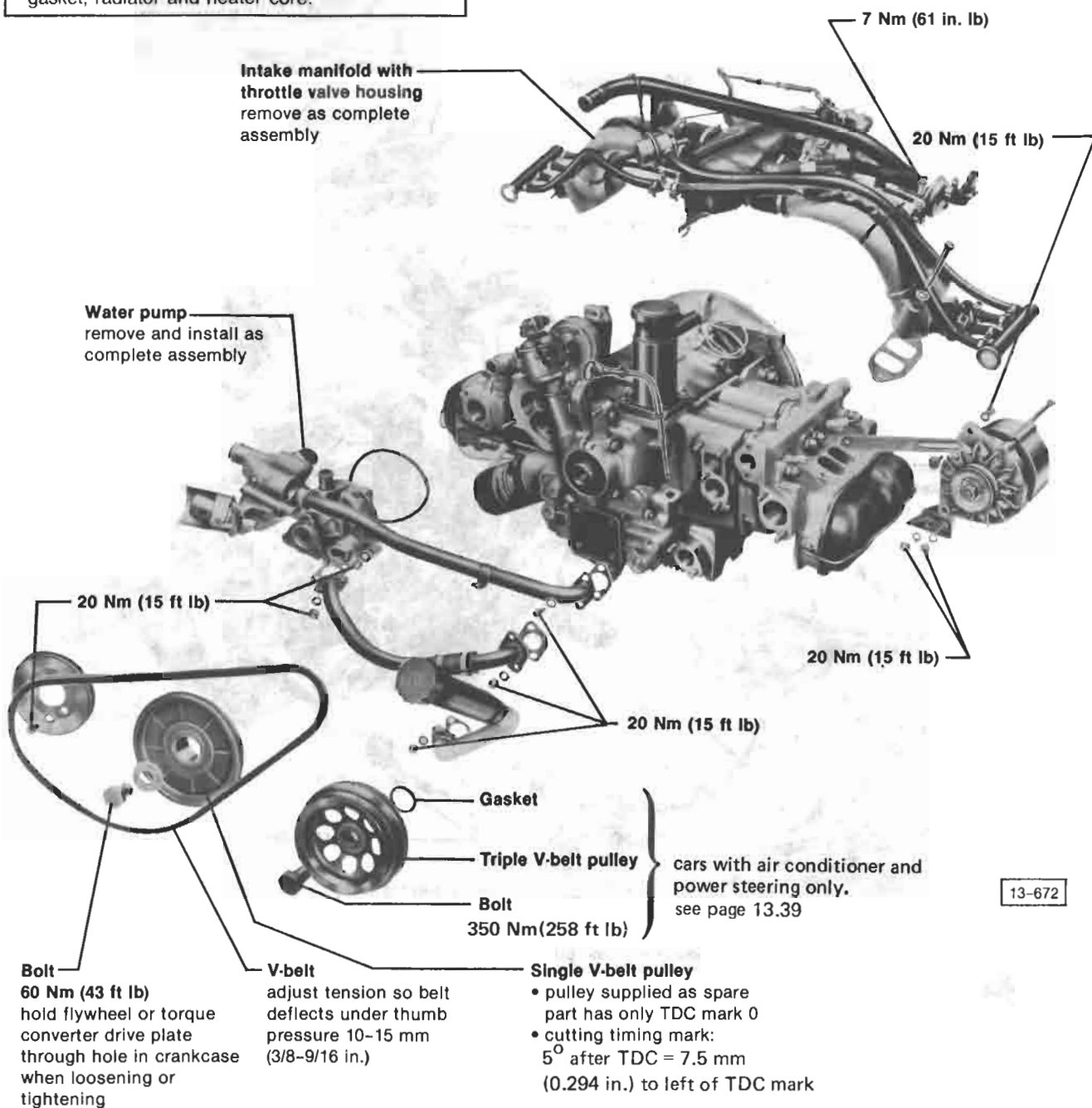
\*metal surface faces cyl. head

**Note**

Tighten all hoses with hose clamps

**CAUTION**

Coolant/antifreeze **must not** be reused when replacing engine, cylinder head, cylinder head gasket, radiator and heater core.

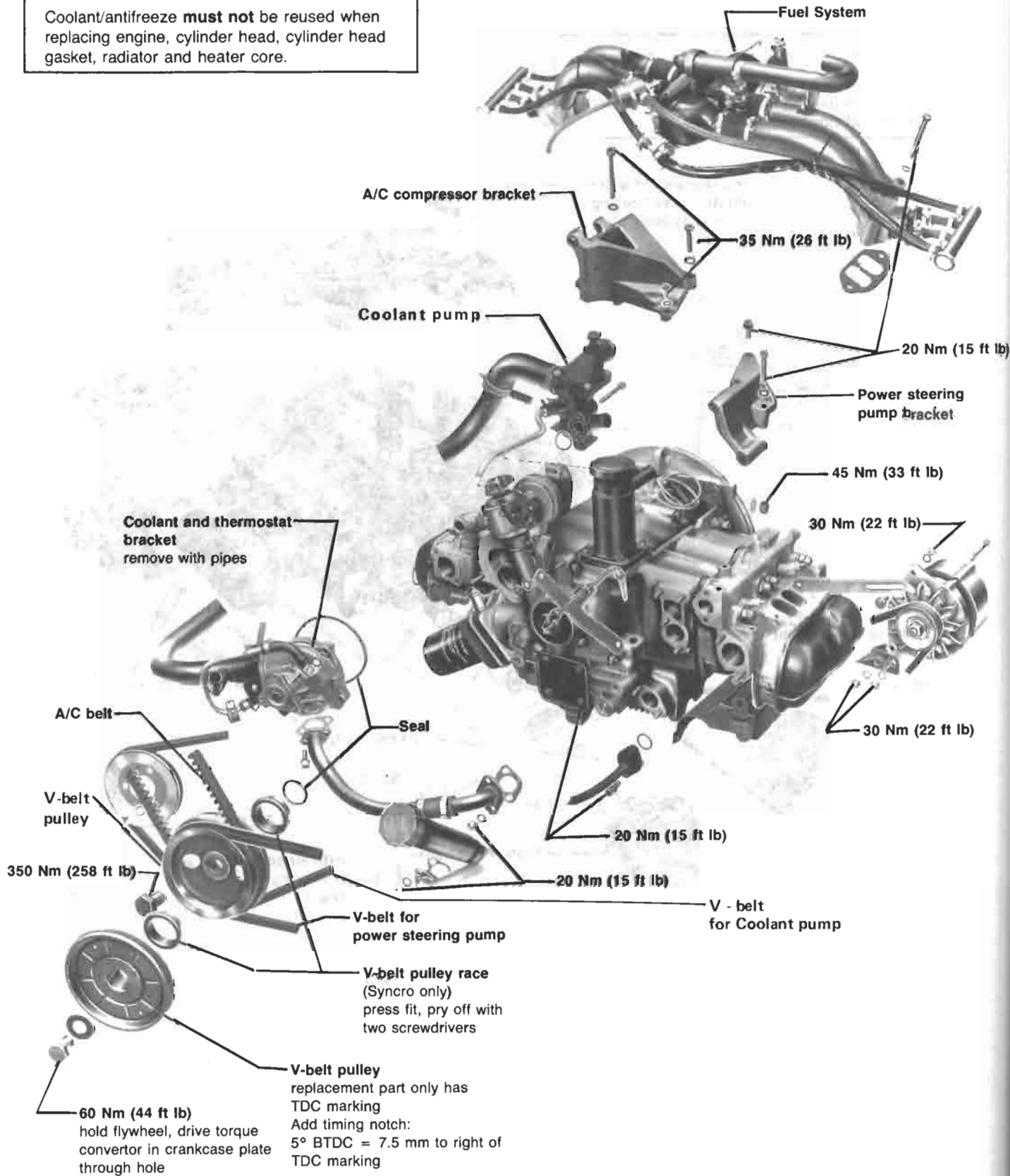


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# 13 Engine - Crankshaft, Crankcase

## CAUTION

Coolant/antifreeze **must not** be reused when replacing engine, cylinder head, cylinder head gasket, radiator and heater core.



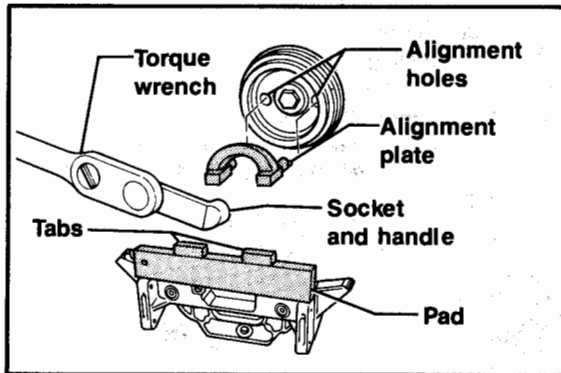
## Removal of three groove pulley

Retainer tool 3149 is required to hold crankshaft from rotating while removing/installing the three groove pulley.

It consists of three separate pieces:

- alignment plate
- pad
- socket and handle

### Work sequence



- loosen power steering pump, if applicable, remove V-belt from crankshaft pulley
- loosen A/C compressor, if applicable, remove V-belt from crankshaft pulley
- loosen alternator, remove V-belt from crankshaft pulley
- unscrew coolant expansion tank, lay to one side
- remove expansion tank bracket
- remove retaining screws and bolts from exhaust heat shield
- reposition heat shield down and under its original position

### Note

When tool 3149 is used, it will **not** be necessary to remove muffler.

- rotate pulley so both **alignment holes** are horizontal
- insert **alignment plate** into pulley
- place pad across engine mounts with tabs pointing upward
- attach socket and handle
- remove crankshaft pulley bolt and pulley
- installation of three groove pulley is in reverse order

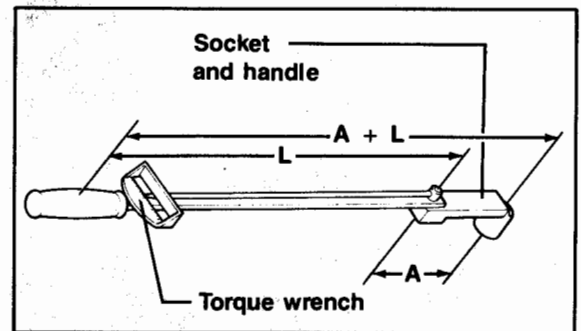
### CAUTION

Tightening torque applies **only** when socket and handle is used in alignment with torque wrench.

Correct torque wrench setting **must be calculated** to achieve 350 Nm (258 ft lb) at crankshaft pulley bolt.

- torque crankshaft pulley bolt to 350 Nm (258 ft lb)

### How to compute torque when using adapter



$$TA = \frac{TW \times (L + A)}{L} \text{ where:}$$

TA = Torque at end of adapter

TW = Torque wrench scale reading

L = Lever length of torque wrench

A = Lever length of adapter

Example:

TA = Unknown

TW = 100 lb.-ft.

L = 15 inches

A = 7.5 inches

Now use the formula as follows:

$$TA = \frac{TW \times (L + A)}{L}$$

$$TA = \frac{100 \times (15 + 7.5)}{15}$$

$$TA = \frac{100 \times (22.5)}{15}$$

$$TA = \frac{2250.0}{15}$$

$$TA = 150 \text{ ft.-lb.}$$

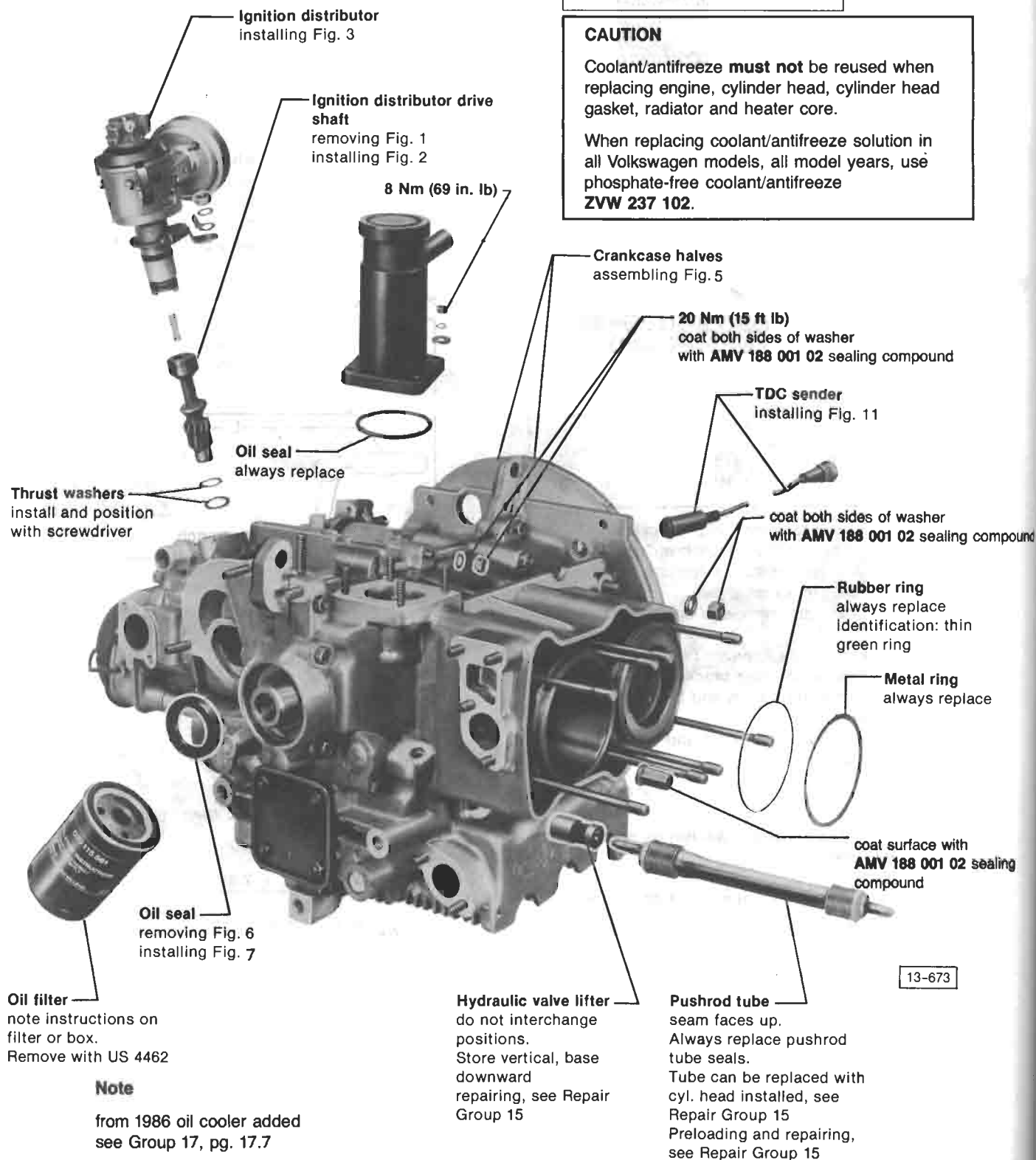
- adjust all belts to specification
- top off coolant level in expansion tank



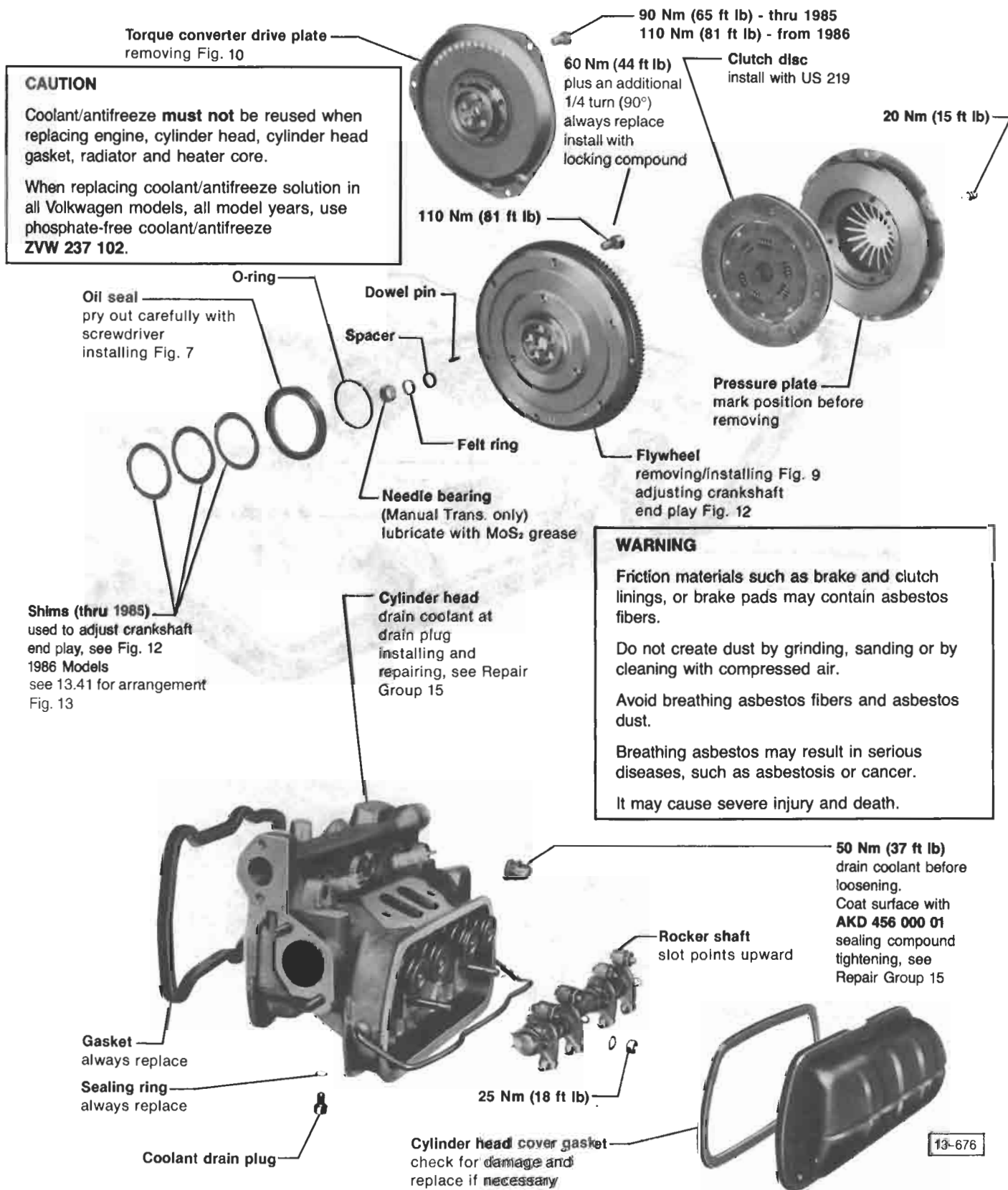
# 13 Engine – Crankshaft, Crankcase

**CAUTION**  
When assembling crankcase halves, see Fig. 5

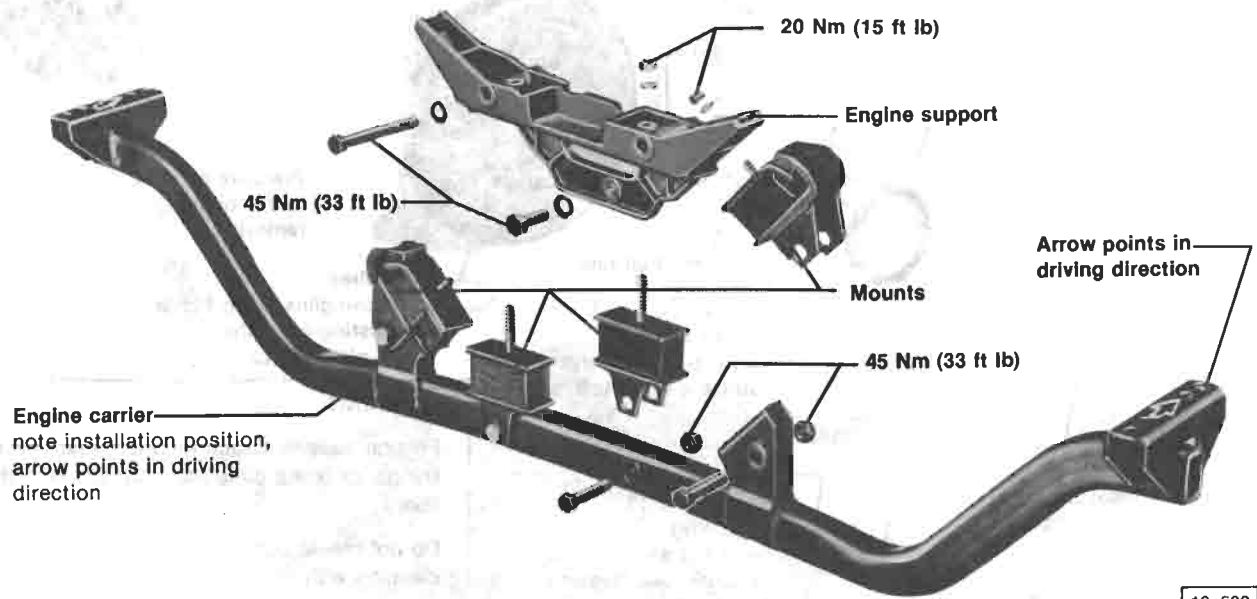
**CAUTION**  
Coolant/antifreeze **must not** be reused when replacing engine, cylinder head, cylinder head gasket, radiator and heater core.  
When replacing coolant/antifreeze solution in all Volkswagen models, all model years, use phosphate-free coolant/antifreeze ZVW 237 102.



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# 13 Engine-Crankshaft, Crankcase



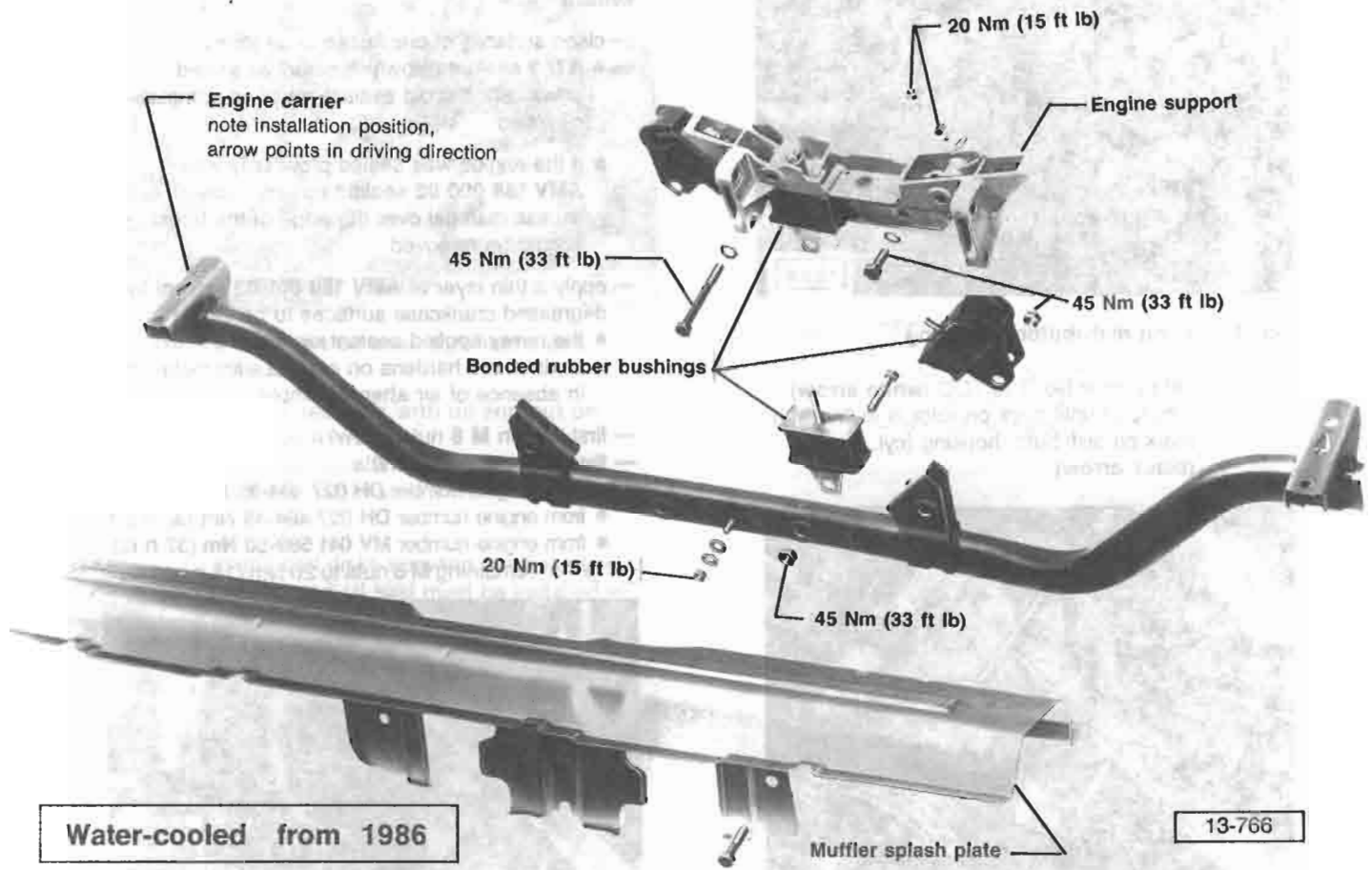
**13.37a**

Engine, carrier/support  
Engine, disassembling/assembling

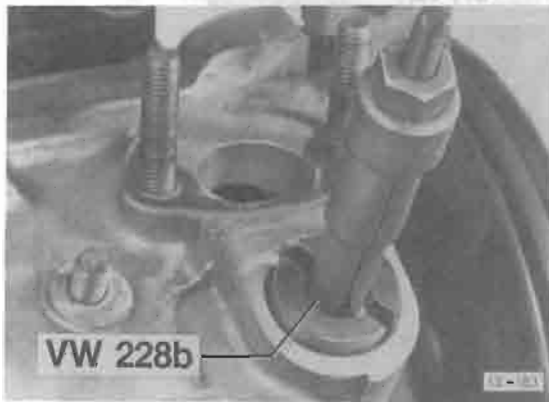
**Water-cooled**

**1983-1985**

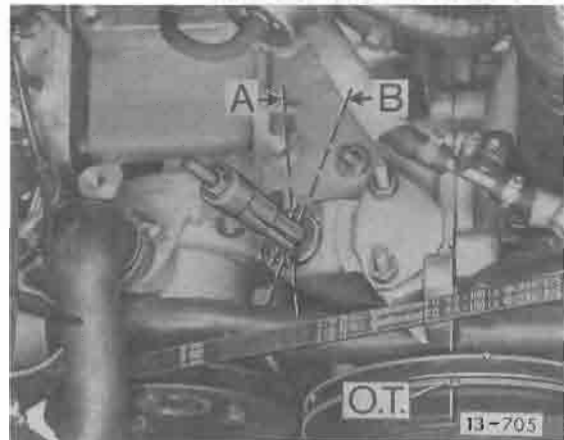
Engine mount/mount bracket can be removed/installed with engine in vehicle.



## Engine, disassembling/assembling —All-water-cooled



**Fig. 1 Ignition distributor drive shaft, removing**  
— use puller as shown



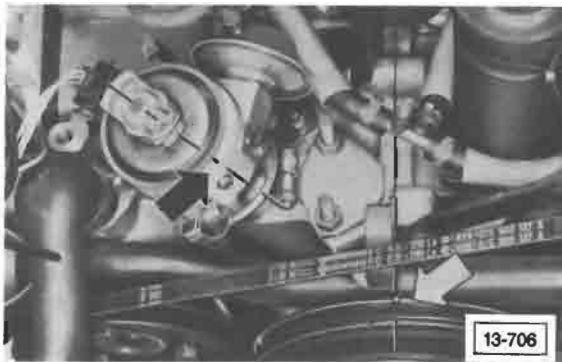
**Fig. 2 Ignition distributor drive shaft, installing**  
— set crankshaft to TDC on cyl. No. 1  
— install drive shaft so that offset slot faces bolt (arrow)  
— small segment faces water pump  
A = inserted position  
B = installed position

**Water-cooled**

**Engine, carrier/support**  
**Engine, disassembling/assembling**

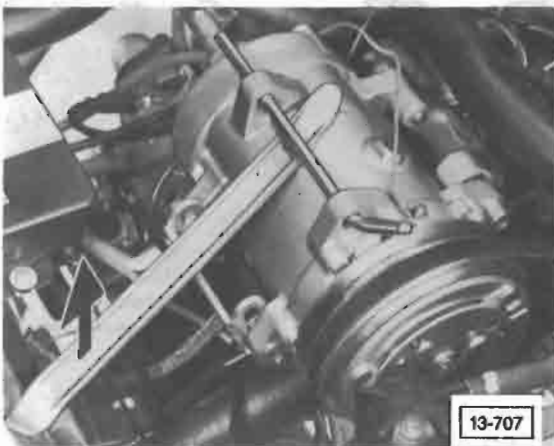
**13.38**

# 13 Engine-Crankshaft, Crankcase



**Fig. 3 Ignition distributor, installing**

- set cylinder No. 1 to TDC (white arrow)
- turn rotor until mark on rotor is in line with mark on distributor housing (cyl. No. 1) (black arrow)



**Fig. 4 A/C compressor V-belt, tightening (if applicable)**



**Fig. 5 Crankcase halves, assembling**

**Note**

AMV 188 001 02 sealant is now being used when assembling crankcase halves.

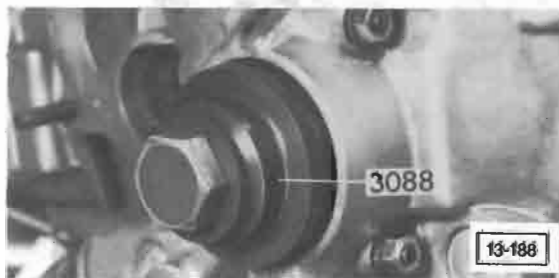
When repairing engines, use only **AMV 188 001 02** sealant.

- clean surfaces of crankcase to be joined
  - if **D 3** sealant (brownish color) was used previously, the old sealant **must** be completely removed
  - if the engine was sealed previously with **AMV 188 000 02** sealant (green colored), only excess material over the edge of the housing should be removed
- apply a thin layer of **AMV 188 001 02** sealant to degreased crankcase surfaces to be joined
  - the newly applied sealant dissolves the old sealant and hardens on contact with metal and in absence of air after assembly
- first tighten **M 8** nut (arrow)
- then tighten all **M 10** nuts
  - up to engine number **DH 027 404-35** Nm (26 ft lb)
  - from engine number **DH 027 404-45** Nm (33 ft lb)
  - from engine number **MV 041 599-50** Nm (37 ft lb)
- tighten remaining **M 8** nuts to 20 Nm (15 ft lb)



**Fig. 6 Crankshaft oil seal, removing**

- pry out



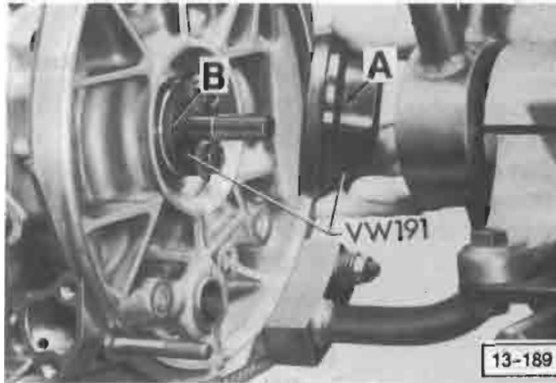
**Fig. 7 Crankshaft oil seals, installing**

**Single pulley**

- coat seal lips with oil and install seal with **3088** and pulley bolt without washer (**3162** in Syncro)
- then tighten bolt with washer until stop

**Triple pulley**

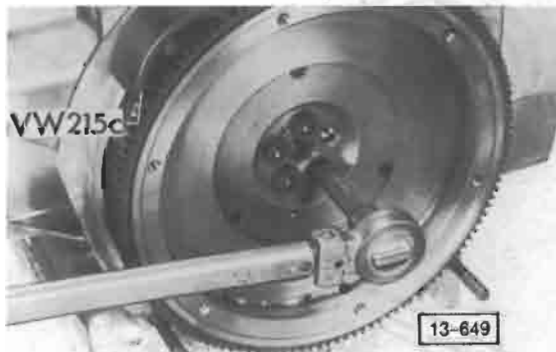
- coat seal lips with oil and install with **3088** and pulley bolt **without washer** and tighten bolt until stop



**Fig. 8 Crankshaft oil seal (flywheel side), installing**

- coat seal lips with oil and put on guide **A**
- screw base **B** into crankshaft and press in guide **A** with seal until seated

shims and disks **between** crankshaft bearing and oil seal must be installed in correct order. See Fig. 13.



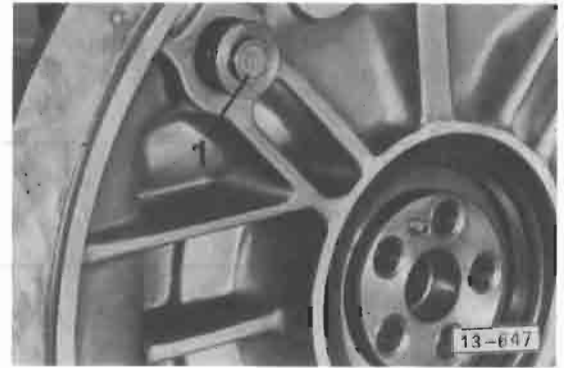
**Fig. 9 Flywheel, removing**

- lock flywheel with tool



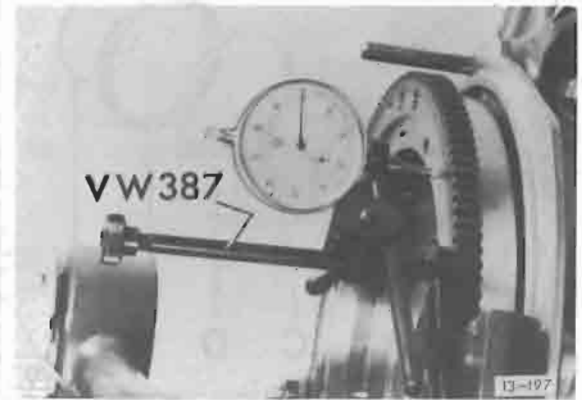
**Fig. 10 Torque converter drive plate, removing**

- lock plate with VW 802
- to remove, screw in bolt 1 (M 18 × 1.5 × 60). Thread length of bolt must be at least 45 mm (1.77 in.)



**Fig. 11 TDC sender, installing**

- use piston pin and plastic hammer to drive TDC sender in until stop
- do not damage inner ring 1



**Fig. 12 Crankshaft end play, checking/adjusting**

- check crankshaft end play
  - new: 0.07–0.13 mm (0.003–0.005 in.)
  - wear limit: 0.15 mm (0.006 in.)
- if out of specification proceed as follows:
- install flywheel with 2 shims but **without** O-ring and crankshaft oil seal
- mount dial indicator with bracket on crankcase
- move crankshaft in and out and measure movement (crankshaft end play)
- determine thickness of 3rd shim

**Example**

dial indicator reading	0.44 mm (0.017 in.)
specified end play	— 0.10 mm (0.004 in.)
thickness of 3rd shim	0.34 mm (0.013 in.)

Shims C on vehicles from 1986, see Fig. 13

go to next page

# 13 Engine - Crankshaft, Crankcase

## Note

Thickness of shim is etched on shim. Always recheck with micrometer

### CAUTION

Always install **three** shims to obtain correct crankshaft end play

- remove flywheel
- install O-ring, crankshaft oil seal and felt ring
- install all three shims
- install flywheel
- tighten bolts to 60 Nm (44 ft lb) plus an add'l 1/4 turn (90°)
- recheck crankshaft end play

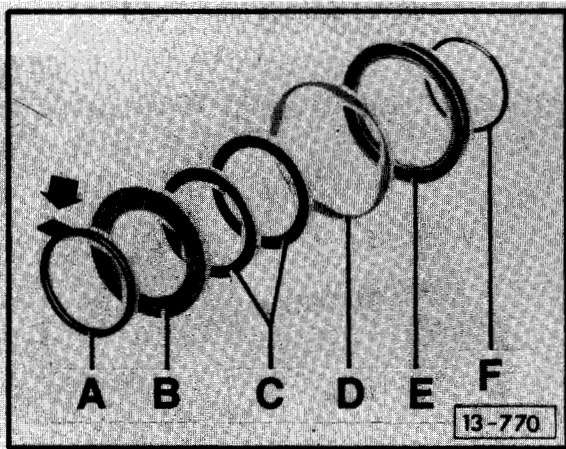


Fig. 13 Shim arrangement (from 1986)

- A = Thrust washer
  - lip points toward crankshaft bearing
- B = 0.81 mm shim
- C = 0.75 mm shims
- D = 0.94 mm
- E = Oil seal
  - pry out with screwdriver
- F = O-ring
  - always replace

Apply light film of oil on **both** sides of thrust washer A.

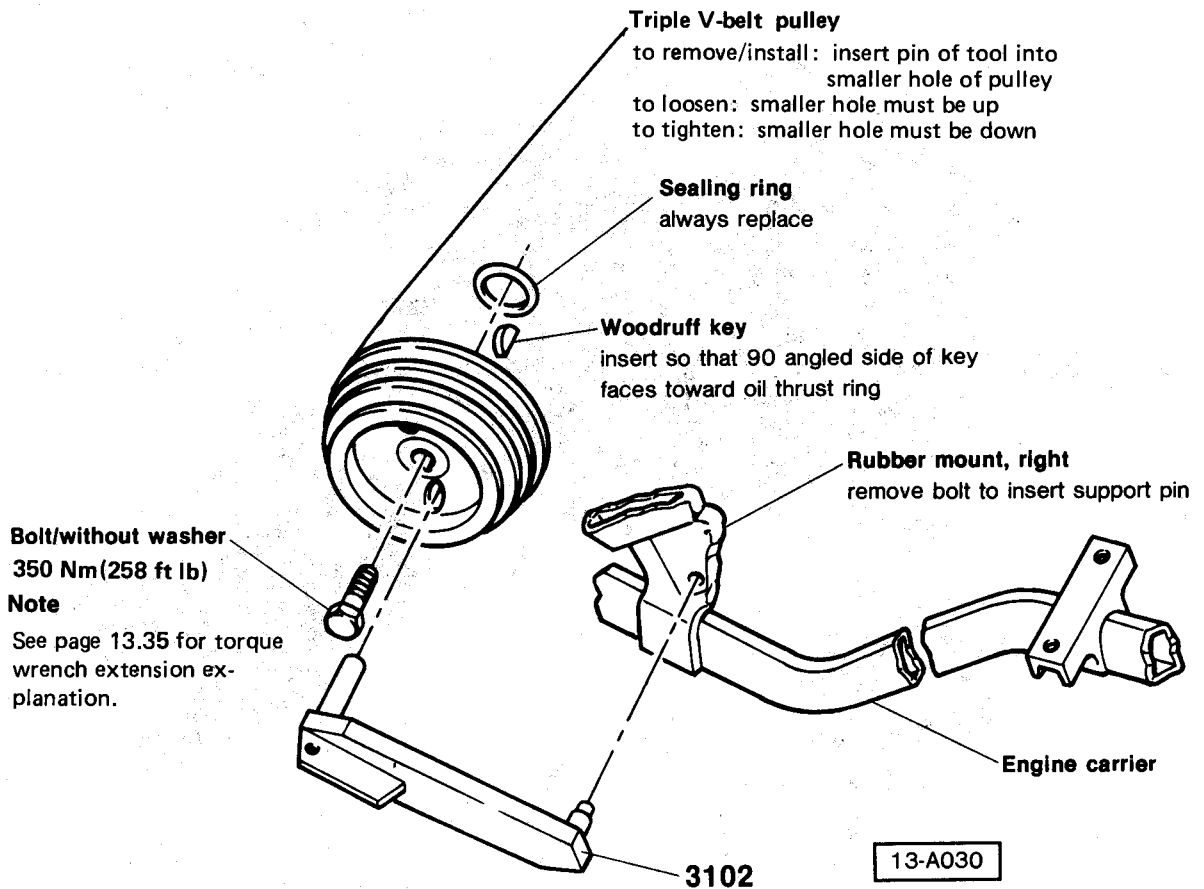
Install with lip (arrow) pointing **toward** crankshaft bearing

- press shim B to A
  - install flywheel **without** O-rings, E, F
  - mount dial indicator with bracket on crankcase
- Proceed to determine thickness of shim C (see fig. 12)
- remove flywheel
  - install shims C, D, and oil seal E
  - install flywheel with F
  - tighten bolts to 60 Nm (44 ft lb) plus an add'l 1/4 turn (90°)
  - recheck crankshaft end play

## Parts required

Description	Part no.	Quantity
Thrust washer	025 105 283	1
81.0mm (3.2 in.) diameter shim	025 105 281	1
75.0mm (3.0 in.) diameter shims	021 105 281	2
	(0.30mm thickness)	
	021 105 283	
	(0.32mm thickness)	
	021 105 285	
	(0.34mm thickness)	
	021 105 287	
	(0.36mm thickness)	
	021 105 289	
	(0.38mm thickness)	
	021 105 291	
	(0.24mm thickness)	
94.0mm (3.7 in.) diameter shim	025 105 635	1
Oil seal	029 105 245 B	1
O-ring	021 105 279	1





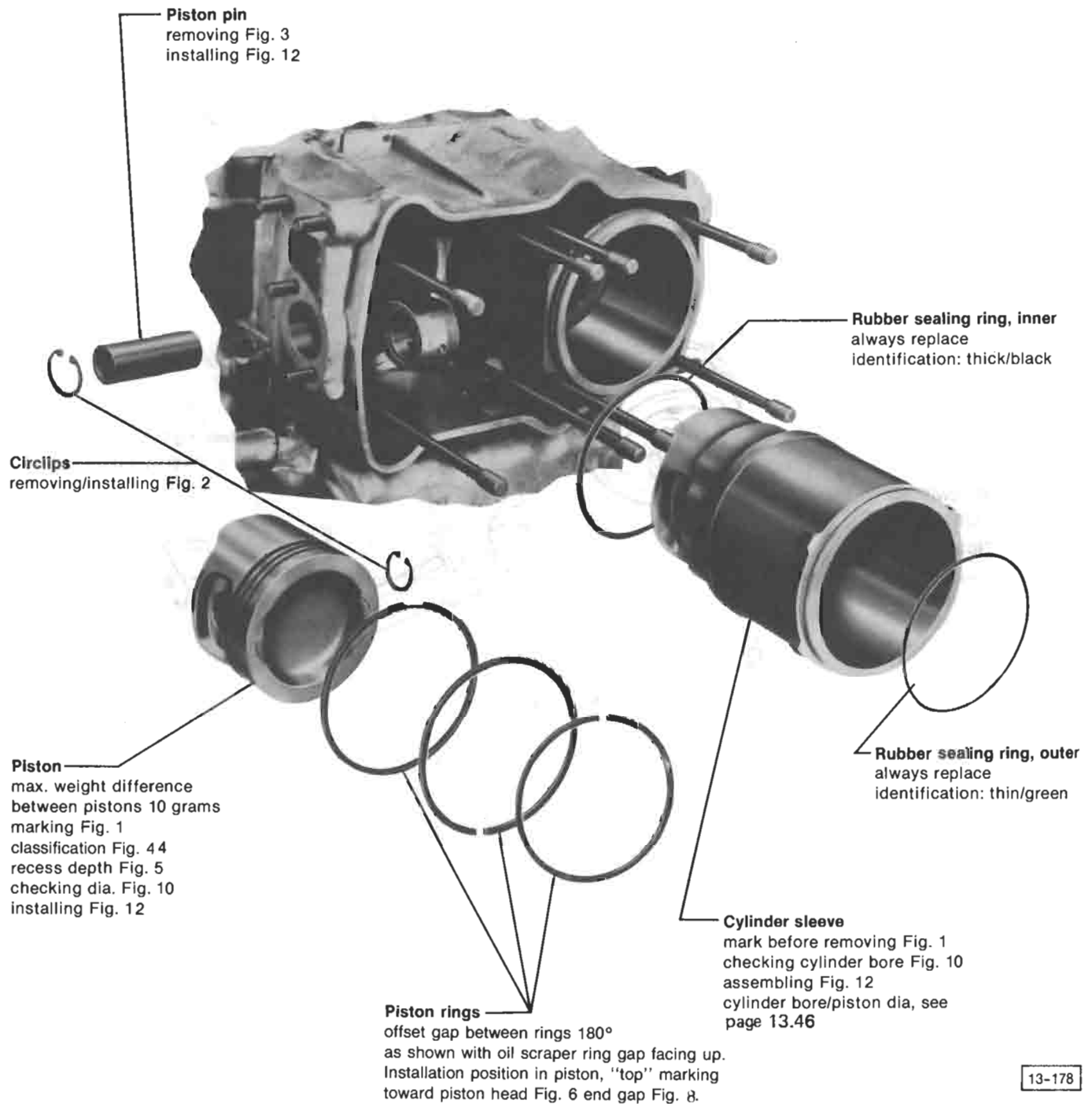
# 13 Engine-Crankshaft, Crankcase

## Note

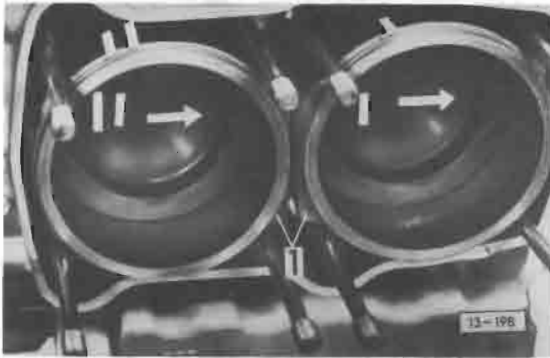
Remove deposits (scale) from cylinders/crankcase and cylinder head

## Note

Before proceeding with repairs, verify availability of all tools.

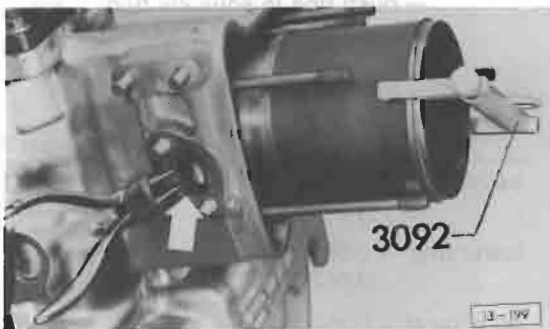


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**Fig. 1 Piston/cylinder sleeve, marking**

- arrow points to flywheel
- before removing, mark matching numbers on pistons and cylinder sleeves
- cylinder boss 1 faces inward



**Fig. 2 Circlips, removing/installing on V-belt side:**

- with piston at TDC, pull out cylinder sleeve with 3092 until piston pin circlip visible (arrow)

**at flywheel end:**

- with first cylinder sleeve removed



**Fig. 3 Piston pins, removing**

- remove pins as shown (arrow)

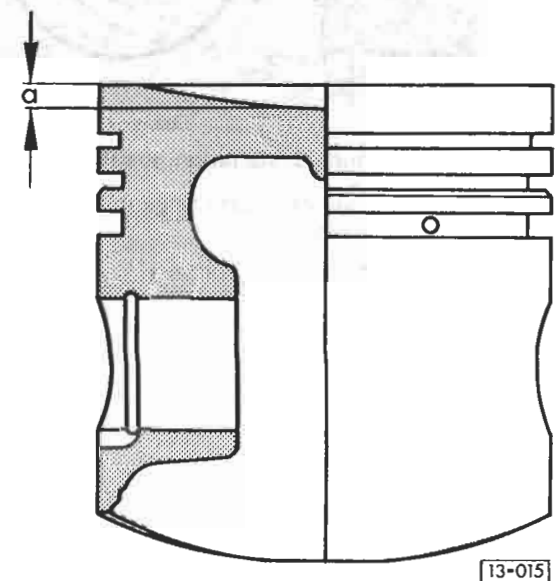
**Note**

If piston pin cannot be pulled out of piston, remove 3091 and remove burr in piston pin bore with reamer 3159.



**Fig. 4 Piston classifications**

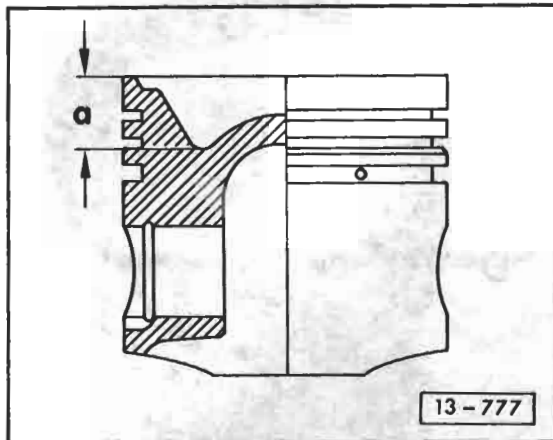
- A = arrow (stamped on) must point toward flywheel when piston is installed
- B = paint dot (blue) indicates matching size
- C = weight group (+ or -) stamped on
  - weight = 448–456 grams
  - + weight = 457–464 grams
- D = piston size in millimeters (see table on page 13.46)



**Fig. 5 Piston recess depth**

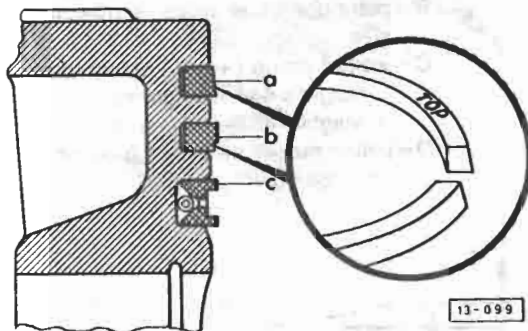
- measurement a = 11.65 mm (0.458 in.)

# 13 Engine-Crankshaft, Crankcase



**Fig. 6 Piston distinguishing characteristics**  
- 2.1 L Digifant/Syncro only

engine code	dimension 'a'
MV	15.5 mm



**Fig. 7 Piston rings, installation position**

- TOP mark on piston rings must face to top of piston
- a = upper ring
- b = lower ring
- c = oil scraper ring



**Fig. 8 Piston ring end gap, checking**

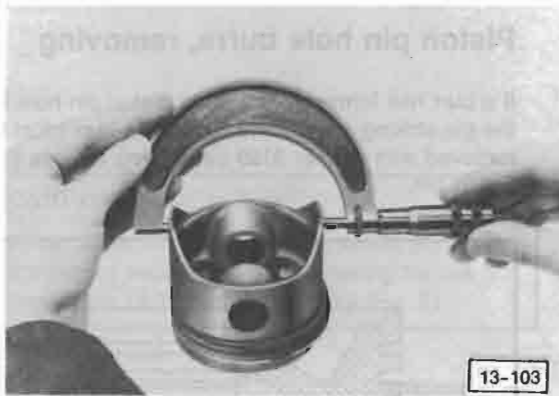
- push ring in squarely from lower cylinder opening about 4-5 mm (3/16 in.)
- measure gap with feeler gauge

	ring end gap	wear limit
upper ring	= 0.30-0.45 mm (0.012-0.018 in.)	0.90 mm (0.035 in.)
lower ring	= 0.30-0.50 mm (0.012-0.020 in.)	0.90 mm (0.035 in.)
oil scraper ring	= 0.25-0.40 mm (0.010-0.016 in.)	0.95 mm (0.037 in.)



**Fig. 9 Piston ring side clearance, checking**

	clearance	wear limit
upper ring	= 0.05-0.08 mm (0.002-0.003 in.)	0.12 mm (0.005 in.)
lower ring	= 0.04-0.07 mm (0.002-0.003 in.)	0.10 mm (0.004 in.)
oil scraper ring	= 0.02-0.05 mm (0.001-0.002 in.)	0.10 mm (0.004 in.)



**Fig. 10 Piston, checking diameter/wear**

- measure at bottom of skirt approx. 15 mm (9/16 in.) from edge (diameter stamped in top of piston)

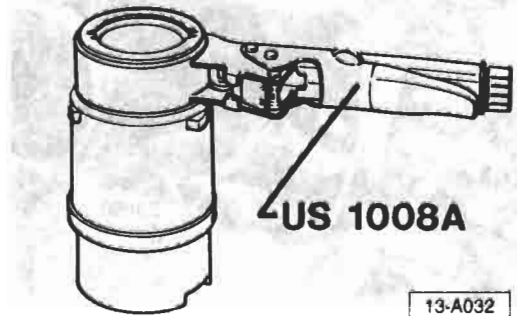


**Fig. 11 Cylinder sleeve, checking for wear**

- measure 10-16 mm (3/8-5/8 in.) from top
  - piston to sleeve clearance is sleeve diameter minus piston diameter
  - new** = 0.03-0.06 mm (0.001-0.002 in.)
  - wear limit** = 0.2 mm (0.008 in.)

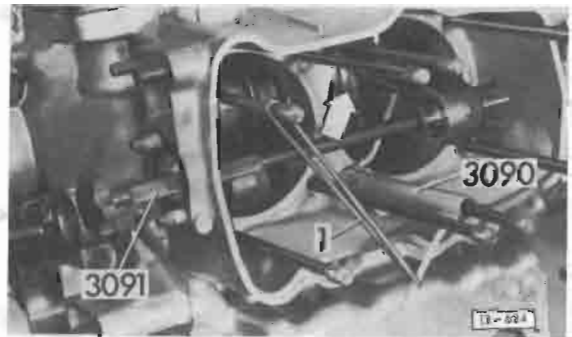
**Cylinder sleeve bore/Piston diameter**

size	color	cylinder diameter	matching piston diameter
standard	blue	94.005-94.016 mm	93.98 mm
1st			
oversize	pink	94.016-94.027 mm	93.99



**Fig. 12 Piston and cylinder sleeve, installing**

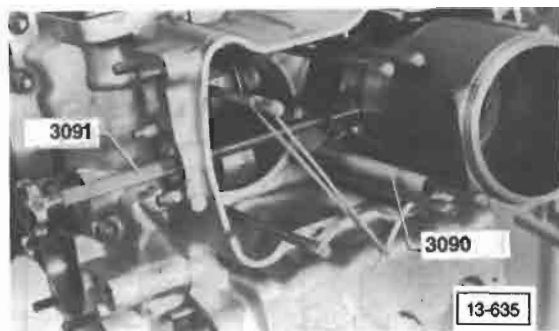
- replace rubber sealing rings for cylinder sleeves:
  - cylinder head end = thin ring (green)
  - crankcase end = thick ring (black)
- install piston into cylinder sleeve (flywheel side first)
  - arrow on piston points toward flywheel
  - gap of oil scraper ring must be to top
  - piston ring gaps offset by 180° (see explosion view)
- insert circlip for piston pin on flywheel side of piston



**Fig. 13 Piston and cylinder sleeve, installing**

- note markings on connecting rod support 3090
  - R = right side of engine
  - L = left side of engine
- push connecting rod support onto center stud so finger of tool supports connecting rod; then secure it with rubber band 1 to prevent it from slipping
- align connecting rod such that piston pin can be installed through hole in housing
  - crankshaft must be at TDC
  - lug on rod faces up

# 13 Engine – Crankshaft, Crankcase

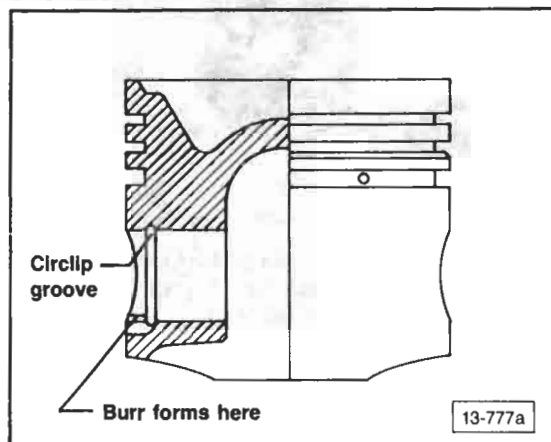


**Fig. 14 Piston and cylinder sleeve, installing**

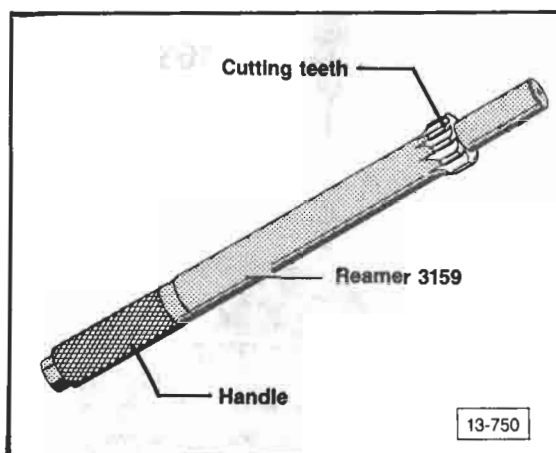
- install piston pin with **3091** and insert circlip

## Piston pin hole burrs, removing

If a burr has formed in the outer piston pin hole from the pin striking against the circlip, the burr must be removed with reamer **3159** before you remove the piston pin.



- remove circlip



- insert reamer **3159** into piston pin hole
- remove burr with reamer
- remove piston pin with tool **3091**

**CAUTION**

When assembling crankcase halves, observe tightening sequence and tightening torque (see page 13.36 and page 13.39, Fig. 5)

**Oil pickup line with filter screen**  
cleaning Fig. 4  
replacing Fig. 5

**Dowel**  
check for tight fit  
in case

**Crankcase**  
clean and blow through all  
oil channels with  
compressed air.  
Coat joining surfaces with  
**AMV 188 001 02** sealing  
compound

**Main bearing No. 2**  
lubricate before installing  
crankshaft.  
Note installation position  
when removing and install  
in same position as  
removed

**Camshaft end cap**  
coat with sealing  
compound when installing.  
Watch installation position

**Main bearing No. 1**  
lubricate before installing  
crankshaft.  
Hole for dowel offset  
toward flywheel

**Camshaft bearing**  
lubricate before installing.  
Tabs must engage in  
recess

**Crankshaft**  
disassembling/assembling,  
see page 13.54

**Camshaft**  
runout, checking Fig. 1  
end play, checking Fig. 2  
installing Fig. 3

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# 13 Engine – Crankshaft, Crankcase

## CAUTION

When assembling crankcase halves, observe tightening sequence and tightening torque.

Oil pickup line with filter screen. Fig. 4

**Dowel**  
check for tight fit in case

**Crankcase**  
clean and blow through all oil channels with compressed air  
Coat joining surfaces with **AMV 188 001 02** sealing compound

**Main bearing No. 1**  
color coded red/blue corresponding to crankshaft dimensions  
lubricate before installing in crankshaft  
tabs on bearing fit into recesses in crankshaft housing  
oil holes in left side of crankshaft

**Camshaft end cap**  
install with sealing compound

**Thrust washer**  
tab points toward crankshaft bearing and separating line  
Fig. 6

**Camshaft bearing**  
notches fit to each other

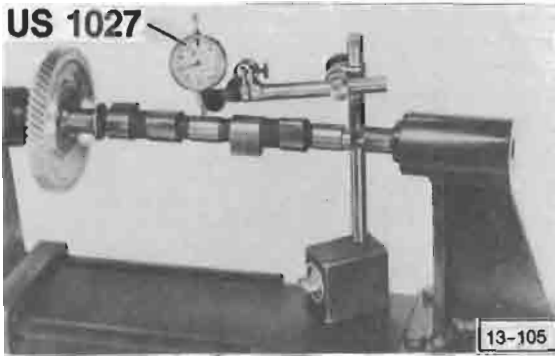
**Crankshaft**

**Crankshaft bearing No. 3**  
oil holes in left half of crankshaft housing tabs engage in recess

**Camshaft**  
face marked with blue runoff Fig. 1

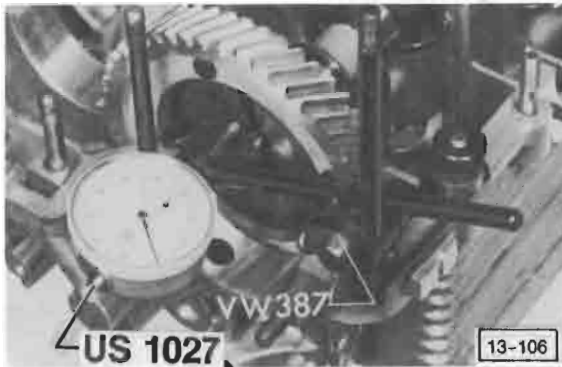
**Main bearing No. 2**  
lubricate before installing  
color coded blue or red corresponding to crankshaft dimensions

13-771



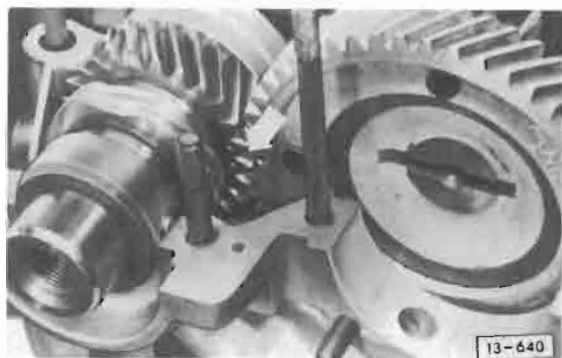
**Fig. 1 Camshaft runout, checking**

- wear limit 0.04 mm (0.0015 in.)



**Fig. 2 Camshaft end play, checking**

- wear limit 0.16 mm (0.006 in.)
- if out of specification, replace camshaft bearings



**Fig. 3 Camshaft, installing**

- mark on camshaft gear tooth must be between marks on crankshaft gear teeth (arrow)
- check backlash of timing gears
  - 0.0–0.05 mm (0–0.002 in.)
  - backlash must be hardly noticeable

- turn crankshaft **backward**
  - camshaft **must** not lift out of bearings
  - if camshaft lifts out of bearings, install camshaft with smaller timing gear

**Note**

To obtain specified backlash, camshafts with various size timing gears are available. Markings are on **inner face** of timing gear

**Example**

“–0.1”, “+0.1”, “+0.2”, indicates in 1/100 mm how much pitch radius differs from standard pitch radius “0”

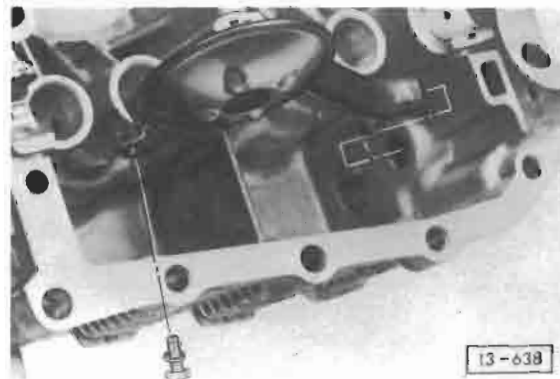
**CAUTION**

Mark **0** on **outer face** of camshaft timing gear is timing mark and must not be confused with markings on **inner face**. Crankshaft timing gear is available in one size only



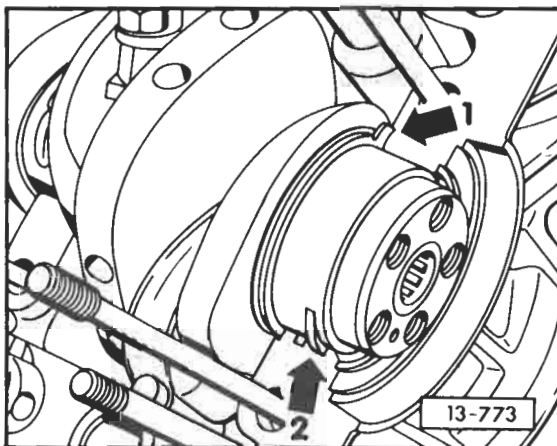
**Fig. 4 Oil pickup line with filter screen, cleaning**

- clean oil channels by blowing through with compressed air (arrow)



**Fig. 5 Oil suction line with filter screen, replacing**

# 13 Engine-Crankshaft, Crankcase

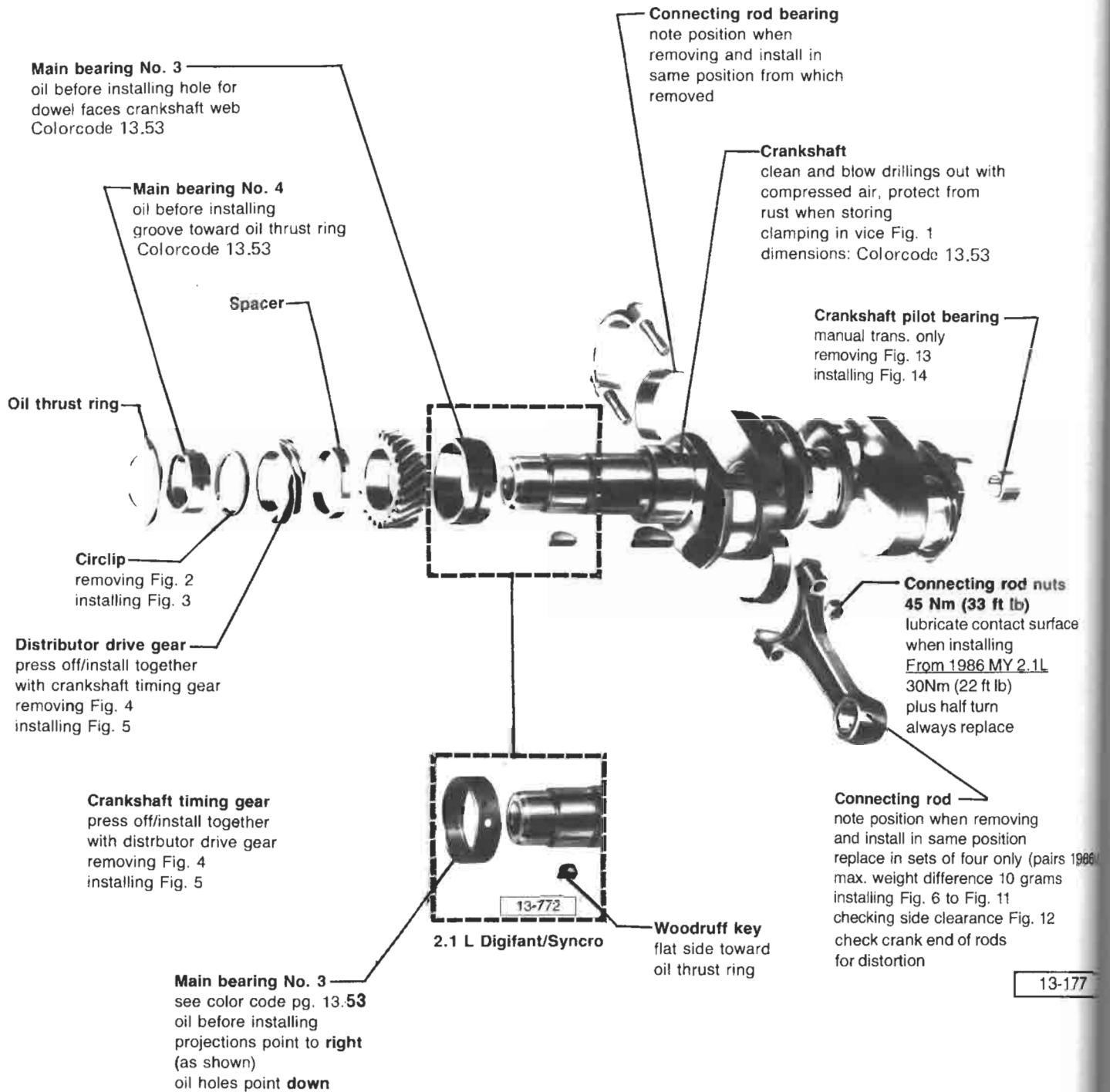


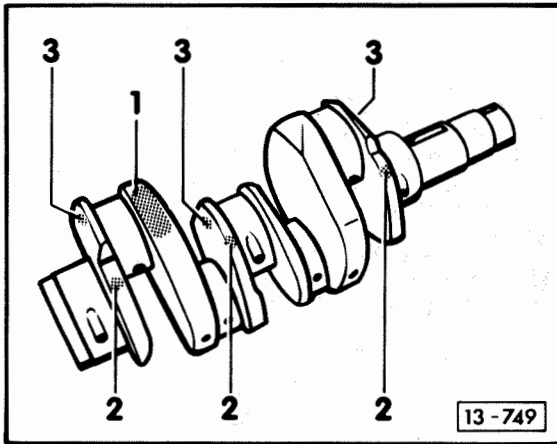
**Fig. 6** Thrust washer and main bearing 1, installing

**Arrow 1:** projection on thrust washer points toward main bearing and separating line of crankcase.

**Arrow 2:** projection on main bearing fit into notches in crankcase. Oil holes are in left half of crankcase housing.

# 13 Engine - Crankshaft, Crankcase





### Crankshaft color code

- 1 = Color code **green** (2.1 L engine-Digifant/Syncro)
- 2 = Color code **blue** or **red** (crankshaft code/size)

### Note

On some crankshafts the blue or red code can appear in position **three**.

### Crankshaft journal sizes (mm)

	Bearing No. 1	Bearing No. 2	Bearing No. 3	Bearing No. 4	Connecting rod
Standard size (thru 1985)	59.980-59.990 (marked: blue dot)	54.971-54.990	54.980-54.990 (marked: blue dot)	39.984-40.00	54.983-54.996
2.1 L Digifant, Syncro	59.971-59.979 (marked: red dot)	54.980-54.990 (marked: blue dot)  54.971-54.979 (marked: red dot)	54.971-54.979 (marked: red dot)		

### Note

If crankshaft has blue or red dot **only** main bearings with same color code can be used.

Code for main bearings, 1, 2, 3 = 001 (blue), 004 (red)

# 13 Engine-Crankshaft, Crankcase

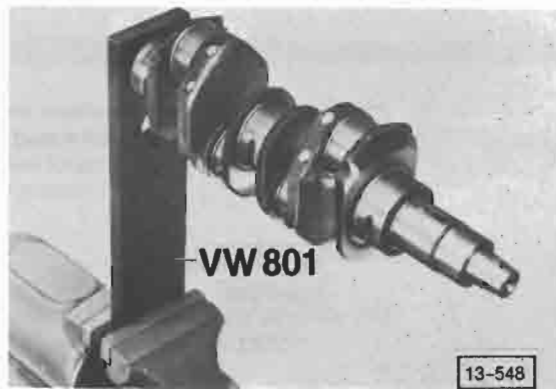


Fig. 1 Crankshaft, clamping in vise



Fig. 2 Circlip, removing

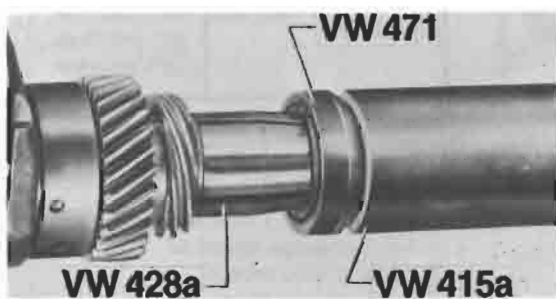


Fig. 3 Circlip, installing



Fig. 4 Distributor drive gear/crankshaft timing gear, removing



Fig. 5 Distributor drive gear/crankshaft timing gear, installing

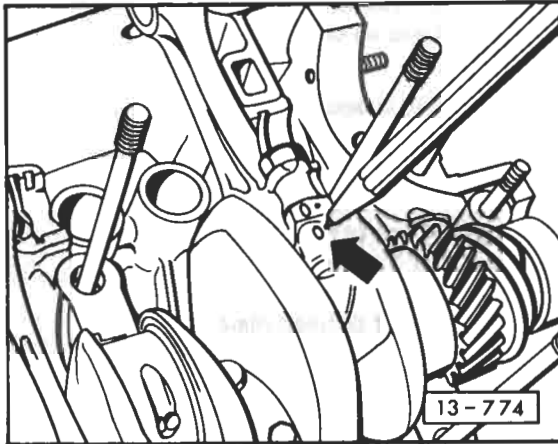
— heat gears to approx. 80°C (175°F) before installing



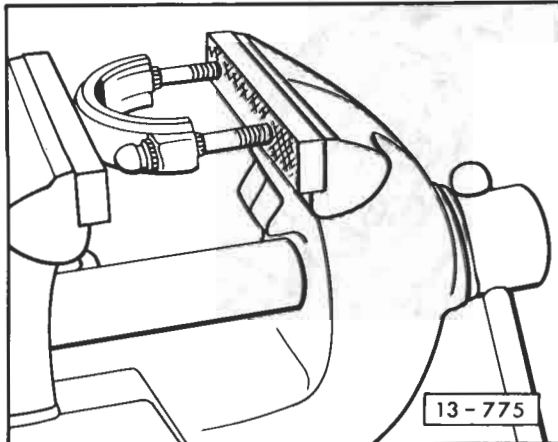
Fig. 6 Connecting rod, installing

— numbers (arrow) on rod and cap must match and be on same side

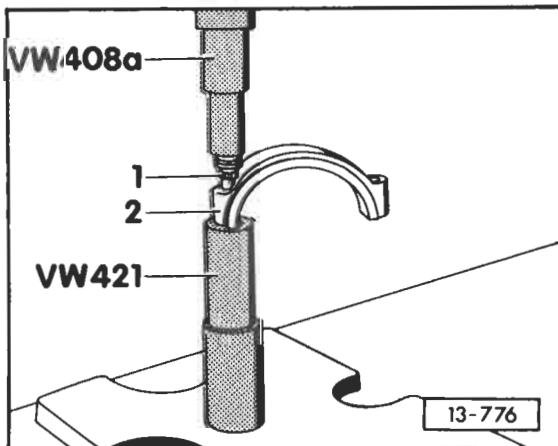
## Connecting rod bolts, removal/installing 2.1L Digifant/Syncro



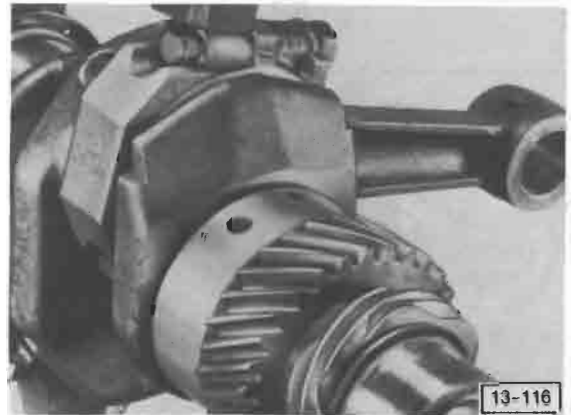
**Fig. 7** Mark matching connecting rod/bearing cover with cylinder



**Fig. 8** Connecting rod bolts, removing

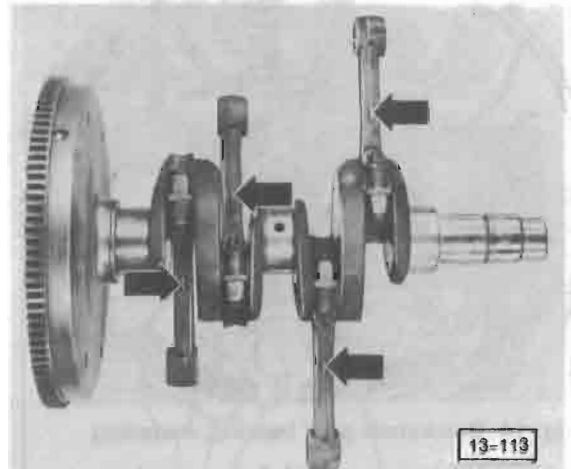


**Fig. 9** Connecting rod bolts, installing



**Fig. 10** Connecting rod, installing

- lightly tap both sides of connecting rod with hammer to eliminate slight pinching of bearing shells when installing connecting rod



**Fig. 11** Connecting rods, installation position

- forged mark on rods (arrows) must face up when rods are installed

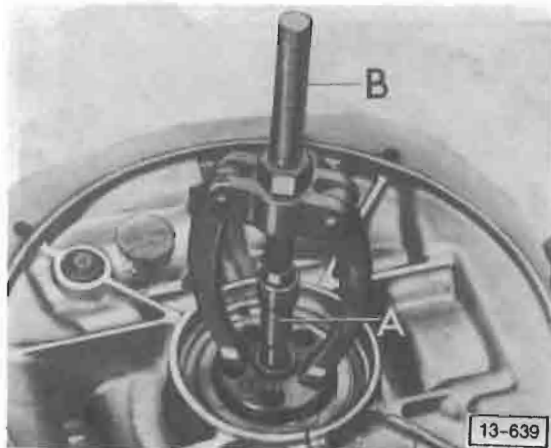


**Fig. 12** Connecting rod, checking side clearance

- wear limit 0.7 mm (0.028 in.)

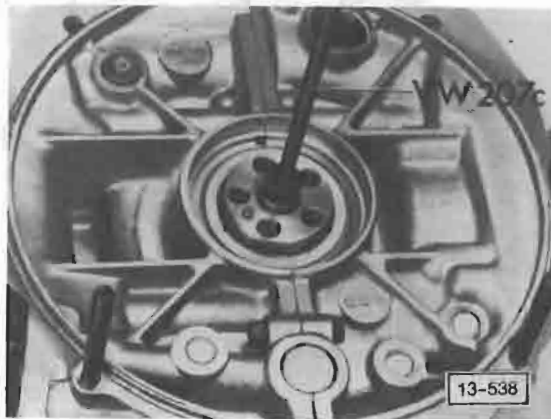


# 13 Engine-Crankshaft, Crankcase



**Fig. 13 Crankshaft pilot bearing, removing**

A = US 8028  
B = US 1039 & US 1039/3



**Fig. 14 Crankshaft pilot bearing, installing**

- lubricate with MoS<sub>2</sub> grease when installing
- markings on bearing cage must face outward

## Replacing 1.9L crankcase

Effective immediately, the replacement crankcase for 2.1L waterboxer engines will also be used for 1.9L waterboxer engines.

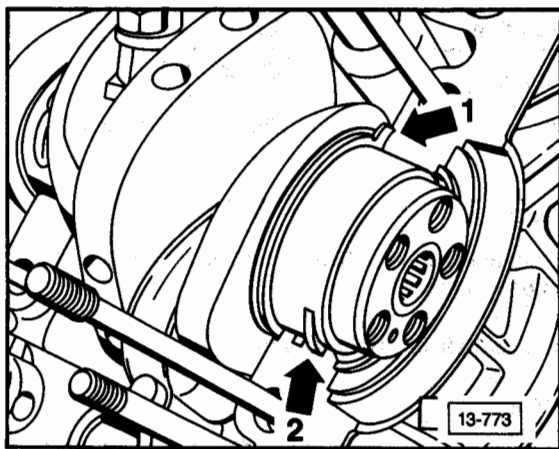
When replacing the 1.9L crankcase note the following:

### Intake air distributor

Install intake air distributor **025 133 055 B** when changing from a 1.9L crankcase to a 2.1L crankcase.

### Thrust washer and main bearing 1

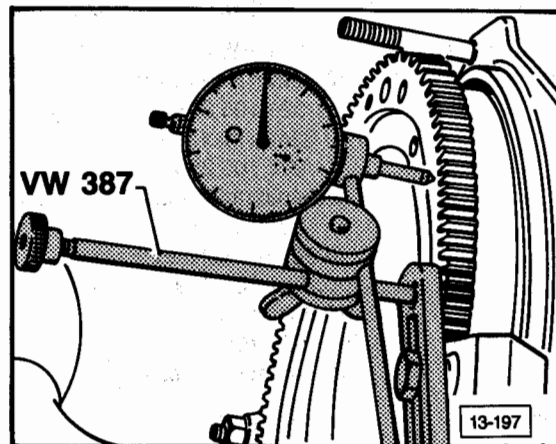
#### Installing



**Arrow 1:** Tab on thrust washer points toward main bearing and separating line of crankcase halves.

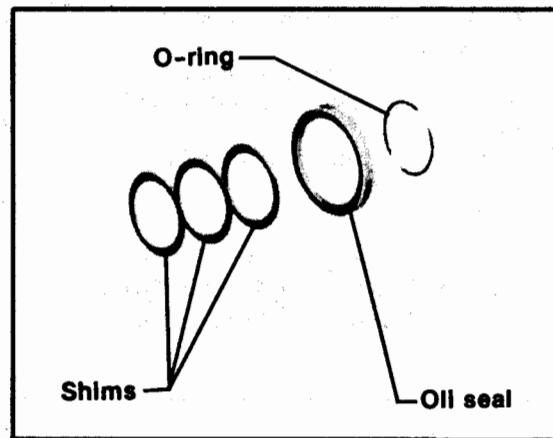
**Arrow 2:** Tab on main bearing fits into notches in crankcase. Oil holes are in left half of crankcase housing.

### Crankshaft end play, checking



- check crankshaft end play (main bearing 1 without shoulder)
  - new: 0.07-0.13 mm (0.003-0.005 in.)
  - wear limit: 0.15 mm (0.006 in.)
- if out of adjustment, adjust

### Crankshaft end play, adjusting



#### Shim arrangement

#### Note

Shims are available in different thicknesses. Thickness is etched on each shim.

#### Oil seal

- pry out with screwdriver
- O-ring
- always replace

# 13 Engine - Crankshaft, Crankcase

## Parts required

Description	Part no.	Quantity		
75.0mm (3.0 in.) diameter shims	021 105 281 (0.30mm thickness)	3		
	021 105 283 (0.32mm thickness)			
	021 105 285 (0.34mm thickness)			
	021 105 287 (0.36mm thickness)			
	021 105 289 (0.38mm thickness)			
	021 105 291 (0.24mm thickness)			
	Oil seal		029 105 245 B	1
	O-ring		021 105 279	1

- check crankshaft end play
  - new: 0.07–0.13 mm (0.003–0.005 in.)
  - wear limit: 0.15 mm (0.006 in.)
- if out of specification proceed as follows:
  - install flywheel with 2 shims but **without** O-ring and crankshaft oil seal
  - mount dial indicator with bracket on crankcase
  - move crankshaft in and out and measure movement (crankshaft end play)
  - determine thickness of 3rd shim

### Example

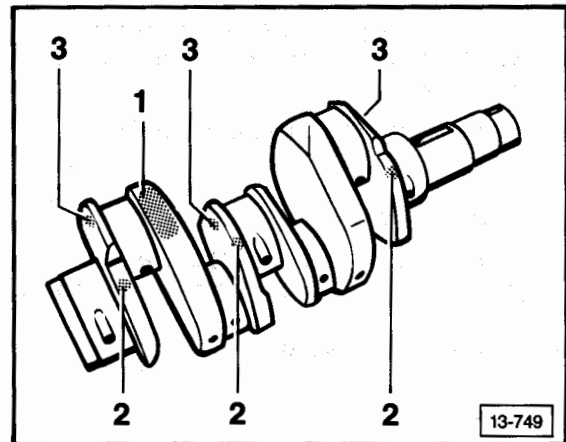
dial indicator reading	0.44 mm (0.017 in.)
specified end play	–0.10 mm (0.004 in.)
thickness of 3rd shim	0.34 mm (0.013 in.)

### CAUTION

Always install **three** shims to obtain correct crankshaft end play

- remove flywheel
- install O-ring, crankshaft oil seal and felt ring
- install all three shims
- install flywheel
- tighten bolts to 60 Nm (44 ft lb) plus an add'l 1/4 turn (90°)
- recheck crankshaft end play

## Crankshaft color code



Position	Color
1	Green (2.1L crankshaft only)
2	Red or blue (crankshaft journal size)

### Note

On crankshafts the blue or red code can also appear in position **three**.

### Crankshaft journal sizes (mm)

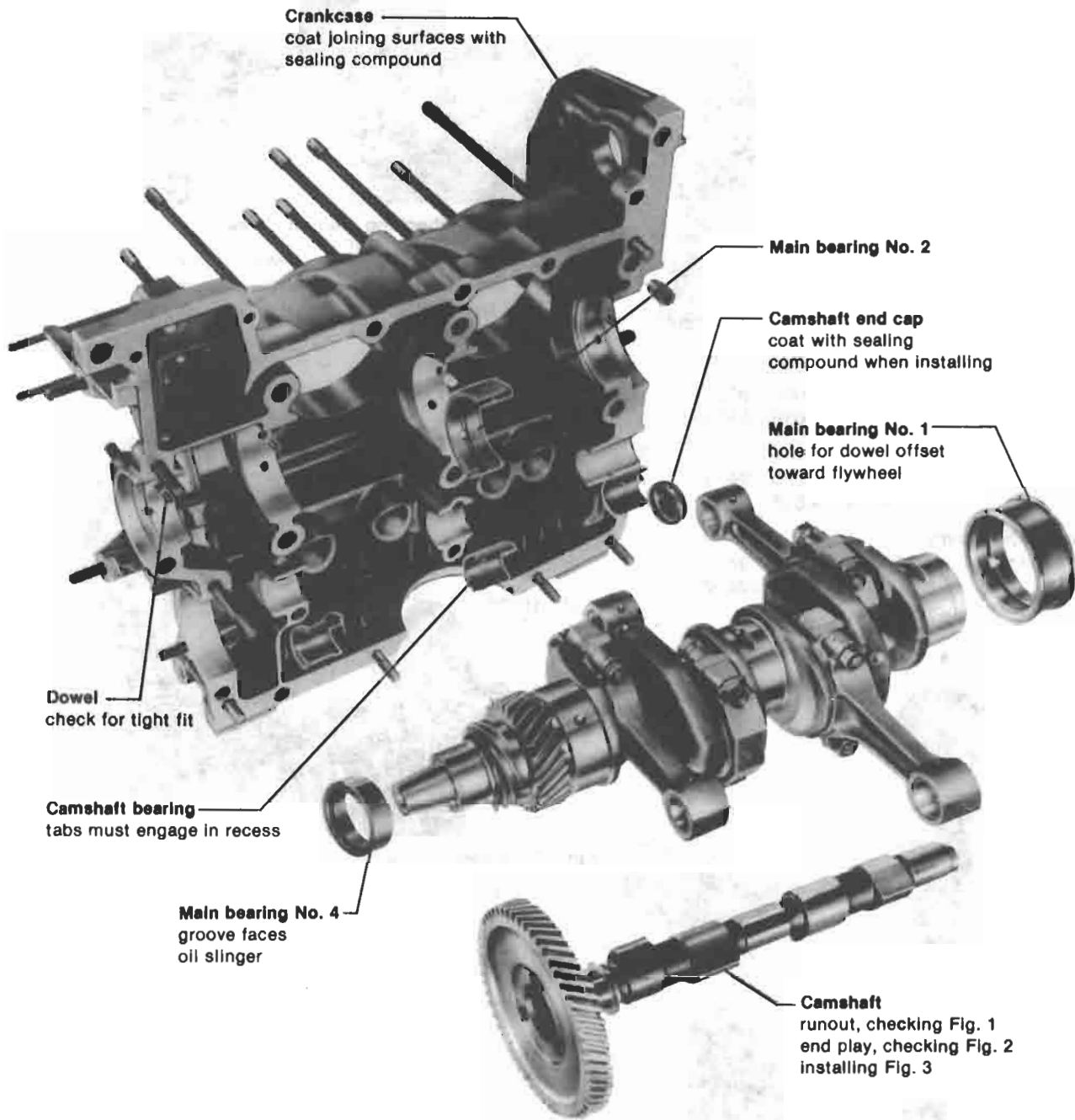
### Note

If crankshaft has blue or red dot **only main bearings with same color code can be used.**

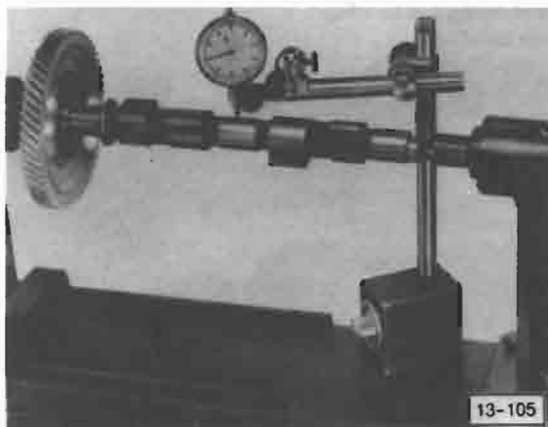
Code for main bearings, 1, 2, 3 = 001 (blue), 004 (red)

Bearing no.	Standard size	Grinding dimensions
1 (Flywheel side)	60.00 (blue or red dot)	59.980-59.990 (marked blue dot) 59.971-59.979 (marked red dot)
2, 3	55.00 (blue or red dot)	54.980-54.990 (marked blue dot) 54.971-54.979 (marked red dot)
4	40.00 (no color code)	39.984-40.00 (no color code)
Connecting rod	55.00 (no color code)	54.983-54.996 (no color code)

# 13 Engine - Crankshaft, Crankcase



13-545



**Fig. 1 Camshaft runout, checking**

- wear limit 0.04 mm (0.0015 in.)



**Fig. 2 Camshaft end play, checking**

- wear limit 0.16 mm (0.006 in.)
- if out of specification, replace camshaft bearings



**Fig. 3 Camshaft, installing**

- mark on camshaft gear tooth must be between marks on crankshaft gear teeth
- check backlash of timing gears
  - 0.0–0.05 mm (0–0.002 in.)
  - backlash must be hardly noticeable

- turn crankshaft **backward**
  - camshaft must not lift out of bearings
  - if camshaft lifts out of bearings, install camshaft with smaller timing gear

**Note**

To obtain specified backlash, camshafts with various size timing gears are available.

Markings are on **inner face** of timing gear.

**Example**

“– 0.1”, “+ 0.1”, “+ 0.2”, indicates in 1/100 mm how much pitch radius differs from standard pitch radius “0”

**CAUTION**

Mark **0** on **outer** face of camshaft timing gear is timing mark and must not be confused with markings on **inner** face. Crankshaft timing gear is available in one size only

# 13 Engine - Crankshaft, Crankcase

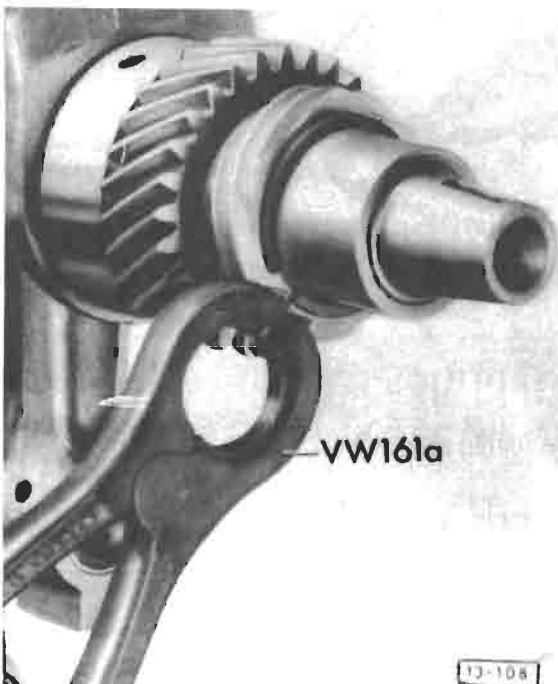
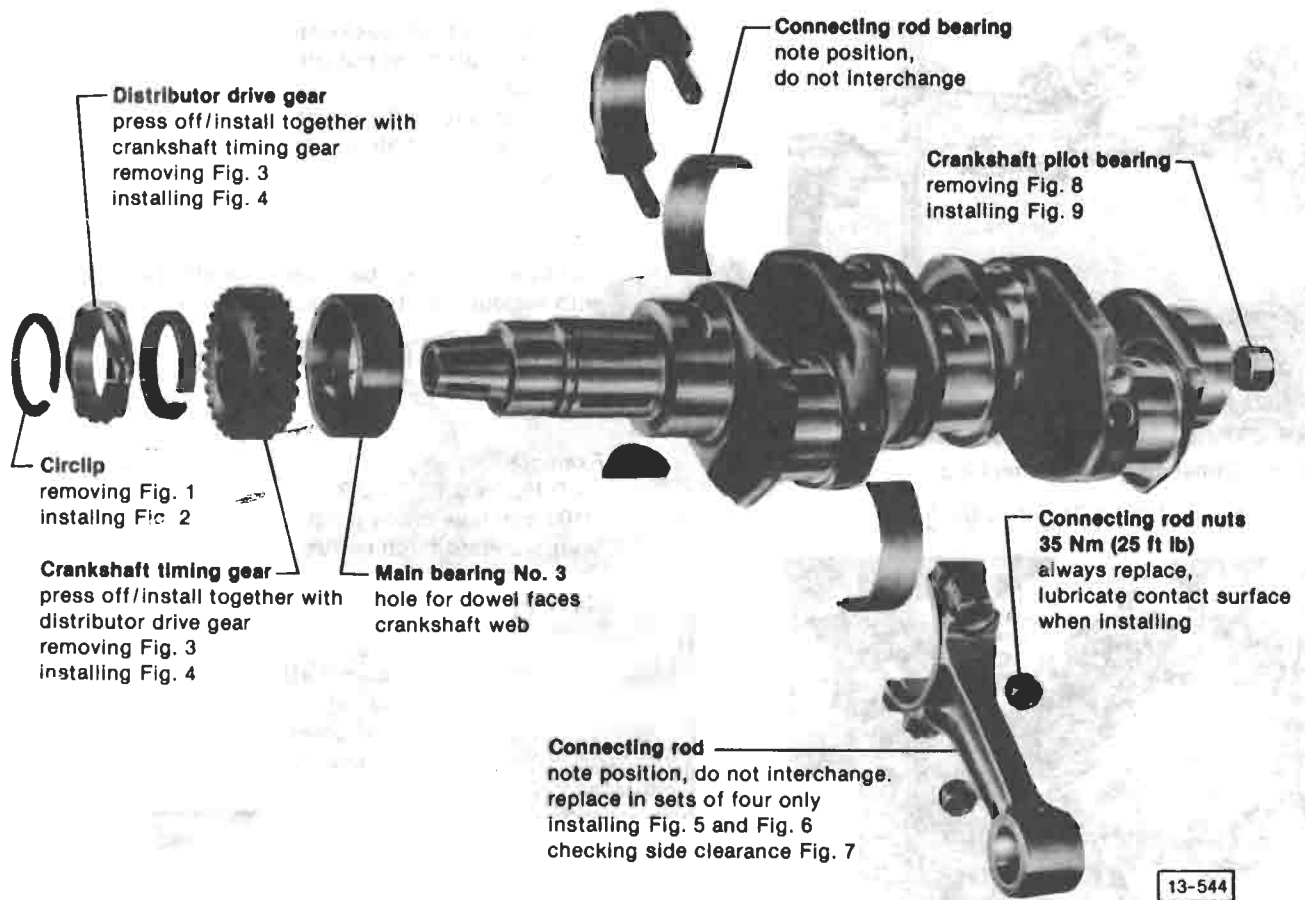


Fig. 1 Circlip, removing

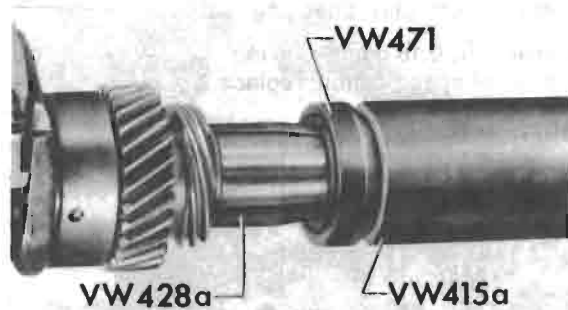


Fig. 2 Circlip, installing

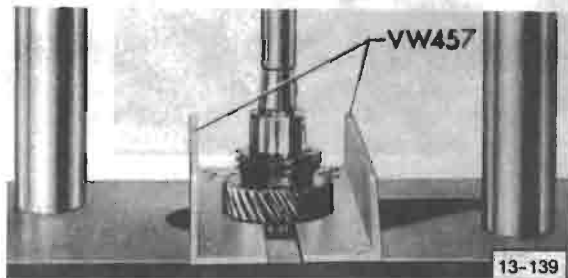
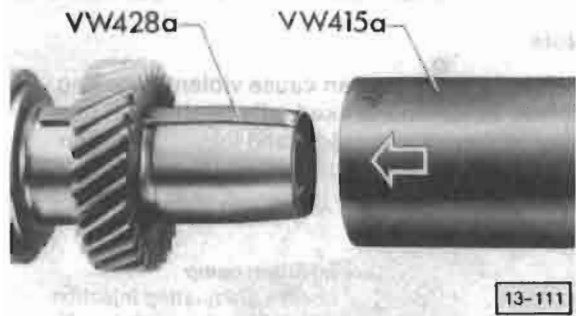


Fig. 3 Distributor drive gear/crankshaft timing gear, removing



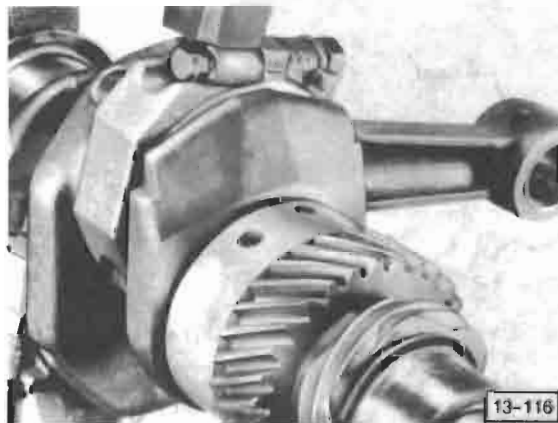
**Fig. 4** Distributor drive gear/crankshaft timing gear, installing

— heat gears to approx. 80°C (175°F) before installing



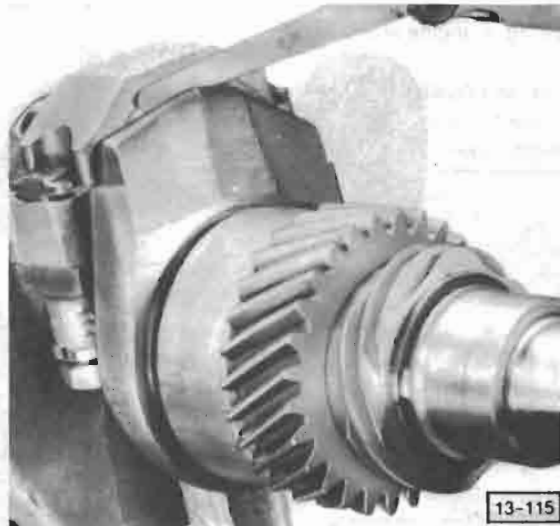
**Fig. 5** Connecting rod, installing

— numbers (arrow) on rod and cap must be on same side



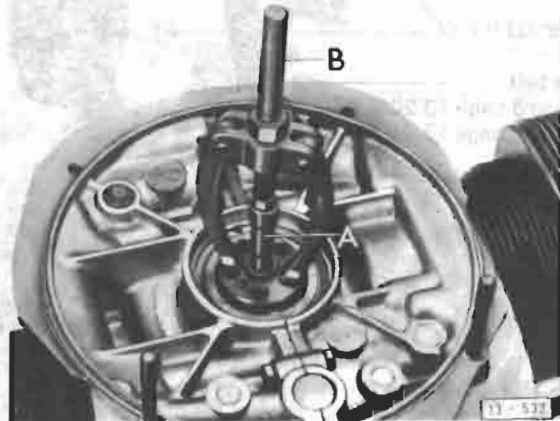
**Fig. 6** Connecting rod, installing

— lightly tap both sides of connecting rod with hammer to eliminate slight pinching of bearing shells when installing connecting rod



**Fig. 7** Connecting rod, checking side clearance

• wear limit 0.7 mm (0.028 in.)



**Fig. 8** Crankshaft pilot bearing, removing

A = US 8028

B = US 1039 & US 1039/3



**Fig. 9** Crankshaft pilot bearing, installing

— lubricate with MoS<sub>2</sub> grease when installing

• markings on bearing cage must be visible when installed

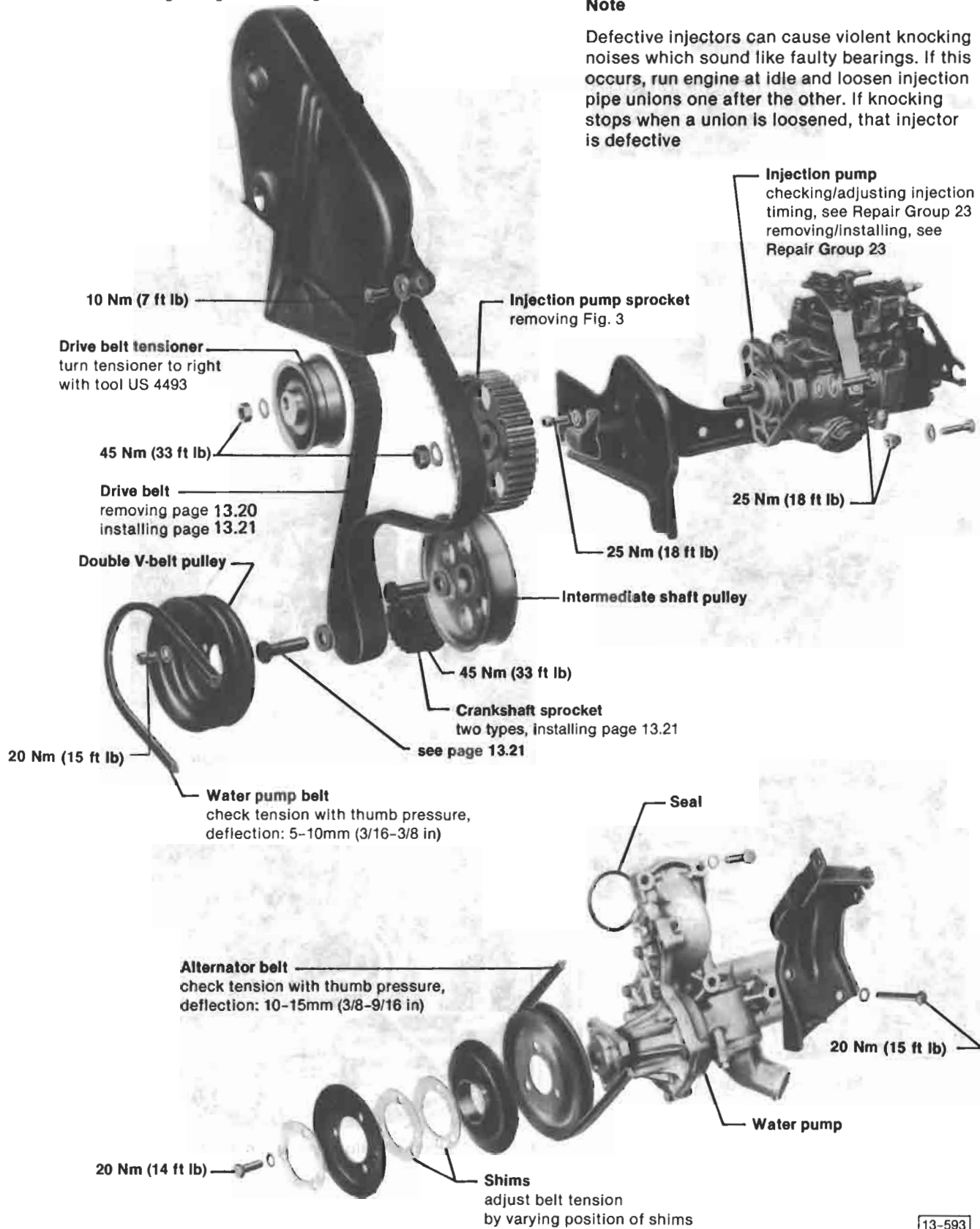


# 13 Engine-Crankshaft, Crankcase

**Engine**  
mounting in engine stand Fig. 1

**Note**

Defective injectors can cause violent knocking noises which sound like faulty bearings. If this occurs, run engine at idle and loosen injection pipe unions one after the other. If knocking stops when a union is loosened, that injector is defective

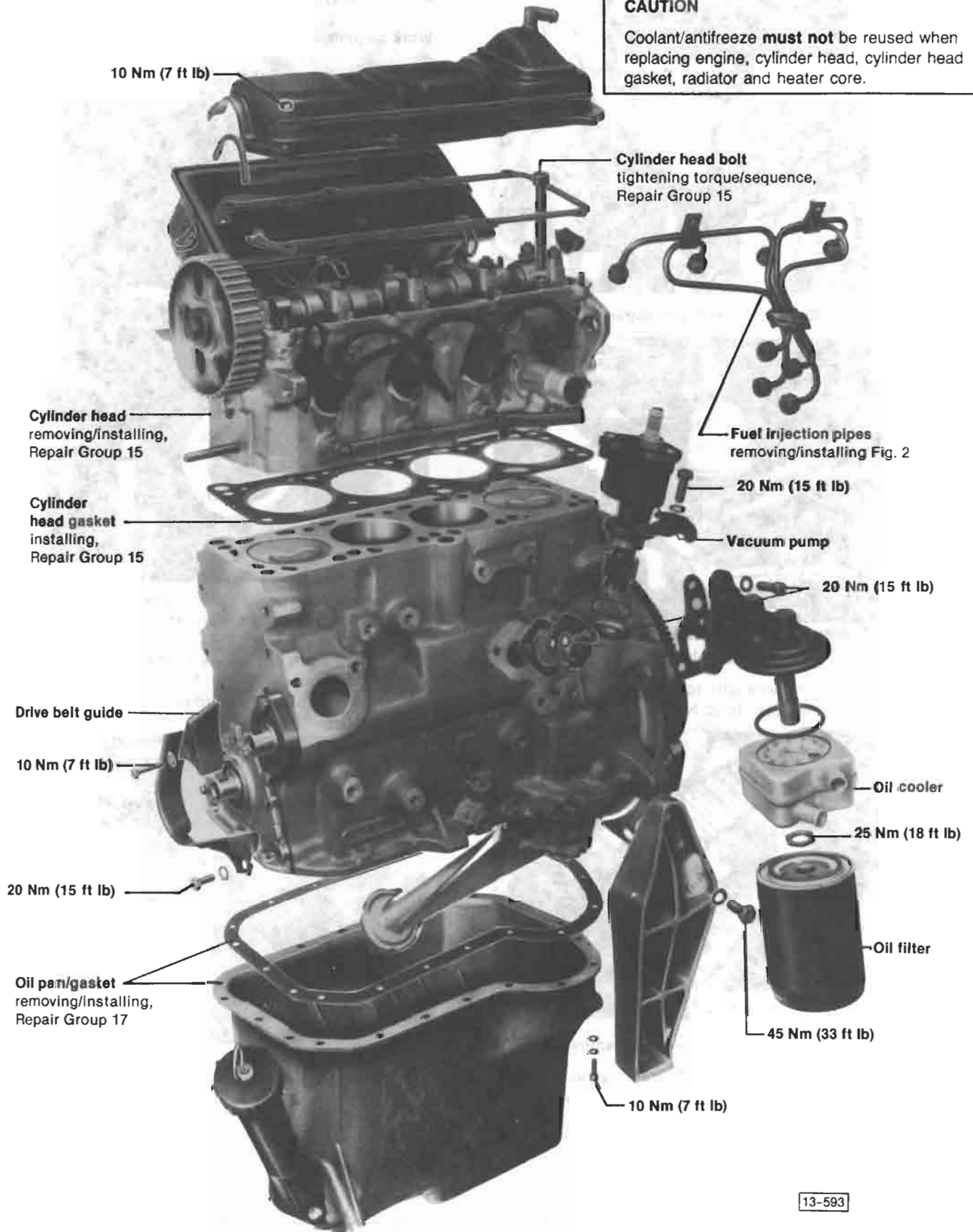


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# Engine - Crankshaft, Crankcase 13

## CAUTION

Coolant/antifreeze **must not** be reused when replacing engine, cylinder head, cylinder head gasket, radiator and heater core.



Diesel

Engine, disassembling/assembling

13.19

# 13 Engine-Crankshaft, Crankcase



Fig. 1 Engine, mounting in engine stand

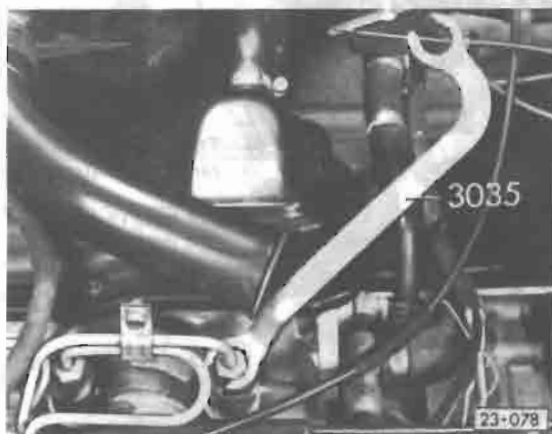


Fig. 2 Fuel injection pipes, removing/installing

- remove with tool 3035
- tighten to 25 Nm (18 ft lb)

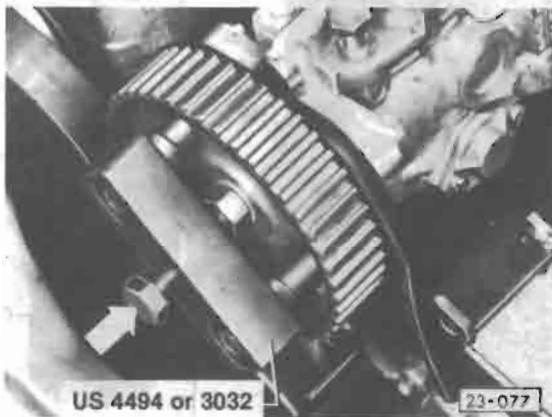


Fig. 3 Injection pump sprocket, removing

- loosen sprocket retaining nut slightly
- carefully apply tension with puller
- hit puller spindle head (arrow) with light hammer taps until sprocket loosens from injection pump shaft
- remove puller and nut
- remove sprocket by hand

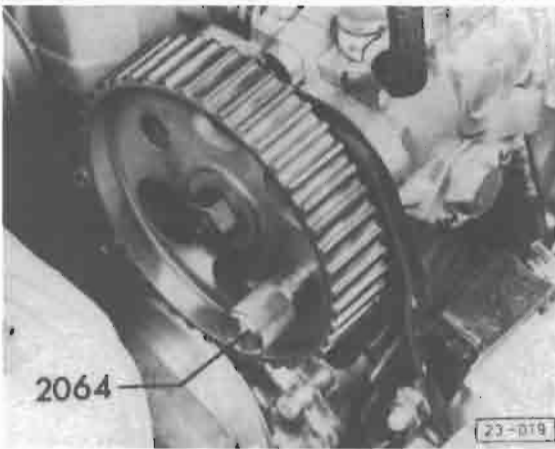
## Drive belt, removing

### Work sequence

- remove bolt cover and valve cover



- turn engine to TDC arrow on cylinder No. 1 and fix camshaft in position with tool 2065A
- align tool as follows:
  - turn camshaft until one end of tool touches cylinder head
  - measure gap at other end of tool with feeler gauge
  - take half of measurement and insert feeler of this thickness between tool and cylinder head
  - turn camshaft so that tool rests on feeler
  - insert second feeler of same thickness between other end of tool and cylinder head



- lock injection pump sprocket in position with pin 2064
- check that marks on sprocket, bracket and pump body are aligned (engine at TDC)
- loosen tensioner

- remove V-belt pulley from crankshaft
- remove drive belt

## Drive belt, installing

### Work sequence

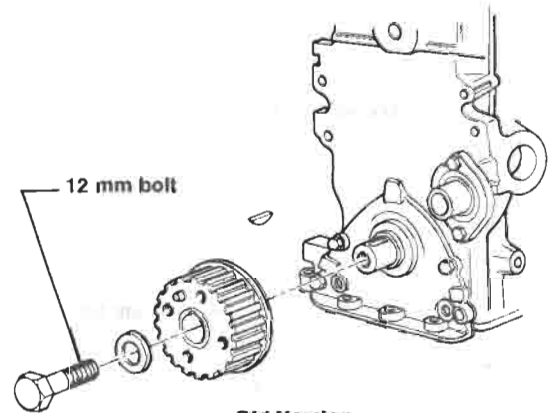
- check that TDC mark on clutch pressure plate is aligned with reference mark
- loosen camshaft sprocket bolt 1/2 turn and loosen gear from camshaft by tapping with rubber hammer
- install drive belt and remove pin 2064 from injection pump sprocket
- tension belt by turning tensioner to right



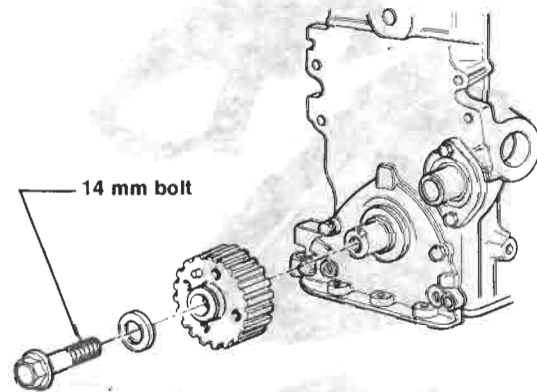
- check that on VW 210, scale reads 12–13
  - check belt tension between camshaft sprocket and injection pump sprocket
- tighten camshaft sprocket bolt to 45 Nm (33 ft lb)
- remove tool from camshaft

- turn crankshaft 2 turns in direction of engine rotation (clockwise)
- strike belt once with rubber hammer between camshaft sprocket and injection pump sprocket
- check belt tension again
- check injection pump timing, see Repair Group 23

## Drive belt sprocket bolt, tightening



**Old Version**  
150 Nm (108 ft lb)  
with locking compound



**New Version**  
200 Nm (148 ft lb)  
lubricate threads before installing

Shown above are the two versions of drive belt sprocket used on Diesel Vanagon. Ensure that the correct tightening torque specification is used when repairing these engines.

# 13 Engine-Crankshaft, Crankcase

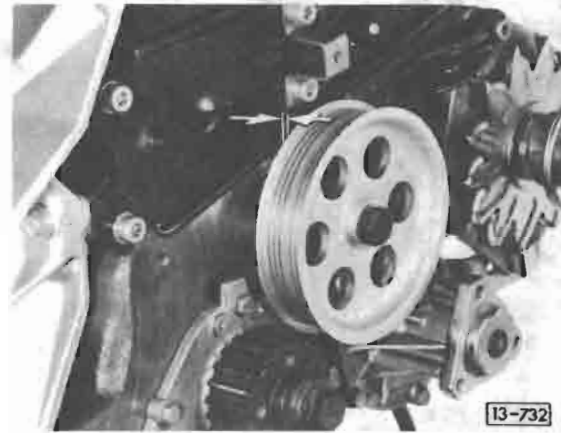
## Fully closed drive belt cover

Beginning in February 1984, the Diesel engine has been produced with a fully closed drive belt cover.

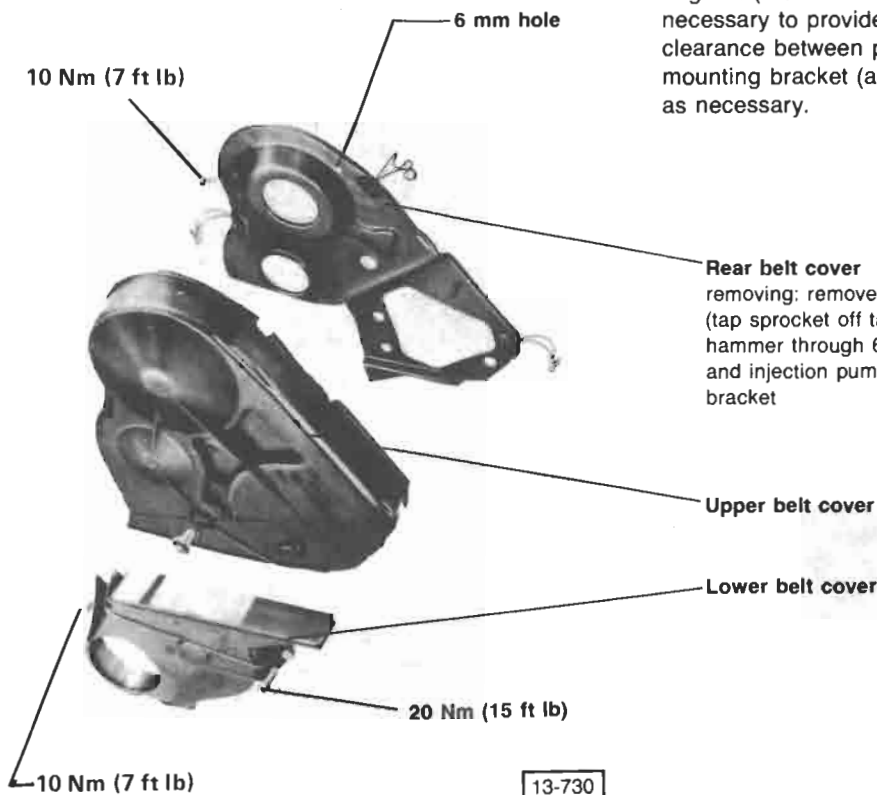
Additional new parts include a revised injection pump mounting bracket and intermediate shaft pulley. The pulley now mounts closer to the engine block.

### Note

Only the new version pulleys will be supplied as service parts.



When installing the new version pulley in earlier engines (without fully closed belt cover) it is necessary to provide at least 0.5 mm (0.020 in.) clearance between pulley and injection pump mounting bracket (arrows). Rework pump bracket as necessary.

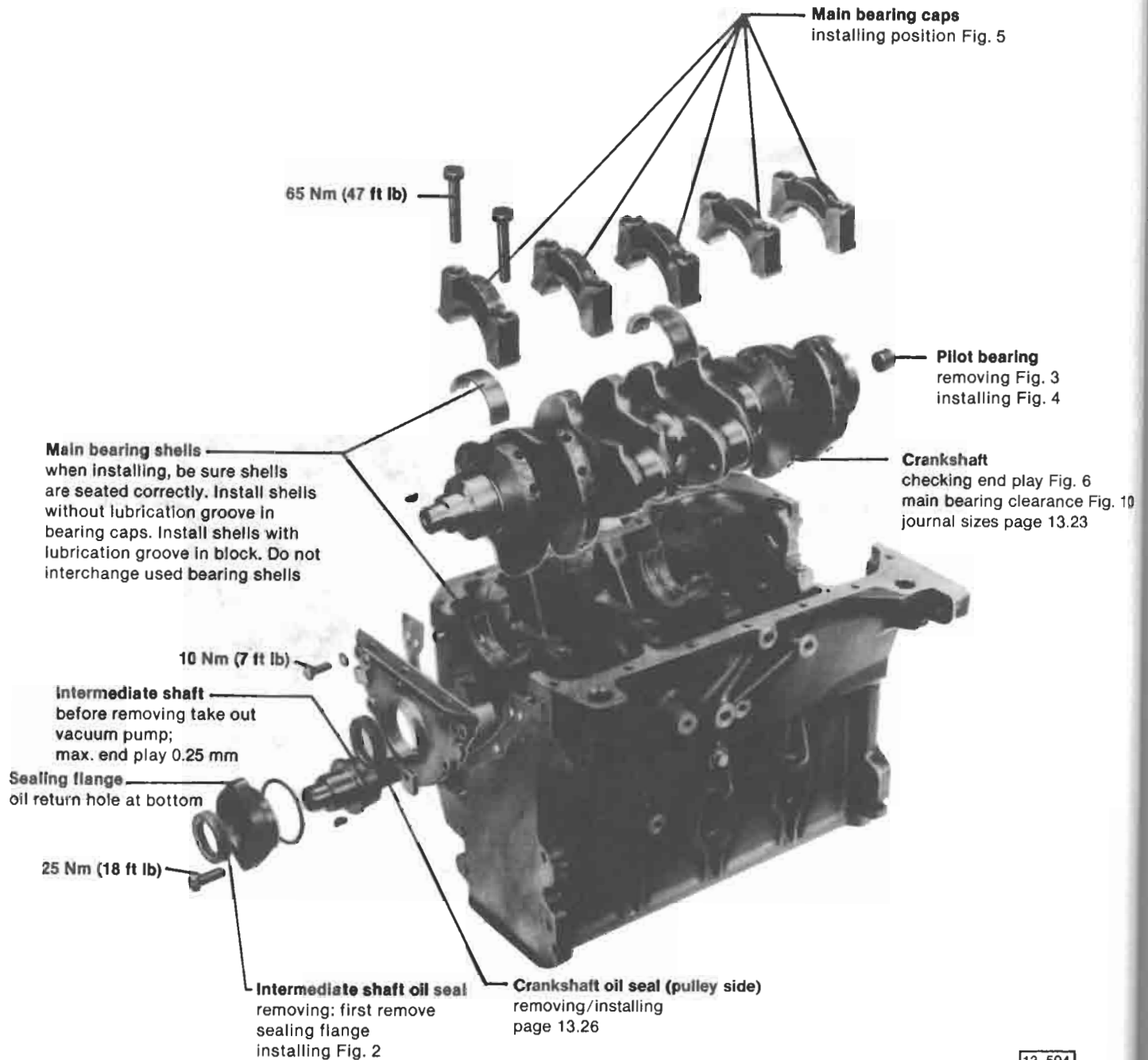


**Rear belt cover**  
removing: remove camshaft sprocket (tap sprocket off taper with punch and hammer through 6 mm hole), tensioner and injection pump. Loosen pump mounting bracket

# 13 Engine-Crankshaft, Crankcase

## Note

Defective injectors can cause violent knocking noises which sound like faulty bearings. If this occurs, run engine at idle and loosen injection pipe unions one after the other. If knocking stops when a union is loosened, that injector is defective





**WARNING**

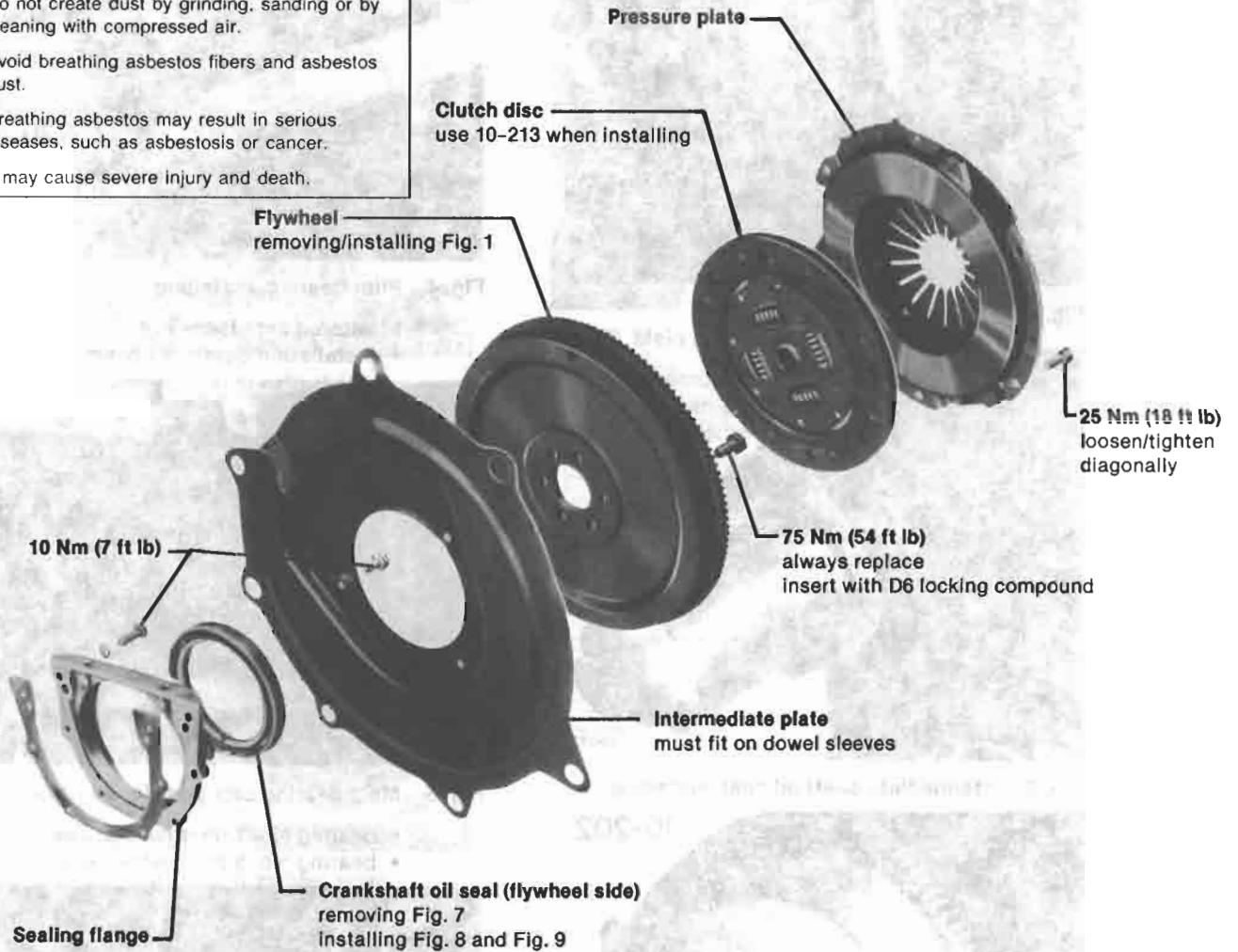
Friction materials such as brake and clutch linings, or brake pads may contain asbestos fibers.

Do not create dust by grinding, sanding or by cleaning with compressed air.

Avoid breathing asbestos fibers and asbestos dust.

Breathing asbestos may result in serious diseases, such as asbestosis or cancer.

It may cause severe injury and death.



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**Crankshaft journal sizes (mm)**

Stage	Main bearing journals	Max. out of round	Connecting rod journals	Max. out of round
Standard	53.96-53.98	0.03	47.76-47.78	0.03
1st undersize	53.71-53.73	0.03	47.51-47.53	0.03
2nd undersize	53.46-53.48	0.03	47.26-47.28	0.03
3rd undersize	53.21-53.23	0.03	47.01-47.03	0.03

**Note**

3 undersizes of bearing shells available in graduations of 0.25 mm



# 13 Engine - Crankshaft, Crankcase

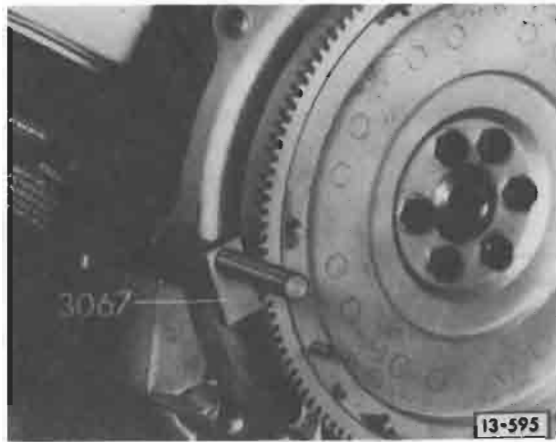


Fig. 1 Flywheel, removing/installing

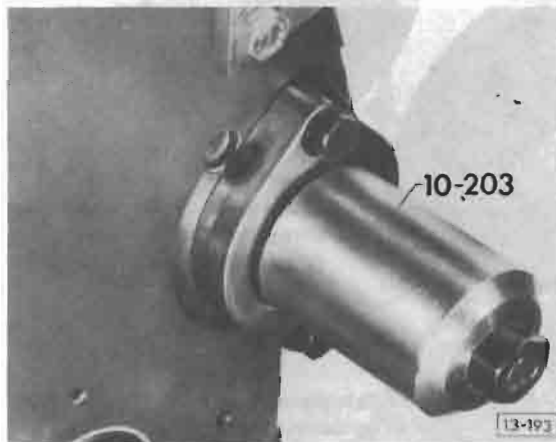


Fig. 2 Intermediate shaft oil seal, installing

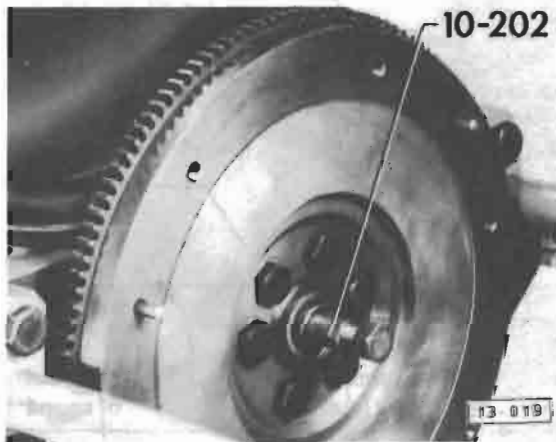


Fig. 3 Pilot bearing, removing

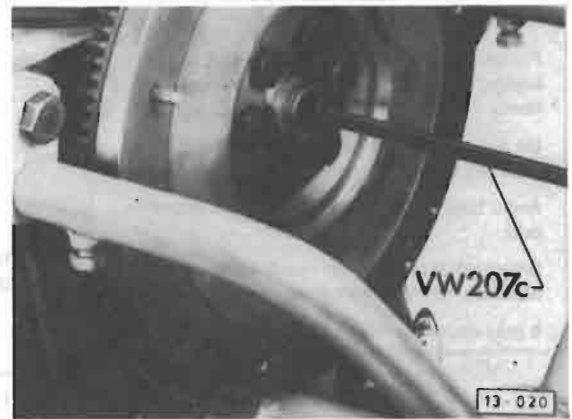


Fig. 4 Pilot bearing, installing

- lettered side faces out
- installation depth = 1.5 mm (0.060 in)

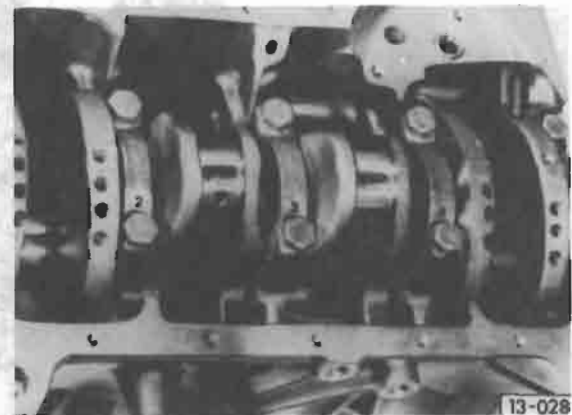


Fig. 5 Main bearing cap, positions

- bearing No. 1 on drive belt side
- bearing No. 5 on flywheel side

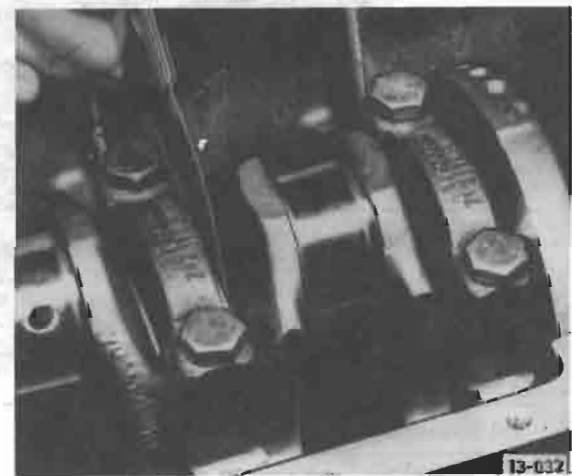
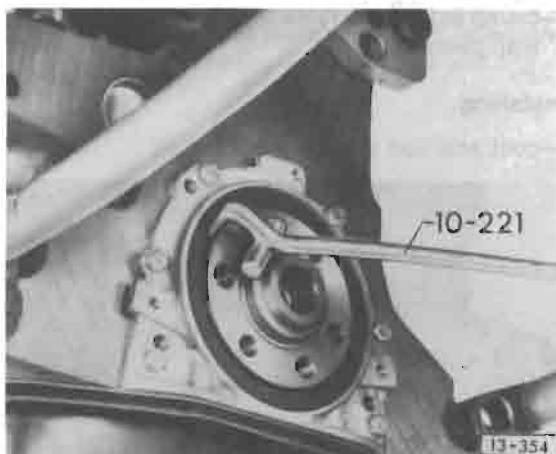


Fig. 6 Crankshaft end play, checking

- check with feeler gauge on main bearing No. 3
- new part = 0.07–0.17 mm (0.003–0.007 in.)
  - wear limit = 0.37 mm (0.015 in.)

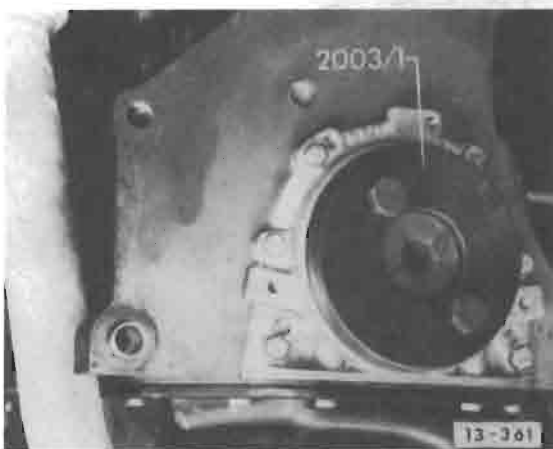


**Fig. 7 Crankshaft oil seal (flywheel side), removing**



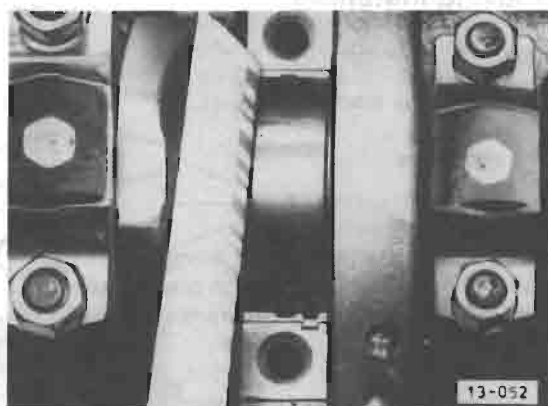
**Fig. 8 Crankshaft oil seal (flywheel side), installing**

—center with sleeve first



**Fig. 9 Crankshaft oil seal (flywheel side), installing**

—press in seal until fully seated



**Fig. 10 Main bearing clearance, checking**

- remove bearing caps
- clean shells and journals
- measure clearance with Plastigage
  - new part: 0.03–0.08 mm (0.001–0.003 in.)
  - wear limit: 0.17 mm (0.007 in.)

**CAUTION**

Do not turn crankshaft

## Diesel Injection System

Quick Data	Index
	<p><b>Diesel Injection System</b></p> <ul style="list-style-type: none"><li>—Cold start cable 23.5</li><li>—Engine speed 23.5</li><li>—Fuel cut-off solenoid 23.5</li><li>—Fuel delivery valve/ housing 23.7, 23.8</li><li>—Fuel filter water indicator kit, installing 23.10, 23.11</li><li>—Fuel injectors 23.8–23.10</li><li>—Injection pump 23.6, 23.7</li><li>—Injection pump/valve timing 23.3, 23.4</li><li>—Injection system 23.2</li><li>—Injection timing 23.4</li></ul>

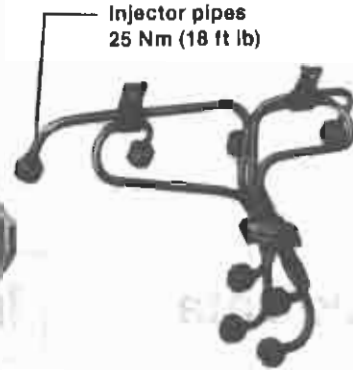
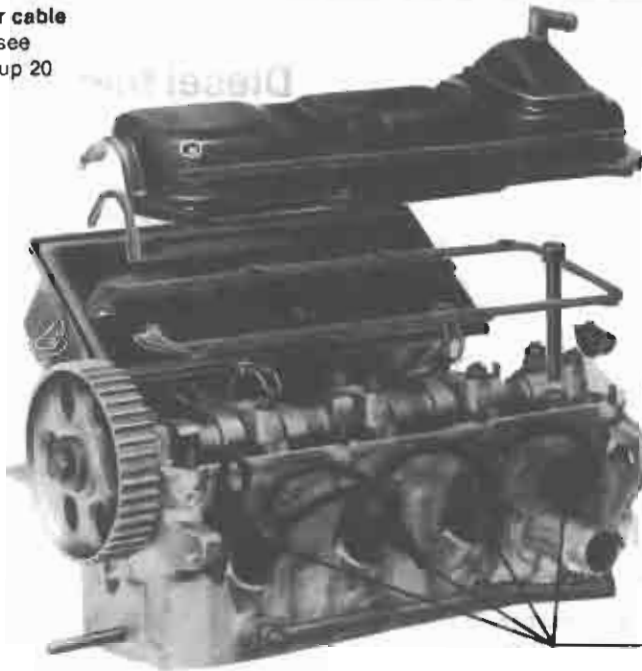
# 23 Diesel Injection System

Accelerator cable  
adjusting, see  
Repair Group 20

## WARNING

Disconnect battery when working on fuel system. Never smoke when working with fuel or have anything in area that can ignite it.

Always replace seals and fuel hose clamps



Injector pipes  
25 Nm (18 ft lb)

Injectors  
70 Nm (51 ft lb)  
removing/installing page 23.9  
cleaning page 23.9  
checking page 23.10

Cold start cable  
adjusting page 23.5

Engine speed  
checking/adjusting  
page 23.5

Glow plugs  
checking, see  
Repair Group 28

Tensioner  
use tool US 4493  
to tension

45 Nm (33 ft lb)

Drive belt  
removing/installing  
see Repair Group 13

20 Nm (14 ft lb)



Double V-belt pulley

Fuel delivery valves  
45 Nm (33 ft lb)  
checking/replacing  
page 23.8

Injection pump  
removing page 23.6  
installing page 23.7  
adjusting page 23.4  
checking page 23.3

25 Nm (18 ft lb)

25 Nm (18 ft lb)

Injection pump sprocket  
removing page 23.7

Intermediate shaft pulley

45 Nm (33 ft lb)

Crankshaft sprocket

Crankshaft sprocket bolt  
110 Nm (80 ft lb)  
do not use locking compound

13-593

## CAUTION

To avoid damage, keep injection parts clean when removing, installing, disassembling and assembling. Do not spill diesel fuel on any rubber hoses

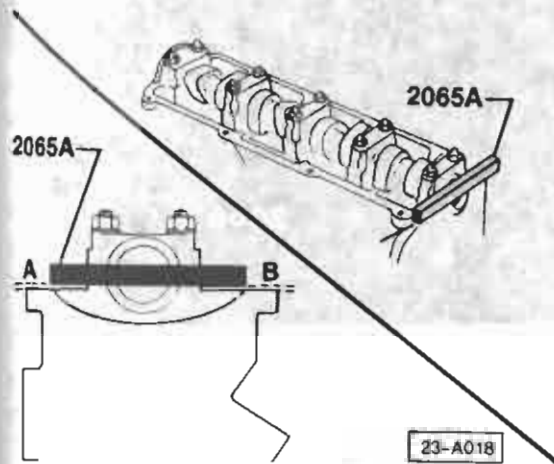
## Injection pump/Valve timing, checking

### Work sequence

#### Note

Drive belt must be checked for proper tension and be centered in sprockets before checking injection pump/valve timing

- remove cylinder head cover/drive belt cover
- rotate engine until lobes of camshaft on cylinder No. 1 point upward (TDC position)



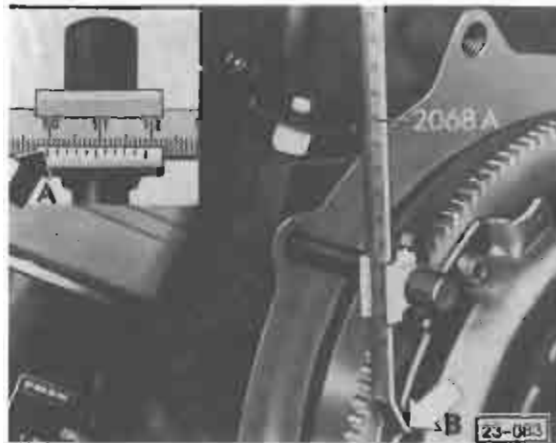
- install setting bar 2065A on cylinder head
- turn camshaft until one end of setting bar touches cylinder head
- measure gap at other end with feeler gauge
- take half of measurement and insert feeler of this thickness between bar and cylinder head at A
- turn camshaft so bar rests on feeler gauge
- insert second feeler gauge of same thickness between other end of bar and cylinder head at B



—check that marks on sprocket, pump and mounting plate (black arrow) are approximately aligned

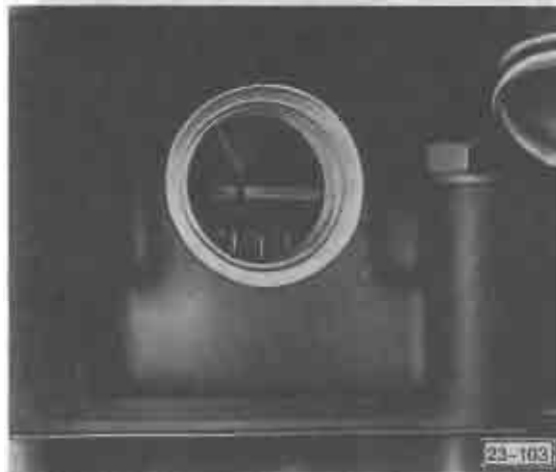
if **YES**, pump in correct position, continue with work sequence

if **NO**, pump incorrectly positioned, adjust pump/valve timing (see page 23.4)



(engine removed)

- attach tool 2068A to crankcase
- set scale to 100 mm (arrow A)
- tip of scale must align with TDC mark on clutch pressure plate (arrow B)



(engine installed)

—check that TDC mark on clutch pressure plate is in line with boss on bell housing  
if **YES**, valve timing **OK**; next check injection timing (see page 23.4)  
if **NO**, valve timing incorrect, proceed as follows:

- loosen camshaft sprocket bolt 1 turn
- tap back of camshaft sprocket with rubber hammer until it is loose
- hand tighten sprocket bolt until end play is eliminated but sprocket still turns freely on camshaft

- rotate engine until TDC marks align on flywheel
- torque camshaft bolt to 45 Nm (33 ft lb)
- recheck marks
- check injection timing (see page 23.4)

# 23 Diesel Injection System

## Injection pump/Valve timing, adjusting

### Work sequence

- remove cylinder head cover/drive belt cover
- set engine to TDC No. 1 cylinder
- lock camshaft in position with setting bar (see page 23.3)
- loosen camshaft sprocket bolt 1 turn
- tap back of camshaft sprocket with rubber hammer until it is loose
  - hand tighten sprocket bolt until end play is eliminated but sprocket still turns freely on camshaft
- loosen belt tensioner
- remove belt from injection pump sprocket



- turn pump sprocket until marks on sprocket, pump and mounting plate are in line
- lock pump sprocket with pin 2064
- reinstall drive belt



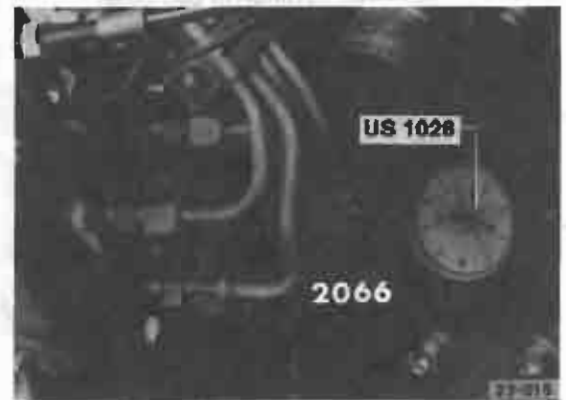
- tighten camshaft bolt to 45 Nm (33 ft lb) and remove setting bar
- remove lock pin from pump sprocket
- install belt tension gauge VW 210
- tension drive belt by turning tensioner clockwise
  - reading on belt tensioner = 12-13 (measured between camshaft sprocket and pump sprocket)
- lock tensioner
- turn crankshaft 2 complete turns and recheck belt tension
  - eliminate play in drive belt by striking once, between camshaft and pump sprockets, with rubber hammer
- recheck valve timing
- check injection timing

## Injection timing, checking/adjusting

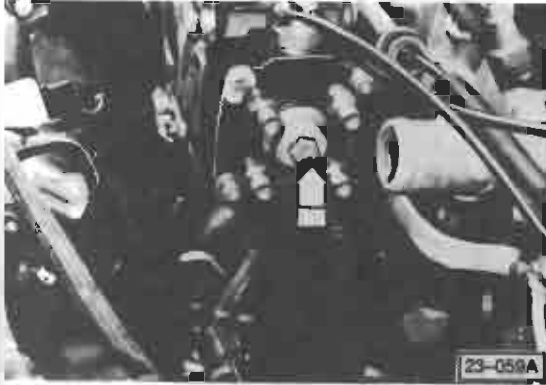
### Work sequence

#### CAUTION

Push in cold start device completely when checking or adjusting injection timing



- remove center plug from injection pump cover
- install adaptor and dial gauge 0 to 3 mm (0 to 0.118 in.) in place of plug and preload gauge to approx. 2.5 mm (0.097 in.)
- turn engine slowly counterclockwise (opposite to normal rotation) until dial gauge needle stops moving
- zero gauge
- turn engine clockwise until TDC mark on clutch pressure is aligned with boss on bell housing
- check that gauge reads 0.78-0.88 mm
- if necessary, loosen upper bolts on mounting plate and bolt of rear support
- set lift by turning pump until gauge reads  $0.86 \pm 0.02$  mm
- tighten pump mounting bolts and recheck injection timing



Tightening torque of the Diesel Injection pump center plug (arrow) is:

- $17 \pm 3$  Nm ( $12 \pm 2$  ft lb) with copper seal (reddish-brown in color)
- $22 \pm 2$  Nm ( $16 \pm 2$  ft lb) with bronze seal (yellow-brown in color)

### CAUTION

To avoid fuel leaks, always replace seal for center plug (arrow)

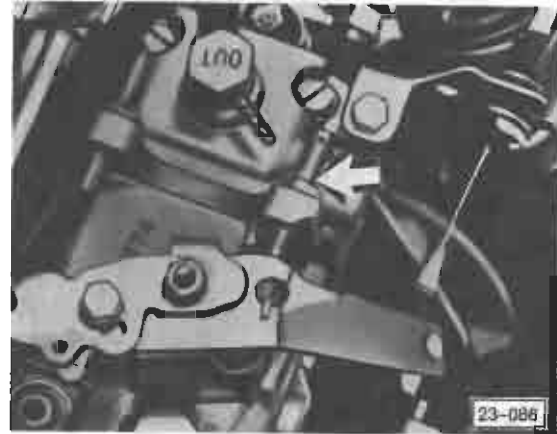
## Engine speed, checking/adjusting

### Work sequence

- start engine and warm up
- place engine RPM sensor US 1324 on cylinder head cover and attach to battery
- install positive lead of VAG 1367 to US 1324



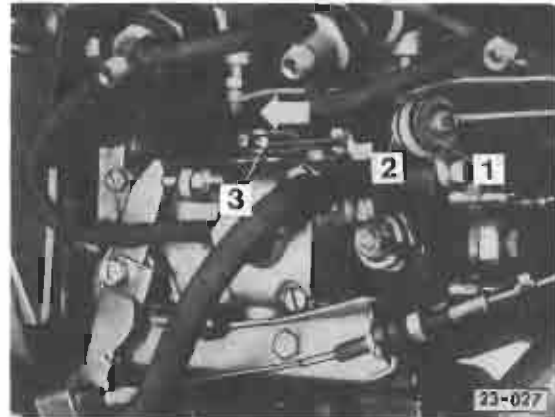
- check that idle speed is 800–850 RPM
  - oil temperature  $60^{\circ}\text{C}$  ( $140^{\circ}\text{F}$ )
- if NO
  - loosen locknut (arrow)
  - adjust idle speed screw
    - turning clockwise increases RPM
  - tighten locknut



- check that maximum speed is  $4800 \pm 50$  RPM if NO
  - loosen locknut (arrow)
  - adjust maximum speed screw
    - turning clockwise decreases RPM
  - tighten locknut

## Cold-start cable, adjusting

### Work sequence



- insert washer 1 onto cable
- install cable in bracket with rubber bushing and insert inner cable into pin 3
- install horseshoe lock clip 2
- push in cold-start knob fully
- move lever to stop in direction of arrow
- pull inner cable tight and secure pin 3 with clamping screw

### WARNING

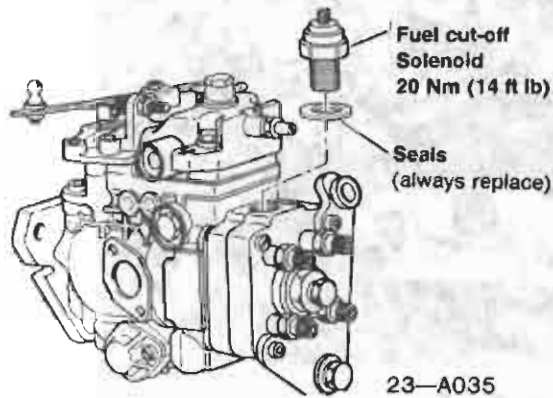
Disconnect battery when working on fuel system. Never smoke when working with fuel or have anything in area that can ignite it.

Always replace seals and fuel hose clamps.



# 23 Diesel Injection System

## Fuel cut-off solenoid, testing



The following test procedure must be performed before replacement of fuel cut-off solenoid:

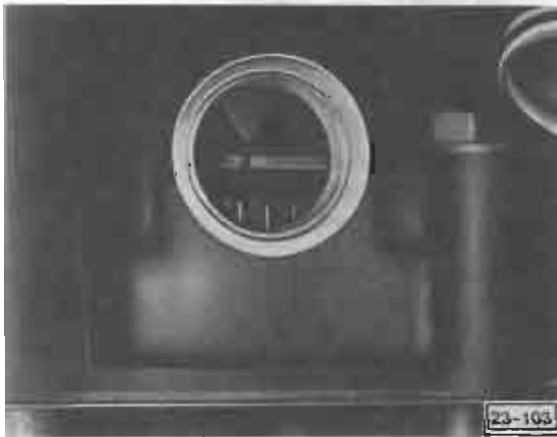
- Clean surrounding area and remove fuel cut-off solenoid from injection pump
- Inspect solenoid plunger and seat for foreign matter
- Clean solenoid plunger and check for free movement in solenoid
- Clean solenoid mounting surfaces
- Reinstall fuel cut-off solenoid using new seal and tighten to 20 Nm (14 ft lb)
- Check for proper operation

## Injection pump, removing

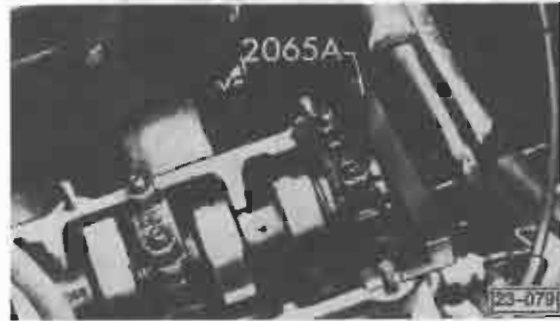
### Work sequence

#### CAUTION

When working on injection system, everything must be kept extremely clean. Wipe pipe unions clean before loosening



- turn engine until TDC mark on clutch pressure plate is in line with boss on bell housing
- disconnect battery ground strap



- remove cylinder head cover
- lock camshaft with setting bar
- remove drive belt
- loosen injection pump sprocket retaining nut slightly



- attach puller so jaws are at right angles to cross bar and point in direction of spindle rotation
- carefully apply tension with puller

#### CAUTION

Never apply excessive tension with puller, as this may damage sprocket

- hit puller spindle head (arrow) with light hammer taps until sprocket loosens from injection pump shaft taper
- remove puller and nut
- remove sprocket by hand
- detach all fuel pipes from pump. Cover unions with clean cloth
- disconnect wire from fuel shutoff solenoid on injection pump and detach accelerator and cold start cables



- remove three bolts from injection pump mounting plate 2

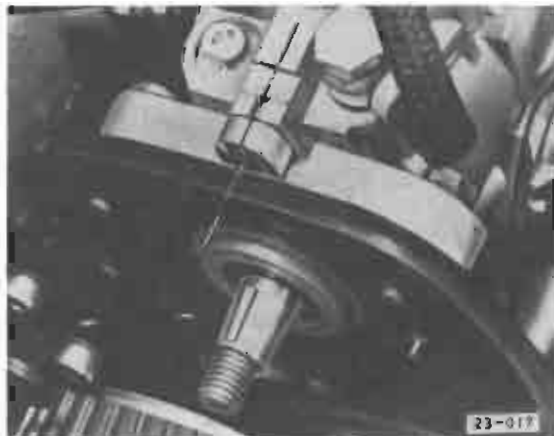
### CAUTION

To avoid damage to distributor plunger, do not loosen bolts (arrows) on fuel distributor head

- remove bolt 1 from rear support and remove pump

## Injection pump, installing

### Work sequence



- install pump, align marks on pump and mounting plate. Install pump sprocket

### Tightening torques

- |                 |                  |
|-----------------|------------------|
| • Pump bolts    | 25 Nm (18 ft lb) |
| • Fuel pipes    | 25 Nm (18 ft lb) |
| • Pump sprocket | 45 Nm (33 ft lb) |



### CAUTION

Do not interchange fuel supply (arrow A) and return (arrow B) pipe union screws. For identification, fuel return pipe union screw is marked **OUT** on hex. head

- adjust injection pump/valve timing (see page 23.4)
- adjust injection timing (see page 23.4)

## Fuel delivery valves, checking

### Work sequence

#### Note

Fuel leaks from fuel delivery valves are usually caused by improper removal of injector pipes. If fuel delivery valve leaks proceed as follows:



- remove injector pipes
- retorque fuel delivery valves (arrows) to 45 Nm (33 ft lb)
- reinstall injector pipes and tighten to 25 Nm (18 ft lb)
- start engine and check for leaks
  - if fuel leak did not stop replace fuel delivery valve housing and seal

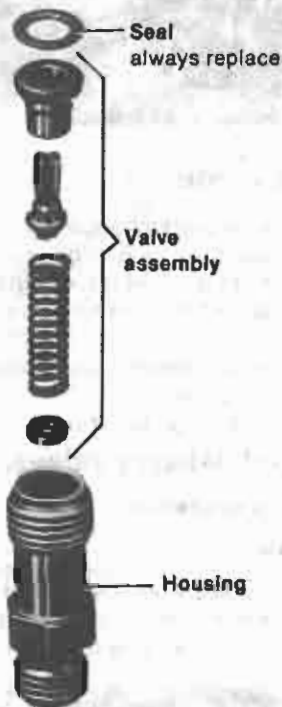
# 23 Diesel Injection System

## Fuel delivery valve housing, replacing

### Work sequence

#### CAUTION

When removing or replacing fuel delivery valves, do not interchange valve assemblies



- clean all injector pipe fittings
- remove injector pipes
- remove fuel delivery valve
- transfer valve assembly to new housing
- install fuel delivery valve, with new seal and tighten to 45 Nm (33 ft lb)
- reinstall injector pipes and tighten to 25 Nm (18 ft lb)
- start engine and check for leaks

## Fuel injectors, removing/installing

### Work sequence

#### Note

First signs of injector trouble usually appear as follows:

- knocking in one or more cylinders
- engine overheating
- loss of power
- smoky black exhaust
- increased fuel consumption

Faulty injectors can be located by loosening pipe union on each injector in turn with engine at fast idle. If engine speed remains constant after loosening a pipe union, this indicates a faulty injector

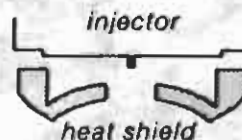
### Removing

#### CAUTION

To avoid damage, keep injection parts clean when removing, installing, disassembling and assembling

- clean all injector pipe fittings
- remove injector pipes
- disconnect fuel return hoses
- remove injectors using US 2775 or equivalent
- remove heat shields and discard

### Installing



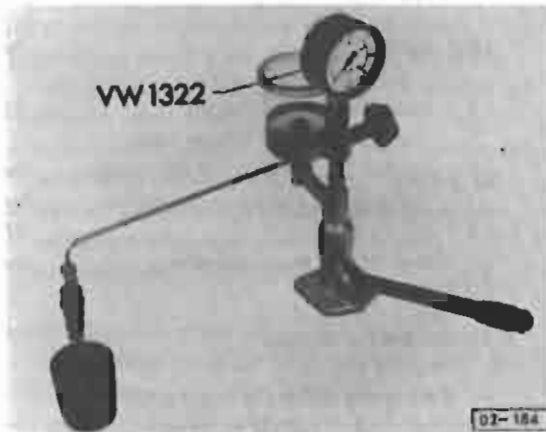
- install new heat shields as shown
- install injectors and tighten to 70 Nm (51 ft lb)
- install injector pipes and tighten to 25 Nm (18 ft lb)
- reconnect fuel return hoses
- start engine and accelerate a few times to clear air bubbles
- check for leaks

## Fuel injectors, checking

### Work sequence

#### WARNING

Diesel fuel will penetrate skin if hands are exposed to working pressure of injector spray



—test injectors with US 1111

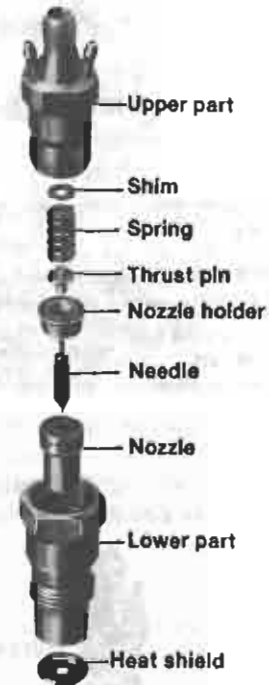
#### Spray test

- fill tester container with clean diesel fuel
- attach injector to tester
- pump tester a few times to clear air bubbles
- turn valve on tester so pressure gauge is **OFF**
- pump tester with rapid short strokes (4 to 6 strokes per sec.)
  - spray should be even, well atomized and stop cleanly
  - injector must not drip

#### Opening pressure test

- turn valve on tester so pressure gauge is **ON**
- press pump lever down slowly
- note opening pressure when injector sprays
  - used injectors = 120 to 130 bar (1740 to 1885 psi)
  - new injectors = 130–138 bar (1885–2001 psi)

if **NO**—continue as follows



- remove injector from tester and disassemble
- remove shim and measure
- select proper shim
  - thicker shim increases pressure
  - a change in thickness of 0.05 mm (0.0019 in.) changes pressure approximately 5 bar (72 psi)
  - shims are available from 1 to 1.95 mm (0.039–0.070 in.) in steps of 0.05 mm (0.0019 in.)
- reassemble injector and retest until correct opening pressure is reached

#### Note

When servicing used injectors, set opening pressure to value for new injectors

#### Leakage test

- pressure gauge still **ON**
- press pump lever down slowly
- hold pressure at approximately 110 bar (1595 psi) for 10 seconds
  - fuel should not drip from injector at nozzle

#### Note

All **new** and **rebuilt** injectors have a settling effect of approx. 5 bar. When installing new/rebuilt injectors, they must have a 5 bar higher opening pressure.

# 23 Diesel Injection System

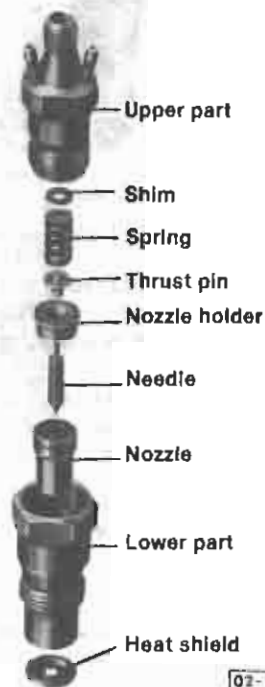
## Fuel injectors, cleaning

### Work sequence

#### CAUTION

Disassemble and clean one injector at a time. Effectiveness of injectors will change if parts from other injectors are interchanged

- clamp upper part of injector in vise and loosen lower part
- turn injector over, lightly clamp lower part of injector in vise and disassemble



- clean parts of injectors in clean diesel fuel
  - gasoline may be used to clean carbon deposits but part must be rinsed in diesel fuel immediately
- visually check injector parts for
  - damaged, carbonized or rough needle seat
  - worn or damaged injection needle and nozzle
  - needle binding in nozzle
- reassemble injector and tighten halves to 70 Nm (51 ft lb)

## Fuel filter water indicator kit, installing

Water level indicator light will light when it is necessary to drain water from trap in fuel filter

### Parts required

Qty	Description	Part No.
1	water level indicator kit	175 988
1	"double" (single female into double male) electrical connector	local supply
1	"ring type" electrical connector	local supply
1	grommet	171 971
	blue 18 ga. electrical wire	local supply

### Installation procedure

- disconnect battery ground cable
- drop down Fuse/Relay Panel



- remove trim cover from front of floor duct

Mount control unit as follows:

- mount retaining clip (included in Kit) to fresh air tube with sheet metal screw (included in Kit) so control unit will clip into position shown in photo
- also attach brown ground wire (included in Kit) under mounting screw with "ring type" connector
- install double connector on terminal **15** of control unit and clip unit in place
- connect ground wire from mounting screw to terminal **31** of control unit

Install and connect indicator light as follows:

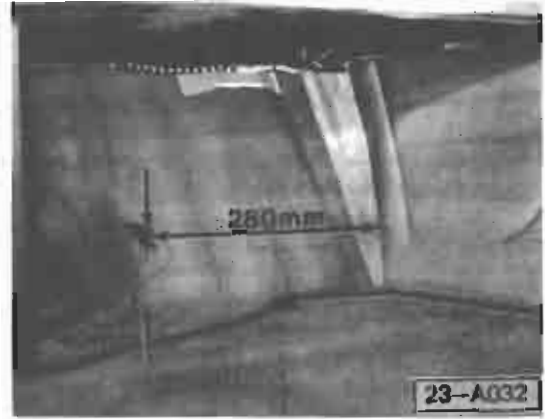
- mark and drill a 9 mm hole approx. 50 mm to right of cold start cable and mount indicator light
- connect white wire (included in Kit) to light
- route wire to control unit and attach to one male terminal of double connector on terminal **15**
- connect yellow wire (included in Kit) to light
- route wire to control unit and attach to terminal **31b**

Install and connect water sensor as follows:

- replace water drain-screw in fuel filter with drain-screw/sensor, included in Kit
- connect blue wire (included in Kit) to terminal **A** of control unit



- route wire under left side of floor vent, between handbrake and left seat base. Continue around back of left seat base under carpeting and to rear along left side of passenger compartment under carpeting



- continue to route wire under carpeting under left side of rear seat
- route wire out from under carpeting where shown

### Note

Blue wire provided is too short and must be lengthened to reach fuel filter in engine compartment

- mark and drill a 13 mm hole at location shown in rear panel under back seat
- insert grommet in hole and route wire through to left rear wheel well area
- from wheel well, carefully route wire across vehicle above transmission, and then back to fuel filter
- connect wire to terminal on new drain-screw/sensor
- connect black wire (included in Kit) to remaining male terminal of double connector on terminal **15** of control unit
- route wire to rear of Fuse/Relay Panel and connect to fused side of fuse **12**
- reinstall Fuse/Relay Panel
- reinstall trim cover for floor duct
- reconnect battery ground cable
- test system by switching ignition on and grounding blue wire from sensor on fuel filter casing. Light should come on and remain on until ignition is switched off

Suggested Installation Time: 125 T.U.  
Labor Operation: 20 34 31 0

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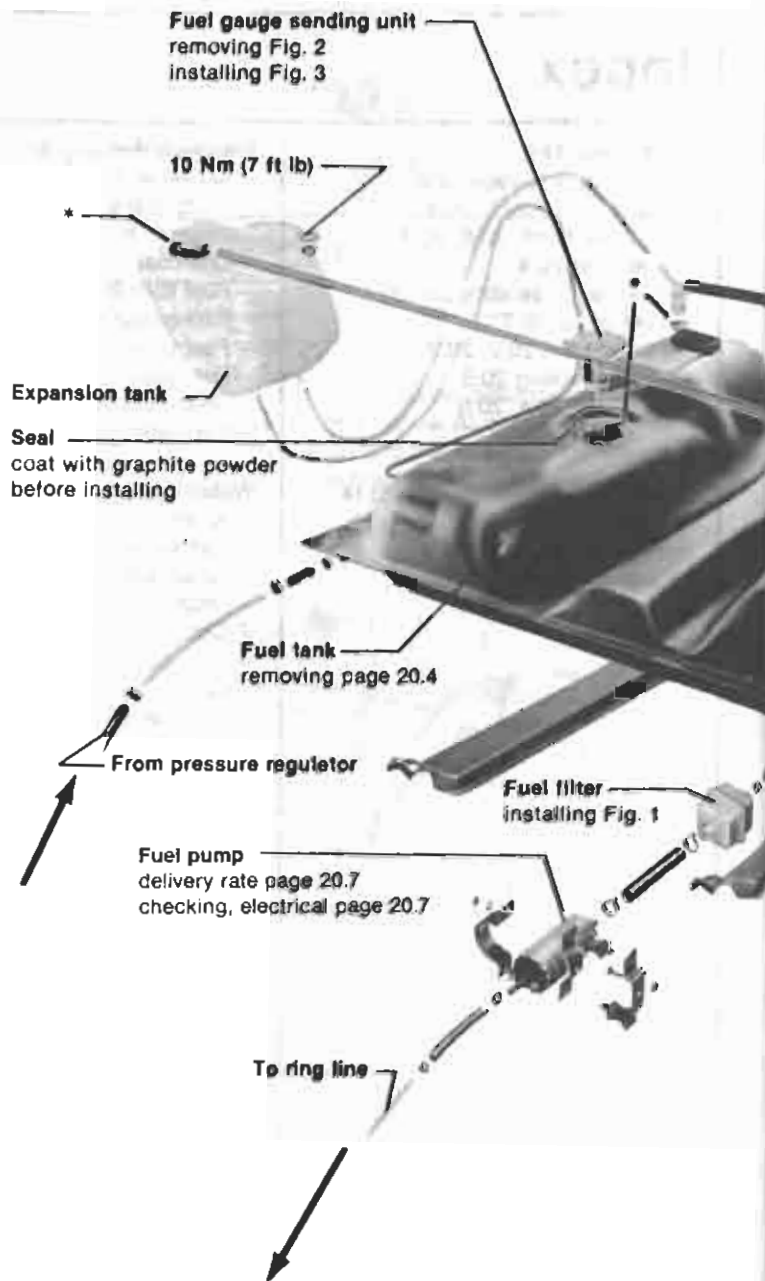
# 20 Fuel Supply

## Note

California models, from 1981, have a:

- new fuel-tank filter that is self cleaning and requires **NO SERVICING**
- new and enlarged fine-mesh in-line fuel filter which requires **NO SERVICING**

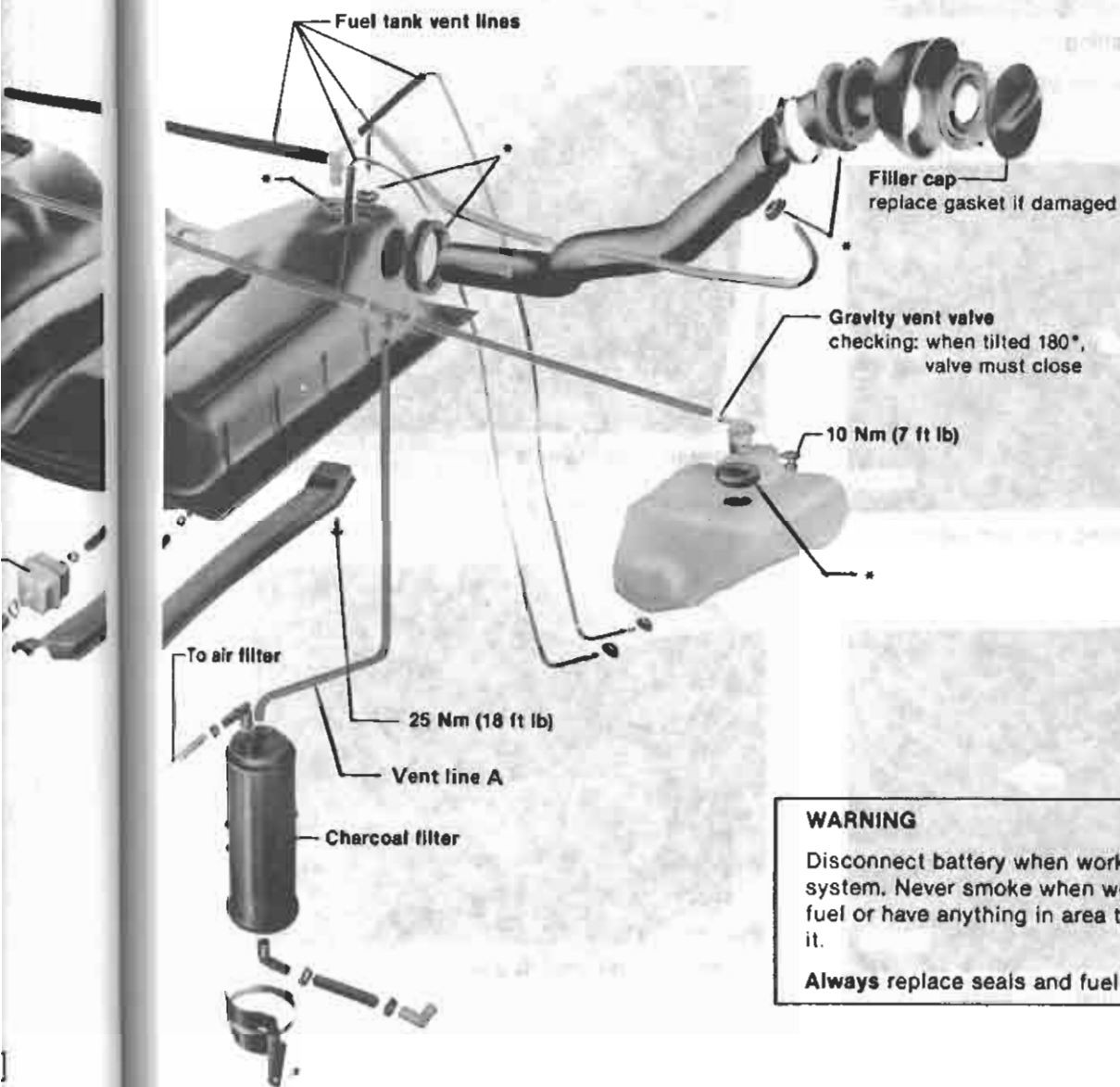
## Fuel supply system components, Removing and installing



## Note

Check system for leaks using a soap solution at spots marked with an \*. Seal if necessary.

20-304



### WARNING

Disconnect battery when working on fuel system. Never smoke when working with fuel or have anything in area that can ignite it.

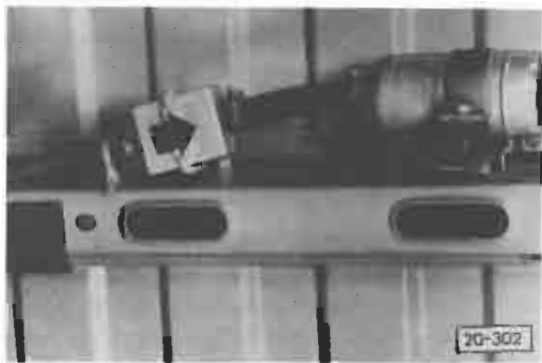
Always replace seals and fuel hose clamps

20-304

Air-cooled

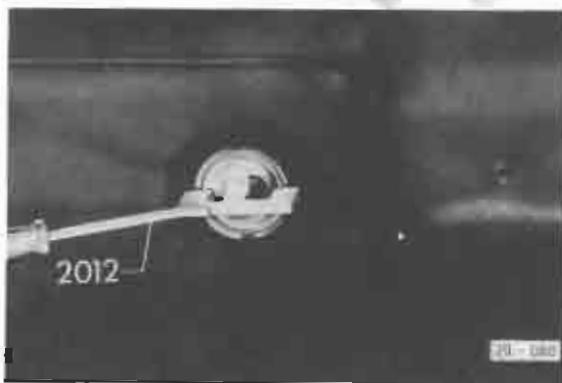
AFC

Fuel system **20.3**



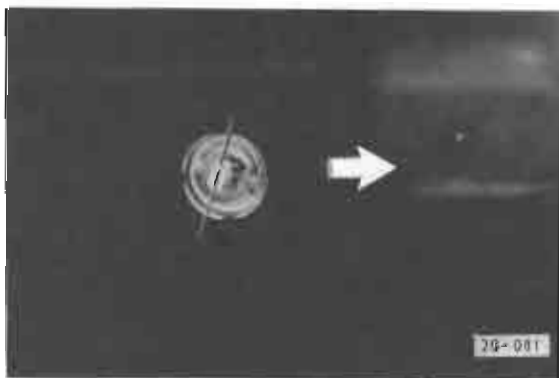
**Fig. 1 Fuel filter, installing**

- install with arrow pointing toward fuel pump



**Fig. 2 Fuel gauge sending unit, removing**

- first remove fuel tank



**Fig. 3 Fuel gauge sending unit, installing**

- coat seal with graphite powder and position carefully
- install sending unit with electrical connector as shown (arrow points to front of vehicle)

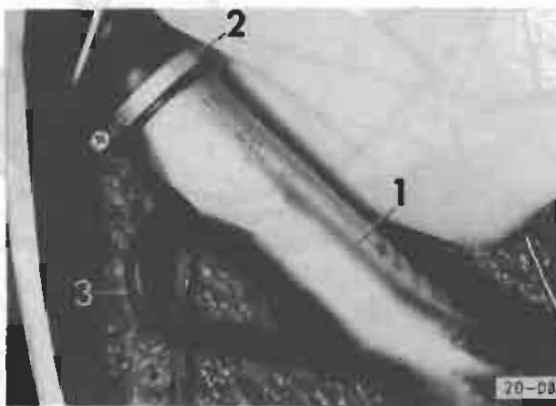
## Fuel tank, removing

### Work sequence

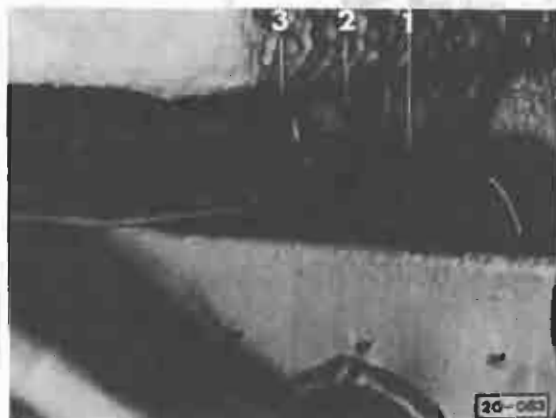
#### WARNING

Fire hazard! Do not smoke or have anything in area that can ignite fuel

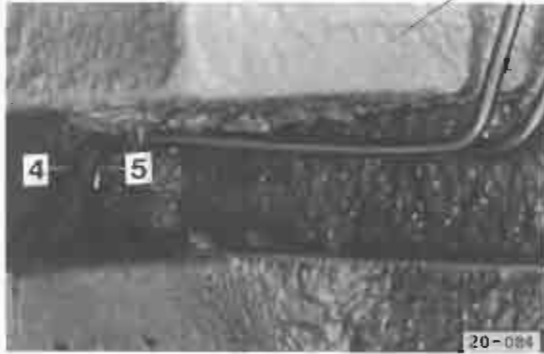
- disconnect battery ground cable
- drain fuel tank



- loosen hose clamp 2
- remove filler neck 1
- remove vent hose 3



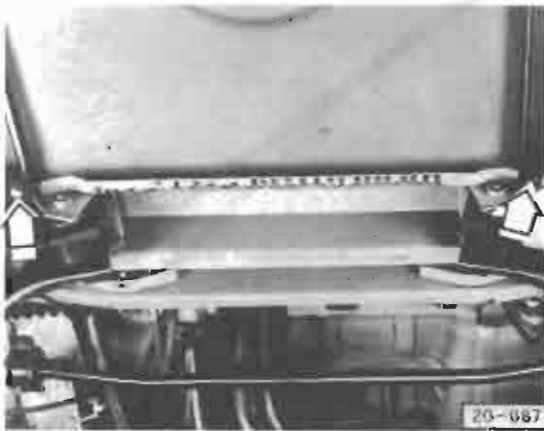
- remove vent hoses 1, 2 and 3



— remove vent hoses 4 and 5



— remove fuel supply hose 1 and fuel return hose 2 from fuel tank



— loosen bolts on fuel tank mounting rails (white arrows) and remove rails from rear channel  
 — lower fuel tank and disconnect electrical connector on fuel gauge sending unit  
 — remove fuel tank

## Fuel system, leak checking

Refer to illustration on pages 20.2 and 20.3 for location of vent line indicated below.

After removal/repairs on fuel tank, always check fuel system for leaks as follows:

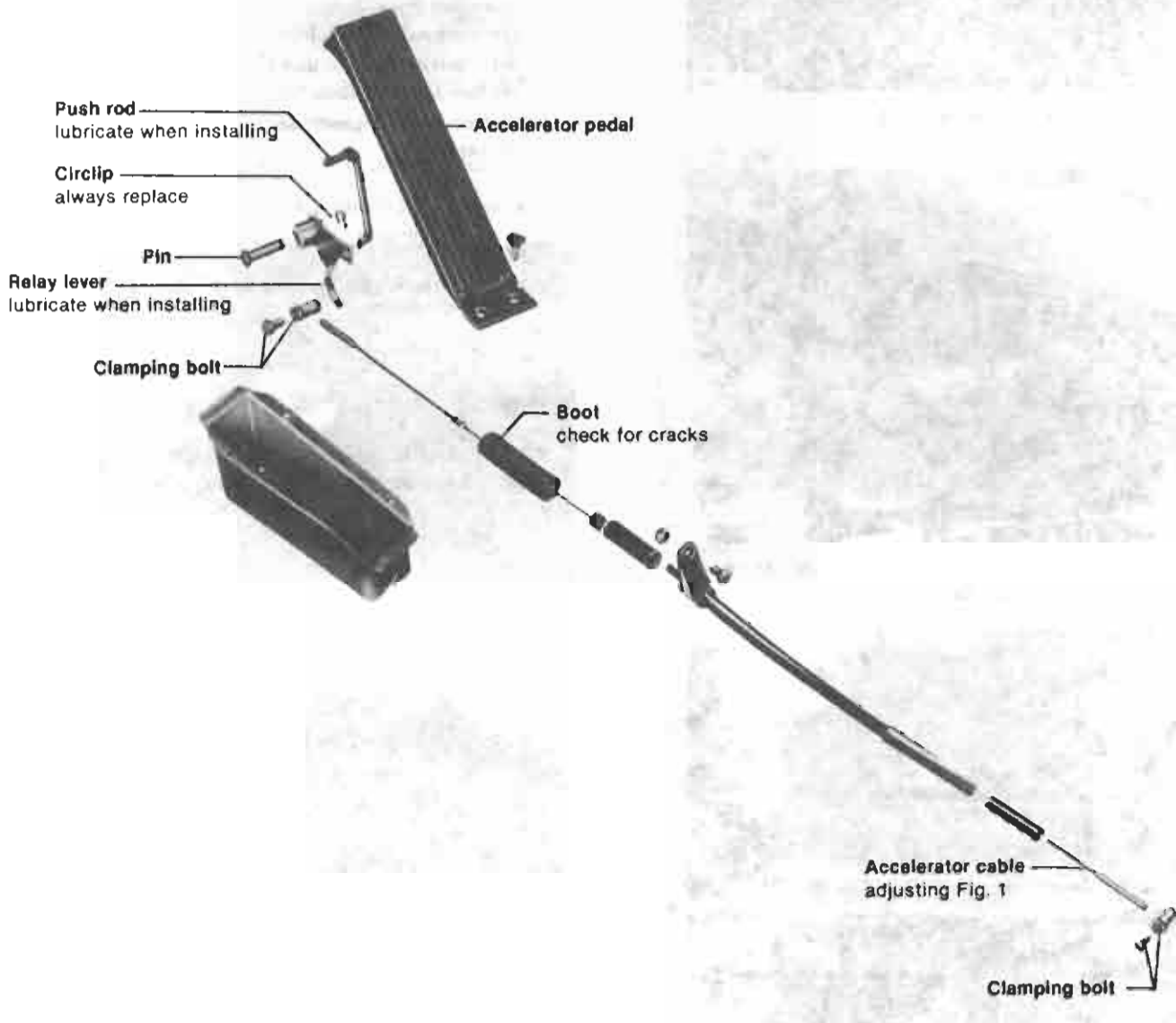
- remove small hose **A** from activated charcoal filter and connect to leak tester US 4487.
- set leak tester scale to "0".
- pressurize system with hand pump to 1.3 in. of mercury.
  - system OK if pressure is 1.0 in. or greater after 5 minutes.
  - system leaking if pressure drops below 1.0 in. after 5 minutes.

### Note

Check system for leaks using soap solution at spots marked with an \*. Seal if necessary.

# 20 Fuel Supply

## Accelerator linkage/cable Manual transmission



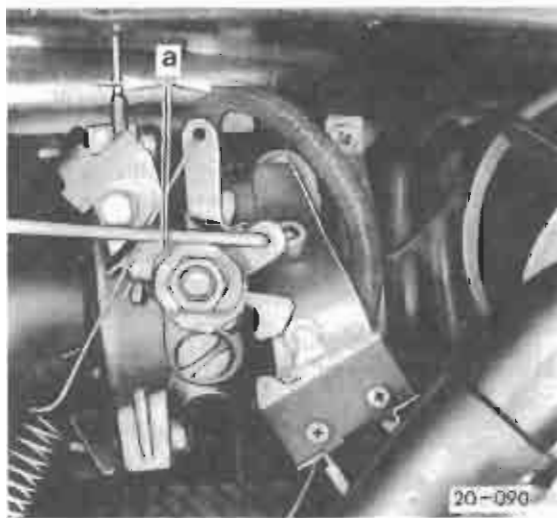
20-093

## 20.6

Accelerator linkage/cable

Air-cooled AFC

Manual Trans.



**Fig. 1 Accelerator cable, adjusting**

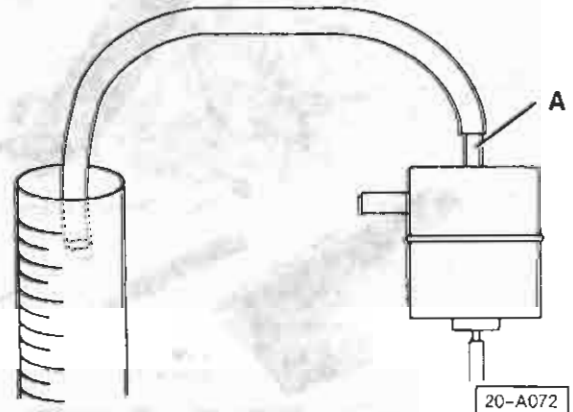
- adjust cable so that clearance is obtained between throttle valve lever and stop on throttle valve housing
  - $a = 1.0\text{--}1.5\text{mm}$  (0.040–0.060 in.)

## Fuel pump delivery rate, checking

### Work sequence

#### WARNING

Fire hazard! Never smoke or have anything in area that can ignite fuel



- disconnect fuel return line at pressure regulator
- attach hose to return line fitting on pressure regulator **A** and place other end of hose in one quart measuring container
- turn on ignition and open air sensor (or bridge air sensor plug terminals 36 and 39). Run pump exactly 30 seconds
  - delivery quantity should be at least 500 cc (approx. 1/2 quart)
- If **NO**, check fuel filter is not blocked, ground connections are O.K. and voltage at pump is at least 11.5 volts before replacing pump

## Fuel pump, checking (electrical)

### Note

Battery must be fully charged

- connect ammeter at fuel pump in series with pump and current supply

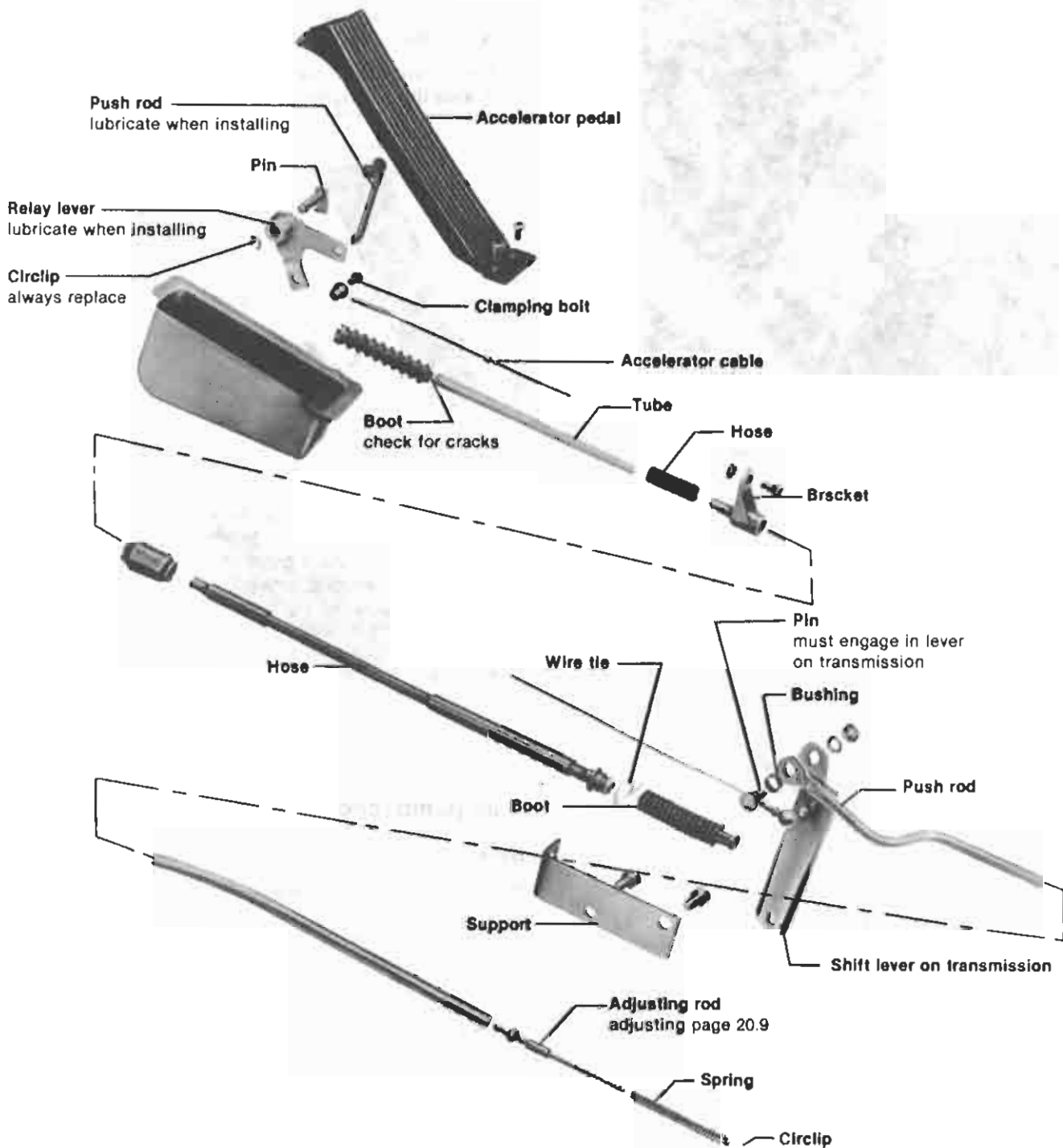
#### CAUTION

Do not touch positive connection to ground

- turn on ignition and open air sensor flap (or bridge air sensor plug terminals 36 and 39)
  - ammeter should read 6.5–8.5 amps
  - lower reading may indicate poor ground connections
  - higher reading usually indicates dragging pump motor and unit must be replaced

# 20 Fuel Supply

## Accelerator linkage/cable Automatic transmission



37-435



## Accelerator linkage/cable adjustment, checking

(automatic transmission)

### Work sequence

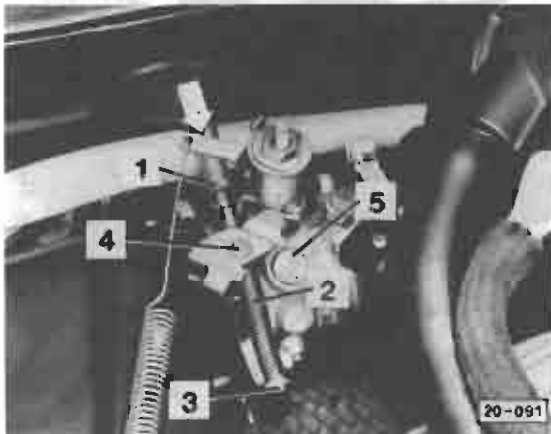
- depress accelerator pedal to full throttle position
  - throttle valve lever must contact stop, but kickdown lever on transmission must **not** be in kickdown position
- press accelerator pedal beyond full throttle to floor
  - override spring must be tensioned and kickdown lever on transmission must be in kickdown position

if **NO**, adjust as follows:

## Accelerator linkage/cable, adjusting

(automatic transmission)

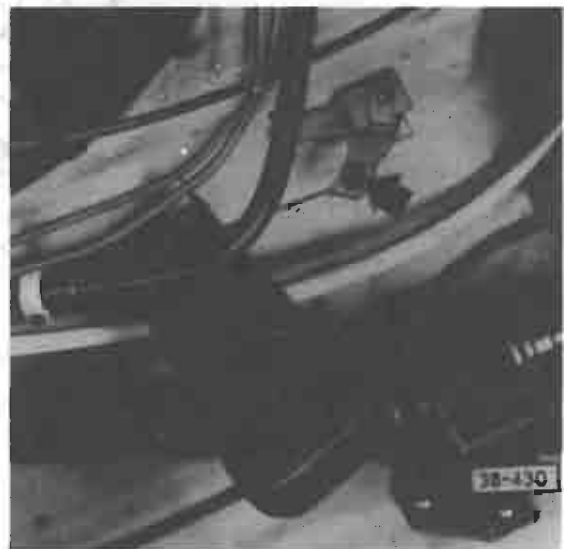
### Work sequence



- loosen nut 1
- remove override spring 2
- start engine and let idle
- adjust idle speed at screw 5 (see Repair Group 24)
- shut engine **OFF**
- press accelerator rod in direction of arrow to stop
- turn adjusting rod 3 with screwdriver until shoulder of adjusting rod just contacts pivot of throttle lever 4
- reinstall override spring 2
- start engine and check idle speed
  - adjust if necessary by turning rod 3
- lock adjusting rod 3 in position with nut 1



- press accelerator pedal to floor
  - lever 6 must be in kickdown position (arrow), with approx. 1–2mm (1/32–3/32 in.) free play between lever and stop
- release accelerator pedal
- lever must be in idle position (out of kickdown)



- if necessary, adjust accelerator cable at clamping bolt (arrow)

# 20 Fuel Supply

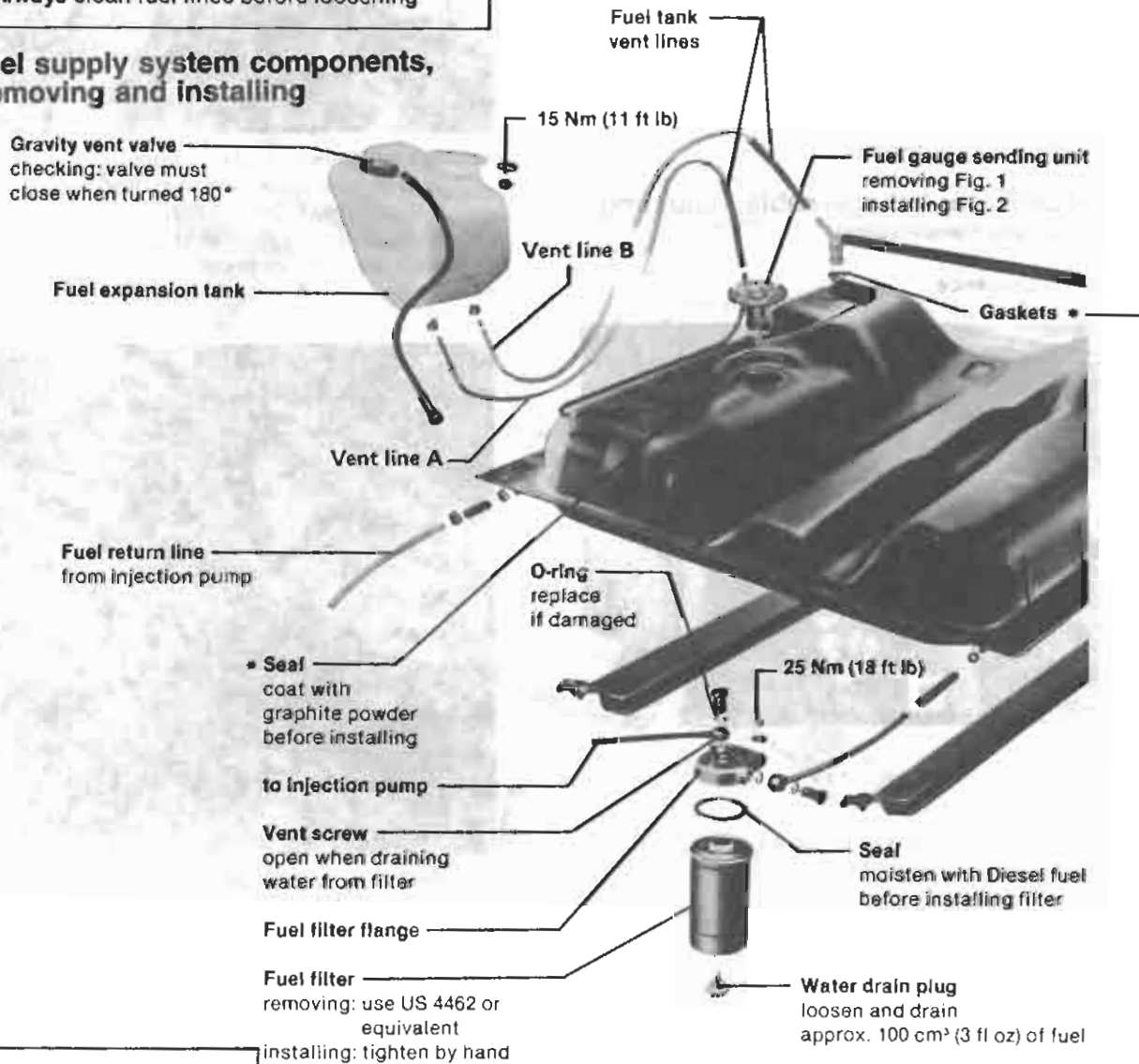
## WARNING

Disconnect battery when working on fuel system. Never smoke when working with fuel or have anything in area that can ignite it.

Always replace seals and fuel hose clamps.

Always clean fuel lines before loosening

## Fuel supply system components, Removing and installing



## CAUTION

Use only approved fuel filters for maintenance service or repairs. Not all after-market filters meet the filtering, fuel flow, or water separation requirements of the injection system.

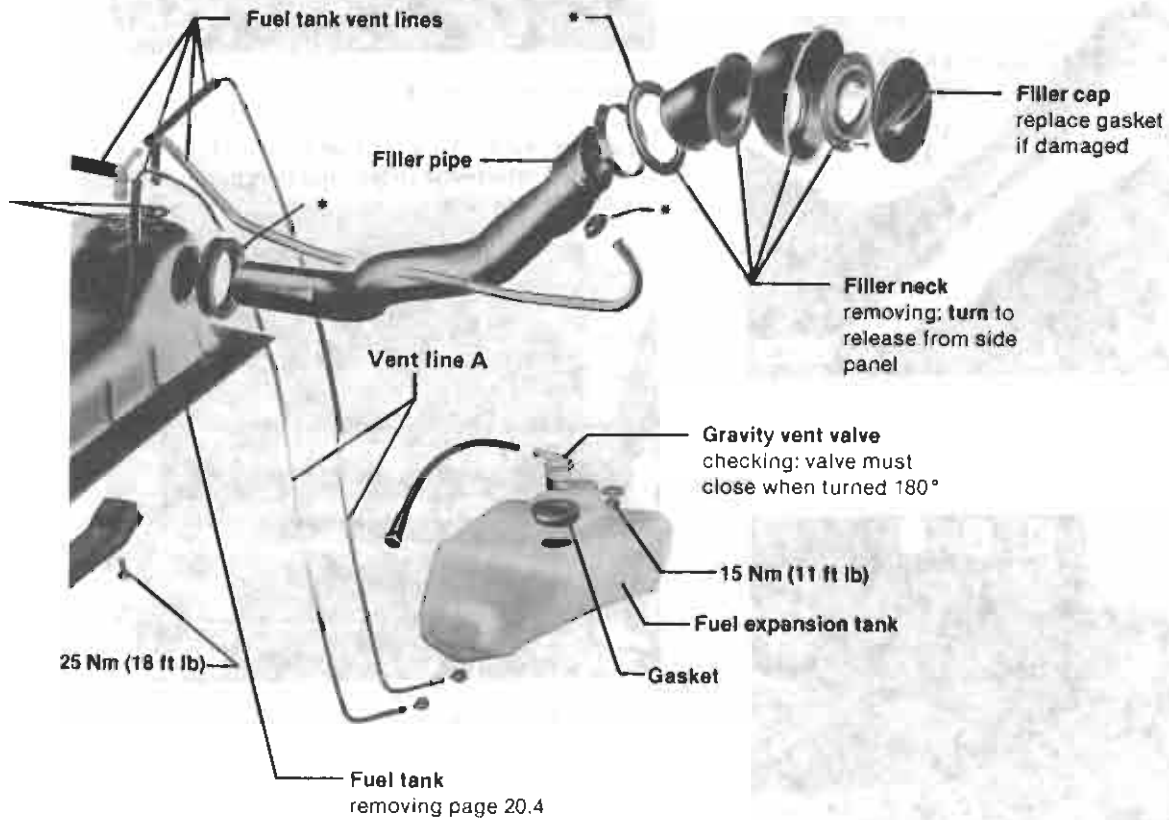
23-094

## WARNING

Disconnect battery when working on fuel system. Never smoke when working with fuel or have anything in area that can ignite it.

**Always** replace seals and fuel hose clamps.

**Always** clean fuel lines before loosening



## Note

Check system for leaks using a soap solution at spots marked with an \*. Seal if necessary.

# 20 Fuel Supply

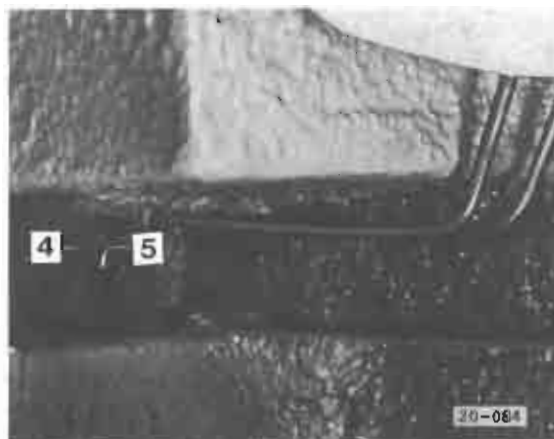
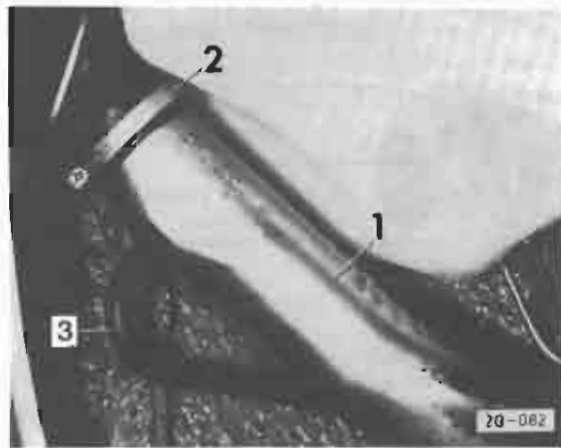
## Fuel tank, removing

### Work sequence

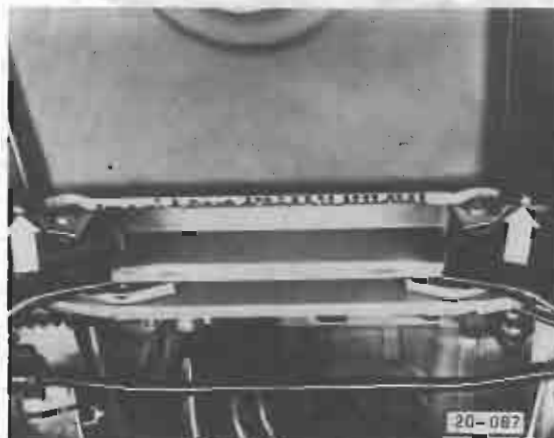
#### WARNING

Fire hazard! Do not smoke or have anything in area that can ignite fuel

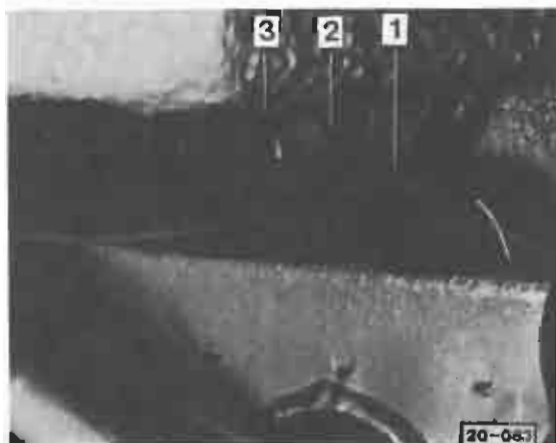
- disconnect battery ground cable
- drain fuel tank



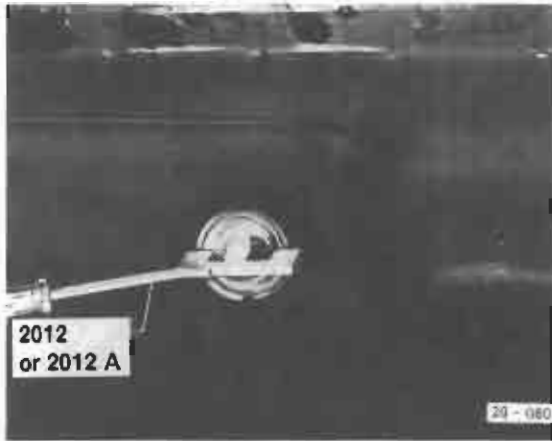
- remove vent hoses 4 and 5
- pull fuel suction line (to fuel filter on right side) and fuel return line (from injection pump, left side) off fuel tank



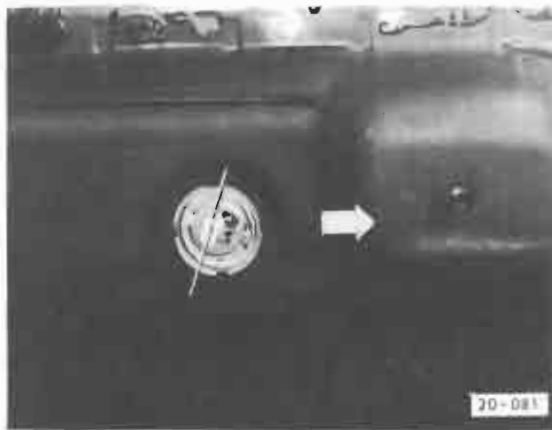
- loosen bolts on fuel tank mounting rails (white arrows) and remove rails from rear channel
- lower fuel tank and disconnect electrical connector on fuel gauge sending unit
- remove fuel tank



- remove vent hoses 1, 2 and 3



**Fig. 1 Fuel gauge sending unit, removing**  
 — first remove fuel tank



**Fig. 2 Fuel gauge sending unit, installing**  
 — coat seal with graphite powder and position carefully  
 — install sending unit with electrical connector as shown (arrow points to front of vehicle)

## Fuel system, leak checking

Refer to illustration on pages 20.10 and 20.11 for location of vent lines indicated below.

After repairs/removal of fuel tank, always check fuel system for leaks as follows:

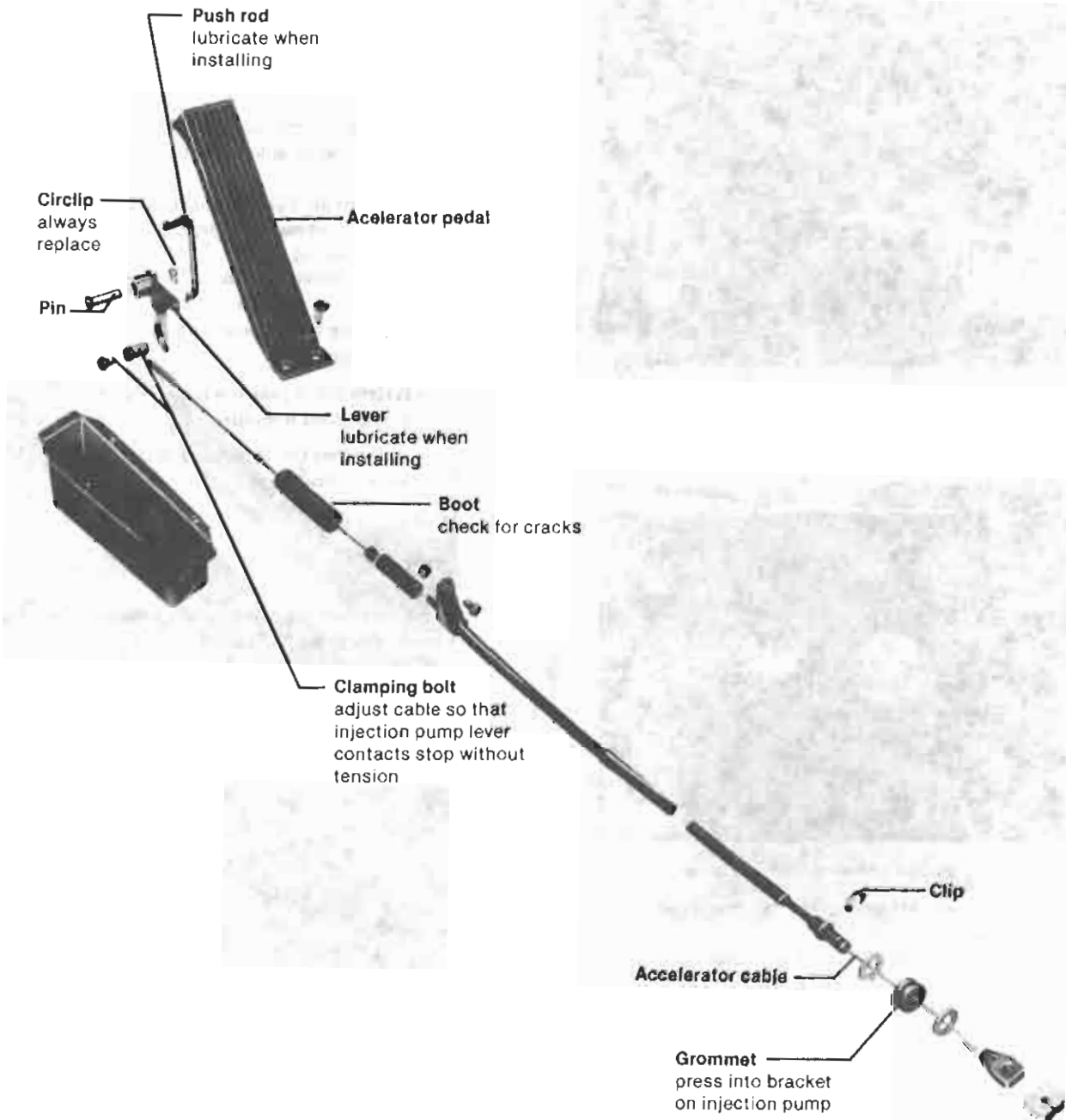
- pinch off all 3 vent hoses **A** with clamp.
- remove vent hose **B** from canister and connect to leak tester US 4487.
- set leak tester scale to "0".
- pressurize fuel system with hand pump to 1.3 in. of mercury.
  - system OK if pressure remains at 1.0 in. Hg or greater after 5 minutes.
  - system not OK if pressure drops below 1.0 in. Hg after 5 minutes.

### Note

Check system for leaks using a soap solution at spots marked with an \*. Seal if necessary.

# 20 Fuel Supply

## Accelerator linkage/cable Manual transmission



23-096

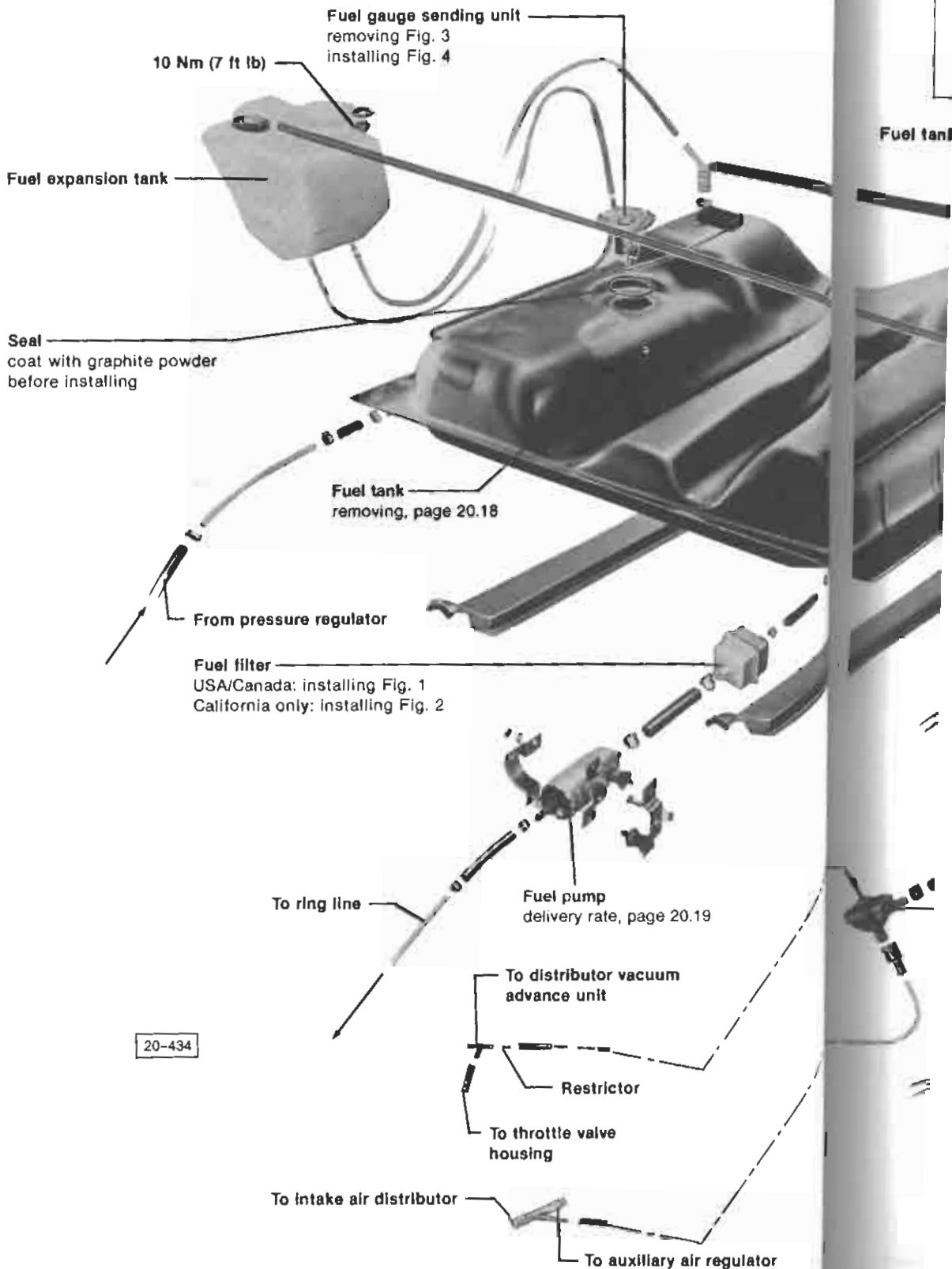
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# 20 Fuel Supply

## Fuel supply system components, Removing and installing

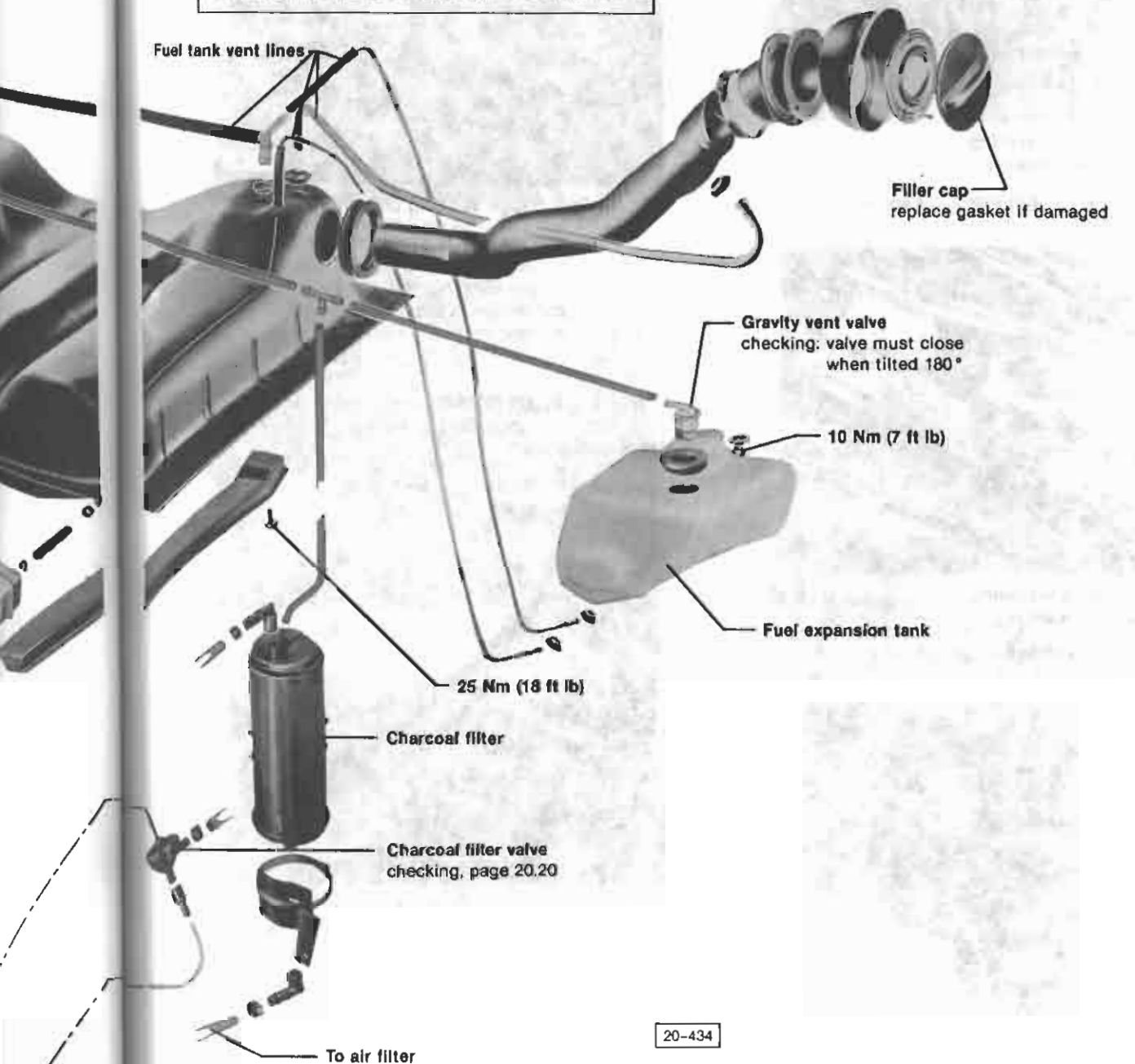
Fuel system checking for leaks, see page 20.21

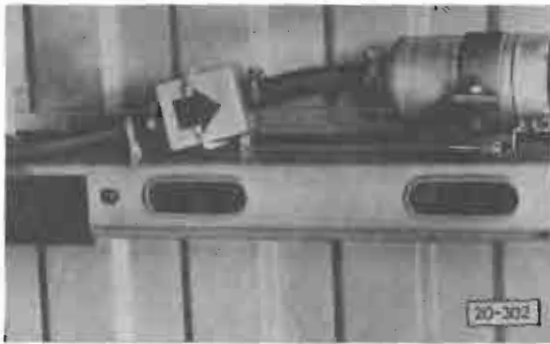


## WARNING

Disconnect battery when working on fuel system. Never smoke when working with fuel or have anything in area that can ignite it.

Always replace seals and fuel hose clamps





**Fig. 1 Fuel filter, installing (USA and Canada)**

- arrow on filter faces toward fuel pump



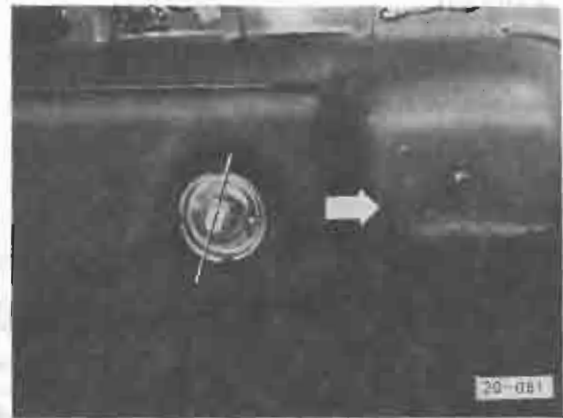
**Fig. 2 Fuel filter, installing (California only)**

- arrow on filter faces toward engine



**Fig. 3 Fuel gauge sending unit, removing**

- before removing unit, remove fuel tank



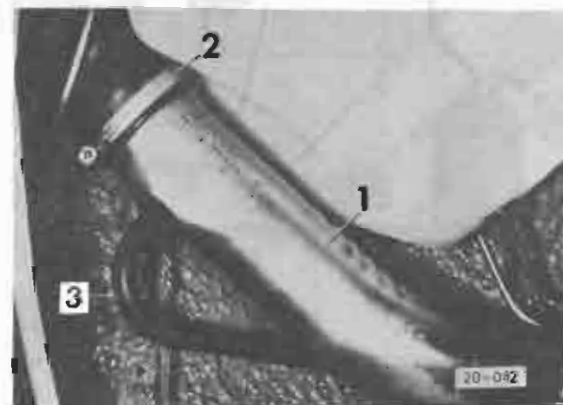
**Fig. 4 Fuel gauge sending unit, installing**

- coat seal with graphite powder and position carefully
- install sending unit so that electrical connector is aligned with dotted line
- arrow points to front of vehicle

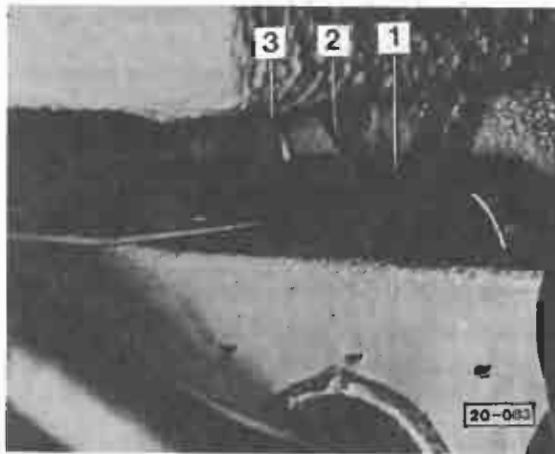
## Fuel tank, removing

### Work sequence

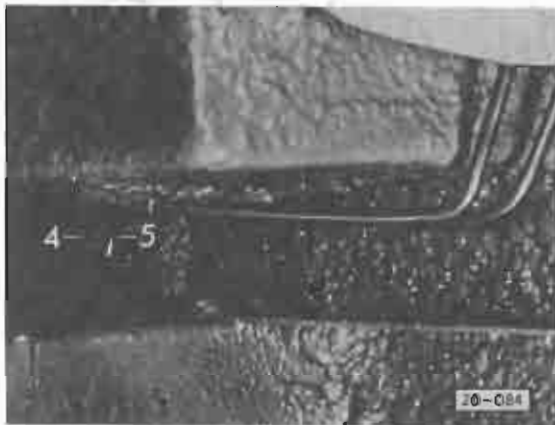
- disconnect battery ground strap
- drain fuel tank



- loosen clip 2 on filler elbow
- remove filler pipe 1 and puff out breather pipe 3
- go to next page



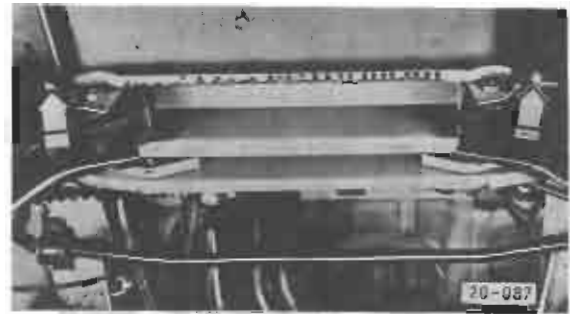
— remove vent hoses (on right) 1, 2 and 3



— remove vent hoses 4 and 5



— remove fuel supply hose 1 and fuel return hose 2 from fuel tank



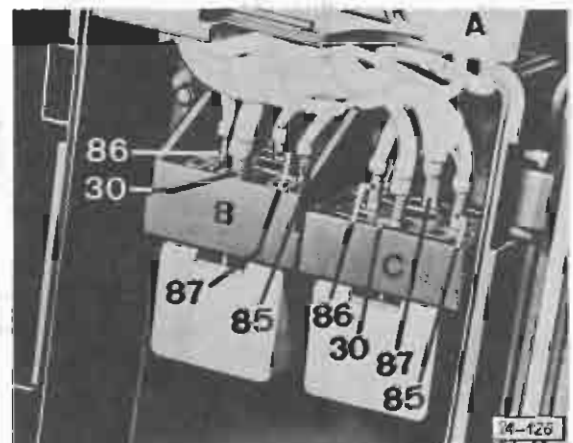
- loosen bolts on fuel tank mounting rails (white arrows) and remove rails from rear channel
- lower fuel tank and disconnect electrical connector on fuel gauge sending unit
- remove fuel tank

## Fuel pump delivery rate, checking

### Work sequence

#### WARNING

Fire hazard! Never smoke or have anything in area that can ignite fuel



- disconnect fuel return line at pressure regulator and block line
- attach hose to return line fitting on pressure regulator and place other end of hose in one quart measuring container
- remove relay C
- connect terminals 30 and 87 with tester US 4480/3
- switch on for 30 seconds
  - minimum fuel delivery rate should be 500 cm<sup>3</sup>

# 20 Fuel Supply

## Charcoal filter valve, checking



- disconnect hose 1 from charcoal filter valve 2
- connect vacuum pump to filter valve connection instead of hose 1
- disconnect hose 3 from T-piece 4
  
- operate vacuum pump and suck with mouth on hose 3
  - filter valve must be open
- **without** operating vacuum pump suck with mouth on hose 3
  - filter valve must be closed

If NOT, replace charcoal filter valve



## Fuel system, checking for leaks

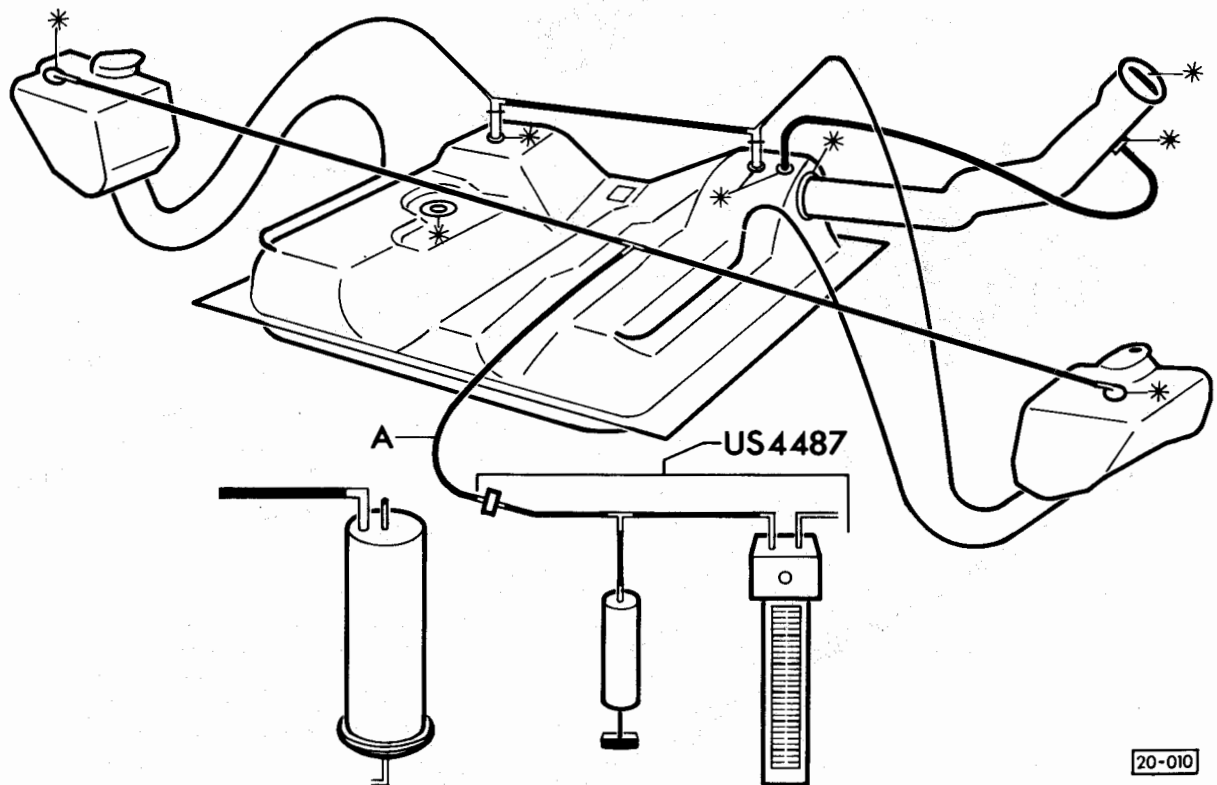
(Vehicles with rear wheel drive ONLY)

### WARNING

Disconnect battery when working on fuel system. Never smoke when working with fuel or have anything in area that can ignite it.

### Note

After performing repairs on fuel tank, always check fuel system for leaks as follows:



20-010

### Work sequence

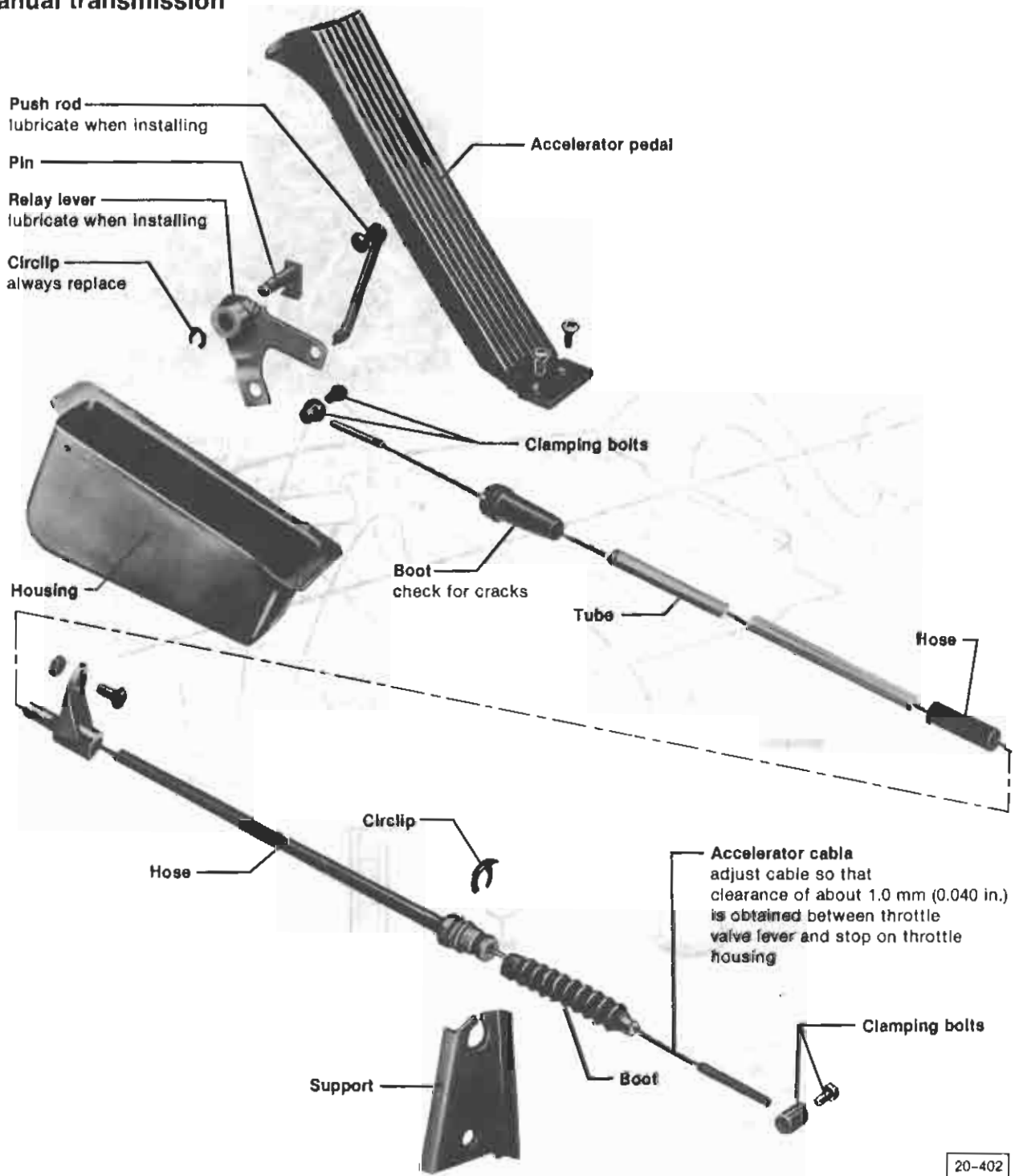
- Remove small hose **A** at charcoal filter and connect to leak tester US 4487
- Set leak tester scale to "0"
- Pressurize system with hand pump to 3.3 cm (1.3 in) of mercury
  - system OK if pressure is 2.54 cm (1.0 in) or greater after 5 minutes
  - system leaking if pressure drops below 2.54 cm (1.0 in) after 5 minutes

### Note

Check system for leaks using soap solution at spots marked with\*. Seal if necessary.

# 20 Fuel Supply

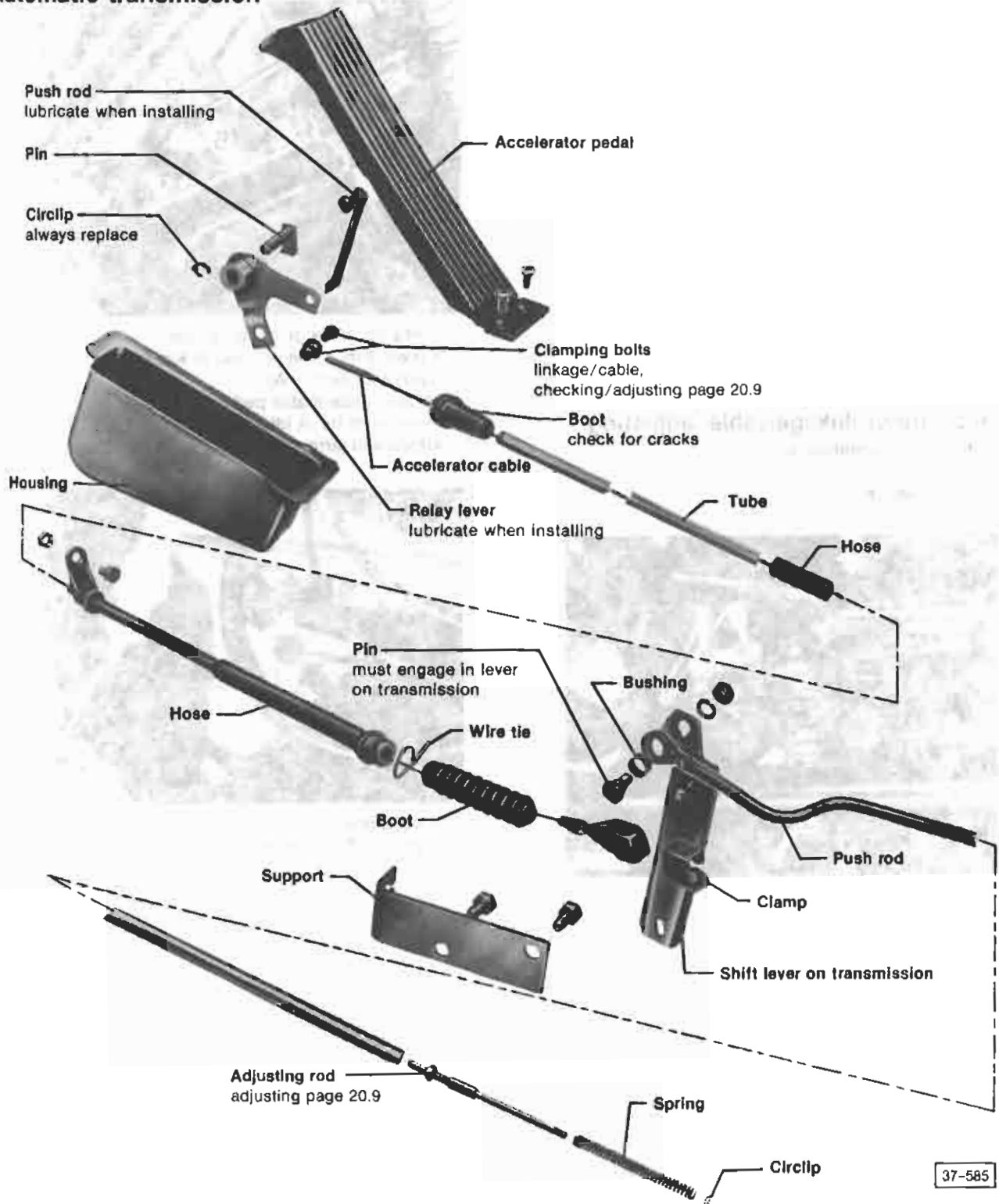
## Accelerator linkage/cable Manual transmission



20-402



Accelerator linkage/cable  
Automatic transmission



# 20 Fuel Supply

## Accelerator linkage/cable adjustment, checking

(automatic transmission)

### Work sequence

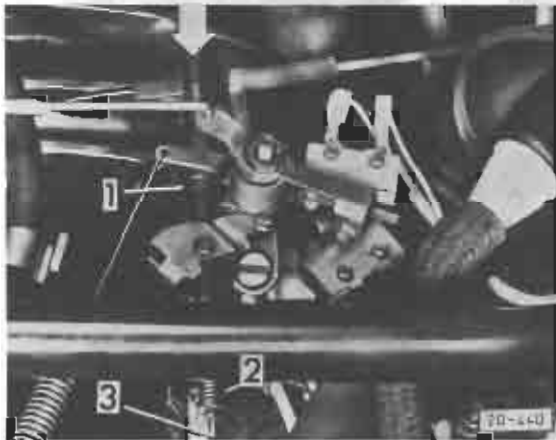
- depress accelerator pedal to full throttle position
  - throttle valve lever must contact stop, but kickdown lever on transmission must **not** be in kickdown position
- press accelerator pedal beyond full throttle to floor
  - override spring must be tensioned and kickdown lever on transmission must be in kickdown position

if **NO**, adjust as follows:

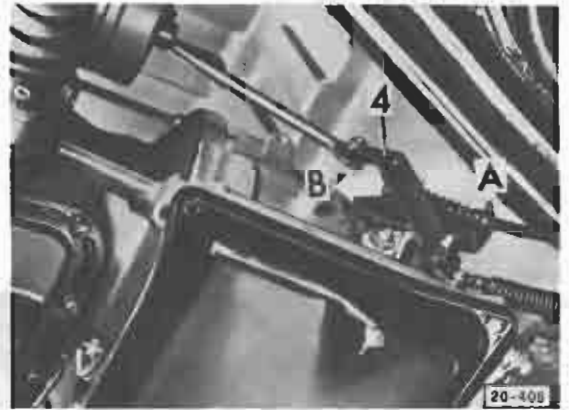
## Accelerator linkage/cable, adjusting

(automatic transmission)

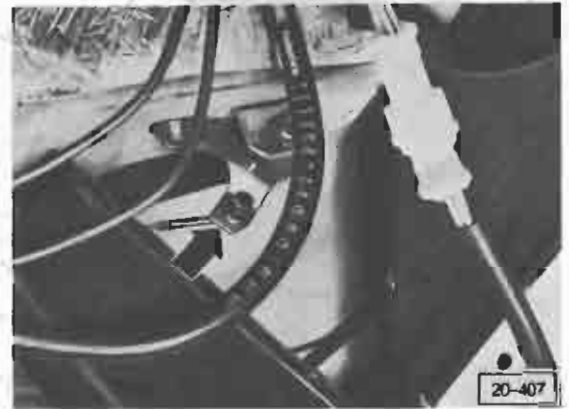
### Work sequence



- loosen nut 1
- remove override spring 2
- start engine and let idle
- adjust idle speed at screw (see Repair Group 24)
- shut engine **OFF**
- press accelerator rod in direction of arrow to stop
- turn adjusting rod 3 with screwdriver until shoulder of adjusting rod just contacts pivot of throttle lever
- reinstall override spring 2
- start engine and check idle speed
  - adjust if necessary by turning rod 3
- lock adjusting rod 3 in position with nut 1



- press accelerator pedal to floor
  - lever 4 must be on stop in kickdown position (arrow A)
- release accelerator pedal
- lever must be in idle position (out of kickdown) (arrow B)



- if necessary, adjust accelerator cable at clamping bolt (arrow)

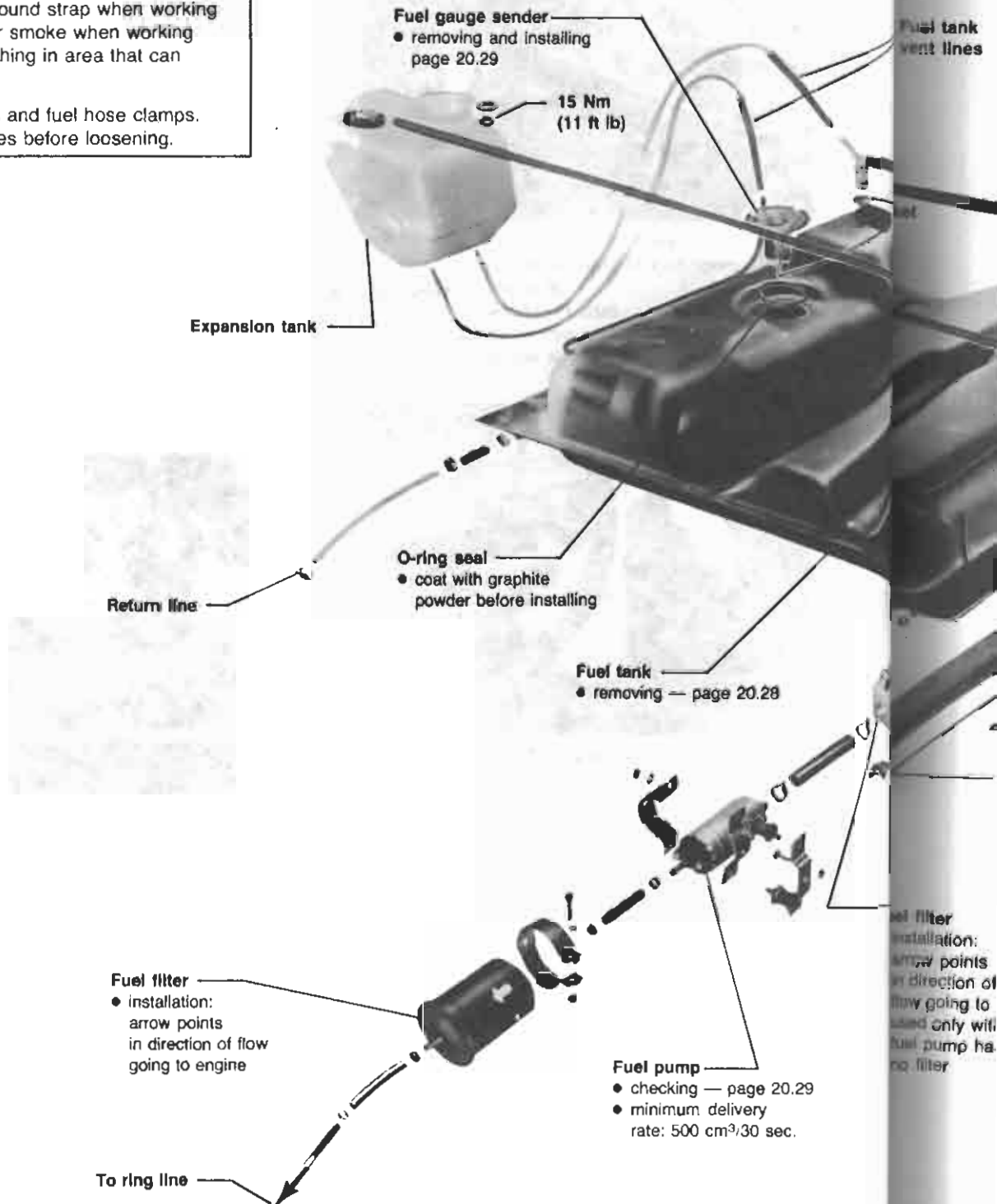
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## Fuel supply system components, Removing and installing

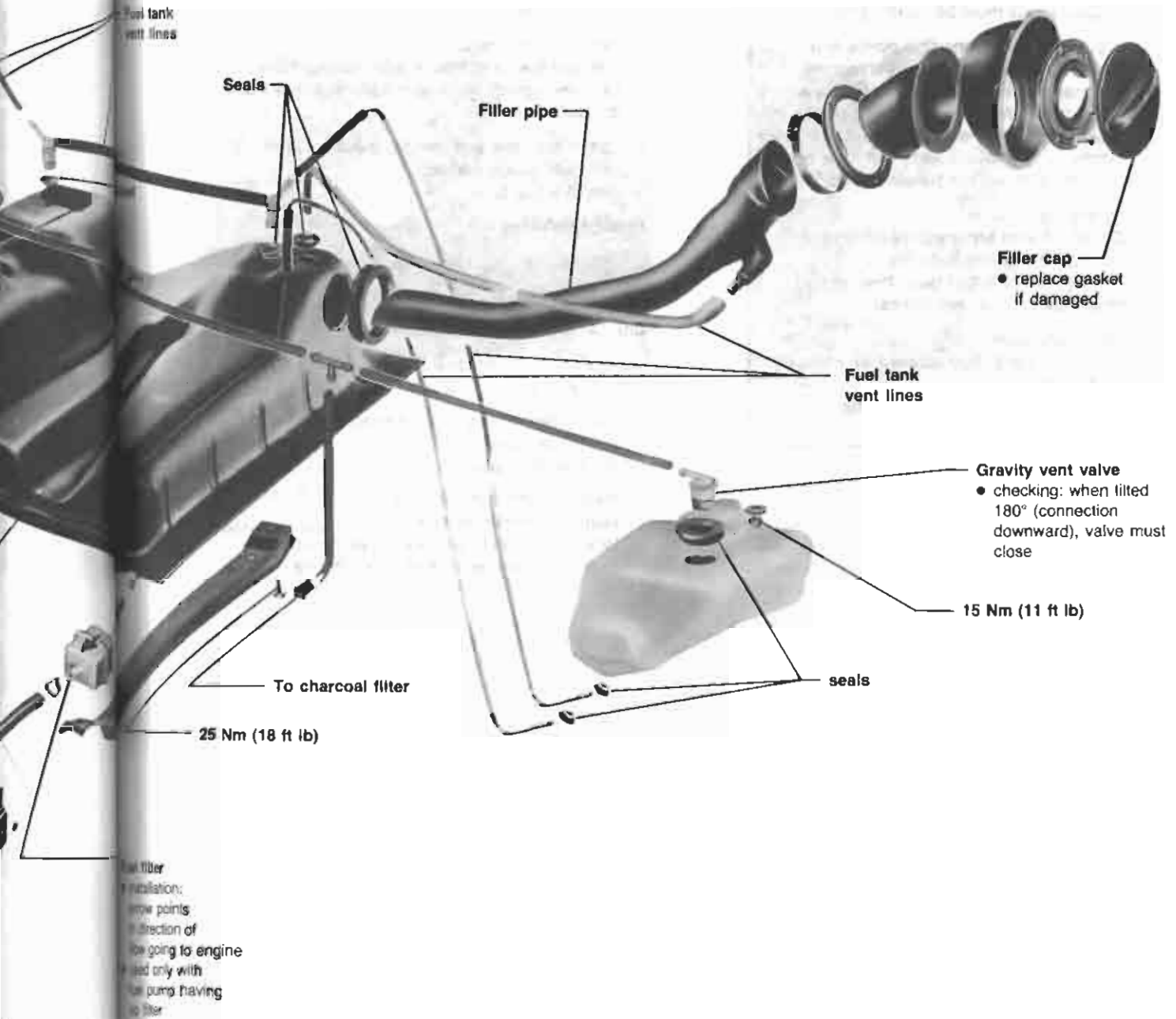
### WARNING

Disconnect battery ground strap when working on fuel system. Never smoke when working with fuel or have anything in area that can ignite it.

**Always** replace seals and fuel hose clamps.  
**Always** clean fuel lines before loosening.



- Rules of cleanliness, 20.28
- Checking for leaks, 20.21



20-547

## Rules of cleanliness

### CAUTION

When working on the fuel system, the following rules of cleanliness must be carefully followed.

- Thoroughly clean connecting points and surrounding areas **before loosening**.
- Lay pieces that have been removed on a **clean** surface and cover them with plastic film or paper — do not use cloths with lint.
- Carefully wrap or close parts that have been opened if repair will not be completed.
- Use only **clean** parts.
  - Do not unwrap replacement parts until immediately before installing.
  - Do not use parts that have been stored unwrapped (i.e. in tool boxes).
- With system open:
  - Avoid the use of compressed air as much as possible.
  - Avoid moving vehicle as much as possible.

## Fuel tank, removing

### Vehicles with rear wheel drive only

- Disconnect battery ground strap
- Empty fuel tank
- Remove filler pipe
- Remove vent lines
- Remove feed and return lines from fuel tank
- Unscrew splash plate from body and take out of brackets
- Lower fuel tank and remove electrical connector from fuel gauge sender
- Remove fuel tank

### Syncro vehicles

#### Note

Removing and installing the fuel tank is possible after removing the transmission.

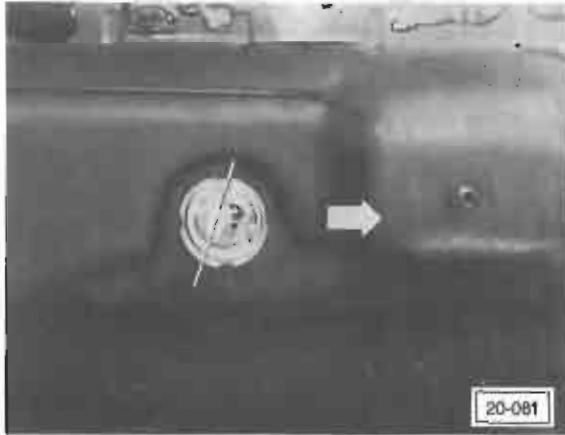
For transmission removal and installation: see Repair Group 34.

- Disconnect battery ground strap
- Drain fuel tank
- Remove filler pipe
- Remove vent and fuel lines
- Remove restraining straps
- When taking out fuel tank, carefully push or secure coolant pipes and hoses to one side

## Fuel gauge sender, removing and installing

Vehicles with rear wheel drive only

— remove fuel tank — page 20.28



— remove and install sender with tool 2012 A

### Note

Installing: electrical connector must line up with dotted line. Arrow points in driving direction.

### Syncro vehicles

- disconnect battery ground strap
- empty fuel tank until float lies below level of sender opening
- remove sender behind rear wheel house
- when installing the sender, make sure that return line is inserted into expansion tank inside of fuel tank (see Fig. 20-549, Page 20.34)

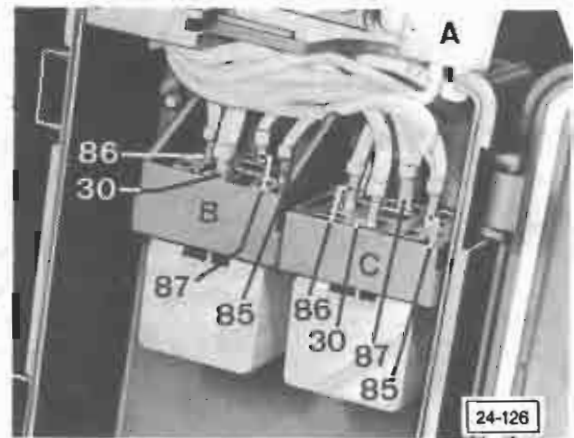
### Note

After installation of sender:  
Rocker arm must be able to be swung downwards.

## Fuel pump delivery rate, checking

### WARNING

Fire hazard! Never smoke or have anything in area that can ignite fuel.

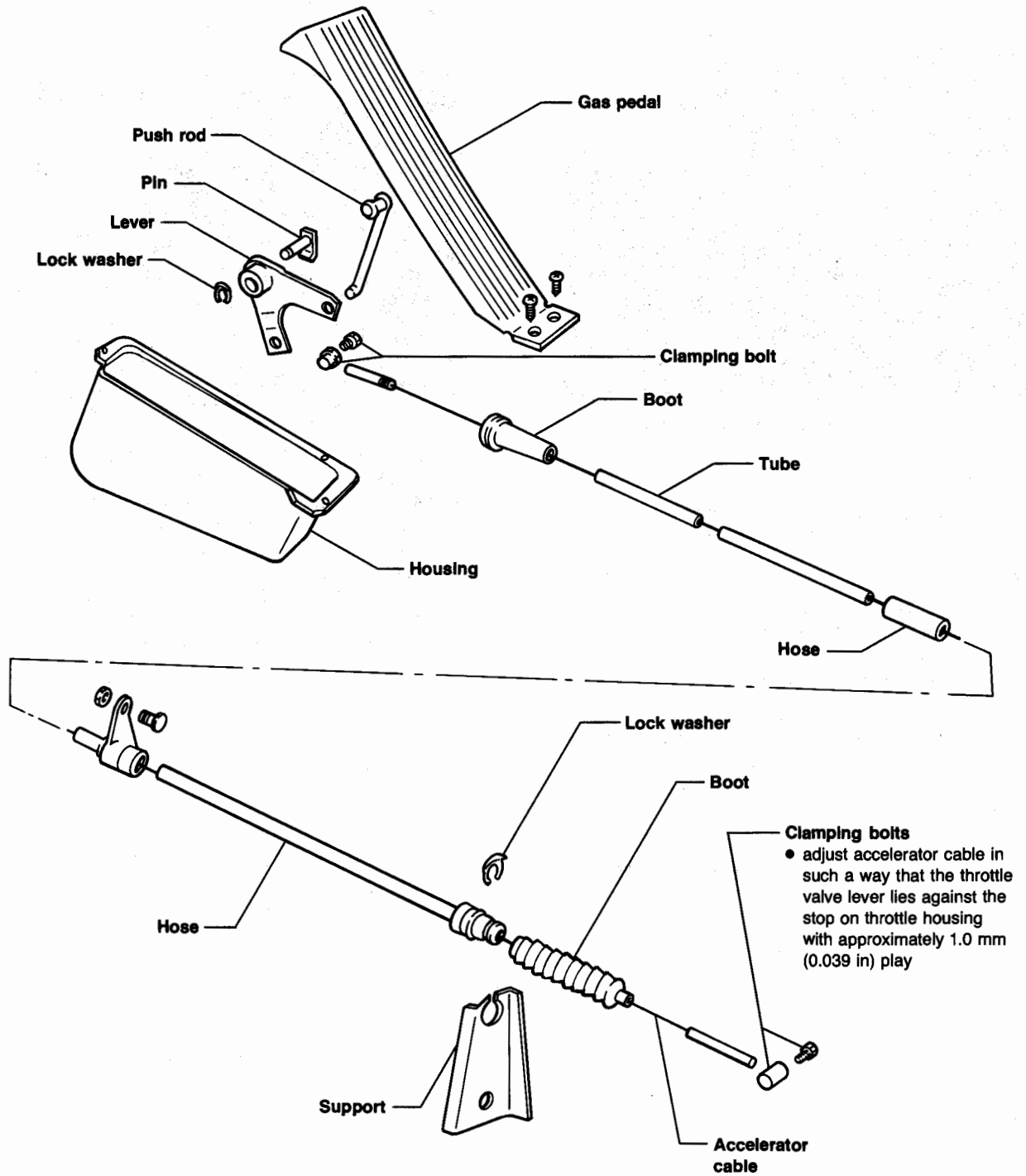


- disconnect fuel return line at pressure regulator and block line
- attach hose to return line fitting on pressure regulator and place other end of hose in one quart measuring container
- remove relay C
- connect terminals 30 and 87 with tester US 4480/3
- switch on for 30 seconds
  - minimum fuel delivery rate should be 500 cm<sup>3</sup>



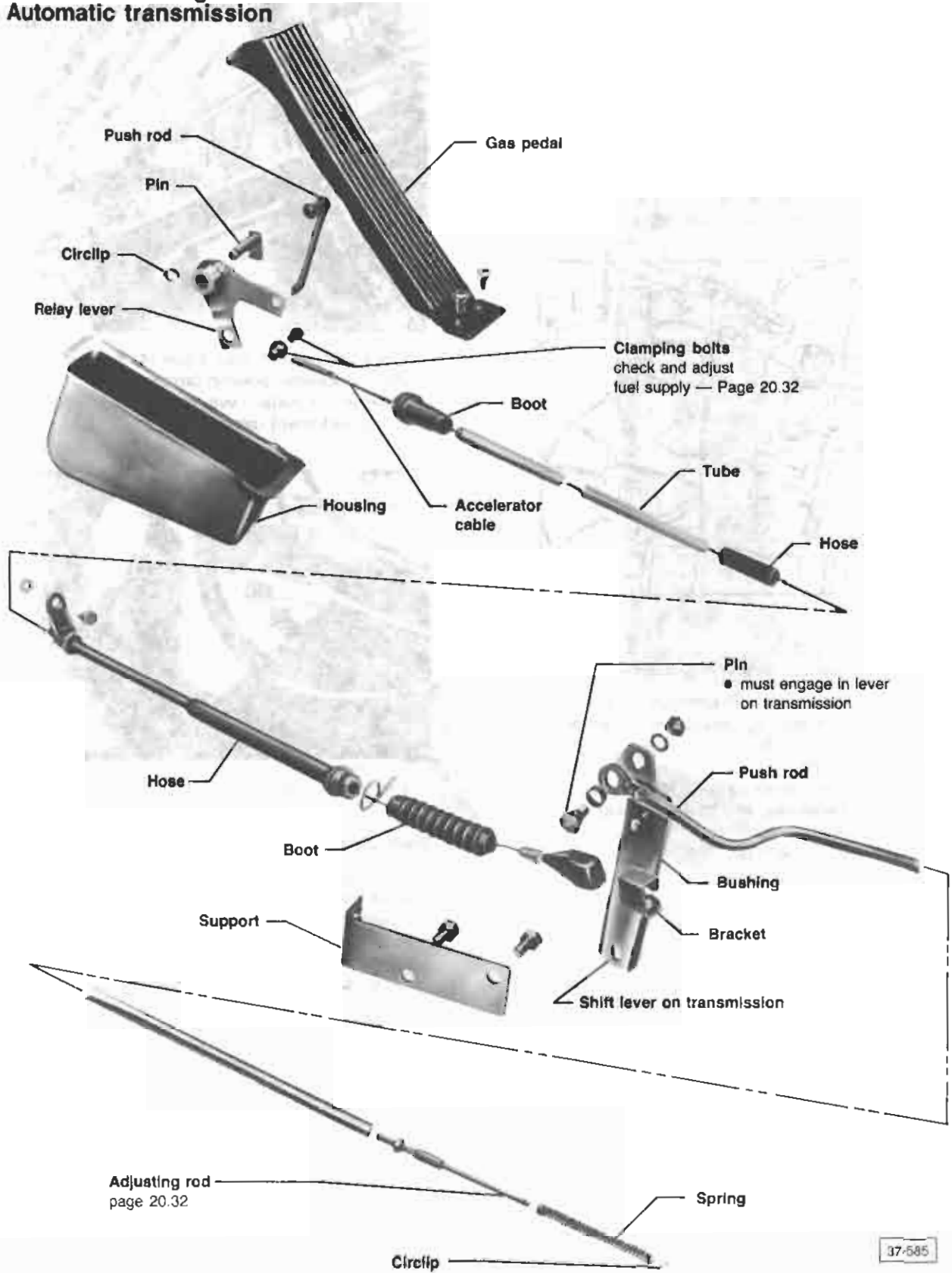
# 20 Fuel Supply

## Accelerator linkage/cable Manual transmission



20-402

## Accelerator linkage/cable Automatic transmission

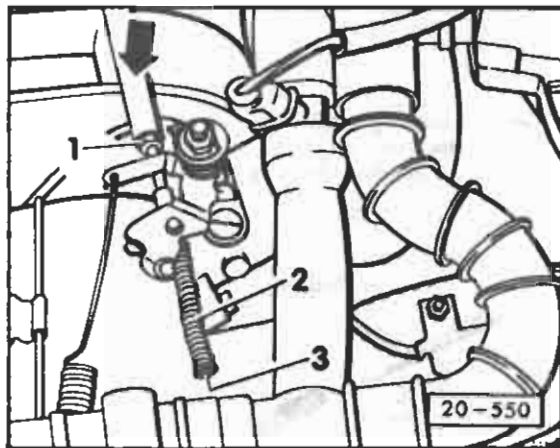


37-585

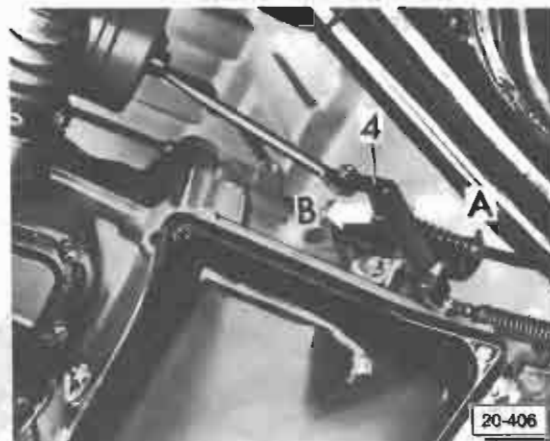
## Accelerator linkage/cable, adjusting

The accelerator linkage/cable should be adjusted in such a way that with throttle valve closed, (idle), the lever on transmission is against stop in no-gas position; otherwise, shifting occurs too late in middle speed ranges.

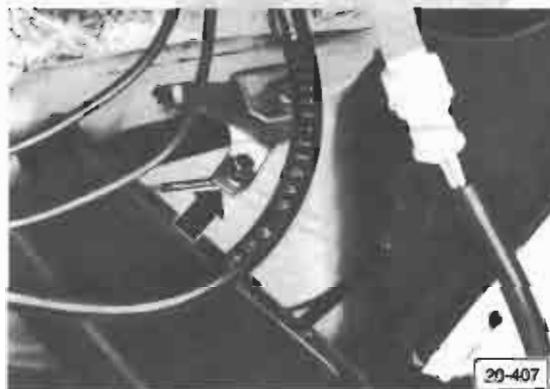
The accelerator linkage/cable should be adjusted as follows at idle speed (engine at operating temperature, with throttle valve closed):



- Loosen nut (1)
- Remove spring (2)
- Pull accelerator rod in direction of arrow
- Turn adjusting rod (3) with screwdriver until shoulder of adjusting rod just contacts pivot of throttle lever
- Install spring (2)
- Start engine and check to see if idle rpm is reached. If necessary, re-adjust by turning adjusting rod (3)
- lock adjusting rod with nut (1)



- Press gas pedal to floor. Lever (4) must be on stop in kickdown position (arrow A)
- Release gas pedal. Lever must be in idle position (out of kickdown) (arrow B)

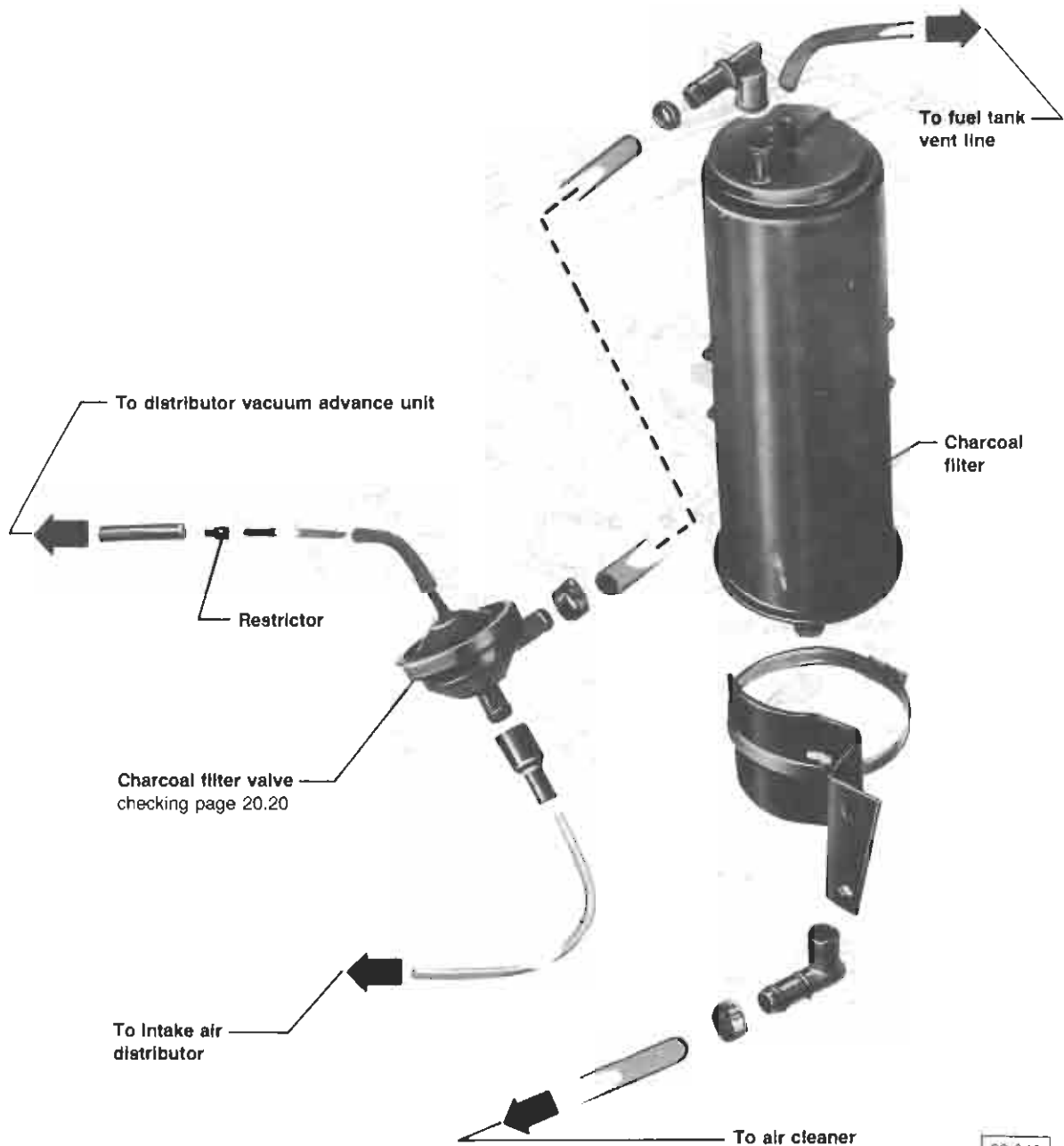


- If necessary, adjust accelerator cable at clamping bolt

### Checking adjustment

- Push gas pedal down to full throttle point. Throttle valve lever must lie against stop (without kickdown)
- Push gas pedal past full throttle point to stop. Spring must be compressed. Lever on transmission must be in kickdown position (A).

## Charcoal filter assembly

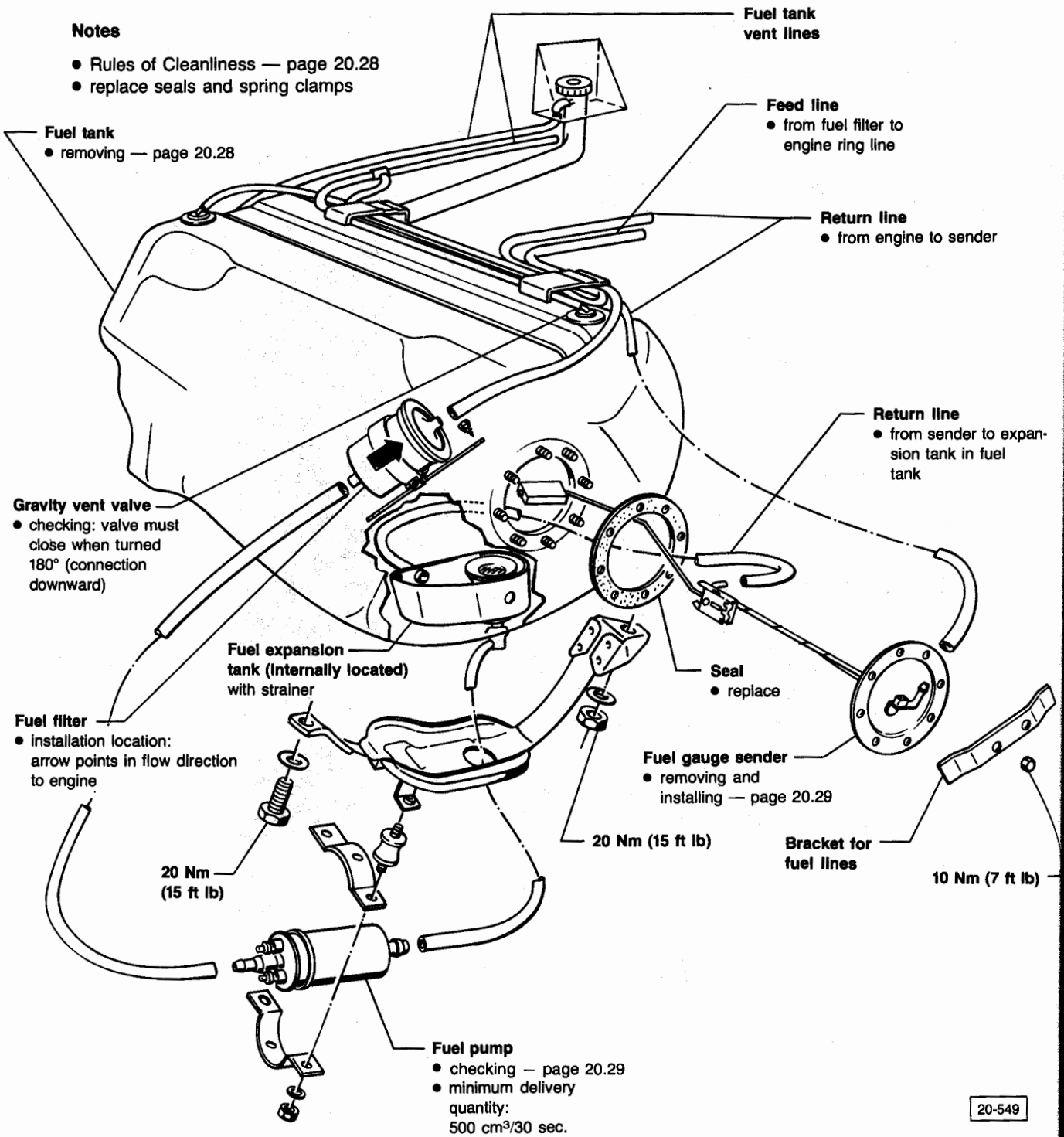


# 20 Fuel Supply

## Fuel supply system, components Syncro vehicles

### Notes

- Rules of Cleanliness — page 20.28
- replace seals and spring clamps



20-549

# Engine Cooling System

## Index

### Air-cooled

- Cooling air control flap  
adjusting 19.3
- Cooling fan  
removing 19.3
- Fan housing  
assembly 19.2  
removing 19.3
- Snap-lock wiring connectors  
installing 19.19
- Thermostat  
checking 19.3
- V-belt  
assembly 19.2  
tension, adjusting 19.3

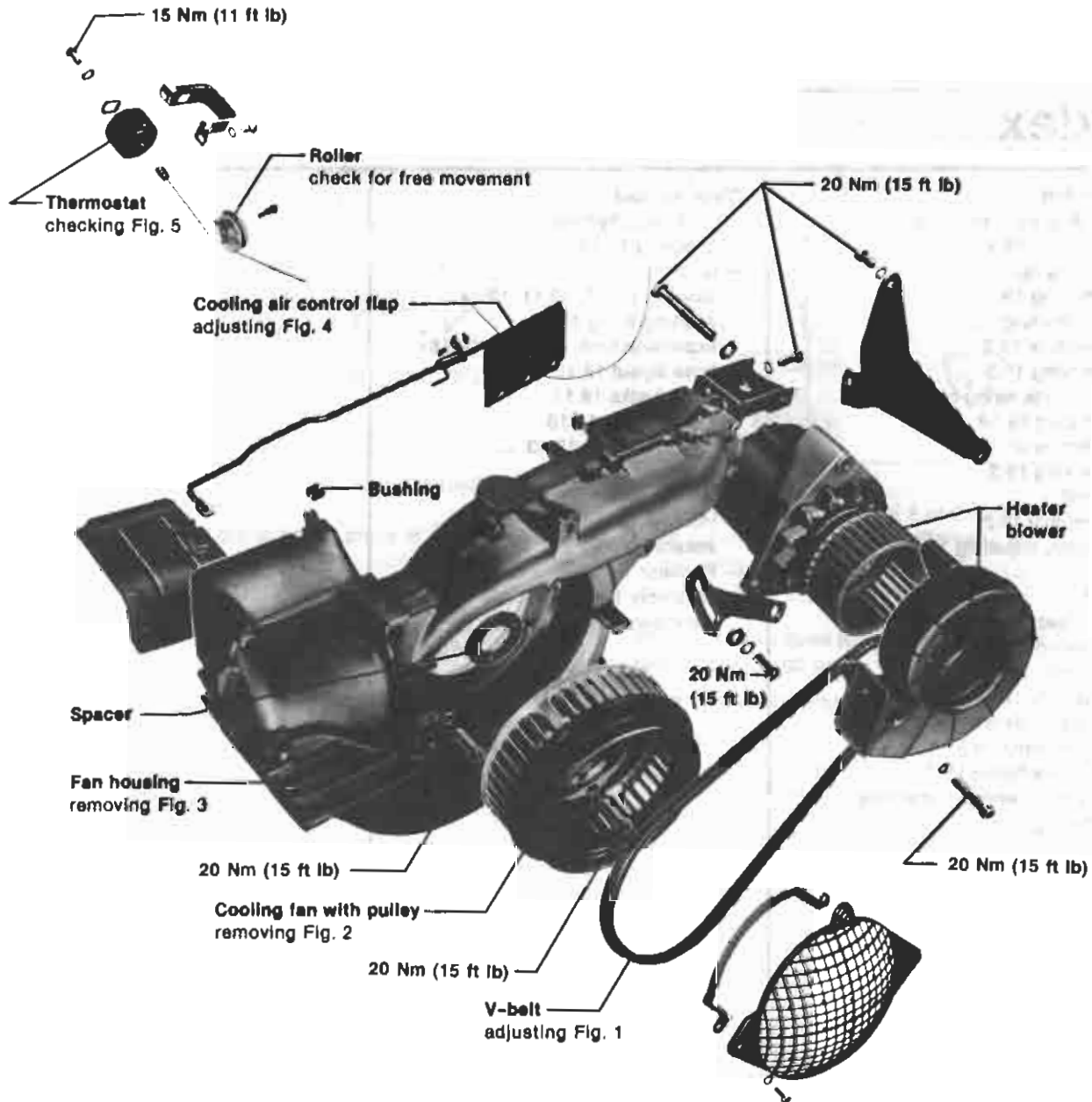
### Diesel

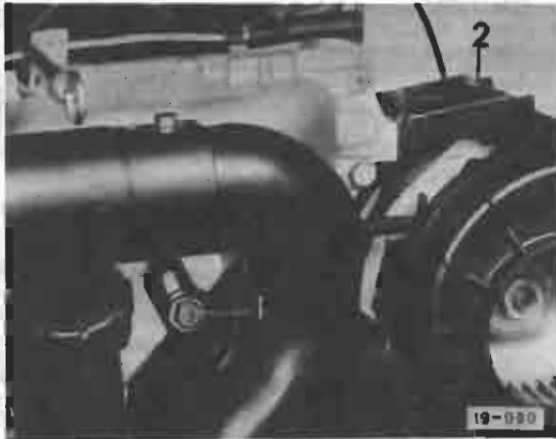
- Antifreeze hydrometer  
checking 19.7
- Coolant  
assembly 19.4  
draining/filling 19.6  
mixture ratio 19.5  
pipes, replacing 19.7a
- Snap-lock wiring connectors  
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- Pressure Cap  
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### Water-cooled

- Antifreeze hydrometer  
checking 19.17
- Coolant  
assembly 19.8, 19.11, 19.14  
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hose layout 19.10  
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mixture ratio 19.18  
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- Hose spring clamps  
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- Radiator  
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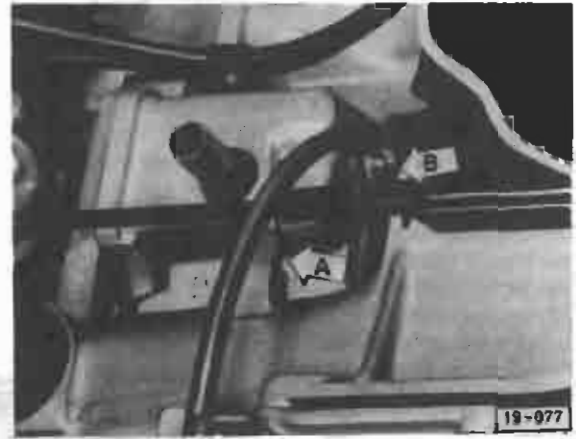
# 19 Engine-Cooling System





**Fig. 1 V-belt tension, adjusting**

- loosen bolts 1 and 2
- move alternator to tension belt
  - belt deflection must be 10-15mm (3/8-9/16 in.) in middle when pressing firmly with thumb
- tighten bolts

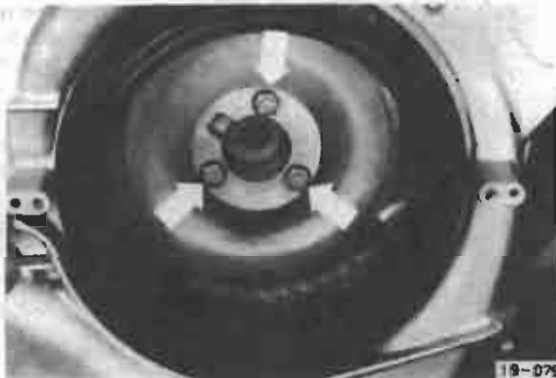


**Fig. 4 Cooling air control flap, adjusting**

- press flaps to fully closed position and tighten cable clamp

**Note**

Bent ends of return spring must rest on boss of housing (arrow A) and on cable guide (arrow B)



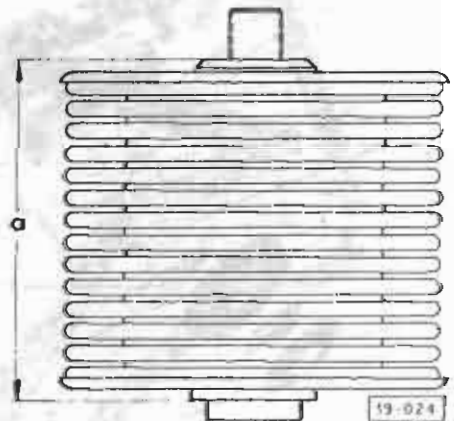
**Fig. 2 Cooling fan with pulley, removing**

- remove bolts (arrows)



**Fig. 3 Fan housing, removing**

- disconnect cooling air control flap cable
- remove bolts (arrows)
- remove housing



**Fig. 5 Thermostat, checking**

- put thermostat in water 85-90°C (185-194°F)
  - a = min. 46 mm (1 13/16 in.)



# 19 Engine – Cooling System

## Note

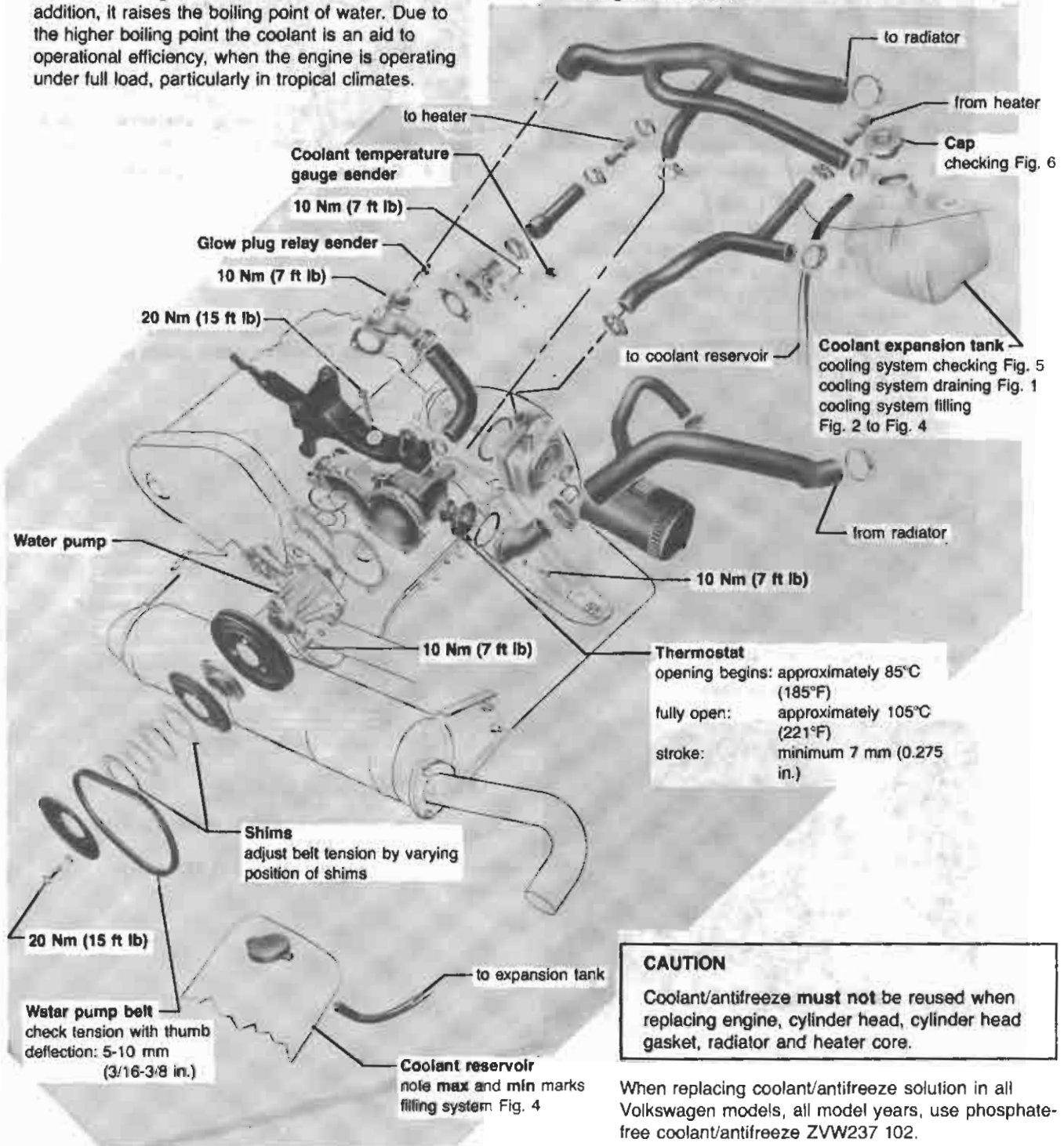
The cooling systems of all Volkswagen vehicles are filled at the factory with a mixture of water and an antifreeze solution (G 11) with corrosion inhibitors. This coolant mixture should be used year-round.

Phosphate-free anti-freeze prevents frost and corrosion damage, the formation of chalk and in addition, it raises the boiling point of water. Due to the higher boiling point the coolant is an aid to operational efficiency, when the engine is operating under full load, particularly in tropical climates.

## CAUTION

Antifreeze other than specified by Volkswagen may cause corrosion of the cooling system thus leading to engine overheating and damage.

Always use new gaskets when installing parts. Cooling system parts can be removed and installed with engine in vehicle.

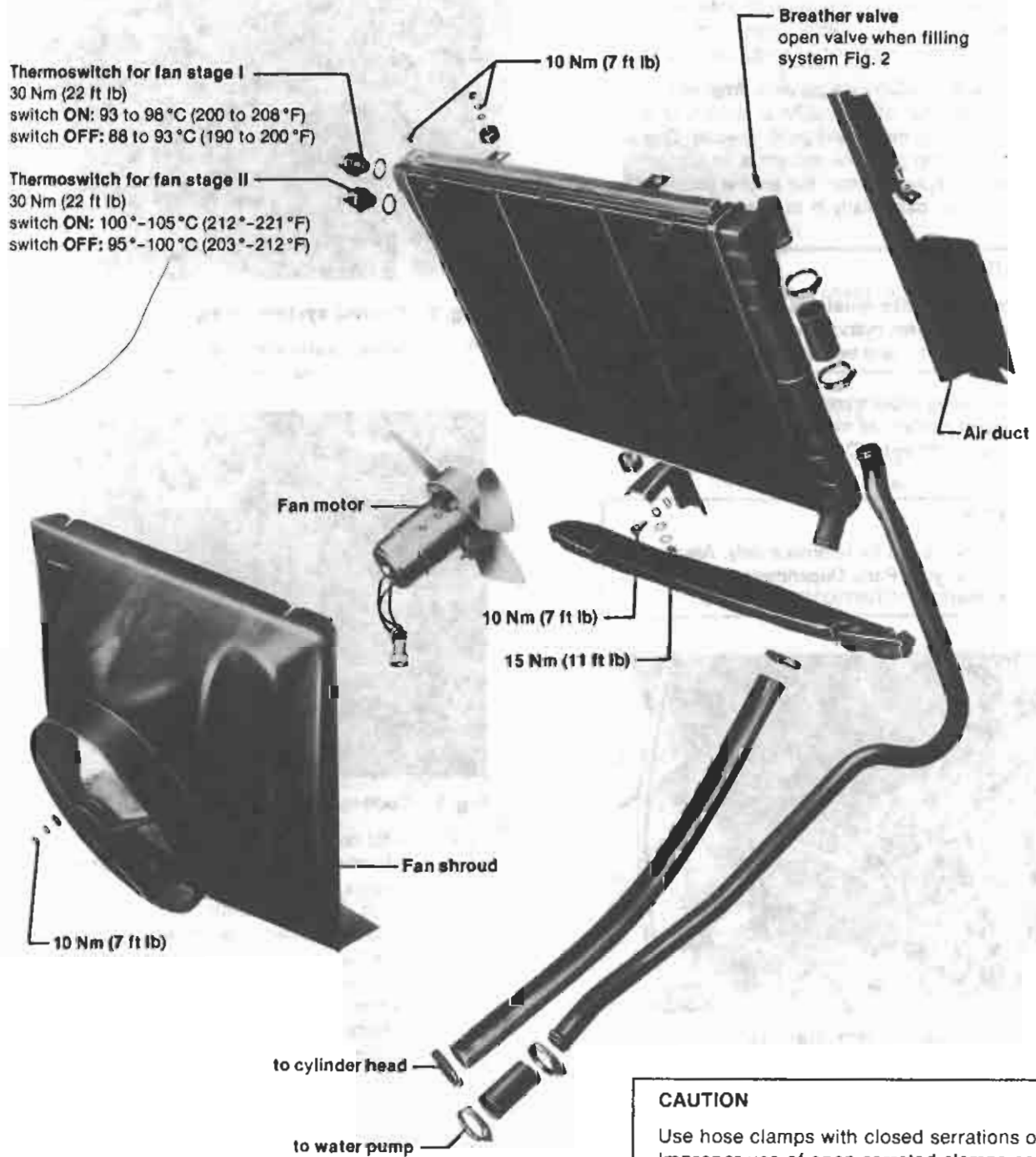


# Engine-Cooling System 19

Coolant mixture ratio

Coolant capacity 16.0 ltr (16.9 US qt)

Outside Temperature	Antifreeze	Water
- 25°C (- 13°F)	6.4 ltr (6.75 US qt)	9.6 ltr (10.15 US qt)
- 35°C (- 30°F)	8.0 ltr (8.45 US qt)	8.0 ltr (8.45 US qt)



**CAUTION**

Coolant/antifreeze **must not** be reused when replacing engine, cylinder head, cylinder head gasket, radiator and heater core.

**CAUTION**

Use hose clamps with closed serrations only. Improper use of open serrated clamps can tear hose and cause coolant leaks.

19-215

# 19 Engine – Cooling System

## Cooling system, draining/filling

The cooling systems of all Volkswagen vehicles are filled at the factory with a mixture of water and an antifreeze solution (G 11) with corrosion inhibitors. This coolant mixture should be used year-round.

Phosphate-free anti-freeze prevents frost and corrosion damage, the formation of chalk and in addition, it raises the boiling point of water. Due to the higher boiling point the coolant is an aid to operational efficiency, when the engine is operating under full load, particularly in tropical climates.

### CAUTION

Coolant/antifreeze must not be reused when replacing engine, cylinder head, cylinder head gasket, radiator and heater core.

When replacing coolant/antifreeze solution in all Volkswagen models, all model years, use phosphate-free coolant/antifreeze ZVW237 102.

### CAUTION

Part numbers are for reference only. Always check with your Parts Department for latest information.

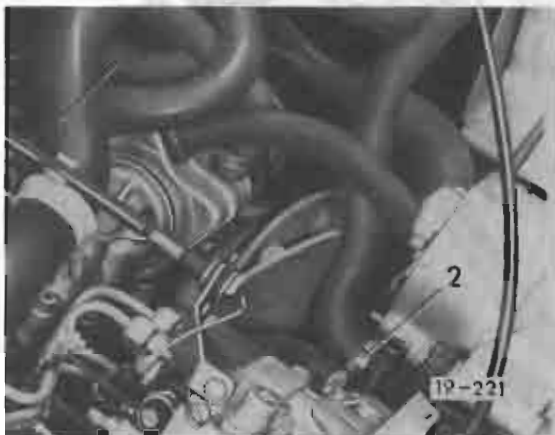


Fig. 1 Cooling system, draining

- fully open heater controls
- open cap on expansion tank
- disconnect lower coolant hose 1 from water pump at connection pipe
- disconnect center coolant hose 2 from water pump

**Note** • save coolant for reuse (see caution)

When removing radiator, drain rest of coolant by detaching lower hose from radiator



Fig. 2 Cooling system, filling

- set heater controls to position **WARM**
- open breather valve (arrow) on radiator



Fig. 3 Cooling system, filling

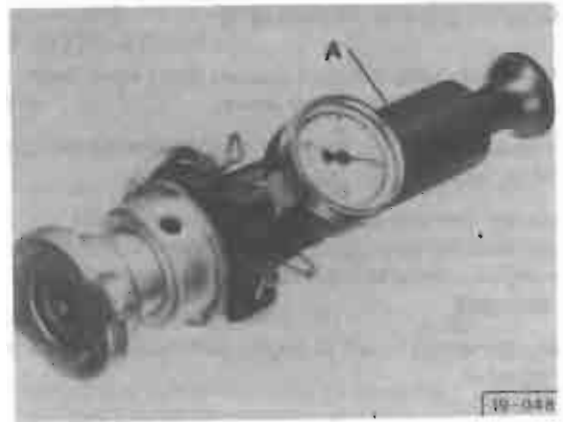
- fill cooling system via expansion tank (arrow) until tank is filled to brim and remains filled
- run engine at about 2500 rpm until coolant flows at breather valve with **NO** bubbles
- close breather valve
- check coolant level and top up as necessary
- close expansion tank with cap



**Fig. 4 Cooling system, filling**  
—fill reservoir up to mark max (arrow)



**Fig. 5 Cooling system, checking**  
—attach tester A in place of pressure cap  
• A = Stant tester ST-255A, AC-PCT-3 or equivalent  
—apply pressure of approximately 1 bar (14 psi)  
• if pressure remains constant, system is OK



**Fig. 6 Pressure cap, checking**  
—attach cap on tester A  
• A = Stant tester ST-255A, AC-PCT-3 or equivalent  
—apply a pressure of 0.9 to 1.15 bar (11 to 16 psi)  
• if pressure relief valve opens within this range, cap is OK

## Antifreeze hydrometer, checking

Calibration of hydrometer must be checked frequently to ensure accuracy.

- mix a 50/50 mixture of antifreeze and water together in a small container
- hydrometer should read  $-35^{\circ}\text{C}$  ( $-30^{\circ}\text{F}$ )
  - if not, put a mark (paint dot) to indicate where  $-35^{\circ}\text{C}$  ( $-30^{\circ}\text{F}$ ) should be.

# 19 Engine—Cooling System

## Coolant pipes, replacing

Since March 1985 the steel coolant pipes have been replaced with plastic coolant pipes.

In cases of repair, the **original** steel coolant pipes must be replaced with the new plastic pipes.

Since the diameter of the plastic coolant pipes is larger than the steel pipes, the hose hole openings in the engine compartment and cross members must be enlarged.

Also, connecting hoses to engine and radiator must be replaced.

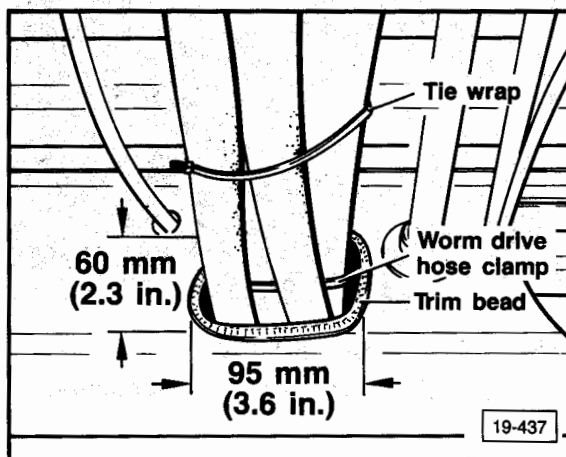
### Parts required

#### CAUTION

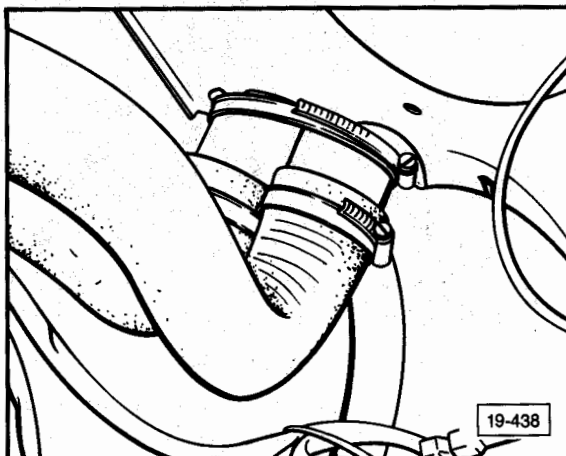
Part numbers are for reference only. Always check with your Parts Department for latest information.

Description	Part number	Quantity
Plastic pipe (from cylinder head)	251 121 397G	1
Plastic pipe (to coolant pump)	251 121 399G	1
Engine hose (from cylinder head)	068 121 101H	1
Engine hose (to coolant pump)	068 121 073G	1
Radiator hose (from cylinder head)	251 121 082	1
Radiator hose (to coolant pump)	251 121 083H	1
Clamps	411 261 679	2
Worm drive hose clamps	obtain locally	2
Tie-wraps	obtain locally	X
Trim beading	obtain locally	X

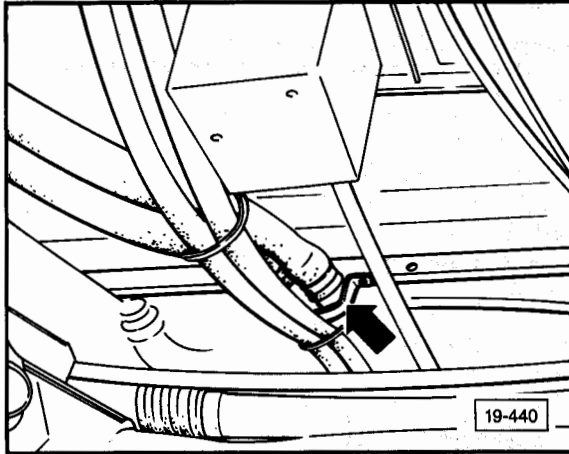
- remove fuel tank
- remove steel coolant pipes
- pull back hoses for heater to engine from cross member



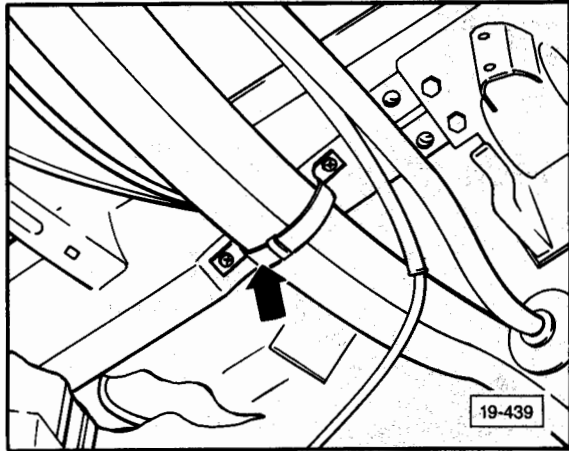
- rework holes for heater to engine in cross member (as shown)
- rework holes in cross member and engine compartment wall to side and downward
- cover sheet metal edges on cross member with trim bead



- push plastic pipes from engine side through cross member and fasten to attachment tabs on cross member and engine wall with a worm drive hose clamp (as shown)



- bend and attach clamps Part No. 411 261 679 to shape and secure plastic pipes to cross member in front (**arrow**)



- attach clamp in back with self tapping screws (**arrow**)
- tie coolant water pipes and heater hoses together with tie wraps (see illustration 19-437 at 30 cm (approximately 12 in.) intervals)

## Installing new coolant water hoses – to engine/radiator

### Note

#### Vehicles up to 8/82

- shorten hose Part No. 251 121 083H for return flow from the radiator to coolant pump to fit  
\*note the different hose diameters of 32 mm (1-1/4 in.) and 38 mm (1-31/64 in.)

#### Vehicles from VIN 24C 017 500 (approximately 12/82)

- connecting sleeve diameter for hose Part No. 068 121 101H on expansion tank was increased from 20 mm (25/32 in.) to 32 mm (1-1/4 in.)

Proceed as follows when installing connecting hose Part No. 068 121 101H to vehicles with 20 mm (25/32 in.) connecting sleeve on the expansion tank:

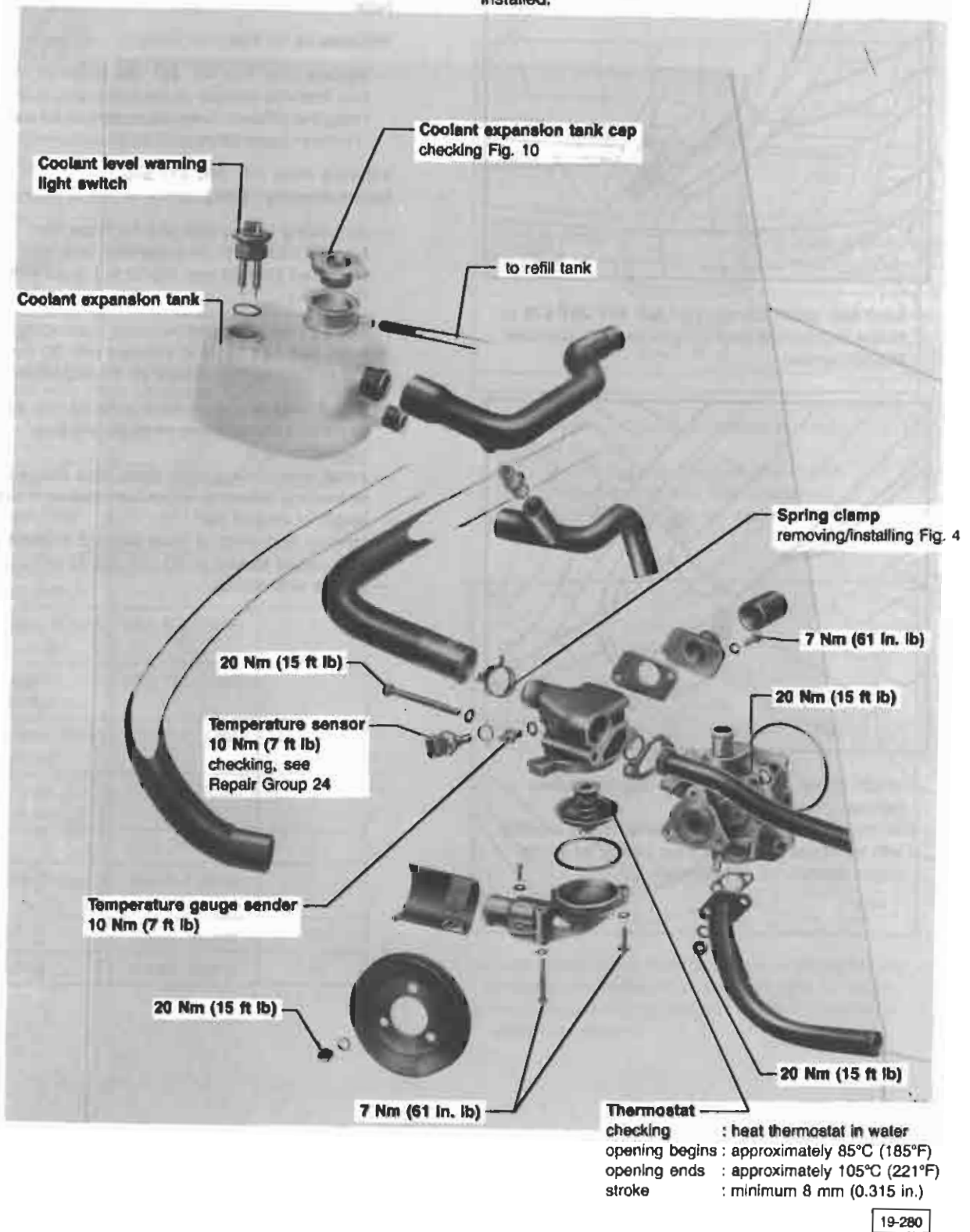
- cut off original coolant hose (with 20 mm sleeve) approximately 120 mm (4-11/16 in.) from expansion tank
- install new coolant water hose, and shorten connecting sleeve to expansion tank to match length of original part
- connect both ends of hose with aid of piece of pipe (made locally) of 20 mm (25/32 in.) diameter
- secure with clamps

# 19 Engine-Cooling System

**Cooling system**  
draining Fig. 1 to Fig. 4  
checking for leaks Fig. 9

**Note**

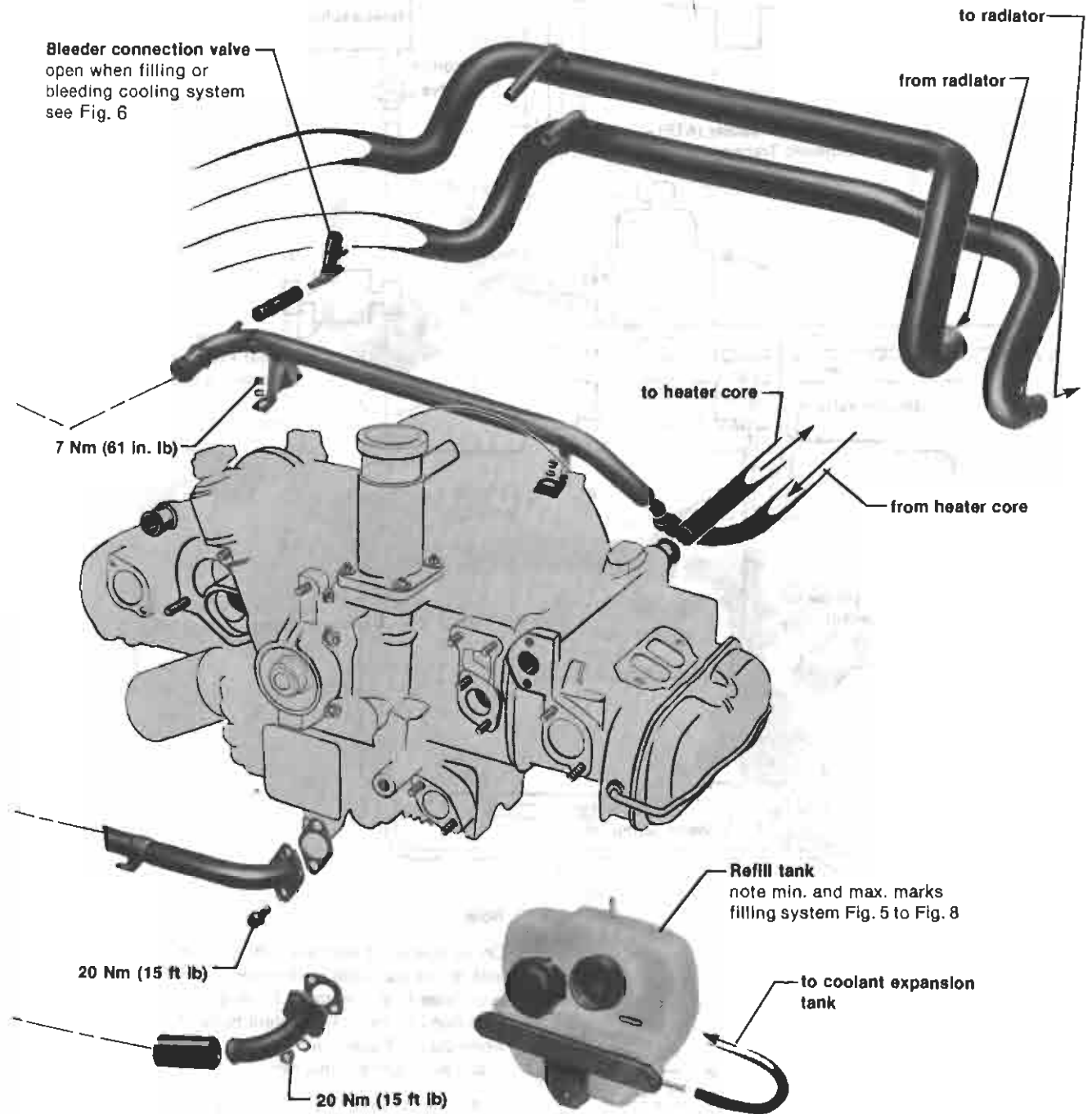
Always replace all gaskets. All parts of cooling system can be removed and installed with engine installed.





## CAUTION

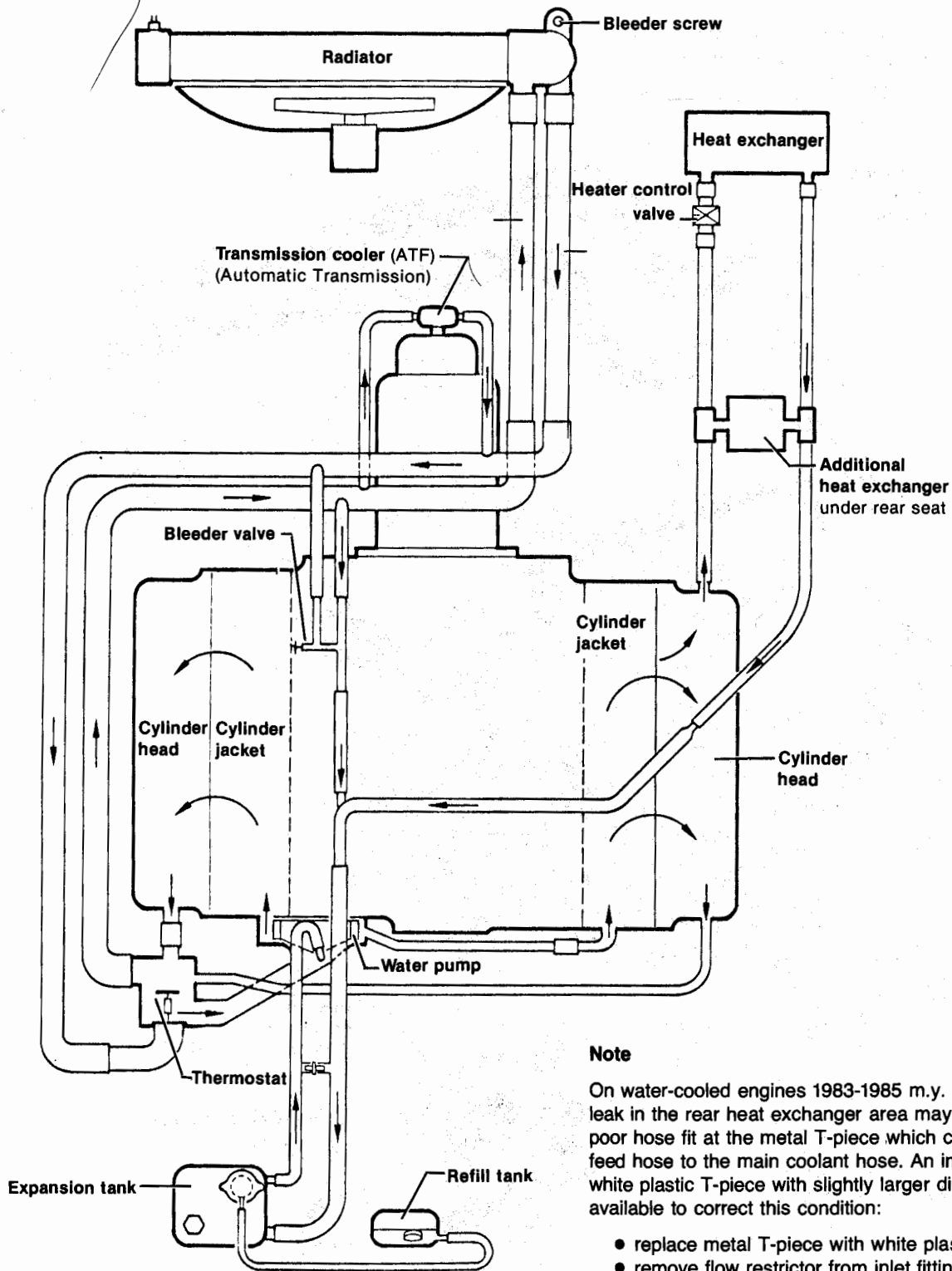
Coolant/antifreeze **must not** be reused when replacing engine, cylinder head, cylinder head gasket, radiator and heater core.



19-281



# 19 Engine - Cooling System



## Note

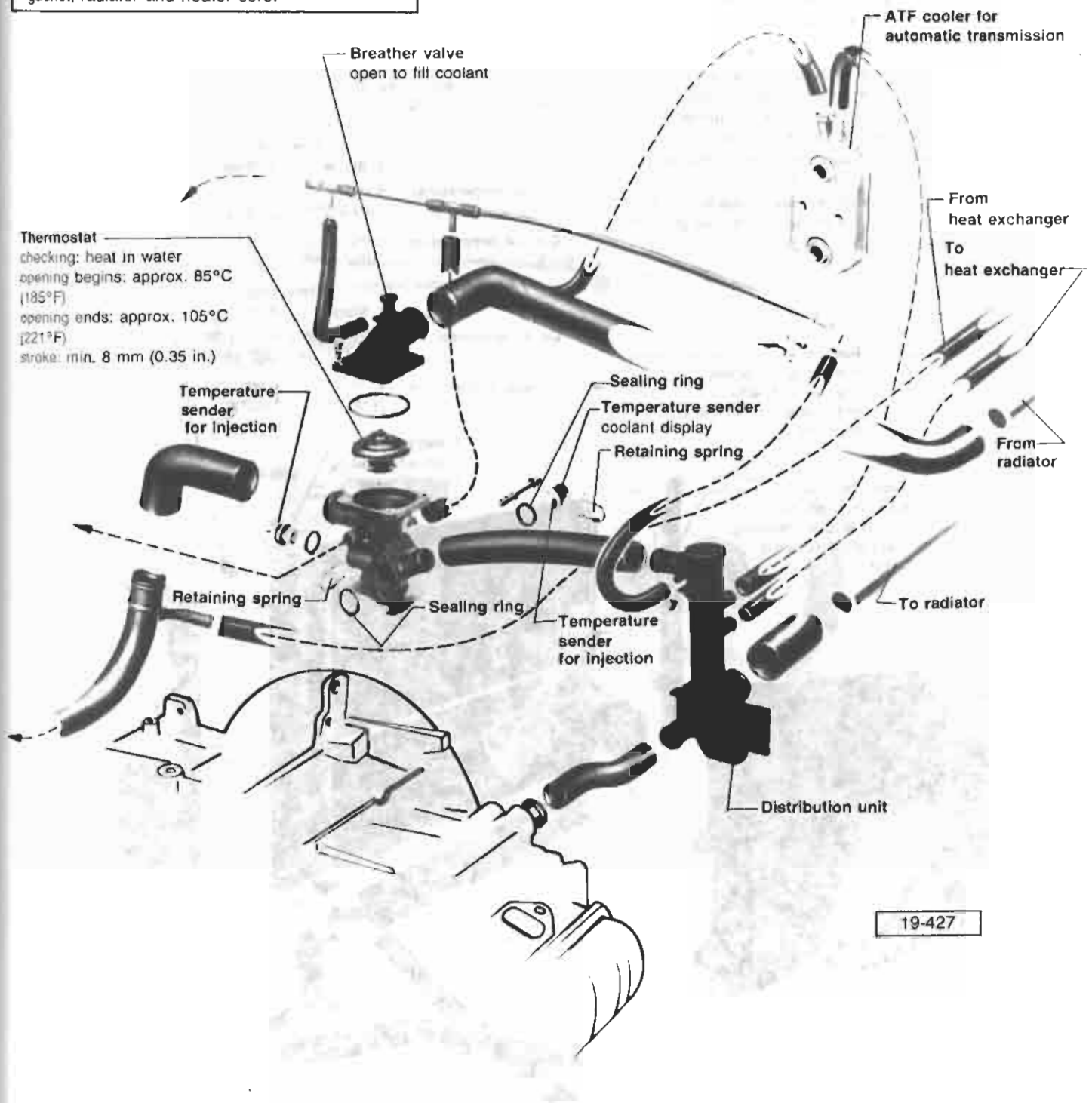
On water-cooled engines 1983-1985 m.y. a coolant leak in the rear heat exchanger area may be due to poor hose fit at the metal T-piece which connects the feed hose to the main coolant hose. An improved, white plastic T-piece with slightly larger diameter is available to correct this condition:

- replace metal T-piece with white plastic version
- remove flow restrictor from inlet fitting of heater valve

19-276

## CAUTION

Coolant/antifreeze **must not** be reused when replacing engine, cylinder head, cylinder head gasket, radiator and heater core.



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# 19 Engine – Cooling System

## Note

The cooling systems of **all** Volkswagen vehicles are filled at the factory with a mixture of water and an antifreeze solution (G 11) with corrosion inhibitors. This coolant mixture should be used year-round.

Phosphate-free anti-freeze prevents frost and corrosion damage, the formation of chalk and in addition, it raises the boiling point of water. Due to the higher boiling point the coolant is an aid to operational efficiency, when the engine is operating under full load, particularly in tropical climates.

When replacing coolant/antifreeze solution in all Volkswagen models, all model years, use phosphate-free coolant/antifreeze ZVW237 102.

## CAUTION

Coolant/antifreeze **must not** be reused when replacing engine, cylinder head, cylinder head gasket, radiator and heater core.

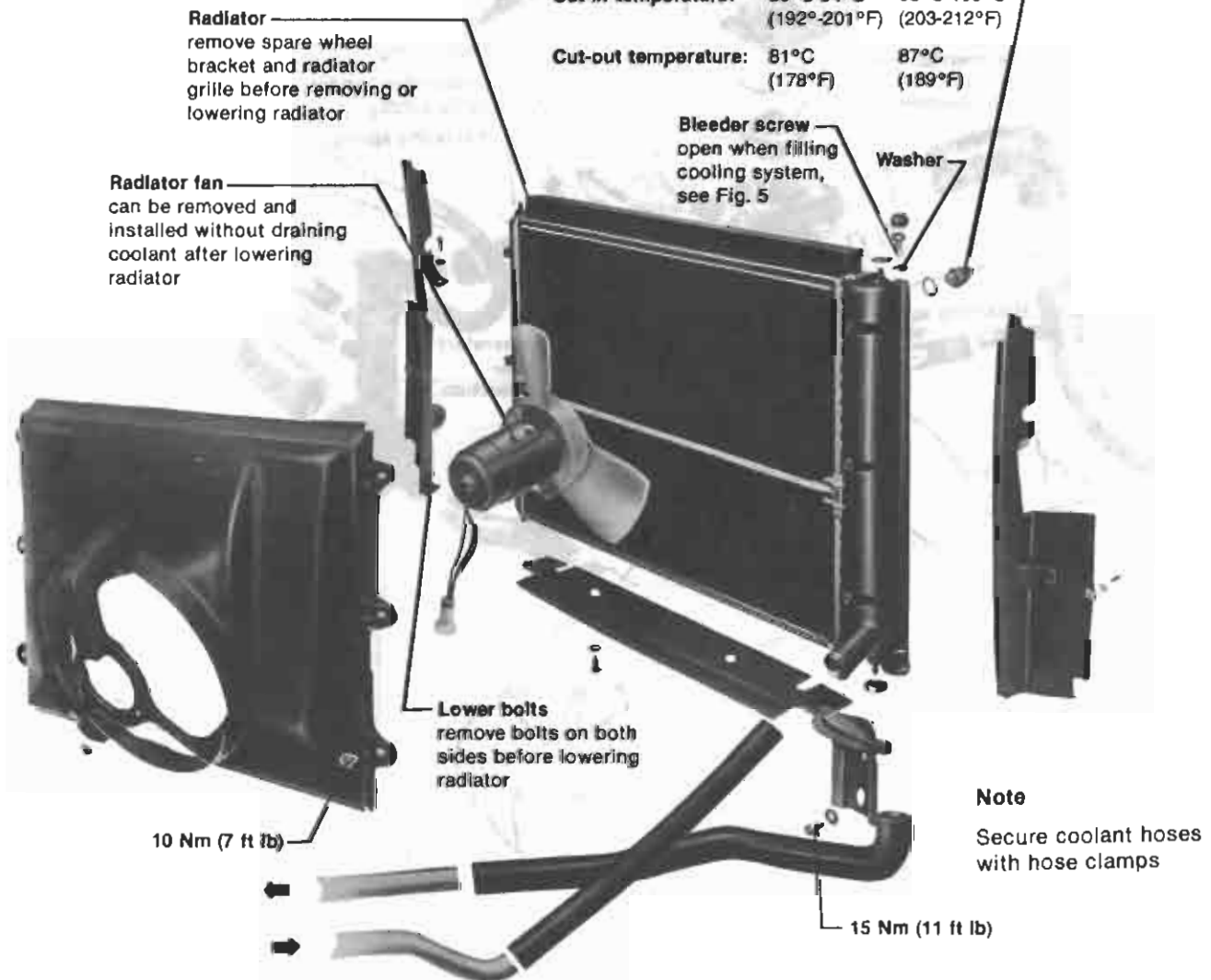
**Thermo-switch for fan**  
(located at left on radiator)  
removing/installing: remove radiator grille and move left cardboard air deflector to side

### Thru 1985

	I. Stage	II. Stage
<b>Cut-in temperature:</b>	93°C-98°C (199-208°F)	99°C-105°C (210°-221°F)
<b>Cut-out temperature:</b>	88°C-93°C (190-199°F)	91°C-97°C (196-206°F)

### From 1986

	I. Stage	II. Stage
<b>Cut-in temperature:</b>	89°C-94°C (192°-201°F)	95°C-100°C (203-212°F)
<b>Cut-out temperature:</b>	81°C (178°F)	87°C (189°F)

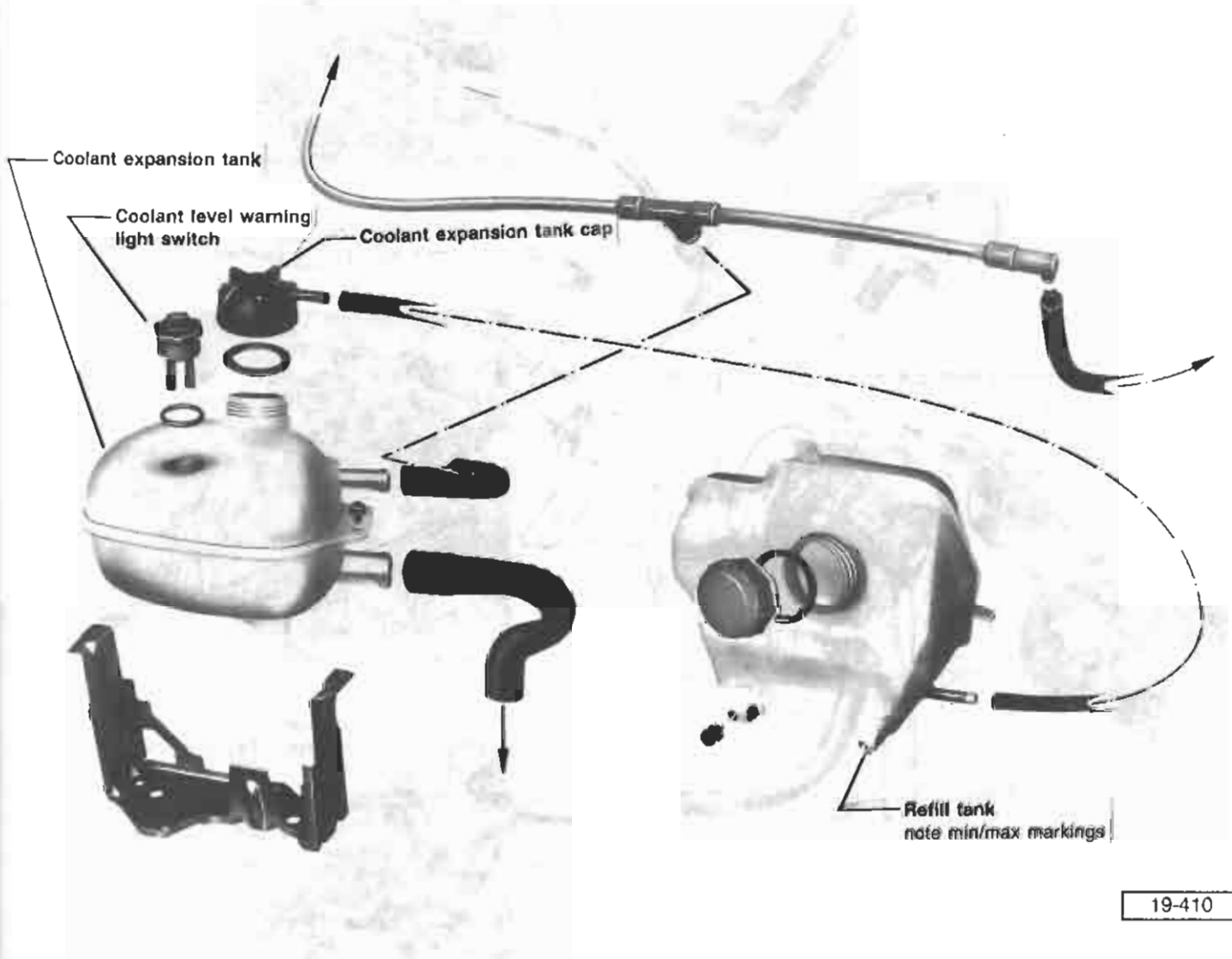


19-254

# Engine-Cooling System 19

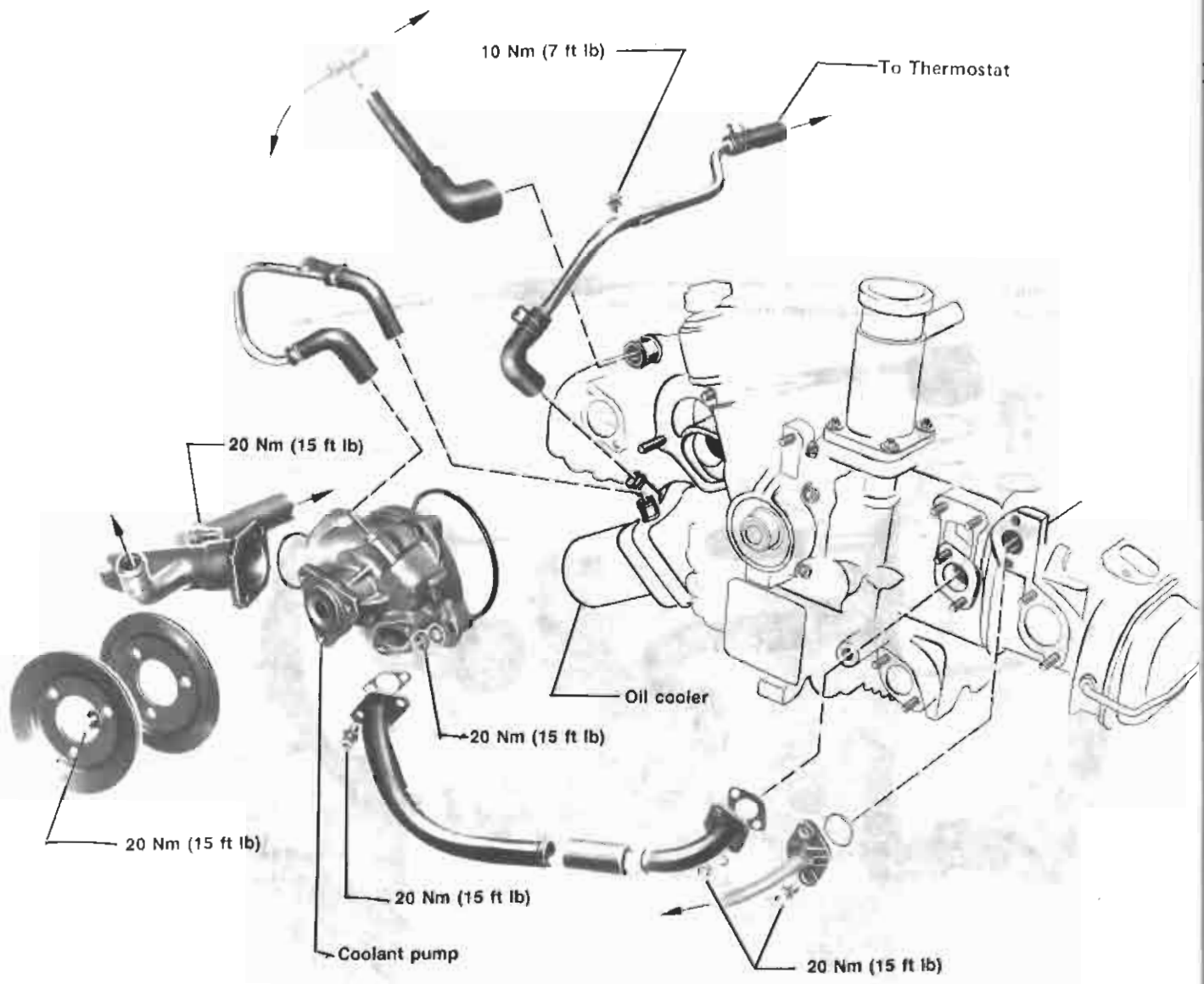
## Note

Always replace all gaskets. All parts of cooling system can be removed and installed with engine installed in vehicle.



19-410

# 19 Engine-Cooling System



19-411



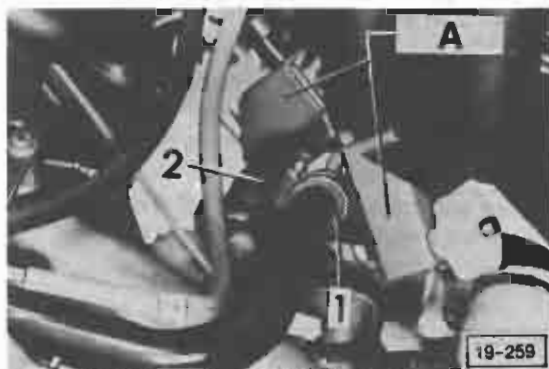
**Fig. 1 Coolant system, draining**

- open coolant expansion tank cap
- drain coolant at drain plugs 1 on cylinder heads



**Fig. 2 Coolant system, draining (when removing engine)**

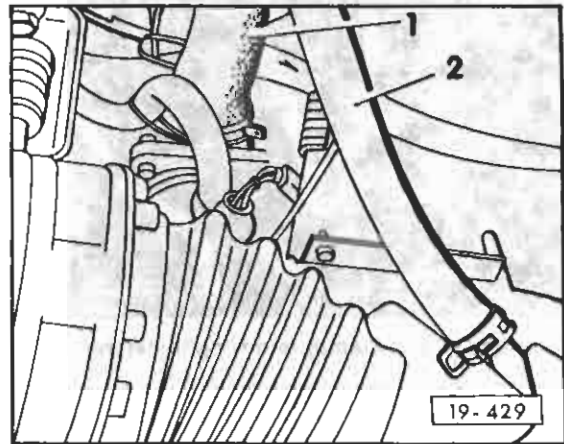
- pinch coolant hoses with hose clamp (A-local supply) (arrows) before removing



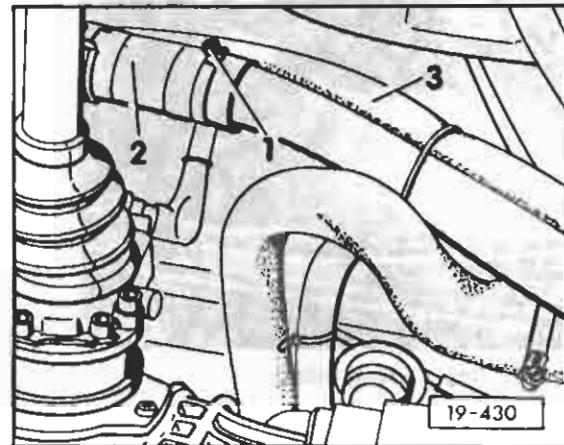
**Fig. 3 Coolant system, draining**

- in case that coolant hoses 1 and 2 for heat exchanger have to be removed, pinch hoses with hose clamp (A-local supply)

## Draining - From 1986



- close hose 1 from radiator to thermostat with hose clamp
- close hose 2 from heat exchanger to coolant pipe with hose clamp

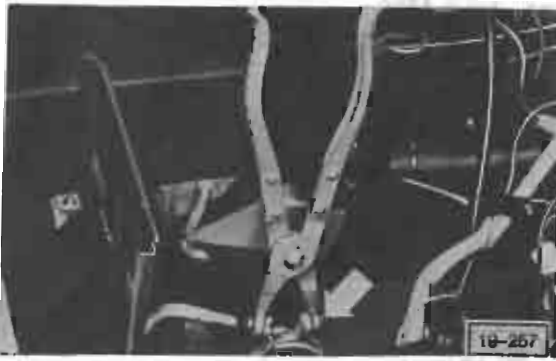


- loosen hose clamp 1, close hose 2 from radiator to distribution piece with hose clamp
- close hose 3 from heat exchanger to distribution piece with hose clamp
- drain coolant at drain plugs (Fig. 1)
  - save coolant for reuse (see caution)
- open coolant expansion tank cap

### CAUTION

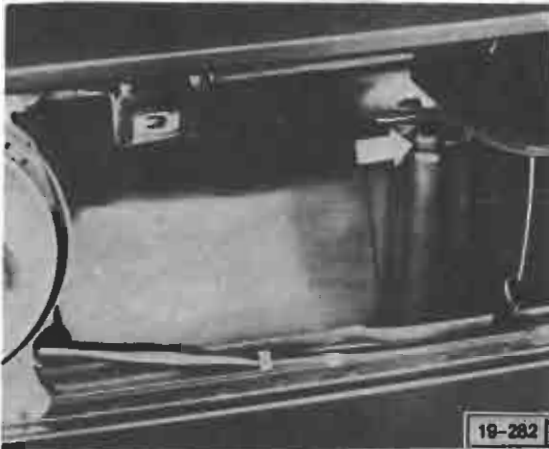
Coolant/antifreeze **must not** be reused when replacing engine, cylinder head, cylinder head gasket, radiator and heater core.

# 19 Engine-Cooling System



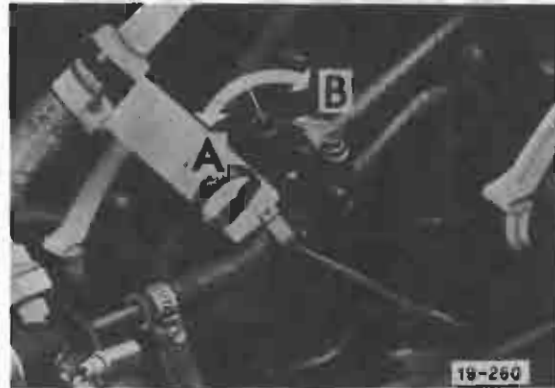
**Fig. 4 Hose spring clamp, removing/installing**

- use universal pliers or hose clamp pliers to remove or install clamp (arrow)



**Fig. 5 Cooling system, filling**

- set heater control to maximum heating
- open control valve for auxiliary heater under rear seat
- remove radiator grille
- raise vehicle approx. 10 cm (4 in.) at front under cross-member with floor jack and wooden support or equivalent
- open bleeder screw (arrow) on radiator
- have up to two gallons of pre-mixed coolant on hand



**Fig. 6 Cooling system, filling**

- open bleeder valve in engine compartment
- A = open
- B = closed



**Fig. 7 Cooling system, filling**

- fill coolant until expansion tank is full (approx. 4-5 litres/4.25-5.3 US qt)
- start engine
- at approx. 2000 rpm, top up tank until coolant flows from bleeder screw on radiator (bubble free), maintain 2000 rpm
- close bleeder screw on top of radiator when coolant flows out
- add coolant until tank is full and close tank with cap, allow engine to idle
- turn engine off and lower vehicle
  
- additional coolant may need to be added to the expansion tank to top off

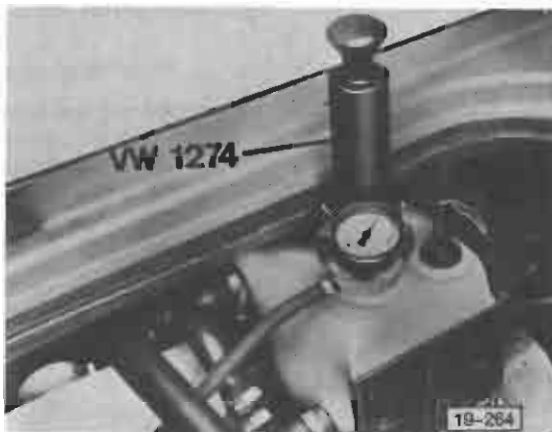
**WARNING —**

- Hot coolant can scald. Do not remove expansion tank cap unless engine is cold.
- Engine must also be running at approx. 2000 rpm before removing coolant expansion tank cap to prevent loss of coolant.



**Fig. 8** Cooling system, filling

- fill refill tank up to max. mark (arrow)



**Fig. 9** Cooling system, checking for leaks

- attach tester in place of pressure cap
  - Stant tester St-255 A, AC-PCT3 or equivalent
- apply pressure of approx. 1 bar (14.5 psi)
  - if pressure remains constant, system is **OK**
  - if pressure drops, look for leaks and eliminate

## Antifreeze hydrometer, checking

Calibration of hydrometer must be checked frequently to ensure accuracy.

- mix a 50/50 mixture of antifreeze and water together in a small container
- hydrometer should read  $-35^{\circ}\text{C}$  ( $-30^{\circ}\text{F}$ )
  - if not, put a mark (paint dot) to indicate where  $-35^{\circ}\text{C}$  ( $-30^{\circ}\text{F}$ ) should be.



# 19 Engine-Cooling System



Fig. 10 Expansion tank cap, checking

- attach cap on tester
  - Stant tester ST-255 A, AC-PCT-3 or equivalent
- apply pressure of 0.9 to 1.15 bar (13–17 psi)
  - if pressure relief valve opens within this range, cap is OK

## Note

Cap has 3 important functions:

1. it opens at pressure of 0.9–1.15 bar (13–17 psi) allowing flow to expansion tank
2. it opens at a vacuum of 0.02–0.1 bar (0.3–1.45 psi) allowing flow from expansion tank
3. it seals radiator neck

Only item 1 can be checked with tester.

If it is suspected that items 2 and 3 are not in order, replace cap

## Coolant mixture ratio

- coolant capacity 17.5 ltr (18.4 US qt)

## Note

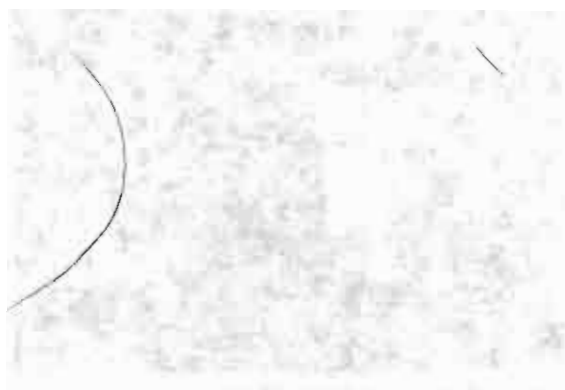
Cooling system is filled at factory with mixture of water and antifreeze/corrosion protective solution.

Coolant mixture should be used all year.

When replacing coolant only use ethylene glycol based antifreeze (phosphate-free).

Due to higher boiling point, coolant is an aid to operating on full load, particularly in warm climates

Outside Temperature	Antifreeze	Water
–25°C (–13°F)	7.0 ltr (7.4 US qt)	10.5 ltr (11 US qt)
–35°C (–30°F)	8.75 ltr (9.2 US qt)	8.75 ltr (9.2 US qt)



## Snap-lock connectors, installing

Starting Jan. 1986, the electrical connection on replacement radiator cooling fan motors is now a snap-lock connector.

When replacing a fan motor also replace the connector on the wiring harness.

This snap-lock connector was introduced on Vanagon as a running change during Jan. 1986 production.

### Note

This work procedure will be applicable when all existing stocks of replacement radiator cooling fan motors with a push-on connector are exhausted.

## Three wire harness

### Parts required

#### Three pin connector

Part No. 191 906 232B

Qty 1

#### Rubber boot

Part No. 191 972 525B

Qty 2

#### Terminals

Part No. N 902 644 02

Qty 3

### Work sequence

- disconnect battery ground strap
- cut off old connector from wiring harness
- push wires through rubber boot
- attach terminal to wire
- insert wires into connector (cavity numbers on connector)
  - Red/Black to cavity 3
  - Red/White to cavity 2
  - Brown to cavity 1
- attach connector to fan motor
- attach rubber boot
- reconnect battery ground strap
- check fan for proper operation

## Two wire harness

### Parts required

#### Three pin connector

Part No. 191 906 232B

Qty 1

#### Rubber boot

Part No. 191 972 525B

Qty 1

#### Terminals

Part No. N 902 644 02

Qty 2

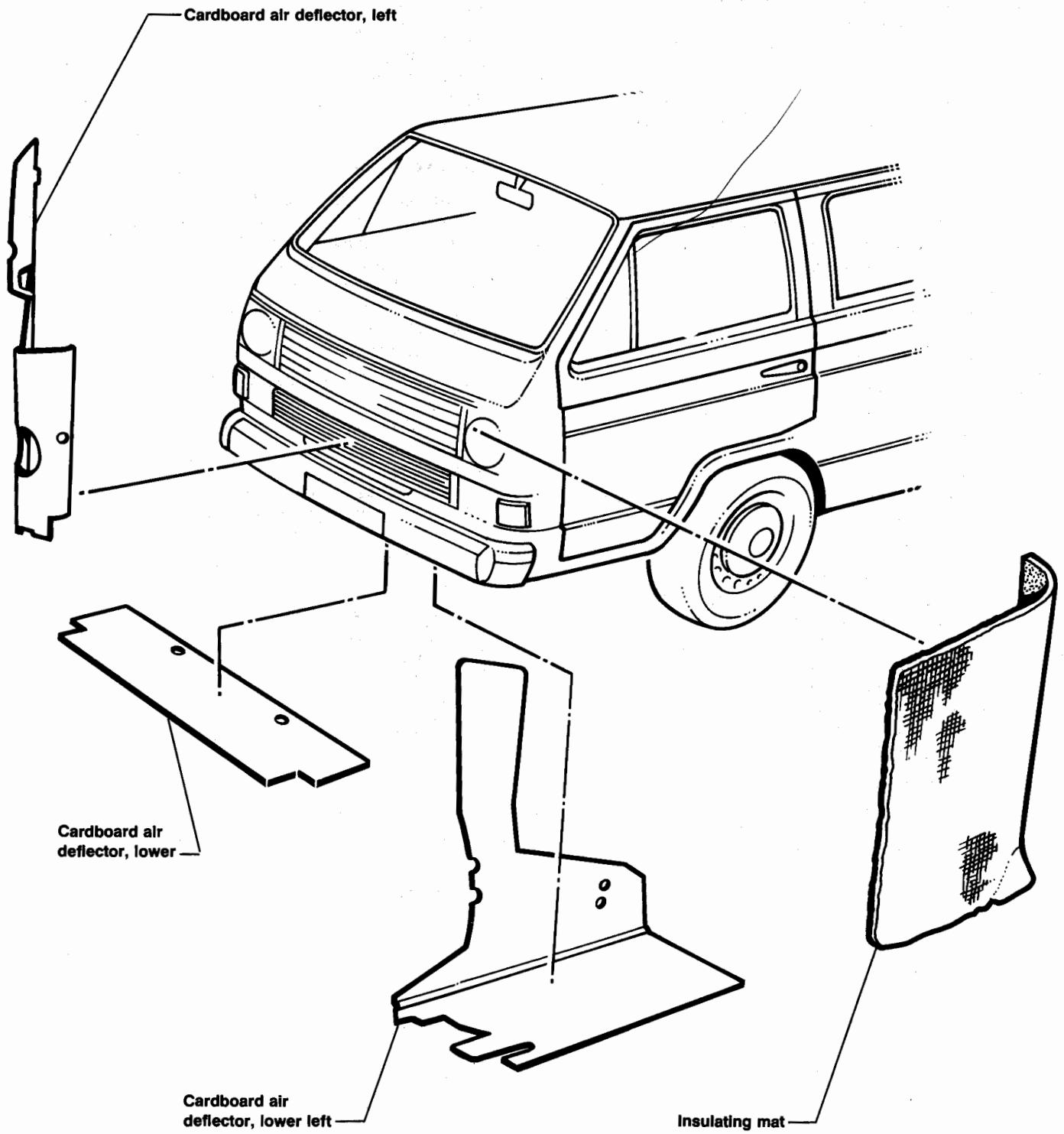
### Work sequence

- disconnect battery ground strap
- cut off old connector from wiring harness
- push wires through rubber boot
- attach terminal to wire
- insert wires into connector (cavity numbers on connector)
  - Red/Black to cavity 2
  - Brown to cavity 1
- seal cavity 3 with sealer **AMV176 000 05** or equivalent
- attach connector to fan motor
- attach rubber boot
- seal empty wire hole in rubber boot
- reconnect battery ground strap
- check fan for proper operation

### CAUTION

Part numbers are listed for reference only. Always consult with the Parts Department for latest information.

# 19 Engine – Cooling System



**19.20**

Hot footwell kit,  
assembly

Water-cooled

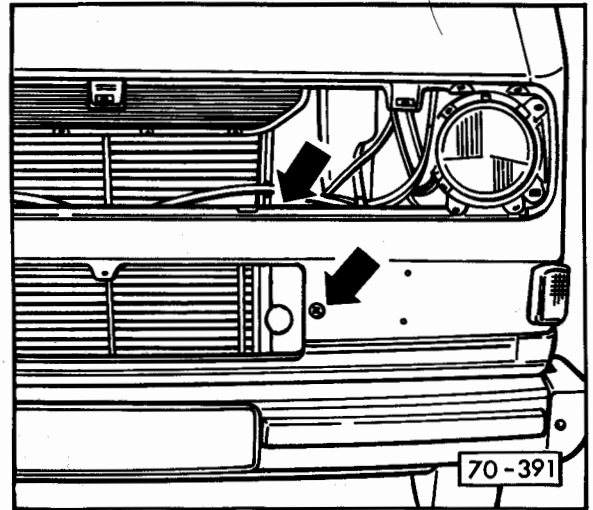
## Hot footwell kit, installing

### Parts

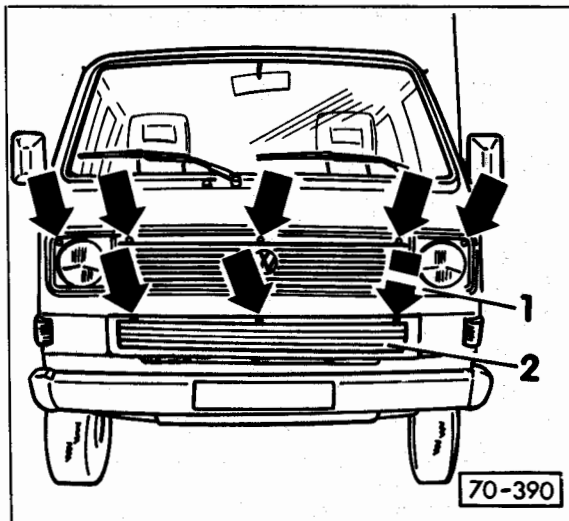
- Cardboard air deflector, left  
– delete
- Cardboard air deflector, lower  
– modify
- Cardboard air deflector, lower left  
– new part Part No. 251 121 291
- Insulating mat  
– new part Part No. 251 864 249 8

### CAUTION

Part numbers are for reference only. Always check with your Parts Department for latest parts information.

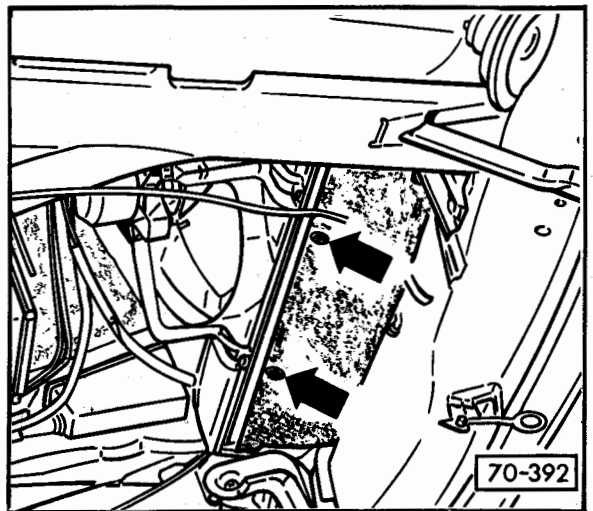


### Work sequence



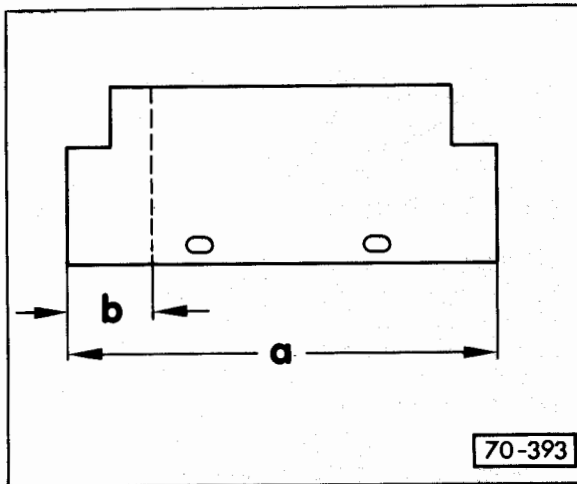
- remove fresh air intake trim 1 (five securing pins – upper arrows)
- remove radiator grille 2 (three Phillips screws – lower arrows)

- pry out air deflector clip (upper arrow)
- remove Phillips screw from lower apron (lower arrow)
- disconnect radiator fan harness connector
- remove left cardboard air deflector
- reinstall radiator fan harness connector, fresh air intake trim, and radiator grille
- remove spare tire and left spare tire bracket



- remove lower cardboard air deflector by removing two Phillips screws (arrows)

# 19 Engine – Cooling System

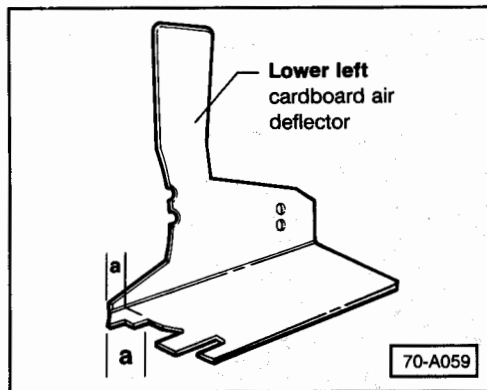


- shorten lower cardboard air deflector by 50mm (2.0 in.) and reinstall
  - dimension a = 490 mm (19.1 in.)
  - dimension b = 50 mm (2.0 in.)

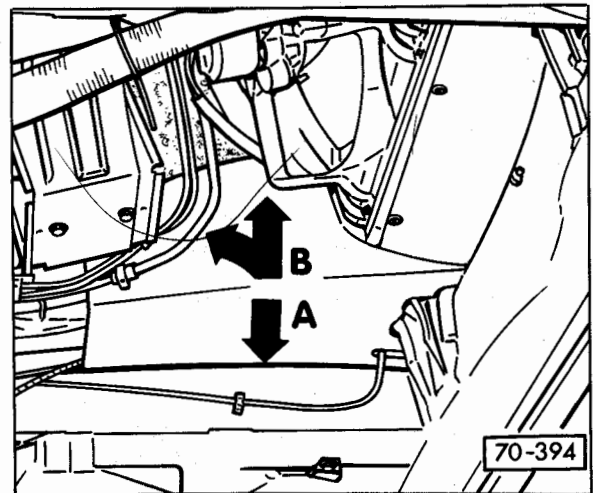
### Note

Vehicles equipped with air conditioning may already have the lower deflector modified

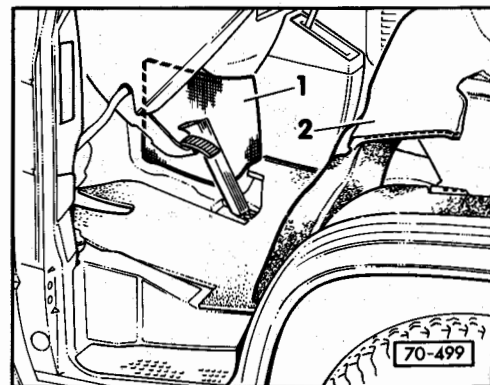
### Vehicles with air conditioning



- modify lower left cardboard deflector
  - dimension a = 50 mm (2.0 in.)



- push lower left cardboard air deflector over left longitudinal member (arrow A) and secure behind radiator fan shroud and brake lines (arrow B)
- reinstall spare tire bracket and spare tire



- fold back floor covering 2 from left side of console
- remove 25mm (1.0 in.) of backing from self-adhesive insulating mat 1 and apply to floor panel
- remove remaining backing and finish applying insulating mat
- reinstall floor covering 2

### Note

If the floor pan continues to heat up, adjust ventilation ducts so that fresh air is directed to the floor pan.

## Engine Lubrication System

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  - removing 17.3

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- Oil filter 17.4, 17.5
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#### Water-cooled /Syncro

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crankcase breather 17.9
- Oil pressure switch 17.9
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# 17 Engine-Lubrication System

**Oil pressure**  
checking Fig. 5

**Engine oil filling capacity**  
with oil filter change—3.5 ltr (3.7 US qt)  
without oil filter change—3.0 ltr (3.2 US qt)

**Oil pressure switch**  
removing/installing Fig. 4  
checking Fig. 5

**Oil cooler seal**  
always replace

**Oil dipstick**  
difference between  
min. and max.  
0.6 ltr (0.6 US qt)

25 Nm (18 ft lb)

**Oil cooler**  
check for leaks Fig. 3  
Replace oil cooler if there are  
metal particles on pistons,  
crankcase bores, or in engine  
oil

**Oil strainer**  
**Oil filter**  
note instructions on  
filter

**Self-locking nut**  
always replace  
**Oil pressure relief valve**  
20 Nm (15 ft lb)

**Oil strainer cover**

13 Nm (9 ft lb)

**Oil drain plug**  
25 Nm (18 ft lb)

20 Nm (15 ft lb)

**Oil pump insert**  
removing Fig. 2

25 Nm (18 ft lb)

**Oil pump housing**  
removing Fig. 1

**Oil pump gears**

17-064

17.2

Oil pump  
Oil pressure switch  
Oil cooler

**Air cooled--AFC**

I-2

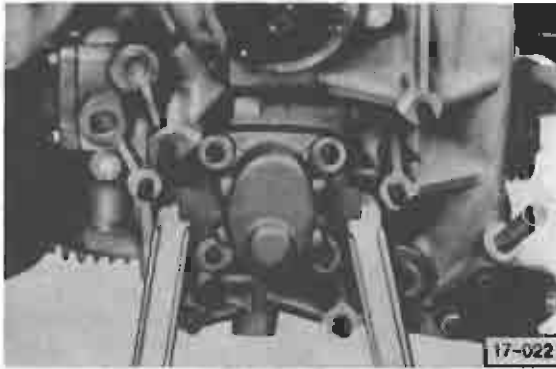


Fig. 1 Oil pump housing, removing

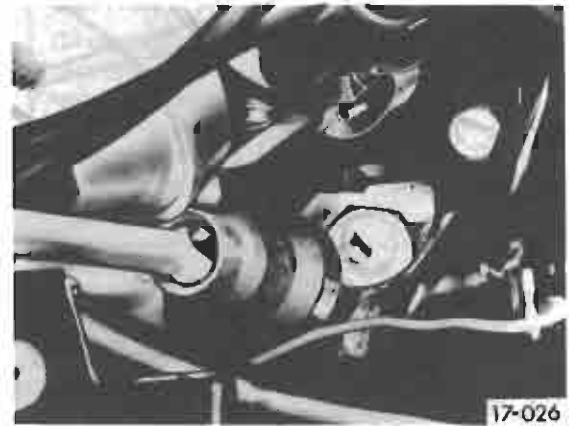


Fig. 4 Oil pressure switch, removing/Installing



Fig. 2 Oil pump insert, removing

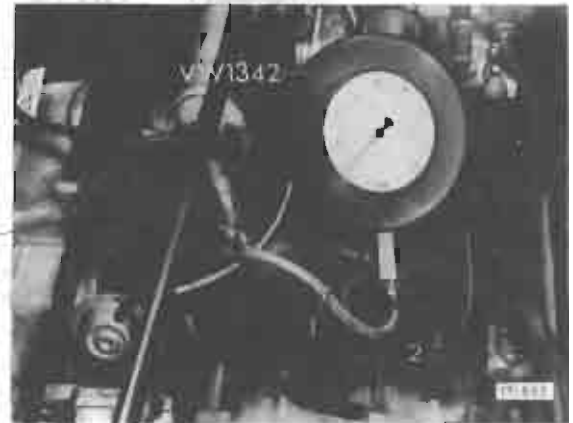


Fig. 5 Oil pressure/switch, checking



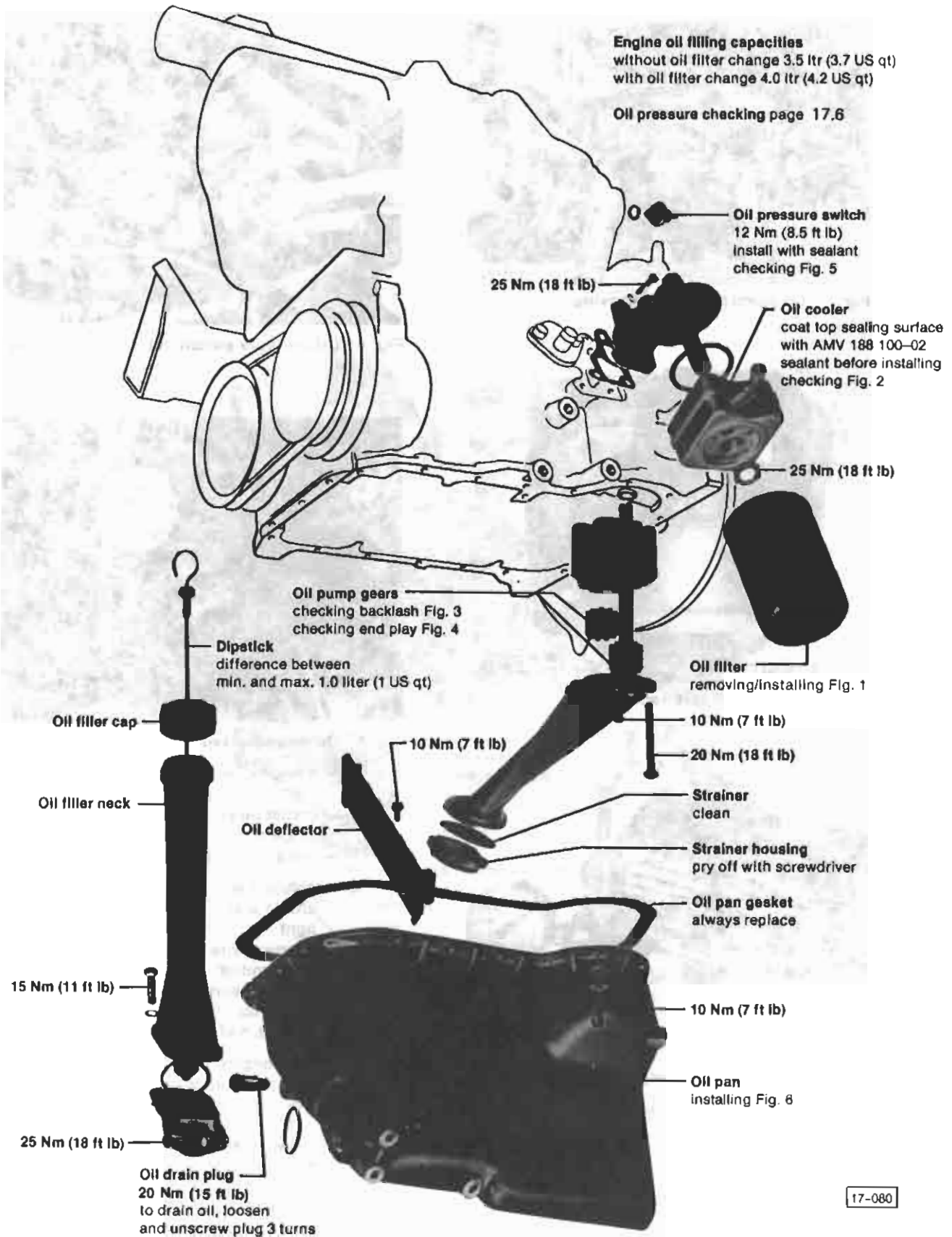
Fig. 3 Oil cooler, checking for leaks

- test pressure max. 5.9 bar (85 psi)

- engine oil temperature should be 80°C (176°F)
- install oil pressure gauge/adaptor in place of oil pressure switch
- install switch in gauge
- connect wire 1 to oil pressure switch and to wire from oil pressure warning light
- connect wire 2 to ground
- turn ignition ON
  - oil pressure warning light must light up
  - if NO, switch is defective
- start engine
  - oil pressure warning light must go out at oil pressure of 0.15—0.45 bar (2—6.5 psi)
- increase engine speed
  - at 2000 rpm, pressure should be min. 2.0 bar (29 psi)



# 17 Engine-Lubrication System



## 17.4

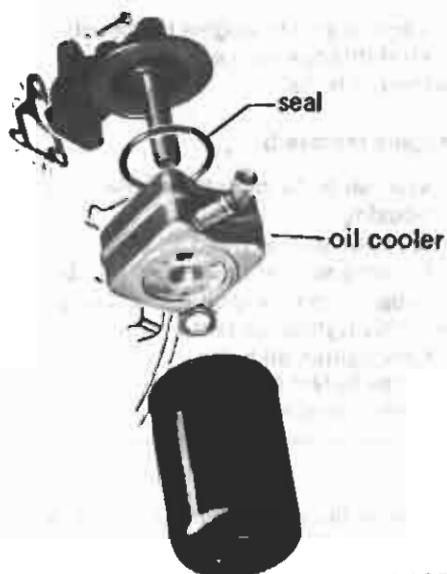
Oil pump  
Oil filter  
Oil pan

**Diesel**



**Fig. 1 Oil filter, removing/installing**

– loosen with US 4474



**Fig. 2 Oil cooler, checking**

If oil contamination is found in the cooling system, one possible source of leakage is the oil cooler.

- remove oil cooler from vehicle
- plug one hose fitting and pressurize remaining fitting with air
- submerge cooler in water and check for air bubbles which indicate a leak in cooler
- if leaking is noticed, replace cooler

**Note**

Always use a new seal coated with clean engine oil when reinstalling oil cooler.

- clean cooling system thoroughly (use Prestone Super Flush AS - 107 or equivalent)

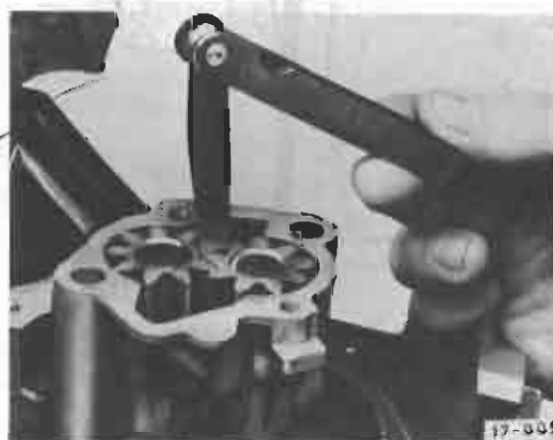
**CAUTION**

Oil contamination of coolant may have deteriorated coolant hoses. Inspect and replace hoses depending on condition and/or length of time oil has been in cooling system.

**CAUTION**

Do not loosen oil cooler when removing oil filter

- when installing, hand tighten according to instructions on filter element or carton



**Fig. 3 Oil pump backlash, checking**

- new: 0.05 mm (0.002 in.)
- wear limit: 0.2 mm (0.008 in.)



**Fig. 4 Oil pump end play, checking**

- maximum 0.15 mm (0.006 in.)

**Diesel**

Oil filter  
Oil pump  
Oil cooler, checking

**17.5**

# 17 Engine-Lubrication System

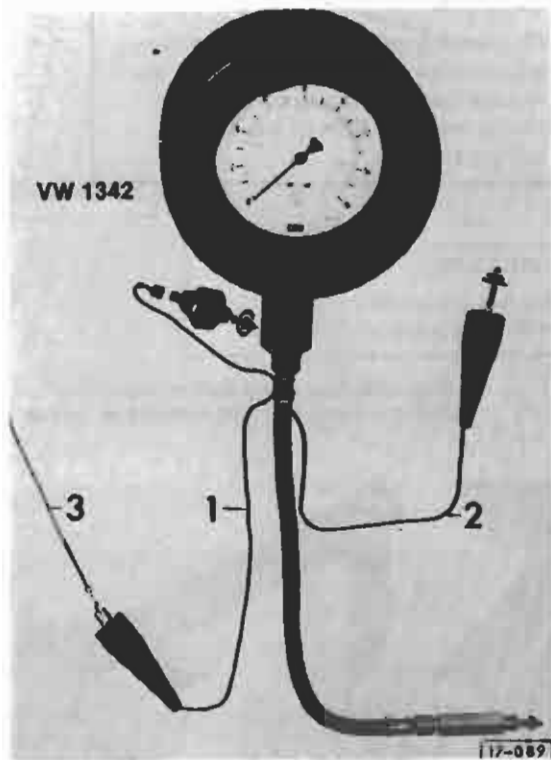


Fig. 5 Oil pressure switch, checking

- remove oil pressure switch and insert into tester
- connect tester into cylinder head in place of switch
- connect test wire 1 (blue) of tester to oil pressure switch and wire 3 from oil pressure switch
  
- connect test wire 2 (brown) to ground
- turn ignition **ON**, oil warning light must light (assuming bulb and wire are OK)
  - if **NO**, switch is defective
- start engine and increase speed slowly. At oil pressure of 0.15–0.45 bar (2–6 psi) oil pressure warning light must go out
  - if **NO**, switch is defective
- increase speed further. At 2000 rpm and oil temperature of 80 °C (176 °F) minimum oil pressure must be 2.0 bar (28 ft lb)

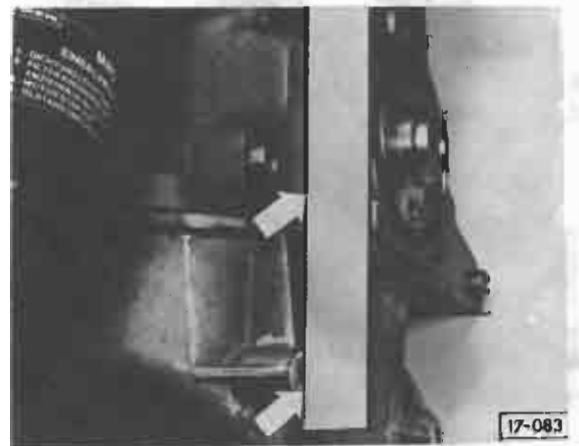


Fig. 6 Oil pan, installing (engine installed)

- align oil pan to engine block with straightedge (arrows)
- tighten bolts

**(engine removed)**

- start all bolts including those in clutch housing
- press oil pan by hand against clutch housing so that there is no gap between oil pan and clutch housing
- lightly tighten all bolts
- fully tighten all bolts
  - M6 to 10 Nm (7 ft lb)
  - M10 to 45 Nm (33 ft lb)

**CAUTION**

Oil pan must be flush with end face of engine block. If it protrudes or there is a gap, clutch housing will be stressed and could break

**Note**

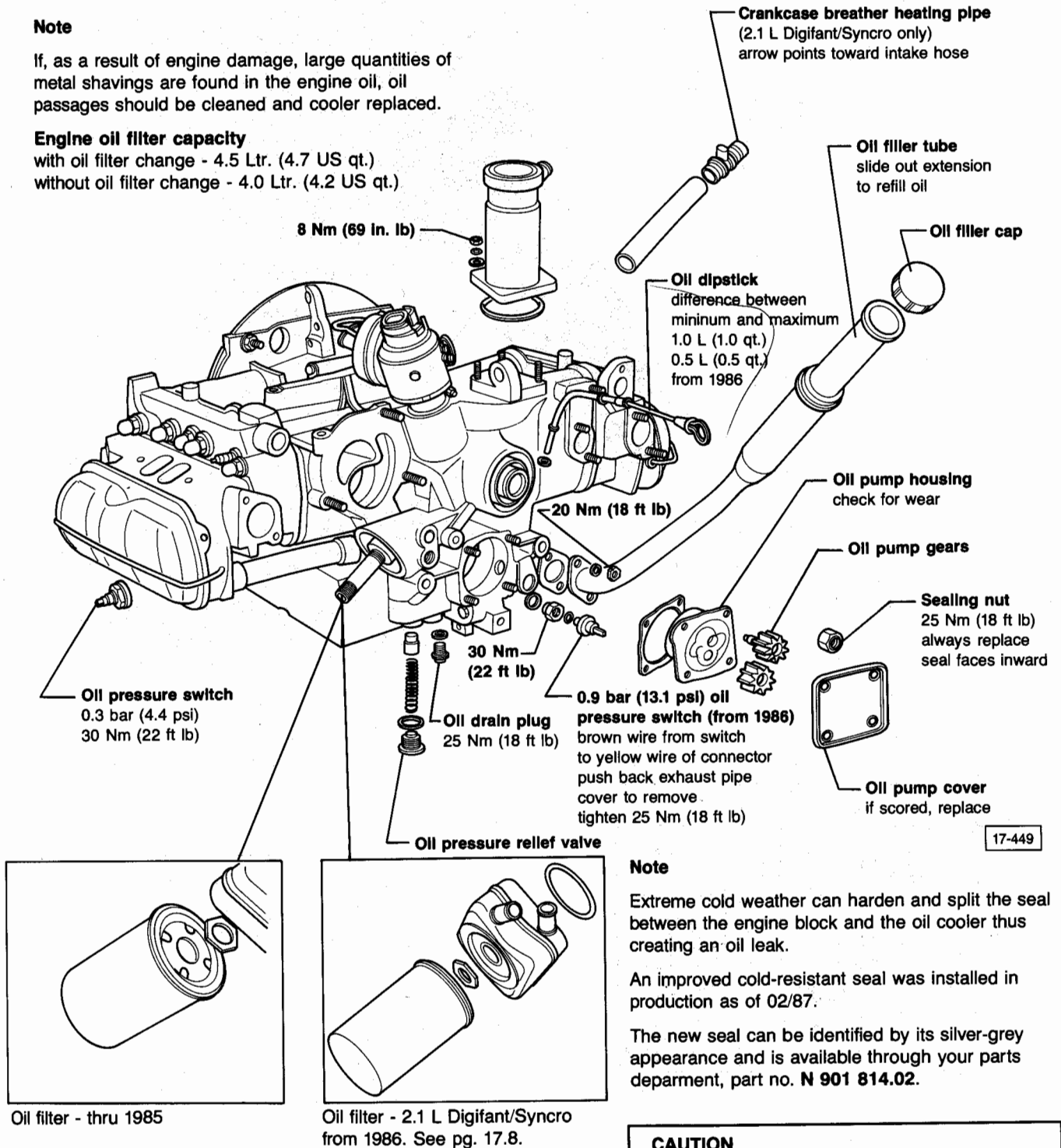
Always replace all gaskets and sealing rings.

**Note**

If, as a result of engine damage, large quantities of metal shavings are found in the engine oil, oil passages should be cleaned and cooler replaced.

**Engine oil filter capacity**

with oil filter change - 4.5 Ltr. (4.7 US qt.)  
without oil filter change - 4.0 Ltr. (4.2 US qt.)



17-449

**Note**

Extreme cold weather can harden and split the seal between the engine block and the oil cooler thus creating an oil leak.

An improved cold-resistant seal was installed in production as of 02/87.

The new seal can be identified by its silver-grey appearance and is available through your parts department, part no. **N 901 814.02**.

**CAUTION**

Part numbers are for reference only. Always check with your Parts Department for latest information.

**Note**

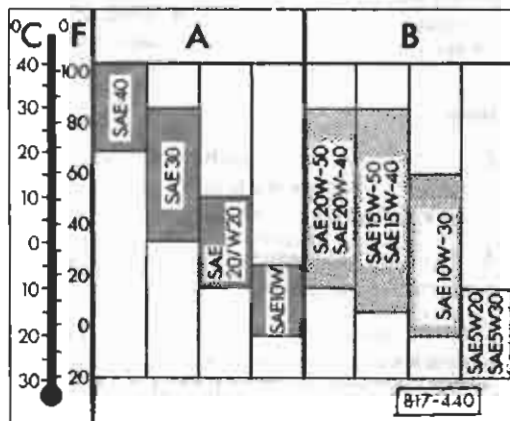
Observe installation instructions on filter.

**Water-cooled**

Oil pump  
Oil pressure switch  
Oil filter

# 17 Engine-Lubrication System

Oil cooler - from 1986



Oil viscosity grades

A - single weight oils

B - Multigrade oils

Only use oils marked 'SF' under API system.

## 17.8

Oil viscosity  
Oil cooler

Water-cooled - from 1986

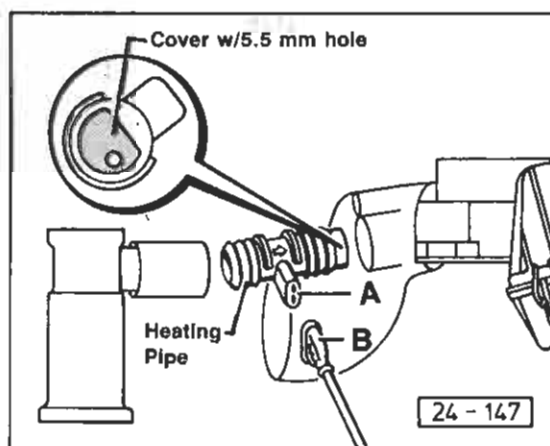


**Fig. 1 Oil pump housing, removing**



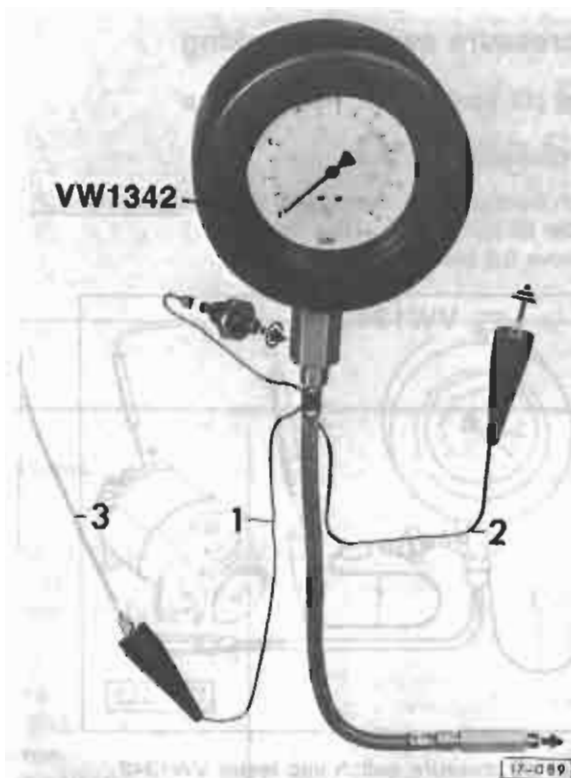
**Fig. 2 Oil pump end play, checking**

- max. 0.1 mm (0.004 in.)



**Fig. 3 Checking heating pipe for crankcase breather**

- A = resistance 4-17 ohms @ 25°C (77°F)
- B = approx. 12V, with ignition on



**Fig. 4 Oil pressure/switch, checking**

- engine oil temperature should be 80°C (176°F)
- remove oil pressure switch and install in gauge
- install oil pressure gauge/adaptor in place of oil pressure switch
- connect wire 1 (blue) of gauge to oil pressure switch and wire of oil pressure warning light 3 as shown
- connect wire 2 (brown) to ground
- turn ignition ON
  - oil pressure warning light must light up
- if NO, switch is defective, replace switch
- start engine
  - oil pressure warning light must go out at an oil pressure of 0.15–0.45 bar (2–6.5 psi)
- increase engine speed
  - at 2000 rpm, pressure should be minimum 2.0 bar (29 psi)

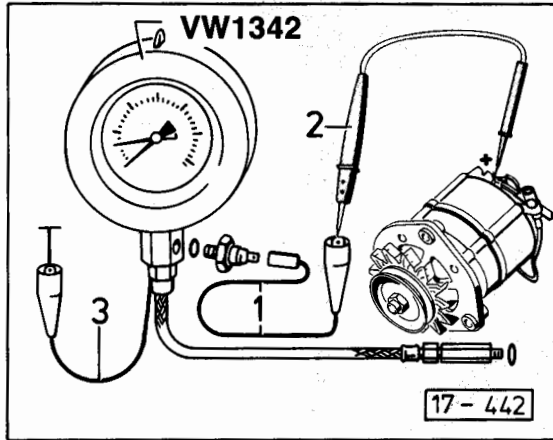
# 17 Engine-Lubrication System

## Oil pressure switch, checking

0.9 bar (13.1 psi) switch, near oil pump

### Work procedure

- push back exhaust cover plate (mounting screw under oil pump) with screw driver
- remove 0.9 bar (13.1 psi)



- screw oil pressure switch into tester VW1342
- connect wire 1 (blue)
- screw tester into crankcase in place of oil pressure switch
- connect test lamp 2 to wire 1 and alternator positive connection
- ground wire 3 (brown)
- start engine, slowly raise RPM
- at tester reading 0.75-1.05 bar (10.9-14.8 psi) test lamp must **light up**
  - replace oil pressure switch if tester does **not** light

### Note

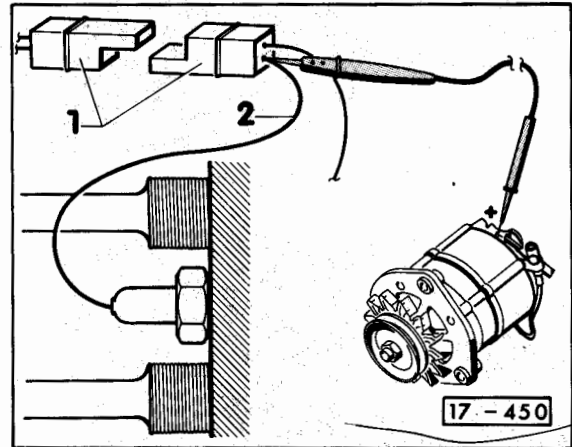
As necessary, check switching point of oil pressure switch at starting RPM

0.3 bar (4.4 psi) oil pressure switch

### Note

Tester connections are identical to 0.9 (13.1 psi) switch

0.3 bar (4.4 psi) oil pressure switch located between left side push rod tubes



- disconnect connector 1
- connect test lamp to wire 2 of 0.3 bar (4.4 psi) oil pressure switch and to alternator positive
- test lamp **must** light up
- start engine, raise RPM

When pressure goes to 0.15-0.45 bar (2.2-6.5 psi) test lamp must go **out**.

If not, replace oil pressure switch

- raise RPM
- at oil temperature of 80°C (176°F) and RPM of 2000, oil pressure should be 2.0 bar (29 psi)

# Engine Cylinder Head Valve Drive

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### Air-cooled

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- Cylinder head assembly 15.2
- Gasoline additive reducing carbon deposits 15.25
- Rocker arm shaft installing 15.3
- Valves assembly 15.2 dimensions 15.3 guides 15.4 hydraulic lifters 15.6 seats, refacing 15.4 springs 15.2

### Diesel

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- Compression pressure checking 15.16
- Cylinder head assembly 15.8 bolts 15.9 distortion 15.14 gasket 15.9
- Valves assembly 15.10

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- Compression pressure checking 15.20
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- Engine block assembly 15.22
- Pushrod tubes replacing 15.25
- Valves assembly 15.17 dimensions 15.18 hydraulic lifters 15.23 guides 15.20 seats, refacing 15.18 springs 15.18

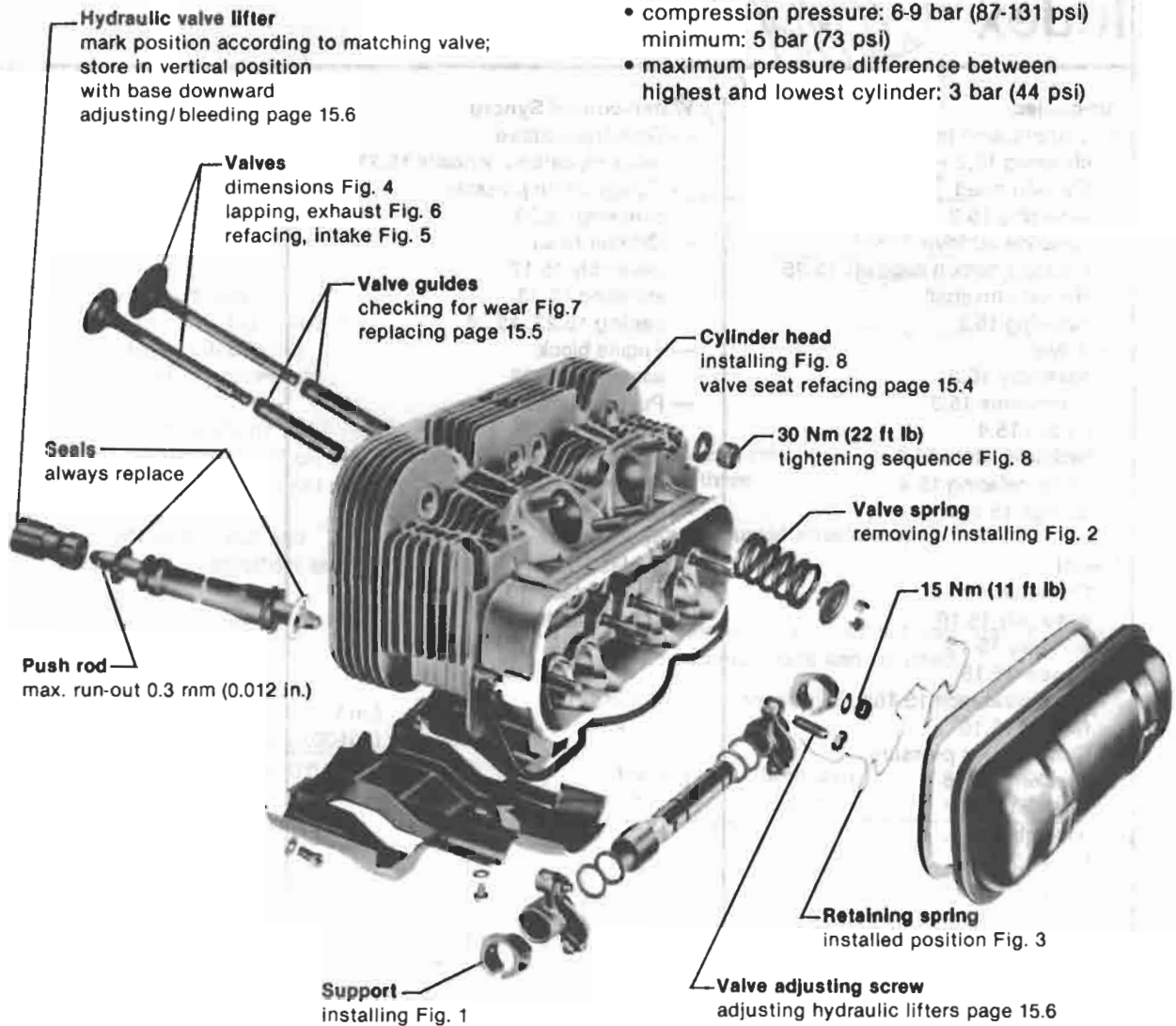


# 15 Engine—Cylinder Head, Valve Drive

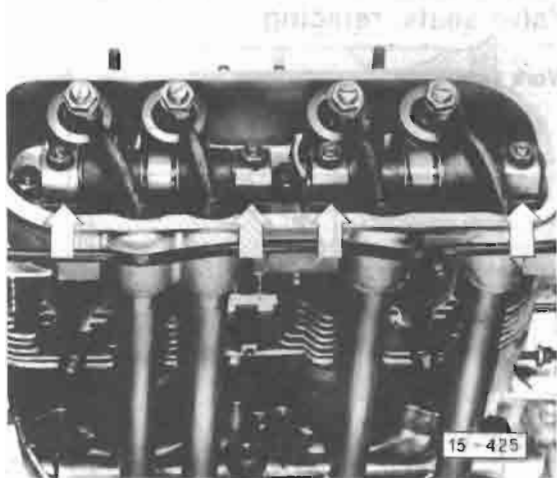
## Compression, checking

### WARNING

On vehicles with electronic ignition, disconnect terminal 4 on ignition coil and connect to ground before performing compression test



15-429

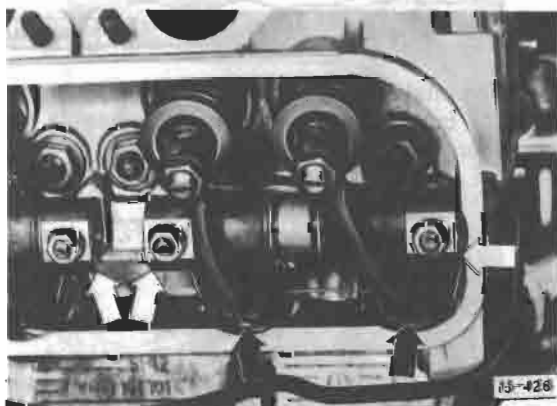


**Fig. 1** Rocker arm shaft supports, installing

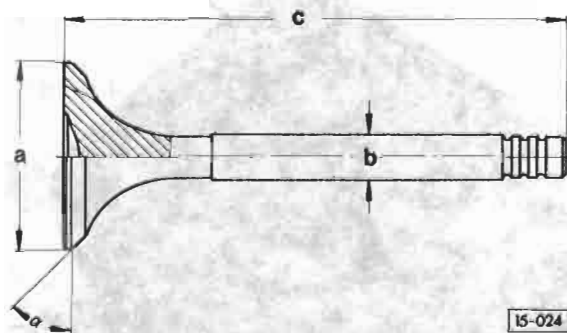
- slot downward (arrows)
- chamfer outward



**Fig. 2** Valve spring, removing/installing



**Fig. 3** Retaining spring for pushrod tube, installed position (arrows)



**Fig. 4** Valves, dimensions

**Intake valve**

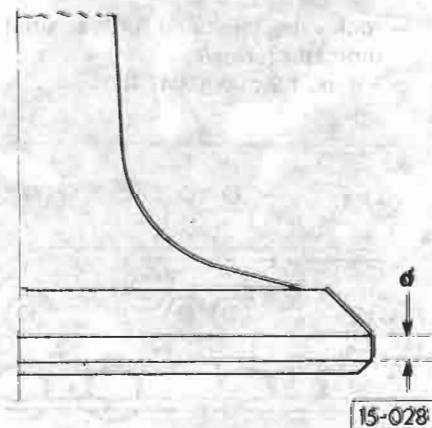
- a** = 39.3 mm (1.547 in.) diameter
- b** = 7.95 mm (0.313 in.) diameter
- c** = 115.4 mm (4.540 in.) length
- α** = 29°30'

**Exhaust valve**

- a** = 33.0 mm (1.299 in.) diameter
- b** = 8.92 mm (0.351 in.) diameter
- c** = 115.4 mm (4.540 in.) length
- α** = 45°

**CAUTION**

Do not rework exhaust valves by machine; lap by hand only



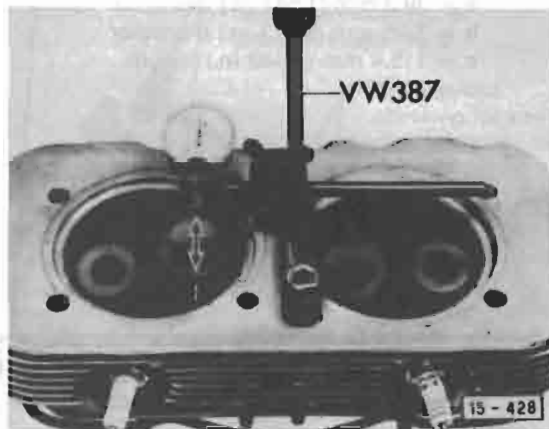
**Fig. 5** Intake valves, refacing

- check stem diameter
- grind seat angle to 29°30'
- valve margin **d** must not be less than 0.5 mm (0.020 in.)

# 15 Engine-Cylinder Head, Valve Drive

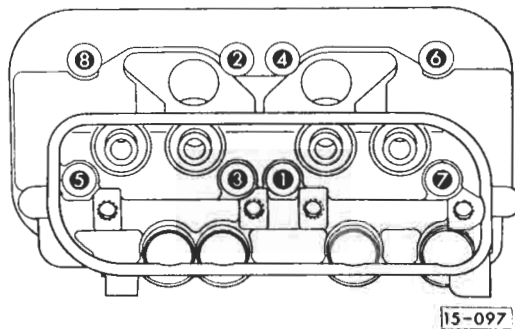


**Fig. 6 Exhaust valves, lapping**  
— lift and turn frequently



**Fig. 7 Valve guide checking for wear**

- remove carbon
- insert new valve into valve guide
  - valve stem must be flush with valve guide end
- rock valve back and forth against dial indicator (arrow)
  - max. 1.2 mm (0.047 in.)

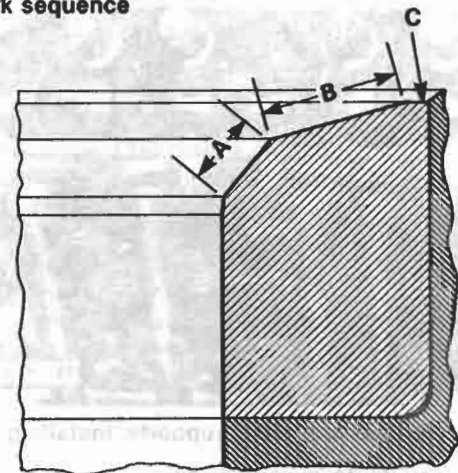


**Fig. 8 Cylinder head, installing**

- tighten nuts lightly by hand
- torque in numbered sequence to 30 Nm (22 ft lb)

## Valve seats, refacing

### Work sequence

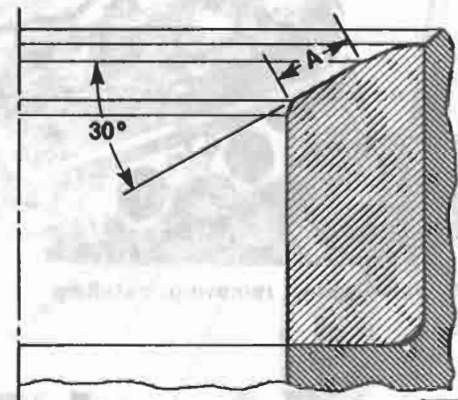


15-A019

### CAUTION

Damaged or burnt seats can be refaced if:

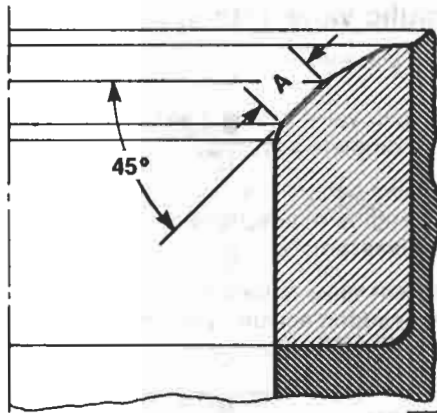
- permissible width of seat **A** is maintained
- 15° chamfer **B** does not exceed outer diameter of valve seat insert in cylinder heat at **C**



15-A020

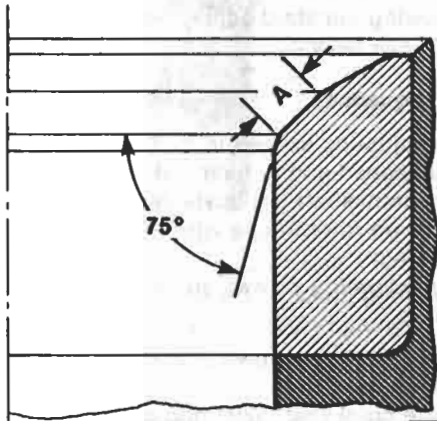
— reface intake valve seats **A** to 30° angle

- stop cutting as soon as complete seat is cleaned



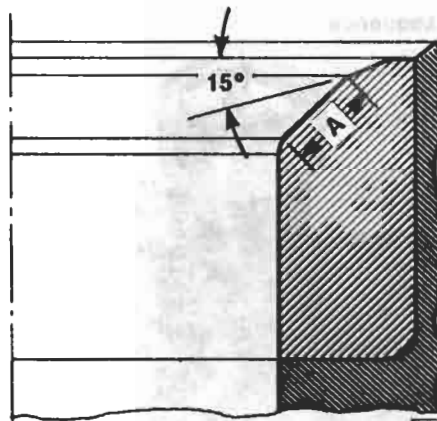
15-A021

- reface exhaust valve seats **A** to 45° angle
- stop cutting as soon as complete seat is cleaned



15-A022

- lightly chamfer edges of intake and exhaust valve seats **A** with 75° cutter



15-A023

- using 15° cutter, narrow intake valve seat widths **A** to 1.8-2.2 mm (0.070-0.086 in.)
- using 15° cutter, narrow exhaust valve seat widths **A** to 2.0-2.5 mm (0.078-0.098 in.)

## Valve guides, replacing

### Work sequence

- clean cylinder head
- check for cracks in head and in valve seats



15-A015

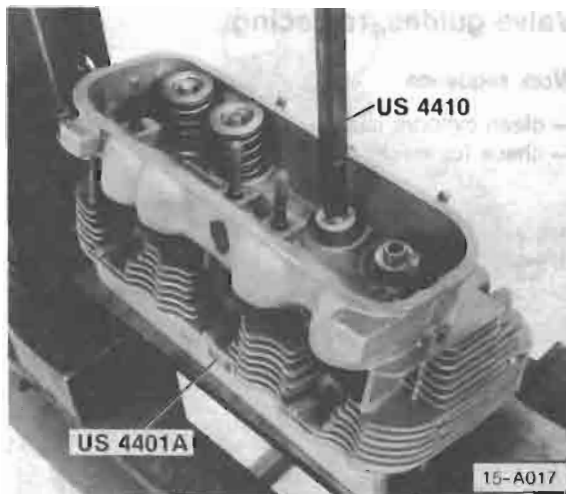
- mount head on US 4401A
- drill guides with shouldered drill to depth of 40-50 mm (1.575-1.968 in.)



15-A016

- drive out remaining part of guide
- go to next page

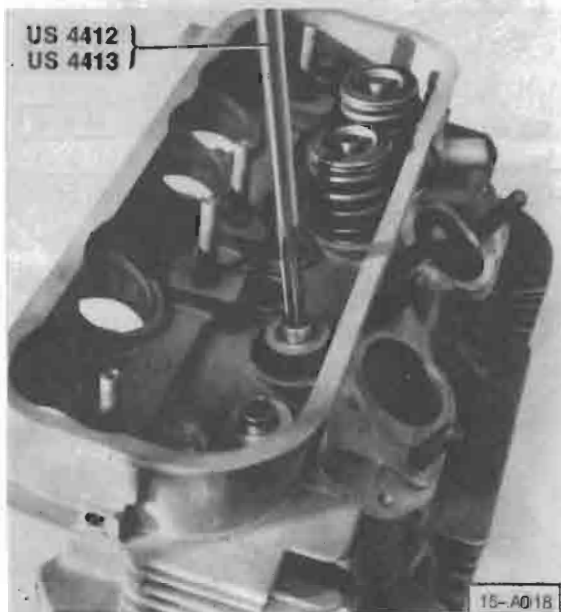
# 15 Engine-Cylinder Head, Valve Drive



— coat new guide with engine oil and press in

### CAUTION

Do not use more than 2 tons of pressure



— ream guides to size  
• use cutting oil

### CAUTION

After valve guides have been replaced, valve seats must be refaced

## Hydraulic valve lifters, adjusting

### Note

Never repair valve lifters; if worn or damaged, replace complete assembly.

Valve lifters can be removed and replaced without engine removal and without major engine disassembly.

Intermittent valve noises are normal upon starting, sudden acceleration, high temperatures or high engine speed

### CAUTION

If metal particles are found in oil pan, remove, disassemble, clean and reinstall all valve lifters from position removed

If rocker shafts have been removed, following standard adjustment is necessary

### Work sequence

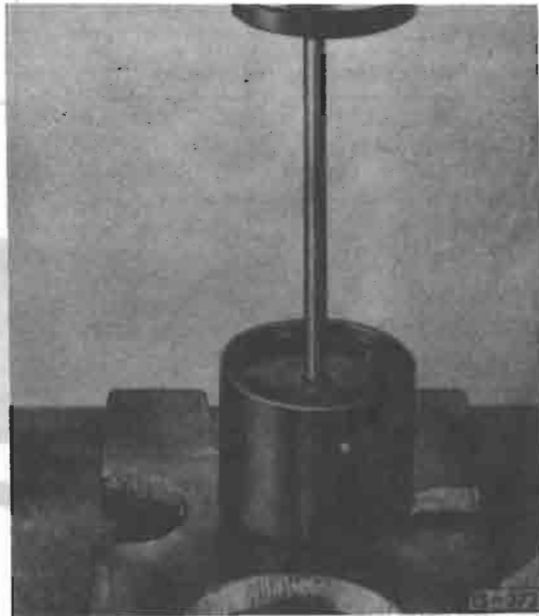
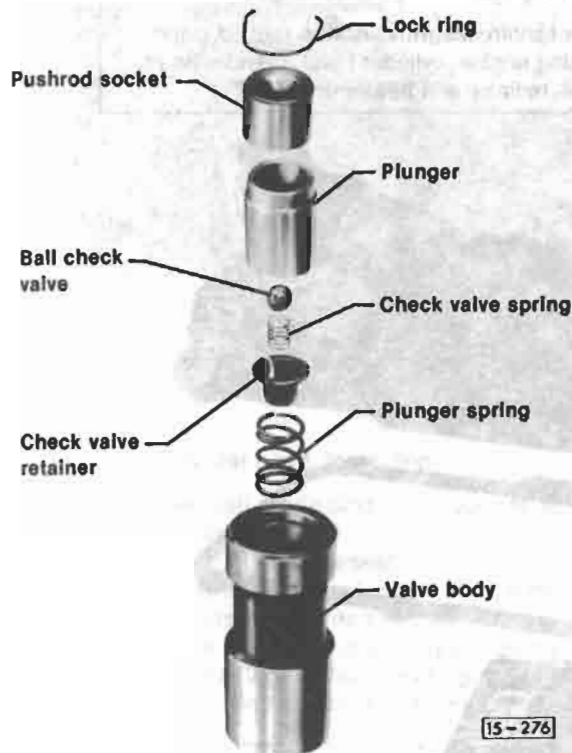
- set adjusting screws in rocker arms so that ball shaped end is flush with surface of arm
- turn crankshaft until cylinder No. 1 is at TDC (mark on rotor in line with mark on distributor housing)
- turn adjusting screws so they just touch valve stems
- turn adjusting screws 2 turns clockwise and tighten locknuts
- rotate crankshaft 180° and adjust next cylinder
- repeat until all cylinders are adjusted

## Hydraulic valve lifters, bleeding

### Work sequence

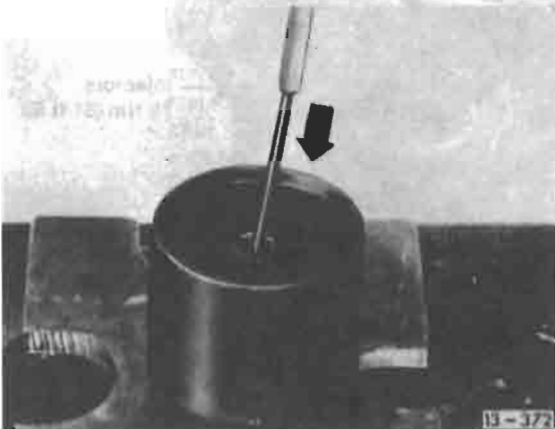


- before installing, check that valve lifter is bled correctly
    - check by applying firm thumb pressure on push rod socket in direction of arrow. Resistance should be felt
- if NO, bleed lifter as follows:



- insert pushrod socket
- place valve lifter (leave in can of oil) in press and force down slowly with Type 1 pushrod until lock ring can be installed
- install lock ring

- fill tin can with engine oil
- cut an old Type 1 pushrod in half
- remove lock ring, pushrod socket, plunger, ball check valve with spring and plunger spring from body
- place valve lifter body in tin can
  - body must be completely covered by oil
- insert plunger spring, check valve retainer, check valve spring, ball check valve and plunger into valve body



- open valve with scribe (arrow), so that oil can flow out of lower part of plunger



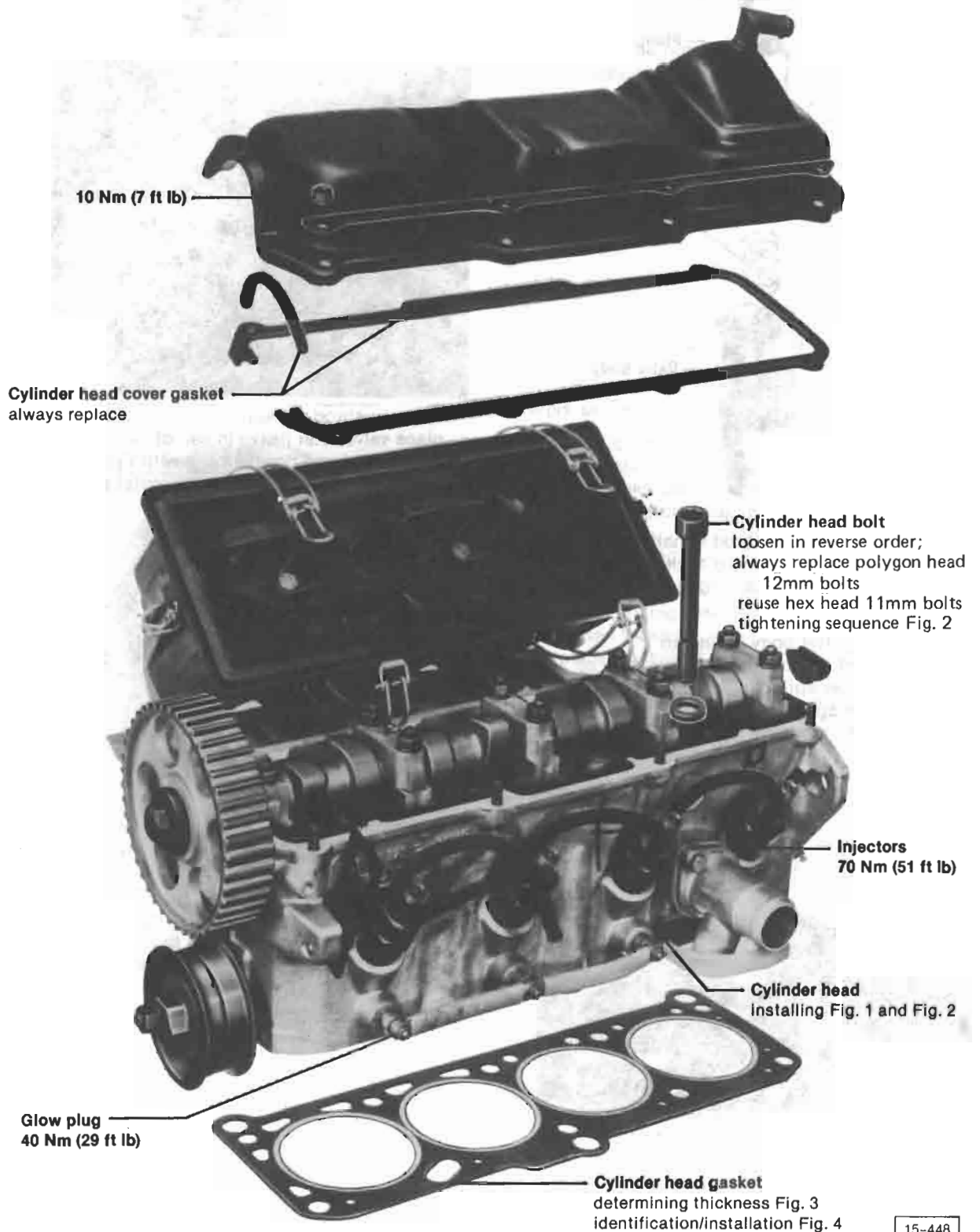
# 15 Engine-Cylinder Head, Valve Drive

## CAUTION

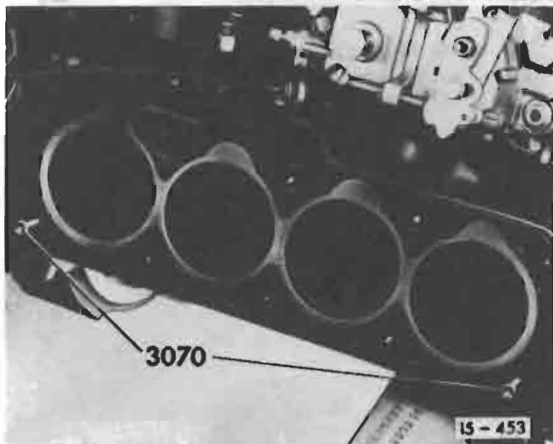
Diesel cylinder heads **cannot** be resurfaced

## CAUTION

Coolant/antifreeze **must not** be reused when replacing engine, cylinder head, cylinder head gasket, radiator and heater core.

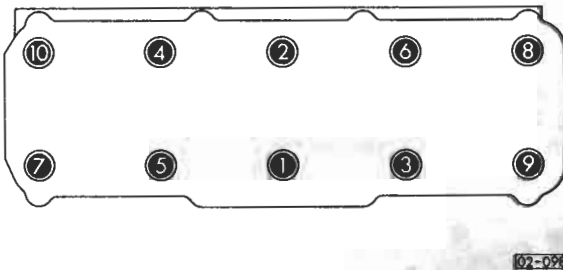


15-448



**Fig. 1 Cylinder head, installing**

- install guide pins from tool set 3070 as shown
- install head gasket
- install head and insert other 8 head bolts and tighten by hand
- remove guide pins with tool and install other 2 head bolts and tighten by hand
- tighten head bolts, see Fig. 2

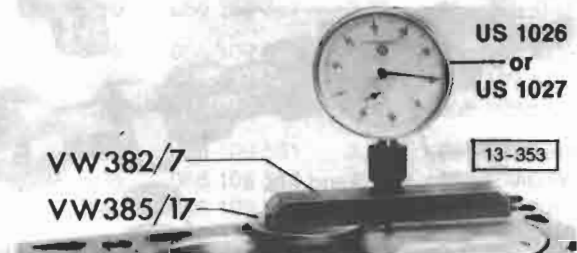


**Fig. 2 Cylinder head bolts, tightening sequence**

- with engine cold, torque cylinder head bolts in sequence in following steps:
  - step 1 to 40 Nm (30 ft lb)
  - step 2 to 60 Nm (44 ft lb)
  - step 3 to 75 Nm (55 ft lb)
- after step 3, turn bolts in sequence with breaker bar ½ turn (180°) further (two ¼ turns are O.K.)
- run engine until it reaches normal operating temperature (engine oil temperature 50°C/122°F or when radiator fan starts running)
- stop engine and retighten head bolts in sequence ¼ turn (90°) further with breaker bar without first loosening them
- after about 1000 miles (with engine either cold or warm) retighten cylinder head bolts with breaker bar, turning bolts in sequence ¼ turn (90°) without loosening them and without interruption

**Note**

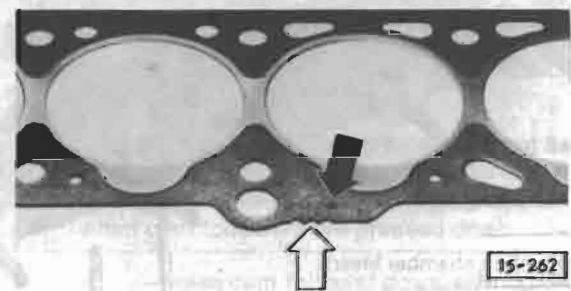
Head can be removed and installed with engine in car.  
 Removing and installing drive belt—see Repair Group 13.  
 Before working on head, remove injectors and glow plugs.  
 Every time head is removed, cylinder head bolts must be torqued, and again after about 1000 miles as described above



**Fig. 3 Cylinder head gasket, determining thickness**

- piston height must be measured when installing new pistons or short block and head gasket selected
- measure piston height and select gasket from following table

Piston height mm (in.)	Identification (notches in gasket)	Part No.
0.63-0.82 (0.025-0.032)	1	068 103 383 L
0.83-0.92 (0.033-0.036)	2	068 103 383 M
0.93-1.02 (0.037-0.040)	3	068 103 383 N



**Fig. 4 Cylinder head gasket, identification/installation**

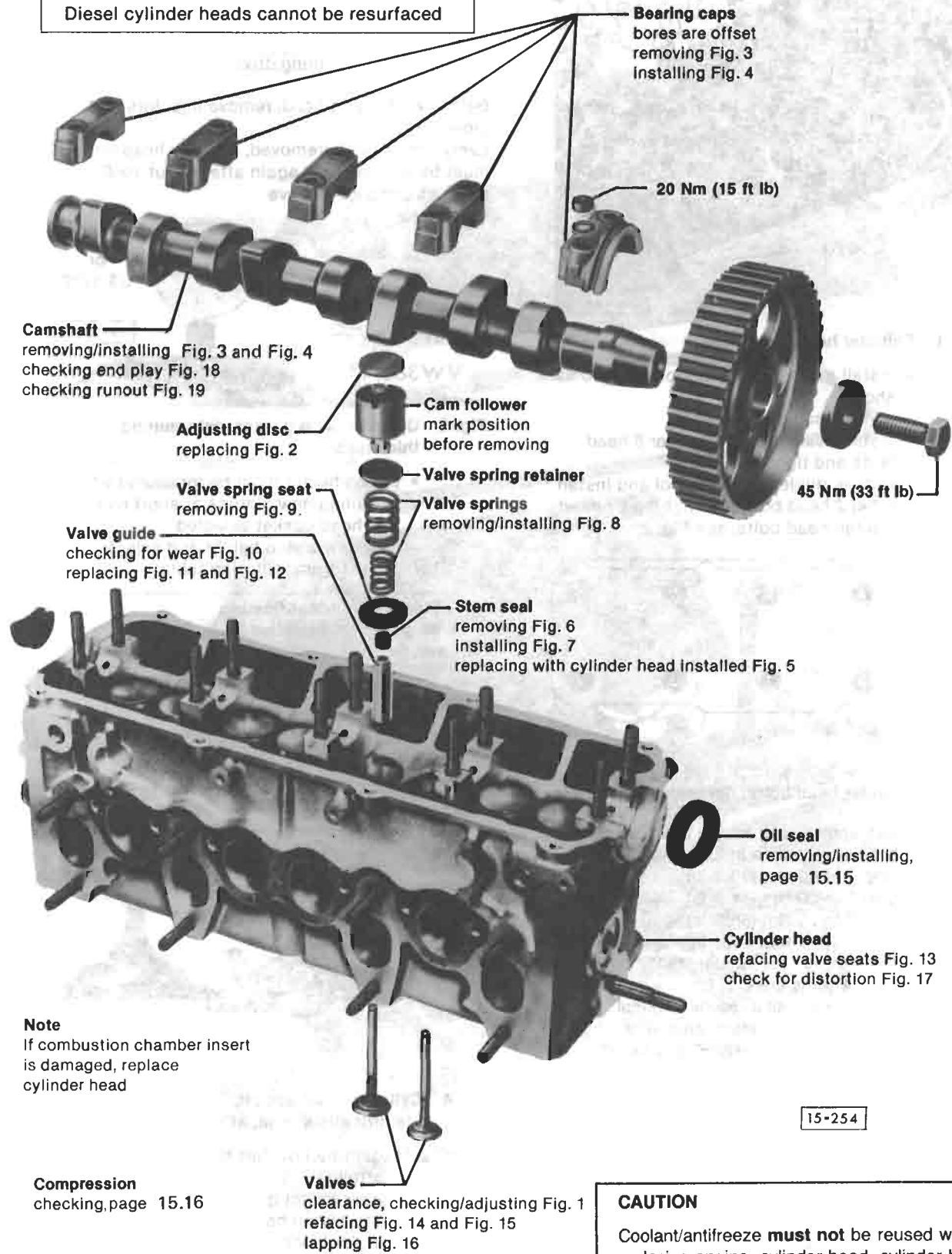
- identified by Part No. and notches (arrows)
- always select gasket thickness according to piston height above top of cylinder block
- marking **OBEN** on gasket must face cylinder head



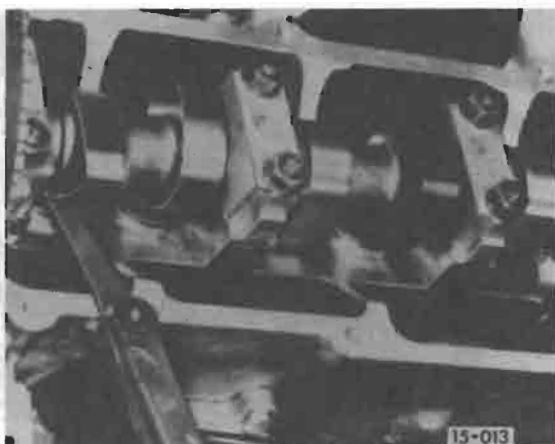
# 15 Engine-Cylinder Head, Valve Drive

**CAUTION**

Diesel cylinder heads cannot be resurfaced



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**Fig. 1 Valve clearance, checking/adjusting**

**Warm**

- warm up engine. Cylinder head moderately warm. Coolant temperature above 35°C (95°F)
- turn camshaft by pushing vehicle in 4th gear. Cam lobes of valve to be adjusted should point upward
- check that valve clearances are:
  - Intake: 0.20–0.30 mm (0.008–0.012 in.)
  - Exhaust: 0.40–0.50 mm (0.016–0.020 in.)

**CAUTION**

Do not turn camshaft by mounting bolt. This will stretch drive belt

- if measured valve clearance is larger than given tolerance, remove existing adjusting disc and insert thicker disc to specification (see Fig. 2)
- if measured valve clearance is smaller than given tolerance, remove existing disc and insert thinner disc to specification (see Fig. 2)

Example	Intake	Exhaust
specified clearance	0.20–0.30 mm (0.008–0.012 in.)	0.40–0.50 mm (0.016–0.020 in.)
measured clearance	0.35 mm (0.014 in.)	0.35 mm (0.014 in.)
Insert disc that is	0.10 mm (0.004 in.) thicker	0.10 mm (0.004 in.) thinner

**Cold**

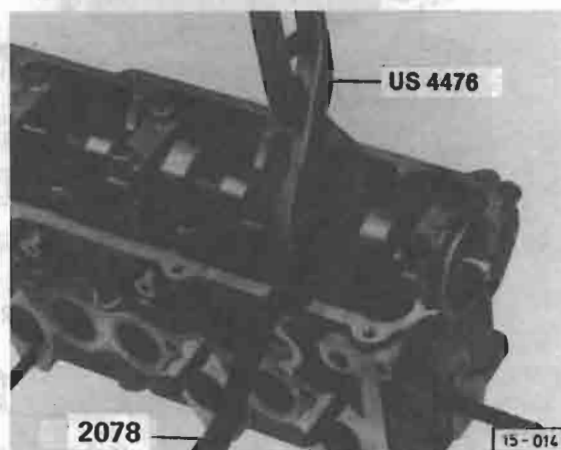
- with engine cold, check that valve clearances are:
  - Intake: 0.15–0.25 mm (0.006–0.010 in.)
  - Exhaust 0.35–0.45 mm (0.014–0.018 in.)

**Note**

After cylinder head repairs, valve clearance must be checked and if necessary adjusted after 1000 miles. Adjust to mid-point of range

**Valve adjusting discs**

Thick-ness	Part Number	Thick-ness	Part Number
3.00	056 109 555	3.65	056 109 568
3.05	056 109 556	3.70	056 109 569
3.10	056 109 557	3.75	056 109 570
3.15	056 109 558	3.80	056 109 571
3.20	056 109 559	3.85	056 109 572
3.25	056 109 560	3.90	056 109 573
3.30	056 109 561	3.95	056 109 574
3.35	056 109 562	4.00	056 109 575
3.40	056 109 563	4.05	056 109 576
3.45	056 109 564	4.10	056 109 577
3.50	056 109 565	4.15	056 109 578
3.55	056 109 566	4.20	056 109 579
3.60	056 109 567	4.25	056 109 580



**Fig. 2 Valve adjusting disc, removing/installing**

**CAUTION**

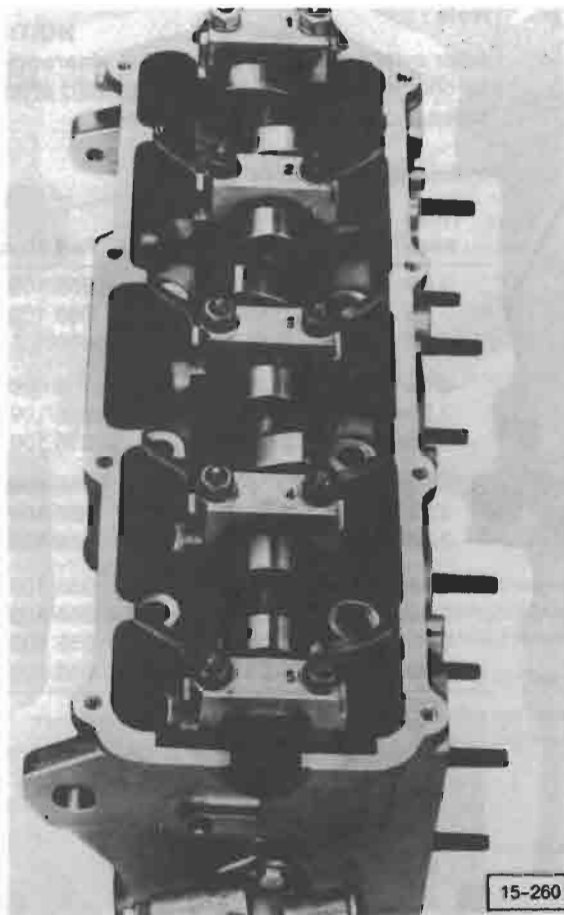
When adjusting valves, pistons **must not** be at TDC. Turn crankshaft about 1/4 turn past TDC so that valves do not contact pistons when cam followers are pressed down

- press cam follower down with **2078**
- remove valve adjusting disc with **US 4476**

**Note**

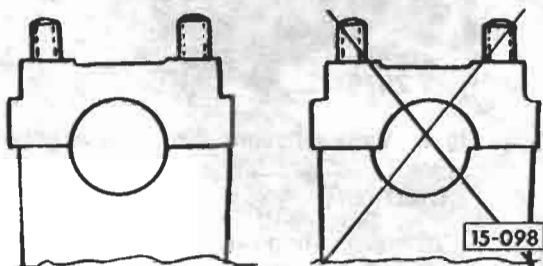
Thickness of valve adjusting disc etched on underside. When installing be sure that markings face downward (toward cam follower). Discs can be reused if not worn or damaged. Use tray 10–212 for storing discs

# 15 Engine-Cylinder Head, Valve Drive



**Fig. 3 Camshaft bearing caps, removing**

- remove bearing caps 5, 1 and 3
- diagonally loosen bearing caps 2 and 4



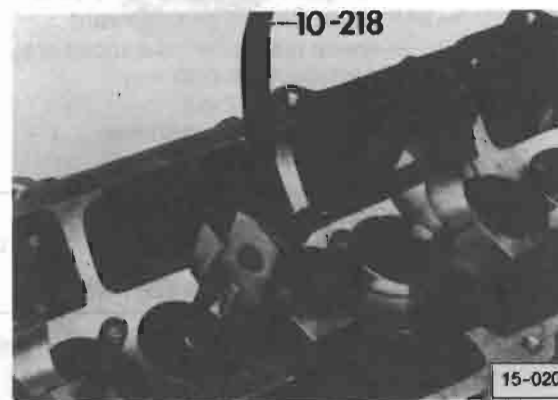
**Fig. 4 Camshaft bearing caps, installing**

- lubricate bearing surfaces and camshaft journals
- install caps in proper order—observe off center bearing position; numbers on bearing caps are not always on same side
- lightly tighten bearing caps 2 and 4 diagonally
- install caps 5, 1 and 3
- tighten all camshaft bearing cap nuts to 20 Nm (14 ft lb)

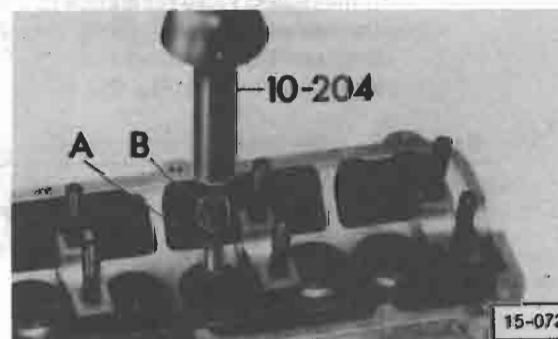


**Fig. 5 Valve stem seal, removing (with cylinder head installed)**

- remove camshaft, adjusting discs and followers
- turn crankshaft until piston of cylinder concerned is at TDC
- remove valve springs with VW 541
- replace valve stem seal

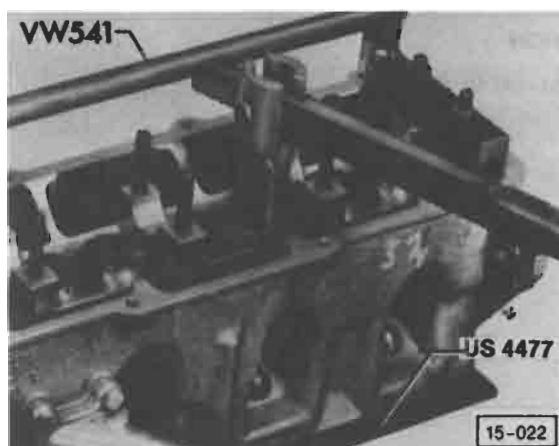


**Fig. 6 Valve stem seal, removing**



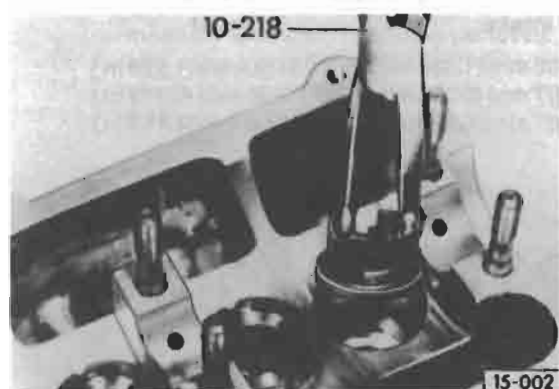
**Fig. 7 Valve stem seal, installing**

- slide plastic sleeve **A** onto valve stem
- lubricate valve stem seal **B**
- push seal carefully onto valve guide using plastic seal protector, otherwise seal will be damaged and engine will use too much oil

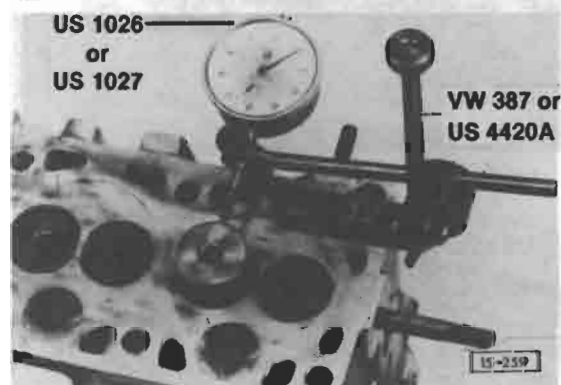


**Fig. 8 Valve springs, removing/installing**

—first install US 4477 under cylinder head

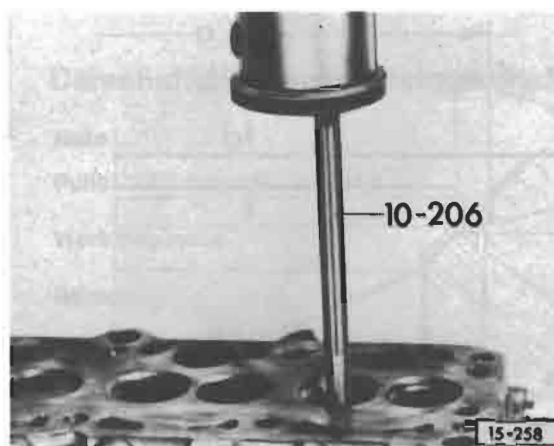


**Fig. 9 Valve spring seat, removing**



**Fig. 10 Valve guide, checking for wear**

- remove carbon
- insert **new valve** into valve guide
- valve stem end **must be flush** with valve guide end
- rock valve **back and forth** against dial indicator. Dial indicator reading shows valve guide wear
- dial indicator reading = max. 1.3 mm (0.051 in.)

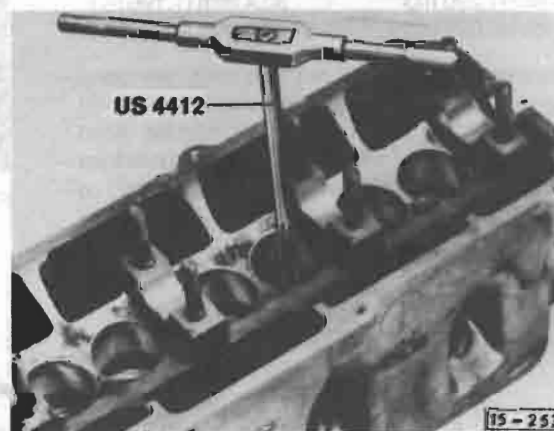


**Fig. 11 Valve guide, replacing**

- first check cylinder head for cracks or excessively worn seats
- press worn guides out from combustion chamber side
- coat new guides with oil and press into cold cylinder head from camshaft side. Press guides in as far as they will go

**CAUTION**

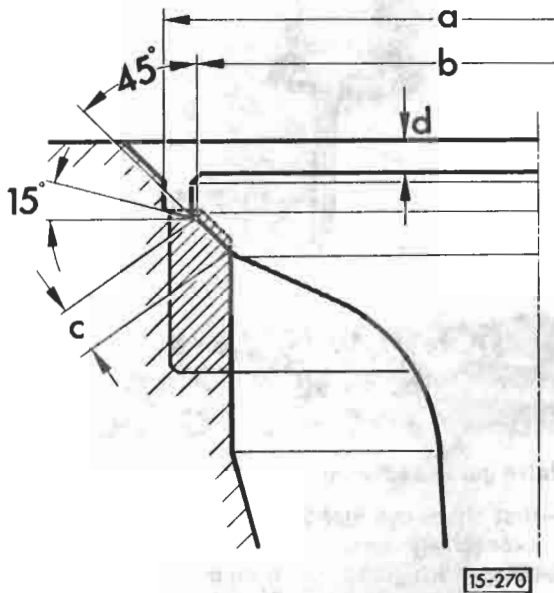
Once guide shoulder is seated do not use more than 1 ton pressure or guide shoulder may break



**Fig. 12 Valve guides, replacing**

- ream guide by hand using proper cutting lubricant

# 15 Engine-Cylinder Head, Valve Drive



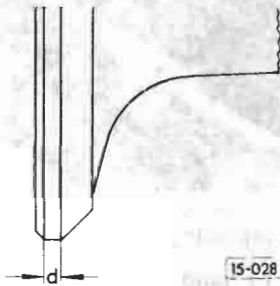
**Fig. 13 Valve seats, refacing**

- seat refacing pilot must be properly installed
- Valve seat angle = 45°
- Correction angle = 15°
- Dimension **d** must not be more than 1.5 mm (0.059 in.)

Intake	Exhaust
a = 35.2 mm (1.384 in.)	33.2 mm (1.306 in.)
b = 32.8 mm (1.290 in.)	30.4 mm (1.196 in.)
c = 2.0 mm (0.078 in.)	2.4 mm (0.096 in.)

**Note**

Valve seats which are worn or burned can be refaced provided that correction angle and seat width are maintained. Otherwise, cylinder head must be replaced

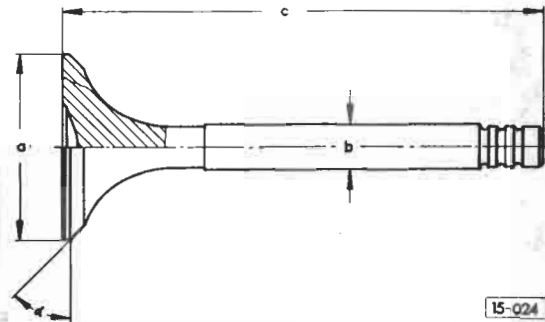


**Fig. 14 Intake/Exhaust valves, refacing**

- valve margin **d** must not be less than 0.5 mm (0.019 in.)

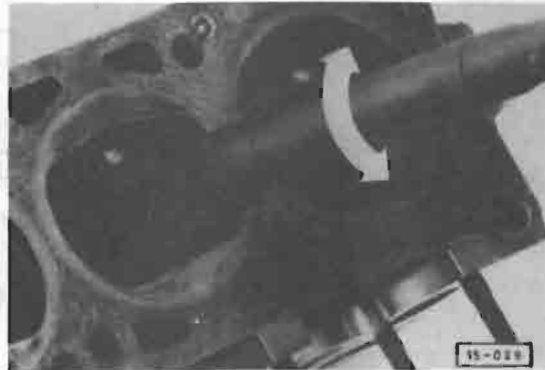
**CAUTION**

Do not reface exhaust valves on a machine. Lap them in by hand only



**Fig. 15 Intake/Exhaust valves, refacing**

Intake	Exhaust
a = 34.00 mm (1.338 in.)	31.00 mm (1.220 in.)
b = 7.97 mm (0.314 in.)	7.95 mm (0.313 in.)
c = 104.8 mm (4.125 in.)	104.6 mm (4.117 in.)
$\alpha = 45^\circ$	45°



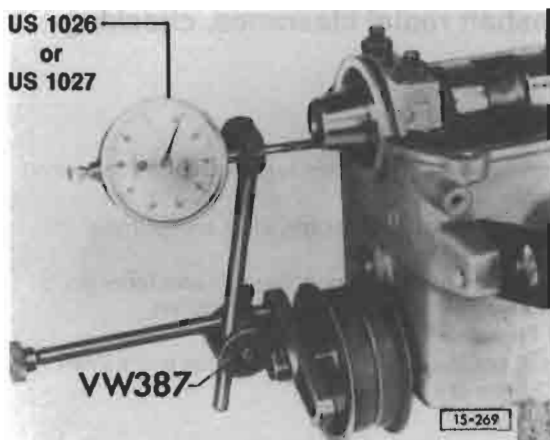
**Fig. 16 Valves, lapping**

—lift and turn regularly



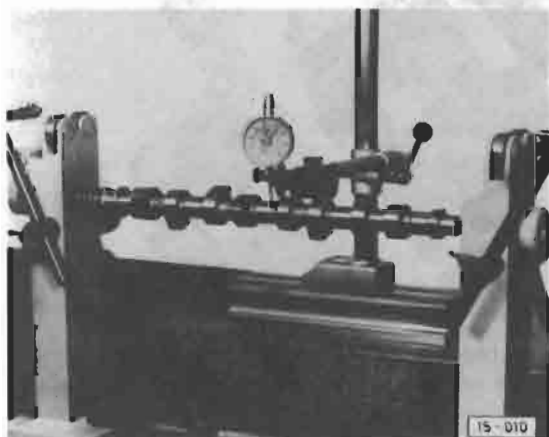
**Fig. 17 Cylinder head distortion, checking**

- max. 0.1 mm (0.004 in.)
- Diesel cylinder heads cannot be resurfaced



**Fig. 18 Camshaft end play, checking**

- measure with cam followers removed and caps 1 and 5 installed and torqued
- check that end play is not more than 0.15 mm (0.006 in.)



**Fig. 19 Camshaft runout, checking**

- max. 0.01 mm (0.0004 in.)

## Camshaft oil seal, removing/installing

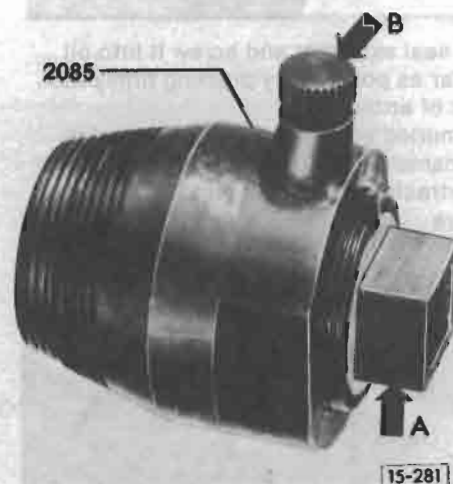
### Note

Puller 2002 may also be used

### Work sequence

#### Removing

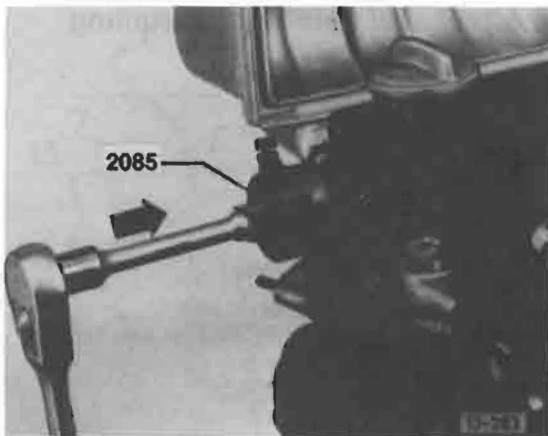
- set engine at TDC for cylinder No. 1
- remove drive belt cover and drive belt
- loosen camshaft sprocket bolt 1/2 turn and tap sprocket with rubber hammer
- remove bolt and sprocket



- unscrew inner part (arrow A) of oil seal extractor 2085 2 turns (approx. 3mm/1/8 in.) out of outer part
- lock in position with knurled screw (arrow B)
- to guide extractor, screw sprocket bolt into camshaft until it projects about 15 mm (5/8 in.)
- lubricate threads on tapered end of seal extractor



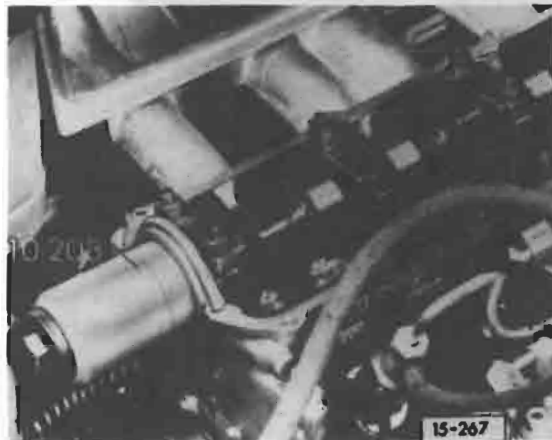
# 15 Engine-Cylinder Head, Valve Drive



- position seal extractor and screw it into oil seal as far as possible by pushing firmly in direction of arrow
- loosen knurled screw and turn inner part in against camshaft until oil seal is pulled out
- clamp extractor in vise and remove oil seal with pliers

## Installing

- coat seal lips and outer edge of seal with oil



- press seal in flush

## Camshaft radial clearance, checking

### Work sequence

- remove camshaft sprocket
- remove camshaft and cam followers (mark followers)
- remove oil seal
- clean camshaft bearing caps, seats and journals
- place camshaft on cylinder head so cam lobes do not touch valve spring retainers or valves
- lay Plastigage® across journal
- install bearing caps in correct position and tighten to 20 Nm (14 ft lb)

### CAUTION

Do not rotate camshaft.



- remove bearing caps
- compare width of Plastigage® with measuring scale  
wear limit — 0.1 mm (0.004 in.)

### Note

If this limit is exceeded, check the radial clearance again with a new camshaft.

If the clearance with a new camshaft also exceeds the wear limit, the cylinder head must be replaced.

- after completing repairs, check and adjust valve clearances

# 15 Engine—Cylinder Head, Valve Drive

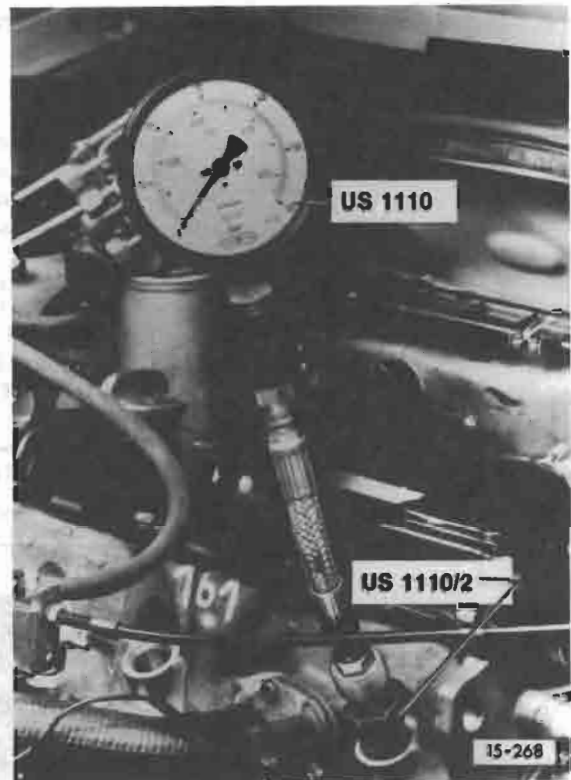
## Compression (Diesel), checking

### Work sequence

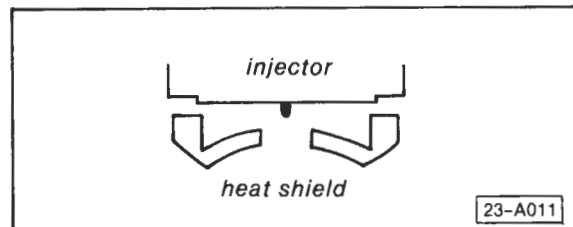
#### CAUTION

To avoid damage, keep injection parts clean when removing, installing, disassembling and assembling

- engine oil temp 30°C (86°F)
- disconnect wire from fuel shutoff solenoid on injection pump and insulate
- clean all injector pipe fittings
- remove injector pipes with tool 3035
- disconnect fuel return hoses
- remove injectors using US 2775 or equivalent
- remove heat shields
- place old heat shield in cylinder to be checked



- screw in adaptor and compression tester
- set parking brake and place transmission in neutral
- operate starter
  - 28–34 bar (406–493 psi)
  - maximum pressure differential between highest and lowest cylinder, 5 bar (73 psi)
- repeat for other three cylinders



- install new heat shields as shown
- reinstall injectors and tighten to 70 Nm (51 ft lb)
- reconnect fuel return hoses
- reinstall injector pipes and tighten to 25 Nm (18 ft lb)
- reconnect wire to fuel shutoff solenoid on injection pump
- start engine and accelerate a few times to clear air bubbles



## Note

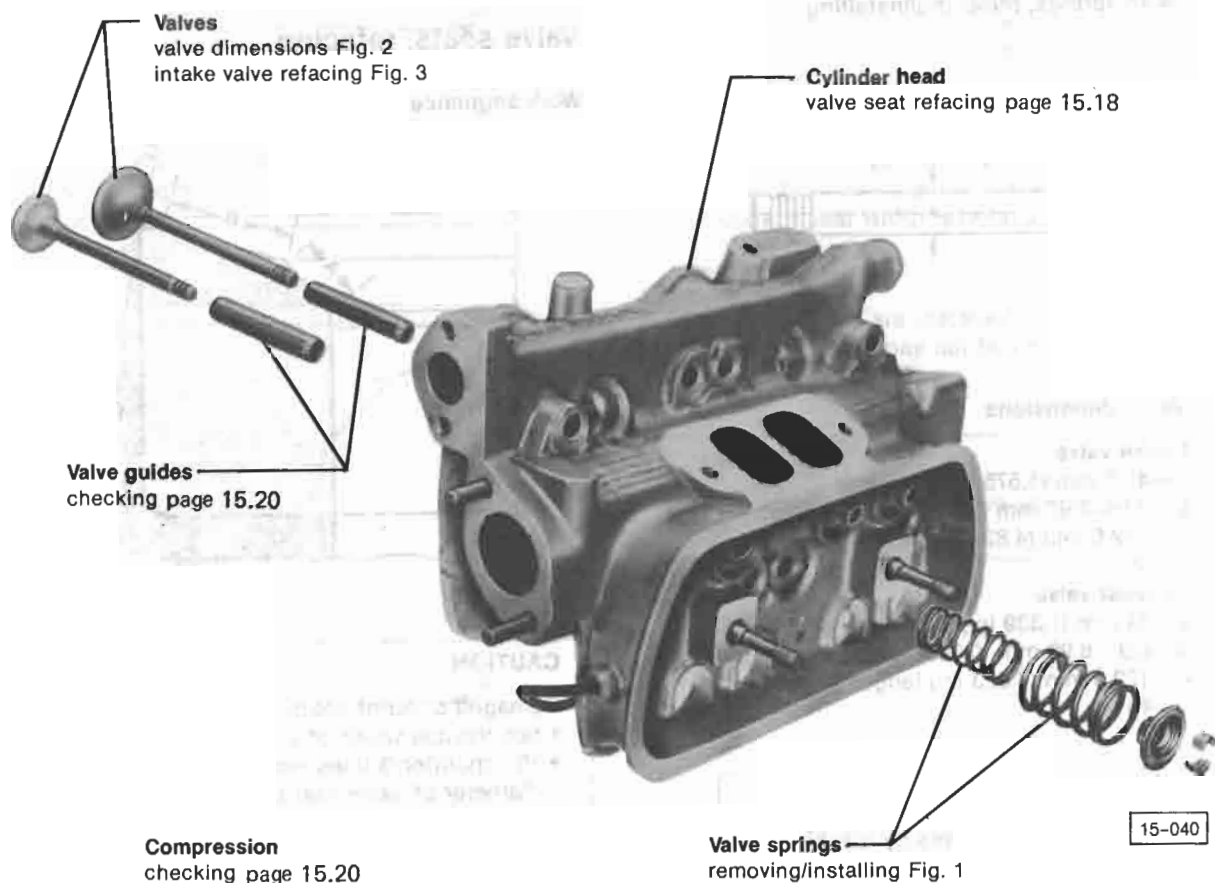
Cylinder heads with cracks between valve seats or between a valve seat and spark plug thread can be used again without reducing service life provided that cracks are small and not more than 0.5 mm (0.019 in.) wide or that only first coil of plug thread is cracked

## Note

Cylinder head can be removed and installed with engine installed

### CAUTION

Coolant/antifreeze **must not** be reused when replacing engine, cylinder head, cylinder head gasket, radiator and heater core.



# 15 Engine-Cylinder Head, Valve Drive

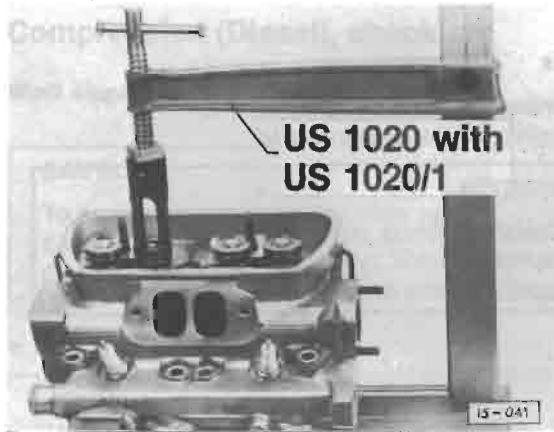


Fig. 1 Valve springs, removing/installing

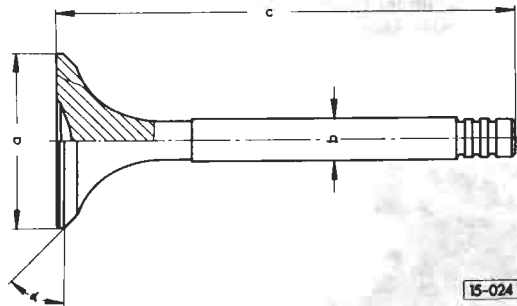


Fig. 2 Valve, dimensions

**Intake valve**

- a = 40.0 mm (1.575 in.) diameter
- b = 7.96–7.97 mm (0.313–0.314 in.) dia.
- c = 122.5 mm (4.823 in.) length
- $\alpha = 45^\circ$

**Exhaust valve**

- a = 34 mm (1.339 in.) diameter
- b = 8.91–8.92 mm (0.3508–.3512 in.) dia.
- c = 122.5 mm (4.823 in.) length
- $\alpha = 45^\circ$

**CAUTION**

Do not rework **exhaust valves** by machine, lap by hand only

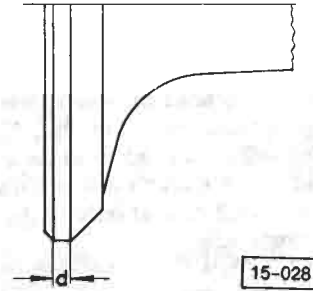
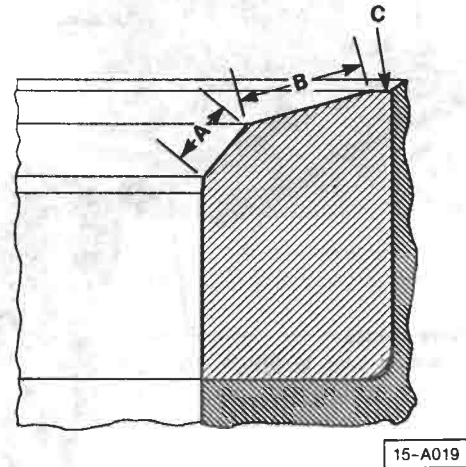


Fig. 3 Intake valves, refacing

- valve margin **d** must not be less than 0.5 mm (0.020 in.)

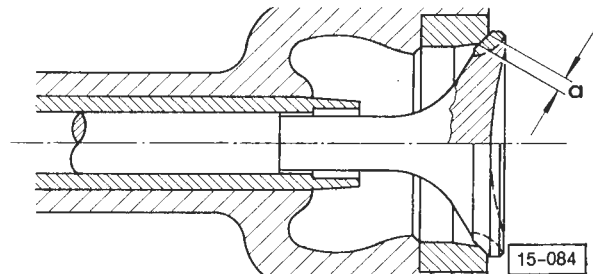
**Valve seats, refacing**

**Work sequence**

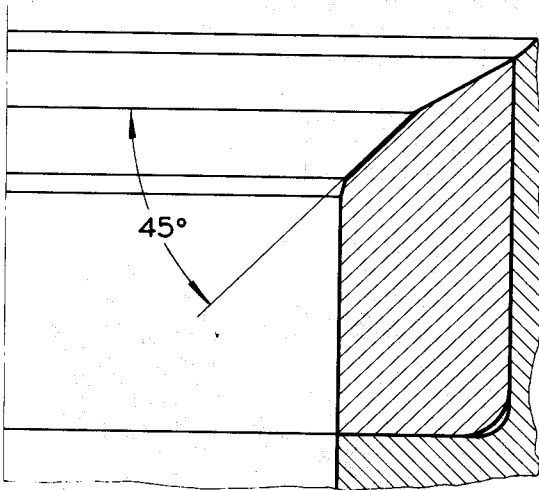


**CAUTION**

- Damaged or burnt seats can be refaced if:
- permissible width of seat **A** is maintained
  - 15° chamfer **B** does not exceed outer diameter of valve seat insert in cylinder head at **C**

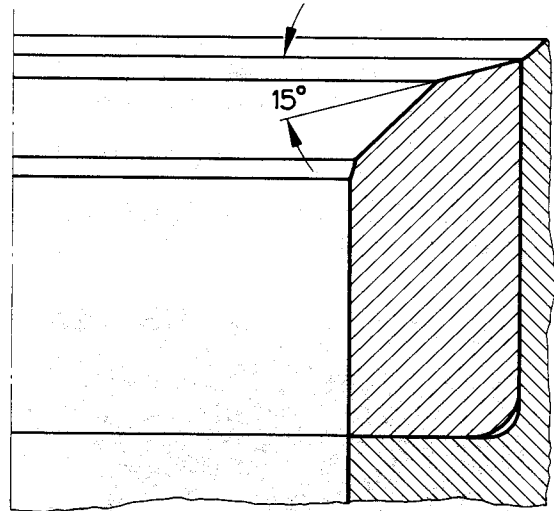


— seat width **a** = 1.4–2.5 mm (0.055–0.098 in.)



15-085

- reface valve seats to 45° angle
  - stop cutting as soon as complete seat is cleaned



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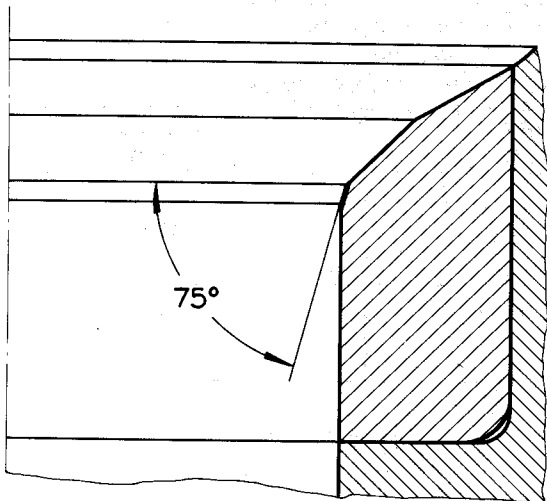
- reface surface to 15° angle
  - chamfer upper edge of valve seat until correct seat width is obtained

**Note**

When new valves are installed in properly reworked seats, it may not be necessary to lap in valves

**CAUTION**

After lapping valve, remove all traces of grinding paste



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- reface surface to 75° angle
  - slightly chamfer lower edge of valve seat

# 15 Engine-Cylinder Head, Valve Drive

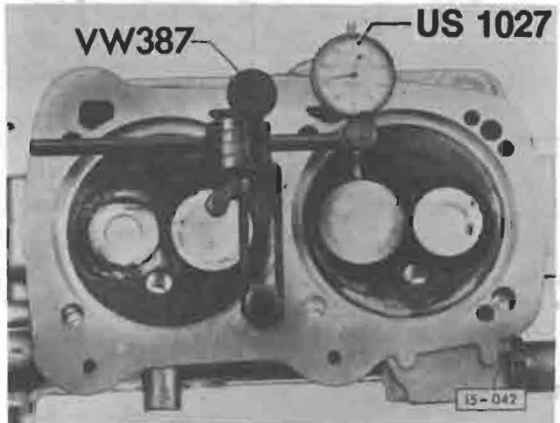
## Valve guides, checking

### Note

When repairing engines with leaking valves it is not sufficient to rework or replace valve seats and valves.

It is also necessary to check valve guides for wear.

This is particularly important on engines which have considerable mileage.



- remove carbon
- insert new valve into valve guide
  - valve stem must be flush with valve guide end
- rock valve back and forth against dial indicator (arrow)
  - max. 1.2 mm (0.047 in.)

## Compression pressure, checking

- engine oil temperature minimum 30°C (86°F)
- throttle valve open fully (accelerator pedal in full throttle position)

- remove all spark plugs
- disconnect coil wire at ignition distributor and connect to ground with clamp



- check compression with tool US 1120
- operate starter until tester no longer indicates a rise in pressure

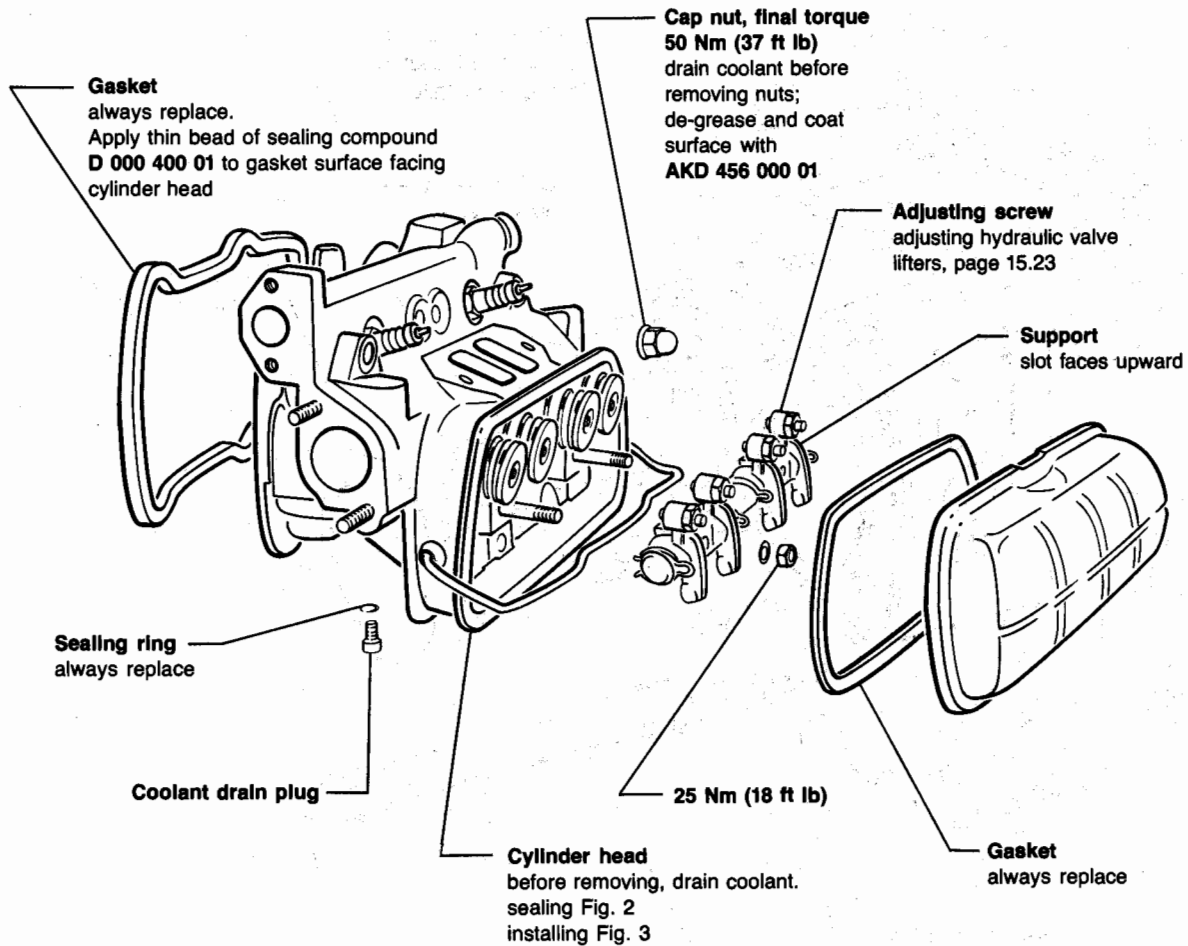
### Compression pressure values

Engine code	Compression pressure
1.9L	10 – 13 bar (145 – 189psi)
2.1L	
Minimum	8 bar (116 psi)

**CAUTION**

Coolant/antifreeze **must not** be reused when replacing engine, cylinder head, cylinder head gasket, radiator and heater core.

When replacing coolant/antifreeze solution in all Volkswagen models, all model years, use phosphate-free coolant/antifreeze only, **ZVW 237 104**.



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# 15 Engine—Cylinder Head, Valve Drive

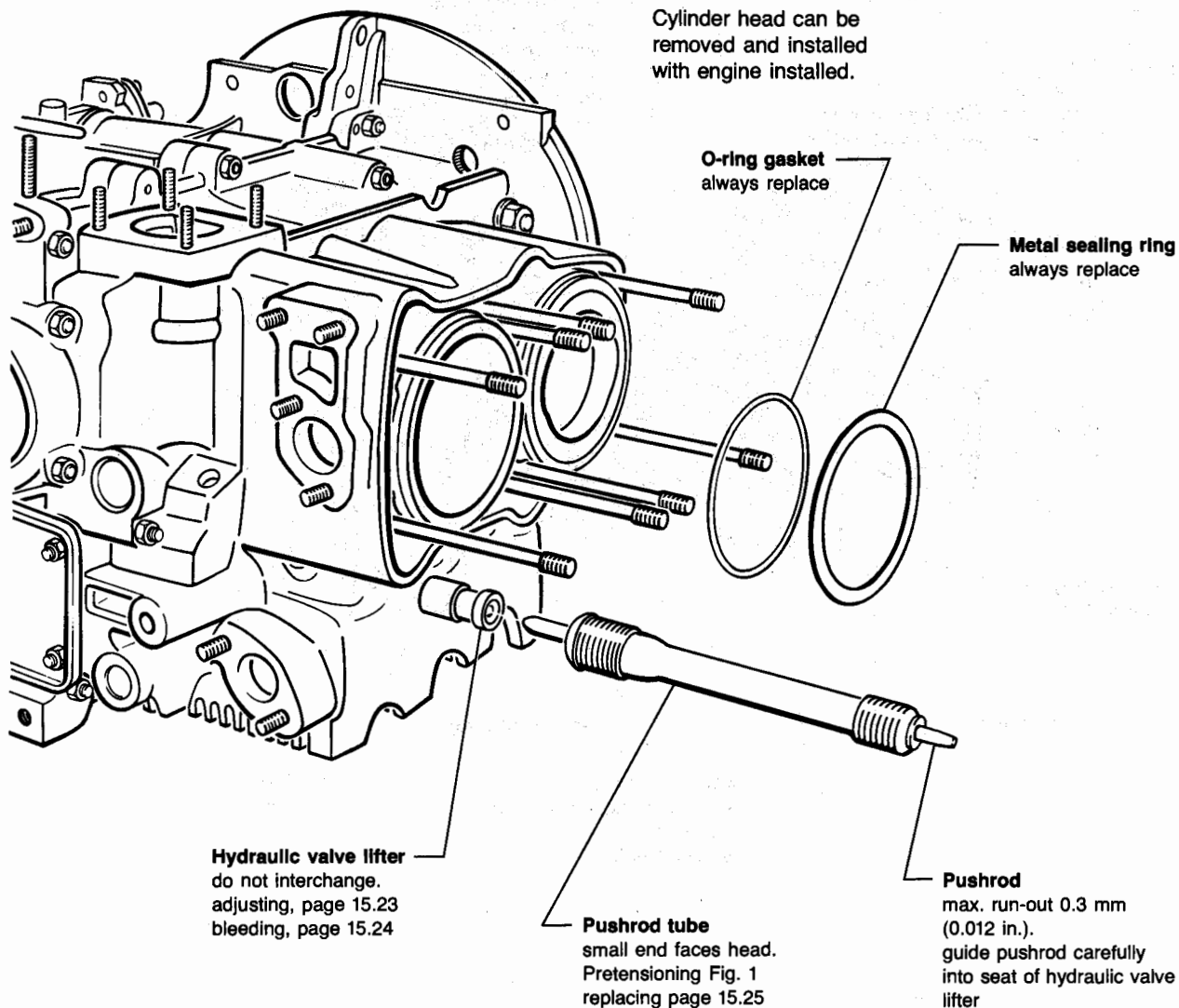
## CAUTION

Coolant/antifreeze **must not** be reused when replacing engine, cylinder head, cylinder head gasket, radiator and heater core.

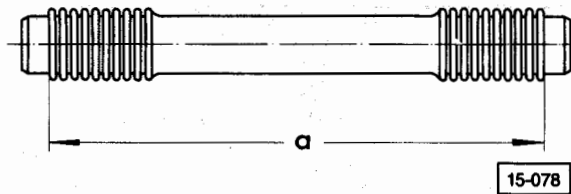
When replacing coolant/antifreeze solution in all Volkswagen models, all model years, use phosphate-free coolant/antifreeze only, ZVW 237 104.

## Note

Cylinder head can be removed and installed with engine installed.

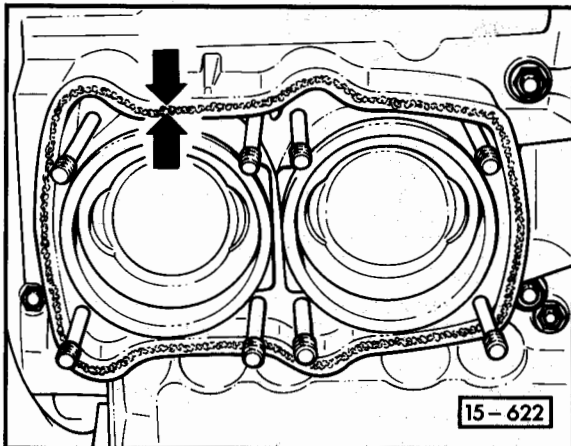


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**Fig. 1 Pushrod tube, pretensioning**

- pretension tube to correct length
  - **a** = approximately 194 mm (7.6 in.)
- when installing, seam faces upward and small end to cylinder head
- always replace sealing rings, head gasket
  - pushrod tubes can be replaced with engine installed



**Fig. 2 Cylinder head, sealing**

**Applying sealant D 000 400 01**

To improve sealing of painted/unpainted sealing surfaces on cylinder head, use **D 000 400** sealant.

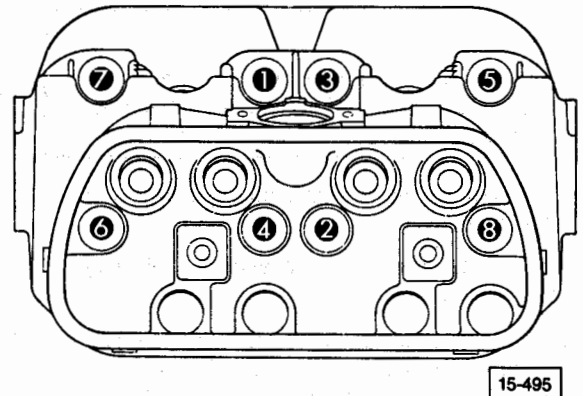
- if paint is damaged, clean cylinder head sealing surface with fine sand paper
- clean sealing surface with solvent
- apply 1 to 2 mm (3/64-5/64 in.) bead of sealing compound **D 000 400** in the center of the new water jacket gasket (**arrows**)

**CAUTION**

**DO NOT USE TOO MUCH SEALANT.** Excessive sealant could plug cylinder head coolant passages or hydrolock cap nuts.

**Note**

Cylinder head must be installed within 45 minutes of the sealant application.



**Fig. 3 Cylinder head, installing**

- tighten cylinder head at stud 1 with cap nut just enough so that all remaining 7 cap nuts can be installed
- coat surface of cap nut with **AKD 456 000 01** sealing compound

**Torque sequence**

**CAUTION**

Do **NOT** use click type torque wrench. Use only beam or dial type wrench.

**First stage:** tighten cap nuts in numbered sequence (see above) to 10 Nm (7 ft lb)

**Note**

Be sure that push rod tubes are properly seated.

**Second stage:** tighten cap nuts, in numbered sequence to 50 Nm (37 ft lb)

- recheck final 50 Nm (37 ft lb)
- reinstall push rods, rocker arms
  - push rods must be properly seated before tightening rocker arms
  - torque: 25 Nm (18 ft lb)

**Hydraulic valve lifters, adjusting**

**Note**

Never repair valve lifters; if worn or damaged, replace complete assembly.

Valve lifters can be removed and replaced without engine removal and without major engine disassembly.

Intermittent valve noises are normal upon starting, sudden acceleration, high temperatures or high engine speed.

# 15 Engine—Cylinder Head, Valve Drive

## CAUTION

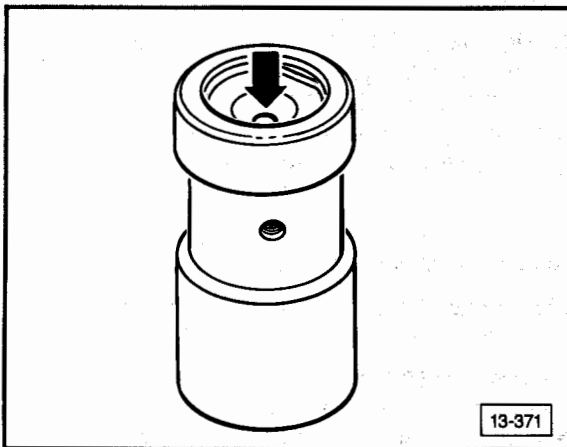
If metal particles are found in oil pan, remove, disassemble, clean and reinstall all valve lifters from position removed.

- guide pushrod carefully into socket of hydraulic valve lifter

If rocker shafts have been removed, the following adjustment is necessary:

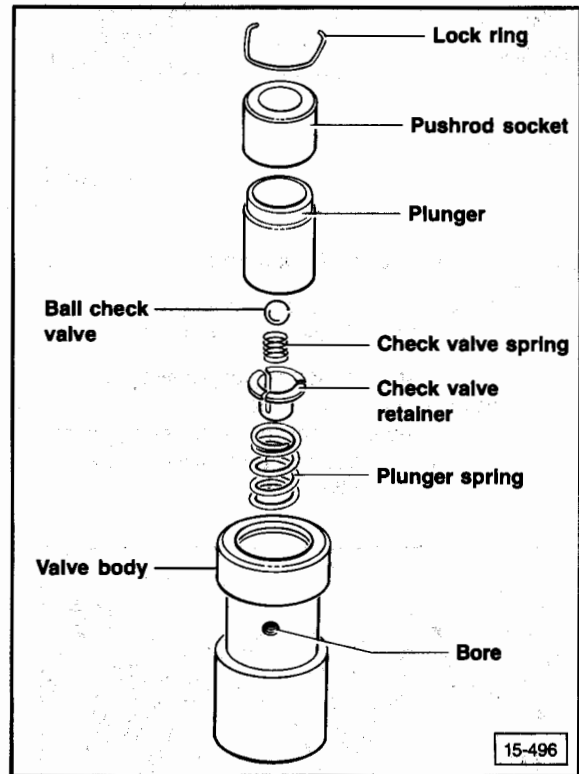
- backout adjusting screws in rocker arms until ball shaped end is flush with surface of arm
- turn crankshaft until cylinder No. 1 is at TDC
  - mark on rotor in line with mark on distributor housing
- turn adjusting screws in until they just touch valve stems
- turn adjusting screws 2 turns clockwise and tighten lock nuts
- rotate crankshaft 180° and adjust next cylinder
- repeat until all cylinders are adjusted

## Hydraulic valve lifters, bleeding

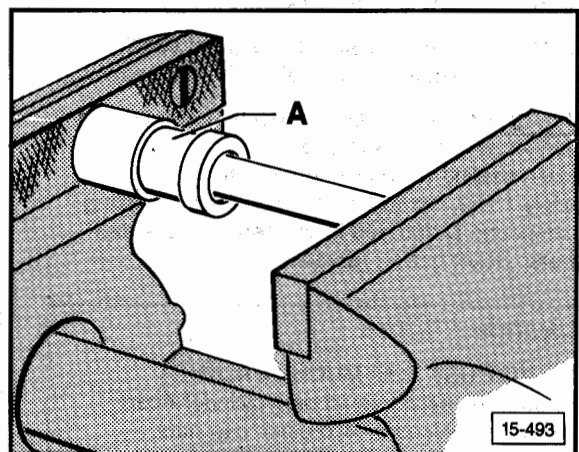


- before installing, ensure valve lifter is bled correctly
  - check by applying firm thumb pressure on push rod socket in direction of arrow. Lifter should not move.

If **NO**, bleed lifter as follows:



- pry out lock ring
- remove pushrod socket, plunger, ball check valve with spring, check valve retainer and plunger spring from body
- fill valve lifter body with oil up to bleed hole
- insert plunger spring
- install plunger with ball check valve, spring and valve retainer and push downward; at same time, open ball check valve with scribe



- insert pushrod in socket and slowly press together with valve guide or sawed-off pushrod in vise (bore A must face upward) or in press until lock ring can be installed
- install lock ring

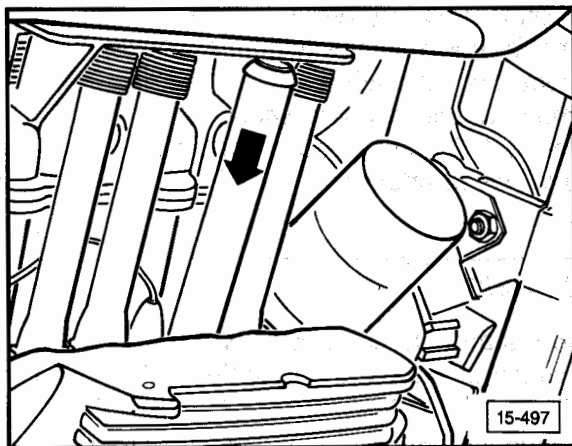


## Pushrod tubes, replacing

### Note

Pushrod tubes supplied as replacement parts can be installed with engine in place.

- remove valve cover
- remove rocker arm shaft, pull pushrod out
- remove lower cover plate
- remove defective pushrod tube with pliers or screwdriver



- squeeze new pushrod tube together and insert with new sealing rings as shown (**arrow**) (tube seam faces upward, small end to head)
- insert pushrod and install rocker arm shaft

### CAUTION

Guide pushrod carefully into seat of hydraulic valve lifter.

If pushrod rests on edge of lifter basic setting will be incorrect and lifter will be damaged when engine is started.

- adjust hydraulic valve lifters, see page 15.23

# 15 Engine—Cylinder Head, Valve Drive

## Cylinder head, resealing

### Note

To reseal cylinder heads, follow this procedure. Always do both sides. Cylinder heads can be removed without removing the engine.

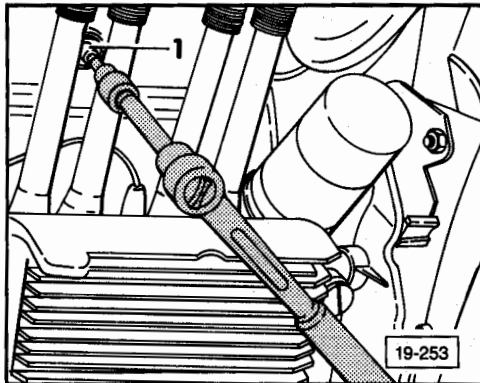
### Removing

- disconnect battery ground strap
- remove rear mattress (where applicable), carpet, engine cover
- remove air cleaner assembly
- remove A/C compressor from bracket, leave hoses attached

### WARNING

Fire hazard. Do not smoke or have anything in area that can ignite fuel.

- remove left/right fuel rails, injector ground wires and intake manifolds
- remove left/right splash shields
- remove push rod tube shields
- disconnect oxygen sensor
- remove coolant drain plugs **1** at both cylinder heads, drain coolant from engine
- drain engine oil, remove oil filter



### Note

Do not reinstall oil drain plug until repair is completed.

- remove spare tire cover under front of vehicle, disconnect coolant hoses
- reconnect radiator coolant hoses
- close spare tire cover
- remove coolant pump

- remove exhaust system, including cross-over pipes, muffler with converter and exhaust heat shield
- remove crankshaft pulley
  - see Repair Group 13
- remove power steering pump
- remove coolant cross-over pipes at front/rear of cylinder head
- remove valve covers, rocker arms, push rods, oil filler pipe

## Note

Mark push rods for reinstalling to original location.

- remove cylinder head cap nuts, push rod tubes and cylinder head
  - stuck cylinder sleeves may be removed by lightly tapping with small solid rubber mallet
- clean old gasket material from cylinder heads, engine block, valve covers
- inspect sealing surface of cylinder head, replace if pitting or cavitation present
- mark matching numbers on piston/cylinders
- pull out cylinder sleeves with tool **3092** until piston circlip is visible
  - see Repair Group 13
- remove piston circlips, wrist pins with tools **3091, 3159**
  - see Repair Group 13

## Installing

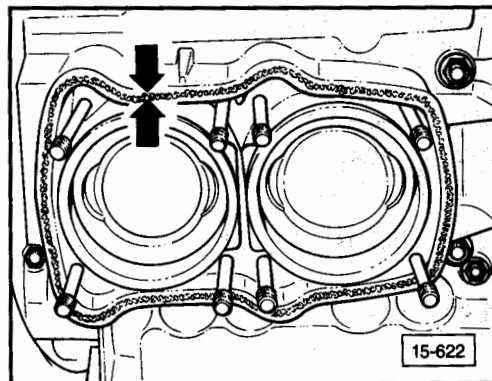
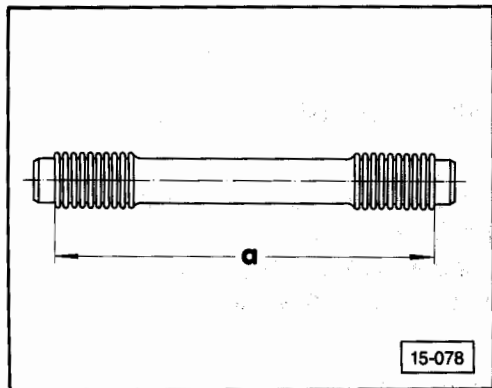
### CAUTION

Always replace gaskets, seals, O-rings, lubricants.

### CAUTION

Part numbers are listed for reference only. Always consult with the Parts Department for latest information.

# 15 Engine—Cylinder Head, Valve Drive



- inspect cylinder head studs for corrosion, and replace as required
- clean wrist pins, cylinder sleeves, pistons
- replace both cylinder sleeve O-rings
- reinstall piston and cylinder sleeve onto corresponding connecting rod
  - install wrist pin to connecting rod
  - see Repair Group 13
- clean push rod tubes, rocker arms, valve covers, cylinder head cap nuts
- measure and adjust push rod tubes to length **a**
  - a** = approximately 194 mm (approximately 7.6 in.)
- install new cylinder head gasket

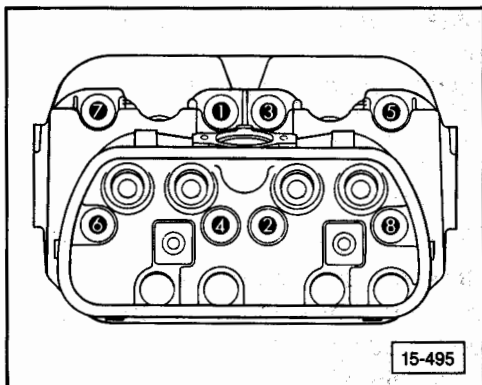
## CAUTION

Do not use too much sealant. Excessive sealant could plug cylinder head coolant passages or hydrolock cap nuts.

- apply cylinder head sealant Part No. **D 000 400 01** in 1.0-2.0 mm (3/64-5/64 in.) bead (**arrows**) in center of gasket side facing cylinder head
- install cap nut location in 1.0 mm (3/64 in.) bead
- reinstall cylinder heads, push rod tubes, seam side up

## CAUTION

DO NOT use click type torque wrench. Use only beam or dial torque wrench.



- tighten cylinder head at stud 1 with cap nut just enough so that remaining 7 cap nuts can be installed

## Torque sequence

### Note

Ensure that push rod tubes are properly seated.

**First stage:** tighten cap nuts in numbered sequence to 10 Nm (7 ft lb)

**Second stage:** tighten cap nuts in numbered sequence to 40 Nm (30 ft lb)

**Third stage:** tighten cap nuts in numbered sequence to 50 Nm (37 ft lb)

- recheck final 50 Nm (37 ft lb)
- reinstall push rods, rocker arms
  - push rods must be properly seated before tightening rocker arms
  - torque: 25 Nm (18 ft lb)

## Hydraulic valve lifters, adjusting

- back out adjusting screws in rocker arms until ball shaped end is flush with surface of arm
- turn crankshaft until cylinder No. 1 is at TDC
  - mark on rotor must be in line with mark on distributor housing
- turn adjusting screws in until they just touch valve stems
- turn adjusting screws 2 turns clockwise and tighten lock nuts
- rotate crankshaft 180° clockwise and adjust next cylinder
- repeat until all cylinders are adjusted

# 15 Engine—Cylinder Head, Valve Drive

- reinstall all other components in reverse order of removal
- check expansion tank pressure cap with **VAG 1274/99**

## CAUTION

Coolant/antifreeze must not be reused when performing this procedure. When replacing coolant solution in all Volkswagen models, all years, use phosphate-free coolant **ZVW 237 104**.

- reinstall coolant drain plugs between cylinders
- refill with coolant
- reinstall engine drain plug, refill with oil
- reconnect battery ground strap
- remove radiator grille
- raise front of vehicle approximately 40 cm (16 in.) under cross member
- bleed air from coolant system
- lower vehicle to ground
- reinstall radiator grille
- pressure check cooling system for leaks with tool **VAG 1274/99**
- check and adjust engine specifications, as necessary

## Gasoline additive

"Autobahn Gasoline Additive" has been tested by Volkswagen, and found to be effective in reducing carbon deposits that result from fuel and lubricating oil residue. The additive works best with unleaded gasoline, but also works with leaded fuel.

"Autobahn Gasoline Additive" is supplied by Volkswagen of America under Part No. ZVW 246 001.

### Note

Read product label for additional information. Read all cautions and warnings.

#### Caution

Do not exceed this recommendation:

Oil change interval	Max. Treatments between oil changes
Miles	
5,000	2
7,500	4

Excessive carbon deposits reduce engine performance by:

- idle hunting (idle speed goes up and down)
- poor hot or cold starting (starter cranking takes longer)
- engine run-on (dieseling)
- pinging during full-throttle acceleration

To help clean out carbon deposits and minimize future carbon build-up:

- make sure that ignition and fuel systems are adjusted to specifications
- add one (1) 20 oz. bottle "Autobahn Gasoline Additive" to fuel tank. Fill tank completely. Do not refill until the gauge reads "1/4"
- use only gasoline with a detergent additive package. Information about fuel composition is available from any gas station or from the station's fuel supplier.

#### CAUTION

Part numbers are for reference only. Always consult your Parts Department for latest information.

## Diesel Injection System

Quick Data	Index
	<p><b>Diesel Injection System</b></p> <ul style="list-style-type: none"><li>—Cold start cable 23.5</li><li>—Engine speed 23.5</li><li>—Fuel cut-off solenoid 23.5</li><li>—Fuel delivery valve/ housing 23.7, 23.8</li><li>—Fuel filter water indicator kit, installing 23.10, 23.11</li><li>—Fuel injectors 23.8–23.10</li><li>—Injection pump 23.6, 23.7</li><li>—Injection pump/valve timing 23.3, 23.4</li><li>—Injection system 23.2</li><li>—Injection timing 23.4</li></ul>



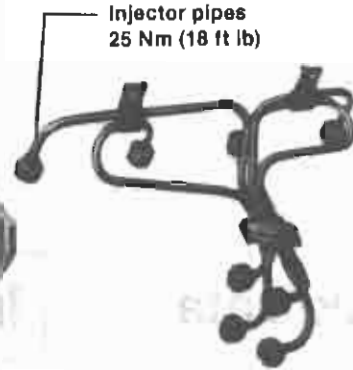
# 23 Diesel Injection System

Accelerator cable  
adjusting, see  
Repair Group 20

## WARNING

Disconnect battery when working on fuel system. Never smoke when working with fuel or have anything in area that can ignite it.

Always replace seals and fuel hose clamps



Injector pipes  
25 Nm (18 ft lb)

Injectors  
70 Nm (51 ft lb)  
removing/installing page 23.9  
cleaning page 23.9  
checking page 23.10

Cold start cable  
adjusting page 23.5

Engine speed  
checking/adjusting  
page 23.5

Glow plugs  
checking, see  
Repair Group 28

Tensioner  
use tool US 4493  
to tension

45 Nm (33 ft lb)

Drive belt  
removing/installing  
see Repair Group 13

20 Nm (14 ft lb)



Double V-belt pulley

Fuel delivery valves  
45 Nm (33 ft lb)  
checking/replacing  
page 23.8

Injection pump  
removing page 23.6  
installing page 23.7  
adjusting page 23.4  
checking page 23.3

25 Nm (18 ft lb)

25 Nm (18 ft lb)

Injection pump sprocket  
removing page 23.7

Intermediate shaft pulley

45 Nm (33 ft lb)

Crankshaft sprocket

Crankshaft sprocket bolt  
110 Nm (80 ft lb)  
do not use locking compound

13-593

## CAUTION

To avoid damage, keep injection parts clean when removing, installing, disassembling and assembling. Do not spill diesel fuel on any rubber hoses

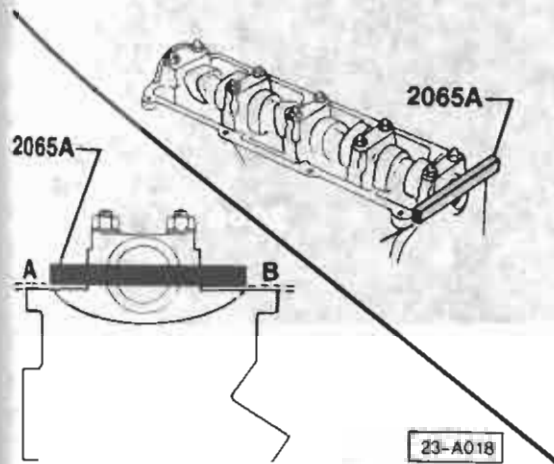
## Injection pump/Valve timing, checking

### Work sequence

#### Note

Drive belt must be checked for proper tension and be centered in sprockets before checking injection pump/valve timing

- remove cylinder head cover/drive belt cover
- rotate engine until lobes of camshaft on cylinder No. 1 point upward (TDC position)



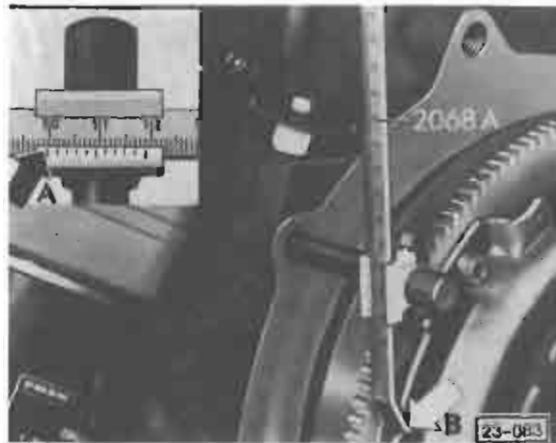
- install setting bar 2065A on cylinder head
- turn camshaft until one end of setting bar touches cylinder head
- measure gap at other end with feeler gauge
- take half of measurement and insert feeler of this thickness between bar and cylinder head at A
- turn camshaft so bar rests on feeler gauge
- insert second feeler gauge of same thickness between other end of bar and cylinder head at B



—check that marks on sprocket, pump and mounting plate (black arrow) are approximately aligned

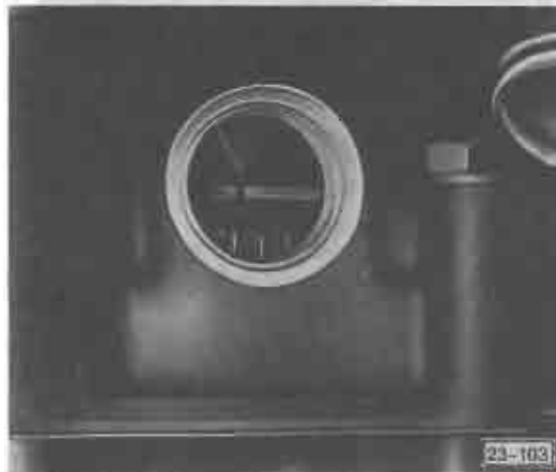
if **YES**, pump in correct position, continue with work sequence

if **NO**, pump incorrectly positioned, adjust pump/valve timing (see page 23.4)



(engine removed)

- attach tool 2068A to crankcase
- set scale to 100 mm (arrow A)
- tip of scale must align with TDC mark on clutch pressure plate (arrow B)



(engine installed)

—check that TDC mark on clutch pressure plate is in line with boss on bell housing  
if **YES**, valve timing **OK**; next check injection timing (see page 23.4)  
if **NO**, valve timing incorrect, proceed as follows:

- loosen camshaft sprocket bolt 1 turn
- tap back of camshaft sprocket with rubber hammer until it is loose
- hand tighten sprocket bolt until end play is eliminated but sprocket still turns freely on camshaft

- rotate engine until TDC marks align on flywheel
- torque camshaft bolt to 45 Nm (33 ft lb)
- recheck marks
- check injection timing (see page 23.4)

# 23 Diesel Injection System

## Injection pump/Valve timing, adjusting

### Work sequence

- remove cylinder head cover/drive belt cover
- set engine to TDC No. 1 cylinder
- lock camshaft in position with setting bar (see page 23.3)
- loosen camshaft sprocket bolt 1 turn
- tap back of camshaft sprocket with rubber hammer until it is loose
  - hand tighten sprocket bolt until end play is eliminated but sprocket still turns freely on camshaft
- loosen belt tensioner
- remove belt from injection pump sprocket



- turn pump sprocket until marks on sprocket, pump and mounting plate are in line
- lock pump sprocket with pin 2064
- reinstall drive belt



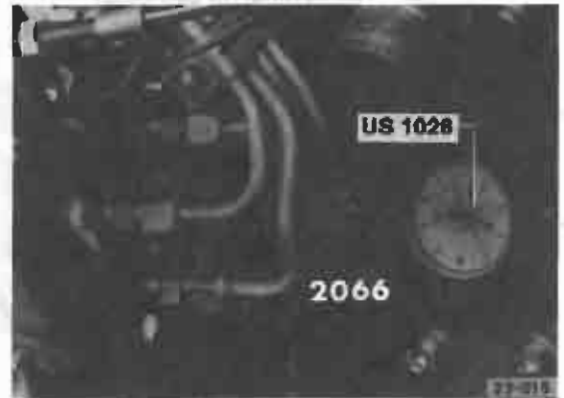
- tighten camshaft bolt to 45 Nm (33 ft lb) and remove setting bar
- remove lock pin from pump sprocket
- install belt tension gauge VW 210
- tension drive belt by turning tensioner clockwise
  - reading on belt tensioner = 12-13 (measured between camshaft sprocket and pump sprocket)
- lock tensioner
- turn crankshaft 2 complete turns and recheck belt tension
  - eliminate play in drive belt by striking once, between camshaft and pump sprockets, with rubber hammer
- recheck valve timing
- check injection timing

## Injection timing, checking/adjusting

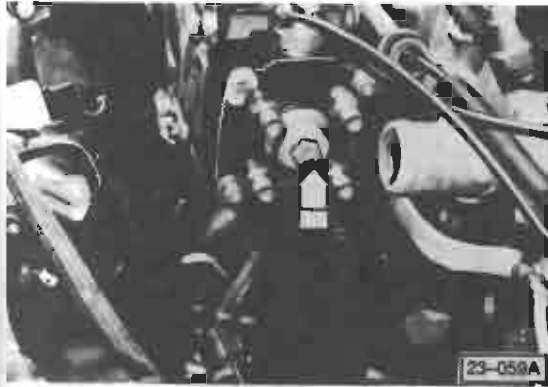
### Work sequence

#### CAUTION

Push in cold start device completely when checking or adjusting injection timing



- remove center plug from injection pump cover
- install adaptor and dial gauge 0 to 3 mm (0 to 0.118 in.) in place of plug and preload gauge to approx. 2.5 mm (0.097 in.)
- turn engine slowly counterclockwise (opposite to normal rotation) until dial gauge needle stops moving
- zero gauge
- turn engine clockwise until TDC mark on clutch pressure is aligned with boss on bell housing
- check that gauge reads 0.78-0.88 mm
- if necessary, loosen upper bolts on mounting plate and bolt of rear support
- set lift by turning pump until gauge reads  $0.86 \pm 0.02$  mm
- tighten pump mounting bolts and recheck injection timing



Tightening torque of the Diesel Injection pump center plug (arrow) is:

- $17 \pm 3$  Nm ( $12 \pm 2$  ft lb) with copper seal (reddish-brown in color)
- $22 \pm 2$  Nm ( $16 \pm 2$  ft lb) with bronze seal (yellow-brown in color)

### CAUTION

To avoid fuel leaks, always replace seal for center plug (arrow)

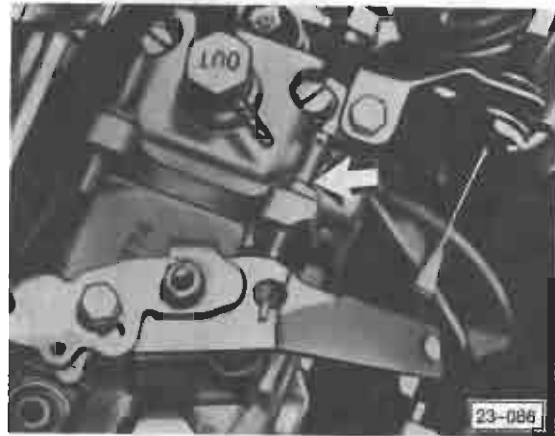
## Engine speed, checking/adjusting

### Work sequence

- start engine and warm up
- place engine RPM sensor US 1324 on cylinder head cover and attach to battery
- install positive lead of VAG 1367 to US 1324



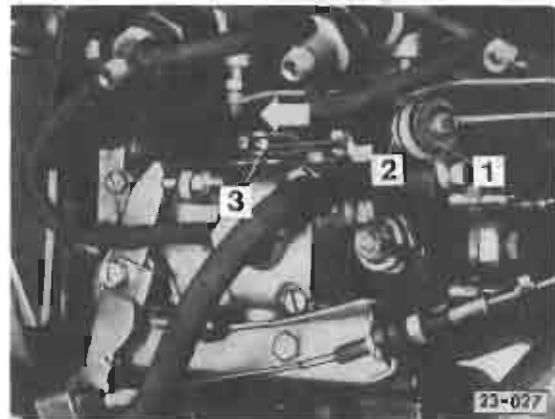
- check that idle speed is 800–850 RPM
  - oil temperature  $60^{\circ}\text{C}$  ( $140^{\circ}\text{F}$ )
- if NO
  - loosen locknut (arrow)
  - adjust idle speed screw
    - turning clockwise increases RPM
  - tighten locknut



- check that maximum speed is  $4800 \pm 50$  RPM if NO
  - loosen locknut (arrow)
  - adjust maximum speed screw
    - turning clockwise decreases RPM
  - tighten locknut

## Cold-start cable, adjusting

### Work sequence



- insert washer 1 onto cable
- install cable in bracket with rubber bushing and insert inner cable into pin 3
- install horseshoe lock clip 2
- push in cold-start knob fully
- move lever to stop in direction of arrow
- pull inner cable tight and secure pin 3 with clamping screw

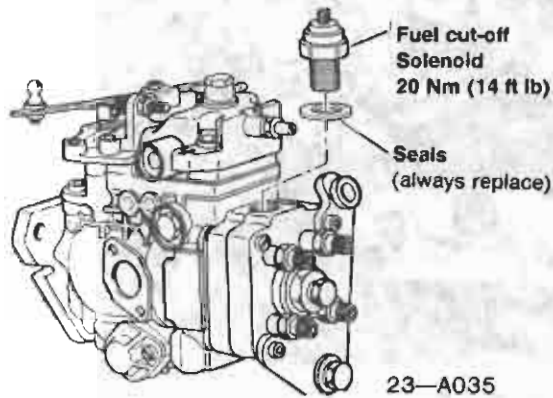
### WARNING

Disconnect battery when working on fuel system. Never smoke when working with fuel or have anything in area that can ignite it.

Always replace seals and fuel hose clamps.

# 23 Diesel Injection System

## Fuel cut-off solenoid, testing



The following test procedure must be performed before replacement of fuel cut-off solenoid:

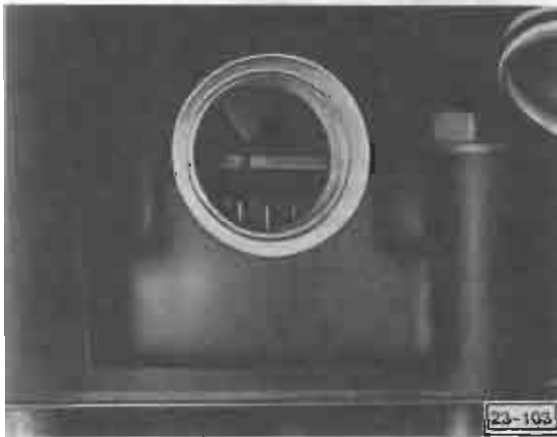
- Clean surrounding area and remove fuel cut-off solenoid from injection pump
- Inspect solenoid plunger and seat for foreign matter
- Clean solenoid plunger and check for free movement in solenoid
- Clean solenoid mounting surfaces
- Reinstall fuel cut-off solenoid using new seal and tighten to 20 Nm (14 ft lb)
- Check for proper operation

## Injection pump, removing

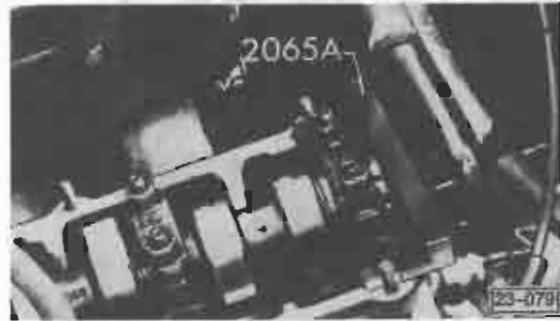
### Work sequence

#### CAUTION

When working on injection system, everything must be kept extremely clean. Wipe pipe unions clean before loosening



- turn engine until TDC mark on clutch pressure plate is in line with boss on bell housing
- disconnect battery ground strap



- remove cylinder head cover
- lock camshaft with setting bar
- remove drive belt
- loosen injection pump sprocket retaining nut slightly



- attach puller so jaws are at right angles to cross bar and point in direction of spindle rotation
- carefully apply tension with puller

#### CAUTION

Never apply excessive tension with puller, as this may damage sprocket

- hit puller spindle head (arrow) with light hammer taps until sprocket loosens from injection pump shaft taper
- remove puller and nut
- remove sprocket by hand
- detach all fuel pipes from pump. Cover unions with clean cloth
- disconnect wire from fuel shutoff solenoid on injection pump and detach accelerator and cold start cables



- remove three bolts from injection pump mounting plate 2

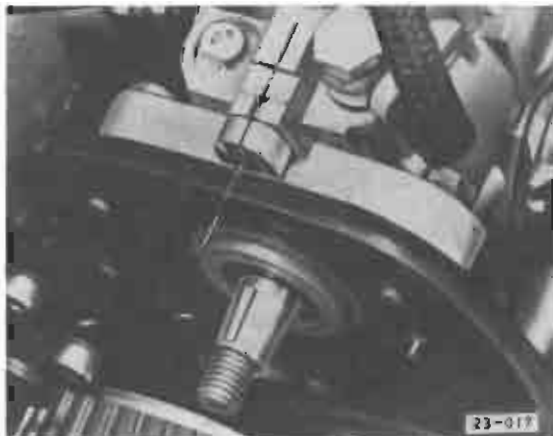
### CAUTION

To avoid damage to distributor plunger, do not loosen bolts (arrows) on fuel distributor head

- remove bolt 1 from rear support and remove pump

## Injection pump, installing

### Work sequence



- install pump, align marks on pump and mounting plate. Install pump sprocket

### Tightening torques

- |                 |                  |
|-----------------|------------------|
| • Pump bolts    | 25 Nm (18 ft lb) |
| • Fuel pipes    | 25 Nm (18 ft lb) |
| • Pump sprocket | 45 Nm (33 ft lb) |



### CAUTION

Do not interchange fuel supply (arrow A) and return (arrow B) pipe union screws. For identification, fuel return pipe union screw is marked **OUT** on hex. head

- adjust injection pump/valve timing (see page 23.4)
- adjust injection timing (see page 23.4)

## Fuel delivery valves, checking

### Work sequence

#### Note

Fuel leaks from fuel delivery valves are usually caused by improper removal of injector pipes. If fuel delivery valve leaks proceed as follows:



- remove injector pipes
- retorque fuel delivery valves (arrows) to 45 Nm (33 ft lb)
- reinstall injector pipes and tighten to 25 Nm (18 ft lb)
- start engine and check for leaks
  - if fuel leak did not stop replace fuel delivery valve housing and seal



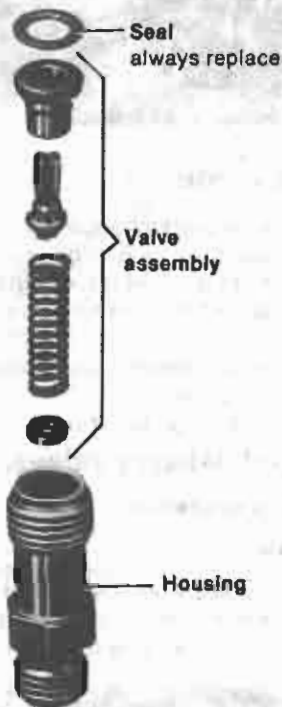
# 23 Diesel Injection System

## Fuel delivery valve housing, replacing

### Work sequence

#### CAUTION

When removing or replacing fuel delivery valves, do not interchange valve assemblies



- clean all injector pipe fittings
- remove injector pipes
- remove fuel delivery valve
  
- transfer valve assembly to new housing
- install fuel delivery valve, with new seal and tighten to 45 Nm (33 ft lb)
- reinstall injector pipes and tighten to 25 Nm (18 ft lb)
- start engine and check for leaks

## Fuel injectors, removing/installing

### Work sequence

#### Note

First signs of injector trouble usually appear as follows:

- knocking in one or more cylinders
- engine overheating
- loss of power
- smoky black exhaust
- increased fuel consumption

Faulty injectors can be located by loosening pipe union on each injector in turn with engine at fast idle. If engine speed remains constant after loosening a pipe union, this indicates a faulty injector

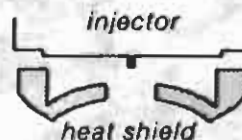
### Removing

#### CAUTION

To avoid damage, keep injection parts clean when removing, installing, disassembling and assembling

- clean all injector pipe fittings
- remove injector pipes
- disconnect fuel return hoses
- remove injectors using US 2775 or equivalent
- remove heat shields and discard

### Installing



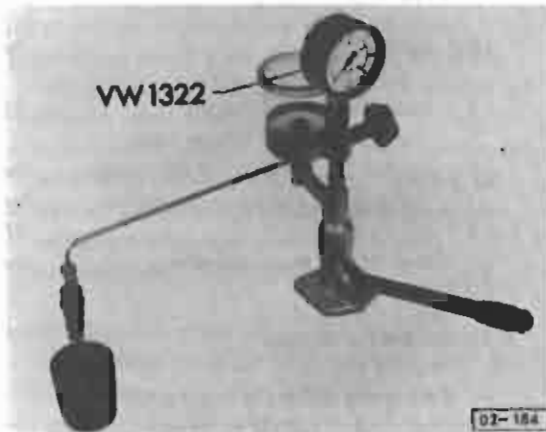
- install new heat shields as shown
- install injectors and tighten to 70 Nm (51 ft lb)
- install injector pipes and tighten to 25 Nm (18 ft lb)
- reconnect fuel return hoses
- start engine and accelerate a few times to clear air bubbles
- check for leaks

## Fuel injectors, checking

### Work sequence

#### WARNING

Diesel fuel will penetrate skin if hands are exposed to working pressure of injector spray



—test injectors with US 1111

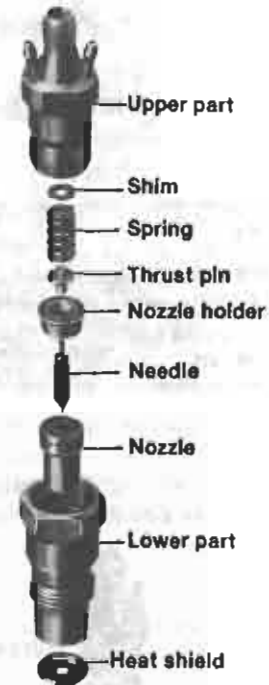
#### Spray test

- fill tester container with clean diesel fuel
- attach injector to tester
- pump tester a few times to clear air bubbles
- turn valve on tester so pressure gauge is **OFF**
- pump tester with rapid short strokes (4 to 6 strokes per sec.)
  - spray should be even, well atomized and stop cleanly
  - injector must not drip

#### Opening pressure test

- turn valve on tester so pressure gauge is **ON**
- press pump lever down slowly
- note opening pressure when injector sprays
  - used injectors = 120 to 130 bar (1740 to 1885 psi)
  - new injectors = 130–138 bar (1885–2001 psi)

if **NO**—continue as follows



- remove injector from tester and disassemble
- remove shim and measure
- select proper shim
  - thicker shim increases pressure
  - a change in thickness of 0.05 mm (0.0019 in.) changes pressure approximately 5 bar (72 psi)
  - shims are available from 1 to 1.95 mm (0.039–0.070 in.) in steps of 0.05 mm (0.0019 in.)
- reassemble injector and retest until correct opening pressure is reached

#### Note

When servicing used injectors, set opening pressure to value for new injectors

#### Leakage test

- pressure gauge still **ON**
- press pump lever down slowly
- hold pressure at approximately 110 bar (1595 psi) for 10 seconds
  - fuel should not drip from injector at nozzle

#### Note

All **new** and **rebuilt** injectors have a settling effect of approx. 5 bar. When installing new/rebuilt injectors, they must have a 5 bar higher opening pressure.



# 23 Diesel Injection System

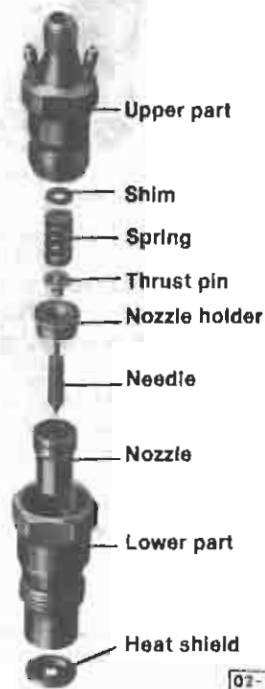
## Fuel injectors, cleaning

### Work sequence

#### CAUTION

Disassemble and clean one injector at a time. Effectiveness of injectors will change if parts from other injectors are interchanged

- clamp upper part of injector in vise and loosen lower part
- turn injector over, lightly clamp lower part of injector in vise and disassemble



- clean parts of injectors in clean diesel fuel
  - gasoline may be used to clean carbon deposits but part must be rinsed in diesel fuel immediately
- visually check injector parts for
  - damaged, carbonized or rough needle seat
  - worn or damaged injection needle and nozzle
  - needle binding in nozzle
- reassemble injector and tighten halves to 70 Nm (51 ft lb)

## Fuel filter water indicator kit, installing

Water level indicator light will light when it is necessary to drain water from trap in fuel filter

### Parts required

Qty	Description	Part No.
1	water level indicator kit	175 988
1	"double" (single female into double male) electrical connector	local supply
1	"ring type" electrical connector	local supply
1	grommet	171 971
	blue 18 ga. electrical wire	local supply

### Installation procedure

- disconnect battery ground cable
- drop down Fuse/Relay Panel



- remove trim cover from front of floor duct

Mount control unit as follows:

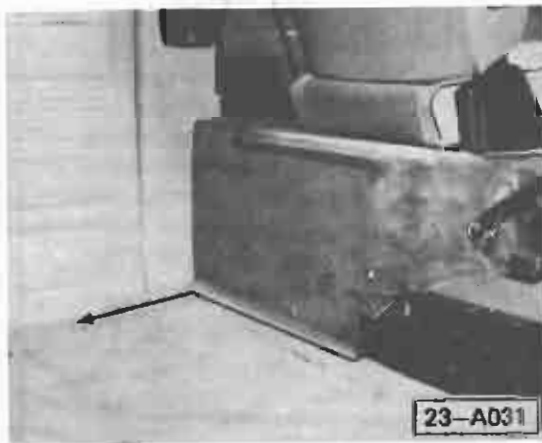
- mount retaining clip (included in Kit) to fresh air tube with sheet metal screw (included in Kit) so control unit will clip into position shown in photo
- also attach brown ground wire (included in Kit) under mounting screw with "ring type" connector
- install double connector on terminal **15** of control unit and clip unit in place
- connect ground wire from mounting screw to terminal **31** of control unit

Install and connect indicator light as follows:

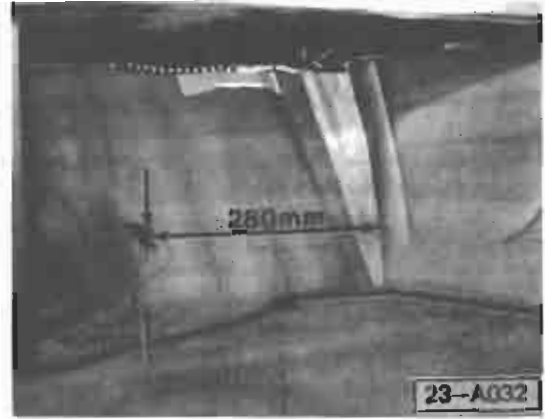
- mark and drill a 9 mm hole approx. 50 mm to right of cold start cable and mount indicator light
- connect white wire (included in Kit) to light
- route wire to control unit and attach to one male terminal of double connector on terminal **15**
- connect yellow wire (included in Kit) to light
- route wire to control unit and attach to terminal **31b**

Install and connect water sensor as follows:

- replace water drain-screw in fuel filter with drain-screw/sensor, included in Kit
- connect blue wire (included in Kit) to terminal **A** of control unit



- route wire under left side of floor vent, between handbrake and left seat base. Continue around back of left seat base under carpeting and to rear along left side of passenger compartment under carpeting



- continue to route wire under carpeting under left side of rear seat
- route wire out from under carpeting where shown

### Note

Blue wire provided is too short and must be lengthened to reach fuel filter in engine compartment

- mark and drill a 13 mm hole at location shown in rear panel under back seat
- insert grommet in hole and route wire through to left rear wheel well area
- from wheel well, carefully route wire across vehicle above transmission, and then back to fuel filter
- connect wire to terminal on new drain-screw/sensor
- connect black wire (included in Kit) to remaining male terminal of double connector on terminal **15** of control unit
- route wire to rear of Fuse/Relay Panel and connect to fused side of fuse **12**
- reinstall Fuse/Relay Panel
- reinstall trim cover for floor duct
- reconnect battery ground cable
- test system by switching ignition on and grounding blue wire from sensor on fuel filter casing. Light should come on and remain on until ignition is switched off

Suggested Installation Time: 125 T.U.  
Labor Operation: 20 34 31 0

rt No.

5 998 030

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1 971 913  
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030

## Fuel Injection, AFC System

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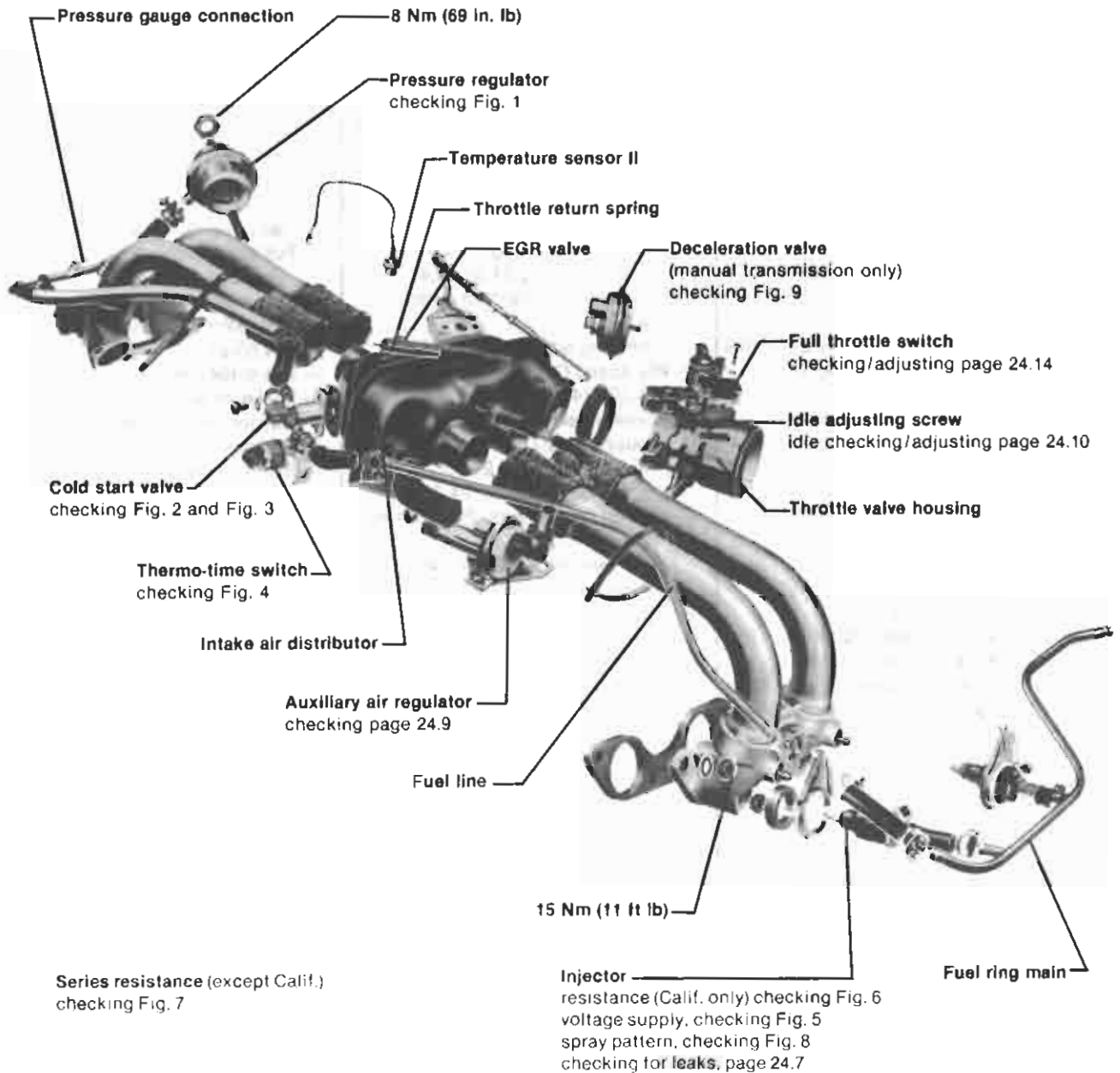
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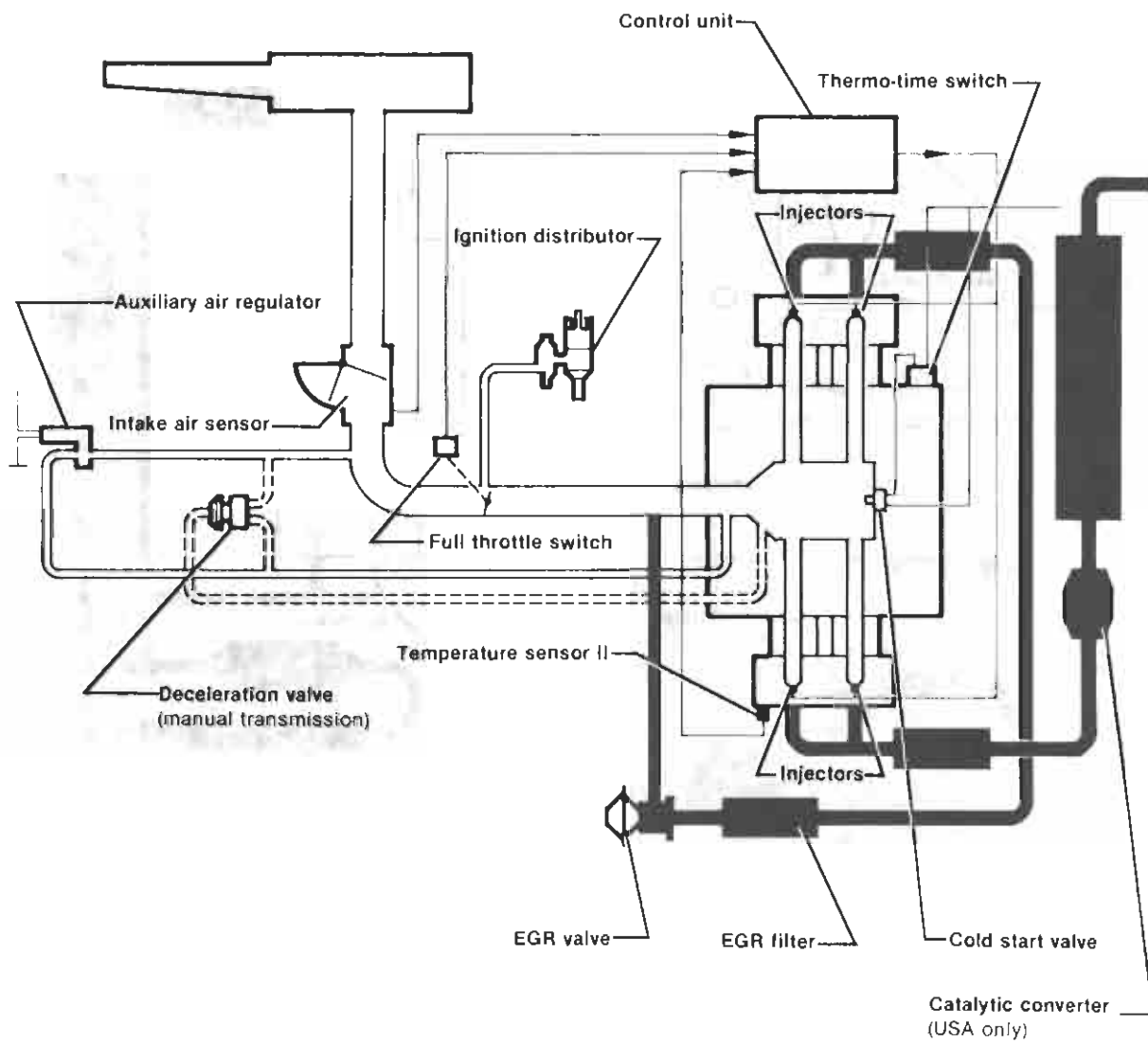
# 24 Fuel Injection, AFC System

## CAUTION

During repairs always replace gaskets, seals and clamps



24-091



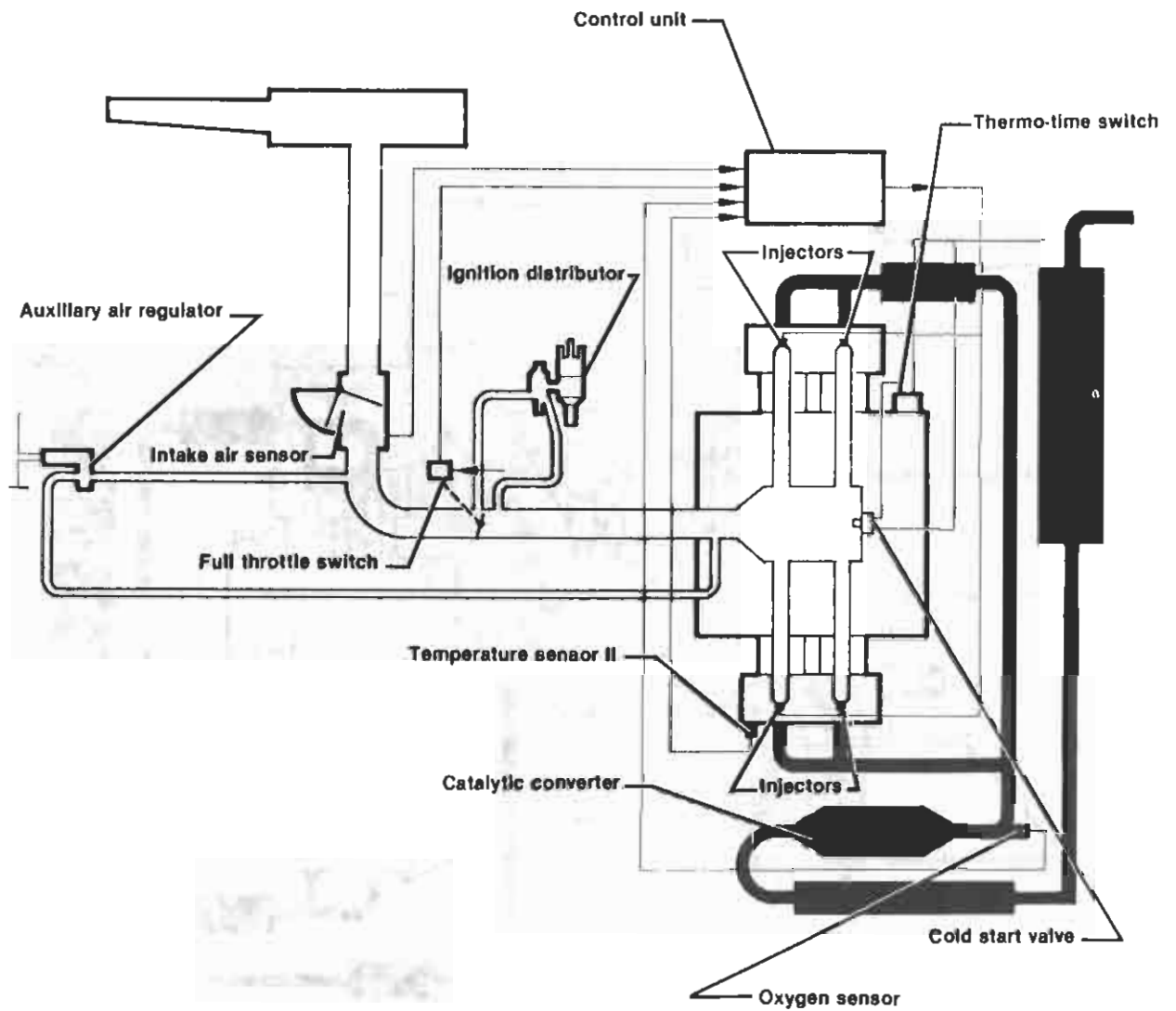
24-104

Canada and USA except Calif.

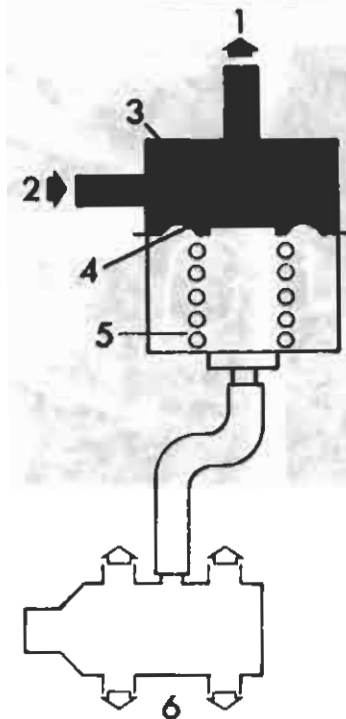
Air-cooled AFC

System component layout **24.3**

# 24 Fuel Injection, AFC System



24-105



**Fig. 1 Pressure regulator, checking**

- 1 = return line
- 2 = from fuel pump
- 3 = fuel pressure chamber
- 4 = diaphragm
- 5 = spring
- 6 = intake air distributor

**Note**

Pressure regulator controls fuel pressure depending on intake air distributor vacuum

**WARNING**

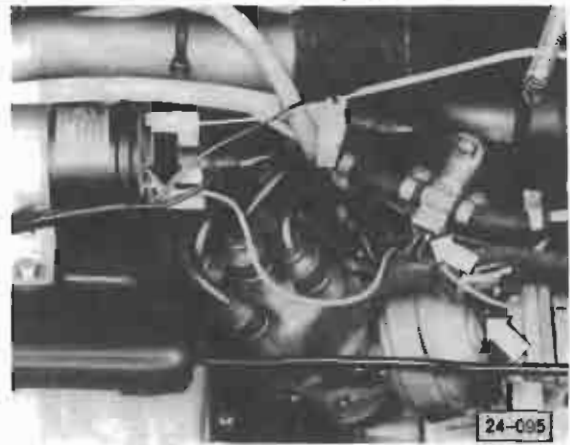
Fire hazard. Do not smoke or have anything in area that can ignite fuel

- connect gauge US 1076 to fuel ring main
- disconnect hose between intake air distributor and pressure regulator
- start engine and run at idle
  - pressure should be: 2.5 bar (36 psi)
- re-connect hose
  - pressure (at idle) must drop to approx. 2.0 bar (29 psi)

If pressure too low, check fuel pump delivery rate

If pressure too high, check return line

If readings still incorrect, replace pressure regulator



**Fig. 2 Cold start valve, checking**

**WARNING**

Fire hazard. Do not smoke or have anything in area that can ignite fuel

- connect gauge US 1076 to fuel ring main
- operate starter briefly until fuel pressure is present
- pull electrical connector off cold-start valve
- operate valve with two jumper wires (arrows)
  - fuel pressure should drop slowly
  - if **NO**, replace cold start valve



**Fig. 3 Cold start valve, checking for leaks**

- pull electrical connector off cold start valve
- remove cold start valve from intake air distributor but leave valve connected to ring main
- pull wire off ignition coil terminal 1
- operate starter
  - cold-start valve should not leak.
  - Replace if necessary

# 24 Fuel Injection, AFC System



**Fig. 4 Thermo-time switch, checking**

- engine cold, air temperature below 20°C (68°F)
- pull electrical connector off cold-start valve
- connect test light
- pull wire off ignition coil terminal 1
- operate starter
  - test light must light up brightly
  - after 11 seconds (maximum) test light must dim or go off



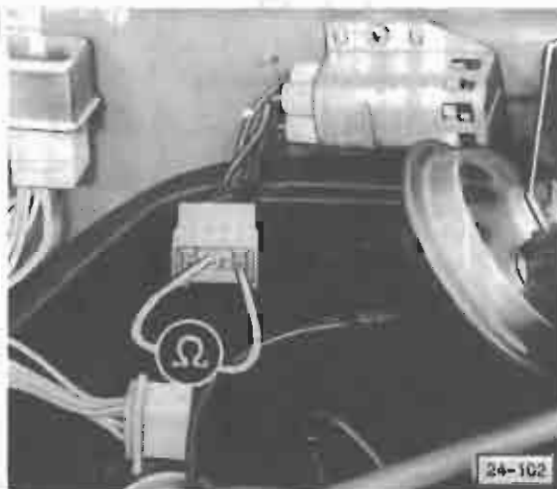
**Fig. 5 Voltage supply at injectors, checking**

- remove connector from injector
- connect test light to wire connector
- operate starter, test light must flicker
- if **NO**, refer to page 24.38



**Fig. 6 Injector resistance, checking**

- pull connector off injector and connect ohmmeter to injector
  - resistance should be 2-3 ohms
- if **NO**, replace injector



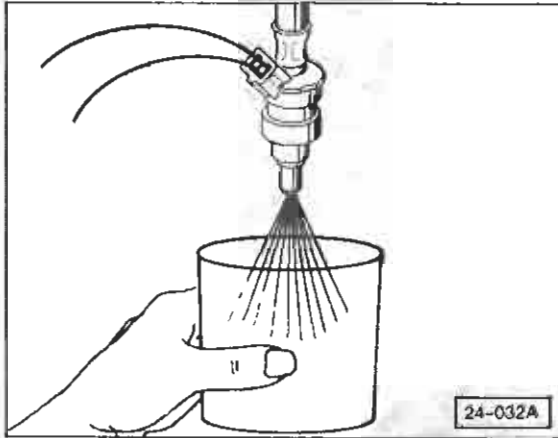
**Fig. 7 Series resistance, checking**  
(USA and Canada except Calif.)

- disconnect connector to series resistance
- connect ohmmeter with one lead to center pin of connector and touch other lead to each side pin
  - resistance for each must be 5.5-6.5 ohms
- if **NO**, replace series resistance as complete unit

## Note

On California vehicles, series resistance is built into fuel injection control unit and can not be checked





**Fig. 8 Injector spray pattern, checking**

- remove injector but leave connected to ring main

**WARNING**

Fire hazard. Do not smoke or have anything in area that can ignite fuel

- operate starter briefly
  - spray pattern must be an even, cone-shaped spray



**Fig. 9 Deceleration valve, checking (manual transmission only)**

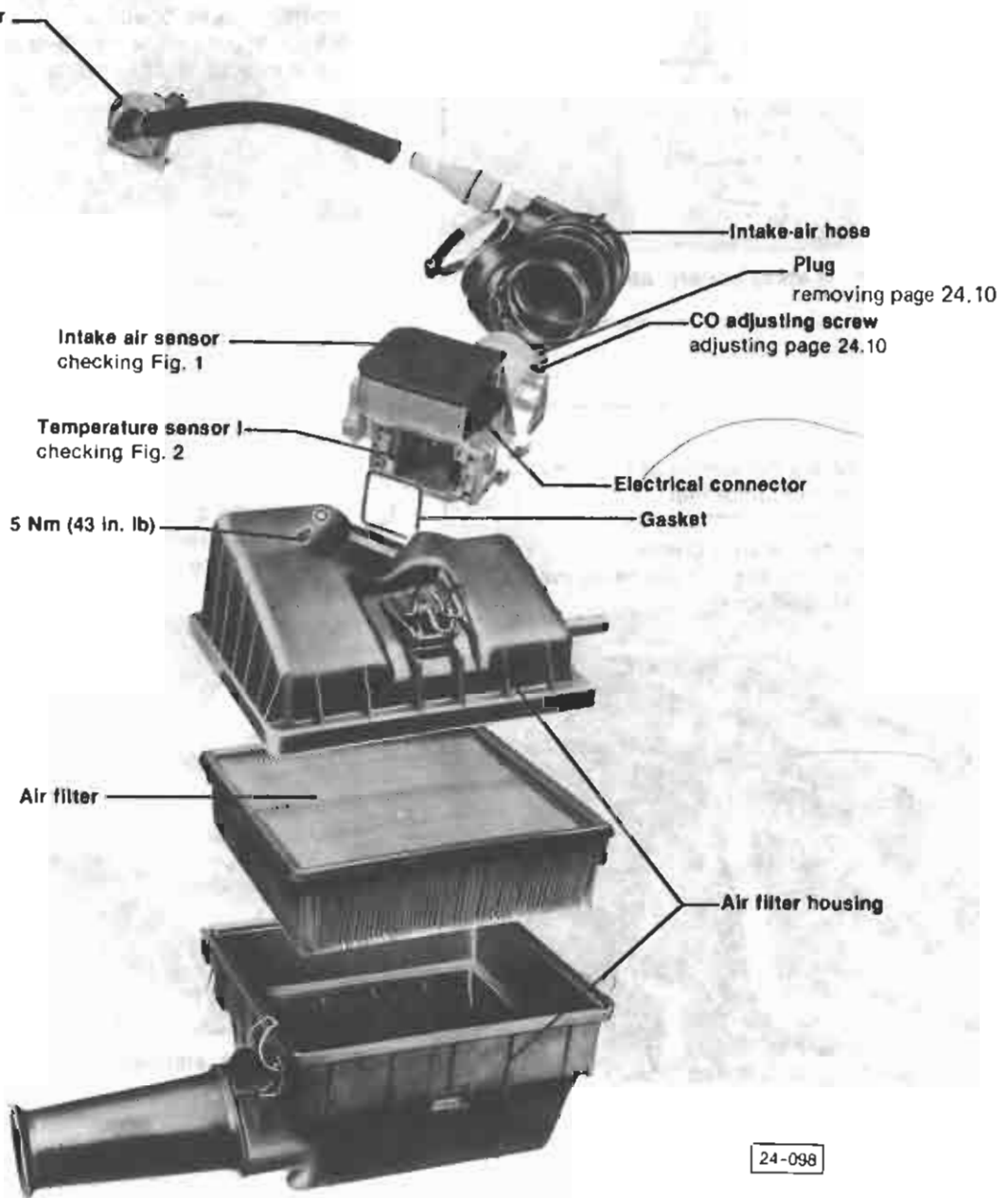
- pull off hose from deceleration valve to air filter at filter
  - start engine and run briefly at approx. 3000 rpm
  - let throttle valve snap closed
  - at same moment check for suction at disconnected hose
- if **NO**, replace deceleration valve

## Injectors, checking for leaks

- remove electrical connector from injector
- remove injector but leave connected to ring main line
- pull off wire from terminal 1 of ignition coil
- operate starter briefly
- check that no more than 2 drops leak from each injector in one minute

# 24 Fuel Injection, AFC System

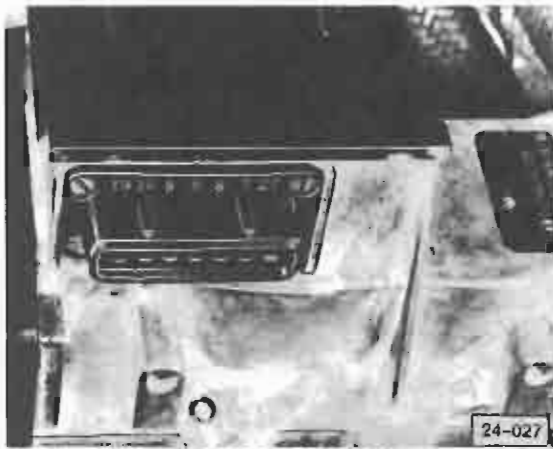
Auxiliary air regulator  
checking Fig. 3



24-098

**24.8** Intake air sensor housing  
Air filter housing  
Auxiliary air regulator

**Air-cooled AFC**



**Fig. 1 Intake air sensor, checking**

- pull off electrical connector from intake air sensor
- check fuel pump contacts in intake air sensor by connecting ohmmeter to terminals 36 and 39
- push air sensor flap open fully
  - meter should read 0 ohms
- release air sensor flap
  - meter should read  $\infty$  ohms

**Note**

If resistance specifications are correct but fuel pump does not work, check for break in wiring between control unit and intake air sensor

- touch probes to following pairs of air sensor connections (flap closed, room temperature)
  - 6 & 9 = 200–400 ohms
  - 6 & 8 = 130–260 ohms
  - 8 & 9 = 70–140 ohms
  - 6 & 7\* = 40–300 ohms
  - 7 & 8\* = 100–500 ohms
  - 6 & 27 if applicable = max. 2,800 ohms at 20°C (68°F)

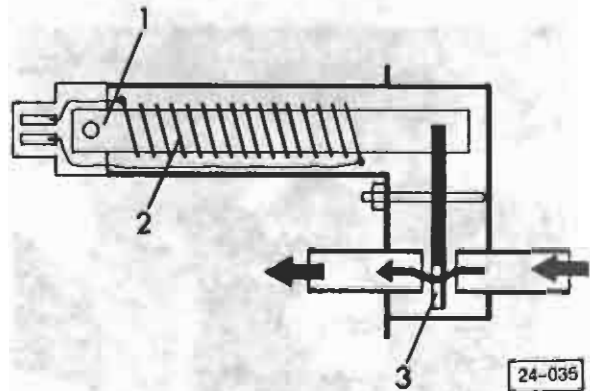
\*To check that resistance strip in intake air sensor is not burnt, proceed as follows:

- check intake air sensor plate is in closed position
- connect ohmmeter to terminals 7 & 8 and open air sensor plate slowly.
  - resistance should not be lower than 40 ohm and not above 500 ohms of values
- repeat on terminals 6 & 7



**Fig. 2 Temperature sensor, checking**

- check that intake air sensor (arrow) has reached room temperature of 20°C (68°F) before checking
- connect ohmmeter to terminals 6 and 27
  - meter should read 2300–2700 ohms



**Fig. 3 Auxiliary air regulator, checking**

**Note**

When engine is cold, regulator is open fully, allowing additional air to engine

- 1 = bimetal spring
- 2 = heating coil
- 3 = rotary gate valve

- check regulator electrically by pulling connector off and attaching ohmmeter to both terminals
  - meter should read approx. 30 ohms
- check mechanically by pulling off both hoses and blowing into regulator
  - with engine cold, regulator must be open
  - with engine warm, regulator must be closed
- turn ignition ON
  - after 5 minutes, regulator must close

# 24 Fuel Injection, AFC System

## Idle speed/CO, checking/adjusting (USA and Canada except Calif.)

### Work sequence

#### Preliminary conditions:

- engine oil temperature min. 60°C (140°F)
- intake air sensor must be 20°C (68°F)
- all electrical equipment must be **OFF**
- hose for charcoal filter must be disconnected and blocked at air filter
- dwell and timing OK (see Repair Group 28)

#### Note

When vehicle has been parked outside at temperatures below 10°C (50°F), adjustment must wait until intake air sensor has reached room temperature 20°C (68°F)

- connect tach/dwell meter according to manufacturer's instructions



- check idle speed and adjust if necessary, with adjusting screw (arrow)
  - manual transmission: 800–950 rpm
  - automatic transmission: 850–1000 rpm
- connect CO meter according to manufacturer's instructions
- connect CO probe ahead of catalytic converter at probe receptacle



- check CO and if necessary adjust at adjusting screw (arrow)
  - 1.0 ± 0.5%
- secure CO adjusting screw with blue cap

#### Note

If CO cannot be adjusted following components may be defective:

- injectors
- spark plugs
- vacuum leak between cylinder head and intake manifold

## Idle speed/CO, checking/adjusting (Calif. only)

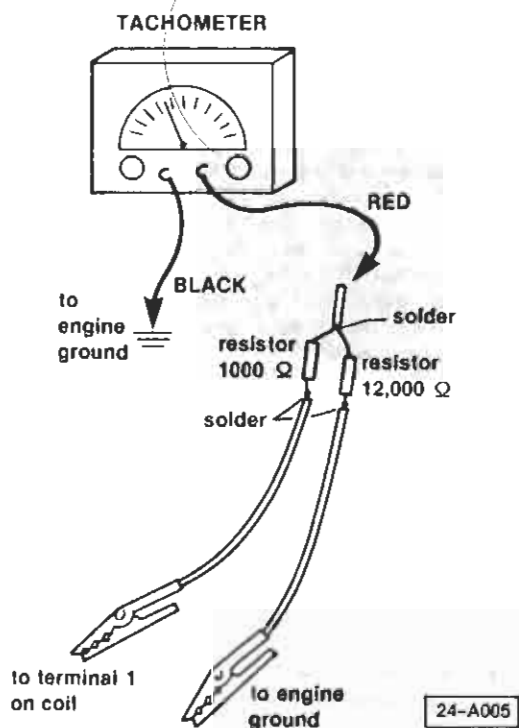
### Work sequence

#### Preliminary conditions:

- engine oil temperature min. 60°C (140°F)
- intake air sensor must be 20°C (68°F)
- all electrical equipment must be **OFF**
- hose for charcoal filter must be disconnected and blocked at air filter

#### Note

To check engine rpm on vehicles with oxygen sensor and electronic ignition (Calif. vehicles), resistor adaptor must be used in conjunction with commercial tach/dwell meter



- assemble and connect adapter according to illustration
- check idle speed (with idle stabilizer connected)
  - 850-950 rpm



- disconnect plugs on idle stabilizer and connect together (arrow)
- check ignition timing and if necessary adjust (see Repair Group 28)
- check idle speed and if necessary, adjust
  - 850-950 rpm (at adjusting screw)
- reconnect idle stabilizer
- start engine and slowly increase engine speed to at least 900 rpm
- release throttle
  - idle must now be: 850-950 rpm

- if timing setting does not change with changes in rpm, replace idle stabilizer

### Note

Before checking or adjusting CO, idle speed and ignition timing must be within specifications

- connect CO meter according to manufacturer's instructions
- connect CO probe ahead of catalytic converter at probe receptacle



- disconnect oxygen sensor (arrow)
- check CO; if necessary adjust at CO adjusting screw (see photo 24-097, page 24.10)
  - $0.7 \pm 0.4\%$

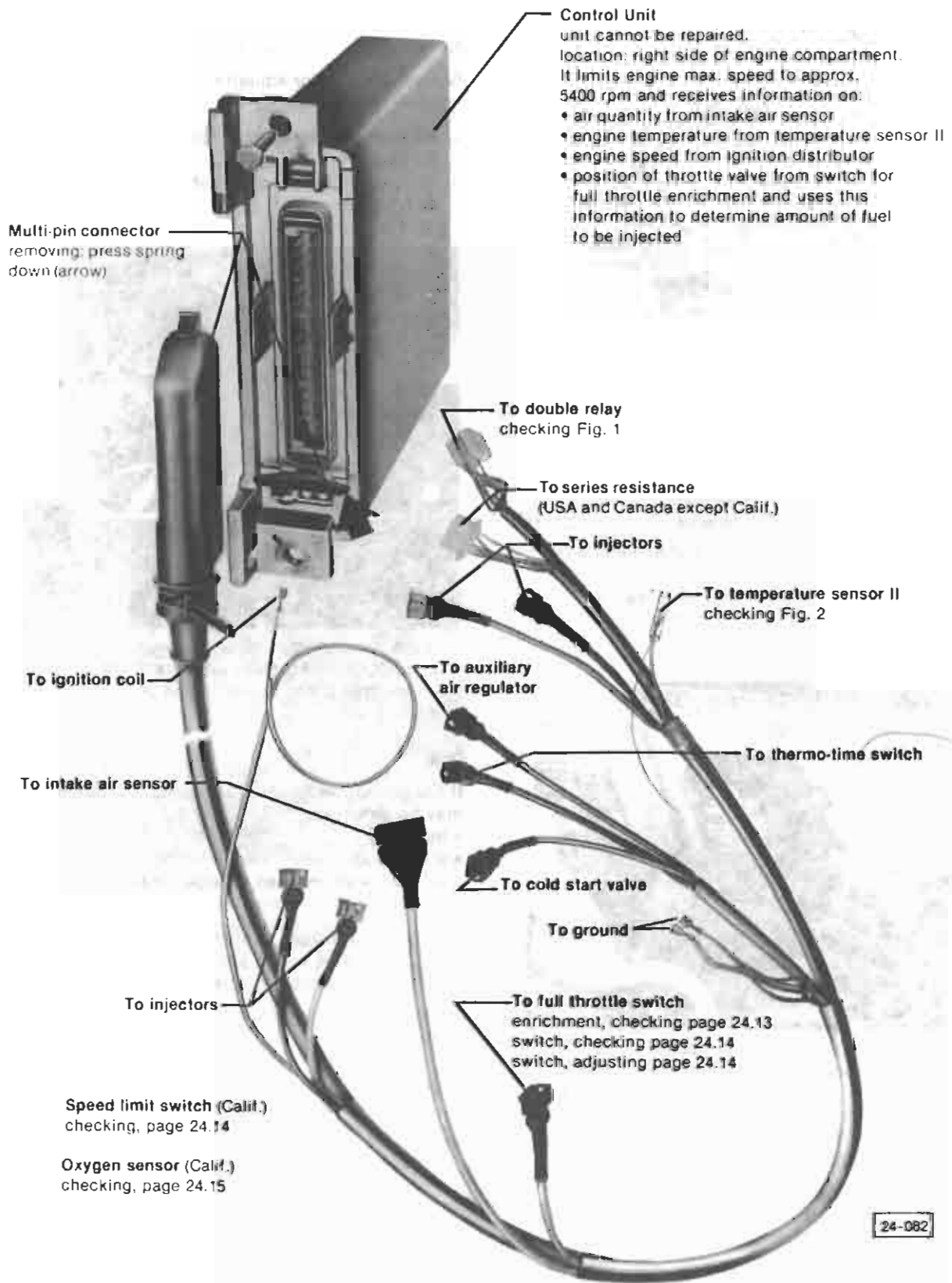
### Note

If CO cannot be adjusted following components may be defective:

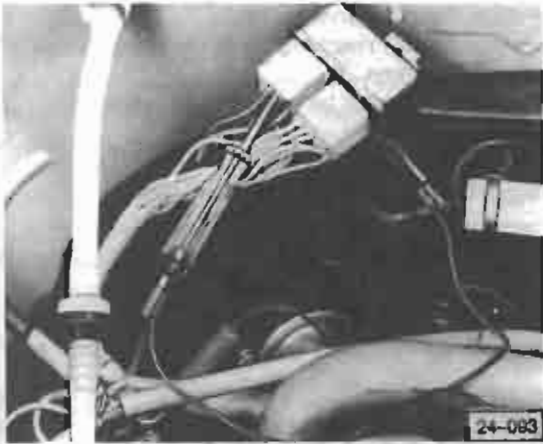
- injectors
- spark plugs
- vacuum leak between cylinder head and intake air sensor

- reconnect oxygen sensor
  - CO must be within specifications
- secure CO adjusting screw with blue cap

# 24 Fuel Injection, AFC System



24-082



**Fig. 1 Double relay, checking**

- detach relay from firewall (do not unplug connectors)
  - check for voltage at terminals at relay by attaching one lead of test light to terminal 85 and touching other lead to following:
    - 86a
    - 88y
    - 88d
  - operate starter
    - test light must light up
- if **NO**, check wire to battery or inline fuse  
if wire or inline fuse OK, double relay defective and must be replaced



**Fig. 2 Temperature sensor II, checking**

**Note**

Temperature sensor in cylinder head supplies control unit with information for starting and warm-up enrichment

- disconnect temperature sensor wire from sensor

- “zero” ohmmeter and connect one probe to temperature sensor and other to ground
- check resistance at oil temperatures below

Oil temperature	Meter reading
- 10°C (14°F)	7,000-11,600 Ω
20°C (68°F)	2,100-3,100 Ω
80°C (176°F)	270-390 Ω

- if resistance reading too high, touch ground probe to steel housing of sensor
- if resistance now OK, problem is corrosion between sensor and cylinder head
- if resistance is still incorrect, replace temperature sensor II

## Full throttle enrichment, checking

### Work sequence

**Note**

This check shows possible defects in control unit or break in wiring between control unit and full throttle switch. At full throttle, this switch signals control unit to increase amount of fuel injected

**California only**

Vehicles for California are equipped with speed limit switch located between full throttle enrichment switch and control unit. Full throttle enrichment will take place when engine runs above 3000 rpm (at same time oxygen sensor switches off)

- warm engine until oil temperature is at least 60°C (140°F)
- check that idle speed, CO, and ignition timing are OK
- go to next page



# 24 Fuel Injection, AFC System



### California only

- use jumper wire and make contact between terminal 4 and 8 (arrow A) of connector for speed limit switch
- pull off connectors for idle stabilizer and connect together (arrow B)

- run engine at idle and adjust to specifications in table

	USA/Canada	Calif.
Manual	800-950 rpm	850-950 rpm
Automatic	850-1000 rpm	850-950 rpm

- operate full throttle switch by hand
  - idle speed must increase approx. 100 rpm
- if NO, check full throttle switch and adjustment position
- if OK, replace control unit or wiring between control unit and switch
- on Calif. vehicles readjust idle speed to specifications on sticker and reconnect idle stabilizer

### Full throttle enrichment switch, checking

#### Work sequence

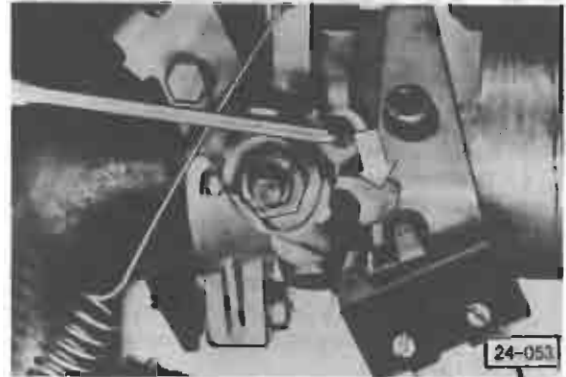


- "zero" ohmmeter and connect to contacts on switch
  - with throttle valve closed, ohmmeter must read  $\infty$  ohms

- open throttle valve slowly
  - just before reaching stop, ohmmeter must read 0 ohms
- if NO, switch must be adjusted or replaced

### Full throttle enrichment switch, adjusting

#### Work sequence



- depress accelerator pedal fully and hold in position
- loosen switch and move it until ohmmeter changes from  $\infty$  ohms to 0 ohms
  - roller should be in center of curved lever (arrow)
- tighten switch

### Speed limit switch, checking

#### Work sequence



- connect positive lead (+) of voltmeter to switch terminal 8 and negative lead (-) to switch terminal 6
- start engine and accelerate to approx. 3000 rpm
  - voltmeter must indicate battery voltage
- if NO, replace speed limit switch

No  
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#14  
#15  
#32  
#33  
#16  
#17  
#34  
#37  
V  
#4  
#10  
#20



**Note**

Entire AFC System can be checked electrically at control unit plug using an ohmmeter or volt meter according to following chart.

Ohmmeter to terminal:	Specs	Checks
#1 and Ground	Disconnect white injection wire at coil $\infty$ ohms; hook wire to ground 0 ohms	Wire to #1 terminal on coil
#3 and #18	Press accelerator pedal down fully. 0 ohms	Full throttle enrichment circuit thru throttle switch
#5 and Ground	0 ohms	Ground Circuit
#6 and #9	200-400 ohms	Air Sensor Circuit
#6 and #8	130-260 ohms	Air Sensor Circuit
#8 and #9	70-140 ohms	Air Sensor Circuit
#6 and #7	40-300 ohms	Air Sensor Circuit
#7 and #8	100-500 ohms	Air Sensor Circuit
#6 and #27	Max 2,800 ohms at 68° F	Air Sensor Circuit
#13 and Ground	2,100-2,900 ohms at 68° F 270-390 at 176° F	Head Sensor
#14 and #10	Approximately 7 ohms	Injector wire and resistor
#15 and #10	Approximately 7 ohms	Injector wire and resistor
#32 and #10	Approximately 7 ohms	Injector wire and resistor
#33 and #10	Approximately 7 ohms	Injector wire and resistor
#16 and Ground	0 ohms	Ground Circuit
#17 and Ground	0 ohms	Ground Circuit
#34 at control unit and #37 on the double relay	Approximately 30 ohms	Auxiliary air regulator and wires
Voltmeter to terminal	Specs	Checks
#4 and Ground	12 volts during cranking 0 volts at all other times	Signal from starter
#10 and Ground	12 volts with key on 0 volts with key off	Voltage supply to computer
#20 and Ground	12 volts with key on and sensor flap open	Pump Circuit

# 24 Fuel Injection, AFC System

## Oxygen sensor, checking (Calif. only)

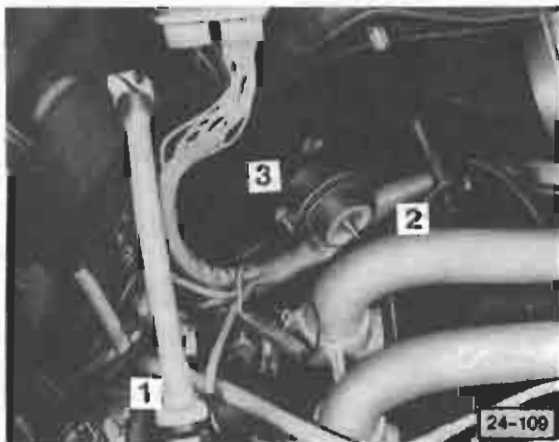
### Work sequence

#### Note

Oxygen sensor is located in exhaust system (in front of catalytic converter). It produces varying voltages (up to 1 volt) dependent on oxygen content of exhaust gases. These voltages are sent to electronic control unit which alter injection time accordingly. Oxygen sensor operates at all engine speeds, except warm-up and full throttle

#### Preliminary conditions:

- engine oil temperature at least 60°C (140°F)
  - air temperature 20°C (68°F). Before starting following test procedures, wait until intake air sensor housing has assumed room temperature
- connect tachometer according to manufacturer's instructions
- connect CO meter to test receptacle in front of converter (do not connect at tailpipe)
- check idle speed and adjust if necessary
- 850-950 rpm



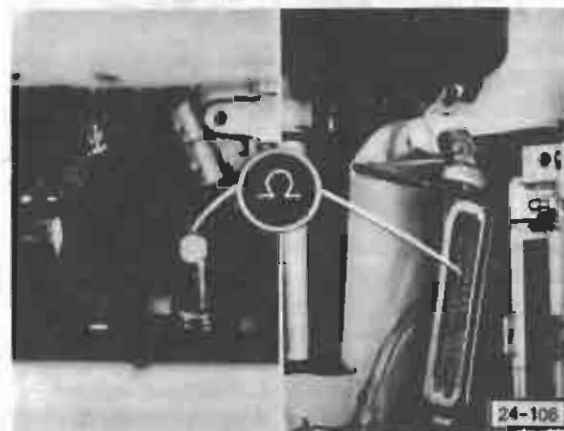
- disconnect oxygen sensor wire 1 to control unit
- check CO
- $0.7 \pm .4\%$
- let engine idle, disconnect vacuum hose 2 at pressure regulator 3 and plug hose
- CO must increase to approx. 2.5%

- reconnect oxygen sensor wire 1
- CO must drop to  $0.7 \pm 0.4\%$  if oxygen sensor is OK

if **NO**, following components may be defective:

- oxygen sensor
- wire between oxygen sensor and control unit
- leak in exhaust system between catalytic converter and cylinder head

## Wire between oxygen sensor and control unit, checking



- connect ohmmeter between oxygen sensor and terminal 24 on control unit
- 0 ohm, sensor wiring OK
  - $\infty$  ohm, sensor wiring defective

unit  
c



or

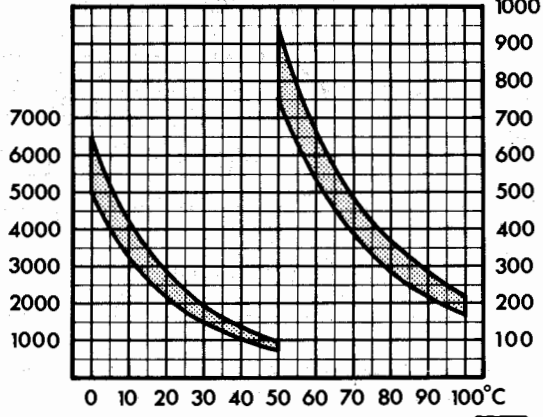
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# 24 Fuel Injection, AFC System

## Technical data and specifications

Components—checking/adjusting	Specifications	Notes
<b>Idle speed</b> see chart page 24.19		• oxygen sensor connected
<b>CO-value</b> checking spec.  adjusting spec.	0.3–1.1%  $0.7 \pm 0.4\%$ *	• oxygen sensor and idle stabilizer connected • oxygen sensor disconnected *
<b>Ignition timing</b>	$5^\circ \pm 1^\circ$ ATDC	• idle stabilizer disconnected
<b>Idle stabilizer control unit</b>	below 940 rpm under load, ignition timing advances	• engage 4th gear at idle speed and engage clutch slowly; timing should advance
<b>Fuel pump delivery rate</b>	min. 500 cm <sup>3</sup> /30 sec.	• disconnect relay connection, turn ignition <b>ON</b> , let fuel pump run by using bridging-adaptor US 4480/3
<b>Pressure regulator/fuel pressure</b> vacuum hose connected vacuum hose disconnected	approx. 2.0 bar (29 psi) approx. 2.5 bar (36 psi)	• idle speed • idle speed
<b>Oxygen sensor</b> wiring disconnected wiring connected	CO above 2% CO 0.3–1.1%	• vacuum hose at pressure regulator disconnected and plugged
<b>Injectors</b> fuel spray pattern voltage supply resistance	even, coneshaped spray test light flickering approx. 16–16.4 ohms	• operate starter • operate starter
<b>Auxiliary air regulator</b> cold warm	open closed	• pinch hose, rpm must drop • after idling about 5 min. pinch hose, rpm does <b>not</b> drop
<b>Intake air sensor terminals:</b> 6 and 9 or 3 and 4 7 and 9 or 2 and 3 6 and 22 or 1 and 4	approx. 560 ohms ohms—changing 2300–2700 ohms	— • move sensor plate • intake air sensor about 20°C (68°F)
<b>Throttle valve switches</b> for deceleration/idle speed for full throttle enrichment	closed only during idle speed closed at full throttle	— —

\* note altitude; see adjustment procedure, page 24.29

Components—checking/adjusting	Specifications	Notes
<p><b>Temperature sensor I and II</b> for intake air temperature and coolant temperature</p>	<p style="text-align: center;">ohms ← Temperature Sensor → ohms</p>  <p style="text-align: center;">Temperature of Temperature Sensor [24-116]</p>	

### Idle speed, specifications

Application/ Model year	Idle stab. control unit, identification/ Test conditions	Idle speed rpm
CAL and CAN 1983-85	green, 251 906 083 control unit by-passed	850 ± 50
49 States 1983-84	control unit connected	900 ± 50
49 States 1985	black, 321 906 083 control unit by-passed	750 ± 80
	control unit connected	800 ± 50

#### Note

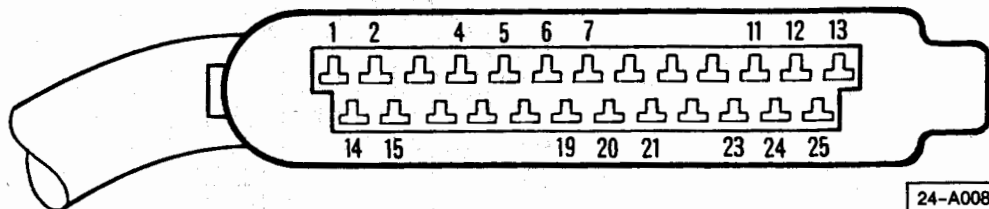
Replacing digital idle stabilization control unit can lower idle speed rpm. When replacing control unit, always recheck idle speed and adjust as necessary.

# 24 Fuel Injection, AFC System

## AFC System check with volt/ohmmeter

### Note

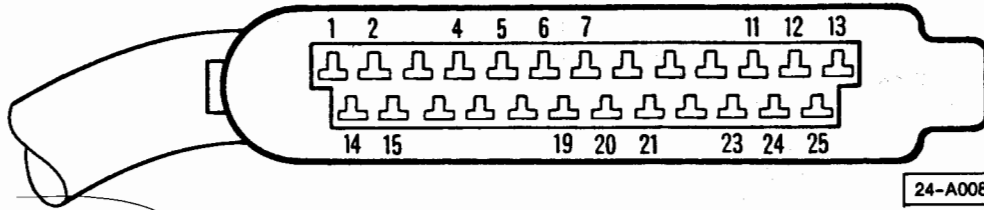
Entire AFC system can be checked electrically at disconnected multi-pin connector of control unit



— remove multi-pin connector and turn ignition ON

Tester to terminal:	Components	Checks	Specs
1 and 7	Hall control unit type: AEG	• voltage with ignition ON	battery voltage or slightly less
1 and ignition coil terminal 15	HALL control unit type: FAIRCHILD	• touch center wire of connector at ignition distributor to ground	1.5 volts or slightly less
2 and 7	Temperature sensor II (coolant temperature)	• resistance at 20°C (68°F) see diagram page 24.19	2300–2700 ohm
4*) and 7	Deceleration/idle switch Full throttle enrichment switch	• idle speed position • full throttle position	0 ohms 0 ohms
5 and 7	Oxygen sensor	• connector disconnected and grounded • connector connected	0 ohms ∞ ohms
6 and 19	Intake air sensor	• resistance/potentiometer	approx. 560 ohms
7 and 25	Ground connection/control unit	• wiring	0 ohms
11 and 7	Fuel injector, cyl. 4	• injector and wiring	approx. 16–16.4 ohms
12 and 7	Fuel injector, cyl. 3	• injector and wiring	approx. 16–16.4 ohms
13 and 7	Relay, left; terminal 87	• ignition ON; function of relay, left	battery voltage
14 and 6	Temperature sensor I (intake air temperature)	• resistance at 20°C (68°F)	2300–2700 ohms
15 and 19	Intake air sensor	• resistance/potentiometer; if sensor plate is moved	ohms—changing

\*) do not connect test light on this terminal if control unit is connected to multi-pin connector



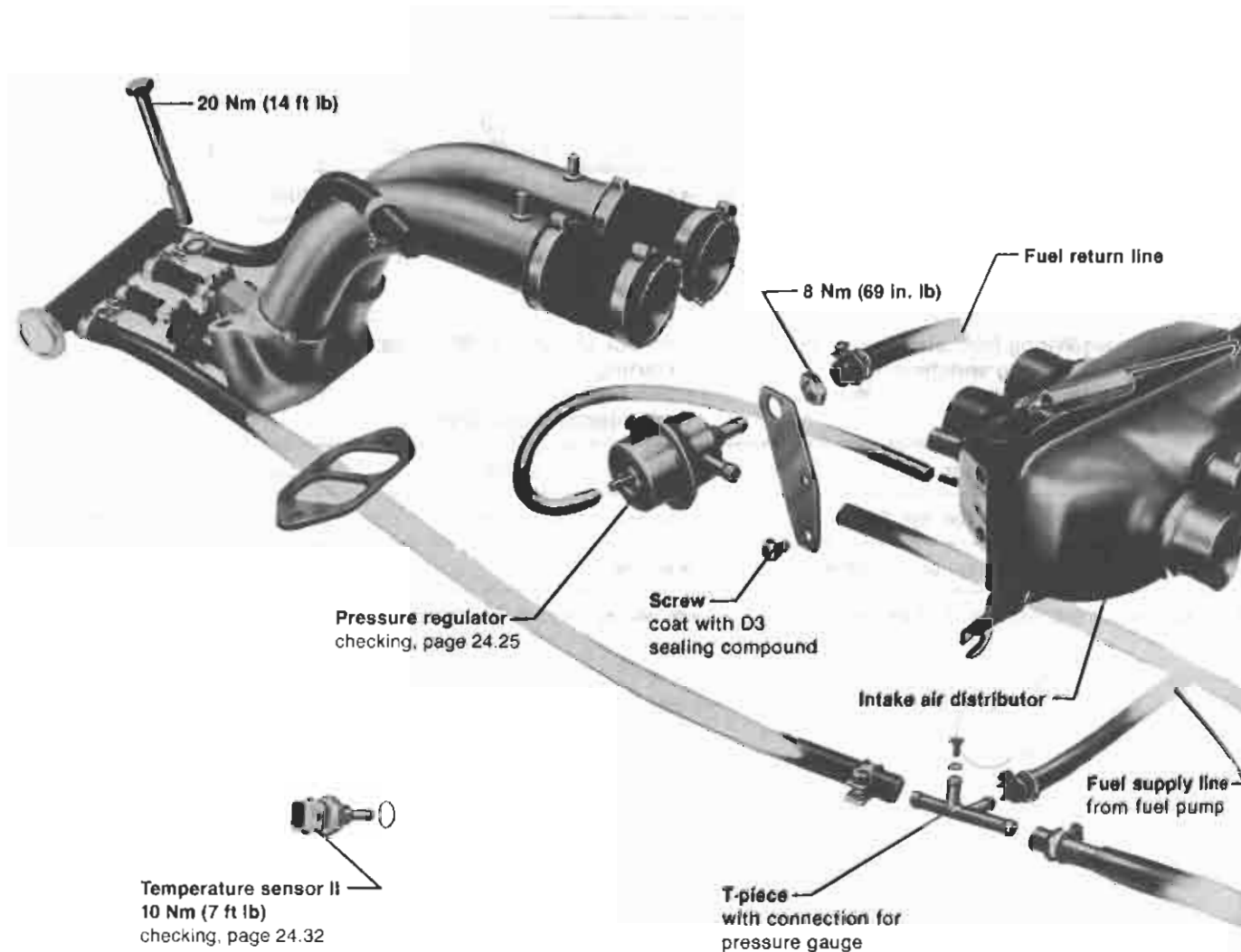
Tester to terminal:	Components	Checks	Specs
20*) and 25 bridged	Relay, right; terminal 86*)	• ignition ON; function of relay, right	fuel pump must run
	Auxiliary air regulator	• ignition ON; function of auxiliary air regulator	power must be supplied to auxiliary air regulator
21 and 7	Wiring from starter; starting enrichment	• voltage at terminal 50 during starting — crank engine (with injector plugs OFF)	cranking voltage
23 and 7	Fuel injector, cyl. 1	• injector and wiring	approx. 16-16.4 ohms
24 and 7	Fuel injector, cyl. 2	• injector and wiring	approx. 16-16.4 ohms
25 and 7	Ground connection/control unit	• wiring	0 ohms

\*) do not connect test light on this terminal if control is connected to multi-pin connector

# 24 Fuel Injection, AFC System

## CAUTION

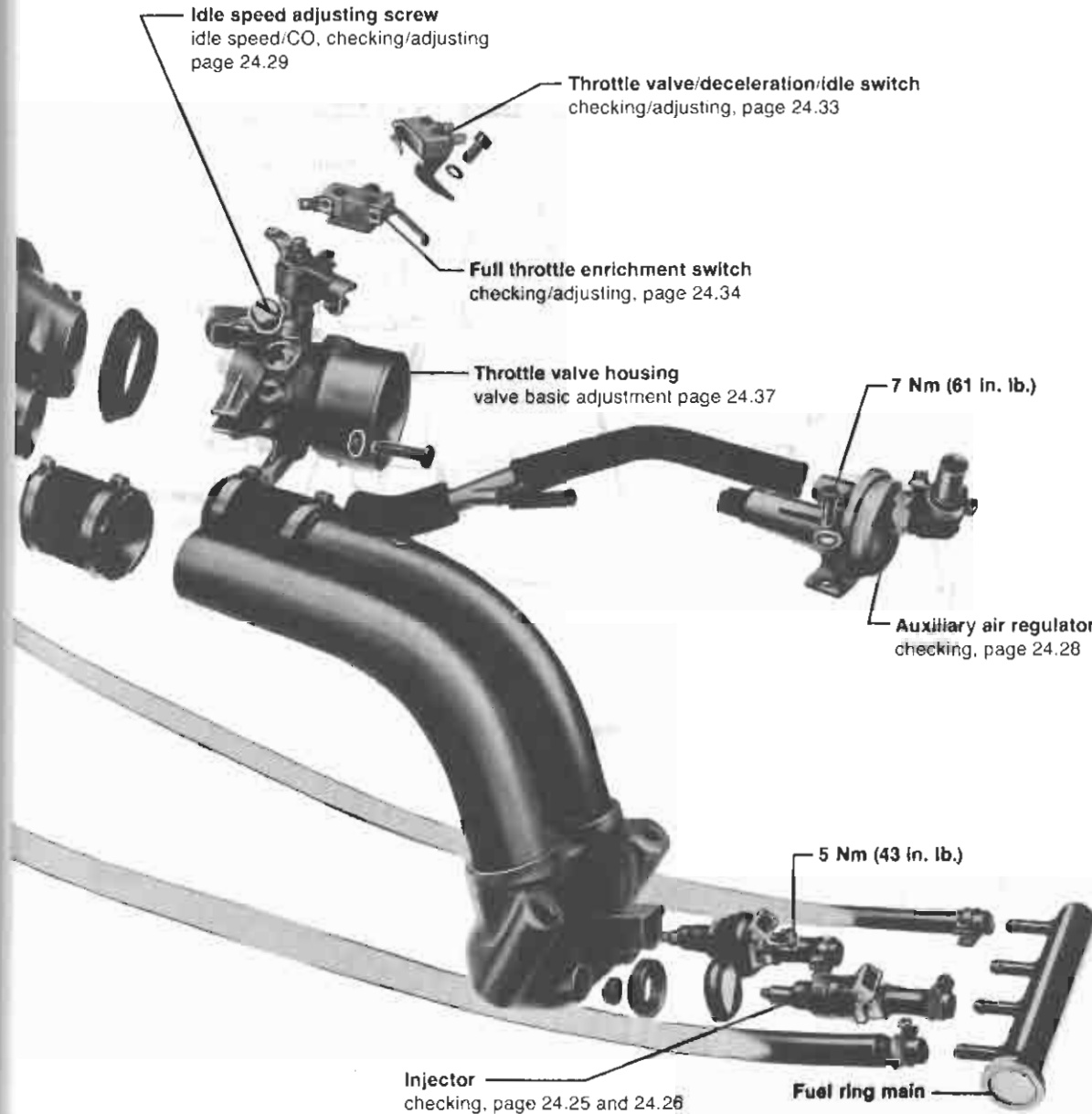
During repairs always replace gaskets, seals and clamps





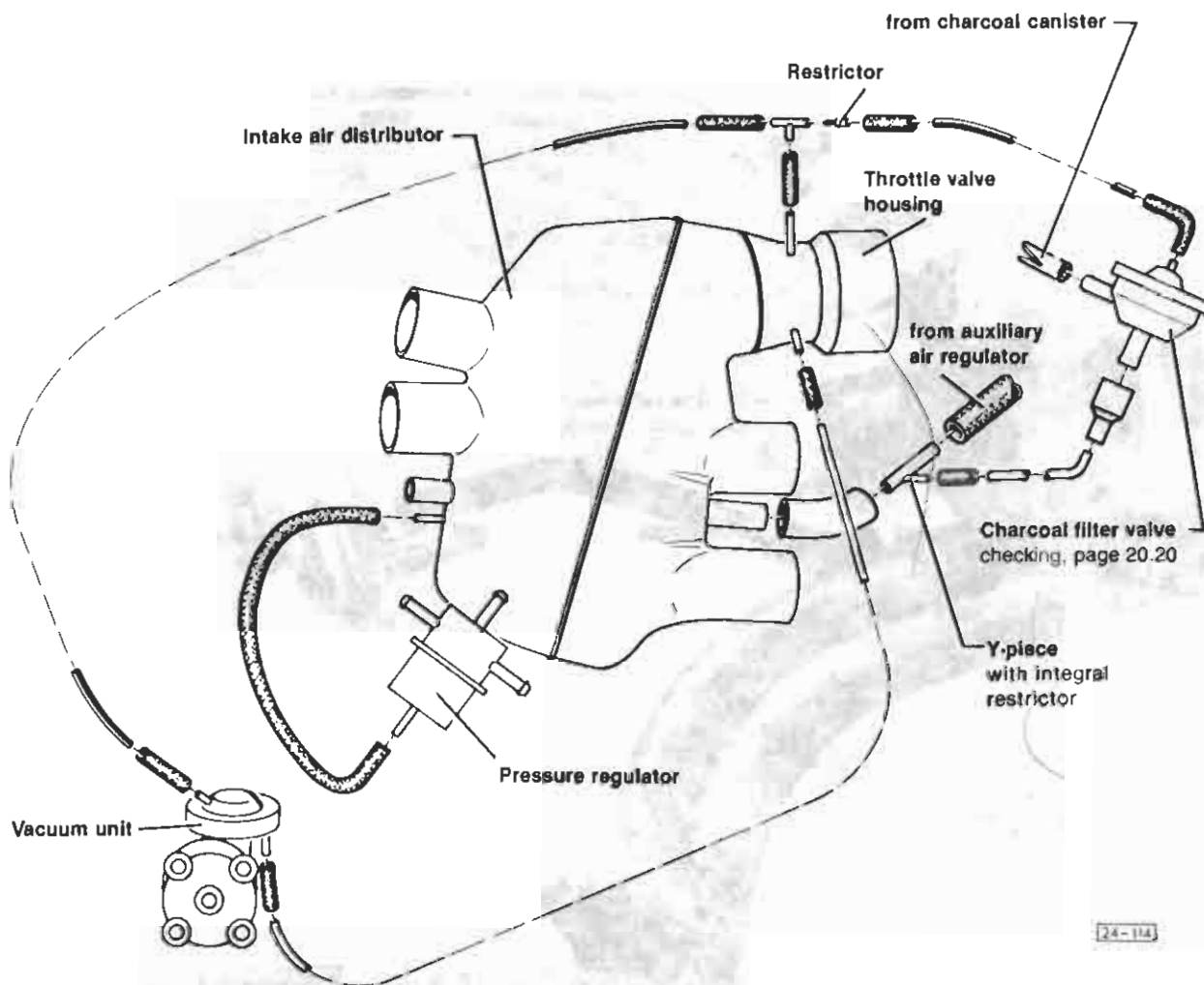
## Note

Later versions have throttle body with 1 switch for idle speed, deceleration fuel shut off, and full throttle enrichment  
checking/adjusting page 24.35  
removing/installing page 24.36



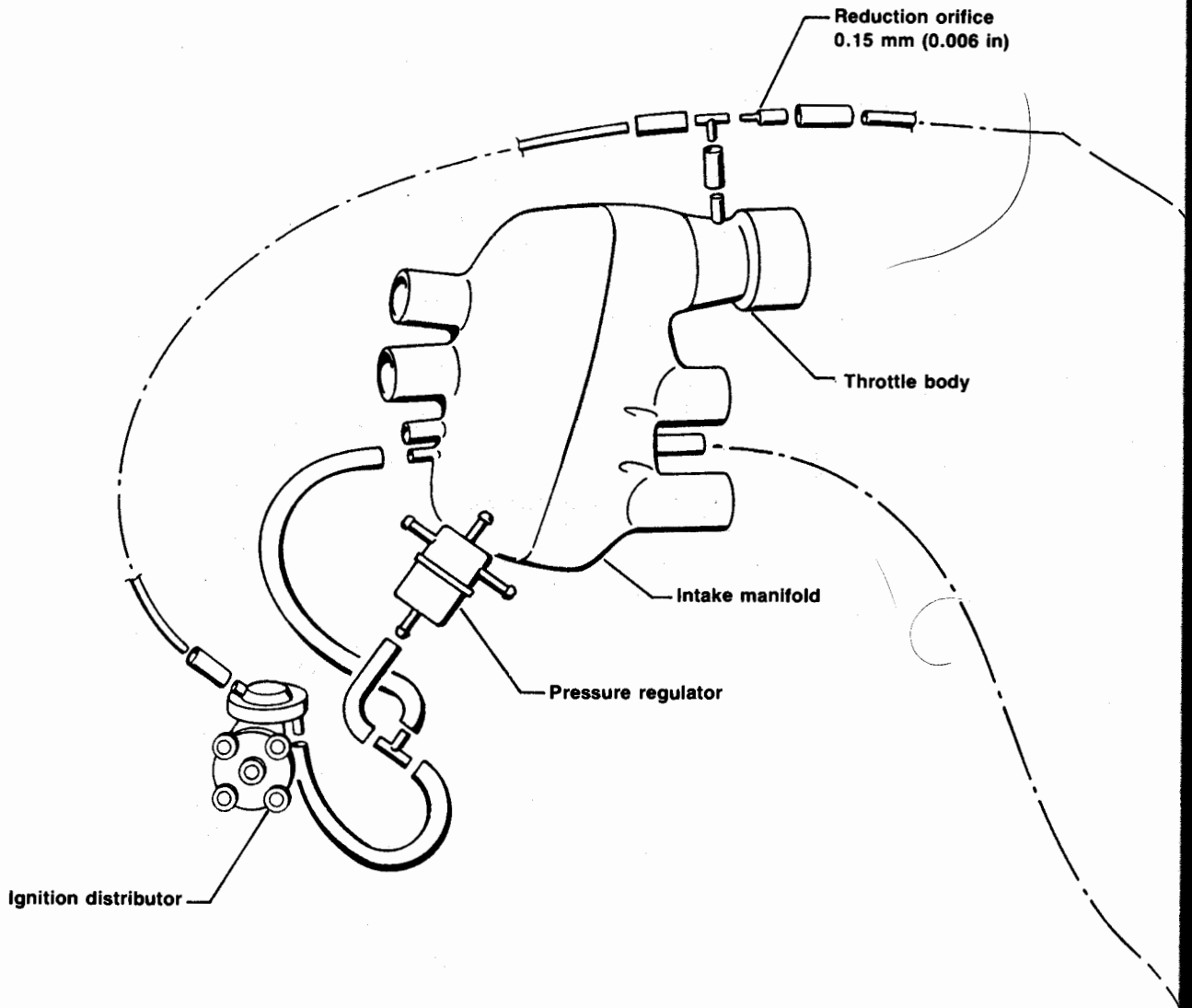
# 24 Fuel Injection, AFC System

Vacuum hose layout  
(early version)



# 24 Fuel Injection, AFC System

Vacuum hose layout  
(late version)



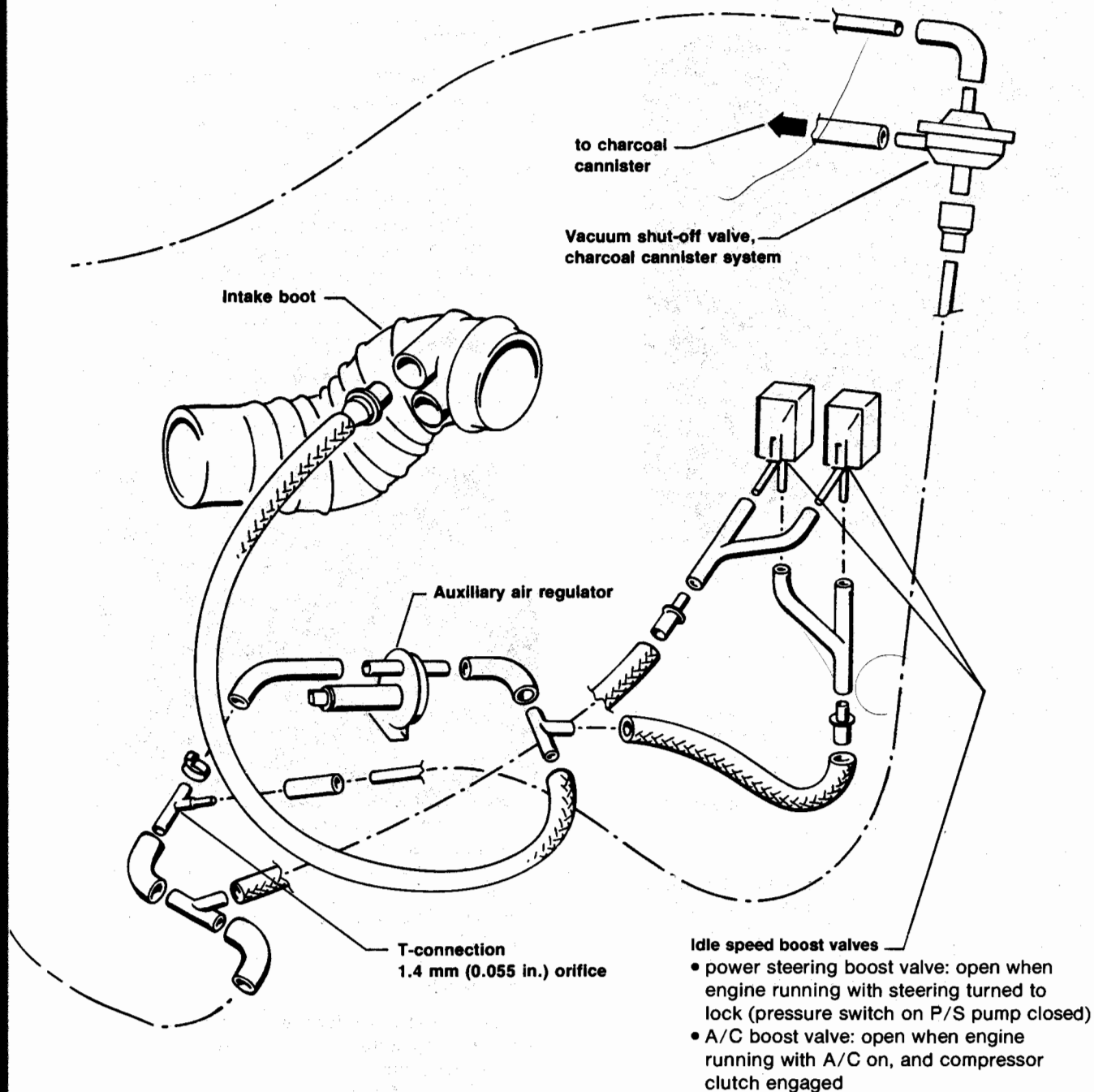
24-148

## 24.24a

System components  
layout (late version)

Water-cooled

Digijet



24-148

# 24 Fuel Injection, AFC System

## Pressure regulator, checking



- connect pressure gauge V.A.G. 1318 or equivalent with adaptor to T-piece 1 of fuel line

### CAUTION

Pressure gauge lever must be in closed position during measurement procedure

- run engine at idle speed and check pressure

### Specifications:

bar (psi)	vacuum hose 2 (shown in above illustration)
approx. 2.0 (29)	connected
approx. 2.5 (36)	disconnected

## Fuel injectors, checking

### Work sequence

#### CAUTION

Do not disconnect terminal 1 at ignition coil when operating starter

### Spray pattern

- pull out fuel injectors in pairs but leave electrical plugs and fuel lines connected
- disconnect electrical plugs at fuel injectors which are still installed (second pair)

#### WARNING

Fire hazard. Do not smoke or have anything in area that can ignite fuel



- hold injectors in jar or pan
- operate starter briefly
  - spray pattern must be an even, coneshaped spray
- reinstall fuel injectors with new sealing rings 1

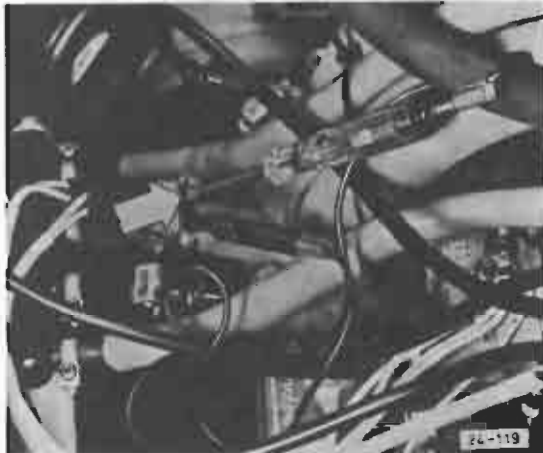
### Leak checking

- pull off electrical plugs at fuel injectors
- pull out injectors in pairs but leave connected to fuel ring line
- turn ignition **ON** for about 5 seconds (fuel pump operates briefly)
- check that no more than 2 drops leak from each injector in one minute

## Voltage supply

### CAUTION

To prevent damage to control unit, **do not** short-circuit connector contacts

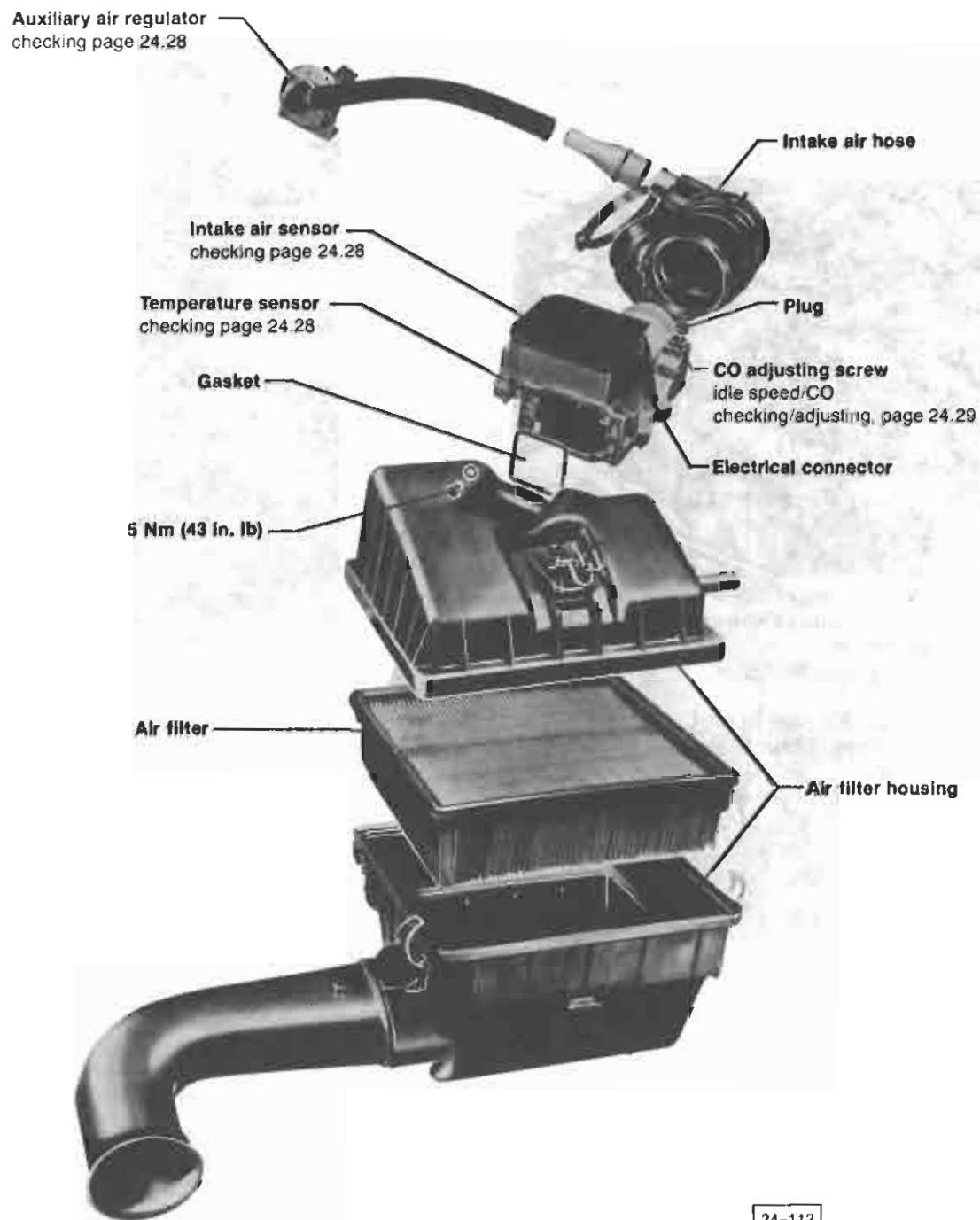


- pull off all electrical plugs from fuel injectors
- connect test light to one plug contact (arrow)
- operate starter
  - test light must flicker

### If NO

- check relays, see page 24.32
- check impulse output of Hall control unit terminal 7
- check all ground connections at cylinder head

# 24 Fuel Injection, AFC System



24-112

## 24.27

Intake air sensor housing  
Air filter housing  
Auxiliary air regulator

Water-cooled

Digijet

## Intake air sensor, checking

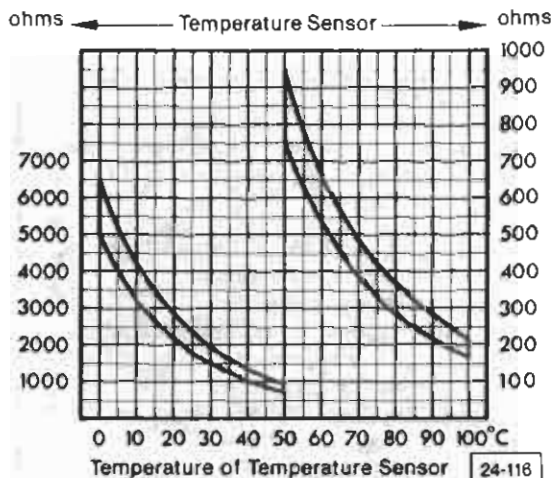


- pull off hose and electrical connector from intake air sensor
- connect US 1119 multimeter to following terminals of potentiometer (**arrows**)
  - 3 and 4 or 6 and 9 = 500 to 1000 ohms
  - 2 and 3 or 7 and 9 when moving sensor plate = resistance varies

## Temperature sensor I, checking



- connect US 1119 multimeter to terminals 6 and 22
  - multimeter reading should correspond to graph



### Note

If specifications are not reached, replace intake air sensor and readjust idle speed/CO value (see pages 24.29, 24.30).

## Auxiliary air regulator, checking



### Note

When engine is cold, regulator is open fully, allowing additional air to engine.

- engine cold
- run engine at idle speed
- pinch hose (**arrow**)
  - RPM must drop
- run engine at idle speed for about 5 minutes more
- repeat above test
  - RPM must not change

### If NO

- disconnect electrical plug from auxiliary air regulator
- check voltage supply with engine running

### If OK

- replace auxiliary air regulator



# 24 Fuel Injection, AFC System

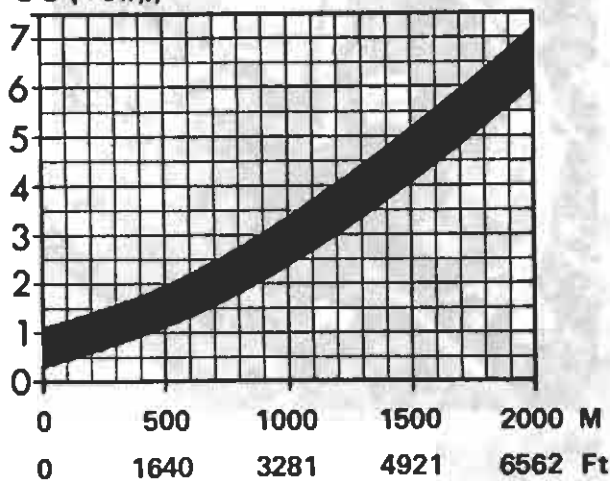
## Idle speed/CO, checking/adjusting

### CAUTION

It is important to follow work sequence when checking and adjusting idle speed and CO value

1. Check ignition timing; if necessary adjust
  - idle stabilizer bypassed
  - oxygen sensor connected
2. Check Idle speed; if necessary adjust
  - idle stabilizer bypassed
  - oxygen sensor connected
3. Check CO value; if necessary adjust
  - idle stabilizer connected
  - disconnect oxygen sensor wiring connection with Ignition OFF
    - adjust CO value corresponding to local altitude. See shaded area of graph, shown below.
    - reconnect oxygen sensor at electrical connection.

### CO(Vol.%)



24-132

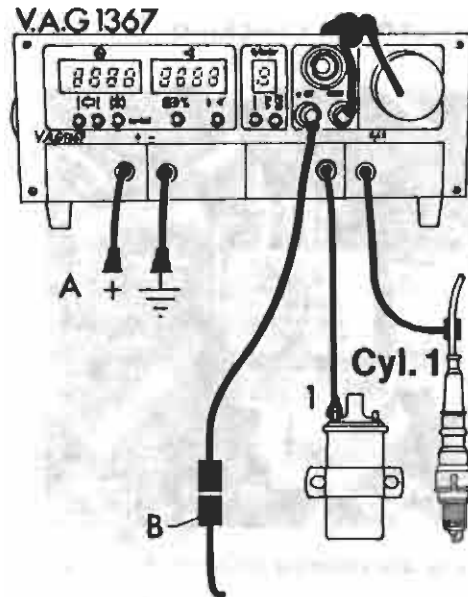
### Work sequence

#### Preliminary conditions:

- engine oil temperature min. 60°C (140°F)
- all electrical equipment must be turned OFF (radiator fan must not run)
- throttle valve switch must be ON at idle

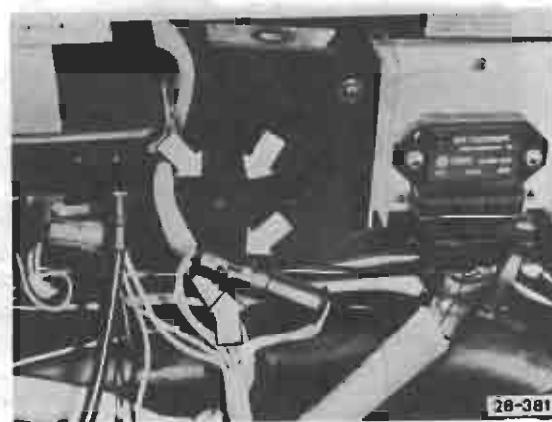
### CAUTION

Ignition must be switched OFF before connecting tester



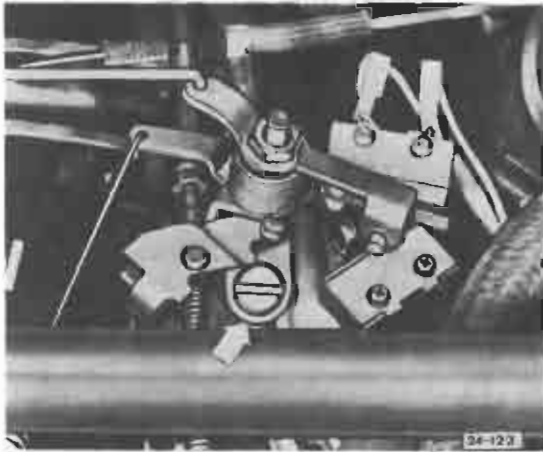
28-380

- connect tester V.A.G. 1367 as follows
  - A to alternator or terminal box
  - B to TDC sender
- connect CO meter to receptacle in left exhaust pipe

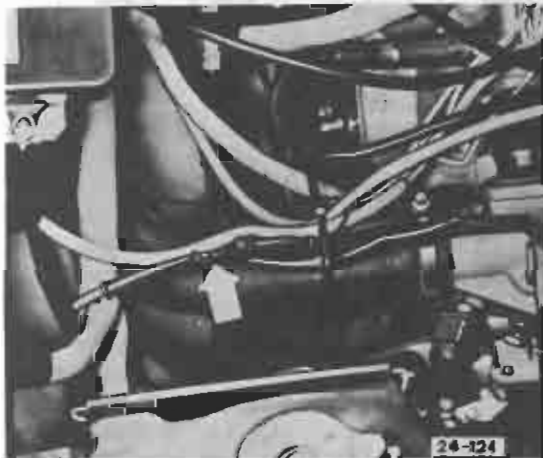


28-381

- check ignition timing and adjust if necessary
- disconnect electrical plugs at idle stabilizer control unit (squeeze to release—arrows)
- connect plugs together
- start engine and check ignition timing and adjust if necessary
  - spec. =  $5 \pm 1^\circ$  ATDC
  - rpm = below 1000
- adjust ignition timing, see Repair Group 28



- run engine at idle speed
- check RPM after 2 minutes, if necessary adjust with screw (arrow)
- stop engine



- check CO and adjust if necessary
  - idle stabilizer connected
- with engine **OFF** disconnect electrical connection at oxygen sensor (arrow)
- start engine and check CO value
  - checking spec. = 0.3-1.1%

**Note**

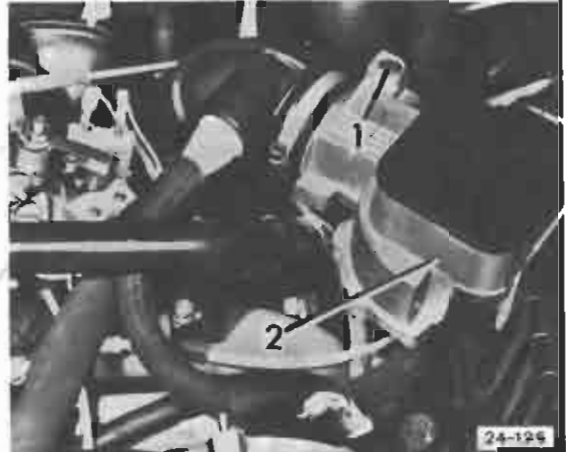
If CO value is above 1.1% pinch crankcase hose.

- CO should drop below 1.1%

if **YES**, CO adjustment is not necessary (engine oil dilution—change engine oil)

if **NO**, adjust CO (continue with procedure)

- stop engine



- adjust CO as follows:
  - remove intake air sensor 2
  - center-punch plug in CO adjusting hole
  - drill 2.5 mm (3/32 in.) hole in center of plug 3.5-4.0 mm (9/64-5/32 in.) deep

**CAUTION**

Clean up any metal shavings

- screw in 3 mm (1/8 in.) sheet-metal screw
- remove plug with screw, using pliers
- reinstall intake air sensor 2
- start engine (oxygen sensor disconnected)
- adjust CO to  $0.7 \pm 0.4\%$
- stop engine
- drive in new plug flush with intake air sensor
- reconnect electrical connection of oxygen sensor

**Note**

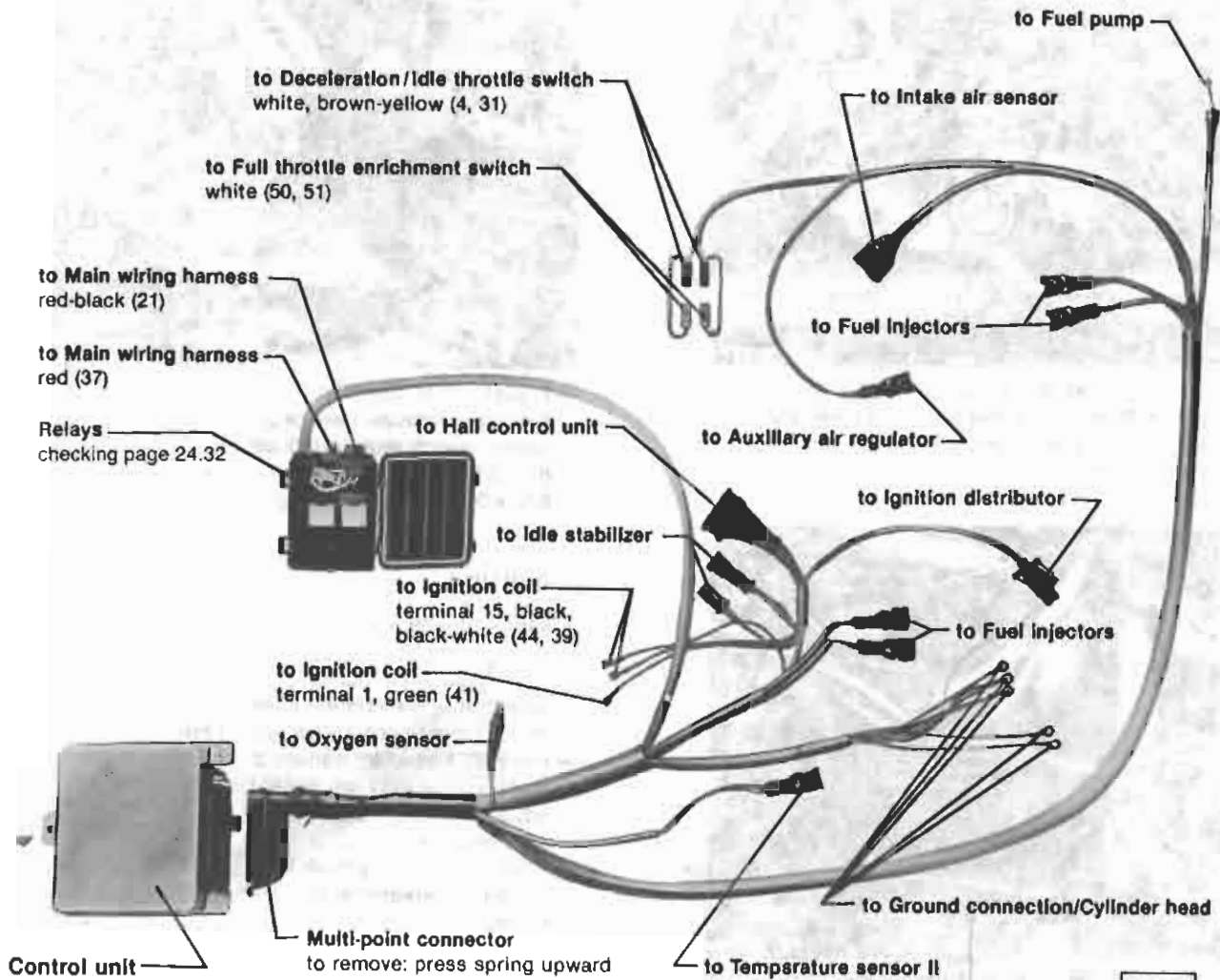
With oxygen sensor and idle stabilizer connected

- CO must be: 0.3-1.1%
- Idle speed: 850-950 rpm

Idle stabilizer control unit checking, see Repair Group 28

Oxygen sensor checking, see Repair Group 26

# 24 Fuel Injection, AFC System



It receives information on:

- air quantity from intake air sensor
- intake air temperature from temperature sensor I in intake air sensor
- engine temperature from temperature sensor II
- engine speed from ignition distributor
- oxygen in exhaust gas from oxygen sensor
- position of throttle valve from full throttle enrichment/deceleration switch and uses this information to determine amount of fuel to be injected

**Note**  
Always replace control unit if defective, can not be repaired in workshop

**Note**  
Wiring has white color, note stamped number on it

## 24.31

Control unit/Wire harness

Water-cooled

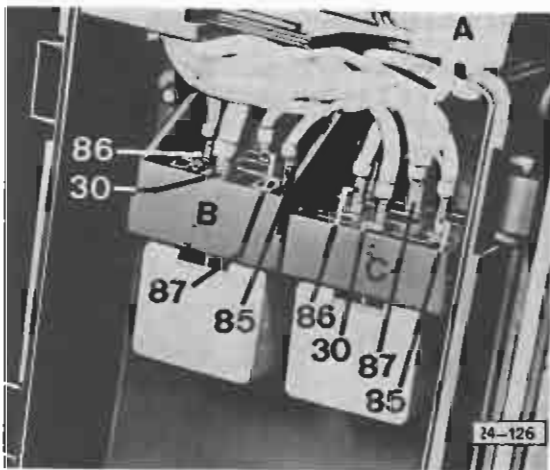
Digijet

## Relays, checking (with relays installed)

### CAUTION

Do not connect any test light to terminal 86 of adaptor C (shown in illustration) if control unit is connected

- remove all electrical plugs at fuel injectors



- turn ignition ON
- connect test light to ground and check following terminals for voltage:
  - connection A = red wire terminal 30
  - adaptor B = terminals 30, 85, 87
  - adaptor C = terminals 30 and 85
  - test light should light
- operate starter and check with test light
  - adaptor C = terminal 87
  - test light should light
  - if test light does not light, check wiring by using current flow diagram
  - if wiring is OK and no voltage at terminal 87, check relay
  - if relay is OK, replace control unit

### Relay on adaptor B, checking

- turn ignition ON
- connect test light to terminals 30 and 86
  - test light must light up
 if NO, check wiring with current flow diagram
- connect test light to terminals 86 and 67
  - test light must light up
 if NO, replace relay on adaptor B

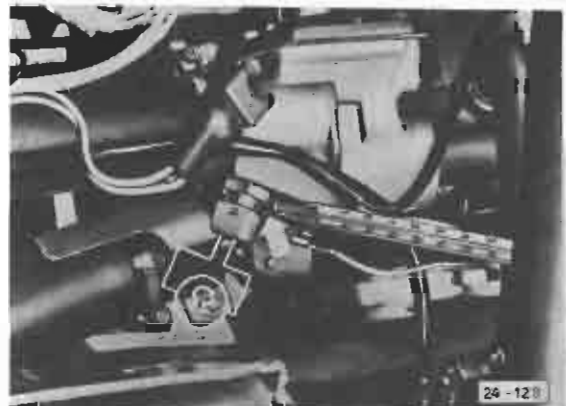
### Relay on adaptor C, checking

- connect test light between terminals 30 and 86
- crank engine
  - test light must light
 if NO, check wire to terminal 20 of control unit
- if OK, replace control unit
- connect test light to terminal 87
- crank engine
  - test light must light
 if NO, replace relay on adapter C

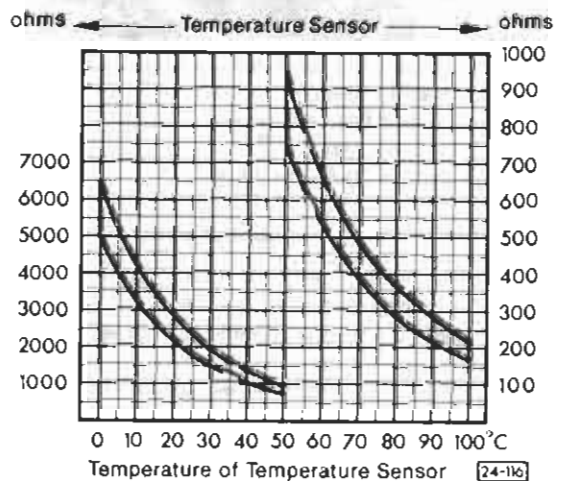
## Temperature sensor II, checking

### Note

Temperature sensor II in coolant thermostat housing supplies control unit with information for starting and warm-up enrichment



- check temperature and resistance of temperature sensor II
  - check specifications, see diagram below:



# 24 Fuel Injection, AFC System

## Throttle valve/deceleration/idle switch, checking

### Note

This switch supplies control unit with information that throttle valve is closed.

If engine is above 1500 rpm with the throttle closed, fuel will be shut off to the injectors.

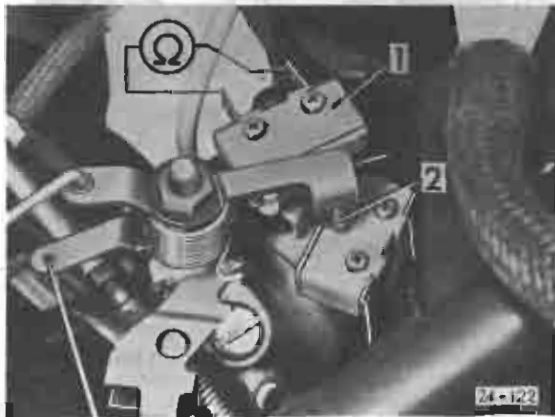
At idle speed, this switch signals control unit to regulate amount of fuel injected

### CAUTION

Do not connect test light to throttle valve switch connectors if control unit is connected

### First check (Throttle valve switch)

- throttle valve switch connectors disconnected



- attach ohmmeter to switch 1
  - throttle valve closed  
switch turned ON = 0 ohm
  - throttle valve open  
switch turned OFF = ∞ ohm

### Second check (Wiring and control unit)

- run engine at idle speed for a short time
  - stop engine and turn ignition ON
  - pull off connectors from both throttle valve switches
  - check voltage between connectors of throttle valve idle switch
    - voltage should be approx. 5 volt
- if NO, control unit is defective or break in wiring

### Third check (Deceleration)

#### Test condition

- result of first and second check must be OK
- throttle valve switch connectors connected
- temperature at temperature sensor II must be minimum 60°C (140°F) and resistance below 550 ohms
- operate throttle valve switch by hand and accelerate slowly
  - engine speed must fluctuate (surges)

If NO, replace control unit

### Throttle valve/deceleration/idle switch, adjusting

- throttle valve closed
- adjust screw 2 so that switch just closes
- from this position turn adjusting screw exactly one turn farther in
- secure adjusting screw with sealant

### Note

Correct adjustment is very important  
If switch is mis-adjusted engine may surge or cut-out during acceleration

## Full throttle enrichment switch, checking

### Note

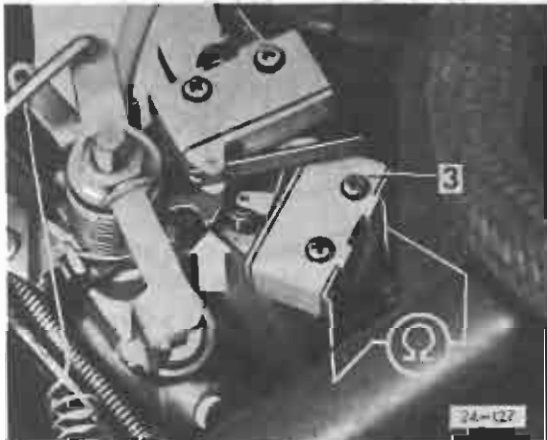
Full throttle enrichment switch supplies the control unit with information to increase amount of fuel injected at full throttle

### CAUTION

Do not test light to throttle valve switch connectors if control unit is connected

### First check (Throttle valve switch)

- throttle valve switch connectors disconnected



- attach ohmmeter to switch 3
  - throttle valve closed  
switch turned **OFF** =  $\infty$  ohms
  - throttle valve full open  
switch turned **ON** = 0 ohms

### Second check (Wiring and control unit)

- run engine at idle for a short time
  - stop engine and turn Ignition **ON**
  - pull off connectors from both throttle valve switches
  - check voltage between connectors of full throttle enrichment switch
    - voltage should be approx. 5 volts
- if **NO**, control unit is defective or break in wiring

### Third check (Full throttle enrichment)

#### Test conditions:

- result of first and second check must be OK
  - throttle valve switch connectors connected
  - temperature at temperature sensor II must be minimum 60 °C (140 °F) and resistance below 550 ohms
  - CO tester and tachometer connected
- run engine for about 2 minutes at idle speed
  - increase idle speed slowly until tachometer reads about 4000 rpm
    - CO should be between 0.3 to 1.1%
  - with engine at about 4000 rpm, operate full throttle enrichment switch 3 by hand for about 15 seconds
    - CO must increase above 1.5%
- if **NO**, control unit is defective

## Full throttle enrichment switch, adjusting

- loosen retaining screw for switch
- open throttle valve fully and move switch until cut-in position is reached
  - position of roller should be nearly in center of cam disk (arrow, photo, 24-127)
- retighten retaining screw for switch

## Throttle valve switch (design with 1 switch)

### Function

With throttle valve **closed**, switch signals control unit about the following

- idle injection quantity
- switching off injection during deceleration

With throttle valve **open**, switch signals control unit about the following

- full throttle injection quantity

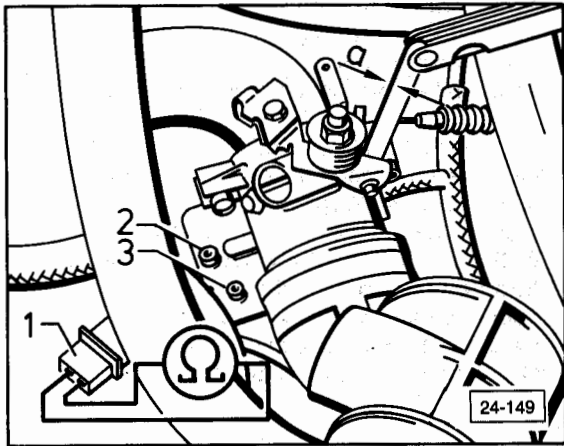
### CAUTION

**DO NOT** connect test light to terminals of throttle switch unless control unit is disconnected.

# 24 Fuel Injection, AFC System

## Throttle valve switch, checking/adjusting

(combined switch in single housing)



- connect multimeter **US 1119** across terminals of unplugged switch connector 1
  - multimeter must read 0 Ω only when throttle lever is at idle stop and full throttle stop
  - check switch-on point of throttle switch as follows
- open throttle valve and slowly close
- measure switch-on point with feeler gauge between idle stop and idle adjusting screw
  - must be 0.05-0.10 mm (0.002-0.004 in) before idle stop (gap a)

If measurement **NOT OK**

- correct by adjusting position of switch. Loosen screw 2 and adjust screw 3

### CAUTION

Basic throttle valve adjustment must **NOT** be changed.

### Note

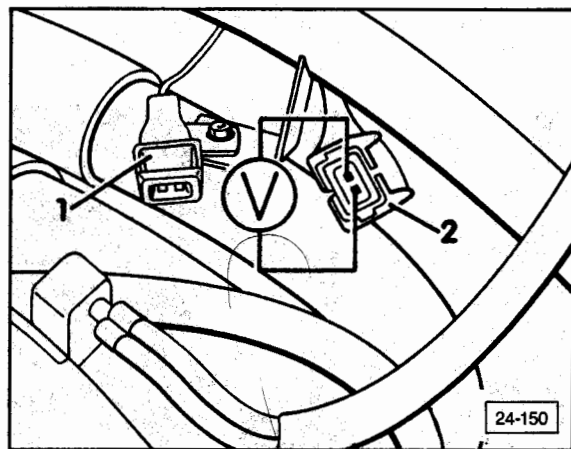
Correct adjustment is important. Following are conditions that are created by improper adjustment:

- gap a too large  
Engine surges with lean condition.
- gap a too small  
With cold engine, stalling at full throttle acceleration.  
With engine warm, no deceleration fuel shut-off.

## Control unit and wiring, checking

### Work sequence

- switch ignition **ON**



- using multimeter **US 1119**, check voltage present across terminals of connector 2
  - must be approximately 5 volts

If voltage reading **NOT OK**

- check for open circuit in wiring according to current flow diagram

If wiring **OK**

- replace control unit

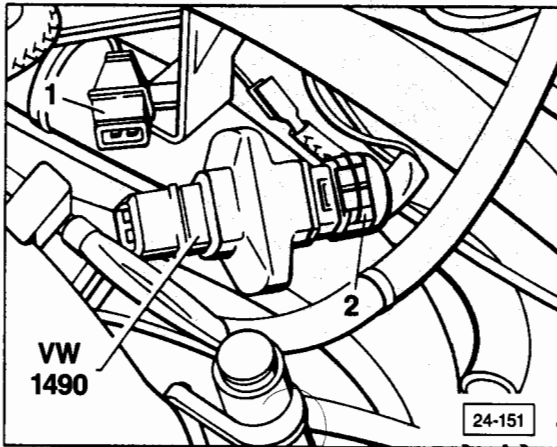


## Deceleration fuel shut-off, checking

### Test conditions

- temp. sensor II minimum 60°C (140°F) with resistance reading less than 550Ω

### Work sequence



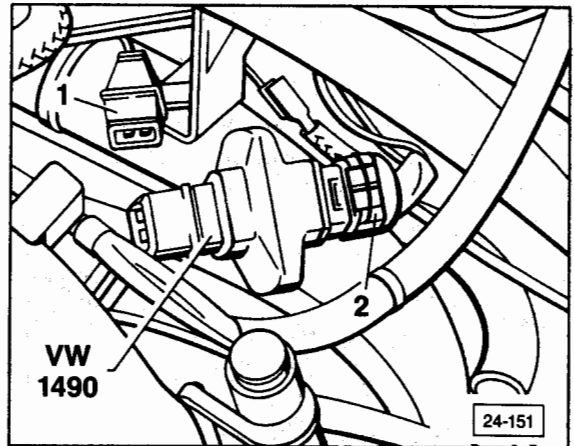
- using  end of tool VW 1490, bridge terminals of connector 2
- accelerate engine slightly
  - engine rpm must fluctuate (deceleration fuel shut-off system operates)

- If rpm **DOES NOT** fluctuate
- replace control unit

## Full throttle enrichment, checking

### Test conditions

- temp. sensor II minimum 60°C (140°F)
- CO tester and VW 1367 connected
- start engine and let idle approximately two minutes
- slowly accelerate engine until 4000 rpm is reached
  - CO must read 0.3-1.1% Vol.



- using  end of tool VW 1490, bridge terminals of connector 2
  - CO reading must increase above 1.5% Vol.

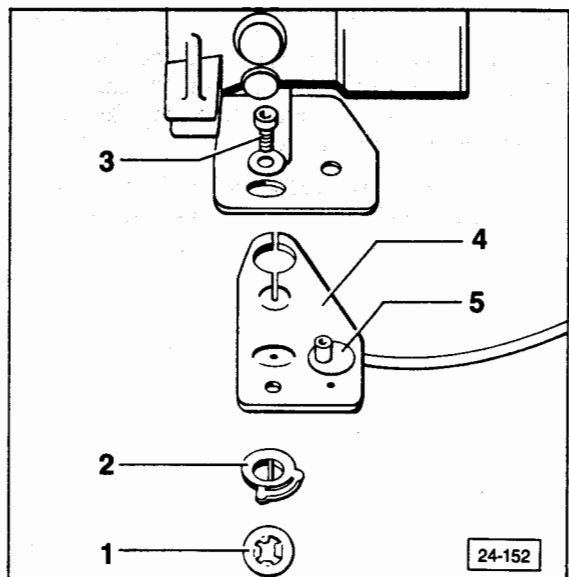
If CO readings **NOT OK**

- replace control unit

## Throttle valve switch, removing/ installing

### Work sequence

- remove throttle body



- remove switch 4 following numerical sequence of components 1 through 5
- install components in reverse order
- perform basic adjustment as follows



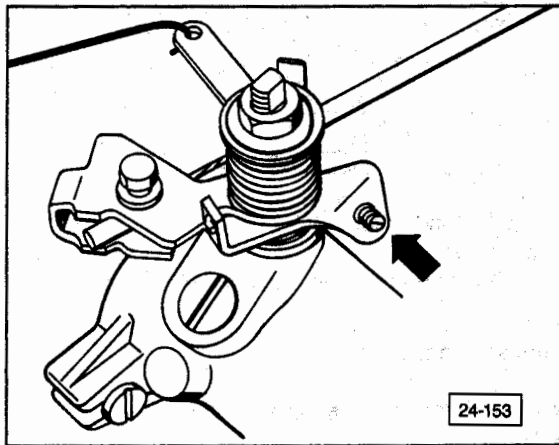
# 24 Fuel Injection, AFC System

## Throttle valve, basic adjustment

### Note

Stop screw is set at factory and should not be moved. If screw position has been altered, check basic adjustment as follows

### Work sequence



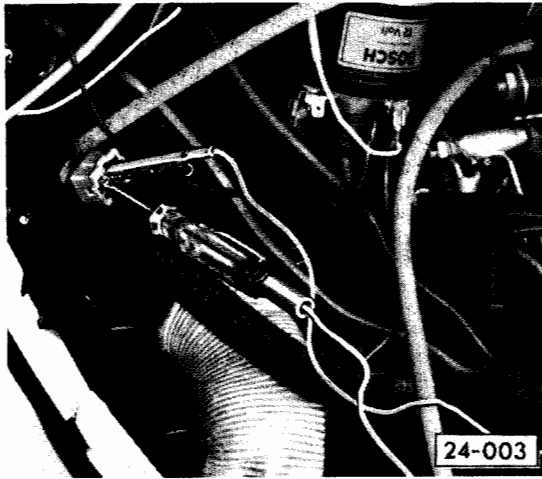
- turn adjusting screw (**arrow**) out until gap exists between stop and screw
- turn screw in until it touches stop

### Note

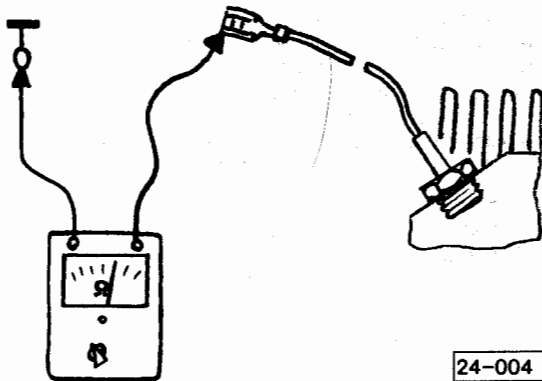
In order to determine exact point of contact with screw stop, place a thin piece of paper between screw and stop. Slide paper and turn screw at same time until screw pinches paper.

- turn screw clockwise additional 1/2 turn
- check idle speed and CO; adjust if necessary

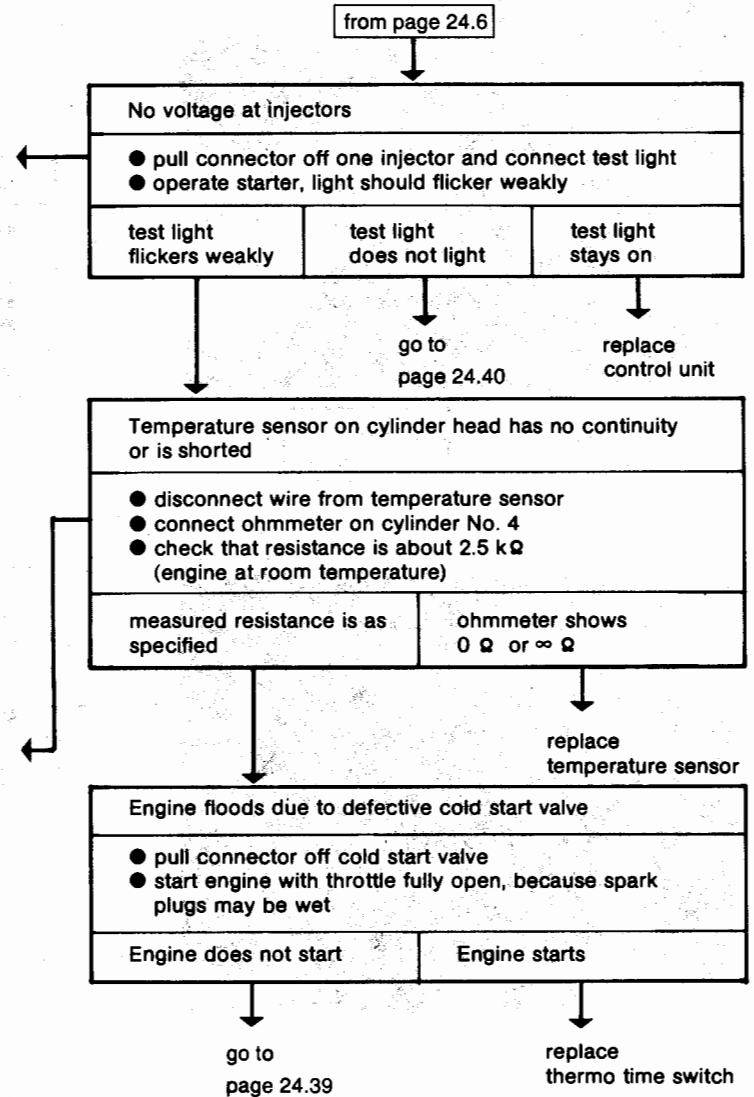
## No voltage at injectors, troubleshooting



Voltage at injectors, checking



Temperature sensor, checking



# 24 Fuel Injection, AFC System

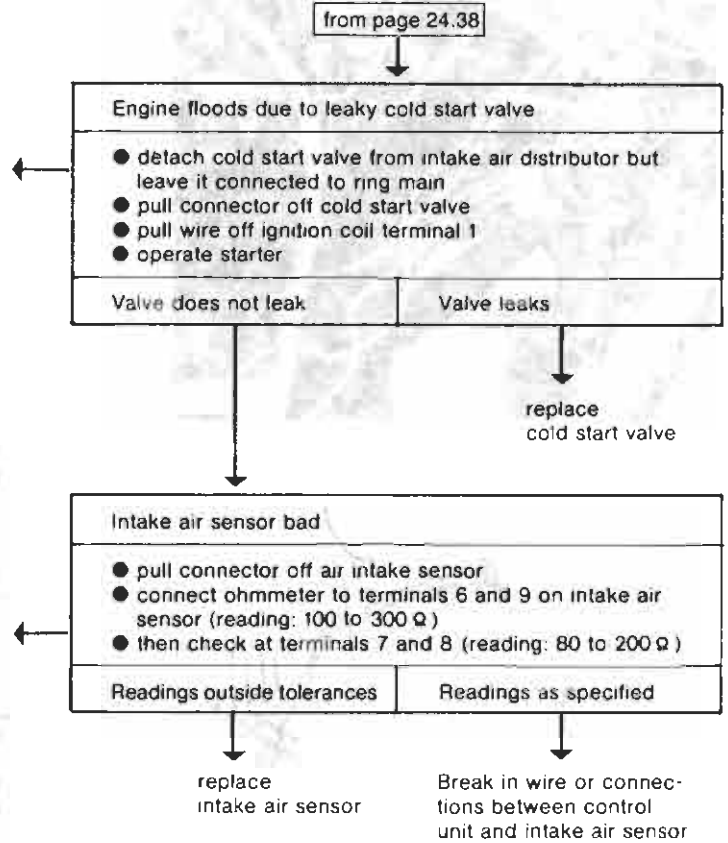


Cold start valve, checking

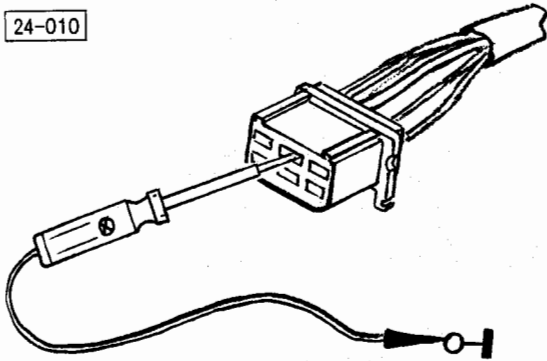
**Warning**  
Fire hazard



Intake air sensor, checking



24-010



Double relay, checking

from page 24.38

Double relay defective	
<ul style="list-style-type: none"> <li>● connect test light between center slot in molded connector of series resistance and ground</li> <li>● switch ignition on</li> </ul>	
Test light lights	Test light does not light

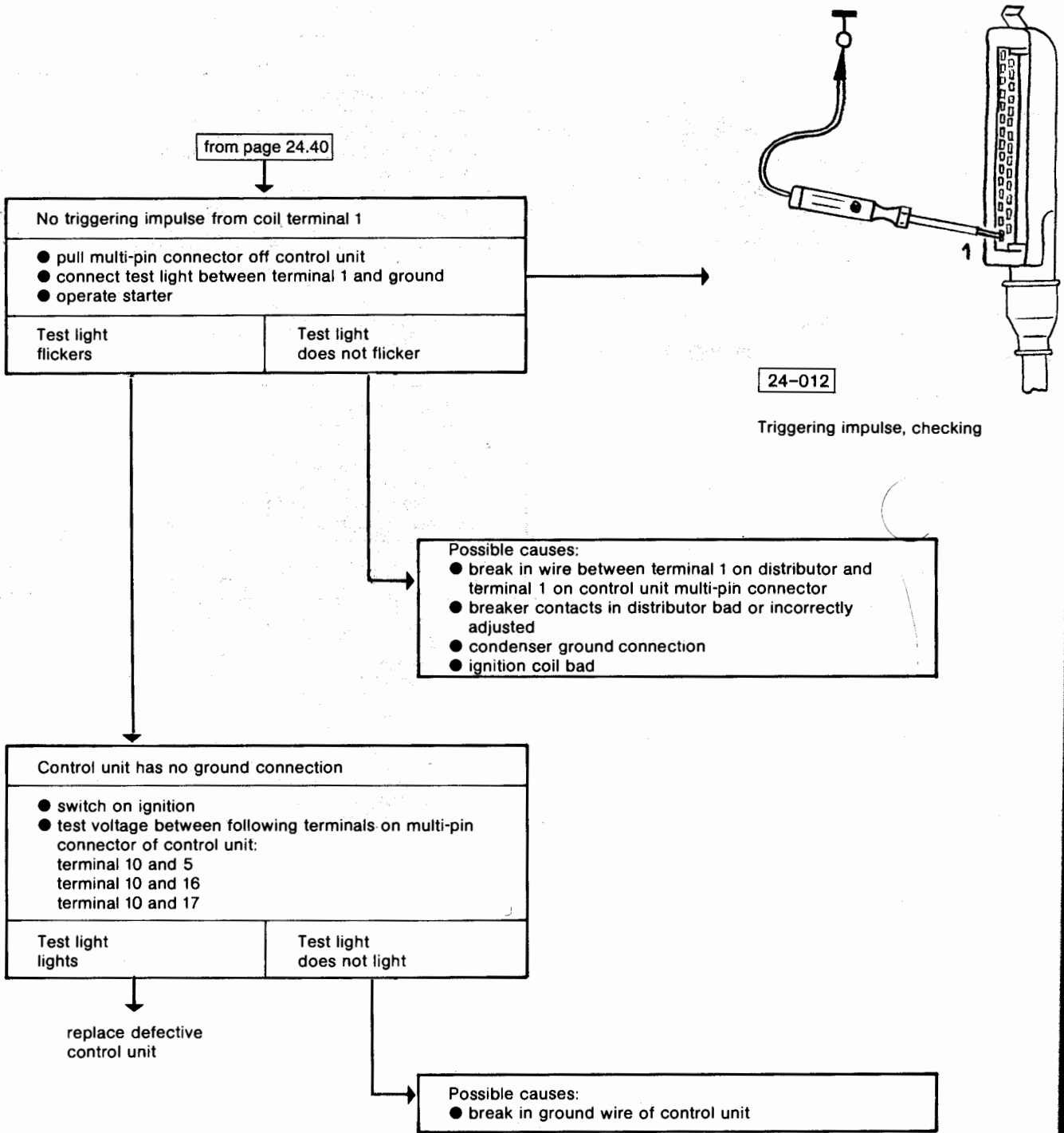
go to page 24.41

No voltage at double relay	
<ul style="list-style-type: none"> <li>● switch ignition on</li> <li>● connect test light between:                             <ul style="list-style-type: none"> <li>terminal 86c and 85 (to coil terminal 15)</li> <li>terminal 88z and 85 (to battery)</li> <li>terminal 88b and 85 (to series resistances)</li> </ul> </li> </ul>	
Test light lights	Test light does not light

replace double relay

break in wire

# 24 Fuel Injection, AFC System



## CAUTION

Do **NOT** touch or disconnect ignition cables when engine is running or starter is cranked.

Disconnect wires in ignition system only when ignition is switched **OFF**.

Connect and disconnect tester leads to ignition system only when ignition is switched **OFF**.

When high tension cable (terminal 4 from coil) is disconnected from distributor, always connect it directly to ground using jumper cable. Otherwise, engine must **NOT** be cranked with starter (such as with compression test).

Vehicles that have a defect in the ignition system or are suspected of having one, may only be towed with the connector from terminal 1 of the ignition coil (green wire) disconnected.

Fast charging may only be used for emergency starting for up to 15 seconds maximum with no more than 16.5 volts. Wait at least one minute after each starting attempt.

Do **NOT** replace ignition coil with conventional type coil.

Battery must be completely disconnected when using arc, spot, or electrical welding equipment.

If components are heated above 80°C (176°F) such as from paint drier or steam cleaner, wait for components to cool down before starting engine.

Do **NOT** wash engine while it is running or ignition is switched **ON**.

Do **NOT** disconnect battery with engine running.

Do **NOT** apply voltage to control unit to simulate output signals.

## CAUTION

When working on fuel system, always follow these precautions on cleanliness

- thoroughly clean all unions and area near connections before disconnecting
- place removed parts on a clean surface and cover over. Use paper or plastic sheet. Use only lint-free cloths
- components which have been opened or disassembled must be covered or sealed carefully if repair cannot be carried out immediately
- only install clean components
- only unpack replacement parts immediately before they are installed
- do not use parts that have been stored loose (for instance, in toolboxes)
- when fuel system is open, do not work with compressed air if this can be avoided or move car unless absolutely necessary

# 24 Fuel Injection, AFC System

## Technical data/specified values

Engine code		<b>MV</b>
Type		2.1 liter 70 kW, 90 SAE net HP
Introduction		October 1985
Part no.		
	Control unit	025 906 022
Ignition timing	checking spec.	3-7° before TDC
	adjusting spec.	5 ± 1° before TDC
• Test and adjustment conditions	no.	1 and 9
Idle adjustment	idle rpm	880 ± 50 rpm
	CO content	0.7 ± 0.4 Vol. %
• Test and adjustment conditions	no.	1 to 6, 7, 8

### Conditions and requirements:

- 1 — engine oil temperature min. 80°C (176°F)
- 2 — electrical consumers turned off
- 3 — crankcase breather hose on oil breather removed and closed tightly
- 4 — throttle valve switch turned on (continuity)
- 5 — idle stabilizer OK (valve vibrates and hums)
- 6 — ignition timing setting: OK
- 7 — connector (single connector) for idle stabilizer control valve disconnected
- 8 — with ignition OFF, disconnect connector (single connector) for oxygen sensor
- 9 — with engine running, double connector for temperature sender disconnected and rpm increased to 2000-2500 rpm by depressing throttle

Engine code	MV
RPM limiter (Control unit) switch-off rpm:	5500-5800 rpm
Idle stabilizer: valve (resistance)	continuity
current ● connector (single connector) for control valve: disconnected	approx. 430 mA constant
connected	approx. 430 ± 20 mA, fluctuating
under load per following conditions: ● steering turned all the way ● selector switch in drive position ● climate control switched on ● electrical consumers turned on ● engine cold	depending on load 440-1000 mA
Power steering pressure switch ● measured at idle speed	
Steering: straight ahead	no continuity
Steering: turned all the way (to either side)	Ω display (continuity)
Fuel pump: delivery quantity	min. 500 cm <sup>3</sup> /30 sec
Pressure regulator ● fuel pressure measured at idle rpm	
vacuum hose: connected	approx. 2.0 bar (29 psi)
vacuum hose: disconnected	approx. 2.5 bar (36 psi)



# 24 Fuel Injection, AFC System

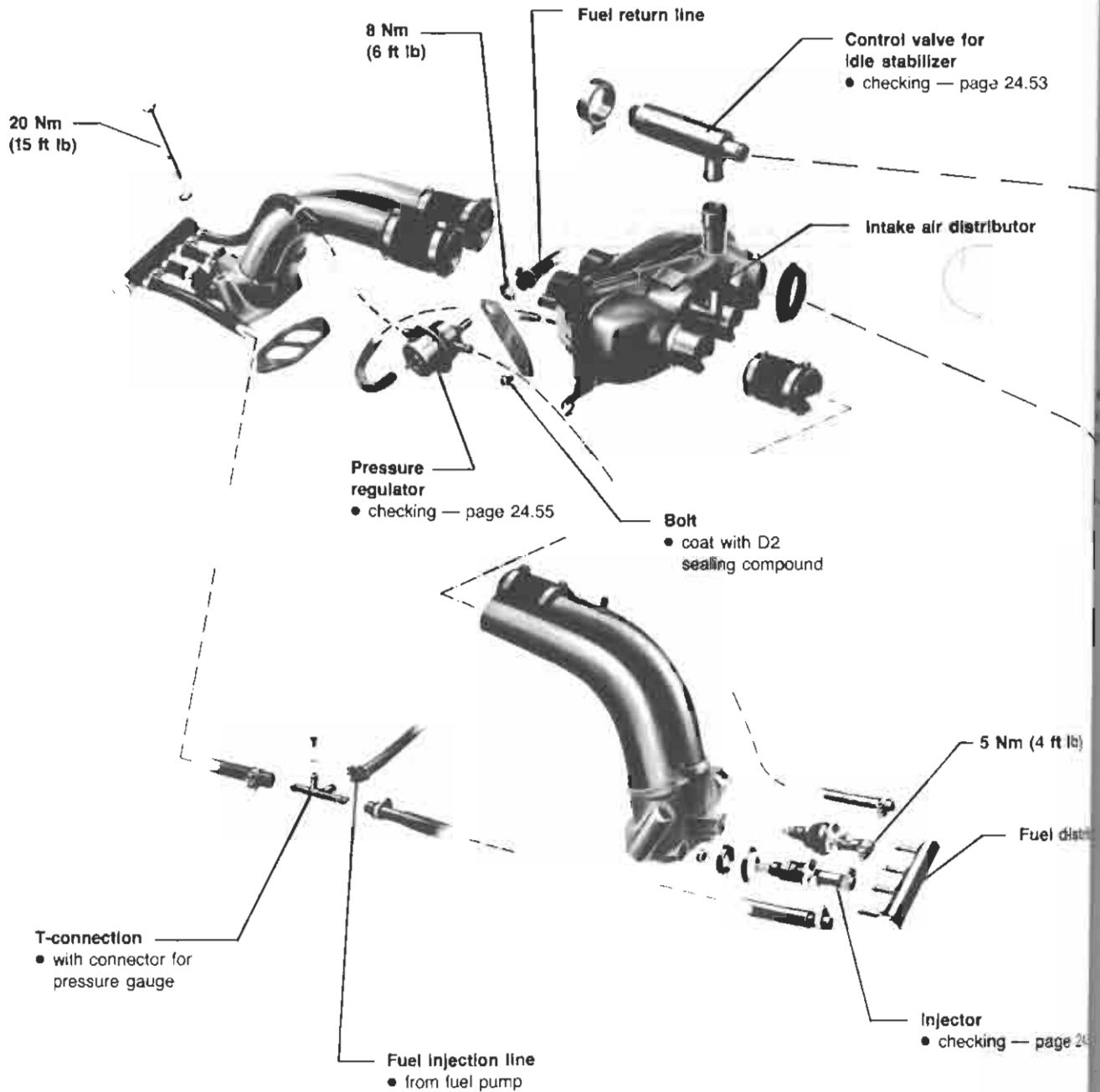
Engine code	MV
Injectors	cone shaped
Spray pattern	
<b>Note</b> ONLY connector connected is valve being checked	
Voltage supply	diode test lamp flickers
● ALL connectors disconnected, starter operated	
Resistance	15-20Ω
● measured on valve	
Air flow sensor	
Resistance between terminals:	500-1000 Ω
3 and 4	
2 and 3	change in resistance when air sensor plate is moved
1 and 4	resistance dependent on temperature of air flow sensor — see diagram
Temperature sender	
● for engine temperature	
● resistance dependent on coolant temperature — see diagram at right	
	<p>resistance dependent on temperature of air flow sensor — see diagram</p> <p>Ω ← → Ω</p> <p>7000 6000 5000 4000 3000 2000 1000</p> <p>1000 900 800 700 600 500 400 300 200 100</p> <p>0 10 20 30 40 50 60 70 80 90 100°C 32 50 68 86 104 122 140 158 176 194 212°F</p> <p>Temperature</p> <p>24-142</p>

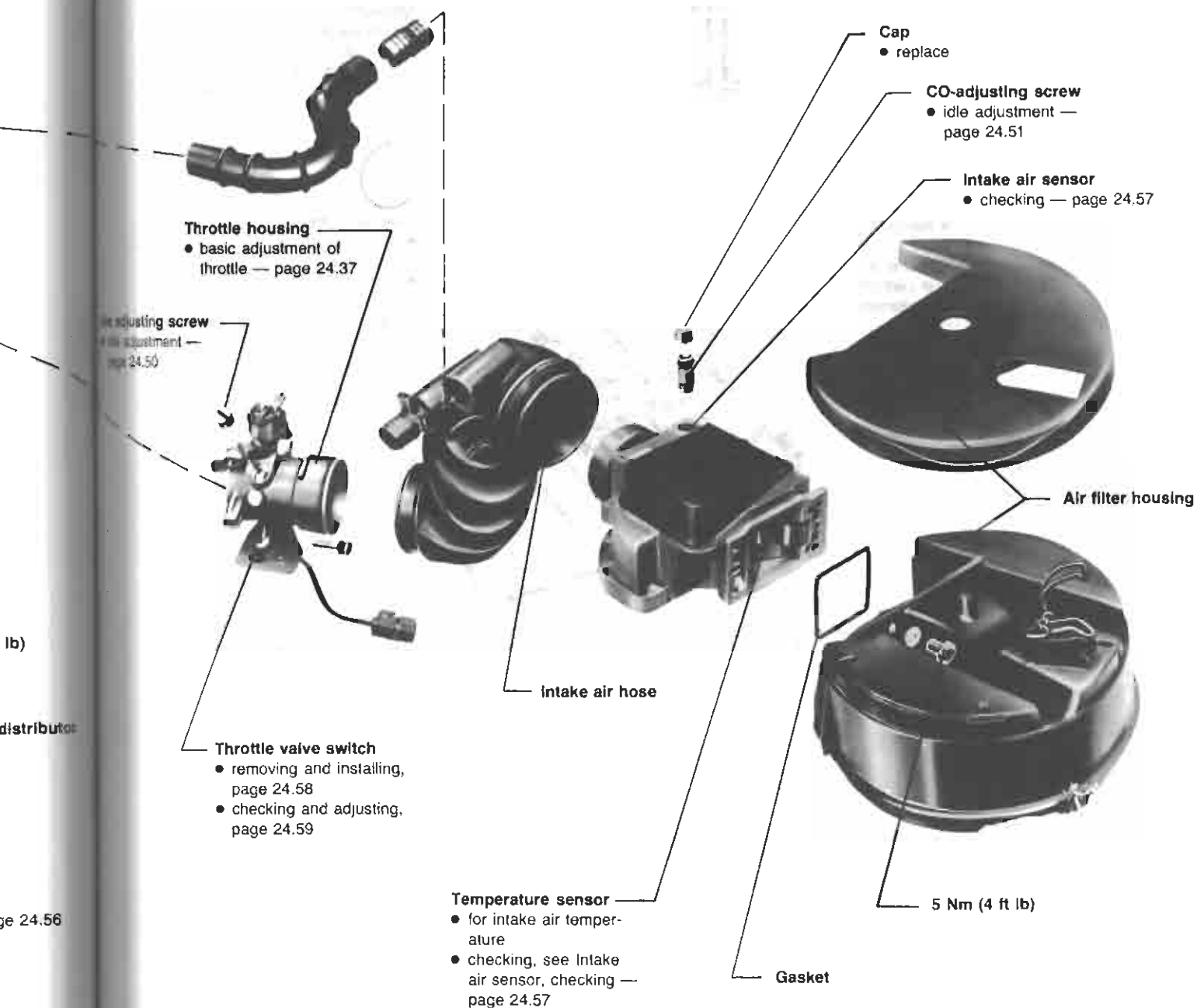
## Fuel injection system, repairing

Technical data/specified value — pages 24.43-24.45

Note Rules of Cleanliness — page 24.42

Replace gaskets, sealing rings and spring clamps





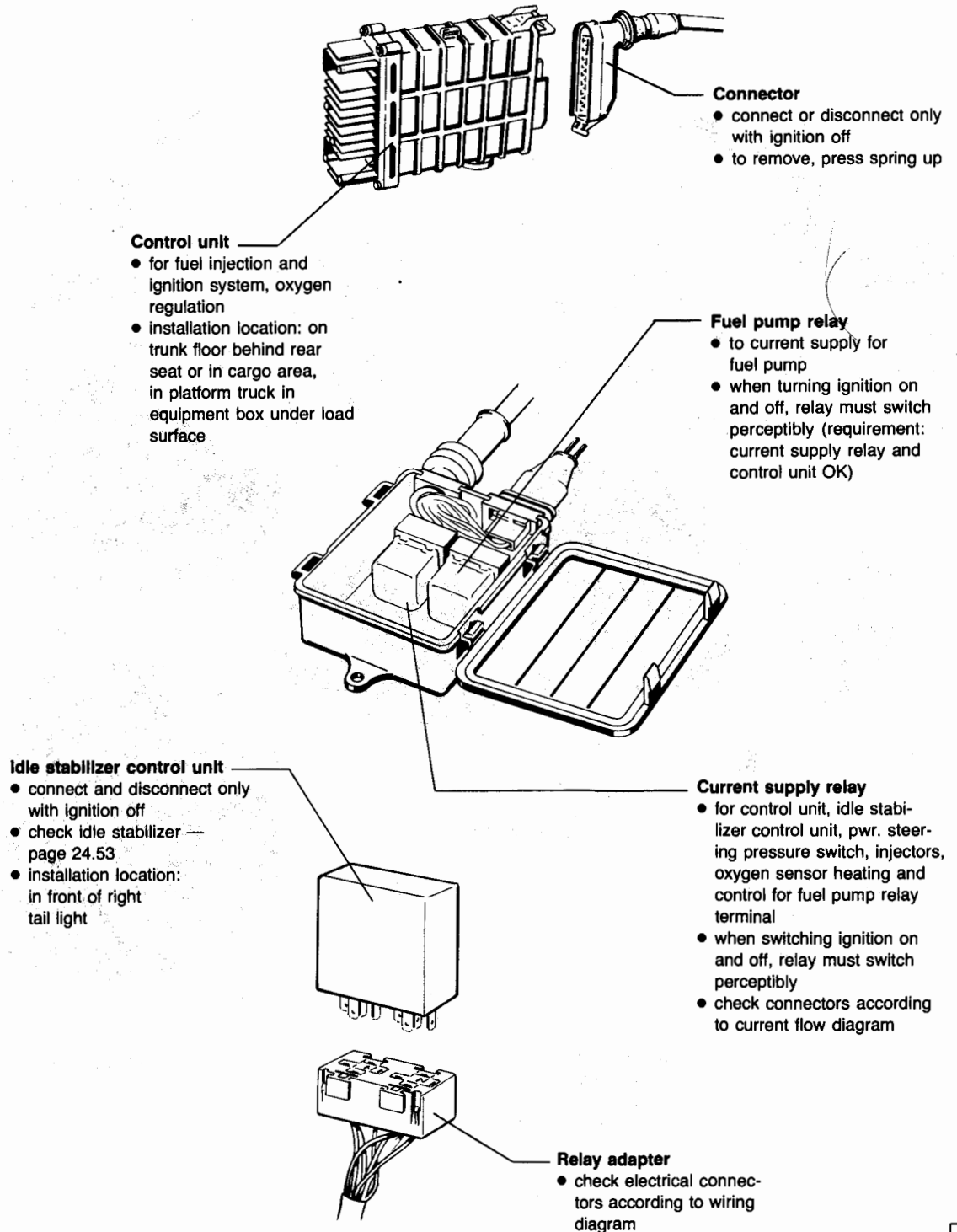
24-183

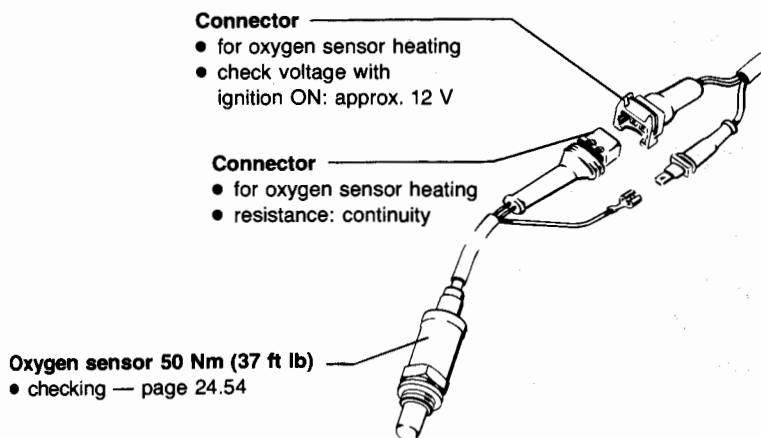
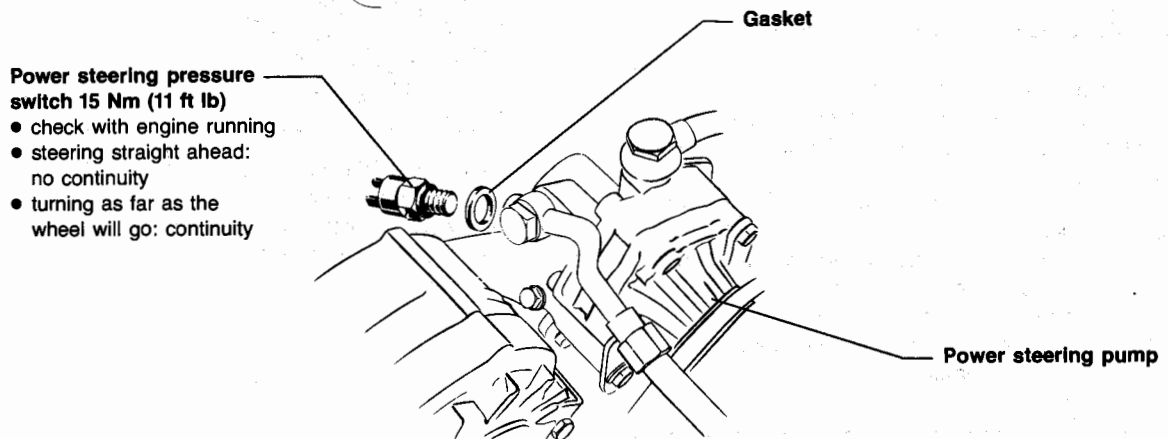
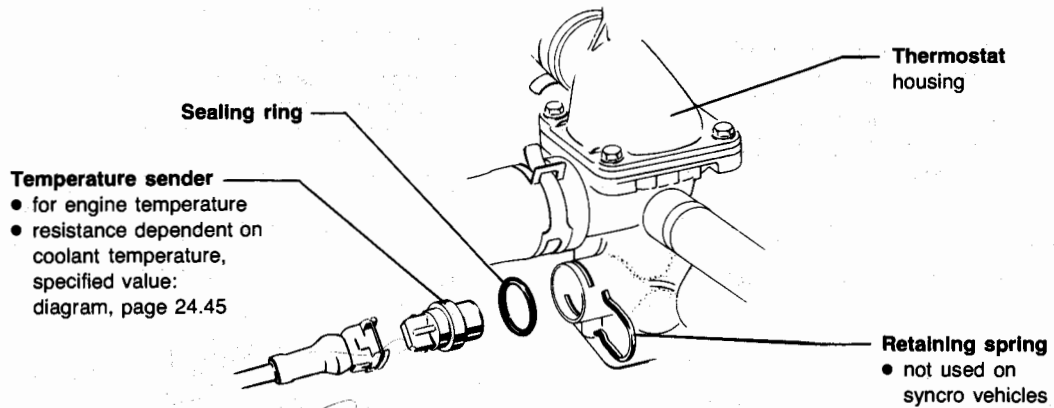
## Fuel injection system components

### Note

Electrical checking of ignition and fuel injection system — pages 24.61, 24.62

Safety precautions — page 24.42





24-184

# 24 Fuel Injection, AFC System

## Idle checking

### Note

It is important to follow the sequence when performing idle checking/adjusting.

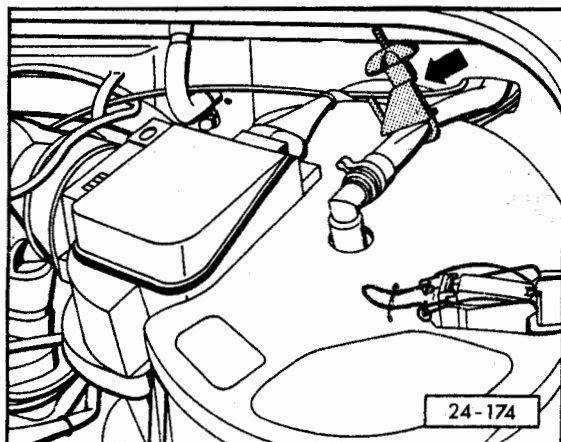
- check timing, adjust if necessary
  - temperature sensor II disconnected
  - rpm — 2000-2500
- check idle speed and CO content, adjust if necessary
  - idle stabilization valve disconnected
  - (with ignition off) disconnect oxygen sensor.

### Note

The oxygen sensor must be disconnected with the ignition off, to cancel the memory in the Electronic Control Unit (ECU).

## Test and adjustment conditions

- engine oil temp min. 80°C (176°F)
- all electrical consumers turned off (radiator fan should not be running while performing checks or adjustments)
- crankcase breather hose removed from oil vent and plugged
- throttle valve switch operating properly (closed when in idle position)
- ignition timing within specifications
- idle stabilizer operating properly (with ignition turned on, valve should vibrate and hum)

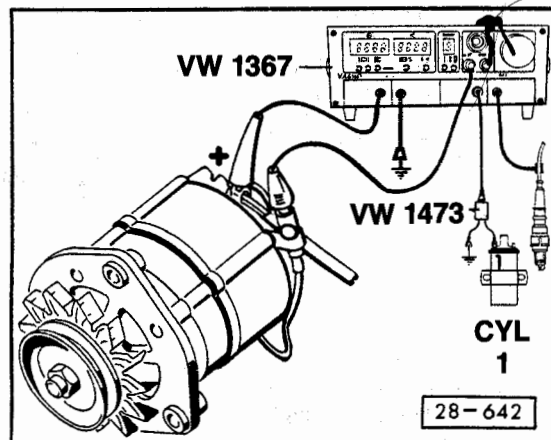


The hose from charcoal cannister to air filter must be pinched closed. See arrow

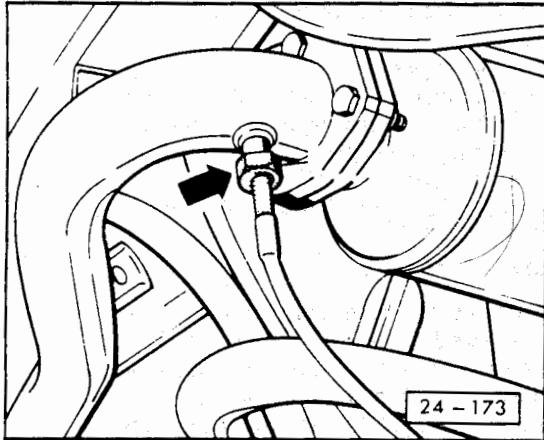
## Connecting test equipment

### WARNING

Ignition must be turned off when connecting test equipment.

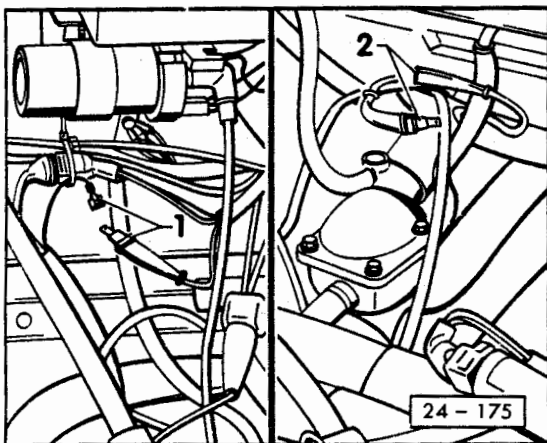


- connect **VW 1367** tester for ignition timing and rpm display functions
- using adapter **VW 1473**, connect tester **VW 1367** to terminal 1 of ignition coil

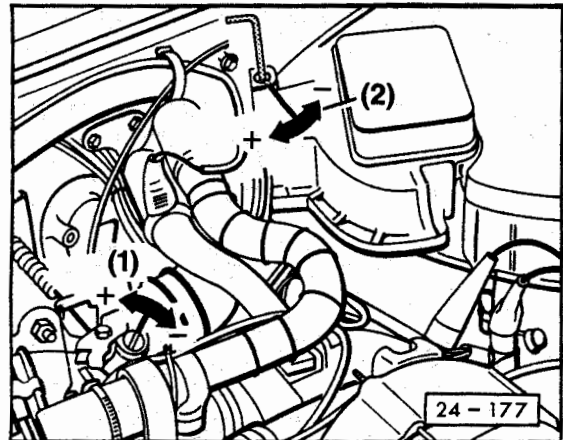


- connect CO tester to adapter on left exhaust pipe, using Sun tool 120.239

## Idle speed and CO content, checking and adjusting



- with ignition switched off, disconnect oxygen sensor connector (1) and idle stabilizer control valve connector (2)



- check idle speed rpm, correct if necessary using adjusting screw (1)
  - specification:  $880 \pm 50$  rpm
- check CO content
  - specification:  $0.7 \pm 0.4\%$  vol.

For CO adjusting, remove screw cap as follows:

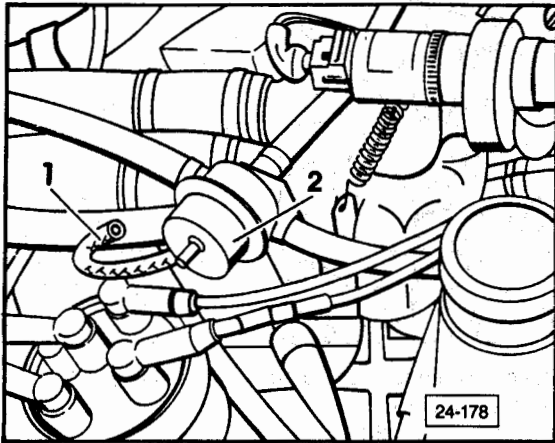
- drill CO adjusting screw cap using 2.5mm (0.098 in.) drill
- thread 3mm (0.137 in.) sheet metal screw into drilled hole
- grasp screw with pliers, pull out cap

Set idle speed and CO content by alternately turning adjusting screws (1 and 2) to obtain specifications

- reconnect oxygen sensor connector and idle stabilizer control valve connector
- let engine idle approx. 2 minutes
- check CO content, correct if necessary by repeating adjusting procedure

# 24 Fuel Injection, AFC System

## Idle speed/CO content, checking and adjusting, continued



Check oxygen regulation function as follows:

- remove hose (1) from pressure regulator (2) and plug

CO should increase briefly, then drop in value.

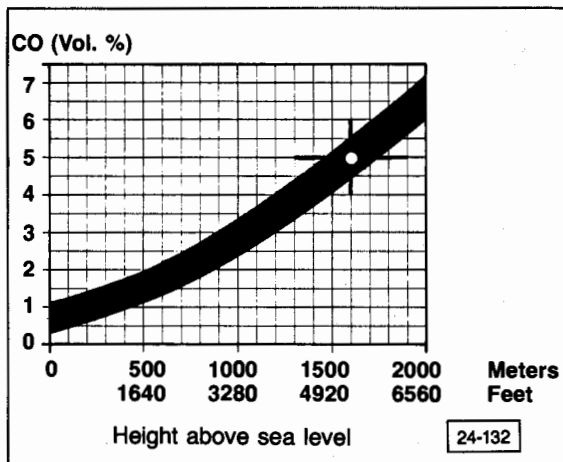
- with ignition switched off, disconnect oxygen sensor

- restart engine, let idle

- CO content should correspond to chart according to elevation of workshop

### Note

CO content is altitude dependent, refer to the following chart to compensate for the altitude of the workshop.



Example: At 1600 meters (approx. 1 mile) CO should be 5% ± .5%

- with ignition switched off, re-connect oxygen sensor
- restart engine, let idle
  - CO content must read within specifications: 0.3 to 1.1% (not dependent upon elevation with sensor connected)
- adjust if necessary
- secure CO adjusting screw with new safety cap

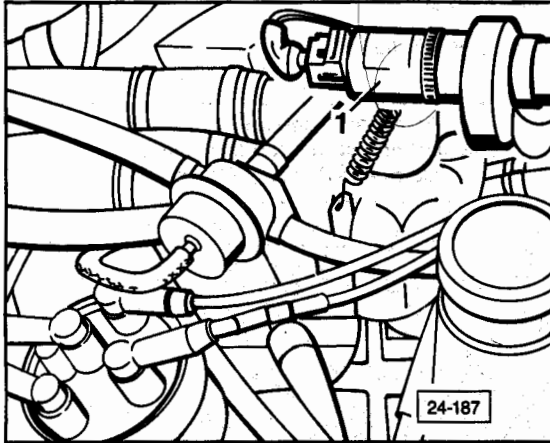
### Note

After adjusting, the hoses for the crankcase must be reconnected. If the control current and the CO content change, this is not due to an improper adjustment, but rather to oil dilution caused by short distance driving. With long distance drives, the amount of fuel in the oil will be reduced and the CO value will normalize again. A short-term solution would be an oil change.



## Idle stabilizer, checking

### 1st check (function)



#### Note

Idle stabilizer triggering can vary depending upon specific vehicle wiring; however, in all cases the following functional check applies.

- start engine and let idle
  - idle stabilizer valve 1 must vibrate and hum

If OK,  
go ahead with 2nd check

- If NO,  
remove connector from valve 1 and check resistance of valve with multimeter US 1119
- specified value: display (continuity)

If specified value NOT obtained  
— replace valve

- If specified value IS obtained  
— re-connect connector to valve and check electrical connections on control unit relay adapter (in front of right tail light) according to wiring diagram

If electrical connections OK  
— replace idle stabilizer control unit

### 2nd check (regulator)

#### Requirements

Engine oil temperature min. 80°C

Electrical consumers turned OFF

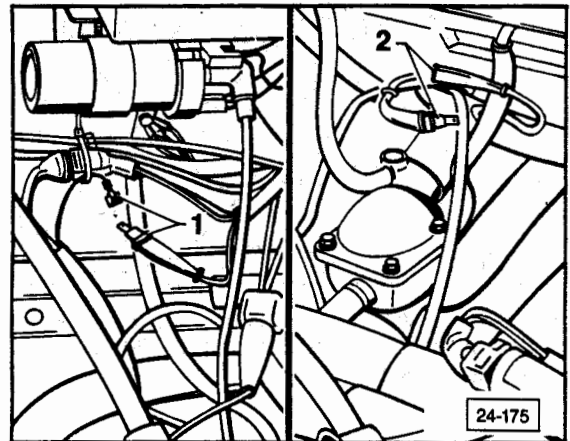
No leaks in intake air system

Ignition timing OK

Idle rpm OK

CO-content OK

- remove crankcase breather hose and close tightly
- connect multimeter US 1119 with adapter VW 1315A/2 to idle stabilizer valve 1
- let engine idle
  - specified value: approximately 430 = 20 mA (fluctuating)



- Disconnect connector 2
  - specified value: approximately 430 mA constant

If test conditions have been met and specified values are NOT obtained

- replace idle stabilizer control unit

# 24 Fuel Injection, AFC System

## Oxygen sensor and oxygen regulation, checking

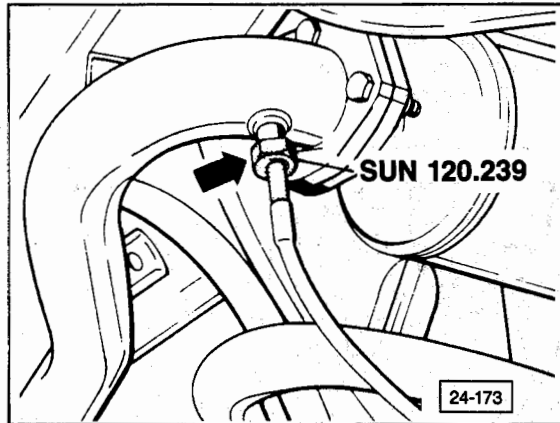
Engine code MV

Requirement

Engine oil temperature min. 80°C (176°F)

### Note

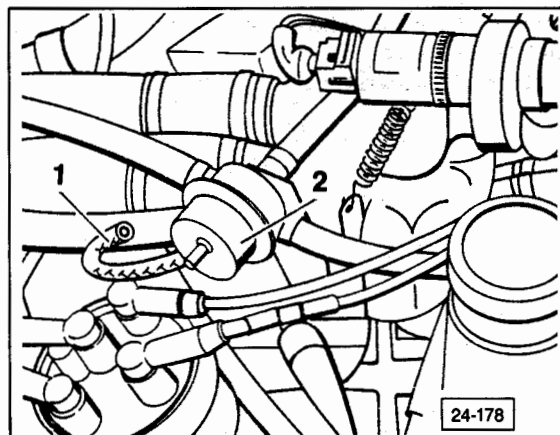
There must be no leaks in the exhaust system between the cylinder heads and the catalytic converter.



— connect CO test equipment hose to the sampling point on left exhaust pipe using Sun 120.239 adapter (arrow)

### Test step I

— let engine run approximately 2 minutes at idle and read CO-content



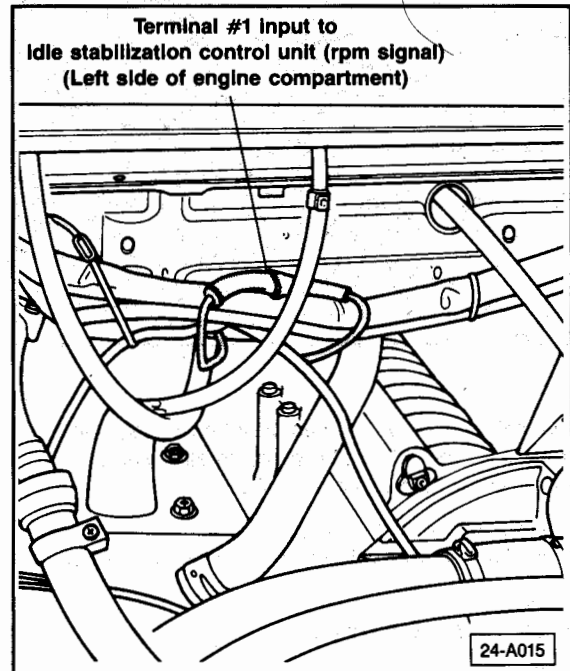
— oxygen sensor connected  
— remove hose (1) from pressure regulator (2) and plug hose  
• CO should increase briefly, then drop in value to 0.3-1.1%

If NO:

proceed to determine whether the problem is with the oxygen sensor or with the control unit

### Test step II

— shut off engine



### Note

As of 9-87 production this connection has moved to the right side of the engine compartment (in front of the air flow sensor).

— disconnect RPM signal wire  
— disconnect oxygen sensor

### Note

The oxygen sensor must be disconnected with the ignition OFF to cancel the memory in the control unit.

— start engine  
— hold disconnected (green) oxygen sensor wire from the control unit to ground  
• CO content must increase

If NO

— check wire connection on control unit, page 24.62 test step II

If OK

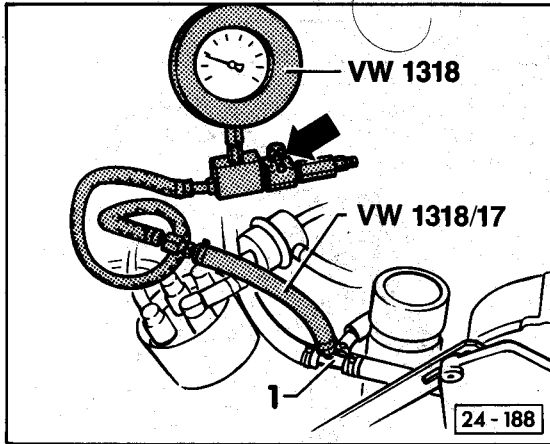
— replace control unit and recheck

### Note

If test step I is not OK but test step II is OK, the oxygen sensor is defective.

## Pressure regulator, checking

The pressure regulator regulates the fuel pressure in relation to the intake manifold pressure.



- connect pressure measuring equipment VW 1318 with adapter VW 1318/17 and hose to t-connection 1 of fuel line

### CAUTION

The switch (**arrow**) on the pressure measuring equipment must remain closed during the measuring process.

- run engine at idle and measure fuel pressure
  - specified values

bar (PSI)	vacuum hose on pressure regulator
approx. 2.0 (29)	connected
approx. 2.5 (36)	disconnected

continue with next column

## Residual pressure, checking

- shut off engine and wait ten minutes
  - 2.0 to 2.5 bar (29 to 36 psi)

If pressure value **NOT** obtained there are three possible causes

### CAUTION

Use extreme care not to damage fuel lines when clamping.

- check fuel pump check valve by clamping off line from fuel pump
- check fuel pressure regulator by clamping off return line to tank
- check fuel injectors by clamping off lines from injectors to pressure regulator, if necessary go to page 24.56 to check injectors

In each of these cases, observe gauge pressure while clamping off the individual lines.

If the pressure drop ceases or slows dramatically, the problem is in the indicated component.

# 24 Fuel Injection, AFC System

## Fuel injectors, checking

### Injector spray pattern, checking

- remove injectors in pairs, (connectors and fuel lines remain connected)
- disconnect connector from second pair of injectors



- operate starter briefly, observe spray pattern:
  - spray pattern must be cone shaped
- re-install injectors

### Note

When installing, make sure seals (1) are present.

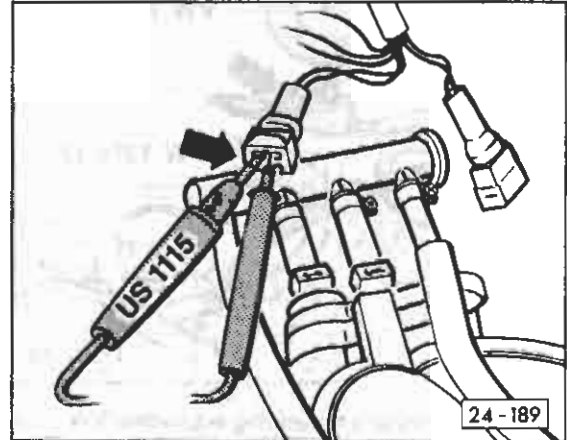
### Checking for leaks

- disconnect all connectors from injectors
- remove injectors in pairs (fuel lines remain connected)
- switch ignition on for about 5 seconds
  - no more than 2 drops per minute per injector may leak out

## Voltage supply, checking

### CAUTION

Avoid short circuits at the connector terminals, otherwise the control unit can be damaged.

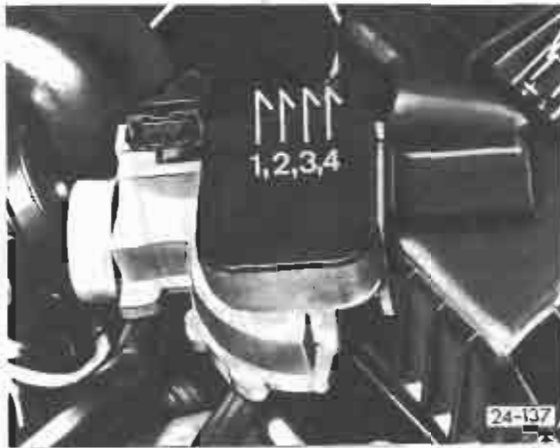


- remove all connectors from injectors and connect voltage tester US1115 on one connector (arrow)
- operate starter
  - LED must flicker

### If NO

- see electrical checks, page 24.61, 24.62, test steps 1 and 5 or control unit defective

## Intake air sensor, checking



- remove connector and hose from intake air sensor and test with digital multimeter US1119 using adapter VW 1315A/1

### Potentiometer, checking

- measure between terminals 3 and 4  
specified value: approx. 0.5-1.0 k
- move air sensor flap and measure resistance between terminals 2 and 3
  - specified value: resistance change

## Intake air temperature sensor, checking (arrow)

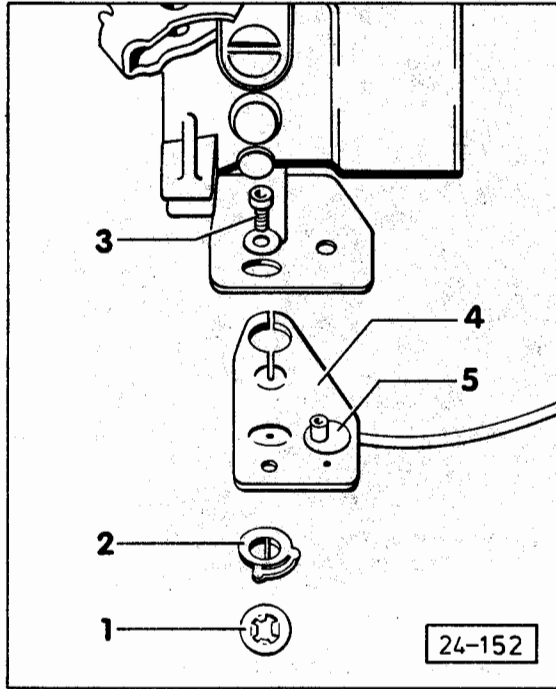


- measure resistance between terminals 1 and 4
  - specified value:
    - 20°C = 2.3 -2.7 k
    - over 20°C = Ω less
    - under 20°C = Ω greater
    - (20°C = 68°F)

# 24 Fuel Injection, AFC System

## Throttle valve switch, removing and installing

- remove throttle valve housing



- remove throttle valve switch 4 in sequence numbered 1 to 5
- installation is reverse of removal

## Throttle valve switch, checking and adjusting

### Note

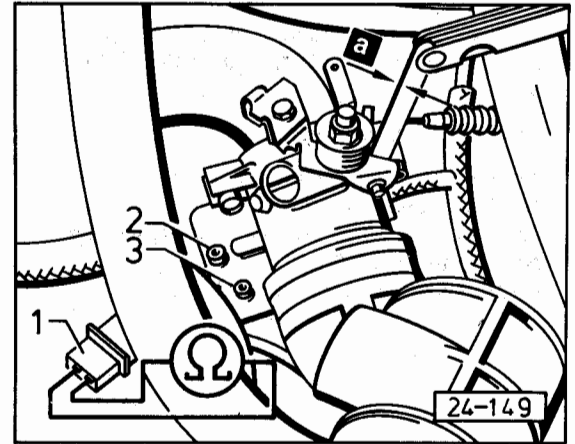
The throttle valve switch supplies the following information to the control unit:

### Throttle valve closed

- injection quantity for idle
- switching off the injection quantity during deceleration fuel shut-off
- ignition point setting in idle (DLS function)

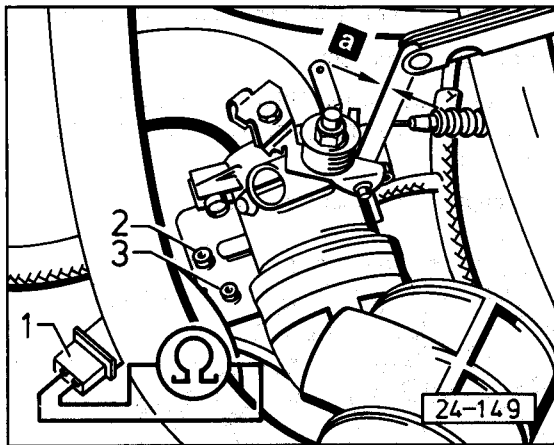
### Throttle valve completely open

- injection quantity for full throttle



- check **continuity** of throttle valve switch at connector 1
  - switch must display continuity only during idle and full throttle position of throttle valve switch

## Throttle valve switch checking, continued



- open throttle valve and close slowly. While doing so, check **switching point** (continuity) of switch with feeler gauge at idle stop of throttle valve lever
  - switching point: gap (a) — 0.05-0.10 mm (0.002-0.004 in) before idle stop
- If necessary, adjust gap (a) with eccentric screw 3 (first loosen screw 2)

### Note

Proper adjustment is important.

If gap (a) too **LARGE**

- engine will surge when throttled slightly

If gap (a) too **SMALL**

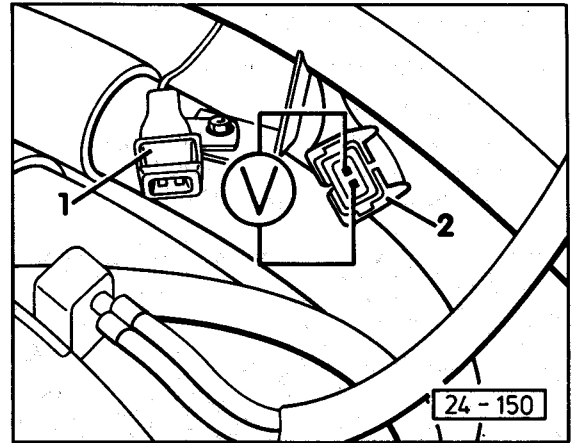
- cold engine will stall out when given gas and warm engine will have **NO** fuel deceleration shut-off or DLS function at idle

### Note

The limiting screw for basic throttle valve adjustment must **not** be changed.

If the screw is turned by mistake, it will be necessary to carry out a basic adjustment of the throttle valve page 24.37.

## Throttle valve switch voltage, checking



### CAUTION

Do not connect test light to throttle valve switch connectors IF control unit is connected.

- disconnect connector 2 from connector 1 of throttle valve switch
- switch ignition ON
- measure voltage on connector 2
  - specified value: approx. 5 volts

If **NO**

- check for break in wiring or control unit is defective

# 24 Fuel Injection, AFC System

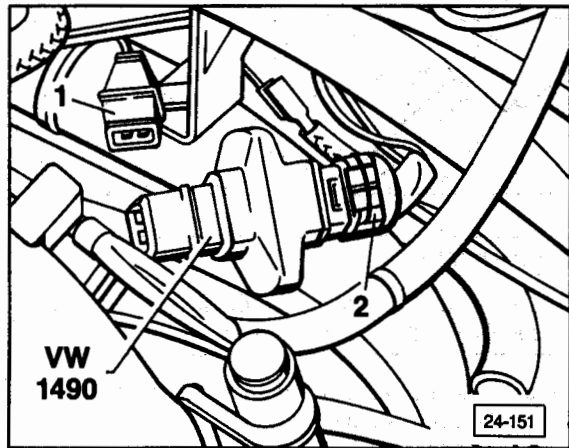
## Deceleration fuel shut-off

### Requirement

Engine oil temperature minimum 80°C

### Fuel shut-off will occur only when:

- throttle is closed
- coolant temperature is above 50°C (122°F)
- engine speed is above 1250 RPM
- engine speed was above 2600 RPM



— bridge connections in connector 2 with side of double adapter **VW 1490** and give slight amount of gas

- engine RPM must vary (surge, then deceleration fuel shut-off begins)
- break in wiring
- temperature sender for engine temperature defective
- control unit defective

## Full throttle enrichment, checking

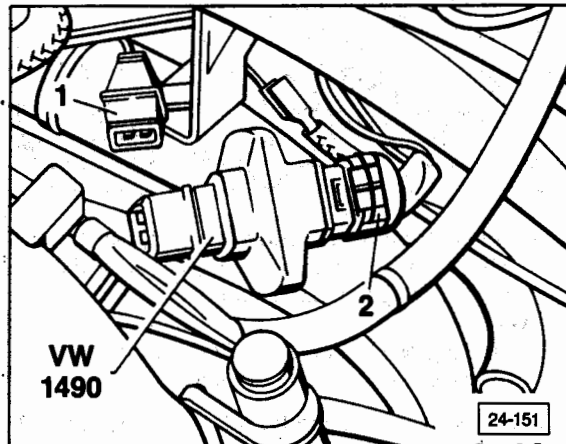
### Requirements

Engine oil temperature minimum 80°C (176°F)

RPM gauge connected

CO tester connected (if catalytic converter present;) on sampling point using **Sun 120.239** adapter

— let engine idle about 2 minutes



- remove connector 2 from connector 1 of throttle valve switch
- slowly increase engine speed to about 4500 RPM
  - connections in connector 2 **not** bridged
- check CO and record
- bridge connections in connector 2 with side of double adapter **VW 1490**
  - CO must raise at least 1 vol.% over recorded value

If **NO**, check for

- break in wiring
- temperature sender for engine temperature defective
- control unit defective



## Electrical testing — ignition and injection system

### Requirements

Battery OK

Fuel pump and fuel pump relay OK

Idle stabilizer control unit OK

### Note

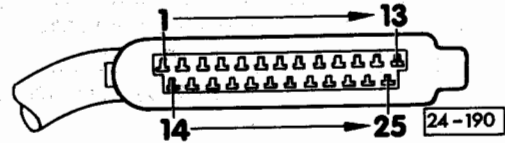
Internal resistance of the test equipment and ambient temperature have a strong influence on test results, digital multimeter US1119 should be used to perform testing.

The specified values given are for ambient temperatures of 0° to +40°C (32°-104°F)

If the measured value deviates from the specified values, determine fault **according to current flow diagram**. Check wiring and connectors before replacing any parts.

### CAUTION

To avoid damage to circuitry, switch to the proper measuring range **before** connecting the test leads.



Measuring range: switch to <b>voltage measurement</b>				
Test step:	(Connector) terminal:	To test	Test conditions, additional steps:	Specified values:
1	13 + 14	control unit voltage supply	switch ignition ON	approx. battery voltage
	14 + 19			
2	13 + 25	wire to ignition coil terminal 1	ignition switched ON	approx. battery voltage
3	1 + 13	wire from starter terminal 50 and from adapter for idle stabilizer control unit terminal 50	Disconnect connector from injectors. Operate starter (selector switch in P or N)	min. 8 V
4	bridge 3 + 13	wire to fuel pump relay	ignition switched ON	fuel pump must run audibly

# 24 Fuel Injection, AFC System

Requirements				
Switch ignition OFF				
Measuring range: switch to resistance measurement $\Omega$				
Test step:	(Connector) terminal:	To test	Test conditions, additional steps:	Specified values:
5	12 + 14	injectors	connect <b>only one</b> injector at a time	15-20 $\Omega$
6	6 + 10	temperature sender for engine temp		see diagram, page
7	6 + 11	throttle valve switch	throttle valve:	
			• closed	continuity
			• slightly open to shortly before full throttle	$\infty \Omega$
		• completely open	continuity	
8	6 + 17	intake air sensor potentiometer		0.5 - 1.0 k $\Omega$
	17 + 21		move air flow sensor	change in resistance
9	6 + 9	intake air temperature sender in intake air sensor		see diagram, page 24.45
10	6 + 8	wiring to Hall sender	remove connector from Hall sender and bridge all three connectors	continuity
	6 + 18			
11	2 + 13	wiring to oxygen sensor	disconnect connector to oxygen sensor and hold green wire to ground (-)	continuity
			re-connect oxygen sensor wiring	$\infty \Omega$

### Note

For additional tests of ignition parts of the digifant system as well as Hall sender test see Repair Group 28.

# Exhaust System—Emission Controls

## Quick Data

## Index

### Air-cooled AFC

- California 26.3
- 1981 26.4
- USA and Canada except California 26.2
- EGR valve 26.5
- Catalytic converter checking 26.11

### Diesel

- Assembly 26.6

### Water-cooled Digijet

- Assembly 26.7
- Oxygen sensor 26.8
- Catalytic converter checking 26.11

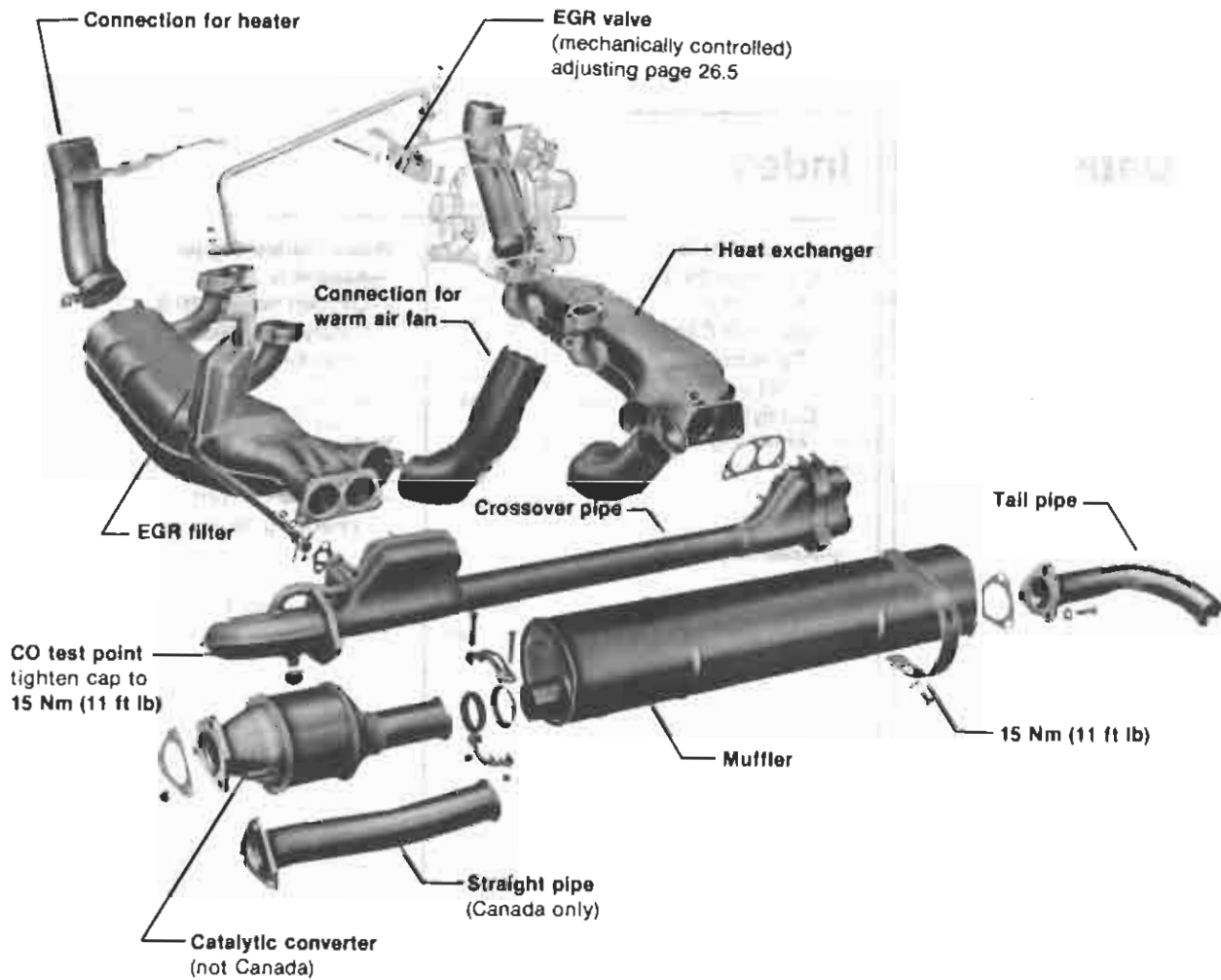
### Water-cooled Digifant

- Assembly 26.9, 26.10
- Catalytic converter checking 26.11

# 26 Exhaust System—Emission Controls

## Note

Always replace gaskets, seals and self-locking nuts. Tighten all M8 bolts and nuts to 20 Nm (14 ft lb)



26-314

## 26.2

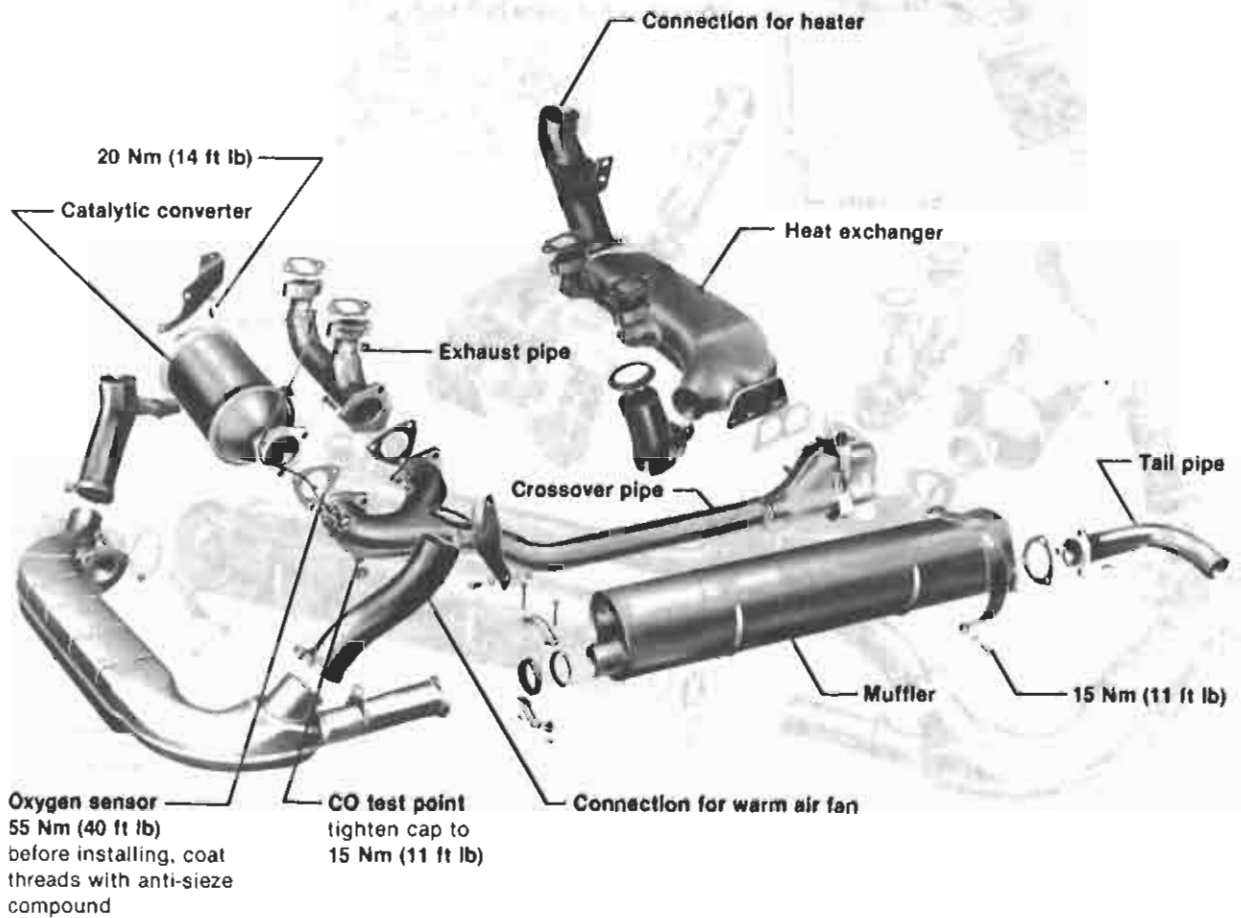
Exhaust system

Air-cooled AFC

CAN/USA, not Calif

**Note**

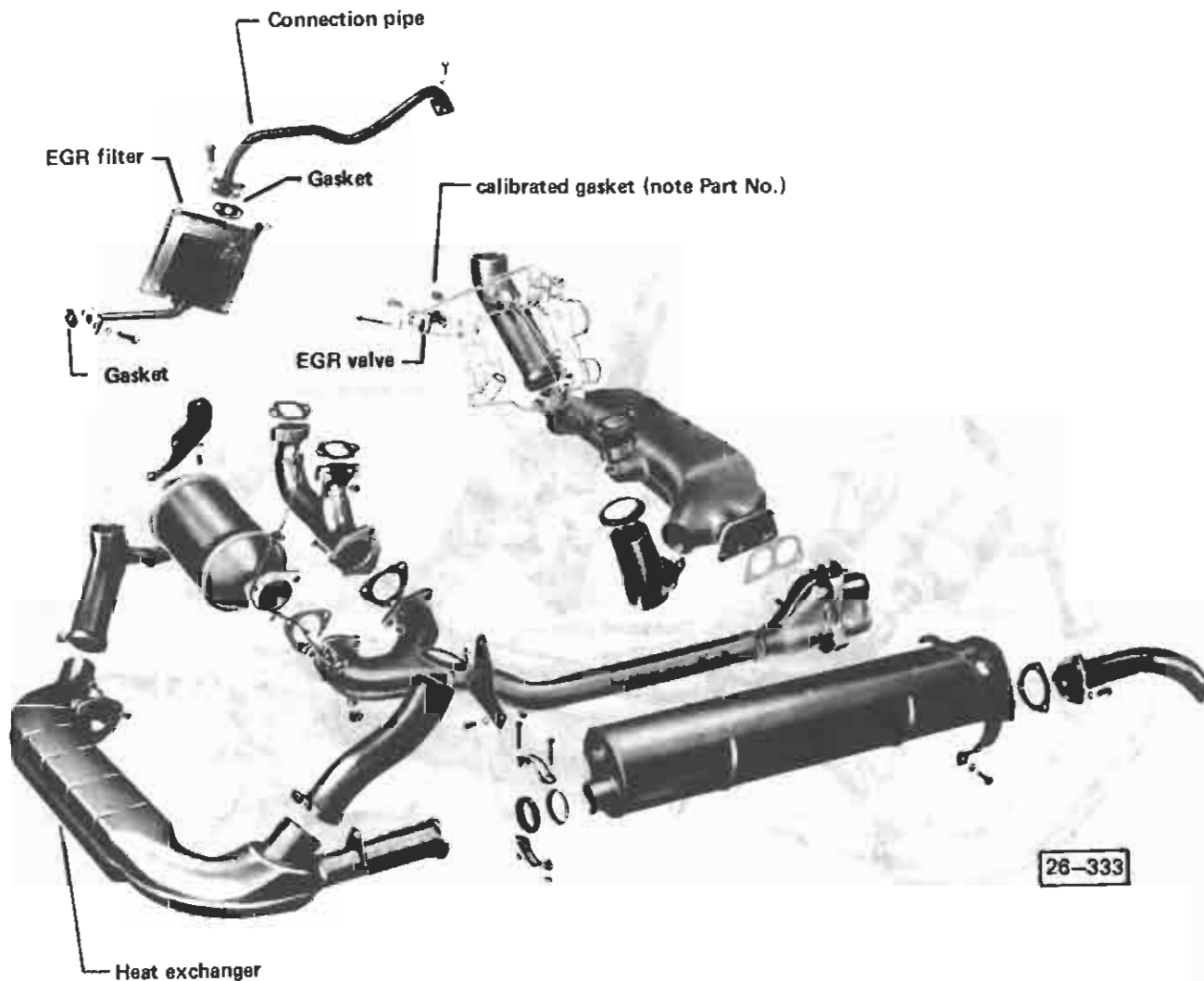
Always replace gaskets, seals and self-locking nuts. Tighten all M8 bolts to 20 Nm (14 ft lb)



26-313

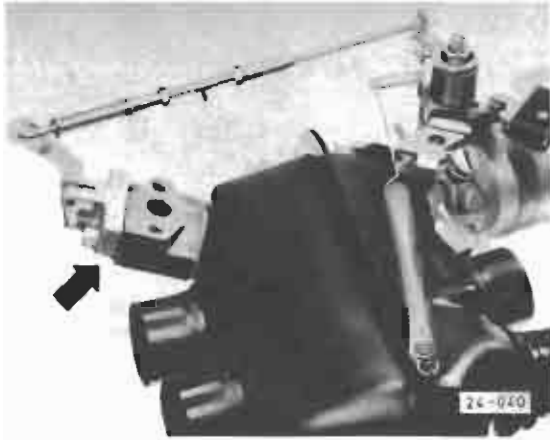
# 26 Exhaust System-Emission Controls

Modified and additional parts – EGR system (California 1981)



## EGR valve, checking

### Work sequence



#### Note

EGR valve (arrow) is operated mechanically by throttle valve lever

#### Checking in idle speed position

- run engine at idle
- check pipe to EGR valve
  - pipe should **not** warm up

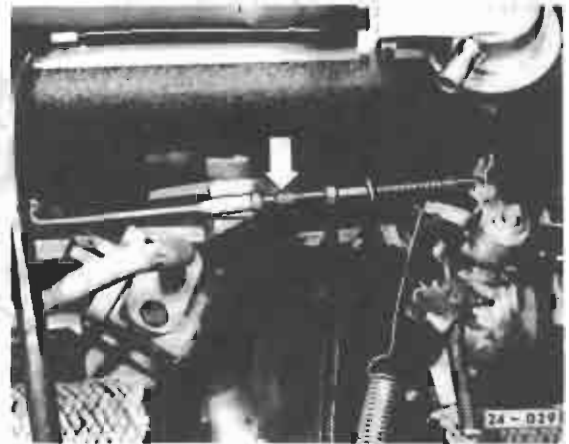
#### Checking in full throttle position

- disconnect rod for EGR valve
- run engine at idle
- push lever on EGR valve to full throttle position
- check pipe to EGR valve
  - pipe should **not** warm up

## ERG valve, adjusting

### Work sequence

- run engine at idle
  - manual transmission: 800-950 RPM
  - automatic transmission: 850-1000 RPM



- shorten rod by turning hex (arrow) until idle speed drops suddenly (valve opens)
- turn rod in opposite direction
  - manual transmission 1 1/16 turns
  - automatic transmission 5/6 turns

#### Note

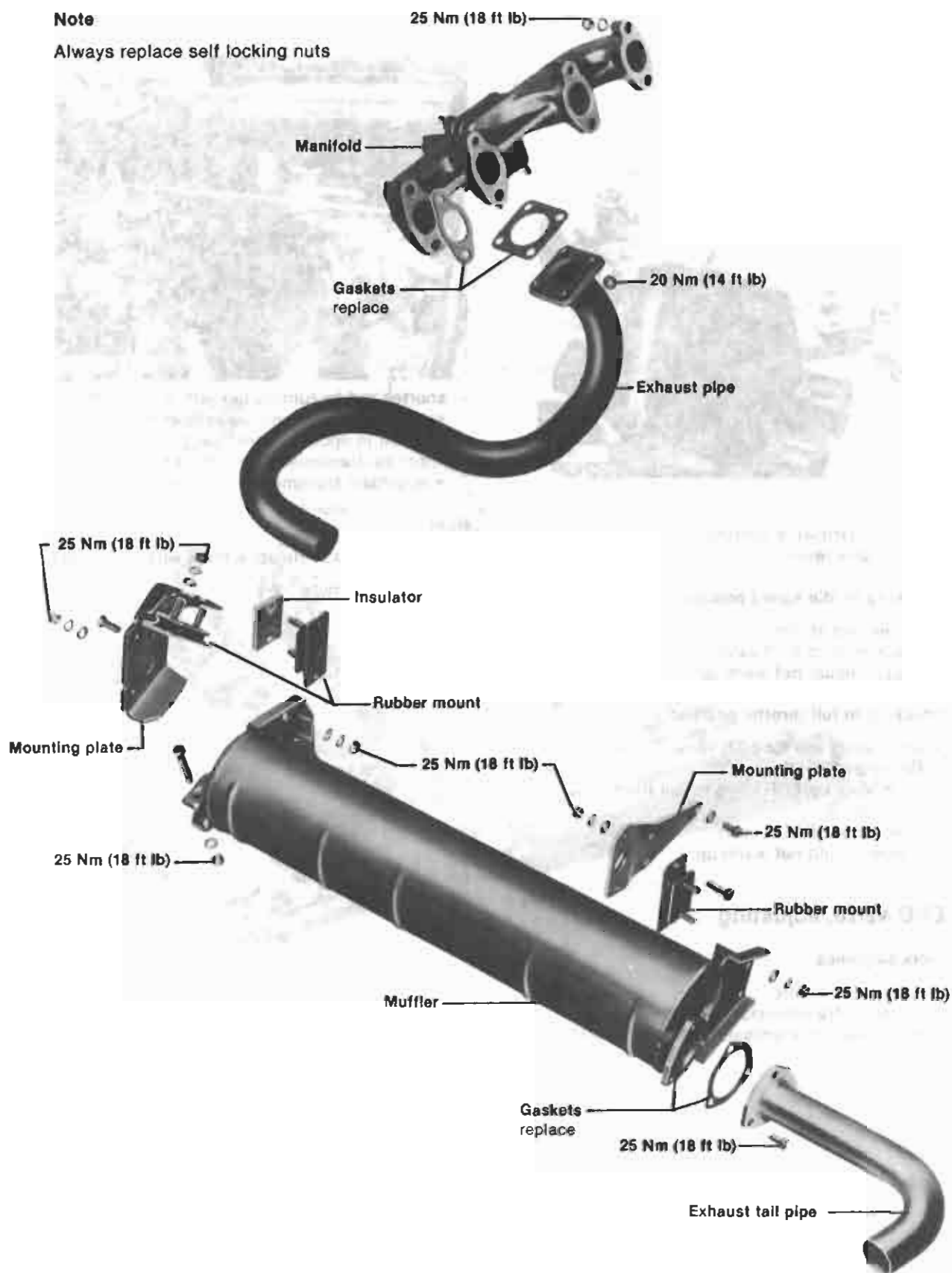
Use pin in hex as reference mark when adjusting

- tighten lock nuts

# 26 Exhaust System-Emission Controls

## Note

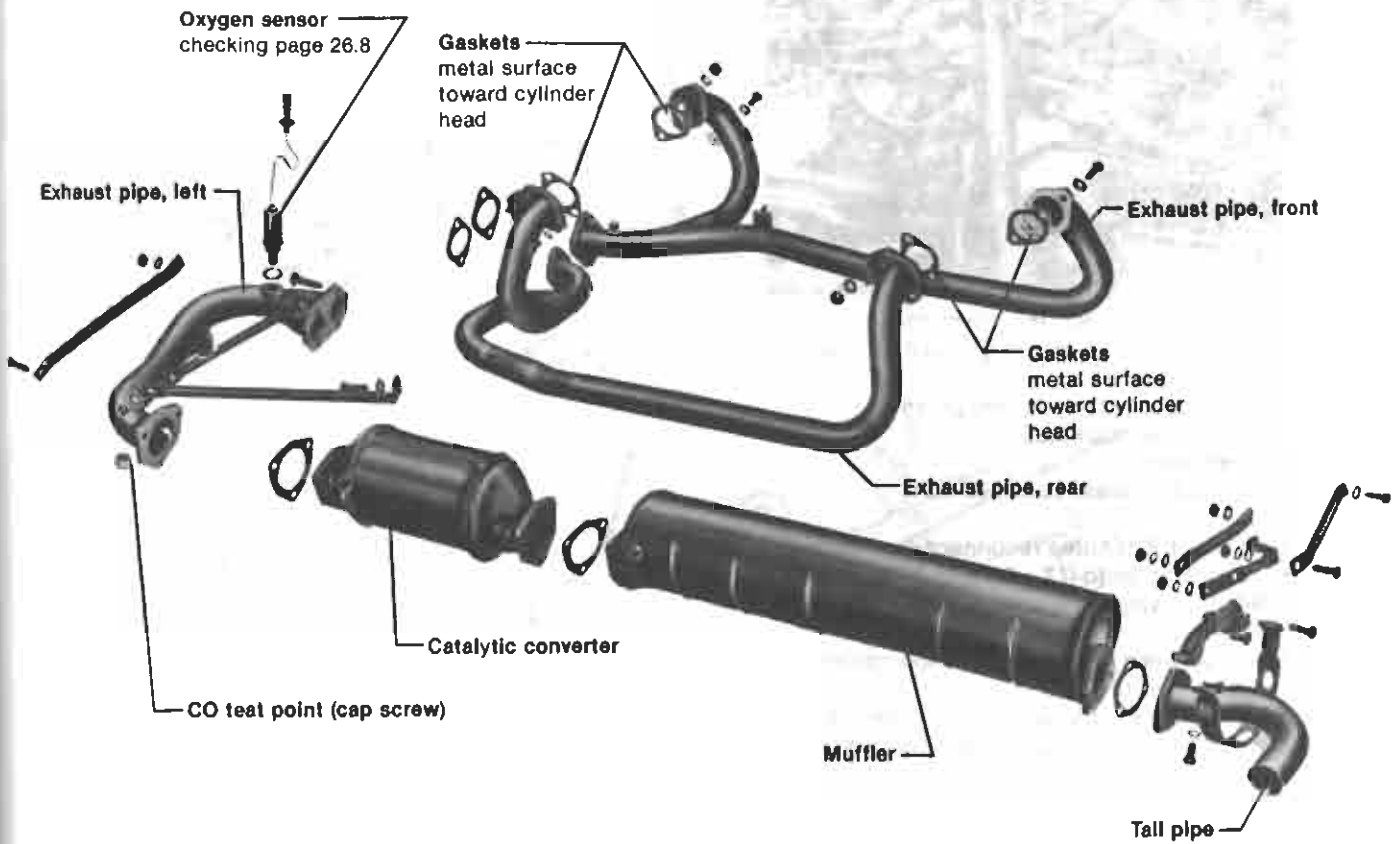
Always replace self locking nuts





## Note

Always replace gaskets, seals and self-locking nuts. Tighten all M8 bolts to **20 Nm (14 ft lb)**



26-375

26-338

Diesel

Exhaust system

# 26.7

# 26 Exhaust System-Emission Controls

## Oxygen sensor, checking

### Preliminary condition:

- engine oil temperature at least 60 °C (140 °F)

### Work sequence

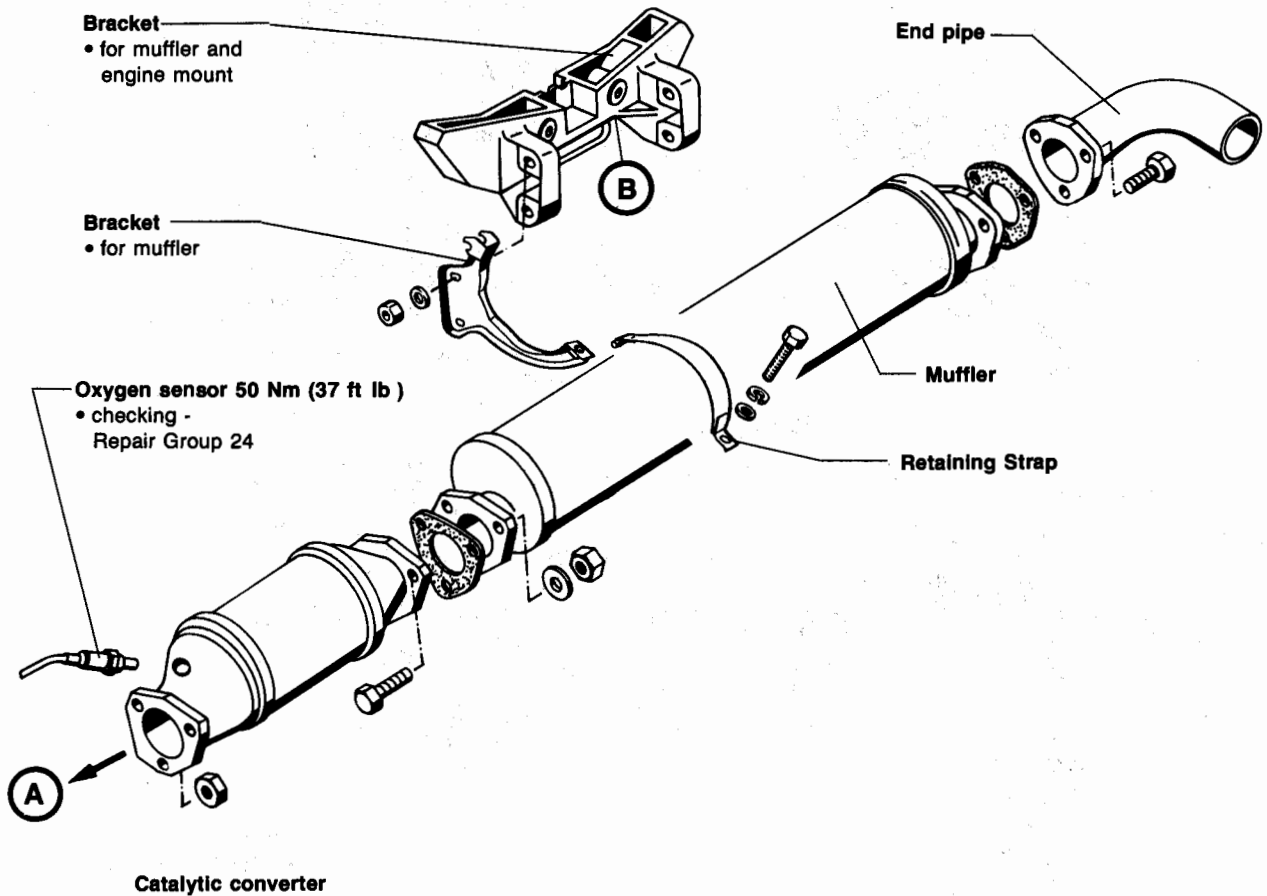
- connect CO meter to test receptacle on exhaust pipe (left side)



- with ignition turned **OFF**, disconnect connection **1** between oxygen sensor and control unit
- pull off vacuum hose **2** from pressure regulator and block hose
- start engine
  - CO must increase to above 1.5%
- after about 2 minutes reconnect connection **1**
  - CO must drop to  $0.7 \pm 0.4\%$
  - If NO**, following components may be defective:
    - wire between oxygen sensor and control unit or control unit
- check wiring by disconnecting connection **1** again and ground wire end coming from control unit
  - CO must increase
  - If OK**, oxygen sensor must be defective or leak in exhaust system between catalytic converter and cylinder head

# 26 Exhaust System—Emission Controls

Exhaust system components,  
removing and installing  
Continued



- replace gaskets
- replace self-locking nuts
- tightening torque for screws and nuts:  
25 Nm (18 ft lb)

26-552

## Catalytic converter, checking

Converter replacement can become necessary if the ceramic insert loosens

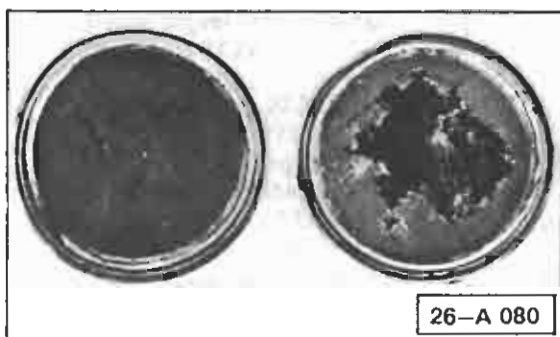
If exhaust "rattles"

- check that exhaust flanges are tight

If "rattle" was not due to loose exhaust flanges, converter may have failed

If exhaust system is tight

- remove catalytic converter
- look through both flange openings against light



If ceramic insert appears broken or melted as shown, converter has failed

If ceramic insert appears OK, check if ceramic insert is firmly seated in converter housing

Check as follows:

- while holding converter vertically, firmly tap flange onto solid wood from a distance of 20 cm (8 in.)

- turn converter over and firmly tap other flange as before

If no knocking sound converter is OK

If no movement of the ceramic insert, converter is OK

If light knocking sound is heard inside converter, ceramic insert is loose and converter has failed

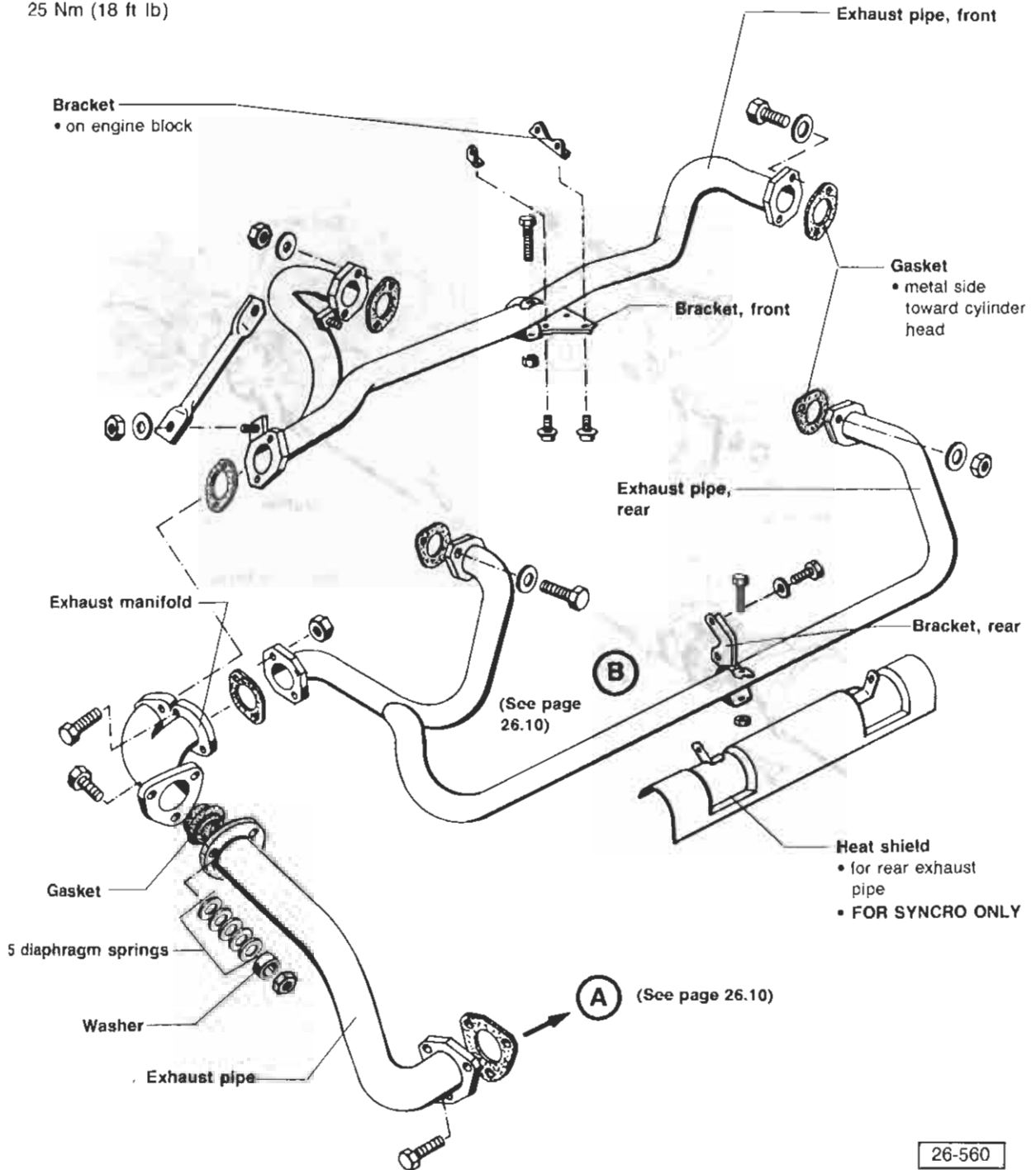
### CAUTION

Avoid the following conditions on vehicles equipped with catalytic converters

- usage of leaded gasoline
- turning off the engine with the vehicle in motion
- excessive prolonged cranking with an intermittent firing of a flooded engine
- prolonged operation under load with a misfiring engine

## Exhaust system components, removing and installing

- replace gaskets
- replace self-locking nuts
- tightening torque for screws and nuts:  
25 Nm (18 ft lb)



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## Index

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- Removing/Installing 27.15
- Repairing (45A, 65A) 27.16
- Repairing (90A) 27.17
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- V-belt, replacing 27.21
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- Checking 27.4, 27.6
- Electrolyte level 27.4
- Filler caps 27.7
- Location(s) 27.8, 27.9
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## Battery, checking and charging

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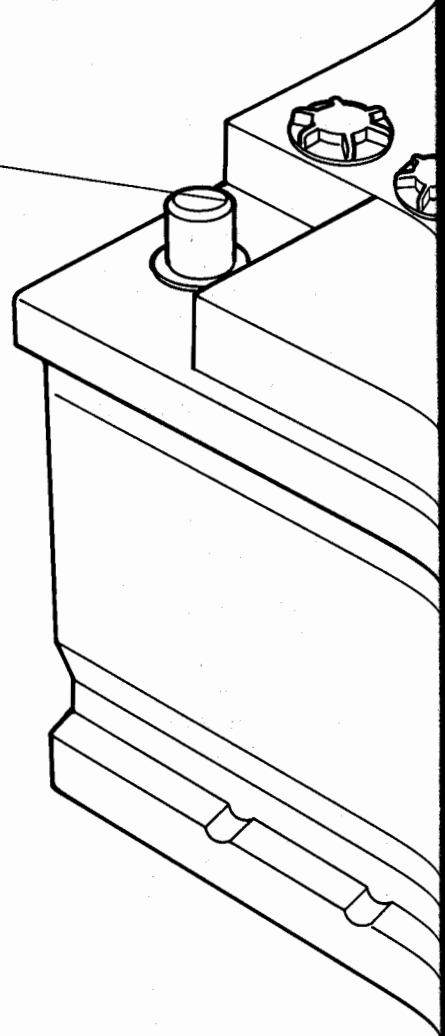
Battery — checking voltage, Page 27.5

Battery — charging — Page 27.5

Troubleshooting guide — battery discharges itself —  
Page 27.10

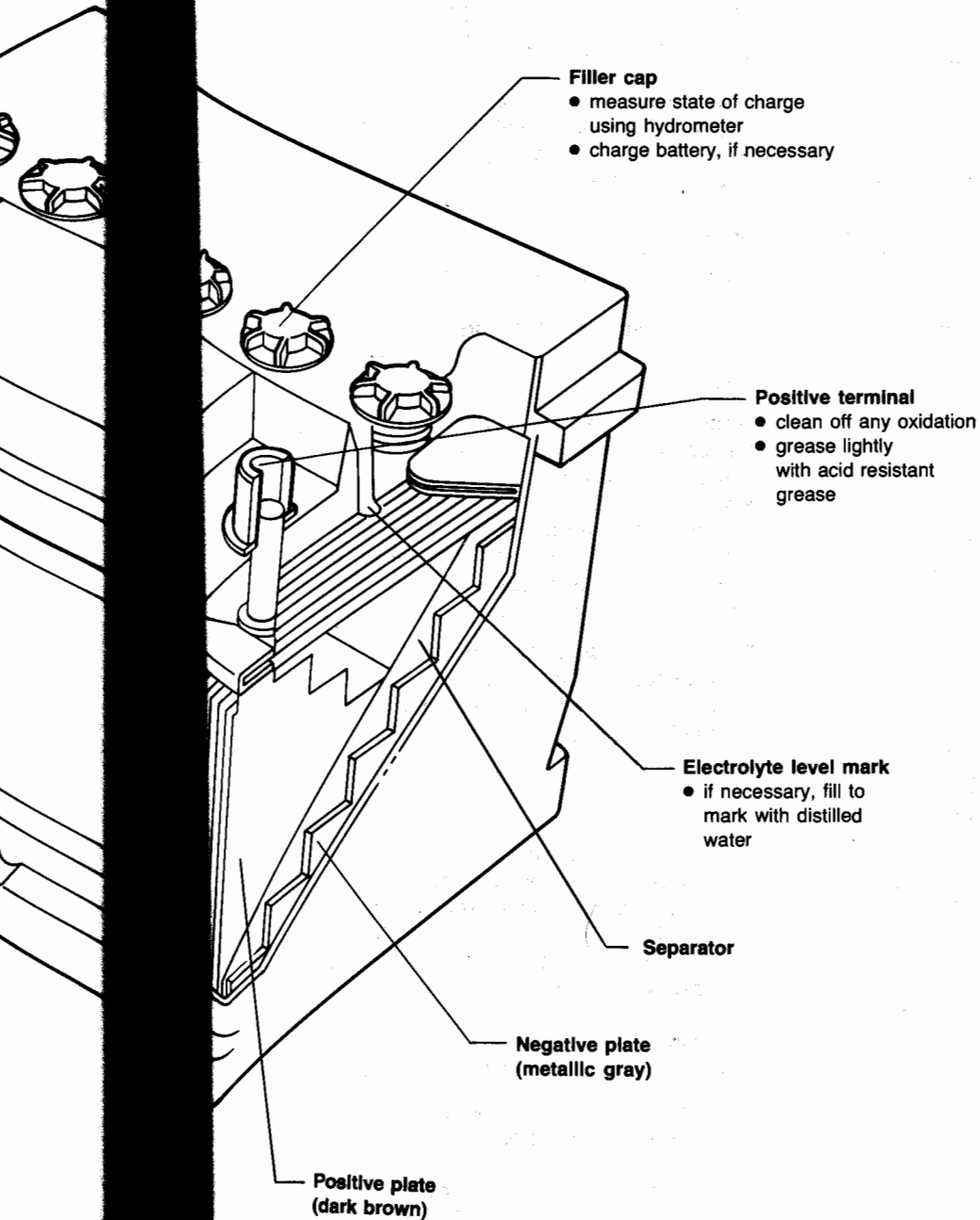
### Negative terminal

- clean off any oxidation
- grease lightly with acid resistant grease



## CAUTION

Before beginning repairs on the electrical system, disconnect battery ground strap.



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# 27 Electrical-Battery, Starter, Alternator

## Battery

### Battery precautions

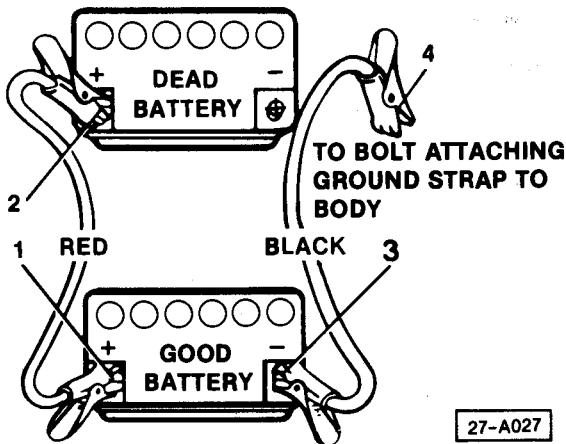
#### WARNING

Battery acid can cause severe burns. When working with electrolyte always wear goggles, rubber gloves, and apron. If electrolyte is spilled on skin or clothing, flush at once with large quantities of water. If it gets into eyes, immediately flush with large quantities of water for several minutes and call a doctor.

Batteries produce explosive gases. Keep flames and sparks away from batteries. Do not smoke near batteries

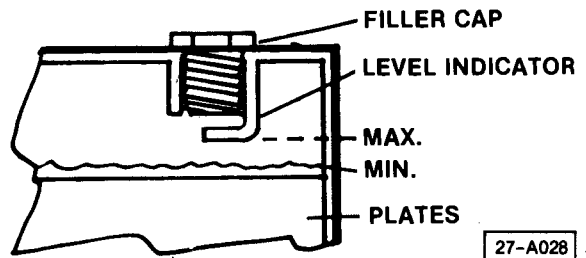
### Battery, jump starting

- car with good battery must not be running when connecting jumper cables



- connect jumper cables in following order:
  - 1 — one end of positive cable to + post of good battery
  - 2 — other end of positive cable to + post of dead battery
  - 3 — one end of negative cable to - post of good battery
  - 4 — other end of negative cable to bolt attaching ground strap to body
- start car which has good battery first
- next start car which has dead battery
- disconnect jumper cables in reverse order

### Battery electrolyte level, checking



- check that electrolyte covers battery plates (including separators) by 5 mm (1/4 in.)
- check battery electrolyte level indicator on side of battery

#### Note

Only use distilled water when refilling battery

### Battery condition, checking

#### Note

Weak battery can be caused by:

- alternator belt slipping (replace belt when glazed)
- ground straps corroded, loose or broken
- alternator or voltage regulator defective
- alternator warning light bulb burned out
- poor ground connection between warning light socket and circuit board

Battery terminals and cables should be coated with grease or petroleum jelly and, if necessary, cleaned to prevent corrosion and ensure good connection

### Visual checks

- check for
  - cracked or leaking case
  - loose or corroded terminals
  - low electrolyte level. If electrolyte is low, refill with distilled water and fast charge battery for several minutes after cells begin gassing (boiling)

### Hydrometer test

(for batteries with removable caps)

- test electrolyte in all cells
  - average specific gravity should be at least 1.225
- correct for electrolyte temperature if necessary
  - for every 10°F above 80°F add .004 to hydrometer reading
  - for every 10°F below 80°F subtract .004 from hydrometer reading
- if specific gravity is above 1.225, load test battery

# Electrical-Battery, Starter, Alternator

- if specific gravity is **below** 1.225, recharge battery
- if specific gravity varies by more than .050 between cells, replace battery

Specific gravity	% of charge
1.265	100%
1.225	75%
1.190	50%
1.155	25%
1.120	0%

### CAUTION

Do not expose fully discharged battery to freezing temperature because battery will be damaged by freezing

### Voltage test—engine not running (for sealed batteries only)

- turn headlights on high beam for 1 minute to remove surface charge
- disconnect battery ground strap
- check battery voltage with an **accurate** voltmeter
  - voltage should be at least 12.4 volts
- if battery is **above** 12.4 volts, load test battery
- if battery is **below** 12.4 volts, charge battery until voltage is at least 12.4 volts

Voltage	% of charge
12.6 or more	100%
12.4	75%
12.2	50%
12.0	25%
11.7 or less	0%

### Load test

#### Note

Before load testing, battery must be at least 75% charged

- connect load tester according to manufacturer's instructions
- load battery to 3 times amp/hour rating or 1/2 0°F cold cranking current rating
- wait 15 seconds and read voltage
  - battery voltage at room temperature should be at least 9.6 volts
- if battery voltage at room temperature is below 9.6 volts, replace battery
- if battery is colder than room temperature, voltage under load will be lower. Use table below if cold battery must be tested

### Approx. electrolyte temp. °F (°C)

### Minimum acceptable voltage under load

60 (16)	9.5
50 (10)	9.4
40 (4)	9.3
30 (-1)	9.1
20 (-7)	8.9
10 (-12)	8.7
0 (-18)	8.5

## Battery charging

### WARNING

Gases given off during charging are explosive. Do not smoke or allow sparks or flame near a charging battery.

Battery charger must be turned off when connecting or disconnecting cables on battery

### CAUTION

Do not allow battery voltage to exceed 17 volts. If battery begins gassing (boiling) violently when charging, reduce charging rate. Do not disconnect battery while engine is running

### Note

Follow battery charger manufacturer's instructions. Before testing a battery that has been charged, load battery with 15 amps for 1 minute to remove surface charge

### Battery with removable caps

If battery level is low and water is added, fast charge battery for a few minutes after battery begins gassing (boiling). Slow charging current should be approximately 10% of battery capacity. Fast charging should be approximately 80-90% of battery capacity. Remove cell caps while charging

- charge battery according to following table:

Specific gravity	Fast charge up to
1.150 or less	1 hour
1.150 to 1.175	3/4 hour
1.175 to 1.200	1/2 hour
1.200 to 1.225	1/4 hour
above 1.225	slow charge <b>ONLY</b> to 1.250-1.280

# 27 Electrical-Battery, Starter, Alternator

## Sealed batteries

Only **slow** charge sealed batteries. Sealed batteries, sometimes called "maintenance free," will not accept high rate of charge, making it necessary to charge it for up to twice as long as battery with removable caps. Also, voltmeter reading will not increase as rapidly as when charging battery with removable caps

### WARNING

Battery acid can cause severe burns. When working with electrolyte always wear goggles, rubber gloves, and apron. If electrolyte is spilled on skin or clothing, flush at once with large quantities of water. If it gets into eyes, immediately flush with large quantities of water for several minutes and call a doctor.

Batteries produce explosive gases. Keep flames and sparks away from batteries. Do not smoke near batteries

### CAUTION

Before working on any part of electrical system disconnect battery ground strap.

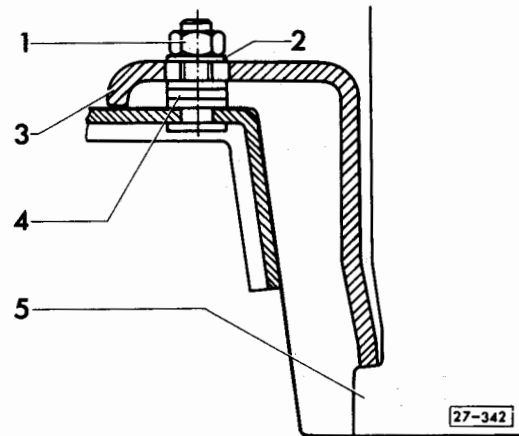
Never run alternator with battery disconnected

## Battery, removing

- disconnect battery ground strap from negative terminal of battery, not from body
- disconnect positive terminal from battery
- remove battery hold-down (note number of shims)
- remove battery

### Note

Special bolt is used to attach ground strap to body. If bolt has been loosened, it must be removed and cleaned free of paint and undercoating. Mounting area must also be cleaned free of paint and undercoating. After installing, coat bolt and mounting area with corrosion resistant material



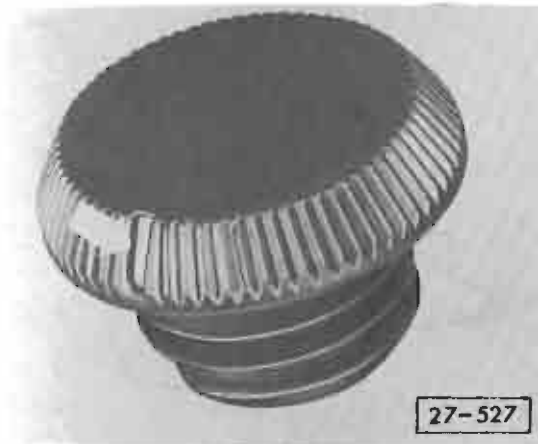
## Battery, installing

- 1 = nut, tighten to 10 Nm (7 ft lb)
- 2 = washer
- 3 = bracket
- 4 = shims (note number)
- 5 = base of battery case

### Note

Bracket must press on base of battery case

## Battery filler cap ( new style )



### Filler cap, removing

- cut filler cap skin at notch (**arrow**) with pocket knife or sharp edged screwdriver



- insert suitable screwdriver into slot
- turn upper part of filler cap counter-clockwise to stop
- remove filler cap

### Filler cap, installing

- install new type of filler cap in same manner as old type filler cap

# 27 Electrical-Battery, Starter, Alternator

## Battery location

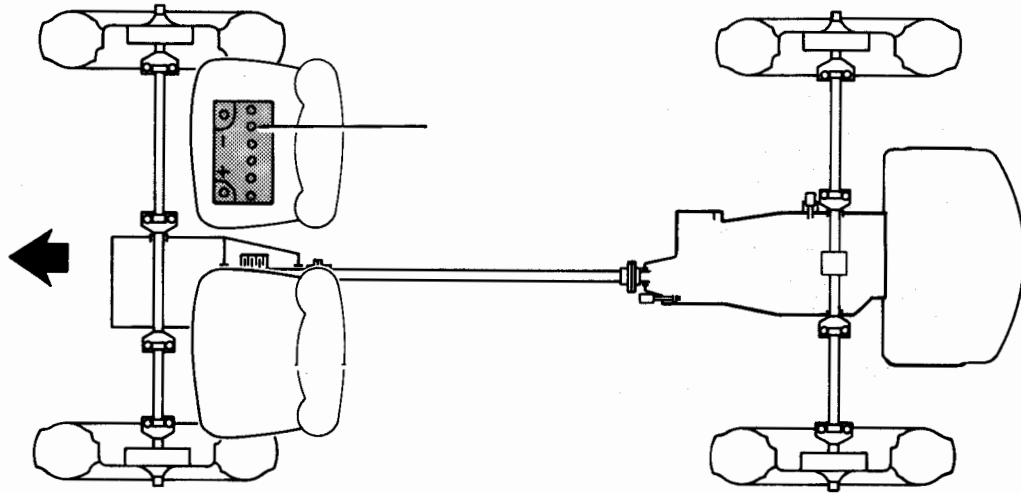


Fig. 1 Battery location

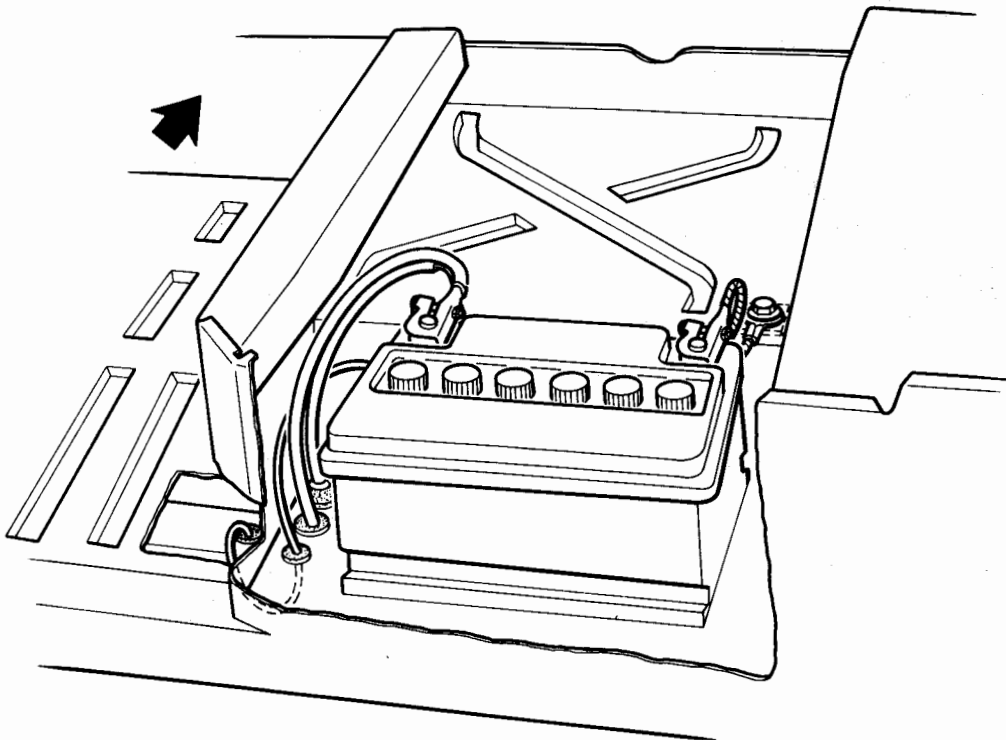


Fig. 2 Installation detail (under right front seat)

## Battery locations, for non-propane refrigerator equipped Camper (P21)

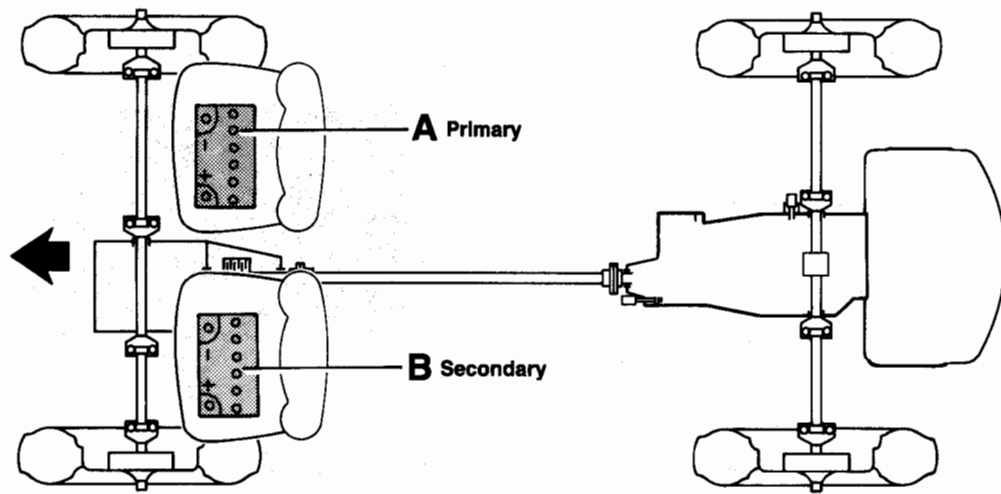


Fig. 3 Battery locations

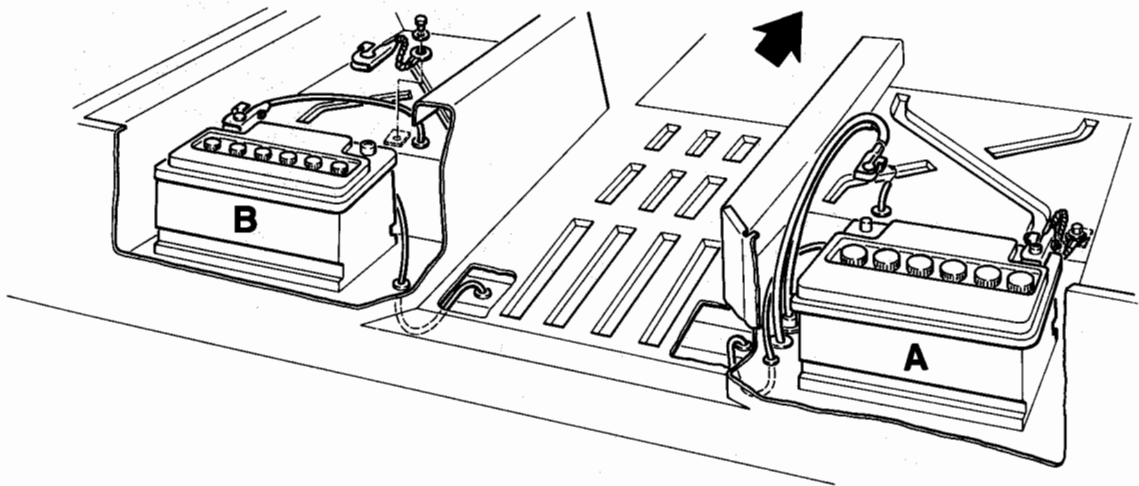


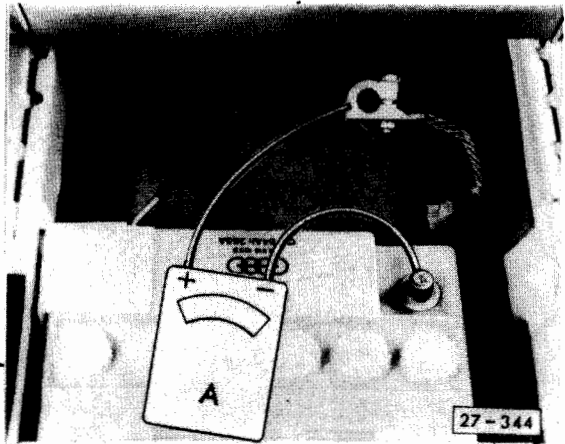
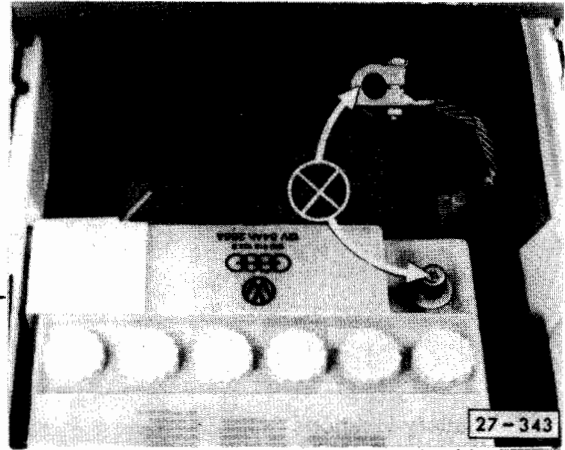
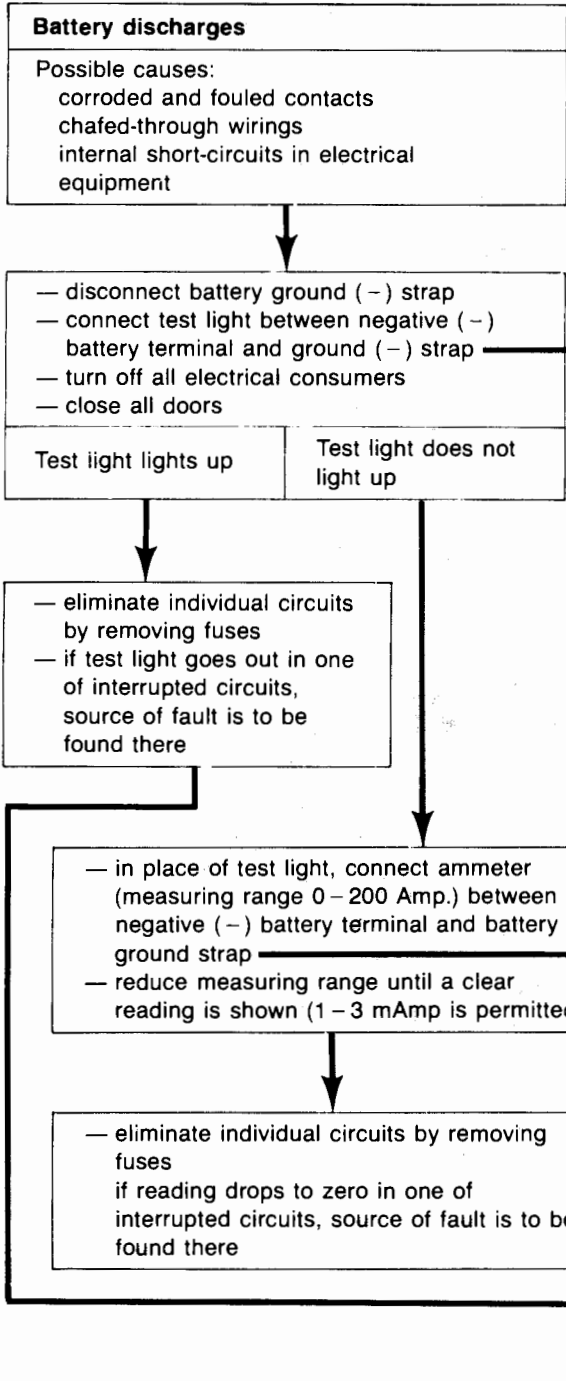
Fig. 4 Installation detail (under front seats)

# 27 Electrical-Battery, Starter, Alternator

**Battery discharges—troubleshooting**  
current draw suspected

**Test conditions**

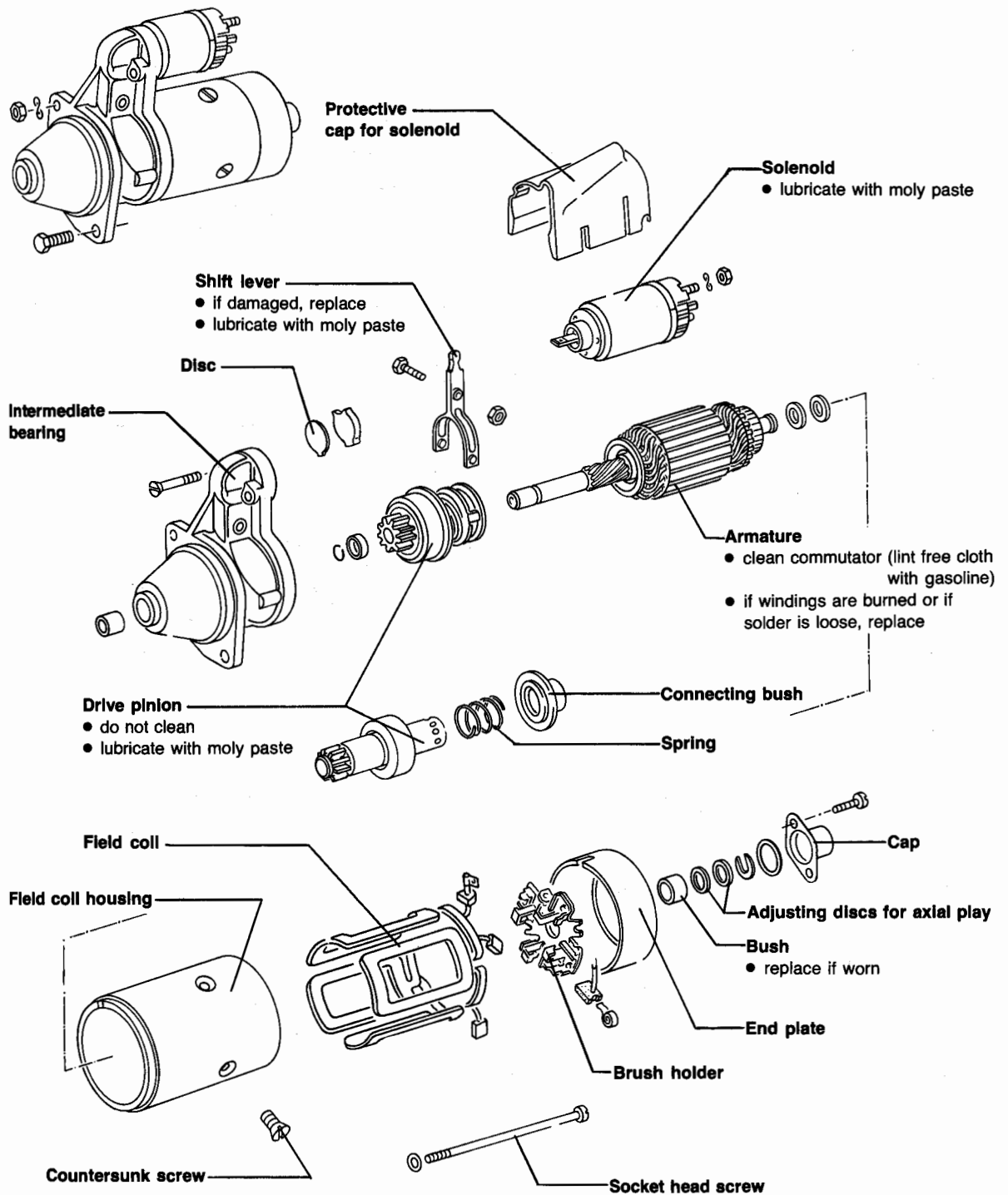
fully charged battery  
clock disconnected



• if no faults are found in fused circuits, disconnect wiring connectors from nonfused components:  
alternator  
starter  
ignition system  
cluster instruments  
coolant fan and so on

## 27.10 Battery

## Starter, repairing



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# 27 Electrical-Battery, Starter, Alternator

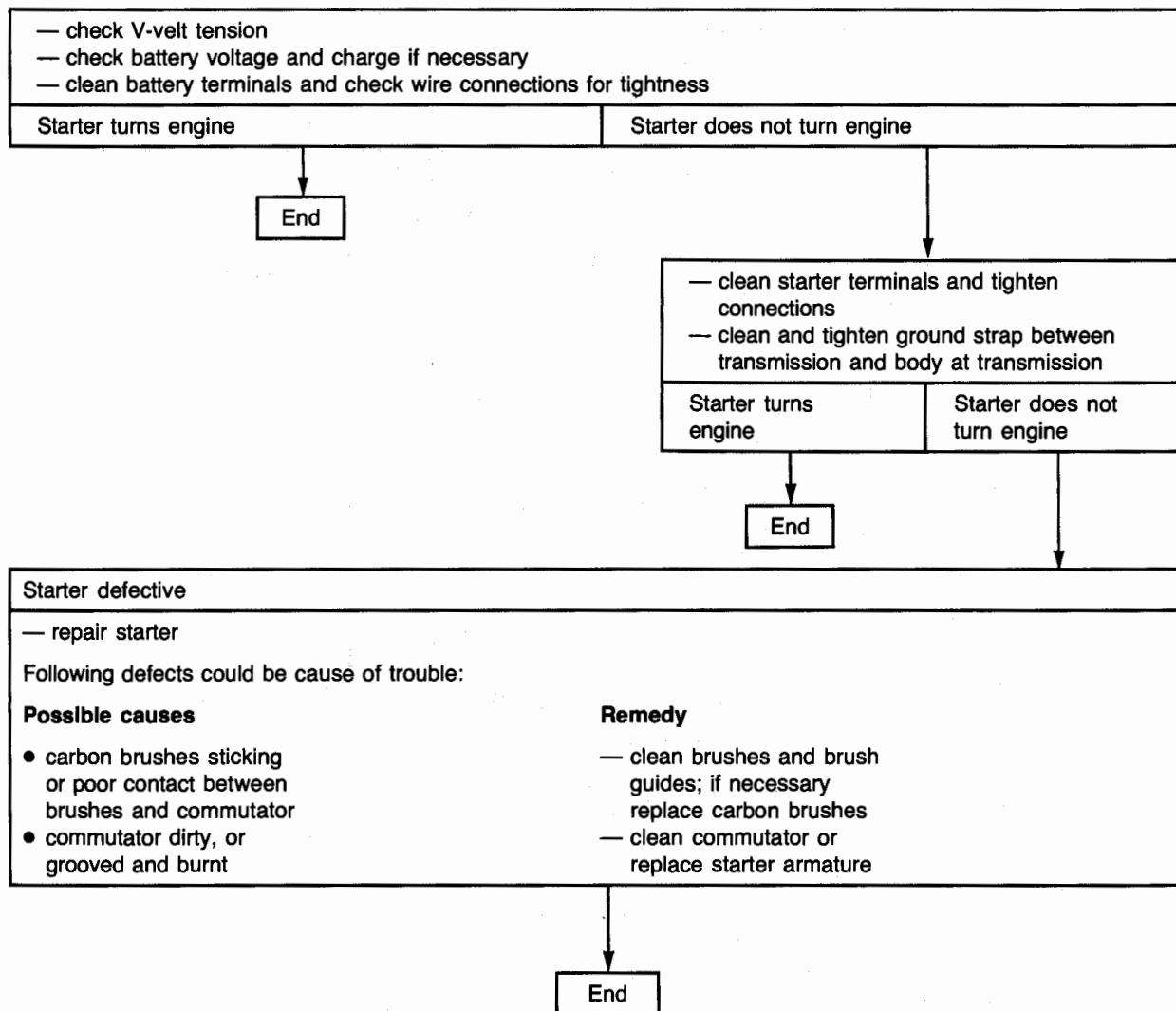
## Starter turns engine too slowly or engages and will not turn engine

### Note

Check that engine is filled with oil of recommended viscosity

### CAUTION

Before working on any part of electrical system, disconnect battery ground strap.



## Starter does not turn engine when ignition/starter switch is operated

### Note

An engine that won't crank or battery that is repeatedly discharged while driving may be caused by poor wiring connections that result from a loose fastening nut on terminal 30 of the starter motor.

To repair this condition:

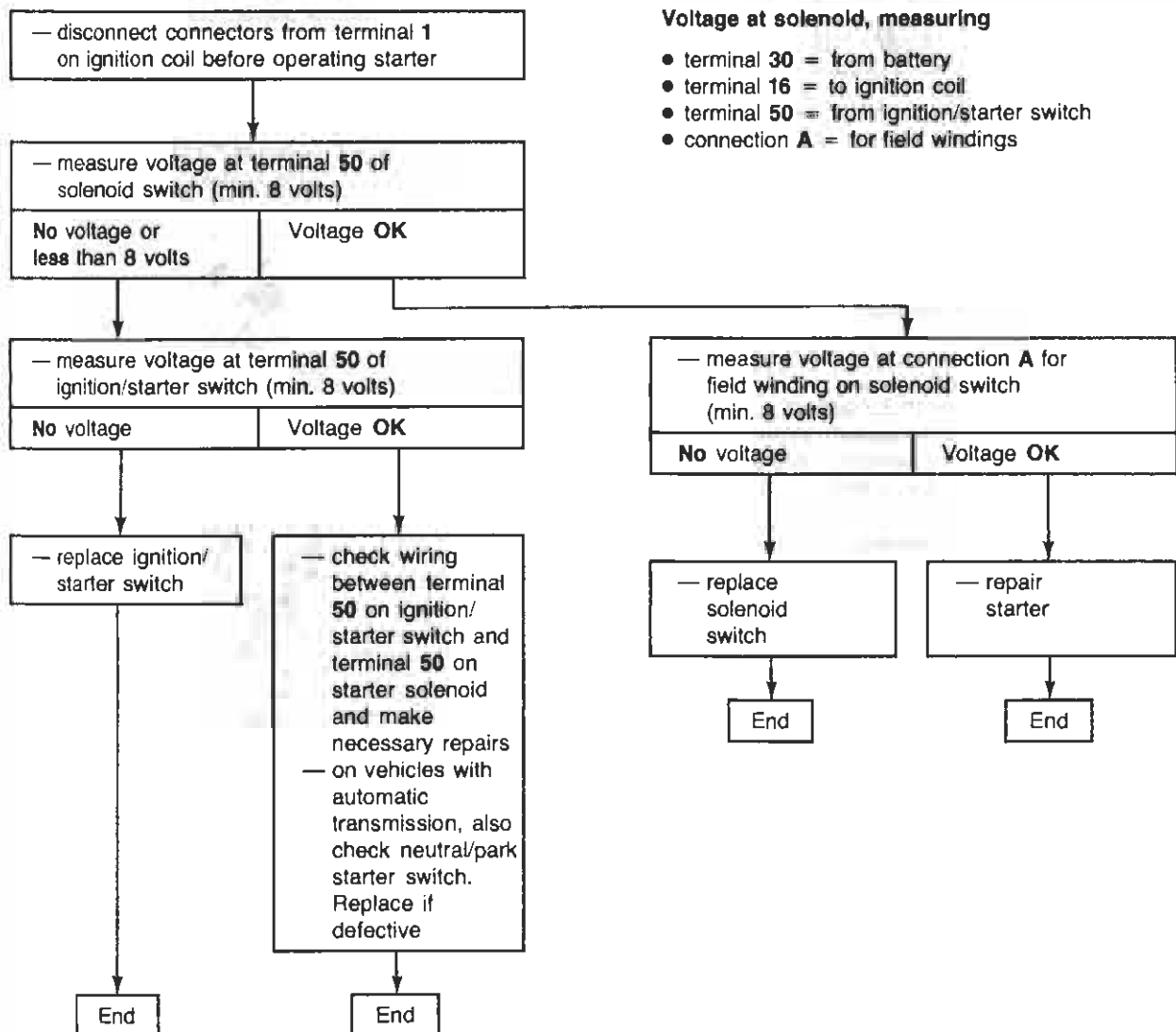
- disconnect battery ground terminal
- clean and inspect connections at terminal 30 of starter. Repair burned/damaged connections as necessary. Torque fastening nut to 10Nm (7.5 ft lb)
- reconnect battery ground terminal

Also check connection on solenoid switch and ground straps for corrosion and tightness.



### Voltage at solenoid, measuring

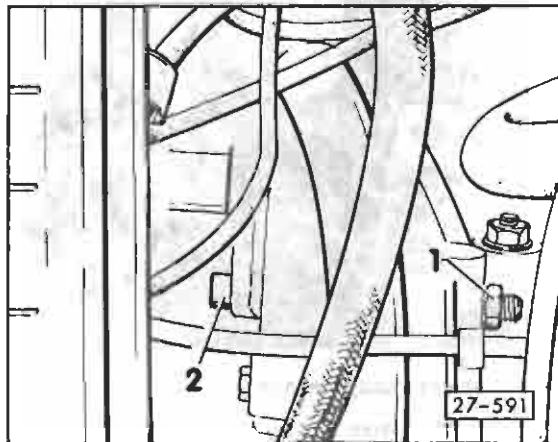
- terminal 30 = from battery
- terminal 16 = to ignition coil
- terminal 50 = from ignition/starter switch
- connection A = for field windings



# 27 Electrical – Battery, Starter, Alternator

## Starter motor, removing and installing

— disconnect battery ground strap



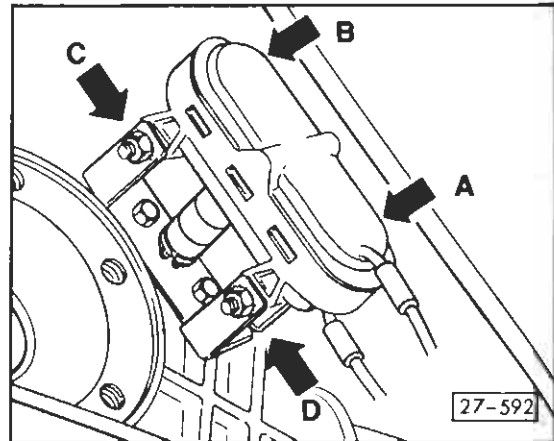
- remove upper mounting nut **1** from starter motor while holding bolt **2** with wrench
- release handbrake (to allow axle shaft rotation)
- raise vehicle on hoist
- disconnect right rear axle shaft from transmission (six bolts) (see Repair Group 34)
- cover exposed CV joint with plastic bag to prevent entry of dirt or foreign material

### Note

You can remove the starter motor without disconnecting the axle shaft, however; if the starter motor area of the engine is caked with dirt, axle removal greatly improves accessibility.

### Differential lock servo, removing

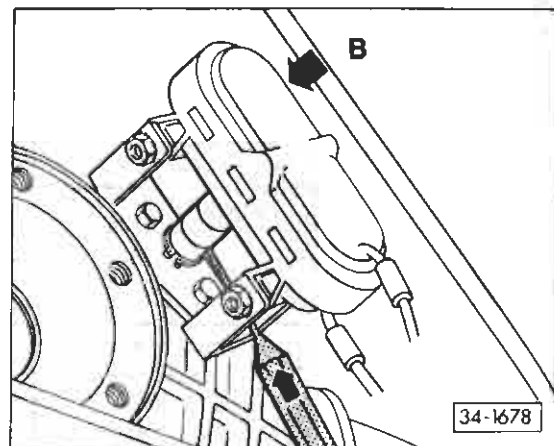
- loosen clamp securing cooling hoses to chassis
- swing hoses to one side (and secure with wire if necessary) to provide working clearance



- remove bolt **A** from differential lock servo
- loosen bolt **B** and withdraw as far as possible (clearance limitations prevent complete removal of bolt **B**)

### CAUTION

Nuts **C** and **D** are welded to the bracket. No attempt should be made to loosen them.



- push back protective sleeve and drive out roll pin
- with bolt **B** withdrawn as far as possible, give servo a slight upward twist and remove from bracket

more

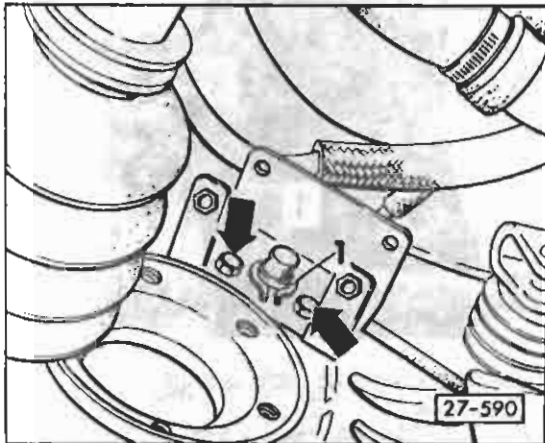
## 27.13a

Starter motor,  
removing and installing

Syncro

H-15

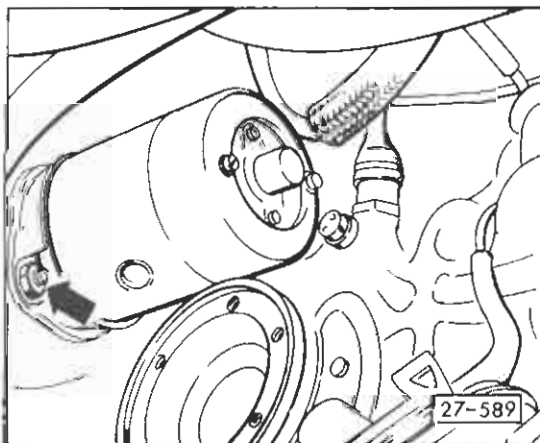
## Starter motor, removing and installing, continued



- remove circlip 1
- remove bolts (arrows)
- remove bracket

## Starter motor, removing

- disconnect wires from solenoid terminals 30 and 50



- loosen lower mounting nut on starter motor (arrow)
- push up slightly on starter motor and remove

## Starter, installing

- clean mating surfaces and apply sealer **AMV 188 000 02** before installing starter
- installation procedure is reverse of removal

Starter motor mounting bolts torque:

- specification: 28 Nm (21 ft lb)

### CAUTION

Part numbers are for reference only. Always check with your Parts Department for latest information.



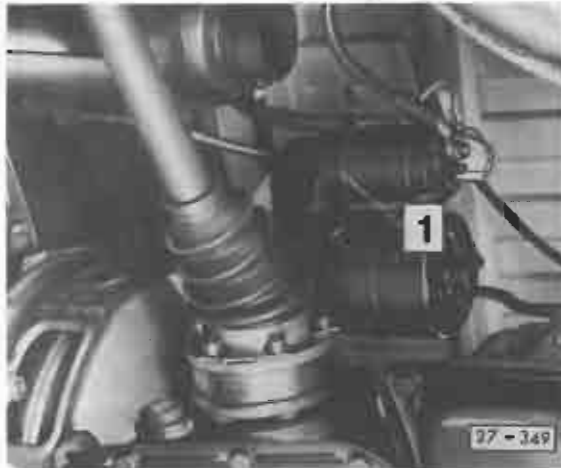
# 27 Electrical-Battery, Starter, Alternator

## Starter, installing

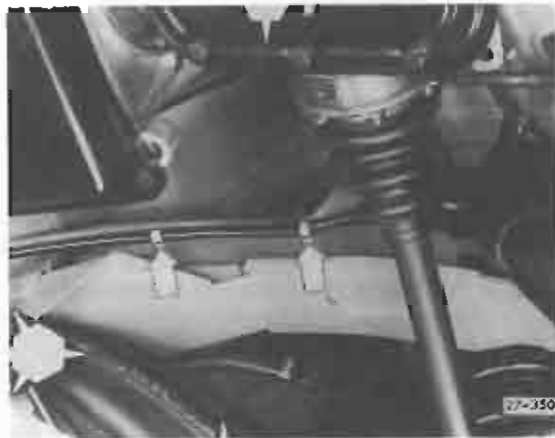
### Work sequence

#### CAUTION

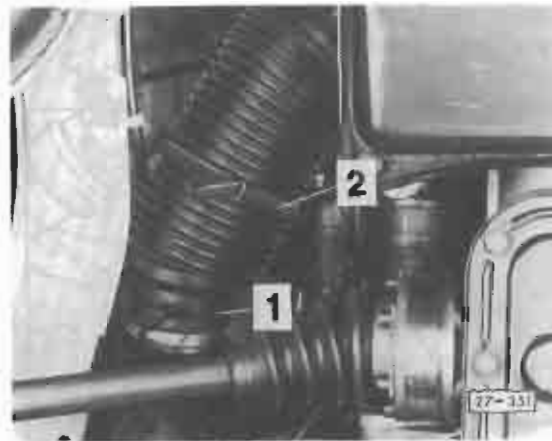
Before starting work on any part of electrical system disconnect battery ground strap



— attach wiring from alternator and wiring for terminal 50 from ignition/starter switch to starter solenoid with cable tie 1



— attach battery/starter cable to frame side member with cable clips (arrows)



— attach battery/starter cable to warm air hose with cable tie at:  
● 1 = vehicles with manual transmission  
● 2 = vehicles with automatic transmission

## Alternator (90A), removing and installing (Bosch)

### Note

To prevent the alternator bolt from becoming loose and breaking, the torque specification has been increased.

The increased torque specification requires use of a new bolt on 1.9L water cooled engine.

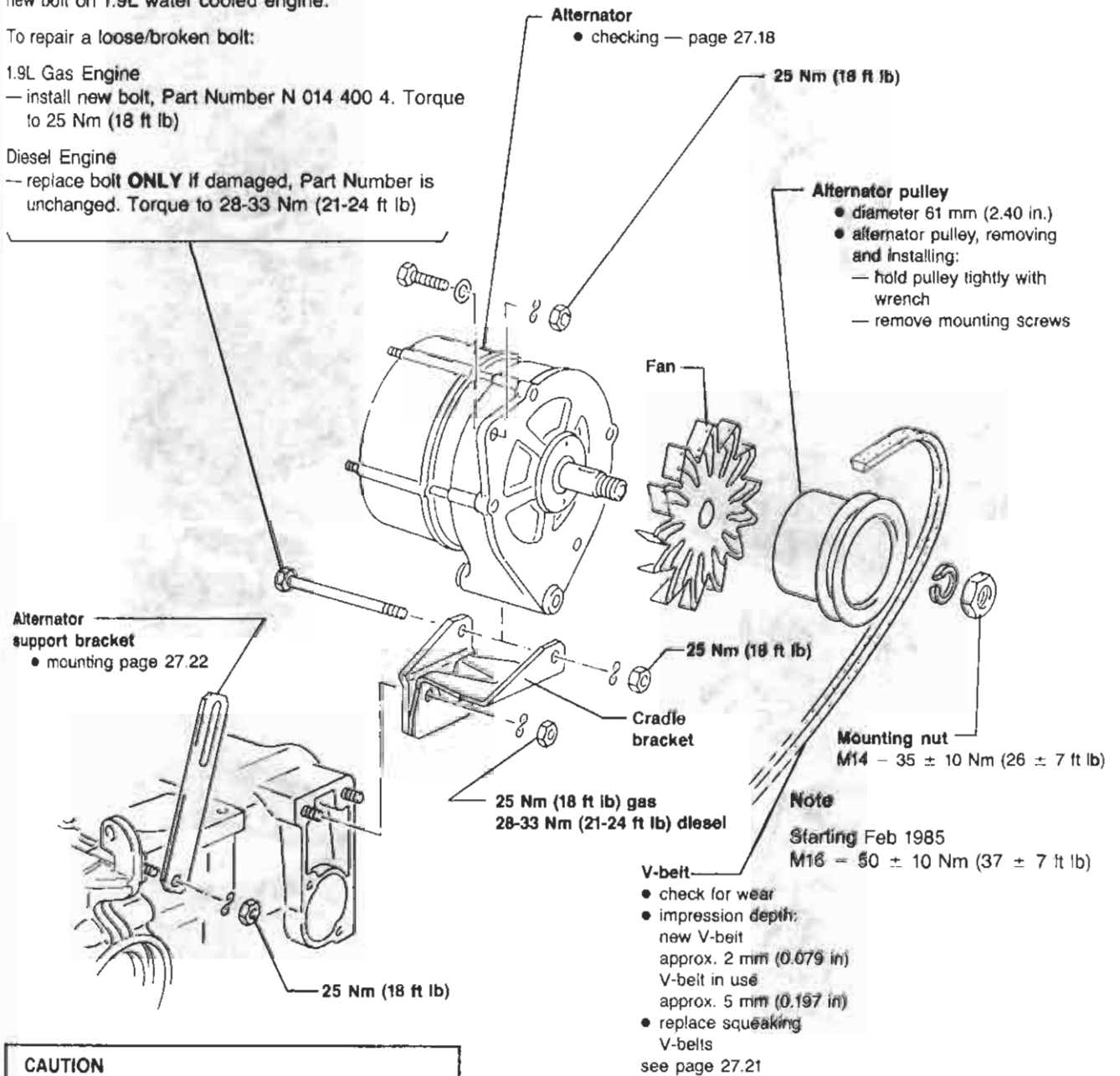
To repair a loose/broken bolt:

#### 1.9L Gas Engine

— install new bolt, Part Number N 014 400 4. Torque to 25 Nm (18 ft lb)

#### Diesel Engine

— replace bolt **ONLY** if damaged, Part Number is unchanged. Torque to 28-33 Nm (21-24 ft lb)



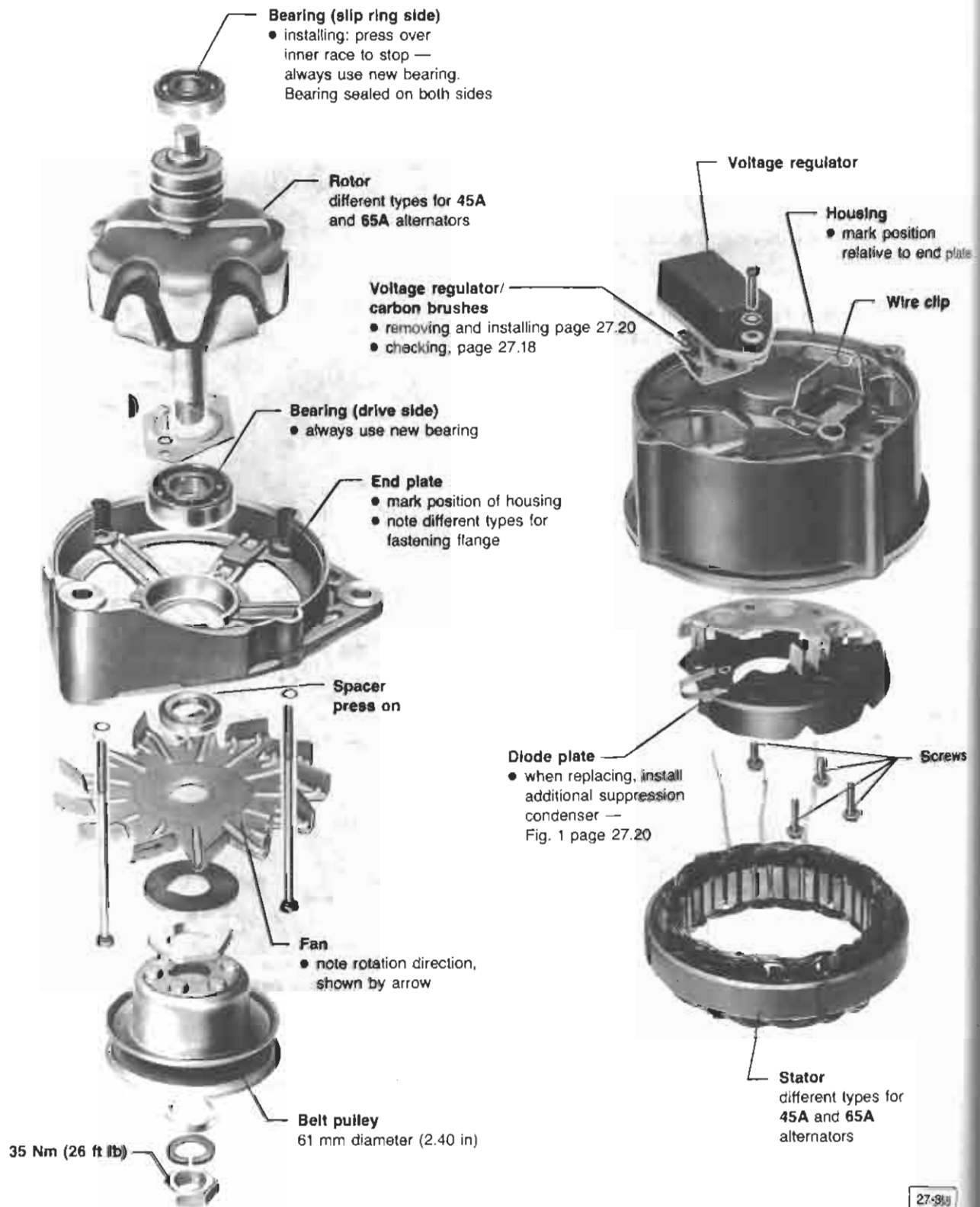
### CAUTION

Part Numbers are for reference only. Always check with the Parts Department for the latest information.

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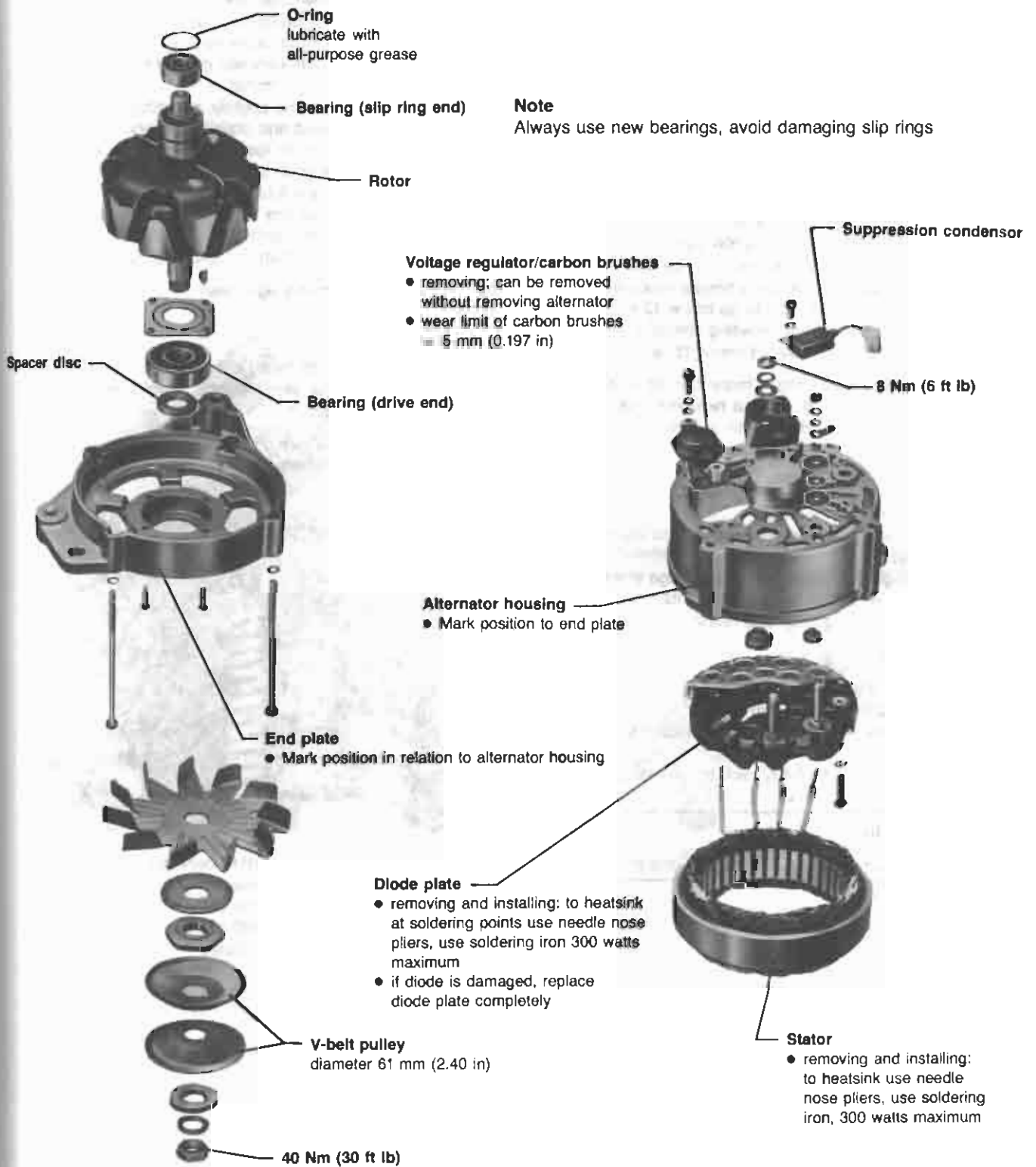
# 27 Electrical-Battery, Starter, Alternator

## Alternator, 45A and 65A, repairing (Bosch)



## 27.16 Alternator, repairing (45A and 65A models)

## Alternator, repairing (90A, Bosch) starting October 1982



27-573



# 27 Electrical-Battery, Starter, Alternator

## Alternator/regulator, checking (with Sun VAT-40 or equivalent)

### Visual checks

- check for:
  - loose or broken ground straps
  - loose or damaged V-belt
  - properly operating alternator charging light
  - proper tightening of alternator

### Work sequence

#### Alternator output test

- connect alternator/regulator tester according to manufacturer's instructions
- start engine and run at 3,000 rpm
  - all electrical accessories must be OFF
- adjust load to maximum ammeter reading
  - do not allow voltage to go below 12 volts
  - maximum ammeter reading should be at least alternator rated output minus 16 amps
  - if ammeter reading is more than 16 amps below alternator rating, replace regulator and retest
  - if ammeter reading is still too low, alternator is defective

#### Regulator test

- tester still connected
- all electrical components OFF and NO ammeter load
- run engine at 3,000 rpm until voltage stops rising
  - voltage should be 13.5-14.5 volts
- if NO, replace regulator and retest

#### Diode test

- tester still connected
- run engine at 3,000 rpm
- adjust load according to manufacturer's instructions
  - if meter reads "bad," replace alternator

### CAUTION

Never run alternator with battery disconnected

### Current drain test

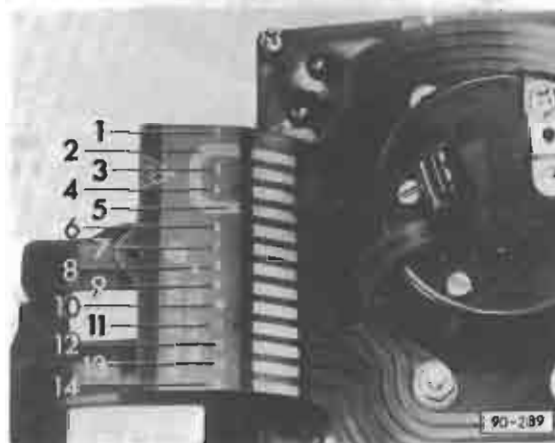
- turn OFF ignition switch, radio, and all lights
- leave rear window defogger switch and air conditioning switches ON to check air conditioner relay and load reduction relay
- disconnect ground cable from battery
- connect test light between ground cable and negative battery terminal
  - if test light burns brightly, something is switched ON or shorted and draining battery
- remove fuses from fuse/relay panel one at a time until test light goes out to help locate problem
  - if no faults are found in fused circuits, disconnect cables from non-fused components, i.e. alternator, starter motor, ignition system and dashboard instruments until test light goes out

### Alternator charging light test

#### Note

If battery is still not being charged, even though charging light operates properly, check alternator charging light circuit

- disconnect battery ground strap
- remove instrument cluster



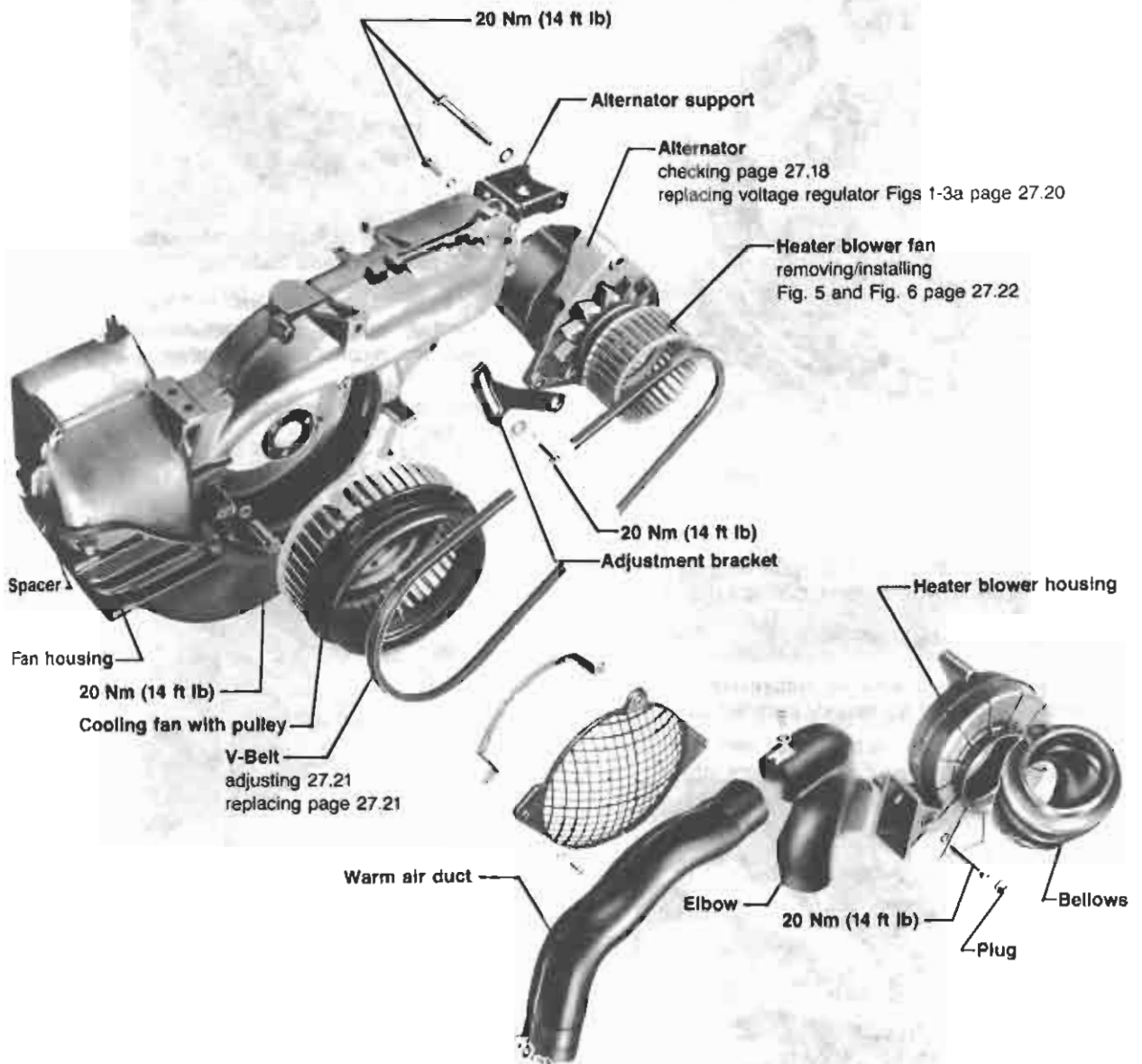
- attach multimeter US1119 between contacts 9 and 13 on printed circuit board
  - specification: 140-160 ohms
- if value is greater than 160 ohms:
  - replace printed circuit board

## Alternator and related components, layout

### CAUTION

Before starting to work on any part of electrical system disconnect battery ground strap.

Never run alternator with battery disconnected.



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# 27 Electrical-Battery, Starter, Alternator

## Voltage regulator, removal, installation and maintenance



Fig. 1 Suppression condenser, connecting

### Note

Voltage regulator with black rectangular housing is supplied as replacement. Part No. 028 903 803A

Voltage regulator can be replaced without removing alternator

- if voltage regulator is replaced, suppressor condenser (Fig. 1) (if not already installed) must be added



Fig. 2 Voltage regulator, removing and installing

### CAUTION

Part numbers are for reference only. Always check with your Parts Department for latest information.

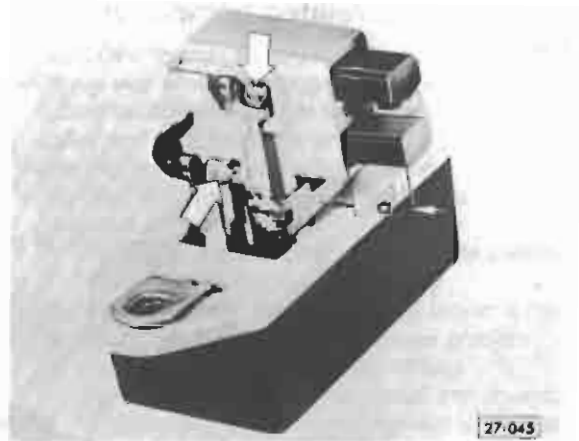


Fig. 3 Voltage regulator/carbon brushes, removing and installing

a = new = 10 mm, wear limit = 5 mm  
If necessary, remove solder from connecting wires (arrows) and replace carbon brushes

Alternator/Voltage regulator (from 1981 model)

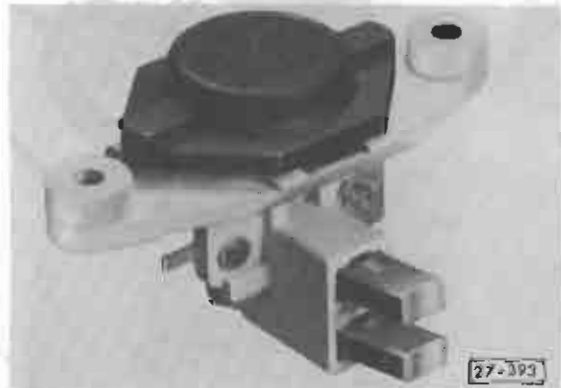


Fig. 3A

Voltage regulator ( hybrid-type ) now has longer carbon brushes

a = approx. 13 mm (19/32 in)  
wear limit = approx. 5 mm (7/32 in)

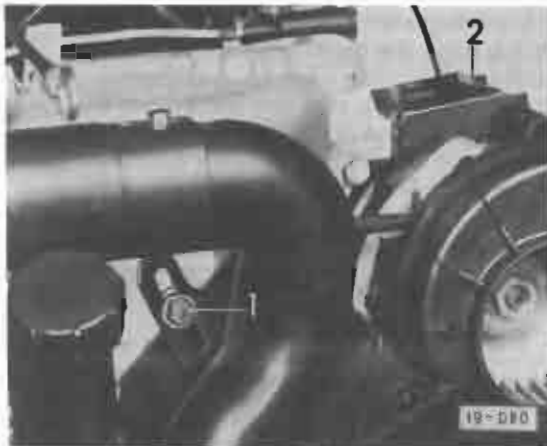
### Note

Do not install new-type voltage regulator (with longer brushes) into old-type alternators

Slip ring (on which brushes make contact) has been reduced in diameter to 28 mm (1 1/8 in) (was 32 mm)

Shape of cooling openings in alternator housing has been changed

## V-belt, adjustment



**Fig. 4 V-belt, adjusting**

Due to higher alternator output, present V-belt tension is insufficient.

Adjust belt tension as follows:

- loosen bolts 1 and 2 and pivot alternator

### Alternator V-belts up to 1000 mm long (39.4 in)

- 2 mm max. (0.079 in) deflection with new belt, thumb pressure
- 5 mm max. (0.197 in) deflection with previously run belt, thumb pressure

### Alternator V-belts over 1000 mm long (39.4 in)

- 10 mm max. (0.394 in) deflection with new belt, thumb pressure
- 15 mm max. (0.59 in) deflection with previously run belt, thumb pressure

### Note

Extremely loud squealing may indicate damaged V-belt that should be replaced

## V-belt, replacing

### Work sequence

- disconnect battery ground strap
- remove bellows from heater blower housing
- remove warm air duct and elbow
- remove guard for fan and ignition timing scale
- loosen bolt for adjustment bracket on fan housing
- remove alternator pivot bolt/upper heater blower housing mounting bolt
- remove lower heater blower housing mounting bolt (on right side of alternator)
- loosen bolt attaching adjustment bracket/heater blower housing to alternator (on left side of alternator)



- remove V-belt from V-belt pulley between alternator and heater blower fan
- install new V-belt and adjust
  - after installing new V-belt, bellows must fit tightly on heater blower housing and fresh air intake duct (see also, pages 27.19, 27.22)



# 27 Electrical-Battery, Starter, Alternator

## Heater blower fan, removing and installing

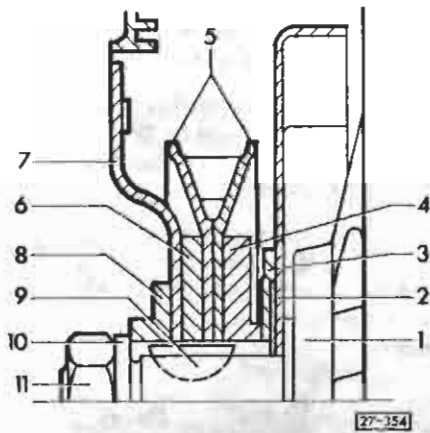


Fig. 5 Heater blower fan, removing/installing

- 1 = alternator
- 2 = alternator cooling fan
- 3 = support ring
- 4 = shim with collar
- 5 = V-belt pulley
- 6 = spacer
- 7 = heater blower fan
- 8 = thrust washer
- 9 = woodruff key
- 10 = spring washer
- 11 = nut, tighten to 35 Nm (25 ft lb)



Fig. 8 Heater blower fan, removing/installing

— hold pulley with V-belt and VW 420

## Alternator mount, adjusting (from illustration 27-576 page 27.15)

If alternator mount is loose, with a consequent rattling noise, the cause can be the elimination of the spring washer under each bracket mounting bolt. The mounting bolts may only partly touch the uneven and rough surface of the cast iron bracket, causing the preload force to be insufficient even with correctly applied torque.

### To correct,

- install spring washer, Part No. NO12 24 111, on each bracket mounting bolt
- install bolts and torque to 22 Nm (16 ft lb)

### Note

Spring washers are now installed on cars beginning with January, 1982 Vanagon production (from VIN 25CH089151).

### Mounting bolts, tightening

If alternator mounting bolts become loose, follow this procedure:

### Waterboxer

- replace old bolts with new bolts of higher strength (New bolt P/N N14 400.4)
- re-torque new bolt to higher torque specification

### Diesel motor

- re-torque old bolts

### Torque specification:

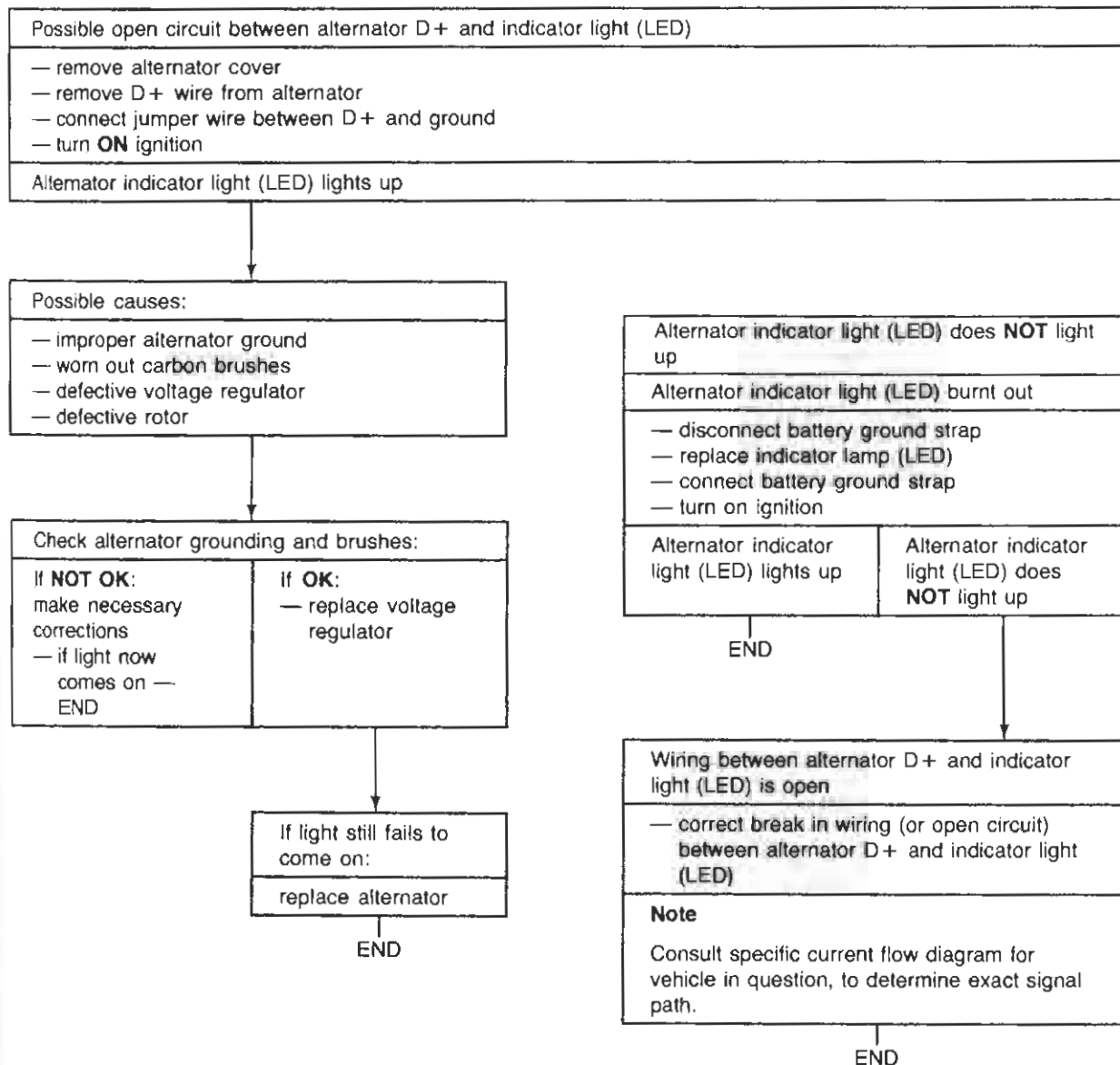
- Waterboxer 24.0 Nm (18 ft lb)
- Diesel motor 28.0-33.0 Nm (21.0-24.0 ft lb)

### CAUTION

Part numbers are for reference only. Always check with your Parts Department for latest information.

## Troubleshooting indicator light for alternator (LED)

Does not illuminate with Ignition ON (engine NOT started)



# 27 Electrical-Battery, Starter, Alternator

## Troubleshooting indicator light for alternator (LED)

Light is on with ignition <b>OFF</b>
— diode (or diodes) defective
— replace alternator

END

Alternator indicator light does <b>NOT</b> go out when RPM increases
Possible causes:
— slipping fanbelt, tighten if necessary — ground short between alternator D+ and indicator light (LED) — Defective alternator

END

Possible short to ground between alternator D+ and indicator light (LED)	
— disconnect alternator wiring — turn <b>ON</b> ignition	
Alternator indicator light (LED) lights up	Alternator indicator light (LED) does <b>NOT</b> light up

— short to ground in wiring between alternator D+ and indicator light (LED) must be corrected
<b>Note</b> Consult specific current flow diagram for vehicle in question, to determine exact signal path.

END

— Test alternator output — test voltage regulator
--

— replace defective component
-------------------------------

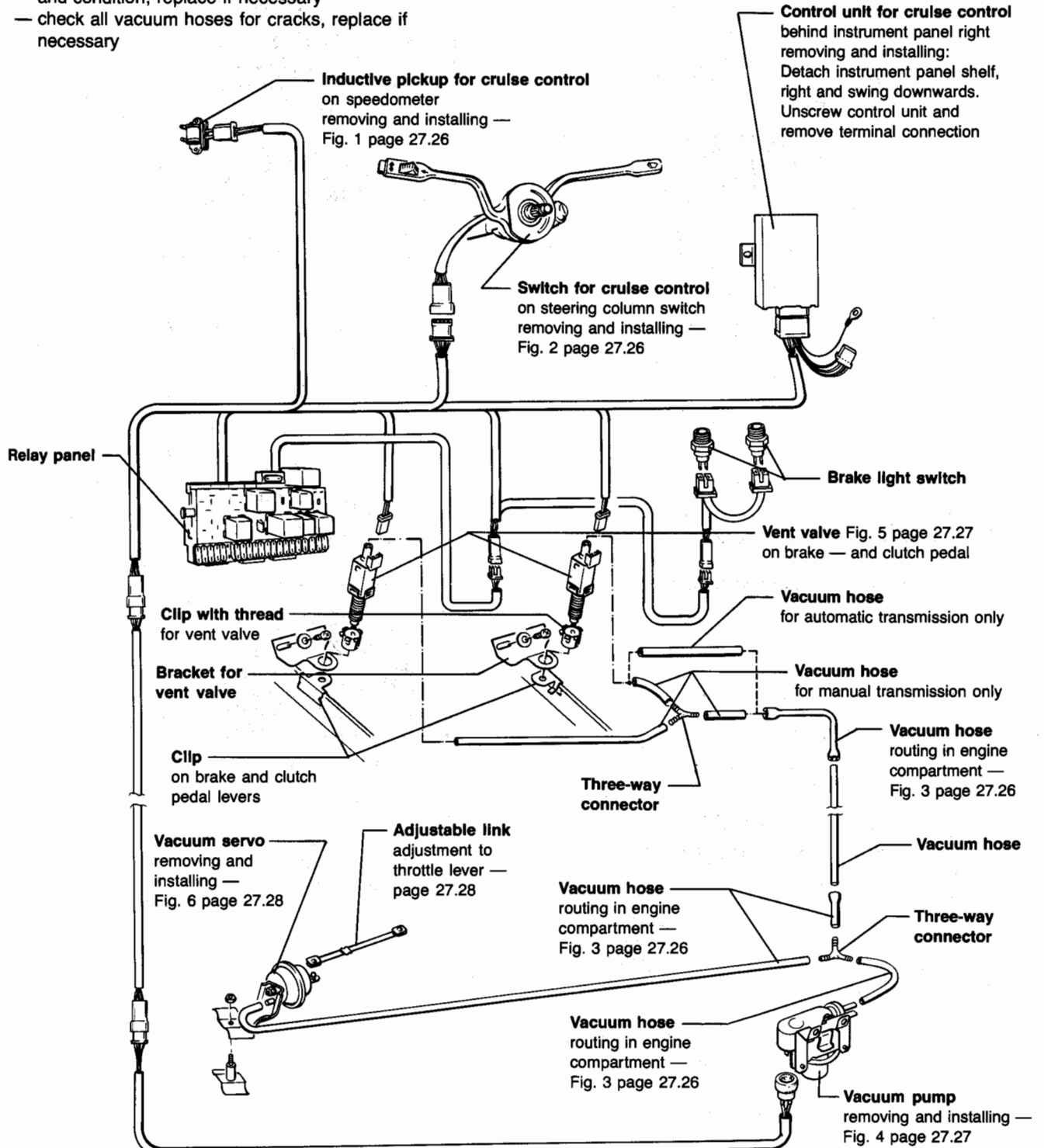
END

## Cruise control system, repairing

### Note

When troubleshooting:

- check vacuum hose on vacuum pump for wear and condition; replace if necessary
- check all vacuum hoses for cracks, replace if necessary



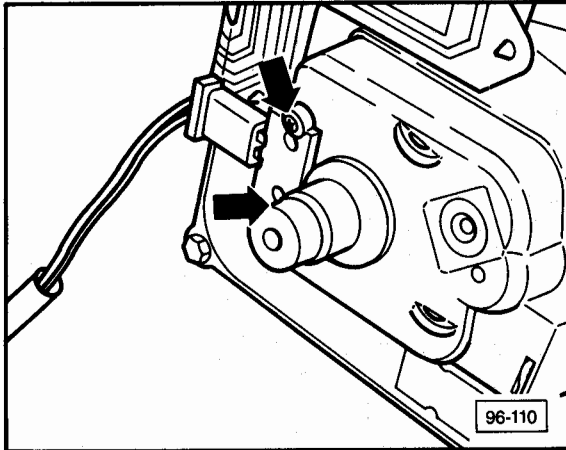
96-109



# 27 Electrical – Battery, Starter, Alternator

**Fig. 1 Inductive pickup for cruise control, removing and installing**

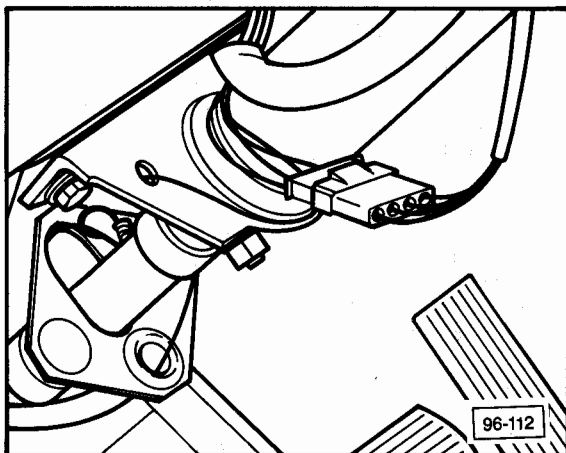
- detach battery ground strap
- remove instrument panel insert cover and foil, located underneath
- remove drive cable for speedometer
- remove electrical connections to instrument panel insert
- unscrew 4 mounting bolts from instrument panel insert



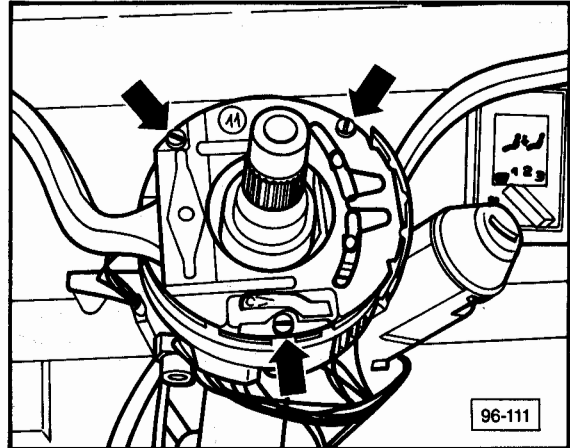
- remove inductive pickup screws and remove from harness connector

**Fig. 2 Switch for cruise control removing and installing**

- remove steering column trim

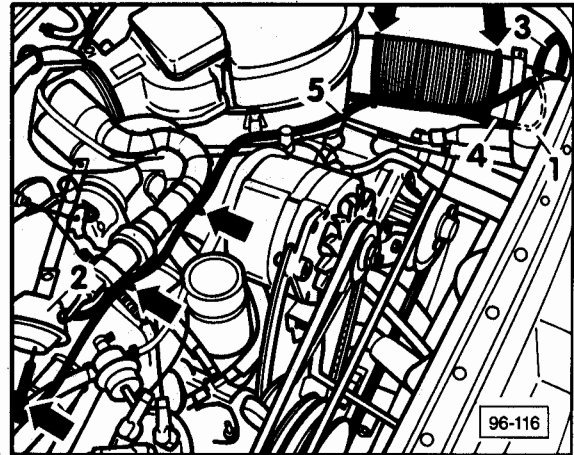


- separate 4-pin terminal connection to switch for cruise control
- pry off cap for horn and remove steering wheel



- remove mounting bolts for steering column switch and remove turn signal with switch for cruise control

**Fig. 3 Routing vacuum hoses in engine compartment**



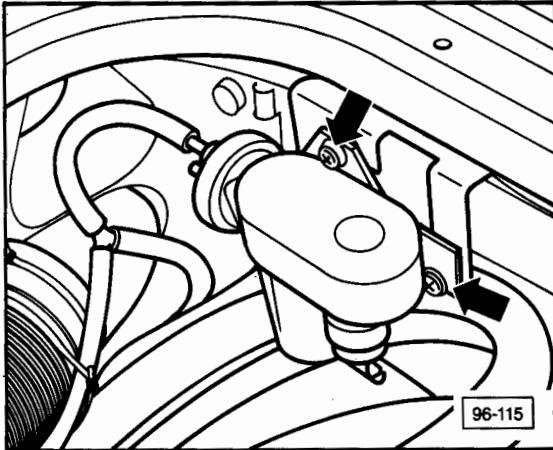
- secure vacuum hoses with tie wraps (arrows)

- 1 — Vacuum pump
- 2 — Vacuum unit with adjustable link
- 3 — Vacuum hose to pump
- 4 — Vacuum hose to vent valves
- 5 — Vacuum hose to vacuum unit

**Fig. 4 Vacuum pump, removing and installing**

The vacuum pump is located at the rear right side of the engine compartment.

- pull off vacuum hose and connector



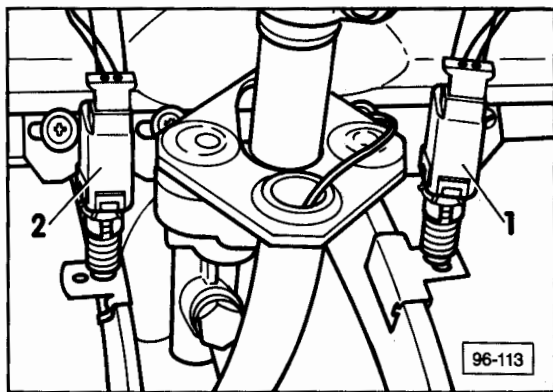
- remove mounting bolts (arrows)

**Fig. 5 Vent valve(s), removing and installing**

**Note**

Vehicles with a manual transmission will have a vent valve for the brake and a vent valve for the clutch. Vehicles with an automatic transmission will have a vent valve for the brake pedal only.

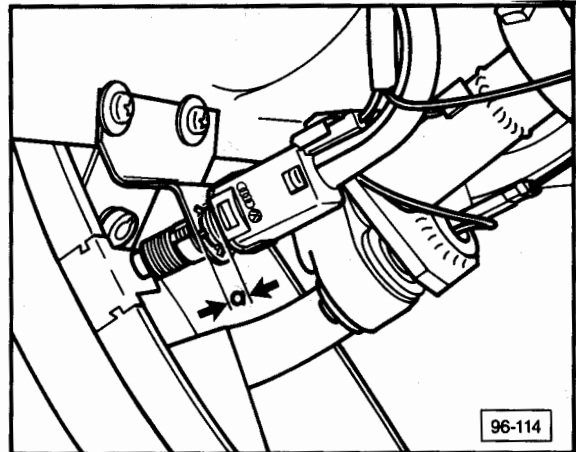
- remove steering column trim



- remove vacuum hose and terminal from brake vent valve (1) and clutch vent valve (2)
- unscrew vent valve from the vent clip

**CAUTION**

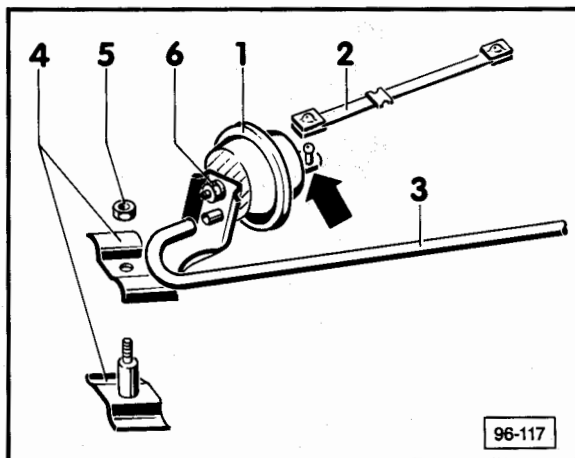
Do not damage thread.



When installing vent valve(s) set distance "a", so that the valve(s) are closed when brake and clutch pedals are in rest position, and opened when pedals are actuated.

# 27 Electrical – Battery, Starter, Alternator

Fig. 6 Removing and installing cruise control vacuum servo



1 — diaphragm

To check diaphragm:

- disconnect vacuum hose from pump
- press vacuum diaphragm inward, then plug detached vacuum hose
  - diaphragm must **NOT** move

2 — adjustable link to throttle valve lever

3 — vacuum hose

4 — securing bracket on intake manifold with stud and spacer

5 — nut

torque: 4 Nm (3 ft lb)

6 — nut with shoulder

torque: 23 Nm (18 ft lb)

### Note

The adjustable link is set to zero clearance at idling speed (**arrow**).

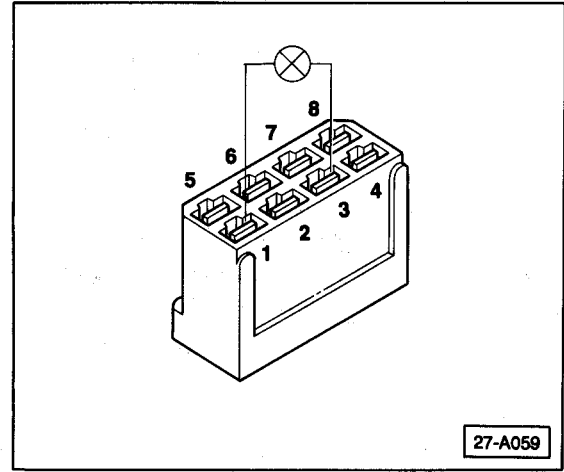
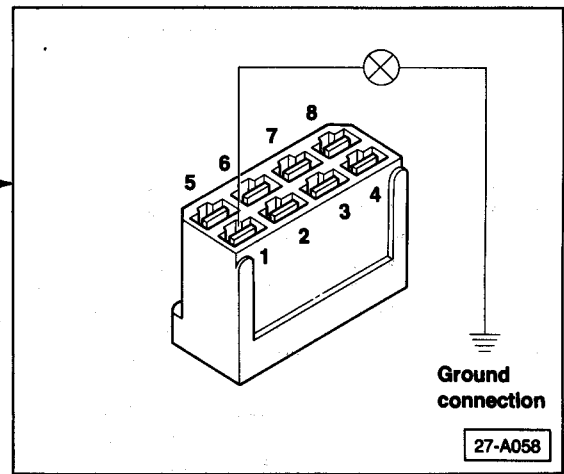
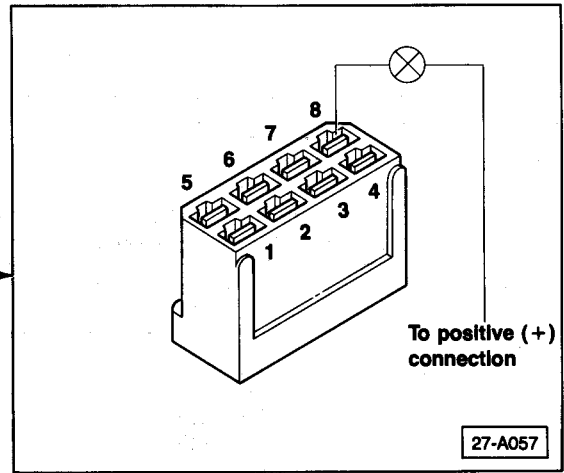
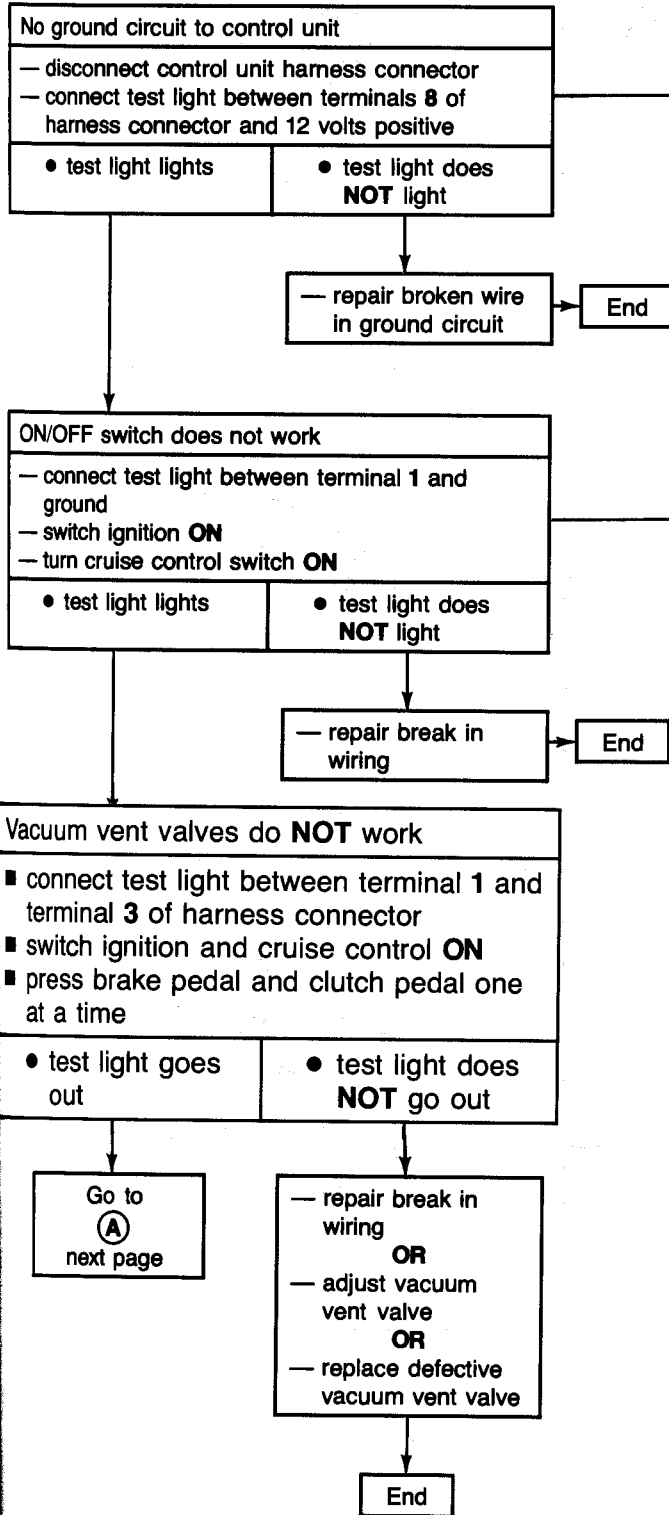
### Setting adjustable link

Attach link to throttle valve lever and adjust ball head on vacuum servo so that the adjustable link can be clipped in place without altering the throttle valve lever position.

## Cruise control troubleshooting

### Note

To perform following test, gear selector lever must be in "D" or "2" (automatic transmission).



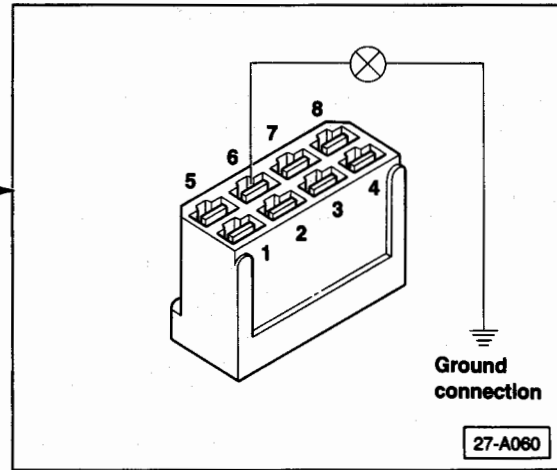
# 27 Electrical – Battery, Starter, Alternator

**(A)**

**Cruise control switch does NOT work**

- connect test light between terminal 6 of harness connector and ground
- switch ignition and cruise control ON
- push RESUME on cruise control switch

• test light lights	• test light does NOT light
---------------------	-----------------------------



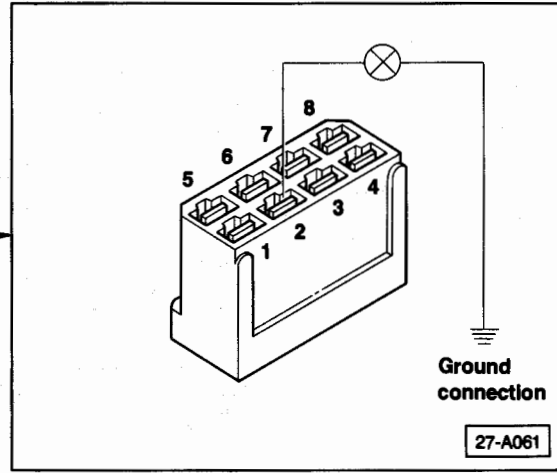
— repair break in wiring  
OR  
— replace defective switch

End

— connect test light between terminal 2 of harness connector and ground

— push SET on cruise control switch

• test light lights	• test light does NOT light
---------------------	-----------------------------



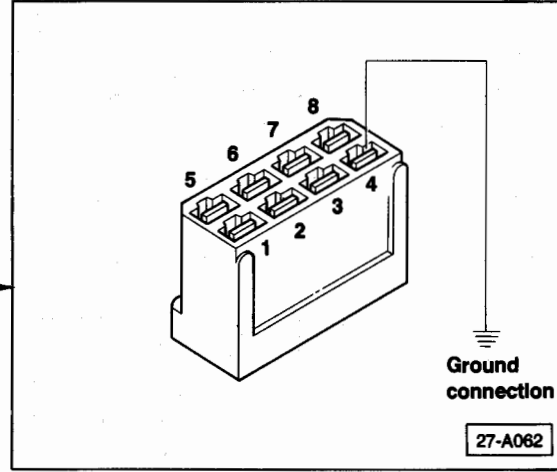
— repair break in wiring  
OR  
— replace defective switch

End

**Vacuum control motor does NOT work**

- connect jumper wire between terminal 4 of harness connector and ground

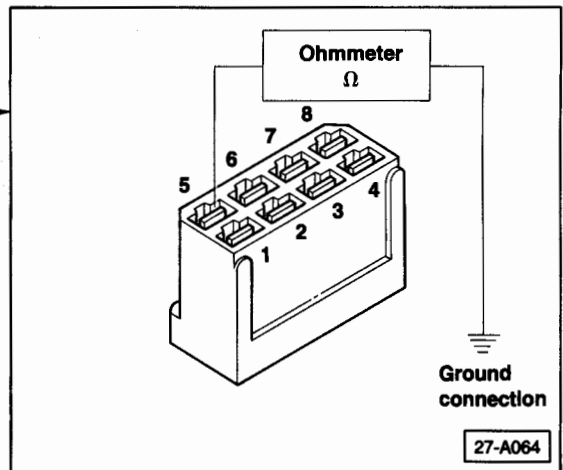
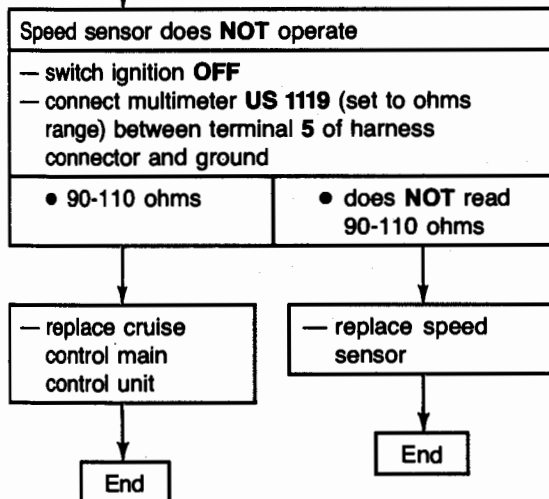
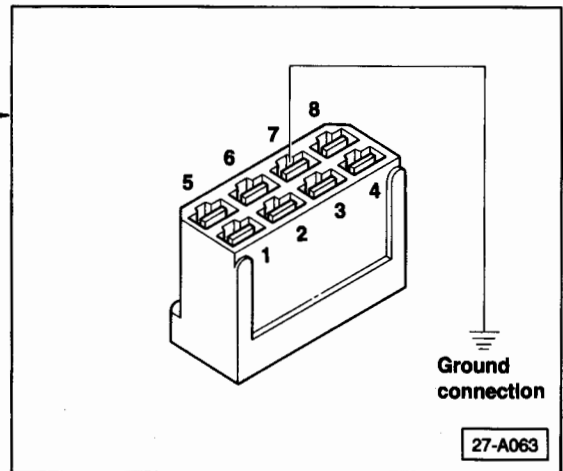
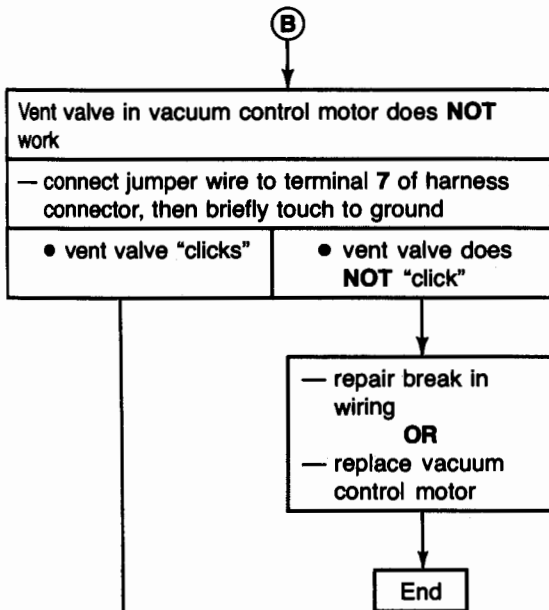
• pump runs	• pump does NOT run
-------------	---------------------



Go to **(B)** next page

— replace pump

End



**Note**

An inoperative cruise control system may be caused by vacuum loss due to cracked or leaking hoses.

## Manual Transmission Controls, Assembly

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- Gearshift
  - adjusting 34.4
  - assembly 34.3
  - bearing plate 34.4
  - linkage 34.2
- Transmission
  - removing 34.14

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# 34 Manual Transmission-Controls, Assembly

## Technical data

- code letters
- application
- gear ratios

<b>Transmission</b> code letters	ACW
<b>date of manufacture</b> from	01/86
to	
type	091/1
<b>Application to engine</b>	2.1 liter, Digifant, 70 Kw (95 bhp)
<b>Gear ratios</b> final drive	29:6 - 4.83
1st gear	34:9 - 3.78
2nd gear	33:16 - 2.06
3rd gear	49:40 - 1.23
4th gear	41:48 - 0.85
reverse gear	33:9 - 3.67
<b>Lubrication</b> capacity	3.0 liter (3.2 U.S. qt) <sup>1</sup>
specification	hypoid API GL-4, Mil-L-2105, SAE 80W, 80W/90
<b>Clutch</b> actuation	hydraulic
disc diameter	228 mm
drive flange diameter	100 mm
<b>speed in 4th gear</b> per 1000 rpm	29 Kph (18 mph)

<sup>1</sup> refill capacity only; 1.5 liters cannot be drained



# Manual Transmission-Controls, Assembly

## Technical data

- code letters
- application
- gear ratios

<b>Code letters</b>		DX
<b>Production</b>	from	10/82
	to	11/83
<b>Application</b>	type	Vanagon
	engine	1.6L Diesel 37 kW (48 bhp)
<b>Ratios</b>	final drive	38:7 = 5.428
	1st gear	37:9 = 4.111
	2nd gear	35:15 = 2.333
	3rd gear	31:21 = 1.476
	4th gear	57:56 = 1.018
	5th gear	49:64 = 0.765
	reverse gear	33:9 = 3.666
<b>Lubricant capacity</b>		4.0 Liters (4.2 US qt)
<b>Specification</b>		hypoid GL-4, MIL-L 2105, SAE 80 or G50 synthetic oil
<b>Clutch actuation</b>		hydraulic
<b>Clutch disc diameter</b>		215 mm
<b>Axle shaft flange diameter</b>		100 mm

5-speed 094

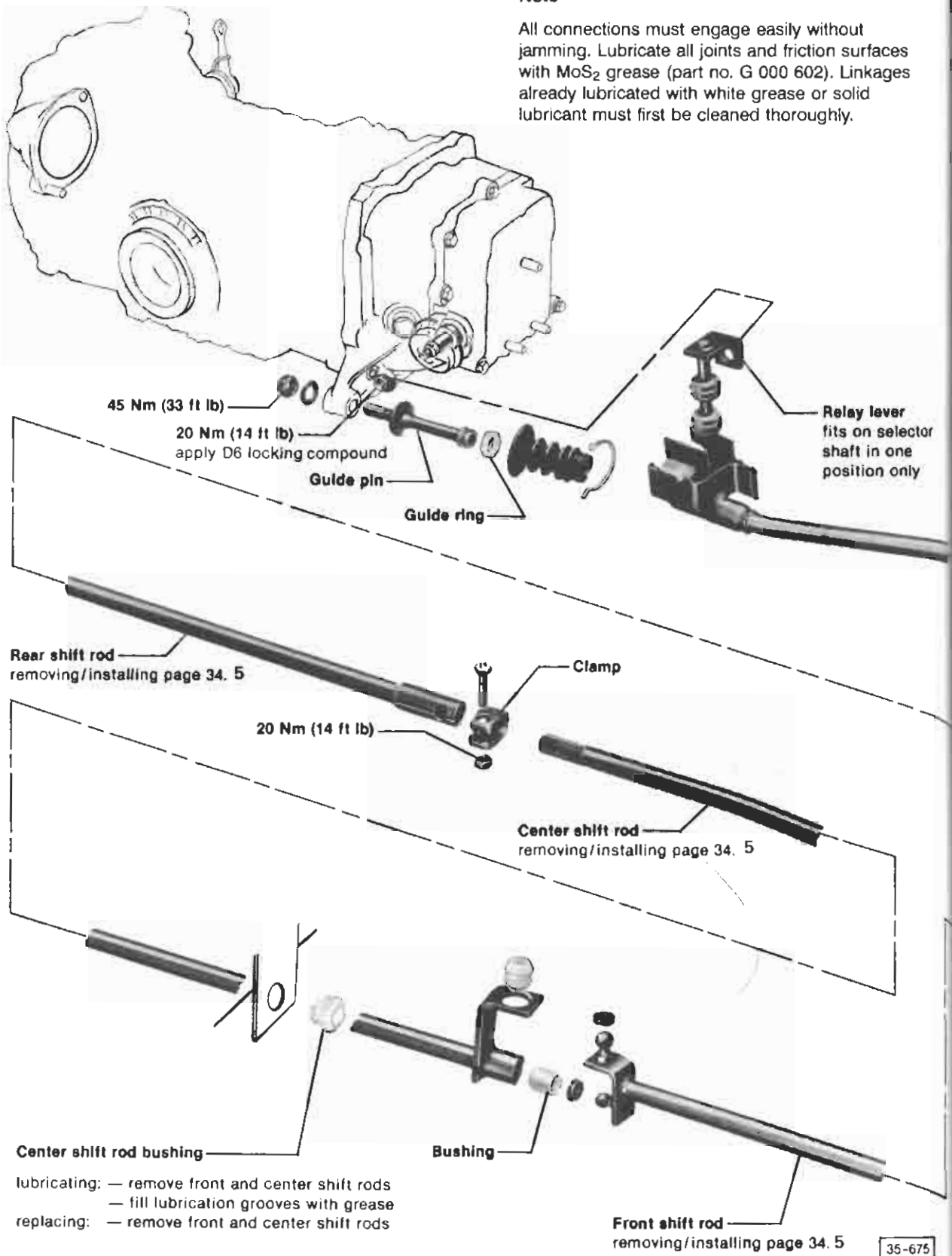
Technical data

**34.1b**

# 34 Manual Transmission-Controls, Assembly

## Note

All connections must engage easily without jamming. Lubricate all joints and friction surfaces with MoS<sub>2</sub> grease (part no. G 000 602). Linkages already lubricated with white grease or solid lubricant must first be cleaned thoroughly.

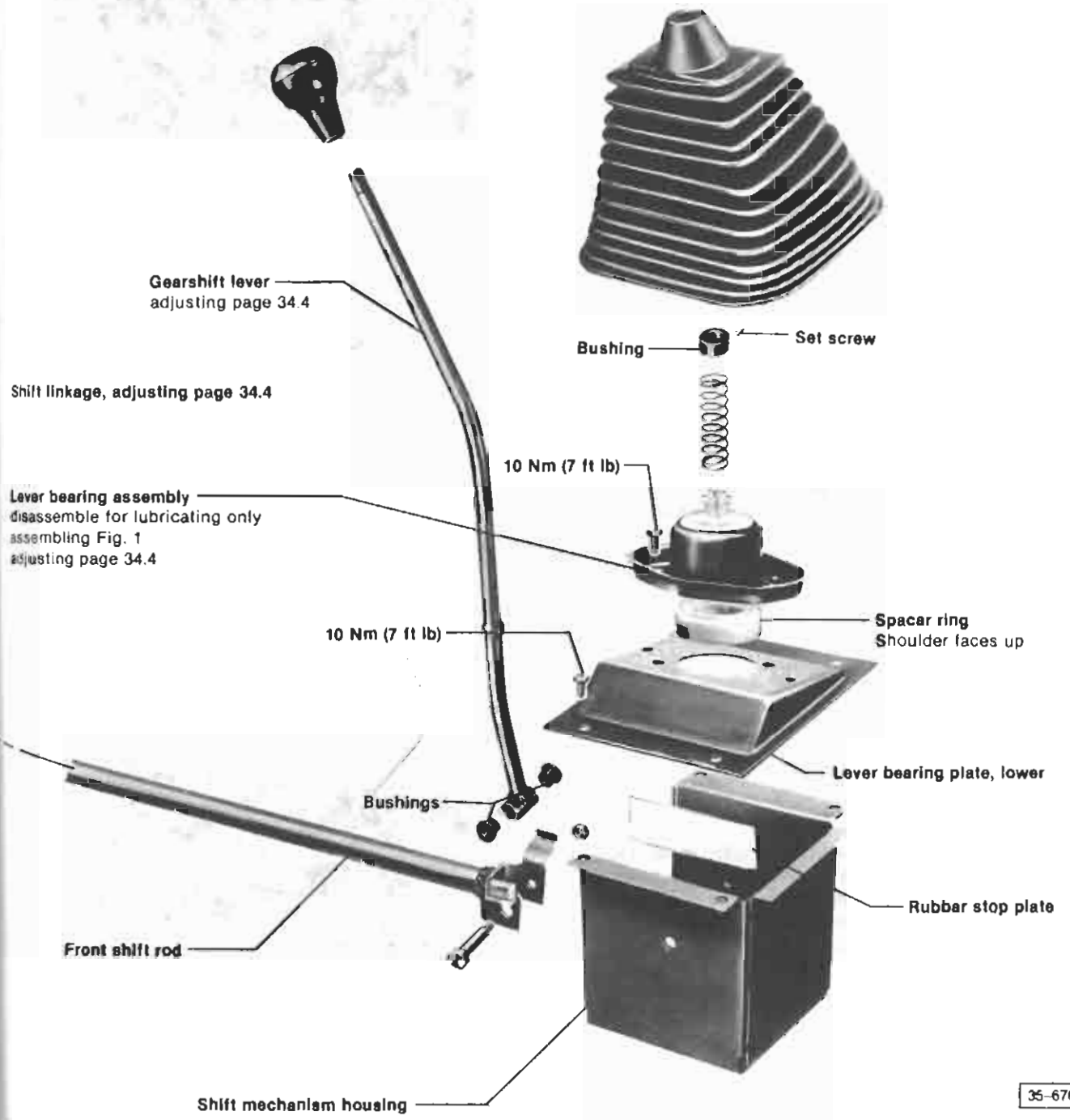


**Note**

Lubricate all joints and friction surfaces with MoS<sub>2</sub> grease (part no. G 000 602). Linkages already lubricated with white grease or solid lubricant must first be cleaned thoroughly.

**CAUTION**

Apply grease to shifter components inside the vehicle with great care. MoS<sub>2</sub> grease cannot be removed from upholstery or carpets.



but  
surfaces  
Linkages  
solid  
ly.

play lever  
s on selector  
raft in one  
osition only

5

35-675

35-676

B-1

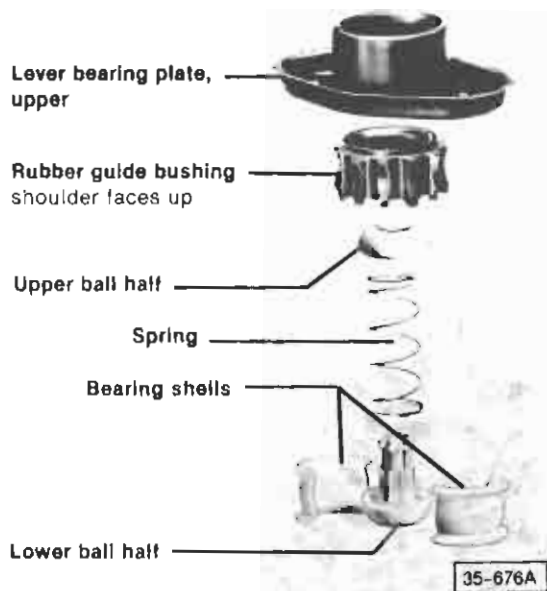
8-5

**4-speed 091**

Gearshift lever  
Shift rod

## 34.3

# 34 Manual Transmission-Controls, Assembly



**Fig. 1 Lever bearing, assembling**

- push both bearing shells into rubber guide bushing
- press lower ball half into shells from bottom (shouldered side of bearing is top)
- insert spring on lower ball half
- pushing shells apart, push in upper ball half
- push rubber guide bushing into upper lever bearing plate (shouldered side first)
- install spacer ring into bottom of upper lever bearing plate with shoulder facing rubber guide bushing

## Shift linkage, adjusting

### Work sequence

- place shift lever in neutral position

### Note

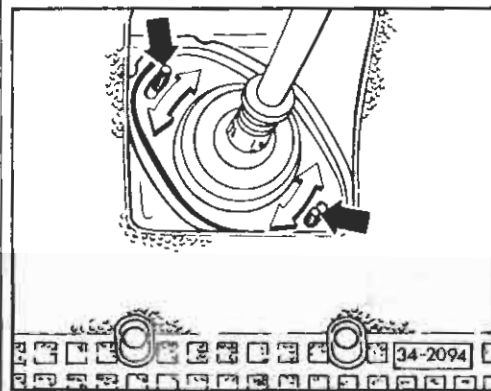
A revised shift lever bearing is installed in vehicles beginning 06-88. In the revised bearing the bearing plate alignment holes are deleted. The revised shift lever bearing can be installed in vehicles manufactured from 10-82 to 06-88.

### With alignment holes (up to 06-88)



- align holes (arrows) of upper bearing plate with holes of lower bearing plate

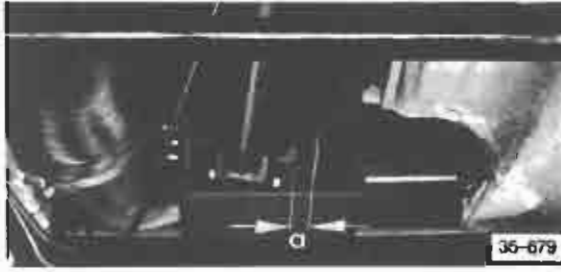
### Without alignment holes (beginning 06-88)



- rotate upper bearing plate so that the mounting studs (black arrows) contact opposite sides of the bearing plate
- tighten mounting nut to 10 Nm (7 ft. lb.)



- loosen shift rod clamp so selector lever can move easily on shift rod
- remove spare tire
- move stop finger of front shift rod to center of rubber stop in housing



- adjust shift rod end
  - up to Chassis No. 25 BH 137 155  
a = 19 mm (3/4 in.)
  - from Chassis No. BH 25 137 156  
a = 22 mm (7/8 in.)  
(to measure use locally fabricated sheet metal strip)
- tighten shift rod clamp
- shift through all gears and check that they engage easily without jamming
- check reverse lock-out for proper operation

**Note**

From Chassis No. BH 25 137 156 a new type mechanism housing has been installed. If 1st gear is jamming on vehicles up to Chassis No. BH 137 155 — even after correct adjustment is made — install new type shift mechanism housing and adjust distance a to 22 mm (7/8 in.)

## Front and center shift rods, removing/installing

**Work sequence**

- loosen clamp
- remove spare tire
- remove bolt holding shift lever to front shift rod
- pull off front and center shift rods in forward direction
- when installing, assemble both shift rods and insert into center shift rod bushing located above fuel tank

## Rear shift rod, removing/installing

**Work sequence**

- loosen clamp
- remove rear shift rod retaining bolt from transmission housing and push bolt into shift rod
- pull off rear shift rod
- install in reverse sequence

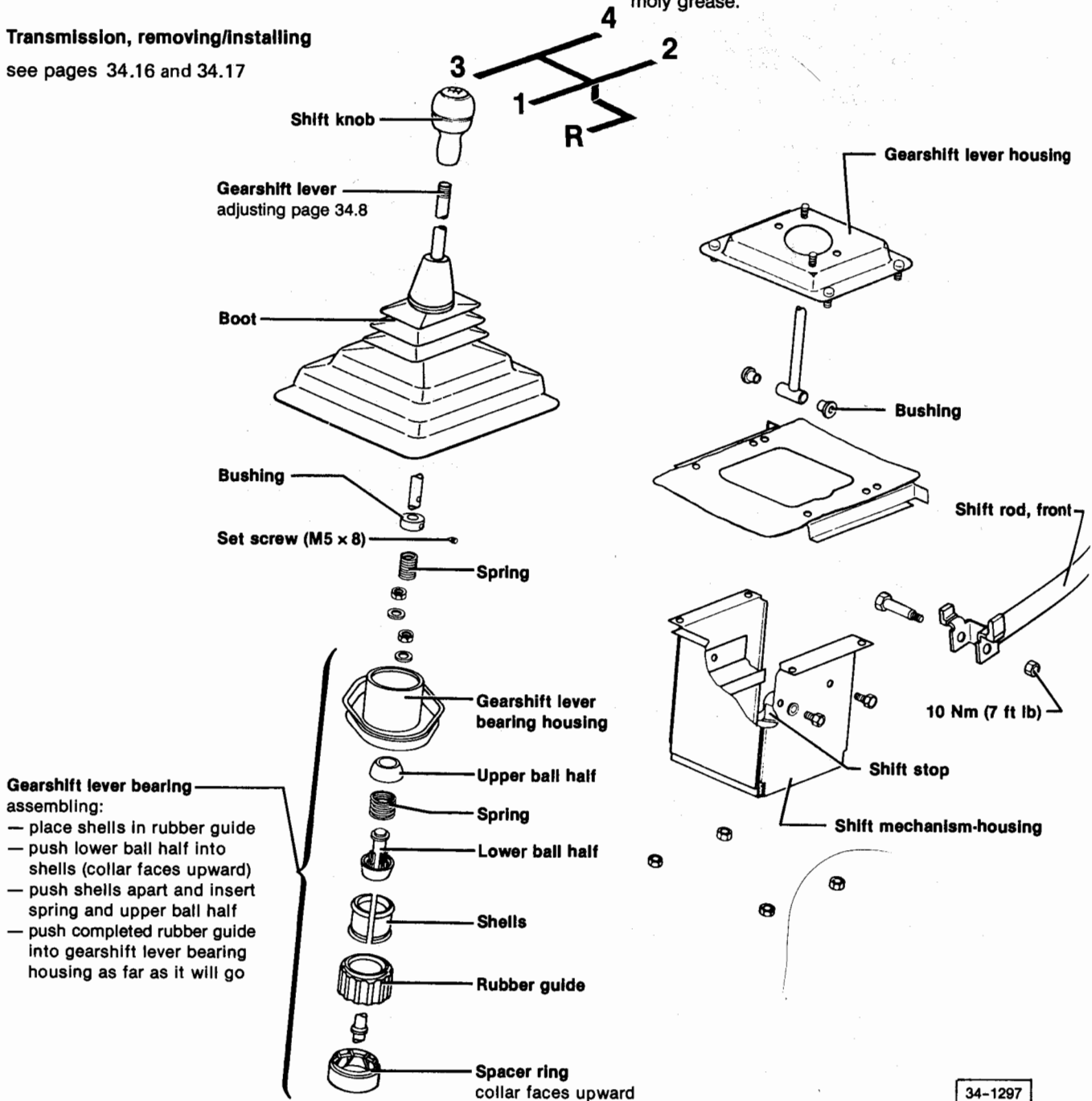
# 34 Manual Transmission-Controls, Assembly

## Note

Lubricate all joints and moving parts with grease (part no. G 000 602) before installing. Linkages already lubricated with white grease or solid lubricant must be cleaned thoroughly before applying moly grease.

## Transmission, removing/installing

see pages 34.16 and 34.17



**Gearshift lever bearing assembling:**

- place shells in rubber guide
- push lower ball half into shells (collar faces upward)
- push shells apart and insert spring and upper ball half
- push completed rubber guide into gearshift lever bearing housing as far as it will go

34-1297

grease  
packages  
solid  
before applying

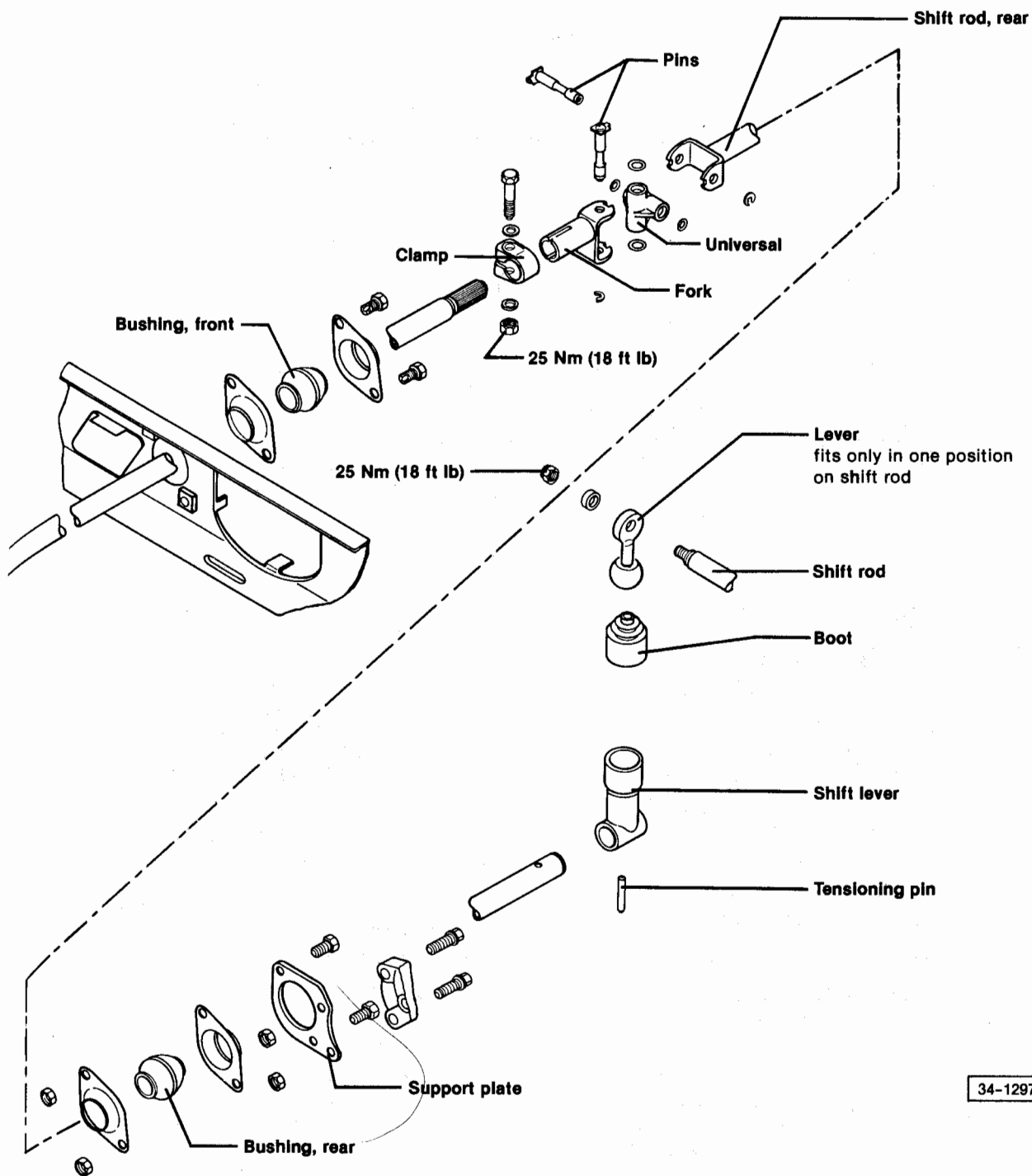
ower housing

ift rod, front

(7 ft lb)

housing

4-1297



34-1297

4-speed 091/1

Gearshift linkage

# 34.7

# 34 Manual Transmission-Controls, Assembly

Beginning in June 1987 a boot is installed on each side of the shift rod bushing.

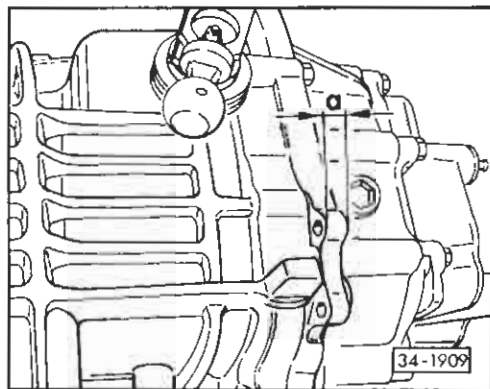
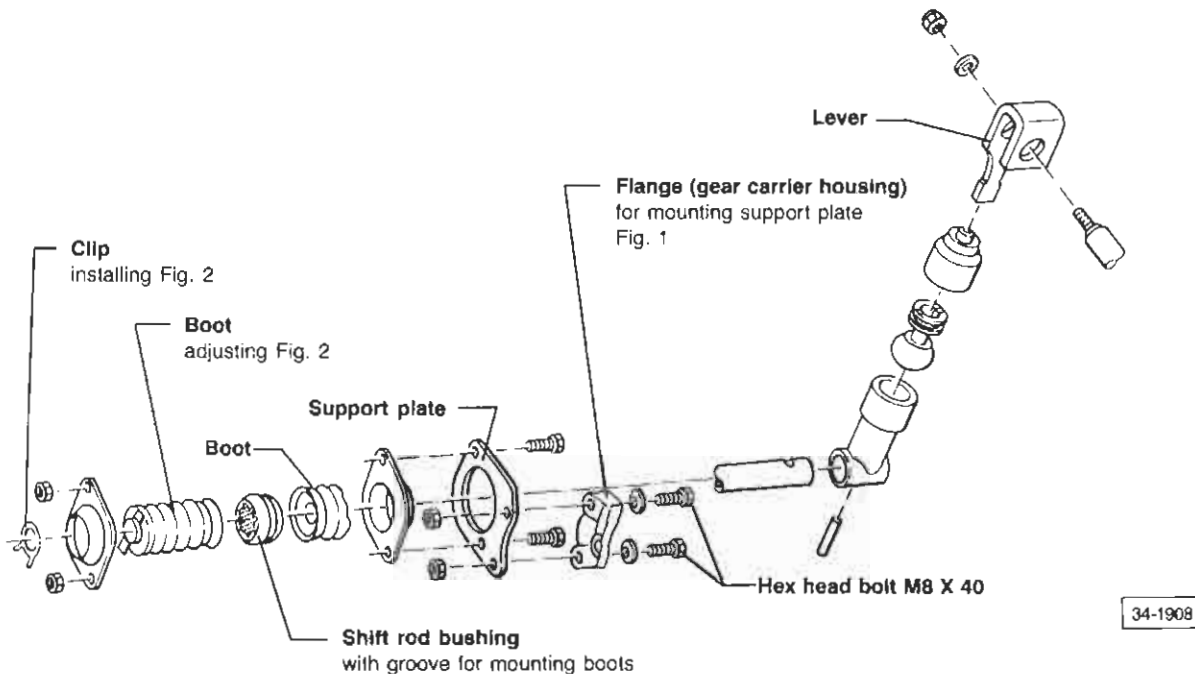


Fig. 1 Flange on gear carrier housing, dimensions

- a = 14.5 mm (previous version)
- a = 21.0 mm (revised version)

**Note**

The shift rod bushing is positioned 6.5 mm further forward on the revised flange. This prevents the rear boot from being compressed too far causing a shift out of gear.

During repairs, a gear carrier housing can be replaced with the revised housing on transmissions from 10/82 on.

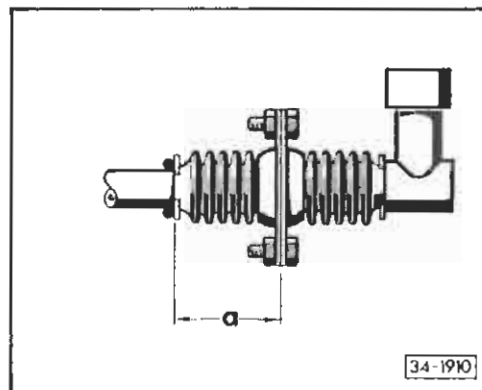


Fig. 2 Front boot, adjusting

- a = 60.0 mm (in neutral position)

**Note**

The revised shift rod mounting can be installed with the previous gear carrier housing. Insert a nut, M8 x 6.5, Part No. N 011 008 18, between flange and support plate. Use M8 x 40 bolt, Part No. N 010 340 4.



# 34 Manual Transmission-Controls, Assembly

## Gearshift lever, adjusting

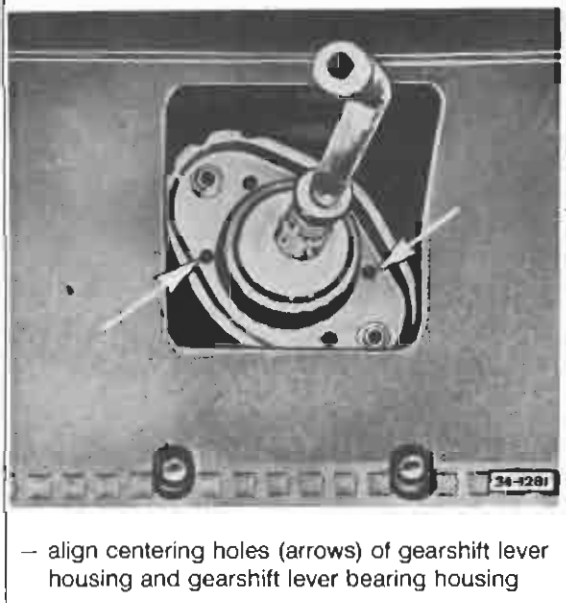
### Note

A revised shift lever bearing is installed in vehicles beginning 06-88. In the revised bearing the bearing plate alignment holes are deleted. The revised shift lever bearing can be installed in vehicles manufactured from 10-82 to 06-88.

### Work sequence

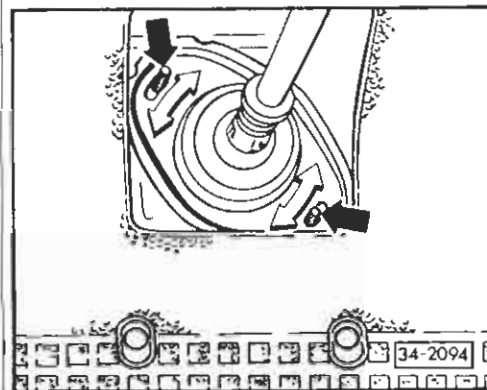
- shift into neutral position

#### With alignment holes (up to 06-88)



- align centering holes (arrows) of gearshift lever housing and gearshift lever bearing housing

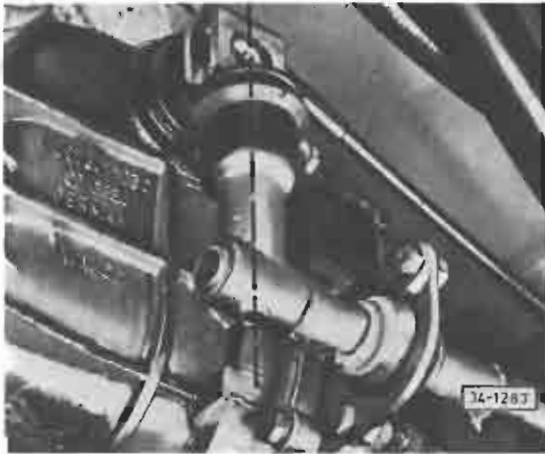
#### Without alignment holes (beginning 06-88)



- rotate upper bearing plate so that the mounting studs (black arrows) contact opposite sides of the bearing plate slots
- tighten mounting nuts to 10 Nm ( 7 ft. lb.)



- loosen clamp nut (arrow)
- check that joints of shift rods slide freely
- remove spare wheel



— set lever on transmission in vertical position, as shown



- move stop finger of front shift rod to center of shift mechanism housing
- adjust shift rod end
  - $a = 23 \text{ mm}$  (29/32 in.)  
(use strip of sheet metal to measure)

**CAUTION**

Transmission must be in neutral, lever on transmission in vertical position

- tighten shift rod clamp
- shift through all gears and check that they engage easily without jamming
- check reverse lock-out for proper operation

**Note**

Check that with 1st gear engaged, distance between shift lever and heater pipe insulation is min. 15 mm (19/32 in.)

**4-speed manual transmission 091/1**  
(1985 MY Vanagons)

Gear Ratios	Trans. DU		
1st gear	34:9	=	3.78
2nd gear	33:16	=	2.06
3rd gear	63:50	=	1.26
4th gear	52:61	=	0.85
Reverse	33:9	=	3.67
Final drive	34:7	=	4.86

Gear Ratios	Trans. ABD		
1st gear	34:9	=	3.78
2nd gear	33:16	=	2.06
3rd gear	49:40	=	1.225
4th gear	41:48	=	0.85
Reverse	33:9	=	3.67
Final drive	29:6	=	4.83

**Lubricant specifications**

lubricant capacity (incl. differential)  
 091/1 ..... 3.0 l (3.2 US qt)  
 viscosity ..... SAE 80W, SAE 80W/90  
 type ..... hypoid, MIL-L-2105; API/GL-4

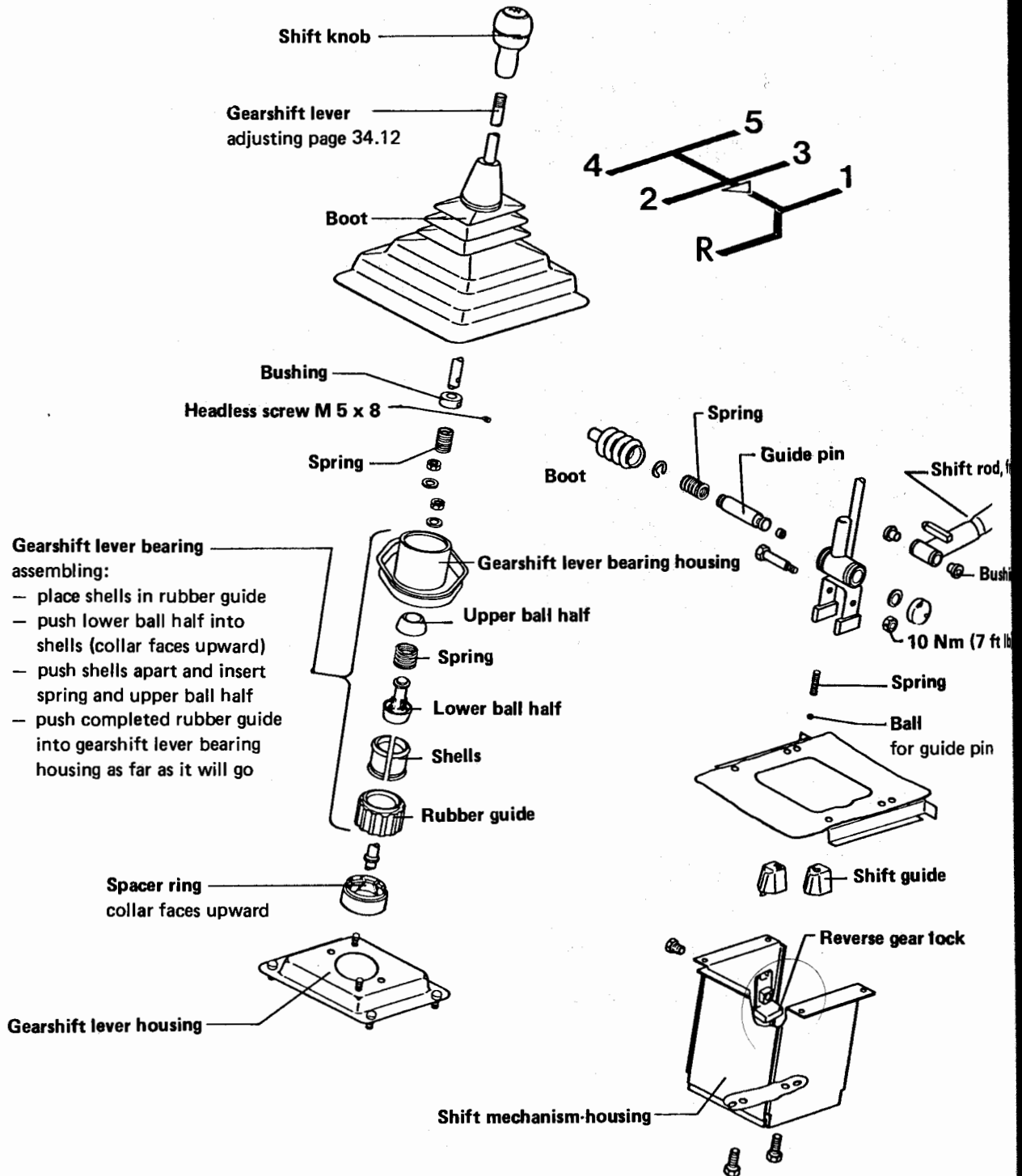
# 34 Manual Transmission-Controls, Assembly

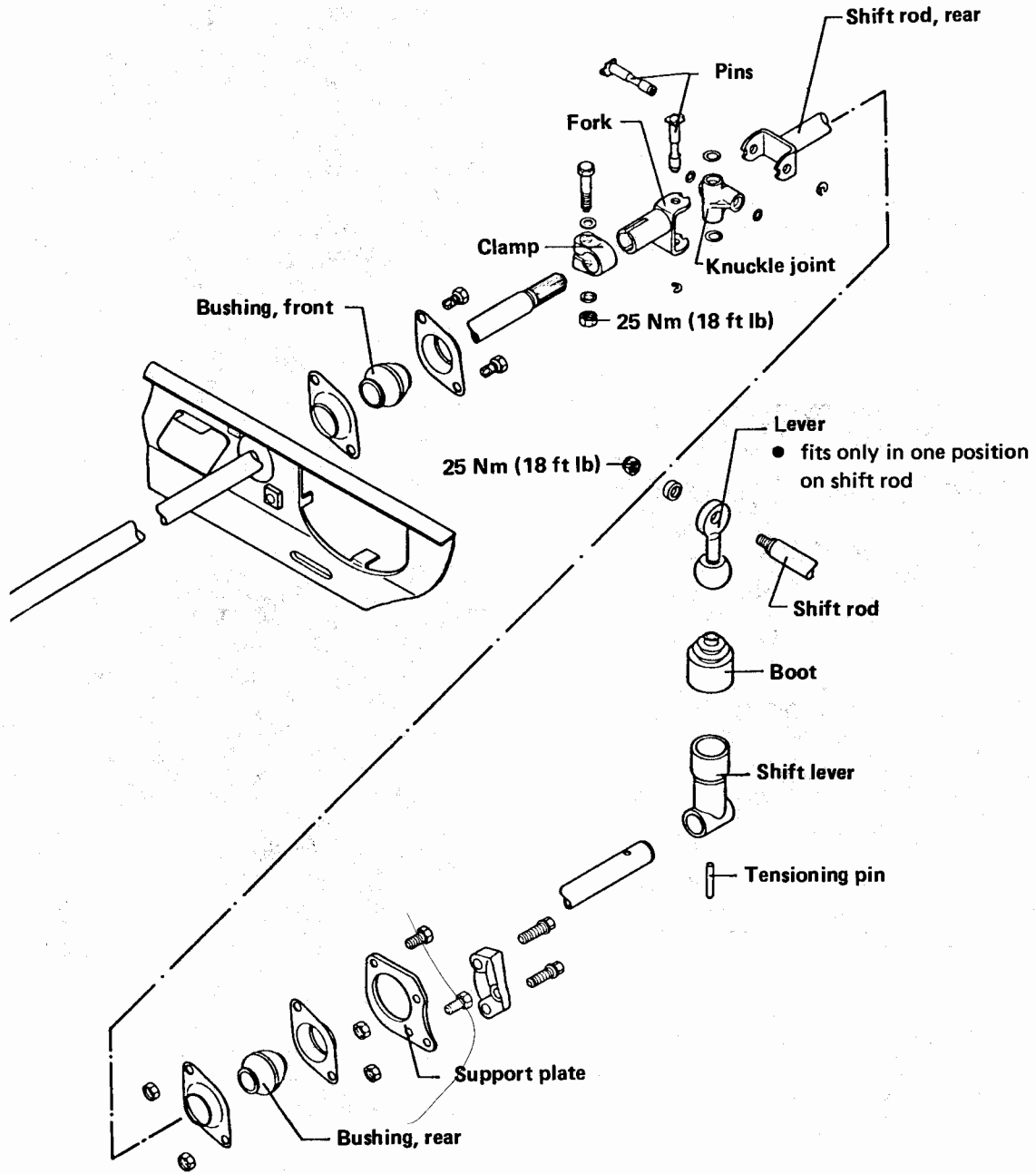
## Note

Lubricate all joints and moving parts with grease (part no. G 000 602) before installing. Linkage already lubricated with white grease or solid lubricant must first be cleaned thoroughly.

## CAUTION

Apply grease to shifter components inside the vehicle with great care. MoS<sub>2</sub> grease cannot be removed from upholstery or carpets.





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# 34 Manual Transmission-Controls, Assembly

## Gearshift lever, adjusting

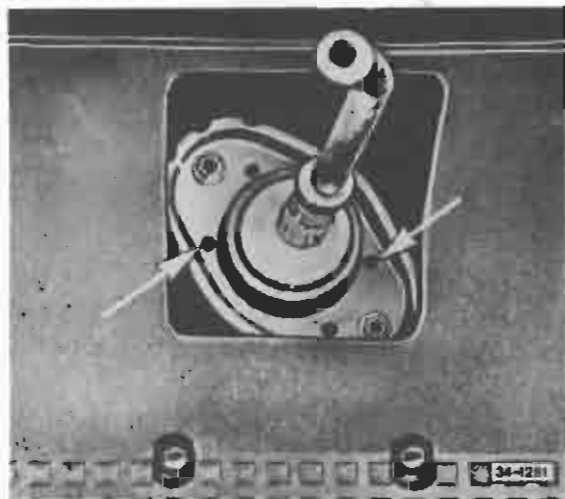
### Work sequence

- shift into neutral position

### Note

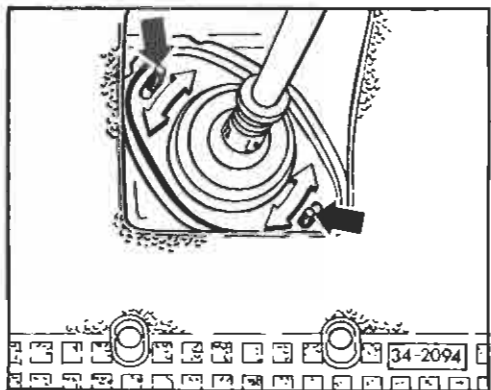
A revised shift lever bearing is installed in vehicles beginning 06-88. In the revised bearing the bearing plate alignment holes are deleted. The revised shift lever bearing can be installed in vehicles manufactured from 10-82 to 6-88.

#### With alignment holes (up to 06-88)



- align centering holes (arrows) of gearshift lever housing and gearshift lever bearing housing

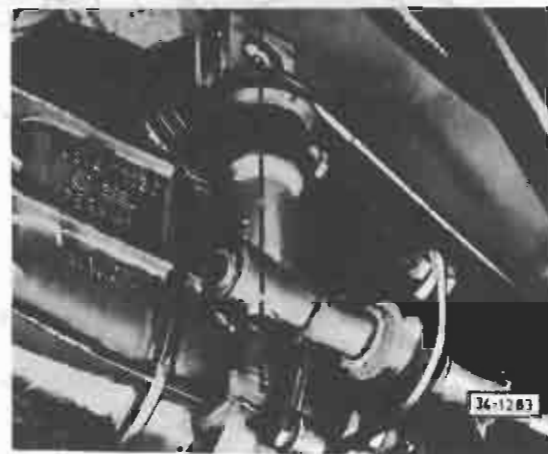
#### Without alignment holes (beginning 06-88)



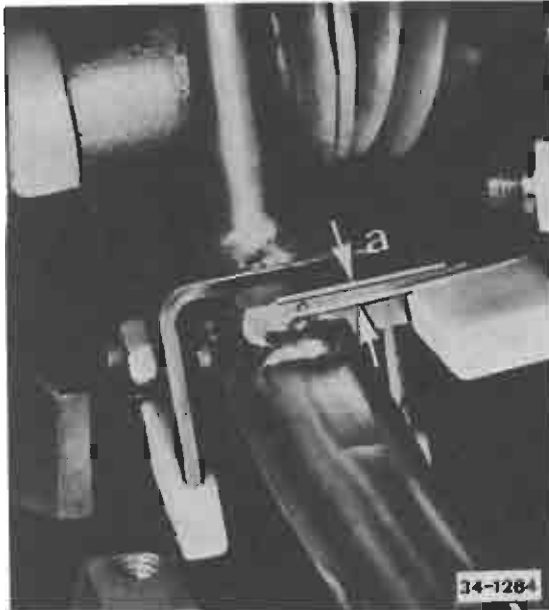
- rotate upper bearing plate so that the mounting studs (black arrows) contact opposite sides of the bearing plate
- tighten mounting nuts to 10 Nm (7 ft. lb.)



- loosen clamp nut (arrow)
- check that joints of shift rods slide freely
- remove spare wheel



- set lever on transmission in vertical position, as shown
- push shift rod into transmission until spring tension is felt; keep shift rod in this position (shift position 2/3 gear)



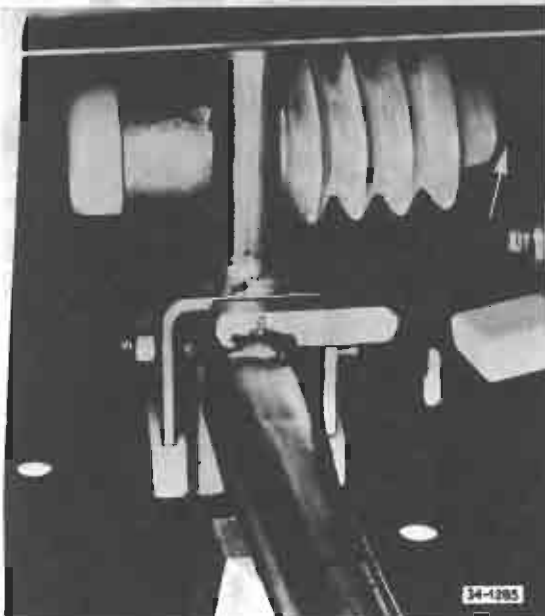
- push shift rod to right (shift position for 1st/reverse gear) and move in longitudinal direction
  - so that measurement a between reverse gear lock and stop of shift rod is 3mm (0.118 in.)

**Note**

Use 90° sheet metal angle piece of 3mm (0.118 in.) thickness

**CAUTION**

Transmission must be in neutral, lever on transmission in vertical position

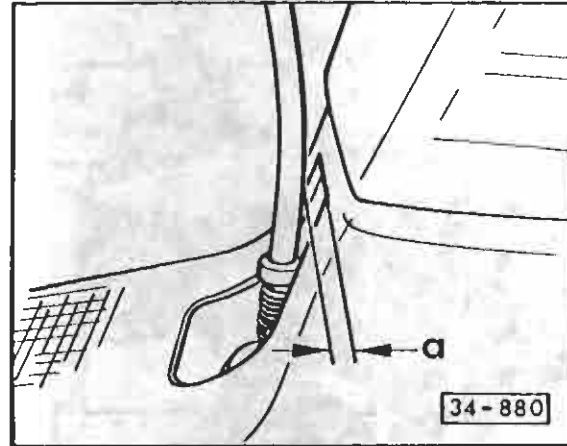


- let shift rod spring back to left into 2nd/3rd gear shift position and push rod slightly to right
  - boot must touch inside of shift mechanism housing (arrow)

**CAUTION**

Transmission must be in neutral, lever on transmission in vertical position

- tighten clamp nut in this position to 25 Nm (18 ft lb)



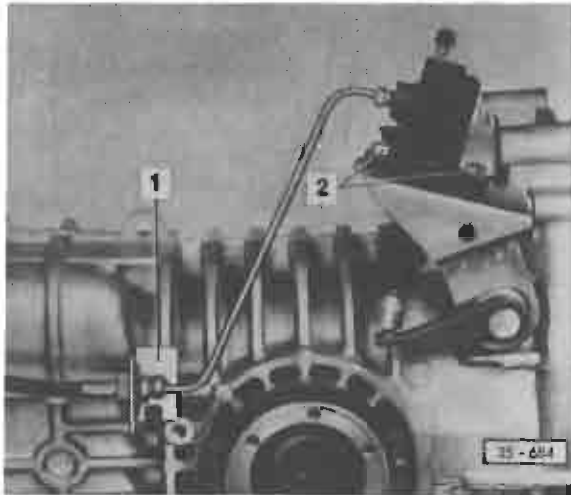
- with 2nd gear engaged, check distance between gear shift lever and heater covering
  - measurement a must be at minimum 15 mm (5/8 in.). If not, adjust gearshift lever bearing by pushing backward in slotted holes
- check that all gears engage easily without jamming. Particularly, check reverse gear lock out

# 34 Manual Transmission-Controls, Assembly

## Transmission, removing (engine installed)

### Work sequence

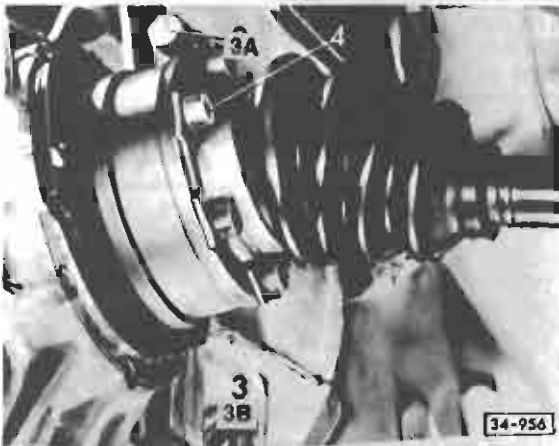
- disconnect battery ground strap
- remove right side upper engine/transmission bolt



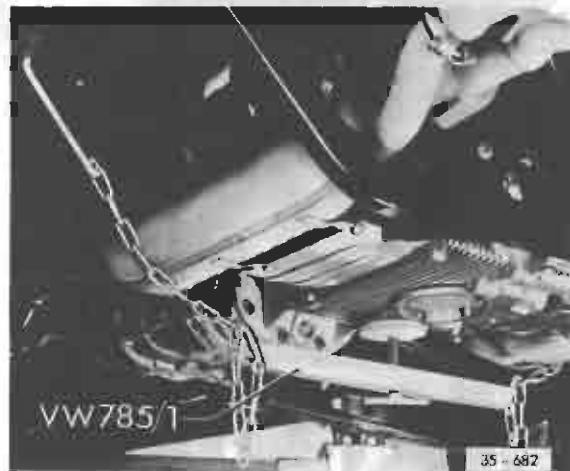
- remove hydraulic clutch line bracket 1 from transmission
  - do not disconnect hydraulic line
- remove clutch slave cylinder from bracket 2 and hang up cylinder with wire



- disconnect starter cables 5
- remove right side drive shaft bolts 6 and remove shaft from transmission
- hang shaft up with wire
- remove right side lower engine/transmission nut 7



- remove left side upper engine/transmission bolt 3A
- remove left side lower engine/transmission nut 3B
- remove left side drive shaft bolts 4
- remove shaft from transmission
- hang shaft up with wire



- support engine with VW 785/1
- go to next page



- disconnect back-up light wiring **8**
- remove shift linkage **9** from transmission
- disconnect ground strap **10**
- remove front transmission mount **11** from body
  - support transmission with US 618 together with US 618/5
- lower front part of transmission (loosen spindle of VW 785/1) until there is enough room to remove transmission
- separate transmission from engine and remove from vehicle

## Transmission, Installing (engine installed)

### Work sequence

Proceed in reverse order of removing and note following:

- install transmission with US 618 together with US 618/5
- clean splines of mainshaft and lubricate lightly with MoS<sub>2</sub>
- note correct position of air deflector plates to body
- check engine compartment seals
- tighten front transmission mounts

### Tightening torques:

- transmission to engine bolts/nuts 30 Nm (22 ft lb)
- drive shafts to transmission 45 Nm (33 ft lb)



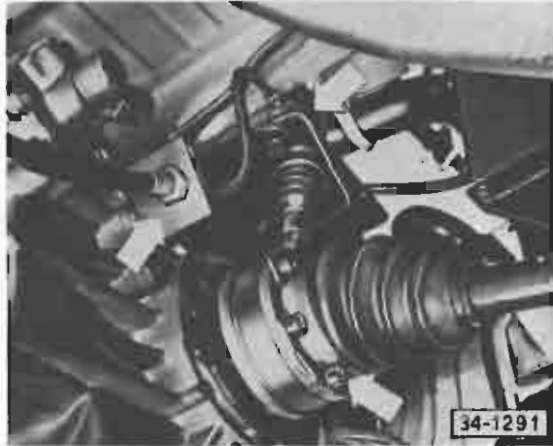


# 34 Manual Transmission-Controls, Assembly

## Transmission, removing (engine installed)

### Work sequence

- disconnect battery ground strap
- remove upper engine/transmission bolt
- remove bracket for accelerator cable



- remove left drive shaft from transmission and hang up with wire
- remove clutch cable bracket from transmission
- remove clutch slave cylinder from bracket and hang up with wire

### Note

Hydraulic system must be closed

- disconnect backup light wiring



- disconnect starter wiring and remove starter complete

- remove right drive shaft from transmission and hang up with wire



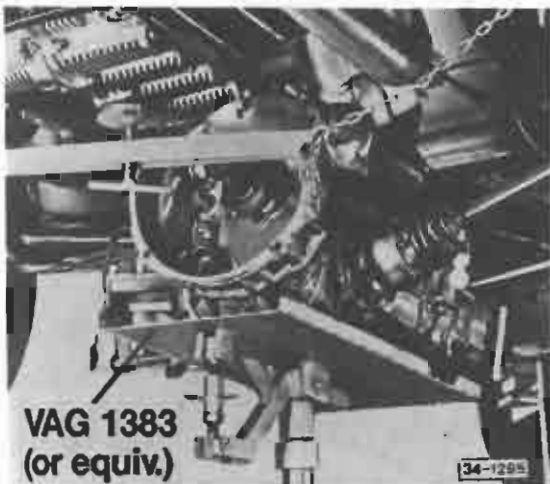
- support engine with VW 785/1B
- remove rubber plugs from left wheel housing to hook in chain



- remove shift rod from transmission (arrows)
- support transmission with suitable tool



- remove ground strap from body (right arrow)
- remove front transmission mount from body (arrows)



- lower front part of transmission (loosen spindle of VW 785/1) until there is enough room to remove transmission
- remove lower engine/transmission bolts
- pull transmission off engine guide bolts and remove from vehicle

**Transmission, installing**  
(engine installed)

Proceed in reverse order of removing and note following:

- clean splines of mainshaft and lubricate lightly with MoS<sub>2</sub> grease
- finally tighten front transmission mounts

**Tightening torques:**

- transmission to engine (M 10) 30 Nm (22 ft lb)
- drive shafts to transmission 45 Nm (33 ft lb)



ision



housing



(arrows)  
tool



(right arrow)  
from body

# 34 Manual Transmission-Controls, Assembly

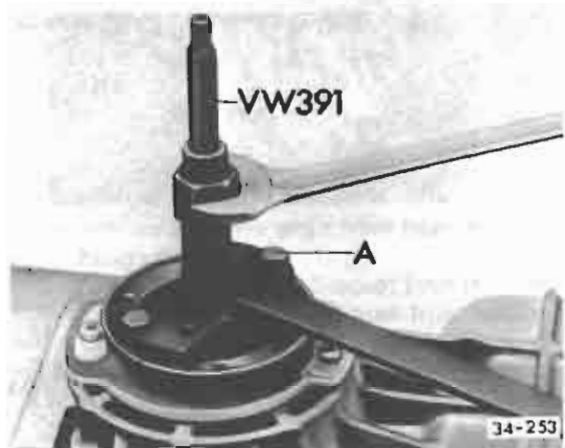
## Drive flange oil seal, removing (Transmission installed)

### Note

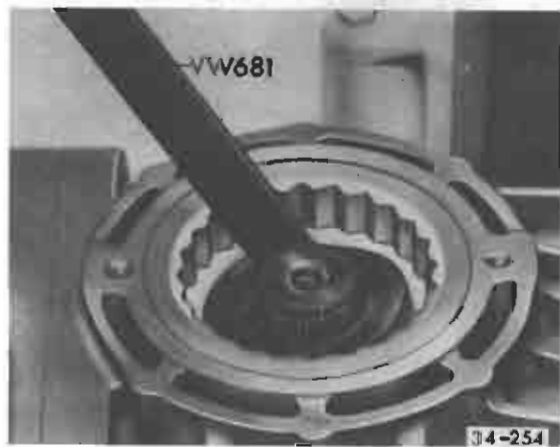
A light film of oil on seal prevents seal lips from running dry. Replacement of seal is necessary only if there is a large amount of oil on seal and transmission housing

### Work sequence

- remove drive shaft bolts from transmission and detach shaft upward
  - hang up shaft with wire
- pierce cap in flange with screwdriver and pry out



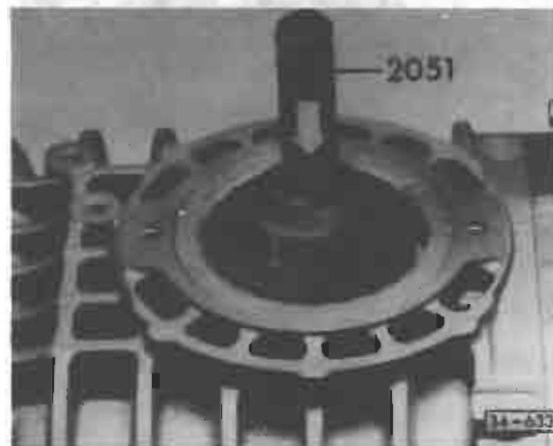
- remove circlip and pull out flange
- insert two bolts A (M 8 x 30) through slots in flange
- pull off flange with tool VW396



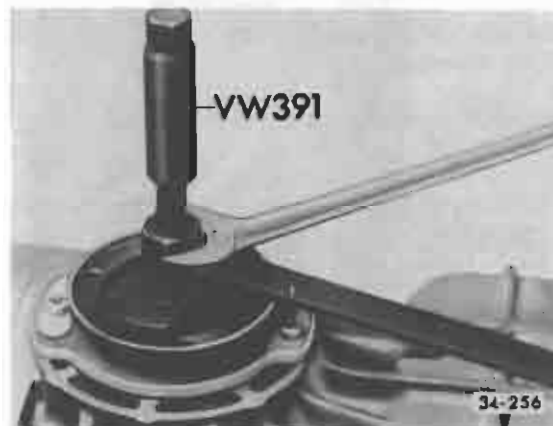
- pry out seal with tool VW681

## Drive flange oil seal, installing (Transmission installed)

### Work sequence



- drive in new seal until it contacts bearing race
- fill lips of seal with multi-purpose grease



- install drive flange with tool VW391
- insert wavy spacer washer and circlip
- press circlip into groove with VW 244 b and at same time check that washer is centered
- press in new cap
- install drive shaft and tighten socket head bolts to 45 Nm (33 ft lb)
- check transmission oil level and add if necessary

## Technical data

- code letters
- application
- gear ratios

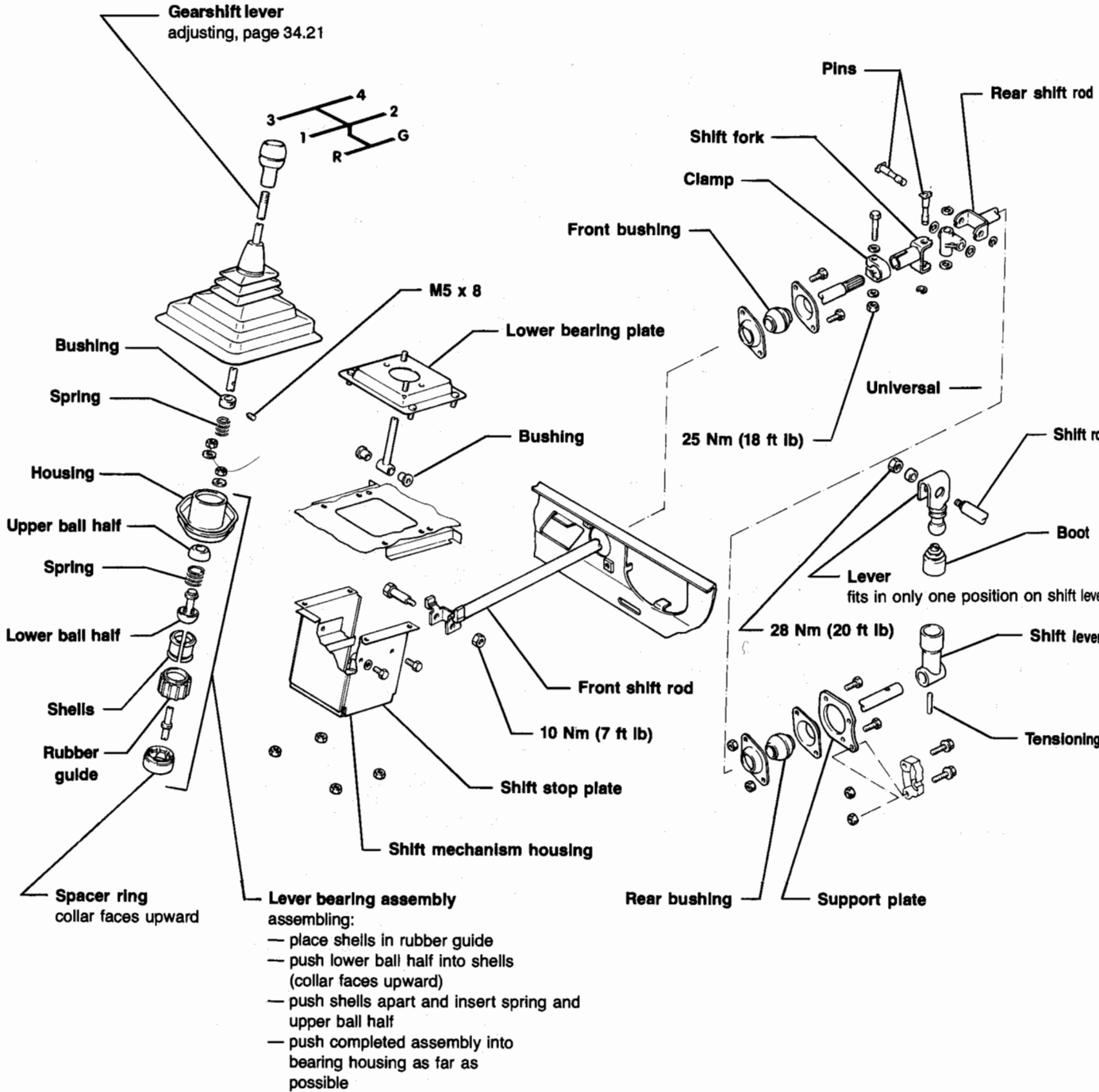
Transmission code letters	AAK	AAN
date of manufacture from to	10/85	10/85
Application vehicle	Vanagon Syncro	
engine	2.1 Liter 95 bhp (net) SAE	
<b>Gear ratios</b>		
1st gear	34 : 9 = 3.78	
2nd gear	33 : 16 = 2.06	
3rd gear	49 : 40 = 1.225	
4th gear	41 : 48 = 0.85	
Low gear	31 : 9 x 28 : 16 = 6.03	
Reverse gear	31 : 9 x 28 : 16 = 6.03	
<b>Final drive ratio</b>	38 : 7 = 5.43	
<b>Capacity</b>	4.7 US qt (4.5 Liters) <sup>1</sup>	
<b>Lubricant specification</b>	Gear oil GL-4 SAE 80	
<b>Clutch mechanism</b>	hydraulic	
<b>Clutch disc diameter</b>	228 mm	
<b>Driveshaft flange diameter</b>	100 mm	
<b>Overall ratio in 4th gear</b>	4.15	
<b>Speed in 4th gear per 1000 rpm</b>	18 mph (29 km/h)	

<sup>1</sup>—When refilling only add 3.2 US qt (3.0 ltr) or fill to edge of filler hole as 1.5 quarts (liters) cannot be drained off.

# 34 Manual Transmission—Controls, Assembly

## Note

Lubricate all joints and moving parts with MoS<sub>2</sub> grease (part no. G 000 602) before installing. Linkages already lubricated with white grease or solid lubricant must first be cleaned thoroughly.



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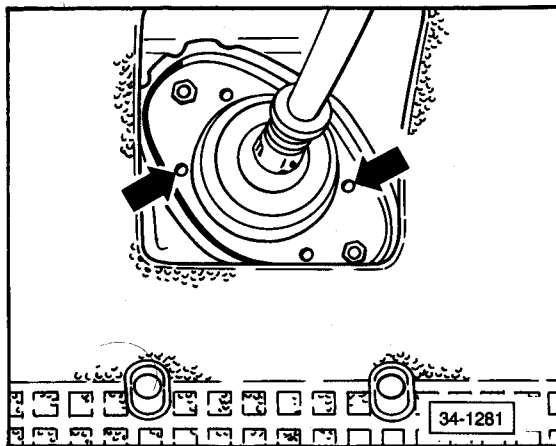
## Shift linkage, adjusting

- place shift lever in neutral

### Note

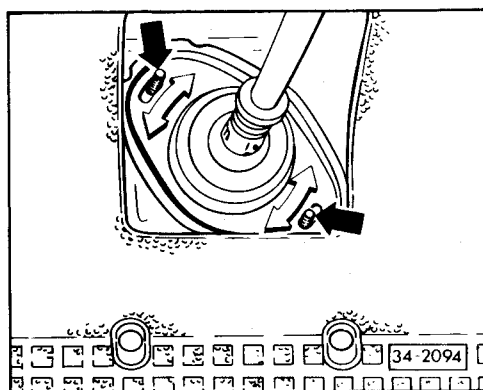
A revised shift lever bearing is installed in vehicles beginning 06-88. In the revised bearing the bearing plate alignment holes are deleted. The revised shift lever bearing can be installed in vehicles manufactured from 10-82 to 06-88.

#### With alignment holes (up to 06-88)

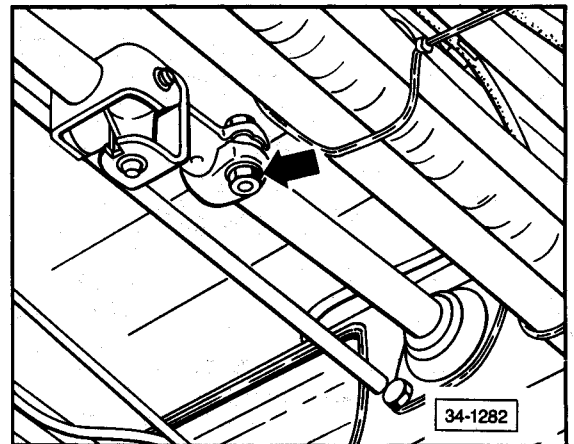


- align holes (**arrows**) of upper bearing plate with holes of lower bearing plate

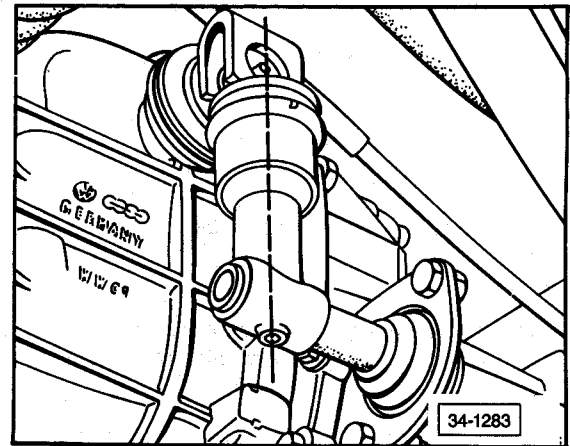
#### Without alignment holes (beginning 06-88)



- rotate upper bearing plate so that the mounting studs (**black arrows**) contact opposite sides of the bearing plate
- tighten mounting nuts to 10 Nm (7 ft. lb.)

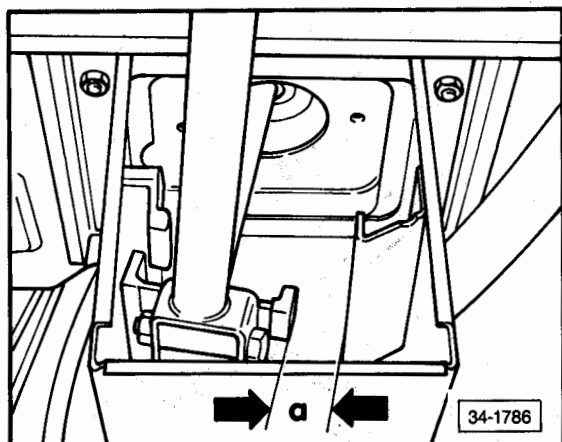


- loosen clamp (**arrow**)
  - selector shaft connection must move freely
- remove skid plate



- set lever on transmission in vertical position
- move stop finger of front shift rod to center of shift mechanism housing

# 34 Manual Transmission – Controls, Assembly



- adjust shift rod end  $a = 23 \text{ mm}$
- use strip of sheet metal to measure

## CAUTION

Transmission must be in neutral, lever on transmission in vertical position.

- tighten clamp in this position
- shift through all gears, they must engage smoothly without jamming
- check reverse lock-out operation

## Note

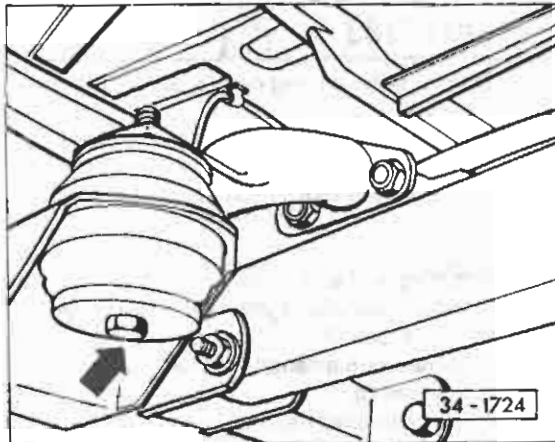
With 1st gear engaged, the distance between the shift lever and heater pipe insulation must be at least 15 mm (19/32 in.).

## Transmission, removing/installing (engine remains in vehicle)

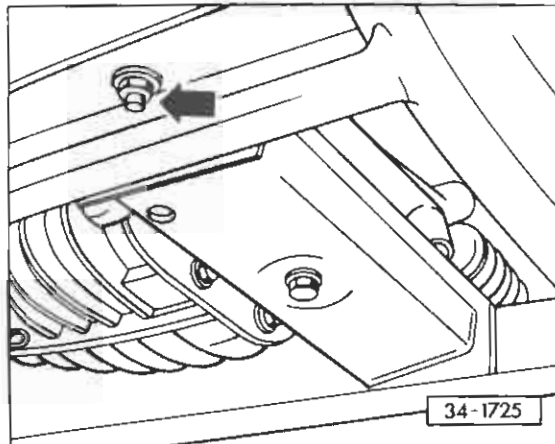
### Work sequence

#### Removing

- disconnect battery ground strap
- remove bolts fastening top of transmission to engine
- remove rear skid plate (under engine and transmission)



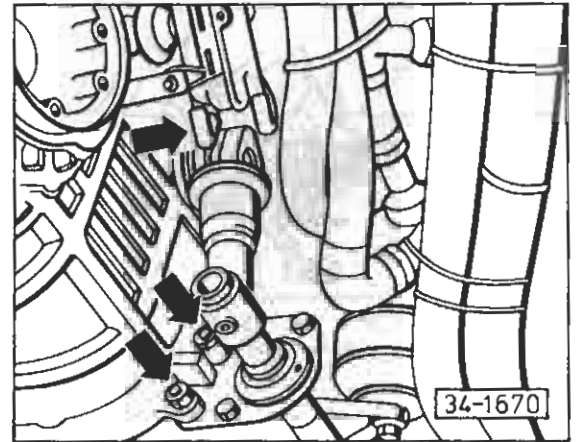
- loosen mounting bolt of front final drive (arrow) Do **NOT** remove bolt.



- loosen side bolts of front final drive mounting bracket (arrow) Do **NOT** remove bolts.
- remove bolts fastening driveshaft to transmission flange and tie driveshaft end to body



- remove left side axle shaft bolts (lower arrow) and remove shaft from transmission
- remove hydraulic clutch line bracket from transmission (center arrow) Do **NOT** disconnect hydraulic line.
- remove clutch slave cylinder from bracket on transmission (upper arrow) and hang cylinder from body with wire
- disconnect back-up light wiring
- remove right side axle shaft from transmission



- remove shift linkage from transmission (arrows)

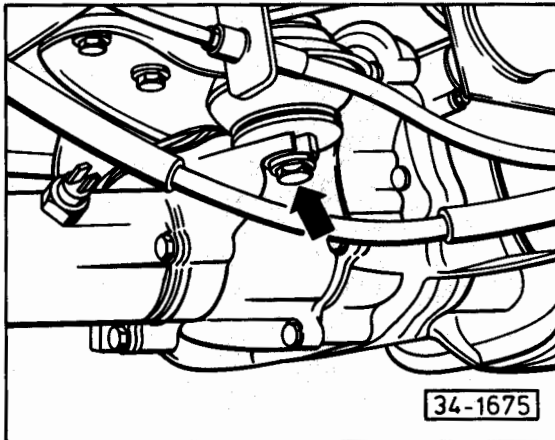
#### Vehicles with rear differential lock:

- remove vacuum hoses from lock servo and disconnect indicator light switch wiring
- remove ground cable from body

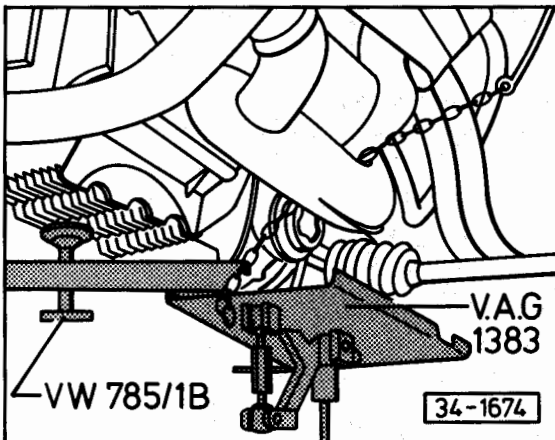


# 34 Manual Transmission-Controls, Assembly

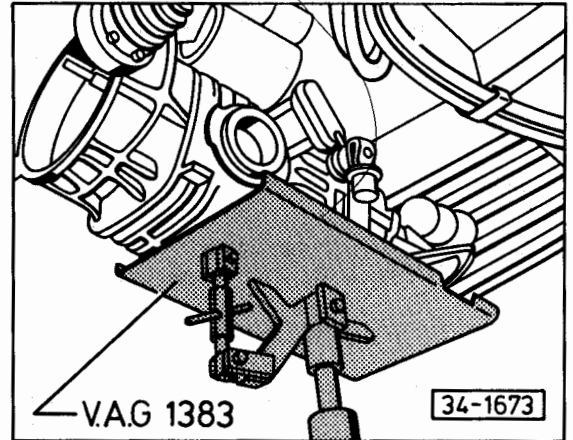
— support transmission with V.A.G. 1383



- remove front transmission bracket (arrow) and lower front of transmission approx. 15 cm (6 in.) at driveshaft flange
- disconnect starter cables
- remove vent hose



- support engine with VW 785/1B
- remove bolts fastening bottom of transmission to engine



- pull transmission off engine guides and remove

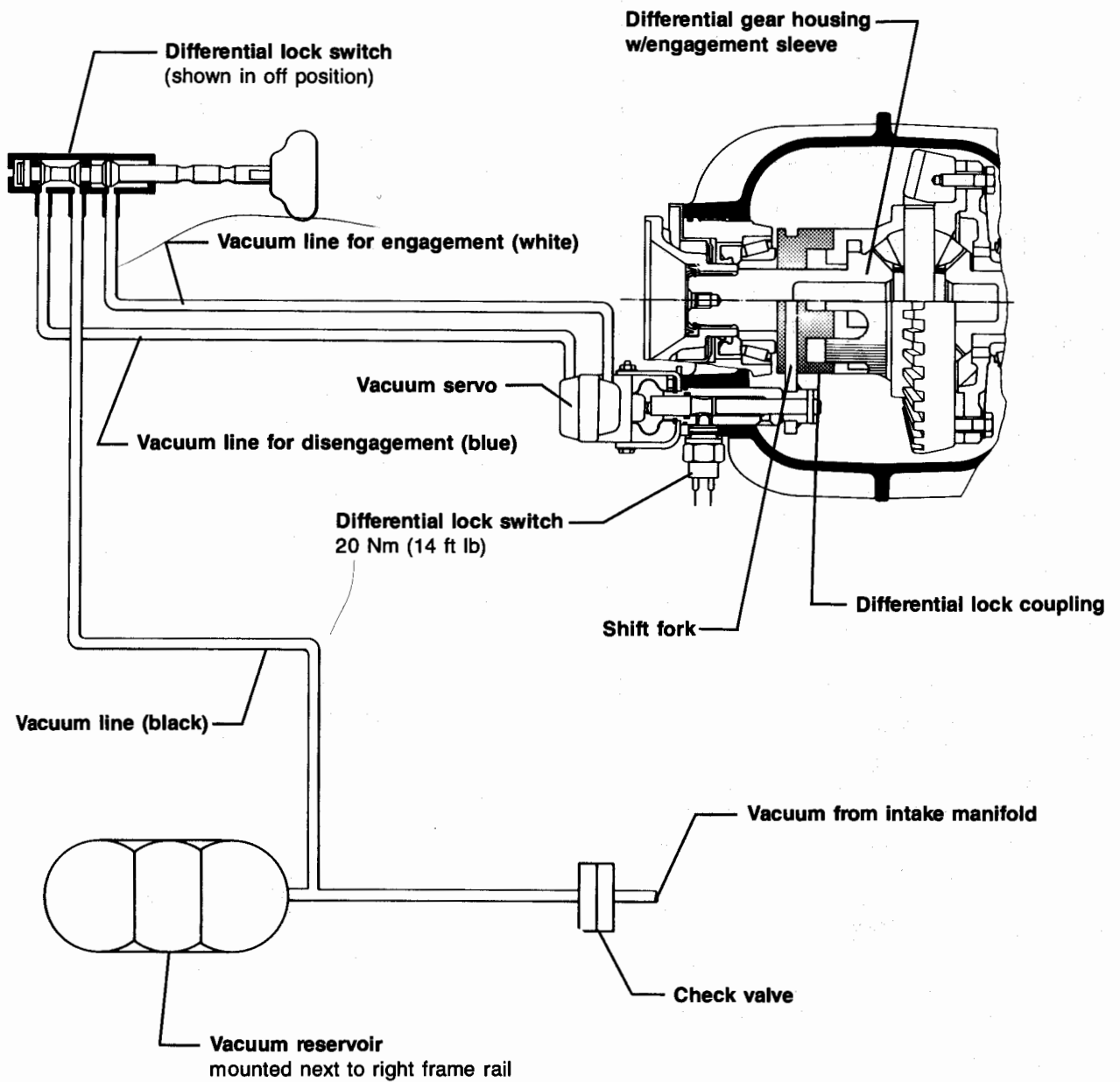
## Installing

Proceed in reverse order of removing and note following:

- clean mating surfaces of engine and transmission and coat lightly with silicone sealer, Part No. 176 005 05
- clean splines of mainshaft and lubricate lightly with MoS grease.
- grease needle roller bearing in crankshaft
- tighten mounting bolts of front final drive last

## Tightening torques

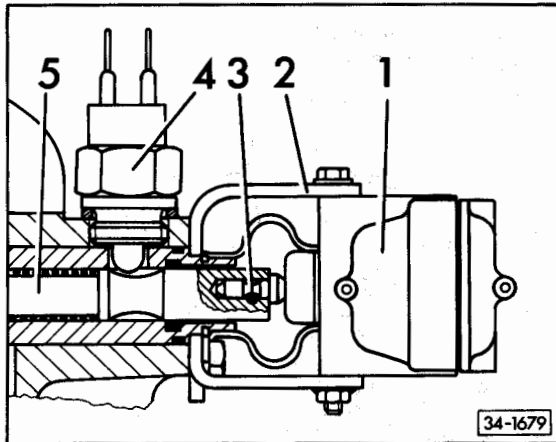
Transmission to engine	30 Nm (22 ft lb)
Axle shaft to transmission	35 Nm (26 ft lb)
Driveshaft to transmission	35 Nm (26 ft lb)



34-1658

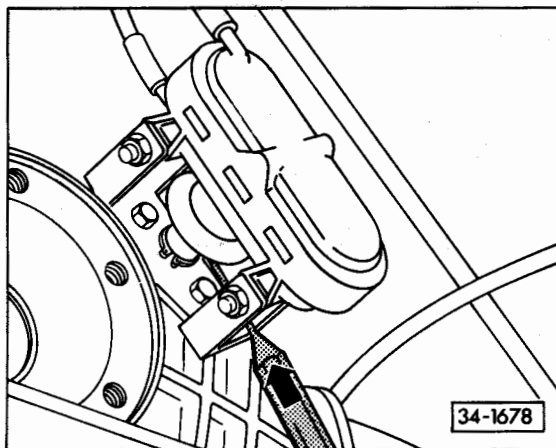
# 34 Manual Transmission – Controls, Assembly

## Differential lock servo, removing



- 1 servo
- 2 bracket
- 3 spring pin
- 4 switch for lock indicator light
- 5 operating rod

### Work sequence

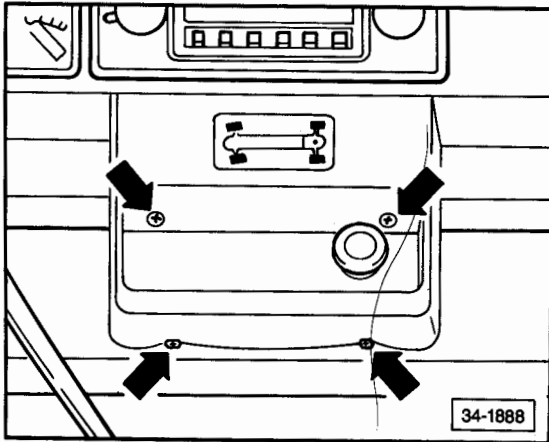


- push protective casing back and drive out pin (arrow)
- remove vacuum lines
- remove bolts attaching servo to bracket

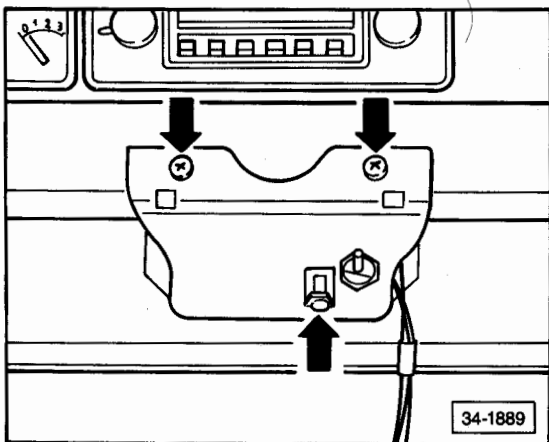
### Note

Only white vacuum hoses are supplied as spare parts (Part No. N 20 139.1). When replacing hose, cut to proper length and mark with tape of appropriate color.

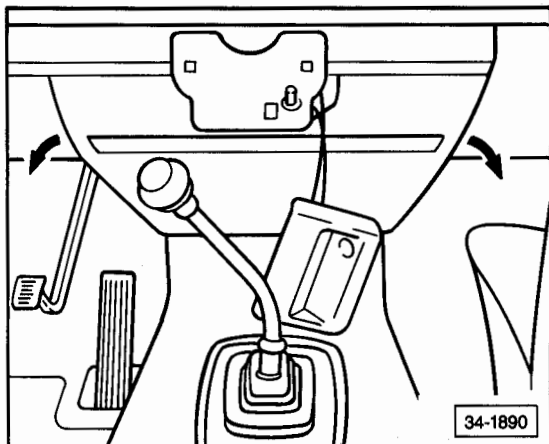
## Differential lock control, repairing Switch, removing/installing



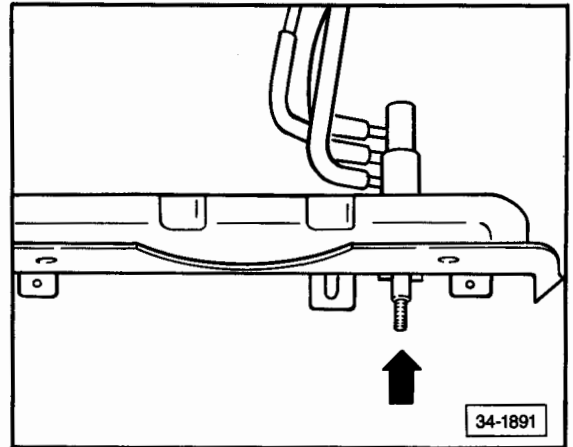
- unscrew knob, if necessary hold switch piston with needle nose pliers
- remove trim plate (arrows)



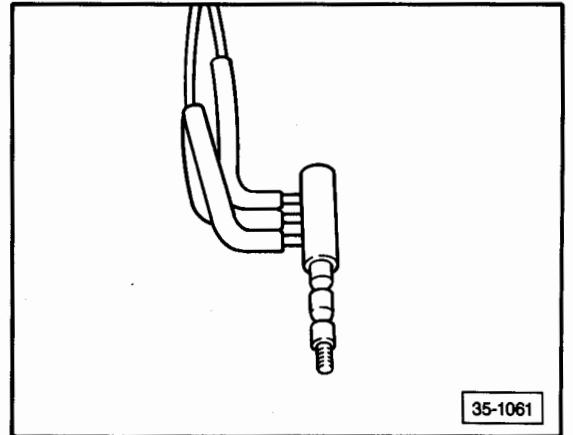
- remove bracket



- remove trim



- press switch out of guide bushing



- detach vacuum hose
- note hose locations

# Torque Converter

Quick Data	Index	
	<ul style="list-style-type: none"><li>—Bushing 32.3</li><li>—Code letter 32.2</li><li>—Draining 32.2</li><li>—Installing 32.3</li><li>—Oil seal 32.3</li></ul>	

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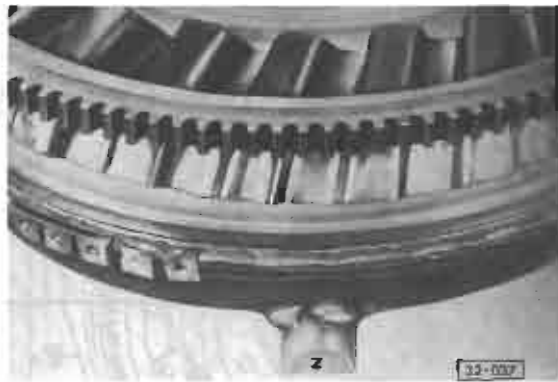
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Index

**32.1**

# 32 Torque Converter



**Fig. 1 Converter code letter**  
D—up to build date 3/27/81  
Z—3/81 to 7/85  
H—from 8/85  
**Note**

Torque converter with code letter Z has a modified impeller and turbine vanes and can be installed in earlier vehicles.



**Fig. 2 Torque converter, draining**

- attach small inside diameter hose, about 8mm (5/16 in.) outside diameter, to plastic bottle of about 2 liter (2 qt) capacity
- hose connection and cap must be air tight

- cut free end of drain hose at an angle
- place converter in sloping position

- squeeze plastic bottle and hold while inserting free end of drain hose into converter hub
- end of hose must rest on bottom of converter
- release plastic bottle so that ATF starts draining
- loosen bottle cap so fluid can siphon



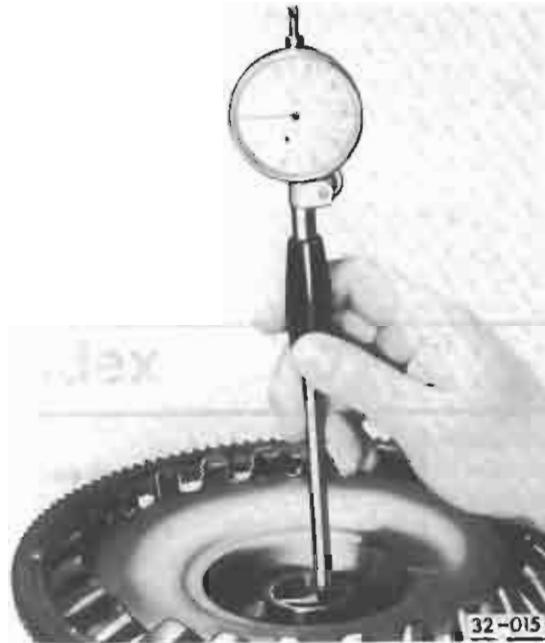
**Fig. 3 Converter oil seal hub, checking**

- check hub (arrow) for scoring from oil seal
- check that chamfer for oil seal is rounded at front
- cover hub bore in converter
- remove sharp edges and burrs with fine emery cloth
- do not damage surface where oil seal contacts hub

**Note**

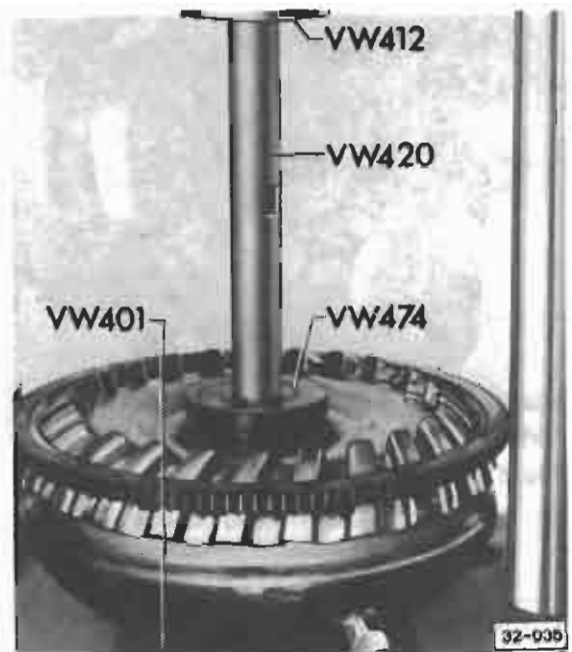
Torque converter bushing can be replaced separately. If torque converter assembly is defective, replace complete unit

## 32.2 Converter assembly



**Fig. 4 Converter bushing, checking**

- wear limit diameter 34.25 mm ( 1.348 in )
- out of round max. 0.03 mm ( 0.001 in )

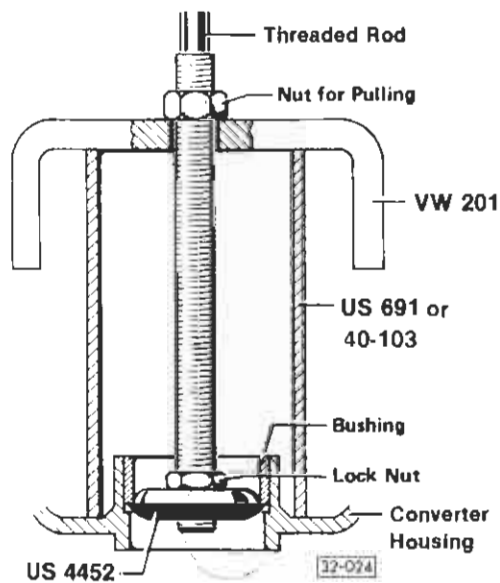


**Fig. 6 Converter bushing, installing**

— press bushing in until seated

### CAUTION

When installed, bushing must have inside diameter of 34.03–34.05 mm (1.340–1.341 in.). If bushing is less than minimum inside diameter, it may seize. After installing bushing, check edge of converter hub for burrs



**Fig. 5 Converter bushing, removing**



**Fig. 7 Converter oil seal, removing**

— pry damaged seal out, carefully clean seat for seal

# 32 Torque Converter



**Fig. 8 Converter oil seal, installing**

- dip seal in ATF and drive in as far as it will go

### CAUTION

Be careful when installing silicone seal. Seal is soft and can be easily damaged. Silicone seals must not contact gasoline or similar cleaning solutions

### Converter assembly, installing

- before installing converter, pump shaft must be inserted fully into pump splines
- place converter carefully on one-way clutch support
- do not tilt or misalign converter
- engage splines by turning converter back and forth

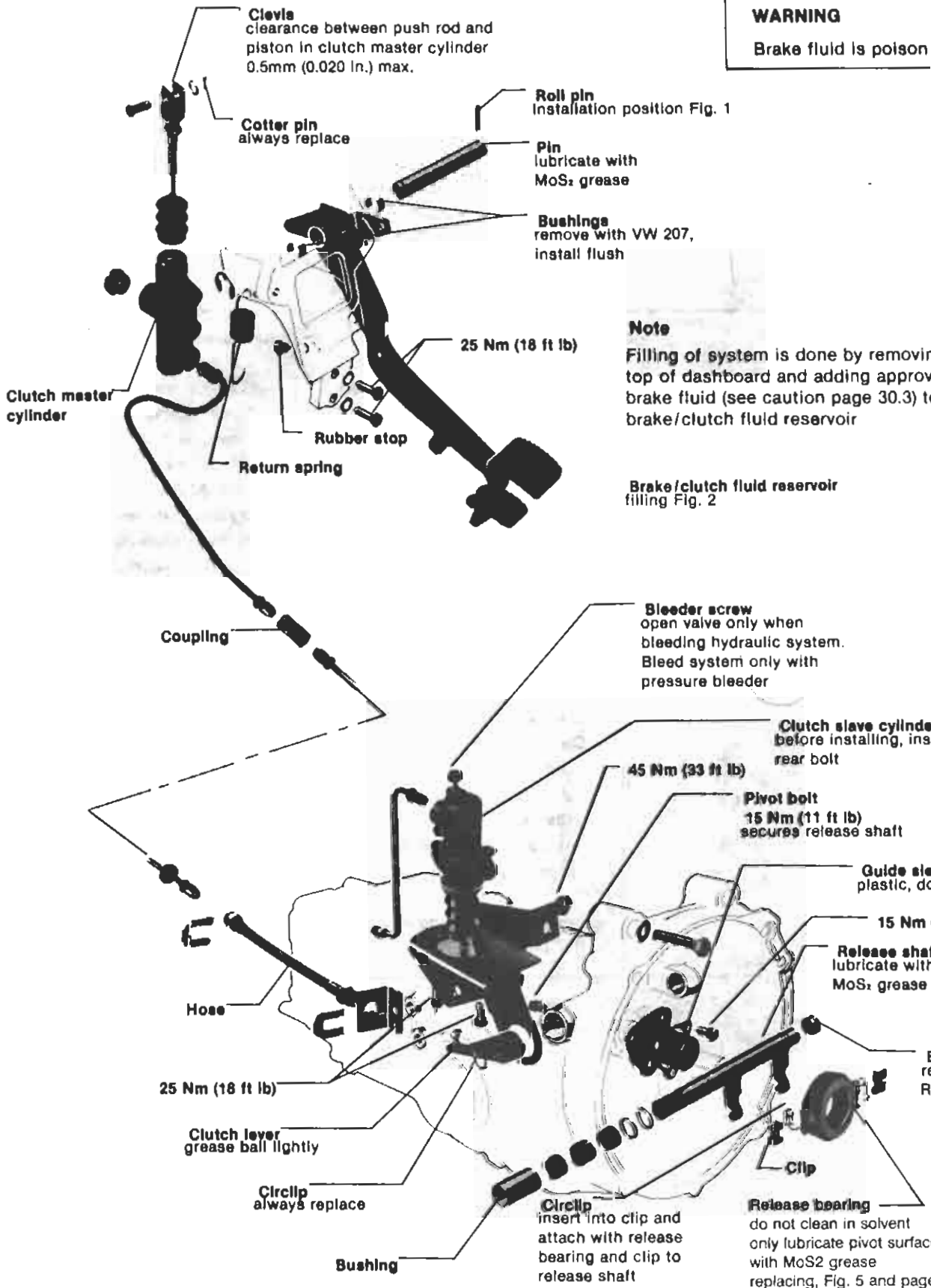


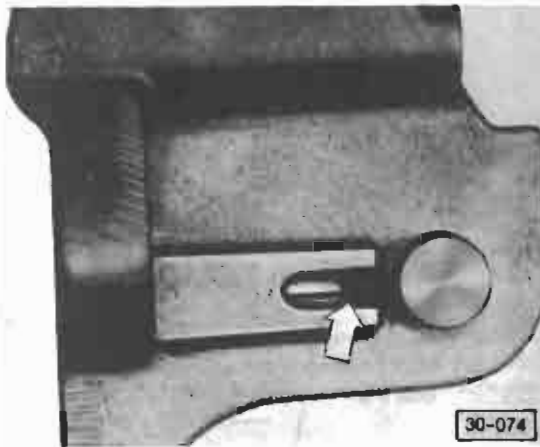
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# 30 Clutch, Controls

## WARNING

Brake fluid is poison





**Fig. 1 Roll pin, installation position**

- roll pin must be engaged in groove (arrow) on side of bracket

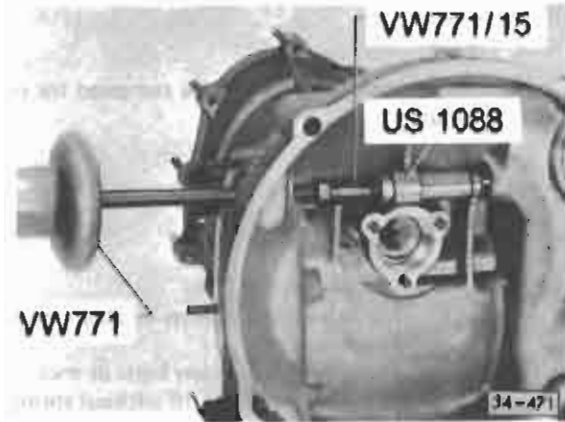
### CAUTION

Brake fluid must not come into contact with paint. Brake fluid absorbs moisture from air and must be replaced every 2 years. Only use new unused DOT 3 or DOT 4 brake fluid according to MOTOR VEHICLE SAFETY STANDARD 116. Do not add or mix DOT 5 silicone type brake fluid with brake fluid in car, as severe component corrosion may result. Such corrosion could lead to clutch and brake system failure

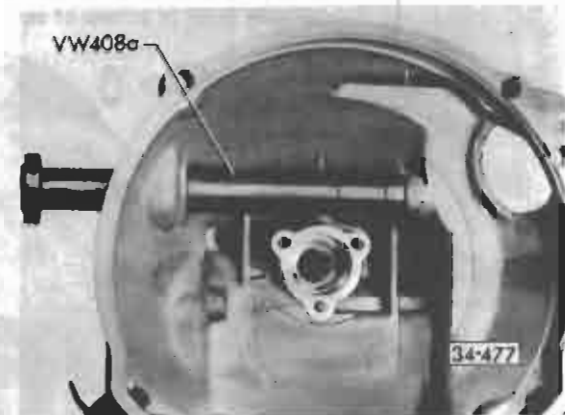


**Fig. 2 Brake/clutch fluid reservoir, filling**

- grasp two recesses on back of dashboard cover and pull up
- fill with brake fluid (see above caution) until level is between "MAX" and "MIN"
- replace cover by inserting front edge first then press cover down firmly

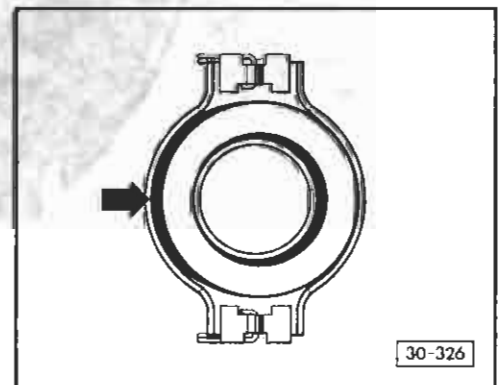


**Fig. 3 Release shaft bushing, removing**



**Fig. 4 Release shaft bushing, installing**

— drive in flush



**Fig. 5 Release bearing, installing**

- new release bearings on which thrust ring is not centrally positioned to housing (arrow) can be installed
- thrust ring automatically centers itself on first application of clutch pedal

# 30 Clutch, Controls

## Note

Only transmission must be removed for clutch repairs

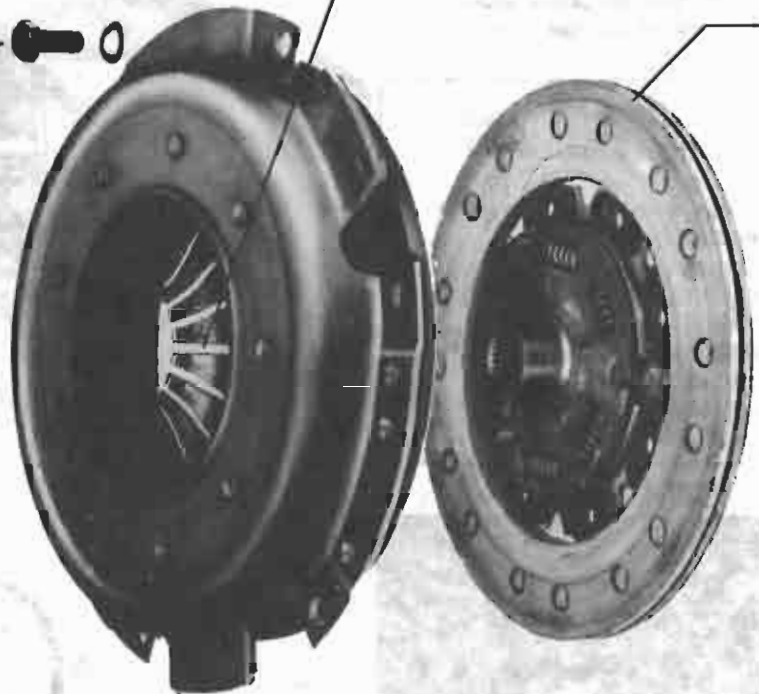
- 25 Nm (18 ft lb)  
loosen and tighten by stages in diagonal sequence
- install hexagon bolts or socket head screws M8 x 16 without spring washer; or
  - install hexagon bolts or socket head screws M8 x 18 with spring washer
  - use only bolts or screws of same length

Clutch diaphragm spring checking fingers Fig. 3 - Fig. 6

## Note

Spring finger length increased; check for compatible release bearing

Clutch dis  
checking



## WARNING

Friction materials such as brake and clutch linings or brake pads may contain asbestos fibers.

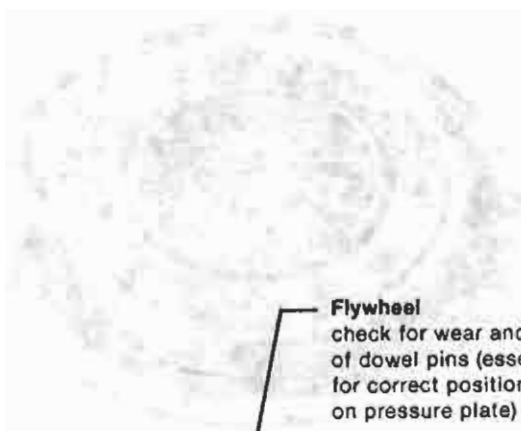
Do not create dust by grinding, sanding or by cleaning with compressed air.

Avoid breathing asbestos fibers and asbestos dust.

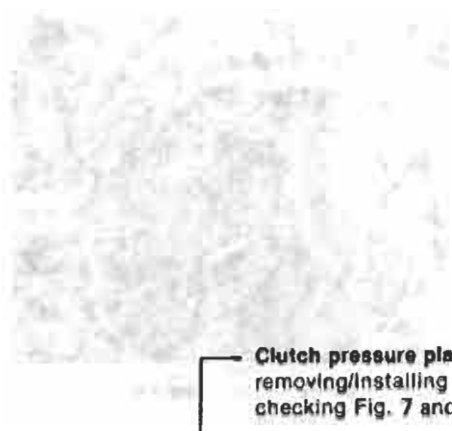
Breathing asbestos may result in serious diseases, such as asbestosis or cancer.

Breathing asbestos may cause severe injury and death.

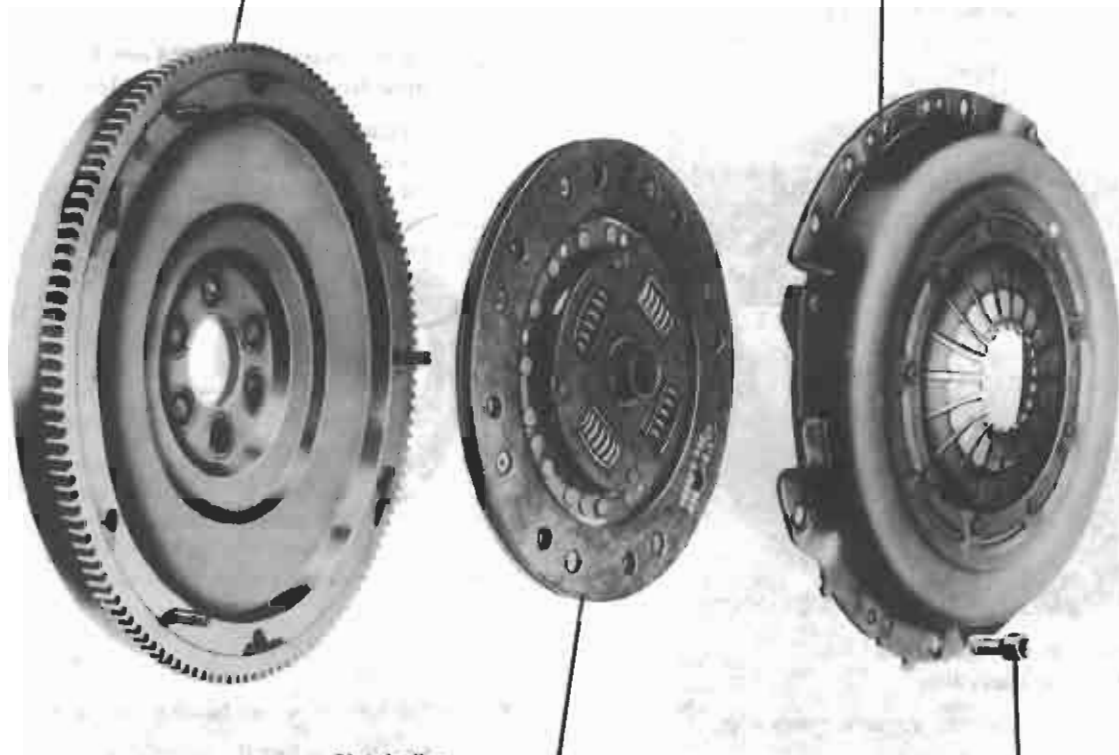
Clutch pressure plate  
removing/installing Fig. 7  
checking Fig. 7 and Fig. 8



**Flywheel**  
check for wear and tightness  
of dowel pins (essential  
for correct position of TDC mark  
on pressure plate)



**Clutch pressure plate**  
removing/installing Fig. 2  
checking Fig. 7 and Fig. 8



**Clutch disc**  
centering Fig. 2  
checking Fig. 9  
Installation position: spring cage  
faces pressure plate

**25 Nm (18 ft lb)**  
loosen and tighten by stages and in  
diagonal sequence  
— install hexagon bolts or socket head screws  
M 8 x 16 **without spring washer**; or  
— install hexagon bolts or socket head screws  
M 8 x 18 **with spring washer**  
— use only bolts or screws of **same length**

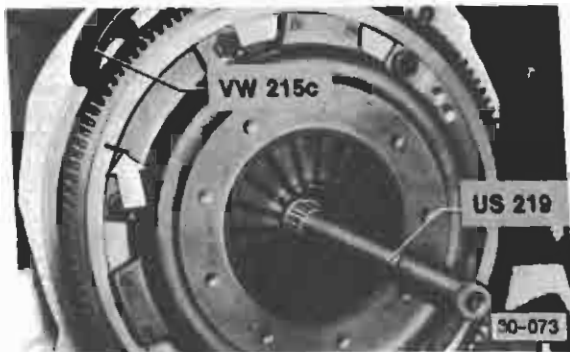
**Note**

For clutch repairs, transmission must  
be removed

30-030

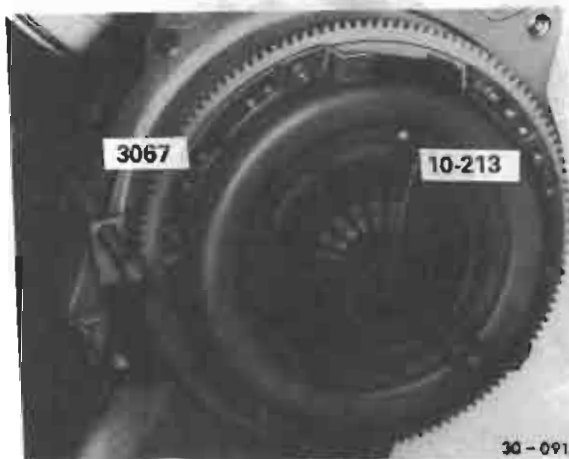
30-092

# 30 Clutch



**Fig. 1 Clutch pressure plate, Gasoline removing/Installing**

- attach flywheel retainer VW 215c
- mark position of pressure plate on flywheel (arrow)
- loosen bolts diagonally



**Fig. 2 Clutch assembly, Diesel removing/installing**

- change retainer over when removing



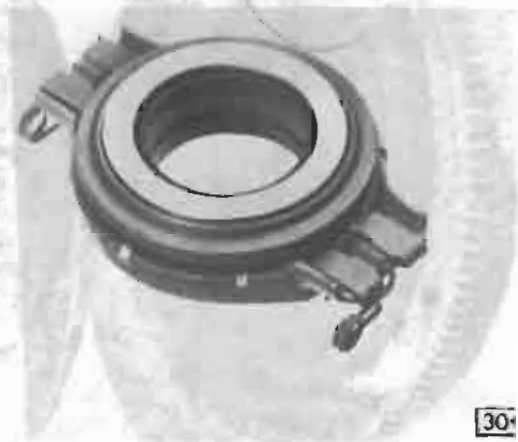
**Fig. 3 Clutch diaphragm spring, checking fingers**

- scores (arrows) up to depth of 0.3 mm (0.012 in.) are OK



**Fig. 4 Clutch pressure plate, 228 mm (9 in.) dia (modification only for air-cooled vehicles)**

- distance a between fingers:  
was = 55mm (2 3/16 in.) dia.  
is now = 46mm (1 13/16 in.) dia.



**Fig. 5 Production release bearing, air-cooled**

- contact surface diameter is 46 mm (1 13/16 in.)

## 30.6

Clutch disc  
Clutch pressure plate  
Clutch diaphragm spring

4-speed 091-091/1 5-speed 094

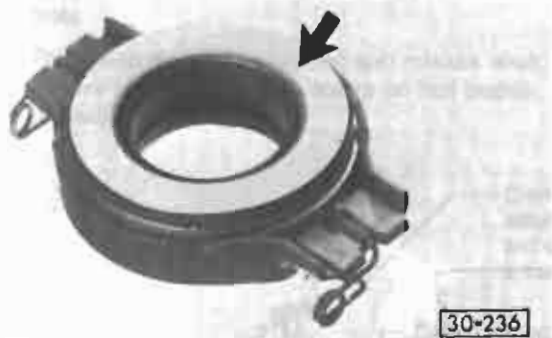


Fig. 6 Replacement release bearing, air-cooled engines

#### Note

Release bearing with wider contact surface (arrow) is the only bearing available as spare part. This release bearing will work with either old or new type pressure plates.

#### Engine replacement

If exchanging engines, be sure that wider-contact-surface release bearing is used if pressure plate is of older type [where a, Fig. 4, = 55 mm (2 3/16 in.) dia.]

#### CAUTION

Do not install release bearing having narrow contact surface [46 mm (1 13/16 in.) dia.] together with short-fingered pressure plate [a = 55 mm (2 3/16 in.) dia.]

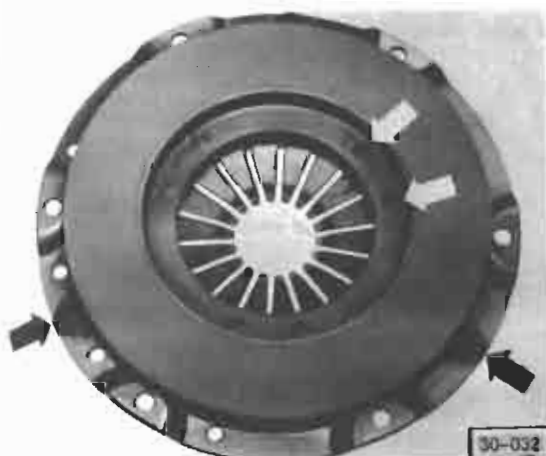


Fig. 7 Clutch pressure plate, checking

- check straps (black arrows) between plate and cover for cracks and tightness of rivets (white arrows)
  - clutches with loose or damaged rivets must be replaced

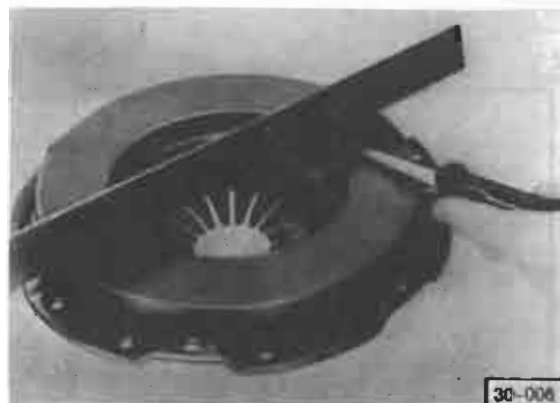


Fig. 8 Clutch pressure plate, checking

- check for cracks, burn marks and wear
  - inward taper: 0.3 mm (0.012 in.) max.

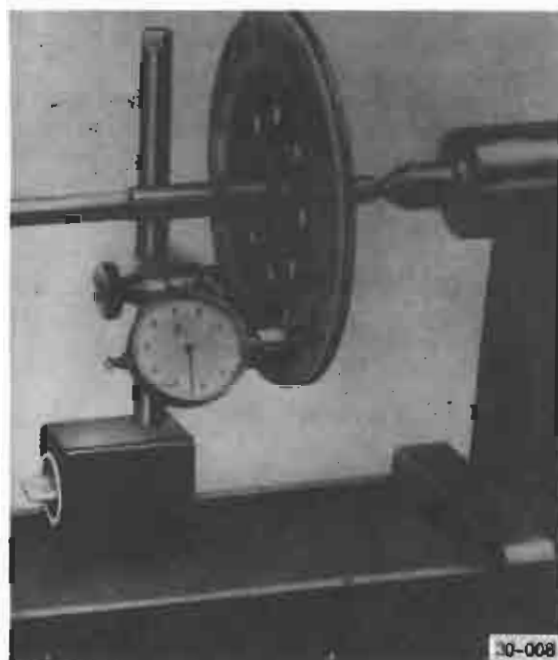


Fig. 9 Clutch disc, checking/installing

- check runout: 0.5 mm (0.020 in.) max.
  - measured 2.5 mm (3/32 in.) from edge of disc
- check lining and splines for wear and rivets for tightness
- when installing, clean corrosion from transmission mainshaft and clutch disc splines
- lightly lubricate clutch splines with grease
  - use grease part no. G 000 100
- place transmission into gear to lock mainshaft and temporarily install clutch disc to check movement
  - spring cage must face pressure plate
  - clutch disc must slide freely on mainshaft
- remove excess grease

# 30 Clutch

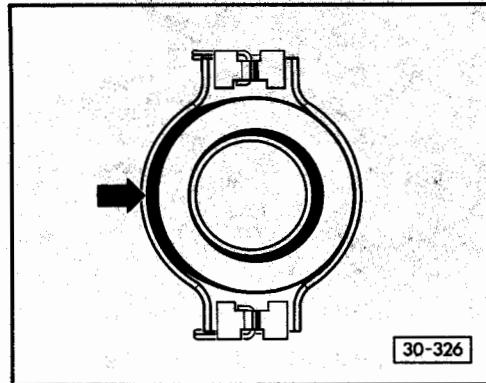


Fig. 10 Release bearing, installing

- New release bearing on which thrust ring is not centrally positioned to housing (**arrow**) can be installed
- thrust ring automatically centers itself on first application of clutch pedal



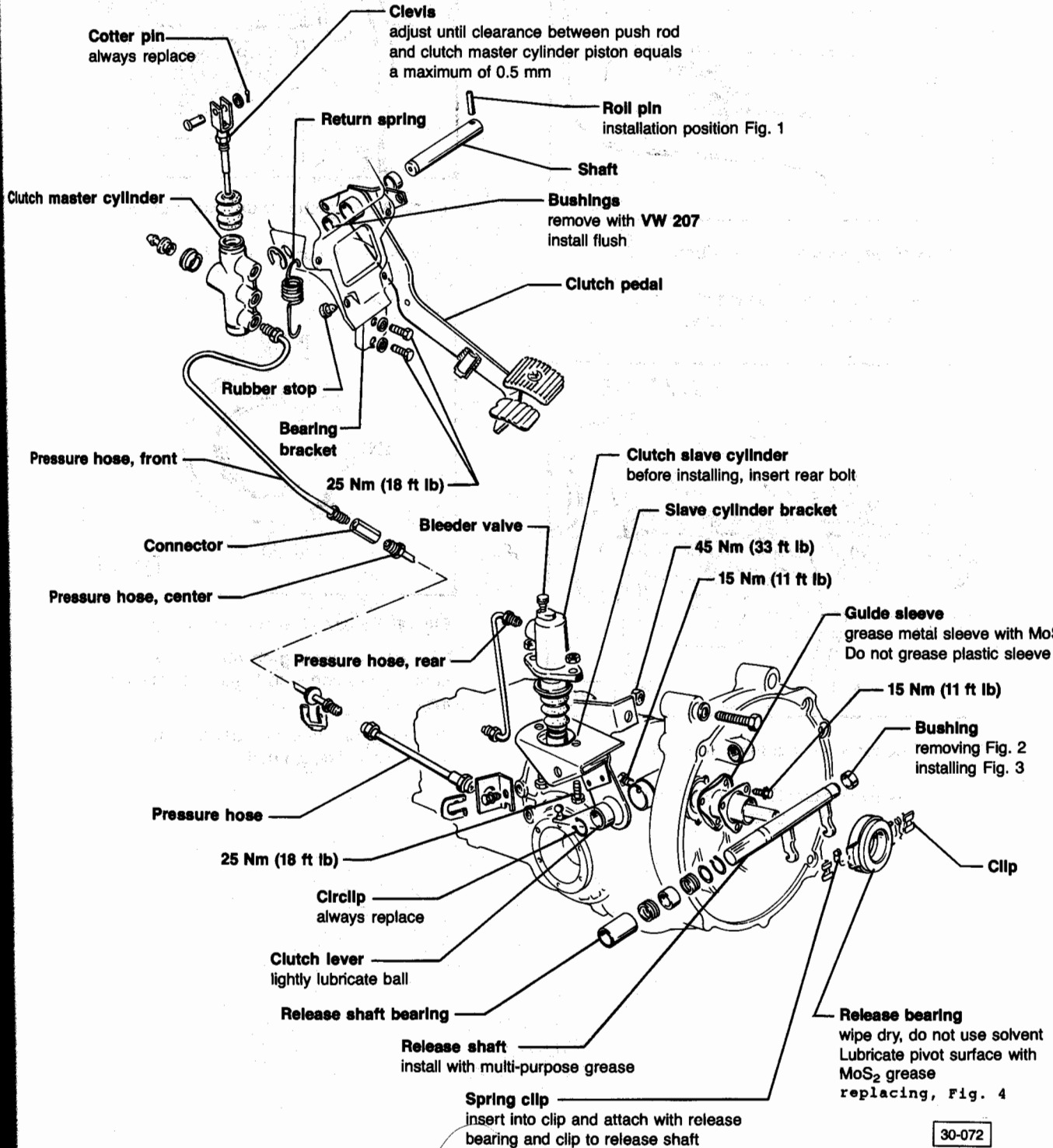
## Note

For repairs on release bearing and release shaft, remove transmission. For repairs on foot pedals, remove instrument panel.

## Clutch, bleeding

Connect brake bleeder **US 1116**  
Operating pressure = 2-2.5 bar.

Leave bleeder valve open until brake fluid drains without any bubbles.



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# 30 Clutch, Controls

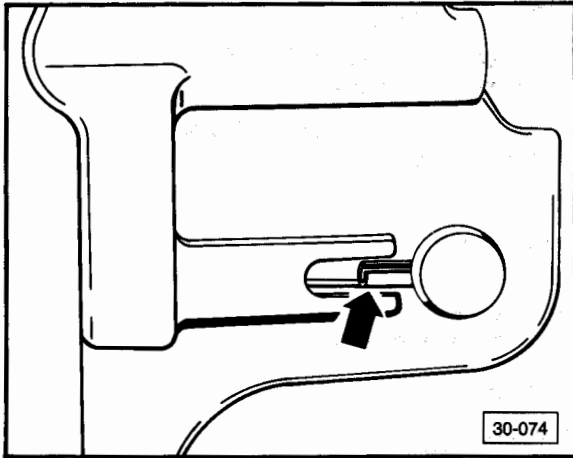


Fig. 1 Roll pin, installation position

— roll pin must be engaged in groove (arrow) on side of bracket

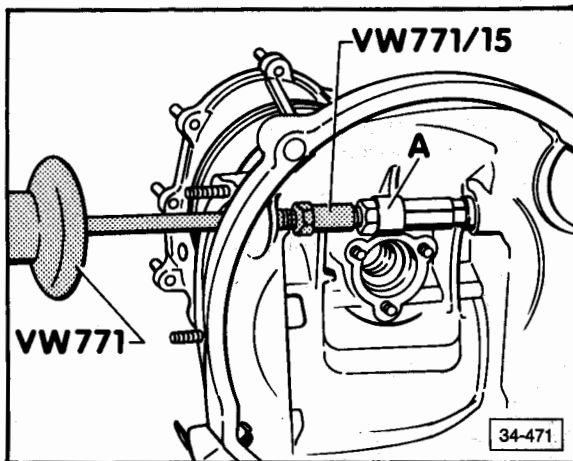


Fig. 2 Release shaft bushing, removing

A — inner extractor 18.5-23.5 mm  
e.g. Kukko 21/3

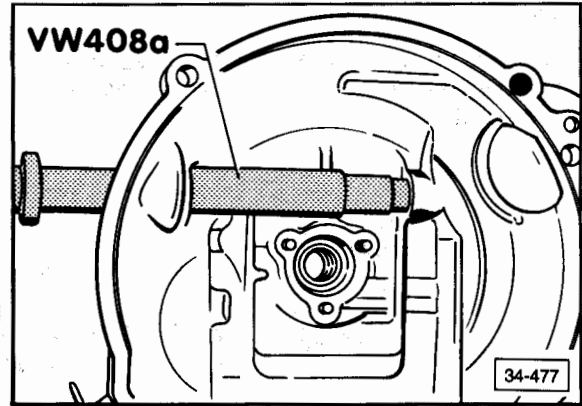


Fig. 3 Bearing shaft bushing, installing

— push bushing in to stop

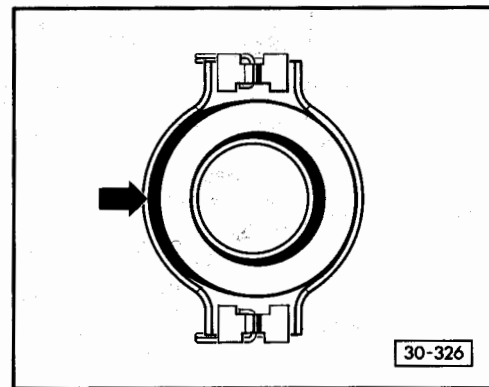


Fig. 4 Release bearing, installing

New release bearing on which thrust ring is not centrally positioned to housing (arrow) can be installed.

The thrust ring automatically centers itself on first application of clutch pedal.

**CAUTION**

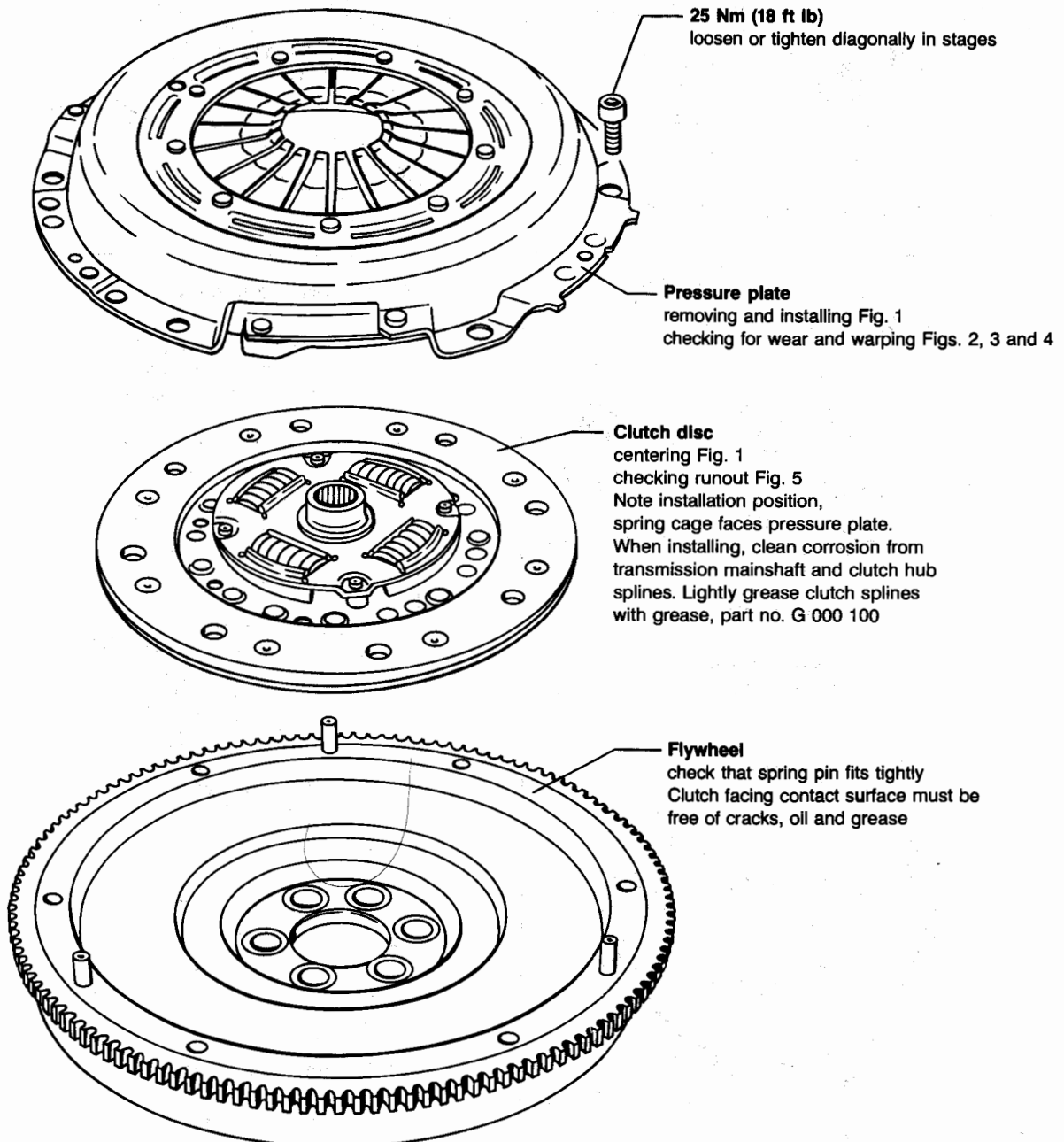
Clutches with damaged or loose riveted connections should be replaced.

**CAUTION**

When replacing engines, transmissions or clutches, make sure the diameter and joint surfaces of release bearing and diaphragm spring match.

**Note**

Remove engine when working on the clutch



30-092

# 30 Clutch, Controls

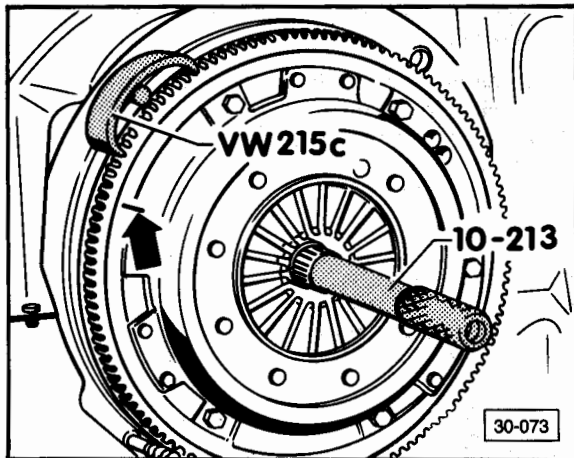


Fig. 1 Clutch removing/installing

- mark installation position (arrow)

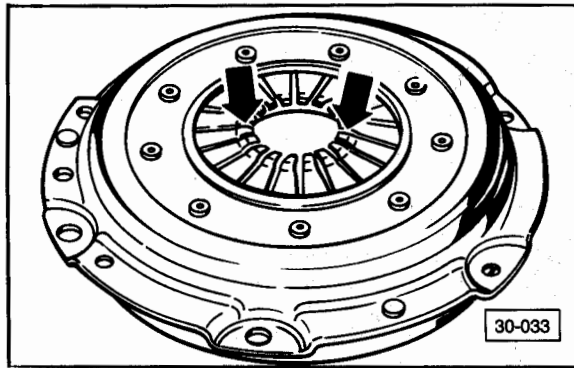


Fig. 2 Clutch diaphragm spring, checking

- examine fingers (arrows)
- scores up to a maximum of 0.3 mm are acceptable

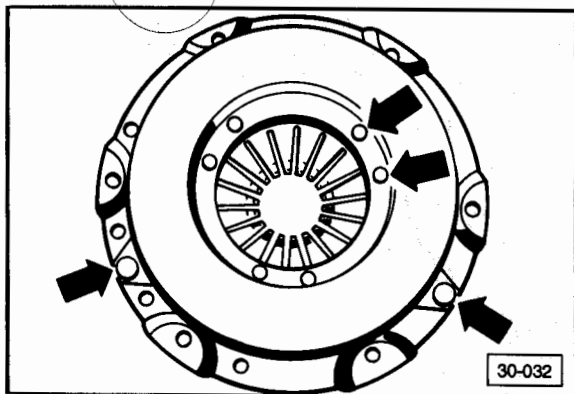


Fig. 3 Clutch, checking

- check straps between pressure plate and cover for cracks and loose rivets (arrows)
- clutches with damaged or loose riveted sections should be replaced

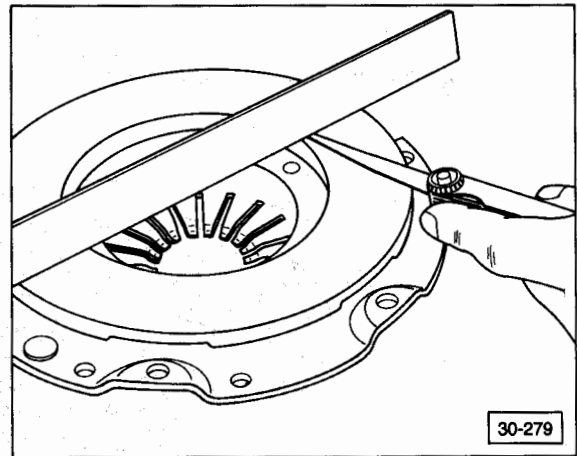


Fig. 4 Pressure plate, checking

- check pressure plate for cracks, burn marks and distortion
- maximum inward taper = 0.3 mm

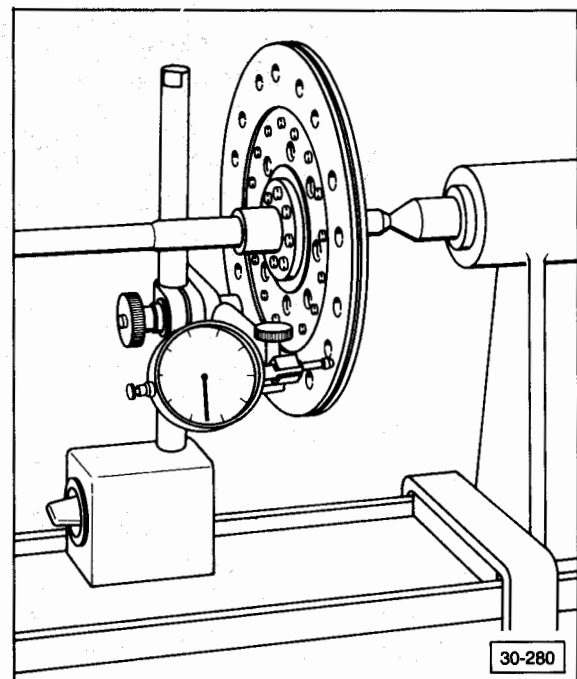


Fig. 5 Clutch disc, checking runout

- maximum runout = 0.5 mm (measure 2.5 mm from outer edge)

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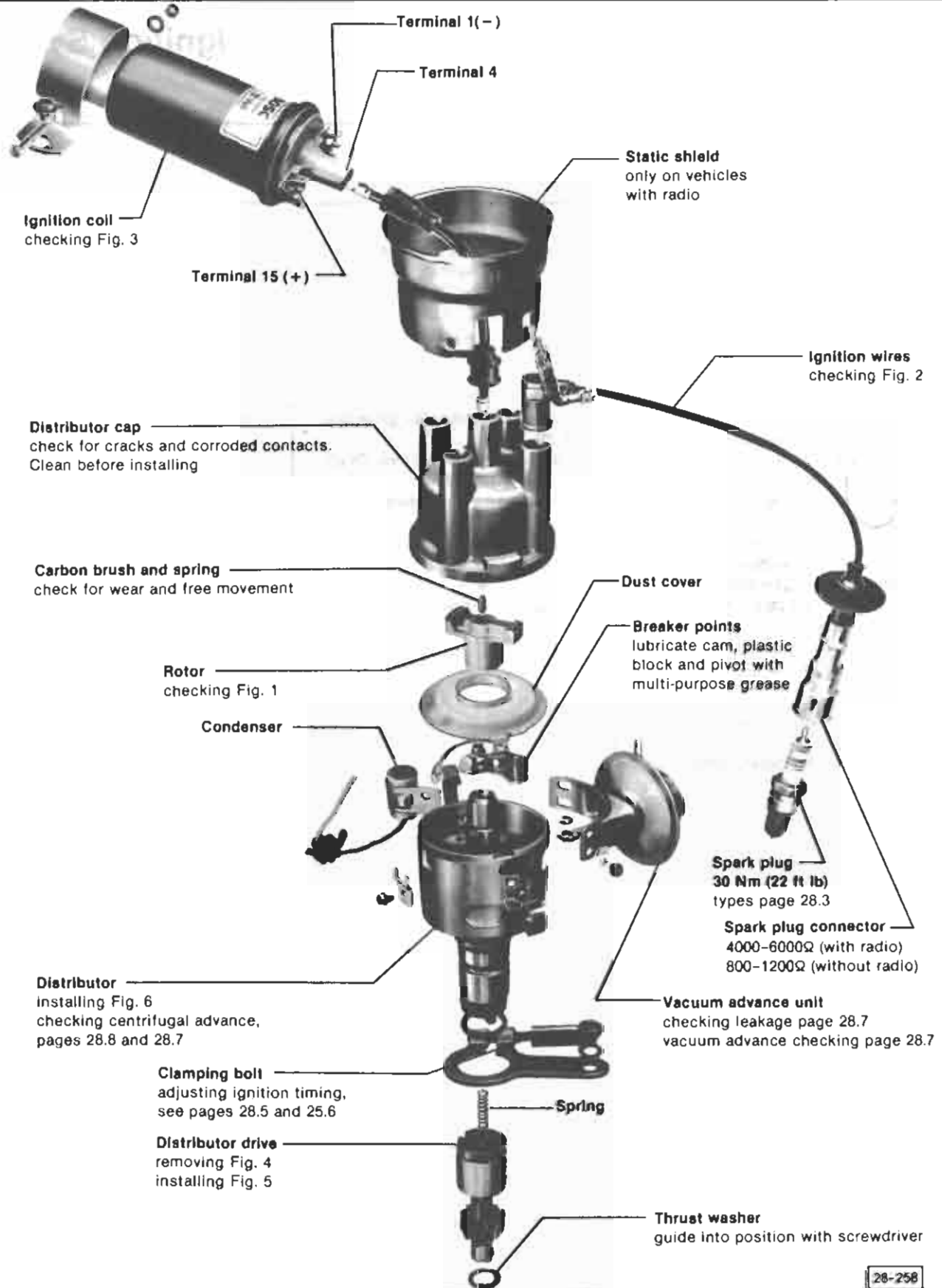
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# 28 Ignition System



28-258

## 28.2 Ignition system

Air-cooled AFC CAN/USA, not California

Engine code letters	CV	
Distributor (Part No.)	022 905 205S	
Ignition timing	7.5° BTDC	
Timing mark location: crankshaft pulley		
Idle speed manual automatic Vacuum hose disconnected	800- 950 rpm 850-1000 rpm	
Dwell angle new points wear limit	44-50° 42-58°	
Centrifugal advance (crankshaft degrees)	start	1000-1200 rpm
	end	9-14° at 1600 rpm 21-25° at 3400 rpm
Vacuum advance	start	107-147 mbar (80-110 mm Hg)
	end	266 mbar (200 mm Hg) 8-12°
Spark plugs Bosch Beru Champion	W 145 M2, W 8 CO 145/14/3L N 288	
Spark plug tightening torque	30 Nm (22 ft lb)	
Spark plug gap	0.6-0.7 mm (0.023-0.028 in.)	
Firing order	1-4-3-2	

**Air-cooled AFC**

**CAN/USA, not Calif.**

Ignition distributor  
and settings

**28.3**

# 28 Ignition System

## Note

A rough idle or misfire during partial load could be caused by ignition sparks jumping from the plug wire connector to the noise suppression shield, or the cylinder head.

- remove and inspect the plug connector for white spots or burn marks
- on those vehicles equipped with a suppressor shield on the distributor cap, it is necessary to remove the shield and check for white spots or burn marks on the distributor cap

If white spots or burn marks are present, replace the damaged components.

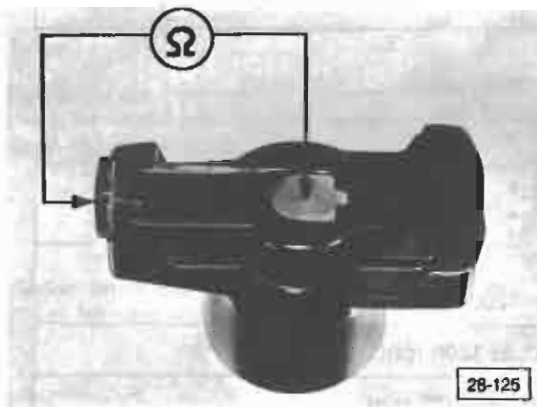


Fig. 1 Rotor, checking

- 4000-6000 ohms

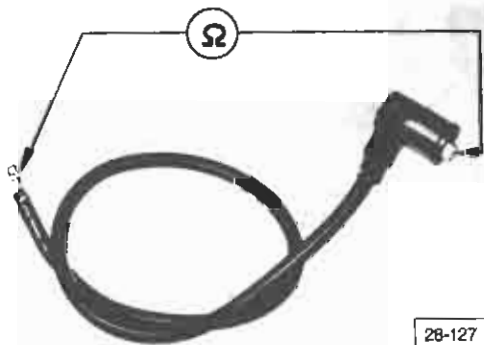


Fig. 2 Ignition wires, checking

- check wires between distributor and spark plugs (including connectors) for continuity
  - resistance should not vary greatly
- check wire between ignition coil and distributor (including connector)
  - resistance should not be greater than 2400 ohms

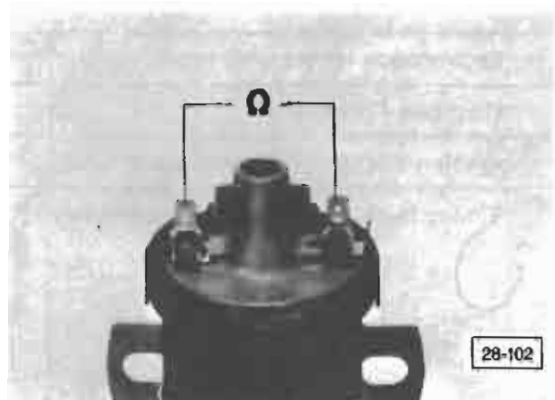


Fig. 3 Ignition coil, checking

- disconnect all wires from coil terminals
- measure resistance between terminals 1 and 15
  - 2.6-3.1 ohms
- measure resistance between terminals 1 and 4
  - 6000-12000 ohms

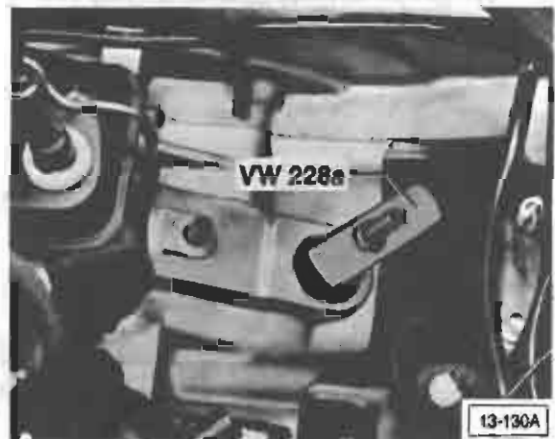


Fig. 4 Distributor drive, removing

28.4

Rotor  
Ignition wires/Coil  
Distributor drive

Air-cooled AFC CAN/USA, not Calif.

J-5





**Fig. 5 Distributor drive, installing**

- set crankshaft to TDC on cylinder No. 1
- install drive shaft so that offset slot is at an angle of about 12° to engine centerline (small segment to coil side)



**Fig. 6 Distributor, installing**

- set crankshaft to TDC on cylinder No. 1
- turn rotor until it is pointing to No. 1 cylinder mark on edge of housing
- install distributor
- clean distributor cap, check for cracks, signs of tracking and rotor tightness on shaft
- adjust ignition timing

## Ignition timing, checking/adjusting with SIEMENS 451 tester or equivalent

### Work sequence

#### Note

If SIEMENS 451 tester is not available, proceed with check using procedure with timing light (see page 28.6)

- run engine until engine oil is at least 30°C (86°F)



- connect SIEMENS tester according to manufacturer's instructions
- run engine at idle speed
  - manual: 800-950 rpm
  - automatic: 850-1000 rpm

- pull off vacuum hose to distributor
- check dwell angle, adjust if necessary
  - new points: 44-50°
  - wear limit: 42-58°

- check timing. Ignition timing point will read directly on SIEMENS tester
  - 7.5° before TDC

if **NO**, loosen distributor clamping bolt and turn distributor

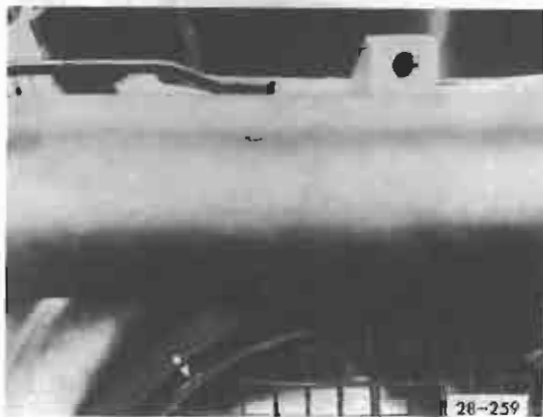
- reconnect vacuum hose to distributor
- retighten clamping bolt

# 28 Ignition System

## Ignition timing, checking/adjusting with timing light

### Work sequence

- run engine until engine oil is at least 30°C (86°F)
- connect dwell/tach according to manufacturer's instructions
- run engine at idle speed
  - manual: 800–950 rpm
  - automatic: 850–1000 rpm
- pull off vacuum hose to distributor
- check dwell angle, adjust if necessary
  - new points: 44–50°
  - wear limit: 42–58°



- flash ignition timing scale with timing light
  - mark on pulley must align with red mark on scale

if **NO**, loosen distributor clamping bolt and turn distributor

- reconnect vacuum hose to distributor
- retighten clamping bolt

## Ignition distributor, checking centrifugal advance with SIEMENS 451 tester or equivalent

### Work sequence



- connect tester according to manufacturer's instructions
- start engine and run at idle
  - ignition timing and rpm will register directly on tester
- adjust idle speed if necessary
  - manual: 800–950 rpm
  - automatic: 850–1000 rpm
- pull hose off vacuum unit
- adjust ignition timing if necessary (see pages 28.5–28.6)
- note advance angle on test instrument (basic advance angle)

### Note

Start of centrifugal advance is shown by increasing advance angle registered on test instrument while increasing rpm

- increase engine speed slowly to 1600 rpm
- read off advance angle on test instrument

### Note

To determine centrifugal advance, subtract basic advance angle from last advance angle measured

### Example

last advance angle measured  
(–) minus basic advance angle  
(=) centrifugal advance

- repeat check at 3400 rpm
- reconnect vacuum hose when test is completed

## Ignition distributor, checking centrifugal advance with timing advance tester

### Work sequence

- connect tester according to manufacturer's instructions
- start engine and run at idle
  - manual: 800–950 rpm
  - automatic: 850–1000 rpm
- pull off hose at vacuum unit
- check ignition timing and adjust if necessary (see pages 28.5 to 28.6)
- flash ignition timing scale with timing light and note indicated angle (basic angle)

### Note

Start of centrifugal advance is shown by movement of notch while increasing rpm

- increase engine speed slowly to 1600 rpm
- bring notch back to original setting by turning knob on tester and read off advance value

### Note

To determine centrifugal advance, subtract basic advance angle from last advance angle measured

### Example

$$\begin{array}{r} \text{last advance angle measured} \\ (-) \text{ minus basic advance angle} \\ \hline (=) \text{ centrifugal advance} \end{array}$$

- repeat check at 3400 rpm
- reconnect vacuum hose when test completed

## Vacuum advance unit, checking for leakage

### Work sequence



- connect vacuum tester Sun VPT 212-1 or equivalent according to manufacturer's instructions

- run engine at approx. 2500 rpm and check that vacuum at throttle valve housing is reaching vacuum unit
- If **NO**, vacuum connection on throttle valve housing may be blocked
- increase engine speed until vacuum tester indicates higher reading than 266 mbar (200 mm Hg)
- switch vacuum tester so it holds vacuum on side connected to vacuum unit
- turn engine **OFF**
- vacuum reading on tester must not drop more than 10% within 1 minute, otherwise vacuum unit or hose is defective

## Vacuum advance, checking

- connect SIEMENS 451 tester or equivalent, or tach and timing light according to manufacturer's instructions
- connect vacuum tester between throttle valve housing and vacuum advance unit connection
- set vacuum tester to allow vacuum to pass through
- start engine and run at idle
  - manual: 800–950 rpm
  - automatic: 850–1000 rpm
- if using SIEMENS tester or equivalent, read off indicated advance angle (basic angle) and note
- if using timing light, flash scale and note advance angle (basic angle)
- increase engine speed until reading on vacuum tester is higher than 266 mbar (200 mm Hg)
- switch vacuum tester so that it holds vacuum on side connected to vacuum unit
- leave engine running at idle (adjust if necessary)
- reduce vacuum on vacuum tester to 266 mbar (200 mm Hg) or 107–147 mbar (80–110 mm Hg)
- note advance angles
- determine vacuum advance by subtracting basic advance angle from measured advance angle

### Example

$$\begin{array}{r} \text{last advance angle measured} \\ (-) \text{ minus basic advance angle} \\ \hline (=) \text{ vacuum advance} \end{array}$$

- compare vacuum advance angles with specified values on page 28.3

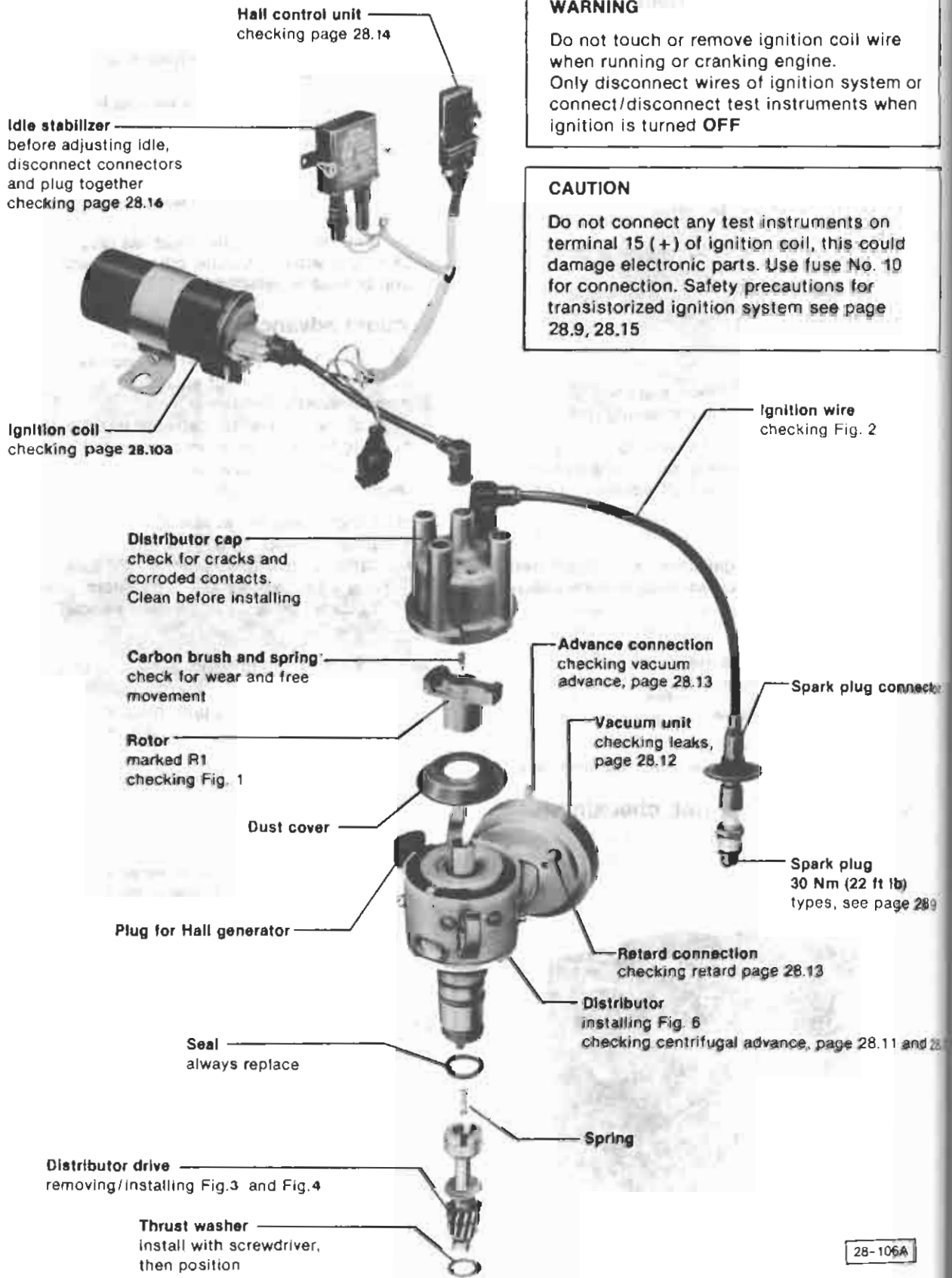
Air-cooled AFC

CAN/USA, not Calif.

Ignition distributor  
Vacuum unit  
Vacuum advance

**28.7**

# 28 Ignition System



**WARNING**

Do not touch or remove ignition coil wire when running or cranking engine. Only disconnect wires of ignition system or connect/disconnect test instruments when ignition is turned OFF

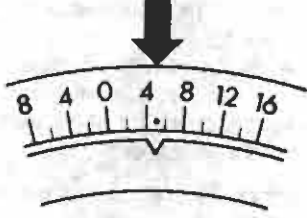
**CAUTION**

Do not connect any test instruments on terminal 15 (+) of ignition coil, this could damage electronic parts. Use fuse No. 10 for connection. Safety precautions for transistorized ignition system see page 28.9, 28.15

28-106A

## 28.8 Ignition timing with Hall Generator

**Air-cooled AFC Calif.**

Engine code letters	CV	
Distributor (Part No.)	039 905 205C	
Ignition timing	5° ATDC	
Timing mark location; crankshaft pulley		
Idle adjustment Vacuum hoses connected Idle stabilizer plugs removed and connected together	850-950 rpm	
Dwell angle setting	not adjustable	
Centrifugal advance (crankshaft degrees)	start	1050-1300 rpm
		9-13° at 1600 rpm
	end	21-25° at 3400 rpm
Vacuum advance	start	90-160 mbar (70-120 mm Hg)
	end	240-280 mbar (180-210 mm Hg) 9-12°
Vacuum retard	start	90-160 mbar (70-120 mm Hg)
	end	200-280 mbar (150-210 mm Hg) 11-13°
Spark plugs	Bosch Beru Champion	W 145 M2, W 8 CO 145/14/3L N 288
Spark plug gap		0.6-0.7 mm (0.023-0.028 in.)
Spark plug tightening torque		30 Nm (22 ft lb)
Firing order		1-4-3-2

**Transistorized ignition system cautions**

Do not connect any condenser/suppressor or test light to terminal 1. Do not connect test instruments with a 12 volt supply on terminal 15 of ignition coil. Do not crank engine before high tension wire of distributor cap (terminal 4) is connected to ground with jumper wire (example: compression check etc.). Do not replace installed coil—211 905 115 C—with conventional type. Do not leave battery connected when electric welding

on car. Do not start engine after heating up to more than 80°C (176°F), example: paint drying booth. Do not wash engine when it is running. Do not use battery booster longer than 15 sec. nor exceed 16.5 volts with booster. Allow 1 minute pause between boosting attempts. Do not disconnect battery while engine is running. Disconnect plug to ignition control unit when car has to be towed.

# 28 Ignition System

## Note

A rough idle or misfire during partial load could be caused by ignition sparks jumping from the plug wire connector to the noise suppression shield, or the cylinder head.

- remove and inspect the plug connector for white spots or burn marks
- on those vehicles equipped with a suppressor shield on the distributor cap, it is necessary to remove the shield and check for white spots or burn marks on the distributor cap

If white spots or burn marks are present, replace the damaged components.

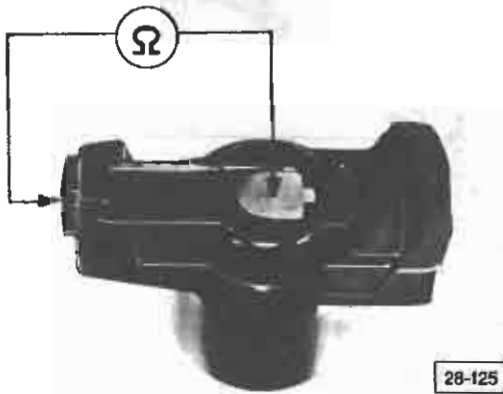


Fig. 1 Rotor, checking

- check that resistance is approximately 1000 ohms

## Note

Do not change rotor when installing radio; rotor must be marked with R1.

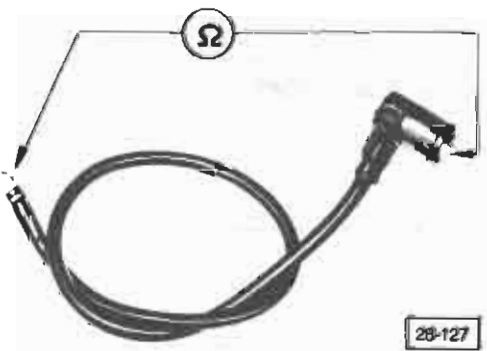


Fig. 2 Ignition wires, checking

- check wires between distributor and spark plugs (including connectors) for continuity
  - resistance should not vary greatly between wires

- check wire between ignition coil and distributor (including connectors)
  - resistance should not be greater than 12000 ohms

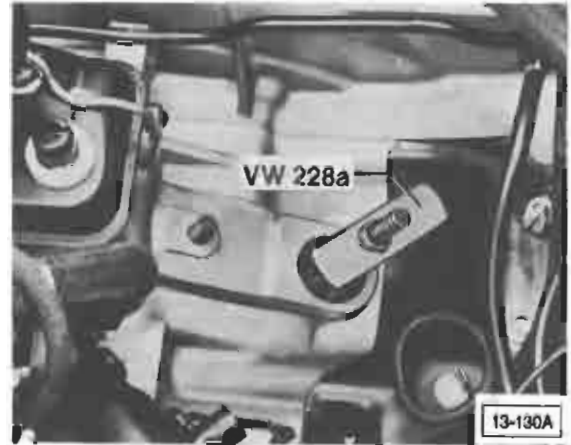


Fig. 3 Distributor drive, removing

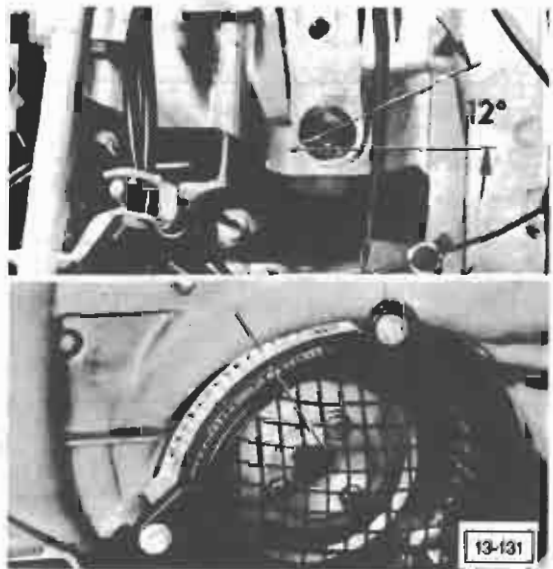


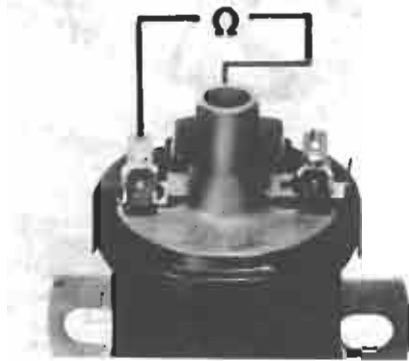
Fig. 4 Distributor drive, installing

- set crankshaft to TDC on cylinder No. 1
- install drive shaft so that offset slot is at an angle about 12° to engine centerline (smaller segment toward coil side)
- install spacer spring

## CAUTION

When working on vehicles with Hall ignition system, observe following precautions to prevent injury or damage to ignition system:

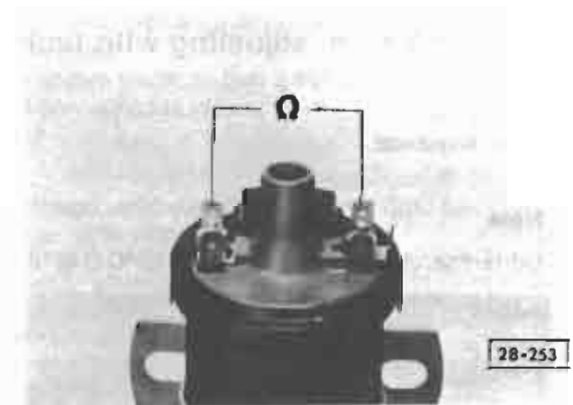
- do not touch or remove high tension wire when running or cranking engine
- disconnect ignition wires **only** when ignition is switched off
- test instruments should be connected/disconnected **only** when ignition is switched off
  
- do not connect any condenser to terminal 1
- do not tow cars without disconnecting plugs on ignition control unit
- do not crank engine until high tension wire of distributor cap (terminal 4) is connected to ground with jumper wire (example: compression check, etc.)
- do not leave battery connected when electric welding on car
- do not substitute rotor of ignition distributor with one of different type
- when installing suppressor, use only 1000 ohms for high tension wires and 1000 to 5000 ohms for spark plug connectors
  
- do not wash engine when it is running
- do not use battery booster longer than 1 minute nor exceed 16.5 volts with booster



28-301

### Ignition coil secondary resistance, checking

- disconnect all wires from coil terminals
- measure resistance between negative terminal 1 and coil high tension terminal 4
  - resistance:
    - 2400 – 3500 ohms
- if not within tolerance, replace ignition coil



28-253

### Ignition coil primary resistance, checking

- disconnect all wires from coil terminals
- measure resistance between positive 15 and negative 1 coil terminals
  - resistance:
    - 0.52–0.76 ohms
- if not within tolerance, replace ignition coil



# 28 Ignition System



**Fig. 6 Ignition distributor, installing**

- set crankshaft to TDC on cylinder No. 1
- turn rotor until it is pointing to No. 1 cylinder mark on edge of housing
- install distributor
- clean distributor cap, check for cracks, signs of tracking and rotor tightness on shaft
- adjust ignition timing

## Ignition timing, adjusting with timing light

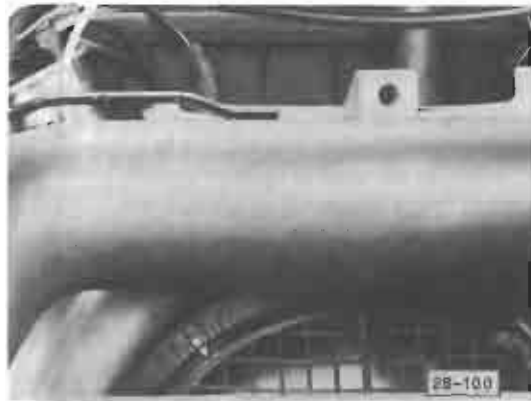
### Work sequence

#### Note

Oil temperature must be at least 60°C (140°F)



- disconnect plugs from idle stabilizer
  - squeeze connectors to release
- connect plugs together (arrow)



- start engine
- adjust engine idle to 850-950 rpm
- flash timing mark with timing light
  - mark on pulley must align with red mark on scale
- if necessary, loosen distributor clamping bolt and turn distributor
- reconnect idle stabilizer
- retighten clamping bolt

## Ignition distributor, checking centrifugal advance with SIEMENS 451 tester or equivalent

### Work sequence



- connect tester according to manufacturer's instructions
- remove idle stabilizer plugs and connect together
- start engine and run at idle
  - ignition timing and rpm will register directly on tester
- adjust idle speed
  - manual: 850-950 rpm
  - automatic: 850-950 rpm
- check and adjust ignition timing if necessary
- go to next page



- pull off both vacuum hoses from distributor vacuum unit
- plug vacuum retard hose
- reset idle speed to specifications
- note advance angle on tester (basic advance angle)

**Note**

Start of centrifugal advance is shown by increasing advance angle registered on tester while increasing rpm

- increase engine speed slowly to 1600 rpm
- read off advance angle on tester

**Note**

To determine centrifugal advance, subtract basic advance angle from last advance angle measured

**Example**

$$\begin{aligned} & \text{last advance angle measured} \\ (-) & \text{ minus basic advance angle} \\ \hline (=) & \text{ centrifugal advance} \end{aligned}$$

- compare centrifugal advance angle to specified value of page 28.9
- repeat test at 3400 rpm
- reconnect vacuum hoses when test completed

**Note**

With vacuum hoses connected, adjust idle speed to given specifications before connecting plugs to idle stabilizer

- reconnect idle stabilizer

## Ignition distributor, checking centrifugal advance with timing advance tester

**Work sequence**

- connect tester according to manufacturer's instructions
- pull advance and retard hoses off vacuum unit
- disconnect plugs from idle stabilizer and connect together
- start engine and adjust idle speed to 900 rpm
- flash timing mark with timing light, and note indicated angle (basic angle)

**Note**

Start of centrifugal advance is shown by movement of notch while increasing rpm

- increase engine speed slowly to 1600 rpm
- bring notch back to original setting by turning knob on tester and read off advance value

**Note**

To determine centrifugal advance, subtract basic advance angle from advance angle measured

**Example**

$$\begin{aligned} & \text{last advance angle measured} \\ (-) & \text{ minus basic advance angle} \\ \hline (=) & \text{ centrifugal advance} \end{aligned}$$

- compare centrifugal advance to chart page 28.9
- repeat check at 3400 rpm
- when check completed, reconnect vacuum hoses
- reconnect idle stabilizer plugs

## Distributor vacuum unit, leak checking

**Work sequence**

- connect vacuum tester between intake manifold and retard connection on vacuum unit
- plug vacuum hose for retard connection
- set vacuum tester to allow vacuum to pass through
- start engine and run at idle
- disconnect hose from advance connection on vacuum unit
- set vacuum tester so that it holds vacuum on side connected to vacuum unit

**Note**

Vacuum registered on tester must not drop by more than 10% within 1 minute

- connect vacuum tester between throttle valve housing and advance connection on vacuum unit
- set vacuum tester to allow vacuum to pass through
- increase engine speed until reading on vacuum tester is higher than 240–280 mbar (180–210 mm Hg)
- if no vacuum is registered on tester, check if connection at throttle valve housing is blocked
- set vacuum tester so that it holds vacuum on side connected to vacuum unit

**Note**

Vacuum registered on tester must not drop by more than 10% within 1 minute

# 28 Ignition System

## Vacuum advance angle, checking

### Work sequence

- connect SIEMENS tester or equivalent (or tach and timing light) according to manufacturer's instructions
- connect vacuum tester between throttle valve housing and vacuum advance unit connection
- set vacuum tester to allow vacuum to pass through
- disconnect plugs from idle stabilizer and connect together
- start engine and adjust idle speed to 900 rpm
- if SIEMENS tester or equivalent is being used, read off indicated advance angle (basic angle)
- if using timing light, flash scale and note advance angle (basic angle)
- increase engine speed until reading on vacuum tester is higher than 240–280 mbar (180–210 mm Hg)
- switch vacuum tester so that tester holds vacuum on side connected to vacuum unit
- let engine continue to run at idle and readjust to 900 rpm if necessary
- reduce vacuum on vacuum tester to 240–280 mbar (180–210 mm Hg) or 90–160 mbar (70–120 mm Hg)
- note advance angles
- determine vacuum advance by subtracting basic advance angle from measured advance angle

### Example

last advance angle measured  
(–) minus basic advance angle

(=) vacuum advance

- compare vacuum advance angles with specified values on chart page 28.9)
- reconnect vacuum hoses and adjust idle speed
- reconnect idle stabilizer

## Vacuum retard angle, checking with SIEMENS 451 tester or equivalent

### Work sequence

- connect tester according to manufacturer's instructions
- disconnect plugs from idle stabilizer and connect together
- check ignition timing and adjust if necessary
- pull both vacuum hoses off distributor vacuum unit and plug retard hose
- adjust idle speed to 900 rpm
- note indicated retard angle on tester
- add 5° to indicated retard angle
- compare with specifications in chart for retard **end** (see page 28.9)
- reconnect vacuum hoses and adjust idle speed to 850–950 rpm
- reconnect plugs to idle stabilizer

## Vacuum retard angle, checking with timing advance tester

### Work sequence

- connect tachometer and timing advance tester according to manufacturer's instructions
- disconnect plugs from idle stabilizer and connect together
- start engine and flash ignition timing mark and note
- pull vacuum retard hose off vacuum unit and plug hose
- adjust idle speed to 900 rpm
- flash timing mark again and bring mark back to original setting by turning knob on timing advance tester
- read off retard angle and compare with specifications in chart (see page 28.9) for retard **end**
- reconnect vacuum hose and adjust idle speed to 850–950 rpm
- reconnect plugs to idle stabilizer

# 28.13

Distributor vacuum unit  
Vacuum advance  
angle

Air-cooled AFC California

## Hall control unit, checking

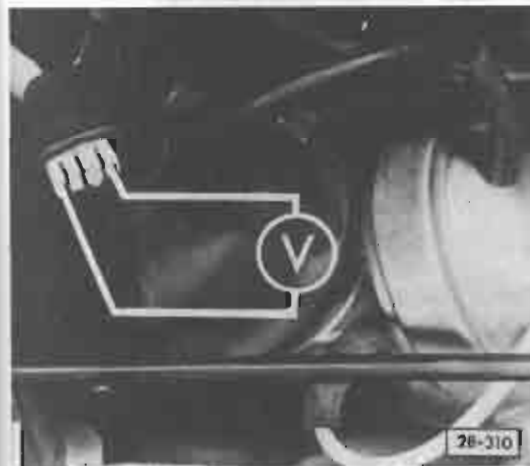
### Work sequence

#### Test condition:

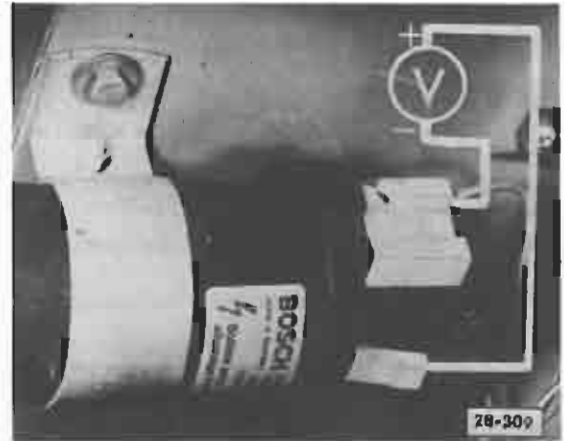
- ignition coil OK, ignition OFF



- disconnect both plugs from idle stabilizer and connect them together (arrow)



- remove connector from Hall control unit
- connect voltmeter with + (plus) to terminal 4 and with - (minus) to terminal 2 in connector
- turn ignition ON
  - spec = approx. battery voltage
  - if not, check for wire breaks and repair (see current flow diagram 97.12)
- turn ignition OFF
- reconnect connector to Hall control unit
- disconnect Hall generator connector from ignition distributor



- connect voltmeter with + (plus) to terminal 15 and with - (minus) to terminal 1 of ignition coil
- turn ignition ON
  - spec. = 2 volts (min.) for about 1-2 seconds and then drops to 0 volts
  - if not, replace Hall control unit and ignition coil
- touch center wire of connector on distributor briefly to ground
  - indicated voltage must increase briefly to 5-6 volts
  - if not, check for wire break in center wire and repair or replace Hall control unit if wire is OK
- turn ignition OFF



- connect voltmeter to outer terminals of Hall generator connector
- turn ignition ON
  - spec. = 5 volts (min.)

#### Note

If readings are within specifications, but defect still exists, replace Hall control unit or check for wire breaks between Hall generator connector and Hall control unit; if necessary, repair

# 28 Ignition System

## Hall generator, checking

### Test conditions:

- disconnect both wire plugs from idle stabilizer and connect them together
- Hall control unit OK
- ignition coil OK
- wiring between Hall control unit and ignition coil OK
- connector pins and sockets on Hall-generator

### CAUTION

When working on vehicles with Hall ignition system, observe following precautions to prevent injury or damage to ignition system:

- do **not** touch or remove high tension wire when running or cranking engine
- disconnect ignition wires **only** when ignition is switched **off**
- test instruments should be connected/disconnected **only** when ignition is switched **off**
- do **not** connect any condenser to terminal 1
- do **not** tow cars without disconnecting plugs on ignition control unit
- do **not** crank engine until high tension wire of distributor cap (terminal 4) is connected to ground with jumper wire (example: compression check, etc.)
- do **not** leave battery connected when electric welding on car
- do **not** substitute rotor of ignition distributor with one of different type
- when installing suppressor, use only 1000 ohms for high tension wires and 1000 to 5000 ohms for spark plug connectors
- do **not** wash engine when it is running
- do **not** use battery booster longer than 1 minute nor exceed 16.5 volts with booster

### Note

Because internal resistance of tester and ambient temperature can influence readings, test should be done with V.A.G. 1315A tester, SUN VAT-40 or equivalent.

Specified values given are valid for ambient temperatures from 0 to 40°C (32 to 104°F).

### CAUTION

Set tester to read voltage before connecting test leads.

- disconnect high tension wire from terminal 4 of distributor and connect to ground, using adapter cable



- pull rubber boot from control unit connector (with connector connected) as shown
- connect + (plus) wire of voltmeter (VAG 1315A or equivalent) to terminal 6 and — (minus) wire to terminal 3
- turn ignition On
- turn engine over slowly by hand (in running direction) and watch tester reading

### Note

Position of Hall-generator aperture rotor (in distributor) changes when engine is turning.

- spec = **0 to 0.7 volt**  
primary current switch OFF — position of aperture rotor open to Hall generator
- **1.8 volt up to battery voltage**  
primary current switched ON — position of aperture rotor-closed to Hall generator
- if not, Hall generator is defective; replace

### Note

Metal shavings or other debris between the ignition control unit and head sink can cause stress which may damage internal circuits of the control unit:

- when replacing ignition control unit, thoroughly clean heat sink before assembly.

## Idle stabilizer, checking

### Work sequence

- if engine is difficult to start, does not start, or engine misfires/cuts out, proceed as follows:
  - disconnect both wire plugs from idle stabilizer and connect them together
  - if engine starting troubles are eliminated:
    - check contact pins and sockets of both idle stabilizer connectors for correct position or damage
    - if OK: idle stabilizer unit must be defective; replace
  - connect V.A.G. 1315A tester, SUN VAT-40 or equivalent according to manufacturer's instructions
  - apply parking brake

### WARNING

No one should be allowed to stand in front of vehicle during this test. Vehicle's wheels must be blocked

### Vehicles with manual transmission

- apply foot brake
- start and accelerate engine (i.e. to 2500-3000 rpm) briefly
- let engine idle and notice ignition timing
- select 4th gear and slowly engage clutch
  - as engine speed drops below 940 rpm ignition timing must move in direction "advance"
- if not, replace idle stabilizer

### Vehicles with automatic transmission

- apply foot brake
- start and allow engine to warm up until idle speed drops below 1000 rpm
- switch ON all electrical consumers including air conditioner (if equipped)
- let engine idle and notice ignition timing
- place selector lever in a speed range
  - as engine speed drops below 940 rpm, ignition timing must move in direction "advance"
- if not, replace idle stabilizer

Air-cooled AFC

California

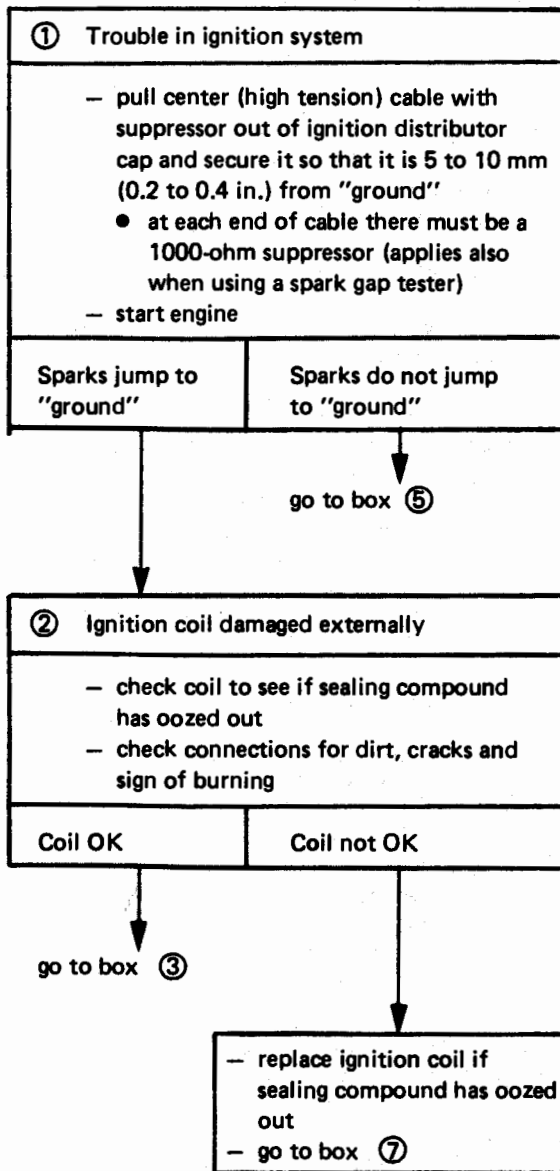
Idle stabilizer **28.16**

# 28 Ignition System

## Hall Ignition System Troubleshooting

Engine does not start or does not run properly

- starter speed normal
- fuel system OK



### Note

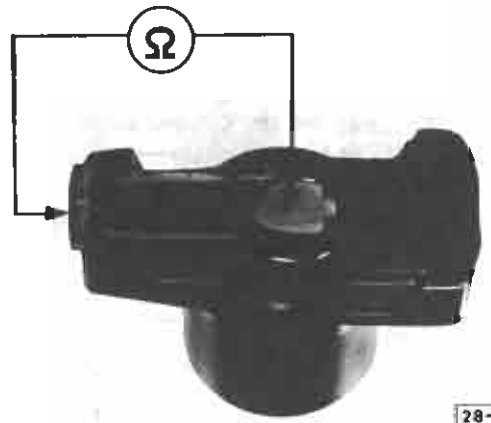
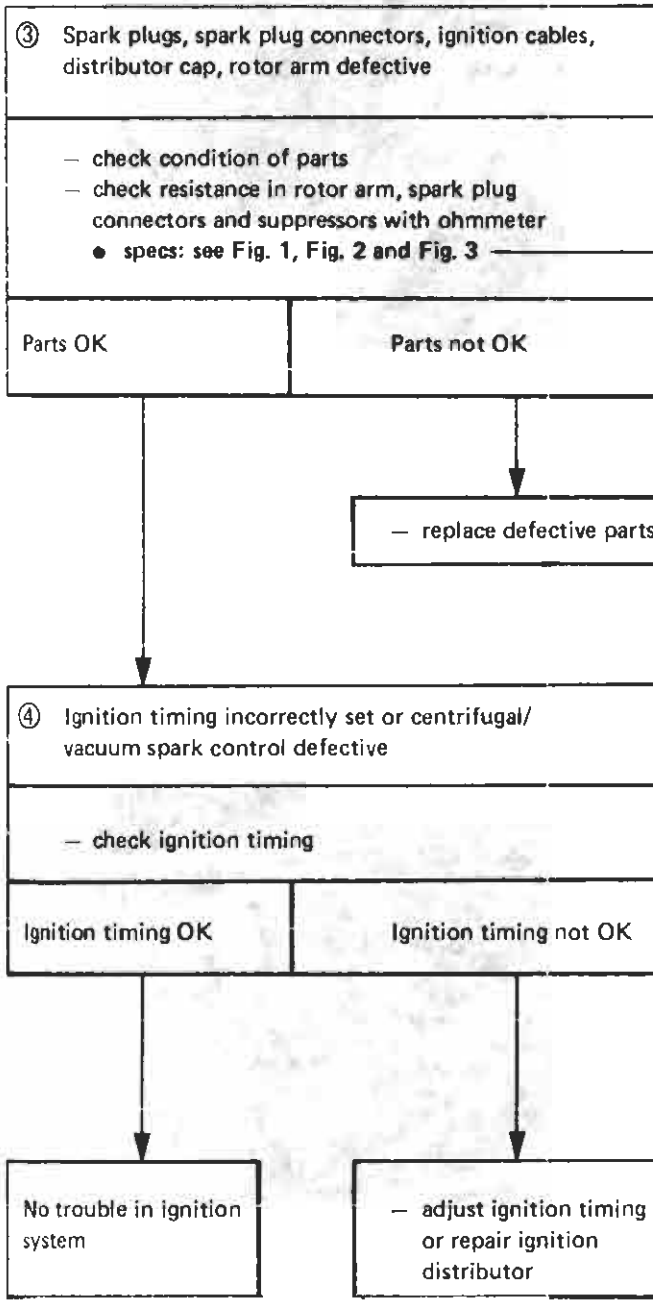
In isolated cases only, there may be trouble in Hall ignition system which cannot be traced with this troubleshooting program.

In such cases, try replacing Hall control unit or Hall generator

### CAUTION

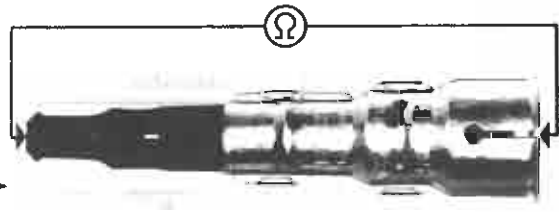
When working on vehicles with Hall ignition system, observe following precautions to prevent injury or damage to ignition system:

- do not touch or remove high tension wire when running or cranking engine
- disconnect ignition wires **only** when ignition is switched **off**
- test instruments should be connected/disconnected **only** when ignition is switched **off**
- do not connect any condenser to terminal 1
- do not tow cars without disconnecting plugs on ignition control unit
- do not crank engine until high tension wire of distributor cap (terminal 4) is connected to ground with jumper wire (example: compression check, etc.)
- do not leave battery connected when electric welding on car
- do not substitute rotor of ignition distributor with one of different type
- when installing suppressor, use only 1000 ohms for high tension wires and 1000 to 5000 ohms for spark plug connectors
- do not wash engine when it is running
- do not use battery booster longer than 1 minute nor exceed 16.5 volts with booster



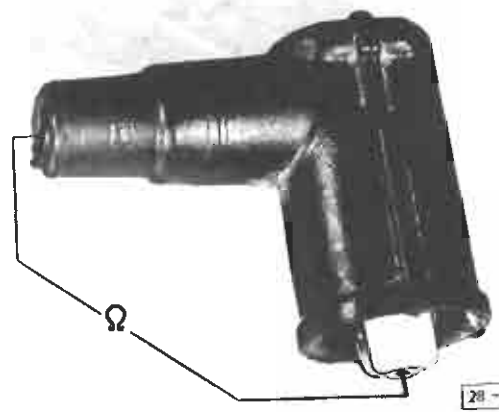
28-125

Fig. 1 Rotor arm:  $1000 \pm 400$  ohms



28-147

Fig. 2 Spark plug connectors:  
 ●  $1000 \pm 400$  ohms (not suppressed) or  
 ●  $5000 \pm 1000$  ohms (suppressed)



28-306

Fig. 3 Suppressor:  $1000 \pm 400$  ohms

# 28 Ignition System

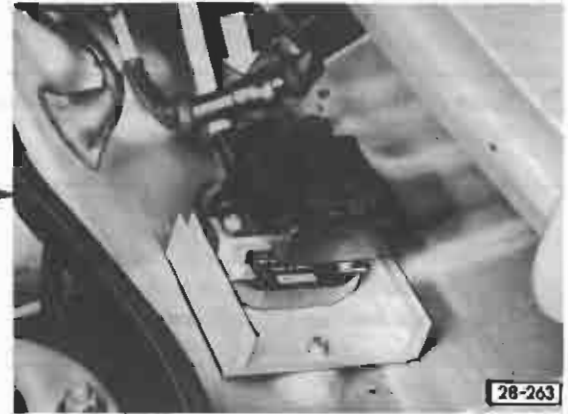
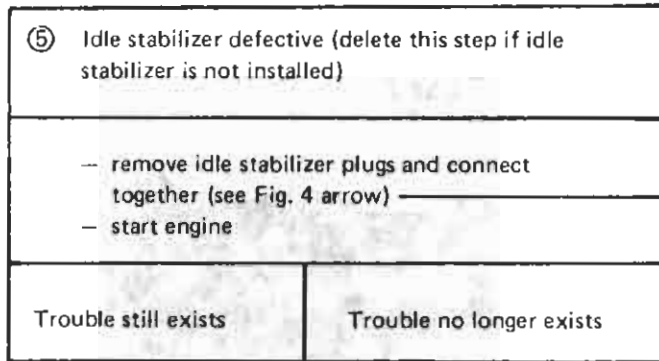


Fig. 4 Idle stabilizer

— connect plugs together (arrow)

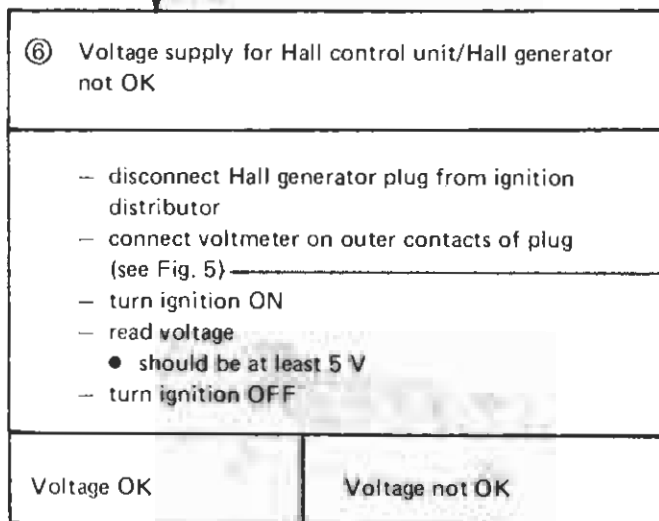
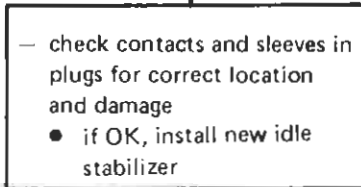
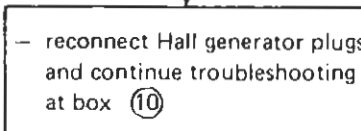


Fig. 5 Hall generator plug on ignition distributor (disconnected)

— connect voltmeter (watch plus and minus connection)

go to box ⑦





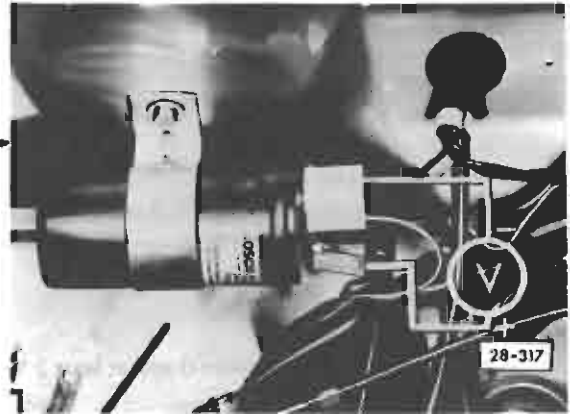
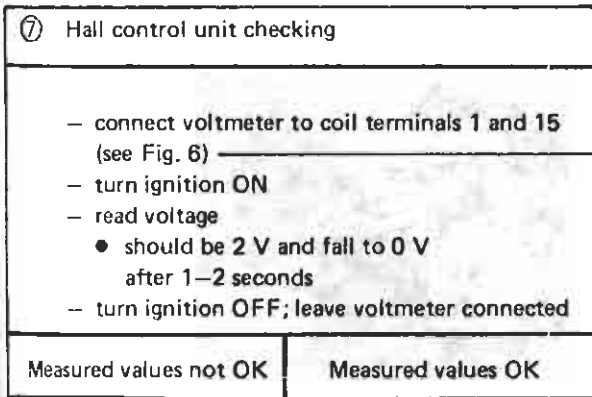


Fig. 6 Ignition coil

– connect voltmeter to terminals 1 and 15

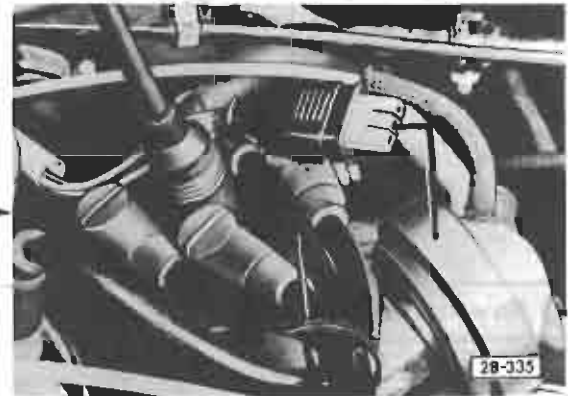
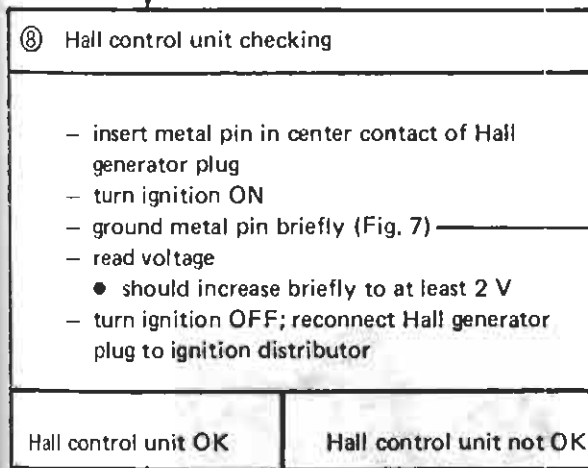
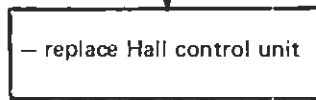
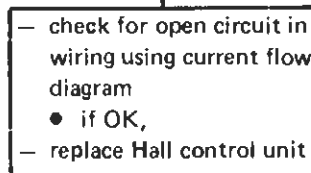


Fig. 7 Hall generator plug

– ground center contact with metal pin briefly (as shown)

go to box ⑨



# 28 Ignition System

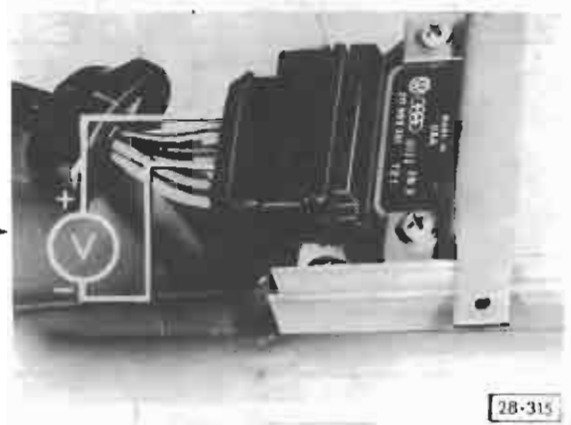
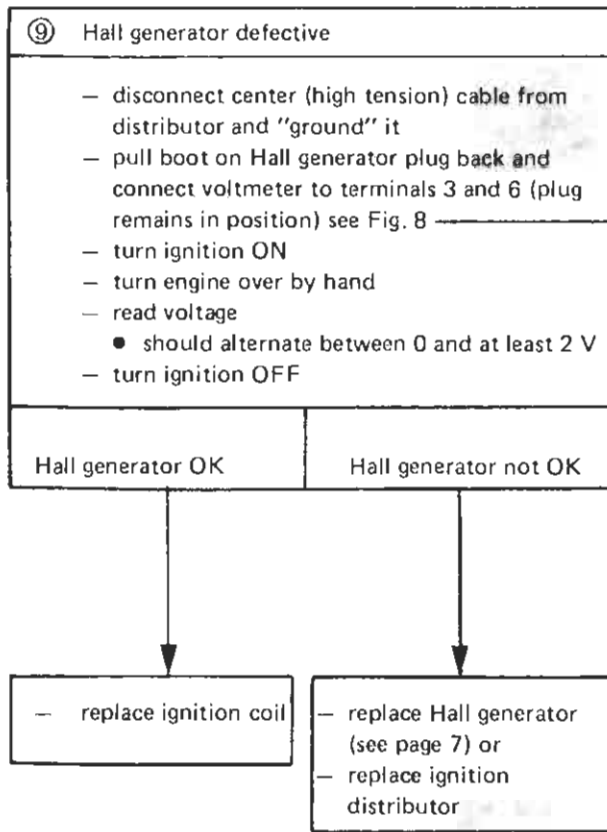


Fig. 8 Hall generator plug

- connect voltmeter to terminals 3 and 6

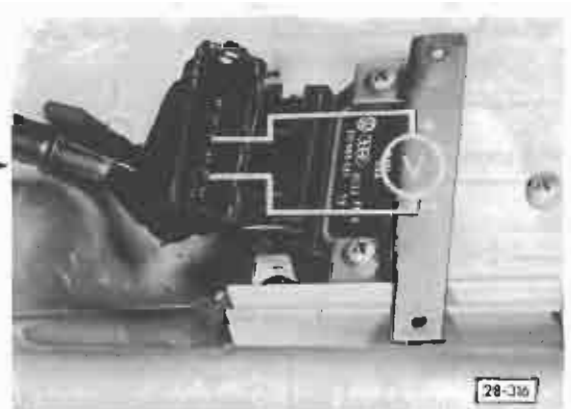
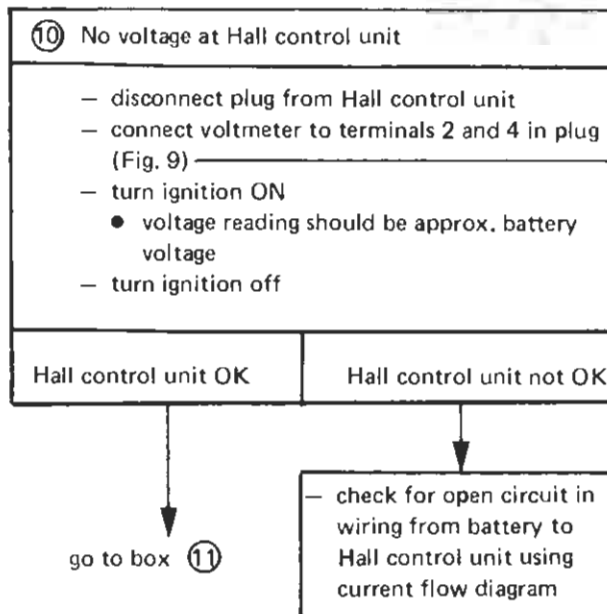
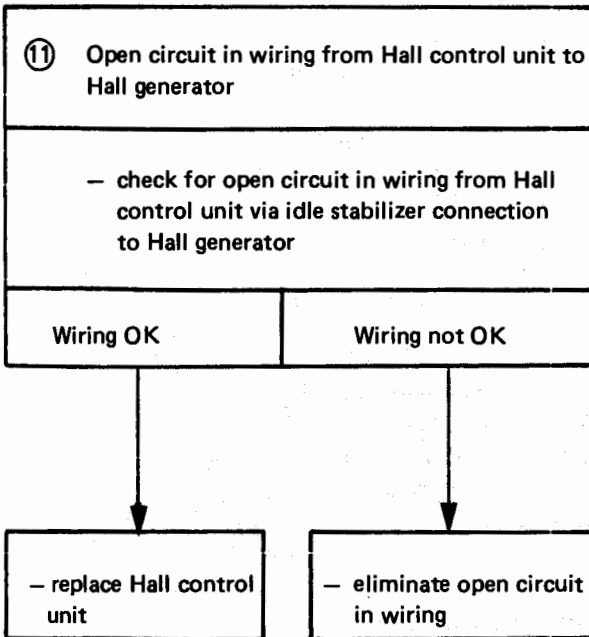


Fig. 9 Hall control unit plug

- connect voltmeter to terminals 2 and 4 in plug



# 28 Ignition System

## Hall generator, replacing

### Note

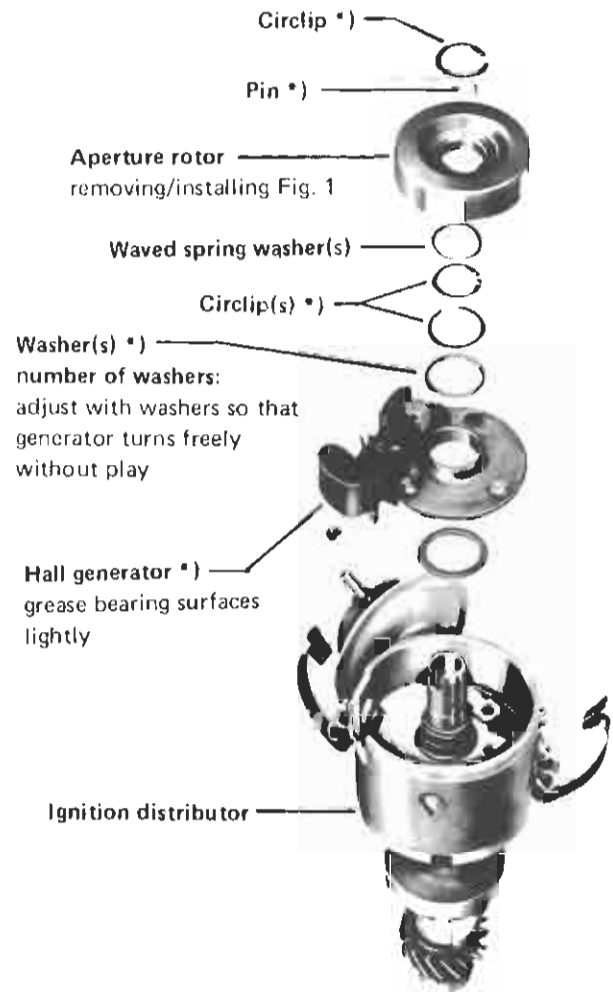
When replacing Hall generator, use repair kit which consists of following parts:

- Hall generator
- circlips
- washers
- pin



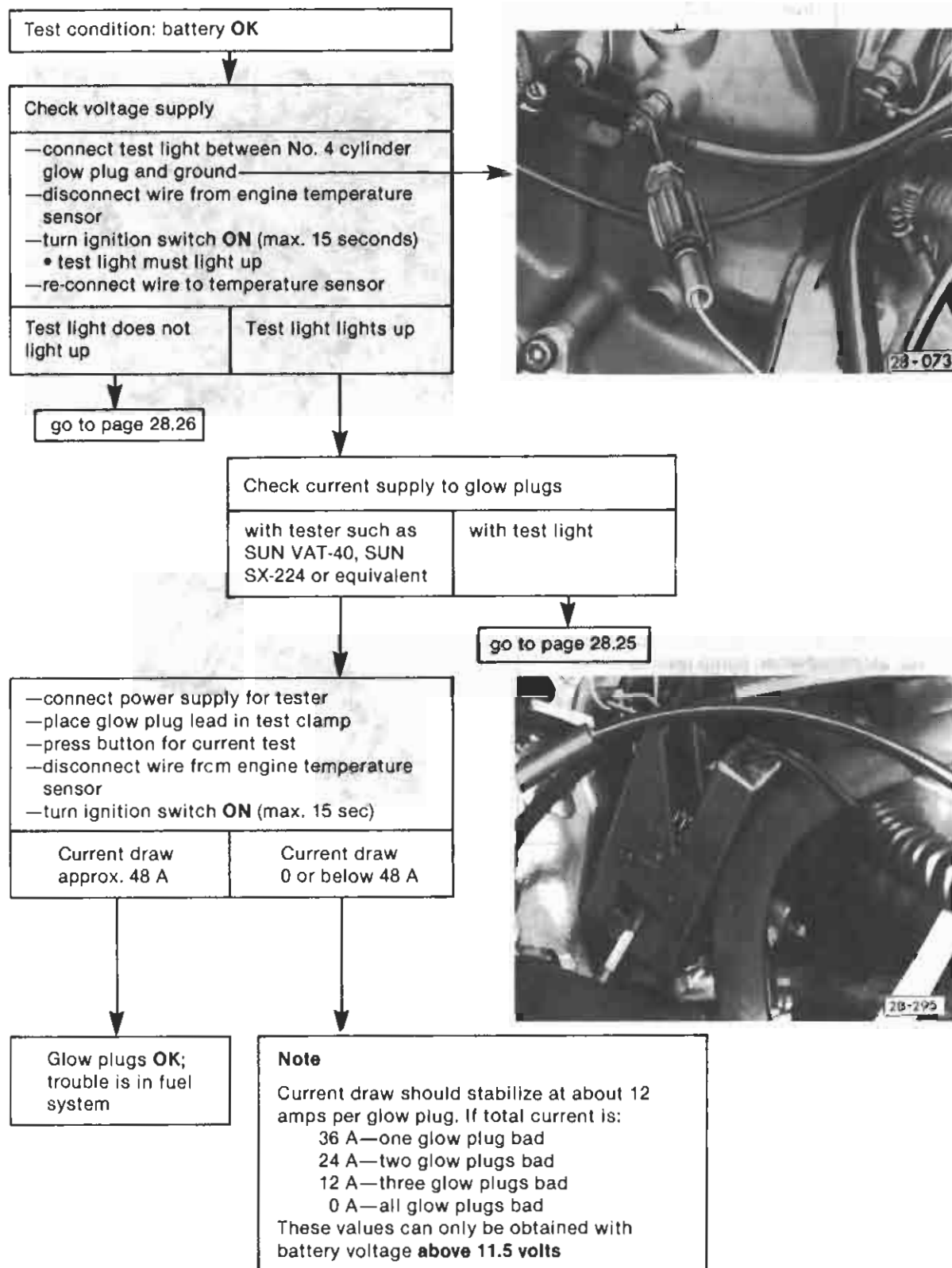
Fig. 1 Aperture rotor, removing/installing

- to avoid bending rotor when prying off, insert screwdrivers through two opposing slots until they contact circlip
- check that aperture rotor turns freely after installation by turning distributor shaft
  - if aperture rotor is bent, it must be replaced
  - **aperture rotor identification:**  
4 gaps;  
marking: 046



\*) parts in repair kit

## Quick glow system—troubleshooting



# 28 Ignition System

from page 28.24

## Checking glow plugs with test light

- remove wire and bus bar from plugs
- connect test light to battery positive (+) terminal and touch test light probe to each glow plug in turn
  - light lights up; glow plug is **OK**
  - light does not light up; glow plug is inoperative, replace plug (tightening torque 30 Nm - 22 ft lb)

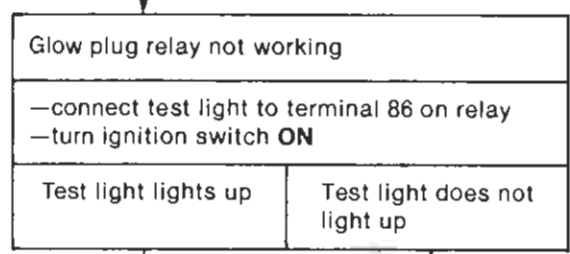
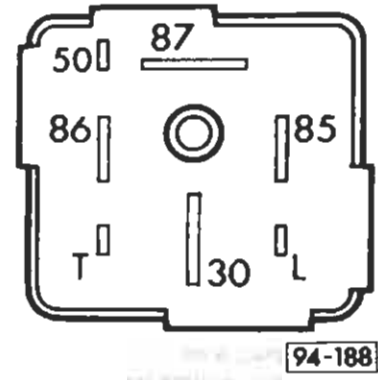
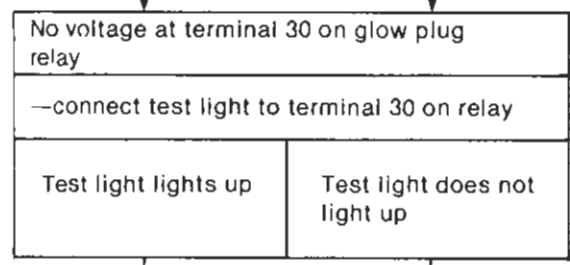
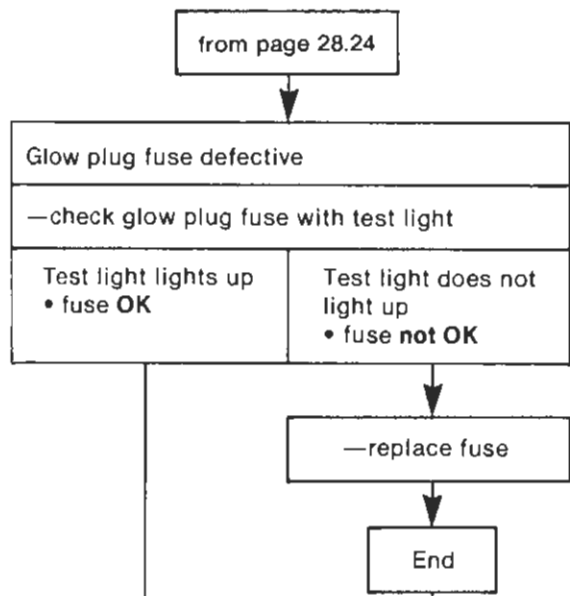


## Note

If glow plug tip (arrow) is worn away, injector spray pattern may not be correct

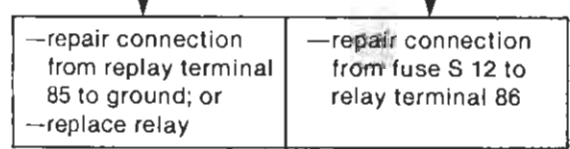
- remove corresponding injector
- check spray pattern, opening pressure and leakage of injector, using tester US 1111; see also pages 23.9 and 23.10
- check that spray pattern is compact and well atomized when pump lever is operated with short rapid strokes (4-6 strokes/sec)
  - if **NO**
- clean injector and recheck spray pattern etc.
  - if still **NO**
- install **new** injector and **new** glow plug





Possible causes:

- break in wire from terminal 30 to battery
- wire defective, replace



**Note**

When engine is difficult to start, check operation of automatic delay glow period and preheat period during starting

- when temperature controlled preheat period has ended (glow plug light out) there should still be voltage at glow plugs for additional 6 to 7 seconds. Do **not** operate starter for this test. If no voltage is present at glow plugs, replace relay
- when starter is engaged there should be voltage at glow plugs. If no voltage, repair wire from glow plug relay terminal 50 to starter or replace glow plug relay
- check Diesel Current Flow Diagram

# 28 Ignition System

## Glow plug light—troubleshooting

Glow plug light defective	
Check glow plug light as follows: —disconnect glow plug relay —ground terminal L in relay socket —turn ignition switch ON	
Glow plug light lights up	Glow plug light does not light up

—replace glow plug light or check wire from relay terminal L to glow plug light

End

Glow plug relay or engine temperature sensor defective	
Check operation of relay—see also Note on page 28.26 — disconnect glow plug wire — disconnect wire from engine temperature sensor — turn ignition switch ON • glow plug light should light up for 25–30 seconds — ground disconnected wire from engine temperature sensor • glow plug light must go out	
Glow plug light lights up	Glow plug light does not light up

—replace engine temperature sensor

End

—replace glow plug relay

End

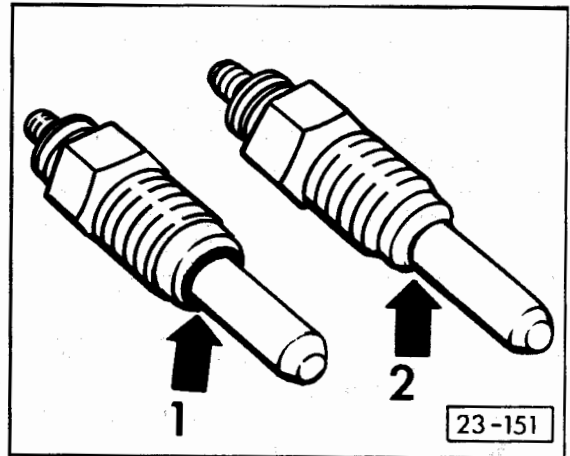
### CAUTION

To avoid glow plug damage from excessive voltage, **DO NOT** operate glow plug system while charging battery with external battery charger.

If using jumper cables to start Diesel equipped vehicles, external power source must not exceed vehicle system voltage (max. 13.5 V)

The torque specification for all glow plugs is:  
• 30 Nm (22 ft lb)

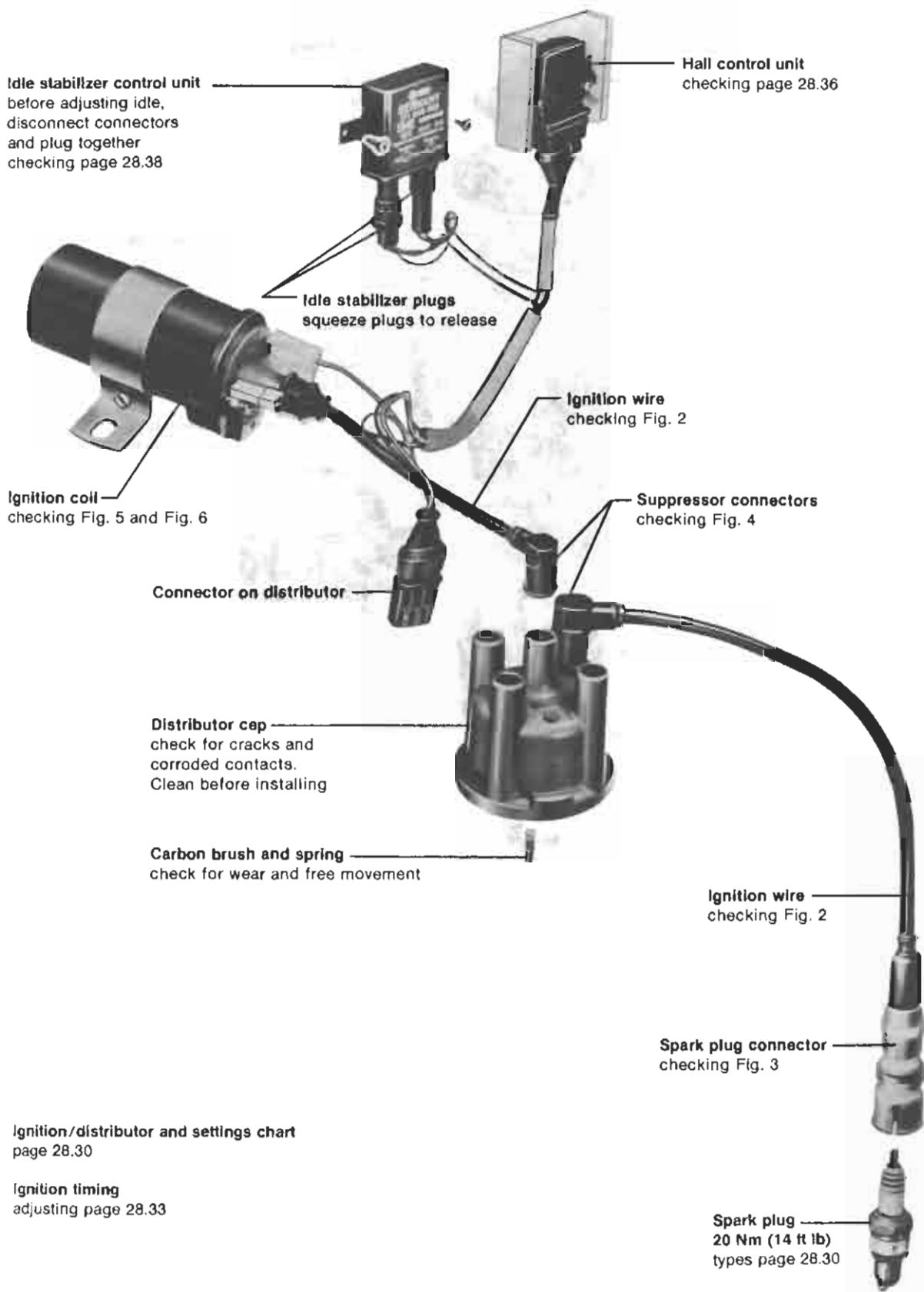
This torque must **NOT** be exceeded because increasing the torque beyond the specification will cause closing of the ring gap, which can lead to premature failure of the glow plug.



1 - Ring gap OK (arrow) approximately 0.5mm (0.02 in.)

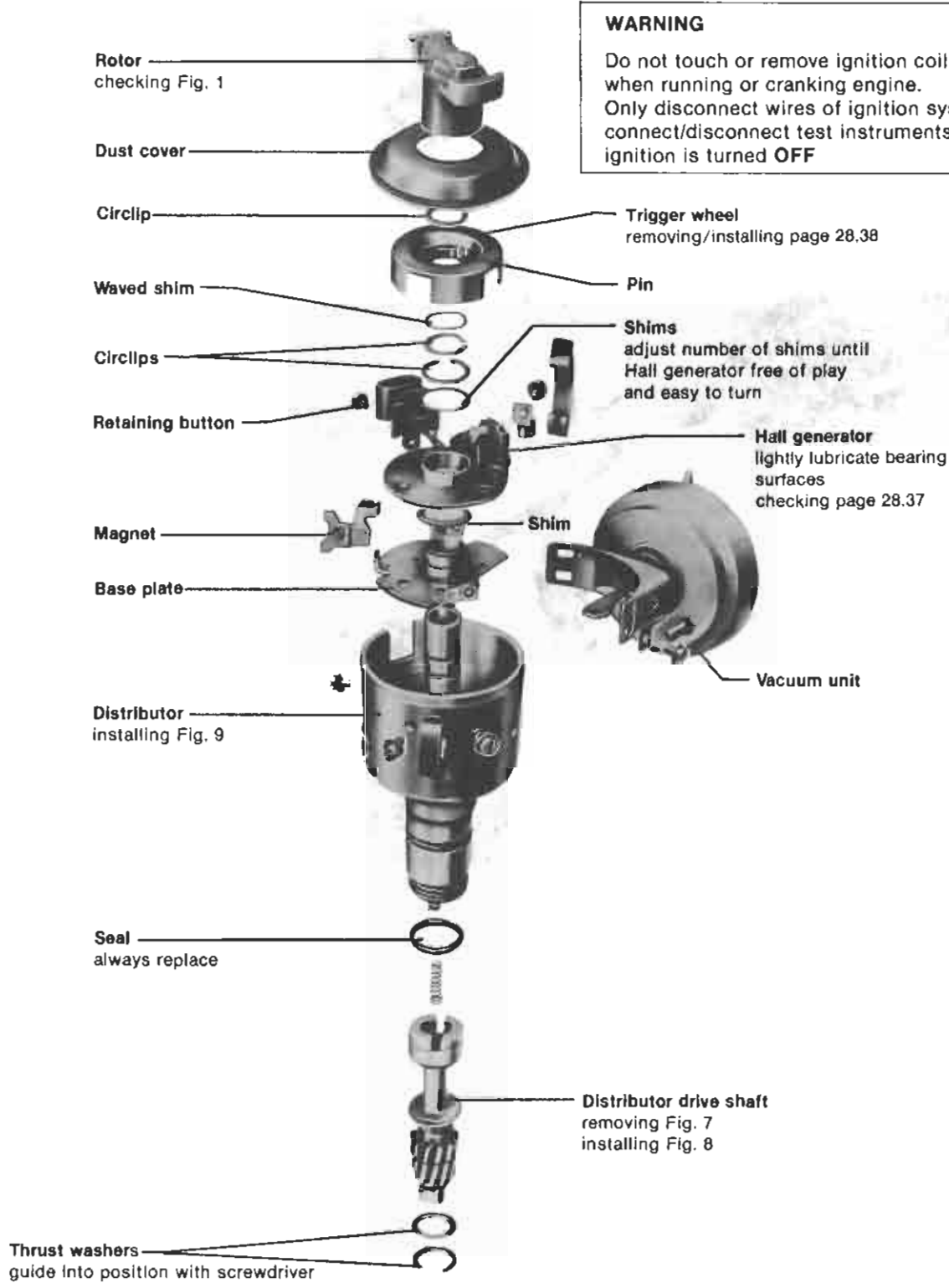
2 - Ring gap closed (arrow) after being over-torqued



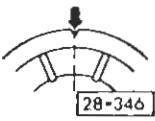


28-341

# 28 Ignition System



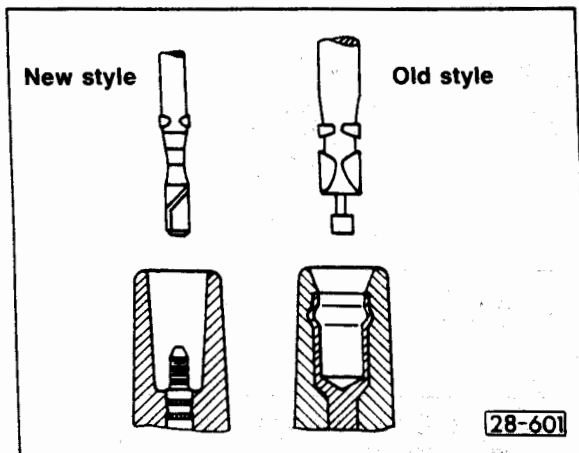
28-371

Engine code letters	DH	
Distributor (Part No.)	025 905 205 D	
Ignition timing	$5 \pm 1^\circ$ ATDC	
Timing mark location: crankshaft pulley		
Idle speed	$850 \pm 50$ rpm	
Vacuum hoses connected		
Idle stabilizer control unit	electrical plugs disconnected from unit and connected together	
Centrifugal advance (crankshaft degrees)	start	1050-1150 rpm
	end	16-20° at 2400 rpm 21-25° at 3800 rpm
Vacuum advance	start	190-230 mbar (14.0-17.0 cm Hg)
	end	360 mbar (27.0 cm Hg) 12-16°
Vacuum retard	start	100-220 mbar (7.5-16.5 cm Hg)
	end	260-360 mbar (19.5-27.0 cm Hg) 9-11°
Spark plugs	Bosch Beru Champion	W 7 C 0 14 L-7 C N 288
Spark plug gap		$0.7 + 0.1$ mm (0.028 + 0.004 in.)
Spark plug tightening torque		20 Nm (14 ft lb)
Firing order		1-4-3-2

# 28 Ignition System

## Ignition cable connectors (new style)

To assure tight connections, ignition cables now have new style (M4) connectors, as illustrated below.



Connections at distributor cap, ignition coil, interference suppressors and spark plugs have all been changed to new style.

### Note

Components with new style (M4) connectors are not interchangeable with old style. If replacement is required, install complete set with all connectors of same style.

## CAUTION

When working on vehicles with Hall ignition system, observe following precautions to prevent injury or damage to ignition system:

- do **not** touch or remove high tension wire when running or cranking engine
- disconnect ignition wires **only** when ignition is switched off
- test instruments should be connected/disconnected **only** when ignition is switched off
- do **not** connect any condenser to terminal 1
- do **not** tow cars without disconnecting plugs on ignition control unit
- do **not** crank engine until high tension wire of distributor cap (terminal 4) is connected to ground with jumper wire (example: compression check, etc.)
- do **not** leave battery connected when electric welding on car
- do **not** substitute rotor of ignition distributor with one of different type
- when installing suppressor, use only 1000 ohms for high tension wires and 1000 to 5000 ohms for spark plug connectors
- do **not** wash engine when it is running
- do **not** use battery booster longer than 1 minute nor exceed 18.5 volts with booster



Fig. 1 Rotor, checking

- check that resistance is  $1000 \pm 400$  ohms

### Note

Rotor must be marked with R 1 for Hall generator equipped cars

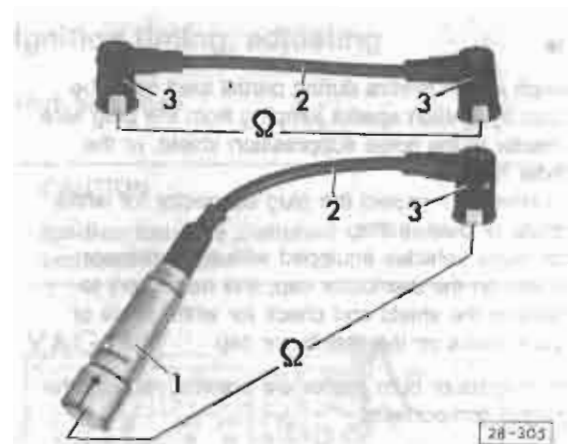


Fig. 2 Ignition wires and connectors, checking

- check wire 2 between ignition coil and distributor (including connectors 3)
  - resistance should be  $= 2000 \pm 800$  ohms
- check wires 2 between distributor and spark plugs (including connectors 3 and 1)
  - resistance should be  $= 6000 \pm 1400$  ohms
- if values are not as specified, check wires and connectors individually
  - resistance of wires (without connectors) must be  $= 0$  ohm

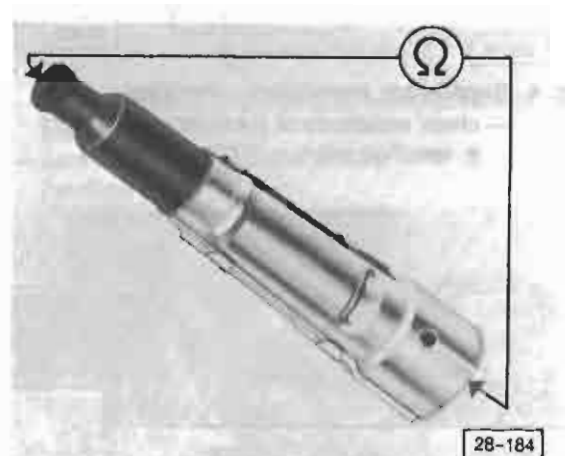


Fig. 3 Spark plug connectors, checking

- check connectors resistance
  - specified value  $= 5000 \pm 1000$  ohms

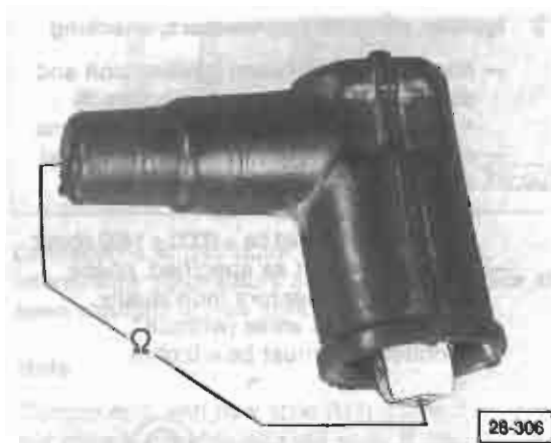
# 28 Ignition System

## Note

A rough idle or misfire during partial load could be caused by ignition sparks jumping from the plug wire connector to the noise suppression shield, or the cylinder head.

- remove and inspect the plug connector for white spots or burn marks
- on those vehicles equipped with a suppressor shield on the distributor cap, it is necessary to remove the shield and check for white spots or burn marks on the distributor cap

If white spots or burn marks are present, replace the damaged components.



**Fig. 4 Suppressor connectors, checking**

- check resistance of suppressor connectors
  - specified value =  $1000 \pm 400$  ohms



**Fig. 5 Ignition coil primary resistance, checking**

## Note

If traces of leakage from ignition coil are visible check HALL control unit and replace ignition coil

- disconnect all wires from coil terminals
- connect ohmmeter between terminal 1 (-) and terminal 15 (+)
  - resistance should be =  $0.420 - 0.760$  ohms
- check secondary resistance (Fig. 6)



**Fig. 6 Ignition coil secondary resistance, checking**

- connect ohmmeter between terminal (-) and terminal 4
  - resistance should be =  $2400 - 3500$  ohms

If NO, replace ignition coil

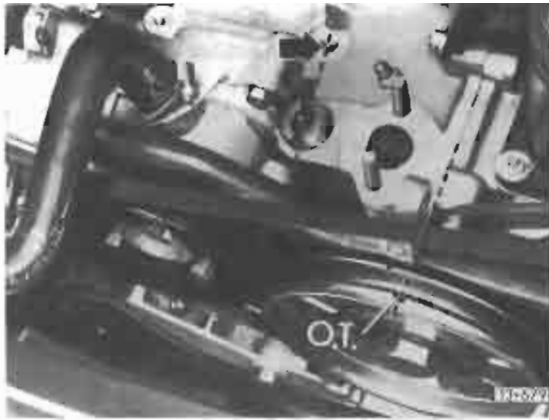
## Note

If resistance readings are correct, but no high voltage occurs at ignition coil, check Hall generator and Hall control unit. If necessary, replace ignition coil.



**Fig. 7 Distributor drive shaft, removing**

- use extractor with diameter  $14.8-18.1$  (0.583-0.728 in.)



**Fig. 8 Distributor drive shaft, installing**

- set crankshaft to TDC on No. 1 cylinder
- insert drive shaft so that off-set slot in top of drive shaft is pointing toward tapped hole (arrow)
- smaller segment points to water pump



**Fig. 9 Distributor, installing**

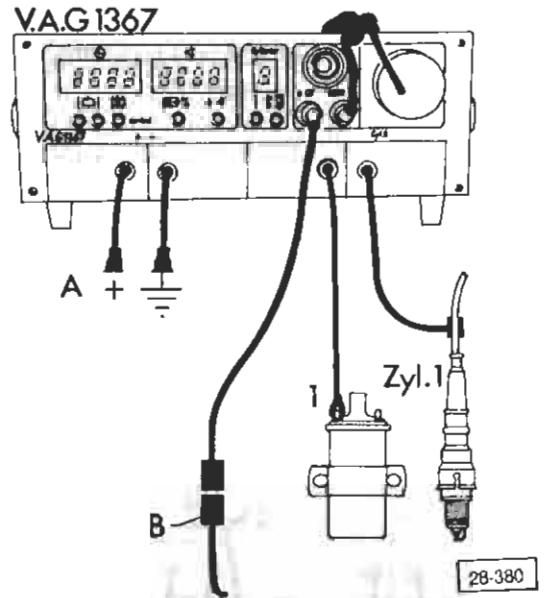
- set crankshaft to TDC on cylinder No. 1
- turn rotor until it is pointing to No. 1 cylinder mark on edge of housing
- install distributor
- clean distributor cap, check for cracks, signs of tracking and rotor tightness on shaft
- adjust ignition timing

## Ignition timing, adjusting

### Work sequence

#### CAUTION

Ignition must be switched OFF before connecting tester



- connect tester according to manufacturer's instructions
- connect + (plus) cable to alternator or junction box



- disconnect idle stabilizer plugs from control unit (squeeze plugs to release—upper arrows)
- connect plugs together (lower arrows)
- adjust idle speed to  $850 \pm 50$  rpm

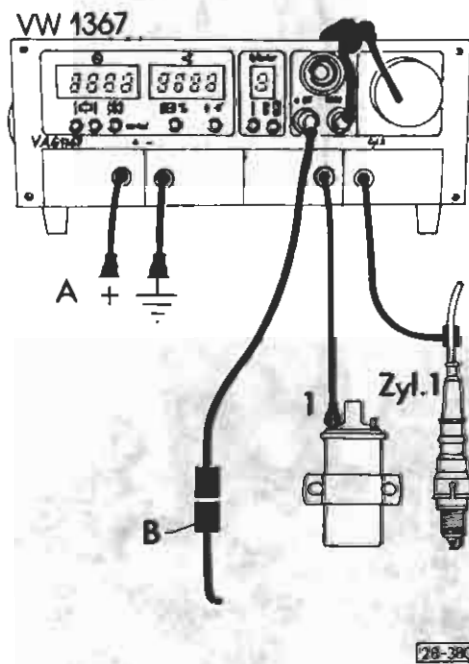
■ go to next page

# 28 Ignition System

- adjusting ignition timing with TDC sensor:
  - ignition timing is indicated directly on tester.
  - specification = 5° ATDC
- adjusting ignition timing with timing light:
  - shine timing light on timing mark.
  - mark on pulley must align with crankcase half parting line.

## Ignition distributor, checking centrifugal advance with TDC sensor

**CAUTION**  
Ignition must be switched OFF before connecting tester.



- connect tester according to manufacturer's instructions.
- connect positive lead to alternator or connection box.
- pull both hoses off distributor vacuum unit.
- disconnect plugs from idle stabilizer and connect together.
- start engine and adjust idle speed to 900 RPM.
- note basic advance angle shown on tester.

- increase engine speed slowly. centrifugal advance is indicated by an increase in the number of degrees.
- increase engine speed to next test speed.
- read advance angle on tester.

### Note

To determine centrifugal advance, subtract basic advance angle from last advance angle measured.

### Example

last advance angle measured  
(-) minus basic advance angle

---

(=) centrifugal advance

- compare centrifugal advance angle to specified value on page 28.30.
- repeat test at other test speeds.
- reconnect vacuum hoses when completed testing.
- adjust idle speed. See Repair Group 24.

## Ignition distributor, checking centrifugal advance with timing light

- connect tester according to manufacturer's instructions.
- pull both hoses off distributor vacuum unit.
- disconnect plugs from idle stabilizer and connect together.
- start engine and adjust idle speed to 900 RPM.
- shine timing light on timing mark and note indicated angle (basic angle).

### Note

Start of centrifugal advance is shown by movement of notch while increasing RPM.

- increase engine speed slowly to 1600 RPM.
- bring back notch to original setting by turning knob on tester. Read off advance value.

### Note

To determine centrifugal advance, subtract basic advance angle from last advance angle measured.

### Example

last advance angle measured  
(-) minus basic advance angle

---

- repeat check at other test speeds.
- reconnect vacuum hose when test completed.
- adjust idle speed. See Repair Group 24.



## Vacuum advance unit, checking for leaks

### Work sequence



- connect vacuum tester VAG 1368 or equivalent according to manufacturer's instructions.
- run engine at approx. 2500 RPM and check that vacuum at throttle valve housing is reaching vacuum unit.

If **NO** vacuum connection on throttle valve housing may be blocked.

- increase engine speed until vacuum tester indicates higher reading than 360 mbar (270mm Hg).
- switch vacuum tester so it holds vacuum on side connected to vacuum unit.
- turn engine **OFF**.
- vacuum reading on tester must not drop more than 10 % within 1 minute, otherwise vacuum unit or hose is defective.

## Vacuum advance, checking

- connect VAG 1368 tester or equivalent according to manufacturer's instructions.
- connect vacuum tester between throttle valve housing and vacuum advance unit connection.
- set vacuum tester to allow vacuum to pass through.
- pull off hose from vacuum retard unit.
- disconnect plugs from idle stabilizer control unit and connect together.
- start engine and adjust idle speed to 900 RPM.
- **checking with TDC sensor:**
- note advance angle on tester (basic advance angle).

- **checking with timing light:**
- shine timing light on ignition timing scale and note indicated angle (basic angle).
- increase engine speed until reading on vacuum tester is higher than 360 mbar (270 mm Hg).
- switch vacuum tester so that it holds vacuum on side connected to vacuum unit.
- leave engine running at idle: 900 RPM
- reduce vacuum on vacuum tester to 360 mbar (270 mm Hg) or 190-230 mbar (140-170 mm Hg).
- note advance angles.
- determine vacuum advance by subtracting basic advance angle from measured advance angle.

### Example

last advance angle measured  
 (-) minus basic advance angle

---

vacuum advance

- compare vacuum advance angles with specified values on page 28.30.
- readjust idle speed. See Repair Group 24.

## Vacuum retard angle, checking

- connect vacuum tester VAG 1368 or equivalent according to manufacturer's instructions.
- disconnect plugs from idle stabilizer control unit and connect together.
- start engine.
- pull off hose from vacuum advance unit.
- check ignition timing; if necessary adjust to 5° ATDC.
- pull off hose from vacuum retard unit.
- **check with TDC sensor:**
- add 5° to indicated retard angle.
- compare with specifications on chart for retard end (see page 28.30).
- **checking with timing light:**
- shine timing light on timing mark again and bring mark back to original setting by turning knob on timing advance tester.
- read off retard angle and compare with specifications on chart for retard end. (See page 28.30.)
- reconnect vacuum hose to vacuum unit.
- reconnect plugs to idle stabilizer control unit.

# 28 Ignition System

## Hall control unit, checking

### Requirement

- ignition coil OK



- disconnect idle stabilizer plugs from control unit (squeeze plugs to release — upper arrows)
- connect plugs together (lower arrows)



- remove harness connector from Hall control unit
- connect multimeter **US 1119** with + (plus) to terminal 4 and with (minus) to terminal 2 in connector
- turn ignition **ON**
  - approximately battery voltage

### If NO

- check for wire breaks using wiring diagram and repair as necessary
- turn ignition **OFF**
- reconnect Hall control unit harness connector
- disconnect Hall generator harness connector from ignition distributor



- connect multimeter with + (plus) to terminal 1 and with - (minus) to terminal 1 of ignition coil
- turn ignition **ON**
  - 2 volts (min.) for about 1-2 seconds and drops to 0 volts

### If NO

- replace Hall control unit **and** ignition coil



- touch center wire of connector on distributor briefly to ground
  - indicated voltage must increase briefly (minimum)

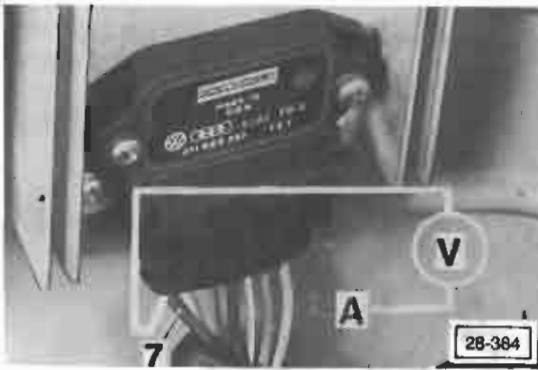
### If NO

- check for wire break in center wire and repair as necessary

### If wire OK

- replace Hall control unit
- turn ignition **OFF**

more



**Note**

Two different types of Hall control units can be installed.

— connect Multimeter as follows:

**Fairchild, Bosch and Siemens — Hall control unit (Build #33)**

— connection **A** to terminal 15 (+) of ignition coil and other connection to terminal 7

**Fairchild and Telefunken (AEG) — Hall control unit (Build #35)**

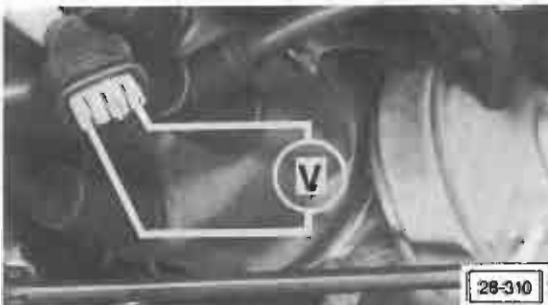
— connection **A** to ground and other connection to terminal 7

- multimeter must show **approximately battery voltage**

**checking procedure regardless of type:**

— touch center wire of connector on distributor briefly to ground (see illustr. 28-335)

- indicated voltage must drop briefly below 3 volts



— connect multimeter to outer terminals of Hall generator connector

— turn ignition **ON**

- spec. = 5 volts (min.)

**Note**

If readings are within specifications, but defect still exists, replace Hall control unit or check for wire breaks between Hall generator connector and Hall control unit; if necessary, repair.

## Hall generator, checking

**Requirements**

- disconnect both wire plugs from idle stabilizer and connect them together
- Hall control unit **OK**
- ignition coil **OK**
- wiring between Hall control unit and ignition coil **OK**
- connector pins and sockets on Hall-generator, distributor, and Hall control unit **OK**

Specified values given are valid for ambient temperatures from 0 to 40°C (32 to 104°F).

**CAUTION**

Switch multimeter to voltage range before connecting test leads.

— disconnect center coil wire from terminal 4 of distributor and connect to ground, using jumper wire



— pull rubber boot from control unit connector (with connector connected) as shown

— connect + (plus) wire of multimeter to terminal 6 and - (minus) wire to terminal 3

— turn ignition **ON**

— turn engine over slowly by hand (in running direction) and watch tester reading

- voltage must fluctuate between 0 and 2 volts minimum

**If NO**

— replace Hall generator.

**Note**

Metal shavings or other debris between the ignition control unit and heat sink can cause stress which may damage internal circuits of the control unit:

— when replacing ignition control unit, thoroughly clean heat sink before assembly

# 28 Ignition System

## Idle stabilizer, checking

### Work sequence

#### Note

If engine is difficult to start, does not start, or engine misfires/stalls, proceed as follows:

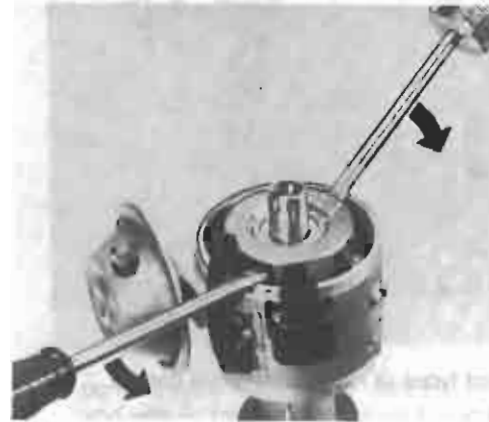
- disconnect both wire plugs from idle stabilizer
- check contact pins and sockets of both idle stabilizer connectors for correct position or damage
- connect both plugs together
- start engine
  - if starting troubles are still experienced, idle stabilizer control unit is **not** defective
  - if engine starting troubles are eliminated, but troubles start again after reconnecting plugs to idle stabilizer unit, idle stabilizer unit must be defective; replace
- connect VW 1367 tester or equivalent according to manufacturer's instructions
- apply parking brake

#### WARNING

No one should be allowed to stand in front of vehicle during this test. Vehicle's wheels must be blocked

- apply foot brake
- start and accelerate engine (i.e. to 2500-3000 rpm) briefly
- let engine idle and note ignition timing
- select 4th gear and slowly engage clutch
  - as engine speed drops **below 940 rpm** ignition timing must move in "advance" direction
- if not, replace idle stabilizer control unit

## Trigger wheel, removing/installing



- remove circlip
- to avoid bending trigger wheel when pulled off, insert screwdrivers through two opposite slots until they contact circlip
- check that trigger wheel turns freely after installation by turning distributor shaft
  - if trigger wheel is bent, it must be replaced

## Ignition and injection system, repairing

Engine code: MV

- note safety precautions — page 28.31
- distributor data, spark plugs — page 28.41
- ignition timing, adjusting — page 28.42
- electrical testing of ignition and injection system — Group 24

### Control unit

- for injection and ignition system
- installation location: under rear seat bench or in luggage compartment

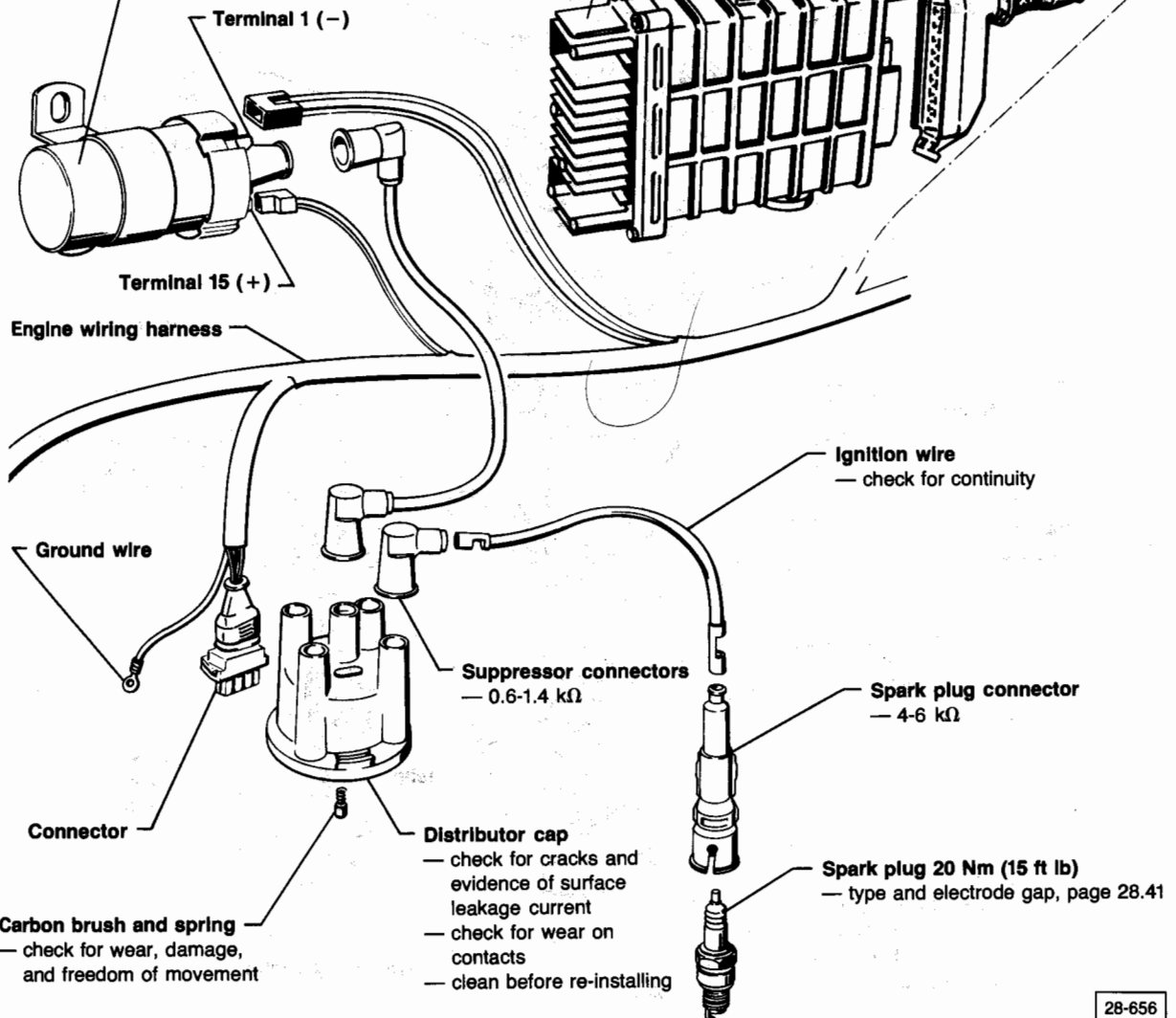
### Connector

- connector must be connected or disconnected with ignition OFF
- to remove, press spring upward

### Ignition coil (green label)

#### Note

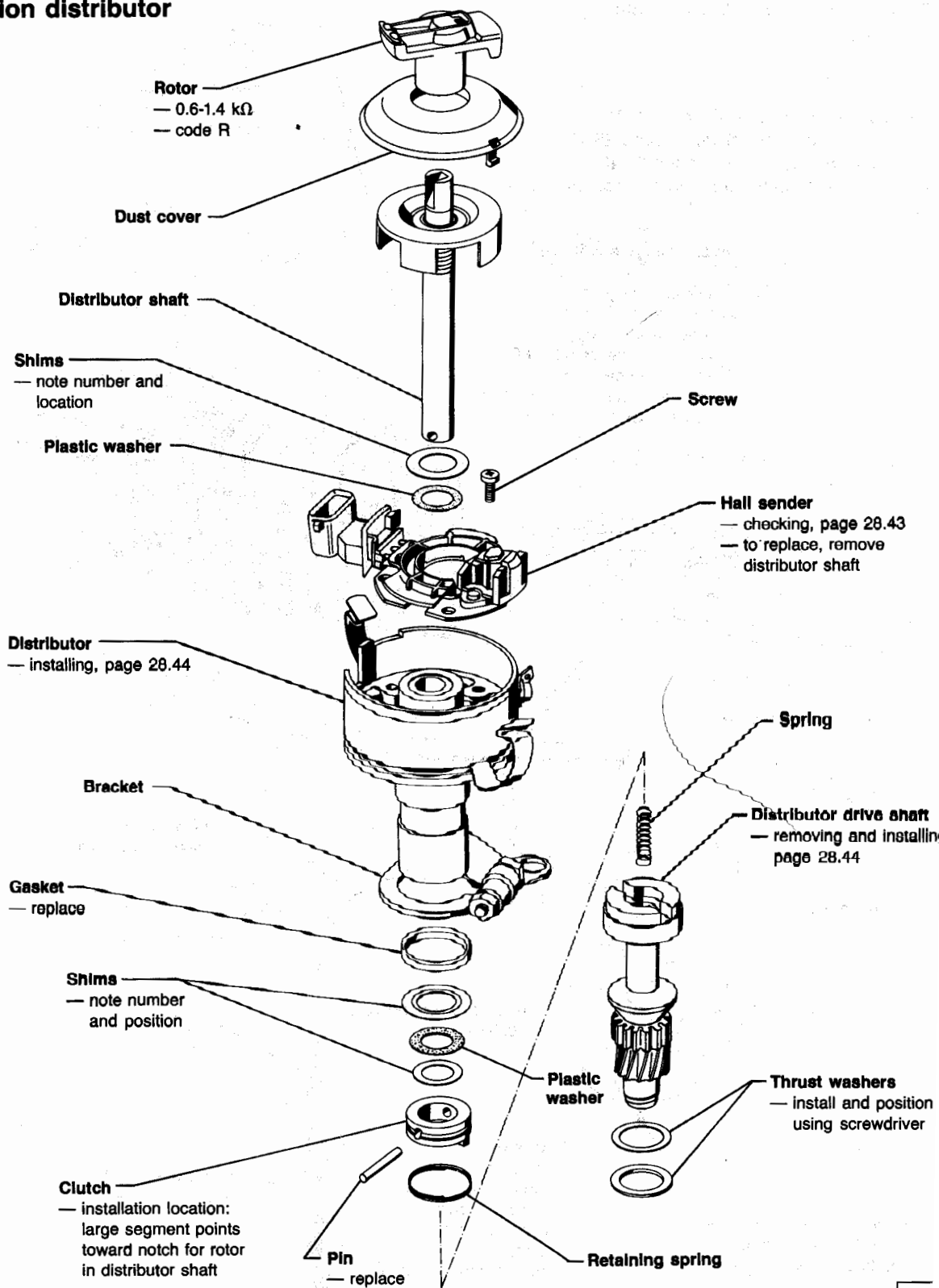
- In case of replacement; coils with gray labels should be replaced with green
- primary resistance 0.5-0.8Ω (between terminals 1 and 15)
- secondary resistance 2.4-3.5 kΩ (between terminals 4 and 15)



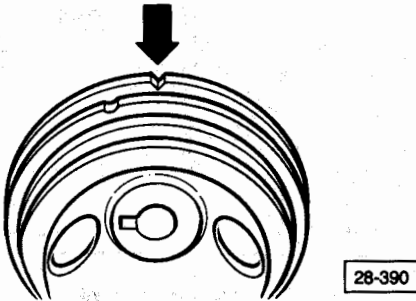
28-656

# 28 Ignition System

## Ignition distributor



28-6

Introduction		October 1985
Engine code		MV
Part no.:	Ignition distributor	025 905 205 M
	Digifant control unit***	025 906 022D old 025 906 022/022A new
Ignition timing	Checking value	3° - 7° before TDC
	Adjusting value	5° ± 1° before TDC
Timing mark location		
RPM*		2000 - 2500
Ignition adjustment** -- timing map --	RPM	Approx. 3000
	Degrees	35 ± 5°
RPM limit	Switch-off RPM of digifant control unit	5600
Firing order	CYL.	1 - 4 - 3 - 2
Spark plugs (tightening torque: 20 Nm (14 ft lb))	Bosch Beru Champion	W 7 CCO 14L-7CU, 14L-7C N 288
Spark plug gap	mm (in)	0.7 ± .1 mm (0.028 ± 0.003 in)

\*) Engine oil temperature 80° C, (176°F) connector of temperature sensor II disconnected with engine running.

\*\*\*) Engine oil temperature 80°C, connector of temperature sensor II connected.

\*\*\*) When replacing control unit always replace old control unit with newer version.

### CAUTION

Part numbers are for reference only. Always check with your parts department for latest part information.

# 28 Ignition System

## Ignition timing, checking

### Requirement

Engine oil temp. minimum 80° C (176° F)

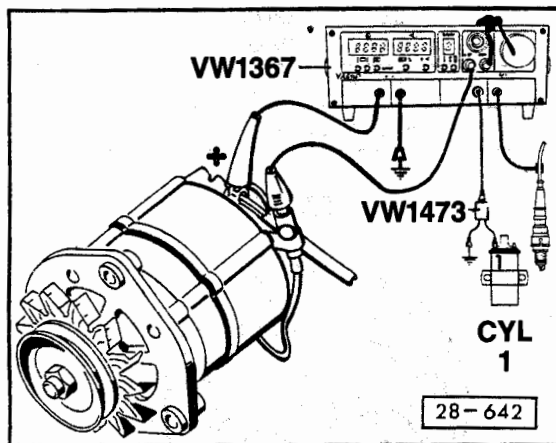


Fig. 1 Connecting test equipment

- connect test equipment for ignition timing and rpm as shown in 28-642

### WARNING

Ignition must be switched off when connecting ignition timing tester and rpm display.

- start engine and allow to idle

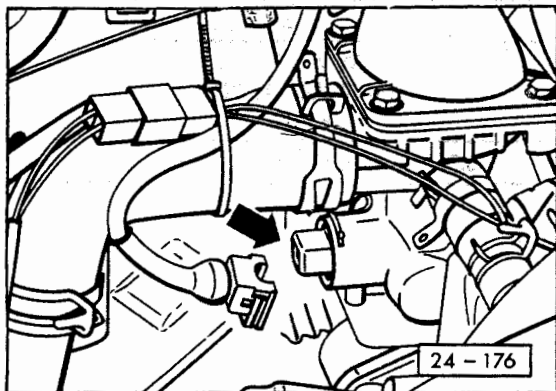


Fig. 2 Temperature sensor II

- disconnect temperature sensor II
- raise engine speed to 2000-2500 rpm
- record timing value displayed on tester
- reconnect temperature sensor II
- raise engine speed to 3000 rpm
- read timing on tester, subtract recorded value from this reading
  - calculated value must be 35° ± 5°

If NO

- check electrical connections for temperature sensor II, air flow sensor and digifant control unit according to wiring diagrams

## Ignition timing, adjusting

### Requirement

Engine oil temp. minimum 80° C (176° F)

- connect test equipment for ignition timing and rpm (see Fig. 1)

### Note

Use adaptor VW 1473 for connecting tester VW 1367 to terminal 1 of ignition coil.

- start engine and allow to idle
- disconnect temperature sensor II (see Fig. 2)
- check ignition timing at 2000-2500 rpm correct if necessary

## Adjustment with TDC marker

Ignition timing is displayed directly on tester.

specifications:

- checking value 3° - 7° BTDC
- adjusting value 5° ± 1 BTDC

## Adjustment with timing light

Notch on V-belt pulley must match separating line on crankcase

- correct idle setting if necessary

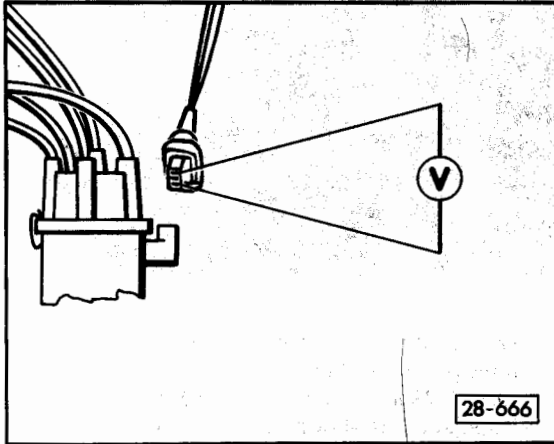


## Hall sender, checking

### Requirement

Electrical checks (wiring and component checks)  
OK

### Voltage supply, checking



— disconnect Hall sender (distributor) and connect multimeter US 1119 to outer terminals of Hall sender connector

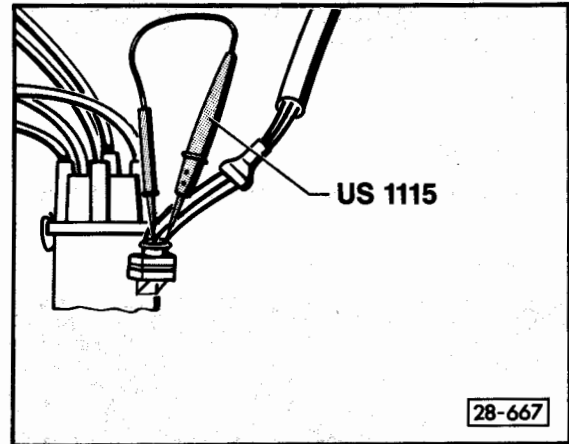
— switch ignition ON  
• specified value: minimum 10 volts

If NO

— replace control unit  
— switch ignition OFF

### Function, checking

— slip back rubber boot from Hall sender connector  
— ground coil wire (use adaptor if necessary)



— connect voltage tester US 1115 to center and outer contacts of Hall sender connector (if necessary, use jumper wire)

— operate starter and check signal from Hall sender  
• if LED flickers, Hall sender is OK

If NO

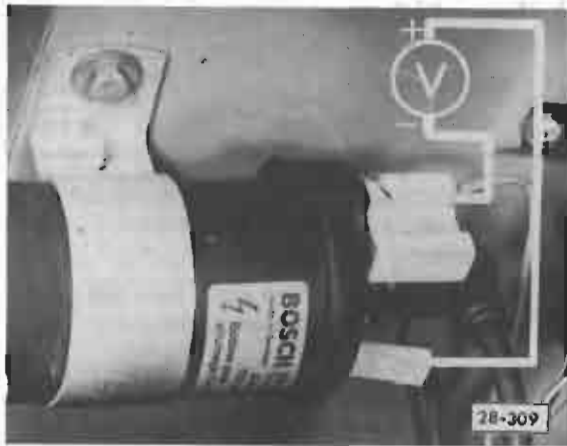
— replace Hall sender

# 28 Ignition System

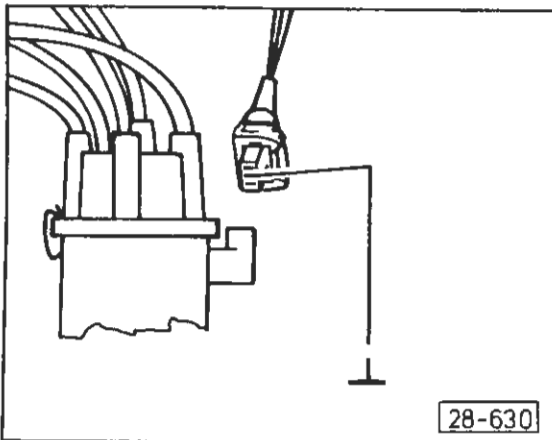
## Checking ignition switching function from control unit

### Requirements

- Ignition coil OK
- Electrical checks (wiring and component checks) OK
- See Group 24



- connect digital multimeter US 1119 between terminal 1 (-) and terminal 15 (+) of ignition coil
- disconnect Hall sender (on distributor)
- switch ignition ON

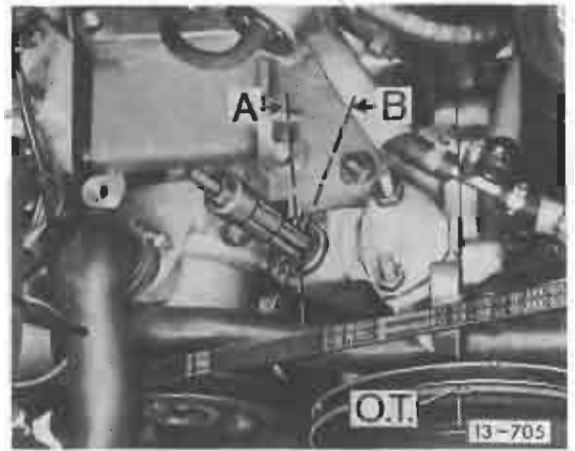


- hold center wire of connector from distributor to ground for approx. 3 seconds
  - displayed voltage must increase briefly to approx. 4.5 volts

If NO

- replace control unit

## Distributor drive shaft, removing and installing



- set crankshaft to cylinder 1 TDC
- remove (or install) using 14.5-18.5 mm (0.57-0.73 in) diameter, extractor i.e. Kukko 21/2
- insert shaft as shown in position A
- push and twist until shaft seats
  - should result in position B

### Note

The small segment points toward coolant pump.

## Distributor, installing



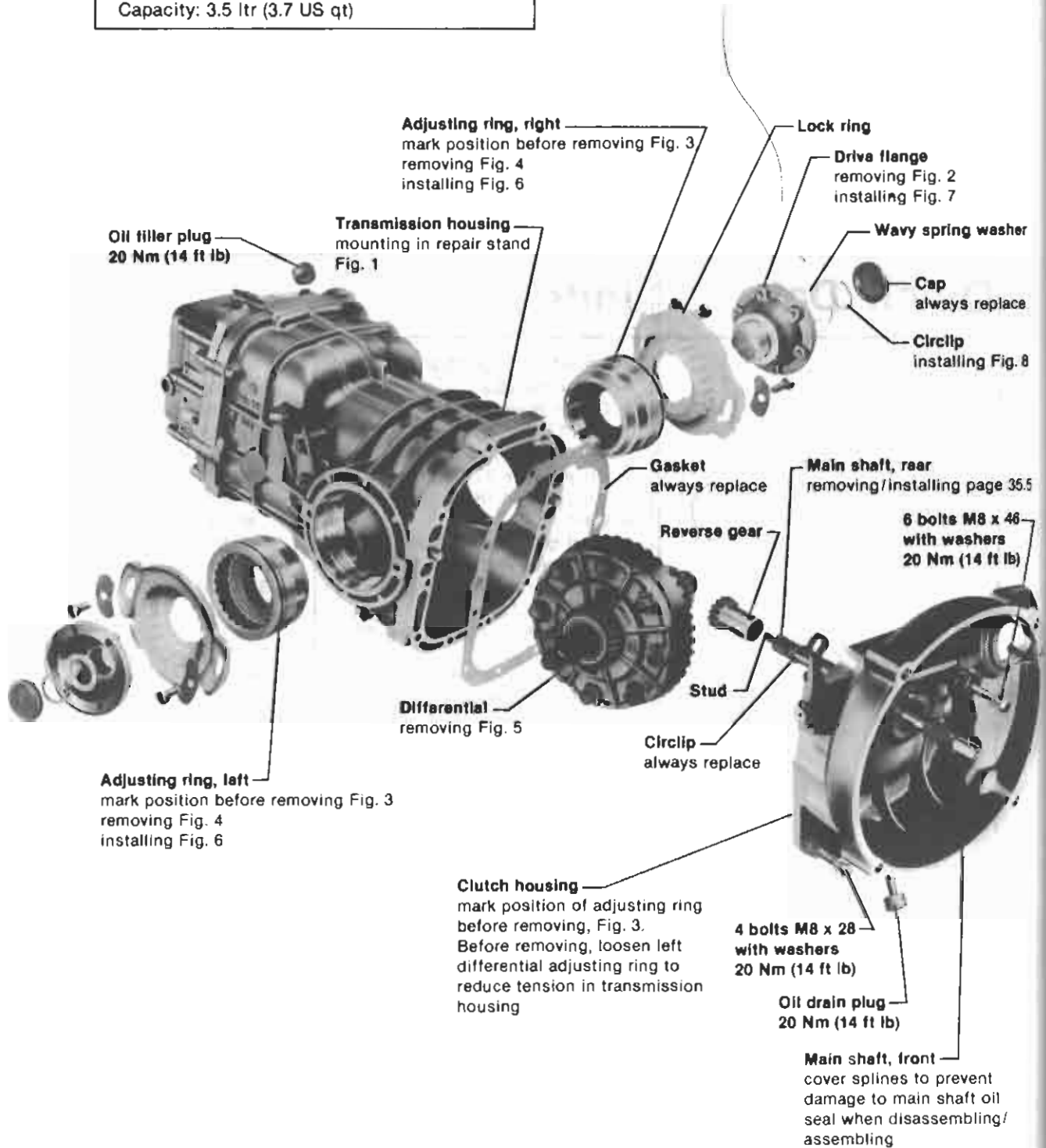
- set crankshaft to timing notch (cylinder 1)
- turn rotor far enough that it points toward mark for cylinder 1 on distributor housing

## 4-Speed 091 Manual Transmission Case, Gears, Shafts

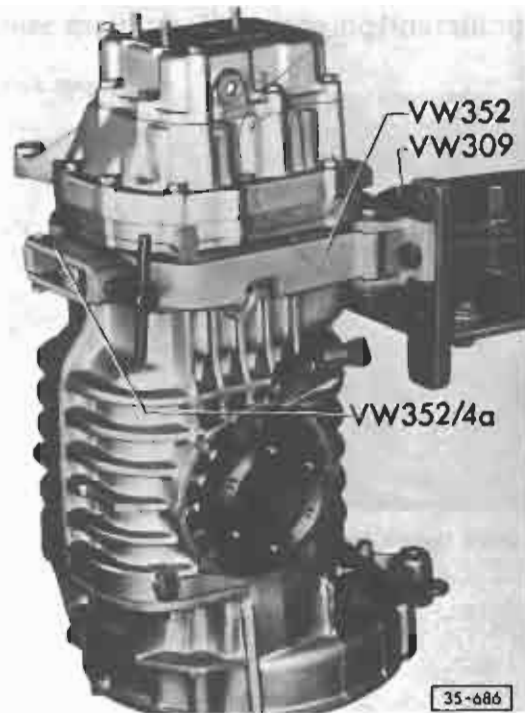
Quick Data	Index	
	<ul style="list-style-type: none"> <li>— Adjusting rings 35.3, 35.4</li> <li>— Assembly 35.2</li> <li>— Clutch housing/mechanism 35.12</li> <li>— Differential 35.4</li> <li>— Drive flange 35.3, 35.4 oil seal 34.18, 35.15</li> <li>— Gear               <ul style="list-style-type: none"> <li>1st gear needle bearing 35.27</li> <li>3rd gear end play 35.29</li> </ul> </li> <li>— Gear carrier/Gearshift housing 35.6, 35.7, 35.18</li> <li>— Gear carrier housing assembly 35.8, 35.16</li> <li>— Gearshift lever 34.3</li> <li>— Gearshift linkage 34.2, 34.3</li> <li>— Interlock/Detent plungers 35.17</li> <li>— Installing 34.15</li> <li>— Lever bearing plate 34.4</li> <li>— Main shaft assembly 35.9, 35.20 ball bearing 35.23 oil seal 35.13</li> <li>— Pinion needle bearing 35.23, 35.29</li> </ul>	<ul style="list-style-type: none"> <li>— Pinion shaft assembly 35.9, 35.24, 35.25</li> <li>— Rear main shaft 35.5</li> <li>— Release shaft bushing 35.13</li> <li>— Removing 34.14, 34.15</li> <li>— Retaining ring 35.7</li> <li>— Reverse gear 35.14 end play 35.17 shaft circlip 35.15</li> <li>— Rocker lever shaft 35.19</li> <li>— Selector shaft 35.19</li> <li>— Shift forks 35.10, 35.11</li> <li>— Shift rod 34.3</li> <li>— Starter bushing 35.13</li> <li>— Synchronizers               <ul style="list-style-type: none"> <li>1st/2nd gear 35.26, 35.28</li> <li>3rd/4th gear 35.21, 35.22</li> <li>circlips 3rd/4th gear 35.21, 35.26</li> <li>ring identification 35.30</li> </ul> </li> <li>— Tapered roller bearing 35.26, 35.27</li> <li>— Transmission housing 35.14</li> </ul> <p><b>4-Speed 091/1</b> — See page 35.31</p> <p><b>5-Speed 094</b> — See page 35.61</p> <p><b>094-4WD Syncro</b> — See page 35.93</p>

# 35 Manual Transmission-Case, Gears, Shafts

**Transmission/Final drive lubricant:**  
 Hypoid oil API/GL-4; MIL-L2105  
 SAE 80W, SAE 80W/90  
 Capacity: 3.5 ltr (3.7 US qt)



35-685



**Fig. 1 Transmission housing, mounting in repair stand**

- mount transmission in repair stand
- drain transmission oil

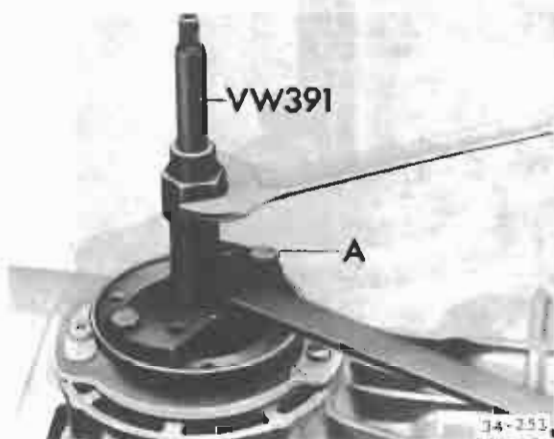


**Fig. 3 Adjusting ring, marking position**

**Note**

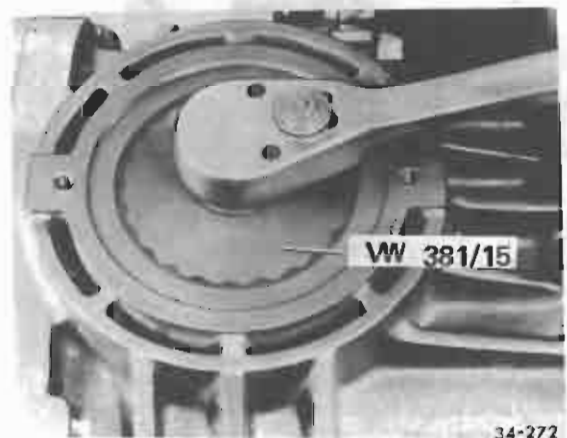
Before starting repair work (which does not require final drive to be adjusted) mark position of adjusting rings on transmission housing. Measure depth to which they are installed with VW 382/7 and write down readings

- scribe left side (ring gear side) with one mark (arrow)
- scribe right side with two marks



**Fig. 2 Drive flange, removing**

- remove circlip and wave washer
- attach VW391 to flange with 2 bolts
  - A = M8 x 30 bolts
- pull drive flange out



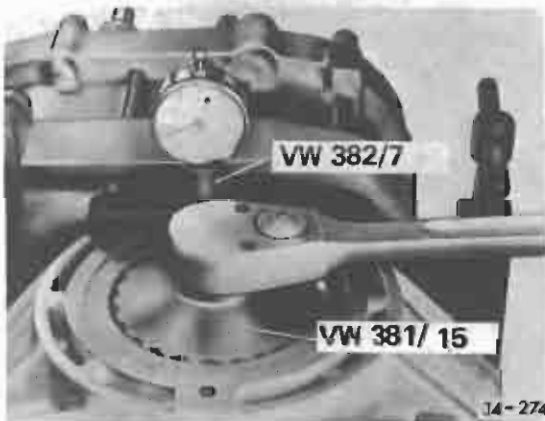
**Fig. 4 Adjusting rings, removing**

# 35 Manual Transmission-Case, Gears, Shafts



**Fig. 5 Differential, removing**

- remove adjusting rings and rear main shaft
- lift out differential

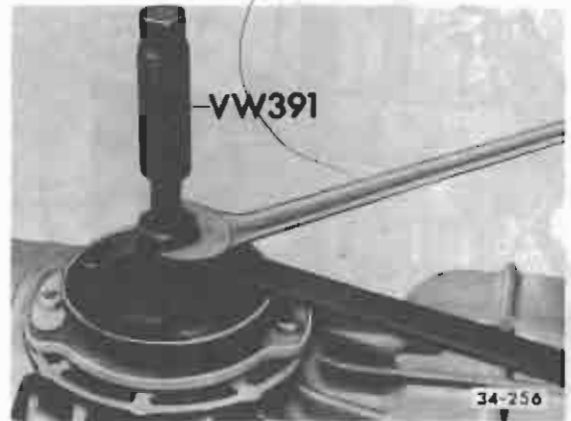


**Fig. 6 Adjusting rings, installing**

- install left and right adjusting rings and align marks at depth previously measured
- lubricate threads with MoS<sub>2</sub> grease

## CAUTION

Do not tighten left side adjusting ring until clutch housing has been installed and bolts torqued



**Fig. 7 Drive flange, installing**

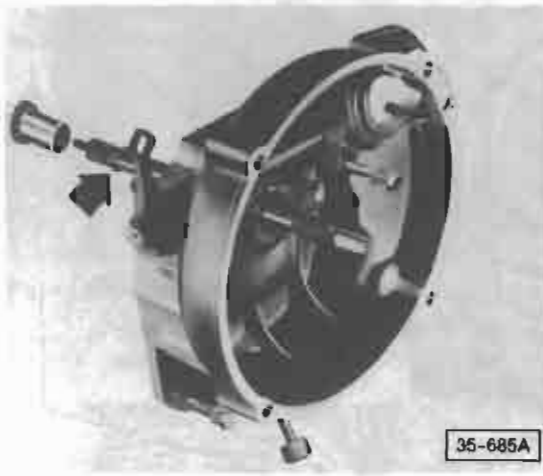


**Fig. 8 Circlip for drive flange, installing**

- insert wave washer
- press circlip into groove with VW 244b and at same time check that washer is centered

## Rear main shaft, removing/installing

### Work sequence



### Removing

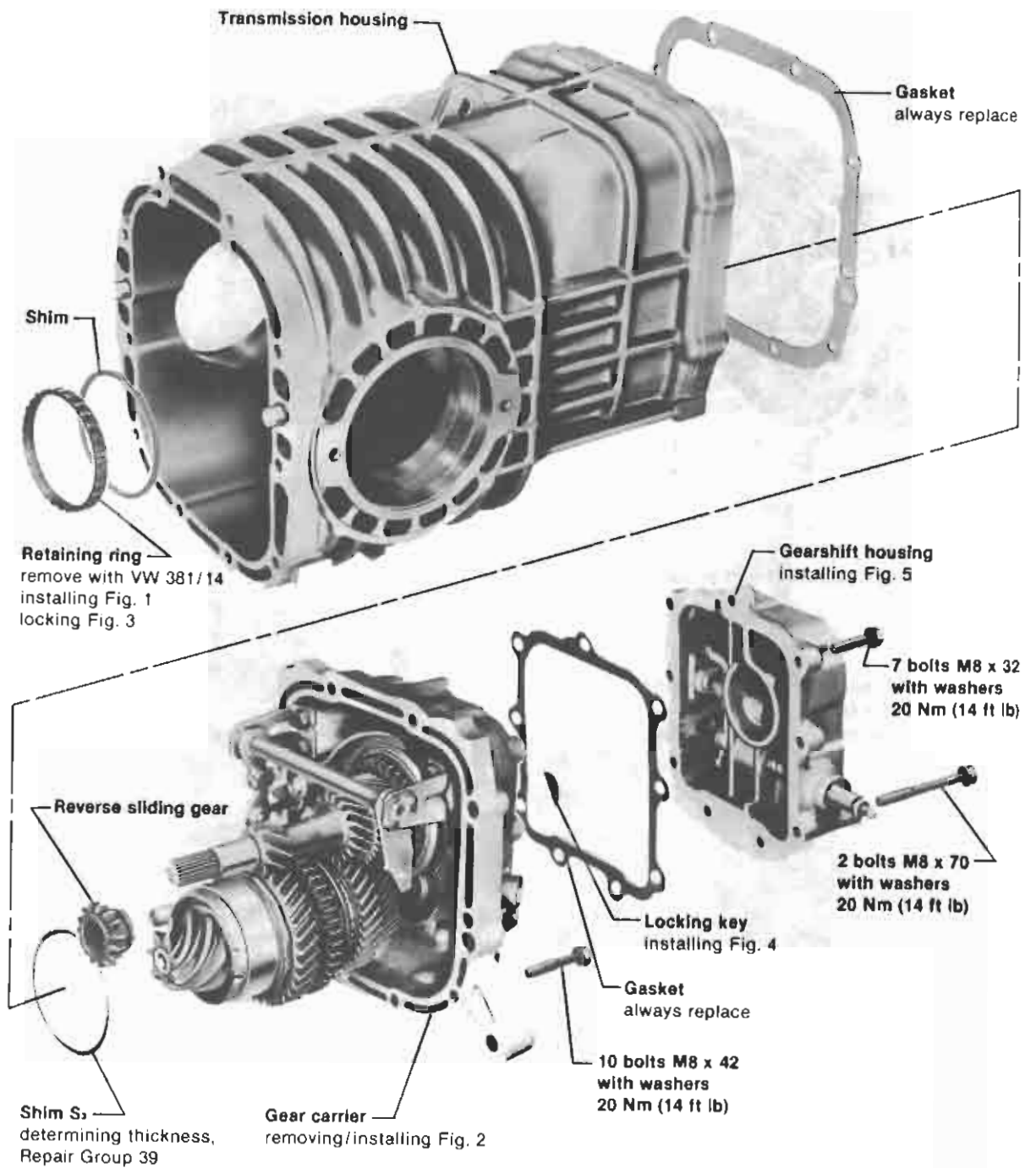
- remove circlip (arrow)
- push reverse gear backward and screw out main shaft

### Installing

- screw front and rear main shafts together, then back off one spline
- push reverse gear on and install new circlip



# 35 Manual Transmission-Case, Gears, Shafts



## Note

Differential must be removed  
before gear carrier can be removed,  
see page 35.4

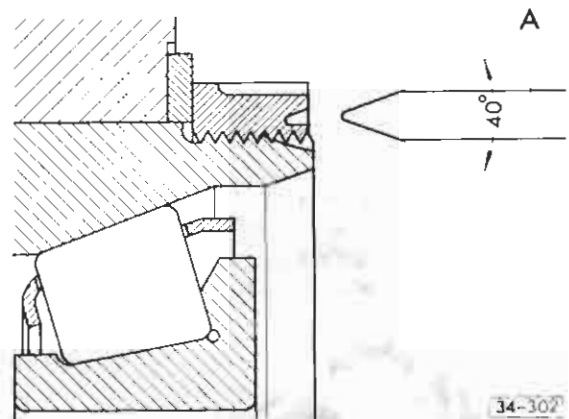
35-689





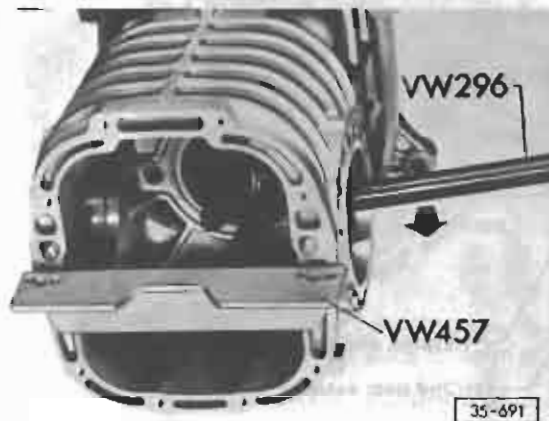
**Fig. 1 Retaining ring, installing**

- tighten to 225 Nm (162 ft lb), then back off and retighten to 225 Nm (162 ft lb)



**Fig. 3 Retaining ring, locking**

- lock ring by peening twice with tool A



**Fig. 2 Gear carrier, removing/installing**

**Note**

If bearing and/or transmission housing are replaced, and dimension *r* is not marked on ring gear, pinion depth must be measured and noted **before** gear carrier is removed. This is dimension *r*. See Repair Group 39. When assembling, parts must be installed in same position. See Ring gear/pinion, adjusting, Repair Group 39

**Work sequence**

**Removing**

- use two M8 x 20 bolts to attach VW 457
- press gear carrier out with VW 296

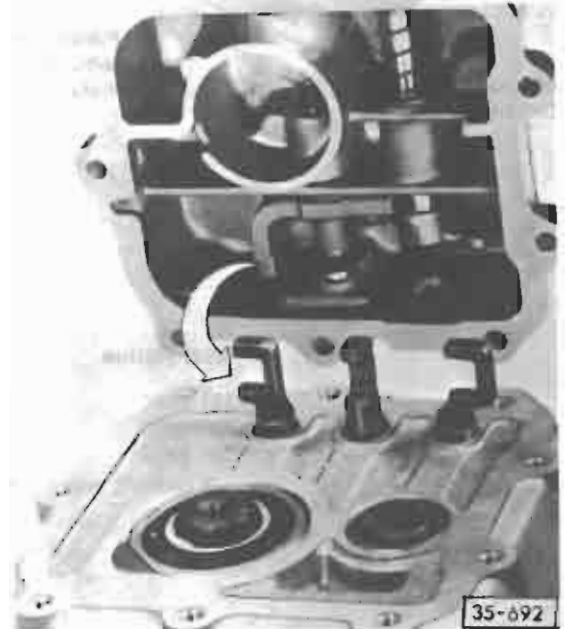
**Installing**

- tap on pinion with plastic hammer to install
- turn reverse shaft so that reverse sliding gear slips onto splines properly
- align flat on bearing with recess in housing



**Fig. 4 Main shaft bearing locking key B, installing**

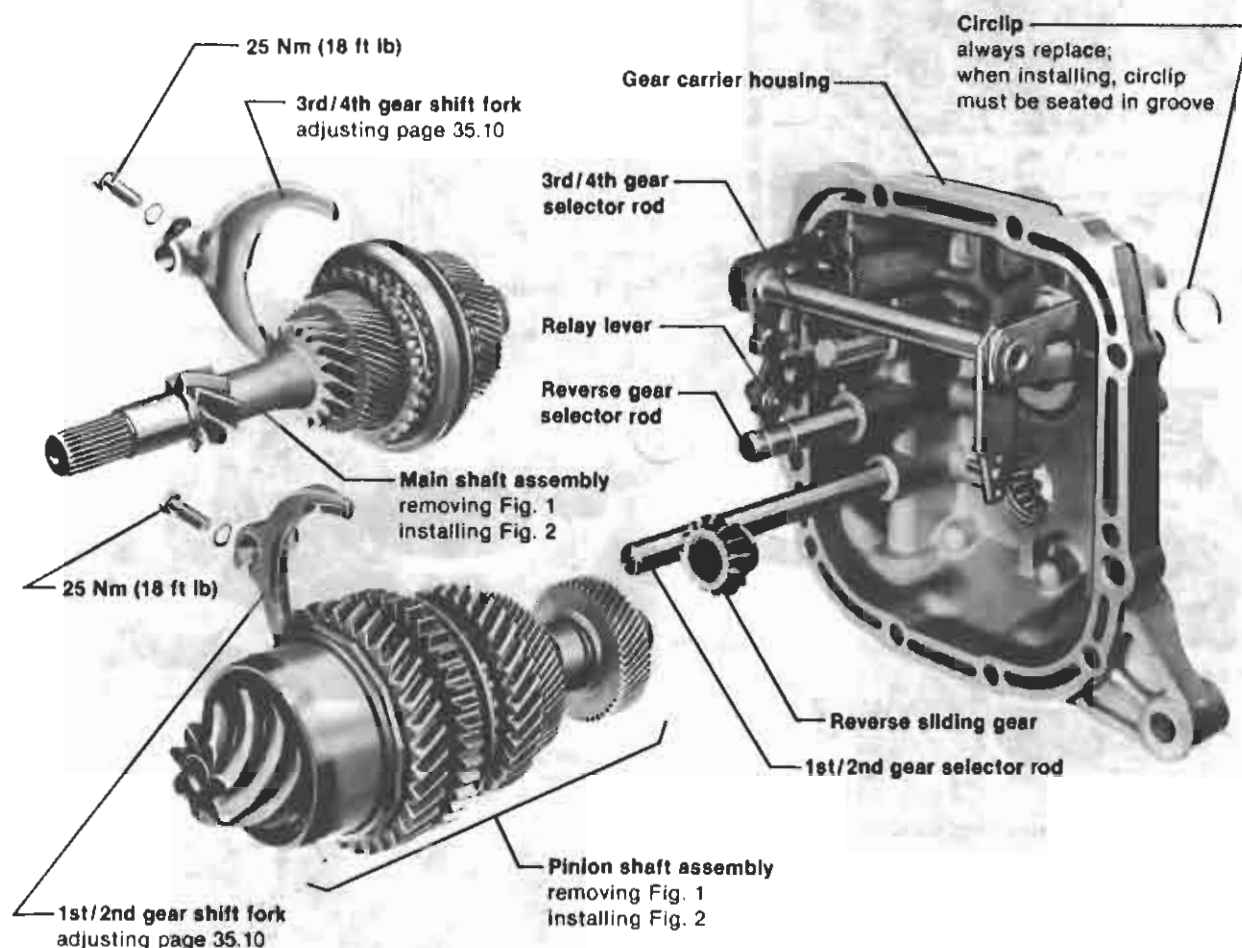
- press locking key B into recess (arrow)



**Fig. 5 Gear shift housing, installing**

- guide inner shift lever into 3rd/4th gear selector shaft (arrow) when installing

# 35 Manual Transmission-Case, Gears, Shafts



35-700

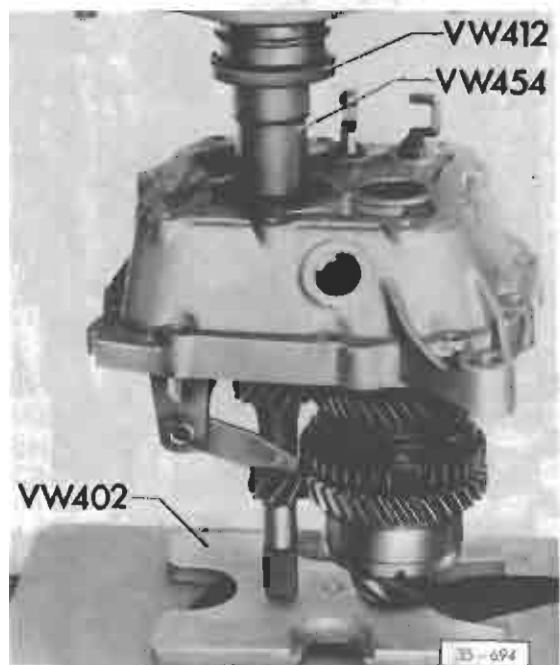
## Gear Ratios

1st gear	3.78(9:34)
2nd gear	2.06(17:35)
3rd gear	1.26(50:63)
4th gear	0.852(61:52)
Reverse	3.28(13:16 x 15:40)
Final drive	4.57(7:32)



**Fig. 1** Main shaft/pinion shaft assemblies, removing

- remove circlip
- remove shift fork for 1st/2nd gear
- move selector shaft back to neutral
- remove clamp bolt for 3rd/4th gear shift fork
- engage 3rd gear, pull selector shaft back until shift fork is free
- engage 4th gear
- loosen union nut on relay lever support
- lift pinion shaft when pressing out and guide it carefully so that gears and needle bearings do not jam and get damaged
- check 3rd/4th gear for free movement



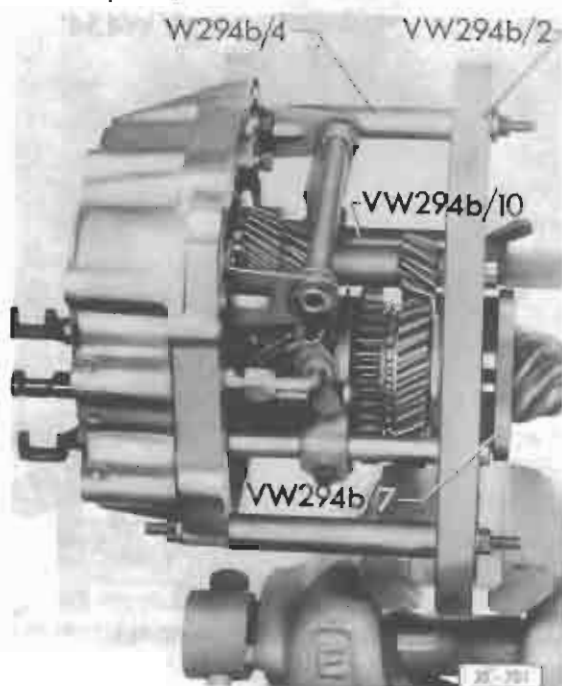
**Fig. 2** Main shaft/pinion shaft assemblies, installing

- insert 3rd/4th gear shift fork and check for free movement when pressing in shafts
- lift pinion shaft and guide carefully when pressing in
- after installing shafts, adjust shift forks, see page 35.10

# 35 Manual Transmission-Case, Gears, Shafts

## Shift forks, adjusting

### Work sequence

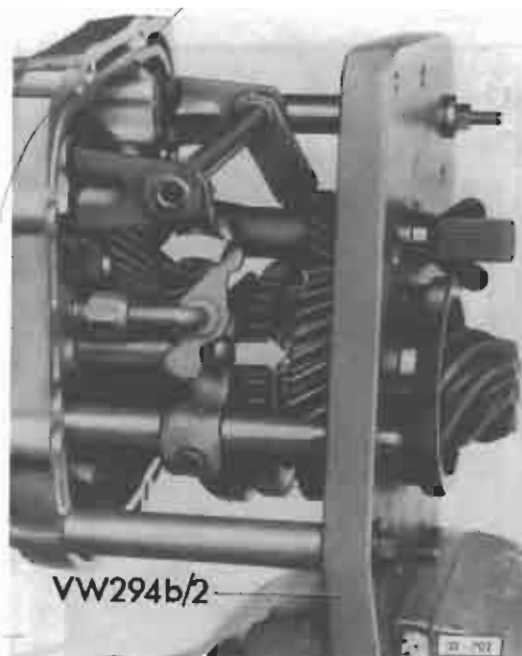


- position gear carrier, with shim  $S_2$  (see Repair Group 39), in tool VW 294b **without** gasket for gear carrier
  - length of bolts VW 294b = 106 mm (4-3/16 in.)
- tighten retaining ring VW 294b/7 by hand
- install shift forks for 1st/2nd and 3rd/4th gears

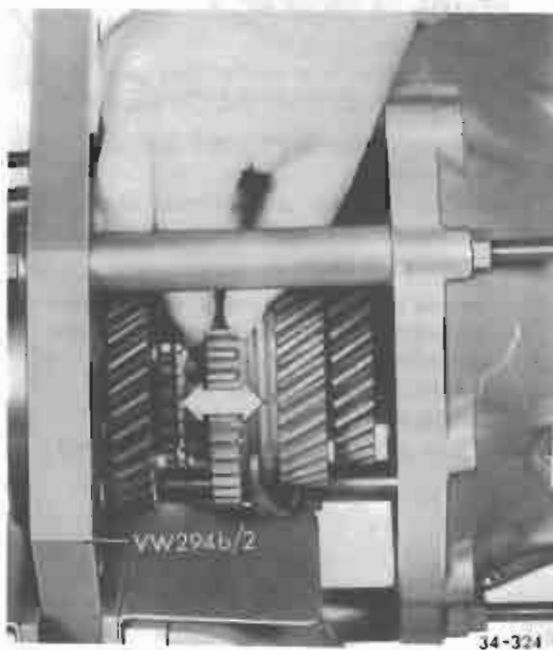
### CAUTION

Shift fork for 1st/2nd gear (wider fork, marking: No. 551 A) is installed with flat side **away** from gear carrier.

Shift fork for 3rd/4th gear (thinner fork, marking: No. 561 A) is installed with flat side **toward** gear carrier.



- install relay lever support together with relay lever



- put 1st/2nd gear selector shaft in 2nd gear position
- slide operating sleeve with fork over synchronizing teeth until it is against 2nd gear
- center shift fork in groove of operating sleeve and tighten clamp screw

## CAUTION

Shift fork must not rub or exert pressure on sides of groove in operating sleeve when in neutral position or when gear is engaged. **There must always be clearance**

- select 1st and 2nd gears several times while turning main shaft and check clearance of shift fork in operating sleeve in each position
  - if necessary, alter shift fork position until there is same amount of clearance on selector shaft in both end positions
- tighten clamp screw to 25 Nm (18 ft lb)
- put 3rd/4th gear selector shaft in 3rd gear position
- adjust 3rd/4th gear shift fork in same way as 1st/2nd gear shift fork

## CAUTION

For correct adjustment of 3rd/4th gears, main shaft ball bearing must be pressed fully into gear carrier housing

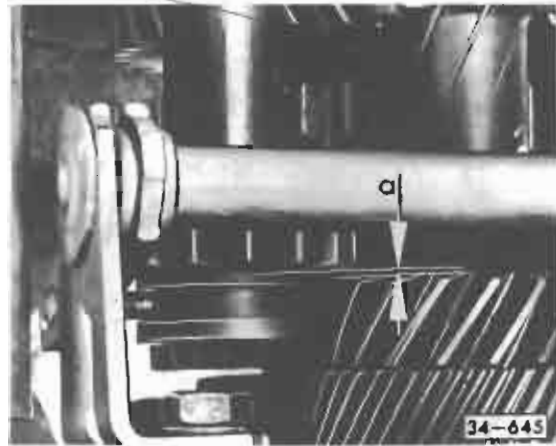
- press reverse gear selector shaft into reverse gear position

## Note

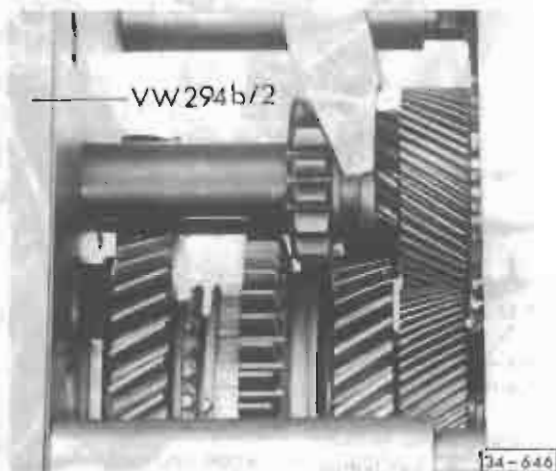
After repair work on gear carrier housing, adjust axial play in reverse sliding gear before adjusting reverse gear



- adjust reverse gear so that sliding gear is fully in mesh with teeth on operating sleeve for 1st/2nd gear (arrow)
- tighten union nut on relay lever support

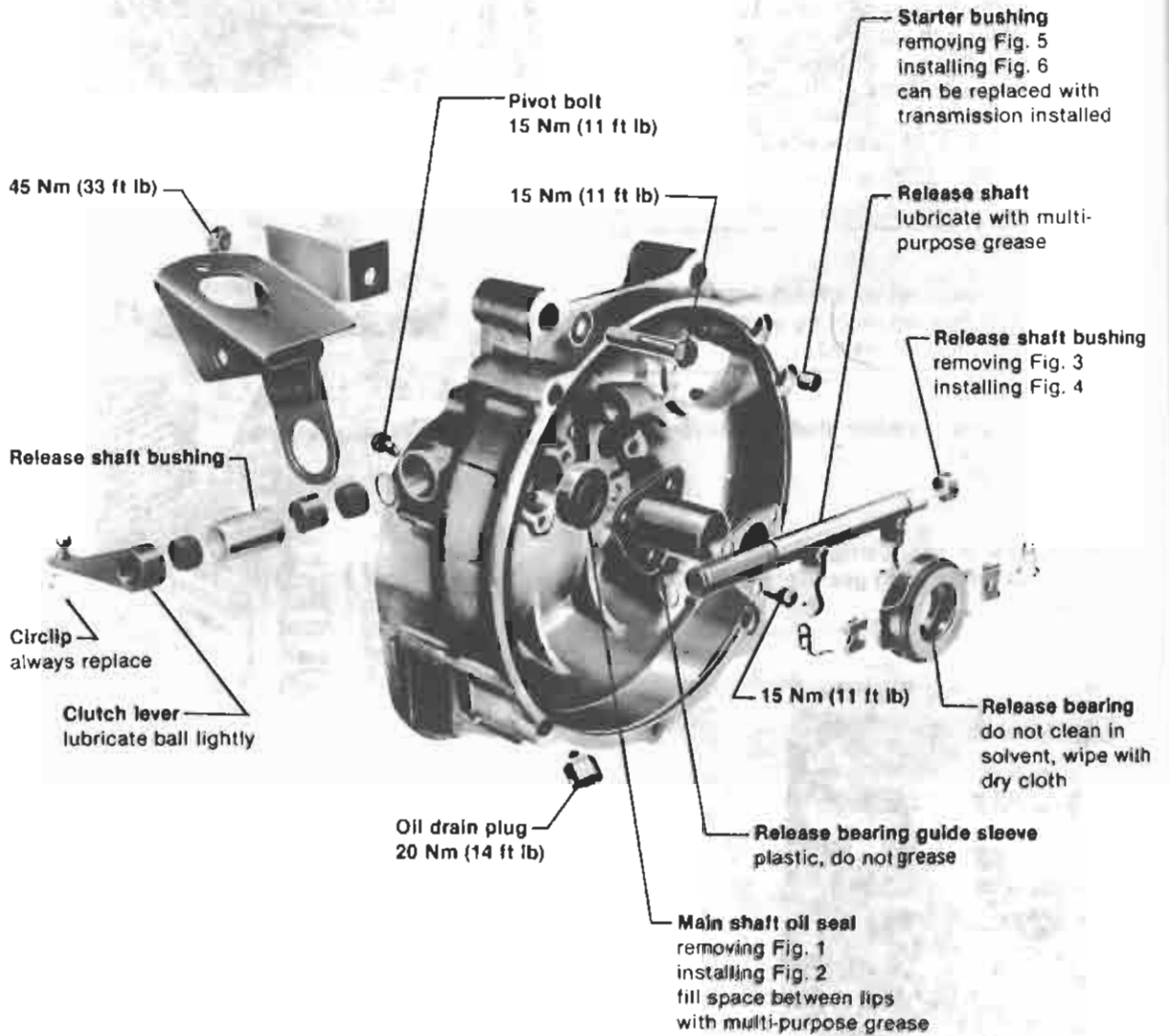


- shift out of reverse gear and press sliding gear lightly toward gear carrier housing. Clearance between reverse gear and 2nd gear on main shaft must be
  - a = min. 0.5 mm (0.020 in.)



- engage 2nd gear
- check clearance between operating sleeve and reverse sliding gear in this position and adjust if necessary
- check interlock mechanism
  - when gear is engaged it must not be possible to engage any other gear

# 35 Manual Transmission-Case, Gears, Shafts



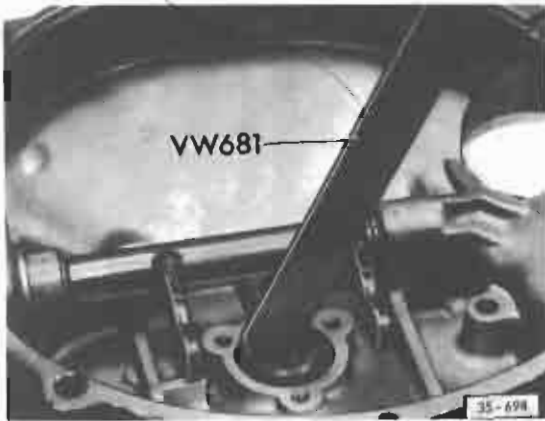


Fig. 1 Main shaft oil seal, removing.

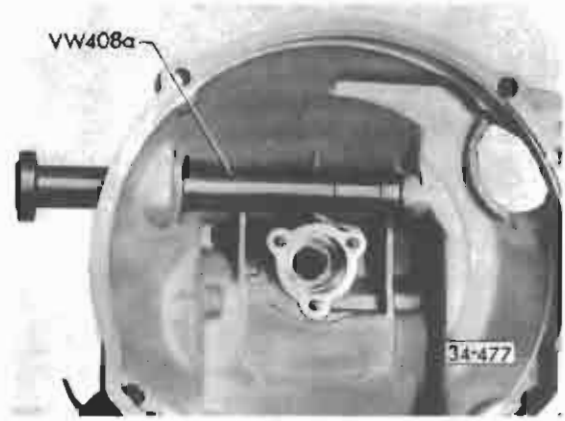


Fig. 4 Release shaft bushing, installing  
— drive in flush

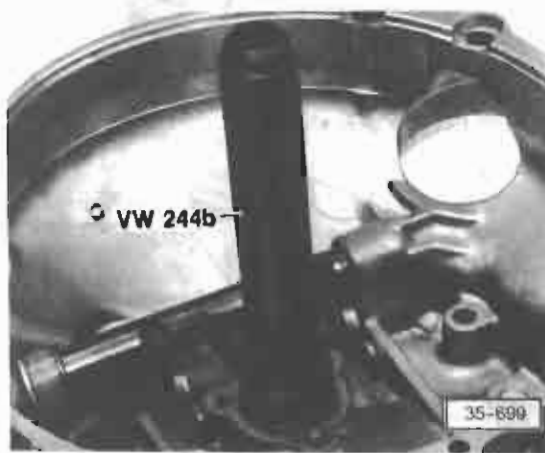


Fig. 2 Main shaft oil seal, installing

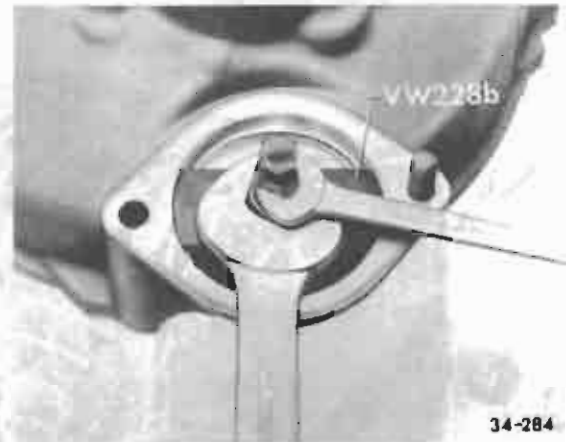


Fig. 5 Starter bushing, removing  
(transmission installed)

- when transmission is removed, use drift VW 222a

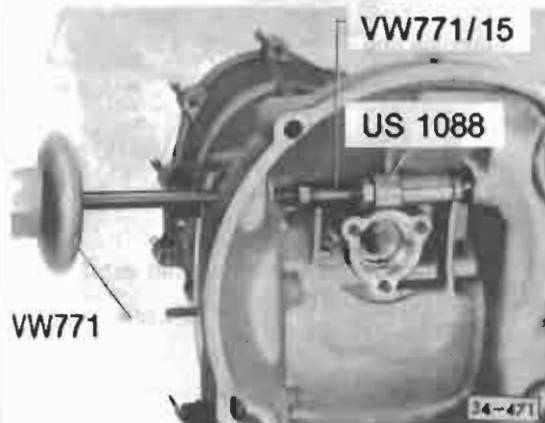


Fig. 3 Release shaft bushing, removing

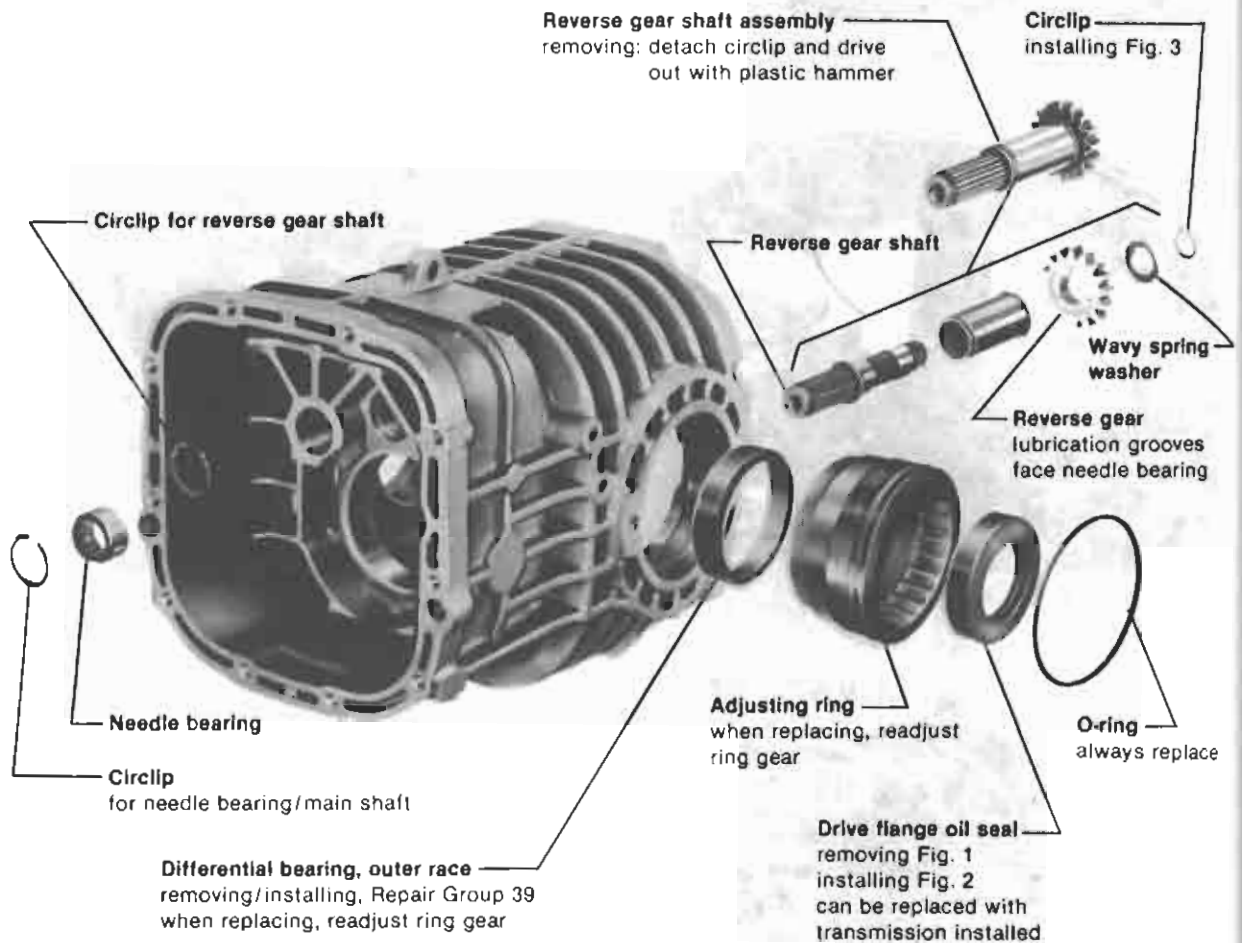


Fig. 6 Starter bushing, installing

- lubricate bushing and drive in flush



# 35 Manual Transmission-Case, Gears, Shafts

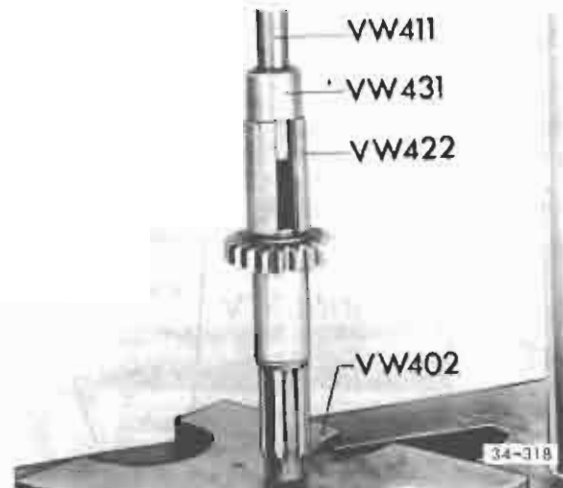


35-695





**Fig. 1 Drive flange oil seal, removing**



**Fig. 3 Reverse gear shaft circlip, installing**

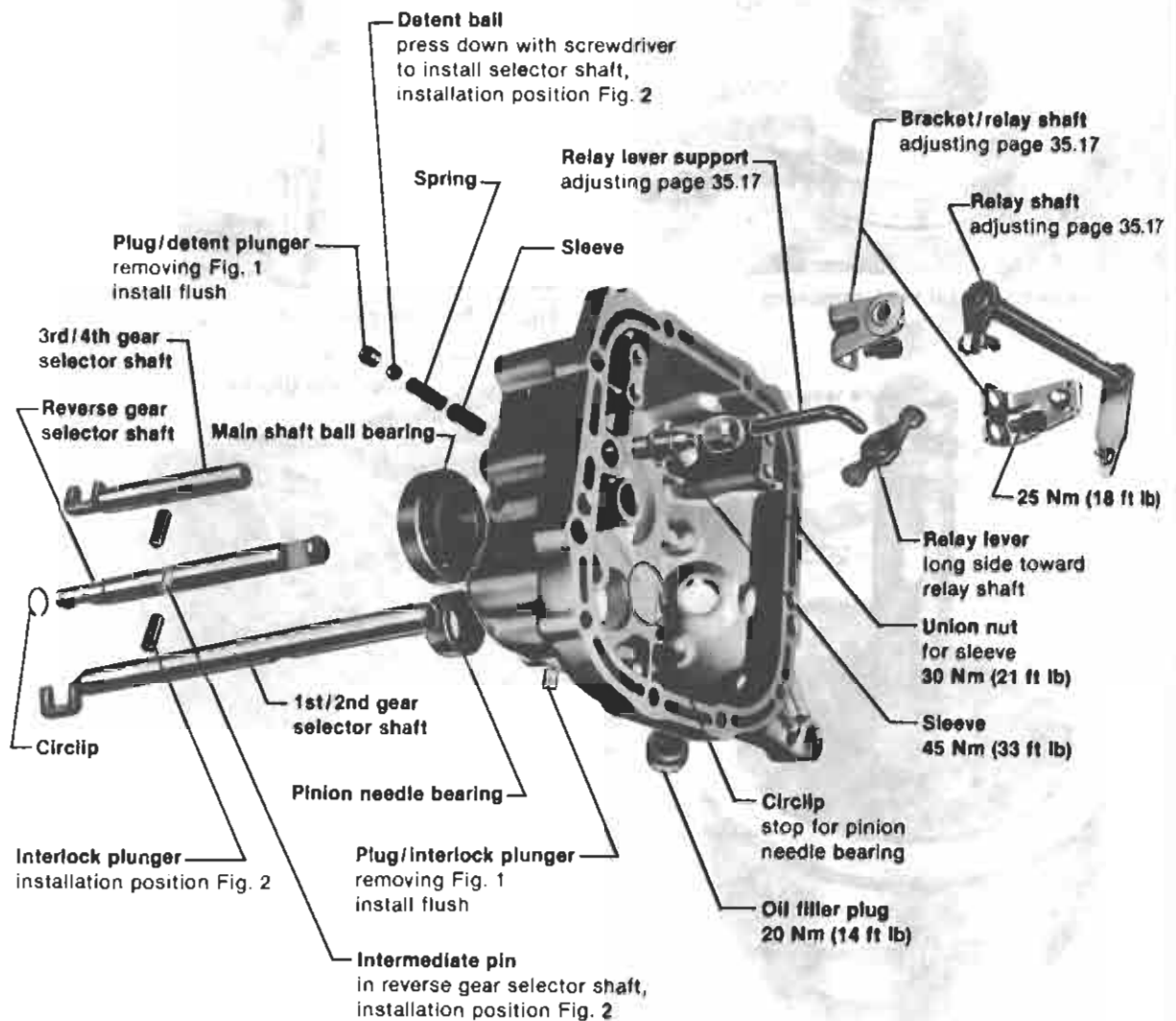
- press circlip into groove
- squeeze into groove with waterpump pliers



**Fig. 2 Drive flange oil seal, installing**

- press in flush

# 35 Manual Transmission-Case, Gears, Shafts

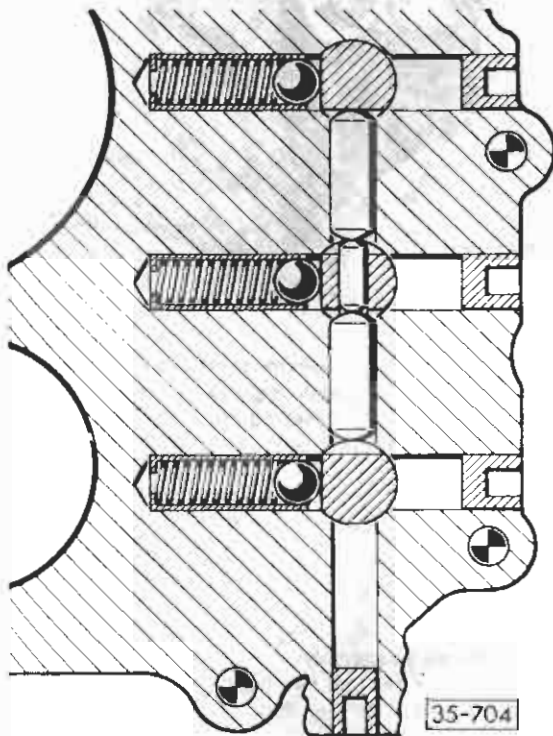


35-703



**Fig. 1 Plug for interlock/detent plunger, removing**

- tap 6 mm thread in plug and pull out with bolt (always use new plug)



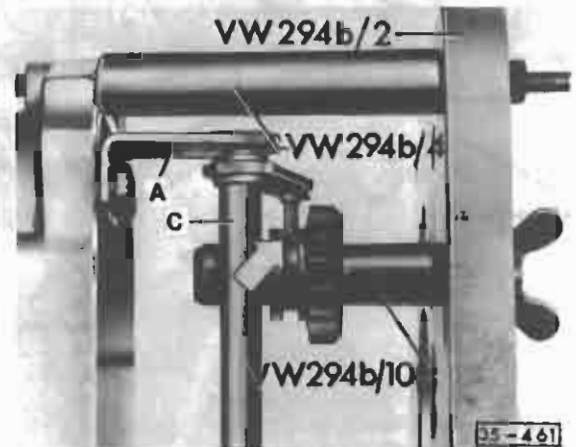
**Fig. 2 Interlock plungers, positioning**

- check that when gear is engaged it is not possible to engage any other gear

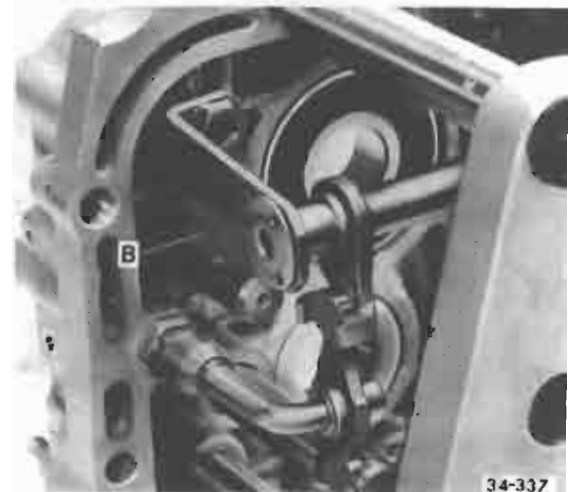
## Reverse gear clearance, adjusting

### Note

When reverse relay shaft and brackets have been removed, play between reverse gear and pin (arrow) on relay shaft must be adjusted by moving shaft and brackets vertically (as shown)

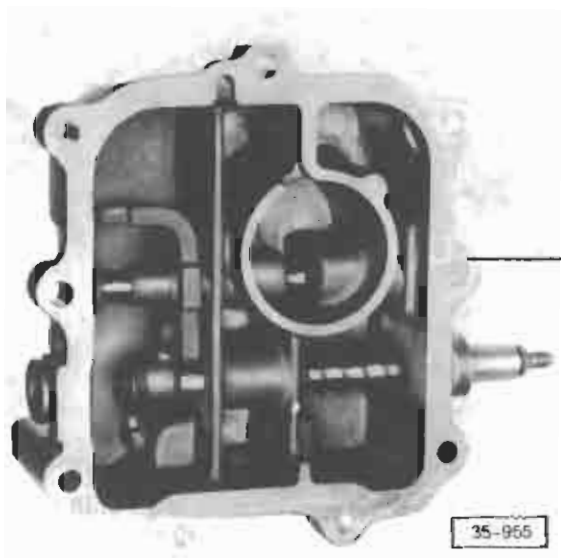
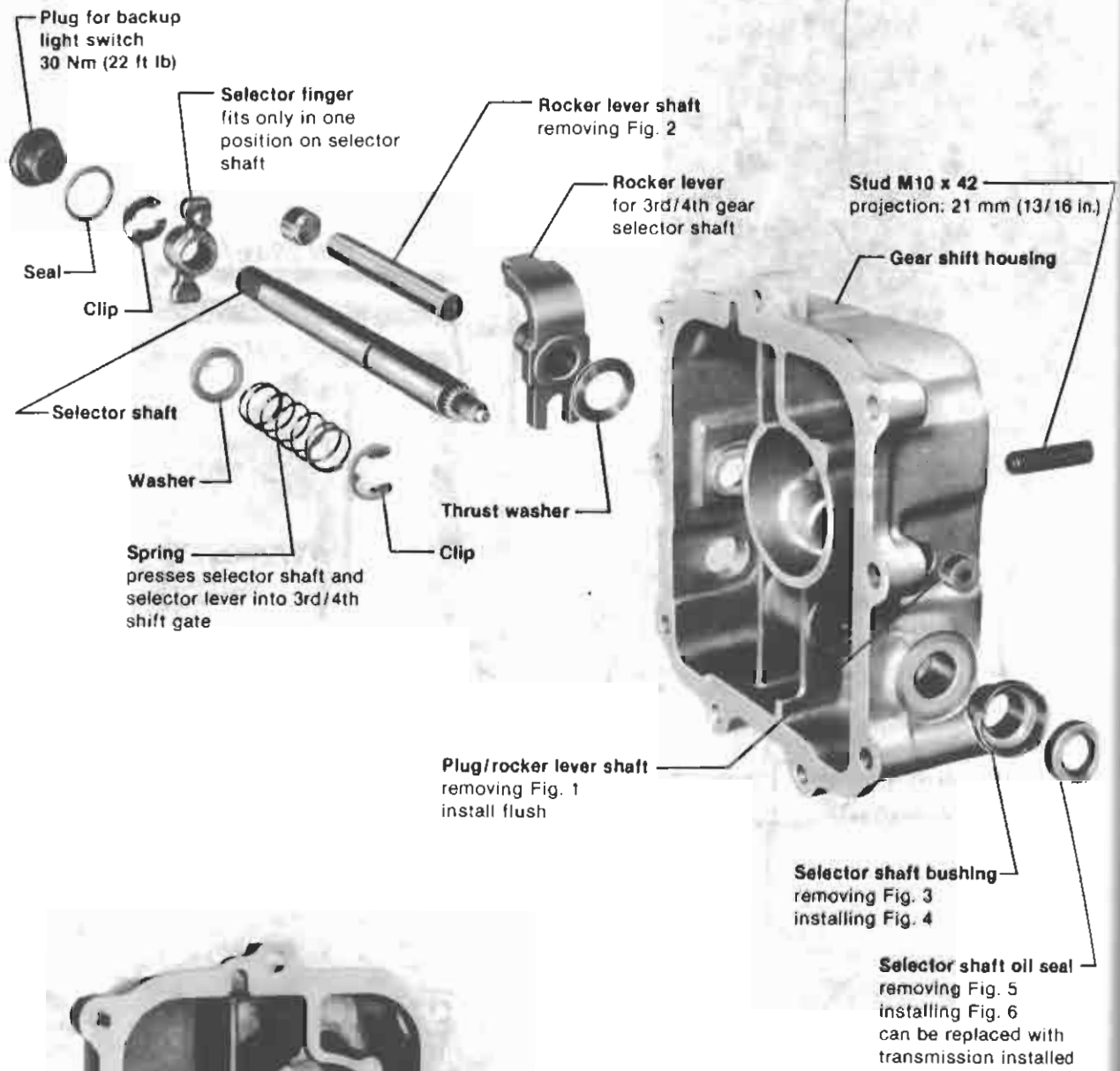


- install gear carrier with reverse gear in setting tool VW 294b
- loosen bolts on both brackets
- slide bracket A down against shaft C until pin (arrow) on relay shaft is firmly against reverse gear
- pull bracket back slightly until there is clearance between pin and reverse gear
- tighten bolts on bracket A

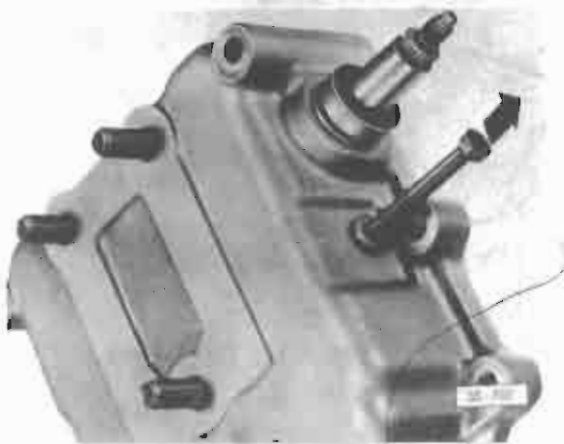


- press bracket B against relay shaft until relay shaft is installed firmly and without play
- tighten bolts on bracket B

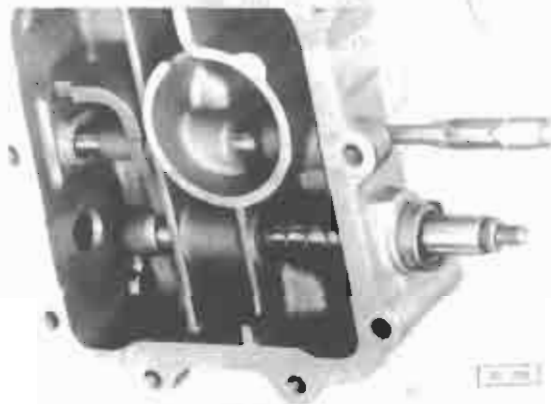
# 35 Manual Transmission-Case, Gears, Shafts



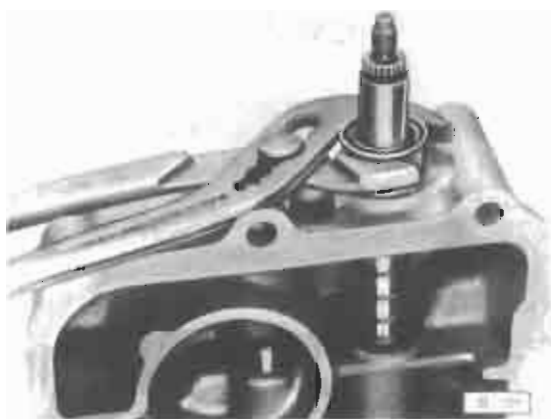
35-706



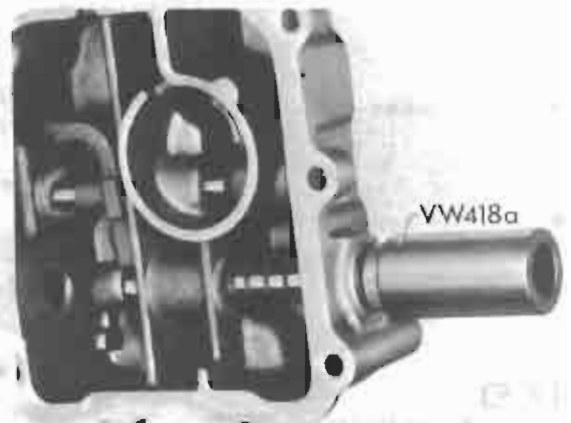
**Fig. 1 Plug for rocker lever shaft, removing**  
 — tap 6 mm thread in plug and pull out with bolt (always use new plug)



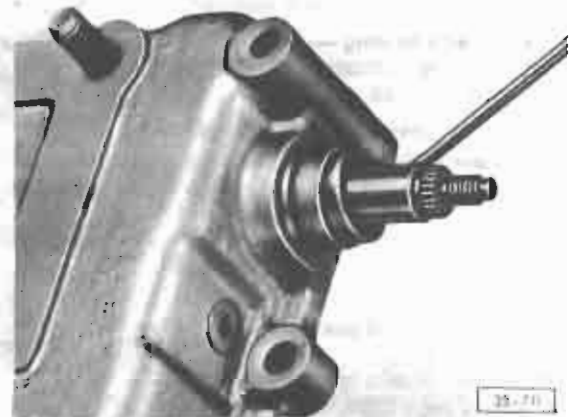
**Fig. 2 Rocker lever shaft, removing**  
 — first remove plug, see Fig. 1



**Fig. 3 Selector shaft bushing, removing**



**Fig. 4 Selector shaft bushing, installing**



**Fig. 5 Selector shaft oil seal, removing**  
 — pull out with screwdriver



**Fig. 6 Selector shaft oil seal, installing**  
 — fill space between lips with multi-purpose grease

3/16 in.)

ing

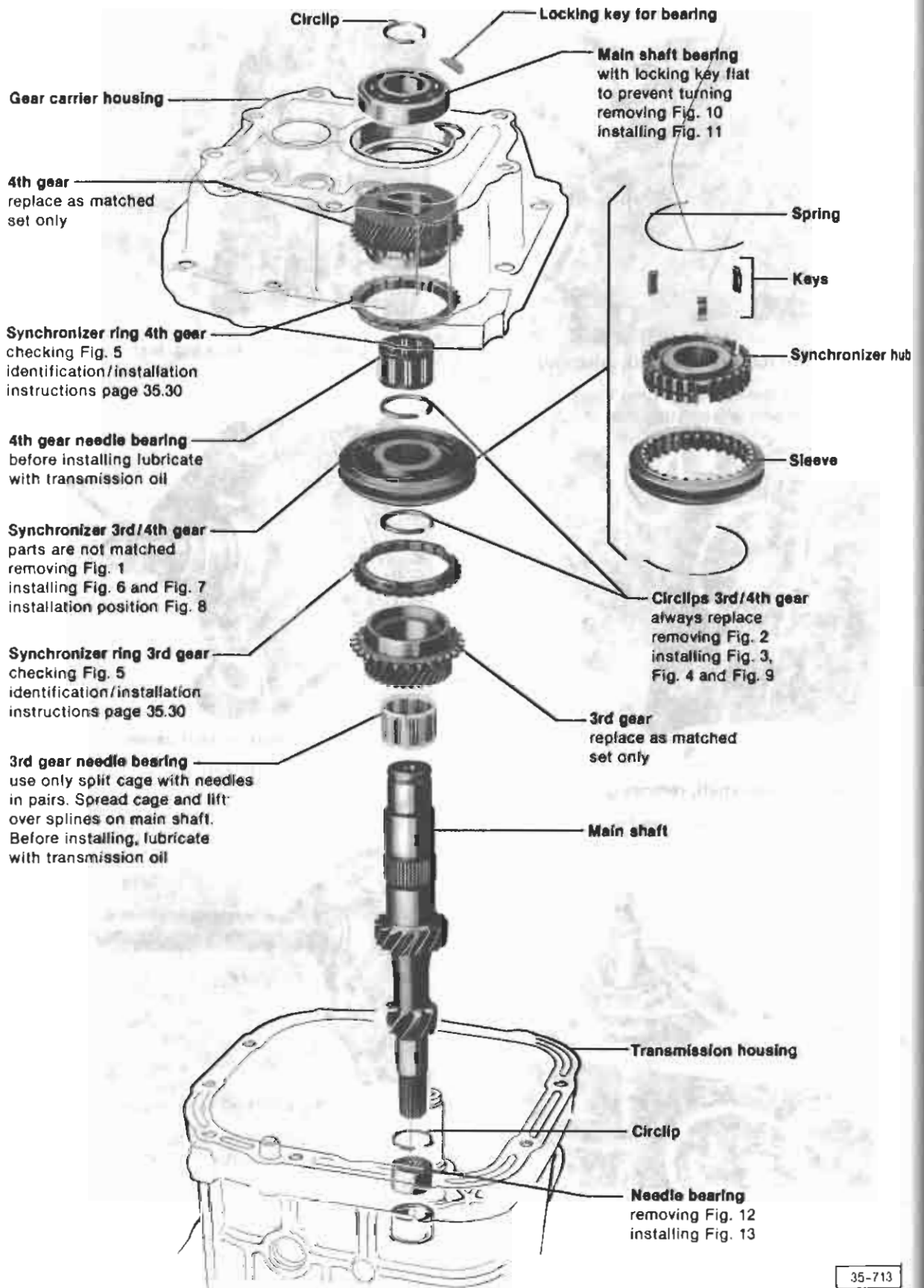


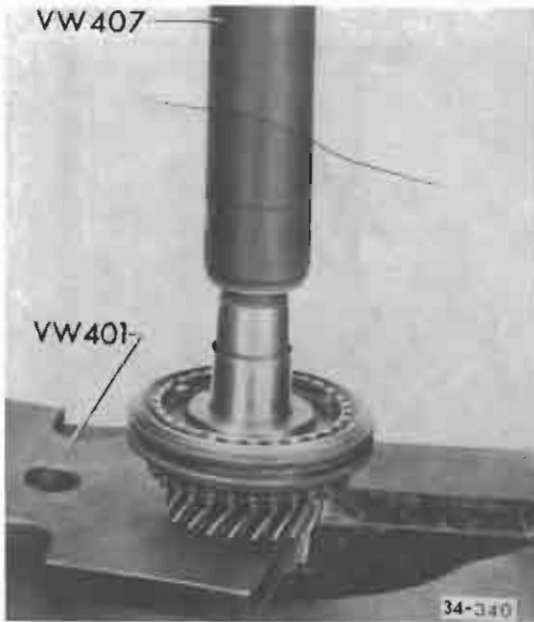
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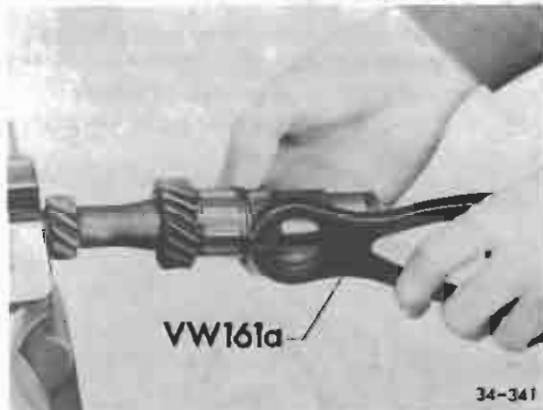
35-706

# 35 Manual Transmission-Case, Gears, Shafts

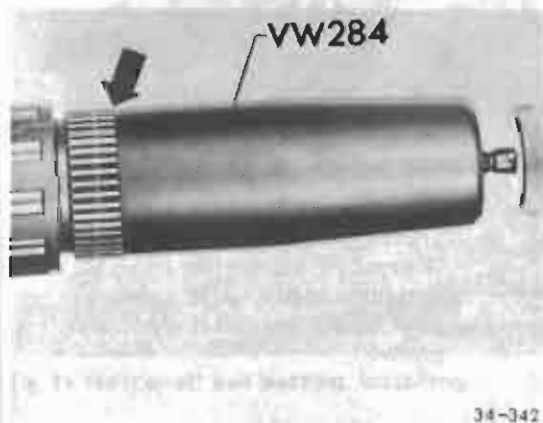




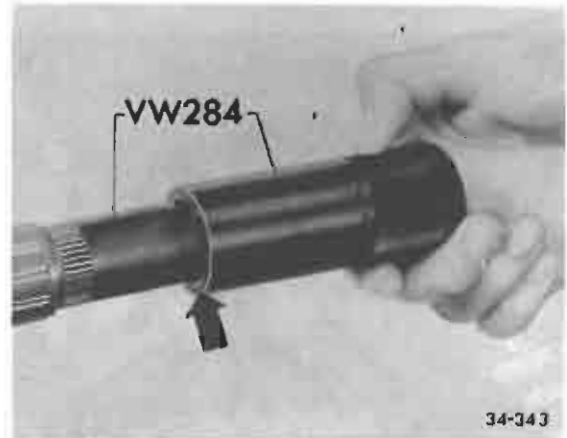
**Fig. 1 Synchronizer 3rd/4th gear, removing**  
— press off together with 3rd gear



**Fig. 2 Circlips 3rd/4th gear, removing**



**Fig. 3 Circlip 3rd/4th gear, installing**  
— slide sleeve over shaft until it contacts splines for hub (arrow). It may be necessary to back out knurled screw

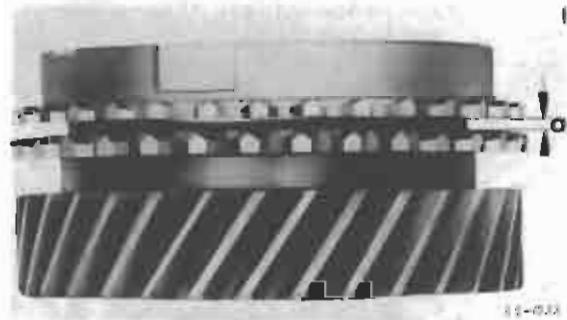


**Fig. 4 Circlip 3rd/4th gear, installing**

— place new circlip (arrow) on sleeve and push over splines with tube until circlip snaps into groove

### CAUTION

Circlip must be located inside relieved part of installing tool while it is being pushed on so that it expands uniformly over complete circumference



**Fig. 5 Synchronizer rings 3rd/4th gear, checking**

— press synchronizer rings onto gear by hand and measure gap a with feeler gauge

	New Part mm (in.)	Wear limit mm (in.)
Gap a	1.0-1.7 (0.039-0.067)	0.5 (0.020)

### Note

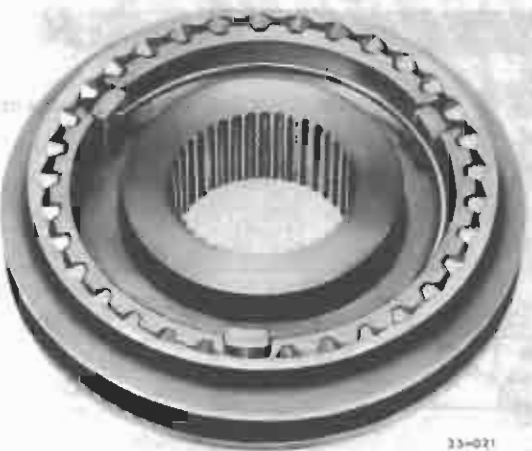
Synchronizer ring identification marks and installation instructions, page 35.30





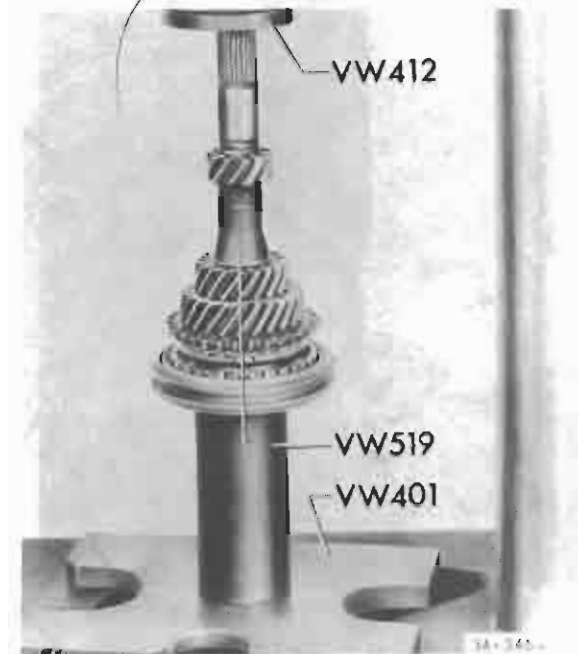
**Fig. 6 Synchronizer 3rd/4th gear, assembling**

- identification grooves (arrows) of sleeve and hub are on opposite sides. Groove on sleeve (white arrow) faces 4th gear
- sleeve and hub are not matched and can be replaced separately
- assemble parts at several positions before installing to determine position of smoothest operation with minimum backlash



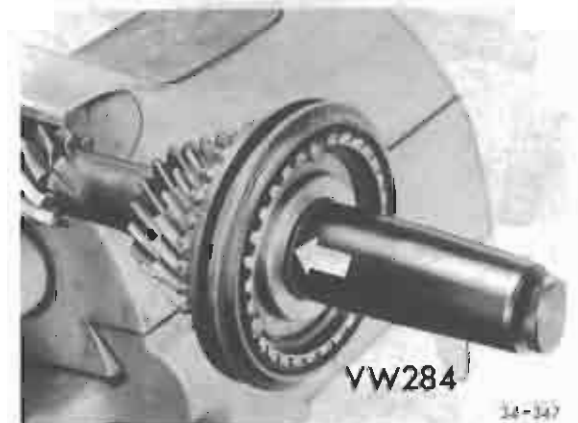
**Fig. 7 Synchronizer 3rd/4th gear, assembling**

- slide sleeve over synchronizer hub. Matched position is not necessary
- insert keys and install springs with ends offset 120°. Angled ends of springs must fit into keys



**Fig. 8 Synchronizer 3rd/4th gear, installing**

- turn synchronizer ring until grooves are in line with keys
- identification groove on sleeve (Fig. 6, white arrow) faces 4th gear



**Fig. 9 Circlip 3rd/4th gear, installing**

- slide sleeve over shaft and turn knurled screw in until groove (arrow) is exposed. If necessary, use M6 x 60 bolt instead of knurled screw
- push circlip on until it snaps into groove



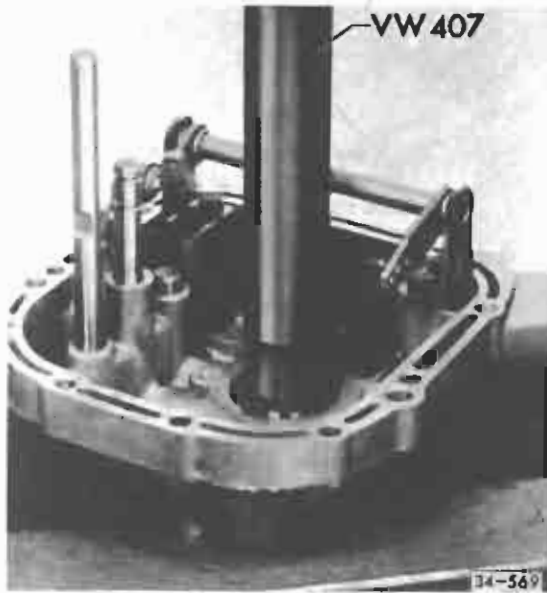


Fig. 10 Main shaft ball bearing, removing



Fig. 12 Pinion needle bearing in housing, removing



Fig. 11 Main shaft ball bearing, installing

- press in so that recess in bearing is aligned with recess (arrow) in housing
- install locking key to prevent bearing from turning

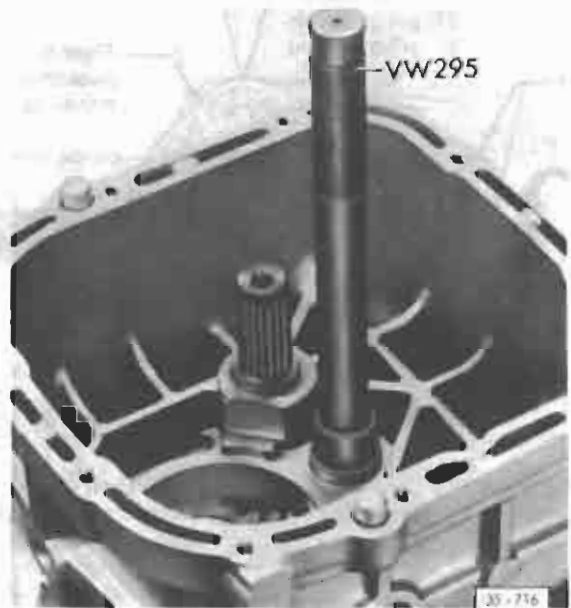


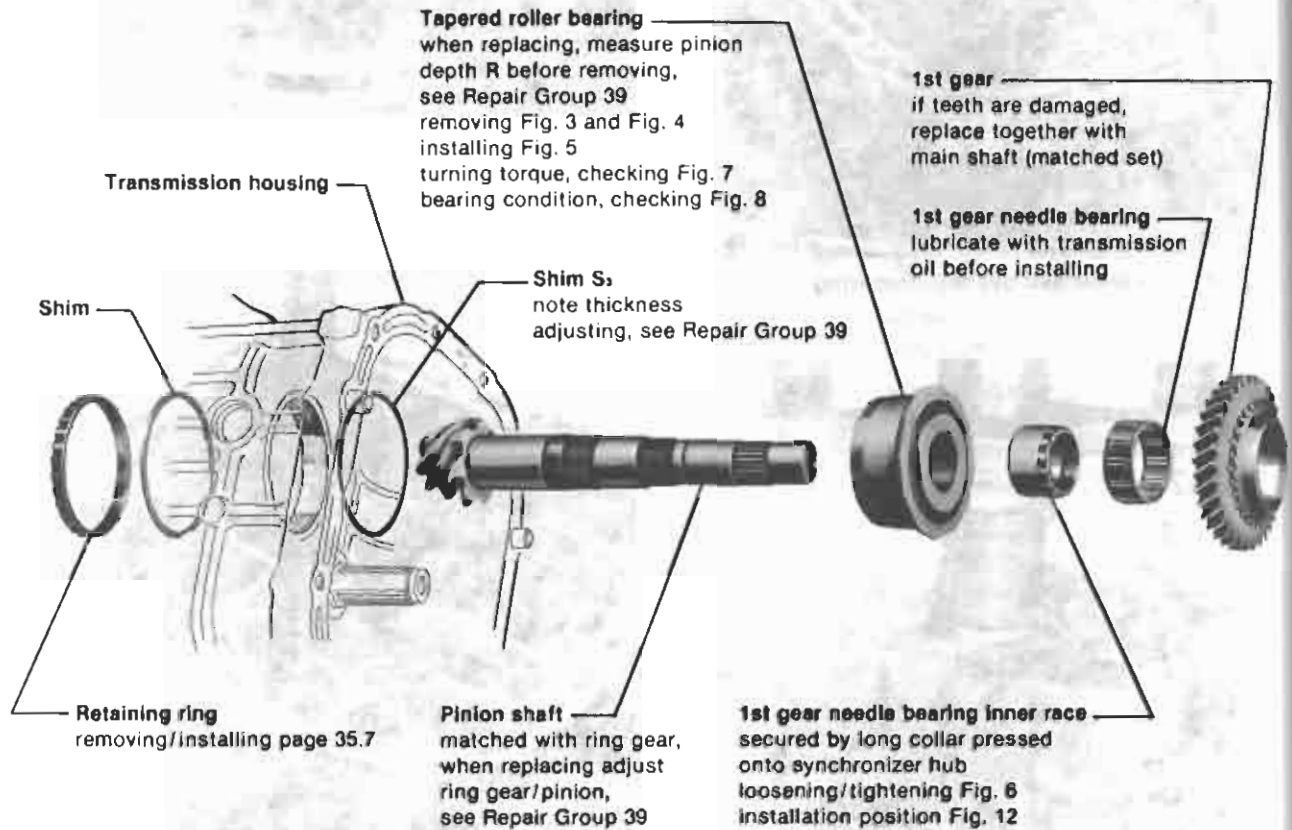
Fig. 13 Pinion needle bearing in housing, installing

— press in flush

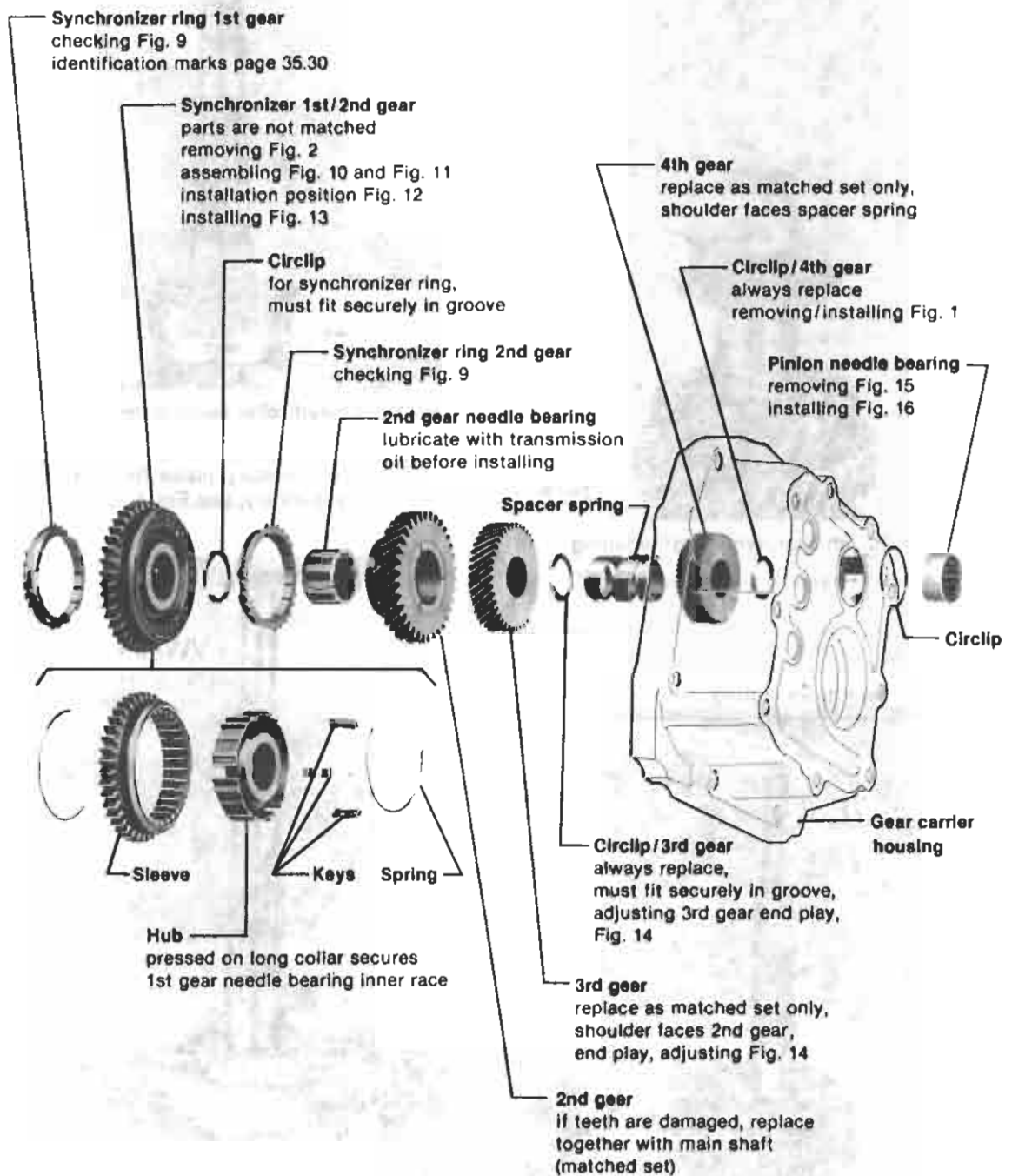
**CAUTION**

When installing, lettered side of bearing (thicker material) must face installing tool

# 35 Manual Transmission-Case, Gears, Shafts



35-717



35-717

35-717

D-2

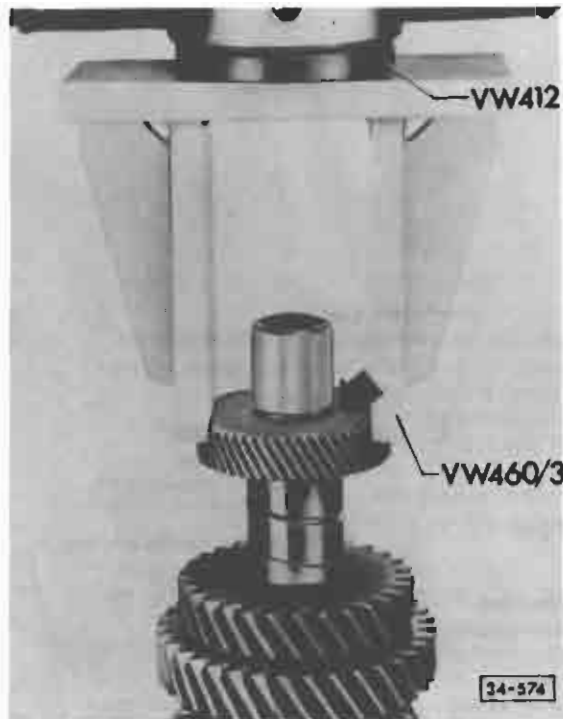
0-3

4-speed 091

Pinion shaft assembly

35.25

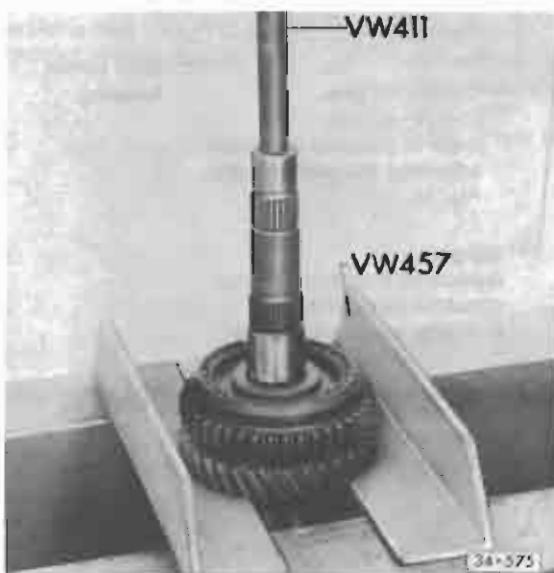
# 35 Manual Transmission-Case, Gears, Shafts



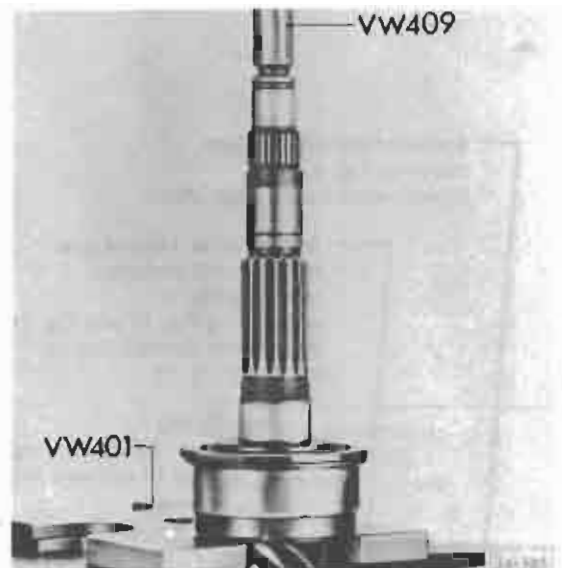
**Fig. 1 Circlip/4th gear, removing/installing**  
• must fit securely in groove (arrow)

**CAUTION**

Hold 4th gear down (spring under tension)

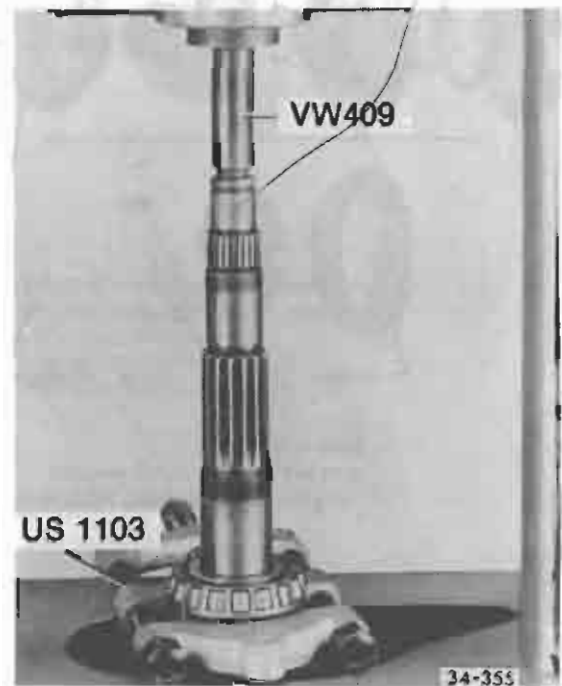


**Fig. 2 Synchronizer sleeve/hub and 1st gear, removing**

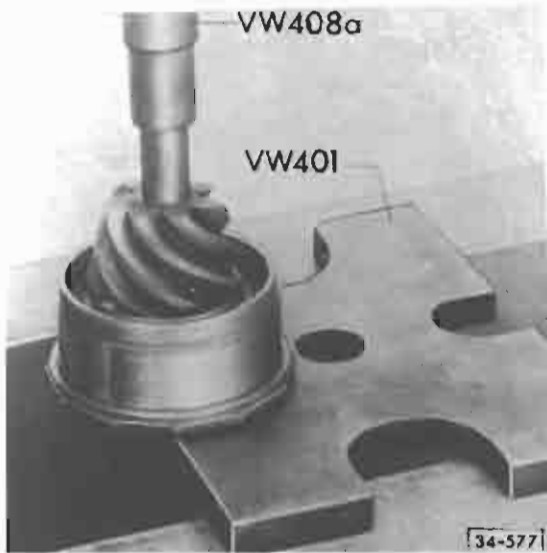


**Fig. 3 Tapered roller bearing, removing**

- press off by supporting outer race
- if necessary, press 2nd inner race off separately, see Fig. 4

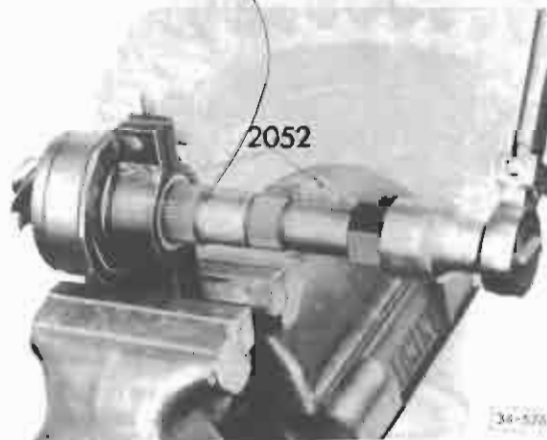


**Fig. 4 Tapered roller bearing 2nd inner race, removing**



**Fig. 5 Tapered roller bearing, installing**

- heat inner races to about 100°C (212°F) and press on
- before tightening needle bearing inner race, let tapered roller bearing cool to room temperature



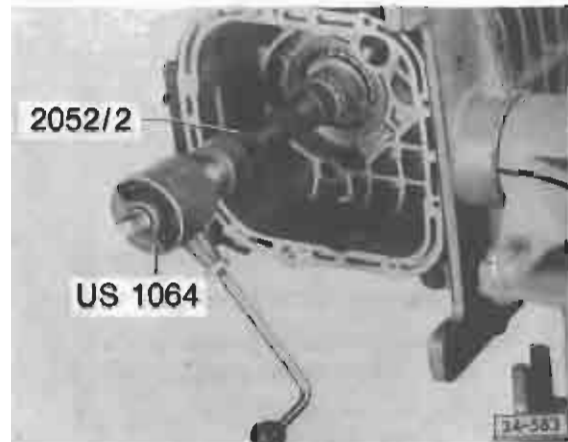
**Fig. 6 1st gear needle bearing inner race, loosening/tightening**

- heat inner race to about 60°C (140°F) and screw on as far as possible by hand

**CAUTION**

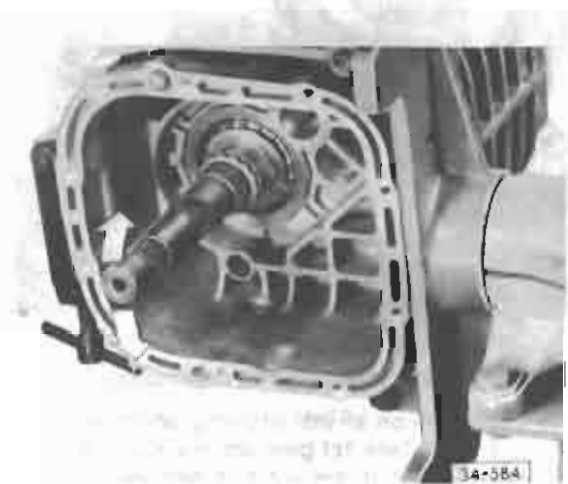
Inner race is **hot**. Do not touch with bare hand

- place pinion shaft in tool 2052 and tighten wing nut lightly
- tighten inner race to 210 Nm (152 ft lb)
- check turning torque of tapered roller bearing, see Fig. 7



**Fig. 7 Tapered roller bearing, checking turning torque**

- lubricate bearings with transmission oil and tighten retaining ring, see page 35.7
- turn pinion shaft in both directions about 15–20 times
- turn further and read turning torque
  - new bearings: up to 210 Ncm (180 in. lb)
  - used bearings\*: up to 70 Ncm (61 in. lb) (\*after running at least 30 miles)
  - if no turning torque can be measured, see Fig. 8



**Fig. 8 Bearing condition, checking**

- check for rock at end of pinion. There must not be any detectable movement if **YES**, replace tapered roller bearing



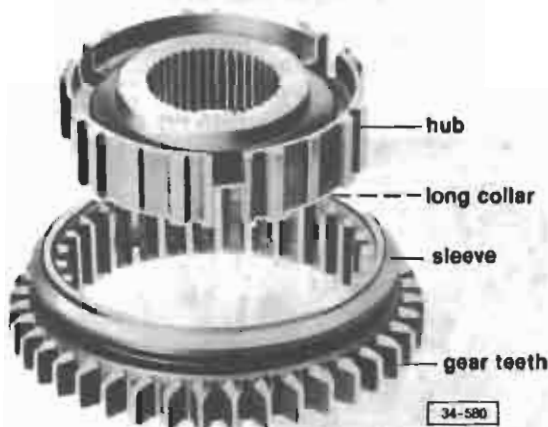
**Fig. 9 Synchronizer ring 1st/2nd gear, checking**

- press synchronizer rings onto gear by hand and measure gap *a* with feeler gauge

	New Part mm (in.)	Wear limit mm (in.)
Gap <i>a</i>	1.0-1.7 (0.039-0.067)	0.5 (0.020)

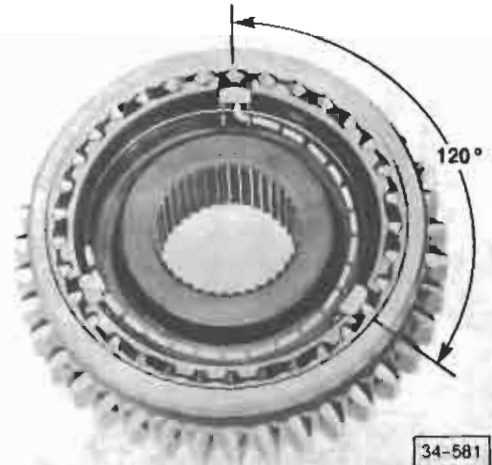
**Note**

Synchronizer ring identification marks and installation instructions, page 35.30



**Fig. 10 Synchronizer 1st/2nd gear, assembling**

- gear teeth on sleeve and long collar on hub must face 1st gear when installing
- sleeve and hub are not matched and can be replaced separately



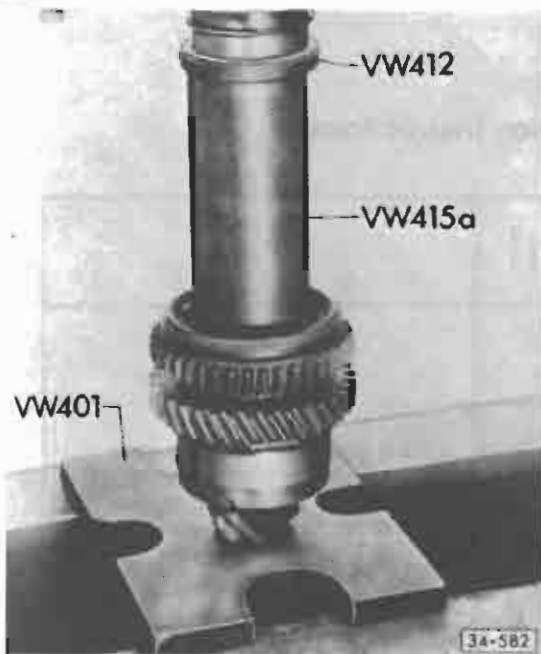
**Fig. 11 Synchronizer 1st/2nd gear, assembling**

- slide sleeve over synchronizer hub. Matched position is not necessary
- insert keys and install springs with ends offset 120°. Angled ends of springs must fit into keys



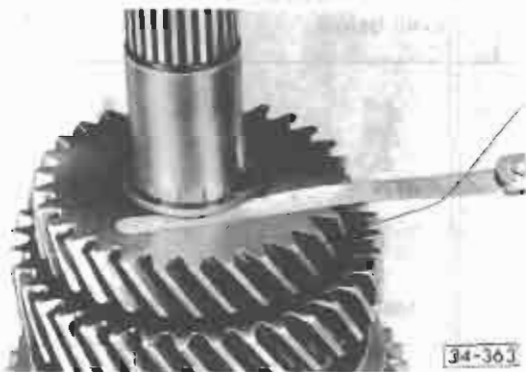
**Fig. 12 Synchronizer assembly 1st/2nd gear and 1st gear needle bearing inner race, installation position**

- position synchronizer assembly on needle bearing inner race so that old marks on long collar of synchronizer hub (from lugs on needle bearing inner race) are now opposite gaps on needle bearing inner race
- sleeve and hub are not matched and can be replaced separately



**Fig. 13 Synchronizer 1st/2nd gear, installing**

- turn synchronizer ring until grooves are in line with keys (installation position, see Fig. 10 and Fig. 11)

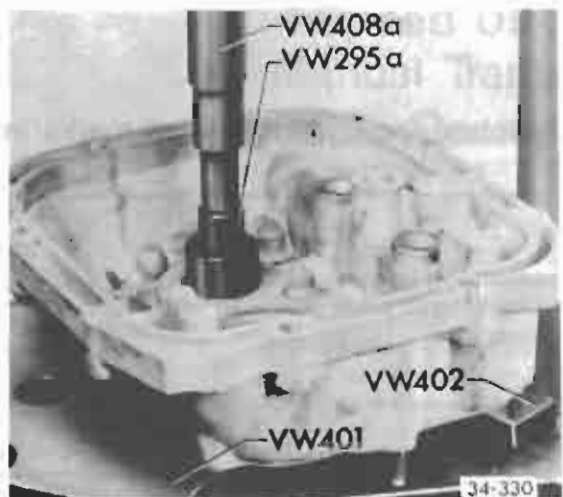


**Fig. 14 3rd gear end play, adjusting**

- measure end play with feeler gauge
- adjust by selecting suitable circlip
  - play should be 0.05 mm-0.20 mm (try to keep lower limit)

Circlips available:

Thickness mm	Color	Part No.
1.60	black	113 311 382
1.75	blue	113 311 383
1.90	brown	113 311 384
2.05	gray	113 311 385
2.20	copper	113 311 386
2.30	brass	113 311 387
2.40	silver	113 311 388



**Fig. 15 Pinion needle bearing in gear carrier housing, removing**

- press out without damaging circlip



**Fig. 16 Pinion needle bearing in gear carrier housing, installing**




- press in until seated



## Synchronizer rings, Identification marks/Installation instructions

### Note

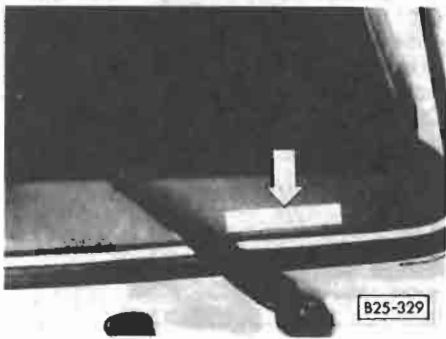
When assembling transmission, install synchronizer ring to same gear from which it was removed

Synchronizer ring	1st gear	2nd gear	3rd gear	4th gear
markings	 <p>without notches</p>		 <p>3 notches (arrow)</p>	
production	brass ring coated with molybdenum, Part No. 091 311 247 B	brass ring coated with molybdenum	special brass ring coated with molybdenum, Part No. 091 311 295 A, shown below	brass ring
spare part	brass ring coated with molybdenum, Part No. 091 311 247 B	special brass ring coated with molybdenum, Part No. 091 311 295 A, marked as shown on right	 <p>teeth all around circumference</p>	



# TECHNICAL DATA

## VEHICLE IDENTIFICATION



### The Vehicle Identification Number (VIN)

is located on the instrument panel on the driver's side so that it is visible from the outside through the windshield.

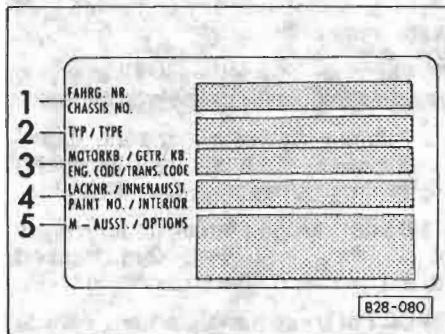
### The safety compliance sticker

is your assurance that your new vehicle complies with all applicable Federal Motor Vehicle Safety Standards which were in effect at the time the vehicle was manufactured. You can find this sticker on the left doorjamb. It shows the month and year of complete and incomplete (campmobile only) production and the vehicle identification number of your vehicle (perforation) as well as the Gross Vehicle Weight Rating and the Gross Axle Weight Rating.

### The Vehicle Identification Label

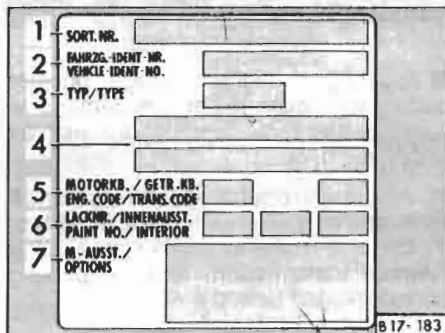
is located on the left side under the dashboard. The label contains the following information:

#### 1980-1985:



- 1 Vehicle Identification Number
- 2 Vehicle Code
- 3 Engine and Transmission Code
- 4 Paint and Interior Code
- 5 Option Codes

#### From 1986:



1. Production control no.
2. Vehicle identification no.
3. Type code number
4. Type designation
5. Engine and transmission code letter
6. Paint no./Interior
7. Optional equipment nos.

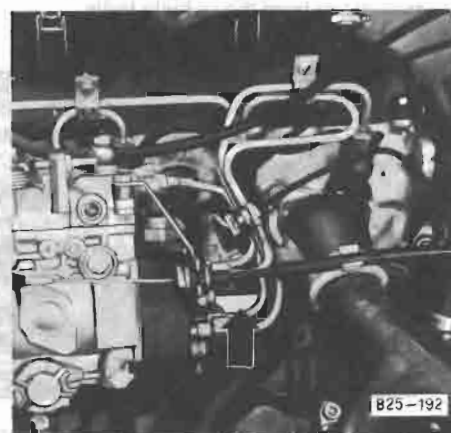
### The Engine Number

#### Air-cooled:



The engine number (arrow) is located on the right side of the engine compartment directly in front of the fan housing.

#### Diesel:



The engine number (arrow) is located on the engine block next to the injection pump.

#### Water-cooled:



The engine number (arrow) is located on the right side of the engine block.

# TECHNICAL DATA

## ENGINE

### Air-cooled

- Four-cylinder, horizontally opposed with four crankshaft main bearings
- Air cooling with thermostatically-controlled cooling fan
- Self-adjusting hydraulic valve lifters (no adjustment)
- AFC (air-flow controlled) electronic fuel injection
- Breaker-point ignition with combined vacuum and centrifugal advance and speed limiter
- Breakerless electronic ignition on California models

### Diesel

- Four-stroke, four-cylinder diesel
- Five main-bearing crankshaft and spur-belt driven overhead camshaft
- Liquid cooling (thermostatically-controlled) with thermostatically-controlled electric radiator cooling fan
- Mechanical fuel-injection pump

### Water-cooled

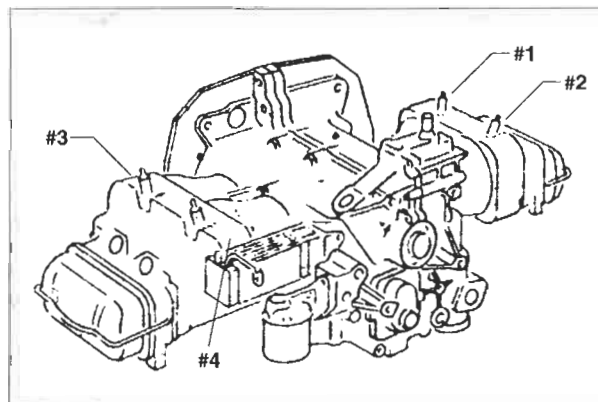
- Four-cylinder, horizontally opposed with four crankshaft main bearings
- Liquid cooling (thermostatically-controlled) with thermostatically-controlled electric radiator cooling fan
- Digijet/Digifant air-flow controlled electronic fuel injection
- Breakerless electronic ignition

	Air-cooled	Diesel	Water-cooled up to 1986 (Digijet)	Water-cooled from 1986 (Digifant)
<b>Maximum output, SAE net:</b>	67 hp @ 4200 rpm	48 hp @ 4200 rpm	82 hp @ 4800 rpm	90 hp @ 4800 rpm*
<b>Maximum torque, SAE net:</b>	101 ft-lb @ 3000 rpm	97 ft-lb @ 2000 rpm	105 ft-lb @ 2600 rpm	117.3 ft-lb @ 3200 rpm
<b>Displacement:</b>	120 cu. in. (1970 cc)	97 cu. in. (1588 cc)	117 cu. in. (1913 cc)	129 cu. in. (2109 cc)
<b>Stroke:</b>	2.80 in. (71 mm)	3.40 in. (86.4 mm)	2.70 in. (68.9 mm)	2.99 in. (76.0 mm)
<b>Bore:</b>	3.70 in. (94 mm)	3.01 in. (76.5 mm)	3.70 in. (94.0 mm)	3.70 in. (94.0 mm)
<b>Compression ratio:</b>	7.3:1	23:1	7.3:1	9.0:1
<b>Firing order:</b>	1-4-3-2	--	1-4-3-2	1-4-3-2

\*1987-1988: 90 hp @ 5500 rpm

Capacities	
<b>Fuel tank</b> (total with reserve) Syncro: Reserve:	16 gal. (60 liters) 18.5 gal. (70 liters) 2.5 gal. (10 liters)
<b>Engine oil (with filter change)</b> Air-cooled: Diesel: Water-cooled: <b>(without filter change)</b> Air-cooled: Diesel: Water-cooled:	3.7 US qt. (3.5 liters) 4.2 US qt. (4.0 liters) 4.8 US qt. (4.5 liters) 3.2 US qt. (3.0 liters) 3.7 US qt. (3.5 liters) 4.2 US qt. (4.0 liters)
<b>Automatic transmission fluid (ATF) refill:</b>	3.2 US qt. (3.0 liters)
<b>Cooling System</b> Diesel: Water-cooled:	16.9 US qt. (16 liters) 18.6 US qt. (17.5 liters)
<b>Windshield washer reservoir:</b>	4.3 US qt. (4.2 liters)
<b>Rear window washer reservoir:</b>	1.1 US qt. (1.0 liters)

### Cylinder Location (Air-cooled and Water-cooled)



**Lubrication, Emissions and Vehicle Maintenance Schedules**  
**Air-cooled, Water-cooled and Diesel models: 1982-1985**

<b>first 1,000 miles (1,600 km):</b>	
Engine:	change oil (air-cooled) check oil level, add if necessary check for leaks
Engine (diesel only):	retorque cylinder head bolts adjust valve clearance replace cover gasket
Brakes:	check for damage and brake fluid leaks
Cooling system:	check tightness of hoses and clamps, check coolant level, add if necessary
Exhaust system:	check for damage
Fuel system:	check visually for leaks
V-belt:	check tension, adjust if necessary (diesel)
During Road Test:	Check efficiency of braking, steering, heating and <b>ventilation system</b> , automatic transmission kickdown (where applicable)
After Road Test: Engine: Engine idle speed: Engine idle mixture (CO): Exhaust system:	check for leaks <b>check</b> check (1984-1985 models) check for exhaust leaks

<b>every 7,500 miles (12,000 km):</b>	
Engine:	change oil replace oil filter check for leaks
Brakes:	check for damage and brake fluid leaks check brake pad thickness
Cooling system:	<b>check coolant level</b> , add if necessary
Fuel filter:	drain water (diesel only)

<b>every 15,000 miles (24,000 km):</b>	
Engine:	change oil replace oil filter check for leaks
Engine (diesel only):	adjust valve clearance replace cover gasket clean valve cover breather screen
Fuel filter:	replace (except diesel)
Ignition distributor:	replace breaker points, adjust dwell and timing (air-cooled except California)

**1982-1985**

**Lubrication, Emissions and Vehicle Maintenance Schedules  
Air-cooled, Water-cooled and Diesel models: 1982-1985**

every 15,000 milese (24,000 km): (cont'd)	
Spark plugs:	replace (air-cooled)
Automatic transmission final drive:	check for leaks check gear oil level, add if necessary
Battery:	check electrolyte level, add distilled water if necessary
Brakes:	check for damage and brake fluid leaks check brake fluid level, add if necessary
Brake linings and pads:	check thickness
Brake pressure regulator:	check (where applicable)
Cooling system:	check tightness of hoses and clamps, check coolant level, add if necessary
Crankcase ventilation system:	inspect hoses and connections (1982-1983 models)
Door check rods:	lubricate
Drive shafts:	check protective boots for damage
EGR system:	inspect, reset EGR mileage counter (air-cooled except California)
Exhaust system:	check for damage
Front axle:	check dust seals on ball joints and tie rod ends check tie rods for wear and damage
Fuel filter:	drain water (diesel only)
Fuel system:	check visually for leaks
Headlights:	check alignment and adjust if necessary
Ignition:	check vacuum hoses, ignition wires, distributor cap and rotor, replace if necessary
Manual transmission:	check gear oil level, add if necessary
Sliding door:	lubricate mounting points, guide tracks and roller guides
Steering:	check protective boots for damage
V-belt(s):	check tension and condition, adjust/replace if necessary
Wheels and tires:	check for wear and damage
During Road Test:	Check efficiency of braking, steering, heating and ventilation system, automatic transmission kickdown (where applicable)
After Road Test: Automatic transmission: Engine: Engine idle speed: Engine idle mixture (CO): Exhaust system: Power steering:	check automatic transmission fluid (ATF) level check for leaks check check (1984-1985 models) check for exhaust leaks check fluid level, add if necessary

1982-1985

continued

**Lubrication, Emissions and Vehicle Maintenance Schedules  
Air-cooled, Water-cooled and Diesel models: 1982-1985**

<b>every 30,000 miles (48,000 km):</b>	
Air cleaner:	replace filter element
Automatic transmission:	change automatic transmission fluid (ATF) clean pan and strainer, replace pan gasket
Brake fluid:	replace every two years regardless of mileage
Engine:	change oil replace oil filter check for leaks compression test (except diesel)
Engine (air-cooled only):	clean oil strainer
Engine (diesel only):	adjust valve clearance replace cover gasket clean valve cover breather screen
Fuel filter(s):	replace
Ignition distributor:	replace breaker points, adjust dwell and timing (air-cooled <b>except California</b> )
Oxygen sensor (air-cooled):	replace, reset OXS mileage counter (California only)
Oxygen sensor (water-cooled):	replace every 30,000 miles regardless of time since delivery (1984 models, 1985 models except California)
Spark plugs:	replace
V-belt:	replace (diesel)
Valve cover gaskets:	replace (air-cooled)
Automatic transmission final drive:	check for leaks check gear oil level, add if necessary
Battery:	check electrolyte level, add distilled water if necessary
Brakes:	check for damage and brake fluid leaks
Brake linings and pads:	check thickness
Brake pressure regulator:	check (where applicable)
Brake warning light switch:	check function
Cooling system:	check tightness of hoses and clamps, check coolant level, add if necessary
Crankcase ventilation system:	inspect hoses and connections (1982-1983 models)
Door check rods:	lubricate
Drive shafts:	check protective boots for damage
EGR system:	inspect, reset EGR mileage counter (air-cooled except California)
Exhaust system:	check for damage

**1982-1985**

**Lubrication, Emissions and Vehicle Maintenance Schedules  
Air-cooled, Water-cooled and Diesel models: 1982-1985**

<b>every 30,000 miles (48,000 km): (cont'd)</b>	
Front axle:	check dust seals on ball joints and tie rod ends check tie rods for wear and damage
Fuel system:	check visually for leaks
Headlights:	check alignment and adjust if necessary
Ignition:	check vacuum hoses, ignition wires, distributor cap and rotor, replace if necessary
Manual transmission:	check gear oil level, add if necessary
Sliding door:	lubricate mounting points, guide tracks and roller guides
Steering:	check protective boots for damage check play
V-belt(s):	check tension and condition, adjust/replace if necessary
Wheels and tires:	check for wear and damage
During Road Test:	Check efficiency of braking, steering, heating and ventilation system, automatic transmission kickdown (where applicable)
After Road Test: Automatic transmission: Brakes: Engine: Engine idle speed: Engine idle mixture (CO): Exhaust system:	check automatic transmission fluid (ATF) level, add if necessary check brake fluid level, add if necessary check for leaks check check (1984-1985 models) check for exhaust leaks

<b>every 60,000 miles (96,000 km): all items listed for 30,000 mile (48,000 km) interval, plus:</b>	
Oxygen sensor:	replace every 60,000 miles (96,000 km) regardless of time after delivery

**1982-1985**

## Lubrication, Emissions and Vehicle Maintenance Schedules Water-cooled models from 1986

<b>every 7,500 miles (12,000 km):</b>	
Engine:	change oil replace oil filter
Brakes:	check brake pad thickness

<b>every 15,000 miles (24,000 km):</b>	
Engine:	change oil replace oil filter
Automatic transmission final drive:	check for leaks check gear oil level, add if necessary
Brakes:	check for damage and brake fluid leaks <b>check</b> brake fluid level, add if necessary
Brake linings and pads:	check thickness
Cooling system:	check coolant level, add if necessary
Drive shafts:	check protective boots for damage
Exhaust system:	check for damage
Manual transmission:	check gear oil level, add if necessary
Sliding door:	lubricate mounting points, guide tracks and roller guides
During Road Test:	Check efficiency of braking, steering, automatic transmission kickdown (where applicable), heating, ventilation and air conditioning, power accessories and electrical systems
After Road Test: Automatic transmission: Engine: Engine idle speed: Exhaust system: Power steering:	check automatic transmission fluid (ATF) level check for leaks check check for exhaust leaks check fluid level, add if necessary

<b>every 30,000 miles (48,000 km):</b>	
Air cleaner:	replace filter element
Automatic transmission:	change automatic transmission fluid (ATF), clean pan and strainer, replace <b>pan gasket*</b>
Brake fluid:	replace every two years regardless of mileage
Engine:	change oil replace oil filter check for oil leaks compression test
* Specified in the case of severe conditions such as extremely high temperatures, continuous mountain driving, trailer towing, and predominantly stop-and-go traffic	

**from 1986**

**Lubrication, Emissions and Vehicle Maintenance Schedules  
Water-cooled models from 1986**

<b>every 30,000 miles (48,000 km): (cont'd)</b>	
Spark plugs:	replace
Automatic transmission final drive:	check for leaks check gear oil level, add if necessary
Brakes:	check for damage and brake fluid leaks
Brake linings and pads:	check thickness
Cooling system:	check coolant level, add if necessary
Drive shafts:	check protective boots for damage
Exhaust system:	check for damage
Front axle:	check dust seals on ball joints and tie rod ends <b>check tie rods for wear and damage</b>
Manual transmission:	check gear oil level, add if necessary
Sliding door:	lubricate mounting points, guide tracks and roller guides
V-belt(s):	check tension and condition, adjust/replace if necessary
During Road Test:	Check efficiency of braking, steering, automatic transmission kickdown (where applicable), heating, ventilation and air conditioning, power accessories and electrical systems
After Road Test: Automatic transmission: Engine: Engine idle speed: Exhaust system: Power steering:	check automatic transmission fluid (ATF) level, add if necessary check for leaks check check for exhaust leaks check fluid level, add if necessary

<b>every 60,000 miles (96,000 km): all items listed for 30,000 mile (48,000 km) interval, plus:</b>	
Oxygen sensor:	replace every 60,000 miles (96,000 km) regardless of time after delivery (1986-1987 models only)

<b>every 90,000 miles (144,000 km): all items listed for 30,000 mile (48,000 km) interval, plus:</b>	
Oxygen sensor:	replace every 90,000 miles (144,000 km) regardless of time after delivery (models from 1988)

**from 1986**



## DO-IT-YOURSELF-SERVICE

### JACK AND TOOLS

The jack and the tools necessary to change a wheel are in a bag stored under the driver's seat.

On vehicles with swivel seats they are stored under the rear seat bench.

The screwdriver has a reversible blade.

#### WARNING

■ Use the jack only for changing a wheel. Never use the jack to lift other vehicles or other loads as this may lead to accidents and personal injury.

■ The jack must never be used as a support to work underneath the vehicle. If the jack is accidentally dislodged, you could be seriously injured.

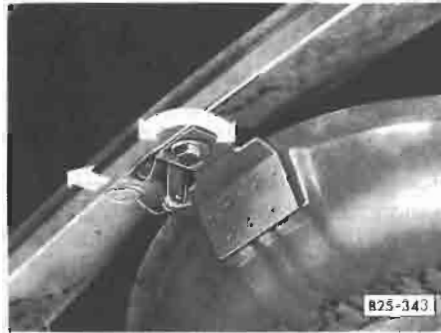
■ Do not raise the vehicle using a bumper jack. The bumper system would be damaged. Also, the jack may slip which could cause personal injury.

■ Do not support your car on cinder blocks, bricks or other props that may crumble under continuous load.

■ Do not start or run the engine while the vehicle is supported by the jack.

■ When working under the vehicle, always use safety stands specifically designed for this purpose.

### SPARE WHEEL



The spare wheel is located underneath the floor panel of the driver cab, where it rests on a hinged metal plate.

■ To take out the spare wheel, remove the bolt (curved arrow) from the holding bracket with wheel wrench.

#### WARNING

Keep hands and arms away from underbody of vehicle.

■ Stand in front of the vehicle and pull the catch hook (arrow) forward to let the metal plate drop.

■ Pull out the spare wheel.



■ When re-installing the spare wheel, slide spare wheel onto metal plate.

■ Give the plate a hard upward push and make sure the catch hook is securely engaged.

■ Replace bolt and tighten firmly.

#### WARNING

Never drive the vehicle without a firmly tightened bolt on the holding bracket. Should the catch hook disengage accidentally, you could lose control of the car.

Check the inflation pressure periodically to keep the tire ready for use.

#### WARNING

Under no circumstances should you store the spare wheel unsecured in the luggage compartment. This could cause serious personal injury to passengers in the vehicle in case of a collision.

# DO-IT-YOURSELF-SERVICE

## CHANGING A WHEEL

### WARNING

■ If you have a flat tire, move a safe distance off the road. Turn off the engine, the emergency flasher on and use other warning devices to alert other motorists.

■ Passengers must not remain in the vehicle when it is jacked up.

■ Make sure that passengers wait in a safe place away from the vehicle and well away from the roadway and traffic.

■ Before you change a wheel, be sure the ground is level and firm. If necessary, use a board under the jack.

■ Set the parking brake and block the wheel opposite the defective wheel on the other side of the vehicle. Engaging a gear or placing the Automatic transmission selector lever in P (Park) position is not a substitute for fully setting the parking brake.

### Step 1

■ Take out the bag with jack and tools from under the driver's seat.

### Step 2

■ With the wheels still firmly resting on the ground, remove the hub cap/wheel cover of the defective wheel.

#### Wheels with hub cap

■ The wheel cover can be pulled off with puller clip and lug wrench.



#### Wheels with wheel cover

■ Remove chrome plated hub cap with puller clip and lug wrench. Insert clip in holes at rim of a hub cap. Put wheel wrench through clip, brace one end of wrench on wheel rim and pull lightly on other end.

When you place the hub cap face down, you can use it as a tray for lug bolts (front wheels) or lug nuts (rear wheels).



### Step 3

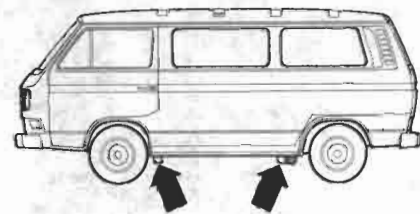
■ Loosen wheel nuts or bolts counterclockwise about one turn with the lug wrench. **Do not yet remove the nuts or bolts.**

To loosen — turn counterclockwise

To tighten — turn clockwise

### Step 4

There are two jack ports on each side under the car body for front and rear wheel changing — see right illustration.



### WARNING

■ Mounting the jack at any other place may damage the car or may result in personal injuries.

■ Provide a firm base for the jack on the ground. If necessary, use a board.

■ Securely insert the jack into the jack port closest to the wheel to be changed.

■ Before inserting jack, clear jack port.

■ Place jack as straight as possible, as shown.

## Step 5

**Never jack the vehicle up by the bumper or body.**

**Do not raise the vehicle until you are sure the jack is securely engaged.**

**Passengers must not remain in the vehicle when jacked up.**

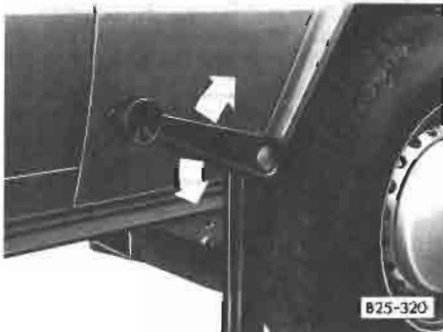
■ **Make sure that passengers wait in a safe place away from the vehicle and well away from the roadway and traffic.**

■ **To raise the vehicle, turn the handle clockwise.**  
Only raise the vehicle as much as is needed to change a wheel.

## Step 6

### WARNING

**Before installing the spare wheel, accumulated road dirt must be removed from the inside and outside of the wheel nut/bolt holes to assure a secure mount on front hub or rear drum.**



■ Fully unscrew wheel nuts or bolts and place them into the hub cap. Take the top nut or bolt off last. Place the spare wheel against the wheel hub and slightly rotate the wheel until a bolt hole in the wheel is in line with a threaded stud in the wheel hub. Reinstall nuts or bolts and tighten them crosswise by hand before jacking the car down.

## Step 7

■ **To lower the vehicle, turn the handle counterclockwise.**



## Step 8

■ Then go crosswise from one nut or bolt to another tightening them firmly with the lug wrench.

■ **Correct tightness of the wheel nuts is important.**

■ Correctly tightened nuts or bolts should have a torque of 130 ft lb/180 Nm. This torque can be obtained with the lug wrench by any person of average strength. If in doubt about the correct tightness of the wheel nuts, have them checked with a torque wrench by your dealer or at service station.

## Step 9

■ **To install the hub cap, place it around the lower part of the wheel center.** With a firm blow of your hand on the upper part, the hub cap will snap into place. Make sure it is firmly seated.

## Step 10

■ Fully lower the vehicle and remove jack.

■ **Correct the air pressure of the tire you have just put on.** For correct tire inflation pressures, see the sticker on the left door-jamb.

■ **Store the jack and tools under the driver's seat.**

■ **Store damaged tire in spare wheel metal plate under front of vehicle.**

■ **Engage lock for metal plate and firmly secure plate with bolt.**

■ **Have flat tire repaired and replaced promptly.**

## FUSES

A failure in the electrical system may be caused by a burned fuse.

Fuses are arranged in one centralized unit. The unit is located on the left side under the dashboard behind a cover.

### Removing cover:

Detach cover at front, swing downwards and take it off.

### Installing cover:

Hang cover in the eyes of fuse box bracket, swing it upwards and press it firmly into position.

### Replacing a fuse

**Before replacing a fuse, turn off all lights and accessories and remove the ignition key to avoid damaging the electrical system.**

■ Consult the appropriate electrical wiring diagram to find out which fuse belongs to the component that has failed.

■ Remove blown fuse with the plastic clip located on cover in front of fuse box.

Three spare fuses can be attached to the bottom of the fuse panel. It is good planning to keep a supply of spare fuses on hand. They are available at your Volkswagen dealer.

■ **Replace the blown fuse which can be recognised by the burnt metal strip, with a fuse of equal ampere rating.**

### WARNING

**Do not use a fuse of higher amperage, because this could damage the electrical part and fire can result.**

**If a fuse blows repeatedly, do not keep on replacing it. The cause of the short circuit or overload must be found. On no account should fuses be patched up with tin foil or wire as this may cause serious damage elsewhere in the electrical circuit or cause a fire.**

## REPLACING BULBS

Before starting to replace a bulb, switch off the respective circuit.

Do not touch the glass part of the new bulb with bare fingers. Finger prints left on the glass evaporate when the bulb gets hot, the vapor settles on the reflector surface and dims it.

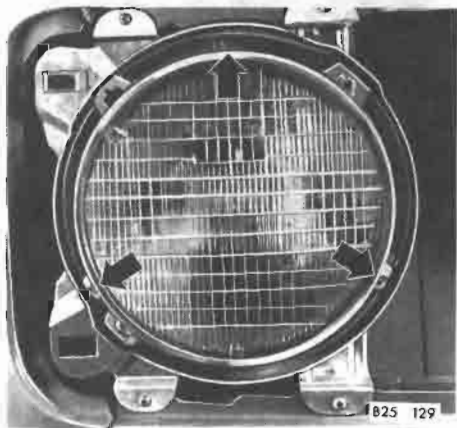
Always use the same type of bulb. The designation is marked on the bulb.

### Headlights

Should it become necessary to replace a headlight bulb, the air intake grille must be removed first.

- With a screwdriver loosen the five quick-release screws along upper edge of grille.
- Pull the grille slightly toward you.
- Then lift the grille out of its retainer.

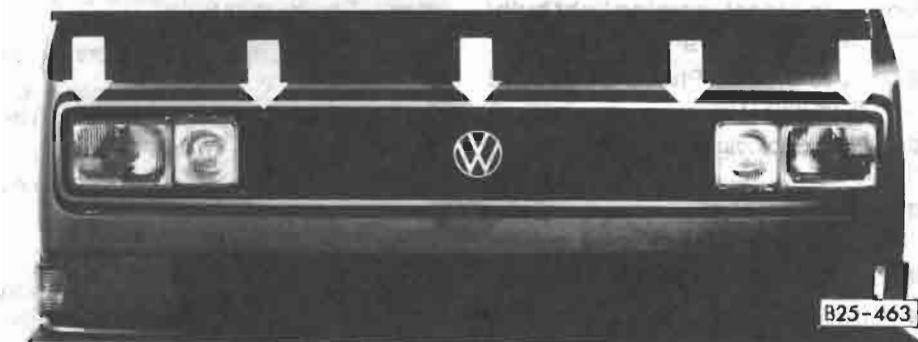
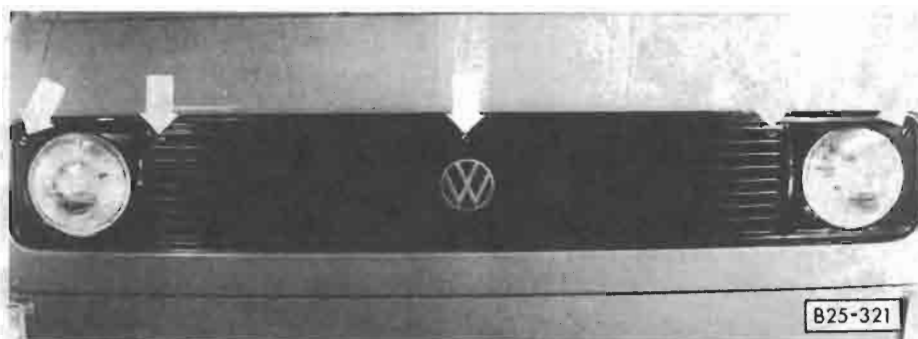
### 1980-1984:



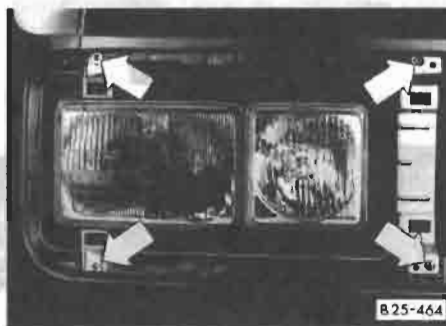
- Remove the three short screws in the sealed beam retaining ring and take the ring off.
- Do not alter the position of the long headlight adjustment screws.
- Take the sealed beam unit out of the support ring and pull the cable connector off.

**When installing a new sealed beam unit, be sure the three lugs on the headlight engage properly in the support ring.**

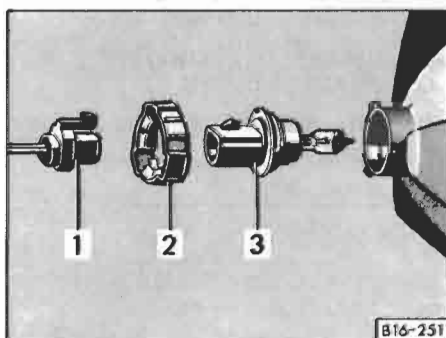
If no other headlight part as described here was removed or its position changed, it should not be necessary to aim the headlights. If in doubt have the adjustment checked by your dealer.



### From 1985:



- Remove the four screws (arrows) and take the headlight out.



### Outer headlights

- Disconnect wire connector (1)
- Twist lock ring (2) counterclockwise, pull bulb (3) out of headlight housing and discard.

- Install new bulb so that the locating lugs on the headlight housing engage the recesses on the bulb.

- Reinstall lock ring so that its recesses engage the locating lugs on the headlight housing.

- Twist lock ring clockwise until firmly seated.

- Reconnect wire connector. Have headlight beam alignment checked.

### Auxiliary driving lamps

- Turn cap to left and take off.

- Pull wire connector off.

- Unhook spring clip holding bulb and swing it away.

- Take bulb out and insert new bulb so that the locating lug on bulb plate engages recess in reflector.

- Swing spring clip over bulb plate. Squeeze clip together and engage it in the retaining lugs.

- Attach wire again.

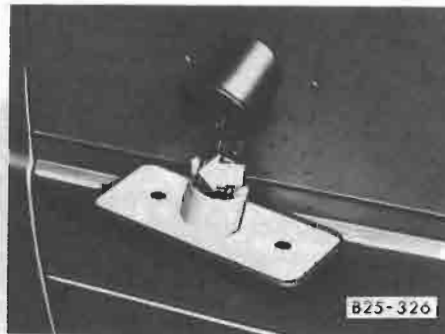
- Install cap and turn to right.

- Have headlight setting checked.



**Front turn signal / parking light bulb / front side marker light bulb**

- Remove the two Phillips screws and take off the lens cover.
- Pull out bulb holder and push down the rubber boot.
- Press spring clip inward and take out bulb holder.
- Give bulb a left turn and remove.
- Replace bulb and reverse the above procedure to install bulb holder and lens cover.



**Rear side marker bulb**

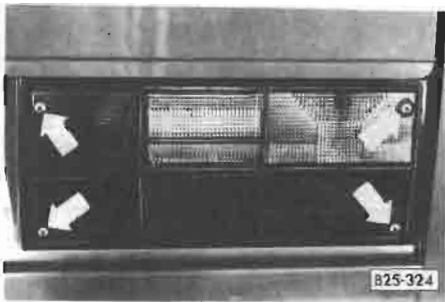
- Remove the two Phillips screws and take off lens cover.
- Pull out bulb holder and push down the rubber boot.
- Press spring clip outward and take out bulb holder.
- Give bulb a right turn and remove.
- Replace bulb and reverse the above procedure to install bulb holder and lens cover.

**License plate light bulb**

There is one bulb housing on each side of the license plate. Only if both bulbs are operative is the license plate properly illuminated.

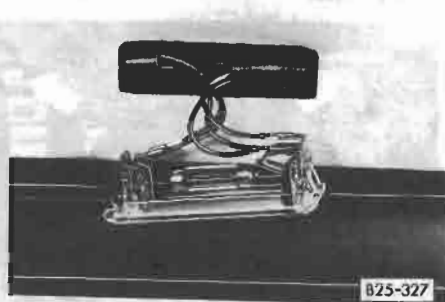
- Take the bulb housing off by pulling it down.
- Remove the two Phillips screws and take off lens cover.
- Press bulb into housing, turn left and take out.
- Replace bulb and reverse above procedure to install bulb housing and lens cover.

Make sure the spring clip on each side of the housing is securely engaged in the cutouts provided at upper edge of cross panel.



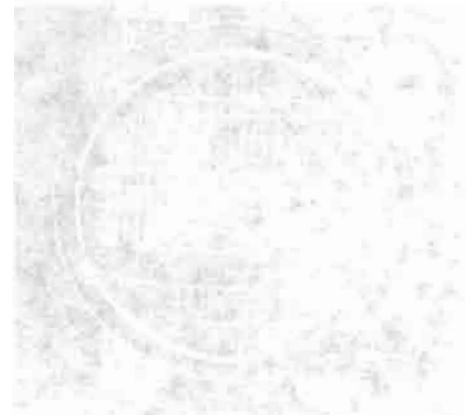
**Rear turn signal, stop / tail / back-up light bulb**

- Remove the four Phillips screws and take off lens cover with bulb housing.



**Interior light**

- To remove lamp, press against spring clip on left side and lift out the housing.
- Take out bulb from between the two spring contacts and install new bulb.
- Install lamp by inserting switch side of housing into cut-out first.
- Then press in the other side until spring clip engages.



B25-325

- Squeeze the two side springs inward (arrow) and lift out the bulb housing.
- Press defective bulb into bulb holder, turn left and take out bulb.
- Replace bulb and reverse the above procedure to install bulb housing with lens cover.



## HEADLIGHT ADJUSTMENT



The proper headlight adjustment is very important for traffic safety. The headlight adjustment should therefore only be done with a special appliance.

Adjust the headlight using the Phillips screwdriver from the vehicle tools.



The illustration show the adjustment on the right headlights. On the left headlights the adjustment are symmetrically opposite.

A – lateral adjustment  
B – hight adjustment

To reduce the beam range, turn the screwdriver clockwise.

## EMERGENCY STARTING

### Starting with jumper cables

#### WARNING

- Always shield your eyes and avoid leaning over the battery whenever possible.
- Do not allow battery acid to contact eyes or skin. Flush any contacted area with water immediately.
- Improper use of booster battery to start a vehicle may cause an explosion.
- Vehicles batteries generate explosive gases. Keep sparks, flame and lighted cigarettes away from batteries.
- Do not charge a frozen battery; allow it to thaw out first. Gas trapped in the ice may cause an explosion.
- Do not try to jump start any vehicle with a low electrolyte level in the battery.
- The voltage of the booster battery must also have a 12-volt rating. The capacity (Ah) of the booster battery should not be lower than that of the discharged battery. Use of batteries of different voltage or substantially different Ah rating may cause an explosion and personal injury.

■ Applying a higher voltage booster battery will cause expensive damage to sensitive electronic components, such as relays, radio, etc...

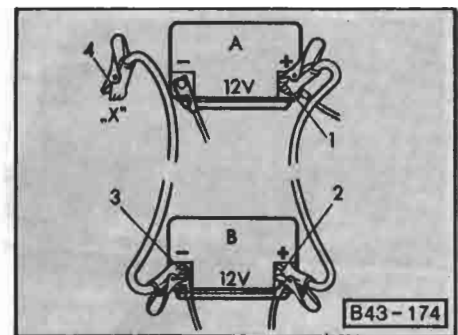
■ Vehicle with discharged battery: turn off lights and accessories, move lever to **N** or **P** (Automatic transmission) or into Neutral (Manual transmission) and set parking brake.

### Use of jumper cables

#### WARNING

- To avoid serious personal injury and damage to the vehicle, heed all warnings and instructions of the jumper cable manufacturer. If in doubt, call for road service.
- The jumper cables must be long enough so that the vehicles do not touch.
- When connecting jumper cables, make sure that they cannot get caught in any moving parts in the engine compartment.

Improper hook-up of jumper cables can ruin the alternator.



A – Discharged battery  
B – Booster battery  
X – To bolt securing ground strap to body

### Always connect

**POSITIVE (+) to POSITIVE (+), and NEGATIVE (-) to bolt securing ground strap to body.**

1. Connect clamp of plus-cable to positive (+) terminal (1) of discharged battery.
2. Connect clamp on opposite end of cable to positive (+) terminal (2) of booster battery.
3. Connect clamp of minus-cable to negative (-) terminal (3) of booster battery.
4. Connect clamp on opposite end of cable to a bare metal part bolted directly to bolt securing ground strap to body (4) of vehicle with discharged battery. Connect clamp as far away from battery as possible.
5. Start the engine of the vehicle with the booster battery. Run the engine at a moderate speed.
6. Start engine with discharged battery in the usual manner. If engine fails to start, do not continue to crank but contact nearest workshop.
7. With engine running, remove jumper cables from both vehicles in exact reverse order: Steps 4 through 1.

### Starting by pushing or towing

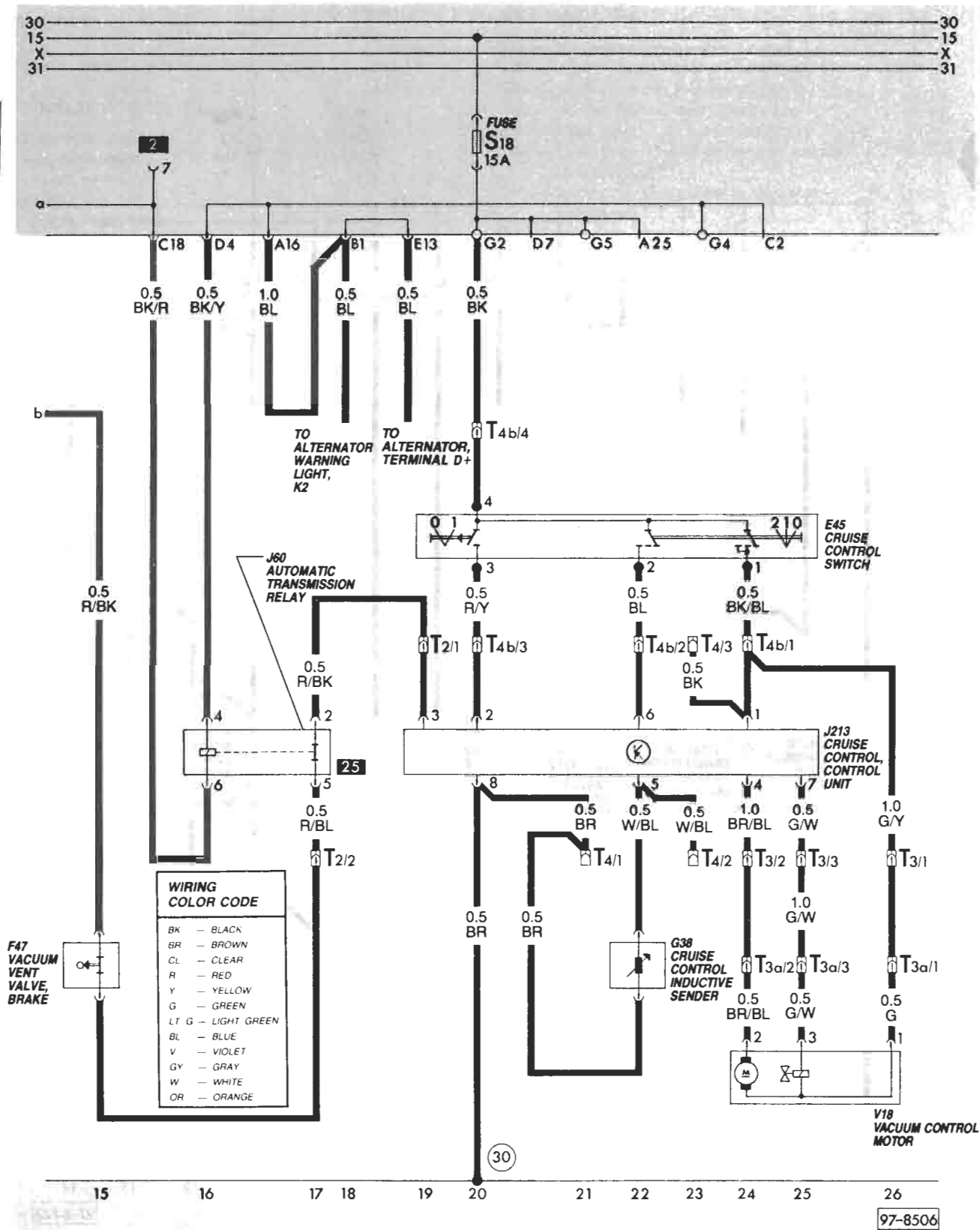
**Vehicles with Automatic Transmission cannot be started by pushing or towing.**

**Vehicles with Manual Transmission not be started by pushing or towing.**

**Damage to the catalytic converter and/or other parts of the vehicle may result.**

Always heed WARNINGS on page C

# 97 Electrical System—Wiring, Waterboxer



**97.231**

Cruise control

Water-cooled—Digifant from 1990

Auto. trans.

## Description

**Brake light switch, F**  
**Brake light, left, M9**  
**Brake light, right, M10**  
  
**Cruise control inductive sender, G38**  
**Cruise control switch, E45**  
**Cruise control, control unit, J213**  
  
**Fuse, S2**  
**Fuse, S18**  
  
**Vacuum control motor, V18**  
**Vacuum vent valve, brake, F47**  
**Vacuum vent valve, clutch, F36**

## Current track

**2-3**  
**1**  
**3**  
  
**7**  
**5-9**  
**5-9**  
  
**2**  
**6**  
  
**8-10**  
**4**  
**4**

## Wire connectors

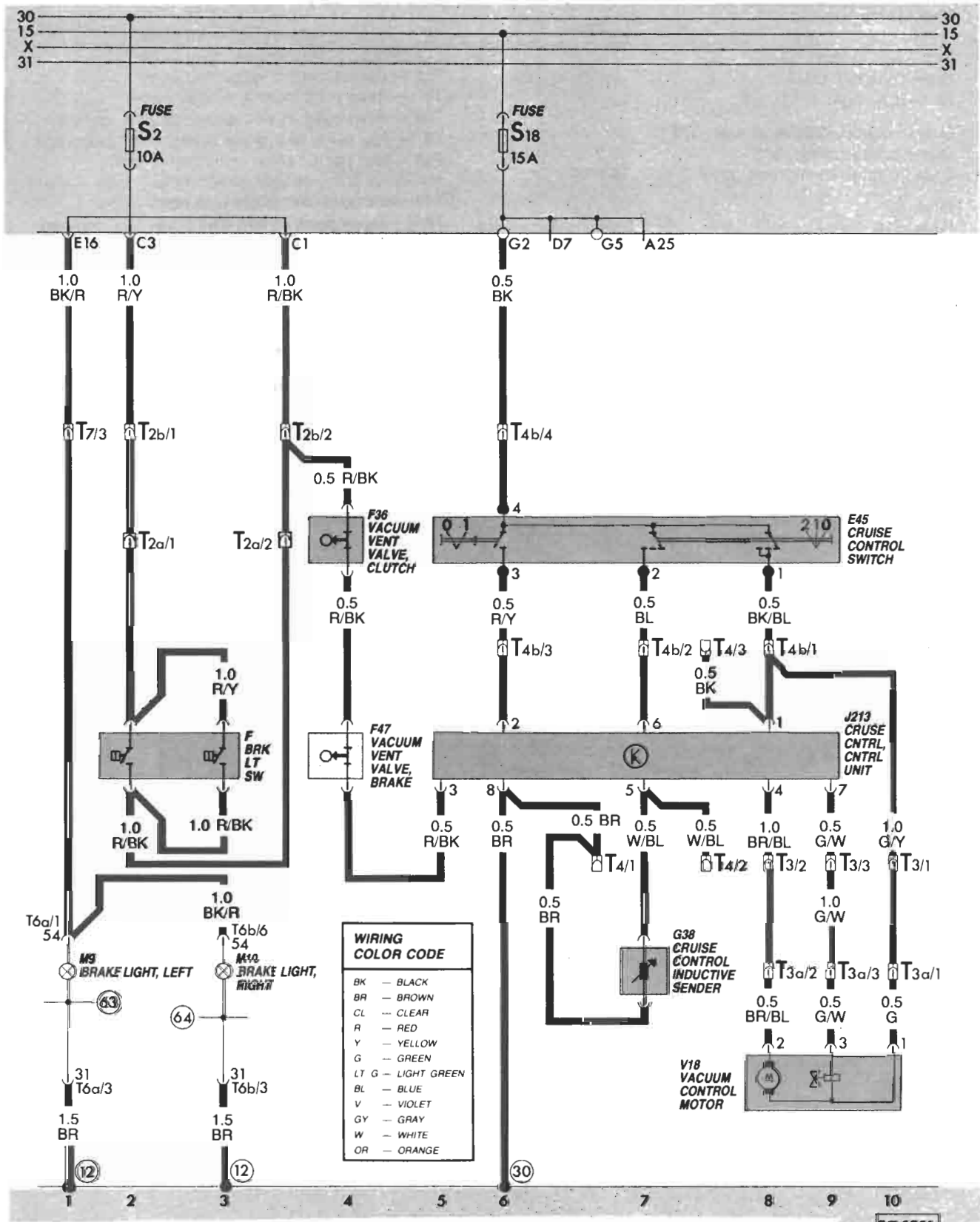
**T2** — double, behind instrument panel  
**T2a** — double, behind instrument panel  
**T2b** — double, behind instrument panel  
**T3** — three point, near fuse/relay panel  
**T3a** — three point, in wire distributor, eng. compart.  
**T4** — four point, near cruise control main control unit  
**T4b** — four point, behind instrument panel  
**T6a** — six point, on taillight bulb holder, left  
**T6b** — six point, on taillight bulb holder, right  
**T7** — seven point, in wire distributor, eng. compart.

## Ground connections

**12** — in engine compart., left side  
**30** — near fuse/relay panel  
**63** — on taillight bulb holder, left  
**64** — on taillight bulb holder, right



# 97 Electrical System—Wiring, Waterboxer



97-3951

**97.233** Cruise control

Water-cooled-Digifant from 1990

Manual trans.

Description	Current track
Daytime driving light relay, J89	15-17
Daytime driving lights resistor, N53	16
Fuse, S20	9
Fuse, S7	17
Fuse, S8	19
Fuse, S9	35
Fuse, S22	36
Fuse, S10	37
Fuse, S21	40
Fuse, S50	11
Headlight dimmer/flasher switch, E4	22-23
Headlight, left, L1	39, 40
Headlight, right, L2	35, 36
High-beam headlight, left, L13	37
High-beam headlight, right, L14	33
Instrument panel light dimmer switch, E20	10
License plate light, X	13-14
Light switch, E1	4-10
Load reduction relay, J59	3-5
Parking light, left, M1	25
Parking light, right, M3	32
Tail light, left, M4	42
Tail light, right, M2	41
Turn signal light, left front, M5	26
Turn signal light, left rear, M6	27
Turn signal light, right front, M7	31
Turn signal light, right rear, M8	30

### Wire connectors

- T1 — single, behind instrument panel, left
- T2 — double, in wire distributor, engine compartment
- T2a — double, behind instrument panel, left
- T2b — double, behind instrument panel, left
- T7 — seven-point, in wire distributor, engine compartment
- T8 — eight-point, on radio
- T14 — fourteen-point, on instrument cluster

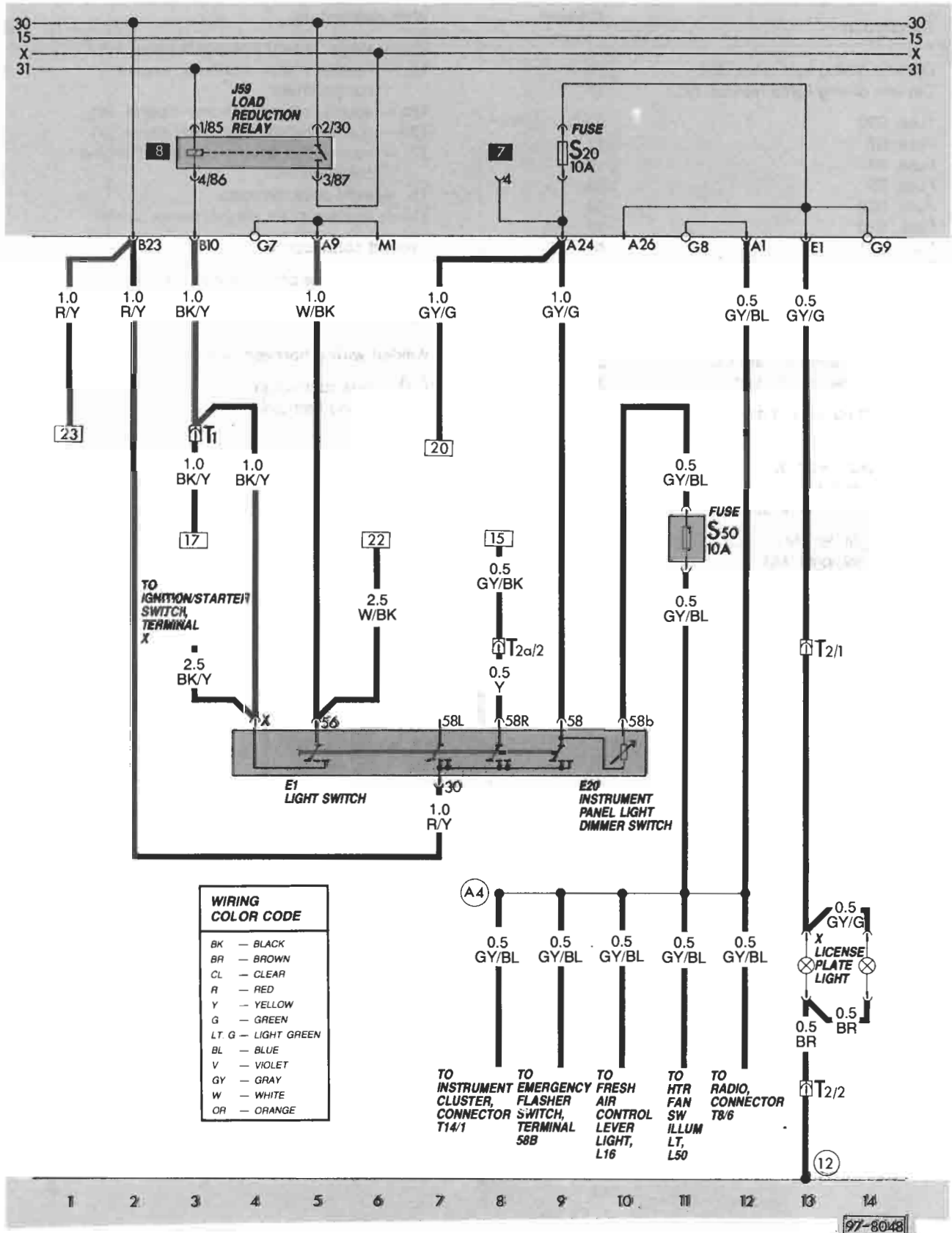
### Ground connections

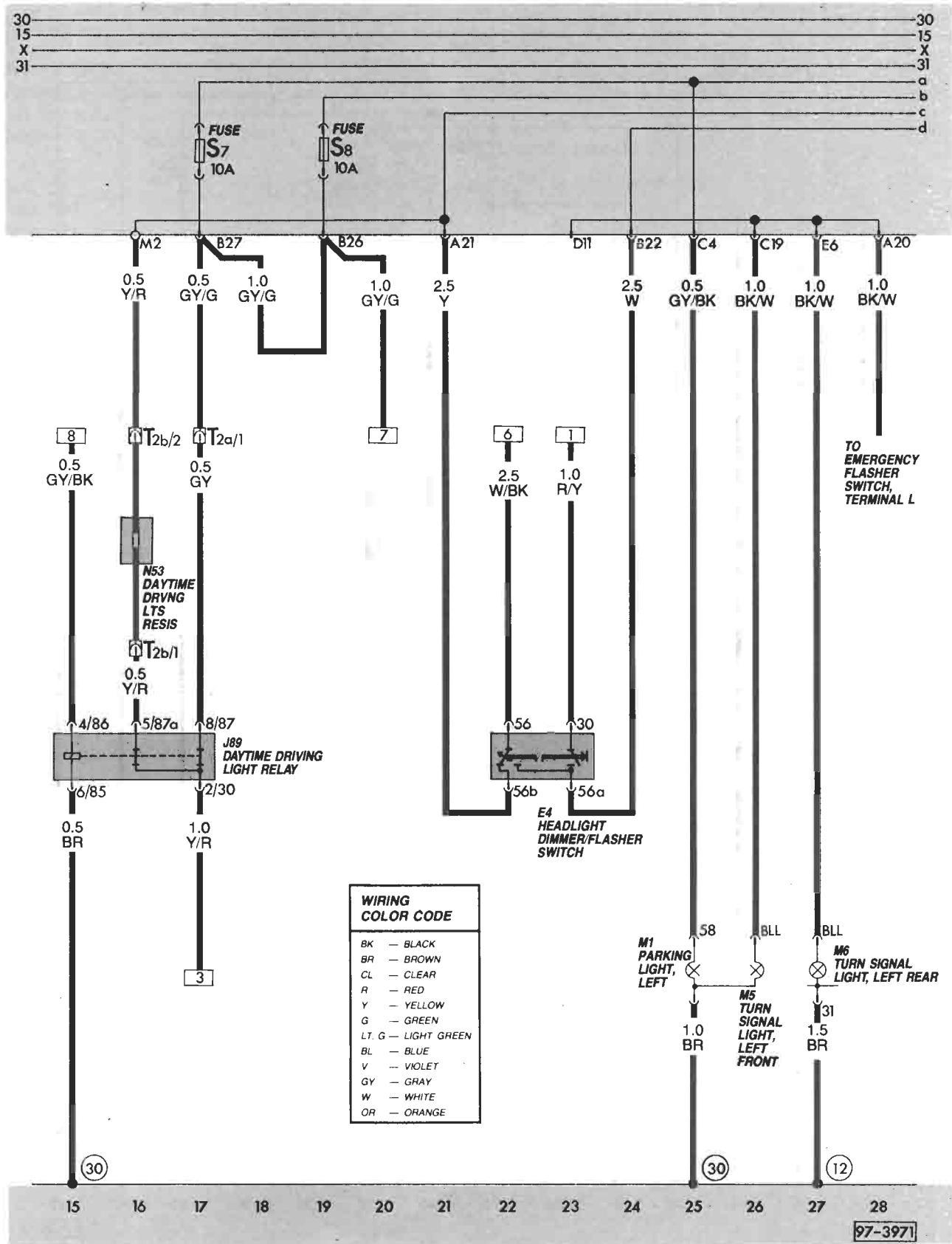
- ⑫ — in engine compartment, left side
- ③⑩ — near fuse/relay panel

### Welded wiring harness points

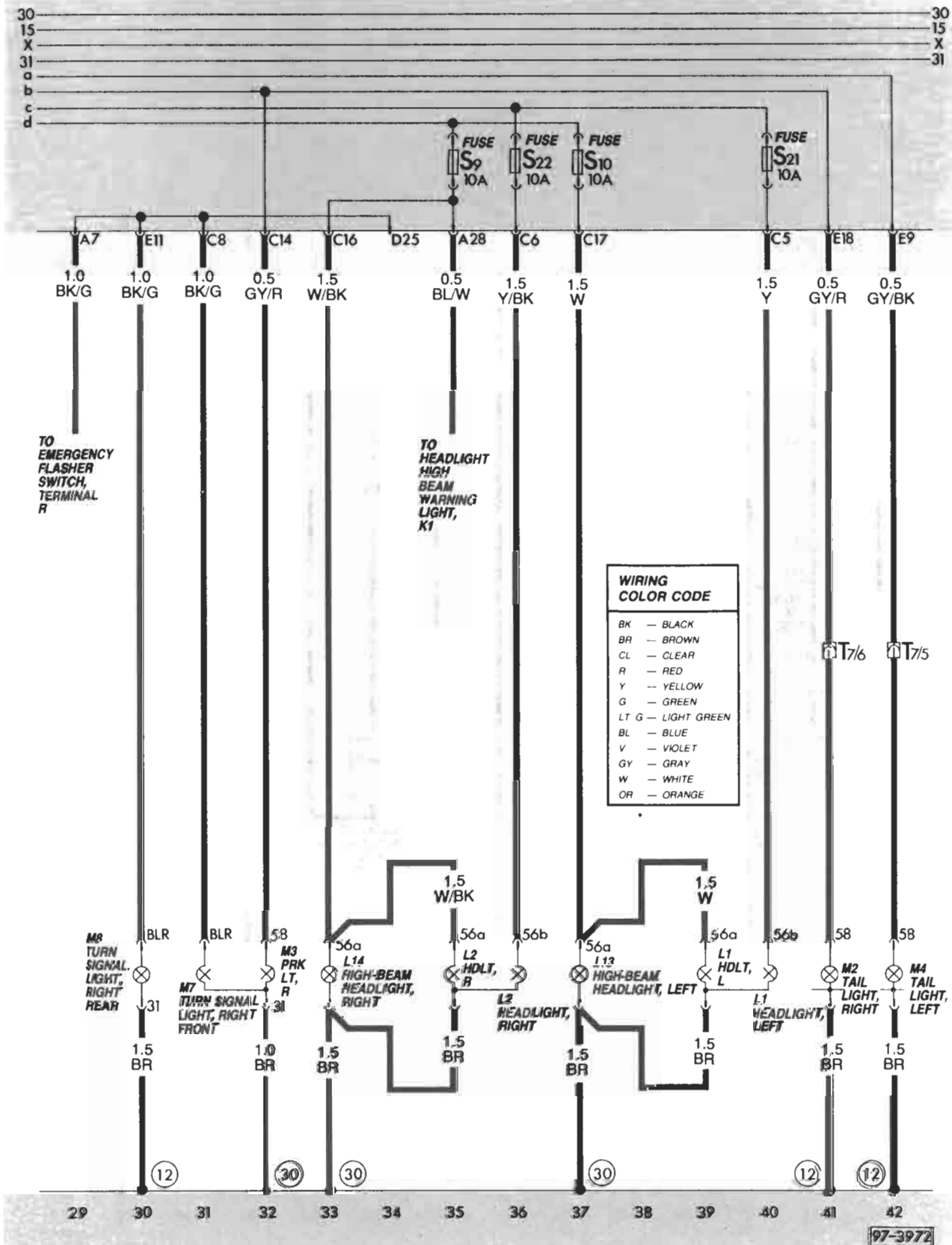
- Ⓐ④ — plus connection (58b), in instrument cluster wiring harness

# 97 Electrical System—Wiring, Waterboxer



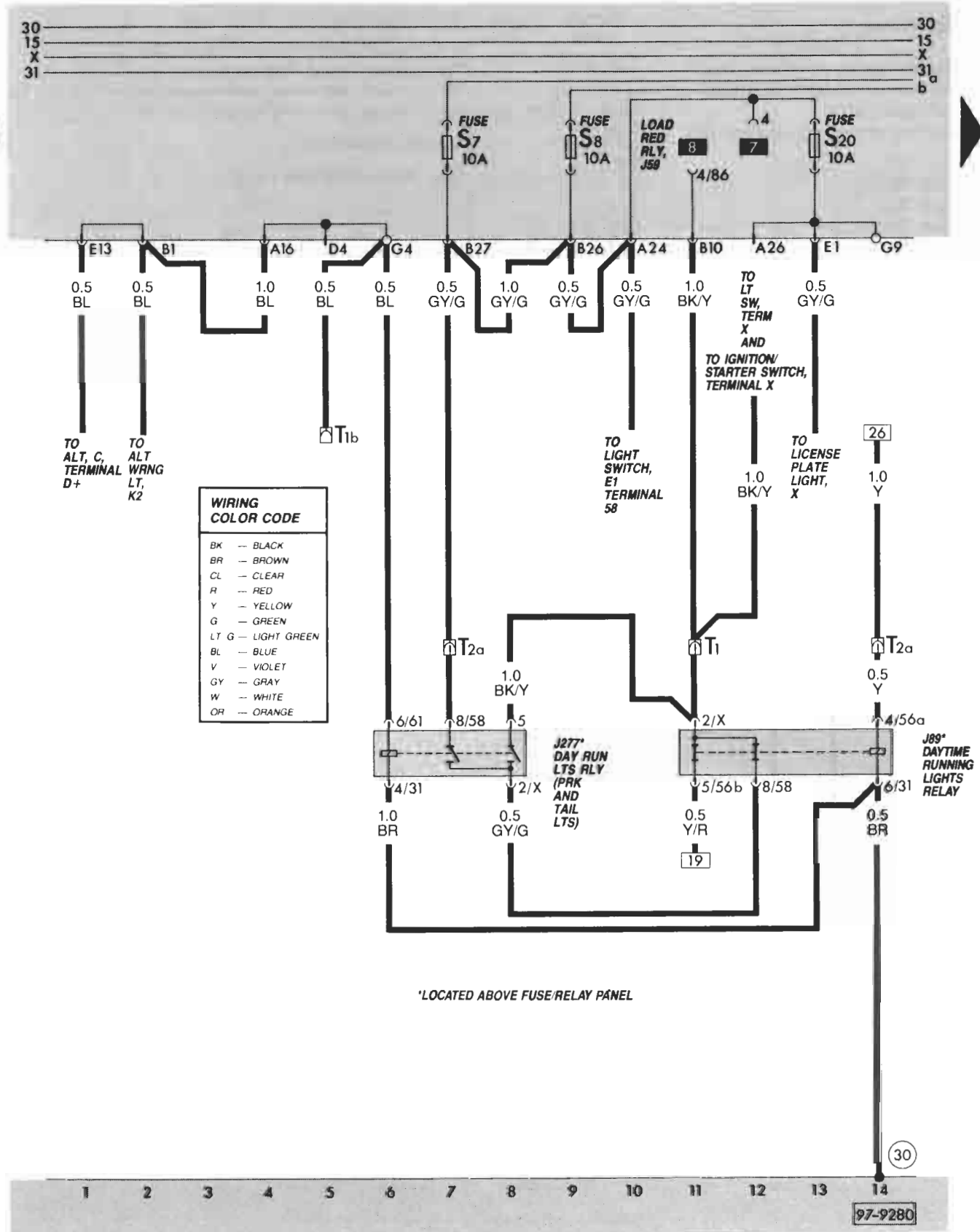


# 97 Electrical System—Wiring, Waterboxer



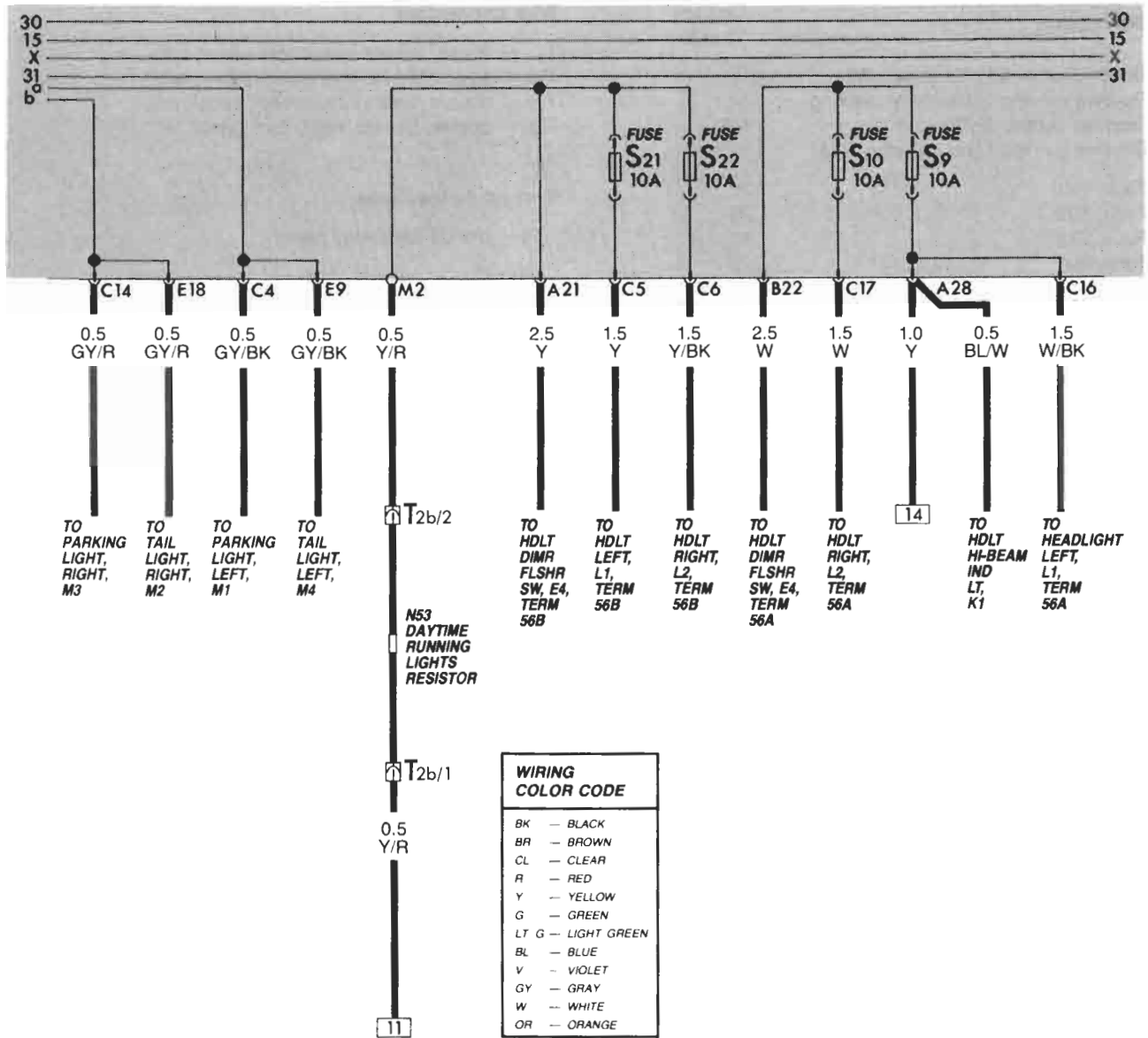
Description	Current track	Wire connectors
Daytime running lights relay, J89	11-14	T1 — single, behind instrument panel, left
Daytime running lights relay (parking and tail lights), J277	6-8	T1b — single, behind instrument panel, left
Daytime running lights resistor, N53	19	T2 — double, behind instrument panel, left
Fuse, S7	7	T2a — double, behind instrument panel, left
Fuse, S8	9	<b>Ground connections</b>
Fuse, S20	13	③0 — beside fuse/relay panel
Fuse, S21	22	
Fuse, S22	23	
Fuse, S10	25	
Fuse, S9	26	

# 97 Electrical System—Wiring, Waterboxer



**WIRING COLOR CODE**

BK	--	BLACK
BR	--	BROWN
CL	--	CLEAR
R	--	RED
Y	--	YELLOW
G	--	GREEN
LT G	--	LIGHT GREEN
BL	--	BLUE
V	--	VIOLET
GY	--	GRAY
W	--	WHITE
OR	--	ORANGE





# 97 Electrical System—Wiring, Waterboxer

## Description

Daytime running lights relay, J89  
Daytime running lights relay (parking  
and tail lights), J277  
Daytime running lights resistor, N53  
  
Fuse, S21  
Fuse, S22  
Fuse, S10  
Fuse, S9  
Fuse, S7  
Fuse, S8  
Fuse, S20  
  
Load reduction relay, J59

## Current track

14  
4-6  
19  
22  
23  
25  
26  
7  
9  
13  
6

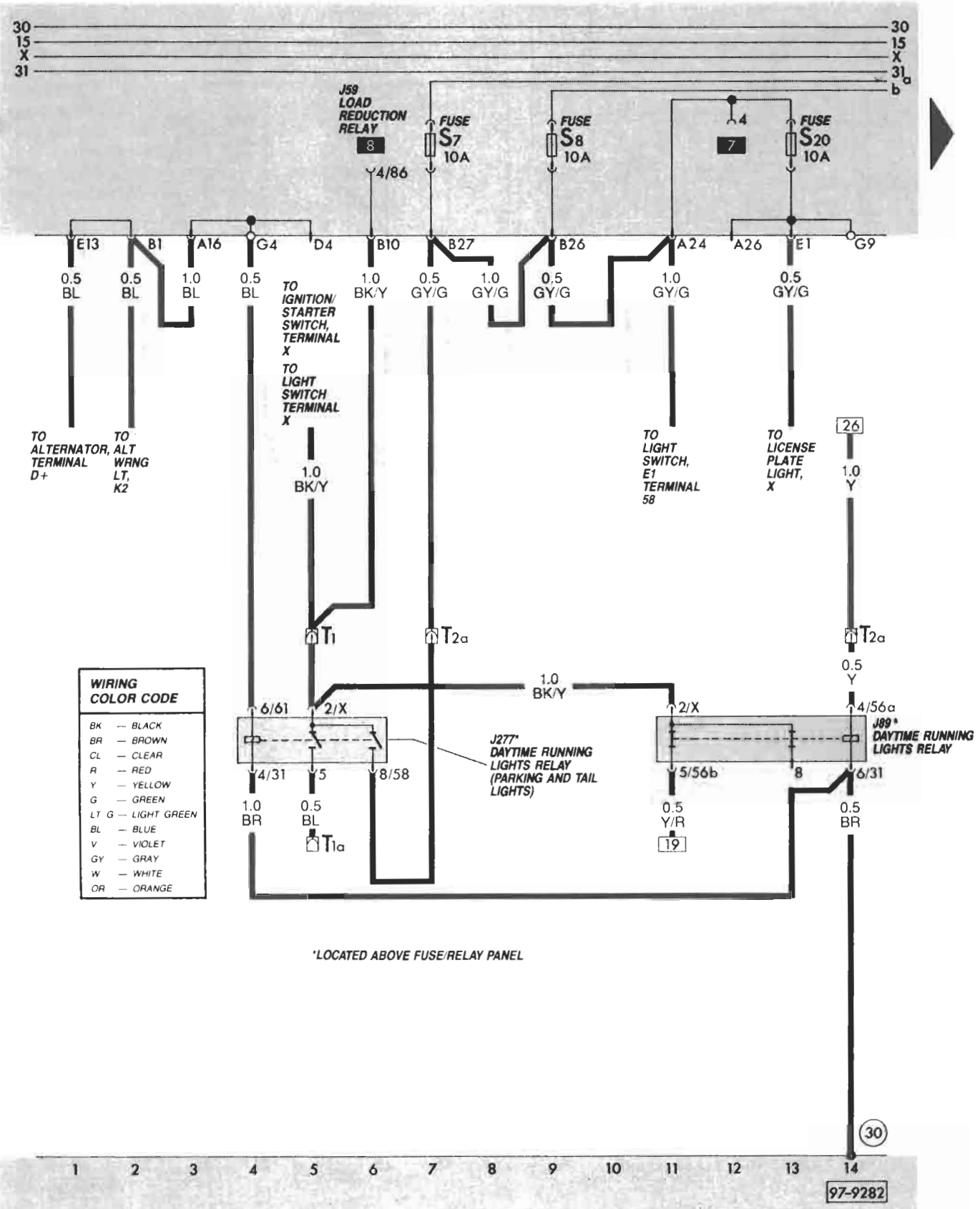
## Wire connectors

T1 — single, behind instrument panel, left  
T1a — single, behind instrument panel, left  
T2a — double, behind instrument panel, left  
T2b — double, behind instrument panel, left

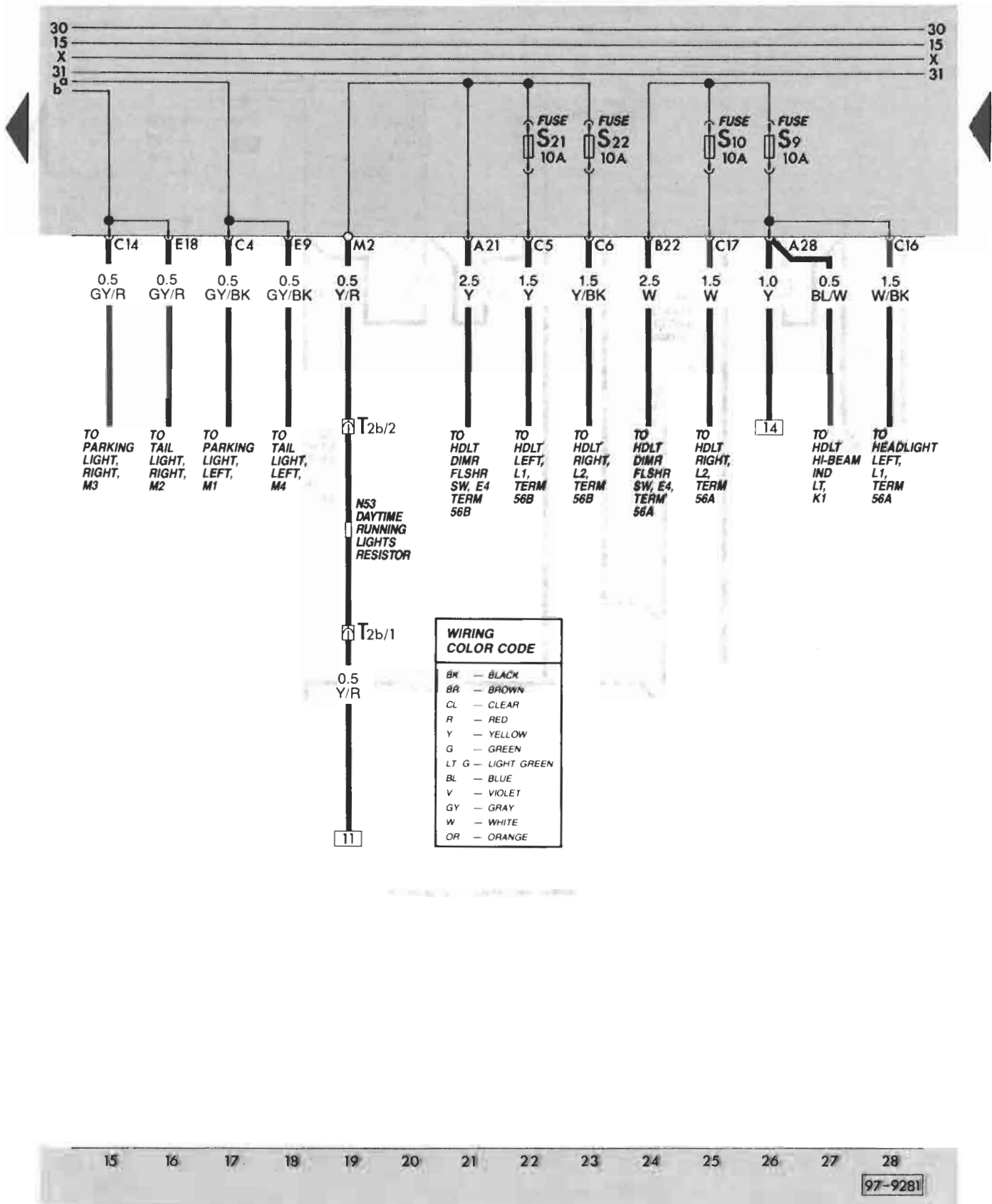
## Ground connections

③0 — beside fuse/relay panel

# Electrical System—Wiring, Waterboxer 97



# 97 Electrical System—Wiring, Waterboxer



## Description

Driver's seat heater control unit, J131  
 Driver's seat temperature sensor, G59  
 Fuse, S18  
 Fuse, S50  
 Heat element, driver's backrest, Z7  
 Heat element, driver's seat, Z6  
 Heat regulating switch, driver's seat, E94  
 Seat heater switch indicator light, L44

## Current track

3-6  
 3  
 6  
 1  
 5  
 4  
 2-4  
 2-4

## Wire connectors

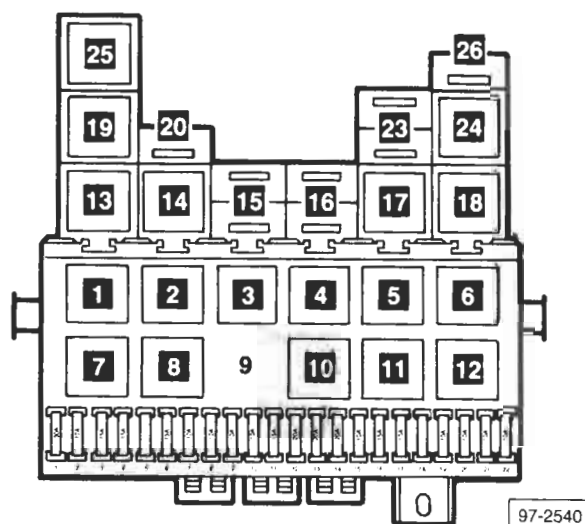
T1 — single, behind fuse/relay panel  
 T1a — single, behind fuse/relay panel  
 T1b — single, behind instrument panel, left  
 T2 — double, behind instrument panel, left  
 T6 — six-point, under driver's seat

## Ground connections

③0 — near fuse/relay panel

## Welded wiring harness points

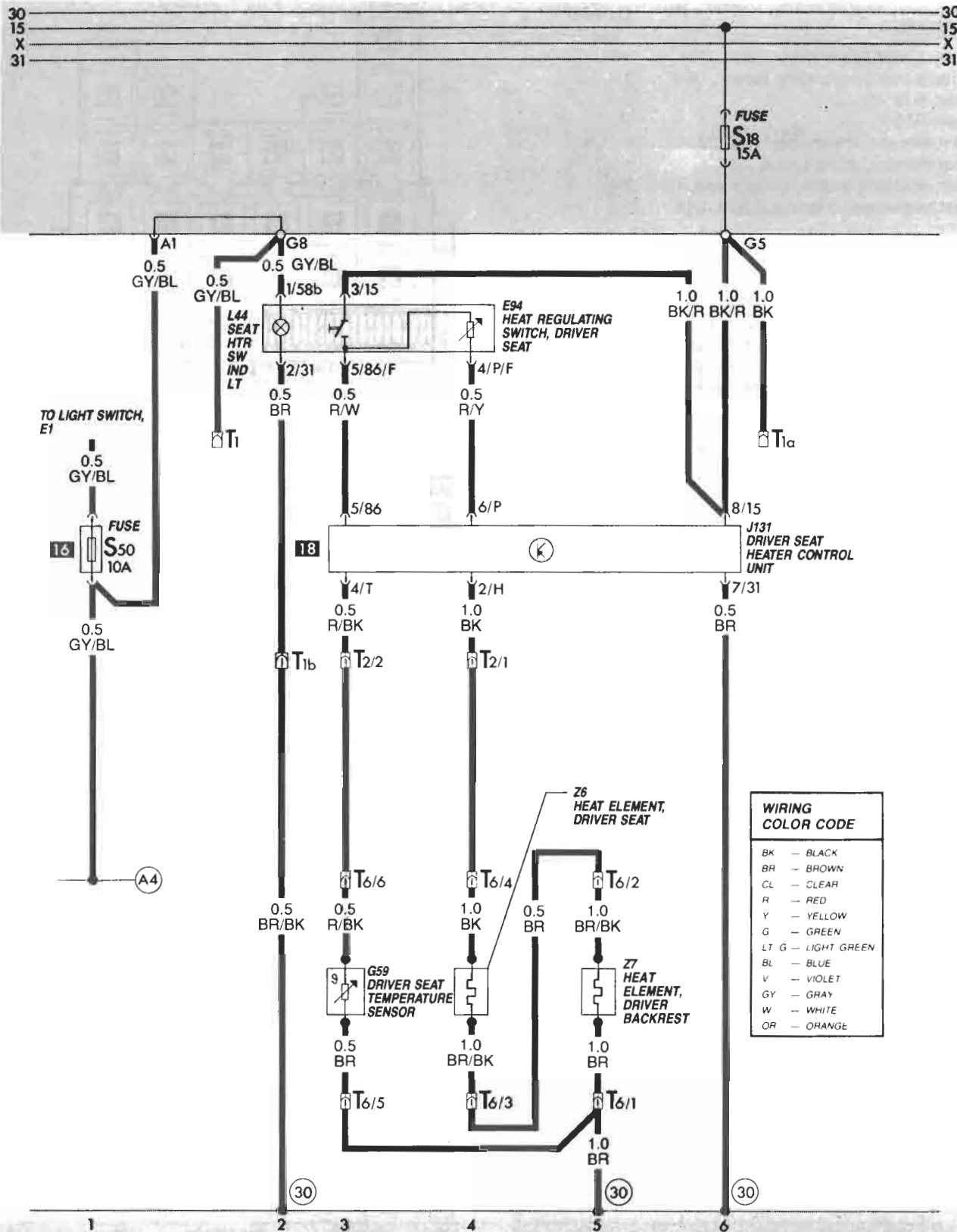
Ⓐ4 — plus (+) connection, terminal 58b in instrument panel wiring harness



## Fuse/relay panel

16 — Fuse S50, terminal 58b 10A  
 17 — Driver's seat heater control unit

# 97 Electrical System—Wiring, Waterboxer

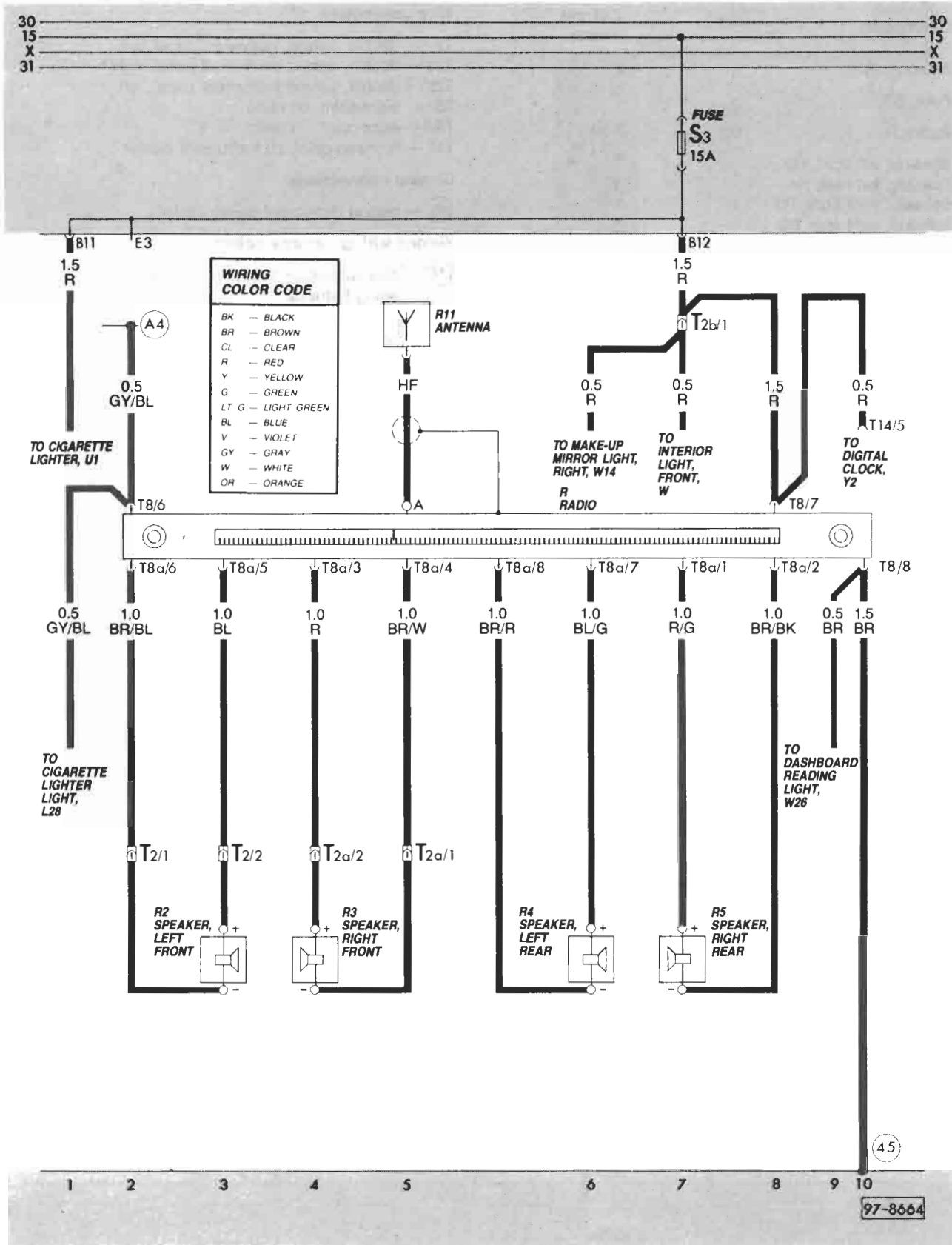


WIRING COLOR CODE	
BK	— BLACK
BR	— BROWN
CL	— CLEAR
R	— RED
Y	— YELLOW
G	— GREEN
LT G	— LIGHT GREEN
BL	— BLUE
V	— VIOLET
GY	— GRAY
W	— WHITE
OR	— ORANGE

97-8429

Description	Current track	Wire connectors
Antenna, R11	5	T2 — double, behind instrument panel, left
Fuse, S3	7	T2a — double, behind instrument panel, right
Radio, R	2-10	T2b — double, behind instrument panel, left
Speaker, left front, R2	3	T8 — eight-point, on radio
Speaker, left rear, R4	6	T8a — eight-point, on radio
Speaker, right front, R3	4	T14 — fourteen-point, on instrument cluster
Speaker, right rear, R5	7	<b>Ground connections</b>
		④5 — behind instrument panel, center
		<b>Welded wiring harness points</b>
		④A4 — plus connection (58b), in instrument panel wiring harness

# 97 Electrical System—Wiring, Waterboxer



# 97 Electrical System - Wiring, Waterboxer

Description	Current Track
Antenna	3
Balance control	9-12
Cigar lighter	1
Cigar lighter lite	5-6
Radio	4-8
Speaker, LF	12
Speaker, LR	11
Speaker, RF	9
Speaker, RR	10

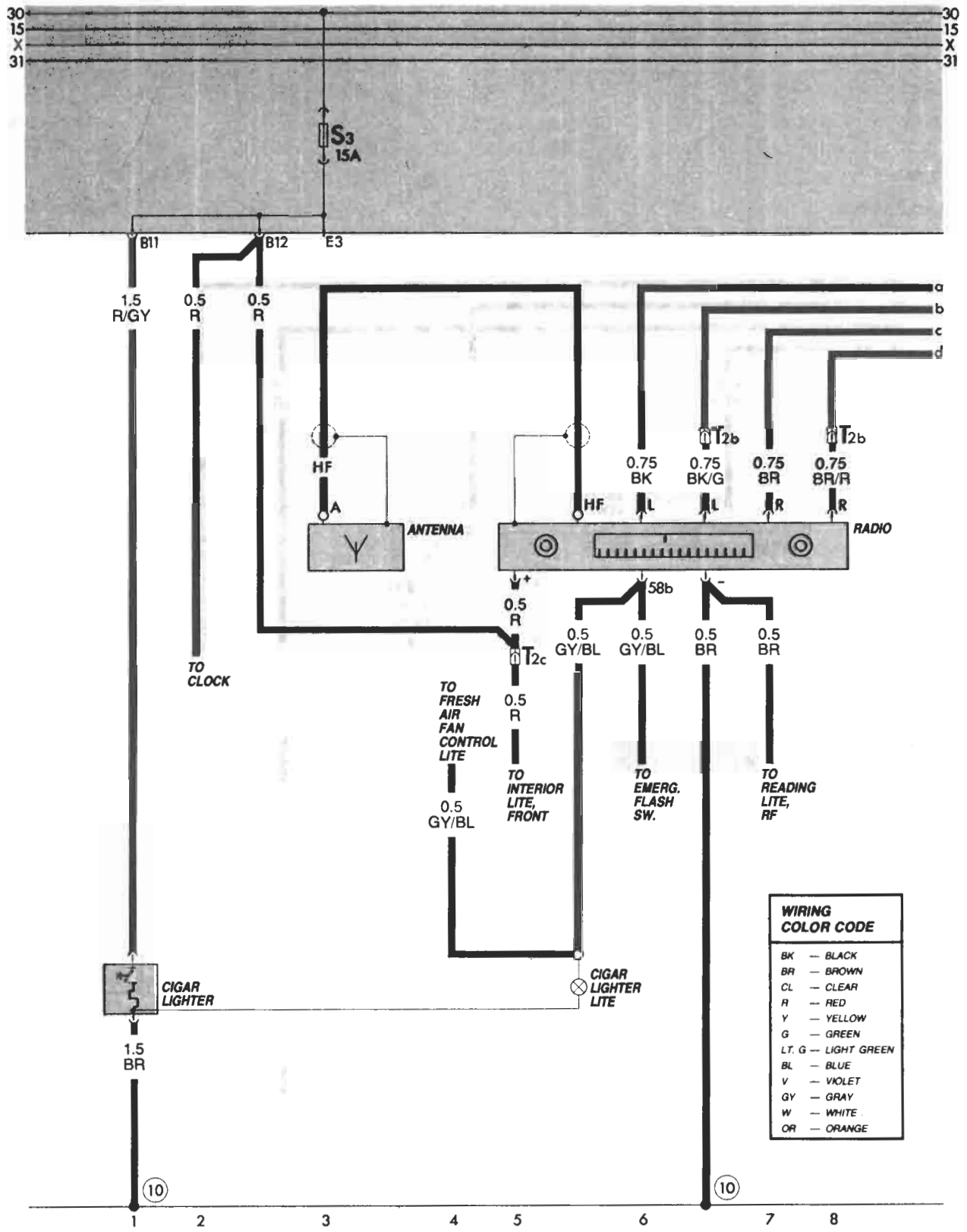
### Wire connectors

- T2 — double, behind instrument panel
- T2a — double, behind instrument panel
- T2b — double, behind instrument panel
- T2c — double, behind instrument panel
- T3 — three-point, behind instrument panel

### Ground connections

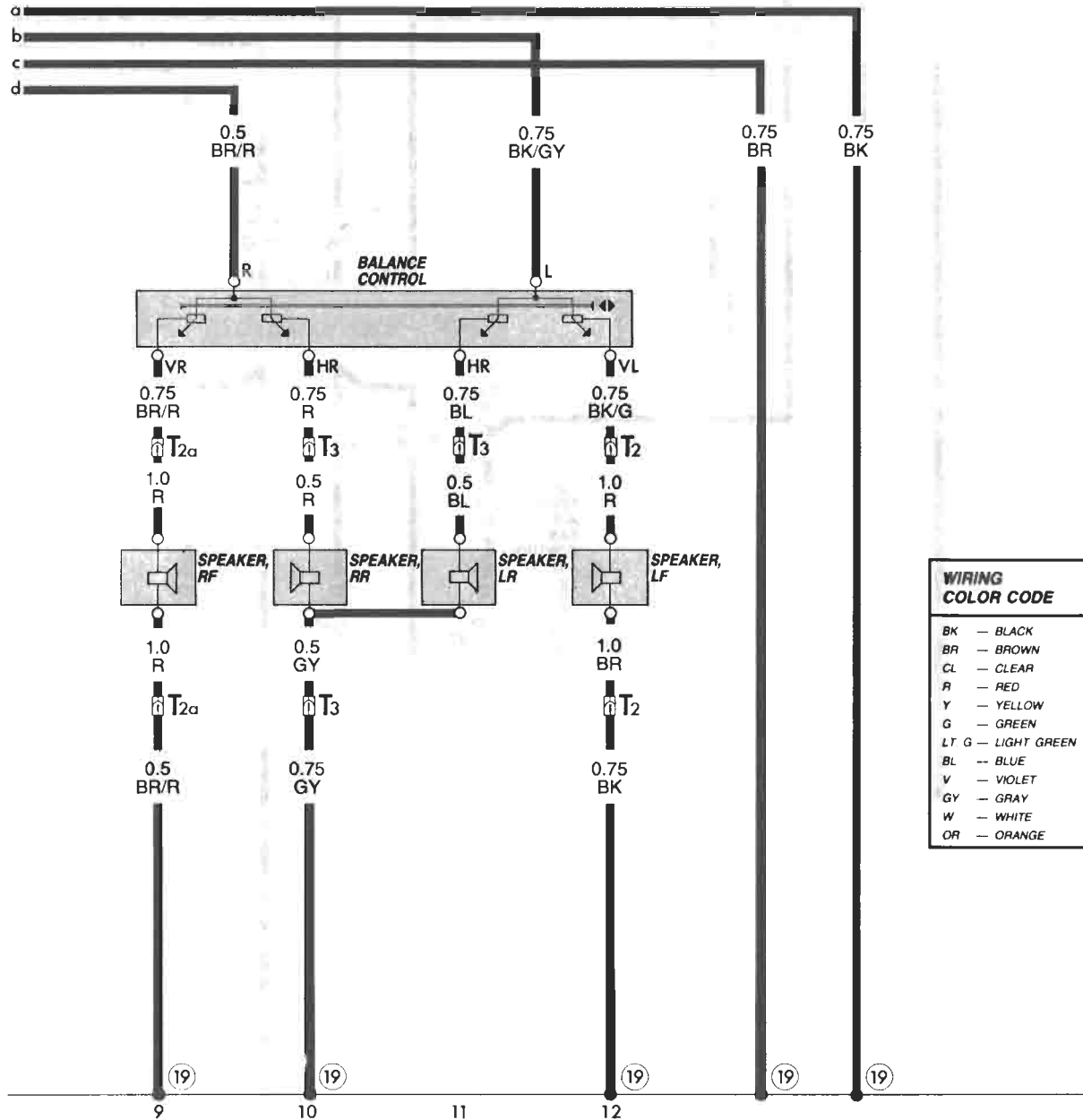
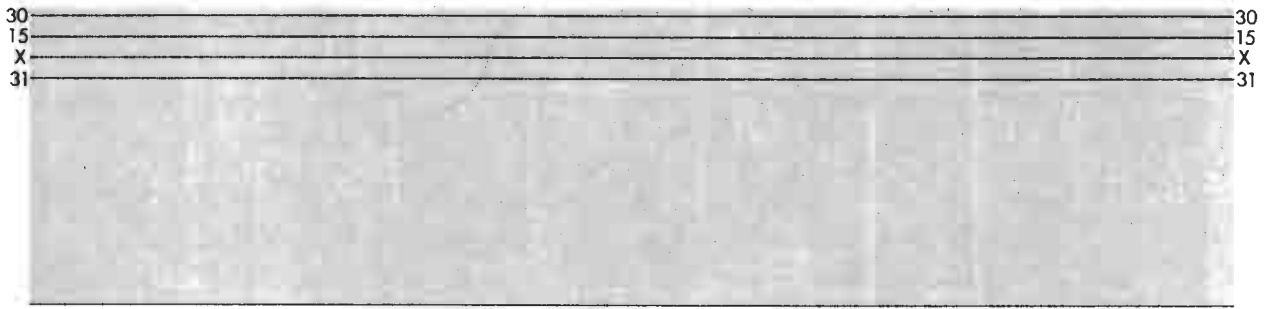
- ①9 — in balance control wiring harness





97-2293

# 97 Electrical System - Wiring, Waterboxer



97-2294

## Rear footwell heater blower

Description	Current track
Fuse S10	1
Series resistance	2
Warm air blower	1
Warm air blower switch	1-2

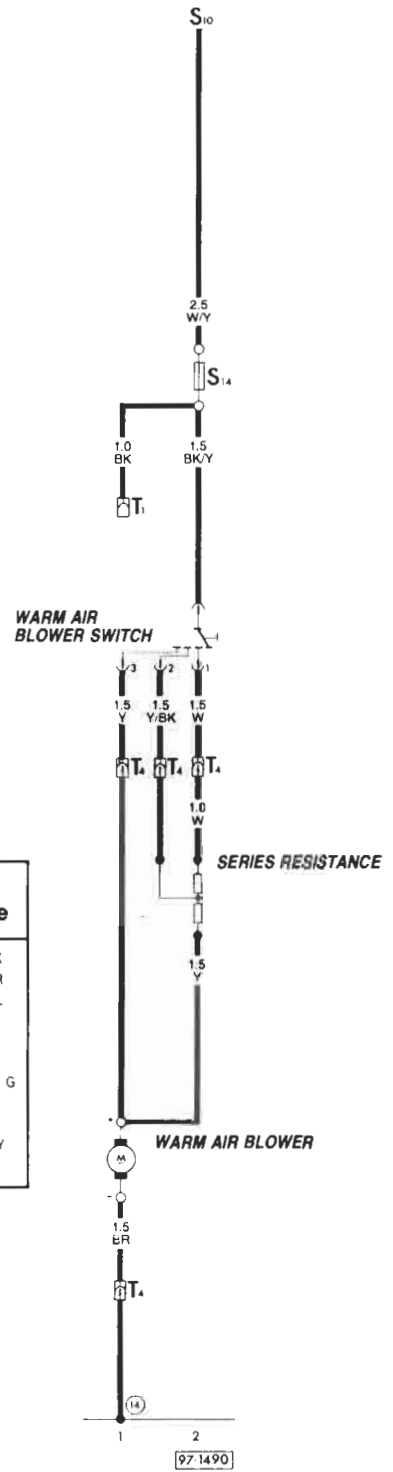
### Wire connectors

T4 — 4-point, under rear bench seat

### Ground connectors

⑭ — under rear bench seat

Wiring Color Code	
Black	— BK
Brown	— BR
Clear	— CL
Red	— R
Yellow	— Y
Green	— G
Light Green	— Lt G
Blue	— BL
Violet	— V
Gray	— GY
White	— W



# 97 Electrical System - Wiring, Waterboxer

Description	Current track	Wire connectors
Antenna	3	T2a — double, under instrument panel, left
Map/reading lite, right front	8	T2b — double, under instrument panel, right
Radio	1-8	T2c — double, under instrument panel, left
Speaker, left front	2	T4 — four point, under instrument panel
Speaker, left rear	6	T8 — eight point, back of radio, middle
Speaker, right front	3	T8a — eight point, back of radio, bottom
Speaker, right rear	7	T14 — fourteen point, under instrument panel

**Ground connections**

Ⓢ1 — in instrument panel wiring harness

**Welded wire connections**

Ⓢ4 — plus (+) connection 586 in inst. panel wire harness



# 97 Electrical System - Wiring, Waterboxer

## Description

Amplified speaker, left center  
Amplified speaker, left front  
Antenna  
Map/reading light, right front  
Radio  
Speaker, left front  
Speaker, left rear  
Speaker, right front  
Speaker, right rear

## Current track

8-9  
8-10  
9  
11  
2-10  
3  
6  
4  
7

## Wire connectors

T2 — double, under instrument panel, left side  
T2a — double, under instrument panel, right side  
T2c — double, under instrument panel, left side  
T3 — three-point, under instrument panel, left side  
T8 — eight-point, on radio  
T8a — eight-point, on radio  
T10 — ten-point, on radio

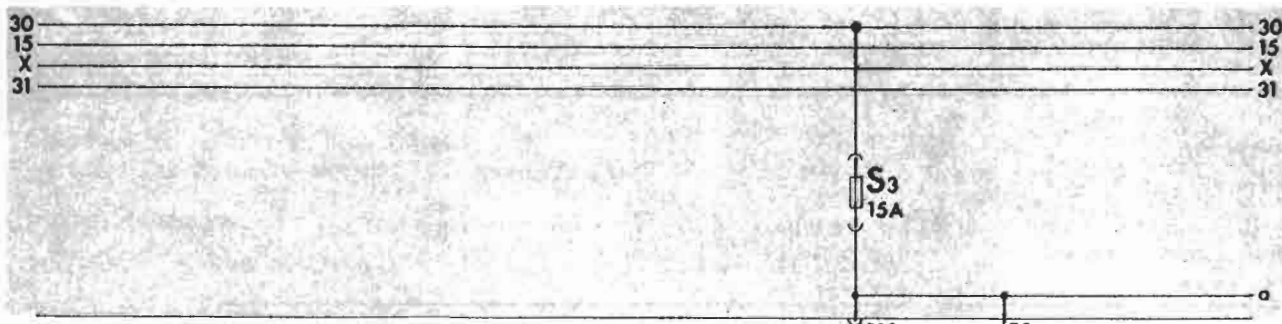
## Welded wire connections

(A4) — plus (+) connection, terminal 58b in instrument panel wiring harness

## Ground connections

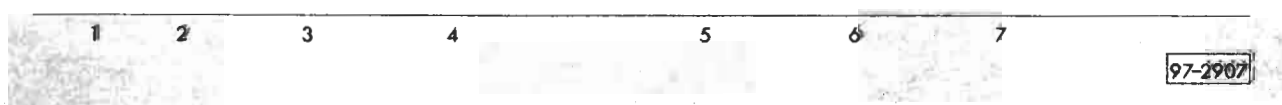
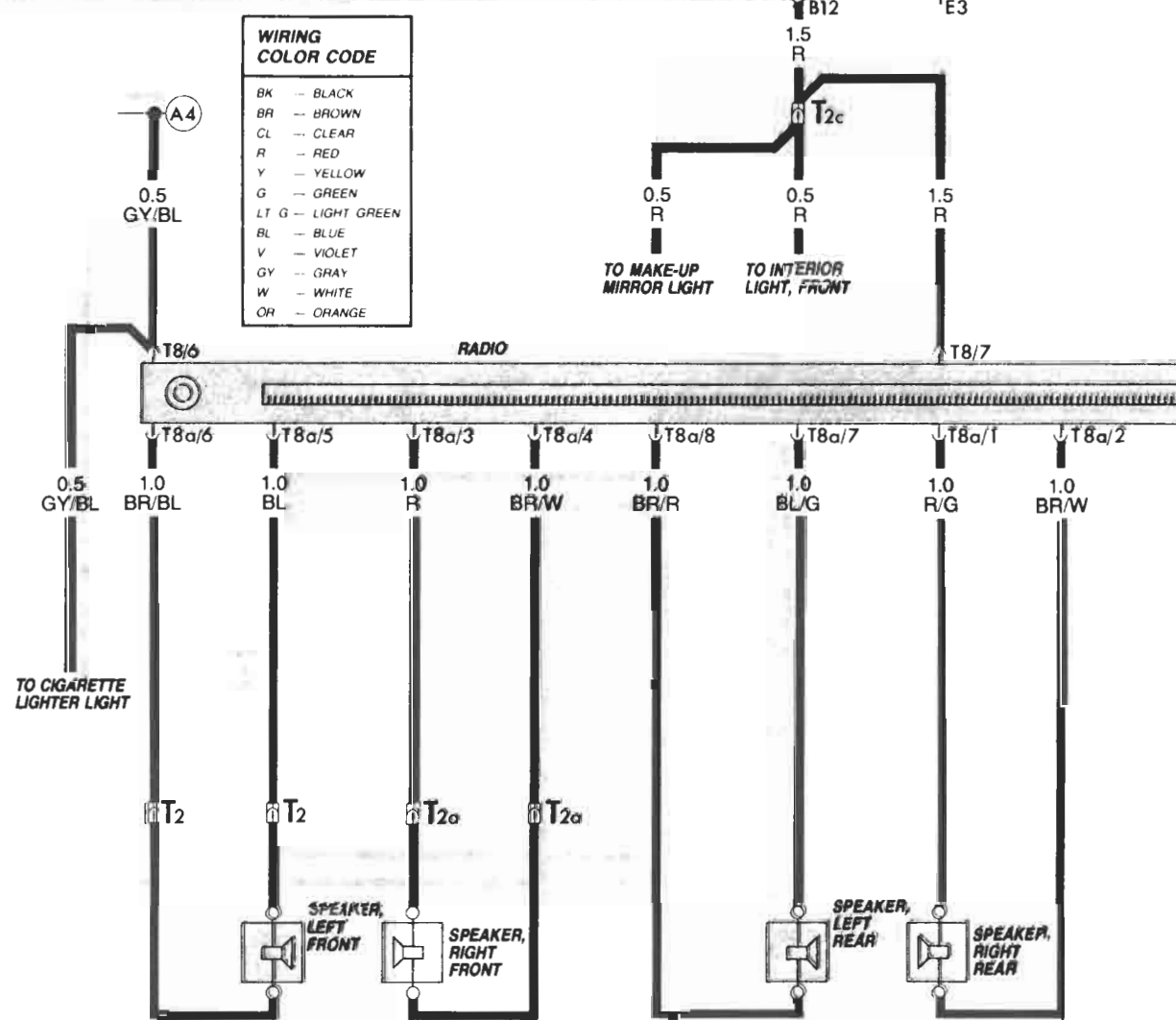
(45) — under instrument panel, middle

# Electrical System - Wiring, Waterboxer 97



**WIRING COLOR CODE**

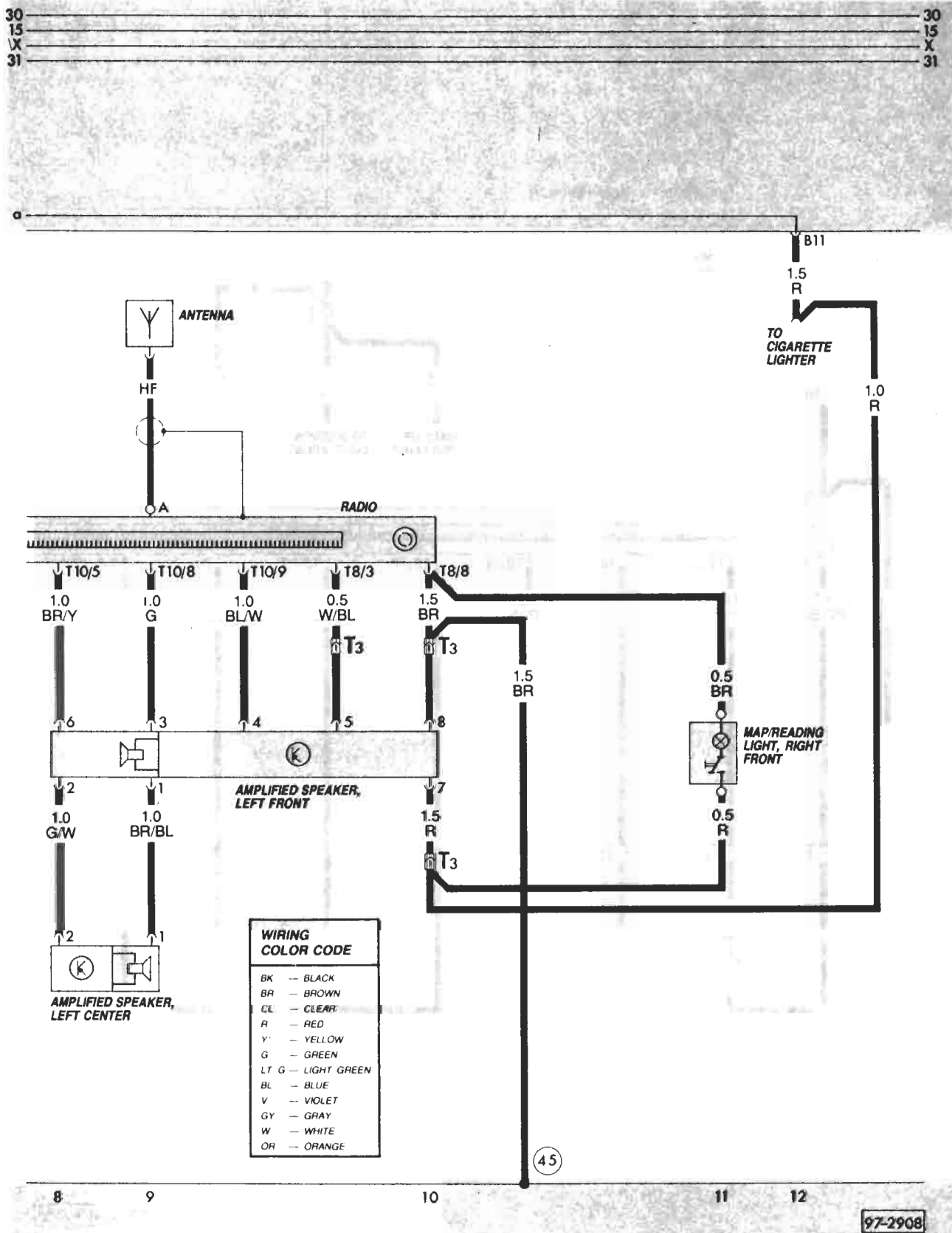
BK	--	BLACK
BR	--	BROWN
CL	--	CLEAR
R	--	RED
Y	--	YELLOW
G	--	GREEN
LT G	--	LIGHT GREEN
BL	--	BLUE
V	--	VIOLET
GY	--	GRAY
W	--	WHITE
OR	--	ORANGE



Water-cooled-Digifant from 1988

Stereo radio with amplified speakers **97.198**

# 97 Electrical System - Wiring, Waterboxer



97-2908



## Description

Description	Current track
Radiator cooling fan	1
Radiator cooling fan after run series resistance	1
Radiator cooling fan relay (2nd stage)	2-4
Radiator cooling fan thermostwitch	1,2

## Wire connectors

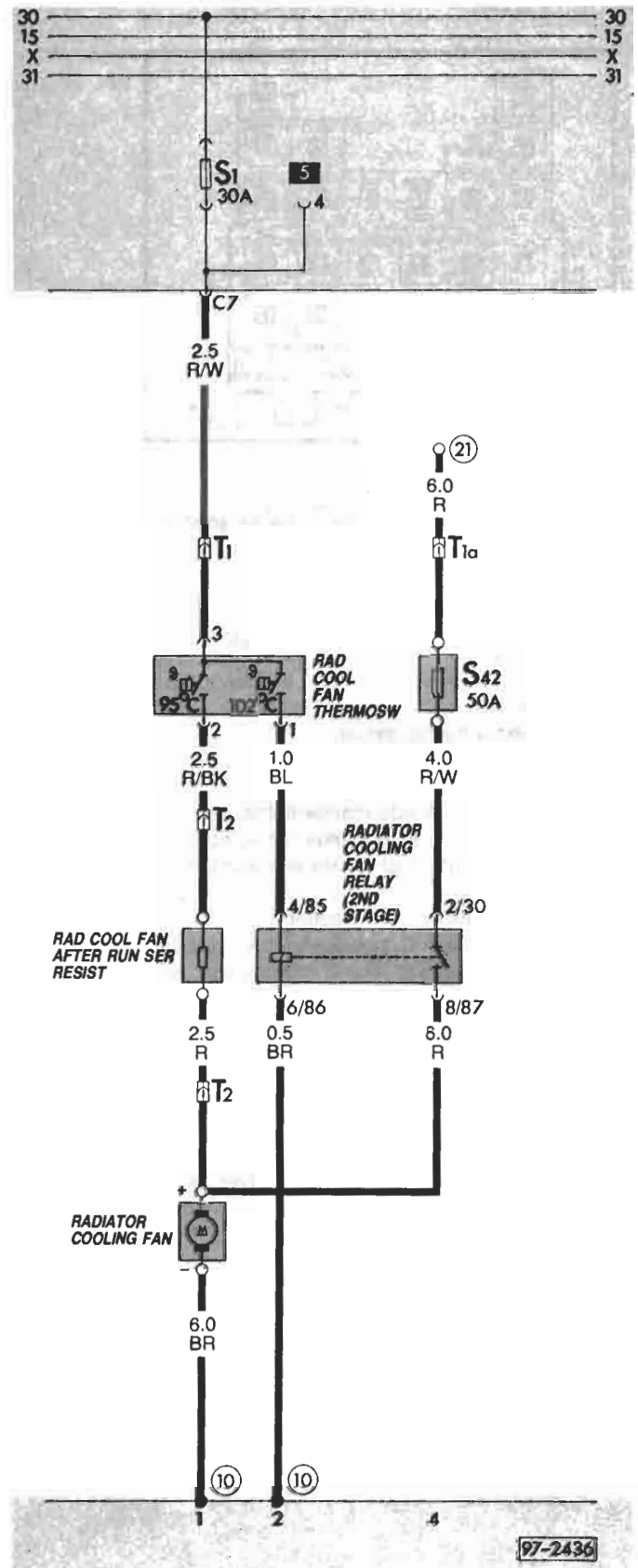
- T1 — single, under fuse/relay panel
- T1a — single, under instrument panel
- T2 — double, under instrument panel

## (+) connectors

- (21) — terminal 30, in wire distributor in eng. compart.

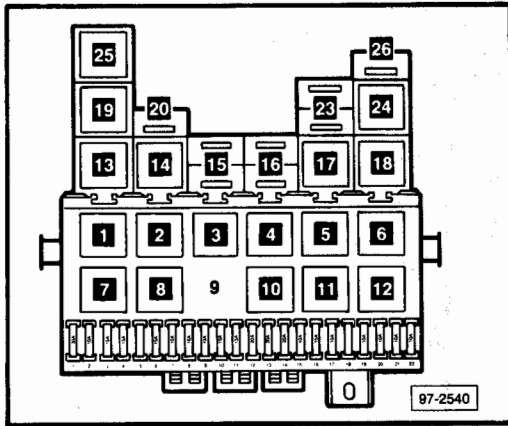
## Ground connectors

- (10) — near fuse/relay panel



97-2436

# 97 Electrical System—Wiring, Waterboxer



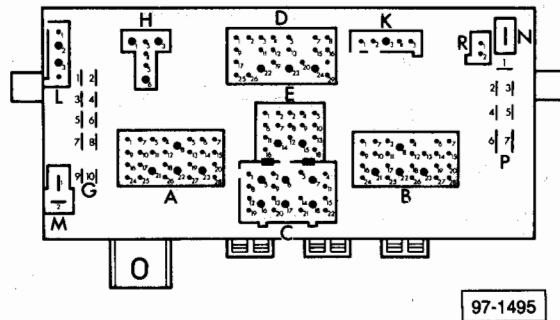
## Fuse arrangement

according to numbers on fuse panel as seen from left to right:

	Amp.
1 Radiator cooling fan .....	30
2 Brake lights .....	15
3 Cigarette lighter, radio, clock, interior lights, illuminated make-up mirror .....	15
4 Emergency flasher system .....	15
5 Open	
6 Open	
7 Tail, parking and side marker lights, left .....	10
8 Tail, parking and side marker lights, right .....	10
9 High beam right, high beam indicator light .....	10
10 High beam left .....	10
11 Windshield wipers and washer .....	15
12 Cruise control, A/C, power windows, auxiliary heater fresh air fan, power mirrors, rear window wiper .....	20
13 Fresh air fan .....	20
14 Rear window defogger .....	20
15 Back-up lights .....	10
16 Horn .....	15
17 Windshield wipers .....	10
18 Seat belt warning relay, brake and park brake indicator, cruise control, heated driver's seat ..	10
19 Turn signals .....	10
20 License plate lights .....	10
21 Low beam left .....	10
22 Low beam right .....	10

## Fuse/relay panel

- 3** — Low coolant level control unit (43)\*, J120
- 5** — Rad. cool. fan relay 2<sup>nd</sup> stage (53)\*, J101
- 8** — Load reduction relay (18)\*, J59
- 10** — Intermittent wash/wiper relay (19)\*, J31
- 11** — Rear window wash/wiper relay (72)\*, J30
- 12** — Emerg. flash/turn sig. relay (21)\*, J2
- 19** — Seat belt warning system control unit, J34



## Connections and plugs on fuse/relay panel

- A — multi-point connector (blue) for instrument panel wiring harness
- B — multi-point connector (red) for instrument panel wiring harness
- C — multi-point connector (yellow) for front wiring harness
- D — multi-point connector (white) for windshield wiper and main wiring harness
- E — multi-point connector (black) for main wiring harness
- G — single connector
- H — multi-point connector (brown) to connector for rad. cool. fan relay, 2<sup>nd</sup> stage
- K — multi-point connector (colorless) to radiator coolant low-level control unit
- L — multi-point connector (gray) for horns
- M — open
- N — single connector
- P — single connector (terminal 30)
- R — open

\*Numbers in parentheses indicate production control number stamped on relay housing.

Description	Current Track	Description	Current Track	Description	Current Track
Air flow sensor potentiometer, G19	24	Fuse, S9	110	Parking brake warning light switch, F9	136
Alternator, C	5	Fuse, S19	112	Parking light, left, M1	102
Alternator warning light, K2	54	Fuse, S4	113	Parking light, right, M3	108
Back-up light switch, F4	128	Fuse, S2	126	Power steering pressure switch, F88	39-40
Back-up light, left, M16	128	Fuse, S15	128	Radiator cooling fan, V7	144
Back-up light, right, M17	129	Fuse, S16	131	Radiator cooling fan relay (2nd stage), J101	146-149
Battery, A	1	Fuse, S18	134	Radiator cooling fan thermoswitch, F18	144-145
Brake and parking brake indicator light, K7	136	Fuse, S6	138	Reading light, behind driver's seat, W22	83-84
Brake fluid level warning contact, F34	137	Fuse, S14	140	Reading light, left rear, W11	85-86
Brake light switch, F	125-126	Fuse, S13	143	Rear window defogger indicator light, K10	139
Brake light, left, M9	127	Fuse, S1	144	Rear window defogger switch, E15	138-140
Brake light, right, M10	126	Fuse, S11	153	Rear window defogger switch light, L39	138
Cigarette lighter, U1	74	Fuse, S17	154	Rear window heater element, Z1	140
Cigarette lighter light, L28	75	Fuse, S12	164	Rear window washer pump, V13	160
Clock light, L8	64	Half generator, G40	17-19	Rear window wiper motor, V12	162-163
Coolant low level control unit, J120	70-71	Headlight dimmer/flasher switch, E4	104-105	Rear window wiper/washer relay, J30	161-162
Coolant low level sensor, G32	70	Headlight high beam warning light, K1	66	Seat belt switch, left, E24	133
Coolant overheat warning light, K28	69	Headlight, left, L1	99	Seat belt warning light, K19	135
Coolant temperature gauge, G3	68	Headlight, left, L1	101	Seat belt warning system control unit, J34	132-135
Coolant temperature sensor, G62	21	Headlight, right, L2	109	Side marker lights, rear, M12	105,106
Coolant temperature sending unit, G2	72	Headlight, right, L2	111	Spark plug connectors, P	13-15
Digitant control unit, J169	16-29	Headlight, right, L2	111	Spark plugs, Q	13-15
Digitant control unit relay, J176	34-37	Heater blower series resistance, N72	151-152	Starter, B	3-4
Digital clock, Y2	56	Heater fan switch illumination light, L50	148	T.D.C. sensor, G7	46-47
Door contact switch, left front, F2	81-82	Heating element (crankcase ventilation), N79	12	Tachometer, G5	57
Door contact switch, right front, F3	84	High-beam headlight, left, L13	100	Tail light, left, M4	103
Emergency flasher relay, J2	114-115	High-beam headlight, right, L14	110	Tail light, right, M2	107
Emergency flasher switch, E3	112-120	Horn button, H	130	Throttle valve switch (enrichment), F25	20
Emergency flasher warning light, K6	120	Horns, H1	131	Turn signal indicator light, K5	65
Engine oil pressure control unit, J114	58-59	Idle stabilizer control unit, J142	39-45	Turn signal light, left front, M5	122
Engine oil pressure switch (0.3 bar), F22	51	Idle stabilizer valve, N71	43-44	Turn signal light, left rear, M6	121
Engine oil pressure switch (1.8 bar), F1	50	Ignition coil, N	14	Turn signal light, right front, M7	124
Engine oil pressure warning light, K3	60	Ignition distributor, O	13-15	Turn signal light, right rear, M8	123
Fresh air blower series resistance, N23	143	Ignition/starter switch, D	8-11	Turn signal switch, E2	116-117
Fresh air control lever light, L16	141	Injector, cyl. 1, N30	29	Voltage regulator, C1	5
Fresh air fan, V2	142	Injector, cyl. 2, N31	30	Voltage stabilizer, J6	67
Fresh air fan switch, E9	142-143	Injector, cyl. 3, N32	31	Warm air blower, V47	149
Fuel gauge, G1	67	Injector, cyl. 4, N33	32	Warm air blower switch, E100	150-152
Fuel gauge sending unit, G	73	Instrument panel light, L10	61-63	Washer/wiper intermittent relay, J31	156-158
Fuel pump, G6	33	Instrument panel light dimmer switch, E20	96	Windshield washer pump, V5	159
Fuel pump relay, J17	32-33	Intake air temperature sensor, G42	23	Windshield wiper motor, V	153-154
Fuse, S5	21	Interior light, front, W	81-82	Windshield-wiper intermittent switch, E22	155-158
Fuse, S51	12	License plate light, X	97-98		
Fuse, S3	82	Light switch, E1	88-96		
Fuse, S7	92	Load reduction relay, J59	89-91		
Fuse, S8	94	Make-up mirror light, right, W14	80		
Fuse, S20	98	Map/reading light, right front, W13	78		
Fuse, S10	100	Overheat fuse, S24	150-151		
Fuse, S21	101	Oxygen sensor, G39	27-28		
Fuse, S22	109				

# 97 Electrical System—Wiring, Waterboxer

## Wire connectors

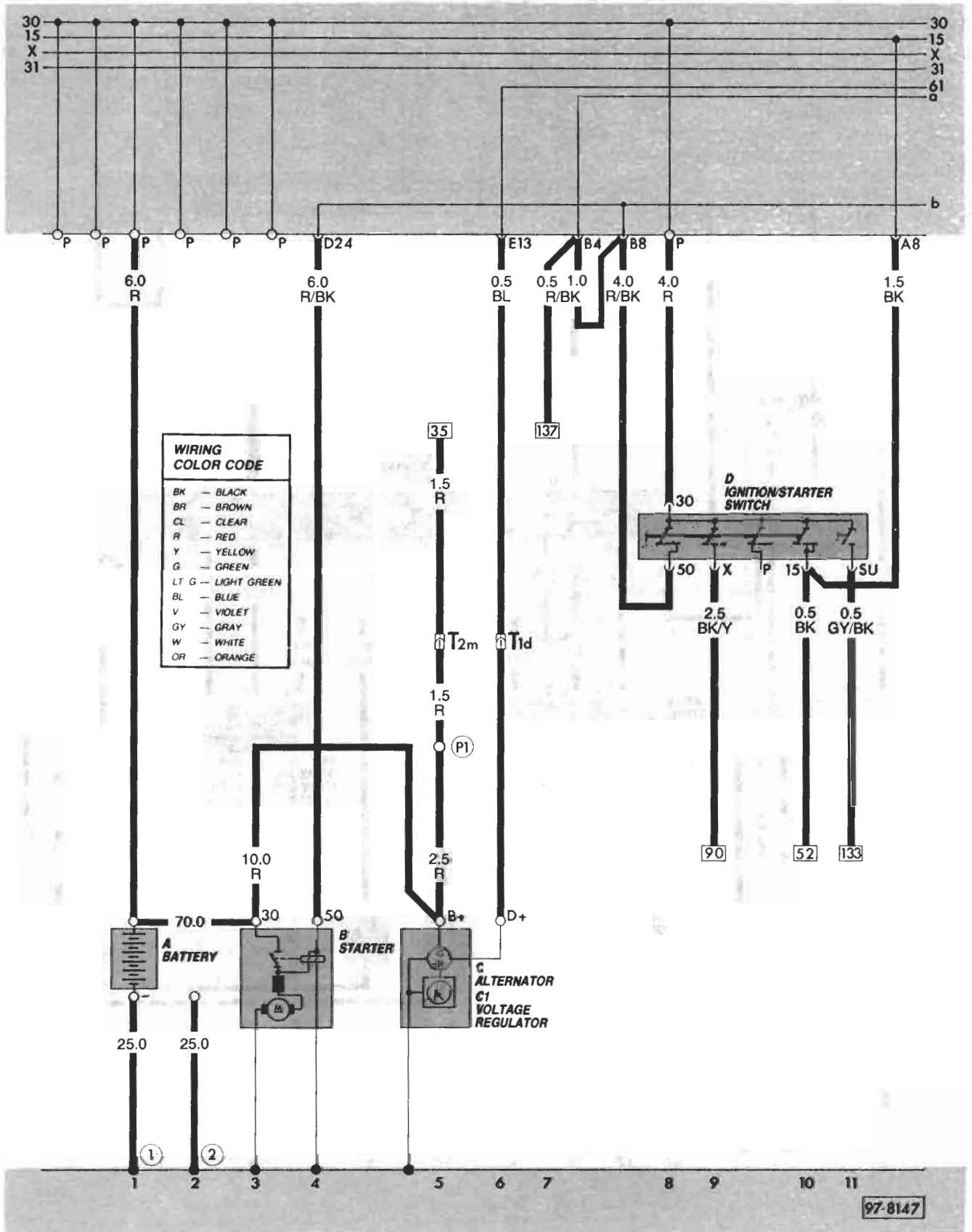
- T1 — single, under instrument panel, left side
- T1a — single, above left rear window
- T1d — single, in wire distributor box, engine compartment
- T1e — single, under instrument panel, left side
- T1g — single, in wire distributor box, engine compartment
- T1h — single, engine compartment, left side
- T1i — single, under instrument panel
- T1k — single, engine compartment, left
- T1m — single, near relay panel, engine compartment
- T1n — single, near relay panel, engine compartment
- T1o — single, under instrument panel, left side
- T2c — double, under instrument panel, left side
- T2d — double, upper right 'A' pillar
- T2e — double, in rear deck lid, near wiper motor
- T2f — double, on upper right 'C' pillar, behind cover
- T2g — double, under instrument panel, left side
- T2i — double, in wire distributor box, engine compartment
- T2k — double, in engine compartment, left
- T2m — double, near relay panel, engine compartment
- T2o — double, near driver's seat belt buckle
- T2x — double, in engine compartment, middle
- T3 — three-point, near alternator
- T3a — three-point, behind instrument panel, right side
- T3b — three-point, behind instrument panel, left side
- T3d — three-point, behind front grille
- T3x — three-point, under instrument panel, left side
- T7 — seven-point, in wire distributor box, engine compartment
- T7a — seven-point, in wire distributor box, engine compartment
- T8 — engine-point, under instrument panel, middle
- T14 — fourteen-point, on instrument cluster

## Ground connections

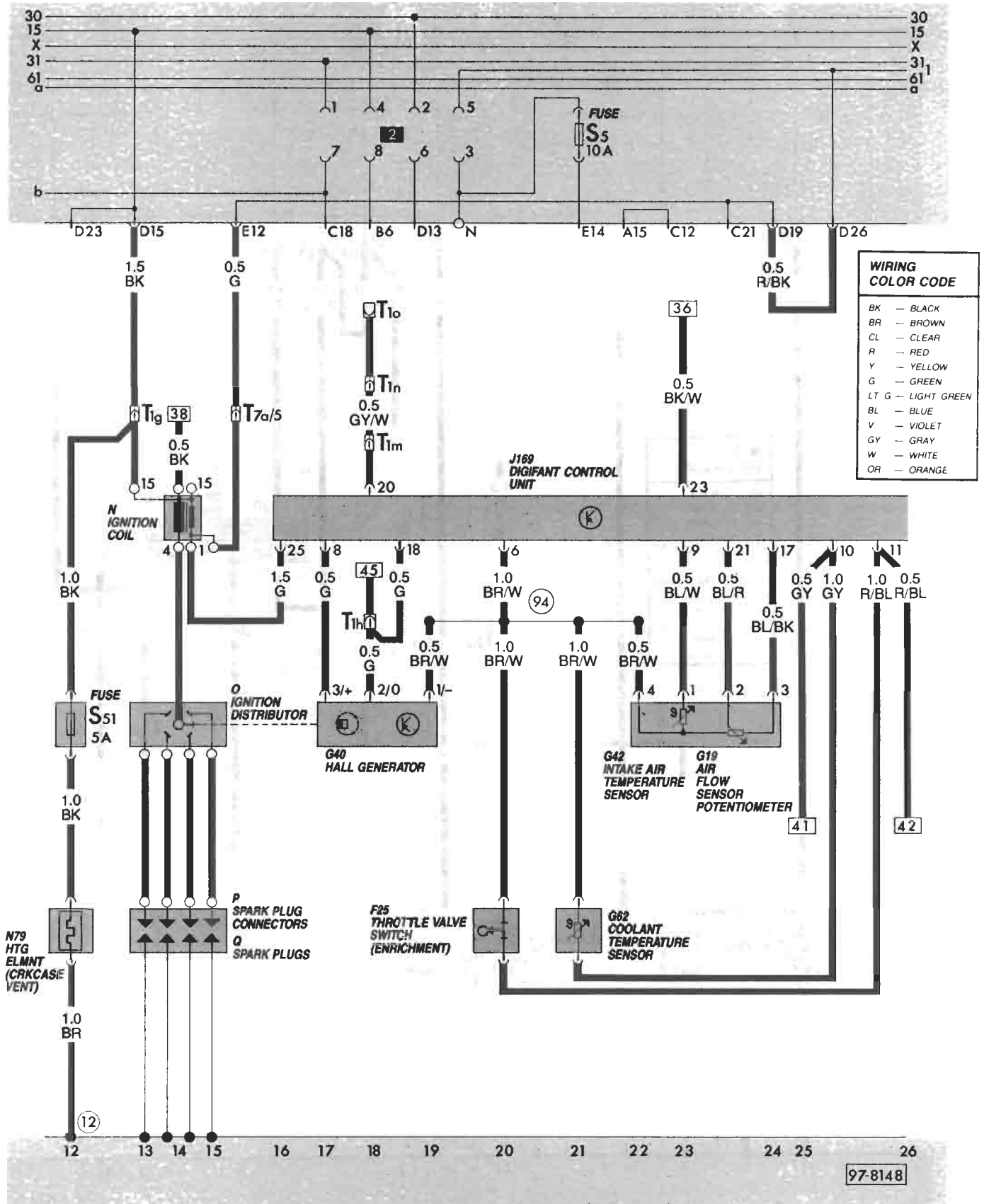
- ① — battery to body
- ② — transmission to body
- ⑫ — in engine compartment, left
- ⑱ — on engine block
- ⑳ — ground wire, above steering gear
- ㉑ — near fuel gauge sending unit
- ⑳ — near relay panel
- ④⑤ — under instrument panel, middle
- ⑤② — in rear decklid, left
- ⑤③ — in rear decklid, right
- ⑤⑥ — near rear washer bottle holder
- ⑤⑧ — near rear window wiper motor
- ⑦⑨ — near rear decklid opening
- ⑧① — ground connection, instrument panel wiring harness
- ⑨④ — ground connection, in Digifant wiring harness

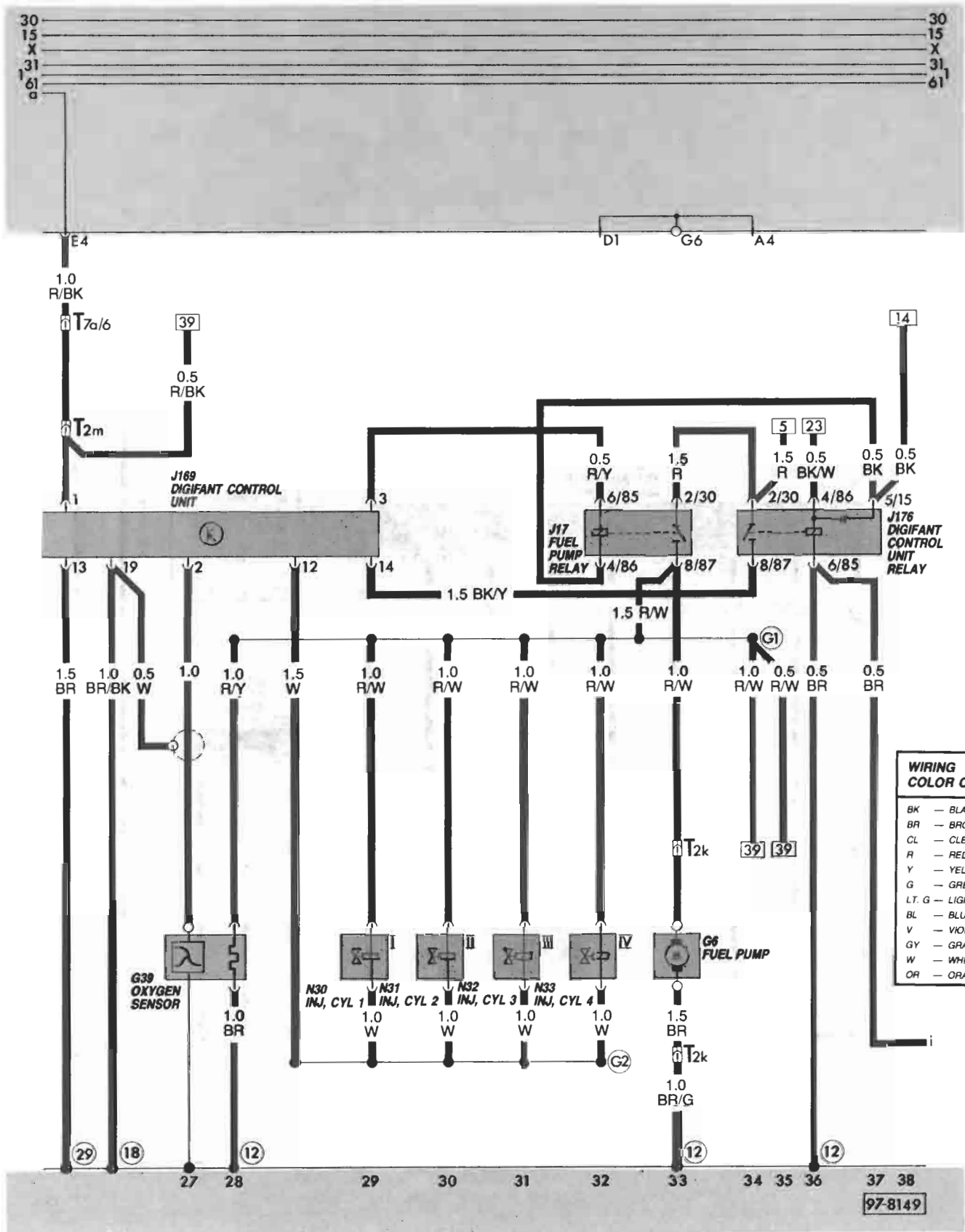
## Welded wiring connections

- Ⓐ④ — plus (+), terminal 58b, in instrument panel wiring harness
- Ⓒ① — plus (+), in Digifant wiring harness
- Ⓒ② — in Digifant wiring harness
- Ⓐ① — plus (+) 30 terminal, in wire distributor box, engine compartment



# 97 Electrical System—Wiring, Waterboxer



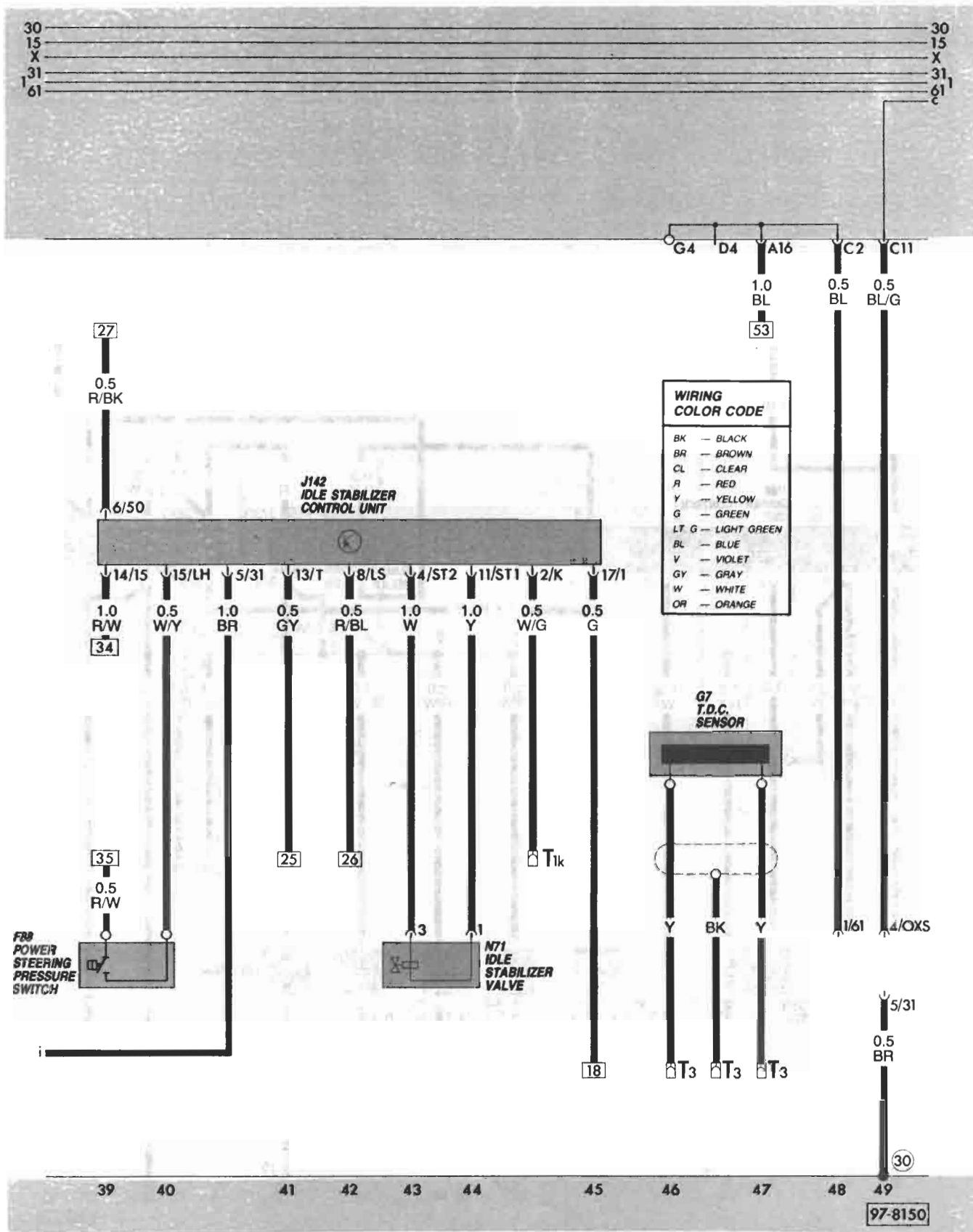


Water-cooled-Digifant from 1990

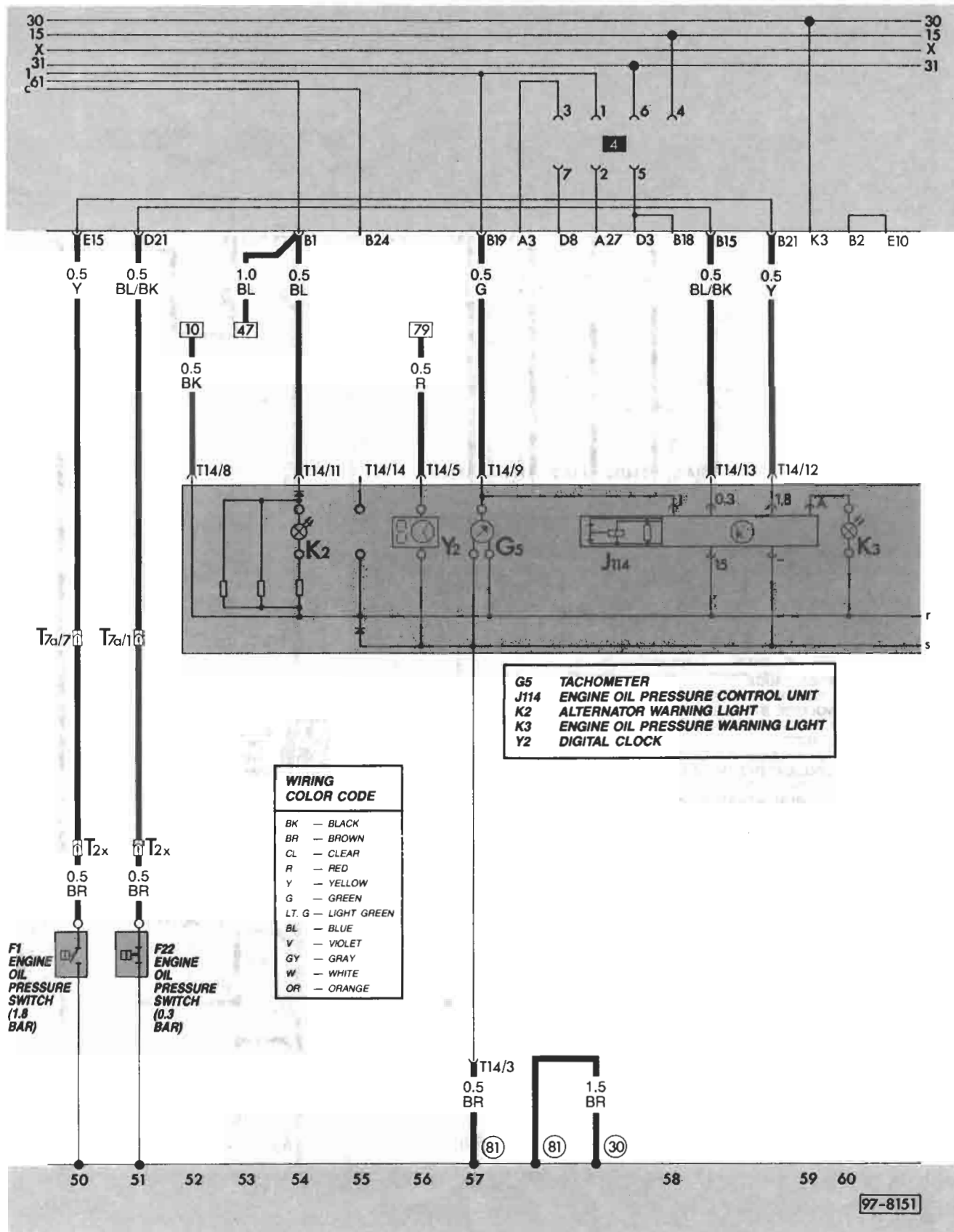
Main wiring diagram

97.206

# 97 Electrical System—Wiring, Waterboxer







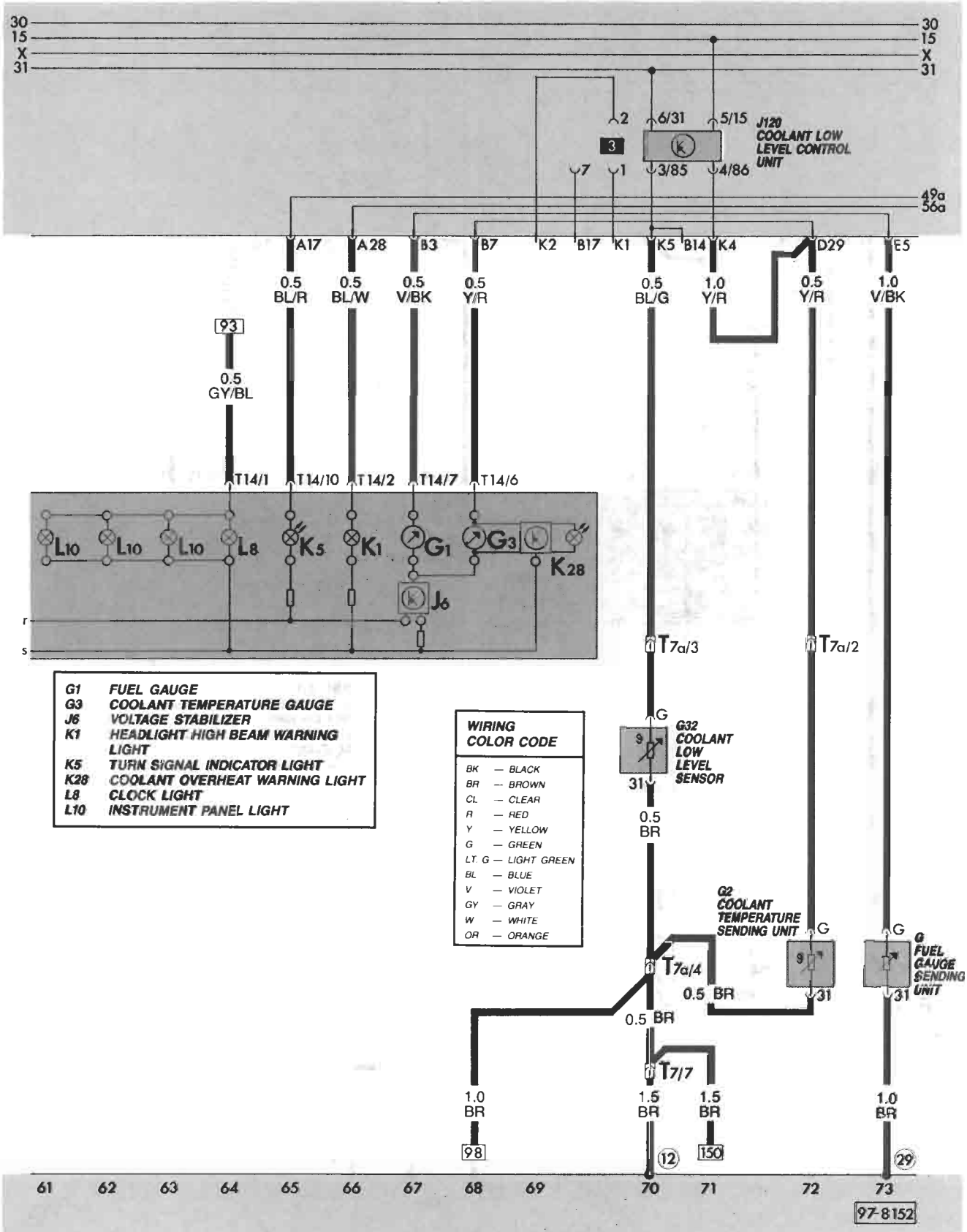
- |      |                                   |
|------|-----------------------------------|
| G5   | TACHOMETER                        |
| J114 | ENGINE OIL PRESSURE CONTROL UNIT  |
| K2   | ALTERNATOR WARNING LIGHT          |
| K3   | ENGINE OIL PRESSURE WARNING LIGHT |
| Y2   | DIGITAL CLOCK                     |

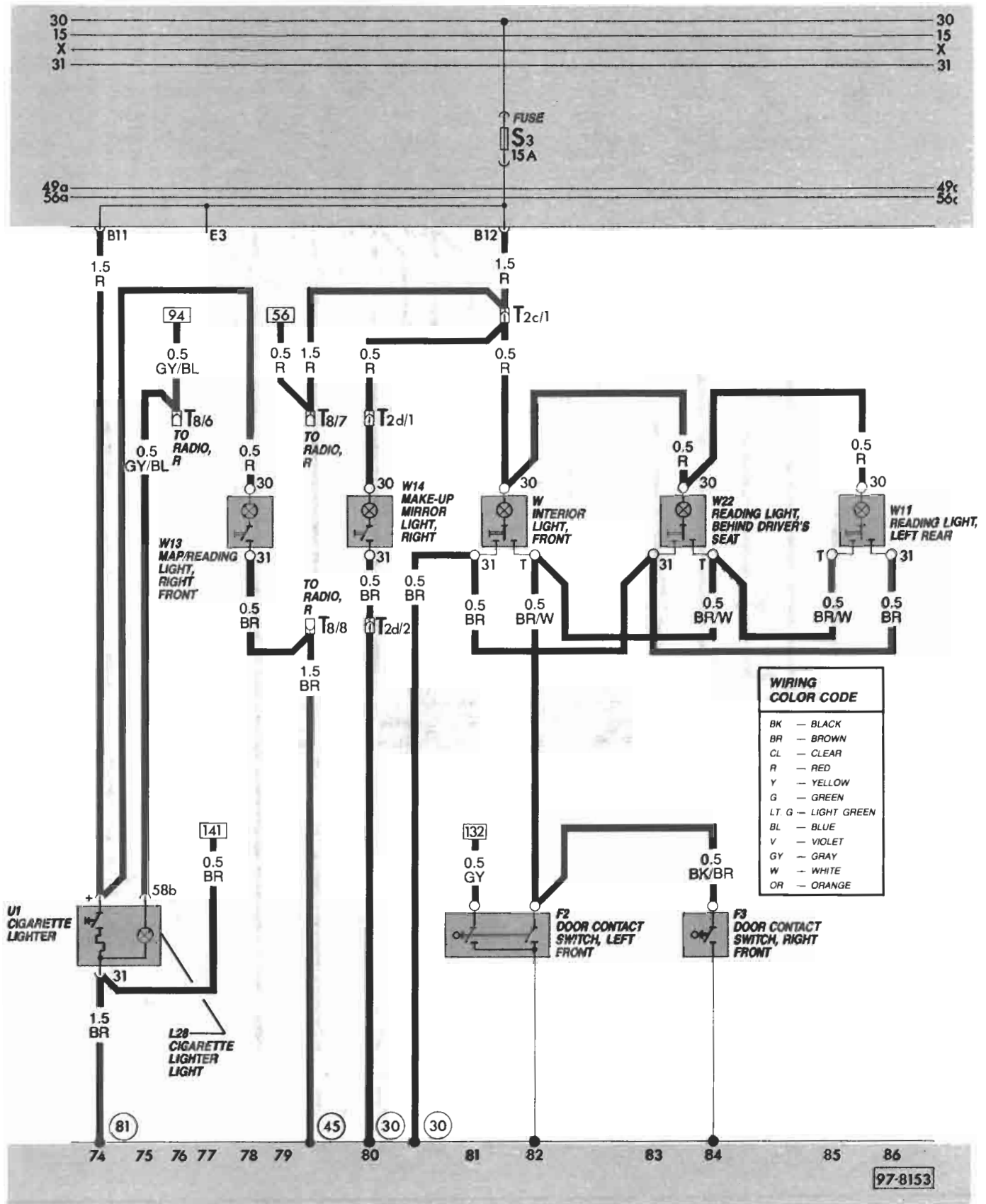
WIRING COLOR CODE	
BK	— BLACK
BR	— BROWN
CL	— CLEAR
R	— RED
Y	— YELLOW
G	— GREEN
LT. G	— LIGHT GREEN
BL	— BLUE
V	— VIOLET
GY	— GRAY
W	— WHITE
OR	— ORANGE

Water-cooled—Digifant from 1990

Main wiring diagram **97.208**

# 97 Electrical System—Wiring, Waterboxer



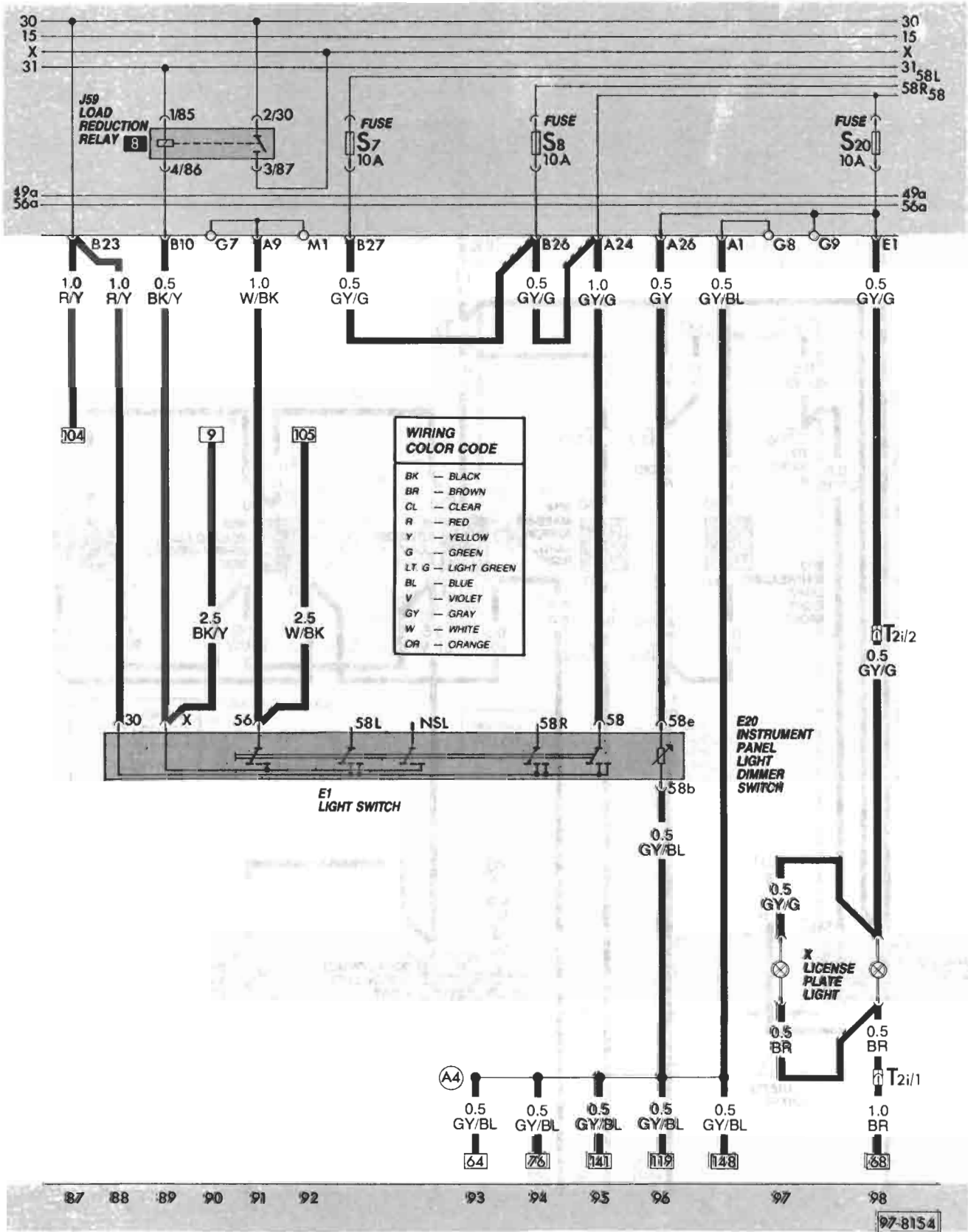


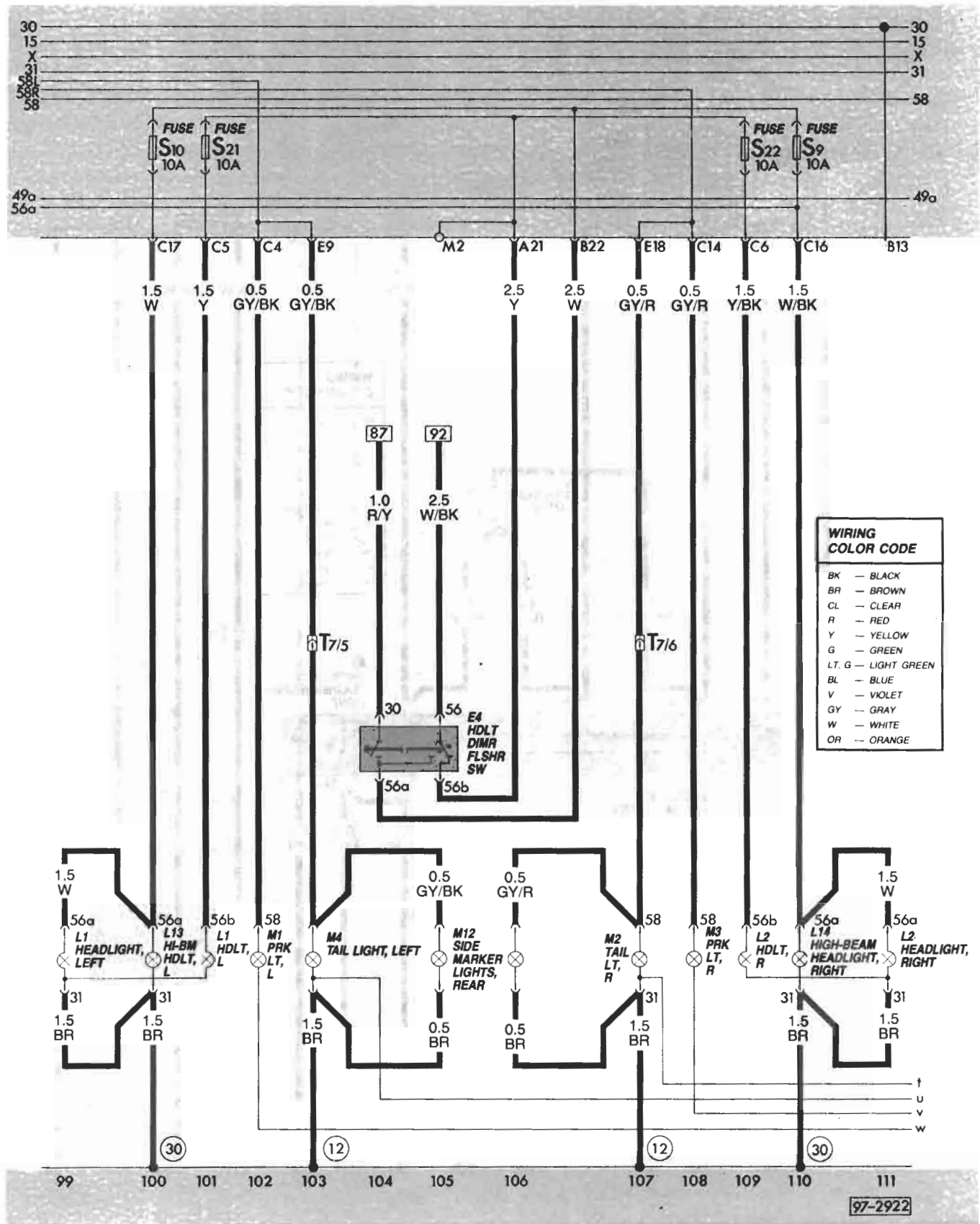
Water-cooled—Digifant from 1990

Main wiring diagram

97.210

# 97 Electrical System—Wiring, Waterboxer



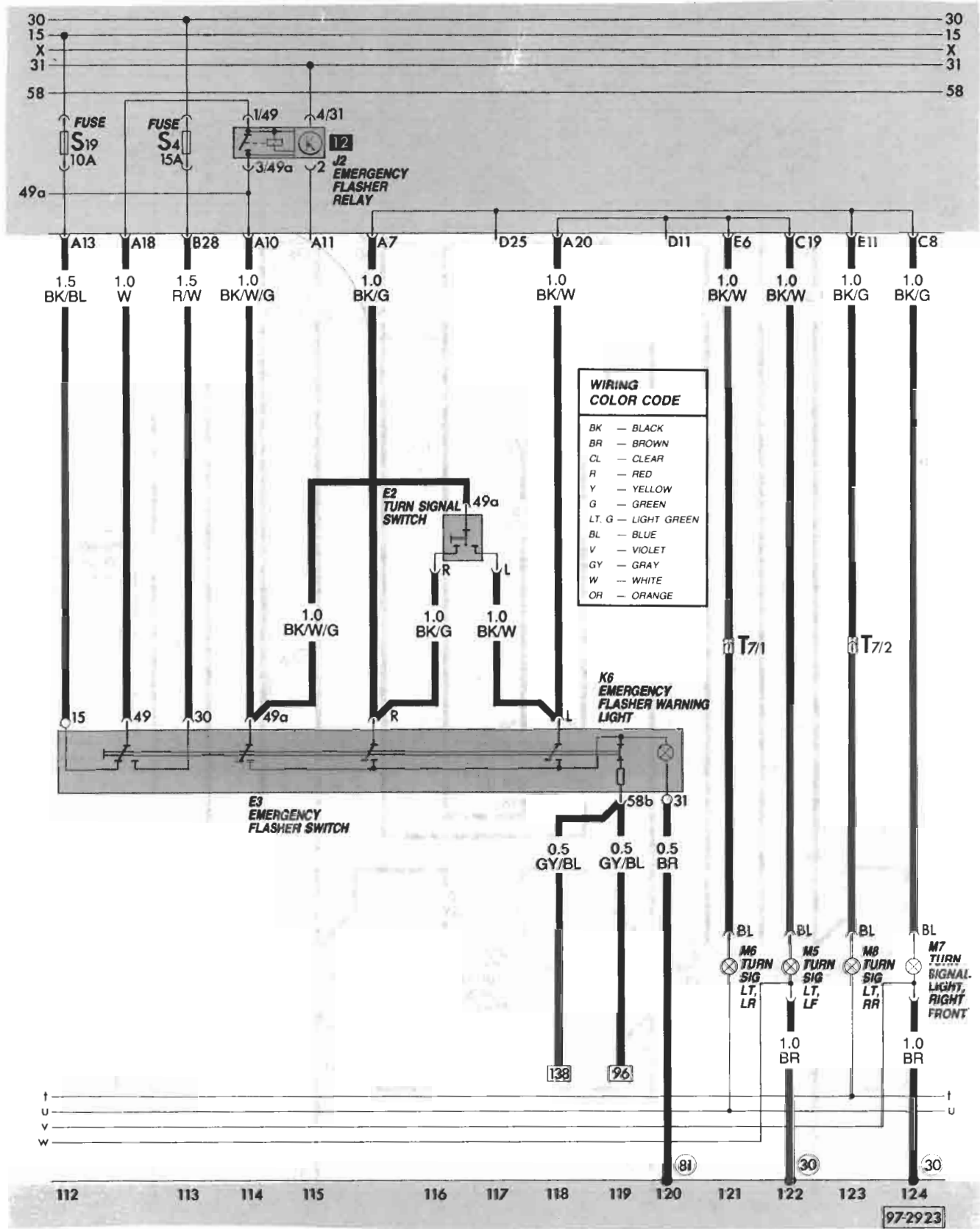


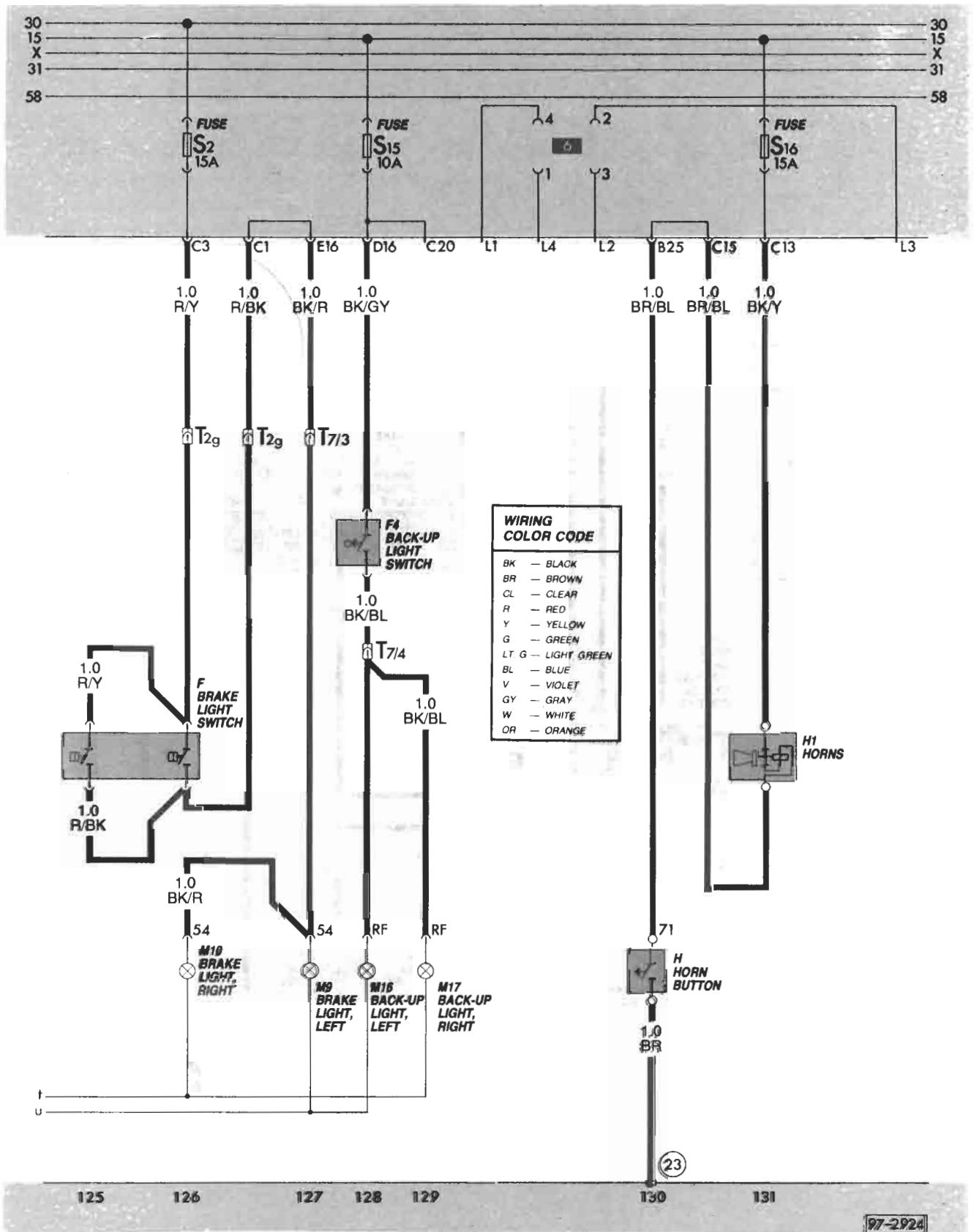
Water-cooled-Digifant from 1990

Main wiring diagram **97.212**

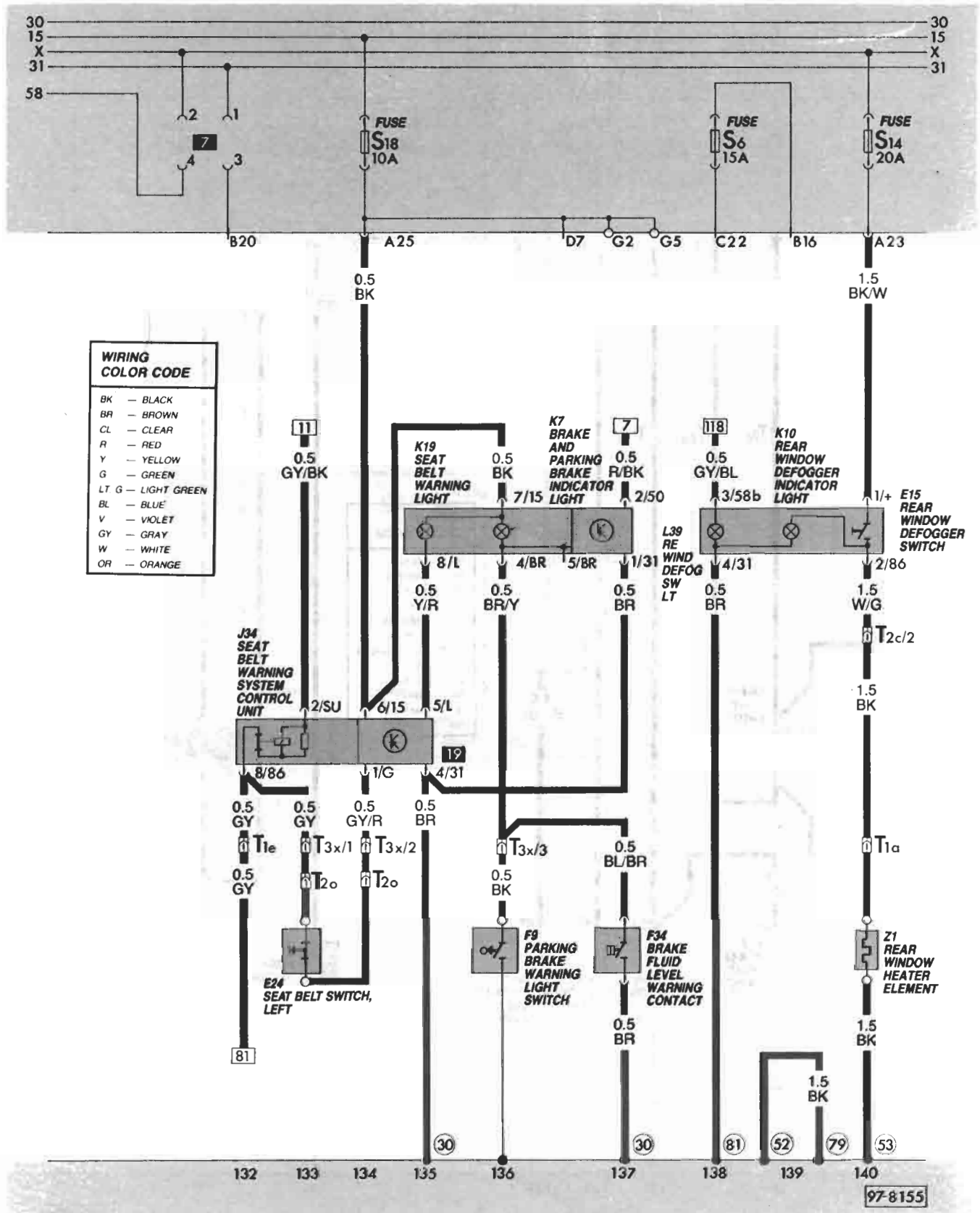
97-2922

# 97 Electrical System—Wiring, Waterboxer

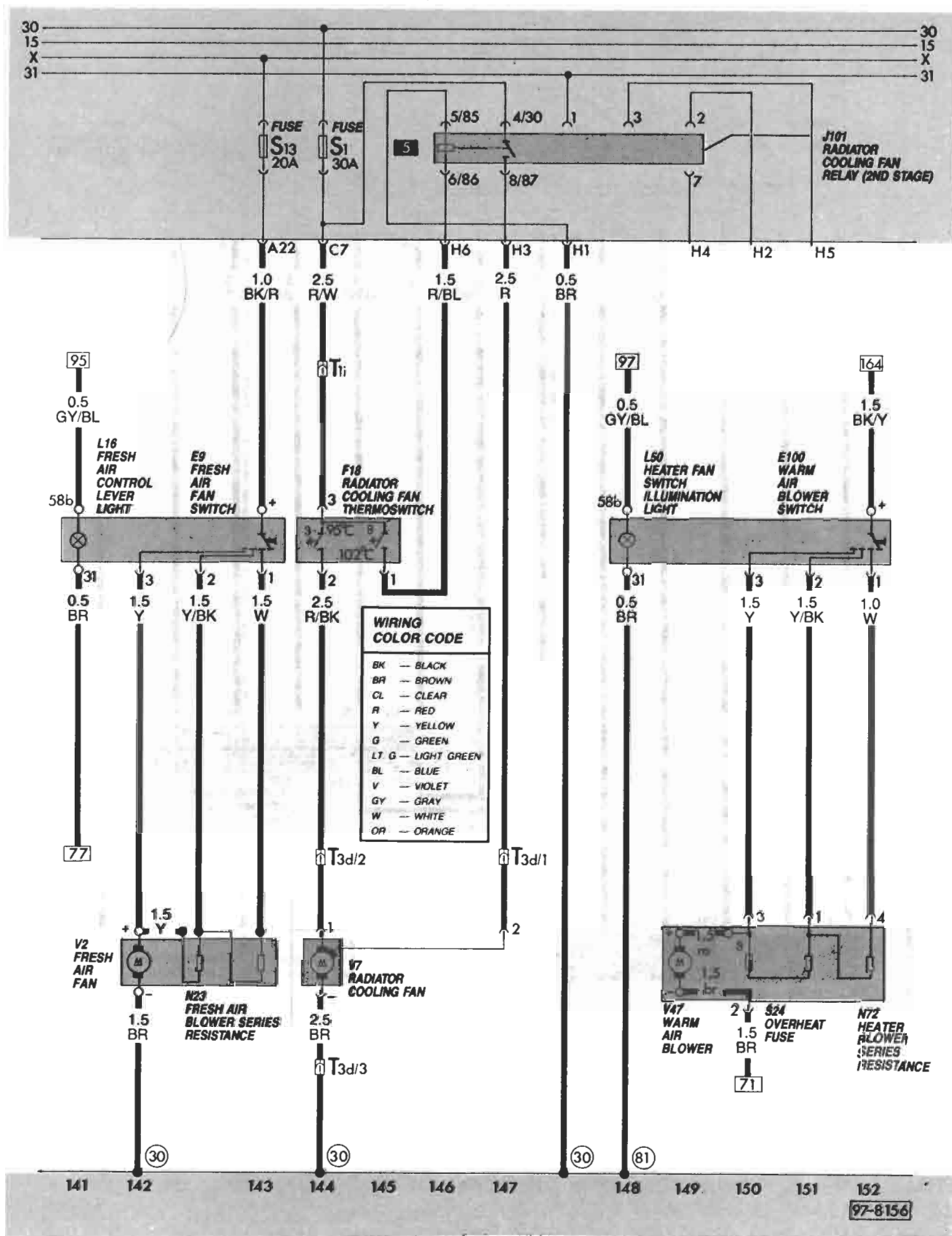




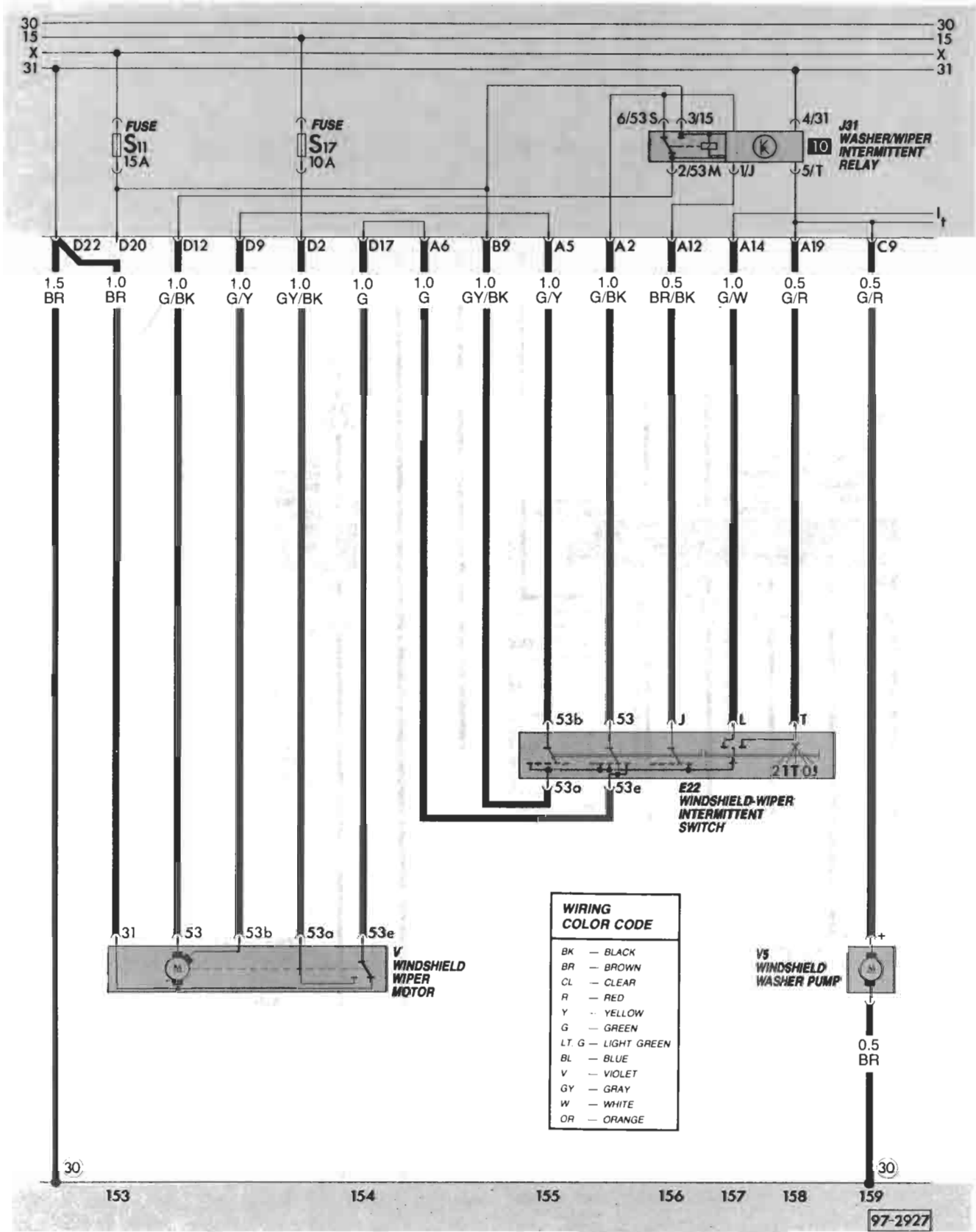
# 97 Electrical System—Wiring, Waterboxer

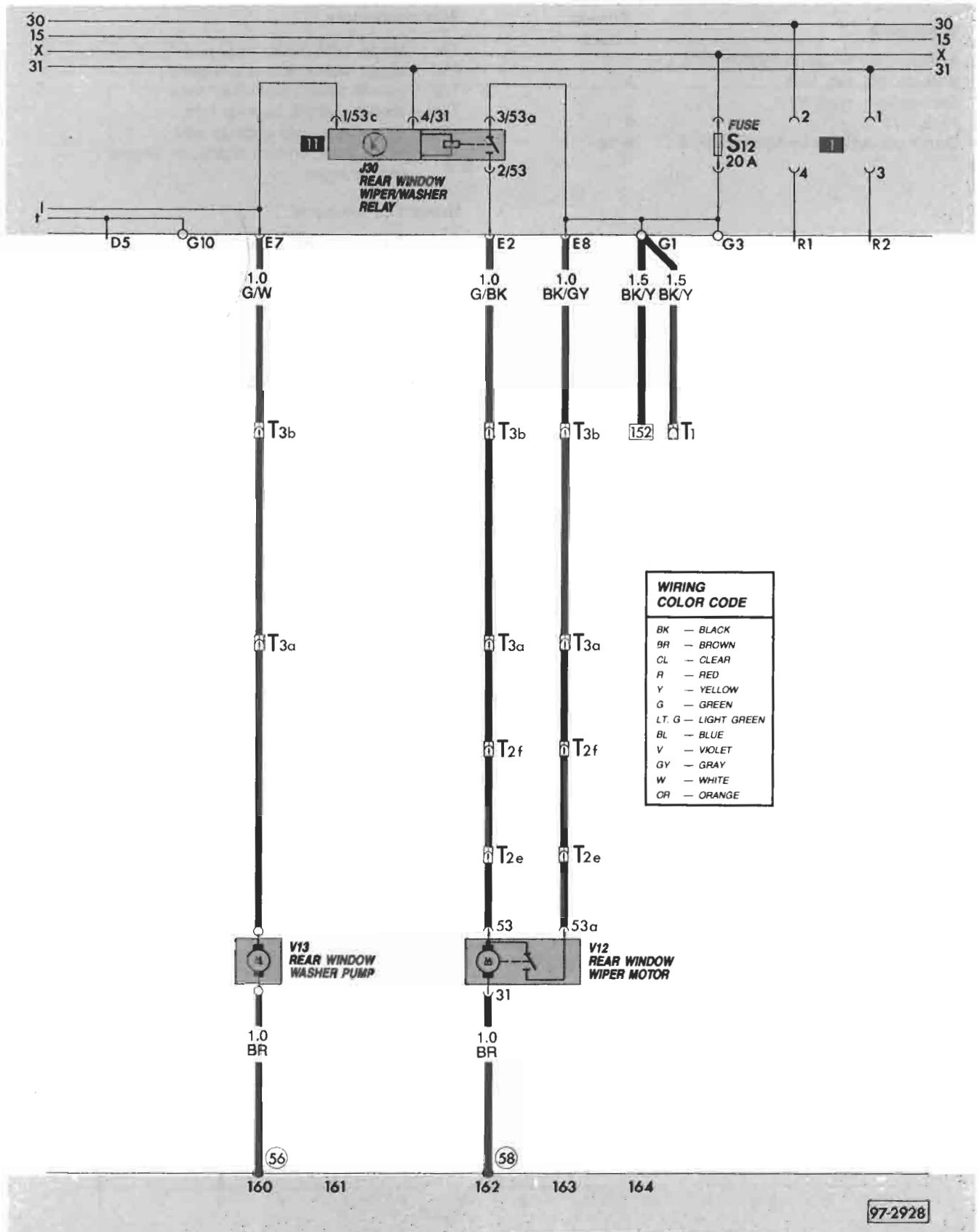






# 97 Electrical System—Wiring, Waterboxer





# 97 Electrical System—Wiring, Waterboxer

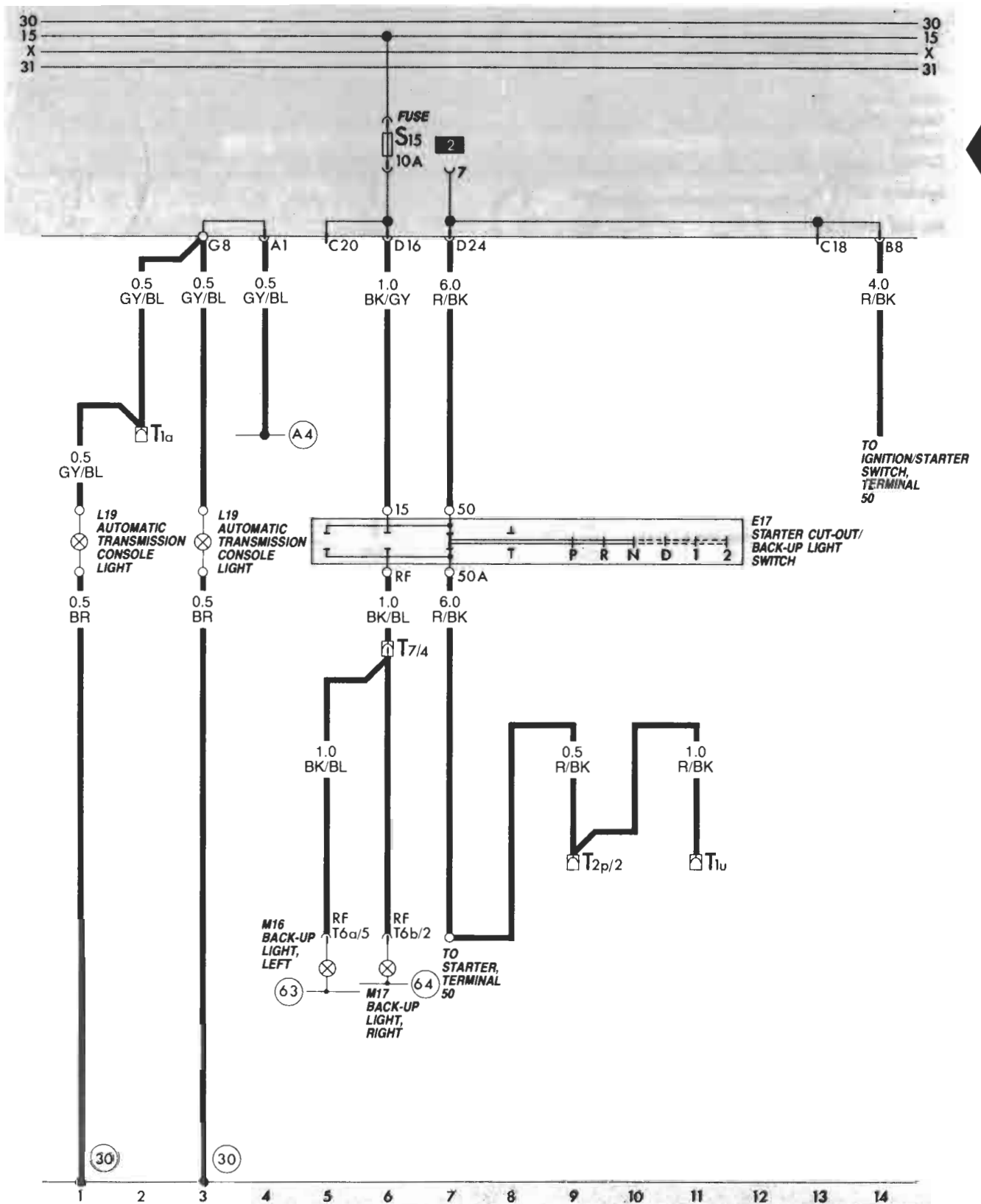
Description	Current track	Wire connectors
Automatic transmission console light, L19	1, 3	T1a — single, behind fuse/relay panel
Back-up light, left, M16	5	T1u — single, behind instrument panel
Back-up light, right, M17	6	T2p — double, behind fuse/relay panel
Fuse, S15	6	T6a — six-point, at left back-up light
Starter cut-out/back-up light switch, E17	5-12	T6b — six-point, at right back-up light
		T7 — seven point, on wire distributor, engine compartment

Ground connections
⓪30 — beside fuse/relay panel
⓪63 — on left tail light bulb holder
⓪64 — on right tail light bulb holder

Welded wiring harness points
⓪A4 — plus connection (58b), in instrument panel wiring harness



97-8213

# 97 Electrical System—Wiring, Waterboxer

Description	Current Track
Alternator	6
Auto trans. console lites	13-14
Auxiliary battery	2
Back-up lite, left	15
Back-up lite, right	17
Battery	1
Battery cut-out relay	2-4
Ign./start sw.	9-12
Neutral safety switch	15-17

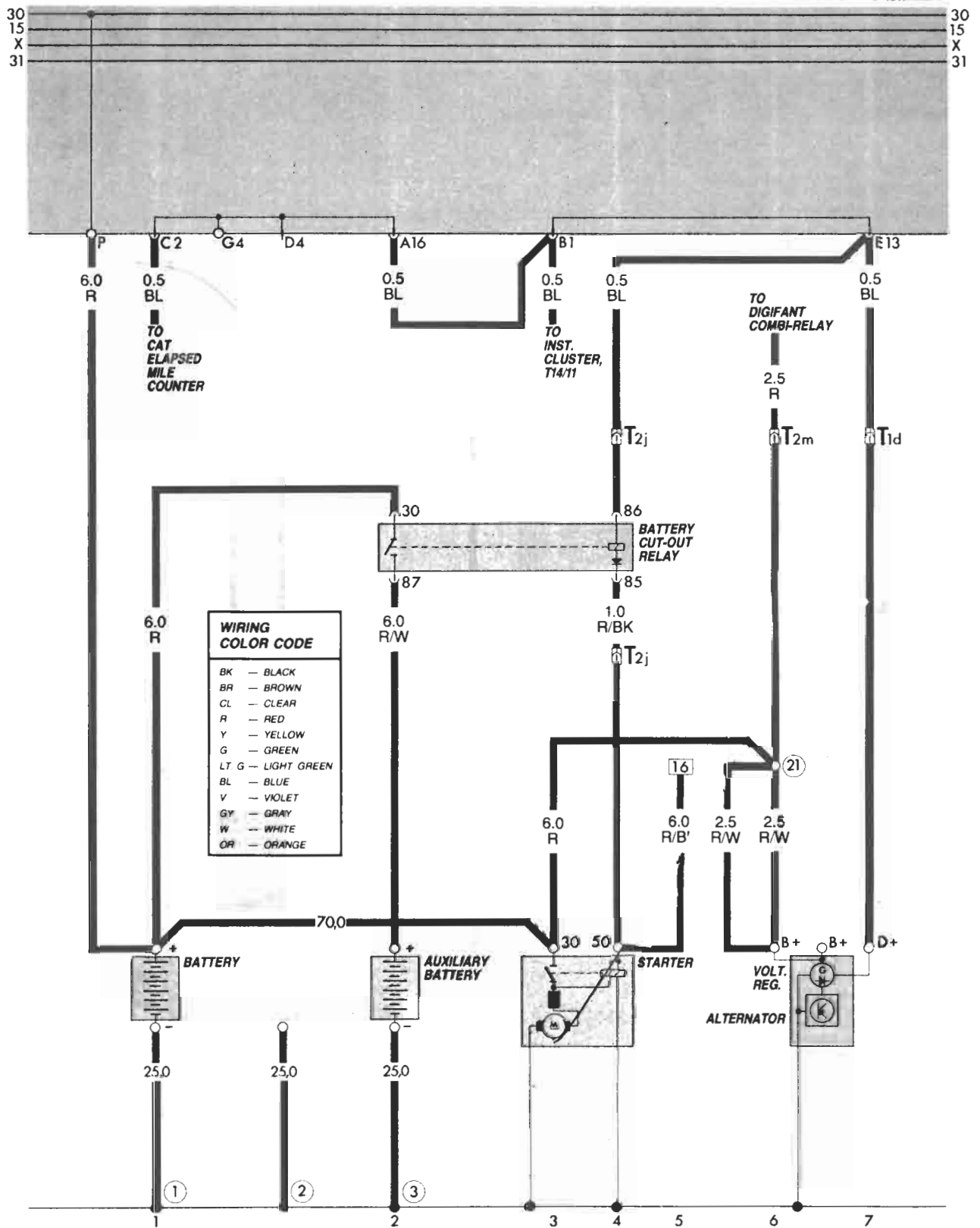
## Wire connectors

T1b — single, wire distributor, LF eng. compart.  
T1d — single, wire distributor, LF eng. compart.  
T2j — double, under fuse/relay panel  
T2m — double, under fuse/relay panel  
T7a/ — seven-point, wire distributor, LF eng. compart.  
T14/ — fourteen-point, on inst. cluster

## Ground Connections

- ① — ground from battery to body
- ② — ground from transmission to body
- ③ — ground from aux. battery to ground
- ⑫ — on LF cross member
- ⑮ — in eng. compart. near ign. coil

# Electrical System—Wiring, Waterboxer 97

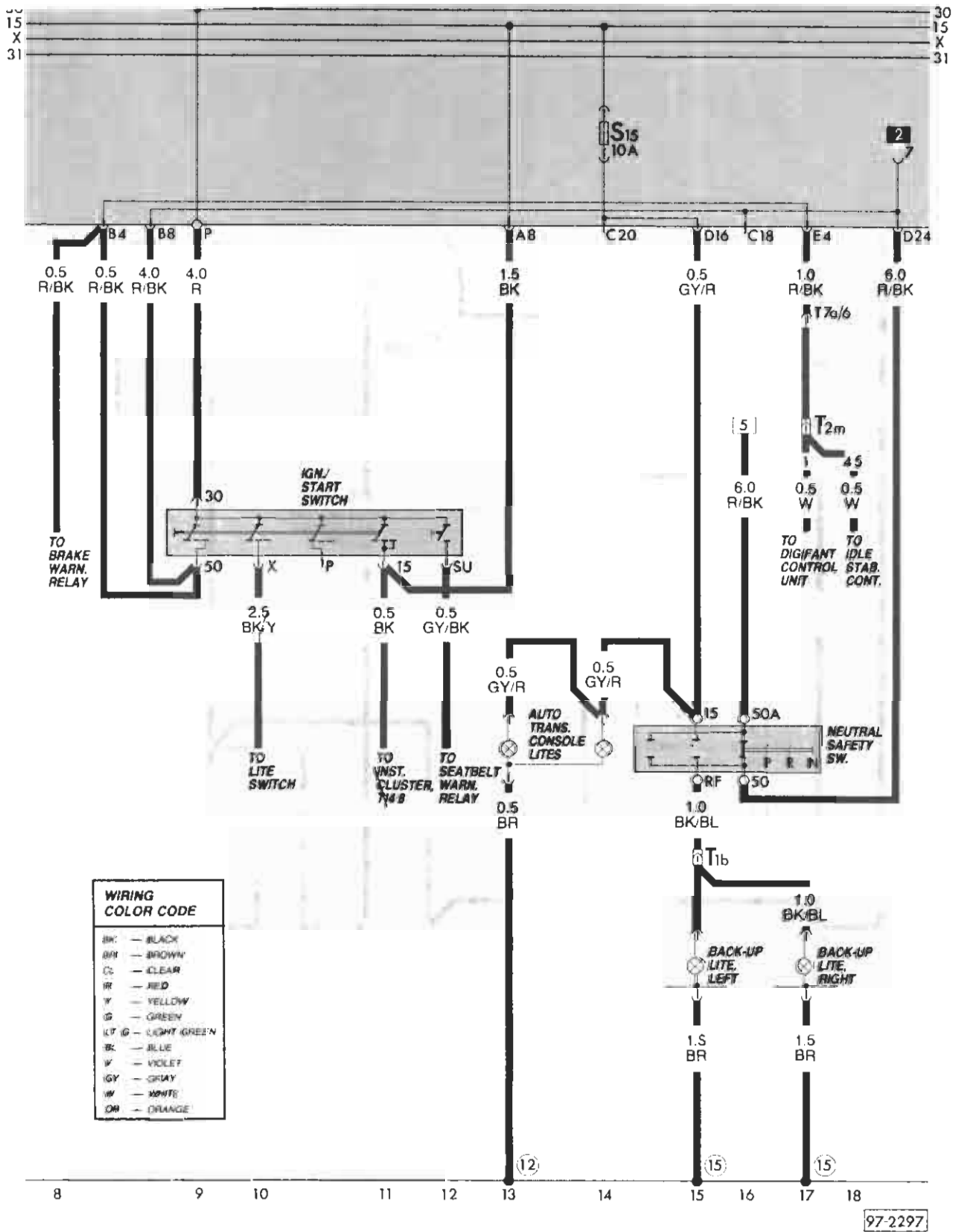


Auto. trans.

1986-1989

Auxiliary battery **97.222**

# 97 Electrical System—Wiring, Waterboxer



**97.223** Auxiliary battery

Auto. trans.

1986-1989



**Description**

Auxiliary battery, A1  
Battery, A  
Battery cut-out relay, J7

**Current track**

5  
9  
4-5

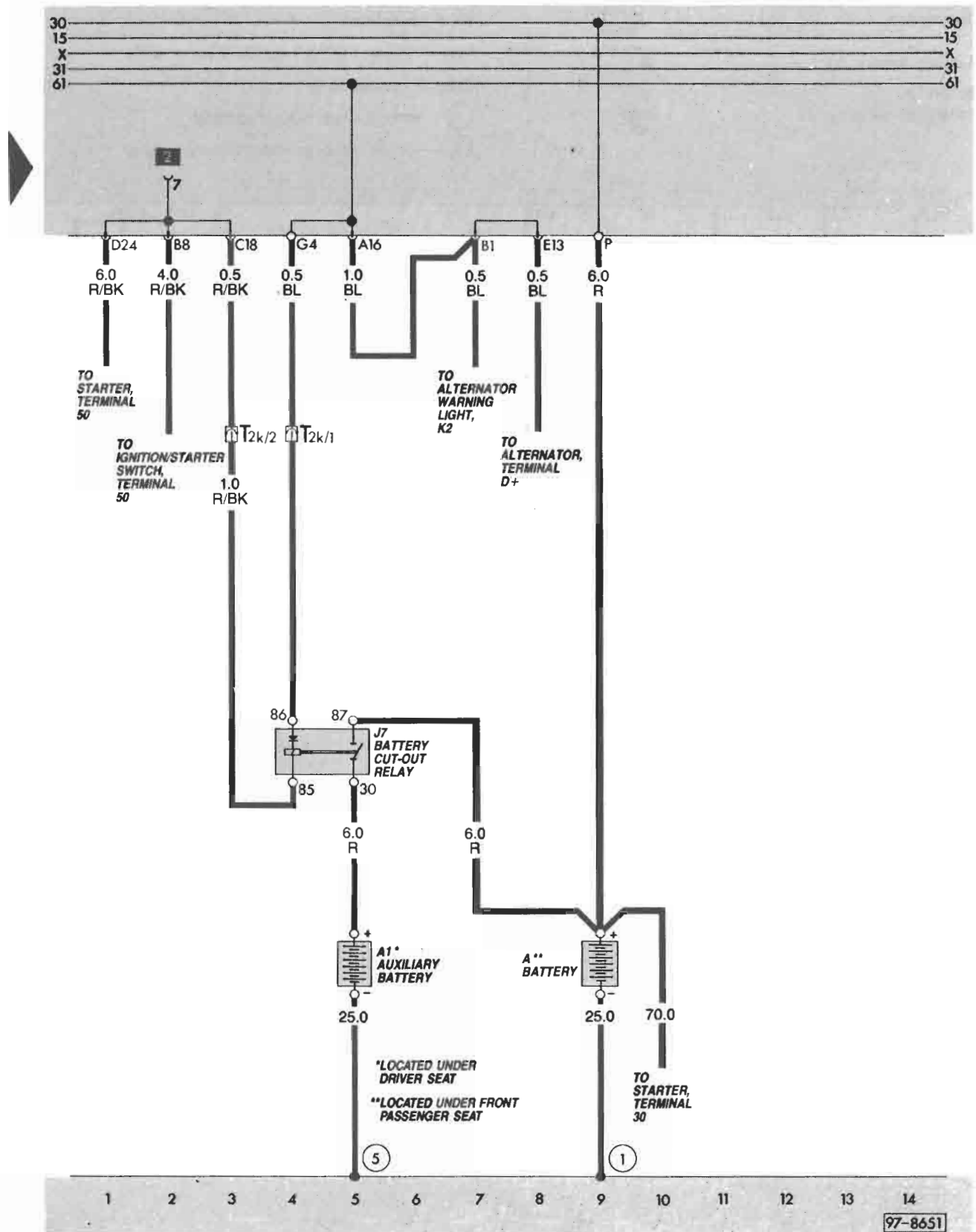
**Wire connectors**

T2K—double, behind instrument panel, left

**Ground connections**

- ①—ground strap, battery to body
- ⑤—ground strap, auxiliary battery to body

# 97 Electrical System—Wiring, Waterboxer



**97.225** Auxiliary battery

Water-cooled—Digifant from 1990

## Description

Central locking system fuse, S52  
 Central locking system motor, decklid, V53  
 Central locking system motor, driver door, V56  
 Central locking system motor, passenger door, V57  
 Central locking system motor, sliding door, V58  
 Sliding door contact switch, F7

## Current track

2  
 11-12  
 1-3  
 4-6  
 7-9  
 7-10

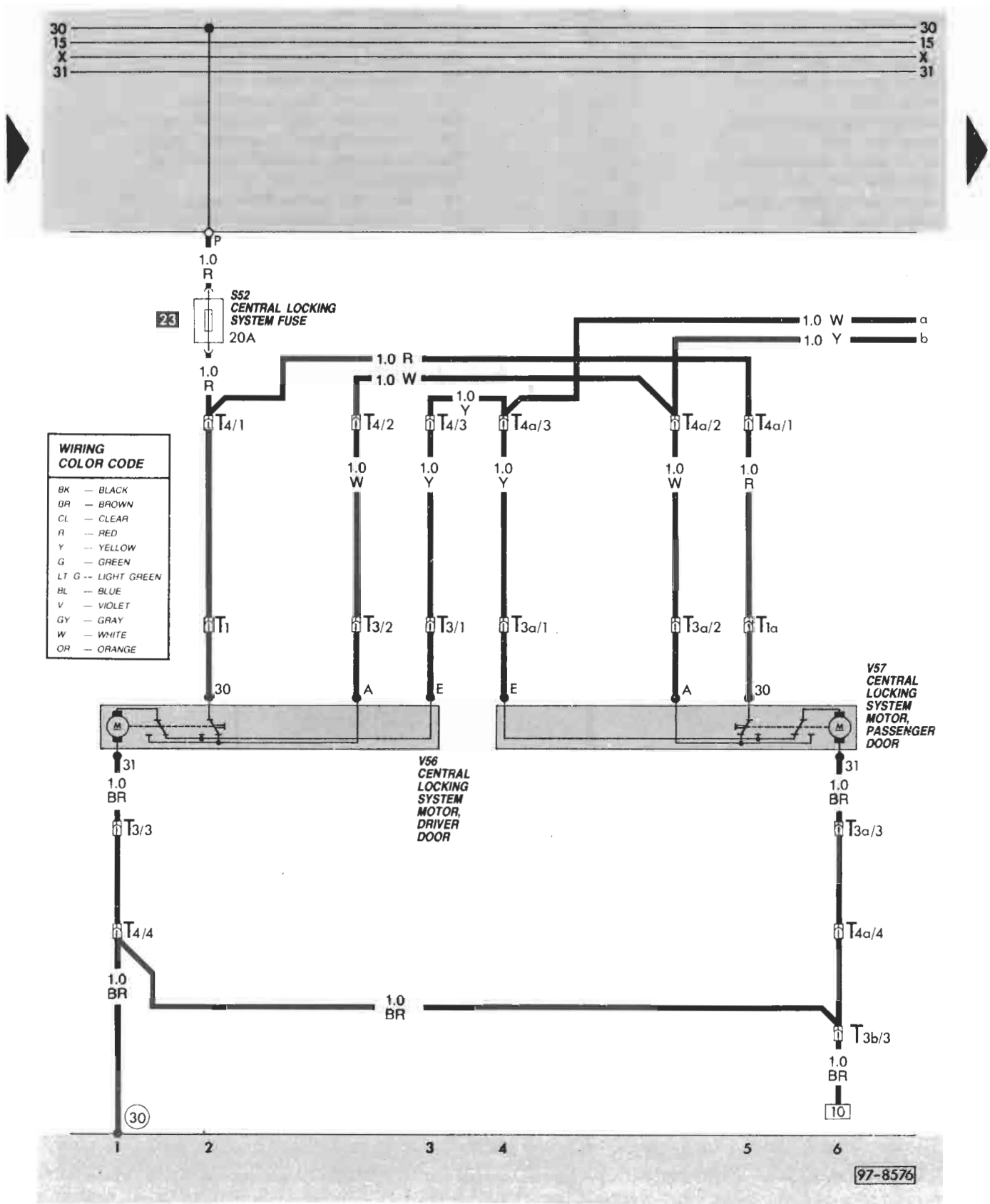
## Wire connectors

T1 — single, in driver's door  
 T1a — single, in passenger's door  
 T3 — three-point, in driver's door  
 T3a — three-point, in passenger's door  
 T3b — three-point, behind instrument panel, right  
 T3c — three-point, near upper right B-pillar  
 T3d — three-point, above left rear window  
 T3e — three-point, on rear deck lid  
 T4 — four-point, behind instrument panel, left  
 T4a — four-point, behind instrument panel, right

## Ground connections

③0 — near fuse/relay panel

# 97 Electrical System—Wiring, Waterboxer

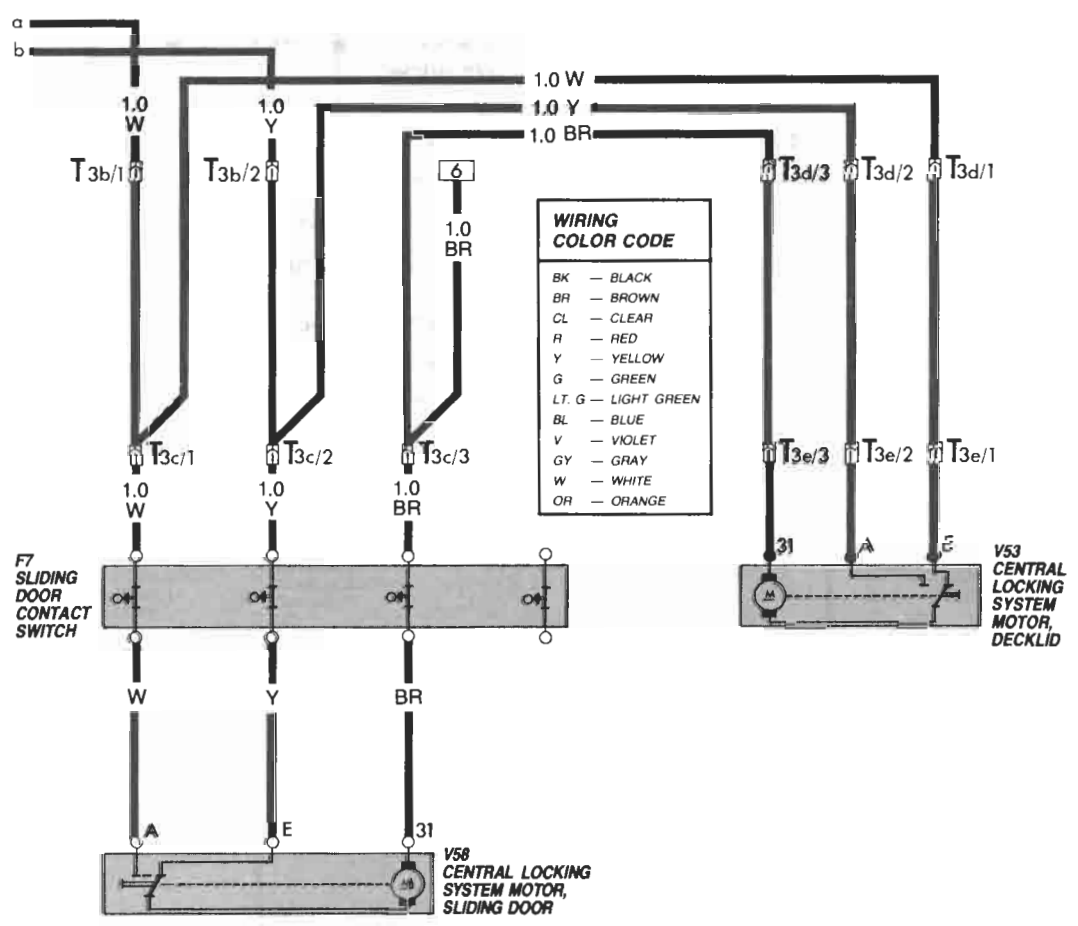


97.227

Central locking system

Water-cooled—Digifant from 1990

30	30
15	15
X	X
31	31



# 97 Electrical System—Wiring, Waterboxer

## Description

## Current track

Automatic transmission console light, L19	1, 3
Automatic transmission relay, J60	16-17
Back-up light, left, M16	6
Back-up light, right, M17	9
Brake light switch, F	11, 13
Brake light, left, M9	10
Brake light, right, M10	13
Cruise control inductive sender, G38	22
Cruise control switch, E45	19-25
Cruise control, control unit, J213	19-25
Fuse, S2	11
Fuse, S15	9
Fuse, S18	20
Starter cut-out/back-up light switch, E17	6-9
Vacuum control motor, V18	24-26
Vacuum vent valve, brake, F47	15

## Wire connectors

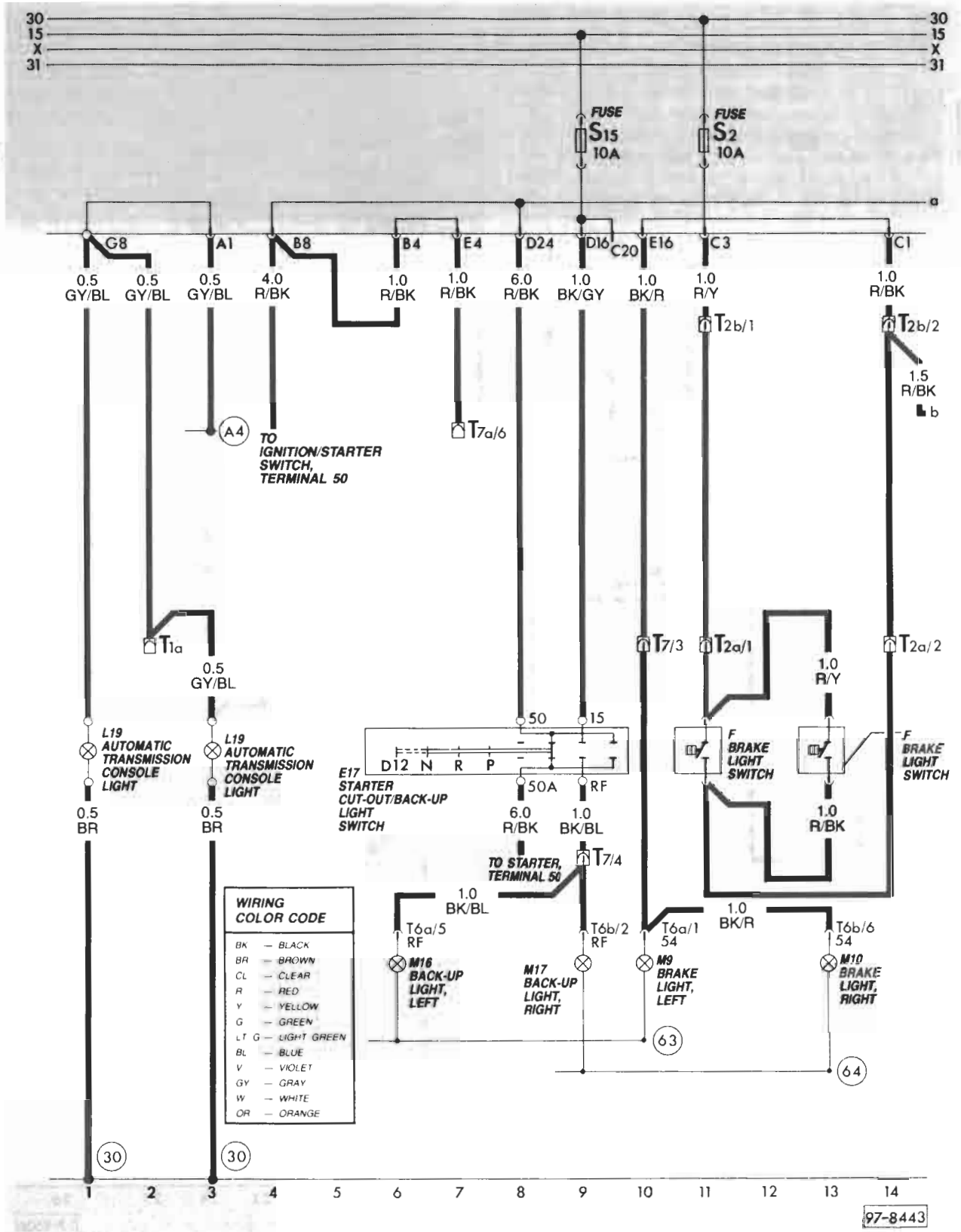
T1a	— single, behind fuse/relay panel
T2	— double, behind instrument panel
T2a	— double, behind instrument panel
T2b	— double, behind instrument panel
T3	— three-point, near fuse/relay panel
T3a	— three-point, in wire distributor, engine compartment
T4	— four-point, near cruise control main control unit
T4b	— four-point, behind steering column switch cover
T6a	— six-point, on taillight bulb holder, left
T6b	— six-point, on taillight bulb holder, right
T7	— seven-point, in wire distributor, engine compartment
T7a	— seven-point, in wire distributor, engine compartment

## Ground connections

30	— near fuse/relay panel
63	— on taillight bulb holder, left
64	— on taillight bulb holder, right

## Welded wiring harness points

A4	— plus connection 58b, in instrument cluster wiring harness
----	---

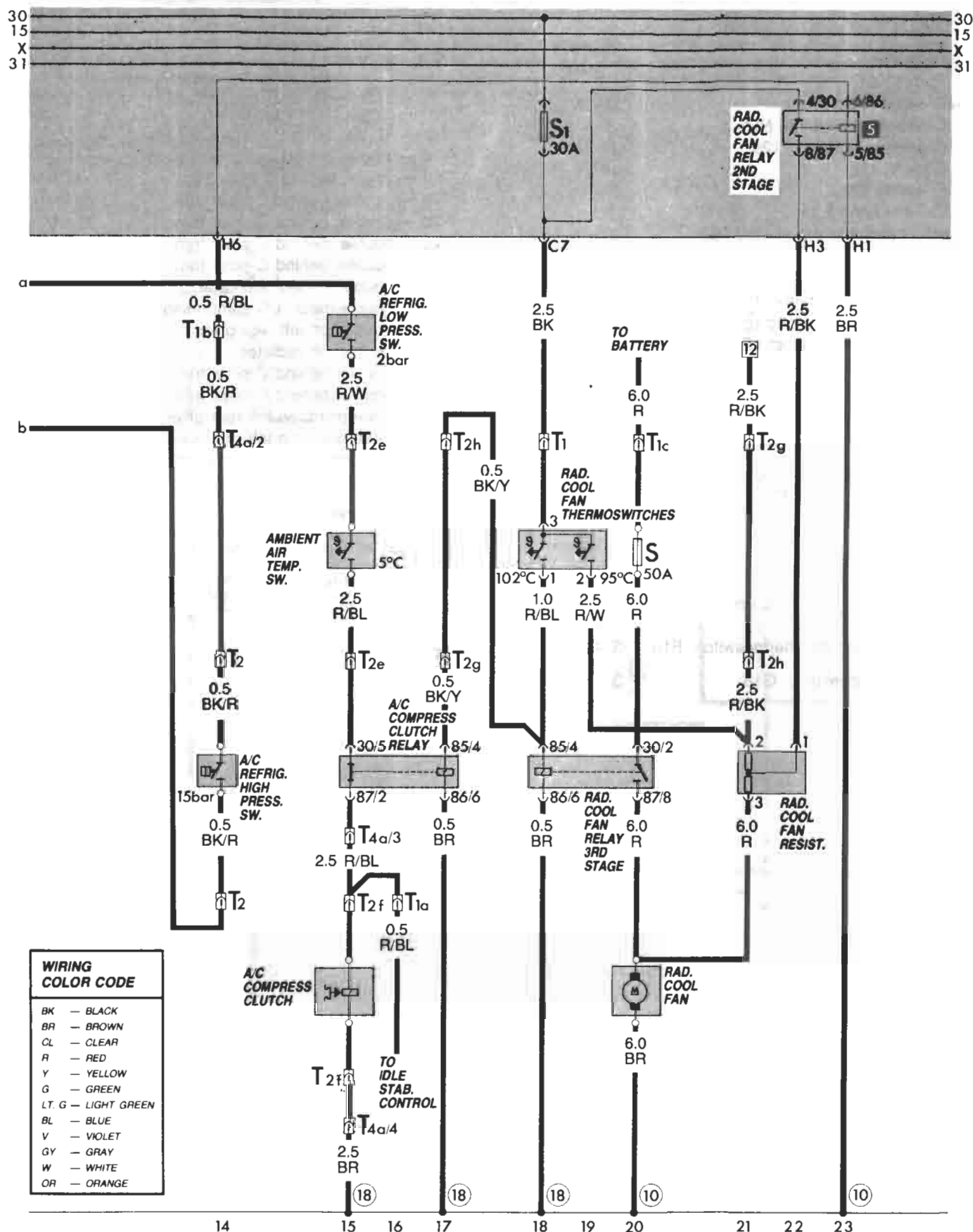


Auto. trans.

Water-cooled—Digifant from 1990

Cruise control **97.230**

# Electrical System - Wiring, Waterboxer 97



87-880b



# 97 Electrical System—Wiring, Waterboxer

Description	Current track
A/C clutch relay, J44	26-28
A/C compressor clutch, N25	26
A/C pressure switch, F129	23-24
A/C relay, J32	16-21
A/C switch, E35	2-4
A/C thermostat, E33	2-5
Ambient temperature switch, F38	26
Cooling fan fuse, S42	33
Evaporator blower relay, J157	7-8
Evaporator blower series resistor, N81	10-12
Evaporator blower switch, E110	7-12
Evaporator fan, V20	8, 12
Fuse, S12	4
Fuse, S51	10, 14
Fuse, S23	17
Fuse, S1	31
Radiator cooling fan, V7	33
Radiator cooling fan relay (2nd stage), J101	37-38
Radiator cooling fan relay (3rd stage), J135	31-33
Radiator cooling fan series resistance, N39	36-37
Radiator cooling fan thermostic switch, F18	31-32
Temperature sensor II, G18	3

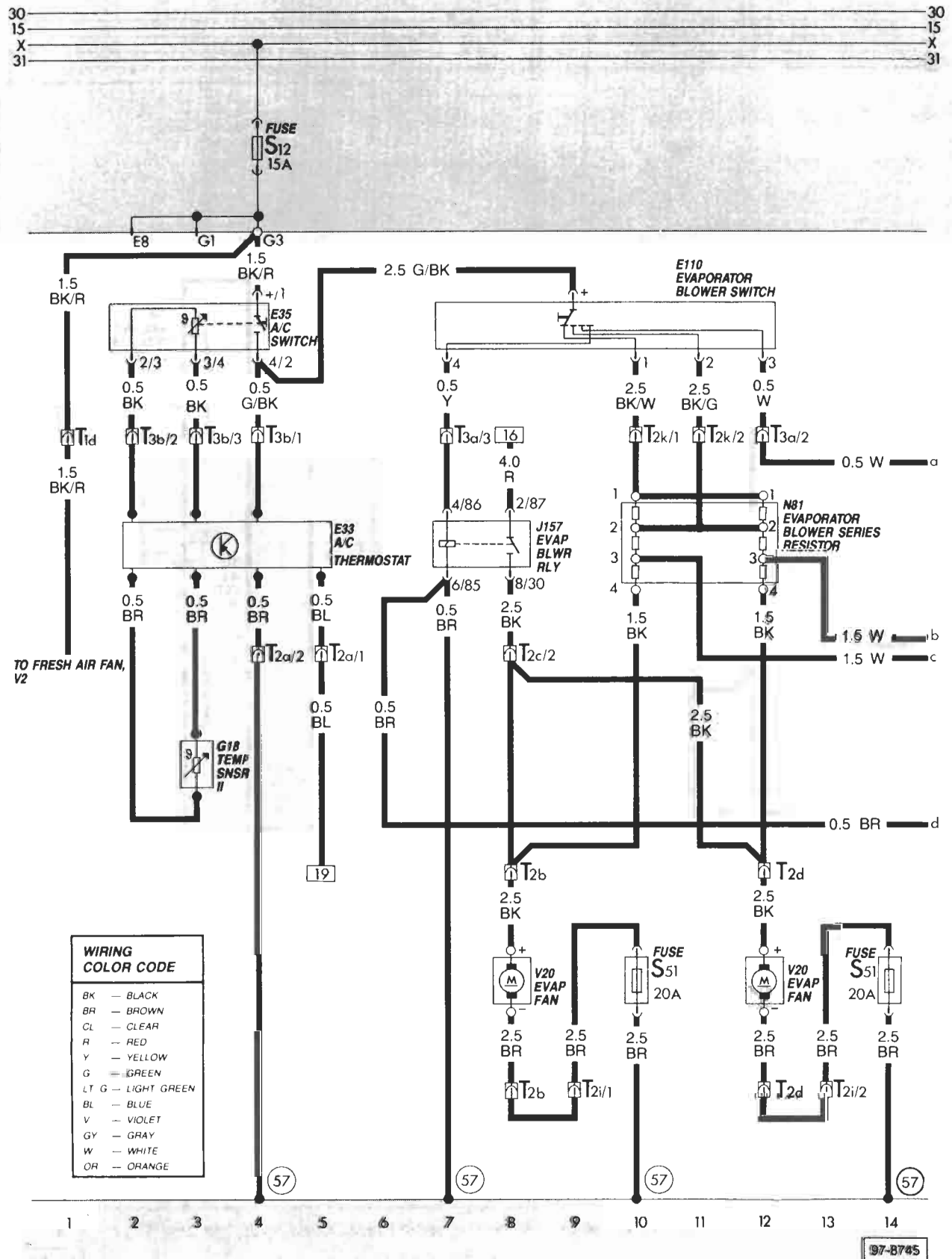
## Wire connectors

- T1 — single, behind instrument panel
- T1a — single, near ignition coil
- T1b — single, behind instrument panel
- T1c — single, behind instrument panel
- T1d — single, behind C-pillar trim
- T2a — double, behind C-pillar trim
- T2b — double, behind C-pillar trim
- T2c — double, behind C-pillar trim
- T2d — double, behind C-pillar trim
- T2e — double, on left rear pillar
- T2f — double, near A/C compressor
- T2g — double, on left rear pillar
- T2h — double, on radiator
- T2i — double, behind C-pillar trim
- T2k — double, behind C-pillar trim
- T3a — three-point, on left rear pillar
- T3b — three-point, on left rear pillar
- T4a — four-point, on left rear pillar
- T4b — four-point, on left rear pillar

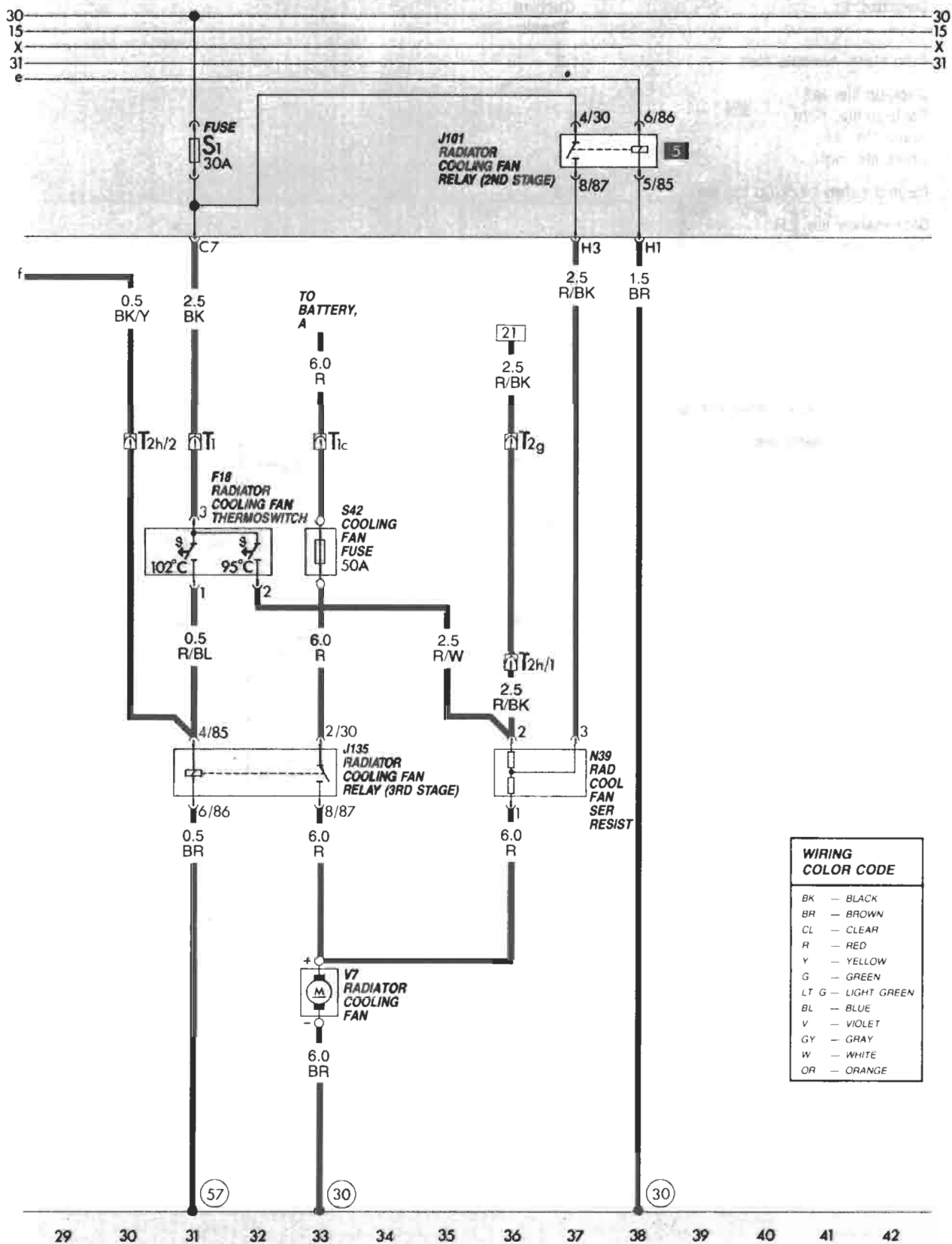
## Ground connections

- ③① — near fuse/relay panel
- ⑤⑦ — on left rear pillar

# Electrical System—Wiring, Waterboxer 97







WIRING COLOR CODE	
BK	— BLACK
BR	— BROWN
CL	— CLEAR
R	— RED
Y	— YELLOW
G	— GREEN
LT G	— LIGHT GREEN
BL	— BLUE
V	— VIOLET
GY	— GRAY
W	— WHITE
OR	— ORANGE

29   30   31   32   33   34   35   36   37   38   39   40   41   42

97-8747

Water-cooled—Digifant from 1989

Air conditioning **97.145**

# 97 Electrical System - Wiring, Waterboxer

Description	Current Track
Auto trans. console lites	1-2
Back-up lite, left	3
Back-up lite, right	5
Brake lite, left	2-3
Brake lite, right	5-6
Neutral safety/back-up lite sw.	2-5
Side marker lite, LR	1
Side marker lite, RR	8
Tail lite, left	2
Tail lite, right	7
Turn sig., LR	2-3
Turn sig., RR	6

## Wire Connectors

T1b — single, wire distributor, eng. compart.

## Ground Connections

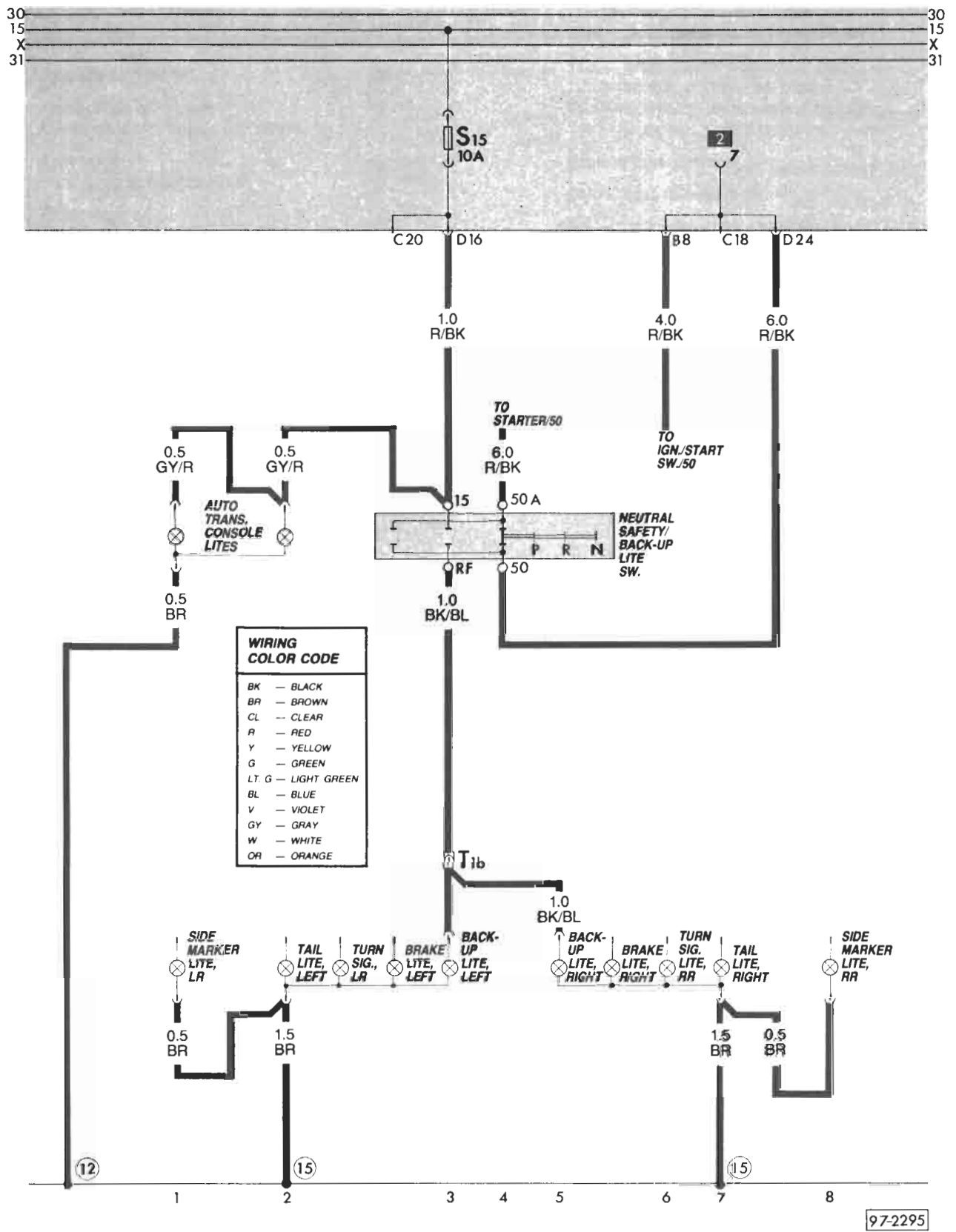
⑫ — on sub-frame, LF

⑮ — eng. compart., under ignition coil

97.146

Automatic transmission

Water-cooled — Digifant 1986–1989



Water-cooled—Digifant 1986—1989

Automatic transmission

## 97.147

Description	Current track
By-pass air blower	7
Combustion air blower	10
Combustion air blower suppressor	12
Fuel pump	9
Fuel pump contact breaker	9
Glow/spark plug	13,14
Glowplug/heater condenser	14
Heater contact breaker	12
Heater indicator lite	3
Heater relay	8-11
Heater relay	5-7
Heater-time temperature control switch	1-4
Heater/combustion sensor	11-13
Heater/overheat control switch	8
Ignition coil	12
Main suppressor	7
Safety switch (relay)	15,16
Temperature sensor (NTC)	17

### Wire connectors

- T1a — single, under instrument panel
- T2 — double, on fresh air blower
- T4a — four-point, under instrument panel
- T4b — four-point, under instrument panel

### Ground connections

- ⑧ — near fuse/relay panel
- ⑱ — on crossmember near fuel pump

Go to next page ↓

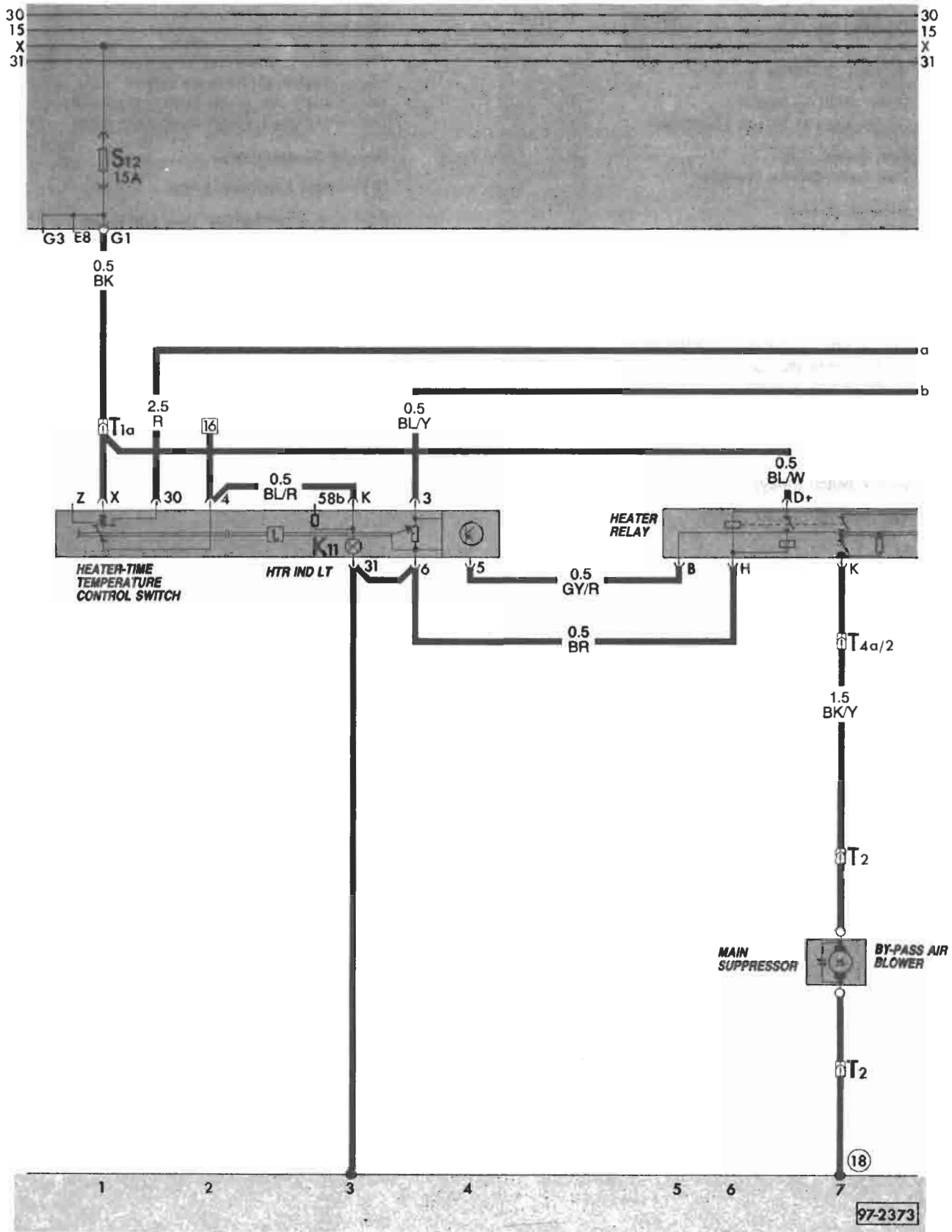
Canada

Water-cooled—Digifant from 1987

Auxiliary heater BA6

# 97.148

# 97 Electrical System - Wiring, Waterboxer

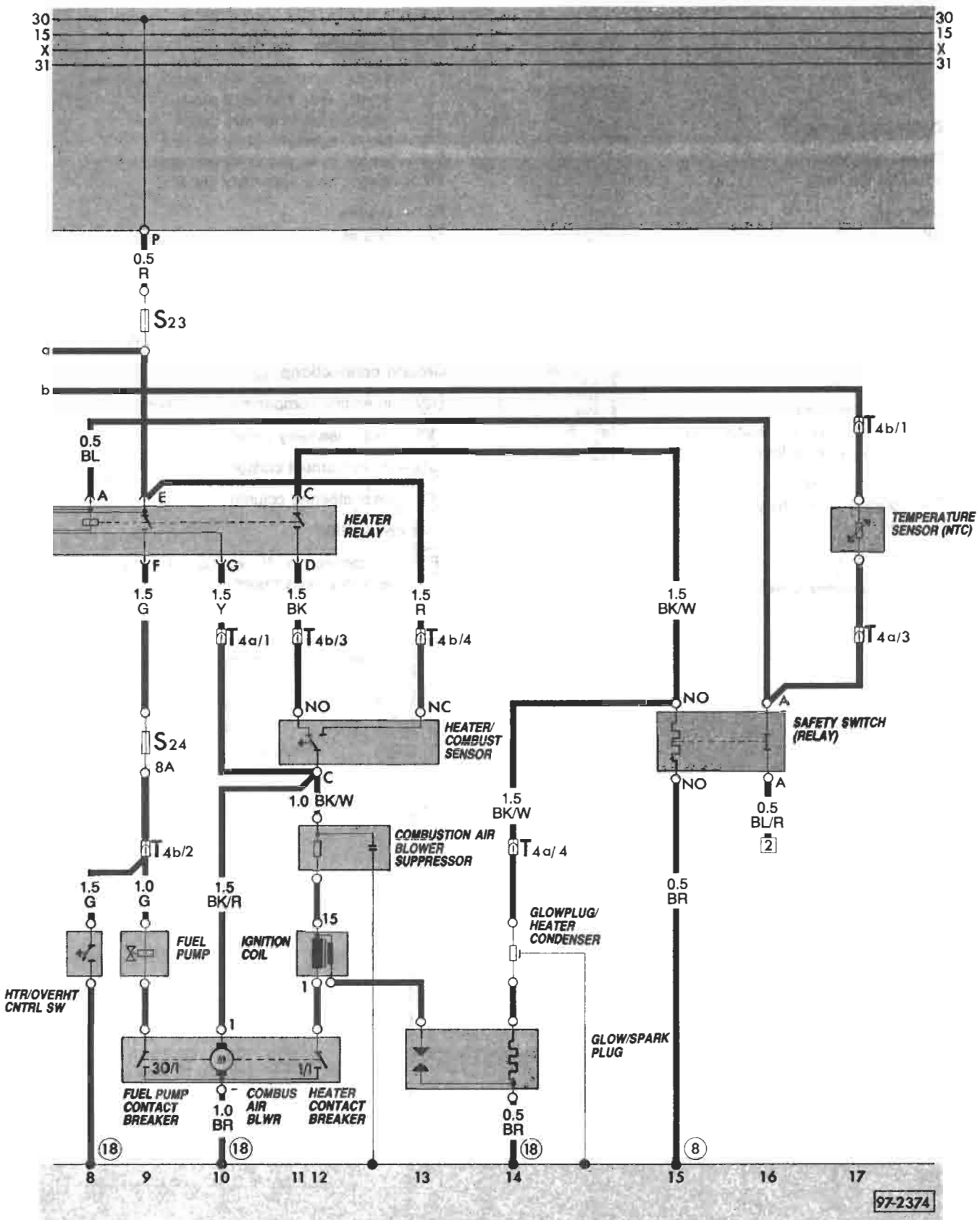


**97.149** Auxiliary heater BA6

Water-cooled Digifant from 1987

Canada





Canada

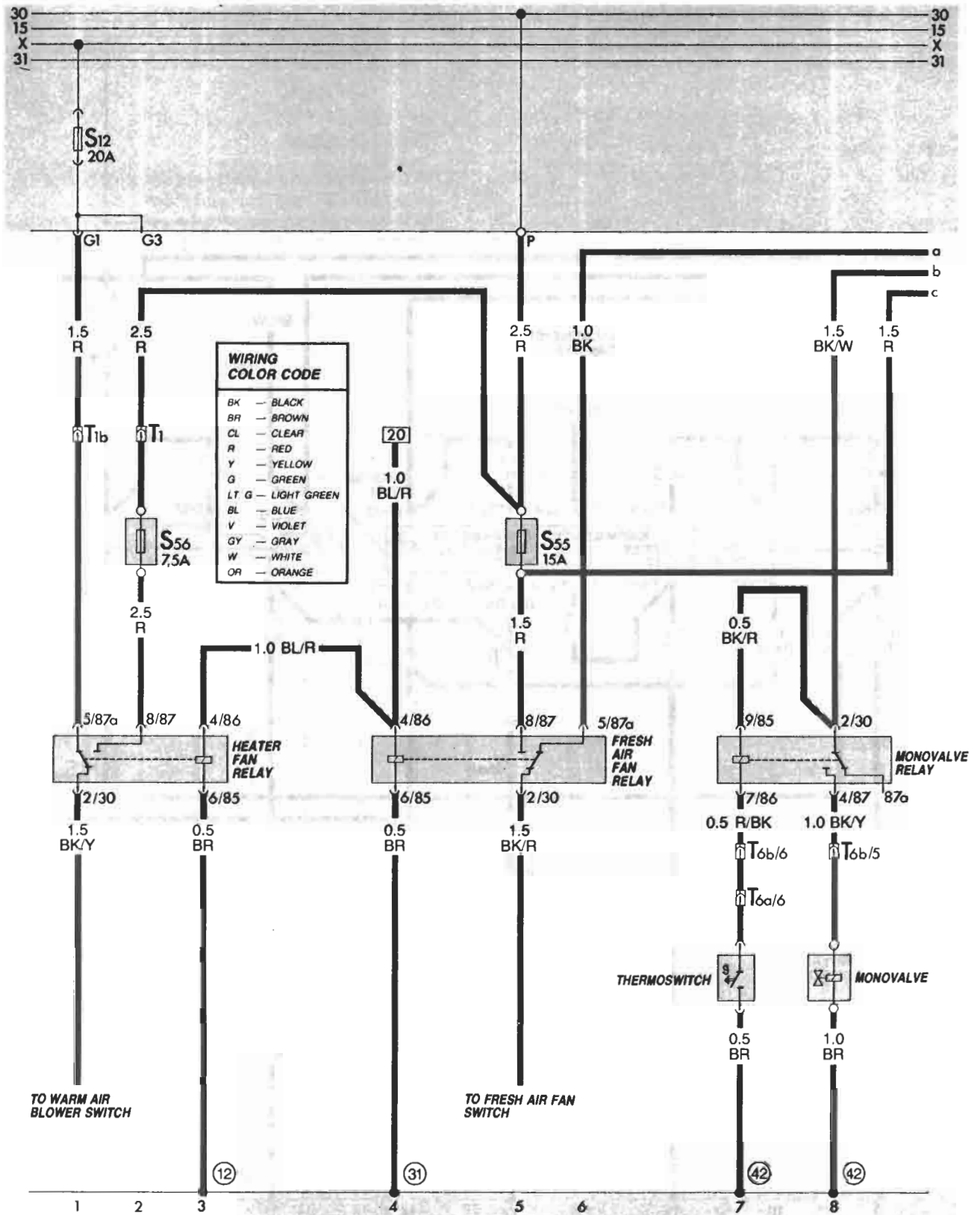
Water-cooled-Digifant from 1987

Auxiliary heater BA6 **97.150**

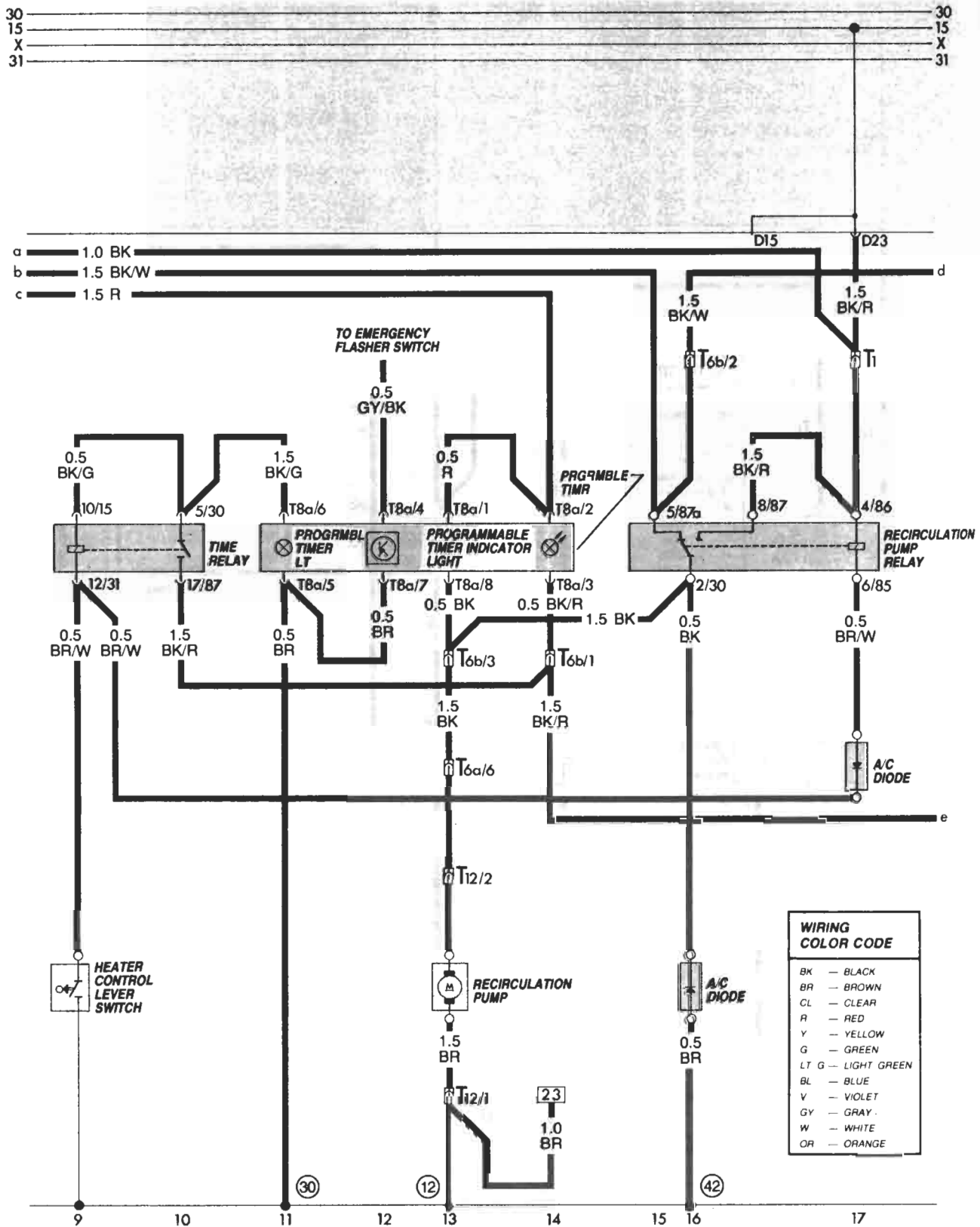
# 97 Electrical System - Wiring, Waterboxer

Description	Current track	Wire connectors
A/C diode	16,17	T1 — single, under instrument panel, right side
Combustion air blower	23	T1a — single, near fuse/relay panel
Flame detector	22	T1b — single, near fuse/relay panel
Fresh air fan relay	4-8	T1d — single, in engine compartment
Glow plug	24	T1e — single, in engine compartment
Glow plug relay	26,27	T1f — single, near fuse/relay panel
Heater control lever switch	9	T2 — double,
Heater control unit	18-24	T2a — double,
Heater fan relay	1-3	T2c — double,
Metering pump	20	T6a — six-point, in engine compartment, left side
Monovalve	8	T6b — six-point, near fuse/relay panel
Monovalve relay	7,8	T12 — twelve-point, on heater control unit
Programmable timer	11-14	<b>Ground connections</b>
Programmable timer indicator light	14	⓫ — in engine compartment, left side
Programmable timer light	11	⓫ — near fuse/relay panel
Recirculation pump	13	⓫ — on instrument cluster
Recirculation pump relay	15-17	⓫ — near steering column
Resistor	23	<b>Plus connection</b>
Series resistor	24	⓫ — + connection (30) wire distributor box, engine compartment
Temperature sensor (NTC)	21	
Thermoswitch	7	
Time relay	9,10	

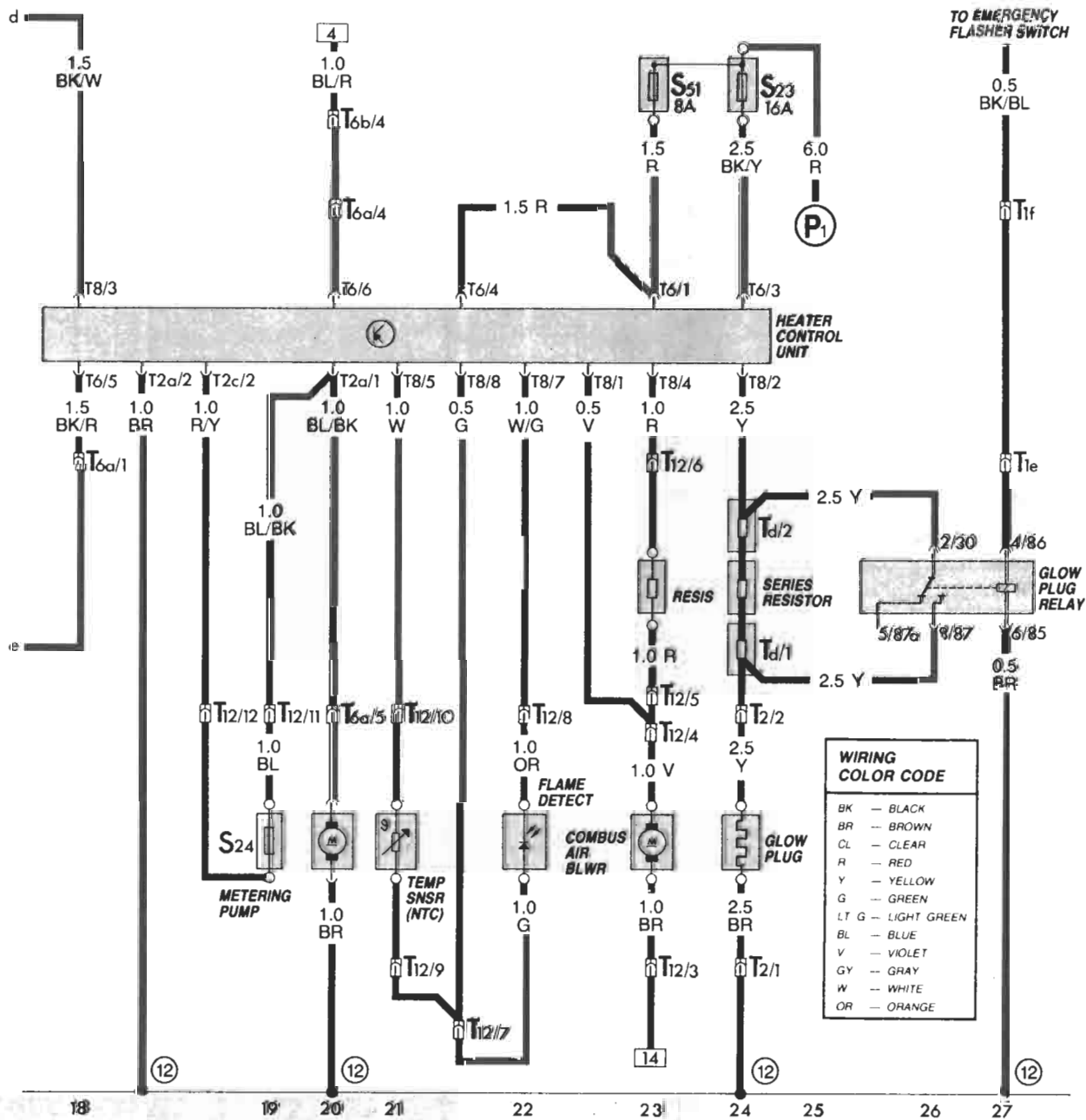
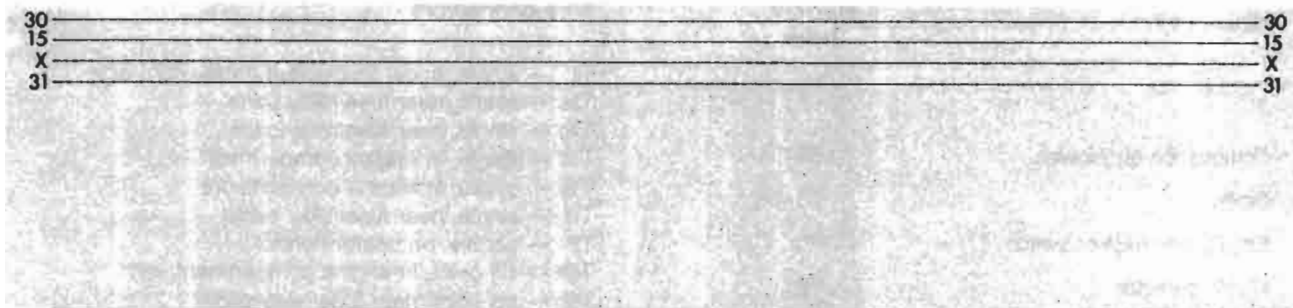
# Electrical System - Wiring, Waterboxer 97



# 97 Electrical System - Wiring, Waterboxer



97-2683



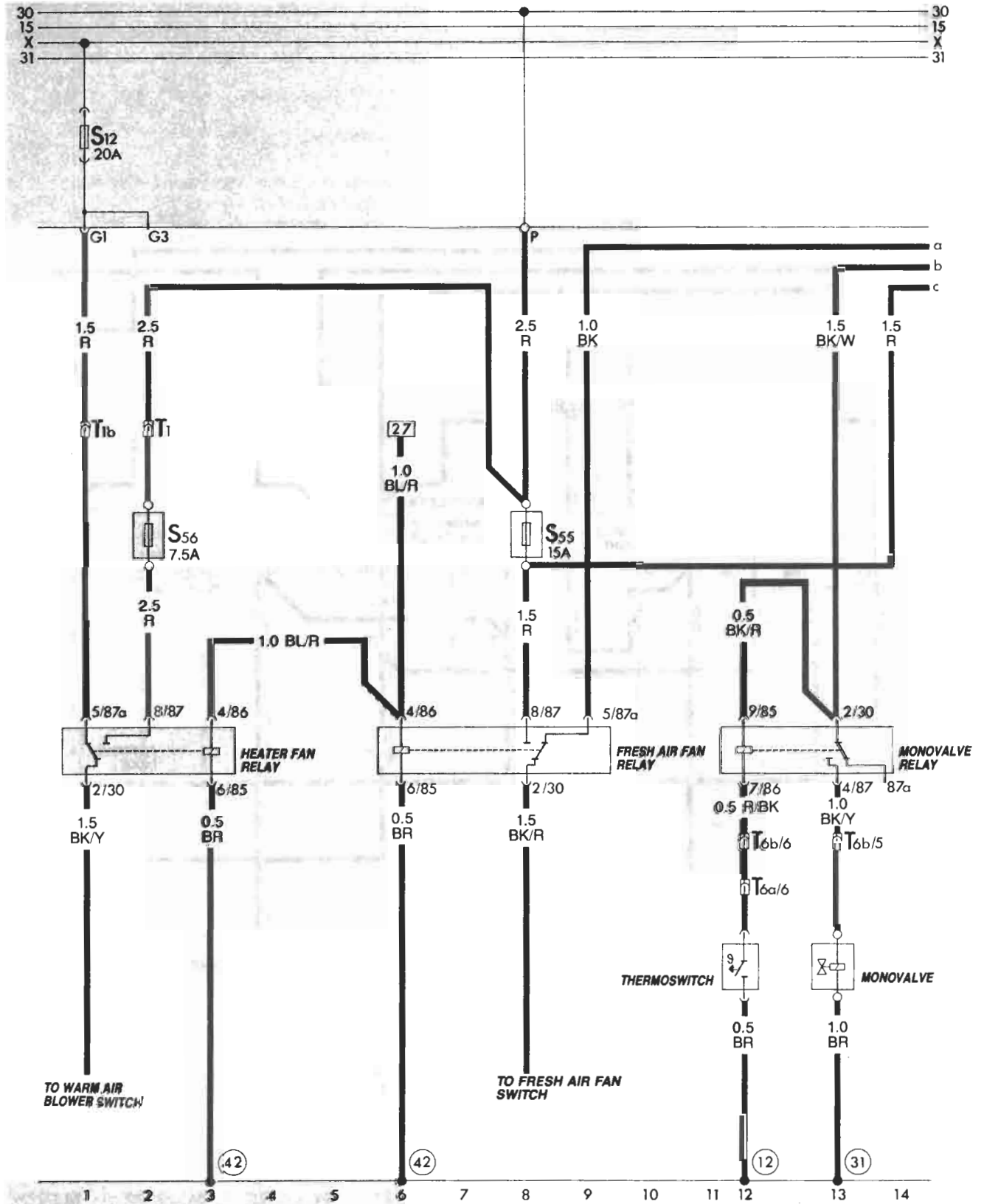
WIRING COLOR CODE	
BK	— BLACK
BR	— BROWN
CL	— CLEAR
R	— RED
Y	— YELLOW
G	— GREEN
LT G	— LIGHT GREEN
BL	— BLUE
V	— VIOLET
GY	— GRAY
W	— WHITE
OR	— ORANGE

97-2684

# 97 Electrical System - Wiring, Waterboxer

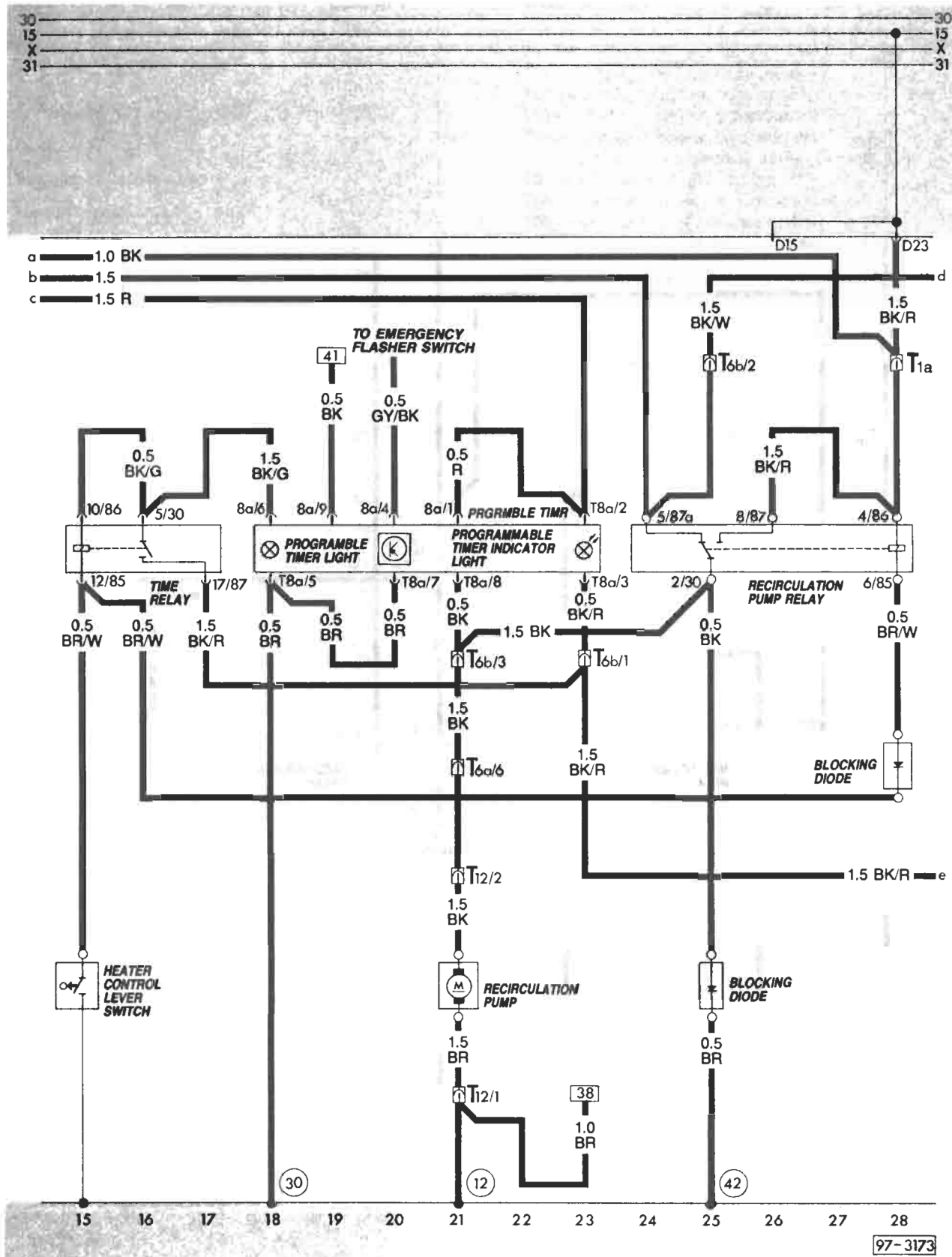
Description	Current track	Wire connectors
Combustion air blower	38	T1 — single, under instrument panel, right side
Diode	25, 28	T1a — single, near fuse/relay panel
Emergency flasher switch	20	T1b — single, near fuse/relay panel
Flame detector	36	T1d — single, in engine compartment
Fresh air fan relay	9	T1e — single, in engine compartment
Fresh air fan switch	8	T1f — single, near fuse/relay panel
Fuse	38	T2 — double, on heater control
Glow plug	39	T6a — six-point, in engine compartment, left
Glow plug relay	40	T6b — six-point, near fuse/relay panel
Heater control lever switch	15	T12 — twelve-point, on heater control
Heater control unit	39	
Heater fan relay	3	
Main heater fuse (16 amp)	39	<b>Plus (+) wiring connections</b>
Metering pump	33	(P1) — in wire distributor, engine compartment
Monovalve	13	
Monovalve relay	14	<b>Ground connections</b>
Overheat fuse	32	(12) — in engine compartment, left side
Programmable timer	21	(30) — near fuse/relay panel
Programmable timer indicator light	22	(31) — on instrument cluster
Programmable timer light	19	(42) — near steering column
Recirculation pump	21	
Recirculation pump relay	27	
Resistor	38	
Temperature sensor (NTC)	34	
Thermoswitch	12	
Time relay	16	

# Electrical System - Wiring, Waterboxer 97



97-3172

# 97 Electrical System - Wiring, Waterboxer



**97.157**

Auxiliary heater  
BBW 46

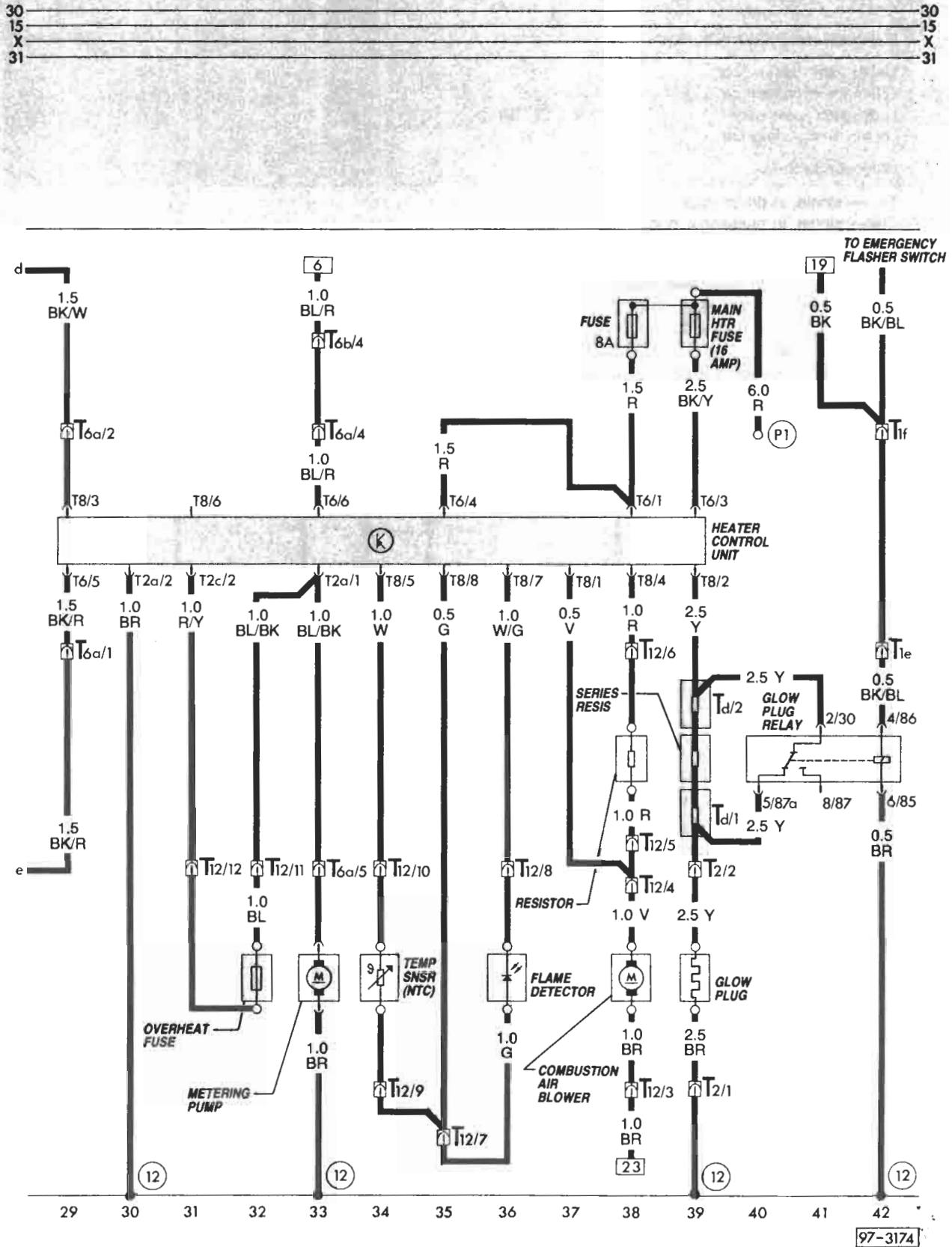
Sincro

Canada

Water-cooled-Digifant from 1989



# Electrical System - Wiring, Waterboxer 97



# 97 Electrical System - Wiring, Waterboxer

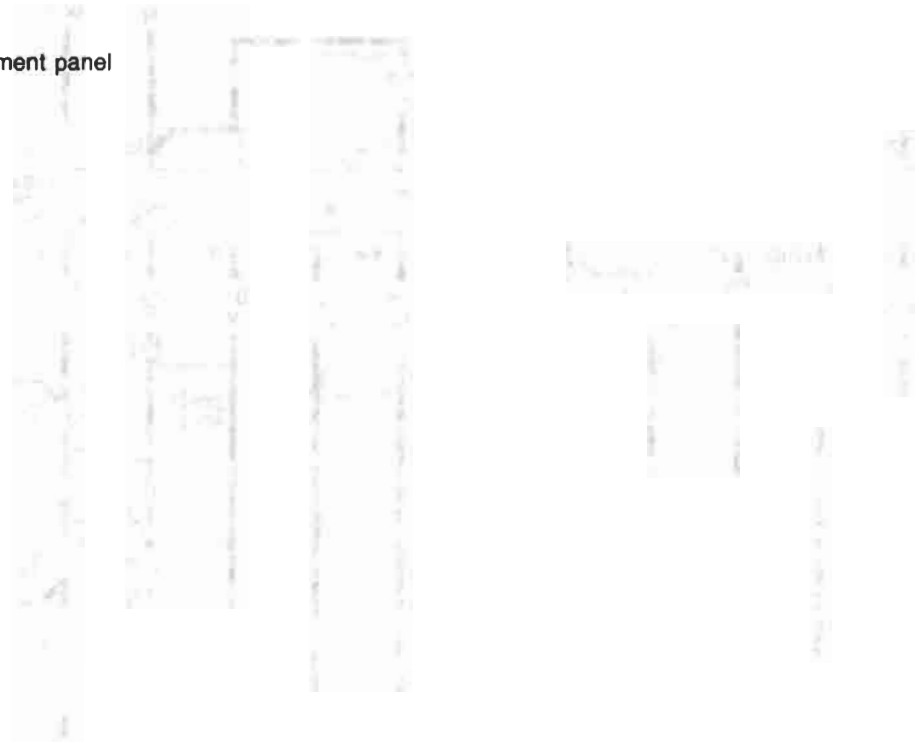
Description	Current track
Door lock contact, sliding door	9-11
Lock motor, driver door	1,2
Lock motor, passenger door	7,8
Lock motor, rear door	12, 13
Lock motor, sliding door	9-11

## Wire connectors

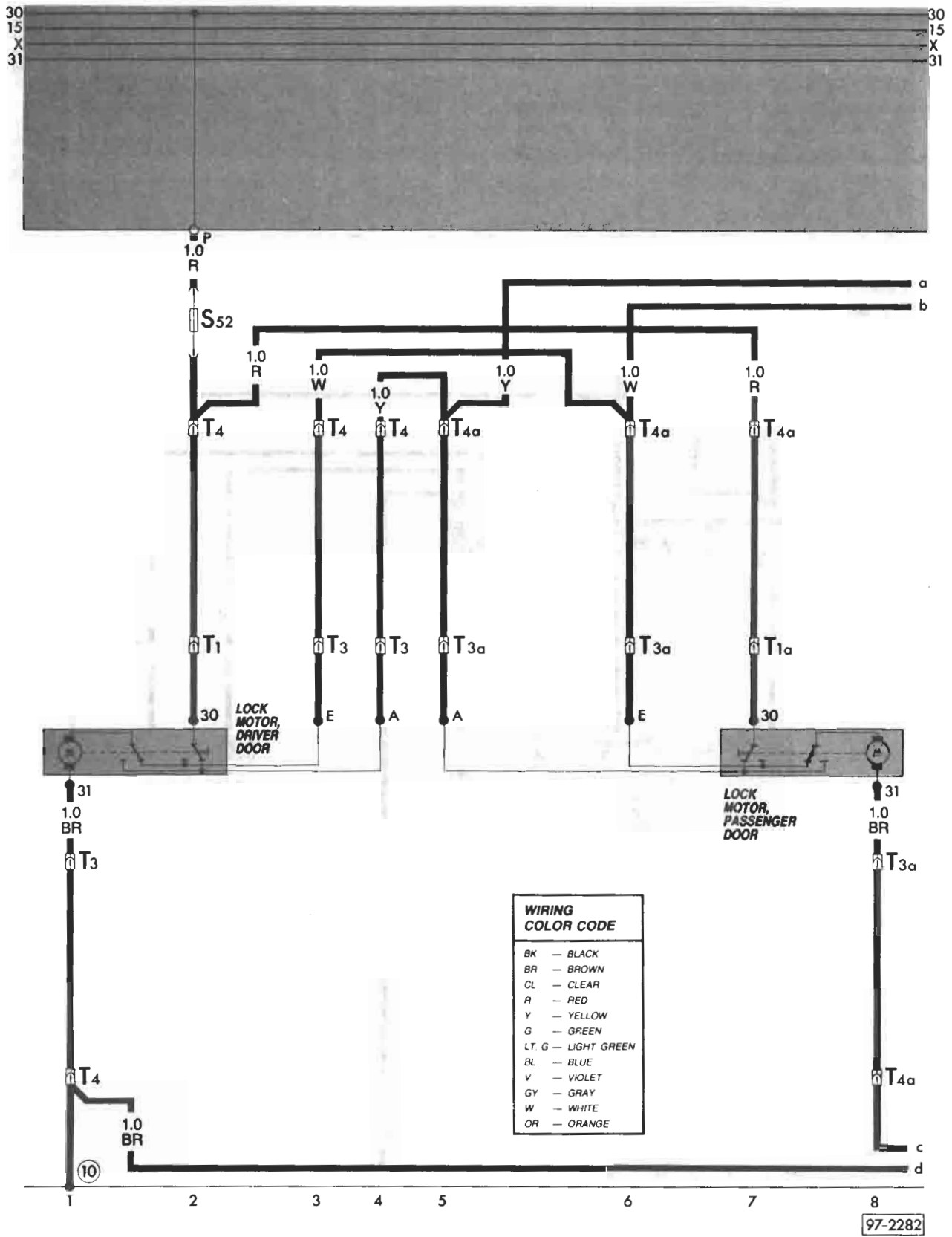
- T1 — single, in driver door
- T1a — single, in passenger door
- T3 — three point, in driver door
- T3a — three point, in passenger door
- T3b — three point, under instrument panel
- T3c — three point, in sliding door
- T3d — three point, in rear door
- T4 — four point, under instrument panel
- T4a — four point, under instrument panel

## Ground connector

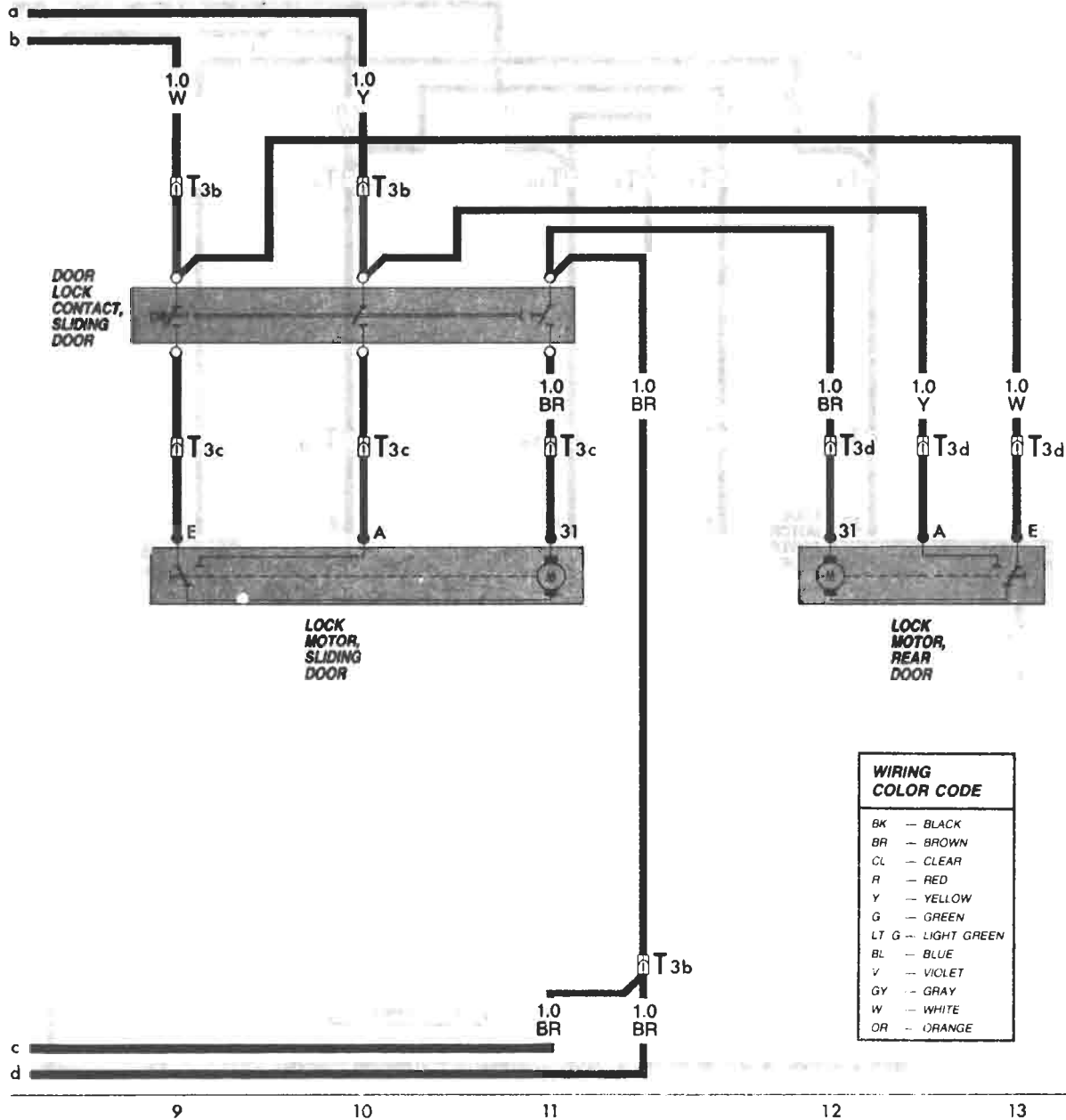
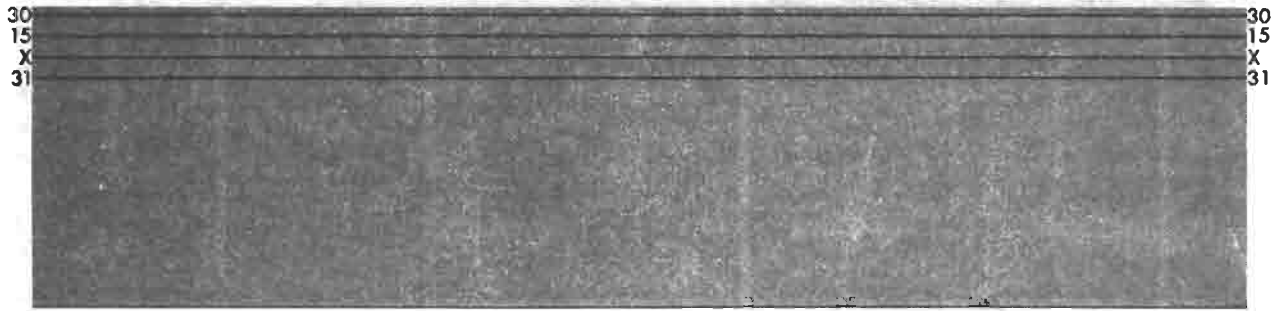
- ⑩ — under instrument panel



Go to next page ▶



# 97 Electrical System - Wiring, Waterboxer



97-2283

# 97 Electrical System - Wiring, Waterboxer

## Description

Central locking system motor, decklid  
 Central locking system motor, driver door  
 Central locking system motor, passenger door  
 Central locking system motor, sliding door  
 Sliding door contact switch

## Current track

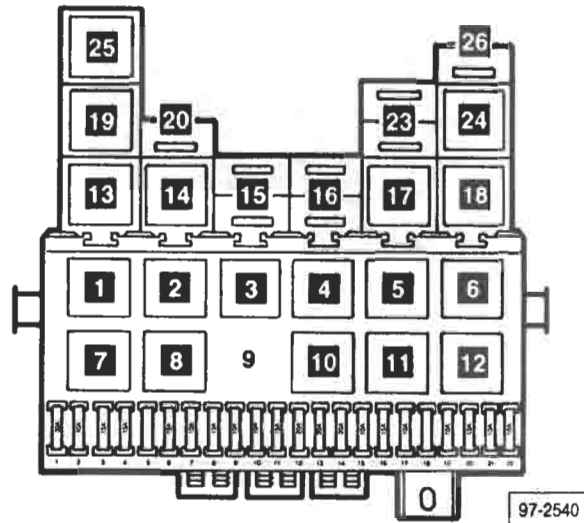
11,12  
 1,2  
 5,6  
 7-9  
 7-10

## Wire connectors

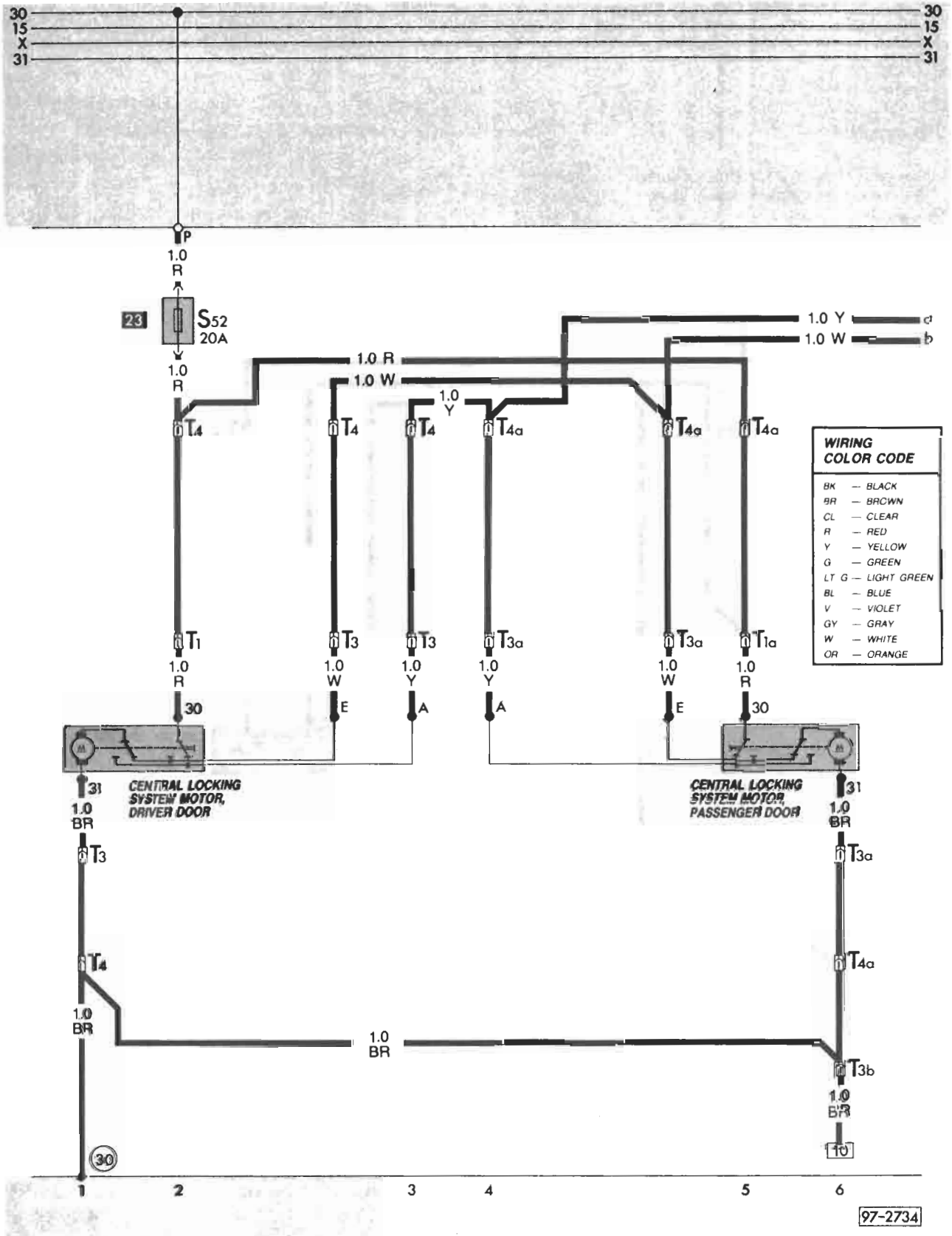
T1 — single, in LF door  
 T1a — single, in RF door  
 T3 — three-point, in LF door  
 T3a — three-point, in RF door  
 T3b — three-point, under inst. panel, right side  
 T3c — three-point, near upper right "B" pillar  
 T3d — three-point, upper half of left rear window  
 T3e — three-point, in rear decklid

## Ground connection

⓪ — near fuse/relay panel

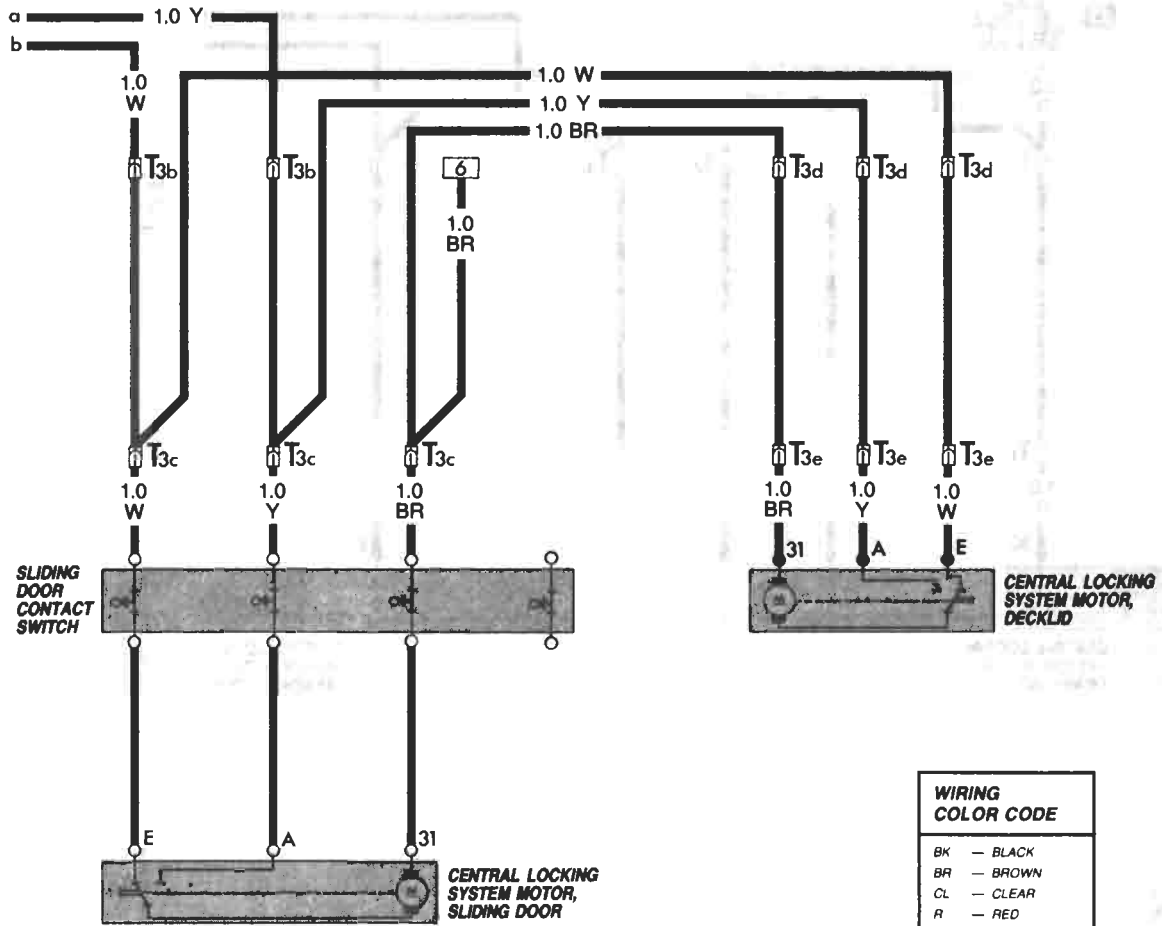


23 — fuse for central locking system



# 97 Electrical System - Wiring, Waterboxer

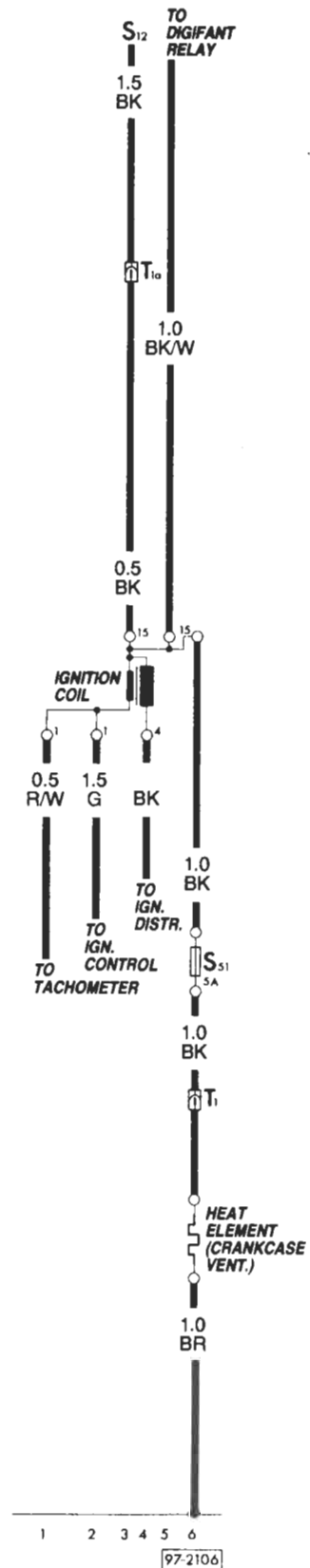
30	30
15	15
X	X
31	31



7	8	9	10	11	12	97-2735
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# Electrical System - Wiring, Waterboxer 97

Description	Current Track
Heat element (crankcase vent)	6
Ignition coil	4-5
<b>Wire connectors</b>	
T1 — in wire distributor	
T1a — in engine compartment	



WIRING COLOR CODE	
BK	— BLACK
BR	— BROWN
CL	— CLEAR
R	— RED
Y	— YELLOW
G	— GREEN
LT G	— LIGHT GREEN
BL	— BLUE
V	— VIOLET
GY	— GRAY
W	— WHITE
OR	— ORANGE



# 97 Electrical System - Wiring, Waterboxer

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Description	Current Track
Heat element (crankcase vent)	4
Ignition coil	2-3

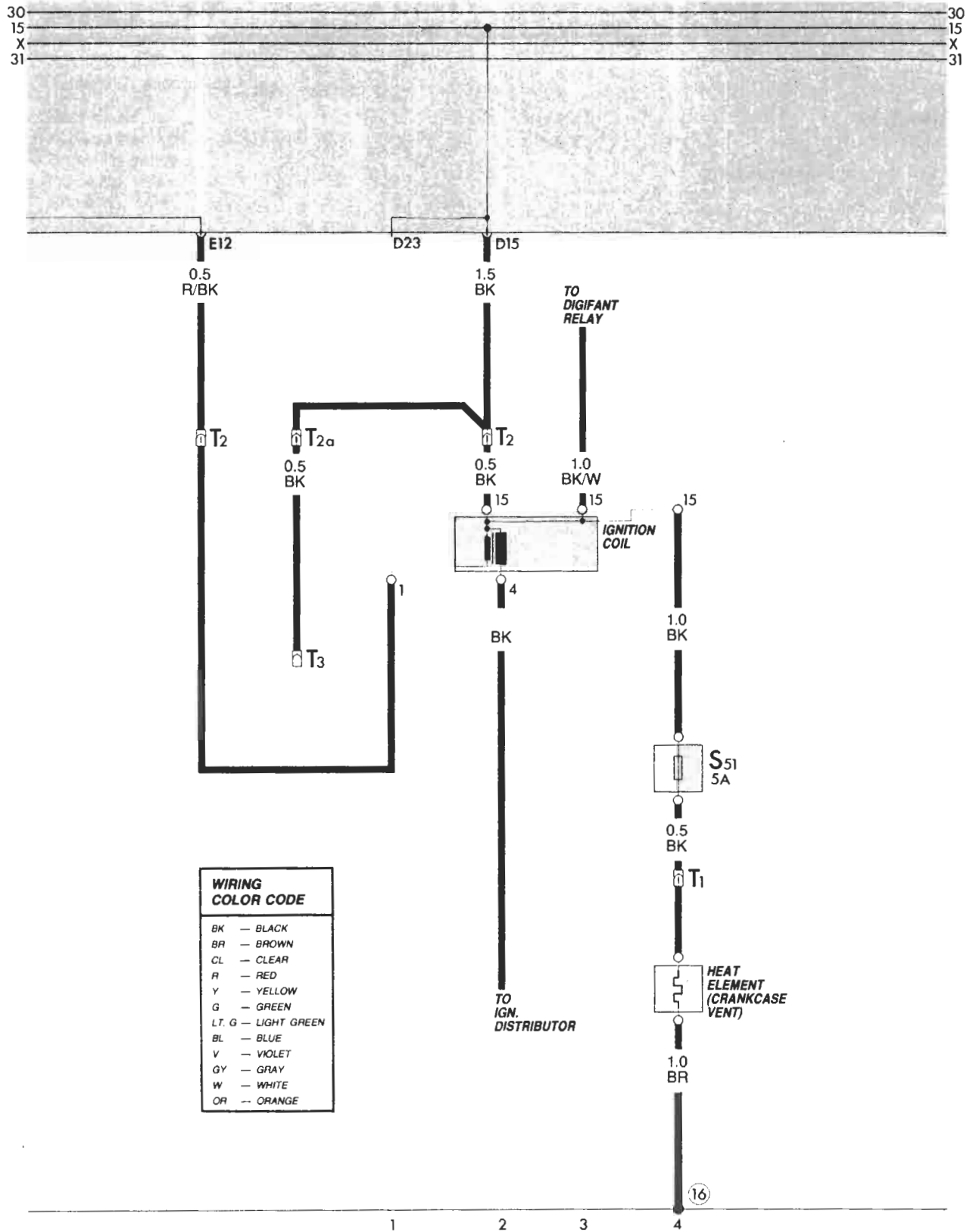
## Wire connectors

- T1 — single, eng. compartment
- T2 — double, wire distributor, eng. compart, LF
- T2a — double, under rear seat, left
- T3 — three-point, under rear seat, right

## Ground connections

- ⑩ — on left cylinder head

# Electrical System - Wiring, Waterboxer 97



97-2349

Water-cooled — Digifant 1986

Crankcase ventilation  
Heat element

97.167

Description	Current track
Automatic transmission console lite	4,5
Automatic transmission relay	12,13
Back-up lite, left	7
Back-up lite, right	6
Brake lite switch	9,10
Brake lite, left	8
Brake lite, right	9
Cruise control inductive sender	16
Cruise control switch	15-17
Cruise control, main control unit	14-18
Starter	2,3
Starter cut-out/back-up lite switch	3,4
Vacuum control motor	17,18
Vacuum vent valve, brake	11

**Wire connectors**

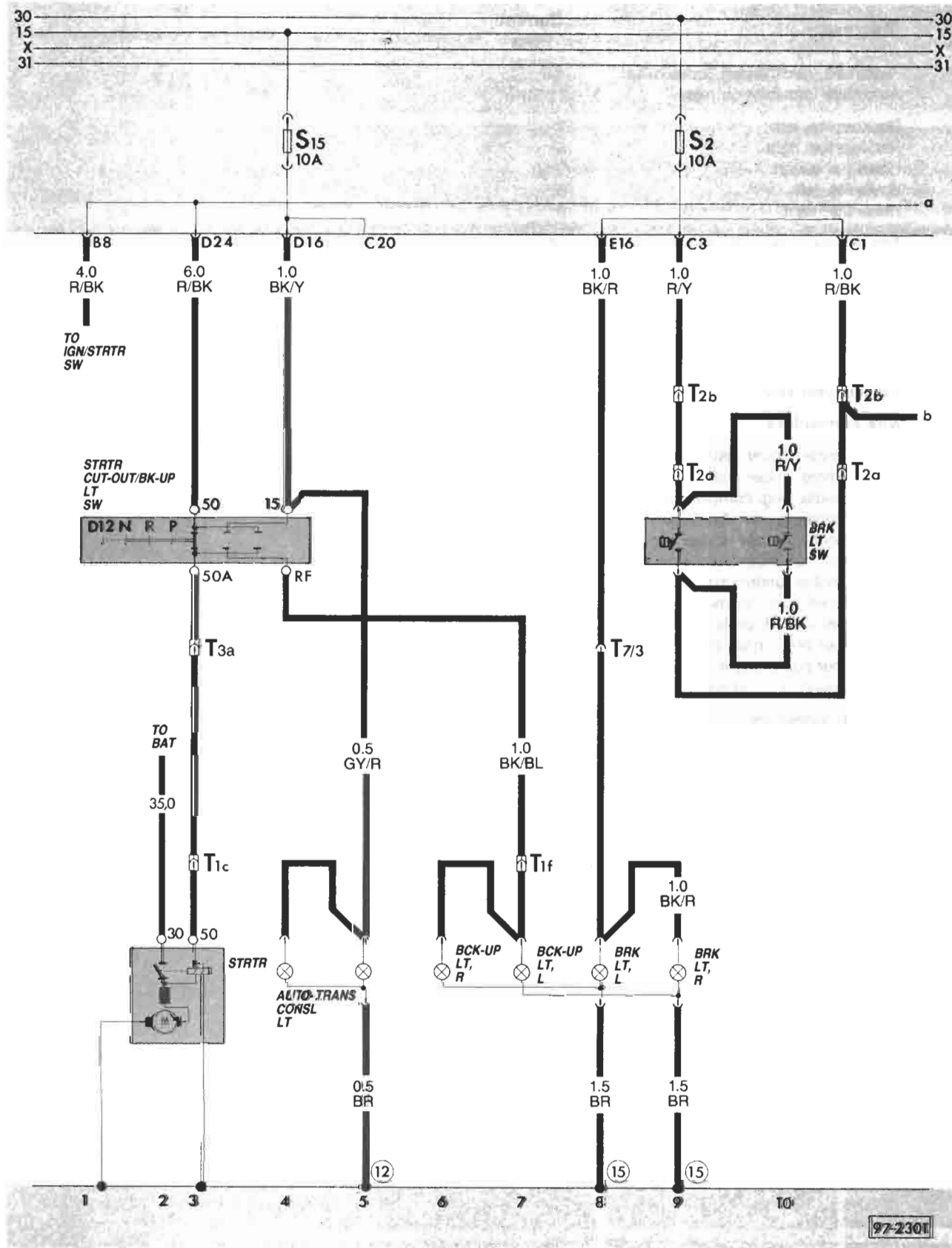
- T1 — single, under instrument panel
- T1a — single, under instrument panel
- T1c — single, eng. compart., near starter
- T1f — single, in wire distributor
- T2 — double, under instrument panel
- T2a — double, under instrument panel
- T2b — double, under instrument panel
- T3 — three point, in eng. compartment
- T3a — three point, under instrument panel
- T4 — four point, near cruise control main control
- T4b — four point, under instrument panel
- T7/ — seven point, in wire distributor box

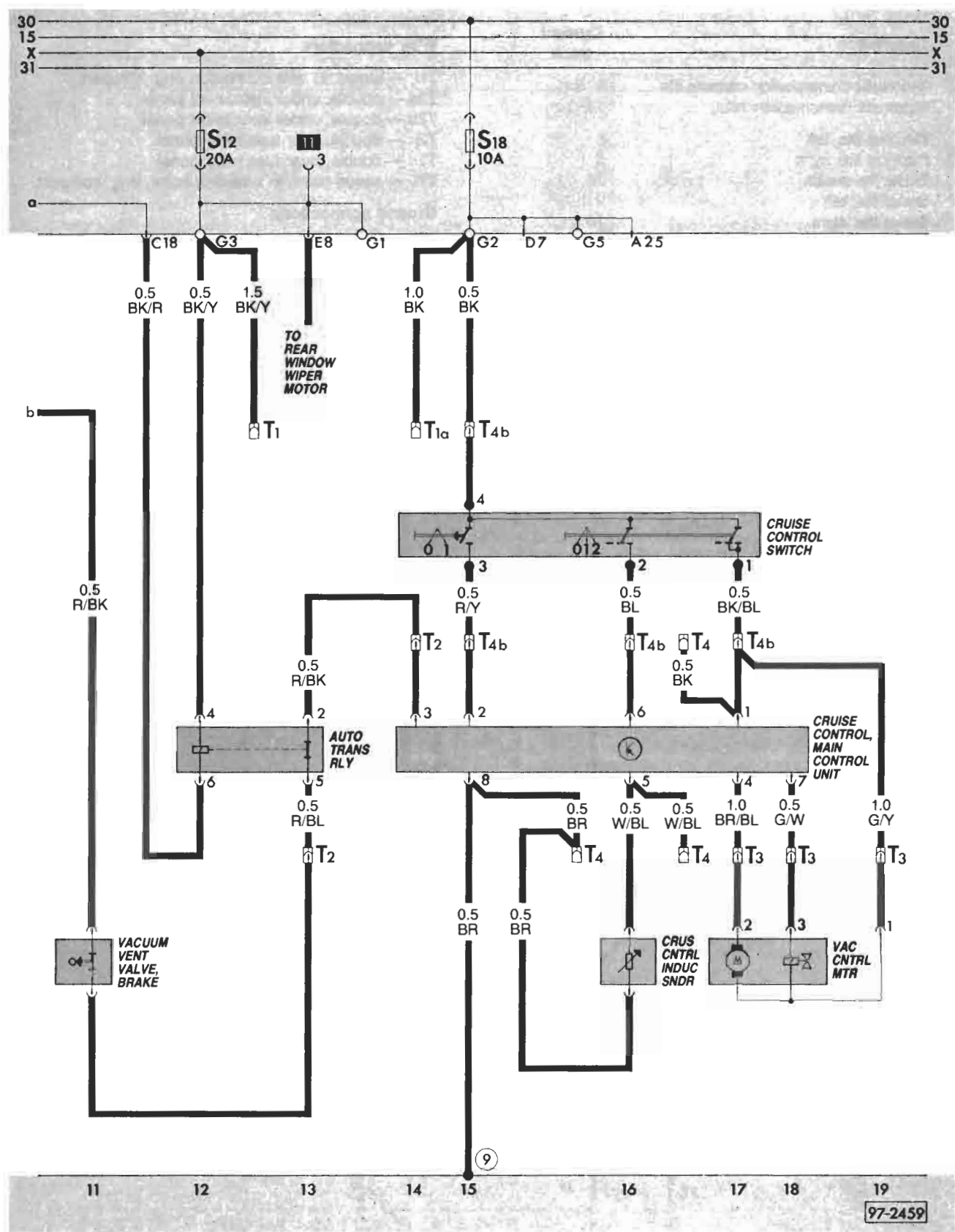
**Ground connections**

- ⑨ — under instrument panel
- ⑫ — on left front crossmember
- ⑮ — in eng. compart., under ign. coil

Go to next page ▶

# 97 Electrical System - Wiring, Waterboxer





Auto. trans.

Water-cooled - Digifant 1986

Cruise control

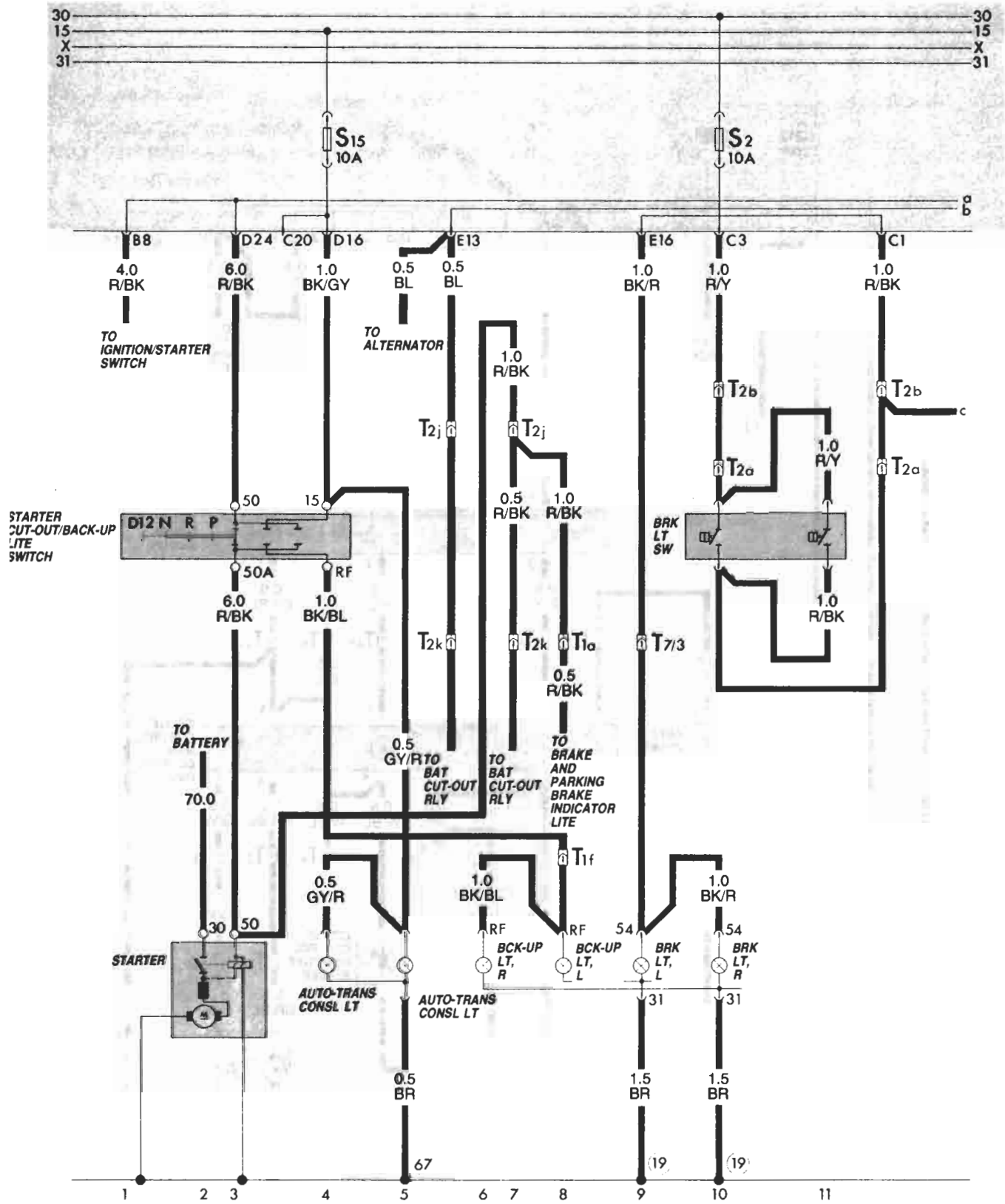
# 97.170

97-2459

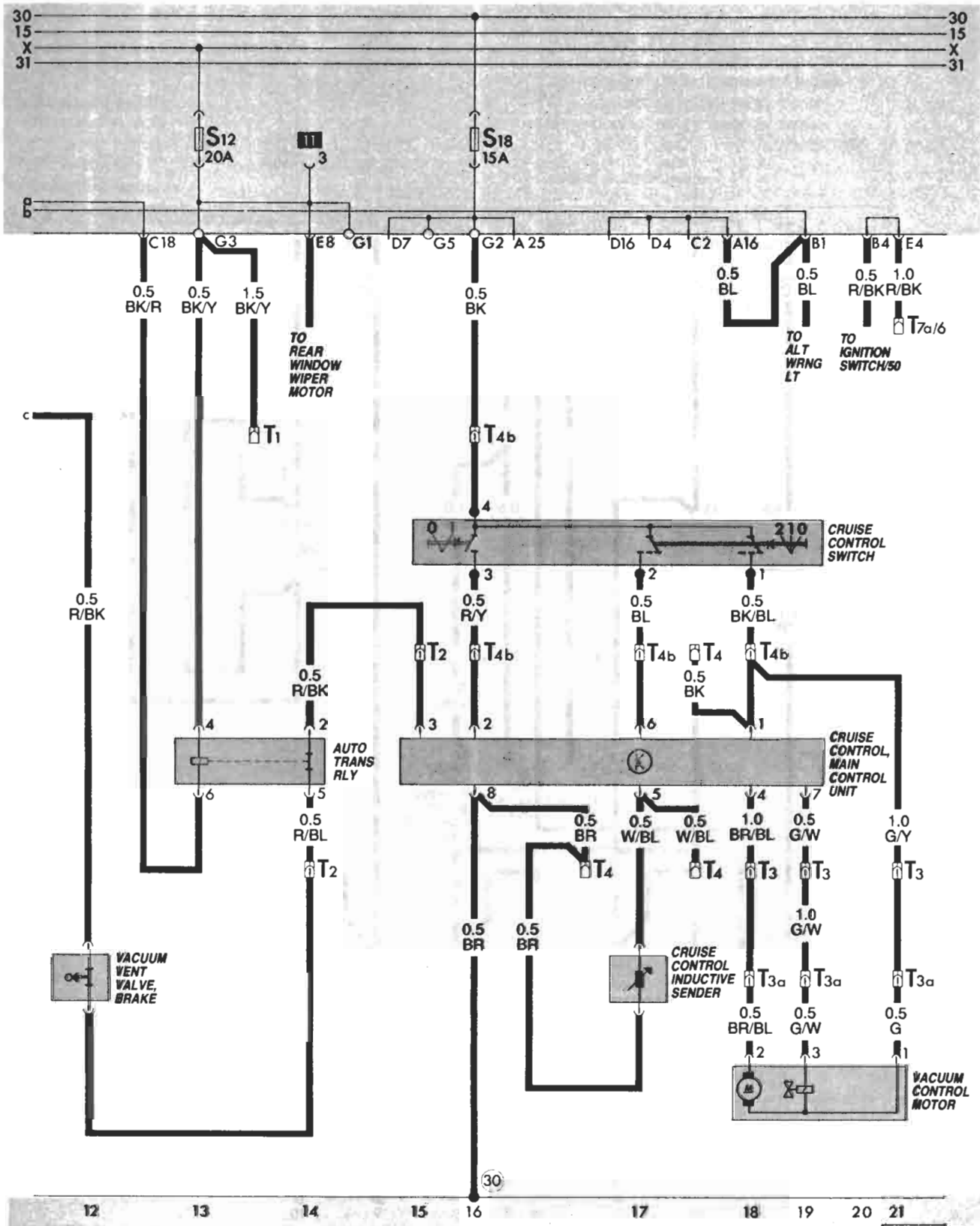
# 97 Electrical System - Wiring, Waterboxer

Description	Current track	Wire connectors
Automatic transmission console lite	4, 5	T1f — single, in wire distributor, eng. compart.
Automatic transmission relay	13, 14	T2a — double, under instrument panel
Back-up lite, left	8	T2b — double, under instrument panel
Back-up lite, right	6	T2j — double, near fuse/relay panel
Brake lite switch	10, 11	T2k — double, near fuse/relay panel
Brake lite, left	9	T7l — seven point, in wire distributor, eng. compart.
Brake lite, right	10	
Cruise control inductive sender	17	<b>Ground connections</b>
Cruise control switch	15-19	①9 — in engine compart., left
Cruise control, main control unit	15-19	①67 — on left front crossmember
Starter	1-3	
Starter cut-out/back-up lite switch	1-4	
Vacuum control motor	18-21	
Vacuum vent valve, brake	12	

# Electrical System - Wiring, Waterboxer 97



# 97 Electrical System - Wiring, Waterboxer



97-2533



Description	Current Track
Brake lite, left	1
Brake lite, right	3
Brake lite, switch	2-3
Cruise control main control	4-9
Cruise control switch	5-9
Inductive sender	6
Vacuum control motor	8-10
Vacuum vent valve, brake pedal	4
Vacuum vent valve, clutch pedal	4

#### Wire Connectors

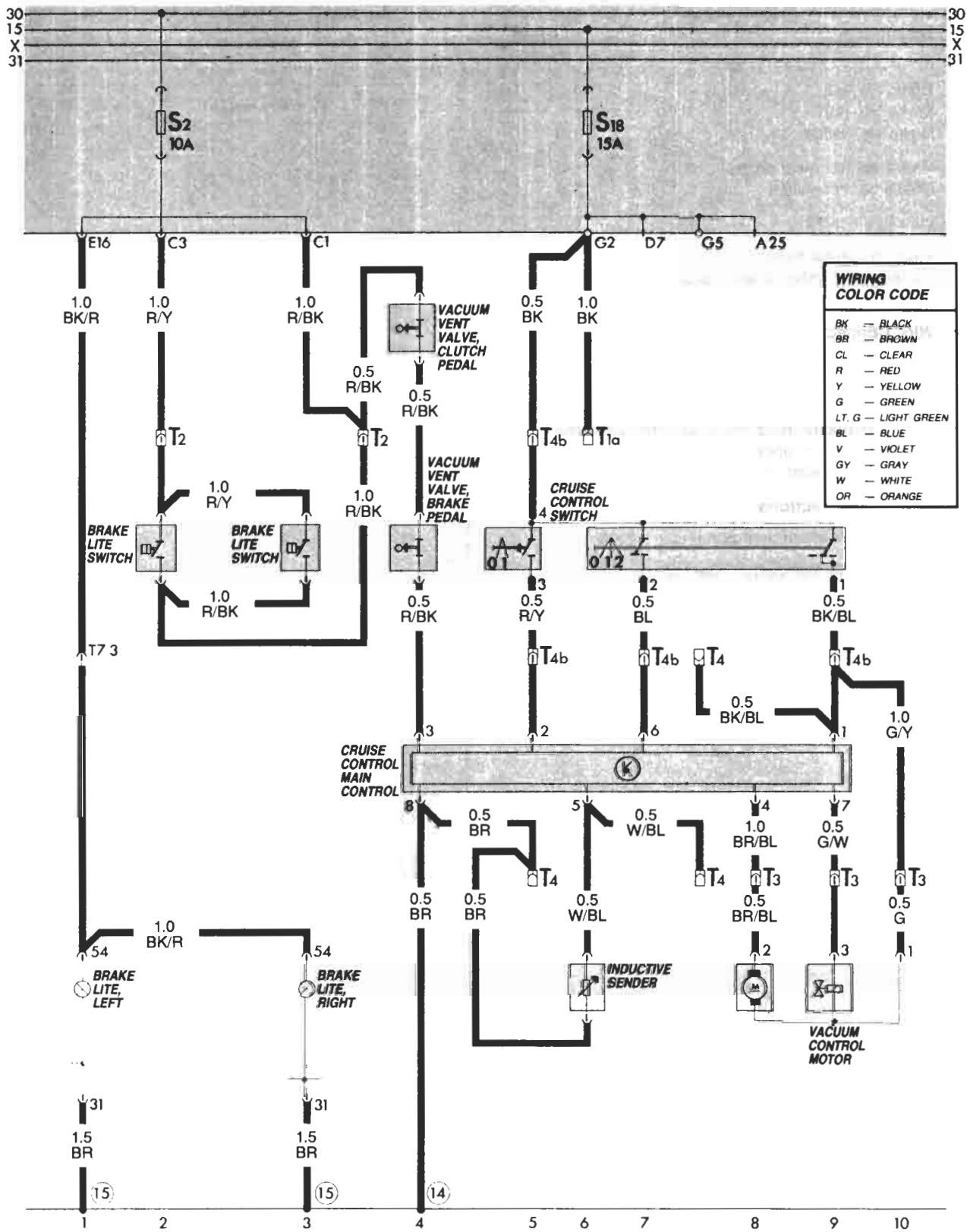
- T1a — single, under instrument panel
- T2 — double, under instrument panel
- T3 — three-point, in eng. compart.
- T4 — four-point, near cruise control main control
- T4b — four-point, under instrument panel
- T7/ — seven-point, in wire distributor box

#### Ground Connections

- ⑭ — under instrument panel
- ⑮ — in eng. compart., under coil

Go to next page: ♦

# 97 Electrical System - Wiring, Waterboxer



97-2193

## Description

Brake lite switch  
 Brake lite, left  
 Brake lite, right  
 Cruise control inductive sender  
 Cruise control switch  
 Cruise control, main control unit  
 Vacuum control motor  
 Vacuum vent valve, brake  
 Vacuum vent valve, clutch

## Current track

2, 3  
 1  
 3  
 7  
 5-9  
 5-9  
 8  
 4  
 4

## Wire connectors

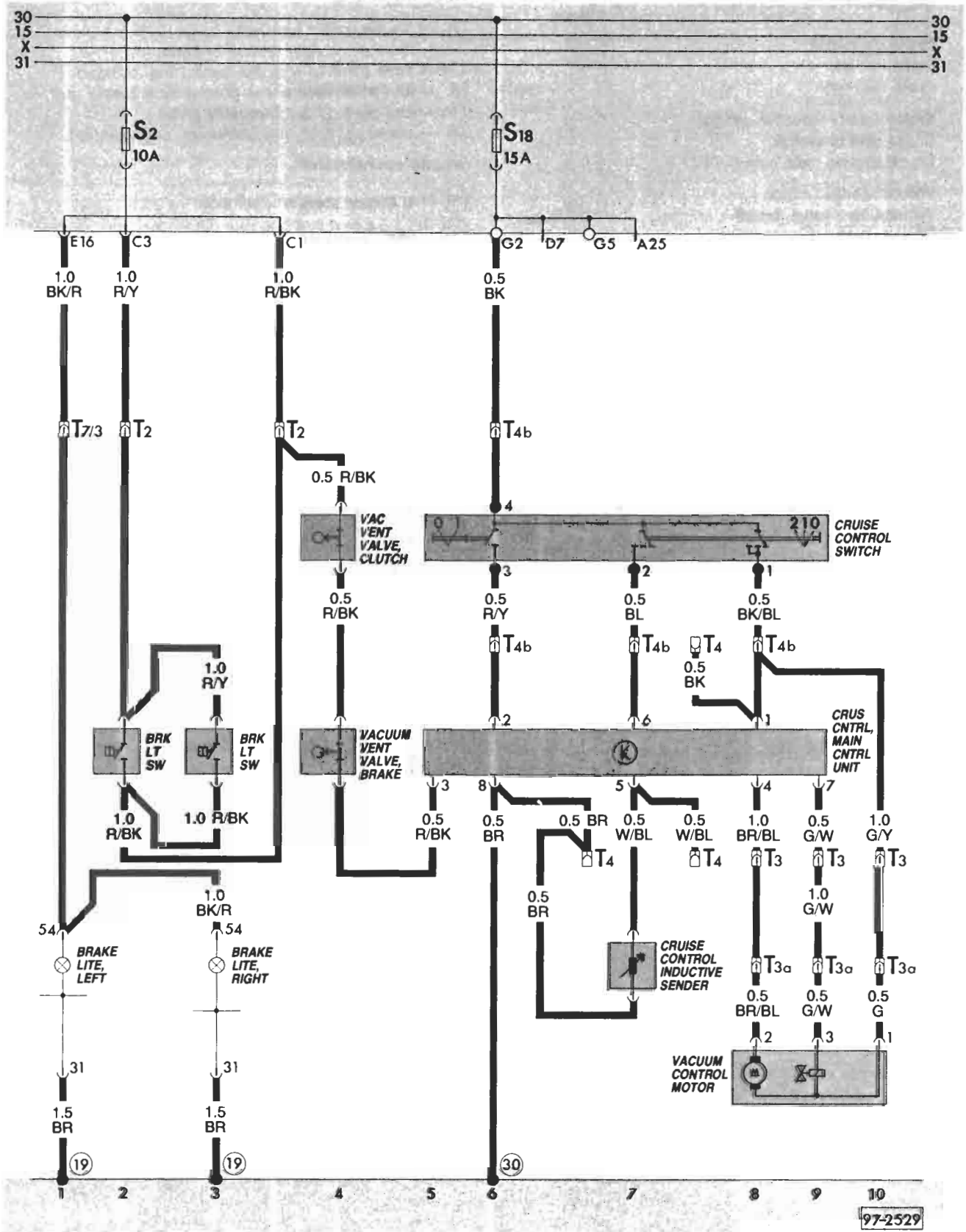
T2 — double, under fuse/relay panel  
 T3 — three point, near fuse/relay panel  
 T3a — three point, in wire distributor, eng. compart.  
 T4 — four point, near cruise control main control unit  
 T4b — four point, under fuse/relay panel  
 T7I — seven point, in wire distributor, eng. compart.

## Ground connections

①9 — in engine compart., left side  
 ③0 — near fuse/relay panel



# 97 Electrical System - Wiring, Waterboxer



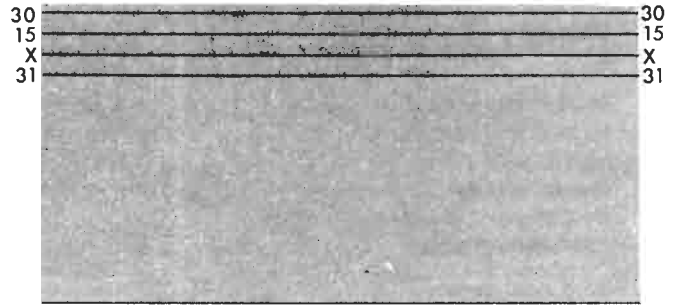
Description	Current track
Differential lock indicator lite	2
Differential lock switch	2

**Wire connectors**

- T3 — three point, under instrument panel
- T3a — three point, under inst. panel, near fuse/relay panel

**Ground connections**

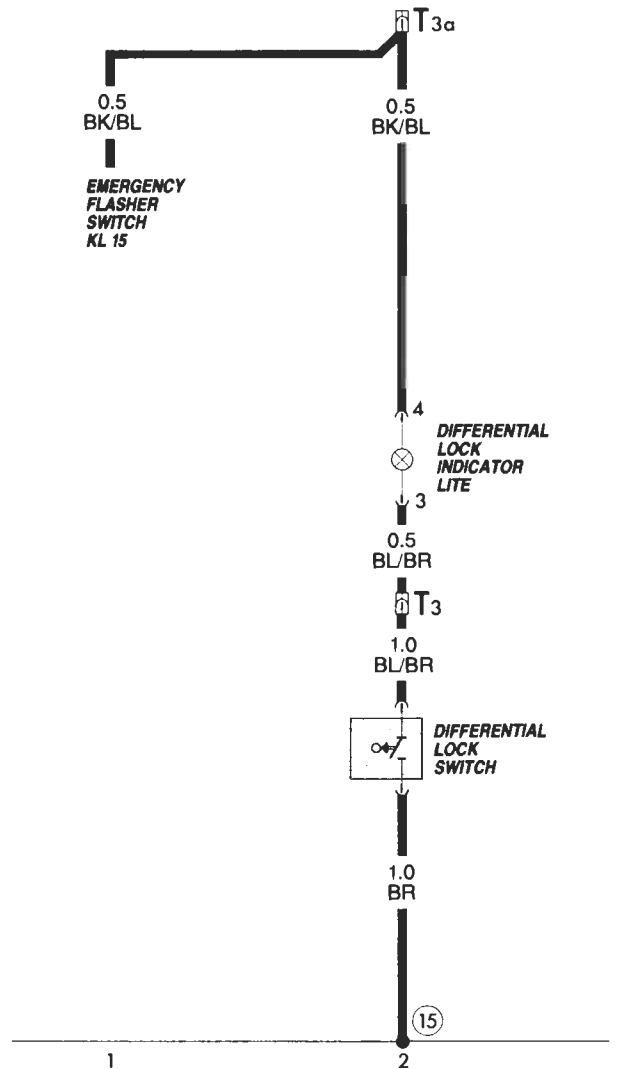
- ⑮ — in eng. compart, under ign. coil



**Note**

Differential switches on instrument panel are vacuum operated and do not appear on the wiring diagram.

WIRING COLOR CODE	
BK	— BLACK
BR	— BROWN
CL	— CLEAR
R	— RED
Y	— YELLOW
G	— GREEN
LT G	— LIGHT GREEN
BL	— BLUE
V	— VIOLET
GY	— GRAY
W	— WHITE
OR	— ORANGE



97-2333

# 97 Electrical System - Wiring, Waterboxer

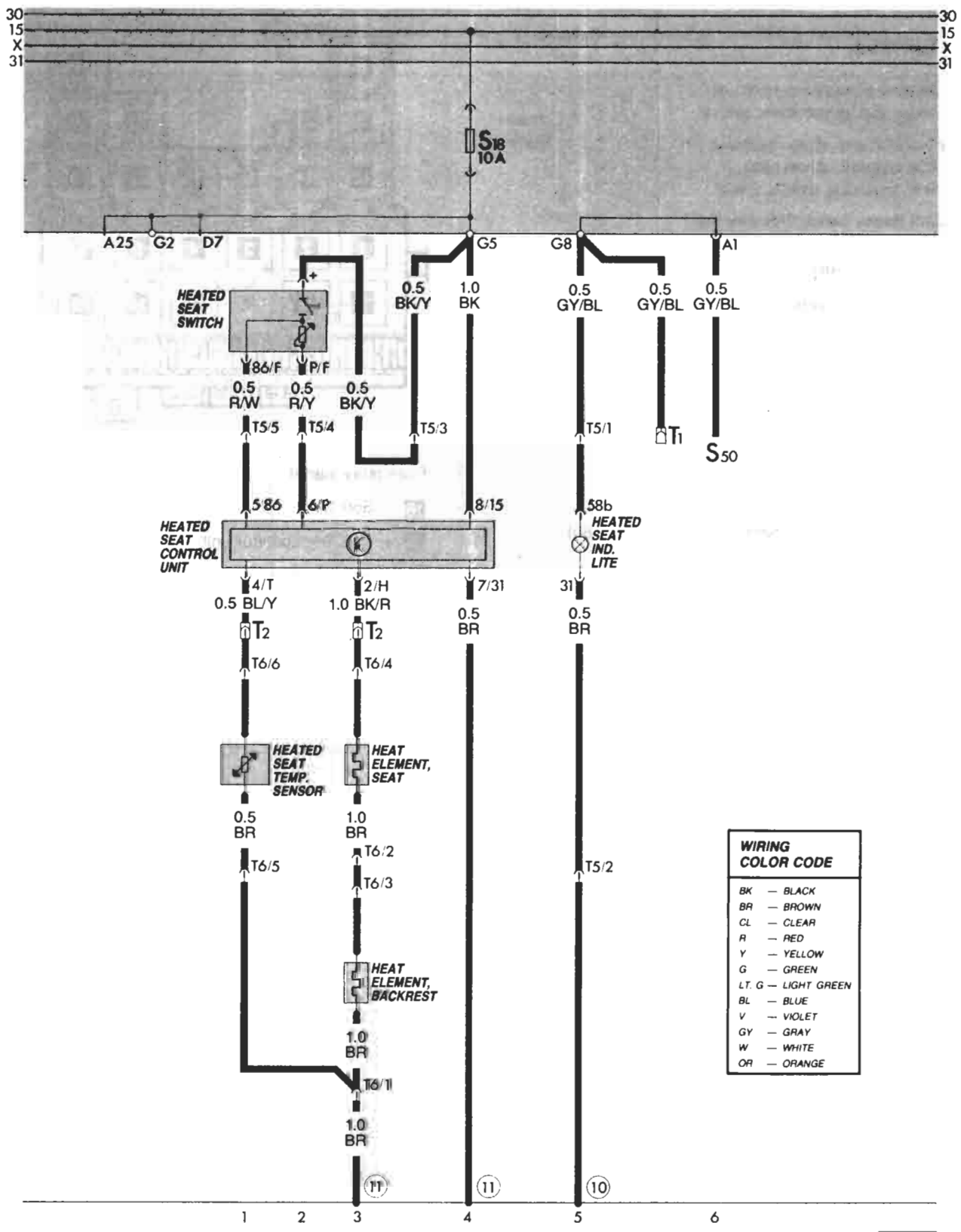
Description	Current Track
Heated seat control unit	1-4
Heated seat indicator lite	5
Heated seat switch	1-2
Heated seat temp. sensor	1
Heat element, backrest	3
Heat element, seat	3

## Wire connectors

- T1 — single, behind instrument panel
- T2 — double, behind instrument panel
- T5/ — five-point, behind instrument panel
- T6/ — six-point, behind instrument panel

## Ground connections

- ⑩ — behind inst. panel, near fuse/relay panel
- ⑪ — behind instrument panel



WIRING COLOR CODE	
BK	— BLACK
BR	— BROWN
CL	— CLEAR
R	— RED
Y	— YELLOW
G	— GREEN
LT. G	— LIGHT GREEN
BL	— BLUE
V	— VIOLET
GY	— GRAY
W	— WHITE
OR	— ORANGE

97-2191

# 97 Electrical System - Wiring, Waterboxer

## Description

Driver seat heater control unit  
 Driver seat temperature sensor  
 Heat element, driver backrest  
 Heat element, driver seat  
 Heat regulating switch, driver  
 Seat heater switch indicator lite

## Current track

3-6  
 3  
 5  
 4  
 3,4  
 2

## Wire connectors

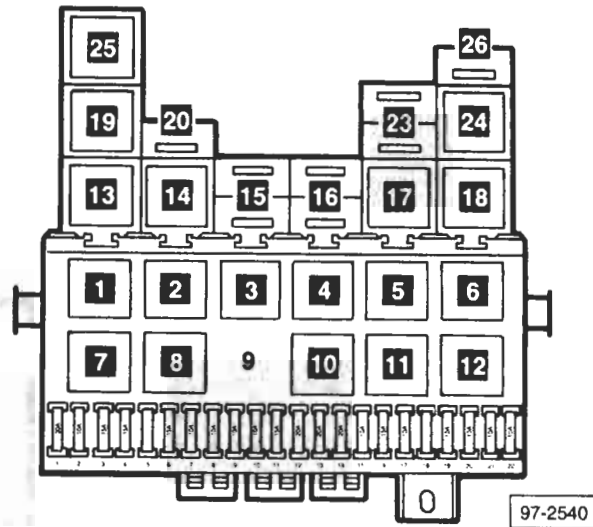
T1 — single, under fuse/relay panel  
 T1a — single, under fuse/relay panel  
 T2 — double, under instrument panel  
 T6 — six-point, under left front seat

## Ground connections

⓪ — near fuse/relay panel

## Plus (+) connections

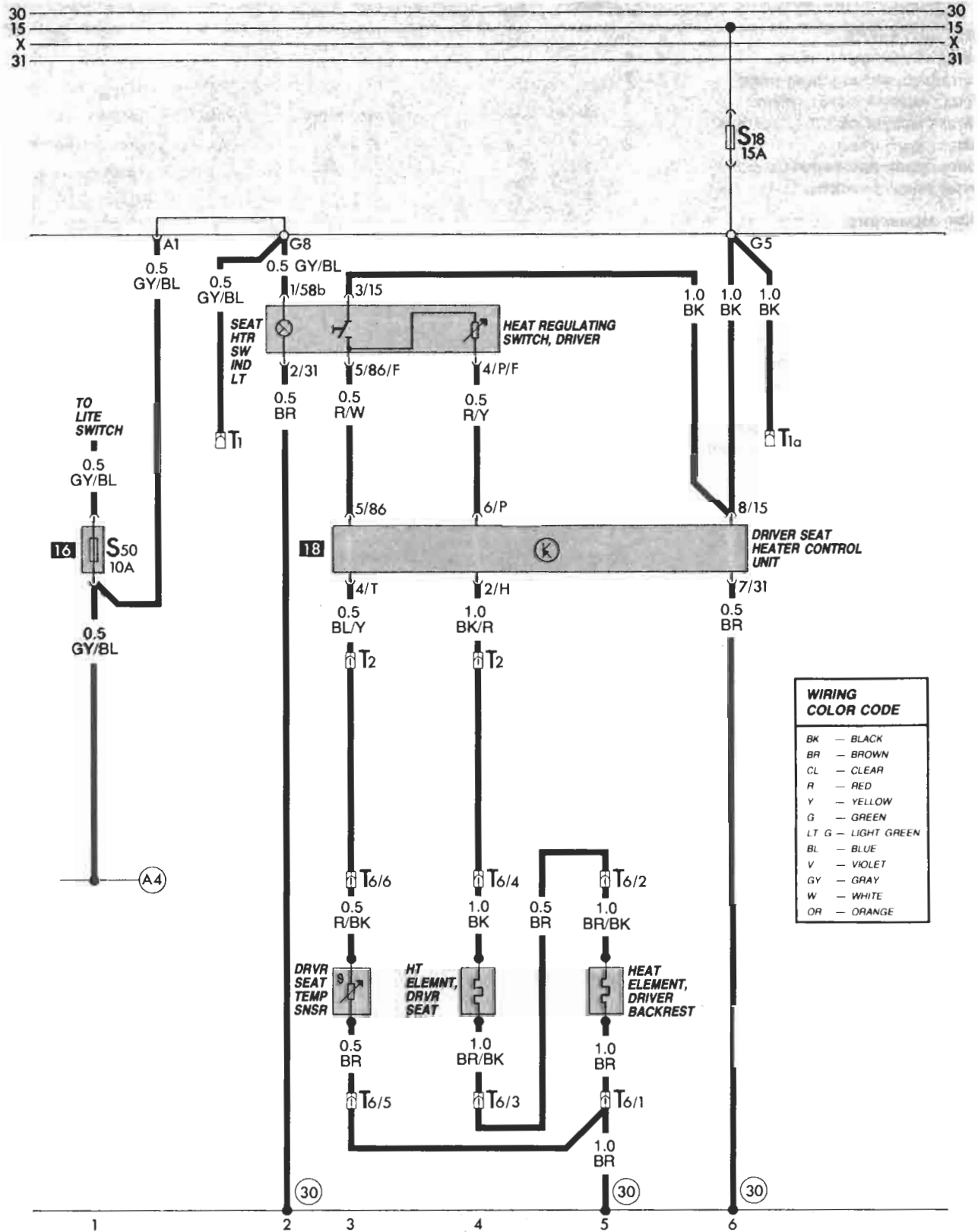
Ⓐ — in instrument panel wiring harness (58b)



## Fuse/relay panel

16 — S50 10A  
 18 — Seat heat control unit





97-2736

# 97 Electrical System - Wiring, Waterboxer

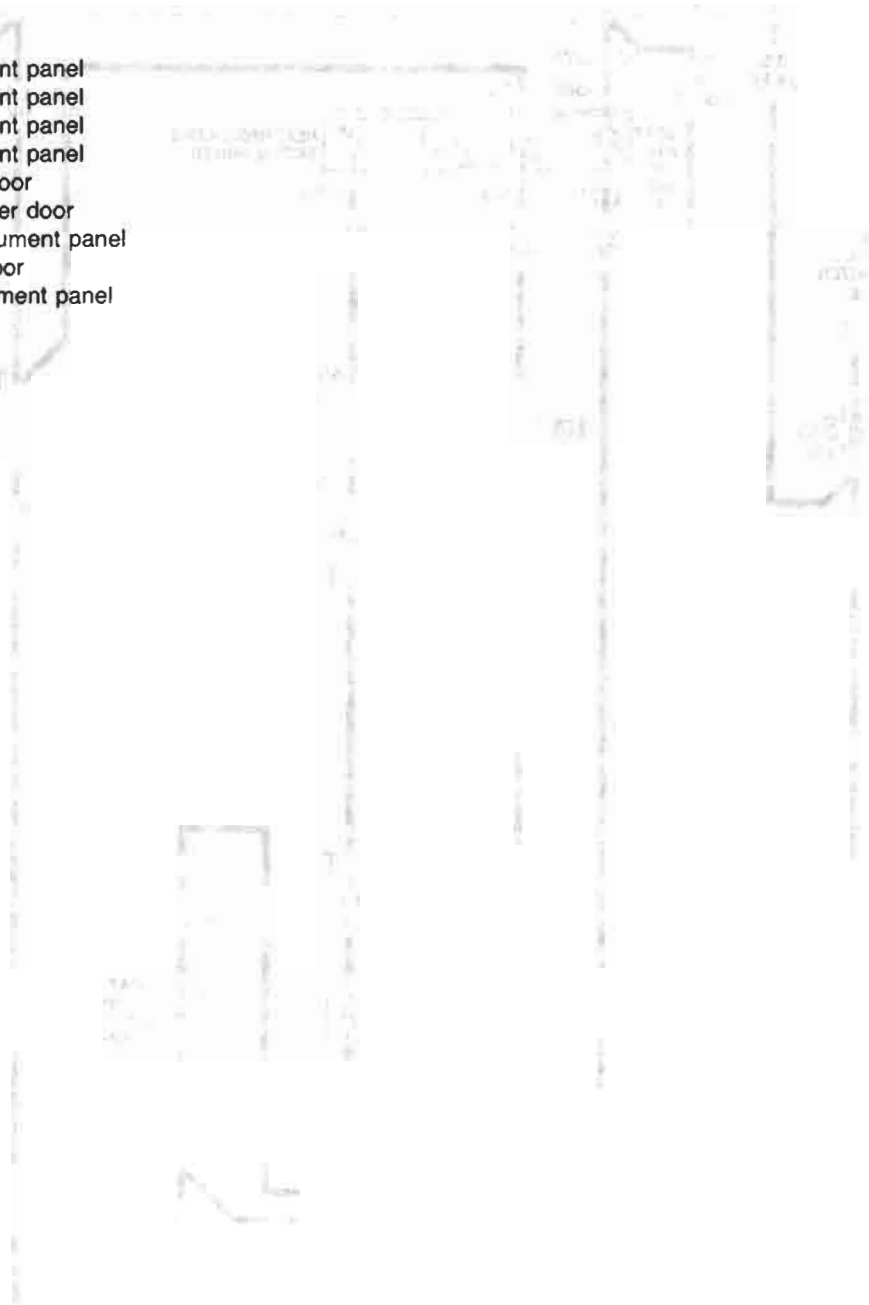
Description	Current Track
Mirror adj. switch	1-4
Mirror heat element, driver	6
Mirror heat element, passenger	7
Mirror magnetic clutch, driver	4
Mirror magnetic clutch, passenger	5
Mirror motor, driver	2
Mirror motor, passenger	1
Mirror selector switch	1-2

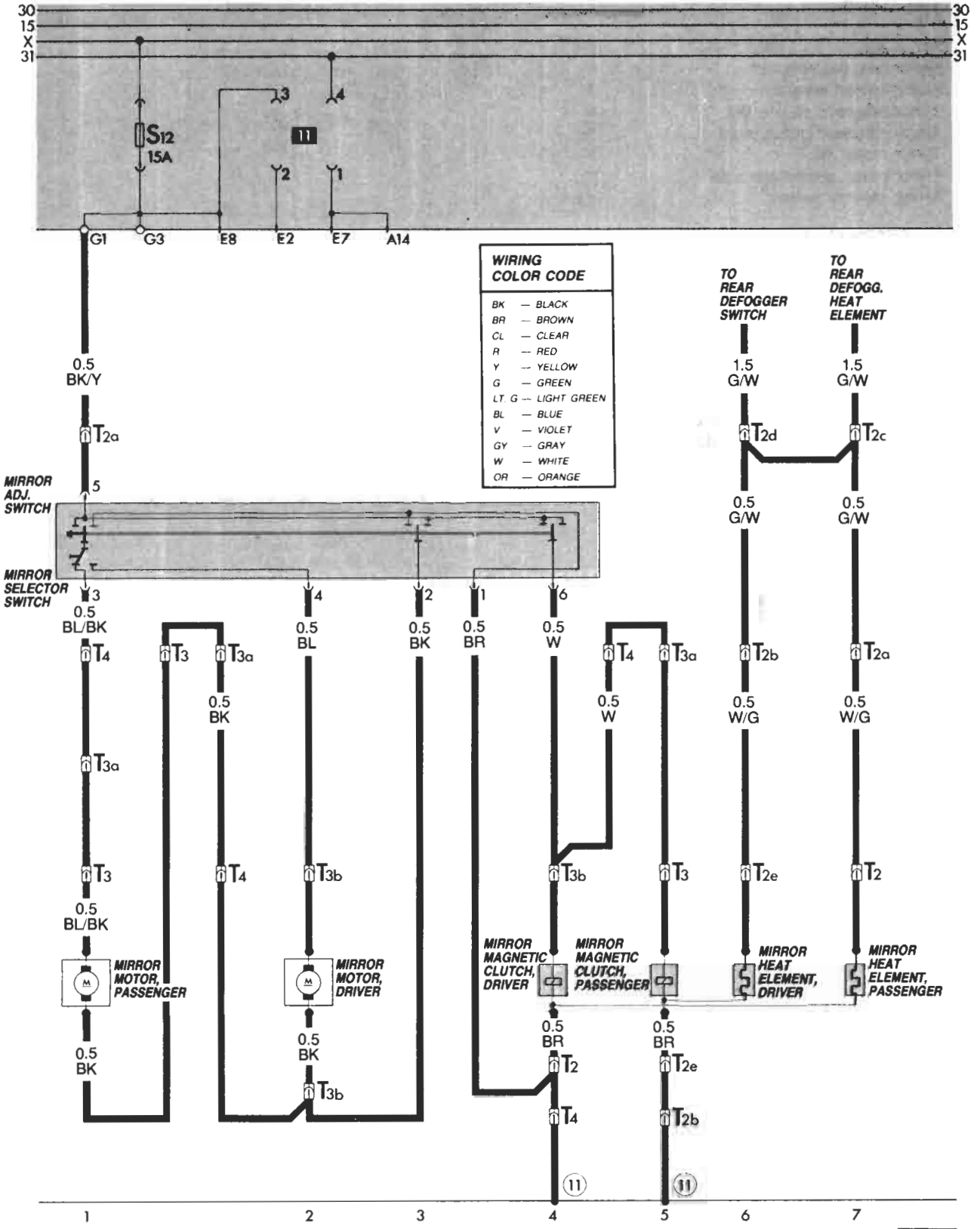
## Wire connectors

- T2 — double, in driver door
- T2a — double, under instrument panel
- T2b — double, under instrument panel
- T2c — double, under instrument panel
- T2d — double, under instrument panel
- T2e — double, in passenger door
- T3 — three-point, in passenger door
- T3a — three-point, under instrument panel
- T3b — three-point, in driver door
- T4 — four-point, under instrument panel

## Ground connector

- (11) — under instrument panel





97-2192

# 97 Electrical System - Wiring, Waterboxer

## Description

## Current track

Mirror adjustment switch  
Mirror heat element, left  
Mirror heated element, right  
Mirror magnetic clutch, left  
Mirror magnetic clutch, right  
Mirror motor, left  
Mirror motor, passenger side  
Mirror selector switch

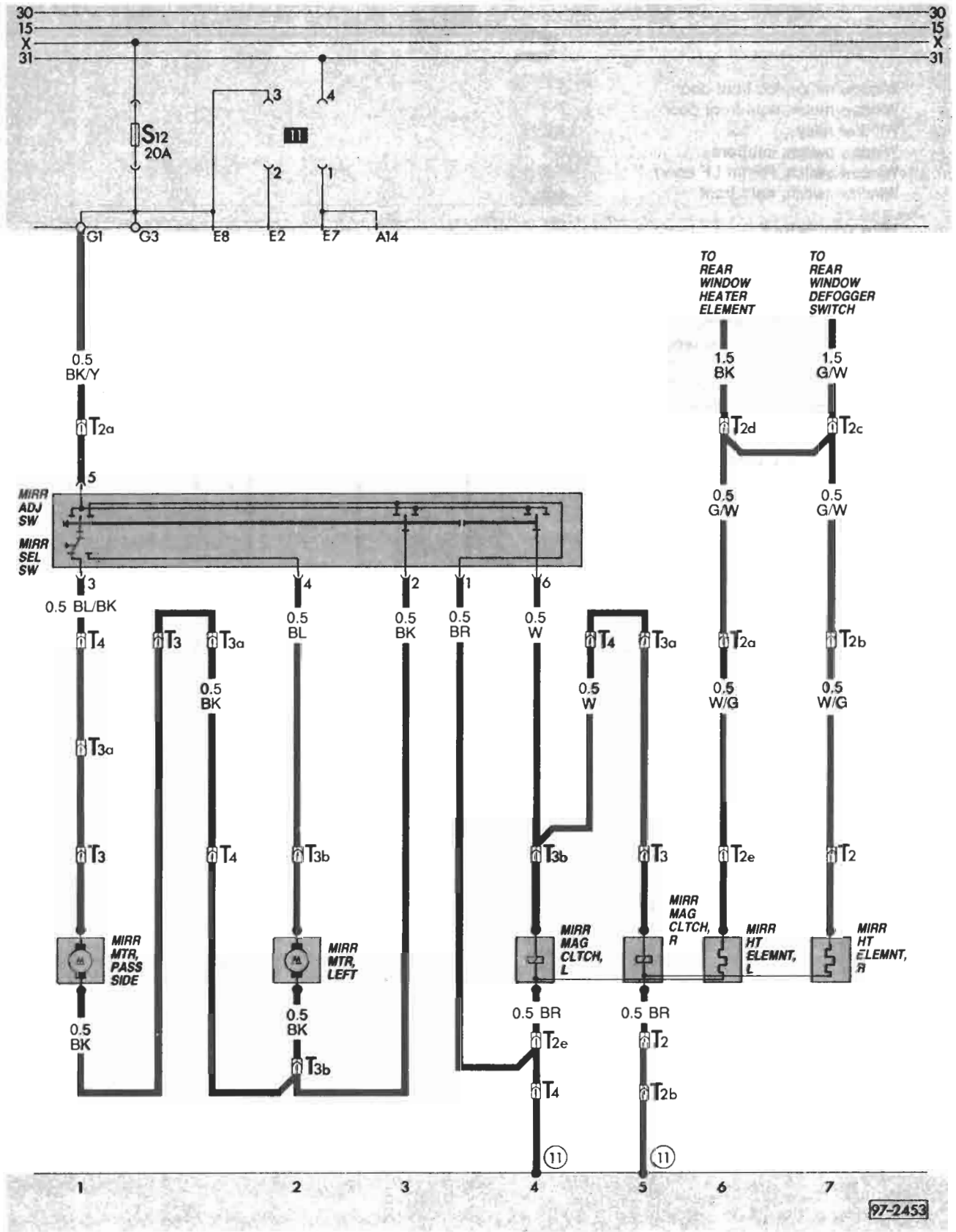
1-4  
6  
7  
4  
5  
2  
1  
1,2

## Wire connectors

T2 — double, in passenger door  
T2a — double, under instrument panel  
T2b — double, under instrument panel  
T2c — double, under instrument panel  
T2d — double, under instrument panel  
T2e — double, in driver door  
T3 — three point, in passenger door  
T3a — three point, under instrument panel  
T3b — three point, in driver door  
T4 — under instrument panel

## Ground connections

① — under instrument panel



# 97 Electrical System - Wiring, Waterboxer

Description	Current track
Window motor, left front door	3
Window motor, right front door	7
Window relay	1,2
Window switch, left front	2-5
Window switch, RF (in LF door)	6-9
Window switch, right front	6-9

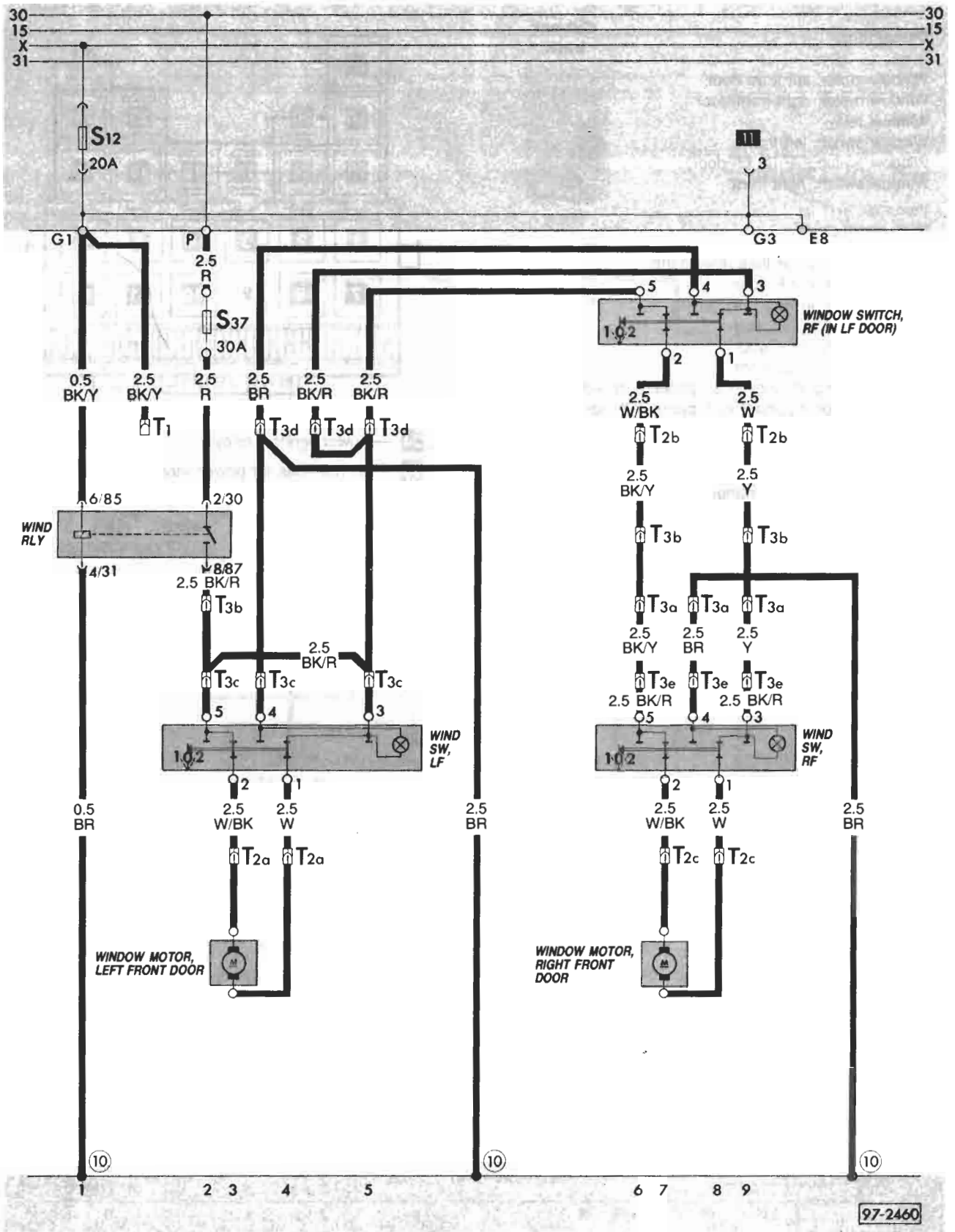
## Wire connectors

- T1 — single, under fuse/relay panel
- T2a — double, in driver door
- T2b — double, in driver door
- T2c — double, in passenger door
- T3a — three-point, in passenger door
- T3b — three-point, in driver door
- T3c — three-point, in driver door
- T3d — three point, in driver door
- T3e — three point, in passenger door

## Ground connections

- ⑩ — near fuse/relay panel





# 97 Electrical System - Wiring, Waterboxer

## Description

Window motor, left front door  
 Window motor, right front door  
 Window relay  
 Window switch, left front  
 Window switch, RF (in LF door)  
 Window switch, right front

## Current track

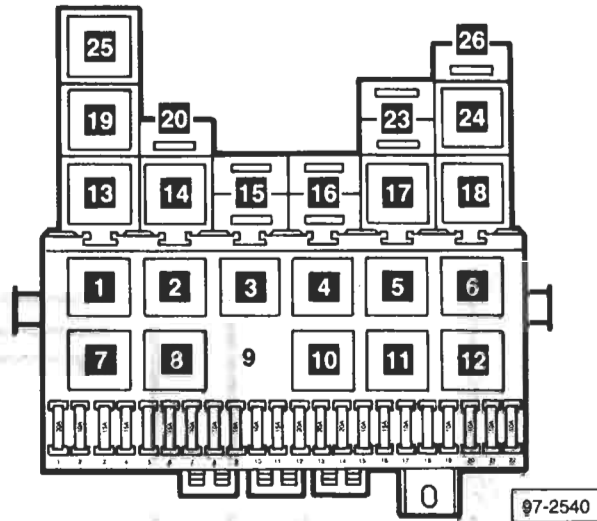
4  
 9  
 1,2  
 3-6  
 7-12  
 7-12

## Wire connectors

T1 — single, under fuse/relay panel  
 T2a — double, in LF door  
 T2b — double, in RF door  
 T2c — double, in RF door  
 T2d — double, in LF door  
 T2e — double, in LF door  
 T3a — three-point, under inst. panel, right side  
 T3b — three-point, under inst. panel, left side  
 T3e — three point, in RF door

## Ground connection

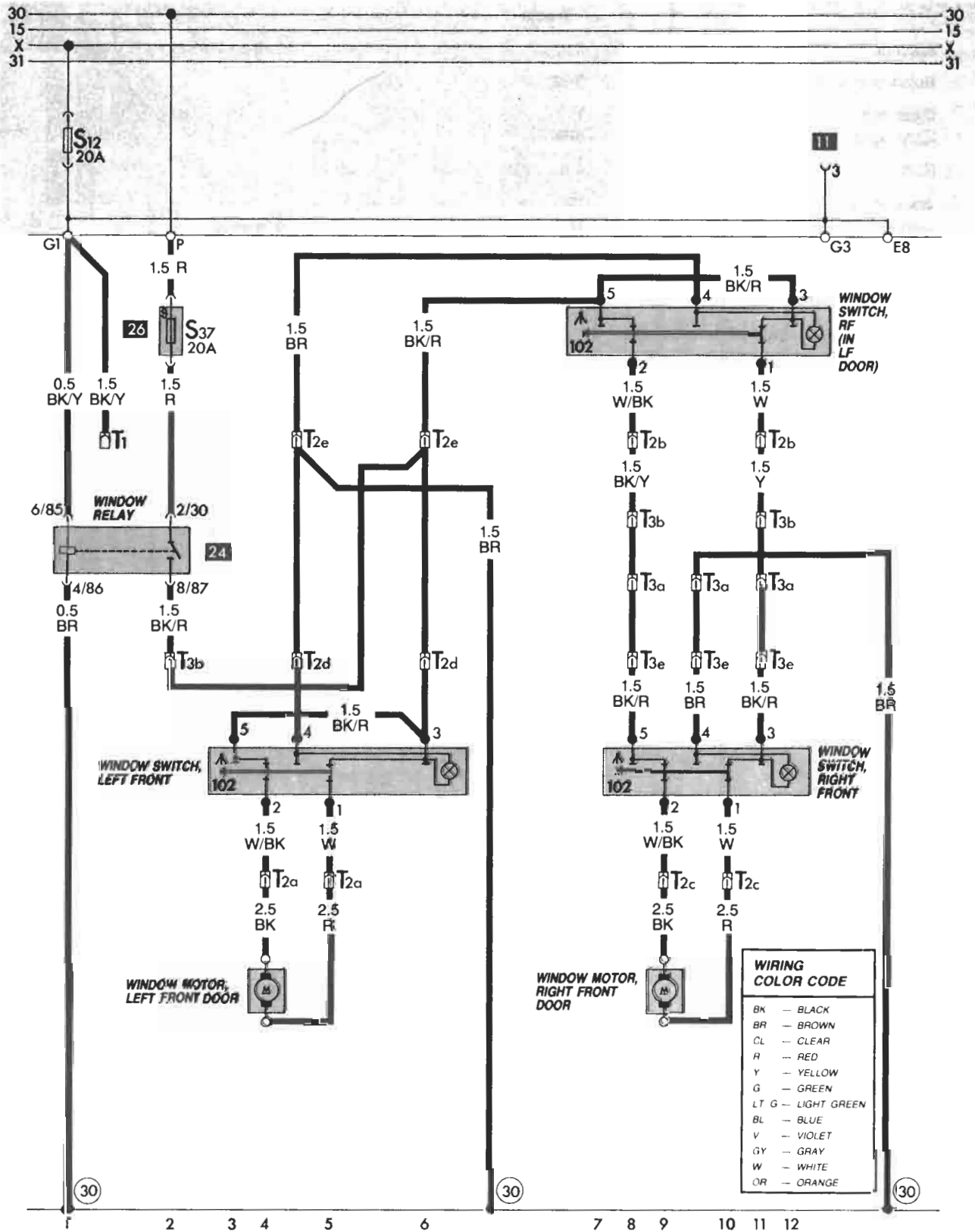
③⑩ — near fuse/relay panel



24 — power window relay  
 26 — thermo fuse for power windows

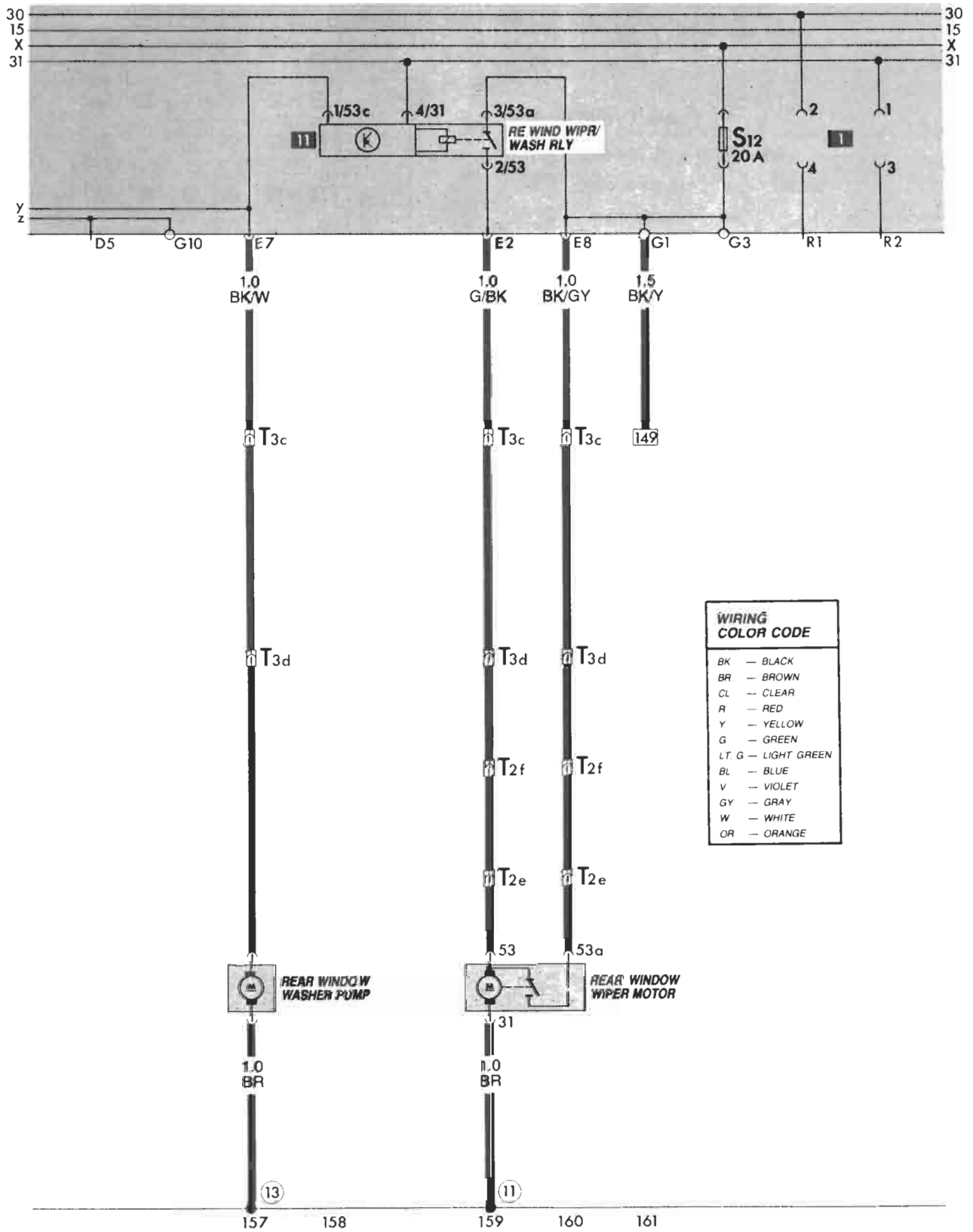


# Electrical System - Wiring, Waterboxer 97



97-2733

# Electrical System - Wiring, Waterboxer 97

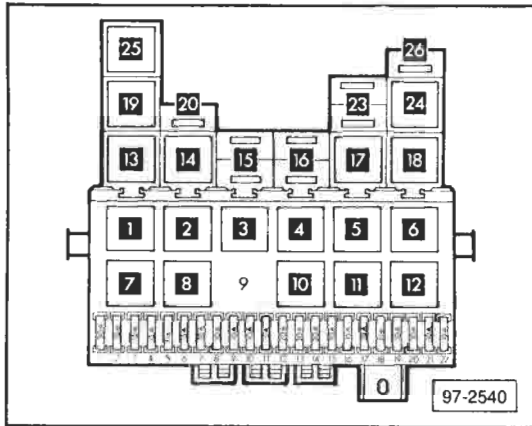


97-2424

Water-cooled—Digifant 1986

Main wiring diagram  
Rear window wiper  
from VIN G 055 690

97.101



### Fuse arrangement

according to numbers on fuse panel as seen from left to right:

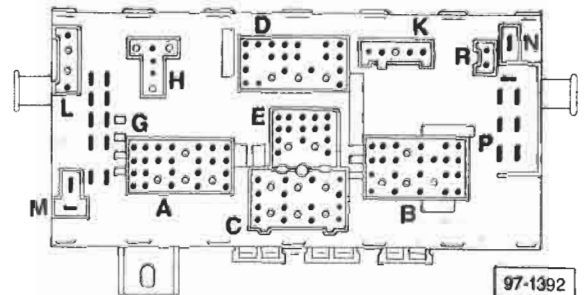
	Amp.
1 Radiator fan .....	30
2 Stop lights .....	10
3 Cigarette lighter, radio, clock, interior lights, central locking system .....	10
4 Emergency flasher system .....	15
5 not connected	
6 Vacant	
7 Tail, parking and side marker lights, left .....	10
8 Tail, parking and side marker lights, right .....	10
9 High beam right, high beam indicator light .....	10
10 High beam left .....	10
11 Wind. wipers and washer .....	15
12 Heater fan, rear wiper, cruise control, A/C, outside rear view mirror adjustment .....	20
13 Fresh air fan .....	15
14 Rear window defogger .....	20
15 Back-up lights, shift console light (Auto. Transmission) .....	10
16 Horn (single tone) .....	15
17 Windshield wiper motor .....	10
18 Dual horn, coolant level and temp. warning light .....	10
19 Turn signals, brake warning light .....	10
20 License plate lights .....	10
21 Low beam left .....	10
22 Low beam right .....	10

### Separate fuses above fuse panel

Power windows .....	30
A/C .....	30

### Fuse/Relay Panel

- 3** — coolant level control unit
- 5** — rad. cool. fan relay, 2<sup>nd</sup> stage
- 8** — load reduction relay
- 10** — intermitt. wash/wiper relay
- 11** — rear window wash/wiper relay
- 12** — emerg. flash/turn sig. relay
- 13** — not used
- 16** — fuse, terminal 58b



### Connections and plugs on fuse/relay panel

- A** — multi-point connector (blue) for instrument panel wiring harness
- B** — multi-point connector (red) for instrument panel wiring harness
- C** — multi-point connector (yellow) for front wiring harness
- D** — multi-point connector (white) for windshield wiper and main wiring harness
- E** — multi-point connector (black) for main wiring harness
- G** — single connector
- H** — multi-point connector (brown) to connector for rad. cool. fan relay, 2<sup>nd</sup> stage
- K** — multi-point connector (colorless) to radiator coolant low-level control unit
- L** — multi-point connector (gray) for horns
- M** — open position
- N** — single connector
- P** — single connector (terminal 30)
- R** — open position

# 97 Electrical System - Wiring, Waterboxer

Description	Current track	Description	Current track	Wire connectors
A/C compressor overheat fuse	151	Instrument panel lite dimmer switch	95	T2c — double, under inst. panel, left
Air flow sensor potentiometer	22-24	Interior lite, front	77,78	T2d — double, under upper right 'A' pillar
Alternator	5	License plate lite	96,97	T2e — double, in decklid near washer motor
Alternator warning lite	51	Lite switch	85-95	T2f — double, under upper right 'C' pillar cover
Back-up lite switch	128	Load reduction relay	86-88	T2g — double, under inst. panel
Back-up lite, left	128	Make-up mirror lite	76	T2i — double, in wire distrib., eng. compart.
Back-up lite, right	129	Map/reading lite, right front	75	T2k — double, eng. compart., left
Battery	1	OXS elapsed mileage indicator	52	T2m — double, in relay plate, eng. compart.
Brake and parking brake indicator lite	137	Oxygen sensor	25,26	T2o — double, near seat belt switch
Brake fluid level warning contact	138	Parking brake warning lite switch	137	T2p — double, near horn
Brake lite switch	125,126	Parking lite, left	101	T2x — double, eng. compart., middle
Brake lite, left	127	Parking lite, right	107	T3 — three-point, near alternator
Brake lite, right	126	Power steering pressure switch	36,37	T3a — three-point, under inst. panel, right
CAT elapsed mileage counter	45,46	Radiator cooling fan	145	T3b — three-point, under inst. panel, left
Cigarette lighter	72	Radiator cooling fan relay (2nd stage)	147-150	T3d — three-point, behind upper front grille
Cigarette lighter lite	73	Radiator cooling fan thermostic	145, 146	T3x — three point, under inst. panel
Clock lite	61	Reading lite, behind driver's seat	80,81	T7/ — seven point, in wire distrib., eng. compart.
Coolant low level control unit	68,69	Reading lite, left rear	82,83	T7a/ — seven point, in wire distrib., eng. compart.
Coolant low level warning switch	68	Rear window defogger indicator lite	140	T14/ — fourteen point, on inst. cluster
Coolant overheat warning lite	66	Rear window defogger switch	139-141	
Coolant temperature gauge	65	Rear window defogger switch lite	139	
Coolant temperature sending unit	70	Rear window heater element	141	
Digifant control unit	16-27	Rear window washer pump	160	
Digijet control unit relay	32-34	Rear window wiper motor	162,163	
Digital clock	53	Rear window wiper/washer relay	161,162	
Door contact switch, left front	77,78	Safety belt switch, left	134	
Door contact switch, right front	81	Seat belt warning lite	136	
Emergency flasher relay	114,115	Seat belt warning relay	133-136	
Emergency flasher switch	111-120	Side marker lites, rear	104,105	
Emergency flasher warning lite	120	Spark plug connectors	13-15	
Engine oil pressure control unit	55,56	Spark plugs	13-15	
Engine oil pressure switch (0.3 bar)	48	Starter	3,4	
Engine oil pressure switch (0.9 bar)	47	T.D.C. sensor	43,44	
Engine oil pressure warning lite	57	Tachometer	54	
Fresh air blower series resistance	144	Tail lite, left	102	
Fresh air control lever lite	142	Tail lite, right	106	
Fresh air fan	143,144	Temperature sensor II	21	
Fresh air fan switch	142-144	Terminal 58b fuse	95	
Fuel gauge	64	Throttle valve switch (enrichment)	20	
Fuel gauge sending unit	71	Turn signal indicator lite	62	
Fuel pump	31	Turn signal lite, left front	122	
Fuel pump relay	30,31	Turn signal lite, left rear	121	
Fuse	12	Turn signal lite, right front	124	
Hall generator	17-19	Turn signal lite, right rear	123	
Headlite dimmer/flasher switch	103,104	Turn signal switch	116,117	
Headlite high beam warning lite	63	Voltage regulator	5	
Headlite, left	98,100	Voltage stabilizer	64	
Headlite, right	108,110	Warm air blower	150-152	
Heater blower series resistance	151,152	Warm air blower switch	149-152	
Heater fan switch illumination lite	149	Washer/wiper intermittent relay	156-158	
Heating element (crankcase ventilation)	12	Windshield washer pump	159	
High-beam headlite, left	99	Windshield wiper motor	153,154	
High-beam headlite, right	109	Windshield-wiper intermittent switch	155-158	
Horn button	130			
Horns	132			
Idle speed stabilizer valve	40,41			
Idle stabilizer control unit	36-42			
Ignition coil	14			
Ignition distributor	13-15			
Ignition/starter switch	8-11			
Injector, cyl. 1	27			
Injector, cyl. 2	28			
Injector, cyl. 3	29			
Injector, cyl. 4	30			
Instrument panel lite	58-60			

### Ground connections

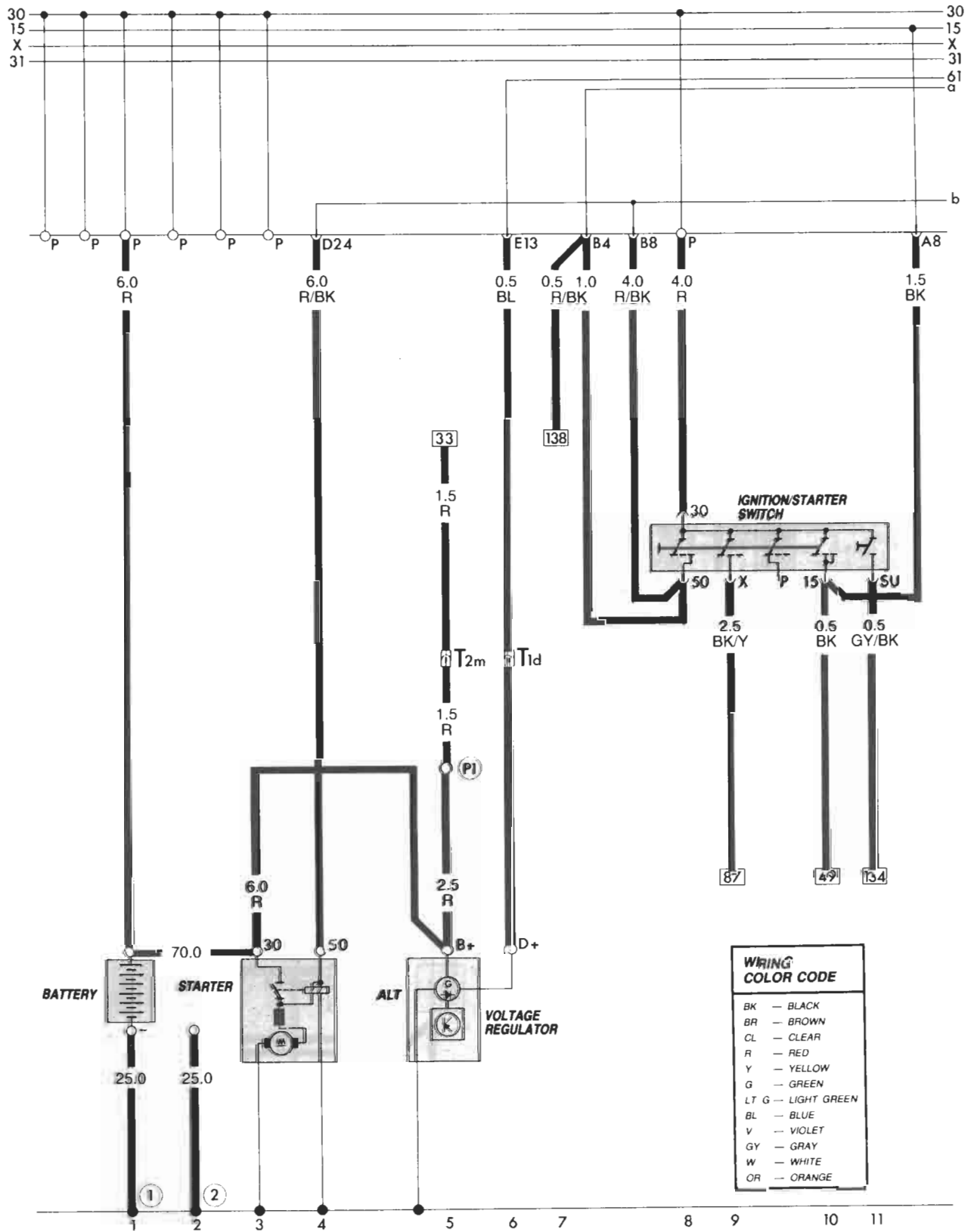
- ① — battery to body
- ② — transmission to body
- ⑫ — in eng. compart., left
- ⑱ — on engine block
- ⑳ — ground cable, above steering box
- ㉑ — near Digifant control unit
- ⑳ — under relay panel
- ⑵ — in rear decklid, left
- ⑶ — in rear decklid, right
- ⑶ — near rear washer bottle bracket
- ⑸ — near rear wiper motor
- ⑹ — near left rear decklid hinge
- ⑸ — in inst. panel wiring harness
- ⑹ — in Digifant wiring harness

### Plus (+) connections

- ⑶ — (term. 30) in wire distrib., eng. compart.
- ⑶ — in Digifant wiring harness
- ⑶ — in Digifant wiring harness
- ⑶ — (term. 58b) in inst. panel wiring harness

### Wire connectors

- T1a — single, near left rear roof bow
- T1b — single, in wire distrib., eng. compart.
- T1d — single, in wire distrib., eng. compart.
- T1e — single, under inst. panel, left
- T1f — single, under inst. panel
- T1g — single, in wire distrib., eng. compart.
- T1h — single, in eng. compart., left
- T1i — single, under inst. panel
- T1k — single, in eng. compart., left



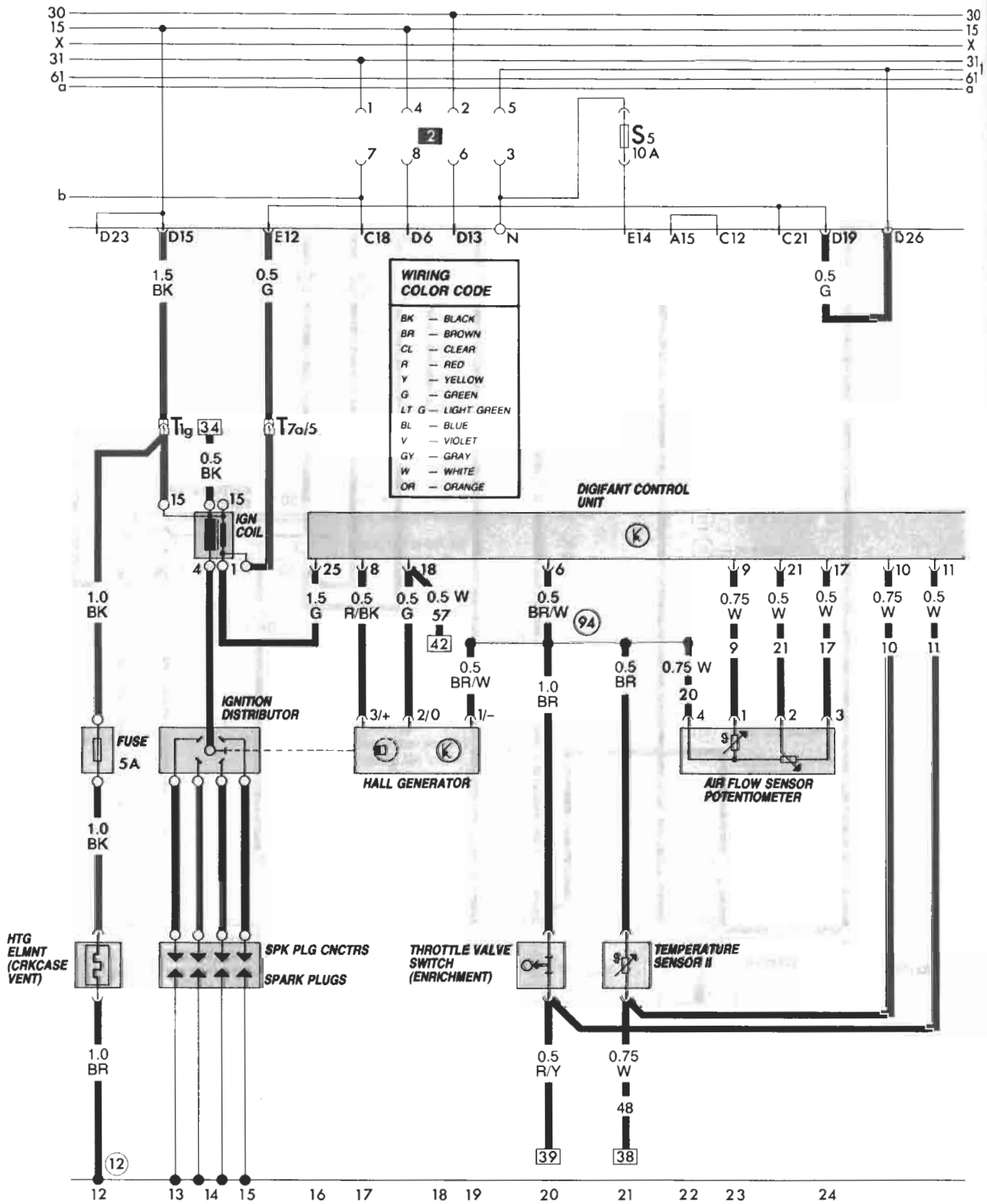
97-2624

Water-cooled — Digifant 1987

Main wiring diagram  
Alternator/Starters/  
Ignition switch

## 97.104

# 97 Electrical System - Wiring, Waterboxer

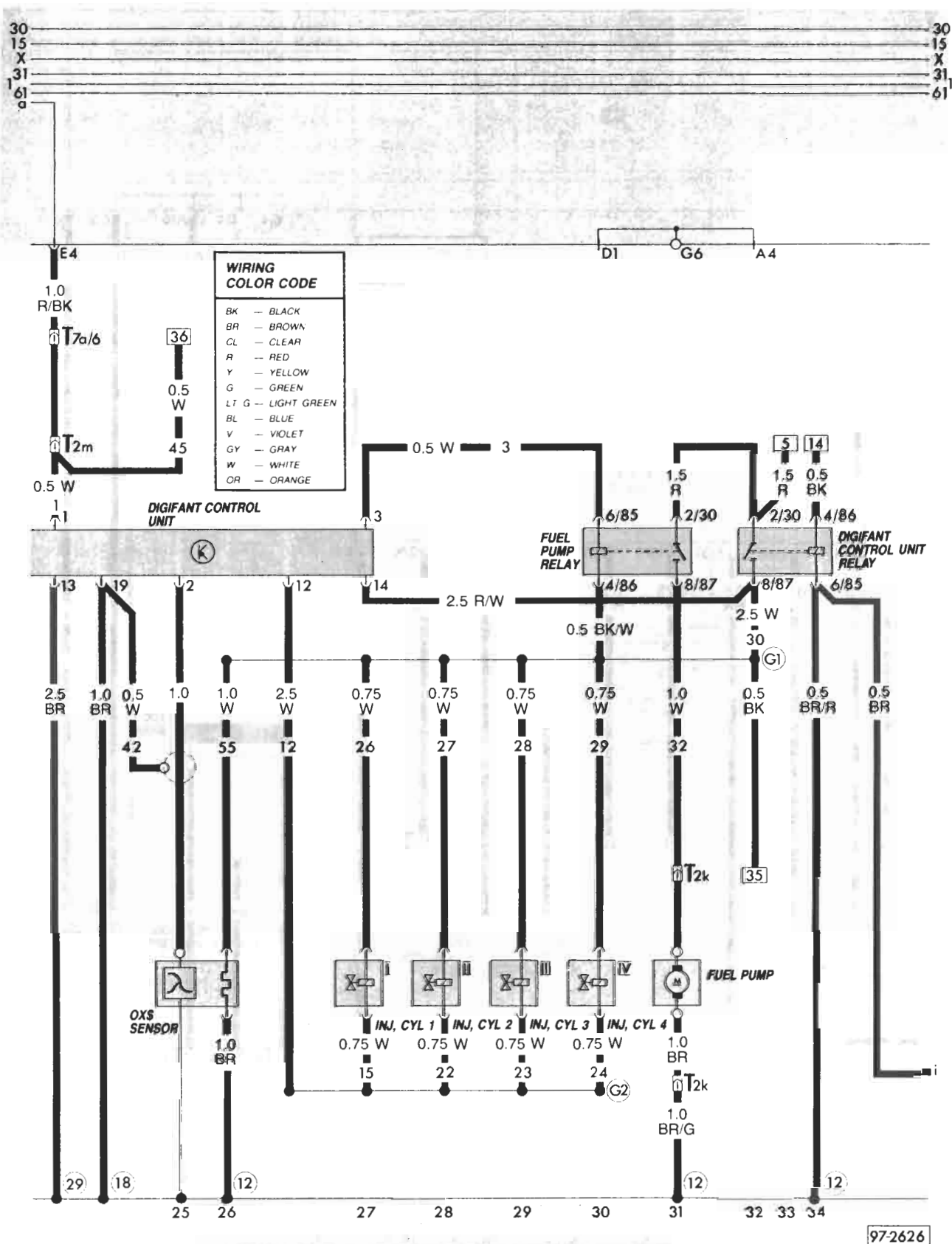


97-2625

**97.105**

Main wiring diagram  
Digifant injection system

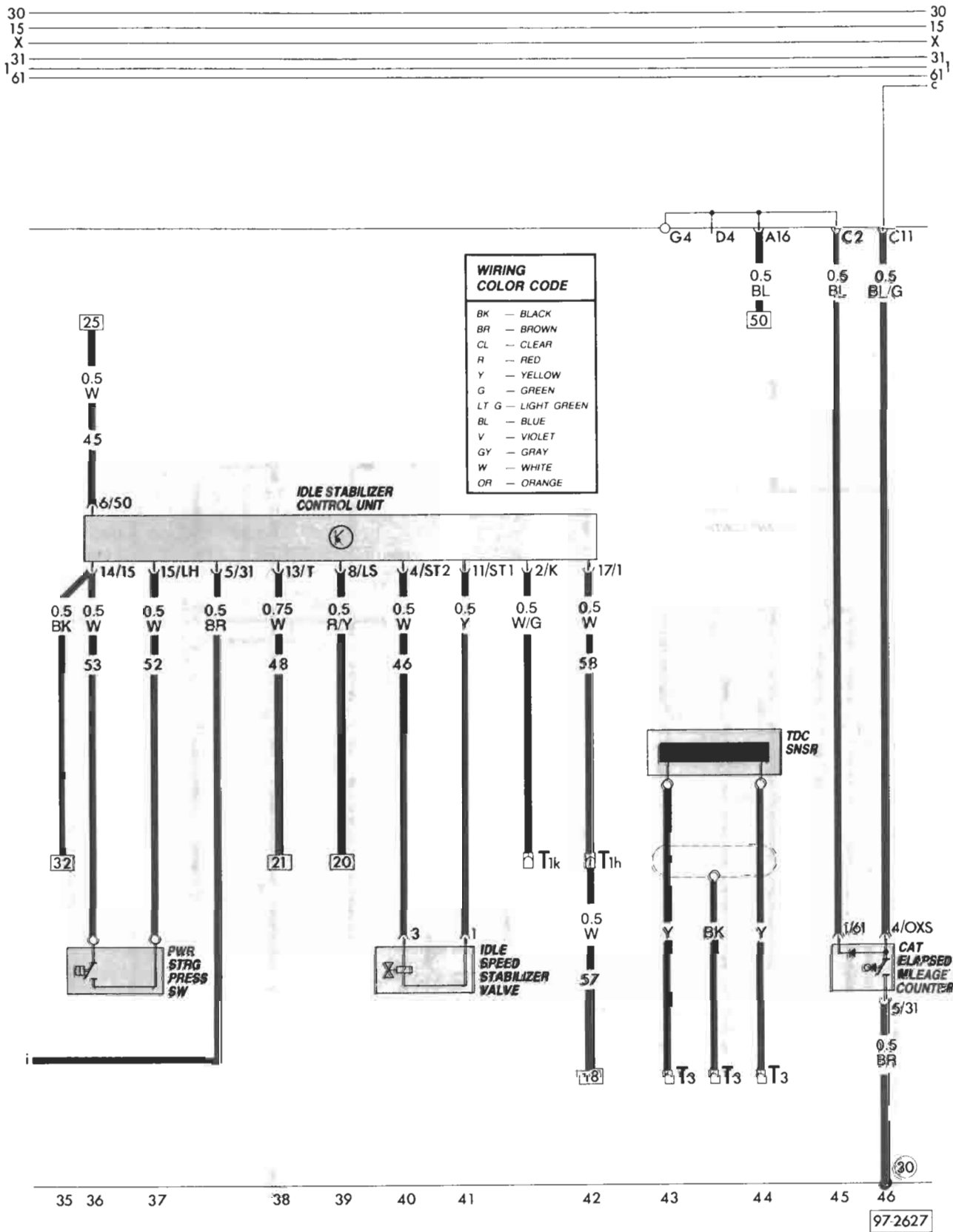
Water-cooled — Digifant 1987



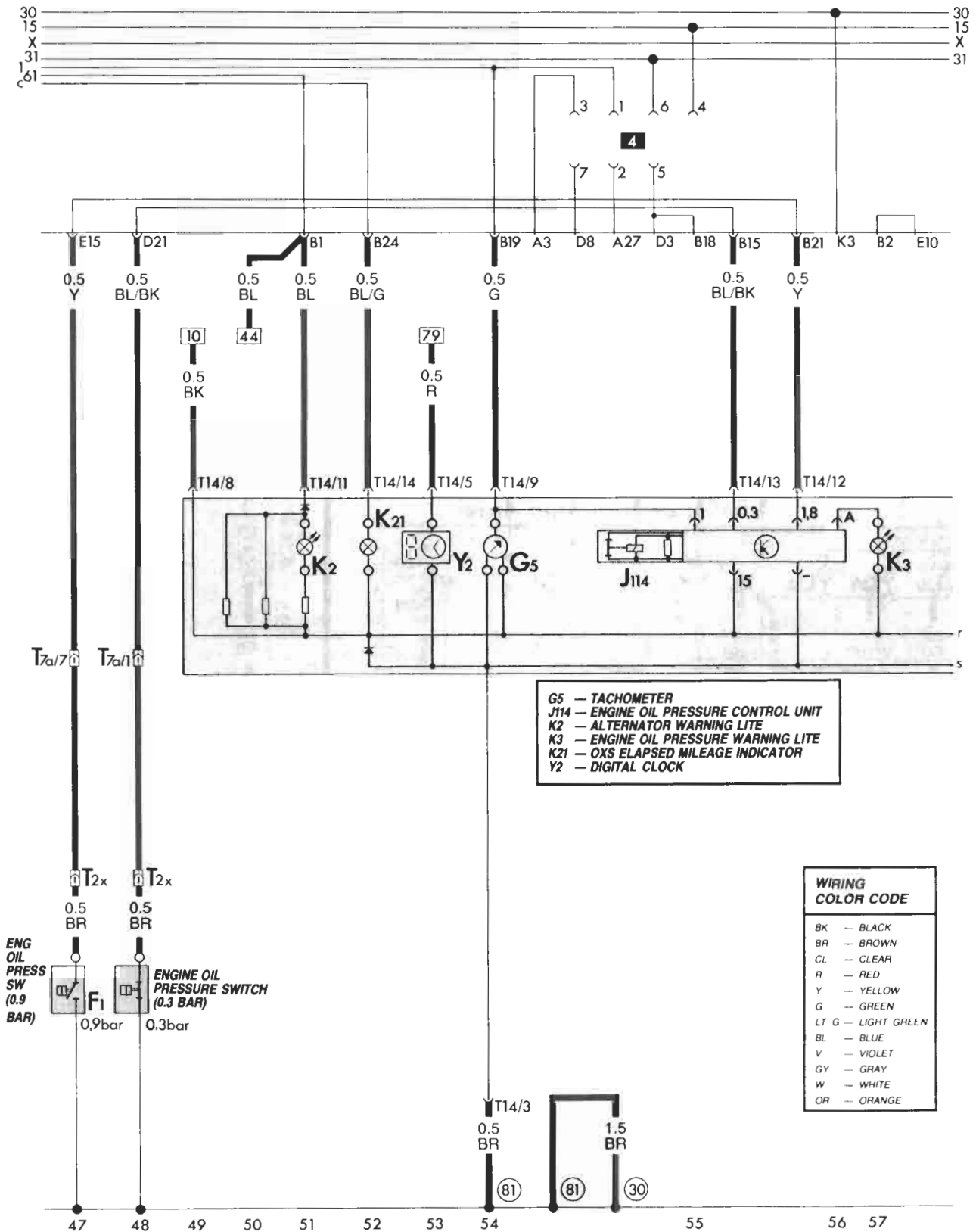
Water-cooled - Digifant 1987

Main wiring diagram  
Digifant injection system

# 97 Electrical System - Wiring, Waterboxer







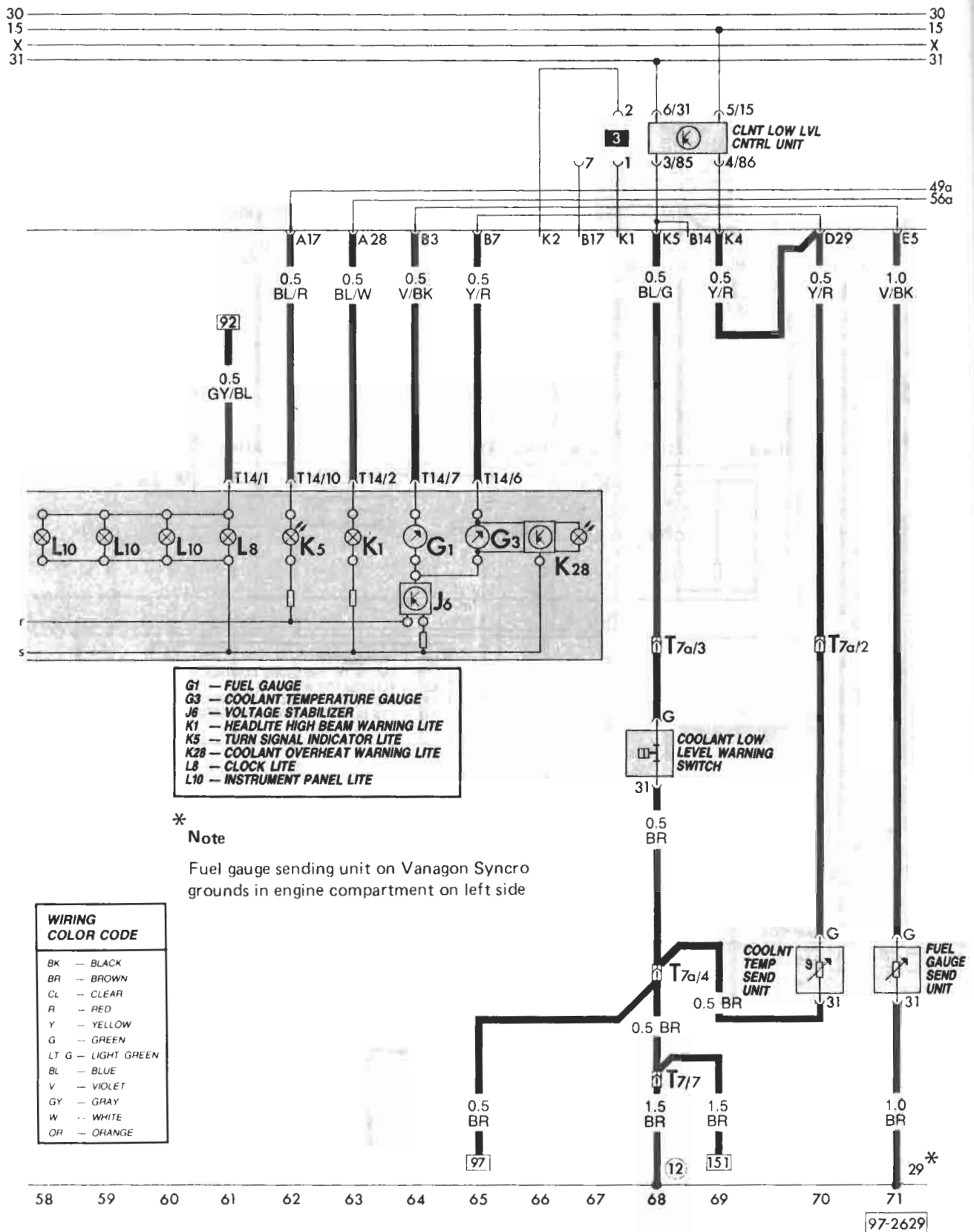
97-2628

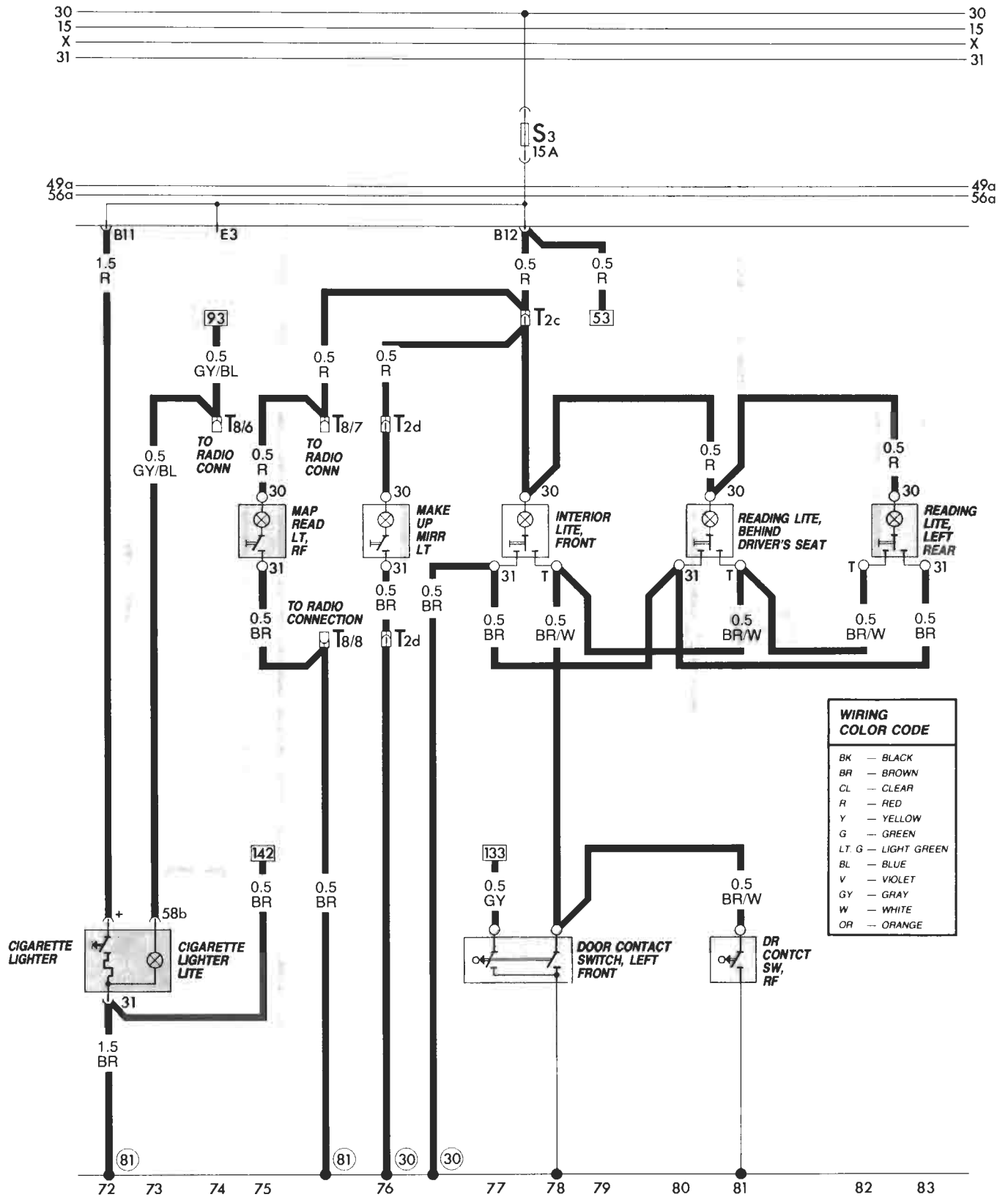
Water-cooled - Digifant 1987

Main wiring diagram  
Oil pressure warning  
Instrument cluster

## 97.108

# 97 Electrical System - Wiring, Waterboxer

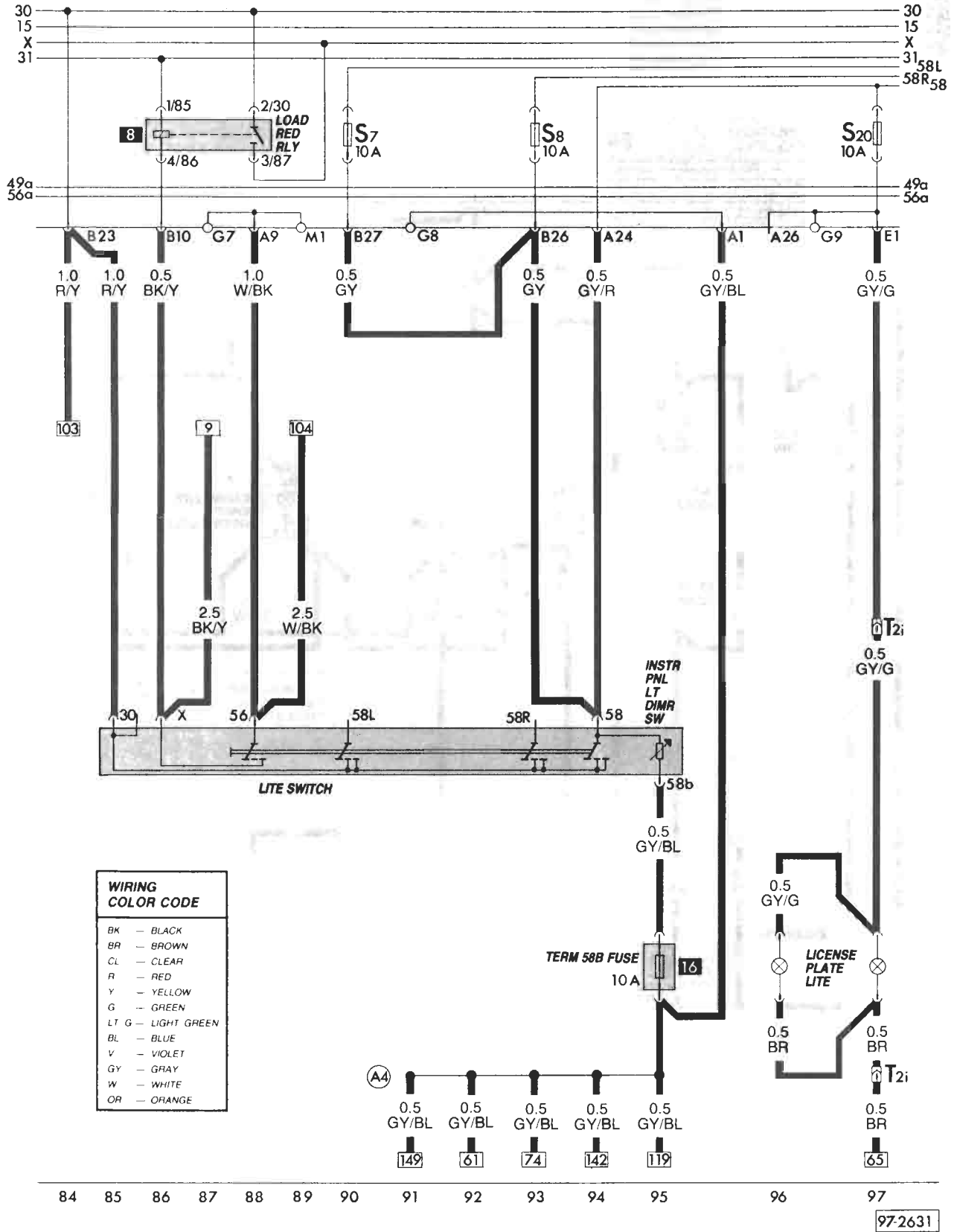




WIRING COLOR CODE	
BK	— BLACK
BR	— BROWN
CL	— CLEAR
R	— RED
Y	— YELLOW
G	— GREEN
LT. G	— LIGHT GREEN
BL	— BLUE
V	— VIOLET
GY	— GRAY
W	— WHITE
OR	— ORANGE

97-2630

# 97 Electrical System - Wiring, Waterboxer



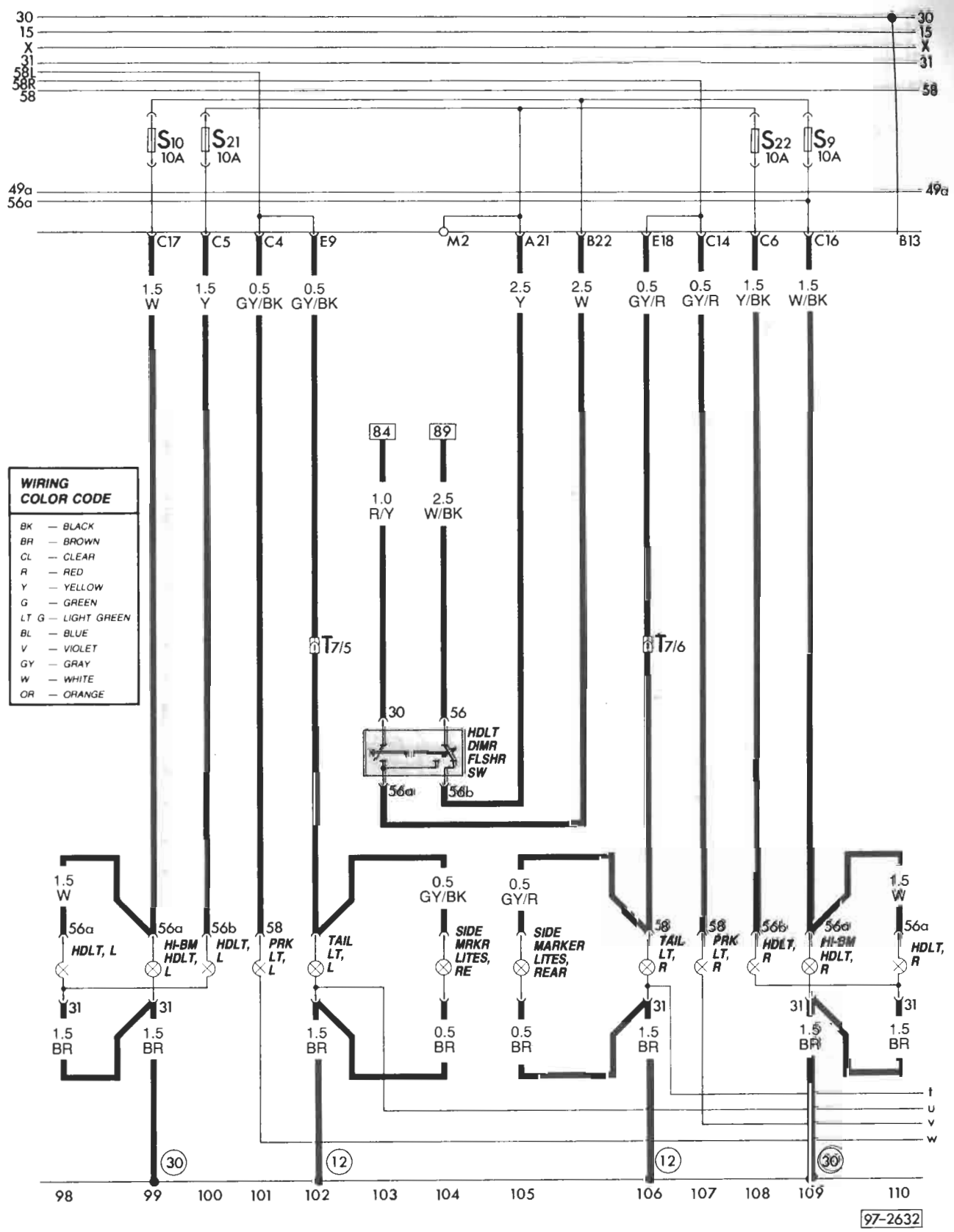
WIRING COLOR CODE	
BK	— BLACK
BR	— BROWN
CL	— CLEAR
R	— RED
Y	— YELLOW
G	— GREEN
LT G	— LIGHT GREEN
BL	— BLUE
V	— VIOLET
GY	— GRAY
W	— WHITE
OR	— ORANGE

97.111

Main wiring diagram  
Load reduction relay,  
Light switch

Water-cooled — Digifant 1987

# Electrical System - Wiring, Waterboxer 97

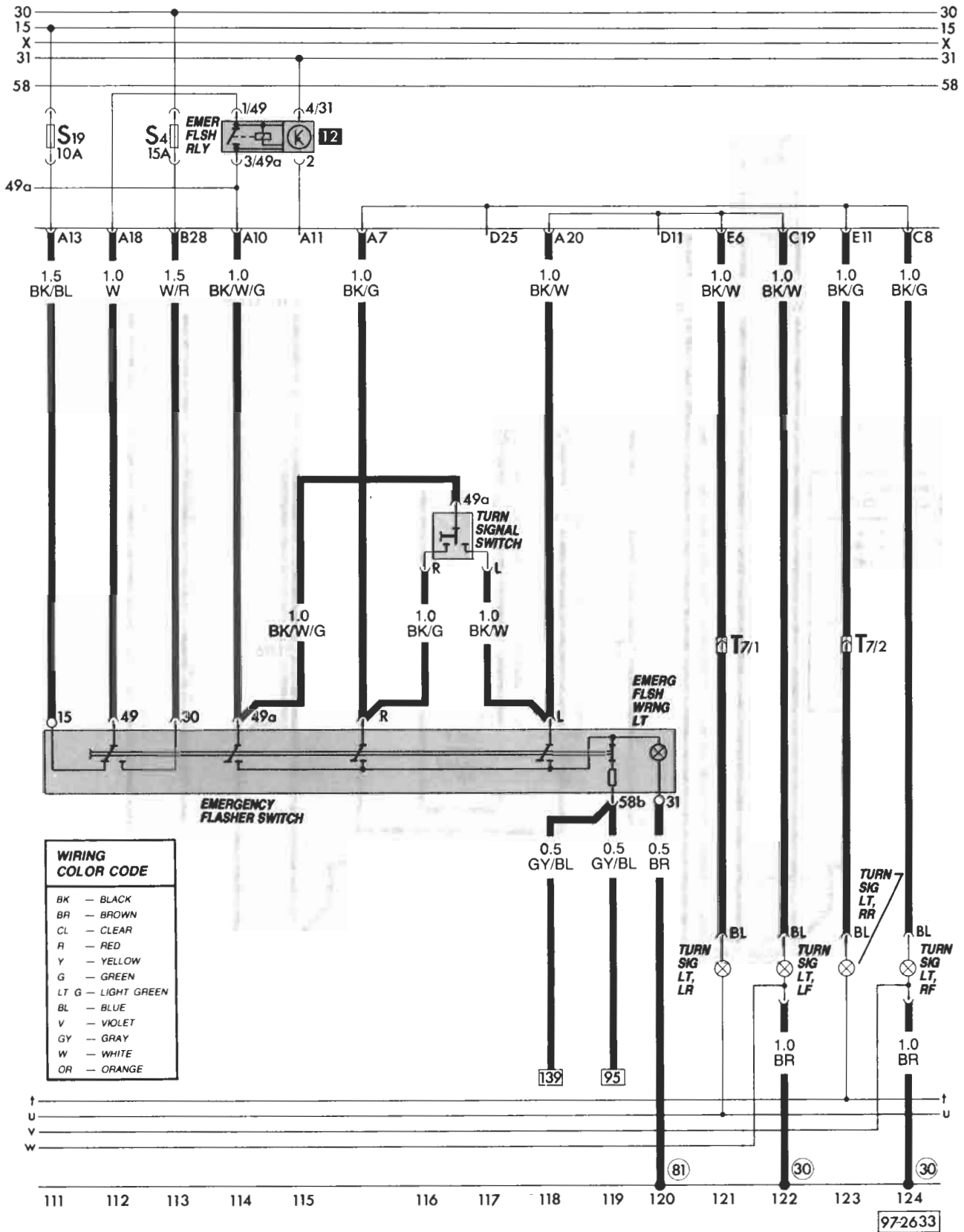


Water-cooled—Digifant 1987

Main wiring diagram  
Exterior lights

97.112

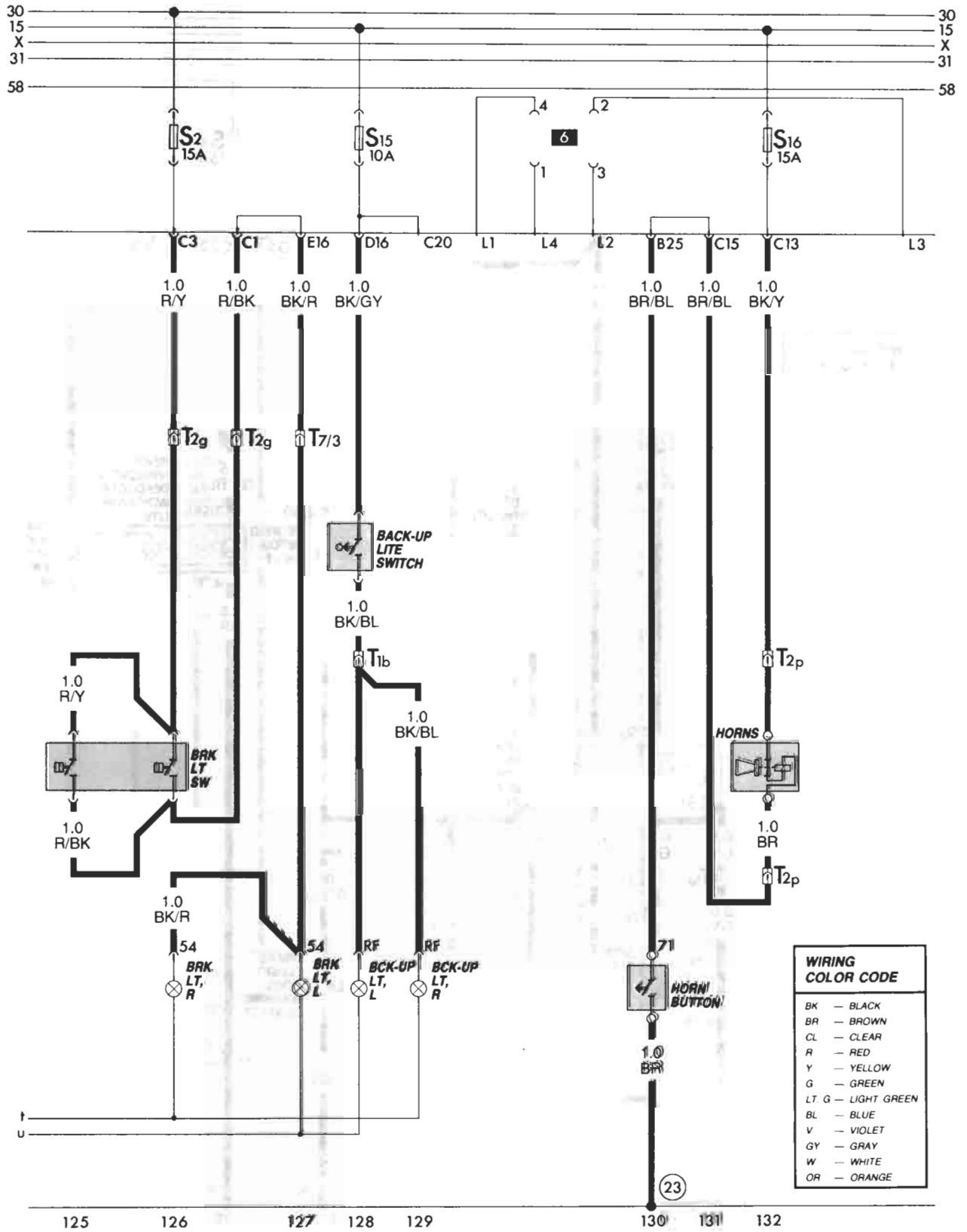
# 97 Electrical System - Wiring, Waterboxer



**97.113**

Main wiring diagram  
Emergency flashers  
Turn signals

Water-cooled — Digifant 1987



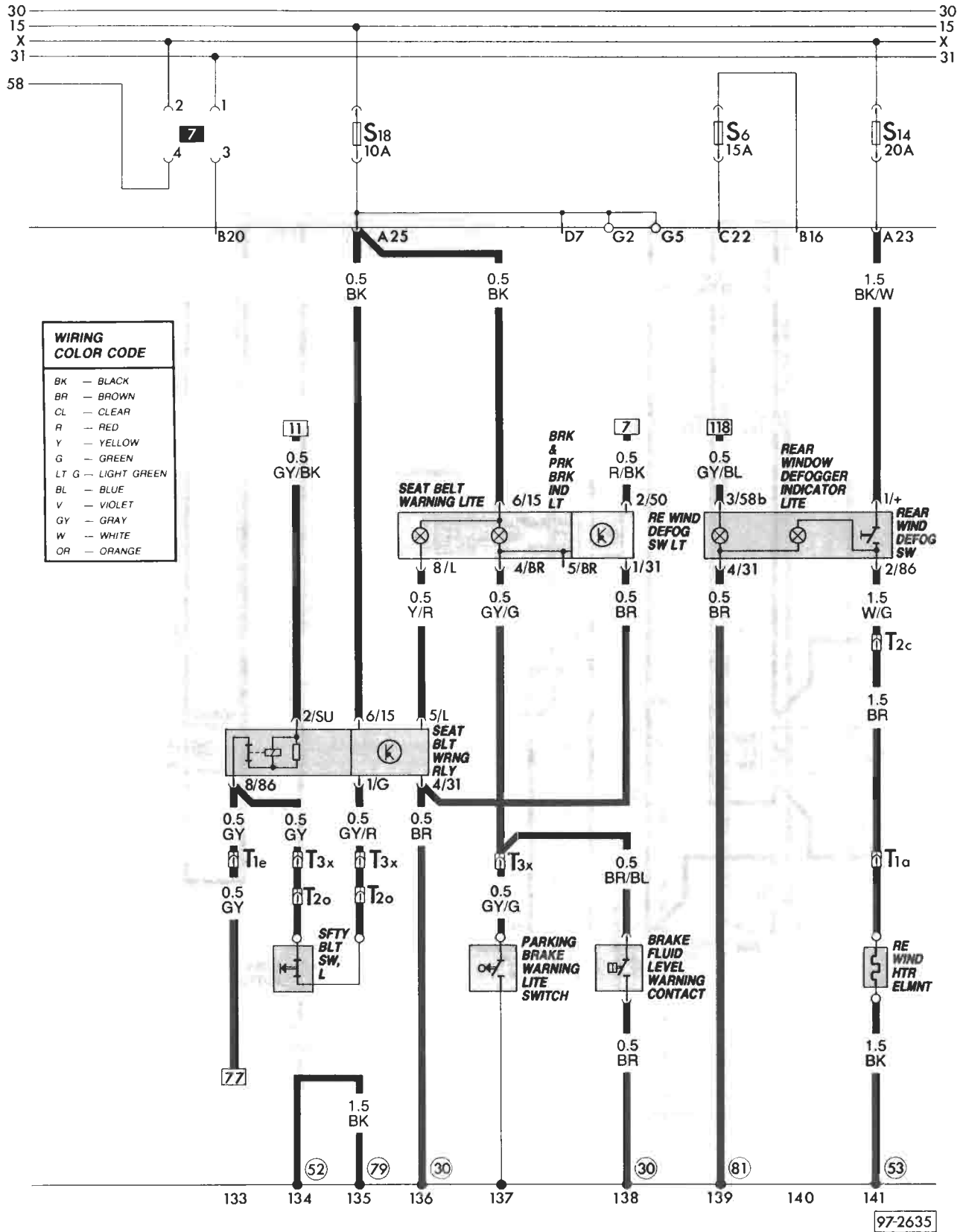
97-2634

**Water-cooled - Digifant 1987**

**Main wiring diagram  
Brake lights  
Horns**

**97.114**

# 97 Electrical System - Wiring, Waterboxer

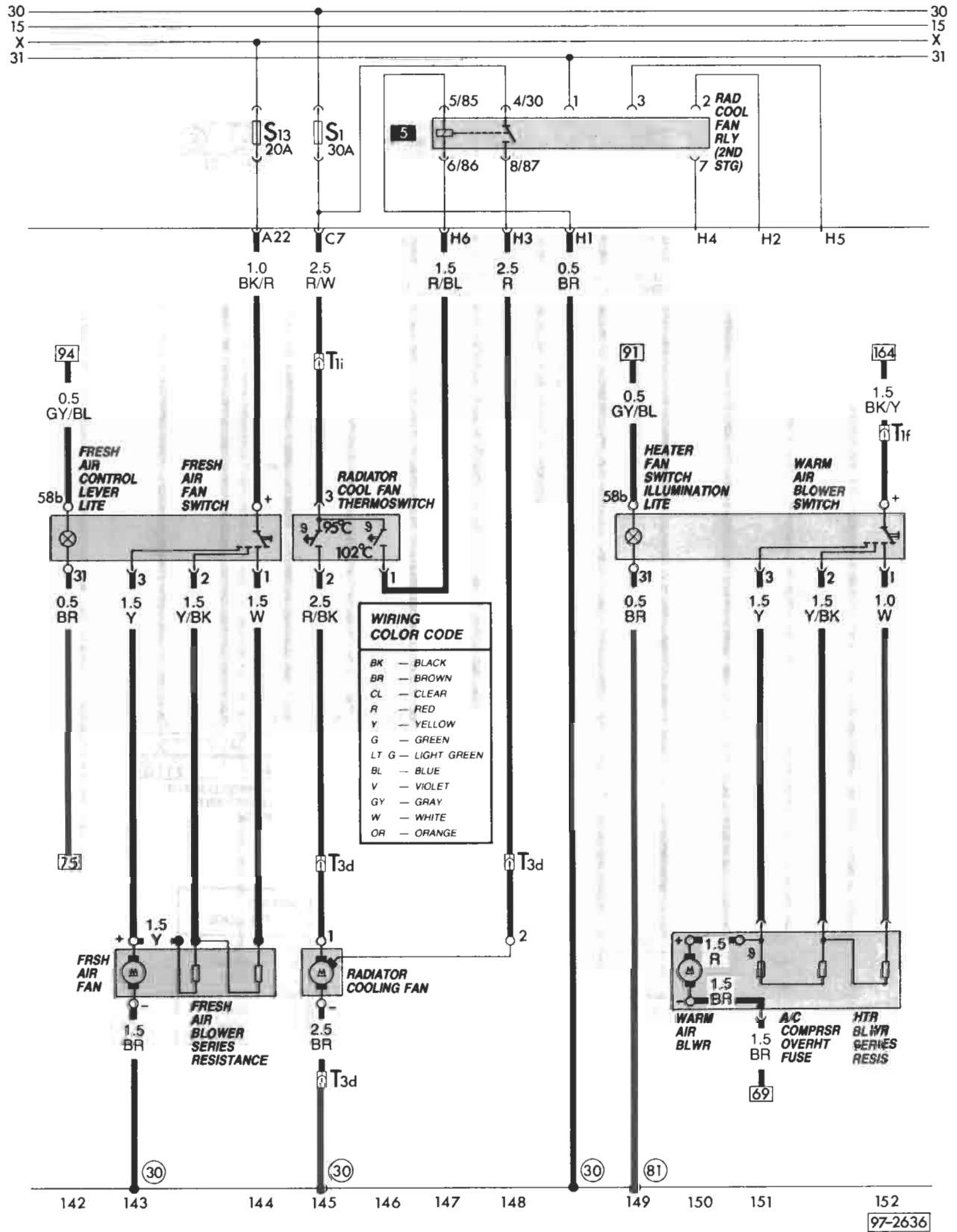


97.115

Main wiring diagram  
 Seat belt system  
 Rear defogger

Water-cooled – Digifant 1987



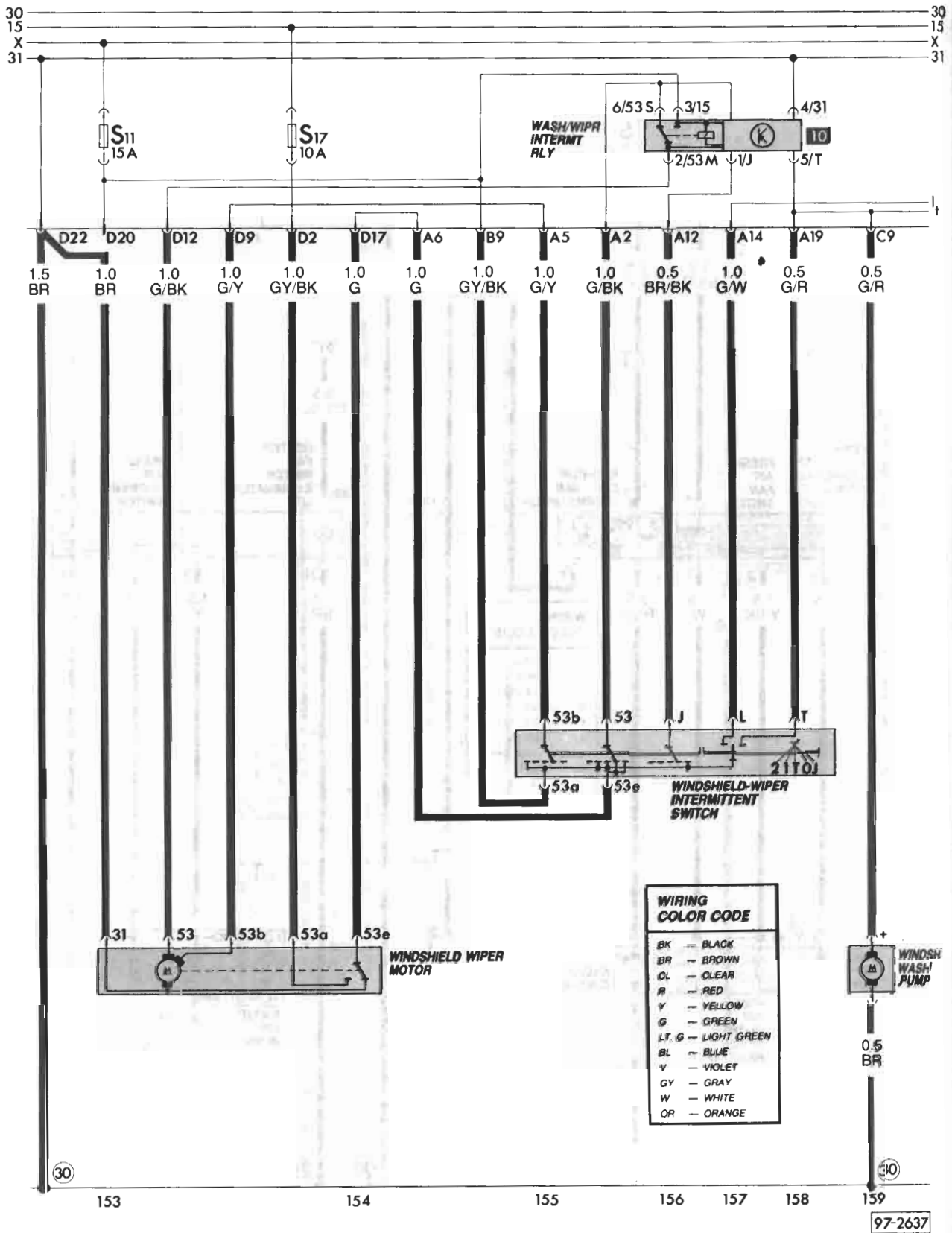


Water-cooled—Digifant 1987

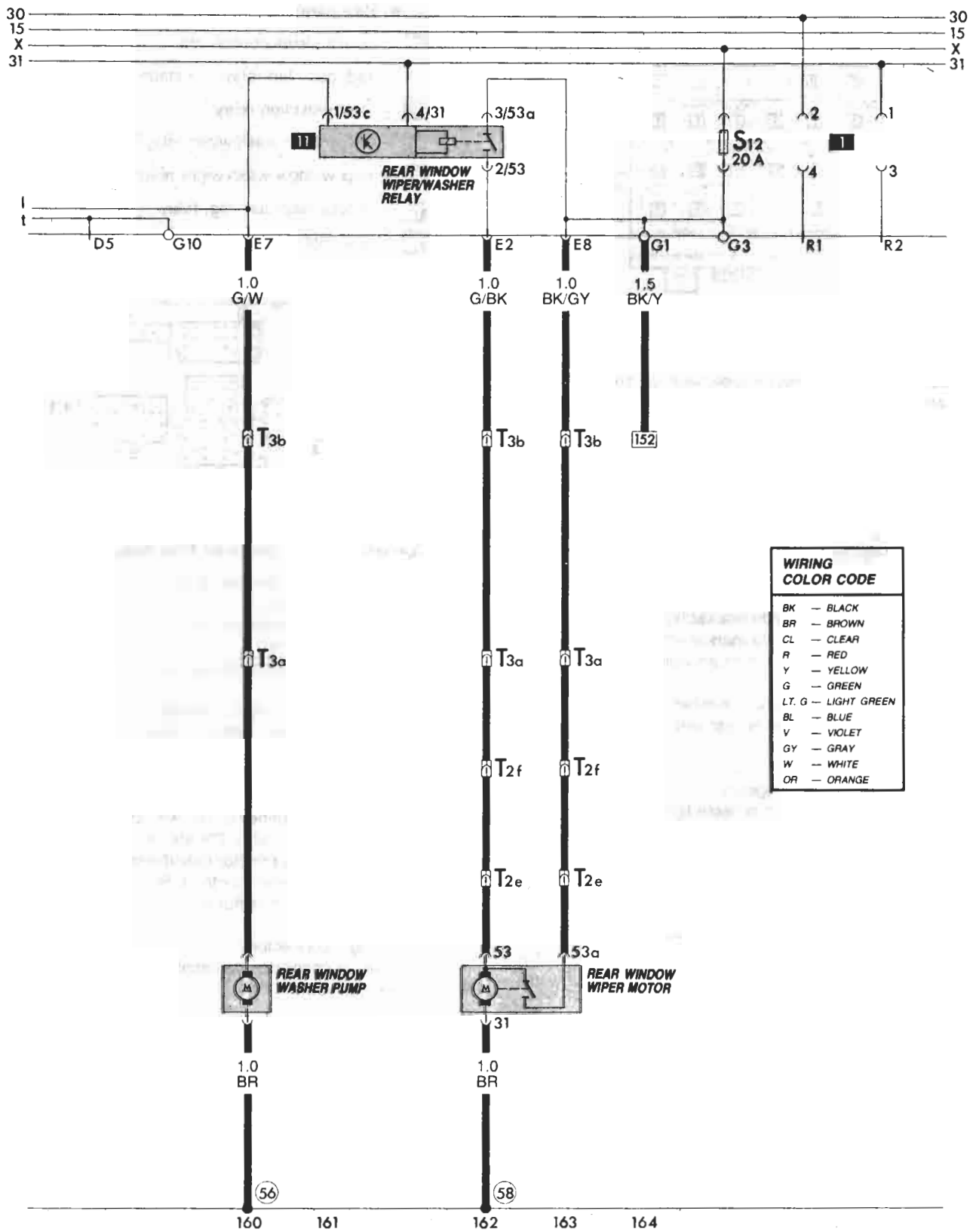
Main wiring diagram  
Radiator cooling fan  
Fresh air fan

## 97.116

# 97 Electrical System - Wiring, Waterboxer

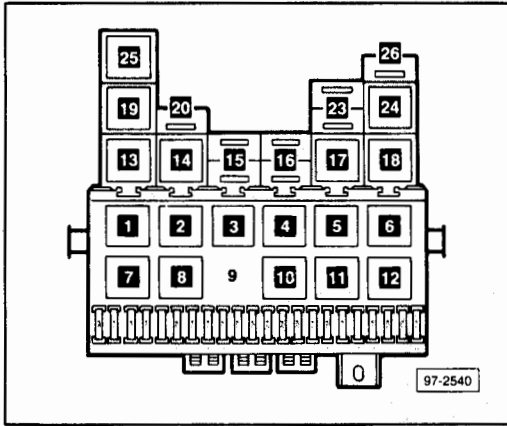


# Electrical System - Wiring, Waterboxer 97



97-2638

# 97 Electrical System - Wiring, Waterboxer



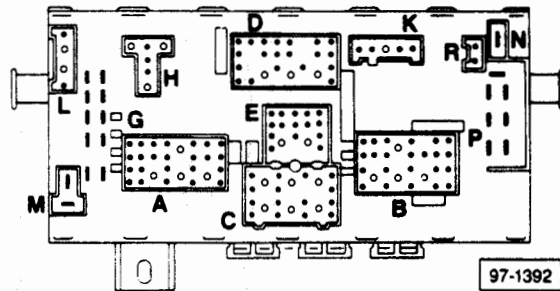
## Fuse arrangement

according to numbers on fuse panel as seen from left to right:

	Amp.
1 Radiator fan .....	30
2 Stop lights .....	15
3 Cigarette lighter, radio, clock, interior lights, central locking system .....	10
4 Emergency flasher system .....	15
5 Not used	
6 Not used	
7 Tail, parking and side marker lights, left .....	10
8 Tail, parking and side marker lights, right .....	10
9 High beam right, high beam indicator light .....	10
10 High beam left .....	10
11 Windshield, wipers and washer .....	15
12 Heated seats, outside rear view mirror adjustment .....	15
13 Fresh air fan .....	20
14 Rear window defogger .....	20
15 Back-up lights, shift console light (auto. transmission) .....	10
16 Horn (single tone) .....	15
17 Windshield wipers .....	10
18 Seat belt warning relay, brake and park brake indicator .....	10
19 Turn signals, brake warning light .....	10
20 License plate lights .....	10
21 Low beam left .....	10
22 Low beam right .....	10

## Fuse/relay panel

- 3** — coolant level control unit
- 5** — rad. cool. fan relay, 2<sup>nd</sup> stage
- 8** — load reduction relay
- 10** — intermittent wash/wiper relay
- 11** — rear window wash/wiper relay
- 12** — emerg. flash/turn sig. relay
- 16** — fuse S50



## Connections and plugs on fuse/relay panel

- A — multi-point connector (blue) for instrument panel wiring harness
- B — multi-point connector (red) for instrument panel wiring harness
- C — multi-point connector (yellow) for front wiring harness
- D — multi-point connector (white) for windshield wiper and main wiring harness
- E — multi-point connector (black) for main wiring harness
- G — single connector
- H — multi-point connector (brown) to connector for rad. cool. fan relay, 2<sup>nd</sup> stage
- K — multi-point connector (colorless) to radiator coolant low-level control unit
- L — multi-point connector (gray) for horns
- M — open position
- N — single connector
- P — single connector (terminal 30)
- R — open position

# Electrical System - Wiring, Waterboxer 97

Description	Current track	Description	Current track	Description	Current track
Air flow sensor potentiometer	22,24	Fuel gauge sending unit	73	Radiator cooling fan	144
Alternator	5	Fuel pump	33	Radiator cooling fan relay	
Alternator warning light	54	Fuel pump relay	32,33	(2nd stage)	146-149
Back-up light switch	128	Hall generator	17,18	Radiator cooling fan	
Back-up light, left	128	Headlight dimmer/flasher switch	104,105	thermoswitch	144,145
Back-up light, right	129	Headlight high beam warning light	66	Radio connection	76-79
Battery	1	Headlight, left	99,101	Reading light, driver's seat	83
Brake and parking brake indicator light	136,137	Headlight, right	109,111	Reading light, left rear	85,86
Brake fluid level warning contact	137	Heater blower	149	Rear window defogger indicator light	139
Brake light switch	125,126	Heater blower switch	148-152	Rear window defogger switch	140
Brake light, left	127	Heater blower series resistance	150-152	Rear window defogger switch light	138
Brake light, right	126	Heater fan switch illumination light	148	Rear window heater element	140
Cigarette lighter	74	Heating element (crankcase ventilation)	12	Rear window washer pump	160
Cigarette lighter light	75	High-beam headlight, left	100	Rear window wiper motor	162,163
Clock light	64	High-beam headlight, right	110	Rear window wiper/washer relay	161,162
Coolant low level control unit	70,71	Horn button	130	Safety belt switch, left	133
Coolant low level warning switch	70	Horns	131	Seat belt warning light	135
Coolant overheat warning light	69	Idle speed stabilizer valve	43,44	Seat belt warning relay	132-135
Coolant temperature gauge	68	Idle stabilizer control unit	39-45	Side marker lights, rear	105,106
Coolant temperature sending unit	72	Ignition coil	13,15	Spark plug connectors	13,15
Digifant control unit	16,29	Ignition distributor	13,15	Spark plugs	13,15
Digifant control unit	16,29	Ignition/starter switch	8-11	Starter	3,4
Digifant control unit relay	34-37	Injector, cyl. 1	29	T.D.C. sensor	46,47
Digital clock	56	Injector, cyl. 2	30	Tachometer	57
Door contact switch, left front	81,82	Injector, cyl. 3	31	Tail light, left	103
Door contact switch, right front	84	Injector, cyl. 4	32	Tail light, right	107
ECS-Malfunction indicator light and switch	20	Instrument panel light	61-63	Temperature sensor II	21
Emergency flasher relay	114,115	Instrument panel light dimmer switch	96	Throttle valve switch (enrichment)	20
Emergency flasher switch	112,120	Interior light, front	81,82	Turn signal indicator light	65
Emergency flasher warning light	120	License plate light	97-98	Turn signal light, left front	122
Engine oil pressure control unit	58,59	Light switch	88-96	Turn signal light, left rear	121
Engine oil pressure switch (0.3 bar)	52	Load reduction relay	89-91	Turn signal light, right front	124
Engine oil pressure switch (1.8 bar)	50	Make-up mirror light	80	Turn signal light, right rear	123
Engine oil pressure warning light	60	Map/reading light, right front	78	Turn signal switch	116,117
Fresh air blower series resistance	142,143	OXS Elapsed mileage counter	48,49	Voltage regulator	5
Fresh air control lever light	141	OXS elapsed mileage indicator	55	Voltage stabilizer	67
Fresh air fan	142,143	Oxygen sensor	27,28	Washer/wiper intermittent relay	156-158
Fresh air fan switch	141-143	Parking brake warning light switch	136	Windshield washer pump	159
Fuel gauge	67	Parking light, left	102	Windshield wiper motor	153,154
		Parking light, right	108	Windshield-wiper intermittent switch	155-158
		Power steering pressure switch	39,40		

# 97 Electrical System - Wiring, Waterboxer

## Wire connectors

- T1 — single, under instrument panel, left side
- T1a — single, above left rear window
- T1d — single, in wire distributor box, engine compartment
- T1e — single, under instrument panel, left side
- T1g — single, in wire distributor box, engine compartment
- T1h — single, engine compartment, left side
- T1i — single, under instrument panel
- T1k — single, engine compartment, left
- T1m — single, near relay panel, engine compartment
- T1n — single, near relay panel, engine compartment
- T1o — single, under instrument panel, left side
- T2c — double, under instrument panel, left side
- T2d — double, upper right 'A' pillar
- T2e — double, in rear deck lid
- T2f — double, behind left 'C' pillar cover
- T2g — double, under instrument panel
- T2i — double, in wire distributor box, engine compartment
- T2k — double, in engine compartment, left
- T2m — double, near relay panel, engine compartment
- T2o — double, under driver's seat
- T2x — double, in engine compartment, middle
- T3 — three-point, near alternator
- T3a — three-point, behind instrument panel, right side
- T3b — three-point, behind instrument panel, left side
- T3c — three-point, near instrument cluster
- T3d — three-point, behind front grille
- T3x — three-point, under instrument panel
- T7 — seven-point, in wire distributor box, engine compartment
- T7a — seven-point, in wire distributor box, engine compartment
- T8 — eight-point, under instrument panel, middle
- T14 — fourteen-point, on instrument cluster

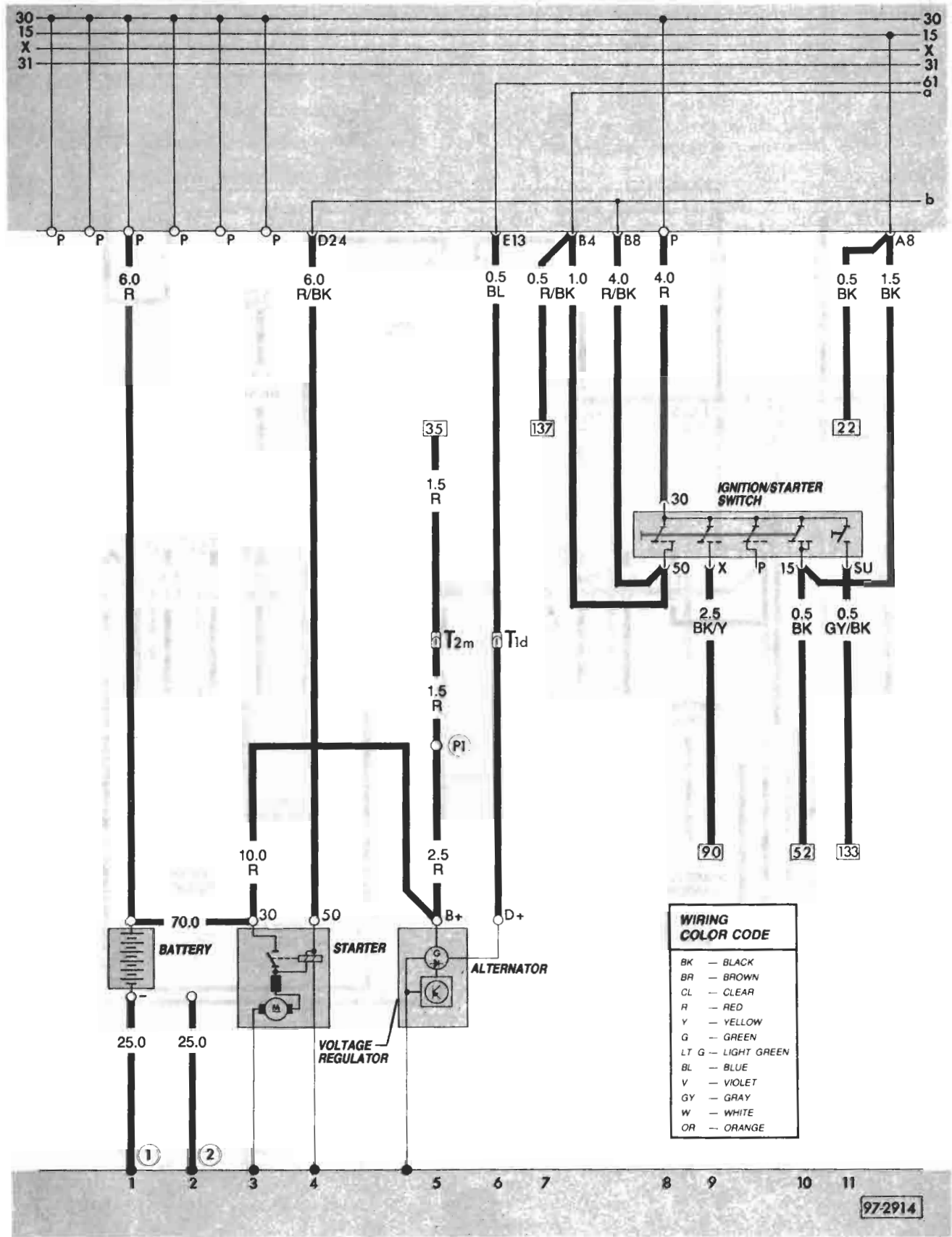
## Ground connections

- ① — battery to body
- ② — transmission to body
- ⑫ — in engine compartment, left
- ⑱ — on engine block
- ⑳ — ground wire, above steering gear
- ㉑ — near Digifant control unit
- ⑳ — near relay panel
- ④⑤ — under instrument panel, middle
- ⑤② — in rear decklid, left
- ⑤③ — in rear decklid, right
- ⑤⑥ — near rear washer bottle holder
- ⑤⑧ — near rear window wiper motor

## Welded wiring connections

- ⑧① — ground connection, instrument panel wiring harness
- ⑨④ — ground connection, in Digifant wiring harness
- ④④ — plus (+), terminal 58, instrument panel wiring harness
- ④① — plus (+), in Digifant wiring harness
- ④② — in Digifant wiring harness
- ④① — plus (+) 30 terminal, in wire distributor box, engine compartment

# Electrical System - Wiring, Waterboxer 97

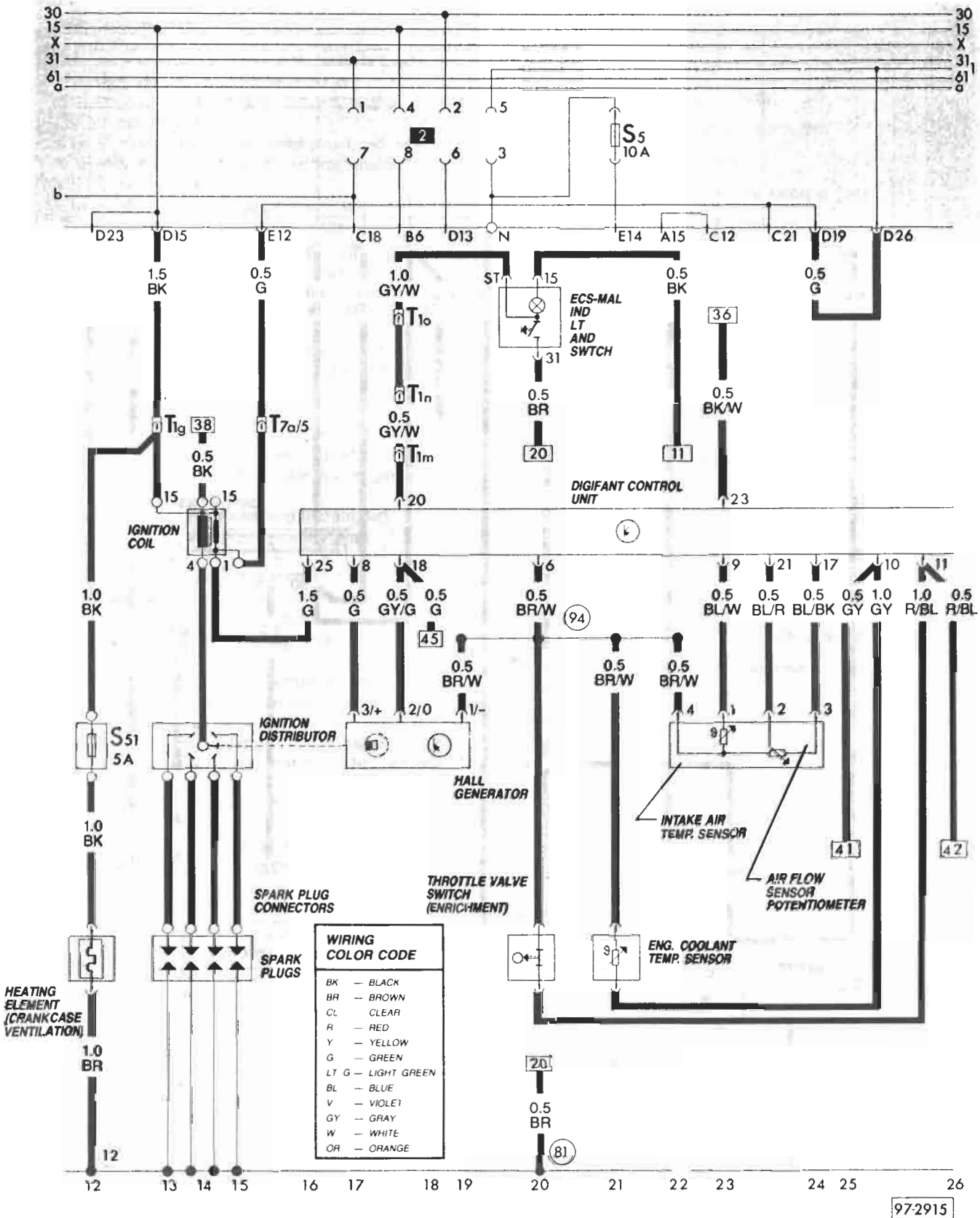


Water-cooled — Digifant 1988, 1989

Main wiring diagram  
Alternator/Starter/  
Ignition Switch

97.122

# 97 Electrical System - Wiring, Waterboxer

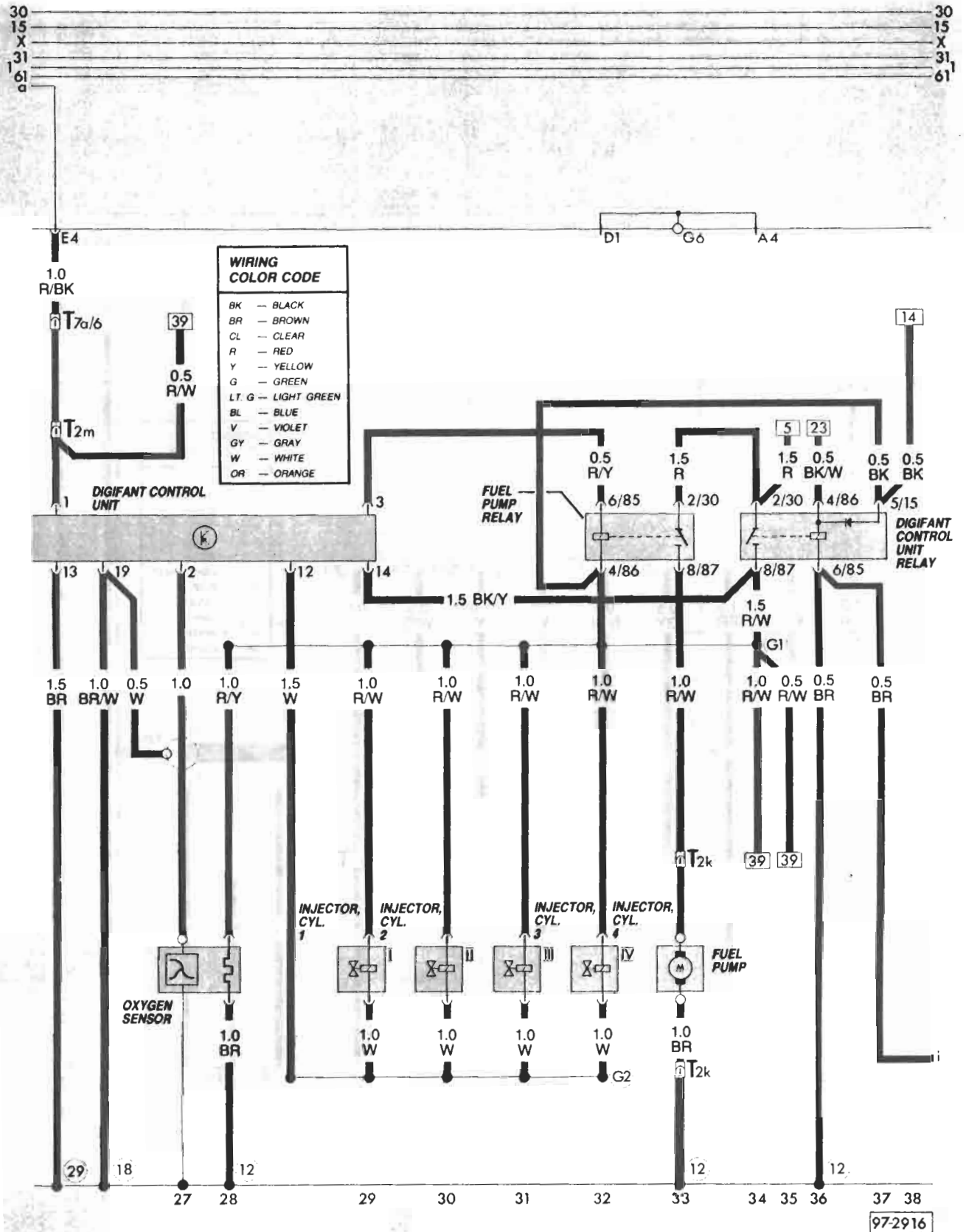


**97.123**

Main wiring diagram  
Ignition system  
Digifant system

Water-cooled -- Digifant 1988, 1989



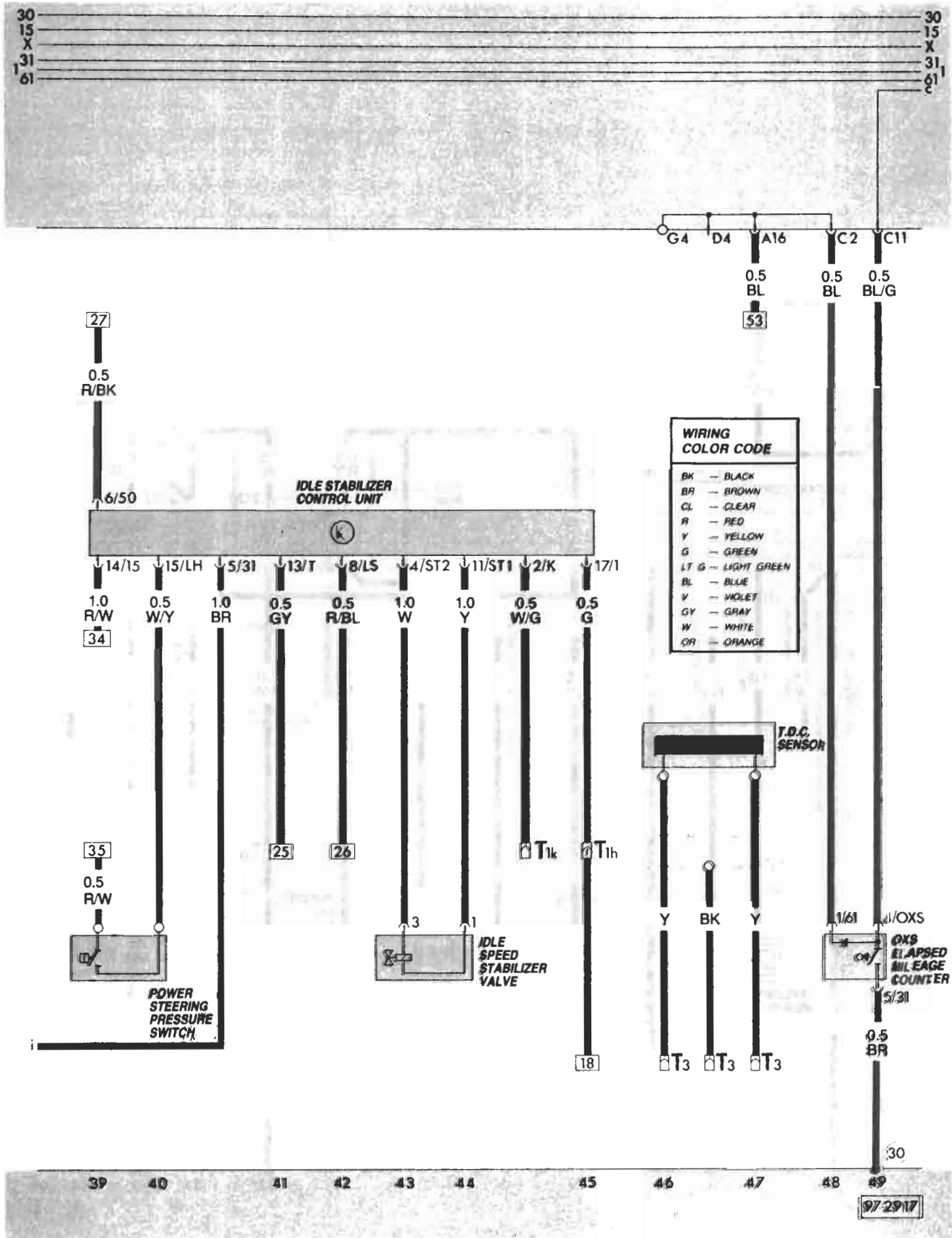


Water-cooled - Digifant 1988, 1989

Main wiring diagram  
Digifant power supply,  
fuel injectors

97.124

# 97 Electrical System - Wiring, Waterboxer



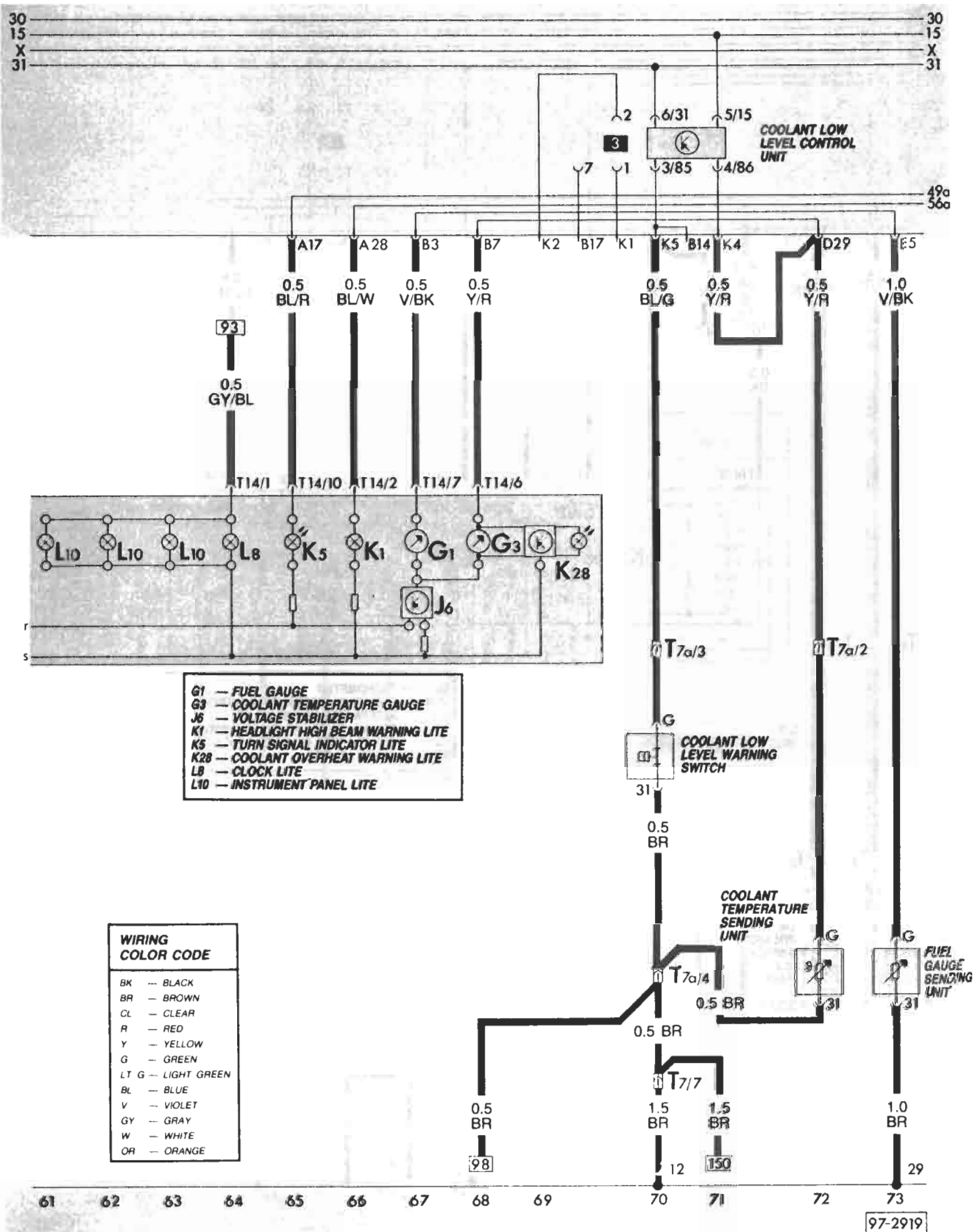
97.125

Main wiring diagram  
Idle stabilizer control

Water-cooled — Digifant 1988, 1989

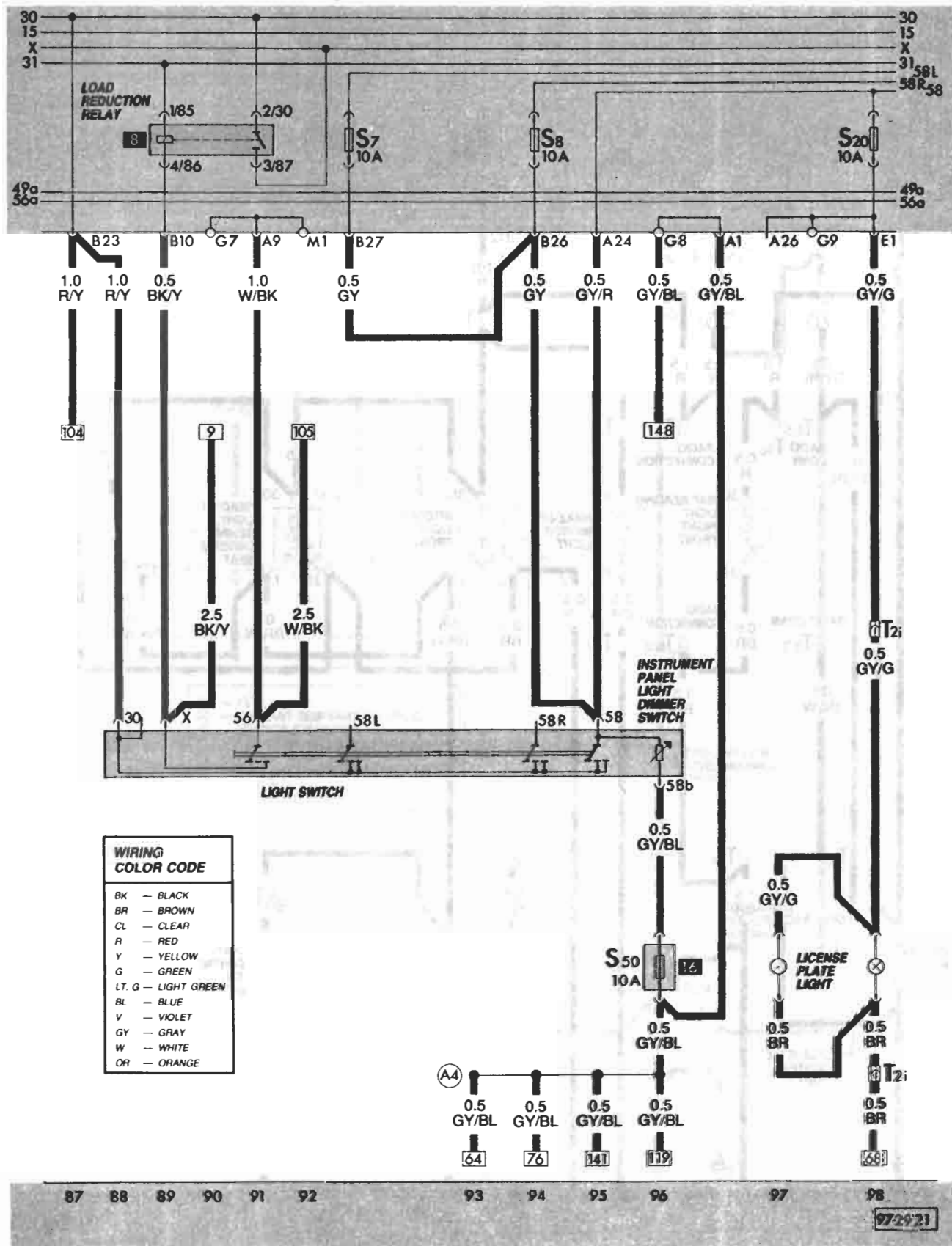


# 97 Electrical System - Wiring, Waterboxer





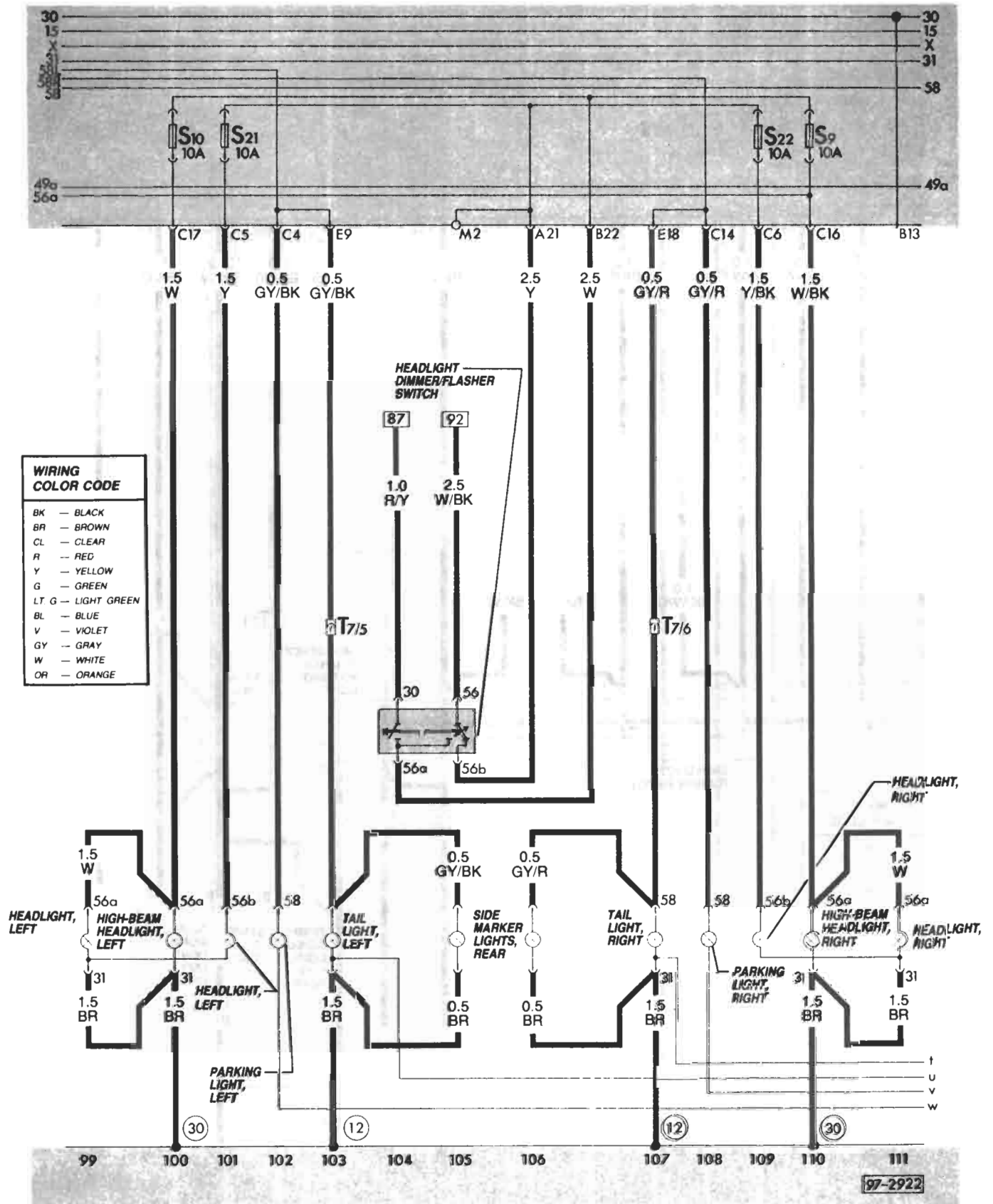
# 97 Electrical System - Wiring, Waterboxer



**97.129**

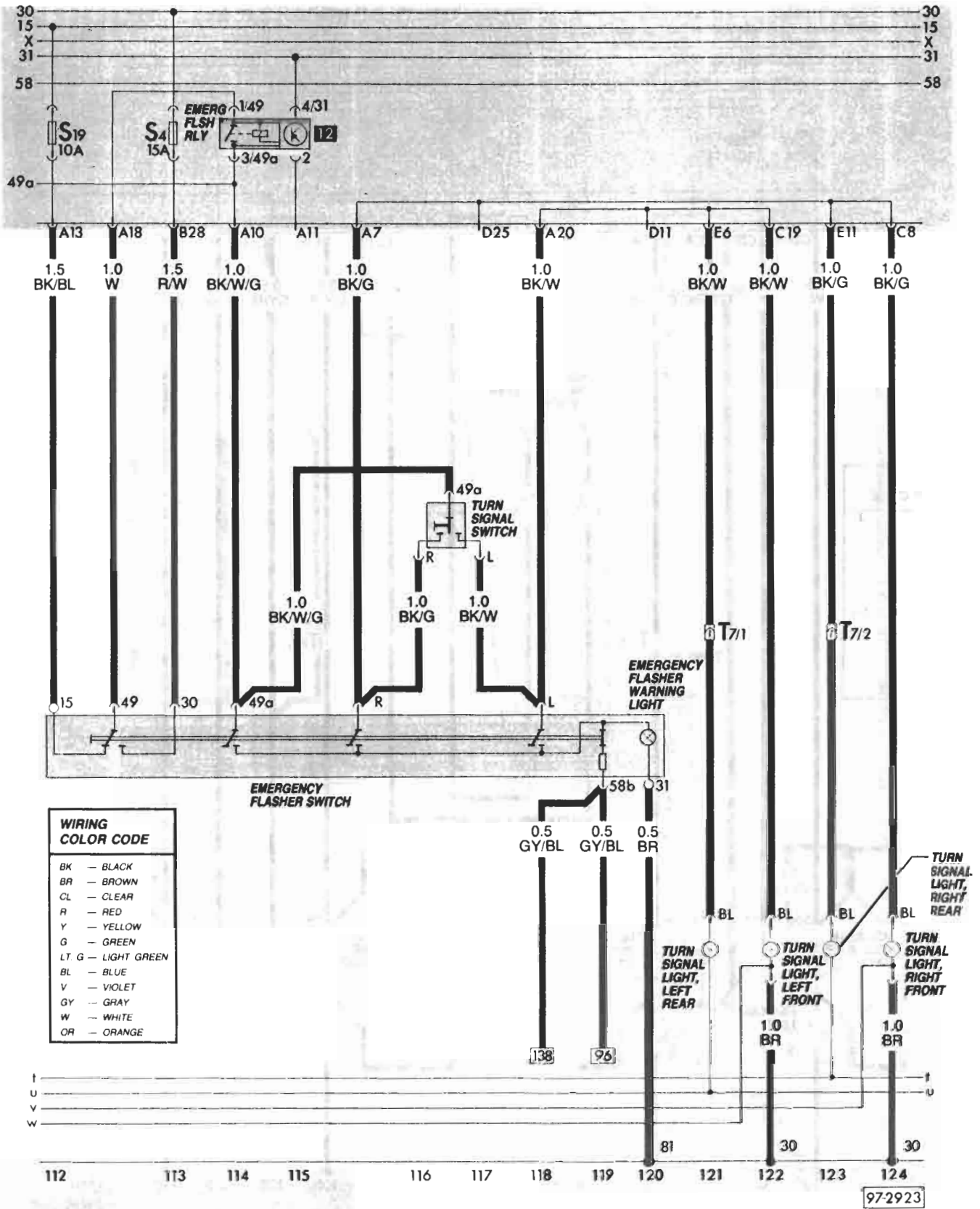
Main wiring diagram  
Load reduction relay,  
light switch

Water-cooled—Digifant 1988, 1989





# 97 Electrical System - Wiring, Waterboxer



**WIRING COLOR CODE**

BK	—	BLACK
BR	—	BROWN
CL	—	CLEAR
R	—	RED
Y	—	YELLOW
G	—	GREEN
LT G	—	LIGHT GREEN
BL	—	BLUE
V	—	VIOLET
GY	—	GRAY
W	—	WHITE
OR	—	ORANGE

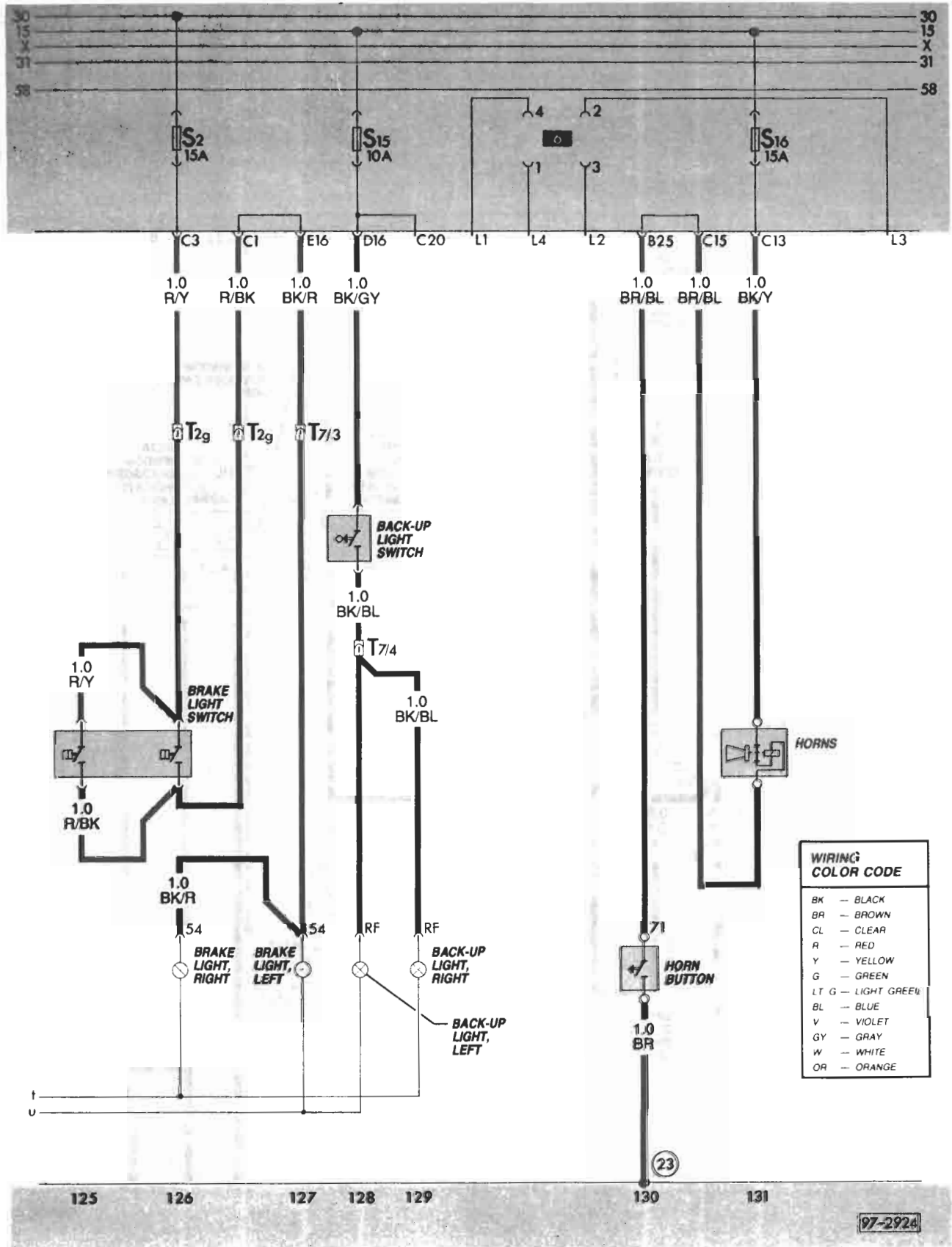
**97.131**

Main wiring diagram  
Emergency flashers,  
turn signals

**Water-cooled — Digifant 1988, 1989**



# Electrical System - Wiring, Waterboxer 97

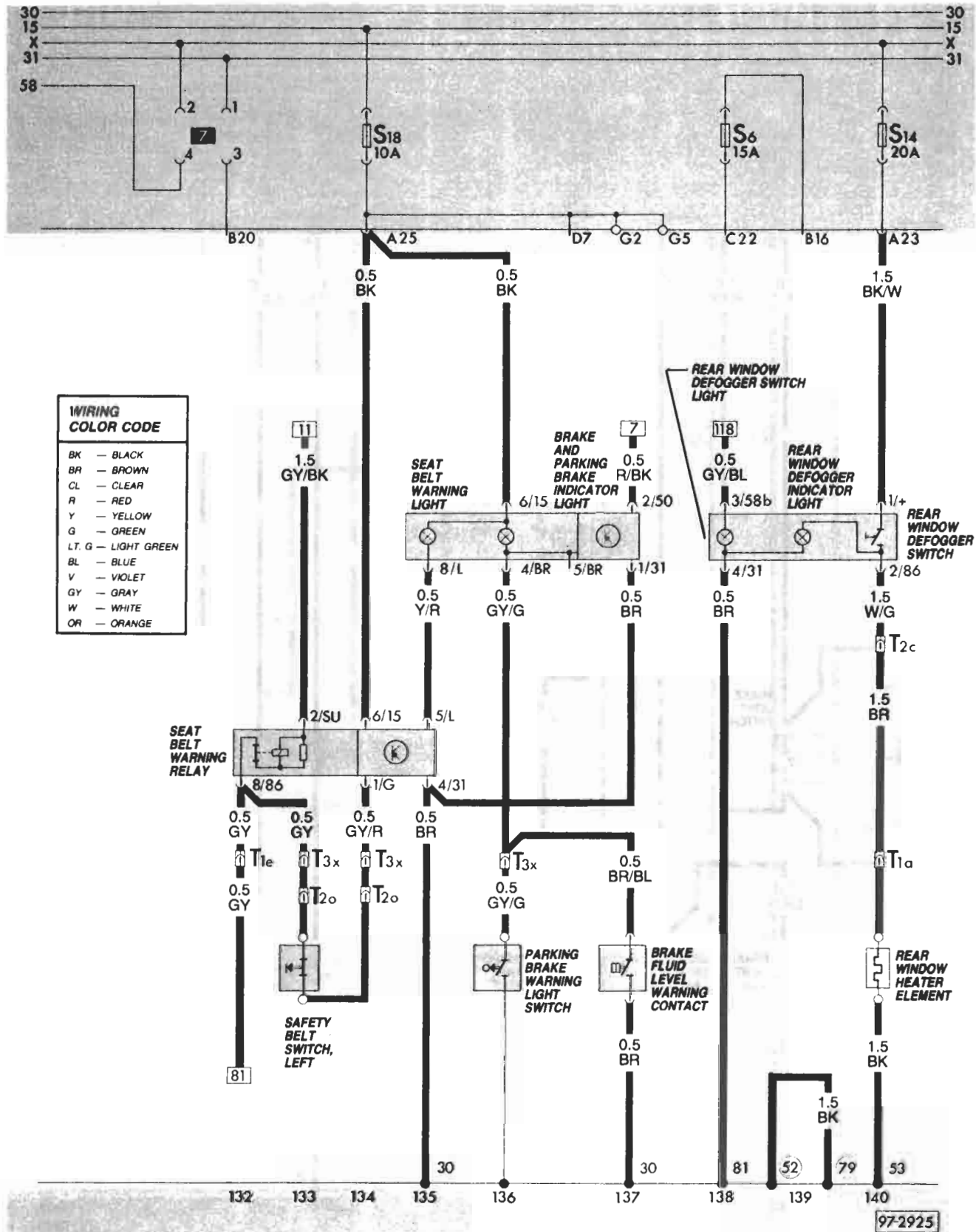


Water-cooled — Digifant 1988, 1989

Main wiring diagram  
Brake lights, horns

97.132

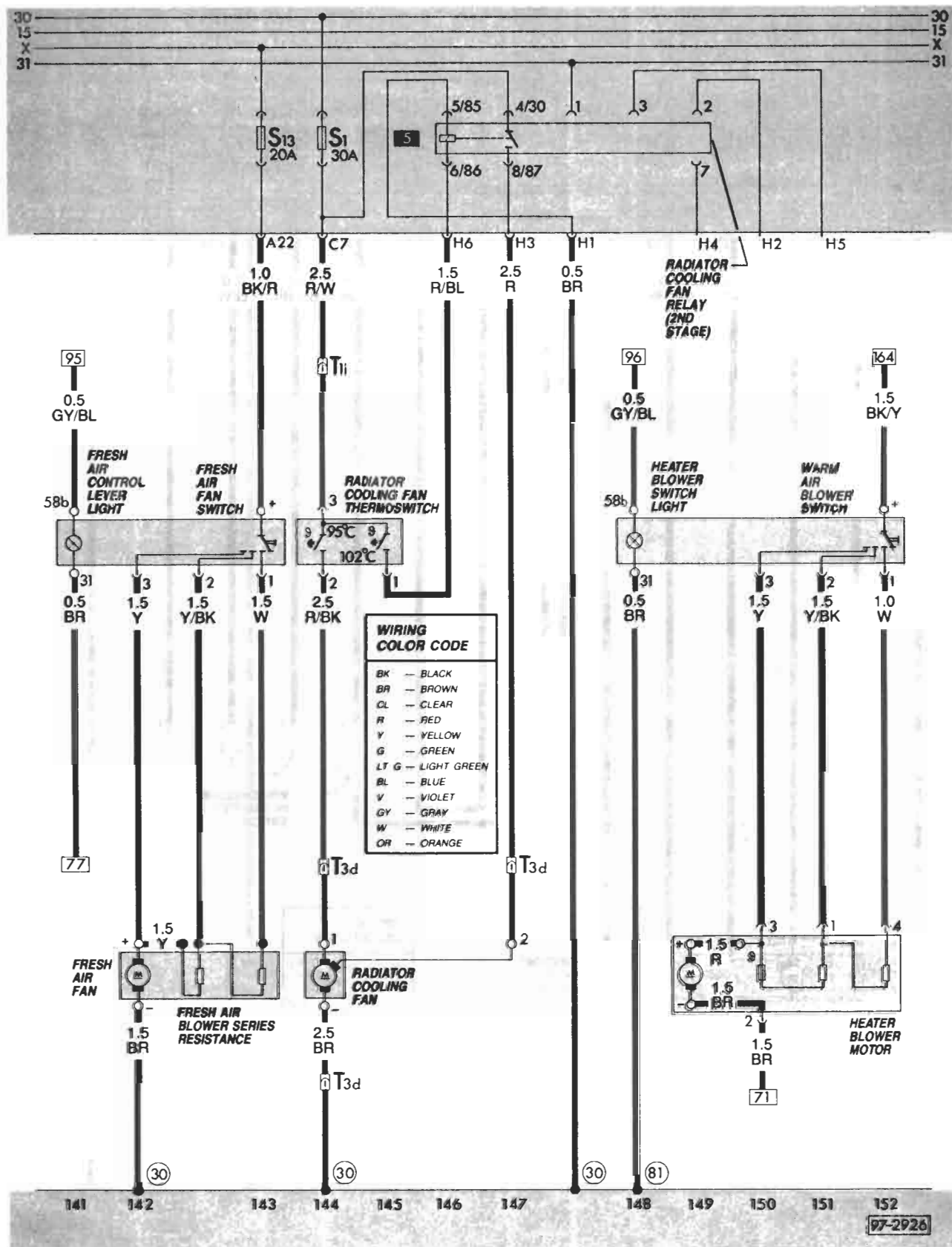
# 97 Electrical System - Wiring, Waterboxer



**97.133**

Main wiring diagram  
Seat belt system,  
rear defogger

Water-cooled — Digifant 1988, 1989



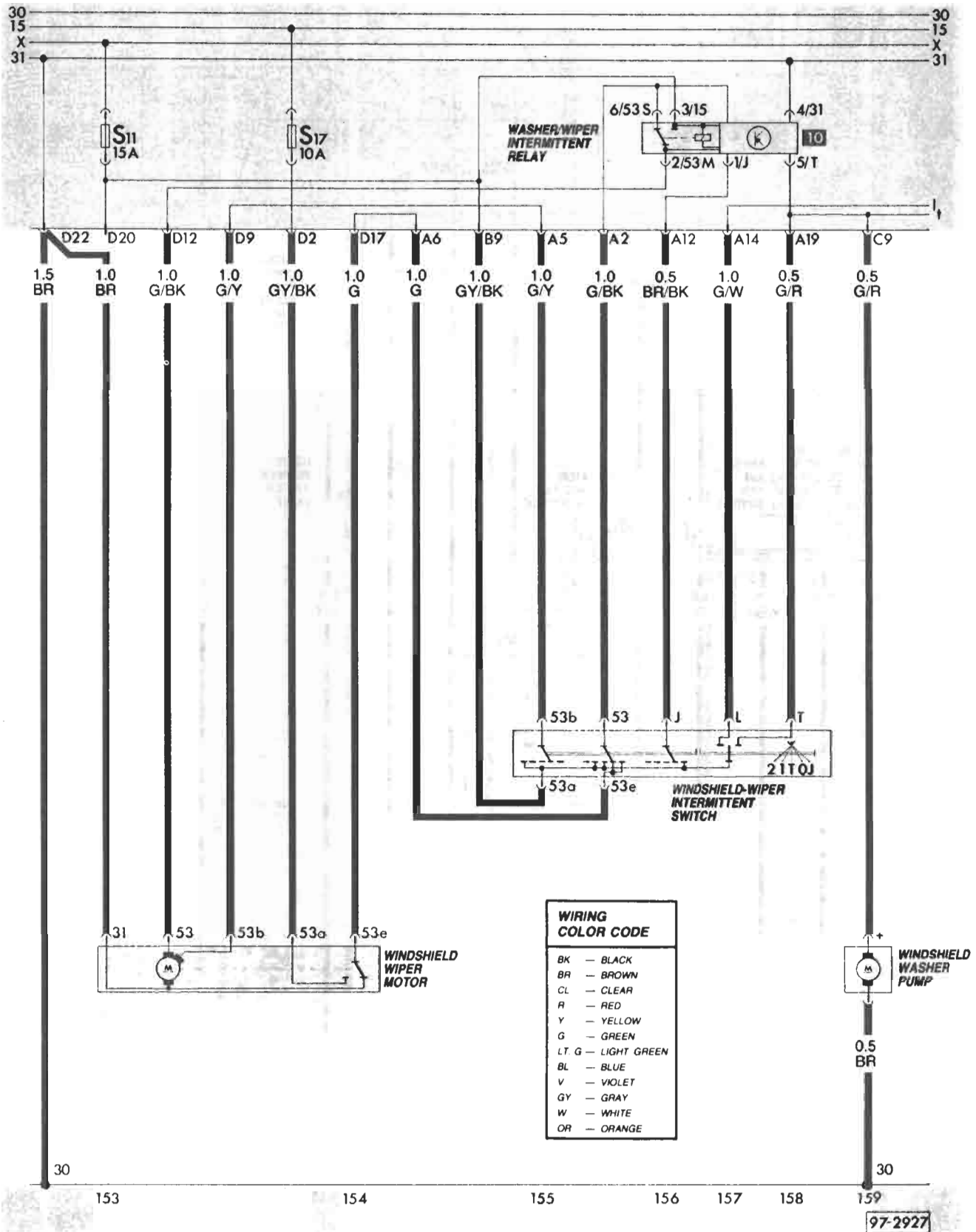
Water-cooled – Digifant 1988, 1989

Main wiring diagram  
Radiator cooling fan,  
fresh air fan

# 97.134

97-2926

# 97 Electrical System - Wiring, Waterboxer

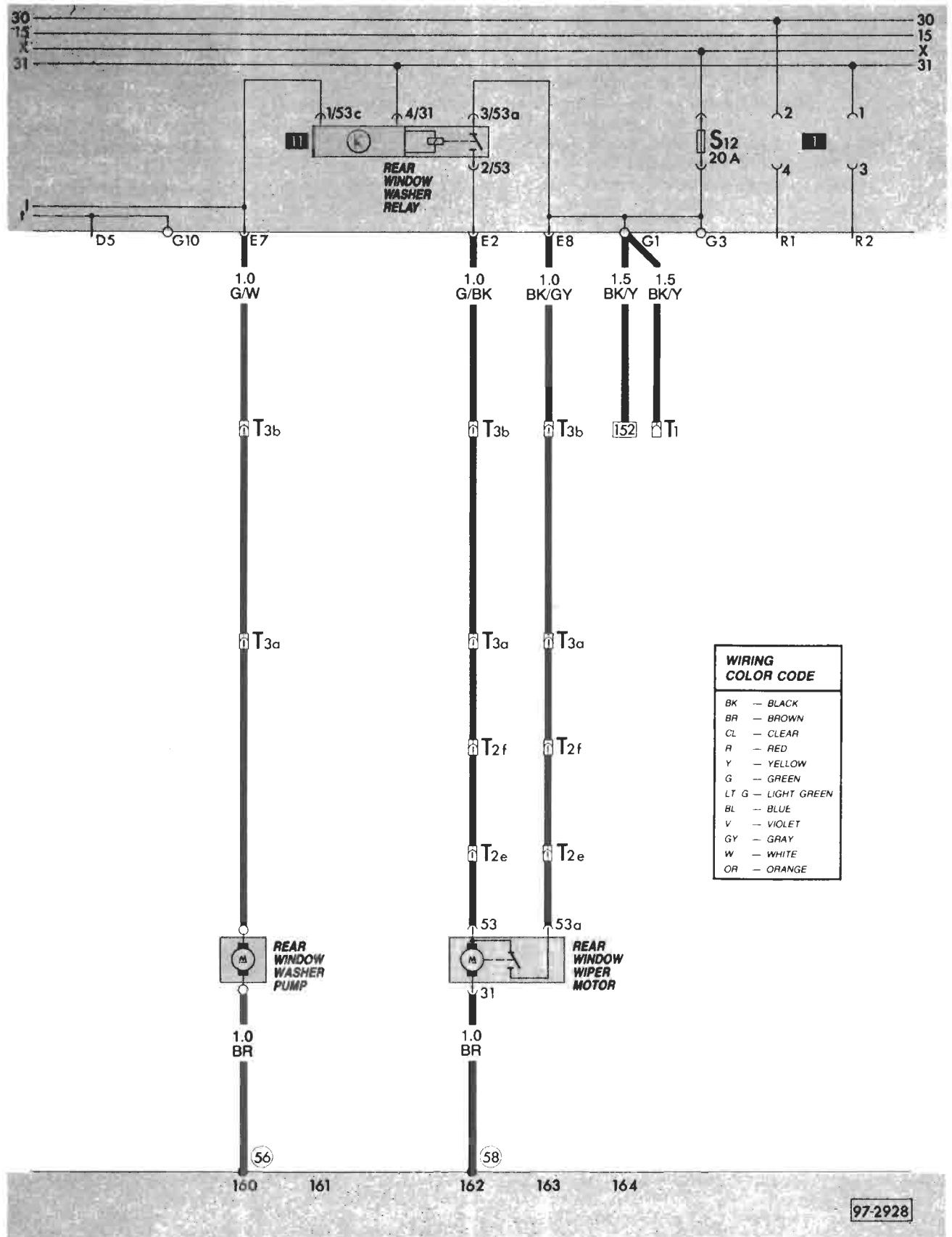


**97.135**

Main wiring diagram  
Windshield wipers

Water-cooled—Digifant 1988, 1989

97-2927



Water-cooled—Digifant 1988, 1989

Main wiring diagram  
Rear window wiper

97.136

97-2928

Description	Current Track
A/C compressor clutch	14
A/C compressor cut-out relay	12-13
A/C thermostat	13
Evaporator fan	18
Evaporator fan range switch	16, 17
Evaporator fan relay	3
Evaporator fan switch	13-15
Idle speed stabilizer valve	13
Rad./condensor cool. fan relay	9, 10
Rad. cooling fan	2
Rad. cool. fan relay	1-3
Rad. cool. fan thermoswitch	3, 4

### Connectors

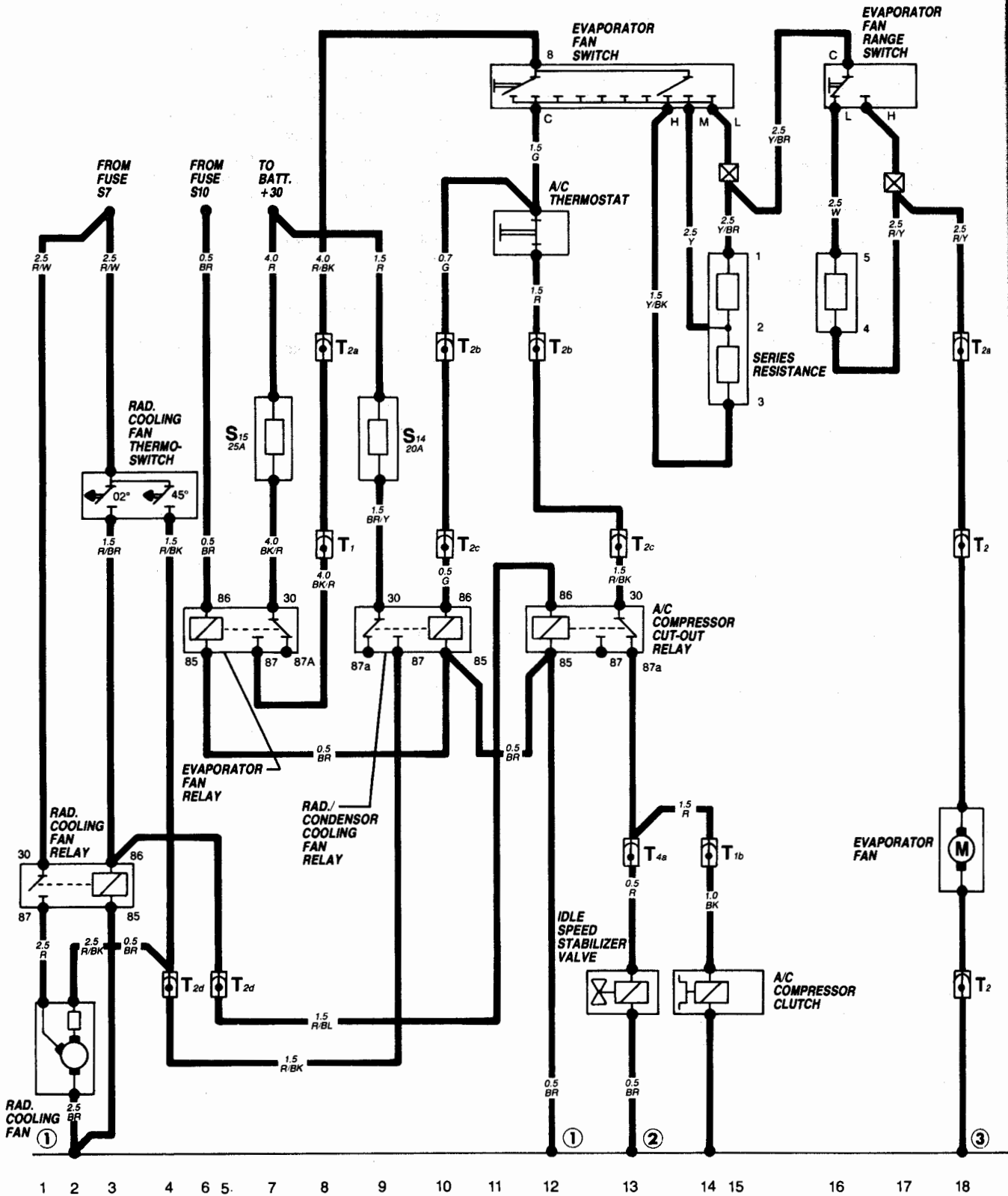
- T1 — single, behind left 'B' pillar cover
- T1a — single, eng. comp., left
- T1b — single, eng. comp., left
- T2 — double, in evaporator housing
- T2a — double, in air tunnel
- T2b — double, in air tunnel
- T2c — double, behind left 'B' pillar cover
- T2d — double, above fuse panel

### Ground Connections

- ① — near fuse panel
- ② — in engine compartment
- ③ — in evaporator housing (near left side)

Go to next page ▶

# 97 Electrical System—Wiring, Waterboxer



87-833

Description	Current Track
A/C compress. clutch	15
A/C compress. clutch relay	15-17
A/C refrig. high press. sw.	14
A/C refrig. low press. sw.	15
A/C switch	1-3
A/C thermostat	1-3
Ambient air temp. sw.	15
Evap. fan	7-8
Evap. fan sw.	6-8
Evap. fan relay	5-6
Evap. series resistance	7-8
Rad. cool fan	20
Rad. cool fan relay 2 <sup>nd</sup> stage	21-23
Rad. cool fan relay 3 <sup>rd</sup> stage	18-20
Rad. cool fan resistance	22
Rad. cool fan thermostiches	18-20

### Wire Connectors

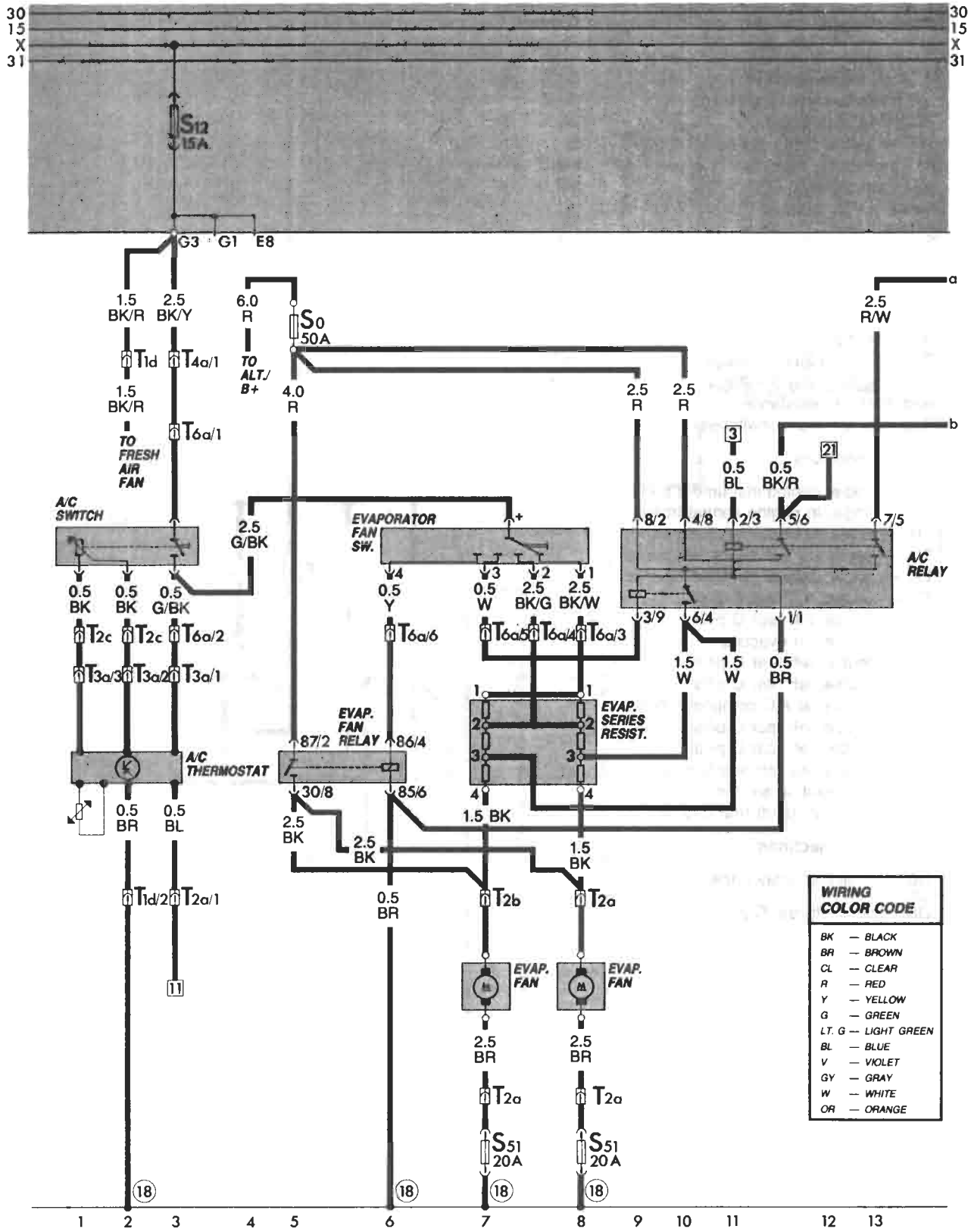
- T1 — single, behind instrument panel
- T1a — single, in engine compartment
- T1b — single, behind instrument panel
- T1c — single, behind instrument panel
- T1d — single, behind instrument panel
- T2 — double, left rear C-pillar
- T2a — double, left rear C-pillar
- T2b — double, on evaporator
- T2c — double, left rear C-pillar
- T2e — double, left rear C-pillar
- T2f — double, at A/C compress. clutch
- T2g — double, left rear C-pillar
- T2h — double, left rear C-pillar
- T3a — three-point, left rear C-pillar
- T4a — four-point, in air duct
- T6a — six-point, in left rear C-pillar

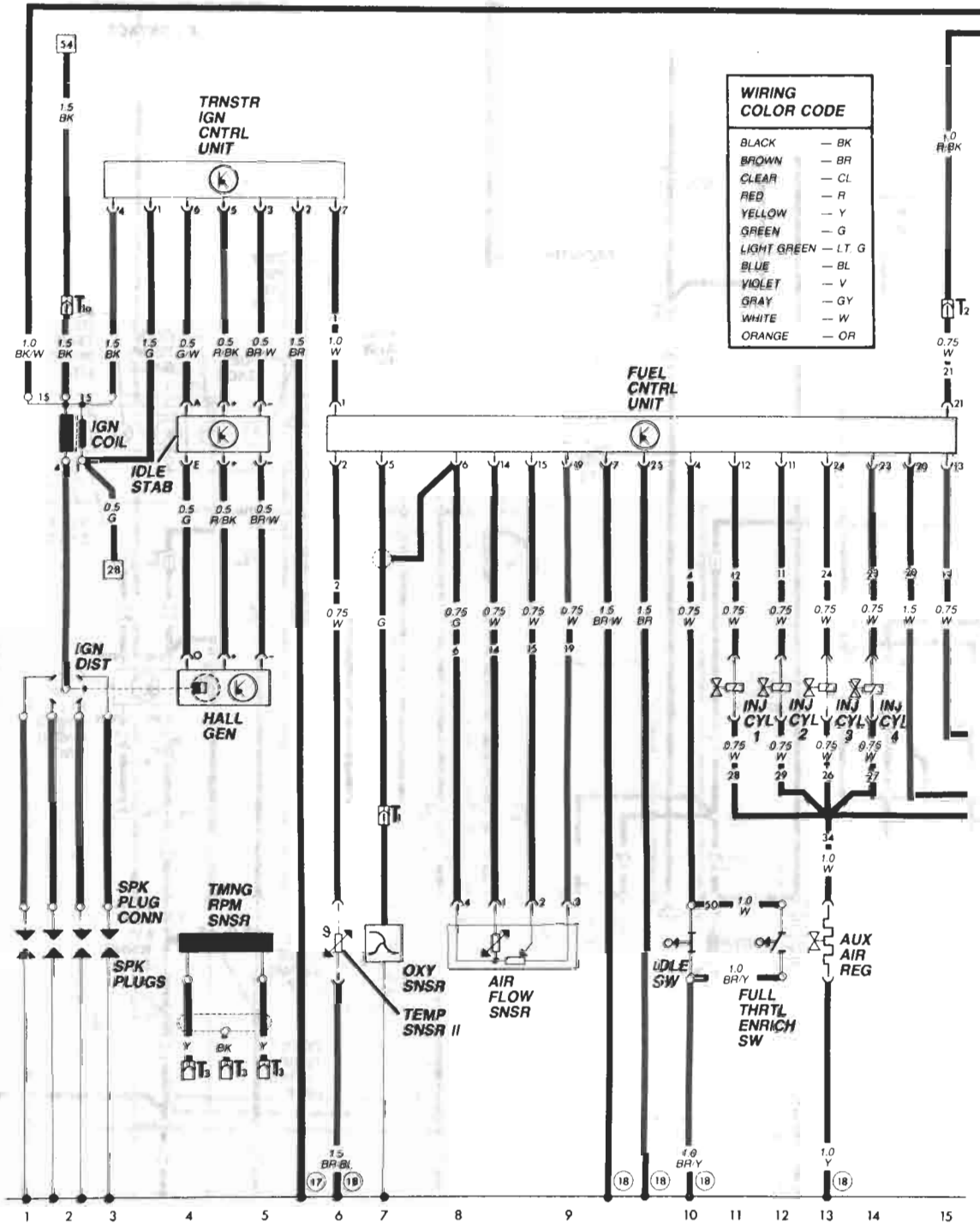
### Ground Connections

- ⑩ — near fuse/relay panel
- ⑱ — near left rear C-pillar



# 97 Electrical System - Wiring, Waterboxer

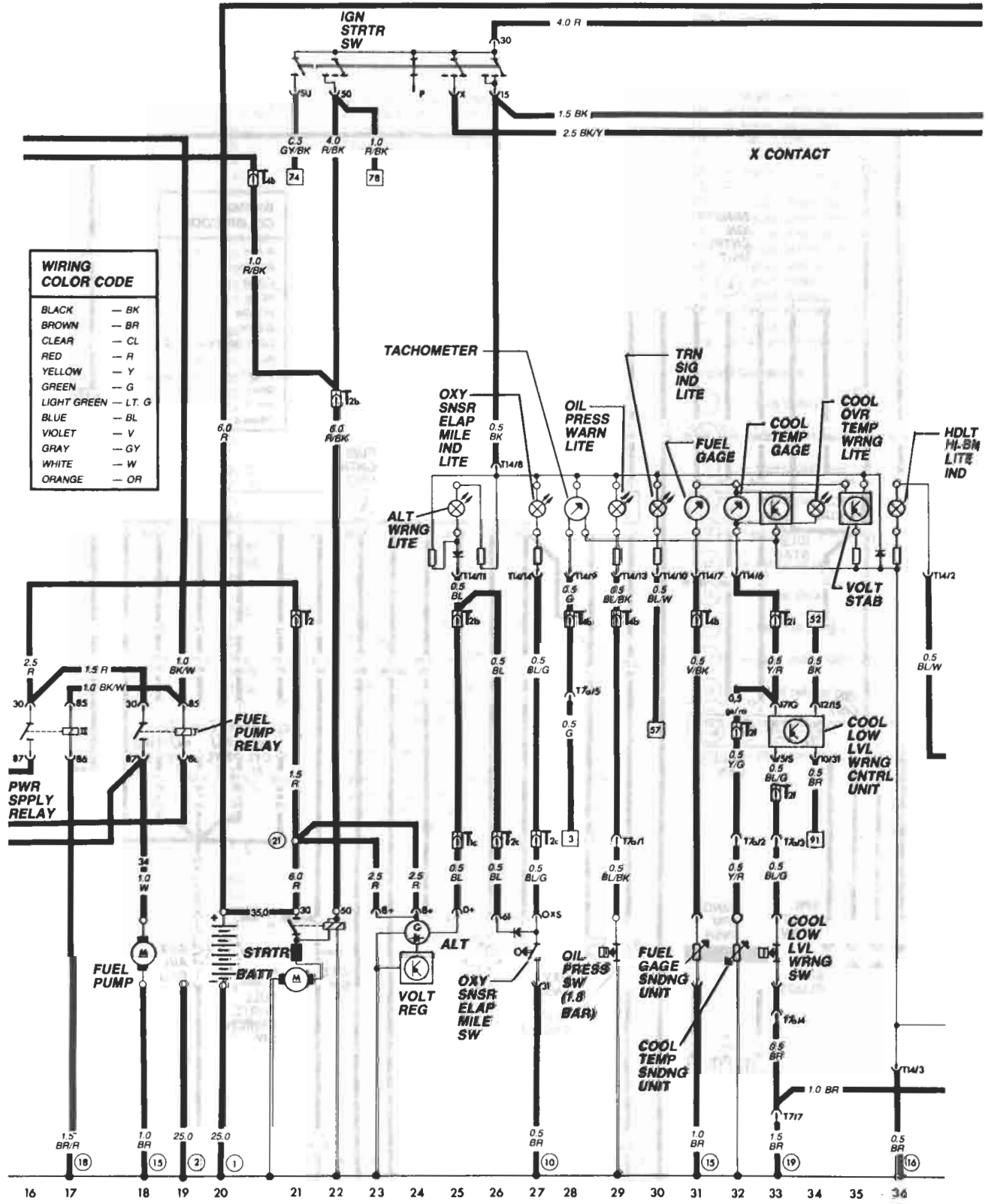


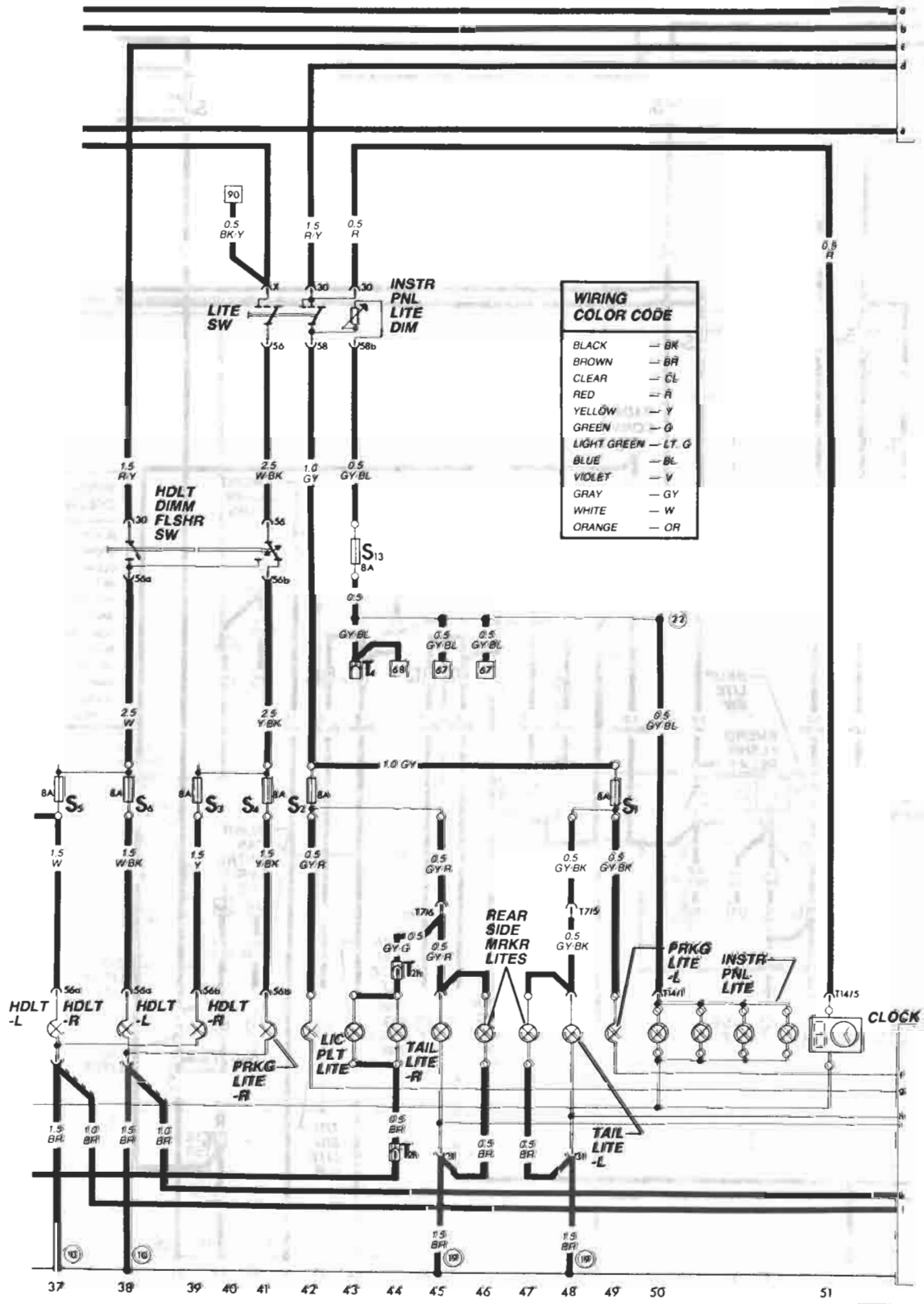


**Water-cooled—Digijet 1985**

**Main wiring diagram**

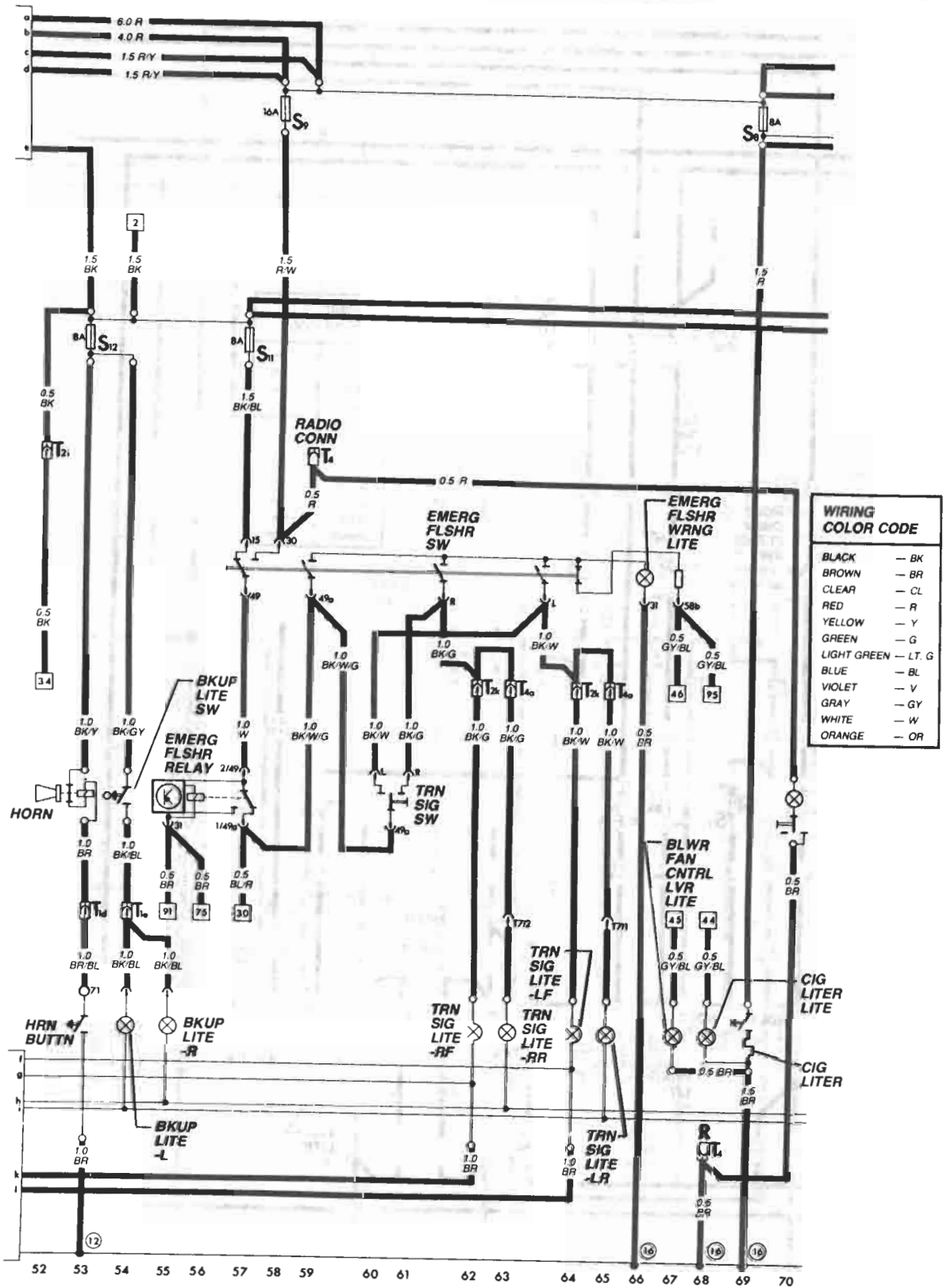
# 97 Electrical System—Wiring, Waterboxer

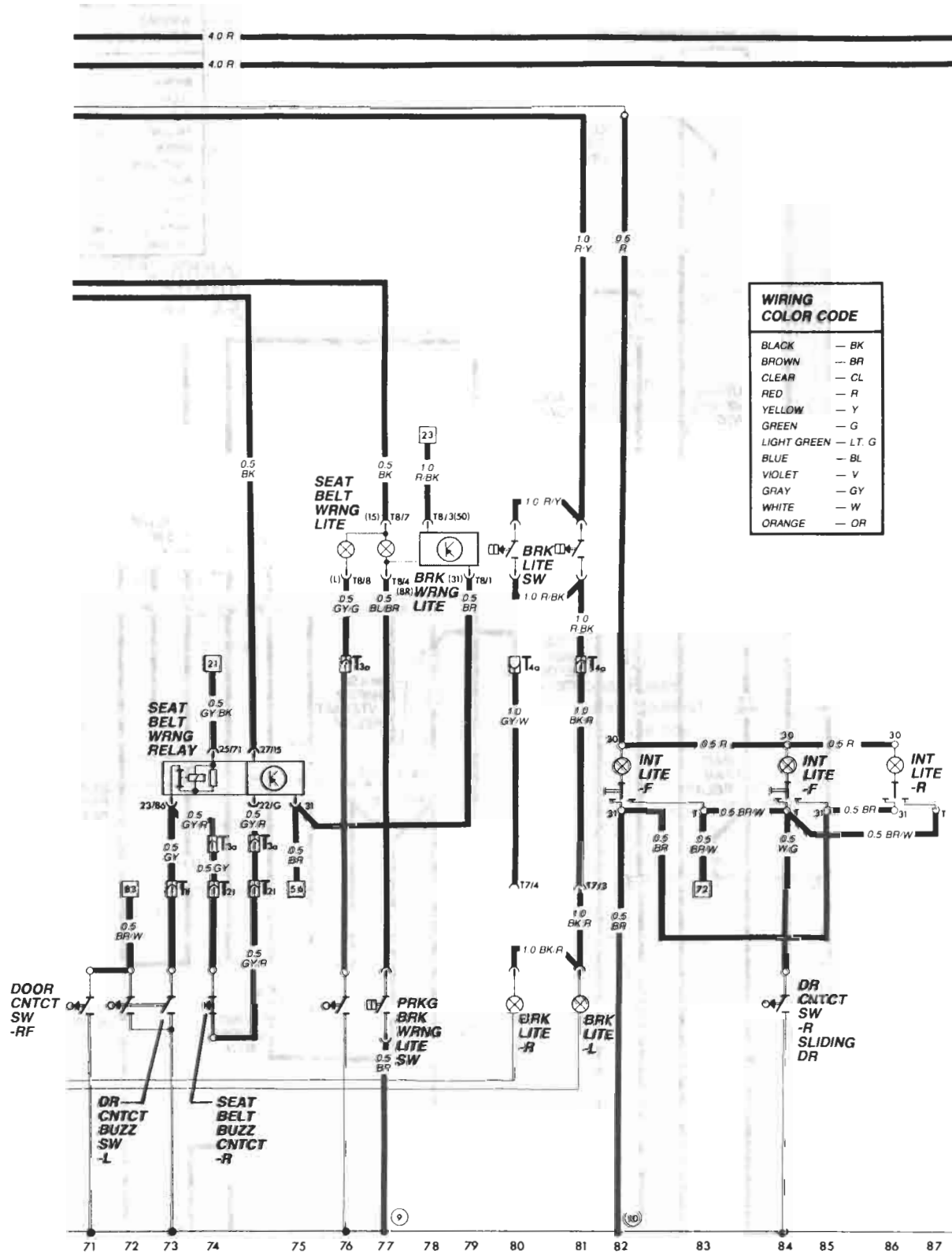




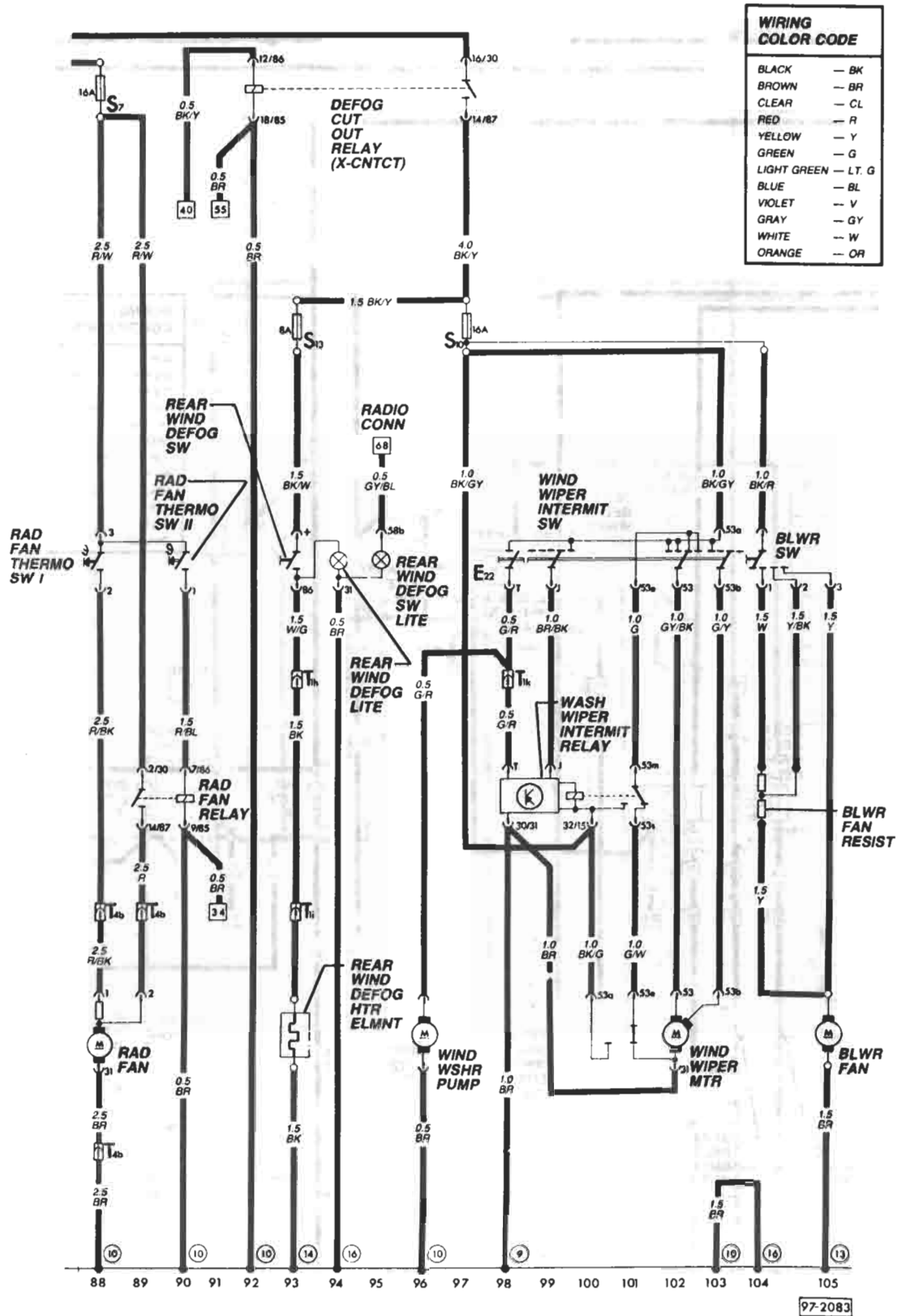
97-2082

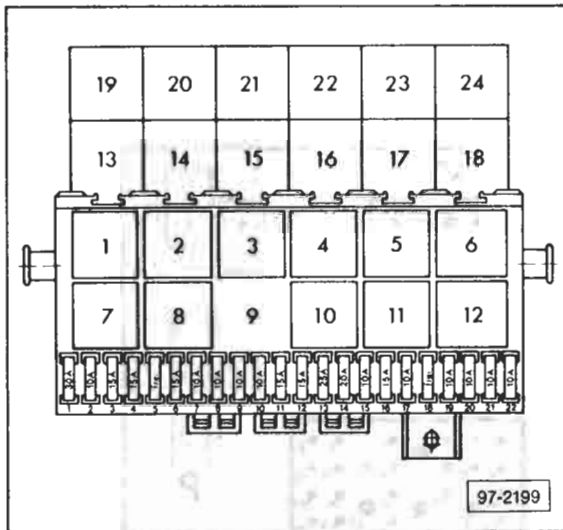
# 97 Electrical System—Wiring, Waterboxer





# 97 Electrical System—Wiring, Waterboxer





### Fuse/Relay Panel

- 3** — coolant level control unit
- 5** — rad. cool. fan relay, 2<sup>nd</sup> stage
- 8** — load reduction relay
- 10** — intermitt. wash/wiper relay
- 11** — rear window wash/wiper relay
- 12** — emerg. flash/turn sig. relay

### CAUTION

Relay locations are subject to change and may vary from vehicle to vehicle depending on options.

Use extreme care when troubleshooting the electrical system.

If you encounter problems identifying a particular relay, consult your Parts Department.

### Fuse Arrangement

according to numbers on fuse panel as seen from left to right:

No.	Component	Amp.
1	Radiator fan	30
2	Brake lights	10
3	Interior lights, illuminated Make-up mirror, clock	15
4	Emergency flasher system	15
5	Vacant	
6	Vacant	
7	Tail and side light left	10
8	Tail and side light right	10
9	High beam right	10
10	High beam left	10
11	Windshield washer	15
12	Rear wiper, Cruise control system	15
13	Rear window heating, fresh air fan	25
14	Auxiliary heat exchanger, light for lighting switch	20
15	Back-up lights	10
16	Double tone horn	15
17	Windshield wiper	10
18	Brake warning light, heated driver's seat	10
19	Turn signals	10
20	Number plate light, headlight washer	10
21	Low beam right	10
22	Low beam left	10

### Additional Fuses

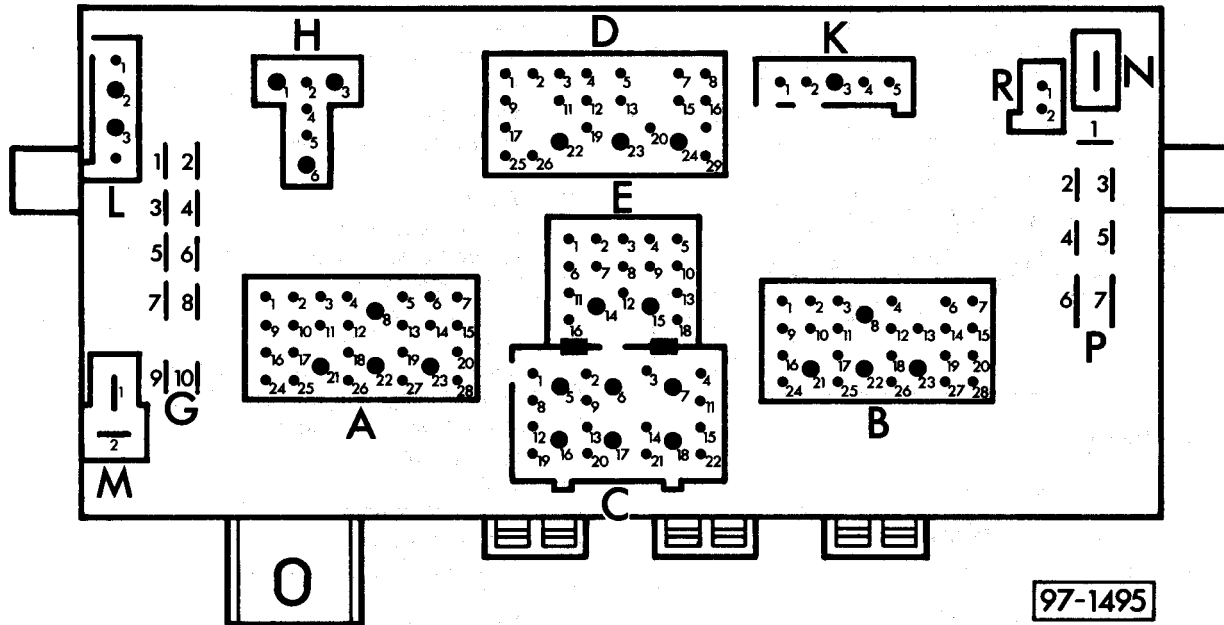
(in separate holders) above the fuse box:

Instrument lighting	10
Overheating fuse for auxiliary heater	10
Main fuse for auxiliary heater	20
Emergency horn system	15
Central locking	20
Automatic fuse for power windows	20



# 97 Electrical System - Wiring, Waterboxer

## Fuse/relay panel, rear view



- A — multi-point connector (blue) for instrument panel wiring harness
- B — multi-point connector (red) for instrument panel wiring harness
- C — multi-point connector (yellow) for front wiring harness
- D — multi-point connector (white) for windshield wiper harness and main wiring harness
- E — multi-point connector (black) for main wiring harness
- F — single connector
- H — multi-point connector (brown), relay connections for rad. cool. fan, 2nd stage
- K — multi-point connector (colorless), connectors for low coolant warning control unit
- L — multi-point connector (gray), horn connections
- M — multi-point connector (black), open terminal (used for light switch terminal 56) and switch for hand operated brights and dimmers terminal 56b
- N — single plug
- P — single plug — terminal 30
- R — open

### CAUTION

Relay locations are subject to change and may vary from vehicle to vehicle depending on options.

Use extreme care when troubleshooting the electrical system.

If you encounter problems identifying a particular relay, consult your Parts Department.

Description	Current Track
Air flow sensor	21-22
Alternator	5-7
Alt. warn. lite	46
Back-up lite, L	118
Back-up lite, R	117
Back-up lite switch	118
Battery	1
Brake fluid level switch	130
Brake lite, L	116
Brake lite, R	115
Brake lite switch	113-114
Brake/park brake warn. lite	128-130
Cigar lighter	65
Cigar lighter lite	66
Clock	47
Clock lite	54
Coolant low-level control unit	61-62
Coolant low-level switch	61-62
Coolant temp. gauge	58
Coolant temp. sender	73
Coolant temp. warn. lite	59
Digifant control unit	16-26
Door contact sw., LF	123-124
Door contact sw., RF	122
Emerg. flasher relay	102-103
Emerg. flasher switch	100-107
Eng. oil press. control unit	49, 50
Eng. oil press. sw. (0.3 bar)	42
Eng. oil press. sw. (0.9 bar)	41
Fresh air control lvr. lite	134
Fresh air fan	135
Fresh air fan switch	135-136
Fuel enrich switch	19
Fuel inj. cyl. 1	26
Fuel inj. cyl. 2	27
Fuel inj. cyl. 3	28
Fuel inj. cyl. 4	29
Fuel gauge	57
Fuel gauge sender	64
Fuel pump	30
Hall generator	17-18
Headlite flash/dim sw.	92-93
Headlite, hi-beam ind.	56
Headlite, hi-beam, left	87
Headlite, hi-beam, right	99
Headlite, left	88-89
Headlite, right	97-98
Heater fan	142
Heater switch	142-143
Heater switch lite	141
Horn	121
Horn button	119
Idle stab. control unit	32-36
Idle stab. valve	34-35
Idle switch	18
Ign. coil	14-15
Ign. distributor	13-14

Description	Current Track
Ign./start sw.	9-12
Inst. panel lite dimmer	83-84
Inst. panel lites	52-53
Interior lite, front	69-70
Interior lite, rear	72
License plate lites	85-86
Lite switch	74-83
Load reduction relay	76-78
Make-up mirror lite	68
OXS/CAT elapsed mile counter	40
OXS ind. lite	46
OXS sensor with heater	24-25
Park brake lite sw.	128
Park lite, left	90
Park lite, right	96
Power steer. press. sw.	32
Rad. cool fan	137
Rad. cool fan relay 2nd stage	139-141
Rad. cool fan thermostich	137-138
Radio connections	67-68
Rear defogg. heat element	123
Rear defogg. ind. lite	132
Rear defogg. sw.	133
Rear defogg. sw. lite	131
Rear washer motor	151
Rear wiper motor	153-154
Rear wiper/washer relay	152-153
Seat belt switch, LF	125-126
Seat belt warn. lite	127
Seat belt warn. relay	124-128
Series resist. for fresh air fan	136
Series resist. for heater fan	143
Side marker lites, rear	94
Spark plug connectors	13-14
Spark plugs	13-14
Starter	3-4
Tachometer	48
Tail lite, left	91
Tail lite, right	95
TDC sensor	37-38
Temp. sensor II	20
Turn sig. ind.	55
Turn sig. lite, LF	110
Turn sig. lite, LR	109
Turn sig. lite, RF	112
Turn sig. lite, RR	111
Voltage regulator	5-7
Voltage stabilizer	57
Washer motor	150
Wash/wipe intermitt. relay	147-149
Wash/wiper intermitt. switch	146-149
Wiper motor	150
<b>Wire connectors</b>	
T1 — single, in eng. compart., left	
T1a — single, in eng. compart., left	
T1b — single, in wire distributor box	

### Wire Connectors

- T1c — single, in eng. compart., left
- T1d — single, in wire distributor box
- T1e — single, in eng. compart., middle
- T1f — single, under instrument panel
- T1k — single, in eng. compart., middle
- T2 — double, under driver's seat
- T2a — double, in eng. compart., left
- T2b — double, in the relay panel
- T2c — double, under instrument panel, left
- T2d — double, in upper right "A" pillar
- T2e — double, in rear deck lid
- T2f — double, behind RR side trim panel
- T2j — double, under instrument panel, left
- T2i — double, in wire distributor box
- T2m — double, in the relay panel
- T3 — three point, in eng. compart. on alternator
- T3a — three point, under instrument panel
- T3b — three point, behind upper air intake flap (near radiator)
- T3c — three point, behind instrument panel
- T3d — three point, behind "C" pillar cover
- T4 — four point, under instrument panel
- T4a — four point, on series resistor for heater fan, under rear seat
- T7/ — seven point, in wire distributor box
- T7a/ — seven point, in wire distributor box
- T8 — eight point, on brake warning indicator
- T14/ — 14 point, on instrument cluster

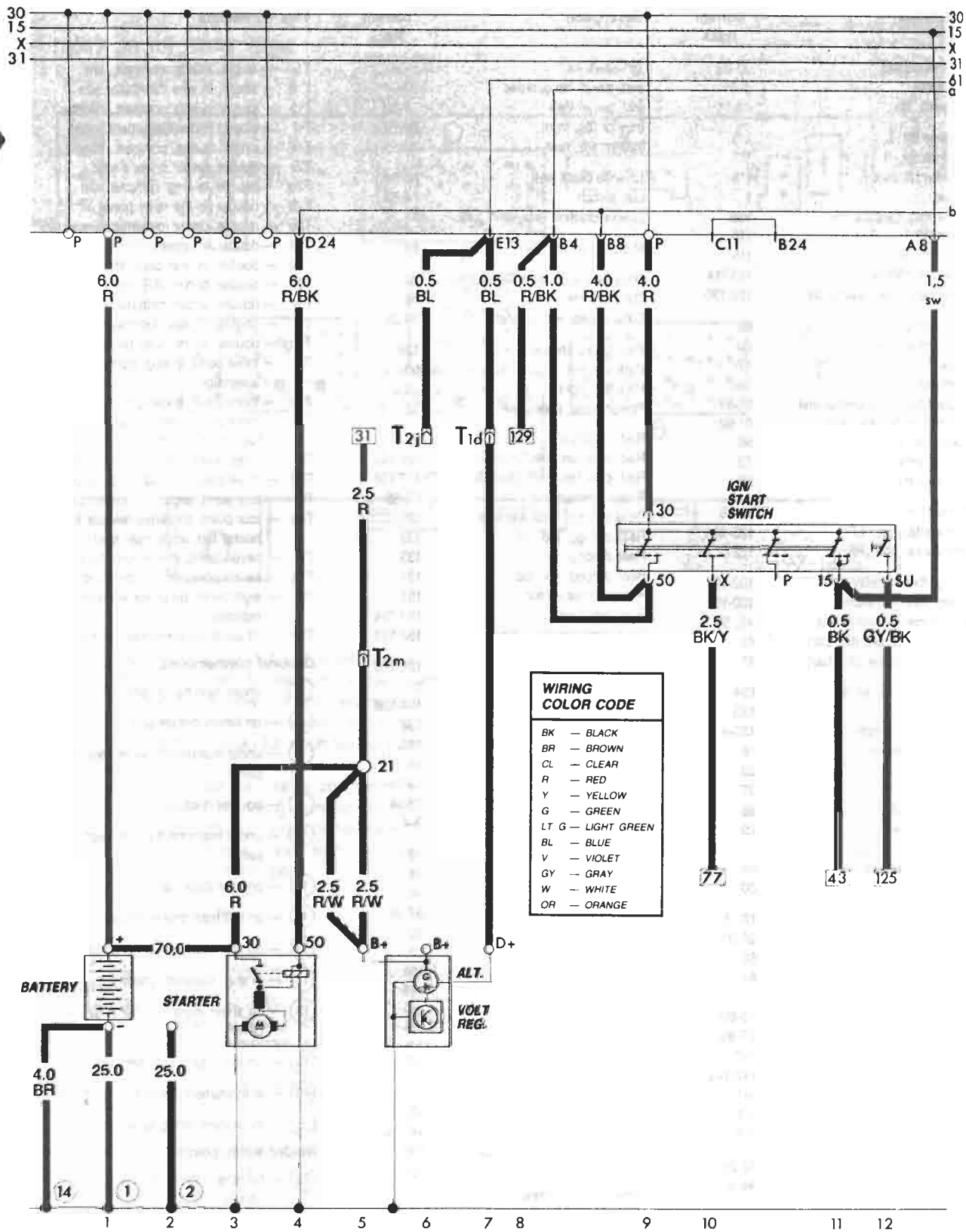
### Ground connections

- ⑥ — under rear bench seat
- ⑦ — on steering gear box
- ⑧ — under instrument panel near relay panel
- ⑨ — on rear deck lid
- ⑩ — under instrument panel near relay panel
- ⑪ — on rear deck lid
- ⑫ — on left front crossmember
- ⑬ — on rear washer fluid bracket
- ⑮ — in eng. compart. under ign. coil
- ⑱ — on sheet metal bracket near fuel pump
- ⑲ — on left side of cylinder head
- ⑳ — in instrument panel wiring harness
- ㉕ — in Digifant wiring harness

### Welded wiring points (+)

- ㉔ — terminal 58b in inst. panel wiring harness
- ㉚ — + connection bolted to wire distributor box

# 97 Electrical System - Wiring, Waterboxer

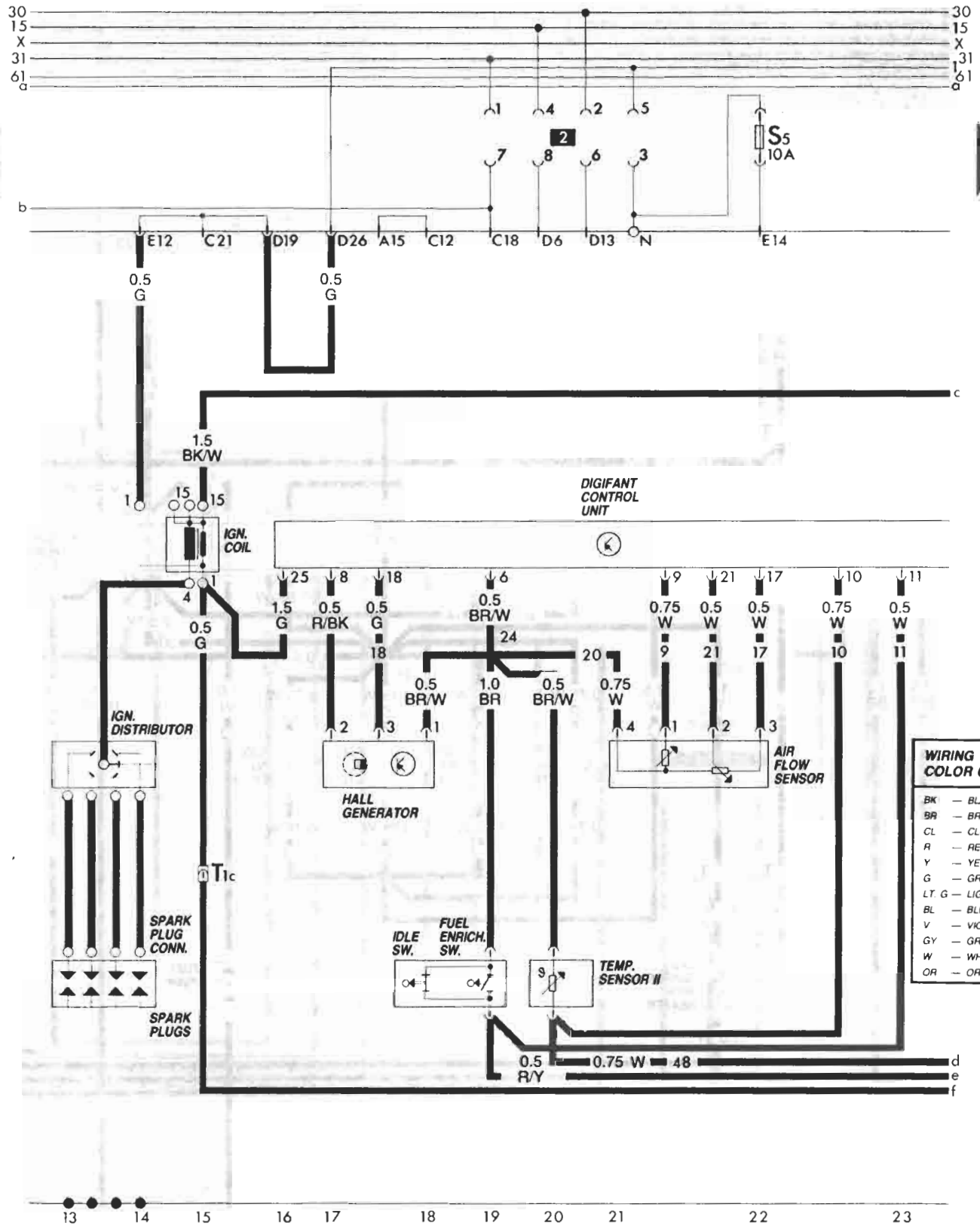


97-2252

97.70

Main wiring diagram  
Alternator/Starter/Ignition  
up to VIN G 055 689

Water-cooled--Digifant 1986



WIRING COLOR CODE	
BK	— BLACK
BR	— BROWN
CL	— CLEAR
R	— RED
Y	— YELLOW
G	— GREEN
LT. G	— LIGHT GREEN
BL	— BLUE
V	— VIOLET
GY	— GRAY
W	— WHITE
OR	— ORANGE

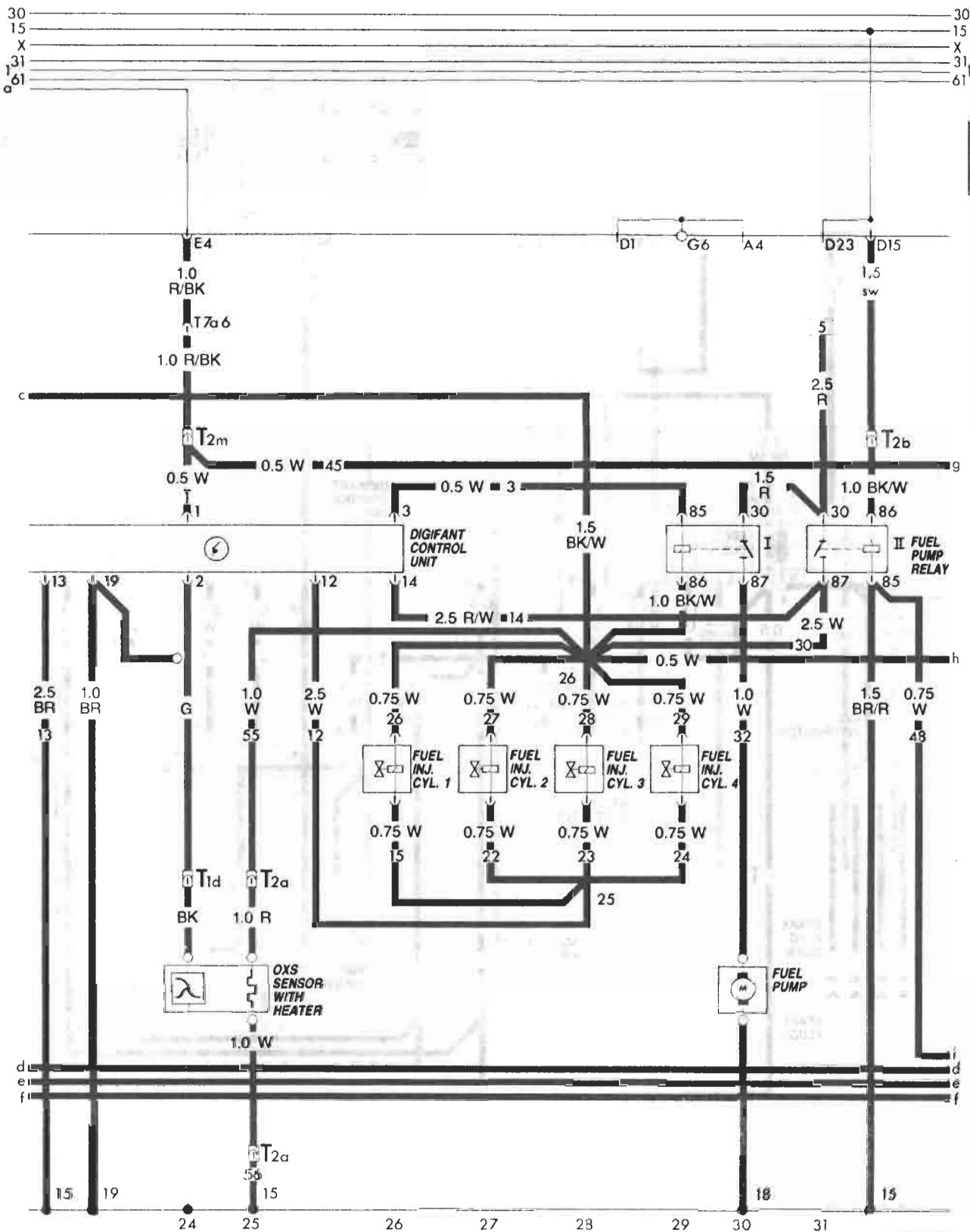
97-2253

Water-cooled — Digifant 1986

Main wiring diagram  
Digifant control unit  
up to VIN G 055 689

## 97.71

# 97 Electrical System - Wiring, Waterboxer



97 2254

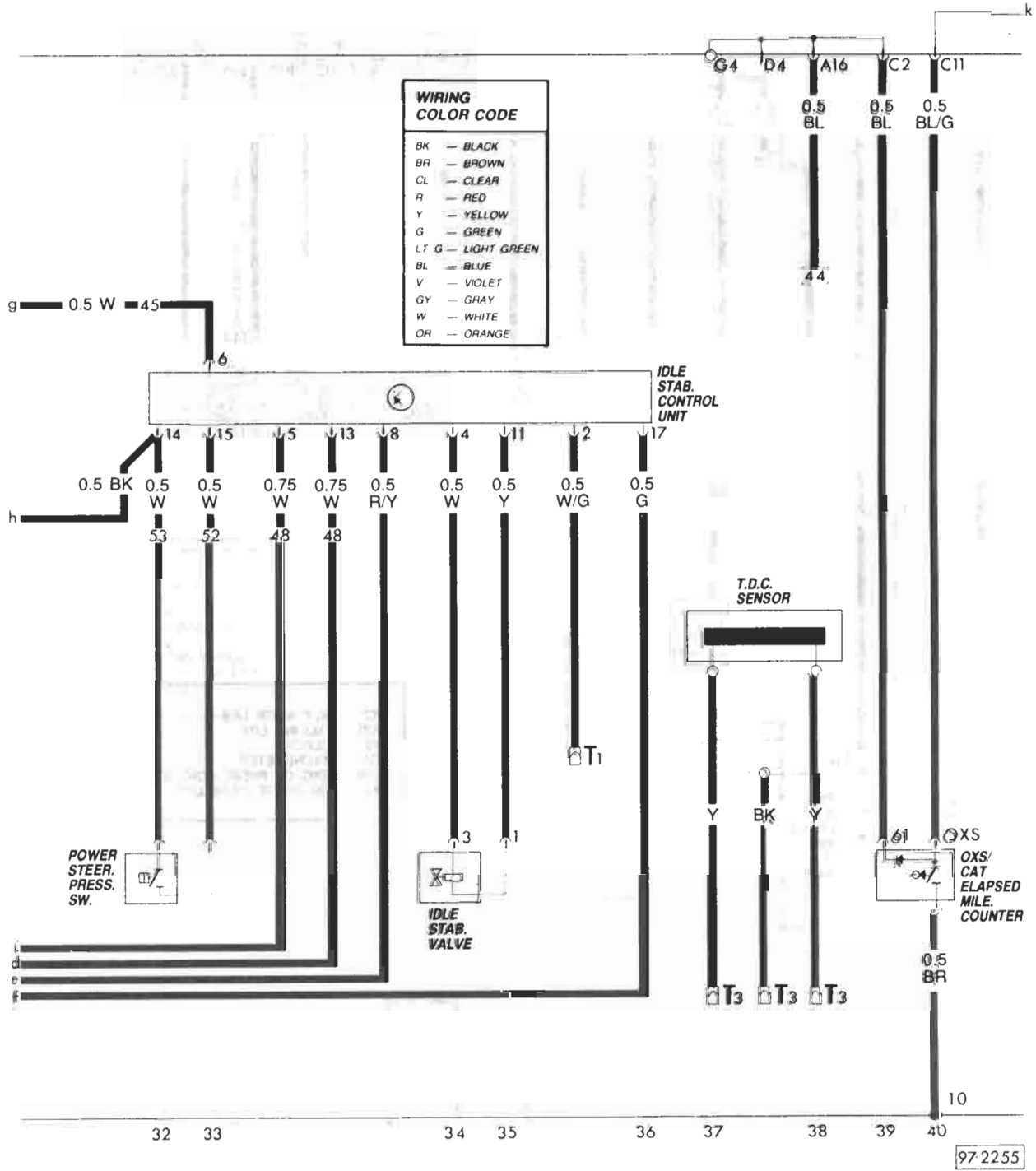
**97.72**

**Main wiring diagram  
Fuel injection  
up to VIN G 055 689**

**Water-cooled-- Digifant 1986**

# Electrical System - Wiring, Waterboxer 97

30  
15  
X  
31  
61

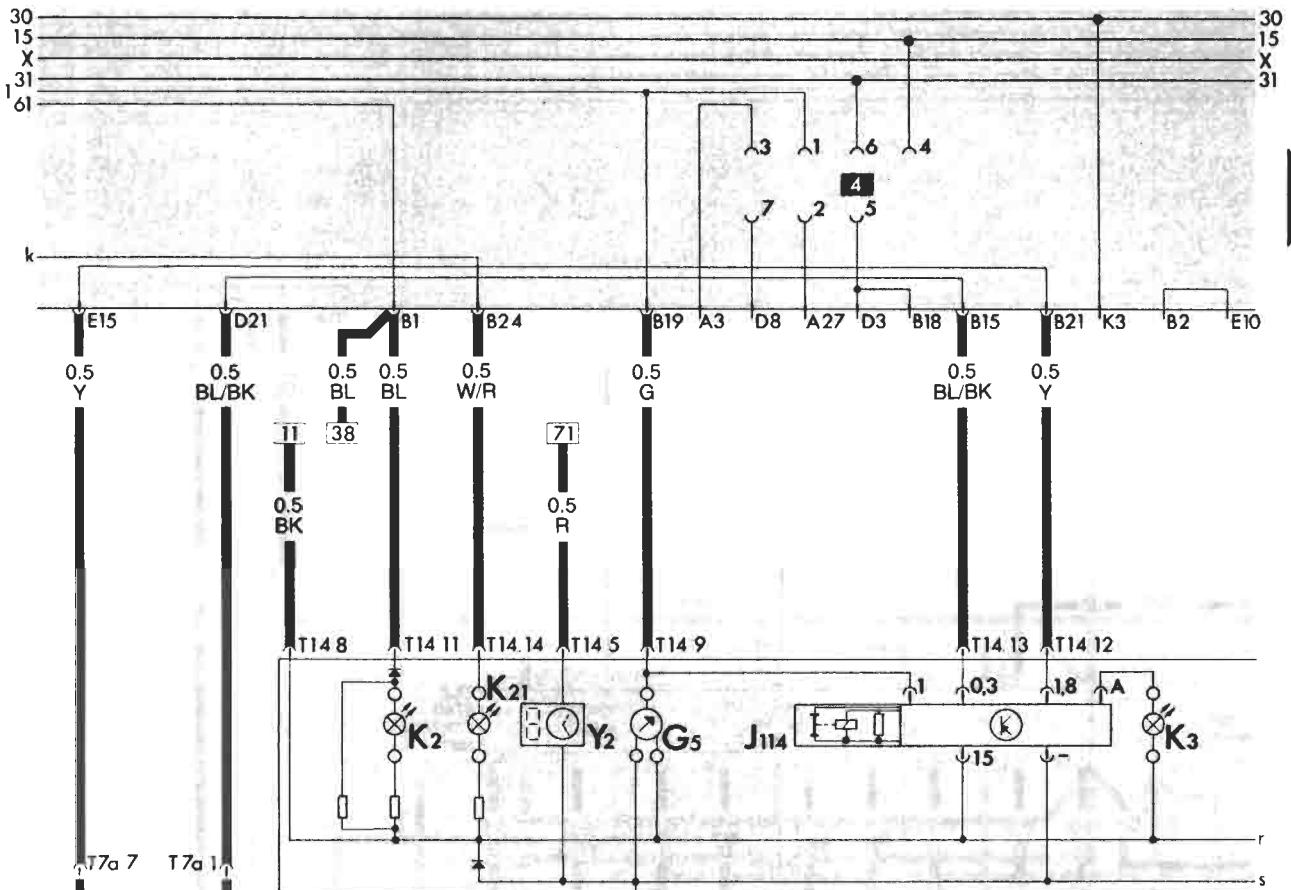


Water-cooled — Digilant 1986

Main wiring diagram  
Idle stabilizer  
up to VIN G 055 689

97.73

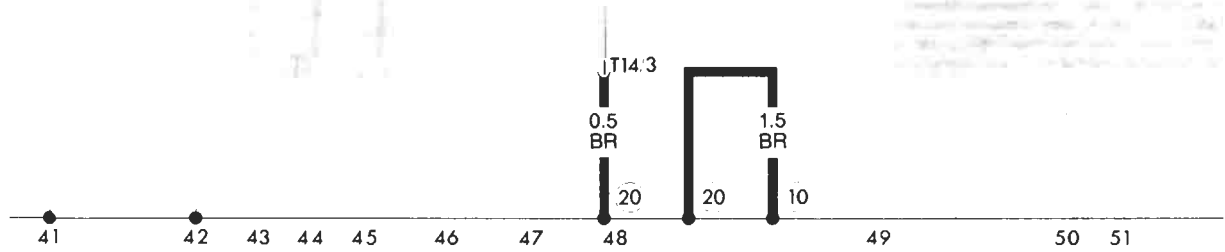
# 97 Electrical System - Wiring, Waterboxer



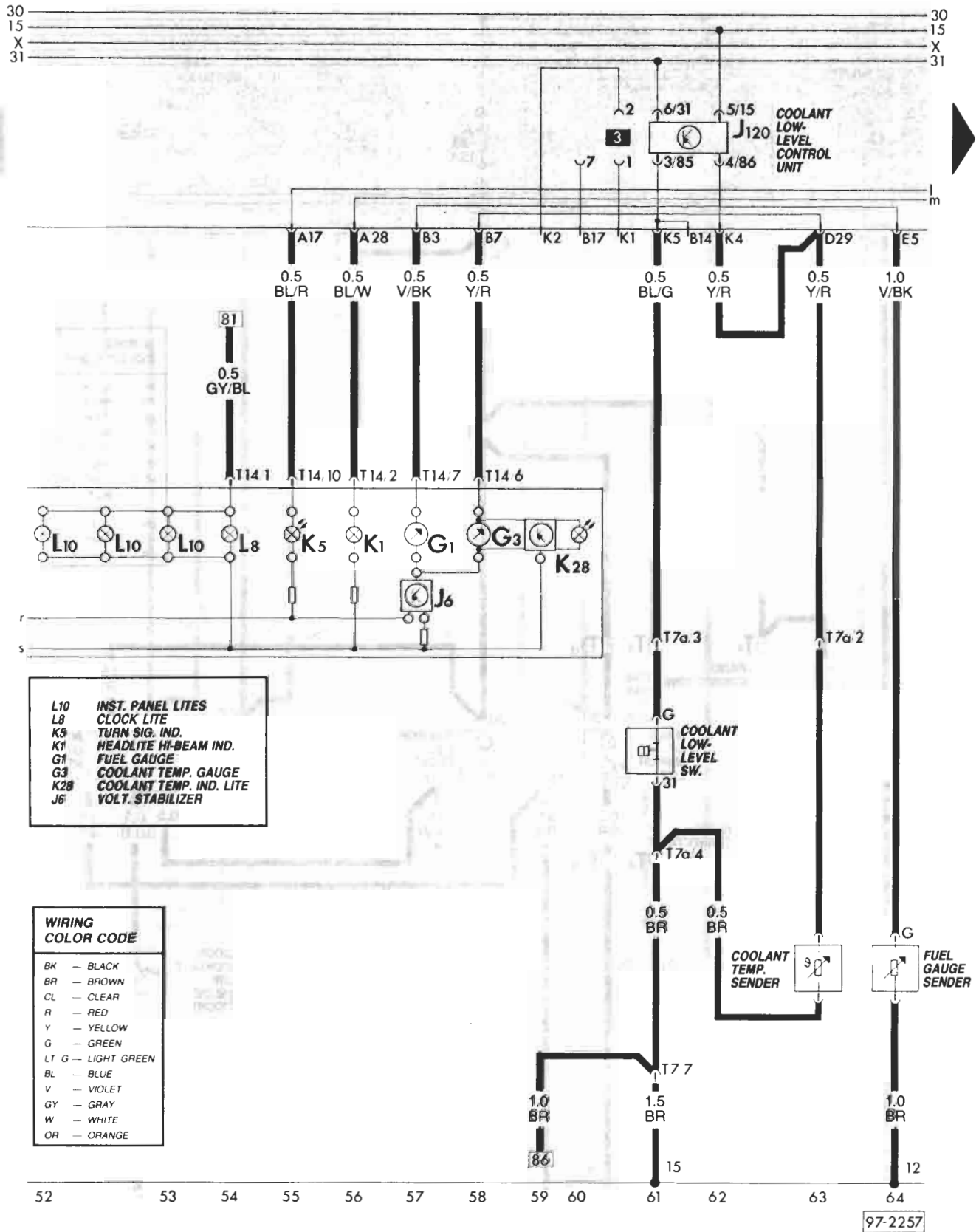
**WIRING COLOR CODE**

BK	— BLACK
BR	— BROWN
CL	— CLEAR
R	— RED
Y	— YELLOW
G	— GREEN
LT G	— LIGHT GREEN
BL	— BLUE
V	— VIOLET
GY	— GRAY
W	— WHITE
OR	— ORANGE

K2	ALT. WARN. LITE
K21	OXS IND. LITE
Y2	CLOCK
G5	TACHOMETER
J114	ENG. OIL PRESS. CONT. UNIT
K3	OIL PRESS. WARN. LITE



97-2256



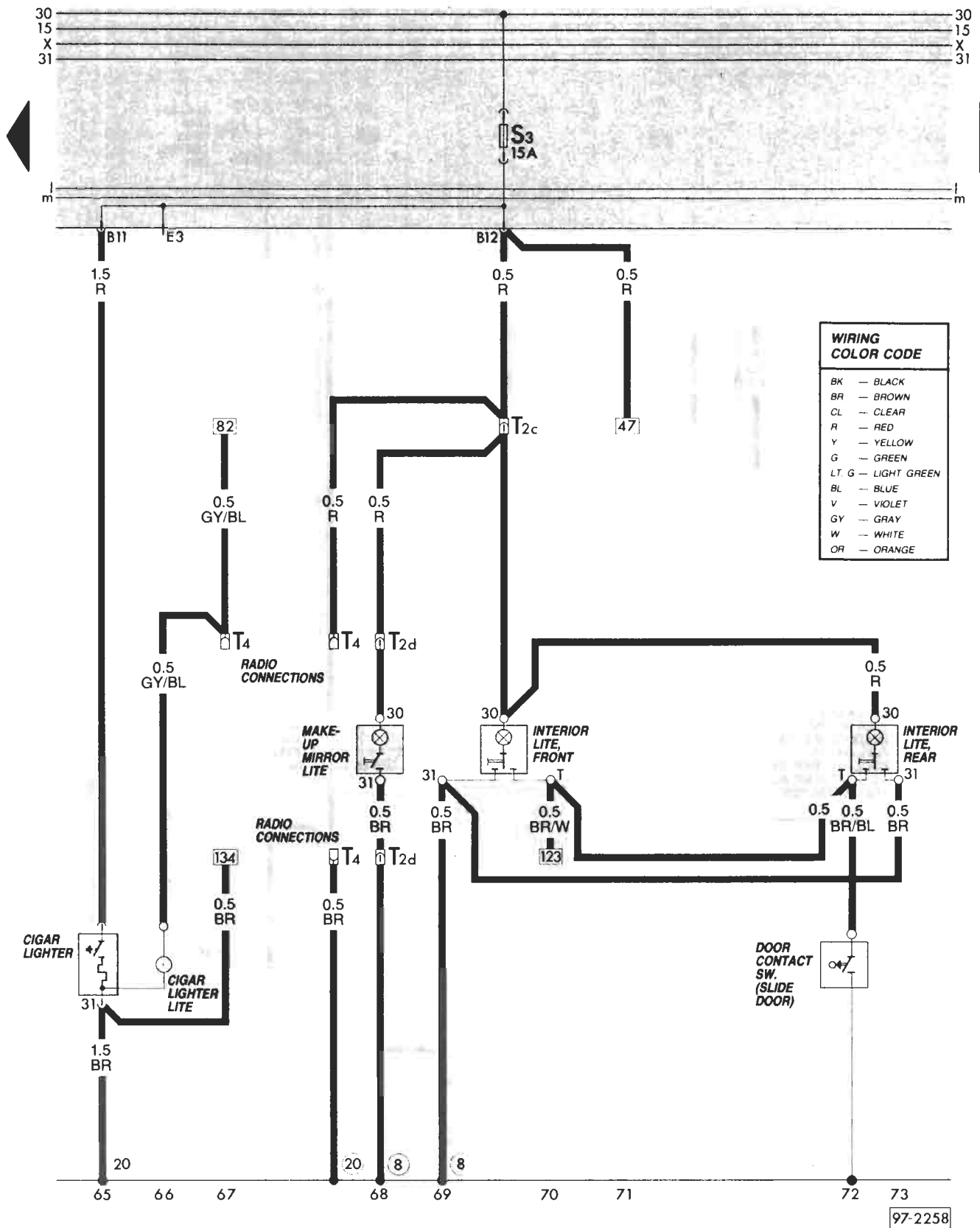
Water-cooled – Digifant 1986

Main wiring diagram  
Instruments  
up to VIN G 055 689

97.75



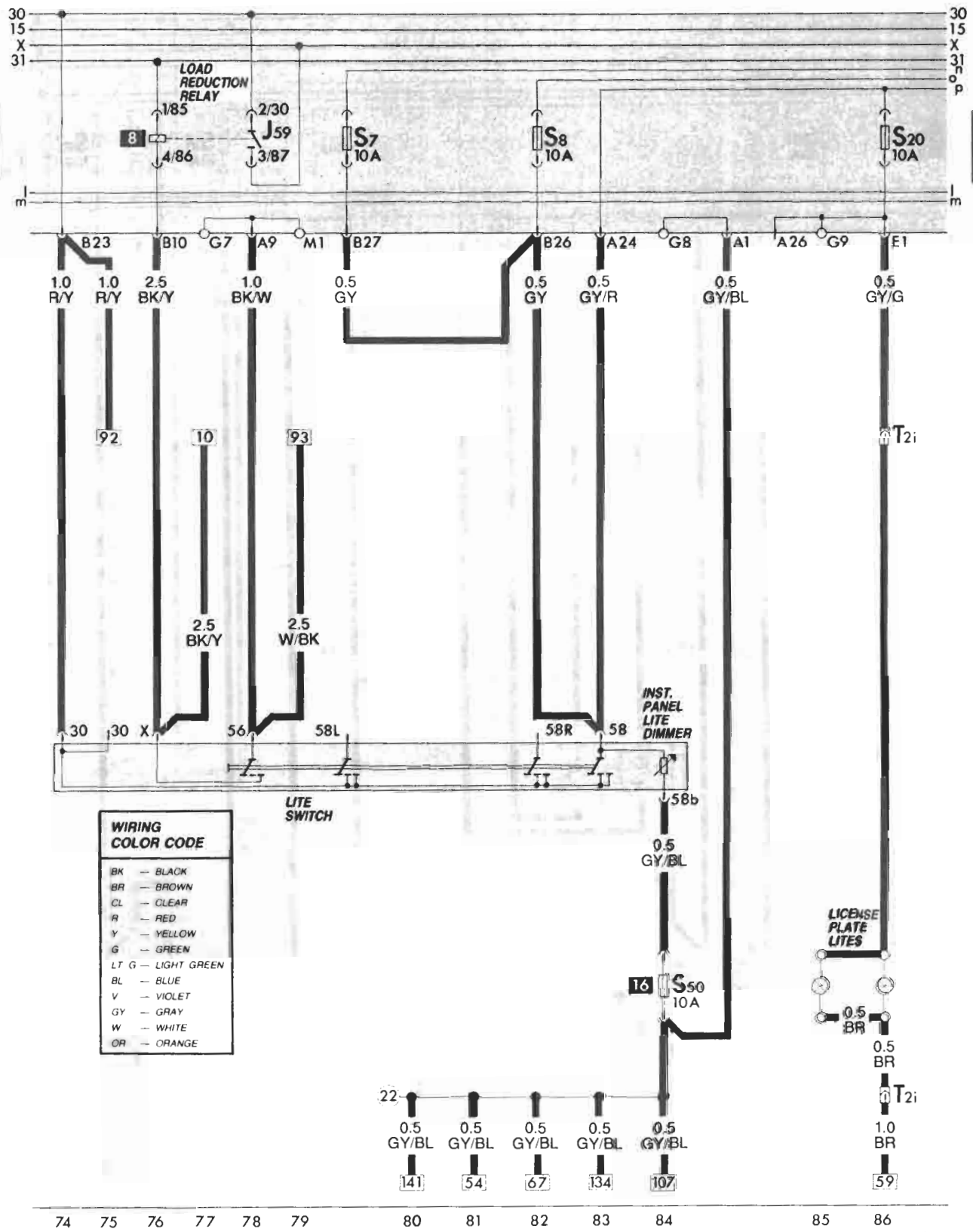
# 97 Electrical System - Wiring, Waterboxer



**97.76**

Main wiring diagram  
Interior lights  
up to VIN G 055 689

Water-cooled — Digifant 1986



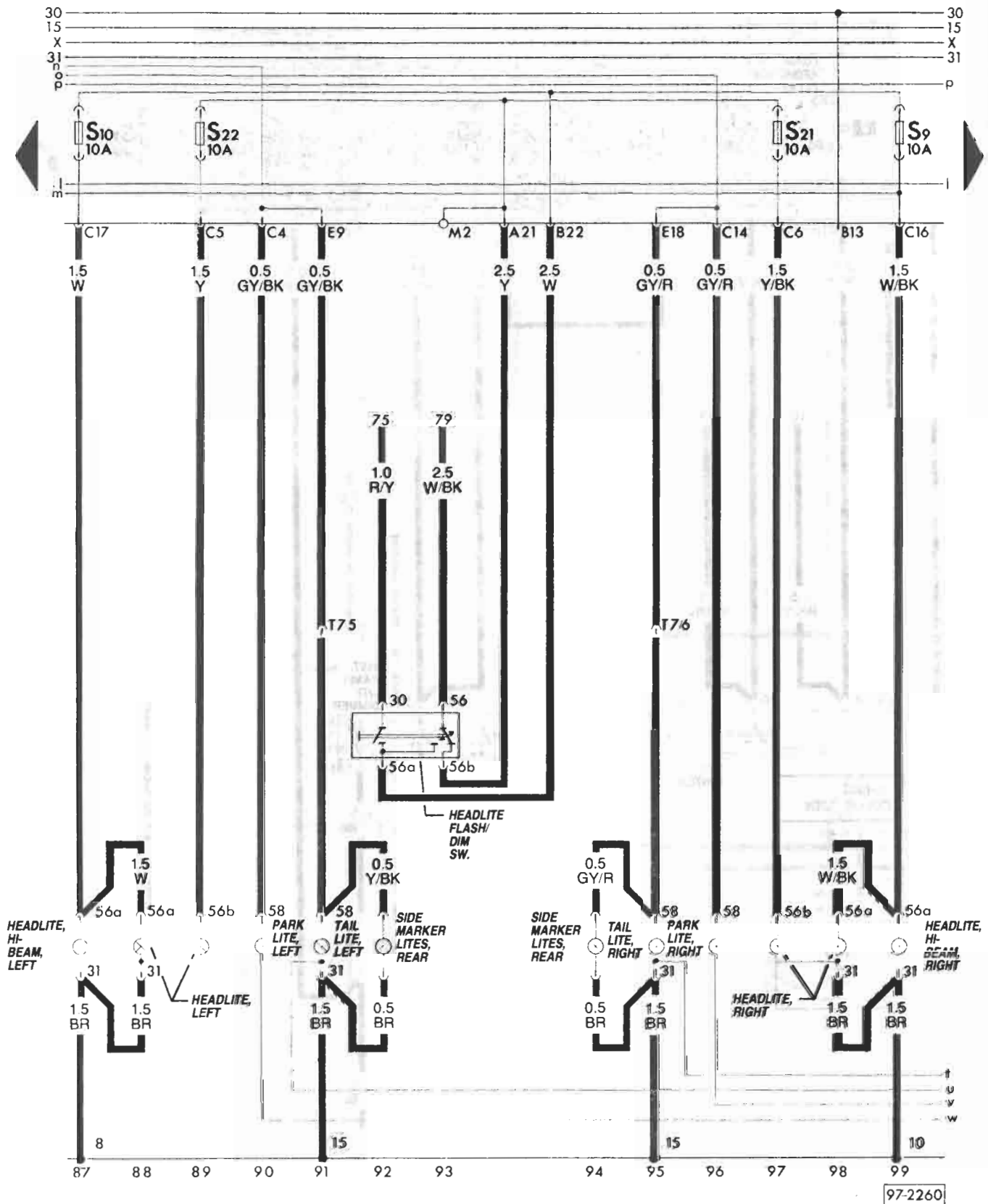
97-2259

Water-cooled—Digifant 1986

Main wiring diagram  
Light switch  
up to VIN G 055 689

## 97.77

# 97 Electrical System - Wiring, Waterboxer

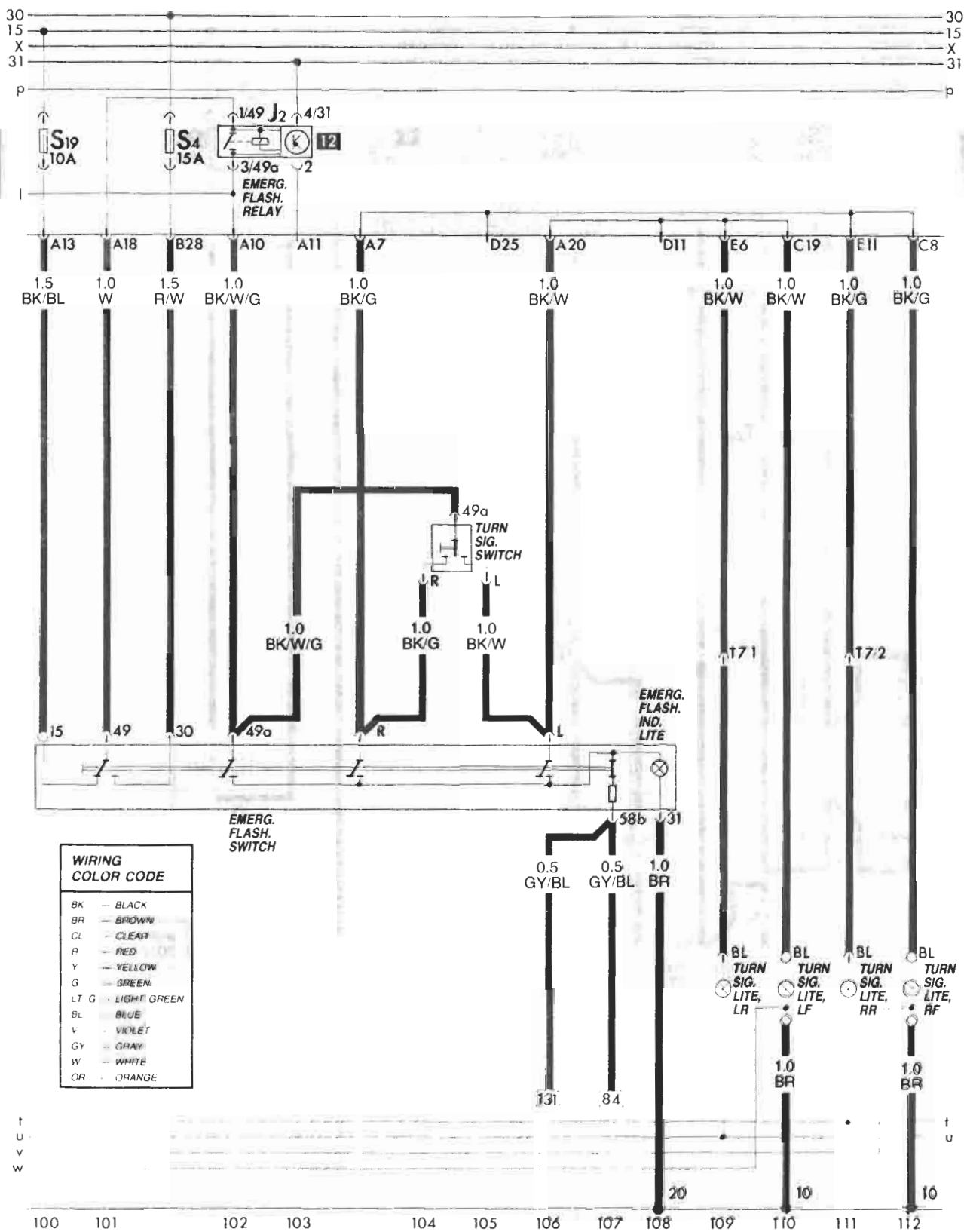


97-2260

## 97.78

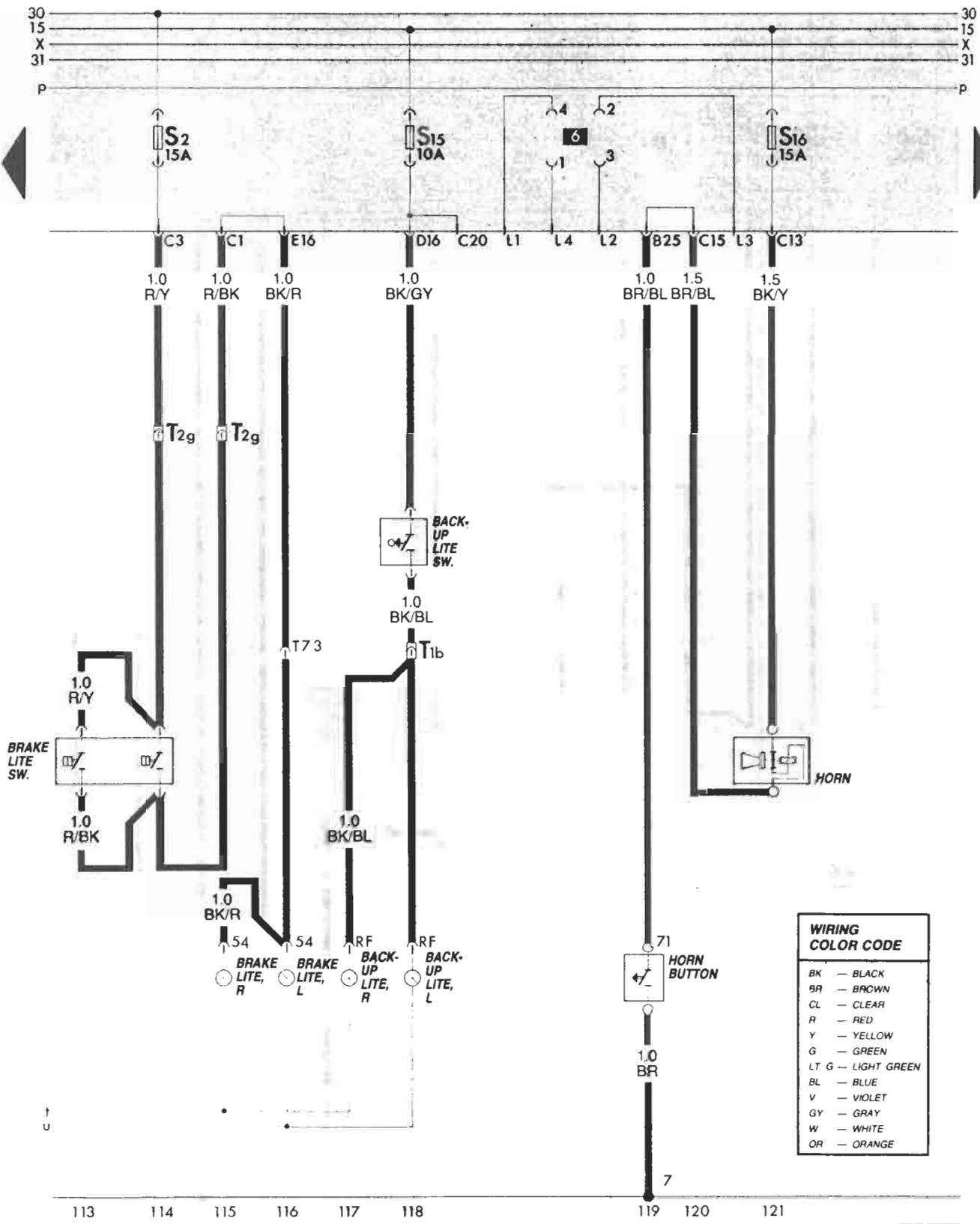
Main wiring diagram  
Lights  
up to VIN G 055 689

Water-cooled - Digifant 1986



97-2261

# 97 Electrical System - Wiring, Waterboxer



WIRING COLOR CODE	
BK	— BLACK
BR	— BROWN
CL	— CLEAR
R	— RED
Y	— YELLOW
G	— GREEN
LT. G	— LIGHT GREEN
BL	— BLUE
V	— VIOLET
GY	— GRAY
W	— WHITE
OR	— ORANGE

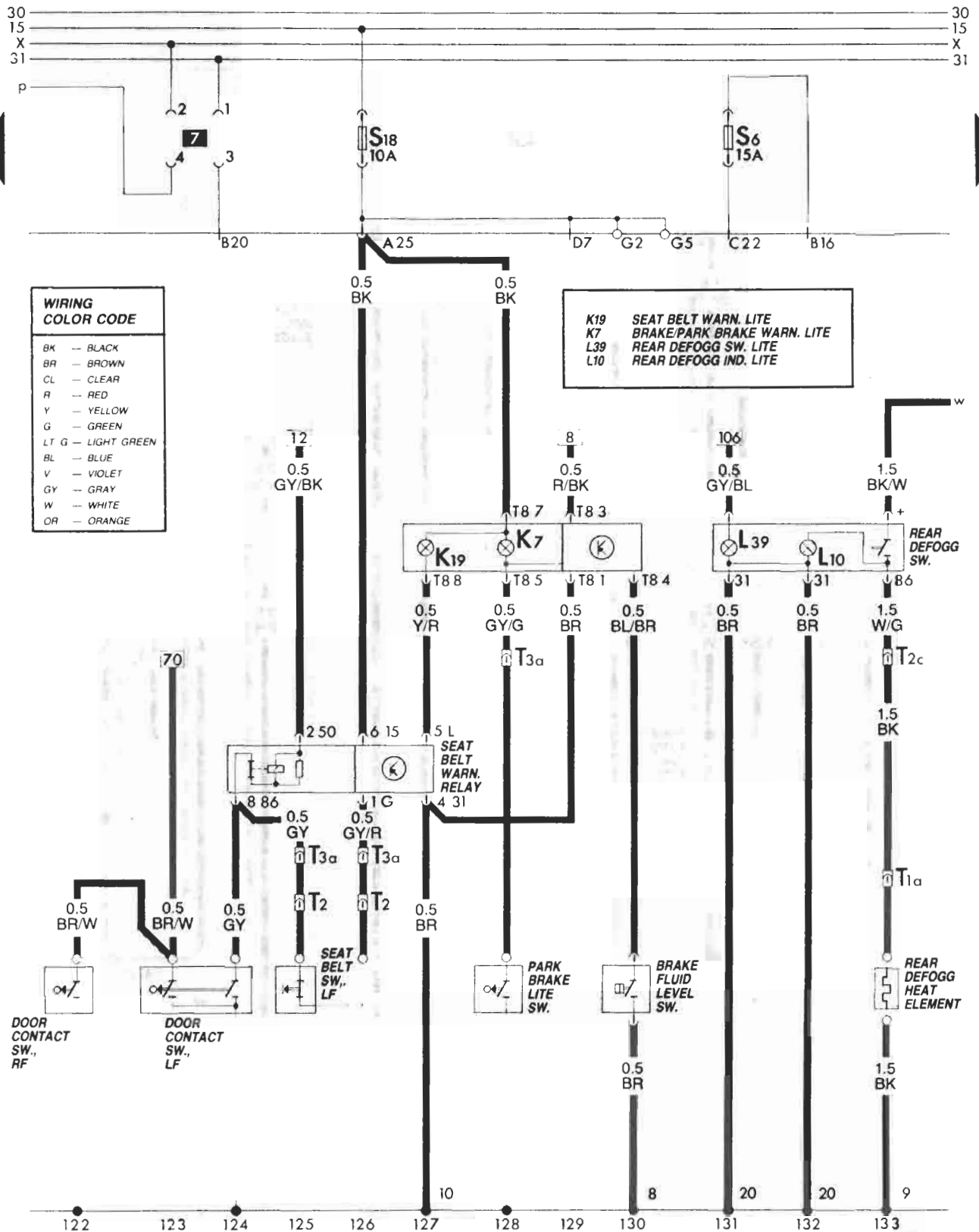
97-2262

**97.80**

Main wiring diagram  
Rear lights  
up to VIN G 055 689

**Water-cooled – Digifant 1986**

# Electrical System - Wiring, Waterboxer 97



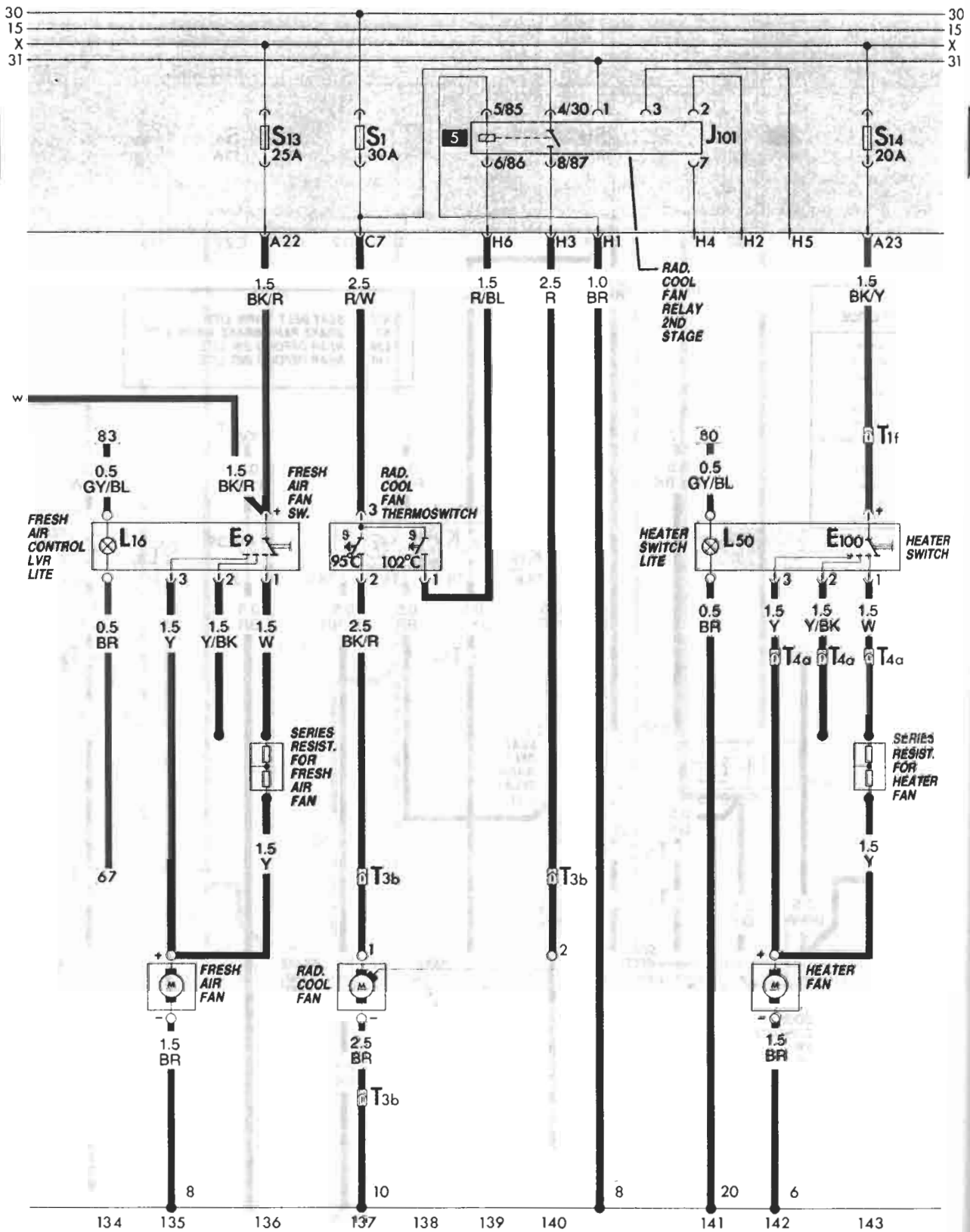
97-2263

Water-cooled - Digifant 1986

Main wiring diagram  
 Warning lights  
 up to VIN G 055 689

97.81

# 97 Electrical System - Wiring, Waterboxer

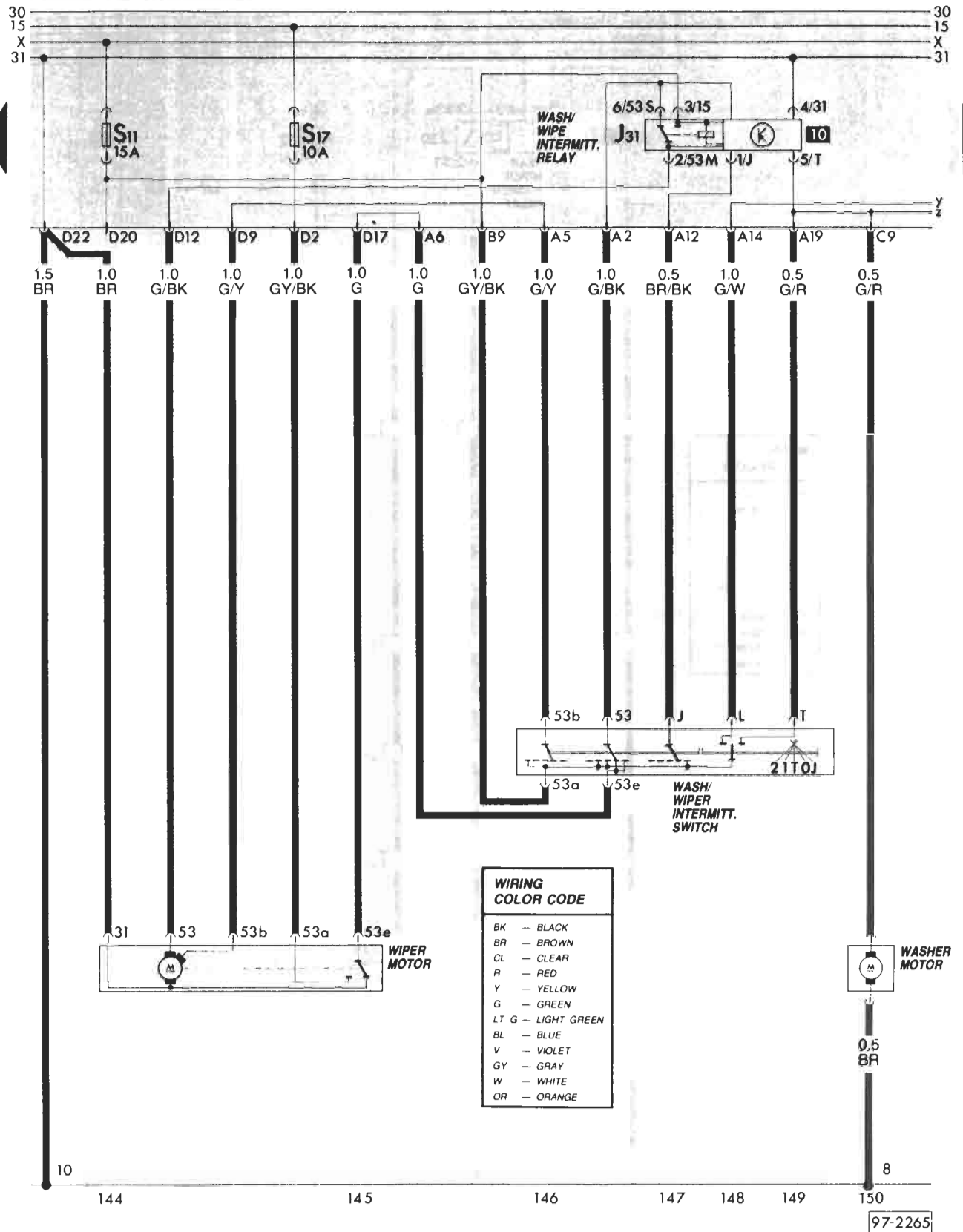


97-2264

97.82

Main wiring diagram  
Fans  
up to VIN G 665 689

Water-cooled-Dijifant 1986



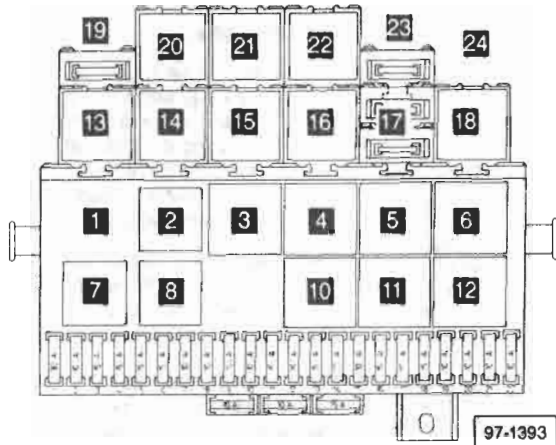
Water-cooled — Digifant 1986

Main wiring diagram  
Wiper/Washer  
up to VIN G 055 689

## 97.83







### Fuse arrangement

according to numbers on fuse panel as seen from left to right:

	Amp.
1 Radiator fan	30
2 Stop lights	10
3 Cigarette lighter, radio, clock, interior lights, central locking system	10
4 Emergency flasher system	15
5 Electric fuel pump	15
6 Vacant	
7 Tail, parking and side marker lights, left	10
8 Tail, parking and side marker lights, right	10
9 High beam right, high beam indicator light	10
10 High beam left	10
11 Wind. wipers and washer	15
12 Heated seats, outside rear view mirror adjustment	15
13 Rear window defogger, heated rear view mirror	15
14 Fresh air fan, glove compartment light	20
15 Back-up lights, shift console light (Auto. Transmission)	10
16 Horn (single tone)	15
17 Vacant	
18 Dual horn, coolant level and temp. warning light	10
19 Turn signals, brake warning light	10
20 License plate lights	10
21 Low beam left	10
22 Low beam right	10

### CAUTION

Relay locations are subject to change and may vary from vehicle to vehicle depending on options.

Use extreme care when troubleshooting the electrical system.

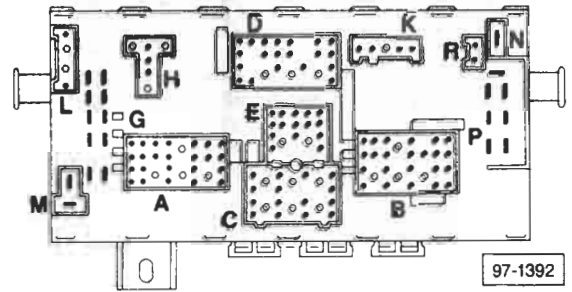
If you encounter problems identifying a particular relay, consult your Parts Department.

### Separate fuses above fuse panel

Power windows	30
A/C	30

### Fuse/Relay Panel

- 3** — coolant level control unit
- 5** — rad. cool. fan relay, 2<sup>nd</sup> stage
- 8** — load reduction relay
- 10** — intermitt. wash/wiper relay
- 11** — rear window wash/wiper relay
- 12** — emerg. flash/turn sig. relay



### Connections and plugs on fuse/relay panel

- A — multi-point connector (blue) for instrument panel wiring harness
- B — multi-point connector (red) for instrument panel wiring harness
- C — multi-point connector (yellow) for front wiring harness
- D — multi-point connector (white) for windshield wiper and main wiring harness
- E — multi-point connector (black) for main wiring harness
- G — single connector
- H — multi-point connector (brown) to connector for rad. cool fan relay, 2<sup>nd</sup> stage
- K — multi-point connector (colorless) to radiator coolant low-level control unit
- L — multi-point connector (gray) for horns
- M — open position
- N — single connector
- P — single connector (terminal 30)
- R — open position

# 97 Electrical System - Wiring, Waterboxer

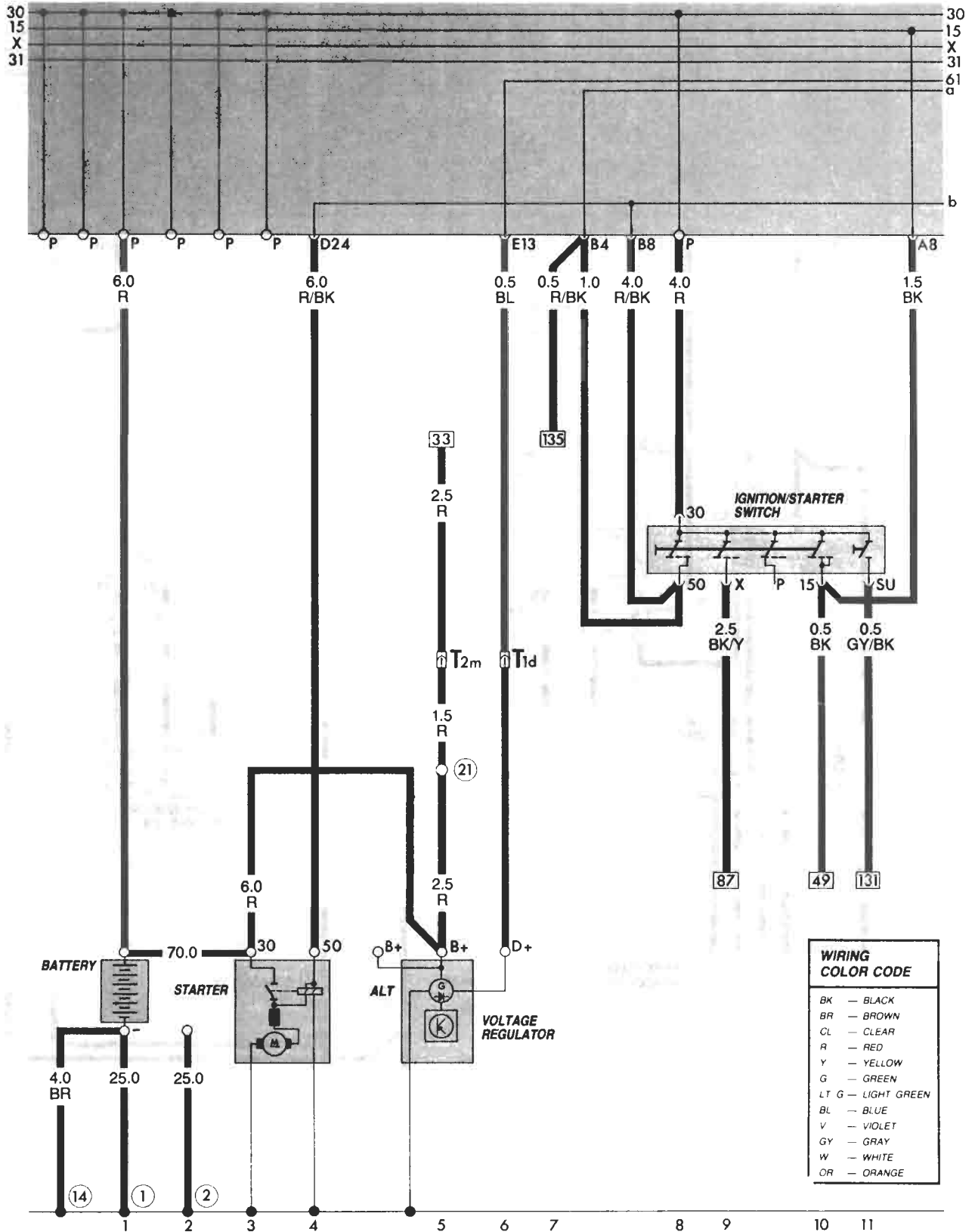
Description	Current track	Description	Current track	Wire Connectors
Air flow sensor potentiometer	22-24	Injector, cyl. 1	27	T1a — single, under instrument panel
Alternator	5,6	Injector, cyl. 2	28	T1c — single, eng. compart., left
Alternator warning lite	51	Injector, cyl. 3	29	T1d — single, in wire distributor box
Back-up lite switch	127	Injector, cyl. 4	30	T1e — single, eng. compart., left
Back-up lite, left	127	Instrument panel lite	58-60	T1f — single, under instrument panel
Back-up lite, right	126	Instrument panel lite dimmer switch	94	T1g — single, under instrument panel
Battery	1	Interior lite, front	77,78	T1h — single, eng. compart., left
Brake and parking brake indicator lite	134	Interior lite, rear	82,83	T2a — double, eng. compart., left
Brake fluid level warning contact	136	Interior lite, right	80,81	T2b — double, eng. compart., left
Brake lite switch	122,123	License plate lite	95,96	T2c — double, under inst. panel, left
Brake lite, left	125	Lite switch	85,94	T2d — double, behind sunvisor attaching screws, right
Brake lite, right	124	Load reduction relay	86-88	T2e — double, in rear decklid
CAT elapsed mileage counter	45,46	Make-up mirror lite	76	T2f — double, behind right 'c' pillar cover
Cigarette lighter	72	Map/reading lite, right front	75	T2g — double, under instrument panel
Cigarette lighter lite	73	OXS elapsed mileage indicator	52	T2m — double, near fuse/relay panel
Clock lite	61	Oxygen sensor	25,26	T2x — double, eng. compart., middle
Coolant low level control unit	68,69	Parking brake warning lite switch	134	T3 — three-point, on alternator
Coolant low level warning switch	68	Parking lite, left	100	T3a — three-point, under instrument panel
Coolant overheat warning lite	67	Parking lite, right	106	T3b — three-point, behind front air duct
Coolant temperature gauge	65	Power steering pressure switch	36,37	T3c — three-point, under instrument panel
Coolant temperature sending unit	70	Radiator cooling fan	143	T3d — three-point, under right 'c' pillar cover
Digifant control unit	16-27	Radiator cooling fan relay (2nd stage)	147	T4 — four-point, under instrument panel
Digijet control unit relay	32,34	Radiator cooling fan thermostwitch	143,144	T4a — four point, under rear seat bench
Digital clock	53	Rear window defogger indicator lite	38	T7/ — seven-point, in wire distributor box
Door contact switch, left front	77,78	Rear window defogger switch	139	T7a/ — seven-point, in wire distributor box
Door contact switch, right front	81	Rear window defogger switch lite	137	T14/ — fourteen-point, on instrument cluster
Emergency flasher relay	111	Rear window washer pump	157	
Emergency flasher switch	110,117	Rear window wiper motor	159,160	
Emergency flasher warning lite	117	Rear window wiper/washer relay	158,159	
Engine oil pressure control unit	55,56	Safety belt switch, right	131,132	
Engine oil pressure switch (0.3 bar)	48	Seat belt warning lite	133	
Engine oil pressure switch (1.8 bar)	47	Seat belt warning relay	130-133	
Engine oil pressure warning lite	57	Side marker lites, rear	102,104	
Fresh air blower series resistance	142	Spark plug connectors	13-15	
Fresh air control lever lite	140	Spark plugs	13-15	
Fresh air fan	141	Starter	3,4	
Fresh air fan switch	141,142	T.D.C. sensor	43,44	
Fuel gauge	64	Tachometer	54	
Fuel gauge sending unit	71	Tail lite, left	101	
Fuel pump	31	Tail lite, right	105	
Fuel pump relay	30,31	Temperature sensor II	21	
Hall generator	17-19	Throttle valve switch (enrichment)	20	
Headlite dimmer/flasher switch	102,103	Turn signal indicator lite	82	
Headlite high beam warning lite	63	Turn signal lite, left front	119	
Headlite, left	97,99	Turn signal lite, left rear	118	
Headlite, right	107,108	Turn signal lite, right front	121	
Heater blower series resistance	149	Turn signal lite, right rear	120	
Heater fan switch illumination lite	147	Turn signal switch	113,114	
Heating element (crankcase ventilation)	12	Voltage regulator	5,6	
High-beam headlite, left	98	Voltage stabilizer	64	
High-beam headlite, right	109	Warm air blower	148	
Horn button	128	Warm air blower switch	148,149	
Horns	129	Washer/wiper intermittent relay	153-155	
Idle speed stabilizer valve	40,41	Windshield washer pump	156	
Idle stabilizer control unit	36,42	Windshield wiper motor	150,151	
Ignition coil	14	Windshield-wiper intermittent switch	152-155	
Ignition distributor	13-15			
Ignition/starter switch	8-11			

### Ground Connections

- ① — battery to body
- ② — from body to transmission
- ⑦ — on steering rack
- ⑩ — near fuse/relay panel
- ⑪ — in rear decklid
- ⑫ — on left front crossmember
- ⑬ — near rear washer fluid bottle
- ⑭ — under rear seat bench
- ⑮ — under ignition coil
- ⑰ — under rear seat bench
- ⑱ — near fuel pump
- ⑲ — on cylinder head
- ⑳ — in instrument panel wiring harness
- ㉔ — near digifant wiring harness

### Plus Connections

- ㉑ — terminal 30, in wire distributor box
- ㉒ — terminal 58b, in instrument panel wiring harness
- ㉓ — in digifant wiring harness



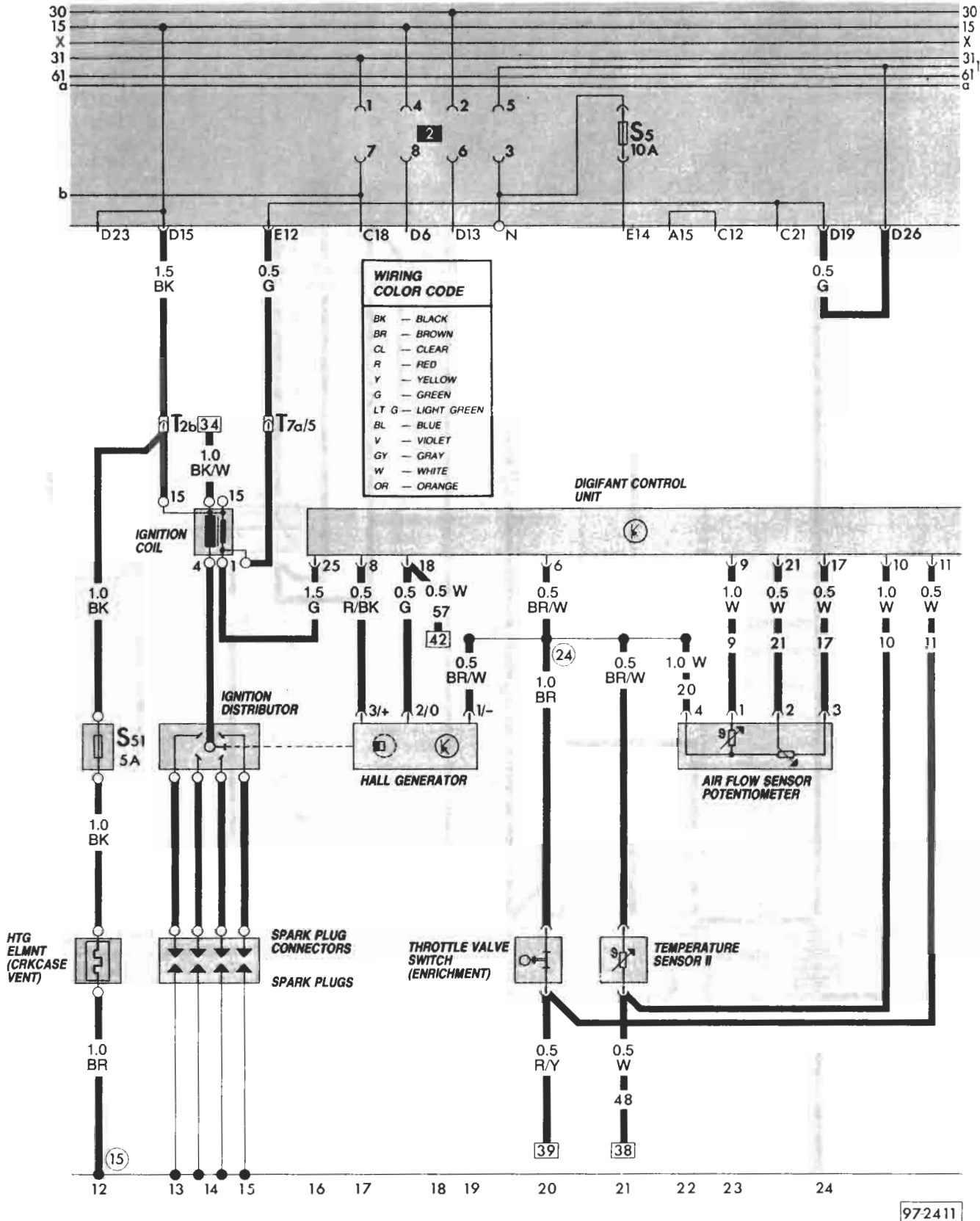
97-2410

Water-cooled — Digifant 1986

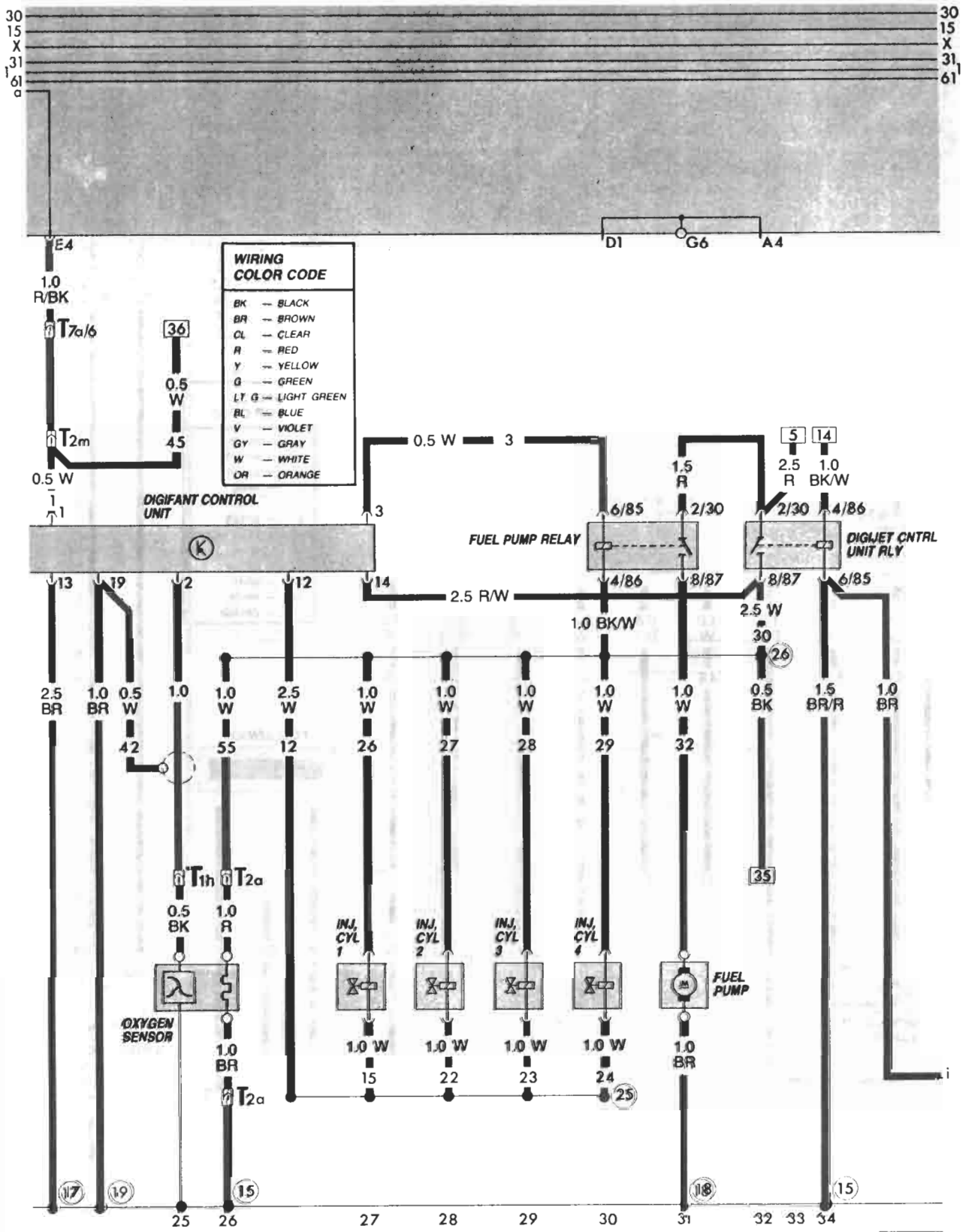
Main wiring diagram  
Alternator/Starter  
from VIN G 055 690

## 97.87

# 97 Electrical System - Wiring, Waterboxer



97-2411



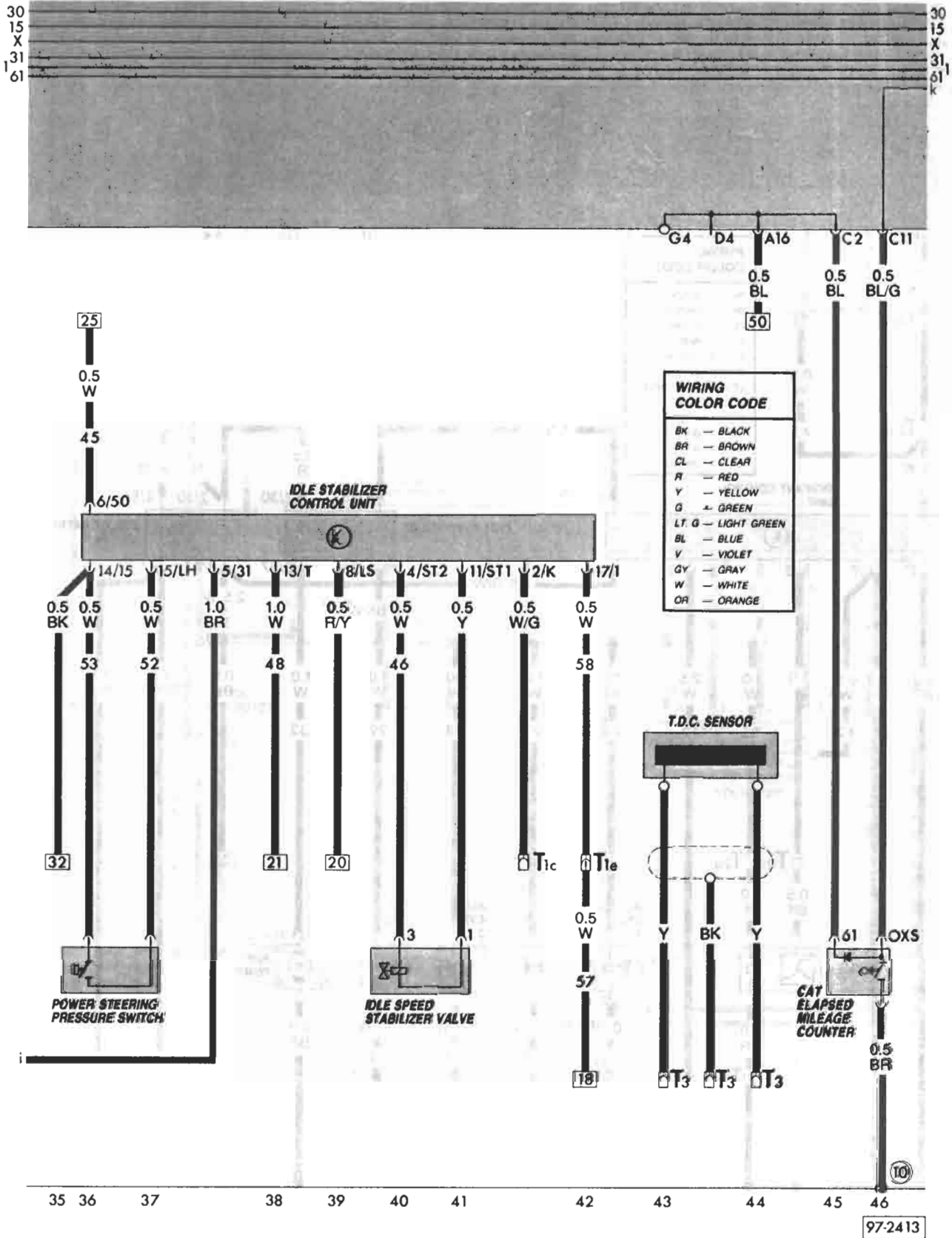
97-2412

Water-cooled—Digifant 1986

Main wiring diagram  
Digifant system  
from VIN G 055 690

97.89

# 97 Electrical System - Wiring, Waterboxer

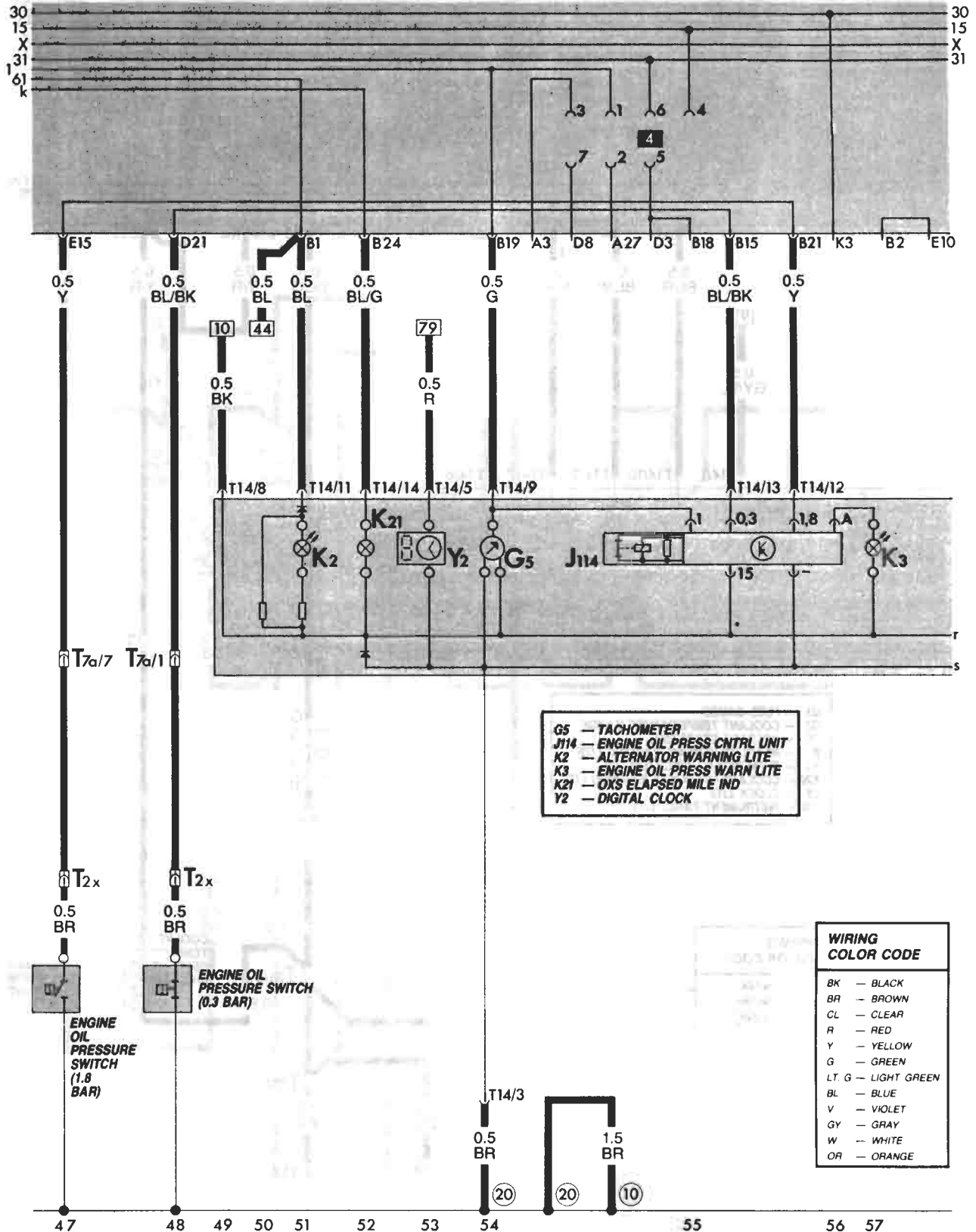


**97.90**

Main wiring diagram  
Idle stabilizer control  
from VIN G 055 690

Water-cooled—Digifant 1986

97-2413



**G5** — TACHOMETER  
**J114** — ENGINE OIL PRESS CNTRL UNIT  
**K2** — ALTERNATOR WARNING LITE  
**K3** — ENGINE OIL PRESS WARN LITE  
**K21** — OXS ELAPSED MILE IND  
**Y2** — DIGITAL CLOCK

WIRING COLOR CODE	
BK	— BLACK
BR	— BROWN
CL	— CLEAR
R	— RED
Y	— YELLOW
G	— GREEN
LT G	— LIGHT GREEN
BL	— BLUE
V	— VIOLET
GY	— GRAY
W	— WHITE
OR	— ORANGE

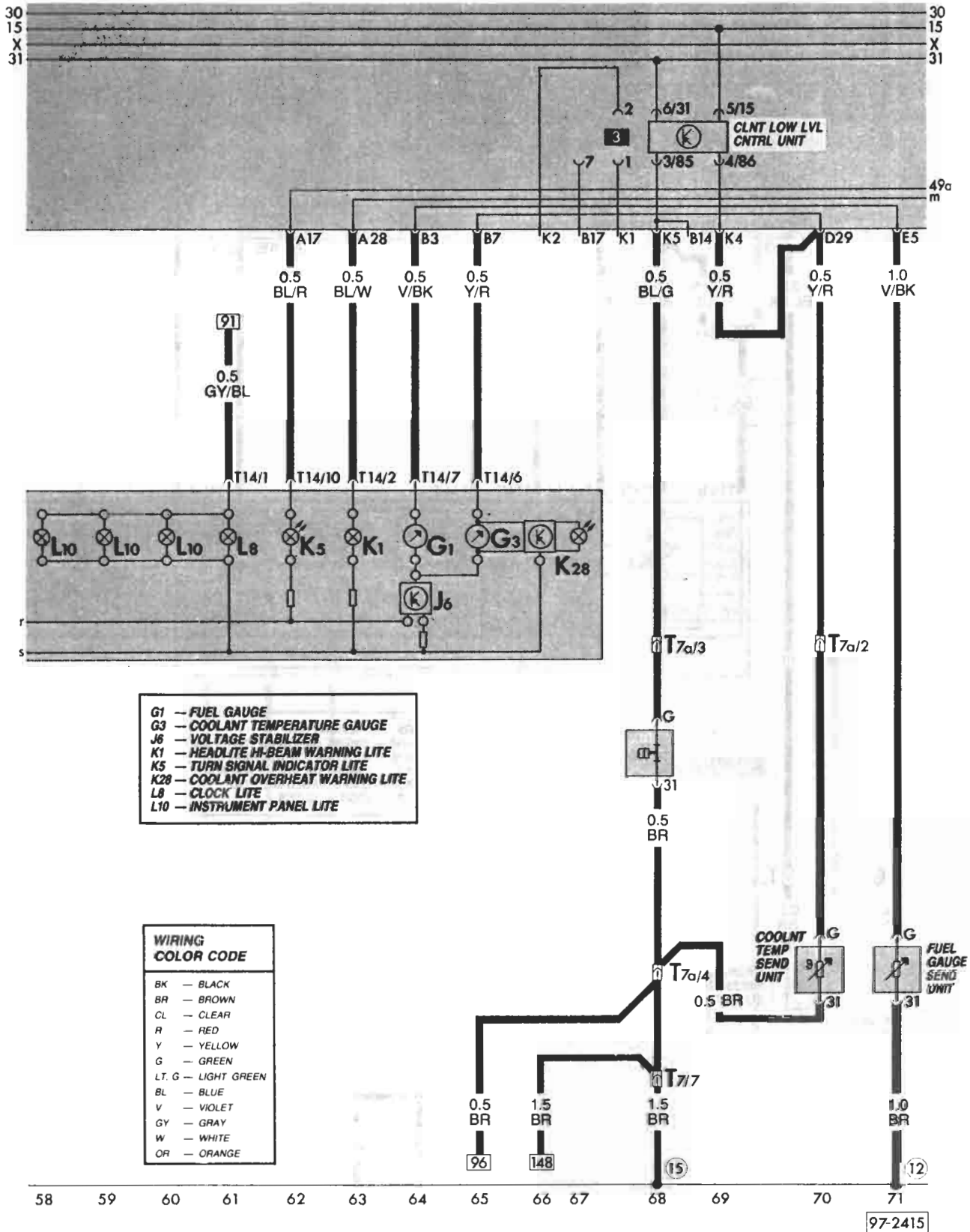
97-2414

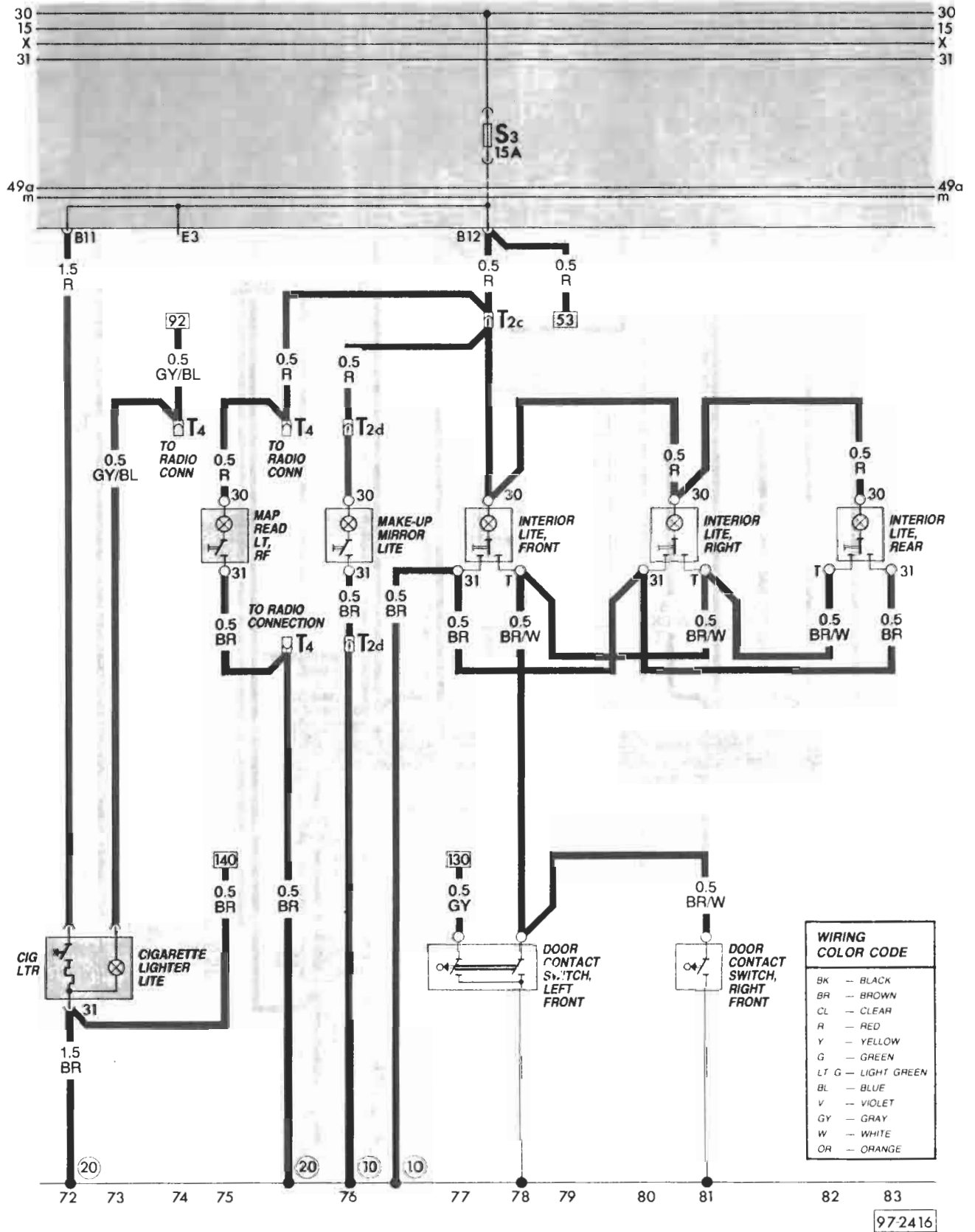
Water-cooled — Digifant 1986

Main wiring diagram  
Instrument cluster  
from VIN G 055 690



# 97 Electrical System - Wiring, Waterboxer



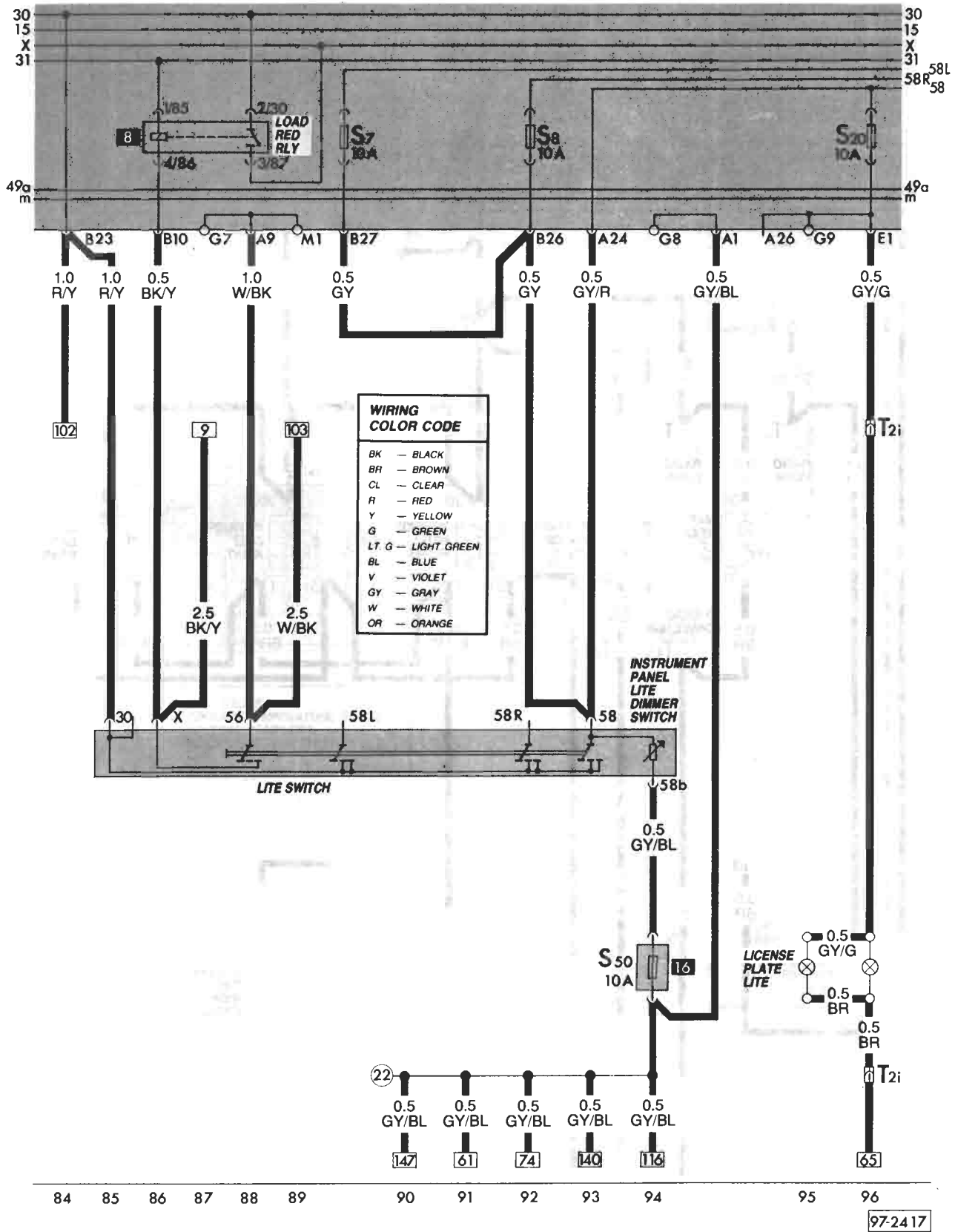


Water-cooled—Digifant 1986

Main wiring diagram  
Interior lights  
from VIN G 055 690

## 97.93

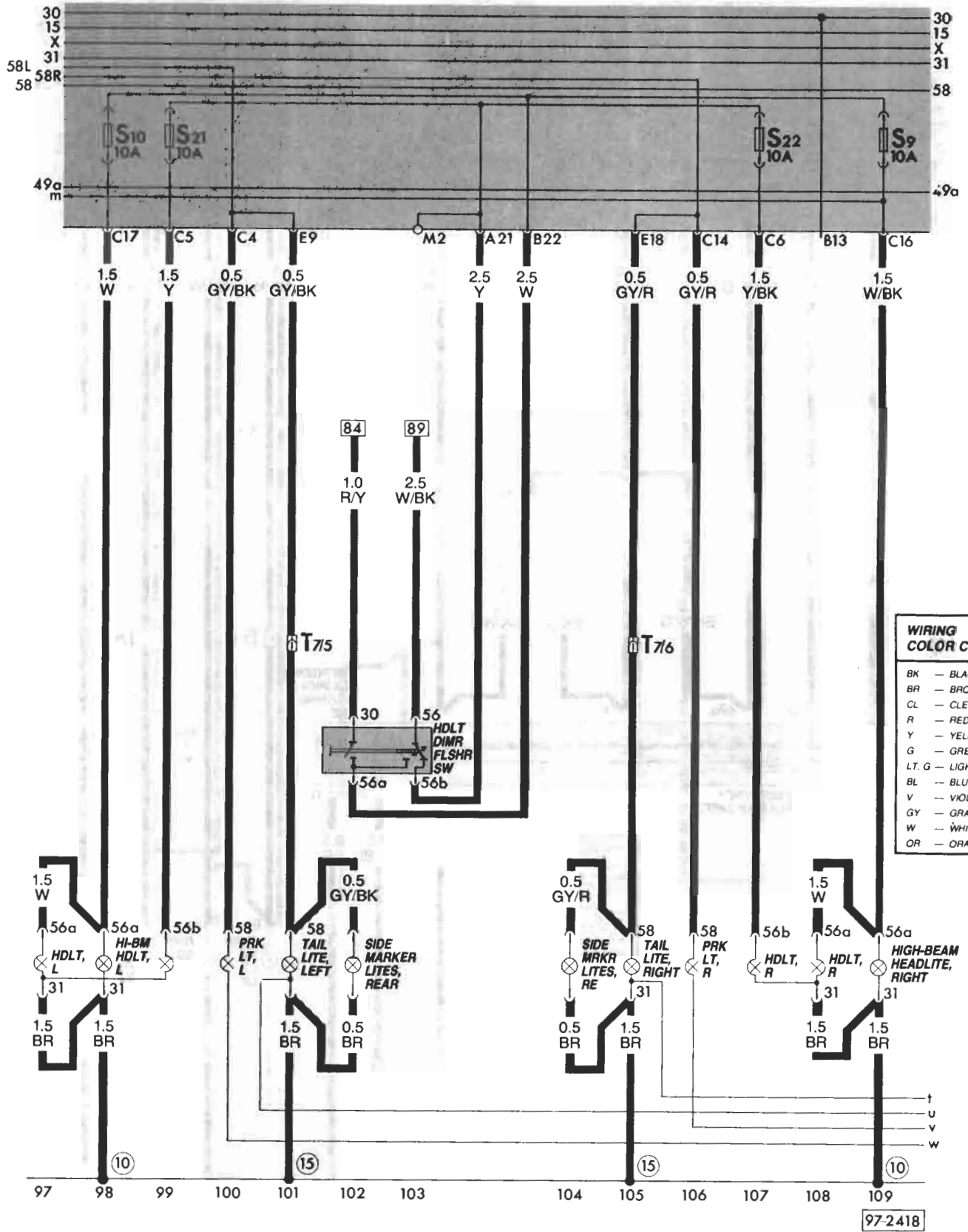
# 97 Electrical System - Wiring, Waterboxer



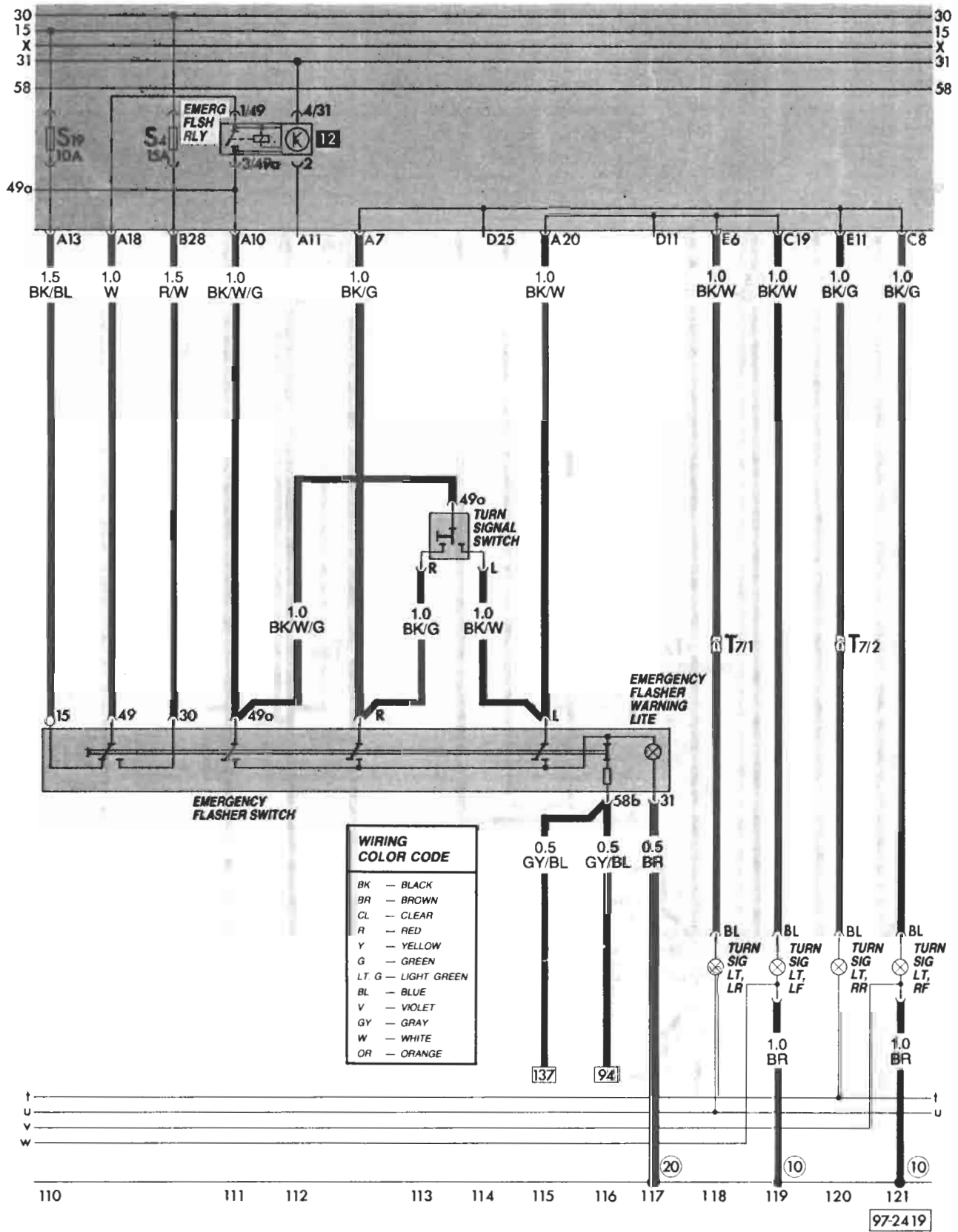
97.94

Main wiring diagram  
Light switch  
from VIN G 055 690

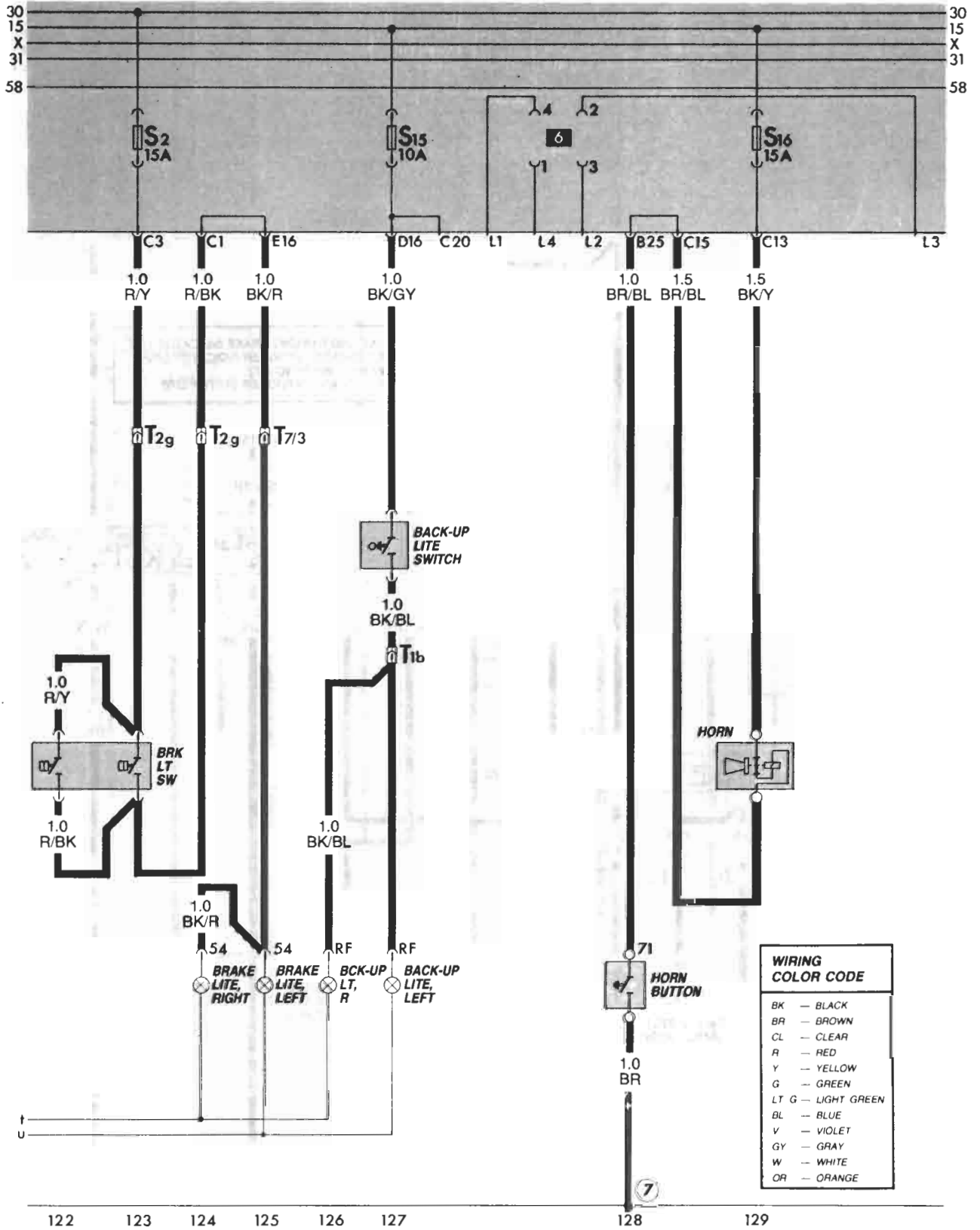
Water-cooled—Digifant 1986



# 97 Electrical System - Wiring, Waterboxer

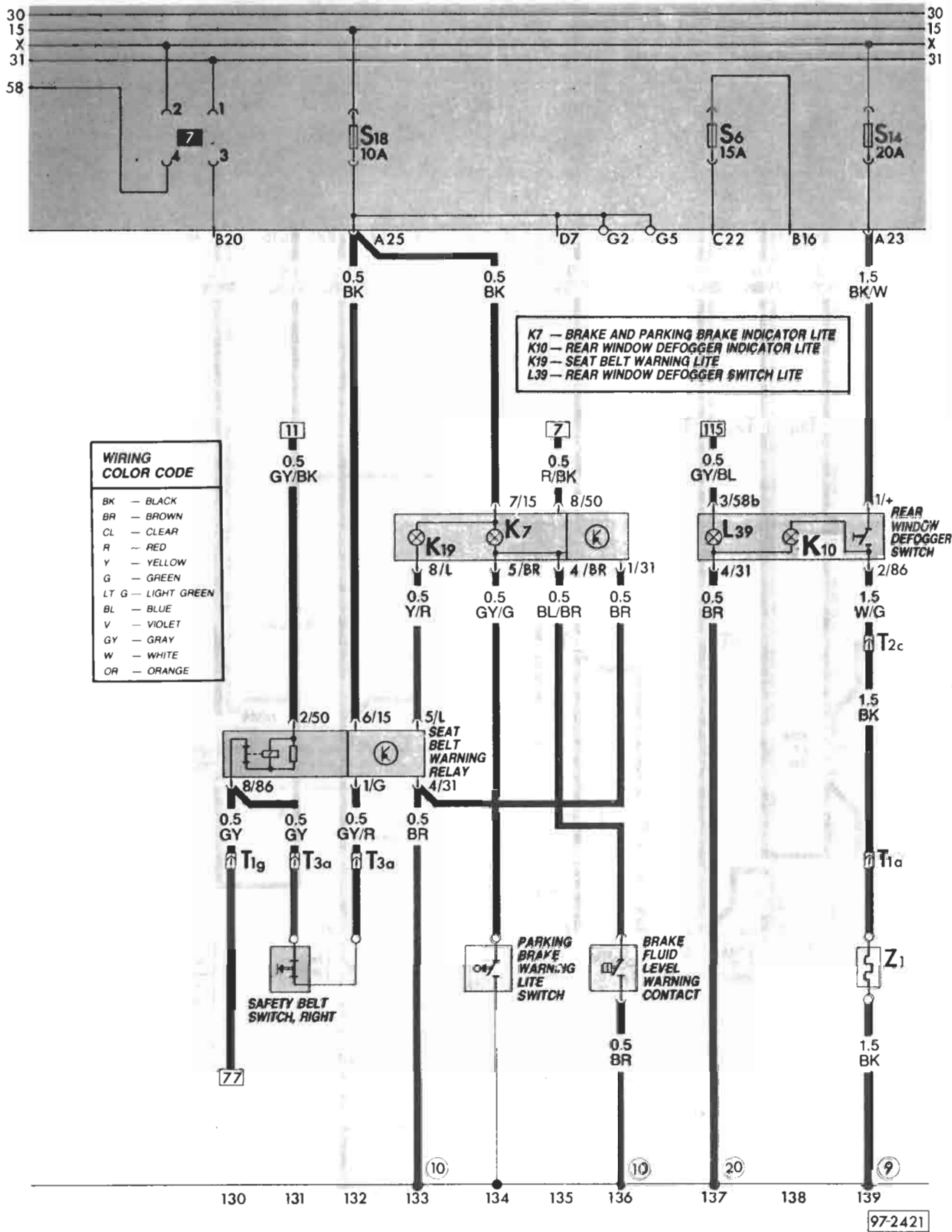


# Electrical System - Wiring, Waterboxer 97



97-2420

# 97 Electrical System - Wiring, Waterboxer



97.98

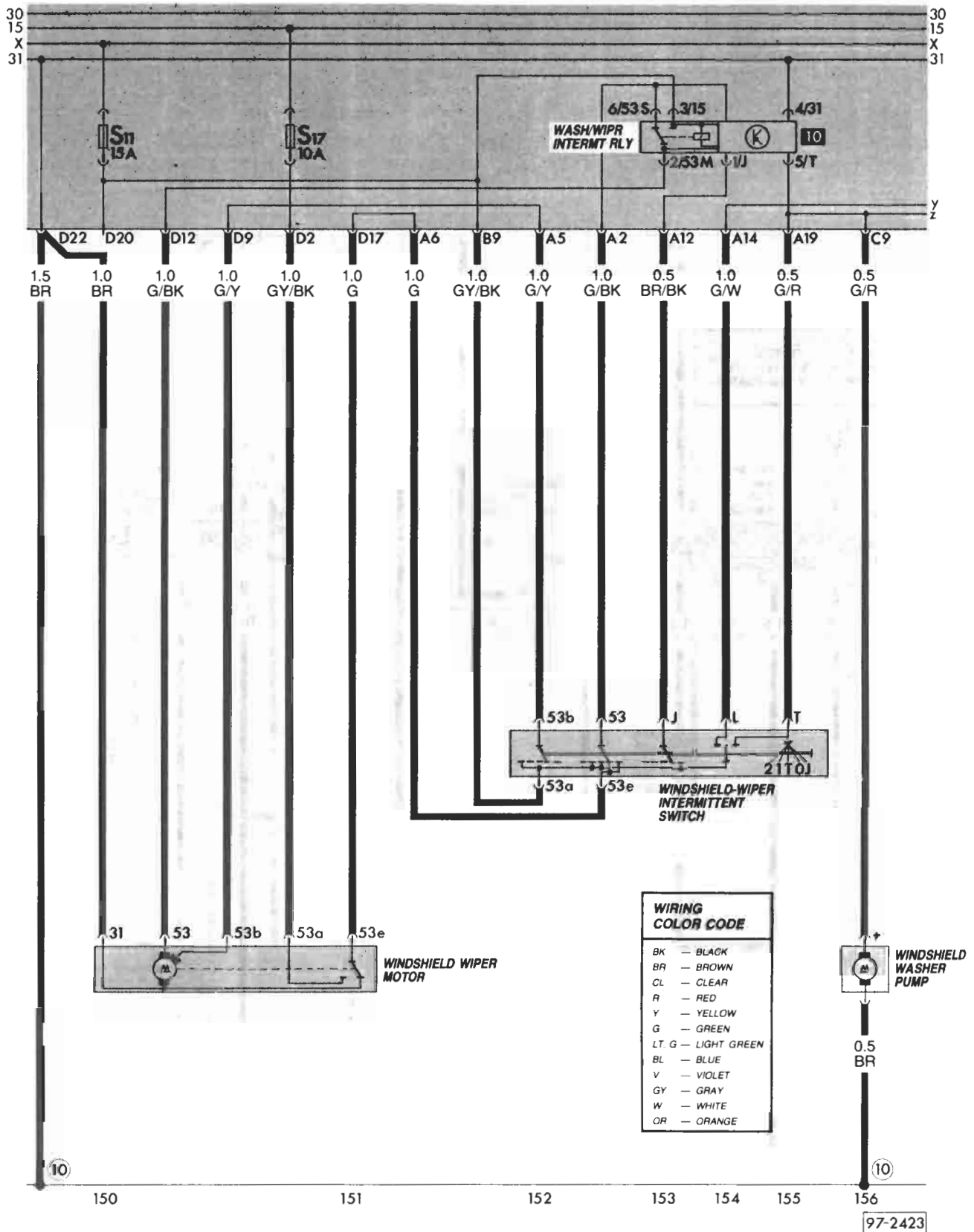
Main wiring diagram  
 Indicator lights  
 from VIN G 055 690

Water-cooled — Digifant 1986





# 97 Electrical System - Wiring, Waterboxer



- if any indicator light does not light during test, indicator light panel is defective
- replace complete indicator light panel if necessary
- if indicator light panel **OK**, check wiring
- if wiring **OK**, replace water tank sender unit

- if test light does not light, indicator light panel is defective
- replace complete indicator light panel if necessary
- if test light lights, check wiring and water pump switch in faucet
- if wiring and switch **OK**, replace water pump

## Water pump, checking

- visually check level of water in water tank— must be minimum 1 US gal. (approximate)

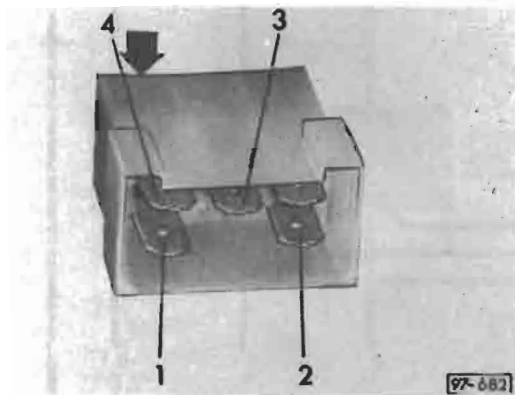
### Note

Water pump shuts off automatically if water level is below 0.5 US gal. (Basic model) or 0.8 US gal. (DeLuxe model) to prevent pump from running dry

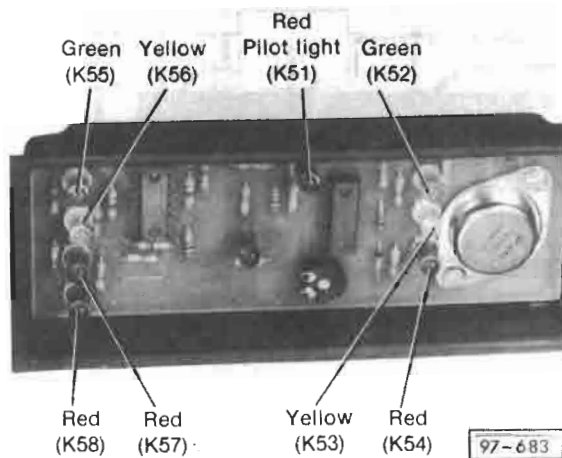
- check fuse on water pump and fuse located under driver's seat
- remove indicator light panel from sink cabinet but do **not** disconnect multi-point connector

### WARNING

Never remove/install external electrical outlet, inside electrical outlets, circuit breaker with switch, or refrigerator if vehicle is connected to 115 volts AC. Check for good ground connections on 115-volt system after installing electrical equipment or components. Use suitable test equipment to check voltage on 115-volt system.



- connect test light to back-side of terminal 4 (arrow)



- if either green(K55), yellow(K56), or red(K57) water tank level indicator light is lit, test light must also light

# 97 Electrical System—Wiring, Camper

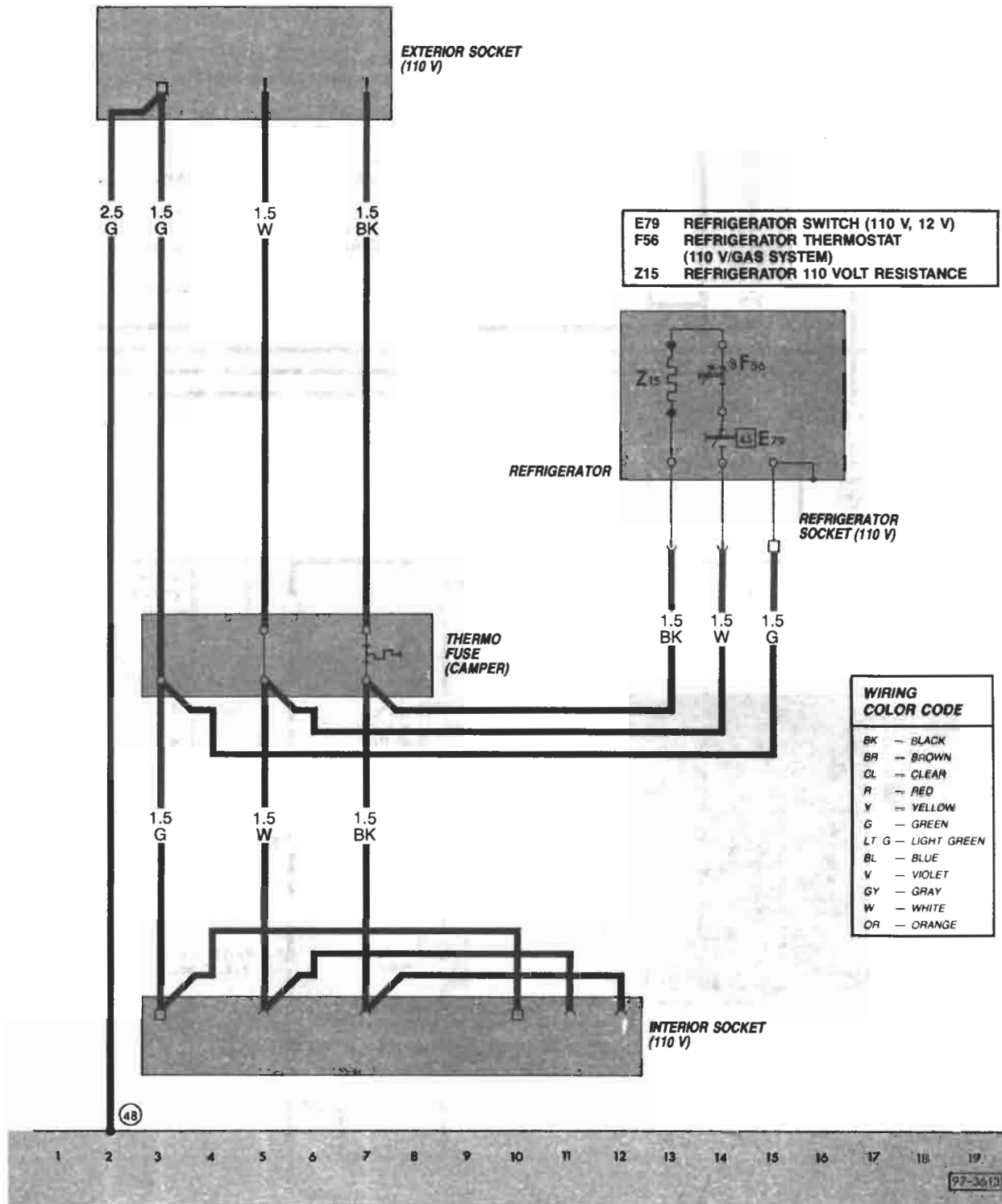
Description	Current track
Amber light diode, battery voltage below 12.5 volts	25
Amber light diode, water tank level full	24
Display unit	21-27
Display unit switch	23
Exterior socket (110 V)	2-7
Gas flame ON sensor	44
Gas flame ON warning light	24
Green light diode, battery voltage above 12.5 volts	25
Green light diode, water tank level full	24
Interior light, center	49-50
Interior socket (110 V)	3-12
Red light diode, battery voltage below 12.0 volts	25
Red light diode, water tank level part empty	24
Refrigerator	12-16, 41-46
Refrigerator 110 volt resistance	13
Refrigerator 12 Volt resistance	45
Refrigerator 12-Volt heater relay	24-26
Refrigerator condenser fan	42
Refrigerator fan thermoswitch	42
Refrigerator socket (110 V)	15
Refrigerator switch (110 V, 12 V)	14, 45
Refrigerator thermostat (110 V/gas system)	14
Thermo fuse (Camper)	3-8
Water pump	31
Water pump switch	31
Water tank low level sensor	34

## Wire connectors

- T1 — single, on refrigerator
- T3a — three-point, on refrigerator
- T4 — four-point, on water tank
- T6 — six-point, on display unit

## Ground connections

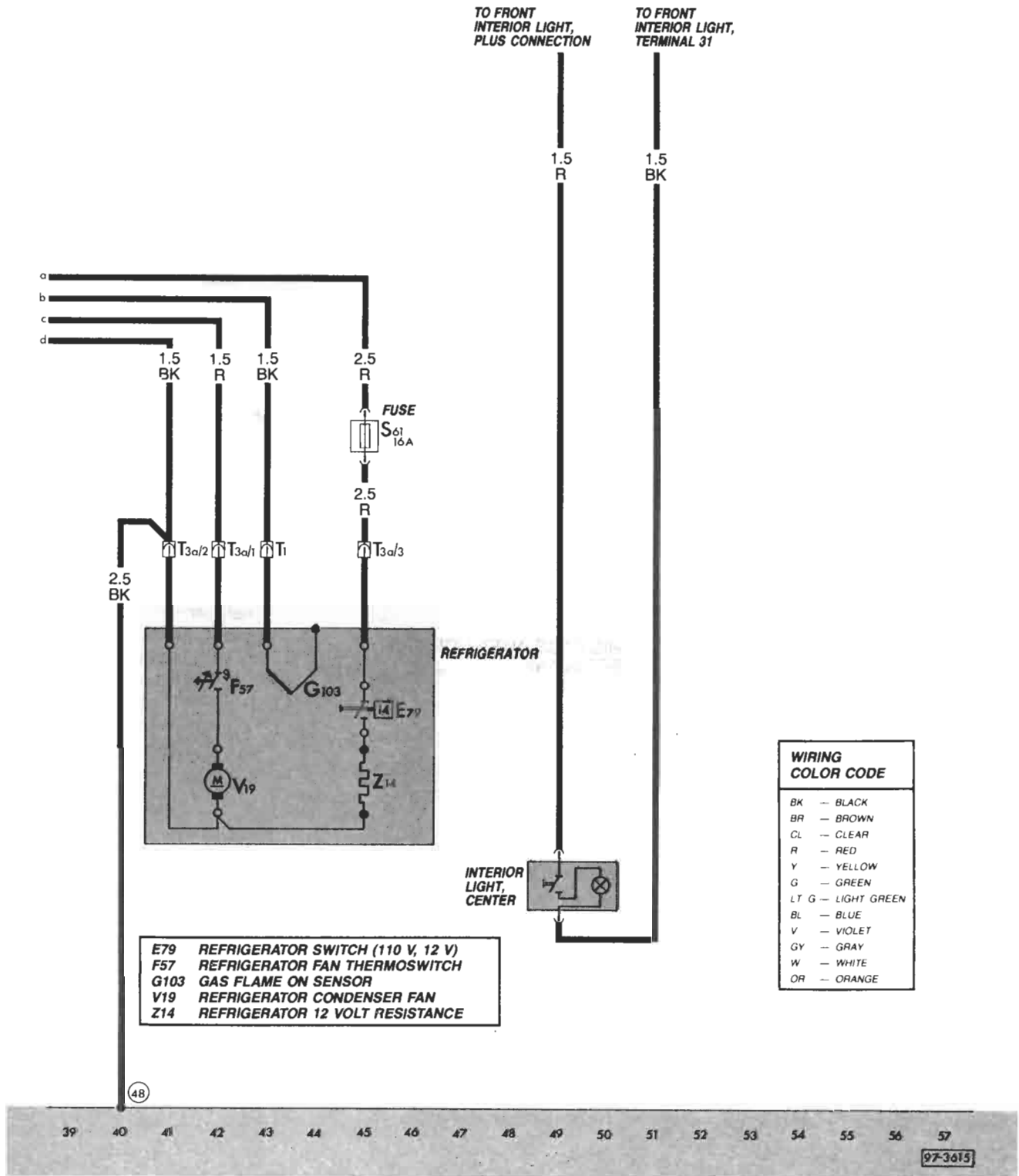
- ④8 — behind refrigerator, left side



**WIRING COLOR CODE**

BK	— BLACK
BR	— BROWN
CL	— CLEAR
R	— RED
Y	— YELLOW
G	— GREEN
LT G	— LIGHT GREEN
BL	— BLUE
V	— VIOLET
GY	— GRAY
W	— WHITE
OR	— ORANGE

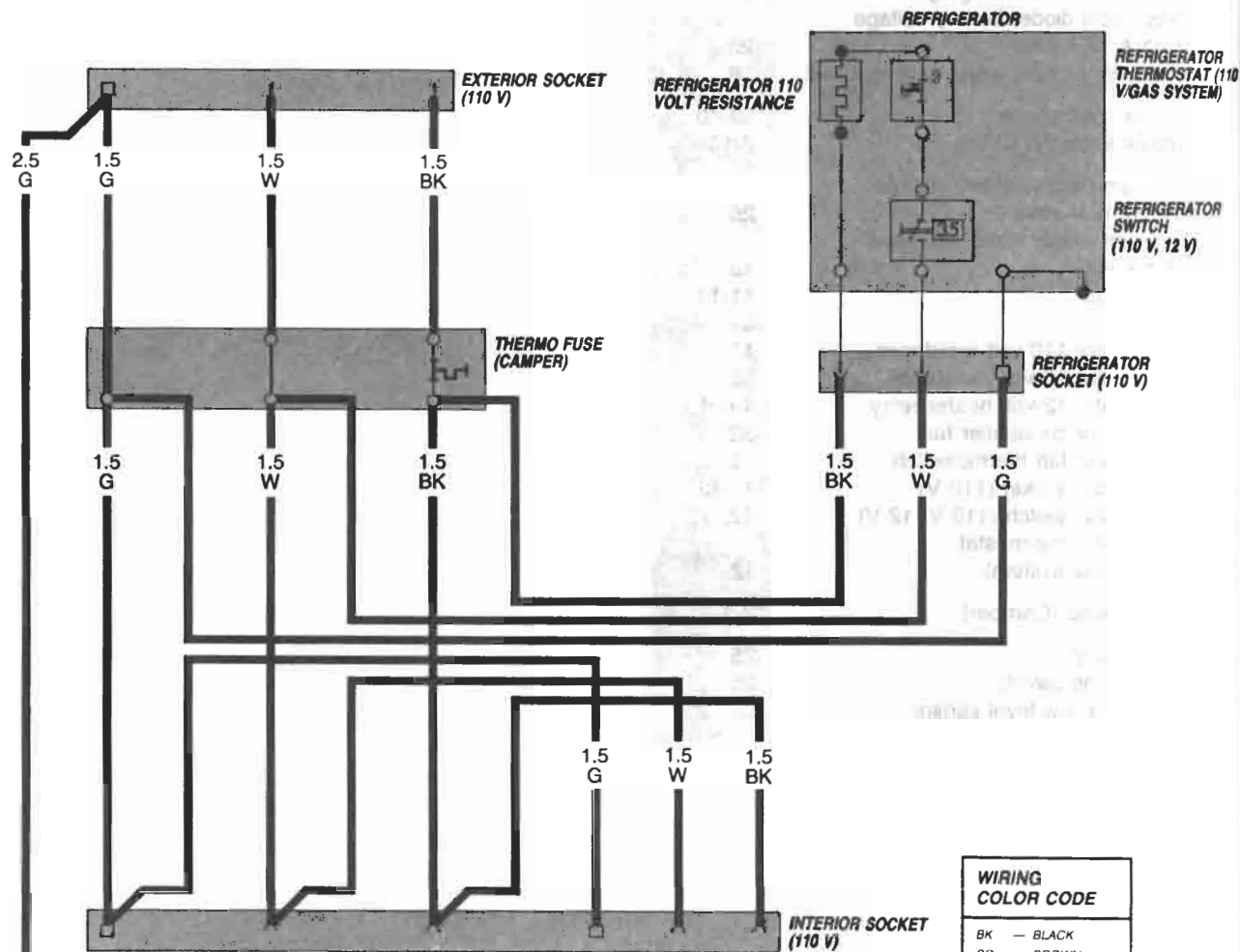




Description	Current track	Wire connectors
Amber light diode, battery voltage below 12.5 volts	20	T1 — single, on refrigerator
Amber light diode, water tank level full	18	T2a — two-point, behind dashboard
Display unit	15-22	T3a — three-point, on refrigerator
Display unit switch	17	T4 — four-point, on water tank
Exterior socket (110 V)	2-6	T6 — six-point, on display unit
Gas flame ON sensor	33	<b>Ground connections</b>
Gas flame ON warning light	18	④8 — behind refrigerator, left side
Green light diode, battery voltage above 12.5 volts	20	
Green light diode, water tank level full	18	
Interior light, center	39-40	
Interior socket (110 V)	2-10	
Red light diode, battery voltage below 12.0 volts	20	
Red light diode, water tank level part empty	18	
Refrigerator	11-14, 31-36	
Refrigerator 110 volt resistance	11	
Refrigerator 12 volt resistance	35	
Refrigerator 12-volt heater relay	19-21	
Refrigerator condenser fan	32	
Refrigerator fan thermoswitch	32	
Refrigerator socket (110 V)	11-13	
Refrigerator switch (110 V, 12 V)	12, 35	
Refrigerator thermostat (110 V/gas system)	12	
Thermo fuse (Camper)	2-6	
Water pump	25	
Water pump switch	25	
Water tank low level sensor	28	

# 97 Electrical System—Wiring, Camper

30	30
15	15
X	X
31	31



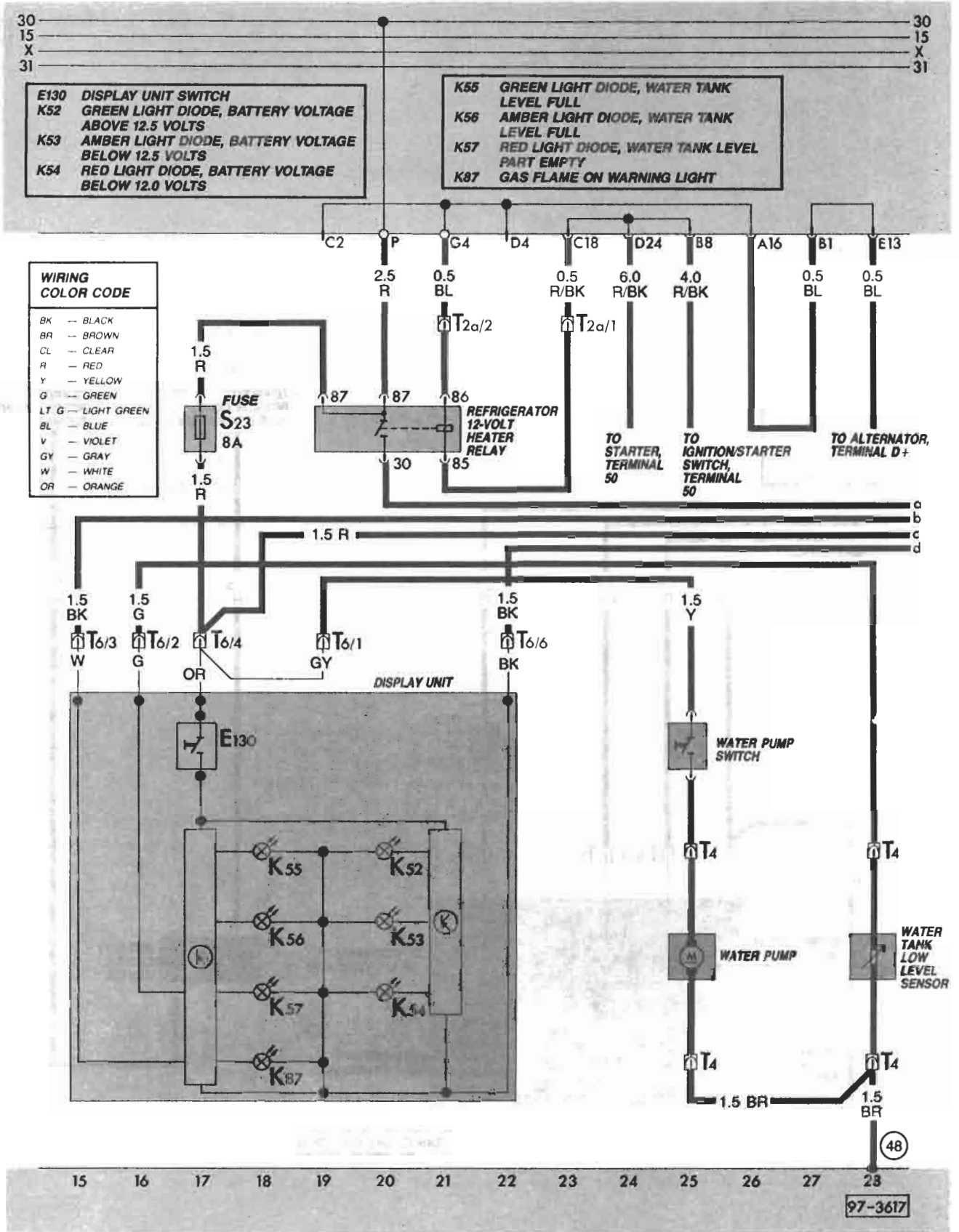
WIRING COLOR CODE	
BK	— BLACK
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G	— GREEN
LT. G	— LIGHT GREEN
BL	— BLUE
V	— VIOLET
GY	— GRAY
W	— WHITE
OR	— ORANGE

(48)

1	2	3	4	5	6	7	8	9	10	11	12	13	14
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97-3616

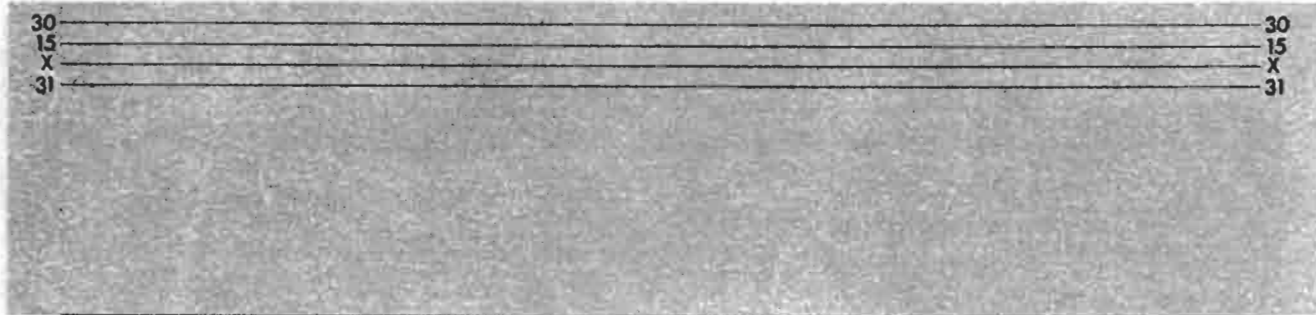




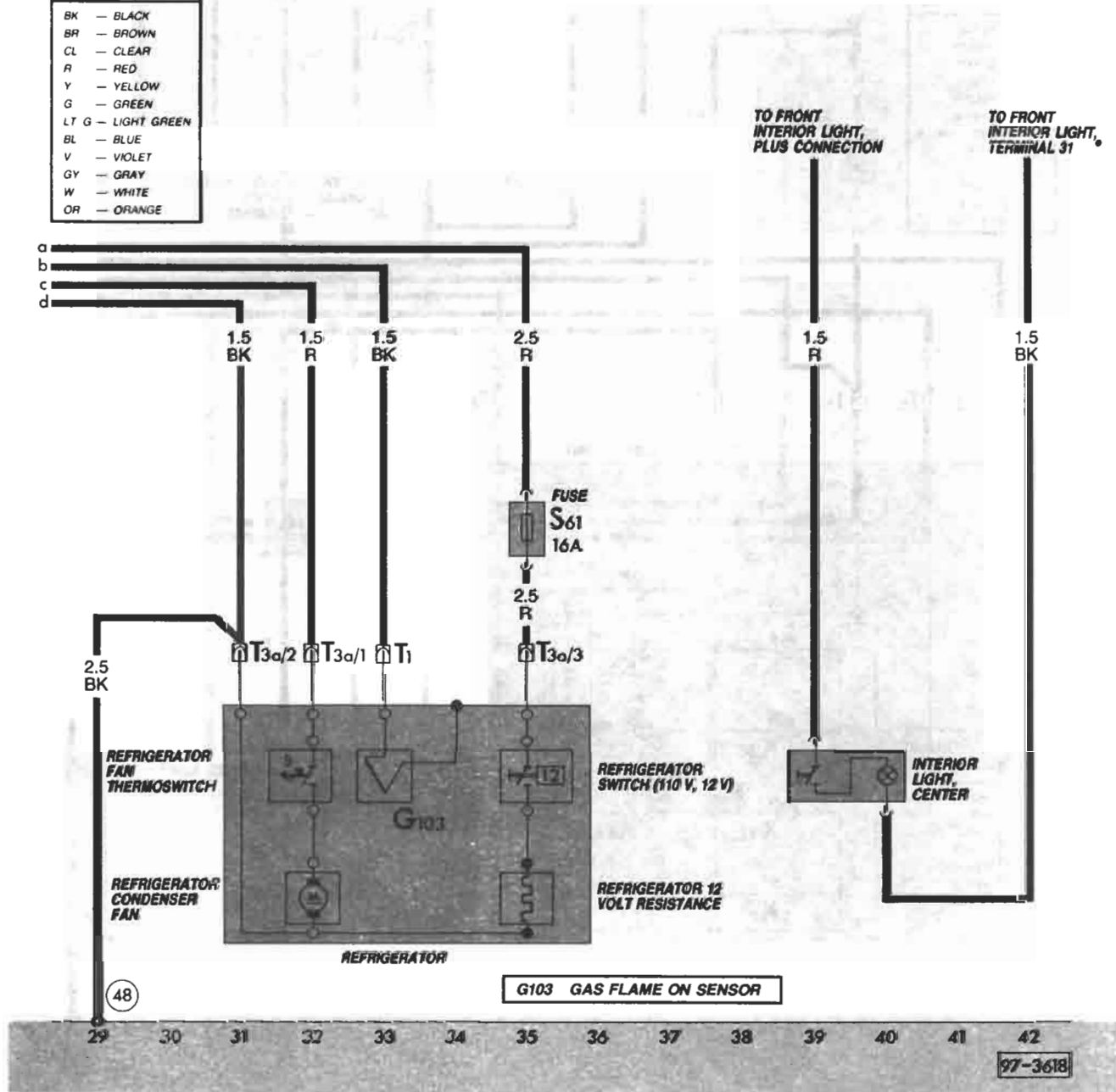
Camper from 1986

Electrical equipment **97.33b**

# 97 Electrical System—Wiring, Camper



WIRING COLOR CODE	
BK	— BLACK
BR	— BROWN
CL	— CLEAR
R	— RED
Y	— YELLOW
G	— GREEN
LT G	— LIGHT GREEN
BL	— BLUE
V	— VIOLET
GY	— GRAY
W	— WHITE
OR	— ORANGE



Description	Current Track
Alternator	6
Auxiliary battery	2
Battery	3
Battery cut-out relay	1-2
Ignition/start switch	12-15
Starter	4-5
Voltage regulator	6-7

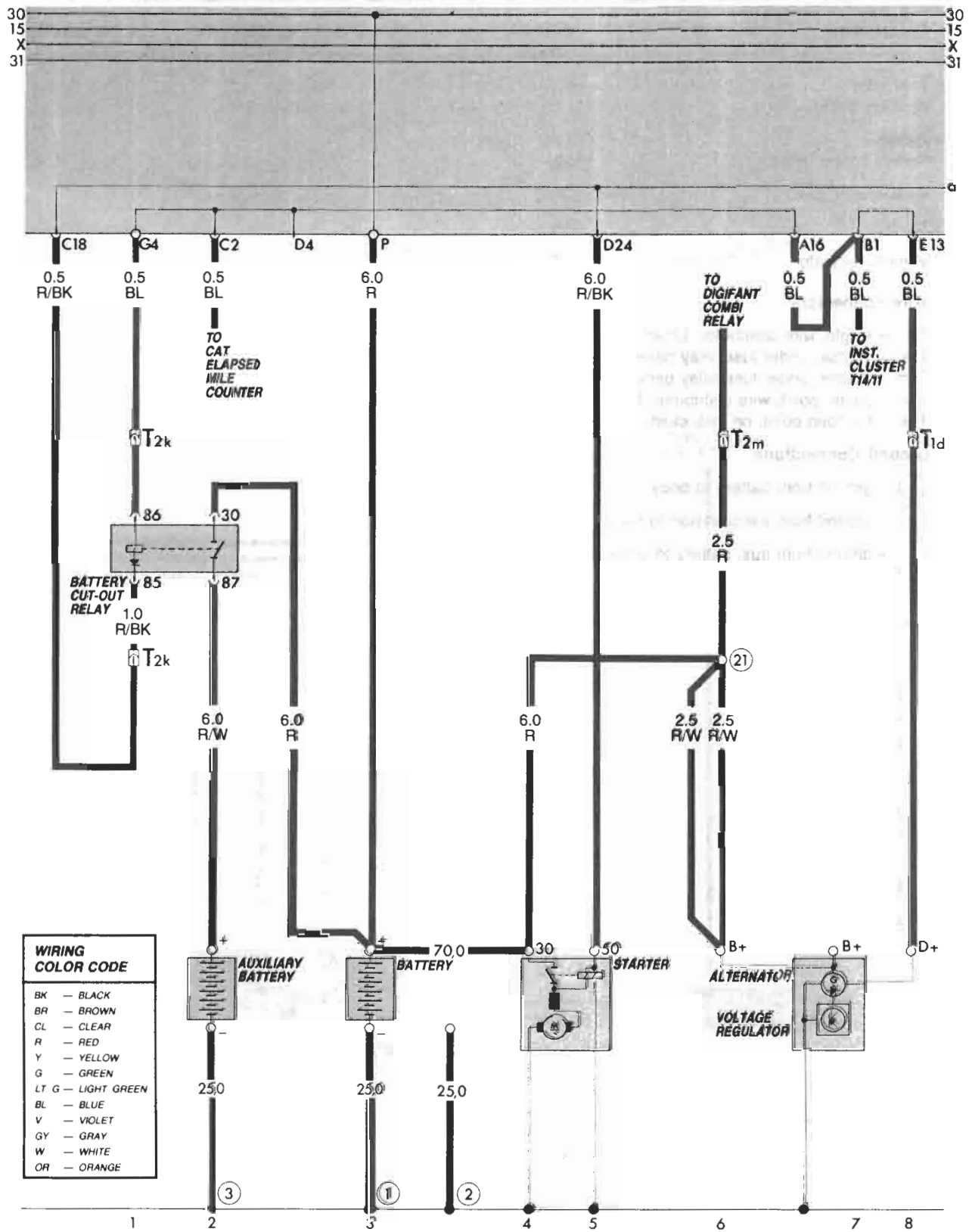
#### Wire connectors

T1d — single, wire distributor, LF eng. compart.  
T2k — double, under fuse/relay panel  
T2m — double, under fuse/relay panel  
T7a — seven point, wire distributor, LF eng. compart.  
T14 — fourteen point, on inst. cluster

#### Ground Connections

- ① — ground from battery to body
- ② — ground from transmission to body
- ③ — ground from aux. battery to body

# 97 Electrical System – Wiring, Camper



97-2298

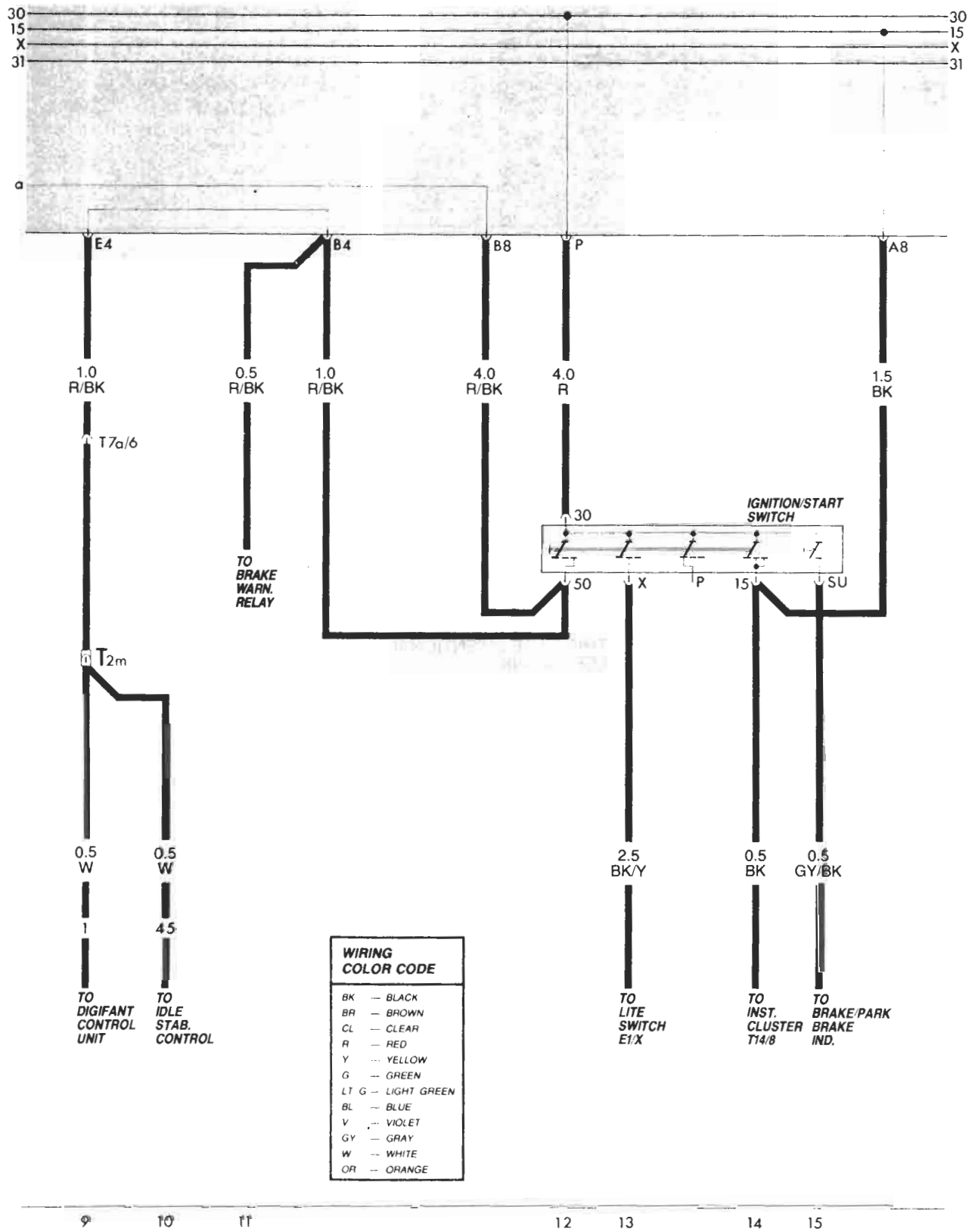
97.34a

Auxiliary battery

Manual trans.

Camper 1986-1989

# Electrical System – Wiring, Camper 97



97-2299

## Electrical System—Wiring, Diesel

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#### 1983 Diesel

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- Heater booster 97.49-97.51
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  current track index 97.41
- Rear window wiper 97.26

#### Air-cooled AFC

- Refer to 97.11

#### Camper

- Refer to 97.29

#### Waterboxer/Syncro (Water-cooled Digifant, Digijet)

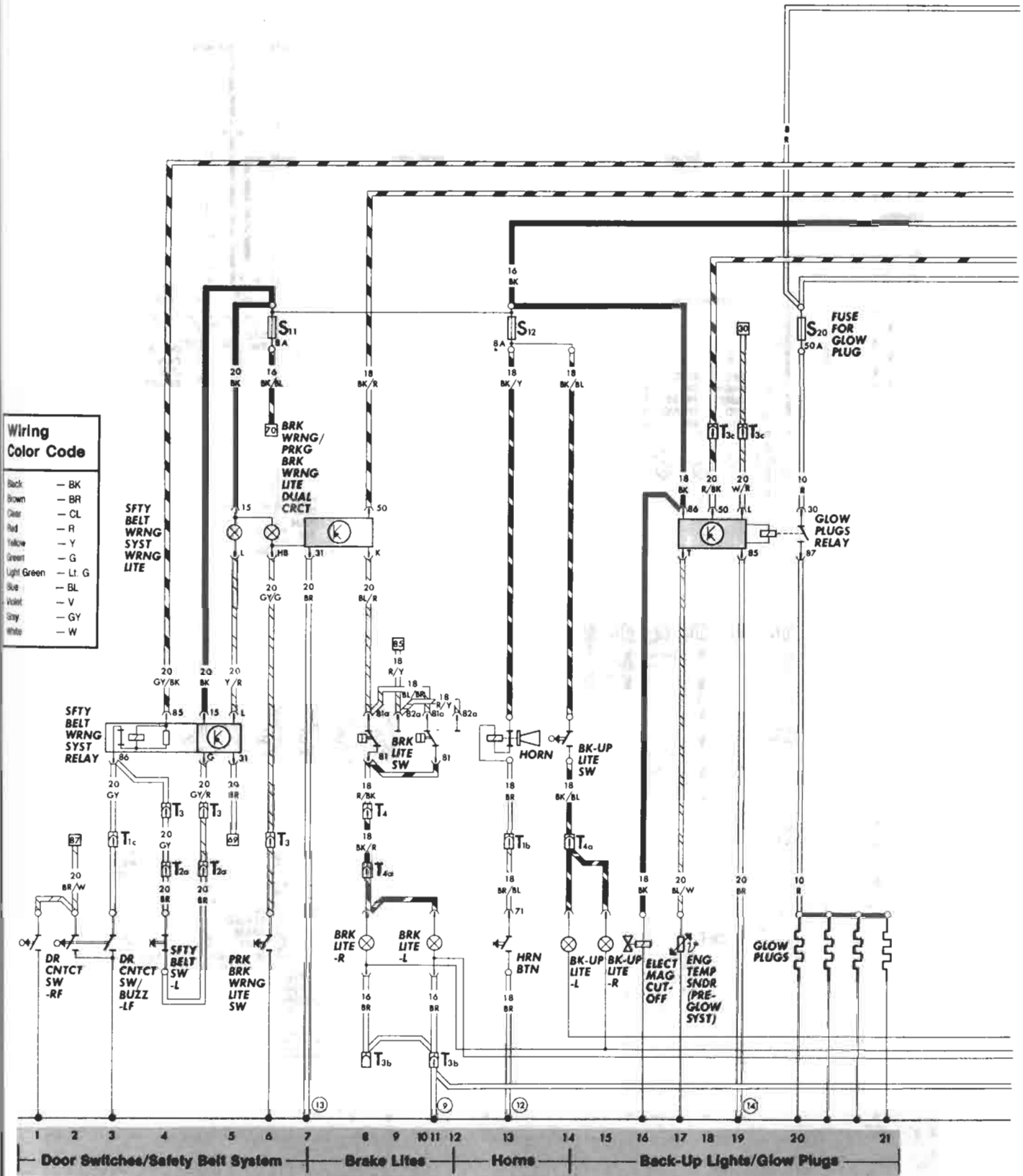
- Refer to 97.53

## 1982 Vanagon Diesel

Description	Current Track	Description	Current Track
Alternator	28, 29	Safety belt switch, left	4
Alternator warning light	29	Safety belt warning system warning light	5
Back-up light, left	14	Safety belt warning system relay	3-5
Back-up light, right	15	Sealed-beam unit, left	40-42
Back-up light switch	14	Sealed-beam unit, right	41, 43
Battery	22	Side-marker light, rear	47, 52
Brake light, left	11	Side-marker lights, rear	88
Brake light, right	8	Starter	24-28
Brake light switch	8-12	Tail light, left	51
Brake warning/parking brake warning light, dual circuit	6-8	Tail light, right	46
Cigarette lighter	84	Turn signal, front left	76
Cigarette lighter light	83	Turn signal, front right	77
Clock	58	Turn signal, rear left	75
Coolant over-temperature warning light	36	Turn signal, rear right	78
Coolant temperature gauge	34	Turn signal switch	73
Coolant temperature gauge sender	34	Turn signal warning light	32
Door contact switch/buzzer, front left	3	Voltage regulator	28
Door contact switch, front right	3	Voltage stabilizer	37
Electro-magnetic cut-off	16	Windshield washer pump	59
Emergency flasher relay	69-71	Windshield wiper motor	64-66
Emergency flasher switch	70-79	Windshield wiper switch	59-66
Emergency flasher warning light	79	Windshield wiper/washer intermittent relay	60-63
Engine oil pressure switch	31		
Engine oil pressure warning light	31	<b>Wire Connectors</b>	
Engine temperature sender (pre-glow system)	17	T1b — single, behind dash	
Fresh air controls light	82	T1c — single, behind dash	
Fresh air fan	58	T1d — single, in engine compartment next to alternator	
Fresh air fan resistor	57	T — single, behind dash	
Fresh air fan switch	57, 58	T1f — single, next to interior light rear, left	
Fuel gauge	33	T1k — single, behind dash	
Fuel gauge sender	33	T2 — double, behind dash	
Fuses, in fuse/relay panel (S-1 to S13)		T3 — double, under driver's seat	
Fuse strip for glow plug, in engine compartment	20	T3b — three-point, in connector	
Glow plugs	20, 21	T3c — three-point, behind dash	
Glow plugs relay		T4a — four-point, in connection	
Headlight dimmer and flasher switch	43-44	T4b — four-point, in connection	
Headlight high-beam warning light	38	T4c — four-point, behind dash	
Horn	13	T14/ — fourteen-point, on instrument cluster	
Horn button	13		
Instrument panel light	53-55	<b>Ground Connectors</b>	
Instrument panel light resistor	46	① — Battery ground strap, to body	
Interior light, front	86, 87	② — transmission/body	
Interior light, rear	88-89	⑨ — in connection box	
License plate light	48, 49	⑩ — behind dash, next to fuse/relay panel holder	
Light switch	44-47	⑪ — on rear lid	
Load reduction relay (X-contact)	65-68	⑫ — on steering box	
Parking brake warning light switch	6	⑬ — behind fuse box	
Parking light, left	50	⑭ — in engine compartment, next to glowing-time relay	
Parking light, right	45	⑮ — on crossmember, front left	
Pre-glow/starter switch	24-31		
Pre-glow time indicator light	30		
Radiator cooling fan	90		
Radiator cooling fan relay for 2nd stage	91, 92		
Radiator cooling fan thermostwitch (switch on at 95°C/203°F)	90		
Radiator cooling fan thermostwitch (switched on at 110°C/230°F)	92		
Radio connectors	46, 85		
Rear-window defogger heating element	81		
Rear-window defogger switch	81-83		
Rear-window defogger switch light	82		
Rear-window defogger warning light	81		

**Wiring Color Code**

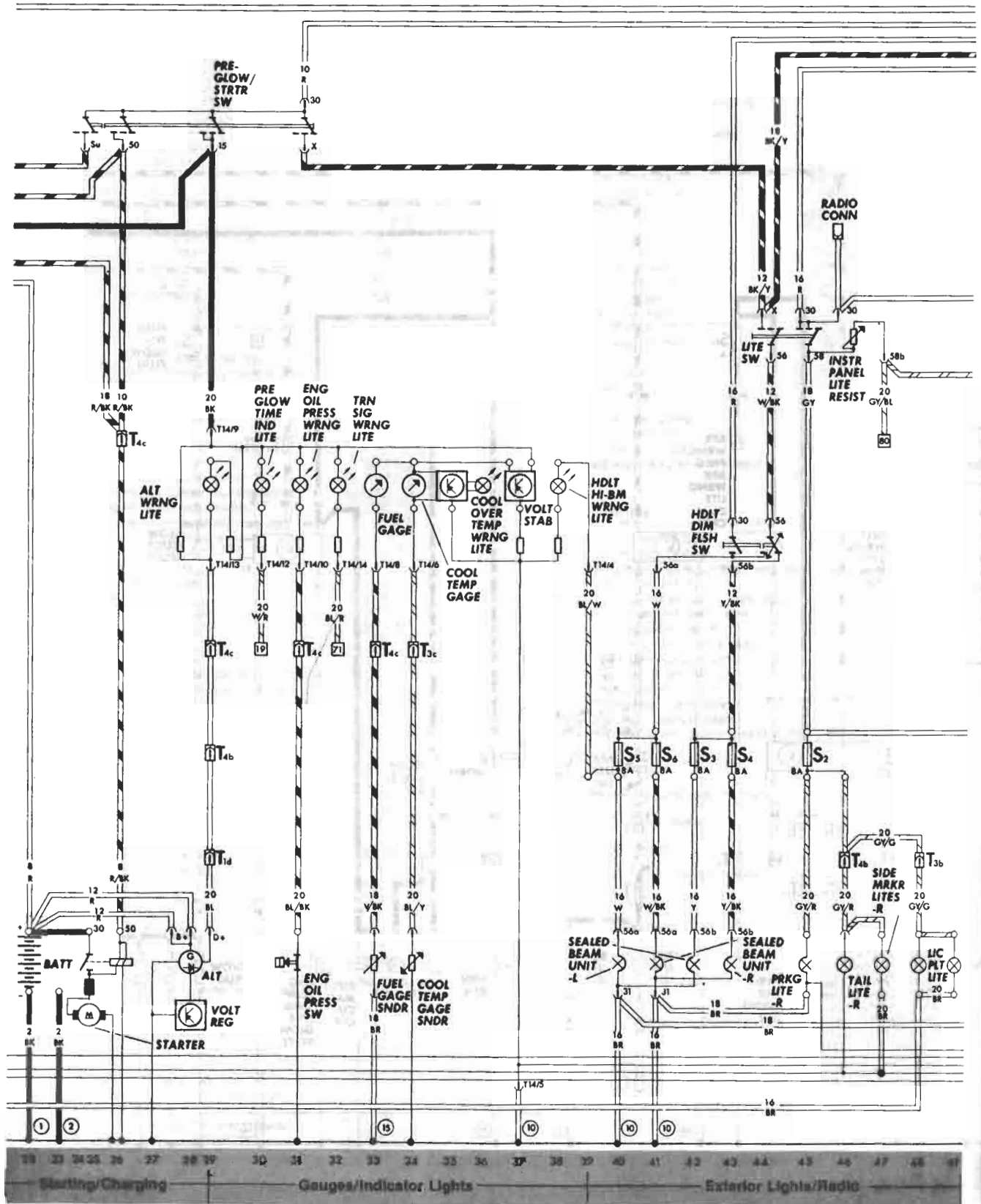
Black	- BK
Brown	- BR
Clear	- CL
Red	- R
Yellow	- Y
Green	- G
Light Green	- Lt. G
Blue	- BL
Violet	- V
Gray	- GY
White	- W



All wire sizes American Wire Gauge



# 97 Electrical System—Wiring, Diesel



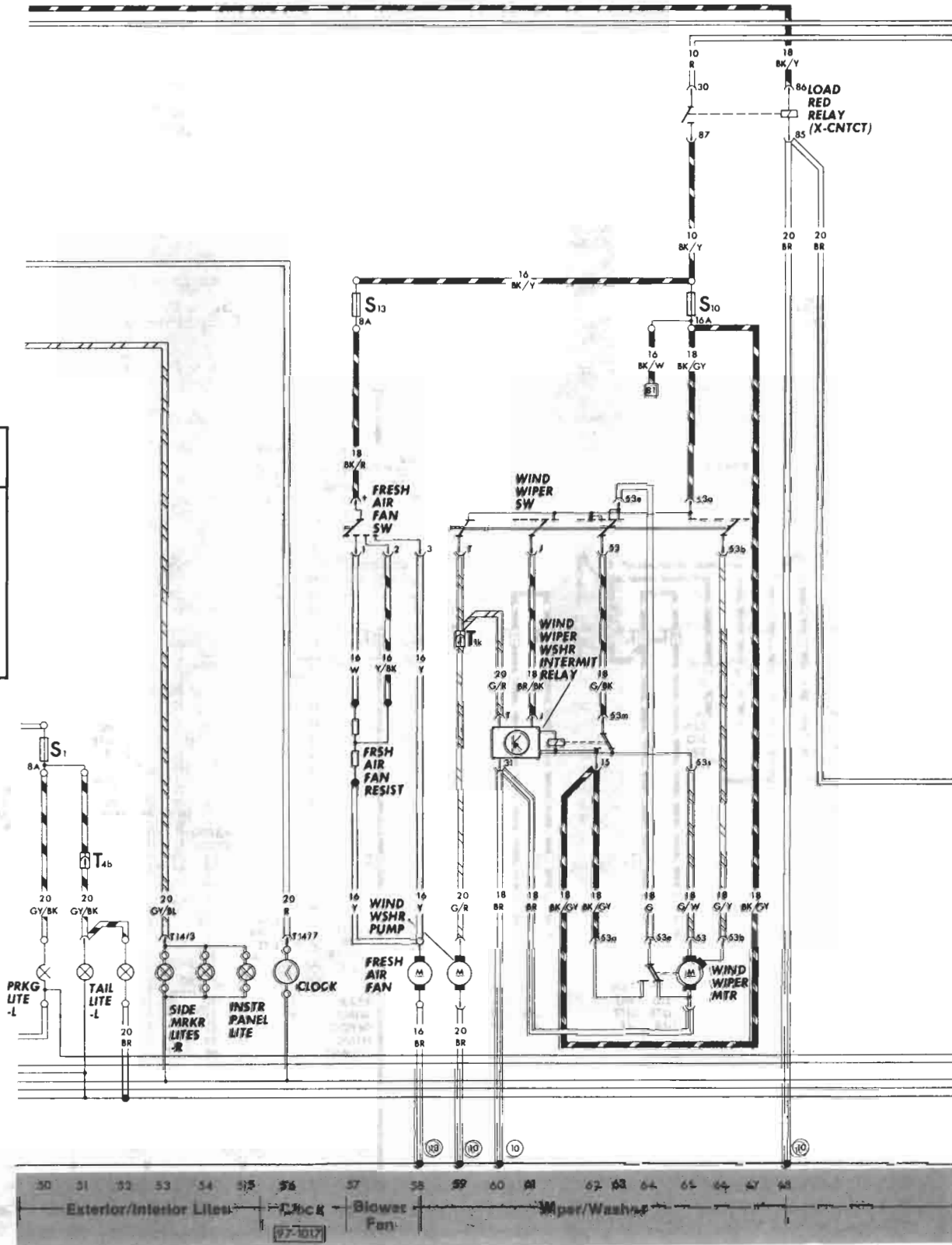
97.38

Main wiring diagram

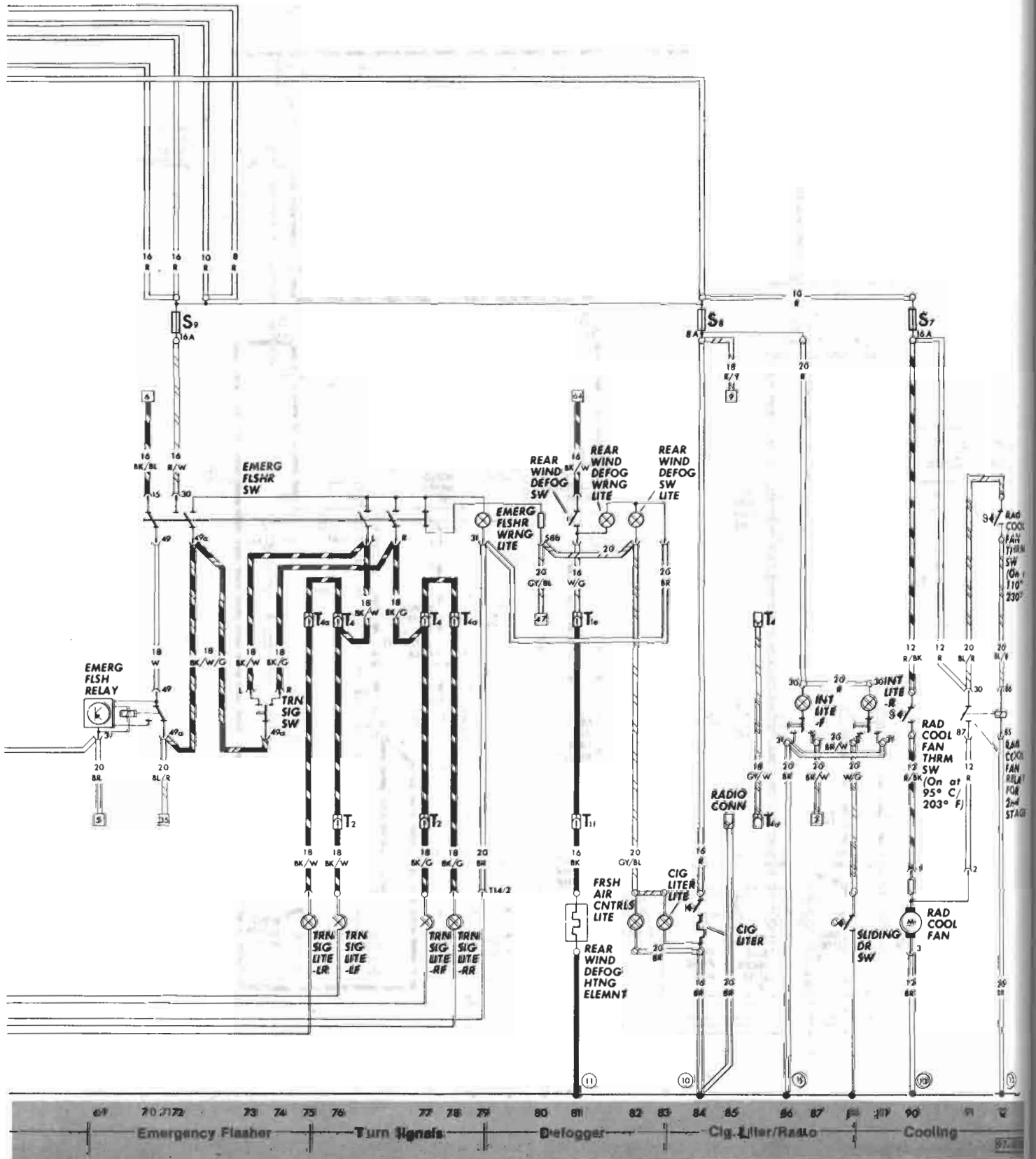
Diesel 1982

### Wiring Color Code

Black	- BK
Brown	- BR
Clear	- CL
Red	- R
Yellow	- Y
Green	- G
Light Green	- Lt. G
Blue	- BL
Violet	- V
Gray	- GY
White	- W



# 97 Electrical System—Wiring, Diesel



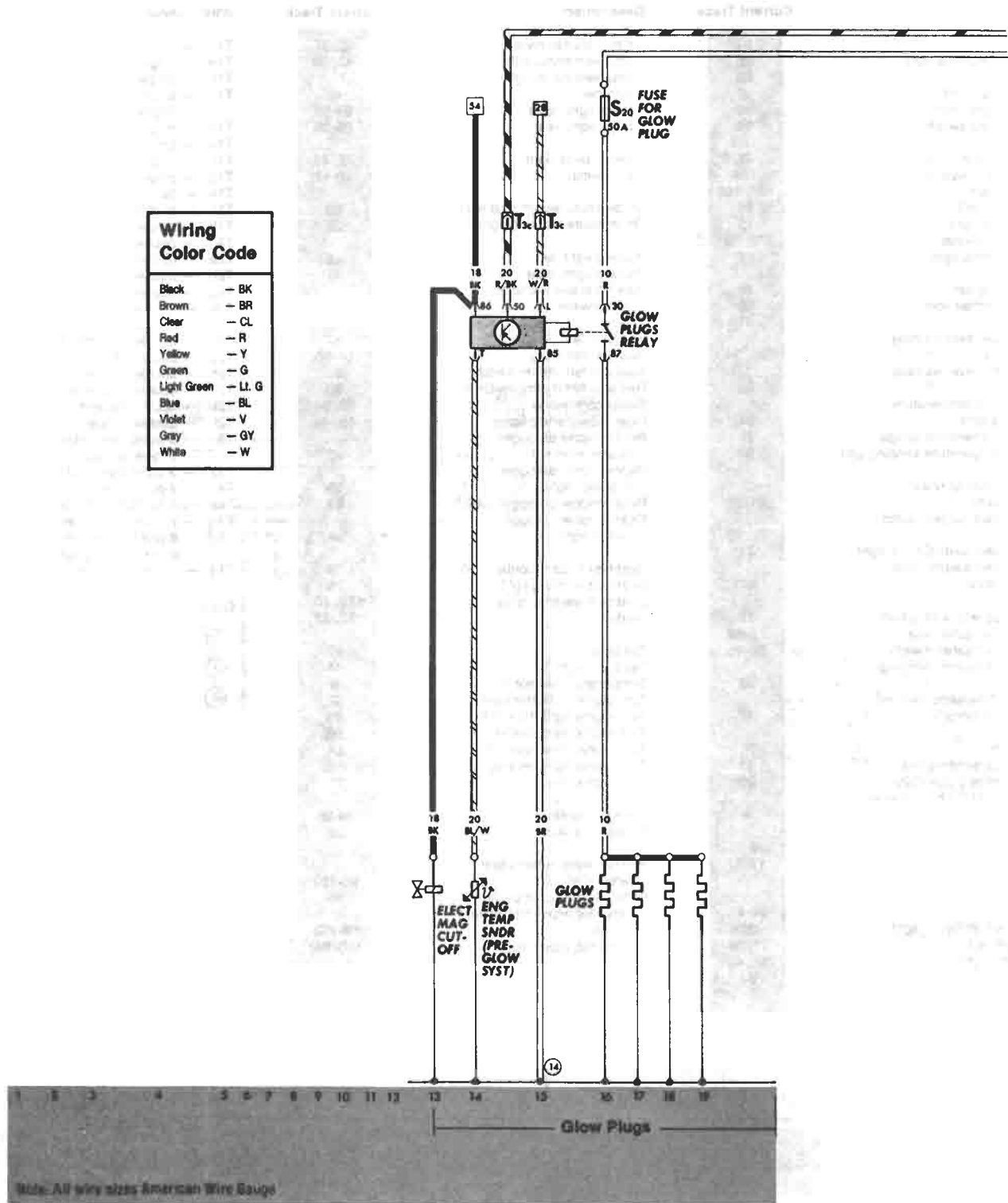
## 1983 Vanagon Diesel

Description	Current Track	Description	Current Track	Wire Connectors
Alternator	24-26	Ignition/starter switch	22-27	T1 — single, in engine compart. left
Alternator warning light	26	Instrument panel light	49, 50	T1a — single, in connector housing
Battery	20	Instrument-panel light dimmer	42	T1b — single, in connector housing
Back-up light, left	55	Interior light, front	81-83	T1c — single, near alternator in engine compart.
Back-up light, right	56	Interior light, rear	84-86	T1d — single, behind dash
Back-up light switch	55	License plate light	42, 43	T1e — single, in connector housing
Blower fan	105	Light switch	40-42	T1f — single, behind dash
Blower-fan control-lever light	67	Oil-pressure switch (1.8 bar)	29	T1g — single, behind dash
Blower-fan resistance	104	Oil pressure warning light	29	T1h — behind dash
Blower switch	104, 105	Parking light, left	46	T1i — at roof cross-beam, rear right
Brake light, left	80	Parking light, right	41	T1k — single, behind dash
Brake light, right	79	Parking-brake warning light switch	76	T2 — double, on fuse/relay panel
Brake-light switch	79, 80	Radiator fan	87	T2a — double, behind dash
Brake warning light	66	Radiator-fan relay	88-90	T2b — double, behind dash
Cigarette lighter	70	Radiator-fan thermostwitch I	87	T2c — double, behind dash
Cigarette lighter light	69	Radiator-fan thermostwitch II	90	T2d — double, behind dash
Clock	51	Radio connection	60, 94	T2e — double, in connector housing
Coolant low-level-warning control unit	83, 34	Rear side-marker lights	45, 46	T2f — double, behind dash
Coolant low-level-warning switch	33	Rear-window defogger heater element	92	T2g — double, in connector housing
Coolant over-temperature warning light	34	Rear-window defogger indicator light	93	T2h — double, in connector housing
Coolant-temperature gauge	32	Rear-window defogger switch	92	T2i — double, in connector housing
Coolant-temperature sending unit	32	Rear-window defogger switch light	94	T2k — double, behind dash
Defogger cut-out relay (X-contact)	91-97	Seat-belt buzzer contact, left	74	T2l — double, below driver's seat
Door contact/buzzer switch, left	72, 73	Seat-belt warning light	75	T3 — 3-point, near alternator in engine compart.
Door contact switch, front right	71	Seat-belt warning relay	73, 75	T3a — 3-point, behind dash
Door contact switch, right sliding door	84	Starter	22, 23	T4 — 4-point, behind dash
Electromagnetic fuel cut-off	16	Tail light, left	47	T4a — 4-point, behind dash
Emergency-flasher relay	56-58	Tail light, right	44	T7 — 7-point, in connector housing
Emergency-flasher switch	58-68	Temperature sensor II	6	T8 — 8-point, behind dash, near brake warning lights
Emergency-flasher warning light	66	Turn-signal indicator light	30	T14 — 14-point on instrument cluster
Engine temperature sender (pre-glow system)	17	Turn-signal light, front-left	65	
Fuel gauge	31	Turn-signal light, front-right	62	
Fuel-gauge sending unit	31	Turn-signal light, rear-left	64	
Fuse for glow plugs (S20)	20	Turn-signal light, rear-right	63	
Fuses (S1-S13) on fuse/relay panel	—	Turn-signal switch	61	
Glow plugs	20-21	Voltage regulator	24-26	
Glow plugs relay	17-20	Voltage stabilizer	35	
Headlight dimmer/flasher switch	38-40	Washer/wiper intermittent relay	98-100	
Headlight-high-beam light	36	Windshield-washer pump	96	
Headlight, left	37, 39	Windshield-wiper intermittent switch	98-103	
Headlight, right	38, 40	Windshield wiper motor	100-103	
Horn	53			
Horn button	53			

### Ground Connectors

- ① — from battery to body
- ② — from transmission to body
- ⑨ — behind dash near fuse/relay panel
- ⑩ — behind dash
- ⑫ — at steering-gear housing
- ⑬ — behind air vent
- ⑭ — at rear deck
- ⑮ — near fuel pump at floor board/crossmember
- ⑰ — near ignition distributor
- ⑱ — left at cylinder head
- ⑲ — near ignition coil in engine compart., left
- ⑳ — plus connection, in connector housing

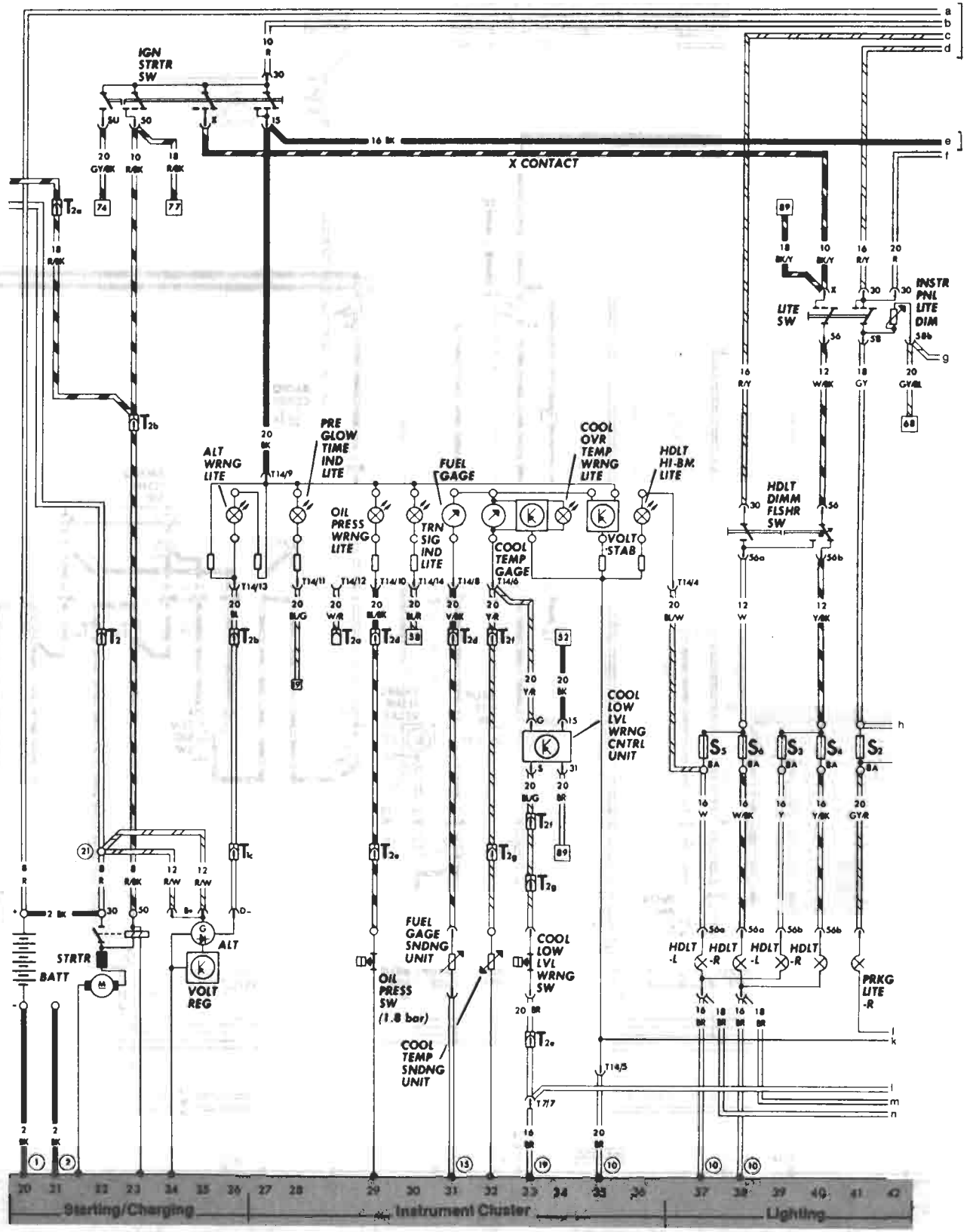
# 97 Electrical System—Wiring, Diesel



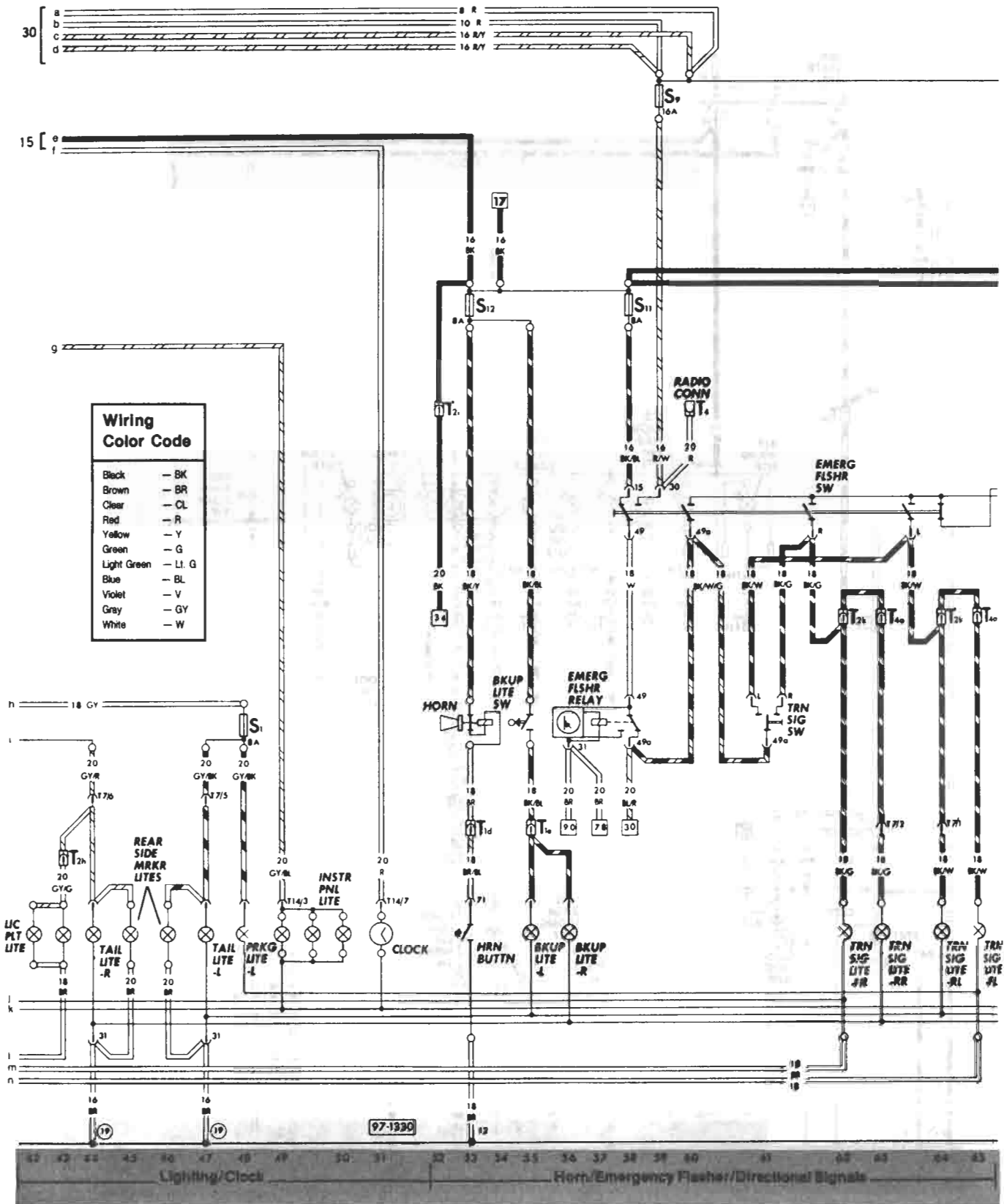
97.42

Main wiring diagram

Diesel 1983



# 97 Electrical System—Wiring, Diesel









Description	Current Track
Air recirculation blower	8
Combustion air blower	11
Condensar	14
Flame switch	12
Fuel pump	10
Fuel pump contact breaker	10
Glow plug	13
Heater contact breaker	12
Heater element	14
Heater ignition coil	12
Heater indicator lite	6
Heater relay	7-12
Main suppressor	8
Overheat switch	9
Safety switch	15, 16
Suppressor	12, 13
Temp. regulating switch	1-6
Temp. sensor	8
To load reduction relay	6

### Wire Connectors

- T1a — single, under instrument panel
- T2 — double, on air recirc. blower
- T4a — four point, on heater control
- T4b — four point, on heater control

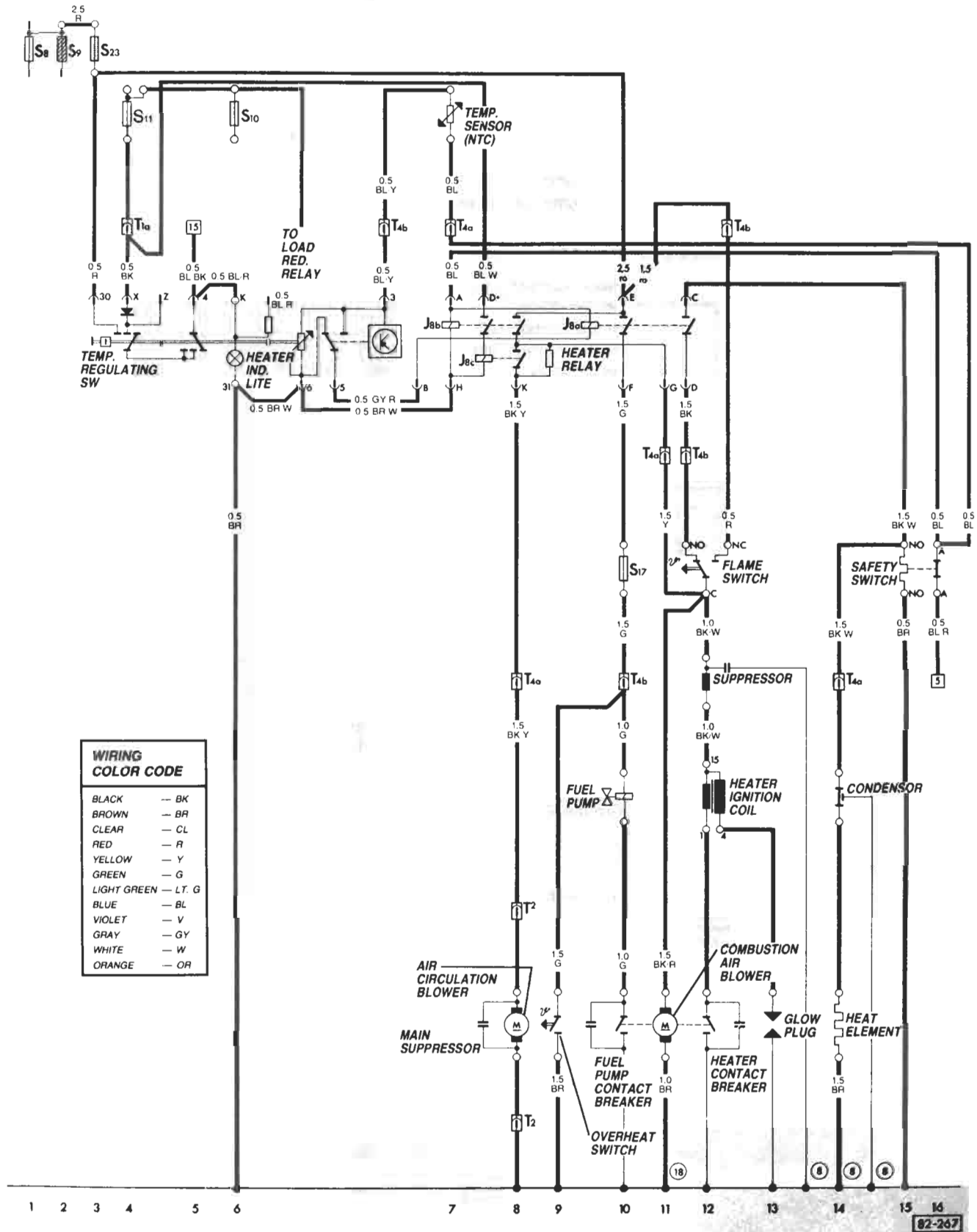
### Ground Connections

- ⑧ — bolt on heater control
- ⑱ — bolt on heater ignition coil

Go to next page ▶

# 97 Electrical System—Wiring, Diesel

TO BATTERY + TERMINAL



WIRING COLOR CODE	
BLACK	— BK
BROWN	— BR
CLEAR	— CL
RED	— R
YELLOW	— Y
GREEN	— G
LIGHT GREEN	— LT. G
BLUE	— BL
VIOLET	— V
GRAY	— GY
WHITE	— W
ORANGE	— OR

82-267

## Heater Booster Diesel

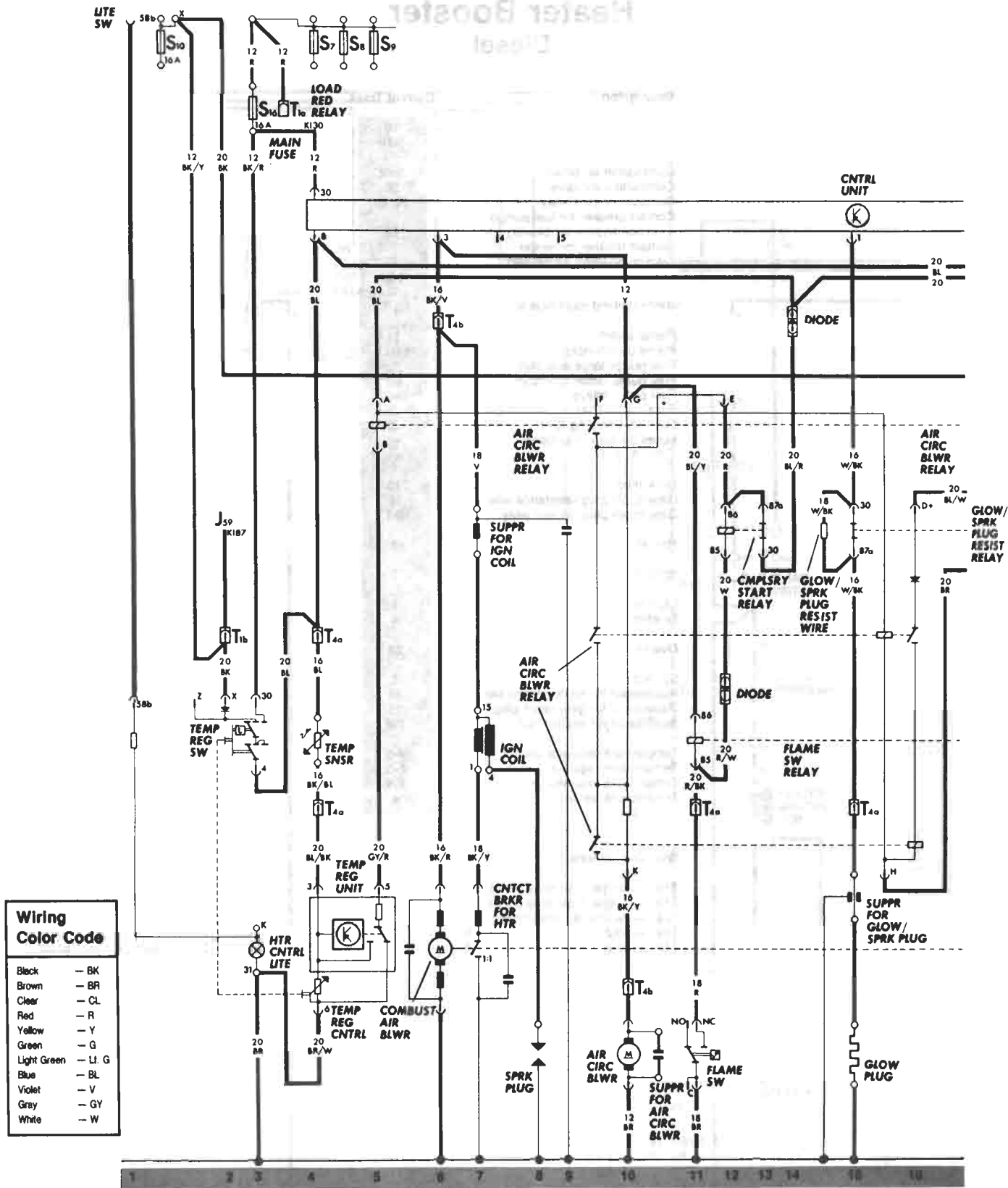
Description	Current Track
Air circulation blower	10
Air circulation blower relay	5-18
Combustion air blower	6-22
Combustion air valve	20
Compulsary start relay	12-13
Contact breaker for fuel pumps (in combustion air blower)	22
Contact breaker for heater (in combustion air blower)	7
Control unit	4-24
Diode (behind dash next to relay)	12, 14
Flame switch	11
Flame switch relay	11-17
Fuel pump (large quantity)	22
Fuel pump (small quantity)	22
Fuel pump relays	18-22
Fuse main (16A)	3
Fuse, overheating (8A)	23
Fuses on fuse/relay panel S7, 8, 9, 10	—
Glow plug	15
Glow/spark plug resistance wire	15
Glow/spark plug resistor relay	15-17
Heater control light	3
Ignition coil	7
Light switch	1
Load-reduction relay	4
Overheat switch	23
Spark plug	8
Suppressor for air circulation blower	10
Suppressor for glow/spark plug	15
Suppressor for ignition coil	7-8
Temperature regulator control	4-5
Temperature regulator switch	1-3
Temperature regulator unit	4-5
Temperature sensor	4

### Wire Connectors

- T1a — single, fuse relay panel
- T1b — single, fuse relay panel
- T2a — two-point, behind dash, left
- T4a — four-point, behind dash, left
- T4b — four-point, behind dash, left

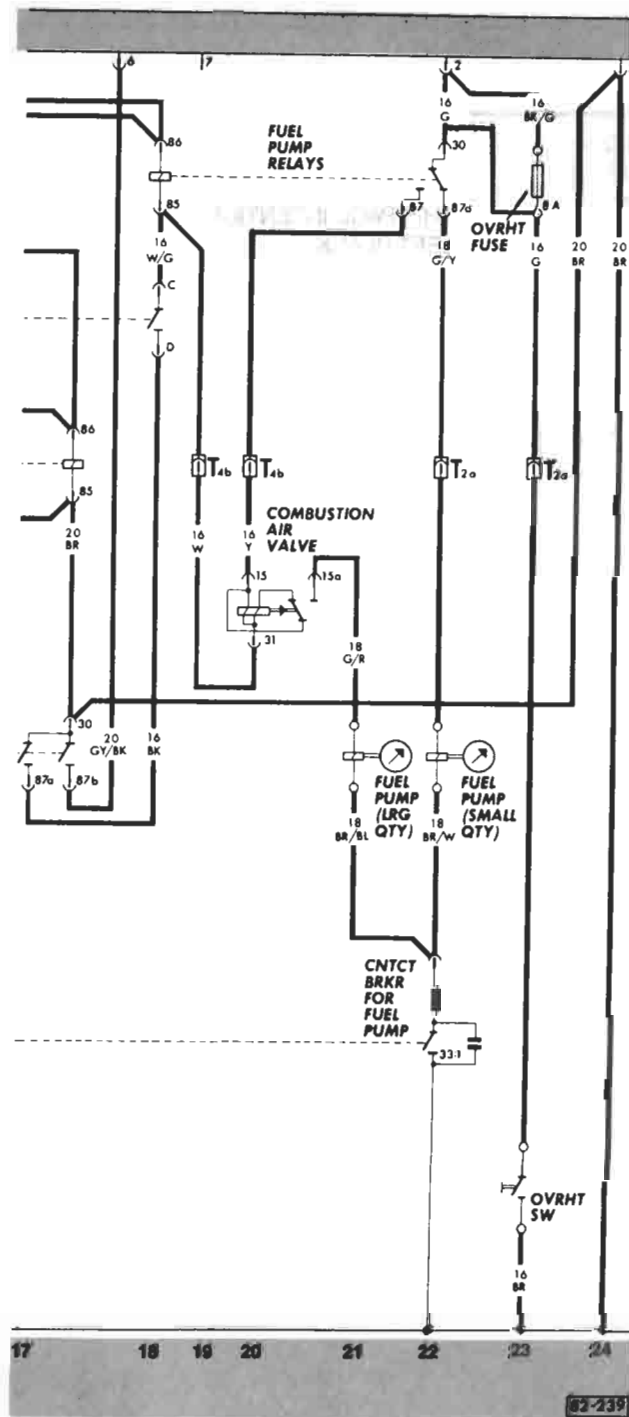
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# 97 Electrical System—Wiring, Diesel



Wiring Color Code	
Black	- BK
Brown	- BR
Clear	- CL
Red	- R
Yellow	- Y
Green	- G
Light Green	- L. G
Blue	- BL
Violet	- V
Gray	- GY
White	- W

Note: All wire sizes American Wire Gauge



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## Electrical System—Wiring, Waterboxer

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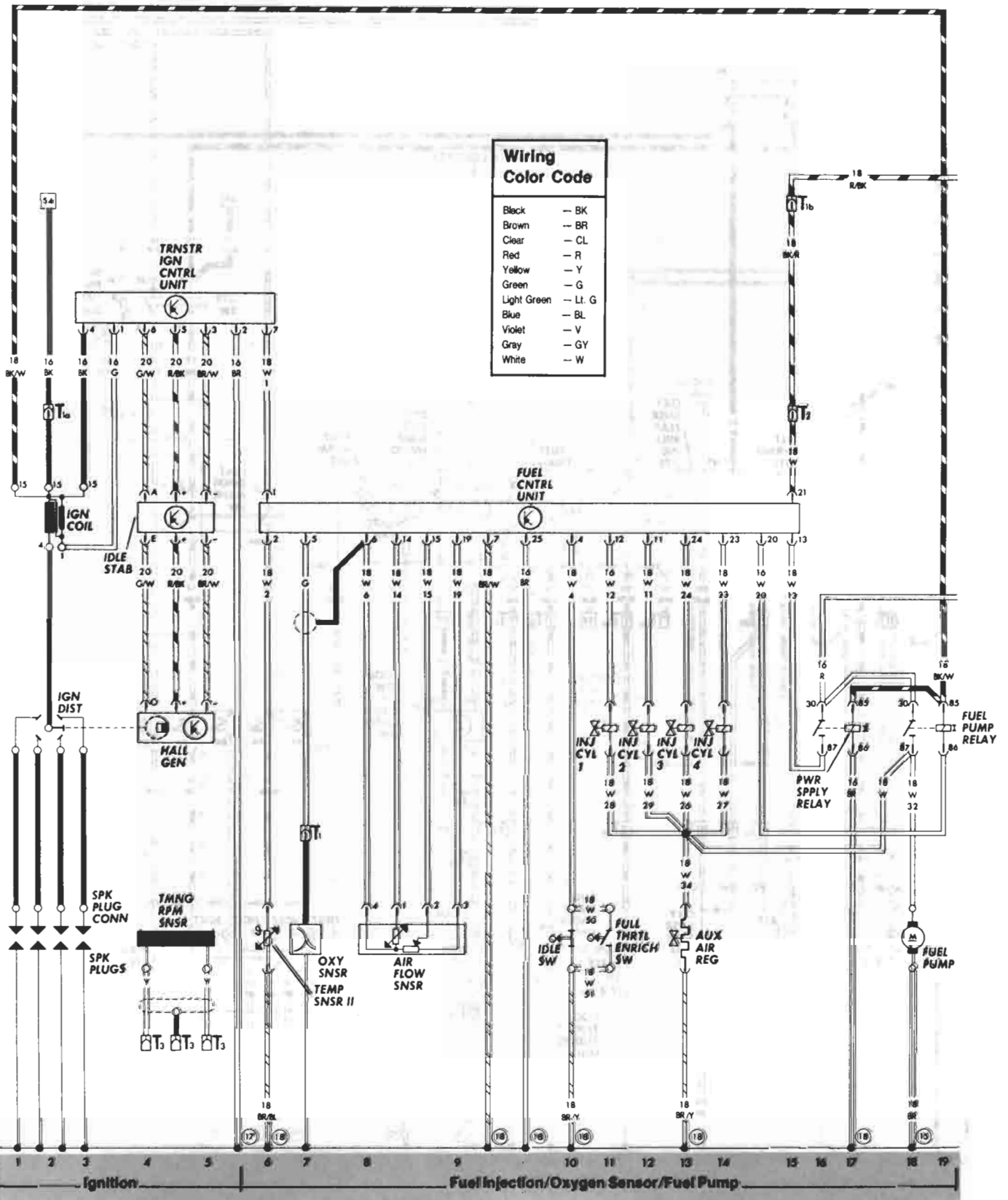


## 1983-84 Vanagon Waterboxer

Description	Current Track	Description	Current Track	Wire Connectors
Air flow sensor	8-9	Ignition distributor	1-3	T1 — single, in engine compart, left
Alternator	24-26	Ignition/starter switch	22-27	T1a — single, in connector housing
Alternator warning light	26	Injector cylinder 1	11	T1b — single, in connector housing
Auxiliary air regulator	13	Injector cylinder 2	12	T1c — single, near alternator in engine compart
Battery	20	Injector cylinder 3	13	T1d — single, behind dash
Back-up light, left	55	Injector cylinder 4	14	T1e — single, in connector housing
Back-up light, right	56	Instrument panel light	49, 50	T1f — single, behind dash
Back-up light switch	55	Instrument-panel light dimmer	42	T1g — single, behind dash
Blower fan	105	Interior light, front	81-83	T1h — behind dash
Blower-fan control-level light	67	Interior light, rear	84-86	T1i — at roof cross-beam, rear right
Blower-fan resistance	104	License plate light	42, 43	T1k — single, behind dash
Blower switch	104, 105	Light switch	40-42	T2 — double, on fuse/relay panel
Brake light, left	80	Oil-pressure switch (1.8 bar)	29	T2a — double, behind dash
Brake light, right	79	Oil pressure warning light	29	T2b — double, behind dash
Brake-light switch	79, 80	Oxygen sensor	7	T2c — double, behind dash
Brake warning light	66	Oxygen sensor elapsed-milage indicator light	28	T2d — double, behind dash
Cigarette lighter	70	Oxygen-sensor elapsed milage switch	28	T2e — double, in connector housing
Cigarette-lighter light	69	Parking light, left	48	T2f — double, behind dash
Clock	51	Parking light, right	41	T2g — double, in connector housing
Coolant low-level-warning control unit	33, 34	Parking-brake warning light switch	76	T2h — double, in connector housing
Coolant low-level-warning switch	33	Power supply relay	16, 17	T2i — double, in connector housing
Coolant over-temperature warning light	34	Radiator fan	87	T2j — double, behind dash
Coolant-temperature gauge	32	Radiator-fan relay	88-90	T3 — 3-point, near alternator in engine compart.
Coolant-temperature sending unit	32	Radiator-fan thermoswitch I	87	T3a — 3-point, behind dash
Defogger cut-out relay (X-contact)	91-97	Radiator-fan thermoswitch II	90	T4 — 4-point, behind dash
Door contact/buzzer switch, left	72, 73	Radio connection	60, 94	T4a — 4-point, behind dash
Door contact switch, front right	71	Rear side-marker lights	45, 46	T7 — 7-point, in connector housing
Door contact switch, right sliding door	84	Rear window defogger heater element	92	T8 — 8-point, behind dash
Emergency flasher relay	56-58	Rear window defogger indicator light	93	T14 — 14-point on instrument cluster
Emergency-flasher switch	58-68	Rear window defogger switch	92	
Emergency-flasher warning light	66	Rear window defogger switch light	94	
Fuel control unit	6-15	Seat-belt buzzer contact, left	74	
Fuel gauge	31	Seat-belt warning light	75	
Fuel-gauge sending unit	31	Seat-belt warning relay	73, 75	
Fuel pump	18	Spark plugs	1-3	
Fuel pump relay	18, 19	Spark plug connectors	1-3	
Full-throttle enrichment switch	11	Starter	22, 23	
Fuses (S1-S13) on fuse/relay panel	—	Tail light, left	47	
Hall generator	4, 5	Tail light, right	44	
Headlight dimmer/flasher switch	38-40	Temperature sensor II	6	
Headlight-high-beam light	36	Timing/RPM sensor	4, 5	
Headlight, left	37, 39	Transistorized ignition control unit	3-6	
Headlight, right	38, 40	Turn-signal indicator light	30	
Horn	53	Turn-signal light, front-left	65	
Horn button	53	Turn-signal light, front-right	62	
Idle stabilizer	4, 5	Turn-signal light, rear-left	64	
Idle switch	4, 5	Turn-signal light, rear-right	63	
Ignition coil	1-3	Turn-signal switch	61	
		Voltage regulator	24-26	
		Voltage stabilizer	35	
		Washer/wiper intermittent relay	98-100	
		Windshield-washer pump	96	
		Windshield-wiper intermittent switch	98-103	
		Windshield-wiper motor	100-103	

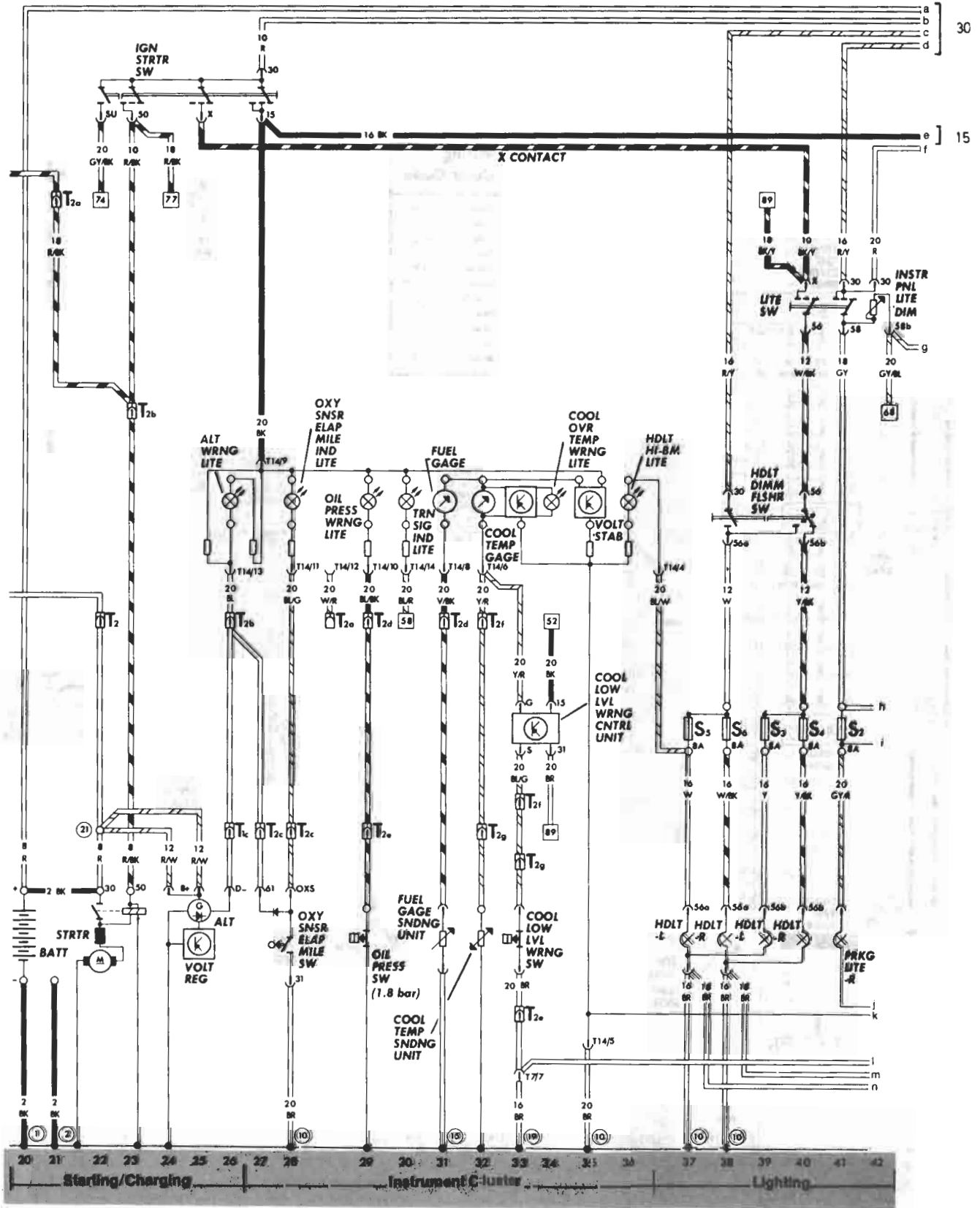
### Ground Connectors

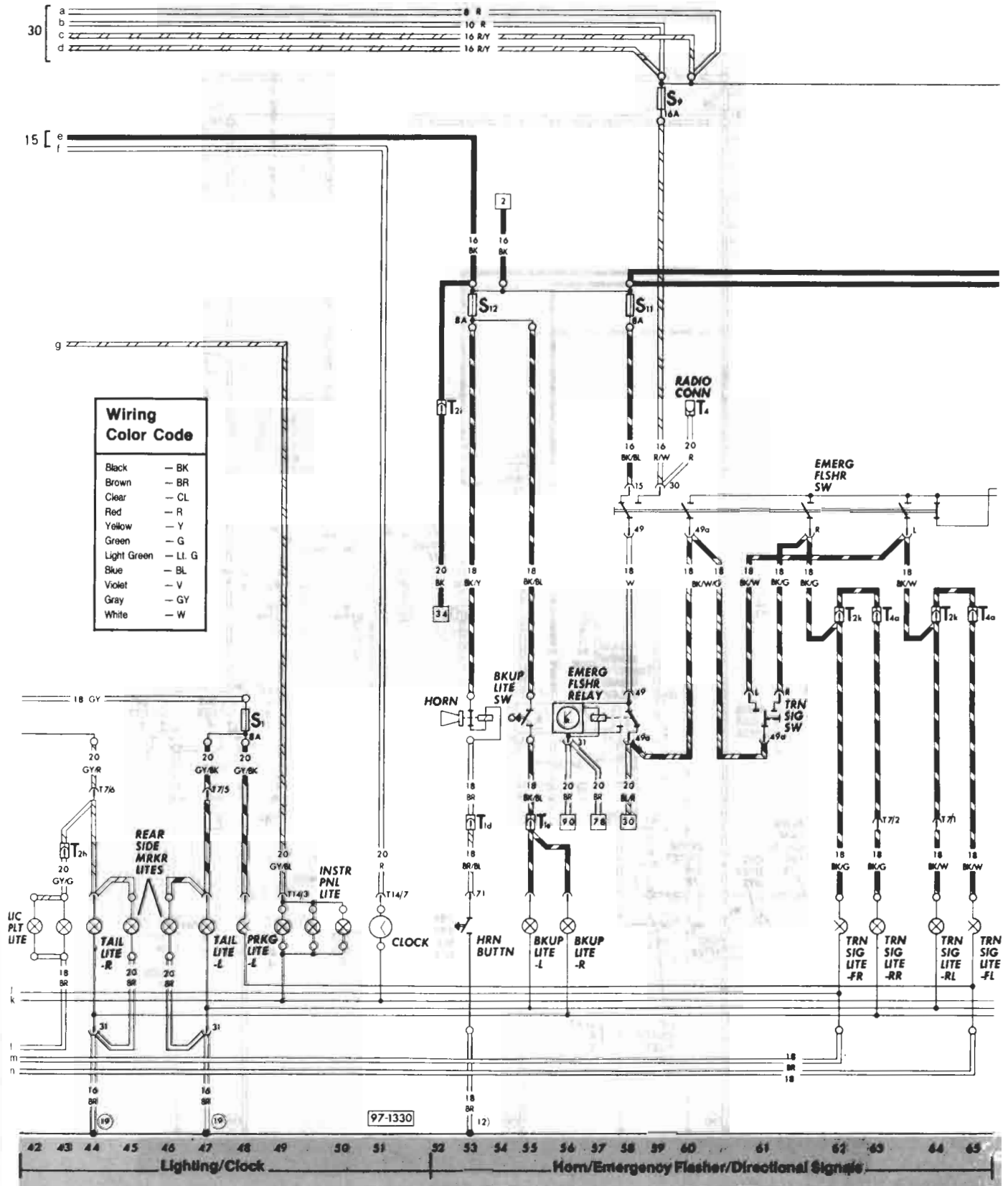
- ① — from battery to body
- ② — from transmission to body
- ⑨ — behind dash near fuse/relay panel
- ⑩ — behind dash
- ⑫ — at steering-gear housing
- ⑬ — behind air vent
- ⑭ — at rear deck
- ⑮ — near fuel pump at floor board/crossmember
- ⑰ — near ignition distributor
- ⑱ — left at cylinder head
- ⑲ — near ignition coil, in engine compart., left
- ⑳ — plus connection, in connector housing



Note: All wire sizes American Wire Gauge

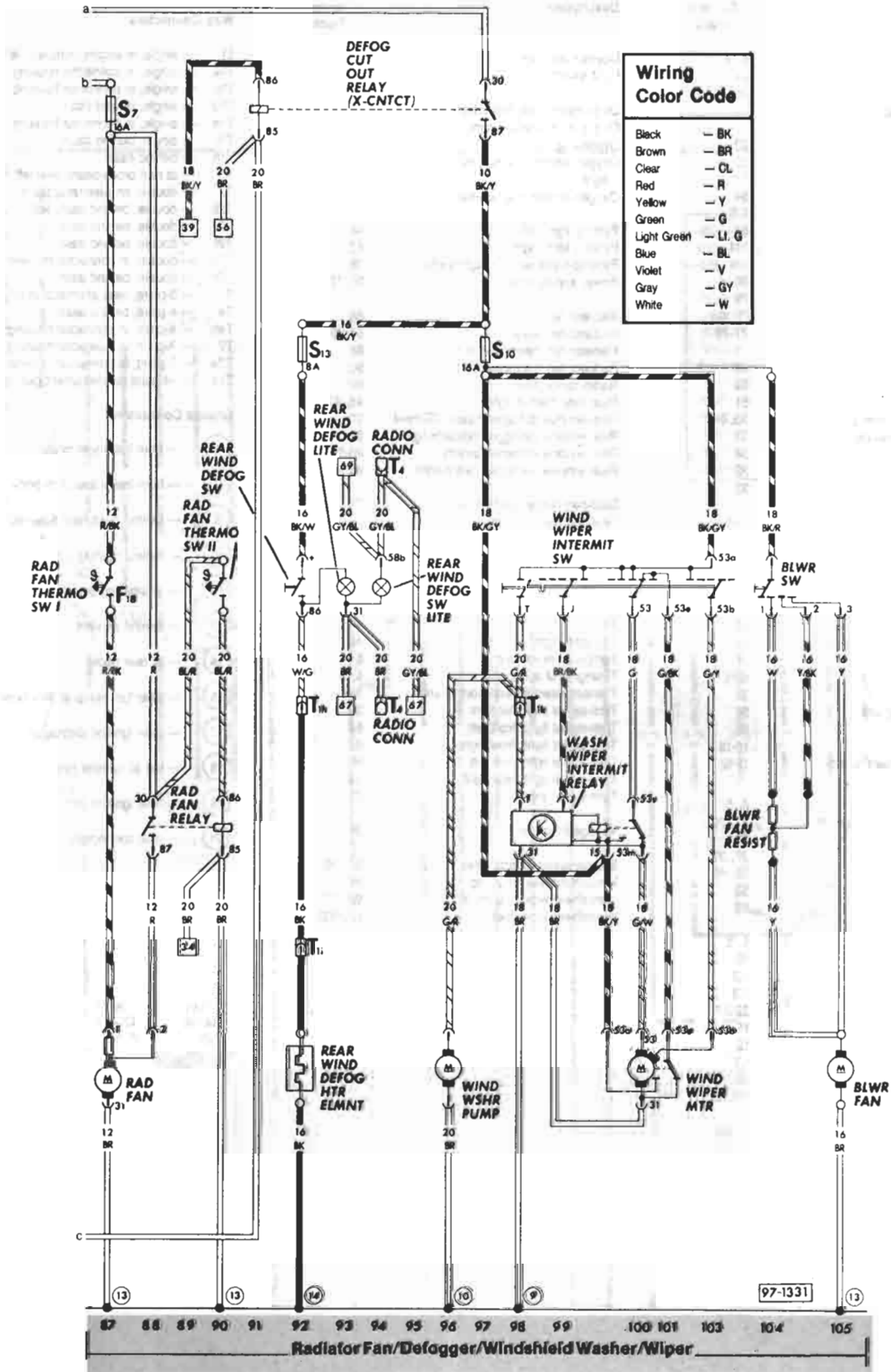
# 97 Electrical System—Wiring, Waterboxer





Note: All wire sizes American Wire Gauge





Note: All wire sizes American Wire Gauge

# 97 Electrical System—Wiring, Waterboxer

Description	Current Track	Description	Current Track	Wire Connectors
Air flow sensor	8, 9	License plate light	42, 43	T1 — single, in engine compart., left
Alternator	24	Light switch	40-42	T1a — single, in connector housing
Alternator warning light	26			T1c — single, in connector housing
Auxiliary air regulator	13	Oil-pressure switch (1.8 bar)	29	T1d — single, behind dash
		Oil-pressure warning light	29	T1e — single, in connector housing
Battery	20	Oxygen sensor	7	T1f — single, behind dash
Back-up light, left	55	Oxygen-sensor elapsed-mileage indicator light	28	T1h — behind dash
Back-up light, right	54	Oxygen-sensor elapsed-mileage switch	28	T1i — at roof cross-beam, rear left
Back-up light switch	54			T2 — double, on fuse/relay panel
Blower fan	105			T2b — double, behind dash, left
Blower-fan control-lever light	67	Parking light, left	48	T2c — double, behind dash
Blower-fan resistance	104	Parking light, right	42	T2f — double, behind dash
Blower switch	104, 105	Parking-brake warning light switch	76	T2h — double, in connector housing
Brake light, left	80	Power supply relay	16, 17	T2i — double, behind dash
Brake light, right	79			T3 — 3-point, near alternator in engine compart.
Brake light switch	79, 80	Radiator fan	88	T4 — 4-point, behind dash
Brake warning light	77-79	Radiator-fan relay	88-90	T4b — 4-point, in connector housing
		Radiator-fan thermostwitch I	88	T7 — 7-point, in connector housing
Cigarette lighter	69	Radiator-fan thermostwitch II	90	T7a — 7-point, in connector housing
Cigarette-lighter light	68	Radio connection	80	T14 — 14-point on instrument cluster
Clock	51	Rear side-marker lights	46, 47	
Coolant low-level-warning control unit	33, 34	Rear-window defogger heater element	93	
Coolant low-level-warning switch	33	Rear-window defogger indicator light	94	
Coolant over-temperature warning light	34	Rear-window defogger switch	93-95	
Coolant-temperature gauge	32	Rear-window defogger switch light	95	
Coolant-temp. sending unit	32			
		Seat-belt buzzer contact, left	73	
Defogger cut-out relay (X-contact)	91-97	Seat-belt warning light	75	
Door contact/buzzer switch, left	72, 73	Seat-belt warning relay	73, 75	
Door contact switch, front right	71	Spark plugs	1-3	
Door contact switch, right sliding door	84	Spark plug connectors	1-3	
		Starter	20, 22	
Emergency-flasher relay	55-57			
Emergency-flasher switch	57-68	Tail light, left	48	
Emergency-flasher warning light	66	Tail light, right	45	
		Temperature sensor	6	
Fuel control unit	6-15	Timing/RPM sensor	4, 5	
Fuel gauge	31	Transistorized ignition control unit	3-6	
Fuel-gauge sending unit	31	Turn-signal indicator light	30	
Fuel pump	18	Turn-signal light, front-left	64	
Fuel pump relay	16-19	Turn-signal light, front-right	62	
Full-throttle enrichment switch	11-12	Turn-signal light, rear-left	65	
		Turn-signal light, rear-right	63	
		Turn-signal switch	61	
Hall generator	4, 5			
Headlight dimmer/flasher switch	37, 39	Voltage stabilizer	35	
Headlight-high-beam light	36			
Headlight, left	37, 39	Washer/wiper interm. relay	98-100	
Headlight, right	38, 40	Windshield-washer pump	96	
Horn	53	Windshield-wiper interm. switch	98-103	
Horn button	53	Windshield-wiper motor	100-103	
Idle stabilizer	4, 5			
Idle switch	10			
Ignition coil	1-3			
Ignition distributor	1-3			
Ignition/starter switch	22-27			
Injector cylinder 1	11			
Injector cylinder 2	12			
Injector cylinder 3	13			
Injector cylinder 4	14			
Instrument-panel light	49, 50			
Instrument-panel light dimmer	43			
Interior light, front	81-83			
Interior light, rear	86, 87			

### Ground Connectors

- ① — from battery to body
- ② — from transmission to body
- ⑨ — behind dash near fuse/relay panel
- ⑩ — behind dash
- ⑫ — at steering-gear housing
- ⑬ — behind air vent
- ⑭ — at rear deck
- ⑮ — near fuel pump at floor board/crossmember
- ⑰ — near ignition distributor
- ⑱ — left at cylinder head
- ⑲ — near ignition coil, in engine compart., left
- ⑳ — plus connection, in connector housing

# Electrical System—Wiring, General

## Index

### General

- Battery/Ground cables 97.9a, 97.9b  
  disconnecting/connecting 97.6
- Cautions and Warnings 97.2
- Dashboard wiring harness 97.7
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- Fuse/Relay panel, removing (1980-1985) 97.10  
  (from 1986 m.y.) 97.10a
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- Symbols used in wiring diagrams 97.5
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### Air-cooled AFC

- Refer to 97.11

### Camper

- Refer to 97.29

### Diesel

- Refer to 97.35

### Waterboxer/Syncro

(Water-cooled Digifant, Digijet)

- Refer to 97.53



## Cautions and Warnings

Whenever working on Volkswagen cars, follow procedures described in the appropriate section of the Repair Manual. Use of tools or procedures other than those recommended may be detrimental to the safe operation of the vehicle as well as the safety of the person doing the repair.

Before working on any car, read Cautions and Warnings:

### CAUTION

- If you lack the skills, tools and equipment, or a suitable workshop for repair on the electrical system, we suggest you leave such repairs to an Authorized Dealer or other qualified shop.
- Before starting a job, make certain that you have all necessary tools and parts on hand. Read all instructions thoroughly; do not attempt shortcuts. Use tools appropriate to the work and use only replacement parts meeting Volkswagen specifications. Makeshift tools, parts, and procedures will not make good repairs.
- Before working on any part of electrical system, disconnect battery ground cable. Do not substitute fuse links with fuse links of other wire gauge or with standard wire. Always replace entire length of fuse link.
- Relay locations are subject to change and may vary from vehicle to vehicle depending on options.
- Use extreme care when troubleshooting the electrical system.
- If you encounter problems identifying a particular relay, consult your Parts Department.

### WARNING

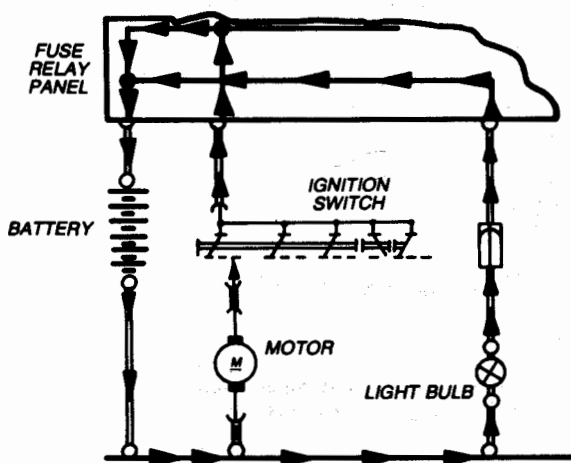
- Never work under a lifted car unless it is solidly supported on stands intended for the purpose. Do not support a car on cinder blocks, hollow tiles, or other props that may crumble under continuous load. Do not work under a car that is supported solely by a jack.
- If you are going to work under a car on the ground, make sure that the ground is level. Block the wheels to keep the car from rolling. Disconnect the battery ground strap to prevent others from starting the car while you are under it.
- Never run the engine unless the work area is well-ventilated. Carbon monoxide kills.
- Tie long hair behind your head. Do not wear a necktie, scarf, loose clothing, or necklace when you work near machine tools or running engines. If your hair, clothing, or jewelry were to get caught in the machinery, severe injury could result.
- Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the car. Make sure its bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.
- Finger rings should be removed so that they cannot cause electrical shorts, get caught in running machinery, or be crushed by heavy parts.
- Keep sparks, lighted matches, and open flame away from the top of the battery. If hydrogen gas escaping from the cap vents is ignited, it will ignite gas trapped in the cells and cause the battery to explode.
- Always observe good workshop practices. Wear goggles when you operate machine tools or work with battery acid. Gloves or other protective clothing should be worn whenever the job requires it.

## Working On The Electrical System

The electrical system of our cars is getting more and more sophisticated. If guesswork and hit-and-miss replacement of parts did not work in the past when attempting repairs, it surely won't work today.

The schematics in this book are called "Wiring Diagrams." By showing how electrical current flows through electrical components that work together in circuits, troubleshooting is much easier with these schematics.

Each diagram in this book shows the powerflow through all wires, connectors, switches, and motors beginning at the top of the page down to ground at the bottom. A test light, or better still, a volt/ohm meter can be very helpful for testing circuits.



To trace a circuit you should start with the ground and then follow the wires back to the source of power. Note the color of wires in the diagram. Sometimes the color will be different on the car. Don't be concerned, just be sure to learn that the wires connect the proper terminals.

To learn more about the details in the diagrams, see 'How to read wiring diagrams' on page 97.4.

## Troubleshooting Procedure

### Verify the complaint:

If you are a professional mechanic, check customer's complaint to understand what the problem is. If possible, let customer show you what happens.

### Analyze the problem:

Find the diagram in the book that applies to the car. Identify the circuit that most likely affects your problem. By following the circuit from ground to power source, get an understanding of how the circuit works.

### Find the problem:

You will find the problem if you follow a simple and logical step-by-step procedure. Test portions of the circuit, one at a time, starting with the most likely area. Test at points that you can reach easily.

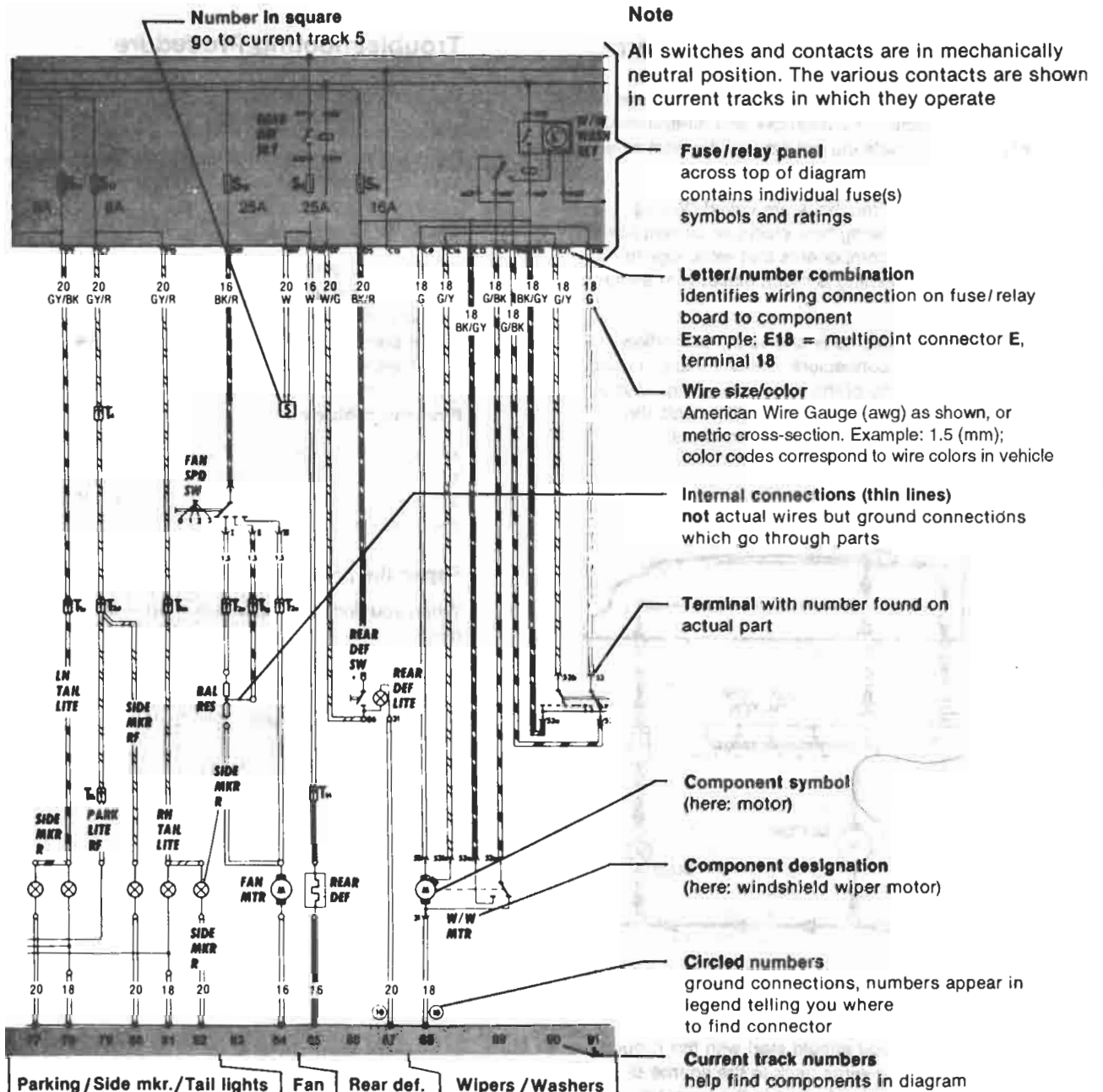
### Repair the problem:

When you find the cause of the problem, make the repair.

### Check the results:

Be sure it works. Check all parts of the circuit that you worked on.

# 97 Electrical System—Wiring, General



Note: All wire sizes American Wire Gauge

97-539

## Sample legend

### Description

Parking light, right front  
Rear window defogger element  
Rear window defogger indicator light  
Rear window defogger relay  
Rear window defogger switch  
Sidemarker, right front  
Sidemarker, rear  
Tail light, right  
Windshield wiper intermittent switch  
Windshield wiper motor

### Current Track

78  
85  
87  
88  
89  
90  
91  
92  
93  
94  
95  
96  
97  
98  
99  
100  
101

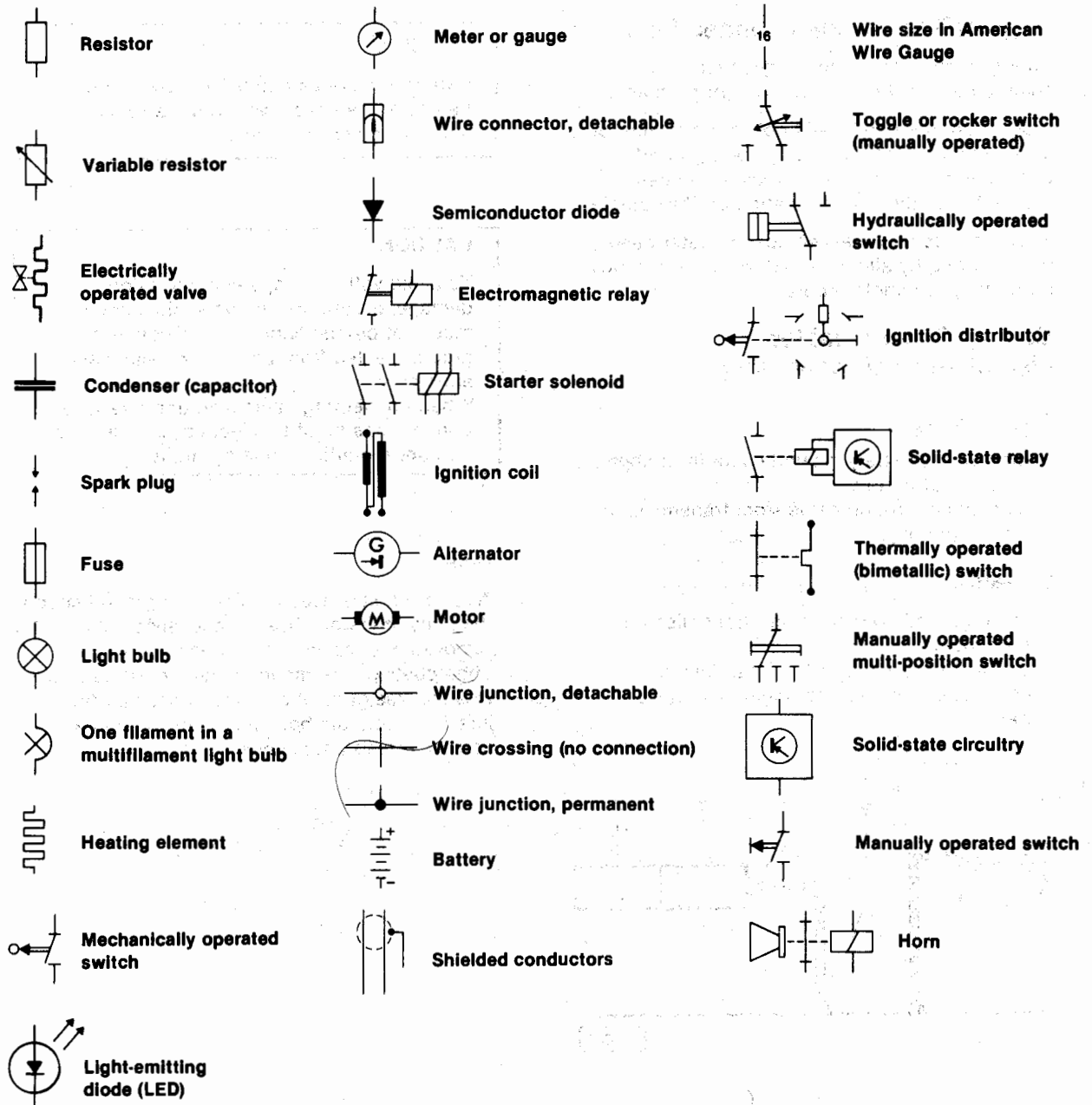
### Wire Connectors

T2d — behind dash  
T2e — behind dash  
⑩ — Ground connector, instrum. clstr.  
⑪ — Ground connector, body

### Current Track

78  
81, 84  
87, 88

Where to find a wire connector on car



### Color Code

Black —BK	Green —G
Brown —BR	Light Green —LT. G
Clear —CL	Blue —BL
Red —R	Violet —V
Yellow —Y	Gray —GY
	White —W

### Wire Connector Code

T1 —single	T6 —6-point
T2 —double	T8 —8-point
T3 —3-point	T12—12-point
T4 —4-point	T14—14-point

# 97 Electrical System—Wiring, General

## Engine/Body ground connections

Poor ground connections may cause speedometer or brake warning light problems.

If speedometer needle will not return to zero or if brake warning light will not go out, ground connections may be bad or may have been connected to the wrong location on the vehicle.

Poor grounds may weaken speedometer needle return spring by allowing battery current to flow through speedometer cable.

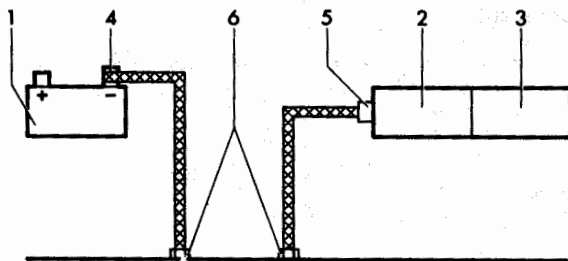
## Battery/Ground cables, disconnecting/connecting

### Disconnecting

- disconnect battery ground cable from negative terminal of battery
- disconnect ground cable from transmission (not from body)

### Connecting

- clean ground connection on transmission to bare metal
- connect ground cable to transmission
- connect ground cable to negative terminal of battery



97-650

### Ground straps

- 1 = Battery
  - 2 = Transmission
  - 3 = Engine
  - 4 = Negative terminal of battery
  - 5 = Ground point (transmission)
  - 6 = Ground point (body)
- do not disconnect

### WARNING

Batteries produce explosive gasses. Keep flames and sparks away from batteries. Do not smoke near batteries

### CAUTION

To avoid voltage drops and corrosion damage, ground cables on vehicle body must not be disconnected. Disconnect ground cables from battery or transmission ends only.

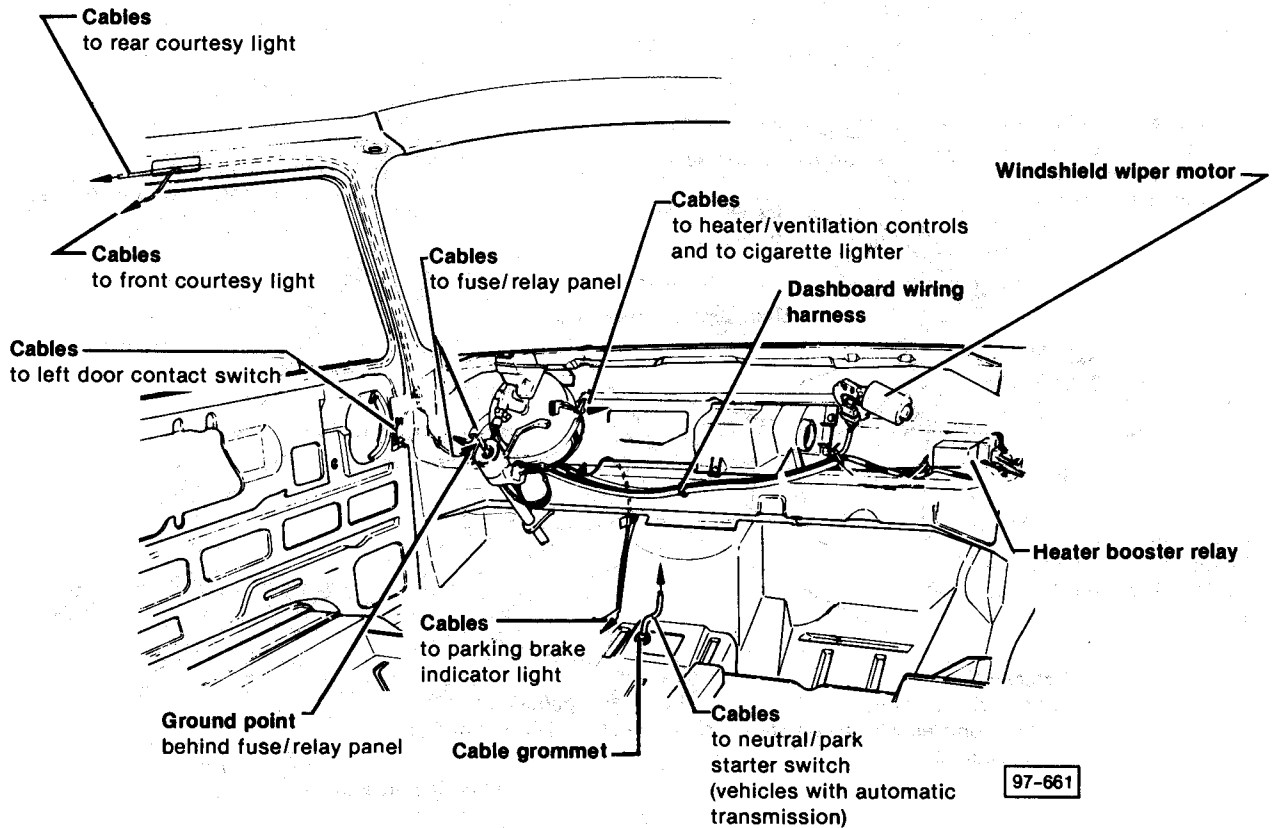
When connecting cables/ground straps, all connections must be cleaned to bare metal. Be sure mounting bolts are tight.

### Note

A special bolt is used to attach the ground strap to the body. If the bolt has been loosened, it must be removed and cleaned free of paint and undercoating. The mounting area must also be cleaned free of paint and undercoating. After installing, coat the bolt and mounting area with corrosion resistant material.

**CAUTION**

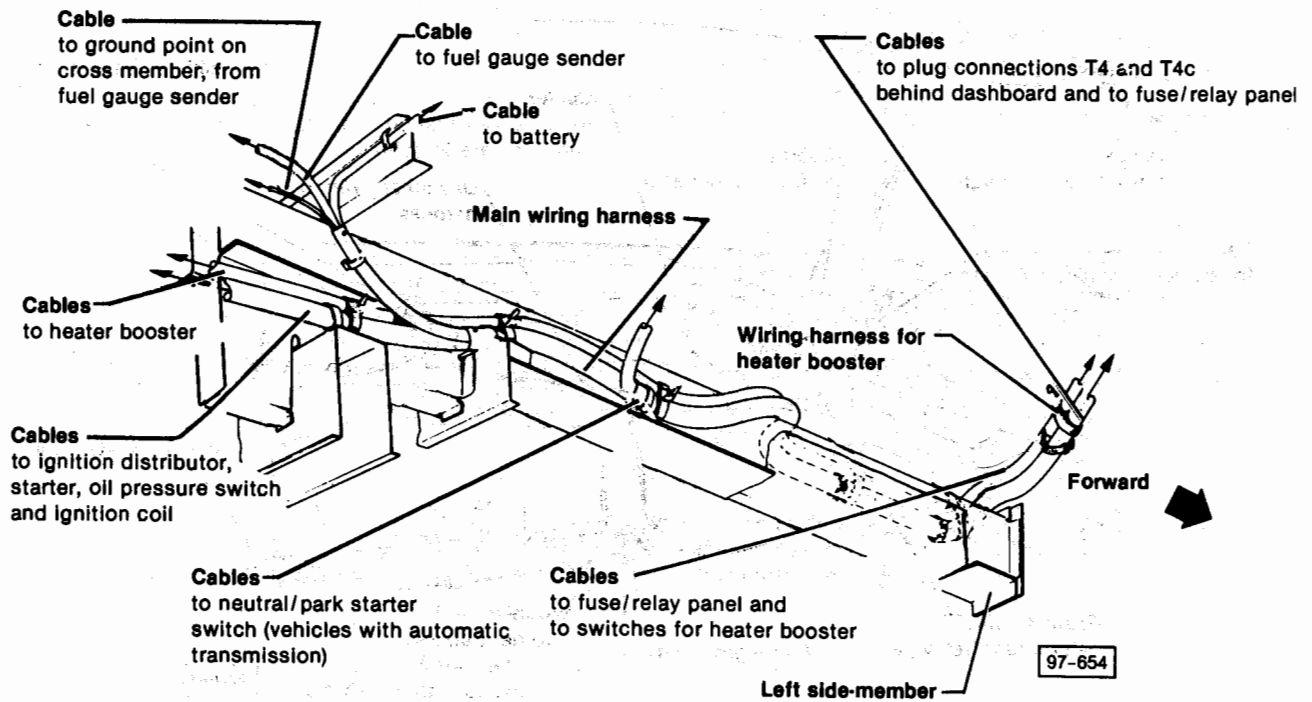
Before working on any part of electrical system, disconnect battery ground strap



# 97 Electrical System—Wiring, General

## CAUTION

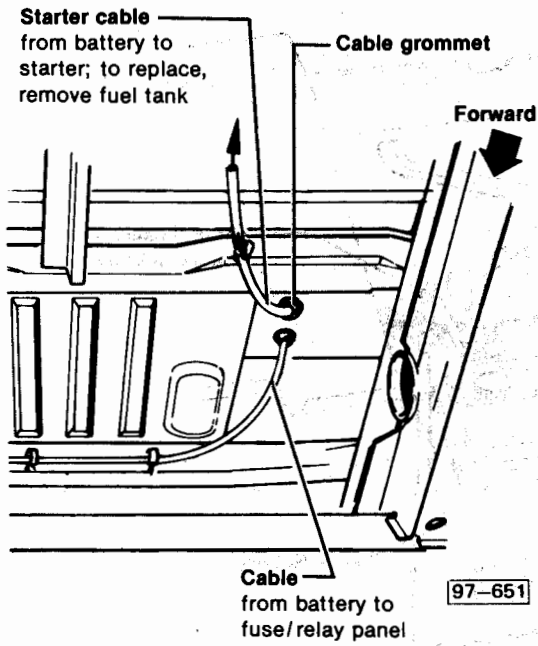
Before working on any part of electrical system, disconnect battery ground strap



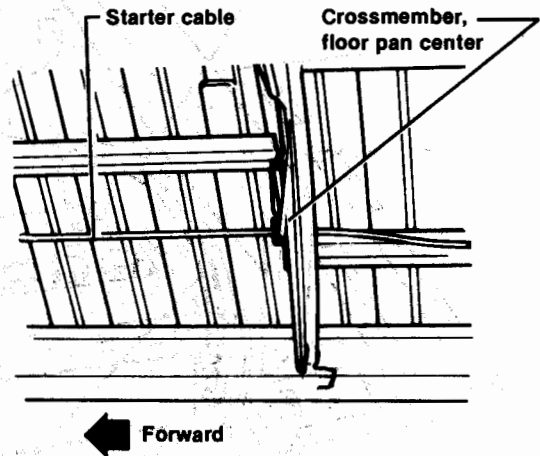
## Starter cable routing

### CAUTION

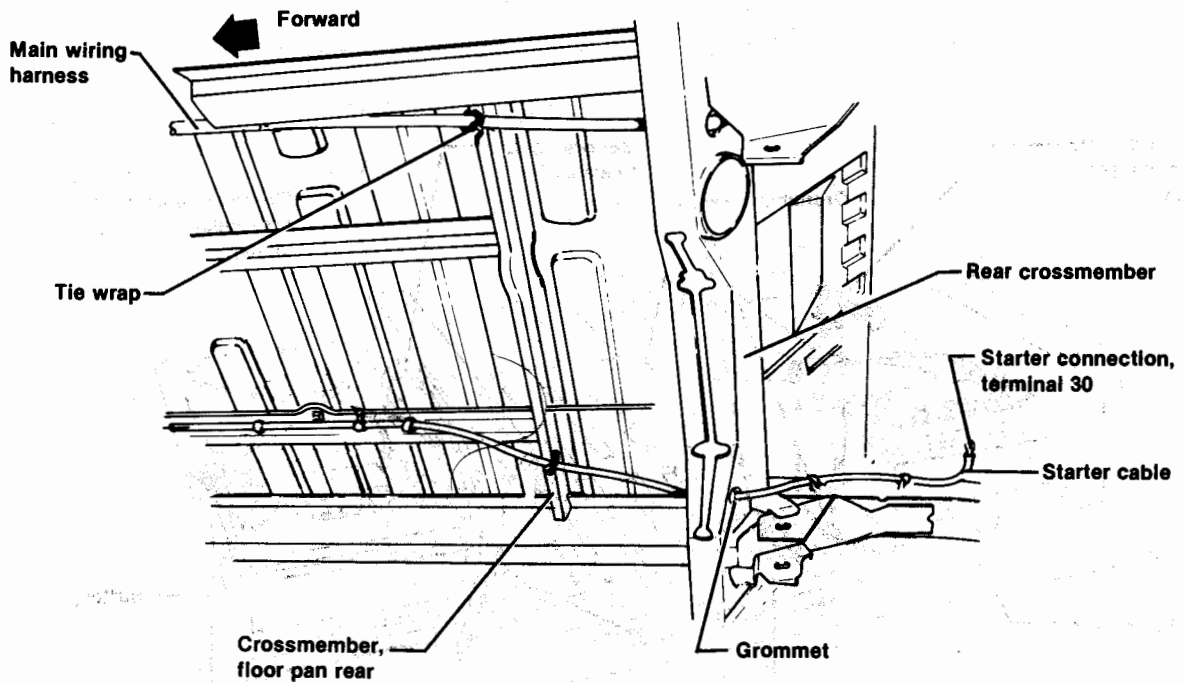
Before working on any part of electrical system, disconnect battery ground strap



97-651



97-652

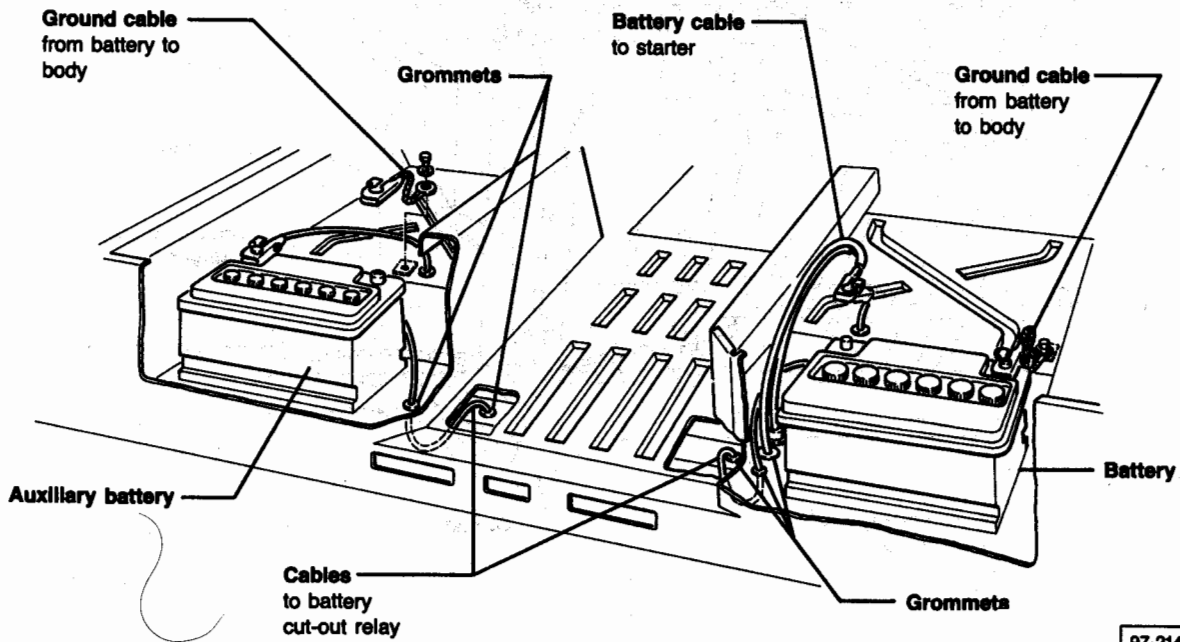
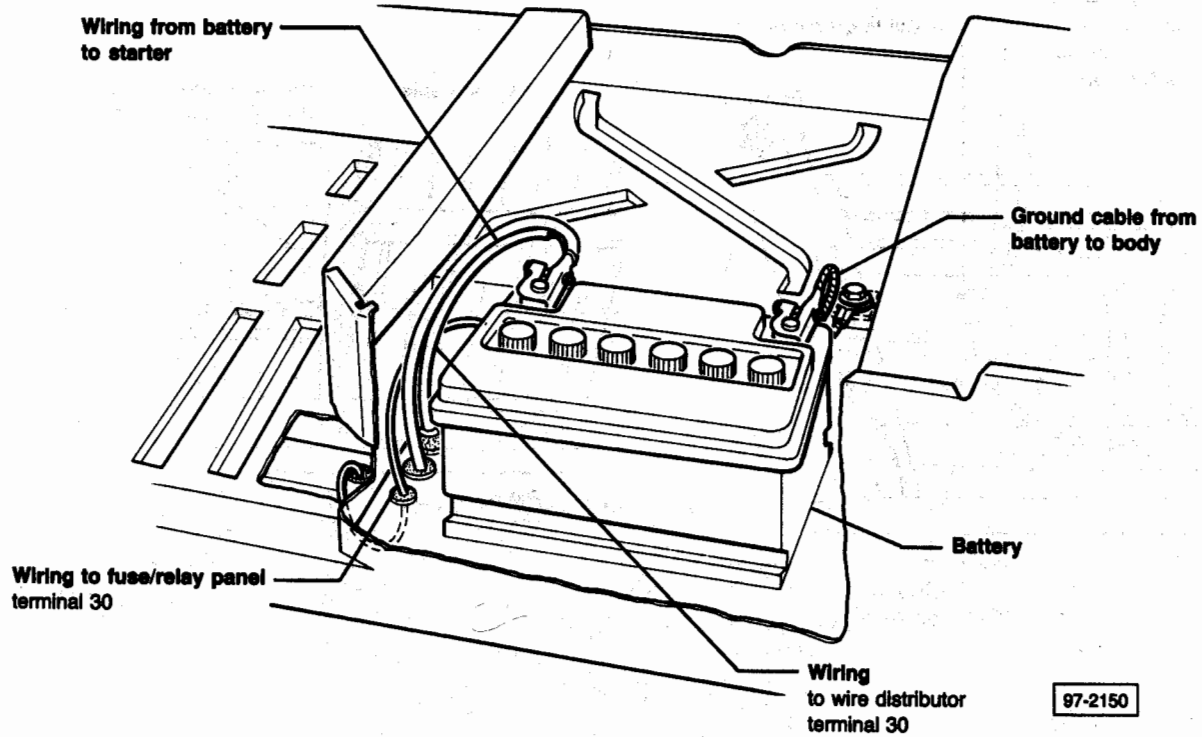


97-653



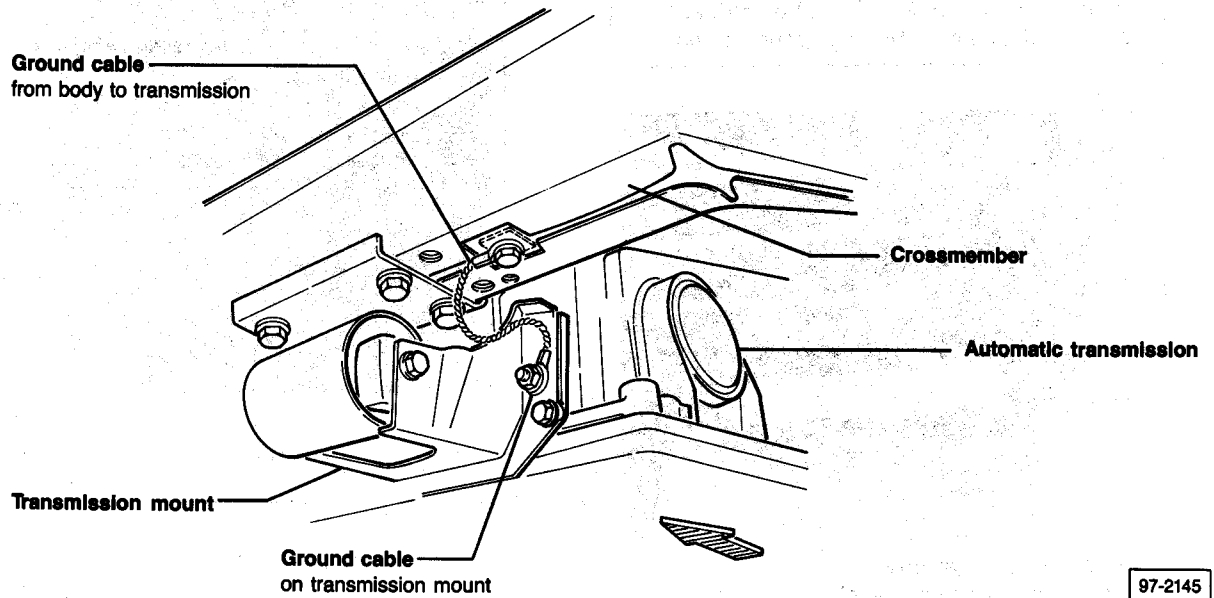
# 97 Electrical System—Wiring, General

## Battery cables, location

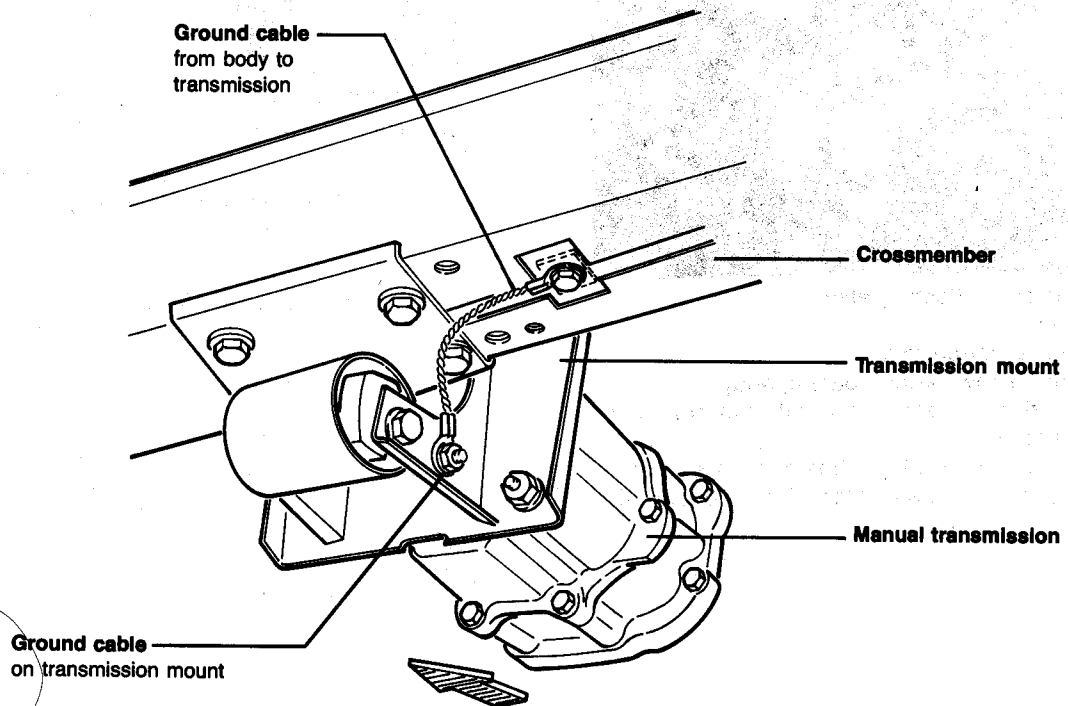


## 97.9a Battery cables

## Ground cable from body to automatic transmission



## Ground cable from body to manual transmission



# 97 Electrical System—Wiring, General

## Fuse/relay panel, removing

### CAUTION

Before working on any part of electrical system, disconnect battery ground strap

### CAUTION

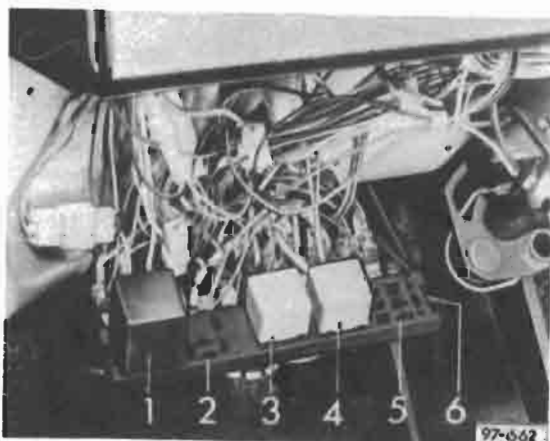
Relay locations are subject to change and may vary from vehicle to vehicle depending on options.

Use extreme care when troubleshooting the electrical system.

If you encounter problems identifying a particular relay, consult your Parts Department.



- remove screws (arrows)
- pull down fuse/relay panel

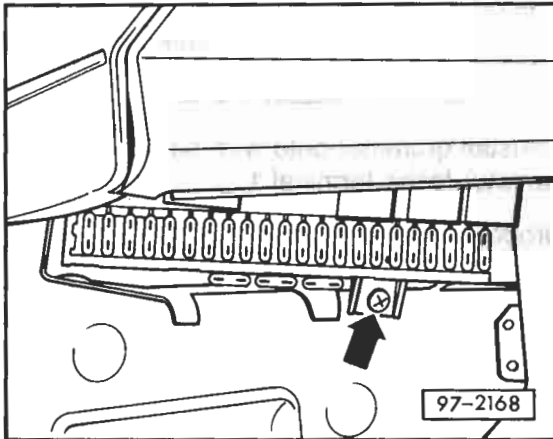


- 1 = emergency flasher relay
- 2 = vacant
- 3 = load reduction relay
- 4 = ignition key warning buzzer/relay
- 5 = windshield wiper/washer intermittent relay (optional)
- 6 = overheat fuse (8A) for heater booster (not shown in illustration, see Repair Group 82)

## Fuse/relay panel, removing



— pull fuse/relay panel cover upward and unhook

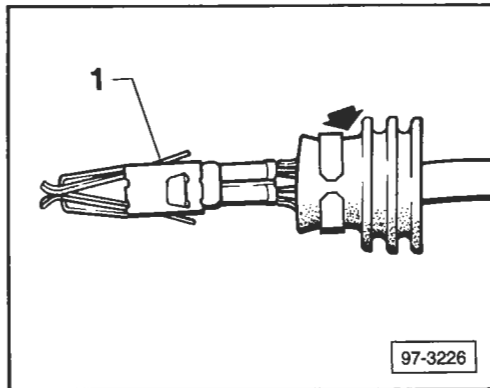


- remove screw (arrow)
- unhook fuse/relay panel and pull down

### Note

Before working on the electrical system, disconnect battery ground cable.

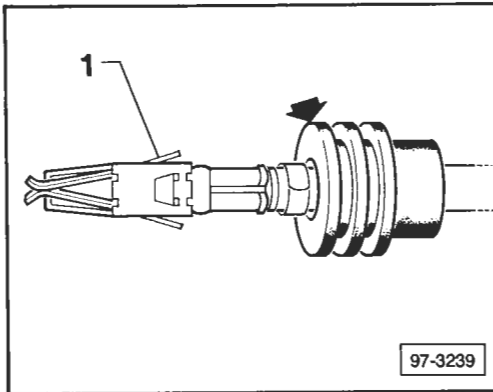
# 97 Electrical System—Wiring, General



## Connector terminal rubber insulating grommet, modifying

A rubber insulating grommet (**arrow**) is installed on some connector terminals at the factory. During wiring repair, the rubber insulating grommet must be reversed before re-inserting into the connector housing.

- remove and discard terminal 1
- slide rubber insulating grommet from wire and rotate end-to-end (180°)
- inspect grommet and replace if damaged



### CAUTION

New replacement grommet must be the same color as original to ensure proper sealing between wire, grommet and housing.

- reinstall grommet onto wire so that collar (**arrow**) faces terminal 1
- properly crimp new terminal 1 to wire

## 97.10b Connector terminal rubber insulating grommet, modifying

## Electrical System—Wiring, Air-cooled—AFC

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- Cautions and Warnings 97.2
- Dashboard wiring harness 97.7
- Engine/Body ground connections 97.6
- Fuse/Relay panel, removing (1980-1985) 97.10  
  (from 1986 m.y.) 97.10a
- How to read wiring diagrams 97.4
- Main wiring harness 97.8
- Starter cable routing 97.9
- Symbols used in wiring diagrams 97.5
- Troubleshooting 97.3
- Working on the electrical system 97.3

#### 1980, 1981 Air-cooled AFC

- Cautions and Warnings 97.2
- Fresh air fan 97.23
- Fuse/Relay panel 97.10
- Heater booster 97.24, 97.25
- Main wiring diagram 97.12-97.17
- Rear window wiper 97.26
- Seat belt interlock system 97.27

#### 1982, 1983 Air-cooled AFC

- Cautions and Warnings 97.2
- Fresh air fan 97.23
- Fuse/Relay panel 97.10
- Heater booster 97.24, 97.25
- Main wiring diagram 97.18-97.22
- Rear window wiper 97.26
- Seat belt interlock system (1982 only) 97.27

#### Camper

- Refer to 97.29

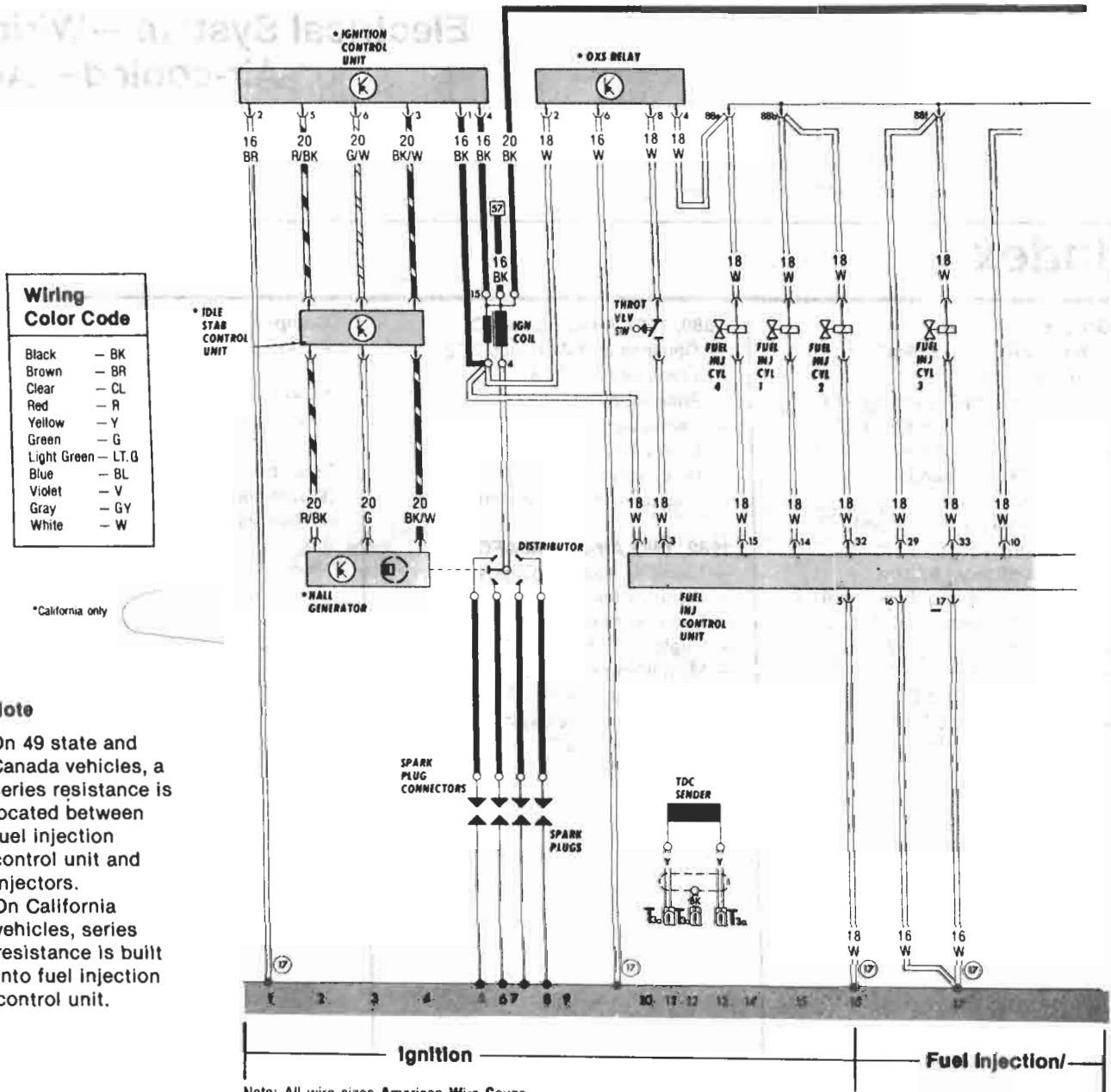
#### Diesel

- Refer to 97.35

#### Waterboxer/Syncro (Water-cooled Digifant, Digijet)

- Refer to 97.53

# 97 Electrical System—Wiring, Air-cooled—AFC



Note: All wire sizes American Wire Gauge

**Description**

- Alternator
- Alternator charging indicator light
- Auxiliary air regulator
- Back-up light, left
- Back-up light, right
- Back-up light switch
- Battery
- Brake light, left
- Brake light, right
- Brake light switch

\*California only

**Current Track**

- 31, 32
- 33
- 34
- 35
- 36
- 37
- 38
- 39
- 40
- 41, 42

**Description**

- Brake warning light
- Cigarette lighter
- Cigarette lighter light
- Clock
- Cold start valve
- Distributor
- Door switch, left front, with buzzer contact
- Door switch, right front
- Elapsed mileage switch for OXS indicator\*
- Emergency flasher indicator light

**Current Track**

- 73-76
- 71
- 70
- 66
- 28
- 8-8
- 78, 79
- 80
- 33, 34
- 87

**Description**

- Emergency flasher relay
- Emergency flasher switch
- Fuel gauge
- Fuel gauge sender
- Fuel injection control unit
- Fuel pump
- Fuel pump relay
- Fuses S1-S12 on fuse/relay panel (under dash)
- Hall generator\*

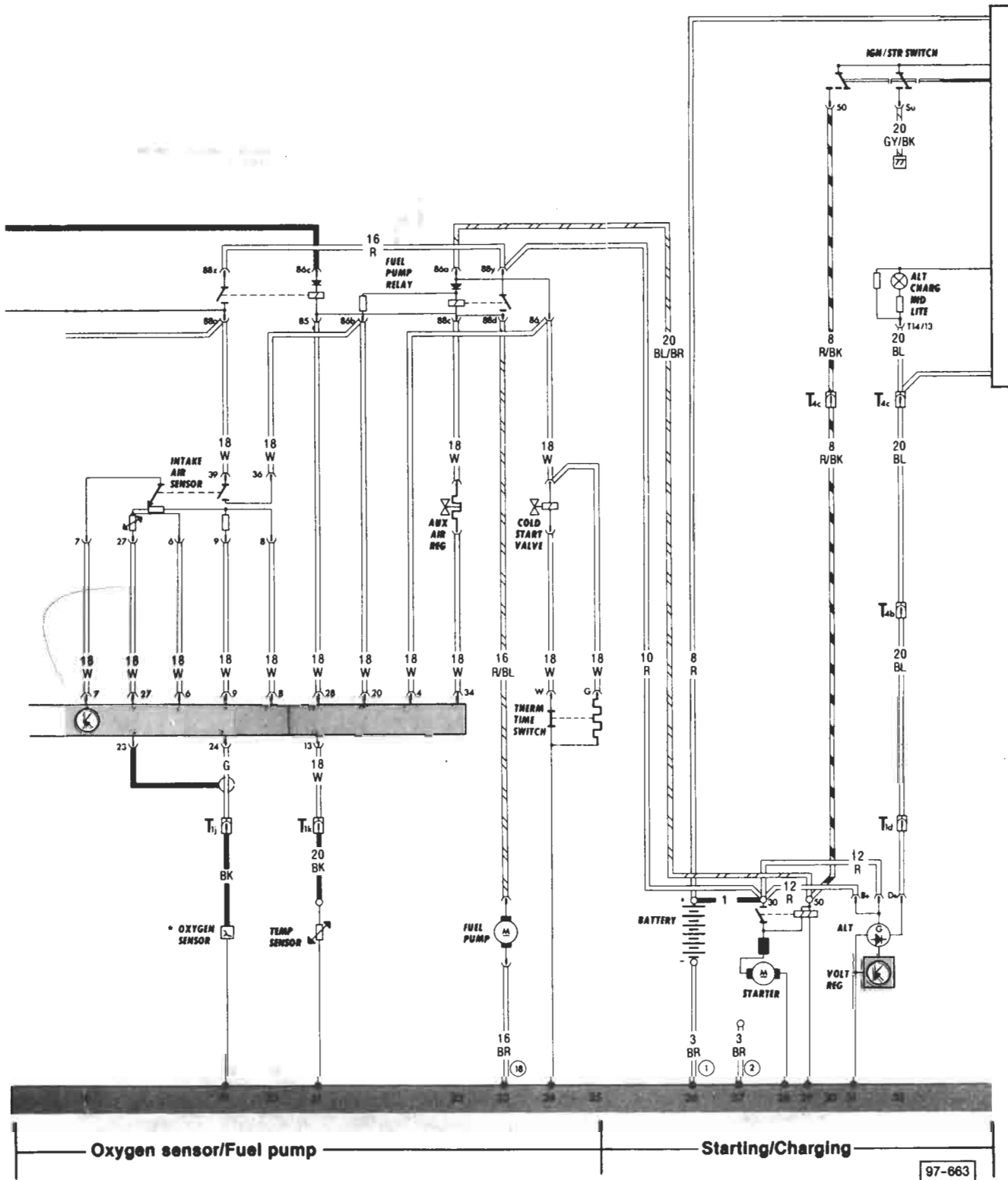
**Current Track**

- 88-91
- 81-88
- 89
- 38
- 10-22
- 23
- 19-24
- 2-4

## 97.12

Main wiring diagram

AFC 1980, 1981



Oxygen sensor/Fuel pump

Starting/Charging

97-663

Description

- Headlight dimmer switch/flasher
- Headlight, left, high
- Headlight, left, low
- Headlight, right, high
- Headlight, right, low
- Heater/fresh air controls light
- High beam indicator light
- Horn
- Horn button
- Idle stabilizer control unit\*

\*California only

Current Track

- 85-88
- 89
- 90
- 91
- 92
- 93
- 94
- 95
- 96
- 97
- 98
- 99
- 100

Description

- Ignition coil
- Ignition control unit\*
- Ignition key warning buzzer
- Ignition/starter switch
- Injector, cylinder 1
- Injector, cylinder 2
- Injector, cylinder 3
- Injector, cylinder 4
- Instrument light dimmer
- Instrument panel lights

Current Track

- 7
- 8
- 9
- 10
- 11
- 12
- 13
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- 15
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- 99
- 100

Description

- Intake air sensor
- Interior light, front
- Interior light, rear
- License plate light
- Light switch
- Load reduction relay
- Oil pressure light
- Oil pressure switch
- Oxygen sensor (OXS)\*
- Oxygen sensor (OXS) indicator light\*

Current Track

- 101
- 102
- 103
- 104
- 105
- 106
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- 108
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F-12

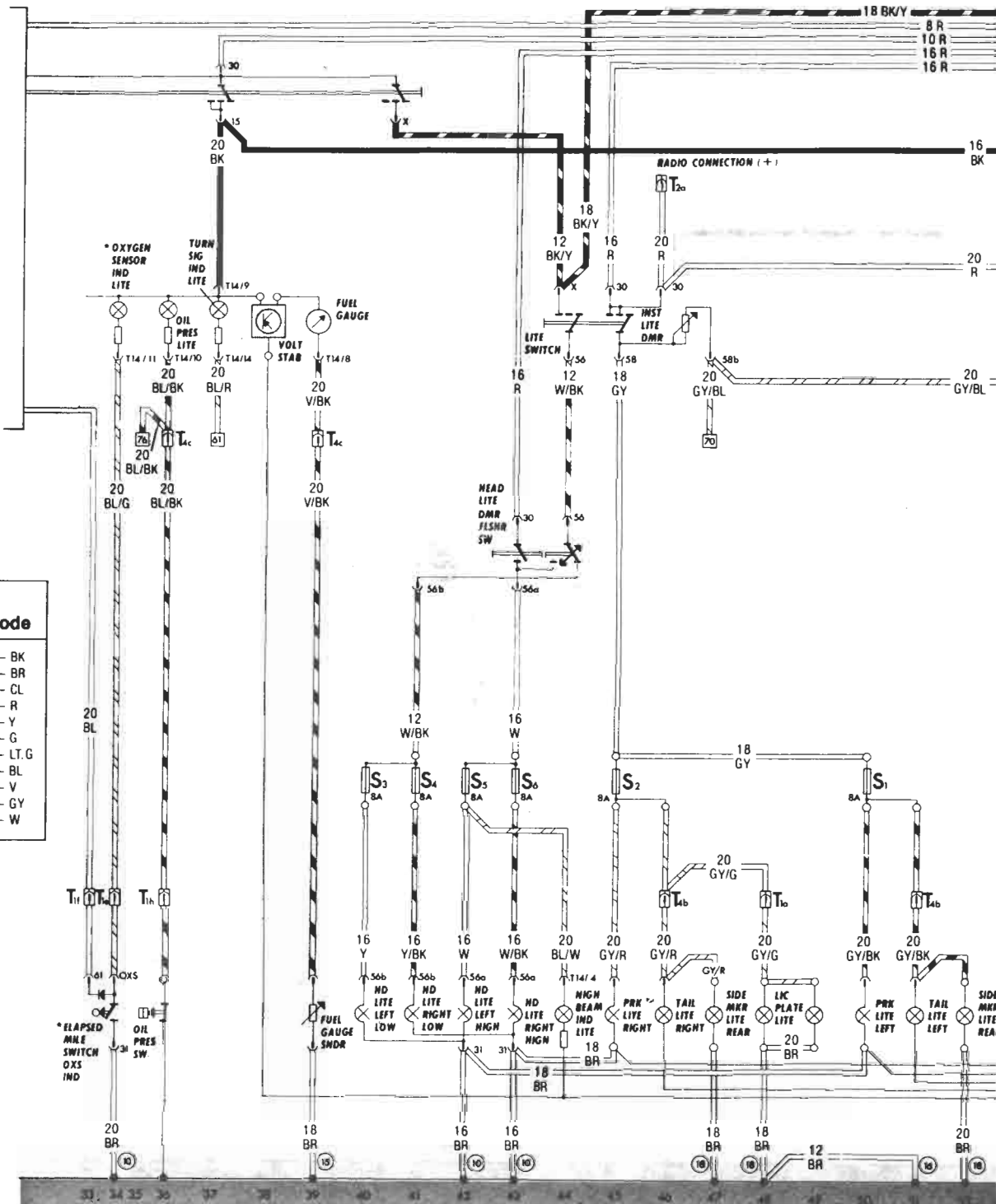
F-13

AFC 1980, 1981

Main wiring diagram

97.13





**Wiring Color Code**

Black	- BK
Brown	- BR
Clear	- CL
Red	- R
Yellow	- Y
Green	- G
Light Green	- LT.G
Blue	- BL
Violet	- V
Gray	- GY
White	- W

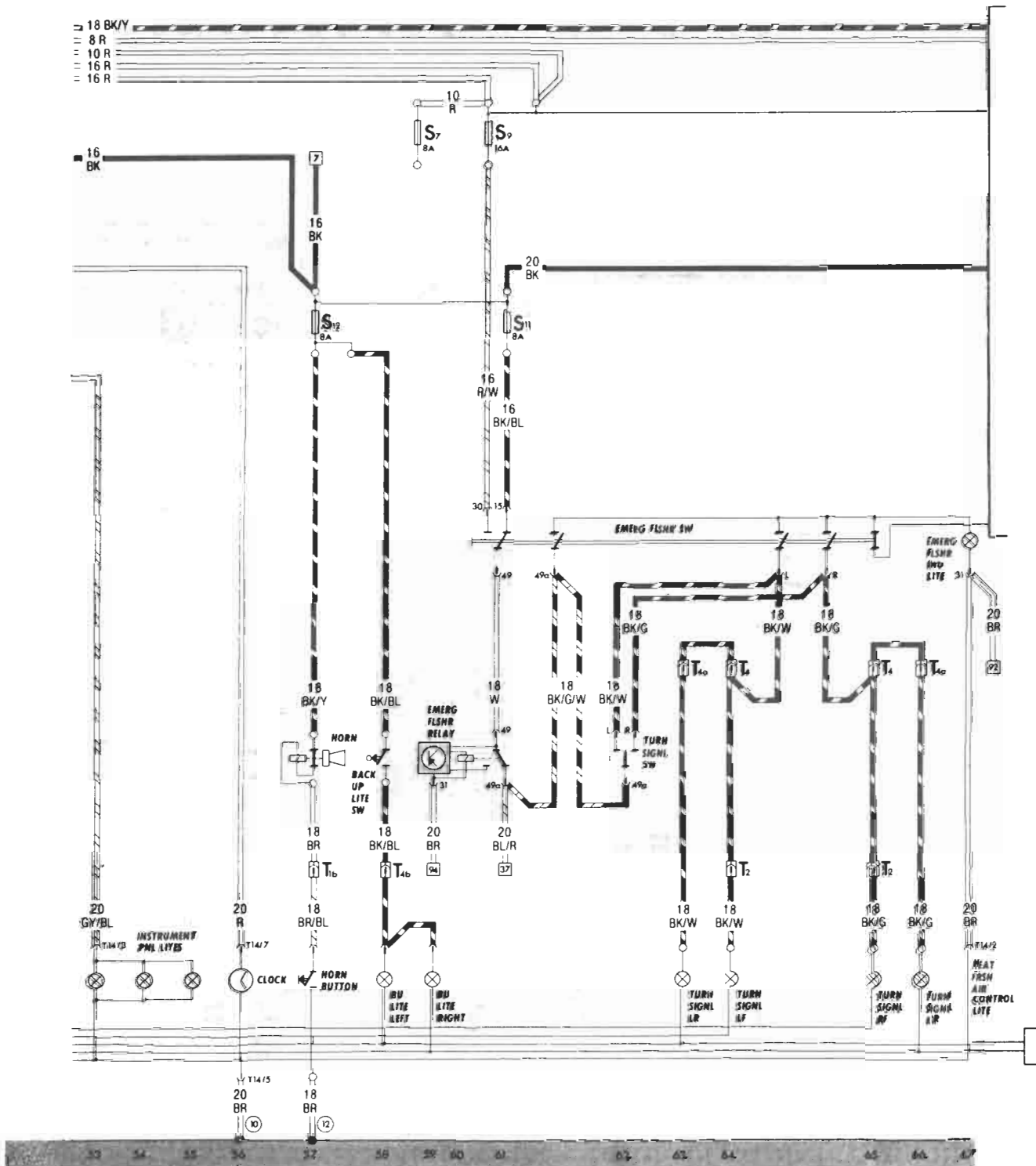
\*California only

Instrument cluster      Lighting/Radio connection (cont.)

Note: All wire sizes American Wire Gauge

Description	Current Track	Description	Current Track	Description	Current Track
Oxygen sensor (OXS) relay*	6-12	Sliding door switch	63	Turn signal, left front	65
Parking brake indicator light switch	73	Spark plug connectors	6-8	Turn signal, left rear	6-8
Parking light, left	90	Spark plugs	11-13	Turn signal, right front	22, 23
Parking light, right	85	Starter	11	Turn signal, right rear	81
Radio connection (-)	72	Tail light, left	40	Turn signal switch	11-13
Radio connection (+)	88	Tail light, right	21	Voltage regulator	11
Rear window defogger	81	TDC sender	11-13	Voltage stabilizer	21
Rear window defogger switch	81, 82	Temperature sensor	11	Windshield washer pump	11, 25
Side marker light, left	82	Thermo time switch	11	Windshield wiper motor	11
Side marker light, right	87	Throttle valve switch	11	Windshield wiper switch	11
		Turn signal indicator light	11	Windshield wiper/washer intermittent relay	11

\*California only

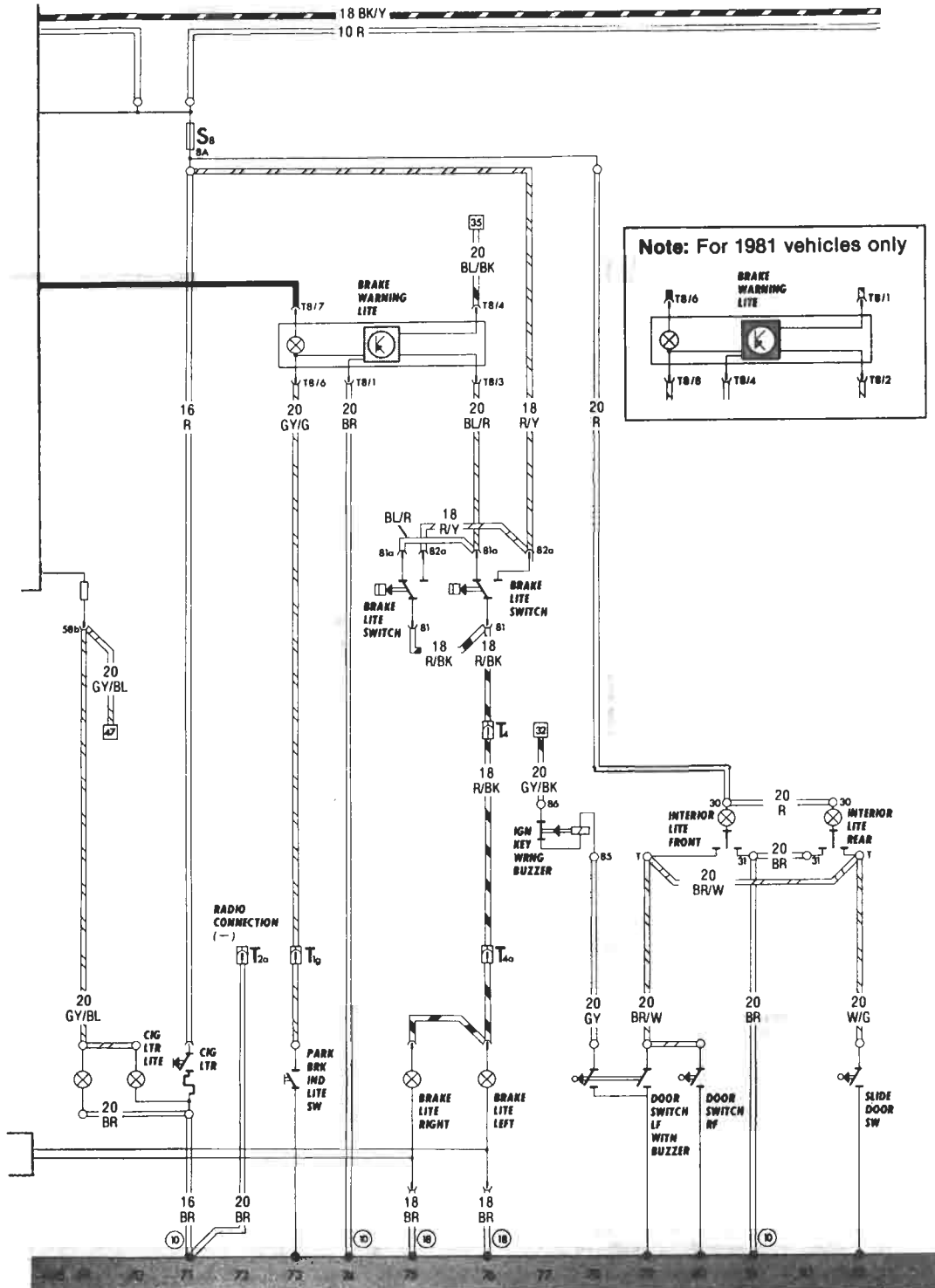


Horn/Emergency flasher/Directional signals

97-664

Description	Current Track	Description	Current Track	Description	Current Track
Alternator	31, 32	Brake warning light	73-76	Emergency flasher relay	30-31
Alternator charging indicator light	32	Cigarette lighter	71	Emergency flasher switch	31-33
Auxiliary air regulator	32	Cigarette lighter light	70	Fuel gauge	30
Back-up light, left	58	Clock	58	Fuel gauge sender	30
Back-up light, right	58	Cold start valve	24	Fuel injection control unit	16-20
Back-up light switch	58	Distributor	6-8	Fuel pump	30
Battery	58	Door switch, left front, with buzzer contact	78, 79	Fuel pump relay	30
Brake light, left	75	Door switch, right front	80	Fuses S11, S12 on fuse/relay panel (under dash)	30
Brake light, right	75	Elapsed mileage switch for OXS indicator*	33, 34	Hall generator*	30-31
Brake light switch	75, 76	Emergency flasher indicator light	37		

\*California only



Note: All wire sizes American Wire Gauge

**Description**  
 Headlight dimmer switch/flasher  
 Headlight, left, high  
 Headlight, left, low  
 Headlight, right, high  
 Headlight, right, low  
 Heater/fresh air controls light  
 High beam indicator light  
 Horn  
 Horn button  
 Idle stabilizer control unit\*  
 Ignition coil

**Current Track**  
 43-44  
 45  
 46  
 47  
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 49  
 50  
 51  
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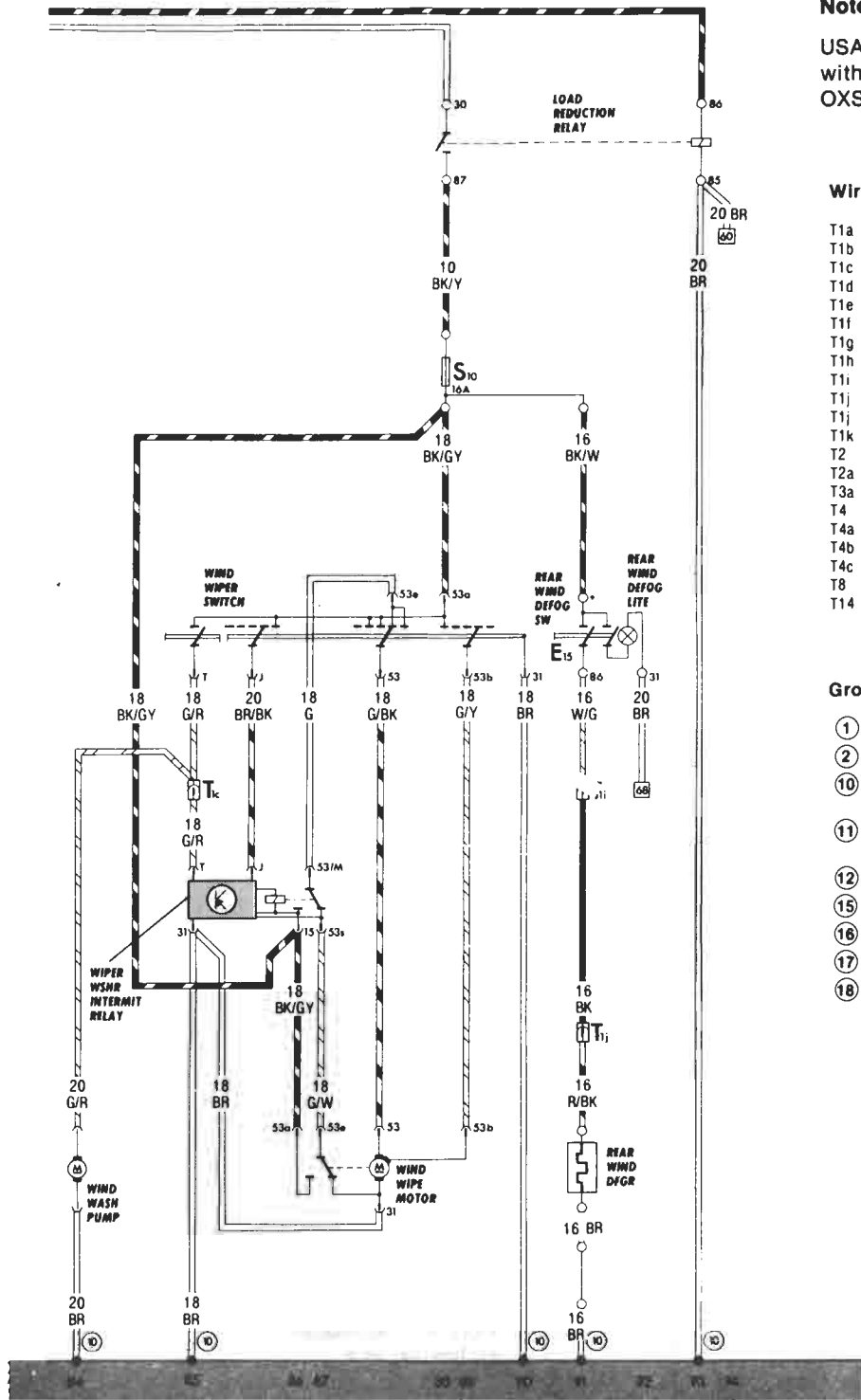
**Description**  
 Ignition control unit\*  
 Ignition key warning buzzer  
 Ignition/starter switch  
 Injector, cylinder 1  
 Injector, cylinder 2  
 Injector, cylinder 3  
 Injector, cylinder 4  
 Instrument light dimmer  
 Instrument panel lights  
 Intake air sensor  
 Interior light, front

**Current Track**  
 1-6  
 77-78  
 30-40  
 15  
 16  
 17  
 14  
 46  
 63-65  
 18-20  
 78-81

**Description**  
 Interior light, rear  
 License plate light  
 Light switch  
 Load reduction relay  
 Oil pressure light  
 Oil pressure switch  
 Oxygen sensor (OXS)\*  
 Oxygen sensor (OXS) indicator light\*  
 Oxygen sensor (OXS) relay\*  
 Parking brake indicator light switch

**Current Track**  
 12-22  
 23-24  
 25-27  
 28-29  
 30-31  
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 99  
 100

\* California only



**Note**

USA and Canada vehicles are equipped with EGR system instead of OXS system. OXS system is for California only.

**Wire Connectors**

- T1a - at fuse/relay panel
- T1b - behind dash
- T1c - behind dash
- T1d - in engine compart. near alternator
- T1e - behind instr. panel
- T1f - behind instr. panel
- T1g - behind dash
- T1h - in engine compart.
- T1i - behind dash
- T1j - behind dash
- T1k - in engine compart.
- T1l - in engine compart.
- T2 - behind dash
- T2a - behind dash
- T3a - in engine compart.
- T4 - behind dash
- T4a - at fuse/relay panel
- T4b - at fuse/relay panel
- T4c - behind instr. panel
- T8 - at brake warning light
- T14 - at instr. panel insert

**Ground Connectors**

- ① - from battery to body
- ② - from transmission to body
- ⑩ - behind instr. panel, to left of fuse/relay panel
- ⑪ - behind instr. panel, to left of fuse/relay panel
- ⑫ - on steering gear
- ⑮ - at left front of crossmember
- ⑯ - near fuse/relay panel
- ⑰ - near ignition distributor
- ⑱ - at fuse/relay panel

**Wiring Color Code**

Black	- BK
Brown	- BR
Clear	- CL
Red	- R
Yellow	- Y
Green	- G
Light Green	- LT.G
Blue	- BL
Violet	- V
Gray	- GY
White	- W



Description	Current Track
Parking light, left	80
Parking light, right	85
Radio connection (-)	87
Radio connection (+)	10
Rear window defogger	16
Rear window defogger switch	18
Side marker light, left	20
Side marker light, right	30
Sliding door switch	31
Spark plug connectors	5-9

\*California only

Description	Current Track
Spark plugs	5-9
Starter	28, 30
Tail light, left	31
Tail light, right	31
TDC sender	48
Temperature sensor	11-13
Thermo time switch	21
Throttle valve switch	20, 22
Turn signal indicator light	71
Turn signal, left front	87
Turn signal, left front	84

Description	Current Track
Turn signal, left rear	85
Turn signal, right front	85
Turn signal, right rear	85
Turn signal switch	85
Voltage regulator	11-13
Voltage stabilizer	21
Windshield washer pump	20, 22
Windshield wiper motor	71
Windshield wiper switch	87
Windshield wiper/washer intermittent relay	84

**AFC 1980, 1981**

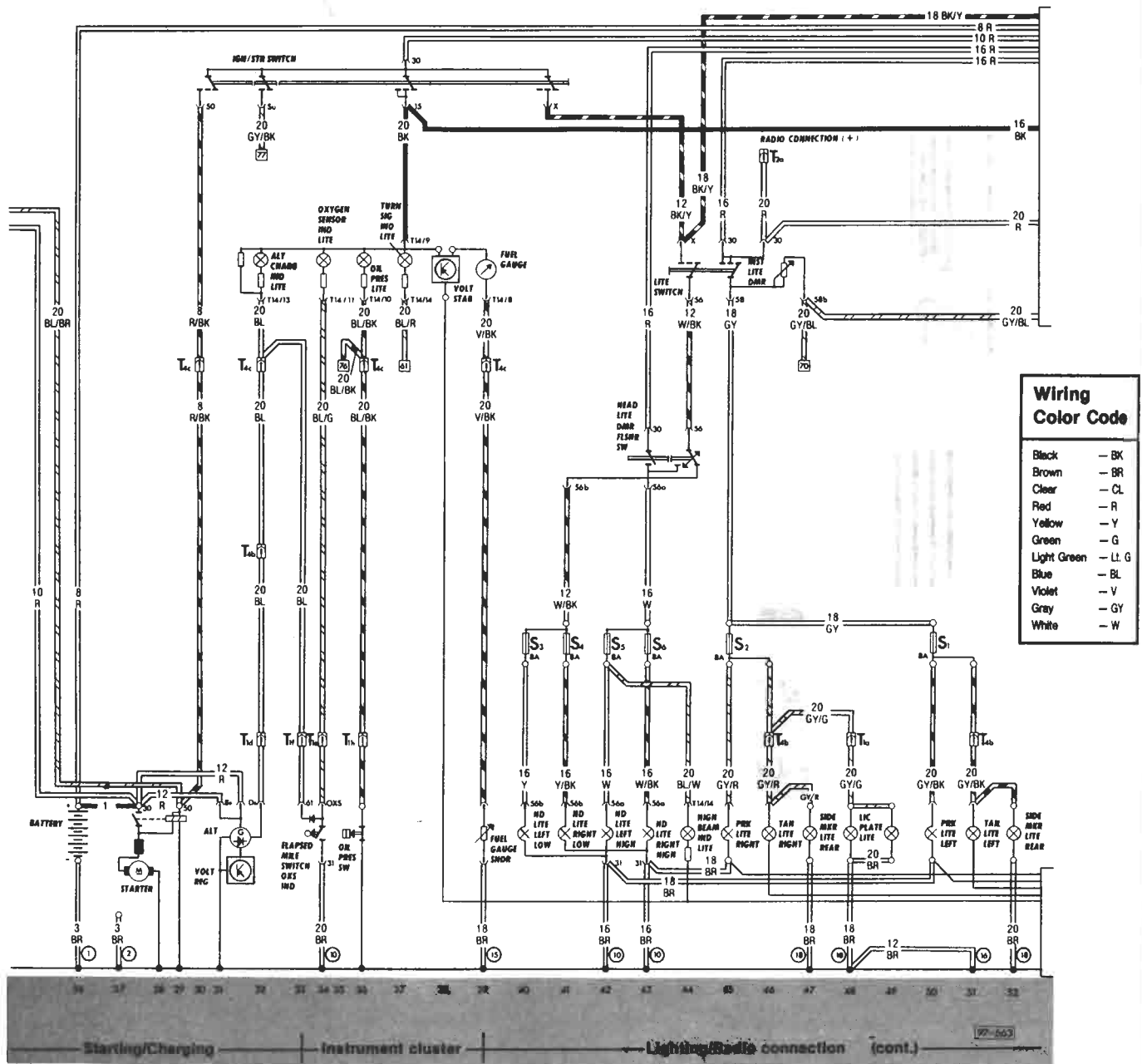
Main wiring diagram

**97.17**





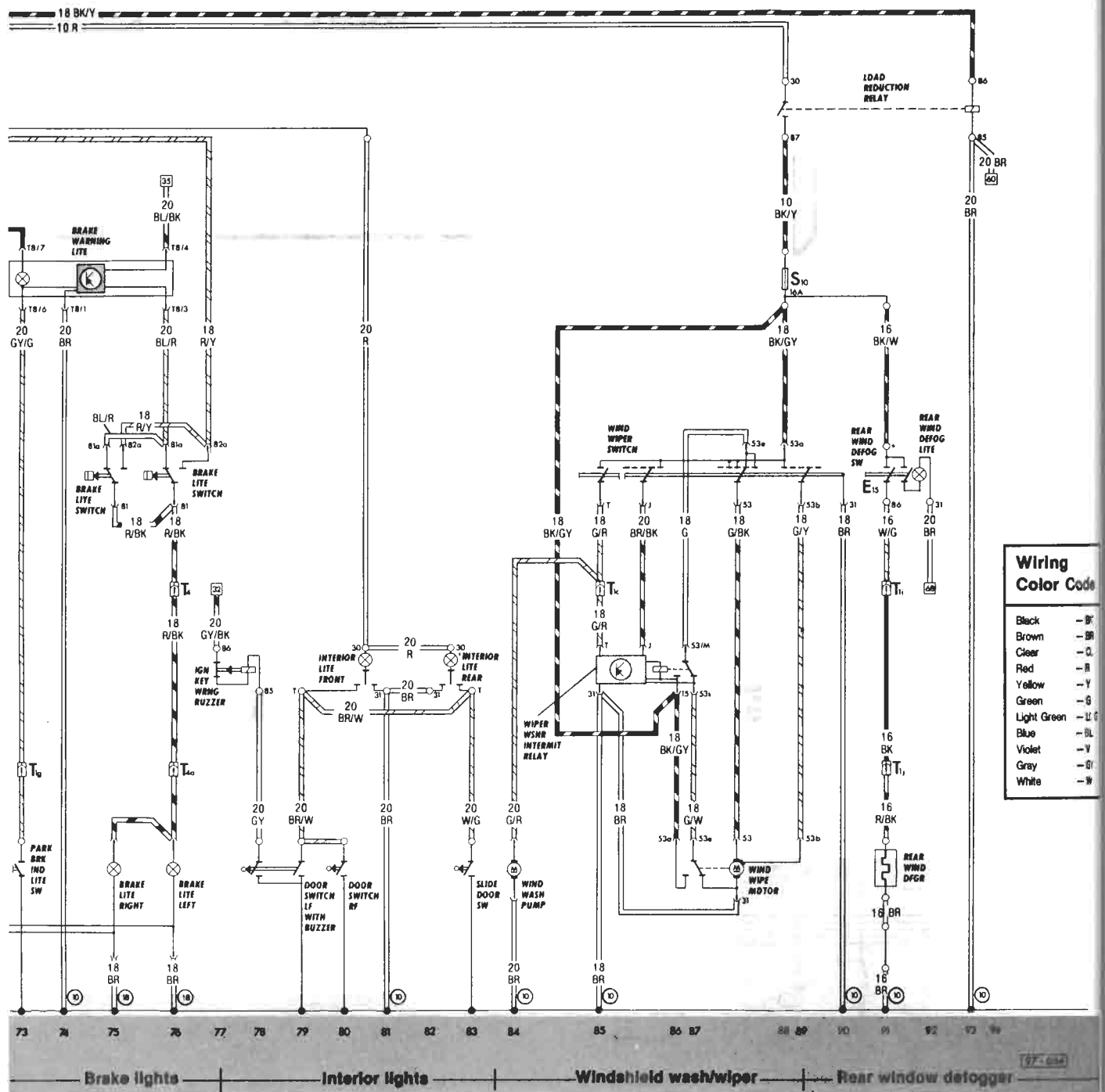
# 97 Electrical System—Wiring, Air-cooled—AFC

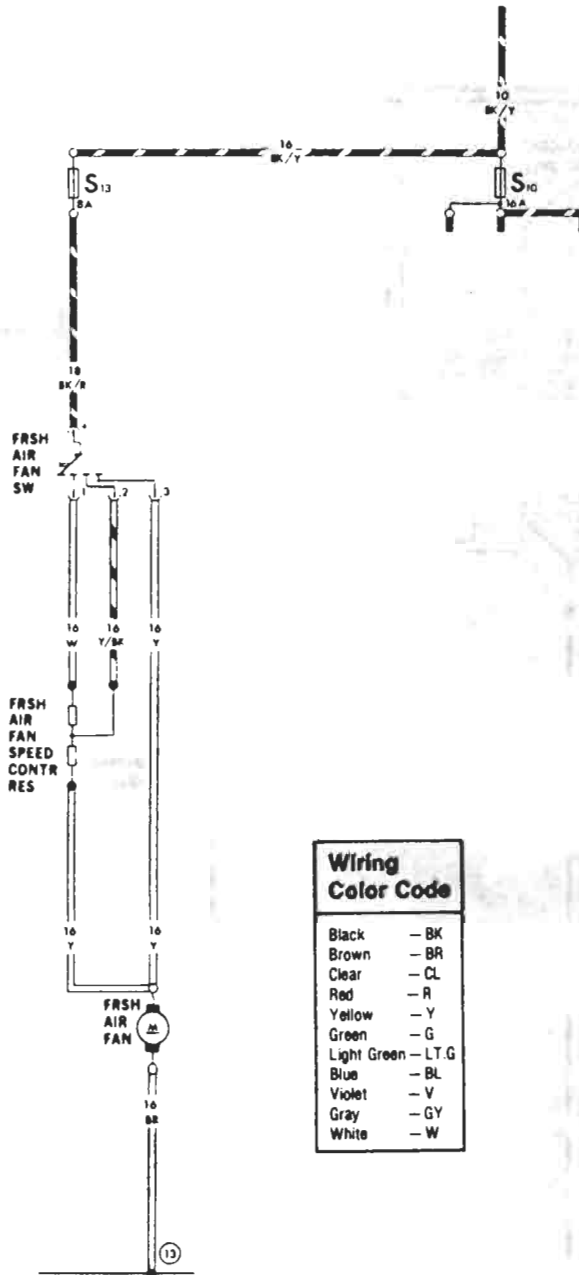






# 97 Electrical System—Wiring, Air-cooled—AFC





**Wiring Color Code**

— BK
— BR
— CL
— R
— Y
— G
Green — Lt. G
— BL
— V
— GY
— W

**Wiring Color Code**

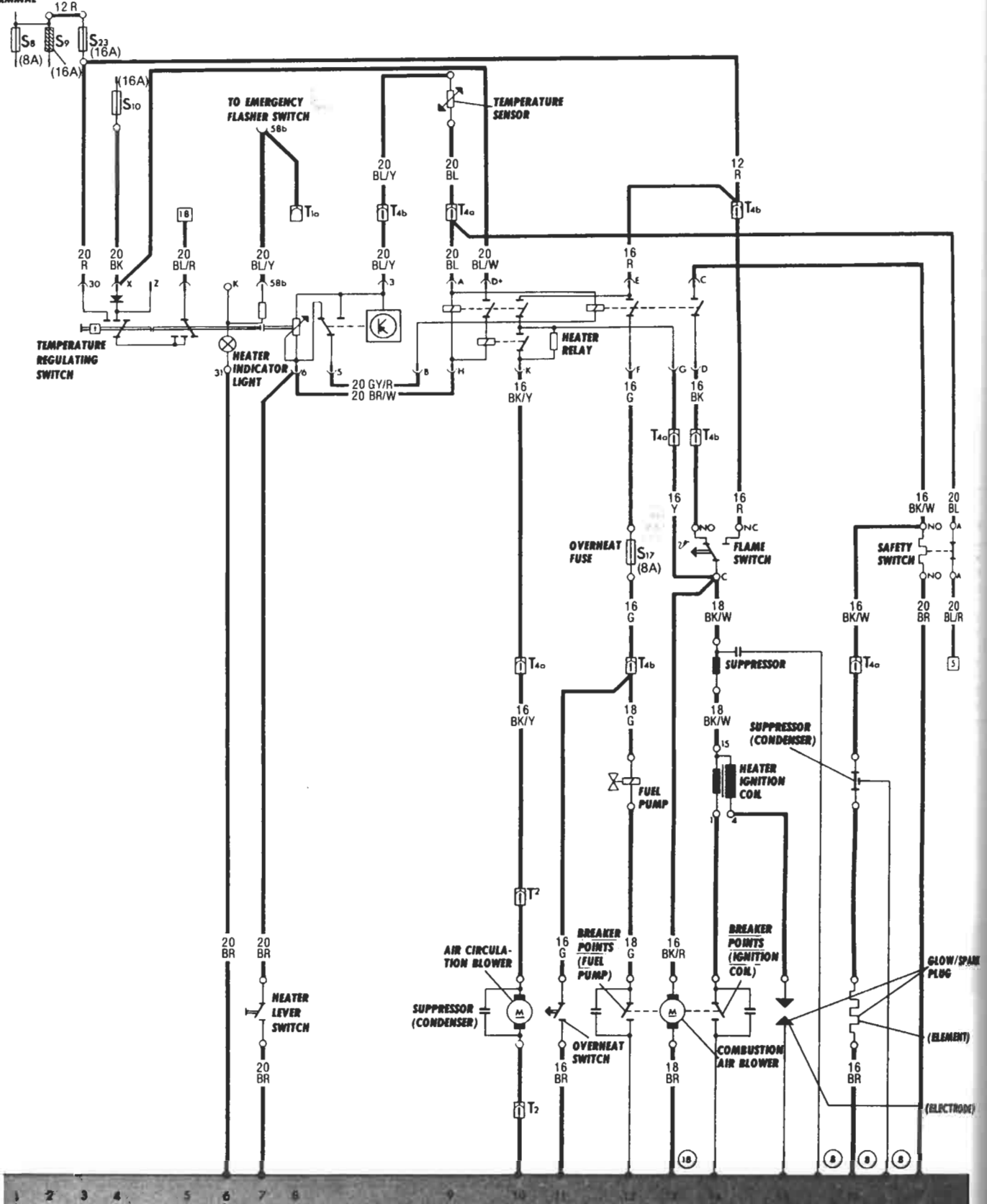
Black	— BK
Brown	— BR
Clear	— CL
Red	— R
Yellow	— Y
Green	— G
Light Green	— LT.G
Blue	— BL
Violet	— V
Gray	— GY
White	— W

Ground Connector  
 ⑬ behind dash

NOTE: All wire sizes American Wire Gauge

# 97 Electrical System—Wiring, Air-cooled-AFC

TO BATTERY  
POSITIVE  
TERMINAL



Note: All wire sizes American Wire Gauge

82-172

## 97.24

Heater booster

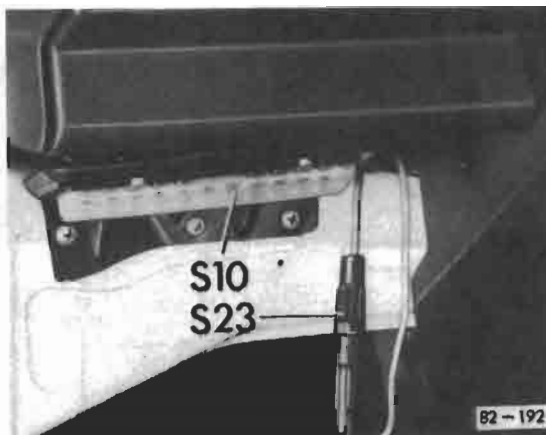
AFC 1980-1983

Description	Current Track
Air circulation blower	10
Breaker points for fuel pump	12
Breaker points for ignition coil	14
Combustion air blower	13
(to) Emergency flasher switch, term. 58b	7
Flame switch	14
Fuel pump	1, 3
Glow/spark plug—element	16
Glow/spark plug—electrode	15
Heater indicator light	6
Heater lever switch	7
Heater relay	9-14
Ignition coil	14
Ignition/starter switch	9
Main fuse S23	3
Overheat fuse S17	12
Overheat switch	11
Safety switch	17, 18
Suppressor for air circulation blower	10
Suppressor for glow/spark plug	16
Suppressor for ignition coil	14, 15
Temperature regulating switch	1-8
Temperature sensor	9
<b>Wire connectors</b>	
T1a—at fuse holder	7
T2 —at air circulation blower	10
T4a—at heater	9,10,13,16
T4b—at heater	8,12,13,14

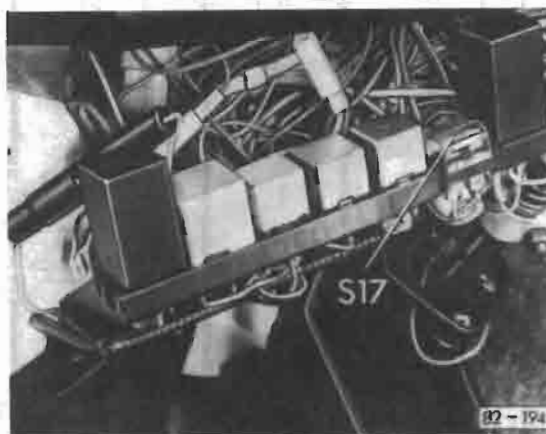
- ⓪—ground connector, at heater
- ⓑ—ground connector, at combustion air blower

Wiring Color Code	
Black	—BK
Brown	—BR
Clear	—CL
Red	—R
Yellow	—Y
Green	—G
Light Green	—LT.G
Blue	—BL
Violet	—V
Gray	—GY
White	—W

**CAUTION**  
Before working on any part of electrical system, disconnect battery ground strap



S10 = Fuse in fuse/relay panel (16A)  
S23 = Main fuse, in-line (16A)



S17 = Overheat fuse (8A)

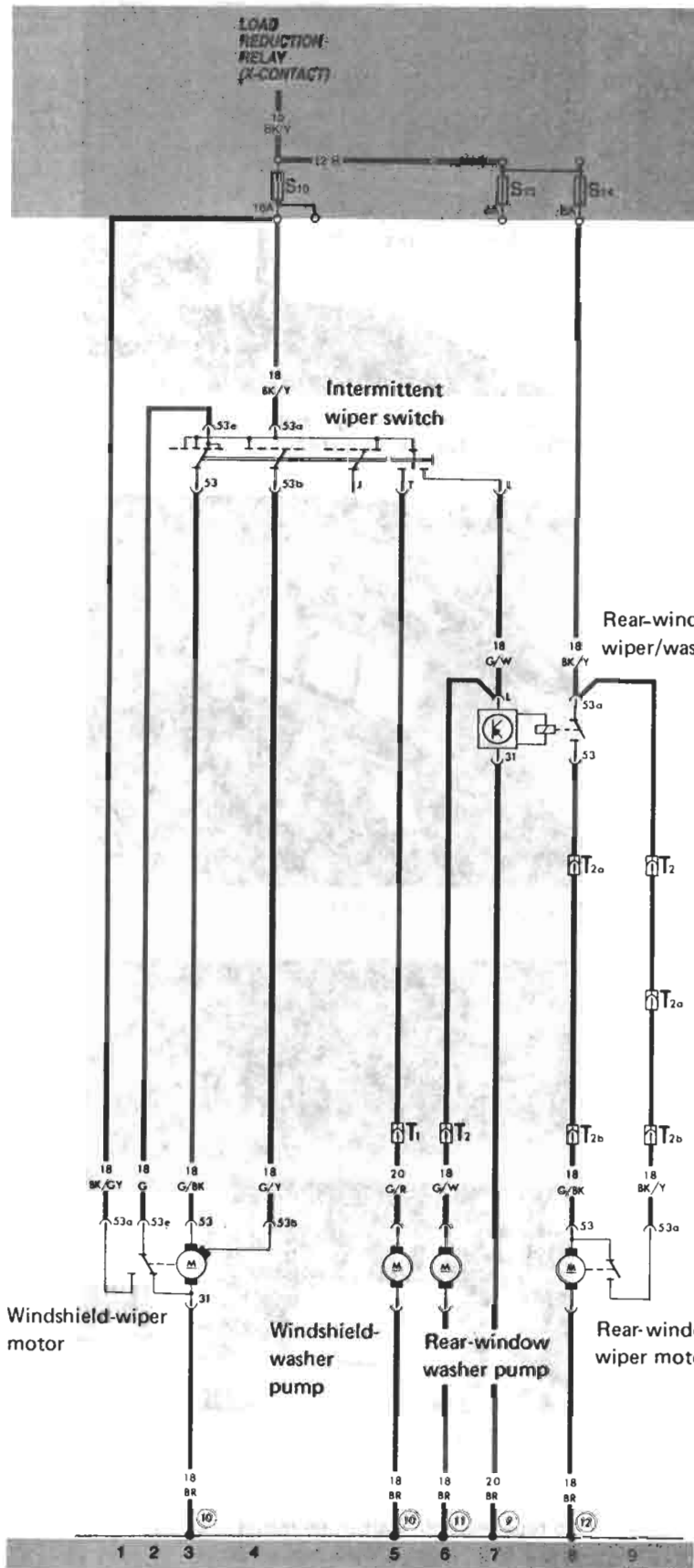


J10 = Safety switch

**Note**

To reset switch, wait three minutes and then press reset lever in direction of arrow

# 97 Electrical System—Wiring, Air-cooled-AFC



### Wire Connectors

- T1 — single, behind dash
- T2 — double, behind dash, right
- T2a — double, on roof, rear, right
- T2b — double, on rear window-wiper motor

### Ground Connectors

- 9 — behind dash, right
- 10 — near fuse panel
- 11 — near rear washer-fluid container, right
- 12 — on rear lid, near rear window-wiper motor

### Wiring Color Code

Black	— BK
Brown	— BR
Clear	— CL
Red	— R
Yellow	— Y
Green	— G
Light Green	— Lt. G
Blue	— BL
Violet	— V
Gray	— GY
White	— W

## 97.26

Rear window wiper

AFC 1981-1983

Diesel 1982, 1983

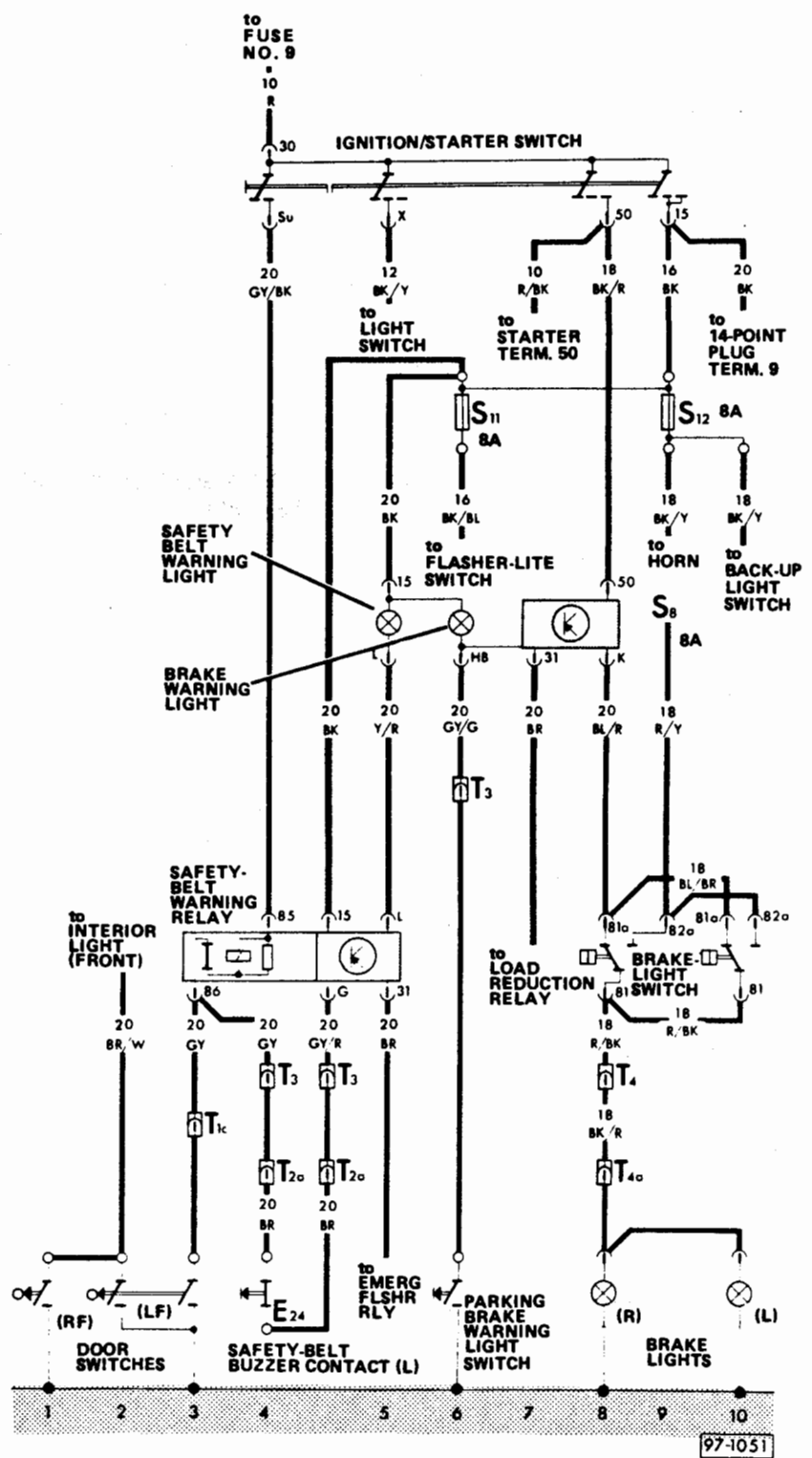
Waterboxer 1983-1985

97-1026

**Wire connectors**

Wire connector	Current Track
T1c single, behind dash	3
T2a double, under driver's seat	4
T3 3-point, behind dash	4, 6
T4 4-point, behind dash	8
T4a 4-point, in engine compartment	8

Wiring Color Code	
Black	— BK
Brown	— BR
Clear	— CL
Red	— R
Yellow	— Y
Green	— G
Light Green	— LT.G
Blue	— BL
Violet	— V
Gray	— GY
White	— W



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## Electrical System—Wiring, Camper

### Index

#### General

- Battery/Ground cables 97.9a, 97.9b  
disconnecting/connecting 97.6
- Cautions and Warnings 97.2
- Dashboard wiring harness 97.7
- Engine/Body ground connections 97.6
- Fuse/Relay panel, removing (1980-1985) 97.10  
(from 1986 m.y.) 97.10a
- How to read wiring diagrams 97.4
- Main wiring harness 97.8
- Starter cable routing 97.9
- Symbols used in wiring diagrams 97.5
- Troubleshooting 97.3
- Working on the electrical system 97.3

#### Camper

- Auxiliary battery 1986-1989 (man. trans.) 97.34  
(also see 97.53)
- Battery level indicator lights 97.30
- Camper electrical equipment 1980-1985 97.32  
from 1986 97.33
- Water pump 97.31
- Water tank level indicator lights 97.30

#### Air-cooled AFC

- Refer to 97.11

#### Diesel

- Refer to 97.35

#### Waterboxer/Syncro (Water-cooled Digifant, Digijet)

- Refer to 97.53



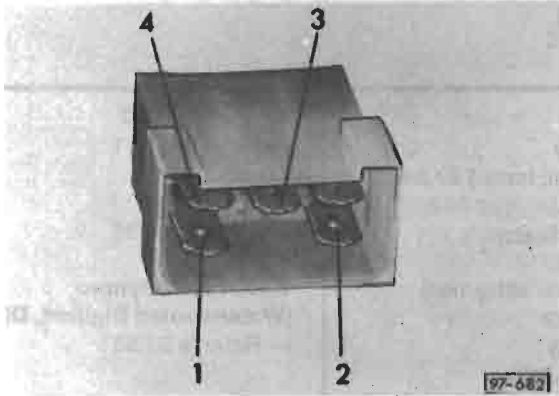
# 97 Electrical System—Wiring, Camper

## Battery level indicator lights, checking

### Note

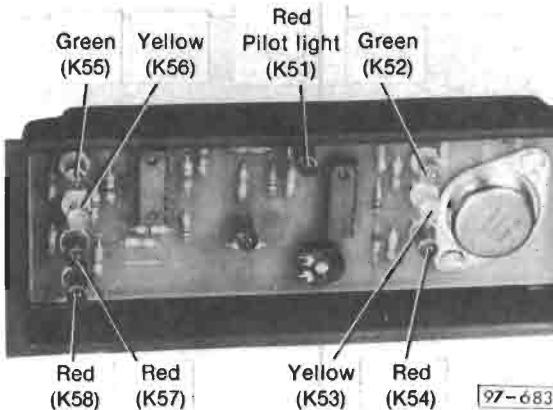
Ignore indicator lights which light but are not mentioned in test being performed

- check indicator light panel fuse located under driver's seat
- remove indicator light panel from sink cabinet and disconnect multi-point connector



- connect indicator light panel to fully charged 12-volt battery as follows:

- terminal 1 to battery positive terminal
- terminal 2 to battery negative terminal



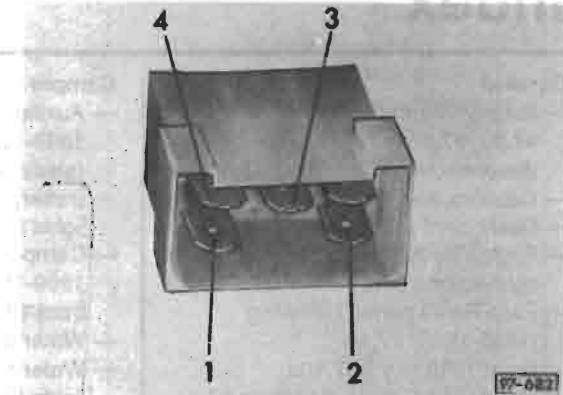
- red pilot light(K51) and green battery level indicator light(K52) will light—battery level above 12.5 volts
- using Sun VAT-40 or equivalent, load battery to maximum 110 A. Battery voltage will start to drop
- battery level indicator lights will light in the following sequence:
  - green(K52)—battery level above 12.5 volts
  - yellow(K53)—battery level below 12.5 volts
  - red(K54)—battery level above 12 volts
- if any indicator light does not light during test, indicator light panel is defective
- replace complete indicator light panel if necessary
- if indicator light panel OK, check wiring

## Water tank level indicator lights, checking

### Note

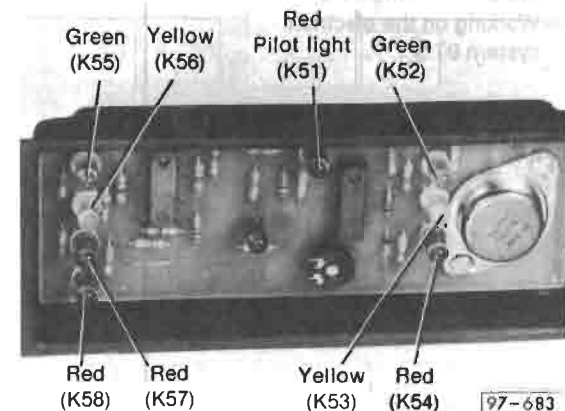
Ignore indicator lights which light but are not mentioned in test being performed

- check indicator light panel fuse located under driver's seat
- remove indicator light panel from sink cabinet and disconnect multi-point connector



- connect indicator light panel to fully charged 12-volt battery as follows:

- terminal 1 to battery positive terminal
- terminal 2 to battery negative terminal

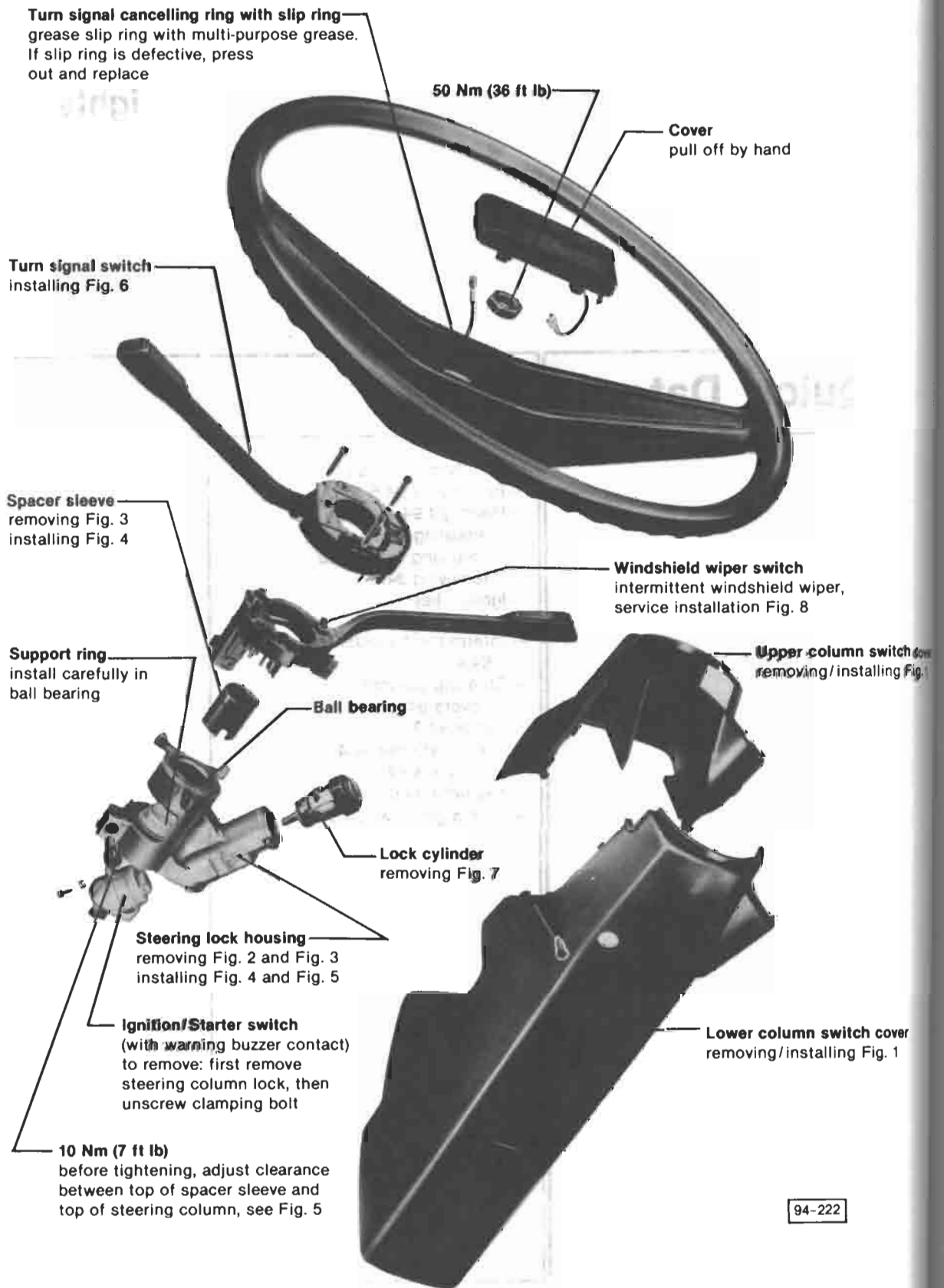


- red pilot light(K51) and red water level indicator light(K58) will light
- connect green wire from known good water tank sender unit to terminal 3 in multi-point connector
- connect one end of jumper wire to battery negative terminal
- connect other end of jumper wire to white, yellow, and green wire of sender unit one after another
  - water tank level indicator lights red(K57), yellow(K56), and green(K55), will light—red water tank level light(K58) will go out
- go to next page

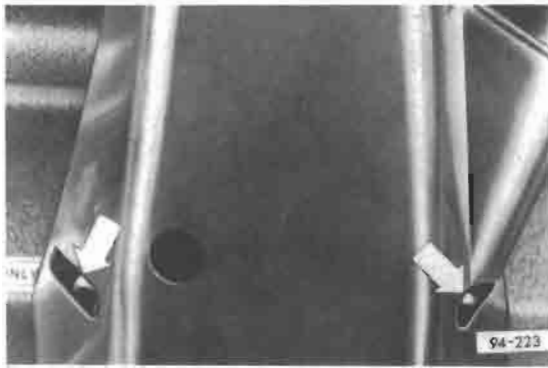
**Electrical System  
Lights**

<b>Quick Data</b>	<b>Index</b>
	<ul style="list-style-type: none"><li>- Aerodynamic 94.5a</li><li>- Bulb holder 94.6</li><li>- Headlight 94.4<ul style="list-style-type: none"><li>adjusting 94.5</li><li>mounting frame 94.5</li><li>removing 94.5</li></ul></li><li>- Ignition key<ul style="list-style-type: none"><li>deburring 94.3a</li></ul></li><li>- Intermittent windshield wiper 94.4</li><li>- Steering column<ul style="list-style-type: none"><li>covers 94.3</li><li>lock 94.3</li><li>lock cylinder 94.4</li><li>switches 94.2</li></ul></li><li>- Tail-light 94.6</li><li>- Turn signal switch 94.3</li></ul>

# 94 Electrical System-Lights

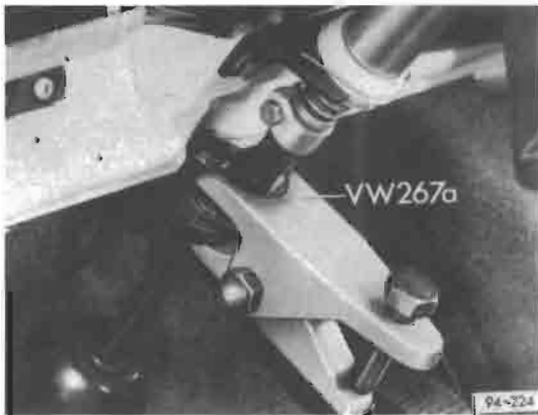


94-222



**Fig. 1 Upper/Lower column switch covers, removing/installing**

- remove two screws (arrows)
- remove clip on lower cover from column tube
- remove both column switch covers



**Fig. 2 Steering lock housing, removing/installing**

- hold coupling together using VW 267a



**Fig. 3 Steering lock housing/Spacer sleeve, removing**

- pull off steering lock housing together with spacer sleeve



**Fig. 4 Steering lock housing/Spacer sleeve, installing**

- installing steering lock housing with support ring onto column tube
- drive spacer sleeve on column using VW 420
- adjust clearance (see Fig. 5)



**Fig. 5 Steering lock housing, installing**

- adjust clearance between top of spacer sleeve and top of column
  - a = 51 mm (2 in.)



**Fig. 6 Turn signal switch, installing**

- adjust clearance between steering wheel and turn signal switch
  - a = 2 to 4 mm (1/16 to 3/16 in.)

switch cover  
installing Fig. 1

cover  
Fig. 1

# 94 Electrical System—Lights

---

## Note

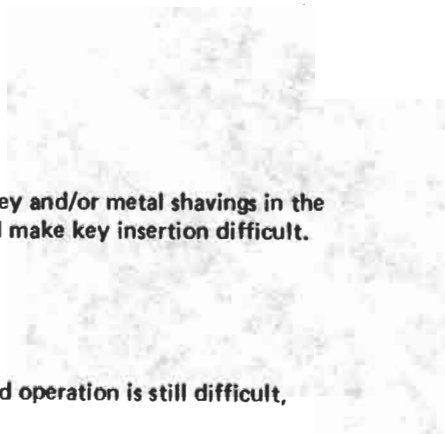
Burrs on ignition key and/or metal shavings in the lock cylinder could make key insertion difficult.

If this occurs,

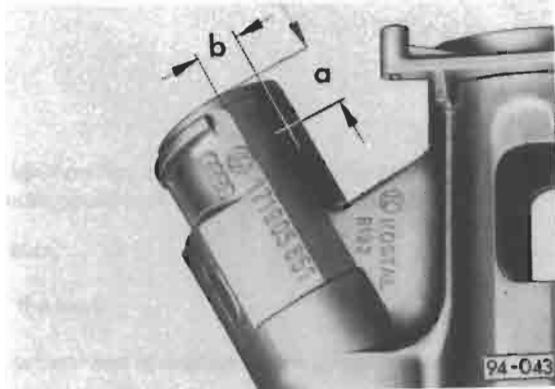
– deburr the keys

If key insertion and operation is still difficult,

– replace ignition lock cylinder and deburr new keys

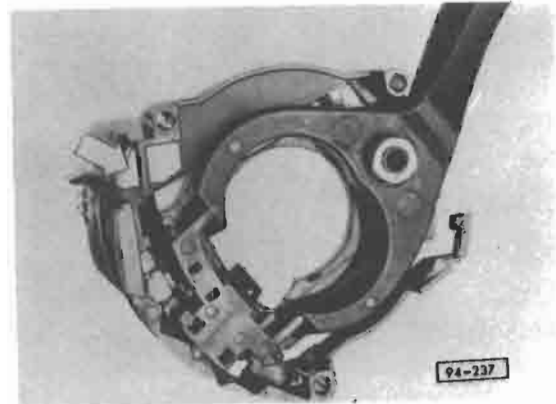


# 94 Electrical System—Lights



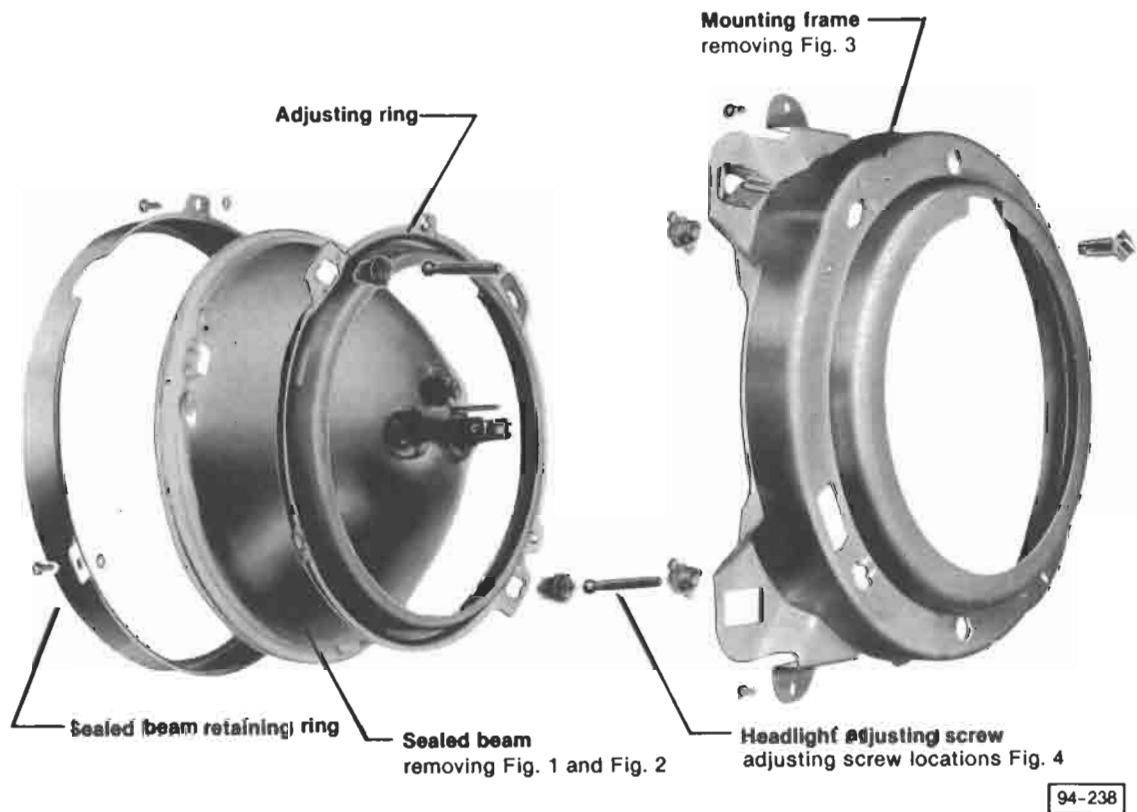
**Fig. 7 Steering lock cylinder, removing**

- carefully drill 3 mm (1/8 in.) hole into housing
  - a = 12 mm (1/2 in.)
  - b = 10 mm (3/8 in.)
- press in pin with punch through drilled hole and pull out lock cylinder

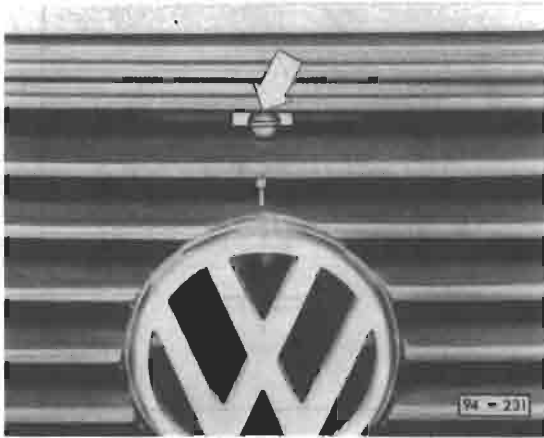


**Fig. 8 Intermittent windshield wiper, service installation**

- remove plastic wedge (arrow) from opening in windshield wiper switch
- install windshield wiper/washer intermittent relay

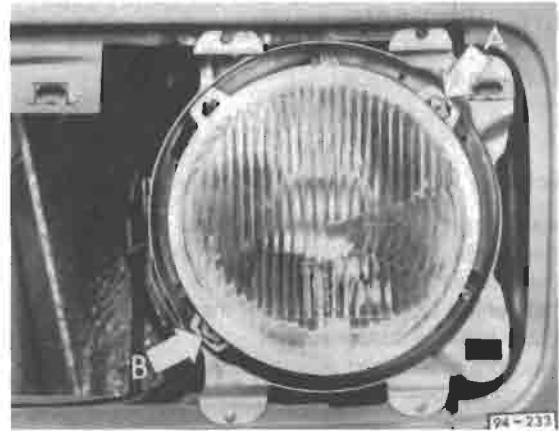


94-238



**Fig. 1 Sealed beam, removing**

- remove grille by turning retainers (arrow) 90°

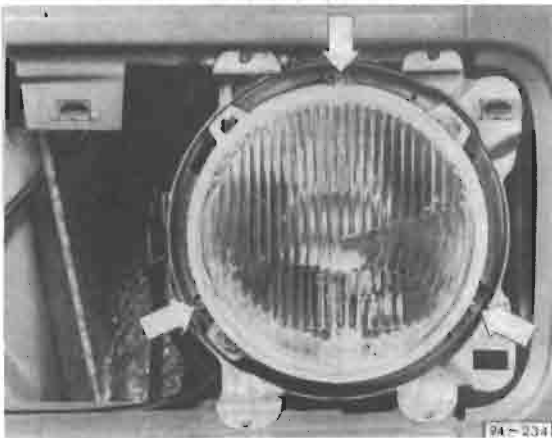


**Fig. 4 Headlight, adjusting screw locations**

- arrow A = left/right adjustment
- arrow B = high/low adjustment

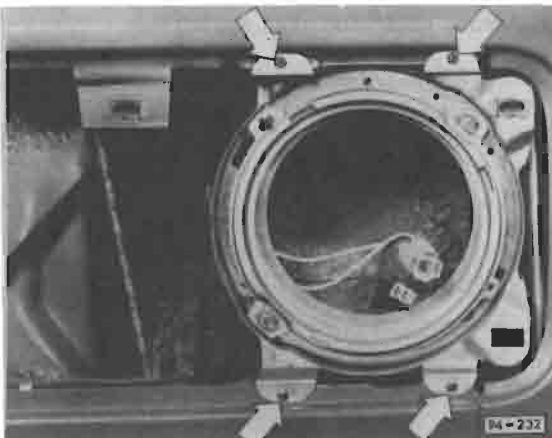
**Note**

Always adjust headlights using Weaver WX-50 tester or equivalent in accordance with local laws



**Fig. 2 Sealed beam, removing**

- remove retainer ring screws (arrows)
- remove sealed beam



**Fig. 3 Mounting frame, removing**

- remove screws (arrows)

# 94 Electrical System—Lights

## Aiming requirements

- park vehicle on flat surface

### Note

It is not necessary that the surface be exactly level.

- remove any large accumulations of mud or ice from wheel wells, fender undersides, bumpers etc.
- check and correct tire pressures
- verify that vehicle has no loads other than driver
- rock vehicle to settle suspension
- clean headlight lenses and aiming pads
- check hi and low beam headlight operation

## Setting up universal adaptor

### Note

Use adaptor 0203 when aiming Vanagon aerodynamic headlights with Hoppe headlight aiming equipment.

- locate aim setting pads on headlight lens

### Note

The settings are designated by the letters **V** and **H**, followed by a number.

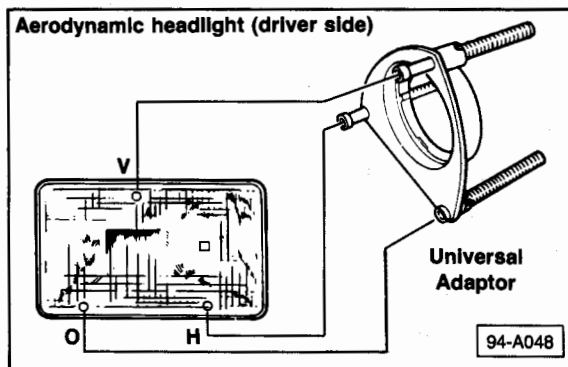


Fig. 1 Aiming pad locations

- V** = vertical setting
- H** = horizontal setting
- O** = inside aiming pad (set always to zero)
- locate
- move adjustable rods of adaptor to correspond to settings found on headlight

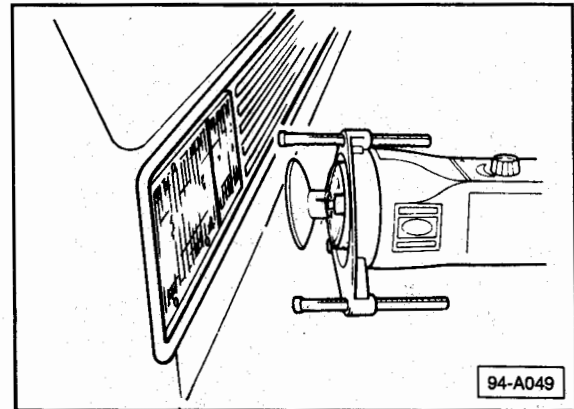


Fig. 2 Placing the adaptor assembly on the aiming pads

- attach aiming device to adaptor
- mount assembly to headlight lens. See Fig. 2.

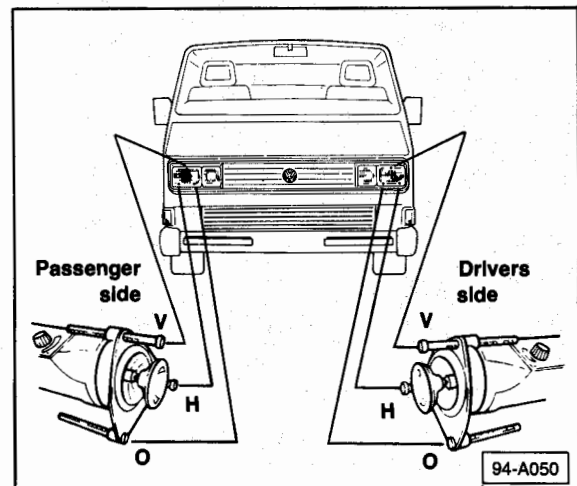
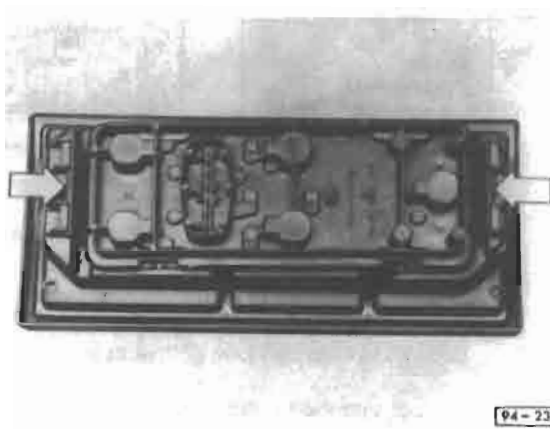
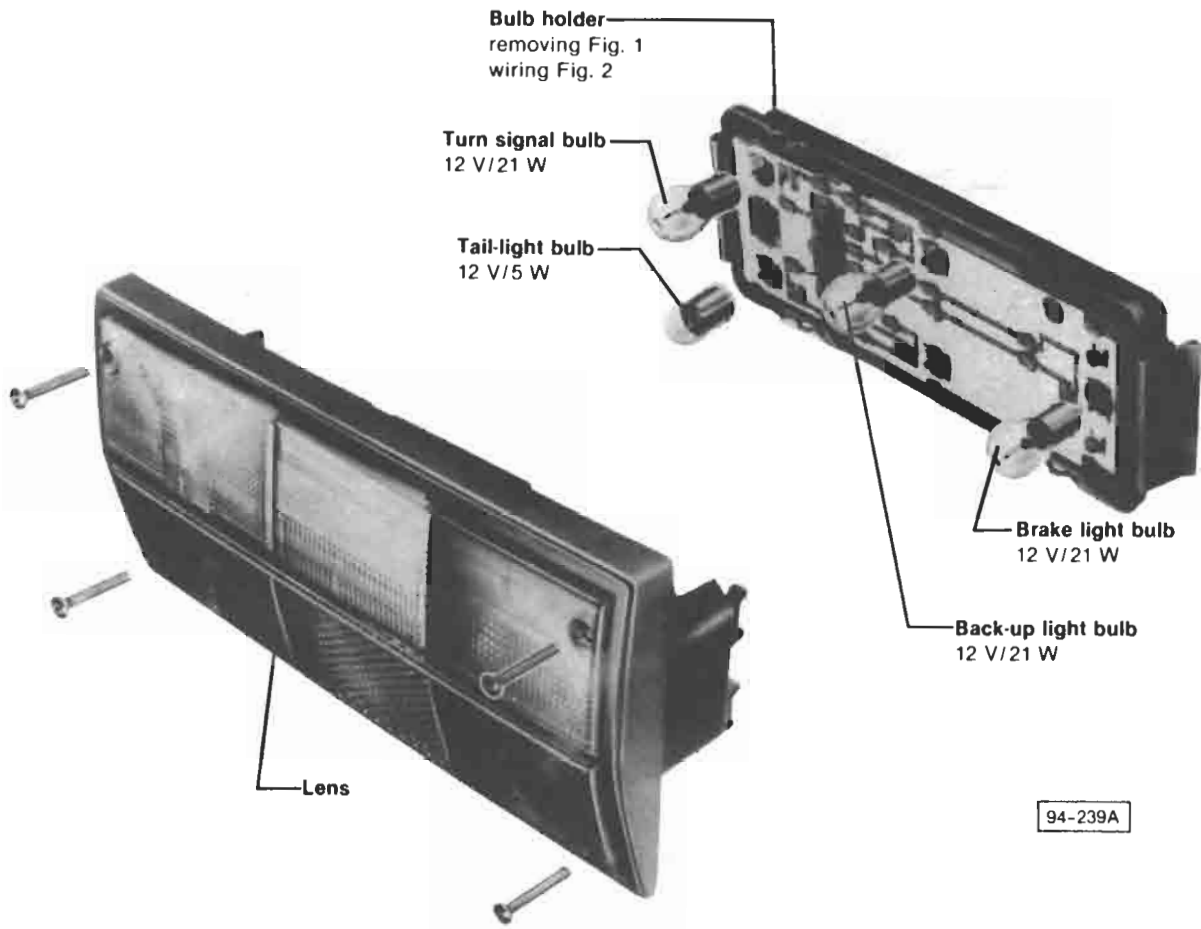


Fig. 3 Adaptor installation, right and left side

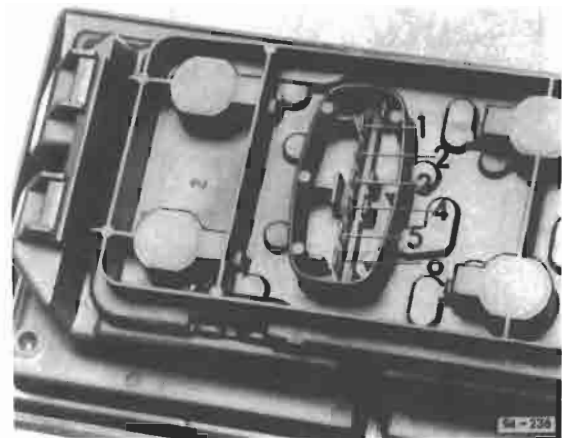
- check headlight aim using mechanical aiming procedure provided by equipment manufacturer
- correct if necessary



# 94 Electrical System-Lights



**Fig. 1 Bulb holder, removing**  
— squeeze at arrows and remove



**Fig. 2 Bulb holder, wiring connections**

- 1 = to tail-light bulb 12 V/5 W
- 2 = vacant
- 3 = to ground
- 4 = to brake light bulb 12 V/21 W
- 5 = to back-up light bulb 12 V/21 W
- 6 = to turn signal light bulb 12 V/21 W

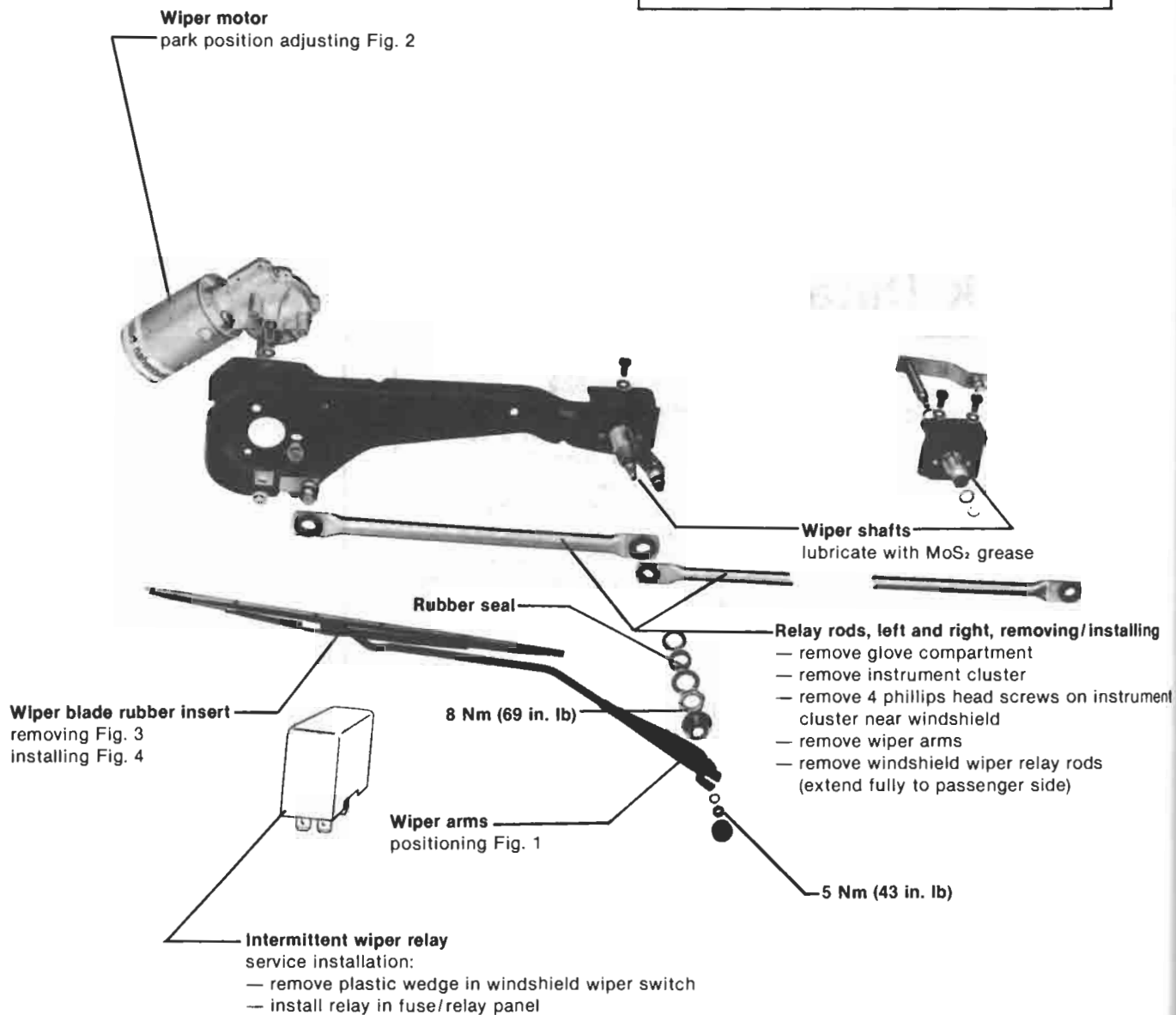
**Electrical System  
Windshield Wiper  
Windshield Washer**

<b>Quick Data</b>	<b>Index</b>
	<ul style="list-style-type: none"><li>—Assembly 92.2</li><li>—Rear window washer/wiper 92.5, 92.6</li><li>  washer pump 92.7</li><li>—Spray jets 92.4</li><li>—Troubleshooting 92.8, 92.9</li><li>—Windshield washer 92.4</li><li>—Wiper arms/motor 92.3</li><li>—Wiper blade rubber insert 92.3</li></ul>

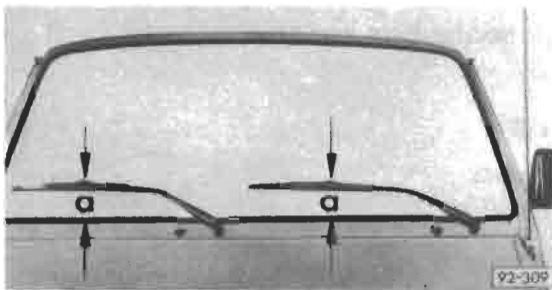
# 92 Electrical System-Windshield Wiper and Washer

## CAUTION

Before starting to work on any part of electrical system, disconnect battery ground strap

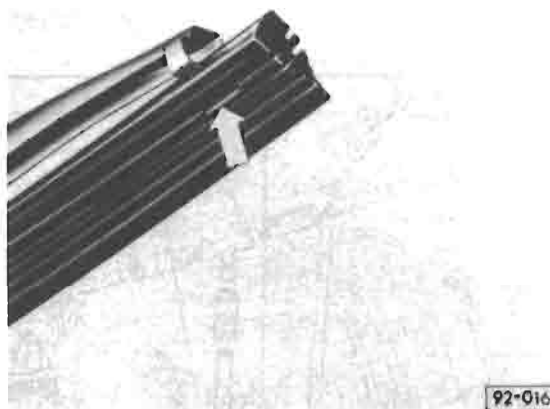


92-305



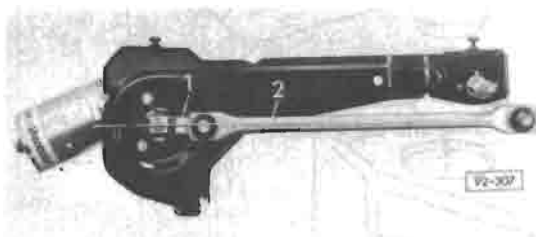
**Fig. 1 Wiper arms, positioning**

- position wiper blades parallel to windshield seal
- a = 70 mm (2 3/4 in.)



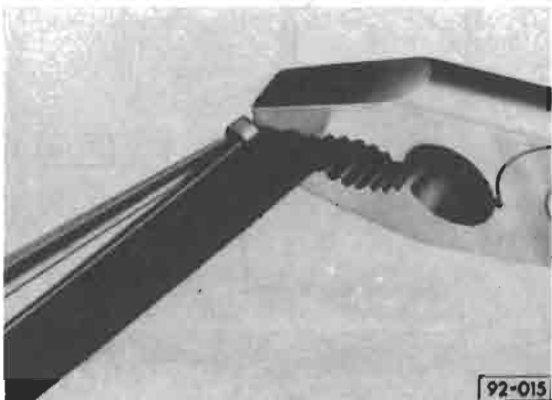
**Fig. 4 Wiper blade rubber insert, installing**

- slide metal inserts into rubber insert upper grooves. Notch in metal insert must face rubber insert
- slide rubber insert into retainers. Retainers must engage recess in second groove (arrow)



**Fig. 2 Wiper motor park position, adjusting**

- run wiper motor to stop position
- align crank 1 and relay rod 2 in direction of line
- attach crank 1 to wiper motor shaft

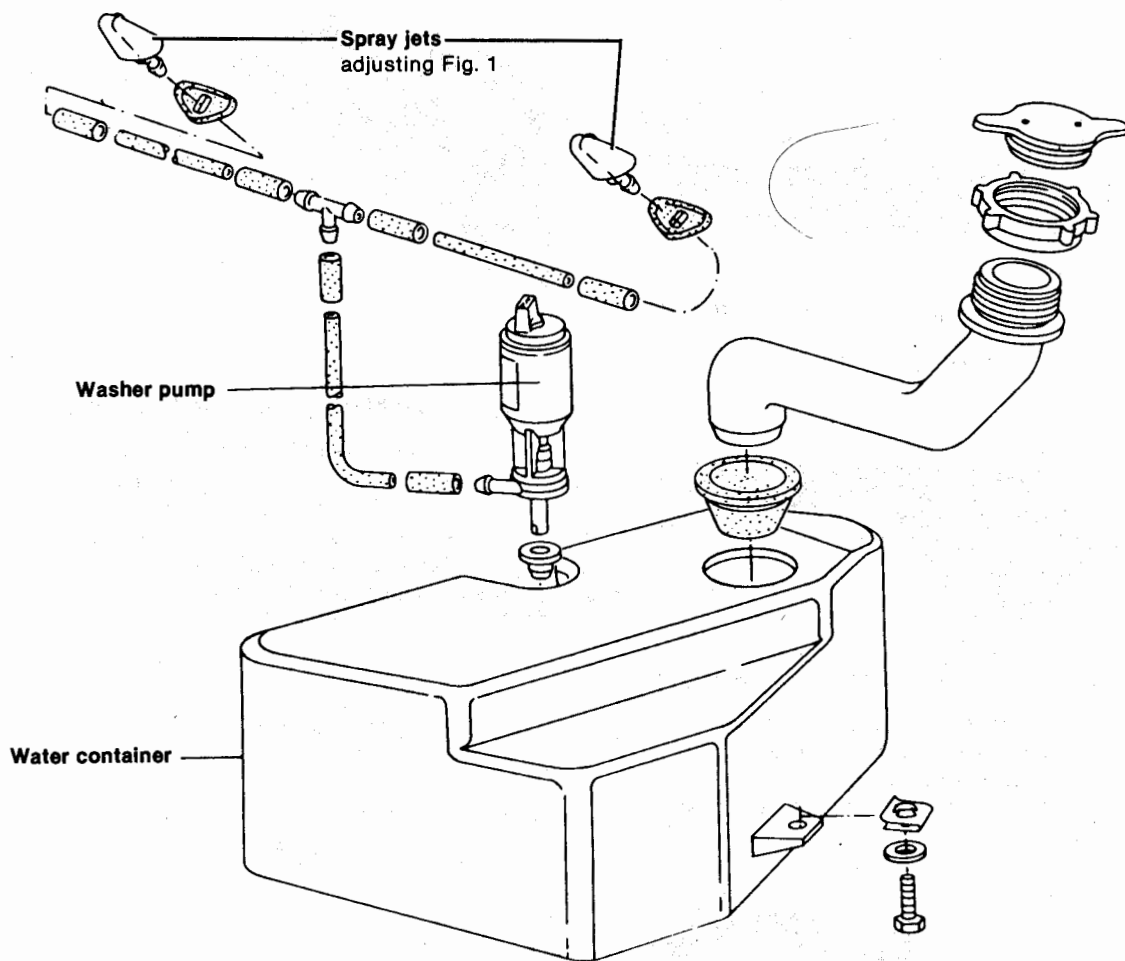


**Fig. 3 Wiper blade rubber insert, removing**

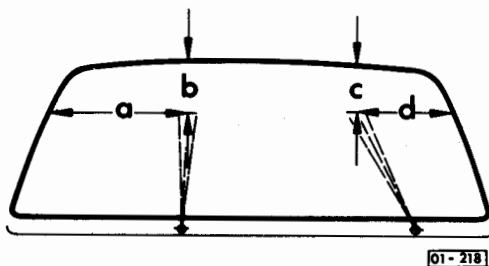
- squeeze metal inserts at open end of rubber insert
- pull metal inserts out of retainer
- remove rubber insert

Installing  
Instrument

# 92 Electrical System-Windshield Wiper and Washer



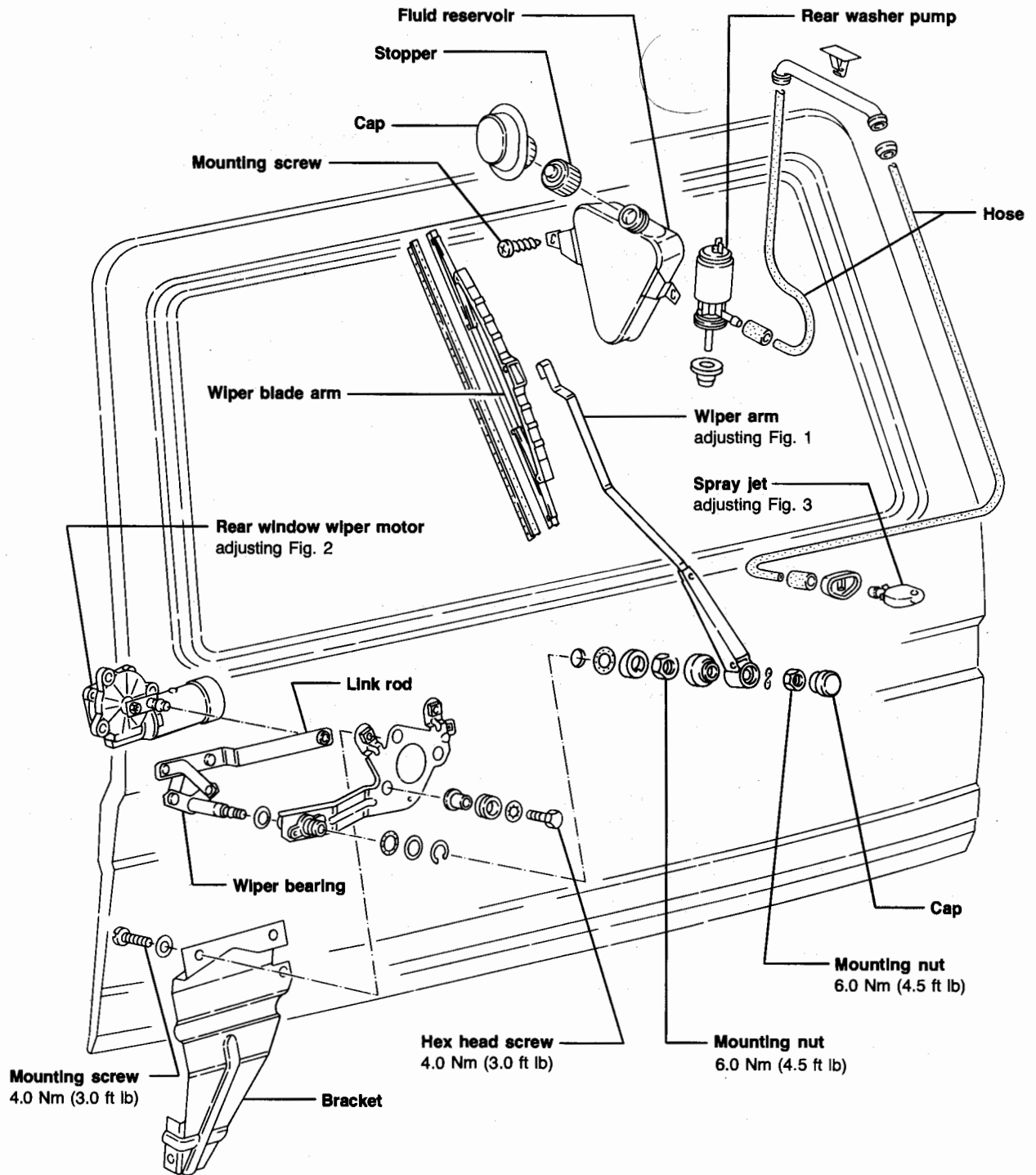
92-310



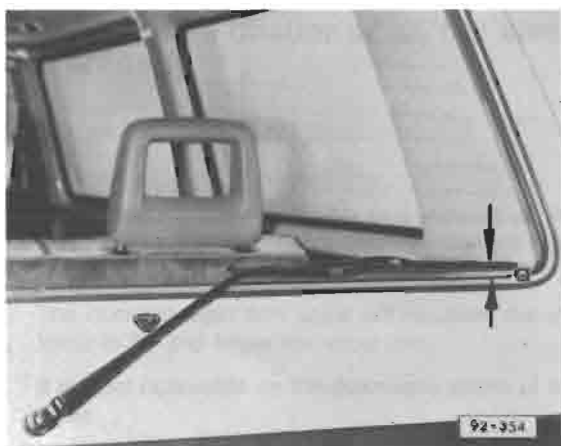
**Fig. 1 Spray jets, adjusting**

- adjust spray jets using pin, until water is directed onto windshield as shown
- a = 490 mm (19 in.)
- b = 220 mm (9 in.)
- c = 190 mm (7 1/2 in.)
- d = 330 mm (13 in.)

## Rear window washer and wiper system, repairing

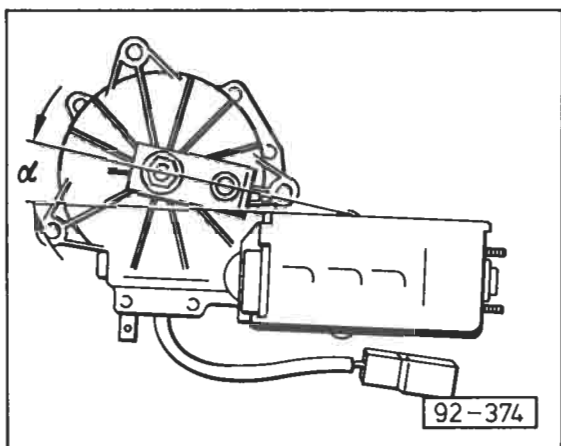


92-365



**Fig. 1** Rear window wiper arm, adjusting end position

a = 27 mm



**Fig. 2** Wiper motor, park position, adjusting

- let wiper motor run to stop position
  - attach crank and adjust as in illustration
- $\alpha = 8^\circ$



**Fig. 3** Spray nozzle, adjusting  
— center of wiping field

## Rear window wiper, removing and installing

### Removing

- remove cover in back hatch



- remove screws (**arrows**) and pull out connector

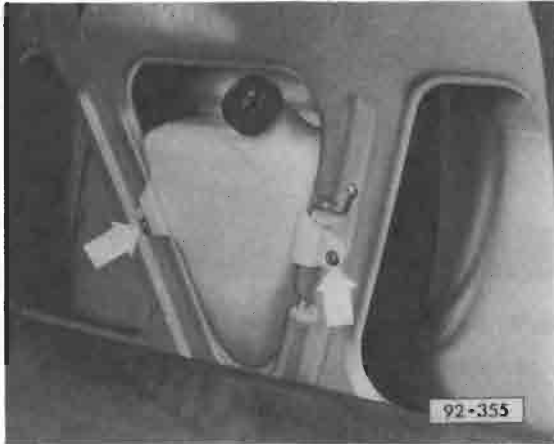
### Installing

- install in reverse order

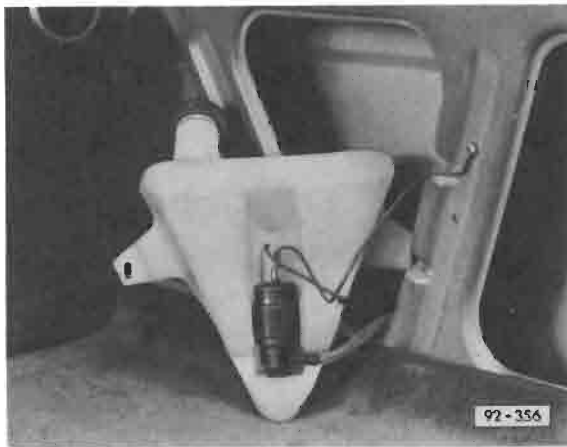
# 92 Electrical System—Windshield Wiper & Washer

## Rear window washer pump, removing and installing

### Removing



- remove right rear trim panel
- remove screws (**arrow**)
- remove fluid reservoir



- take pump out of guides on fluid reservoir

### Installing

- install in reverse order



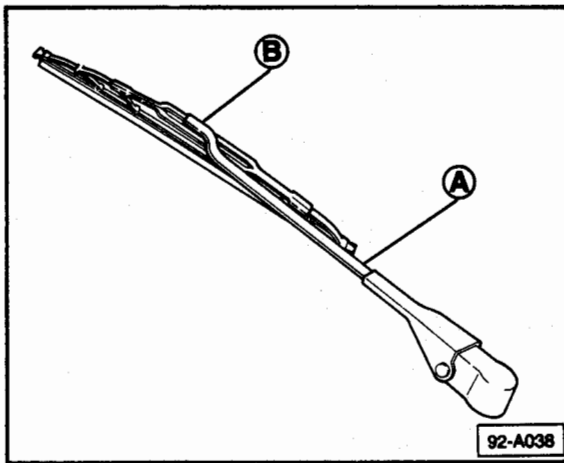
## Windshield wipers chatter or do not clean window properly

Windshield wiper blade chatter and skipping of blade across windshield can be caused by incorrect wiper arm angle.

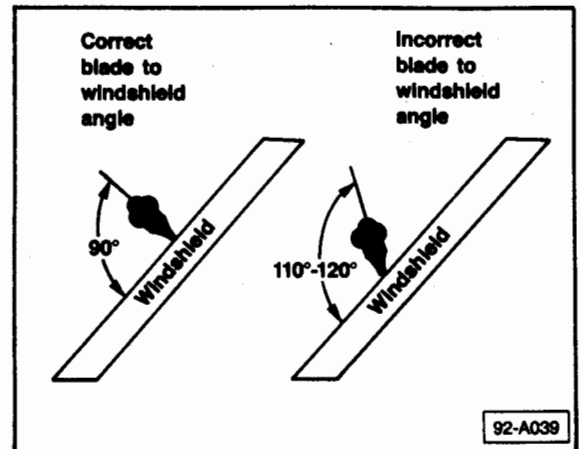
The incorrect wiper arm angle will not allow the wiper blade to flip and follow the wiper arm.

It is most noticeable on the downward stroke of the wiper.

To adjust wiper arm,



- hold wiper arm with duckbill pliers at A
- bend wiper blade arm at B to obtain correct wiper blade angle



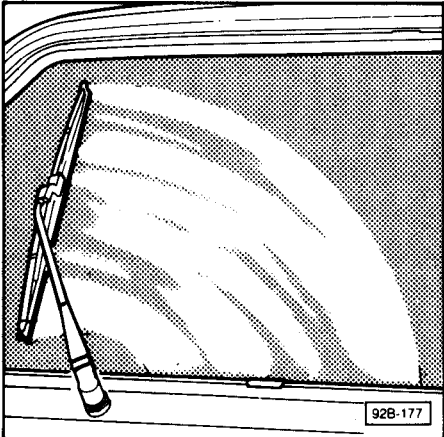
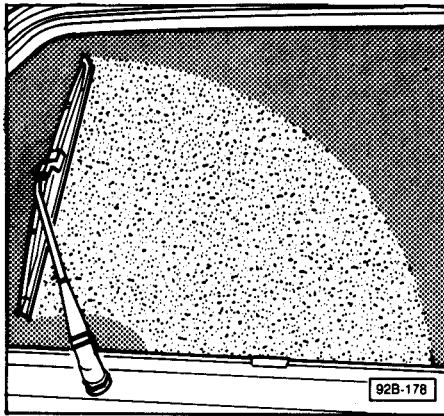
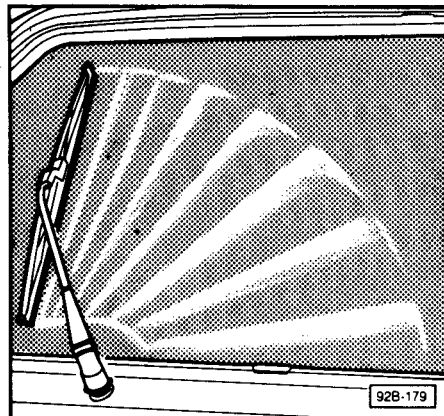
Angle of blade to windshield

Wax and dirt build up on windshield wiper blades can cause streaking and smearing on windshield when using wipers.

- **do not replace** windshield blades that may only need to be cleaned
- clean wax and dirt build up from wiper blades and entire windshield with alcohol based cleaning solution or rubbing alcohol and water
- see troubleshooting chart on page two
- refer customer to instructions in Owner's Manual

more

## Windshield wiper troubleshooting chart

Symptoms	Possible causes	Solutions
<p>Bad wiping (sheeting)</p>  <p style="text-align: right; font-size: small;">92B-177</p>	<ul style="list-style-type: none"> <li>● dirty blade lip</li>   <li>● blade lip worn, torn or broken</li>   <li>● old blade lip</li> </ul>	<ul style="list-style-type: none"> <li>— clean blade lip with wet cloth and soap</li>   <li>— rinse with water</li>   <li>— replace blades</li>   <li>— replace blades</li> </ul>
<p>Some water remains in the wiping area, forming droplets</p>  <p style="text-align: right; font-size: small;">92B-178</p>	<ul style="list-style-type: none"> <li>● windshield glass contaminated by pollutants, oil or film from diesel engine exhaust</li> </ul>	<ul style="list-style-type: none"> <li>— clean windshield glass with clean cloth soaked in solution of alcohol (or ammonia) and warm water</li> </ul>
<p>Windshield wiper blades clean to one side and are deficient to the other (chatter)</p>  <p style="text-align: right; font-size: small;">92B-179</p>	<ul style="list-style-type: none"> <li>● blade lips are deformed or filled with dirt or foreign matter on one side.</li>   <li>● windshield wiper arms are twisted. Rubber lips do not touch glass properly</li>   <li>● glass is dirty or not wet enough, resulting in varying friction between blade and glass</li> </ul>	<ul style="list-style-type: none"> <li>— replace blades</li>   <li>— bend wiper arm to obtain proper blade contact</li>   <li>— clean the glass with clean cloth soaked in solution of alcohol (or ammonia) and warm water</li> </ul>

## Electrical System— Instruments, Radio

### Index

#### 1980-1984

- Cigarette lighter replacing 90.31
- Fuel gauge checking 90.5, 90.9 troubleshooting 90.13
- Fuel gauge sender removing/installing 90.11
- Instrument cluster assembling/disassembling 90.2, 90.6 removing/installing 90.10
- Light emitting diodes (LED) checking 90.5 identifying 90.4, 90.8
- Multi-point connector identifying 90.4, 90.8
- Speedometer calibration 90.30
- Speedometer cable removing/installing 90.10
- Voltage stabilizer 90.4, 90.8

#### From 1985

- Cigarette lighter replacing 90.31
- Coolant temperature gauge locating 90.14 troubleshooting 90.21
- Dynamic oil pressure system assembly 90.22 removing/installing 90.23 troubleshooting 90.24
- Fuel gauge locating 90.14 troubleshooting 90.20
- Instrument cluster assembling/disassembling 90.14 removing/installing 90.10
- Light emitting diodes (LED) checking 90.19 identifying 90.18
- Multi-point connector identifying 90.18
- Speedometer calibration 90.30
- Speedometer cable installing (from VIN 25 H 040 185) except Syncro 90.17 removing/installing 90.17
- Voltage stabilizer checking 90.18

#### From 1990

- Heidelberg VI fixed coded radio coding a new or remanufactured radio 90.32 reactivating radio after reconnecting power 90.33 unlocking an electronically controlled radio 90.34

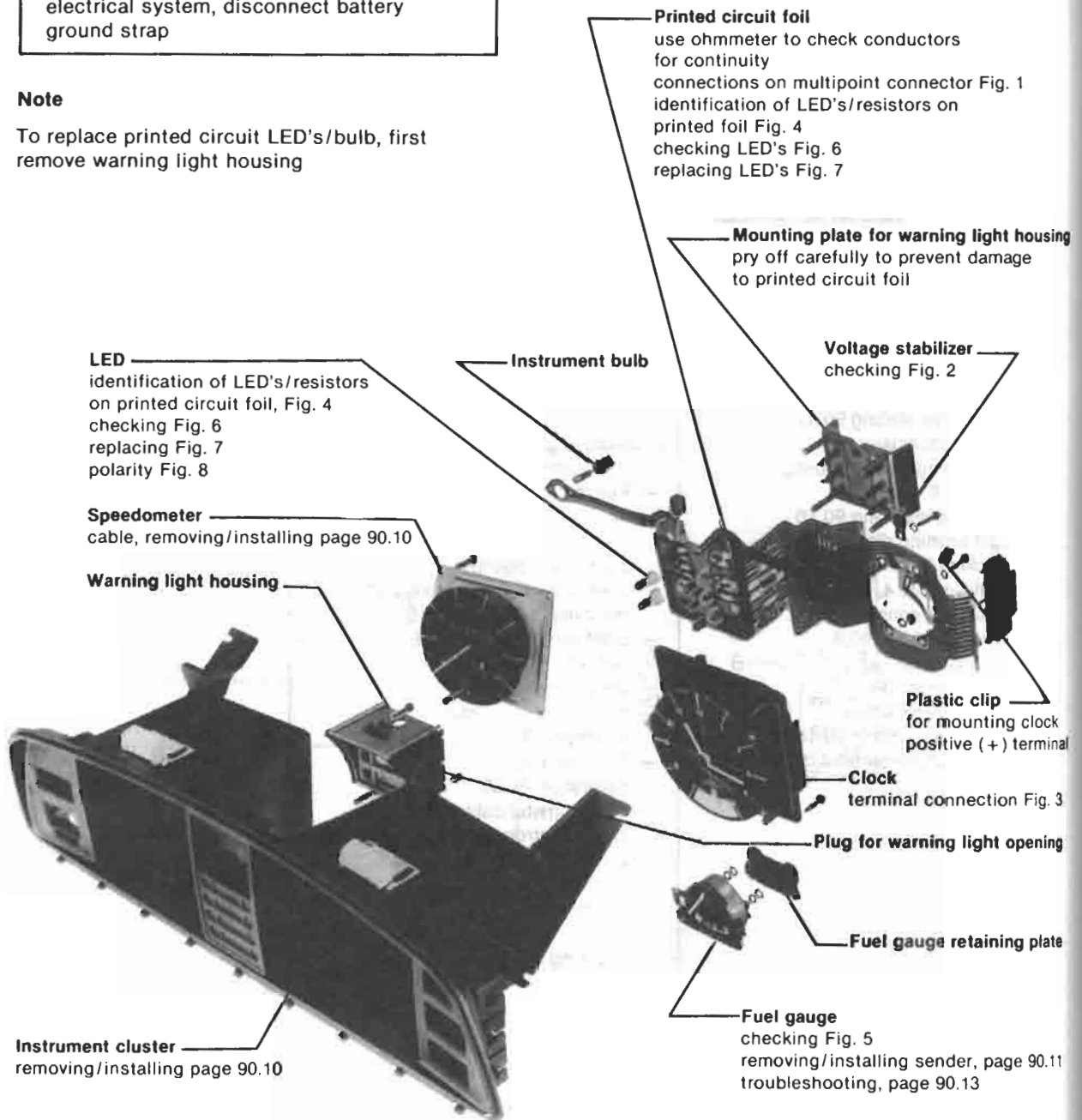
# 90 Electrical System-Instruments, Radio

## CAUTION

Before starting to work on any part of electrical system, disconnect battery ground strap

## Note

To replace printed circuit LED's/bulb, first remove warning light housing

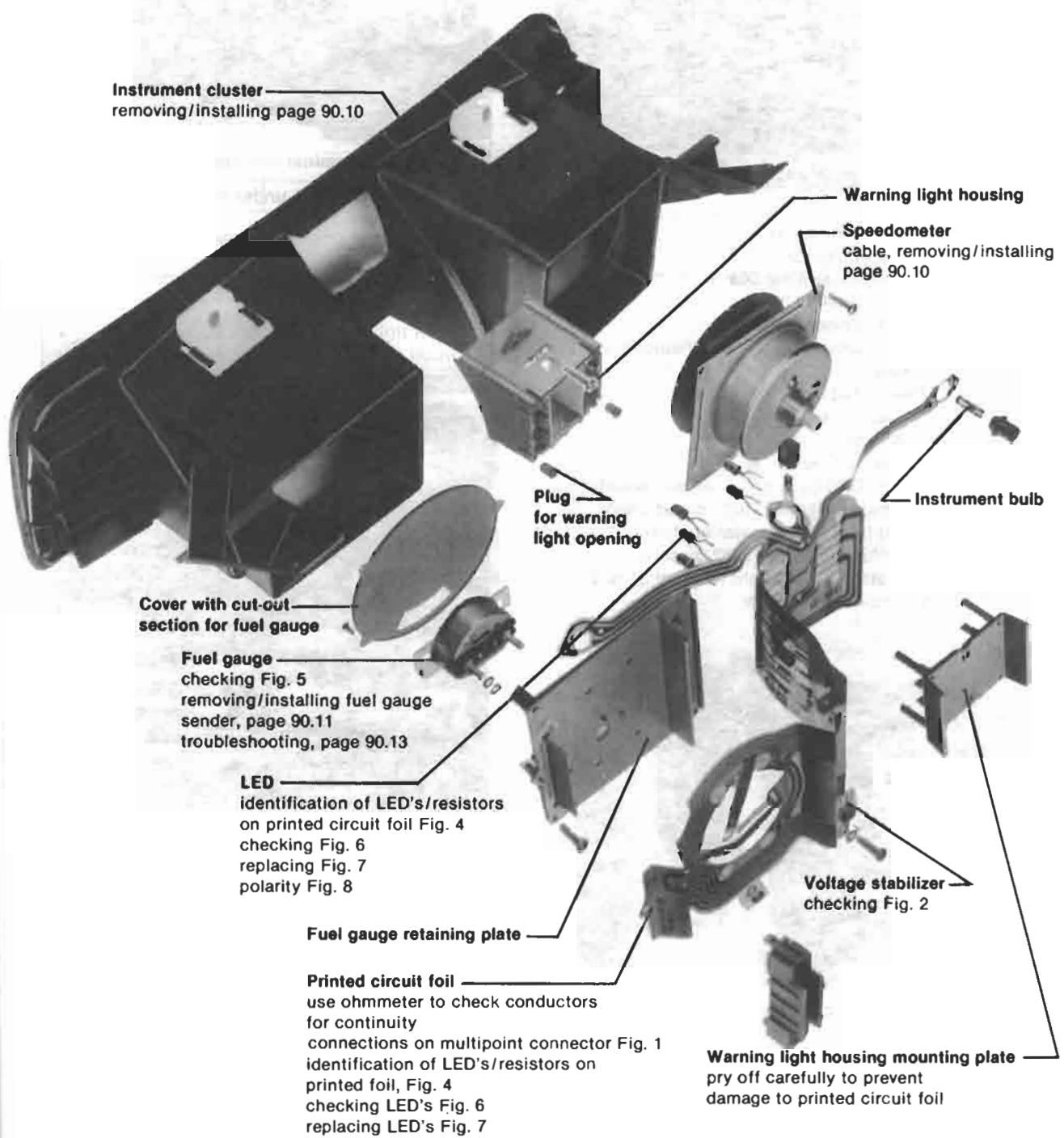


90-313

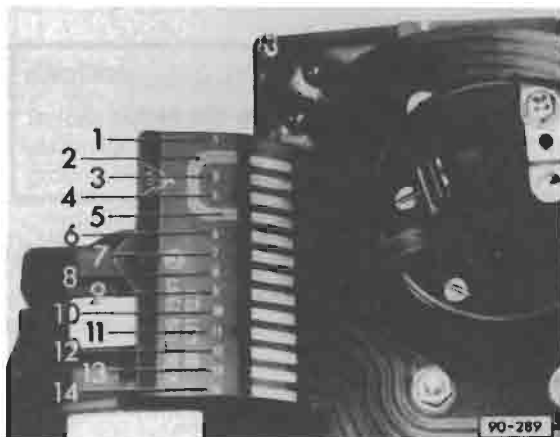
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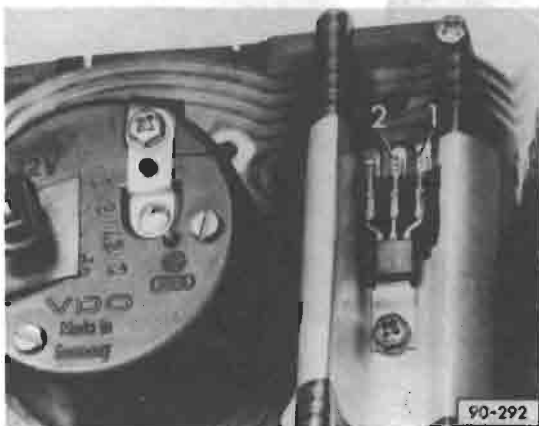


90-317



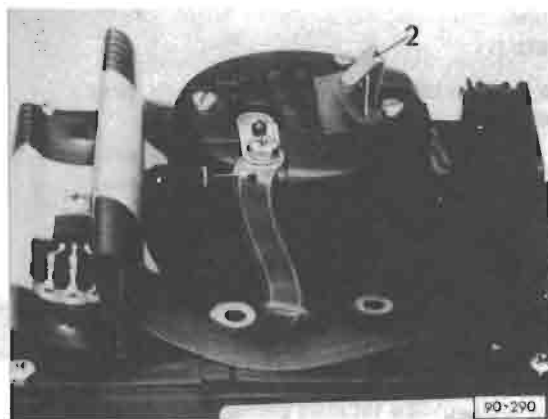
**Fig. 1 Multi-point connector terminals**

- 1 = vacant
- 2 = ground terminal 31
- 3 = instrument lights
- 4 = high beam terminal 56a
- 5 = ground terminal 31
- 6 = vacant (air-cooled)  
coolant temperature gauge (water-cooled, diesel)
- 7 = clock (if not installed, vacant)
- 8 = fuel gauge sender
- 9 = positive terminal 15
- 10 = oil pressure switch
- 11 = EGR or OXS (air-cooled, water-cooled)  
glow plug indicator (1983 diesel only)
- 12 = vacant (air-cooled, water-cooled)  
glow plug indicator (1982 diesel only)
- 13 = alternator warning light terminal 61 or D+
- 14 = indicator terminal 49a



**Fig. 2 Voltage stabilizer, checking**

- connect voltmeter between positive connection 1 and ground 2
- turn ignition switch **ON**
  - voltage should be approximately 10V
  - if voltage is above 10.5V or below 9.5V, voltage stabilizer is defective and must be replaced



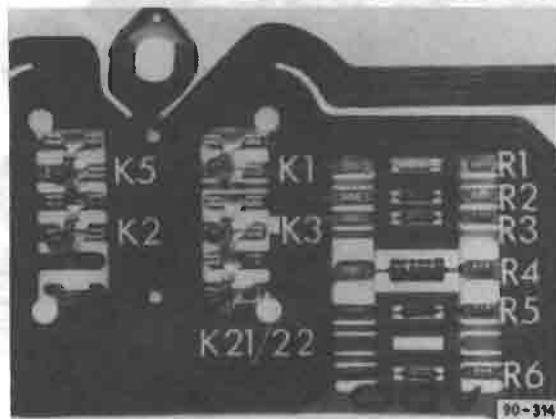
**Fig. 3 Clock terminal connections**

- place foil 1 under ground terminal of clock

### CAUTION

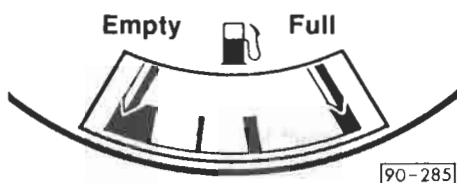
When tightening terminal, do not twist circuit foil or damage to foil may result

- secure terminal 2 with plastic clip



**Fig. 4 Identification of LED's/resistors on printed circuit foil**

- K1 = LED (red) high beam
- K2 = LED (red) alternator
- K3 = LED (red) oil pressure
- K5 = LED (green) turn indicator
- K21/22 = LED (red) EGR or OXS
- R1 = Resistor for K1 (470Ω)
- R2 = Resistor for K3 (470Ω)
- R3 = Resistor for K21/22 (470Ω)
- R4 = Resistor for voltage stabilizer (150Ω)
- R5 = Resistor for K2 (470Ω)
- R6 = Resistor for K5 (470Ω)

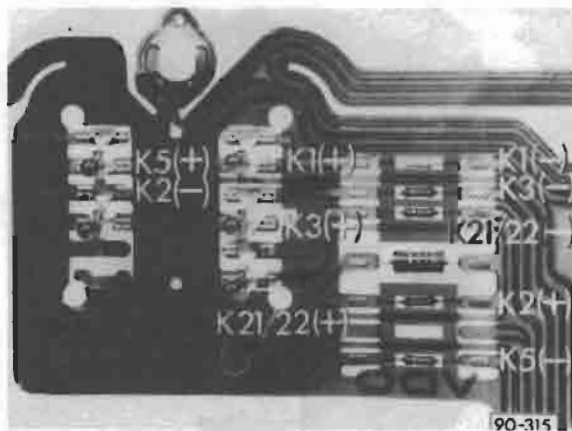


**Fig. 5 Fuel gauge, checking**

— set tester VW 1301 to following test values:

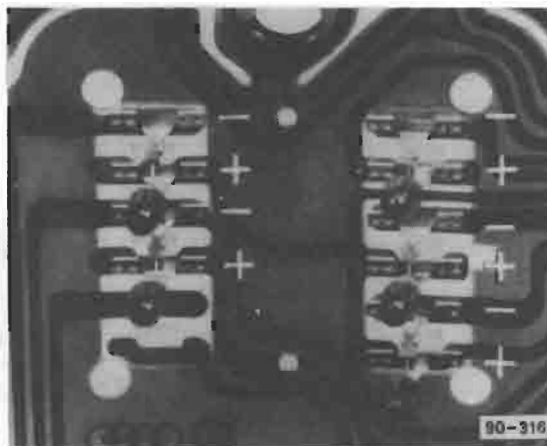
Tester dial setting	Fuel gauge reading*
55	full
560	empty

\*deviation of one needle width to left or right is OK



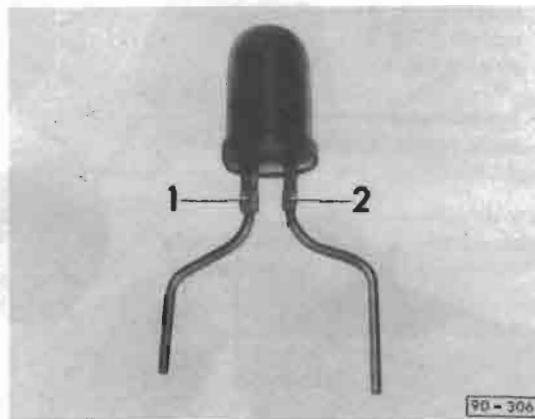
**Fig. 6 LED's, checking**

- connect battery positive lead to LED K1 (+)
- connect negative battery lead to LED K1 (-).
- repeat this test step consecutively on remaining LED's
  - LEDS must light



**Fig. 7 LED's, replacing**

— note polarity of LED's (see Fig. 8) when plugging into printed circuit



**Fig. 8 LED polarity, checking**

- 1 = negative terminal
- 2 = positive terminal
- negative terminal is slightly wider

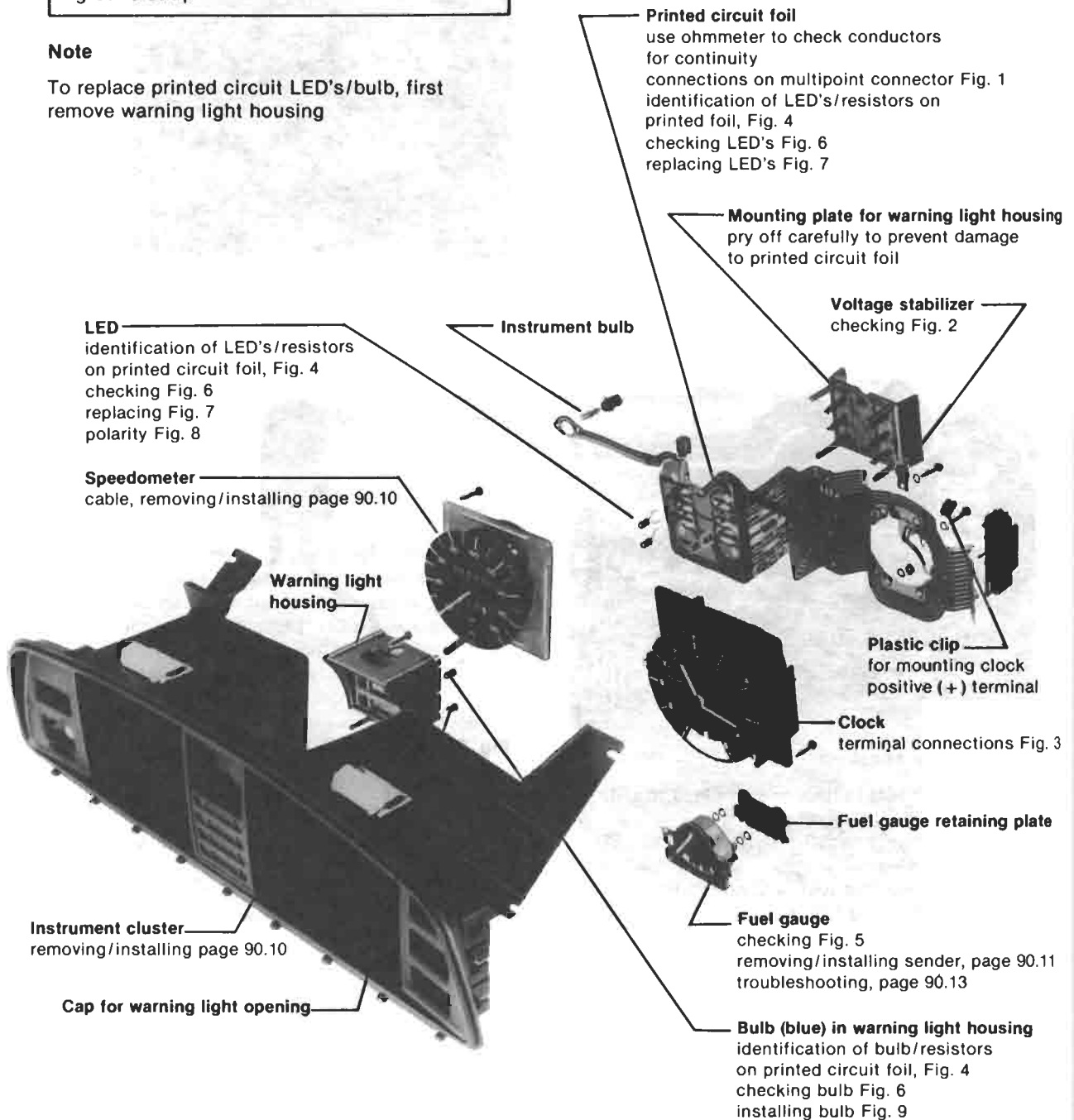
# 90 Electrical System-Instruments, Radio

## CAUTION

Before starting to work on any part of electrical system, disconnect battery ground strap

## Note

To replace printed circuit LED's/bulb, first remove warning light housing



90-286

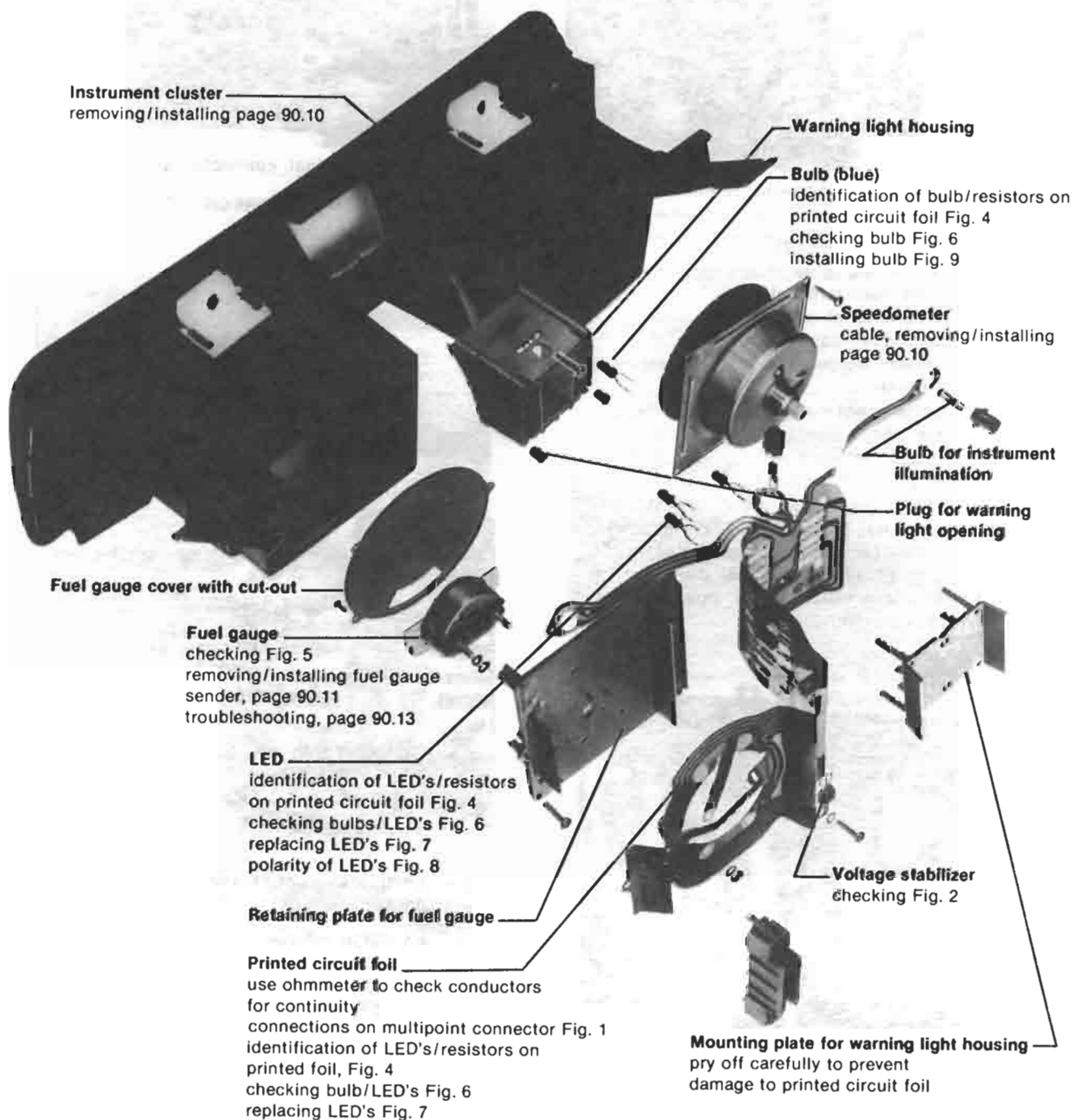


**Note**

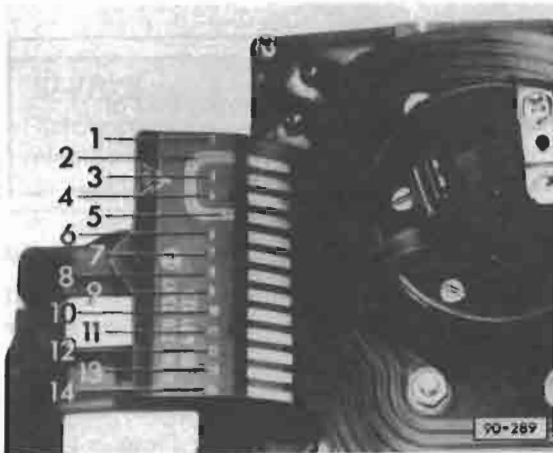
To replace printed circuit LED's/bulb, first remove warning light housing

**CAUTION**

Before starting to work on any part of electrical system, disconnect battery ground strap

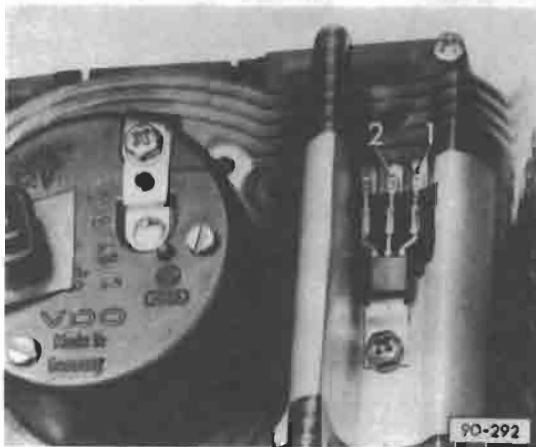


90-284



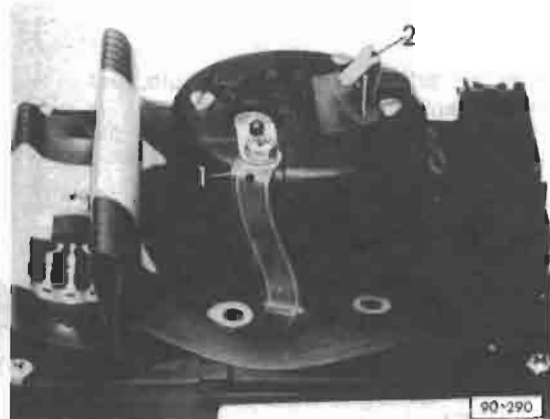
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- 9 = positive terminal 15
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- 11 = vacant (air-cooled, water-cooled)  
glow plug indicator (1983 diesel only)
- 12 = vacant (air-cooled, water-cooled)  
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**Fig. 2 Voltage stabilizer, checking**

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  - voltage should be approximately 10V
  - if voltage is above 10.5V or below 9.5V, voltage stabilizer is defective and must be replaced



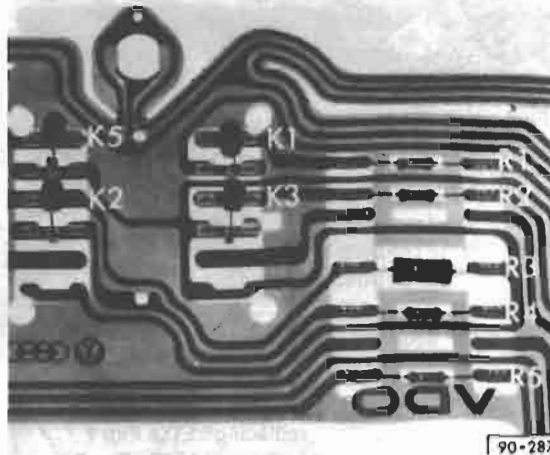
**Fig. 3 Clock terminal, connections**

- place foil 1 under ground terminal of clock

### CAUTION

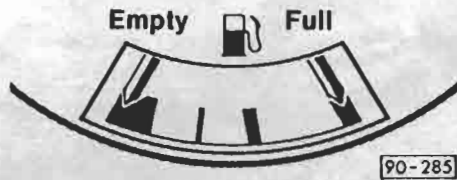
When tightening terminal, do not twist circuit foil or damage to foil may result

- secure terminal 2 with plastic clip



**Fig. 4 Identification of LED's/resistors/bulb on printed circuit foil**

- K1 = bulb (blue) high beam
- K2 = LED (red) alternator
- K3 = LED (red) oil pressure
- K5 = LED (green) turn indicator
- R1 = Series resistor for K1 (270Ω)
- R2 = Series resistor for K3 (470Ω)
- R3 = Series resistor for alternator pre-exciter circuit (150Ω)
- R4 = Series resistor for K2 (470Ω)
- R5 = Series resistor for K5 (470Ω)



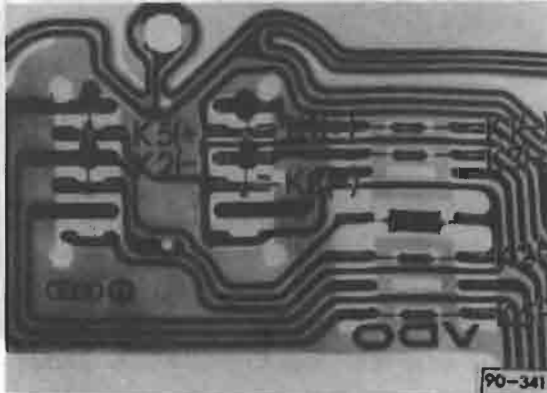
90-285

**Fig. 5 Fuel gauge, checking**

— set tester VW 1301 to following test values:

Tester dial setting	Fuel gauge reading*
55	full
560	empty

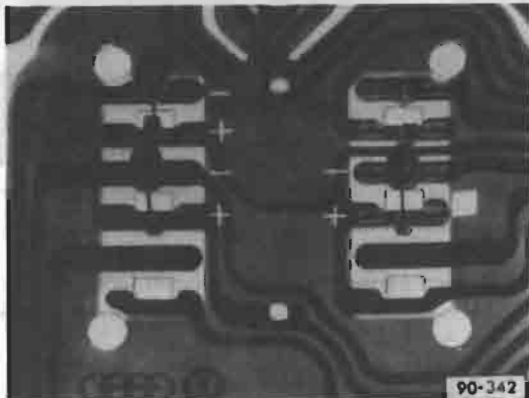
\*deviation of one needle width to left or right is OK



90-341

**Fig. 6 Bulb/LED's, checking**

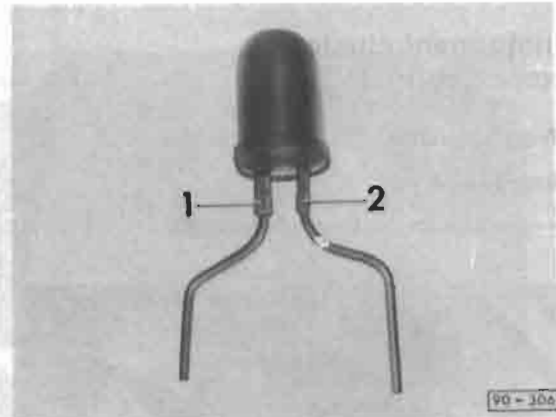
- connect battery positive lead to LED K1 (+)
- connect negative battery lead to LED K1 (-)
- repeat this test step consecutively on remaining LED's
  - warning lights must light



90-342

**Fig. 7 LED's, replacing**

— note polarity of LED's (see Fig. 8) when plugging into printed circuit



90-366

**Fig. 8 LED polarity, checking**

- 1 = negative terminal
- 2 = positive terminal
- negative terminal is slightly wider



90-291

**Fig. 9 Bulb in warning light housing, installing**

- press blue bulb through slot into guide with screwdriver
  - bulb must be heard to engage (LED's slide freely into guide)

## Instrument cluster, removing/installing

### Work sequence

#### Removing

- disconnect battery ground strap



- put fingers into recesses (arrows) and pull up cluster cover



- pull hazard warning switch forward
- pull dual circuit brake/parking brake warning light housing forward (driving direction)
- remove screws (arrow) and instrument cluster

## Installing



- insert cover into retaining lugs
- press frame down and tilt cover forward to engage

## Speedometer cable, removing/installing

### Work sequence

#### Removing

- disconnect battery ground strap
- disconnect speedometer cable
- remove spare tire

#### USA only



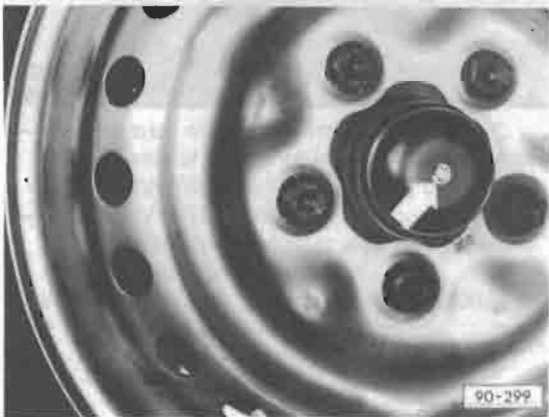
- disconnect speedometer cables from EGR/oxygen sensor mileage counter (arrows)



— remove nut from bracket (arrow)



- when installing cable, align marks (arrows) on cable
- after installing circlip on speedometer cable end, seal with silicone seal



— remove circlip from speedometer cable (arrow)

### CAUTION

To avoid premature cable failure, position cable so it is free of strain or sharp bends. Do not grease connection to speedometer; this could cause needle to stick

## Fuel gauge sender, removing/installing

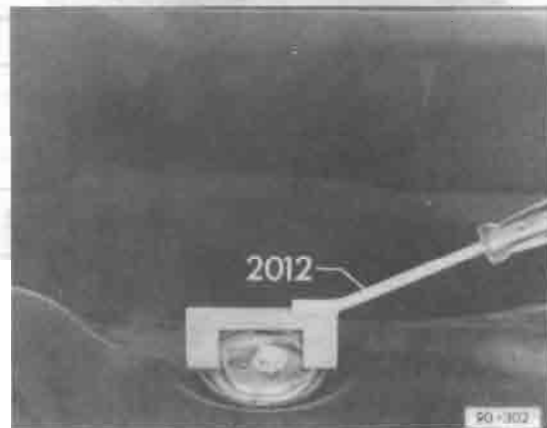
### Work sequence

#### Removing

- disconnect battery ground strap
- remove fuel tank (see Repair Group 20)



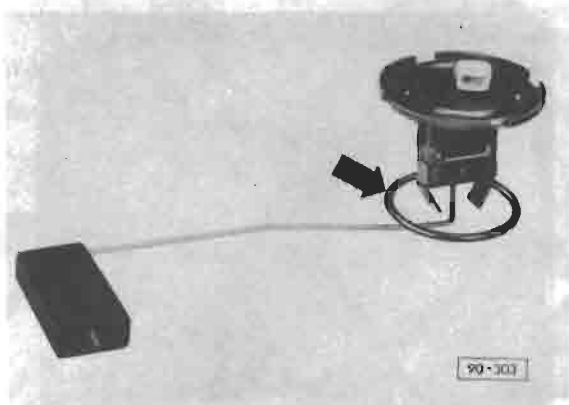
— remove speedometer cable from rubber sleeve in steering knuckle (arrow)



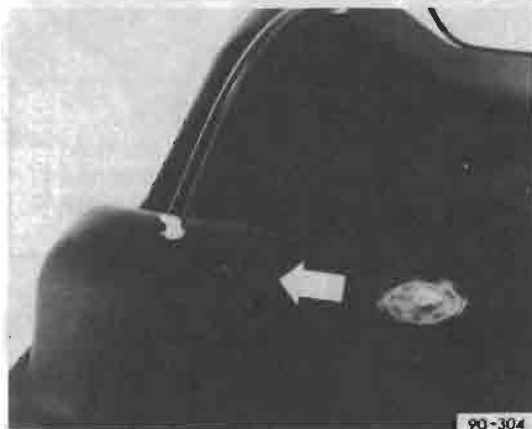
- mark position before removing
- remove sender by turning it counter-clockwise
- go to next page

# 90 Electrical System-Instruments, Radio

## Installing



— coat sealing ring (arrow) with graphite



— install sender unit so float is facing driving direction (arrow)  
— turn sender unit clockwise to stop



— attach positive and negative wires as shown

- 1 = fuel gauge connection
- 2 = ground connection

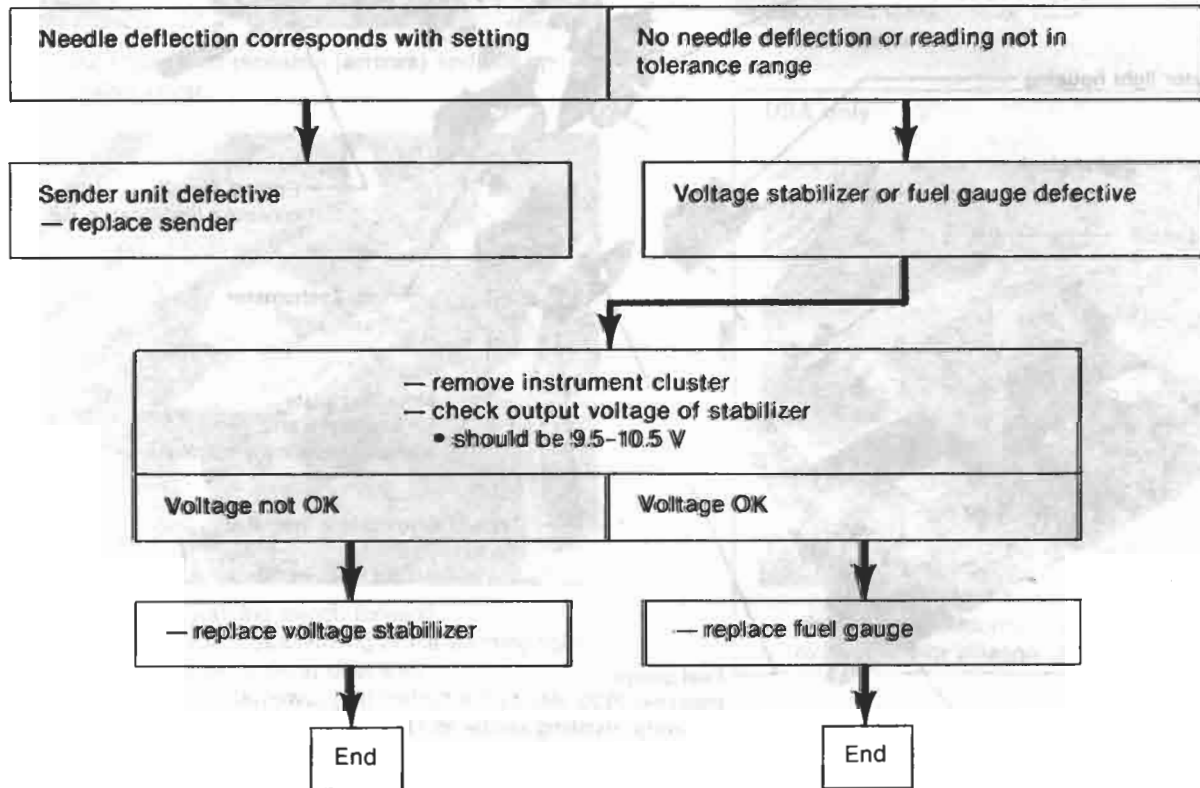


## Fuel gauge, troubleshooting

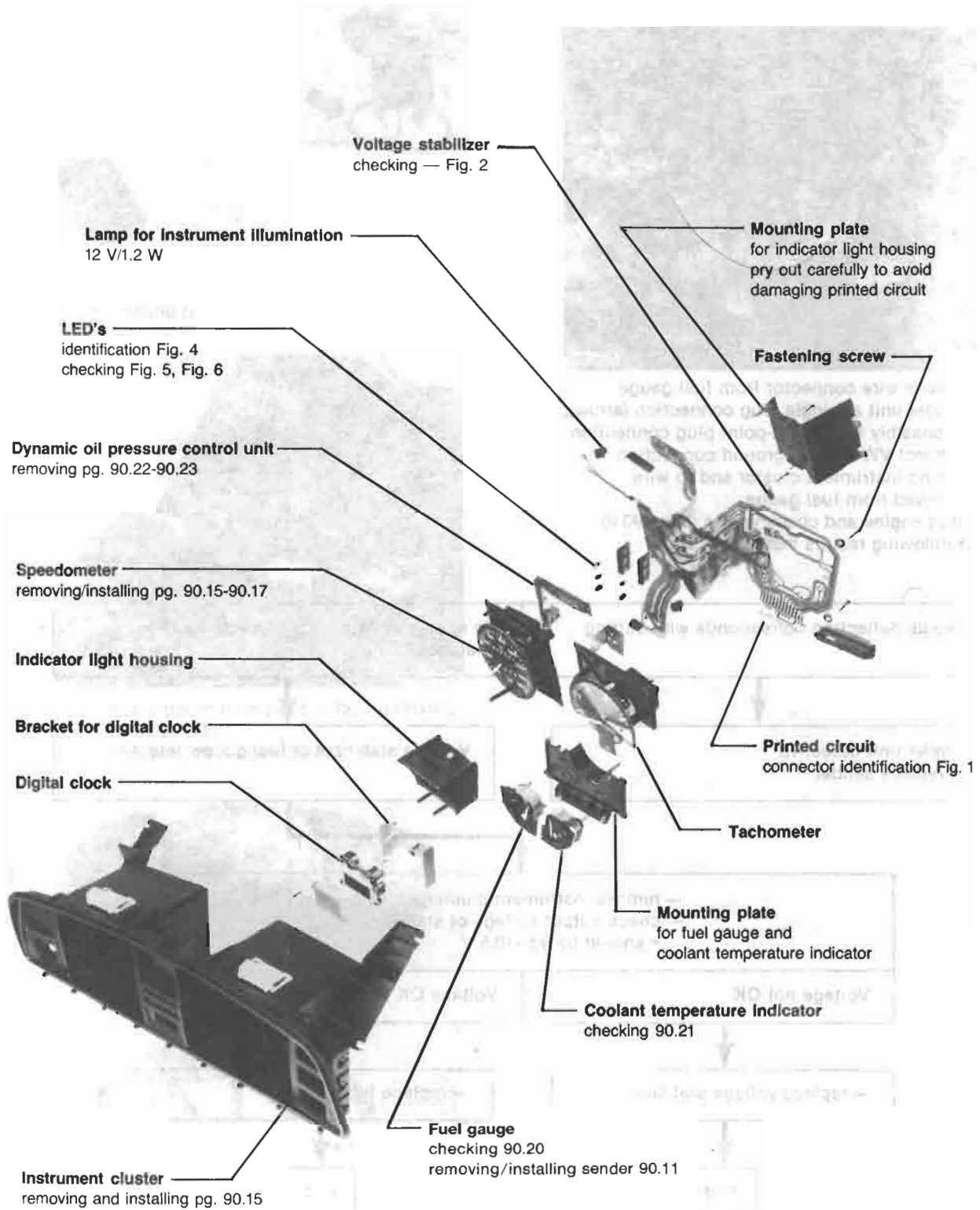
### Work sequence



- remove wire connector from fuel gauge sender unit at single plug connection (arrow), or possibly from multi-point plug connection
- connect VW 1301 to ground connection behind instrument cluster and to wire removed from fuel gauge
- start engine and check values (page 90.9)
  - following results may be shown:



## Instrument cluster, with tachometer





## Instrument cluster, removing/installing

### CAUTION

Before starting to work on any part of the electrical system, disconnect battery ground strap

### Work sequence

#### Removing

- disconnect battery ground strap



- put fingers into recesses (**arrows**) and pull up cluster cover



- pull hazard warning switch forward
- pull dual circuit brake/parking brake warning light housing forward (driving direction)
- remove screws (**arrows**) and instrument cluster

### Installing



- insert cover into retaining lugs
- press frame down and tilt cover forward to engage

## Speedometer cable, removing/installing

### Work sequence

#### Removing

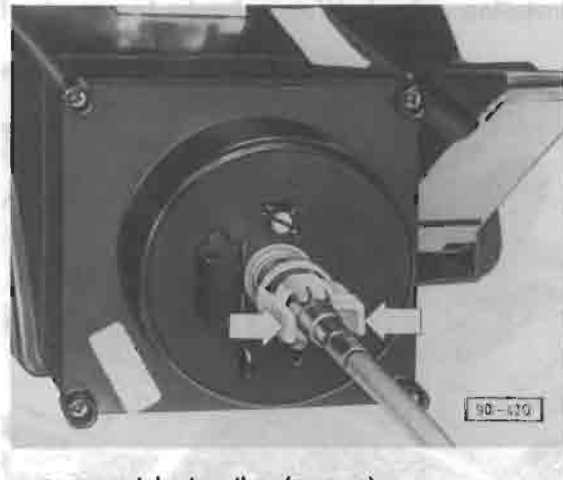
- disconnect battery ground strap
- disconnect speedometer cable
- remove spare tire

### USA only

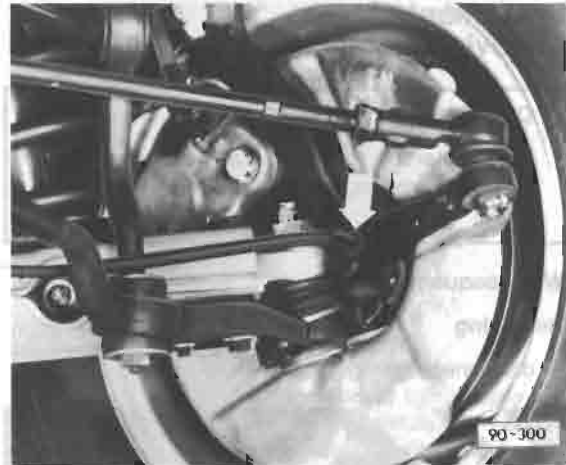


- disconnect speedometer cables from EGR/oxygen sensor mileage counter (**arrows**)

# 90 Electrical System-Instruments, Radio



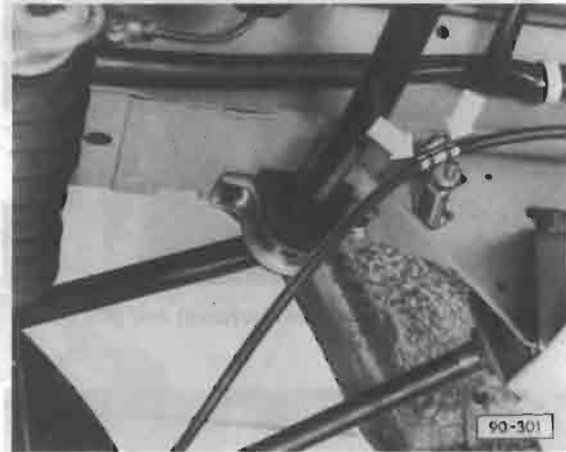
- squeeze tabs together (**arrows**)
- pull cable from speedometer



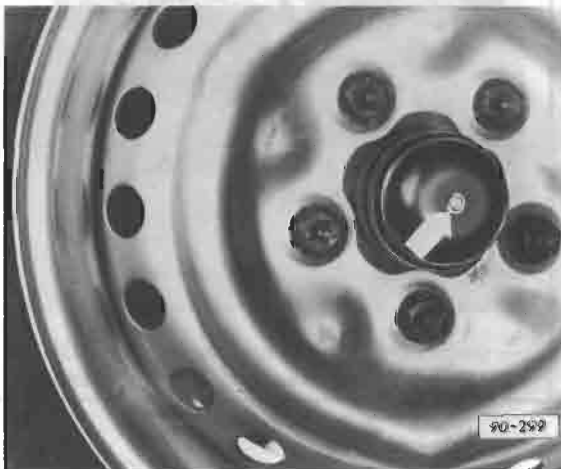
- remove speedometer cable from rubber sleeve in steering knuckle (**arrow**)



- remove nut from bracket (**arrow**)



- when installing cable, align marks (**arrows**) on cable
- after installing circlip on speedometer cable end, seal with silicone seal



- remove circlip from speedometer cable (**arrow**)

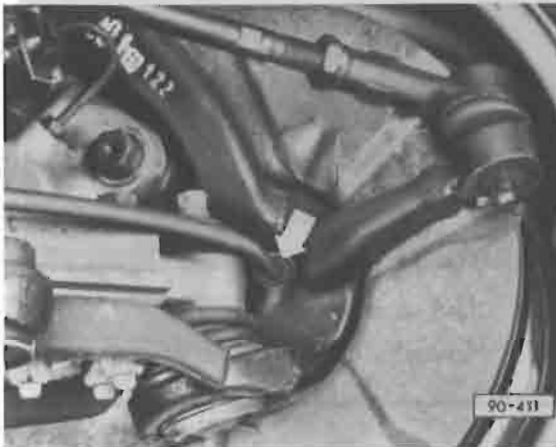
## CAUTION

To avoid premature cable failure, position cable so it is free of strain or sharp bends. Do not grease connection to speedometer; this could cause needle to stick.

more

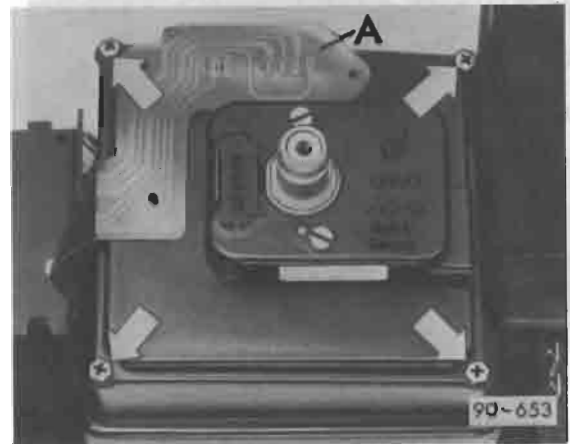
## CAUTION

When replacing the drive cable, the rubber sleeve in the steering knuckle must be replaced.



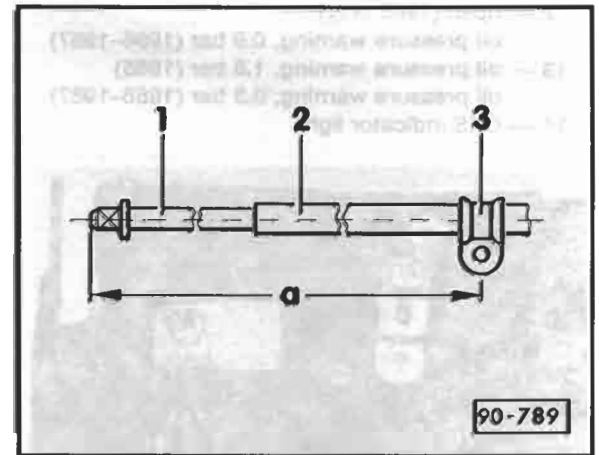
- push rubber sleeve to stop (**arrow**) with socket wrench
  - sleeve must be flush with steering knuckle
- push cable through rubber sleeve and through dust cap
- fasten circlip on speedometer and seal with sealing material

## Speedometer, removing



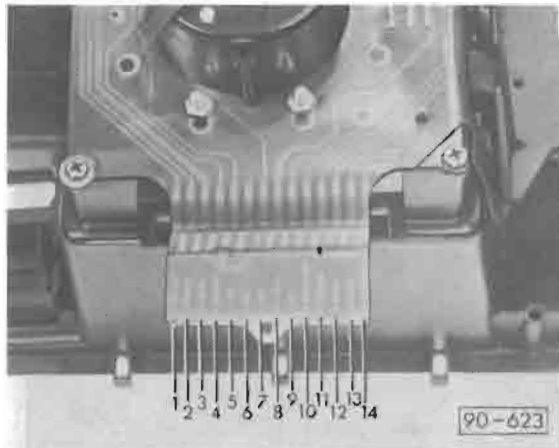
- remove instrument cluster
- remove printed circuit for dynamic oil pressure system (**A**)
- remove screws (**arrows**)
- remove speedometer

## Speedometer cable, installing (from VIN: 25H H 040 185 — except Syncro)



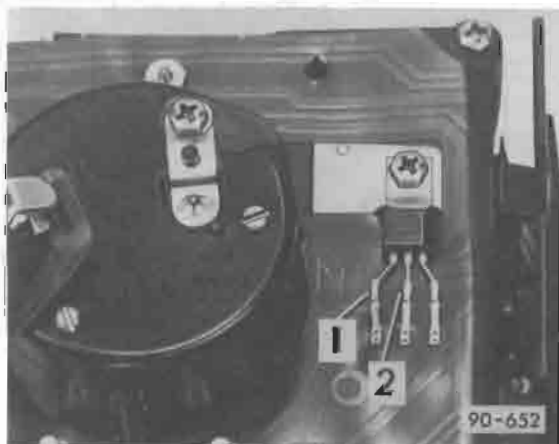
A new speedometer cable has been installed in vehicles from **VIN: 25H H 040 185**. Cable housing **2** has been lengthened and the installation mark found on previous cables has been deleted.

- measure distance **a** from end of cable **1** and mark cable housing **2**
  - **a** = 740 mm (29.1 in.)
- install cable clamp **3** on cable housing and center over mark
- install speedometer cable and tighten cable clamp



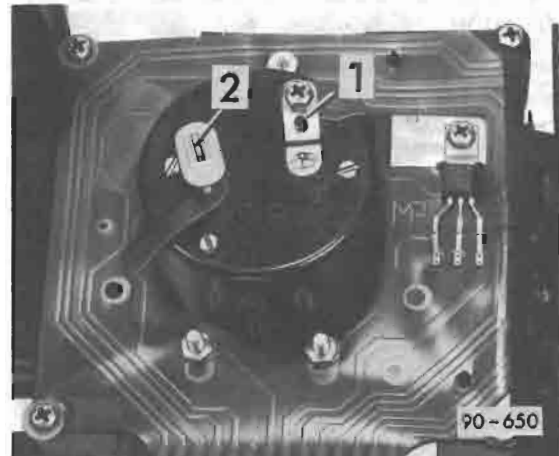
**Fig. 1 Wiring of 14 pin connector**

- 1 — instrument illumination
- 2 — high beam warning — terminal 56a
- 3 — ground, terminal 31
- 4 — open
- 5 — clock
- 6 — coolant temperature display — to sensor
- 7 — fuel gauge — to sender
- 8 — plus, terminal 15
- 9 — tachometer, terminal 1/W
- 10 — blinker warning, terminal 49a
- 11 — alternator warning, terminal 61
- 12 — open (1985 only)  
oil pressure warning, 0.9 bar (1986–1987)
- 13 — oil pressure warning, 1.8 bar (1985)  
oil pressure warning, 0.3 bar (1986–1987)
- 14 — OXS indicator light



**Fig. 2 Voltage stabilizer, checking**

- connect voltmeter between positive connection 1 and ground 2
  - voltage should be approximately 10V
  - if voltage is above 10.5V or below 9.5V, voltage stabilizer is defective and must be replaced



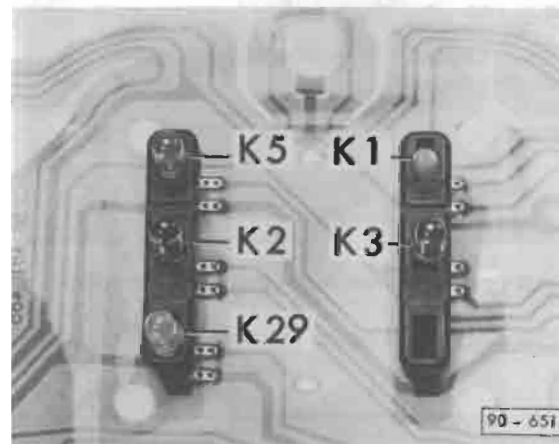
**Fig. 3 Clock terminal, connections**

— place foil 1 under ground terminal of clock

**CAUTION**

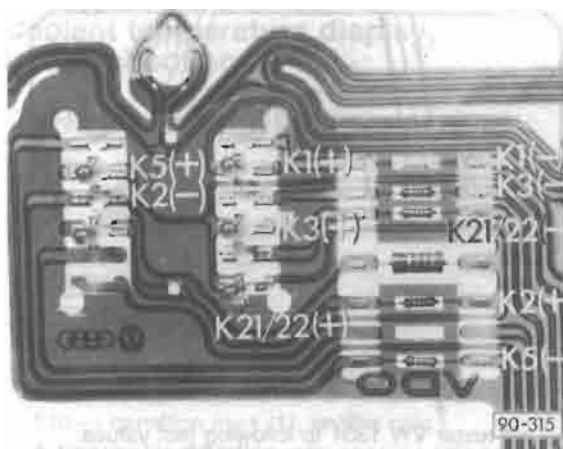
When tightening terminal, do not twist circuit foil or damage to foil may result

— secure terminal 2 with plastic clip



**Fig. 4 Identification of LED's/resistors/bulb on printed circuit foil**

- K1 = bulb (blue) high beam
- K2 = LED (red) alternator
- K3 = LED (red) oil pressure
- K5 = LED (green) turn indicator
- K29 = LED (yellow) glow plugs



**Fig. 5 LED's, checking**

- connect battery **positive** lead to LED **K1 (+)**
- connect **negative** battery lead to LED **K1 (-)**.
- repeat this test step consecutively on remaining LED's
  - LED's must light

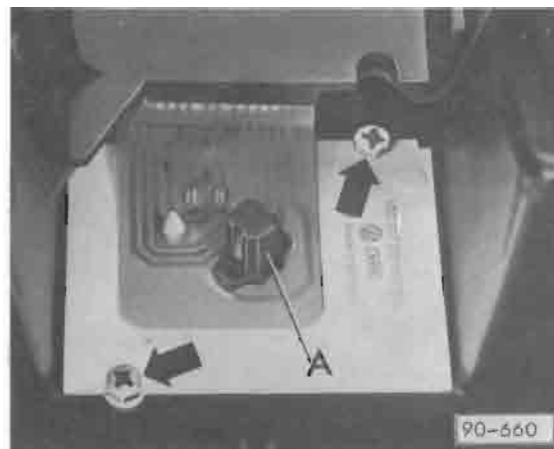
**CAUTION**

When replacing LED's do not reverse polarity



**Fig. 6 LED polarity, checking**

- 1 = negative terminal
- 2 = positive terminal
- negative terminal is slightly wider

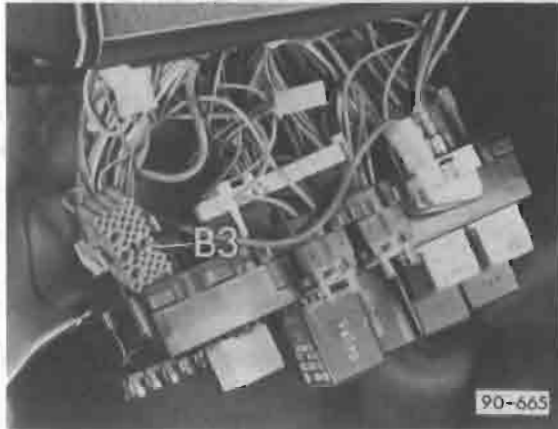


**Fig. 7 Digital clock (LED quartz clock), replacing**

- remove mounting **screws** (arrows)
- remove clock light (**A**)
- remove connector
- remove digital clock

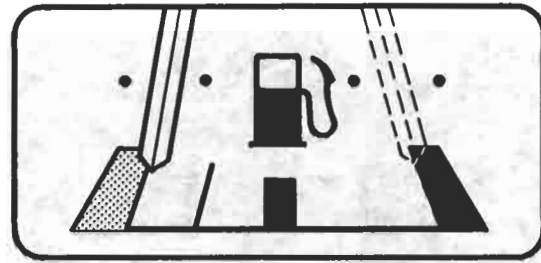
## Fuel gauge, troubleshooting

### Work sequence



- remove multi-point connector (B) (RED)
- connect tester VW 1301 on ground star behind the instrument panel and on multi-point connector terminal B3
- start engine
- check specified values with VW 1301

Full: 50 Empty: 320



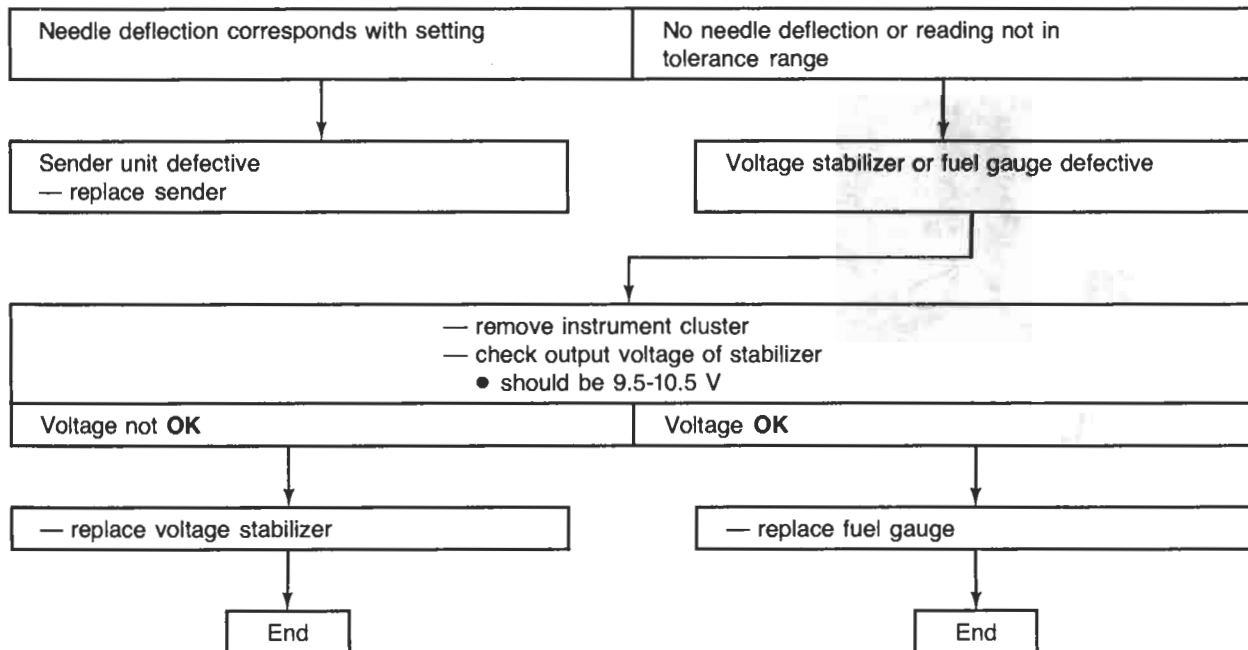
90-269

### Fuel gauge, checking

- set tester VW 1301 to following test values:

Test dial setting	Fuel gauge reading*
50	full
320	empty

\*deviation of one needle width to left or right is OK

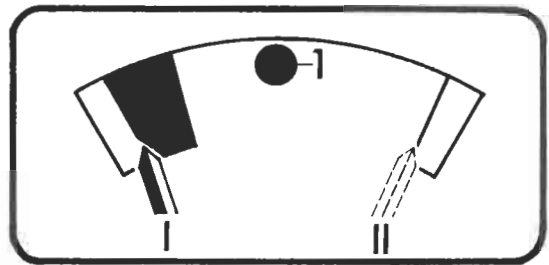
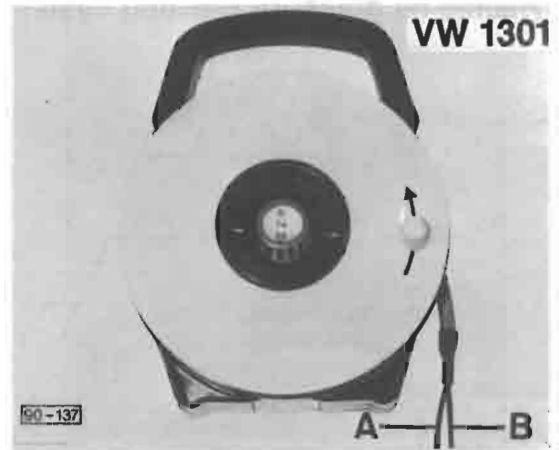


## Coolant temperature display, troubleshooting

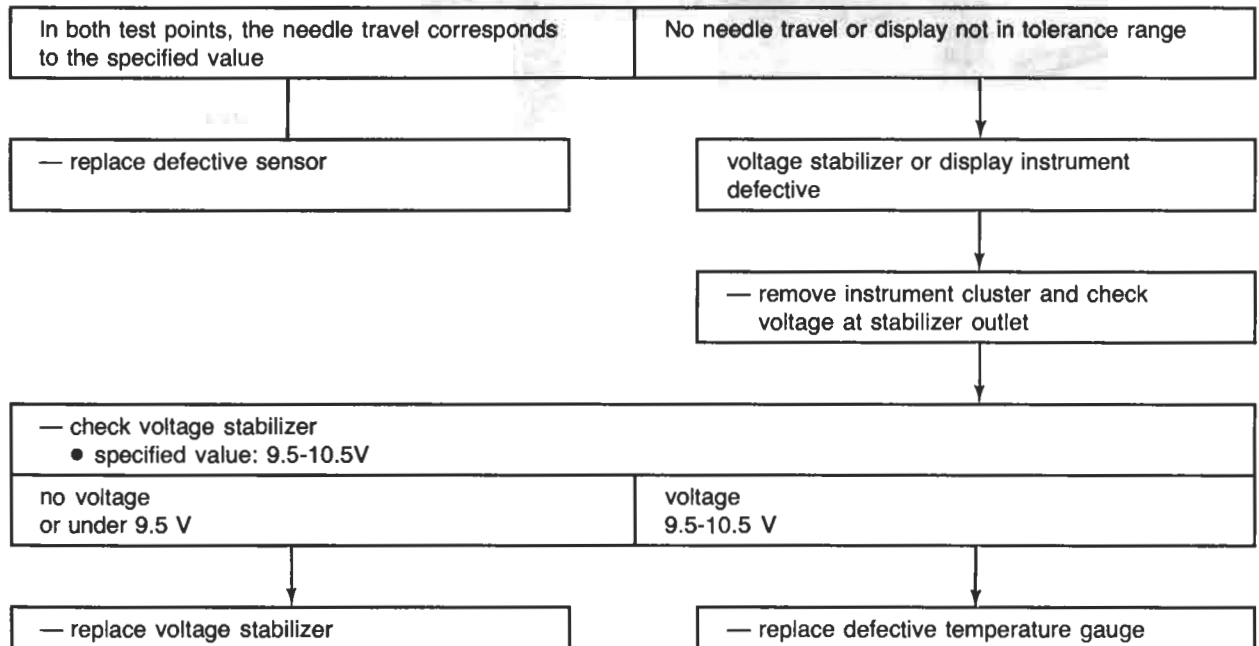
Test requirement: Battery **OK**

- remove wire on coolant temperature sensor
- connect tester VW 1301
  - A — to coolant temperature display
  - B — to ground
- switch ignition **ON**
- set VW 1301 to the following values:
  - 50 — warning range (11), engine too hot  
red LED flashes
  - 510 — transition area (1), engine cold
    - permissible deviation, one needle width right or left.

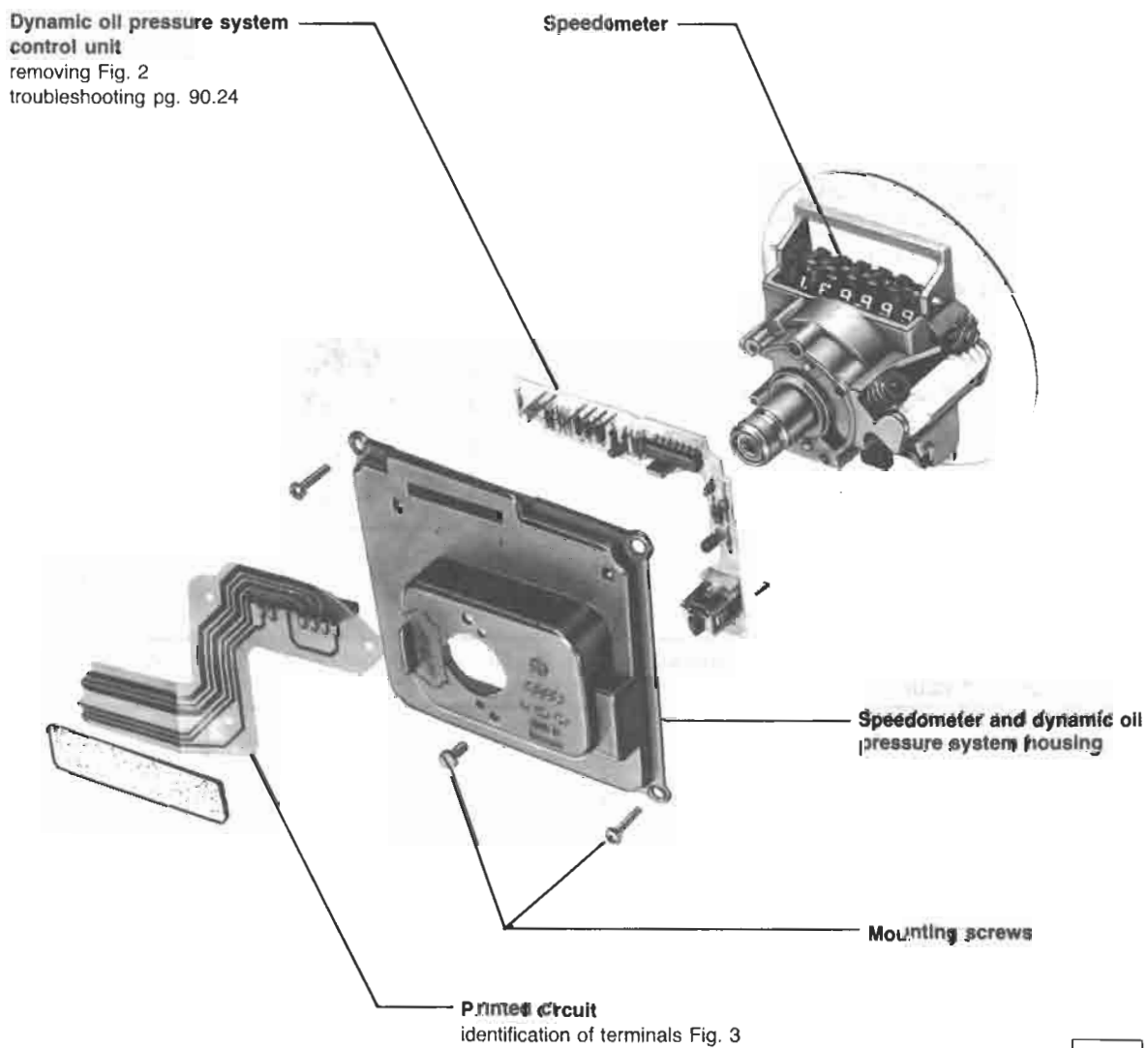
The following results may be obtained:



90-318

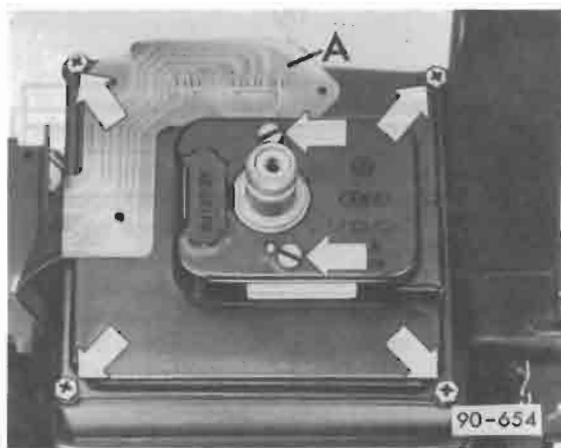


## Dynamic oil pressure warning system



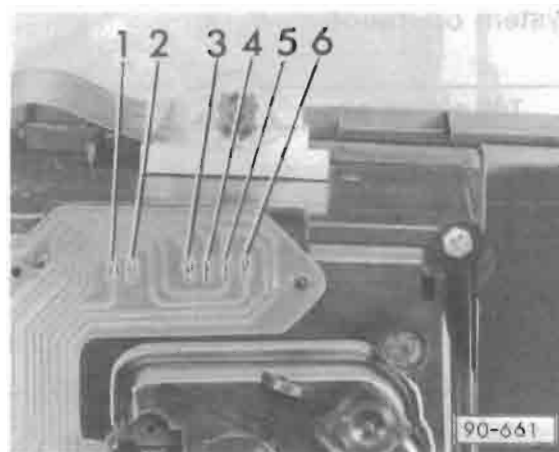
90-624





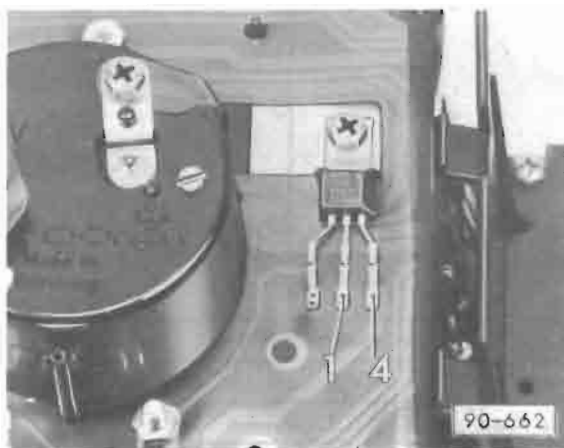
**Fig. 1 Speedometer, removing**

- remove printed circuit (A) and dynamic oil pressure system connection
- remove mounting screws (arrows)
- remove speedometer



**Fig. 3 Dynamic oil pressure control unit, terminal identification**

- 1 — oil pressure switch 0.3 bar
- 2 — oil pressure switch 0.9 bar
- 3 — plus
- 4 — oil pressure warning light
- 5 — ground
- 6 — terminal 1



**Fig. 2 Control unit for dynamic oil pressure system, removing**

- remove screw (1)
- push mounting clips in direction of arrows
- remove dynamic oil pressure control unit

# 90 Electrical System-Instruments, Radio

## System operation

Test sequence	Operation of flashing LED (red) and buzzer*
engine not running ● ignition <b>ON</b>	— LED must flash — buzzer must not sound
engine running less than 2000 rpm ● wire on 0.3 bar oil pressure switch pulled off and connected to ground	— LED must flash — buzzer must not sound
engine running more than 2000 rpm ● wire on 0.9 bar oil pressure switch pulled off but not connected to ground	— LED must flash — buzzer must sound

### Note

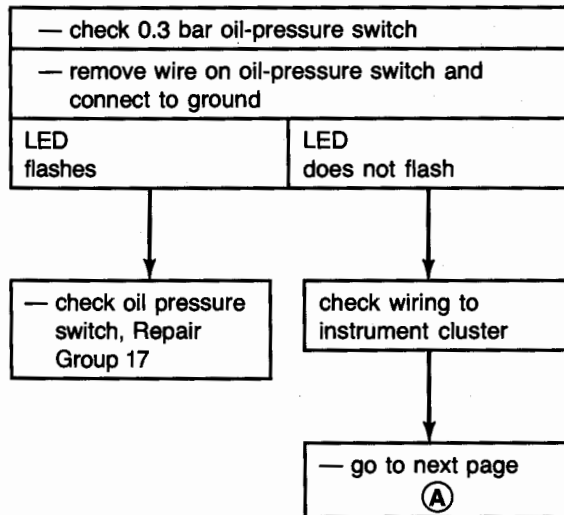
If system is still not operating properly, check by Troubleshooting

### Troubleshooting

Dynamic oil-pressure system light (LED) does not flash when ignition is switched **ON**

check these first:

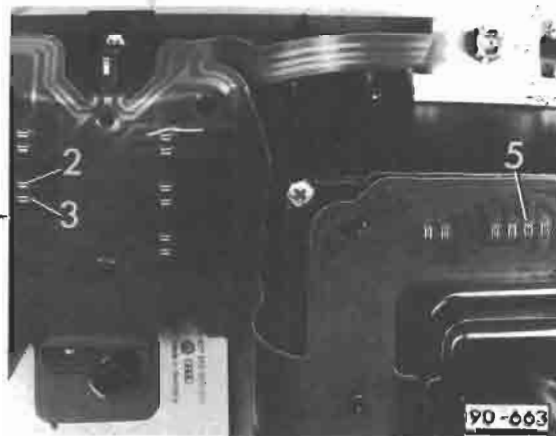
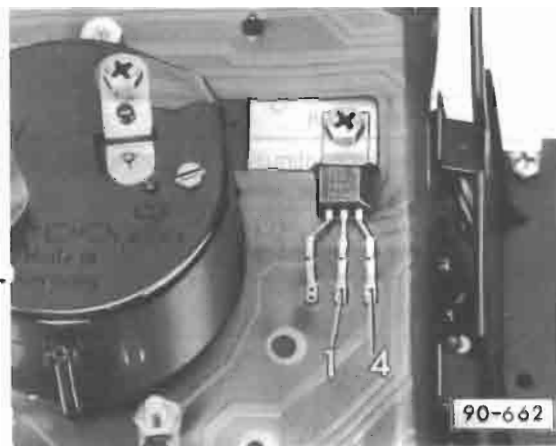
- flashing LED (red) for fuel gauge and coolant temperature gauge is **OK**



Ⓐ

check dynamic oil-pressure system

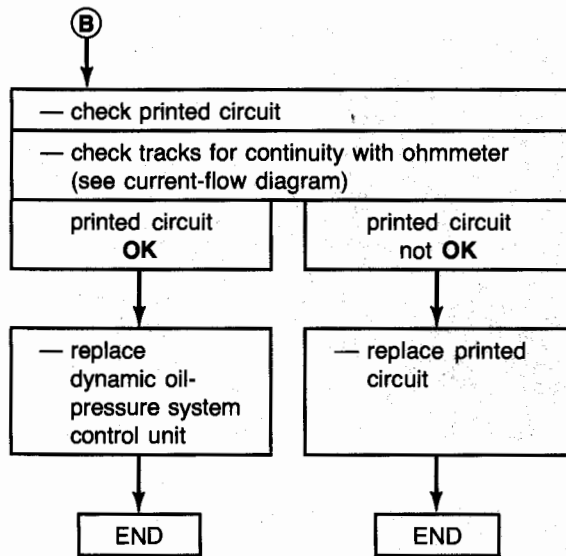
- remove instrument cluster (for following tests use 12 Volt battery as power source and voltmeter)
- connect battery ground to voltage stabilizer 1 with test probe
- connect battery ground to terminal 5 with test probe
- connect voltmeter to terminals 2 and 3
- connect battery plus to voltage stabilizer 4 with test probe



Test shows	voltmeter reading	possible causes	repair instructions
LED flashing	approx. 8.5 V	Zener diode defective	replace printed circuit and LED
	approx. 5.5 V	track of printed circuit broken	replace printed circuit
LED not flashing	approx. 5.0 V	LED defective	replace LED
	approx. 12.0 V	LED and Zener diode defective	replace printed circuit and LED
	approx. 0.0 V		

Go To  
Ⓑ  
NEXT PAGE

# 90 Electrical System-Instruments, Radio

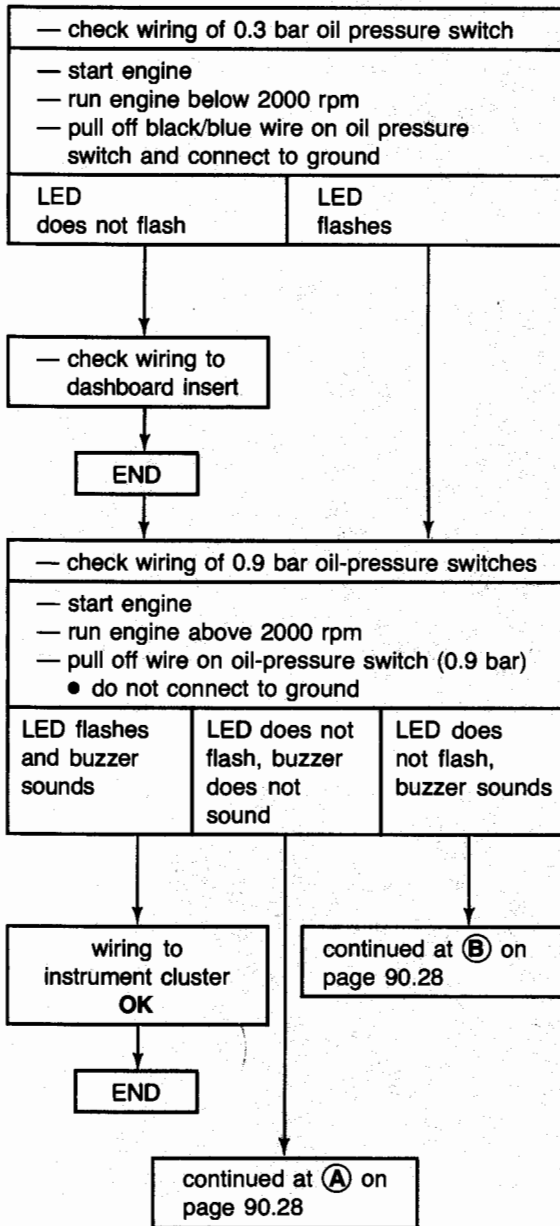


## Troubleshooting

LED flashes and buzzer sounds while driving car although oil pressure is correct

Check these first:

- fuel gauge, coolant-temperature gauge, 0.3 bar and 0.9 bar oil-pressure switches are **OK**



# 90 Electrical System-Instruments, Radio

Ⓐ  
continued  
from page 90.27

check these first:

- voltage from ignition coil terminal 1 present at instrument cluster connector T14/9

voltage from ignition coil terminal 1 is not reaching oil-pressure warning-system control unit

- disconnect battery ground cable
- swing instrument cluster out
  - do not pull off connectors from instrument cluster
- connect battery ground cable
- switch ignition **ON**
- connect test light at 1

test light does not light up

test light lights up

- replace printed circuit

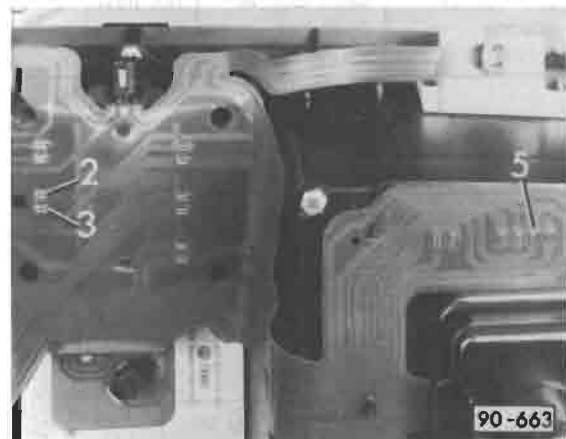
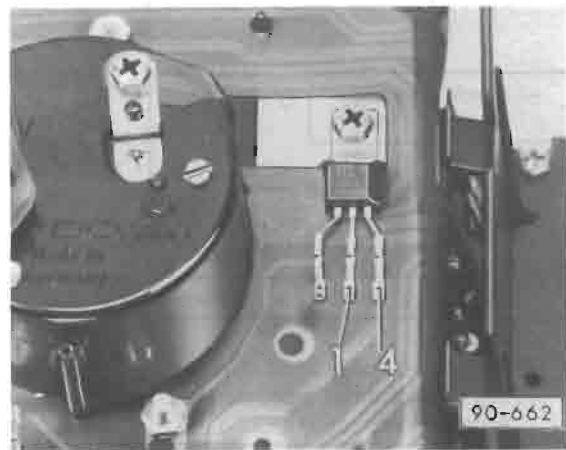
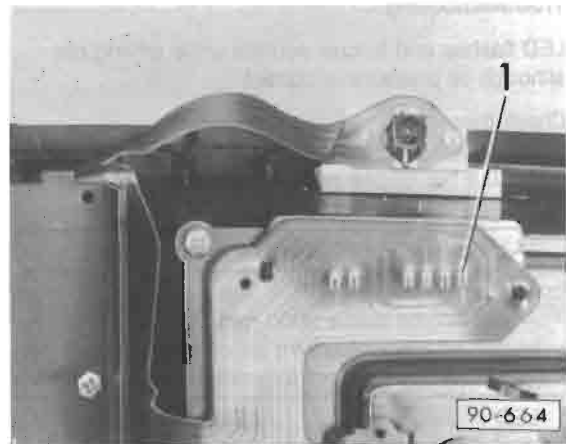
END

Ⓑ  
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from page 90.27

check dynamic oil-pressure system

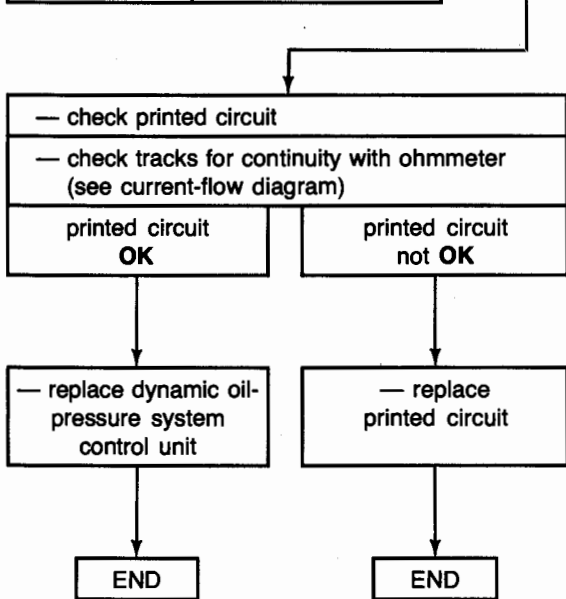
- remove dashboard cluster (for following tests use 12 Volt battery as power source and voltmeter)
- connect battery ground to voltage stabilizer 1 with test probe
- connect battery ground to terminal 5 with test probe
- connect voltmeter to terminals 2 and 3
- connect battery plus to voltage stabilizer 4 with test probe

continued  
on page 90.29



continued  
from page 90.28

Test shows	voltmeter reading	possible causes	repair instructions
LED flashing	approx. 8.5 V	Zener diode defective	replace printed circuit and LED
	approx. 5.5 V	track of printed circuit broken	replace printed circuit
LED not flashing	approx. 5.0 V	LED defective	replace LED
	approx. 12.0 V	LED and Zener diode defective	replace printed circuit and LED
	approx. 0.0 V		



# 90 Electrical System-Instruments, Radio

## Speedometer head

As of May 1983 the existing regulations (FMVSS 127) concerning vehicle speed indication were cancelled by the Department of Transportation (DOT). Starting May 1983, the only requirement is that the vehicles' speedometer indicate a higher speed than is actually being driven.

Speedometers having European calibration specifications were installed in vehicles for model years 1984 through 1985 (until December 1984 production). These speedometer heads have a basic tolerance of (+) 6.2 miles per hour with an additional (+) 5% of the actual speed driven. For example:

Actual Speed	50 Miles Per Hour
+ Basic Tolerance	6.2
+ 5% of Actual	2.5

Maximum indicated speed: 58.7 miles per hour\*

Speedometers with the former FMVSS 127 calibration are installed starting with December 1984 production. These speedometer heads have a tolerance of (+) 3 miles per hour.

For example:

Actual Speed	50 Miles Per Hour
+ Basic Tolerance	3 Miles Per Hour

Maximum indicated speed: 53 miles per hour\*

### \*Note

It is required that vehicles be equipped with OEM tires and wheels showing only normal tire wear.

## Odometer

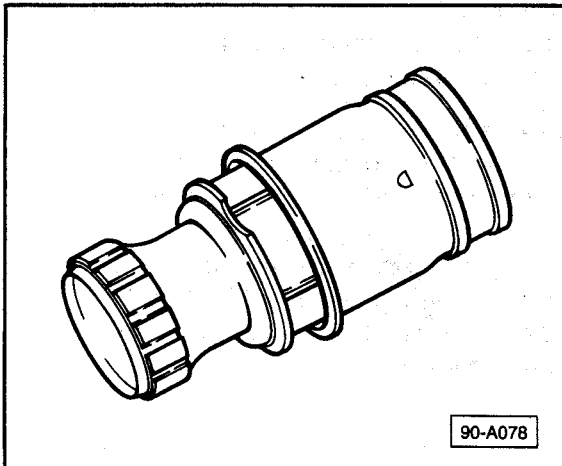
The odometer reading is independent of the speed indication and is regulated by the Federal Trade Commission (FTC). The tolerance of the odometer indication is (-) 1% to (+) 3.75% of the actual number of miles driven.

### Note

The number printed on the speedometer face plate beneath the word MPH shows the number of revolutions required by the speedometer cable multiplied by 100 to travel a distance of 1/100th of a mile (52 feet, 9.5 inches).

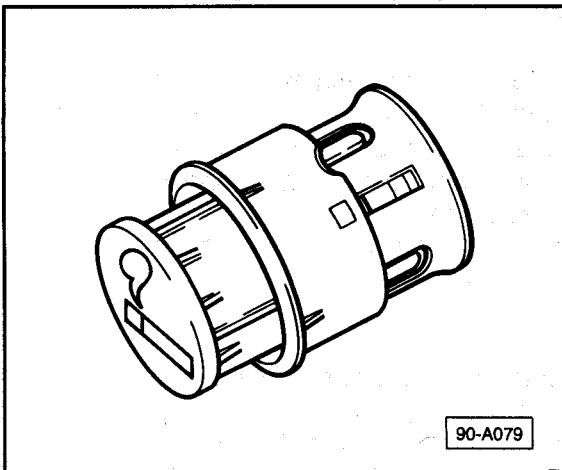


Two different cigarette lighters are used in Volkswagen vehicles and they are **NOT** interchangeable. If installed in the wrong vehicle it is possible that the lighter will not release properly, thus creating a possible safety hazard.



**Fig. 1 Part number 175.919.307B**

Application: Rabbit — all  
Pickup — all  
Golf — all  
GTI — all



**Fig. 2 Part number 171 919 305  
or 191 919 305**

Application: Cabriolet — all  
Jetta — all  
Vanagon — all  
Quantum — all  
Scirocco — all

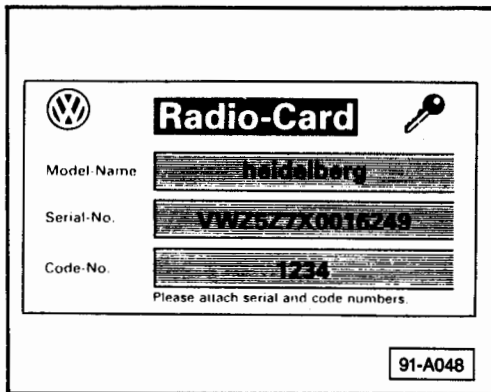
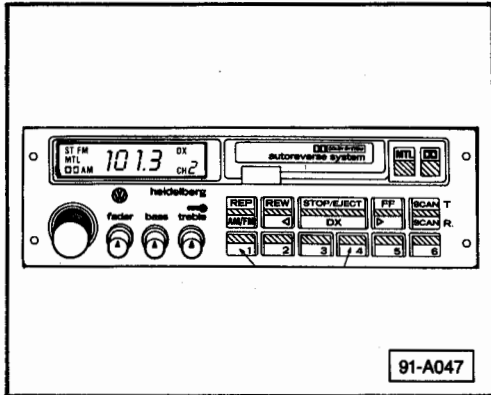
## Heidelberg VI fixed coded radio, coding

The Heidelberg VI radio is assigned a fixed four digit security code from the factory. Unlike previous coded radios, **the security code cannot be changed.**

The Heidelberg VI radio can be identified by white lettering on the face plate and separate knobs for fader, bass and treble control.

**The radios are not coded at the factory.** To activate the theft protection, the radio must be coded during the Pre-Delivery Inspection.

The security code and serial number of the radio are printed on a removable sticker located on the right "B" post near the vehicle identification sticker.



### Coding a new or remanufactured radio

- remove radio security code/serial number sticker and attach to radio card in radio owner's manual

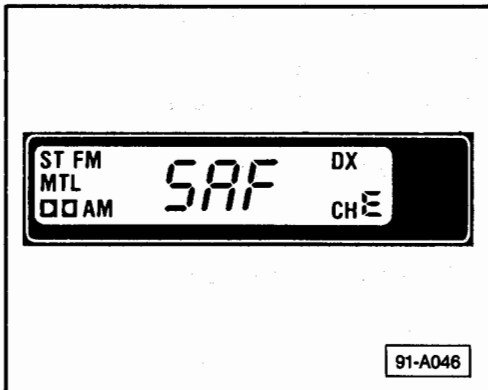
### CAUTION

**DO NOT** keep the security code or radio card with the vehicle. Always instruct customers to detach radio card from operating instructions manual and keep in a safe place.

### Note

The security code/serial number sticker for remanufactured replacement radios comes in the box with the new radio. Place the new sticker over the old sticker on the radio card.

- switch radio **ON**
  - radio plays and radio station frequency is displayed



- push and hold **AM/FM** and **SCAN** buttons to activate coding procedure
  - radio display changes to **CODE** and then **1000**
- release **AM/FM** and **SCAN** buttons
  - **1000** will remain on display
- enter radio's security code using first four program station buttons
  - security code will appear on display
- push and hold **AM/FM** and **SCAN** buttons once again until display changes to **SAFE**

### Note

A new or remanufactured radio will only accept its factory assigned security code. If an incorrect code is entered, the radio display will not change to **SAFE**.

- release **AM/FM** and **SCAN** buttons
  - radio display changes to a radio station frequency
  - radio is now coded

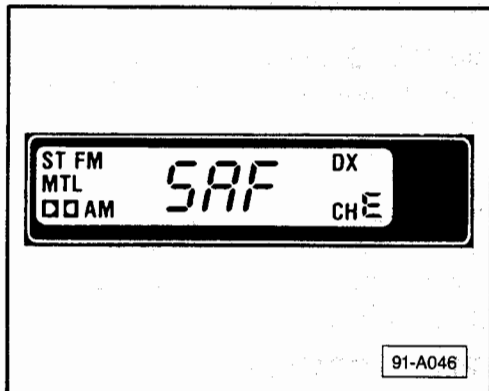
### Reactivating radio after reconnecting power

After disconnecting power (fuse, battery, etc.), the radio will lock up electronically.

To reactivate:

- obtain radio's security code
  - located on radio card
- switch radio **ON**
  - radio will not play
  - radio display shows **SAFE**
- push and hold **AM/FM** and **SCAN** buttons
  - display changes to **1000**
- release **AM/FM** and **SCAN** buttons
  - **1000** remains on display

# 90 Electrical System—Instruments, Radio



## Note

If the **AM/FM** and **SCAN** buttons are held down too long or pushed again, the radio will misinterpret the **1000** as an attempt at coding and one incorrect attempt will be logged.

- enter radio's security code using first four program station buttons
  - security code will appear on display
- push and hold **AM/FM** and **SCAN** buttons once again until display changes to **SAFE**
- release **AM/FM** and **SCAN** buttons
  - radio display changes to a radio station frequency
  - radio is now coded and plays

## Unlocking an electronically locked radio

After two incorrect attempts at entering the security code, the radio will lock-up electronically. The display shows **SAFE** and will not change.

To unlock:

- leave radio switched **ON** for approximately one hour
- after one hour, reactivate (code) radio as it would be after a power interruption

## Note

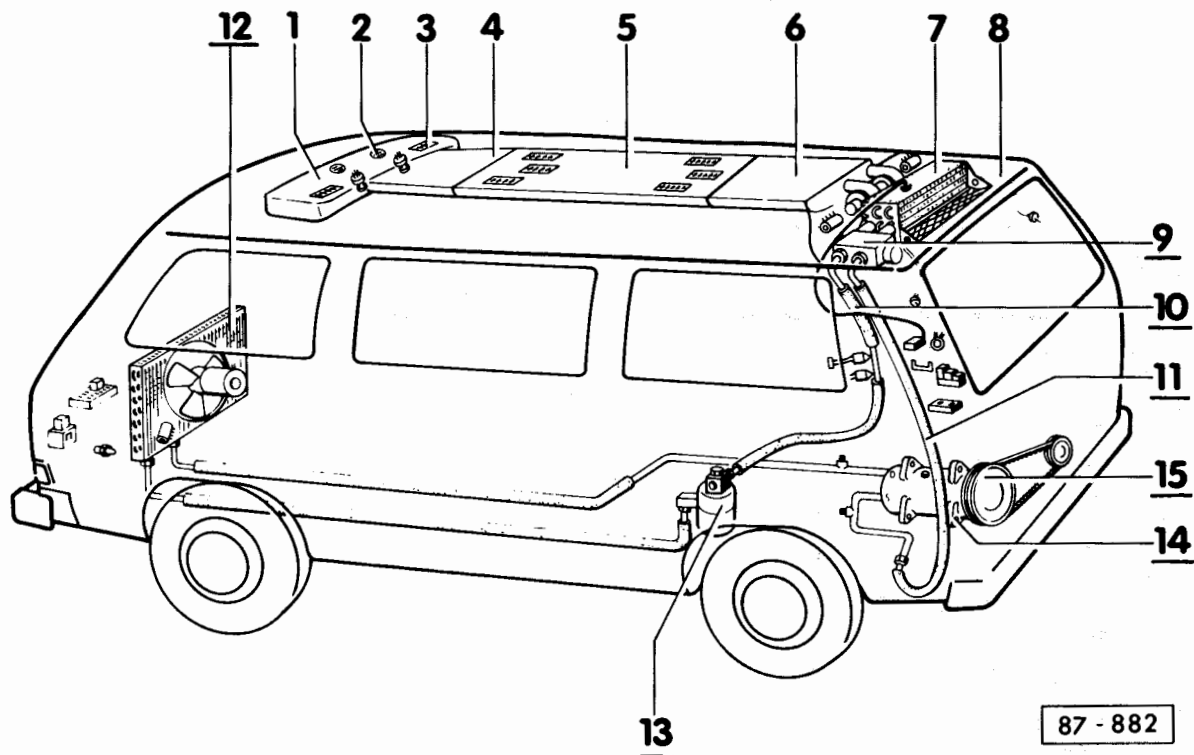
The radio will never permanently lock-up no matter how many incorrect coding attempts are made. The reactivation procedure can be repeated indefinitely.

## Air Conditioner

**Index**

- |   |  |  |
|---|--|--|
| <ul style="list-style-type: none"><li>— A/C adapter valve VAG 1637<br/>installing 87.15</li><li>— A/C components<br/>locations 87.2</li><li>— A/C compressor (Sanden SD510)<br/>replacing 87.16</li><li>— A/C evaporator<br/>removing/installing 87.14</li><li>— A/C evaporator housing<br/>assembling/disassembling 87.12<br/>removing 87.10</li><li>— Air distribution system<br/>components 87.9<br/>outlets, removing 87.13</li><li>— Expansion valve<br/>removing/installing 87.14</li><li>— Fuses<br/>locations 87.4</li><li>— Refrigerant system<br/>capacity 87.7<br/>cautions and warnings 87.7<br/>controls 87.6<br/>discharging 87.8</li><li>— Relays<br/>locations 87.5</li></ul> |  |  |
|---|--|--|

# 87 Air Conditioner

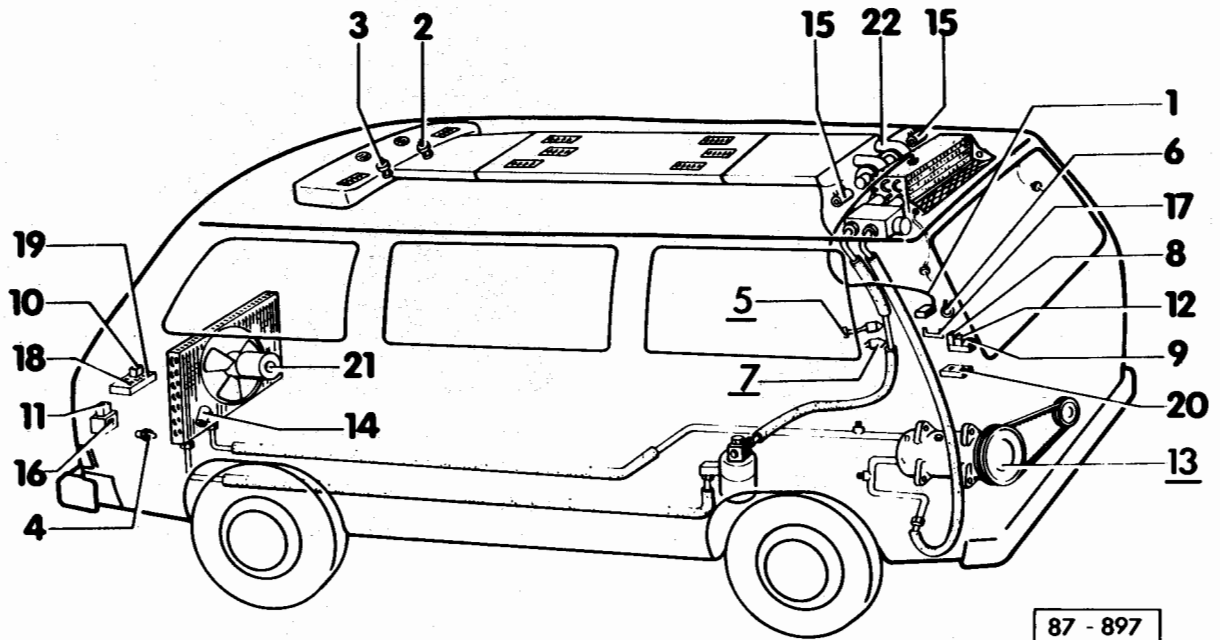


- 1 — Front housing
- 2 — Round air outlet
- 3 — Outlet
- 4 — Front air duct
- 5 — Center air duct
- 6 — Rear air duct
- 7 — Evaporator housing
- 8 — Water drain tubes
- 9 — Expansion valve

- 10 — Low pressure refrigerant hose
- 11 — High pressure refrigerant hose
- 12 — Condenser
  - condenser can be lowered from vehicle with radiator without discharging A/C refrigerant system
- 13 — Receiver/drier
- 14 — A/C compressor
- 15 — A/C compressor clutch

#### Note

Discharge A/C refrigerant system before removing components represented with underlined numbers



- |  |   |
|--|---|
| 1 — A/C thermostat                         | 12 — Evaporator fan relay                   |
| 2 — A/C switch                             | 13 — A/C compressor clutch                  |
| 3 — Evaporator fan switch                  | 14 — Radiator cooling fan series resistance |
| 4 — Radiator cooling fan thermostwitch     | 15 — Evaporator fan series resistance       |
| 5 — A/C refrigerant high pressure switch   | 16 — Radiator cooling fan fuse              |
| 6 — Ambient air temperature switch         | 17 — Fuse S0 (50A)                          |
| 7 — A/C refrigerant low pressure switch    | 18 — Fuse S1 (30A)                          |
| 8 — A/C relay                              | 19 — Fuse S12 (15A)                         |
| 9 — A/C compressor clutch relay            | 20 — Fuse S51 (20A) for evaporator fan      |
| 10 — Radiator cooling fan relay, 2nd stage | 21 — Radiator cooling fan                   |
| 11 — Radiator cooling fan relay, 3rd stage | 22 — Evaporator fan                         |

### Note

As of the 1987 Model Year, the A/C refrigerant high pressure service valve was changed.

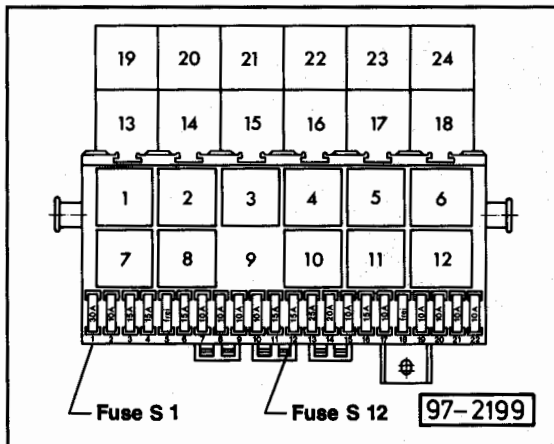
On the Vanagon, the service valve location is under the left rear evaporator panel.

On the Vanagon Camper, the service valve is located in the left rear cabinet.

# 87 Air Conditioner

## Components

### Fuse locations



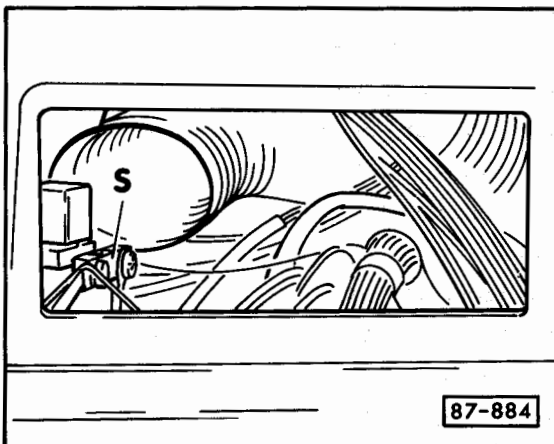
### Fuse/relay panel

#### Fuse S1

- 30A — to Rad. cool. fan thermostats and Rad. cool. fan relay 2nd stage

#### Fuse S12

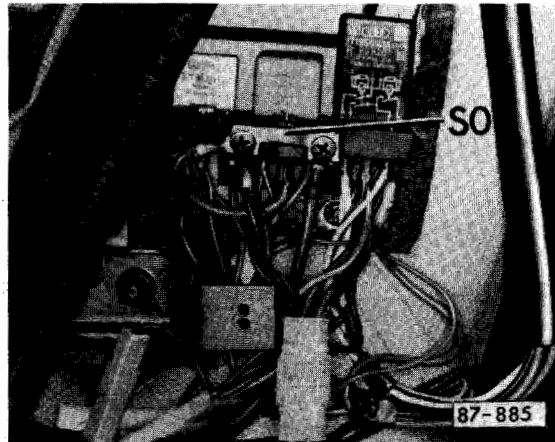
- 15A — to Fresh air fan and A/C switch



### Additional Fuse/relay adaptor (behind left air vent in Instrument panel)

#### Fuse S

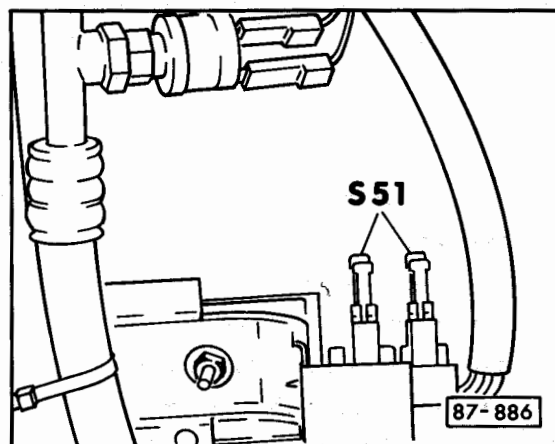
- 50A — to Rad. cool. fan relay 3rd stage



### Additional Fuse/relay panel (behind left rear 'D' pillar cover)

#### Fuse S0

- 50A — to A/C relay and evaporator fan relay



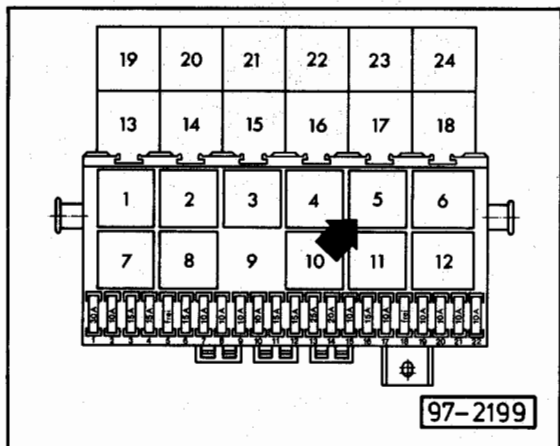
### Additional Fuse/relay panel (behind left rear 'D' pillar cover)

#### Fuses S51

- 20A — one fuse for each A/C evaporator fan

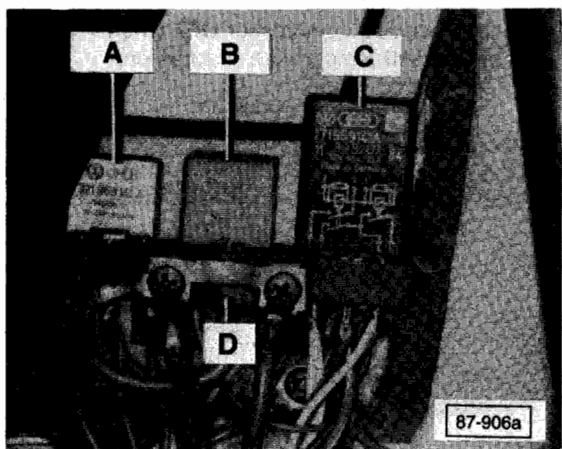


## Relay locations



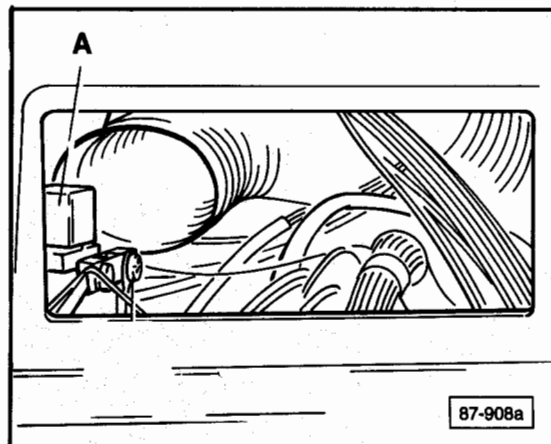
### Fuse/relay panel

Radiator cooling fan relay 2nd stage (arrow)



### Additional Fuse/relay panel (behind left rear 'D' pillar cover)

- A — A/C compressor clutch relay
- B — Evaporator fan relay
- C — A/C relay
- D — Fuse S0

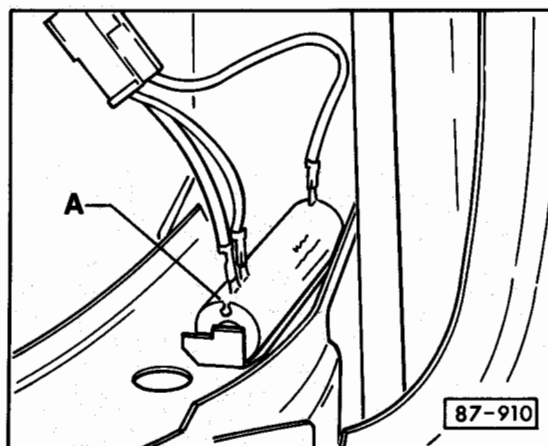


### Additional Fuse/relay panel (behind left front fresh air vent)

Picture with vent removed

A — Radiator cooling fan relay 3rd stage

### Radiator cooling fan series resistance

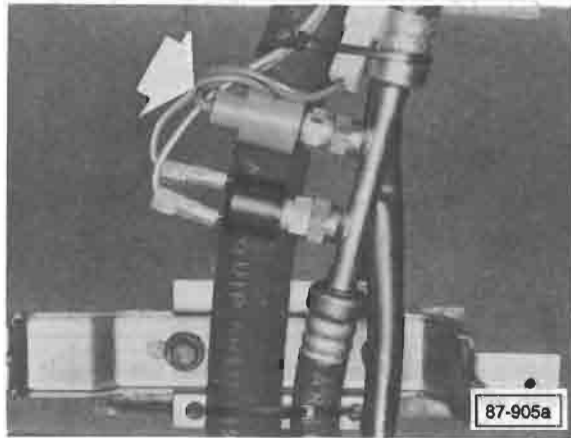


### Radiator cooling fan series resistance

- behind left headlight
- A — Resistor block

## A/C refrigerant system controls

### Locations



#### A/C refrigerant high pressure switch (arrow)

- switches Rad. cool fan to higher speed if refrigerant pressure becomes too high

#### Opens

- 12.0 bar ( 174.0 psi )

#### Closes

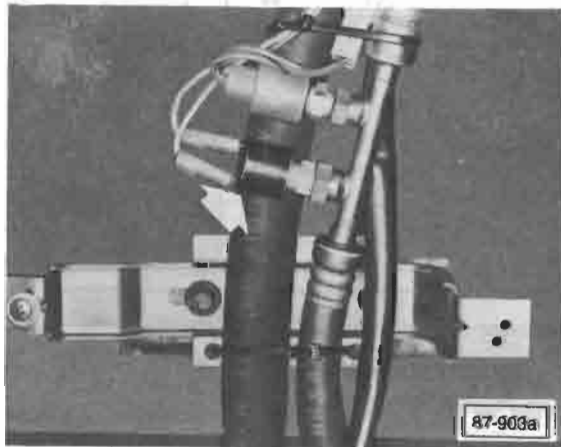
- 14.5 bar ( 210.2 psi )

#### Thread size

- 1/8" - 27 NPT

#### Torque

- 25.0 Nm



#### A/C refrigerant low pressure switch (arrow)

- switches A/C compressor clutch **OFF** when refrigerant pressure is too low

#### Opens

- 2.0 bar + 0.3 bar ( 29.0 psi + 4.3 psi )

#### Closes

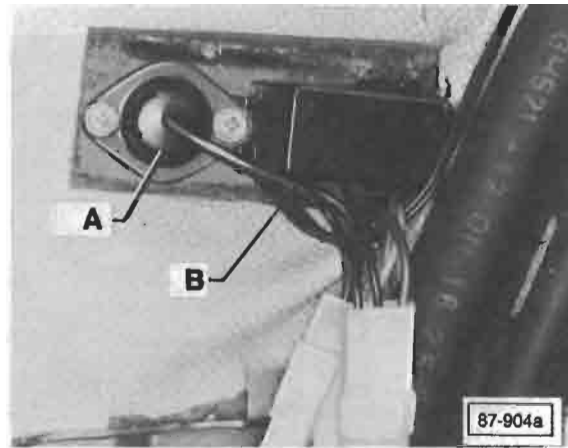
- 3.0 bar + 0.3 bar ( 43.5 psi + 4.3 psi )

#### Thread size

- 3/8" - UNF

#### Torque

- 20.0 Nm



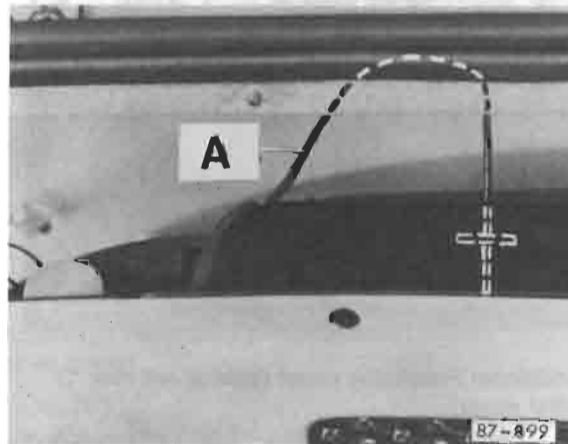
#### Ambient temperature switch and A/C thermostat (behind left rear 'D' pillar cover)

##### A — Ambient temperature switch

- switches A/C compressor **OFF** when outside temperature is under 38°F

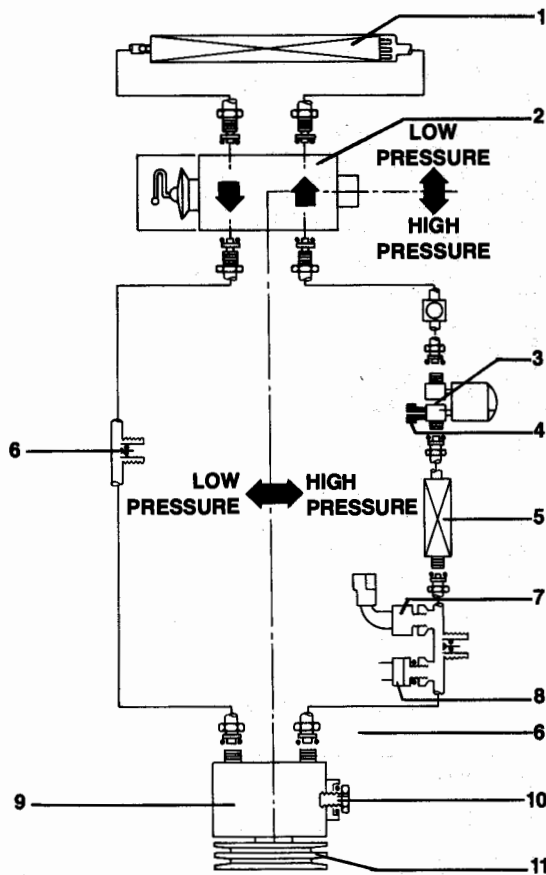
##### B — A/C thermostat

- switches A/C compressor **OFF** when evaporator temperature reaches pre-determined value



#### A/C thermostat capillary tube (A)

- insert through hole in upper evaporator housing
  - approx. 50mm ( 2.0 in )



87-890

- 1 — Evaporator
- 2 — Expansion valve
- 3 — Receiver/drier
- 4 — Safety plug
- 5 — Condenser
- 6 — Service valve
- 7 — A/C refrigerant high pressure switch
- 8 — A/C refrigerant low pressure switch
- 9 — A/C compressor
- 10 — Drain plug
- 11 — A/C compressor clutch

Refrigerant R-12 capacity  
 ● 1450 grams ( 50.75 oz )

Refrigerant oil  
 ● evaporator 2.02 oz  
 ● accumulator 0.3 oz  
 ● high pressure hose 0.3 oz  
 ● low pressure hose 0.3 oz  
 ● compressor 5.07 oz

### WARNING

Always wear safety goggles when charging or discharging system.

Be sure work area is well ventilated. R-12 is heavier than air and can accumulate in areas of poor air circulation.

Avoid inhaling fumes when using flame-type leak detector. R-12 becomes poisonous gas after coming into contact with open flame

### CAUTION

Always discharge refrigerant from air conditioner system before loosening connections, hoses, etc.

### CAUTION

Discharge refrigerant from system when it is necessary to weld near refrigerant hoses with arc or resistance welding systems. During electrical welding process invisible ultraviolet rays are given off which penetrate refrigerant hoses and decompose refrigerant

### Note

Plug all openings in system when removing/replacing parts. This prevents entry of dirt and moisture which may foul system.

Drops of moisture may cause expansion valve to ice up, blocking refrigerant flow and stopping cooling action

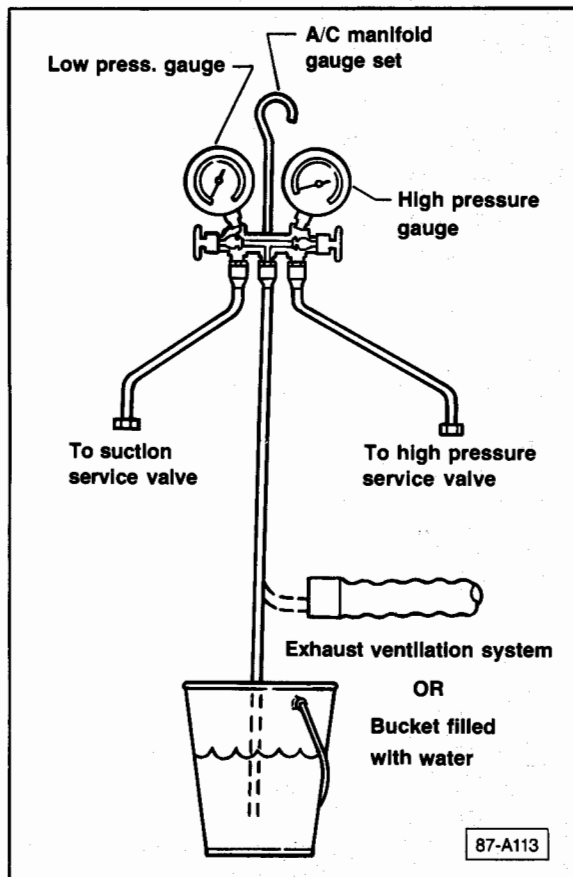
# 87 Air Conditioner

## Refrigerant system, discharging

### Note

Follow safety precautions on pg 87.7 when discharging or charging A/C refrigerant system

- disconnect wires at A/C compressor

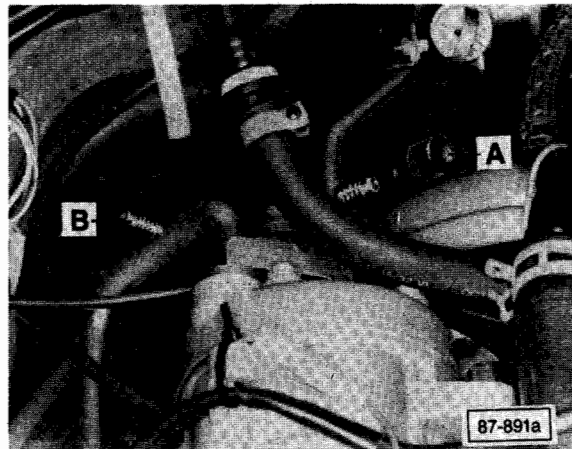


- close both valves on A/C manifold gauge set

### WARNING

Always wear safety goggles when charging or discharging system. Be sure work area is well ventilated. Refrigerant-12 is heavier than air and can accumulate in areas of poor air circulation.

Avoid inhaling fumes when using flame type leak detector. Refrigerant-12 becomes poisonous gas after coming into contact with open flame.



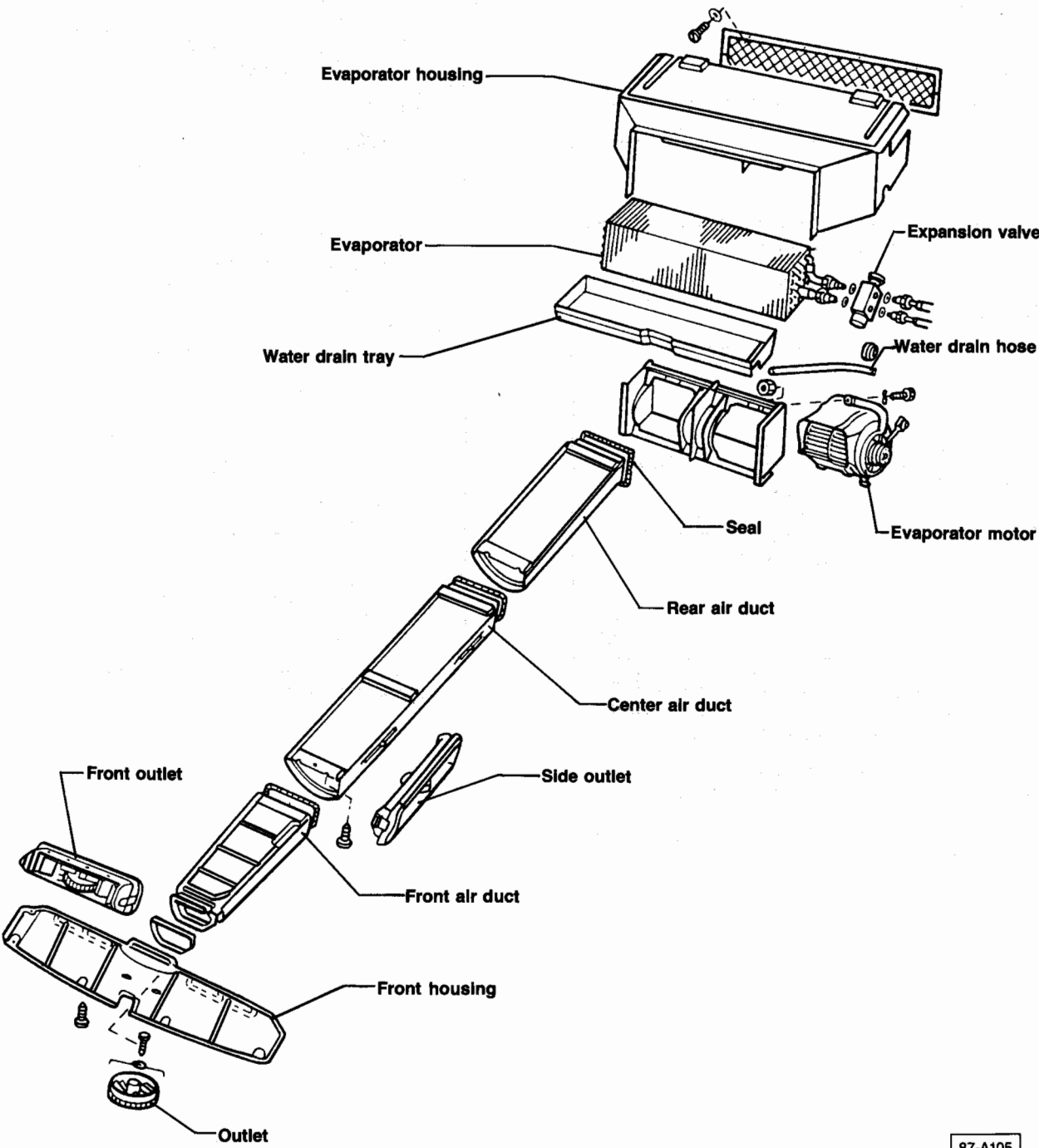
- connect hose from high pressure gauge to high pressure service valve (A)
- connect hose from low pressure gauge to suction service valve (B)
- open low pressure gauge valve until bubbles are visible in water or hiss is heard from discharge hose
- open high pressure valve slightly

### CAUTION

Discharge A/C refrigerant system slowly to prevent loss of refrigerant oil

- close manifold gauge valves when refrigerant stops flowing

Air distribution system



87-A105

# 87 Air Conditioner

## A/C evaporator housing, removing

### Work sequence

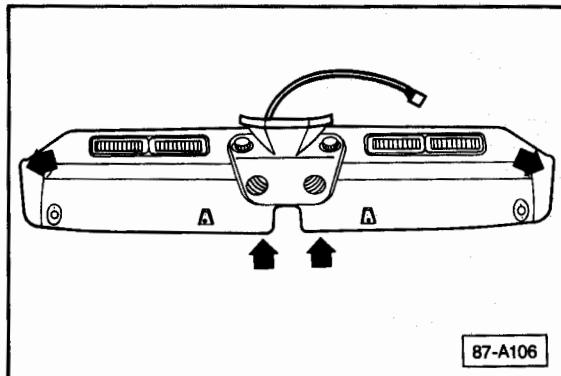
#### CAUTION

Before starting to work on any part of electrical system, disconnect battery ground strap

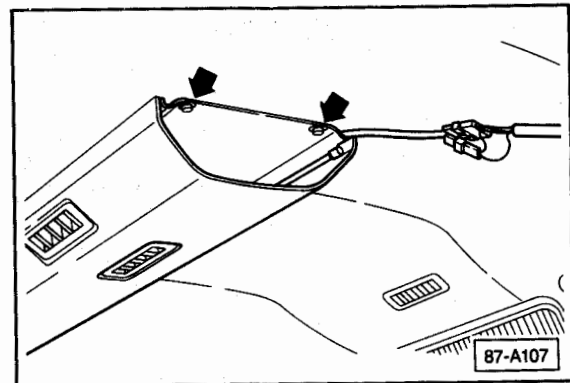
#### Note

It is possible to lower A/C evaporator housing without discharging A/C refrigerant system.

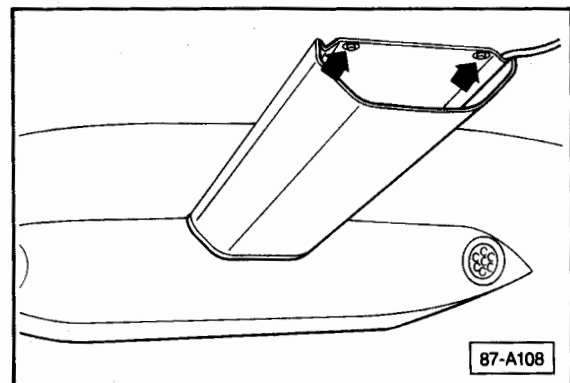
Discharge A/C refrigerant only when replacing parts in refrigerant system.



- remove sunvisors and sunvisor retaining clips
- remove front housing attaching screws (**arrows**)
- lower front housing and front air duct
- disconnect wiring connectors to A/C switches
- remove front housing and front air duct

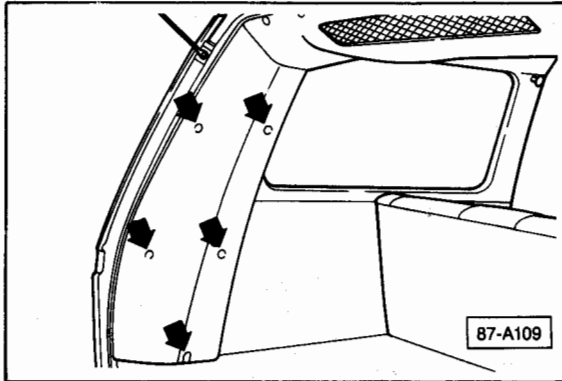


- remove center air duct attaching screws (**arrows**)
- remove center air duct

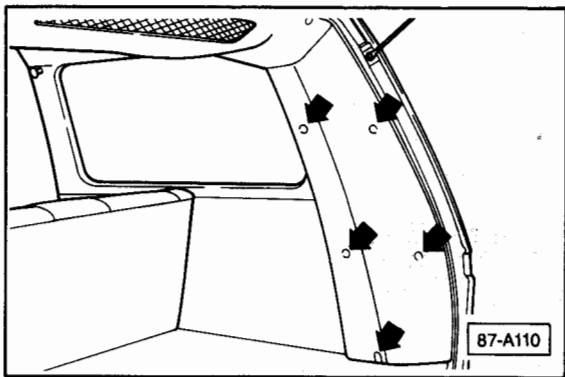


- remove rear air duct attaching screws (**arrows**)
- remove rear air duct

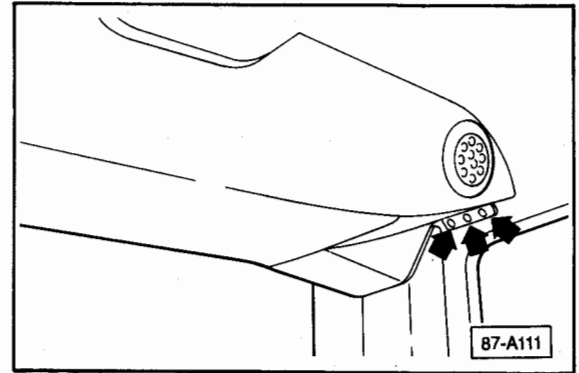
more



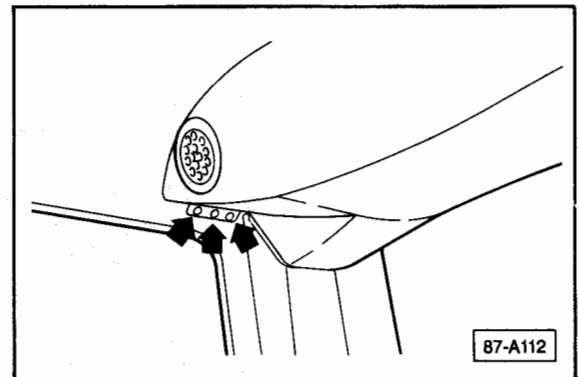
- remove left side rear trim panel screws (**arrows**)
- remove trim panel



- remove right side rear trim panel screws (**arrows**)
- remove trim panel



- support evaporator housing with universal lift crane
- remove left side evaporator housing attaching bolts (**arrows**)



- remove right side evaporator housing attaching bolts (**arrows**)
- lower evaporator housing
- remove evaporator housing covers
- remove evaporator

### Installing

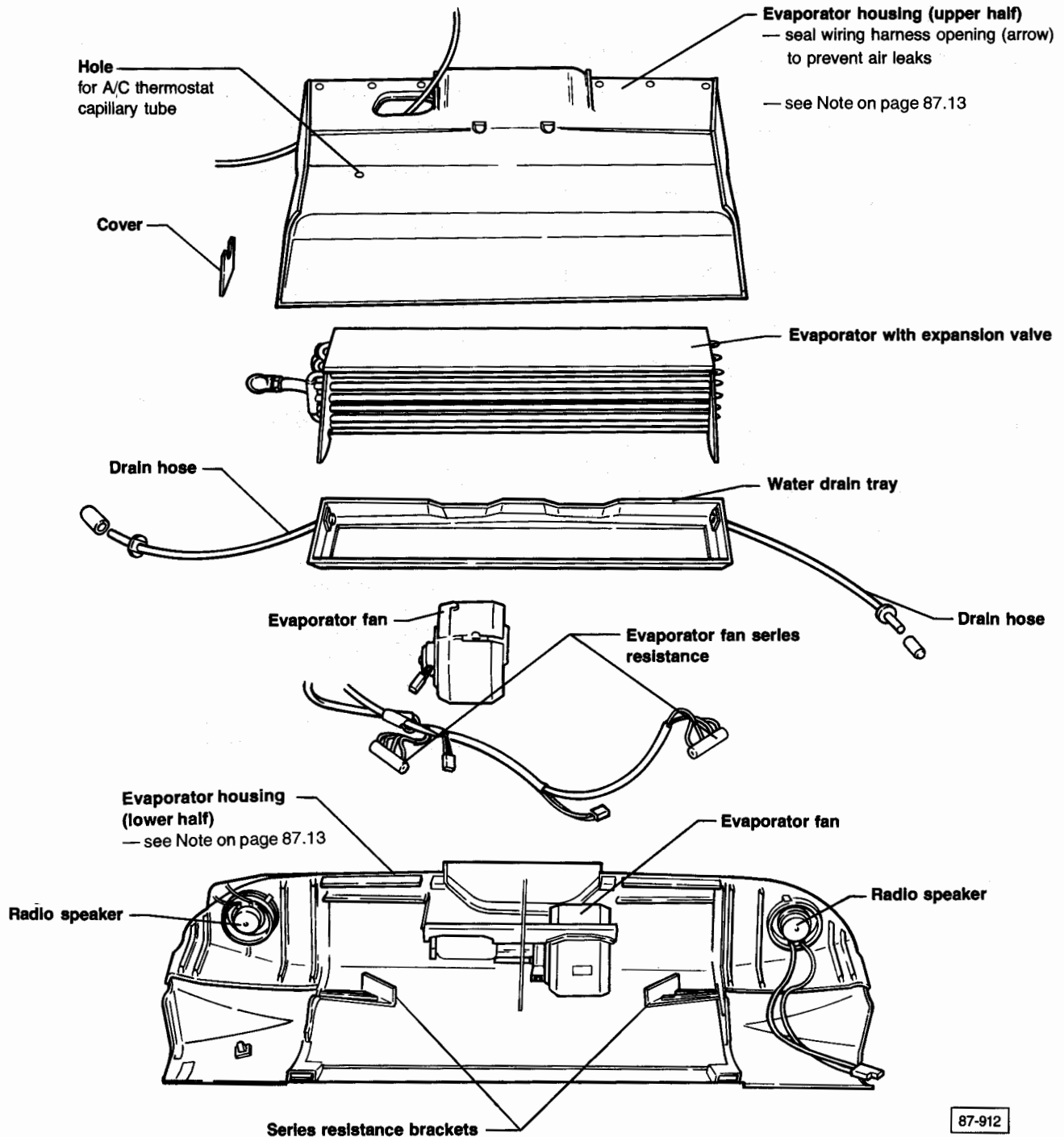
- install in reverse order of removal
- re-charge A/C refrigerant system

# 87 Air Conditioner

## Evaporator housing, assembling/disassembling

### Note

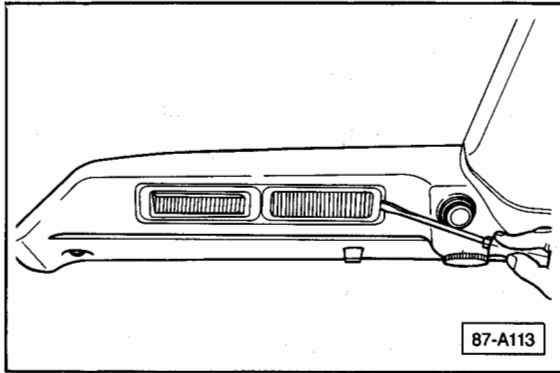
Evaporator housing can be lowered and disassembled without discharging A/C refrigerant system.





## Air outlets, removing

### Work sequence



- push in retaining tab with screwdriver
- pry vent out

## Evaporator housing - modified

Starting April 1988, a running change was made to the evaporator housing and introduced into production. To prevent cracking, the body attachment points have been relocated.

See your Volkswagen Parts Department for the latest information regarding this upgrade. Also see Technical Bulletin Group 87, Number 89-01, dated August 31, 1989.

# 87 Air Conditioner

## A/C evaporator or expansion valve, removing/installing

### Work sequence

#### CAUTION

Before starting to work on any part of electrical system disconnect battery ground strap

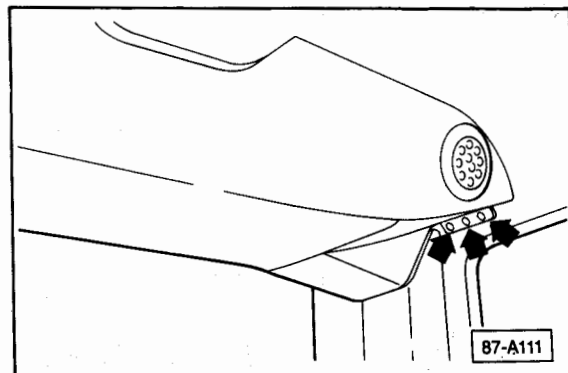
- disconnect wiring to A/C compressor clutch at A/C compressor
- discharge A/C refrigerant system

#### Note

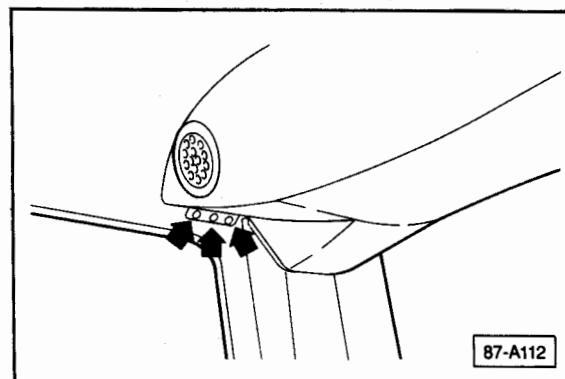
Plug all openings in system when removing/replacing parts. This prevents entry of dirt and moisture which may foul system.

Drops of moisture may cause expansion valve to ice up, blocking refrigerant flow and stopping cooling action

- remove sunvisors and retaining clips
- remove front housing and front air duct
- disconnect wiring harness to A/C switches
  
- remove center air duct
- remove rear air duct
  
- remove carpet in luggage area
- remove left rear trim panel
- remove right rear trim panel



- support evaporator housing with universal lift crane
- remove left side evaporator housing attaching bolts (**arrows**)



- remove right side evaporator housing attaching bolts (**arrows**)
- lower evaporator housing
- remove evaporator housing covers
- remove A/C refrigerant hoses from expansion valve
- remove evaporator from housing
- remove expansion valve from evaporator

#### Installing

- install in reverse sequence

#### CAUTION

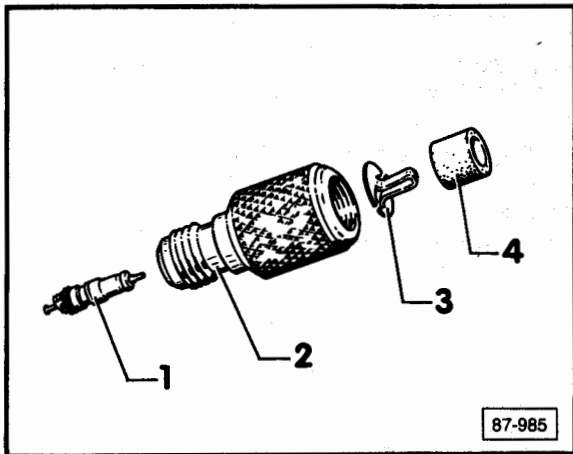
Always replace O-rings when replacing A/C refrigerant components.

Coat O-rings lightly with refrigerant oil before assembly

- re-charge A/C refrigerant system
- connect battery ground cable
- re-connect wiring at A/C compressor clutch

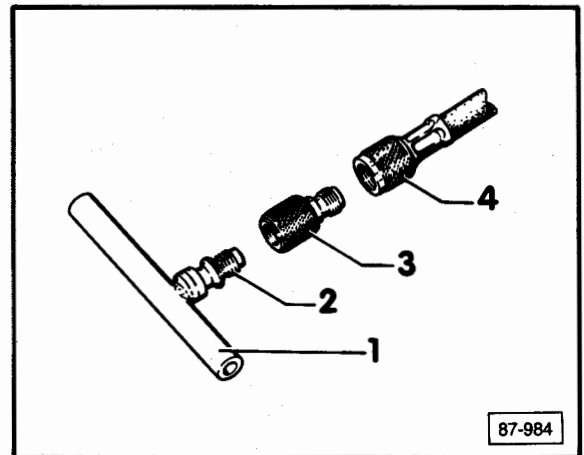
## A/C adaptor valve VAG 1637, installing

Beginning with Vanagon production in May, 1988, the threaded connection on the A/C high pressure service valve has been changed from 7/16"-20 UNF to 3/8" — 24 UNF. Use special adaptor valve, **VAG 1637**, when making connections to the high pressure service valve.



### Adaptor valve VAG 1637

- 1 — Schrader valve
- 2 — Adaptor
- 3 — Valve opener
- 4 — Sealing gasket



### Installation position

- 1 — A/C high pressure line
  - 2 — A/C high pressure service valve (3/8" — 24 UNF)
  - 3 — Adaptor valve **VAG 1637**
  - 4 — Service hose (to pressure gauge set)
- install adaptor valve **VAG 1637** onto A/C high pressure service valve
- install A/C service hose onto adaptor valve **VAG 1637**

# 87 Air Conditioner

## A/C compressor (Sanden SD 510), replacing

The Sanden **SD 510** A/C compressor is no longer available as a spare part and has been superseded to the Sanden model **SD 709**. If A/C compressor replacement is necessary, install the **SD 709** in place of the **SD 510**.

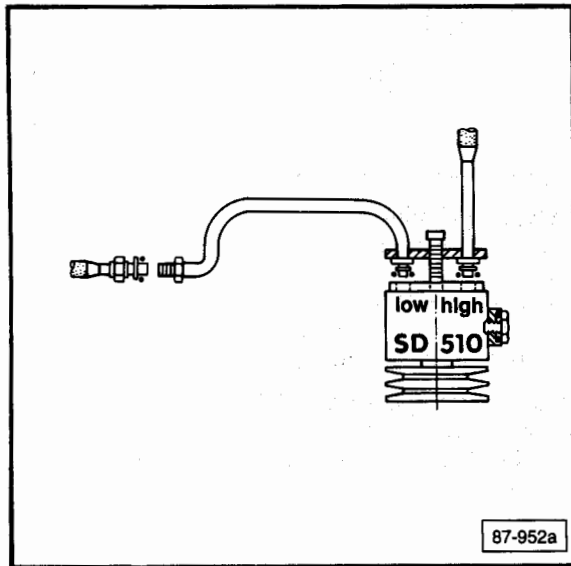


Fig. 1 A/C compressor SD 510 factory installation

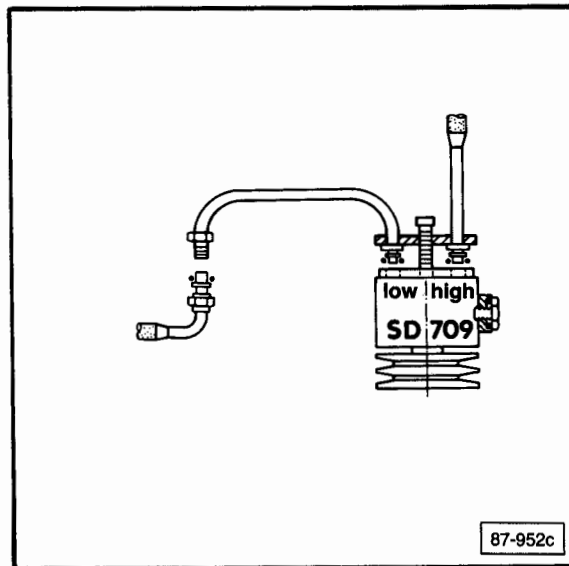


Fig. 2 A/C compressor SD 709 factory installation (from VIN HH 056 819)

### Note

As of VIN **HH 056 819**, all Vanagon vehicles are equipped with the Sanden **SD 709** A/C compressor.

Use the following procedure when replacing the model **SD 510** with the model **SD 709**.

Parts required:

<b>P/N 253 260 797 A</b>	Compressor — <b>SD 709</b>
<b>P/N 253 260 708 E</b>	A/C refrigerant line
<b>P/N 253 260 716 A</b>	A/C refrigerant line
<b>P/N 803 260 749 B</b>	O-ring (two required)
<b>P/N 431 260 749</b>	O-ring (two required)

- discharge A/C system, page 87.8
- remove A/C compressor belt and remove A/C compressor
- remove low pressure A/C line leading from compressor to A/C hose and discard

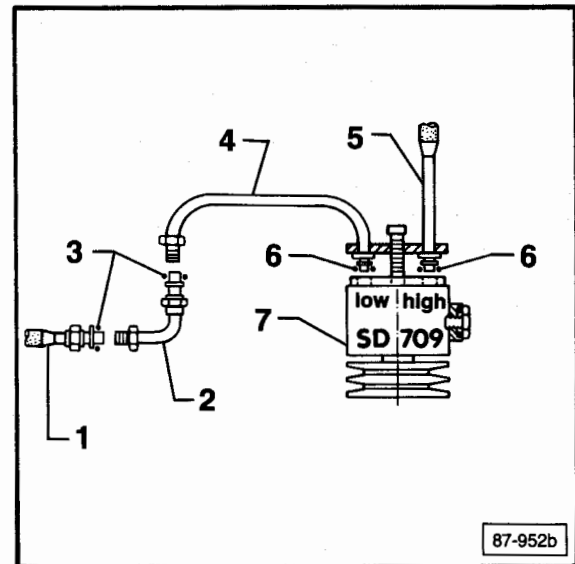


Fig. 3 A/C compressor SD 709 installation (conversion from SD 510)

- install A/C line 2, **P/N 253 260 716 A** to A/C hose 1 using new O-ring 3, **P/N 803 260 749 B**
- install A/C line 4, **P/N 253 260 708 E** and O-ring 3, **P/N 803 260 749 B** to A/C line 2
- install new A/C compressor 7, **P/N 253 260 797 A**
- connect A/C lines 4 and 5 to compressor using new O-rings 6, **P/N 431 260 749**
- install A/C compressor belt and adjust
- evacuate A/C system and recharge
- check A/C system operation

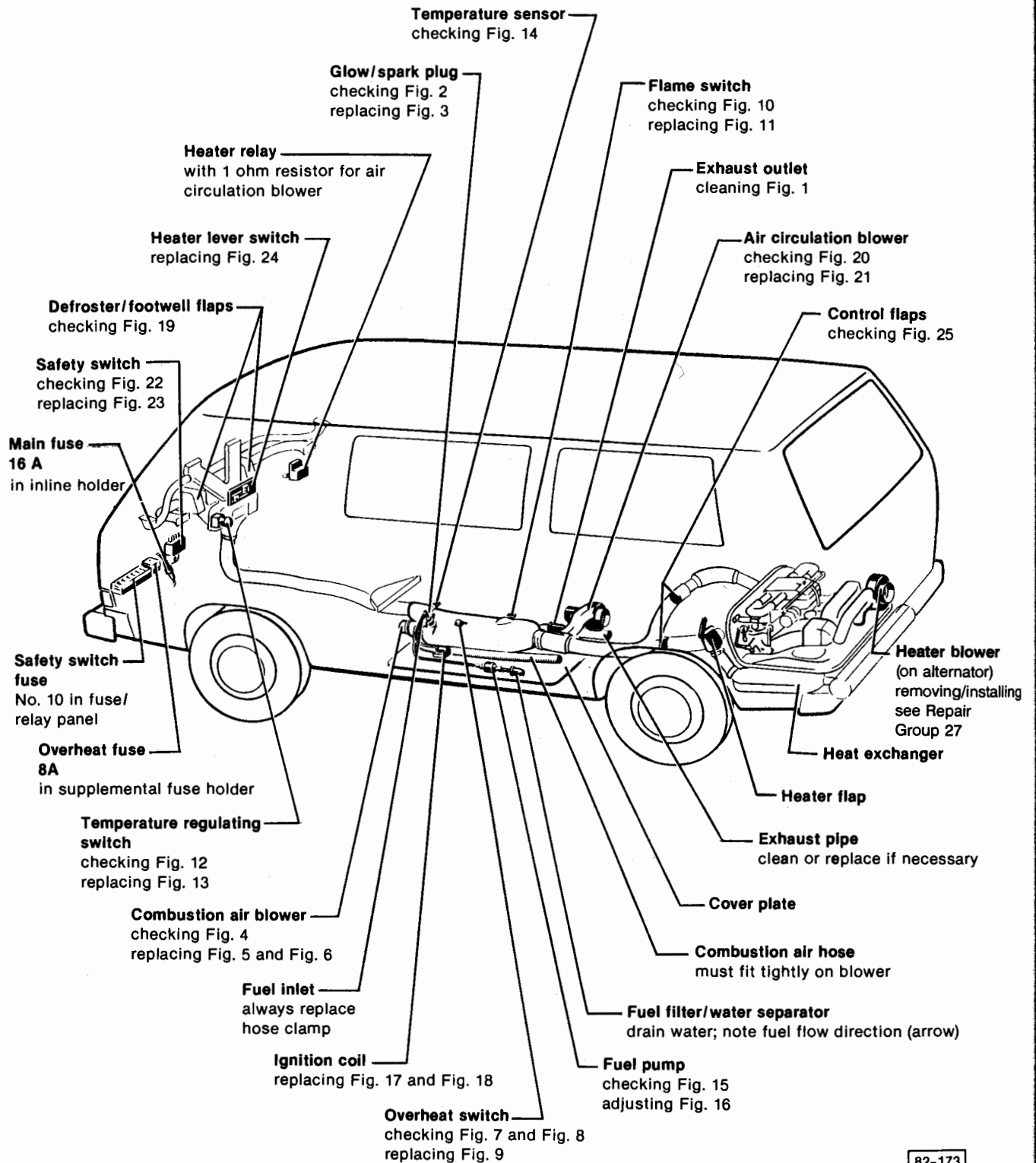
### CAUTION

Part numbers are for reference only. Always check with your Parts Department for latest parts information.

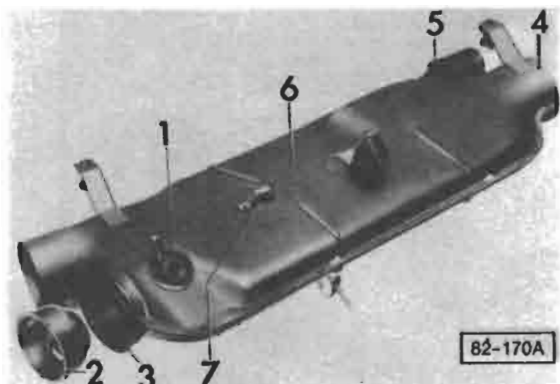
# Heater Booster

Quick Data	Index	
	<p><b>Air cooled – AFC</b></p> <ul style="list-style-type: none"> <li>– Air circulation blower 82.7</li> <li>– Combustion air blower 82.3, 82.4 hose 82.4</li> <li>– Control flaps 82.8</li> <li>– Defrost/Footwell flaps 82.7</li> <li>– Flame switch 82.5</li> <li>– Fuel pump 82.6</li> <li>– Glow/Spark plug 82.3, 82.14a</li> <li>– Heater booster/components 82.2 assembly 82.3</li> <li>– Heater lever switch 82.8</li> <li>– Ignition coil 82.6</li> <li>– Overheat switch 82.4</li> <li>– Safety switch 82.7, 82.8</li> <li>– Temperature regulating switch 82.5</li> <li>– Temperature sensor 82.6</li> <li>– Troubleshooting (heater booster) 82.10, 82.11</li> </ul> <p><b>Diesel</b></p> <ul style="list-style-type: none"> <li>– Air circulation blower 82.17</li> <li>– Combustion air blower 82.14</li> <li>– Control valve 82.17</li> <li>– Flame switch 82.15</li> <li>– Fuel pump 82.17</li> <li>– Glow/Spark plug 82.14</li> <li>– Heater housing 82.14</li> <li>– Ignition coil 82.17</li> <li>– Overheat switch 82.15</li> <li>– System components 82.12</li> <li>– Temperature regulating switch 82.16</li> <li>– Temperature sensor 82.16</li> <li>– Troubleshooting 82.18</li> </ul>	<p><b>Auxiliary heater BBW 46</b></p> <ul style="list-style-type: none"> <li>– Auxiliary heater components 82.20 electrical wiring 82.24 operating 82.25 waterflow 82.22</li> <li>– Combustion air blower adjusting 82.32 removing/installing 82.32</li> <li>– Engine coolant system draining/refilling 82.35</li> <li>– Felt pad removing/installing 82.29</li> <li>– Flame head removing/installing 82.33</li> <li>– Flame switch checking 82.30 removing/installing 82.30</li> <li>– Fuse S24 removing/installing 82.33</li> <li>– Glow plug checking 82.30</li> <li>– Heater core removing/installing 82.33</li> <li>– Metering pump flow rate checking 82.35</li> <li>– Recirculation pump removing/installing 82.32</li> <li>– Series resistor removing/installing 82.32</li> <li>– Temperature sensor checking 82.31 removing/installing 82.31</li> </ul>

# 82 Heater Booster

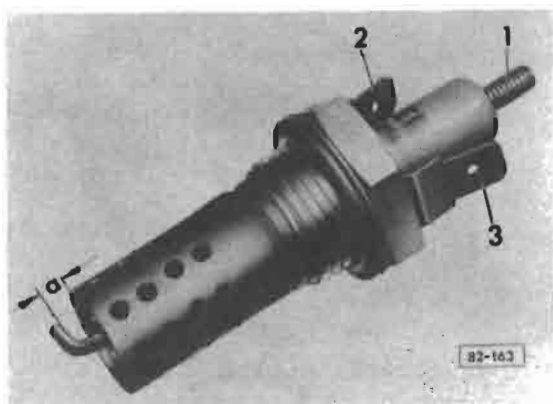


82-173



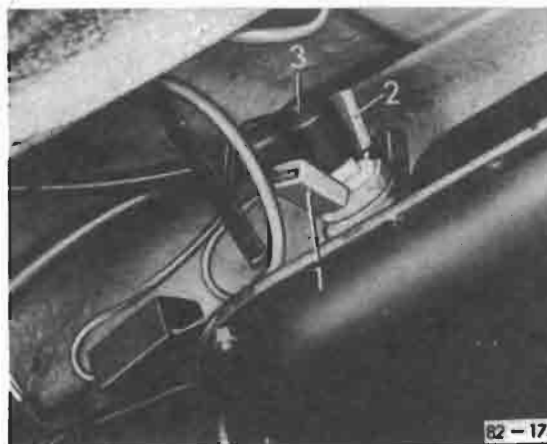
**Fig. 1 Heater booster, checking**

- 1 = glow/spark plug adaptor. If carbon-fouled, clean with toothbrush
- 2 = combustion air blower vane housing. If burned, replace
- 3 = combustion chamber. If carbon-fouled, clean
- 4 = fresh air inlet. If dirty, clean
- 5 = exhaust outlet. If tar-like deposits are noticeable, replace
- 6 = heater booster housing. If distorted by overheating, replace
- 7 = ceramic ring for overheat switch. If damaged, replace



**Fig. 2 Glow/spark plug, checking**

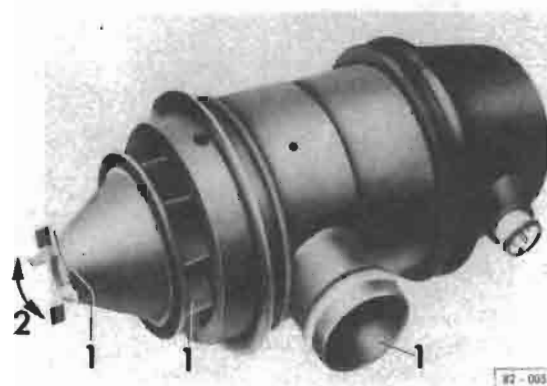
- 1 = high tension terminal
- 2 = glow element terminal
- 3 = ground terminal
- electrode gap a : 2.5 mm (3/32 in.)
- voltage : 12 volts
- resistance : 4000-6000 ohms
- current draw of : 10 A glow element



**Fig. 3 Glow/spark plug**

### CAUTION

Connectors for terminals 1 and 2 must not contact plug connector 3. This may cause ignition trouble



**Fig. 4 Combustion air blower, checking**

- check for damage caused by overheating at points marked 1
- check blower bearing 2 for free movement in both directions

### Note

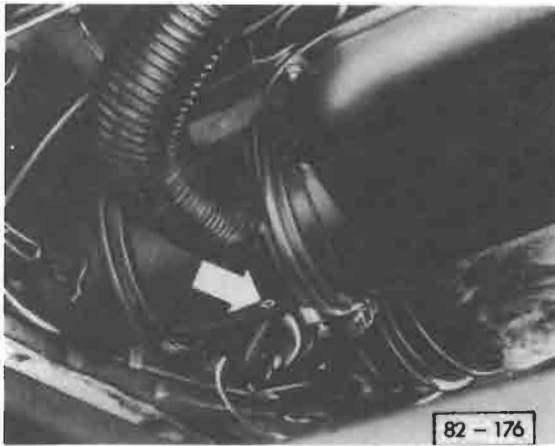
Fuel is injected by pump every 33rd revolution of blower shaft. Each injection stroke can be detected by ticking noise from pump

Number of pump strokes  $\times$  33 = blower speed

speed: 6400-7000 rpm

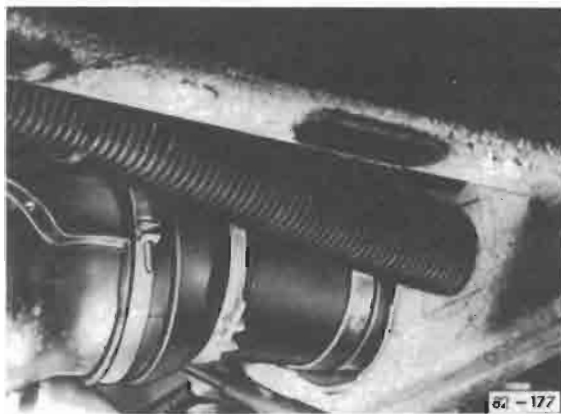
(at 12 volts after running for 10 minutes)

- equivalent to 190-210 pump strokes per minute



**Fig. 5 Combustion air blower, installing**

- condensation drain hole in housing must be at bottom (arrow)



**Fig. 6 Combustion air hose, installing**

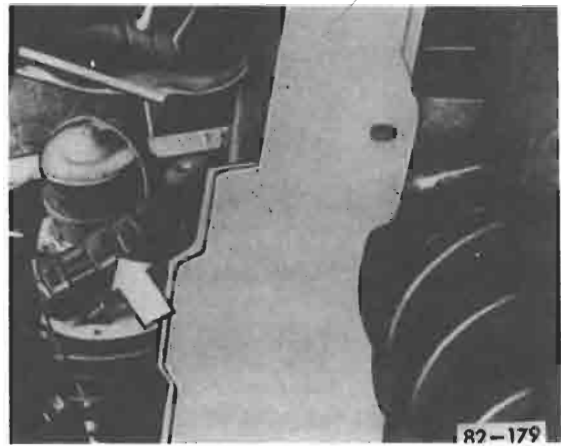
- combustion air hose must fit tightly on blower connection and in rear frame cross member. If hose comes off, heater flame will damage blower



82-178

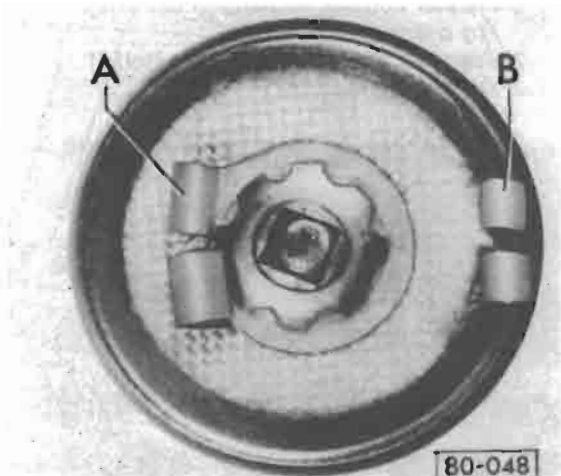
**Fig. 7 Overheat switch, checking**  
(switch installed)

- remove ceramic ring 1 first
- turn heater on (engine not running)
  - heater must start working within 70 seconds



**Fig. 8 Overheat switch, checking**

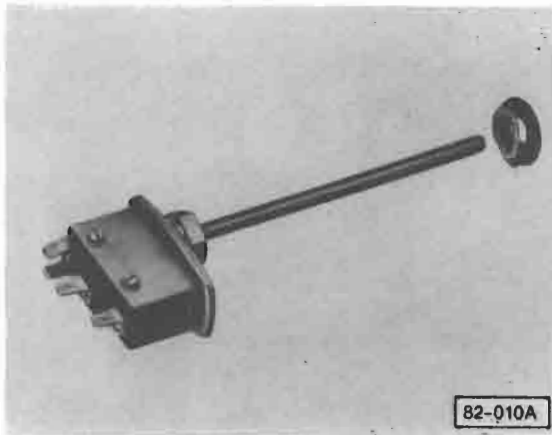
- disconnect wiring (arrow) from blower
- if overheat switch operates within 60 seconds after blower is disconnected, switch is OK (replace fuse)
- if NO, replace overheat switch and fuse



**Fig. 9 Overheat switch, installing**

- crimp green wire to terminal A
- crimp brown wire to terminal B
- solder wires (use rosin-core solder)





**Fig. 10 Flame switch, checking**  
(switch installed)

- turn heater **ON**
    - heater must ignite within 70 seconds at 20°C/68°F
  - turn heater **OFF**
    - run on time must be between 80 and 160 seconds at 20°C/68°F
- If **NO** for either condition, replace flame switch

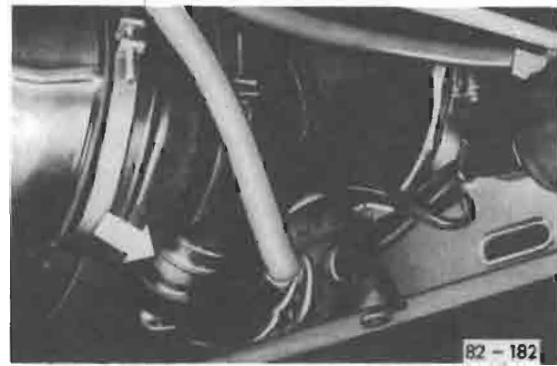


**Fig. 11 Flame switch, removing**

- pull rubber grommet off carefully
- remove union nut and pull switch out

**CAUTION**

Do not bend sensor tube



**Fig. 12 Temperature regulating switch, checking**  
(switch installed)

- turn heater on
- disconnect either wire to temperature sensor (very briefly or overheat switch will operate)
  - fuel pump should continue to run
 If **YES**, temperature regulation **OK**  
 If **NO**, replace temperature regulating switch
- bridge temperature sensor terminals
  - fuel pump should stop running
 If **YES**, temperature regulation **OK**  
 If **NO**, replace temperature regulating switch
- if temperature regulation is still not correct, check temperature sensor Fig. 14



**Fig. 13 Temperature regulating switch, replacing**

**CAUTION**

Disconnect battery ground strap before starting to work

- remove escutcheon with VW 674/1
  - do not interchange wires of terminals 31 and K (outside of multi-pin connector) as this will cause short circuit in switch

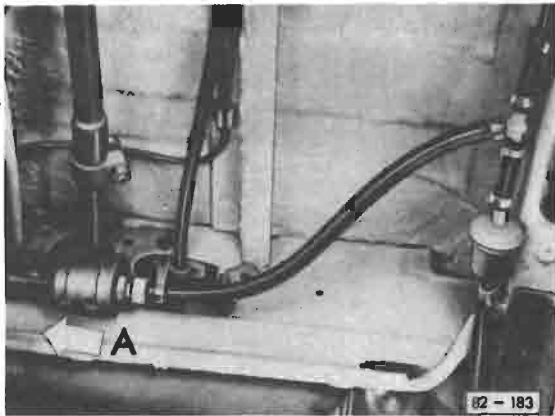
# 82 Heater Booster



82-014A

**Fig. 14 Temperature sensor, checking**

- place in warm water (60°C/140°F)
- resistance: 3500–5000 ohms



**Fig. 15 Fuel pump, checking**  
(pump installed)

- arrow A = direction of fuel flow

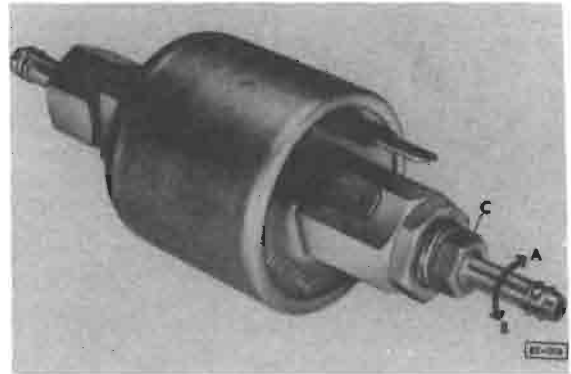
**WARNING**

Fire hazard! Do not smoke or have anything in area that can ignite fuel

- remove hose on pressure side of pump
- connect piece of hose to pump and hold into measuring glass
- turn on heater
- check amount of fuel in measuring glass after 200 strokes of pump
- amount: 18.4 to 21.7 cm<sup>3</sup>

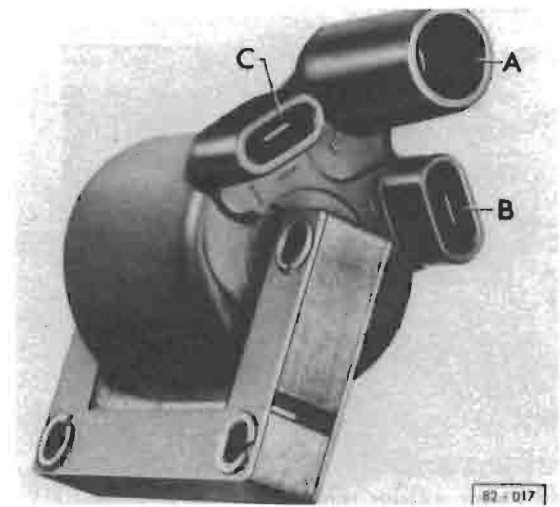
**Note**

To count 200 strokes write down number every 10 strokes.  
If delivery rate is not correct, adjust fuel pump per Fig. 16



**Fig. 16 Fuel pump, adjusting**

- to increase amount of delivery: turn hose adaptor C in direction of arrow B
- to decrease amount of delivery: turn hose adaptor C in direction of arrow A
- lock and seal with paint after adjustment



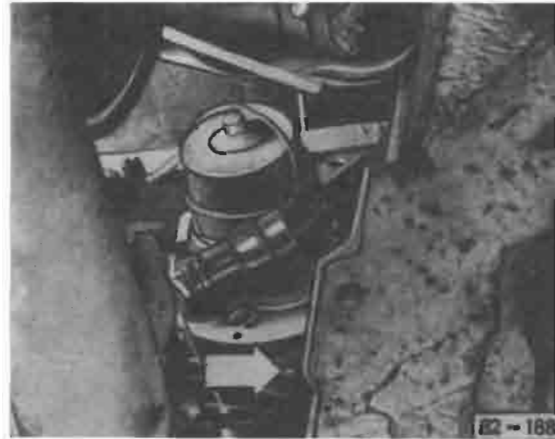
**Fig. 17 Ignition coil, connections**

- A = high tension wire
- B = terminal 15
- C = terminal 1



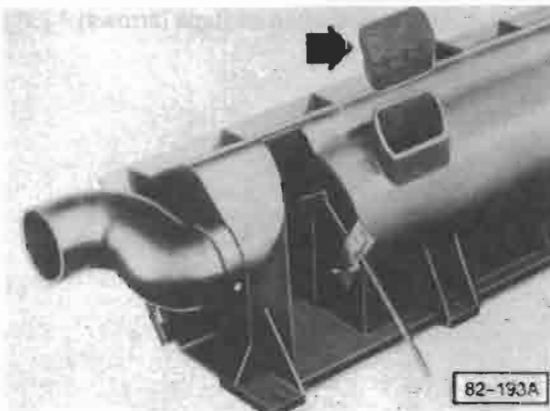
**Fig. 18 Ignition coil, location**

Z = ignition coil



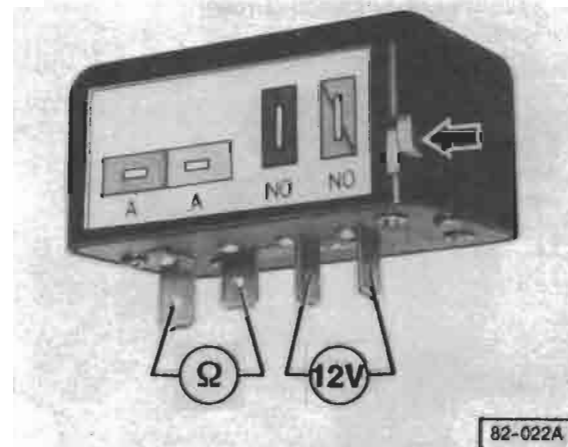
**Fig. 21 Air circulation blower, replacing**

- condensation drain hole (arrow) must be at bottom



**Fig. 19 Defroster/footwell flap, checking**

— check flap (arrow) for free movement



**Fig. 22 Safety switch, checking (switch removed)**



**Fig. 20 Air circulation blower, checking (blower installed)**

- current draw: (engine not running)
  - low speed: 3 to 4A
  - high speed: 6.5 to 7.5A

### CAUTION

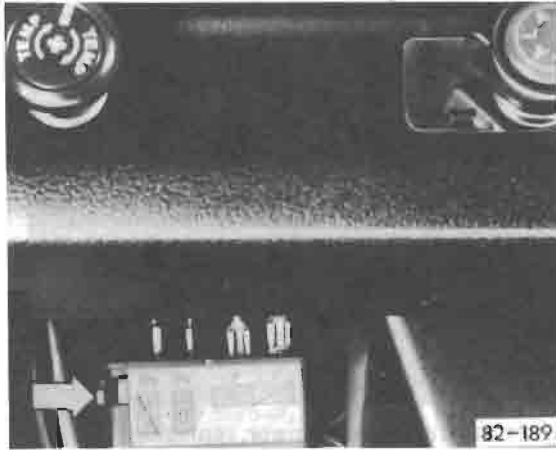
Disconnect battery ground strap. Temperature regulation switch will be damaged if disconnected wires touch one another or ground

- connect ohmmeter to terminals **A**
  - apply 12 volts to terminals **NO**
  - measure elapsed time when voltage is applied until contact is interrupted at terminals **A**
    - switch response time: 150 to 230 seconds at 20°C/68°F
- If **NO**, replace switch

### Notes

If safety switch has operated within required time, press reset lever in direction of **arrow**

# 82 Heater Booster



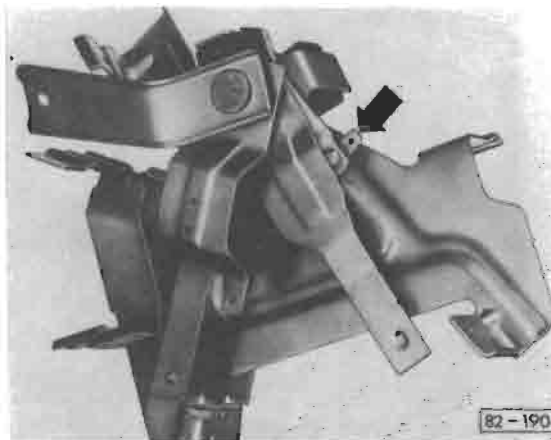
**Fig. 23 Safety switch, replacing**

- disconnect battery ground strap
- safety switch (arrow)



**Fig. 25 Control flaps, checking**

- remove hoses
- check operation of flaps (arrows)

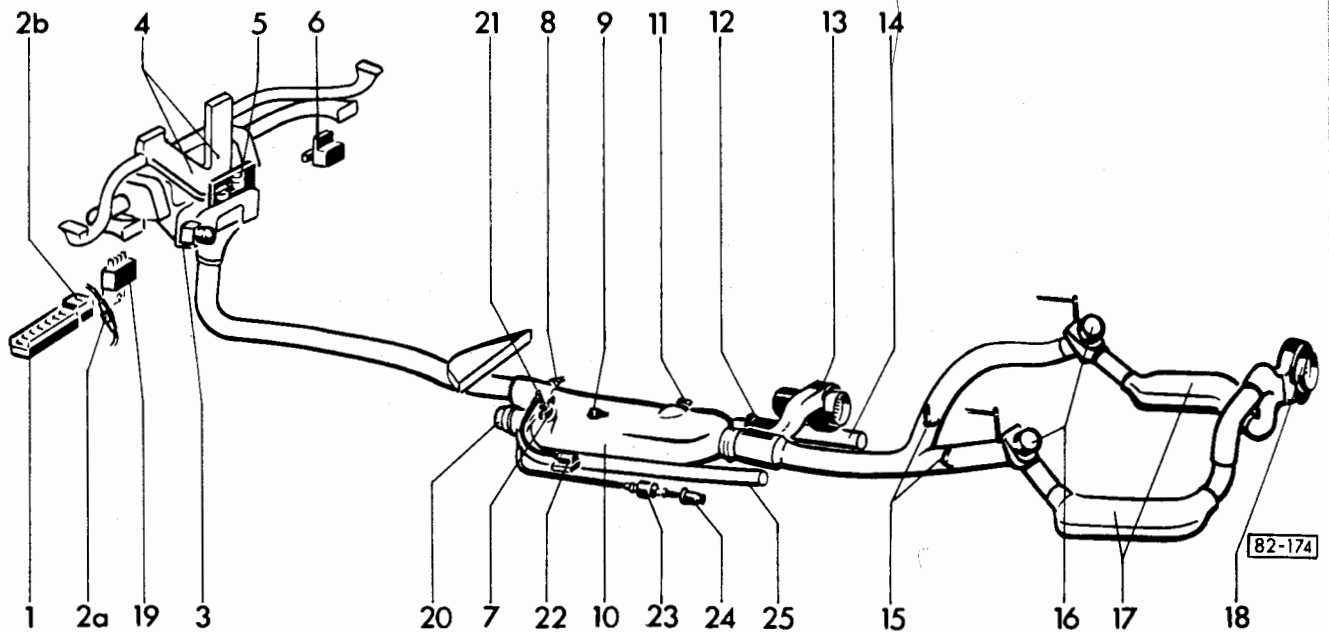


**Fig. 24 Heater lever switch contact, location**

- switch contact (arrow)
- removing/installing, see Repair Group 80

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# 82 Heater Booster



Trouble	Operating conditions
10th fuse (16 A) in fuse relay panel blown	Engine running Heater lever switch 5 ON Temperature regulating switch 3 ON
Main fuse (16 A) in fuse holder blown	Temperature regulating switch 3 ON Heater lever switch 5 ON
Overheat switch 9 has operated and fuse 26 (8 A) has blown	Temperature regulating switch 3 ON Heater lever switch 5 ON
Safety switch 19 has operated	Temperature regulating switch 3 ON Heater lever switch 5 ON
Heater does not run on	Heater and engine turned OFF
Air circulation blower does not run at two speeds	Temperature regulating switch 3 ON Heater lever switch 5 ON Ignition turn ON and OFF
Heater output inadequate and/or heater uses too much fuel	Engine running; heater turned ON
Air circulation blower 13 and combustion air blower 20 continue to run after run on period although heater is turned OFF	Engine running Heater lever switch 5 ON Temperature regulating switch 3 just turned OFF
Heater smokes	Temperature regulating switch 3 ON Heater lever switch 5 ON
Heater does not start up at all	Temperature regulating switch ON Heater lever switch 5 ON

### Note

At least 10 volts required for voltage check at flame switch



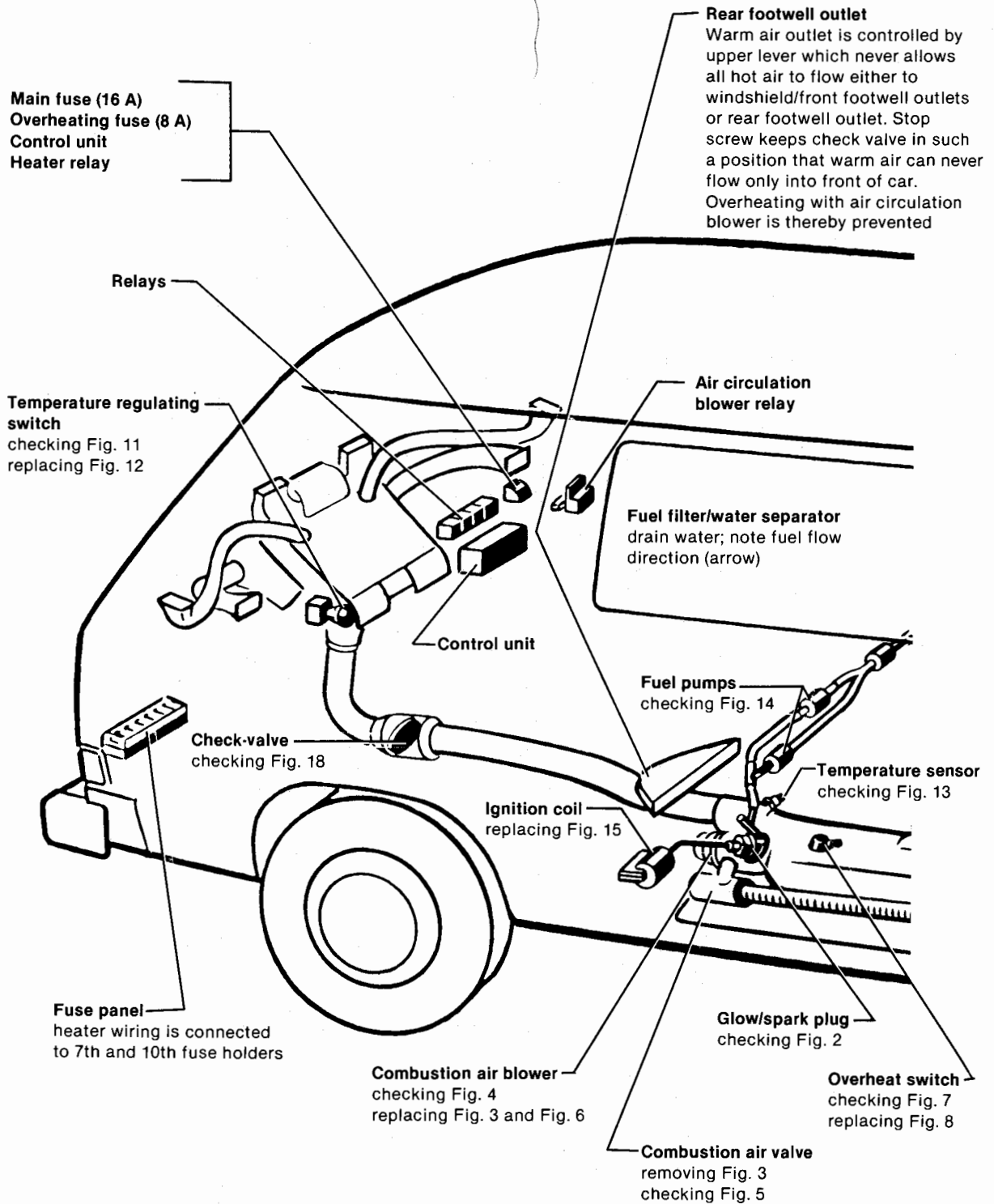
82-174

Trouble caused by		see page	
	1 — 10th fuse (16A) in fuse/relay panel	O	Wiring Diagrams
	2a — Main fuse (16A) in inline fuse holder	O	Wiring Diagrams
	2b — Overheat fuse (8A) in supplemental fuse holder	□	Wiring Diagrams
	3 — Temperature regulating switch	□	82.5
	4 — Defroster/footwell flaps		82.7
	5 — Heater lever switch		82.8
	6 — Heater relay	□	82.2
	7 — Glow/spark plug	□	82.3
	8 — Temperature sensor	△	82.6
	9 — Overheat switch	△	82.4
	10 — Heater booster	△	82.3
	11 — Flame switch	O	82.5
	12 — Exhaust outlet	O	82.2
	13 — Air circulation blower	□	82.7
	14 — Exhaust pipe	O	82.2
	15 — Control flaps	□	82.8
	16 — Heater flap		82.2
	17 — Heat exchanger		82.2
	18 — Heater blower		82.2
	19 — Safety switch	O	82.7
	20 — Combustion air blower	△	82.3
	21 — Fuel inlet	□	82.2
	22 — Ignition coil	O	82.6
	23 — Fuel pump	△	82.6
	24 — Fuel filter/water separator	O	82.2
	25 — Combustion air hose	□	82.2
	— Trace circuit in current flow diagram	O	Wiring Diagrams

Symbols denote degree of trouble probability

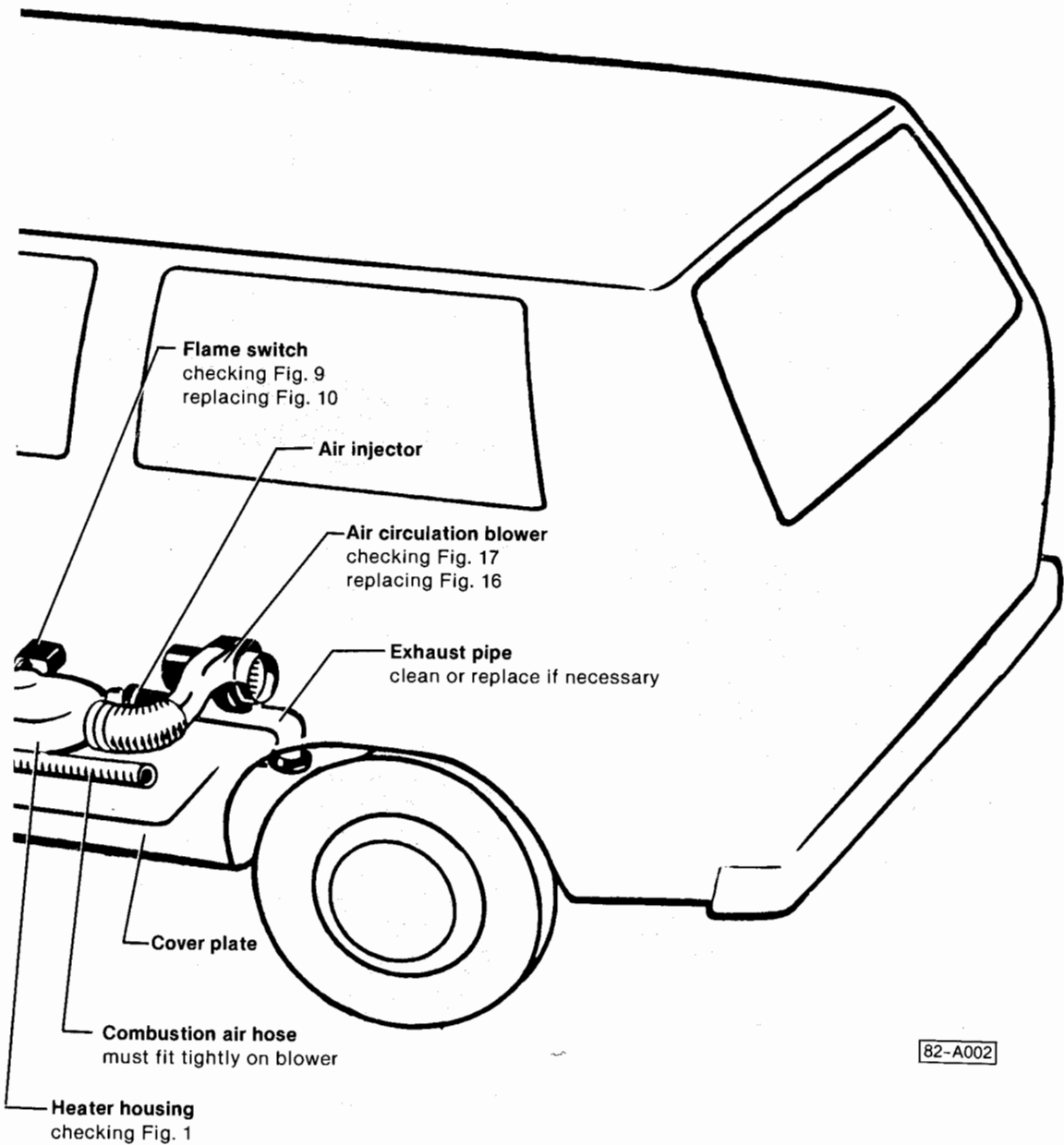
- O = Highly probable
- △ = Not so probable
- = Seldom

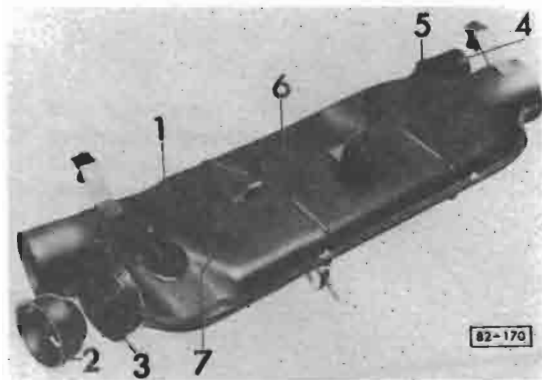
# 82 Heater Booster



Current flow diagram see wiring diagram, repair group  
Troubleshooting page 82.18, 82.19

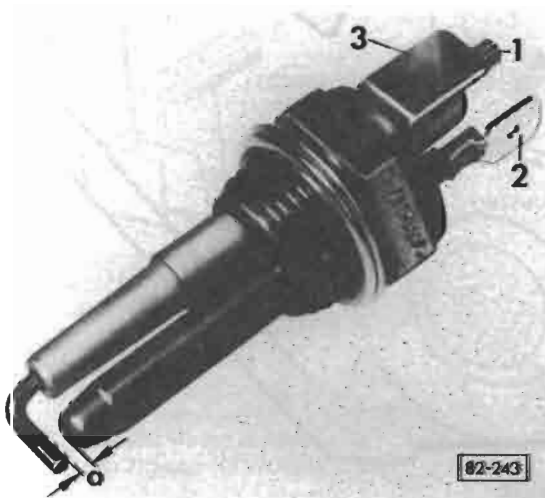






**Fig. 1 Heater booster, checking**

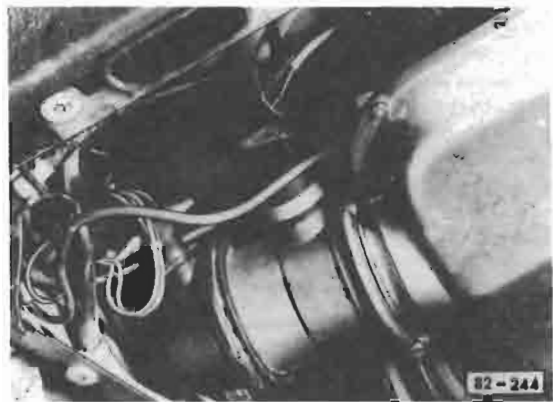
- 1 = Glow/spark plug adaptor. If carbon-fouled, clean with toothbrush
- 2 = Combustion air blower vane housing. If burned, replace
- 3 = Combustion chamber. If carbon-fouled, clean
- 4 = Fresh air inlet. If dirty, clean
- 5 = Exhaust outlet. If tar-like deposits are noticeable, replace
- 6 = Heater booster housing. If distorted by overheating, replace
- 7 = Ceramic ring for overheat switch. If damaged, replace



**Fig. 2 Glow/spark plug, checking**

- 1 = high tension terminal
- 2 = glow element terminal
- 3 = ground terminal
- electrode gap a : 2.5 mm (3/32 in.)
- voltage : 12 volts
- resistance : 4000-6000 ohms
- current draw of : 9A at 11V glow element

See page 82.14a for additional information

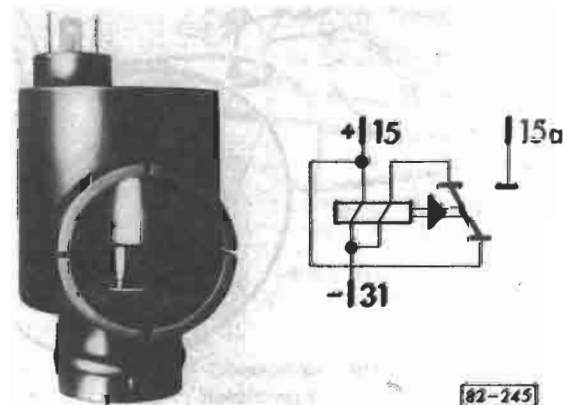


**Fig. 3 Combustion air blower/combustion air valve, removing**



**Fig. 4 Combustion air blower, checking**

- check for damage caused by overheating at points marked 1
- check blower bearing 2 for free movement in both directions

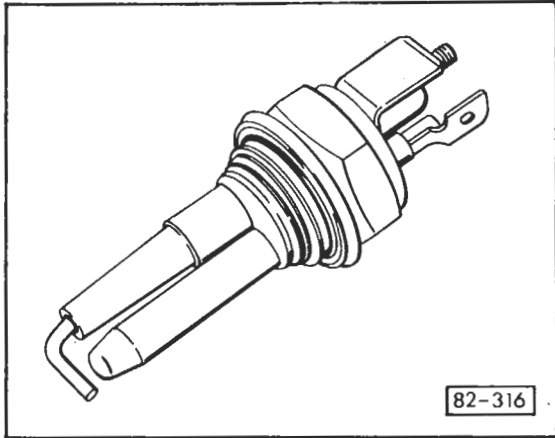


**Fig. 5 Combustion air valve, checking**

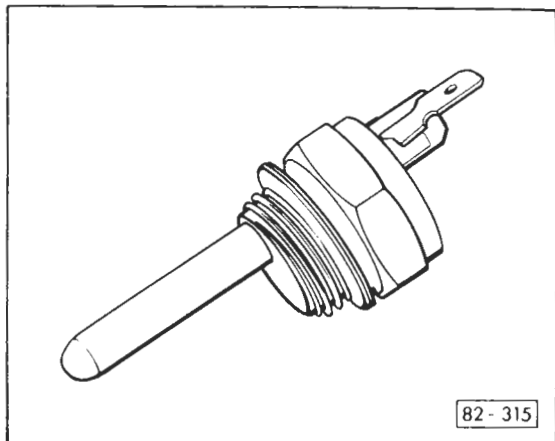
- connect ground wire to terminal 31
- connect hot wire to terminal 15
  - air intake valve must open
- press valve plate against stop
  - check for current flow between terminals 15 and 15a

Engineering tests show that a spark plug is not needed to ignite the diesel fuel/air mixture in the auxiliary heater combustion chamber.

Therefore, the combination glow/spark plug has been superseded by glow plug Part No. 251 963 319F.



Old style spark/glow plug



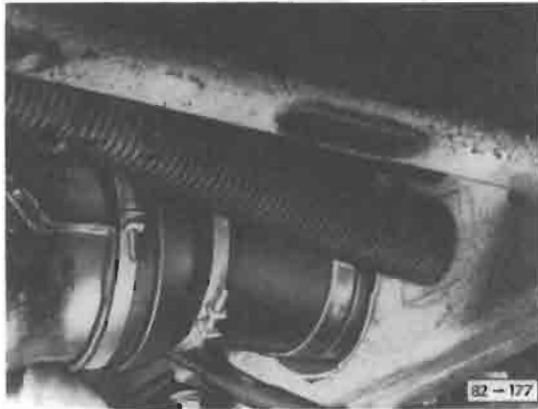
New style glow plug Part No. 251 963 319F

**Note**

Modify wiring when replacing old style combination spark/glow plug with new style glow plug.

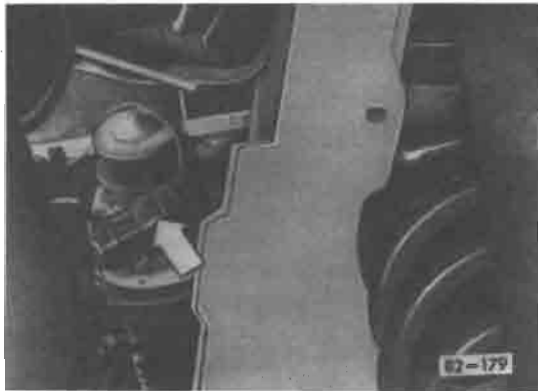
**Work sequence**

- install new style glow plug
- connect positive (+) and ground (-) wires to glow plug
- remove and discard high voltage cable from auxiliary heater ignition coil
- disconnect power supply wire to terminal 15 of auxiliary heater ignition coil and insulate terminal end with electrical tape



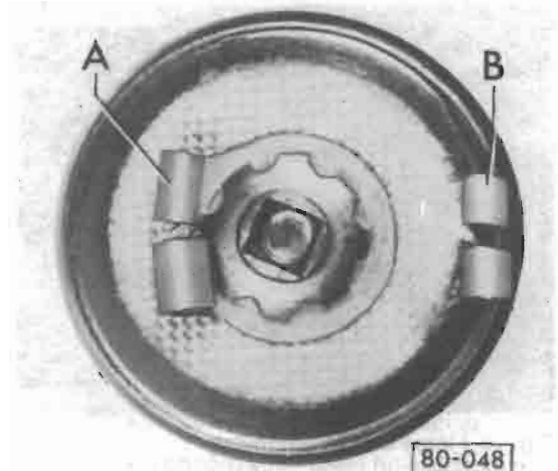
**Fig. 6 Combustion air blower, installing**

- combustion air hose must fit tightly on blower.
- If hose comes off, heater flame will damage blower



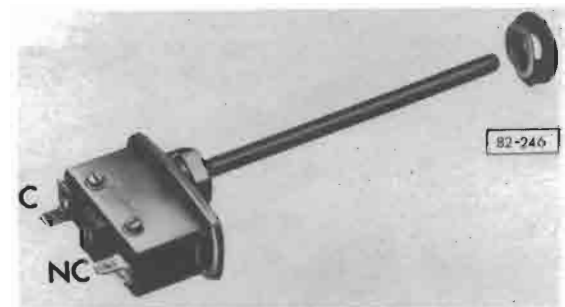
**Fig. 7 Overheat switch, checking**

- turn heater ON and select highest heating
- wait until blowers run at highest speed (flame switch has cut off glow plug)
- disconnect air circulation blower (arrow)
- wait for 90 seconds and reconnect air circulation blower
  - if fuel pump starts running, overheat switch is **OK**
  - if fuel pump does not start running within 90 seconds, overheat fuse is blown
- replace overheat switch



**Fig. 8 Overheat switch, replacing**

- crimp green wire to terminal **A**
- crimp brown wire to terminal **B**
- solder wires (use rosin-core solder)



**Fig. 9 Flame switch, checking**  
(switch installed)

- turn heater **ON**
    - heater must ignite within 100 seconds at 20°C/68°F
  - turn heater **OFF**
    - run-on time must be approx. 180 seconds at 20°C/68°F
- If **NO** for either condition, replace flame switch

# 82 Heater Booster

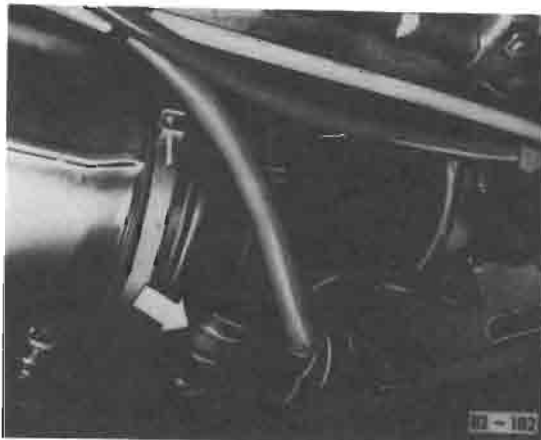


**Fig. 10 Flame switch, removing**

- pull rubber grommet off carefully
- remove union nut and pull switch out

**CAUTION**

Do not bend sensor tube



**Fig. 11 Temperature regulating switch, checking (switch installed)**

- turn heater ON and wait until blower speed increases
- bridge temperature sensor terminals (arrow)
  - one fuel pump (small quantity) must start running
- remove bridge on connector for temperature sensor
  - other fuel pump (large quantity) must start running

if under both conditions, fuel pumps are running, temperature regulating switch is OK



**Fig. 12 Temperature regulating switch, replacing**

**CAUTION**

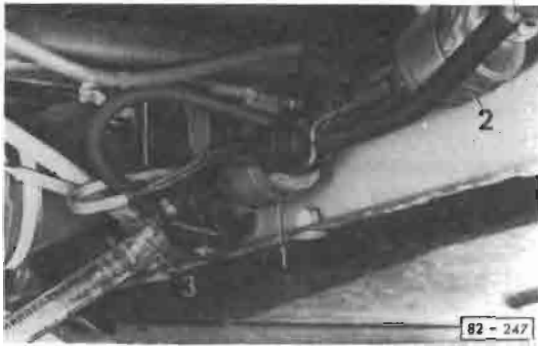
Disconnect battery ground strap before starting to work

- remove escutcheon with VW 674/1
  - do not interchange wires of terminals 31 and K (outside of multi-pin connector) as this will cause short circuit in switch



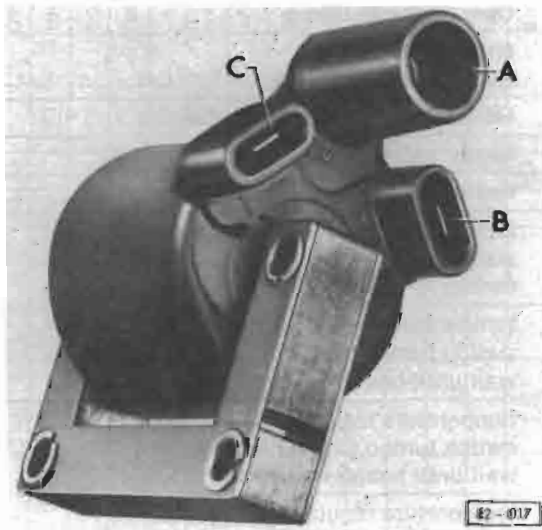
**Fig. 13 Temperature sensor, checking**

- place in warm water (60°C/140°F)
  - resistance: 3500-5000 ohms



**Fig. 14 Fuel pump, checking**  
(pump installed)

- 1—**Fuel pump for small quantity** (Spare Part No. 251 261 467 A)
- 2—**Fuel pump for large quantity** (Spare Part No. 251 261 467 B)
- 3—**T-connector**
  - disconnect hose between heater and T-connector (3) at connector and hold into measuring glass
  - turn heater ON and wait until pump starts pumping
  - check amount of fuel in measuring glass after 100 strokes of pump
    - amount: 4.5–5 cm<sup>3</sup>
  - connect green/yellow wire of fuel pump (1) to fuel pump (2)
  - turn heater ON and wait until pump starts pumping
  - check amount of fuel in measuring glass after 100 strokes of pump
    - amount: 8–9 cm<sup>3</sup>



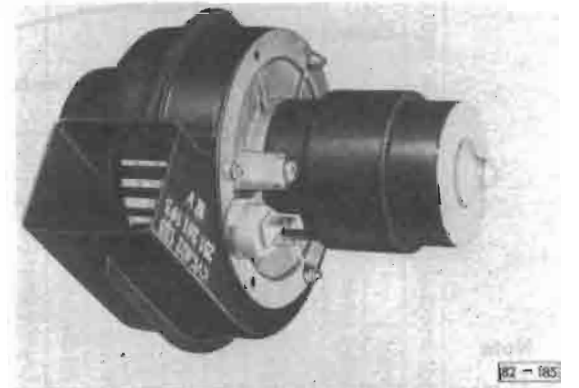
**Fig. 15 Ignition coil, connections**

- A = high tension wire
- B = terminal 15
- C = terminal 1



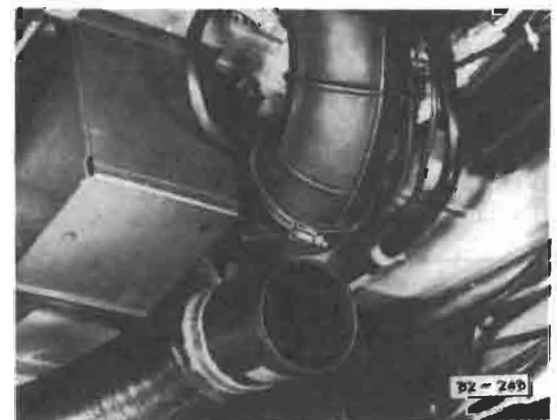
**Fig. 16 Air circulation blower, replacing**

- condensation drain hole (arrow) must be at bottom



**Fig. 17 Air circulation blower, checking**  
(blower installed)

- current draw:  
(engine not running)  
low speed: 3 to 4A  
high speed: 6.5 to 7.5A



**Fig. 18 Control flap, checking**

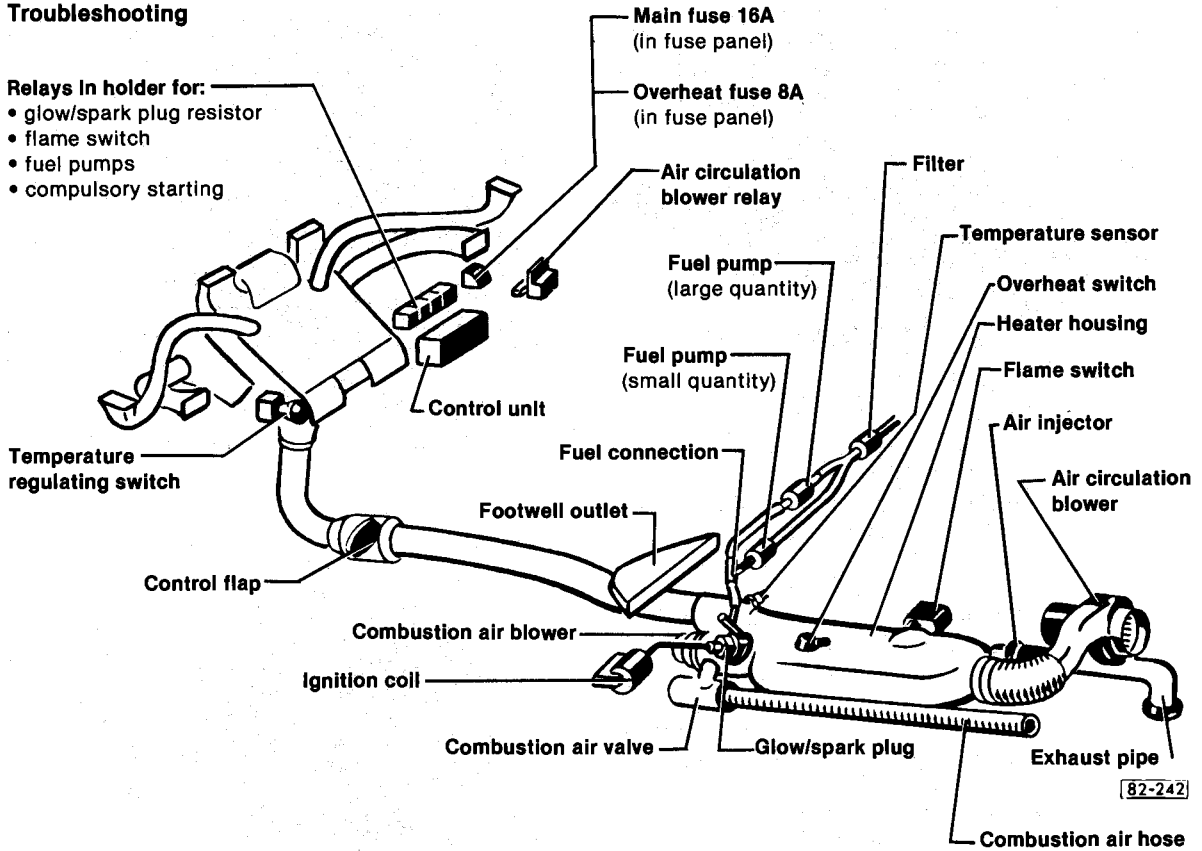
- if 8A overhear fuse is blown, check for free movement of flap

# 82 Heater Booster

## Troubleshooting

### Relays in holder for:

- glow/spark plug resistor
- flame switch
- fuel pumps
- compulsory starting



### Note

At least 10.3 volts required for voltage check at flame switch

Trouble	Operating conditions
main fuse (16 A) blown	engine running, temperature regulating switch ON
overheat switch operates and overheat fuse blows	temperature regulating switch ON
heater cannot be shut OFF	heater switched OFF
heater does not run on	heater switched OFF
air circulation blower does not run at 2 speeds	temperature regulating switch ON, wait until heater responds, switch ignition ON and OFF
heater output inadequate, small quantity fuel pump always works	temperature regulating switch ON, switch turned to high heating, wait until heater responds
heater output too hot, large quantity fuel pump always works	temperature regulating switch ON, switch turned to low heating, wait until heater responds
heater does not start working at all	temperature regulating switch ON
heater stops working after run-on time	temperature regulating switch ON
heater smokes	temperature regulating switch ON
air circulation blower and combustion air blower continue to run on although heater is turned OFF	engine running, temperature regulating switch was turned ON

Symbols denote degree of trouble probability

- = Highly probable
- △ = Not so probable
- = Seldom

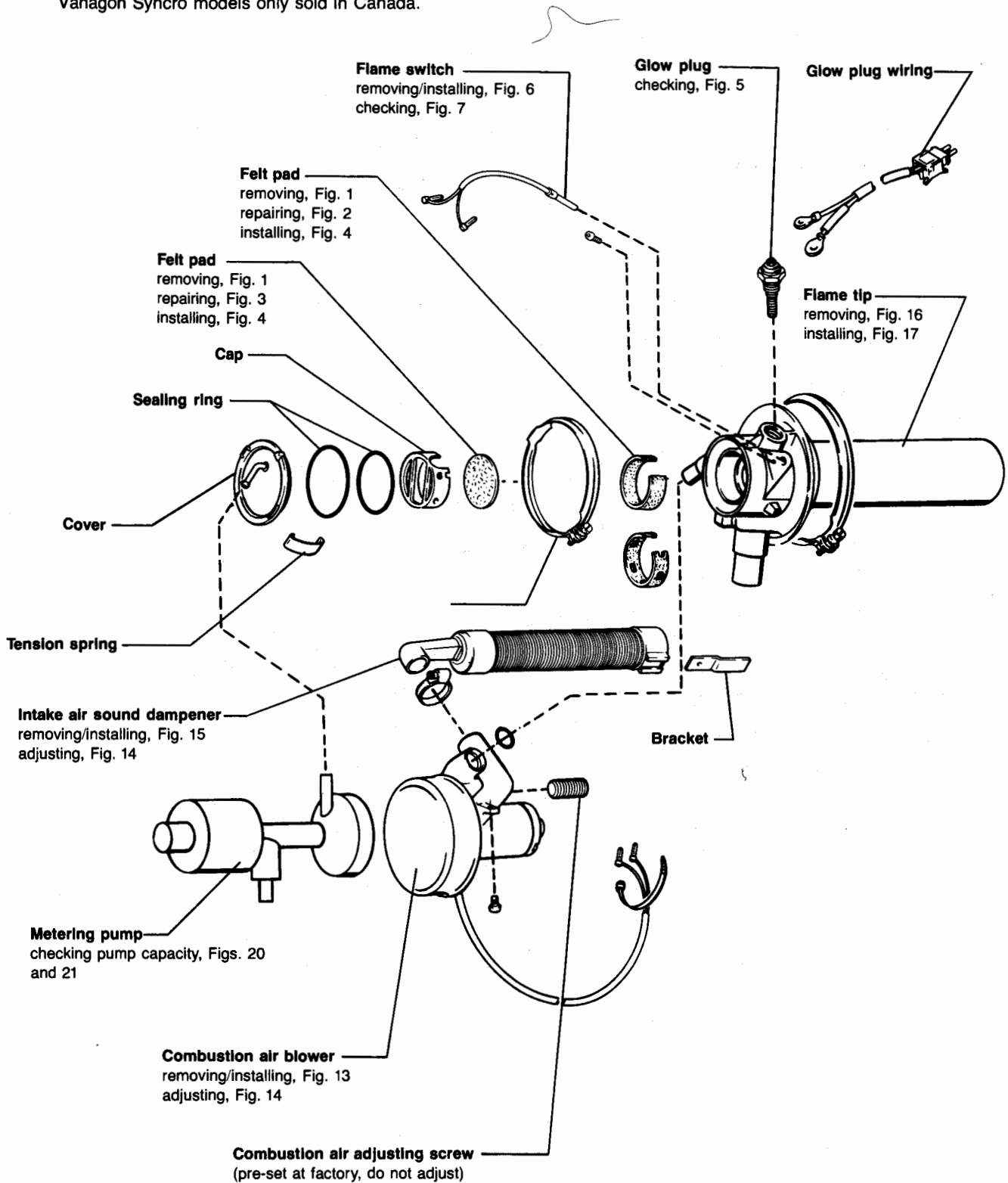
Trouble caused by	
main fuse (16 A)	○
overheat fuse (8 A)	○
temperature regulating switch	△
control unit	△
relays for: • glow/spark plug resistor	□
• flame switch	□
• fuel pumps	□
• compulsory starting	□
air circulating blower relay	□
glow/spark plug	□
temperature sensor	
overheat switch	□
heater housing	
flame switch	△
air injector	○
air circulation blower	
exhaust pipe	
fuel pump (small delivery quantity)	
fuel pump (large delivery quantity)	
combustion air valve	
combustion air blower	
fuel injection connection	
ignition coil	
check valve	○
fuel filter	
combustion air hose	
footwell outlet	○
troubleshoot according to current flow diagram	○

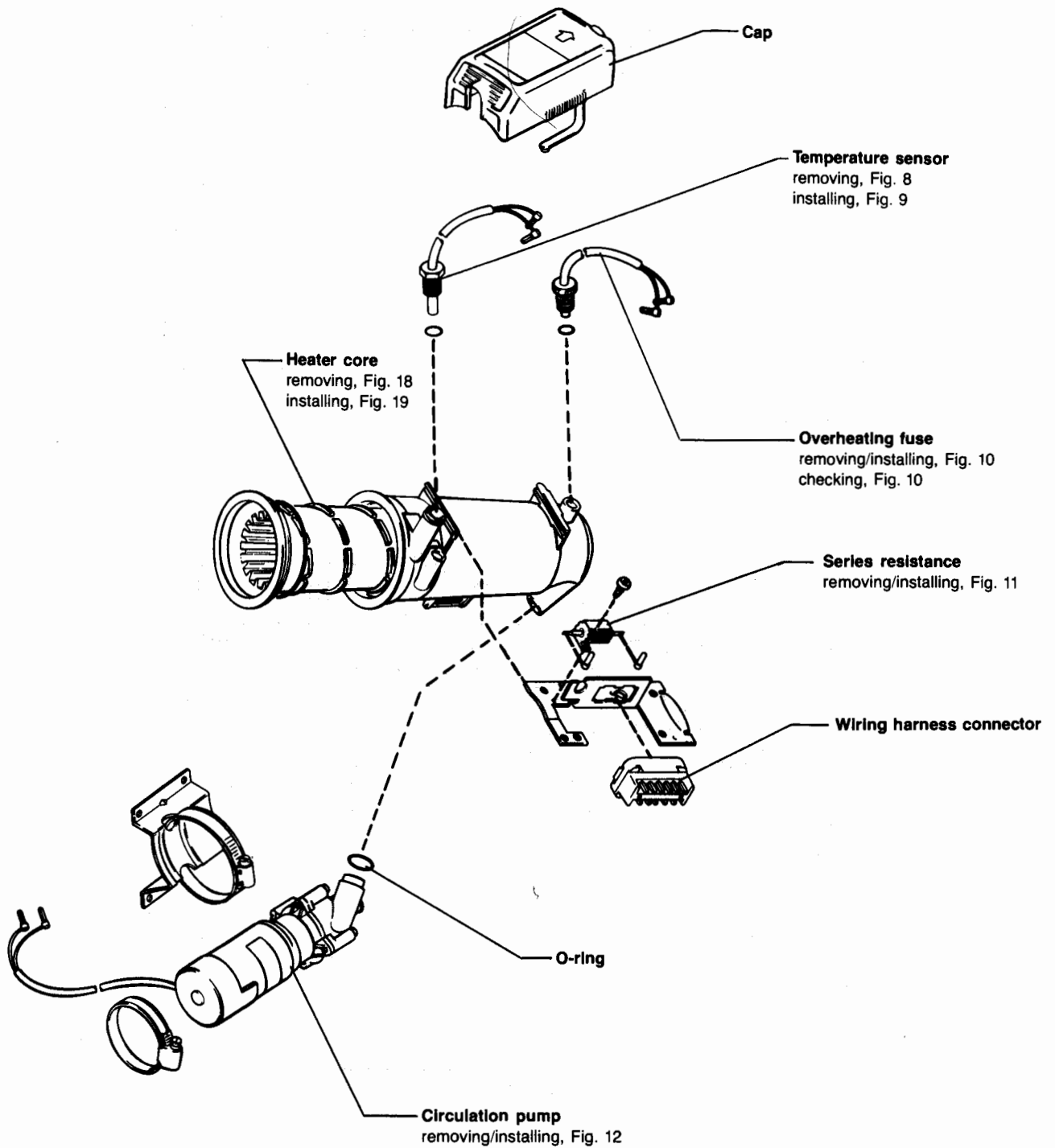


# 82 Heater Booster

## Auxiliary heater BBW 46

This heater is offered as optional equipment on Vanagon Syncro models only sold in Canada.





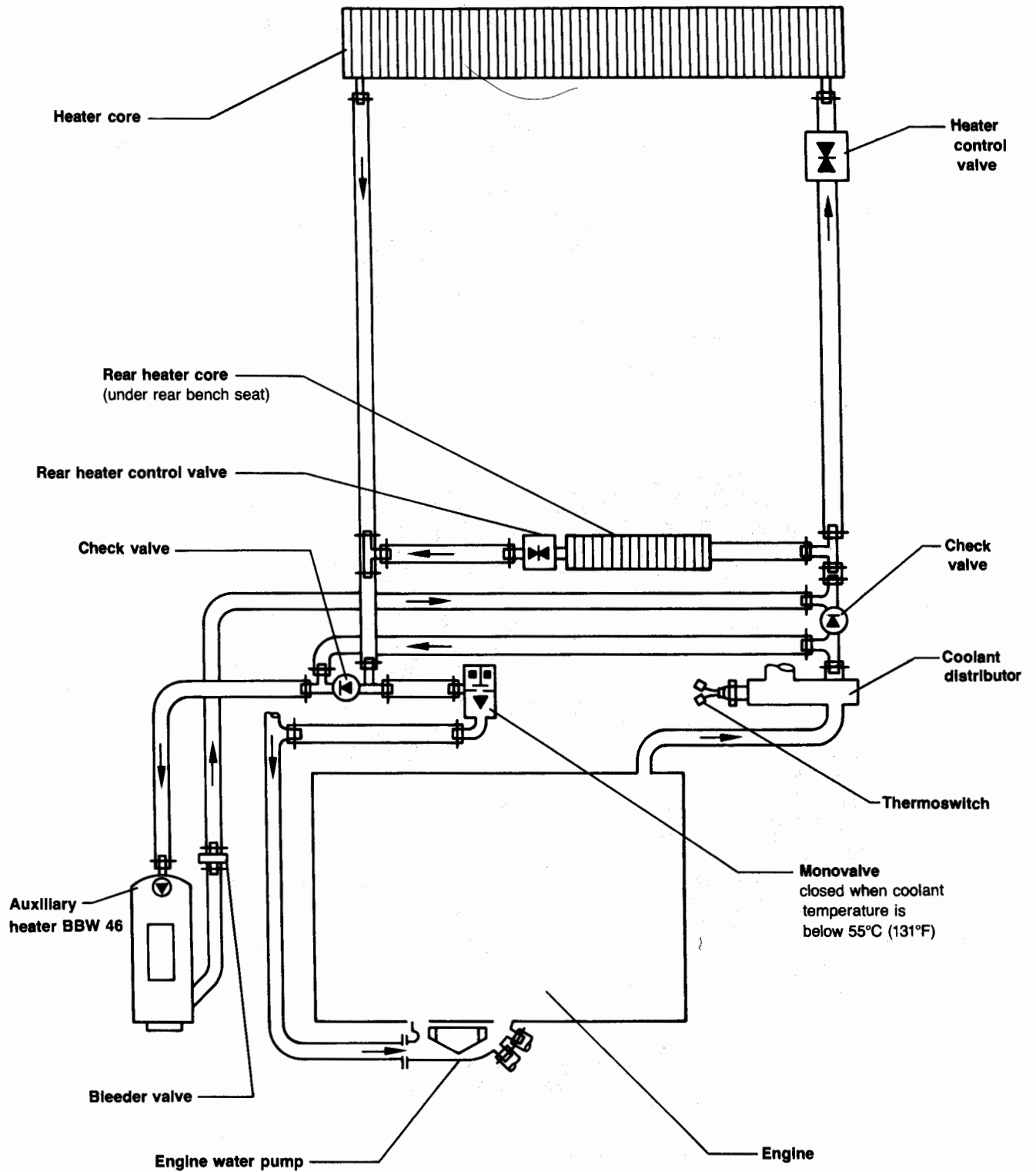
**CAUTION**

Coolant/antifreeze **must not** be reused when replacing engine, cylinder head, cylinder head gasket, radiator and heater core.

82-320

# 82 Heater Booster

Water flow through heater system

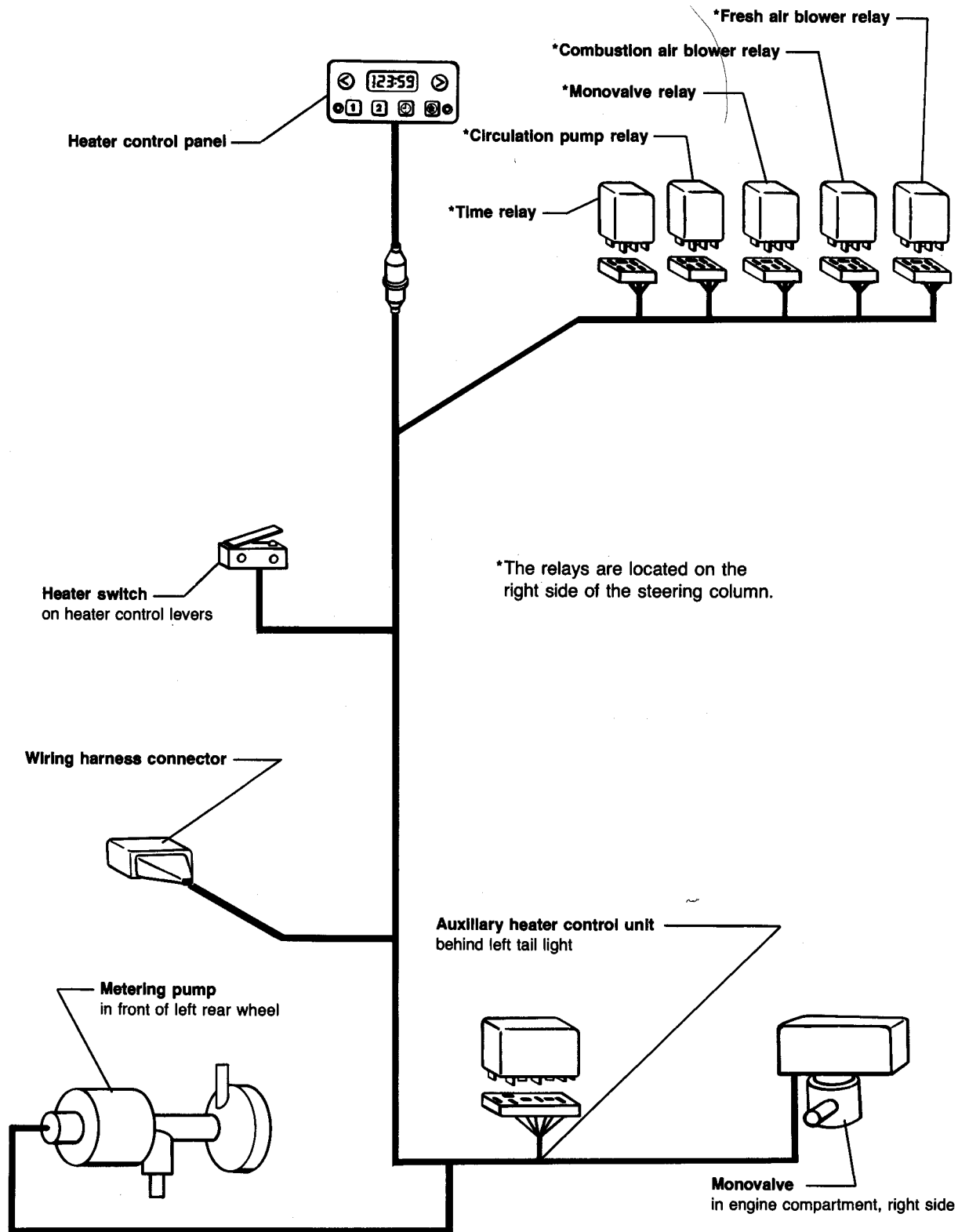


82-344

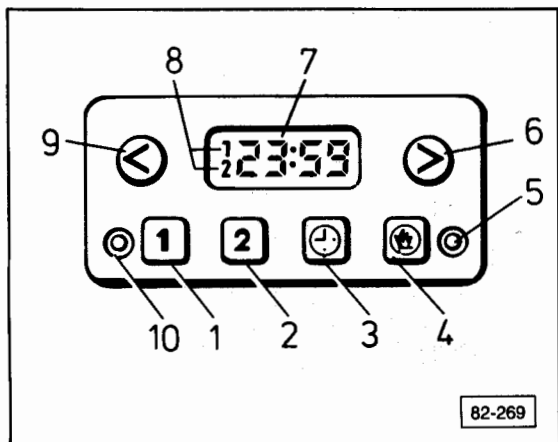
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# 82 Heater Booster

## Auxiliary heater, electrical wiring



82-321



- 1,2 — buttons for pre-selecting times
- 3 — time indicator display button
- 4 — immediate heat button
- 5 — immediate heat indicator light
- 6 — clock set button, forward movement
- 7 — time display
- 8 — pre-selected time indicators
- 9 — clock set button, backward movement
- 10 — pre-selected time ready indicator light (yellow)

### Indicating time of day

- push button 3
  - time of day appears in display as long as button is depressed
- release button 3
  - indicator goes out or pre-selected time will appear if one has been selected (this will last about two seconds)

### Setting time of day

If the display is flashing 8:88 in the indicator field 7, or if time indicated is not the same as actual time,

- push and hold down button 3 and at the same time push either of the two time setting buttons 6 or 9 to set the correct time

### Immediate heating operation

- push button 4 any time to start or stop heating
  - green indicator light 5 lights when heat is switched ON

Heating begins when the engine coolant temperature is below 80°C (176°F) and the heater output lever is pushed all the way to the right until stop.

Heating is limited to 30 minutes.

more

# 82 Heater Booster

## Pre-selecting time for heat operation

A specific time to start heating may be selected up to 24 hours in advance.

### Setting pre-selected time

- push button 1 or 2
  - respective pre-selected indicator time will appear in display (7) with numeral 1 or 2 at display area 8
  - yellow ready light lights
- change pre-selected time by pushing button 9 or 6
  - after 20 seconds, pre-selected time display shuts **OFF**
  - numeral 1 or 2 in the indicator field remains lit
  - pre-selected time is now activated
- move heater output lever all the way to right until stop
- switch fresh air blower to position 1

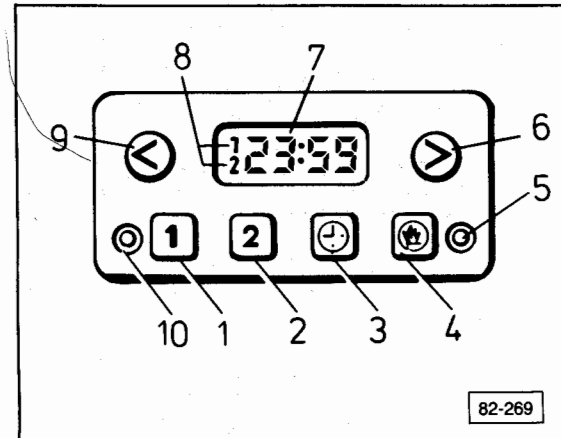
### Note

Heater will not operate at pre-selected time unless the heater output lever is in the full right position and the fresh air blower is in position 1.

### Cancelling a pre-selected time

- push button 1 or 2
  - yellow ready light goes **OFF**
  - numeral 1 or 2 in display area 8 will go **OFF**
  - pre-selected time is now cancelled

## Auxiliary heater BBW 46, operation



- push button 4 to switch heater **ON**
- slide heater output lever fully to right

The following occurs:

- positive (+) voltage from battery via **Fuse S55** travels to auxiliary heater control panel and through output contact of time relay (17/87) to contact **T6/5** of Auxiliary Heater Control unit
- green "ready" control light lights
- Auxiliary Heater Control Unit switches Glow Plug and Recirculation Pump **ON**
- after pre-glowing (approximately 5 seconds), Metering Pump is switched **ON** by voltage from terminal **T2a/1**

### Note

Voltage at **T2a/1** is supplied via **Fuse S24** by Auxiliary Heater Control terminal **T2c/2**.

- a 90 second safety period begins
- fuel advances for approximately 5 seconds and Auxiliary Heater Control Unit **T8/1** sends signal to Combustion Air Blower to run at full speed

During this time, if a flame occurs, (this is normal operation)

- Flame Switch sends signal to Auxiliary Heater Control Unit and Control Unit switches Glow Plug **OFF**
- safety period is automatically reset

### Note

If a flame does not occur during the pre-glowing and safety period,

- a new pre-glow period (approximately 30 seconds) and safety period (approximately 90 seconds) are started automatically

## Combustion operation

The Auxiliary Heater operates at full load immediately after being switched **ON**.

- temperature sensor resistance increases as temperature rises
- Monovalve separates Auxiliary Heater water circulation from circulation of engine coolant up to temperature of 55°C (131°F) if Auxiliary Heater and vehicle engine operate simultaneously

When water temperature reaches 55°C (131°F) the Auxiliary Heater Control Unit begins to regulate heater operation.

## Vehicle fresh air/warm air operation

When water circulation temperature rises above 55°C (131°F), voltage is supplied to terminal **T6/6** of Auxiliary Heater Control Unit.

- Heater Fan Relay and Fresh Air Fan Relay contacts close and Warm Air Blower and Fresh Air Fan operate

When water circulation temperature falls below 50°C (92°F),

- Heater Fan Relay and Fresh Air Fan Relay contacts open and operation of fans stops

## Partial load operation

When water circulation temperature rises above 80°C (176°F),

- current to Combustion Air Blower goes through resistor and blower speed decreases
- Metering Pump output decreases by 50%

## Full load operation

If the temperature drops below 70°C (128°F) during partial operation,

- Auxiliary Heater Control Unit switches back to full load operation
- Metering Pump operates at full capacity

## Regulation pause

If water circulation temperature should rise above 85°C (185°F) during partial load operation, the Auxiliary Heater Control Unit does the following:

- shuts Metering Pump **OFF**

After Flame Switch cools,

- after-run period begins

## After-run operation

After-run operation serves to end the combustion operation in an orderly manner. After the flame is extinguished,

- Flame Detector indicates "dark"
- Fresh Air and Warm Air Blowers continue to run
- Combustion Air Blower runs at full load for approximately 60 seconds

## Note

The after-run period is always approximately 60 seconds long. It is not shortened by a shut down or rapid reduction of temperature.

## Starting Auxiliary Heater after a regulation pause

If the temperature drops below 80°C (176°F) during a regulation pause,

- a new start procedure is automatically begun

When Flame Detector indicates "light,"

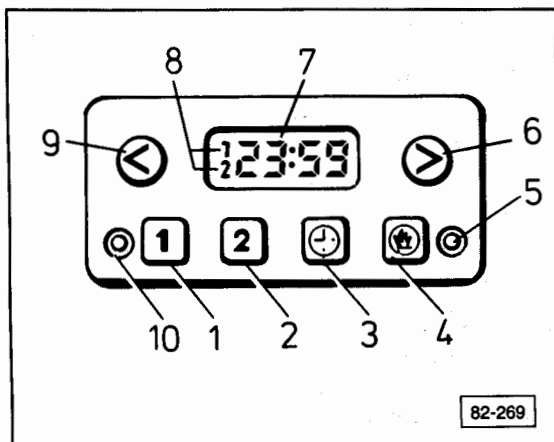
- combustion operation begins at full load and switches to partial load operation when the temperature rises above 80°C (176°F)



# 82 Heater Booster

## Shutting heater OFF

During combustion operation,



— push button 4 to switch heater **OFF**

- Heater Indicator Light (**green**) goes out
- Metering Pump and Fresh Air/Warm Air blowers shut **OFF**

After Flame Switch indicates "dark,"

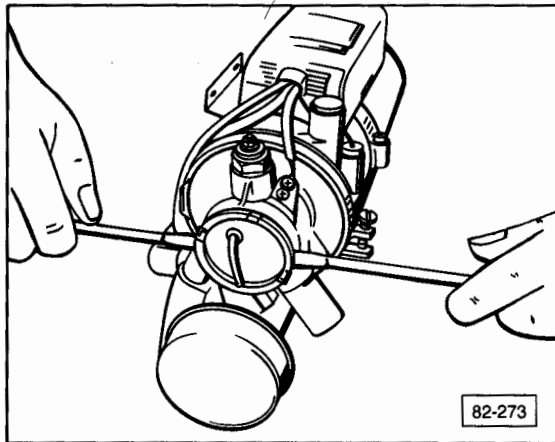
- after-run begins

### Note

Auxiliary Heater can always be shut **OFF** (even if the Flame Detector switch is defective.) If the Flame Switch does not signal "dark" 80 seconds after shut down, a forced shut down and after-run period will occur.

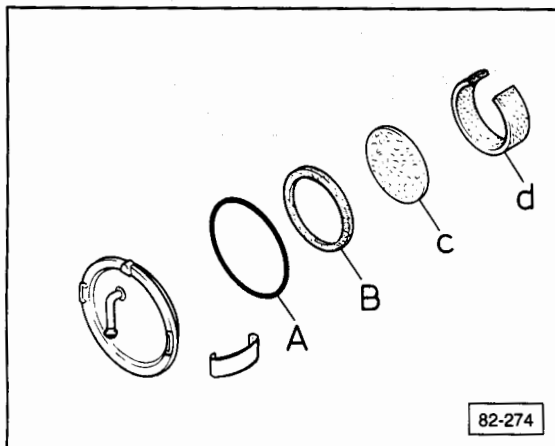
To reactivate Auxiliary Heater,

- switch Auxiliary Heater **OFF**
- wait one minute
- switch Auxiliary Heater **ON**



**Fig. 1 Felt pad, removing**

- remove tension springs
- pry off cover with two screwdrivers in recesses A



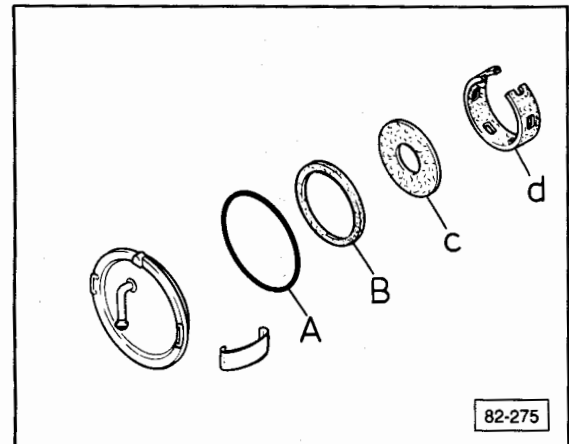
**Fig. 2 Felt pad, servicing**

**Note**

O-rings **A** and **B** must be replaced after each disassembly.

**Do NOT** glue pad **C** into place.

- insert assembly with felt pad into Heater until recesses in ring fit together with tabs on Heater



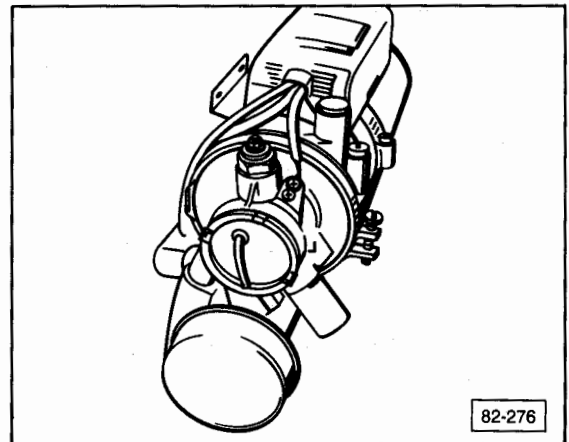
**Fig. 3 Felt pad, servicing (Diesel heaters)**

**Note**

O-rings **A** and **B** must be replaced after each disassembly.

**Do NOT** glue pad **C** into place.

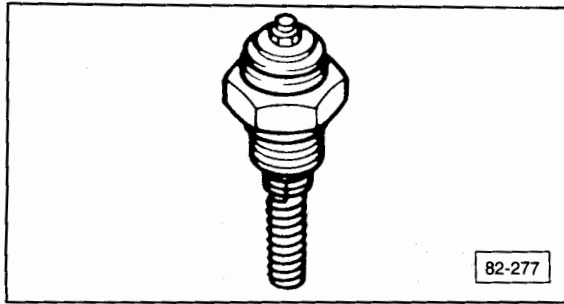
- insert assembly with felt pad into Heater until recesses in ring fit together with tabs on Heater



**Fig. 4 Felt pad, installing**

- slide assembly in noting position of lug **B**

# 82 Heater Booster

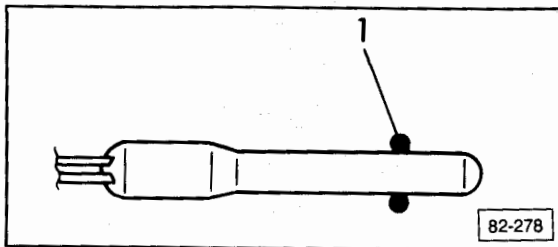


**Fig. 5 Glow plug, checking**

- disconnect wire to glow plug
- remove glow plug
  - 30 Nm (22 ft lb)
- connect glow plug to external 12V source
- connect jumper wire between nut of glow plug and ground connection of 12V source
- measure amperage draw of glow plug using ohmmeter
  - approximately 20A ± 10%

**Note**

Remove carbon deposits on glow plug by glowing the plug and carefully scraping.



**Fig. 6 Flame Switch, removing/installing**

**Removing**

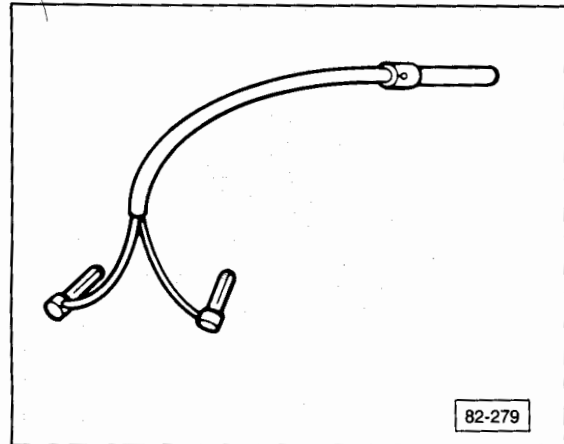
- remove oval-head screw
- pull Flame Switch out
- remove wires

**Installing**

- slide O-ring on to tip of Flame Switch at 1
- install oval head screw
- install wire

**CAUTION**

Do not reverse polarity of Flame Switch wires.



**Fig. 7 Flame switch, checking**

- switch heater **ON**

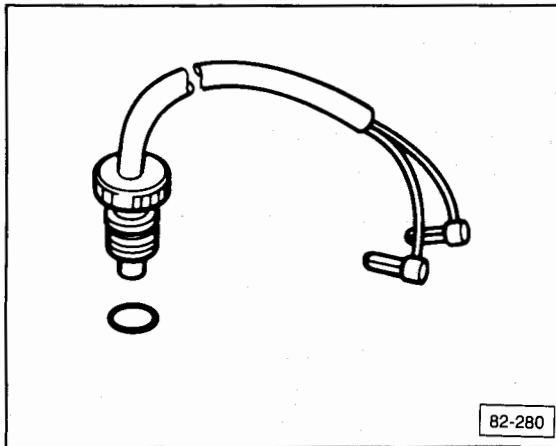
If Auxiliary Heater switches to restart after 30 seconds (without after-running),

- repair short circuit in wiring to Flame Switch

If Auxiliary Heater shuts off 120 seconds after successful start and switches to restart (without after-run) after 240 seconds,

- repair break in wiring to Flame Switch

## Temperature sensor, removing/installing



### CAUTION

Before removing Temperature Sensor, open cap on engine coolant expansion tank to relieve pressure on engine cooling system.

- remove wires from Temperature Sensor
- unscrew Temperature Sensor
  - 30 Nm (22.0 ft lb)

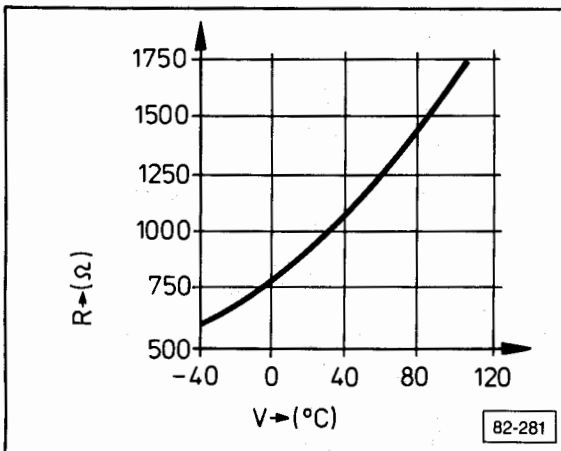


Fig. 9 Temperature Sensor, checking

This temperature sensor is a Positive Temperature Coefficient (PTC) type resistor.

- connect ohmmeter between terminal end and body of Temperature Sensor
- compare measured resistance and temperature of Temperature Sensor with graph
  - difference between measured resistance and graph must not be more than 1.0mA

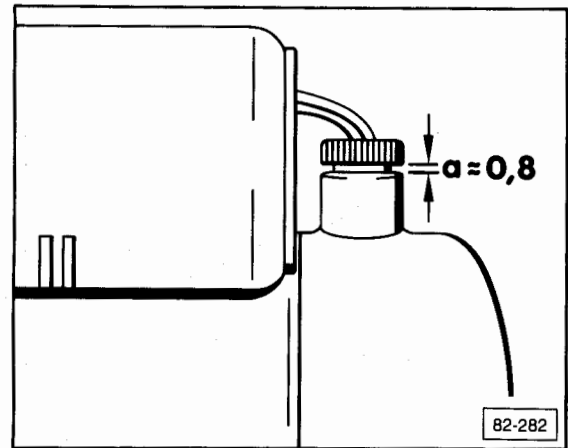


Fig 10. Fuse S24, removing/installing

### CAUTION

Before removing Fuse S24, open cap on engine coolant expansion tank to relieve pressure on engine cooling system.

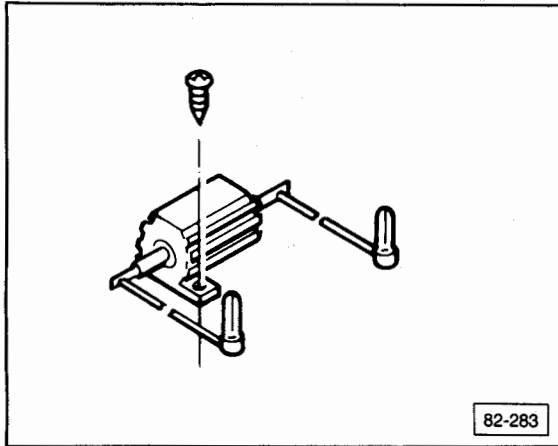
- disconnect wires from fuse
- unscrew fuse
- check fuse for continuity with ohmmeter

### Note

Fuse S24 is installed and tightened by hand. Make sure that the fuse point contacts the Heater tube.

- screw fuse in until cap of fuse is approximately 0.8mm from body of heater
  - $a = 0.8\text{mm}$  (.003 in)

# 82 Heater Booster

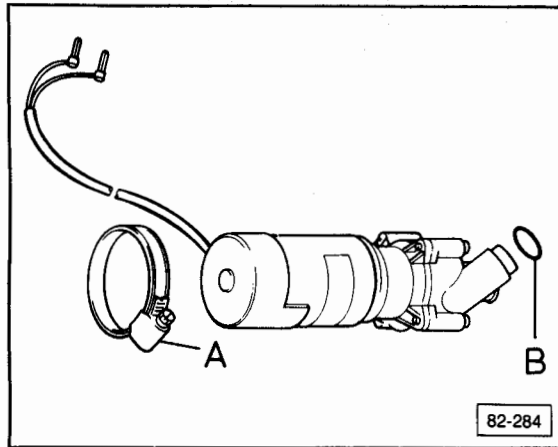


**Fig. 11 Series resistor (for partial load operation), removing/installing/checking**

**CAUTION**

Before removing series resistance, open cap on engine coolant expansion tank to relieve pressure on engine cooling system.

- remove oval head screw
- remove wire connectors
- measure resistance with ohmmeter
  - 3.3 ohm ± 3%
- install in reverse order of removal



**Fig. 12 Recirculation pump, removing/installing**

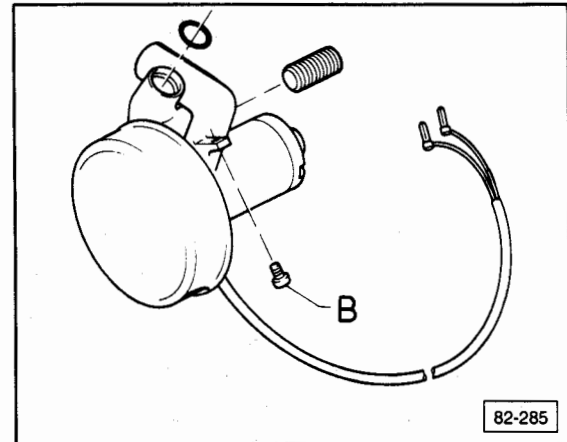
- mark electrical wires (for identification) and remove
- loosen clamp A and remove pump

**Installing**

- insert Recirculation Pump slanted connection into Heater Core
- install clamp

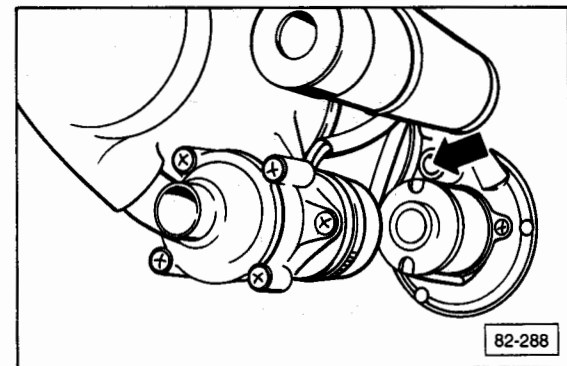
**Note**

Do not reverse wires for Recirculation Pump or it will run in the wrong direction.



**Fig. 13 Combustion Air Blower, removing/installing**

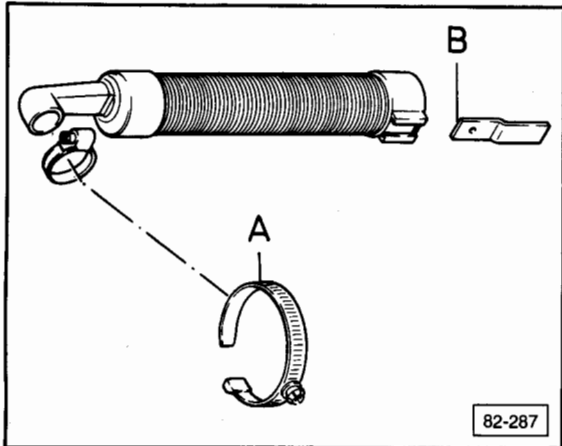
- remove air intake sound dampener
- mark electrical wires (for identification) and remove
  - loosen screw B and remove combustion air blower



**Fig. 14 Combustion Air Blower, adjusting**

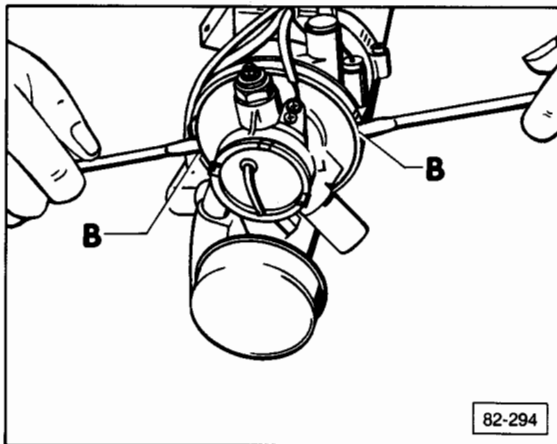
**CAUTION**

The Combustion Air Blower is pre-set at the factory. The adjustment screw (arrow) should not be moved.



**Fig. 15 Intake air noise dampener, removing/Installing/checking**

- unclip reuseable plastic band **A**
- remove noise dampener from bracket **B**
- check noise dampener for cracks

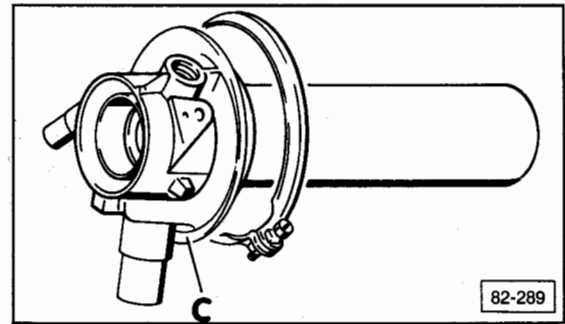


**Fig. 16 Flame head, removing**

**CAUTION**

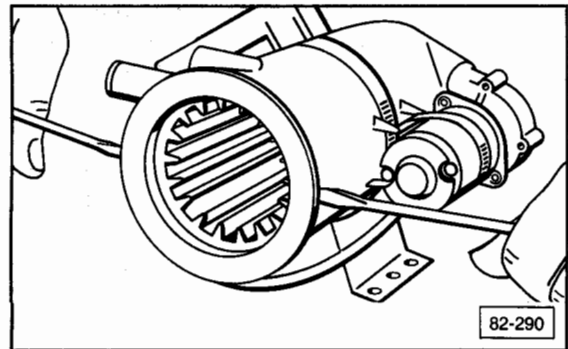
Before removing Flame head, open cap on engine coolant expansion tank to relieve pressure on engine cooling system.

- pinch off water hoses to heater
- unscrew clamps
- insert screwdrivers at recesses **B** and pry off Flame Head
- clean dirt accumulation from all parts



**Fig. 17 Flame head, installing**

- coat area between Flame Head and heat tube (**C**) with sealing paste
- install in reverse order of removal



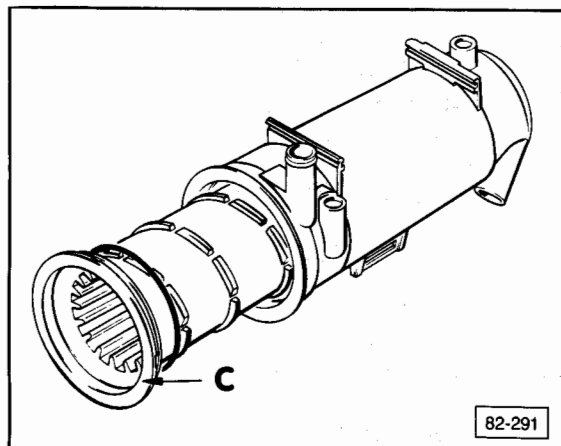
**Fig. 18 Heater core, removing**

**CAUTION**

Before removing Temperature Sensor and Fuse S24, open cap on engine coolant expansion tank to relieve pressure on engine cooling system.

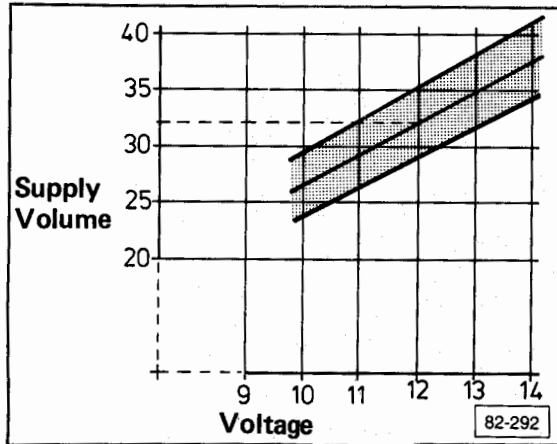
- remove Temperature Sensor and Fuse S24
- remove Flame Head
- insert two screwdrivers into recesses and pry Flame Head out
- clean combustion residue off with water spray and brush

# 82 Heater Booster



**Fig. 19 Heater core, installing**

- coat area between Flame Head and Heat Tube at **C** with sealing paste
- install Heater Core in reverse order of removal



**Fig. 20 Metering Pump, checking flow rate**

- remove connector to glow plug
- remove fuel feed hose from heater and place open end in measuring glass
- connect voltmeter between contacts **T2a/2** and **T6/4** of Auxiliary Heater Control Unit
- switch Auxiliary Heater **ON**
  - after 90 seconds Auxiliary Heater switches **OFF**
  - automatic re-start begins
- switch Auxiliary Heater **ON** again
- measure fuel volume after two 90 minute periods and compare voltage and volume with graph

**For example,**

If voltage measured at Auxiliary Heater is 12.0V,

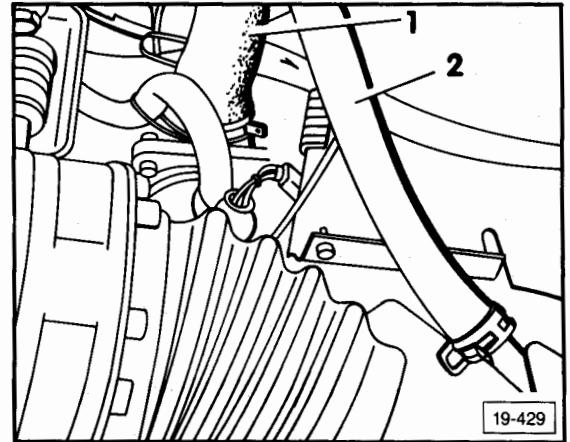
Then, volume output must fall between approximately 29ml and 35ml after two 90 minute measuring periods.

**Engine coolant system, draining/refilling**

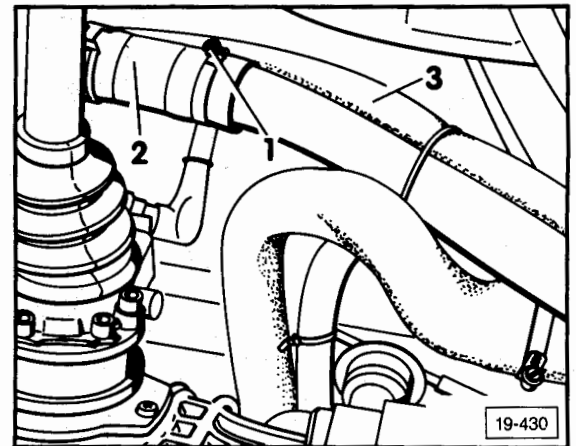
**CAUTION**

Use coolant Part No. **ZVW 237 102** which has corrosion inhibiting agents especially formulated to prevent corrosion damage to the water jacket sealing surfaces of the cylinder head.

Anti-freeze other than specified by Volkswagen may cause corrosion of the cooling system thus leading to engine overheating and damage.



- close hose 1 from radiator to thermostat with hose clamp
- close hose 2 from heat exchanger to coolant pipe with hose clamp



- loosen hose clamp 1, close hose 2 from radiator to distribution piece with hose clamp
- close hose 3 from heat exchanger to distribution piece with hose clamp
- drain coolant at drain plugs (Fig. 1)
- open coolant expansion tank cap

**CAUTION**

Coolant/antifreeze **must not** be reused when replacing engine, cylinder head, cylinder head gasket, radiator and heater core.



# 82 Heater Booster

## Refilling

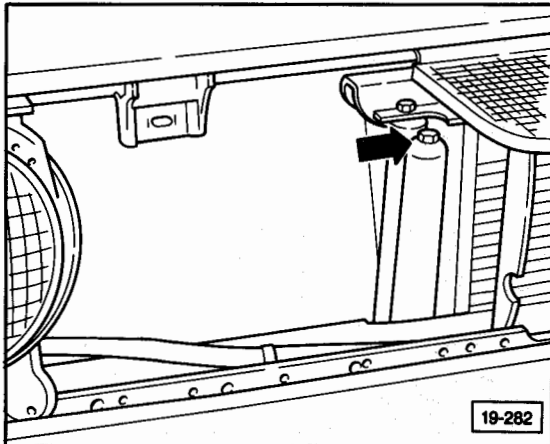
### Coolant mixture ratio

- coolant capacity 17.5 ltr (18.4 US qt)

### Note

Cooling system is filled at factory with mixture of water and antifreeze/corrosion protective solution. Coolant mixture should be used all year. When replacing coolant only use ethylene glycol based antifreeze (phosphate-free). Due to higher boiling point, coolant is an aid to operating on full load, particularly in warm climates

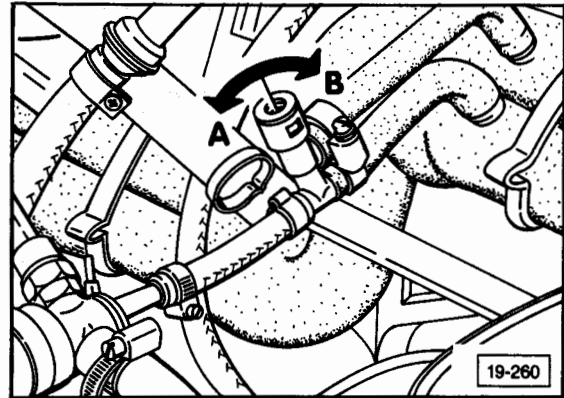
Outside temperature	Antifreeze	Water
-25°C (-13°F)	7.0 ltr (7.4 US qt)	10.5 ltr (11 US qt)
-35°C (-30°F)	8.75 ltr (9.2 US qt)	8.75 ltr (9.2 US qt)



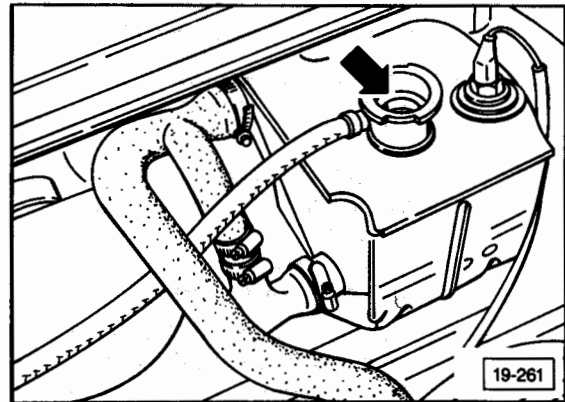
- set heater control to maximum heating
- open control valve for auxiliary heater under rear seat
- remove radiator grille
- raise vehicle approximately 40 cm (15-3/4 in.) at front under cross-member with floor jack and wooden support or equivalent
- open bleeder screw (arrow) on radiator

### CAUTION

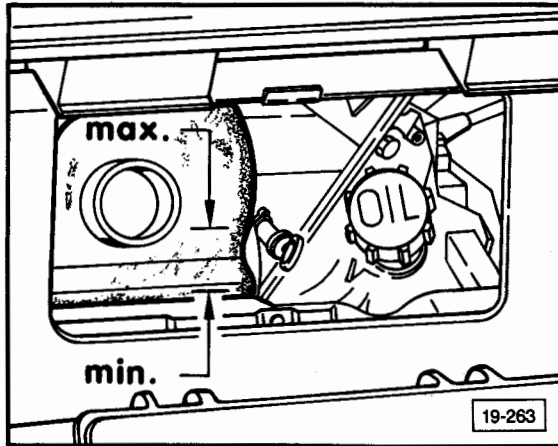
Coolant/antifreeze **must not** be reused when replacing engine, cylinder head, cylinder head gasket, radiator and heater core.



- open bleeder valve in engine compartment
- A = open
- B = closed



- remove electrical connector from monovalve
- fill coolant until expansion tank is full (approximately 4-5 ltr/4.25-5.3 US qt)
- start engine
- at approximately 2000 RPM, top up tank until coolant flows from bleeder screw on radiator (bubble free)
- add coolant until tank is full and close tank with cap
- turn ignition off and start engine again after approximately 20 seconds
- at about 2000 RPM open cap of expansion tank
- close bleeder screw on radiator when coolant flows out
- add coolant if necessary and close expansion tank
- close bleeder valve in engine compartment
- switch engine off

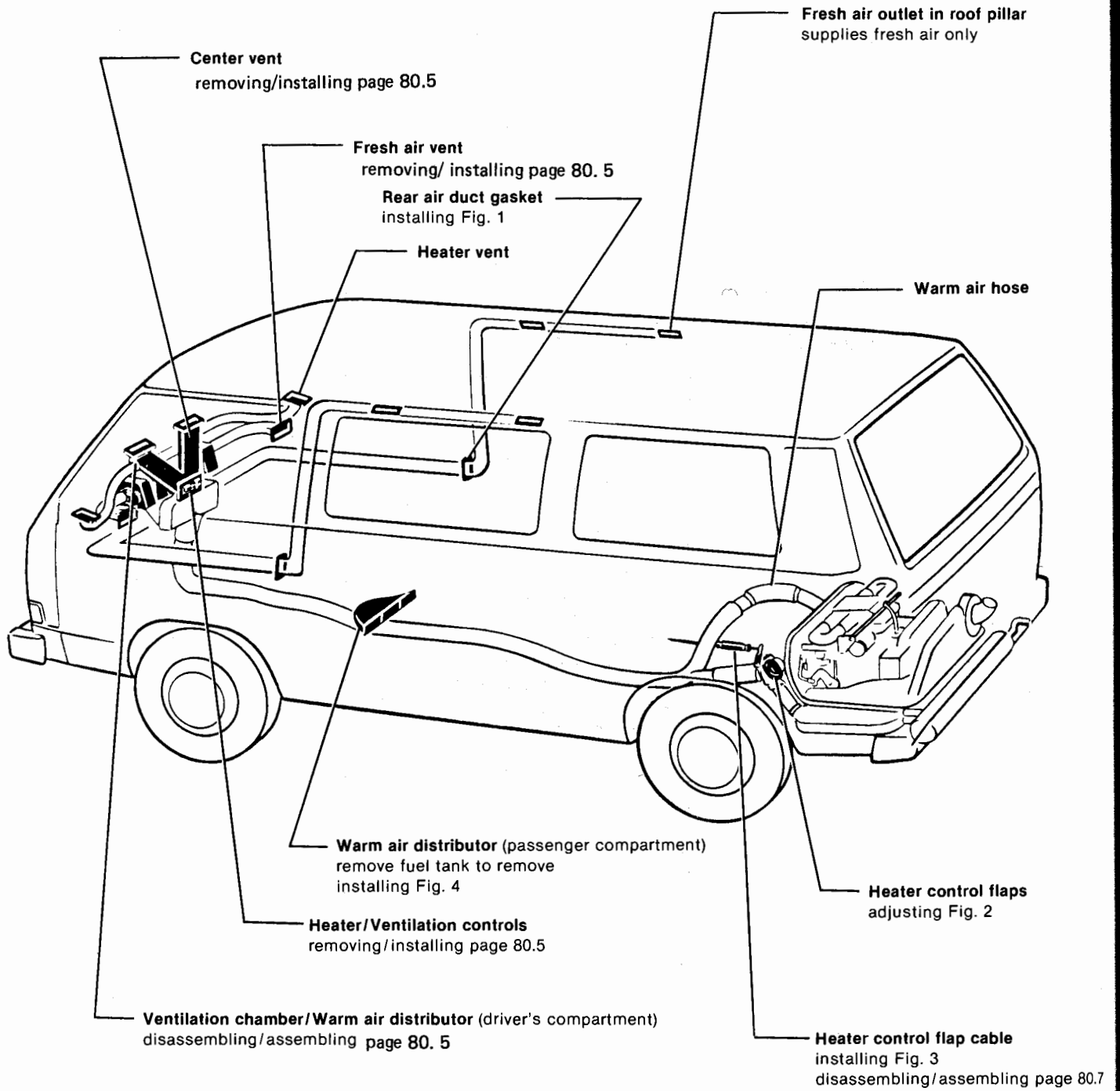


- refill overflow tank to maximum mark (arrow)
- reconnect wiring connector to Monovalve

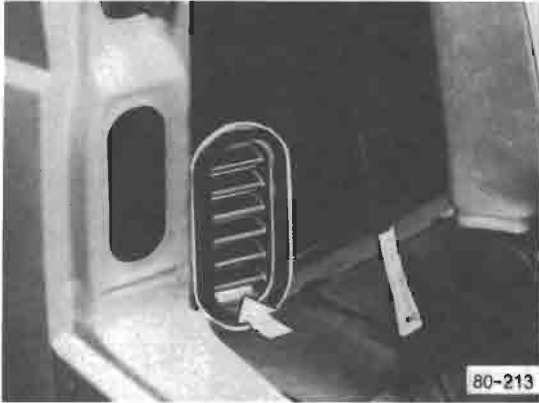
**Heater  
Ventilation**

<b>Quick Data</b>	<b>Index</b>
	<p>Additional heater, under rear bench seat – Water-cooled 80.16</p> <p>Controls assembly – Aircooled without fresh air fan 80.5 – Aircooled with fresh air fan 80.8 – Water-cooled 80.12</p> <p>Flap housing – Aircooled with fresh air fan 80.10 – Water-cooled 80.14</p> <p>Heater/Fresh air box housing – Water-cooled 80.15</p> <p>Heater control flap cable 80.4</p> <p>Rear air duct 80.3</p> <p>System components – Aircooled 80.2 – Water-cooled 80.11</p>

# 80 Heater and Ventilation



80-212



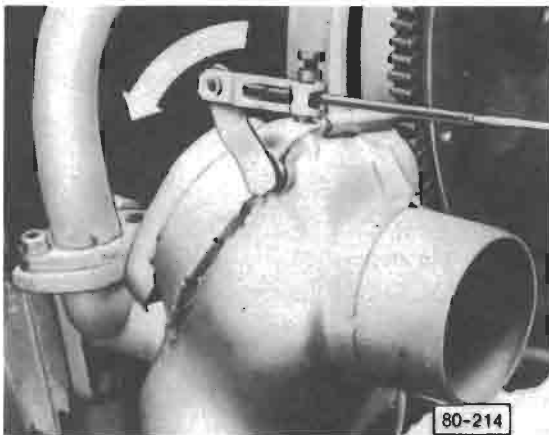
**Fig. 1 Rear air duct gasket, installing**

- install gasket with louvers pointed down (arrow)



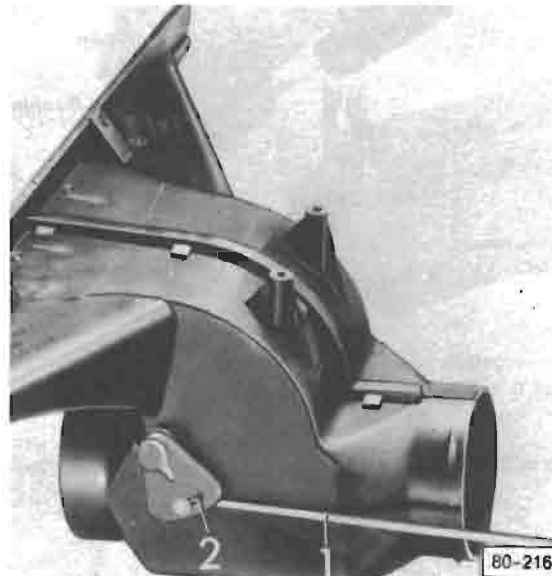
**Fig. 3 Heater control flap cables, installing**

- install sleeve with cable on bracket **B** in hole **1** (long end of cable to outside of vehicle)



**Fig. 2 Heater control flaps, adjusting**

- move center heater/ventilation control lever to left side to stop
- check that spring-loaded heater control flap is at end position (arrow)
- tighten clamping bolt on cable in end position



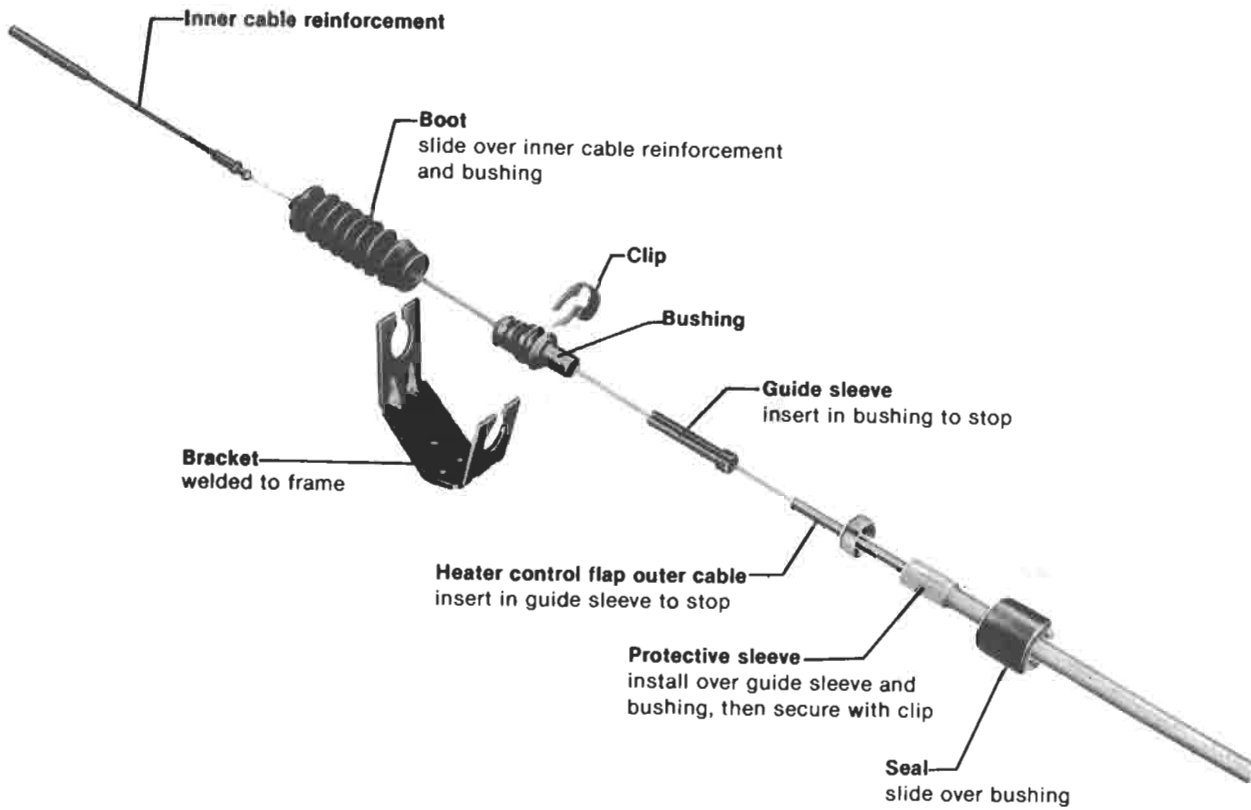
**Fig. 4 Warm air distributor for passenger compartment, installing**

- first, install connecting rod **1** for cable in slot **2** of lever and secure with circlip

# 80 Heater and Ventilation

## Note

Heater control flap outer cable is pressed in guide sleeve

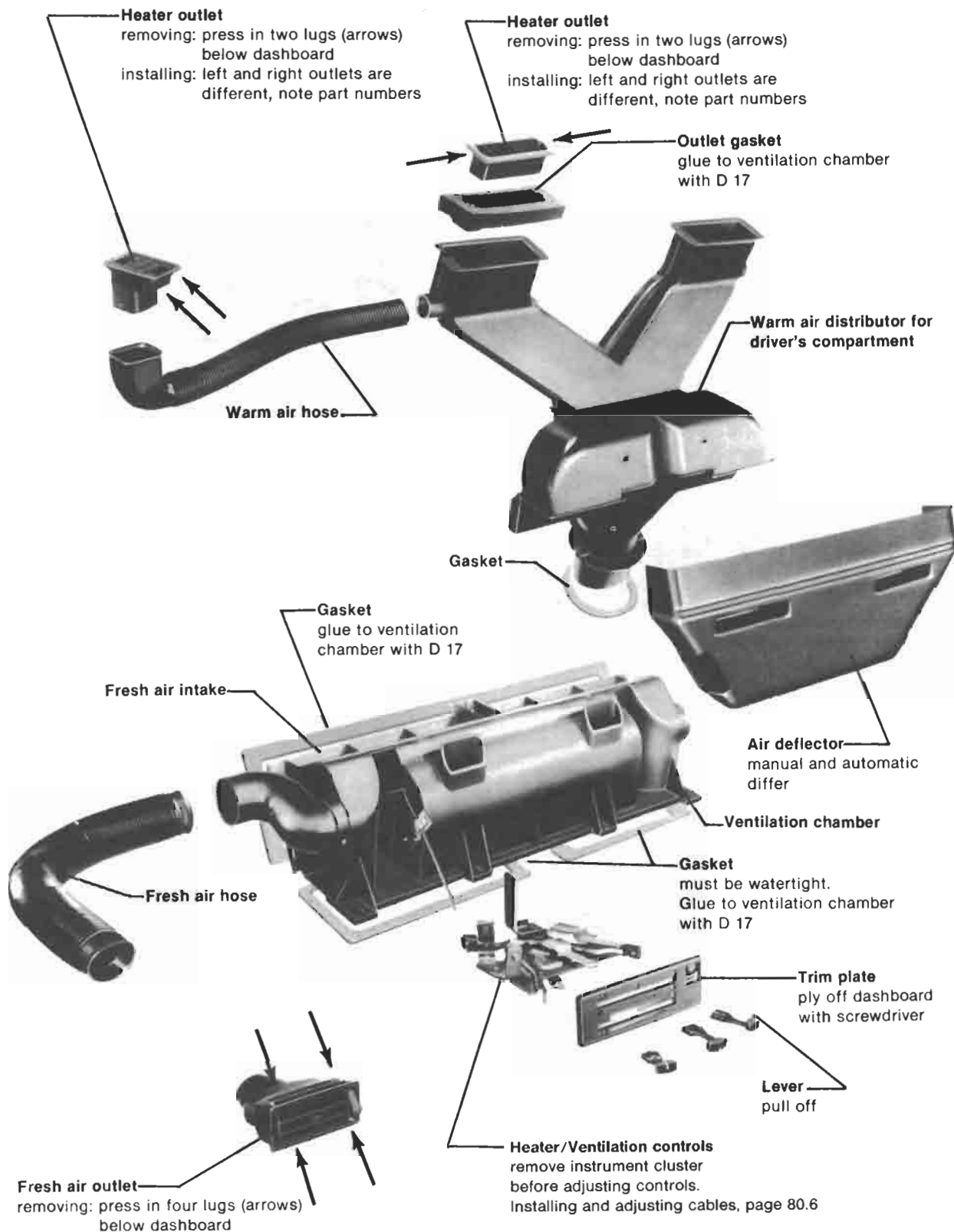


80-211

## 80.4

Heat control flap cable

Air-cooled



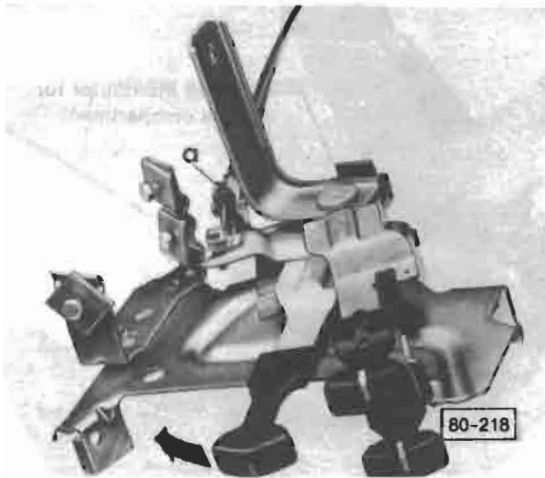
80-217

# 80 Heater and Ventilation

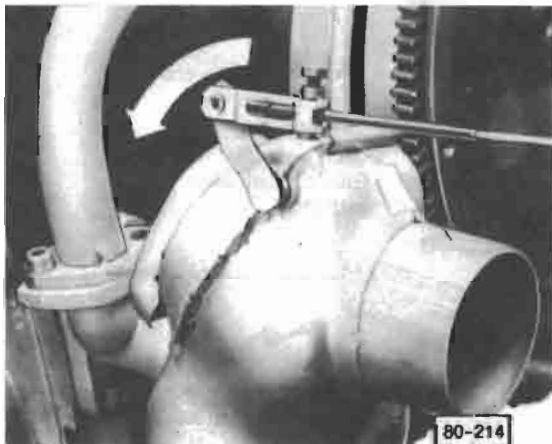
## Heater/Ventilation controls, installing/adjusting cables

### Work sequence

- install controls
- install trim plate
- press on levers
- loosen two heater control flap cables at heater control flaps



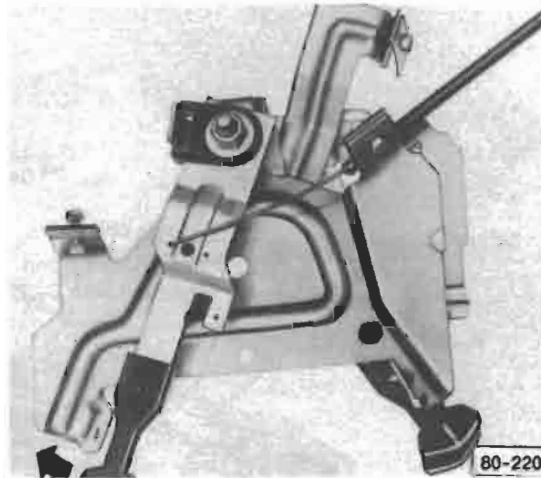
- install both inner cables of heater control flaps in center slide (as shown) and tighten outer cable to controls
- push center control lever to extreme left (arrow)



- check that spring-loaded heater control flap is in end position (arrow)
- tighten clamping bolt and lock inner cable in end position

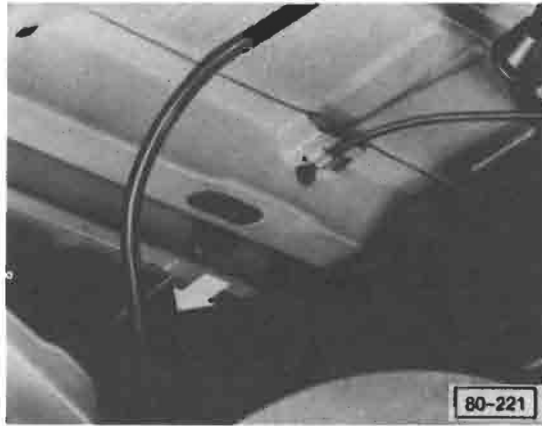


- push lever on ventilation chamber against spring tension (arrow)

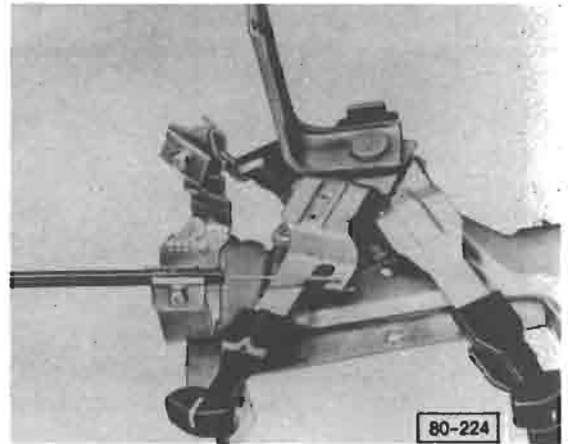


- engage inner cable for ventilation chamber in lower lever
- push lever in direction of arrow toward right side of vehicle
- tighten ventilation chamber outer cable with lever in this position
- go to next page

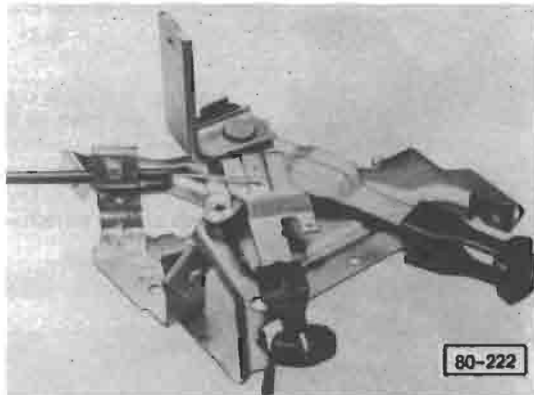




- pull inner cable for warm air distributor (passenger compartment) against spring tension (arrow) toward warm air distributor



- hook inner cable for warm air distributor (driver's compartment) in upper control lever
- secure outer cable on bracket

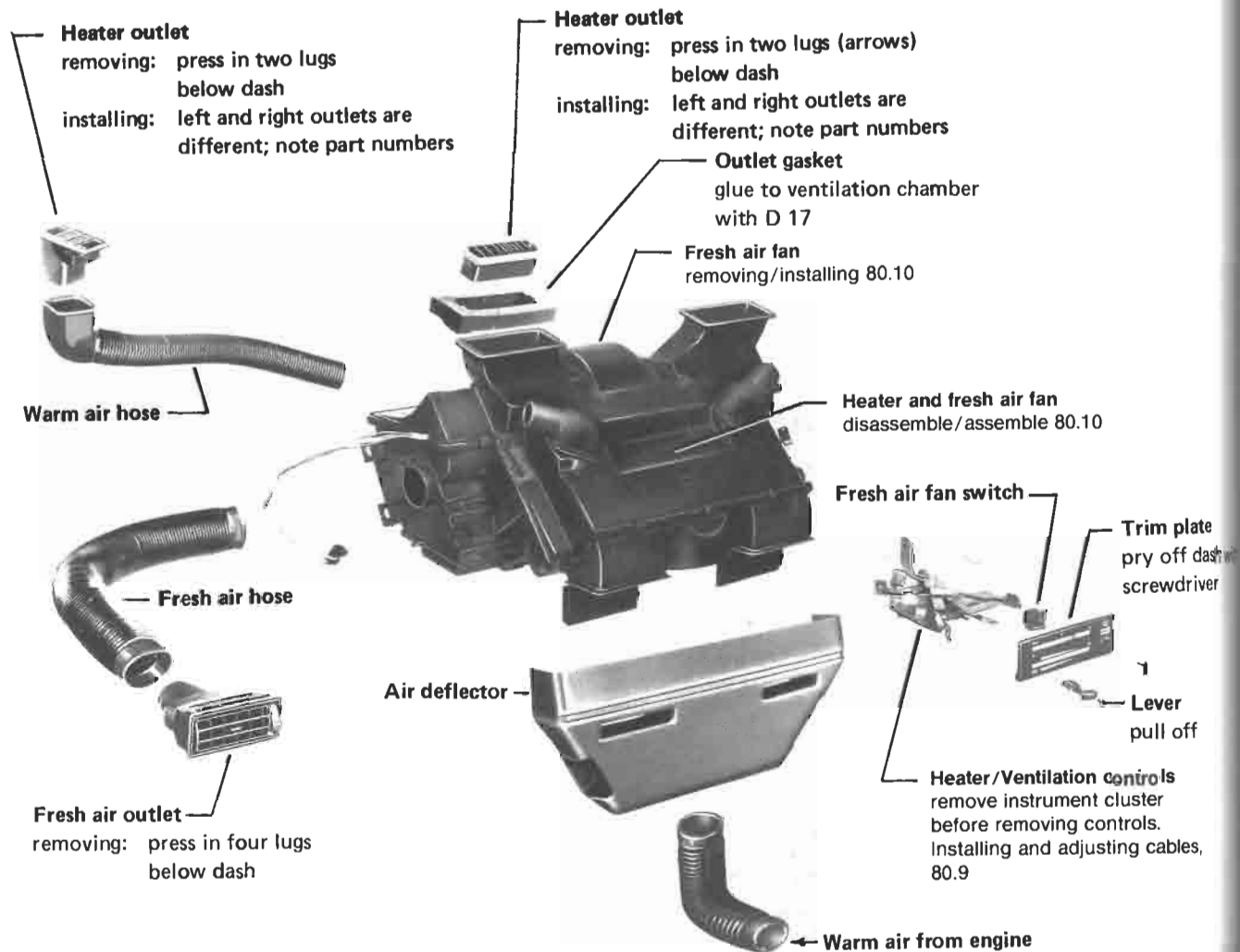


- hook inner cable for warm air distributor (passenger compartment) in upper control lever



- push control lever on warm air distributor (driver's compartment) in direction of arrow and hold in position

# 80 Heater and Ventilation

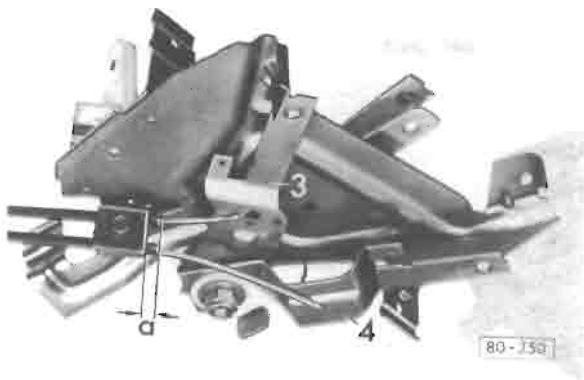


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## 80.8

Heater/Ventilation system

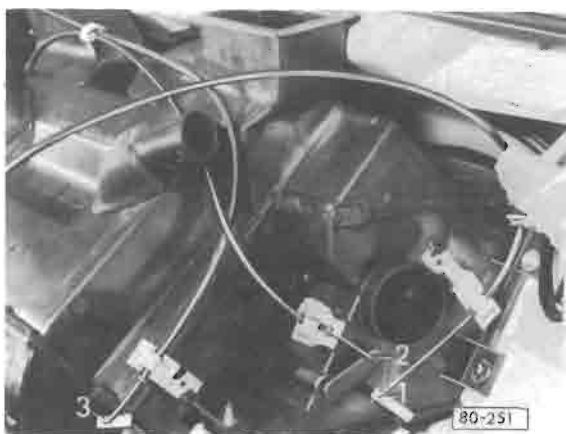
**Air-cooled with Fresh Air Fan**



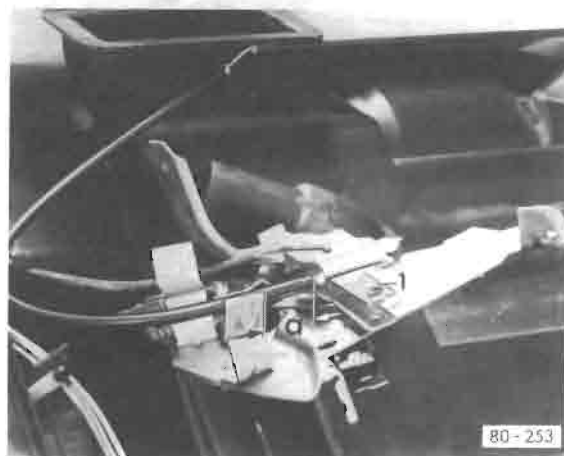
**Fig. 1 Control cables:**  
**on lever 4 -- passenger-compartment ventilation**  
 (cable conduit has 2 green paint marks and projects out of clamp approx. a = 3 mm (1/8 in.)  
**on lever 3 -- main cut-off flap**  
 (cable conduit has green/yellow paint mark and projects out of clamp approx. a = 3 mm (1/8 in.)



**Fig. 3 Control cable**  
**on lever 1 -- heated air distributor in passenger compartment**  
 cable conduit has red paint mark and projects out of clamp approx. a = max 30 mm ( 1 3/16 in. )  
**on lever 2 -- heater flap cable (arrow)**

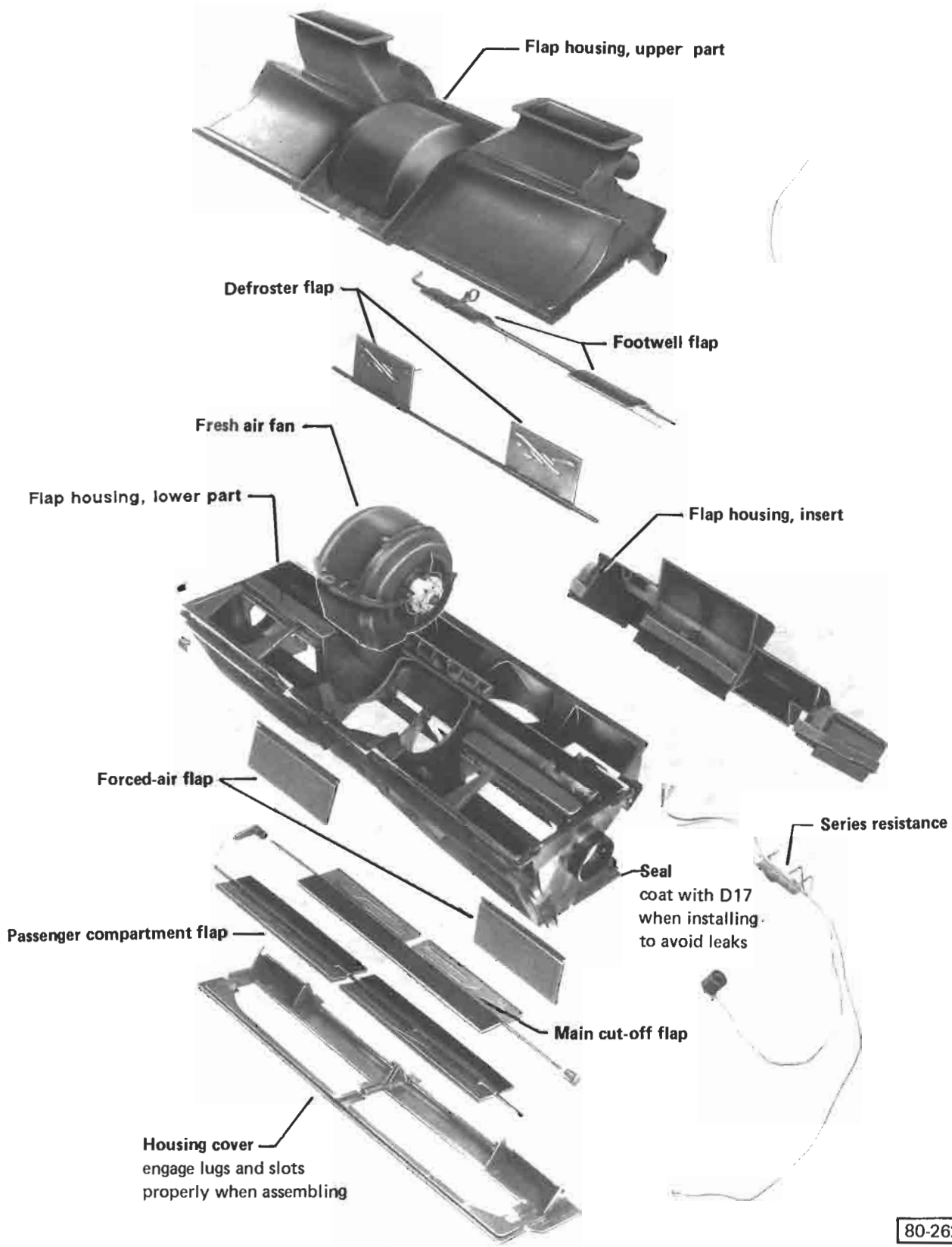


**Fig. 2 Flap-housing cables**  
 1 -- passenger compartment flap  
 2 -- main cut-off flap  
 3 -- defroster flap and footwell flap



**Fig. 4 Control cable**  
**on lever 1 -- defroster/flap footwell flap**  
 cable conduit has red paint mark and projects out of clamp approx. a = 30 mm ( 1 3/16 in. )

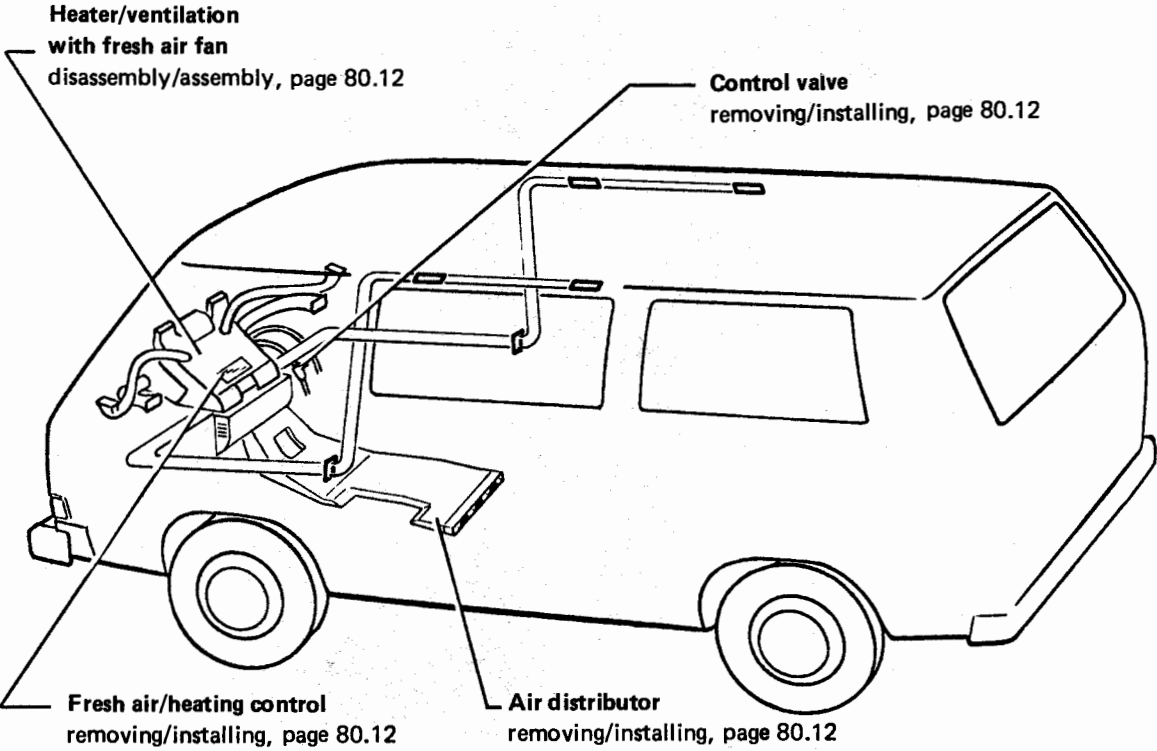
# 80 Heater and Ventilation



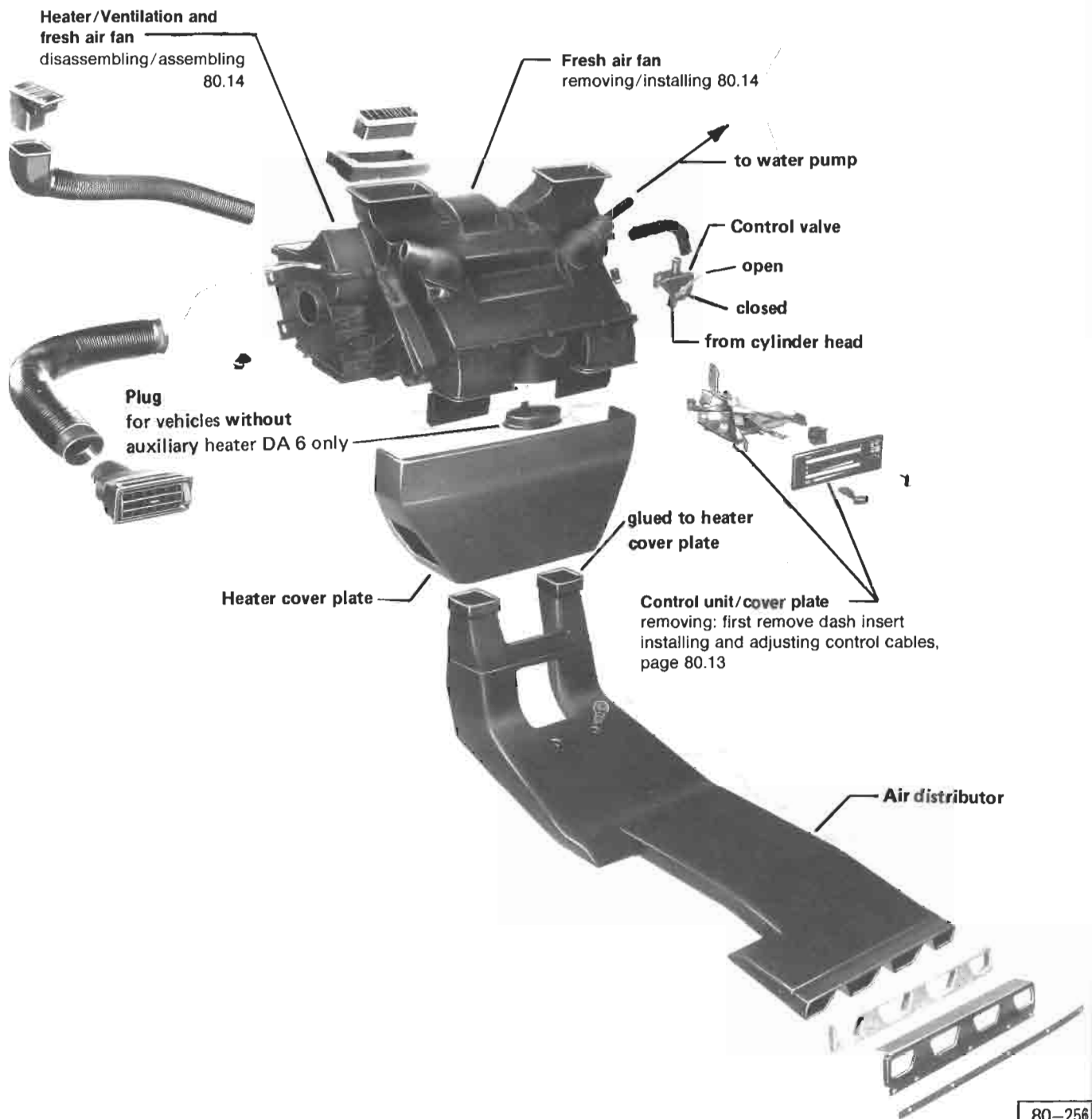
## 80.10

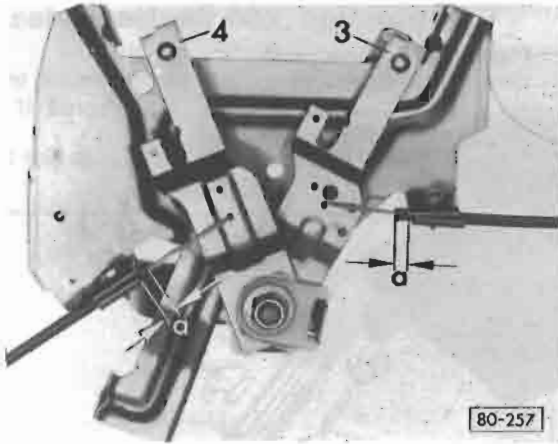
Flap housing,  
disassembling/assembling

Air-cooled with Fresh Air Fan

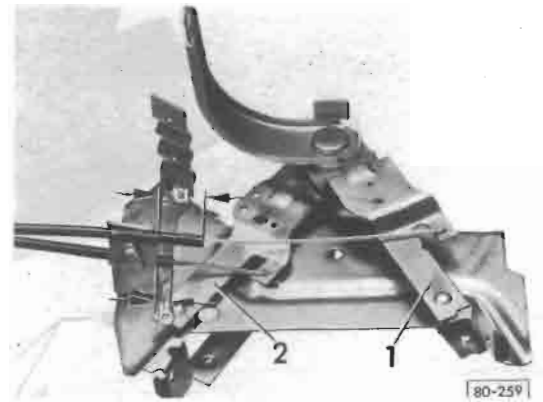


# 80 Heater and Ventilation

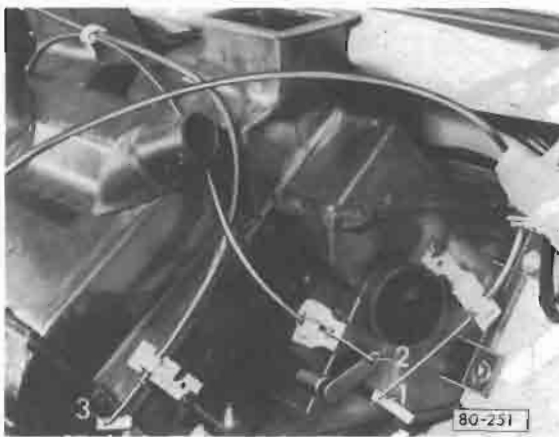




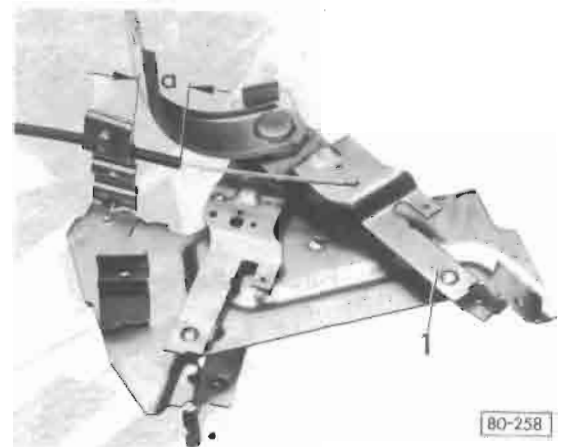
**Fig. 1 Control levers**  
**on lever 4** -- passenger compartment ventilation  
 cable conduit has 2 green paint marks and projects out of clamp approx.  $a = 3 \text{ mm}$  (1/8 in.)



**Fig. 3 Control cable:**  
**on lever 1** -- defroster flap/footwell flap (cable conduit has red paint mark)  
**on lever 2** -- to control valve (cable conduit has 2 blue/yellow paint marks)  
 conduits project out of clamp approx.  
 $a = 30 \text{ mm}$  (1 3/16 in.)  
 $b = 20 \text{ mm}$  (3/4 in.)



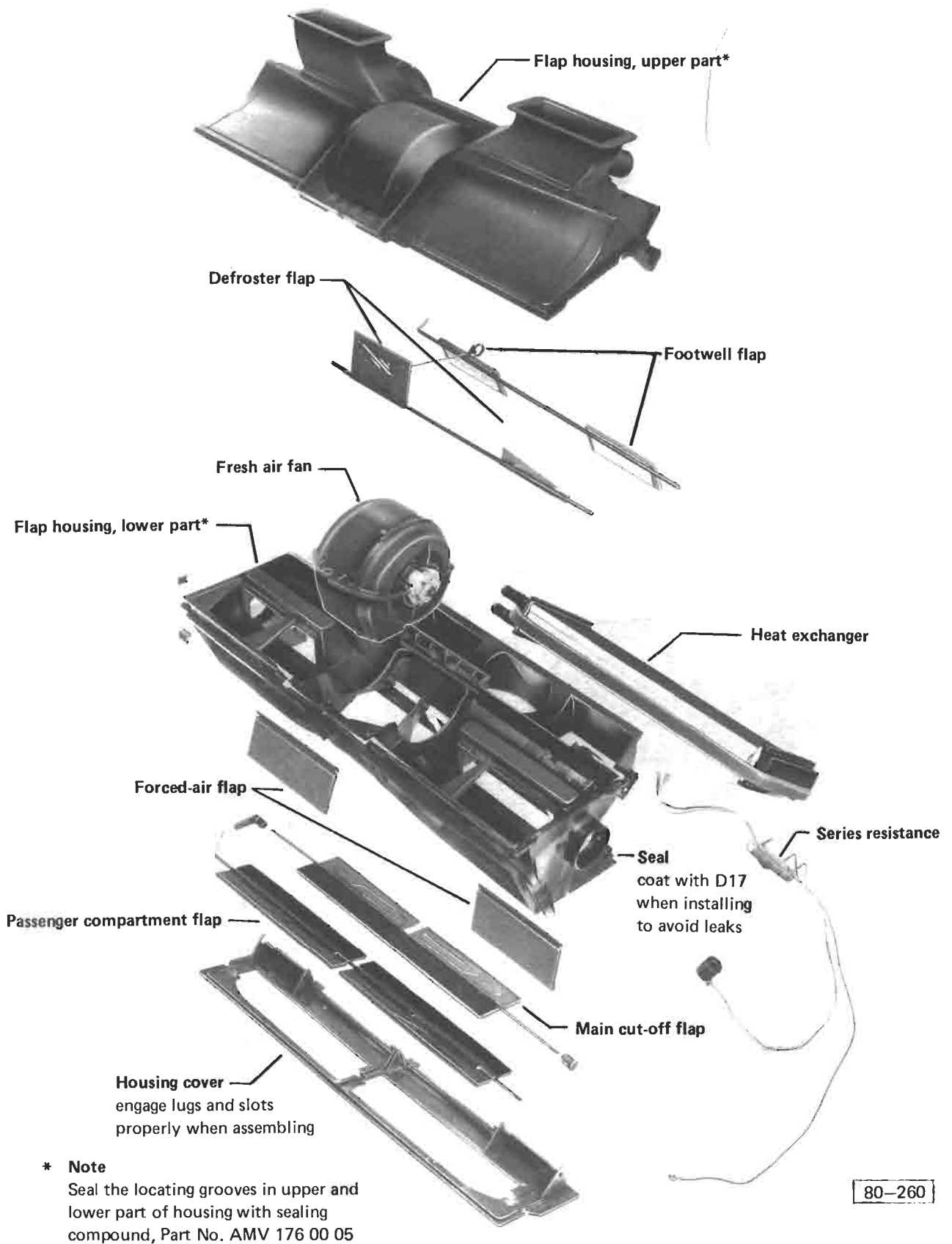
**Fig. 2 Flap-housing cables:**  
 1 -- passenger compartment flap  
 2 -- main cut-off flap  
 3 -- defroster flap and footwell flap



**Vehicles with auxiliary heater DA 6 only**

**Fig. 4 Control cable:**  
**on lever 1** -- heated air distributor in passenger compartment (cable conduit has red paint mark and projects out of clamp approx.  $a = \text{max. } 38 \text{ mm}$  (1 1/2 in.)

# 80 Heater and Ventilation

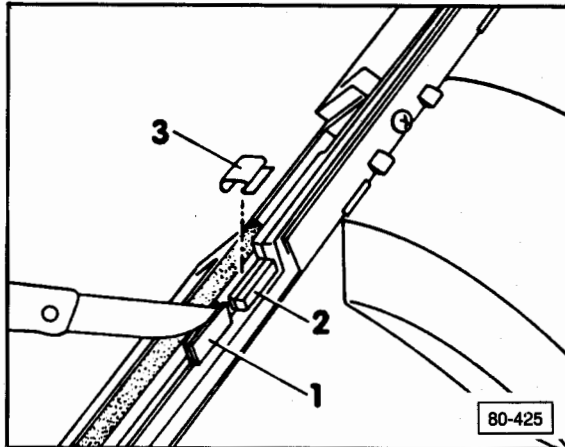




## Heater/fresh air box, splitting

The heater/fresh air box halves are welded together at 18 flange areas.

To split case apart when repairs are needed,



- insert knife along welded flange seam (1)
- hit knife sharply with hammer
- break all 18 welds

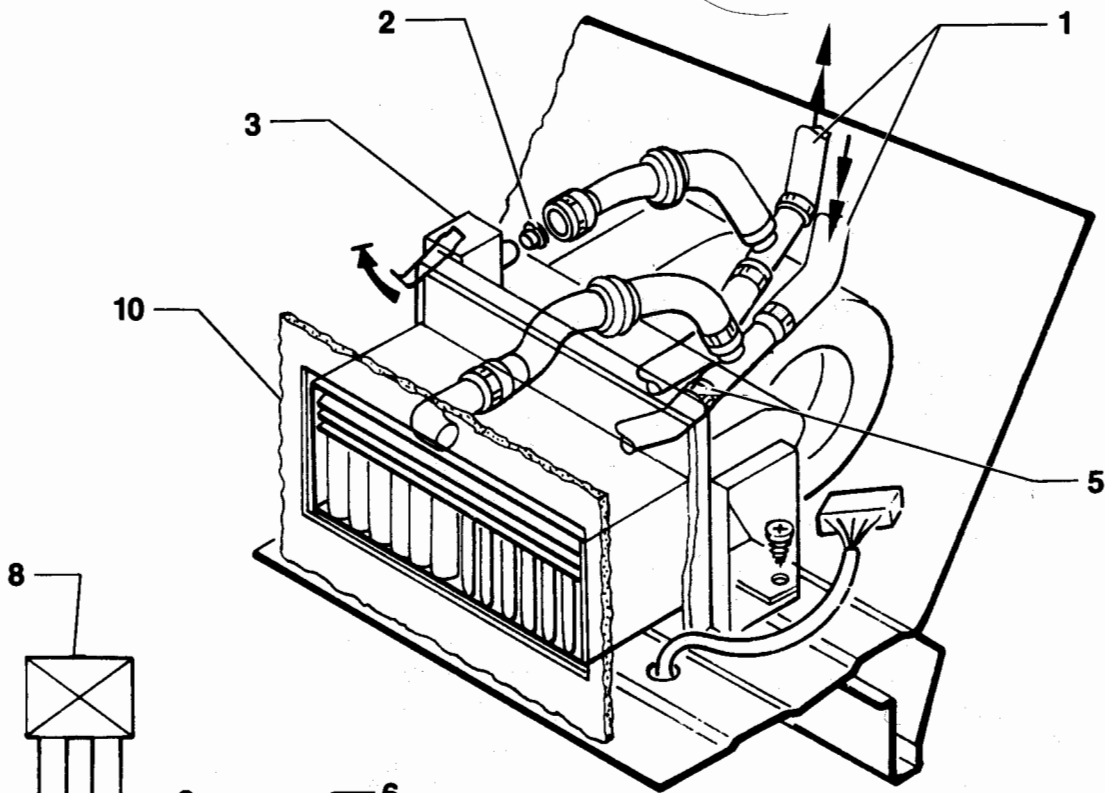
To assemble case halves after welded seams have been broken,

- attach clip (3) at clamp flange (2)
  - requires 11 clips
  - part number 321 819 059

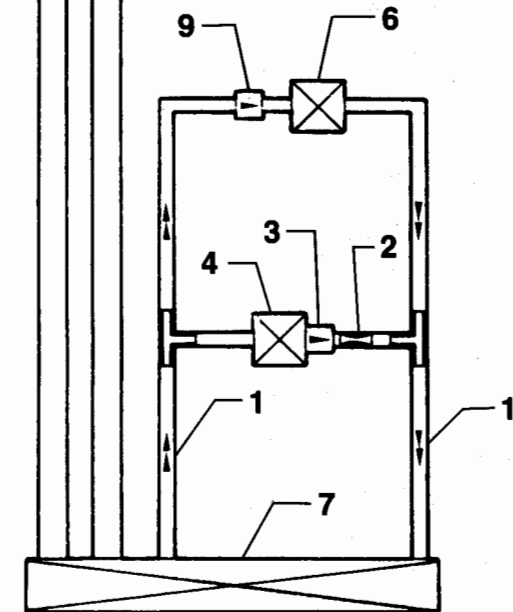
### CAUTION

Part numbers are for reference only. Always check with your Parts Department for latest parts information.

# 80 Heater and Ventilation



82-318



- ① — Water hose to and from engine
- ② — Restrictor
- ③ — Heater valve (additional heating)
- ④ — Heater core (additional heating)
- ⑤ — Clamp
- ⑥ — Heater core (in heater box)
- ⑦ — Engine
- ⑧ — Engine radiator
- ⑨ — Heater valve
- ⑩ — Additional heater

**Note**

Double arrows indicate direction of coolant flow.  
Single arrows indicate flow direction of heater valves.

## 80.16

Additional heater,  
under rear bench seat

All Water-Cooled

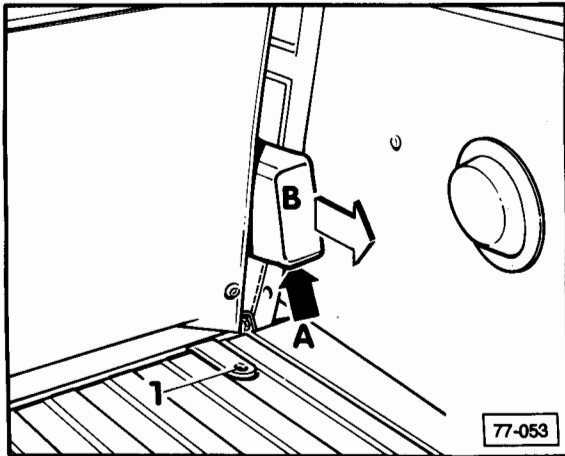
## Index

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| <ul style="list-style-type: none"><li>— Rear seat with storage locker<br/>removing/installing 77.2</li><li>— Roof bed, boards<br/>removing/installing 77.3</li></ul> |  |  |
|--|--|--|

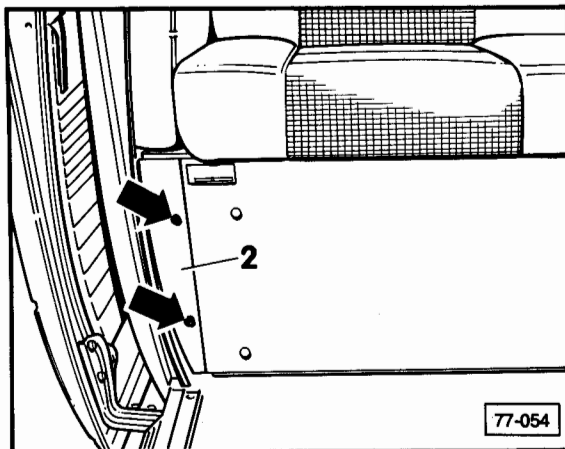
# 77 Seats, Beds

## Rear seat with storage locker, removing

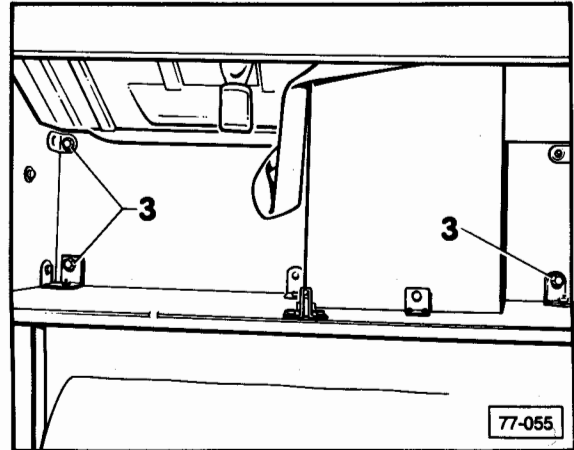
- remove mattress from engine compartment deck



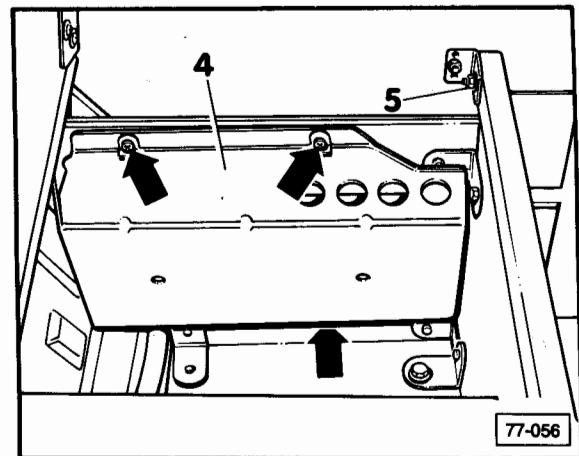
- remove screws 1 from rear seat back-rest bracket on left and right sides
- loosen screws (arrow A) from arm rest B and pull out toward rear (upper arrow)
- lift up rear seat bench
- pull seat belts into storage locker



- pry off caps (arrows), remove screws, and cover 2



- remove bolts 3 in bottom panel on both sides
- remove bracket on locker



- remove 3 screws (arrows) if Digifant equipped
- disconnect Digifant control unit 4, if applicable
- remove nut 5 on each left and right, push bolts out
- pull out storage locker toward front

### CAUTION

Circuit breaker can be easily damaged.

## Rear seat with storage locker, installing

- install in reverse order with the following
- check seat mechanism for proper function

## Roof bed, removing

### Note

For vehicles up to 1984 model year.

Before removing roof-bed, first remove storage shelf, ceiling cabinet and clothes closet, see group 76.

## Removing bed boards

### Note

Up to model year 1984.

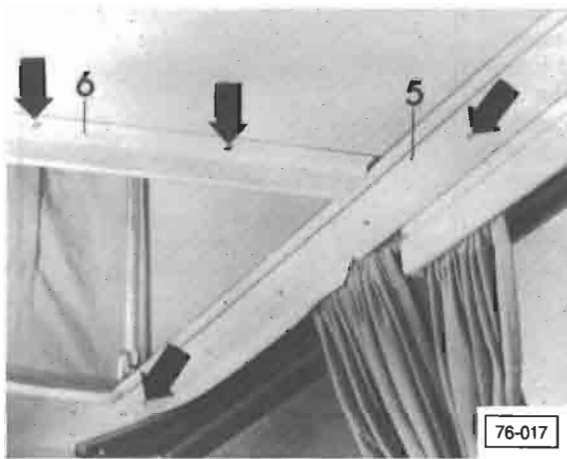
Before bed boards can be removed, storage pan, wall cabinet and clothes closet must be dismantled, see repair group 76.

— Loosen left headliner and remove from retaining rails. See "removal of right air duct, Repair Group 76

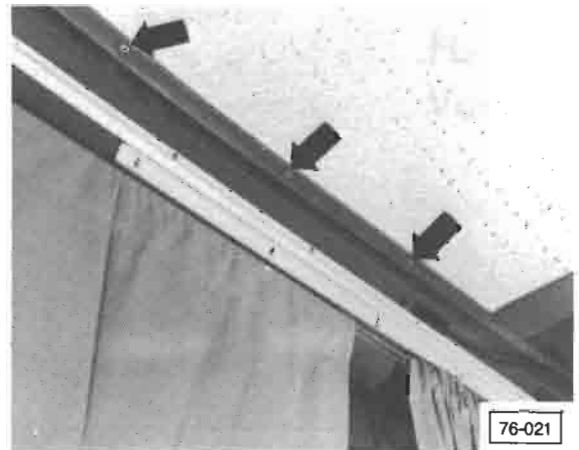
### Note

From model year 1985.

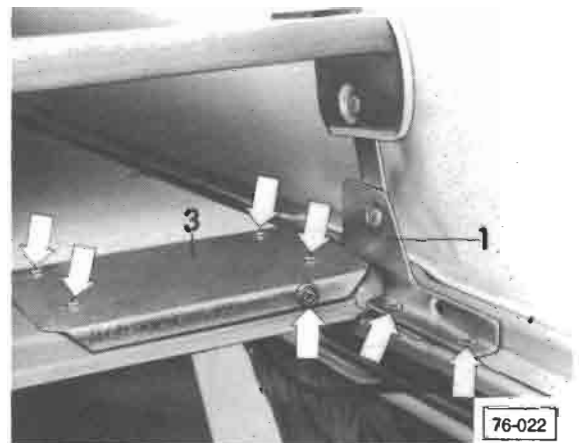
Before bed boards can be removed, storage pan with curtain molding, left, cover with curtain molding, right, wall cabinet and clothes closet must be dismantled, see repair group 76.



- remove screws (**arrows**) for roof rail 5
- remove screws (**arrows**) for center roof reinforcement 6



- remove roof-bed board screws (**arrows**)



- remove hinge 1 screws (**arrows**) in roof frame
- remove front bed board
- remove screws (**arrows**) for cover plate 3
- remove rear bed board

## Roof bed, installing

- install in reverse order

## Cabinets, Water Tank, Refrigerator

### Index

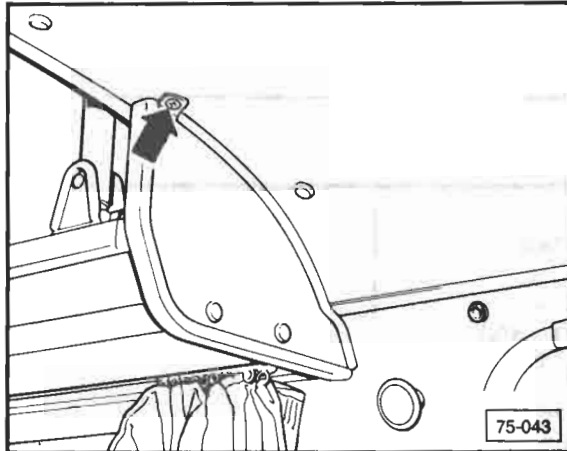
- |   |   |  |
|---|---|--|
| <ul style="list-style-type: none"><li>— Ceiling cabinet<ul style="list-style-type: none"><li>with A/C, installing 76.9</li><li>with A/C, removing 76.7</li><li>without A/C, removing/<br/>installing 76.6</li></ul></li><li>— Clothes closet<ul style="list-style-type: none"><li>installing 76.11, 76.14</li><li>removing 76.9, 76.11</li></ul></li><li>— Curtains<ul style="list-style-type: none"><li>curtain rail w/fresh air duct,<br/>installing 76.6</li><li>curtain rail w/fresh air duct,<br/>removing 76.5</li><li>removing/installing 76.3</li></ul></li><li>— Propane tank<ul style="list-style-type: none"><li>removing/installing 76.23</li></ul></li><li>— Refrigerator<ul style="list-style-type: none"><li>air supply modification 76.25</li><li>installing 76.25</li><li>removing 76.24</li></ul></li><li>— Sink cabinet<ul style="list-style-type: none"><li>installing 76.23</li><li>removing 76.20</li></ul></li><li>— Storage chest w/water tank<ul style="list-style-type: none"><li>installing 76.17</li><li>removing 76.15</li></ul></li></ul> | <ul style="list-style-type: none"><li>— Storage shelf<ul style="list-style-type: none"><li>removing/installing 76.2</li><li>w/curtain rod<br/>removing/installing 76.4</li></ul></li><li>— Water faucet w/pump switch<ul style="list-style-type: none"><li>removing/installing 76.17</li></ul></li><li>— Water level sensor<ul style="list-style-type: none"><li>removing/installing 76.20</li></ul></li><li>— Water pump, kitchen<ul style="list-style-type: none"><li>removing/installing 76.18</li></ul></li></ul> |  |
|---|---|--|

# 76 Cabinets, Water Tank, Refrigerator

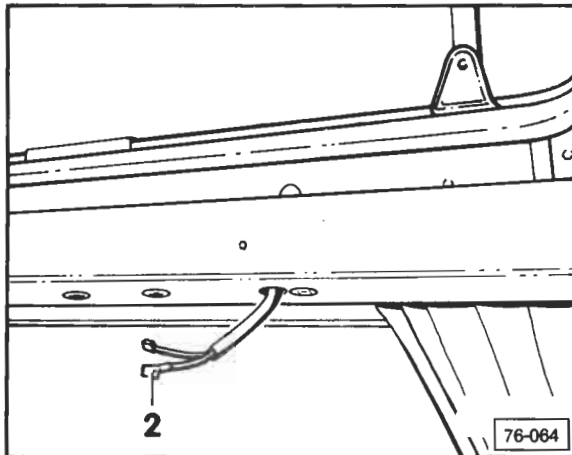
## Storage shelf, removing

### Note

Up to 1984 model year.



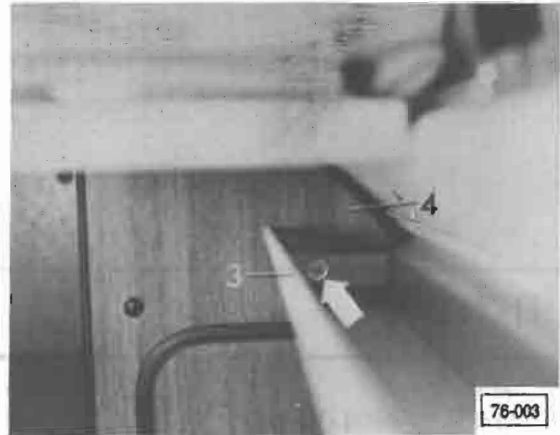
- remove screws (arrows) and end plate 1



### CAUTION

Before working on any part of electrical system, disconnect battery ground strap.

- disconnect wiring for interior light after pulling out of roof reinforcement
- insulate hot wire 2



- remove nut (arrow) and push bolt through storage shelf 3 and clothes closet 4
- swing shelf upward and pull out

## Storage shelf, installing

- place shelf in position and install bolt and screws in reverse order
- connect interior light wiring

### CAUTION

Do not cross wires when reconnecting interior light.

## Curtains (left side), removing

### Note

Up to model year 1984.

### Note

Remove storage shelf first see page 76.4.



- remove curtain cord screw (arrow A) in clothes closet
- remove curtain rail screw (arrow B)
- push rear curtain toward front
- remove both curtain rail screws at front
- pull curtains off rails

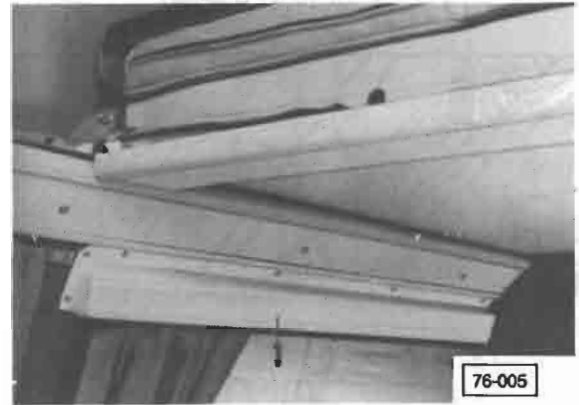
## Curtains (left side), installing

- place curtains on rails
- install curtain rails and tighten screws
- push curtain behind clothes closet
- loosen rail and retighten

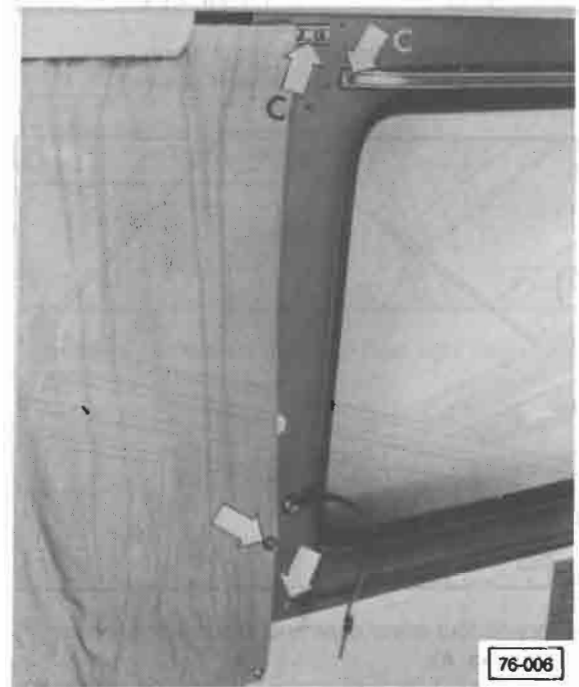
## Curtains (right side), removing

### Note

Up to model year 1984.



- remove cover screws 1



- remove rail screws C
- remove rail screws for sliding door curtain (lower arrows)
- pull curtains off rails

## Curtains (right side), installing

- place curtains on rails
- install rails and tighten screws
- install cover



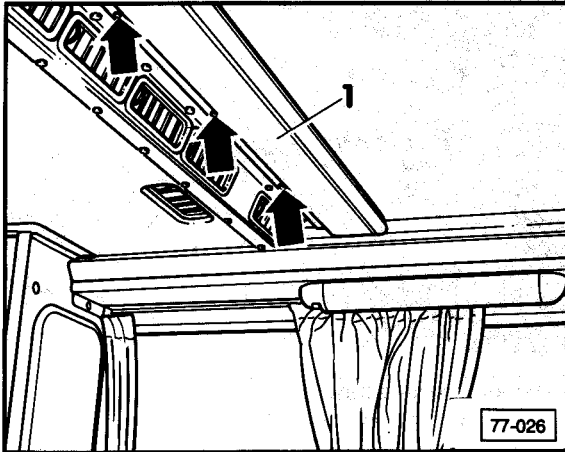
# 76 Cabinets, Water Tank, Refrigerator

## Storage shelf (left) with curtain rail, removing

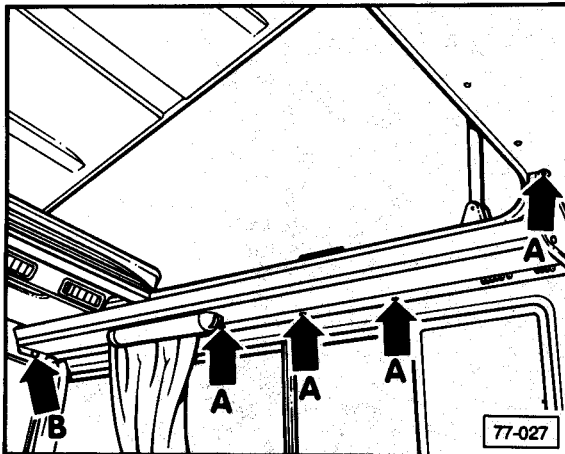
### Note

From model year 1985.

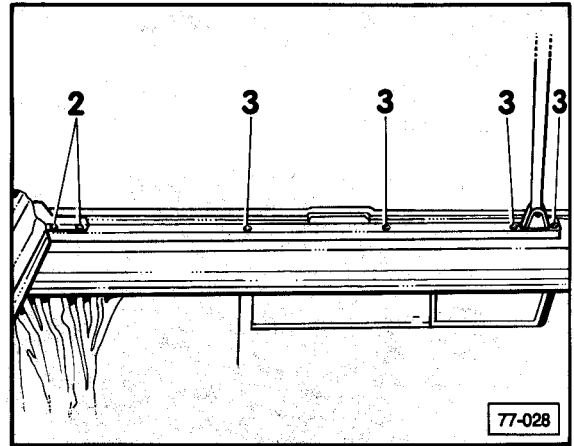
- unhook curtain at left front ("B"-pillar)



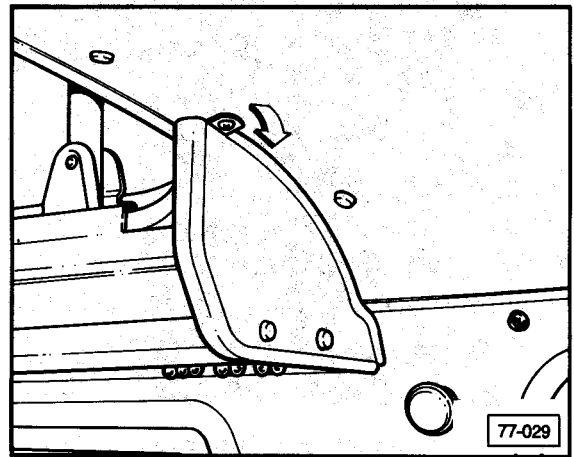
- remove cover 1 from center roof frame reinforcement (four Phillips head screws).



- pry off four cover caps and unscrew four screws (arrows A)
- remove nut (in clothes closet) from bolt (arrow B) and push out carriage bolt



- remove two screws 2 from left hinge of front bed board
- pry off cover caps, unscrew four screws 3



### Note

To prevent damage to front headliner when removing storage shelf with curtain rail on left side, support bracket of end plate must be bent slightly downward.

- move storage shelf with curtain rail to the left side and disconnect wiring connections for passenger compartment light
- insulate battery pos. wire
- remove storage shelf with curtain rail

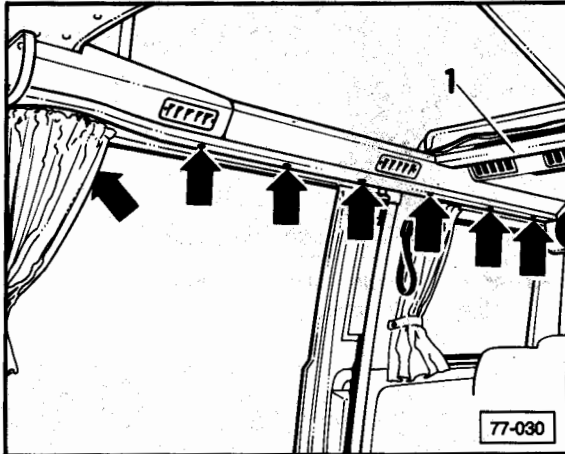
## Storage shelf with curtain rail (left), installing

- install in reverse order of removal

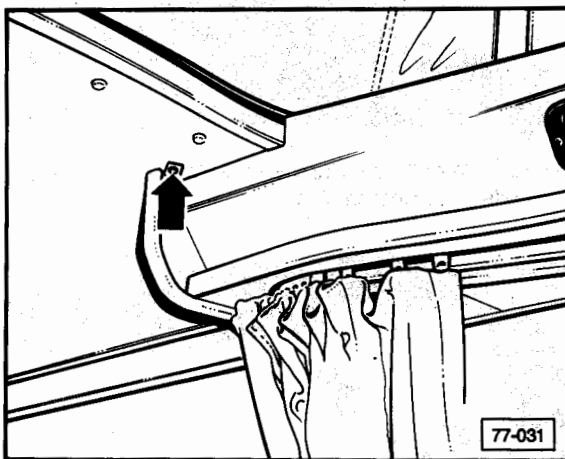
## Fresh air duct with curtain rail (right), removing

### Note

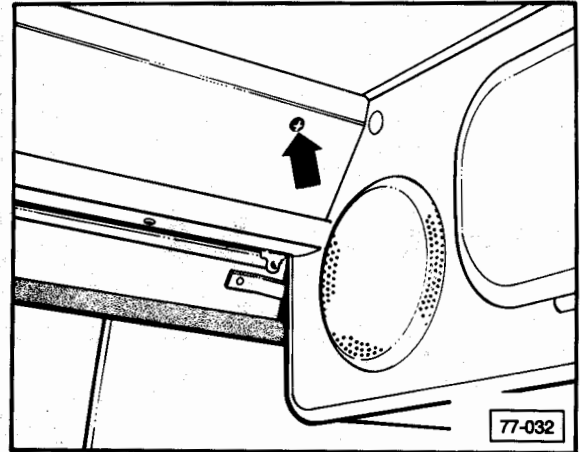
From model year 1985.



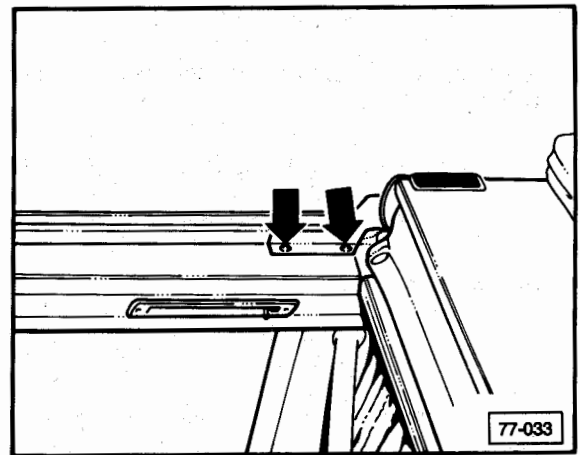
- remove cover 1 from center roof frame reinforcement, four screws
- remove snaps for curtains on the "B and C-pillar", right side
- pry off caps, remove seven screws (arrows) from below curtain rail



- pry off cap, remove one screw (arrow) from cover plate
- bend supporting bracket slightly downward

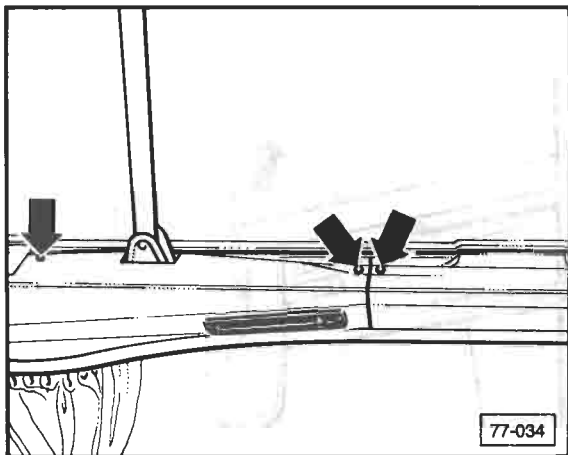


- remove screw (arrow)



- remove two screws (arrows) from right hinge of front bed board

# 76 Cabinets, Water Tank, Refrigerator



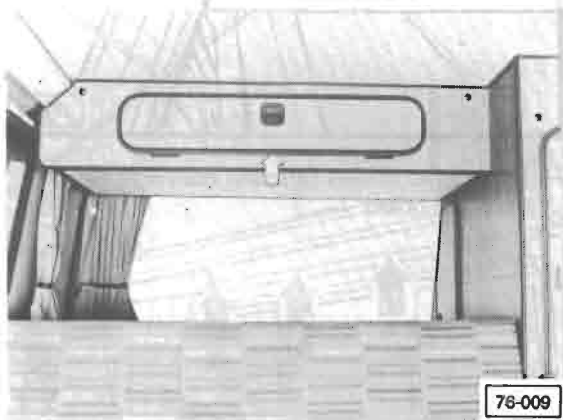
- pry off five protective caps and remove screws (arrows)
- carefully pull off right curtain rail

## Fresh air duct with curtain rail (right), installing

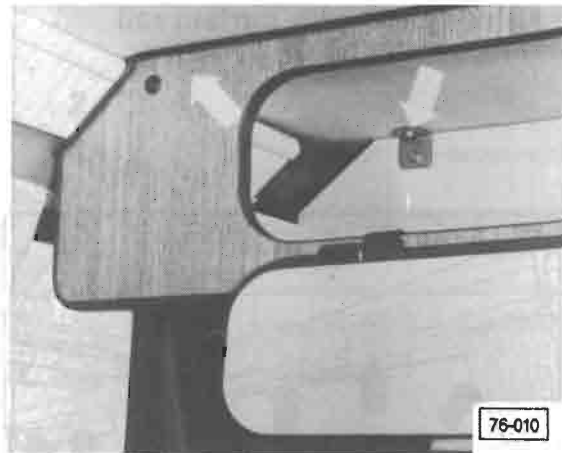
- install in reverse order of removal

## Ceiling cabinet, removing

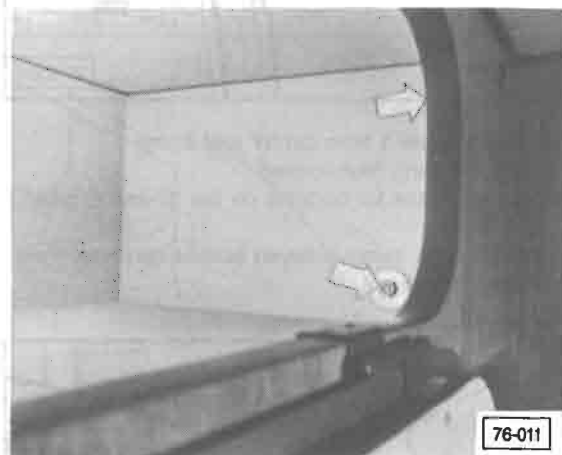
Vehicles without A/C



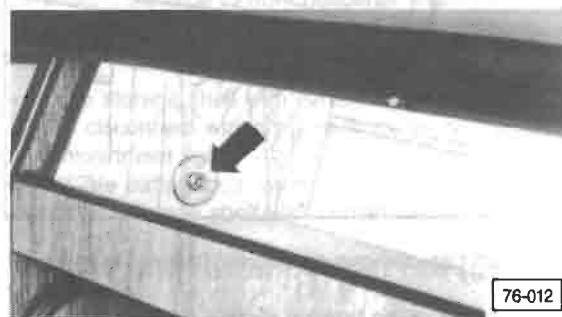
- location of ceiling cabinet (arrow)
- remove roof-bed mattress
- remove part of lower-bed mattress on engine compartment deck



- remove both nuts (arrows) of right side brackets holding ceiling cabinet



- remove both nuts (arrows) on left side and push bolts in to clothes closet



- remove nut (arrow) on left side and push bolt into clothes closet
- lift cabinet out (2 mechanics needed)

## Ceiling cabinet, installing

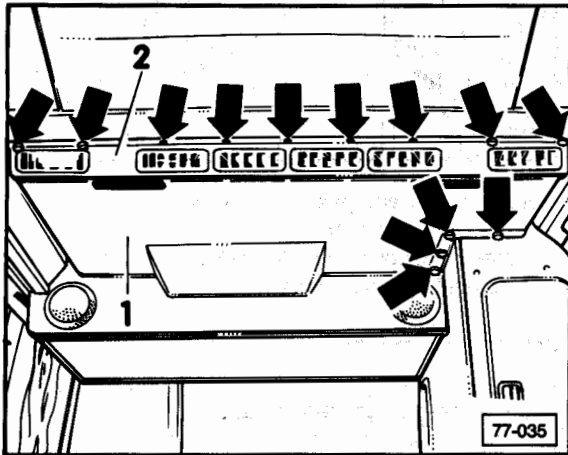
- install in reverse order

## Ceiling cabinet, removing

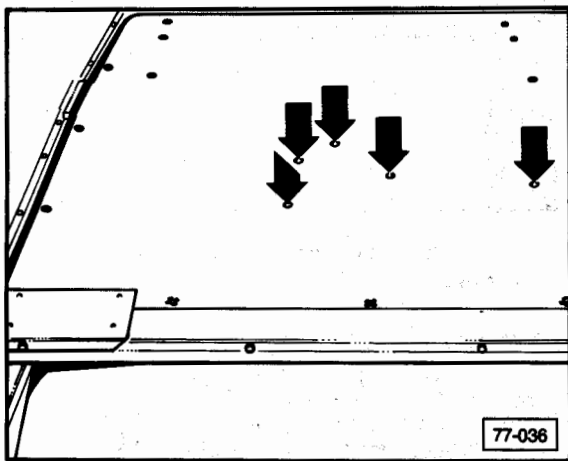
Vehicles with A/C

### Note

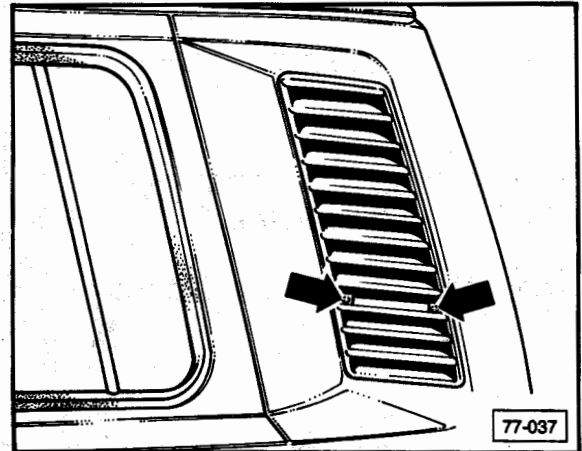
Ceiling cabinet can only be removed if storage shelf with curtain rail, left, is removed first, see p. 76.4, and front bed board with mattress, see repair group 75, has been removed.



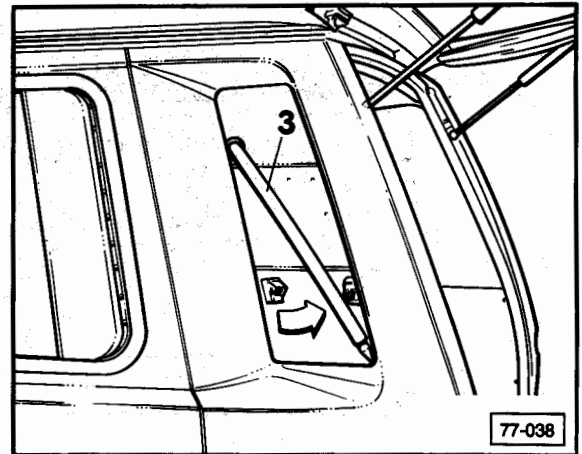
— remove vent 1 with cover 2 (20 screws with protective caps)



— remove five countersunk screws (arrows) from above rear bed board, support vent channel with cover from below with one hand  
 — lower vent channel with cover and remove



— remove two screws each (arrows) from left and right air intake grills, remove grills

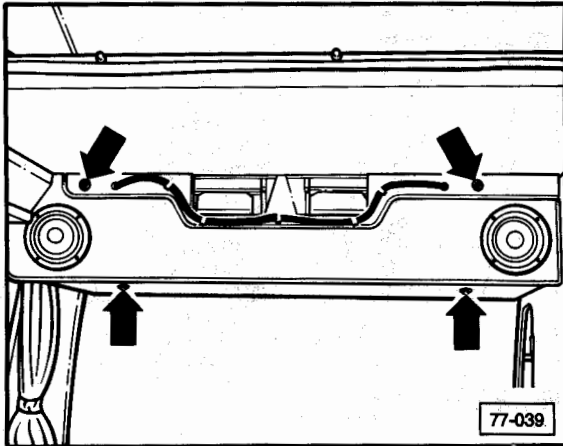


● water drain hoses 3  
 — unhook clothes closet doors

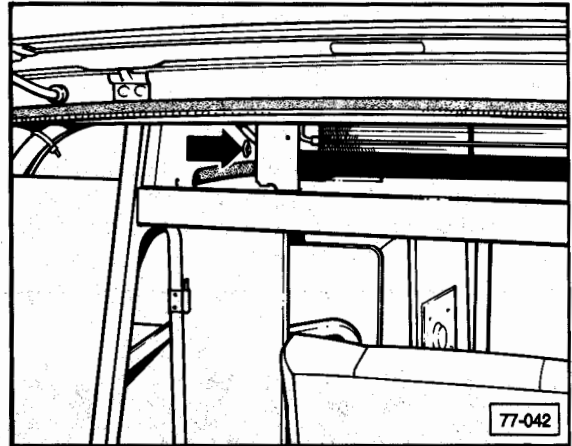
### CAUTION

Before working on any part of electrical system, disconnect battery ground strap.

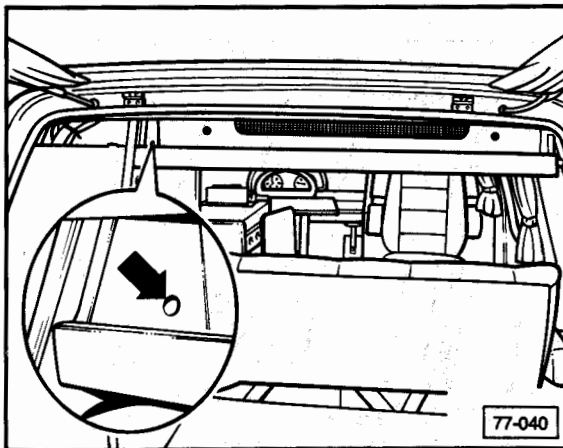
# 76 Cabinets, Water Tank, Refrigerator



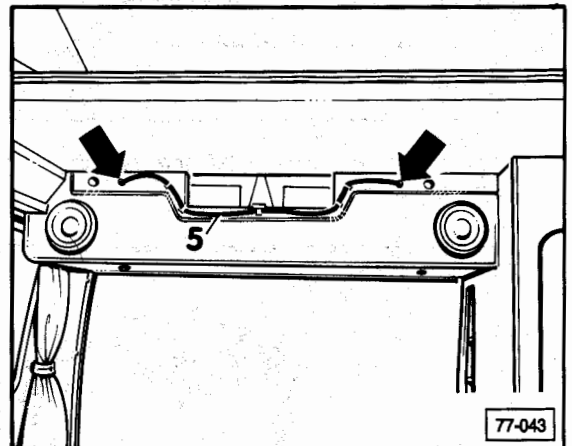
— remove four screws (arrows)



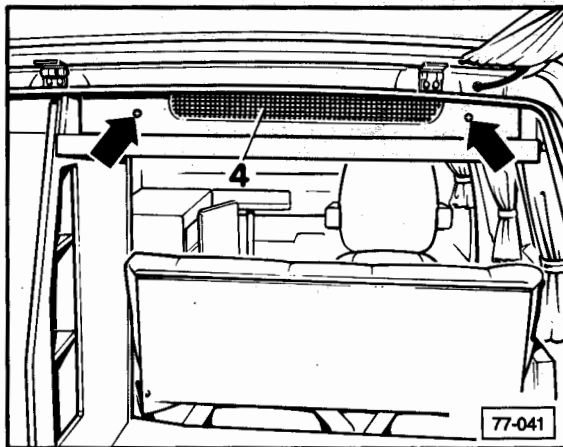
— remove nut and push out carriage bolt (arrow) from clothes closet  
 — carefully lower ceiling cabinet and disconnect left and right speaker wires



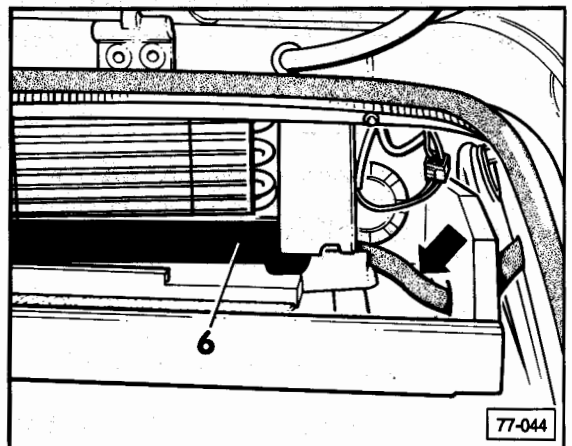
— loosen nut and push carriage bolt (arrow) out of clothes closet



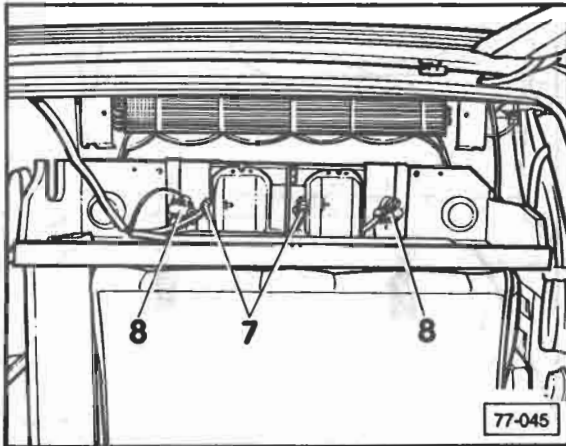
— unclip left speaker wires 5 and pull out of holes (arrows)



— remove two screws (arrows) while second mechanic supports ceiling cabinet  
 — pull ceiling cabinet slightly downward and remove cross wall 4



— disconnect water drain hoses (arrow) right and left from drip pan 6

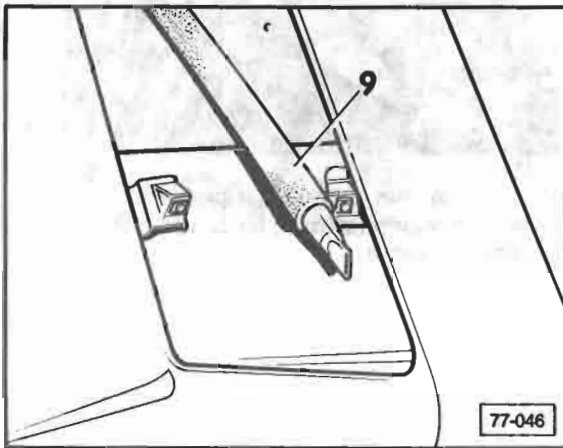


- continue to lower ceiling cabinet and support on backrest
- disconnect two terminals 7 and disconnect both series resistors for evaporator fans 8

**CAUTION**

Disconnect series resistors for evaporator fan very carefully. If one of the series resistors is damaged, the entire resistor block must be replaced.

- remove ceiling cabinet



- when installing water drainage hoses, care must be taken that flapper valves are not obstructed with foreign material
- prior to installation, heat water drainage hoses with hot air blower to ease installing

**Ceiling cabinet, installing**

- install in reverse order of removal

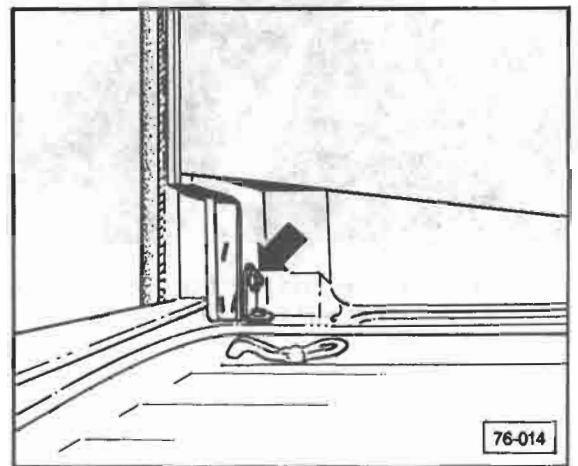
**Clothes closet, removing**

**Note**

Up to 1984 model year, **without** air conditioning. Remove ceiling closet first, see page 76.6.

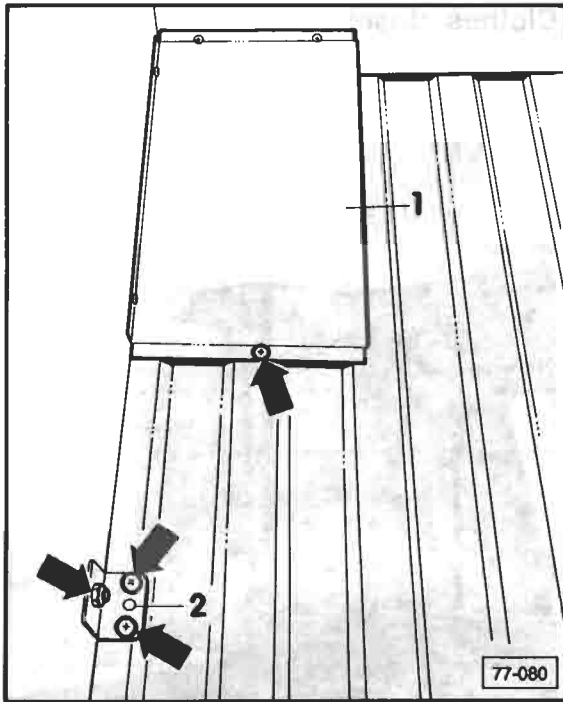


- remove part of lower bed mattress on engine compartment deck
- remove both closet doors

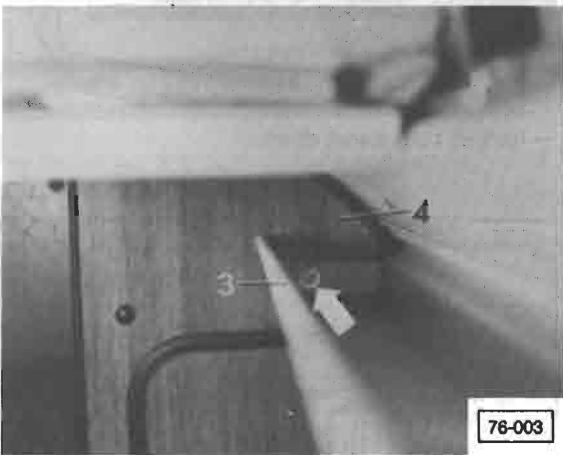


- remove nut (arrow) below closet and push bolt out of bracket

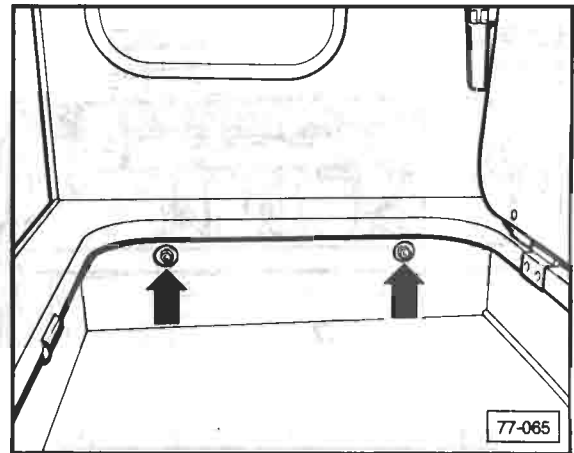
# 76 Cabinets, Water Tank, Refrigerator



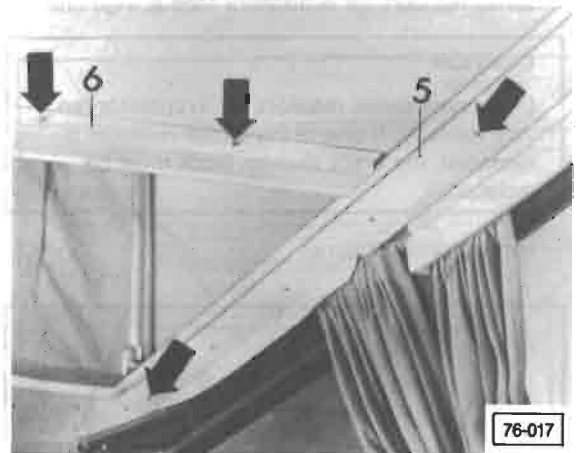
- remove screw in bracket 1 (upper arrow)
- remove nut (left arrow) and push bolt out of bracket
- remove both screws (arrows) holding bracket 2



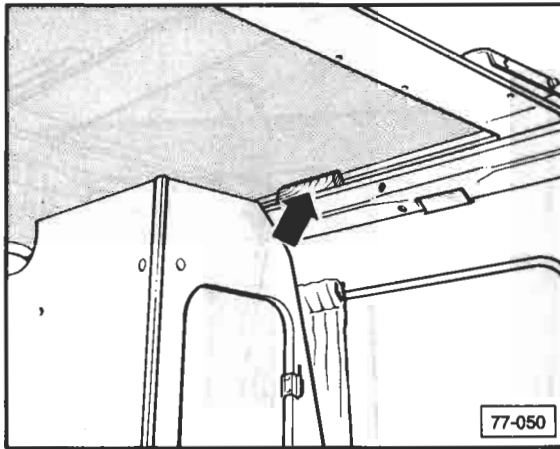
- remove nut (arrow) and push bolt through storage shelf 3 and closet wall 4 into closet



- remove both nuts (arrows) in storage chest and push bolts through closet wall into closet



- remove screws (arrows) for roof rail 5
- remove screws (arrows) for center roof reinforcement 6



- loosen screws holding roof bed board on left and right sides
- lift bed board (**left arrow**) up approximately 10 cm (4 in.) and support with **wedge** as shown
- remove engine compartment deck lid

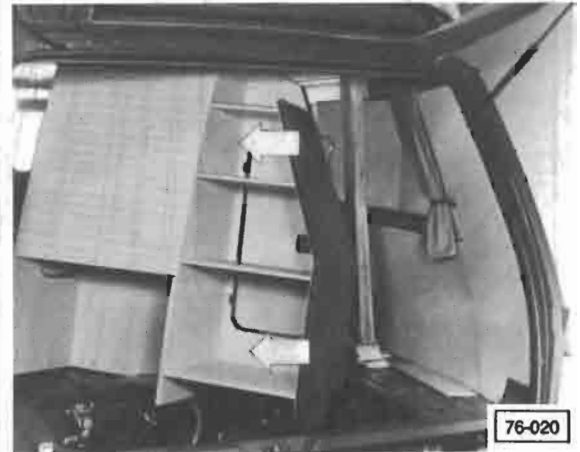


- slightly lift backrest of rear seat bench
- using 2 mechanics pull closet to center of vehicle and lower into engine compartment
- swing closet to front and lift to rear, out of vehicle (**arrows**)

### CAUTION

Do not damage engine components when lowering closet into engine compartment.

### Clothes closet, installing



- pull up backrest of rear-seat bench as far as it will go
- place closet into position (**arrows**)
- slide backrest of rear-seat bench into position
- install engine-compartment deck lid
- install all remaining parts in reverse order

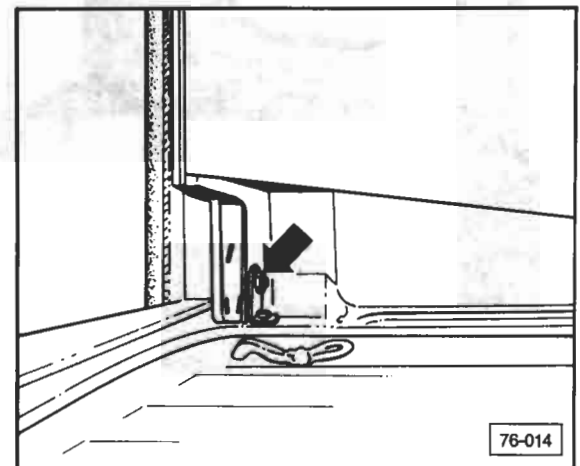
### Clothes closet, removing

#### Note

From 1985 model year, **without** air conditioning.

Clothes closet can be removed if storage shelf with curtain rail, left, and ceiling cabinet have been dismantled first. See 76.4, 76.6

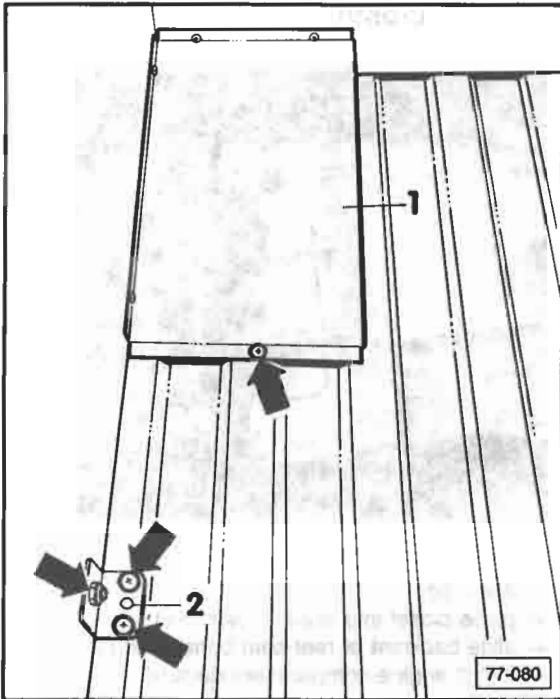
- remove mattress on engine compartment deck
- unhinge both doors of clothes closet and remove



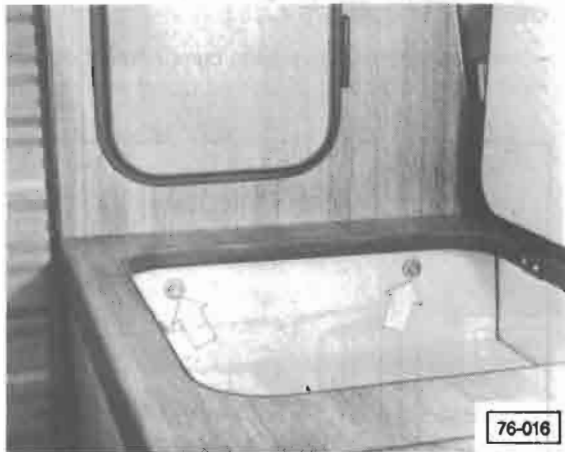
- remove one nut (**arrow**) below closet and push bolt out of bracket



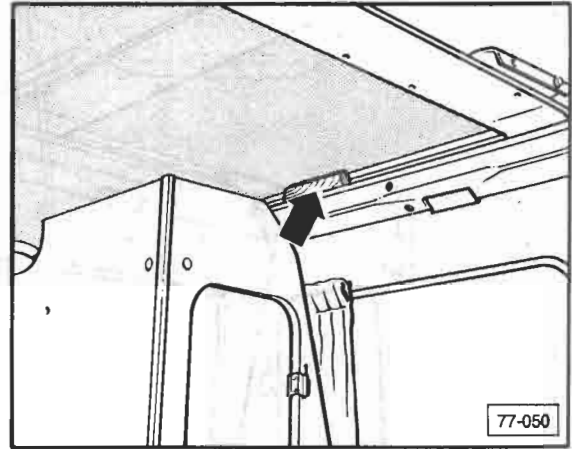
# 76 Cabinets, Water Tank, Refrigerator



- remove one screw in lower front area from support bracket **1**
- remove one nut at support angle and push bolt out
- remove two Phillips head screws from engine compartment deck and remove support angle on floor **2**



- remove two nuts in stowage pan of storage chest and push bolts through chest and clothes closet
- loosen stop for seat bench and pull seat bench forward approximately 10 cm (4 in.)



- unscrew left and rear bed board, seven screws
- lift rear bed board on left side approximately 15-20 mm (3/4 in.) pushing a wedge underneath (arrow)

### Note

Procedure requires 2 persons.

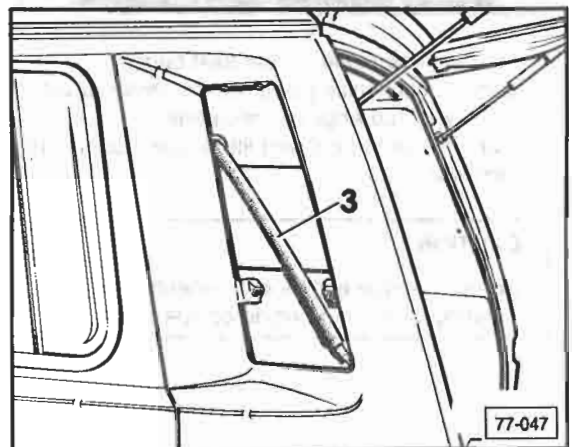
### Clothes closet, installing

- install in reverse order
- swing clothes closet to side, tilt onto engine compartment lid and remove

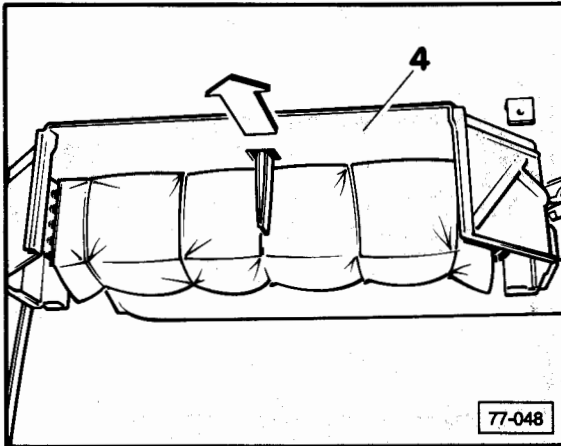
### Clothes closet, removing

### Note

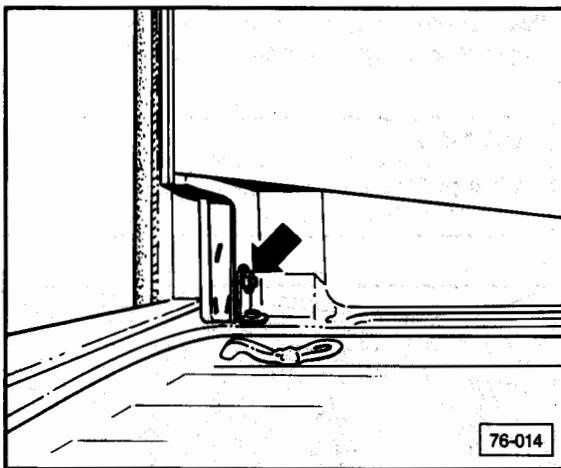
With air conditioning, remove ceiling cabinet first, see 76.6.



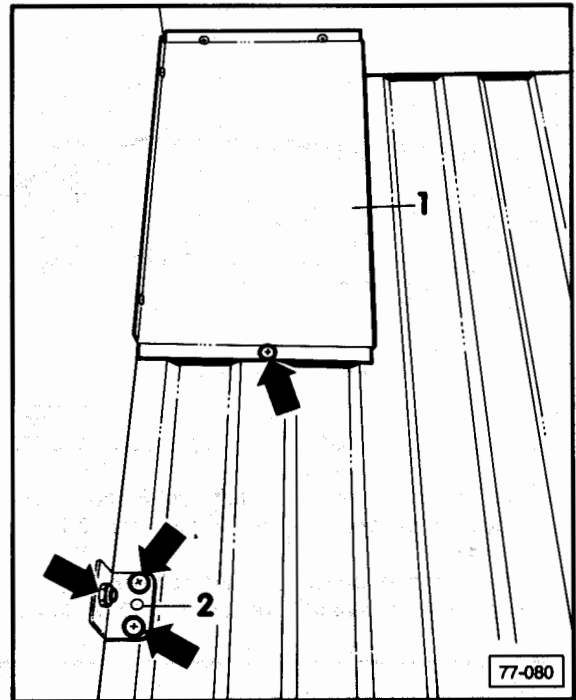
- remove evaporator drain hose **3**



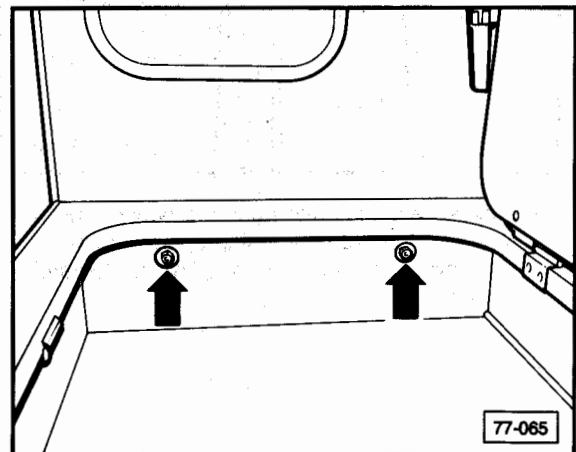
— pull evaporator housing 4 towards front (arrow), and remove



— remove nut (arrow) below closet and push bolt out of bracket

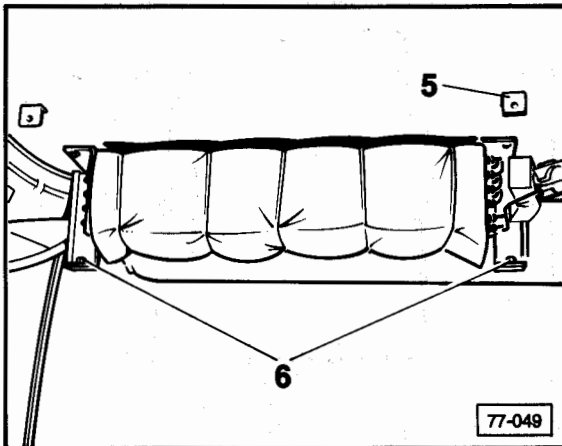


— remove one screw at lower front from support bracket 1 (arrow)  
 — remove one nut at support bracket 2 and push bolt out  
 — remove two screws from engine compartment deck and remove floor support bracket 2

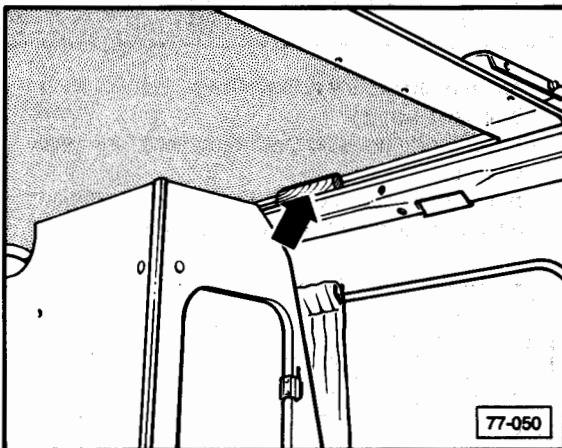


— remove both nuts in stowage pan of storage chest and push bolts through chest and clothes closet

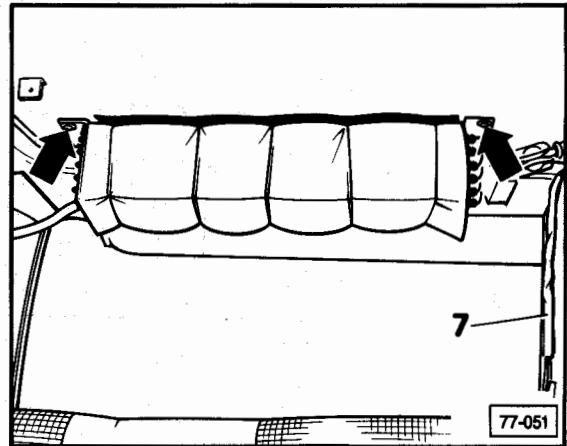
# 76 Cabinets, Water Tank, Refrigerator



- remove support bracket in left front 5 and support bracket in left and right rear 6 from rear bed board
- loosen stop for bench seat and pull bench seat with backrest forward approximately 10 cm (4 in.)



- unscrew seven left and right bed board screws
- lift rear bed board on left side approximately 15-20 mm (3/4 in.) with wedge from underneath (arrow)



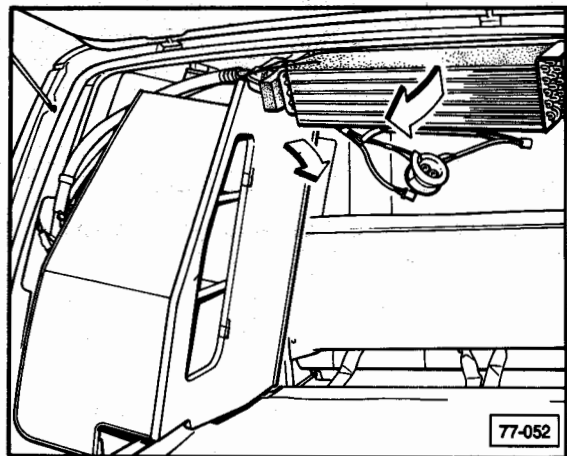
- remove two evaporator mounting screws (arrows)

### Note

This procedure may require a second technician to support evaporator and wiring harness 7.

### CAUTION

Wear protective gloves when holding evaporator.



- lower evaporator slightly
- swing clothes closet to left and swing out evaporator to rear at same time
- remove clothes closet

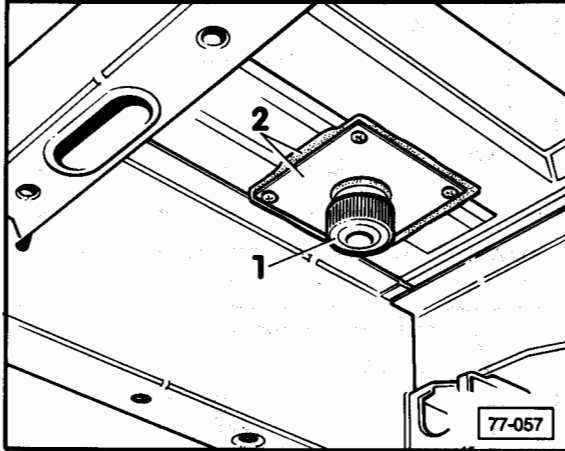
### Clothes closet, installing

- install in reverse order

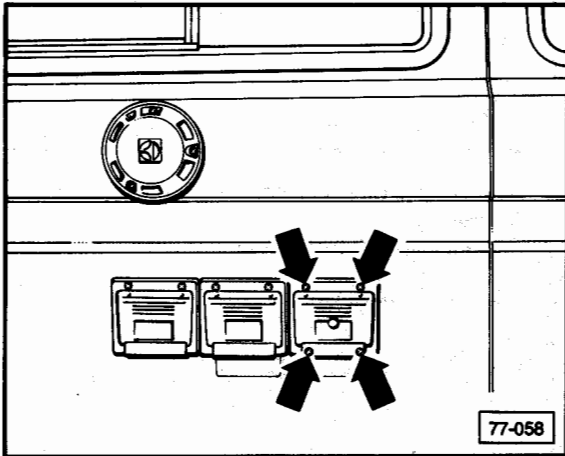
## Storage chest with water tank, removing

### Note

Storage chest with water tank can be removed after rear bench seat, See Repair Group 77.



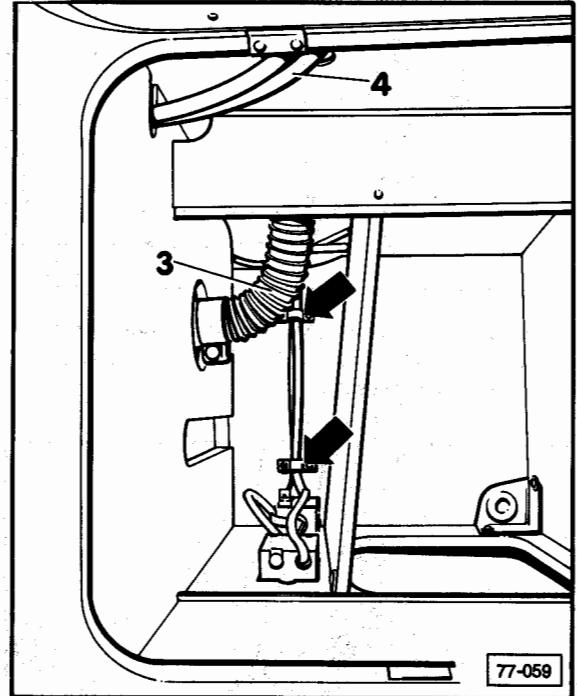
- remove water tank drain pipe cap 1 under left center bottom panel and drain water tank
- remove water drain cover plate and seal 2



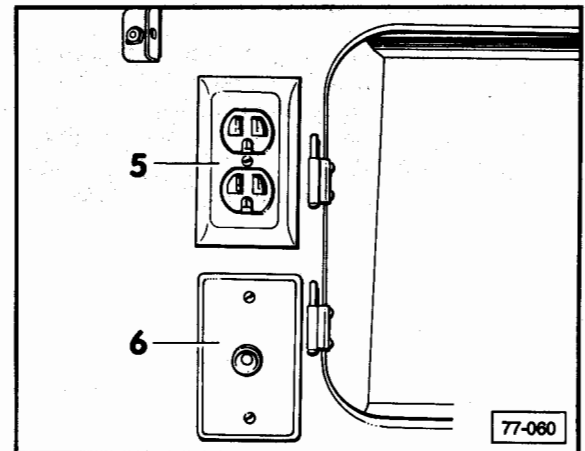
- remove four screws (arrows) from water filler cover plate
- pull filler neck out to access hose clamp
- loosen clamp for water filler hose 3
- remove ventilation hose 4 and remove water filler hose from filler neck
- open storage locker lids and door of storage chest and remove
- remove chest divider

### CAUTION

Before working on any part of electrical system, disconnect battery ground strap.

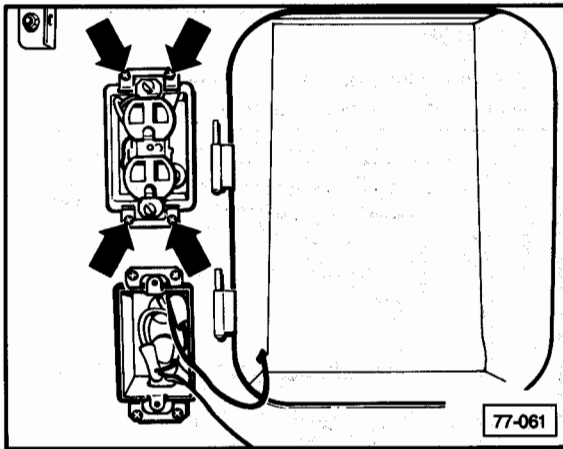


- pull water filler hose 3 and ventilation hose 4 into storage room of chest
- remove two clamps from electric cable (arrows) from bottom panel

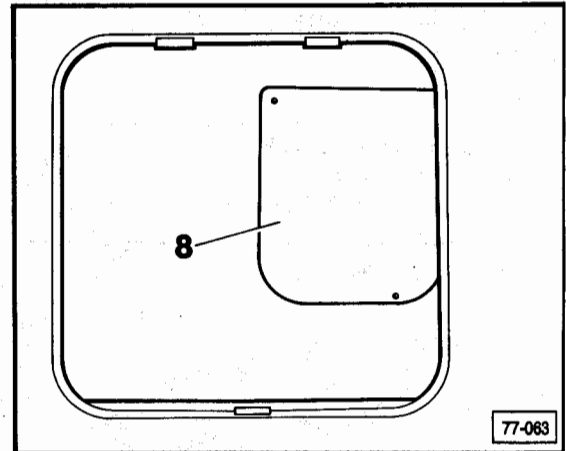


- remove wall outlet cover 5
- remove cover with fuse from circuit breaker 6 and remove cable connections from fuse

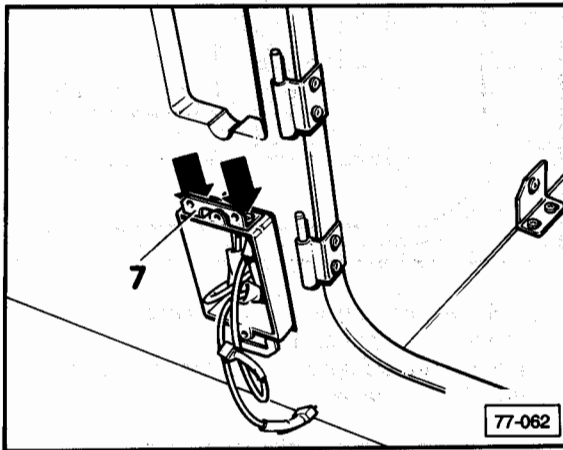
# 76 Cabinets, Water Tank, Refrigerator



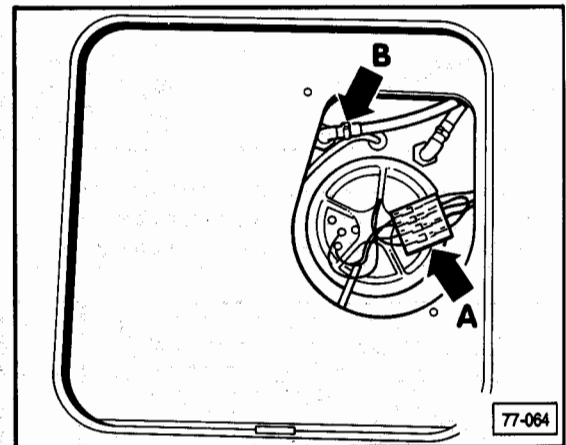
- remove four screws (**arrows**) from socket mount
- remove socket housing, tilt 90° backward and push back into recess



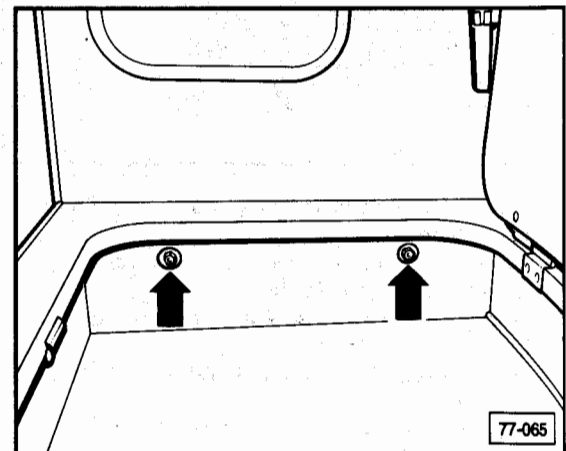
- unscrew two screws and remove cover plate 8



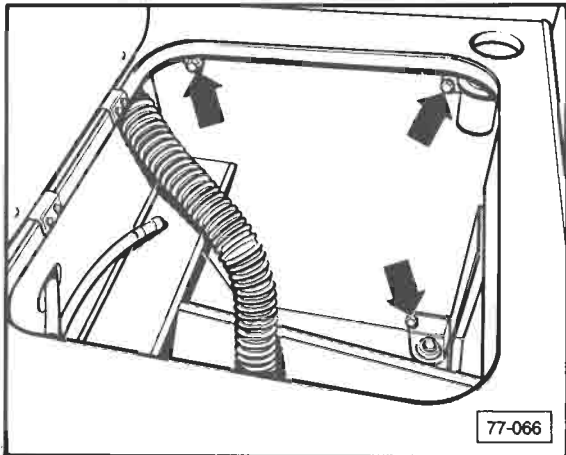
- remove four screws from circuit breaker housing
- remove circuit breaker housing far enough for screws (**arrows**) to be exposed
- loosen both screws (**arrows**) and remove upper support bracket 7
- push circuit breaker housing back into recess



- remove four wire connections from plug terminal (**arrow A**)
- release clamp (**arrow B**) and remove water hose



- remove two nuts (**arrows**) in storage space of chest and push bolts through chest and clothes closet



77-066

- remove three bolts from sink cabinet (**arrows**)
- lift chest with water tank approximately 10 cm (4 in.) and pull out

## Storage chest with water tank, installing

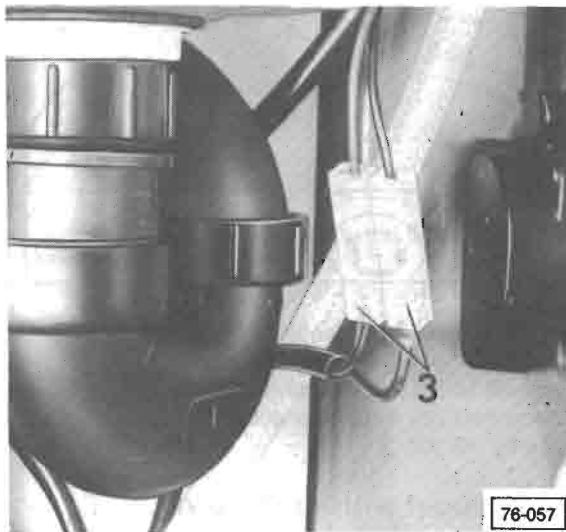
- install in reverse order
- check all water connections for leaks

## Water faucet with pump switch, removing

### Note

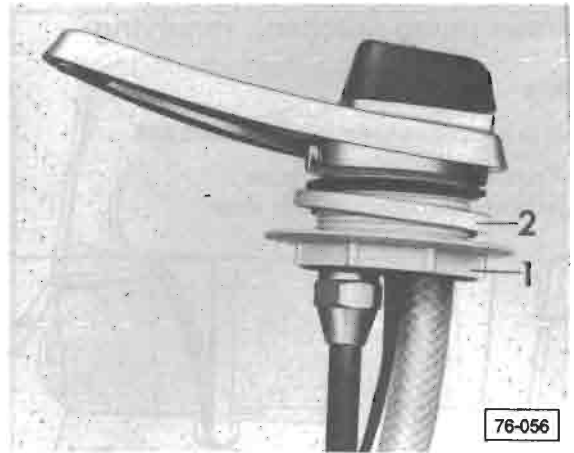
Up to Equipment No. **C.000 858**.

- remove kitchen cabinet drawer
- remove cabinet door
- disconnect battery ground strap



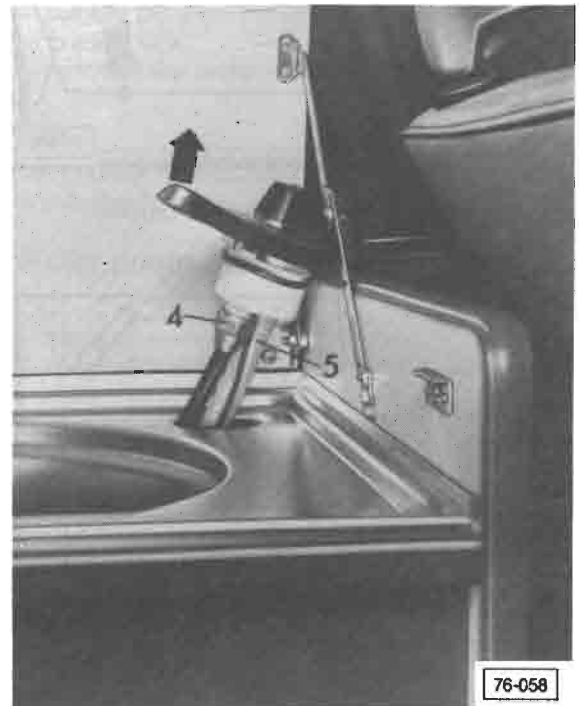
76-057

- disconnect 12V DC electric connection from pump switch at plug terminal **3**



76-056

- remove plastic nut **1** and pull off with spacer **2**



76-058

- remove faucet from counter
- disconnect city water connection **4** and disconnect hose **5**

## Water faucet with pump switch, installing

### Note

Warm hose **5** prior to pushing onto water faucet.

- install in reverse order

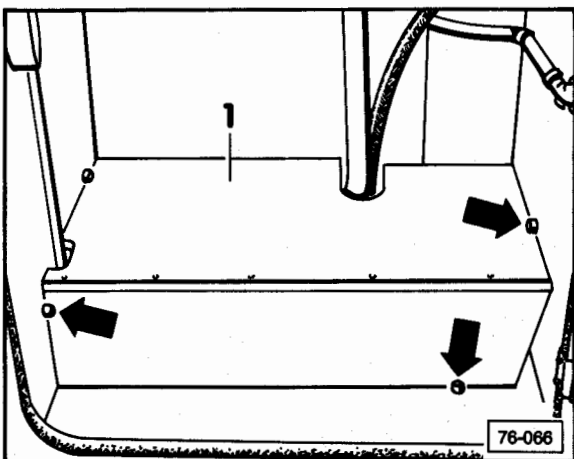
# 76 Cabinets, Water Tank, Refrigerator

## Water pump (kitchen), removing

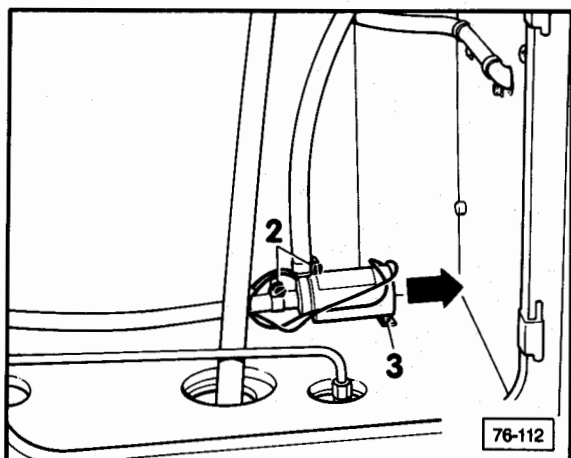
### Note

Up to equipment serial number C.000 858.

- remove kitchen cabinet door
- disconnect battery ground strap



- pull out three pump cover keepers (arrows)
- remove cover 1



- disconnect 12V DC wire connections at pump lead
- loosen hose clamps 2 and disconnect pump hoses
- loosen 2 mounting bracket screws 3 and remove water pump in direction of arrow

## Water pump (kitchen), installing

- install in reverse order

### Note

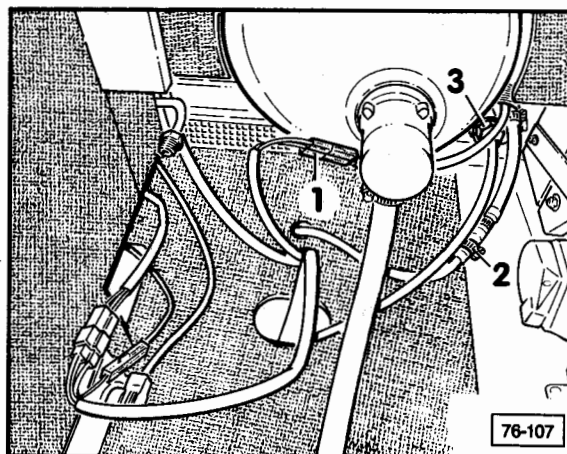
Be sure to check all fluid connections in pump circuit for leaks.

## Water faucet with pump switch, removing

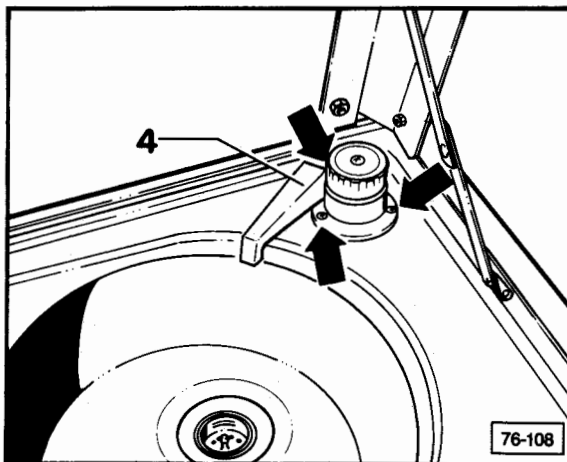
### Note

From equipment serial No. C.000 859.

- remove kitchen cabinet drawer
- un hinge cabinet door
- disconnect battery ground strap



- disconnect 12V DC electric connection from pump switch at plug terminal 1



- open cabinet lid and loosen three screws (arrows)
- remove faucet 4 from kitchen counter and disconnect city water connection, see fig. 76-107, 3

## Water faucet with pump switch, installing

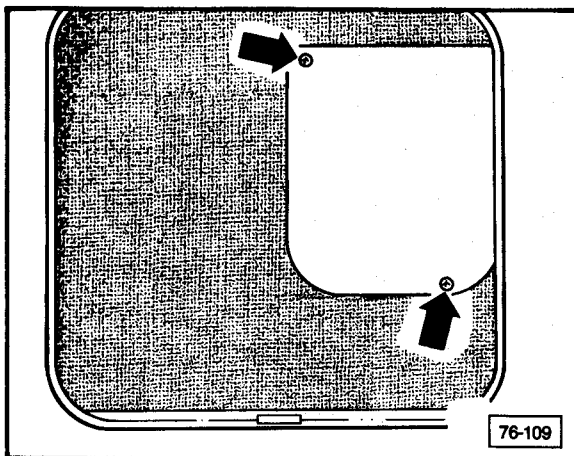
- install in reverse order

## Water pump (kitchen), removing

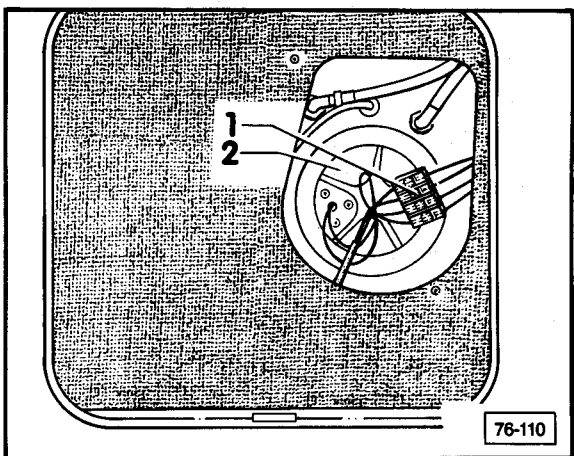
### Note

From equipment serial number C.000 859.

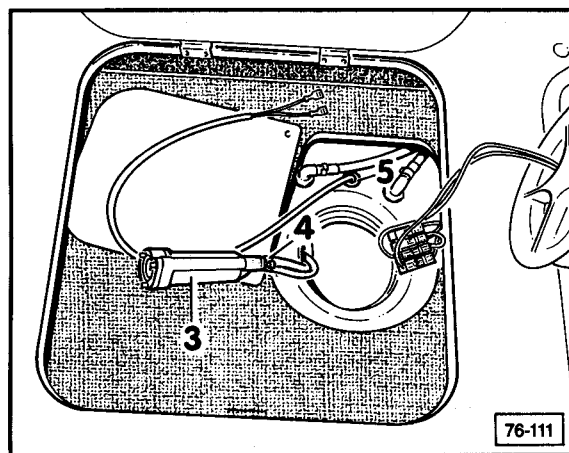
- disconnect battery ground strap



- open left lid of chest and remove cover, two screws (arrows)



- disconnect 12V DC connections at water pump lead 1
- turn out water tank cap 2 and remove pump with sensor



- remove water pump 3 from tank, release clamp 4 and disconnect hose
- pull 12V DC wires through rubber sleeve 5 inward to water tank
- remove water pump with leads from tank

### Note

Do not cross 12 V DC wire connections. Pump works in one direction only.

## Water pump (kitchen), installing

- install in reverse order
- check all fluid connections in pump circuit for leaks



# 76 Cabinets, Water Tank, Refrigerator

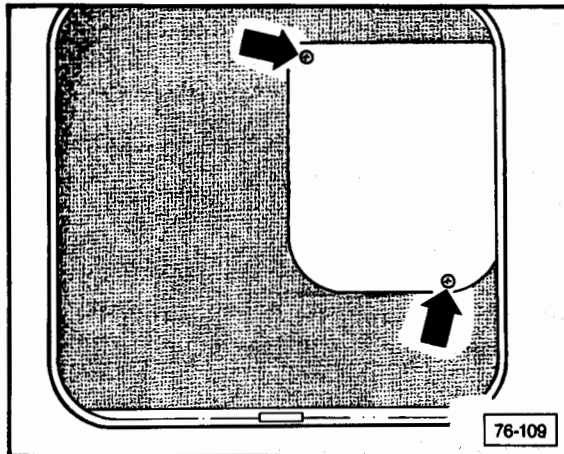
## Water level sensor, removing

### Note

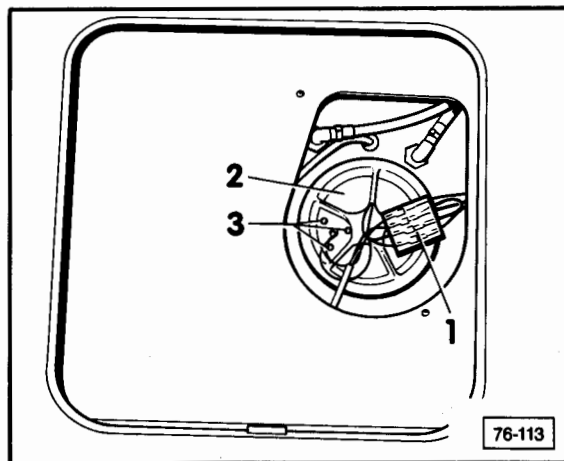
For vehicles from 1988.

### CAUTION

Before working on any part of electrical system, disconnect battery ground strap.



- open left lid of chest and remove cover, two screws (arrows)



- disconnect 12V DC wire connections from sensor at lead connector 1
- remove water tank cap 2 and remove with sensor
- remove sensor from water tank lid, three screws 3

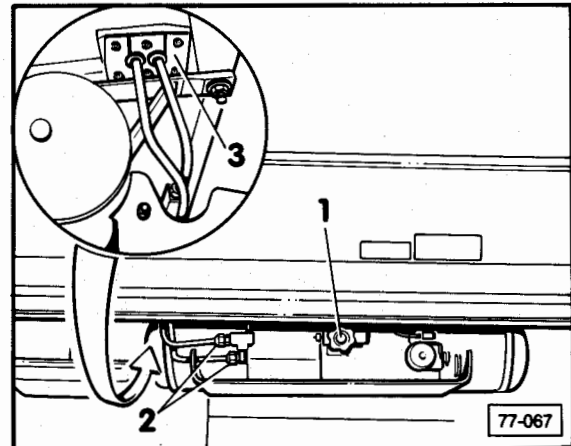
## Water level sensor, installing

- install in reverse order

## Sink cabinet, removing

### Note

On vehicles up to equipment number C.000 858, water pump must be removed, see page 76.18. Equipment number can be found on back left side of rear seat.

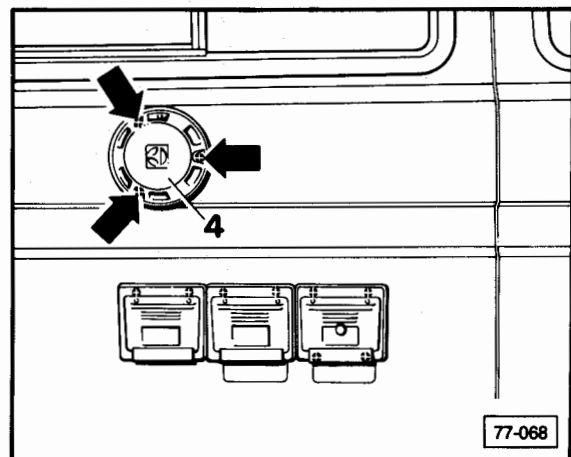


- close propane gas tank valve 1 located under left center floor panel

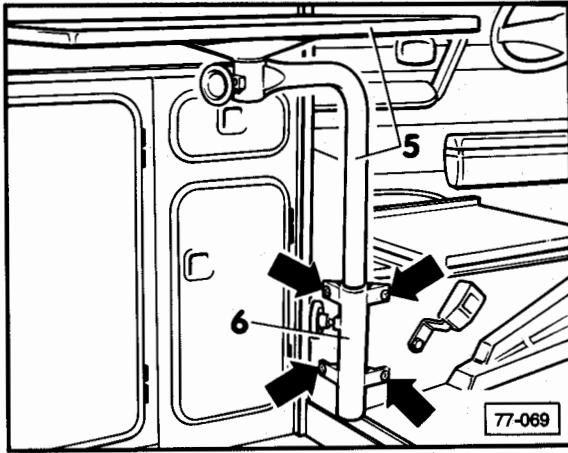
### WARNING

Fire hazard! Do not smoke or have anything in the area that could ignite propane fuel. Ensure adequate ventilation.

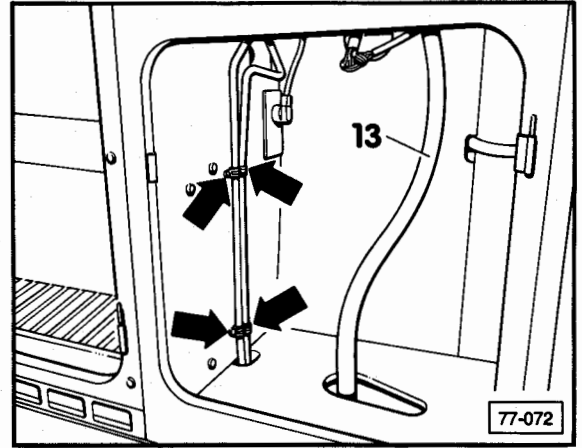
- disconnect gas lines at connections 2
- remove sealing panel 3, six screws



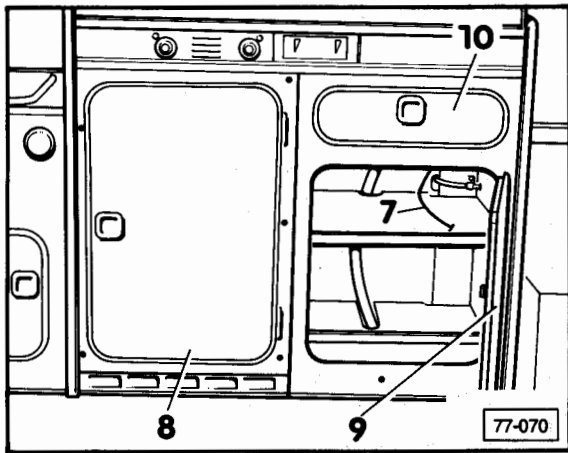
- remove vent cover, 4 washer, mounting plate and gasket



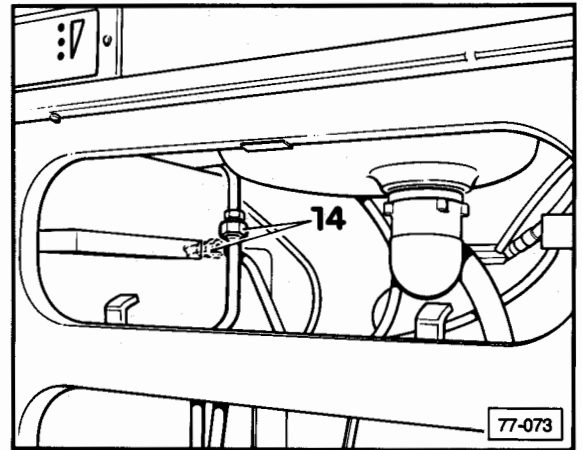
- remove table leg and top 5 from mount 6
- remove table mount 6, four screws (arrows)



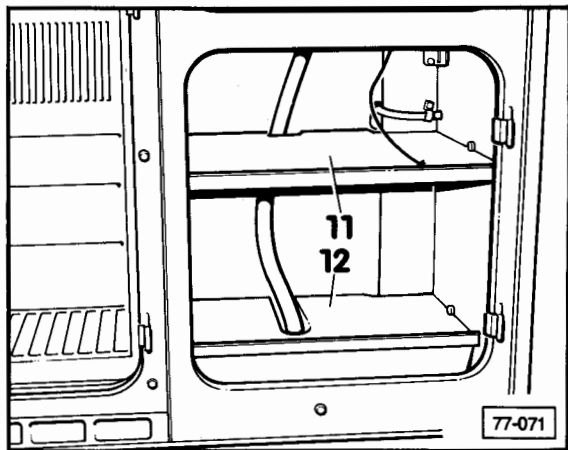
- remove drain hose 13 at bottom
- remove four clamps arrows



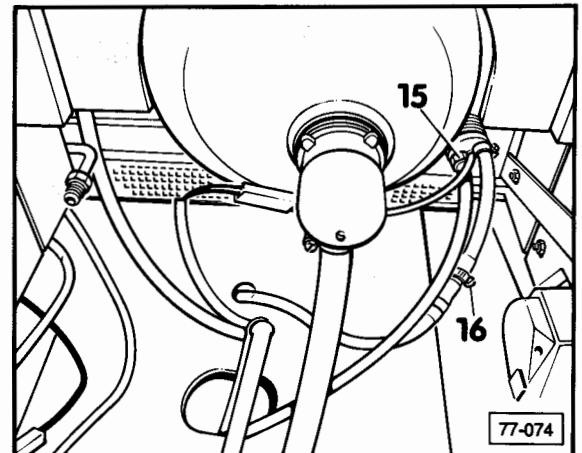
- remove retainer strap for sink cabinet door 7
- unhinge refrigerator door 8 and sink cabinet door 9
- remove drawer 10



- disconnect gas lines at union nuts 14 and remove

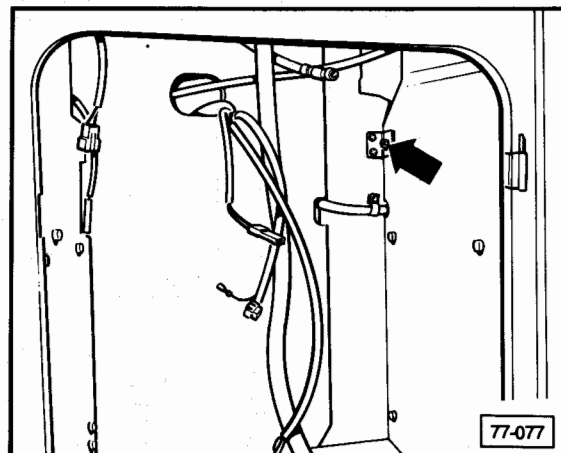
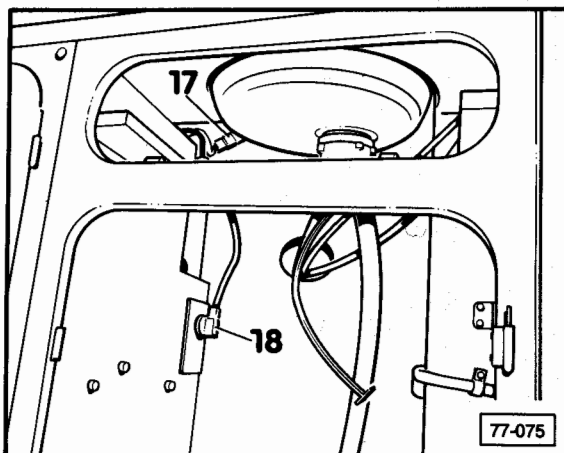


- remove shelf 11 and water pump cover 12



- remove water hose 15 from faucet
- remove hose clamp from valve 16 and disconnect hose

# 76 Cabinets, Water Tank, Refrigerator

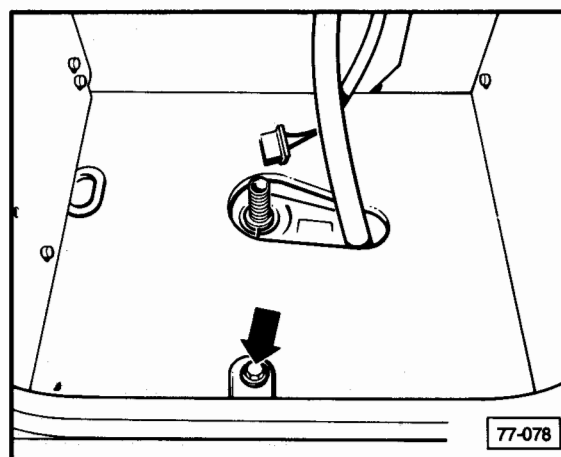


— remove nut (**arrow**) from wall support bracket and push out bolt

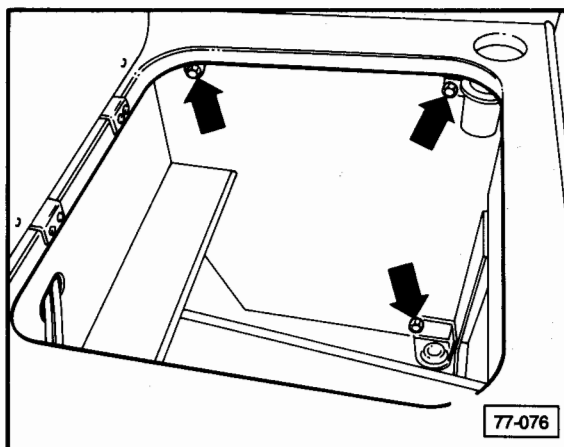
## CAUTION

Before working on any part of electrical system, disconnect battery ground strap.

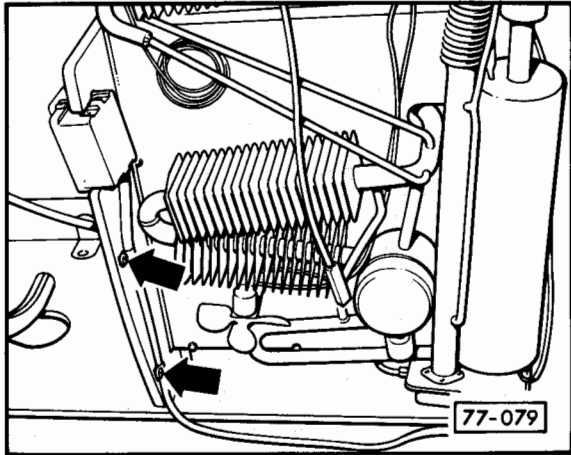
- disconnect 12V DC water pump switch connection 17
- pull 110 disconnect V.A.C. wire from refrigerator 18
- remove cover from 110 V.A.C. outlet
- remove 110 V.A.C. socket (four screws)



- remove bolt (**arrow**) from floor bracket
- lift sink cabinet and refrigerator over floor stud, towards center of vehicle



— remove three bolts (**arrows**) from side wall of chest



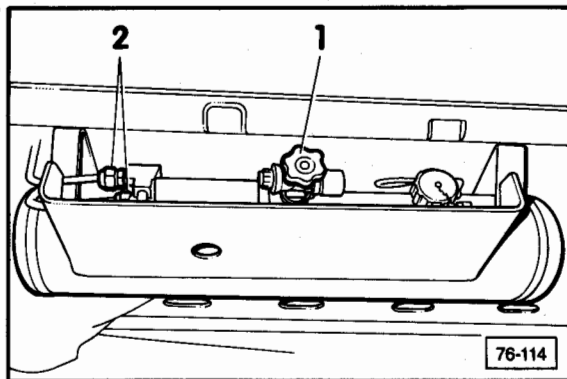
- remove two clamps (arrows) from rear of cabinet and remove 110V socket with cable harness.
- lift sink cabinet with refrigerator from vehicle

## Sink cabinet, installing

### WARNING

If propane gas lines are opened during repair work, a pressurized leak test must be performed, prior to returning the vehicle to service. Use soap water or equivalent to check all fittings.

- install in reverse order of removal



## Propane tank, removing

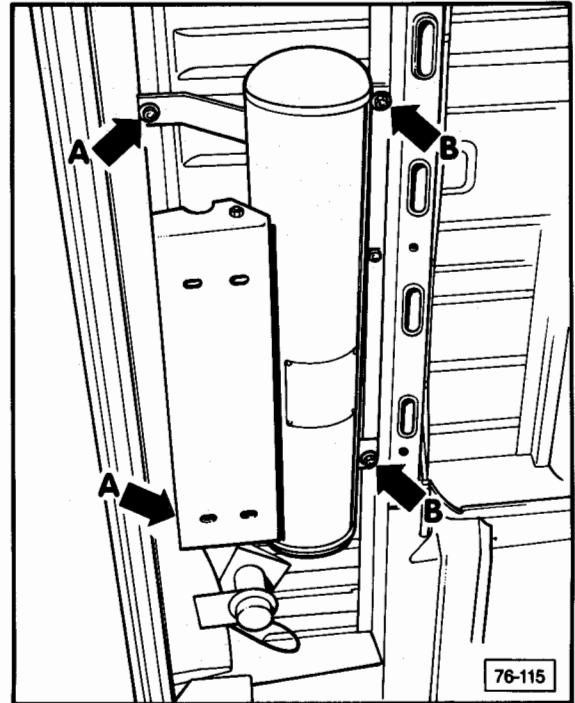
- close valve 1
- disconnect line fittings 2

### WARNING

During repair work on any part of electrical system, the electrical hook-up for 110/220 volt power source **must** be disconnected.

### WARNING

Fire hazard! Do not smoke or have anything in area that can ignite propane fuel. Ensure adequate ventilation.



- remove nuts (arrows A) and loosen nuts (arrows B)
- remove propane tank

## Propane tank, installing

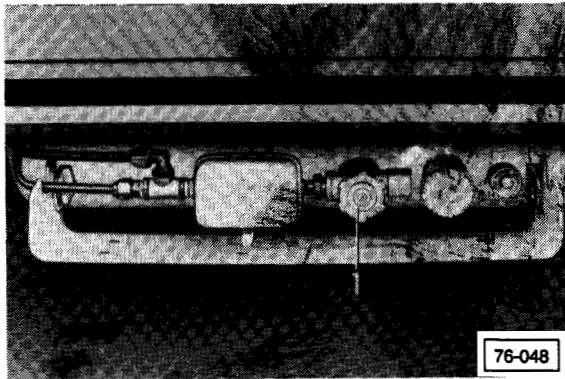
- install in reverse order, noting the following

### WARNING

Always replace self-locking nuts. After installing gas lines, check all fittings for leaks. Apply soap solution to joints and watch for bubbles with lines under pressure.

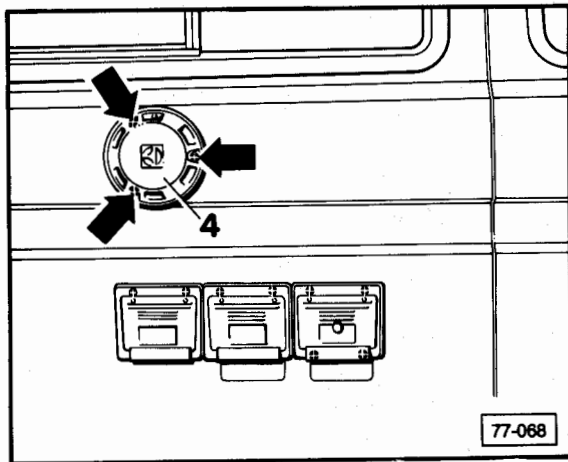
# 76 Cabinets, Water Tank, Refrigerator

## Refrigerator, removing



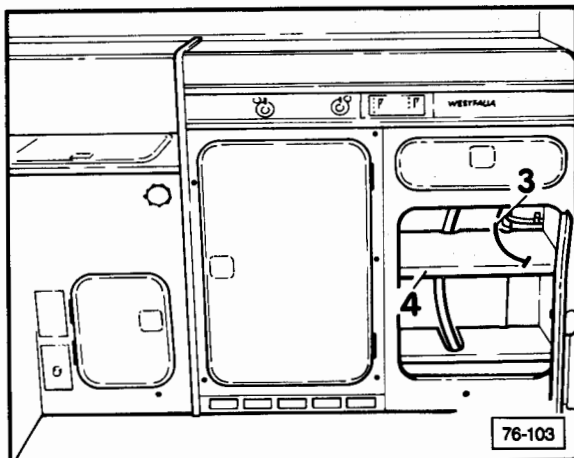
76-048

- close valve 1 on propane tank



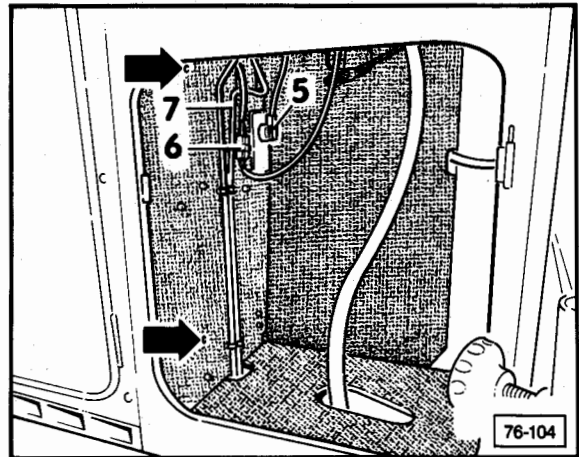
77-068

- remove screws (**arrows**) and remove vent cover 4
- remove cabinet doors and drawer
- remove shelf



76-103

- remove strap 3
- remove cabinet and refrigerator doors
- remove drawer
- remove shelf 4



76-104

### WARNING

During repair work on any part of electrical system, the electrical hook-up for 110/220 volt power source **must** be disconnected.

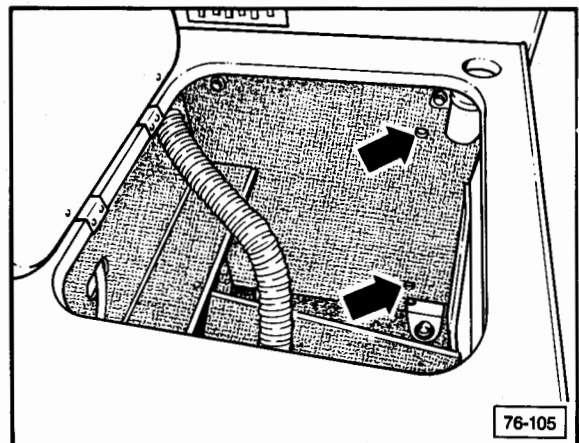
### WARNING

Fire hazard! Do not smoke or have anything in area that can ignite propane fuel. Ensure adequate ventilation.

### CAUTION

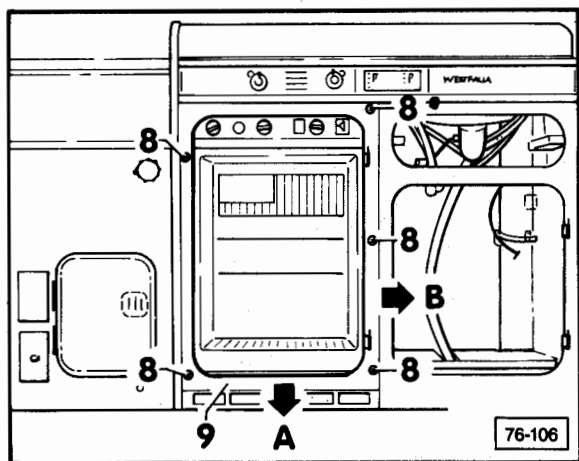
Before working on any part of electrical system, disconnect battery ground strap.

- remove plug 5 for 110 volt AC supply
- disconnect connector 6 for refrigerator
- place wiring harness on top of refrigerator
- disconnect gas pipe 7
- remove both screws (**arrows**)



76-105

- remove shelf in storage chest and screws (**arrows**)



- remove plugs 8 in cover plate 9 and remove screws
- remove cover plate 9 by pulling lower part forward (arrow A) and then to side (arrow B)
- remove refrigerator

**Note**

Ventilator must slide easily out of air duct.

**Refrigerator, installing**

- install in reverse order

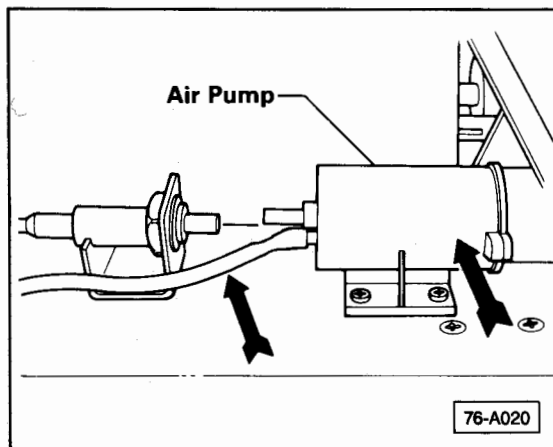
**WARNING**

After installing gas lines, check all fittings for leaks. Apply soap solution to joints and watch for bubbles with lines under pressure.

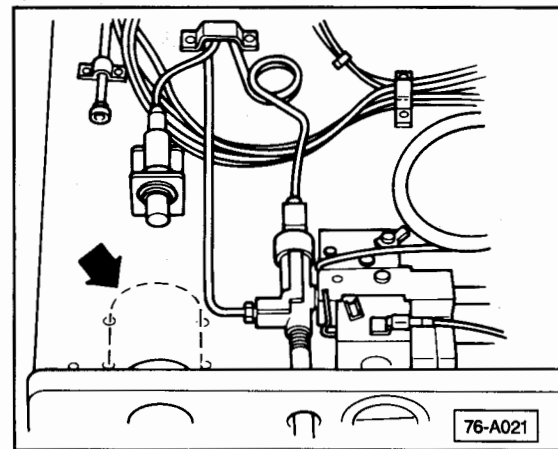
**Refrigerator air supply modification (Dometic 182 models)**

**Note**

When troubleshooting ignition problems on the refrigerator unit, verify spark and fuel are adequate prior to performing air supply modification



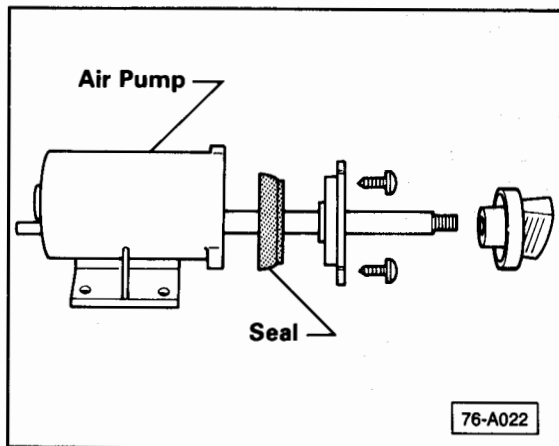
Air pump installed (arrow)



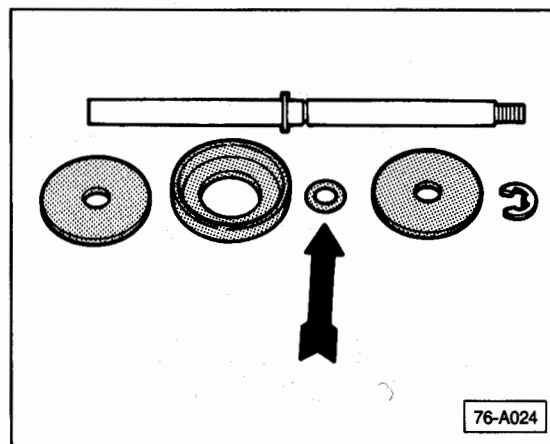
Air pump removed (arrow)

- remove air pump assembly from refrigerator

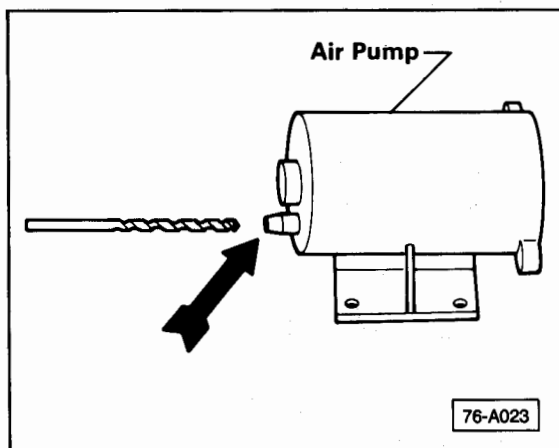
# 76 Cabinets, Water Tank, Refrigerator



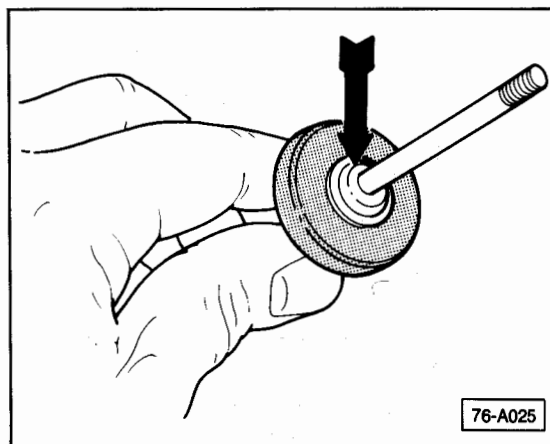
— disassemble air pump



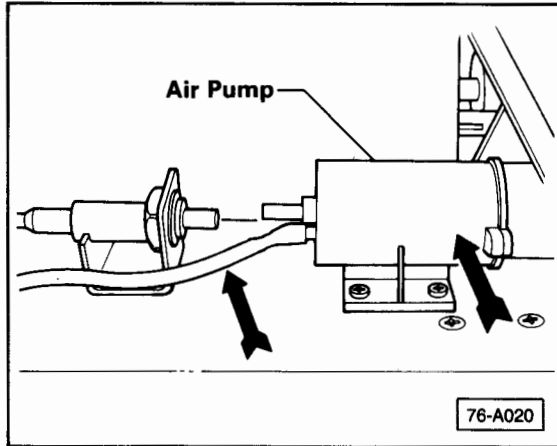
— disassemble air pump piston assembly  
• O-ring (arrow) is not part of original assembly



— drill out air outlet (arrow) of pump housing, using a #40 drill bit (3.54mm, approximately 9/64 in.)



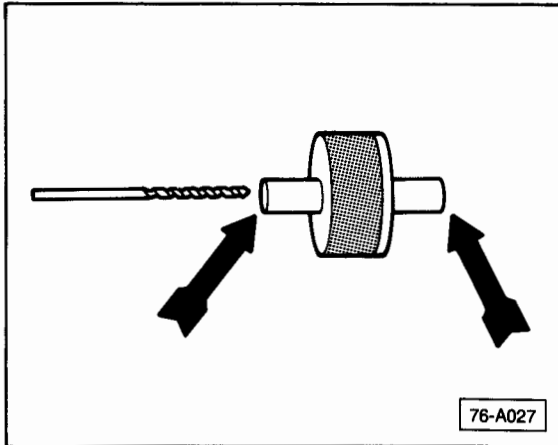
— install O-ring  
• O-ring may be obtained at local hardware or auto supply store  
— reassemble air pump piston assembly with circlip in groove approximately mid-shaft (arrow)  
— reassemble air pump



- remove existing plastic air supply line (left arrow) with one-way check valve and discard
- reinstall air pump (right arrow)

### CAUTION

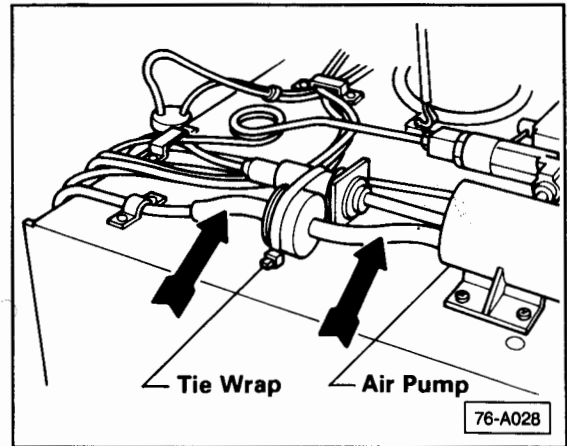
Part numbers are for reference only. Always check with your Parts Department for latest information.



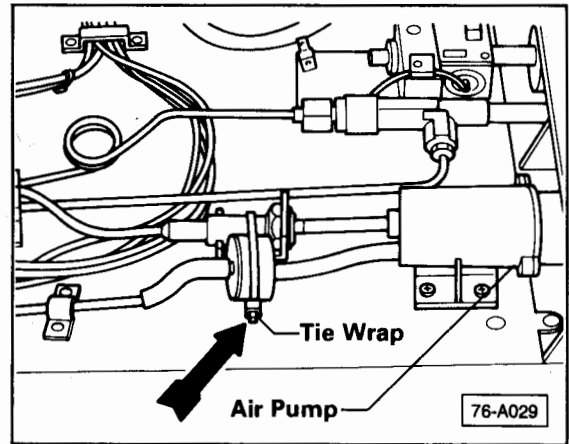
### CAUTION

Be careful not to puncture one way valve diaphragm

- drill out one-way check valve P/N 055 131 101 at inlet and outlet (arrows) using a #40 drill bit (3.5mm approximately) 9/64 in.)



- install replacement one-way valve between two lengths of 4mm (approximately 5/32 in.) ID × 65mm (2.5 in.) long, surgical tubing or equivalent, (arrows)



- secure replacement check valve to ignitor with tie-wrap (arrow)

### CAUTION

To avoid pinching ignitor wire when reinstalling assembly, secure wire with tie wrap to rear of unit.



Interior Panels,  
Roof

**Index**

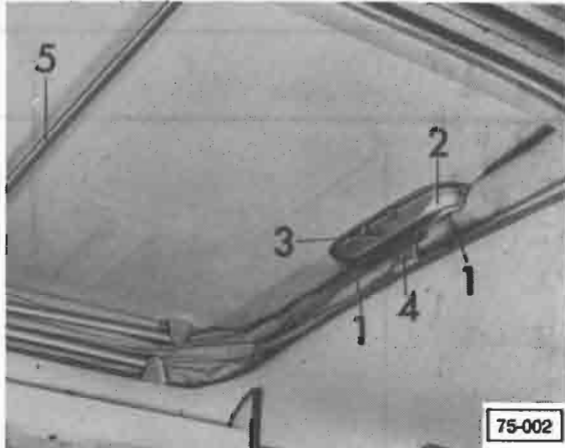
- Front headliner  
installing 75.7a  
removing 75.7
- Luggage rack  
removing 75.8
- Pop-up roof  
installing 75.3  
removing 75.2
- Pop-up roof canvas  
installing 75.5  
removing 75.4
- Pop-up roof seal  
installing 75.6a  
removing 75.6
- Roof vent  
installing 75.7  
removing 75.6a

# 75 Interior Panels, Roof

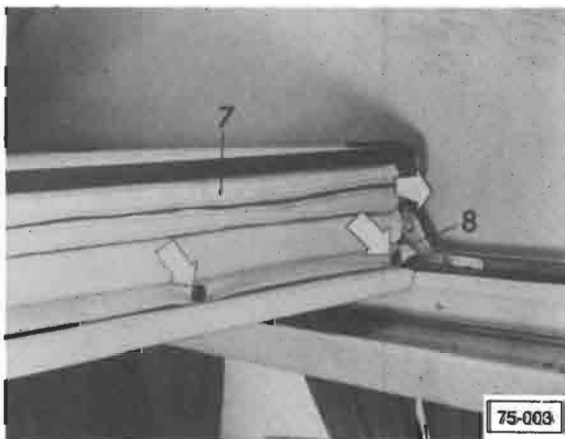
## Pop-up roof, removing

### CAUTION

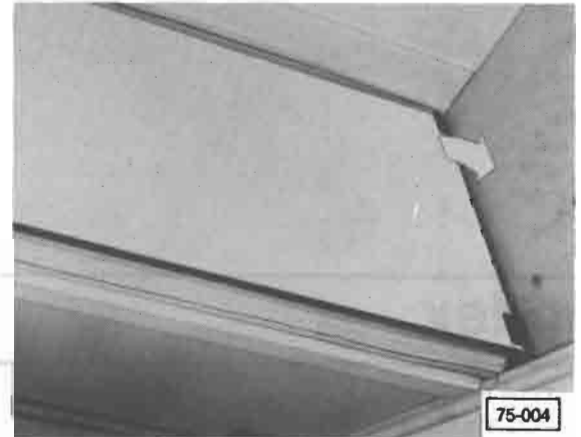
Do not damage inside of roof when swinging front mattress and board



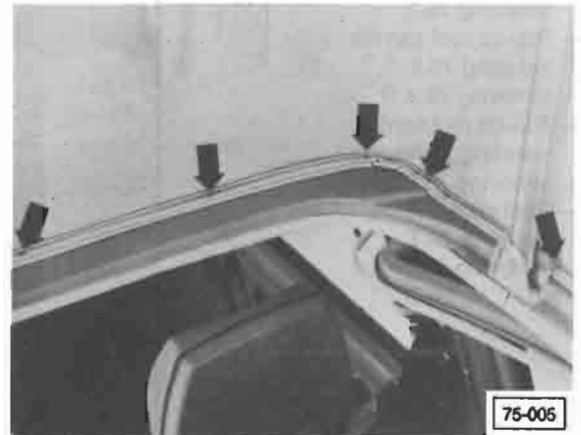
- release lock latches 1 behind lock cover 2 by pulling down firmly with both hands until lock pin 3 disengages at lock plate 4
- push lock cover 2 and roof up as high as possible
- push up roof with crossbar 5 until support struts are locked into position



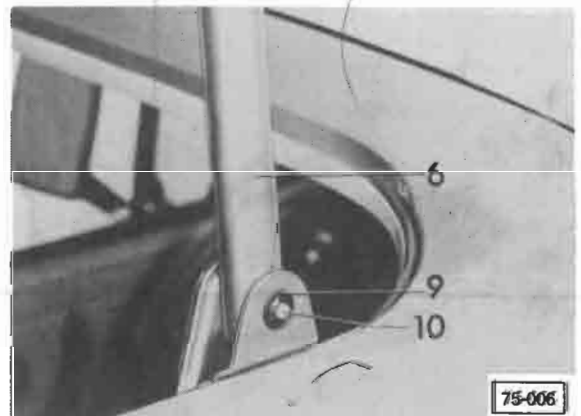
- open snaps (lower arrows) for rear mattress
- pull front mattress and board 7 as far as possible to front with overcentering hinges 8



- swing front mattress and board forward
- open snaps of front mattress and remove mattress



- remove screws (arrows) in channel

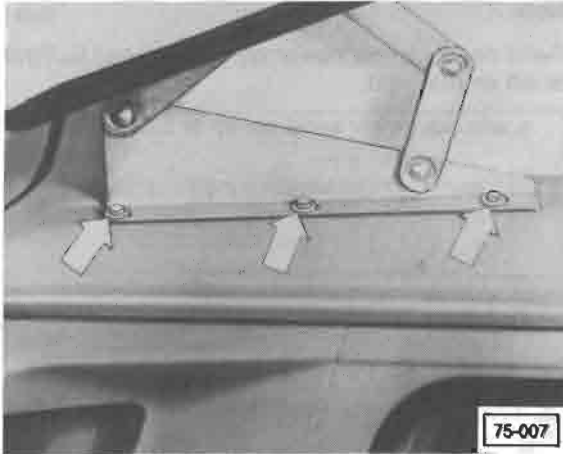


- remove circlip 9 from pin 10 for support struts 6

### Note

Pins 10 remain in brackets 11.

## 75.2 Pop-up roof, removing



75-007

- lower roof halfway and loosen bolts (**arrows**) on each side

**Note**

Following procedure requires three mechanics.

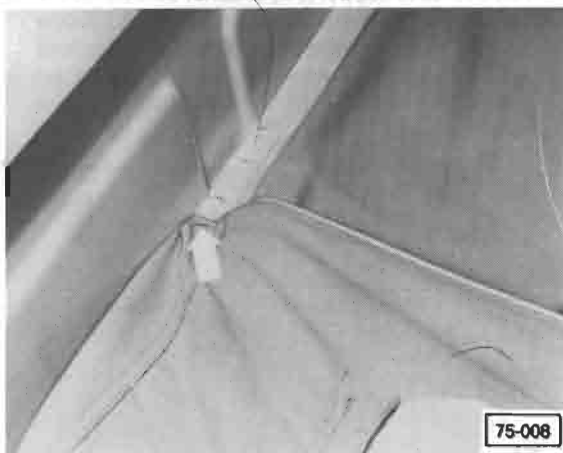
- pull pins 10 out of brackets (see 75.2 figure 75-006)
- remove linkage bolts on each side and tie linkage together

**CAUTION**

Do not damage paint with front support struts when removing roof

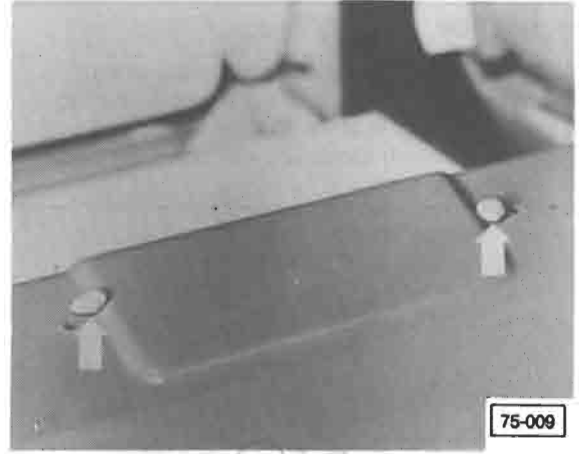
- lift pop-up roof off vehicle

**Pop-up roof, installing**



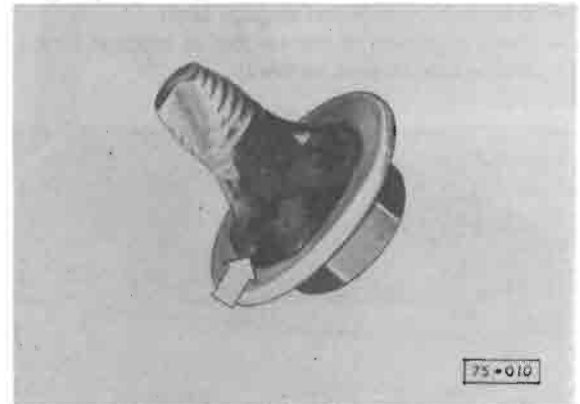
75-008

- staple roof canvas to wooden frame on left and right sides to temporarily hold strut supports in position (**arrow**)



75-009

- apply D14 sealing compound to corners of roof reinforcements (**arrows**) to ensure proper sealing between canvas and roof
- lift pop-up roof with canvas onto vehicle
- let pop-up roof rest at rear of roof
- keep pop-up roof open at front approximately 500 mm (20 in.) and place linkage into position



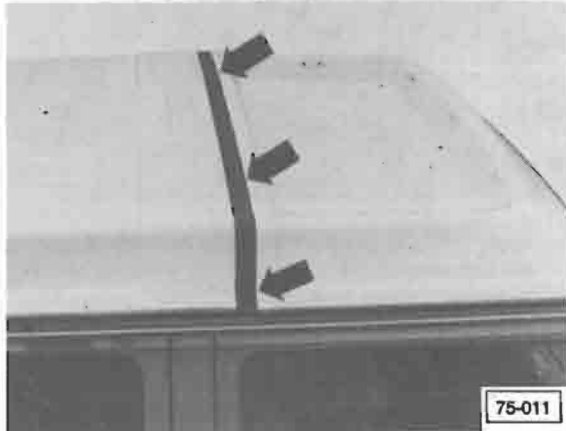
75-010

- apply sealing compound under all linkage bolt heads (**arrow**) as shown
- install bolts and tighten
- position strut supports into brackets and install pins
- install **new** circlips
- lower pop-up roof slightly and let canvas rest on vehicle roof
- make two cuts in beading at each corner to ensure proper seating and sealing
- position retaining rails, align and tighten screws from front to rear

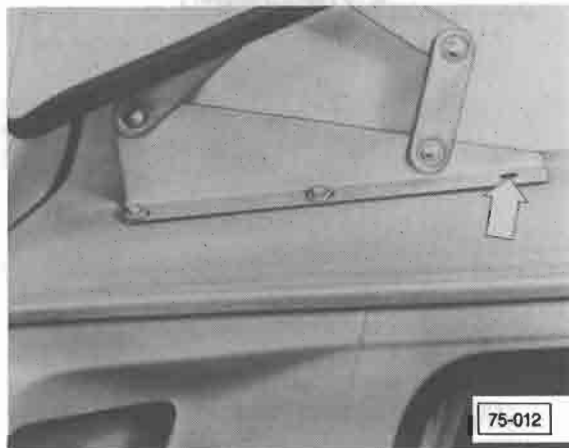
# 75 Interior Panels, Roof

## CAUTION

When lowering top, gather in canvas sides, making sure that no part of canvas is pinched between support struts or latch. Grasp lock cover with both hands and pull down until lock engages in latch



- lower pop-up roof and engage latch
- check alignment of pop-up roof to luggage rack and seating of seal (arrows)



- if necessary realign roof by moving rear linkages in elongated holes (arrow) and tighten bolts

## Pop-up roof canvas, removing

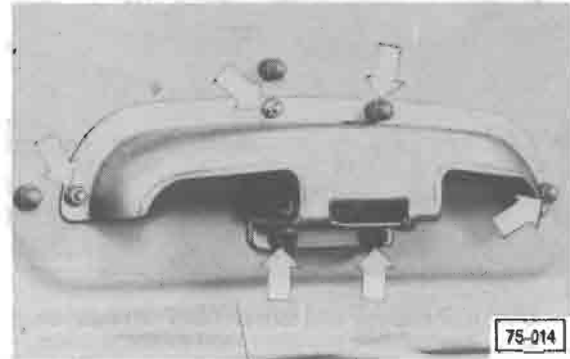
### Note

When canvas must be replaced cut it along vehicle roof. This ensures easy removal of screws in channel. Pop-up roof must be removed to replace roof canvas.

### Note

Serial no. of camper equipment is found on I.D. Plate at left on rear seat.

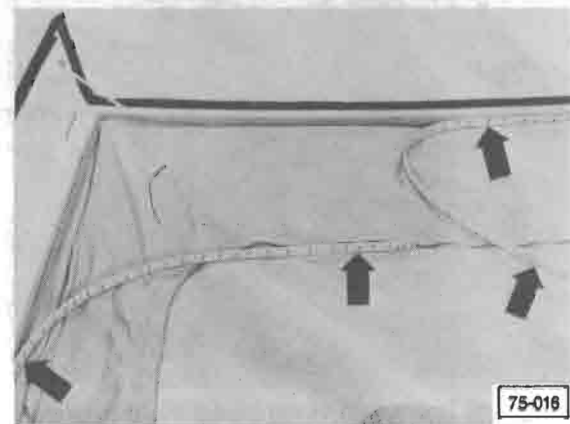
- with equipment serial no. up to E.000 871



- remove lock cover caps and nuts (arrows)
- remove lock cover



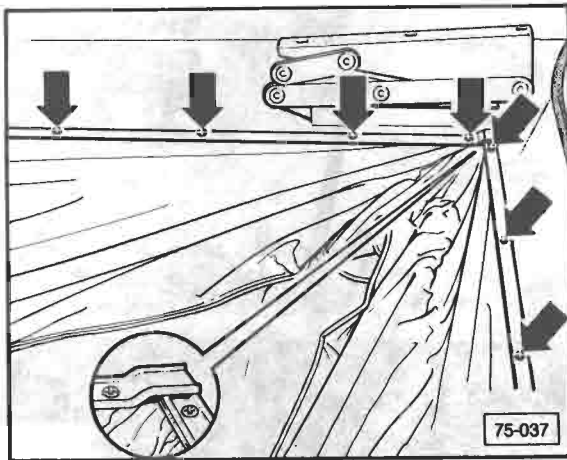
- remove strut supports 6, bracket screws and bolts (arrows)



- remove plastic strip held to wooden frame with staples (arrows)
- pull out staples holding canvas to wooden frame

**Note**

With equipment serial no. from E.000 872.



- remove screws and aluminum rails (see arrows)
- remove staples and canvas

**Note**

When removing canvas, save 8x8x10 mm (5/16 x 5/16 x 3/8 in.) wooden blocks for reuse.

## Pop-up roof canvas, installing

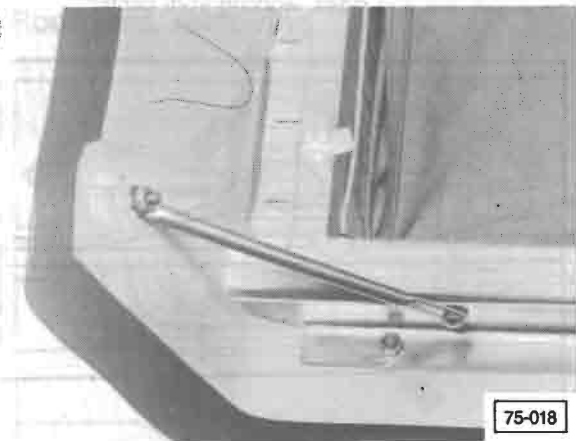
**Note**

Up to equipment serial no. E.000 871.

- fit canvas to all four corners of wooden frame with staples
- attach canvas to front, rear and side sections of wooden frame with staples starting from center of sections and working to corners
- cut 4 plastic strips to following lengths
  - 2 each 2200 mm (86 5/8 in.)
  - 2 each 1150 (45 9/32 in.)
- soften plastic strips in warm water before installing



- staple plastic strips to wooden frame (stretching them to required length)



**Note**

If replacing roof shell only, staple mosquito net to reinforcement strip (arrow).

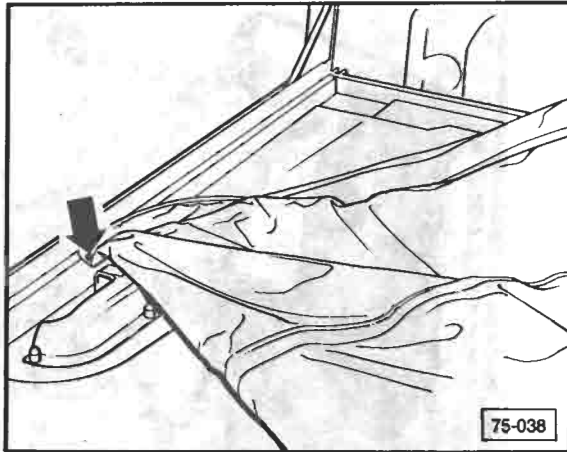
**Note**

From equipment serial no. E.000 872.

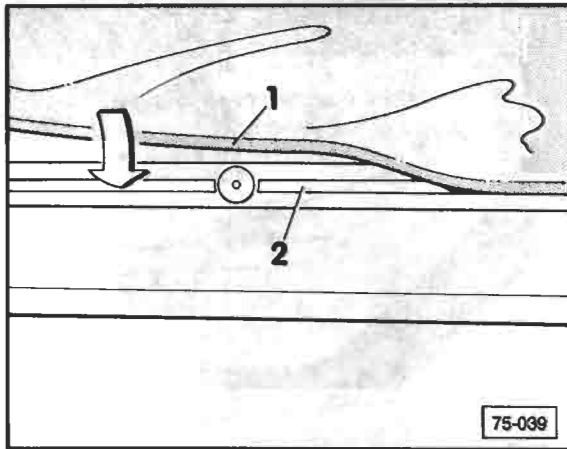
**Note**

Position seams of canvas at left and right edges of roof, approximately 35 mm (1 3/8 in.) from front corners.

# 75 Interior Panels, Roof



- fit canvas and staple to front center of wooden frame. Pull toward two front corners and staple
- pull canvas evenly to rear corners and staple
- staple rear and sides, working from center



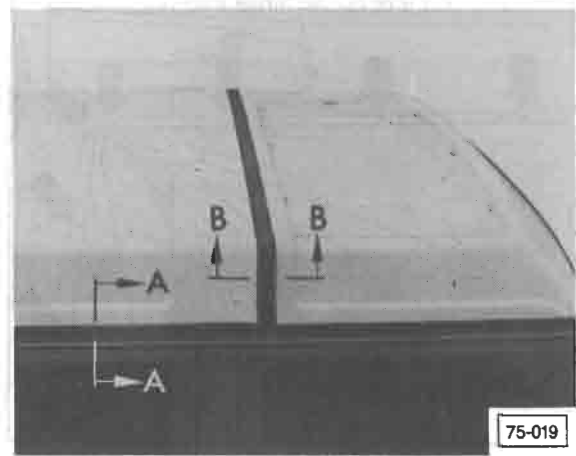
- bolt canvas to rails and ensure bead 1 is centered in guide groove 2 of pop-up roof

### Note

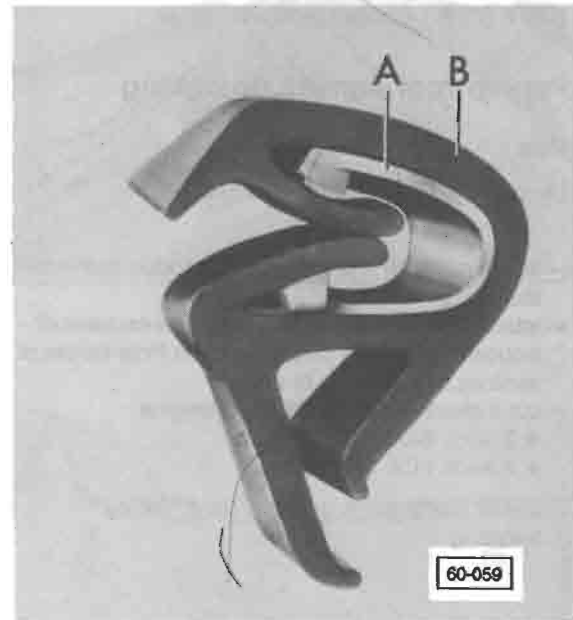
Bolt rails starting from center and progressing toward corners.

## Pop-up roof seal, removing

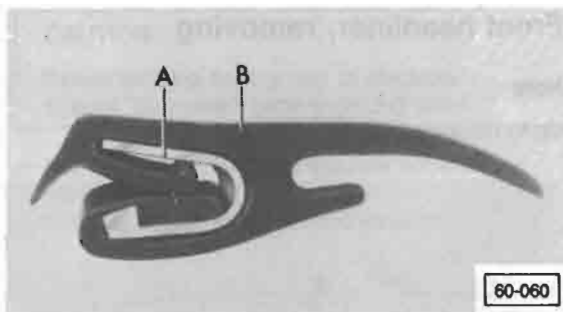
### General Information



- seal with cross section **A-A** is installed around rear, left and right edges of pop-up roof
- seal with cross section **B-B** is installed on front edge of pop-up roof



- seal with cross section **B-B** (photo 75-019) (installed on front)
  - A** = inserted steel clamps
  - B** = rubber part of seal



60-060

- seal with cross section A-A (photo 75-019) (installed on rear and left and right sides)
  - A = inserted steel clamps
  - B = rubber part of seal

**Note**

Correct tension of inserted steel clamps can be restored by squeezing seal together.

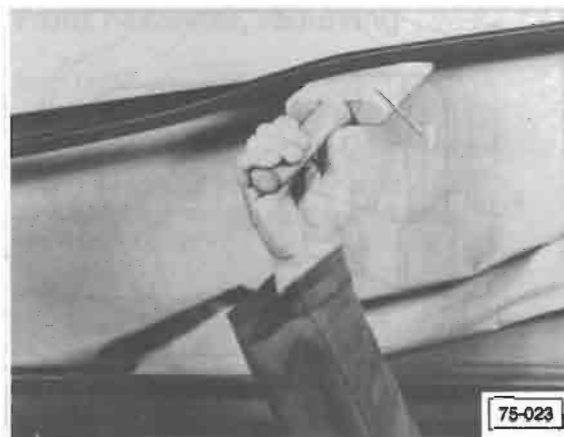
- open roof and pull off seal

**Pop-up roof seal, installing**



75-021

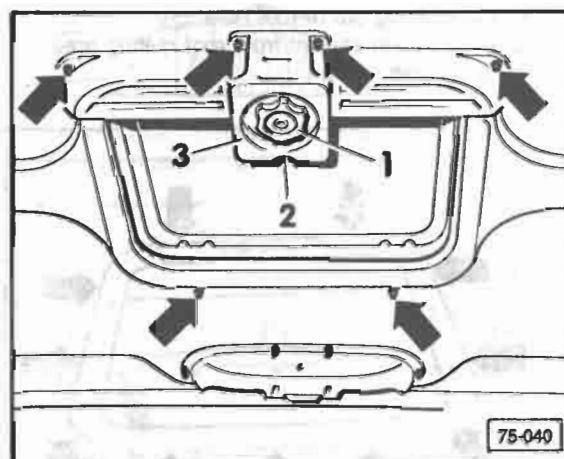
- coat seal with talcum powder
- slide seal on roof starting at both front corners (arrows)



75-023

- to make sure seal with inserted steel clamps is seated properly on roof, press it into edges with plastic wedge 1

**Roof vent, removing**



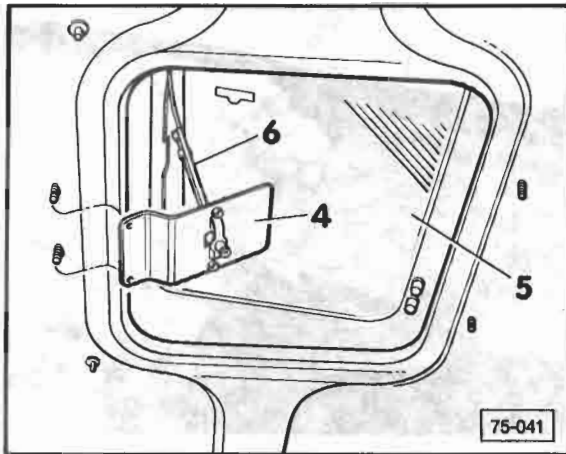
75-040

- open roof vent approximately 1-1/2 turns with hand knob 1
- turn out set screw from hand wheel 1 and remove hand knob
- pry off plastic caps from hex nuts (arrows) and remove nuts
- remove cross-head screw 2
- remove roof vent bracket cover 3

**CAUTION**

Part numbers are for reference only. Always check with your Parts Department for latest information.

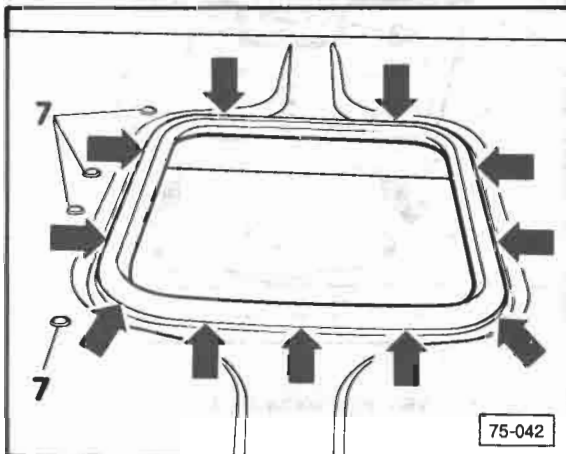
# 75 Interior Panels, Roof



- remove bracket 4 downward from bolts
- remove roof window 5 with support bracket 4, support arm 6 and hinges (upward)

## Roof vent weather molding, removing

- pull old molding out of roof hole
- clean old silicon sealant from roof mating area with a suitable solvent



## Roof vent weather molding, installing

- fit roof vent weather molding into place
- seal weather molding from outside (arrows) with a suitable transparent silicon adhesive compound
- use sealant on vent mounting bolts 7 also

## Roof vent, installing

- install a reverse order of removal, noting the following:
  - use a suitable sealing compound D 001 900 05 or equivalent on six mounting bolts 7

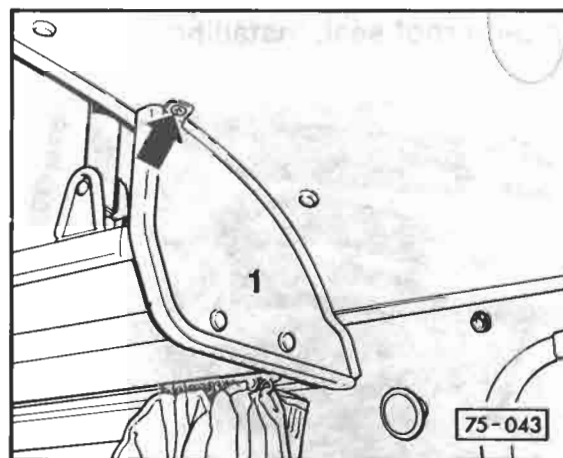
## Front headliner, removing

### Note

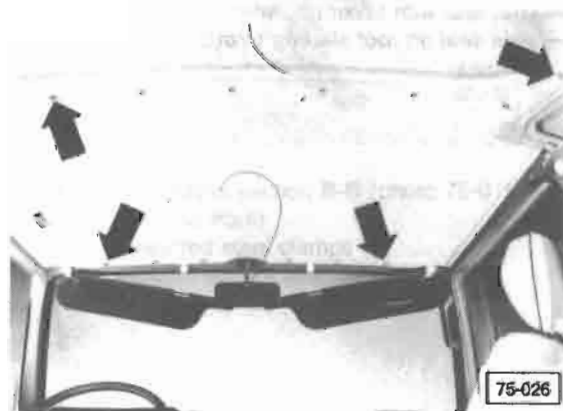
Up to model year 1984.



- location of front headliner (arrow)



- remove screw (arrow) from end plate 1 and storage shelf and remove both parts



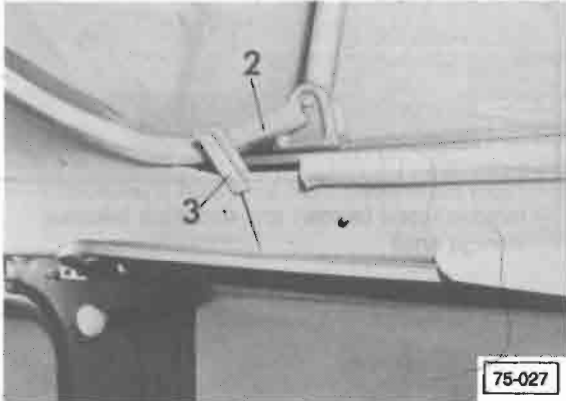
- remove all 14 screws headliner (arrows)



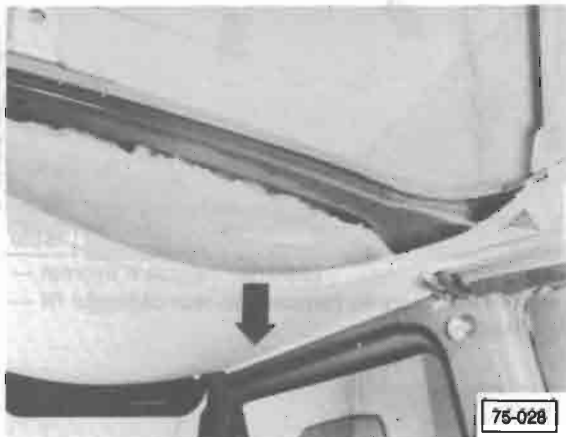
## CAUTION

Before working on any part of electrical system, disconnect battery ground strap

- remove interior light and insulate hot wire
- unclip sun visor
- turn inside rear mirror toward windshield



- remove beadings 2 and seals 3



- pull down headliner slightly at center and slide out of retaining rails (arrow)
- remove headliner

## Front headliner, installing

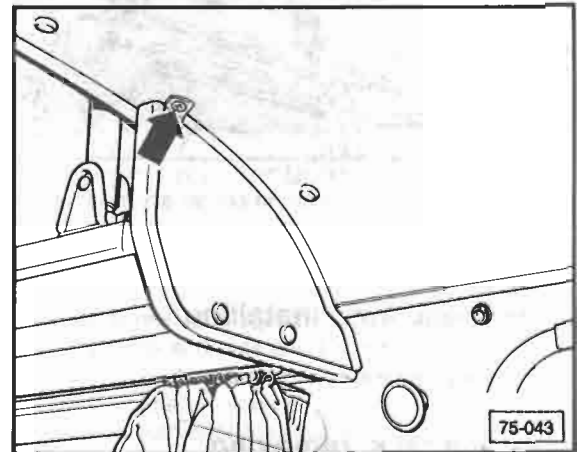
- have second mechanic hold headliner in position
- slide headliner into left retaining rail
- bend headliner down slightly to slide into right retaining rail
- install seals between front and side headliners
- install all 14 screws and tighten
- install beadings and seals at corners
- connect and install interior light and sunvisors
- install end plate

## Front headliner, removing

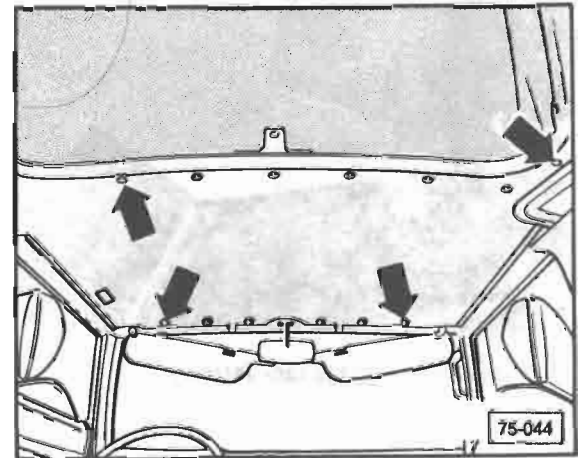
From model year 1985

### Note

Prior to removal of front headliner, roof rail with curtain molding on right must be removed see Repair Group 77.

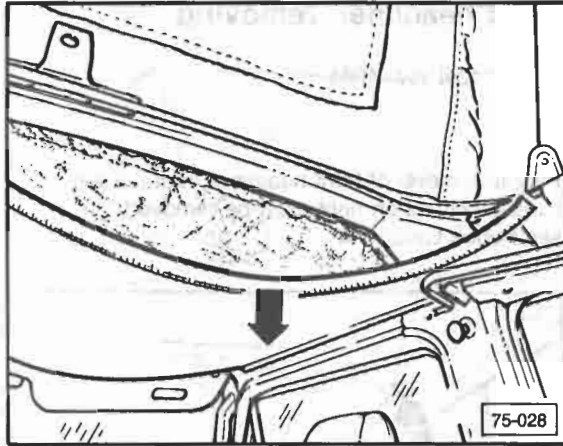


- pry off cover, turn out one screw (arrow), bend support bracket slightly downward



- remove interior light and insulate hot wire
- clip out sun visors and pull toward windshield, turn interior mirror as far as possible toward windshield
- turn out screws (arrows) from front headliner

# 75 Interior Panels, Roof



- pull headliner downward in center and push out of side retaining rails
- remove headliner

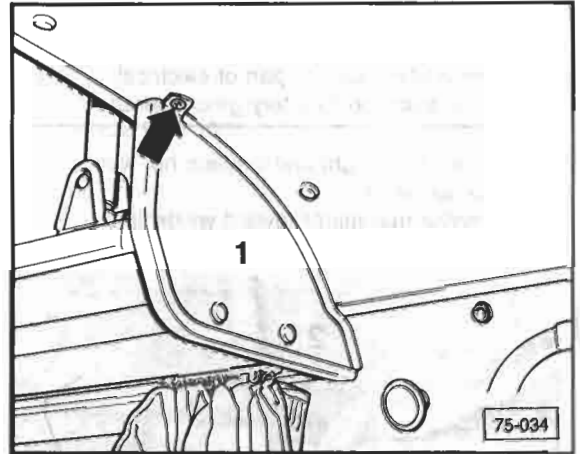
## Front headliner, installing

- installing reverse order of removal

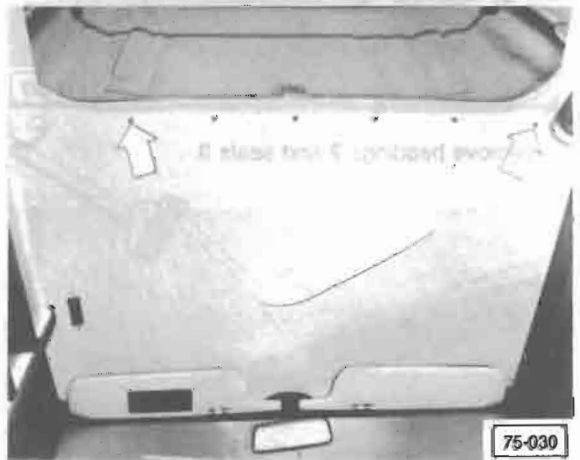
## Luggage rack, removing



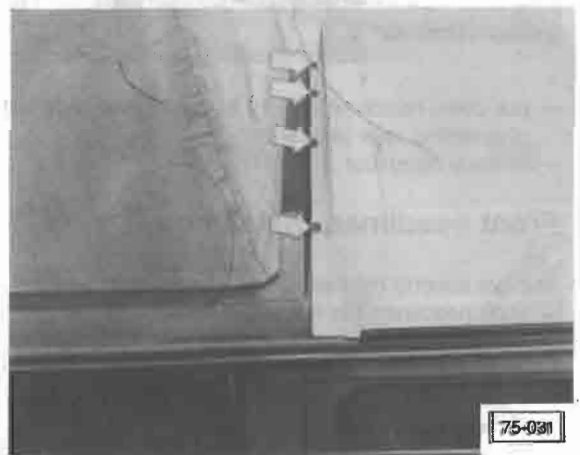
- location of luggage rack (arrow)



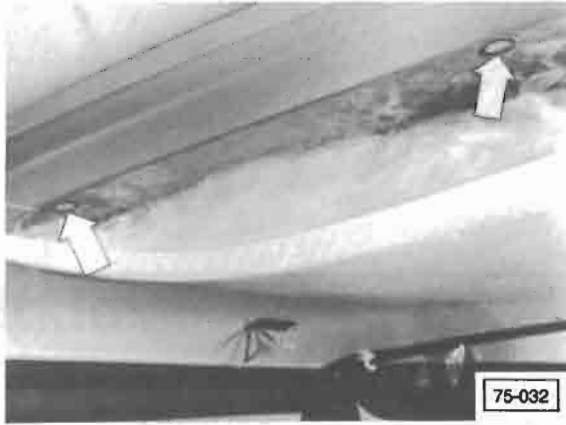
- remove screw (arrow) and end plate 1 from storage shelf



- remove 7 screws (arrows) at rear of front headliner

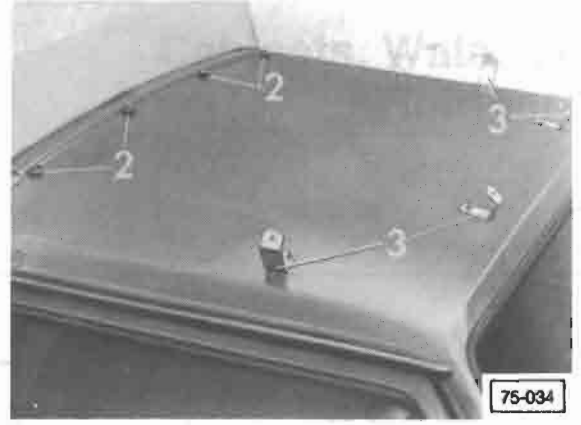


- remove rubber caps (arrows)
- remove nuts



75-032

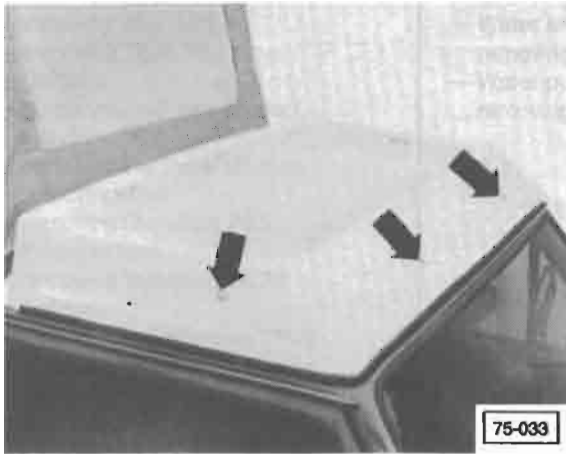
— if necessary, hold bolts from underneath roof (arrows)



75-034

### Luggage rack, installing

- place 2 rubber washers on each hole 2
- place luggage rack on roof of vehicle and align holes
- insert screws and tighten loosely in brackets 3
- install bolts and nuts and tighten loosely
- check alignment of luggage rack on vehicle roof and finally tighten all screws and nuts
- reinstall front headliner and end plate



75-033

— remove 4 screws (arrows)  
 — lift luggage rack off vehicle roof

**Body  
Seat Upholstery**

<b>Quick Data</b>	<b>Index</b>
	<p>- Heated seats (Canada) component location 74.2, 74.3 heat element removing/installing 74.2</p>

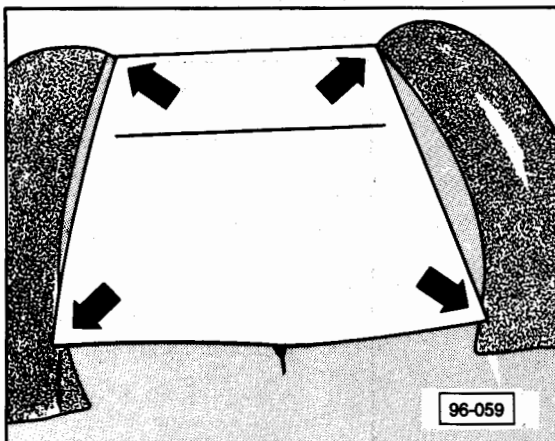
# 74 Body-Seat Upholstery

## Heated seat, seatback element, removing

- disconnect battery ground strap
- disconnect electrical plug under seat
- remove seat from vehicle
- remove wires from electrical plug
- remove seat back
- remove seat or seatback cover
- remove defective element

## Heated seat, seatback element, installing

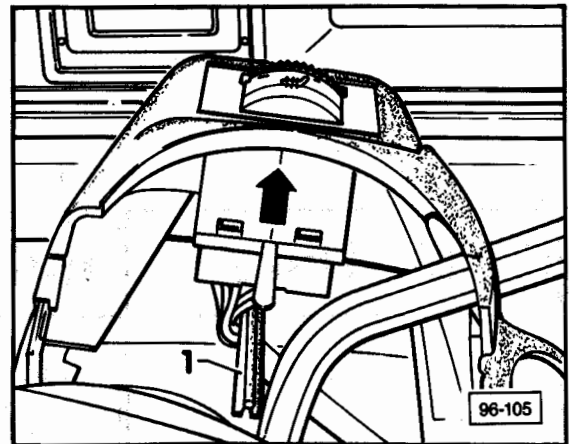
Installation is in reverse order. Note the following:



- ensure replacement element is installed wrinkle free
- check heated seat, seatback for proper function

## Heated seat switch, removing/installing

- disconnect battery ground strap
- unscrew lower steering column cover
- lift upper steering column cover



- push heated seat switch (arrow) up and disconnect electrical plug
- remove switch

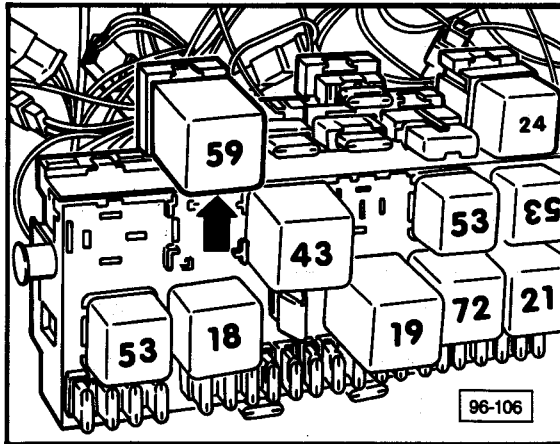
Installation is in reverse order. Note the following:

- route wires to switch around bracket 1
- reconnect battery ground strap
- check system for proper function

## Electric component location

### Control unit

- remove access trim cover for relay board

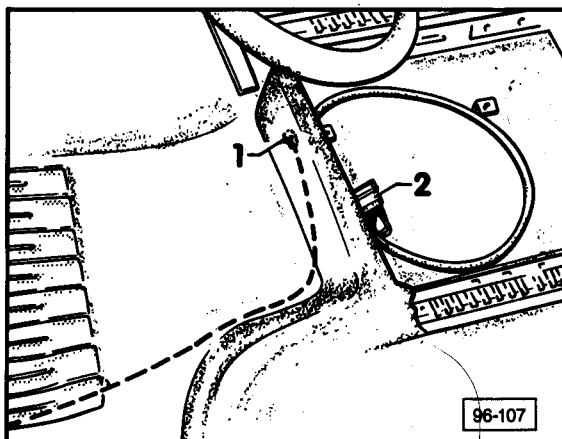


— control unit is identified by number 59 stamped on the top (as shown)

### Electrical wiring to driver's seat

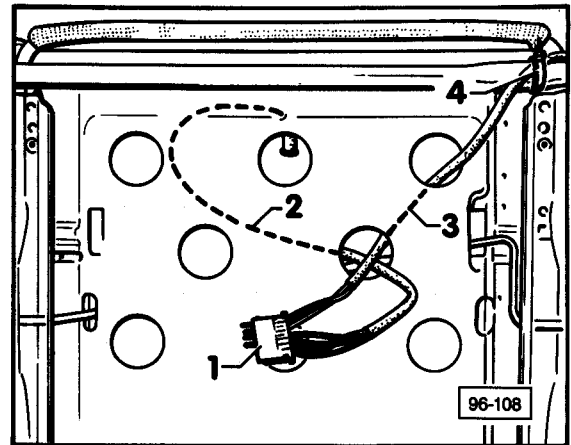
#### Note

Wiring is taped to floor with fabric tape.



1 — wire routed through seat crossmember  
2 — six cavity electrical plug to driver's seat

### Electrical wiring to heated seat elements



1 — six cavity electrical plug  
2 — wire to seat element  
3 — wire to seatback element  
4 — tie wrap

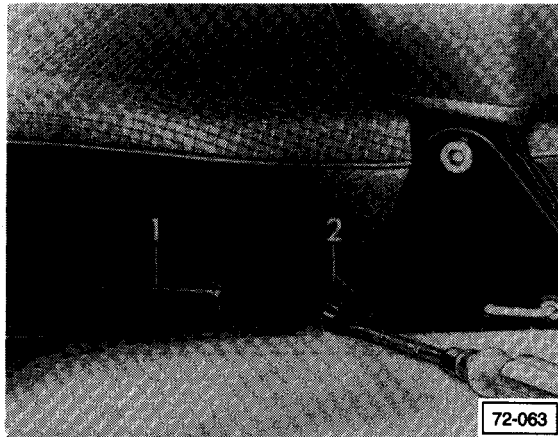
### Electrical troubleshooting

For electrical troubleshooting, refer to appropriate Wiring Diagrams.

Quick Data	Index
	<ul style="list-style-type: none"><li>- Armrest, adjustable assembly 72.5 removing/installing 72.6</li><li>-- Armrest, fold down removing/installing 72.4</li><li>- Front seat removing/installing 72.2</li><li>- Front seat backrest removing/installing 72.2, 72.3</li></ul>

# 72 Body-Seats

## Front seat, removing



- pull front seat adjusting lever 1 upward and push seat forward
- pry locking lever 2 upward with screwdriver and push seat forward out of seat tracks

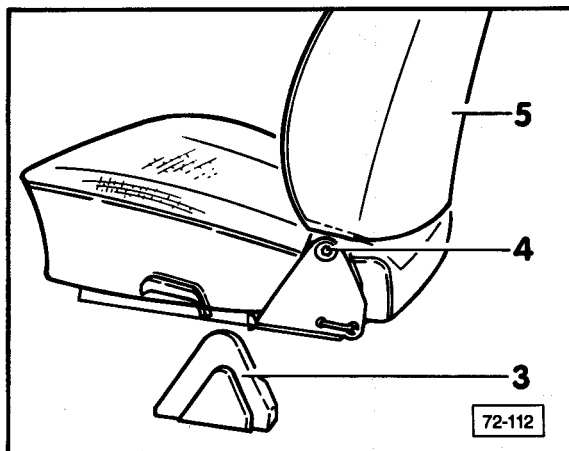
## Front seat, installing

Reinstall all components in reverse order of removal, noting the following:

- check seat for proper function

## Front seat backrest, removing

From 1980 — 1984 m.y.



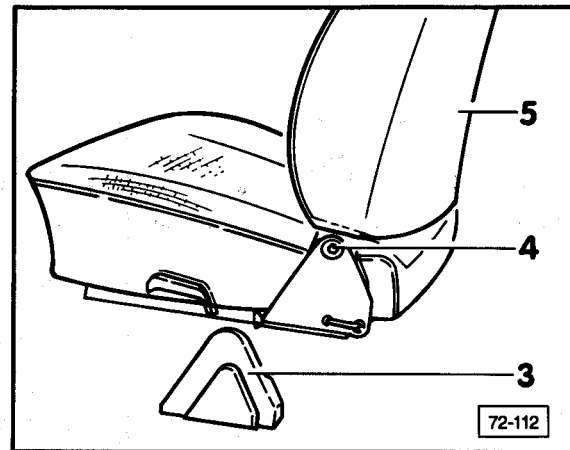
- pry off left/right cover caps 3
- fold backrest 5 to front and lock
- remove socket head bolts 4 from both sides
- fold back backrest all the way back to horizontal
- pull off backrest 5

## Front seat backrest, installing

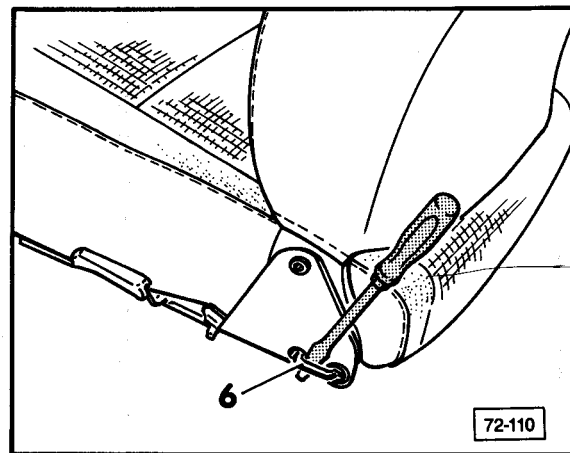
- insert backrest 5, fold forward and lock
- reinstall socket head bolts 4
- reinstall cover caps 3

## Front seat backrest, removing

From 1985 m.y.

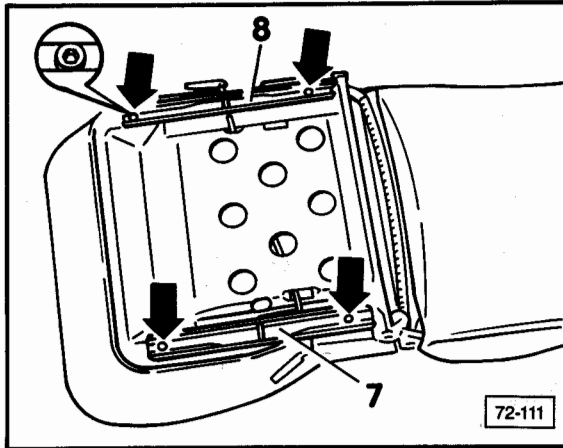


- pry off cover caps 3 from both sides
- remove socket head bolts 4 from both sides



- pry out clamp 6 from outer side of seat with screwdriver
- pull out clamp 6



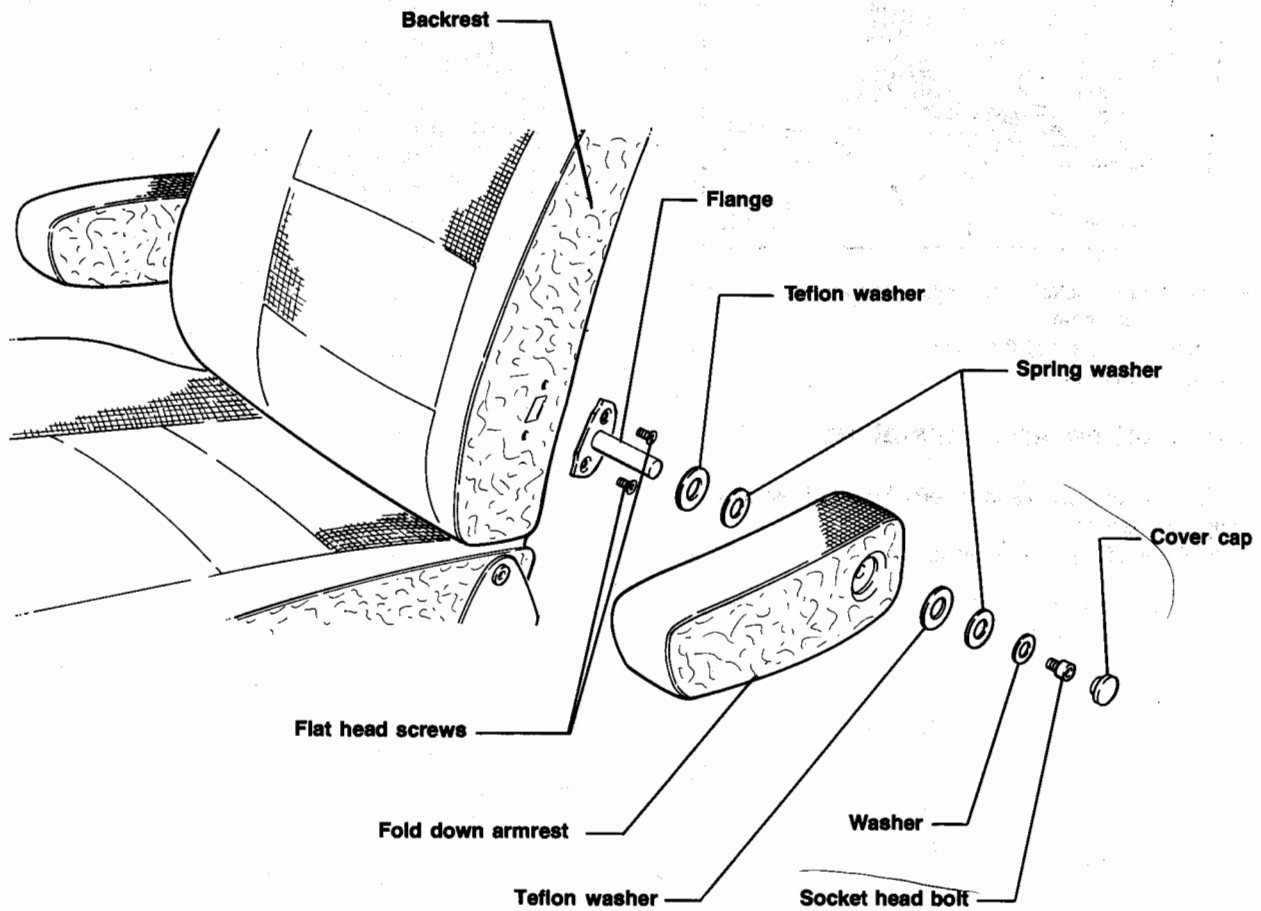


- remove four socket head bolts (**arrows**)
- remove right seat rail **7**
- remove left seat rail **8** to side
- remove backrest

### Front seat backrest, installing

Reinstall all components in reverse order of removal, noting the following:

- check seat for proper function



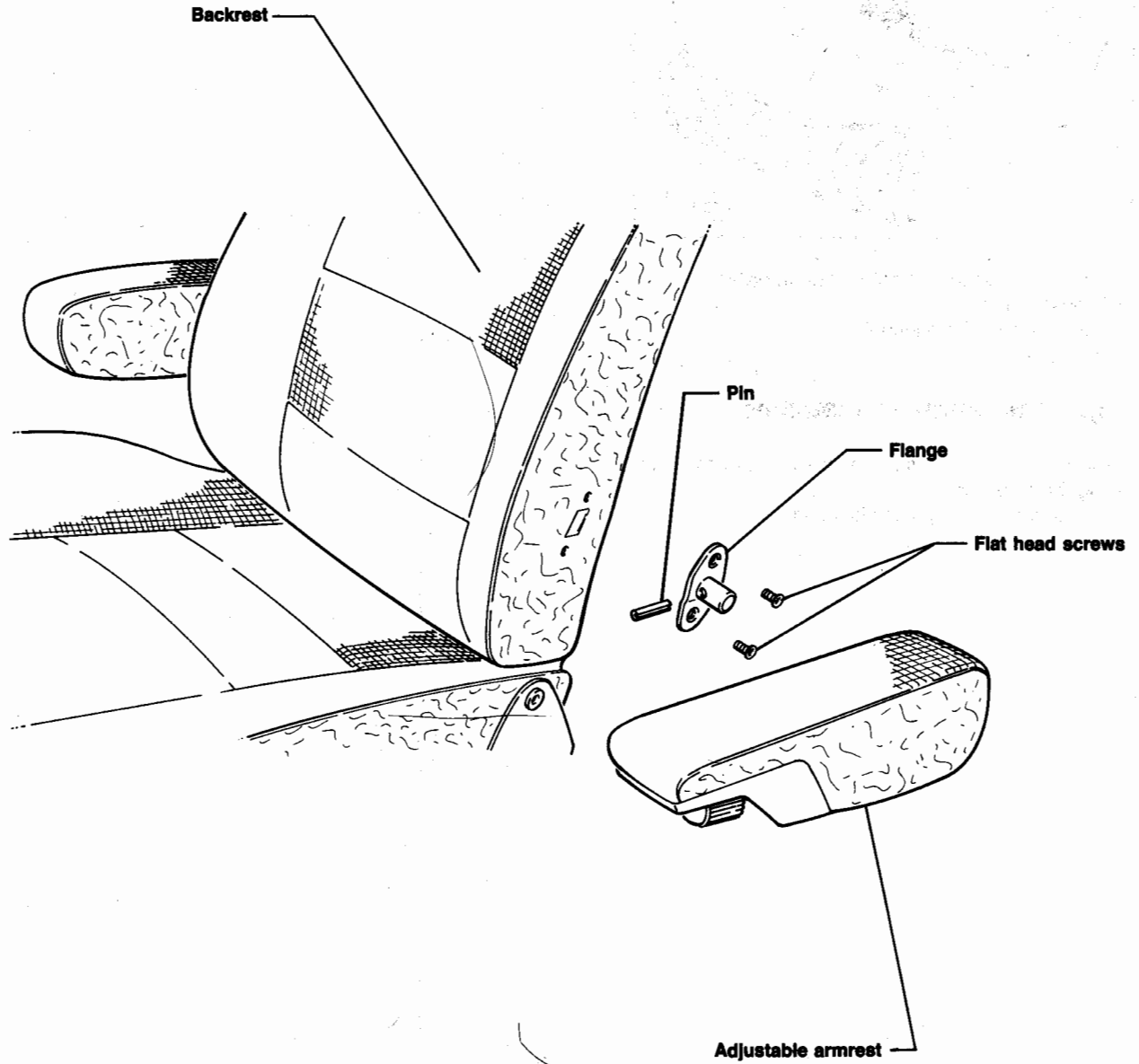
72-113

## Fold down armrest, removing

- remove cover cap
- remove socket head bolt
- carefully pull off armrest from flange

## Fold down armrest, installing

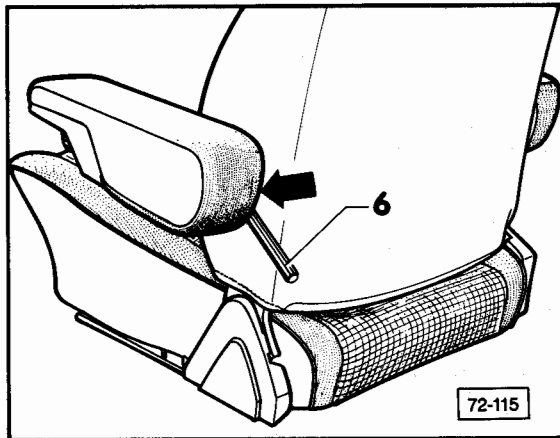
- Reinstall all components in reverse order of removal, noting the following:
- check armrest for proper function



72-114

# 72 Body – Seats

## Adjustable armrest, removing



- push covering of armrest to side in order to expose pin (**arrow**)
- drive out pin with punch **6**
- pull off armrest

## Adjustable armrest, installing

Reinstall all components in reverse order of removal, noting the following:

- check armrest for proper function

## Index

- |  |  |  |
|--|--|--|
| <ul style="list-style-type: none"><li>— Automatic 3-point seat belts retrofit installation 68.5</li><li>— Automatic rear 3-point seat belts retrofit installation 68.7</li><li>— Automatic 3-point left center seat belt retrofit installation 68.10</li><li>— Illuminated vanity mirrors replacing bulbs 68.13</li><li>— Seat belts inspection 68.2 webbing defects 68.4</li><li>— Template measurements 68.6</li></ul> |  |  |
|--|--|--|

# 68 Seat Belt System

## Complete seat belt system

### Note

A visual and functional inspection of seat belts is recommended to assure maximum protection for vehicle occupants.

### CAUTION

Seat belt assemblies must be replaced after being subjected to loading by occupants in a collision.

The following inspection is described separately for front, rear and center seat belt positions. It includes all continuous loop, single retractor 3-point restraint systems, 2-point automatic (passive) front seat restraint systems, and all non-retractable belt systems.

## System inspection, front seat

### Webbing Inspection

- check for twisted webbing due to improper alignment when connecting buckle
- fully extend webbing from retractor. Inspect webbing and replace with new assembly if following conditions are noted:
  - cut or damaged webbing
  - broken or pulled threads
  - cut loops at belt edge
  - color fading as a result of exposure to sun or chemical agents
  - bowed webbing

see page 68.4 for examples of webbing defects

### CAUTION

Do not bleach or redye seat belt webbing. Webbing that is severely faded will not meet strength requirements and must be replaced.

Belt assemblies must be installed in sets. Do not interchange buckle and retractor assemblies with those designated for other seating positions or other car models.

If webbing cannot be pulled out of retractor or will not retract to stowed position, check for the following conditions and clean or correct as necessary:

- dirty webbing coated with gum, syrup, grease or other foreign material
- twisted webbing
- retractor or loop on B-pillar out of position

### Cleaning

Clean the belt webbing only with a mild soap solution recommended for cleaning upholstery or carpets. Follow the instructions provided on soap container.

### Buckle Inspection

- insert tongue of seat belt into buckle until audible click is heard. Pull back on webbing quickly to assure buckle is latched properly
- replace seat belt assembly if buckle will not latch
- depress button on buckle to release belt
  - belt should release with a pressure of approx. 2 lbs.
- replace seat belt assembly if buckle cover is cracked, push button is loose or pressure required to release buckle is too high

### Retractor inspection

Front retractors are dual sensing and will lock up in two modes. The unit will lock up as the belt is being withdrawn from the retractor if the inertia increases dramatically. Also, the unit will lock up with a change in vehicle motion such as rapid braking.

- grasp seat belt webbing and, while pulling from retractor, give belt a fast jerk

### Note

For automatic belt vehicles this mode is difficult to inspect due to a low setting of the inertia unit.

- drive vehicle in an open area away from other vehicles at a speed of approx. 5 to 15 mph and quickly apply footbrake
- if retractor does not lock up under these conditions, remove and replace seat belt assembly

## Note

A passenger can be used to test the right hand retractor. The driver alone can test both retractors simultaneously by grasping the right hand webbing, extracting approx. 26 inches from the retractor and holding the belt while braking.

## Seat belt warning light/buzzer

A light in the instrument panel displaying the words "fasten seat belts" or "fasten belts" along with an audible signal that lasts for four to eight seconds should be noticed when the ignition switch is moved to the "on" or "start" position and the driver's belt is unlatched. If the driver's belt is latched the buzzer should not activate.

For 2-point automatic belts, both belts must be connected to the door in order to start the vehicle. The "fasten belts" light should activate if either automatic belt is disconnected after starting.

## Note

Correct any malfunctions in this system if the customer desires.

## Anchorage inspection

Seat belt mounting bolts are installed at 35.3 Nm to 47.0 Nm (20 to 35 ft lb). Retractors must be securely anchored in place. The bolts at the lower belt anchor point (not the retractor) and upper seat belt loop must be tight and still allow the hardware to swivel. Anchorage areas must be sound and uncorroded.

## Note

Reinforce bolt mounting area if necessary.

## System inspection, rear seat

### Webbing/buckle inspection

same as for front seat

### Retractor Inspection

Rear seat retractors lock automatically when the webbing is extended and allowed to feed back into the retractor.

- check retractor by extending webbing and fastening to buckle. Allow several inches to feed back into retractor and then jerk belt sharply
- if retractor does not lock up, remove and replace seat belt assembly

### Lap and shoulder belts (rear seat)

The 3-point system for the rear seat is the same as for front seat except for the light and buzzer warning system.

### Anchorage Inspection

same as for front seat

### Center seat position (and non-retractable belts)

Some models have a rear center seat belt. These belts do not have a retractor. In addition to checking the webbing and anchorages, the adjustable slide locking of the belt must be checked.

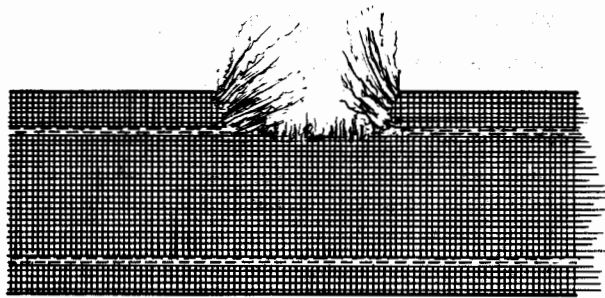
- fasten tongue to buckle and adjust by pulling webbing end at right angle to connector and buckle
- release webbing and pull upward on connector and buckle
- If slide lock does not hold, remove and replace seat belt assembly

### Center seat position (retractable belts)

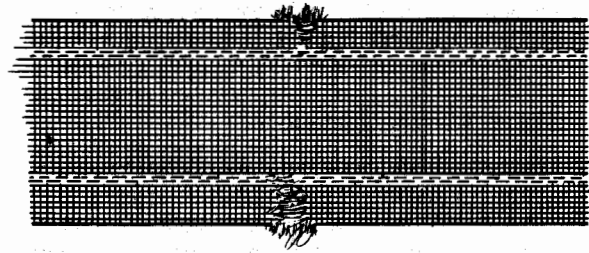
same as for rear seat retractor inspection

# 68 Seat Belt System

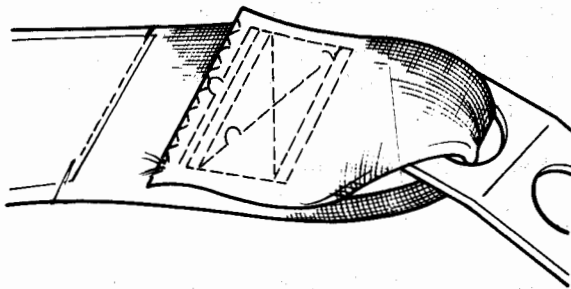
## Examples of webbing defects



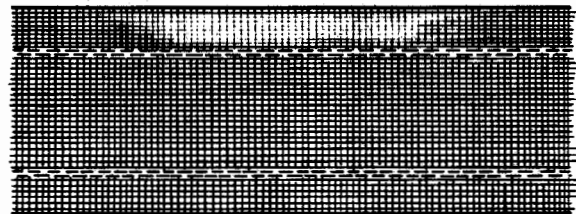
Cut or damaged webbing



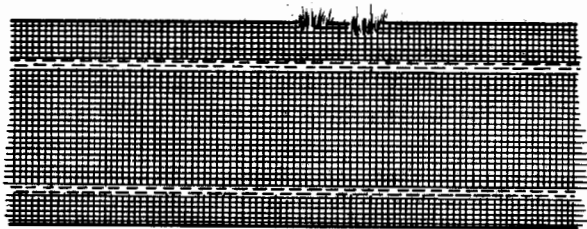
Cut loops at belt edge  
(damage from being caught in door)



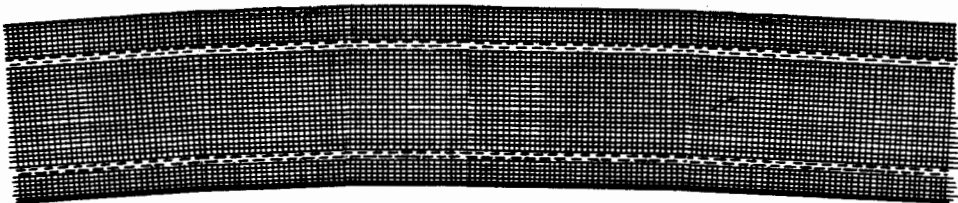
Broken or pulled threads



Color fading



Cut loops at belt edge



Bowed webbing

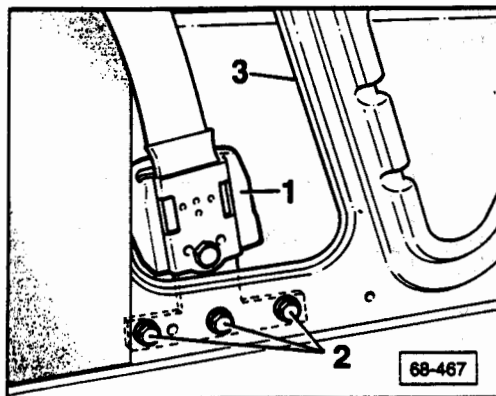


## Automatic rear 3-point seat belts, Retrofit Installation

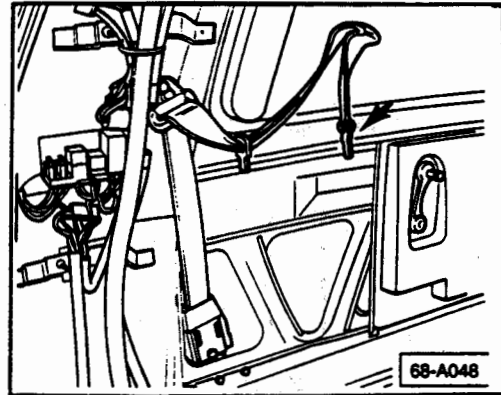
### CAUTION

Always consult with the Parts Department for Part numbers.

- remove rear cushion and floor carpet
- remove rear seat bottom assembly
- remove rear seat back
- remove D-pillar trim
- remove left rear luggage area trim panel
- remove existing 2-point left/right side lap belt
- using template for luggage area trim panel, mark and cut hole in panel as shown
- using template for D-panel, mark and cut side of D-pillar for belt guide

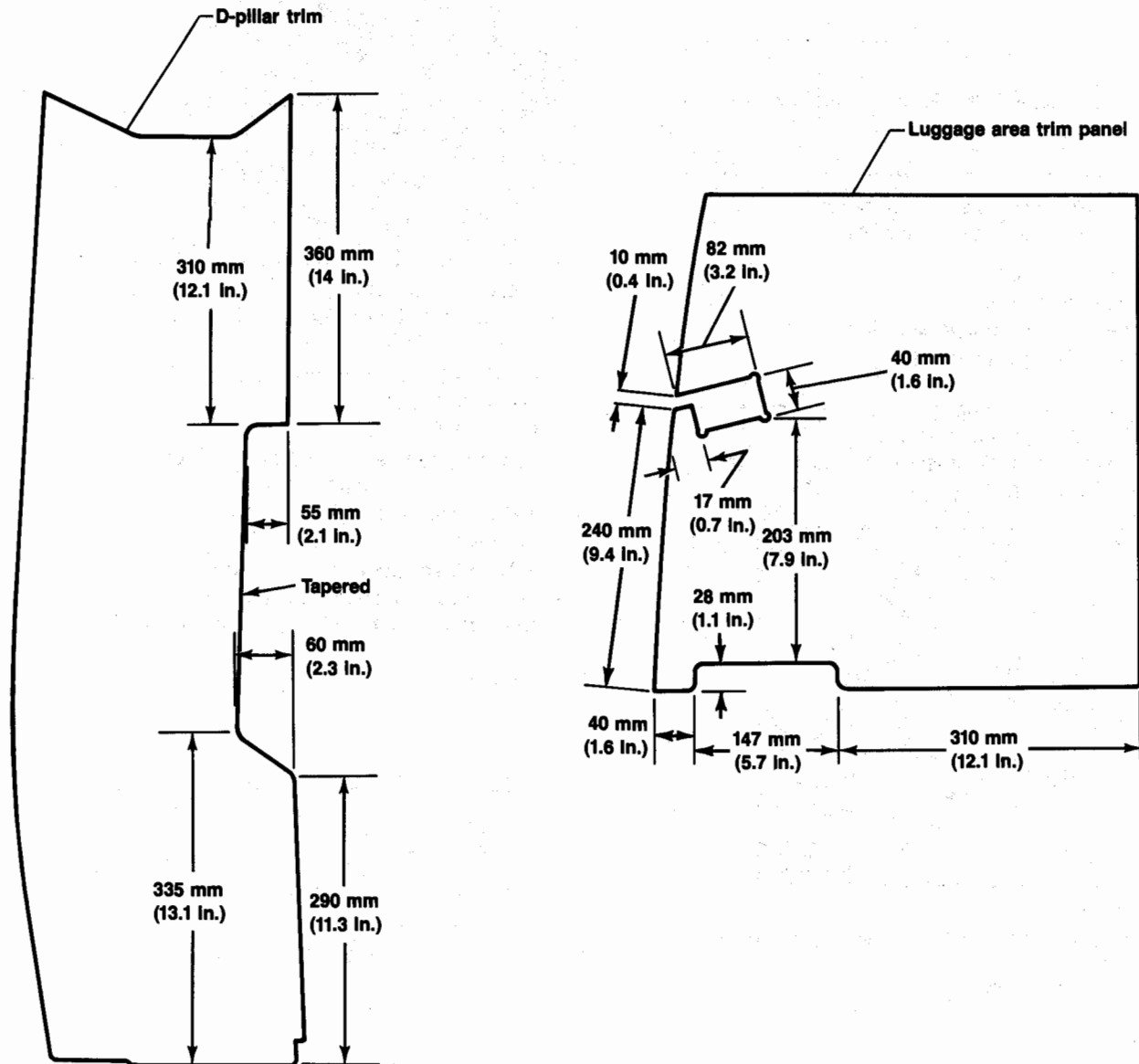


- using bolts 2, mount retractor assembly 1 to side panel 3
  - 40 Nm (30 ft lb)



- install belt through cut hole in trim panel
- mount upper belt guide onto D-pillar
  - 40 Nm (30 ft lb)
- install belt anchor (arrow) to original lap belt anchor point
  - 40 Nm (30 ft lb)
- repeat procedure for right side belt assembly, noting to reverse template dimensions accordingly
- reinstall rear seat back and seat bottom assemblies
- replace both outer seat belt buckles
- reinstall rear cushion and floor carpet
- check rear 3-point belts for proper function

# 68 Body Accessories – Interior



## Automatic rear 3-point seat belts, retrofit installation

### CAUTION

Part numbers are for reference only. Always check with your Parts Department for latest information.

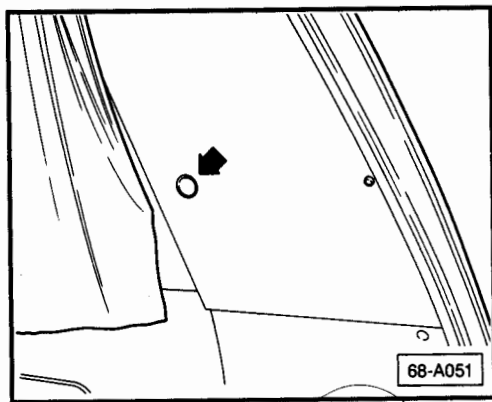
### Parts required

Part Number	Description	Quantity
253 857 815D	Rear 3-point seat belt (left side)	1
253 857 816D	Rear 3-point seat belt (right side)	1

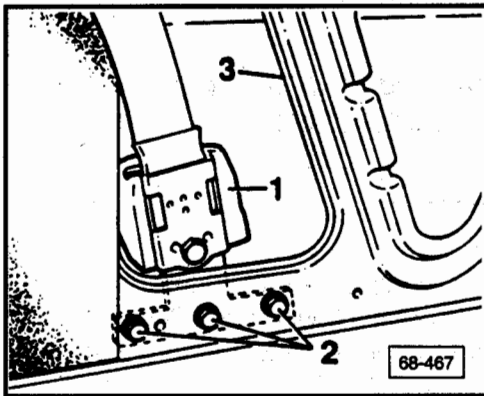
### Note

Check with your Parts Department for additional installation parts. Not all parts listed may be applicable to all vehicles.

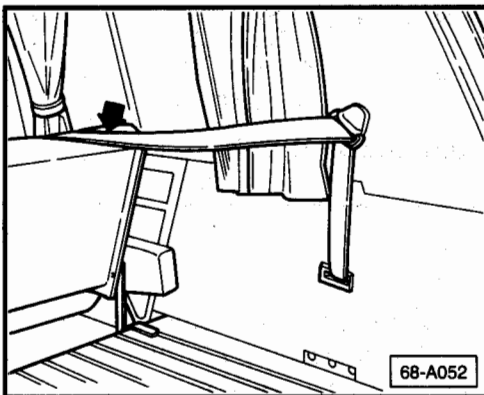
- remove rear seat bottom
- remove existing 2-point left/right side lap belt
- remove rear floor carpet
- remove right rear luggage area trim panel
- mark and cut rear luggage area trim panel using dimensions as shown on page 68 . 9
- locate, by feel, threaded hole under D-pillar trim (**arrow**)
- cut hole in trim to expose threaded bolt hole



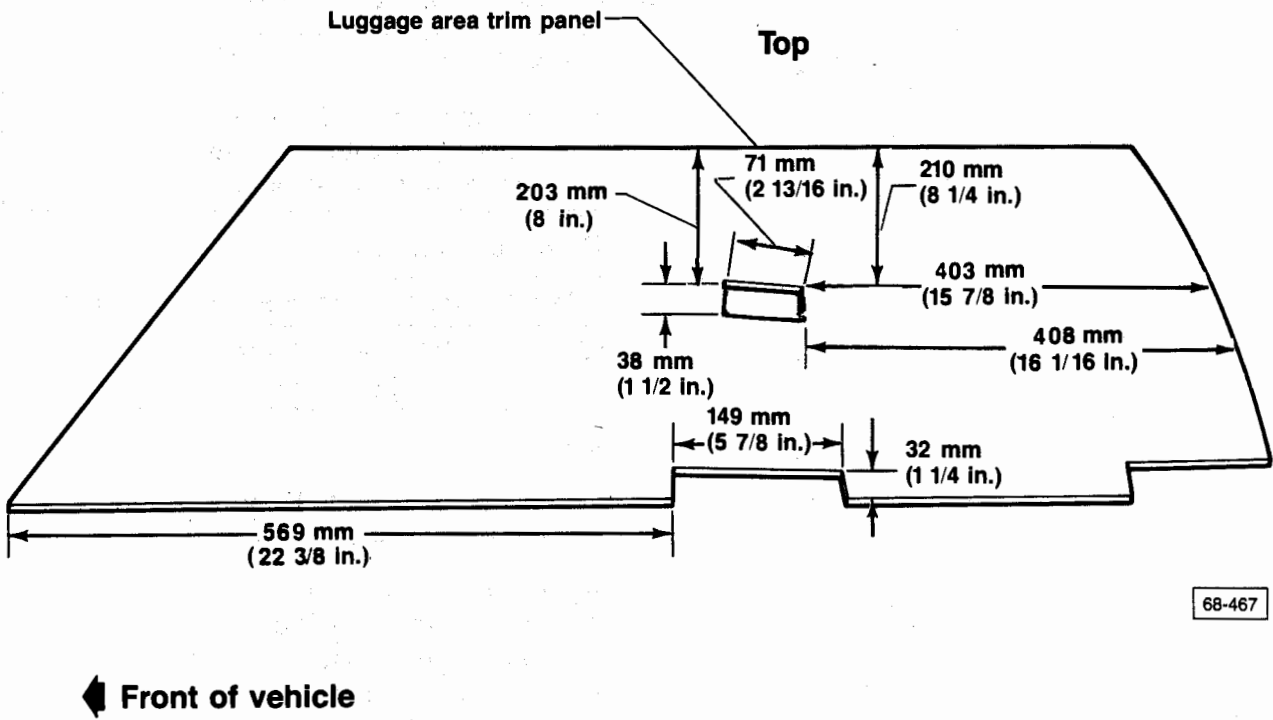
# 68 Body Accessories—Interior



- using bolts 2, mount retractor assembly 1, to side panel 3
  - 40 Nm (30 ft lb)
- install belt through cut hole in trim panel
- mount upper belt guide onto D-pillar
  - 40 Nm (30 ft lb)



- install belt anchor (**arrow**) to original lap belt anchor point
  - 40 Nm (30 ft lb)
- reinstall right rear luggage area trim panel
- repeat procedure for left side belt assembly, noting to reverse dimensions accordingly
- reinstall all other components in reverse order
- check rear 3-point belts for proper function



Camper/Multivan (right side only) – From 1980  
Vanagon 1980-1985, From 1986 w/o A/C

Automatic rear 3-point seat belts,  
retrofit installation

## 68.9

## Automatic 3-point left center seat belt, retrofit installation

### CAUTION

Part numbers are for reference only. Always check with your Parts Department for latest information.

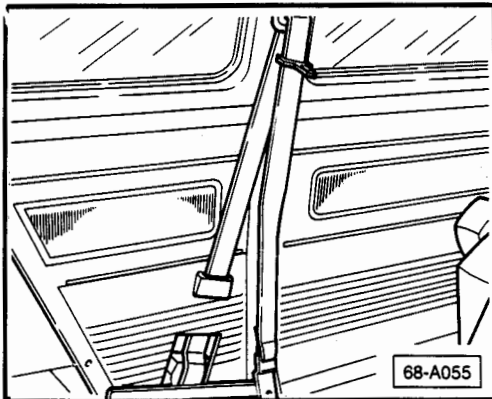
### Parts required

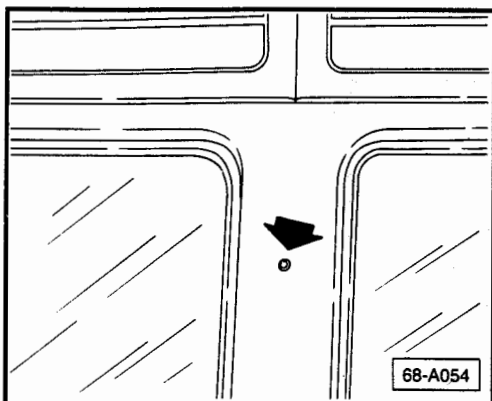
Part Number	Description	Quantity
253 857 811D	3-point seat belt (left side)	1

### Note

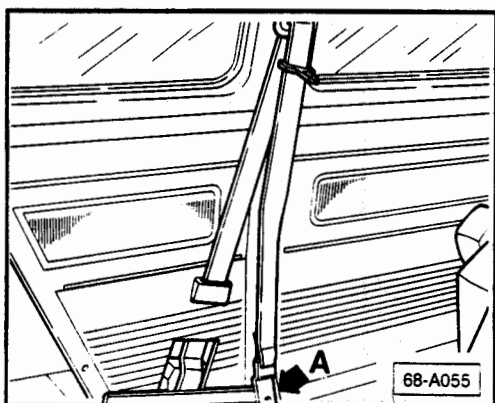
Check with your Parts Department for additional installation parts.

- remove rear seat back
- remove rear seat bottom
- remove original left center belt
- remove rear left side panel trim
- measure location of belt retractor, belt guide, and mounting holes, using dimensions on page 68.12
- cut panel as required
- reinstall trim panel
  
- install seat belt retractor on outside of panel, as shown
  - 40 Nm (30 ft lb)
  - hand tighten forward bolt only





- locate, by feel, threaded hole in C-pillar (**arrow**) for belt guide D-ring
- cut C-pillar trim from threaded hole, install belt guide D-ring
  - 40 Nm (30 ft lb)



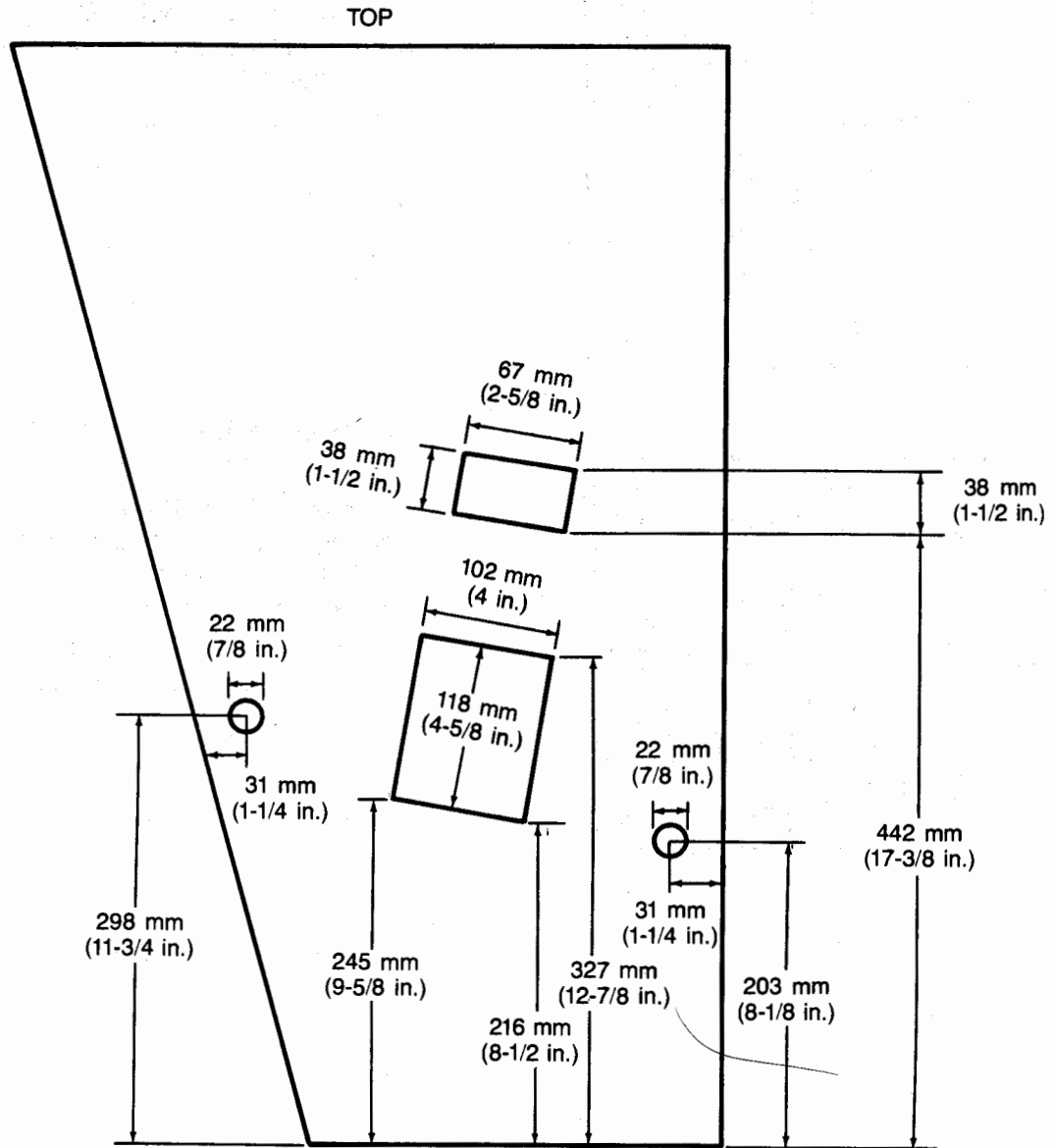
- install anchor of 3-point belt into forward mounting hole of retractor bracket (**arrow A**)
  - 40 Nm (30 ft lb)
- align bracket for belts, reinstall rear seat bottom and belts
- reinstall rear seatback
- install new buckle for 3-point belt
- check seat belt for proper function

All w/center seat (except Camper/Multivan)  
From 1980 m.y.

Automatic 3-point left center seat belts,  
retrofit installation

## 68.11

# 68 Body Accessories—Interior

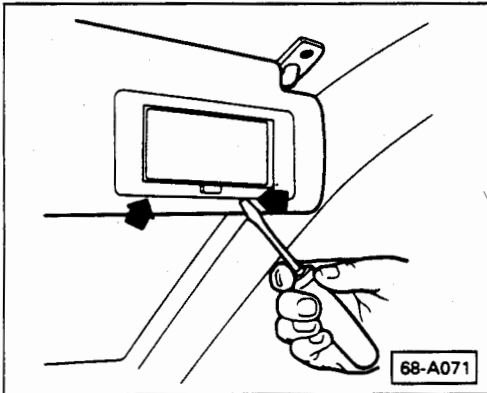


**68.12** Automatic 3-point left center seat belt, retrofit installation

All w/center seat (except Camper/Multivan)  
From 1980 m.y.



## Illuminated vanity mirrors, replacing bulbs



- locate clips under lower edge of vanity mirror assembly (**arrows**)
- carefully pry mirror assembly out of sunvisor with small flat bladed screwdriver (as shown)
- replace bulbs

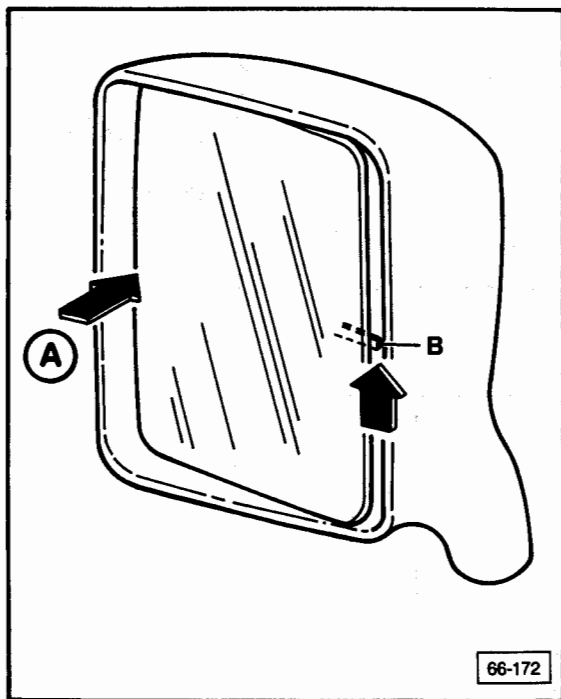
**Body  
Accessories  
Exterior**

**Index**

- |   |  |  |
|---|--|--|
| <ul style="list-style-type: none"><li>- Body side moldings<br/>assembly 66.5<br/>bracket locations 66.6,<br/>66.7<br/>removing/installing 66.7</li><li>- Mirror glass<br/>increasing mirror glass<br/>adjustment range 66.3<br/>removing/installing 66.2</li><li>- Outside mirrors, electric<br/>assembly 66.4<br/>removing/installing 66.4</li></ul> |  |  |
|---|--|--|

# 66 Body Accessories—Exterior

## Mirror glass, removing



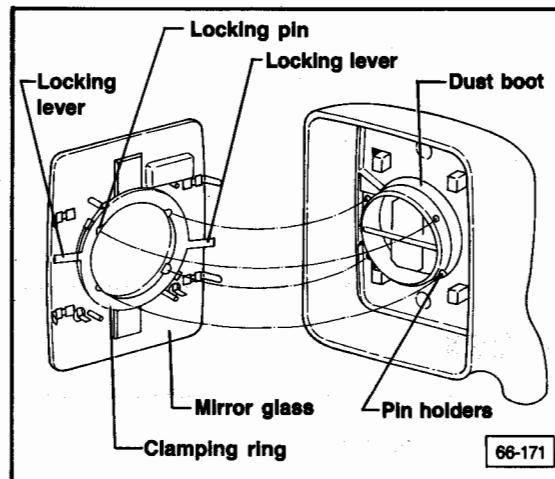
### CAUTION

Wear protective gloves to prevent injury if glass breaks.

Hold glass to prevent falling out.

- push mirror glass at outer edge **A** until locking lever **B** is accessible
- push locking lever **B** (arrow) counterclockwise to unlatch mirror assembly
- tilt and remove mirror glass
- disconnect electric heater element

## Mirror glass, installing



Installation is in reverse order:

- ensure dust boot is properly seated
- locking pins must be engaged in pin holder
- check mirror for proper function

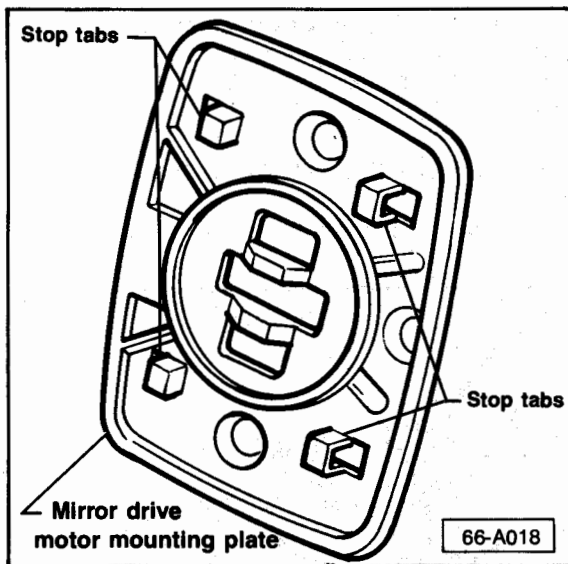
## Increasing mirror glass adjustment range

The mirror glass adjustment range for electric outside mirrors can be increased by shortening the four stop tabs on the mirror drive motor mounting plate.

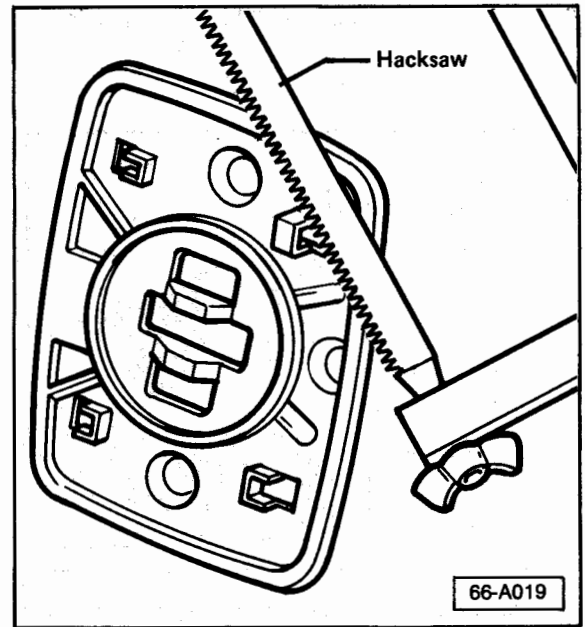
### Note

See page 66.2 for mirror glass removal/installation work procedure.

## Mirror drive plate stop tabs, removing



- disconnect battery ground strap
- remove mirror glass
- remove mirror drive motor
- unscrew and remove mirror drive motor mounting plate

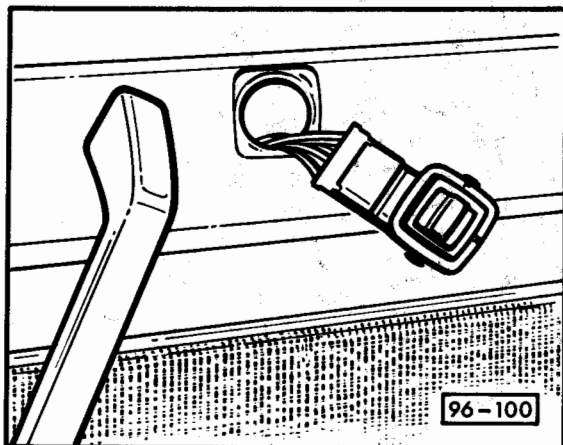


- using hacksaw, cut 3-4mm (7/64-11/64 in.) from all four stop tabs
- install all mirror components in reverse order
- reconnect battery ground strap
- check mirror for proper functioning

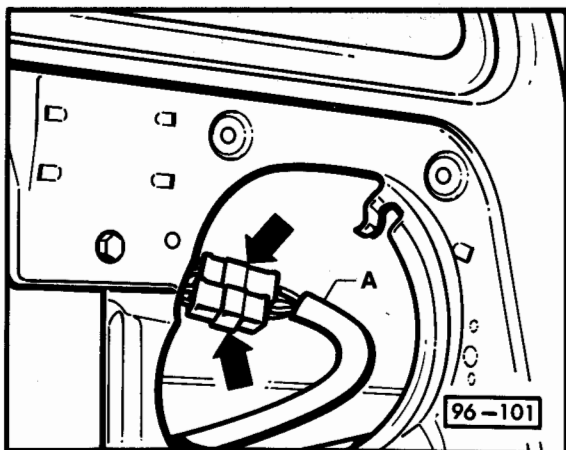
# 66 Body Accessories – Exterior

## Electric mirror assembly, removing

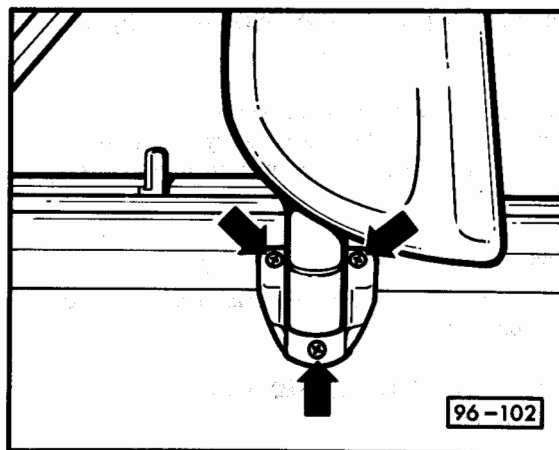
- disconnect battery ground strap



- pry out disconnect electric mirror switch from door trim panel
- remove door trim panel
- carefully pull back plastic moisture barrier



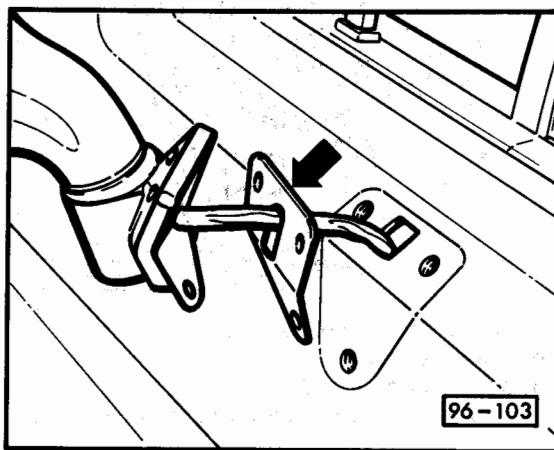
- cut tie wraps holding wire harness to door
- cut open cable sleeve A to expose individual wires
- label and remove mirror wires from plug connector



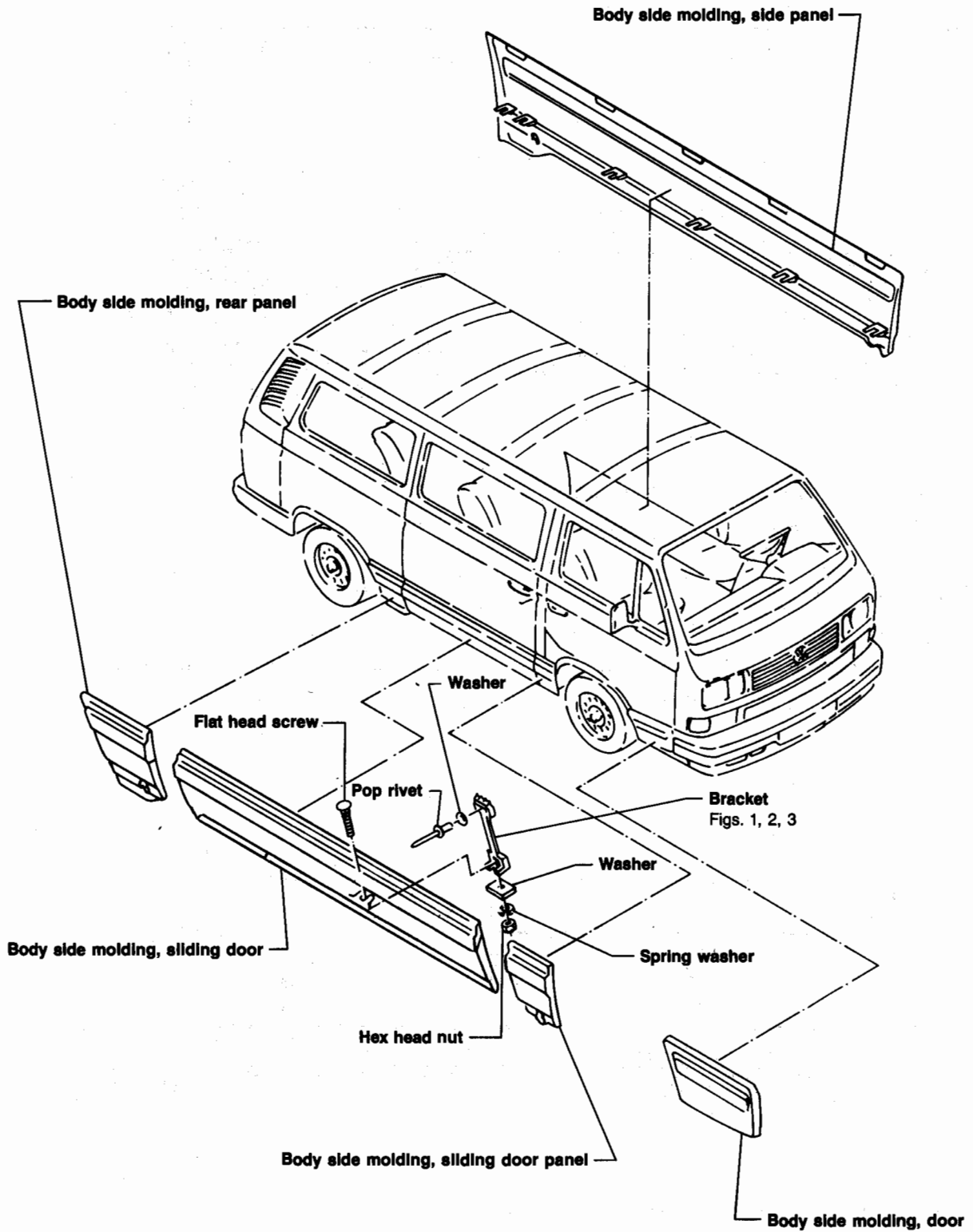
- pry off plastic cap at base of mirror bracket and remove three screws (arrows)
- remove mirror assembly together with wire harness

## Electric mirror assembly, installing

- reinstall all components in reverse order, noting:

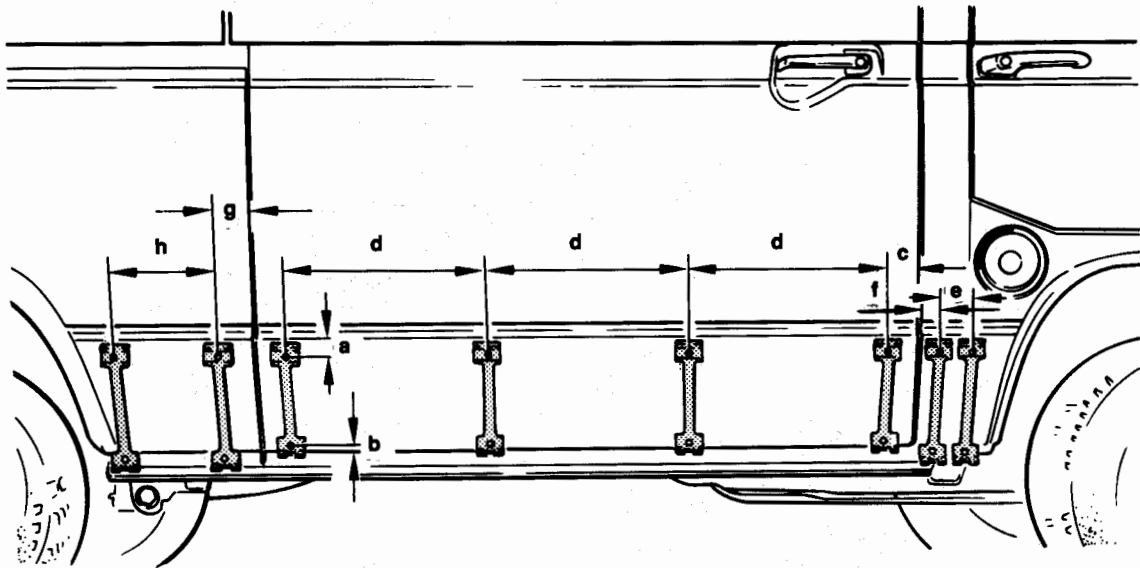


- position seal (arrow) to proper fit
- secure wire harness to door frame with tie wraps
- check mirror for proper function



66-226

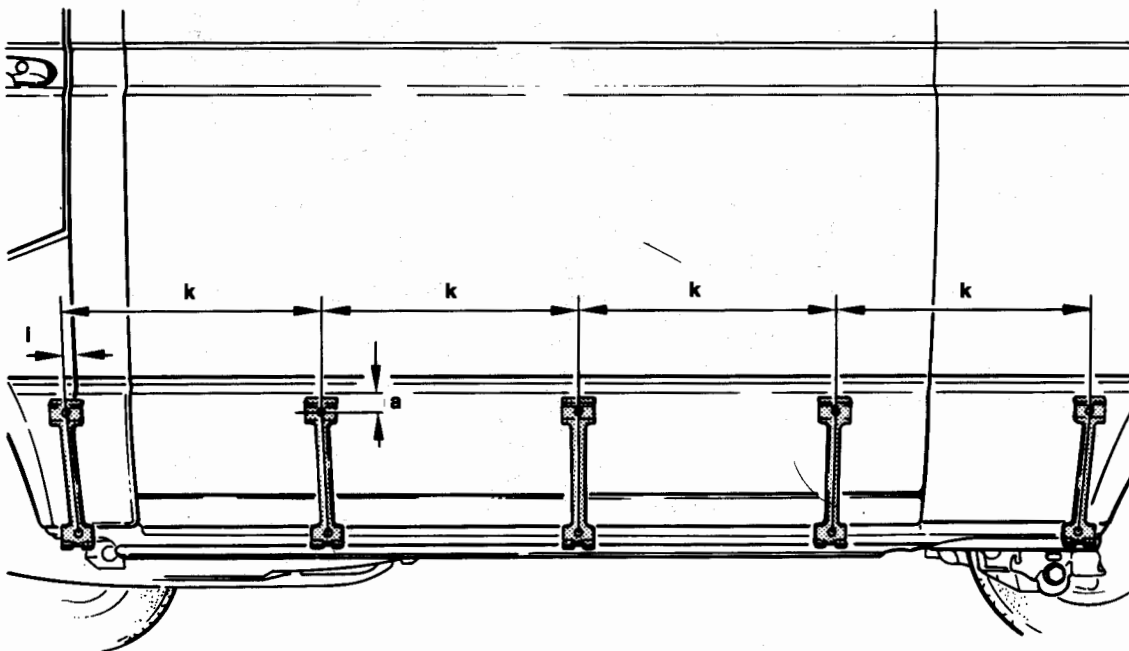
# 66 Body Accessories – Exterior



66-228

**Fig. 1 Body side molding bracket locations, sliding door**

- |                       |                       |
|-----------------------|-----------------------|
| a — 30 mm (1.2 in.)   | e — 60 mm (2.3 in.)   |
| b — 15 mm (19/32 in.) | f — 33 mm (1.3 in.)   |
| c — 53 mm (2.1 in.)   | g — 65 mm (2 1/2 in.) |
| d — 365 mm (13.2 in.) | h — 180 mm (7.0 in.)  |



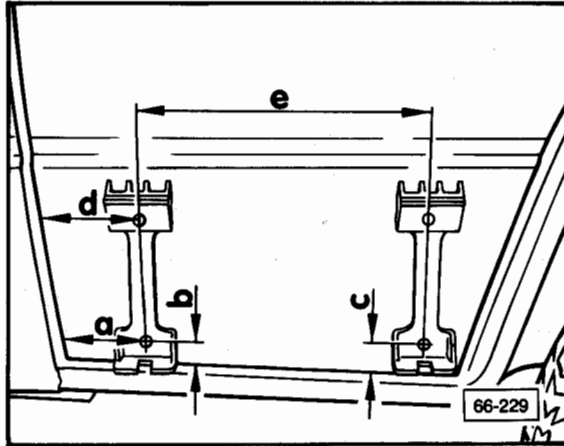
66-228a

**Fig. 2 Body side molding bracket locations, side panel**

- |                       |
|-----------------------|
| a — 30 mm (1.2 in.)   |
| i — 10 mm (25/64 in.) |
| k — 390 mm (15.2 in.) |

**CAUTION**

De-burr, touch-up and apply anti-corrosion primer to bored holes in body as required.



**Fig. 3 Body side molding bracket locations, front doors**

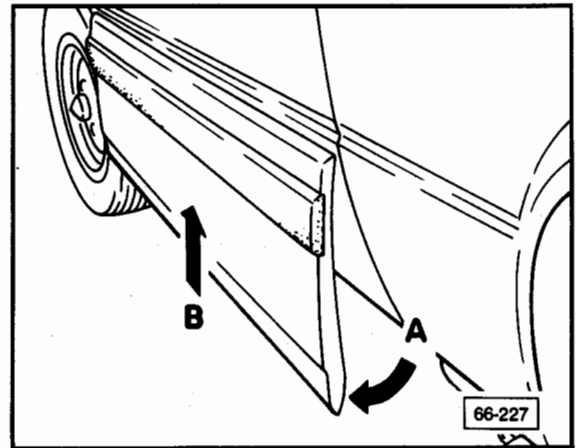
- a — 70 mm (2.7 in.)
- b — 25 mm (63/64 in.)
- c — 35 mm (1.4 in.)
- d — 80 mm (3.1 in.)
- e — 226 mm (8.8 in.)

**CAUTION**

De-burr, touch-up and apply anti-corrosion to bored holes as required.

## Body side moldings, removing

— loosen hex head nuts



- swing molding outward (**arrow A**)
- remove molding from top (**arrow B**)

## Body side moldings, installing

Reinstall all components in reverse order of removal.



# Glass, Window Regulators

## Index

—Sliding window  
replacing guides 64.2

**From 1986 M.Y.**

- Glueing rubber window seals
  - side window 64.4
  - sliding door window 64.5
  - rear lid window 64.5
  - windshield 64.3
- Power window motor
  - removing 64.6, 64.7
  - installing 64.7

# 64 Glass, Window Regulators

## Sliding window guides, replacing

### Note

If the nylon sliding window guides are loose in the window track channel, guide pieces, Part No. 281 847 723, can be installed as follows:

### Work sequence

- remove sliding window interior latch
- remove outer window channel weatherstrip/seal
- lift sliding window up and remove loose guide piece
- lightly sand surfaces of guide piece and window channel to be glued
- clean out window channel with cleaning solvent



- glue replacement guide piece using 3M® brand structural adhesive or equivalent two-part epoxy
- reinstall window channel weatherstrip/seal
- reinstall interior latch

### Note

Mechanically fastened guides were introduced during 4/85 production. These new guides cannot be retrofitted on earlier models.

### CAUTION

Part numbers are for reference only. Always consult your Parts Department for latest information

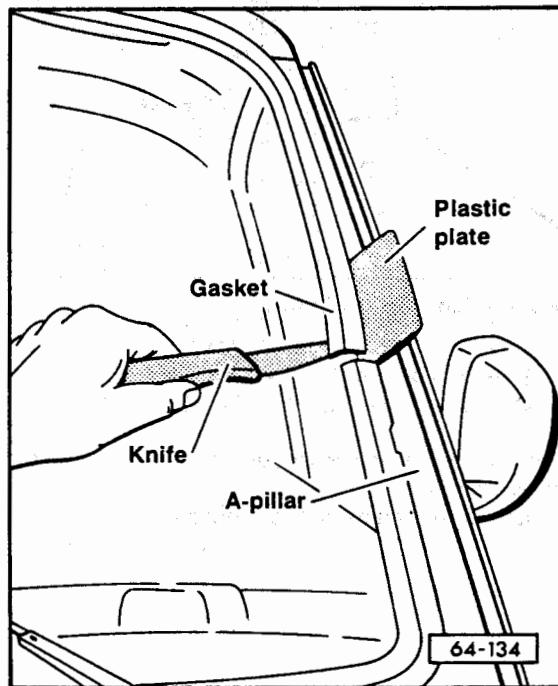
With start of production M.Y. 1986, the rubber seals for the windshield, side windows and rear lid are glued into place.

**Note**

To insure a satisfactory seal, use adhesive AMV 172 003 05 or equivalent specifically made for EPDM rubber.

**Windshield seal, removing**

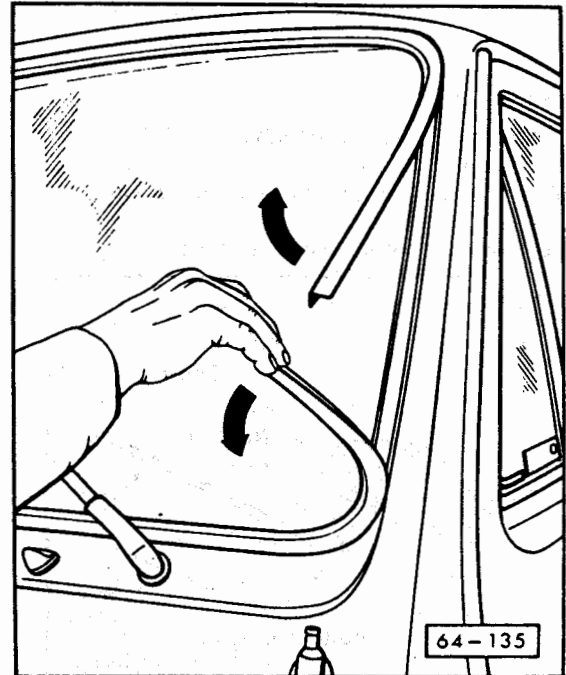
**Work procedure**



- carefully remove trim strip, if applicable, from rubber gasket
- cut through seal at area of A-pillar (as shown)

**CAUTION**

Prevent paint damage by placing piece of flat plastic (as shown) between seal and body.



- pull seal from flange and window glass
- from outside place suction cups on glass and remove windshield
- with plastic wedge remove rest of rubber seal and remaining adhesive to height of 1-2 mm (3/64-5/64 in)

**Note**

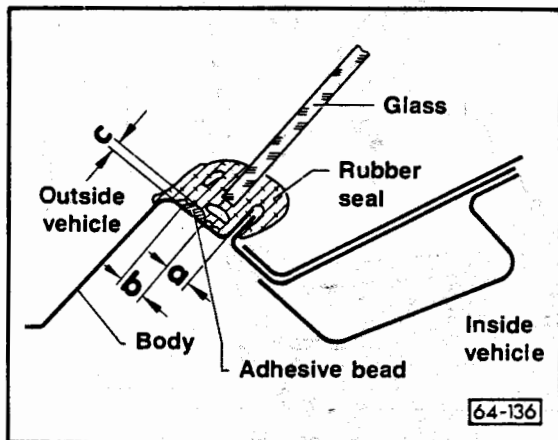
If paint has been damaged, repair before installing new rubber seal.

# 64 Glass, Window Regulators

## Installing

### Work procedure

- reinstall trim strip, if applicable
- install seal on glass
- place plastic cord for installing window into seal lip
- clean sealing area around window opening

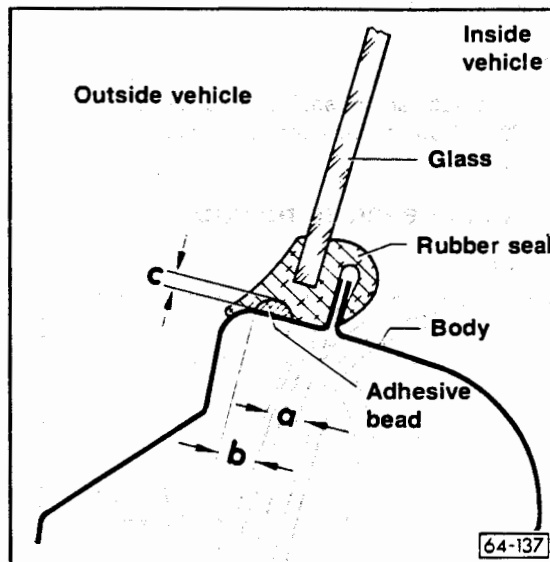


Cross section - Windshield

- A = 7 - 2 mm (9/32 - 5/64 in)
- B = 7 - 2 mm (9/32 - 5/64 in)
- C = 3 + 1 mm (1/8 + 3/64 in)

- place bead of adhesive as shown
- reinstall windshield, checking for proper fit

## Side window seal, removing/installing

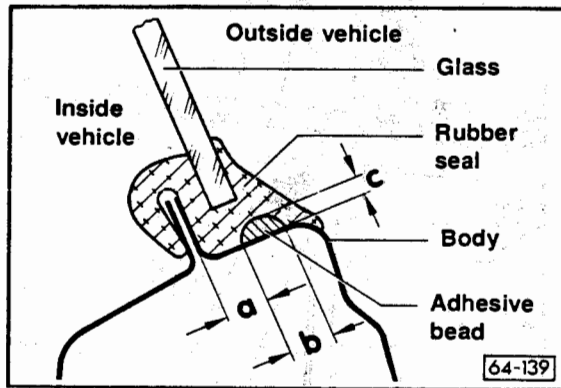


Cross section - Side window

- A = 7 - 2 mm (9/32 - 5/64 in)
- B = 7 - 2 mm (9/32 - 5/64 in)
- C = 3 + 1 mm (1/8 + 3/64 in)

- removal/installation procedure is identical to that of windshield
  - note proper placement of adhesive bead

## Rear lid window seal, removing/installing



Cross section - Rear lid window

A = 7 - 2 mm (9/32 - 5/64 in)

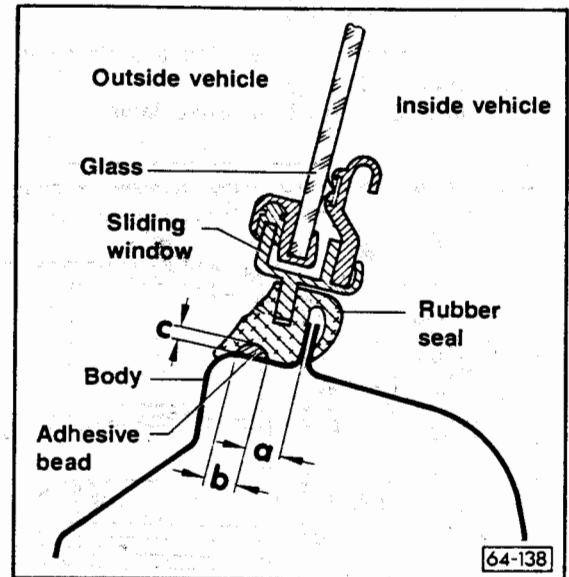
B = 7 - 2 mm (9/32 - 5/64 in)

C = 3 + 1 mm (1/8 + 3/64 in)

— removal/installation procedure is identical to that of windshield seal

- note proper placement of adhesive bead

## Sliding door window seal, removing/installing



Cross section - Sliding door window

A = 7 - 2 mm (9/32 - 5/64 in)

B = 7 - 2 mm (9/32 - 5/64 in)

C = 3 + 3 mm (1/8 + 1/8 in)

— removal/installation procedure is identical to that of windshield

- note proper placement of adhesive bead

### Note

The dimension of adhesive bead ensures no adhesive will get into interior of vehicle. Any excess adhesive must be cleaned off **immediately** with suitable solvent such as 3M<sup>®</sup> General Purpose Adhesive Cleaner or equivalent.

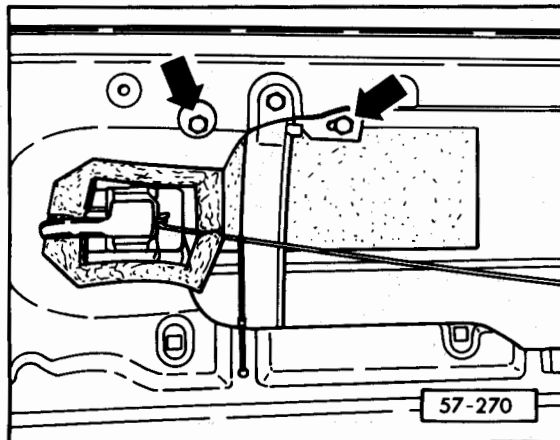
### Adhesive material hardening times

After repairs, vehicle should not be exposed to temperatures below 0°C (32°F) for 12 hours before being driven.

# 64 Glass, Window Regulators

## Power window motor, removing

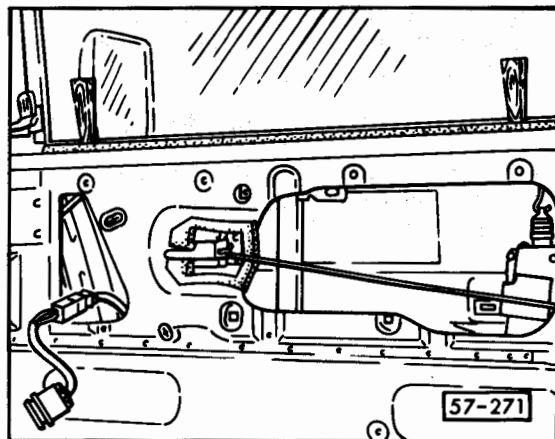
- fully raise door window glass
- disconnect battery ground strap
- remove door trim panel
- disconnect electrical connectors and press out window operating switch
- carefully pull off plastic moisture barrier



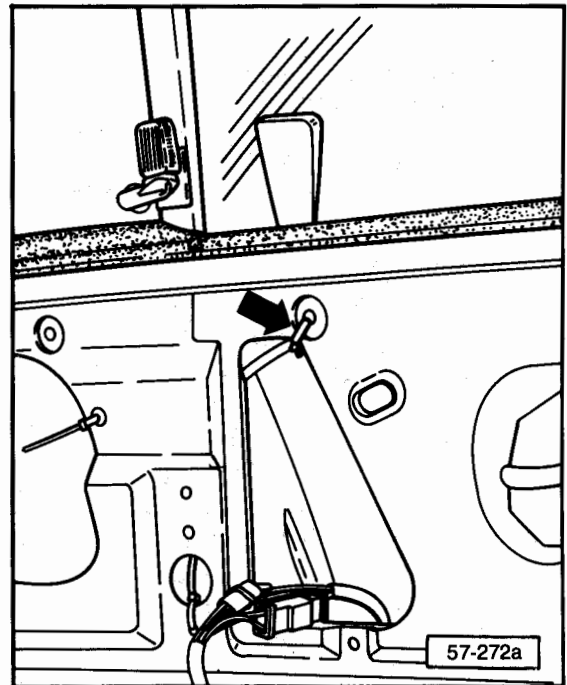
- reconnect window operating switch
- temporarily reconnect battery ground strap
- lower glass sufficiently to remove two hex head bolts (arrows) from regulator

### CAUTION

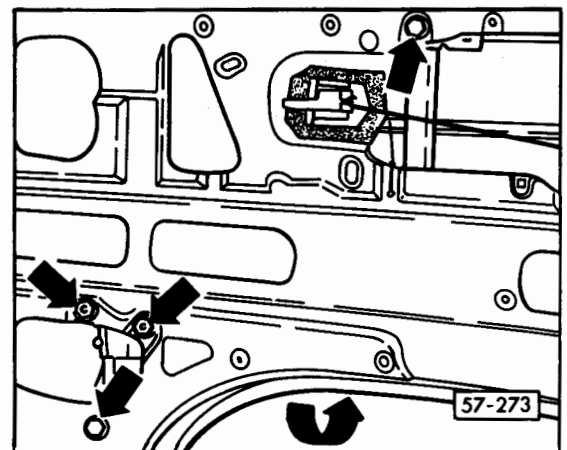
Always use care and wear protective gloves for safety to prevent injury if glass breaks.



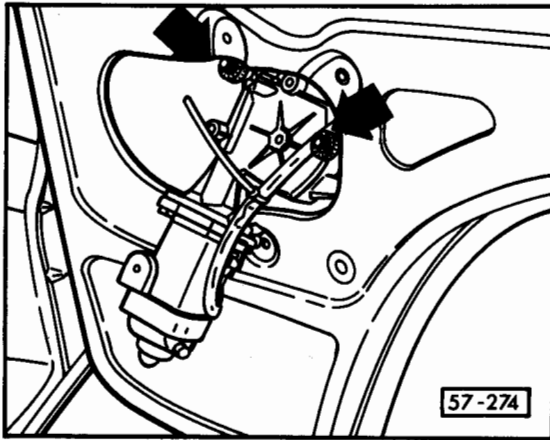
- fully push up glass and secure with wooden wedges (as shown)



- disconnect battery ground strap
- cut off tie-wrap for cable guide (arrow)
- disconnect window operating switch



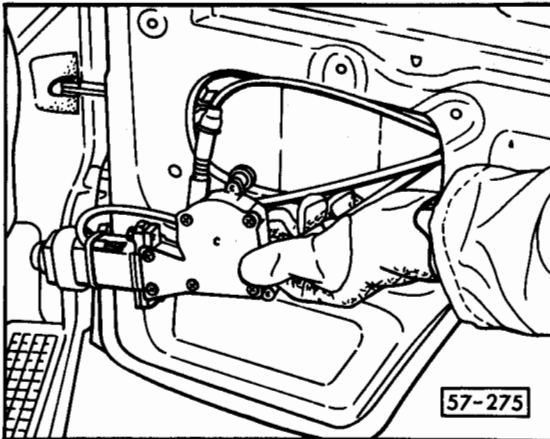
- remove window regulator fasteners (arrows)
- push window guide rail toward outside of door with one hand



- while holding window guide, proceed to withdraw electric motor (as shown)
  - this position will allow threaded bolts to clear door assembly (**arrows**)

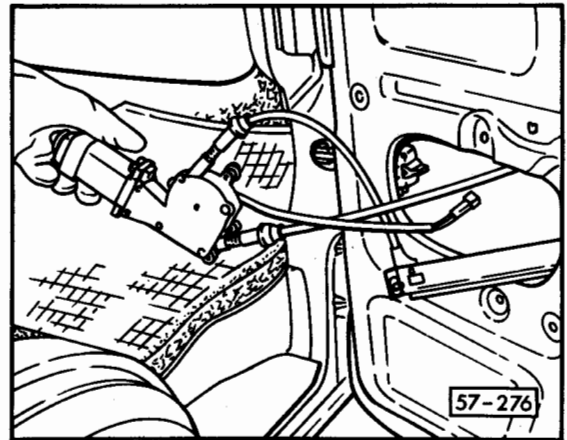
### CAUTION

Do not apply excessive force. Plastic cable guides may break.

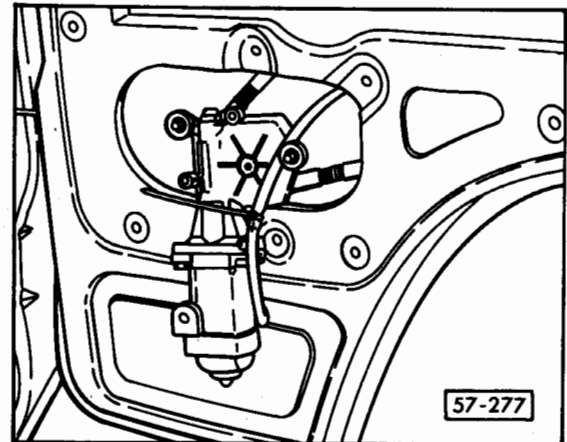


- turning electric motor 180° (as shown) remove window regulator through assembly hole in door shell
  - electric motor and cables are **one** unit

### Power window motor, installing



- guide window motor assembly into door shell (as shown)



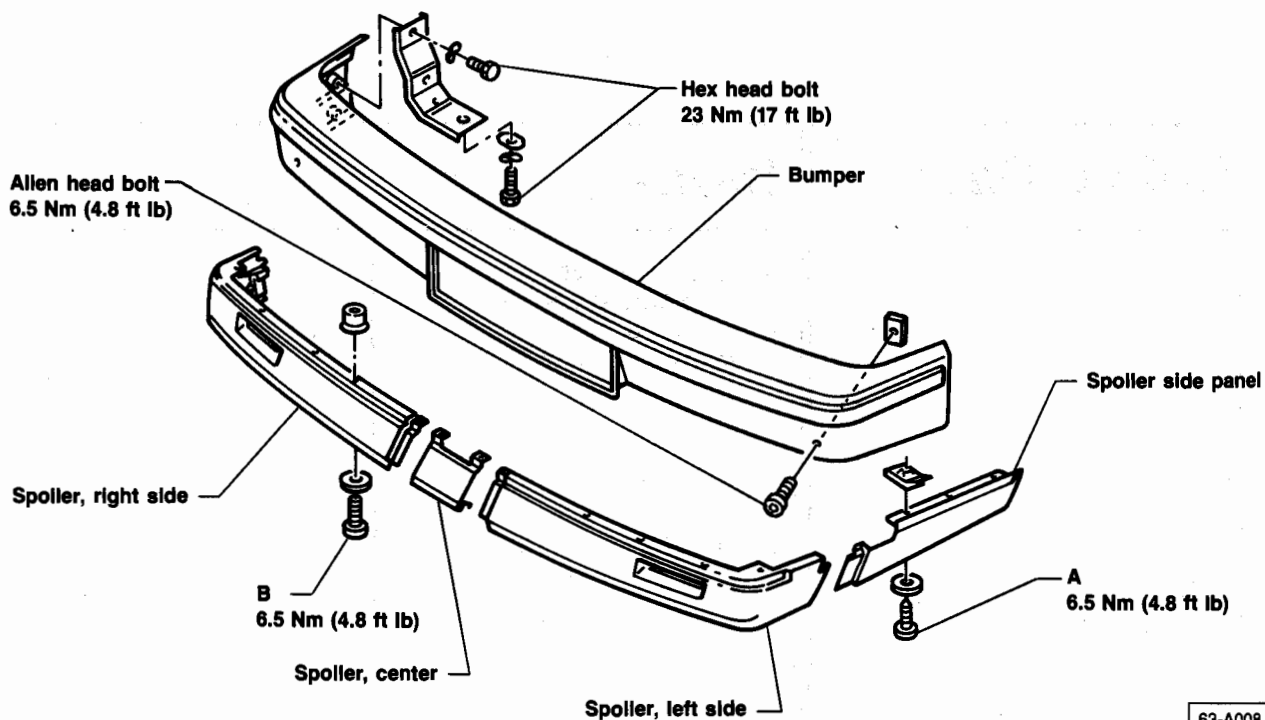
- turn and place electric motor into position (as shown)
- remount electric motor, guide rail and window glass
- push window operating switch into position
- replace tie-wrap for cable guide
- temporarily reconnect battery ground strap and window operating switch
- check window for proper functioning
- disconnect battery ground strap and window operating switch
- starting at top, carefully reinstall plastic moisture barrier, noting
  - replace if damaged
  - ensure adhesive areas are clean
  - ensure installed wrinkle free
- reinstall all electrical connectors and window operating switch
- reinstall door trim panel
- reconnect battery ground strap
- check window for proper functioning

Bumpers

Quick Data	Index	
	<ul style="list-style-type: none"><li>- Front bumper/spoiler removing/installing 63.2</li><li>- Rear bumper removing/installing 63.3</li></ul>	



# 63 Bumpers

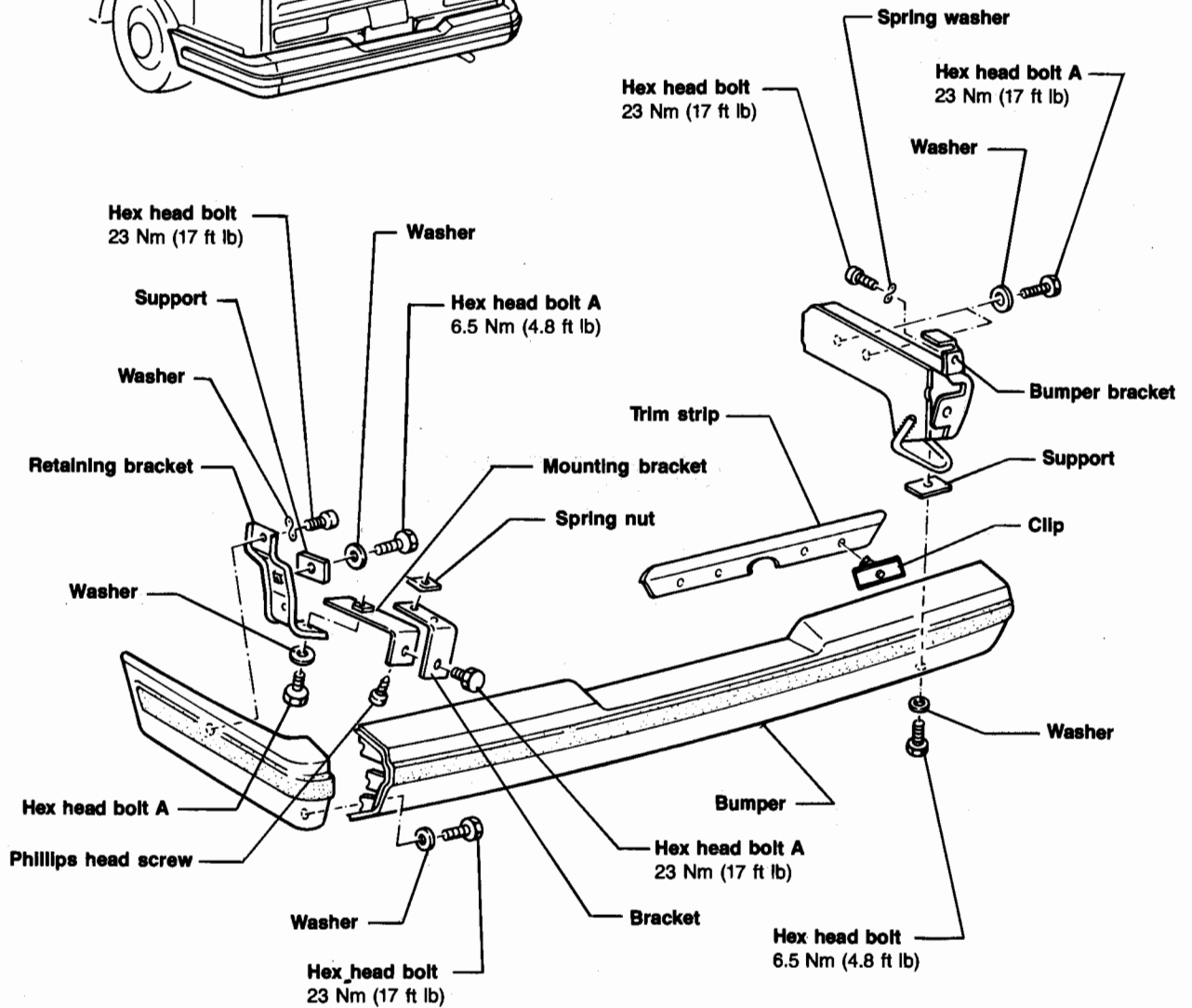
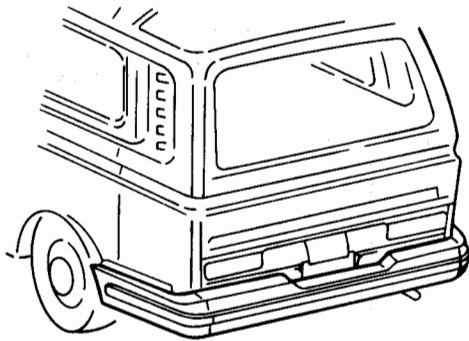


## Front bumper/spoiler, removing

- remove screws **A** from spoiler side panels
- remove right and left spoiler side panels
- remove screws **B** from right, and left spoiler sections
- remove right, left and center spoiler sections
- remove hex head and allen head bolts
- remove bumper by pulling straight from body

## Front bumper/spoiler, installing

- install all components in reverse order of removal



## Rear bumper, removing

- remove hex head bolts A with washers from both sides
- remove bumper by pulling straight from body

## Rear bumper, installing

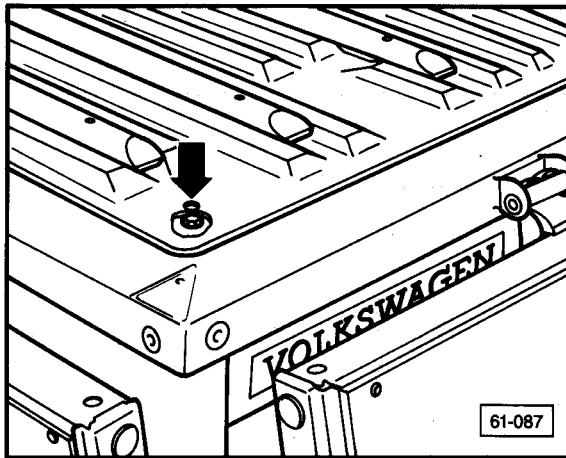
- Reinstall all components in reverse order of removal, noting the following:
- place bumper first into position, tighten bolts slightly
  - align bumper, and fully secure all bolts

**Index**

- Tarpaulin 61.2, 61.3  
(Canada)

# 61 Tarpaulin

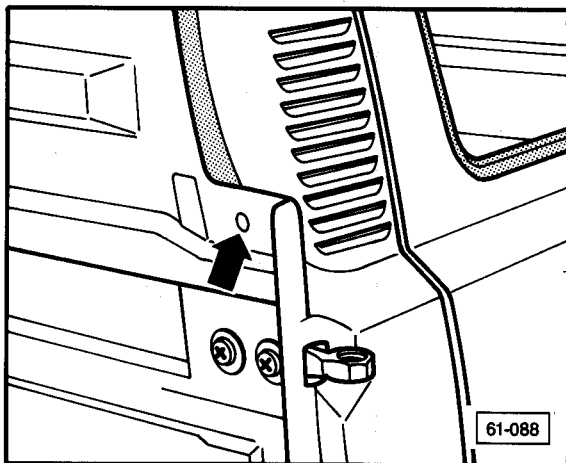
## Tarpaulin frame and tarpaulin, service installation



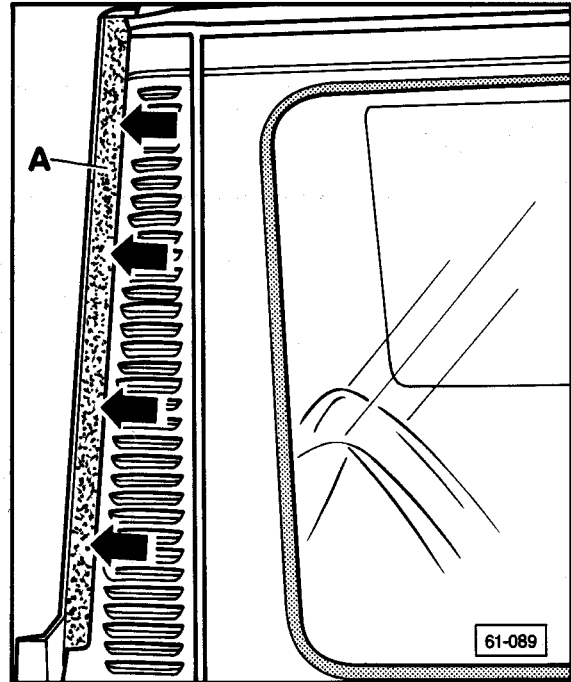
- drill two 10 mm (3/8 in.) diameter holes, one at each dimple located at rear corners of load platform (arrow)

### CAUTION

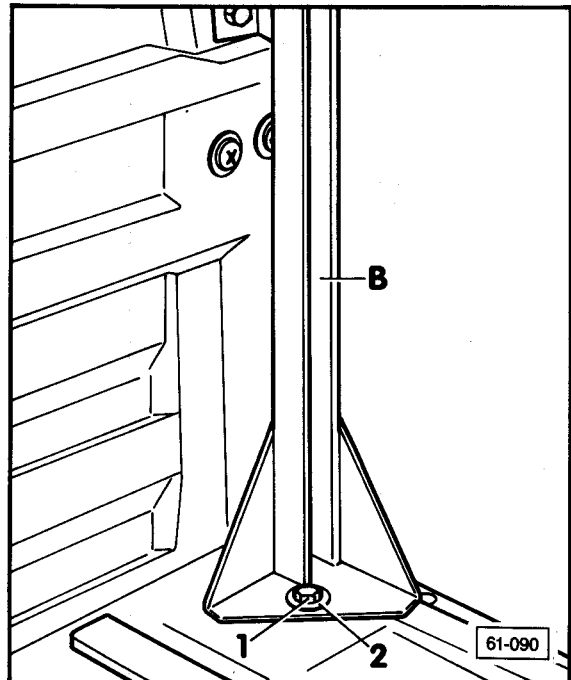
Drill carefully through floor plate and do not damage captive nuts underneath. Touch up drilled holes, apply corrosion protection as required.



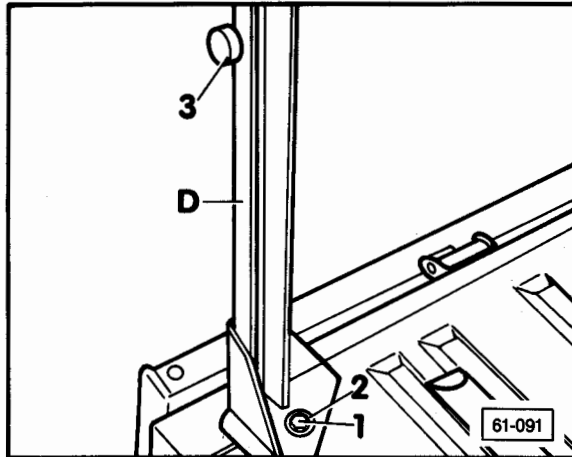
- drill 8.5 mm (21/64 in.) diameter holes at dimples in each side of cab rear panel (arrow)



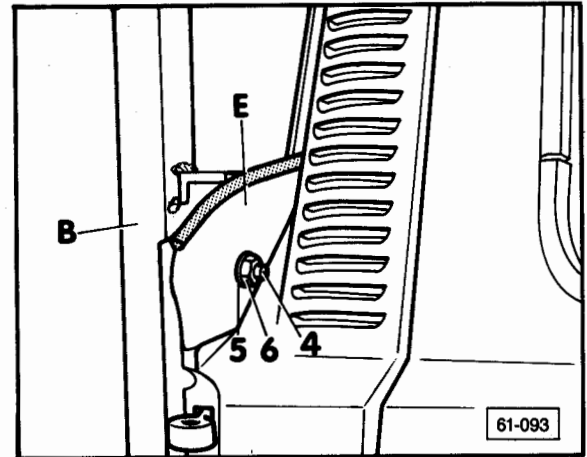
- clean rain channel (arrows) and stick sealing strip **A** in position
- remove plastic plugs from holes at each front corner of load platform



- mount rail **B** at front corner and fasten securely to floor with bolt **1** and washer **2**



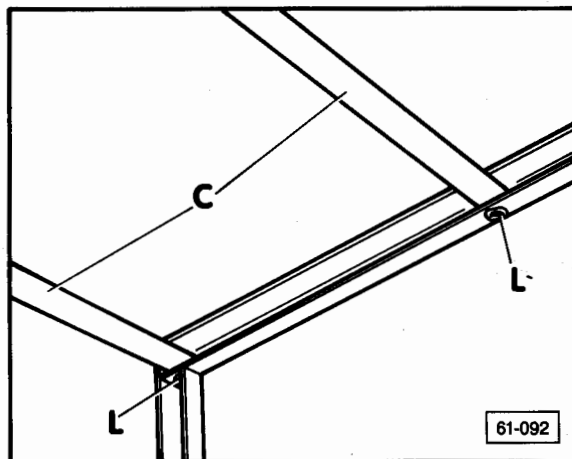
- mount rear rail to floor with bolt 1 and washer 2
- press rubber buffers 3 into both sides of rail D



- install deflector plate E in position and securely fasten to rail B and cab rear panel with bolt 4, washer 5 and nut 6
- mount and align tarpaulin on frame starting at rear

**Note**

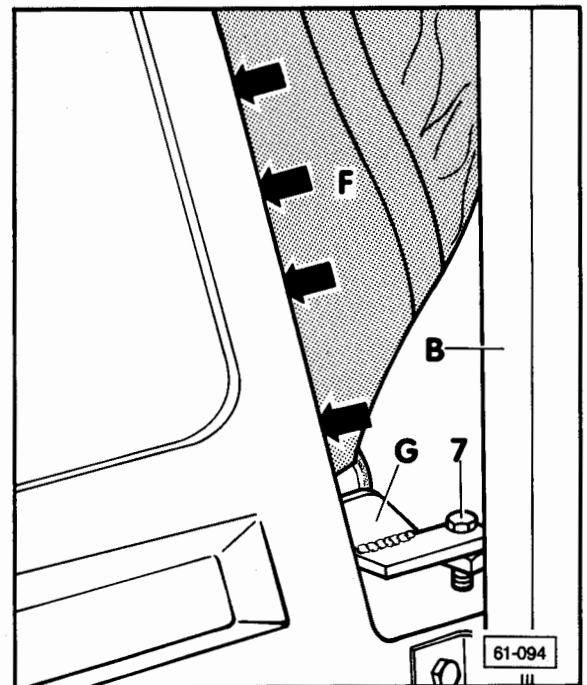
Three mechanics are required to install tarpaulin.



- mount longitudinal rails C in position and fasten to front and rear rails with countersunk screw and nut L

**Note**

Upon reassembly after dismantling frame, countersunk screws are to be installed with D6 locking compound.



- fasten tarpaulin frame G to rail B at front with bolt 7

**Note**

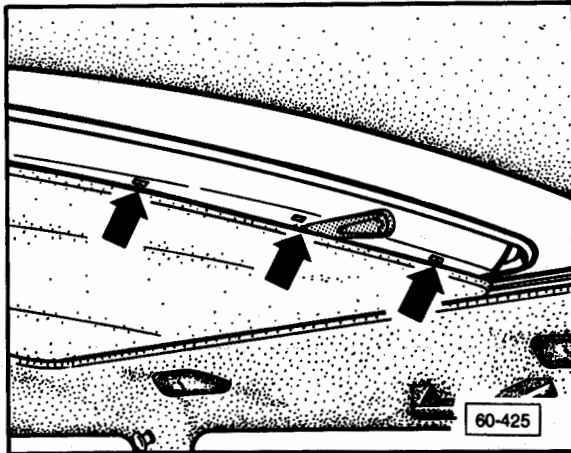
The tarpaulin frame must seal tightly in the rain channel (arrows).

Tailboard bump stops which do not line up with the tarpaulin can be removed and the holes plugged.

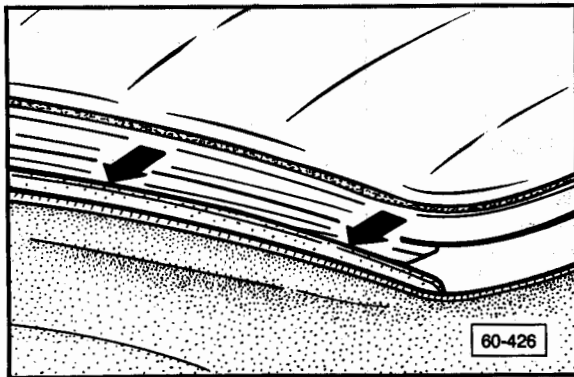
Quick Data	Index
	<ul style="list-style-type: none"><li>- Guide plate adjusting 60.4</li><li>- Height alignment, front 60.3</li><li>- Height alignment, rear 60.4</li><li>- Parallel adjustment 60.4</li><li>- Rear drain hose   replacing 60.6</li><li>- Sunroof panel   adjusting 60.3   removing/installing 60.2</li><li>- Sunroof trim panel   removing/installing 60.3</li><li>- Sunroof water drains   cleaning 60.6</li></ul>

# 60 Sunroof

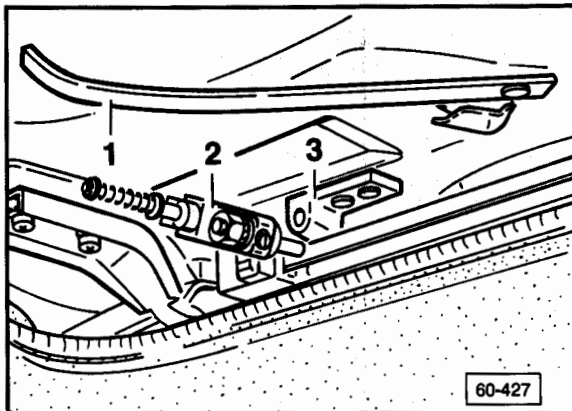
## Sunroof panel, removing



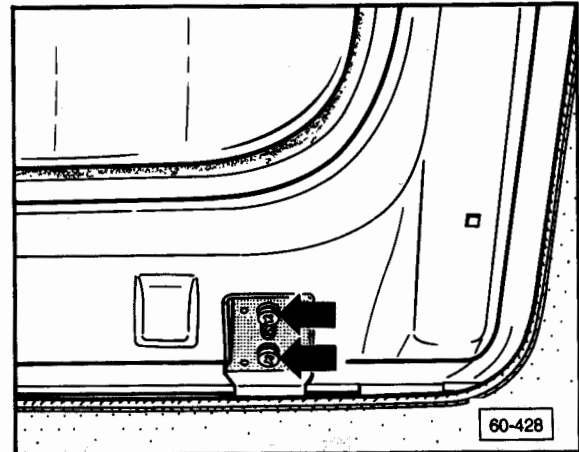
- open sunroof panel slightly
- snap out 5 trim-panel clips (arrows) at front edge of sunroof with plastic wedge



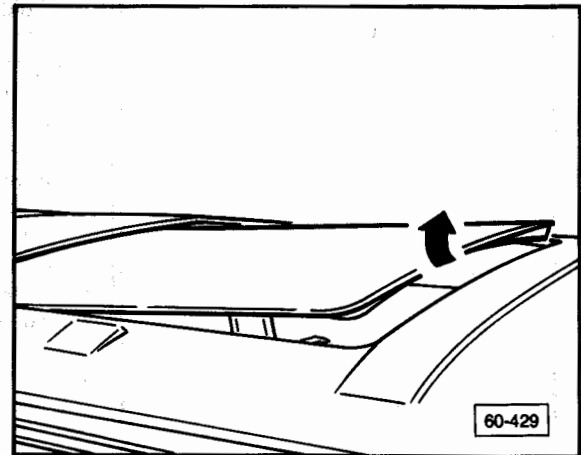
- push trim panel to rear as far as stop (arrow)



- pull sunroof panel forward
  - stop pulling before lifter starts activating
- swing leaf spring 1 to center
- pull crank 2 out of support 3



- remove both Phillips screws (arrows) from front guide



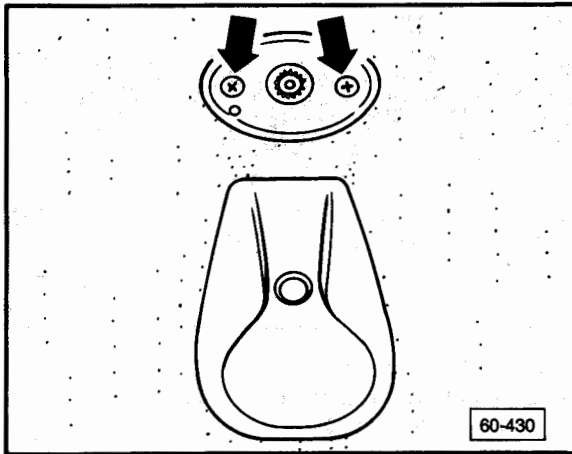
- To remove sunroof panel
- lift panel at front (arrow)
  - lift out panel at rear through openings in guide rail

## Sunroof, installing

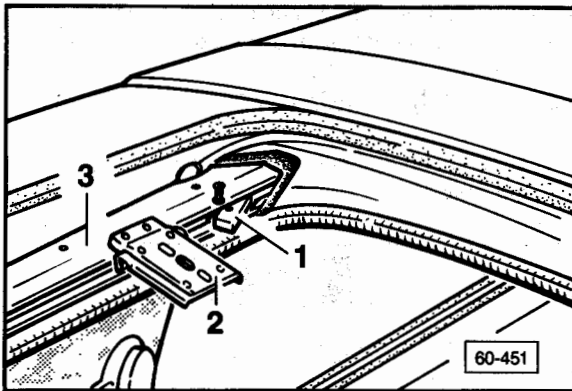
- install in reverse order of removal

## Sunroof trim panel, removing

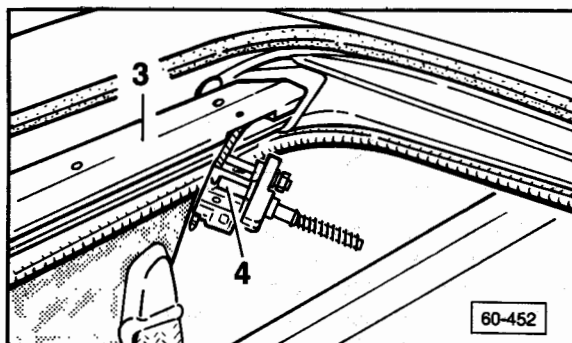
- remove sunroof panel



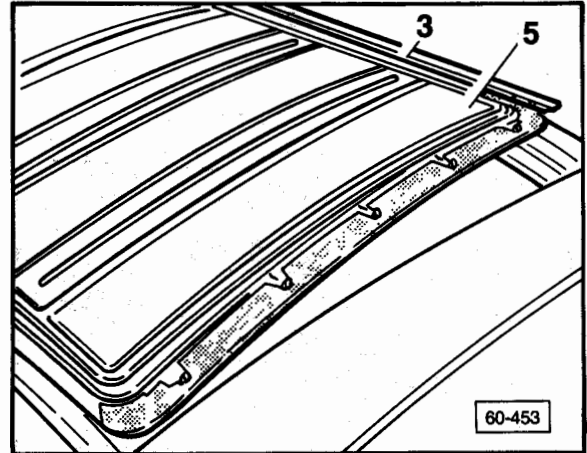
- remove drive handle
- loosen both Phillips screws (arrows) approximately 6 turns
- detach cables at drive



- remove guide block 1
- move guide plate 2 to front and slide out of rail 3



- move cable guides 4 to front and slide out of rail 3 with cable from opening



- remove screws of rail 3 on one side
- push rail to rear and lift together with sunroof trim panel 5
- remove sunroof trim panel 5 by slightly pushing rail 3 to outside

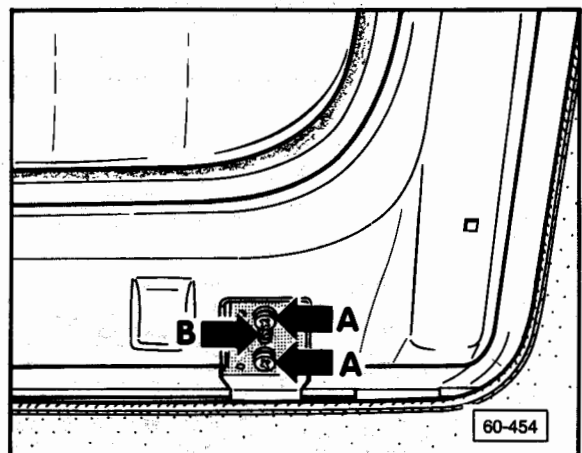
## Sunroof trim panel, installing

- install in reverse order of removal

## Sunroof panel, adjusting

- detach trim panel first and push to rear (see page 60.2)

## Height alignment, front

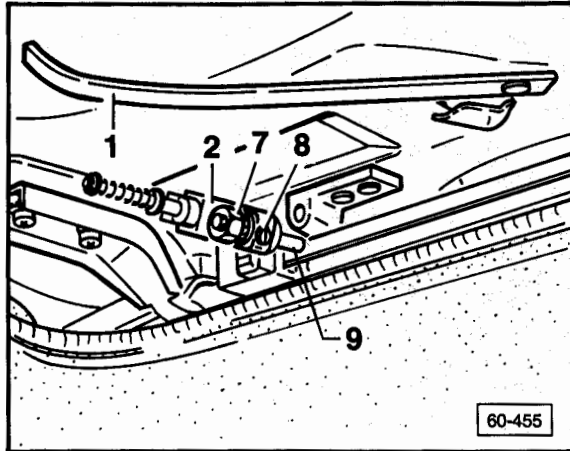


- loosen Phillips screws (arrows A)
- align sunroof panel by turning adjusting screw (arrow B)
- tighten Phillips screws (arrows A)



# 60 Sunroof

## Height alignment, rear

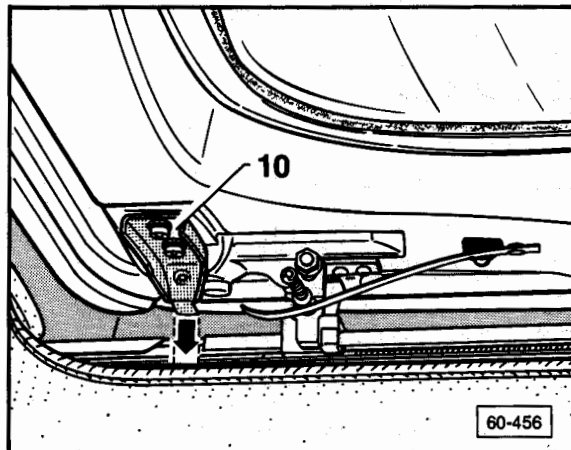


- lower sunroof panel at rear
- swing leaf spring 1 to center
- pull crank 2 out of support
- loosen nut 7 and screw 8
- adjust front height alignment by moving pin 9 in crank slot 2
- tighten screw 8 and nut 7
- slide crank 2 into support
- close sunroof and check height alignment
  - readjust if necessary

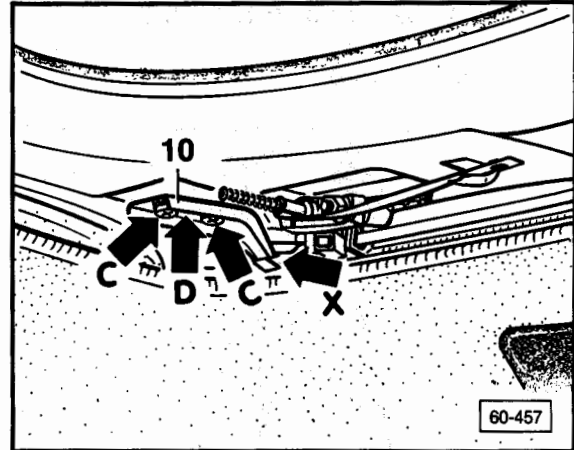
## Guide plate, adjusting

### Note

Always adjust guide plates after sunroof panel rear-height alignment.



- adjust guide plate 10 with sunroof panel closed and plates located above slot in rails (arrow)



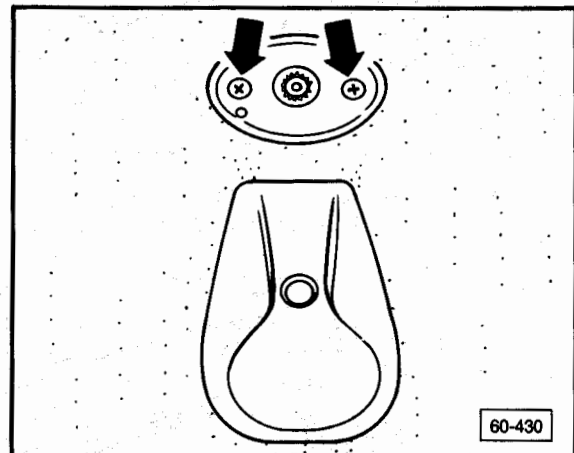
- lower sunroof panel
- loosen Phillips screws (arrows C)
- adjust guide plate 10 in height by turning adjusting screw (arrow D)
  - guide plate 10 must not have play in rail (arrow X)
- tighten Phillips screws (arrows C)

### Note

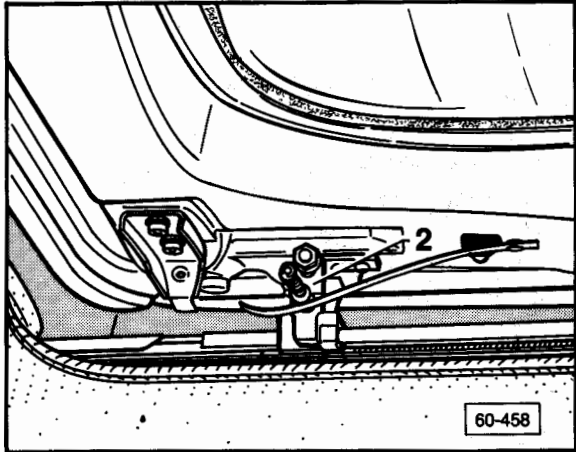
Misadjustment of guide plates can cause noises and make sunroof hard to open and close.

## Parallel adjustment

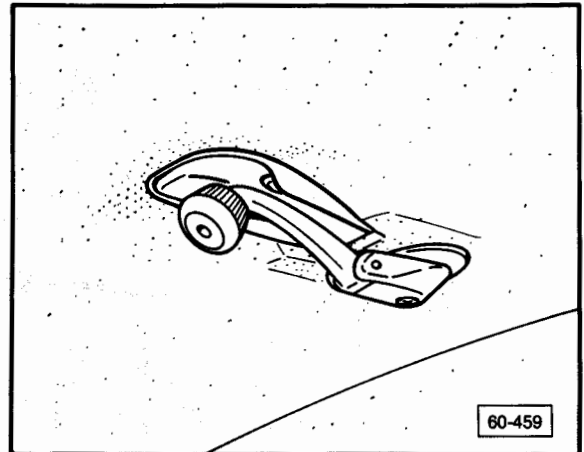
- first detach trim panel and push it to rear (see page 60.2)



- lower sunroof panel at rear (turn drive handle approximately 2 turns counterclockwise)
- remove handle and cover plate
- loosen both Phillips screws (arrows) approximately 6 turns
- detach control cables at drive
- move sunroof panel forward and back in guide rail several times by hand



- push panel to front stop
- press panel upwards by hand at rear
- turn both cranks 2 into upright position



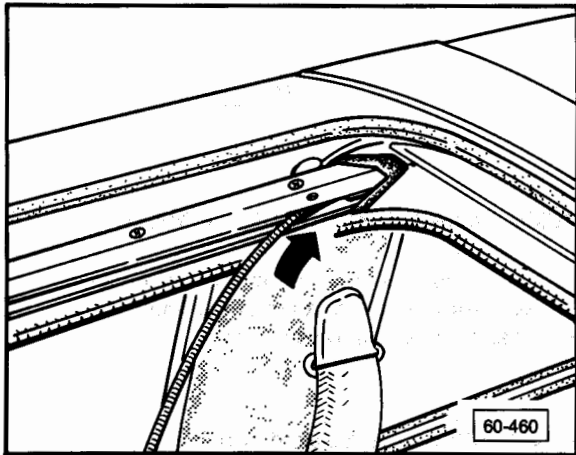
- install cover plate
- install drive handle so it rests in recess when sunroof is closed

**Note**

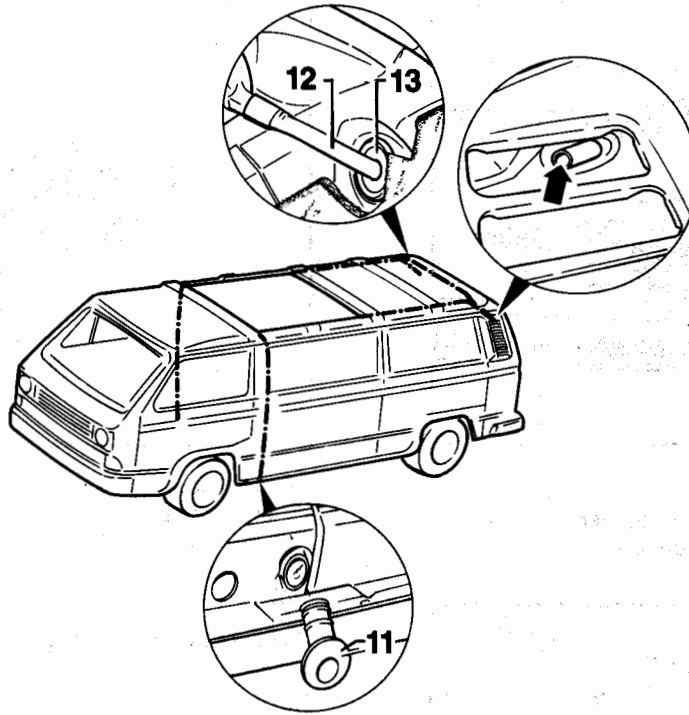
If necessary, replace **both** control cables.

**Note**

The sunroof operates with cables **exposed**. This is so if cables are replaced or panel is hard to move, cables may be lubricated with multipurpose grease.



- turn drive, with handle attached, to the right to stop
- lubricate control cables and attach to drive



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## Sunroof water drains, cleaning

### Front

- pull out flap 11 and clean

### Rear

- clean hose opening in air intake duct (arrow)

### Note

Use a speedocable to clean out drains.

## Rear water drain hose, replacing

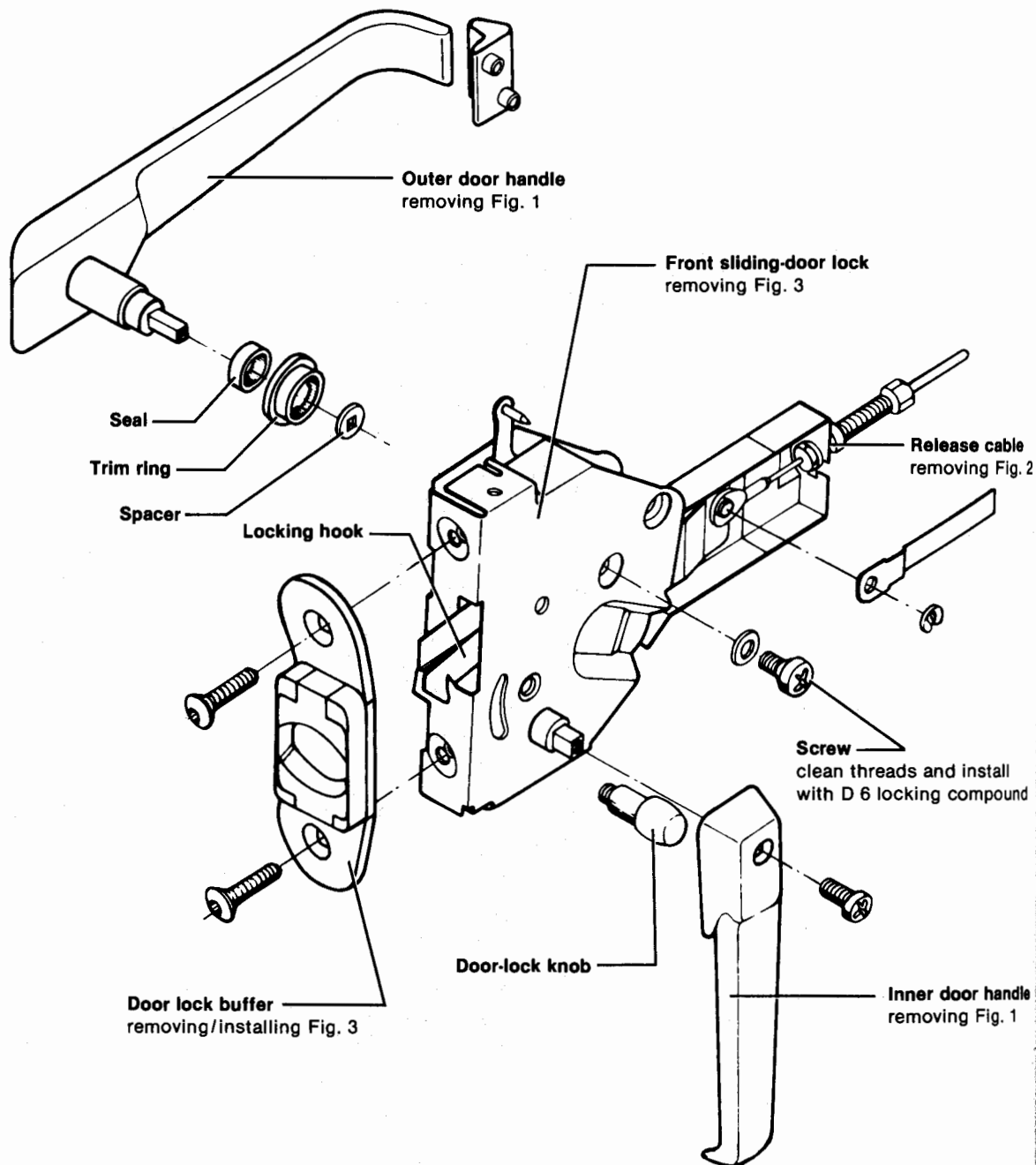
- carefully loosen headliner at rear door opening
- pull hose 12 off pipe, and from grommet 13
- install new hose in reverse order

### Note

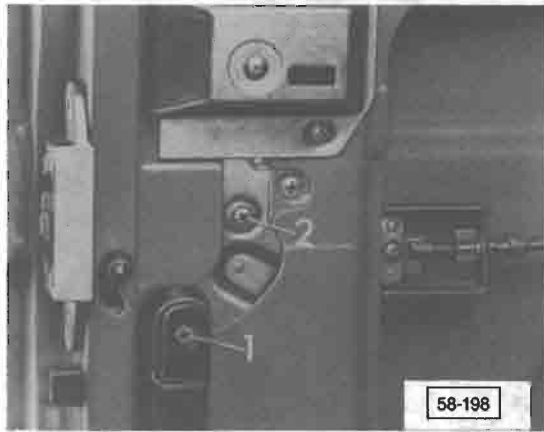
Grommet 13 can be replaced or adjusted without loosening headliner by going through the air intake duct.

Quick Data	Index
	<p><b>Center hinge</b></p> <ul style="list-style-type: none"> <li>- Adjusting 58.9</li> <li>- Assembly 58.8</li> <li>- Removing/installing 58.9</li> </ul> <p><b>Sliding door, 1980-1984 m.y.</b></p> <ul style="list-style-type: none"> <li>- Bowden cables   adjusting 58.7</li> <li>- Door cover 58.3</li> <li>- Door handle   inner/outer 58.3</li> <li>- Door lock buffer 58.3</li> <li>- Lock, front 58.2</li> <li>- Lock, rear 58.6</li> <li>- Lock plate, remote control 58.6</li> <li>- Lubricating 58.7</li> <li>- Removing/installing 58.4</li> <li>- Striker plate, adjusting 58.5</li> </ul> <p><b>Sliding door, from 1985 m.y.</b></p> <ul style="list-style-type: none"> <li>- Assembly 58.10</li> <li>- Central lock 58.20</li> <li>- Door cover 58.11</li> <li>- Handle 58.22</li> <li>- Hinge link, adjusting 58.16</li> <li>- Hinge link, assembly 58.21</li> <li>- Modifications 58.11</li> <li>- Remote control lock 58.18</li> <li>- Removing/installing 58.12</li> <li>- Roller guides   adjusting 58.14</li> <li>- Striker pin, adjusting 58.15</li> </ul>

# 58 Body - Rear Doors

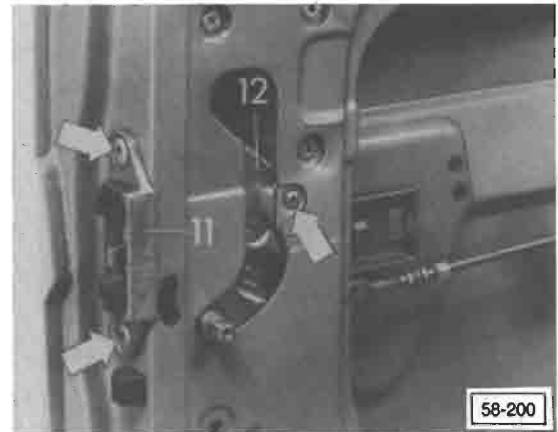


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**Fig. 1 Inner/outer door handles, removing**

- remove Phillips screw 1 and take off inner handle
- remove screw 2 and remove outer handle together with seal and trim ring



**Fig. 3 Front sliding-door lock/door lock buffer, removing/installing**

- remove three screws (arrows)
- remove lock buffer 11
- slide front sliding-door lock 12 out
- install in reverse order

**Note**

Coat threads of screws for door handles with **D 000 600** locking compound or equivalent before installing.

**Sliding door cover, removing**

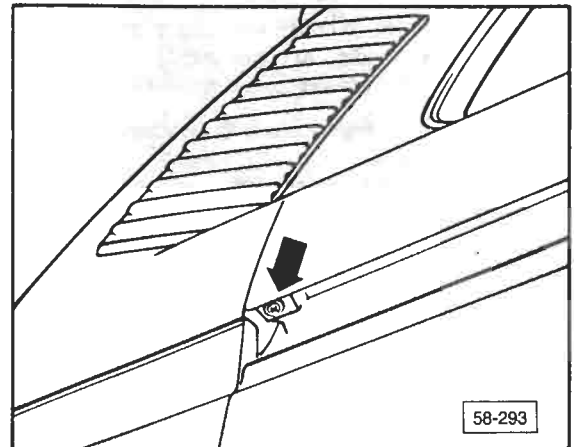
**Note**

Before sliding door can be removed, cover for center guide rail must be removed. Cover and plastic beading are pressed together into U-shaped channel.



**Fig. 2 Release cable/door-lock knob, removing**

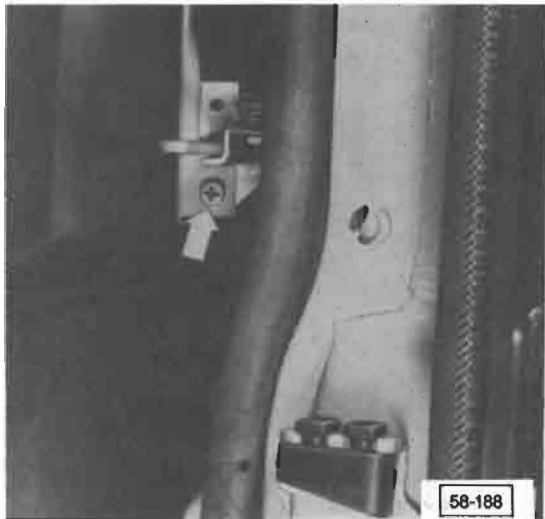
- remove circlip 3 from release cable 8 and rod 4
- loosen securing nut 5 and adjustment nut 6 toward front sliding-door lock
- pry out nut 7 and lift out release cable and rod
- remove lock plate 9 by removing screws (arrows)
- remove door-lock knob 10



- remove Phillips screw (arrow,

more

# 58 Body – Rear Doors



— remove Phillips screw (**arrow**)

### Note

Phillips screw in area of door lock can only be removed with door partially opened.

— remove cover, starting at rear, using hammer and plastic wedge

### Note

Since cover will be firmly seated after it has been in place for some time, apply silicone spray first to ease removal.

## Sliding-door cover, installing

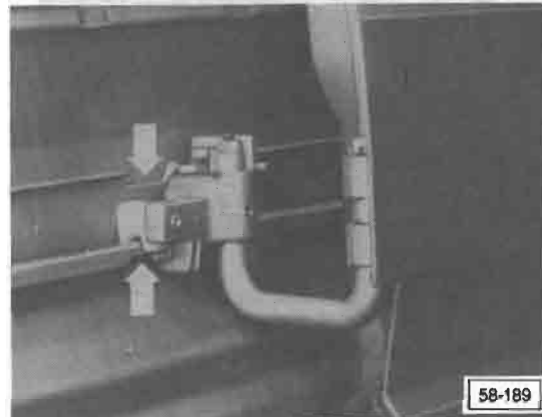
### Note

To make installation of cover with plastic beading easier, first glue beading to cover with **AKD 476 KD5 05** adhesive or equivalent.

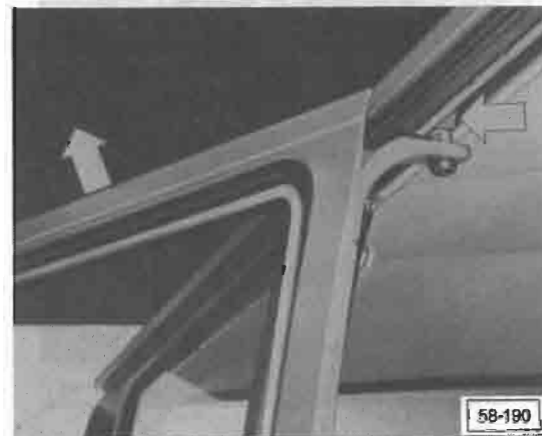
- install cover by pressing lip with beading into U-shaped channel
- drive in fully with hammer and plastic wedge
- using belt-line as reference, align cover with rear corner panel and sliding door. Beading must be seated evenly all around
- install both Phillips screws

## Sliding door, removing

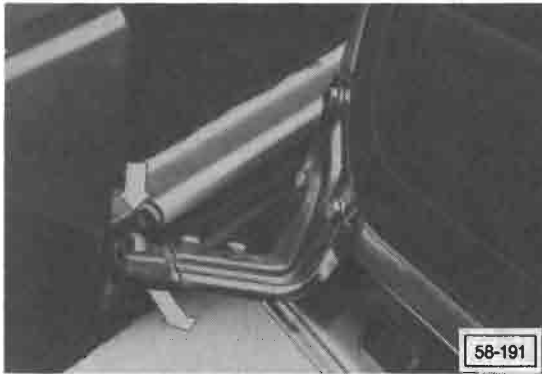
— remove cover



— slide door back until roller and safety guide can be lifted from guide rail at cut-outs (**arrows**)



— slide door back until upper guide (**arrow**) can be removed

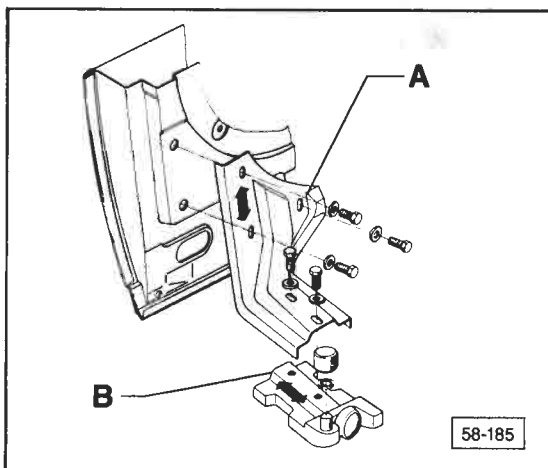


- tilt door slightly away from car
- pull lower lateral and horizontal rollers (**upper arrow**) out of cut-outs in guide rail (**lower arrow**)

### Sliding door, installing

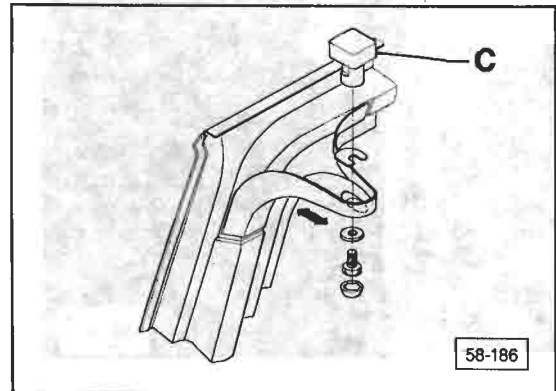
- check guide rails, replace if necessary
- check upper center, and lower guides/rollers, replace if necessary
- replace plastic beading on cover or reattach with **AKD 476 KD5 05** adhesive or equivalent
- insert door into lower guide rail first and then into upper guide rail
- slide door forward far enough to insert roller and safety guide into cut-outs of center guide rail
- check operation of sliding door by repeated opening and closing. If necessary, door may have to be adjusted
- reinstall cover

### Sliding door, adjusting guide/roller/guide carrier



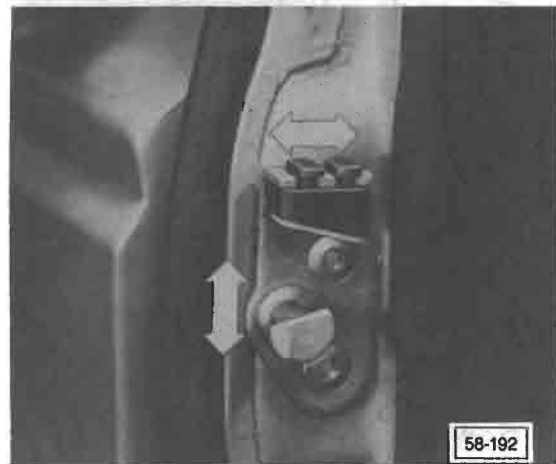
- if door does not line up with door opening, readjust lower guide/roller assembly **B**

- if door height at front is not correct, adjust guide carrier **A**
- adjust height of upper door guide with minimum play between guide and guide rail



- if door does not line up with upper door opening, remove protective cap on bolt and adjust by relocating guide block **C**
- after adjusting, check fit of door over entire travel
- if fit still incorrect, adjust striker plate

### Sliding-door striker plate, adjusting



- sliding door can be adjusted by moving striker plate in direction of arrows

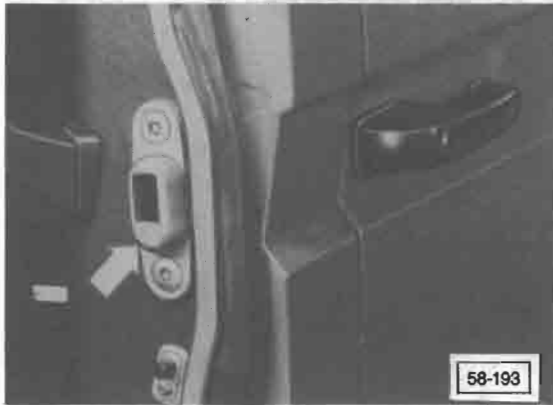
#### Note

After striker plate adjustment, always adjust sliding-door center hinge (page 58.9).



# 58 Body-Rear Doors

## Front sliding-door lock plate, adjusting



- loosen lock plate slightly
- close door from inside to center lock plate
- hold lock plate in position and open door
- tighten both screws securely
- after lock plate is adjusted, check that door locks easily from outside with key and with lock knob from inside. If necessary, install one or two spacers behind lock plate

## Rear sliding-door lock, removing

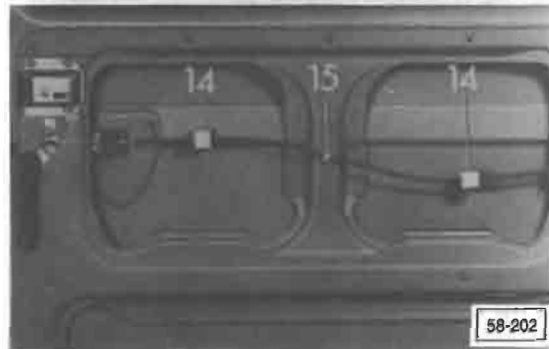


- turn locking pawl to **locked position** while pulling inner door handle
- pull out Bowden cable from center guide (15 on illustration 58-202)
- remove three screws (**arrows**)
- remove rear sliding-door lock **13**

## Rear sliding-door lock, installing

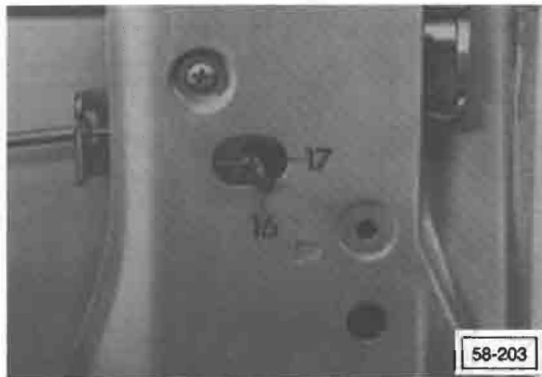
### Note

Bowden cable is protected by clip from disengaging from lock. Changing of clip can only be done after removal of rear sliding-door lock.



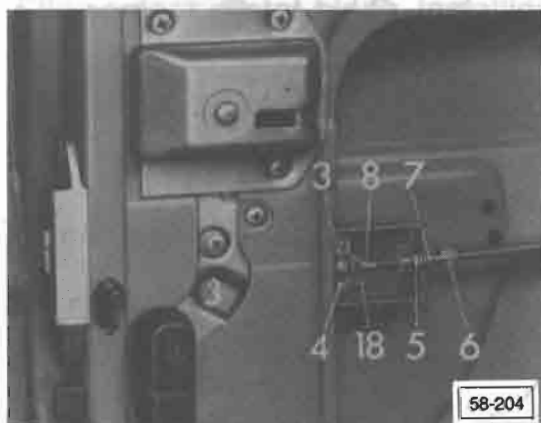
- to prevent rattling noise, foam rubber pads **14** and center guide **15** must be installed

## Bowden cable, adjusting



- turn locking pawl of rear sliding-door lock to locked position while pulling inner door handle
- insert 4 mm screw 16 into opening 17 and fasten actuating lever

## Bowden cable for remote control lock, adjusting

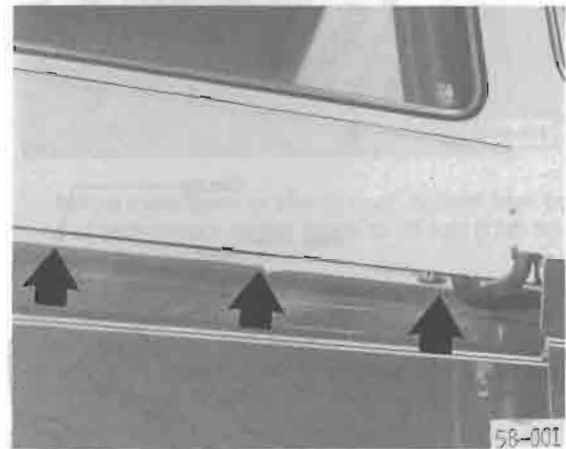


- engage Bowden cable 8 on pull-rod 4 of front sliding-door lock and secure with clip 3
- press nut 7 into opening of front sliding-door lock
- press in guide for Bowden cable
- guide pull rod of front sliding-door lock through adjustment screw 6 to mounting point 18 of pull rod
- secure adjustment screw 6 with lock nut 5

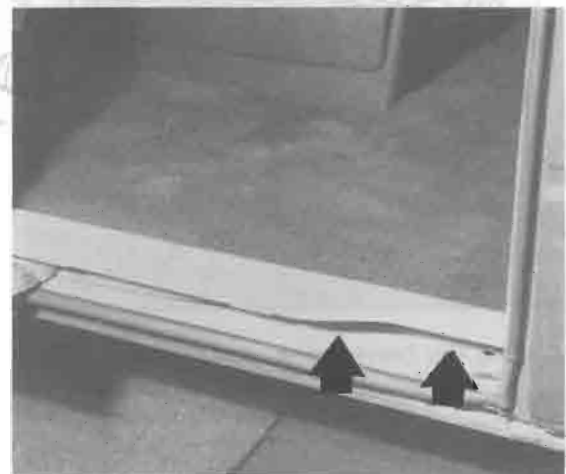
## Bowden cable adjustment, checking

- adjust door for correct fit in door frame
- if door does not close properly, adjust door striker plate and center hinge (see pages 58.5 and 58.9)

## Sliding door, lubricating



### Side Panel runner



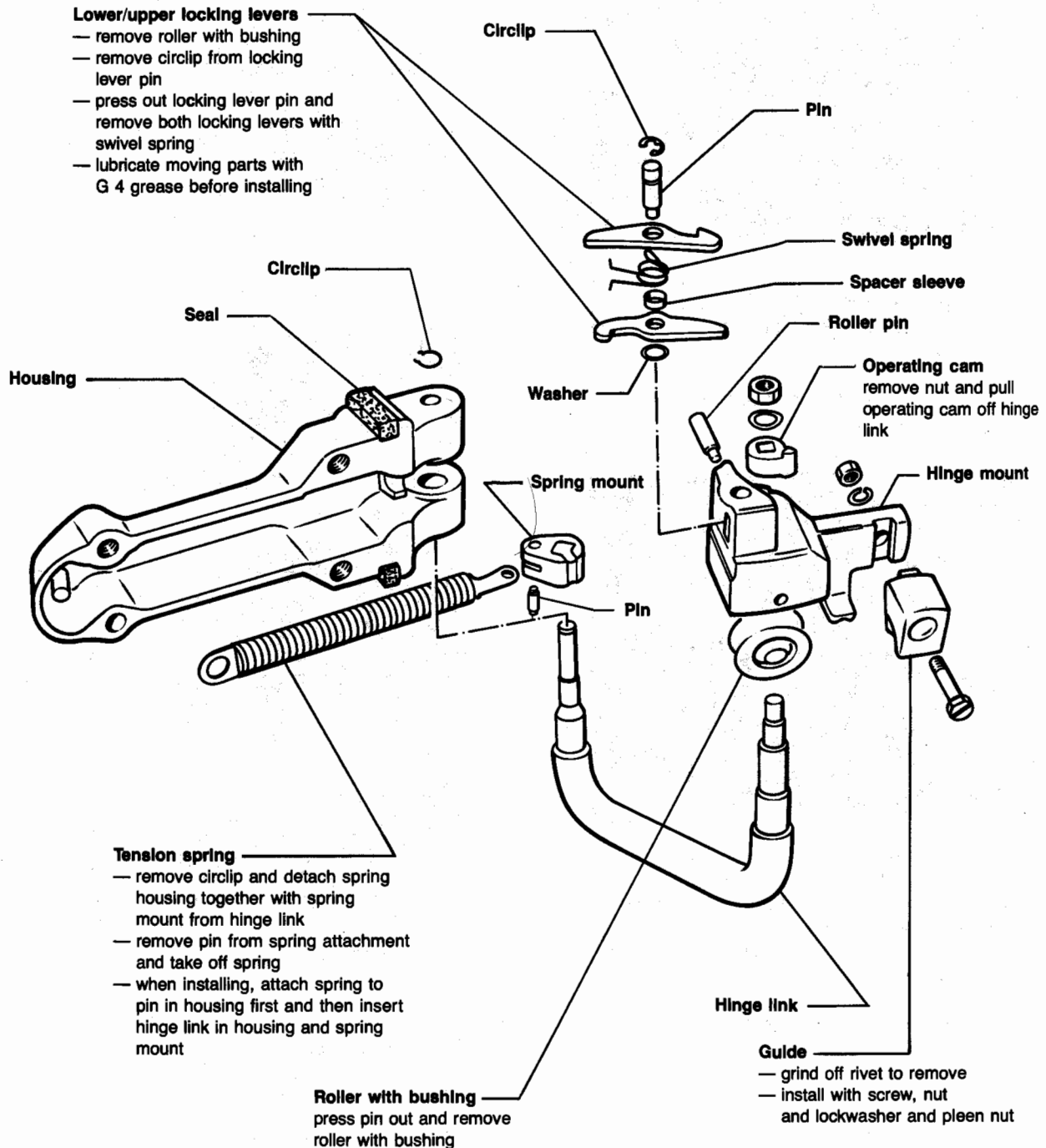
### Lower roller track

#### Note

For the sliding door to work properly, it must be lubricated at the side-panel runner and lower roller track at front end where door goes in.

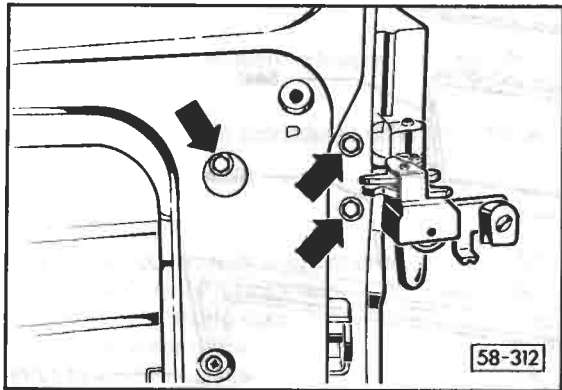
- clean runner and roller track with an oil-soaked cloth
- apply a thin coat of multi-purpose grease to each roller track (arrows)

# 58 Body – Rear Doors



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## Sliding-door center hinge, removing

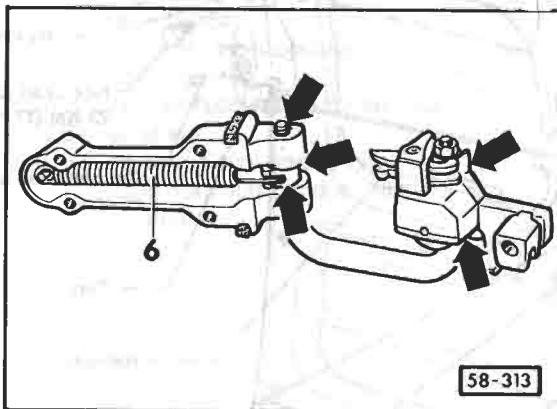


### Note

Center hinge can only be removed when sliding door has been removed.

- remove bolts (arrows) and remove hinge assembly

## Sliding-door center hinge, installing



- before installing lubricate with oil (arrows)
- lubricate return spring 6 with multi-purpose grease
- after installation, adjust hinge assembly

## Sliding-door center hinge, adjusting



- before installation of sliding door, tighten front bolt 1 of sliding-door center hinge to 23 Nm (17 ft lb)
- hand-tighten bolts 2
- install sliding door and close from outside
- check front and rear gap, correct if necessary after loosening bolt 1
- after correction is made, retighten bolt to 23 Nm (17 ft lb)

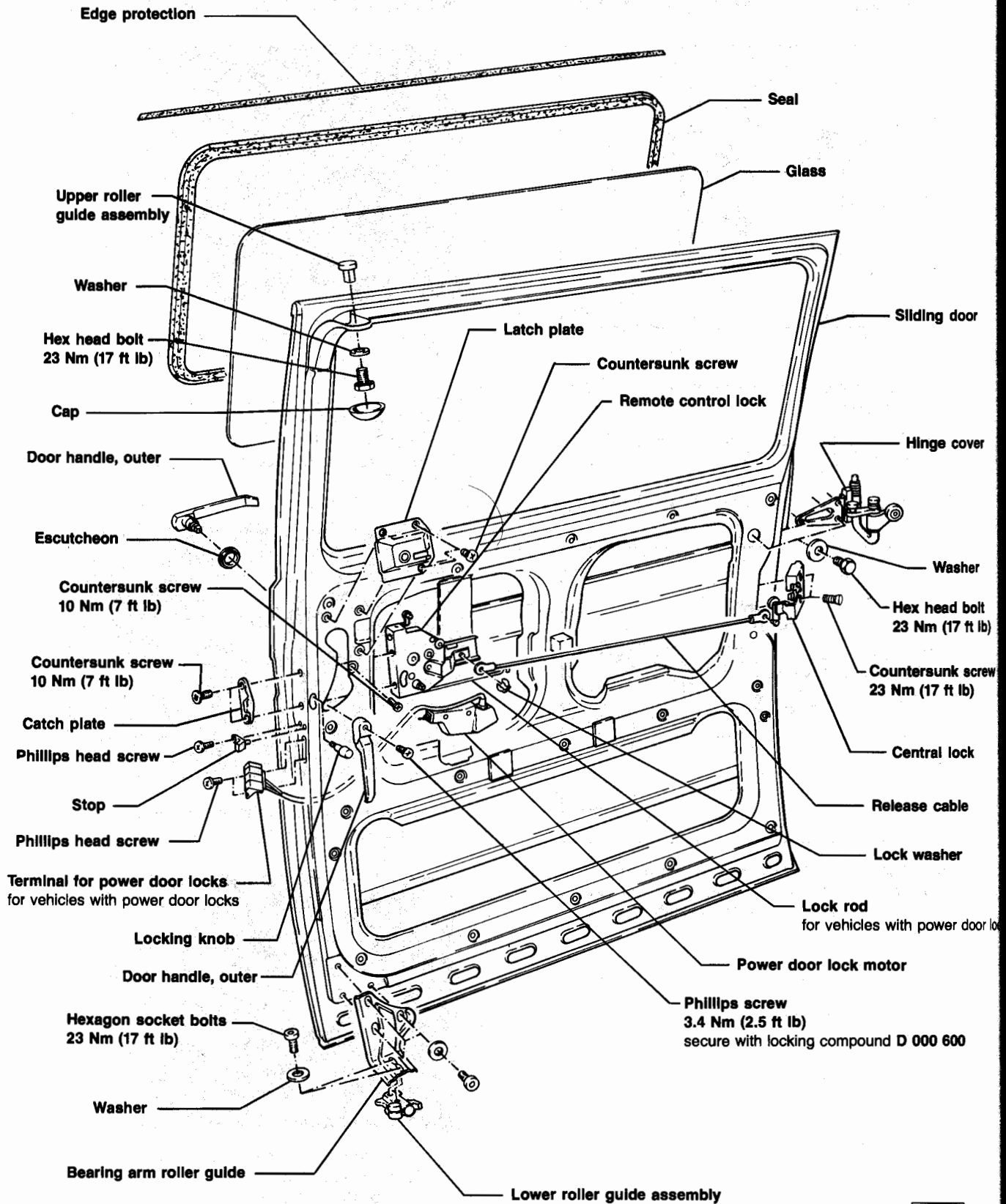


- pry down on guide carrier (arrow) until guide/roller 3 is positioned on center guide rail



- open sliding door carefully while supporting rear of door in area of belt line
- tighten bolts 2 to 23 Nm (17 ft lb)

# 58 Body – Rear Doors



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## 58.10

Sliding door, assembly

From 1985 m.y.

## Sliding door, modifications

(1985 model year)

The sliding door has been redesigned for the 1985 model year.

Some of the following procedures differ from those for earlier models.

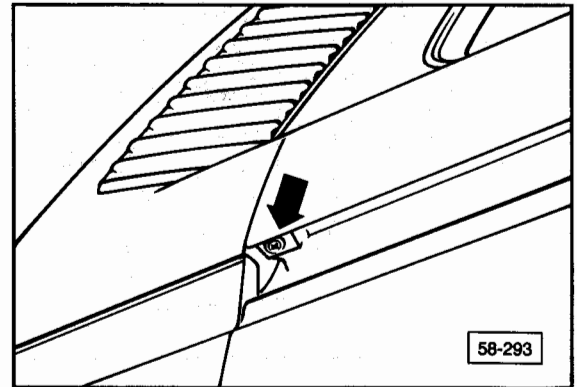
Procedure	Page
Sliding door cover, removing/installing	58.11
Sliding door, removing/installing	58.12
Adjustments to sliding door	
a lower roller guide	58.14
b upper roller guide	58.14
c striker pin with hinge link	58.15
d hinge link	58.16
Remote control lock	58.18
Central lock	58.20
Hinge link/parts subject to wear, replacing	58.21

Problem	Adjustment
Door height at front incorrect	a
Door height incorrect	c
Door is not flush with outer contour of B-pillar at bottom	a
Door not flush with outer contour of C-pillar	c
Front of door not flush with outer contour of B-pillar at top	b
Gap around door differs front to rear	c, d
When opening from outside, door sticks in C-pillar area	d

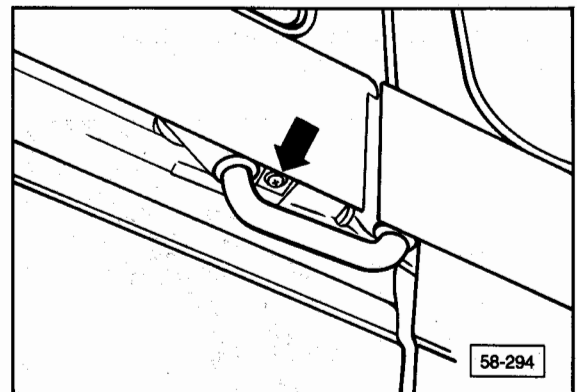
## Sliding door cover, removing

### Note

Before sliding door can be removed, cover for center guide rail must be removed. Cover and plastic beading are pressed together into U-shaped channel.



— remove Phillips screw (arrow)



- open sliding door slightly
- remove screw (arrow) at front of cover
- spray beading with silicone or similar lubricant
- using hammer and plastic wedge, carefully tap cover out towards top. Start from rear and work forward.

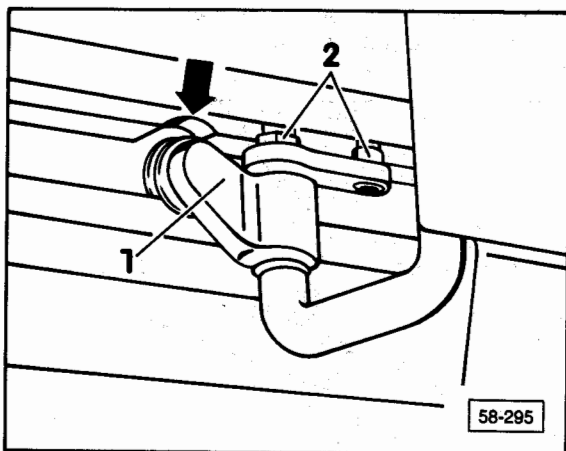
## Sliding door cover, installing

- glue beading to cover with adhesive or equivalent
- press cover and beading into securing rail and tap downward with hammer and plastic wedge
- check position of cover relative to body lines of rear panel and sliding door. The beading must make even contact along entire length
- reinstall screw (arrow)

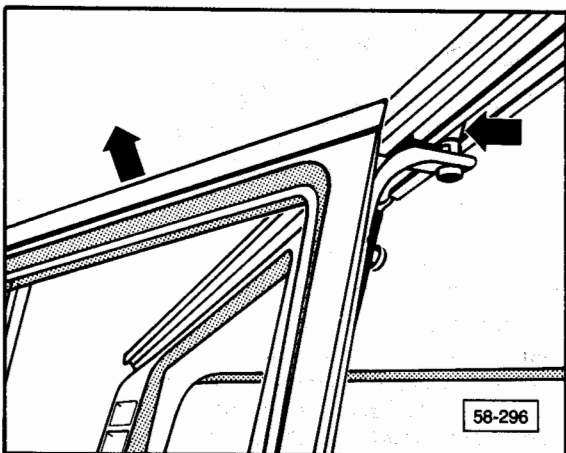
# 58 Body – Rear Doors

## Sliding door, removing

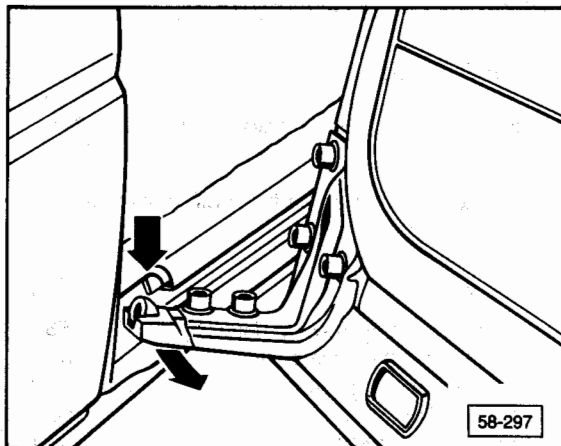
- remove sliding door cover



- push door back until roller carrier 1 is positioned beneath recess in guide rail (**arrow**)
- lift door at rear and pivot roller carrier 1 out of guide rail
- lower door slightly and pivot hinge link upper rollers 2 out of guide rail



- push door back as far as possible and lift at rear until upper roller can be taken out of guide rail.



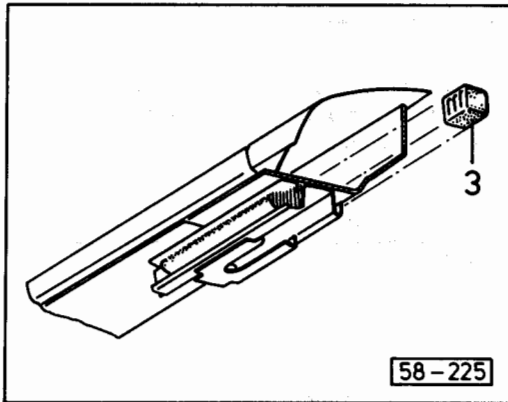
- swing door outward and pull guide and bearing rollers out of guide rail opening

## Sliding door, installing

- check and replace door seal if necessary

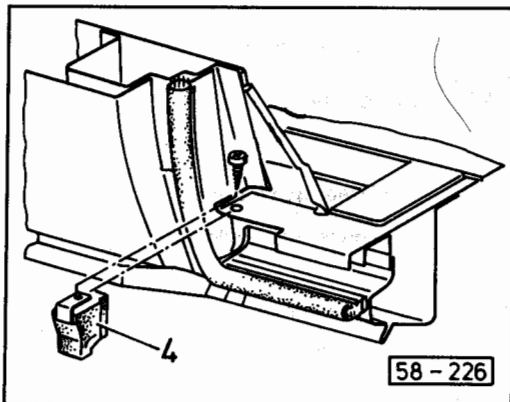
### Note

Before applying adhesive, Part Number **AKD 476 KD5** or equivalent, ensure that the old adhesive has been completely cleaned off.

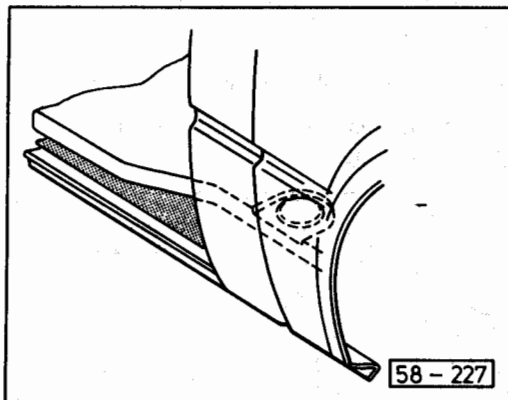


- check upper roller guide and lower bearing and guide rollers on door. Replace if necessary
- insert door in lower guide rail first, then in upper guide rail
- push door forward until bearing roller of carrier is located in guide rail recess area

- insert guide rollers into rail
- pivot roller carrier in direction of rail and locate bearing roller on guide rail beneath recess
- check operation of door during opening and closing. Adjust door as required
- install sliding door cover



- check upper 3 and lower 4 stops and replace if necessary



- lightly lubricate front opening of lower roller guide with multi-purpose grease (shaded area)



# 58 Body – Rear Doors

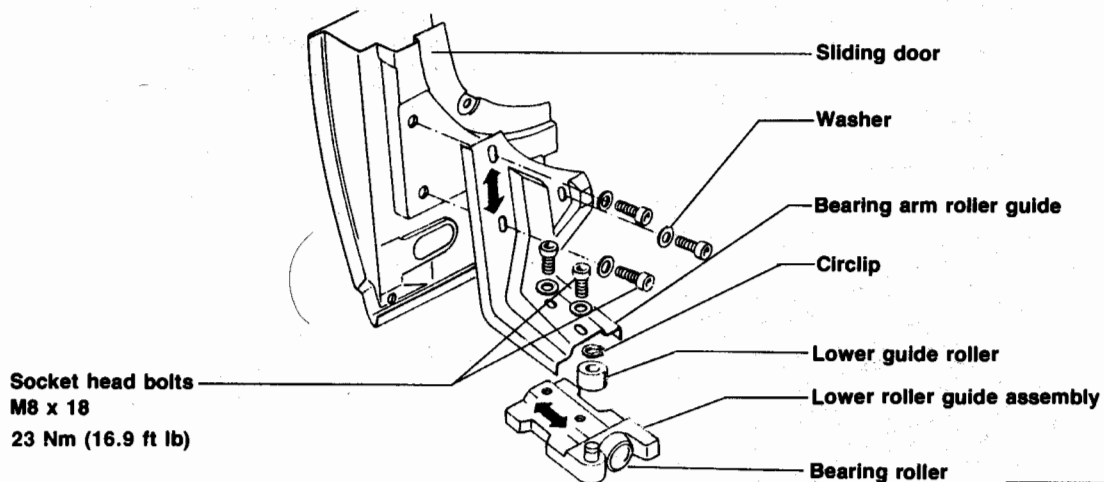
## Sliding door, adjusting

### Note

Two mechanics are required to perform the adjustment operations on the sliding door.

The sliding door is correctly positioned when the gap with the door closed is even all the way around.

The door waistline (depression) must be in line with that on the body. Also, the door must not be positioned too far in or out.



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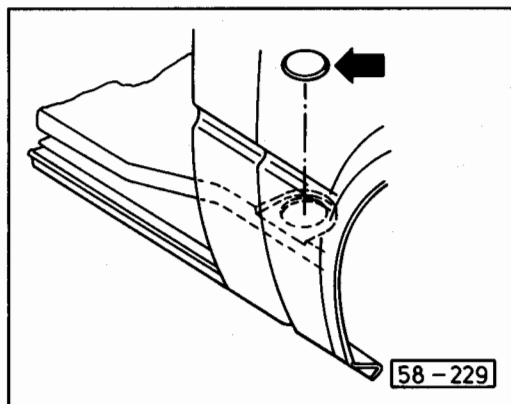
### a - Adjusting lower roller guide

- Door height incorrect at front:
  - relocate bearing arm roller guide by loosening upper bolts and moving door to proper height. Retighten bolts to proper torque
- Front of door not flush with outer contour of B-pillar at the bottom:
  - from inside vehicle, loosen bolt on door side slowly
  - when door is flush with B-pillar outer panel, retighten bolt
  - open door and tighten both bolts to specified torque

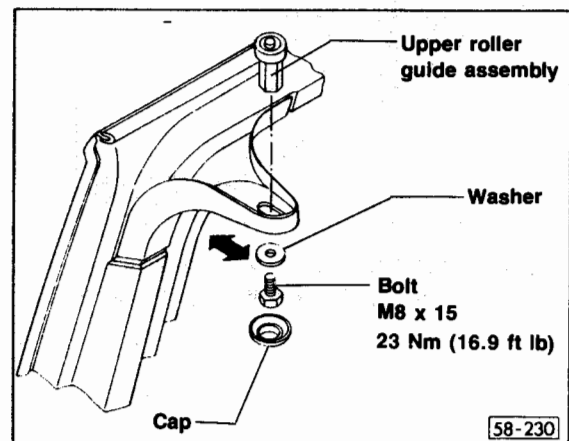


### b - Adjusting upper roller guide

- Front of door not flush with outer contour of B-pillar at the top:
  - remove cap
  - loosen bolt and reposition roller in elongated hole. Retighten bolt to proper torque

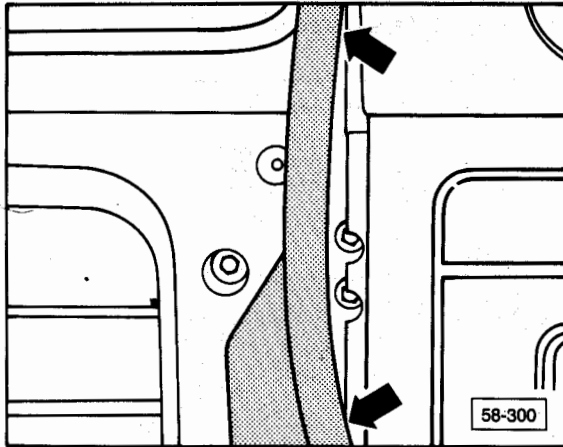


- push plastic cap in floor up from beneath vehicle
- loosen two bolts fastening lower roller guide assembly
- press roller guide as far as door stop and tighten bolt on door side only
- carefully close door

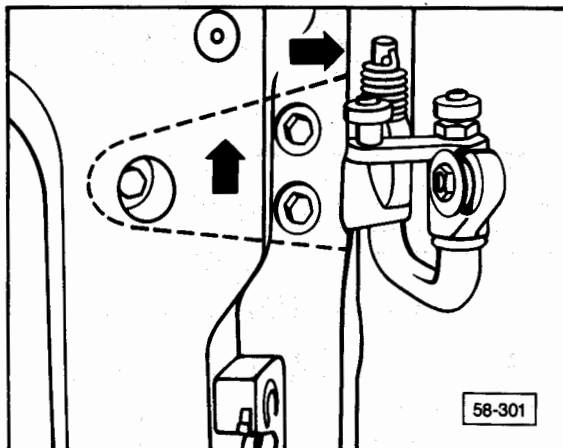


## c - Adjusting striker pin w/hinge link

- door not flush with outer contour of C-pillar
- door height incorrect
- gap around door differs front to rear

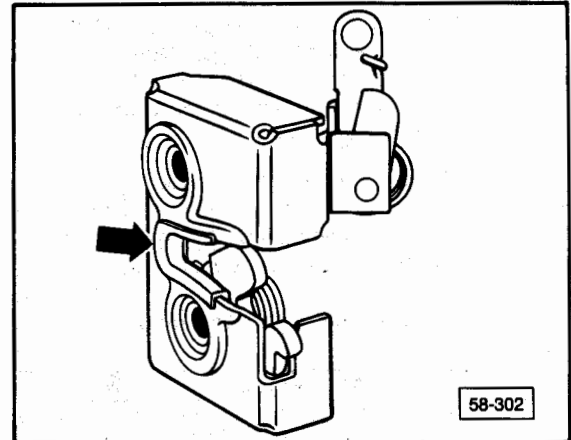


— open door and remove beading from C-pillar (arrows)



### Note

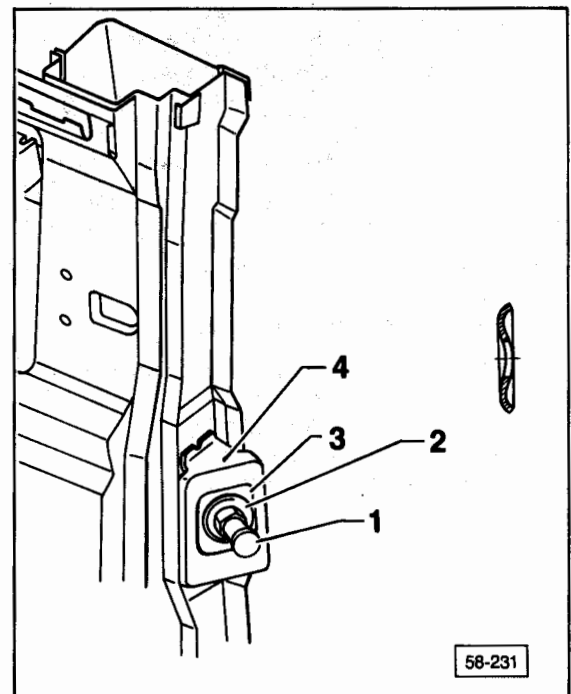
Each time before repositioning or installing the striker pins, the hinge link bolts must be loosened and the link must be pushed upward and to the rear as far as possible (arrows). The bolts should be tightened by hand only.



— insert plastic spacer clip (arrow) in lock opening

### Note

New locks are supplied with plastic clips.



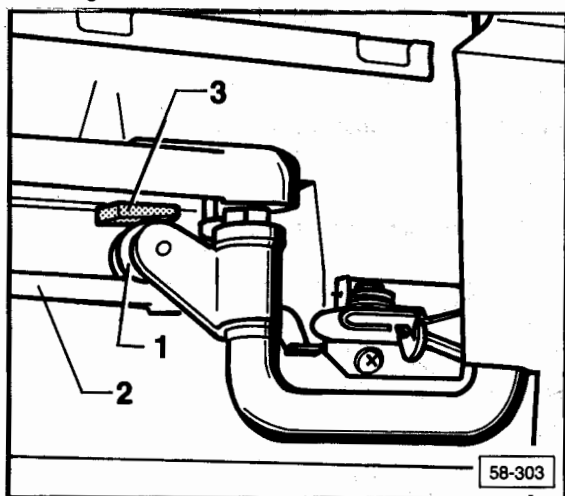
- 1 Striker pin
- 2 Spring plate  
(collar must always face outward)
- 3 Adjustment aid line for striker pin
- 4 Striker pin/spring plate mounting bracket

— install striker pin 1 and spring plate 2 to mounting bracket 4. Ensure that spring plate is located centrally in adjustment line 3

— slowly push door to front, lifting door slightly at same time in waistline area

# 58 Body — Rear Doors

- with door closed, check for height and flushness with outer panel at center of door. Measure amount of correction needed
- open door and mark amount of correction on striker pin mounting bracket
- move striker pin into position marked
- close door and recheck position in opening
- when door is correctly adjusted for height and flushness with outer panels, loosen hinge link bolts
- align door longitudinally from outside using plastic wedge

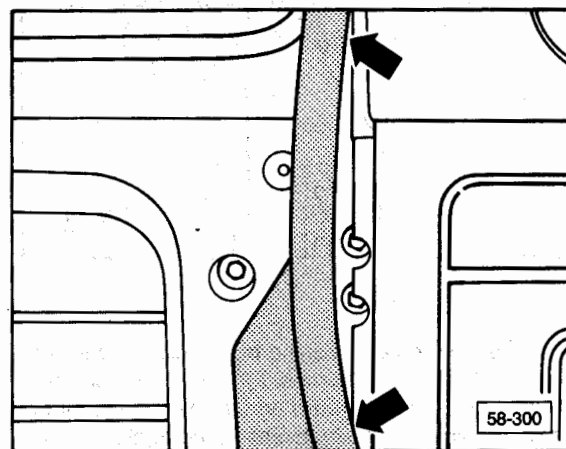
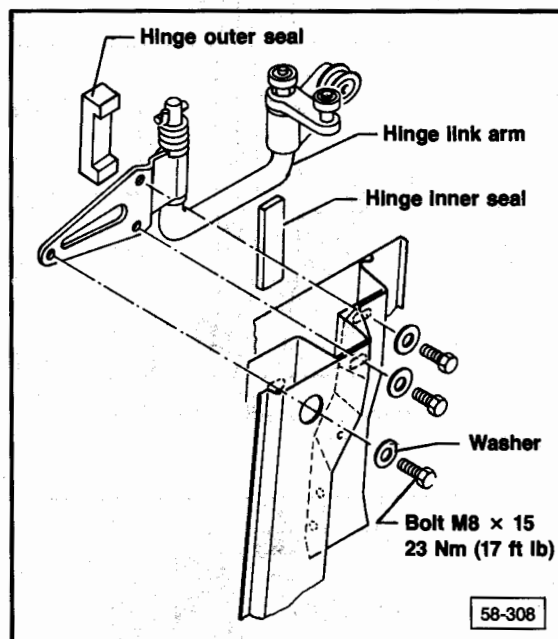


- pull roller carrier 1 down by hinge link until bearing roller rests on rail 2
- tighten hinge link bolts from inside
- open door and remove spacer clip from lock
- tighten all bolts to correct torque
  - hinge link bolts: 23 Nm (17 ft lb)
  - striker pin: 50 Nm  $\pm$  5 (36 ft lb  $\pm$  3.6)
- install beading on C-pillar flange

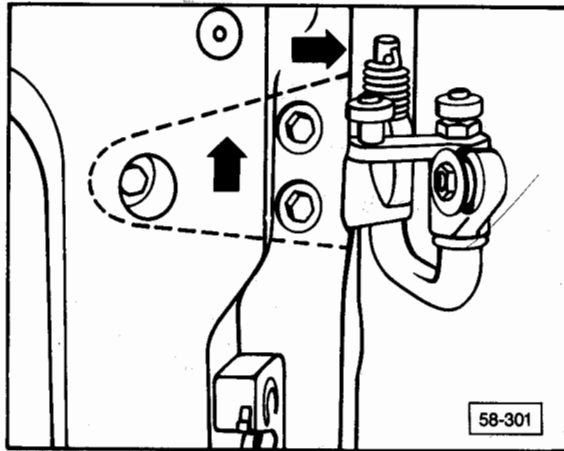
## d - Adjusting hinge link separately

- gap around door differs
- when opening door from outside, door sticks in C-pillar area

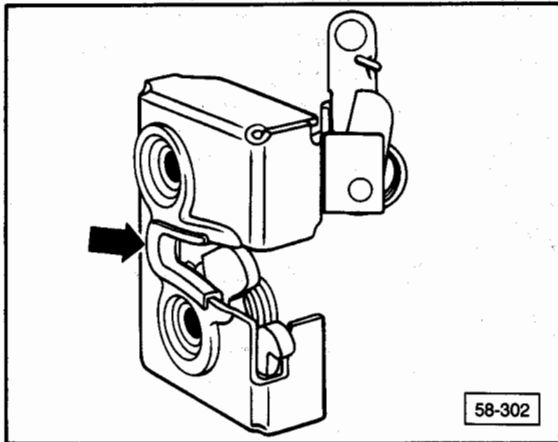
If the striker pin does not need repositioning, the hinge link can be adjusted separately:



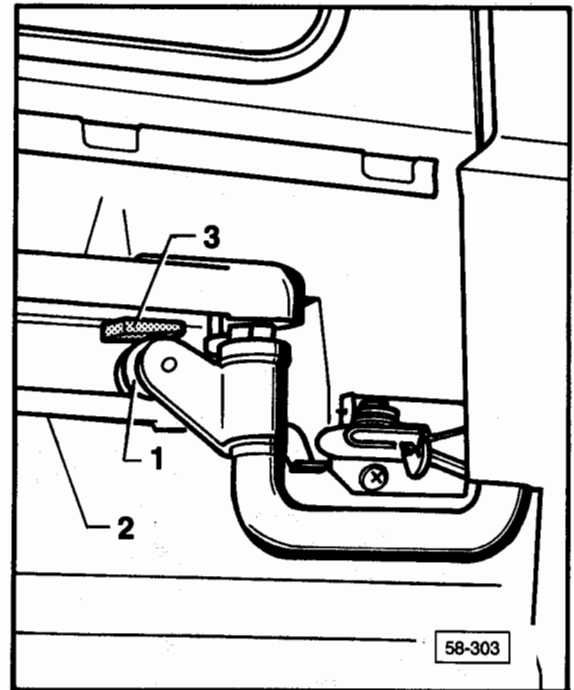
- open door and remove beading from C-pillar (**arrows**)
- remove door complete with hinge link out of center guide rail (see sliding door, removing/installing) and rest rear of door on suitable support
- loosen hinge link bolts



- push hinge link upward and to the rear as far as possible (**arrows**). Hand tighten bolts
- hang door with hinge link into center guide rail

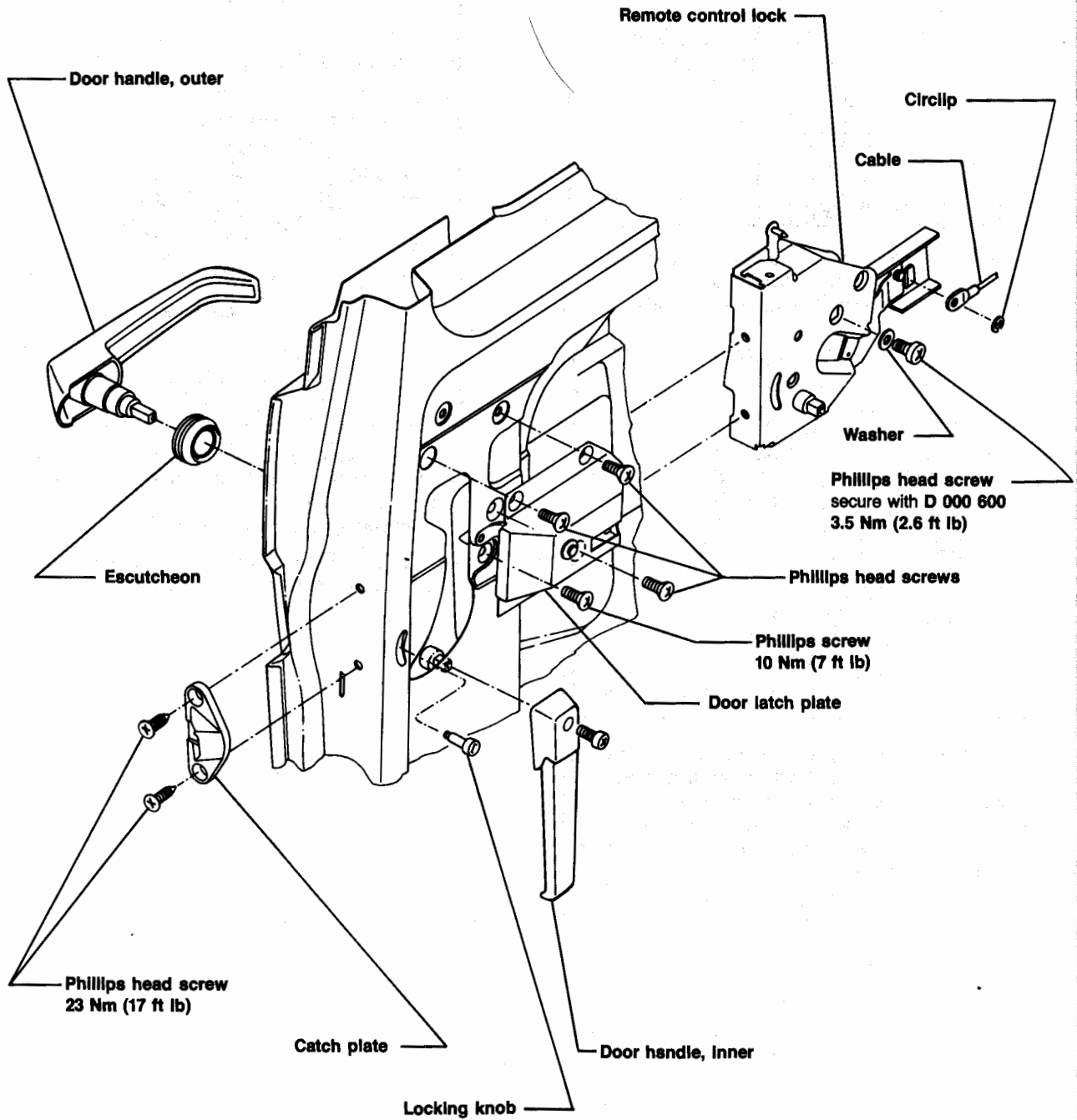


- insert plastic spacer clip (**arrow**) into lock opening
- carefully push door to front slowly, lifting door slightly at same time in waistline area
- loosen hinge link bolts from inside vehicle
- check door gap at front and rear and adjust door with plastic wedge



- insert piece of wood or plastic wedge **3** between roller carrier and rail **2** until roller **1** rests on rail **2**
- tighten hinge link bolts from inside
  - tightening torque: 23 Nm (17 ft lb)
- open door and remove spacer clip from lock
- install beading on C-pillar flange

# 58 Body – Rear Doors



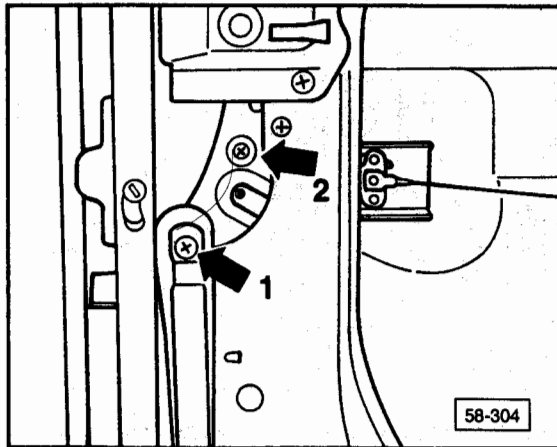
58-268

## 58.18

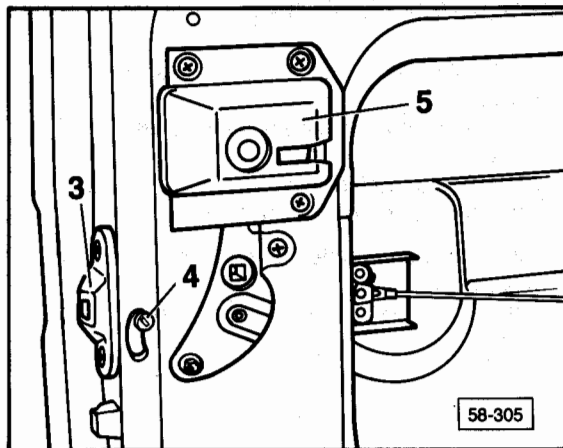
Remote control lock, assembly

From 1985 m.y.

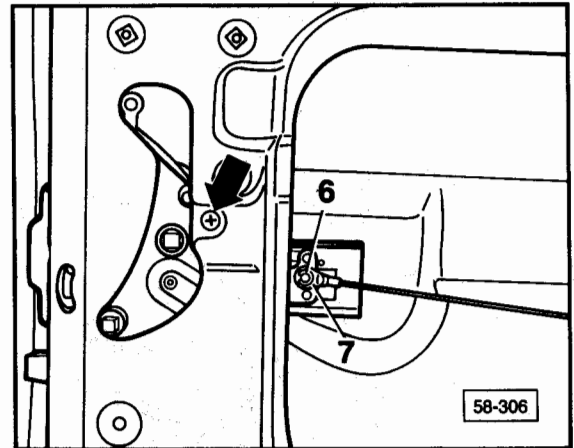
## Remote control lock, removing



- remove screws 1 and 2 from inner and outer door handles
- remove inner and outer door handles and spacer washer



- remove catchplate 3
- remove locking knob 4
- remove door latch plate 5



- remove circlip 6 from remote control lock pin and remove cable 7
- remove screw (arrow) and pull remote control lock out between door inner and outer panels

## Remote control lock, installing

- push lock in between inner and outer panels, align catchplate and screw loosely in position
- coat inner and outer door handle fastening screws with D 000 600 or equivalent and install
- install cable on remote control lock pin and secure with circlip
- tighten lock securing screws

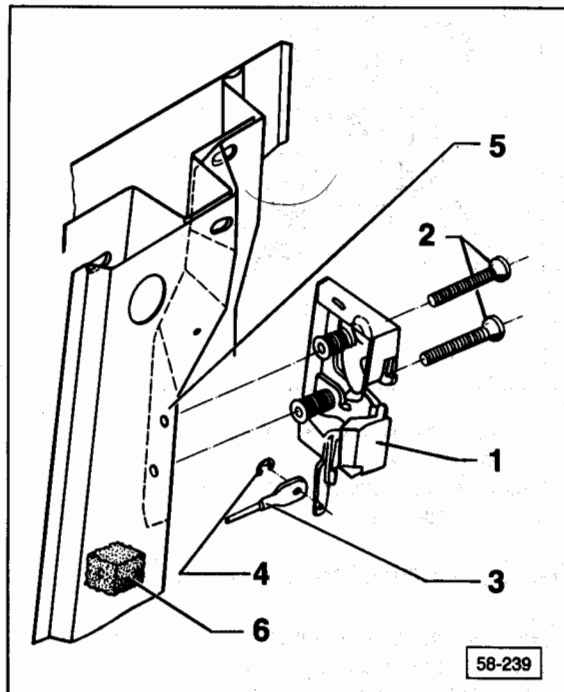
### Note

For tightening torques see Fig. 58-238 on preceding page.

- install locking knob

# 58 Body – Rear Doors

## Central lock, removing

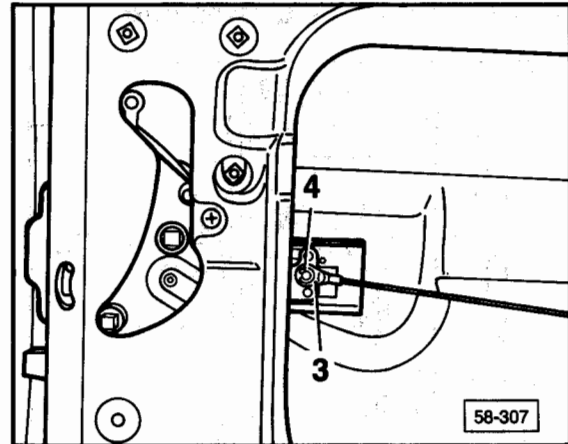


- 1 Central lock
- 2 Countersunk screw
  - 23 mm (17 ft lb)
- 3 Cable
- 4 Circlip
- 5 Sliding door/rear contact surface
- 6 Foam cable pad
  - 20 mm (25/32 in.)

### Note

The central lock can be removed and installed with the door on the vehicle.

- remove sliding door trim panel



- remove circlip 4 from pin on remote control lock and remove cable 3
- remove screws 2 (see Fig. 58-239)
- remove central lock with cable
- remove circlip 4 and remove cable from central lock (see Fig. 58-239)

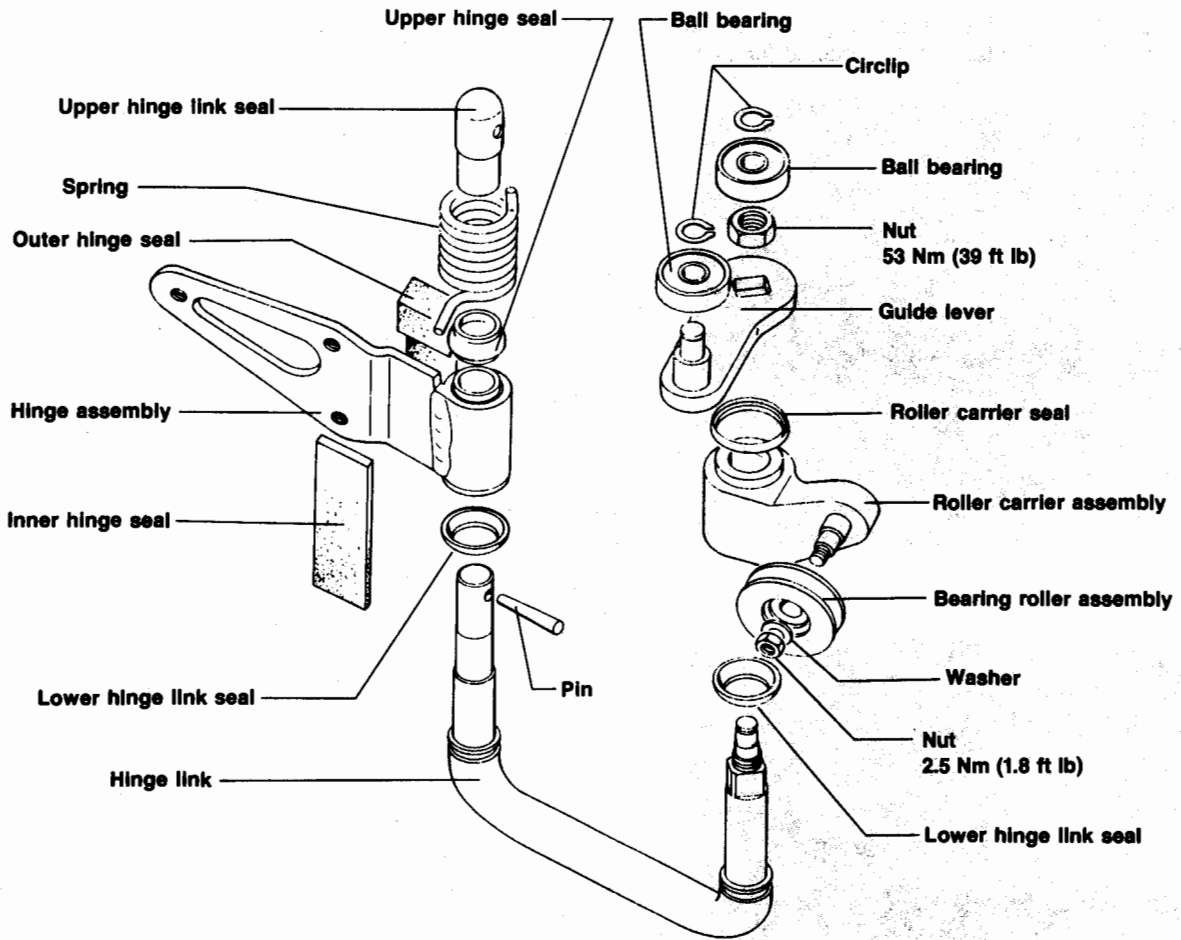
## Central lock, installing

- install cable on central lock pin and secure with circlip
- push cable into door and push foam pad onto cable
- screw lock to sliding door
  - tightening torque: 23 Nm (17 ft lb)
- install cable on remote control lock pin and secure with circlip
- stick foam cable pad to center of door

## Hinge link/parts subject to wear, replacing

### Note

All illustrated parts are available as individual items. Replace only those parts which are actually damaged.



58-242



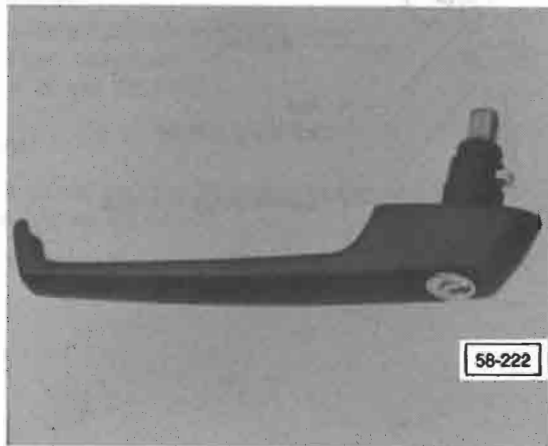
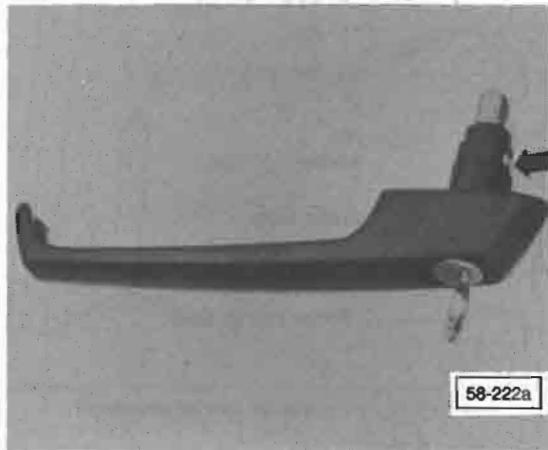
# 58 Body – Rear Doors

## Outside sliding door handle with option M145, installing (Transporter, Canada only)

### Note

When performing repairs to the sliding door or lock, it has been found that the outer door handle locking cylinder is often being damaged as a result of incorrect installation.

Before re-installing the handle, turn the lock with the key so that the locking tab is fully retracted (**arrow**).



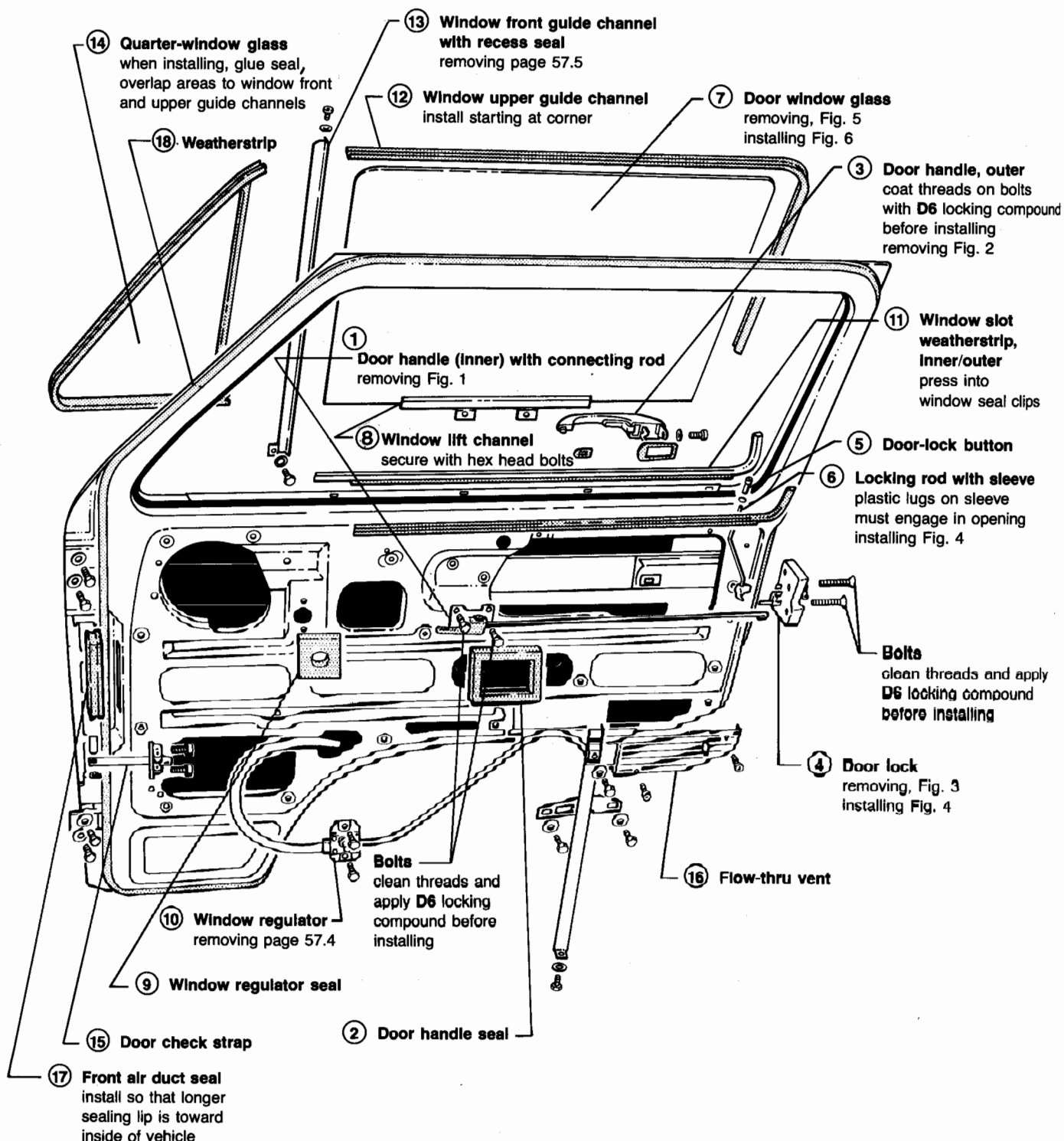
## Index

- Front doors
  - adjusting 57.5
  - assembly 57.2
  - glass 57.4
  - guide channel 57.5
  - handles 57.3
  - lock/lock-rod 57.3
  - power door locks 57.6
  - whistling noises, eliminating 57.10
  - window regulator 57.4
- Lost/broken keys
  - code location 57.8

# 57 Body – Front Doors

## Note

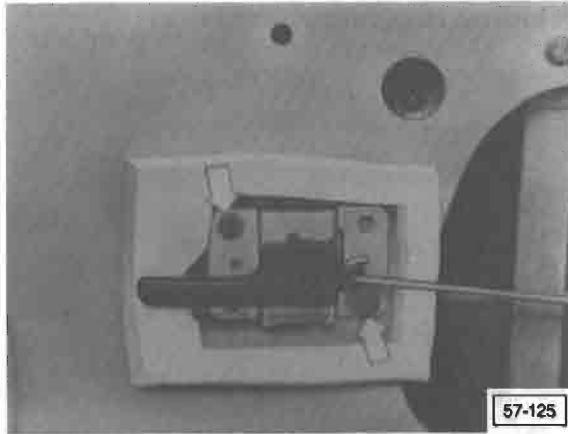
When disassembling door, remove in numerical order; install in reverse order.



57-124

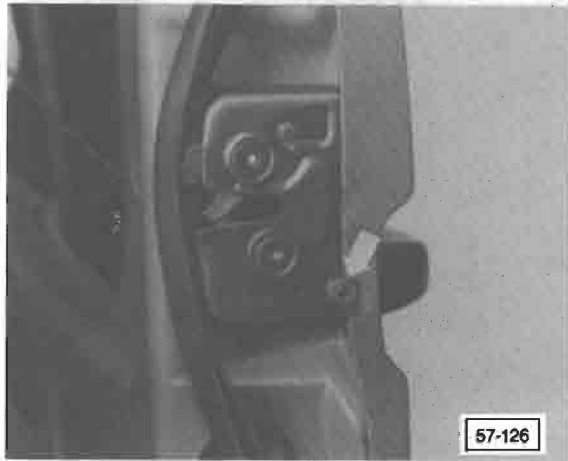
## 57.2

Front door, assembly



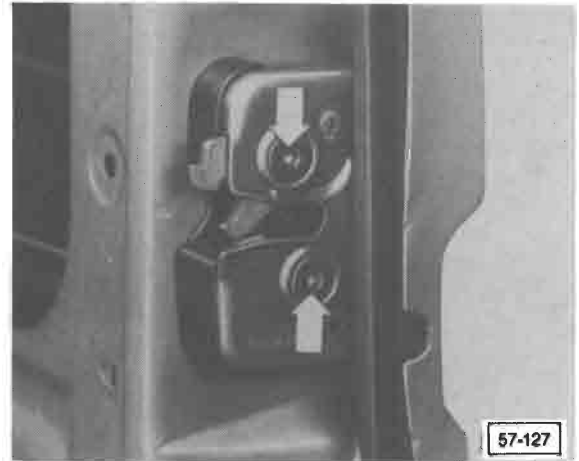
**Fig. 1 Door handle (inner) with connecting rod, removing**

- remove bolts (**arrows**)
- detach connecting rod and remove door handle



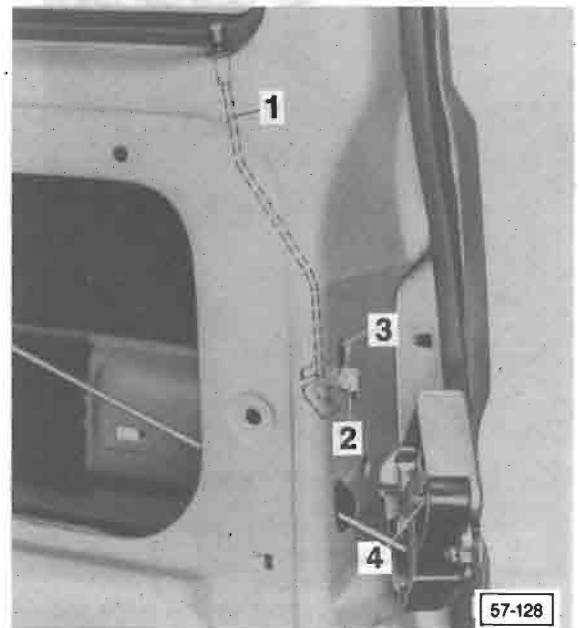
**Fig. 2 Door handle (outer), removing**

- remove door weatherstrip and remove screw (**arrow**)
- push door handle to front of vehicle and remove



**Fig. 3 Door lock, removing**

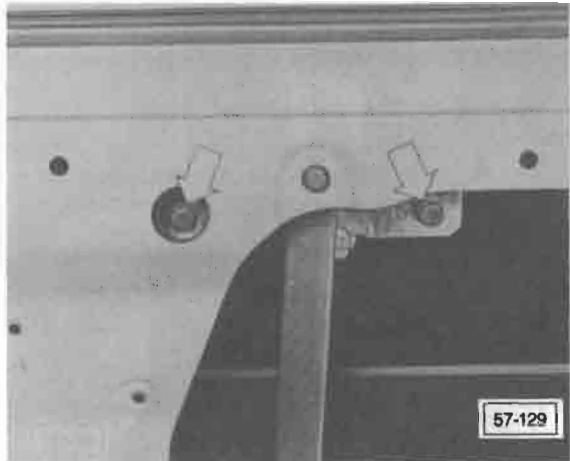
- remove two socket head screws (**arrows**)
- pull door lock out of locking rod sleeve and remove lock complete with connecting rod



**Fig. 4 Door lock/locking rod, installing**

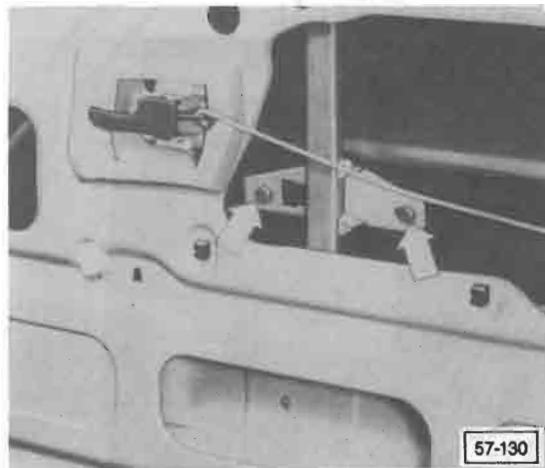
- set locking rod **1** in installed position
- push locking sleeve **2** through door opening **3** so that plastic lugs prevent it from springing back
- push sleeve **2** onto locking lever and at same time install door lock

# 57 Body-Front Doors



**Fig. 5 Door window glass, removing**

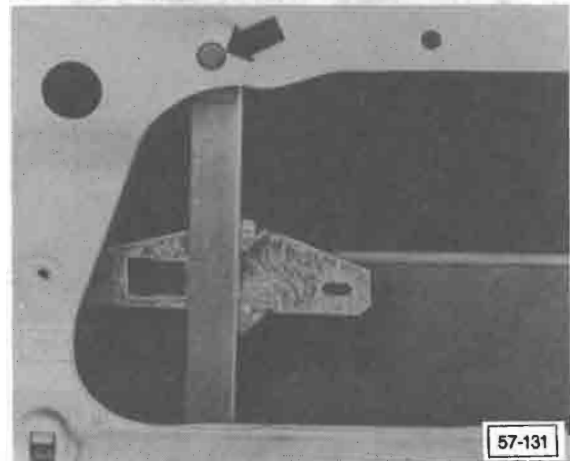
- wind window down slightly
- remove two bolts (**arrows**) from window regulator
- push door window up fully and remove



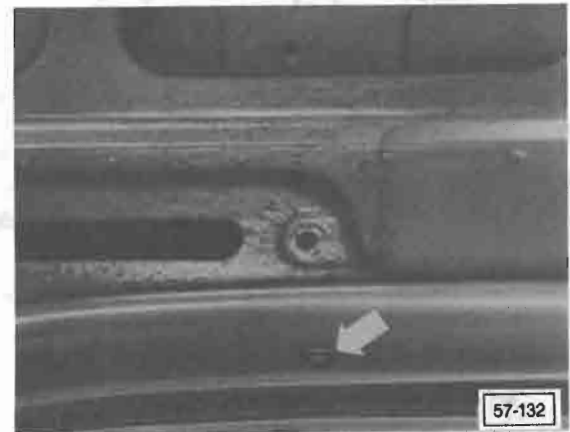
**Fig. 6 Door window glass, installing**

- loosely attach window glass to window regulator (**arrows**)
- wind up window fully
- align window in front window guide and upper window guide channel
- wind window down slightly
- tighten bolts through hole in inner door frame

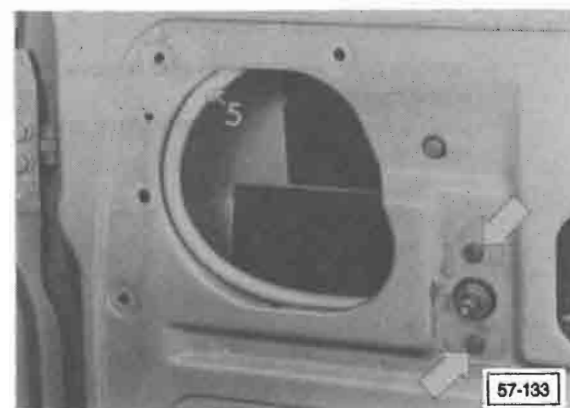
## Window regulator, removing



- remove bolt (**arrow**)

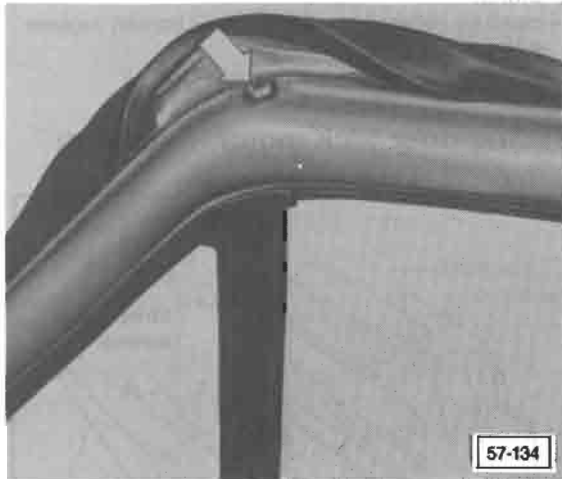


- remove bolt (**arrow**) from underneath door

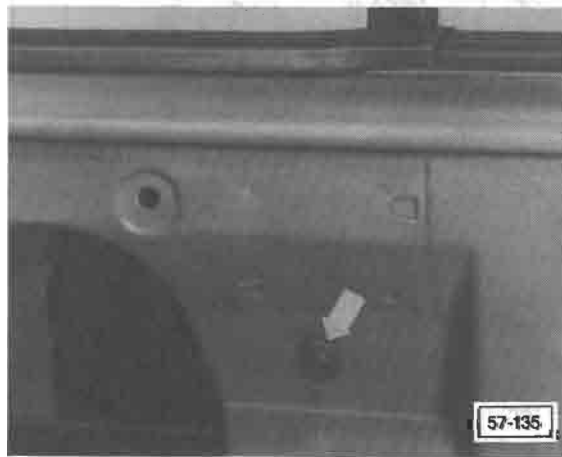


- remove window regulator seal
- remove bolts (**arrows**)
- bend back metal lug **5** and remove window regulator

## Window front guide channel, removing



— pull off weatherstrip and remove screw (**arrow**)



— remove bolt (**arrow**)  
— pull guide channel down and remove

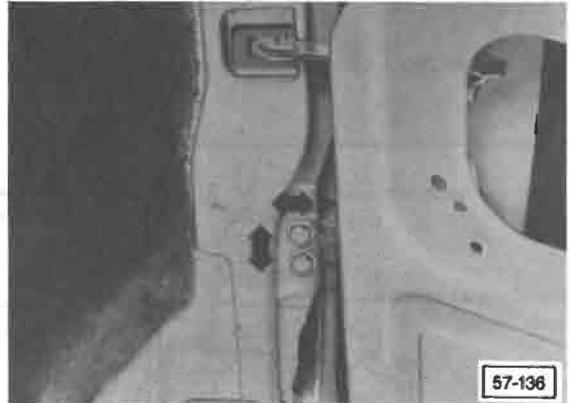
## Window front guide channel, installing

Reinstall all components in reverse order of removal.

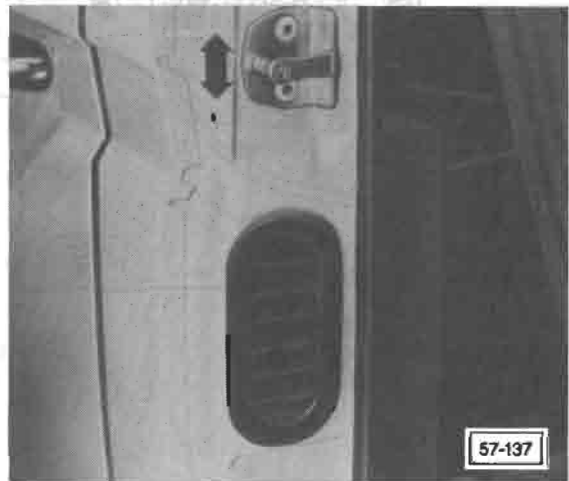
## Front doors, adjusting

### Note

Front door is correctly adjusted when there is an even gap all around door when shut. Door and body belt-line must align and door must be flush with body.



— if door does not line up with outer panel, or an even gap does not exist all around, loosen hinge bolts (**arrows**) and move door as required



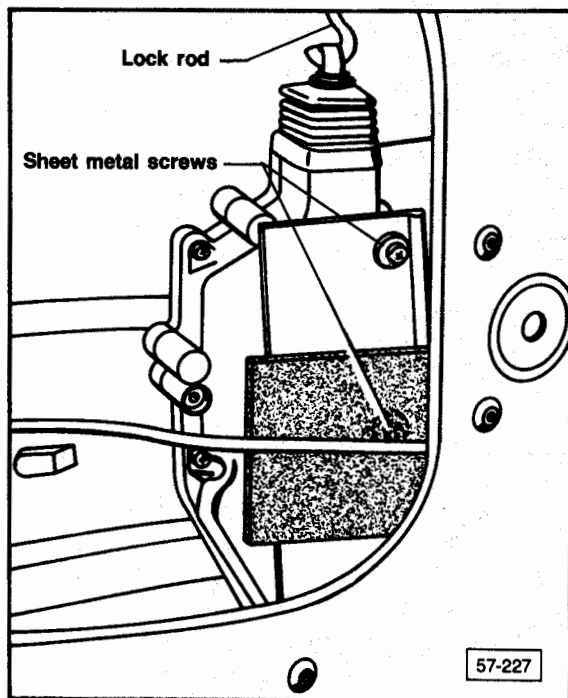
— adjust door at rear by moving striker plate (**arrows**)

# 57 Body – Front Doors

Starting March 1986, power door locks are available for Vanagon vehicles.

## Power door lock motors, removing

- disconnect battery ground strap
- remove door trim panel
- carefully pull off plastic moisture barrier as necessary
- pull off electrical connection for power window switch
- pull off electrical connection from power door lock motor



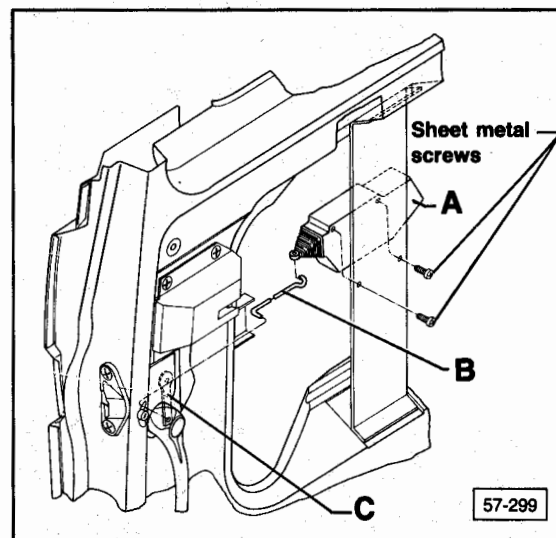
- remove sheet metal screws
- remove power door lock motor

## Power door lock motors, installing

Installation is in reverse order of removal noting the following:

- carefully reinstall plastic moisture barrier, replace if damaged
- check locks for proper functioning

## Sliding door lock motor, removing



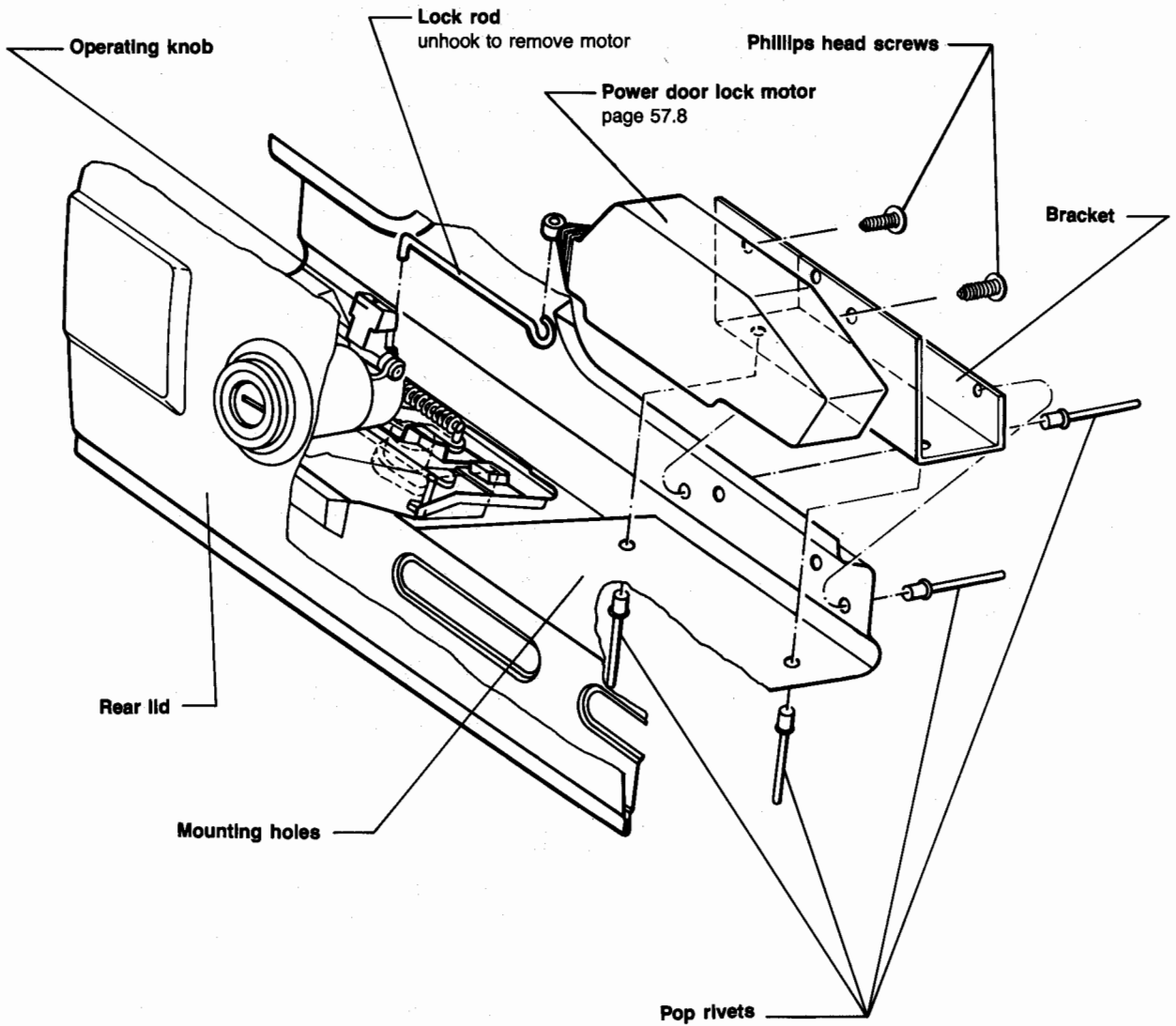
- A — power door lock motor
- B — lock rod
- C — remove control lock

- disconnect battery ground strap
- remove door trim panel
- pull off electrical connection from power lock motor
- remove two sheet metal screws
- take out power door lock motor

## Sliding door lock motor installing

Installation is in reverse order of removal noting the following:

- check lock for proper functioning



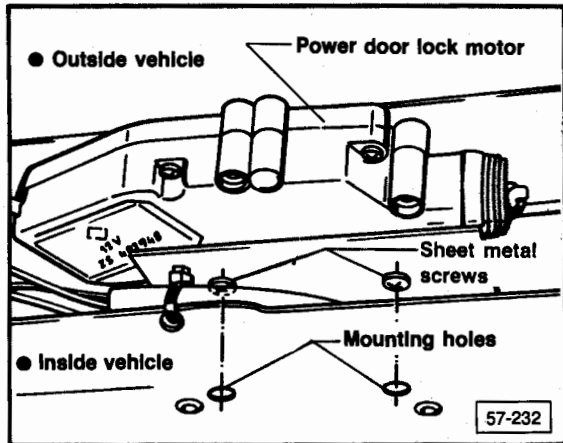
57-230



# 57 Body – Front Doors

## Rear lid door lock motor, removing

- disconnect battery ground strap
- remove rear lid trim panel
- pull off electrical connection from power door lock motor



- remove sheet metal screws

### Note

Sheet metal screws are recessed into rear lid frame.

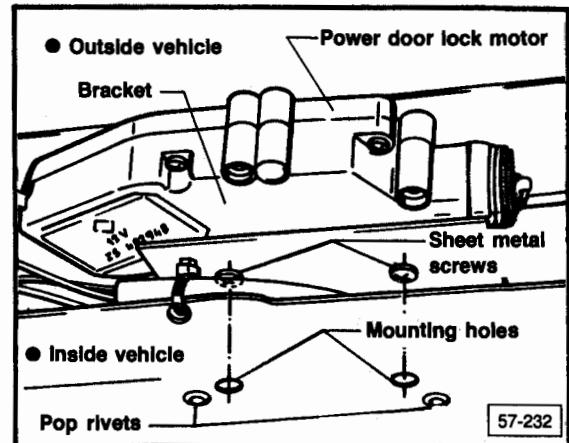
- remove power door lock motor

## Rear lid door lock motor, installing

Installation is in reverse order, noting the following:

- check door lock for proper function

## Power door lock motor/bracket installation, spare parts only

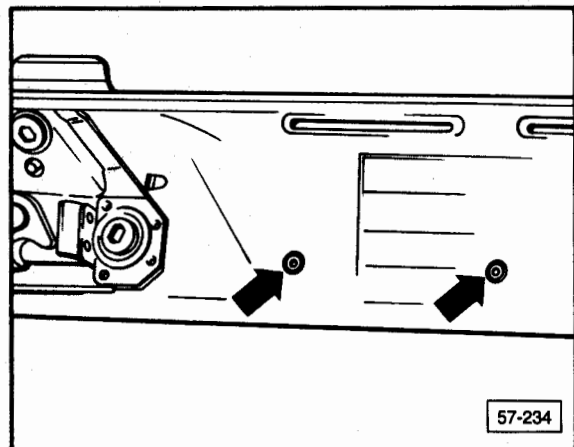


Replacement rear lids are provided with holes pre-punched for pop rivets in the inner sheet metal.

Additionally, both mounting holes for fastening power door lock motor to bracket are provided.

### Installing

- position bracket and fasten with pop rivets



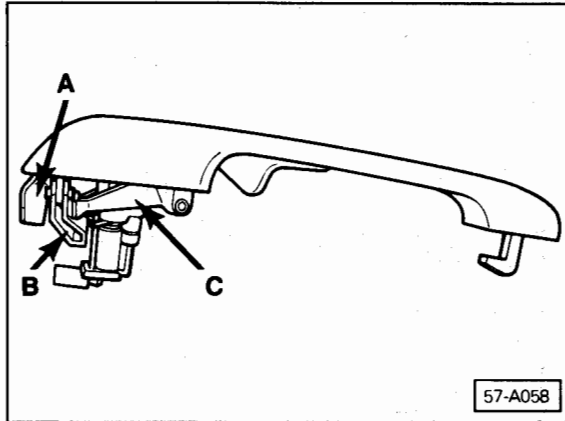
- from inside of lid drill two 4 mm (5/32 in.) holes for lower pop rivets

### Note

Drill bit must extend at least 65 mm (2.5 in.) out of chuck.

- remove any burrs from holes and touch up with paint and corrosion protection
- install rivets (arrows) from outside with a riveting tool

## Lost/broken keys, key code



In the event of a lost or broken key, the key code can be obtained from three possible locations on the outside door handle (after removal).

- A — Release lever.
- B — Front hold-down hook.
- C — Transfer lever

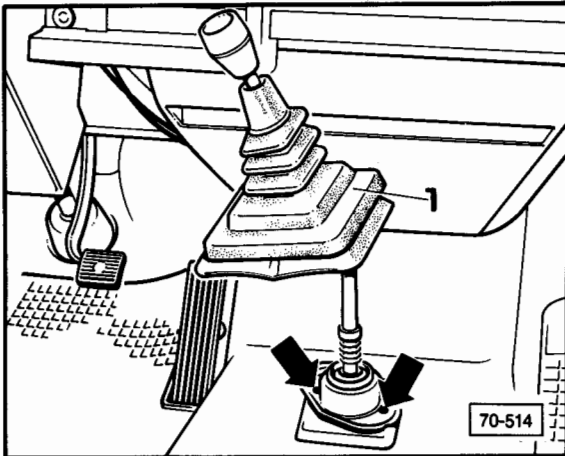
# 57 Body—Front Doors

## Whistling noises, eliminating

Since the routing of ventilation from driver's door to rear side windows, whistling noises have occurred at approximately 70km (42 mph), or when vehicle is parked and fresh air blower is running at 2nd or 3rd speed.

**Test drive vehicle to determine location.**

## Whistling noises from center of instrument panel, eliminating



### Note

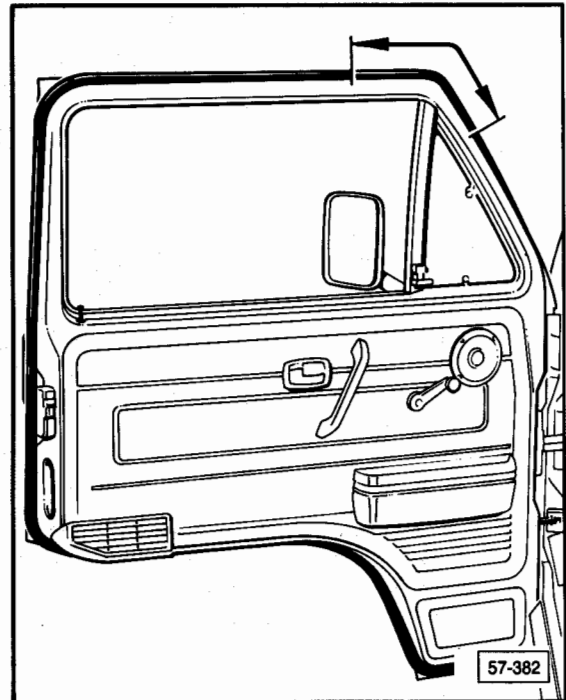
Procedure applies only to vehicles with:

- gearshift lever bracket Part No. 251 711 231A
- without raised center instrument panel
- up to VIN 25JH087797

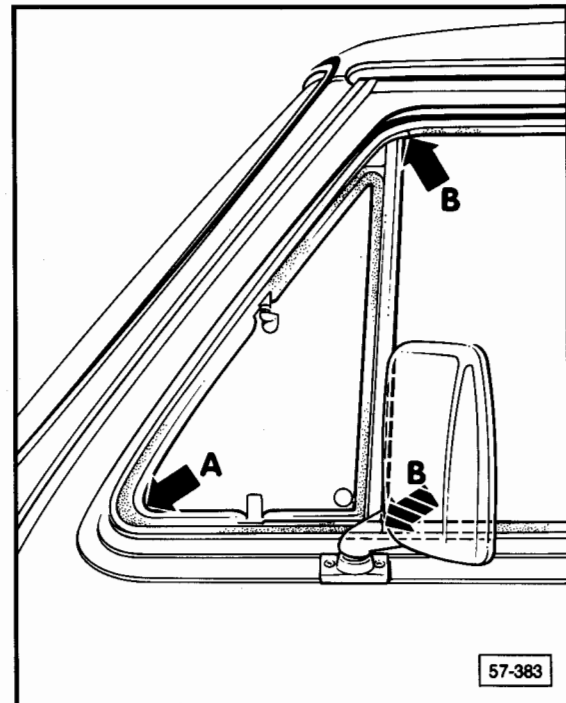
- pull up boot 1
- seal assembly holes (arrows) with 5.0mm (13/64 in.) dia. bead of adhesive strip AKD 476 KD5 05 or equivalent

## Whistling noises at driver's/passenger front door, eliminating

- check and adjust driver's/passenger front door as required

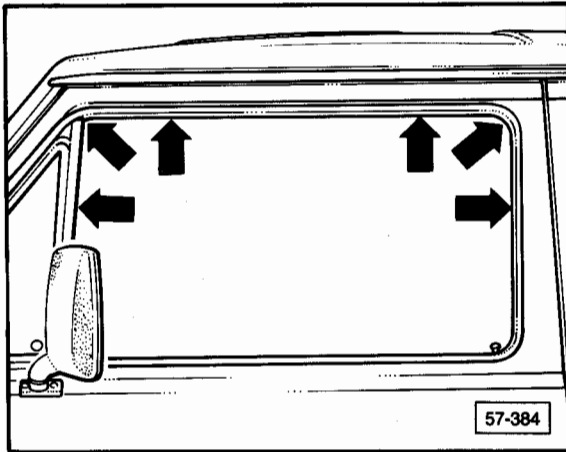


- check fit of door seal at area over window guide (arrow)
- seal with adhesive D 002 100 or equivalent

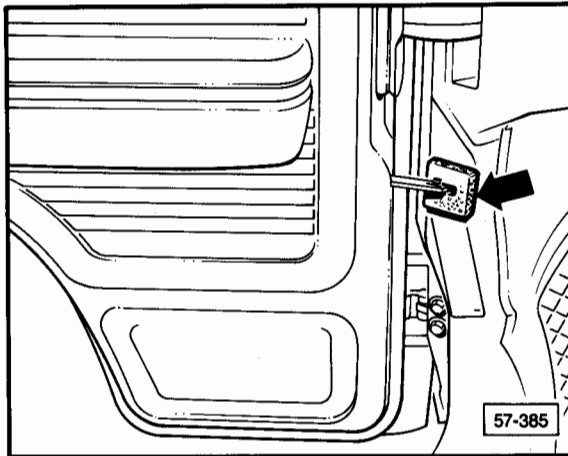


- check for secure fit at quarter window (arrow A) replace if necessary

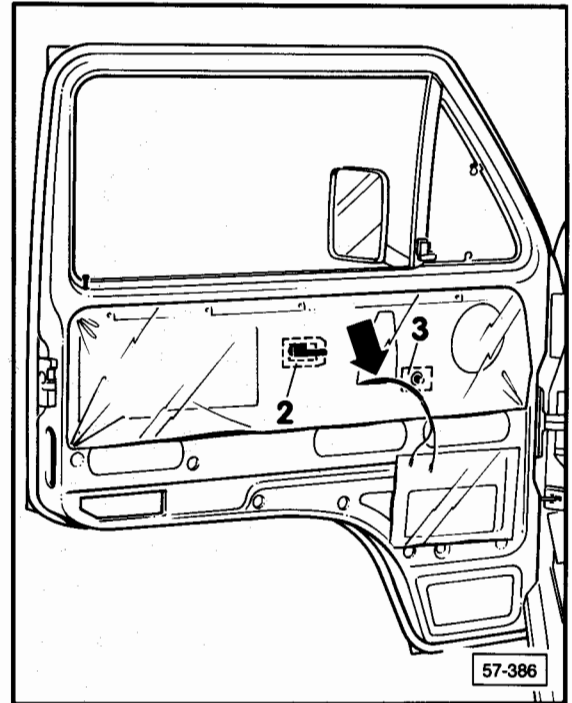
- check bonding at overlap area of seal (window guide and channel seal) (**arrow B**)
- reseal with adhesive **D 002 100** or equivalent



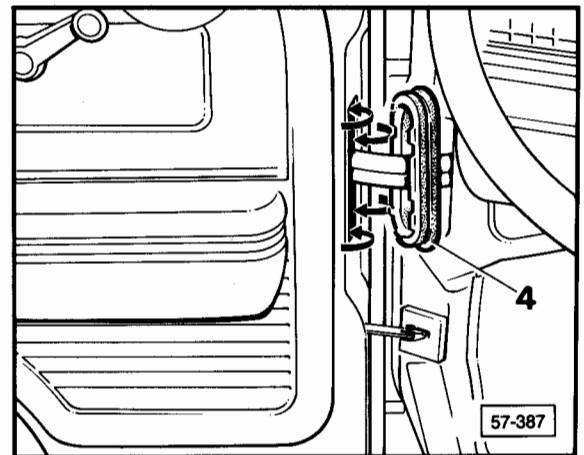
- check fit of door glass in guide when closed
- adjust as required



- check bracket seal (**arrow**)
- replace if defective

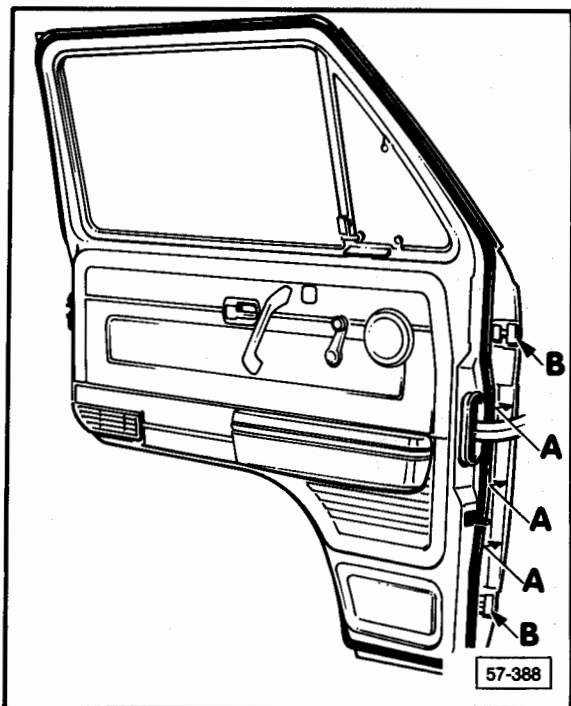


- check plastic moisture barrier for damage
- replace or resecure as necessary
- seal opening for cables for door speakers, power windows or mirrors, if equipped (**arrow**)
- check correct fit of foam for window crank **3**, inside door opening mechanism **2**



- pry out seal for front air channel seal **4**
- seal gaps with sealant **AKD 476 KD5 05** or equivalent at inlet area of door air channel
- reinstall seal for front air channel **4**

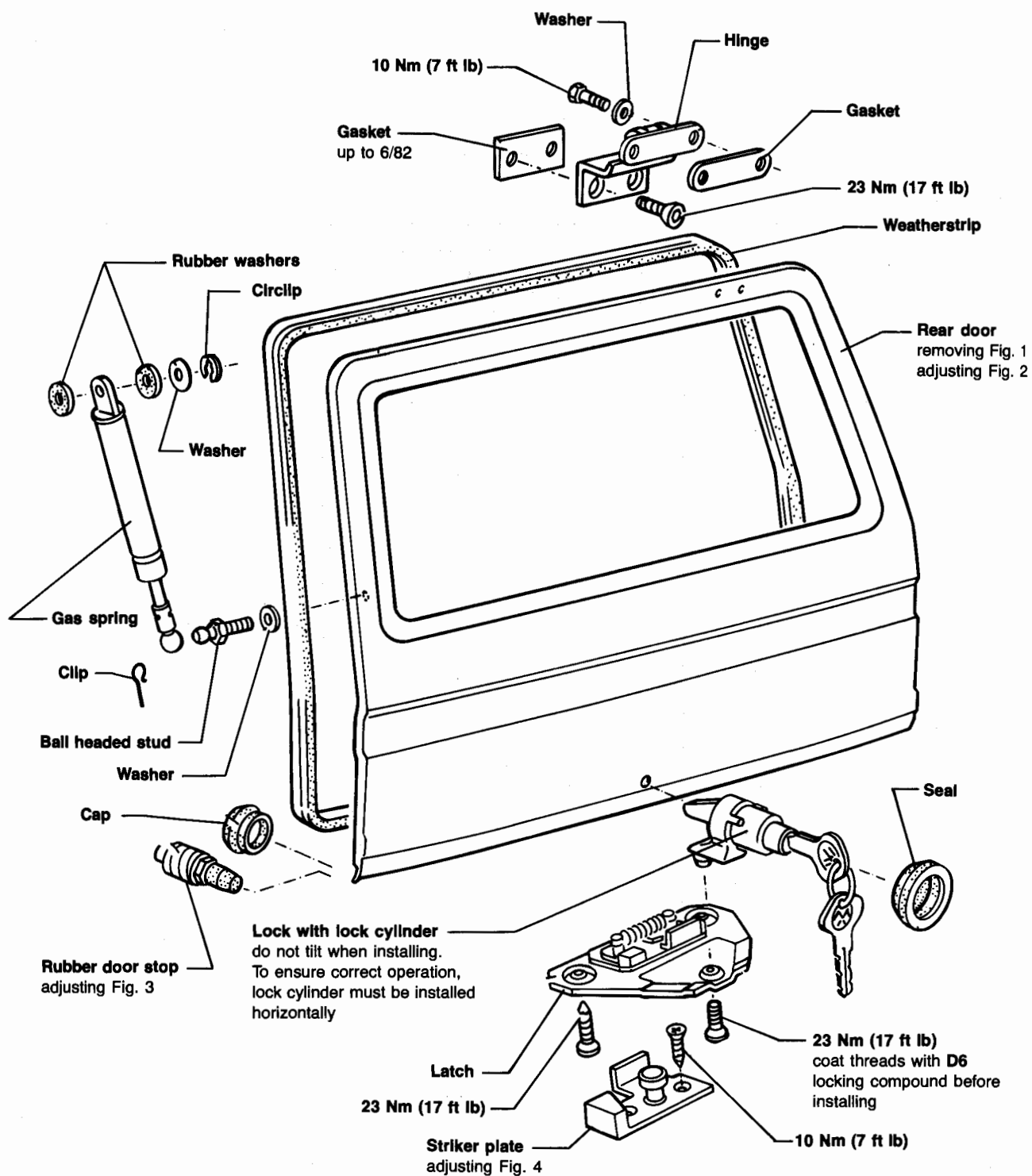
# 57 Body—Front Doors



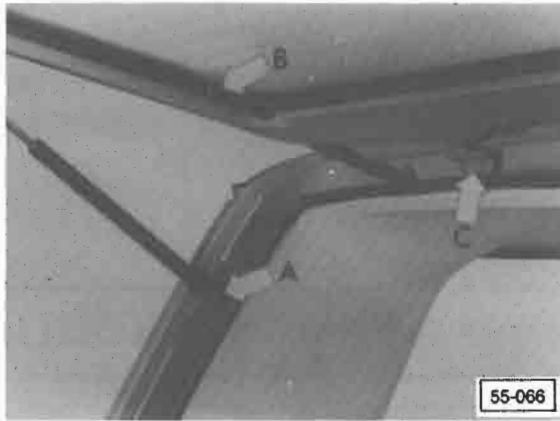
- remove door
- seal cowl weld flange (arrow A), door hinges (arrow B)
- test drive or operate fresh air blower and check for whistling noises

<b>Index</b>	
	<ul style="list-style-type: none"><li>— Rear door/lock cylinder 55.2</li><li>— Rear lid spring 55.4</li><li>— Rubber door stop 55.3</li><li>— Striker plate 55.3</li></ul>

# 55 Hoods, Lids

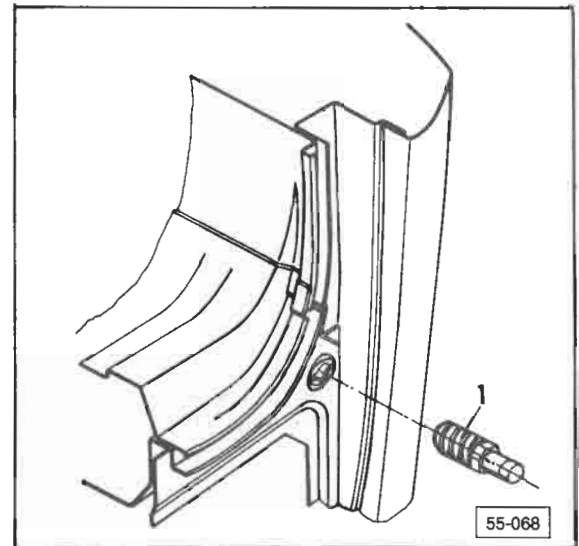


## 55.2 Rear door/lock cylinder, assembly



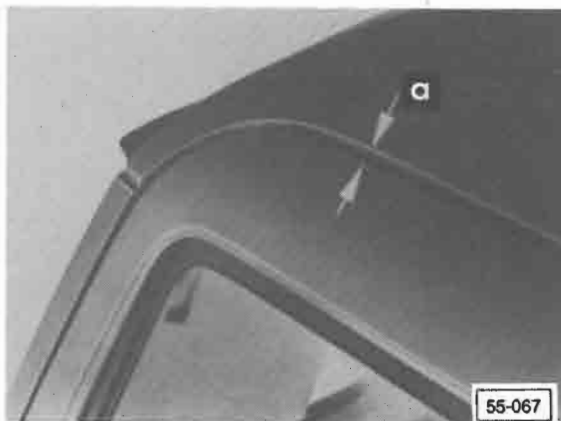
**Fig. 1 Rear door, removing**

- pry off circlip (arrow **A**) and pull off gas spring from ball headed stud
- disconnect rear window defogger wire connection (arrow **B**), connection for heated side mirror, remove ground cable and pull wiring harness out of rear door
- remove socket head screws (arrow **C**) and take off rear door



**Fig. 3 Rubber door stop, adjusting**

- adjust rubber stop **1**, by screwing in or out until rear door is flush with outer panel



**Fig. 2 Rear door, adjusting**

- loosen hinge socket head screws and move door up or down as necessary
  - **a** = 12 ± 1.0 mm (15/32 ± 3/64 in.)
- move door to left or right to obtain even gap at rear door sides



**Fig. 4 Striker plate, adjusting**

- loosely attach striker plate (arrow)
- close rear door
- open rear door and tighten screws
  - 10 Nm (7 ft lb)



# 55 Hoods, Lids

---

## Rear lid variable gas spring

For complaints that rear-lid gas spring causes rear hatch to open completely, such that lid is too high for some people to reach to close, correct as follows:

- install new-type variable gas cylinders, Part No. 251829331B/332 (in pairs only). These cylinders allow the rear hatch to stay open in various positions

### Note

New-type gas cylinders are installed in current production vehicles (starting May, 1982; VIN No. 25 CH 126332)

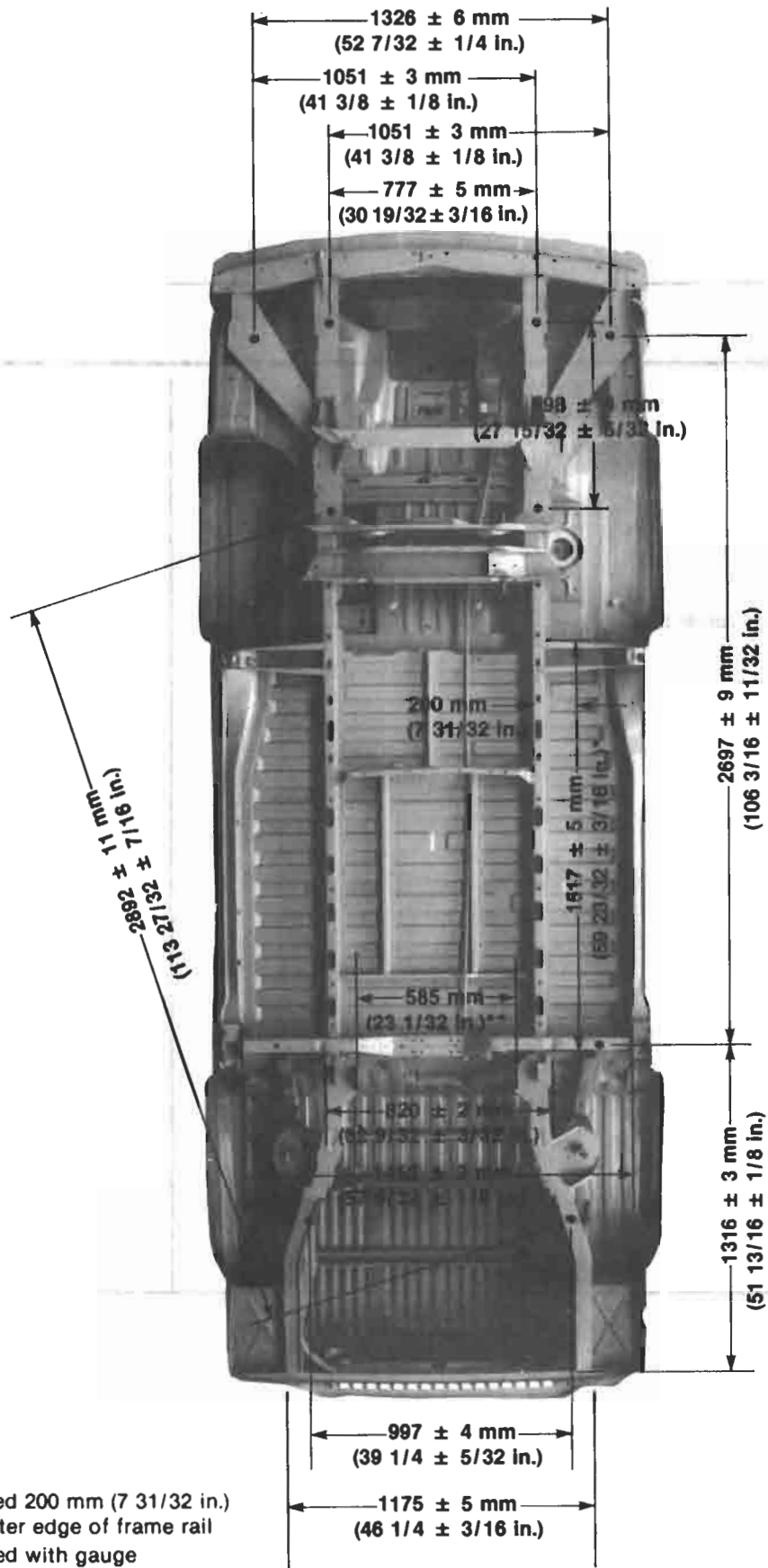
### CAUTION

Part numbers are for reference only. Always check with your Parts Department for latest parts information

# Index

- Acid rain  
removing spots 50.6
- Adhesives  
materials 50.5
- Body dimensions  
door 50.4  
floor 50.2  
windshield 50.4
- Painting  
pop-up roof/luggage carrier 50.5
- Plastics  
identifying 50.5  
repairing 50.5

# 50 Body



00-913

## 50.2 Floor section dimensions

Please note the following floor dimension measurements for Vanagon Syncro.  
All other dimension measurements remain valid.

**Note**

**Measurement Key**

- A =  $750 \pm 2\text{mm}$  ( $29\frac{1}{2} \pm \frac{3}{32}$  in.)
- B =  $704 \pm 1\text{mm}$  ( $27\frac{3}{4} \pm \frac{1}{16}$  in.)
- C =  $683 \pm 1\text{mm}$  ( $26\frac{7}{8} \pm \frac{1}{16}$  in.)
- D =  $225 \pm 1\text{mm}$  ( $8\frac{7}{8} \pm \frac{1}{16}$  in.)
- E =  $253\text{mm}$  (9.96 in.)
- F =  $289 \pm 1\text{mm}$  ( $11\frac{3}{8} \pm \frac{1}{16}$  in.)



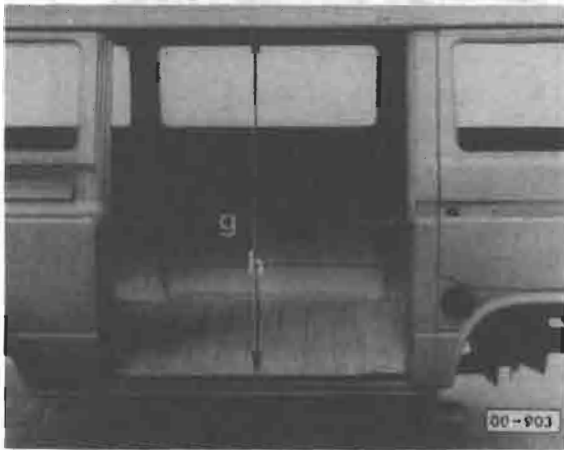
00-2221

# 50 Body



**Front door**

- a = 1157 ± 3 mm (45 9/16 ± 1/8 in.)
- b = 1270 ± 4 mm (50 ± 5/32 in.)
- c = 1564 ± 1 mm (61 9/16 ± 1/32 in.)
  - largest distance between welded body seams
- d = 1566 ± 1 mm (61 21/32 ± 1/32 in.)
  - distance between door contact switch holes



**Side door**

- g = 1185 ± 5 mm (46 21/32 ± 3/16 in.)
- h = 1348 ± 4 mm (53 1/16 ± 5/32 in.)



**Rear door**

- j = 1050 ± 2 mm (41 11/32 ± 3/32 in.)
- l = 1618 ± 5 mm (63 11/16 ± 3/16 in.)
- a = 340 mm (13 3/8 in.)



**Windshield**

- k = 723 ± 4 mm (28 15/32 ± 5/32 in.)
- l = 1469 ± 5 mm (57 27/32 ± 3/16 in.)

## 50.4 Door/Windshield dimensions

## Identifying/painting and repairing plastic parts

Refer to the Volkswagen of America Refinishing Guide, Lit. No. **W42-701-008-1**.

## Body assembly materials

Refer to the Volkswagen of America Refinishing Guide, Lit. No. **W42-701-008-1**.

### CAUTION

Part numbers are for reference only. Always check with your Parts Department for latest parts information.

## Pop-up roof/luggage carrier, painting

### Color determination

- locate pop-up roof/luggage color on vehicle identification plate
- if pop-up roof/luggage carrier is painted in a color other than the body, consult a color chart for the correct color code

### Surface preparation

- thoroughly clean and dry pop-up roof/luggage carrier
- roughen surface with steel wool
- reclean and thoroughly leave dust free

### Painting

- paint surface with synthetic resin, acrylic, or two-component paint in selected color
  - adhesive promoter is not necessary

## Acid rain spots on paint, removing

### Note

Applies to all vehicles without acrylic transport protection

Acid rain spots are most visible under fluorescent light and look like water spots.

In most cases, you can remove these spots by performing the following procedures and thus avoid re-painting.

Do **NOT** confuse the effects of acid rain damage with industrial fallout. Industrial fallout consists of small airborne metallic particles that settle onto the paint and eventually eat their way into the finish. Rubbing your hand across the clean surface will reveal a gritty texture.

If acid rain spot removal is new to you, we recommend that you contact a good body shop or reconditioning center.

### WARNING

Before using any chemicals or cleaning compounds, carefully read all of the cautions and medical information on the container. Always follow all of the manufacturer's recommendations.

Most makers of professional automotive reconditioning products recommend the following six steps **IN SEQUENCE** to repair acid rain paint spots:

### Step 1: Inspection

- wash vehicle with mild soap and water, then dry completely

### CAUTION

Do **NOT** wash or dry vehicle in direct sunlight. Ordinary water spots could form and confuse the inspection.

- inspect the following surfaces under a fluorescent light
  - hood, roof, rear deck, tops of fenders, painted surfaces of bumpers and doors from the belt line up

## Step 2: Neutralization

The continuing effect of the acid must be stopped by neutralizing.

- mix a solution of baking soda and water (4 tablespoons per gallon) and stir until completely dissolved
- apply solution to all affected areas and let stand for a few minutes before rinsing off with clear water

Commercial neutralizing products such as "Blue Max" by Car Brite® or equivalent work well.

## Step 3: Buffing

You can buff by hand or with a low speed orbital buffer or with a high speed buffer.

### CAUTION

It is extremely important that power buffing be done by an experienced person. If done incorrectly, power buffing can quickly and easily damage the paint finish.

Use clean buffing pads at **ALL** times.

- mask off any trim or glass close to affected areas
- buff small areas at a time, no larger than two feet by two feet
- buff using a light polishing compound such as "Finesse-It" by 3MR, "Acid Rain Creme" by Car Brite®, or equivalent. Follow the manufacturers instructions to achieve the best possible results.



**CAUTION**

Do **NOT** use general purpose rubbing or buffing compounds. They are too coarse for this application and could damage the finish.

- buff surface until acid spots are removed

**Note**

Inspect the work surface frequently during buffing to ensure that only a minimum of original finish is removed. If the color of the vehicle shows up on the buffing pad, you have cut through the clearcoat and you have to repaint the affected area.

**Step 4: Cleaning**

- wash vehicle thoroughly with a solution of mild soap and water
- rinse vehicle with clear water then dry completely
- inspect vehicle to see if another application is necessary

**Step 5: Polishing**

Polish the finish to restore the original luster either by hand or with a power buffer. Always follow polishing with an application of wax.

**CAUTION**

It is extremely important that power buffing be performed by an experienced person. If done incorrectly, power buffing can quickly and easily damage the paint and finish.

Use clean buffing pads at **ALL** times.

- buff with polishes such as "Liquid Polish" by 3MR, "Crystal Shine" by Car Brite®, or equivalent. Follow the manufacturers instructions to get the best possible results.

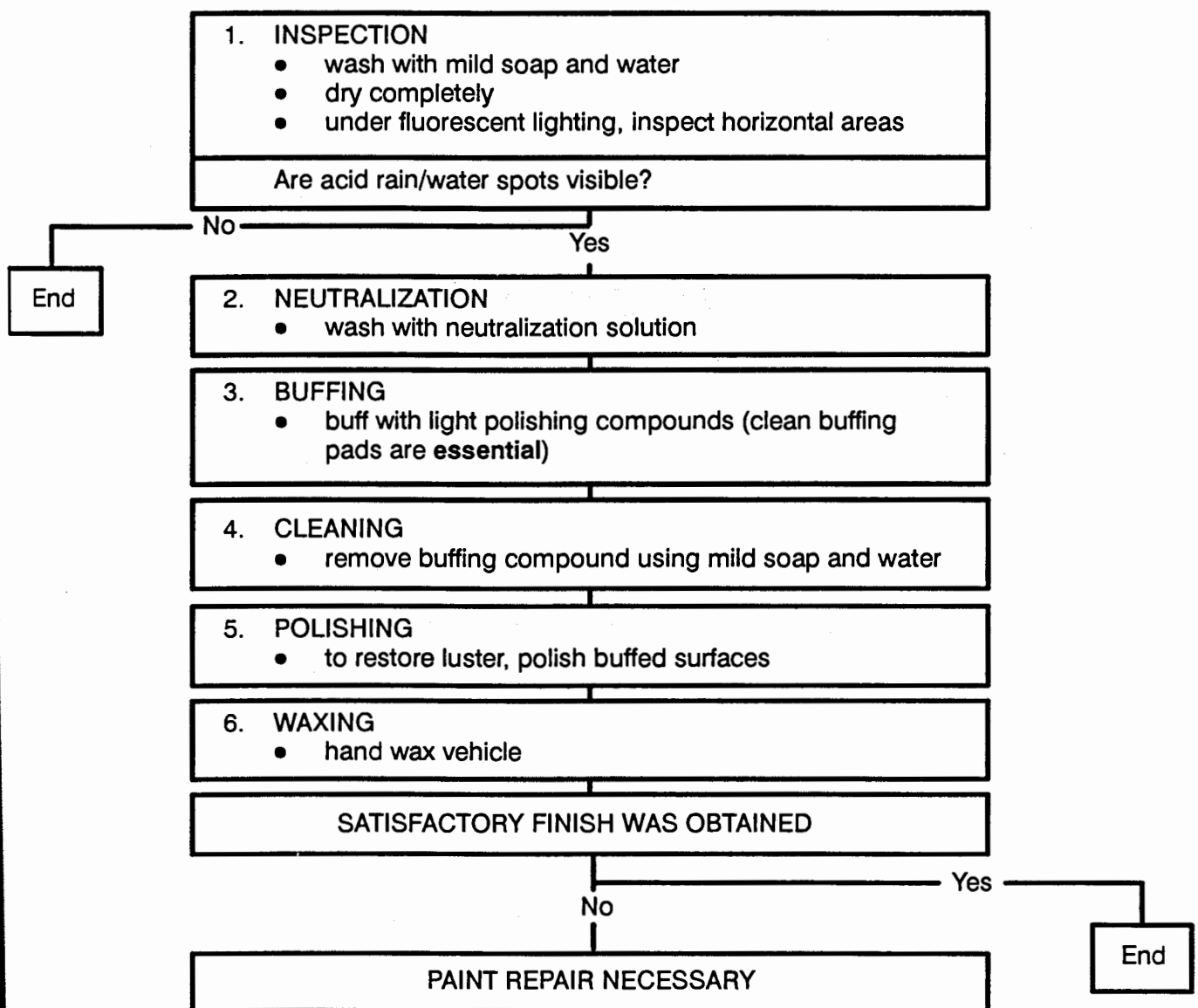
**Step 6: Waxing**

Waxing (unlike polishing) will seal the finish and prevent acid rain from leaving spots.

- **HAND WAX** using clean cheesecloth and a good quality non-abrasive wax.

If, in extreme cases, you can still see acid rain spots after the previous six steps, or if the clearcoat has been rubbed through, it will be necessary to re-paint the affected areas.

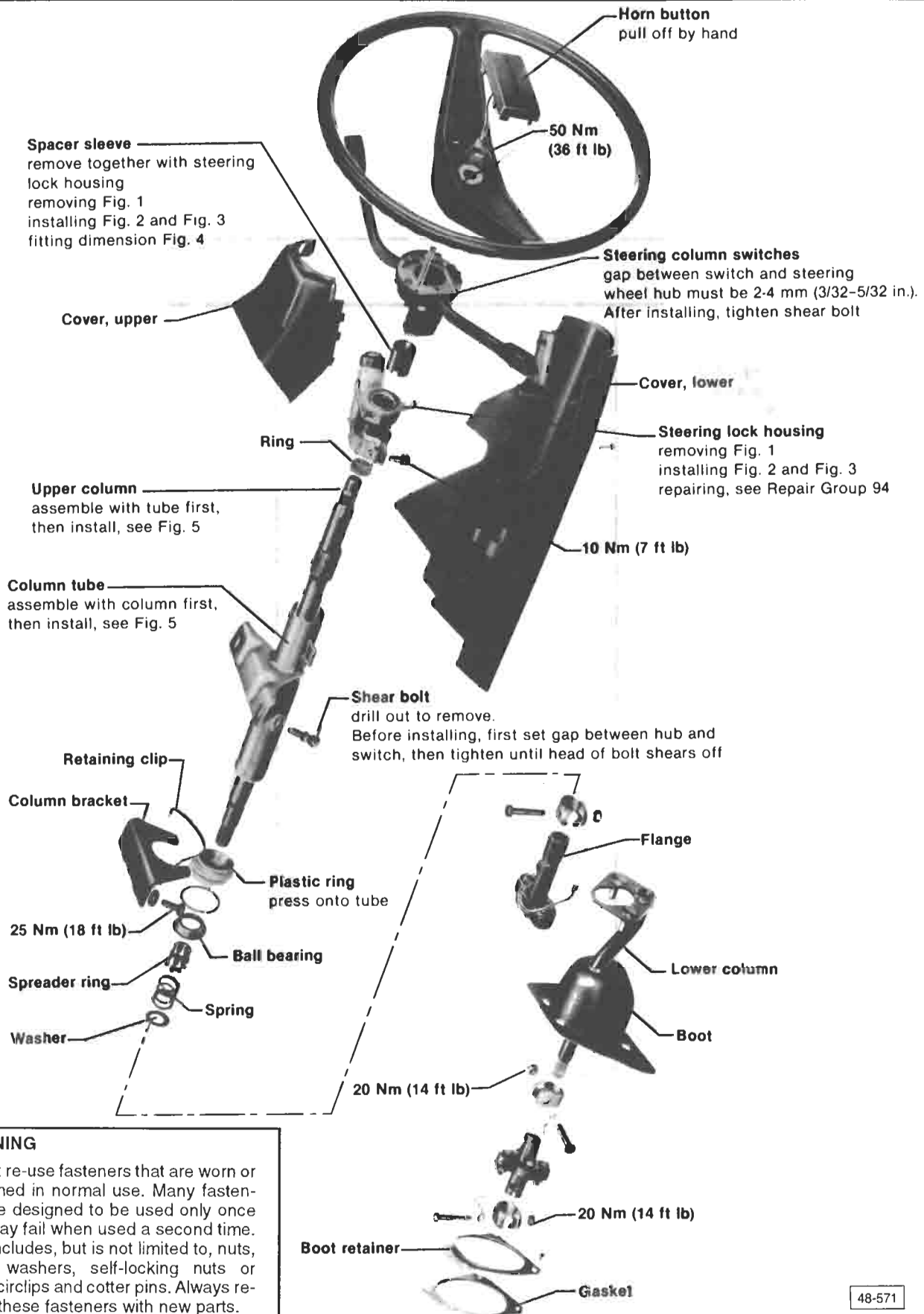
**Acid Rain Spot Removal Flowchart**  
(See detailed instructions on previous pages)



## Index

- Power steering
  - checking for leaks 48.7
  - pressure/flow limiting valve 48.11
  - suspension changes 48.6
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# 48 Steering



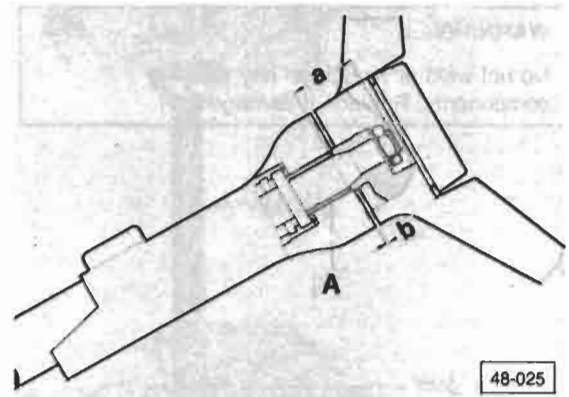
**WARNING**

Do not re-use fasteners that are worn or deformed in normal use. Many fasteners are designed to be used only once and may fail when used a second time. This includes, but is not limited to, nuts, bolts, washers, self-locking nuts or bolts, circlips and cotter pins. Always replace these fasteners with new parts.

48-571



**Fig. 1 Steering lock housing, removing**  
 — pull off steering lock housing together with spacer sleeve

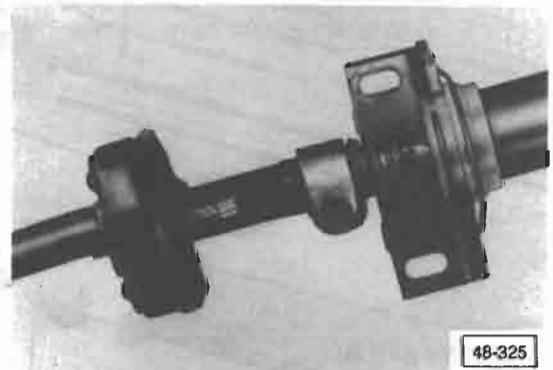


**Fig. 4 Spacer sleeve, installation dimension**

A = spacer sleeve  
 a = 51 mm + 5 mm (2.0 in. + 13/64 in.)  
 b = 2-4 mm (3/32-5/32 in.)



**Fig. 2 Steering lock housing/spacer sleeve, installing**  
 — when installing spacer sleeve, clamp steering column at top and bottom



**Fig. 5 Upper steering column/column tube, assembling**



**Fig. 3 Steering lock housing/spacer sleeve, installing**  
 — note dimension a of Fig. 4

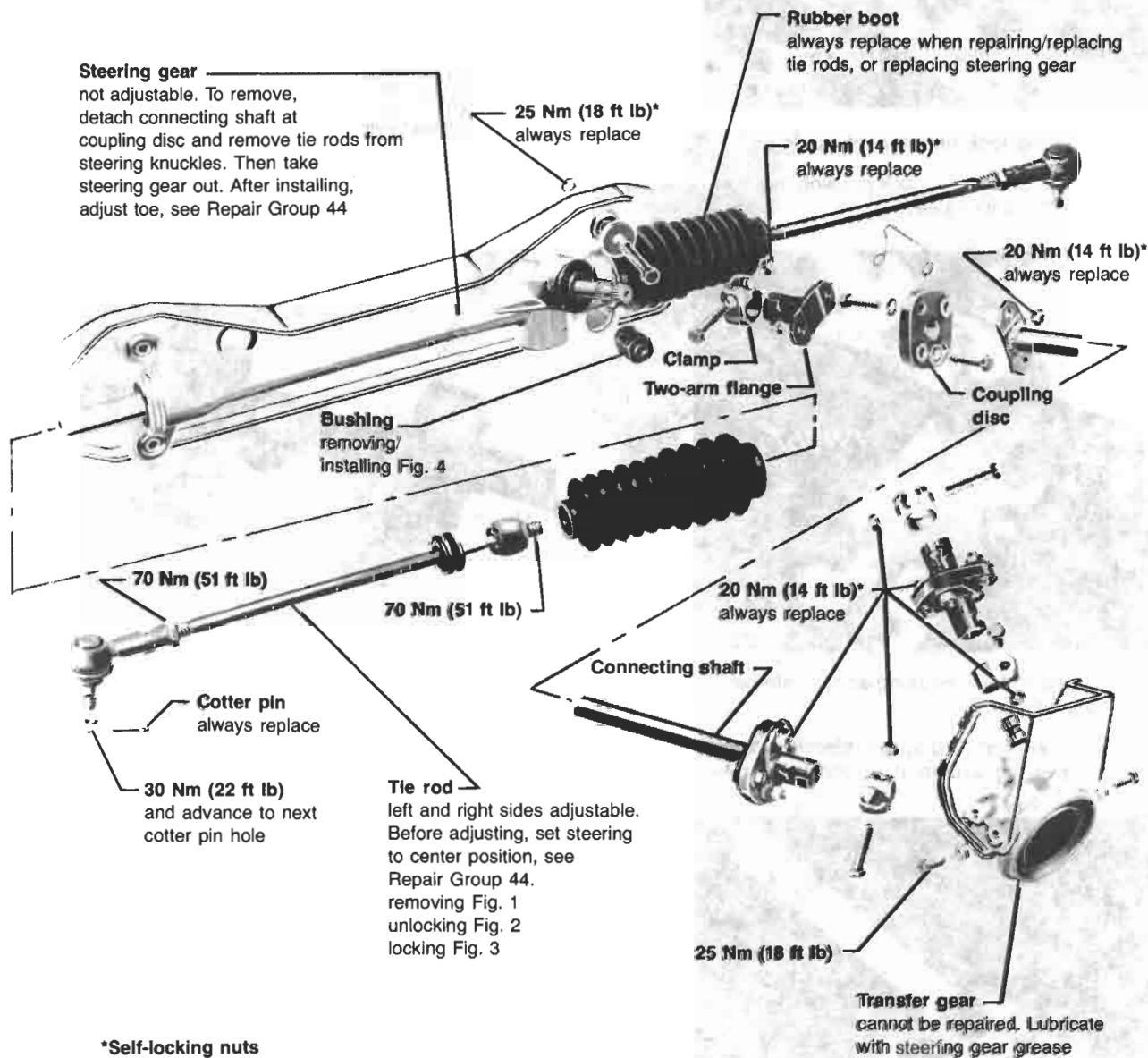
# 48 Steering

## WARNING

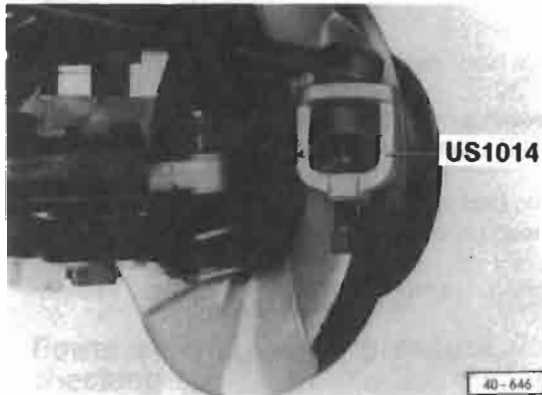
Do not weld or straighten any steering components. Replace if damaged.

## CAUTION

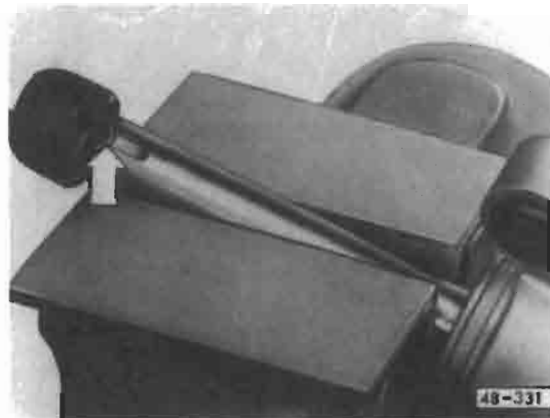
Only use special steering gear grease Part Number AOF 063 000 04, or equivalent, to lubricate steering gear.



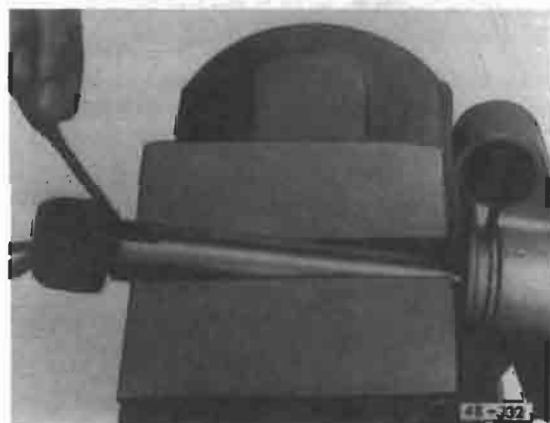
48-329



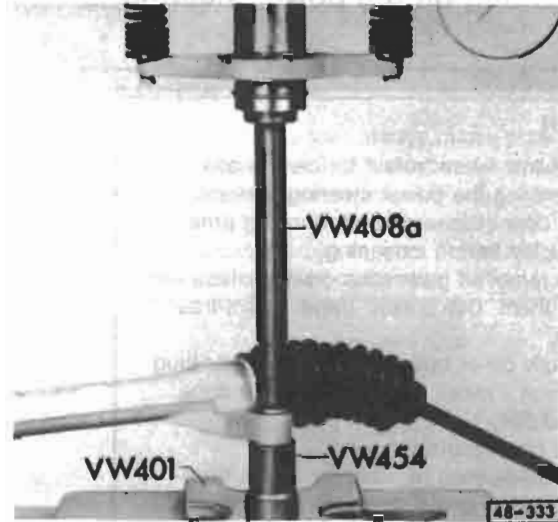
**Fig. 1 Tie rod, removing**  
— press tie rod off steering knuckle



**Fig. 2 Tie rod, unlocking**  
— unlock tie rod (arrow) from steering gear



**Fig. 3 Tie rod, locking**  
— tighten tie rod to 70 Nm (51 ft lb) and lock



**Fig. 4 Bushing, removing/installing**  
— press out or in as shown  
• flat surface of bushings must be vertical when rack is installed in vehicle

# 48 Steering

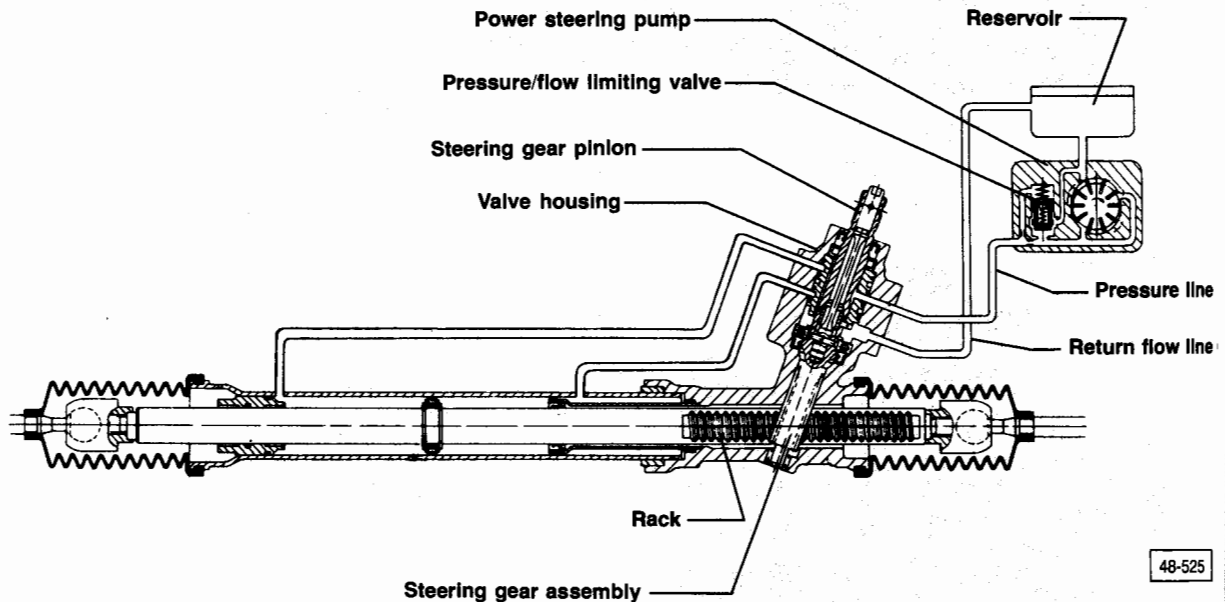
## When working on the power steering system

### CAUTION

Always follow these "rules" for cleanliness when repairing the power steering system:

1. Clean connections and surrounding area thoroughly before loosening.
2. Place removed parts on a clean surface and cover them. Use plastic, paper or lint-free cloths.
3. Carefully cover opened components or plug openings if repair is not going to be done immediately.
4. Install clean parts only.
  - do not remove replacement parts from packaging until just before installation
  - do not use parts that were stored unpacked
5. When the power steering hydraulic system is opened:
  - do not use compressed air in the immediate area
  - do not move the vehicle unless absolutely necessary

## Power steering system layout



## Suspension changes for power steering

- steering knuckles are different
- coupling disc (between steering gear pinion and transfer gear connecting shaft) has been replaced by universal joint

## Technical data for power steering

Lubricant capacity	1.25L (1.3 US qt)
Type	ATF Dexron®
System pressure (at idle)	115-120 bar/1668-1740 psi



## Steering system, checking for leaks (engine running)

- rotate steering wheel lock to lock and hold at limit of travel (no longer than 5 sec.)
- check all line connections and tighten if necessary
- if leak occurs at steering pinion, replace steering gear assembly
- if steering rack seals are leaking (pull boot off steering gear to check), replace steering gear assembly
- check power steering pump for leaks

## Power steering pump pressure, checking



- connect pressure gauge **US 1074 B** between pressure line and valve housing (valve in **open** position)

### Note

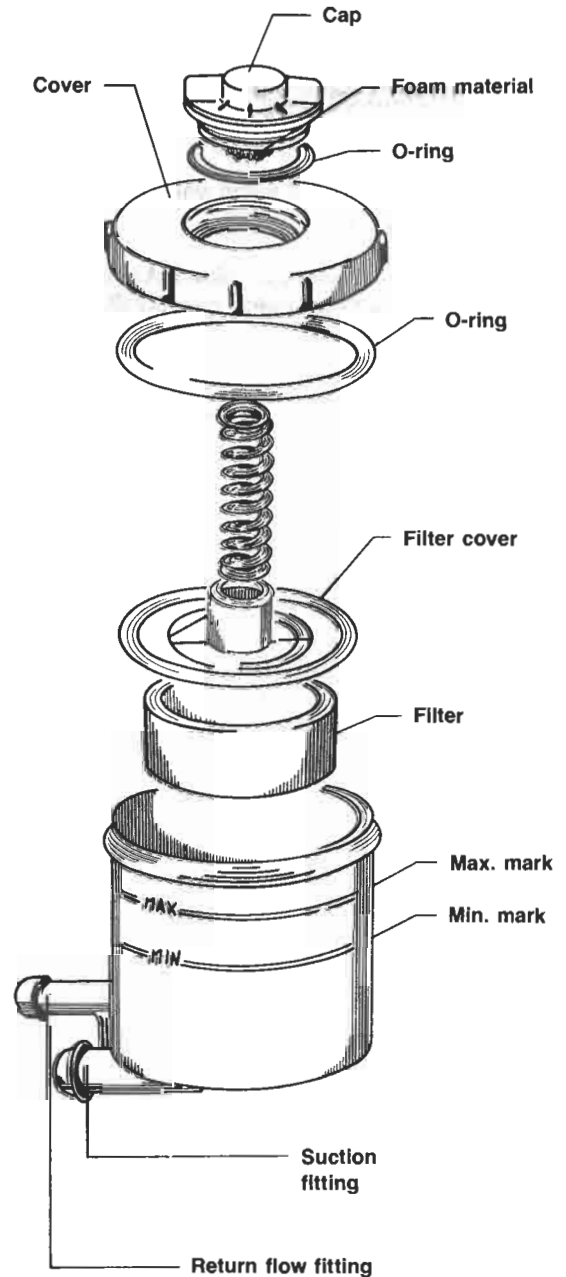
When installing gauge, turn it upwards as far as possible.

- start engine and run at idle
- top up ATF in reservoir if necessary
- close valve (no longer than 5 sec.)
- read pressure
  - 115-120 bar (1668-1740 psi)
- if pressure differs, check pressure/flow limiting valve, see page 48.12
- if pressure/flow limiting valve **OK**, replace power steering pump

## Power steering system, filling/bleeding

### CAUTION

If ATF level is too low, always check power steering system for leaks. Always fill and bleed power steering system with ATF after opening system for repair. Do **not** reuse fluid which has been drained. Always replace power steering filter in reservoir when changing ATF.



Power steering reservoir

# 48 Steering

---

- fill power steering reservoir to **MAX** with ATF
- lift front of vehicle
- with engine **off**, rotate steering wheel from lock to lock
- top up reservoir to **MAX** mark
- start engine briefly several times (switch **OFF** immediately after engine starts)
- add ATF until level is maintained at **MAX** mark

## CAUTION

Do not allow reservoir to be pumped dry.

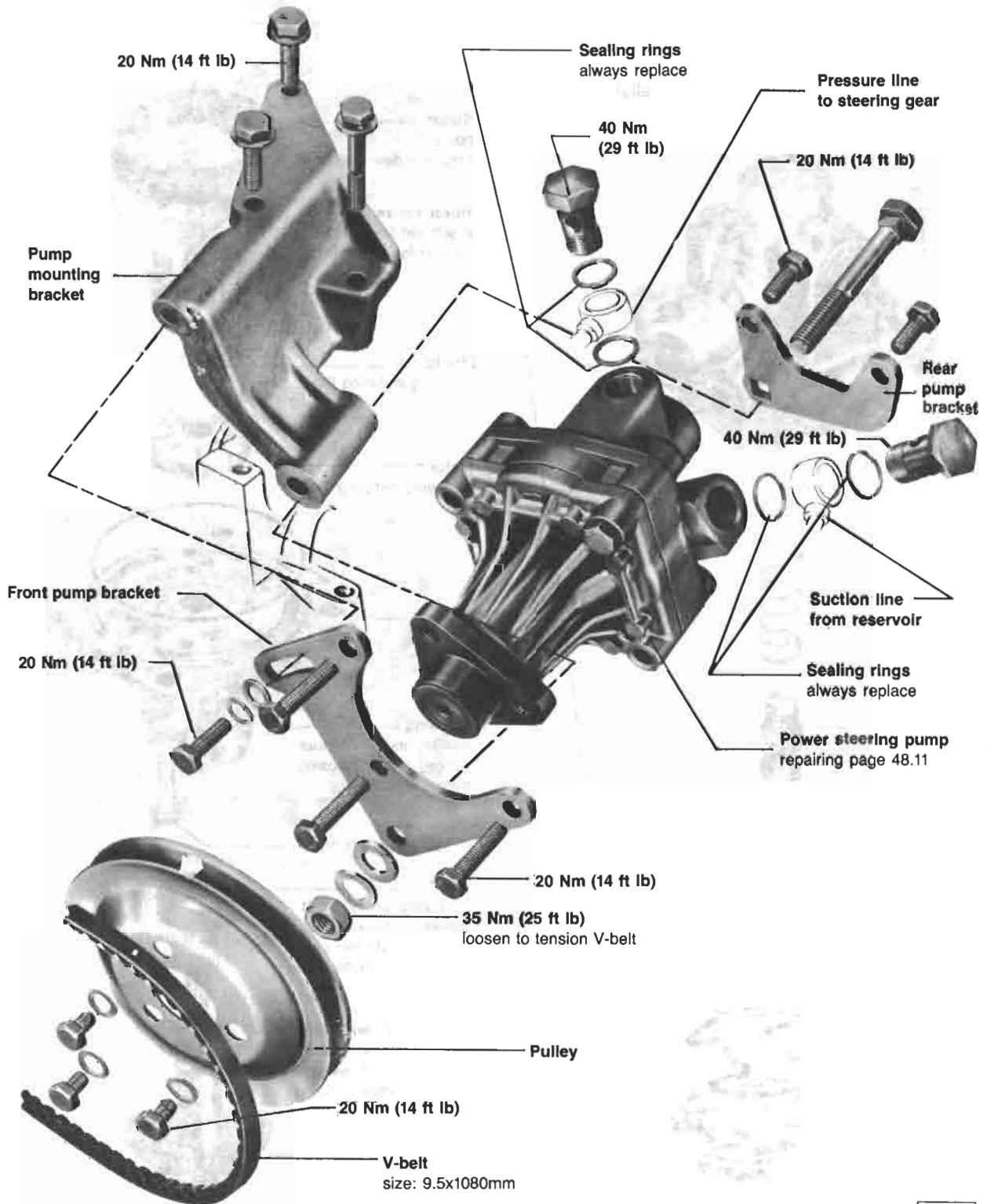
- when ATF level no longer drops, start and run engine
- rotate steering wheel lock to lock several times

## Note

Do not use more force on steering wheel than necessary to turn wheel.

- add more ATF if level drops below **MAX** mark
- check that no bubbles appear in reservoir and level remains constant

## Power steering pump, removing/installing



48-502

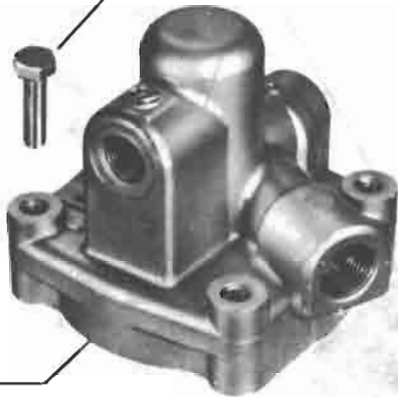
## Power steering pump, repairing

### Note

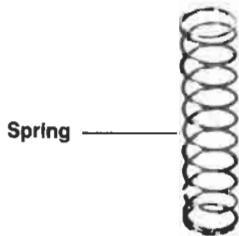
When repairing pump, replace all parts marked with an asterisk.

Coat all sealing components with ATF on installation.

20 Nm (14 ft lb)



**Housing**  
blow through channels



**Spring**

**Pressure/flow limiting valve**  
installing Fig. 1  
checking page 48.12



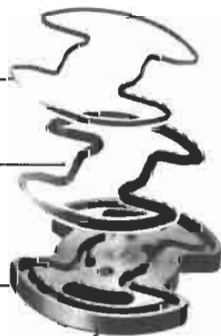
**Valve retainer**  
installing Fig. 1



**Seal support**

**Seal**

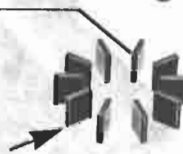
**Valve plate**



**Stator**  
position:  
long pins downward



**Rotor vanes**  
machined front edges  
(arrow) face outward



**Circlip\***  
removing/installing Fig. 2

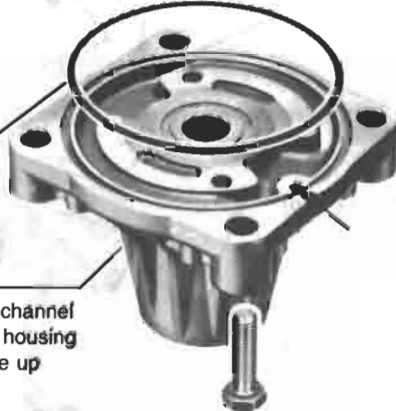


**Rotor**  
removing/installing Fig. 2



**O-ring\***

**Housing**  
sealing ring oil channel  
(arrow) in both housing  
halves must line up



20 Nm (14 ft lb)

**Seal\***  
removing: use VW 681  
installing: drive in to stop  
fill space between sealing lips  
with multi-purpose grease



**Pump shaft with flange**  
check for scoring and  
wear marks. If necessary,  
replace complete pump

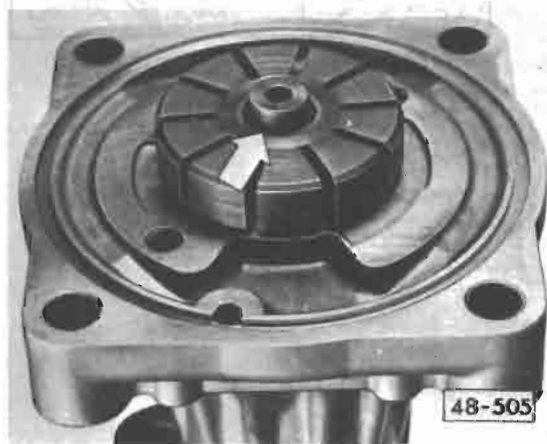


48-501



**Fig. 1 Pressure/flow limiting valve retainer, installing**

- install angled ends of retainer in housing slot
- press down angled ends with screwdriver



**Fig. 2 Rotor and shaft, removing/installing**

**Note**

Rotor and shaft must be removed from housing to replace pump shaft seal.

- press rotor down
- remove circlip from groove (arrow)
- after installing rotor and shaft, secure circlip by pulling rotor up

**Note**

Circlip must fit properly in groove and be secured by

**Pressure/flow limiting valve, checking**

**Note**

Incorrect functioning of pressure/flow limiting valve causes periodic lack of steering assistance.

- check valve and housing bore for wear
  - valve drillings must be completely clear of any dirt or restriction
  - valve must move freely in housing bore
- if maximum pump pressure is not obtained after checking pressure/flow limiting valve, replace complete power steering pump

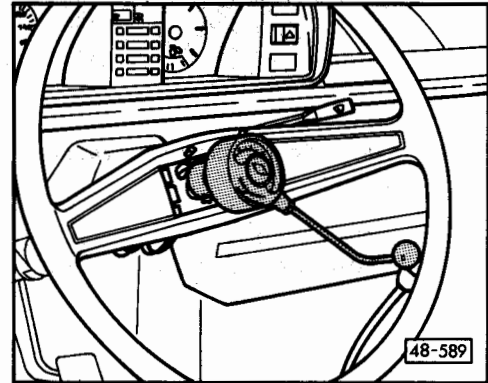
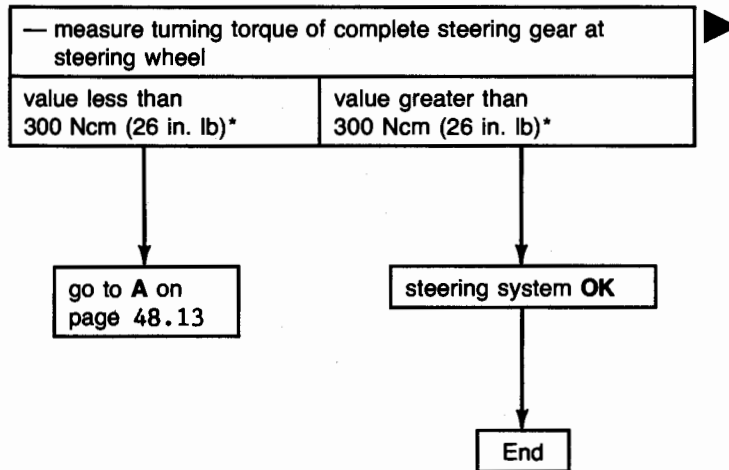
# 48 Steering

## Troubleshooting

Use the following procedure to troubleshoot complaints of heavy or stiff steering:

### Test conditions

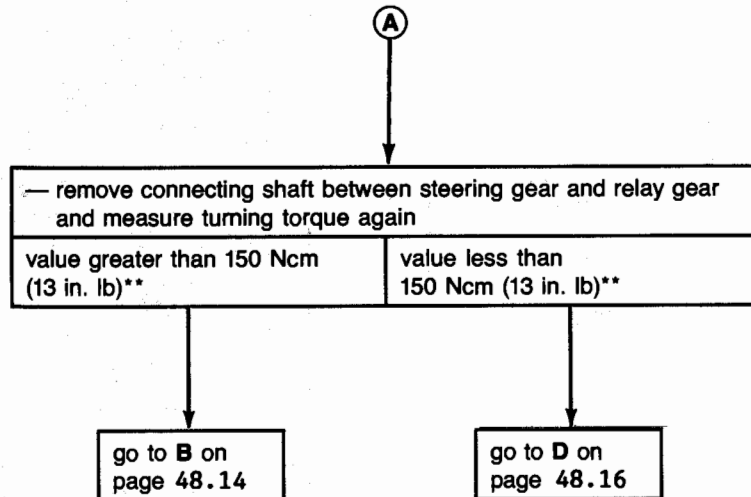
- vehicle at room temperature (approximately 68°F)
- vehicle raised on hoist
- steering turned 3 times from lock to lock at steering wheel



\*vehicles with  
0-1000 km (1600 mi) = 300 Ncm (26 in. lb)

vehicles with  
1000-3000 km (1600-4800 mi)  
= 230 Ncm (20 in. lb)

vehicles with more than  
3000 km (4800 mi) = 170 Ncm (15 in. lb)

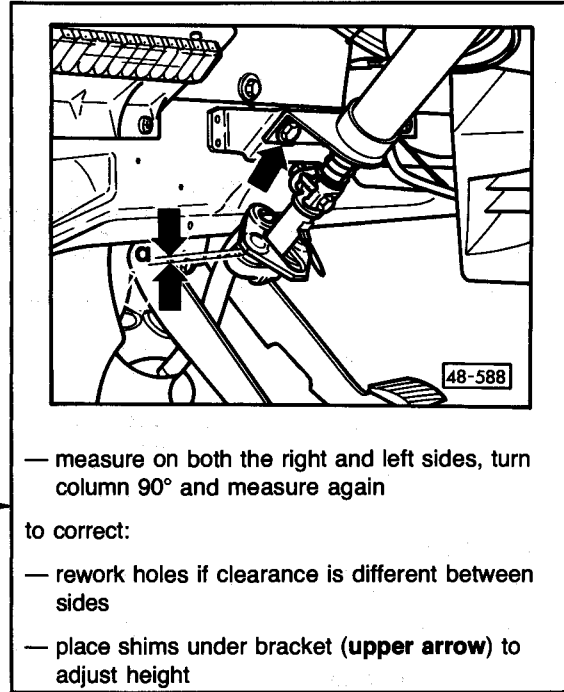
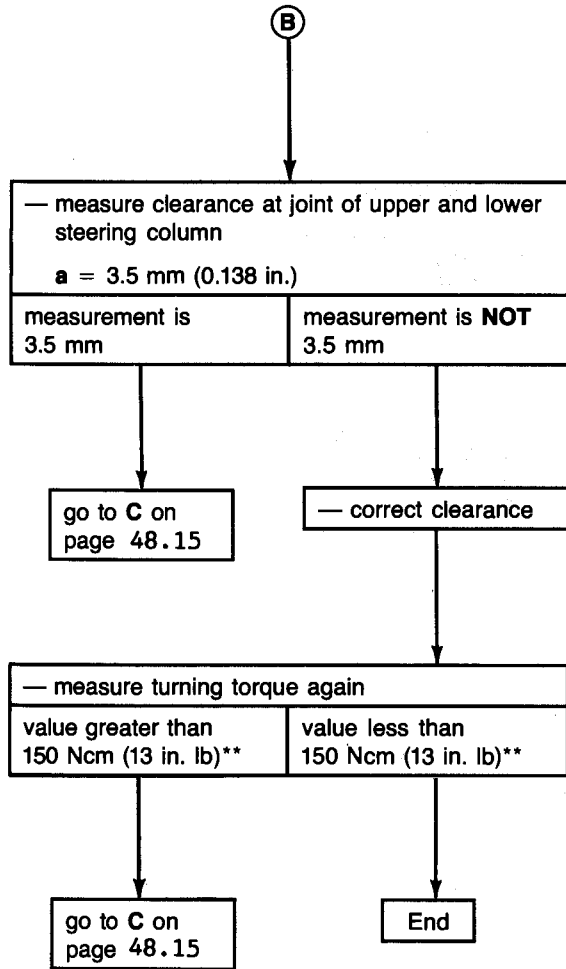


\*\*vehicles with  
0-1000 km (1600 mi) = 150 Ncm (13 in. lb)

vehicles with  
1000-3000 km (1600-4800 mi)  
= 130 Ncm (11 in. lb)

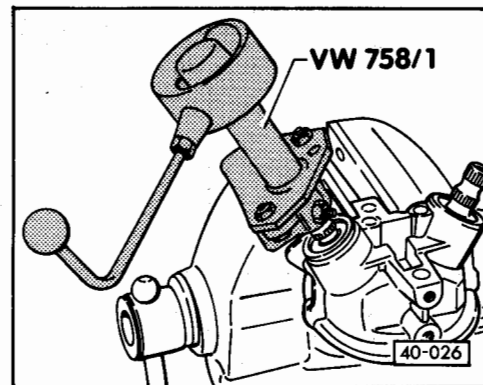
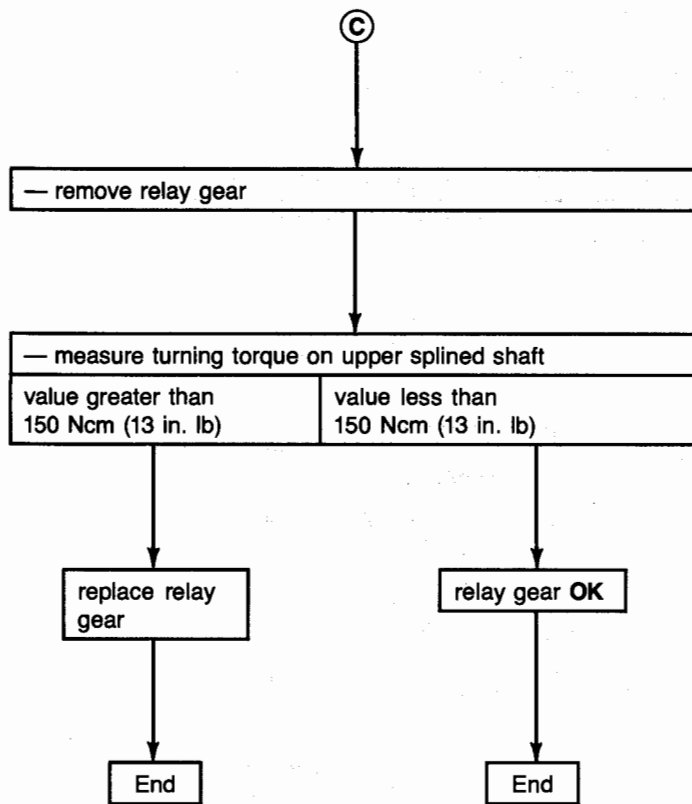
vehicles with more than  
3000 km (4800 mi) = 110 Ncm (10 in. lb)

# 48 Steering

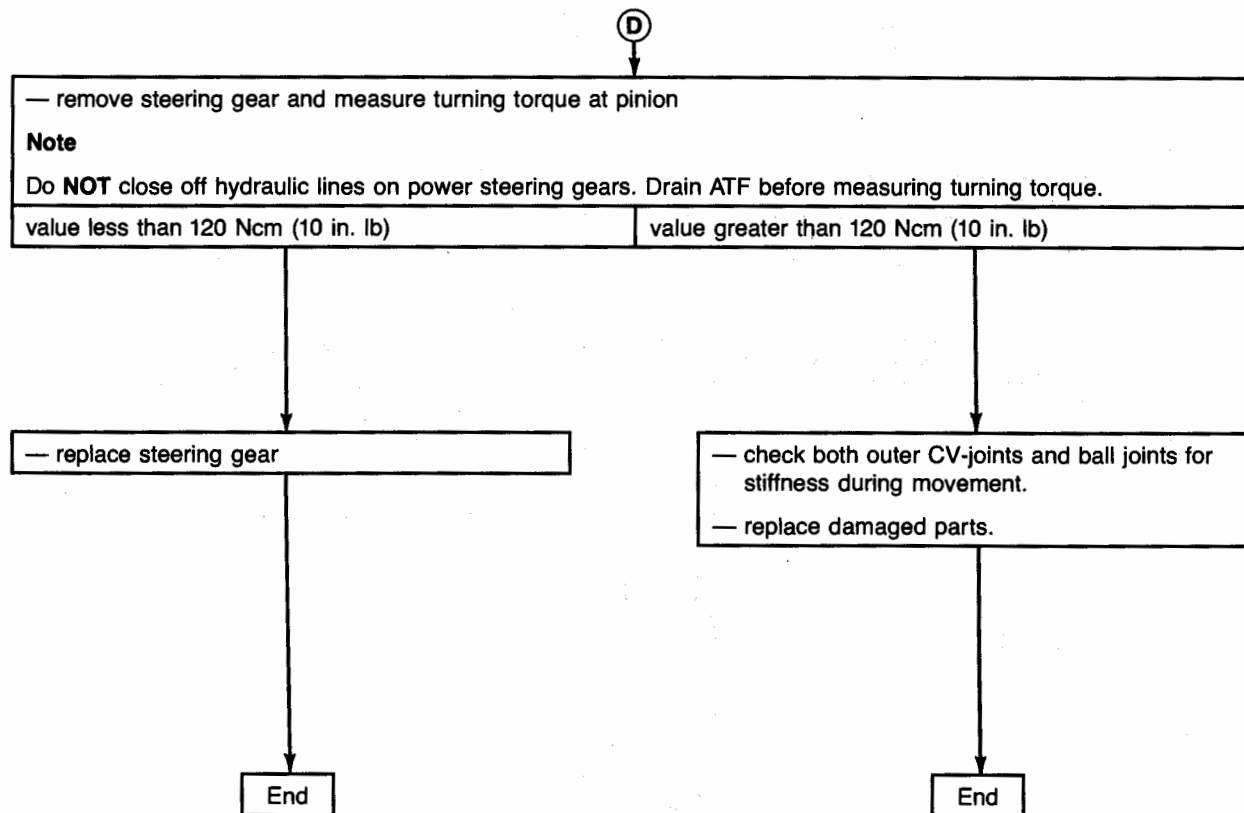


\*\*see page 48.13





# 48 Steering



## Troubleshooting

Condition/fault	Possible cause	Remedy
Fluid level in ATF reservoir low	Air trapped in steering system has escaped during normal operation	Fill reservoir to "MAX" mark
	Valve housing seal leaking, ATF leaks out at steering gear pinion	Replace seal and O-rings
	Leaks at connections on steering gear, hoses, pump or reservoir	Check system for leaks and repair
Fluid level in ATF reservoir low again after refilling — no external leaks evident	Additional air trapped in steering system has escaped during normal operation	Fill reservoir to "MAX" mark
	Steering rack seal defective (leaking fluid is found inside steering gear boot)	Replace seal (install complete repair kit)
Steering effort becomes greater as wheel is turned	Pressure/flow limiting valve in pump housing is sticking	Clean or replace pressure/flow limiting valve in pump housing
	Dirt/foreign matter in valve control slot	Clean valve unit
	Insufficient pump pressure	Check pump pressure and replace pump if necessary
Noises in power steering system	ATF level in reservoir too low	Fill reservoir to "MAX" mark
	Insufficient pump drive belt tension	Tighten or replace belt
	Reservoir filter dirty	Replace filter
	Loose connection at pump drawing air into system (ATF foaming in reservoir)	Tighten pump connections

## Brake—Hydraulic Components, Regulator, Booster

### Index

#### WARNING

Friction materials such as brake and clutch linings or brake pads may contain asbestos fibers.

Do not create dust by grinding, sanding or by cleaning with compressed air.

Avoid breathing asbestos fibers and asbestos dust.

Breathing asbestos may result in serious diseases, such as asbestosis or cancer.

Breathing asbestos may cause severe injury and death.

- Brake booster assembly 47.10  
checking 47.10
- Brake caliper  
Girling (1980-1985) assembly 47.5  
Girling/Teves (1980-1985),  
disassembling/assembling 47.6  
Girling/Teves (From 1986 m.y.)  
assembly 47.7a  
Teves (1980-1985), assembly 47.4  
Teves (1980-1985),  
noise damping plates 47.7
- Brake fluid, changing  
with US 1116 47.8  
without US 1116 47.8a
- Brake hydraulic system  
general repair notes 47.8
- Brake master cylinder  
assembly 47.2
- Brake pressure regulator  
checking 47.8a
- Brake system, bleeding  
with US 1116 47.8  
without US 1116 47.8a
- Check valve  
checking 47.10
- Rear wheel cylinder  
assembly 47.8

# 47 Brake-Hydraulic Components, Regulator, Booster

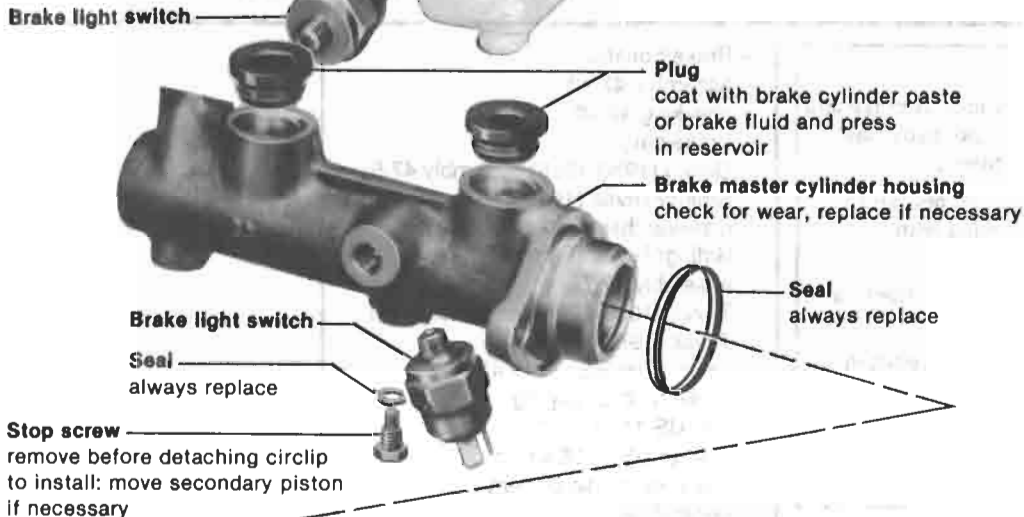


**WARNING**

Brake fluid is poisonous

**CAUTION**

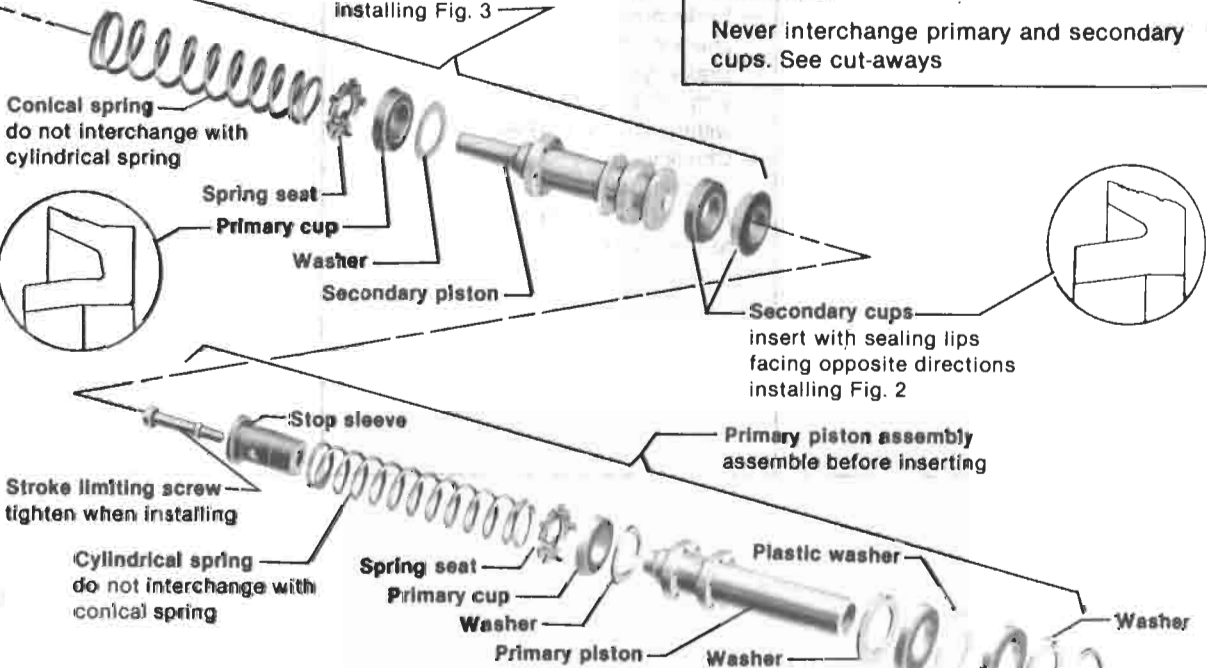
When repairing brake master cylinder always use all parts in repair kit. Lubricate shaft of primary piston with silicone grease supplied in repair kit. Coat all other cups and pistons lightly with VW brake cylinder paste before installation



**Secondary piston assembly**  
assemble before installing installing Fig. 3

**WARNING**

Never interchange primary and secondary cups. See cut-aways



**Note**

When installing pistons, guide lips of cups/seals into housing with blunt tool

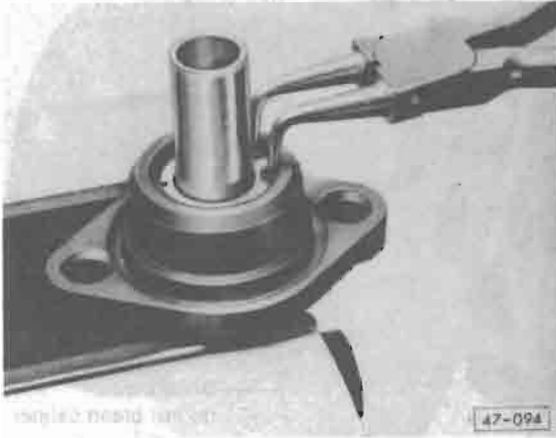
47-342

**Note**

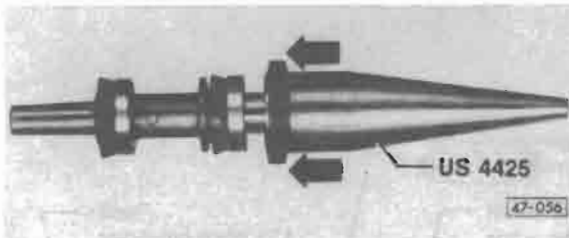
DOT 4 brake fluid is now used in all production vehicles. The new fluid is recommended for all Volkswagen brake systems and is completely compatible with the previous DOT 3 fluid.

DOT 4 brake fluid has been phased into the spare parts program effective June, 1984.

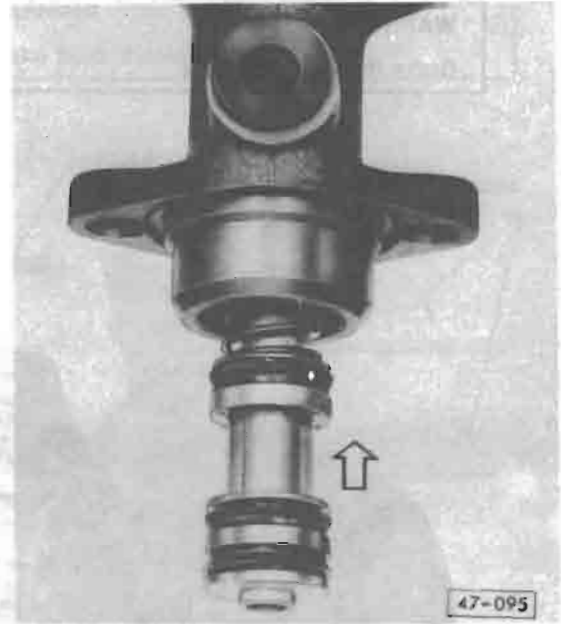
The previous DOT 3 version brake fluid, Part No. ZVW 247 101, has been superseded to the new DOT 4 version, Part No. ZVW 239 102.



**Fig. 1** Circlip, removing/installing



**Fig. 2** Secondary cups, installing  
 • always use fitting sleeve US 4425



**Fig. 3** Secondary piston, installing  
 — hold brake master cylinder with opening facing down  
 — guide lips of cups in carefully with blunt tool

**Note**

After installing brake master cylinder bleed brake system (see page 47.8)

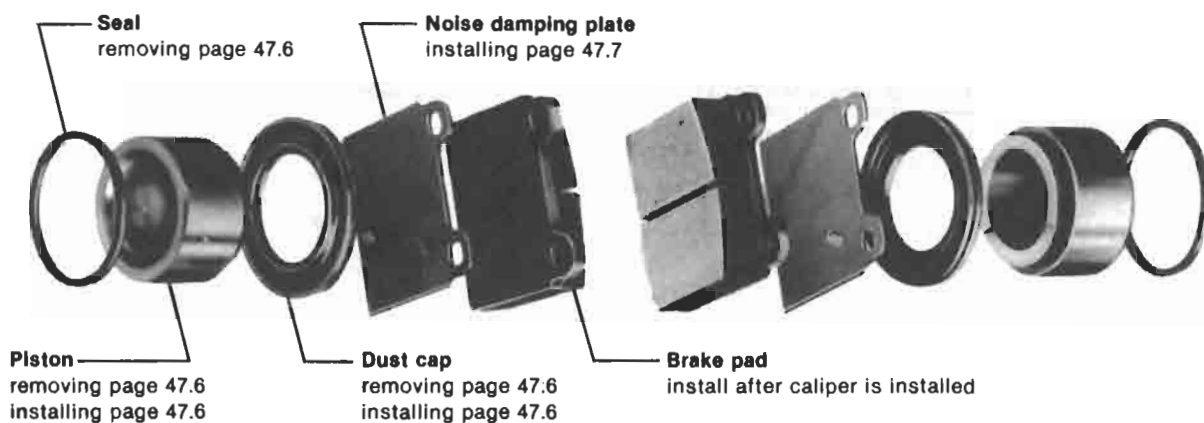
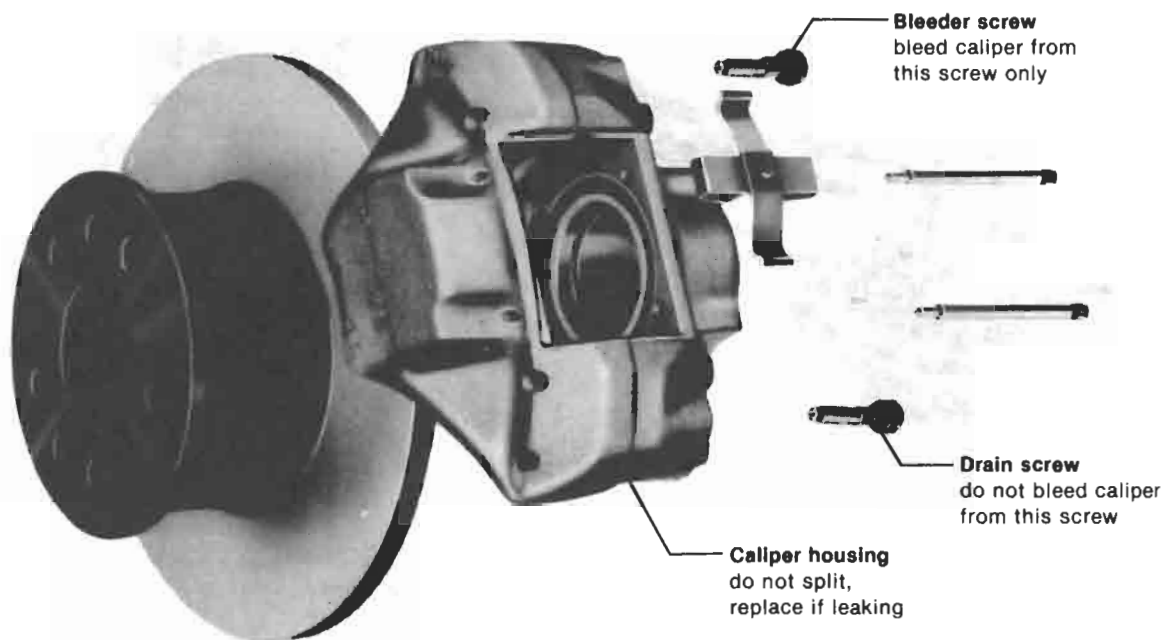
# 47 Brake-Hydraulic Components, Regulator, Booster

## WARNING

Brake fluid is poisonous

## CAUTION

Use all parts in repair kit. Coat seals and pistons lightly with VW brake cylinder paste or equivalent before installing



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## Note

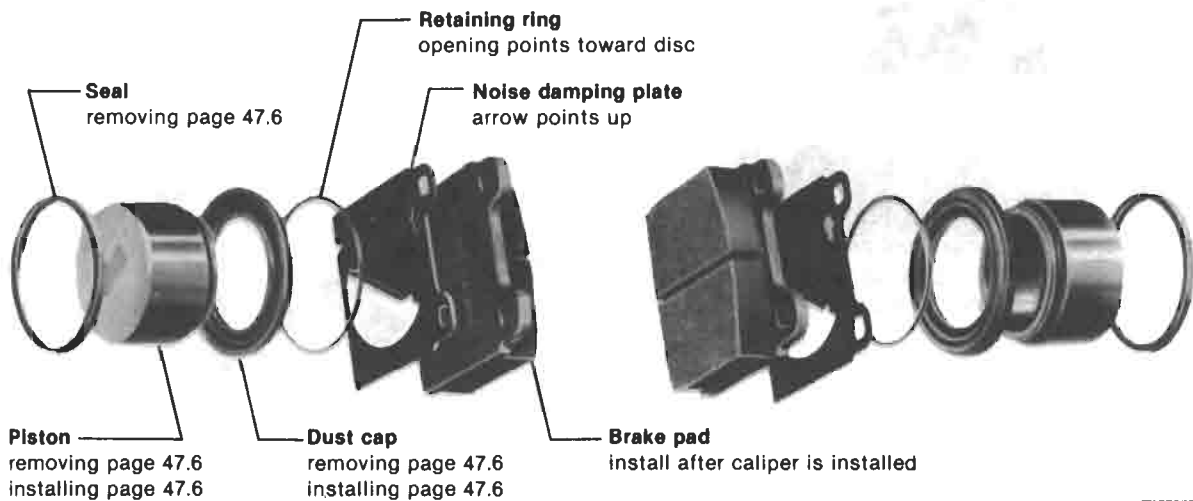
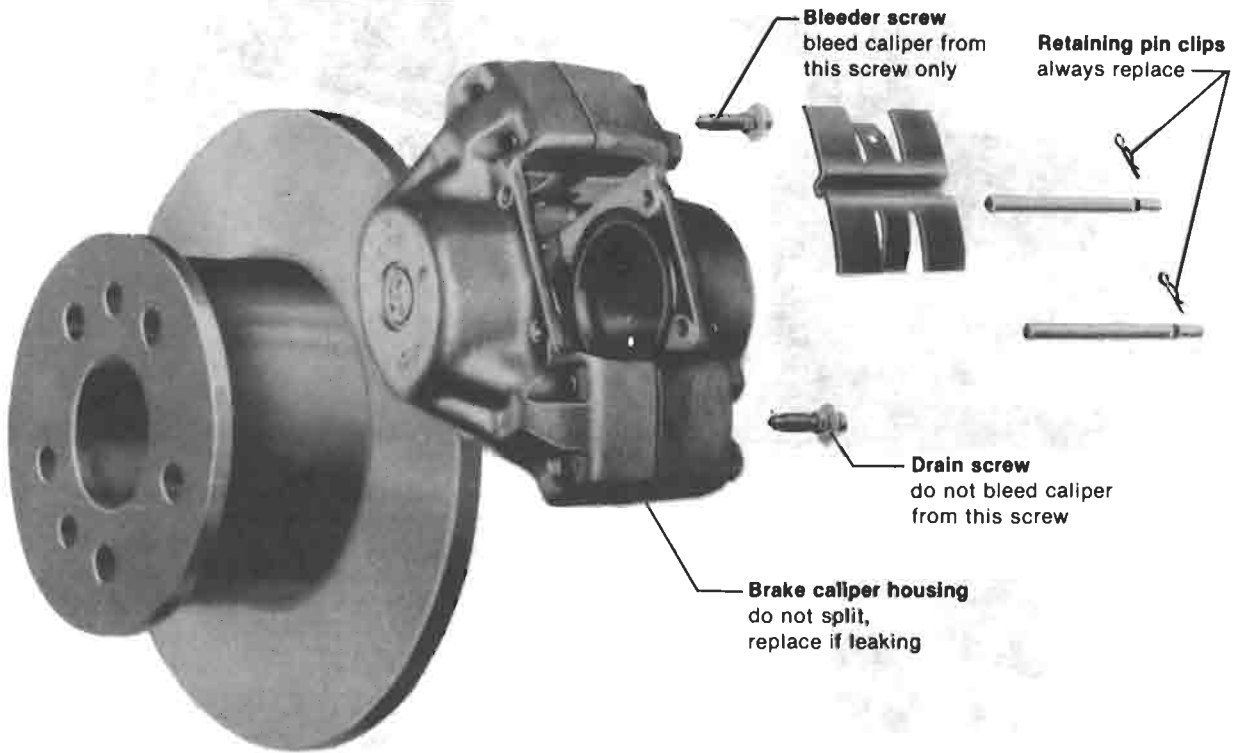
Cars may have either Teves or Girling calipers

**CAUTION**

Use all parts in repair kit. Coat seals and pistons lightly with VW brake cylinder paste or equivalent before installing

**WARNING**

Brake fluid is poisonous



**Note**

Cars may have either Girling or Teves calipers

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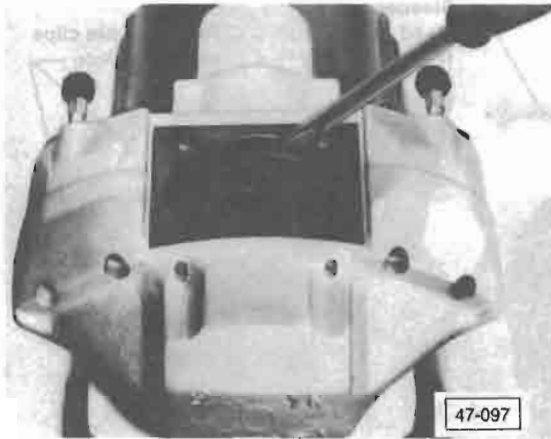
47-096



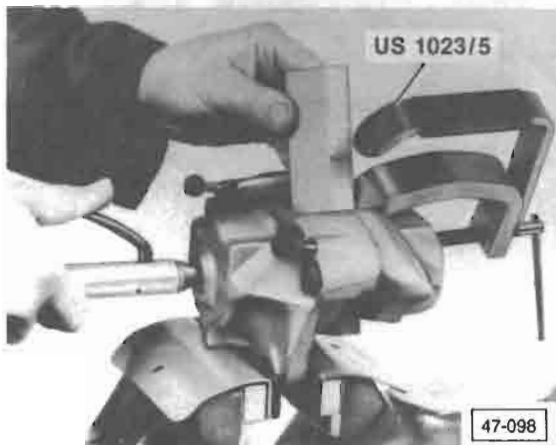
# 47 Brake—Hydraulic Components, Regulator, Booster

## Brake caliper, disassembling

### Work sequence



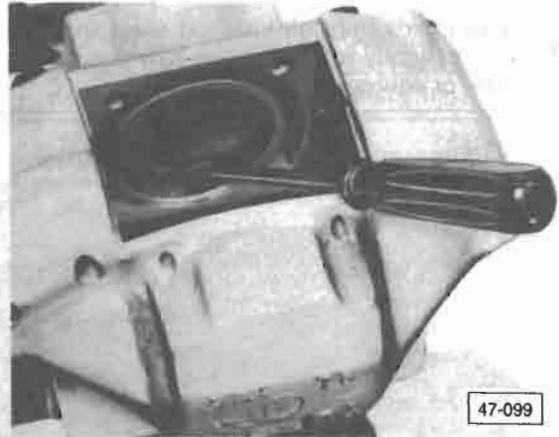
— pry dust cap out without scratching piston



— blow out piston with compressed air

### Note

Hold other piston with clamp **US 1023/5**. Place wooden block in caliper to prevent damage to piston



— remove seal without scratching cylinder

### WARNING

Friction materials such as brake and clutch linings or brake pads may contain asbestos fibers.

Do not create dust by grinding, sanding or by cleaning with compressed air.

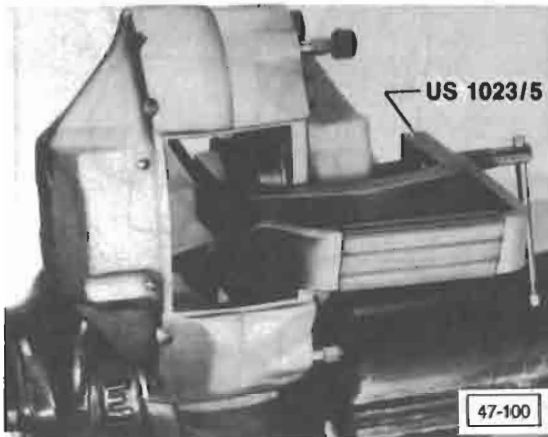
Avoid breathing asbestos fibers and asbestos dust.

Breathing asbestos may result in serious diseases, such as asbestosis or cancer.

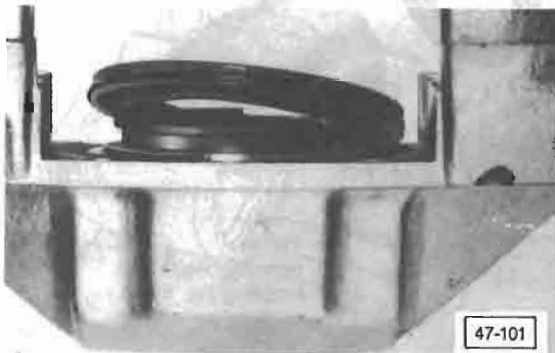
Breathing asbestos may cause severe injury and death.

## Brake caliper, assembling

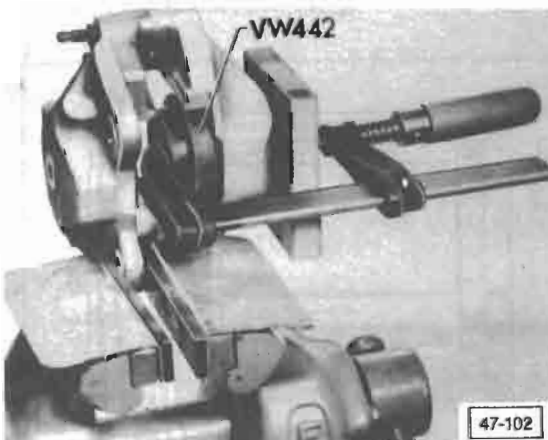
### Work sequence



- install seal
- lubricate piston and cylinder bore lightly with brake cylinder paste
- press in piston with installing clamp



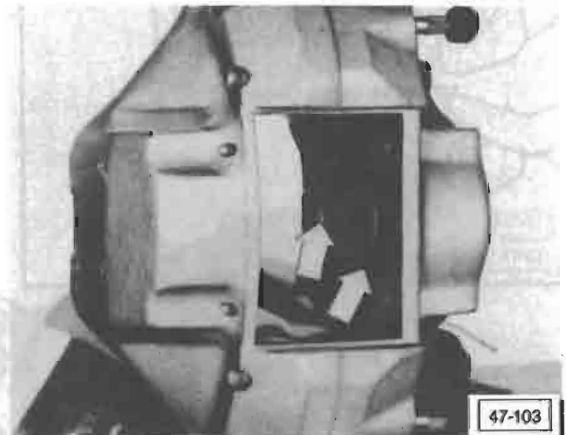
- install dust cap by hand



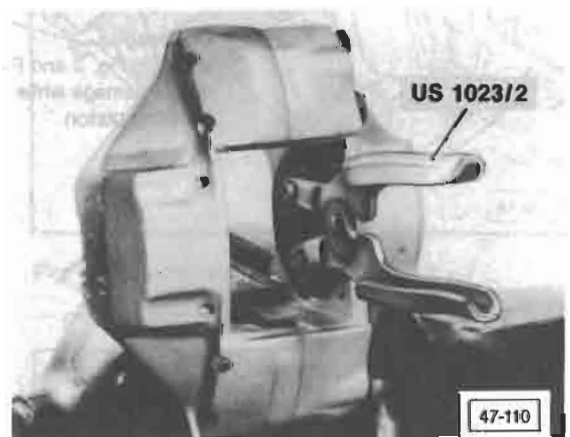
- press dust cap with **VW 442** against recess
  - piston is now fully seated

## Noise damping plates, installing (Teves caliper)

### Work sequence

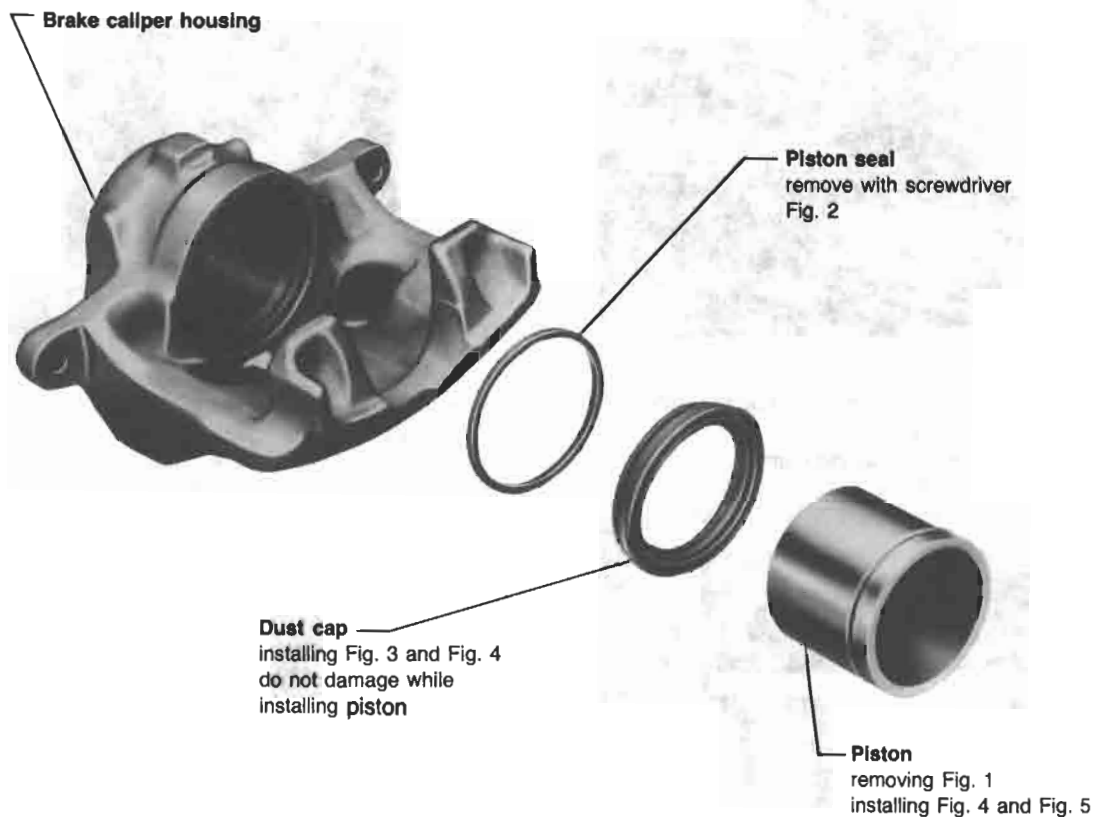


- insert noise damping plates and check position of piston
  - recess in piston (arrows) point against direction of brake disc rotation when moving forward. Lugs on noise damping plates engage in recess on piston



- if necessary readjust position of piston by using turning pliers **US 1023/2**

# 47 Brake-Hydraulic Components, Regulator, Booster



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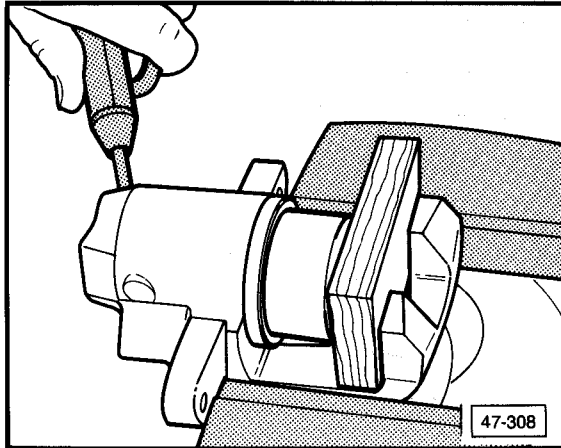
## CAUTION

Use all parts in repair kit. Coat seals and pistons lightly with VW brake cylinder paste or equivalent before installing.

# 47.7a

Brake caliper

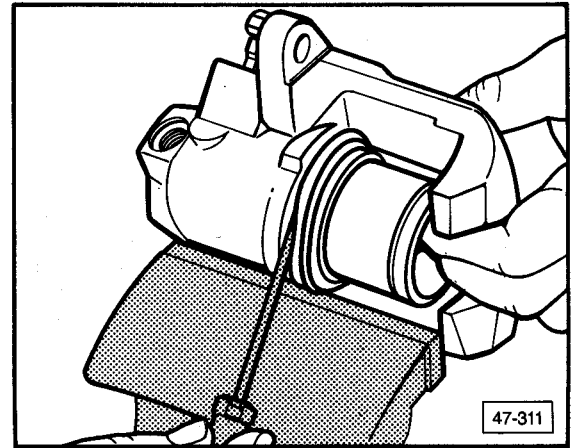
From 1986 m.y.



**Fig. 1 Caliper piston, removing with compressed air**

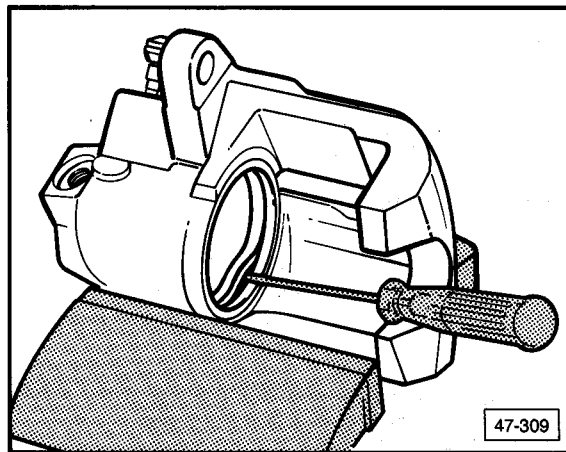
**Note**

Place a wooden block in caliper to prevent damage to piston.

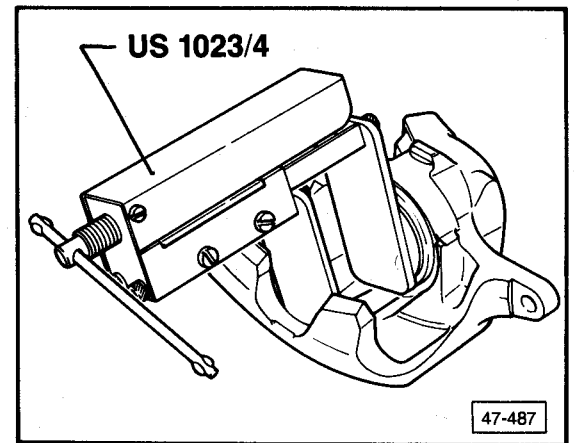


**Fig. 4 Piston and dust cap, installing**

— insert inner lip of cap into groove in cylinder while holding piston



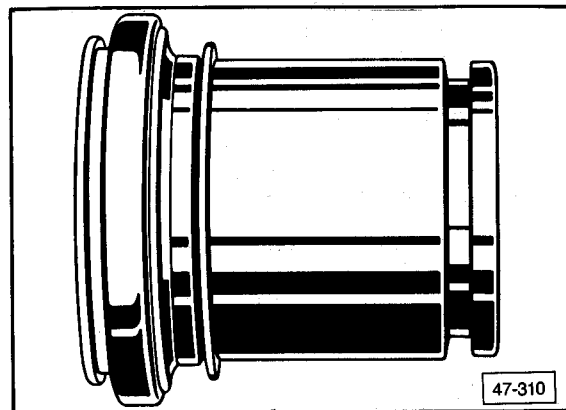
**Fig. 2 Piston seal, removing**



**Fig. 5 Piston, installing**

— press piston as far as it will go

**CAUTION**  
Outer lip of dust cap must slip into groove in piston.



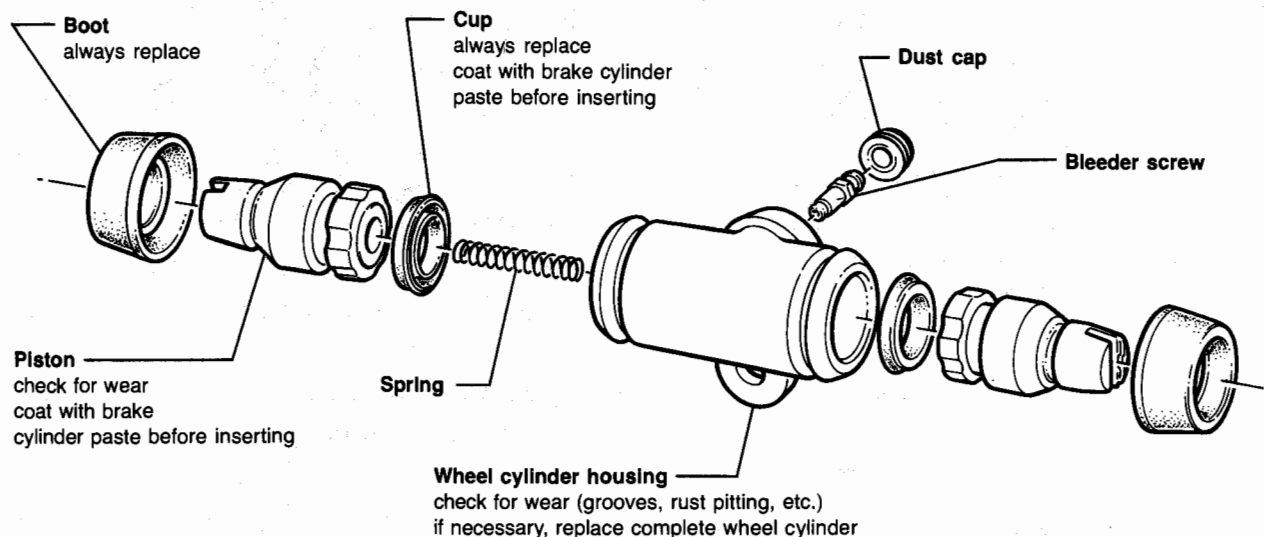
**Fig. 3 Dust cap, installing**

# 47 Brake—Hydraulic Components, Regulator, Booster

## Rear wheel cylinder, disassembling/assembling

### CAUTION

When repairing wheel cylinders always use all parts of repair kit.



47-605

## Brake hydraulic system

### General repair notes

#### WARNING

Brake fluid is poisonous. Do **NOT** siphon by mouth.

#### CAUTION

Brake fluid must **NOT** come into contact with paint.

Brake fluid absorbs moisture from air and must be replaced every 2 years.

Only use new DOT 3 or DOT 4 brake fluid according to SAE recommendation J 1703 and conforming to MOTOR VEHICLE SAFETY STANDARD 116. Do **NOT** add or mix DOT 5 silicone type brake fluid with brake fluid in car as severe component corrosion may result. Such corrosion could lead to brake system failure.

## Brake system, bleeding

Whenever possible use pressure bleeder (**US 1116**). To bleed brake system, use bottle with transparent hose attached so that brake fluid can be checked for air bubbles.

Do **NOT** re-use fluid removed from reservoir. Water and other contaminants in fluid can cause brake performance problems.

On vehicles with brake booster, turn engine **OFF** and then disconnect vacuum hose/check valve from brake booster prior to bleeding brake system. When bleeding brake system **push lever on brake pressure regulator in direction of rear axle**.

### (With pressure bleeder **US 1116**)

- connect pressure bleeder **US 1116** to brake fluid reservoir. Turn bleeder switch to **ON** position
- connect hose from bleeder bottle to bleed screws and bleed brakes in following sequence:
  1. Right rear wheel cylinder/caliper
  2. Left rear wheel cylinder/caliper
  3. Right front caliper (upper screw)
  4. Left front caliper (upper screw)
- after bleeding, fill reservoir to maximum mark

(Without pressure bleeder US 1116)

- connect hose from bleeder bottle to bleed screws using previously mentioned sequence
- pump brake pedal several times and then hold pedal down
- open bleed screw, with pedal depressed
- close bleed screw, with pedal depressed
- release brake pedal
- repeat operation until brake fluid flows without air bubbles

## Brake fluid, changing

### CAUTION

The brake fluid level in the reservoir must never fall below the **MIN** mark during the fluid replacement procedure.

(With pressure bleeder US 1116)

- connect pressure bleeder **US 1116** to brake fluid reservoir. Turn bleeder switch on **ON** position
- connect hose from bleeder bottle to bleed screws, using sequence in the table provided
  - specified amount of fluid must flow out

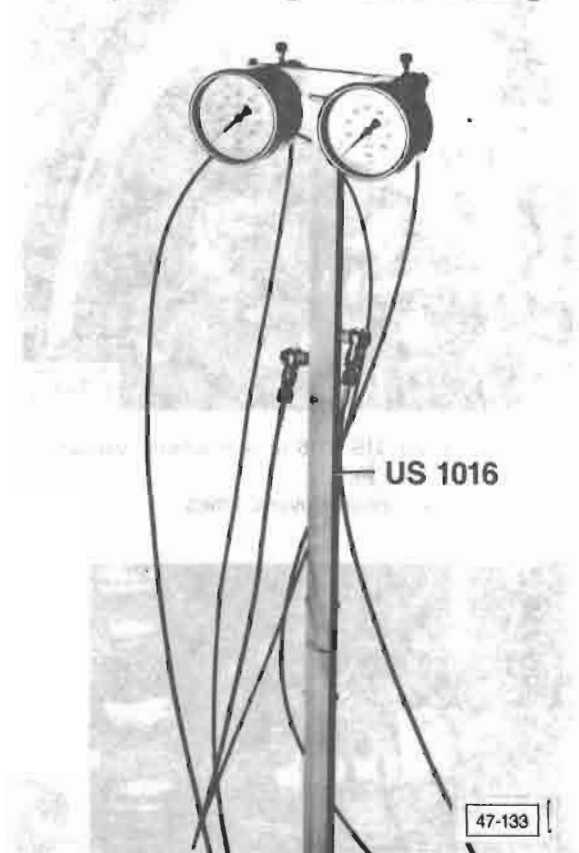
Bleeding sequence	Volume of brake fluid to be extracted from cylinders/calipers
right rear	500 cm <sup>3</sup> (30.5 in. <sup>3</sup> )
left rear	500 cm <sup>3</sup> (30.5 in. <sup>3</sup> )
right front, lower	500 cm <sup>3</sup> (30.5 in. <sup>3</sup> )
right front, upper	100 cm <sup>3</sup> (6.1 in. <sup>3</sup> )
left front, lower	500 cm <sup>3</sup> (30.5 in. <sup>3</sup> )
left front, upper	100 cm <sup>3</sup> (6.1 in. <sup>3</sup> )

- fill the system with new brake fluid
- bleed as described previously

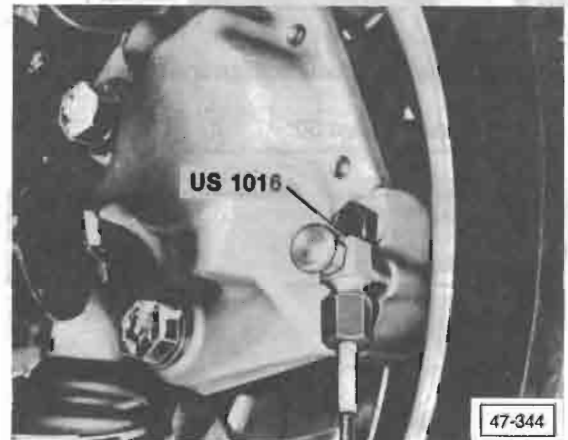
(Without pressure bleeder US 1116)

Follow the same procedure for bleeding brakes without a pressure bleeder, covered in this section. Remove brake fluid until the new fluid flows without air bubbles.

## Brake pressure regulator, checking

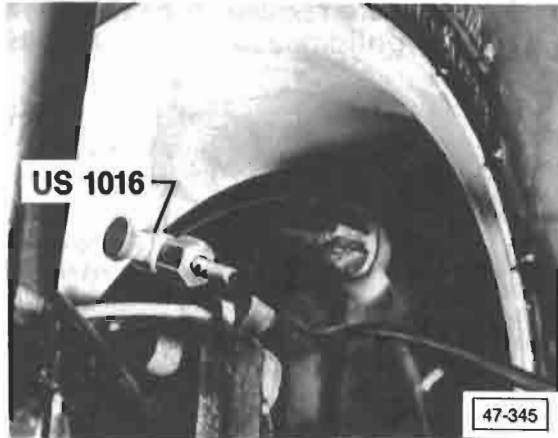


— lift vehicle with hoist

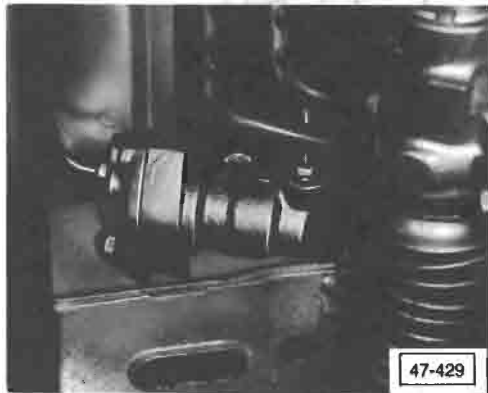


— connect gauge **US 1016** to front brake caliper

# 47 Brake—Hydraulic Components, Regulator, Booster



- connect gauge **US 1016** to rear wheel cylinder
- bleed both gauges
- depress brake pedal several times



- remove nuts holding regulator
- press brake pedal until both gauges read 50 bar (725 psi)
- tilt regulator forward 30°

## CAUTION

Do not damage brake lines.

- increase pressure on brake pedal until gauge connected to front brake caliper reads 100 bar (1450 psi)
  - pressure at gauge connected to rear wheel cylinder must read 55-65 bar (798-943 psi)
- if **NO**, replace brake pressure regulator
- reinstall regulator

## CAUTION

Note installation position. Bolt heads must face forward (driving) direction.

- disconnect gauges
- bleed brakes

## Brake booster, checking

- depress brake pedal firmly several times with engine off to exhaust vacuum in system
- depress pedal with medium pressure and hold
- start engine
  - if brake booster is working properly, pedal will fall slightly and then hold

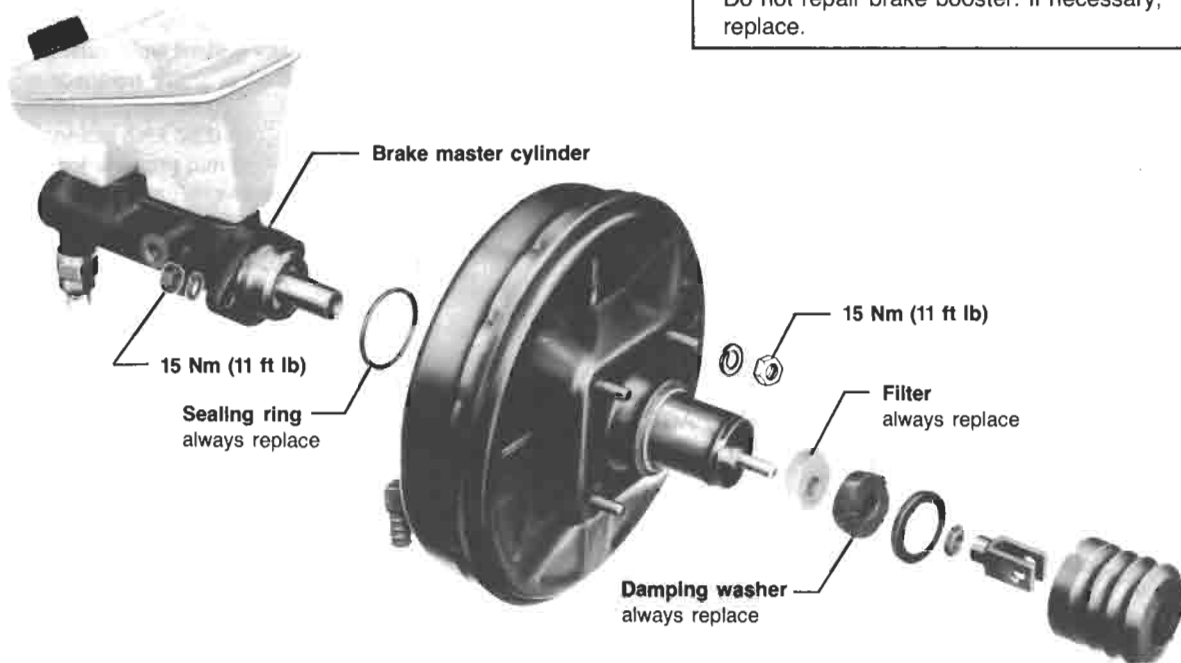
## Note

Brake boosters are supplied from two different manufacturers. They are identified, "ATE" for the Teves Co. and "BENDIX" for the Bendix Co. A Teves booster is shown in the illustration.

Complete boosters can be used as replacements for each other, independent of manufacturer (i.e. a Teves booster can be combined with a Bendix master cylinder or vice versa).

## CAUTION

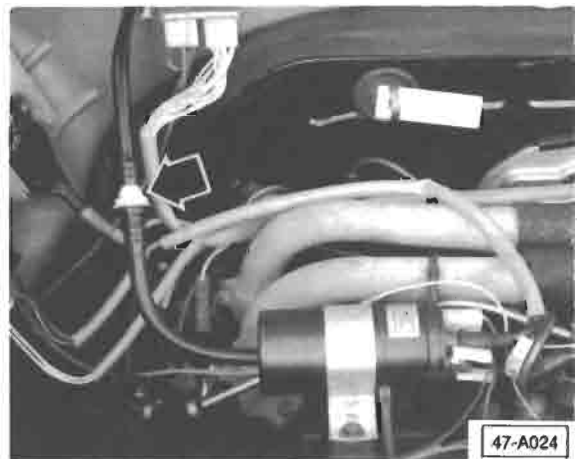
Do not repair brake booster. If necessary, replace.



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## Check valve, checking (install in vacuum hose)

- remove valve (arrow) from hose
- blow through valve in direction of arrow (on housing)
  - air must pass through valve
- blow through valve in opposite direction
  - no air must pass through valve



47-A024



## Brakes— Mechanical Components

### Index

**WARNING**

Friction materials such as brake and clutch linings or brake pads may contain asbestos fibers.

Do not create dust by grinding, sanding or by cleaning with compressed air.

Avoid breathing asbestos fibers and asbestos dust.

Breathing asbestos may result in serious diseases, such as asbestosis or cancer.

Breathing asbestos may cause severe injury and death.

- Brake pedal/linkage assembly 46.10
- Front brake assembly (1980-1985) 46.2  
assembly (from 1986 m.y.) 46.5  
pads (1980-1985)  
removing/installing 46.3  
pads (from 1986 m.y.)  
removing installing 46.5a
- Parking brake assembly 46.11
- Rear brake assembly 46.6  
shoes, adjusting 46.9  
shoes, removing/installing 46.7

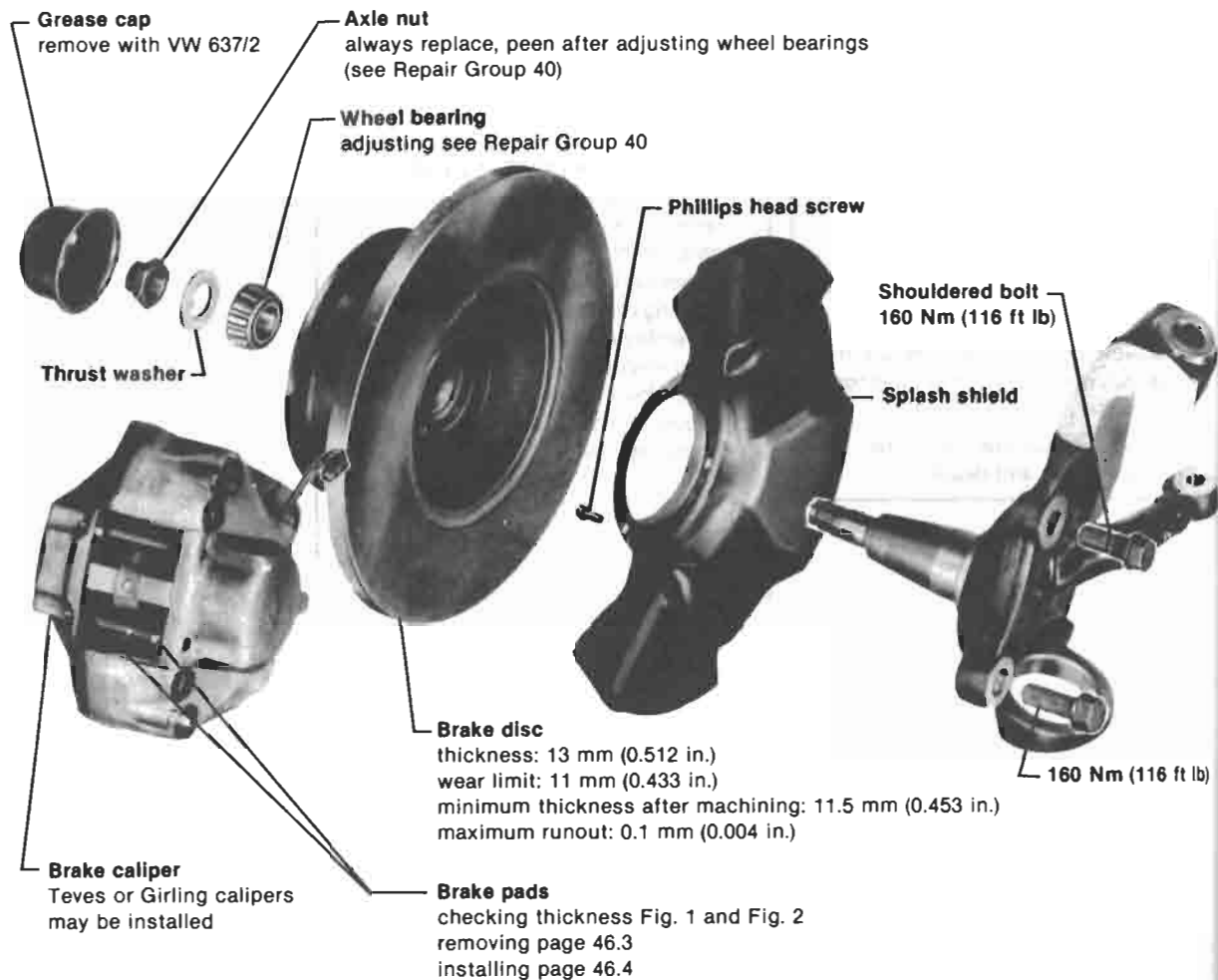
# 46 Brakes-Mechanical Components

## CAUTION

Always remove brake caliper before removing disc.  
Never try to remove disc by using force.  
Force may cause caliper mounting frame to crack or break

## Note

When removing caliper only, never disconnect brake hose, hang caliper on frame.  
Disconnect brake hoses only when repairing brake calipers

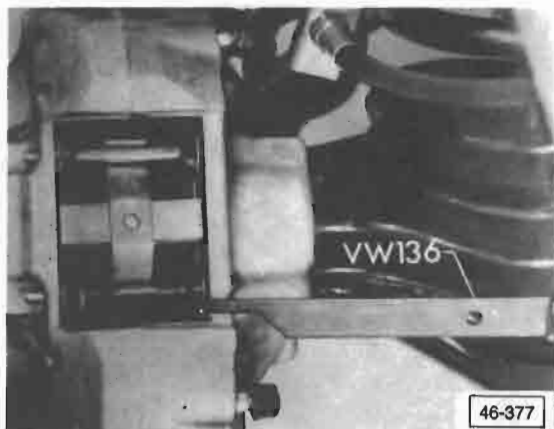


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## CAUTION

After installing new brake pads, depress brake pedal firmly several times before driving to permit piston and brake pads to adjust to brake disc

When machining brake discs, equal amounts must be taken off each side of disc.  
Never machine one side only



**Fig. 1** Brake pad thickness, checking (Teves caliper)



**Fig. 2** Brake pad thickness, checking (Girling caliper)

- with wheel mounted, slide gauge from inside between rim and brake caliper
- try to insert gauge into gap at lower retaining pin, between spreader spring and brake pad backing plate
  - if gauge cannot be inserted, brake pads are worn to wear limit of 2 mm (0.080 in.) and must be replaced

**CAUTION**

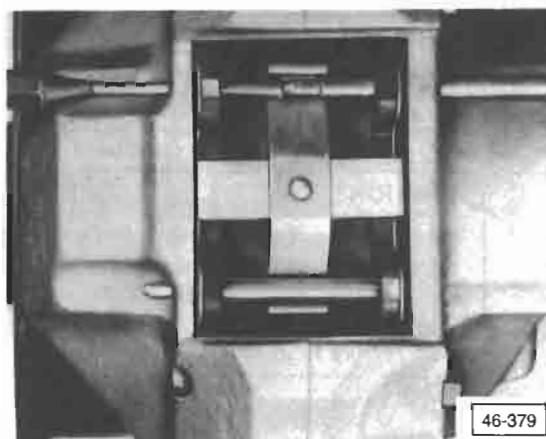
Always replace all pads on one axle and use same manufacturer of linings.

**CAUTION**

When re-using brake pads, mark pads to prevent changing inside to outside or from one caliper to another. Mixed pads can cause uneven braking.

## Brake pads, removing

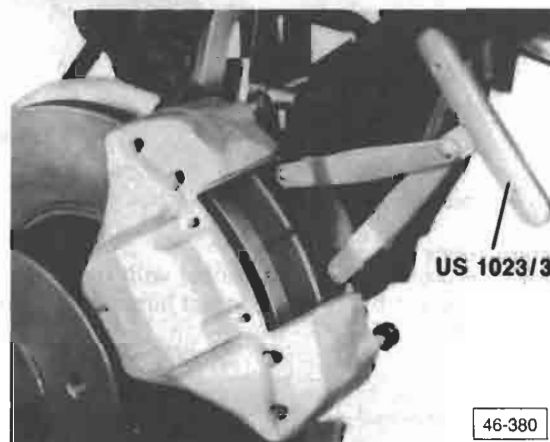
### Work sequence



- drive out brake pad retaining pins

**Note**

On Girling calipers, remove circlips first.



- pull out brake pads

**WARNING**

Friction materials such as brake and clutch linings or brake pads may contain asbestos fibers.

Do not create dust by grinding, sanding or by cleaning with compressed air.

Avoid breathing asbestos fibers and asbestos dust.

Breathing asbestos may result in serious diseases, such as asbestosis or cancer.

Breathing asbestos may cause severe injury and death.

6 ft lb)

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# 46 Brakes-Mechanical Components

## Brake pads, installing

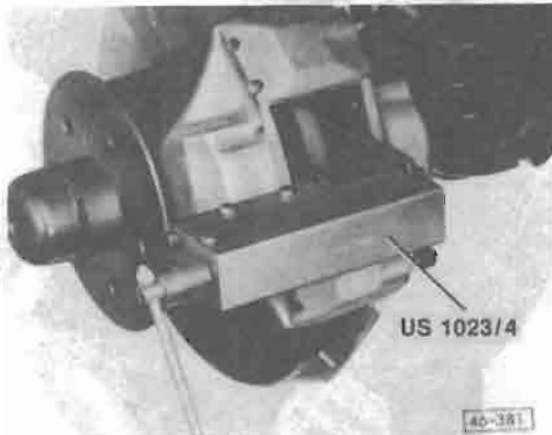
### Work sequence

#### WARNING

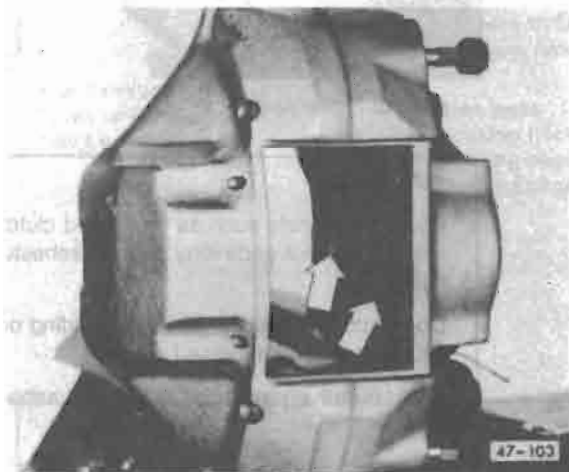
Brake fluid is poisonous.  
Do not siphon by mouth

#### CAUTION

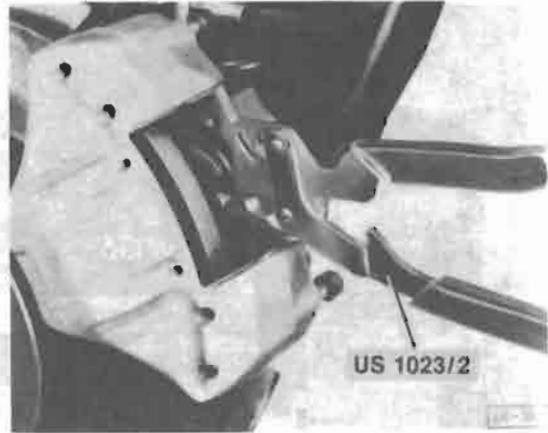
When piston is pushed into caliper, brake fluid is pushed into reservoir. To prevent overflowing, siphon some fluid out with an appliance which is used for this purpose only. Brake fluid will damage paint



- press piston into caliper with tool
- clean brake pad contact surfaces in caliper



- check position of piston (**Teves caliper only**)
  - recess in piston (arrows) must face bottom.**Lugs on noise damping plate engage in recess**

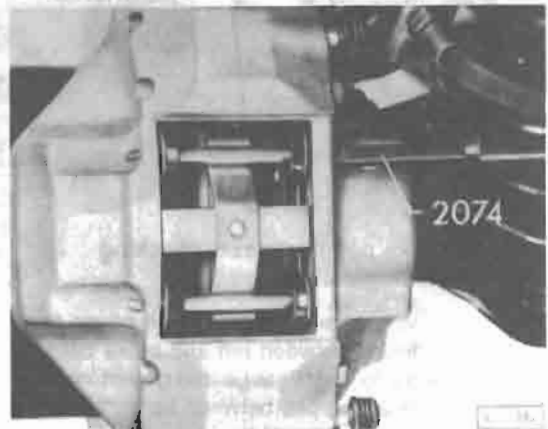


- if necessary, correct position of piston using pliers US 1023/2

#### Note

Girling calipers have arrows on noise damping plates. Arrows must point up

- install noise damping plates, brake pads and spreader springs



- install retaining pins (on Girling calipers)
- install new circlips on retaining pins

#### CAUTION

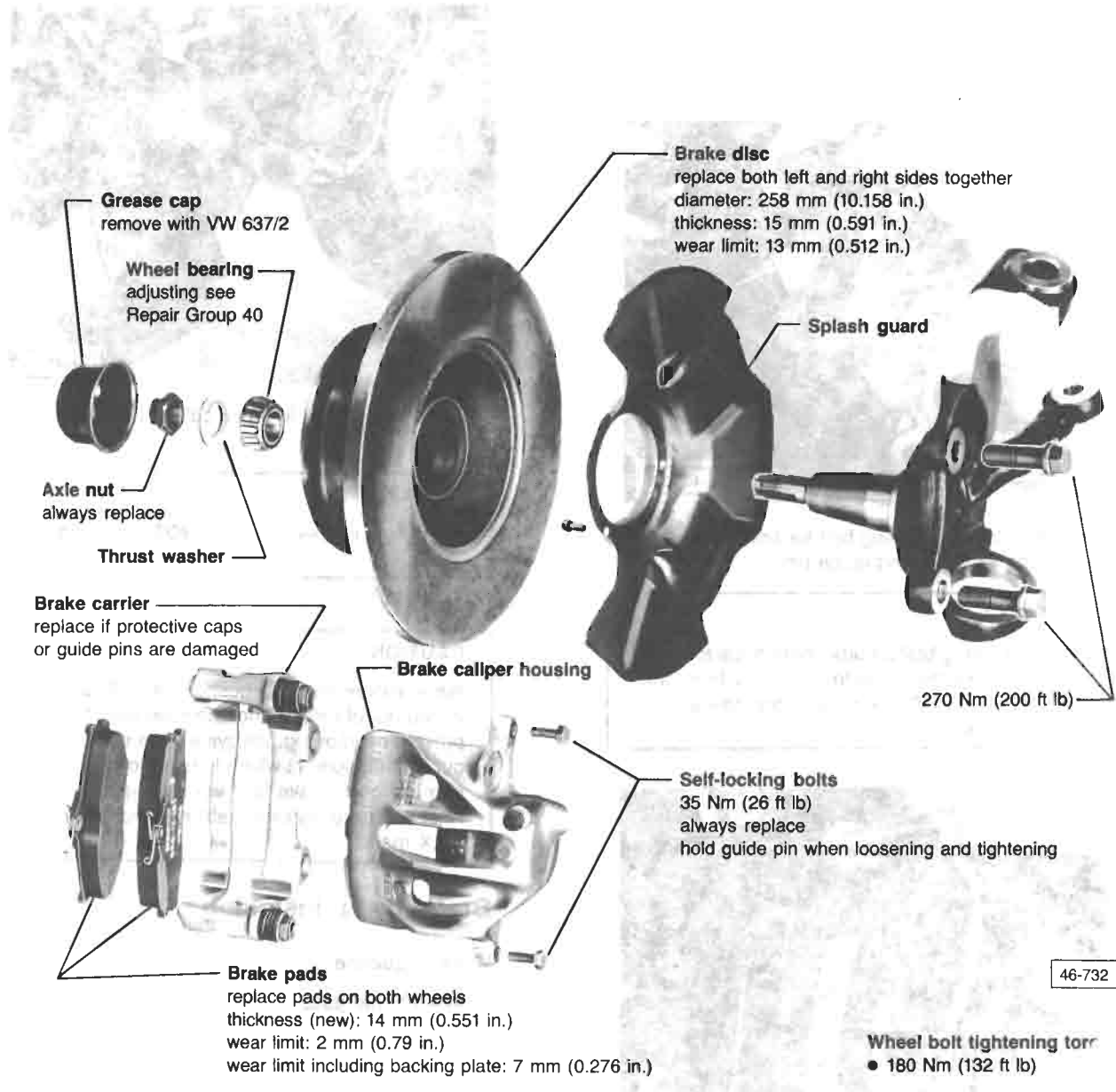
After installing brake pads, depress brake pedal firmly several times before driving to permit pistons and brake pads to adjust to brake disc

#### Note

If brake hose brackets were removed, reinstall with clearance of 25 mm (1 in.) between hose and tire.

Check clearance by turning wheel from left to right.

Correct clearance by bending bracket



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**CAUTION**

After installing new brake pads, depress brake pedal firmly several times before driving to permit piston and brake pads to adjust to brake disc.

When machining brake discs, equal amounts must be taken off each side of disc.

Never machine one side only.

Always remove brake caliper before removing disc.

When removing caliper only, never disconnect brake hose, hang caliper on frame.

Disconnect brake hoses only when repairing brake calipers.

# 46 Brakes—Mechanical Components

## Brake pads, removing

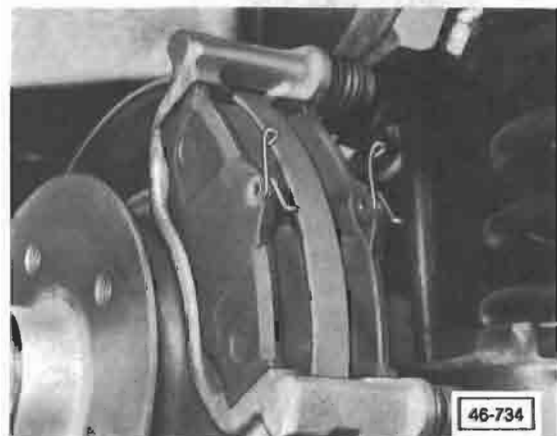
### Work sequence



- remove lower fastening bolt for brake caliper housing while holding guide pin

### CAUTION

When re-using brake pads, mark pads to prevent changing inside to outside or from one caliper to another. Mixed pads can cause uneven braking.

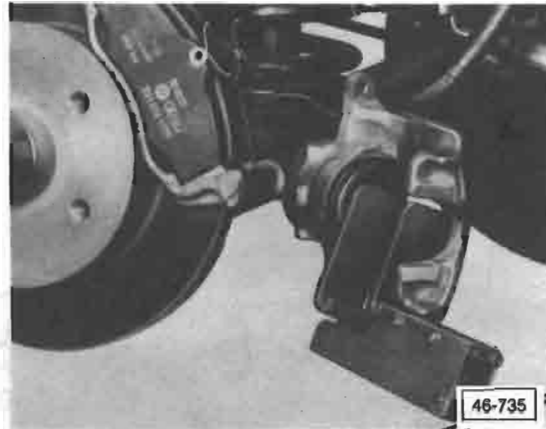


- swing brake caliper housing upward and remove brake pads

### WARNING

Friction materials such as brake and clutch linings or brake pads may contain asbestos fibers.

Do not create dust by grinding, sanding or by cleaning with compressed air.



- press piston back in brake caliper housing

### WARNING

Brake fluid is poisonous. Do **NOT** siphon by mouth.

### CAUTION

When caliper piston is pushed back, fluid is forced out of caliper and into reservoir. To prevent overflowing, always siphon some fluid out with equipment which is used for this purpose only. Brake fluid will damage paint. After pads are installed, refill reservoir only to MAX mark.

## Brake pads, installing

### Work sequence

- insert brake pads into carrier
- swing caliper housing down and tighten bolts to 35 Nm (26 ft lb)

### Note

New self-locking bolts **MUST** be used when refastening brake caliper housing.

- depress brake pedal firmly several times before driving

Avoid breathing asbestos fibers and asbestos dust.

Breathing asbestos may result in serious diseases, such as asbestosis or cancer.

Breathing asbestos may cause severe injury and death.

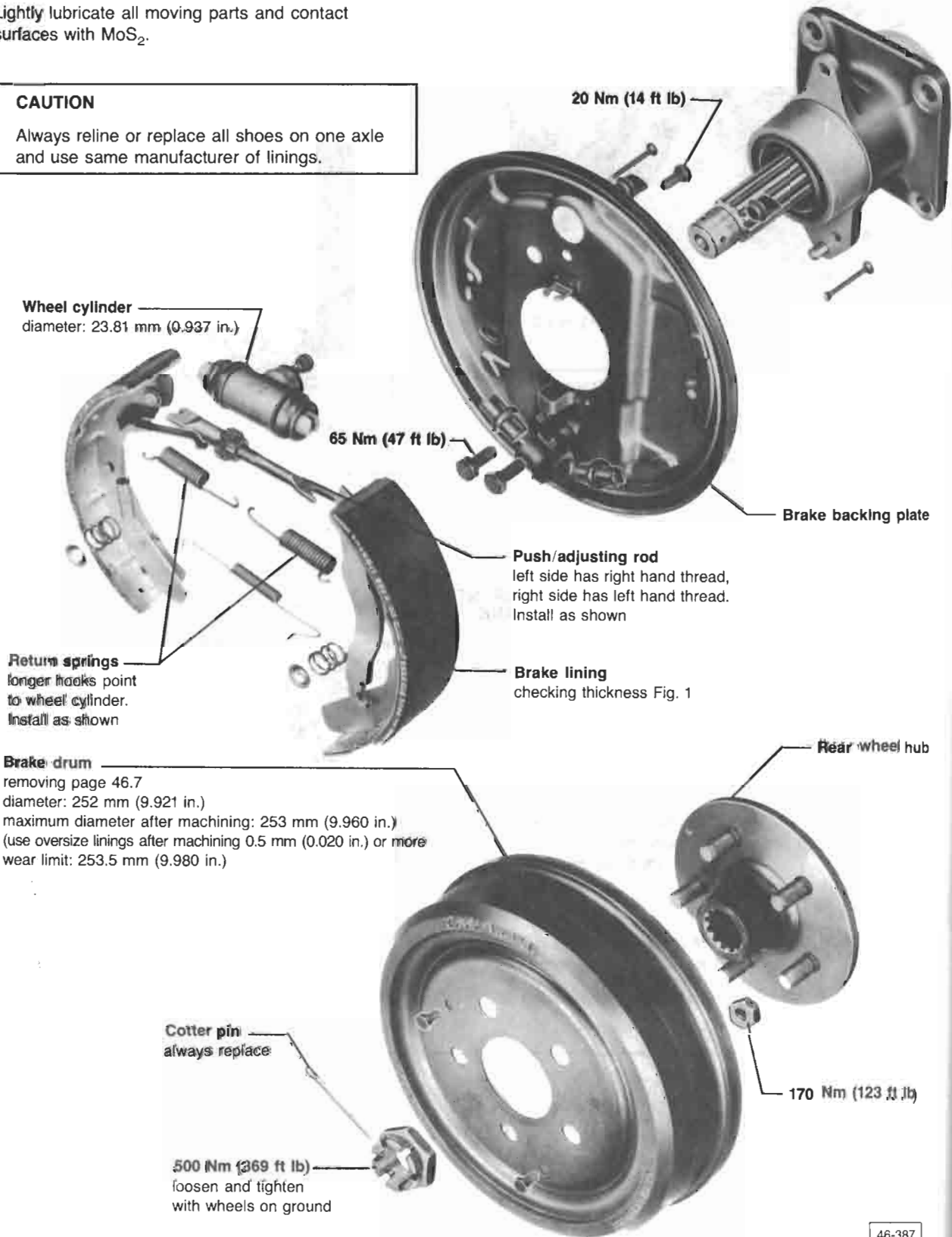
# 46 Brakes—Mechanical Components

## Note

Lightly lubricate all moving parts and contact surfaces with MoS<sub>2</sub>.

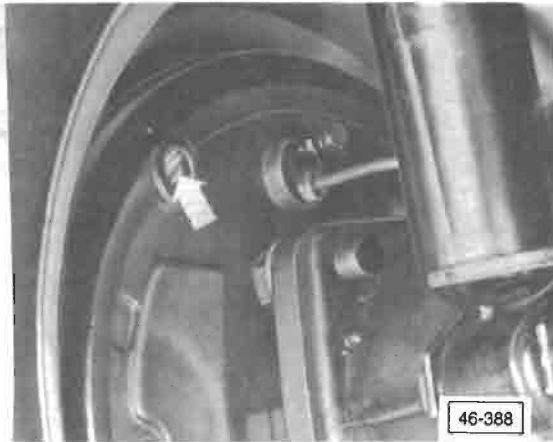
## CAUTION

Always reline or replace all shoes on one axle and use same manufacturer of linings.



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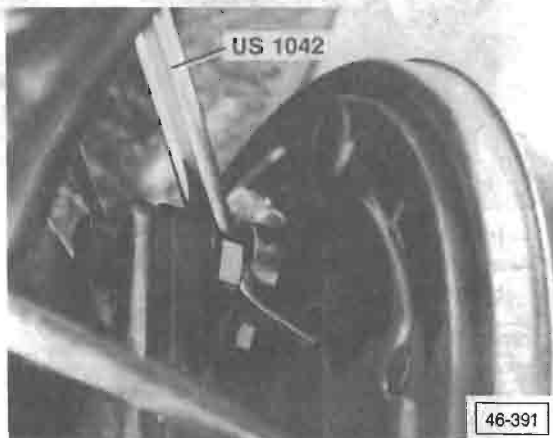


**Fig. 1 Brake linings, checking (arrow)**

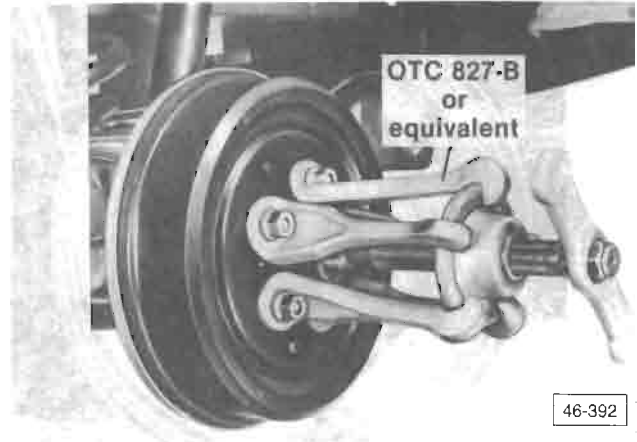
- standard lining thickness:  
6.0 mm (0.236 in.)
- oversize lining thickness:  
6.5 mm (0.256 in.)
- wear limit:  
2.5 mm (0.098 in.)

## Brake drum, removing

### Work sequence



- release parking brake cables by loosening nuts at parking brake equalizer
- back off adjuster through hole in backing plate



- pull off drum and hub

### Note

Drum must rotate freely when being pulled off.

## Brake shoes, removing

### Work sequence



- remove spring retainers and hold down springs (arrow)
- unhook parking brake cable at lever on brake shoe
- remove lower return spring
- remove adjuster spring
- go to next page

### Warning

Friction materials such as brake and clutch linings or brake pads may contain asbestos fibers.

Do not create dust by grinding, sanding or by cleaning with compressed air.

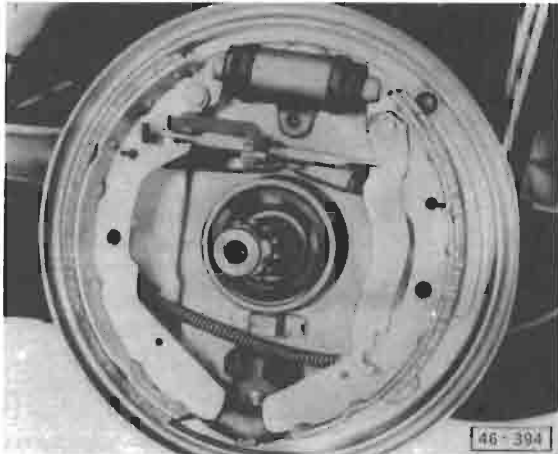
Avoid breathing asbestos fibers and asbestos dust.

Breathing asbestos may result in serious diseases, such as asbestosis or cancer.

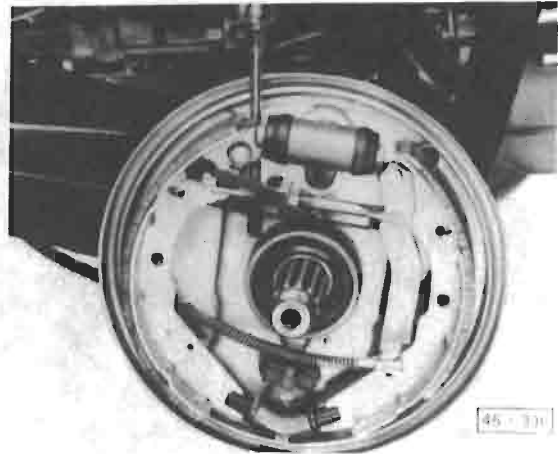
Breathing asbestos may cause severe injury and death.



# 46 Brakes-Mechanical Components



- move brake shoes out of lower support
- unhook return springs
- remove brake shoes together with push/adjusting rod



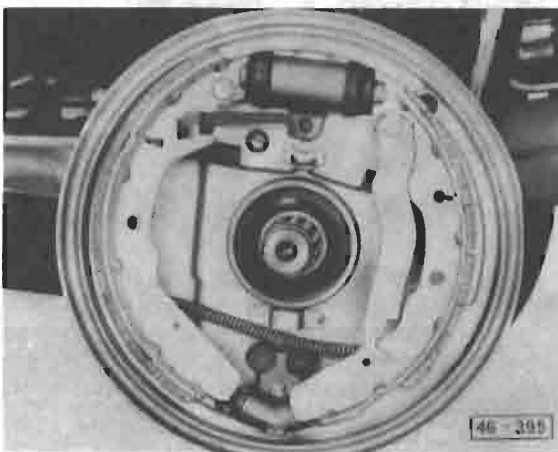
- pry brake shoe away from wheel cylinder with screwdriver and install push/adjusting rod
- install hold down springs and retainers

## CAUTION

Do not press pistons out of wheel cylinder

## Brake shoes, installing

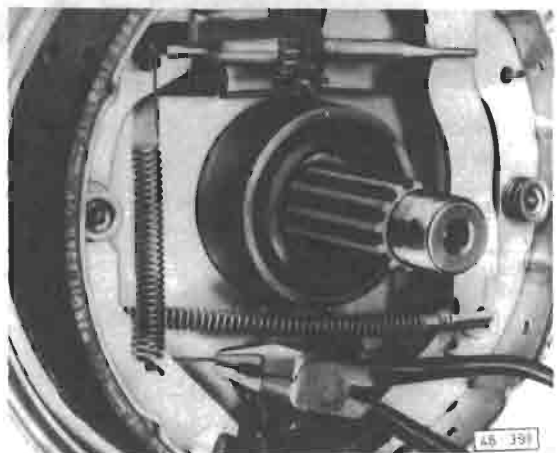
### Work sequence



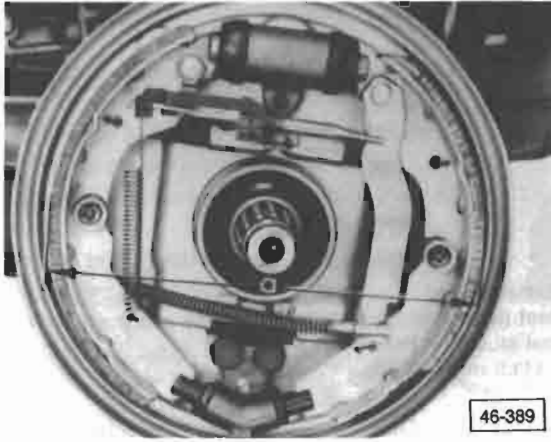
- lubricate thread of push/adjusting rod and check that adjuster moves freely
- install brake shoes together with return springs
- insert brake shoes into lower supports



- install adjuster spring
- attach parking brake cable to lever on brake shoe



- install lower return spring

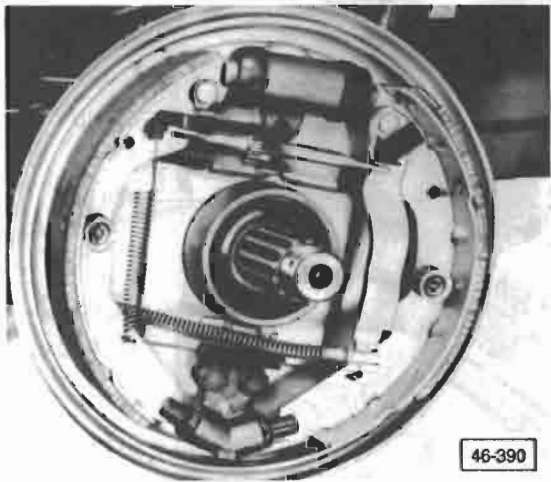


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— make basic adjustment of brake shoes by turning adjuster until measurement **a** is obtained

### Example

brake drum inner diameter:	252.2 mm (9.929 in.)
minus clearance:	1.5 mm (0.059 in.)
measurement <b>a</b> =	250.7 mm (9.870 in.)



46-390

- adjust parking brake cables at parking brake equalizer (see page 46.11)
  - there must be no play between lever on brake shoe and push/adjusting rod
- install brake drum
- tighten slotted nut to **500 Nm** (369 ft lb) and turn further until new cotter pin fits into hole in axle shaft

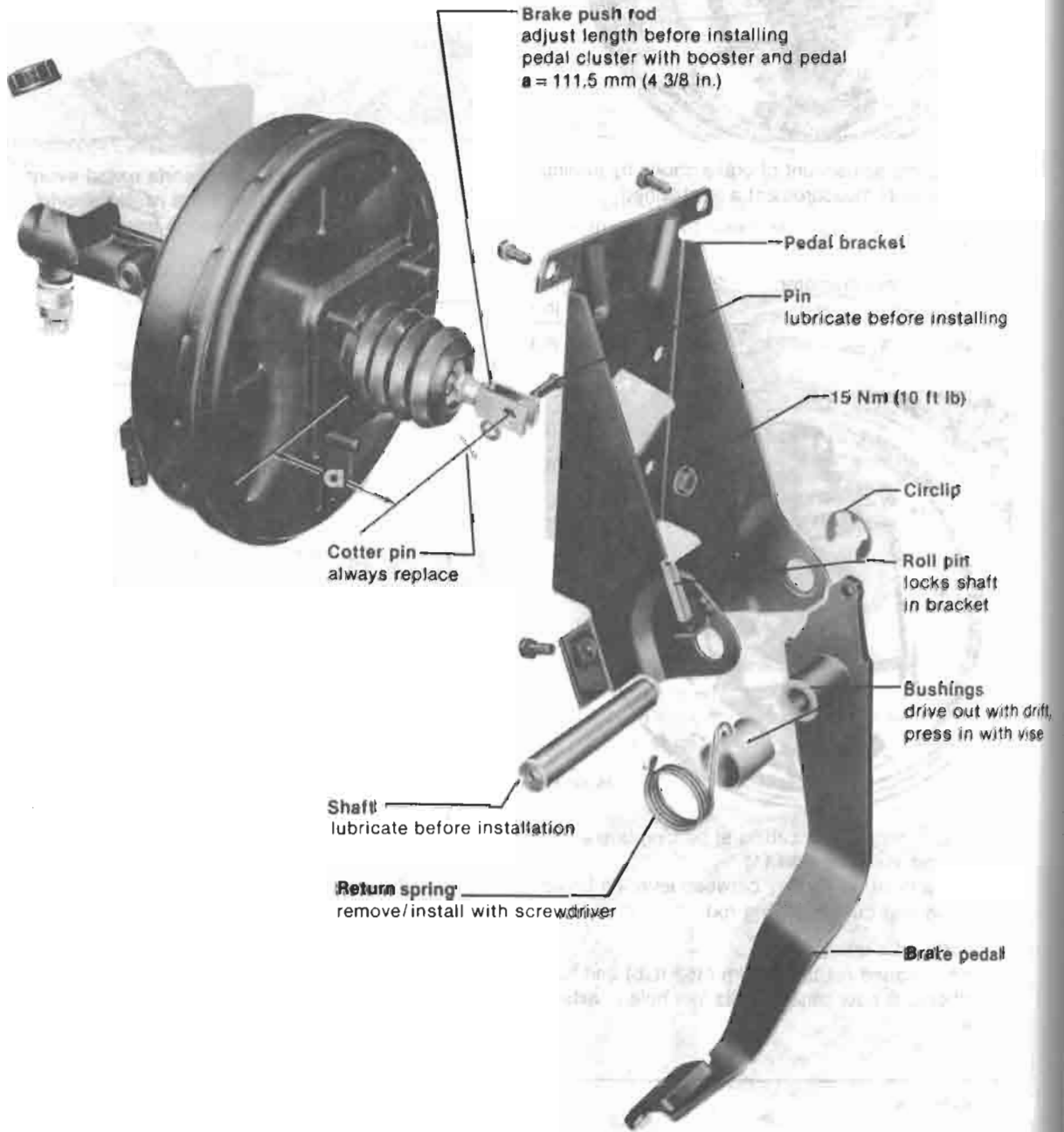
### CAUTION

Depress brake pedal several times before driving so that rear brakes self adjust.

# 46 Brakes-Mechanical Components

## Note

Instrument panel must be removed before booster and bracket with pedal connected, can be taken out



46-386

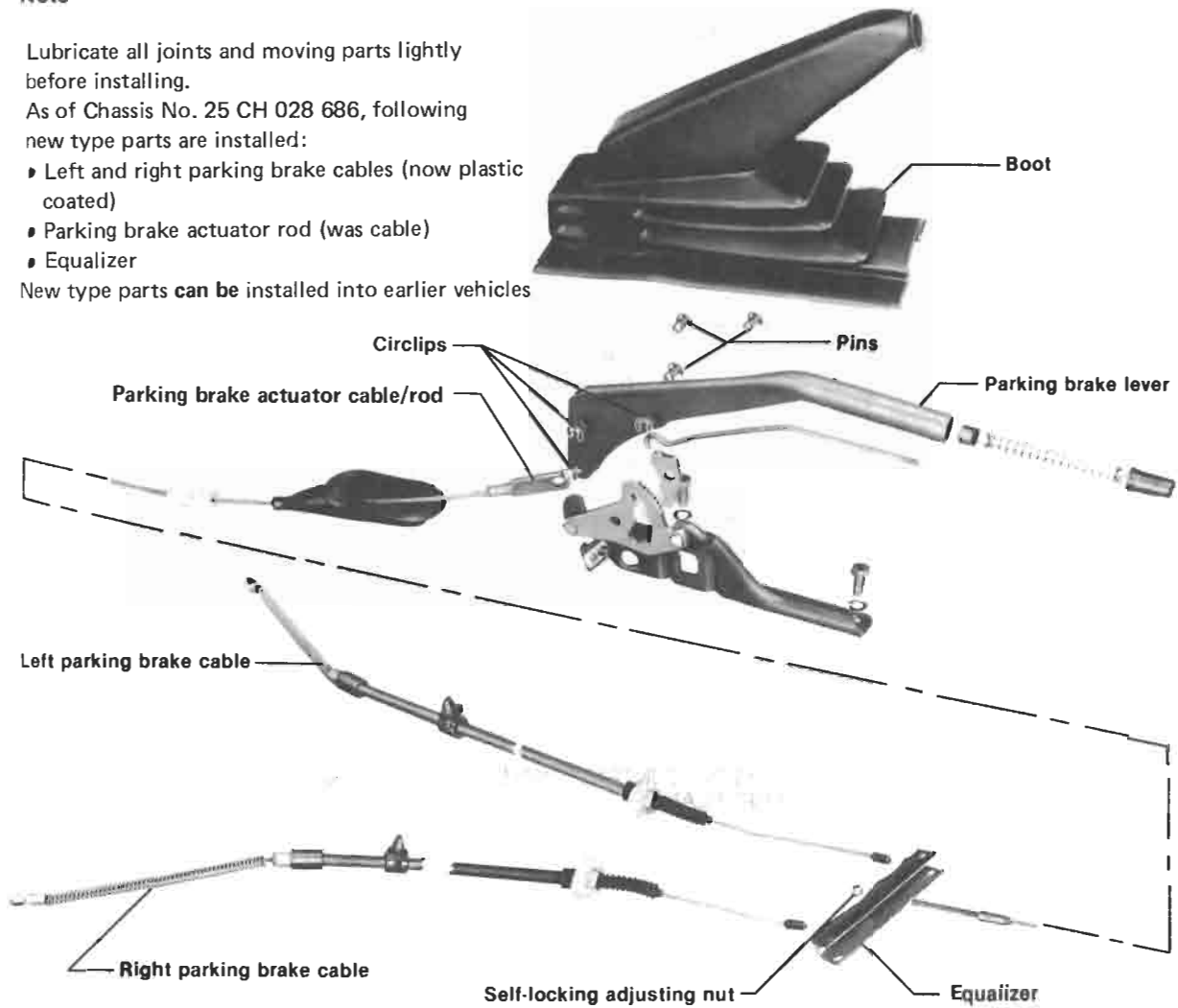
## Note

Lubricate all joints and moving parts lightly before installing.

As of Chassis No. 25 CH 028 686, following new type parts are installed:

- Left and right parking brake cables (now plastic coated)
- Parking brake actuator rod (was cable)
- Equalizer

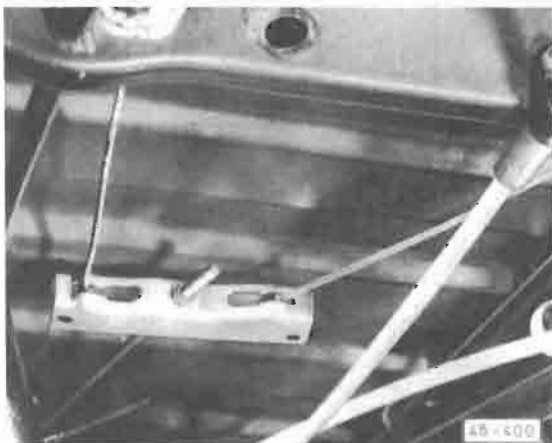
New type parts **can be** installed into earlier vehicles



46-399

## Parking brake, adjusting

### Work sequence



### CAUTION

Rear brakes must be properly adjusted before adjusting parking brake

- release parking brake
- tighten adjusting nut (self locking) until there is no noticeable play at brake components
  - check by pulling slightly on brake cable housings
- apply and release parking brake several times
- check proper adjustment of parking brake
  - rear wheels can not be turned by hand when brake lever is pulled 2-4 notches
  - rear wheels must rotate freely when parking brake is released

46-386

# Wheels—Tires, Wheel Alignment

## Index

— Tires  
  rotating 44.1a  
— Wheel alignment  
  front 44.3  
  rear 44.4  
  specifications 44.2

**Syncro**  
— Wheel alignment  
  determining front toe 44.3a  
  specifications 44.5

## Tires, rotating

Most tire manufacturers have changed their tire rotation policy on radial belted tires. Previously, radial belted tires were to be rotated only from front to rear and rear to front on the same side of the vehicle.

All radial belted tires approved for use on Volkswagen vehicles can be rotated diagonally if unusual wear, such as feather-edging, is observed.

# 44 Wheels—Tires, Wheel Alignment

## Wheel alignment data for front and rear axles

When checking wheel alignment, the following conditions are important:

- except in emergency, alignment should not be checked until vehicle has run 625-1250 miles and coil springs have settled
- vehicle empty

- tire pressures correct
- testing surface level and horizontal
- vehicle bounced several times
- steering gear correctly adjusted
- steering linkage free of play

### Front axle

	Empty 800 kg (1764 lbs.)	Half load* 1000 kg (2204 lbs.)	Maximum load* 1100-1200 kg (2425-2646 lbs.)
Toe per wheel (not pressed)	+10' ± 15'	+10' ± 15'	0° ± 15'
Total toe (wheels not pressed)	+20' ± 30' 2.0 ± 3.5 mm (0.08 ± 0.138 in.)	+20' ± 30' 2.0 ± 3.5 mm (0.08 ± 0.138 in.)	0° ± 30' 0 ± 3.5 mm (0.08 ± 0.138 in.)
Camber (wheels in straight-ahead position)	0 ± 30'	15' ± 30'	0 ± 30'
Total angle difference, at 20° lock to left and right (not adjustable)	1° 10' ± 20'	1° 10' ± 20'	1° 50' ± 20'
Caster (vehicle on level)**  corresponds to camber difference of wheel on lock from 20° left and right  maximum permissible difference between left and right	+7° 15' ± 15'  4° 50' ± 10'  1°	6° 30' ± 15'  4° 20' ± 10'  1°	6° ± 15'  4° ± 15'  1°

### Rear axle

	Empty 700 kg (1543 lbs.)	Half load* 1050 kg (2314 lbs.)	Maximum load* 1300-1400 kg (2865-3086 lbs.)
Toe per wheel Total toe (at specified camber)	0° ± 10' 0° ± 20'	+10' ± 10' + 20' ± 20'	+10' ± 10' + 20' ± 20'
Camber  maximum permissible difference between left and right	-50' ± 30'  30'	-1° 30' ± 30'  30'	-2° 10' ± 10'  30'

\*Measurements given for "half load" and "full load" apply for vehicles which cannot be measured unladen because of special equipment installed

Some models, from 1986 on, have a lower chassis height. For these vehicles use the "half-load" measurements as "empty" settings.

\*\*If vehicle is inclined to front or rear, 10' must be added or subtracted for each 15' angle off level (measured in sliding door opening)

Example: Angle measured on stand :6° 40'  
correction angle for vehicle angle (1° to front) : 40'  
actual caster angle :7° 20'

### Note

Angle of vehicle: to front — add correction figure  
to rear — subtract correction figure

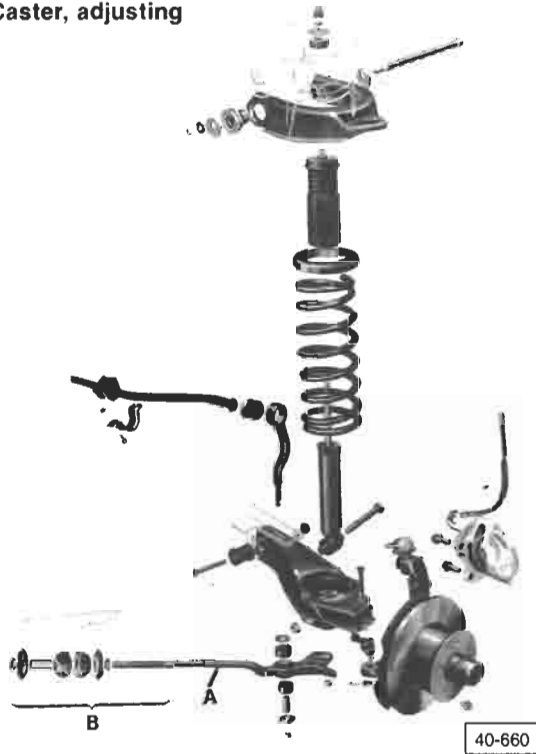
## Front wheels, aligning

### Work sequence

#### Note

Caster, camber and toe must **always** be adjusted in this sequence with vehicle on its wheels.

### Caster, adjusting



- set caster by adjusting length of radius bar **A** at location **B**

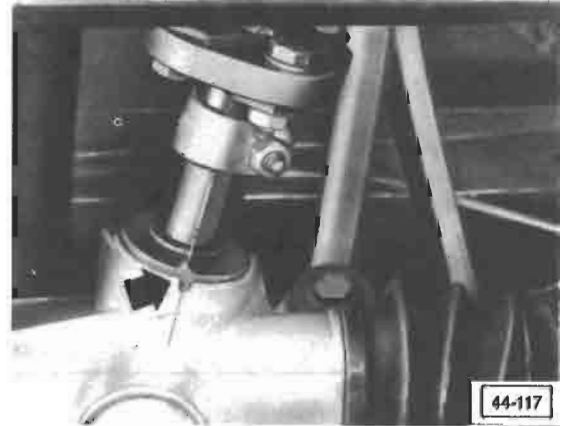
### Camber, adjusting



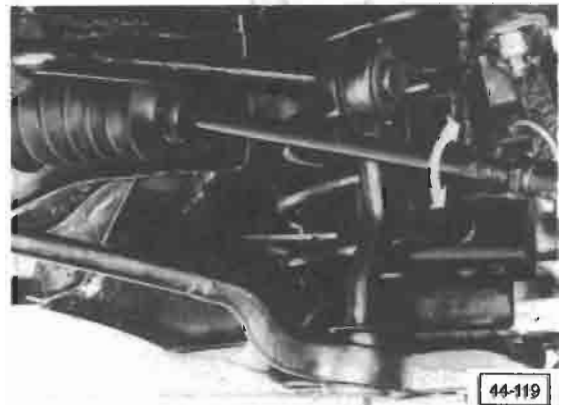
- loosen nut (**left arrow**) on upper control arm shaft
- set camber by turning upper control arm shaft (**right arrow**)
- tighten nut to **75 Nm (54 ft lb)**

### Toe adjusting

- set steering gear to center position by turning steering wheel from lock to lock and counting number of turns



- turn wheel back, 1/2 the total number of turns, and align lug on rubber washer on pinion shaft with notch in steering housing (**arrow**)



- loosen lock nuts and turn both tie rods until setting for toe is reached
- tighten lock nuts

#### Note

Steering must remain in center position.

- after turning tie rods, check that bellows are not twisted
- perform road test and check that steering wheel is in center position

#### Note

**For non-Syncro vehicles only**, if steering wheel cannot be centered by adjusting tie rods, remove steering wheel and center it on splines.



# 44 Wheels—Tires, Wheel Alignment

The specification for total toe at the front axle is determined by the jounce condition (ride height) of the vehicle.

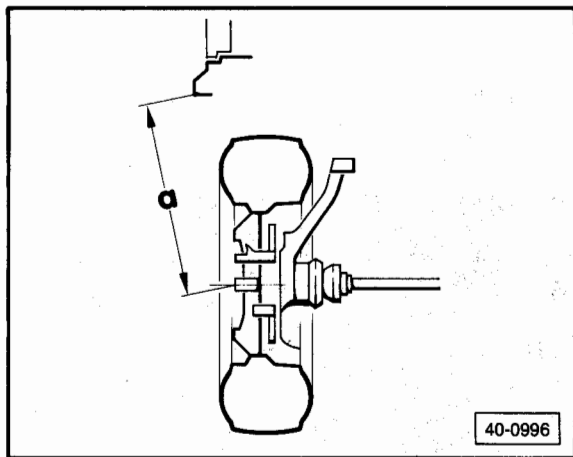
## Front toe specification, determining

— bounce front of vehicle several times to settle suspension

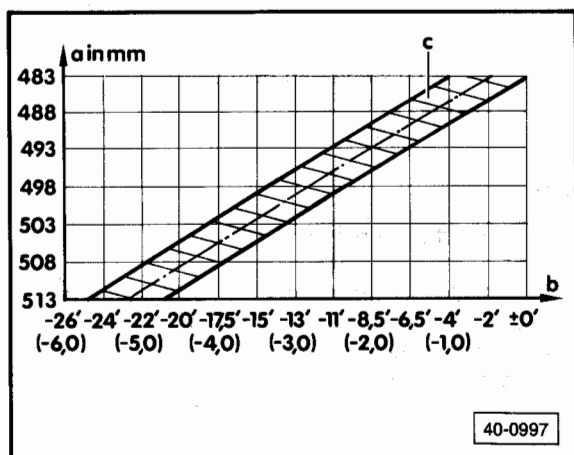
### Note

The vehicle must be empty of cargo and occupants during measurement.

- remove one front wheel cover
- measure from center of bore in axle shaft to lower edge of wheel house (measurement a)



— use measurement a to find corresponding toe specification on the following graph:



- a — dimension (mm) between wheel center and lower edge of wheel house
- b — toe per wheel  
total toe = toe per wheel x 2  
(values in parentheses = total toe in mm)
- c — tolerance band for total toe

### Note

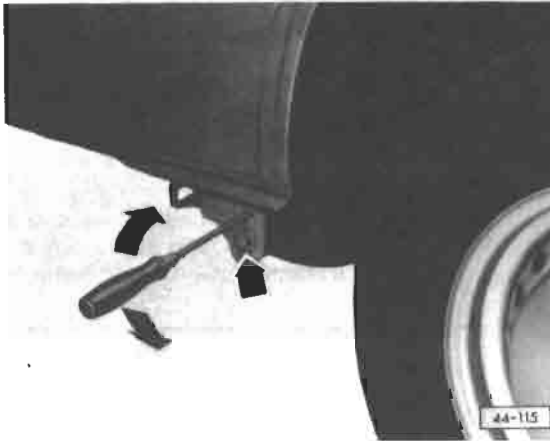
If measured distance a falls outside the range on the graph, use the toe specification last shown at the appropriate end of the graph's vertical axis. Toe values must be adjusted as precisely as possible.

# 44 Wheels, Tires, Wheel Alignment

## Rear wheels, aligning

### Work sequence

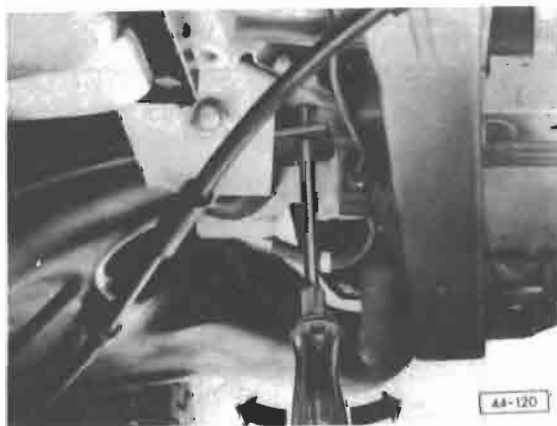
### Camber, adjusting



- loosen outer bolt (right arrow) on trailing arm
- adjust camber by moving trailing arm up or down with screwdriver
- tighten bolt to 105 Nm (76 ft lb)

### Toe, adjusting

- loosen inner bolt on trailing arm



- adjust toe by moving trailing arm to front or rear with screwdriver
- tighten bolt to 105 Nm (76 ft lb)

## Wheel alignment data for front and rear axles

When checking wheel alignment, the following conditions are important:

- alignment should not be checked until vehicle has run 625-1250 miles and coil springs have settled

- tire pressures correct
- test surface level and horizontal
- vehicle bounced properly
- steering gear correctly adjusted
- steering linkage free of play

Front axle	Empty	Full load
Toe per wheel (not pressed)	see page 44.3a	
Camber, wheels in straight ahead position Maximum permissible difference between sides	+20' ± 20' 20'	-30' 20'
Caster, with zero vehicle tilt	+4° 40' ± 15'	+3° 35'

Rear axle	Empty	Full load
Camber Maximum permissible difference between left and right	-15' + 30' -10' 20'	-1° 10'  20'
Toe of each wheel (at specified camber)	+5' ± 10'	+0° 5'

## Rear Wheel Suspension Shafts & Axle

### Index

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| <ul style="list-style-type: none"><li>— Axle shaft<br/>assembly 42.4, 42.7<br/>removing /installing 42.4</li><li>— Constant velocity joint<br/>assembly 42.7<br/>disassembling/assembling 42.8<br/>removing/installing 42.8</li><li>— Rear axle<br/>assembly 42.4</li><li>— Rear wheel suspension<br/>assembly 42.2</li><li>— Shock absorber<br/>bushing/sleeve 42.3</li><li>— Trailing arm<br/>bushing 42.3</li><li>— Wheel bearings, inner/outer<br/>grease seals 42.5<br/>removing/installing 42.5</li><li>— Wheel studs<br/>removing/installing 42.6</li></ul> |  |  |
|--|--|--|

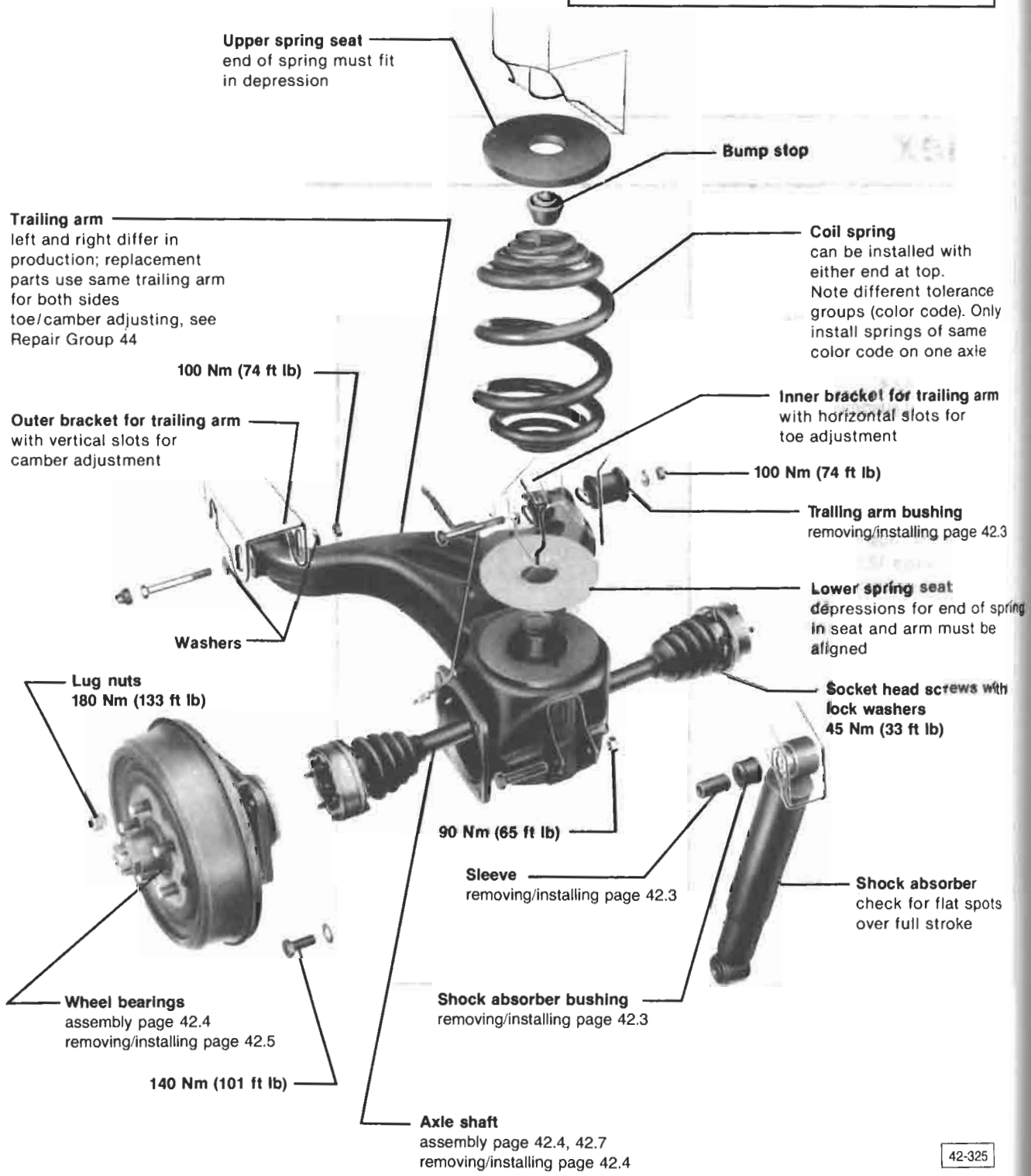
# 42 Rear Wheel Suspension, Shafts and Axle

**Note**

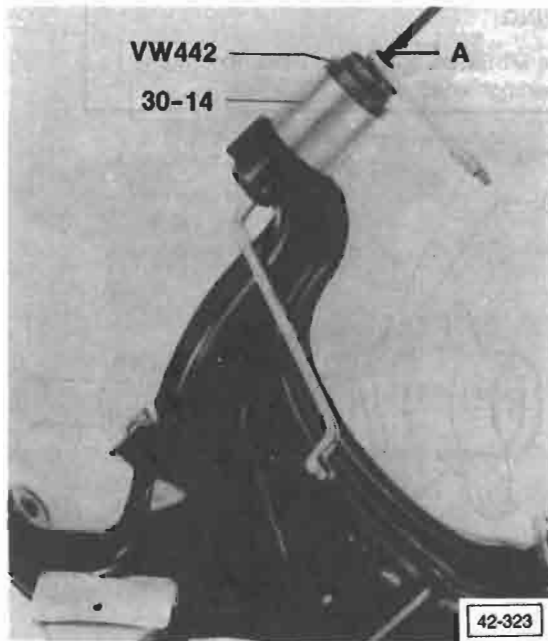
Replace self-locking nuts.

**CAUTION**

Do not attempt to straighten or weld wheel suspension parts.

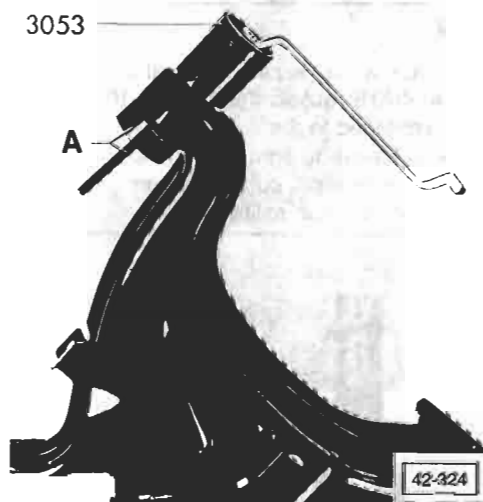


42-325



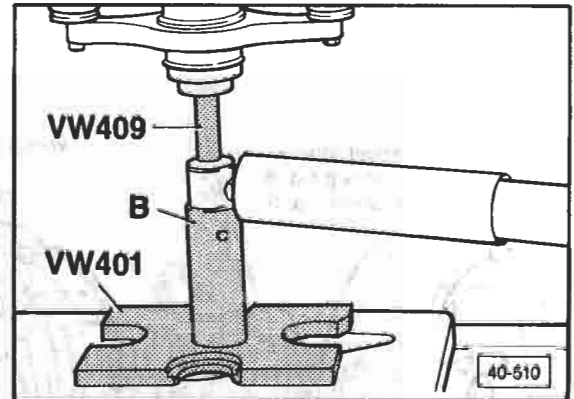
**Fig. 1 Trailing arm bushing, removing**

- A = threaded rod
- coat washer with oil and put between nut and tool
- pull bushing out of trailing arm



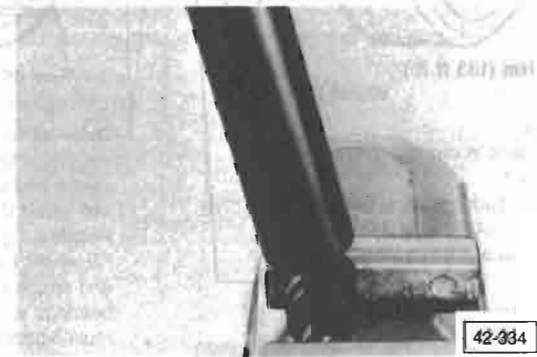
**Fig. 2 Trailing arm bushing, installing**

- A = thrust pad and threaded rod
- coat installation tool, bushing, and hole in trailing arm with soap solution
- pull bushing into trailing arm until sleeve contacts tool, then wait about 30 seconds before removing tool. Bushing will seat itself
- if necessary, press edge of bushing out



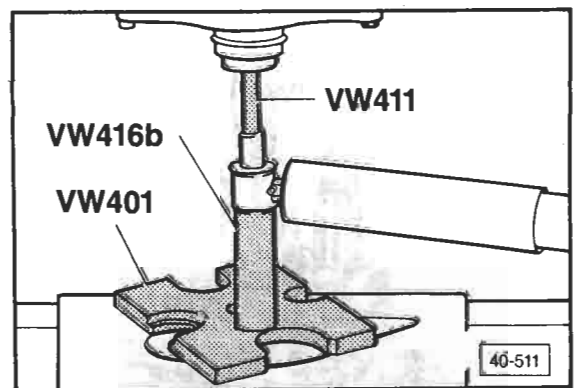
**Fig. 3 Shock absorber bushing and sleeve, removing**

- B = press tube



**Fig. 4 Shock absorber bushing and sleeve, installing**

- break sharp edge on one end of sleeve before installing
- coat parts with soap solution
- press sleeve half way into bushing with vise



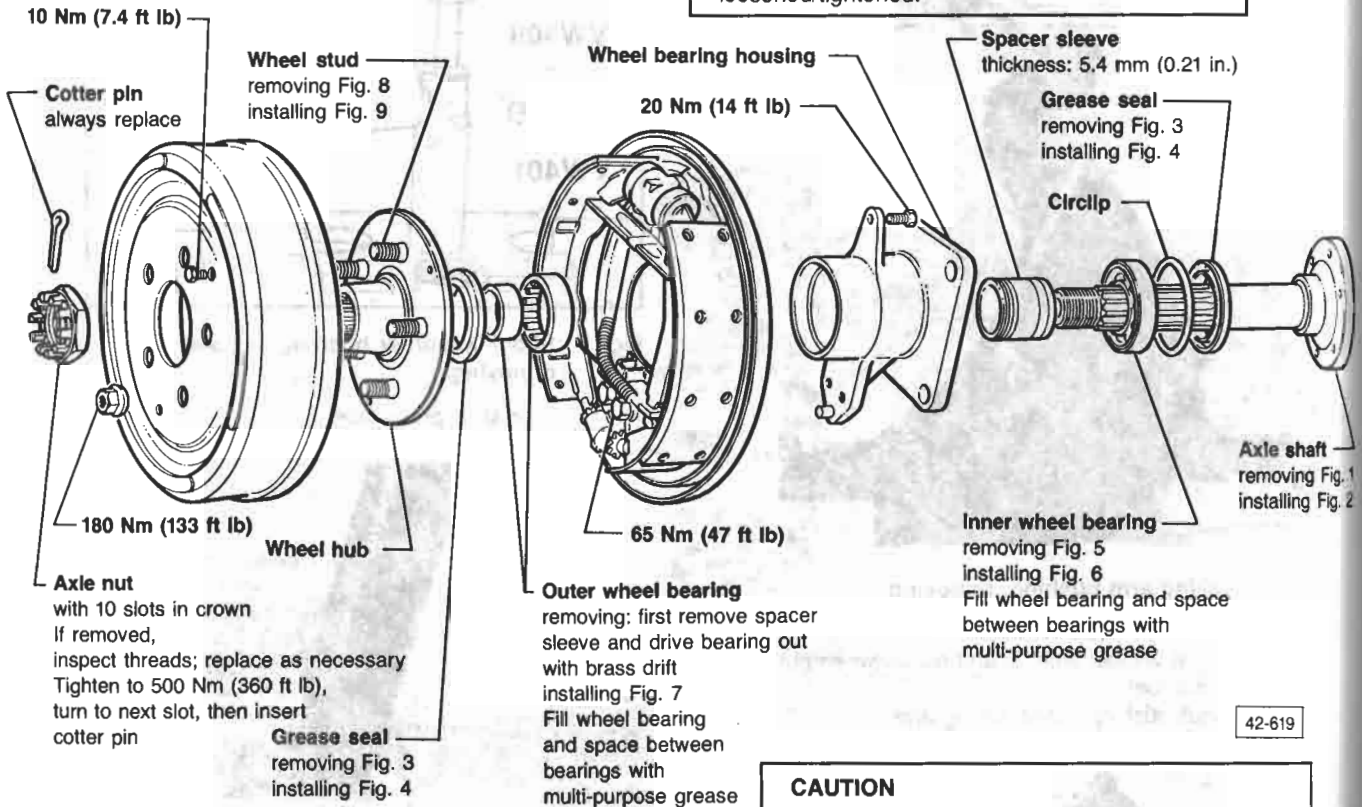
**Fig. 5 Shock absorber bushing and sleeve, pressing**

- press bushing and sleeve in fully

# 42 Rear Wheel Suspension—Shafts & Axle

## WARNING

Vehicle **MUST** be on ground when axle nut is loosened/tightened.



42-619

## CAUTION

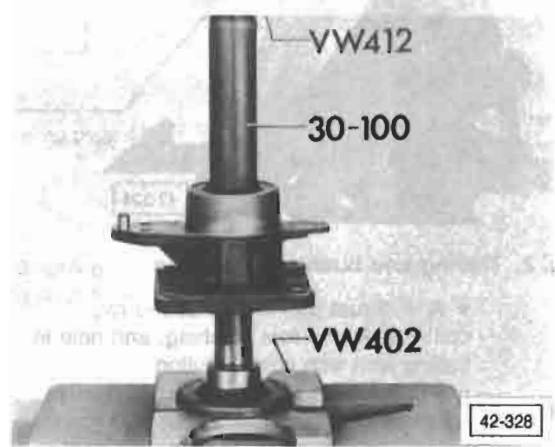
On any repairs which require removal of the axle nut, **ALWAYS** reassemble using a 10-slot crown nut tightened to the exact torque specification. Failure to tighten the axle nut to the correct specification, could result in damage to the hub/axle splines.

## Note

During repairs on vehicles prior to VIN 25ZBH19362, install new sleeves and axle nuts and torque nuts to 500 Nm (360 ft lb)



**Fig. 1 Axle shaft, removing**  
— press shaft out of wheel bearing housing



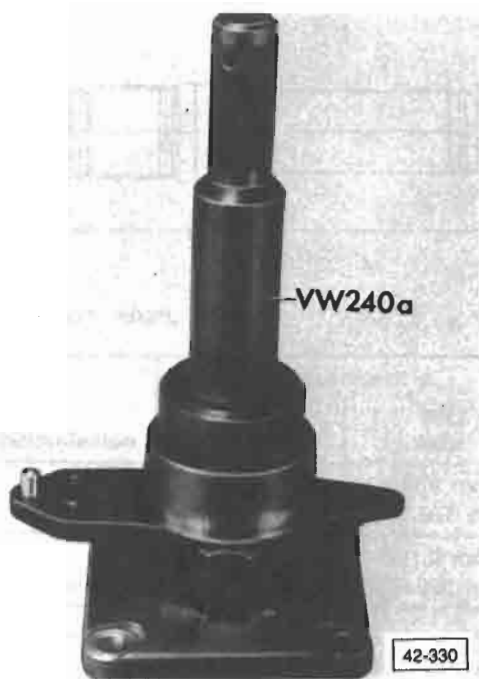
**Fig. 2 Axle shaft, installing**  
— press shaft into wheel bearing housing



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**Fig. 3 Grease seals in wheel bearing housing, removing**

- pry out with screwdriver



42-330

**Fig. 4 Grease seals in wheel bearing housing, installing**

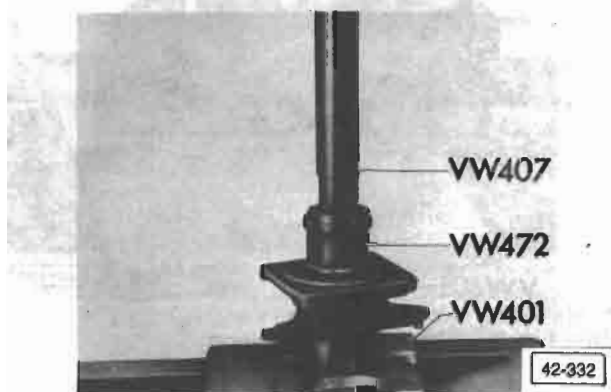
- first install spacer sleeve and inner race of outer wheel bearing
- press in flush on wheel side and against circlip on flange side



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**Fig. 5 Inner wheel bearing, removing**

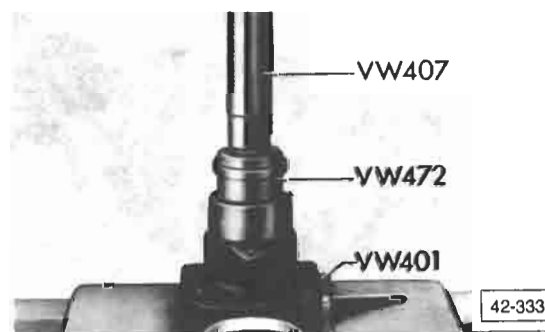
- remove inner race of outer wheel bearing and spacer sleeve
- drive outer wheel bearing out with brass drift
- press out inner wheel bearing



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**Fig. 6 Inner wheel bearing, installing**

- grease bearing
- press bearing in until seated



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**Fig. 7 Outer wheel bearing, installing**

- grease bearing and fill space between inner and outer bearings with multi-purpose grease
- press bearing in until seated

Grease seals  
Inner wheel bearing  
Outer wheel bearing



# 42 Rear Wheel Suspension, Shafts and Axle

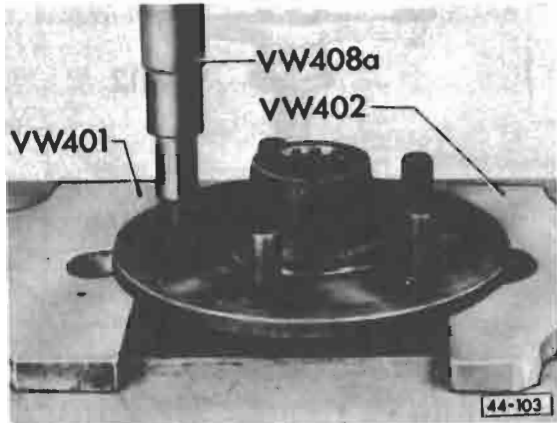


Fig. 8 Wheel studs, removing

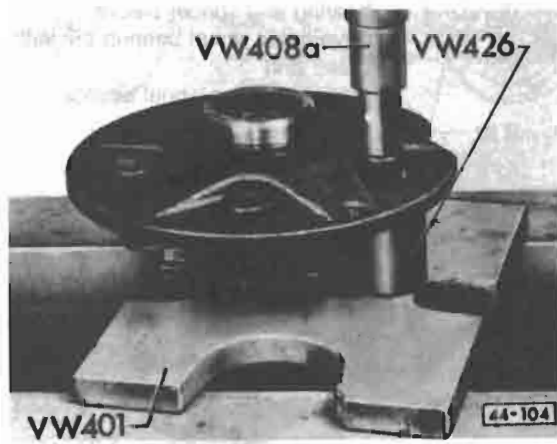
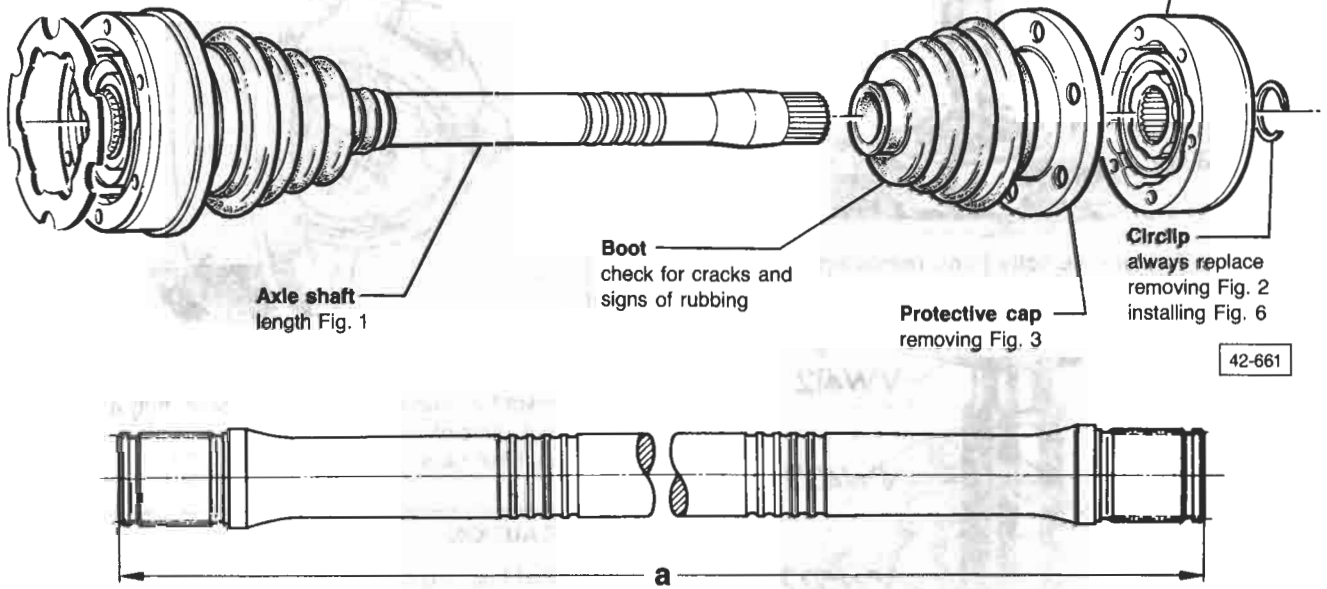


Fig. 9 Wheel studs, installing  
— press in until seated

**Note**

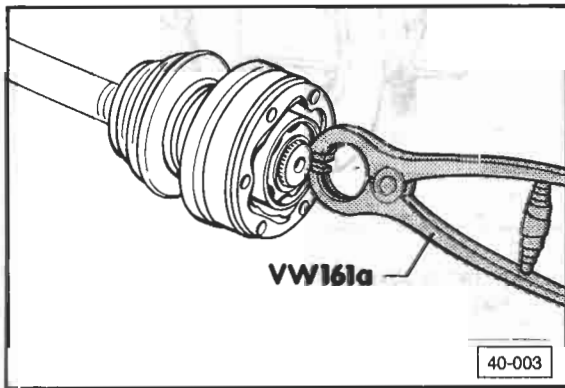
Constant velocity joint must be checked for wear if boot is torn and dirt has entered joint. If joint was disassembled, pack 45 grams of G-6.3 grease into **each side** of joint when assembling. If boot was torn, apply grease as necessary.

Constant velocity joint  
removing Fig. 5  
installing Fig. 6  
disassembling/checking/  
assembling page 42.8 and 42.9

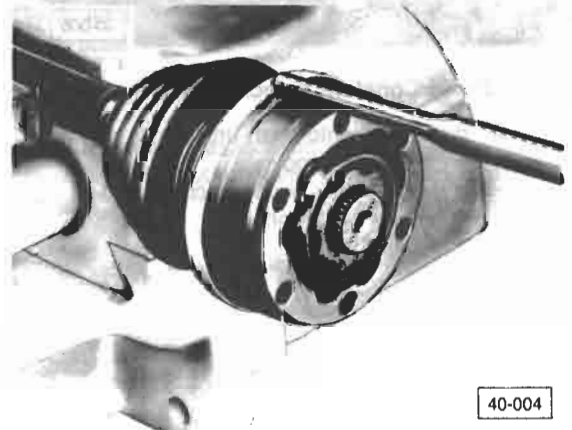


**Fig. 1 Axle shaft, length**

Transmission	Measurement a	
	right side	left side
manual	547.8 mm (21.567 in.)	547.8 mm (21.567 in.)
automatic	579.3 mm (22.807 in.)	531.0 mm (20.906 in.)



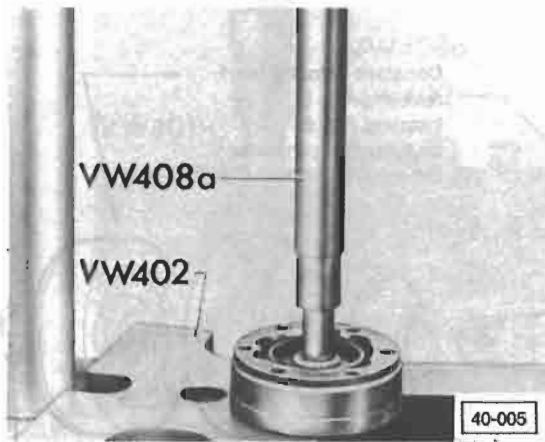
**Fig. 2 Circlip, removing**



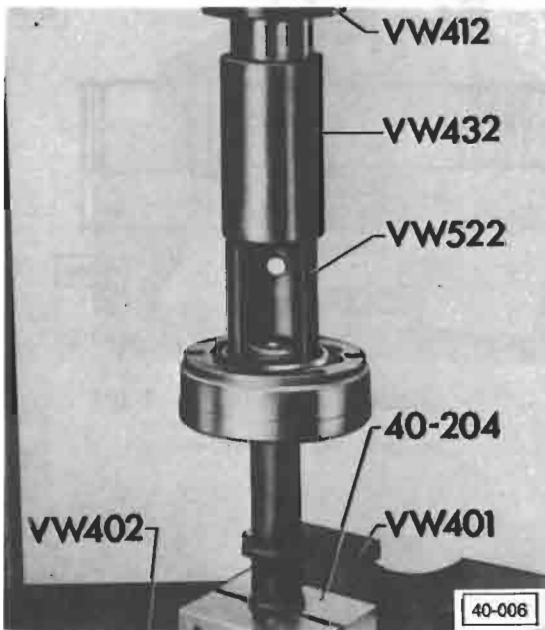
**Fig. 3 Protective cap, removing**

— drive off with drift

# 42 Rear Wheel Suspension—Shafts & Axle



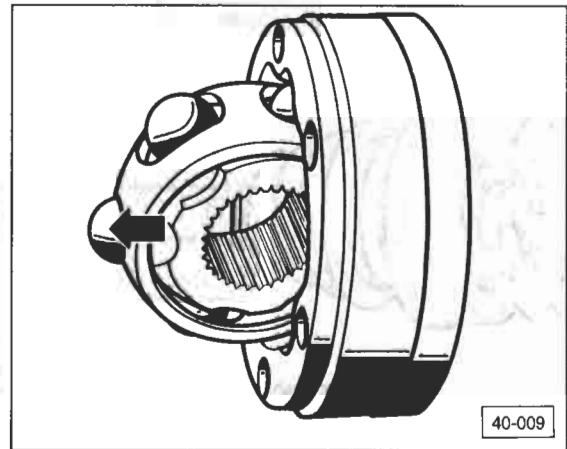
**Fig. 5 Constant velocity joint, removing**  
— press out axle shaft



**Fig. 6 Circlip/Constant velocity joint, installing**  
— press joint onto shaft until circlip can be pressed into groove  
• if necessary, squeeze circlip into groove with pliers

## Constant velocity joint, disassembling

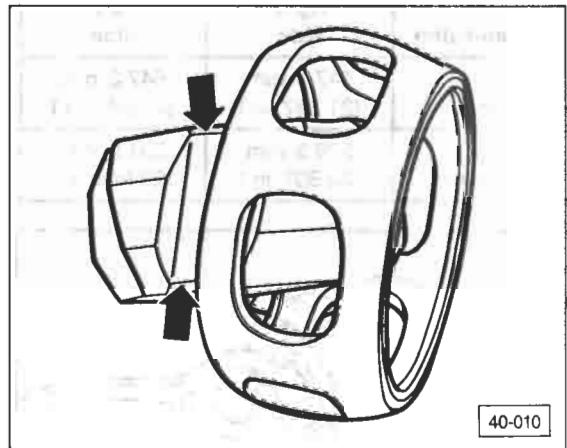
### Work sequence



- pivot ball hub and cage out of outer ring and push out (**arrow**)
- pull out balls

### CAUTION

Ball hub and outer ring are paired. One hub, or one ring, must not be exchanged with another. The 6 balls for each joint belong to one tolerance group, therefore **always** replace hub, outer ring, ball cage and balls together.



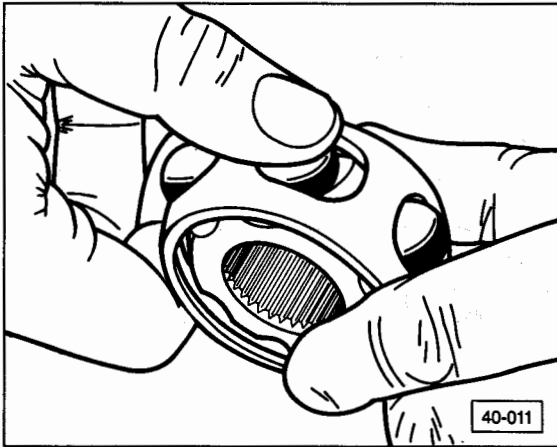
- align two grooves (**arrows**) and take ball hub out of ball cage

### Note

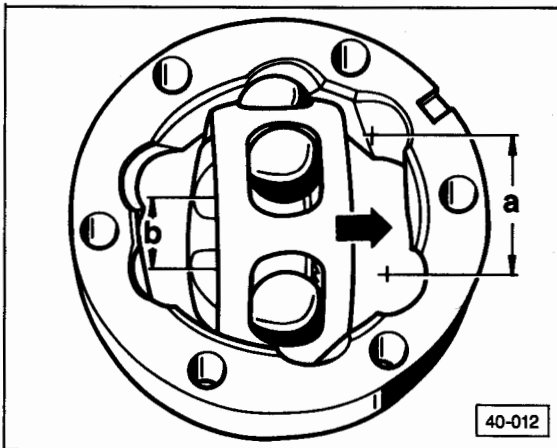
Check housing, hub, cage, and balls for pitting.

## Constant velocity joint, assembling

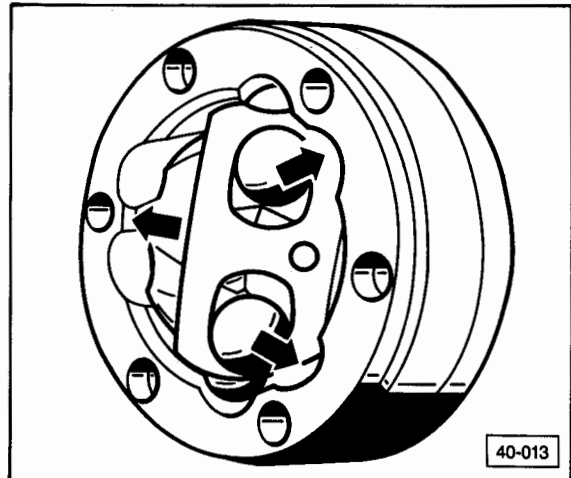
### Work sequence



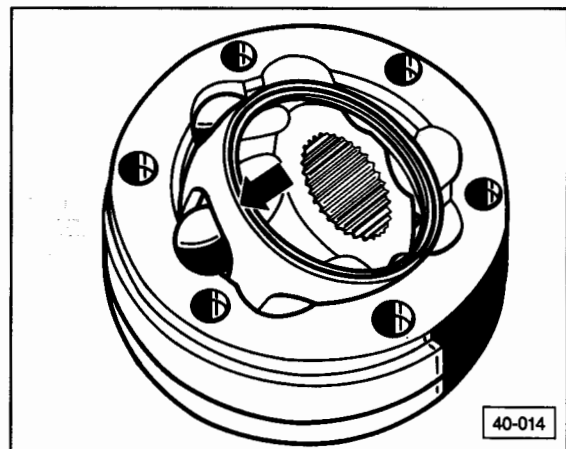
- insert ball hub along both grooves in ball cage
  - installation position is not important
- push balls into cage
- insert ball hub into proper outer ring
  - chamfer on inside diameter of ball hub (splines) must point to contact shoulder on axle shaft and to larger diameter of outer ring



- insert hub with cage and balls into outer ring vertically
- be sure that in each case a wide ball groove in outer ring **a** and a narrow groove in hub **b** are together on one side when hub is swung into outer ring



- when pivoting ball hub with cage and balls into outer ring, hub should be pivoted out of cage (arrows) until balls are spaced to fit grooves



- press cage firmly (arrow) until hub swings fully into position
- fill **each side** of joint with 45 g (1.6 oz) of G-6.3 grease

### Note

Joint is correctly assembled when ball hub can be moved in and out, by hand, over full range of axial motion.

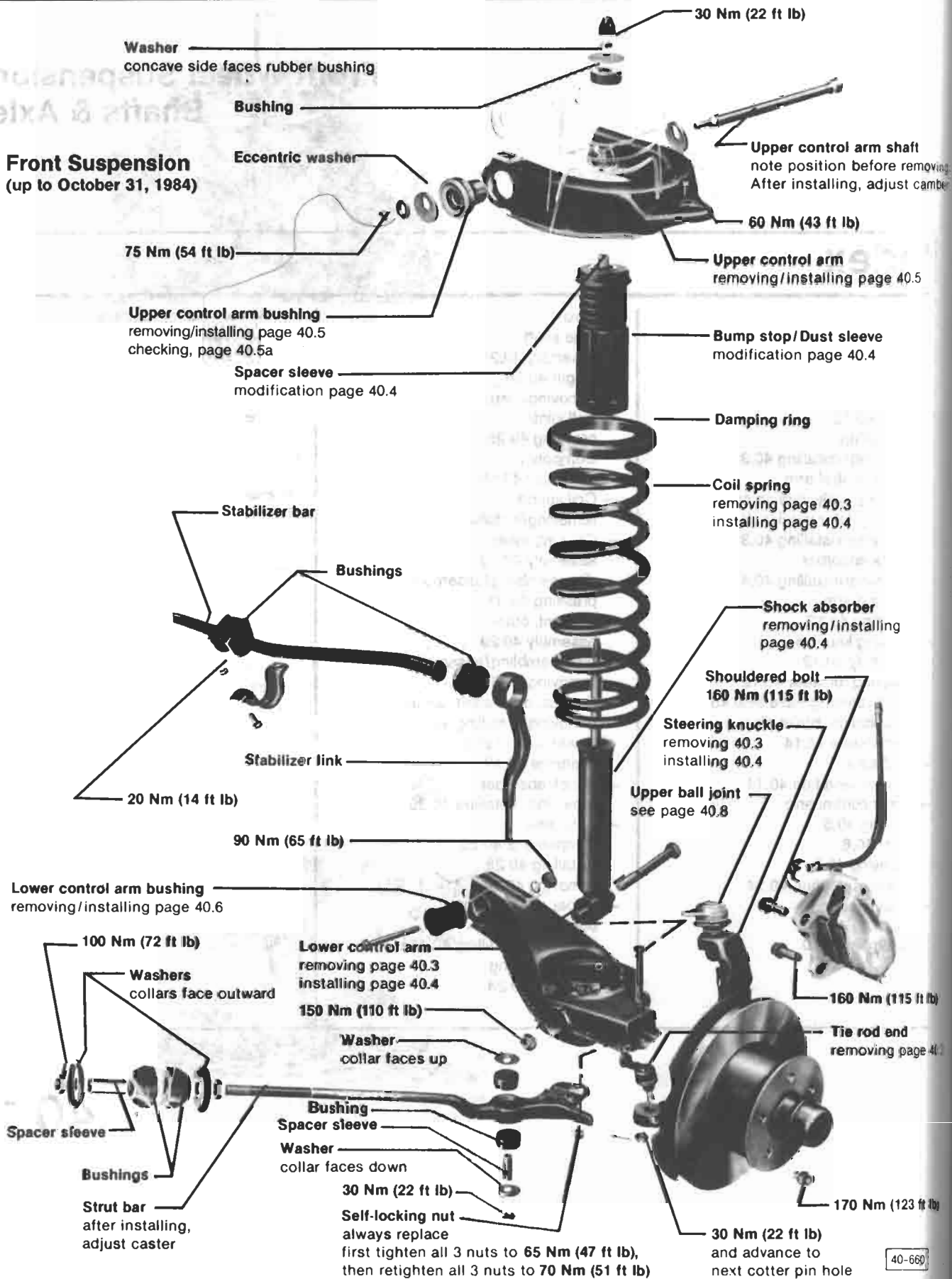
## Front Wheel Suspension Shafts & Axle

### Index

- |  |  |   |
|--|--|---|
| <ul style="list-style-type: none"> <li>— Assembly               <ul style="list-style-type: none"> <li>early version 40.2</li> <li>late version 40.7</li> </ul> </li> <li>— Ball joints               <ul style="list-style-type: none"> <li>assembly 40.10</li> <li>lower 40.12</li> </ul> </li> <li>— Coil spring               <ul style="list-style-type: none"> <li>removing/installing 40.3</li> </ul> </li> <li>— Lower control arm               <ul style="list-style-type: none"> <li>bushing, early version 40.6</li> <li>bushing, later version 40.8</li> <li>removing/installing 40.3</li> </ul> </li> <li>— Shock absorber               <ul style="list-style-type: none"> <li>removing/installing 40.4</li> </ul> </li> <li>— Steering arm               <ul style="list-style-type: none"> <li>checking 40.12</li> </ul> </li> <li>— Steering knuckle               <ul style="list-style-type: none"> <li>assembly 40.12</li> <li>checking for wear 40.12</li> <li>modification, grease seal 40.13</li> <li>modification, brake disc interference 40.14</li> </ul> </li> <li>— Subframe               <ul style="list-style-type: none"> <li>wax preservation 40.14</li> </ul> </li> <li>— Upper control arm               <ul style="list-style-type: none"> <li>bushing 40.5</li> <li>lower 40.6</li> <li>removing 40.5</li> <li>wax preservation 40.14</li> </ul> </li> <li>— Wheel bearing               <ul style="list-style-type: none"> <li>adjusting 40.11</li> <li>assembly 40.10</li> </ul> </li> </ul> | <p><b>Syncro</b></p> <ul style="list-style-type: none"> <li>— Axle shaft               <ul style="list-style-type: none"> <li>assembly 40.29</li> <li>length 40.30</li> <li>removing/installing 40.28</li> </ul> </li> <li>— Ball joints               <ul style="list-style-type: none"> <li>pressing 40.25</li> </ul> </li> <li>— Components               <ul style="list-style-type: none"> <li>assembly 40.15</li> </ul> </li> <li>— Coil spring               <ul style="list-style-type: none"> <li>removing/installing 40.20</li> </ul> </li> <li>— CV joint, inner               <ul style="list-style-type: none"> <li>assembly 40.29</li> <li>disassembling/assembling 40.33</li> <li>pressing 40.31</li> </ul> </li> <li>— CV joint, outer               <ul style="list-style-type: none"> <li>assembly 40.29</li> <li>disassembling/assembling 40.32</li> <li>removing 40.31</li> </ul> </li> <li>— Guards, drive shaft/engine               <ul style="list-style-type: none"> <li>removing/installing 40.28</li> </ul> </li> <li>— Lower control arm               <ul style="list-style-type: none"> <li>bushings 40.19</li> </ul> </li> <li>— Shock absorber               <ul style="list-style-type: none"> <li>removing/installing 40.20</li> </ul> </li> <li>— Subframe               <ul style="list-style-type: none"> <li>components 40.26</li> <li>installing 40.28</li> <li>removing 40.27</li> </ul> </li> <li>— Upper control arm               <ul style="list-style-type: none"> <li>bushings 40.19</li> <li>removing/installing 40.18a</li> </ul> </li> <li>— Wheel bearing               <ul style="list-style-type: none"> <li>pressing 40.24</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>— Wheel bearing housing               <ul style="list-style-type: none"> <li>assembly 40.23</li> <li>removing/installing 40.17</li> </ul> </li> <li>— Wheel hub               <ul style="list-style-type: none"> <li>assembly 40.23</li> <li>pressing 40.24</li> </ul> </li> </ul> |
|--|--|---|

# 40 Front Wheel Suspension, Shafts and Axle

## Front Suspension (up to October 31, 1984)



40-660

## Strut bar bolts (up to October 31, 1984)

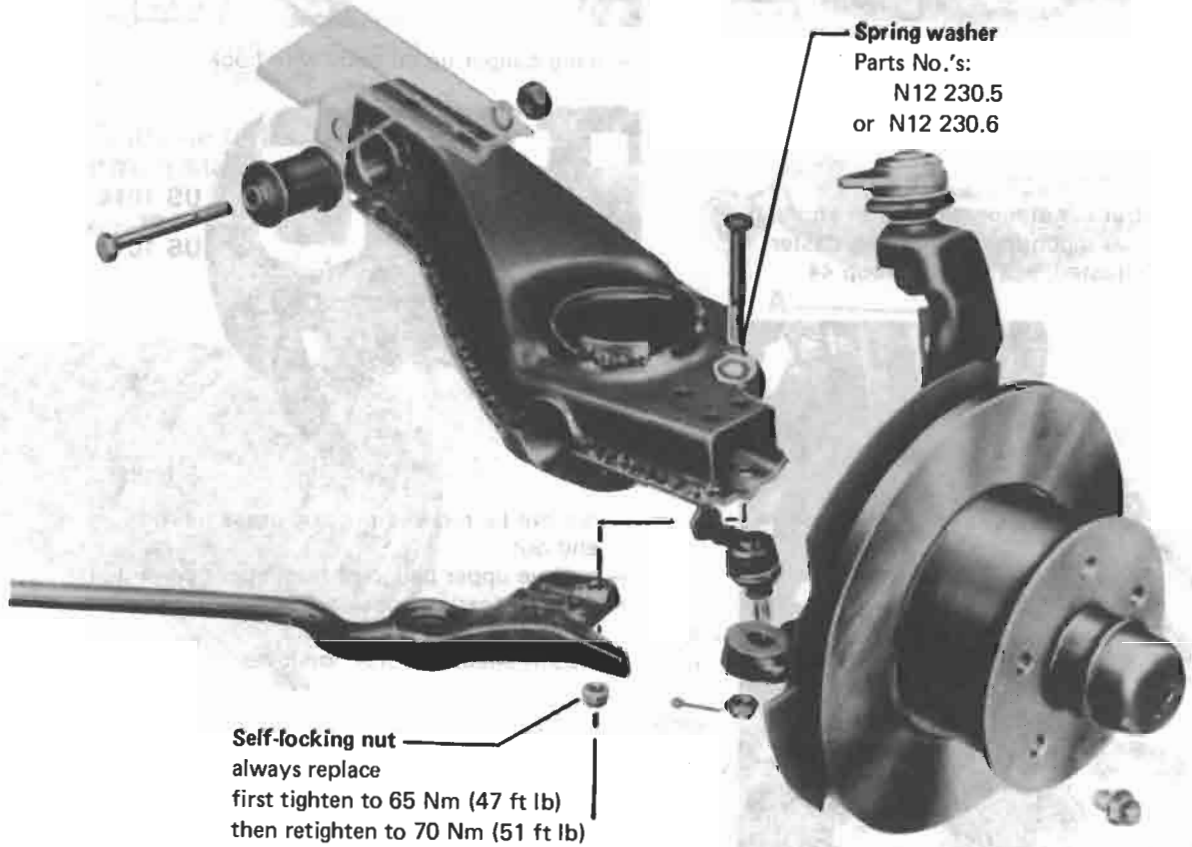
When repairing front axle **always** install spring washer under bolt head

### Note

Do not install spring washer under self-locking nut

### WARNING

Do not re-use any fasteners that are worn or deformed in normal use. Many fasteners are designed to be used only once and become unreliable and may fail when used a second time. This includes, but is not limited to, nuts, bolts, washers, self-locking nuts or bolts, circlips and cotter pins. Always replace these fasteners with new parts.



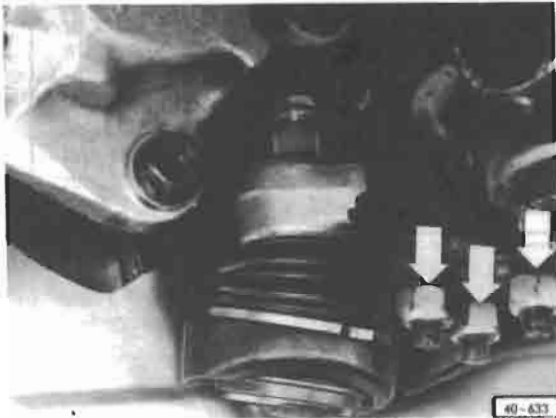
40-A006

# 40 Front Wheel Suspension, Shafts and Axle

## Steering knuckle/coil spring/lower control arm, removing

### Work sequence

- remove wheel
- remove stabilizer bar from strut bar



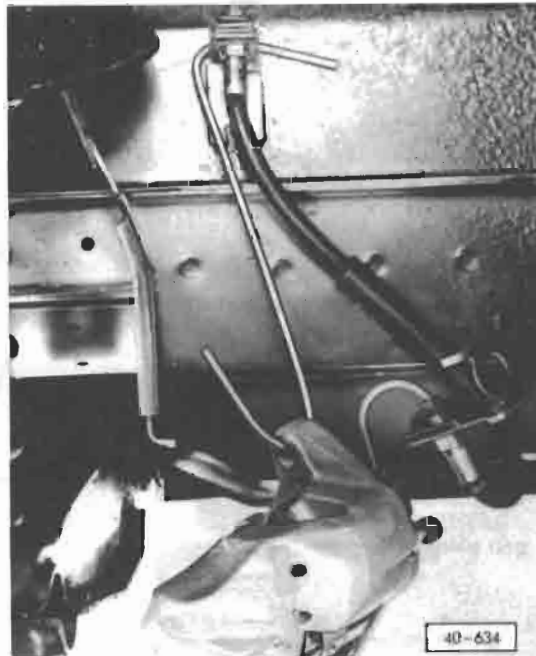
- remove nuts (arrows) holding strut bar, steering knuckle and lower control arm together

### Note

Length of strut bar determines caster angle. If setting at body mounting is changed, caster must be readjusted, see Repair Group 44



- remove brake caliper and brake hose bracket (arrows)



- hang caliper up on body with hook



- remove tie rod end nut and press tie rod end out
- remove upper ball joint from upper control arm
- detach steering knuckle from upper and lower control arms
- loosen shock absorber on lower control arm



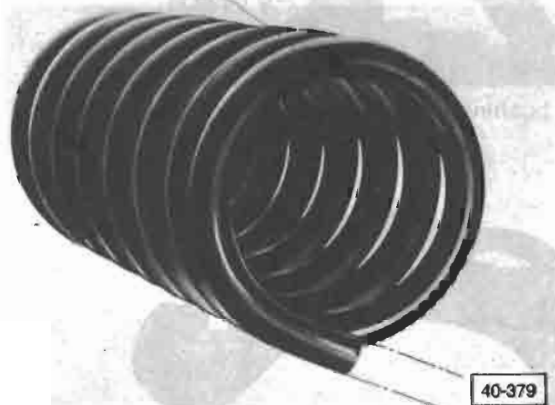


- support lower control arm with jack, and pull shock absorber bolt out of lower control arm
- lower jack slowly and remove coil spring
- remove control arm from body

## Steering knuckle/coil spring/lower control arm, installing

### Work sequence

- install control arm



- check correct position of spring (straight end of spring must be at bottom)
- attach damping ring to top of spring with tape
- install coil spring in correct position (lower end of spring in depression in control arm)
- lift control arm with jack and attach shock absorber to control arm
- attach steering knuckle to control arm. At lower connection, strut bar must also be attached
- install stabilizer bar, tie rod and brake caliper
- reinstall wheel

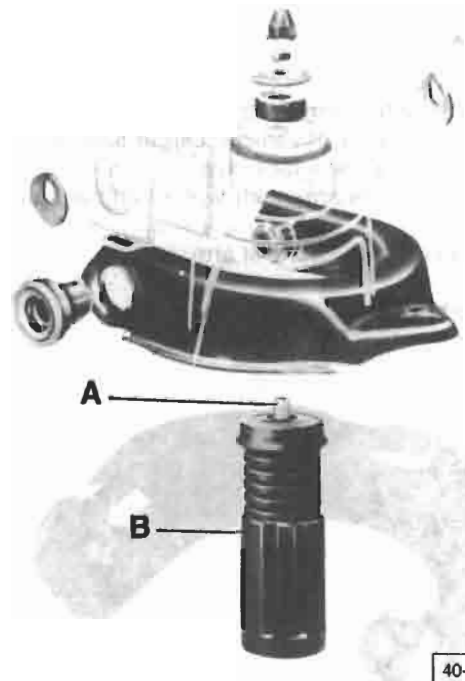
## Shock absorber, removing/installing

- remove shock absorber from control arm at bottom
- lower vehicle onto wheels and pull shock absorber bolt out of control arm
- lift vehicle
- remove shock absorber from body and install new shock absorber to body
- lower vehicle and tighten shock absorber to control arm

### Note

When lifting vehicle without shock absorber, avoid damage to upper ball joint.

## Bump stop/dust sleeve and spacer sleeve, modification



- A = spacer sleeve
- B = bump stop/dust sleeve

### Note

From VIN 25A 007 7959, following parts have been modified:

- new spacer sleeve (length 28.5 mm/1.122 in.), Part No. 251 413 439A
- contact surfaces of bump stop and body

If new bump stop must be installed in vehicles up to VIN 25A 007 7958, spacer sleeve, length 24.5 mm (0.965 in.), Part No. 251 413 439B, must be installed.

# 40 Front Wheel Suspension, Shafts and Axle

## Upper control arm, removing

- remove wheel
- remove bolts holding upper ball joint to control arm
- swing steering knuckle carefully to one side
- remove control arm shaft and detach upper control arm

## Upper control arm, installing

- attach control arm to body and note position of control arm shaft

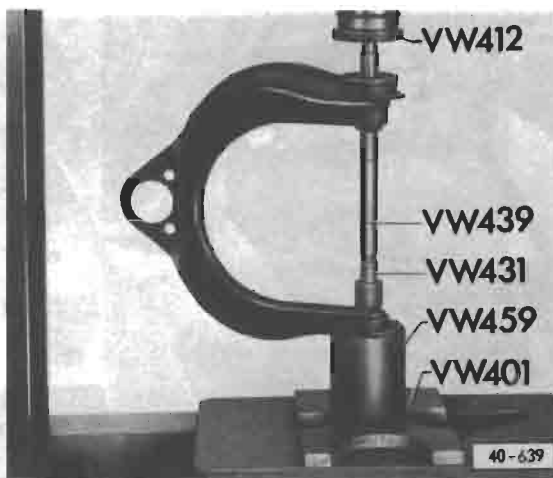


- flat on control arm shaft must be vertical and face center of vehicle. Larger side of eccentric washers face down
- lubricate control arm shaft with multi-purpose grease
- install ball joint in control arm

## Upper control arm bushing, removing

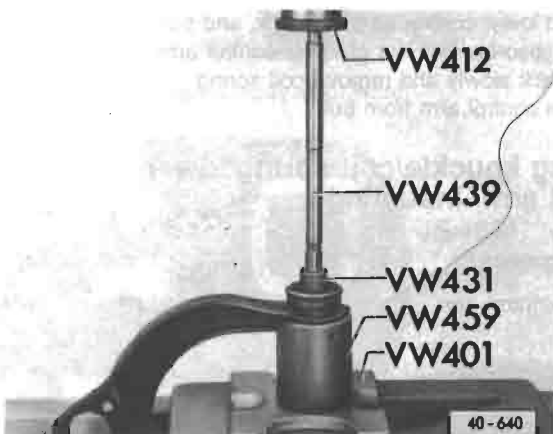


- grind off spot welds (arrows)



- press bushing out

## Upper control arm bushing, installing



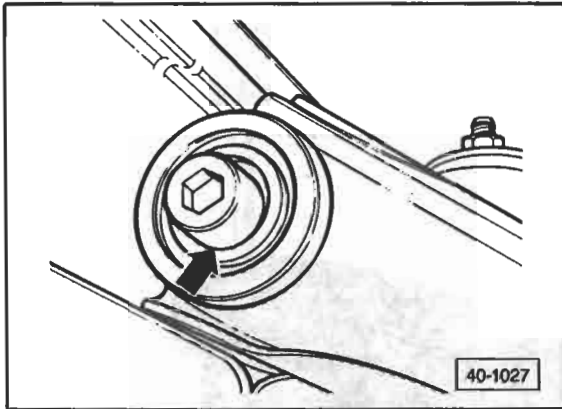
- press bushing in



- secure bushings with spot welds (arrows) to prevent them from turning
- clean up welds and paint

## 40.5

### Upper control arm Upper control arm bushing



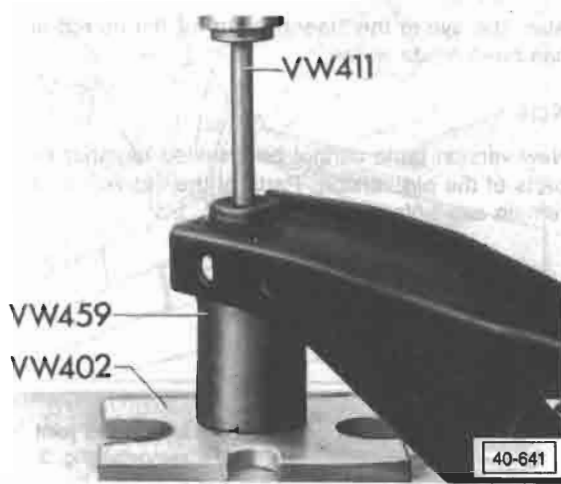
An insufficient seal at the outer ends of the upper control arm bushings can cause premature wear to the bushings.

### Upper control arm bushings, checking

- both front wheels must be on ground
- bolt head (or nut/washer) must be positioned in center of bonded rubber bushing

If bolt head (or nut/washer) comes in contact with supporting ring (**arrow**), wear limit has been reached and bushing must be replaced.

## Lower control arm bushing, removing/installing



— press bushing out



— press bushing in

# 40 Front Wheel Suspension, Shafts and Axle

## Front suspension modifications (from November 1, 1984)

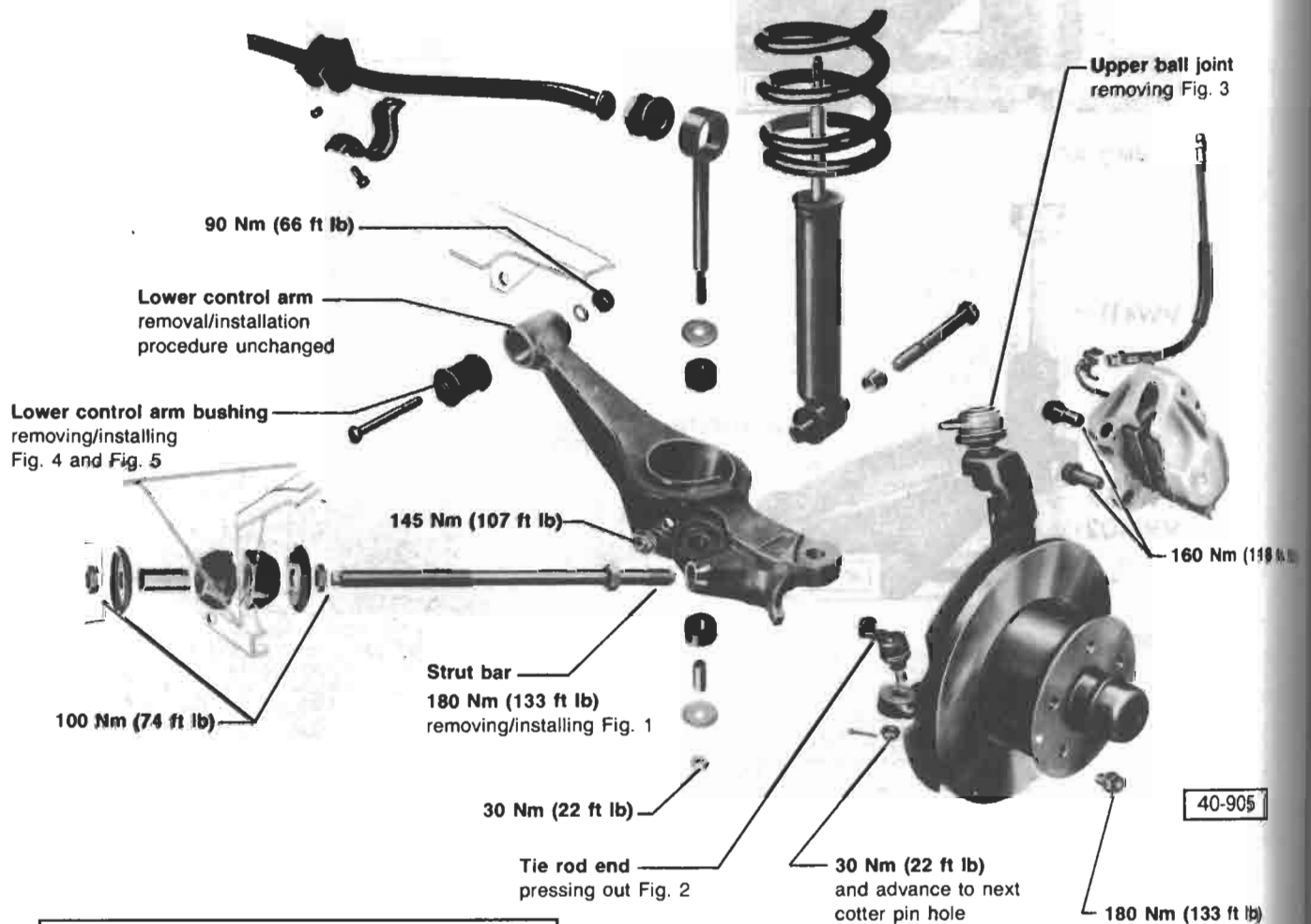
Beginning in November 1984, the sheet metal lower control arm has been replaced by a cast arm.

The strut bar, which was previously bolted to the arm with the ball joint adapter, is now screwed into the cast arm. The ball joint is installed directly in the arm and the adapter has been discontinued.

Also, the eye in the steering arm for the tie rod end has been made wider.

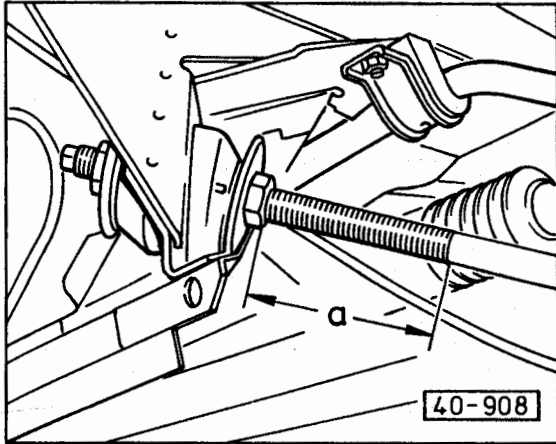
### Note

New version parts cannot be installed together with parts of the old version. Parts of the old version will remain available.



### WARNING

Do not re-use any fasteners that are worn or deformed in normal use. Many fasteners are designed to be used only once and become unreliable and may fail when used a second time. This includes, but is not limited to, nuts, bolts, washers, self-locking nuts or bolts, circlips and cotter pins. Always replace these fasteners with new parts.

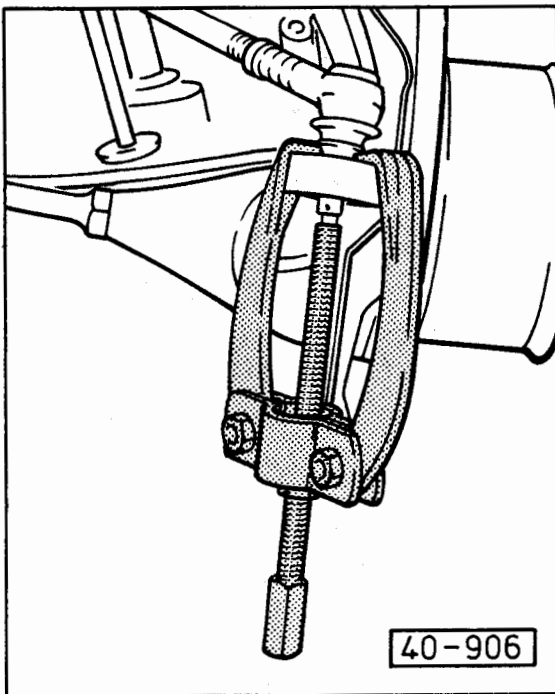


**Fig. 1** Strut bar, removing/installing

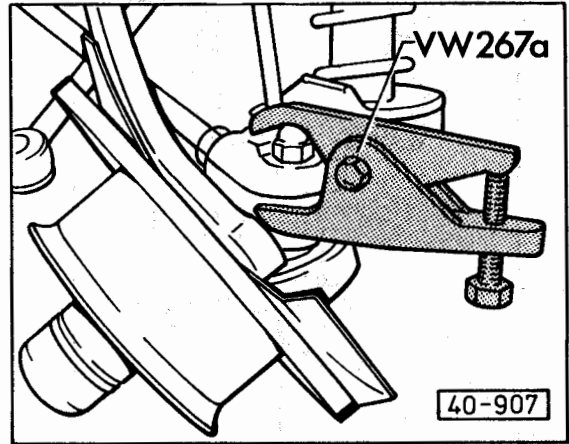
— measure dimension a from end of thread to rear nut before removing

**Note**

When installing rod, the rear nut must be set to the old position or the caster angle reset.

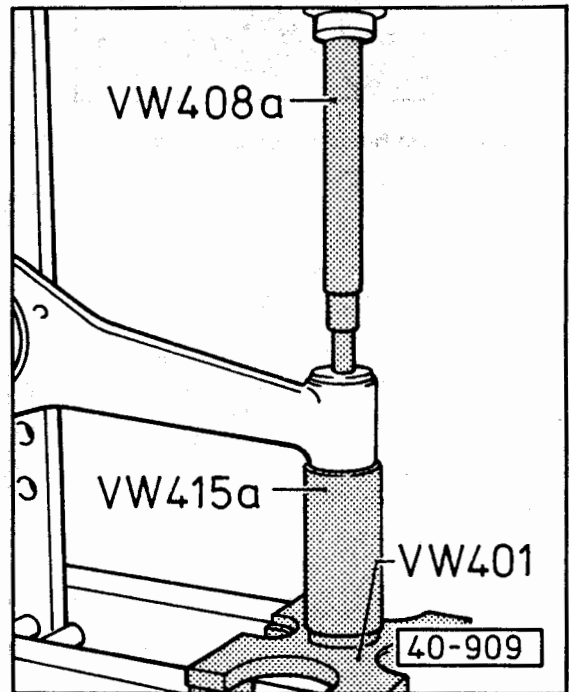


**Fig. 2** Tie rod end, pressing out



**Fig. 3** Steering knuckle, removing

— press ball joints out of arms



**Fig. 4** Control arm bushing, pressing out

# 40 Front Wheel Suspension, Shafts and Axle

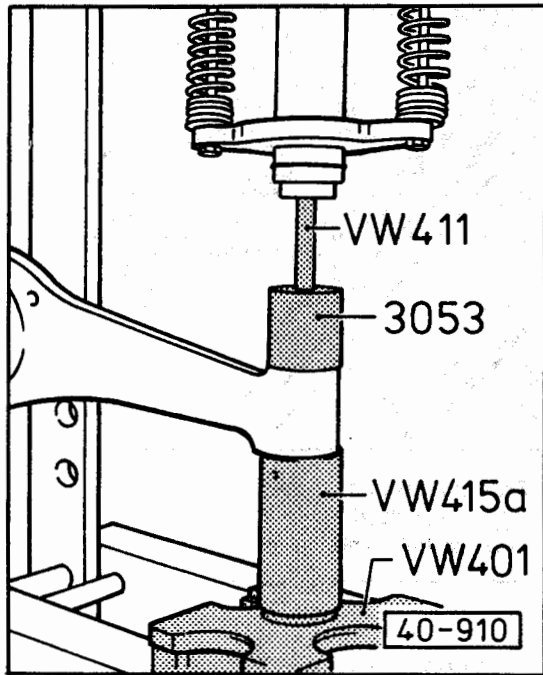


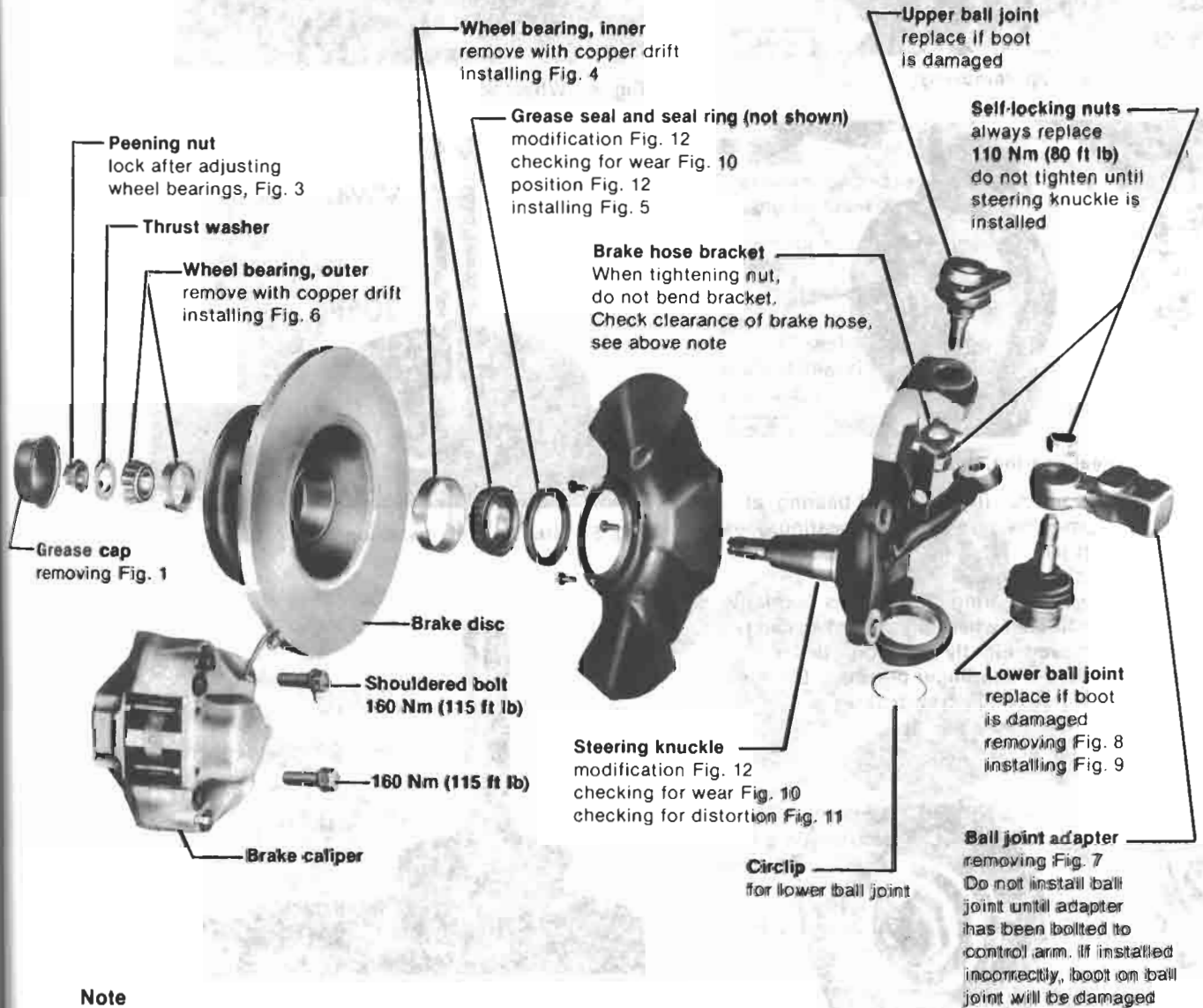
Fig. 5 Control arm bushing, pressing in

## 40.9

Control arm bushing  
(modifications from Nov. 1, 1984)

## WARNING

Do not re-use any fasteners that are worn or deformed in normal use. Many fasteners are designed to be used only once and become unreliable and may fail when used a second time. This includes, but is not limited to, nuts, bolts, washers, self-locking nuts or bolts, circlips and cotter pins. Always replace these fasteners with new parts.



## Note

If brake hose bracket is removed, clearance between wheel and hose must be checked when reinstalling. With wheels at full left and right locks, there must be a minimum clearance of 25 mm (1 in.). If not, bend bracket to adjust

40-647

Steering knuckle  
Ball joints  
Wheel bearing

# 40.10



# 40 Front Wheel Suspension, Shafts and Axle



Fig. 1 Grease cap, removing

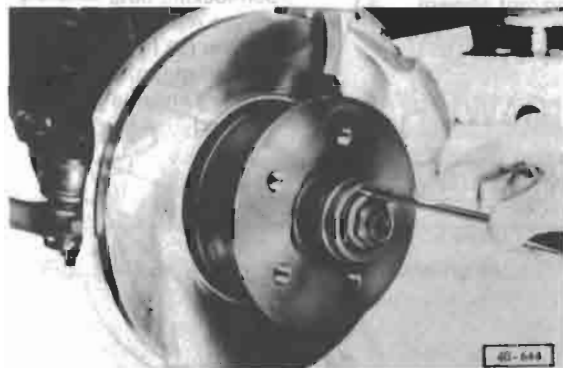


Fig. 2 Wheel bearing, adjusting

- tighten nut firmly to seat bearing, at same time turn wheel so bearing does not jam
- back off nut
  - wheel bearing clearance is correctly adjusted when thrust washer can be moved slightly with screwdriver (arrow) and finger pressure. Do not pry or twist screwdriver
- peen nut (see Fig. 3)
- install grease cap

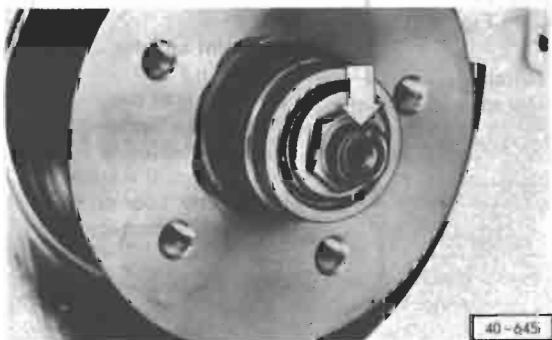


Fig. 3 Peening nut, locking

- peen nut on shoulder (arrow)
- do not reuse peened nut, always replace



Fig. 4 Wheel bearing (inner), installing outer race



Fig. 5 Grease seal, installing

- press in flush

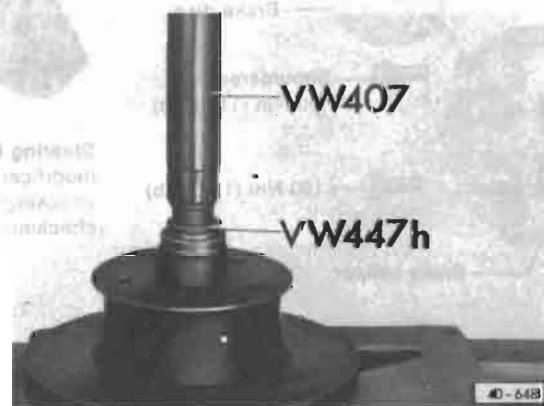
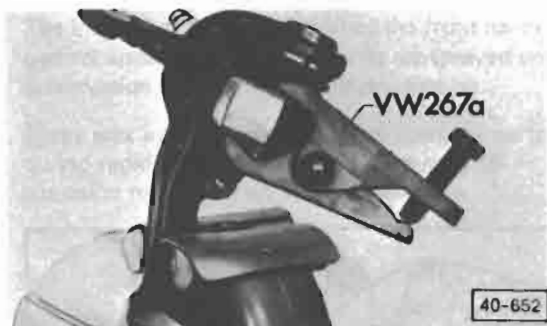


Fig. 6 Wheel bearing (outer), installing outer race



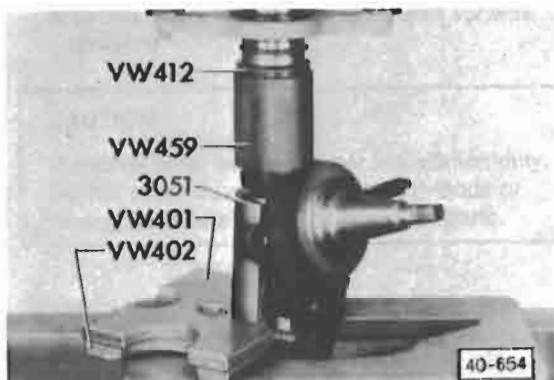
**Fig. 7 Ball joint adapter, removing**

- press lower ball joint adapter off lower ball joint
- press upper ball joint out with same tool



**Fig. 8 Lower ball joint, removing**

- remove circlip for ball joint
- press lower ball joint out of steering knuckle

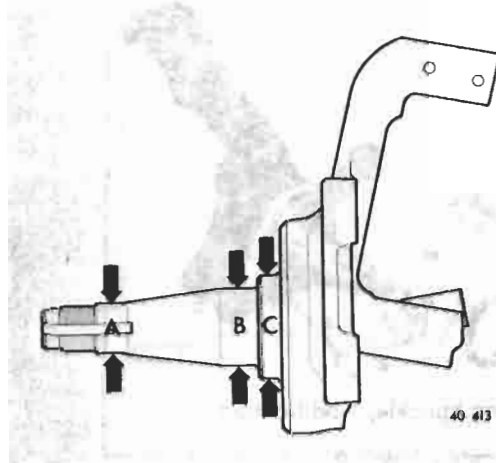


**Fig. 9 Lower ball joint, installing**

- press in, flat side of shoulder faces spindle
- attach adapter loosely to ball joint

**Note**

Do not tighten adapter fully. Adapter must be aligned with control arm when steering knuckle is installed; otherwise, rubber boot will be stretched and torn when steering is in full lock position



**Fig. 10 Wheel bearing/grease seal seats, checking for wear**

- check for scoring or ridges at these points
- A = outer bearing seat
- B = inner bearing seat
- C = oil seal seat/seal ring
- replace seal ring or steering knuckle if necessary



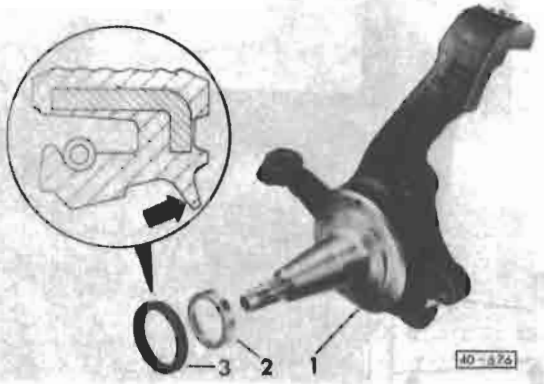
**Fig. 11 Steering arm on steering knuckle, checking**

- measurement must be: 54-56 mm (2.126-2.205 in.)

**CAUTION**

Bent steering knuckles must be replaced. Do not straighten

# 40 Front Wheel Suspension, Shafts and Axle



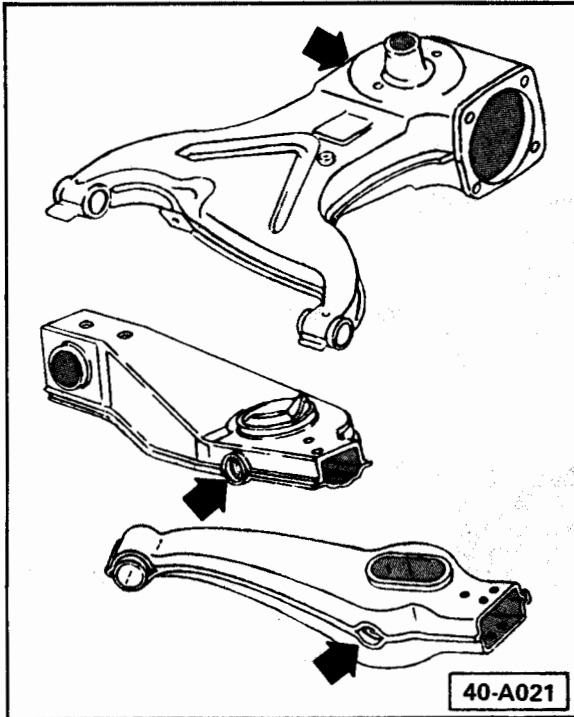
**Fig. 12 Steering knuckle, modification**

- 1 = steering knuckle
- 2 = seal ring (not shown on page 40.10)
- 3 = oil seal

- steering knuckle has a seal ring for grease seal
- if seal ring is scored, seal ring and grease seal must be replaced
- position of grease seal: dust lip (arrow) points away from seal lip
- fill up space between seal lips with multi-purpose grease

The internal portions (cavities) of the front lower control arms and rear trailing arms are sprayed with preservation wax during vehicle production.

Spray wax into the cavities of replacement parts during repairs to ensure the same quality of corrosion resistance as the original parts.



● arrows indicate openings to be used for wax spraying

### CAUTION

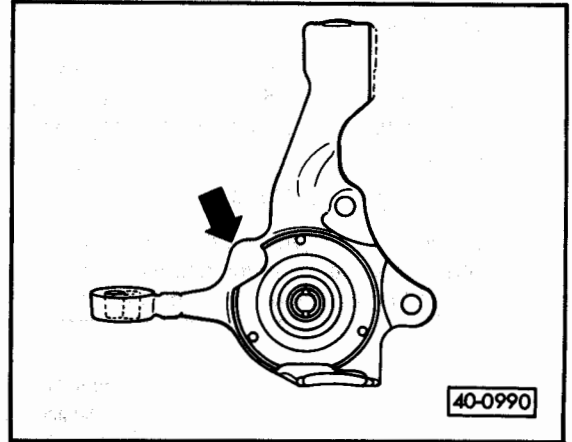
Preserve parts with wax after installation only. Do not allow wax to get into bolt threads or mating surface areas of suspension parts.

### Material

Cavity preservation wax  
Part No. AKR 316 D38 10  
or equivalent

### Note

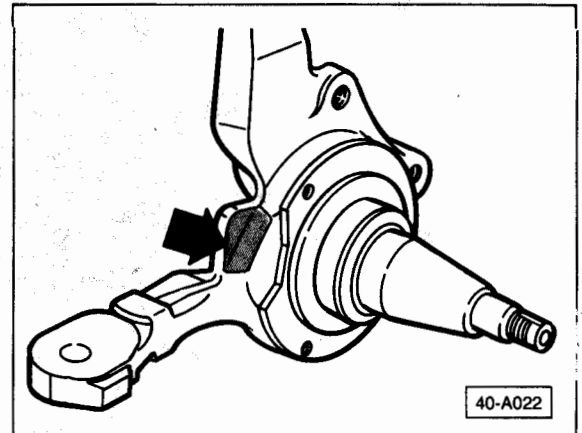
For a description of Volkswagen wax application equipment and its use, see Cavity and Underbody Preservation, service literature No. W42-701-004-1.



When installing replacement steering knuckles with the following Part Numbers:

251 407 311 AE  
251 407 312 AE

contact could be made with the brake disc in the area indicated. (arrow)



Grind down the cast lug on the steering knuckle approx. 8.0 to 10.0 mm (5/16 to 3/8 in.) to provide clearance for the brake disc. (arrow)

If necessary, also modify the splash plate, Part No. 251 407 343 C, to prevent contact in the same area.

### CAUTION

Modified parts must not show scoring marks from grinding and must have smooth, rounded edges.

Paint parts after modification to provide protection against corrosion.

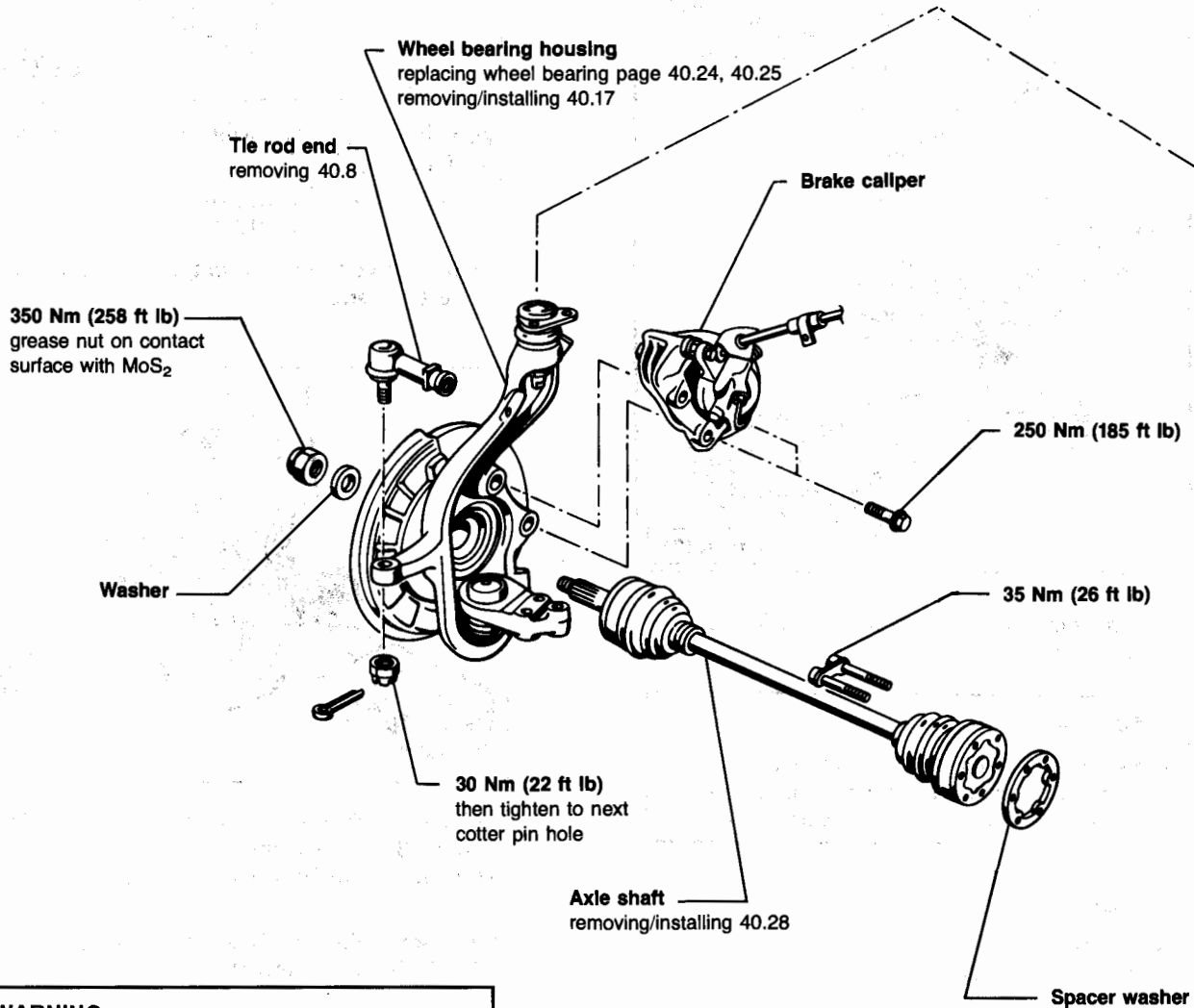
# 40 Front Wheel Suspension—Shafts & Axle

## CAUTION

Welding or straightening procedures must not be performed on load bearing front suspension components and components that position the wheels.

Always replace self-locking nuts.

If vehicles that have an axle shaft removed must be moved, an outer joint must be installed to prevent damage to wheel bearing.

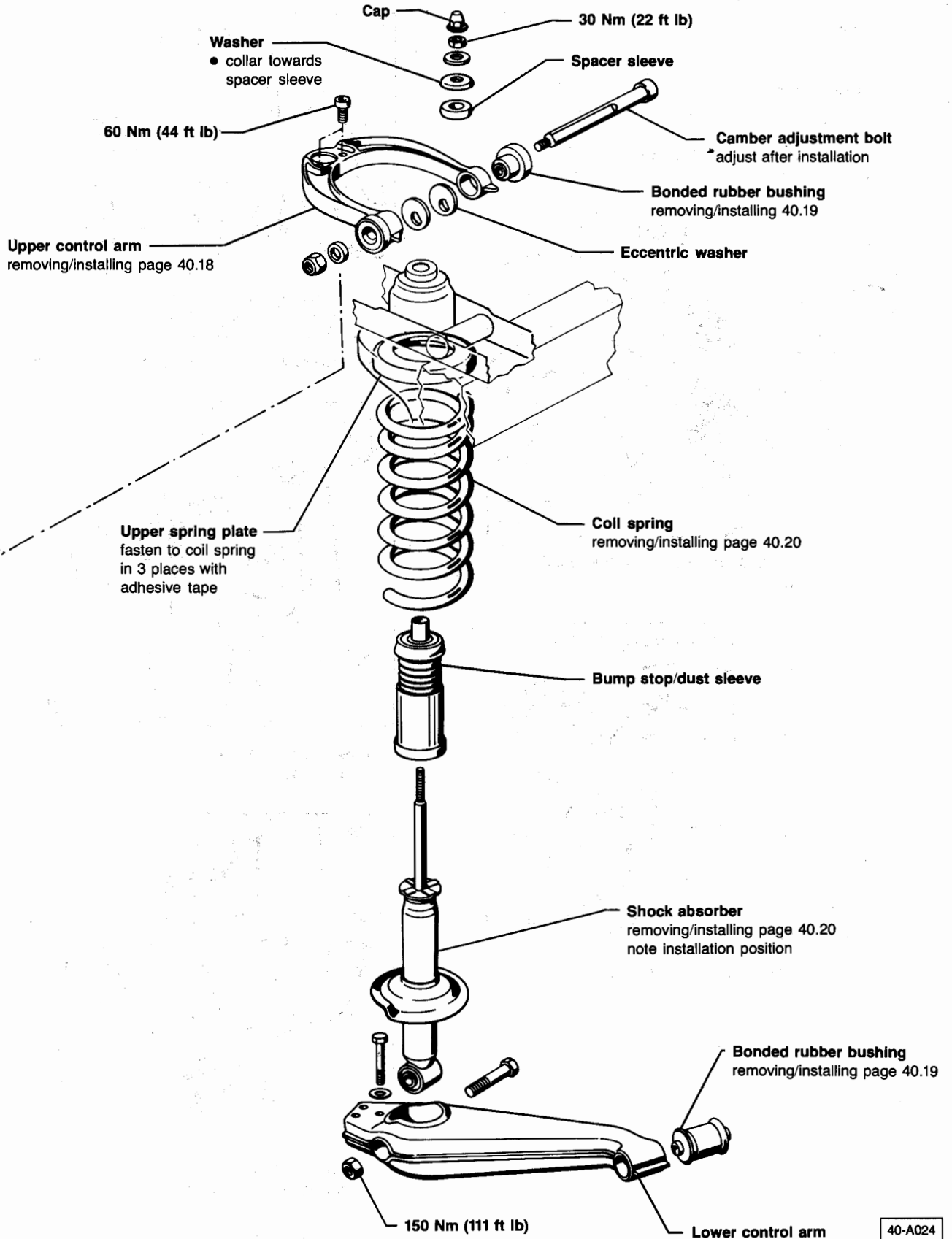


## WARNING

Do not re-use any fasteners that are worn or deformed in normal use. Many fasteners are designed to be used only once and become unreliable and may fail when used a second time. This includes, but is not limited to, nuts, bolts, washers, self-locking nuts or bolts, circlips and cotter pins. Always replace these fasteners with new parts.

40-A023

# Front Wheel Suspension – Shafts & Axle 40



Syncro

Front suspension components

40.16

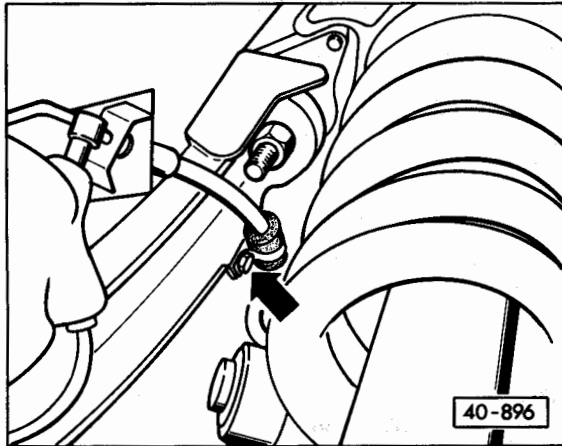
# 40 Front Wheel Suspension, Shafts & Axle

## Wheel bearing housing, removing/installing

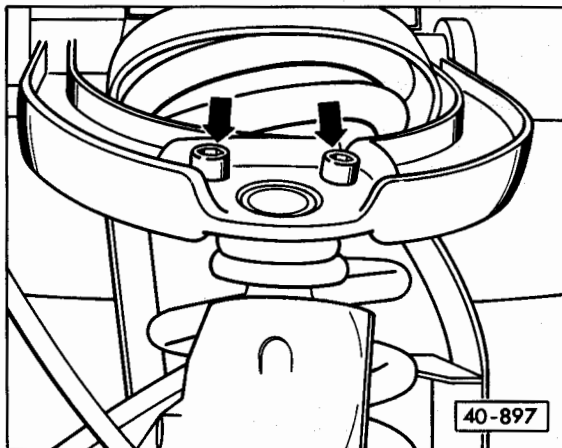
### Work sequence

#### Removing

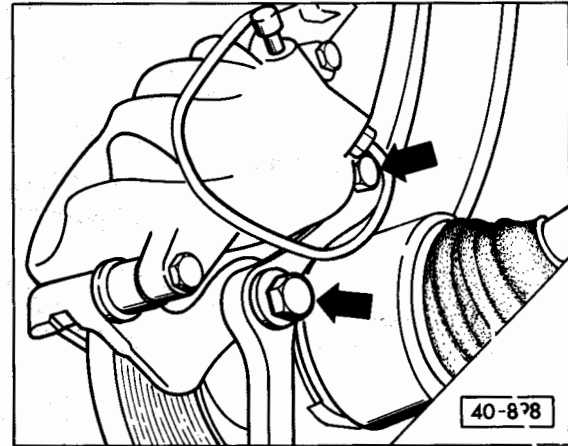
- remove axle nut (vehicle on wheels)
- remove wheel



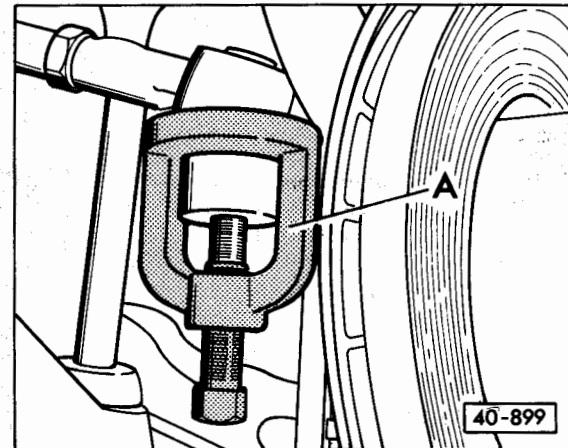
- remove brake line bracket from wheel bearing housing (arrow)



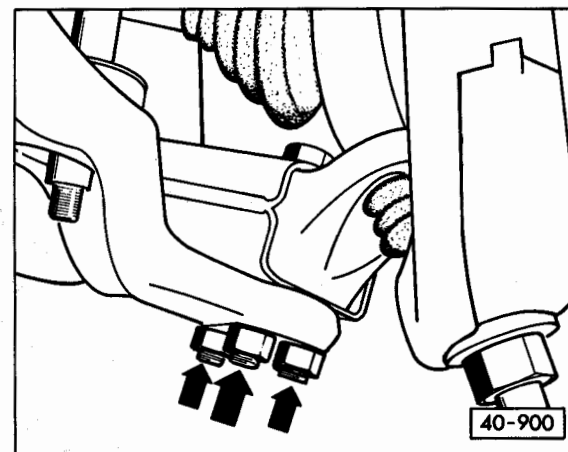
- remove upper ball joint from control arm by removing bolts (arrows)



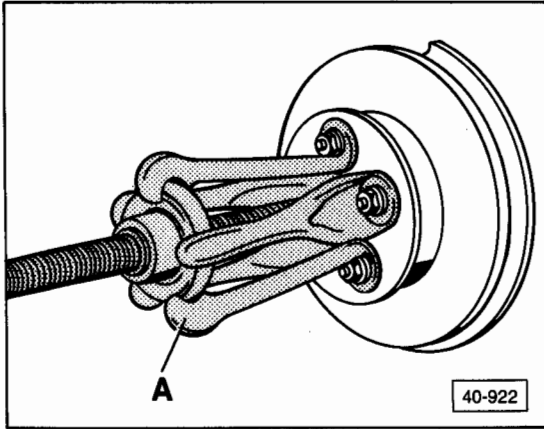
- remove brake caliper (arrows) and tie to body



- press tie rod end out  
A = US 1014



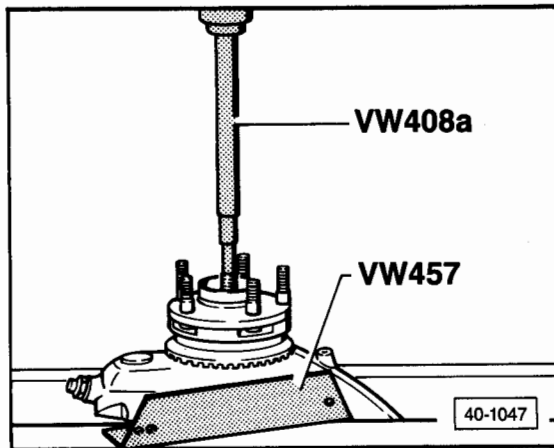
- remove bolts (arrows) and separate radius rod, wheel bearing housing and lower control arm



- press axle shaft out of wheel hub
- A = standard commercial puller

**Note**

If a suitable commercial puller is not available, remove wheel bearing housing together with axle shaft. Press out axle shaft.



**CAUTION**

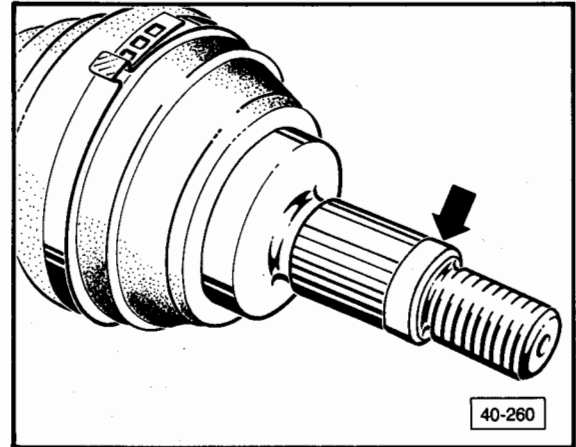
Always remove stub axle with mechanical or hydraulic hub puller **only**. Do **not** heat up wheel bearing housing or wheel bearing will be damaged.

**Installing**

**CAUTION**

Splines on drive shaft and wheel hub must be free of oil, grease and old locking compound.

- apply locking compound D6 around splines of outer CV joint in a bead approximately 20 mm (25/32 in.) wide



Remainder of installation procedure is the reverse of removal.

**Note**

Allow locking compound D6 at least 60 minutes to harden before driving vehicle.



# 40 Front Wheel Suspension—Shafts & Axle

## Upper control arm, removing/ installing

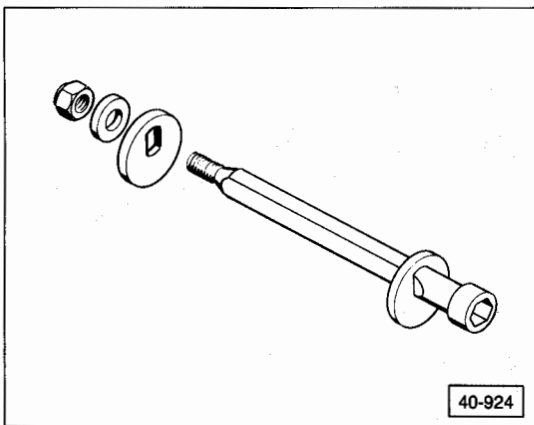
### Work sequence

#### Removing

- remove wheel
- remove bolts attaching upper ball joint to control arm
- remove camber adjustment bolt and take out control arm

#### Installing

- fasten control arm to body



- installation position:  
flat surfaces of adjustment bolt must be vertical and larger side of eccentric washers downward

### CAUTION

A maximum play of 0.5 mm (0.020 in.) is allowable on each side between the bonded rubber bushing in the control arm and the eccentric washer when the bolt is loosened.

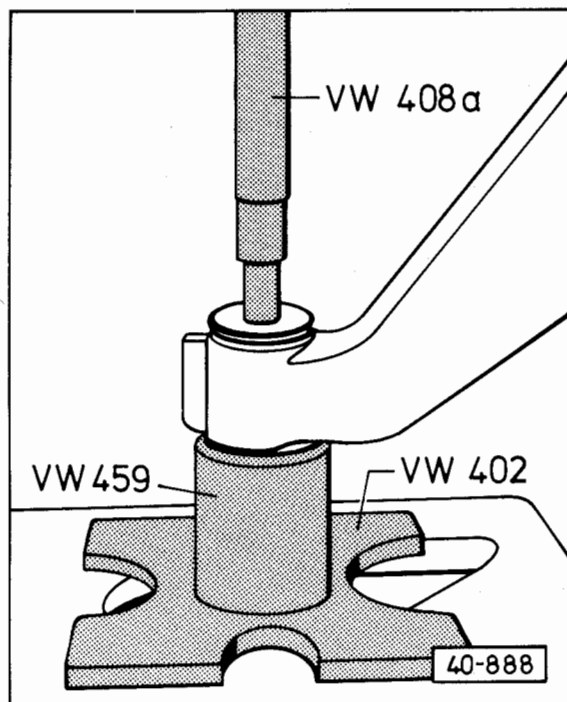
The following eccentric washers are available to adjust the clearance:

Thickness	Part No.
4.0 mm	251 407 133 A
5.0 mm	251 407 133 B
5.5 mm	251 407 133 C

- lubricate camber adjustment bolt with all purpose grease
- attach upper ball joint to control arm

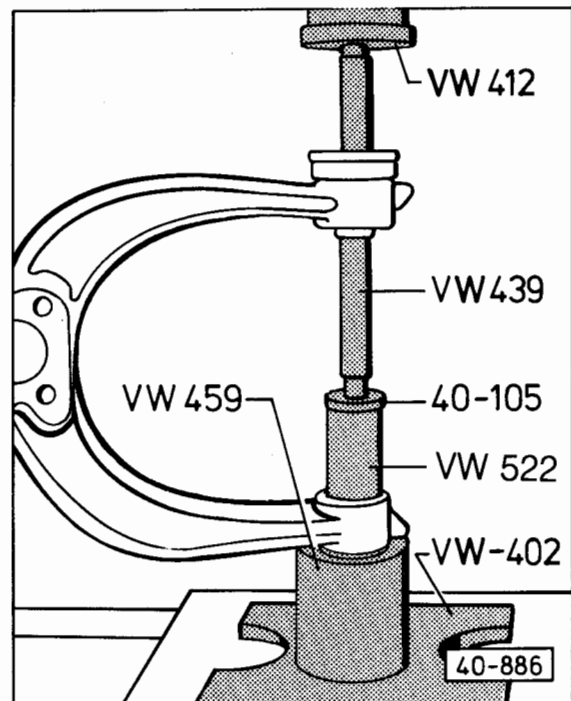
# 40 Front Wheel Suspension, Shafts & Axle

Lower control arm bonded rubber bushing, removing/installing

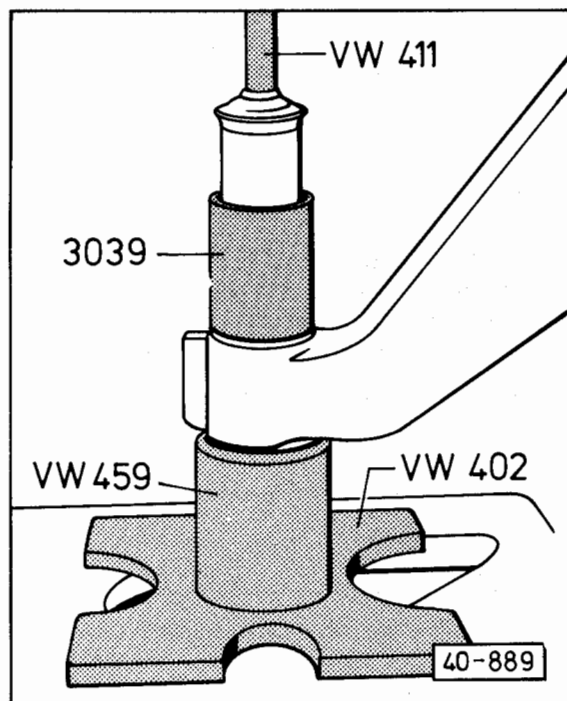


Bonded rubber bushing, pressing out

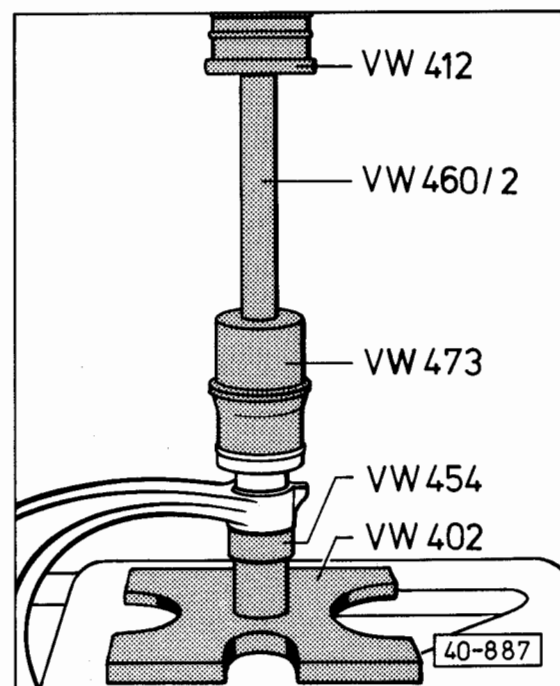
Upper control arm bonded rubber bushing, removing/installing



Bonded rubber bushing, pressing out



Bonded rubber bushing, pressing In

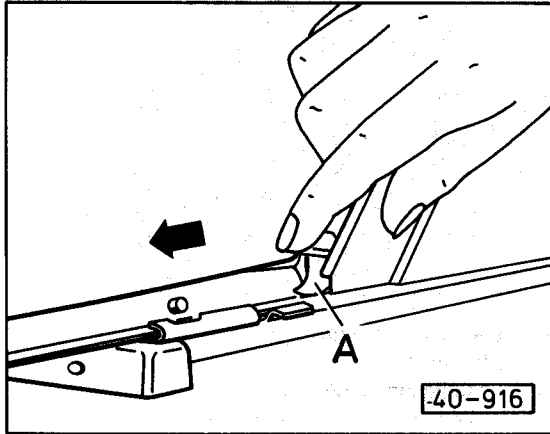


Bonded rubber bushing, pressing In

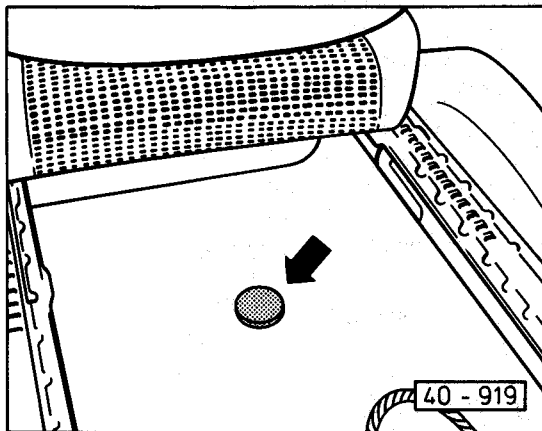
## Coil spring/shock absorber, removing/installing

### Work sequence

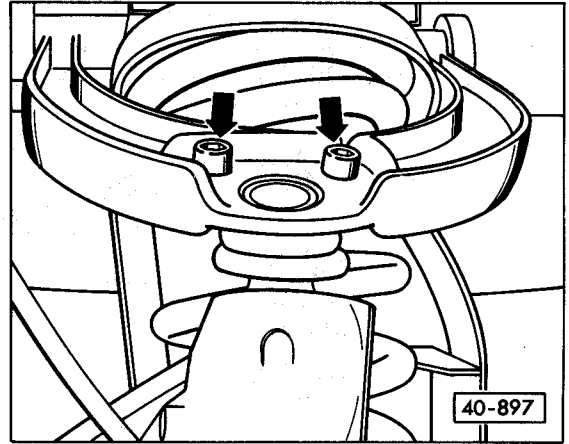
#### Removing



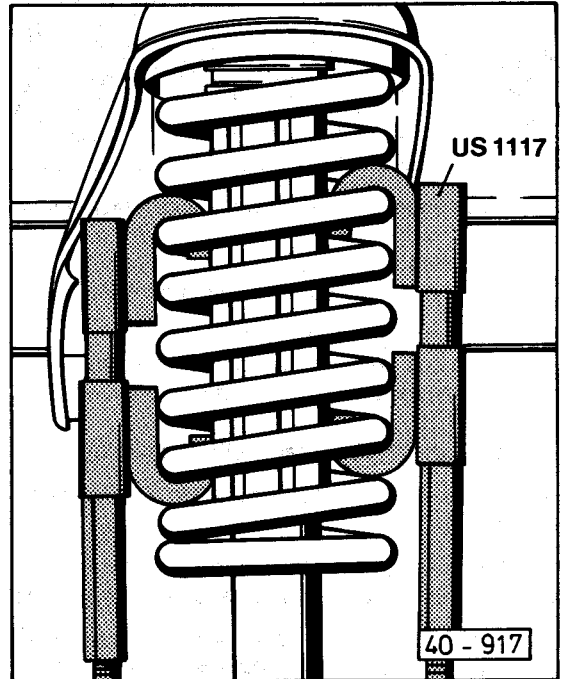
— depress lock catch **A**, push seat to full forward position and release lock catch



— pry out rubber plug (arrow) under seat  
— remove wheel

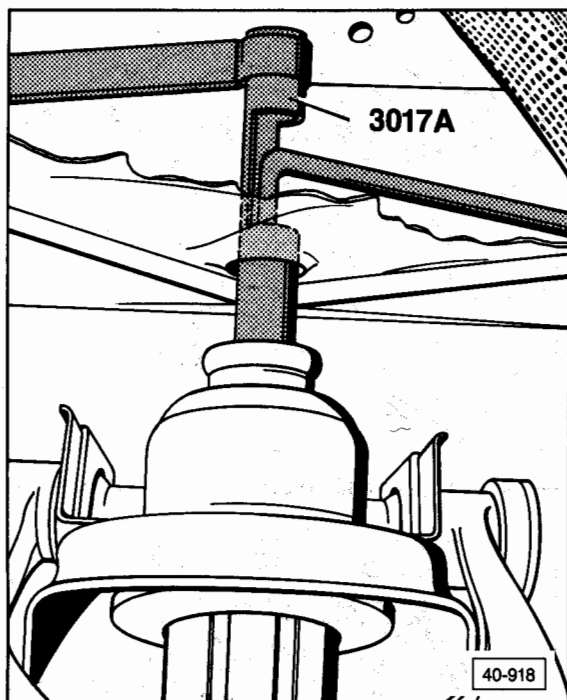


— remove upper ball joint from control arm (arrows)



— attach spring compressor and compress spring

# 40 Front Wheel Suspension—Shafts & Axle



- remove shock absorber from upper attachment on body
- push piston rod down
- swing shock absorber and spring outward
- remove spring and spring plate
- remove bolt from shock absorber attachment to lower control arm and take shock absorber out

### Notes on shock absorber testing/replacing

A defective shock creates a rumbling noise during driving.

Slight oil seepage from the shock is normal. If greater oil loss occurs, performance will be affected.

It will be possible to compress or extend a defective shock in increments, rather than with the smooth stroke characteristic of normal shock testing.

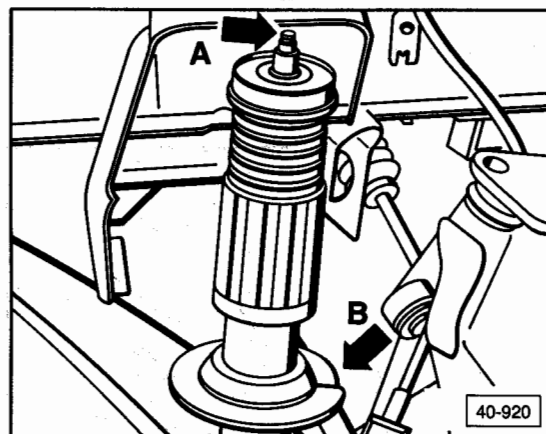
Shocks are maintenance-free and must be replaced rather than repaired. Shock absorber oil cannot be replenished.

Install only original replacement shock absorbers.

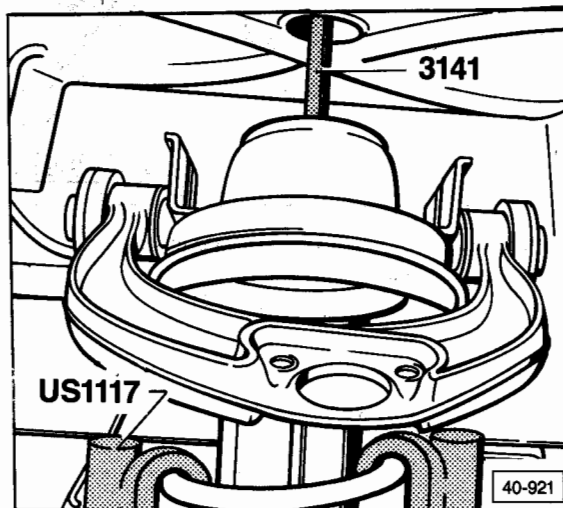
Shock absorbers of different manufacturers that have the same part number are interchangeable.

It is not necessary to replace both shock absorbers if only one is defective.

### Installing

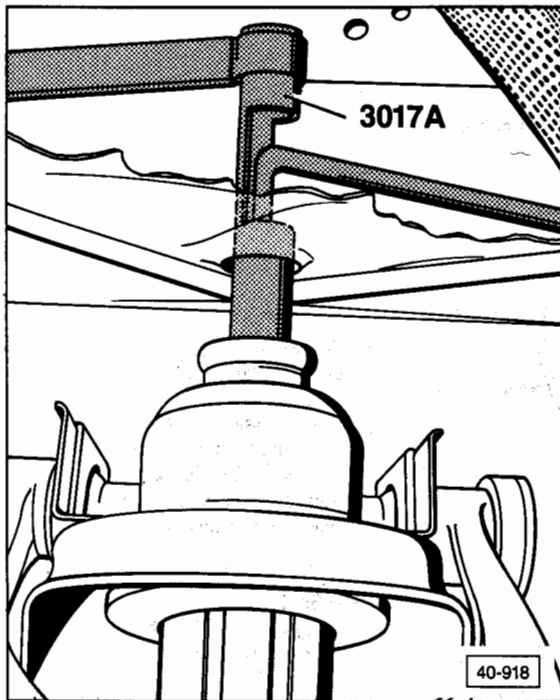


- install shock absorber to lower control arm and hand tighten nut
  - installation position
    - right side: spring end stop B at front
    - left side: spring end stop B at rear
- push piston rod A in enough for installation clearance
- install coil spring with lower spring end in spring end stop
  - installation position:
    - evenly coiled end downwards
- fasten spring plate to top of spring with tape in at least 3 places
- swing shock absorber and spring inward



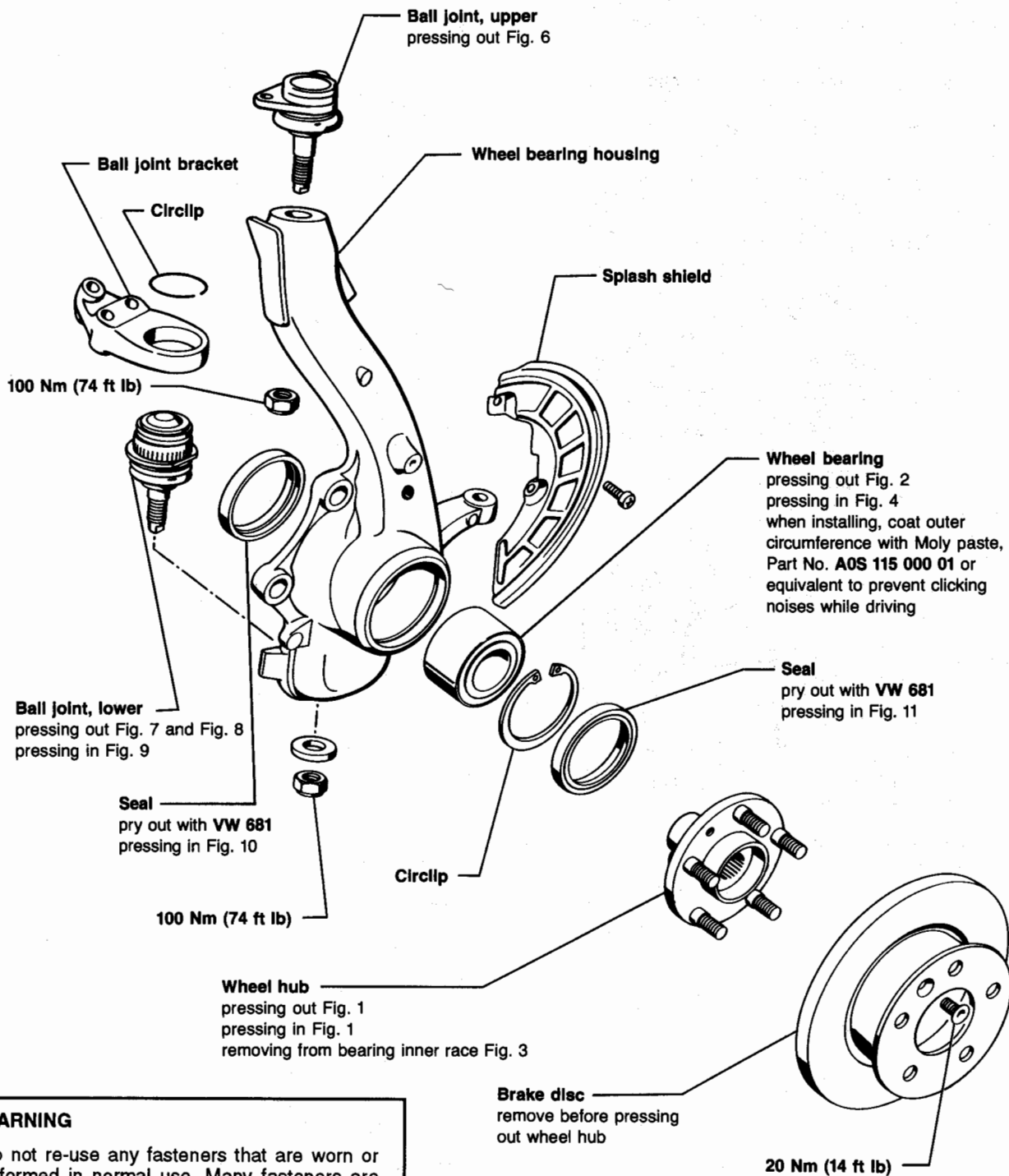
- insert T-handle wrench into piston rod through access hole

- pull piston rod upward
- tighten nut attaching shock absorber to lower control arm, to 150 Nm (110 ft lb)
- install upper ball joint to control arm and tighten to 60 Nm (44 ft lb)
- lift control arm with jack and remove spring compressor
- pull piston rod upward and remove T-handle wrench



- attach shock absorber to body and tighten to 30 Nm (26 ft lb)
- insert plug in access hole
- reposition seat
- install wheel

# 40 Front Wheel Suspension—Shafts & Axle



## WARNING

Do not re-use any fasteners that are worn or deformed in normal use. Many fasteners are designed to be used only once and become unreliable and may fail when used a second time. This includes, but is not limited to, nuts, bolts, washers, self-locking nuts or bolts, circlips and cotter pins. Always replace these fasteners with new parts.

40-895

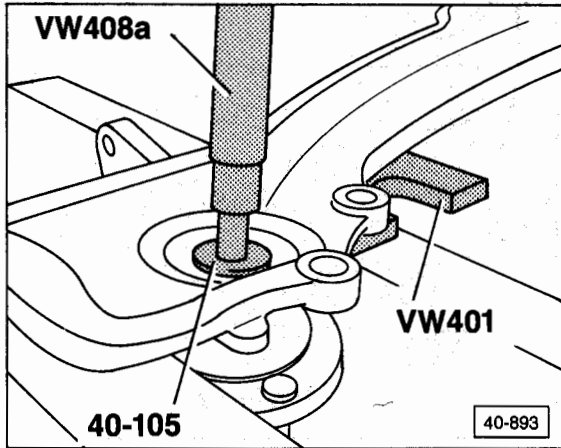


Fig. 1 Wheel hub, pressing out

**Note**

When pressing out hub, wheel bearing is destroyed.

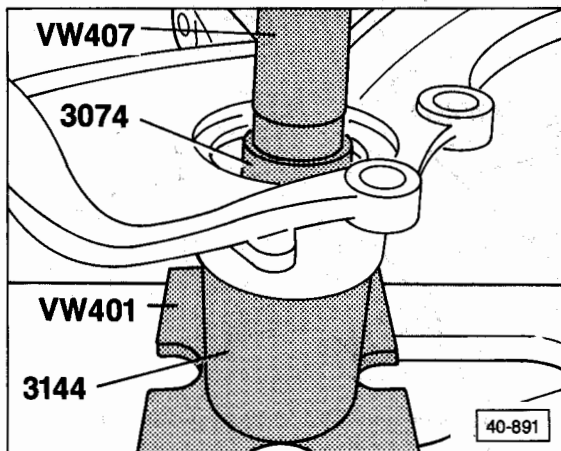


Fig. 2 Wheel bearing, pressing out

- remove oil seal first; replace
- remove circlip

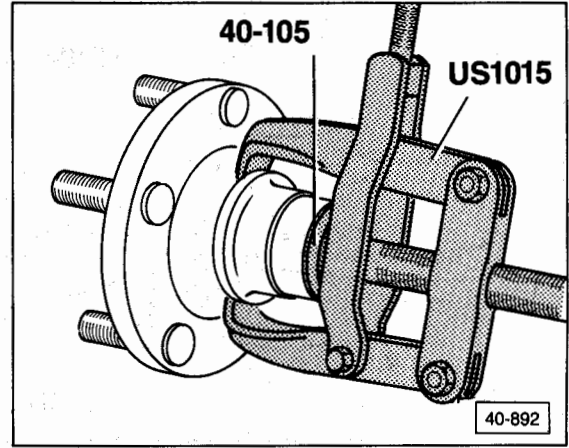


Fig. 3 Inner bearing race, pulling out

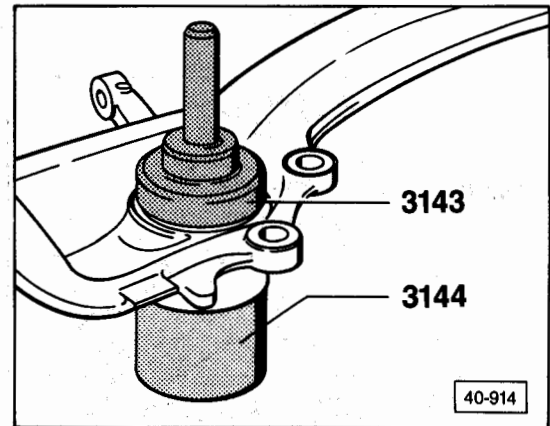


Fig. 4 Inner seal, driving in

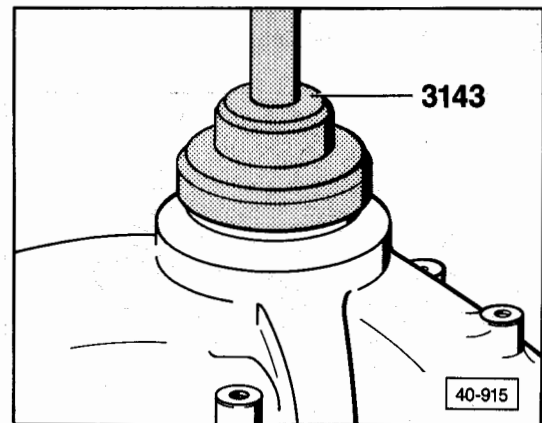


Fig. 5 Outer seal, driving in

40-895

# 40 Front Wheel Suspension—Shafts & Axle

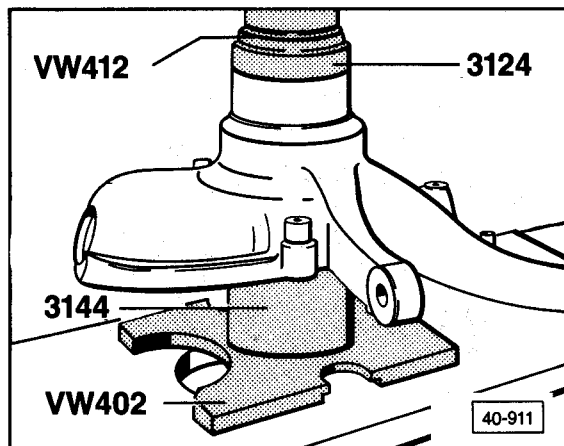


Fig. 6 Wheel bearing pressing in  
— install circlip after pressing in wheel bearing

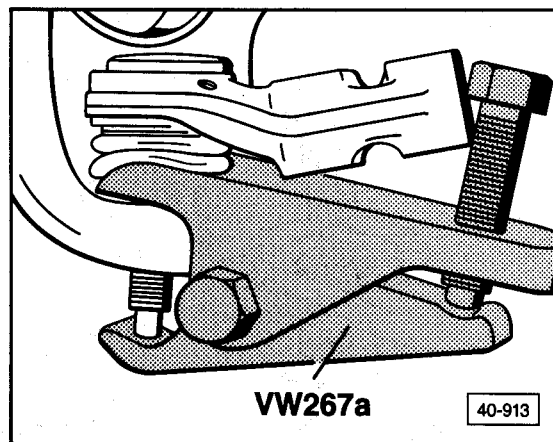


Fig. 9 Lower ball joint, pressing out of wheel bearing housing

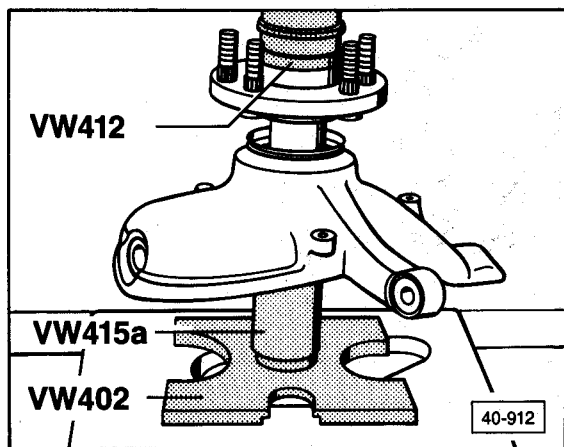


Fig. 7 Wheel hub, pressing in

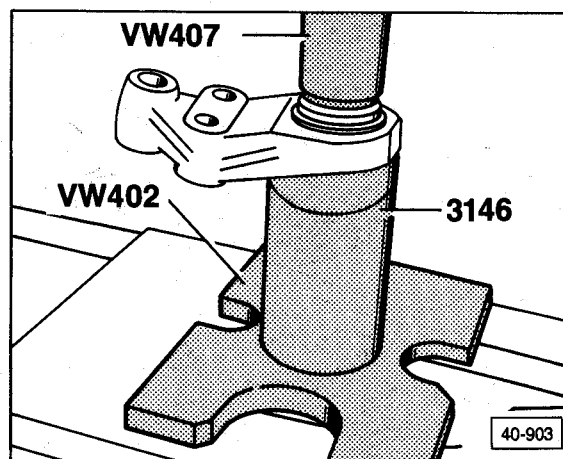


Fig. 10 Lower ball joint, pressing out of bracket

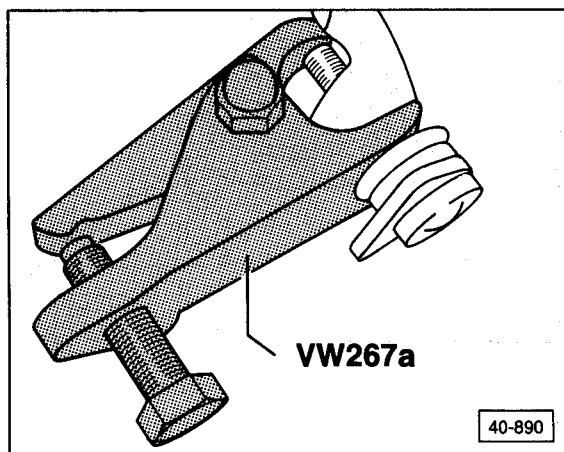


Fig. 8 Upper ball joint, pressing out

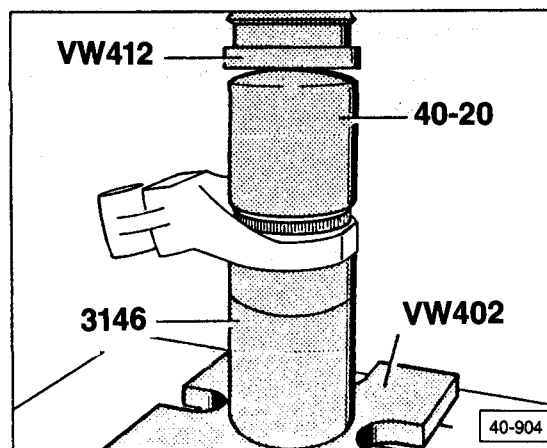
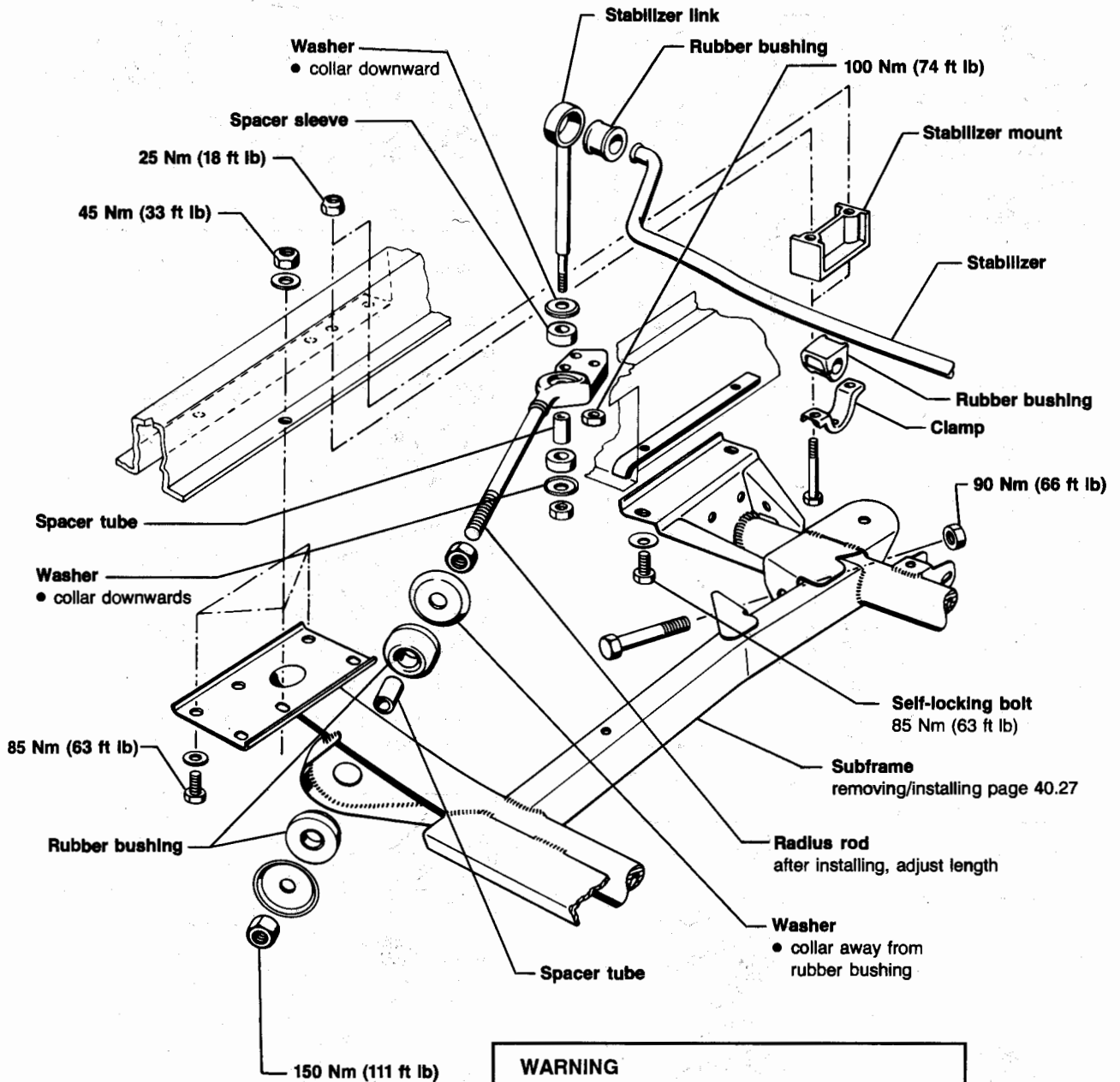


Fig. 11 Lower ball joint, pressing into bracket



# Front Wheel Suspension – Shafts & Axle 40



## WARNING

Do not re-use any fasteners that are worn or deformed in normal use. Many fasteners are designed to be used only once and become unreliable and may fail when used a second time. This includes, but is not limited to, nuts, bolts, washers, self-locking nuts or bolts, circlips and cotter pins. Always replace these fasteners with new parts.

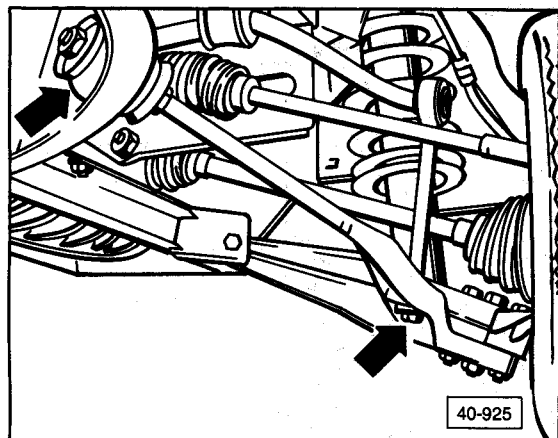
40-937

# 40 Front Wheel Suspension, Shafts & Axle

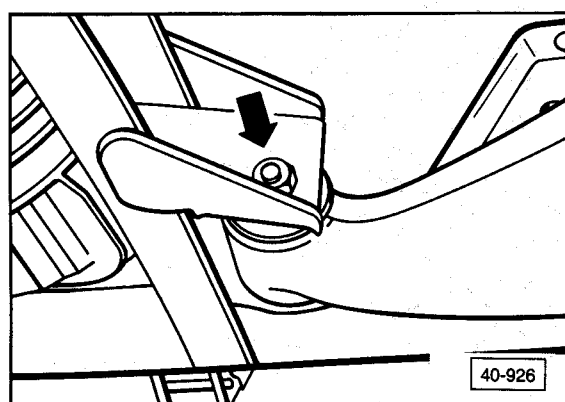
## Subframe, removing/installing

### Work sequence

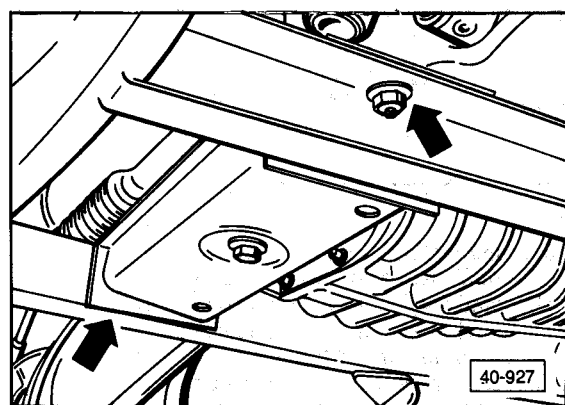
#### Removing



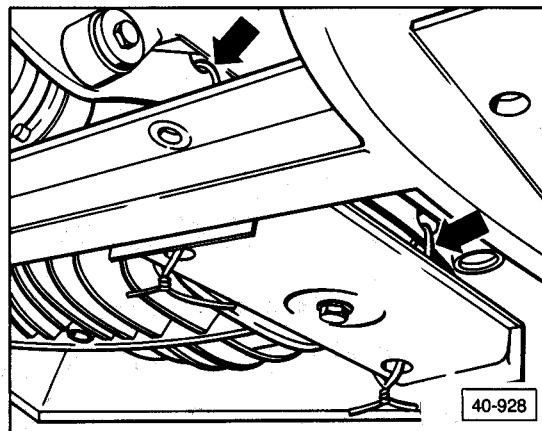
— remove radius rods from subframe and stabilizer (arrows)



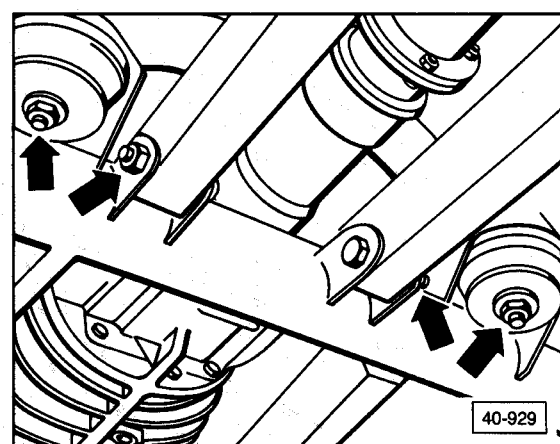
— remove control arm from subframe (arrow)



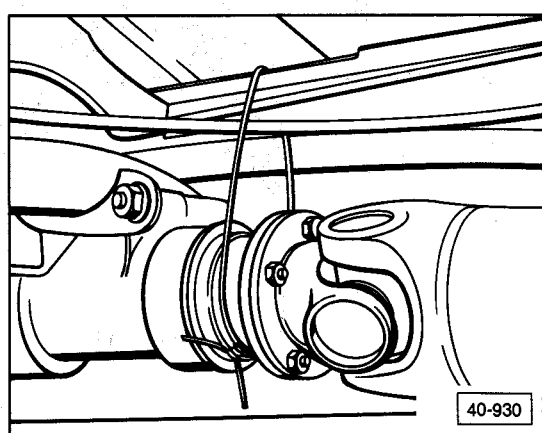
— remove final drive support from subframe (arrows)



— fasten final drive support to body (arrows)



— remove protection bars and bonded rubber bushings (arrows)



— tie up final drive

- use universal transmission jack to support subframe
- remove bolts that attach subframe to body
- carefully lower subframe and remove

## Installing

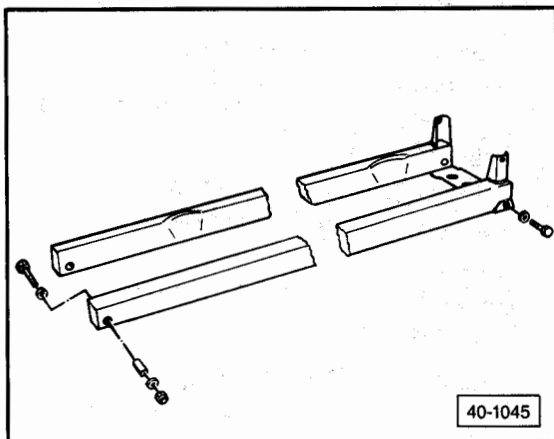
Proceed in reverse order of removal and note the following:

- tighten bolts fastening subframe to body last (see page 40.26 for tightening torques)

## Note

After installation of subframe, vehicle must be aligned. (see group 44)

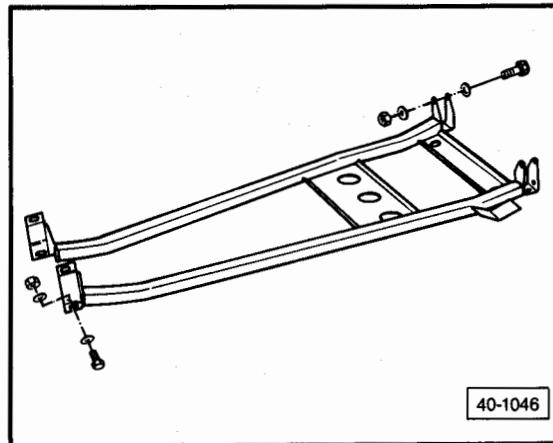
## Guards for drive shaft/engine, removing/installing



## Note

Protection bars for drive shaft can be removed independently of the engine guard (skid plate).

- install protection bars with front and rear recesses to the right, as seen from the driving direction
  - tighten to 45 Nm (33 ft lb)



- remove and install engine guard (skid plate)
  - tighten to 45 Nm (33 ft lb)

## Front axle shaft, removing/installing

### Removing

The axle shaft cannot be removed without first loosening the wheel bearing housing. It is practical, therefore, to remove the axle shaft and the wheel bearing housing together, then press out the axle shaft.

Refer also to **Wheel bearing housing, removing.**

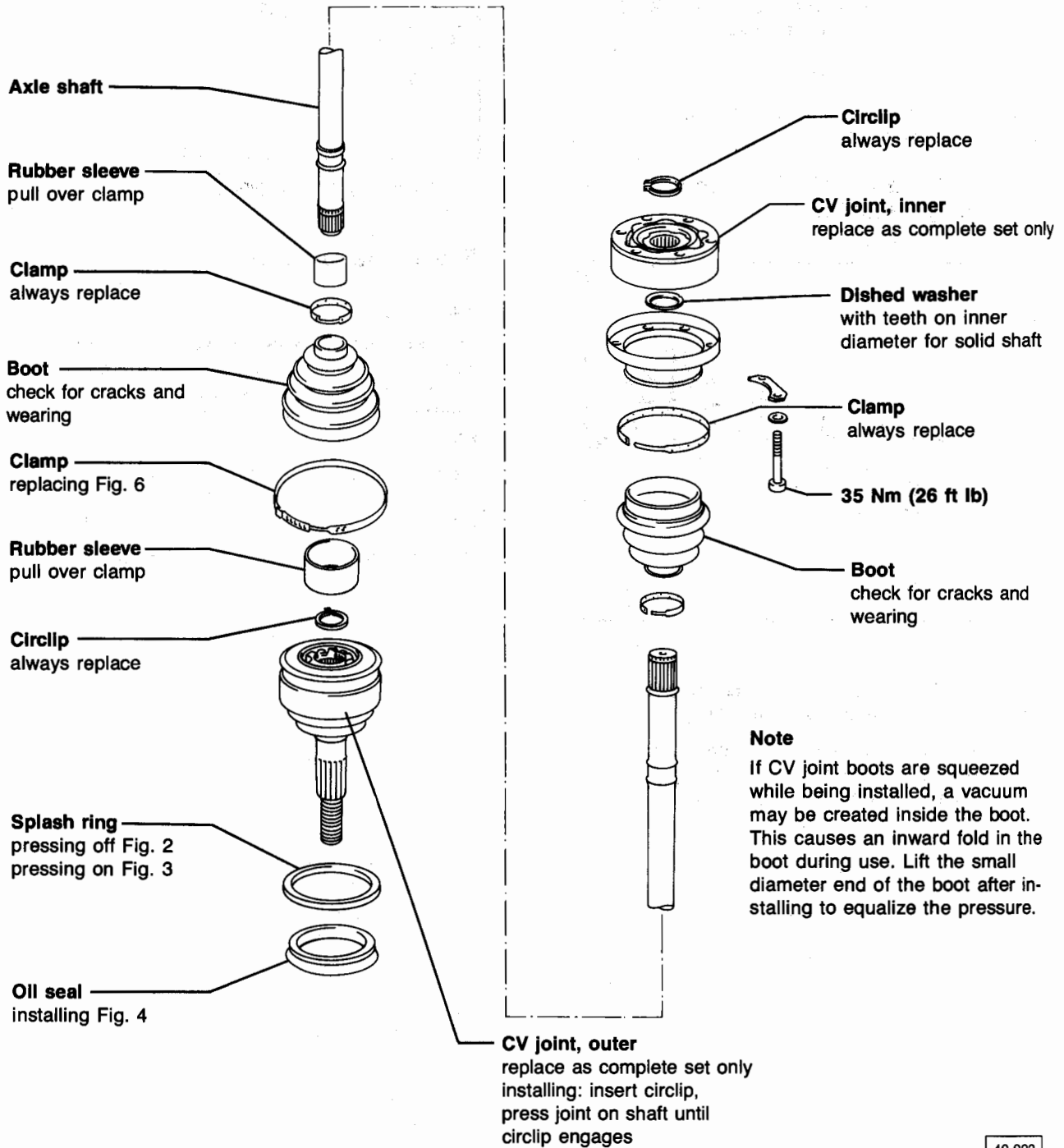
### Installing

Refer to **Wheel bearing housing, installing.**

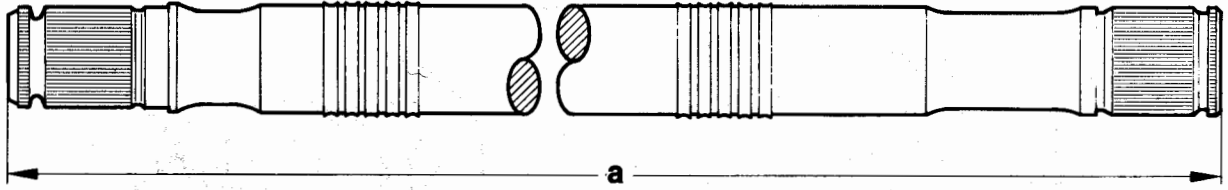
# 40 Front Wheel Suspension—Shafts & Axle

**Note**

When replacing CV joint boots, grease joint if necessary.  
 inner: 45 grams G6.3 grease each side (total 90)  
 outer: 90 grams G6.3 grease



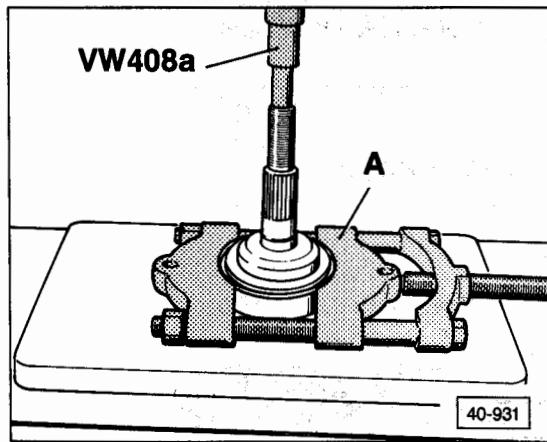
40-923



40-691

Fig. 1 Axle shaft length

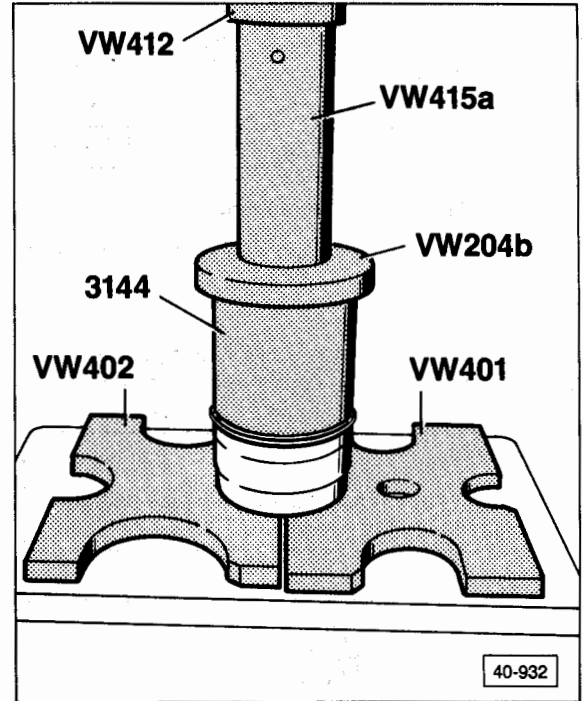
Transmission	Measurement a	
	right side	left side
all	570 mm (22.440 in.)	570 mm (22.440 in.)



40-931

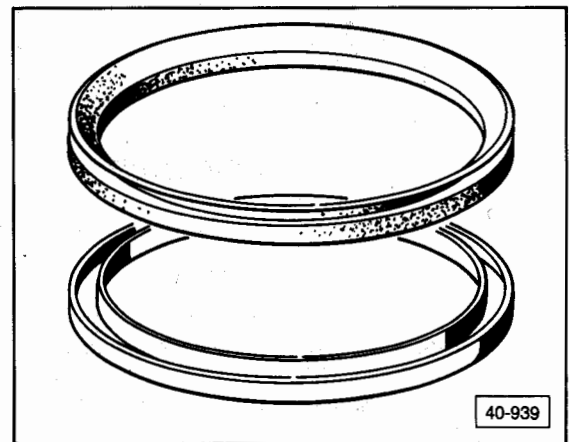
Fig. 2 Splash ring, pressing off

— use separating fixture with aperture of 22-115 mm (7/8-4.5 in.)



40-932

Fig. 3 Splash ring, pressing on

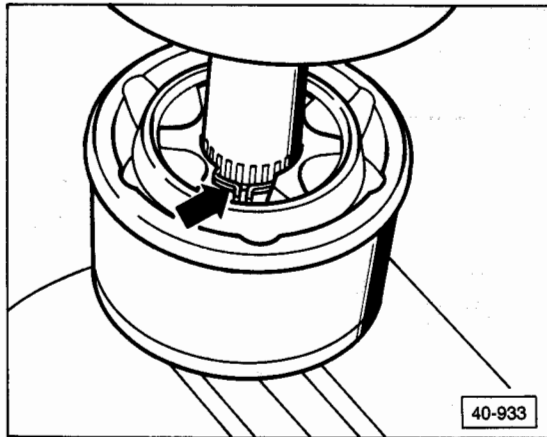


40-939

Fig. 4 Oil seal, pressing into splash ring

40-923

# 40 Front Wheel Suspension—Shafts & Axle



**Fig. 5 Outer CV joint, removing**

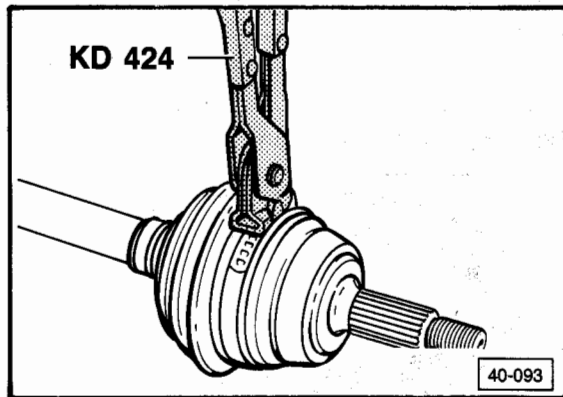
— expand circlip and remove joint from shaft

**Note**

If joint is seized on splines, drive it off shaft by tapping against hub with copper drift or mallet.

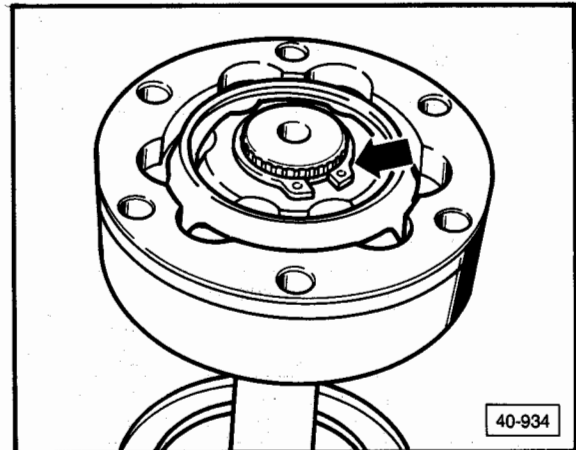
**CAUTION**

Don't jam hub on splines, or otherwise damage splines, during this procedure.

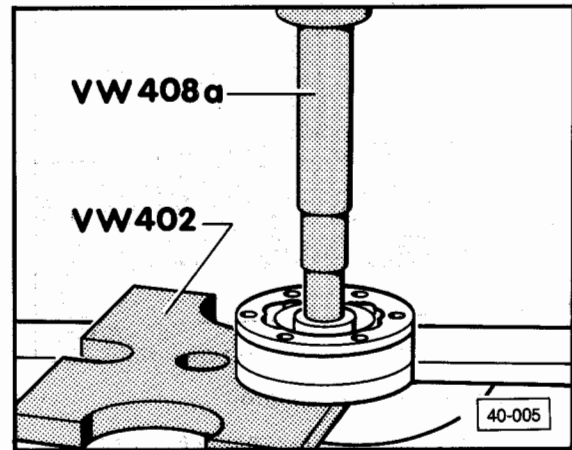


**Fig. 6 Outer CV joint boot clamp, replacing**

- a new clamp made of a stiffer transparent material is used in production beginning in February 1988
- the new clamp requires a force of 400 kg to tighten properly
- tool **KD 424** will apply the necessary force if squeezed very hard with both hands when compressing the clamp
- a gap in the compressed clamp of 1 to 2 mm is permissible after installation

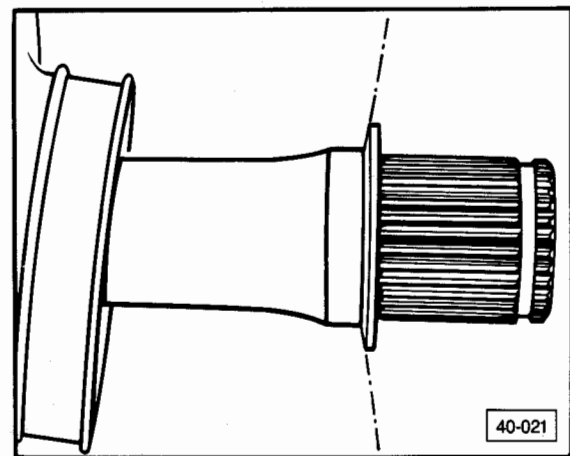


**Fig. 7 Circlip, removing/installing**

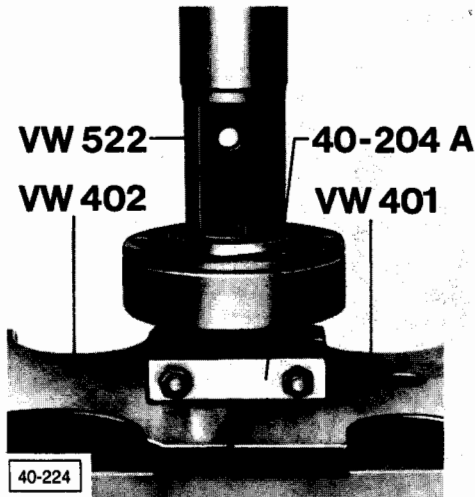


**Fig. 8 Inner CV joint, pressing off**

— support hub during procedure



**Fig. 9 Diaphragm spring, correct positioning**



**Fig. 10 Inner CV joint, pressing on**

- press joint onto seat
- engage circlip into groove

**CAUTION**

Chamfer on inside diameter of ball hub (splines) must face contact shoulder on axle shaft.

**Outer CV joint, disassembling/ assembling**

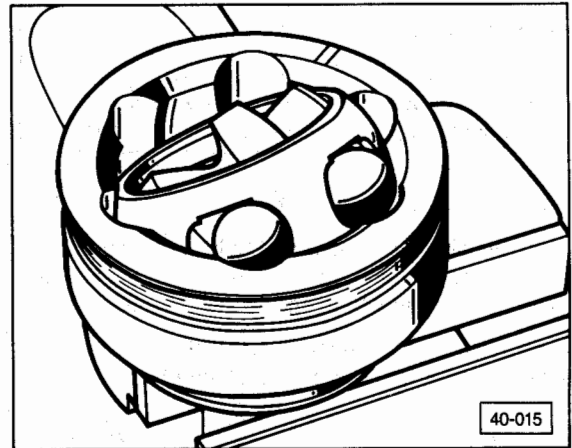
**Work sequence**

**Note**

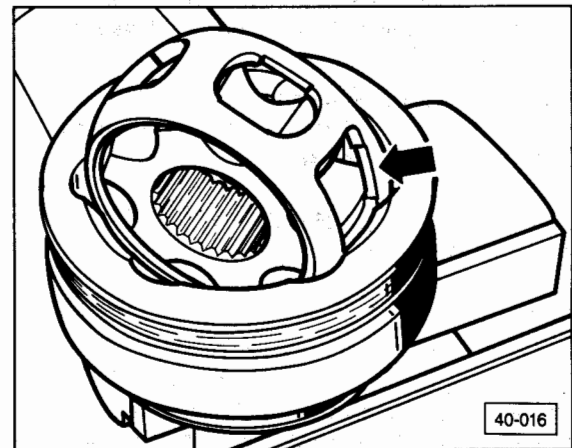
CV joint should be disassembled, and grease replaced, when joint is very dirty or when checking ball tracks for wear and damage.

**Disassembling**

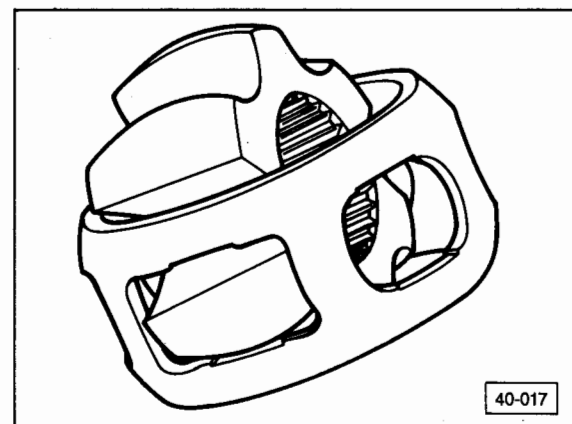
- mark position of hub in relation to cage and housing



- swivel hub and cage
- remove balls one at a time



- turn two larger openings of cage (arrow) until level with joint edge, then remove cage with hub



- swing hub until one segment can be pushed into larger rectangular opening of cage, then tilt hub out

# 40 Front Wheel Suspension—Shafts & Axle

## CAUTION

Set of 6 balls in each joint belong to one tolerance group. Therefore, always replace hub, outer ring, ball cage and balls together.

## Note

Check housing, hub, cage and balls for pitting. Excessive radial clearance in joint is noticeable when shifting gears. When this occurs, replace joint.

Do not replace joint because of polished appearance, or because ball track can be seen.

## Assembling

- lube joint with 45 g (1.6 oz) G 6.3 grease (half of total amount)
- install cage with hub, into housing
  - balls must be installed from opposite side
  - marked position of hub, cage, and housing must match
- install new circlip in hub
- fill joint with remaining G 6.3 grease for a total amount of 90 g (3.2 oz)

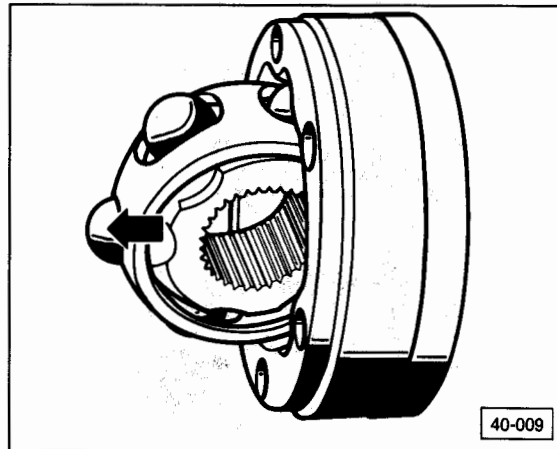
## Inner CV joint, disassembling/ assembling

### Work sequence

## Note

CV joint should be disassembled, and grease replaced, when joint is very dirty or when checking ball tracks for wear and damage.

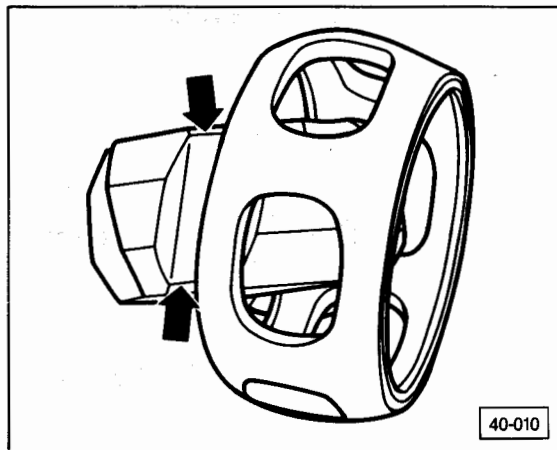
## Disassembling



- pivot ball hub and cage out of outer ring and push outward (**arrow**)
- press balls out of cage

## CAUTION

Ball hub and housing are paired. One hub, or one housing, must not be exchanged with another.



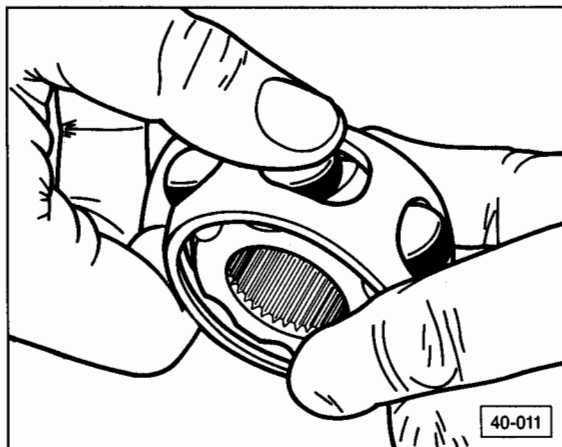
- align two grooves (**arrows**) and remove ball hub out of ball cage

## Note

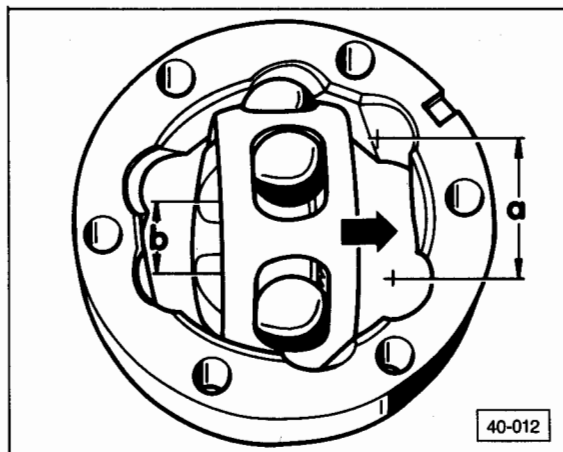
Check housing, hub, cage, and balls for pitting.



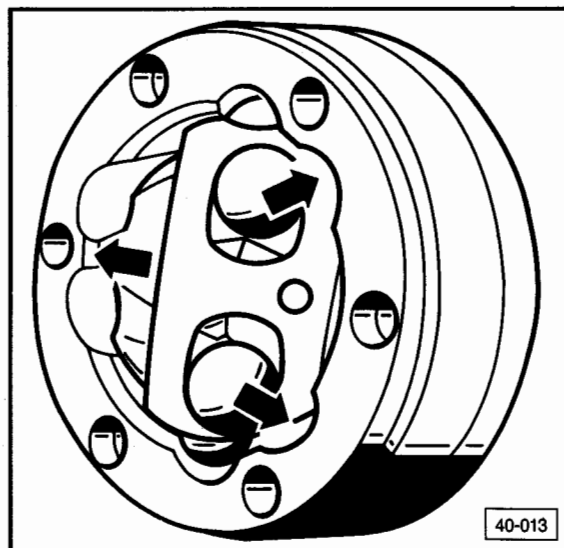
## Assembling



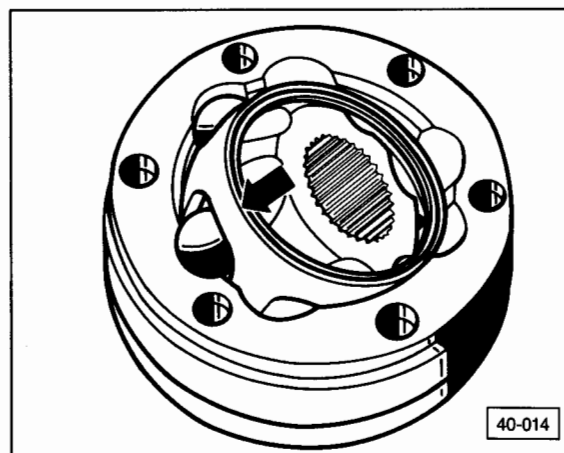
- insert ball hub along both grooves in ball cage
  - installation position not important
- push balls into cage
- insert ball hub into proper outer ring
  - chamfer on inside diameter of ball hub (splines) must point to contact shoulder on axle shaft and to large diameter of outer ring



- insert hub with cage and balls into outer ring vertically
  - wide ball groove in outer ring **a**, and a narrow groove in hub **b** are together on one side when hub is swung into outer ring



- when pivoting ball hub with cage and balls in outer ring, hub should be pivoted out of cage (**arrows**) until balls are spaced to fit groove



- press cage firmly (**arrow**) until hub swings fully into position
- fill each side of joint with 45 g (1.6 oz) of G 6.3 grease

### Note

Joint is correctly assembled when ball hub can be moved in and out, by hand, over full range of axial motion.

## Differential Automatic Transmission

### Index

- Adjusting ring 39.51
- Assembly 39.56
- Cover plate 39.51
- Differential bearing outer race 39.53
- Drive flange oil seal 39.53
- Final drive assembly 39.50
- Governor oil seal 39.52
- Pinion bearing outer race 39.52, 39.54  
inner race 39.54, 39.55
- Pinion oil seals 39.52-39.54
- Ring gear 39.56
- Ring gear/Pinion adjusting 39.57- 39.60  
backlash 39.61, 39.62
- Torque converter oil seal 39.51

# 39 Differential-Automatic Transmission

**Final drive ratio:**

4.09:1

**Final drive lubricant:**

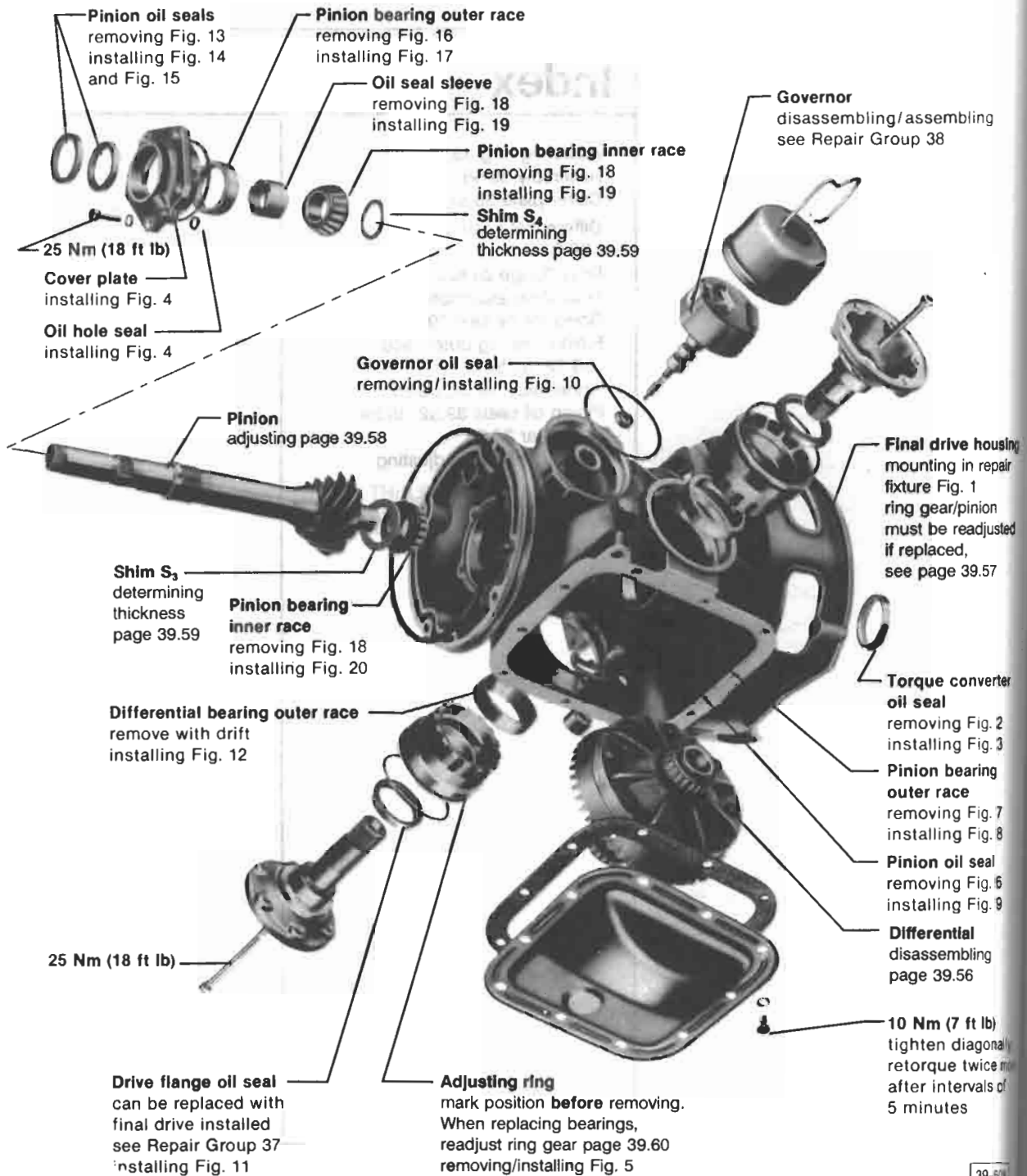
Hypoid oil SAE 90, Mil-L2105 B

**Capacity:**

1.25 ltr (1.3 US qt)

**CAUTION**

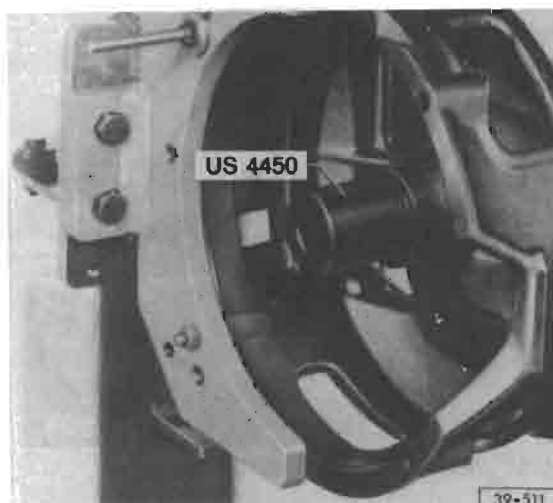
If ring gear/pinion bearings can be reused it is necessary to measure backlash (page 39.13) and turning torque on pinion (page 39.14) **before** disassembling final drive. Note these measurements and adjust during reassembly to obtain same settings



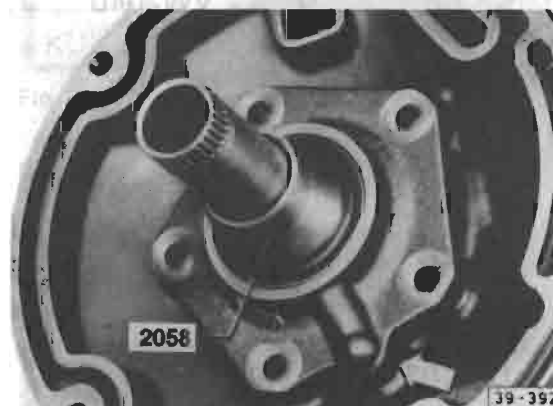
39-50



**Fig. 1 Final drive housing, mounting**



**Fig. 3 Torque converter oil seal, installing**

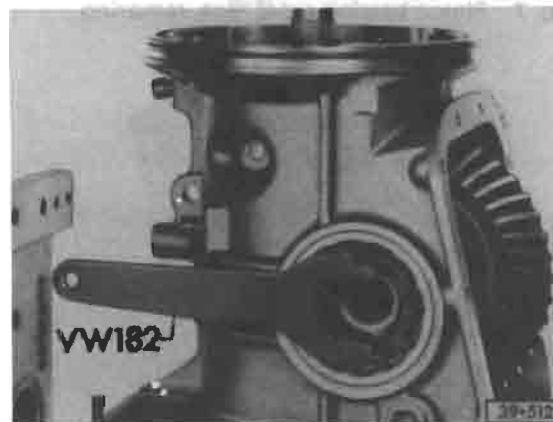


**Fig. 4 Cover plate/Oil hole seal, installing**

- first insert seal (arrow) for oil hole
- install cover plate and tighten to 25 Nm (18 ft lb). Use sleeve 2058 when installing cover



**Fig. 2 Torque converter oil seal, removing**



**Fig. 5 Adjusting ring, removing/installing**

- when reusing ring, mark position before removing

39-508

E-2

E3

Torque converter oil seal  
Cover plate  
Adjusting plate

**39.51**

# 39 Differential-Automatic Transmission



Fig. 6 Pinion oil seal, removing

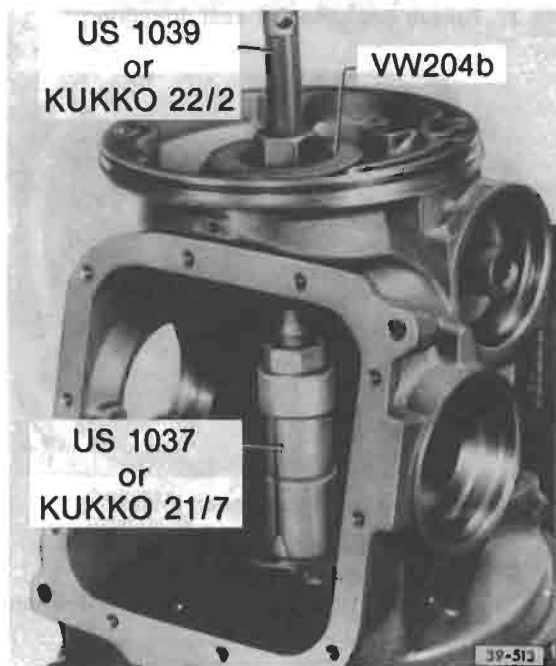


Fig. 7 Pinion bearing outer race, removing



Fig. 8 Pinion bearing outer race, installing  
— drive in until seated

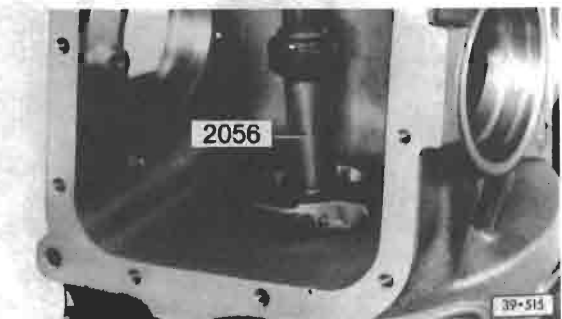
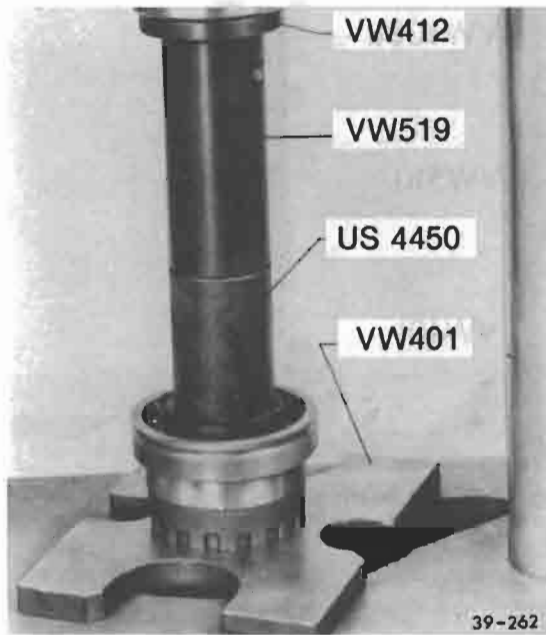


Fig. 9 Pinion oil seal, installing  
• seal lip faces converter

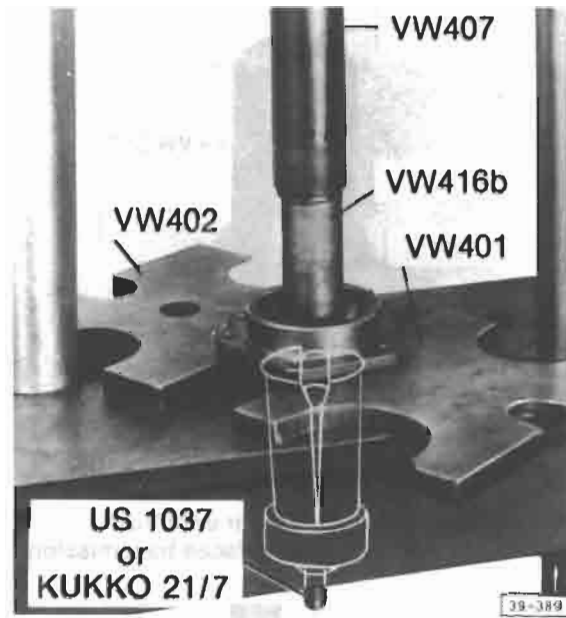


Fig. 10 Governor oil seal, removing/installing  
— remove seal with VW 248/1 together with adapter 248/2  
— drive in oil seal until seated using VW 248/1 without adapter (seal lip faces governor)



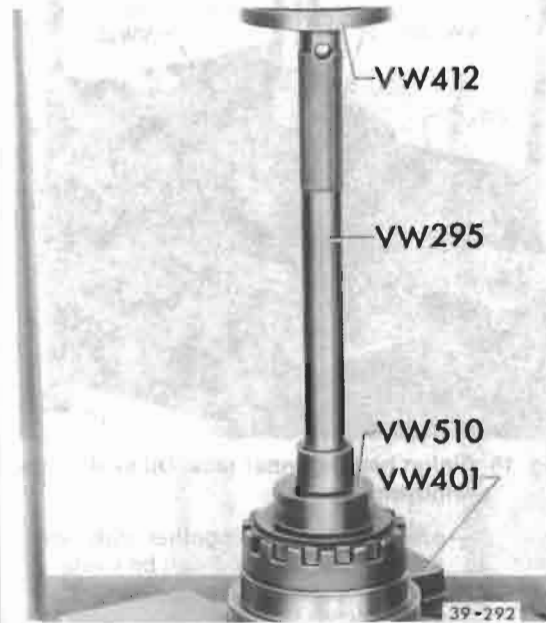
**Fig. 11 Drive flange oil seal, installing**

— fill space between lips with multi-purpose grease and press in flush



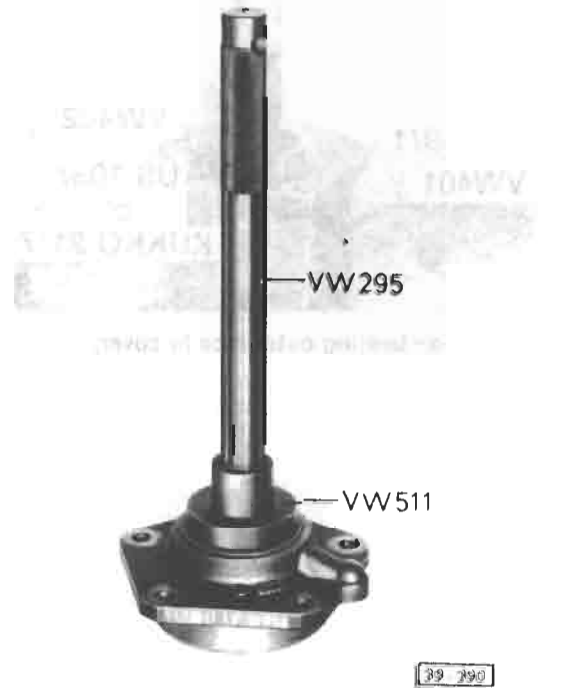
**Fig. 13 Pinion oil seals in cover plate, removing**

— press out seals individually



**Fig. 12 Differential bearing outer race, installing**

— press in until seated



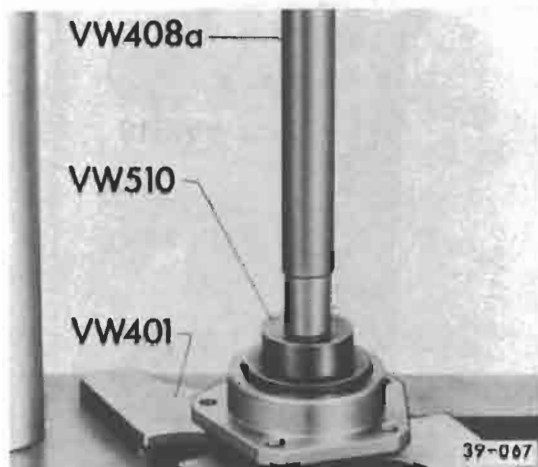
**Fig. 14 Pinion oil seal (inner) in cover, installing**

— drive seal into cover until seated.  
Open side of seal faces final drive

# 39 Differential-Automatic Transmission



**Fig. 15 Pinion oil seal (outer) in cover, installing**  
— drive seal into cover until flush.  
Open side of seal faces transmission



**Fig. 17 Pinion bearing outer race in cover, installing**



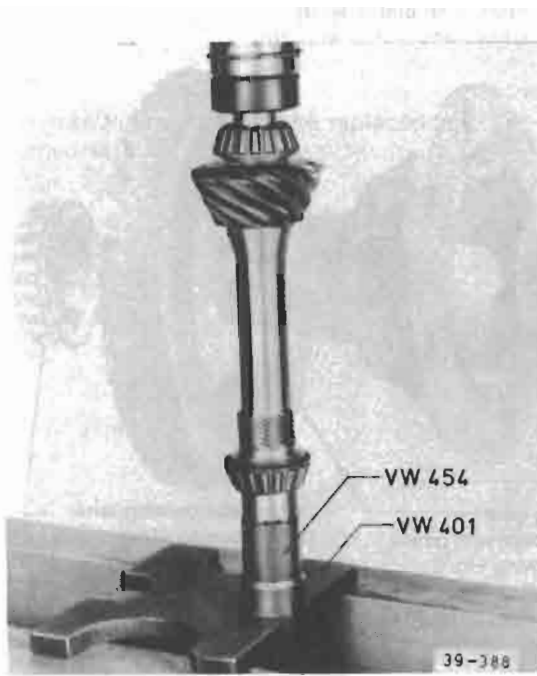
**Fig. 16 Pinion bearing outer race in cover, removing**



**Fig. 18 Pinion bearing inner race/Oil seal sleeve, removing**

— press off bearing together with seal sleeve (tool US 1103 can be used)





**Fig. 19 Pinion bearing inner race/Oil seal sleeve, Installing**

- heat bearing and sleeve to approx. 100°C (212°F)
- press onto pinion shaft



**Fig. 20 Pinion bearing inner race, installing**

- heat inner race to approx. 100°C (212°F) and press into shaft



# 39 Differential-Automatic Transmission

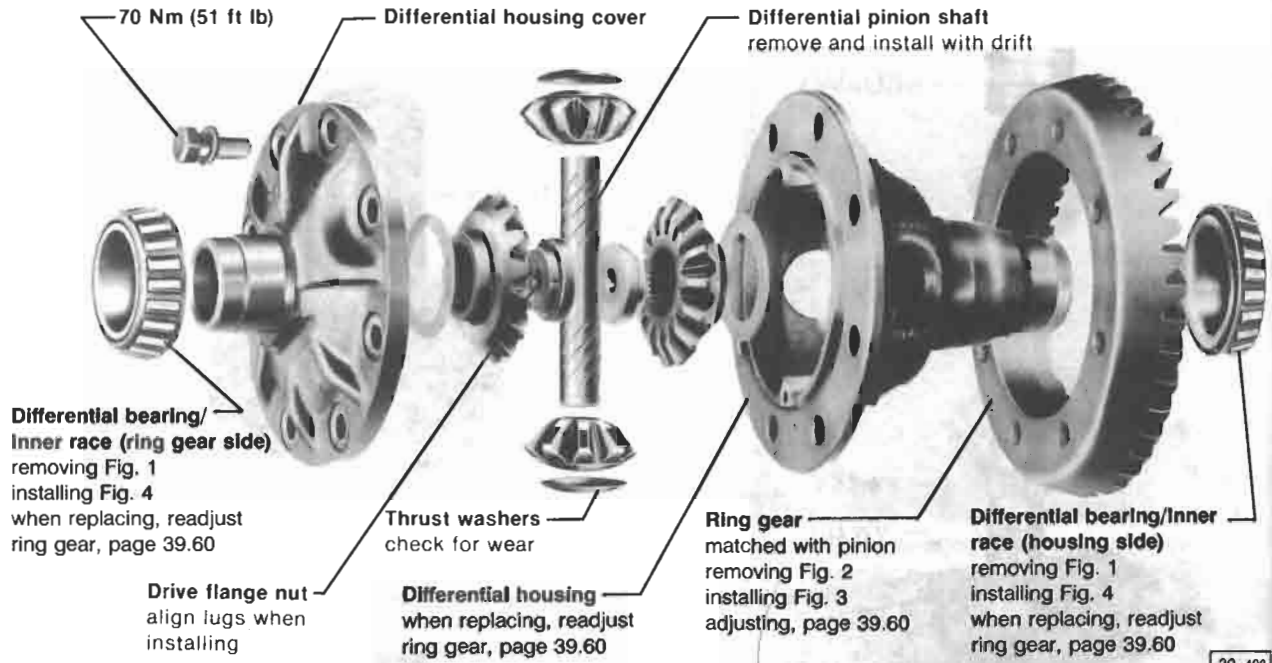


Fig. 1 Differential bearing/Inner race, removing



Fig. 2 Ring gear, removing

- mount differential in vise
- loosen bolts and tap lightly on bolt heads



Fig. 3 Ring gear, installing

- heat ring gear to approx. 100°C (212°F)
- A = centering pins (local manufacture)

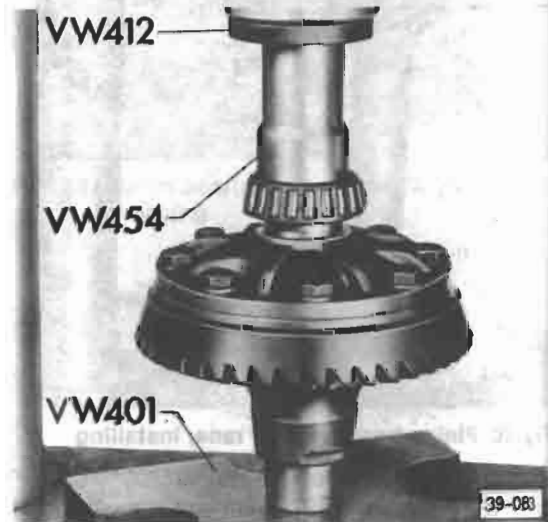


Fig. 4 Differential bearing/Inner race, installing

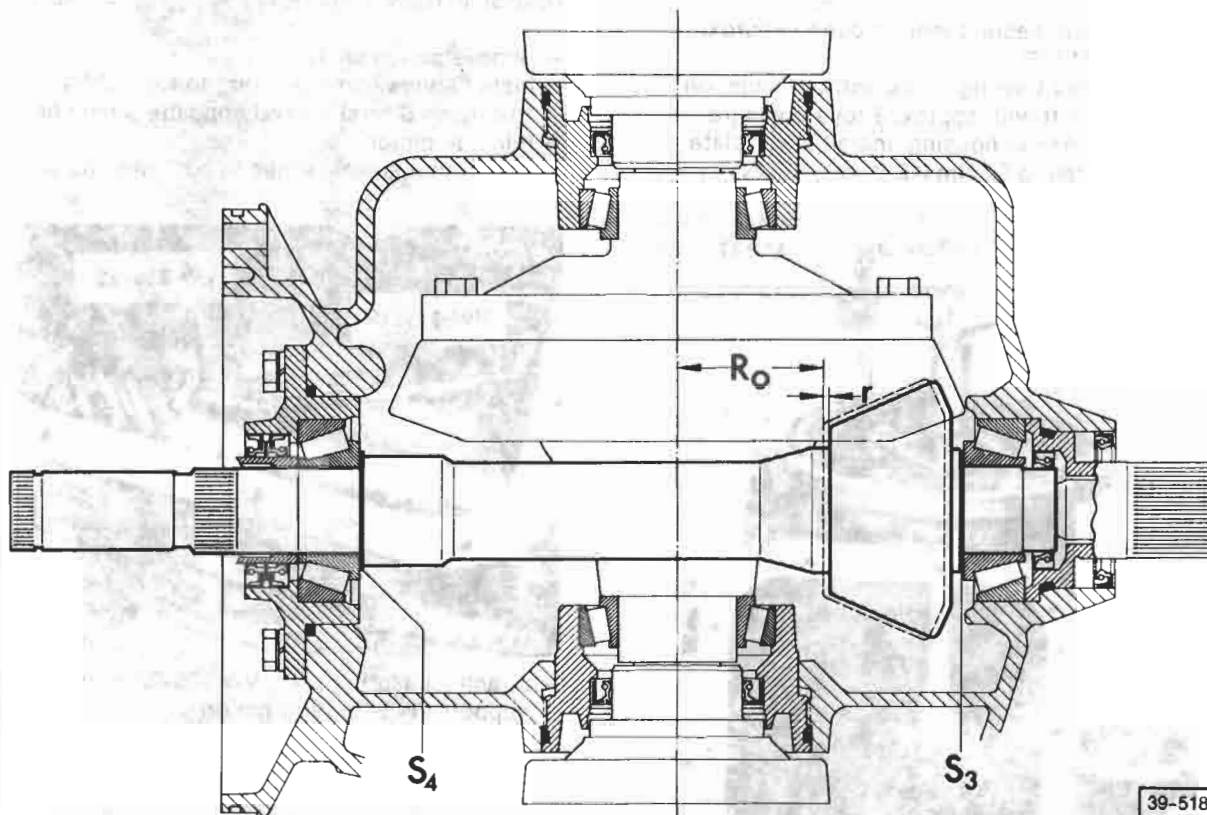
- heat bearing to approx. 100°C (212°F) and press on

Ring  
Note  
Ring  
match  
Posi  
Ro =  
r =  
S<sub>2</sub> =  
S<sub>4</sub> =  
Note  
If pin  
turni  
adju

## Ring gear/Pinion, adjusting

### Note

Ring gear/Pinion may only be replaced as matched set



### Position of shims $S_3/S_4$

$R_0$  = Length of master gauge used in factory testing machine.  $R_0 = 52.60$  mm

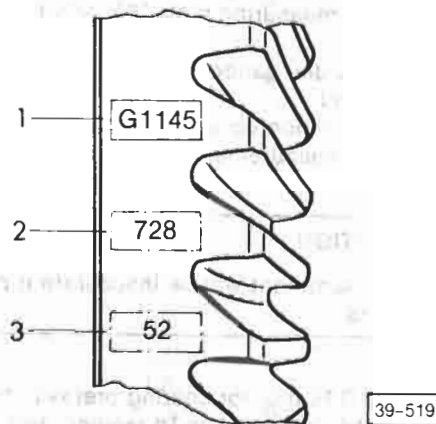
$r$  = Deviation measured against master gauge of testing machine used in production.  
Deviation  $r$  is always given in 0.01 mm. For example 52 means  $r = 0.52$  mm

$S_3$  = Shim for bearing preload (behind pinion head)

$S_4$  = Shim for pinion position (opposite end)

### Note

If pinion bearings will not be changed, measure turning torque of pinion **before** disassembly and **adjust** to same turning torque during assembly



### Marks on ring gear

- 1 = Identification G 1145 refers to Gleason gear set with ratio of 11:45
- 2 = Serial number of matched gear set
- 3 = Deviation  $r$

# 39 Differential-Automatic Transmission

## Pinion, adjusting

### Work sequence

- install bearing outer race into cover plate and housing
- heat pinion bearing inner races to approx. 100°C (212°F)
- press inner bearing races, without shim, on pinion shaft with approx. 3 tons pressure
- insert pinion in housing, install cover plate and tighten to 25 Nm (18 ft lb)



- install dial gauge holder VW 387 on housing
- place measuring plate VW 385/17 on pinion shaft
- install dial gauge and set to zero with 1 mm preload
- move pinion up and down without turning and note measurement

### CAUTION

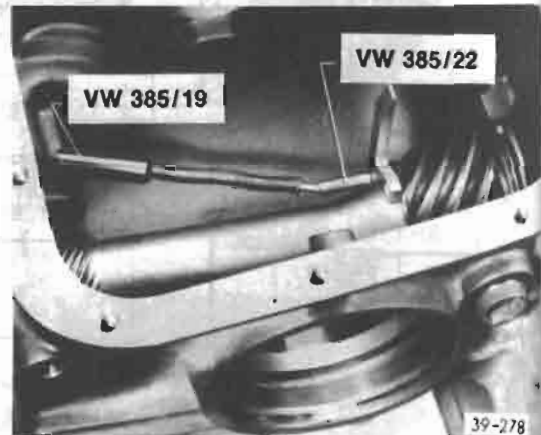
Measurement will be inaccurate if pinion turns

- add 0.10 mm for bearing preload and 0.10 mm for bearing settling to reading. Result is **S total**

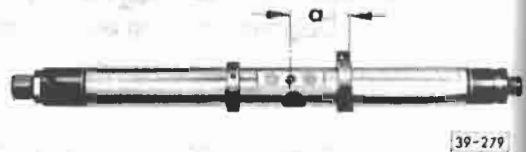
### Example

measured reading	2.46 mm
bearing preload	+ 0.10 mm
settling allowance (constant)	+ 0.10 mm
<b>Total shim thickness (S total)</b>	<b>= 2.66 mm</b>

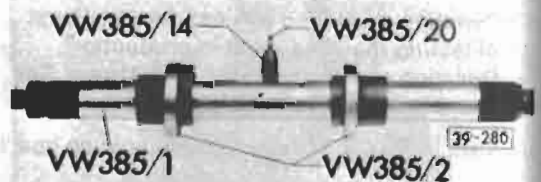
- remove pinion shaft
- install shims corresponding to total shim thickness **S total** on end opposite pinion head
- reinstall pinion
- turn pinion several times in both directions



- attach measuring plate VW 385/22 with support VW 385/19 to pinion

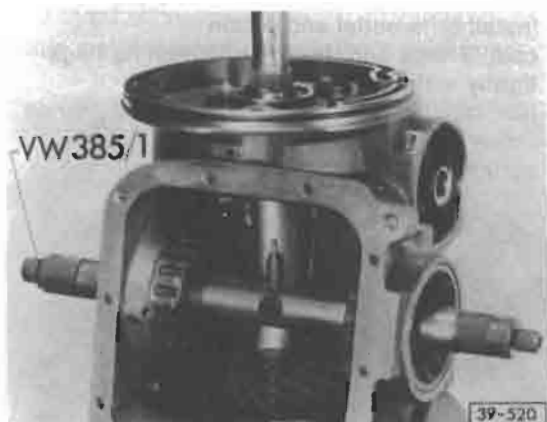


- set clamping ring on universal measuring bar
- a = approx. 74 mm (2.913 in.)



- assemble measuring bar with dial indicator extension VW 385/20
- turn adjusting ring on left side into housing until flush

- insert measuring bar into housing and screw in adjusting ring



- move centering disc outward with movable setting ring until measuring bar can just be turned by hand



- place master gauge VW 385/21 on measuring bar and zero dial indicator with 3 mm preload
- turn measuring bar until dial indicator pin contacts end plate and gauge shows maximum deflection (return point)
- note reading  $e$  (example: 1.72 mm) and determine thickness of shims  $S_3$  and  $S_4$

**Note**

Master gauge VW 385/30 can be used instead of VW 385/21. Set  $R_0$  to 52.60 mm

**Shim  $S_3$ , determining thickness**

$$S_3 = e - r$$

**Example**

dial indicator reading  $e$                       1.72 mm  
 deviation  $r$  marked on ring gear      – 0.42 mm  
 $S_3$  thickness                                      = 1.30 mm

- select shims from table

**Shim  $S_4$ , determining thickness**

$$S_4 = S_{\text{total}} - S_3$$

**Example**

total shim thickness                              2.66 mm  
 $S_3$  thickness                                      – 1.30 mm  
 $S_4$  thickness                                      = 1.36 mm

- select shims from table below

**Shims available**

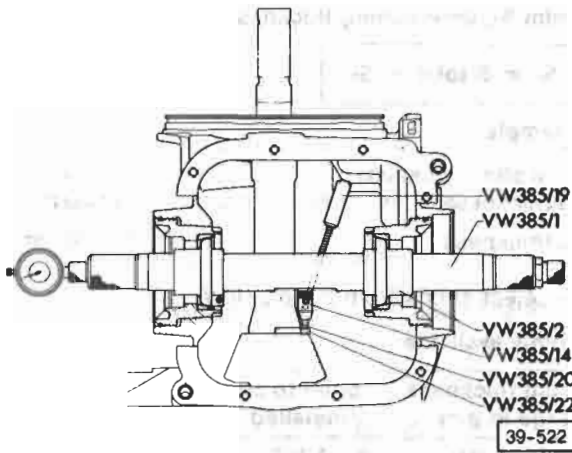
Shim thickness range in mm	Shim to be installed	Part No.
1.050–1.100	1.100	082 519 141 AE
1.105–1.125	1.125	082 519 141 AF
1.130–1.150	1.150	082 519 141 AG
1.155–1.175	1.175	082 519 141 AH
1.180–1.200	1.200	082 519 141 AJ
1.205–1.225	1.225	082 519 141 AK
1.230–1.250	1.250	082 519 141 AL
1.255–1.275	1.275	082 519 141 AM
1.280–1.300	1.300	082 519 141 AN
1.305–1.325	1.325	082 519 141 AP
1.330–1.350	1.350	082 519 141 AQ
1.355–1.375	1.375	082 519 141 AR
1.380–1.400	1.400	082 519 141 AS
1.405–1.425	1.425	082 519 141 AT
1.430–1.450	1.450	082 519 141 BA
1.455–1.475	1.475	082 519 141 BB
1.480–1.500	1.500	082 519 141 BC
1.505–1.525	1.525	082 519 141 BD
1.530–1.550	1.550	082 519 141 BE
1.555–1.575	1.575	082 519 141 BF
1.580–1.600	1.600	082 519 141 BG
1.605–1.625	1.625	082 519 141 BH
1.630–1.650	1.650	082 519 141 BJ
1.655–1.675	1.675	082 519 141 BK
1.680–1.700	1.700	082 519 141 BL
1.705–1.725	1.725	082 519 141 BM
1.730–1.750	1.750	082 519 141 BN
1.755–1.775	1.775	082 519 141 BP
1.780–1.800	1.800	082 519 141 BQ
1.805–1.825	1.825	082 519 141 BR
1.830–1.850	1.850	082 519 141 BS
1.855–1.875	1.875	082 519 141 BT
1.880–1.900	1.900	082 519 141 CA

**Note**

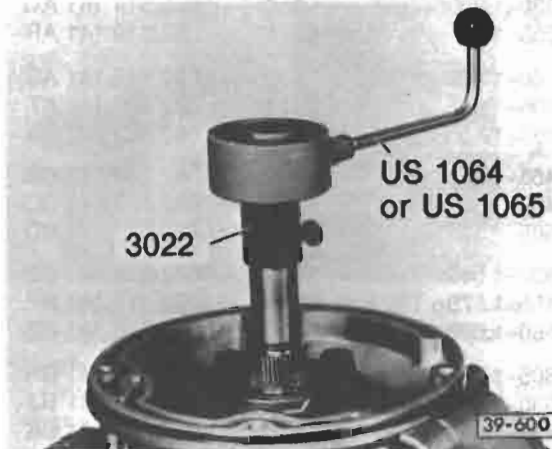
Measure shims at several points with micrometer. Check for burrs and damage. Use only good shims

- go to next page

# 39 Differential-Automatic Transmission



- install shims selected from table
  - S<sub>3</sub> behind pinion
  - S<sub>4</sub> opposite pinion
- install pinion
- lubricate bearings with hypoid gear oil
- turn pinion several times in both directions
- install universal measuring bar
- zero dial indicator with 1 mm preload
- check that indicator reading equals recorded deviation  $r$  within a tolerance of  $\pm 0.04$  mm



- after installing selected shims and pinion shaft, check that turning torque is at least 140 Ncm (12.4 in. lb)

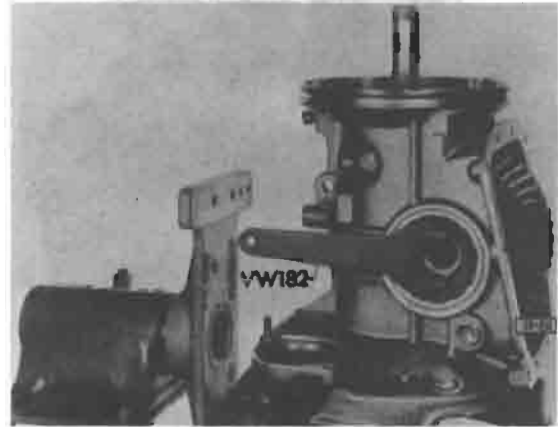
**Note**

This figure is for new bearings. If bearings are to be reused, turning torque should be measured before disassembly. When replacing parts that affect ring gear/pinion setting, check page 39.9 to determine which parts need to be adjusted

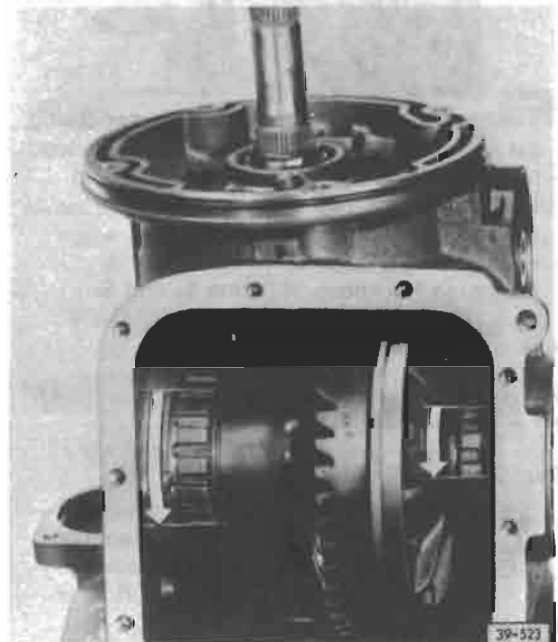
## Ring gear, adjusting

**Work sequence**

- install differential and pinion
- coat O-rings and threads of adjusting rings lightly with multi-purpose grease
- lubricate bearings lightly with hypoid gear oil
- screw in both adjusting rings until outer surface is flush with housing surface



- carefully turn adjusting ring behind ring gear until ring gear meshes with pinion with no backlash
- screw in adjusting ring opposite ring gear as far as possible and preload slightly so that there is no bearing play



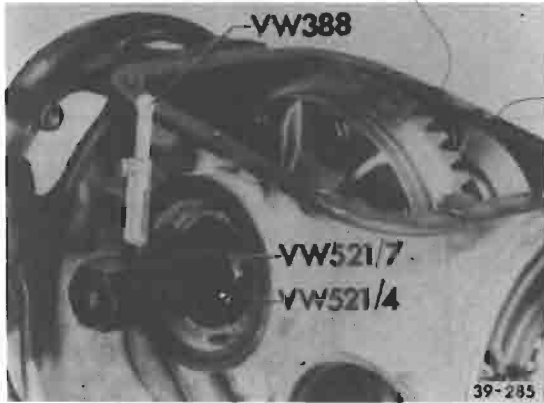
- turn adjusting ring behind ring gear 2 1/2 tooth divisions **out** (right arrow)
- turn adjusting ring opposite ring gear 5 tooth divisions **in** (left arrow). This correctly sets bearing preload and gear backlash



## Backlash, checking

### Work sequence

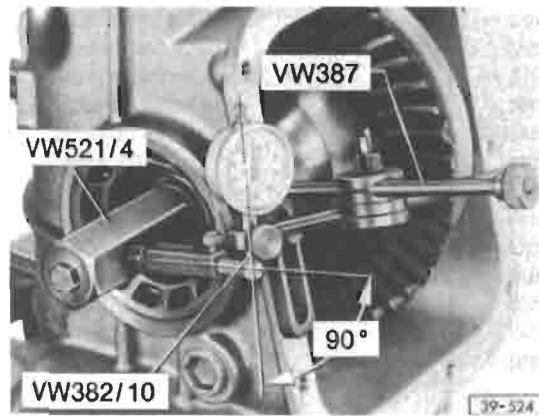
— turn pinion several times in both directions



— attach measuring tools as shown



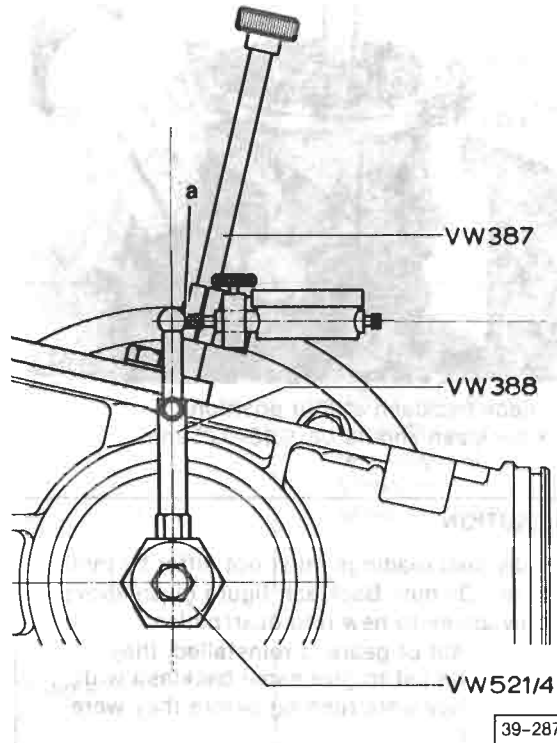
— set measuring lever to 80 mm and place on VW 521/4



— install dial indicator (3 mm range) with extension VW 382/10 (6 mm flat end) in holder VW 387 and bolt holder to transmission housing

### Note

Dial indicator must be located at right angle to measuring bar



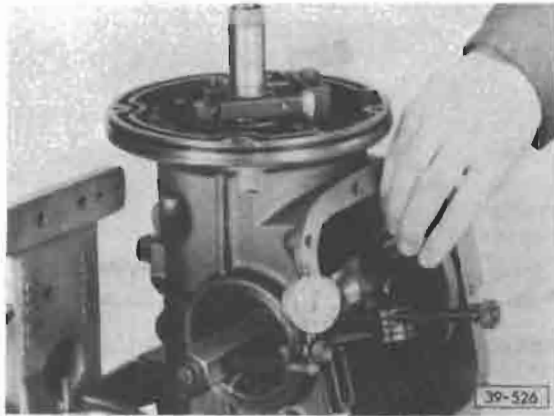
— turn ring gear until measuring lever contacts pin of dial indicator **a** and preloads it to 1.0 mm. Reset dial indicator to zero



— attach clamp VW 386 to cover plate and lock pinion with clamping screw

— go to next page

# 39 Differential-Automatic Transmission



- check backlash at four positions
- backlash should be: 0.15–0.25 mm

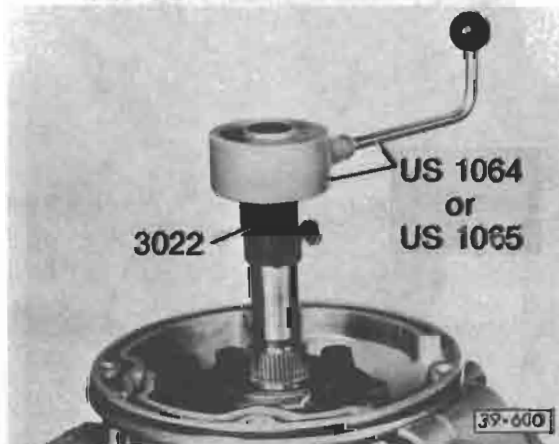
## CAUTION

Individual readings must not differ by more than 0.05 mm. Backlash figure given above only applies to new ring gear/pinion.

If used set of gears is reinstalled, they should be set to give same backlash with which they were running before they were removed

## Note

If backlash of new ring gear/pinion is outside tolerance, it must be corrected by turning both adjusting rings by same amount (in opposite directions) so that bearing preload is not changed



- measure total turning torque of all 4 bearings with torque wrench on pinion shaft
- total turning torque must be at least 20 Ncm (1.8 in. lb) more than turning torque of pinion shaft alone. If necessary, increase turning torque by screwing in both adjusting rings by same amount

## Differential Manual Transmission

Quick Data	Index	
	<p><b>4-Speed 091, 091/1</b>  <b>5-Speed 094</b></p> <ul style="list-style-type: none"> <li>– Assembly 39.2</li> <li>– Bearings 39.3–39.5</li> <li>– Housing 39.3</li> <li>– Pinion               <ul style="list-style-type: none"> <li>adjusting 39.10, 39.11</li> </ul> </li> <li>– Pinion/Side gears 39.6</li> <li>– Ring gear 39.3, 39.4               <ul style="list-style-type: none"> <li>adjusting 39.12, 39.13</li> <li>backlash 39.13, 39.14</li> </ul> </li> <li>– Ring/Pinion gears               <ul style="list-style-type: none"> <li>adjusting 39.7–39.9</li> </ul> </li> <li>– Shim S<sub>3</sub> 39.11</li> </ul> <p><b>Differential—Auto. Trans.</b>            — See page 39.49</p>	<p><b>094-4WD Syncro</b></p> <ul style="list-style-type: none"> <li>– Differential with lock               <ul style="list-style-type: none"> <li>assembly 39.20</li> <li>bearing outer race 39.24</li> <li>bearings 39.21–39.23</li> <li>housing 39.21</li> <li>pinion shafts 39.22</li> <li>ring gear 39.20–39.23</li> </ul> </li> <li>– Differential without lock               <ul style="list-style-type: none"> <li>assembly 39.15</li> <li>bearing outer race 39.19</li> <li>bearings 39.16–39.18</li> <li>housing 39.16</li> <li>pinion shafts 39.17</li> <li>ring gear 39.15–39.18</li> </ul> </li> <li>– Driveshaft               <ul style="list-style-type: none"> <li>flange oil seal 39.44</li> <li>removing/installing 39.43</li> </ul> </li> <li>– Front final drive 39.30, 39.31               <ul style="list-style-type: none"> <li>adjusting rings 39.32, 39.33</li> <li>axle flange 39.32, 39.33</li> <li>circlip 39.33</li> <li>housing 39.34</li> <li>mounting 39.32</li> <li>technical data 39.42</li> </ul> </li> <li>– Front pinion 39.39               <ul style="list-style-type: none"> <li>bearing 39.40</li> <li>grooved nut 39.40</li> <li>turning torque 39.41</li> </ul> </li> <li>– Locking pin 39.28, 39.29               <ul style="list-style-type: none"> <li>backlash 39.29</li> </ul> </li> <li>– Pinion/Side gears 39.25</li> <li>– Removing 39.33</li> <li>– Ring gear/Pinion               <ul style="list-style-type: none"> <li>adjusting 39.26</li> <li>backlash 39.27</li> <li>screw-in depth 39.26, 39.27</li> </ul> </li> </ul>



# 39 Differential-Manual Transmission

## CAUTION

Inner and outer races of tapered roller bearings are matched and must not be interchanged. Replace both bearings at same time. Ring gear/pinion must be adjusted after replacing differential housing, cover or bearings. Side gear end play must be adjusted if differential housing, cover or side gears have been replaced

## Note

Drive flange oil seal can be replaced with final drive installed, see Repair Group 34

Ring gear/pinion adjusting, page 39.7-39.14  
backlash adjusting, page 39.13

Spacer  
determining size page 39.6

Side gears

Differential pinion shaft  
drive out with drift. When installing, do not damage thrust washers

Pin  
drive in flush

Differential bearing/inner race  
(housing side)  
removing Fig. 5 and Fig. 6  
installing Fig. 8

50 Nm (36 ft lb)  
tighten diagonally

Adjusting ring

Differential bearing/outer race  
removing Fig. 10  
installing Fig. 11

Differential bearing/inner race  
(ring gear side)  
removing Fig. 4  
installing Fig. 7

Differential cover  
removing Fig. 3  
when installing, oil  
holes (arrow) must be  
offset approximately 90°  
to differential pinion shaft

Thrust washers  
check for wear

Differential pinion gears  
installing page 39.6

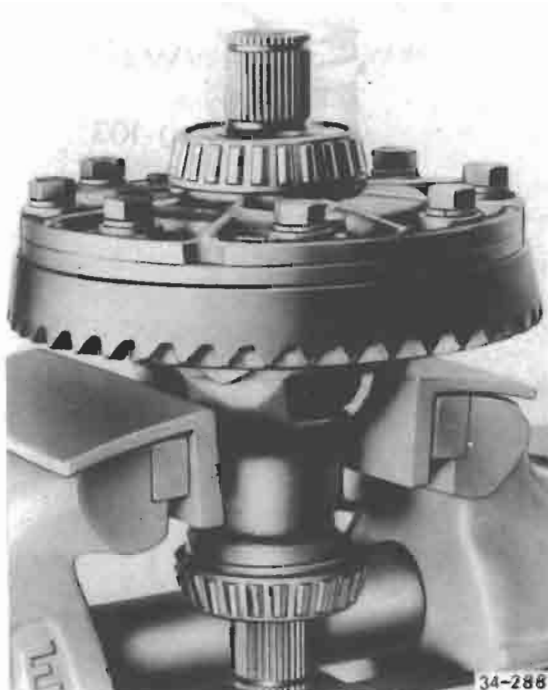
Differential housing  
disassembling Fig. 1

Ring gear  
(matched to pinion)  
removing Fig. 2  
installing Fig. 9

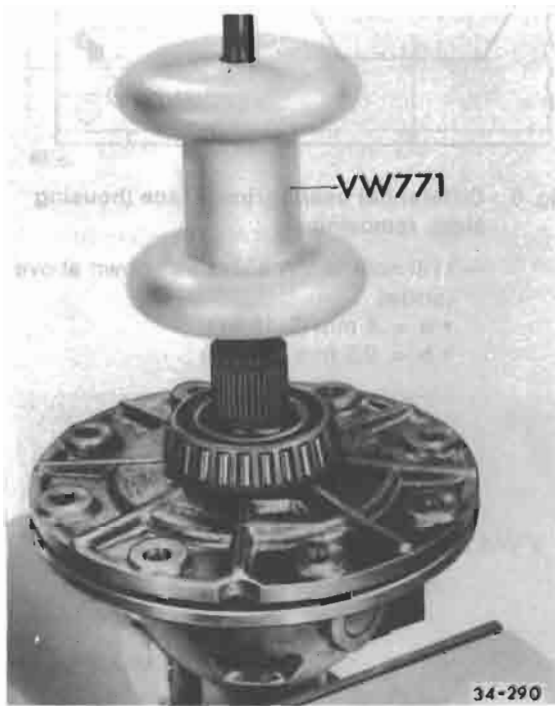
Differential bearing/outer race  
removing Fig. 10  
installing Fig. 11

Transmission housing

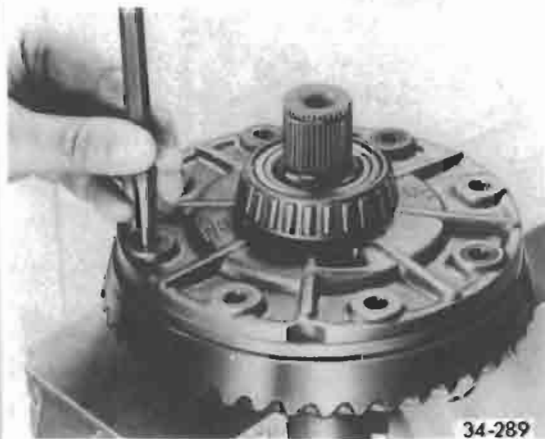
35-719



**Fig. 1 Differential housing, disassembling**  
— use jaw covers on vise



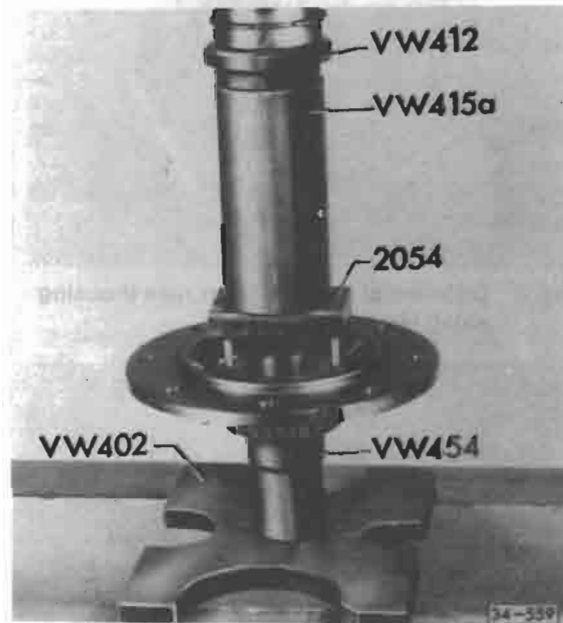
**Fig. 3 Differential cover, removing**



**Fig. 2 Ring gear, removing**  
(matched to pinion)  
— use drift to separate ring gear from housing

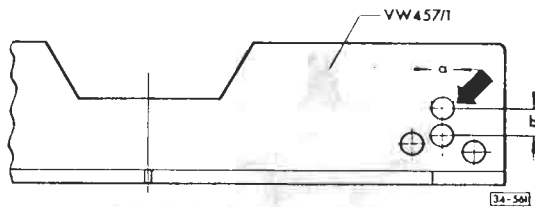
**CAUTION**

Do not damage threads in ring gear



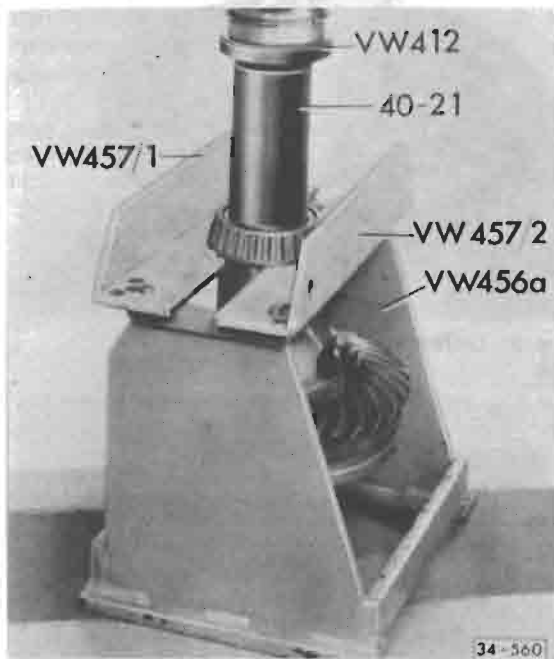
**Fig. 4 Differential bearing/inner race (ring gear side), removing**

# 39 Differential-Manual Transmission

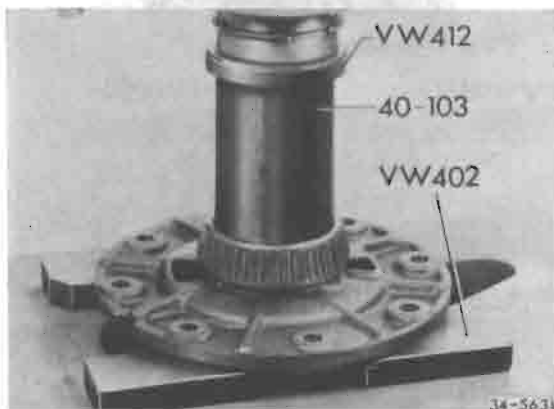


**Fig. 5 Differential bearing/inner race (housing side), removing**

- drill hole in VW 457/1 as shown above (arrow)
- a = 8 mm (5/16 in.)
- b = 9.5 mm (3/8 in.)

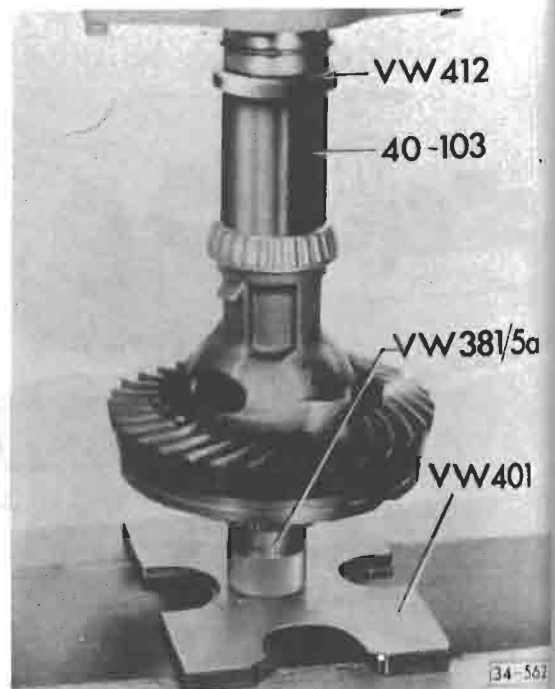


**Fig. 6 Differential bearing/inner race (housing side), removing**



**Fig. 7 Differential bearing/inner race (ring gear side), installing**

- heat to approx. 100°C (212°F) and press on



**Fig. 8 Differential bearing/inner race (housing side), installing**

- heat to approx. 100°C (212°F) and press on



**Fig. 9 Ring gear, installing**

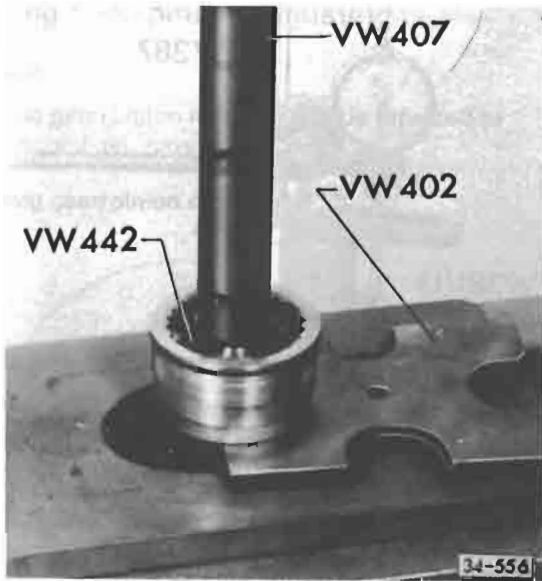
### CAUTION

Clean contact surfaces are essential to ensure that ring gear, differential housing, and cover fit properly. Remove all burrs and pressure marks with oil stone

- heat ring gear to approx. 100°C (212°F) and install
- A = centering pins (local manufacture)

### Note

If ring gear/pinion are replaced, readjustment is necessary



**Fig. 10 Differential bearing/outer race, removing**



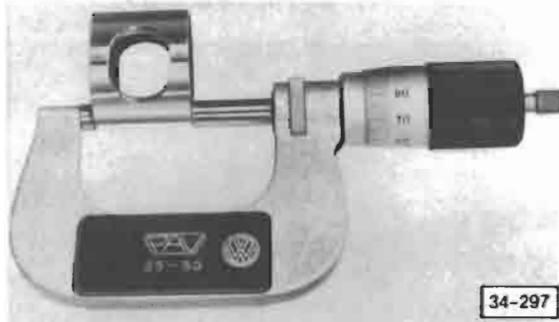
**Fig. 11 Differential bearing/outer race, installing**  
— press race in until seated

# 39 Differential-Manual Transmission

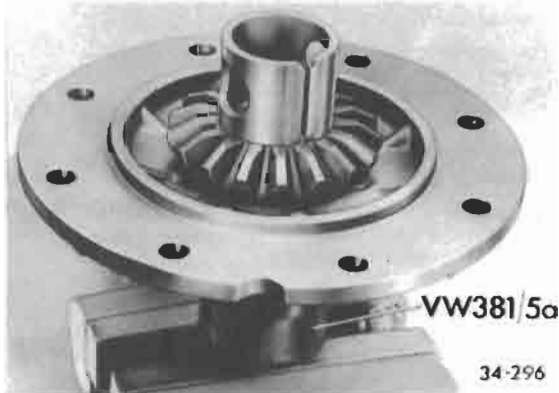
## Differential pinion/side gears, adjusting end play

### Note

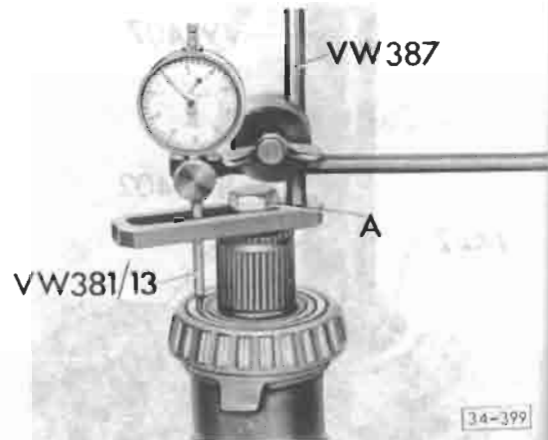
Spacer sleeve ensures adequate backlash between side gears and differential pinion gears even when there is axial pressure on side gears. If differential housing, cover, side gear or spacer sleeve is replaced, size of spacer sleeve must be determined again



- measure **shortest** spacer sleeve, Part No. 002 517 241, with micrometer and mark dimension on sleeve with electric marker or similar device. Sleeve **should then** always be used as measuring sleeve



- place side gear (with short shaft) and both thrust washers in cover
- attach clamping sleeve VW 381/5a and clamp gear tightly against cover
- place side gear (with long shaft) in differential housing
- insert measuring sleeve, and bolt housing and cover together with 4 M8 x 20 bolts



- install dial indicator with 3 mm range
  - A = M10 x 25 bolt
  - VW 381/13 = 52 mm
- zero dial indicator with 2 mm preload
- find end play by moving side gear up and down
- add measured play and length of measuring sleeve together. Find this figure in table under x range and select proper sleeve

x range	Sleeve length	Part No.
31.87-31.95	31.84	002 517 241
31.96-32.04	31.93	002 517 242
32.05-32.13	32.02	002 517 243
32.14-32.22	32.11	002 517 244
32.23-32.33	32.20	002 517 245

- disassemble differential and remove measuring sleeve
- install sleeve selected from above table and assemble differential **without** differential pinion shaft
- recheck play. Play should be
  - 0.03-0.17 mm

## Ring gear/pinion, adjusting

### Note

Ring gear/pinion must **always** be replaced as matched set, never individually

### Ring gear/pinion markings

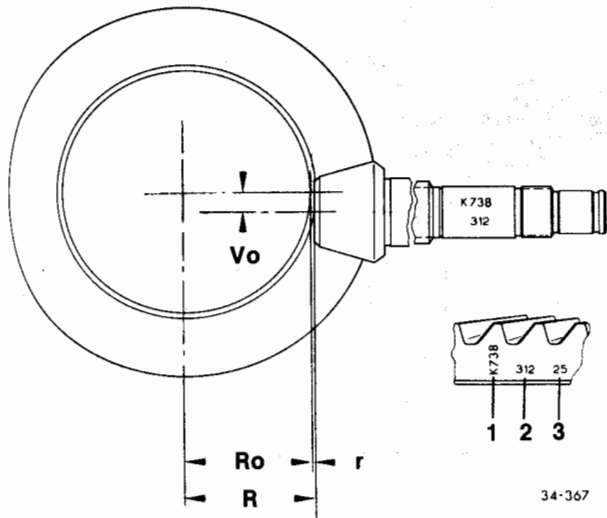


Fig. 1 Service gears

- 1 = Marking K 738 means Klingelberg gear set with ratio of 7:38 teeth
  - 2 = Matching number of gear set 312
  - 3 = Deviation  $r$  based on master gauge used in special test machine in production. Deviation  $r$  is always given in 1/100 mm. 25 shown in example means that  $r = 0.25$  mm
- $R_o$  = Length of master gauge in production:  $R_o = 63$  mm
- $R$  = Actual dimension between ring gear centerline and end face of pinion at quietest running point for this gear set
- $V_o$  = Hypoid offset = 10 mm

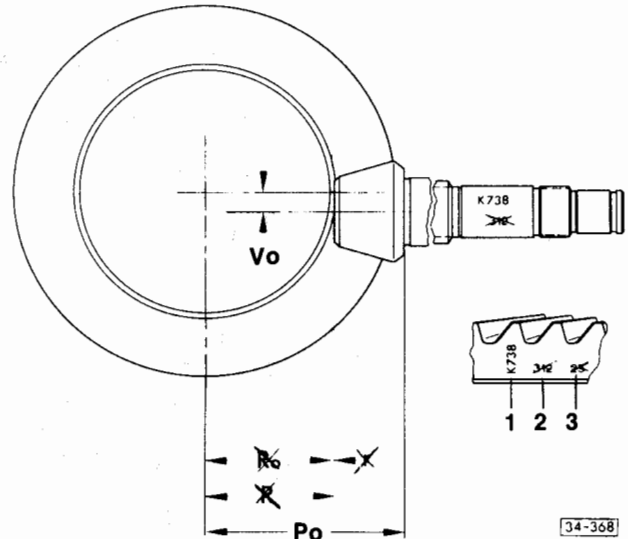


Fig. 2 Production gears

- X = Markings x'ed-out are not shown on production gears
- $P_o$  = Setting dimension for production gears

### CAUTION

In production, position of pinion is determined by dimension  $P_o$  (ring gear centerline to back of pinion head)

Marking of deviation  $r$  on ring gear and matching number have been discontinued. It is therefore necessary to measure position of pinion **before** removing it when parts which affect position of pinion are to be replaced. See page 39.9

# 39 Differential-Manual Transmission

## Ring gear/pinion, adjusting

### CAUTION

Maximum possible care and cleanliness during all assembly and measuring operations are essential for satisfactory results

### Note

Ring gear/pinion must be adjusted if gears themselves have been replaced. If other parts which affect position of pinion are to be replaced, pinion depth **R** must be measured **before** disassembling, and pinion set to this dimension when assembling. See page 39.9

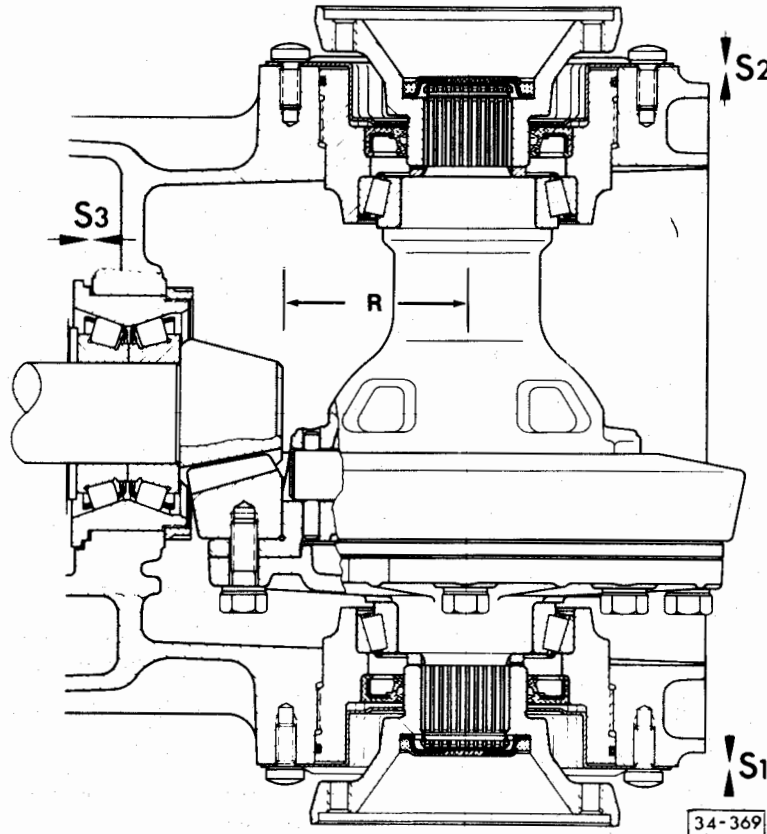


Fig. 3 Ring gear/pinion adjustment points

- S<sub>1</sub> = Screw-in depth of adjusting ring (ring gear side)
- S<sub>2</sub> = Screw-in depth of adjusting ring (housing side)
- S<sub>3</sub> = Shim for pinion

## Ring gear/pinion adjustment procedure

### Work sequence

- find screw-in depth S<sub>1</sub> and S<sub>2</sub>
  - tapered roller bearing preload is determined by ring gear turning torque
- adjust pinion and check S<sub>3</sub>
  - adjust pinion with shims so that correct dimension R is attained
- adjust backlash

## Ring gear/pinion, adjusting

### Note

It is only necessary to adjust pinion, ring gear, or both, or shift forks if parts which directly influence setting have been replaced. See table to avoid unnecessary adjustments

To be adjusted Parts replaced	Shift forks see Repair Group 35	Pinion $S_3$ from actual dimension R see page 39.9	Pinion $S_3$ from deviation r see page 39.10	Ring gear $S_1$ and $S_2$ see page 39.12
Transmission case	X	X		X
Adjusting ring for final drive				X
Differential housing				X
Cover for differential housing				X
Differential tapered roller bearings				X
Double tapered roller bearing for pinion	X	X		
Ring gear/pinion	X		X	X
Ball bearing for drive shaft	X			

### Finding position of pinion (actual dimension)

Finding position of pinion is only necessary when deviation r is not marked on ring gear, and parts are to be replaced which directly influence position of pinion. These are: **both pinion bearings and transmission housing.**

- measure difference from  $R_0$ . This measurement corresponds to deviation r. Note reading  
**Example: r = 0.25 mm**
- after installing new parts, adjust pinion. See pages 39.10–39.11. Deviation r is used to determine thickness of shim  $S_3$

### Work sequence

- remove differential housing
- assemble measuring bar as described on page 39.10 and place it in transmission housing

VW 385/11 or VW 385/30



- set gauge VW 385/30 to  $R_0 = 63.00$  mm, place on bar and zero dial indicator (3 mm range) with 1 mm preload



# 39 Differential-Manual Transmission

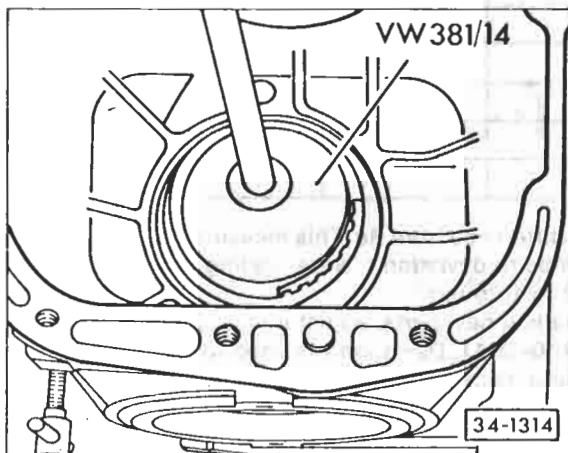
## Pinion, adjusting

### Note

Ring gear/pinion need adjusting if gears themselves have been replaced. If other parts which affect position of pinion are to be replaced, setting must be measured **before** disassembling and pinion set to this dimension when assembling. See page 39.9

### Work sequence

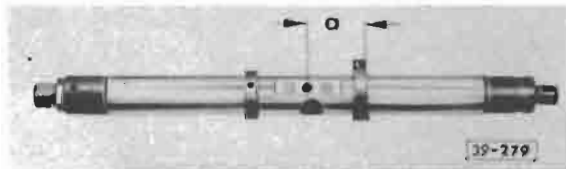
- install tapered roller bearing and needle bearing inner race for 1st gear on pinion shaft
- torque needle bearing inner race to 210 Nm (152 ft lb)



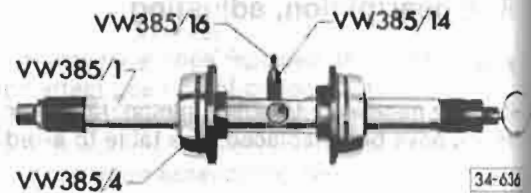
- install pre-assembled pinion in transmission housing **without** shim **S<sub>3</sub>**
- install retaining ring and tighten with VW 381/14 to 225 Nm (162 ft lb)
- back off and retighten to 225 Nm (162 ft lb)

### Finding dimension e

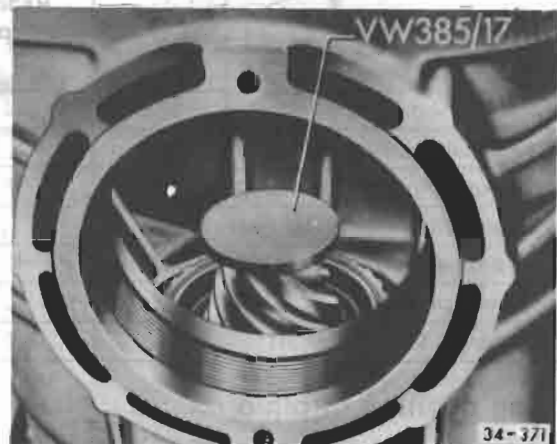
- screw in one adjusting ring until flush with transmission housing



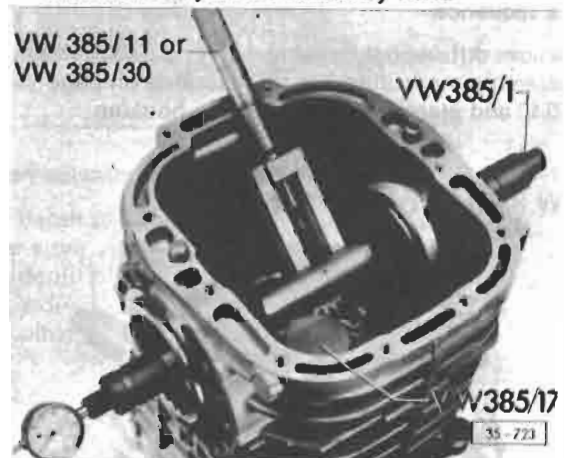
- adjust setting ring on measuring bar VW 385/1 to dimension **a**
  - **a** = approx. 57 mm



- assemble measuring bar as shown
  - dial gauge extension VW 385/16 = 12.3 mm



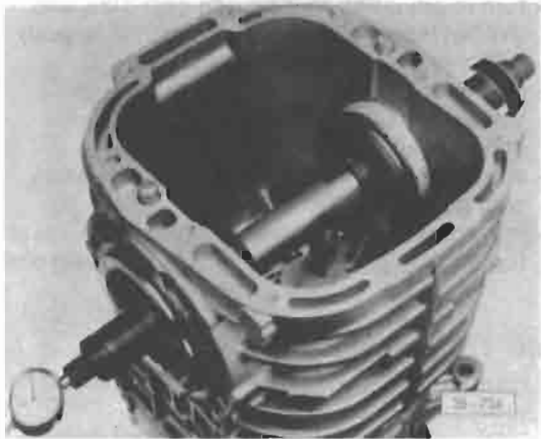
- place measuring disc VW 385/17 on end of pinion
- place measuring bar in housing and screw 2nd adjusting ring in until flush with housing
- move 2nd centering ring VW 385/4 outward with movable setting ring on measuring bar until bar can just be turned by hand



- set universal gauge VW 385/30 to  $R_o = 63.00$  mm and place it on measuring bar
- zero dial gauge (3 mm range) with 1 mm preload

### Note

Gauge VW 385/11 can be used instead of universal gauge VW 385/30



— turn bar until measuring pin touches measuring disc on end of pinion, and needle shows maximum deflection. This is dimension **e**  
**Example: e = 0.40 mm**

### Shim $S_3$ , determining thickness

$$S_3 = e + r$$

**e** = measured figure (max. deflection)  
**r** = deviation (marked on ring gear in 1/100 mm or found by actual measurement)

### Example

Dial gauge reading for <b>e</b>	0.40 mm
Deviation <b>r</b>	+ 0.25 mm
$S_3$ shim thickness	= 0.65 mm

### $S_3$ shims available

Part No.	Thickness (mm)
001 311 391	0.15
001 311 392	0.20
001 311 393	0.30
001 311 394	0.40
001 311 395	0.50
001 311 396	0.60

### Note

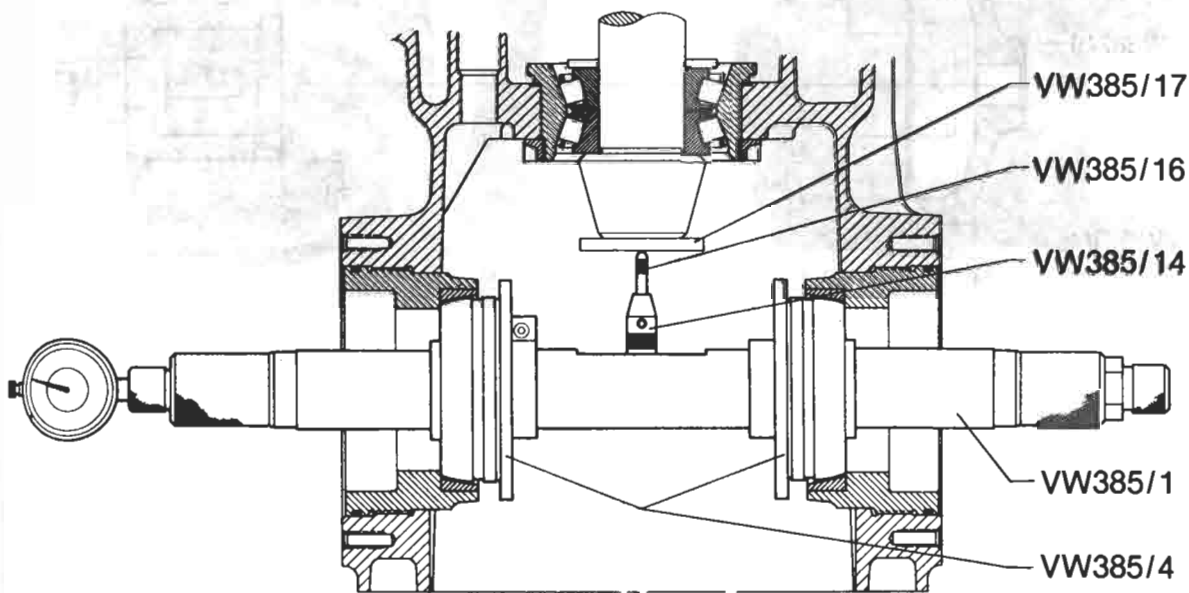
Shim tolerances make it possible to select any required thickness for  $S_3$

Measure shims at several points with micrometer and check for burrs and damage

Use only shims which are in good condition

### Adjustment (dimension **r**), checking

- install pinion with measured shims  $S_3$  and turn several times in both directions
- place measuring bar in position and check measurements
  - if shims have been selected correctly, dial gauge (reading counterclockwise), should show deviation **r** within tolerance of 0.04 mm



34-643

4-speed 091-091/1

5-speed 094

Pinion, adjusting Shim  $S_3$

# 39.11

# 39 Differential-Manual Transmission

## Ring gear, adjusting (pinion removed)

### Note

Ring gear must be adjusted if transmission housing, differential bearings, differential housing/cover, adjusting rings or ring gear/pinion have been replaced. Also see table on page 39.9

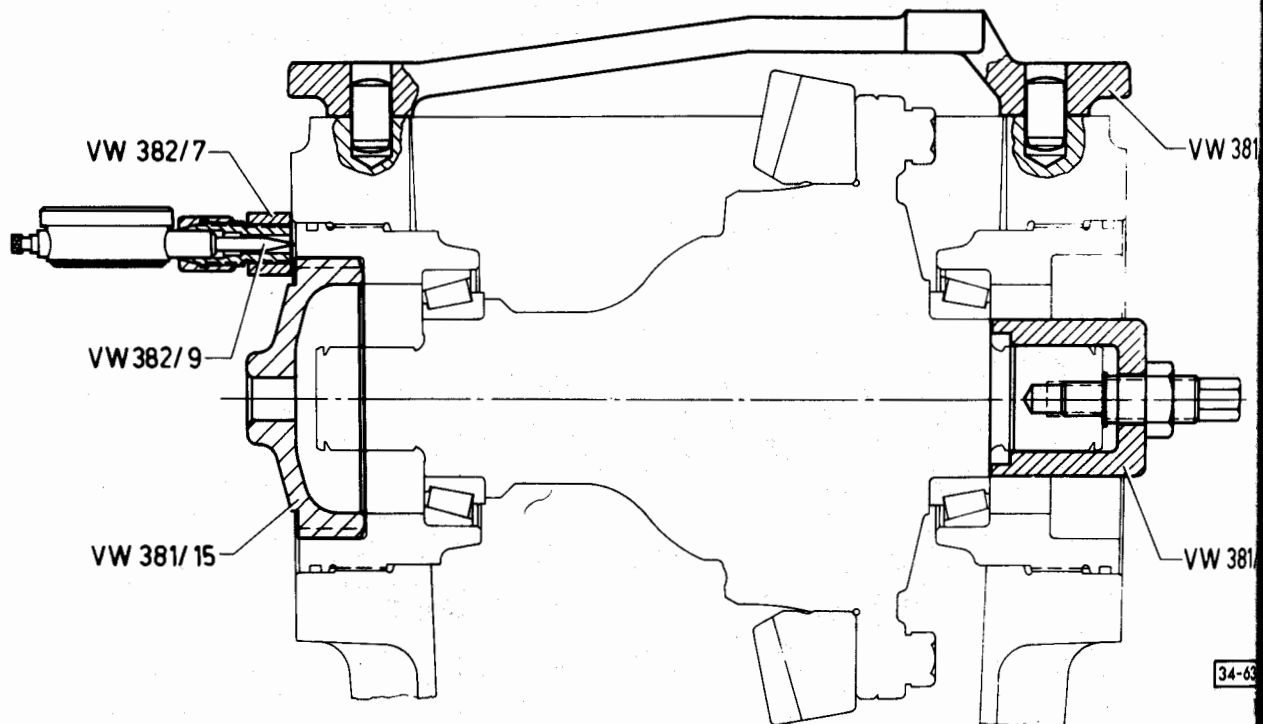
### Work sequence

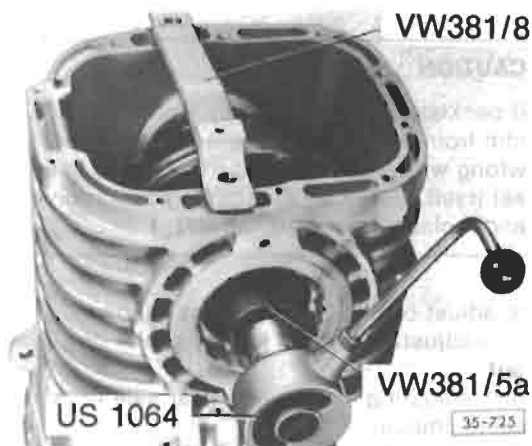
#### CAUTION

Differential bearing outer races must be fully seated in adjusting rings

- install differential with ring gear on driver's side
- install dial indicator (3 mm range) with extension VW 382/9 into bar VW 382/7
- zero dial indicator with 1 mm preload

- turn in adjusting ring on ring gear side with VW 381/15 until upper edge is approximately 0.20 mm below surface of housing
- turn in adjusting ring on other side with VW 381/15 until differential is free of play and without preload
- attach VW 381/5a to ring gear side and lock with hex nut
- turn transmission housing so differential is at top and attach bridge VW 381/8 on dowel pins





- attach torque gauge US 1064
- turn differential in both directions while oiling bearings with transmission oil
- increase bearing preload slowly by turning in adjusting ring on side opposite ring gear with VW 381/15 while turning differential with US 1064 until specified turning torque is reached

### Turning torque

New bearings	Used bearings*
300–350 Ncm (27–31 in. lb.)	30–70 Ncm (2.7–6.2 in. lb.)

\*after running at least 30 miles



- measure screw-in depth of adjusting rings and note readings  $S_1$  and  $S_2$
- mark adjusting rings and do not interchange

### Note

If ring gear is being readjusted, check pinion adjustment, see page 39.10

## Backlash, adjusting

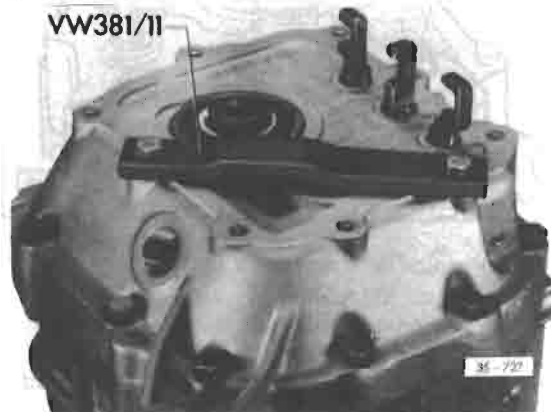
### Work sequence

- install pinion with shim  $S_3$
- install differential with adjusting rings on correct sides
- attach bridge VW 381/8
- turn in adjusting rings while turning differential until measured screw-in depths  $S_1$  and  $S_2$  have been reached



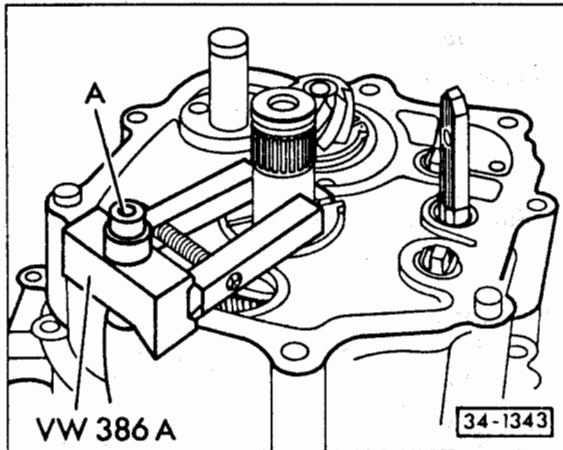
- attach measuring tools as shown

### 4-speed 091



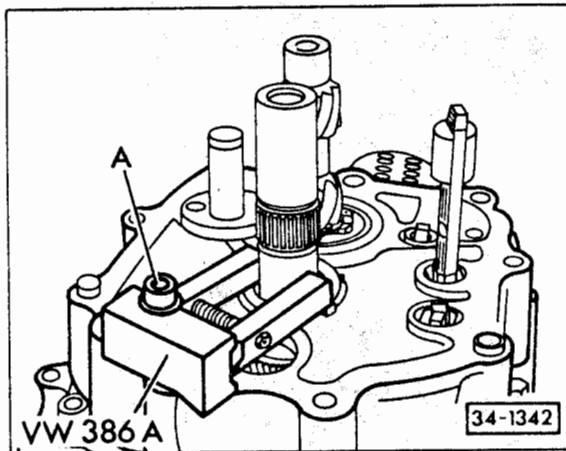
- lock pinion with bar VW 381/11

# 39 Differential-Manual Transmission



- lock pinion with clamp
  - A = bolt M8 x 125

## 5-speed 094



- lock pinion with clamp
  - A = bolt M8 x 125
- turn ring gear to stop and set dial indicator to zero
- turn ring gear in opposite direction and read backlash
- check backlash each 1/4 turn
  - backlash should be 0.15–0.25 mm (0.006–0.010 in.)

### Note

Individual readings must not differ from one another by more than 0.05 mm

### CAUTION

If backlash readings vary by more than 0.06 mm from one another, there is something wrong with installation of ring gear or gear set itself. Check all assembling operations and replace gear set if necessary

- to adjust backlash, proceed as follows
- turn adjusting ring on side opposite ring gear **out**
- turn adjusting ring on ring gear side **in** by same amount
- continue adjusting until backlash is 0.15–0.25 mm (0.006–0.010 in.)

### Note

Keep within tolerance of  $\pm 0.01$  mm

### Backlash, checking

- check backlash each 1/4 turn
  - backlash should be 0.15–0.25 mm (0.006–0.010 in.)

### Note

Individual readings must not differ by more than 0.05 mm

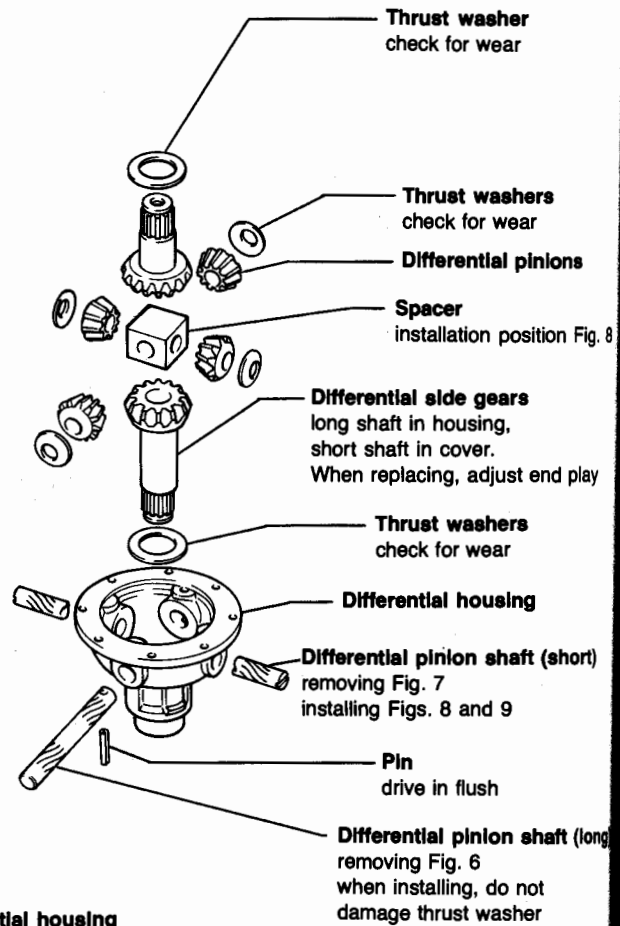
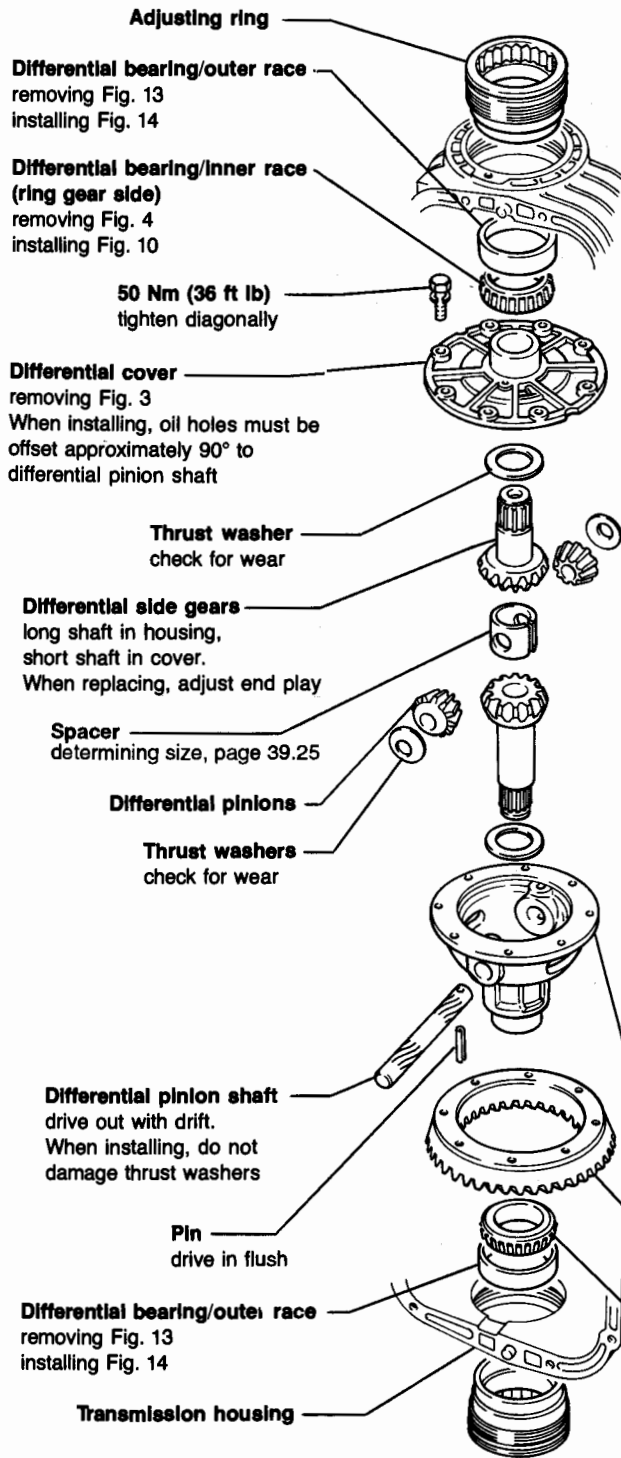
# 39 Differential – Manual Transmission

## Note

Clamp differential gear into a vise before disassembling (Fig. 1).

## CAUTION

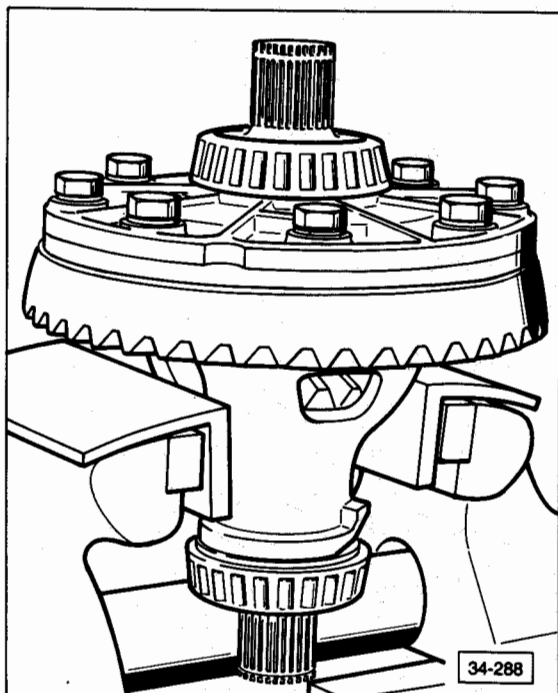
Bearing inner and outer races are matched and must not be interchanged. Replace both bearings at the same time. Ring gear and pinion must be adjusted after replacing differential housing, cover and bearings. Side gear end play must be adjusted if differential housing, cover or side gears have been replaced.



**Differential gear set with two small differential pinions**

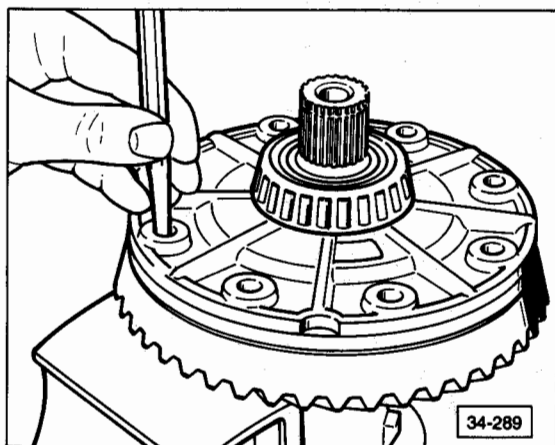
**Differential gear set with four small differential pinions**

39-1133



**Fig. 1 Differential housing, disassembling**

— use jaw covers on vise

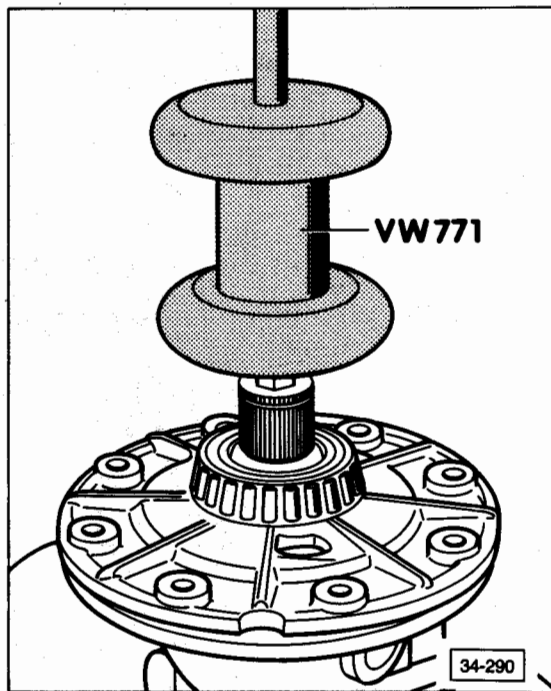


**Fig. 2 Ring gear, removing**

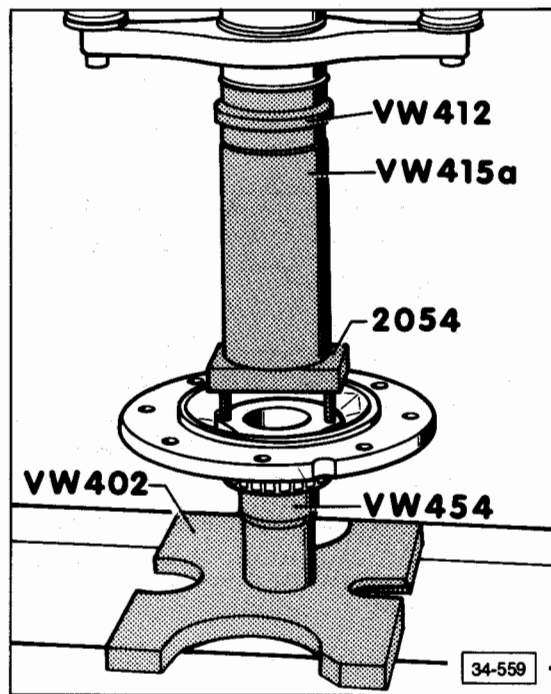
— use drift to separate ring gear from housing

**CAUTION**

Do not damage threads in ring gear.



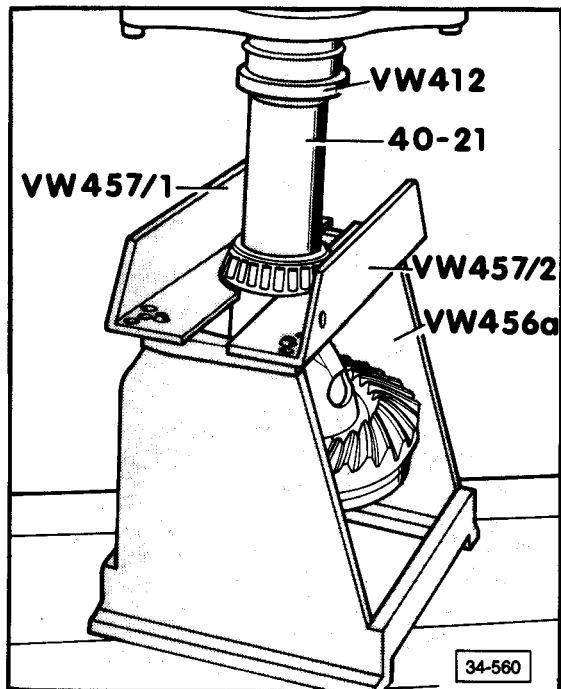
**Fig. 3 Differential cover, removing**



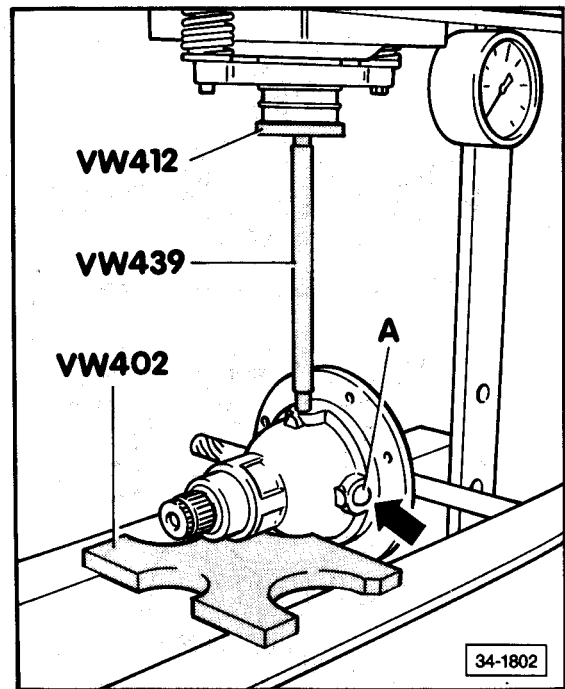
**Fig. 4 Differential bearing/Inner race (ring gear side), removing**

39-1133

# 39 Differential – Manual Transmission

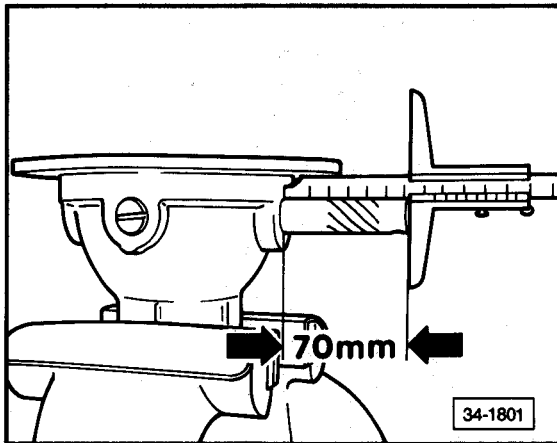


**Fig. 5** Differential bearing/inner race (housing side), removing



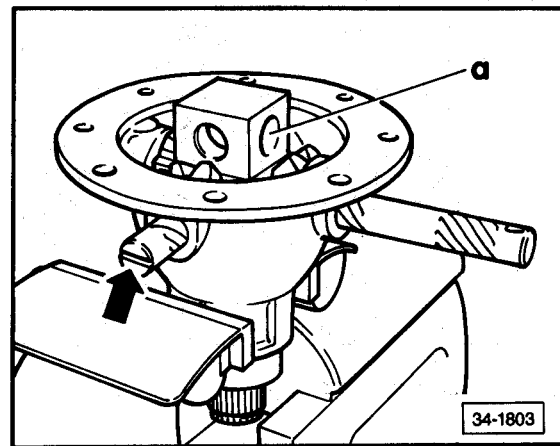
**Fig. 7** Differential pinion shafts (short), removing

- insert greased ball **A** (17 mm diameter) into bore hole of spacer up to stop and secure
- press on shaft



**Fig. 6** Differential pinion shaft (long), removing

- drive out axle until it projects 70 mm on one side



**Fig. 8** Differential pinion shafts, installing

- align short shafts with slots parallel to flange
- drive in all shafts until thrust washers and differential pinions can be positioned
- install spacer with large bore hole **a** facing long axle
- drive in long axle until it matches pin hole



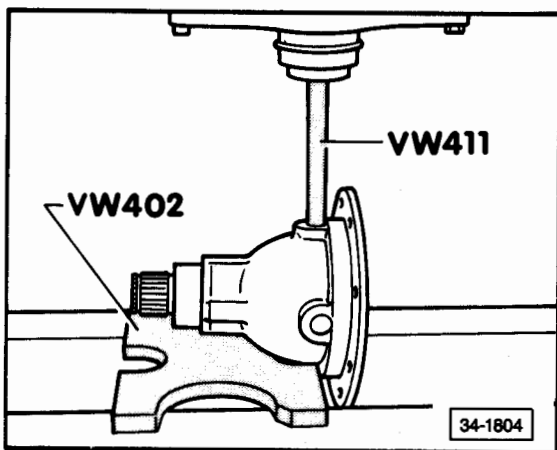


Fig. 9 Shafts, installing

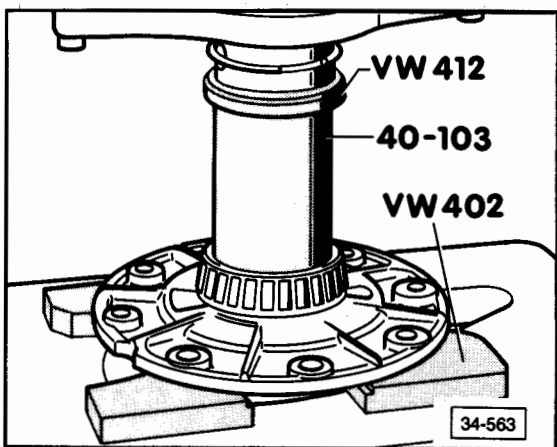


Fig. 10 Differential bearing/inner race (ring gear side), installing

— heat to approximately 100°C (212°F) and press on

**CAUTION**

Clean contact surfaces are essential to ensure that ring gear, differential housing and cover fit properly. Remove all burrs and pressure marks with oil stone.

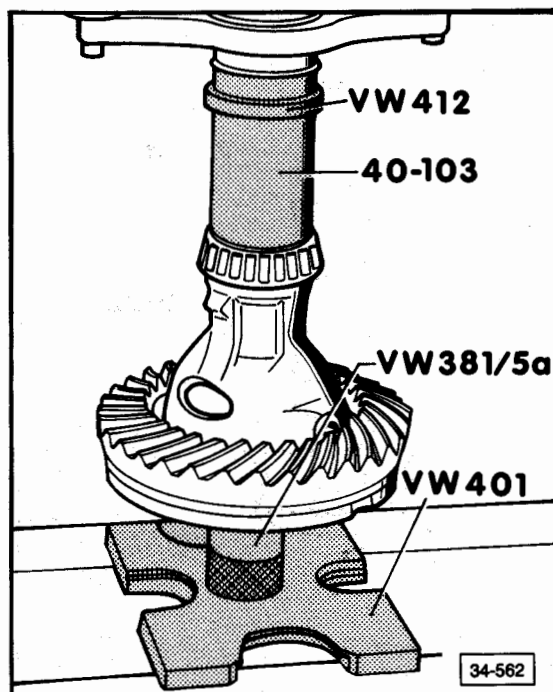


Fig. 11 Differential bearing/inner race (housing side), installing

— heat to approximately 100°C (212°F) and press on

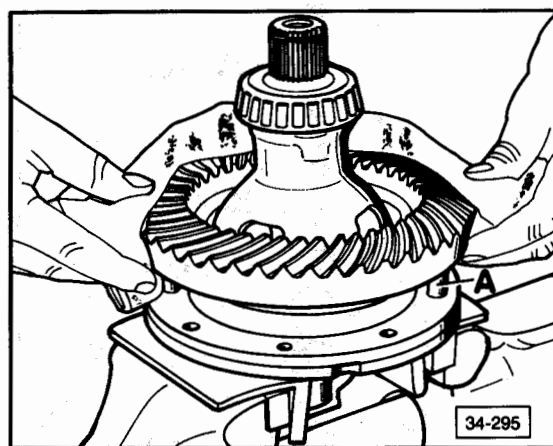


Fig. 12 Ring gear, installing

— heat ring gear to approximately 100°C (212°F) and install

A = centering pins (fabricate)

**Note**

If ring gear/pinion are replaced, readjustment is necessary.

# 39 Differential – Manual Transmission

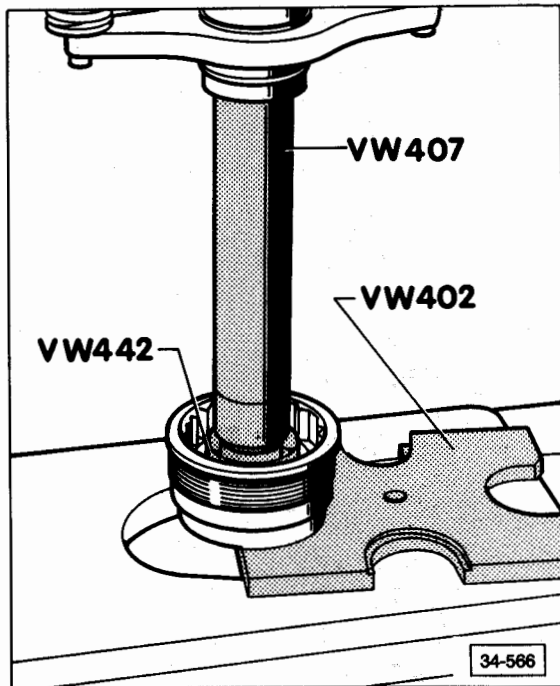


Fig. 13 Differential bearing/outer race, removing

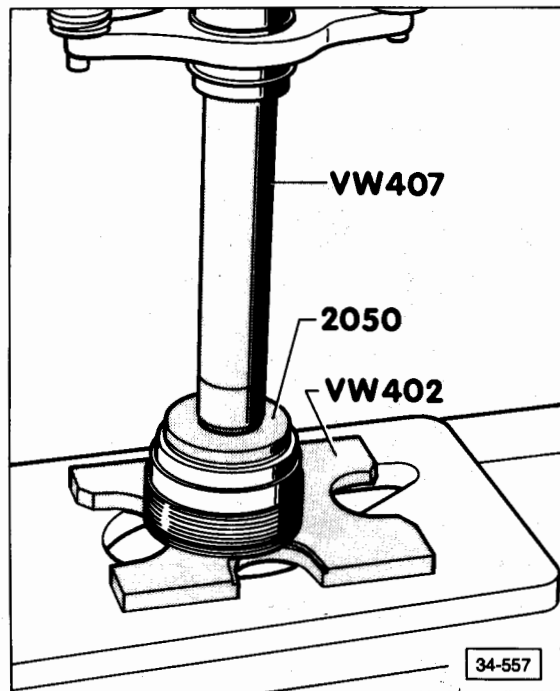


Fig. 14 Differential bearing/outer race, installing

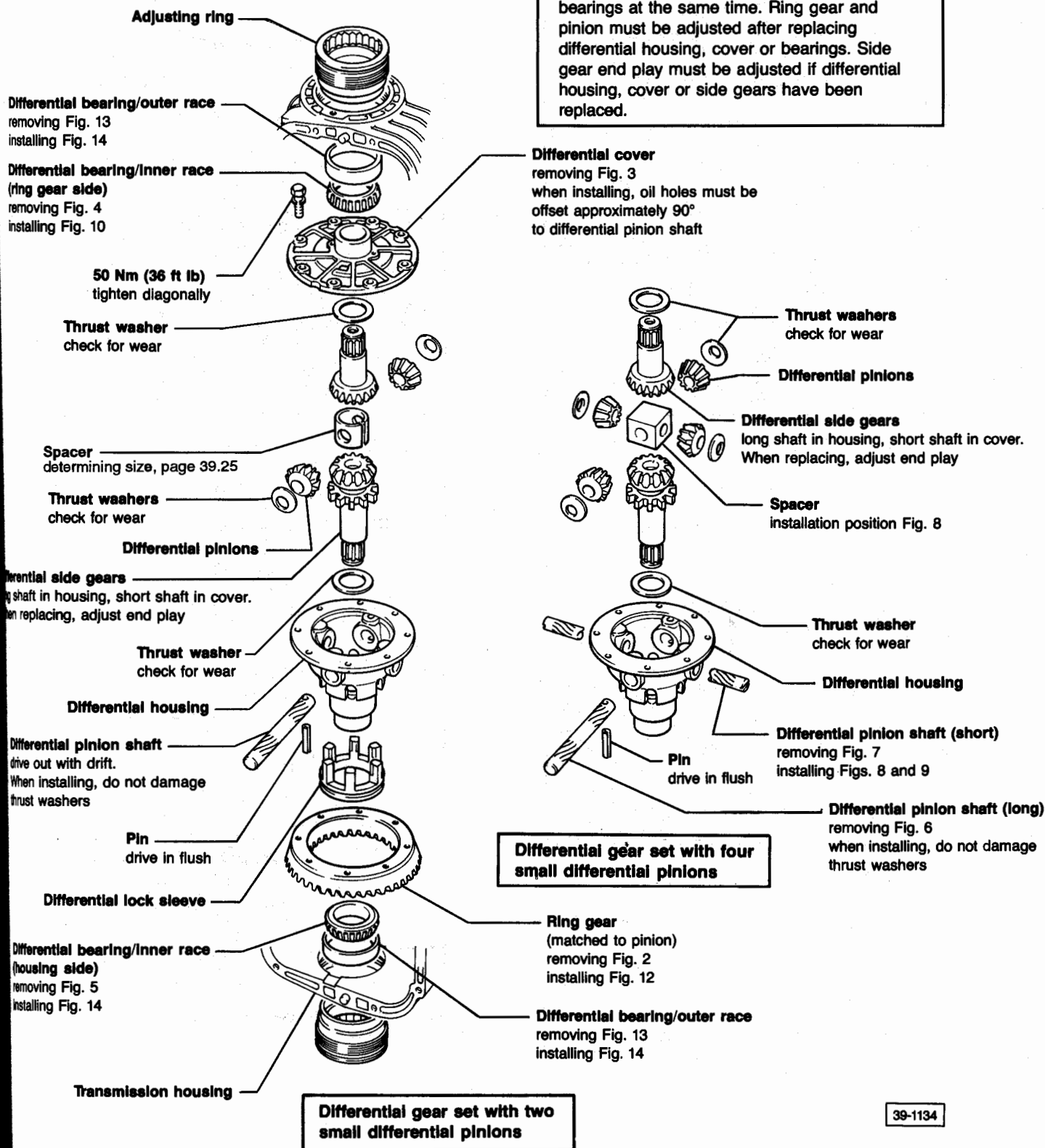
— press race in until seated

**Note**

Clamp differential gear into a vise before disassembling (Fig. 1).

**CAUTION**

Bearing inner and outer races are matched and must not be interchanged. Replace both bearings at the same time. Ring gear and pinion must be adjusted after replacing differential housing, cover or bearings. Side gear end play must be adjusted if differential housing, cover or side gears have been replaced.



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# 39 Differential – Manual Transmission

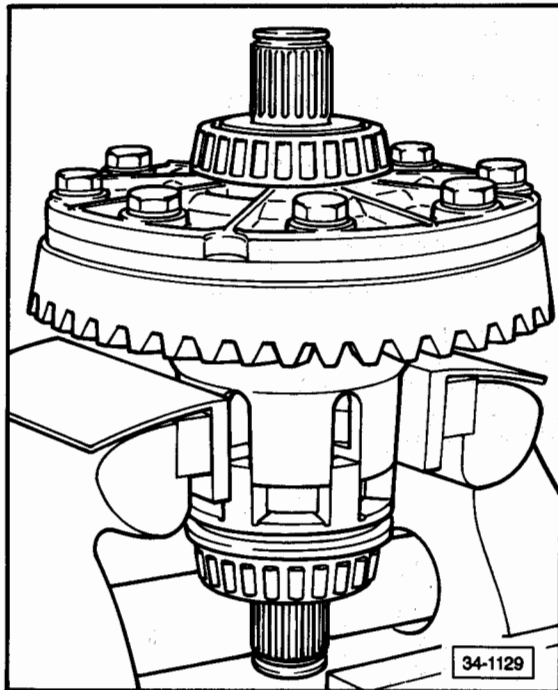


Fig. 1 Differential housing, disassembling

— use jaw covers on vise

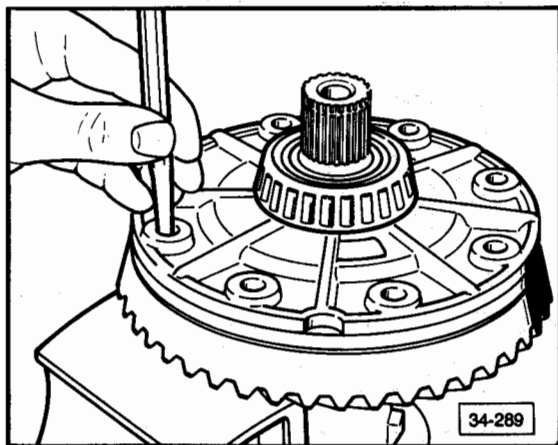


Fig. 2 Ring gear, removing

— use drift to separate ring gear from housing

## CAUTION

Do not damage threads in ring gear.

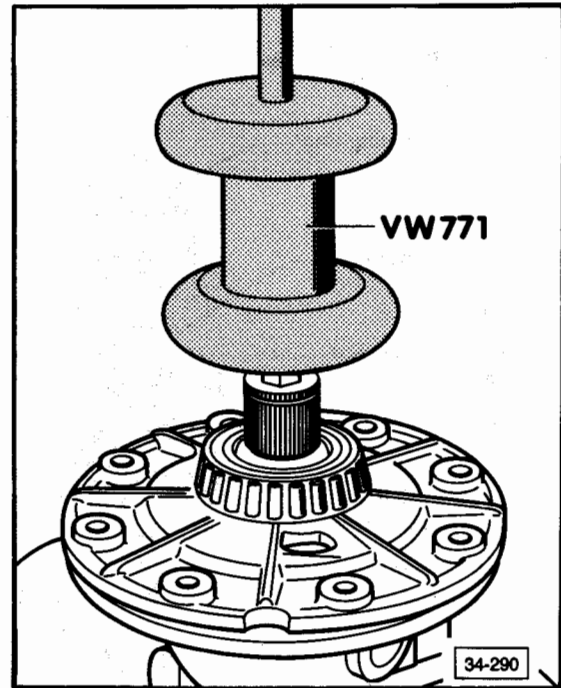


Fig. 3 Differential cover, removing

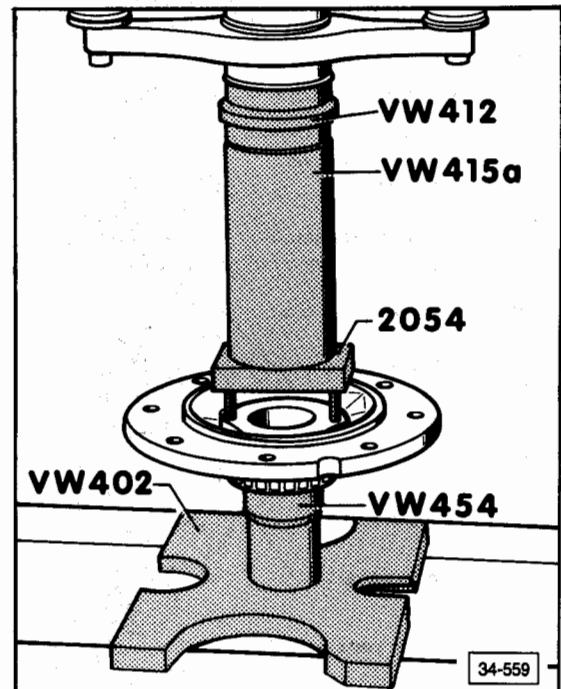
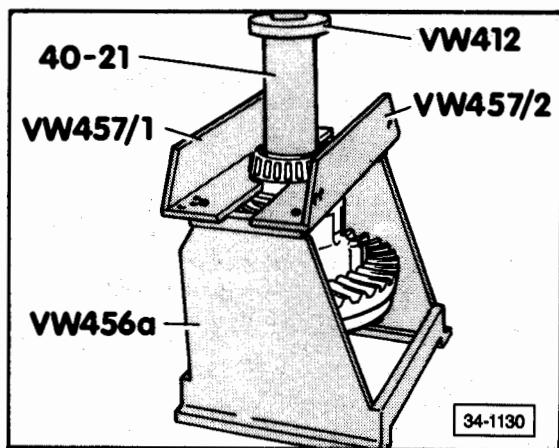


Fig. 4 Differential bearing/inner race (ring gear side), removing

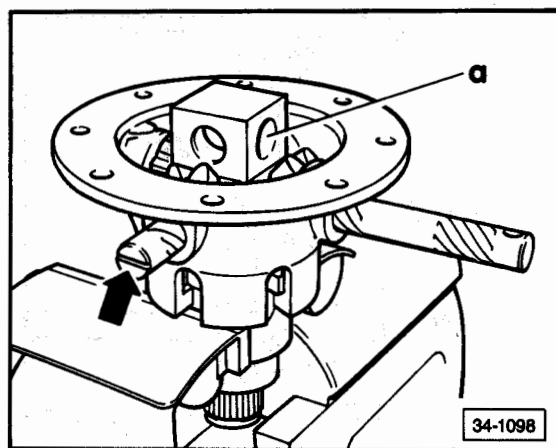
# 39.21

Ring gear  
Differential housing  
Differential bearing

094-4WD

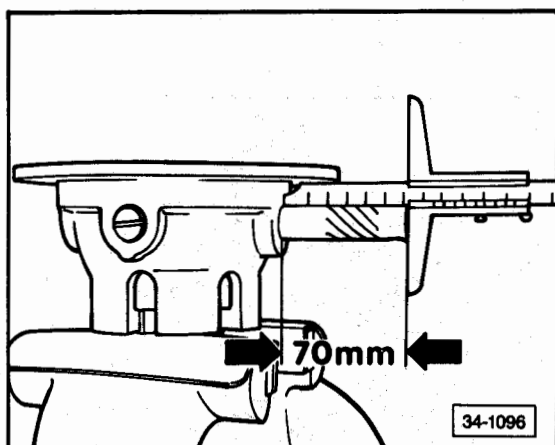


**Fig. 5 Differential bearing/inner race (housing side), removing**



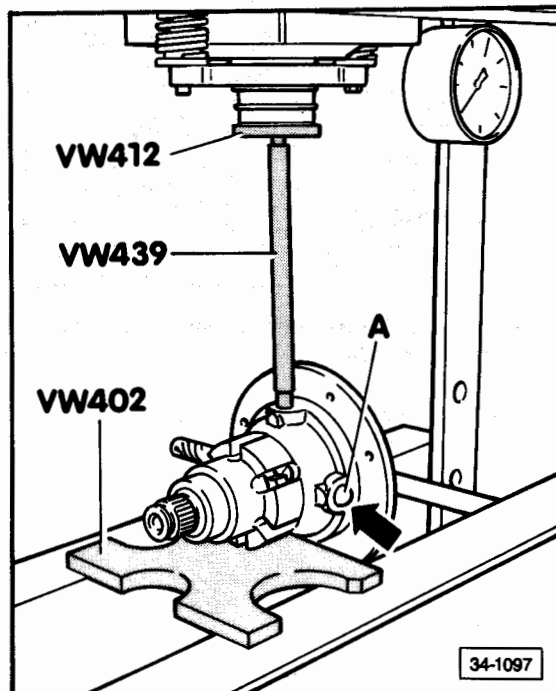
**Fig. 7 Differential pinion shafts (short), removing**

- insert greased ball **a** (17 mm diameter) into bore hose of spacer up to stop and secure
- press on axle



**Fig. 6 Differential pinion shaft (long), removing**

- drive out shaft until it projects 70 mm on one side



**Fig. 8 Differential pinion shafts, installing**

- align short shafts with slots parallel to flange
- drive in all shafts until thrust washers and differential pinions can be positioned
- install spacer with large bore hole **A** facing long shaft
- drive in long shaft until it matches pin hole

# 39 Differential – Manual Transmission

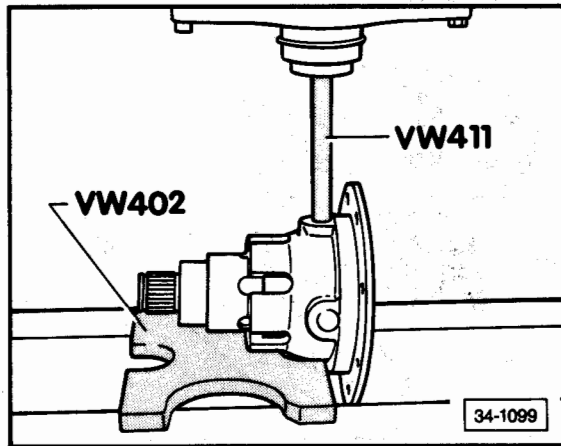


Fig. 9 Shafts, installing

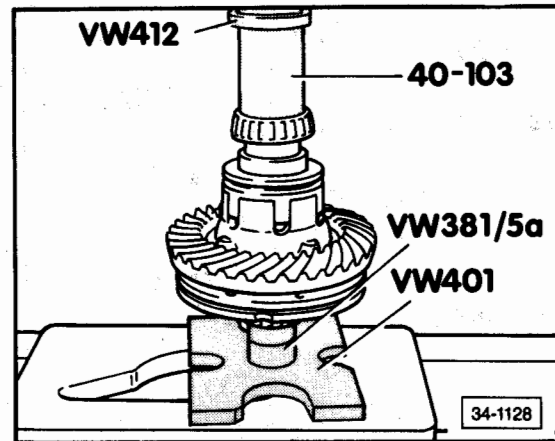


Fig. 11 Differential bearing/Inner race (housing side), installing

— heat to approximately 100°C (212°F) and press on

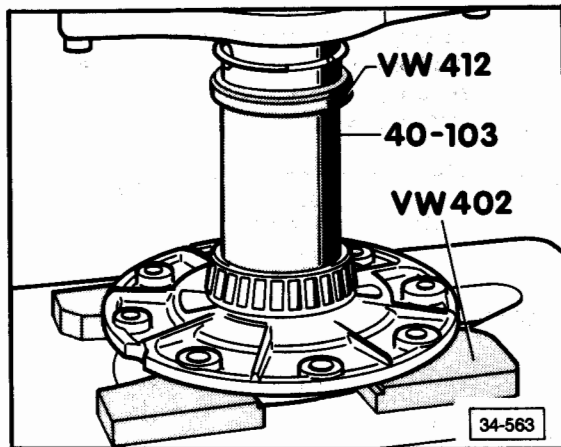


Fig. 10 Differential bearing/Inner race (ring gear side), installing

— heat to approximately 100°C (212°F) and press on

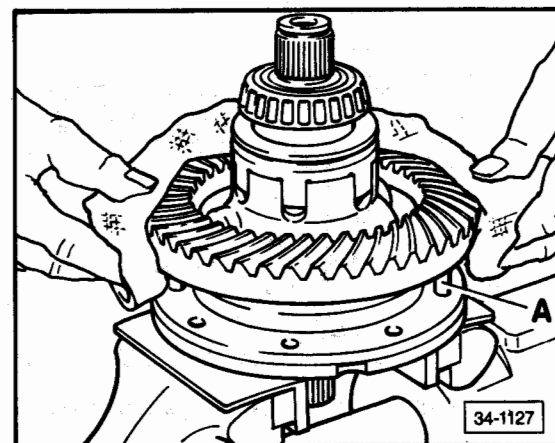


Fig. 12 Ring gear, installing

### CAUTION

Clean contact surfaces are essential to ensure that ring gear, differential housing and cover fit properly. Remove all burrs and pressure marks with oil stone.

— heat ring gear to approximately 100°C (212°F) and install

A = centering pins (fabricate)

### Note

If ring gear/pinion are replaced, readjustment is necessary.

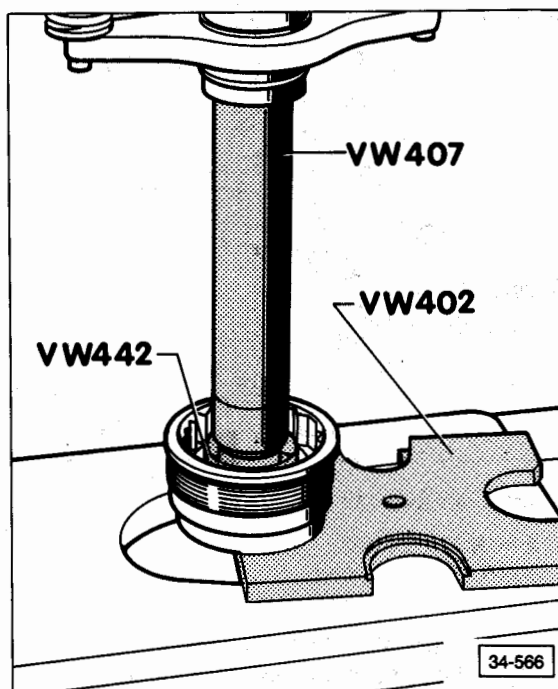


Fig. 13 Differential bearing/outer race, removing

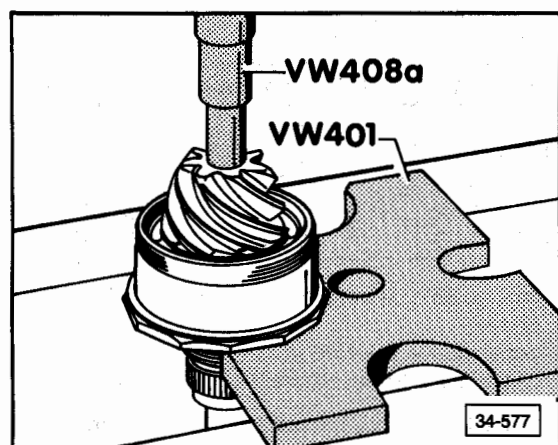


Fig. 14 Differential bearing/outer race, installing

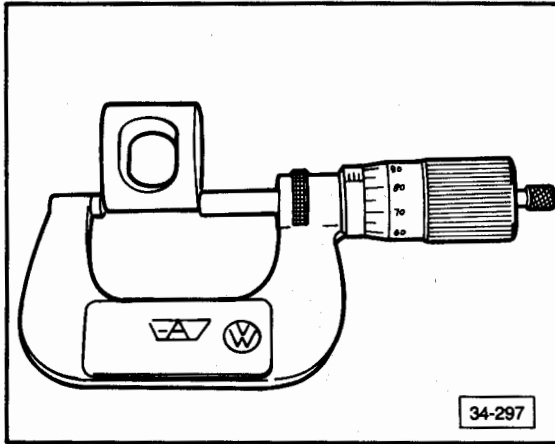
— press race in until seated

# 39 Differential – Manual Transmission

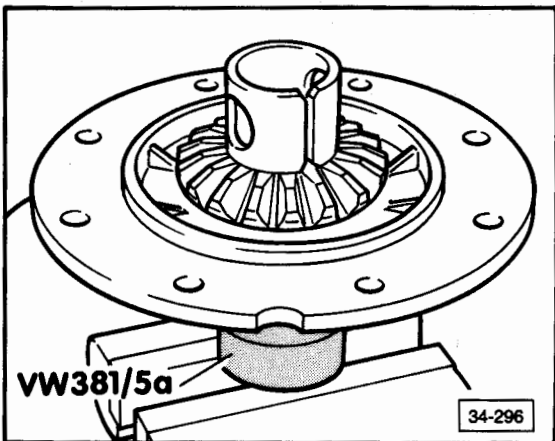
## Differential pinion/side gears, adjusting end play

### Note

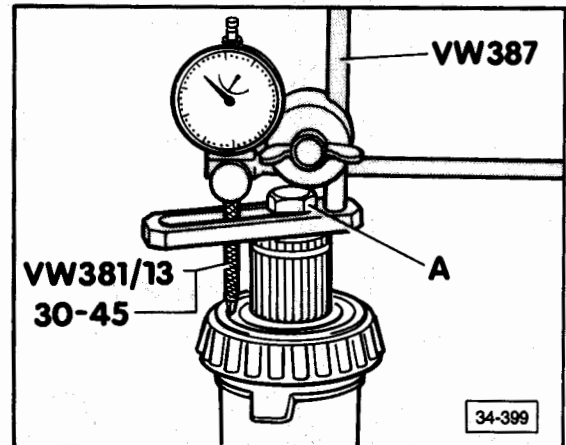
The spacer sleeve ensures adequate backlash between side gears and differential pinion gears even when there is axial pressure on the side gears. If differential housing, cover or spacer sleeve is replaced, the size of the spacer sleeve must be redetermined.



- measure shortest spacer sleeve, Part No. 002 517 241, with a micrometer
- mark dimension on sleeve with electric marker or similar device
- this sleeve should always be used as a measuring device



- place side gear (with short shaft) and both thrust washers in cover
- attach clamping sleeve VW 381/5a and clamp gear tightly against cover
- place side gear (with long shaft) in differential housing
- insert measuring sleeve, bolt housing and cover together with four M8 x 20 bolts



- install dial indicator with 3 mm range

A = M10 x 25 bolt  
 30-45 = 76 mm long  
 VW 381/13 = 52 mm long

- zero dial indicator with 2 mm preload
- find end play by moving side gear up and down
- add measured play and length of measuring sleeve together
- find this figure in the table below under **x range** and select proper sleeve

x range	Sleeve length mm	Part No.
31.87-31.95	31.84	002 517 241
31.96-32.04	31.93	002 517 242
32.05-32.13	32.02	002 517 243
32.14-32.22	32.11	002 517 244
32.23-32.33	32.20	002 517 245

- disassemble differential and remove measuring sleeve
- install sleeve selected from table and assemble differential **without** differential pinion shaft
- recheck play, play should be 0.03-0.17 mm



## Ring gear/pinion, adjusting

Pinion removed

### Note

Ring gear/pinion must **always** be replaced as a matched set, never individually.

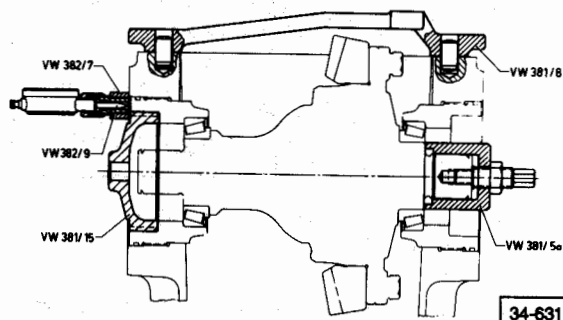
Adjustment of ring gear is required if any of the following are replaced:

Adjusting rings  
Transmission housing  
Differential cover  
Differential bearings  
Differential housing  
Ring gear/pinion

## Screw-in depth, determining

### CAUTION

Differential bearing outer races must be fully seated in adjusting rings



- install differential with ring gear into housing (ring gear lies on left side)
- install dial indicator (3 mm range) with extension VW 382/9 (18 mm long) into bar VW 382/7
- zero gauge with 3 mm preload
- turn in adjusting ring on ring gear side with VW 381/14 until upper edge is approximately 0.20 mm below surface of housing
- turn in adjusting ring on other side with VW 381/15 until differential is free of play and without preload
- attach VW 381/5a to ring gear side and lock with hex nut
- turn transmission housing until differential is at top and attach bridge VW 381/8 on dowel pins

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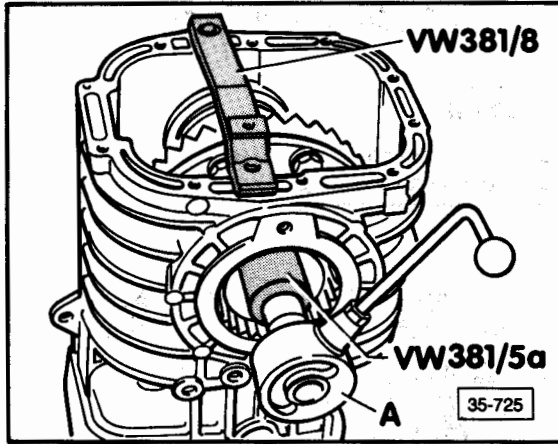
no.

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# 39 Differential – Manual Transmission



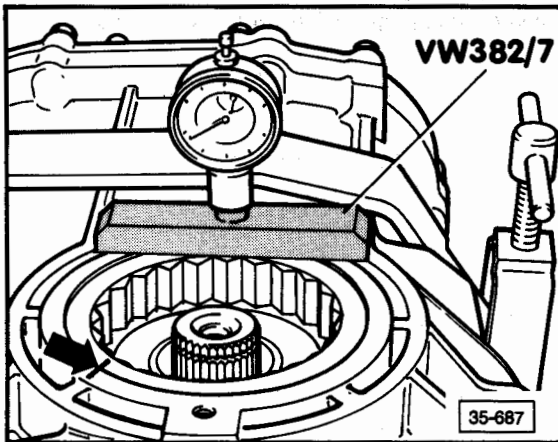
A = Commercial torque wrench, 0-600 Ncm  
(0-54 in. lb)

- insert torque wrench with socket wrench (19 mm)
- turn differential in both directions while oiling bearings with transmission oil
- increase bearing preload slowly by turning in adjusting ring on side opposite ring gear with VW 381/15 while turning differential until specified turning torque is reached

### Turning torque

New bearings	Used bearings*
300-350 Ncm (27-31 in. lb)	30-70 Ncm (2.7-6.2 in. lb)

\*after running at least 30 miles



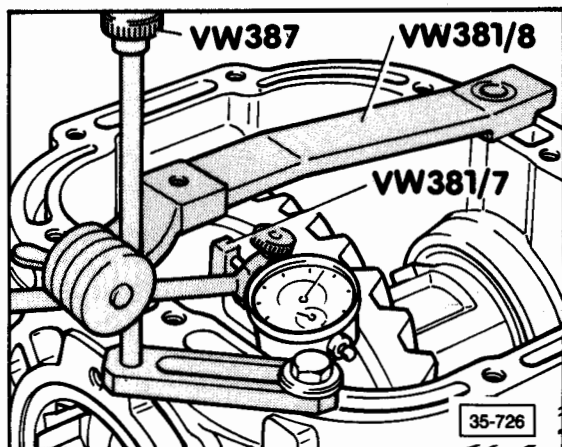
- measure screw-in depth of adjusting rings and note readings S1 and S2
- mark adjusting rings and do not interchange (arrow)

### Note

If ring gear is being readjusted, check pinion adjustment, see page 39.25

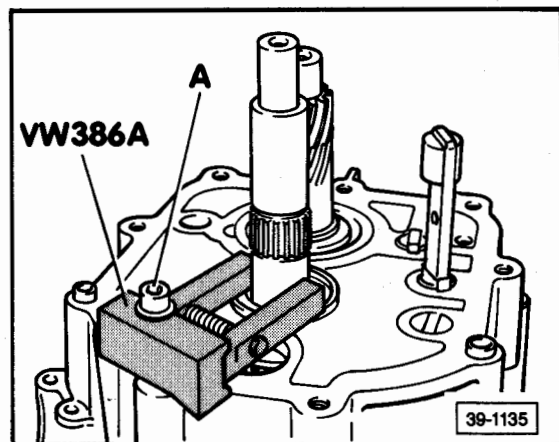
### Backlash, adjusting

- install pinion with shim S3
- install differential with adjusting rings on correct sides
- attach bridge VW 381/8
- turn in adjusting rings while turning differential until measured screw-in depth S1 and S2 have been reached



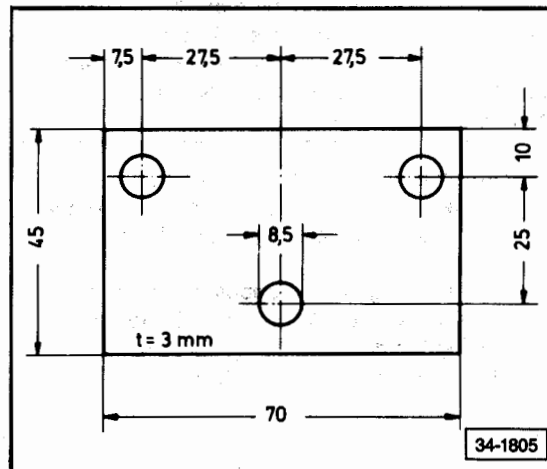
- attach measuring tools as shown
- press in bridge VW 381/7 on two plate screws up to stop

## Locking pinion, standard transmission

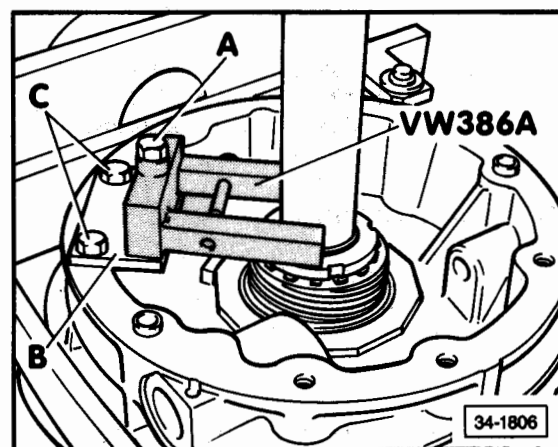


- lock pinion with clamp
- A = M8 x 125 bolt

## Locking pinion, front final drive



- attach special tool 386/A to final drive housing (manufacture a retaining plate from 3 mm thick sheet metal plate)



- lock pinion with clamp
- A = M8 x 60 bolt with M8 nut
- B = Self manufactured retaining plate
- C = M8 x 20 bolts
- turn ring gear to stop and set dial indicator to zero
- turn ring gear in opposite direction and read backlash
- note values
- remove bridge
- check backlash 3 more times, 1/4 turn apart each time

# 39 Differential – Manual Transmission

## CAUTION

If backlash readings vary by more than 0.06 mm from one to another, there is something wrong with installation of ring gear or the gear set itself. Check all assembling operations and replace gear set if necessary.

- to adjust backlash, proceed as follows
- turn **out** adjusting ring on side opposite ring gear
- turn **In** adjusting ring on ring gear side by the same amount
- readjust adjusting ring on opposite side of ring gear one more time after screwing in adjusting ring behind the ring gear
  - keep within tolerance of  $\pm 0.01$  mm

## Note

**S1 + S2** must always equal **S total** to insure that ring gear preload is not changed.

- continue adjusting until backlash is 0.15-0.25 mm (0.006-0.010 in.)

## Note

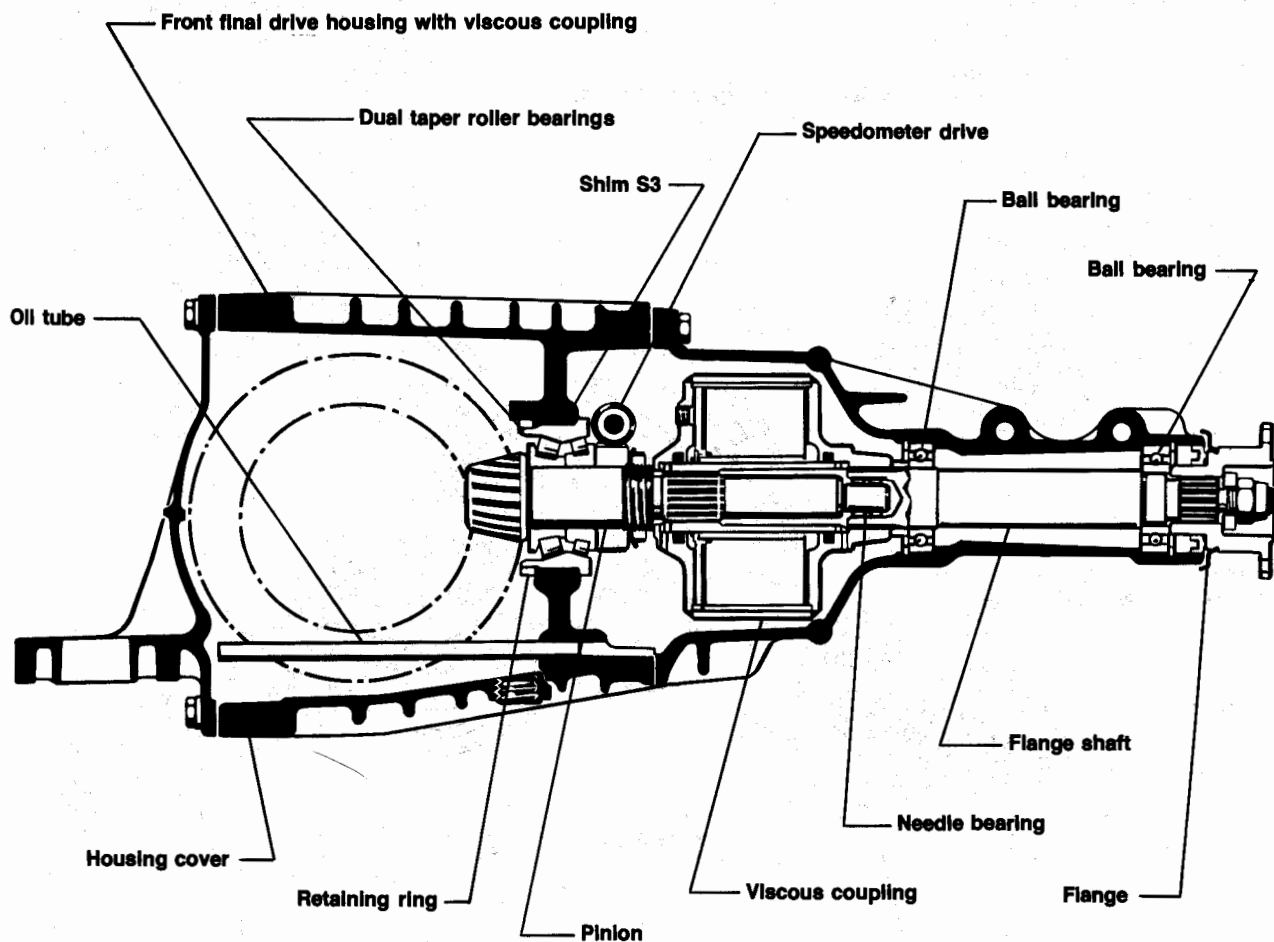
To obtain the required backlash quickly, the determined backlash minus 0.20 mm (0.008 in.) can be used for the first adjustment of the adjusting rings.

## Backlash, checking

- check backlash each 1/4 turn
  - backlash should be 0.15-0.25 mm (0.006-0.010 in.)

## Note

Individual readings must not differ by more than 0.05 mm.

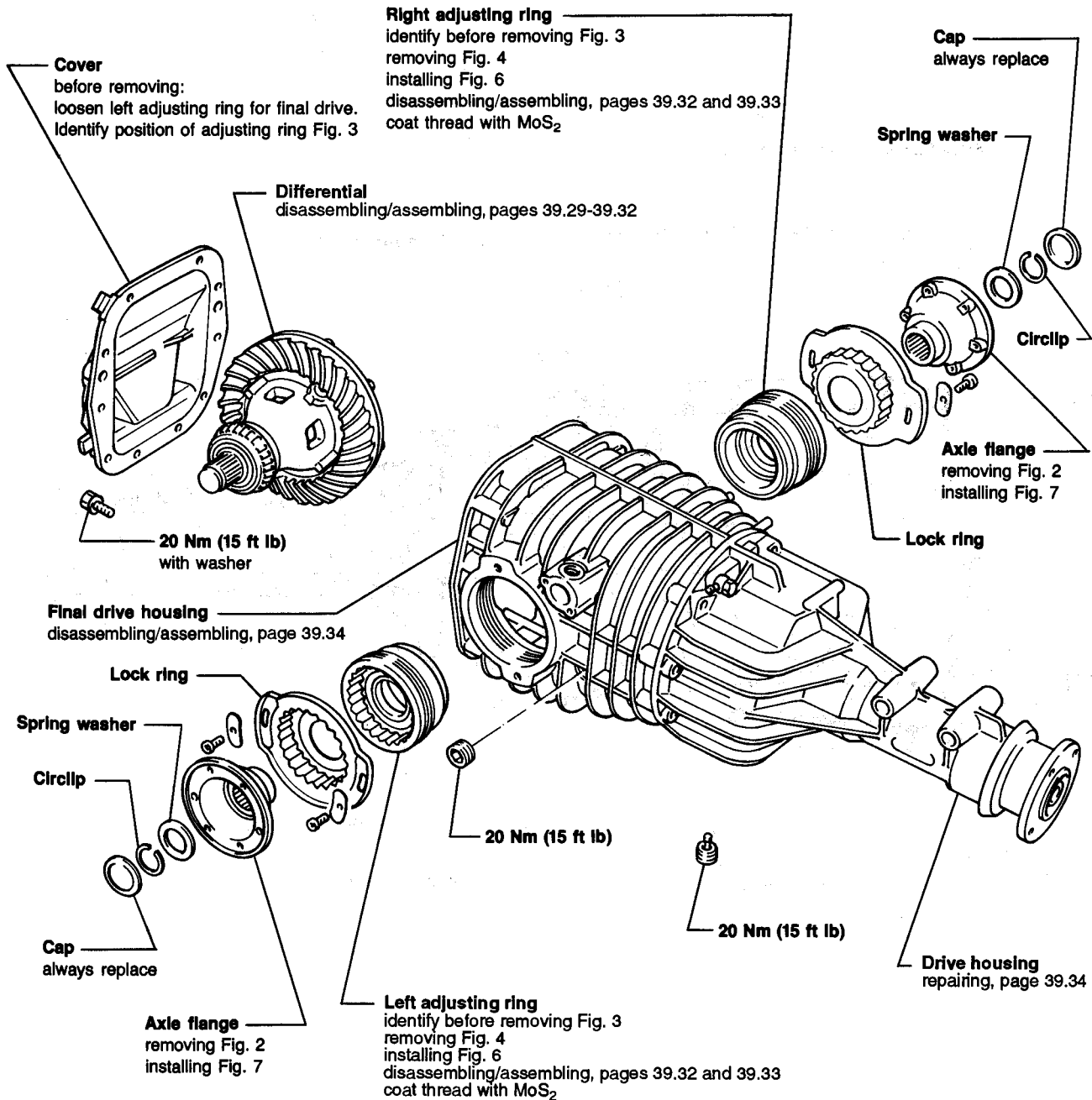


39-1168

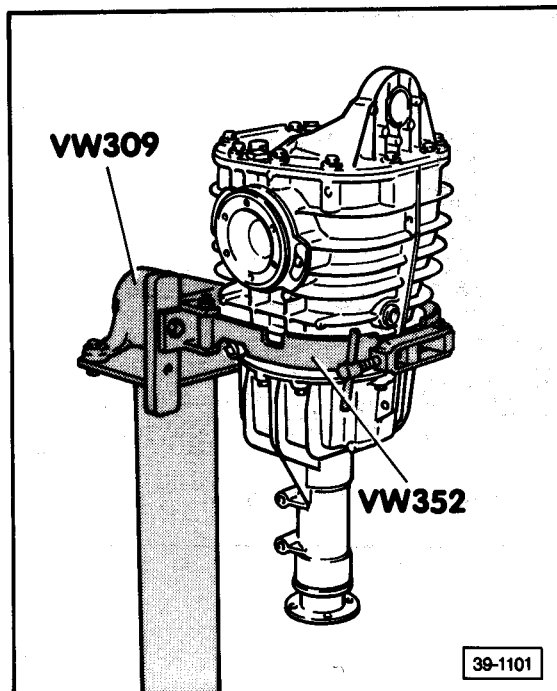
# 39 Differential – Manual Transmission

## Note

Before disassembling, mount to repair stand (Fig. 1) and drain transmission oil.

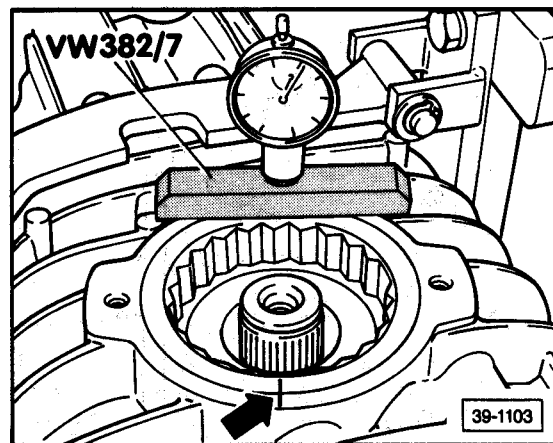


39-1169



**Fig. 1 Final drive, mounting**

— clamp final drive in repair stand

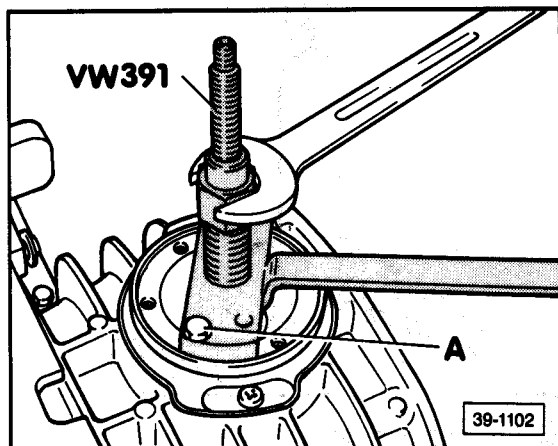


**Fig. 3 Adjusting ring position, determining**

**Note**

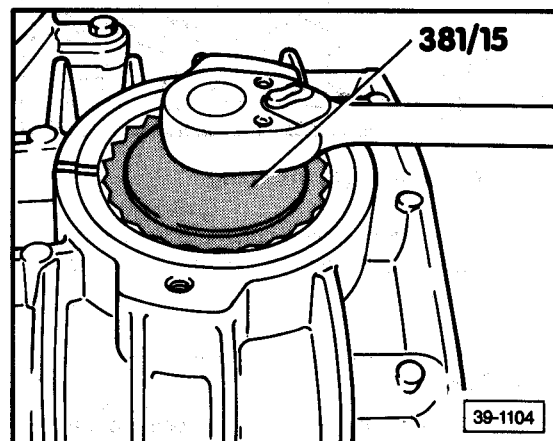
For differential assemblies which do not need readjustment, the adjusting rings position in relation to the transmission housing must be identified with a marked tool (arrow)

- measure screw-in depth with VW 382/7
- note values
- mark left side (ring gear side) with 1 scratch
- mark right side with 2 scratches



**Fig. 2 Axle flange, removing**

A = 2 M8 x 30 hex bolts through slots in joint flange



**Fig. 4 Adjusting rings, removing**

# 39 Differential – Manual Transmission

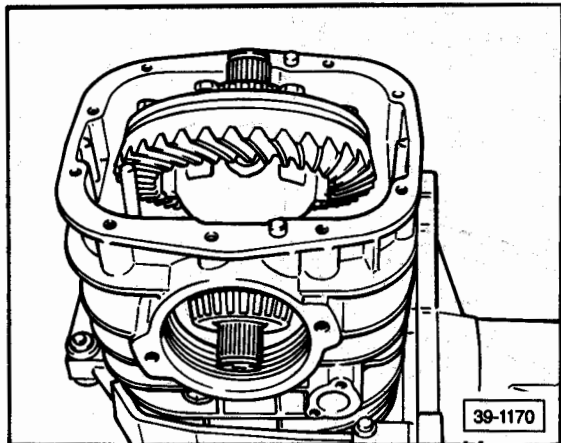


Fig. 5 Differential, removing

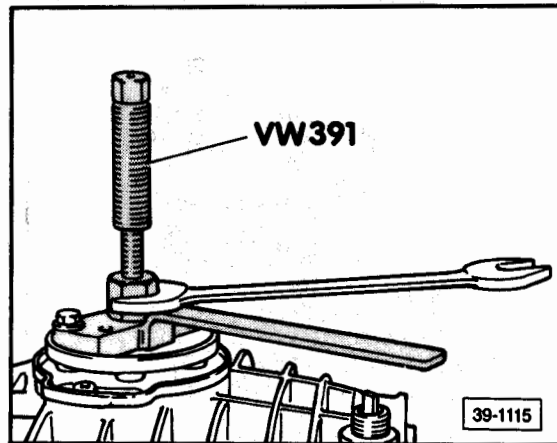


Fig. 7 Axle flange, tightening

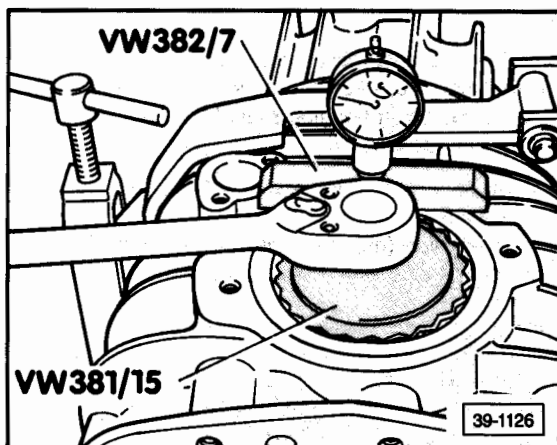


Fig. 6 Adjusting rings, installing

- screw adjustment rings into transmission housing to scratch mark and measure depth

## CAUTION

Tighten left adjusting ring first if housing cover is installed and bolted into place.

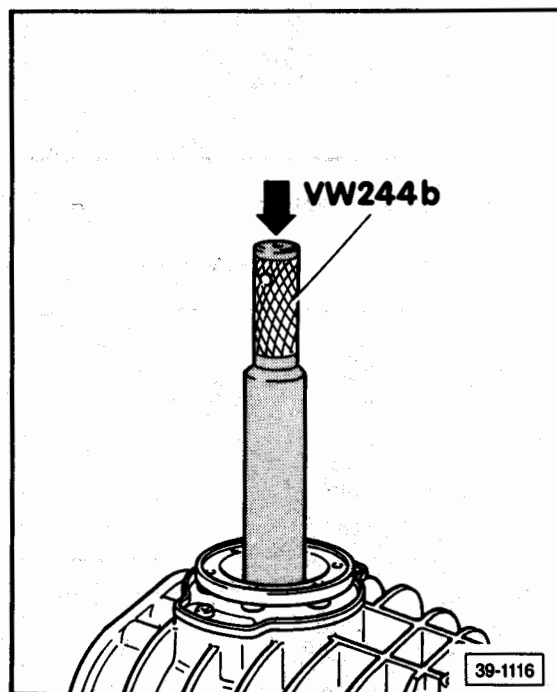
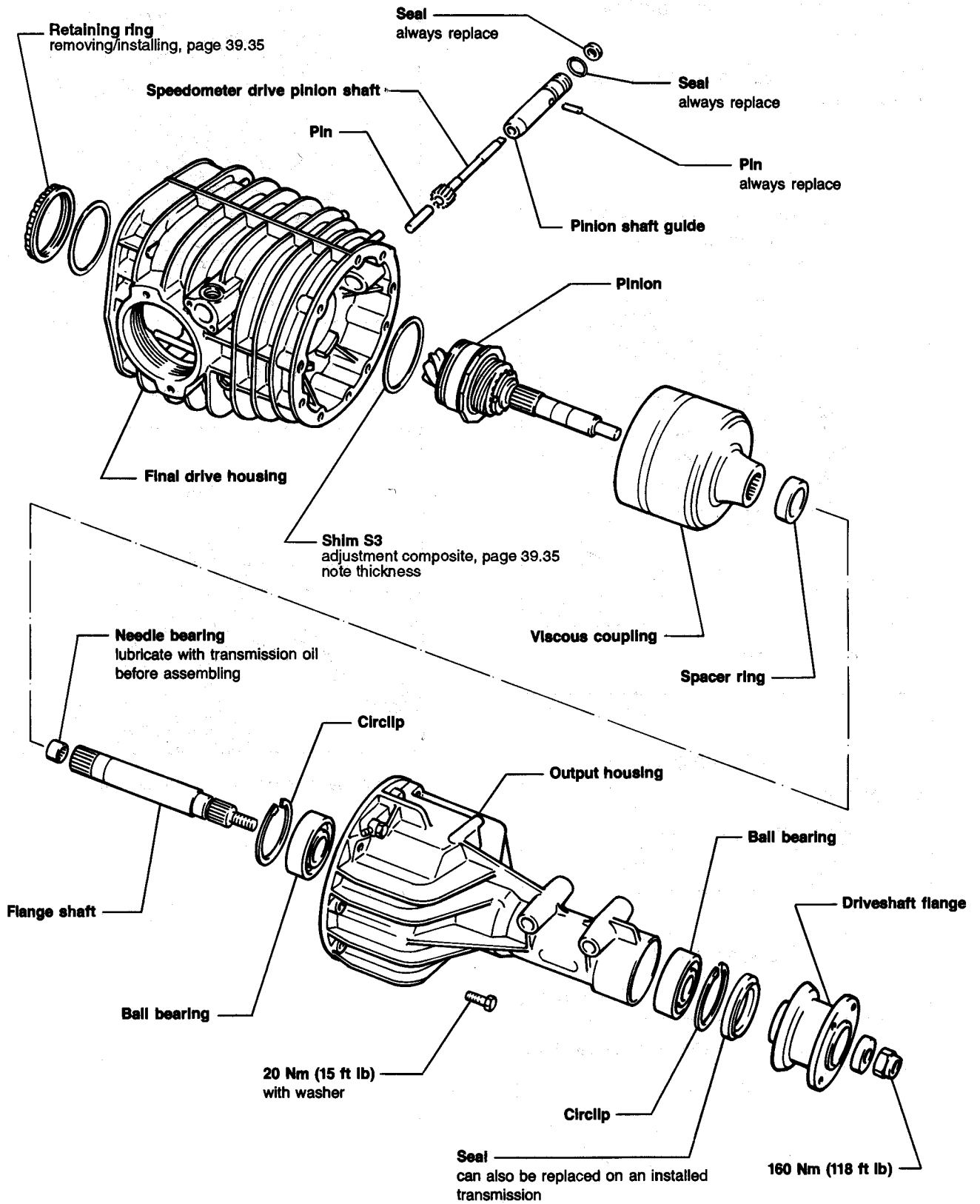


Fig. 8 Circlip, installing

- position spring washer and circlip
- press circlip into groove
- watch for central fit of spring washer





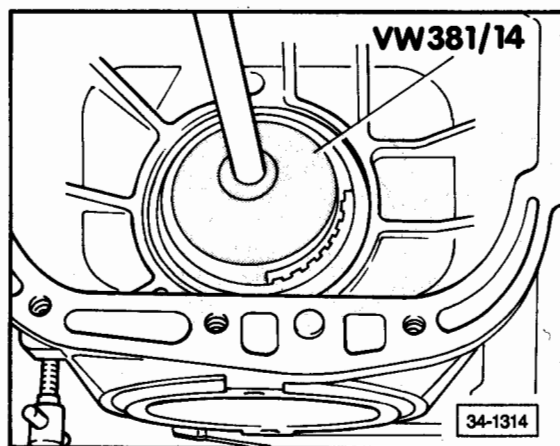
# 39 Differential – Manual Transmission

## Front final drive, disassembling/ assembling

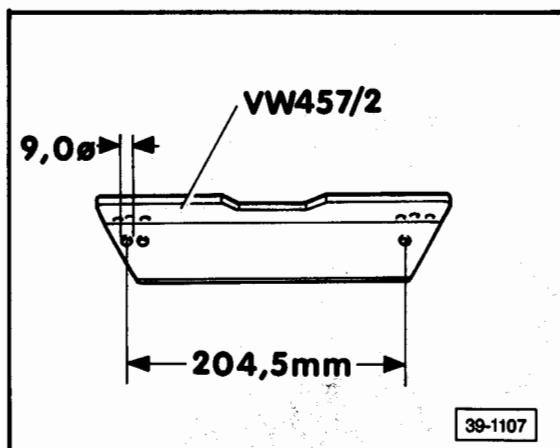
## Final drive housing, disassembling/ assembling

### Disassembling

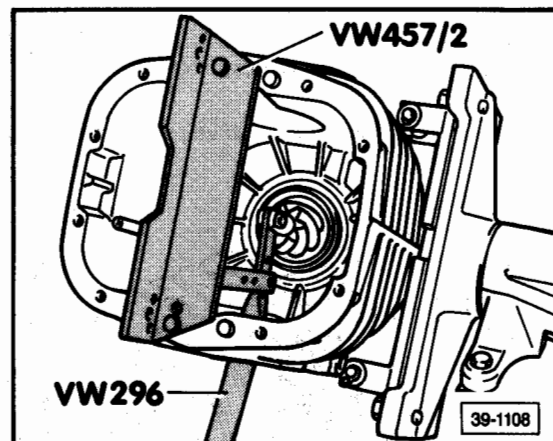
- remove output housing bolts
- remove housing
- remove spacer ring and viscous coupling
- drive out pin for speedometer drive
- pull out speedometer drive



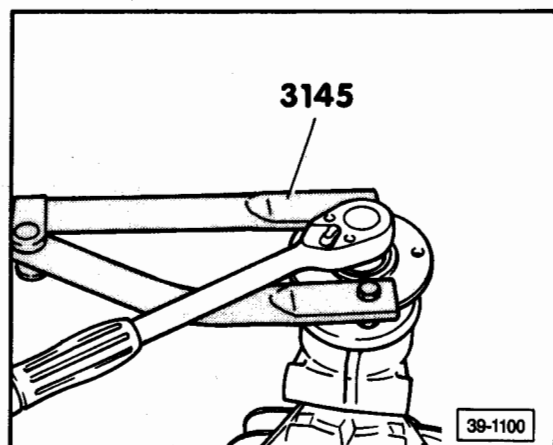
- remove retaining ring



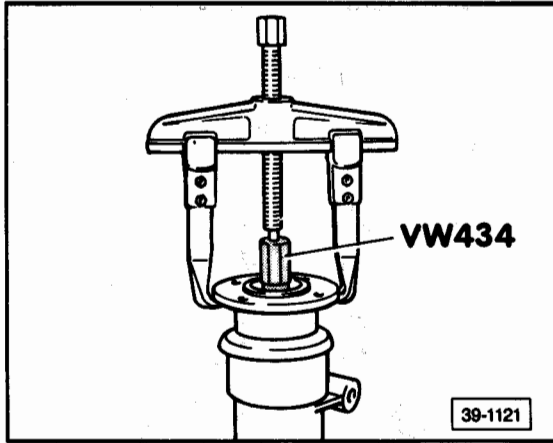
- drill an additional 9.0 mm (0.35 in.) diameter hole in bracket VW 457/2



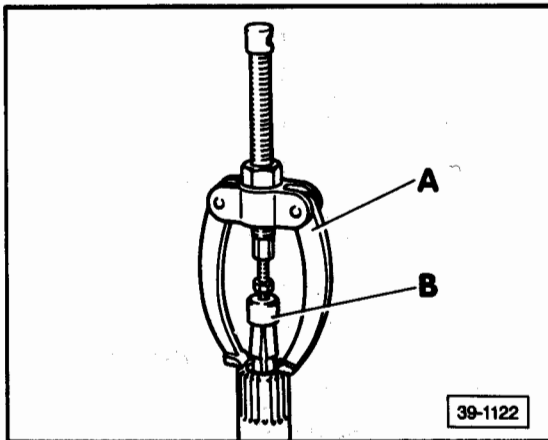
- push out pinion
- fasten VW 457 with two M8 x 20 bolts
- remove shim S3 and note thickness



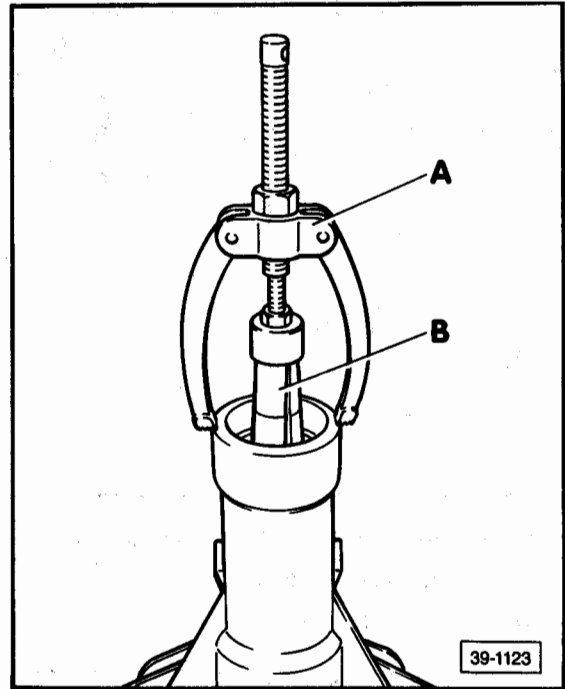
- mount support to flange and remove hex nut



- remove flange, use two-armed extractor if necessary
- remove flange shaft



- remove needle bearing from flange shaft
- A — Puller, e.g. Kukko 22-1
- B — Inner extractor 12 — 14.5 mm, e.g. Kukko 21/1
- pry seal out from cover
- remove seals for outer and inner ball bearing

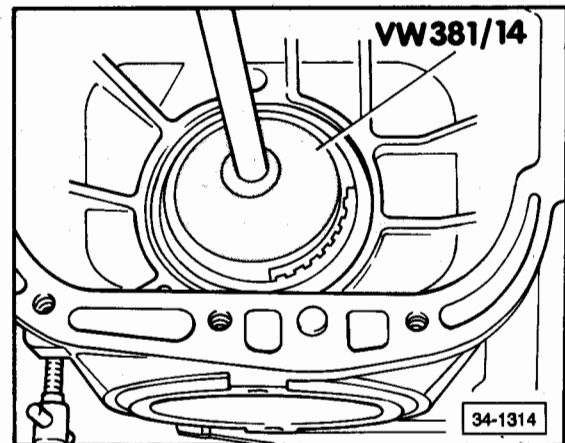


- remove both ball bearings
- A — Puller, e.g. 22-2
- B — Inner extractor, 30-37 mm, e.g. Kukko 21/5

### Assembling

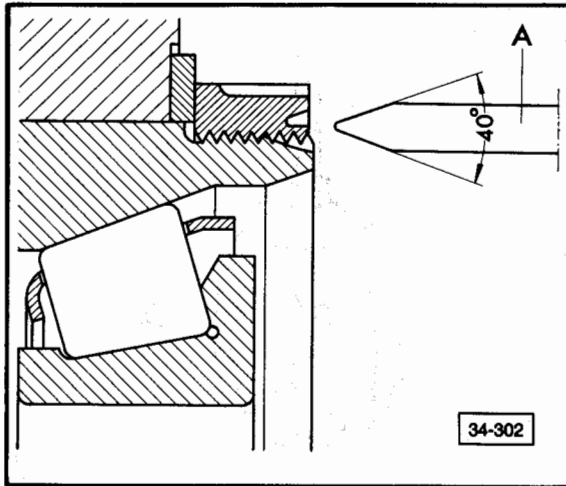
Before assembling:

- position shim S3
- place 12 point of dual bearing on opening in housing
- heat pinion housing at dual bearing seat to 40-60°C (130-166°F)
- drive pinion in using a plastic hammer
- position washer and install retaining ring

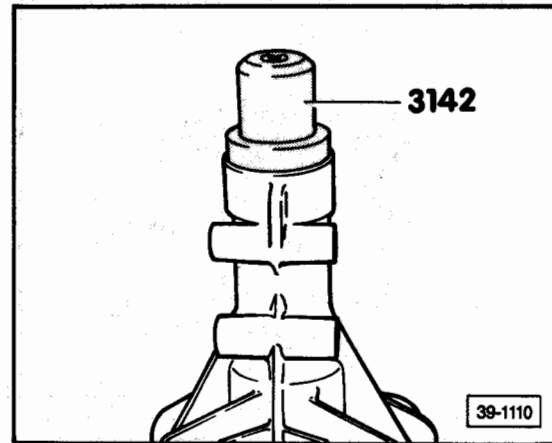


- tighten retaining ring to 225 Nm (166 ft lb)
- loosen retaining ring and retighten to 225 Nm (166 ft lb)

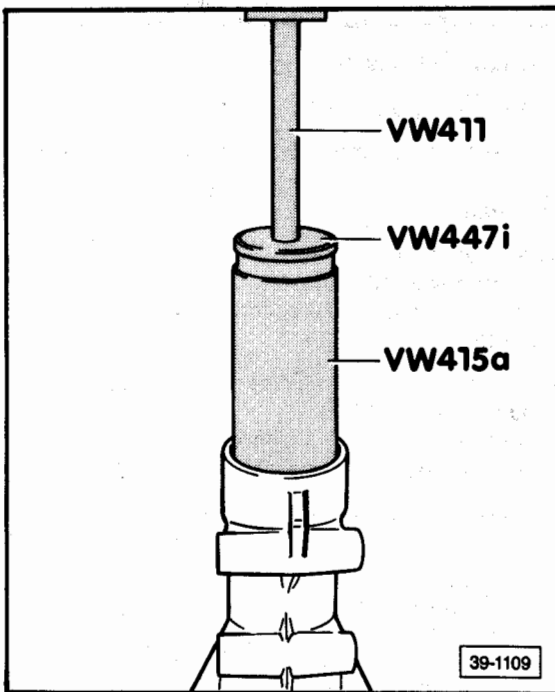
# 39 Differential – Manual Transmission



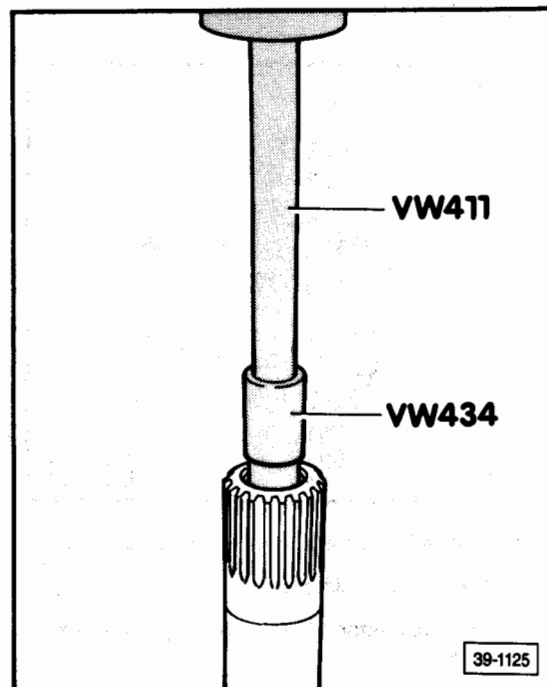
- secure retaining ring by staking in two places
- A** — fabricated staking tool
- install speedometer drive



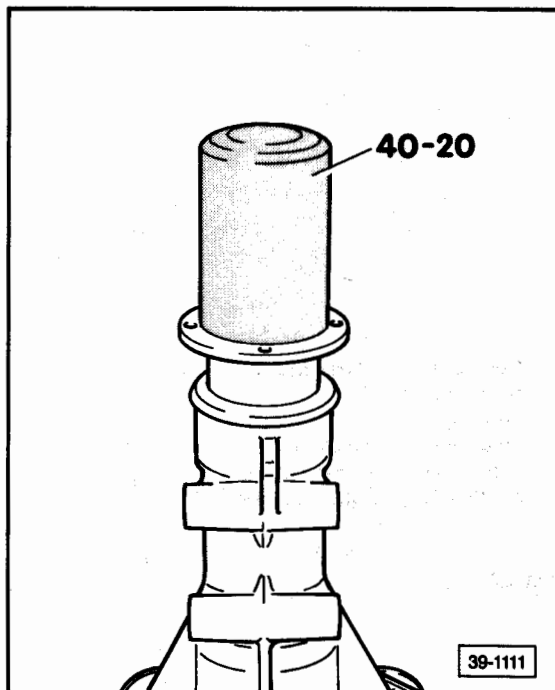
- drive seal in to stop



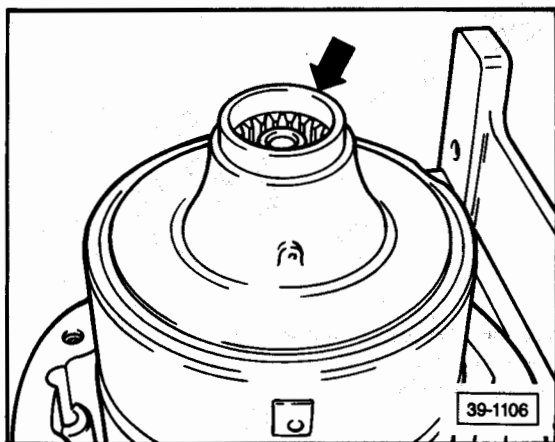
- push both ball bearings up to stop in back cover
- install circlips



- press in flange shaft needle bearings
- install flange shaft into output housing

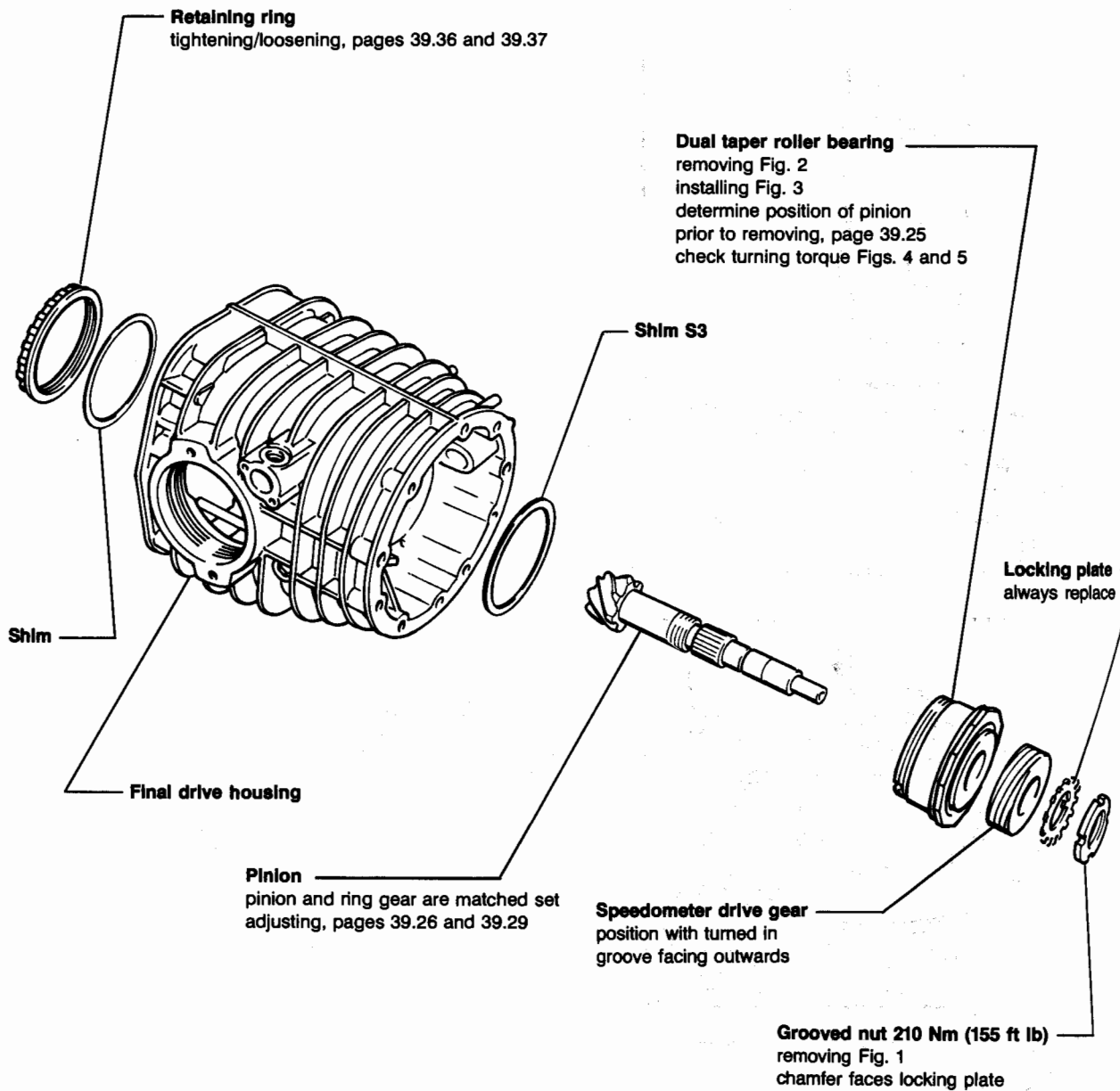


- push on driveshaft flange
- insert washer
- mount puller and tighten hex nut to 160 Nm (118 ft lb)
- position viscous coupling on pinion

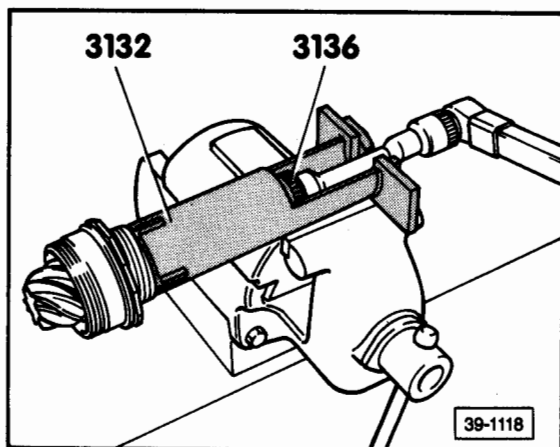


- coat spacer ring with grease and align on viscous coupling
- position output housing and tighten

# 39 Differential – Manual Transmission



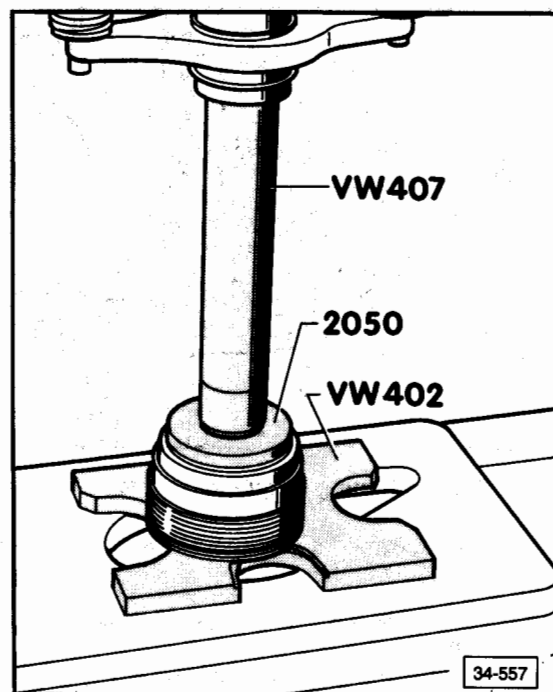
39-1172



**Fig. 1 Grooved nut, removing/installing**

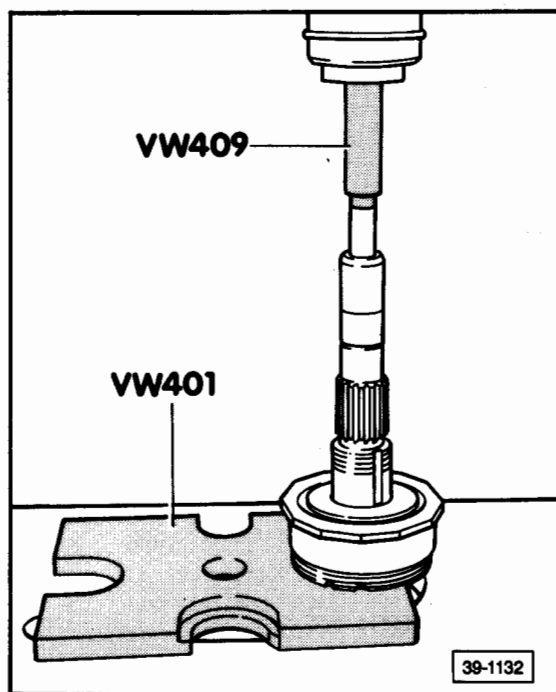
(at final drive with viscous coupling)

- install and tighten grooved nut to 210 Nm (155 ft lb)
- check turning torque of bearing



**Fig. 3 Bearing, installing**

- heat inner rings to approximately 100°C (212°F)
- position and press in



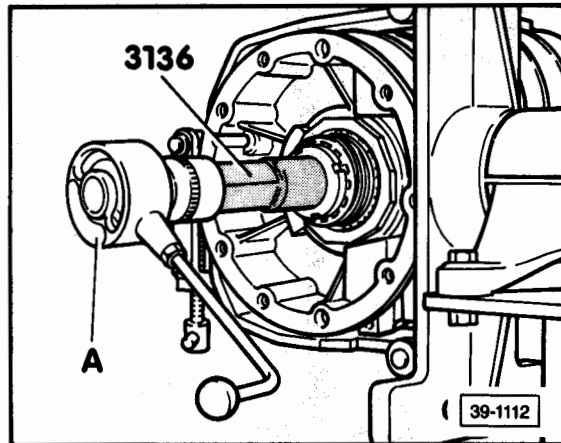
**Fig. 2 Bearing, removing**

g plate  
replace



39-1172

# 39 Differential – Manual Transmission



**Fig. 4 Bearing turning torque, checking**

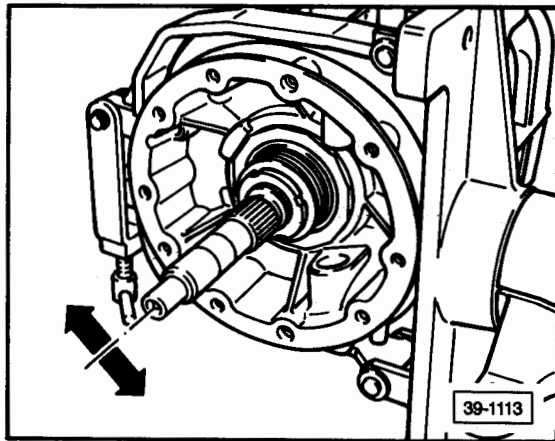
**A** — Commercial gauge, 0-600 Ncm  
(0-54 in. lb)

- lubricate bearing with hypoid transmission oil
- tighten retaining ring as specified
- rotate pinion in both directions 15-20 times without interruption
- rotate again and read turning torque

## Turning torques

New bearings	Used bearings*
to 210 Ncm (19 in. lb)	to 70 Ncm (6.2 in. lb)

\*after running at least 30 miles



**Fig. 5 End play, checking**

- if turning torque equals zero, check pinion shaft bearing for end play
- if any end play is felt, replace bearing



## Technical data

- code letters
- application
- gear ratios

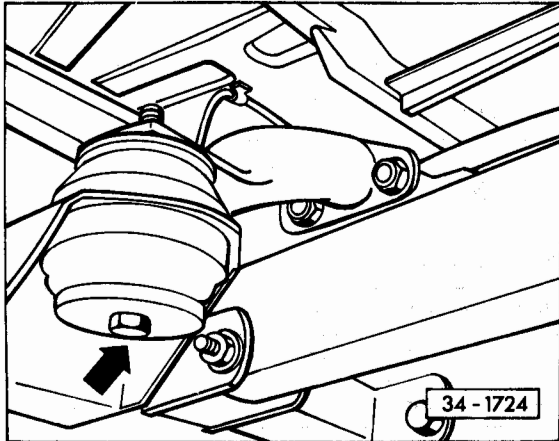
<b>Front final drive code letters</b>	ACU	
<b>date of manufacture from to</b>	10/85	
<b>Application</b> vehicle engine manual transmission	Vanagon Syncro	
	2.1 Liter 70 kw (95 bhp SAE net)	
	AAK	AAN
<b>Ratio</b>	34 : 7 = 4.86	
<b>Capacity</b>	1.6 US qt (1.5 Liters)	
<b>Lubricant specification</b>	Gear oil GL-4 SAE 80	
<b>Axle shaft flange</b>	100 mm	

# 39 Differential – Manual Transmission

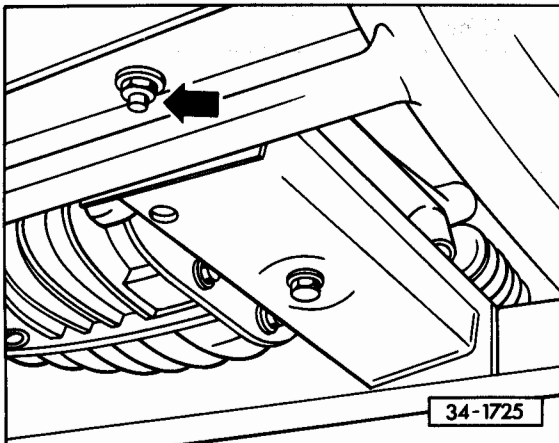
## Driveshaft, removing/installing

### Work sequence

#### Removing



- loosen mounting bolt of front final drive (arrow) Do **NOT** remove bolt.



- loosen side bolts of front final drive mounting bracket (arrow) Do **NOT** remove bolts.

#### CAUTION

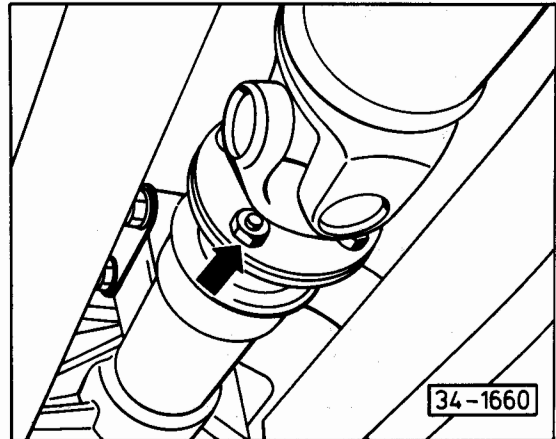
Front final drive mounts **MUST** be loosened to prevent damage to the driveshaft universal joints when removing driveshafts.

#### CAUTION

The installed position of the driveshaft must be noted for reinstallation. Vibrations due to incorrect installation can cause cracks in the transmission housing or engine block.

#### Note

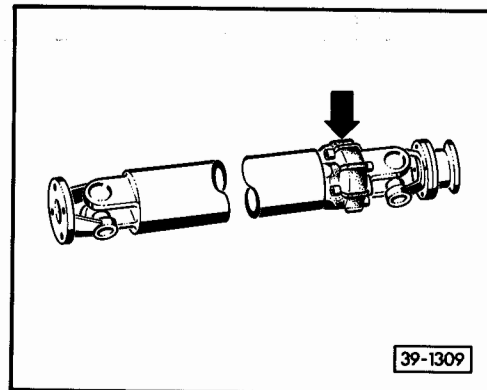
The universal joints cannot be replaced using standard workshop tools and are not available as replacement parts.



- remove bolts (arrow) at front and rear driveshaft flanges and remove driveshaft

#### Installing

- install driveshaft and tighten bolts to 35 Nm (26 ft lb)



#### Note

On vehicles with fuel injection and rubber damper on driveshaft (arrow), damper faces transmission.

- align front final drive in longitudinal direction and tighten mounting bolts

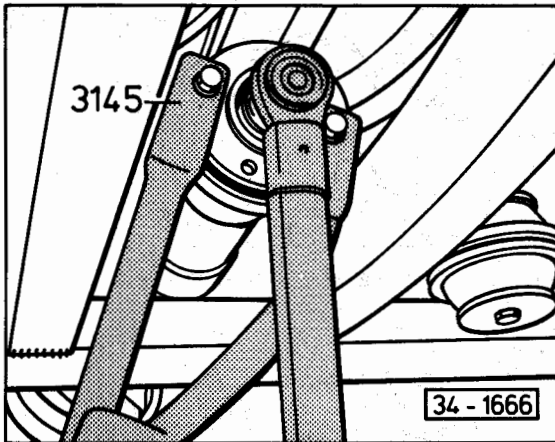
#### CAUTION

Front final drive alignment must be done to ensure driveshaft is installed without distortion.

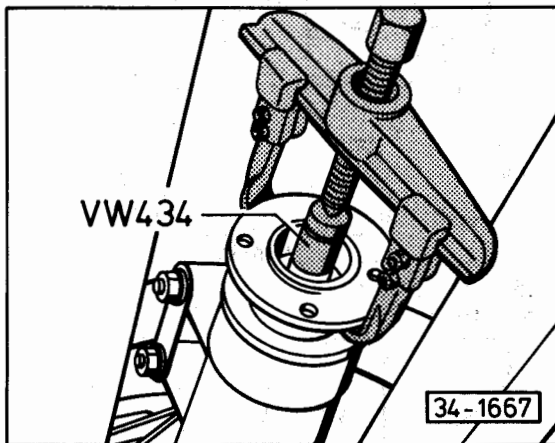
## Driveshaft flange oil seal, replacing (on front final drive or transmission)

### Work sequence

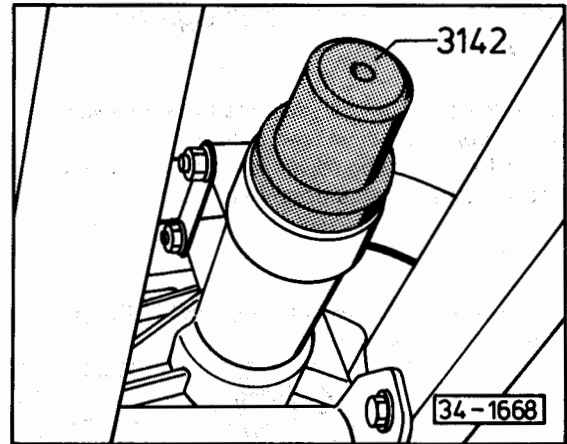
—remove driveshaft (see page 39.43)



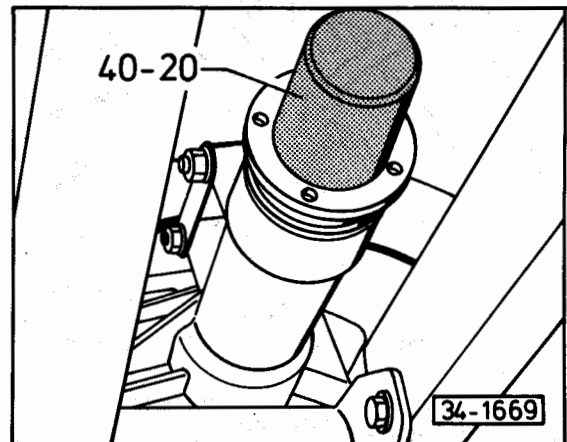
— mount handle on flange and remove flange shaft nut



— remove driveshaft flange. Use two-arm puller if necessary  
— remove oil seal with VW 681 or similar tool



— drive in new seal to stop



— drive in flange  
— mount handle 3145 and tighten flange shaft nut to 160 Nm (118 ft lb)  
— install driveshaft and tighten bolts to 35 Nm (26 ft lb)

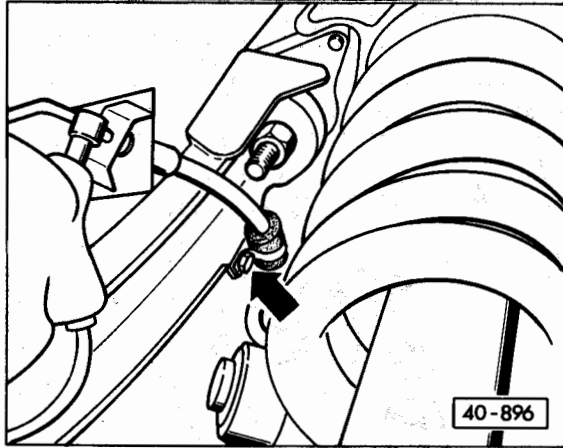
# 39 Differential – Manual Transmission

## Front final drive axle flange oil seals, replacing

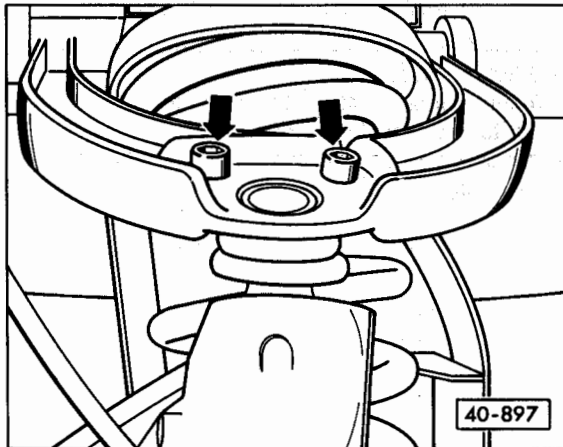
If both left and right oil seals are to be replaced, remove front final drive (see page 39.47).  
If the oil seal is to be replaced on one side only, remove suspension as described below.

### Work sequence

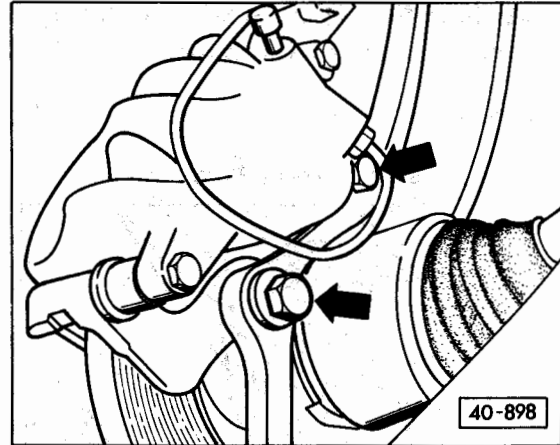
- remove bolts connecting axle shaft to flange
- remove spacer ring



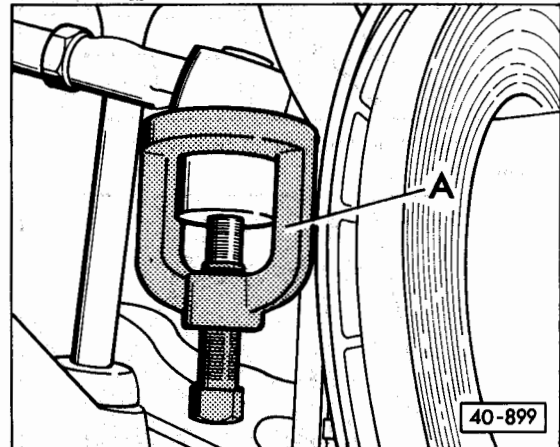
- remove brake line bracket from wheel bearing housing (arrow)



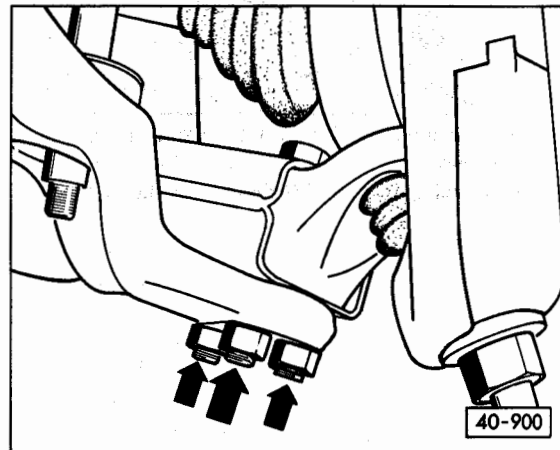
- remove ball joint from upper control arm by removing bolts (arrows)



- remove brake caliper (arrows) and tie to body with wire



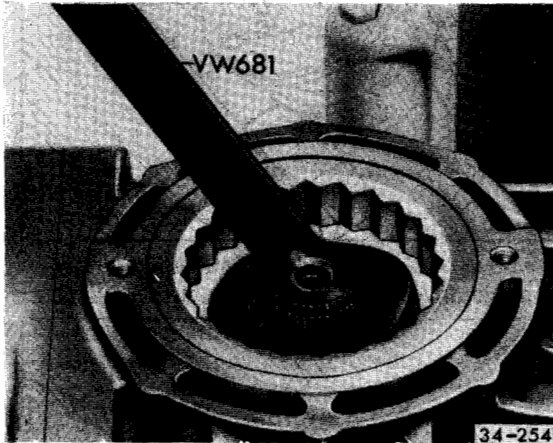
- press tie rod end out  
A = US 1014



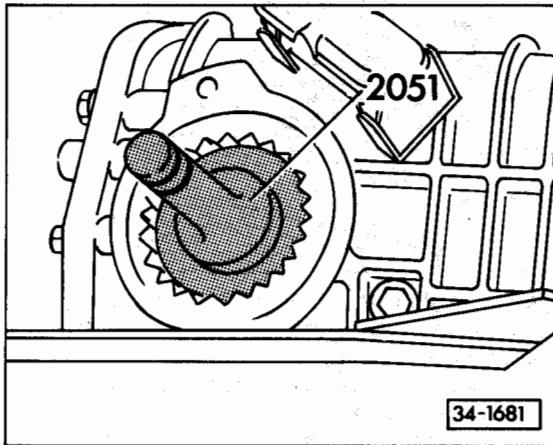
- remove bolts (arrows) and separate radius rod, wheel bearing housing and lower control arm

more

- remove wheel bearing housing complete with axle shaft
- pierce cap in drive flange with screwdriver and pry out
- remove circlip and wave washer
- remove drive flange with VW 391
- remove lock ring



- pry out oil seal



- drive in new oil seal to stop
- install lock ring
- install drive flange with VW 391
- install wave washer
- press circlip into groove with VW 454 and at same time check that washer is centered
- replace cap

- install wheel bearing housing with axle shaft
- install bolts for radius rod, wheel bearing housing and lower control arm

### CAUTION

Do not damage axle shaft boot.

- install tie rod, brake caliper and upper ball joint
- install brake hose bracket
- bolt axle shaft flange with spacer washer to drive flange

### Tightening torques

radius rod/wheel bearing housing on control arm	100 Nm (73 ft lb)
brake caliper to housing	240 Nm (177 ft lb)
wheel bolts	180 Nm (132 ft lb)
axle shaft to drive flange	35 Nm (26 ft lb)
ball joint to upper control arm	60 Nm (44 ft lb)



body



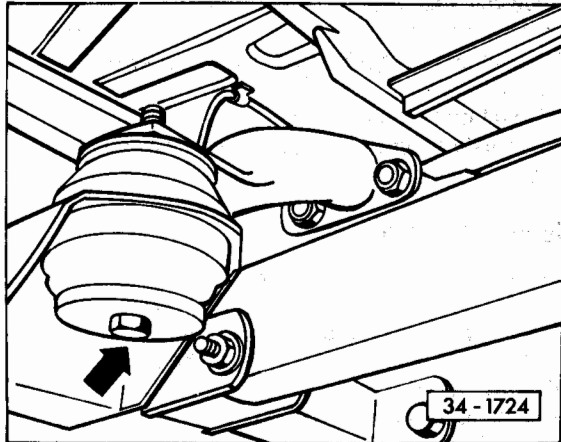
radius rod,  
control arm

# 39 Differential – Manual Transmission

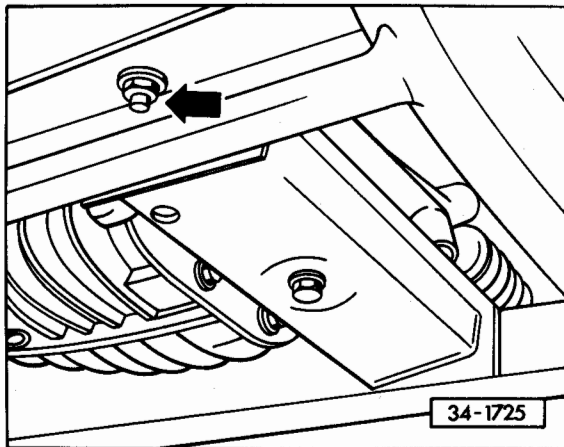
## Front final drive, removing/installing

### Work sequence

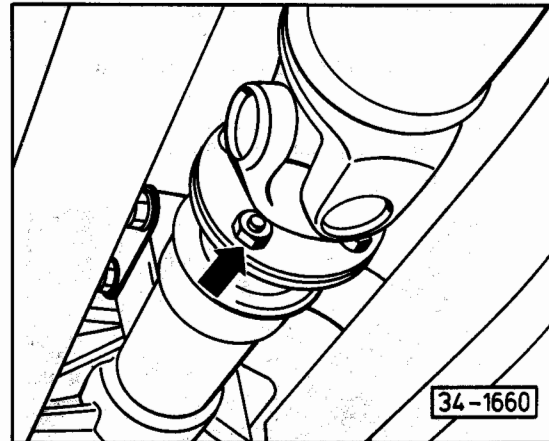
#### Removing



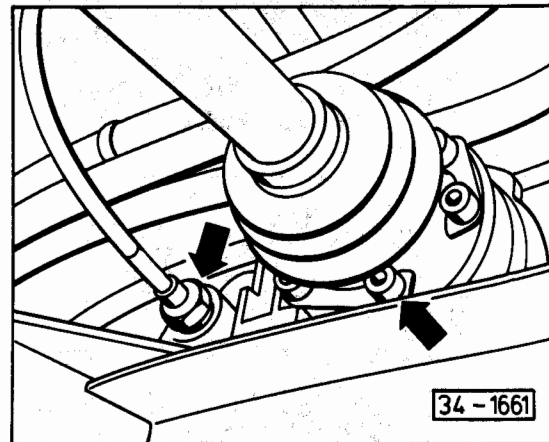
- loosen mounting bolt of front final drive (arrow). Do **NOT** remove bolt.



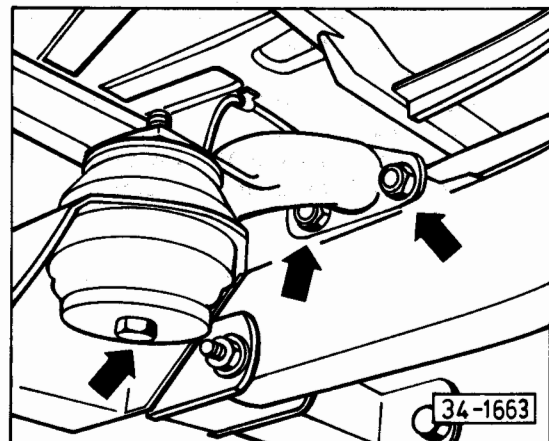
- loosen side bolts of front final drive mounting bracket (arrow). Do **NOT** remove bolts.



- remove bolts at front driveshaft flange (arrow) and tie driveshaft end to skid plate



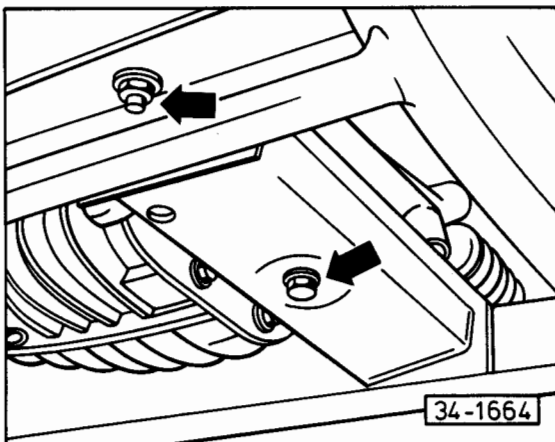
- remove right side axle shaft from final drive (right arrow) and disconnect speedometer cable (left arrow)
- remove left side axle shaft from final drive
- remove vent hose



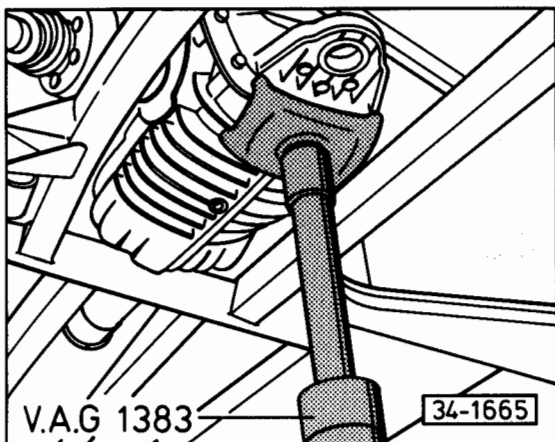
- remove rear mounting bracket (arrows)

more

- support final drive with transmission jack and small adapter



- remove bolts from front mounting (arrows) and take bracket out by pulling forward



- lower final drive and remove from vehicle (2 mechanics required)

### Installing

Proceed in reverse order of removal and note the following:

- tighten mounting bolts of front and rear brackets last

### Tightening torques

axle shaft to final drive	35 Nm (26 ft lb)
driveshaft to final drive	35 Nm (26 ft lb)

## Automatic Transmission Case, Gears, Shafts

### Index

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|---|---|--|



# 38 Automatic Transmission-Case, Gears, Shafts

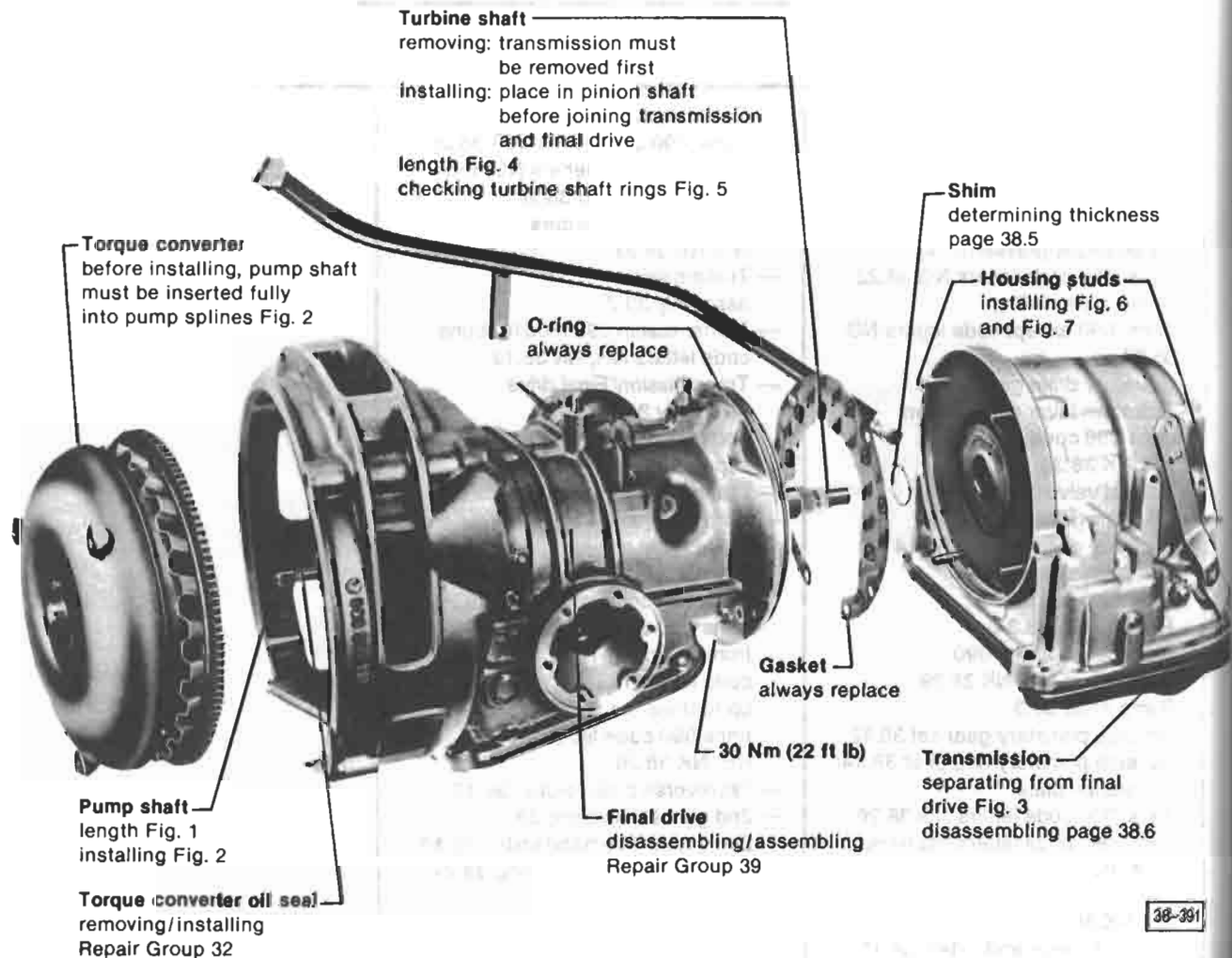
## Note

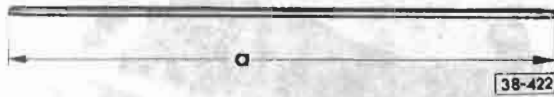
Final drive/transmission oil seal is installed in final drive, but sealing lip fits shoulder on governor drive gear in transmission.

If only oil seal is to be replaced, transmission should not be tilted when removing from final drive to avoid oil leakage and mixing

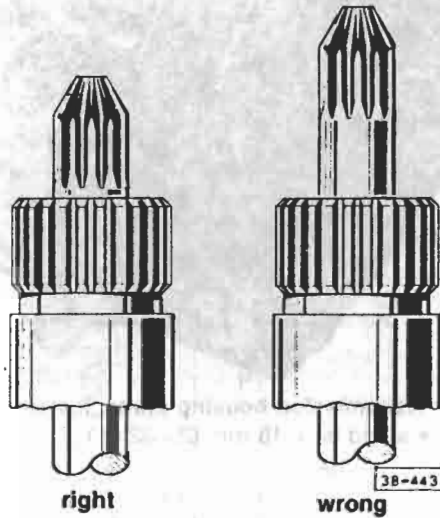
## CAUTION

When final drive or transmission are repaired, check transmission/final drive end play (see page 38.4)

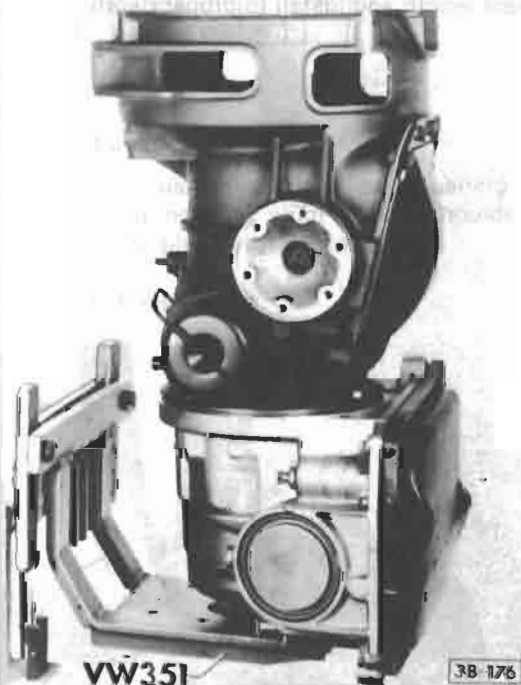




**Fig. 1 Pump shaft length**  
 • a = 546.7 mm (21.524 in.)



**Fig. 2 Pump shaft, inserting**



**Fig. 3 Transmission/Final drive, separating**

- mount transmission/final drive assembly as shown
- drain ATF

- remove final drive
- drain oil from final drive

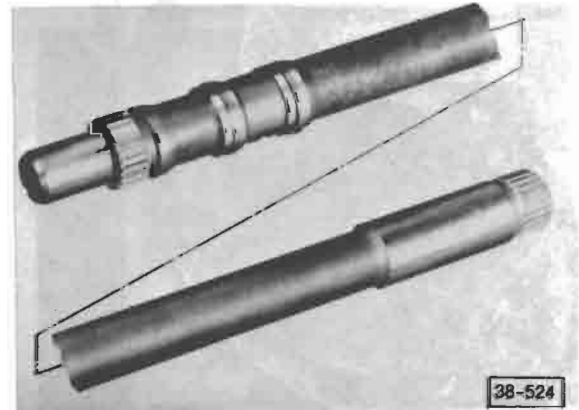


**Fig. 4 Turbine shaft, length**  
 • a = 457.8 mm (18.024 in.)



**Fig. 5 Turbine shaft rings, checking**

- check rings (arrows) for wear and proper seating



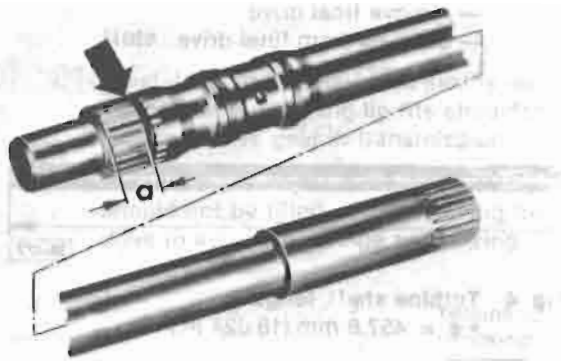
**Fig. 6 Turbine shaft, early version**

- turbine shaft for forward clutch with thrust washer

**Note**

Do not install together with thrust bearing

# 38 Automatic Transmission-Case, Gears, Shaft



**Fig. 7 Turbine shaft, later version**

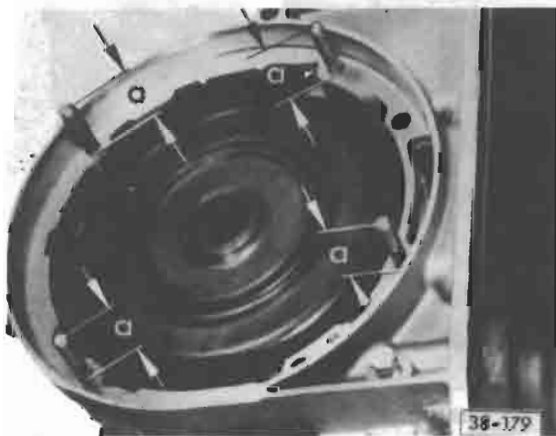
- turbine shaft for forward clutch with thrust bearing
- identification: groove for circlip on splines (arrow)

**CAUTION**

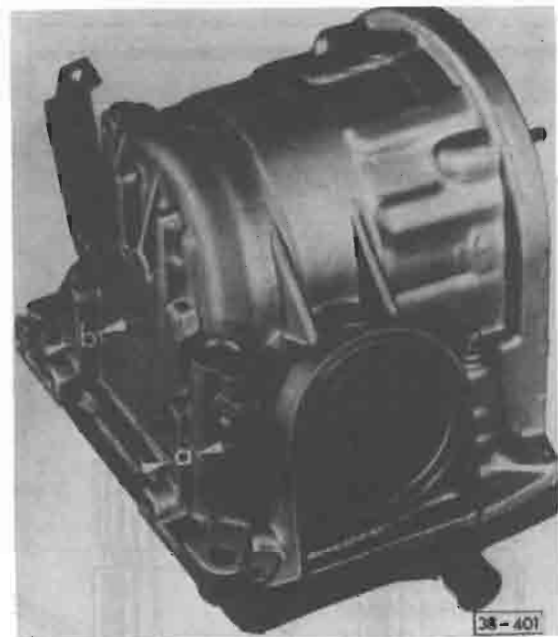
Never install shaft without circlip

**Note**

New shaft with circlip can be installed together with early version oil pump and thrust washer



**Fig. 8 Transmission housing studs, installing**  
• a = 31.5 mm (1 1/4 in.)



**Fig. 9 Transmission housing studs, installing**  
• a and b = 18 mm (23/32 in.)

**Note**

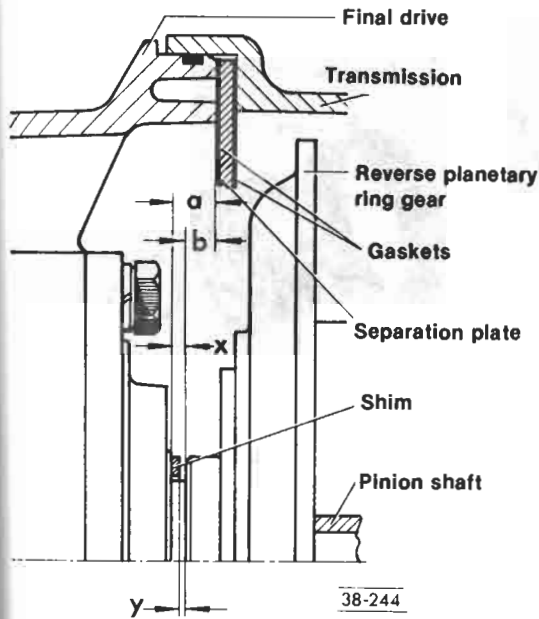
Housings supplied as Spare Parts are without studs. When installing studs, use studs of correct length and install to proper depth

## Transmission/Final drive end play, adjusting

### Note

End play **y** between transmission and final drive must be adjusted to limit end play of reverse planetary ring gear

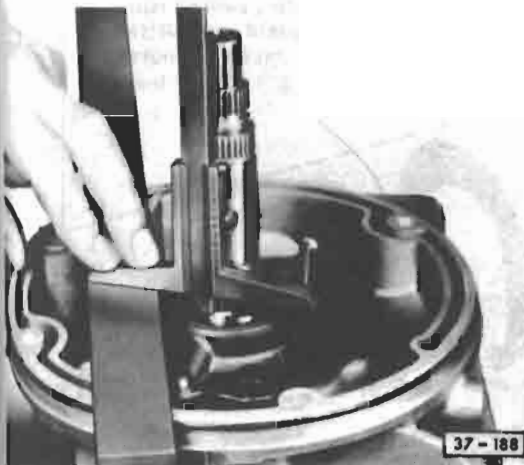
### Work sequence



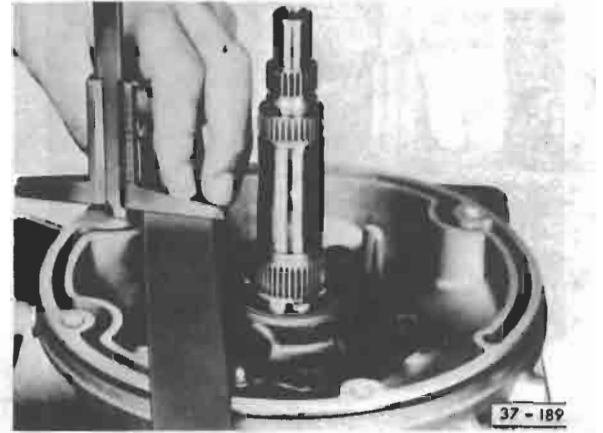
### Measuring points:

- Final drive housing: joint to oil seal bushing **a**
- Transmission housing: shim contact shoulder to separation plate with gasket **b**

### Dimension a, measuring



— measure dimension from straightedge to oil seal bushing

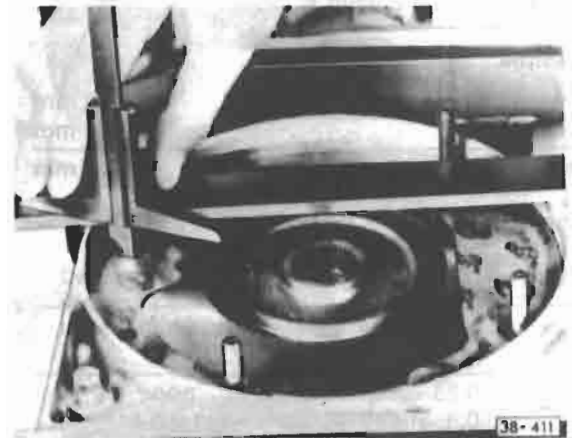


— measure dimension from straight edge to final drive housing joint

### Example

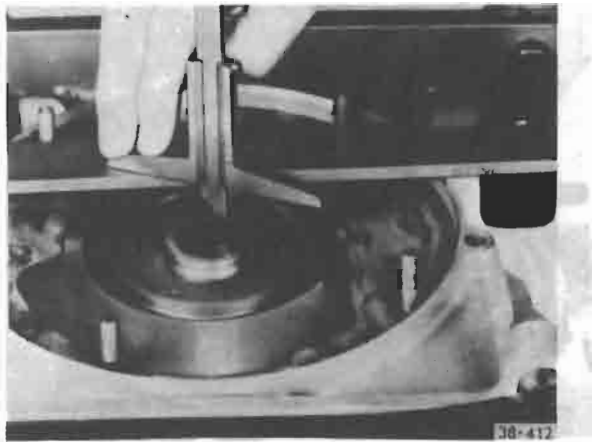
from straight edge to oil seal bushing	18.7 mm
from straight edge to joint	— 8.0 mm
<b>Dimension a</b>	<b>= 10.7 mm</b>

### Dimension b, measuring



— measure dimension from straight edge on housing to gasket on plate

# 38 Automatic Transmission-Case, Gears, Shaft



— measure dimension from **straight edge to shoulder** for shims

### Example

from straight edge to plate = **19.2 mm**

from straight edge to shoulder = **10.0 mm**

Dimension **b** = **9.2 mm**

### Shim thickness, determining

- deduct **b** from **a**
- result is dimension **x**

### Example

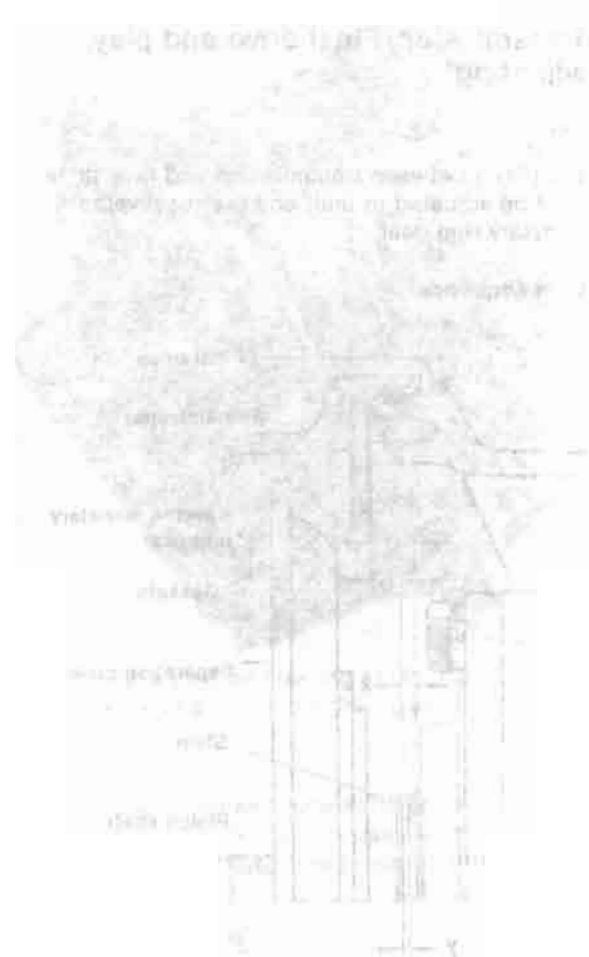
Dimension **a** = **10.7 mm**

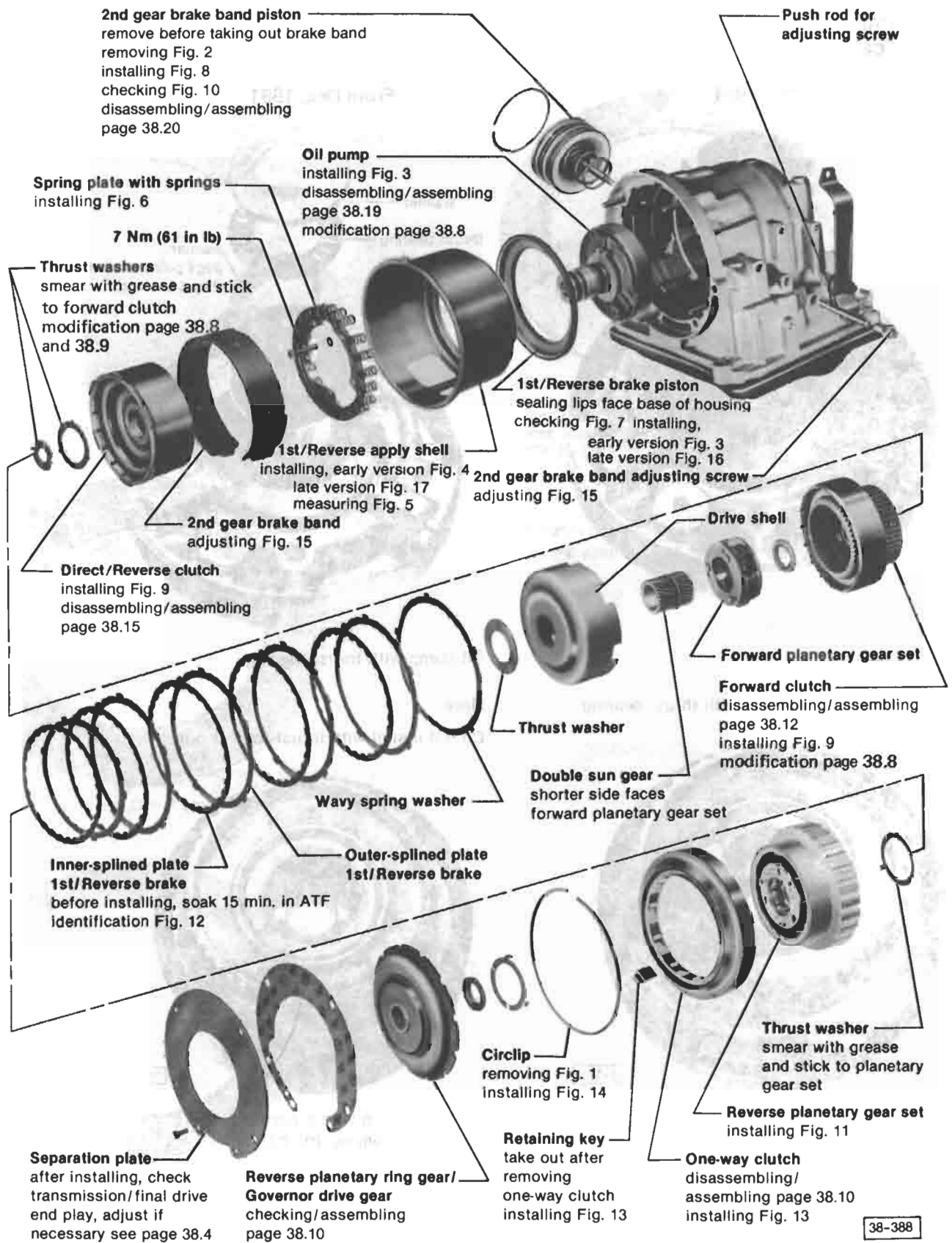
Dimension **b** = **9.2 mm**

Dimension **x** = **1.5 mm**

— select shims from table (shims are available in two thicknesses, 0.4 mm and 1.2 mm)

Dimension <b>x</b> mm	Shim mm
0.23-0.84	none
0.85-1.24	1 × 0.4
1.25-1.64	2 × 0.4
1.65-2.04	1 × 1.2
2.05-2.44	1 × 0.4
	1 × 1.2
2.45-2.84	2 × 0.4
	1 × 1.2
2.85-3.24	2 × 1.2
3.25-3.64	1 × 0.4
	2 × 1.2
3.65-3.88	2 × 0.4
	2 × 1.2





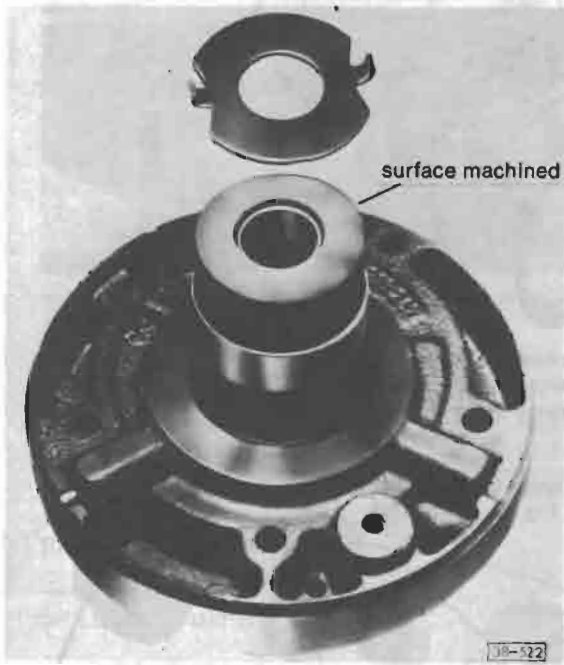
38-388



# 38 Automatic Transmission-Case, Gears, Shaft

## Oil pump and forward clutch, modifications

Up to Dec. 1981

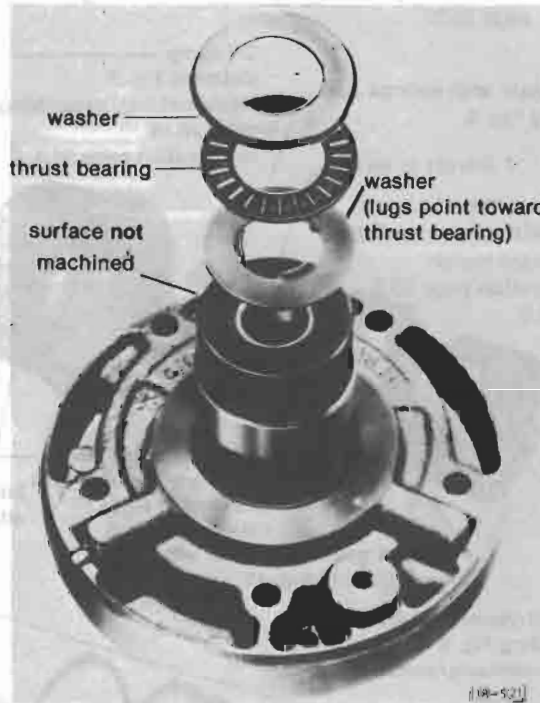


Oil pump with thrust washer

**Note**

Can be installed together with thrust bearing

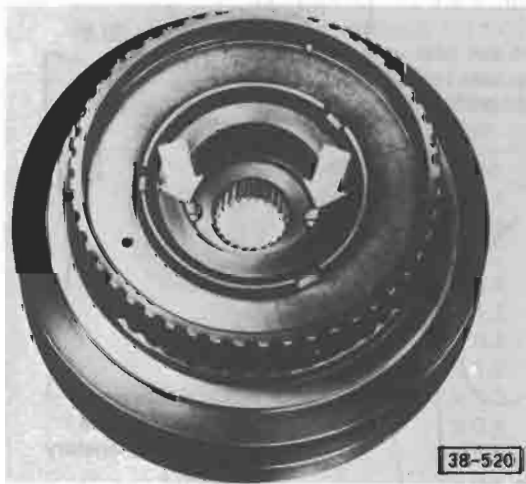
From Dec. 1981



Oil pump with thrust bearing

**Note**

Do not install with thrust washer only

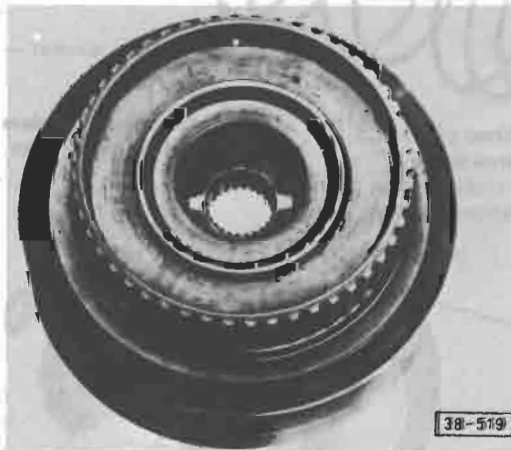


Forward clutch with thrust washer

• identification: drillings (arrows)

**Note**

Do not install together with thrust bearing



Forward clutch with thrust bearing

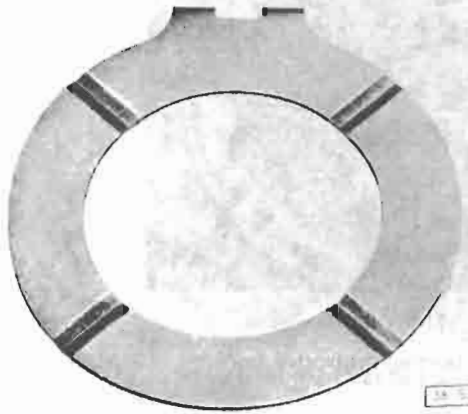
• identification: no drillings

**Note**

Do not install together with thrust washer

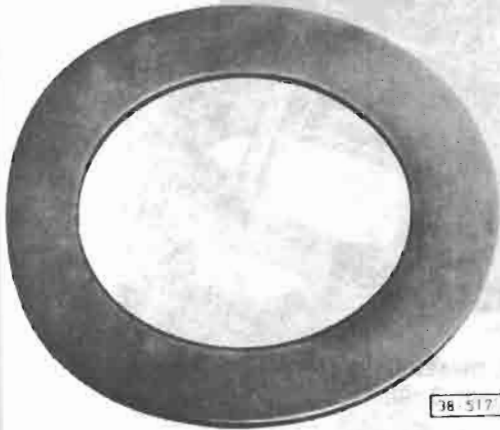
## Thrust washers

Up to Dec. 1981



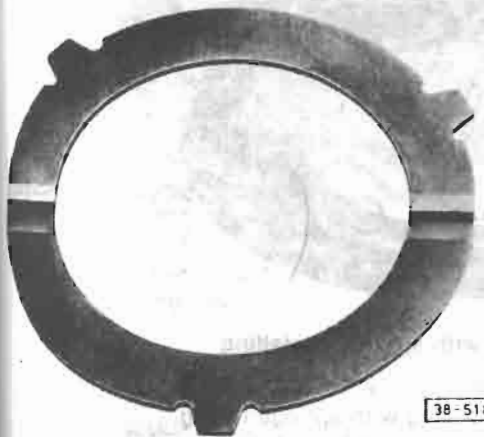
38-513

between oil pump and D + R clutch  
(steel/bronze)



38-517

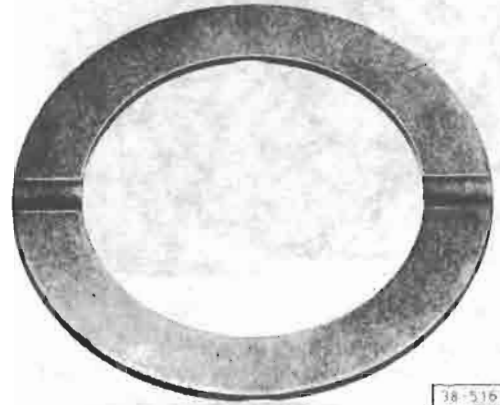
between oil pump and D + R clutch  
(plastic)



38-518

between forward clutch and D + R clutch

From Dec. 1981



38-516

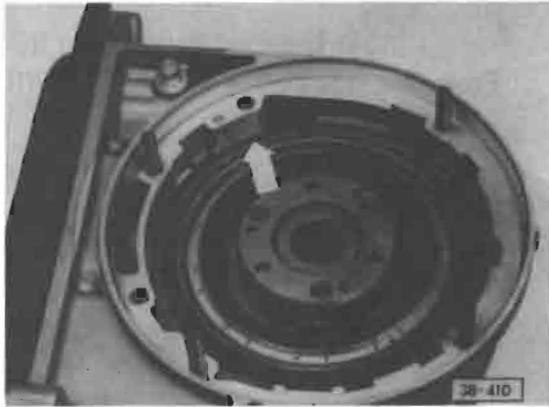
between oil pump and D + R clutch, also  
between forward clutch and D + R clutch  
( plastic )

### Note

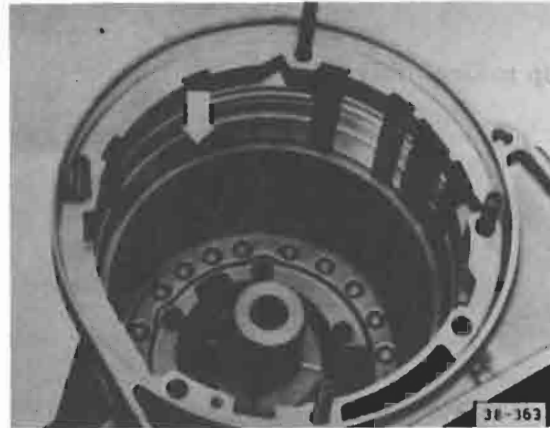
New thrust washers can also be installed in  
previous transmissions



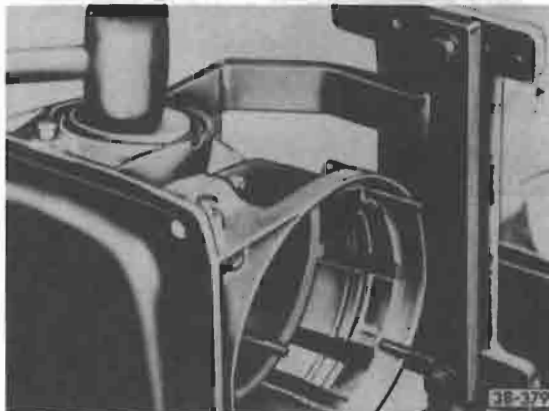
# 38 Automatic Transmission-Case, Gears, Shaft



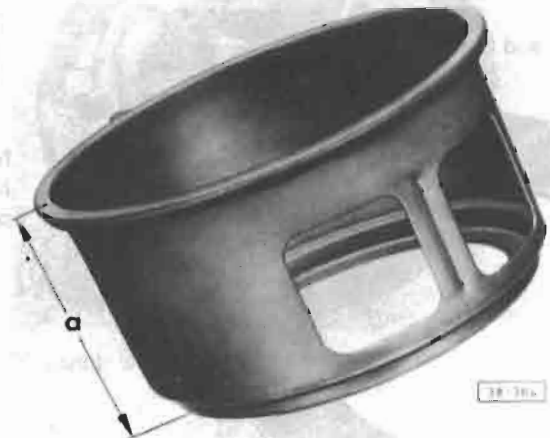
**Fig. 1 Circlip, removing**  
— remove from groove (arrow)



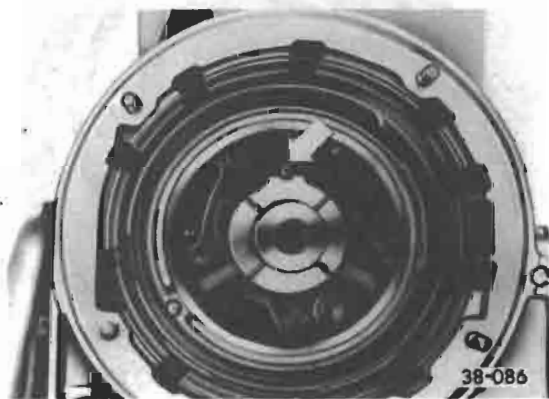
**Fig. 4 Apply shell, installing**  
— insert lug (arrow) in groove shown



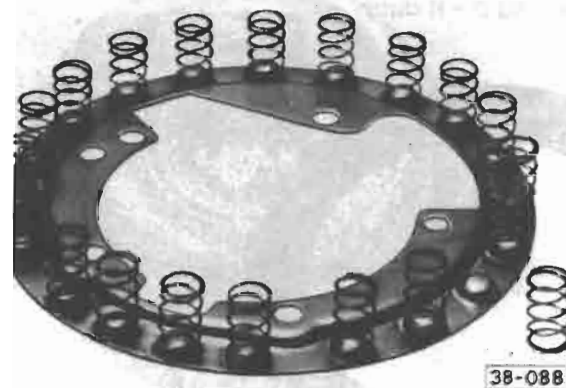
**Fig. 2 2nd gear brake band piston, removing**  
— remove circlip  
— remove piston by tapping lightly with rubber hammer



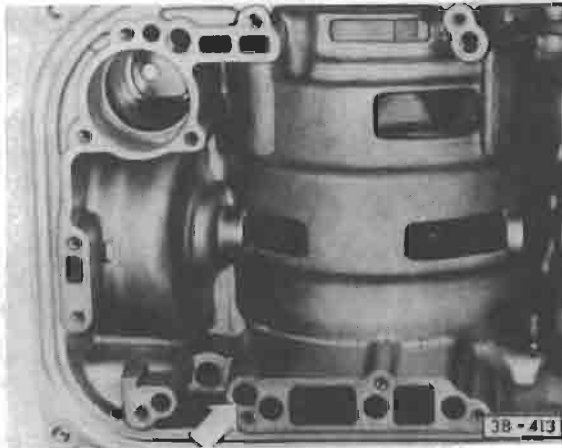
**Fig. 5 Apply shell, measuring**  
• a = 91.4 mm (3.598 in.)



**Fig. 3 1st/Reverse brake piston/Oil pump, installing**  
— push piston onto pump housing and insert pump in housing. Thin rib (arrow) must point up  
— insert pump shaft in drive plate and turn pump. Pump should turn freely

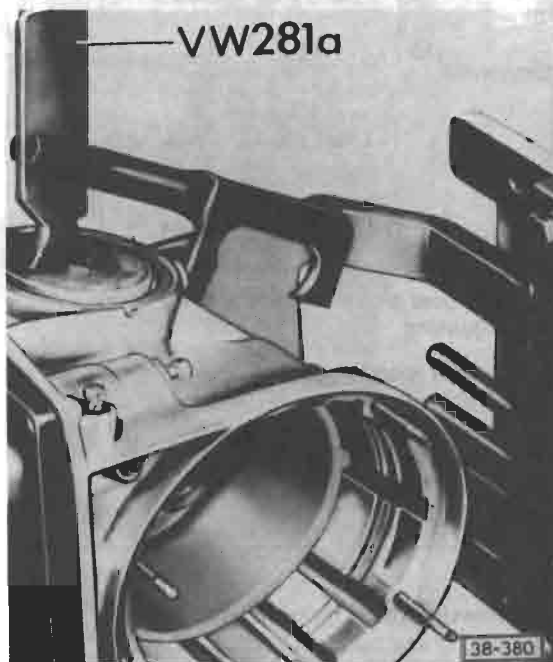


**Fig. 6 Spring plate with springs, installing**  
— place springs on plate  
— place in housing with springs facing down and tighten in this position



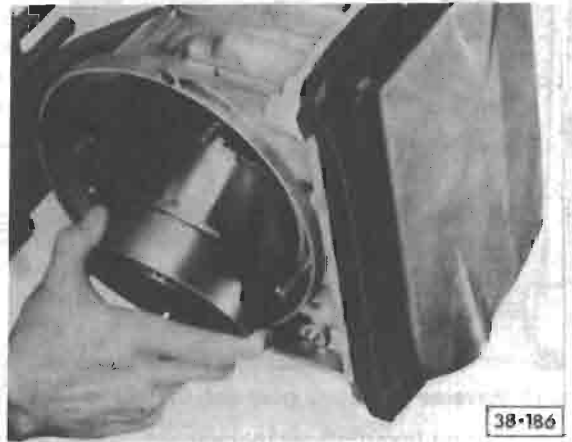
**Fig. 7 1st/Reverse gear brake, checking**

- apply low air pressure to port (arrow)
  - piston must compress springs
  - piston must return to original position, when compressed air is released



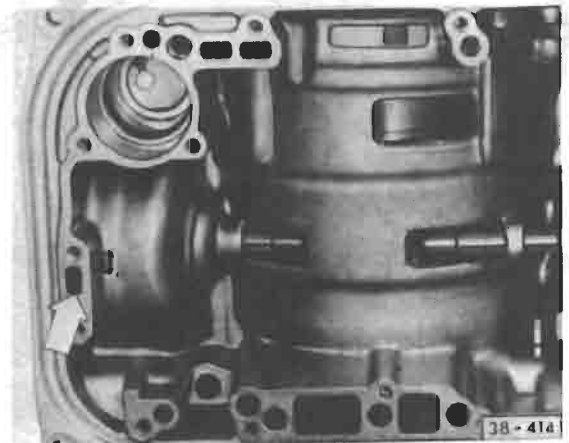
**Fig. 8 2nd gear brake band piston, installing**

- press piston down and insert circlip



**Fig. 9 Direct/Reverse and Forward clutches, installing**

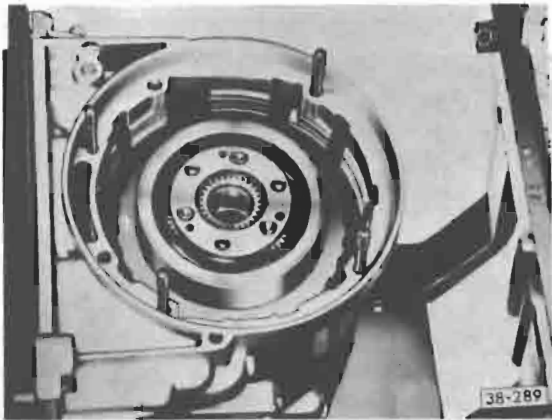
- assemble direct/reverse and forward clutches first
- angle transmission housing downward and slide clutches onto neck of oil pump
- turn transmission so opening faces up



**Fig. 10 2nd gear brake, checking**

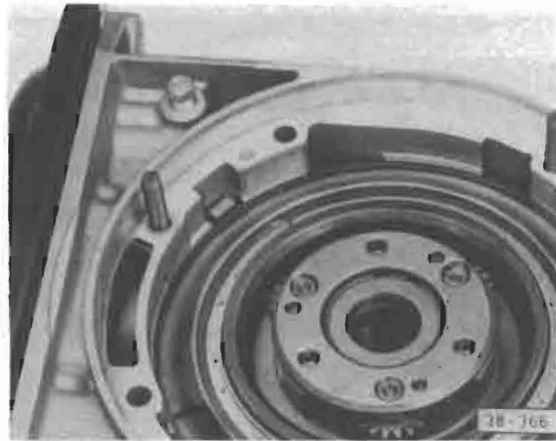
- apply low air pressure to port (arrow)
  - brake band must apply
  - brake band must release when air pressure removed

# 38 Automatic Transmission-Case, Gears, Shaft



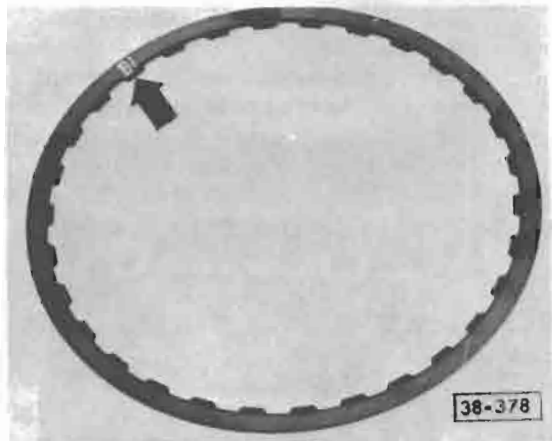
**Fig. 11 Reverse planetary gear set, installing**

- first insert planetary gear set
- insert wavy spring washer and plates



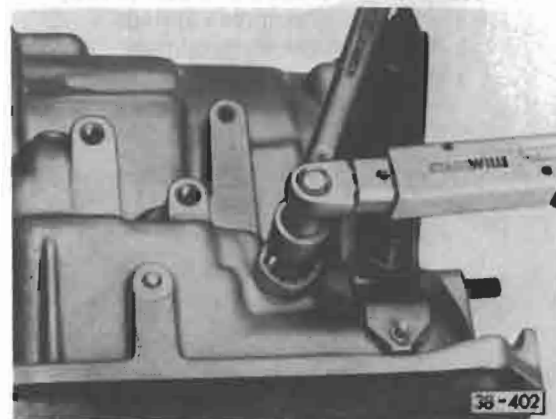
**Fig. 14 Circlip, installing**

- circlip opening must be opposite retaining key



**Fig. 12 1st gear brake splined plates, identification**

- plates are marked B1 (arrow)

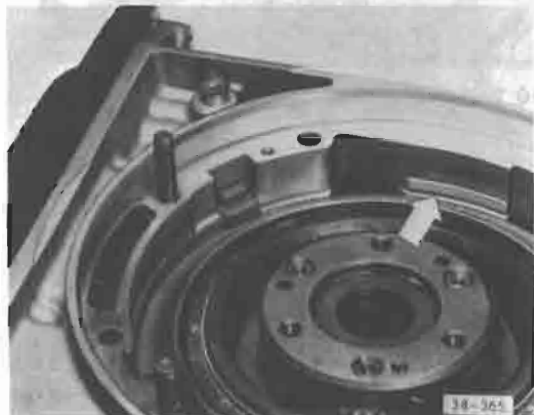


**Fig. 15 2nd gear brake band adjusting screw, adjusting**

- first loosen locknut and tighten adjusting screw to 10 Nm (87 in. lb)
- loosen and retighten to 5 Nm (43 in. lb)
- loosen from this position exactly 2 1/2 turns and tighten locknut

## CAUTION

Transmission must be horizontal when adjusting brake bands; otherwise bands may jam



**Fig. 13 One-way clutch, installing**

- parts are installed properly if groove for circlip is exposed (arrow)
- it must **not** be possible to turn planetary gear set counterclockwise

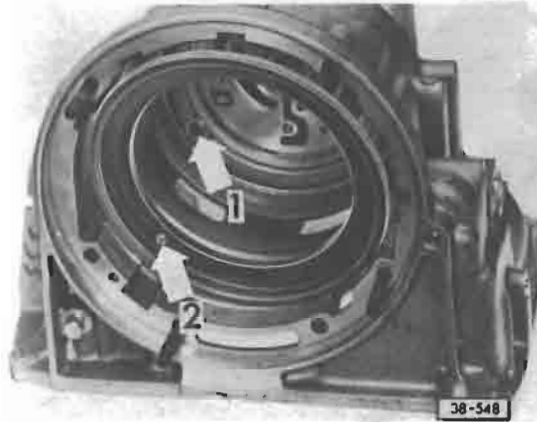
## 38.12

Reverse planetary gear set  
One-way clutch  
2nd gear brake band

## Modifications for transmission 090 — code letters NH, NK

### Note

Wavy spring washer for 1st gear brake has been deleted. Apply shell has been lengthened as a result. 1st gear brake piston now has a ball valve.



**Fig. 16 1st gear brake piston, installing**

— lubricate with ATF

- ball valve in piston (arrow 2) must line up with drilling in transmission housing (arrow 1)



**Fig. 17 Apply shell, installing**

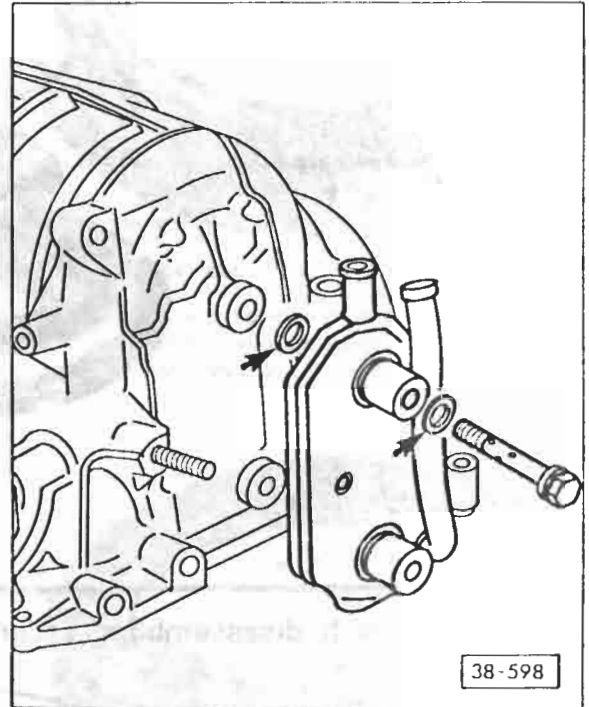
- a = 97 mm
- drilling (arrow) must line up with ball valve on 1st gear brake piston

### Note

Number of inner and outer splined plates used with this length apply shell is 4 each.

New piston with ball valve and apply shell with drilling may be installed in previous transmissions with following requirements:

- do not use wavy spring washer
- only use 4 inner and 4 outer splined plates



**Fig. 18 ATF cooler, installing**

- transmission is equipped with ATF cooler secured to transmission with union bolts and sealed with O-rings (arrows).

— tighten union bolts to 40 Nm (30 ft lb)

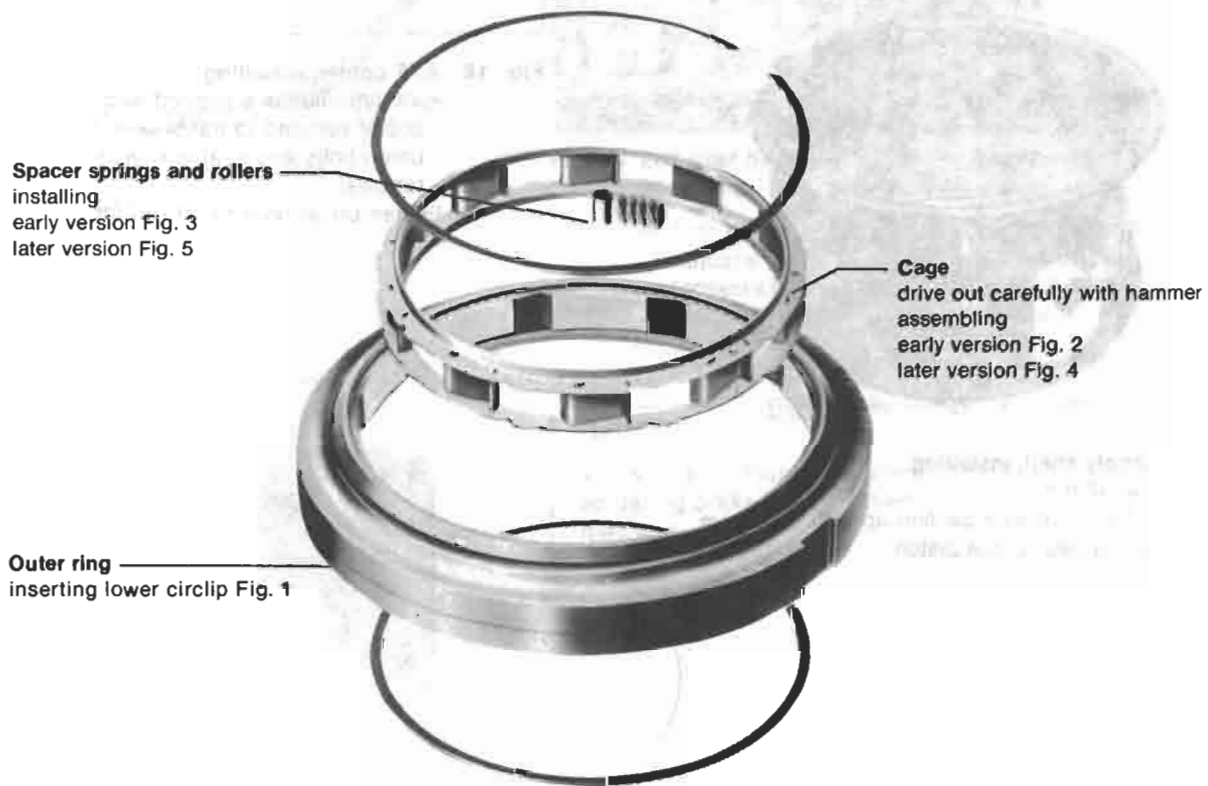
# 38 Automatic Transmission—Case, Gears, Shaft

## Reverse planetary ring gear/Governor drive gear, checking/assembling

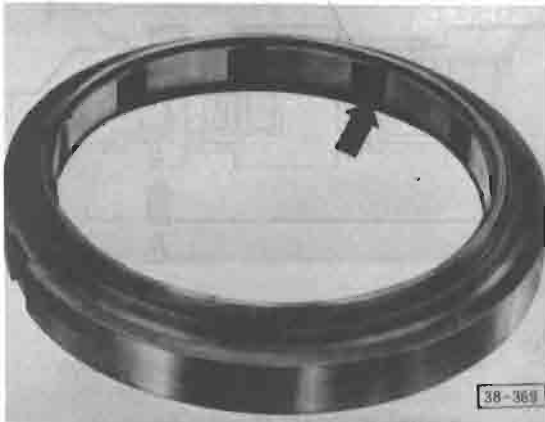


38-187

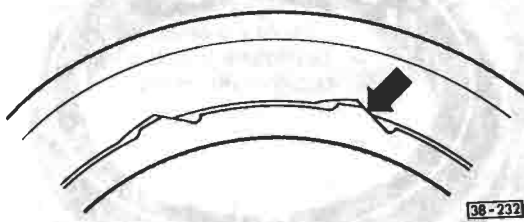
## One-way clutch, disassembling/assembling



38-368



**Fig. 1 One-way clutch outer ring, assembling**  
 — place lower circlip in ring (arrow)



**Fig. 2 One-way clutch cage, assembling**

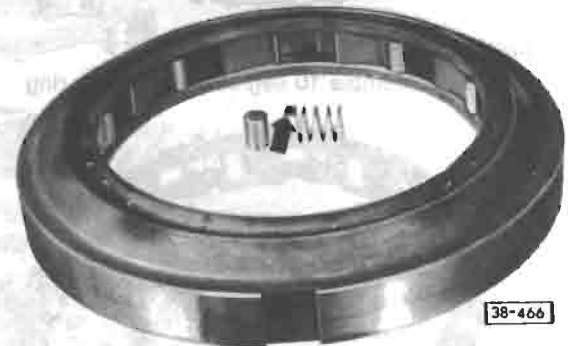
- heat outer ring to at least 150°C (300°F) on a hot plate. Set hot plate to at least 190°C (375°F)
- grip upper shoulder of cage with two pairs of pliers and place it quickly in outer ring
- short sides of retaining lugs on cage must be firmly against shoulders in outer ring (arrow). If necessary, turn cage slightly immediately after inserting it

**CAUTION**

If cage is not properly located on lower circlip and inside of outer ring, do not press it into position. Knock cage out carefully, let cool and repeat procedure



**Fig. 3 Spacer springs and rollers, installing**  
 — rollers/springs must be installed in proper relation to each other (as shown)



When installing spring with guide lug (arrow), always point lug toward roller to ensure best lateral guidance

**Note**

Both springs can be installed together, with and without lug



# 38 Automatic Transmission—Case, Gears, Shafts

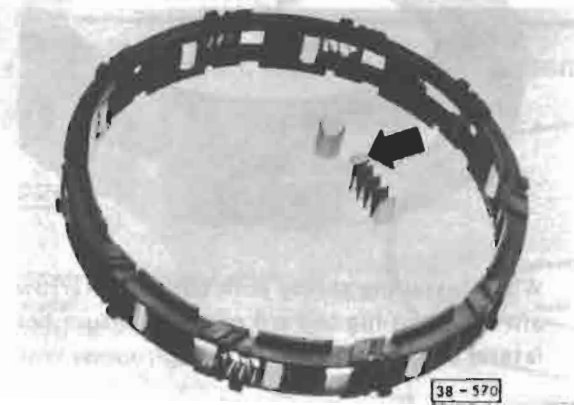
## One-way clutch with plastic cage for rollers and springs

### Note

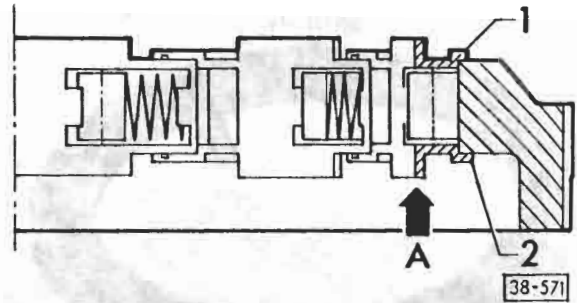
New plastic cage can be service-installed in earlier transmissions. Circlips previously used have been discontinued and cannot be used with plastic cage.



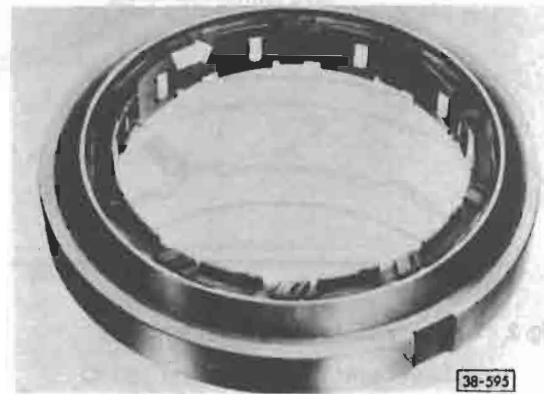
**Fig. 4 Plastic cage segments**  
— assemble 10 segments to form a ring



**Fig. 5 Springs and rollers, installing**  
• spring tab (arrow) toward roller

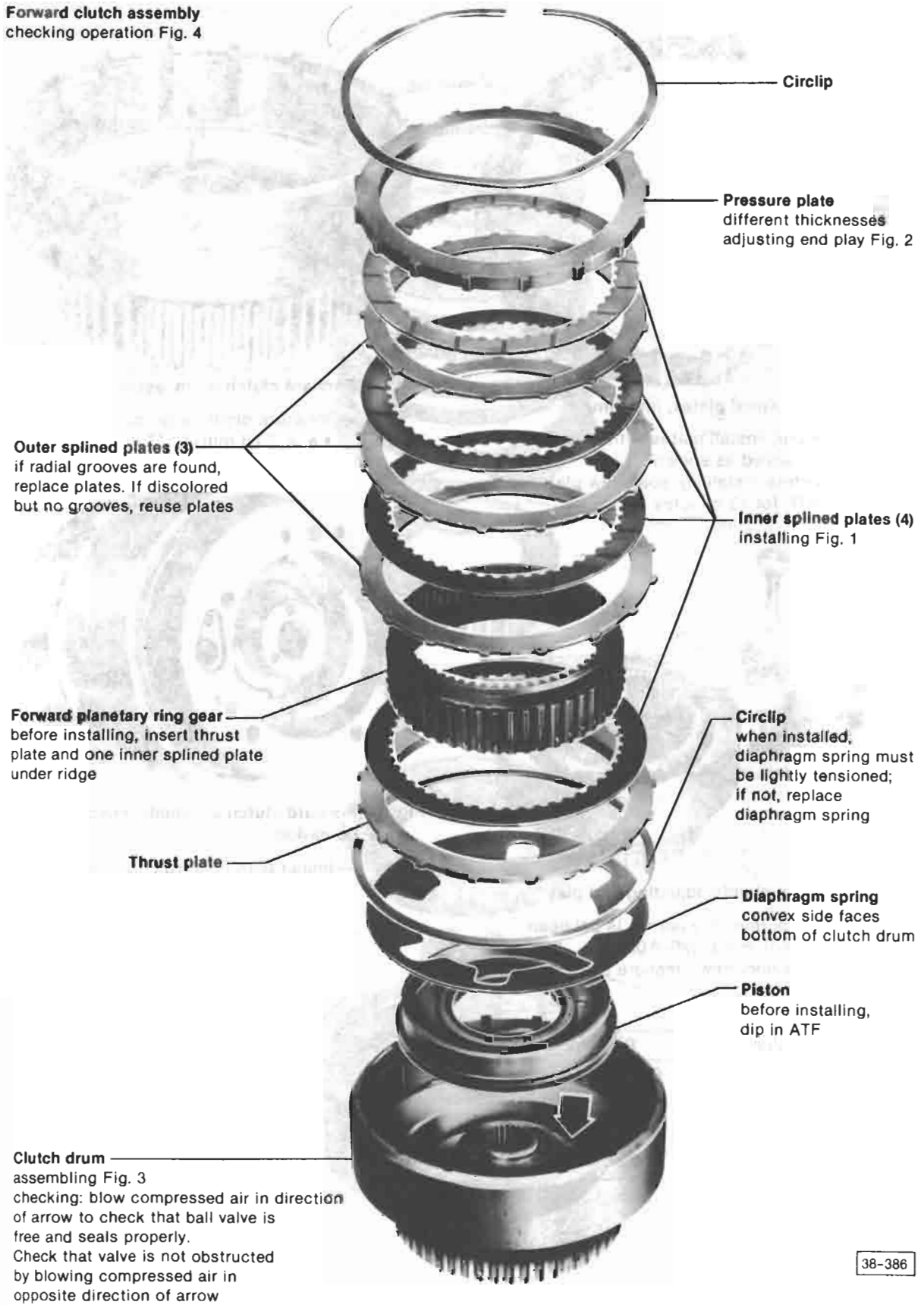


**Fig. 6 Installation position of cage**  
— insert cage into outer ring from below (direction of arrow A)  
• small ledge (1) at top  
• large ledge (2) at bottom



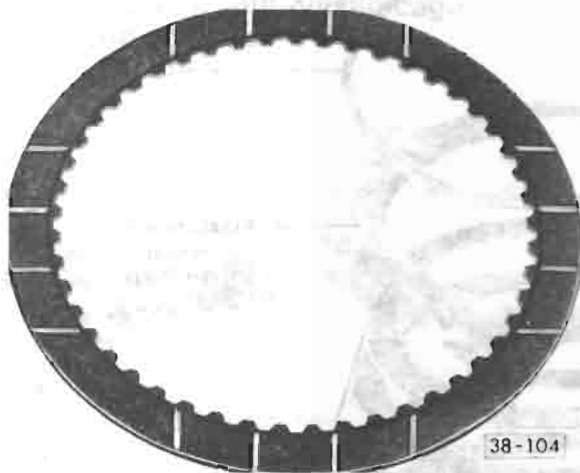
**Fig. 7 Securing cage**  
— turn in direction of arrow

**Forward clutch assembly**  
checking operation Fig. 4





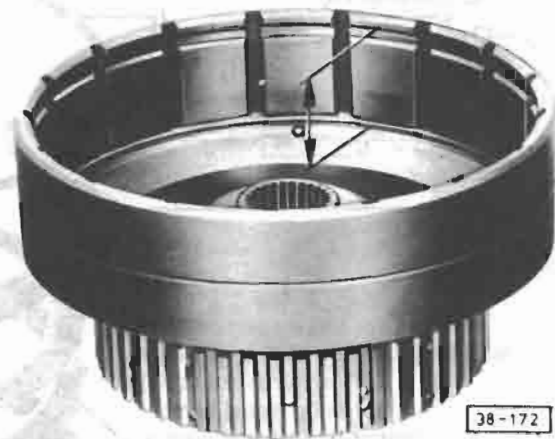
# 38 Automatic Transmission-Case, Gears, Shaft



38-104

**Fig. 1 Inner splined plates, installing**

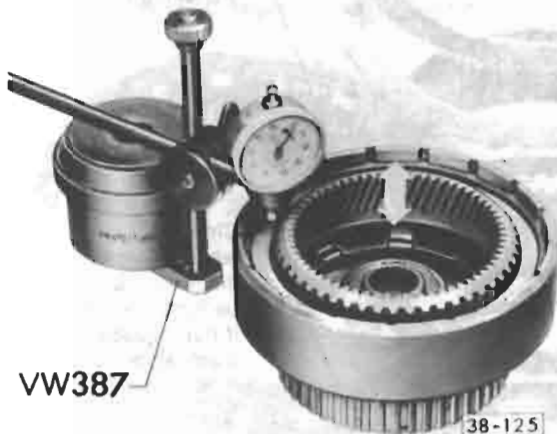
- only install plates with linings marked as shown
- before installing, soak new plates in ATF for 15 minutes



38-172

**Fig. 3 Forward clutch drum, assembling**

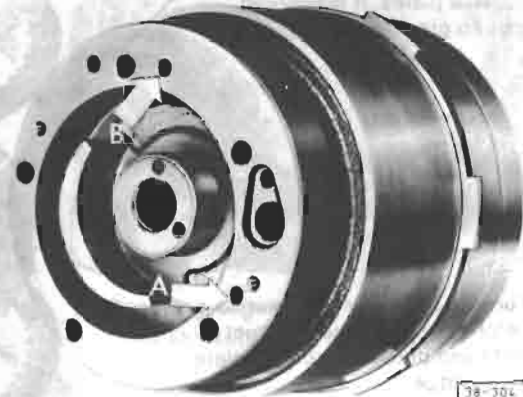
- measure depth of grooves
- a = 29.8 mm (1.173 in.)



38-125

**Fig. 2 Forward clutch, adjusting end play**

- check that play (arrow) is between 0.5-0.9 mm (0.020-0.035 in.)
- if **NO**, select new pressure plate from table



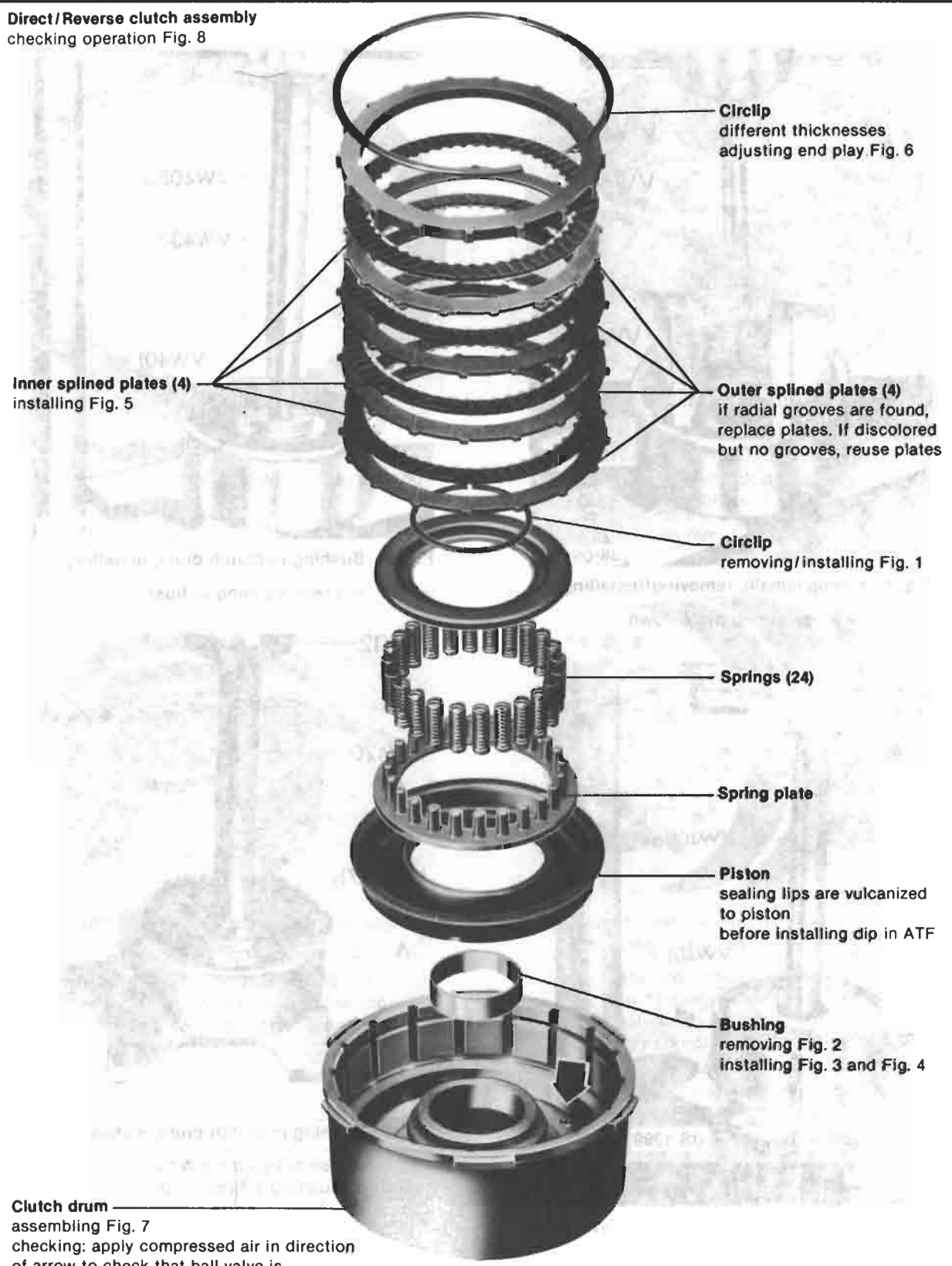
38-104

**Fig. 4 Forward clutch assembly, checking operation**

- install both forward clutch and direct/reverse clutch with thrust washers on oil pump
- apply compressed air to port (arrow A)
  - piston must compress clutch plates
  - piston must release plates when compressed air is removed

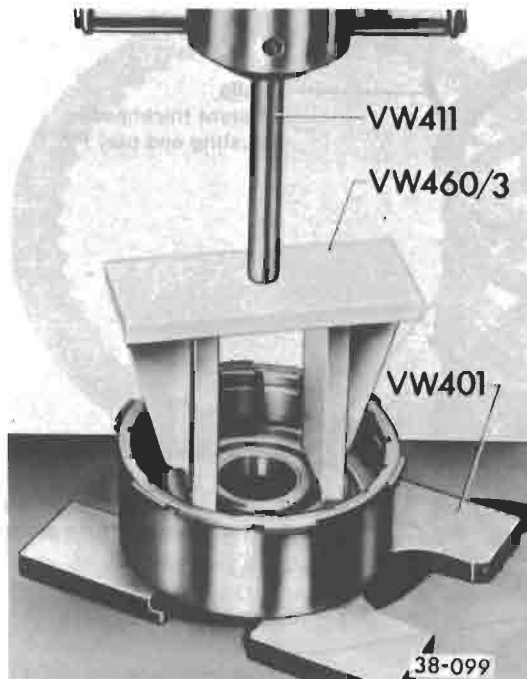
Thickness (mm)	Part No.
6.0	010 323 253 F
6.4	010 323 253 A
6.8	010 323 253 B
7.2	010 323 253 C
7.6	010 323 253 D

**Direct / Reverse clutch assembly**  
checking operation Fig. 8

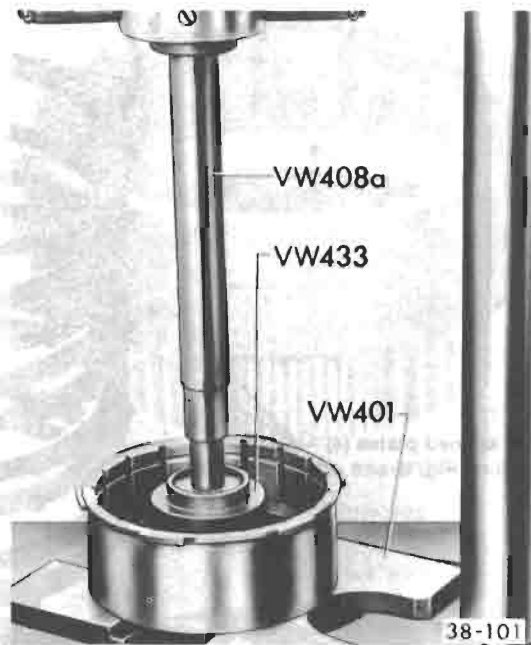


**Clutch drum**  
assembling Fig. 7  
checking: apply compressed air in direction of arrow to check that ball valve is free and seals properly. Check that valve is not obstructed by applying compressed air in opposite direction of arrow

38-389



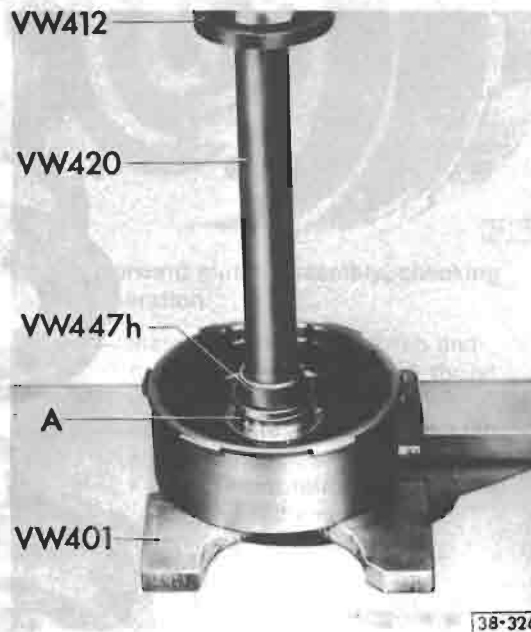
**Fig. 1** Circlip (small), removing/installing  
— press spring plate down



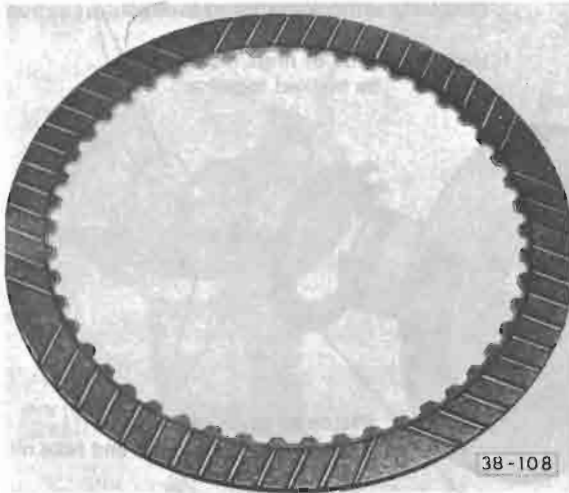
**Fig. 3** Bushing in clutch drum, installing  
— press bushing in flush



**Fig. 2** Bushing in clutch drum, removing  
— press out

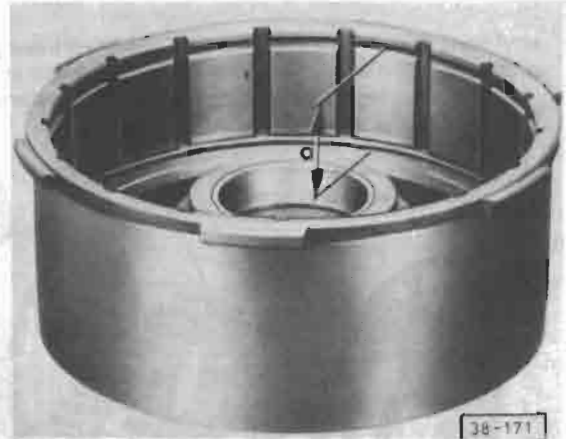


**Fig. 4** Bushing in clutch drum, installing  
— use old bushing A to press new bushing 1.7 mm (0.067 in.) below top edge



**Fig. 5 Inner splined plates, installing**

- only use plates with lining marked as shown
- soak new plates in ATF for 15 minutes before installing

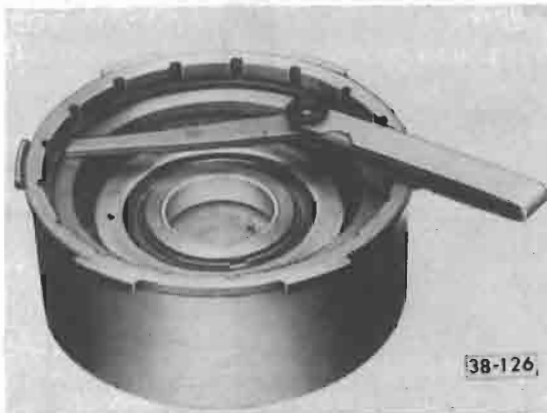


**Fig. 7 Clutch drum/Circlip groove, assembling**

**Note**

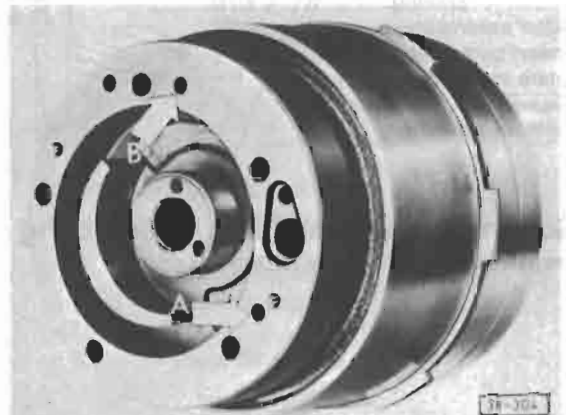
Different size clutch drums are available. Only install drum with correct dimension

- a = 31.25 mm (1.230 in.)



**Fig. 6 Direct/Reverse clutch end play, adjusting**

- check that play is 2.05–2.50 mm (0.081–0.098 in.)
- adjust if necessary by replacing circlip until correct clearance is obtained



**Fig. 8 Direct/Reverse clutch assembly, checking operation**

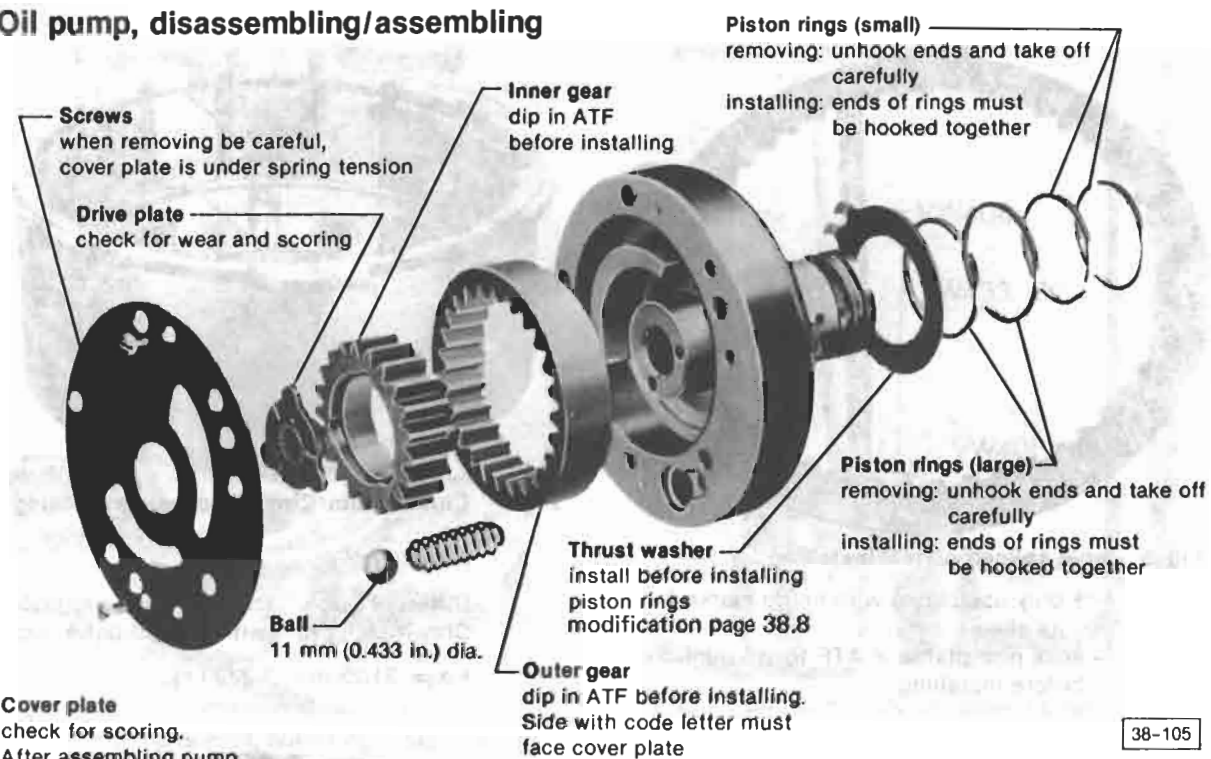
- install both forward clutch and direct/reverse clutch with thrust washers on oil pump
- apply compressed air to port (arrow B)
  - piston must compress clutch plates
  - piston must release plates when compressed air is removed

**Circlip available**

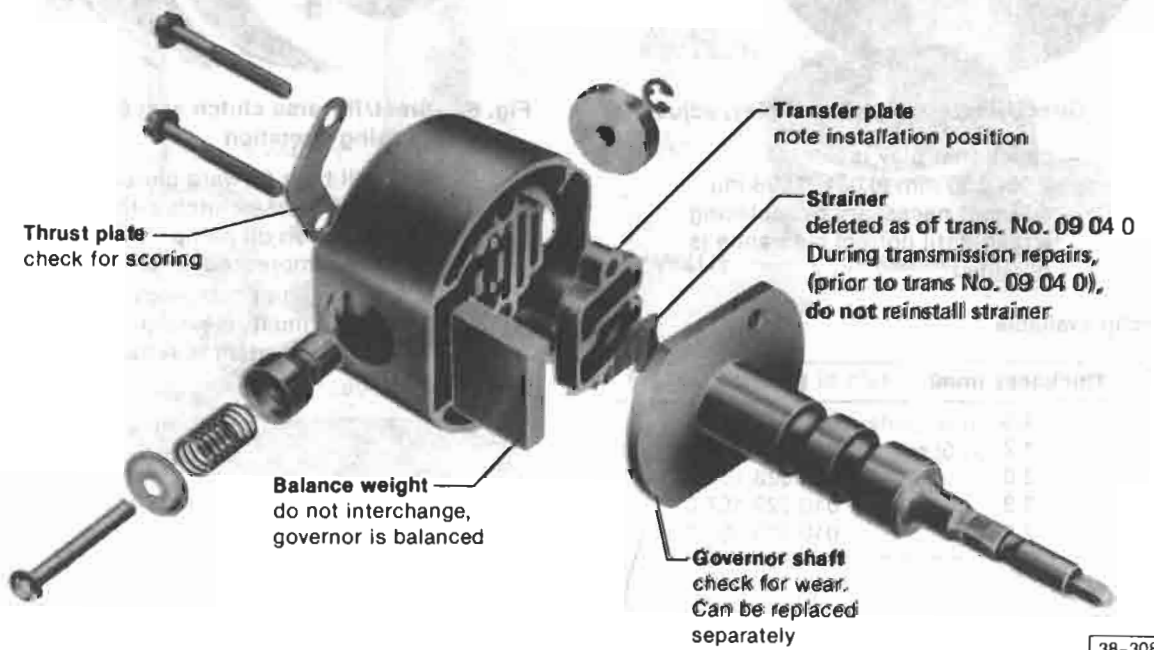
Thickness (mm)	Part No.
1.5	010 323 157 A
1.7	010 323 157 B
2.0	010 323 157
2.3	010 323 157 C
2.5	010 323 157 D

# 38 Automatic Transmission-Case, Gears, Shaft

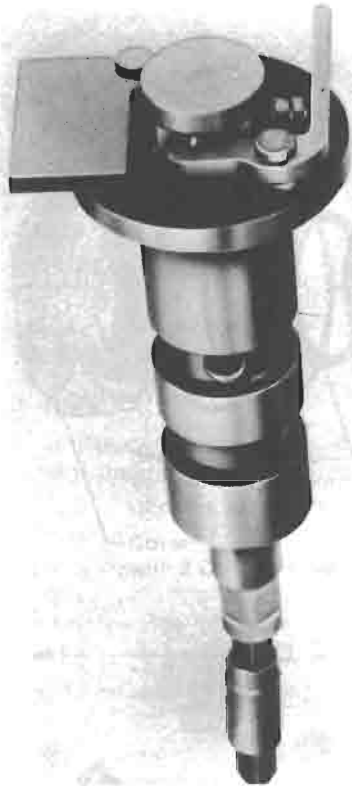
## Oil pump, disassembling/assembling



## Governor, disassembling/assembling (transmission 090—code letters NG only)

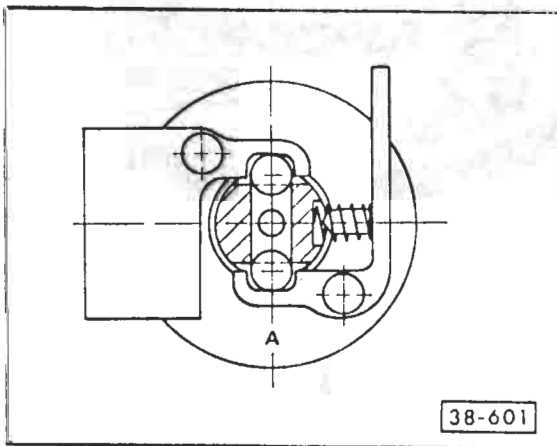


## Governor, removing/installing (Transmission 090—except code letters NG)



38-610

### Flat Governor



38-601

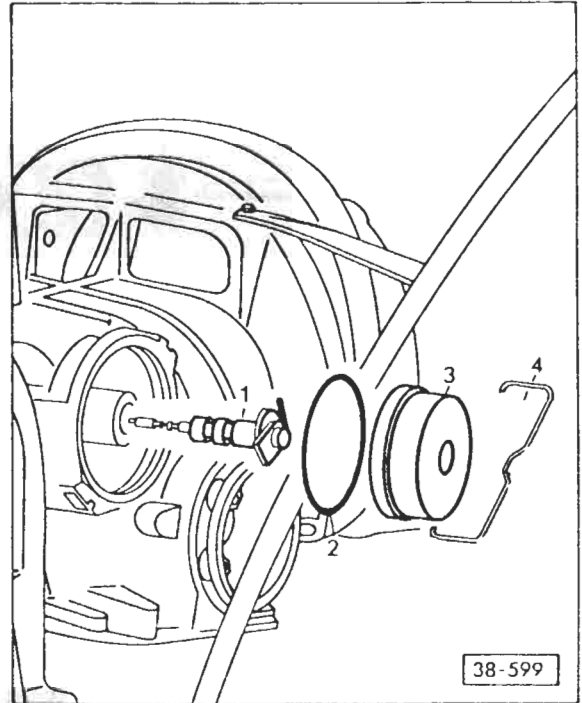
### Governor, identification

Code letters (listed below) are stamped on governor head. New type governors are used only with new type valve bodies (see pages 38.37, 38.38).

Transmission Code Letters	Valve body Code Letters	Governor Code letters
NH	FF	A
NH	FFA	A
NK	FFA	A

### Note

New governor may only be used with new type valve body. Previous type governor may also be used with new valve body.



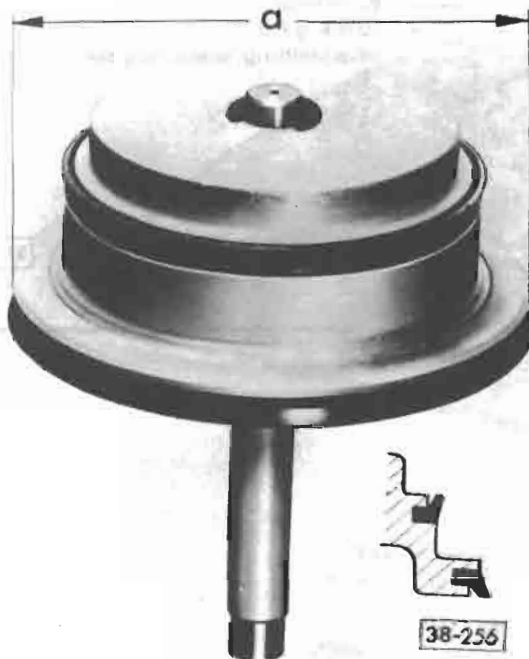
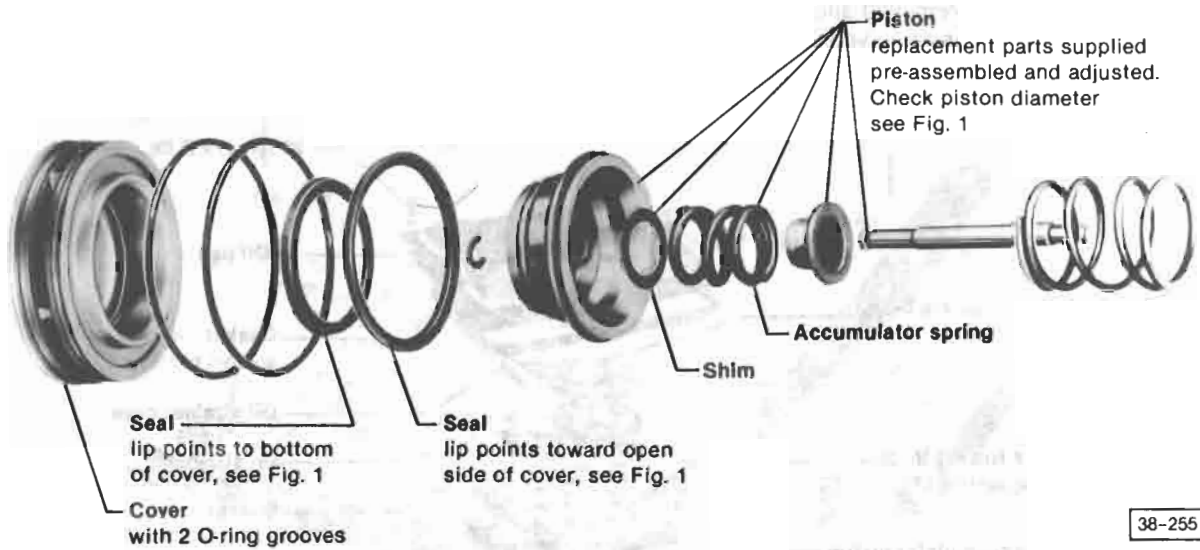
38-599

### Governor, removing/installing

- 1 — Flat governor
- 2 — O-ring
  - always replace
- 3 — Governor cap
- 4 — Clip
  - must be secure

38-308

## 2nd gear brake band piston, disassembling/assembling



**Fig. 1** Piston and piston seals, positions

- a = 96.5 mm (3.799 in.)



# 38 Automatic Transmission-Case, Gears, Shaft

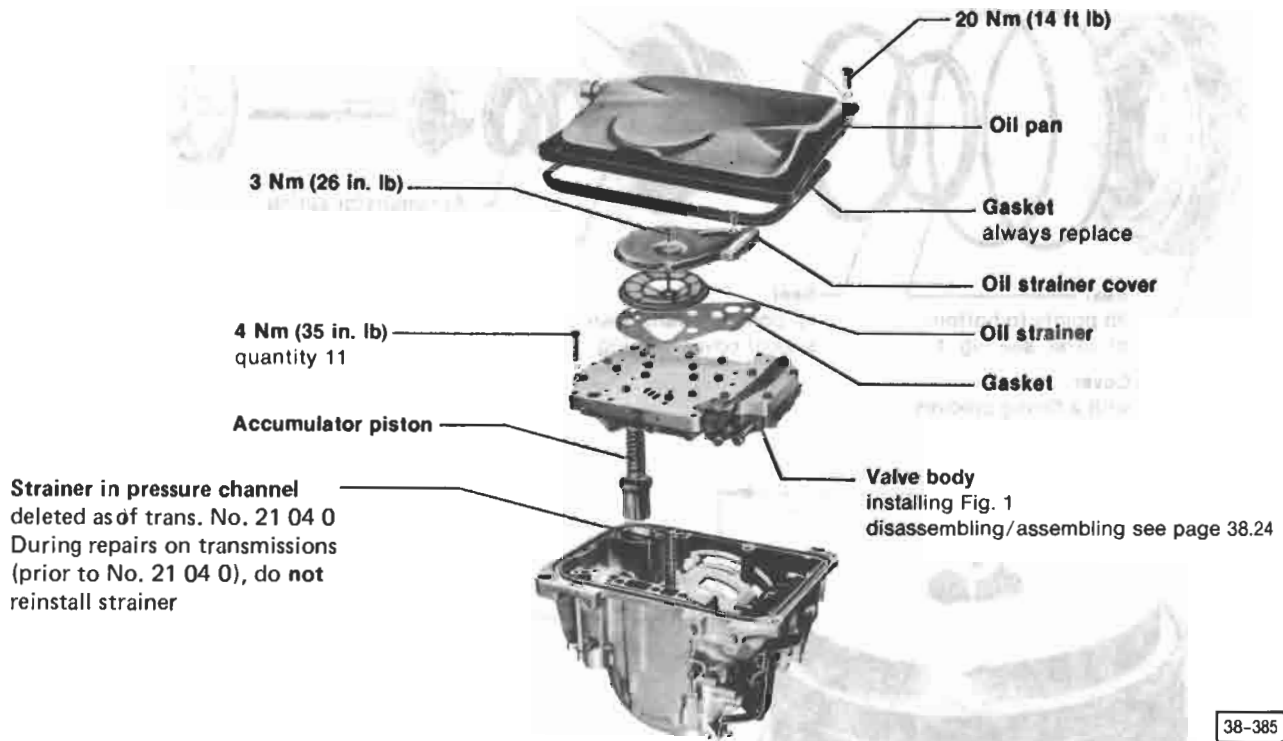
## Valve body, removing/installing

### Note

Valve body can be removed and installed with automatic transmission in vehicle. Drain ATF and remove oil pan first

### CAUTION

Do not run engine or tow vehicle when oil pan is off or with no oil in transmission



**Fig. 1 Valve body, installing**

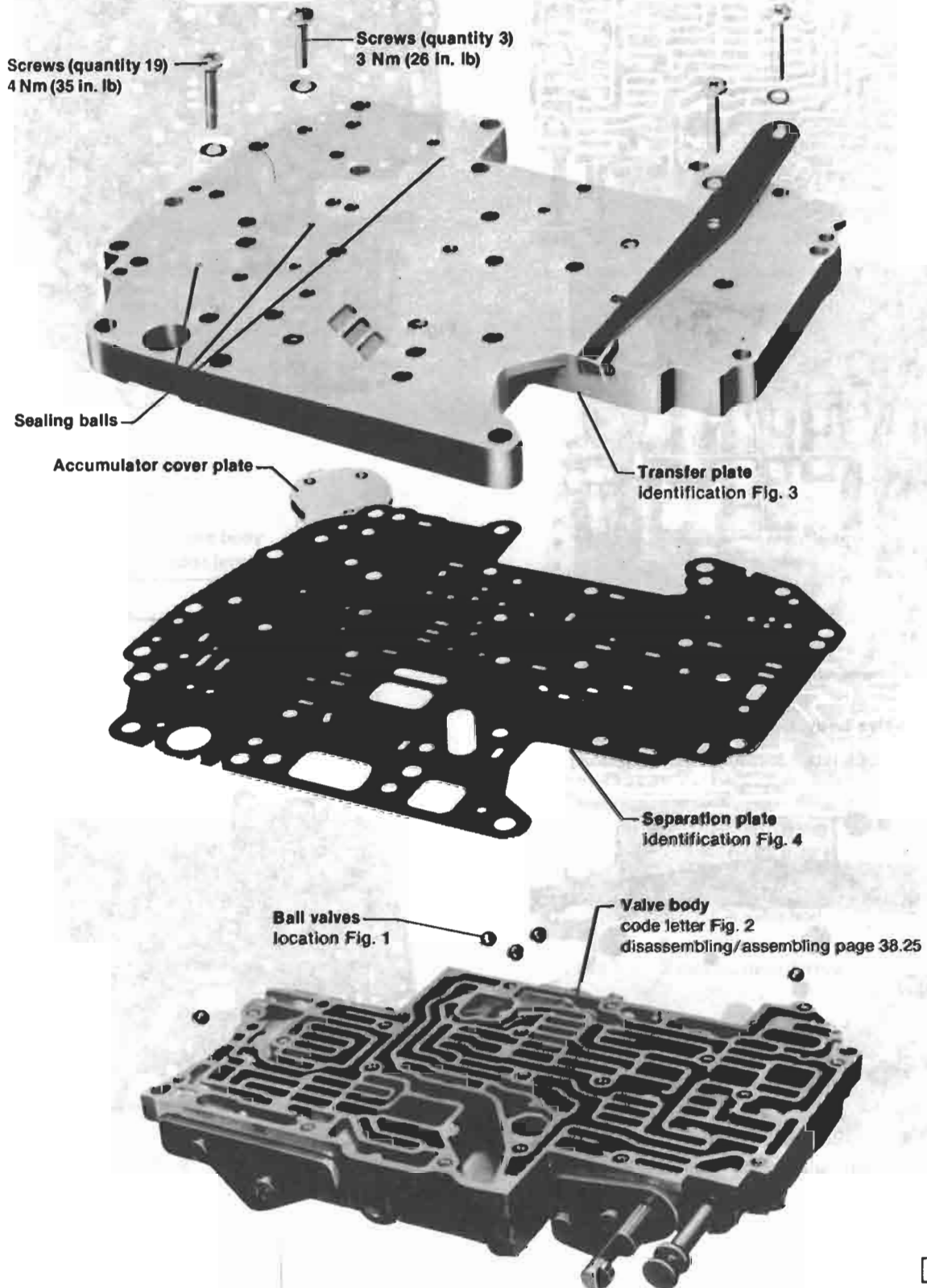
- attach valve body to housing
- connect manual valve (arrow A) and operating lever (arrow B)
- tighten all bolts diagonally



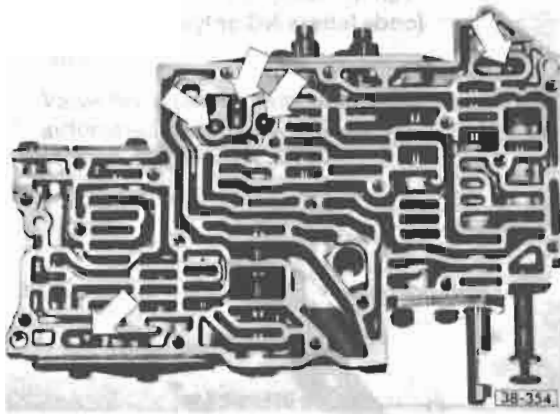
**CAUTION**

Tighten screws evenly in diagonal sequence

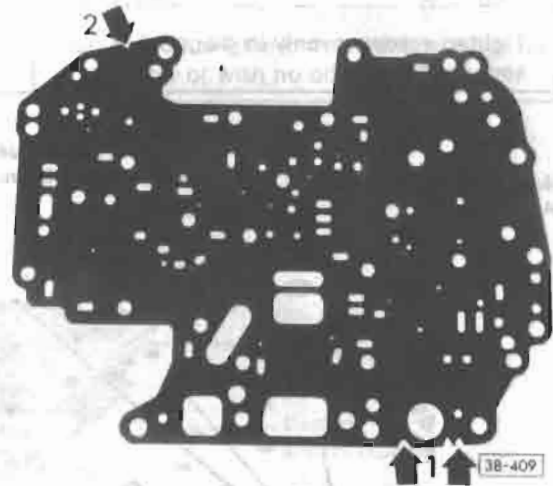
Transmission 090  
(code letters NG only)



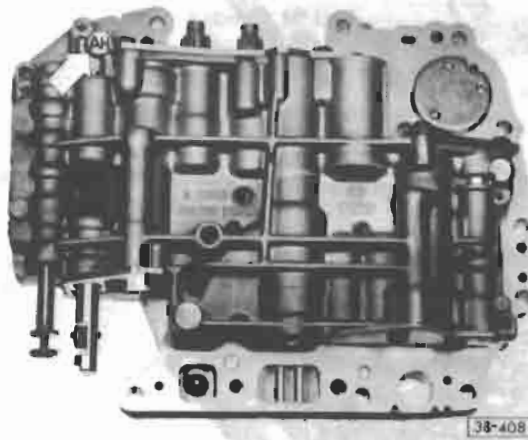
# 38 Automatic Transmission-Case, Gears, Shaft



**Fig. 1 Ball valves, locations in valve body**  
• all balls (arrows) 6 mm diameter



**Fig. 4 Separation plate, identification**  
• at arrows 1 = 3 notches  
• at arrow 2 = 1 notch



**Fig. 2 Valve body, code letter/application**  
• code letter located on boss (arrow)

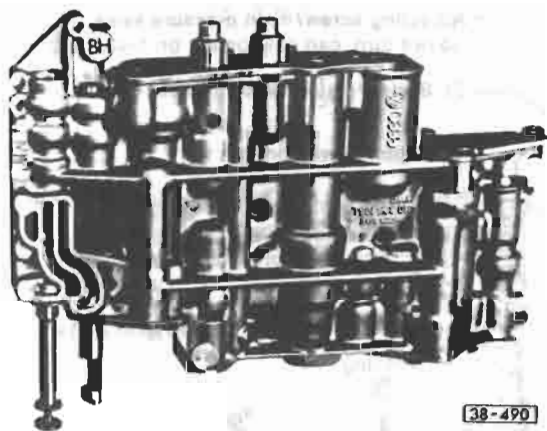


**Fig. 3 Transfer plate, identification**

## Automatic transmission modifications

transmission 090—code letters NG

(from transmission no. 17 07 0)

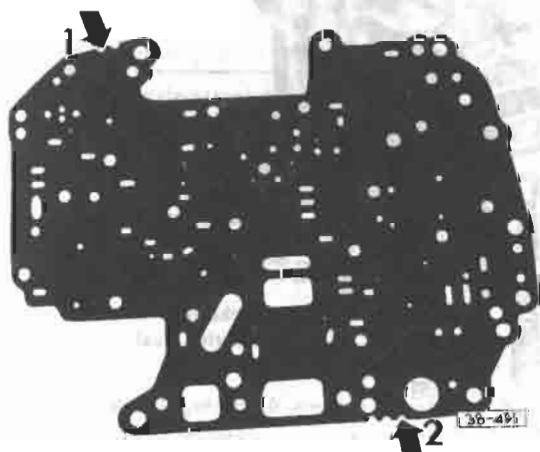


### Valve body code letters

Transmission Code letters	Valve body code letters
NG	BH

### Note

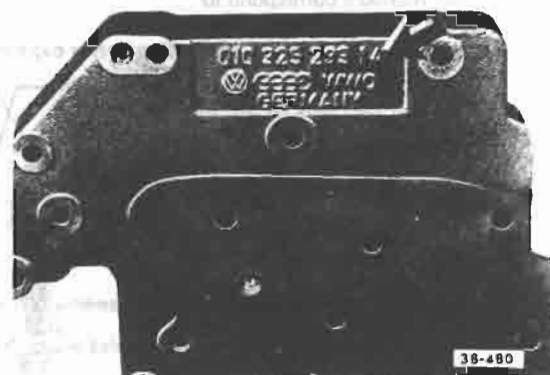
New valve body can be installed in transmissions from transmission No. 01 06 8



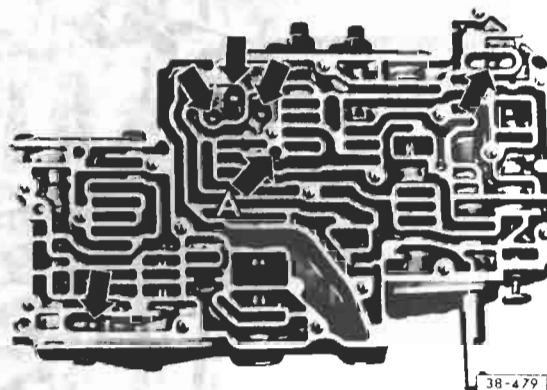
### Separation plate marking

2 notches at arrow 1

3 notches at arrow 2



### Transfer plate identification (arrow)



### Ball valve locations in valve body

5 balls 6 mm diameter (arrows except A)  
1 ball 3 mm diameter (arrow A)

# 38 Automatic Transmission-Case, Gears, Shafts

Valve body assembly transmission 090  
code letters NG  
(up to trans. no. 16 07 0)

**Note**

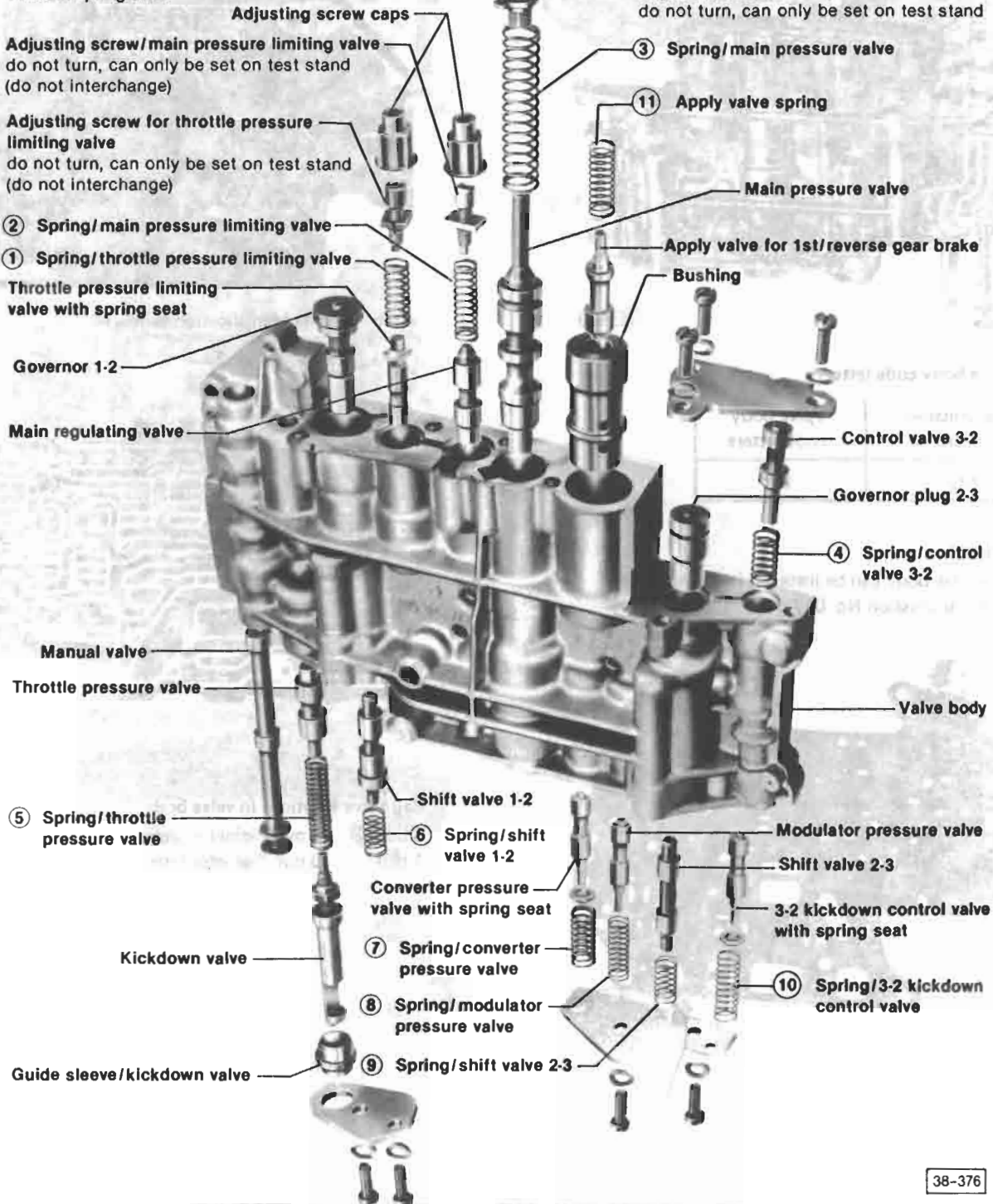
Slight scoring on valves will not cause operating problems

**Spring measurements**

see spring table page 38.26  
Circled numbers correspond to those in spring table

**CAUTION**

Several valve springs have same dimensions. However, do not interchange because they have different tolerances



38-376

## 38.29

Valve body  
code letters NG  
(up to trans. no. 16 07 0)

C4

### Spring table

This table allows identification of springs by their dimensions. Coil diameter and free length can vary between new and used springs (due to settling) so check spring wire thickness and number of coils first, as a means of identifying springs. If this is not enough, also use inner coil diameter and free length

### CAUTION

Several valve springs have similar dimensions. However, they must not be interchanged because they have different tolerances

**Transmission 090—code letters NG up to transmission no. 16 07 0**  
**Transmission 090—code letters NH, NK**

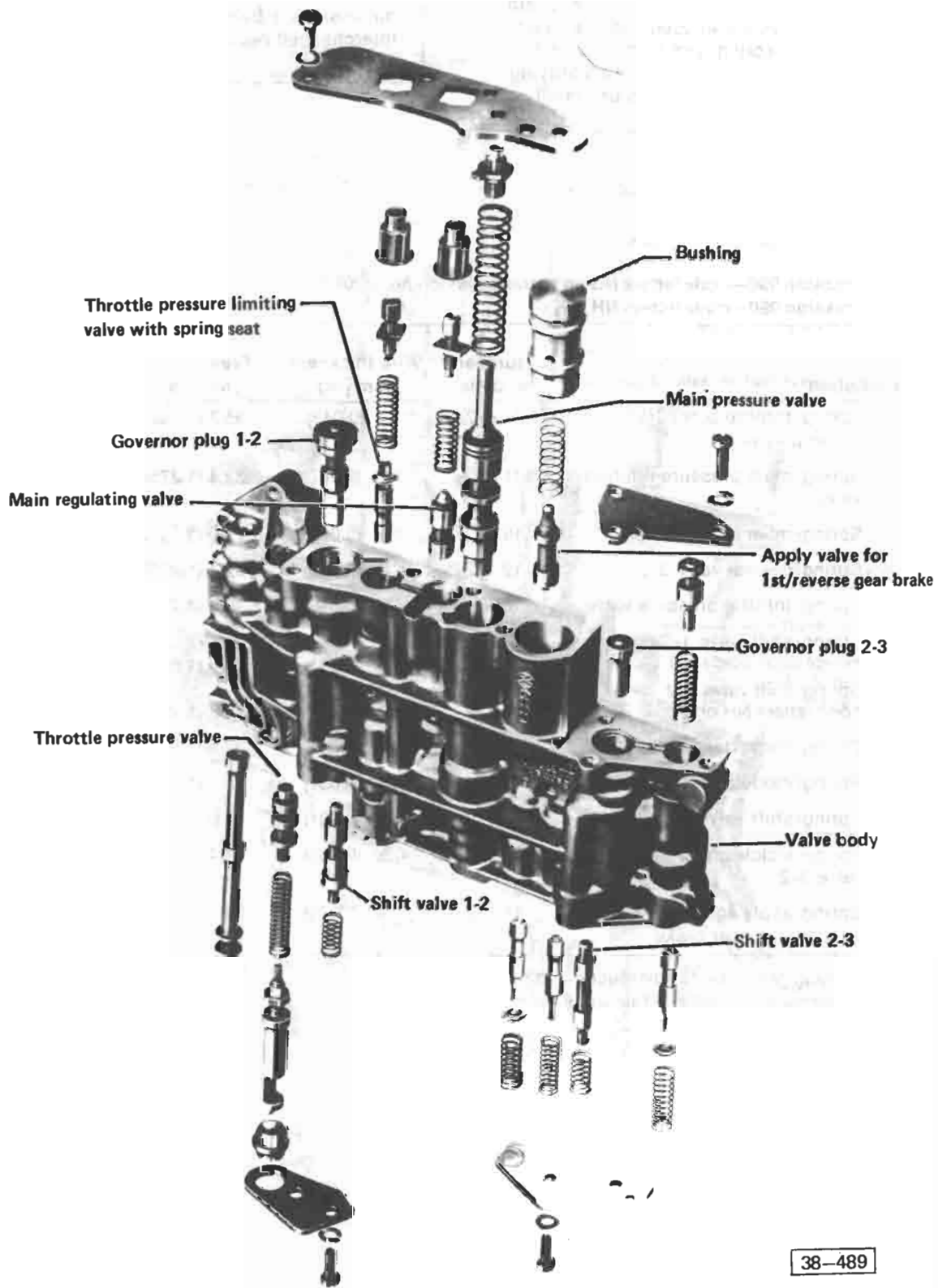
Description	Number of coils	Wire thickness mm (in.)	Free length <sup>1</sup> mm (in.)	Inner diameter <sup>2</sup> of coil mm (in.)
① Spring/throttle pressure limiting valve	14 1/2	1.1 (0.043)	35.3 (1.389)	7.7 (0.303)
② Spring/main pressure limiting valve	11	1.2 (0.047)	32.4 (1.275)	7.7 (0.303)
③ Spring/main pressure valve	16 1/2	1.5 (0.059)	77.0 (3.031)	11.9 (0.468)
④ Spring/control valve 3-2	12 1/2	1.0 (0.039)	32.4 (1.275)	7.7 (0.303)
⑤ Spring/throttle pressure valve	16	1.25 (0.049)	43.4 (1.708)	7.75 (0.035)
⑥ Spring/shift valve 1-2 except code letters NH	9 1/2	0.8 (0.031)	26.0 (1.024)	8.2 (0.323)
Spring/shift valve 1-2 code letters NH only	8 1/2	0.9 (0.035)	28.8 (1.134)	8.1 (0.318)
⑦ Spring/converter pressure valve	8 1/2	1.25 (0.049)	22.2 (0.874)	7.7 (0.303)
⑧ Spring/modulator pressure valve	11 1/2	0.8 (0.031)	28.6 (1.126)	7.75 (0.305)
⑨ Spring/shift valve 2-3	9 1/2	0.8 (0.031)	26.0 (1.024)	8.2 (0.323)
⑩ Spring/kickdown control valve 3-2	11 1/2	0.9 (0.035)	28.4 (1.118)	8.1 (0.318)
⑪ Spring/apply valve 1st/reverse gear brake	11 1/2	0.9 (0.035)	28.4 (1.118)	8.1 (0.318)

<sup>1</sup>Free length can vary due to tolerances and settling

<sup>2</sup>Inner coil diameter is within a tolerance of ± 0.3 mm (0.012 in.)

# 38 Automatic Transmission—Case, Gears, Shaft

Valve body modifications  
transmission 090—code letters NG  
(from transmission no. 17 07 0)



38-489

## 38.31

Valve body  
trans. 090 code letters NG  
(from trans. no. 17 07 0)

## Automatic transmission modifications

transmission 090—code letters NG  
(from transmission no. 17 07 0)

### Spring table

This table allows identification of springs by their dimensions. Coil diameter and free length can vary between new and used springs (due to settling) so check spring wire thickness and number of coils first, as means of identifying springs. If this is not enough, also use inner coil diameter and free length

#### CAUTION

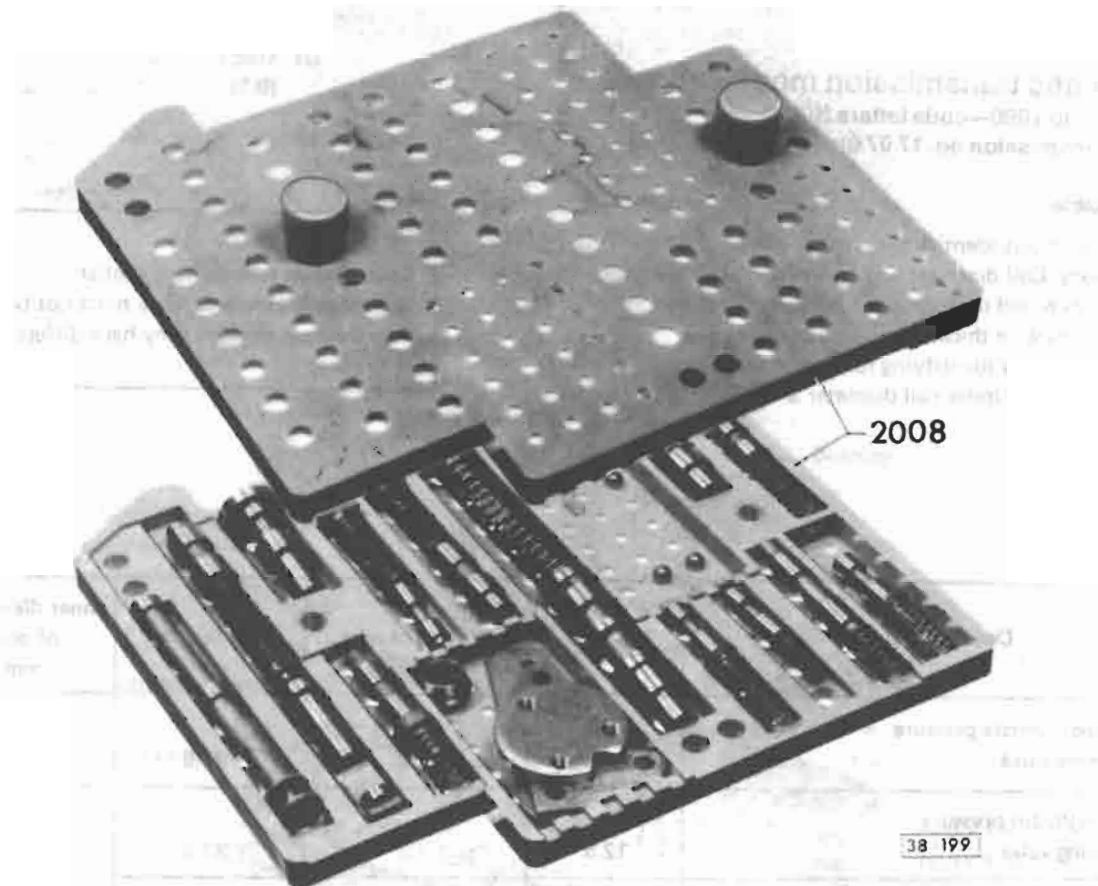
Several valve springs have similar dimensions. However, they must not be interchanged because they have different tolerances

Description	Coils	Wire thickness mm	Free length <sup>(1)</sup> mm	Inner diameter <sup>(2)</sup> of coil mm
Spring/throttle pressure limiting valve	14.5	1.1	37.9	7.7
Spring/main pressure limiting valve	12.5	1.2	27.5	7.6
Spring/main pressure valve	16.5	1.4	69.2	11.9
Spring/control valve 3–2	16.5	1.1	44	7.75
Spring/throttle pressure valve	11.5	0.8	28.6	7.75
Spring/shift valve 1–2	6.5	0.9	19.9	8.1
Spring/shift valve 2–3	8.5	0.8	17.4	6.95
Spring/modulator pressure valve	12.5	1.0	32.4	7.7
Spring/converter pressure valve	8.5	1.25	22.2	7.7
Spring/kickdown control valve 3–2	11.5	0.9	28.4	8.1
Spring/apply valve 1st/reverse gear brake	10.5	0.63	36.3	9.0

(1) Free length can vary due to tolerances and settling

(2) Inner coil diameter is within tolerance of  $\pm 0.3$  mm





## Valve body, disassembling/cleaning

### Note

Valve body should only be disassembled for cleaning or when transmission failure was caused by burnt friction linings or excessively dirty ATF. If ATF is still fairly clean, place the complete valve body in cleaning solution and then dry it afterwards with compressed air.

Storage tray, tool number 2008, is used to store all valves, springs and screws from valve assembly.

Tray outer shape corresponds to shape of valve body.

To be sure parts are reinstalled in their original location, they should be placed in storage tray.

Ball valves can be stored in space provided for bolts

- remove rear end plate, take out valves and springs one after another and place them in tray
- remove end plate from other side and repeat procedure
- place lid on tray
- immerse tray complete with parts in cleaning solution. Dry with compressed air. Do not use water, fluffy rags or cloths when cleaning parts

## Valve body, assembling

### Note

Lubricate all parts with ATF when assembling and check for free movement. Valves should slide under their own weight.

Valves which are slightly scored may be reused. This will not affect operation of transmission.

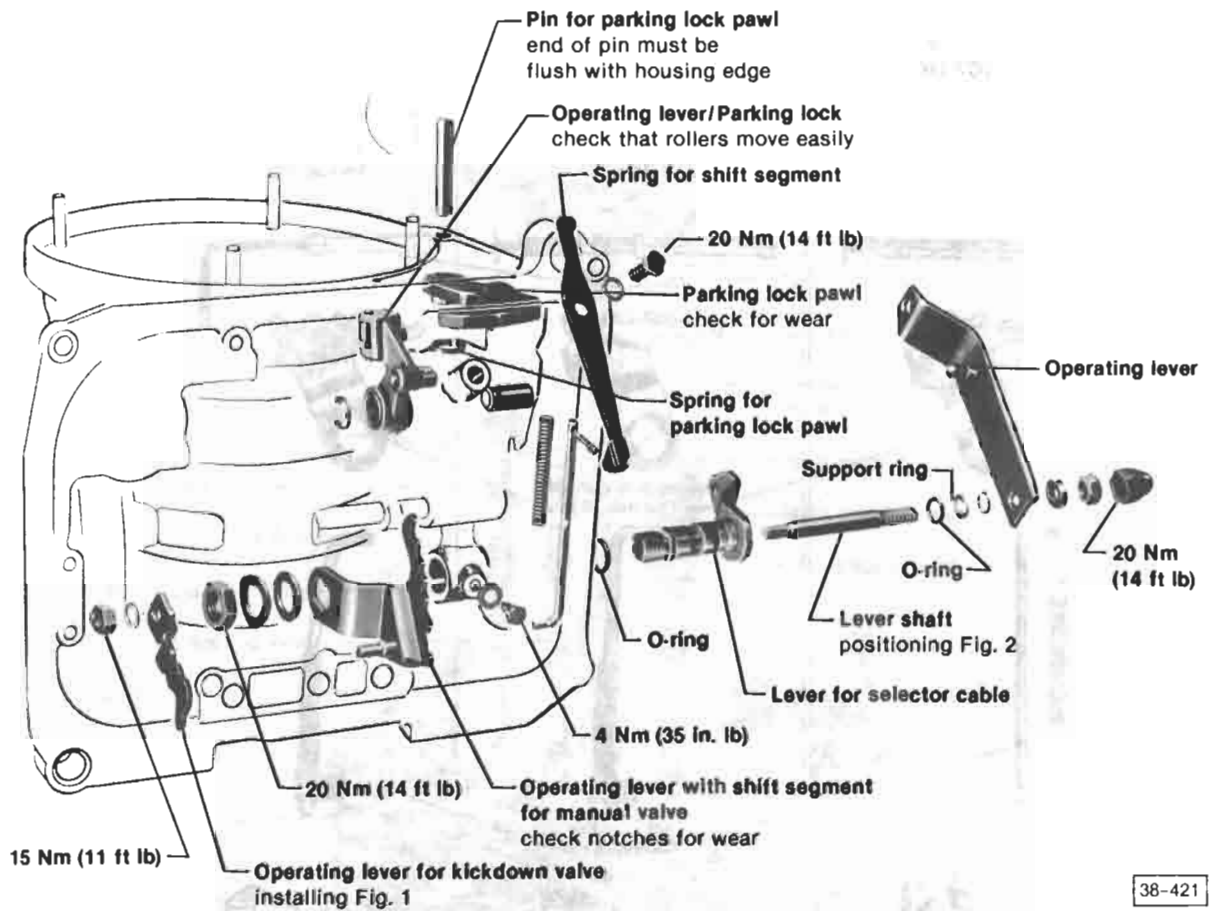
3-2 kickdown control valve must be cleaned separately, because those parts cannot be put into storage tray.

All parts must be completely clean.

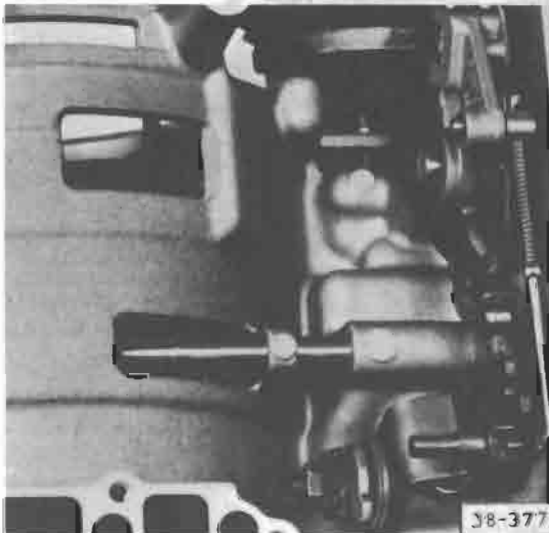
Valves and springs must be put back into same holes from which they were removed

- insert springs and valves into one side in locations shown in exploded view (see page 38.25) and then install end plate before proceeding with other side



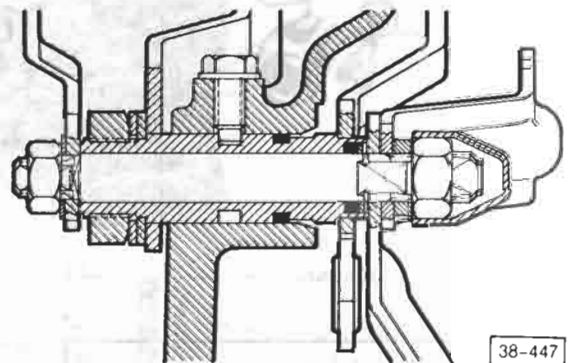


38-421



**Fig. 1** Operating lever for kickdown valve, installing

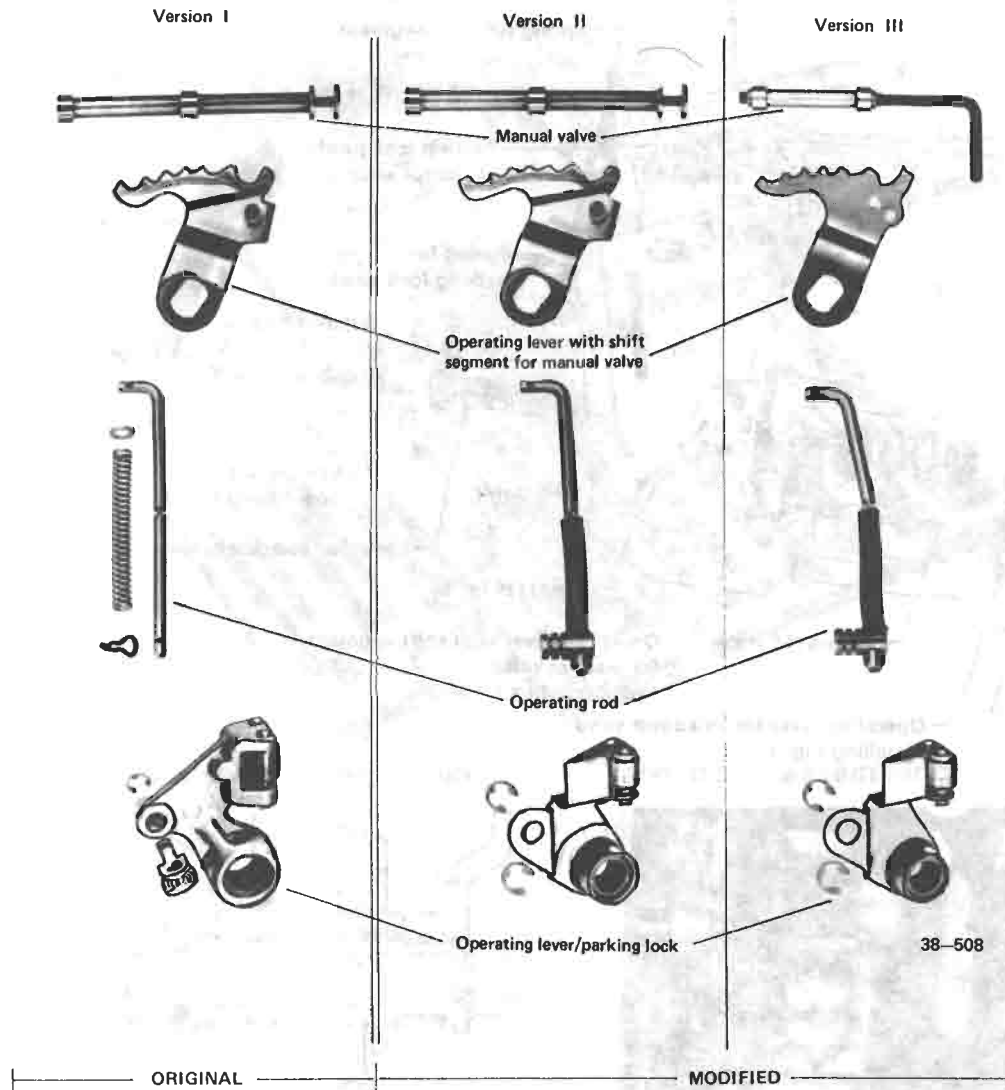
- angled ends of operating lever points toward center of transmission



**Fig. 2** Lever shaft, positioning

# 38 Automatic Transmission-Case, Gears, Shafts

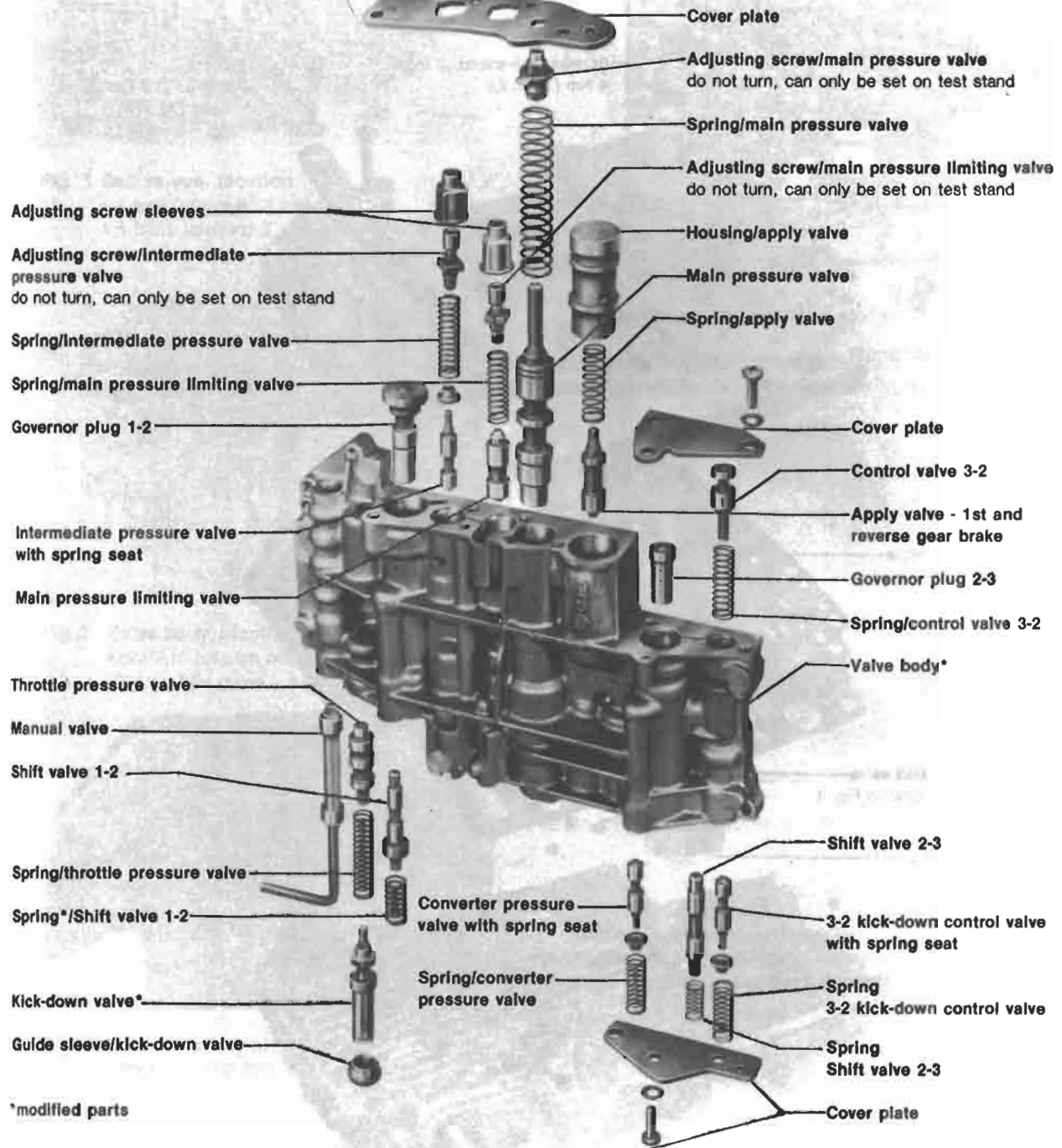
## Manual valve, operating rod and parking lock, modifications



**CAUTION**  
 Only install parts combinations illustrated for each respective version

## Valve Body Assembly, disassembling/assembling

Transmission with code letters NH, NK



### Note

Modified spring shift valve 1-2  
Total coils 8.5, wire thickness 0.9 mm  
Length 28.8 mm, internal coil dia. 8.1 mm

### Note

The modulator pressure valve has been deleted.  
To clean the valve assembly use tray 2008 A.

38-573

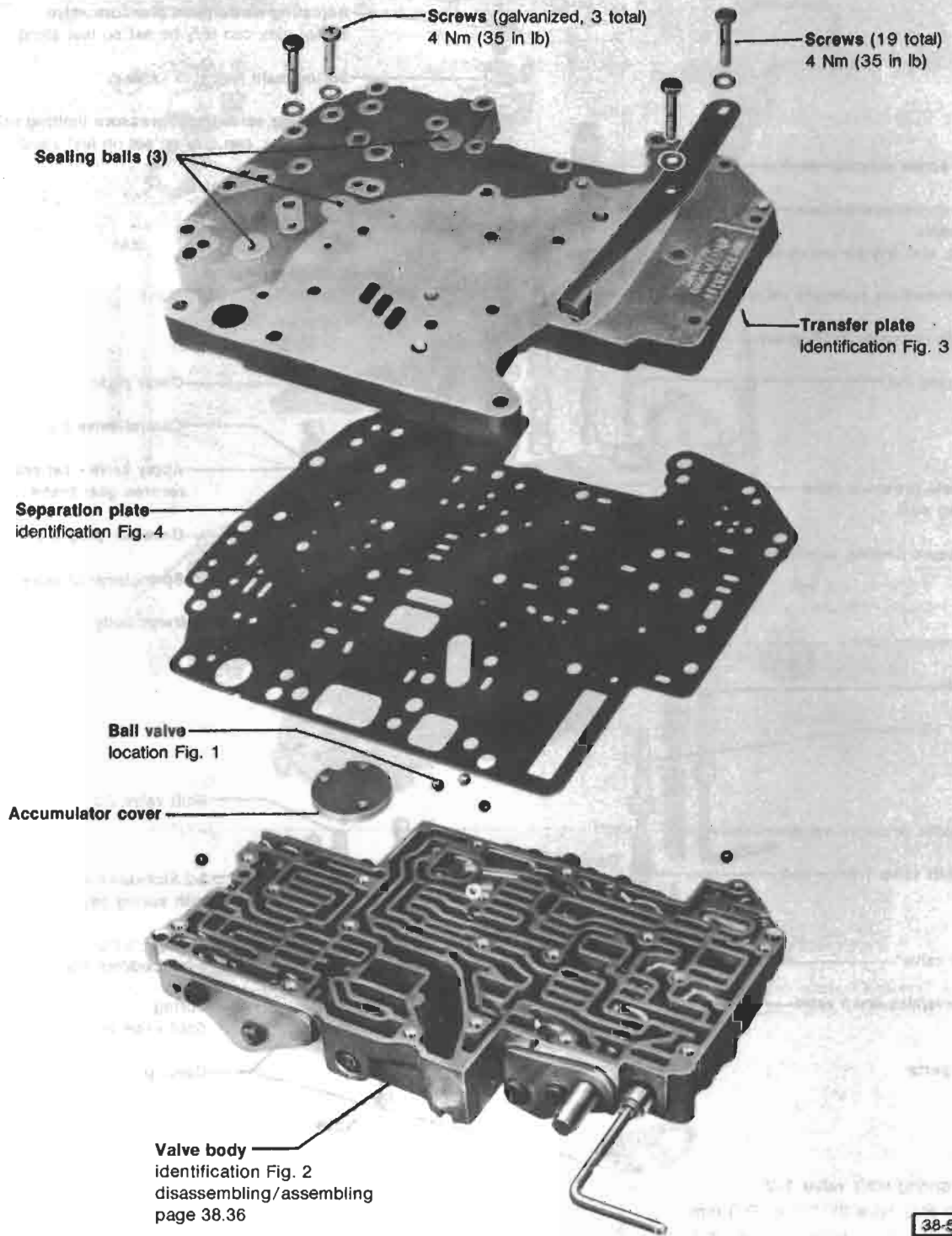
# 38 Automatic Transmission—Case, Gears, Shafts

## Transfer Plate, Separation Plate, Valve Body

Transmission with code letters **NH, NK**  
Modified valve assembly and separation plate

### CAUTION

Tighten screws evenly when assembling



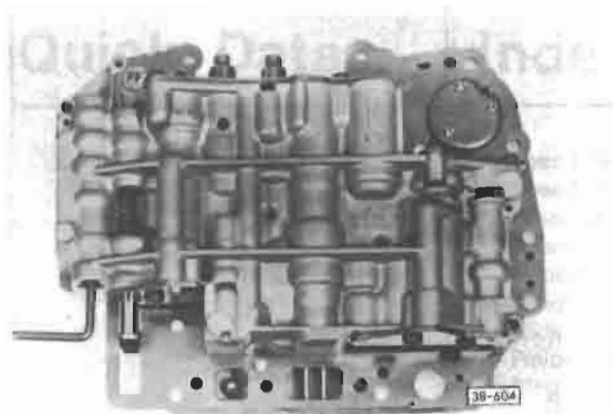
## 38.37

**Transfer plate, Separation plate  
Valve body**  
(trans. 090—code letters NH, NK only)



**Fig. 1 Ball valves, location**

- 1 ball (arrow A) 3 mm dia.
- 5 balls (arrows) 6 mm dia.



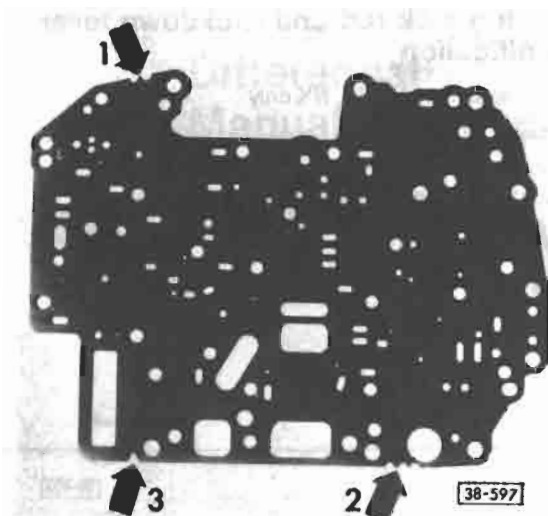
**Fig. 2 Valve body, identification**

- code letters on boss (arrow): FF, FFA (w/NH trans.), NK w/FFA valve body



**Fig. 3 Transfer plate, identification**

- Part No. 010 325 283 J



**Fig. 4 Separation plate, identification**

- 2 notches at arrow 1
- 3 notches at arrow 2
- 1 notch at arrow 3



# 38 Automatic Transmission—Case, Gears, Shafts

## Parking lock rod and Kickdown lever, modification

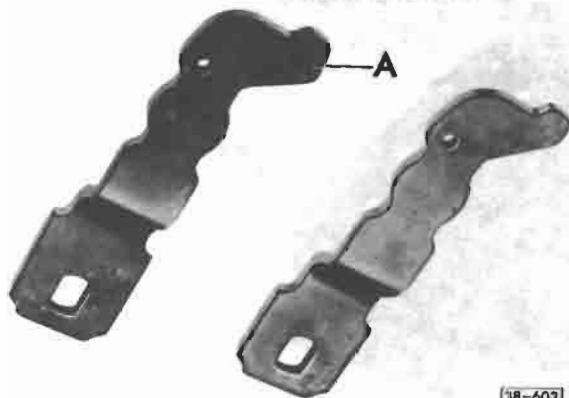
Transmission 090—NH, NK only



38-603

## Parking lock operating rod, modification

With modified operating rod (on hexagon, arrow), parking lock engagement lever is secured with only one circlip



38-602

## Kickdown valve operating lever, modification

Kickdown valve operating lever has been flattened slightly at contact surface **A**

### Note

New kickdown valve operating lever can be installed in previous transmissions, but earlier-type operating lever must not be installed in transmissions with new kickdown valve.

## Automatic Transmission Controls, Assembly

### Index

- |   |  |  |
|---|--|--|
| <ul style="list-style-type: none"><li>— Accelerator cable/linkage<ul style="list-style-type: none"><li>090—except code letters NH 37.12, 37.13</li><li>code letters NH only 37.14, 37.15</li></ul></li><li>— ATF<ul style="list-style-type: none"><li>checking/filling 37.9</li><li>dipstick changes 37.9</li><li>troubleshooting 37.9a</li></ul></li><li>— Final drive oil seal 37.10</li><li>— Installing<ul style="list-style-type: none"><li>090—except code letters NH 37.5, 37.6</li><li>code letters NH only 37.8</li></ul></li><li>— Modifications 37.19</li><li>— Operation 37.17, 37.19</li><li>— Pressure test procedure 37.18</li><li>— Removing<ul style="list-style-type: none"><li>090—except code letters NH 37.4</li><li>code letters NH only 37.6, 37.7</li></ul></li><li>— Selector lever assembly 37.2</li><li>— Selector lever cable 37.3</li><li>— Shift points 37.19</li><li>— Technical data<ul style="list-style-type: none"><li>code letters NG, NH 37.1a</li><li>code letters NK 37.1b</li></ul></li></ul> |  |  |
|---|--|--|

# 37 Automatic Transmission-Controls, Assembly

## Technical Data

- code letters
- application
- number of splined plates and springs
- gear ratios

<b>Transmission</b> code letters	NG		NH	
date of manufacture from to	06/79 10/82		10/82	
Type No.	090			
<b>Torque converter</b> code letter	Z <sup>1</sup>		Z	
<b>Valve body</b> code letters	AH	BH	FF	FFA
date of manufacture from to	06/79 07/80	07/80 10/82	10/82 01/85	01/85
<b>Forward clutch</b> number of splined plates	inner 4	outer 3	inner 4	outer 3
<b>Direct/Reverse clutch</b> number of springs	24		24	
number of splined plates	inner 4	outer 4	inner 4	outer 4
<b>1st/reverse gear clutch</b> number of splined plates	inner <sup>2</sup> 4	outer <sup>2</sup> 4	inner 4	outer 4
<b>2nd gear brake band</b> first tighten, then loosen:	2½ turns		2½ turns	
<b>Application to engine</b>	2.0 ltr. air-cooled 67 bhp SAE net		1.9 ltr. water-cooled 82 bhp SAE net	
<b>Final drive ratio</b>	45:11 = 4:09			
<b>Gear ratios</b>				
1st gear	2.55		2.71	
2nd gear	1.45		1.50	
3rd gear	1.00		1.00	
Reverse	2.46		2.43	
<b>ATF cooler</b>	forward flow 3-row			

1 up to build date 03/27/81 = code letter D

2 up to build date 10/1/81 = 5 inner and 5 outer plates



**Technical data**

<b>Transmission</b>	
Code letters	NK
Manufacture date	07/85 to
Automatic transmission	090
<b>Torque converter</b>	
Code letter	H
<b>Valve body</b>	
Code letters	FFA
Manufacture date	07/85 to
Number of splined plates forward clutch	inner    outer 4        3
Number of springs	24
Number of splined plates direct/reverse clutch	inner    outer 4        4
Number of splined plates 1st gear clutch	inner    outer 4        4
Brake band first tighten, then loosen	2-1/2 turns
<b>Engine application</b>	
Type	Vanagon
Engine	2.1 Liter 90 bhp
<b>Transmission ratios</b>	
Final drive	45:11 = 4.09
1st gear	2.71
2nd gear	1.50
3rd gear	1.00
Reverse gear	2.43
ATF cooler	supply flow 3 row

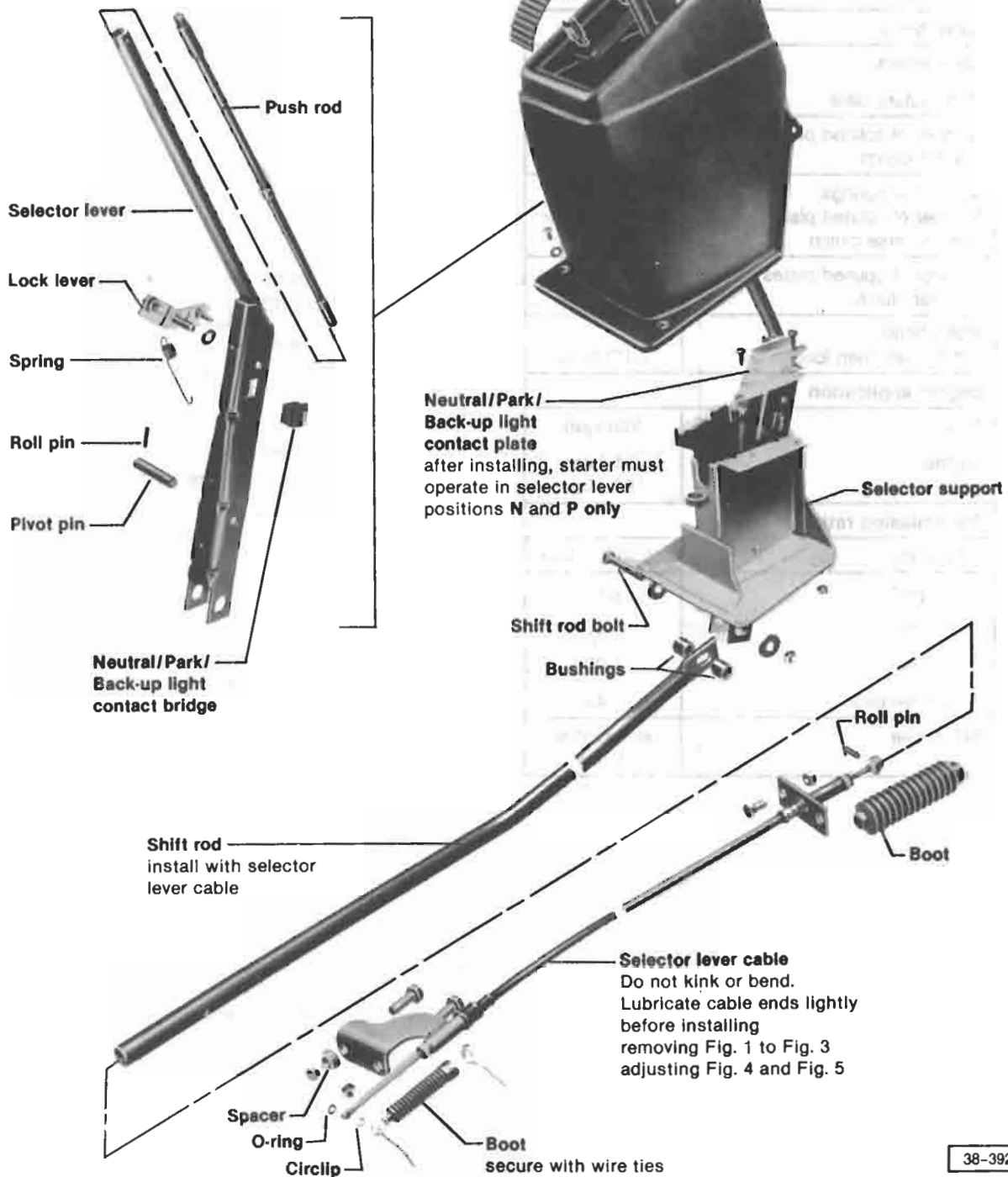
# 37 Automatic Transmission-Controls, Assembly

**CAUTION**

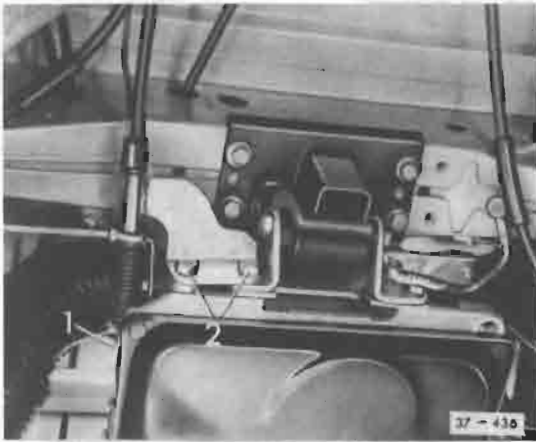
Before starting to work on any part of electrical system disconnect battery ground cable

**Note**

Lubricate all moving parts with G-6 grease.  
Accelerator/Pedal cable adjustment see pages 37.13, 37.15.

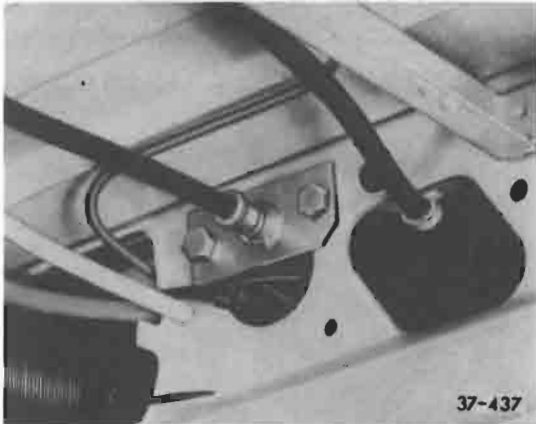


38-392



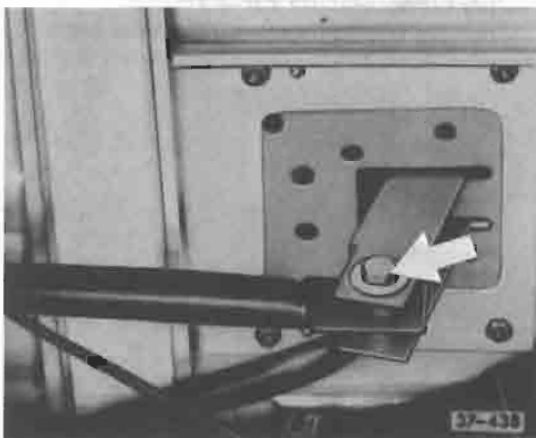
**Fig. 1 Selector lever cable, removing**

- remove circlip 1
- remove selector lever cable bracket 2



**Fig. 2 Selector lever cable, removing**

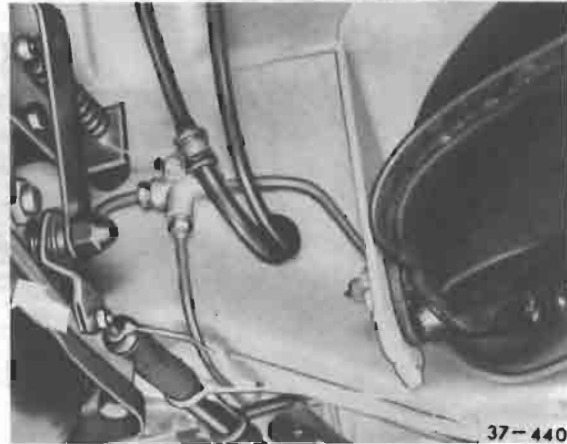
- remove bracket for selector lever cable/shift rod



**Fig. 3 Selector lever cable, removing**

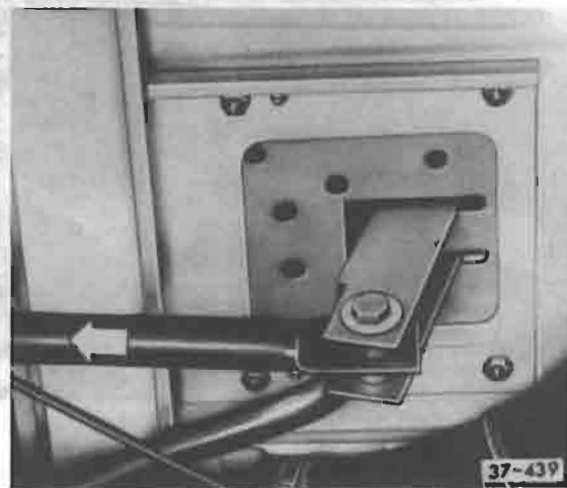
- remove shift rod bolt (arrow)
- guide shift rod with selector lever cable to rear

- press roll pin out of shift rod
- separate selector lever cable from shift rod



**Fig. 4 Selector lever cable, adjusting**

- loosen shift rod bolt (Fig. 3)
- shift selector lever into position P
- push transmission operating lever to rear (arrow), into P position



**Fig. 5 Selector lever cable, adjusting**

- push shift rod to rear (arrow)
- tighten shift rod bolt

38-392

A-6

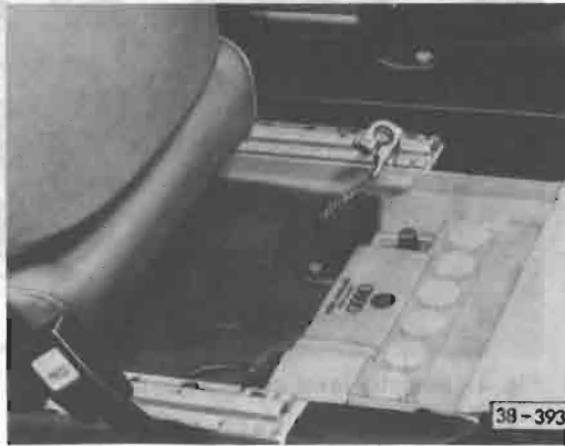
A-9

# 37 Automatic Transmission—Controls, Assembly

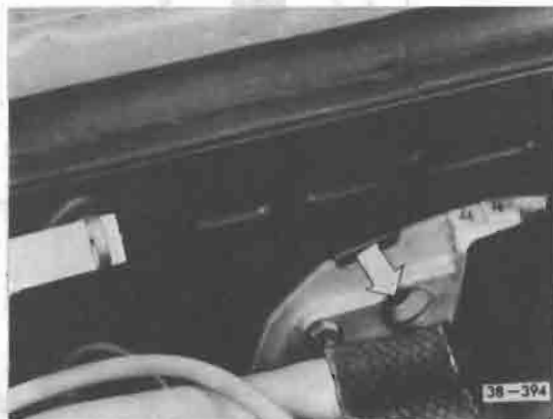
## Automatic transmission, removing (except transmission 090—code letters NH)

Engine installed

Work sequence



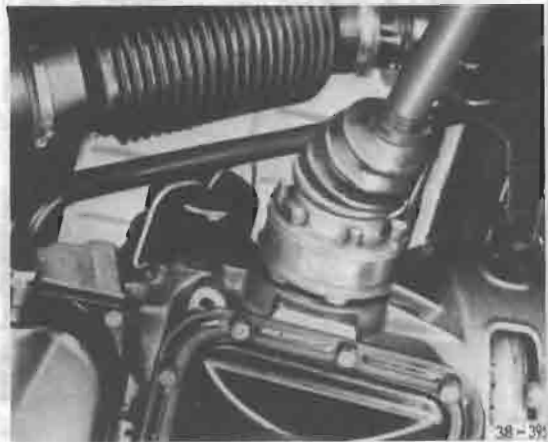
- remove battery ground strap
- remove fan housing grille



### Note

To gain access to torque converter bolts, crankshaft must be rotated until each bolt appears in hole on top of transmission housing (arrow)

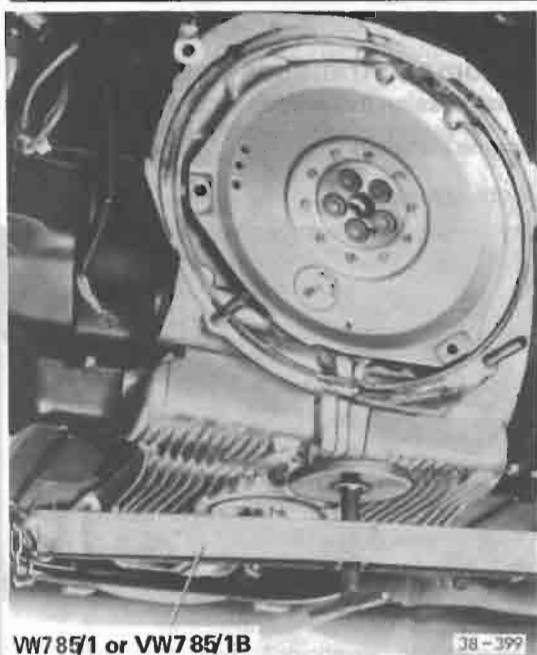
- remove three torque converter bolts through hole (arrow) on top of transmission housing
  - use adaptor 3052, extension and T-handle to turn crankshaft
  - pin on tool must engage in recess of cooling fan hub



- disconnect both drive shafts from transmission
- disconnect wires from starter
- remove starter
- loosen bracket for ATF dipstick tube



- disconnect accelerator linkage 1
- pry off accelerator cable 2
- remove circlip from selector lever cable 3

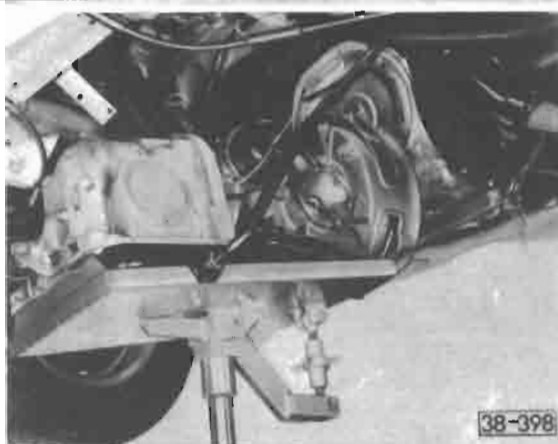


VW785/1 or VW785/1B

- install engine support tool VW 785/1 as shown



- remove ground strap 4
- remove mounting bracket 5 and selector lever cable 6



- support transmission with lifting tool US 618 and US 618/5
- remove rear transmission mount from body (4 bolts)
- remove lower engine/transmission bolts
- lower transmission out of vehicle

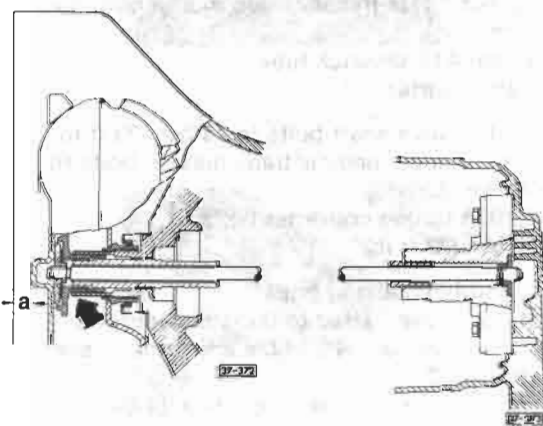
### CAUTION

When lowering transmission out of vehicle, converter must be secured so it does not slide off transmission

### Automatic transmission, installing (except transmission 090—code letters NH)

#### Engine installed

Proceed in reverse order of removing and note following:

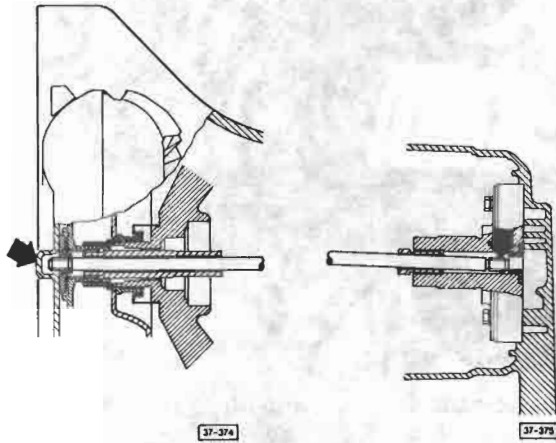


#### Note

When attaching transmission to engine, torque converter must be fully seated on one-way clutch support (arrow) and can be turned by hand. When converter is properly seated, a = 10mm (3/8 in.)

- go to next page

# 37 Automatic Transmission—Controls, Assembly



## CAUTION

If torque converter (left arrow) should slip off of one-way clutch support, it could pull oil pump shaft out of oil pump (right arrow). This could cause serious damage when bolting transmission to engine

- tighten lower engine/transmission bolts to 30 Nm (22 ft lb)

## Note

While tightening engine/transmission bolts, turn torque converter to check for proper seating on one-way clutch support

- tighten 4 rear transmission mount bolts to body
- attach ATF dipstick tube
- install starter
- tighten drive shaft bolts to 45 Nm (33 ft lb)
- tighten upper engine/transmission bolts to 30 Nm (22 ft lb)
- tighten torque converter bolts to 30 Nm (22 ft lb)
- install fan housing grille
- attach ground strap to transmission/body
- check selector lever cable adjustment (see page 37.3)
- check accelerator/pedal adjustment (see page 37.13)

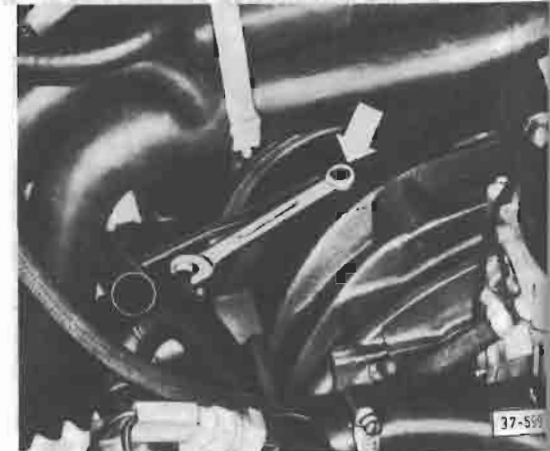
## Automatic transmission, removing (transmission 090—code letters NH only)

Engine installed

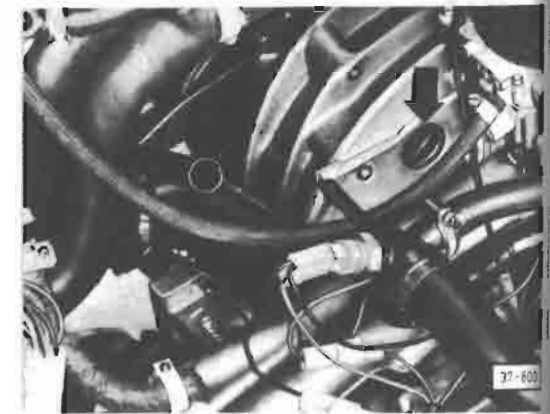
### Work sequence



- disconnect battery ground strap
- remove upper engine/transmission bolts



- remove ATF dipstick
- remove bolt (arrow) for ATF dipstick tube bracket



- remove three torque converter bolts through hole (arrow) on top of transmission housing

## 37.6

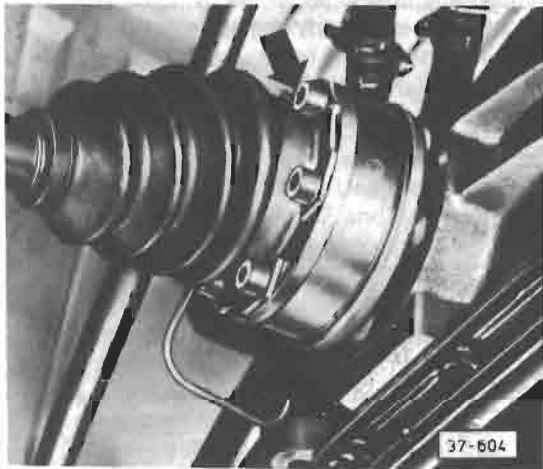
Transmission, removing  
(trans. 090—code letters NH only)

A-11

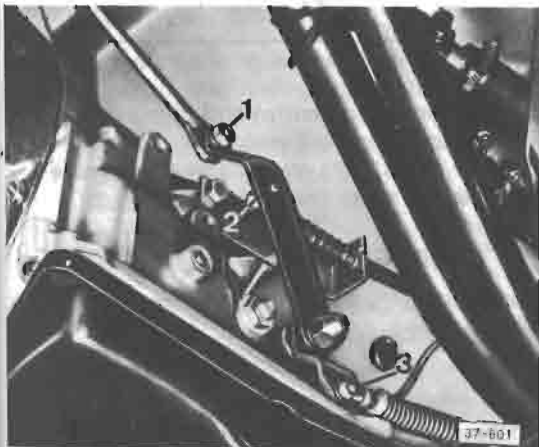


**Note**

Crankshaft must be rotated to gain access to torque converter bolts



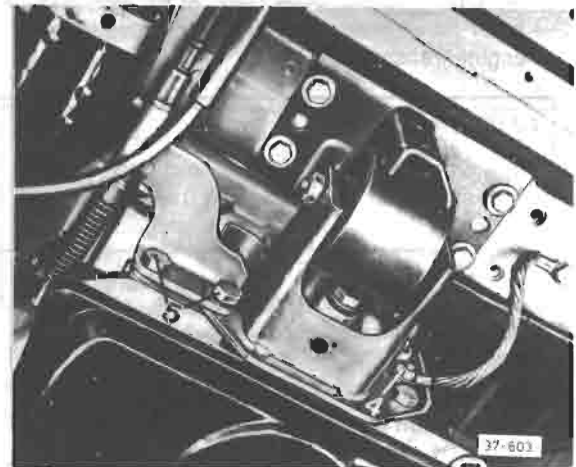
- disconnect both axle shafts from transmission flanges
- disconnect wires from starter
- remove starter



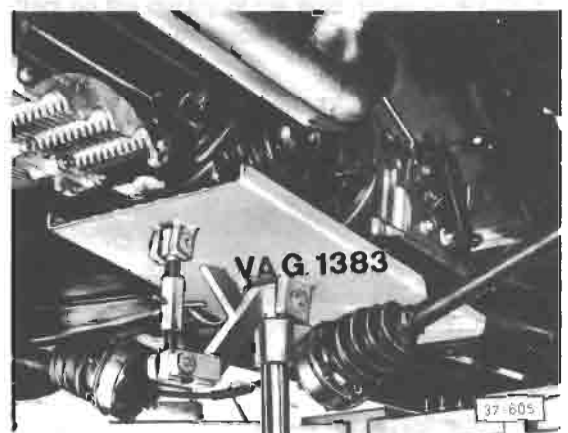
- disconnect push rod from transmission kickdown lever by removing nut 1
- pry off ball socket 2 for accelerator cable and remove cable from bracket
- remove circlip 3 for selector lever cable to disconnect cable



- clamp coolant hoses and remove

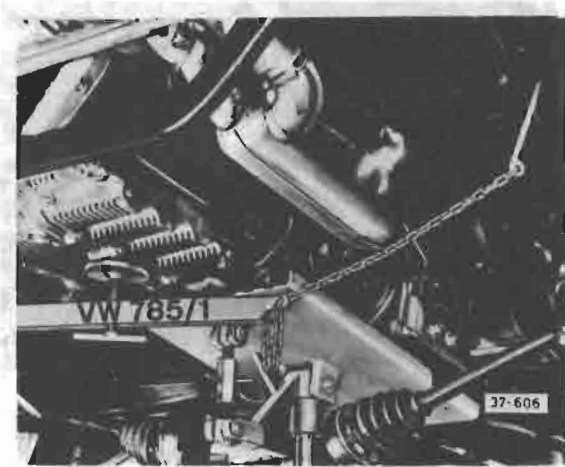


- disconnect ground strap 4
- remove mounting bracket bolts 5 and selector lever cable



- support transmission with US 4470

# 37 Automatic Transmission—Controls, Assembly



- support engine with VW 785/1 or VW 785/1B
- remove rear transmission mount from body (4 bolts)
- lower transmission slightly and remove lower engine/transmission bolt

### CAUTION

Torque converter must be secured from sliding off transmission when lowering transmission out of vehicle.

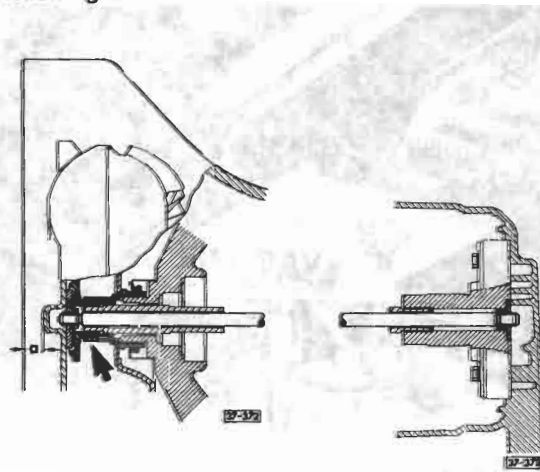
- separate transmission from engine
- lower transmission carefully out of vehicle

## Automatic transmission, installing (transmission 090—code letters NH only)

### Engine installed

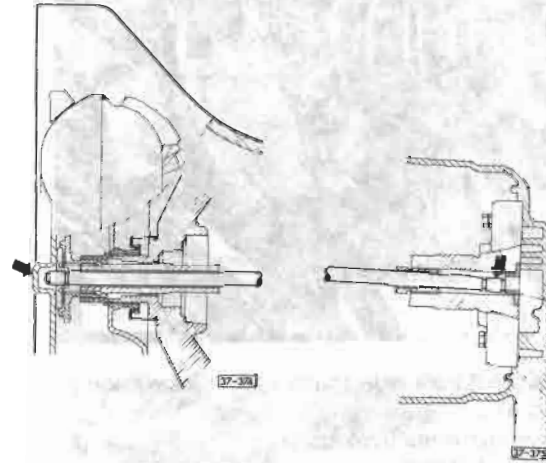
#### Work sequence

Proceed in reverse order of removal and note following:



### Note

When attaching transmission to engine, torque converter must be fully seated on one-way clutch support (arrow) and able to be turned by hand. When torque converter is properly seated,  $a = 10 \text{ mm}$  ( $3/8 \text{ in}$ )



### CAUTION

If torque converter (left arrow) should slip off of one-way clutch support, it could pull oil pump shaft out of pump (right arrow). This could cause serious damage when bolting transmission to engine.

- tighten lower engine/transmission bolts to  $55 \text{ Nm}$  ( $41 \text{ ft lb}$ )

### Note

While tightening engine/transmission bolts, turn torque converter to check for proper seating on one-way clutch support.

- tighten four rear transmission mount bolts to body to  $40 \text{ Nm}$  ( $30 \text{ ft lb}$ )
- tighten axle shaft bolts to  $45 \text{ Nm}$  ( $33 \text{ ft lb}$ )
- tighten upper engine/transmission bolts to  $55 \text{ Nm}$  ( $41 \text{ ft lb}$ )
- tighten torque converter bolts to  $30 \text{ Nm}$  ( $22 \text{ ft lb}$ )
- check selector lever cable and accelerator linkage adjustment (see pages 37.14, 37.15)



## ATF, filling

### CAUTION

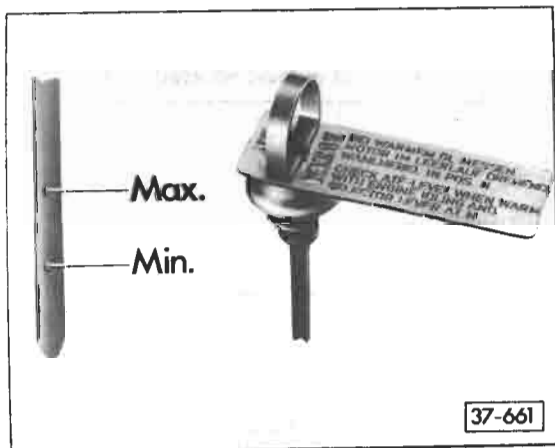
Automatic transmission fluids labeled **DEXRON®** or **DEXRON II®** must be used. All makes or brands of **DEXRON®** ATF may be mixed with one another. Do not use additives.

Tiny particles, dirt or even lint can clog transmission valves. Use only clean funnel and hose to add ATF and wipe dipstick only with clean lint-free cloth

- refill transmission with approved type ATF fluid through ATF dipstick tube with funnel and hose
  - refill capacity 2.5 ltr (2.6 US qt)
- set parking brake, start engine
- move selector lever through all gear positions
- check ATF level and top up to lower mark if necessary
- warm up ATF and check fluid level again
  - must be between two marks on dipstick

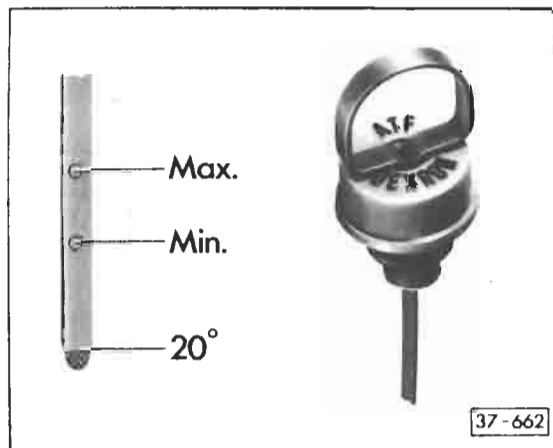
## ATF level, checking

- ATF at operating temperature of approx. 60°C (attained after driving approx. 6 miles after a cold start)
- vehicle on a level surface
- parking brake engaged
- selector lever at "P"
- engine idling
- use a lint-free cloth to wipe dipstick



### Current ATF dipstick

- difference between Min./Max. marks: 0.35 qts. (0.33 L)
- when cold, fill to below the Min. mark, warm up to operating temperature and fill to between marks



### New ATF dipstick

- difference between Min./Max. marks: 0.24 qts. (0.23 L)
- when cold, fill to 20°C mark, warm up to operating temperature and fill to between marks

### CAUTION

Do **NOT** overfill. Too much ATF can cause damage and must be drained.

Use only ATF marked **DEXRON**. Do **NOT** use any lubricant additives.

The ATF used in production vehicles has changed in composition and color from that used in previous years (1980-84).

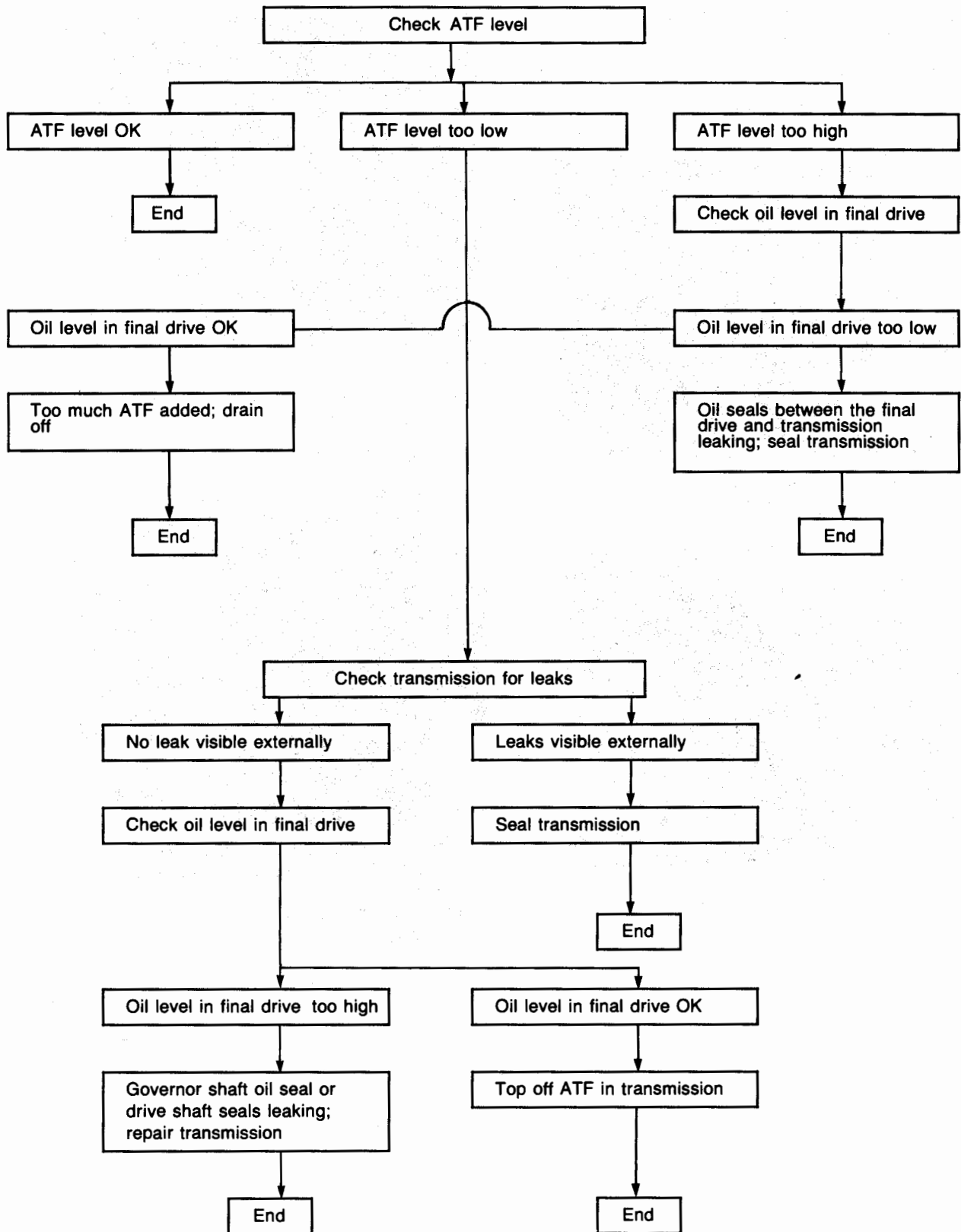
previous color: red

new color: red/brown

The new ATF discolors to black/brown after only short running times. This discoloration has no effect on the quality of the fluid. Changing the fluid is necessary at the recommended service intervals only.

The new ATF and types of ATF **DEXRON** used previously can be mixed.

## ATF level, checking/troubleshooting

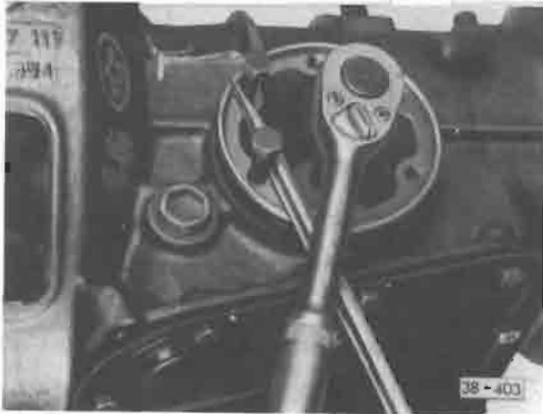


# 37 Automatic Transmission—Controls, Assembly

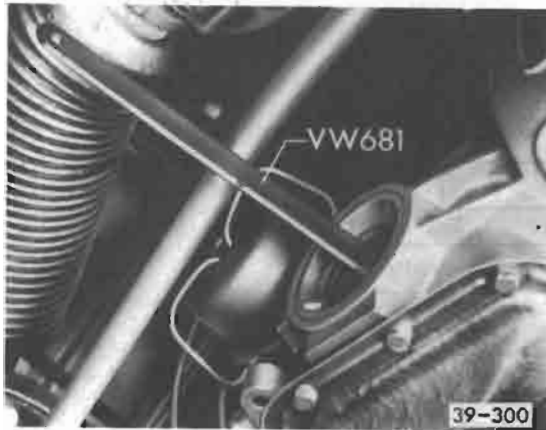
## Final drive oil seals, replacing (Transmission installed)

### Work sequence

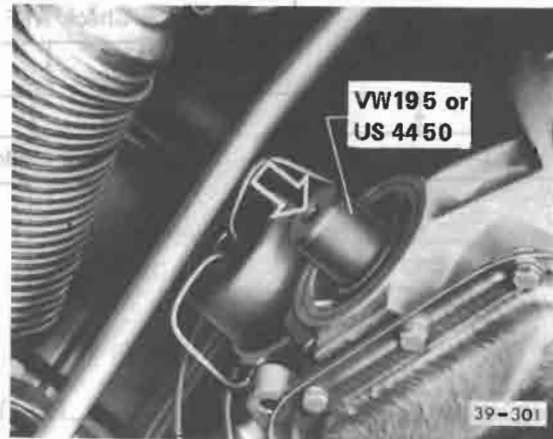
- detach drive shaft from flange



- place drip pan underneath
- remove drive shaft flange



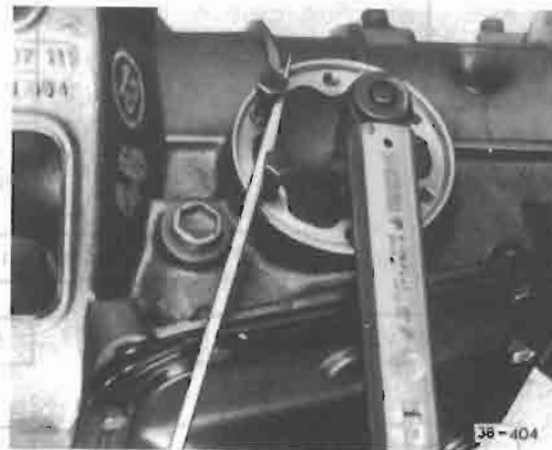
- pry out seal



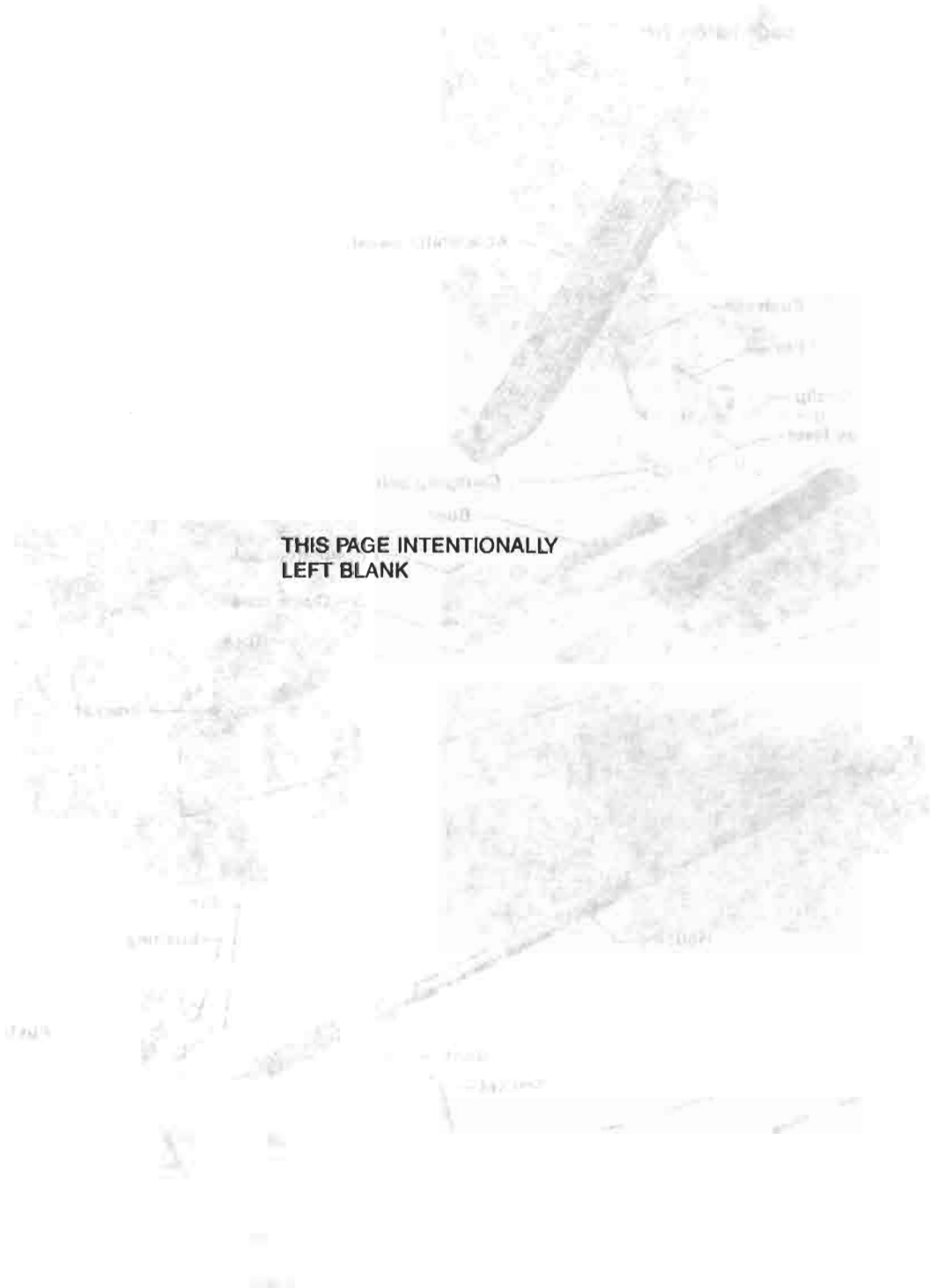
### Note

When installing oil seals, fill space between seal lips with multi-purpose grease

- drive seal in until fully seated

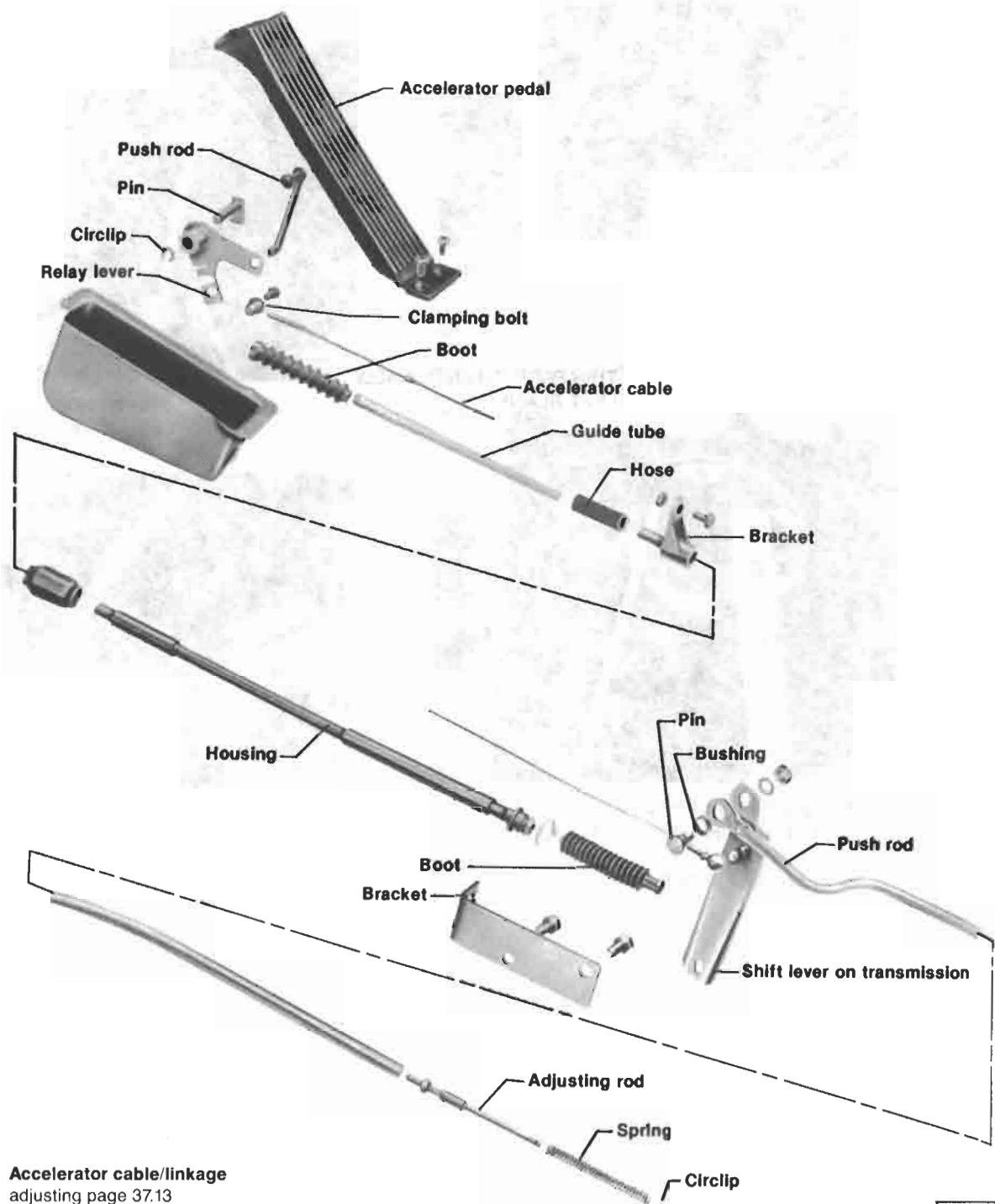


- tighten drive flange bolt to 25 Nm (18 ft lb) and drive shaft mounting bolts to 45 Nm (33 ft lb)
- check transmission oil level and add if necessary



# 37 Automatic Transmission—Controls, Assembly

Accelerator linkage  
(except transmission 090—code letters NH)



Accelerator cable/linkage  
adjusting page 37.13

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## 37.12 Accelerator cable/linkage (except trans. 090—code letters NH)

A-12

A-2

## Accelerator linkage/cable adjustment, checking

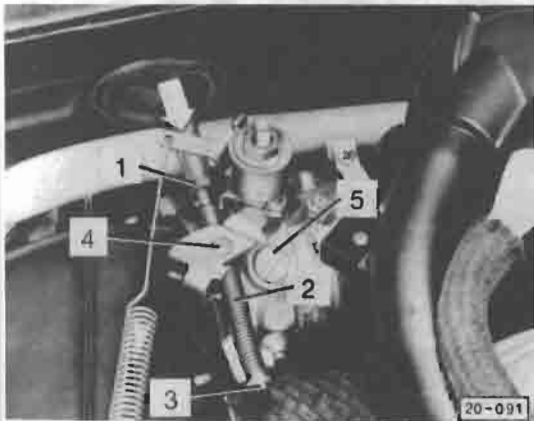
(except transmission 090—code letters NH)

### Work sequence

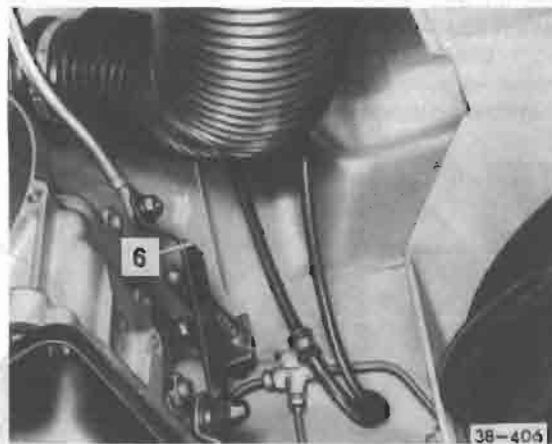
- depress accelerator pedal to full throttle position
    - throttle valve lever must contact stop, but kickdown lever on transmission must **not** be in kickdown position
  - press accelerator pedal beyond full throttle to floor
    - override spring must be tensioned and kickdown lever on transmission must be in kickdown position
- if NO, adjust as follows:

### Accelerator linkage/cable, adjusting

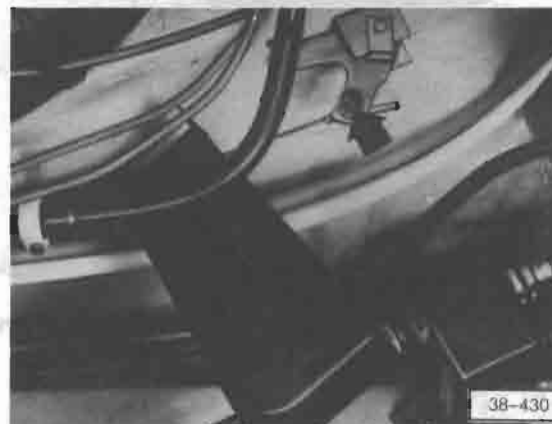
### Work sequence



- loosen nut 1
- remove override spring 2
- start engine and let idle
- adjust idle speed at screw 5 (see Repair Group 24)
- shut engine **OFF**
- press accelerator rod in direction of arrow to stop
- turn adjusting rod 3 with screwdriver until shoulder of adjusting rod just contacts pivot of throttle lever 4
- reinstall override spring 2
- start engine and check idle speed
  - adjust if necessary by turning rod 3
- lock adjusting rod 3 in position with nut 1



- press accelerator pedal to floor
  - lever 6 must be in kickdown position (arrow), with approx. 1–2mm (1/32–3/32 in.) free play between lever and stop
- release accelerator pedal
- lever must be in idle position (out of kickdown)

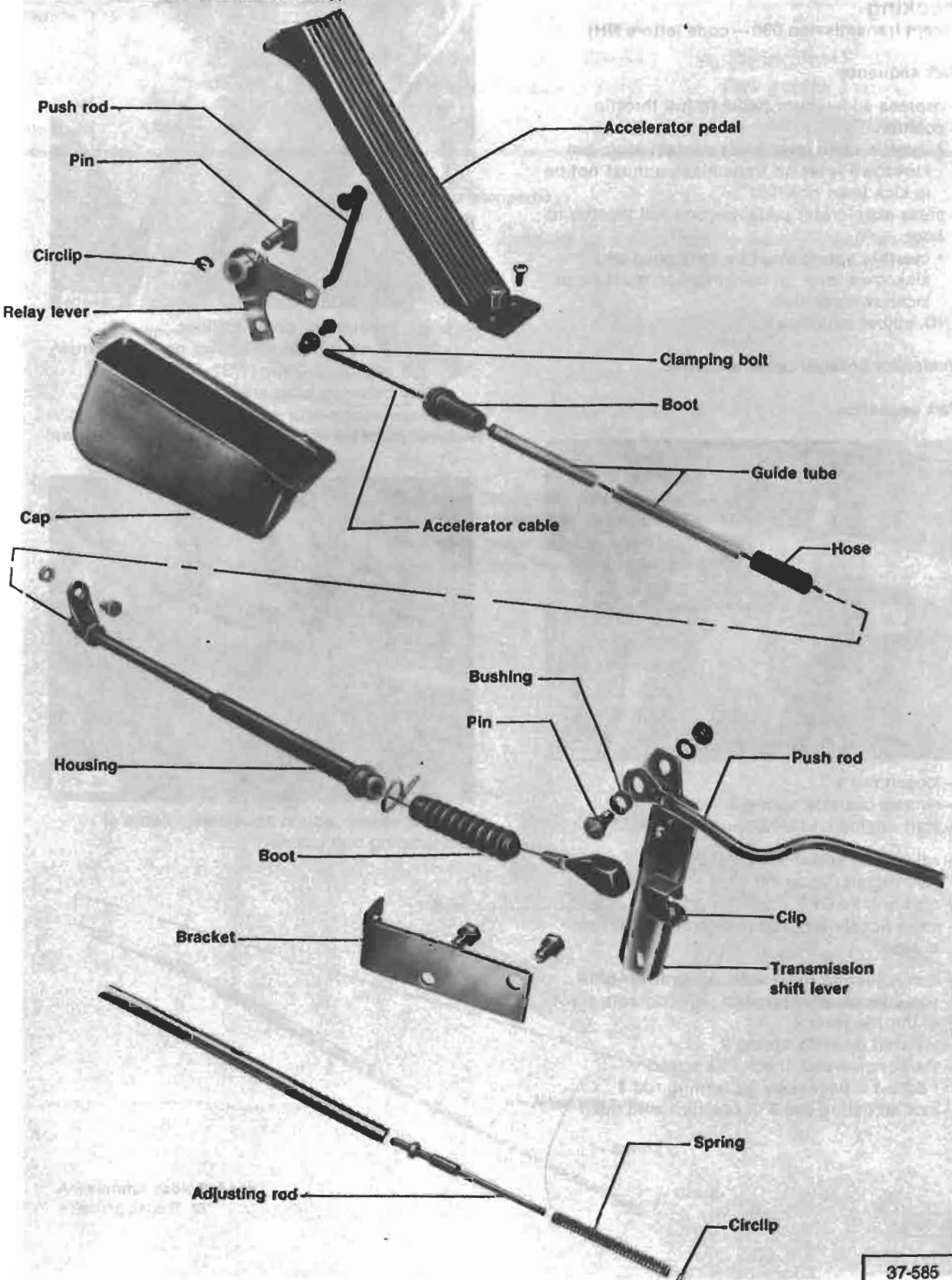


- if necessary, adjust accelerator cable at clamping bolt (arrow)

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# 37 Automatic Transmission—Controls, Assembly

Accelerator linkage  
(transmission 090—code letters NH only)



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## 37.14 Accelerator linkage (trans. 090—code letters NH only)

## Accelerator linkage/cable adjustment, checking

(transmission 090—code letters NH only)

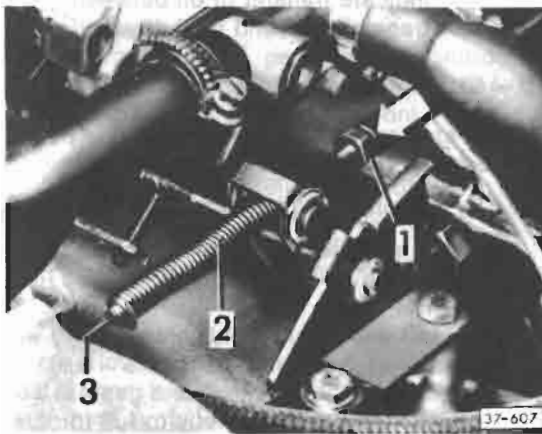
### Work sequence

- depress accelerator pedal to full throttle position
  - throttle valve lever must contact stop, but kickdown lever on transmission must **not** be in kickdown position
- press accelerator pedal beyond full throttle to floor
  - override spring must be compressed and kickdown lever on transmission must be in kickdown position

If **NO**, adjust as follows:

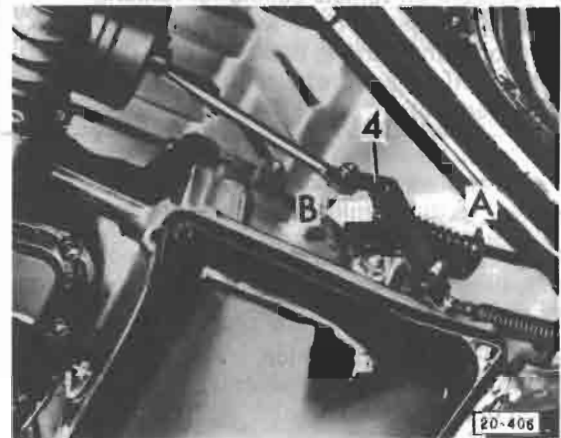
### Accelerator linkage/cable, adjusting

#### Work sequence

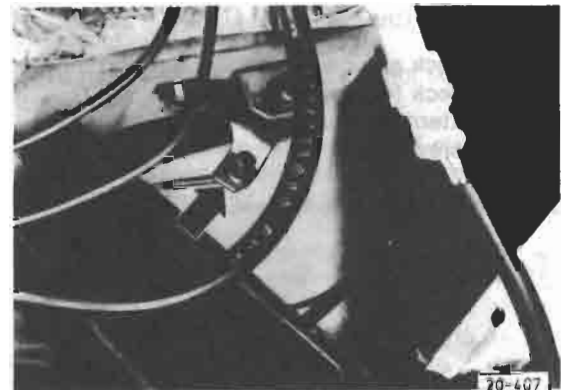


- loosen nut 1
- remove override spring 2
- start engine and run at idle
- check and adjust idle if necessary (see Repair Group 24)
- shut engine **OFF**
- pull accelerator rod in direction of arrow to stop (closed throttle position)
- turn adjusting rod 3 with screwdriver until shoulder of adjusting rod just contacts pivot of throttle lever

- reinstall override spring 2
- start engine and check idle speed
- if necessary, adjust idle speed by turning rod 3
- lock adjusting rod 3 in position with nut 1



- press accelerator pedal to floor
  - kickdown lever 4 must be in kickdown position on stop (arrow A)
- release accelerator pedal
  - kickdown lever 4 must be in closed throttle position on stop (arrow B)



- if necessary, adjust accelerator cable at clamping bolt (arrow)



# 37 Automatic Transmission—Controls, Assembly

## Transmission operation, checking

### CAUTION

All work on vehicle calling for running engine must be done with selector lever at **N** or **P** and parking brake applied. Only exceptions are pressure test and stall speed test

For proper transmission operation, engine idle speed, ignition timing, etc. must be correct.

Poor engine output because of incorrect adjustments or worn parts may give impression of problems with automatic transmission.

Before checking operation, try to find out how problem developed and whether any repairs had been done before.

Trouble is often caused by out of adjustment selector lever cable/accelerator cable, low ATF level or improperly tuned engine.

Before performing tests, do general checks **A** and road test **E**. If problem still exists, proceed with tests **B** to **E**.

### A — General Checks

- check engine idle speed, ignition timing
- check for leaks (ATF or hypoid oil), external damage, loose or missing screws, etc.

### B — Transmission fluid level, checking

- check that vehicle is level
- place selector lever in **P** and apply parking brake. Idle engine. (ATF must be lukewarm)
- check that ATF level is between two marks on dipstick
  - difference between upper and lower marks is approx. 0.5 ltr (0.5 US qt)
- add ATF fluid if necessary

### CAUTION

Tiny particles, dirt or even lint can clog transmission valves. Use only clean funnel and hose to add ATF and wipe dipstick only with clean lint-free cloth

- do not overfill, too much fluid will upset operation of transmission
- check smell and appearance of ATF. Burnt smell may indicate burnt friction linings and trouble in control system

### CAUTION

Automatic transmission fluids labeled **DEXRON®** or **DEXRON II®** must be used. All makes or brands of **DEXRON®** ATF may be mixed with one another. Do not use additives.

### C — Final drive oil level, checking

- final drive oil level must be up to edge of oil filler hole
- if level is too high or too low it may indicate transfer of oil between transmission and final drive

### D — Stall speed test

Check stall speed only if vehicle shows poor performance or poor acceleration

- engine must be warm
- connect tachometer (use adapter to avoid damage to electronic ignition, see Repair Group 28)
- start engine and hold vehicle firmly with parking brake and foot brake
- put selector lever in **D** and depress accelerator pedal briefly to full throttle
- check that engine now runs between
  - 1950 and 2250 rpm (stall speed) for all automatic transmissions except 090—code letters NH
  - 2450 and 2750 rpm (stall speed) for automatic transmissions 090—code letters NH only
  - 2500 and 2750 - code letters NH

### CAUTION

Do not continue stall speed test longer than time required to read tachometer. Maximum stall speed test time 5 seconds. If necessary to repeat test, wait at least 20 seconds.

### Note

Normal stall speed will drop 125 rpm per 3200 ft altitude. Stall speed will also drop slightly at high ambient air temperature

— if stall speed is not as specified, refer to troubleshooting table as follows:

Effect	Cause
Stall speed too high	<p>forward clutch or one-way clutch for 1st gear slipping</p> <p>If stall speed rpm in range D is too high repeat test in range 1</p> <ul style="list-style-type: none"> <li>• if stall speed rpm is within specifications one-way clutch for 1st gear is defective</li> <li>• if stall speed rpm is still too high, forward clutch is defective</li> </ul>
Stall speed too low	
a—if approx. 200 rpm below specified figure	poor engine performance (ignition timing, fuel injection, compression)
b—if approx. 400 rpm below specified figure	stator one-way clutch defective (replace torque converter)

### E — Road test

Vehicle should be driven in all gear ranges and under all possible road conditions. Do not road test if there is obvious mechanical damage

### Shift Points in km/h (mph)

Transmission 090 up to transmission No. 16 07 0 (except code letters NH)		
Shift	Full throttle	Kickdown
1-3	26-33 (16-21)	48-52 (30-32)
2-3	67-72 (42-45)	88-91 (55-57)
3-2	41-48 (25-30)	84-86 (52-53)
2-1	19-22 (12-14)	43-47 (27-29)

Transmission 090—code letters NH only		
Shift	Full throttle	Kickdown
1-2	25-40 (16-25)	50-53 (31-33)
2-3	59-74 (37-46)	85-87 (53-55)
3-2	43-58 (27-36)	80-83 (50-52)
2-1	17-22 (11-14)	39-42 (24-26)

Transmission 090— from transmission No. 17 07 0 (except code letters NH)

— see page 37.19

When checking shift points, speedometer readings may vary within permissible manufacturing tolerances.

- note shift points and compare to chart above. Shifts should be smooth and should take place quickly and without lag in power transmission
- listen for any sign of engine speedup between shifts which indicates slipping brake bands or clutches
- after road test, check transmission for fluid leaks

### Note

If shift points are incorrect or transmission does not kick down, check accelerator cable adjustments.

### F — Pressure test

### Note

Pressure test only if defect cannot be found during other checks.

This test will locate defects in ATF circuit (internal leakage, wear, sticking control valves or dirt in ATF system)



- gauge connection (arrow)
- go to next page

# 37 Automatic Transmission—Controls, Assembly

## Test procedure

- connect gauge with 0-10 kg/cm<sup>2</sup> (0-142 psi) scale
- measure three different main pressures as follows:

Selector lever position	Accelerator pedal position	Code letters	Main pressure kg/cm <sup>2</sup> (psi)	Test conditions
D	idle speed	NG NH NK	2.90-3.00 (41-43)	accelerate to 50 km/h (31 mph), release accelerator pedal (idle speed) and check pressure on gauge*
	full throttle	NG NH	5.85-5.95 (83-84)	*
		NK	6.80-6.90 (96-98)	
R	idle speed	NG	7.62-8.22 (108-117)	vehicle stationary
		NG (from 17 070)	9.10-9.70 (129-138)	
		NH NK	9.00-10.00 (128-142)	

\*These tests should be performed on a dynamometer

If specified values are not reached, check following:

Fault	Remedy
Oil pump defective	Check pump for wear, replace if necessary
Oil leaks at seals and sealing surfaces or leakage in housing	Check for leaks, particularly at valve body transfer plate
Sticking control valve	Disassemble and clean valve body, check valves for free movement

## Shift points in km/h (mph)

Transmission 090 — code letters NG (from transmission 17 07 0)		
Shift	Full throttle	Kickdown
1-2	25-36 (16-22)	49-52 (30-32)
2-3	60-76 (37-47)	89-90 (55-56)
3-2	43-60 (27-37)	84-86 (52-53)
2-1	17-20 (11-12)	44-47 (27-29)

Transmission 090 — code letters NK		
Shift	Full throttle	Kickdown
1-2	22-38 (13-24)	48-58 (30-36)
2-3	59-73 (37-45)	86-95 (53-59)
3-2	36-56 (22-35)	76-86 (47-53)
2-1	14-19 (9-12)	37-47 (23-29)

## Clutch and brake band operation

This table shows which shift components are in operation in various gears.

It provides basis for determining which shift components are not working properly when complaints are made of poor acceleration, faulty shifting or general transmission defects.

**Example:** No drive in 3rd and R gears  
Possible cause; D + R clutch does not work (must be applied)

Selector lever position	1	2 or D	2 or D	D	R
Gears	1st	1st	2nd	3rd	Reverse
Forward clutch	applied	applied	applied	applied	released
D + R clutch	released	released	released	applied	applied
1st + R gear brake plates	applied	released	released	released	applied
2nd gear brake band	released	released	applied	released	released
One-way clutch	inactive	holding	overrun	overrun	inactive

## 094-4WD Manual Transmission Case, Gears, Shafts

Quick Data	Index	
	<ul style="list-style-type: none"> <li>- Adjusting rings installing 35.96 marking/removing 35.95</li> <li>- Assembling/Disassembling 35.99 35.100</li> <li>- Assembly 35.94, 35.98, 35.105</li> <li>- Axle flange installing 35.96 removing 35.95</li> <li>- Bearing, removing 35.122 installing/checking 35.123 inner race, removing 35.122</li> <li>- Clutch housing 35.111</li> <li>- Differential lock servo 35.96</li> <li>- Drive flange seal installing 35.115</li> <li>- Drive pinion 35.121</li> <li>- Driveshaft flange removing 35.104</li> <li>- Flange nut loosening/tightening 35.104</li> <li>- Flange seal installing 35.104</li> <li>- Gear carrier 35.107, 35.116 disassembling/assembling 35.108-35.110</li> <li>- Gears 1st, 2nd and 3rd, removing 35.122</li> <li>- Housing 35.113</li> <li>- Intermediate housing removing 35.106</li> <li>- Low gear idler removing 35.106</li> <li>- Low gear shim measuring 35.101, 35.102</li> <li>- Lower gear bearing removing/installing 35.126</li> </ul>	<ul style="list-style-type: none"> <li>- Main shaft 35.117 bearing, removing/ installing 35.119</li> <li>- Main shaft seal removing/installing 35.112</li> <li>- Needle bearing removing/installing 35.115, 35.119, 35.120</li> <li>- Needle bearing inner race, loosening/ tightening 35.123 outer race, installing 35.126 outer race, removing 35.125</li> <li>- Output housing 35.103</li> <li>- Output shaft bearing removing/installing 35.114</li> <li>- Rear driveshaft measuring 35.97</li> <li>- Reverse gear idler removing/installing 35.106</li> <li>- Shift rod bushing removing/installing 35.115</li> <li>- Shift shaft seal removing/installing 35.114</li> <li>- Starter bushing removing/installing 35.112</li> <li>- Synchronizer rings identification 35.127</li> <li>- 1st/2nd gear synchronizer checking/installing 35.124, 35.125</li> <li>- 3rd gear installing 35.125</li> <li>- 3rd/4th gear synchronizer 35.118 installing 35.119</li> </ul> <p><b>4-Speed 091</b> — See page 35.1</p> <p><b>4-Speed 091/1</b> — See page 35.31</p> <p><b>5-Speed 094</b> — See page 35.61</p>

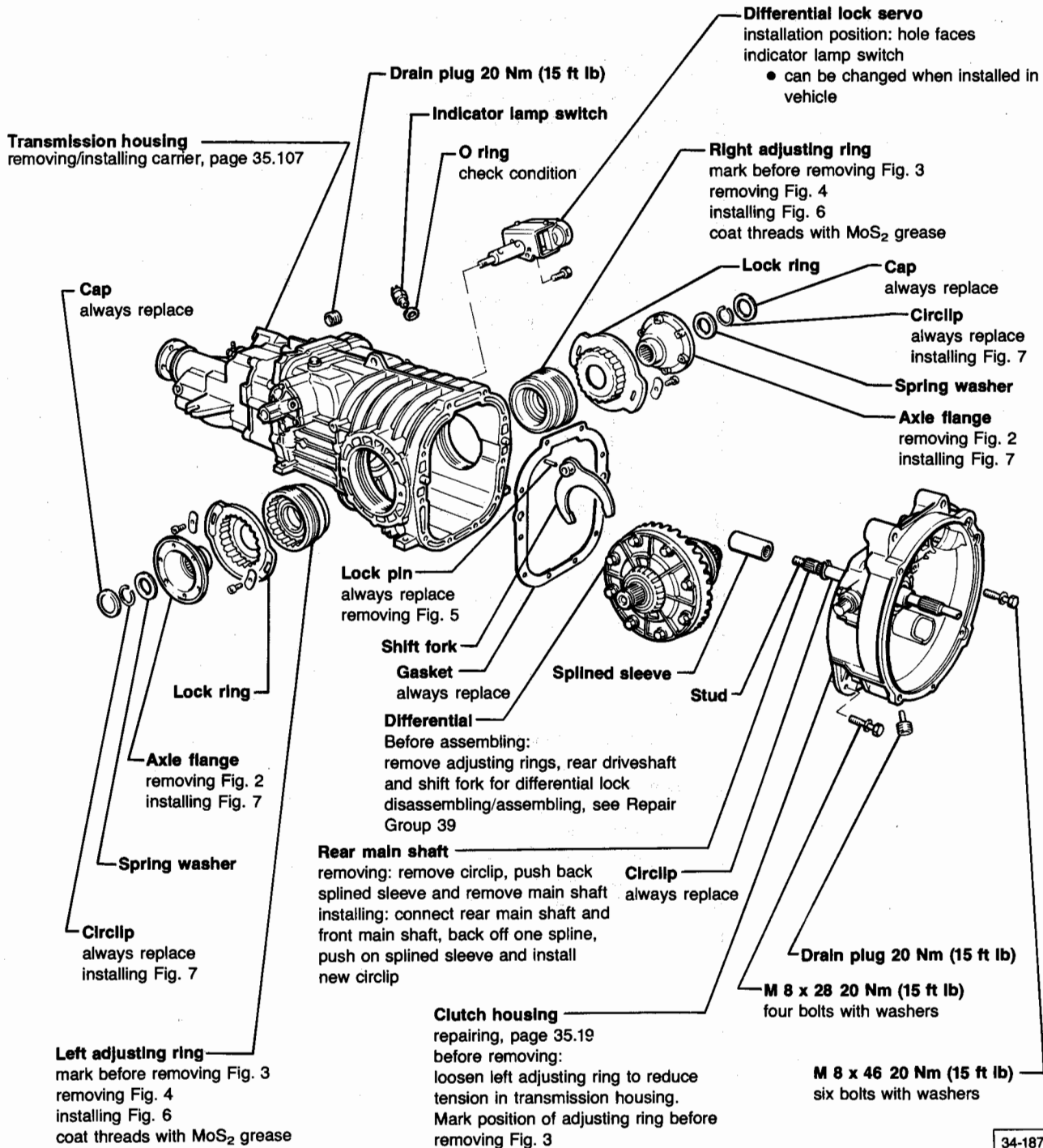
# 35 Manual Transmission—Case, Gears, Shafts

## Note

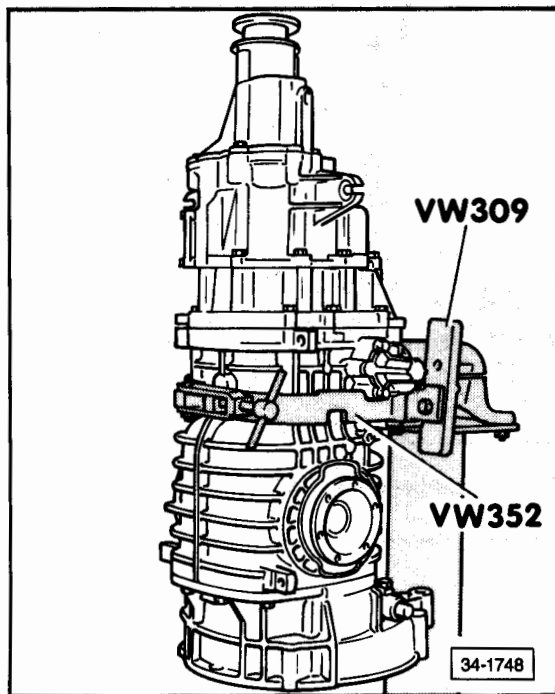
Before disassembling, mount transmission in assembly stand (Fig. 1) and drain transmission fluid.

## CAUTION

Protect driveshaft oil seal from damage by the driveshaft splines before removing and installing the clutch housing. Pull a wiring harness conduit or similar covering over the driveshaft.

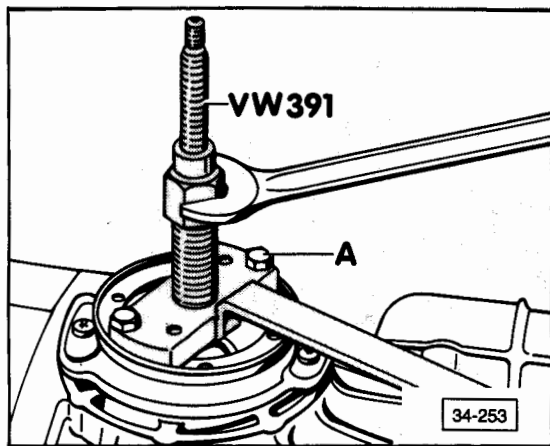


34-1877



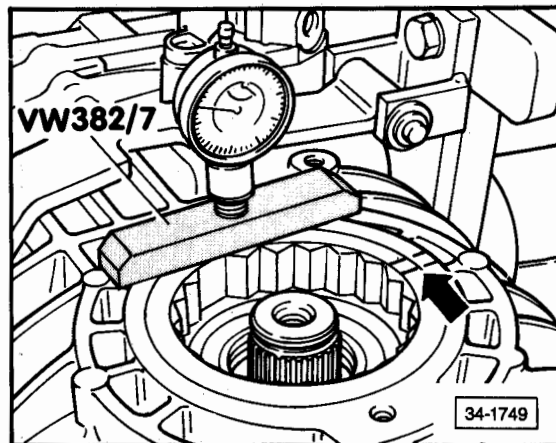
**Fig. 1 Transmission, mounting in repair stand**

— remove shift rod lever and backup lights switch before mounting transmission in repair stand



**Fig. 2 Axle flange, removing**

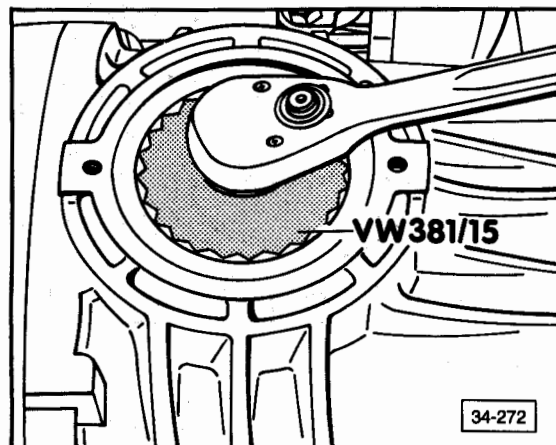
A = screw 2 bolts (M 8 x 30) through slots in axle flange



**Fig. 3 Adjusting ring, marking position**

When differential is not being replaced:

- mark position of adjusting rings in relation to transmission (**arrow**)
- mark left side (ring gear side with one scratch, mark right side with two scratches
- measure installed depth with VW 382/7



**Fig. 4 Adjusting rings, removing**

# 35 Manual Transmission – Case, Gears, Shafts

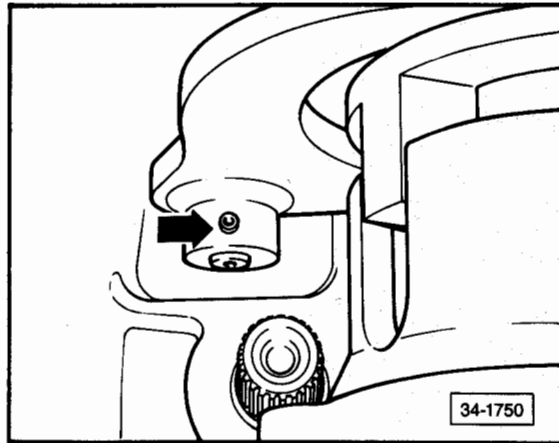


Fig. 5 Differential lock servo, removing

- drive out shift fork lock servo
- remove differential lock servo from shift fork

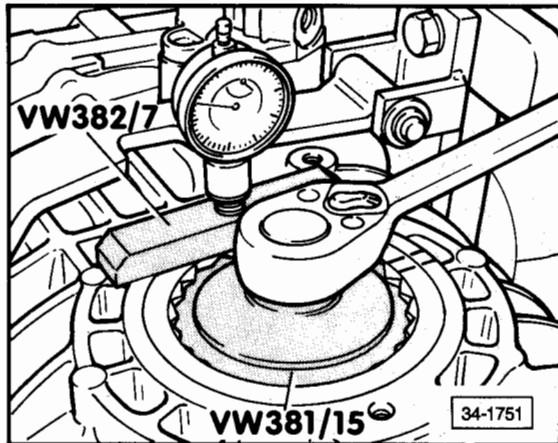


Fig. 6 Adjusting rings, installing

- install adjusting rings into transmission housing using previously marked position
- check that depth equals previous measurement

## CAUTION

Tighten left bearing ring after the clutch housing is installed and torqued.

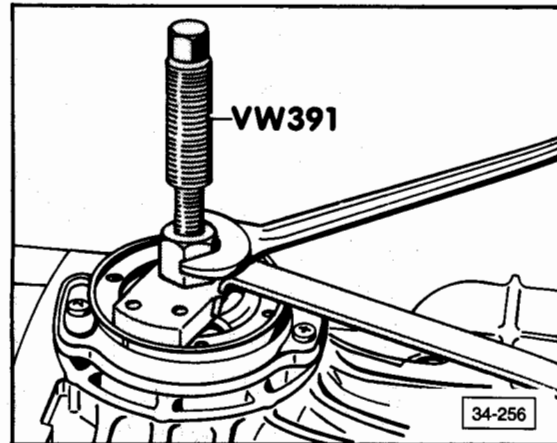


Fig. 7 Axle flange, installing

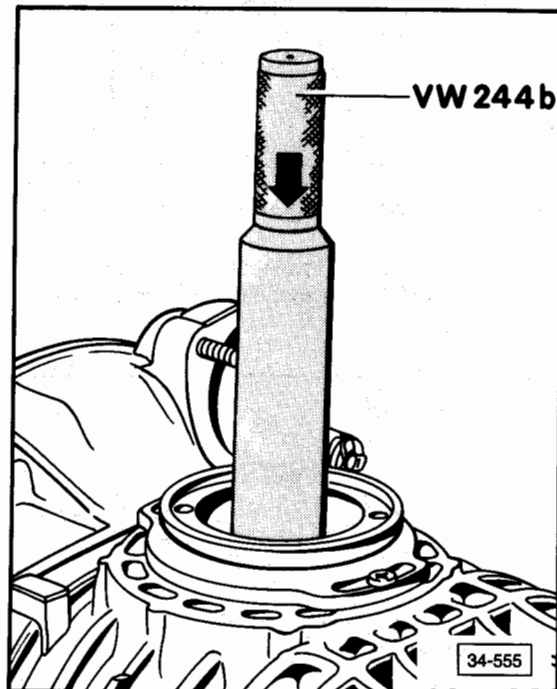
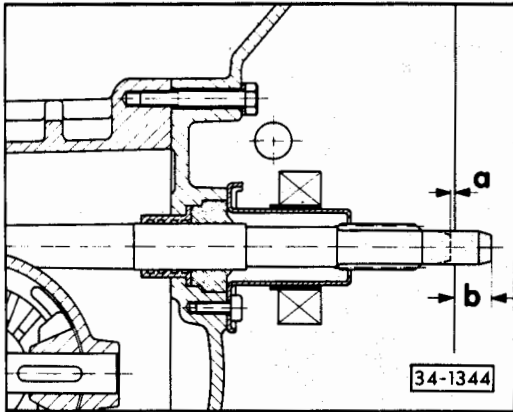


Fig. 8 Circlip, installing

- install spring washer and circlip
- press circlip into groove
  - make sure spring washer is fully seated





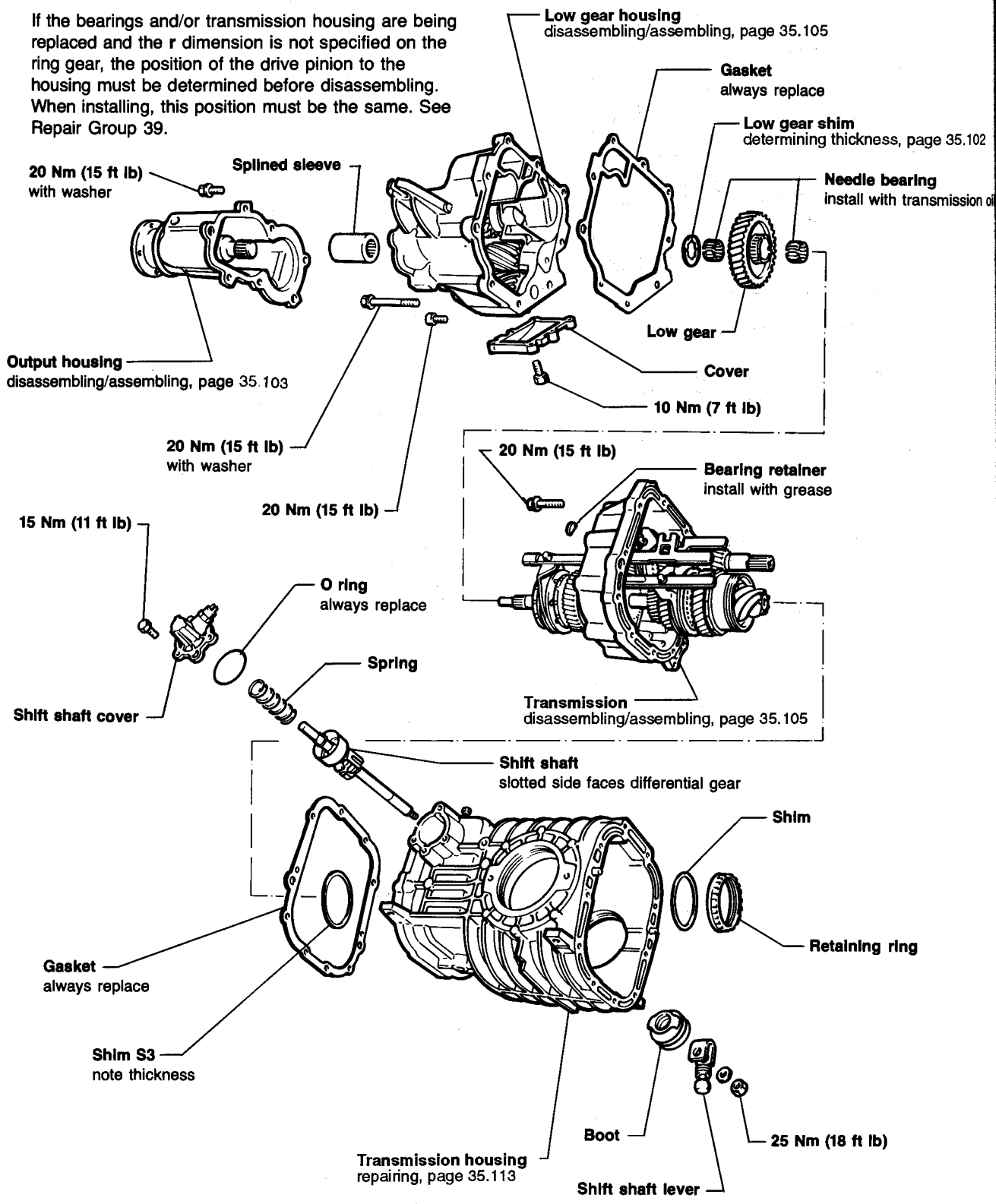
**Fig. 9 Rear driveshaft, measuring**

- dimension **b** = 27 mm (1.06 in.)
- total length = 298 mm (11.73 in.)

# 35 Manual Transmission – Case, Gears, Shafts

**Note**

If the bearings and/or transmission housing are being replaced and the r dimension is not specified on the ring gear, the position of the drive pinion to the housing must be determined before disassembling. When installing, this position must be the same. See Repair Group 39.

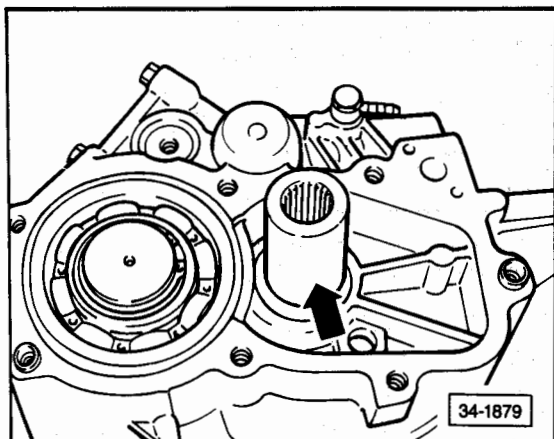


34-1878

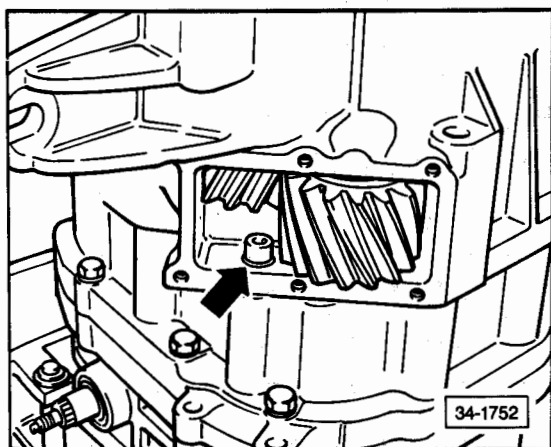
## Transmission, disassembling/ assembling

### Disassembling

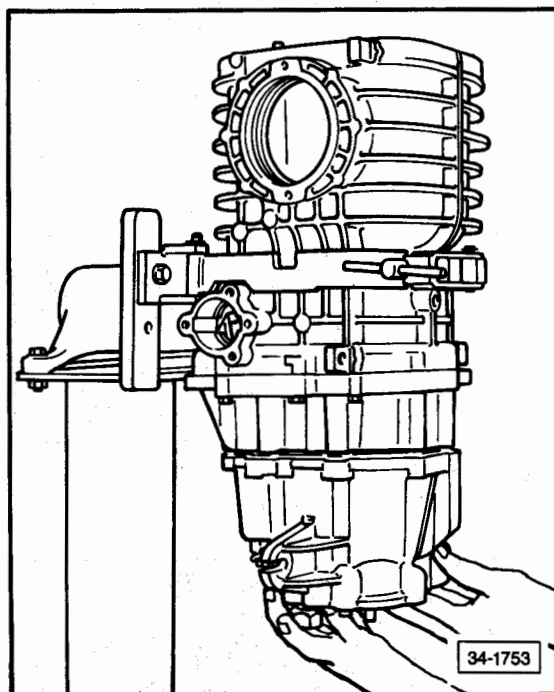
- remove output housing bolts
- remove housing



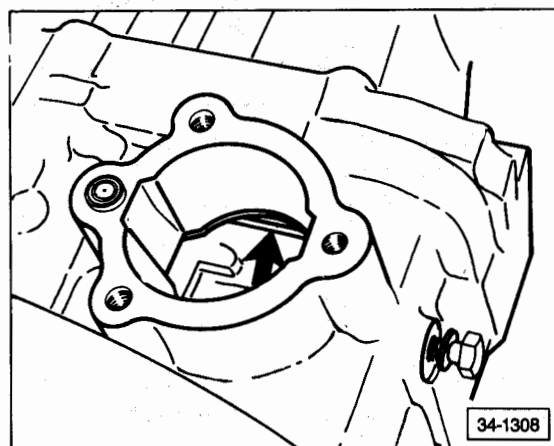
- remove splined sleeve (arrow)
- remove cover for reverse idler gear



- remove bolt (arrow)
- remove low gear housing bolts



- rotate transmission 180° (1/2 turn)
- remove low gear housing along with low gear, needle bearing and shim
- unbolt shift shaft cover
- remove shift shaft



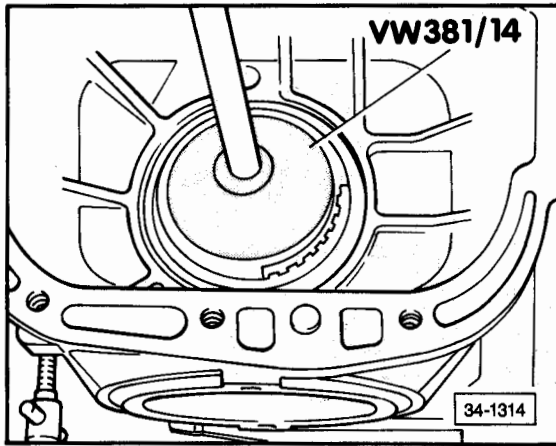
- loosen bolt until relay lever (arrow) pulls against housing
- tighten bolt by hand to lock lever in that position

35.102

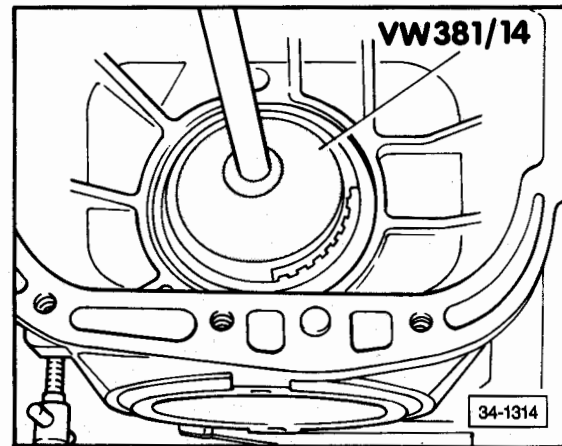
mission oil

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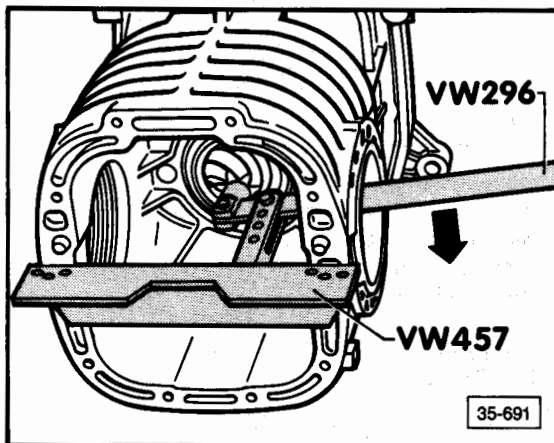
# 35 Manual Transmission – Case, Gears, Shafts



- remove retaining ring
- remove end shield from housing



- tighten retaining ring to 225 Nm (162 ft lb), loosen and tighten again to 225 Nm (162 ft lb)

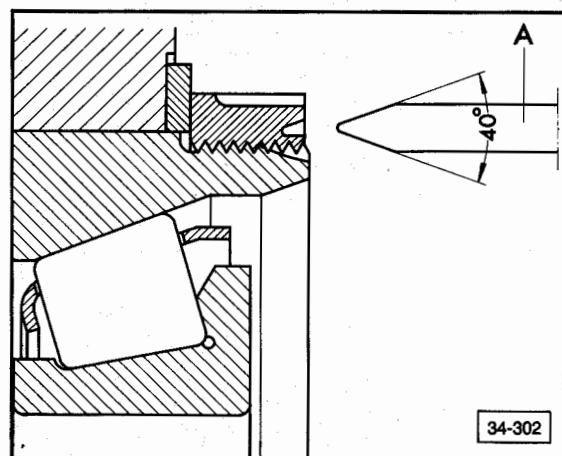


- attach VW 457 with two M 8 x 20 bolts
- push out gear carrier
- remove shim S3 and note thickness

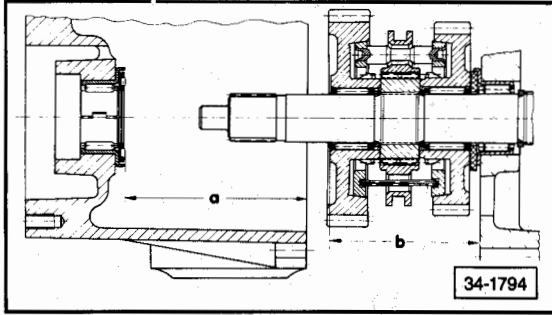
## Assembling

Before installing gear carrier:

- position shim S3 and new gasket
- position shift rail
- position bearing to opening in housing
- heat bearing seat in transmission housing to 40-60° C (130-166° F)
- seat bearing using a plastic hammer on drive pinion
- check for binding
- install retaining ring and shim (75 mm wide)



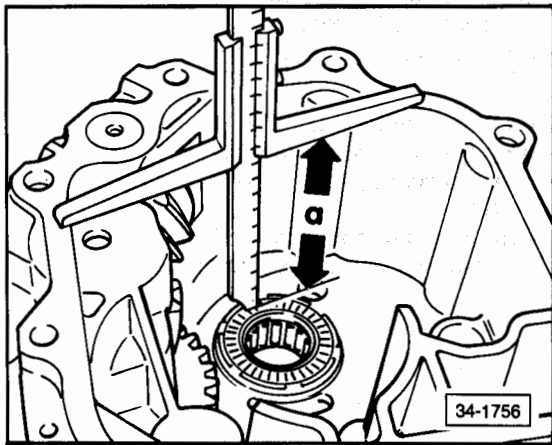
- secure retaining ring at two places by staking
- bolt end shield to transmission housing
- loosen relay lever bolt
- position lever and tighten bolt to 20 Nm (15 ft lb)
- install shift shaft with slotted side facing differential gear
- install new seal in cover
- position cover with spring and tighten bolts to 15 Nm (11 ft lb)



Adjustment range =  $a - b$

Dimension  $b = x - y$

### Low gear shim, determining thickness

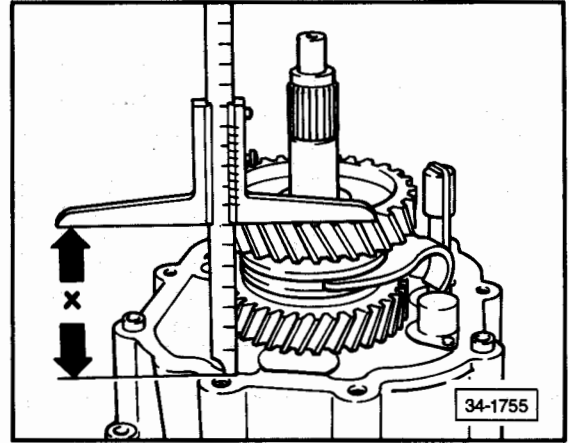


— measure dimension  $a$

#### Example

$a = 77.8 \text{ mm}$
-----------------------

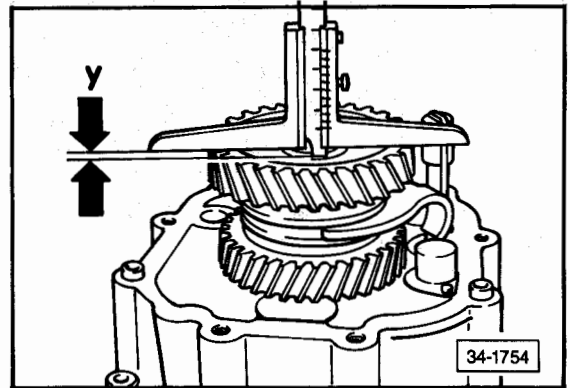
— measure dimension  $x$



#### Example

$x = 77.6 \text{ mm}$
-----------------------

— measure dimension  $y$



#### Example

$y = 1.0 \text{ mm}$
----------------------

Dimension  $b = x - y$

#### Example

$x = 77.6 \text{ mm}$
$-y = 1.0 \text{ mm}$
<hr/>
76.6 mm

Adjustment range =  $a - b$

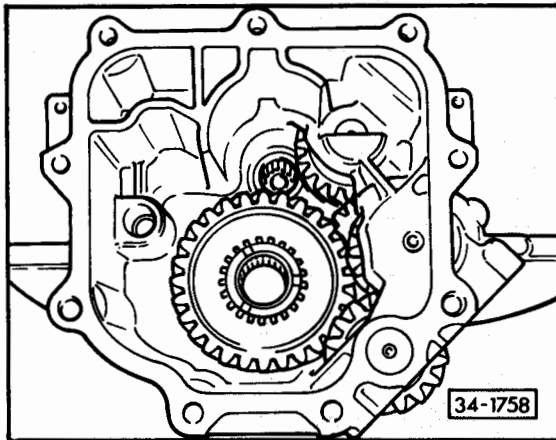
#### Example

$a = 77.8 \text{ mm}$
$-b = 76.6 \text{ mm}$
<hr/>
1.2 mm

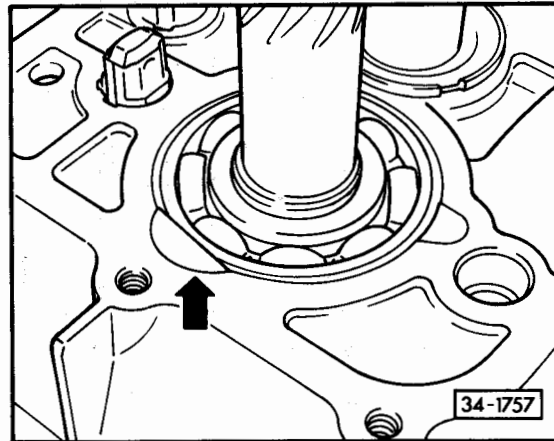
# 35 Manual Transmission – Case, Gears, Shafts

Available shims:

Adjustment range (mm)	Shim Thickness	Part Number
0.95-1.14	0.6	094 311 379
1.15-1.34	0.8	094 311 379 A
1.35-1.54	1.0	094 311 379 B
1.55-1.74	1.2	094 311 379 C
1.75-1.94	1.4	094 311 379 D
1.95-2.14	1.6	094 311 379 E
2.15-2.47	1.8	094 311 379 F



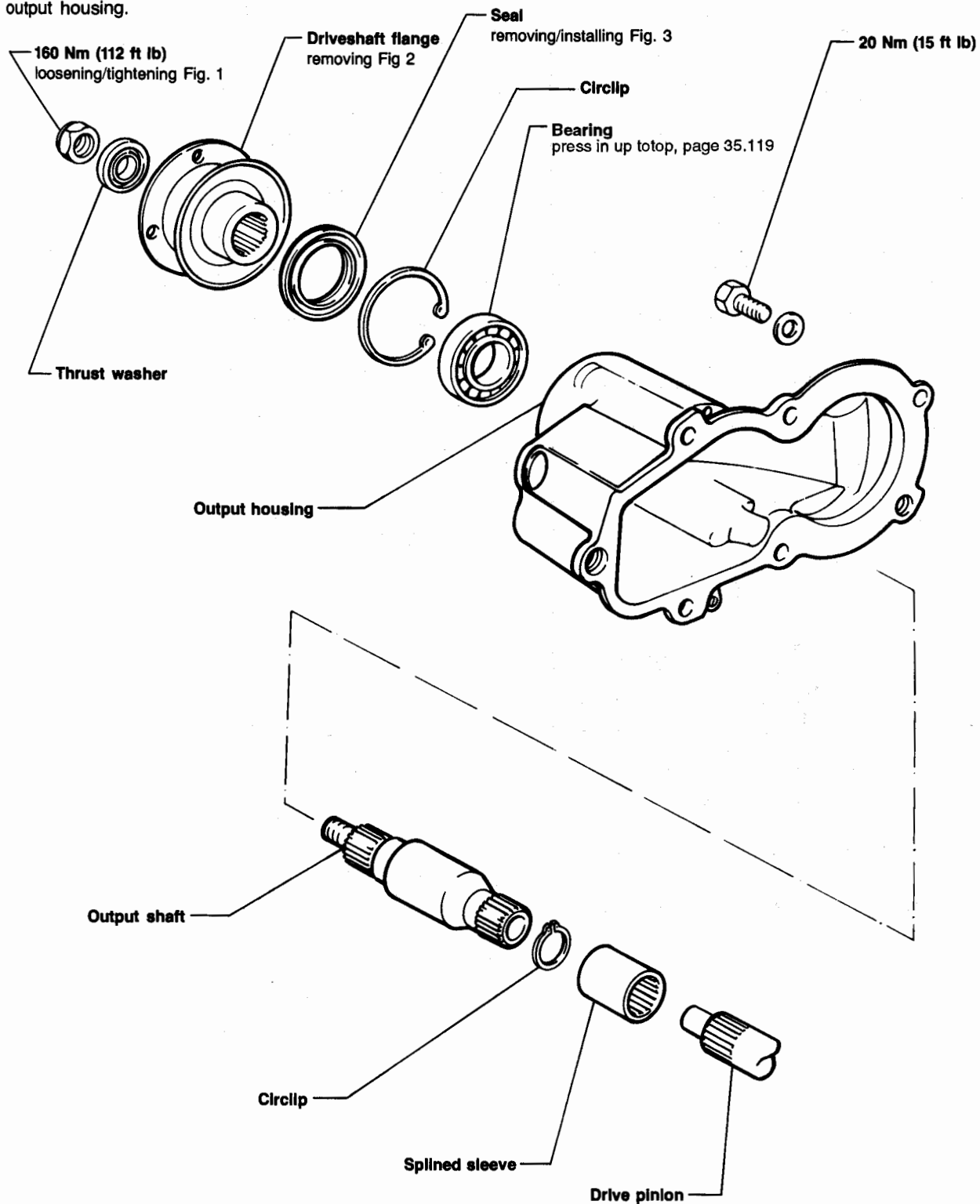
- install shim, low gear disc and needle bearing in low gear housing
- position new gasket



- install bearing retainer with grease (arrow)
- rotate transmission 180° (1/2 turn)
- push low gear housing from below, guiding gear and shim to drive pinion
- install mounting bolt and tighten to 20 Nm (15 ft lb)
- install reverse idler gear cover
- push splined sleeve onto drive pinion
- install output housing, tighten bolts to 20 Nm (15 ft lb)
- install back up light switch and shift shaft lever after removing transmission from repair stand

**Note**

To remove low gear housing, completely remove output housing.

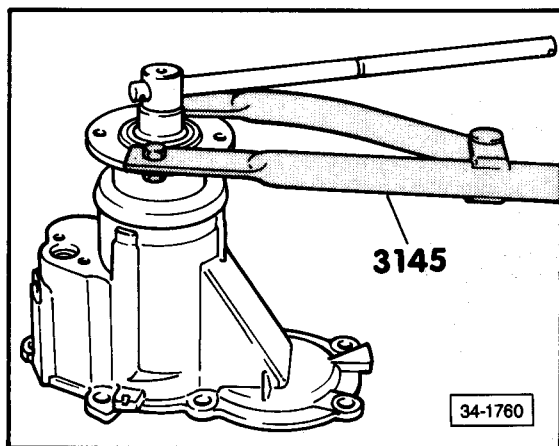


34-1880

094-4WD

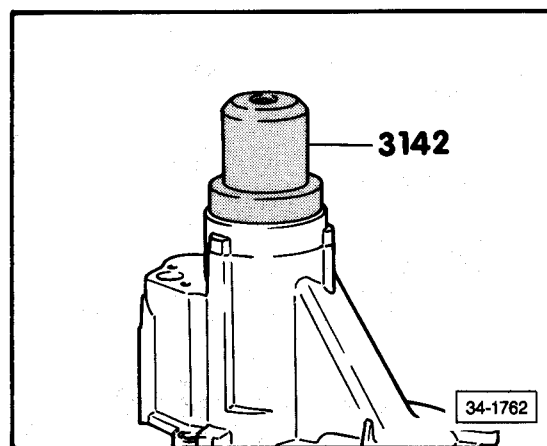
Output housing

**35.103**



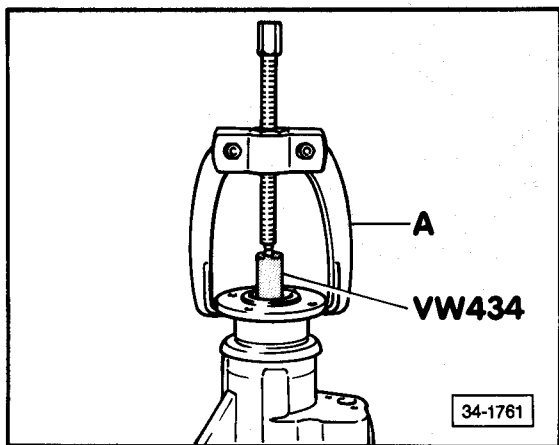
**Fig. 1 Flange nut, loosening/tightening**

- secure flange with tool
- loosen or tighten to 160 Nm (112 ft lb)



**Fig. 3 Flange seal, installing**

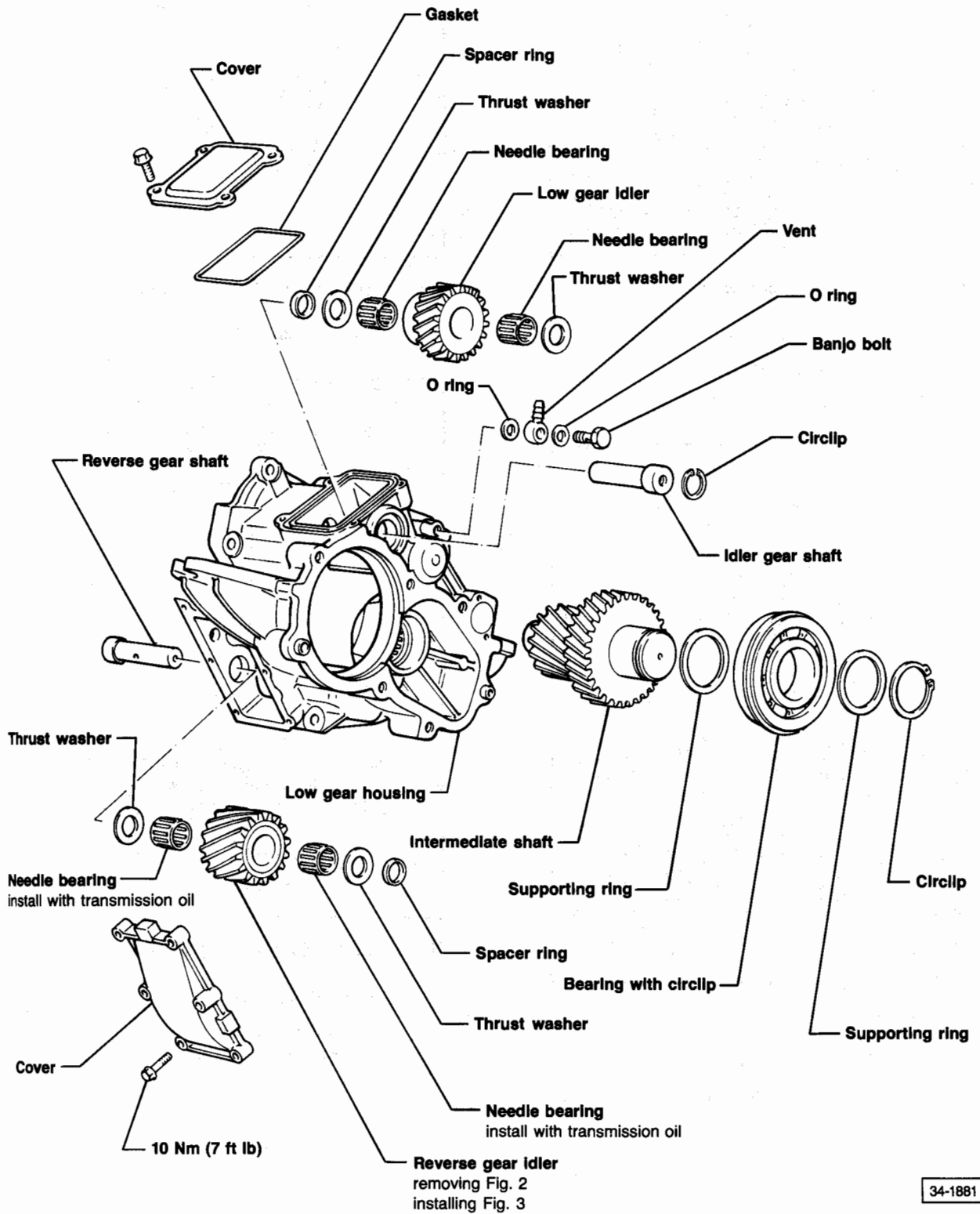
- press seal in to stop



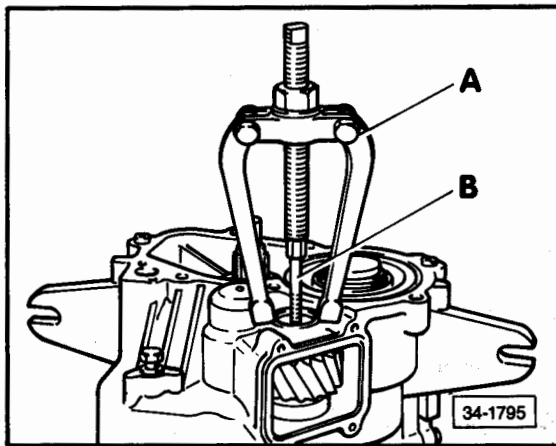
**Fig. 2 Driveshaft flange, removing**

- if necessary, pull off flange with a two armed extractor
- A** — two armed extractor of commercial size, e.g. Kukko 44-2



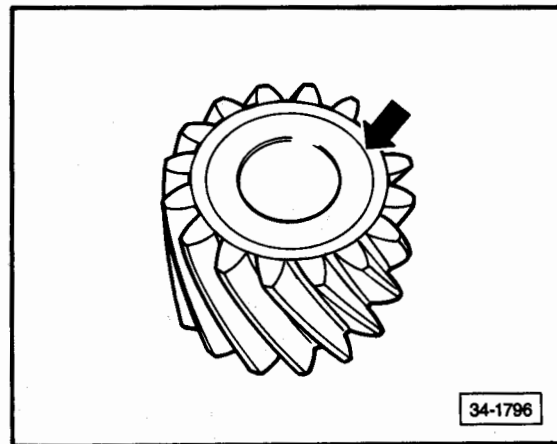


# 35 Manual Transmission – Case, Gears, Shafts



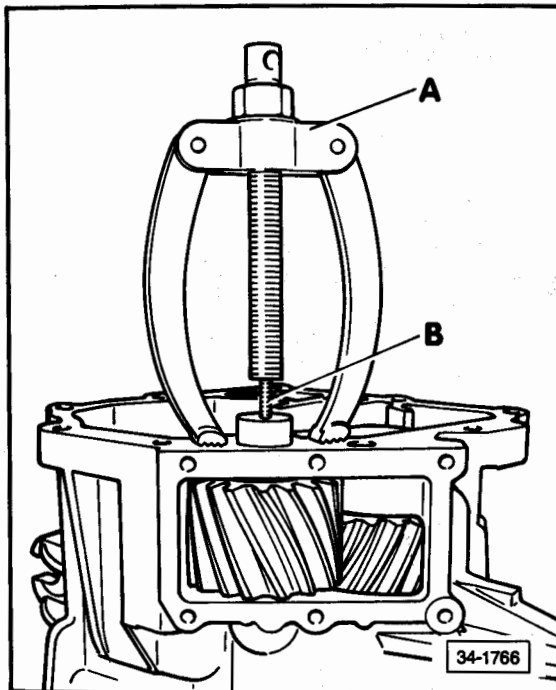
**Fig. 1 Low gear idler, removing**

- remove idler gear shaft
- A — Puller, e.g. Kukko 22-1
- B — Reducing thread bolt M5



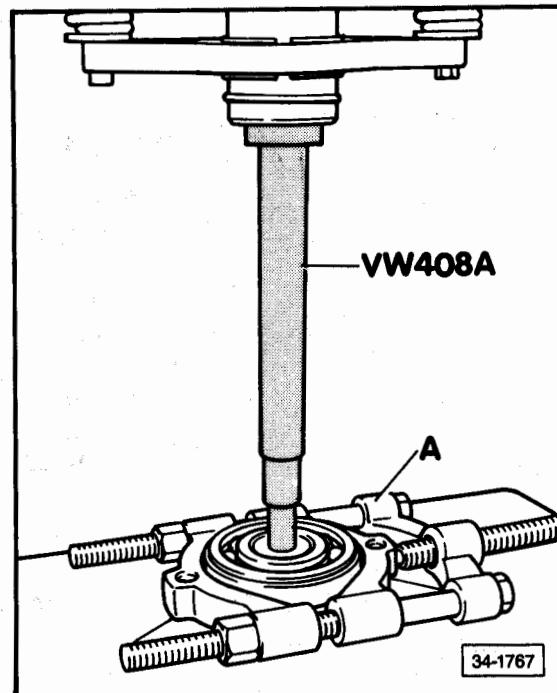
**Fig. 3 Reverse gear idler, installing**

- install with groove pointing up



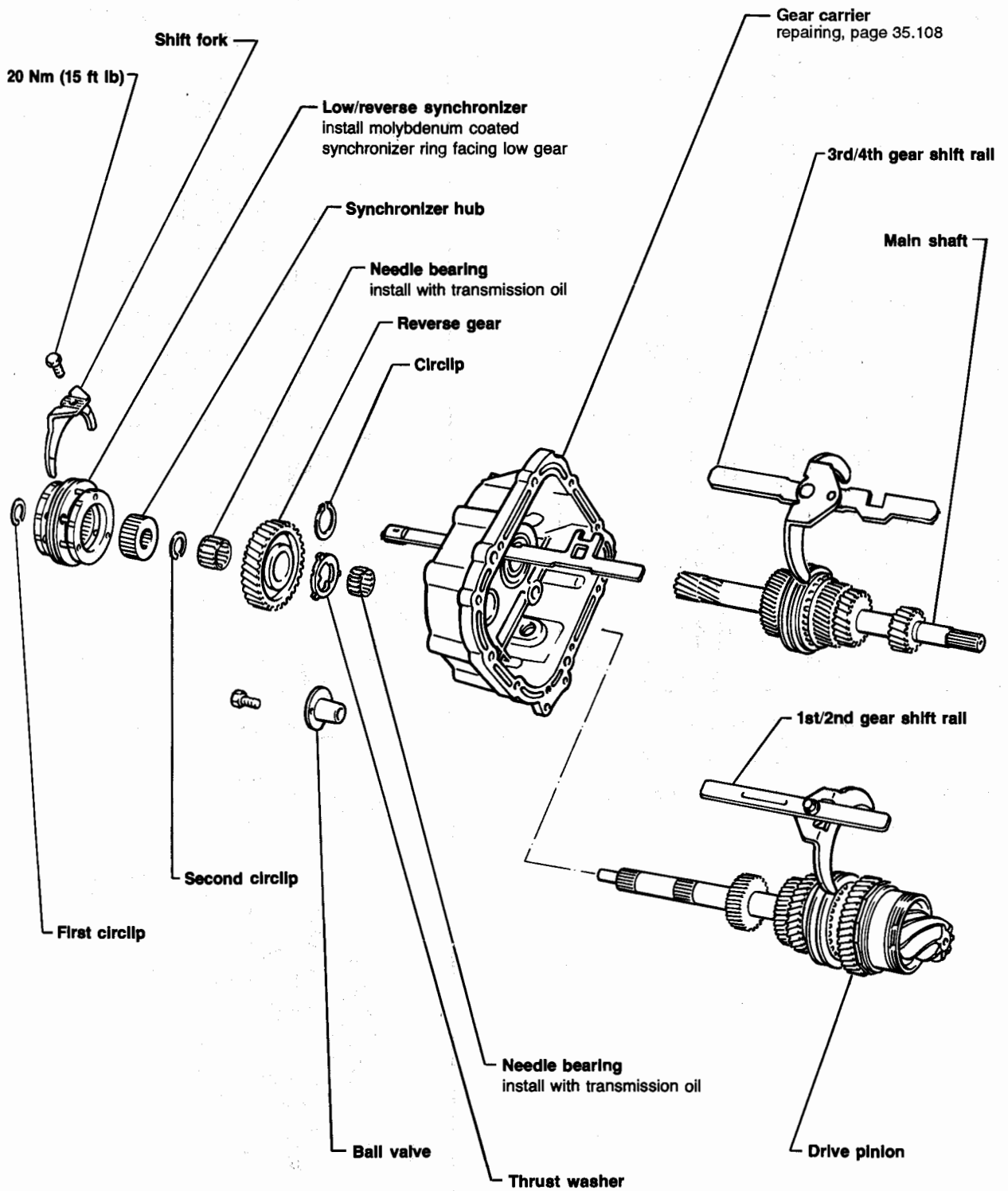
**Fig. 2 Reverse gear idler, removing**

- A — Puller, e.g. Kukko 22-1
- B — Reducing thread bolt M5



**Fig. 4 Intermediate bearing, removing**

- clamp separation device behind bearing
- A — Separation device, e.g. Kukko 15-15, Gr. 2



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094-4WD

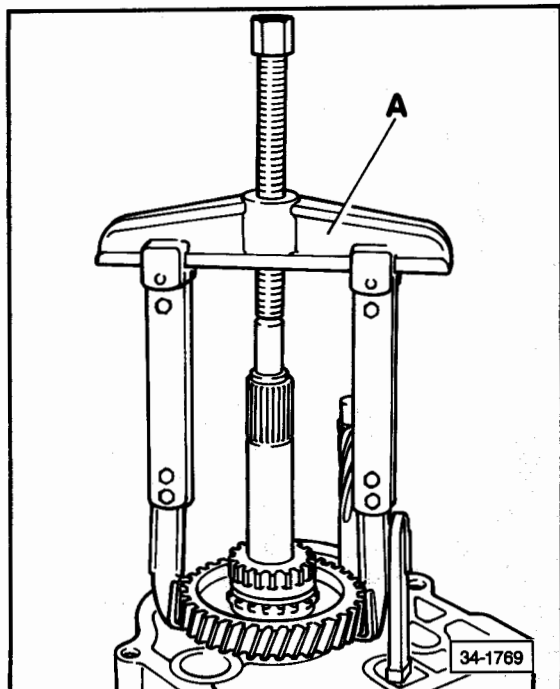
Gear carrier **35.107**

# 35 Manual Transmission – Case, Gears, Shafts

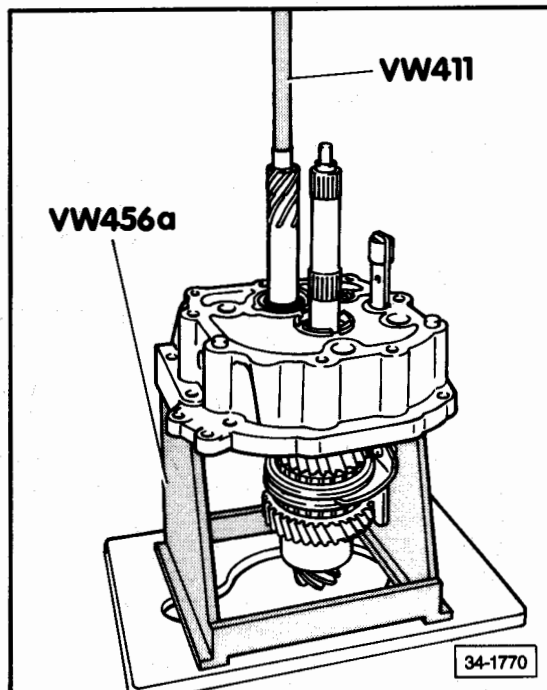
## Gear carrier, disassembly/assembly

### Disassembly

- remove low/reverse gear shift fork
- remove low/reverse gear synchronizer
- remove synchronizer hub first circlip

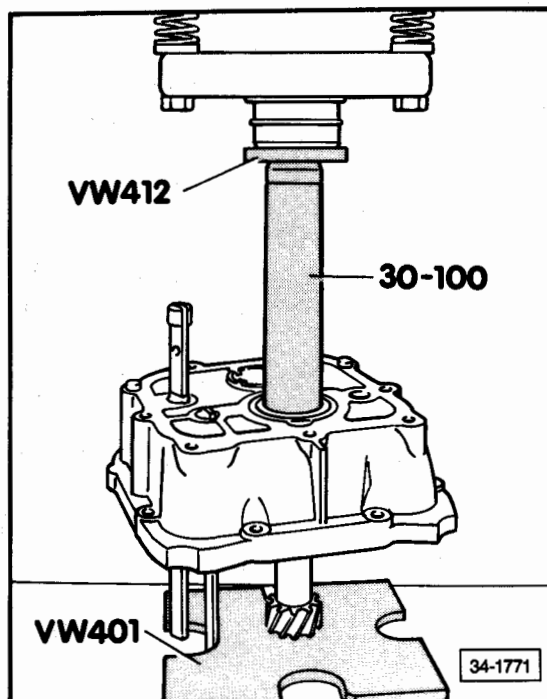


- remove synchronizer hub with control gear
- A** — two armed extractor, e.g. Kukko 20/10
- remove second circlip, thrust washer and needle bearing
- remove main shaft circlip

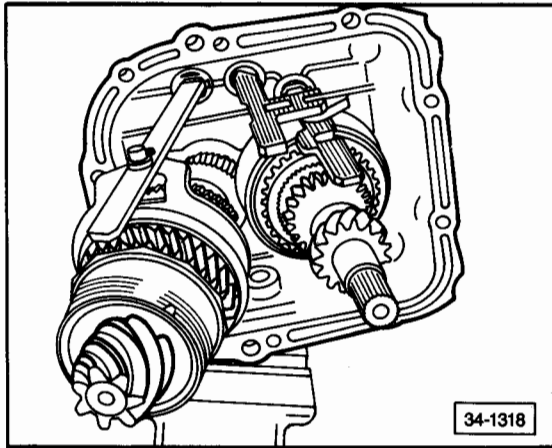


- press out main shaft with drive pinion and shift rails

### Assembly



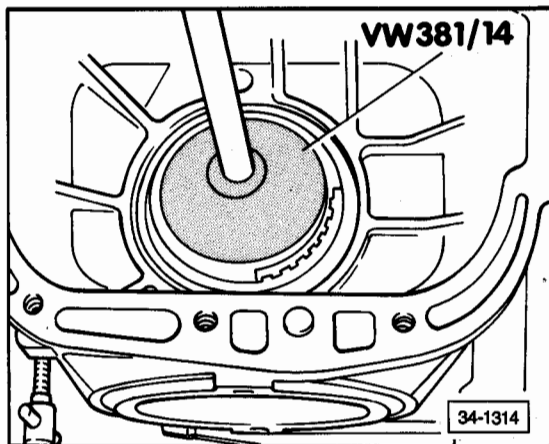
- press in main shaft with shift rail



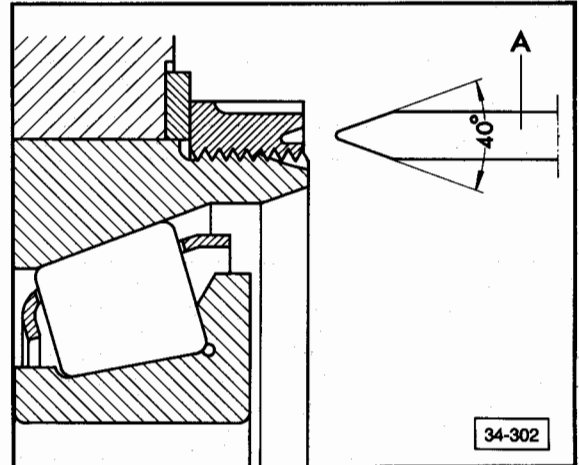
- install drive pinion with shift rail
- shift into 3rd gear
- shift into neutral
- install needle bearing for drive pinion
- install main shaft circlip

Before installing gear carrier:

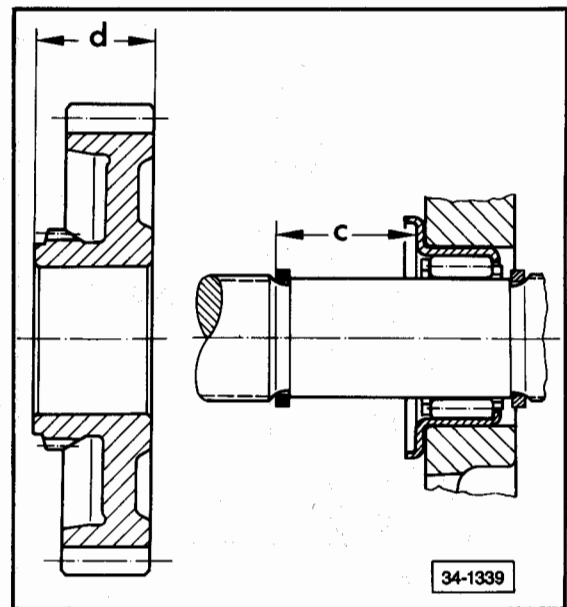
- position shim S3 and new gasket
- position shift rail
- position bearing facing opening in housing
- heat bearing seat in transmission housing to 40-60° C (130-166° F)
- seat bearing using a plastic hammer on drive pinion
- check for binding



- tighten retaining ring (75 mm wide) to 225 Nm (162 ft lb), loosen and tighten again to 225 Nm (162 ft lb)



- secure retaining ring at two places by staking
- install end shield to transmission housing
- determine thickness of reverse gear thrust washer (75 mm wide)



- position circlip and measure dimension c

**Example**

**c = 29.1 mm**

- measure dimension d

**Example**

**d = 24.7 mm**

# 35 Manual Transmission – Case, Gears, Shafts

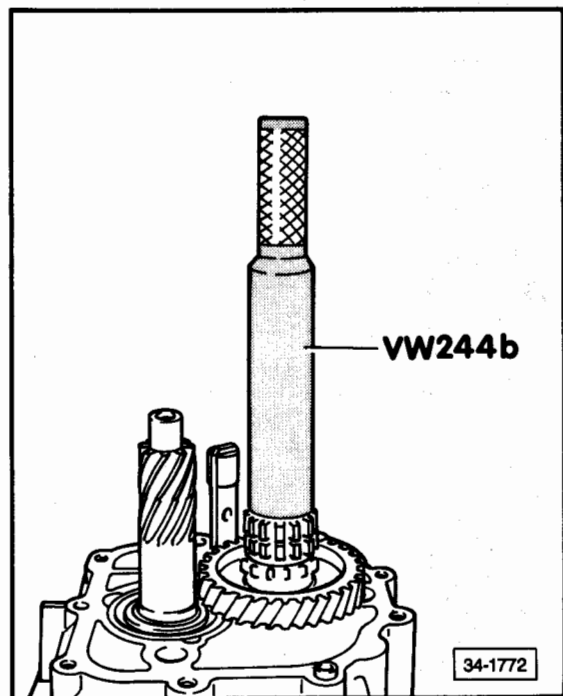
## Example

Dimension c	= 29.1 mm
- Dimension d	= 24.7 mm
= Adjustment range	= 4.4 mm

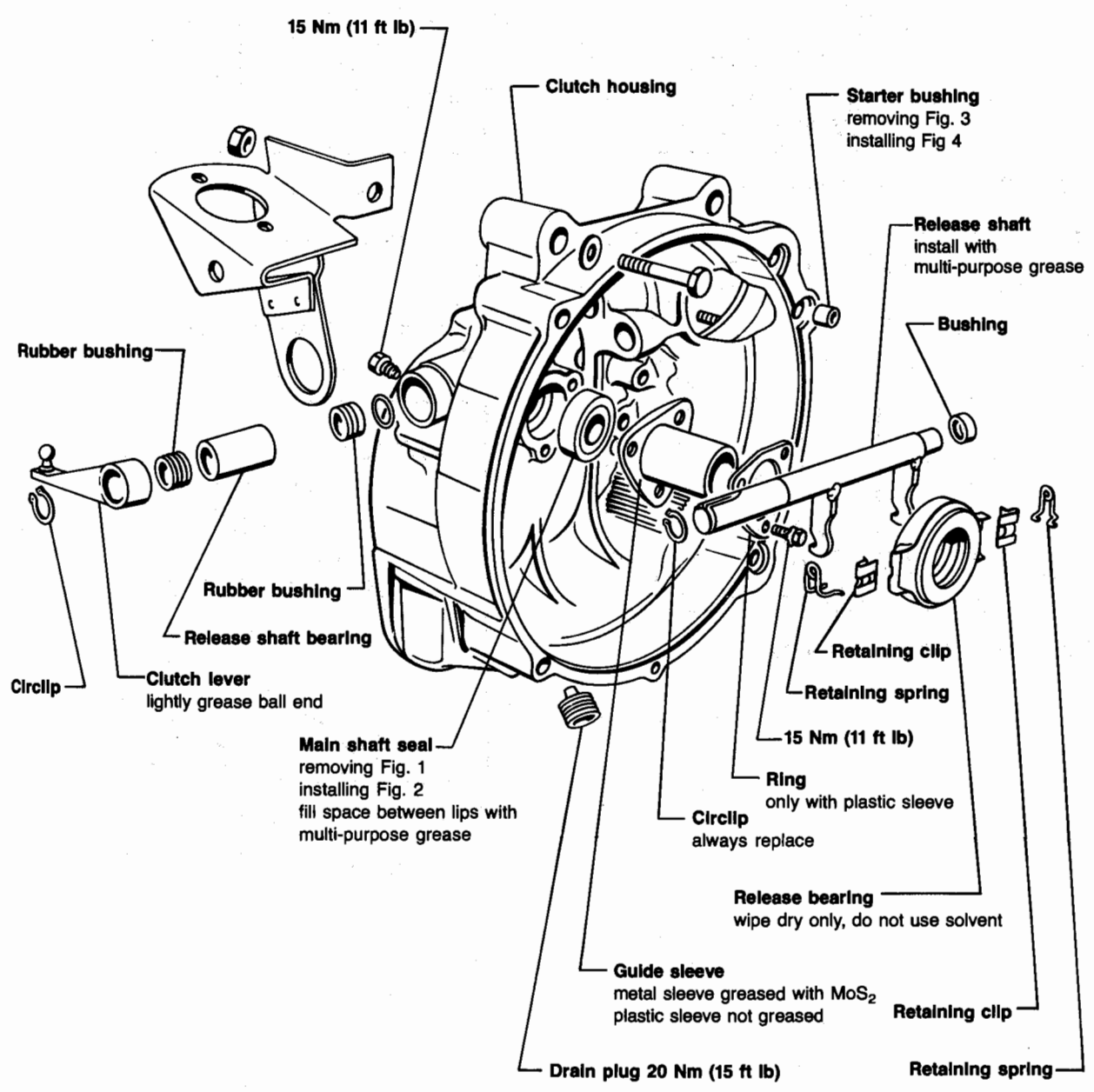
Shims available:

Adjustment range (mm)	Part Number	Color
3.97-4.19	091 311 379	white
4.20-4.39	091 311 379 A	black
4.40-4.59	091 311 379 B	green
4.60-4.90	091 311 379 C	red

— position thrust washer, reverse gear, needle bearing and second circlip



- install synchronizer hub
- position first circlip
- position low/reverse synchronizer with shift fork
- place molybdenum coated circlip on low gear
- fasten shift fork to shift rail
  - coat bolt with D 6 and tighten to 20 Nm (15 ft lb)



35-1013

094-4WD

Clutch housing **35.111**

# 35 Manual Transmission – Case, Gears, Shafts

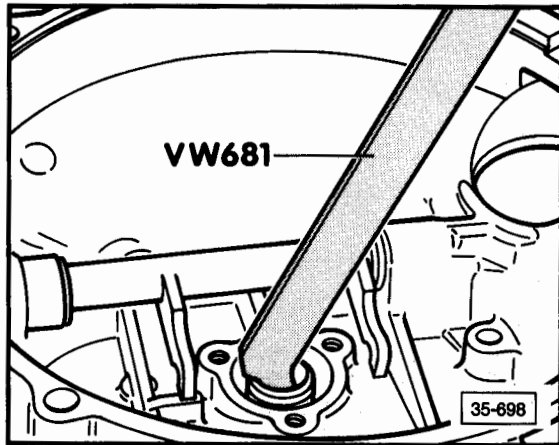


Fig. 1 Main shaft seal, removing

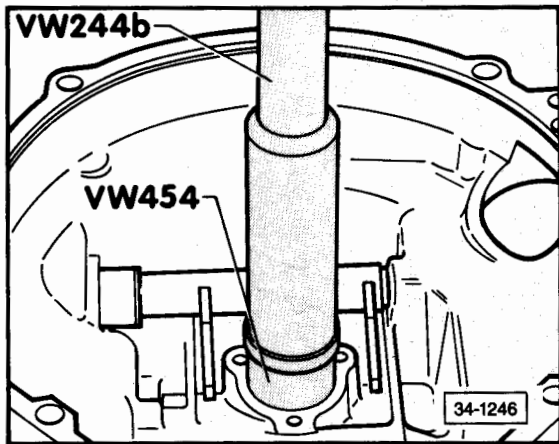


Fig. 2 Main shaft seal, installing

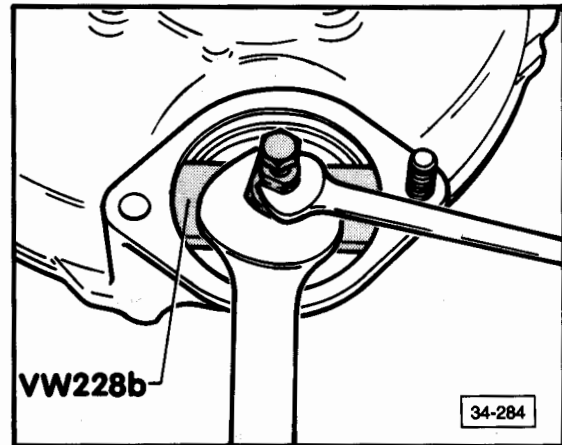


Fig. 3 Starter bushing, removing

(installed transmission)

### Note

For disassembled transmission, remove with VW 222a.

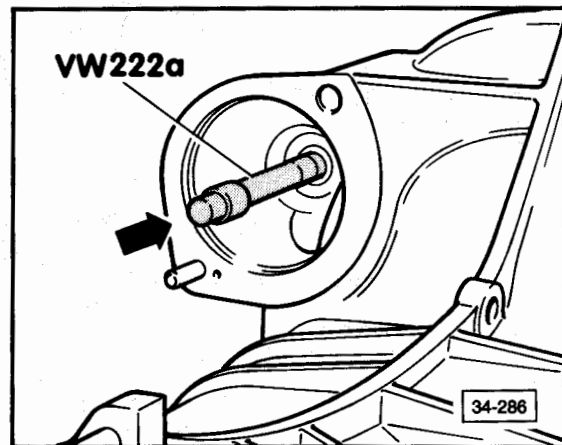
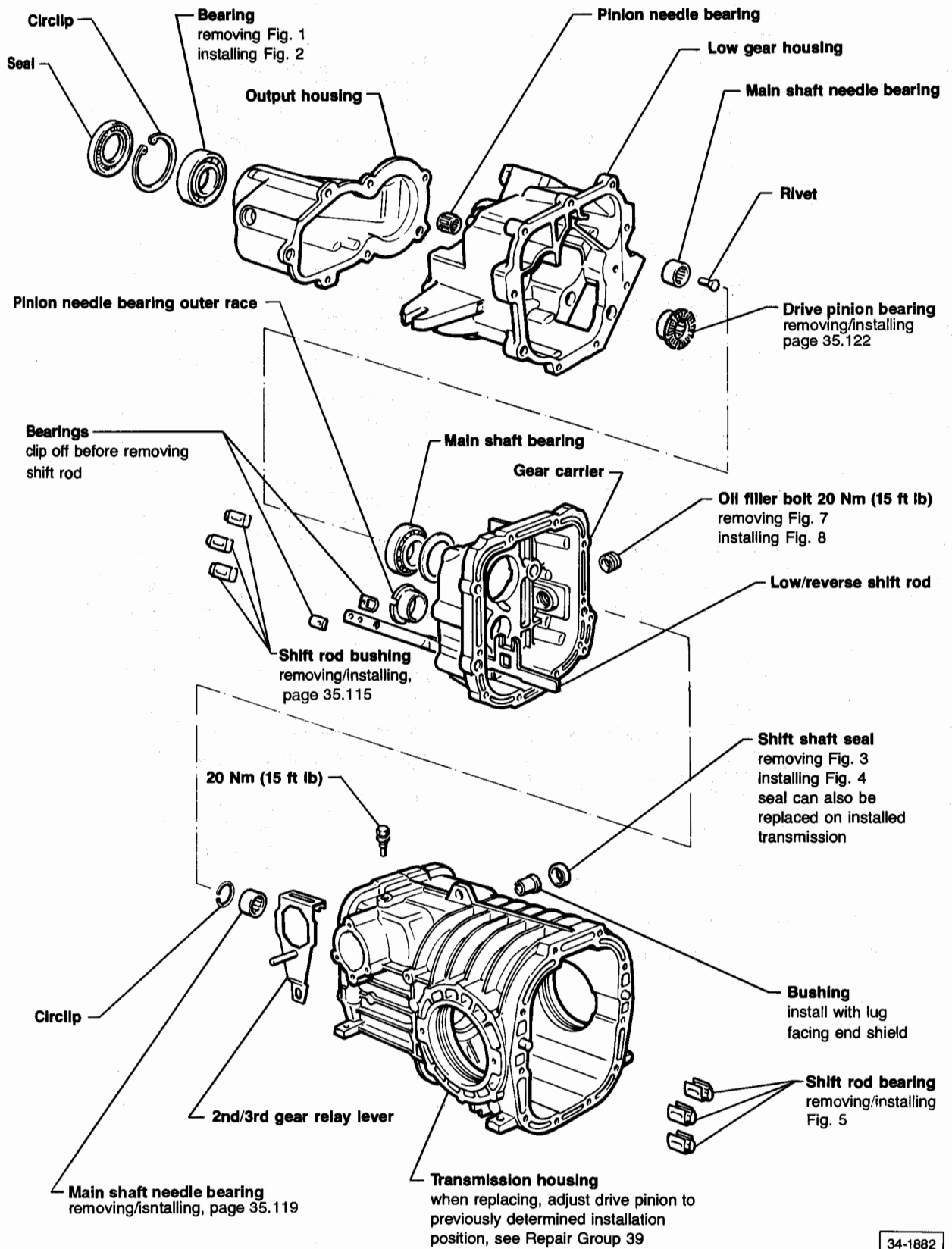


Fig. 4 Starter bushing, installing

— drive in flush





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# 35 Manual Transmission – Case, Gears, Shafts

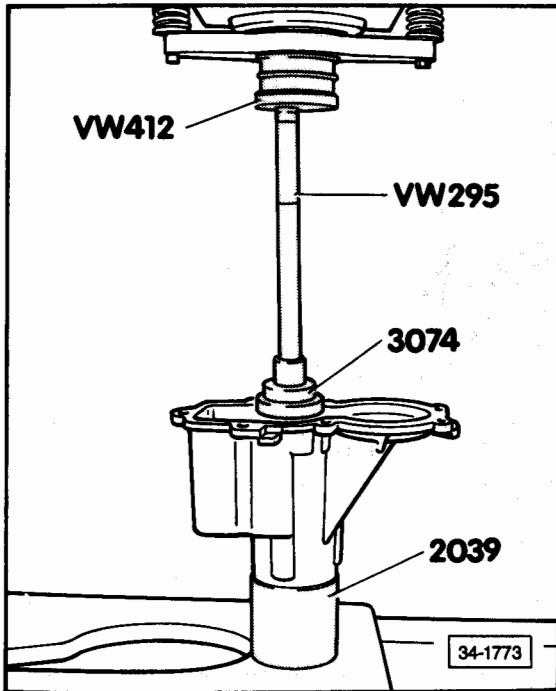


Fig. 1 Output shaft bearing, removing

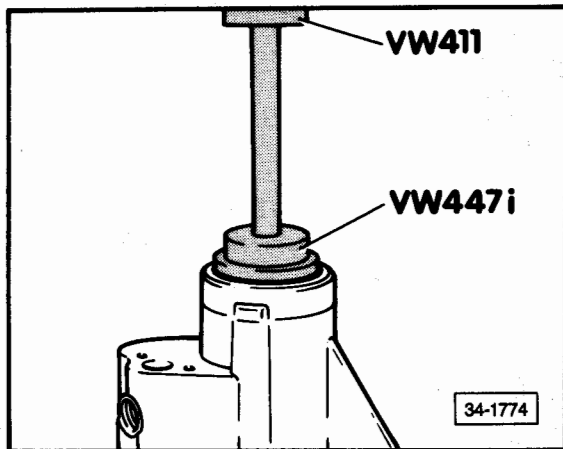


Fig. 2 Output shaft bearing, installing

— push bearing in to stop

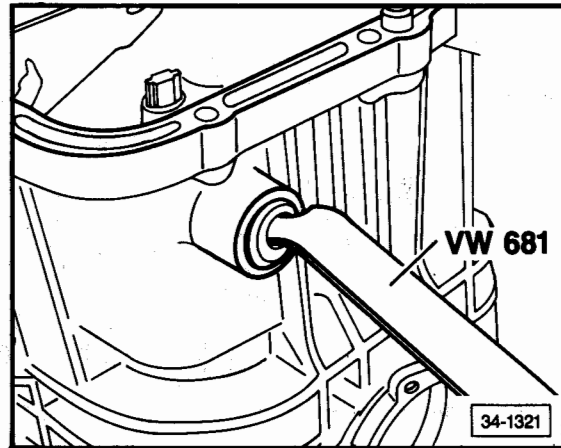


Fig. 3 Shift shaft seal, removing

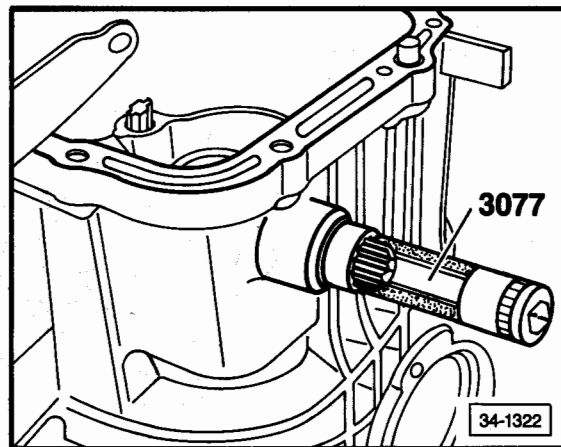
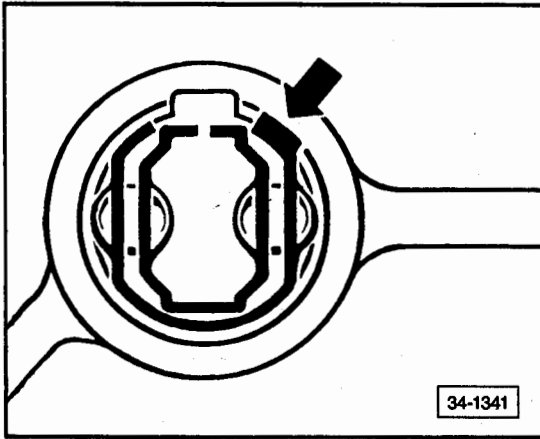


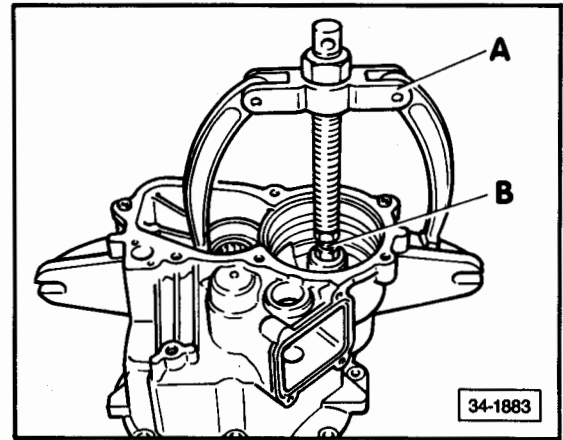
Fig. 4 Shift shaft seal, installing

- remove wire circlip
- drive in seal with 3077
- replace wire circlip



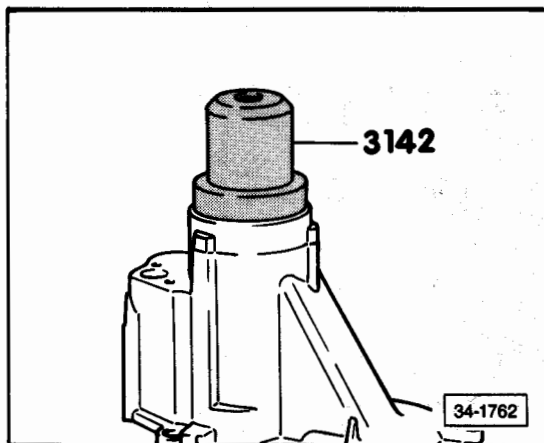
**Fig. 5 Shift rod bushing, removing/installing**

- to remove, rotate until lug (arrow) is positioned over recess in housing
- push out shift rod bushing



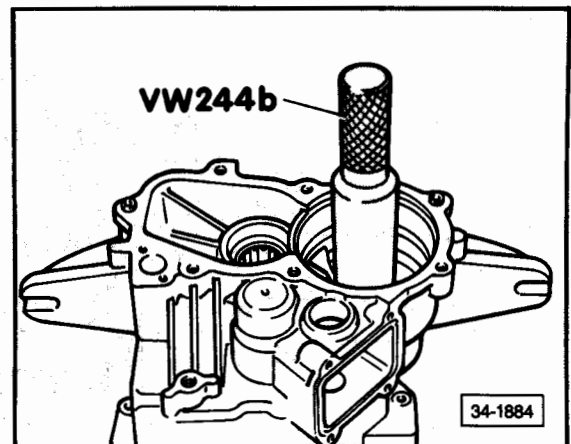
**Fig. 7 Needle bearing, removing**

- A — Puller e.g. Kukko 22-2
- B — Inner extractor 31 - 37 mm e.g. Kukko 21/5



**Fig. 6 Drive flange seal, installing**

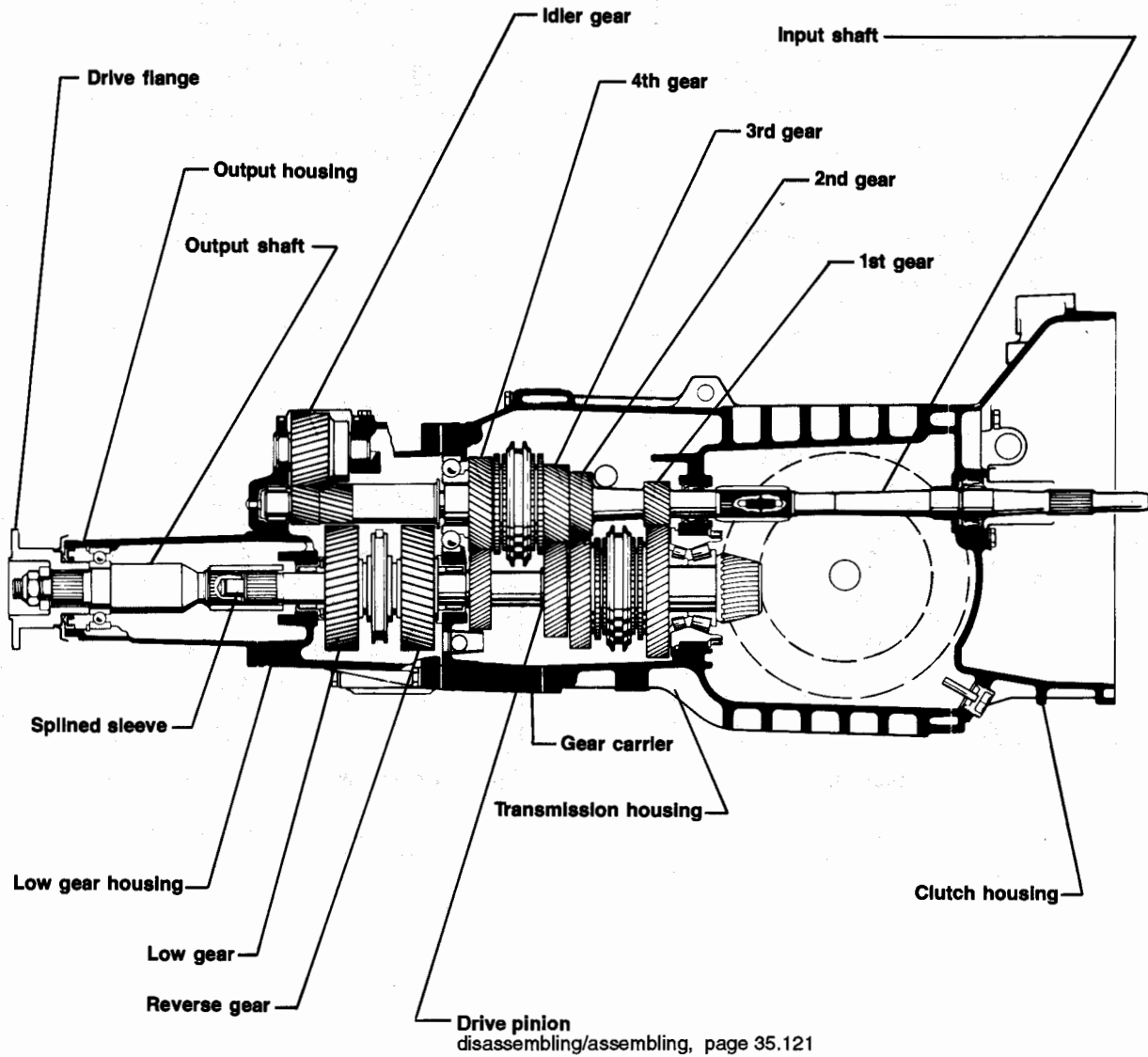
- push in seal up to stop



**Fig. 8 Needle bearing, installing**

- push in needle bearing to stop

# 35 Manual Transmission – Case, Gears, Shafts

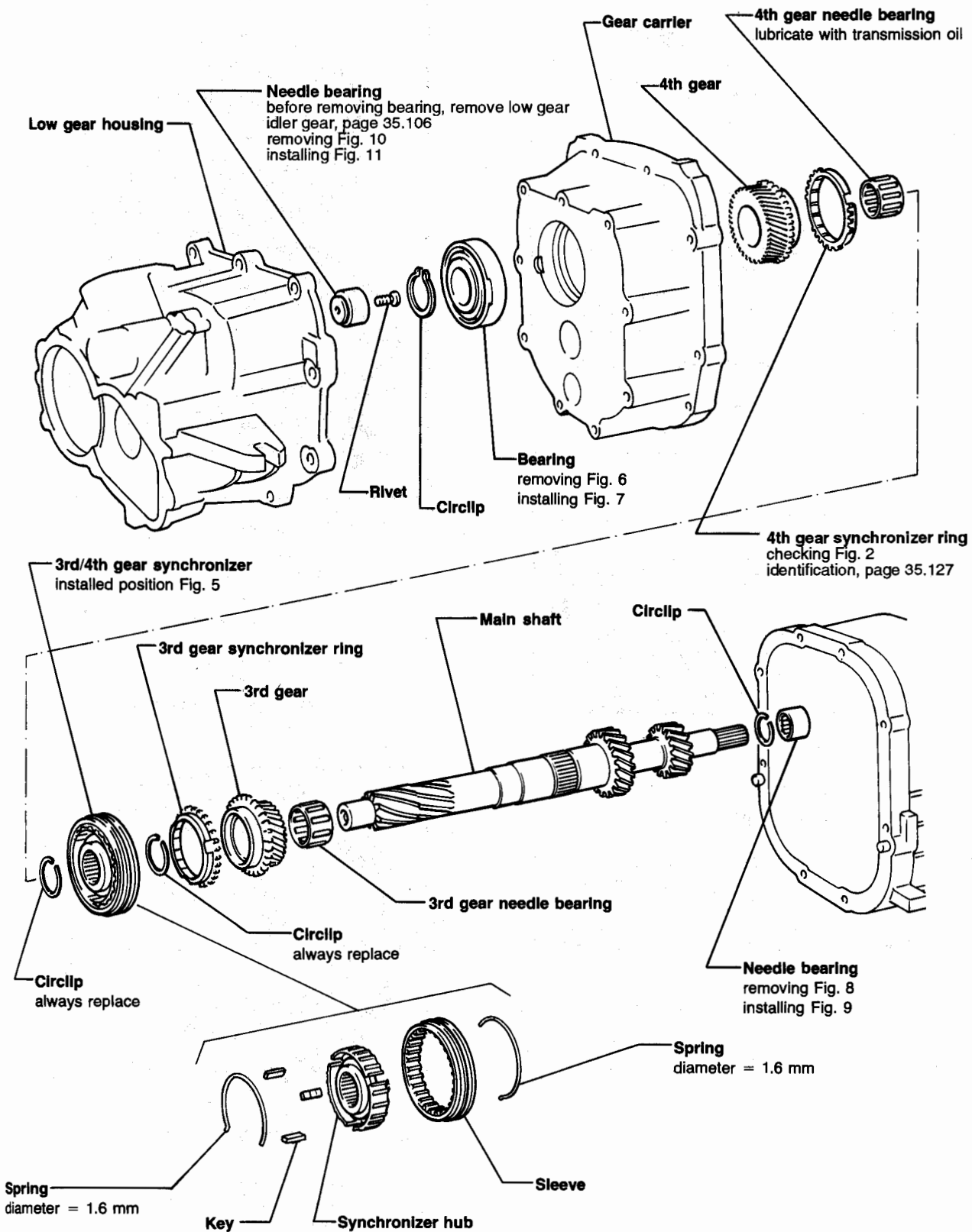


34-1885

## 35.116

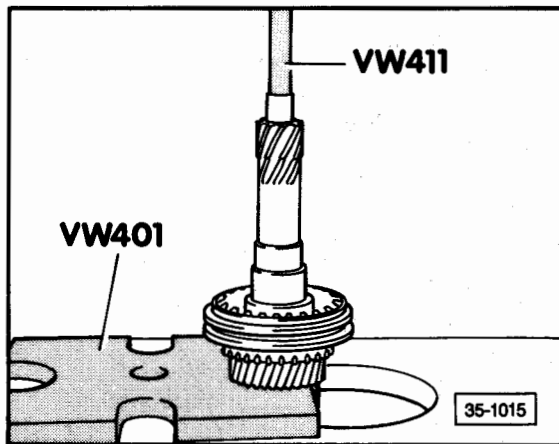
Gear carrier

094-4WD

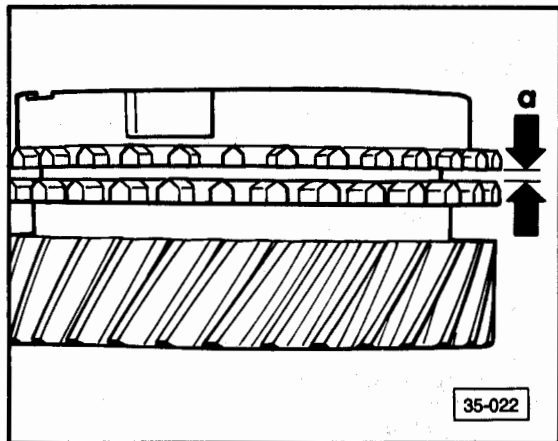


34-1885

35-1012

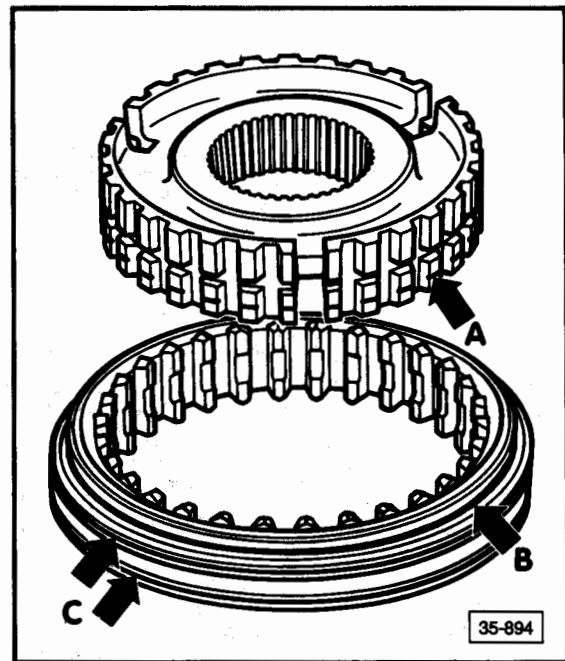


**Fig. 1 Synchronizer 3rd/4th gears, removing**  
— press off with 3rd gear



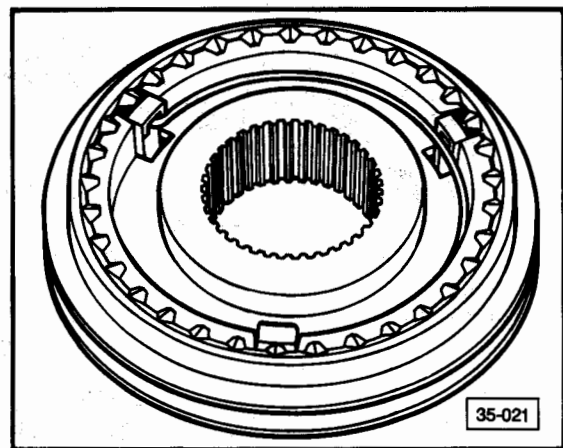
**Fig. 2 Synchronizer rings, checking**  
— push synchronizer rings on to gear cones and measure gap **a** with a feeler gauge

Gap a	New Part mm (In.)	Wear limit
3rd gear	1.25-1.95 mm (0.049-0.077)	0.5 mm (0.020)
4th gear	1.00-1.70 mm (0.039-0.067)	0.5 mm (0.020)



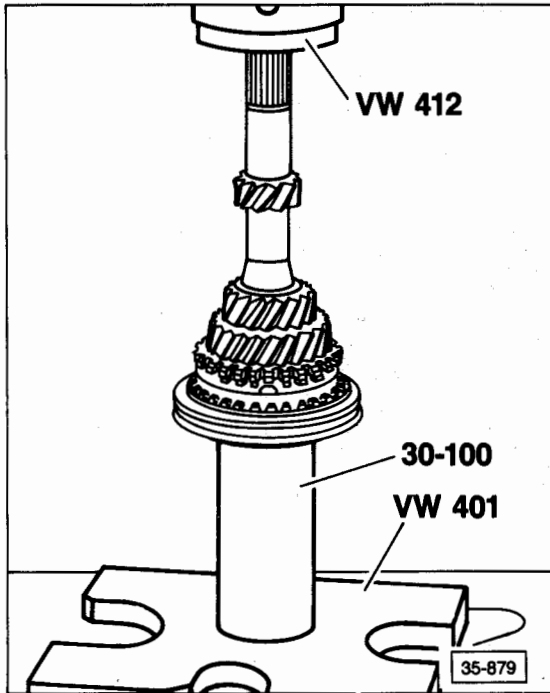
**Fig. 3 3rd/4th gear synchronizer, assembling**

- sleeve and hub identification grooves (arrows **A & B**) are on opposite sides
- clutch sleeve groove (arrow **B**) faces 4th gear
- the grooves (arrows **C**) are for identification:  
1st/2nd gear = one groove  
3rd/4th gear = two grooves



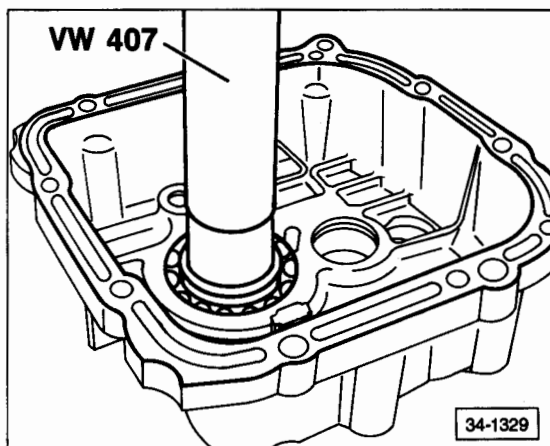
**Fig. 4 Synchronizer 3rd/4th gear, assembling**

- push sleeve over hub
- insert keys and install spring ends 120° apart
- angled ends of spring must fit into hollow key



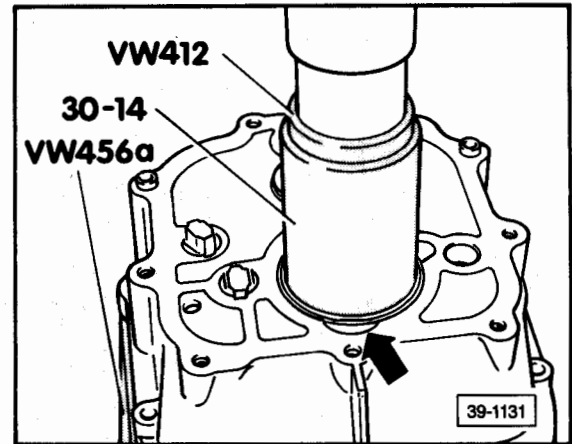
**Fig. 5 Synchronizer 3rd/4th gear, installing**

- rotate synchronizing ring until grooves are in line with keys
- clutch sleeve identification groove (Fig. 3, arrow B) faces 4th gear



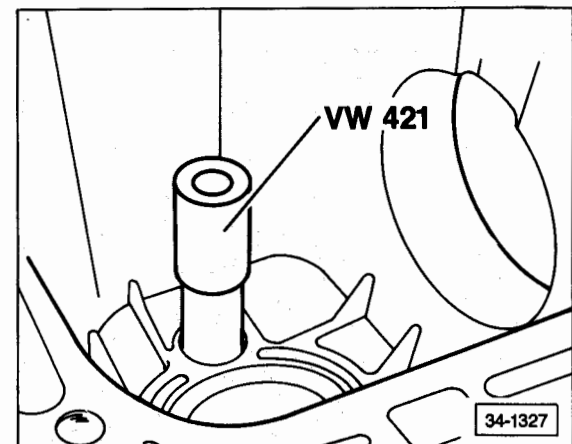
**Fig. 6 Main shaft bearing, removing**

- push bearing out of gear carrier



**Fig. 7 Main shaft bearing, installing**

- press bearing into carrier to stop
- recess on bearing aligns with recess in carrier (arrow)



**Fig. 8 Needle bearing, removing**

- drive bearing out of transmission housing

# 35 Manual Transmission – Case, Gears, Shafts

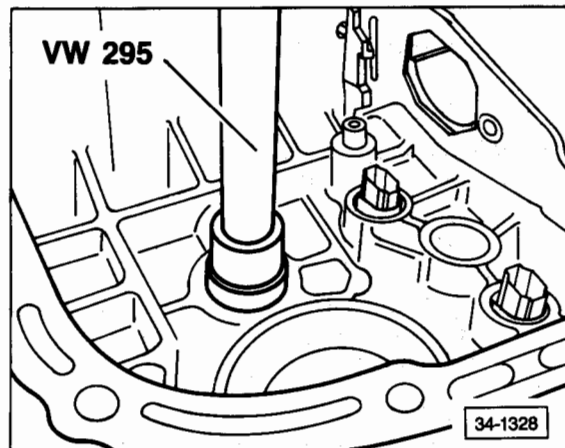


Fig. 9 Needle bearing, installing

**CAUTION**

The lettered side of bearing (thicker material) must face installing tool.

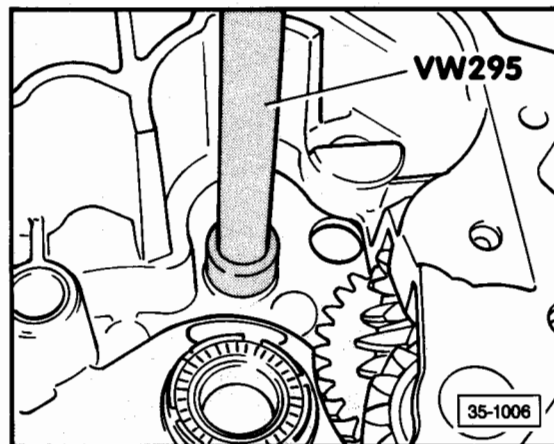


Fig. 11 Low gear needle bearing, installing

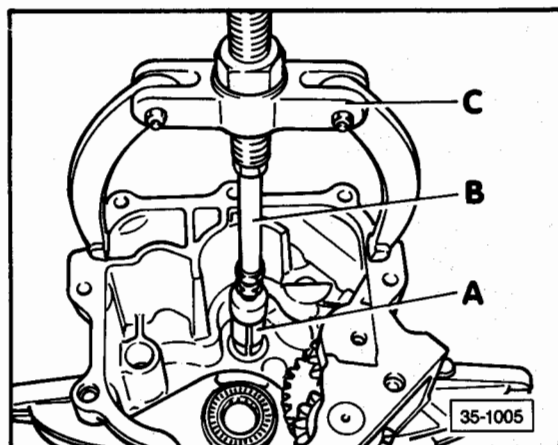


Fig. 10 Low gear needle bearing, removing

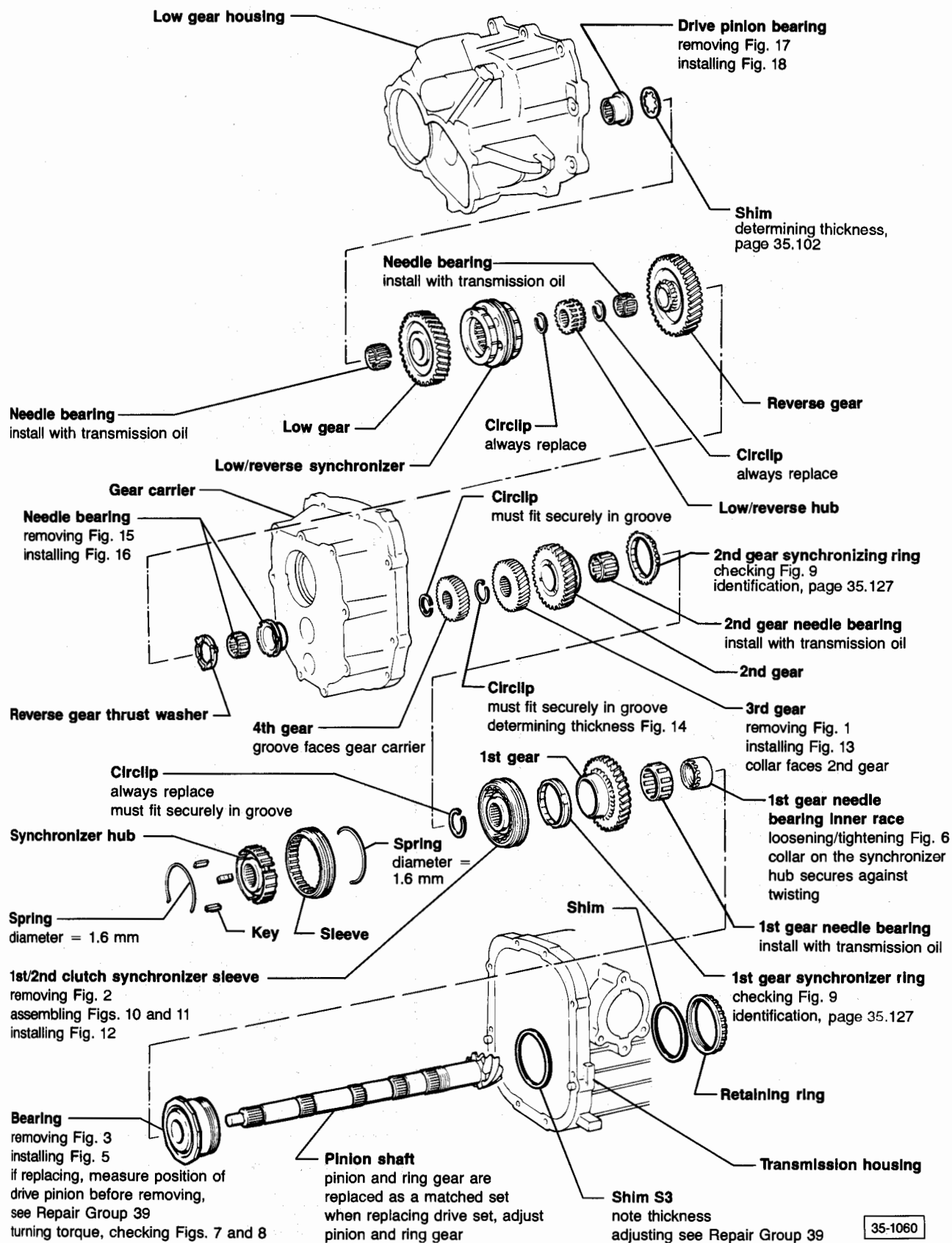
— shear off rivet head before removing bearing

A — Inner extractor 18.5-23.5 mm, e.g. Kukko 21/3

B — Extension

C — Yoke, e.g. Kukko 22/2





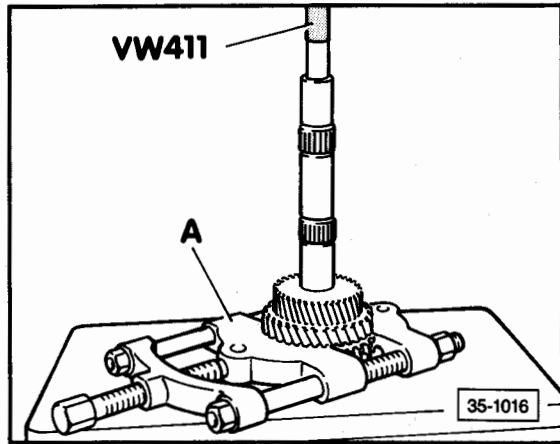
35-1060

094-4WD

Drive pinion

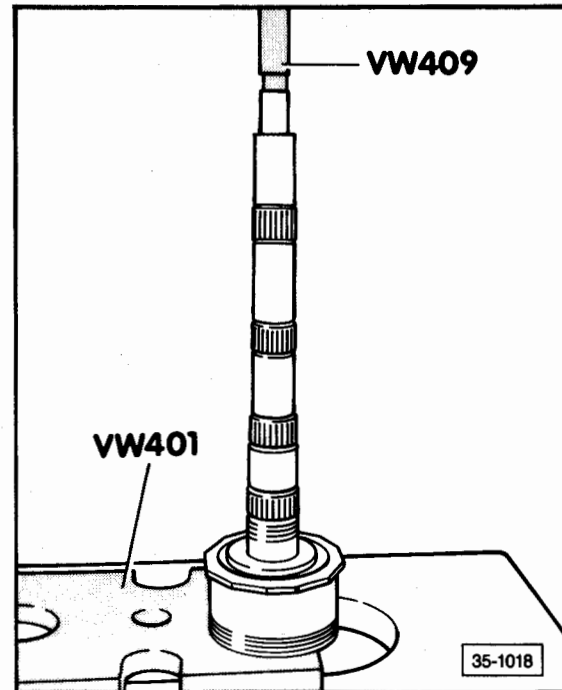
35.121

# 35 Manual Transmission – Case, Gears, Shafts



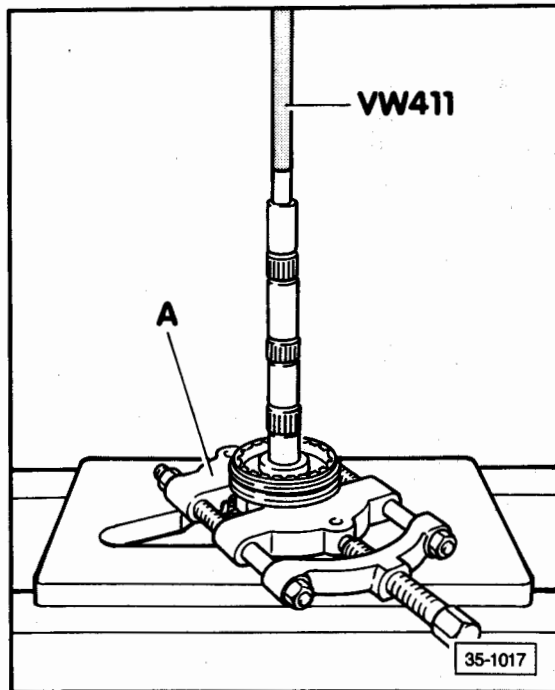
**Fig. 1 3rd and 2nd gears, removing**

A — Separation device 22-115 mm,  
e.g. Kukko 17/2



**Fig. 3 Bearing, removing**

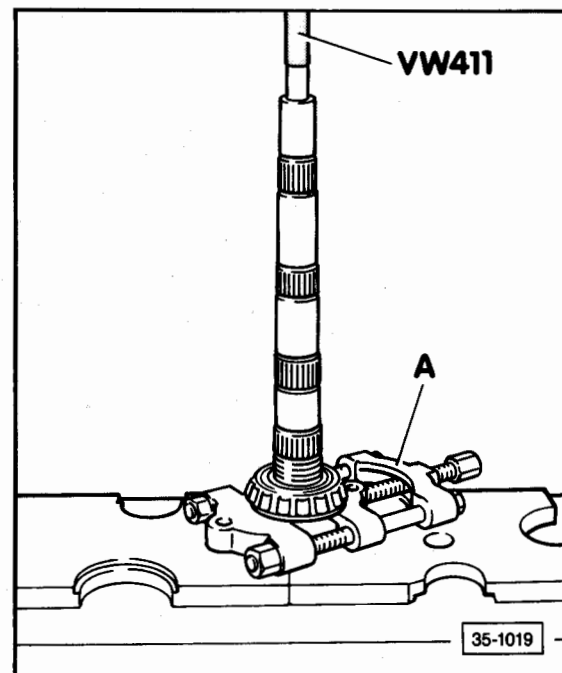
— unscrew needle bearing inner race  
— push bearing over outer race



**Fig. 2 Synchronizer sleeve/hub and 1st gear, removing**

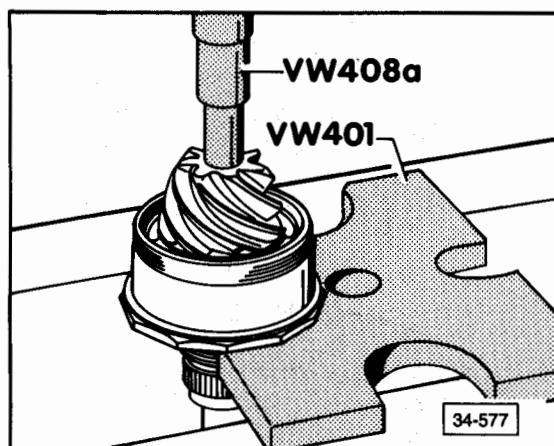
A — Separation device 22-115 mm, e.g.  
Kukko 17/2

— secure separation device behind gear



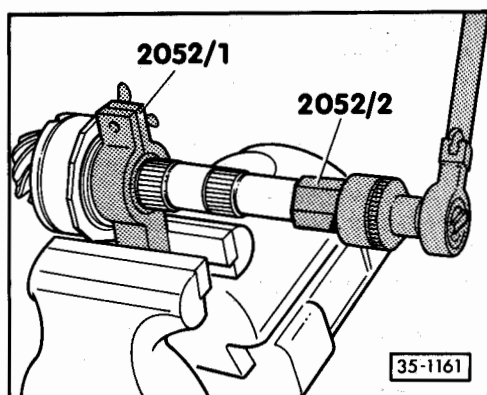
**Fig. 4 Bearing inner race, removing**

A — Separation device 12-175 mm, e.g.  
Kukko 17/1



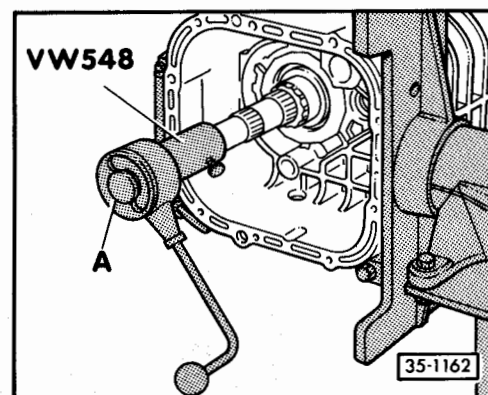
**Fig. 5 Bearing, installing**

- heat inner race to 100° C (212° F)
- before tightening needle bearing inner race, let bearing cool to room temperature



**Fig. 6 Needle bearing inner race, loosening/tightening**

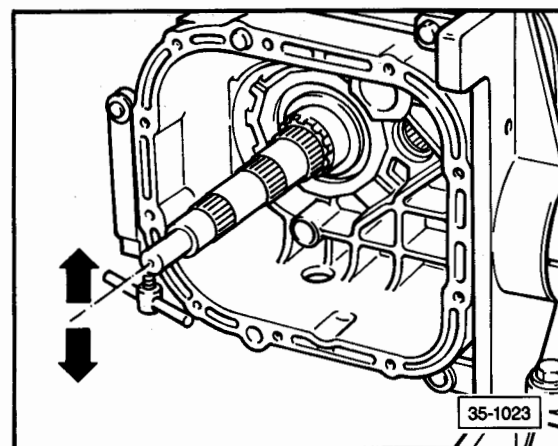
- heat inner race to 60° C (140° F) and screw on by hand as far as possible
- install pinion shaft into tool 2052/1 and tighten wing nut lightly
- tighten inner race to 210 Nm (152 ft lb)



**Fig. 7 Bearing, checking turning torque**

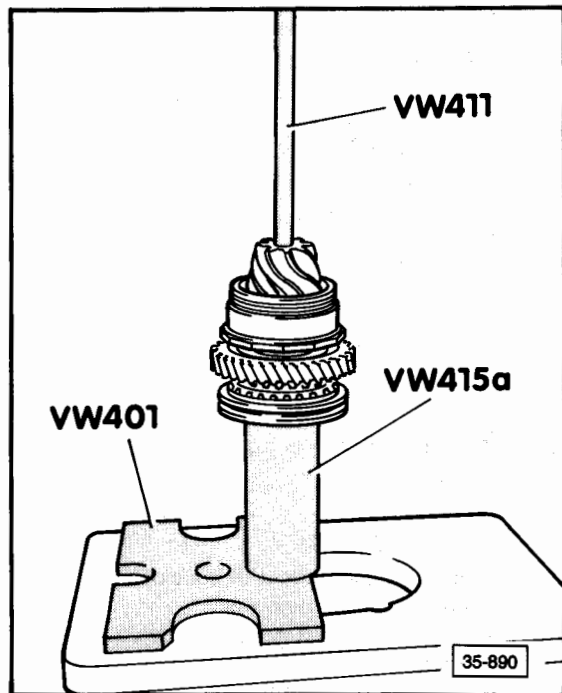
**A** — Torque gauge, 0–600 Nm  
(0–54 in. lb.)

- lubricate bearings with transmission oil and tighten tension nut
- turn pinion shaft in both directions 15–20 times
- turn and read turning torque
  - new bearings: up to 210 Ncm (19 in. lb.)
  - used bearings (after 30 miles): up to 70 Ncm (6.2 in. lb.)



**Fig. 8 Bearing condition, checking**

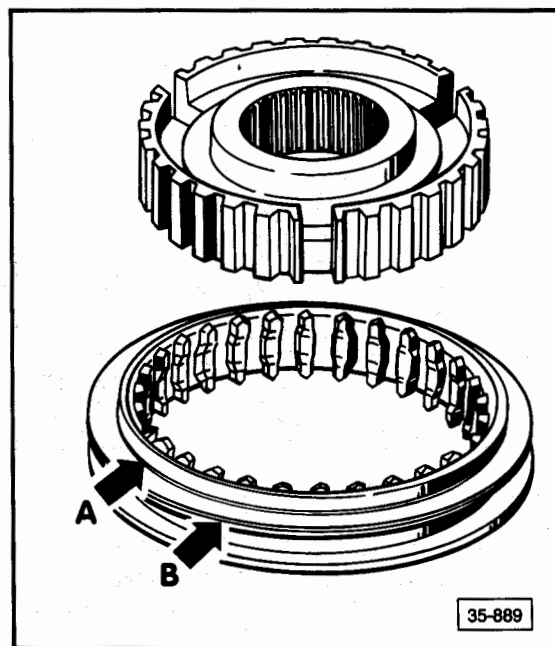
- if turning torque cannot be measured, check for rock at end of pinion
- if there is detectable rock, replace bearing



**Fig. 9 1st/2nd gear synchronizer ring, checking**

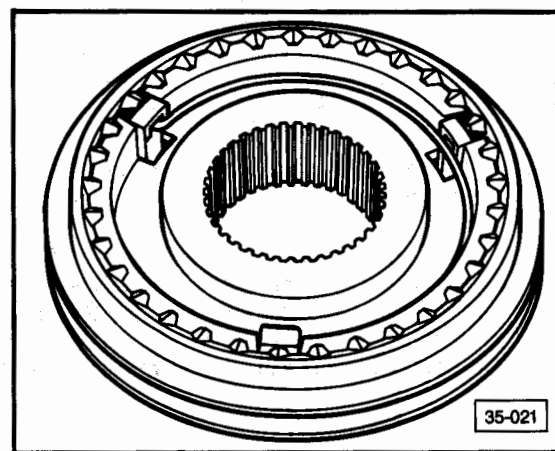
— press synchronizer ring onto gear by hand and measure gap A with feeler gauge

	New part mm (in.)	Wear limit mm (in.)
Gap a	1.3-1.9 (0.051-0.075)	0.5 (0.020)



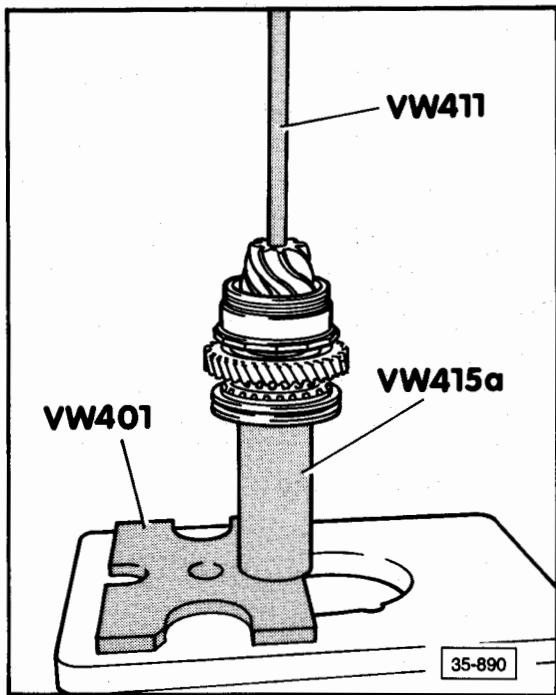
**Fig. 10 1st/2nd gear synchronizer sleeve, assembling**

- groove (arrow A) faces 2nd gear
- hub collar faces 1st gear
- grooves (arrow B) are for identification:
  - 1st/2nd gear = 1 groove
  - 3rd/4th gear = 2 grooves



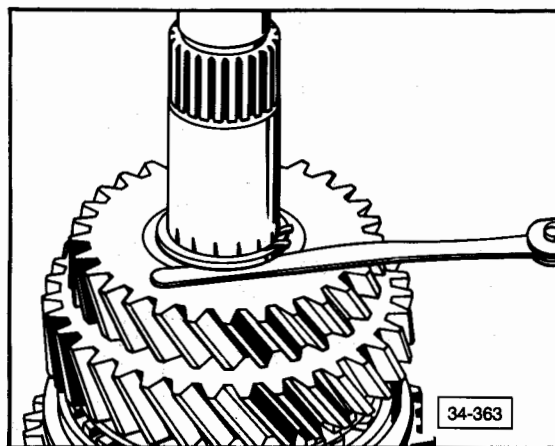
**Fig. 11 1st/2nd gear synchronizer, assembling**

- slide sleeve over hub, matched position is not necessary
- insert keys and install spring ends 120° apart. Angled ends of springs fit into keys



**Fig. 12 1st/2nd gear synchronizer, installing**

- turn synchronizer ring until grooves are in line with keys (installation position, see Fig. 10)

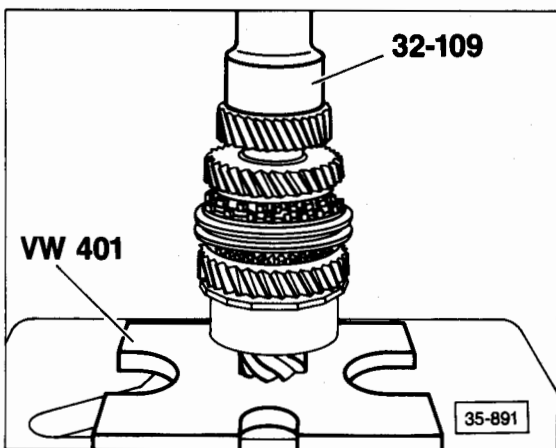


**Fig. 14 3rd gear end play, adjusting**

- measure end play with feeler gauge
- adjust by selecting suitable circlip
  - play should be 0.05 mm-0.20 mm (try to meet lower limit)

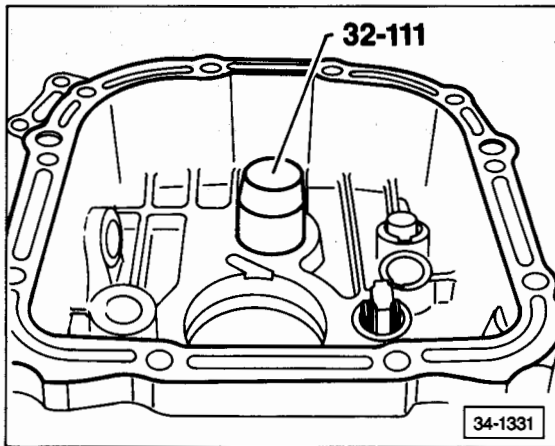
The following circlips are available:

Thickness mm	Color	Part No.
2.20	copper	113 311 386
2.30	brass	113 311 387



**Fig. 13 3rd gear, installing**

- collar faces 2nd gear



**Fig. 15 Needle bearing outer race, removing**

# 35 Manual Transmission – Case, Gears, Shafts

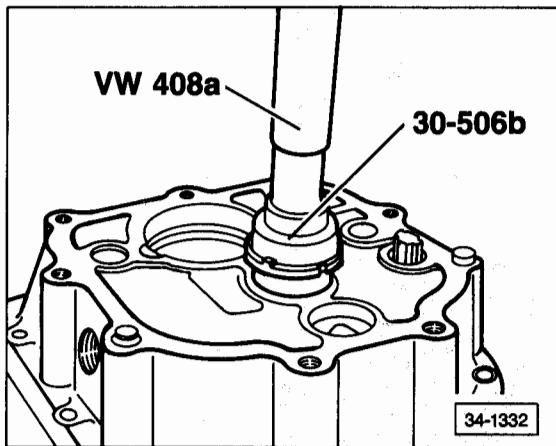


Fig. 16 Needle bearing outer race, installing

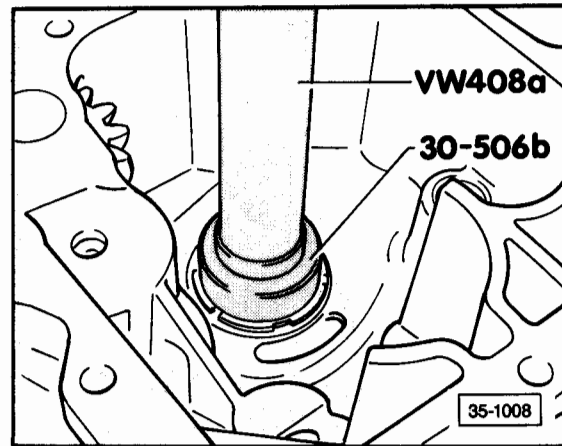


Fig. 18 Bearing, installing

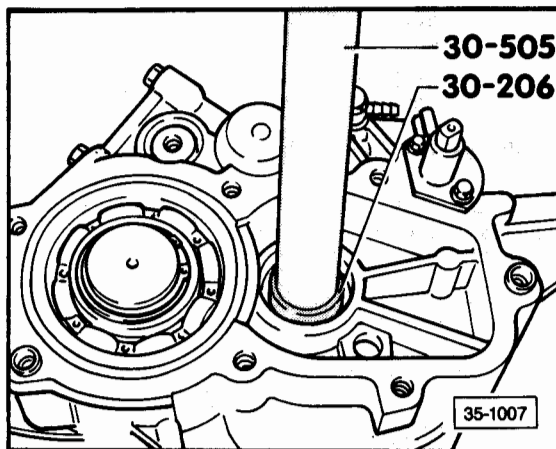
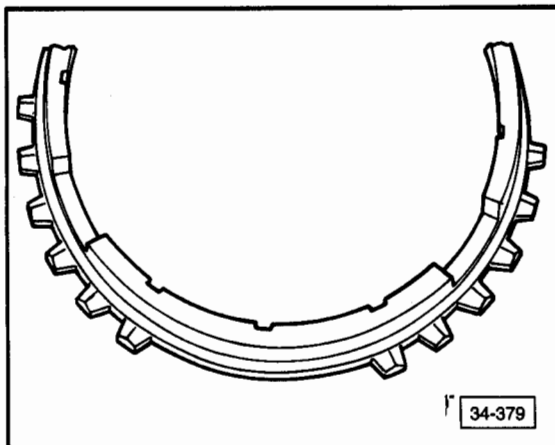


Fig. 17 Low gear bearing, removing

## Synchronizer rings, identification

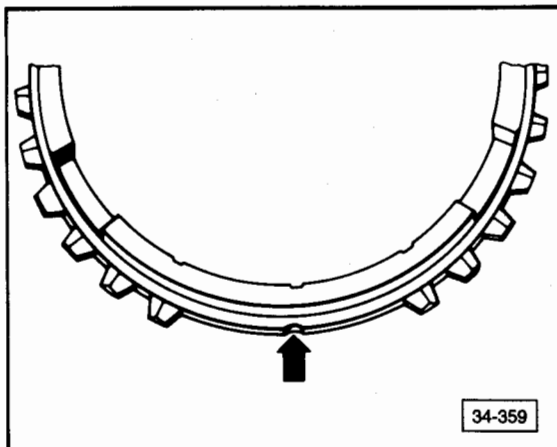
### Note

When assembling transmission, install synchronizer rings to the same gears from which they were removed.



### 1st gear:

brass ring  
molybdenum coated 3 x 6 teeth  
without identification

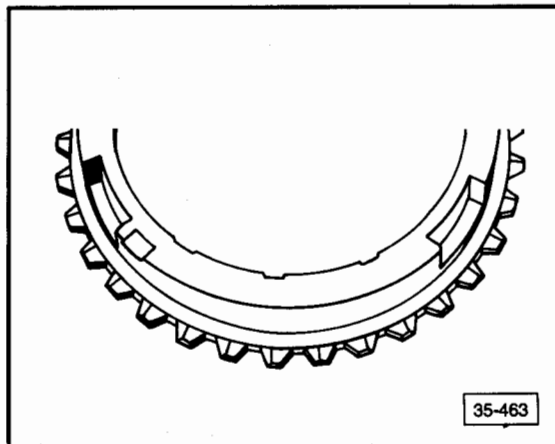


### 2nd gear:

brass ring  
molybdenum coated 3 x 8 teeth  
identification 3 notches

### 4th gear:

brass ring  
3 x 8 teeth  
identification 3 notches



### 3rd gear:

special brass ring  
molybdenum coated teeth around entire  
outer surface

### Note

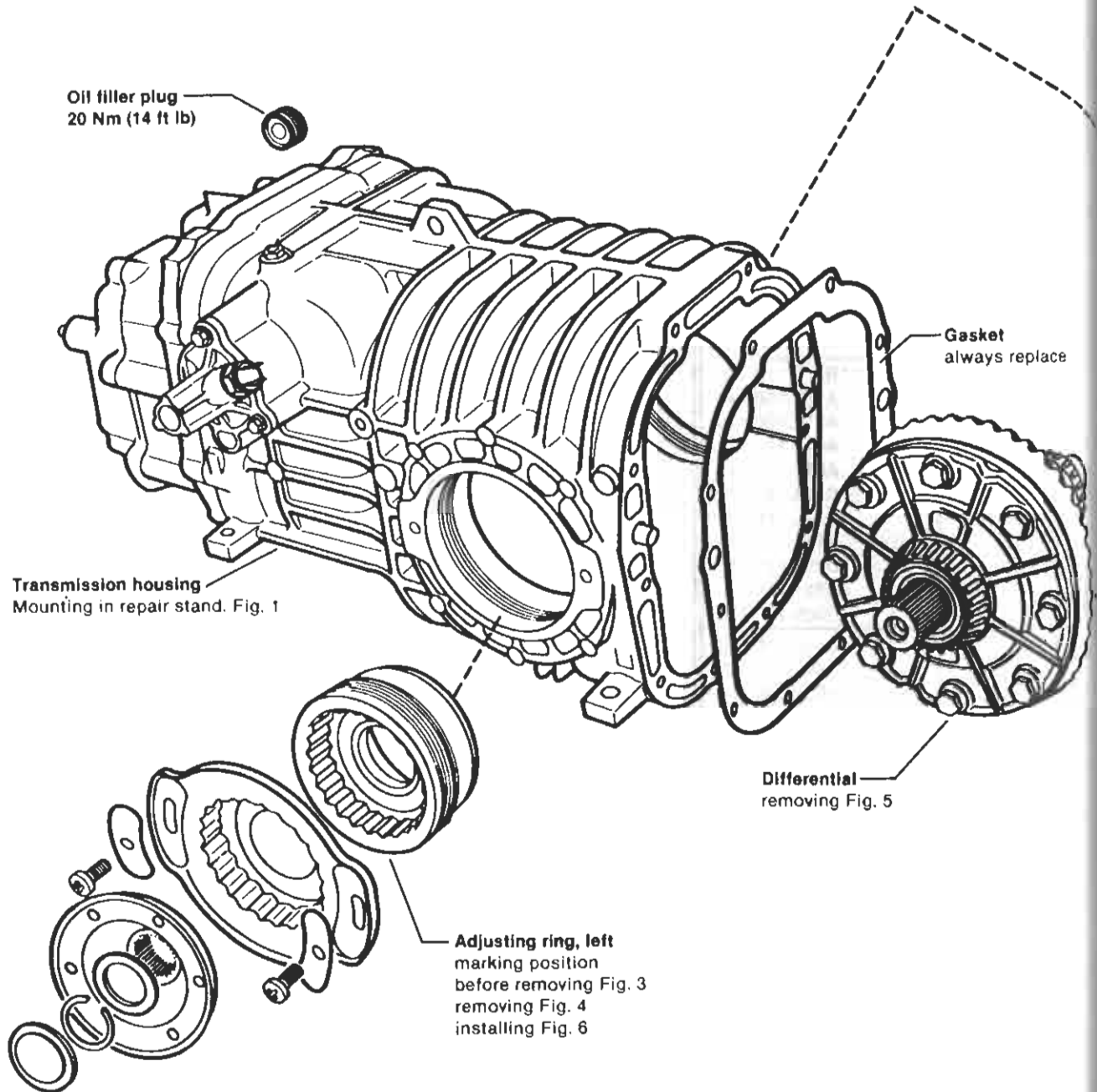
For all gears, install synchronizer ring which is supplied under Spare Part No. **091 311 295 A** (standard production on 3rd gear).

## 5-Speed 094 Manual Transmission Case, Gears, Shafts

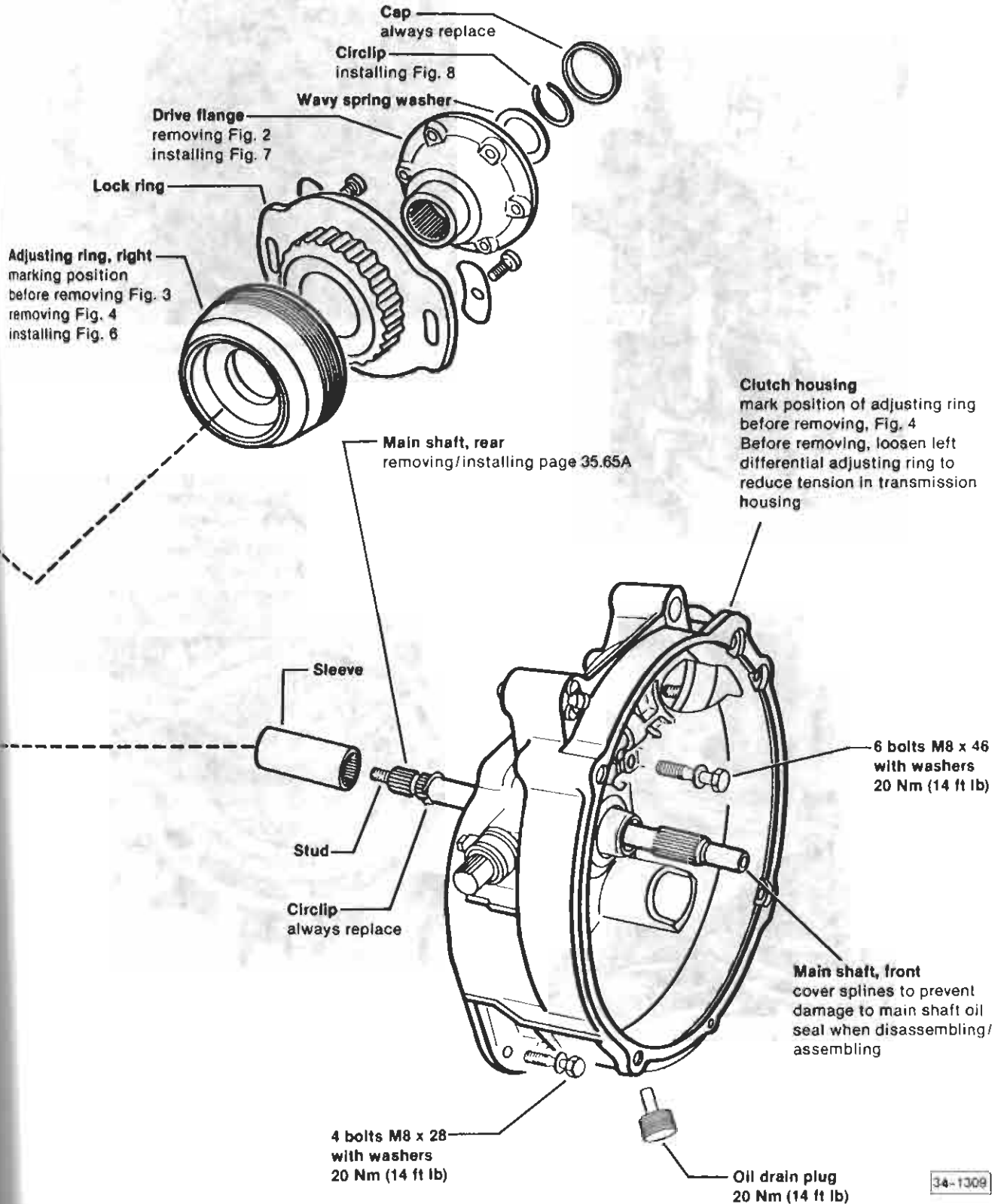
Quick Data	Index	
	<ul style="list-style-type: none"> <li>—Adjusting rings 35.62               <ul style="list-style-type: none"> <li>installing 35.65</li> <li>marking/removing 35.64</li> </ul> </li> <li>—Assembly 35.62, 35.63, 35.66, 35.67               <ul style="list-style-type: none"> <li>mounting in repair stand 35.64</li> </ul> </li> <li>—Clutch housing assembly 35.74</li> <li>—Differential 35.65</li> <li>—Drive flange 35.62               <ul style="list-style-type: none"> <li>circlip, installing 35.65</li> <li>installing 35.65</li> <li>oil seal 34.18</li> <li>removing 35.64</li> </ul> </li> <li>—Gear carrier 35.76               <ul style="list-style-type: none"> <li>assembly 35.66, 35.67</li> <li>assembling 35.70, 35.71</li> <li>cover 35.76</li> <li>installing 35.69</li> <li>removing 35.68</li> </ul> </li> <li>—Gears               <ul style="list-style-type: none"> <li>1st, shim 35.72, 35.73</li> <li>2nd, removing 35.88</li> <li>3rd/4th, removing 35.88</li> <li>4th, end play 35.91</li> <li>installing 35.91</li> </ul> </li> <li>—Gearshift lever 34.10</li> <li>—Gearshift linkage 34.10, 34.11</li> <li>—Installing 34.17</li> <li>—Lever bearing plate 34.10</li> </ul>	<ul style="list-style-type: none"> <li>—Main shaft 35.81               <ul style="list-style-type: none"> <li>assembly 35.80, 35.81</li> <li>ball bearing 35.83</li> <li>lock ring 35.84</li> <li>needle bearings 35.83, 35.84</li> <li>oil seal 35.75</li> <li>rear, removing/installing 35.65a</li> </ul> </li> <li>—Modifications to trans. manufactured prior to Dec. 15, 1982 35.65b–35.65d</li> <li>—Pinion shaft 35.87               <ul style="list-style-type: none"> <li>assembly 35.86, 35.87</li> <li>needle bearings 35.89, 35.91, 35.92</li> <li>roller bearings 35.88, 35.89</li> </ul> </li> <li>—Removing 34.16, 34.17</li> <li>—Retaining rings 35.67               <ul style="list-style-type: none"> <li>installing 35.70</li> <li>removing 35.68</li> </ul> </li> <li>—Shift rod bushing 35.78</li> <li>—Shift shaft oil seal 35.78</li> <li>—Starter bushing 35.75</li> <li>—Synchronizers               <ul style="list-style-type: none"> <li>assembling 35.90</li> <li>checking 35.82</li> <li>installing 35.90</li> <li>removing 35.82, 35.88</li> <li>ring, checking 35.90</li> <li>identification 35.92</li> <li>2nd/3rd gear 35.90</li> <li>4th/5th gear 35.82, 35.83</li> </ul> </li> <li>—Transmission, housing 35.77               <ul style="list-style-type: none"> <li>assembling 35.69</li> <li>disassembling 35.68, 35.69</li> </ul> </li> </ul> <p><b>4-Speed 091</b> — See page 35.1</p> <p><b>4-Speed 091/1</b> — See page 35.31</p> <p><b>094-4WD Syncro</b> — See page 35.93</p>

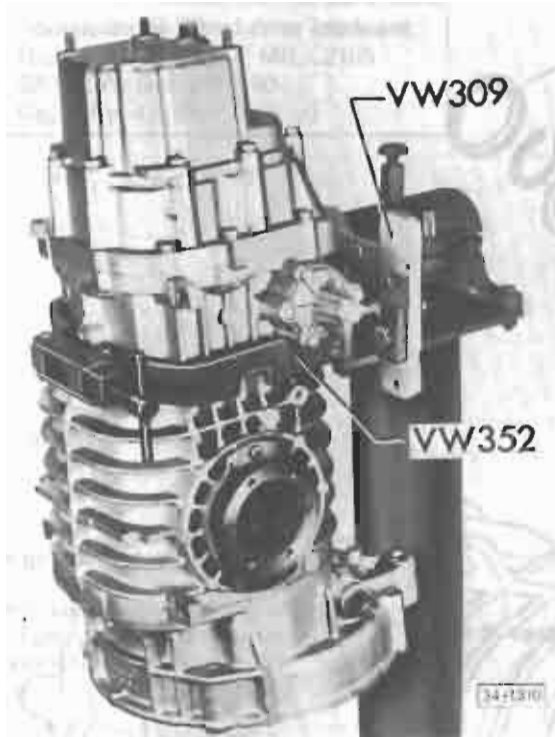


**Transmission/Final drive lubricant:**  
 Hypoid oil API/GL-4; MIL-L2105  
 SAE 80W, SAE 80W/90  
 Capacity: 4.0 ltr (4.2 US qt)



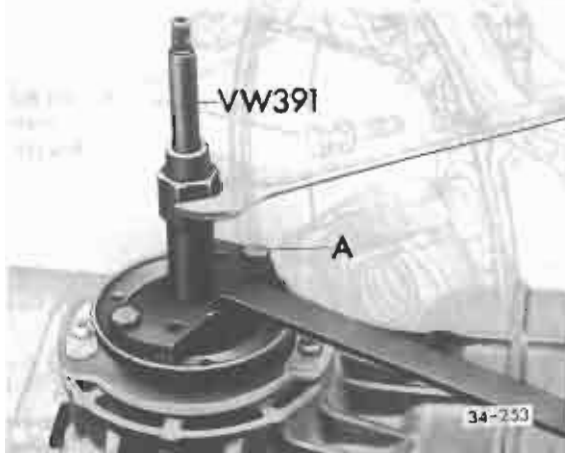
Adjusting  
 marking  
 before re  
 removing  
 installing





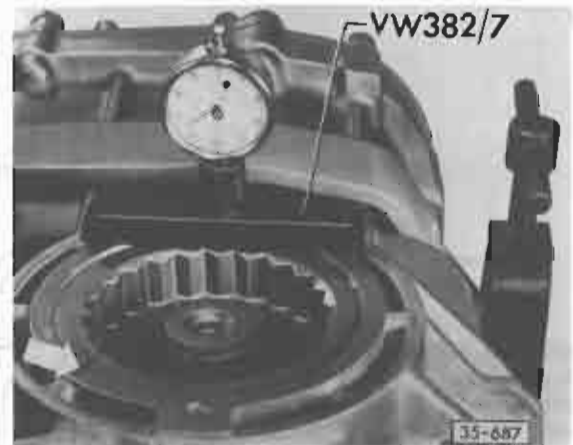
**Fig. 1** Transmission assembly, mounting in repair stand

- drain transmission oil
- mount transmission in repair stand



**Fig. 2** Drive flange, removing

- remove circlip and wavy spring washer
- attach VW391 to flange with 2 bolts
  - A = M8 x 30 bolts
- pull drive flange out

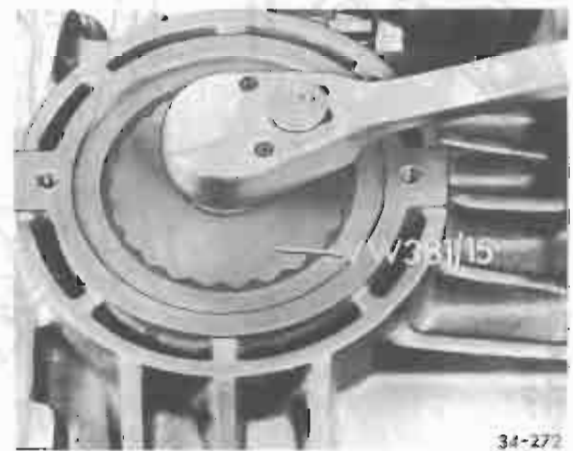


**Fig. 3** Adjusting ring, marking position

**Note**

Before starting repair work (which does not require final drive to be adjusted) mark position of adjusting rings on transmission housing. Measure depth to which they are installed with VW 382/7 and write down readings

- scribe left side (ring gear side) with one mark (arrow)
- scribe right side with two marks

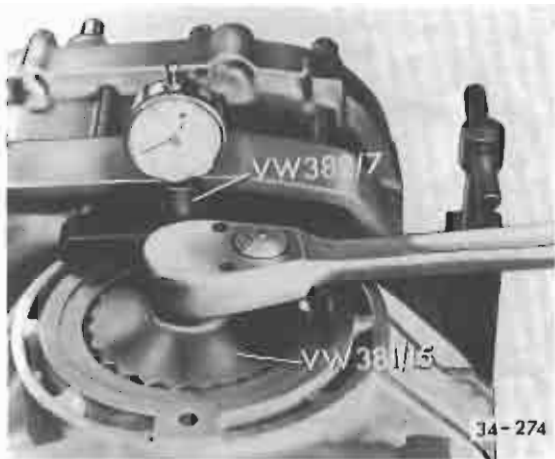


**Fig. 4** Adjusting rings, removing



**Fig. 5 Differential, removing**

- remove adjusting rings and rear main shaft
- lift out differential

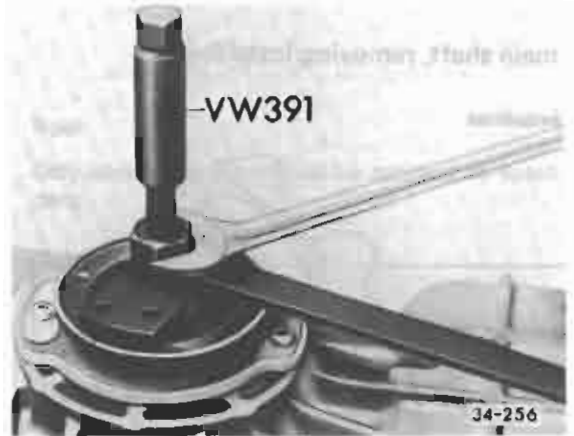


**Fig. 6 Adjusting rings, installing**

- install left and right adjusting rings and align marks at depth previously measured
- lubricate threads with MoS<sub>2</sub> grease

**CAUTION**

Do not tighten left side adjusting ring until clutch housing has been installed and bolts torqued



**Fig. 7 Drive flange, installing**



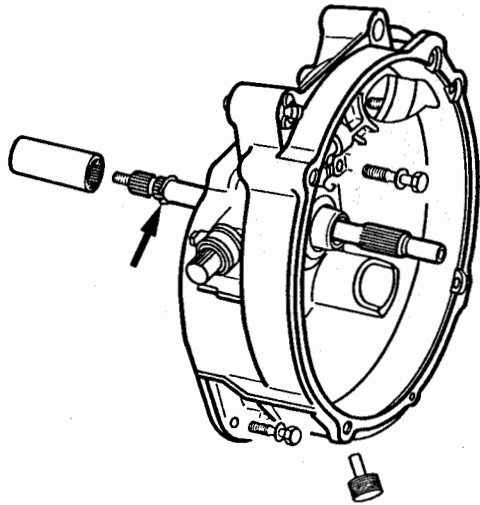
**Fig. 8 Circlip for drive flange, installing**

- insert wavy spring washer and circlip
- press circlip into groove with VW 244b and at same time check that washer is centered

# 35 Manual Transmission-Case, Gears, Shafts

## Rear main shaft, removing/installing

### Work sequence



34-1309 A

### Removing

- remove circlip (arrow)
- push sleeve backward and screw out main shaft

### Installing

- screw front and rear main shafts together, then back off one spline
- push sleeve on and install new circlip

**35.65a** Rear main shaft

5-speed 094

## Transmission modifications (manufactured prior to Dec. 15, 1982)

Transmissions with date of manufacture (see transmission housing code) prior to 15 12 2 (December 15, 1982) are subject to refinements currently used in production. Transmissions needing repair should be inspected and repaired as necessary according to following two groups of procedures with required parts according to dates of manufacture.

### Note

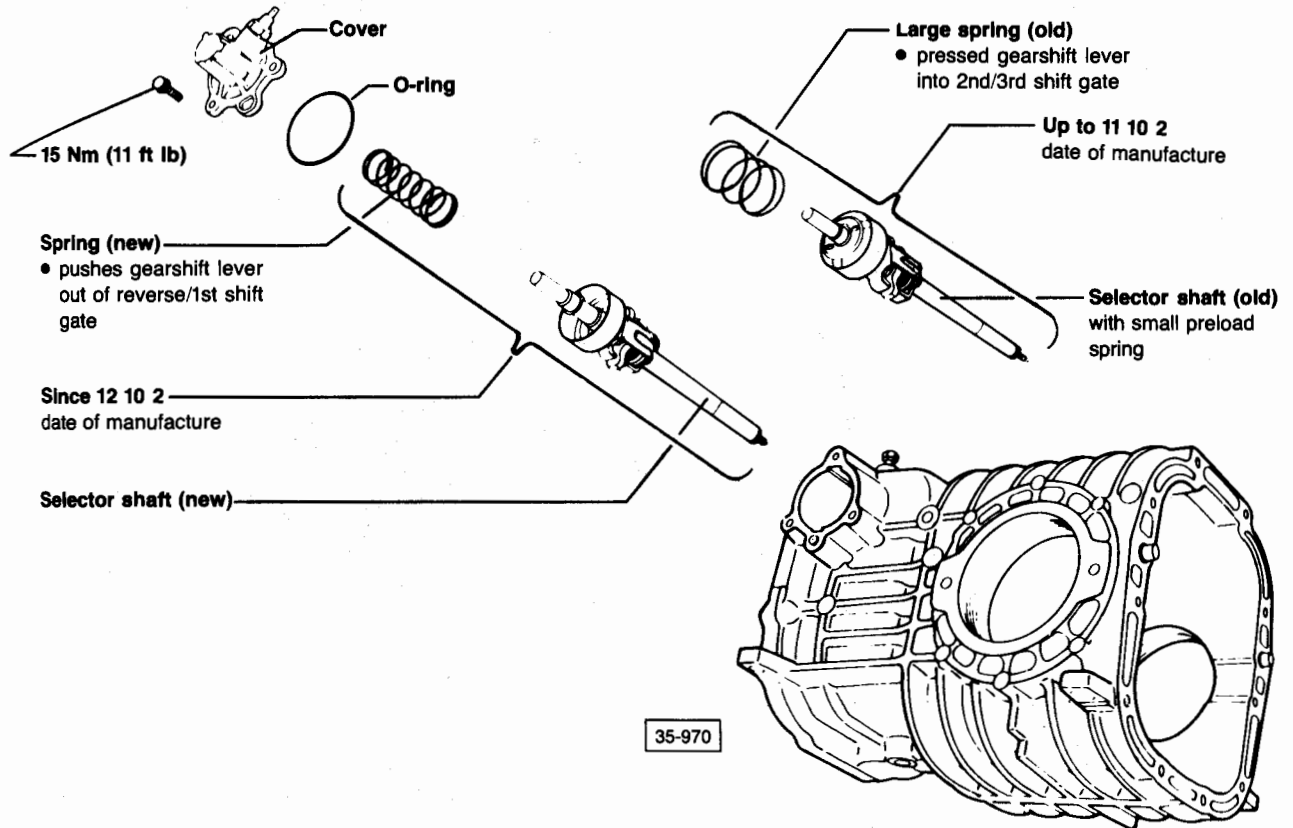
Only latest version parts will be supplied as spare parts.

### CAUTION

Part numbers are for reference only. Always check with your Parts Department for latest parts information.

### Selector shaft, modifications

- external repairs performed without removing transmission



5-speed 094

Modifications to transmissions  
manufactured prior to Dec. 15, 1982

35.65b

# 35 Manual Transmission-Case, Gears, Shaft

- A — Selector shaft
  - replace complete shaft with new version
- B — Selector shaft spring
  - Gearshift lever is now moved by spring pressure out of reverse/1st shift gate rather than into 2nd/3rd shift gate
  - install new selector shaft spring

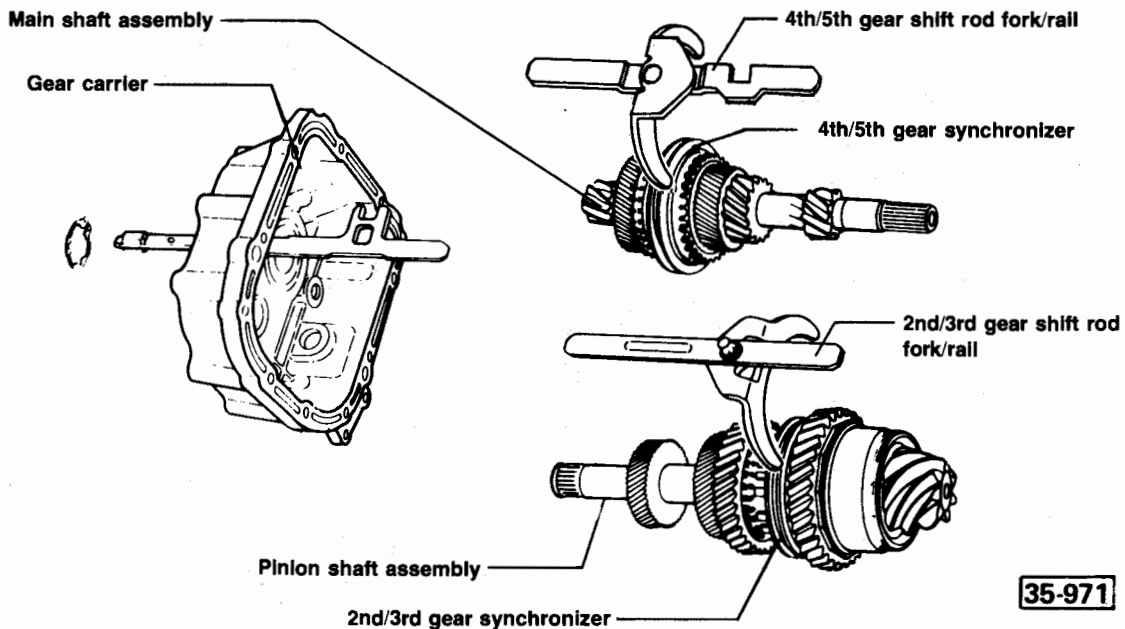
## Note

Large spring may be left in transmissions in which originally installed to accommodate driver's current shifting habits.

- C — Selector shaft cover
  - provided with shoulder for spring to maintain proper position when assembling
  - replace cover and o-ring

## Shift forks/synchronizers, modifications

- internal repairs requiring disassembly of transmission



- D — Shift forks/rails
  - 2nd/3rd and 4th/5th gear shift forks/rails are riveted and welded to maintain proper alignment to each other
  - replace with new shift forks/rails

## E — Synchronizers

- 2nd/3rd and 4th/5th gear synchronizers have been changed to prevent jumping out of gear
- changes cannot be detected visually
- replace with new version synchronizers

# 35.65c

Modifications to transmissions  
manufactured prior to Dec. 15, 1982

5-speed 094

Parts requirements (based on transmission date of manufacture)

**Note**

Previous version parts are not available and must be replaced by latest version listed below.

**CAUTION**  
Part numbers are for reference only. Always check with your Parts Department for latest parts information.

Transmission date of manufacture	Parts required	
	Description	Part Number
Prior to 11 10 2	Selector shaft Selector shaft spring Selector shaft cover Selector shaft cover o-ring Synchronizer (2/3) Synchronizer (4/5) Shift fork (2/3) Shift fork (4/5)	091-311-534B 091-311-548B 091-301-232A 094-301-278A 091-311-241B 091-311-301B 091-311-549A 091-311-559A
From 12 10 2 to 18 11 2	Selector shaft Selector shaft cover Selector shaft cover o-ring Synchronizer (2/3) Synchronizer (4/5) Shift fork (2/3) Shift fork (4/5)	091-311-534B 091-301-232A 094-301-278A 091-311-241B 091-311-301B 091-311-549A 091-311-559A
From 19 11 2 to 24 11 2	Selector shaft Selector shaft cover Selector shaft cover o-ring Shift fork (2/3) Shift fork (4/5)	091-311-534B 091-301-232A 094-301-278A 091-311-549A 091-311-559A
From 25 11 2 to 02 12 2	Selector shaft Selector shaft cover Selector shaft cover o-ring	091-311-534B 091-301-232A 094-301-278A
From 03 12 2 to 14 12 2	Selector shaft	091-311-534B

**5-speed 094**

Modifications to transmissions  
manufactured prior to Dec. 15, 1982

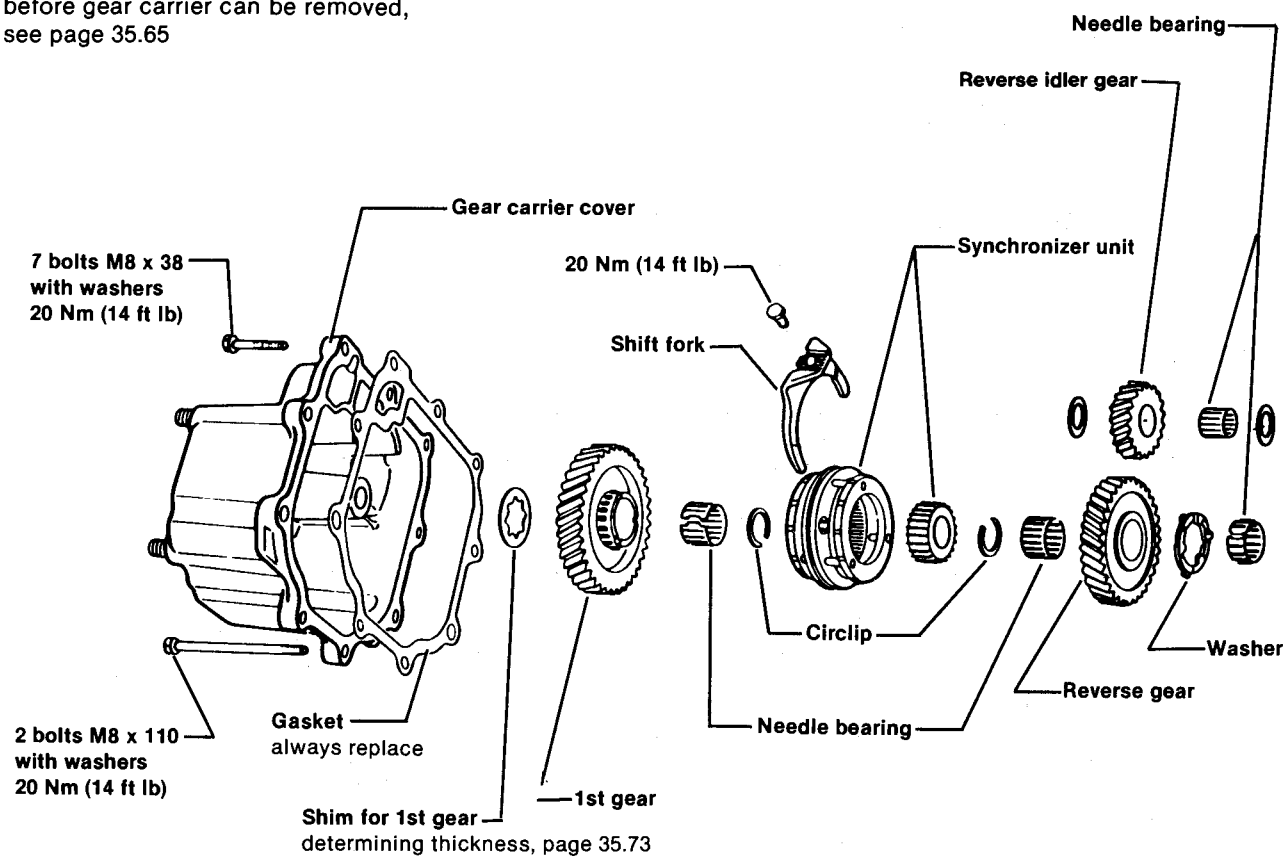
## 35.65d

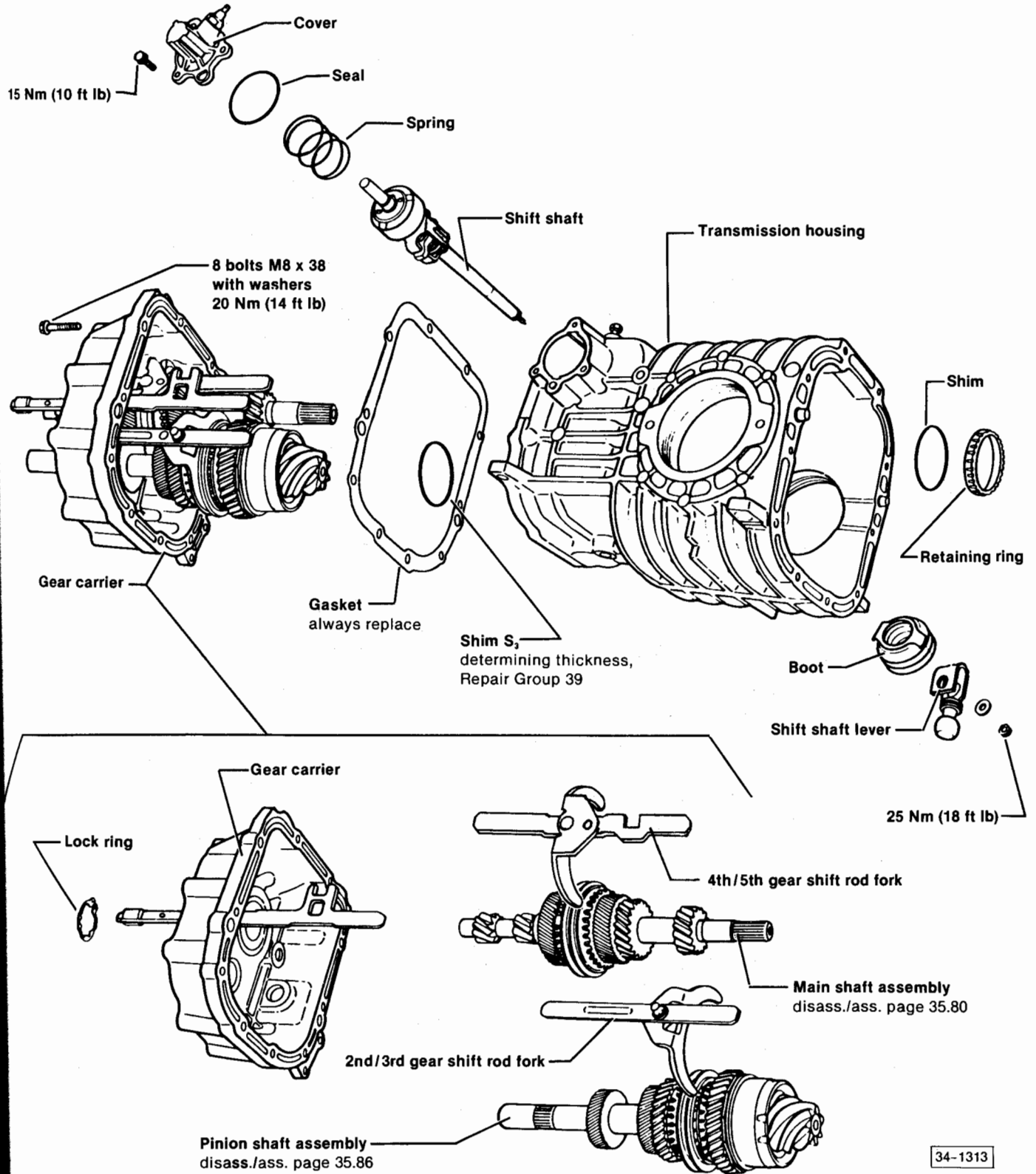


# 35 Manual Transmission-Case, Gears, Shaft

## Note

Differential must be removed before gear carrier can be removed, see page 35.65





5-speed 094

Gear carrier, assembly  
Transmission, assembly

**35.67**

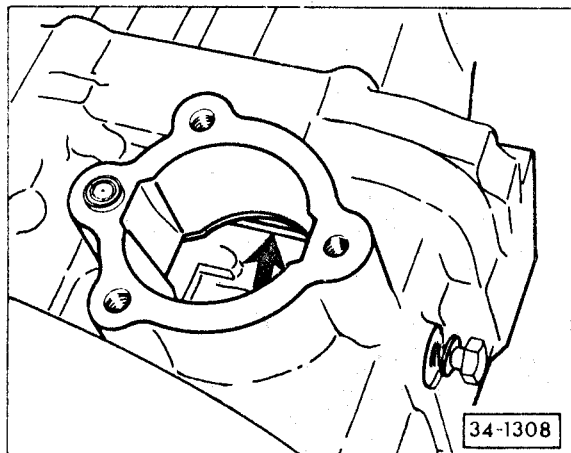
# 35 Manual Transmission—Case, Gears, Shafts

## Transmission

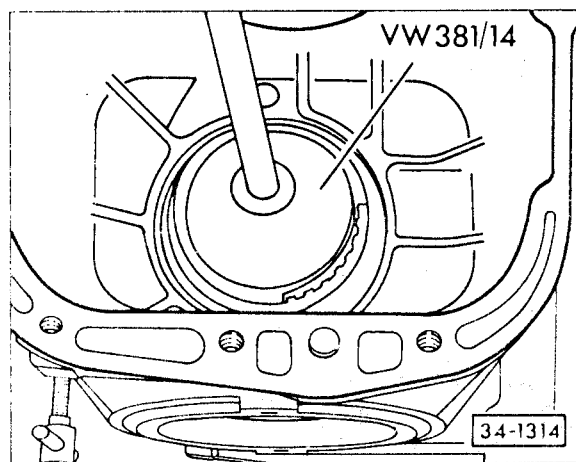
### Disassembling

#### Work sequence

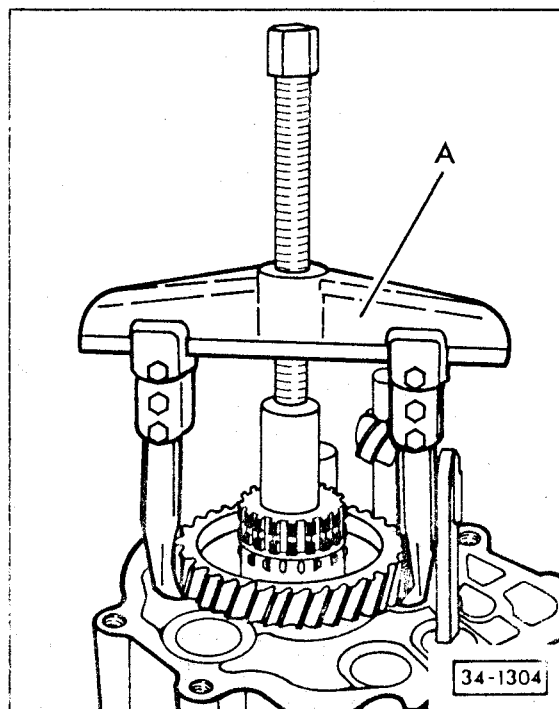
- remove coverplate
- remove shift shaft



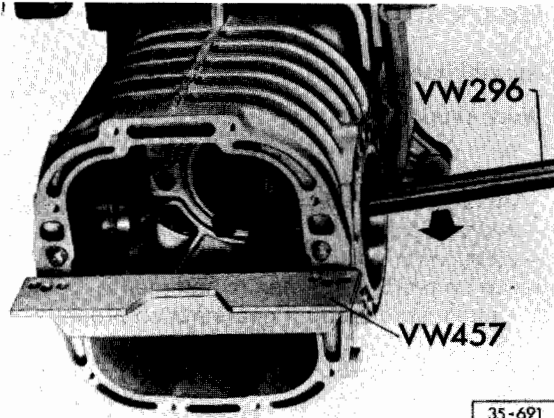
- loosen bolt until relay lever (arrow) can be pulled against housing
- tighten bolt to lock lever in that position



- remove retaining ring
- remove gear shift housing
- remove reverse gear shift rod and hub
- remove outer circlip



- pull off synchronizer hub and reverse gear
  - A-puller US 1078
- remove inner circlip, washer and needle bearing
- remove reverse gear together with needle bearing and washer
- remove gear carrier housing bolts



35-691

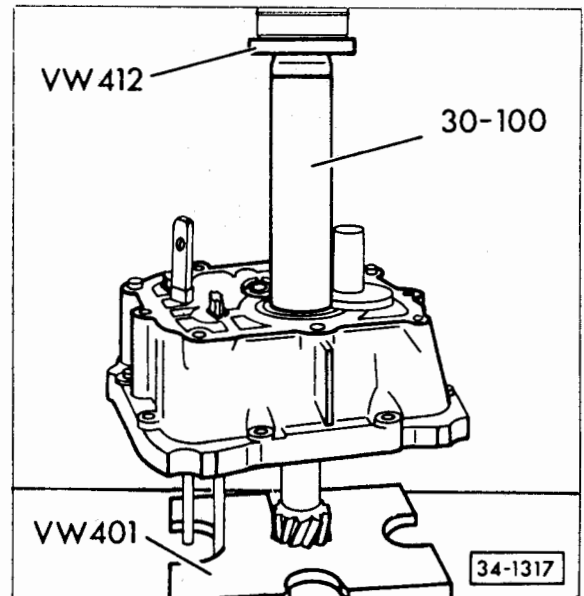
- to remove gear carrier attach VW 457 with two M8 x 20 bolts
- press gear carrier out with VW 296
- remove shim S<sub>3</sub> and note thickness

**Note**

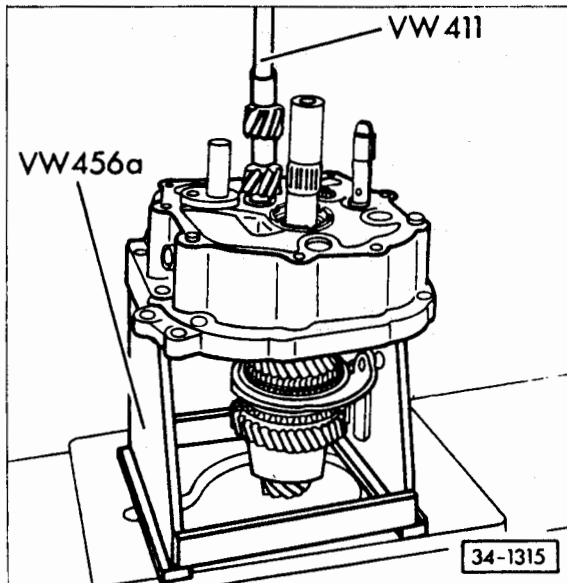
If bearing and/or transmission housing are replaced, and dimension r is not marked on ring gear, pinion depth must be measured and noted **before** gear carrier is removed. This is dimension r. See Repair Group 39. When assembling, parts must be installed in same position. See Ring gear/pinion, adjusting, Repair Group 39

**Assembling**

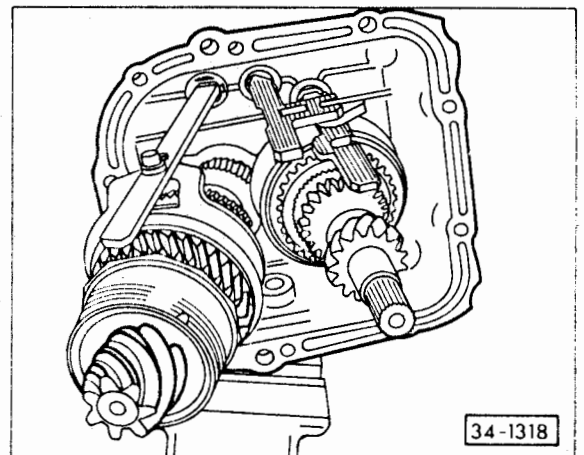
**Work sequence**



- press main shaft with shift rod into gear carrier

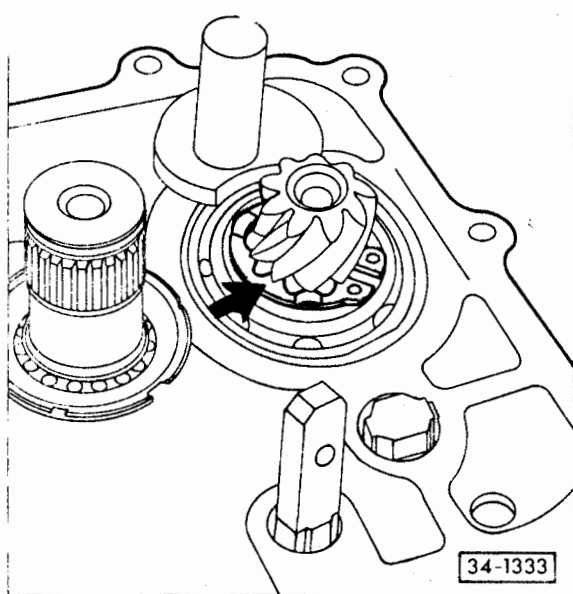


- press pinion shaft with main shaft and shift rod out of gear carrier

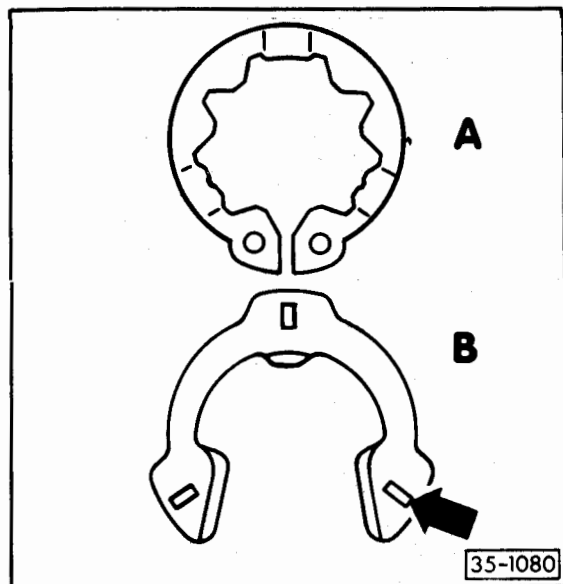


- install pinion shaft with shift rod
  - shift into 4th gear
- shift into neutral
- install pinion shaft needle bearing

# 35 Manual Transmission-Case, Gears, Shafts



- install circlip
  - make sure lugs of circlip are below teeth of pinion head (arrow)



**A** = previous circlip Part No. 091 311 381      **B** = new circlip Part No. 091 311 381 A

**Note**

Use either type of circlip during repairs. The previous circlip will be discontinued when stock is used up.

**CAUTION**

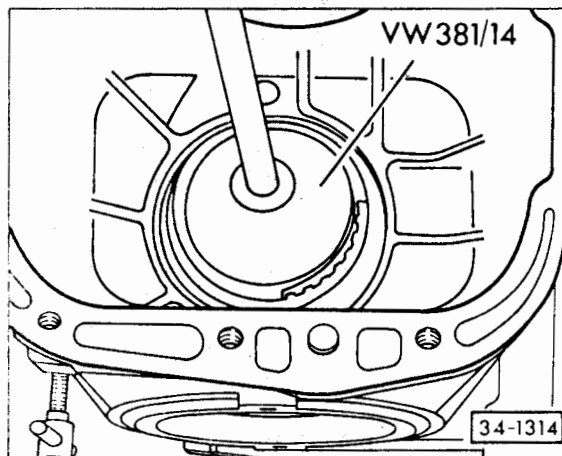
Always replace the circlip during repairs. Identifying marks on a new circlip (arrow) must face reverse gear splines.

## Gear carrier

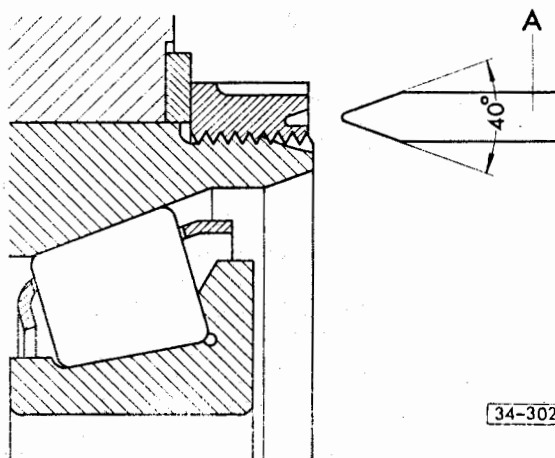
### Assembling

#### Work sequence

- install shim  $S_3$
- install new gasket
- align shift rod
- align flat on piston with recess in housing
- tap on pinion with plastic hammer to install
  - make sure teeth of gears match properly

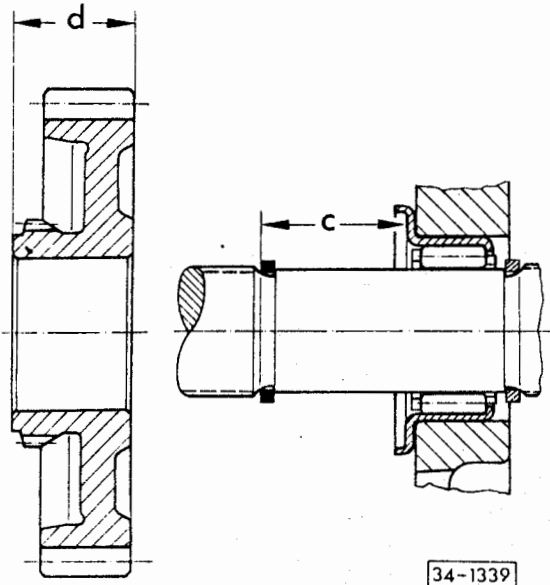


- install retaining ring and tighten to 225 Nm (162 ft lb), then loosen and retighten to 225 Nm (162 ft lb)



- peen retaining ring twice with suitable tool A (local manufacture)
- attach gear carrier to transmission housing and tighten bolts to 20 Nm (14 ft lb)

## determining thickness of spacer for reverse gear



- install circlip
- measure distance C

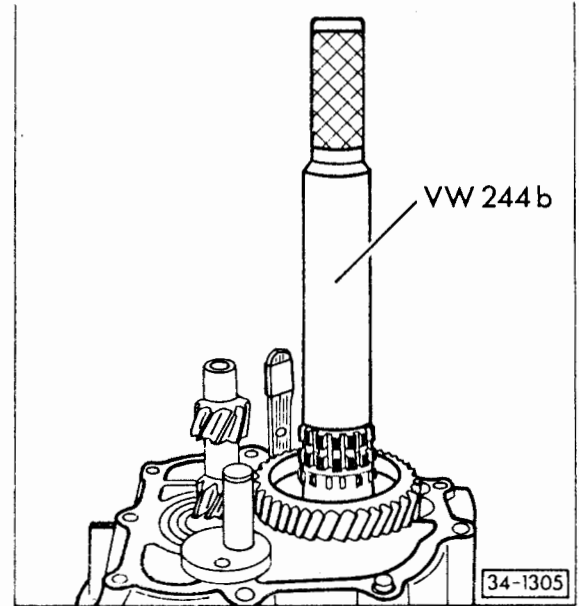
### Example

measurement c	29.1 mm
measurement d	— 24.7 mm
thickness of spacer	4.4 mm

### thickness of spacers available

gap to be adjusted (mm)	Spare part no.	color
3.97-4.19	091 311 379	white
4.20-4.39	091 311 379 A	black
4.40-4.59	091 311 379 B	green
4.60-4.90	091 311 379 C	red

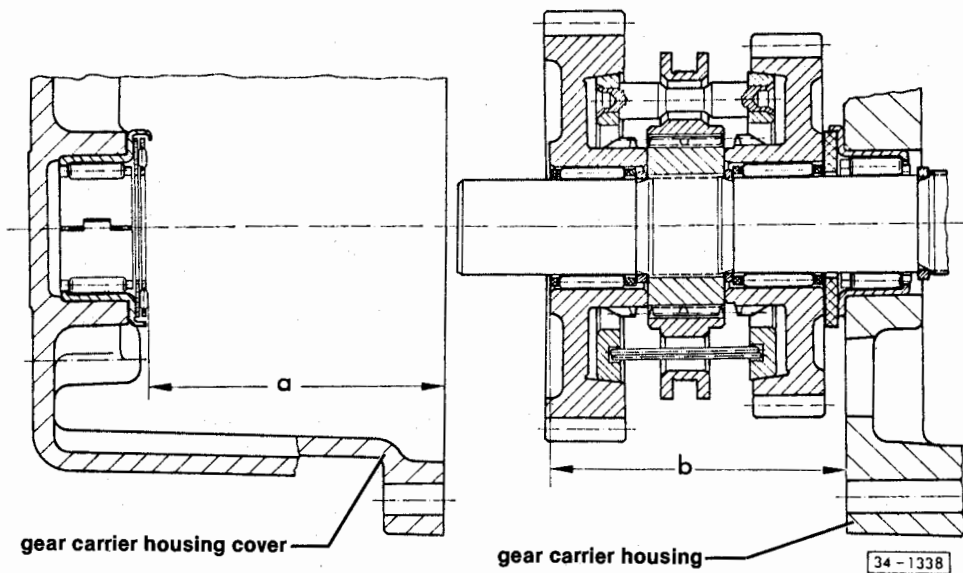
- install selected spacer, reverse gear, needle bearing and circlip



- install synchronizer
- install circlip
- install reverse gear
  - groove in gear must face cover
- install needle bearing and washers
- install synchronizer for 1st/reverse gear and shift fork
  - molybdenum coated side of synchronizer ring faces 1st gear
- install shift rod/fork bolt and tighten to 20 Nm (14 ft lb)
  - before installing coat thread of bolt with D6-locking compound
- install 1st gear
- install needle bearing

# 35 Manual Transmission-Case, Gears, Shaft

Shim for 1st gear



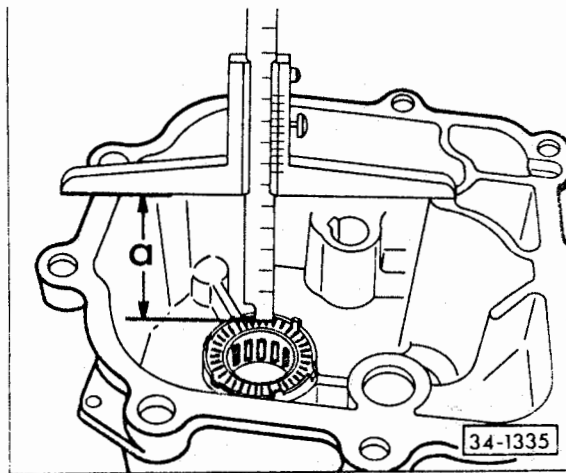
**35.72**

Shim for 1st gear

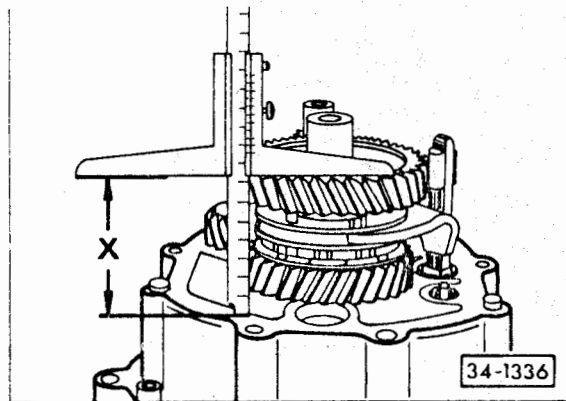
5-speed 094

## Determining thickness

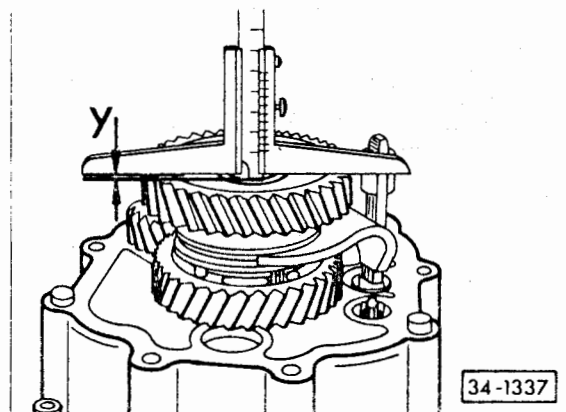
### Work sequence



—measure depth a  
Example: a = 77.8 mm



—measure distance x  
Example: x = 77.6 mm



—measure distance y  
Example y = 1.0 mm

$$b = x - y$$

Example:

$$\begin{array}{r} b = 77.6 \text{ mm} \\ - 1.0 \text{ mm} \\ \hline 76.6 \text{ mm} \end{array}$$

Measurement = a - b

$$\begin{array}{r} = 77.8 \text{ mm} \\ - 76.6 \text{ mm} \\ \hline 1.2 \text{ mm} \end{array}$$

Following shims are available:

Measurement (mm)	Shim thickness (mm)	Spare Part No.
0.95...1.14	0.6	094 311 379
1.15...1.34	0.8	094 311 379 A
1.35...1.54	1.0	094 311 379 B
1.55...1.74	1.2	094 311 379 C
1.75...1.94	1.4	094 311 379 D
1.95...2.14	1.6	094 311 379 E
2.15...2.47	1.8	094 311 379 F

- select correct shim
- install new gasket
- install cover
  - align shaft and bore in cover
- tighten bolts to 20 Nm (14 ft lb)
- loosen relay lever bolt
- push lever into position and tighten bolt to 15 Nm (14 ft lb)
- install shift shaft
  - slotted side toward differential housing
- install new gasket
- install spring
- install cover and tighten bolts to 15 Nm (10 ft lb)
- install back-up light switch
- install shift shaft lever

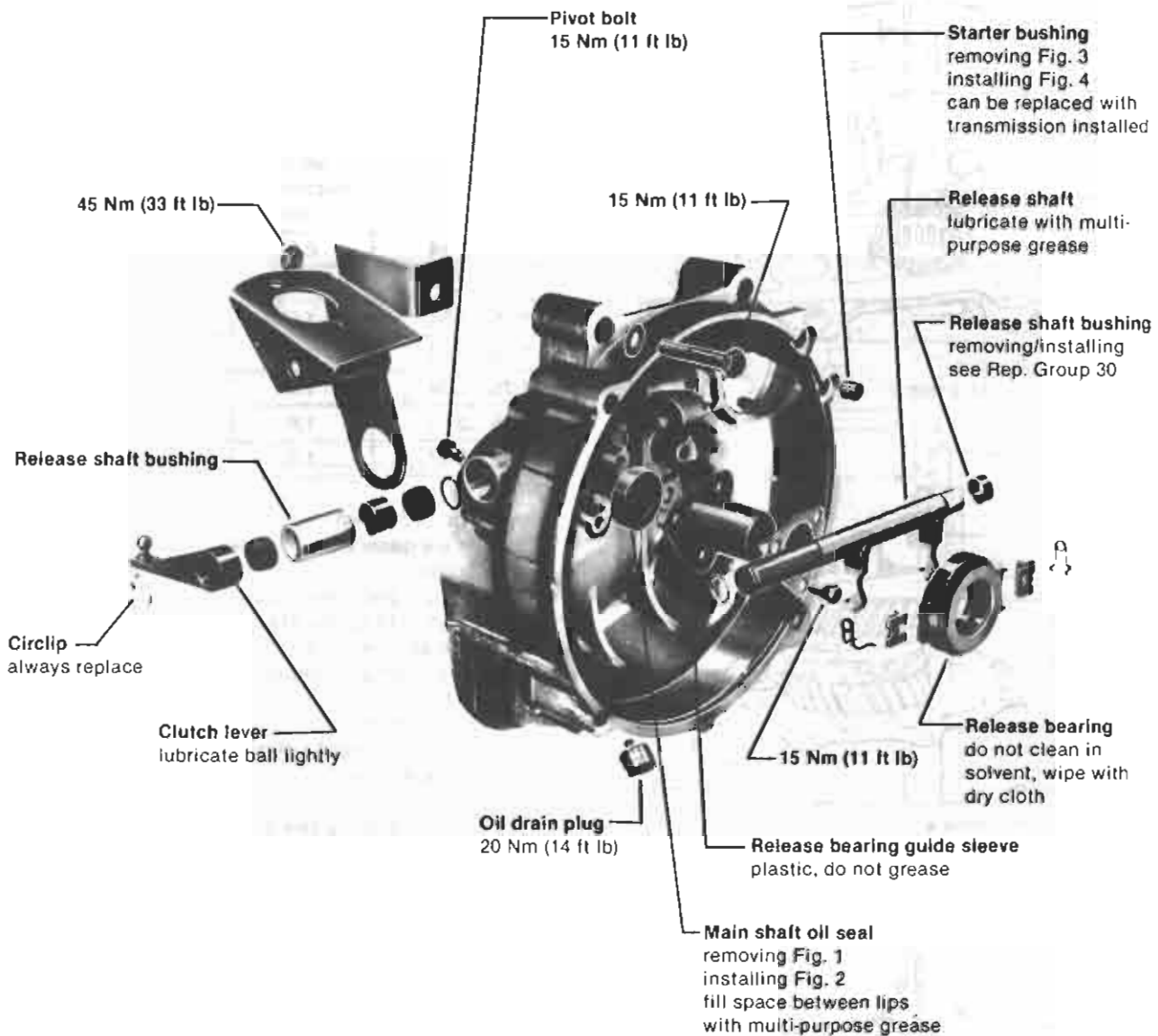
5-speed 094

Shim for 1st gear

35.73



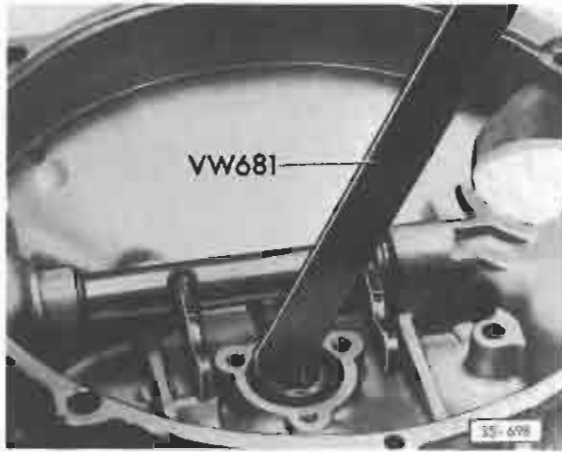
# 35 Manual Transmission-Case, Gears, Shafts



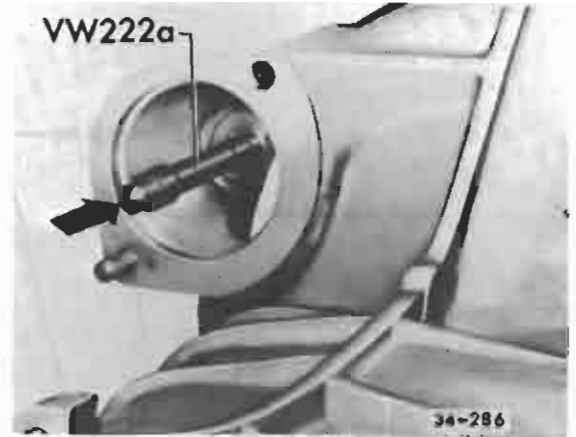
35-697

**35.74** Clutch housing

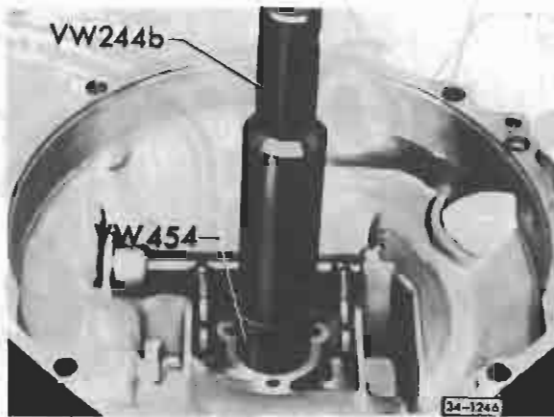
**5-speed 094**



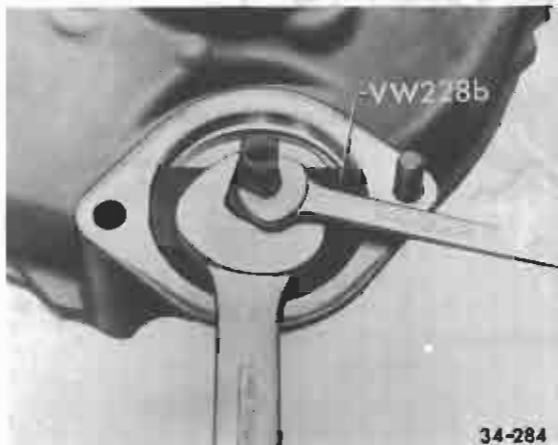
**Fig. 1 Main shaft oil seal, removing**



**Fig. 4 Starter bushing, installing**  
—lubricate bushing and drive in flush



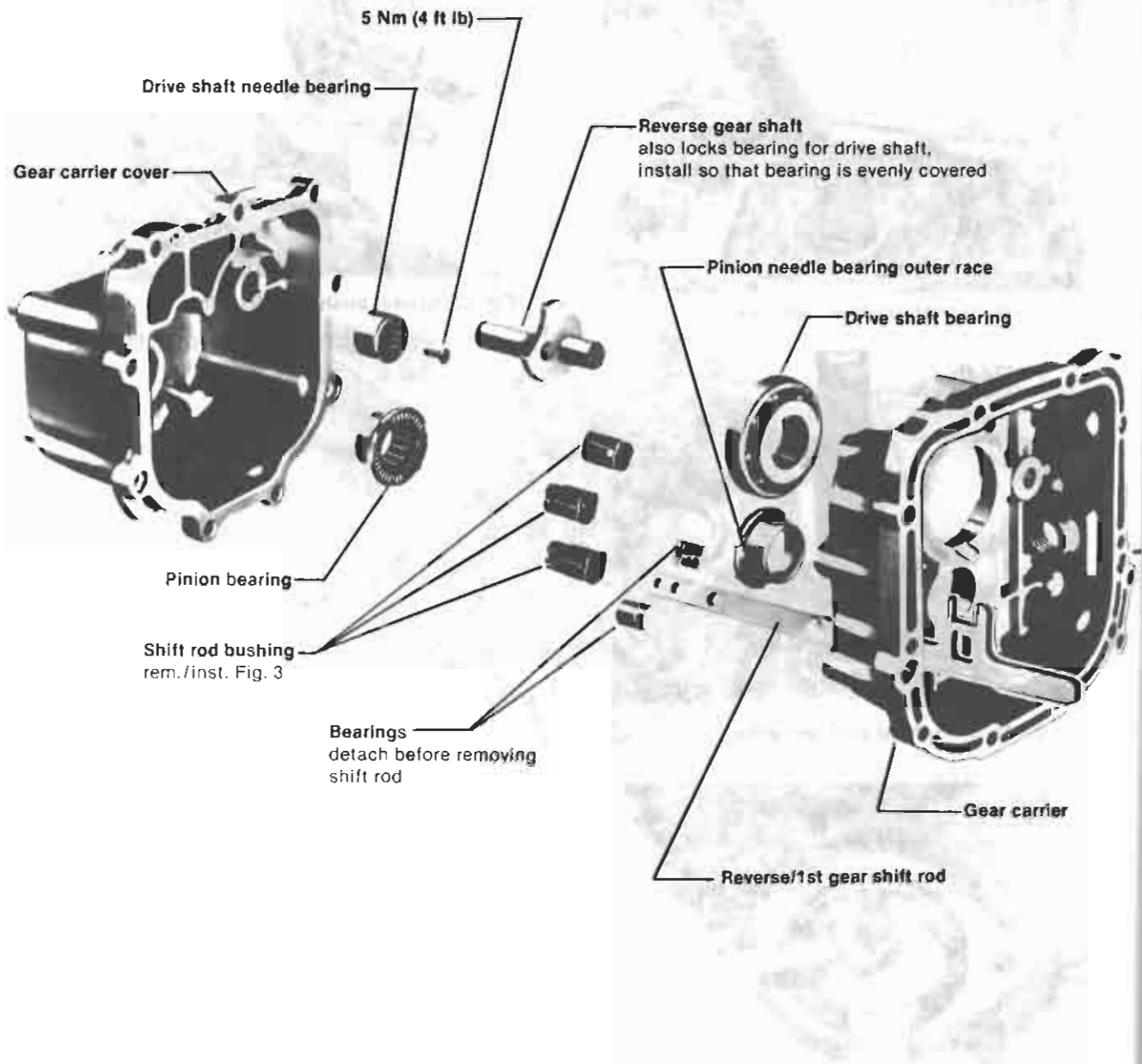
**Fig. 2 Main shaft oil seal, installing**



**Fig. 3 Starter bushing, removing  
(transmission installed)**

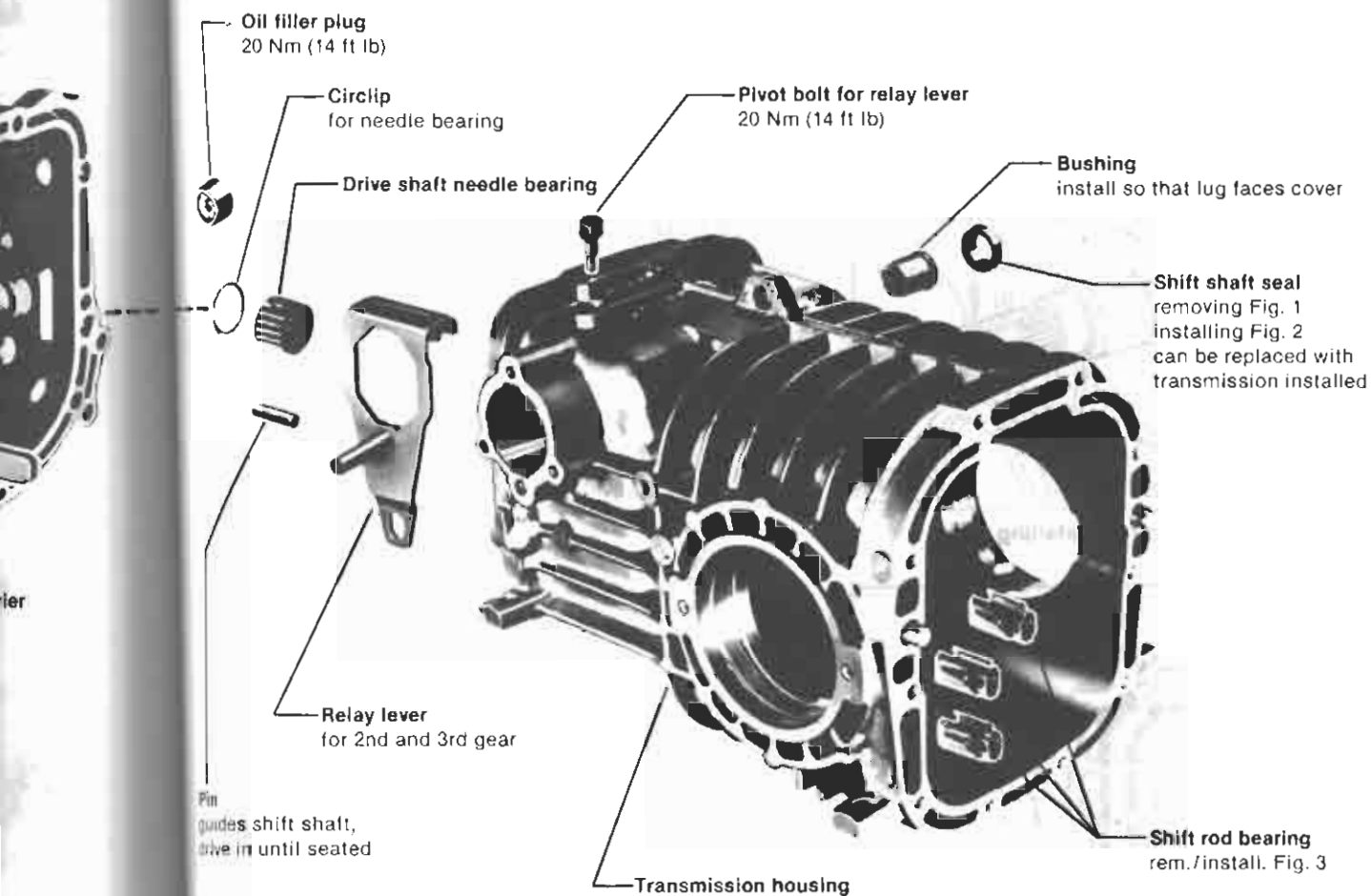
- when transmission is removed, use drift VW 222a

# 35 Manual Transmission-Case, Gears, Shafts



**35.76** Gear carrier housing  
Gear carrier housing cover

**5-speed 094**



34-1320

5-speed 094

Transmission housing

35.77

# 35 Manual Transmission—Case, Gears, Shafts

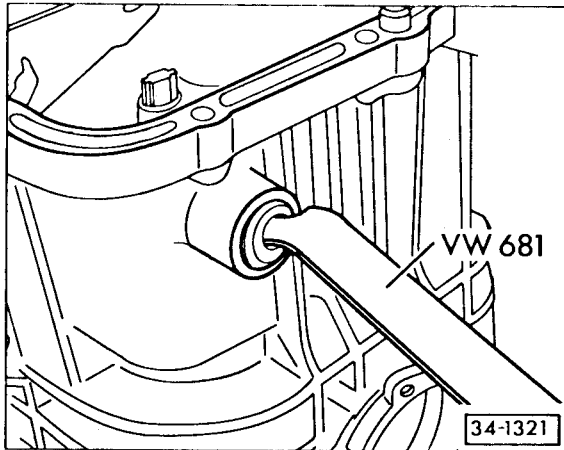


Fig. 1 Shift shaft oil seal, removing

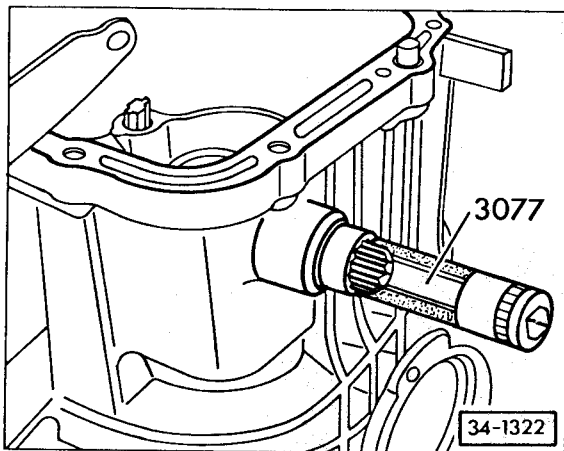


Fig. 2 Shift shaft oil seal, installing

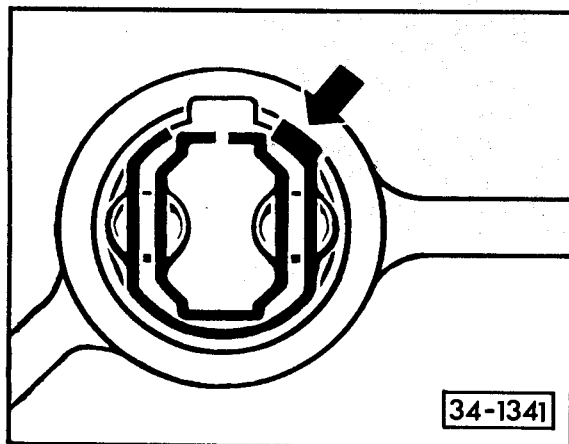
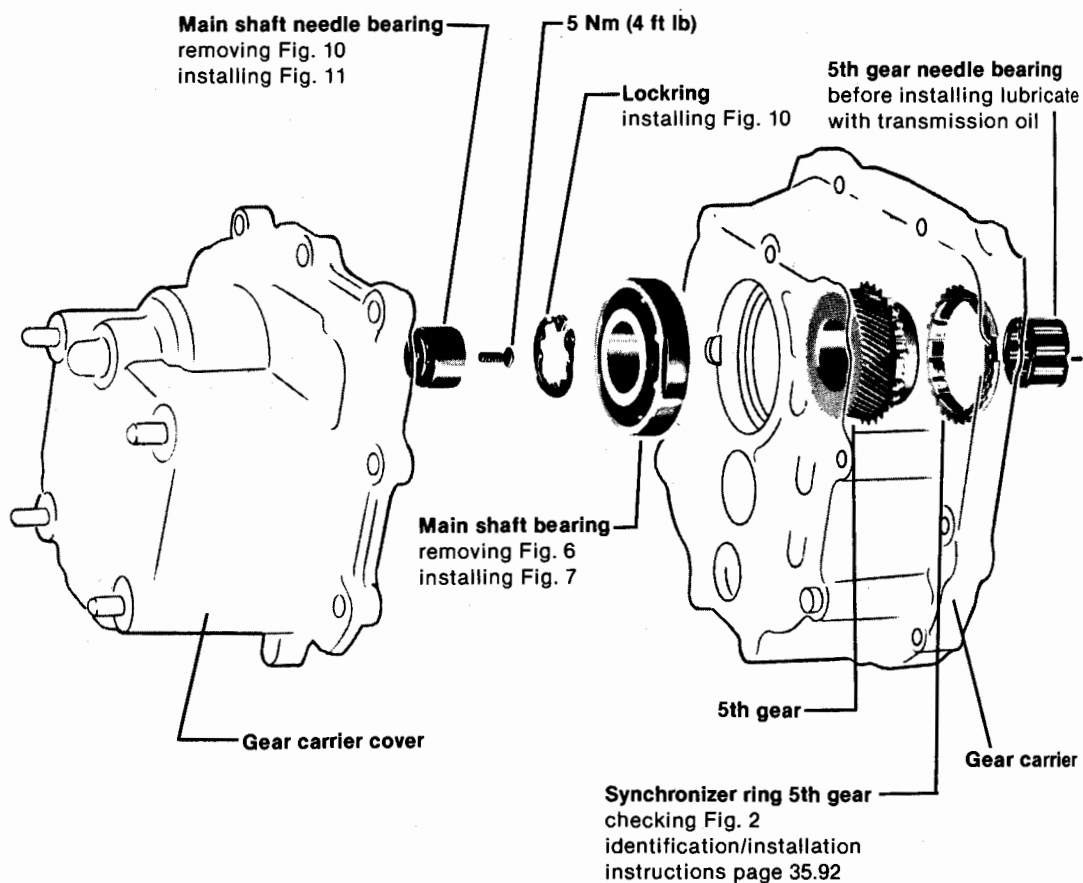


Fig. 3 Shift rod bushing

- removing
  - turn bearing so that lug (arrow) is in recess of housing and press out
- installing
  - align bearing and rod

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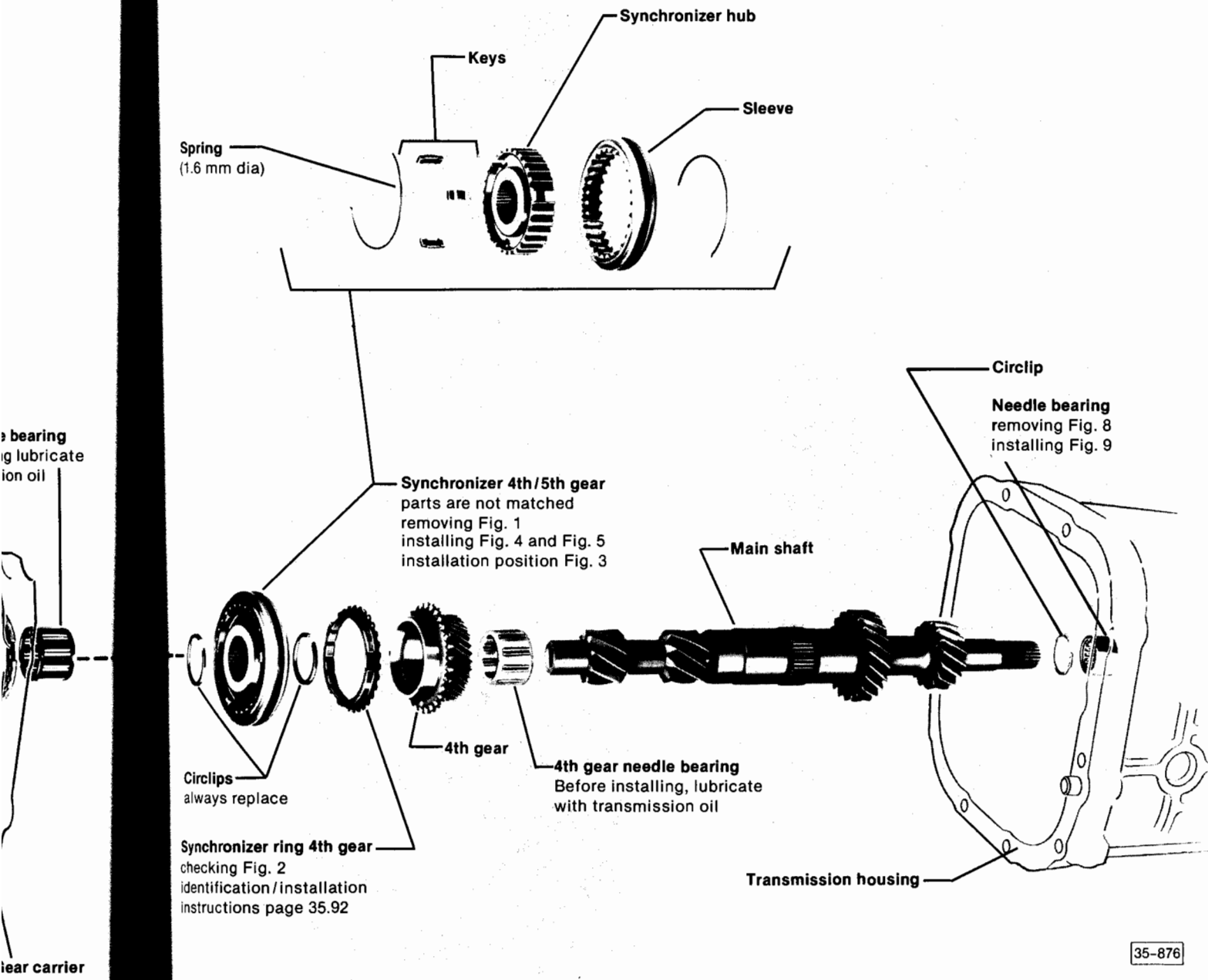
# 35 Manual Transmission-Case, Gears, Shafts



**35.80**

Main shaft

**5-speed 094**



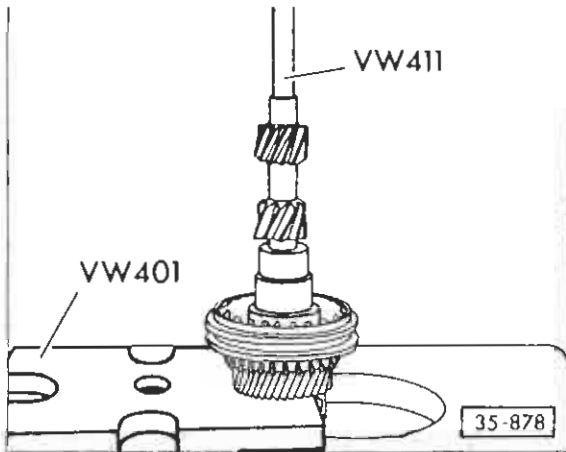
35-876

5-speed 094

Main shaft

35.81





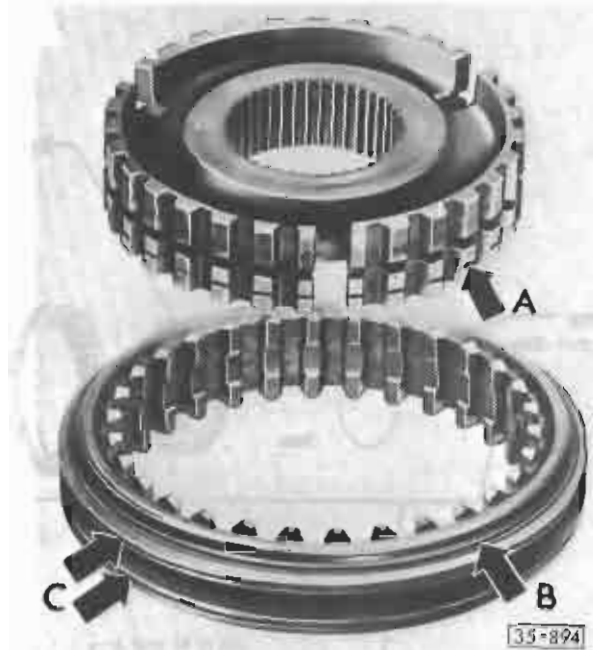
**Fig. 1 Synchronizer, removing**  
—press off together with gear



**Fig. 2 Synchronizer rings, checking**  
—press synchronizer rings onto gear by hand and measure gap a with feeler gauge

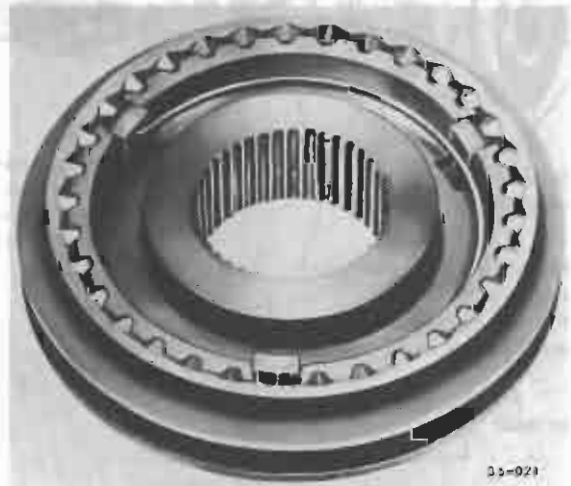
**Gap a**

Gear	New Part mm (in.)	Wear limit mm (in.)
4th/5th	1.0-1.7 (0.039-0.067)	0.5 (0.020)



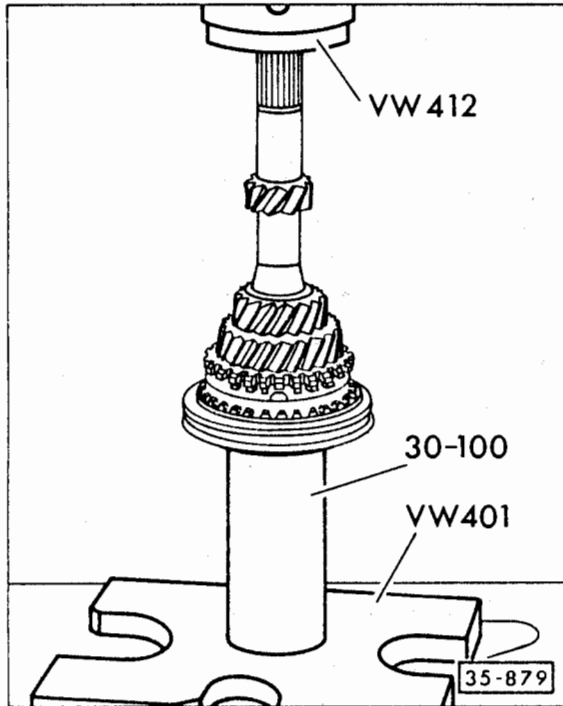
**Fig. 3 Synchronizer 4th/5th gear, assembling**

- identification grooves (arrows A & B) of sleeve and hub are on opposite sides. Groove on sleeve (arrow B) faces 4th gear
- grooves (arrow C) are for identification:  
2nd & 3rd gear = 1 groove  
4th & 5th gear = 2 grooves



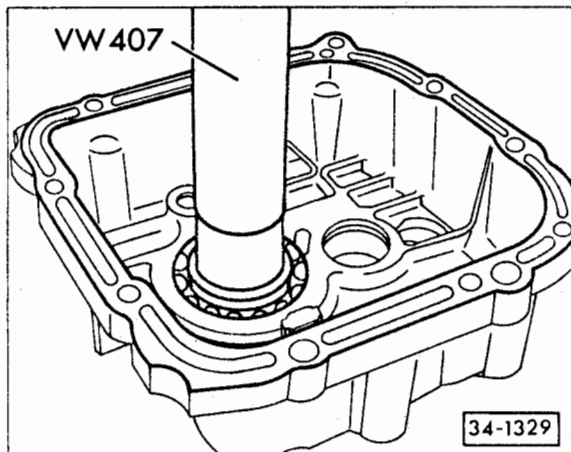
**Fig. 4 Synchronizer 4th/5th gear, assembling**

- slide sleeve over synchronizer hub. Matched position is not necessary
- insert keys and install springs with ends offset 120°. Angled ends of springs must fit into keys

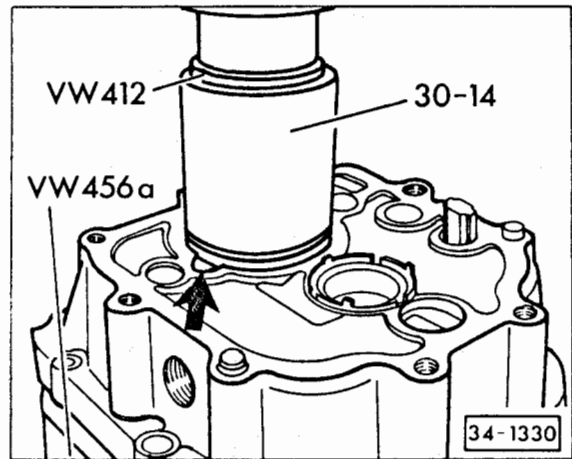


**Fig. 5 Synchronizer 4th/5th gear, installing**

- turn synchronizer ring until grooves are in line with keys
- identification groove on sleeve (Fig. 3, arrow B) faces 4th gear

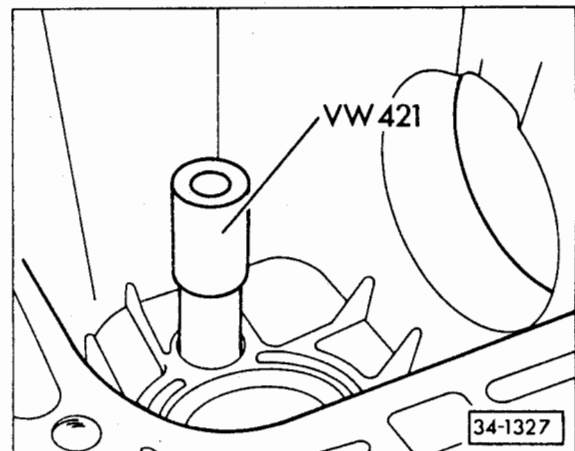


**Fig. 6 Main shaft ball bearing, removing**

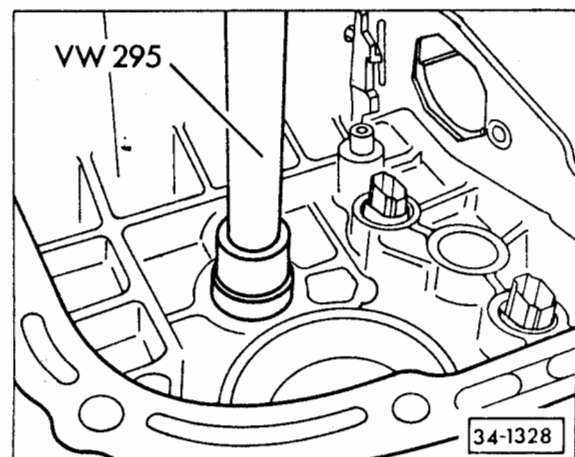


**Fig. 7 Main shaft ball bearing, installing**

- press in so that recess in bearing is aligned with recess (arrow) in housing



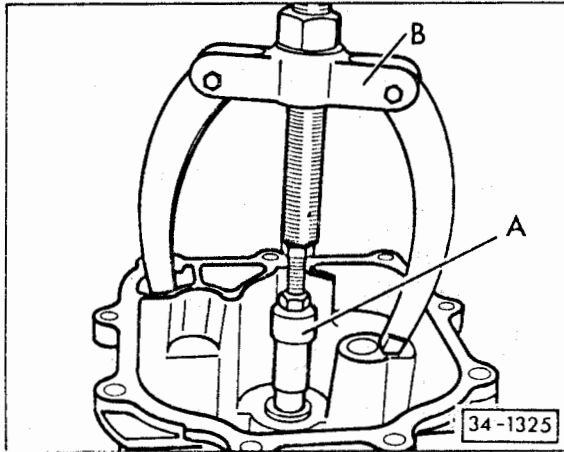
**Fig. 8 Needle bearing in housing, removing**



**Fig. 9 Needle bearing in housing, installing**

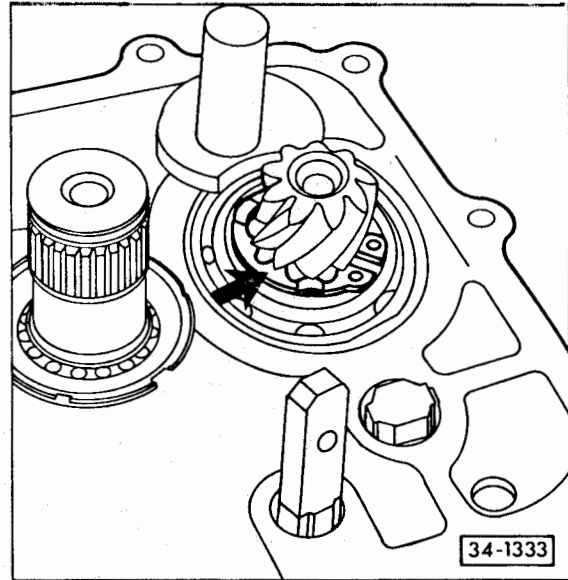
- lettered side of bearing (thicker material) must face installing tool

# 35 Manual Transmission-Case, Gears, Shafts



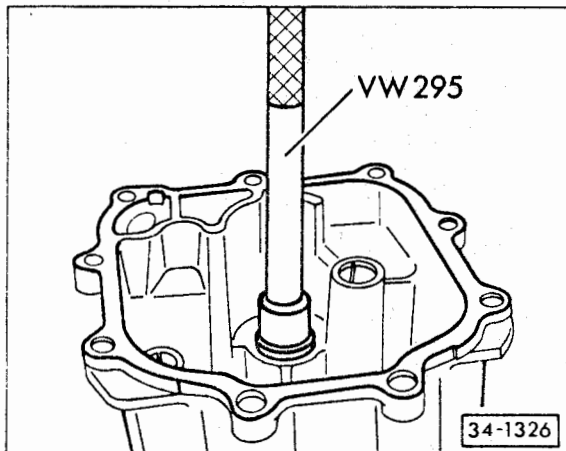
**Fig. 10 Main shaft needle bearing in gear carrier housing cover, removing**

- remove screw
- pull bearing out with
- A—extractor US 1088
- B—puller US 1039



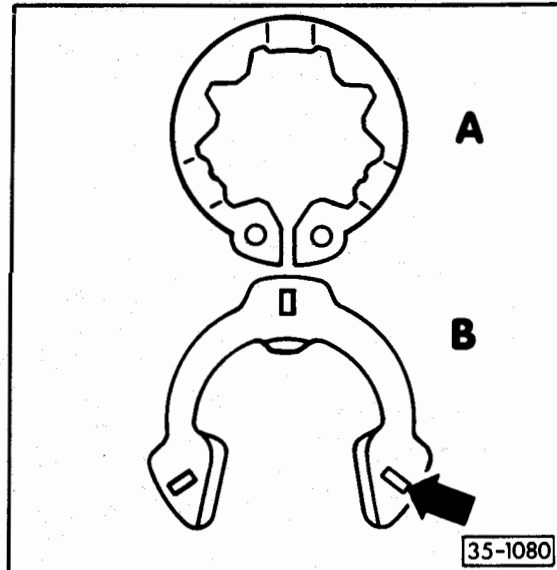
**Fig. 12 Circlip, installing**

- make sure ring is seated correctly (arrow)



**Fig. 11 Main shaft needle bearing in gear carrier housing cover, installing**

- tighten screw to 5 Nm (4 ft lb)



**Fig. 13 Circlip, two types**

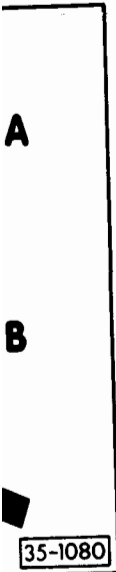
- A = previous circlip Part No. 091 311 381      B = new circlip Part No. 091 311 381

**CAUTION**

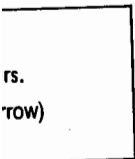
Always replace the circlip during repairs. Identifying marks on a new circlip (arrow) must face reverse gear splines.



rectly

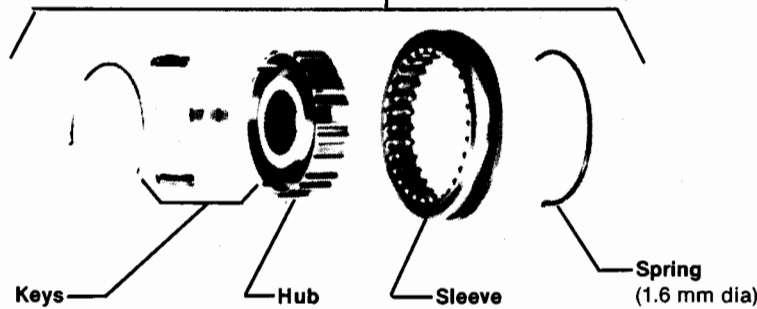
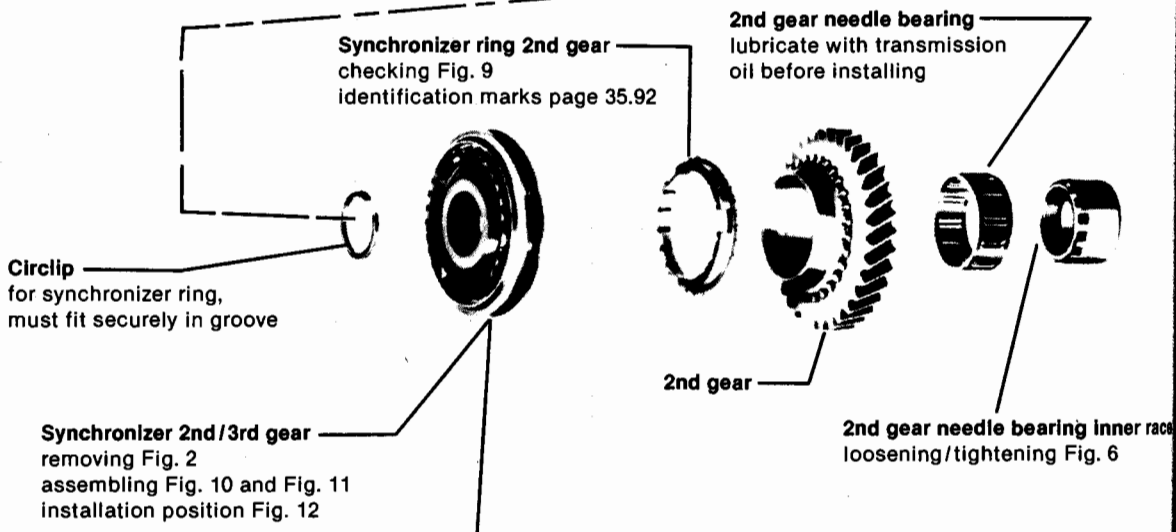
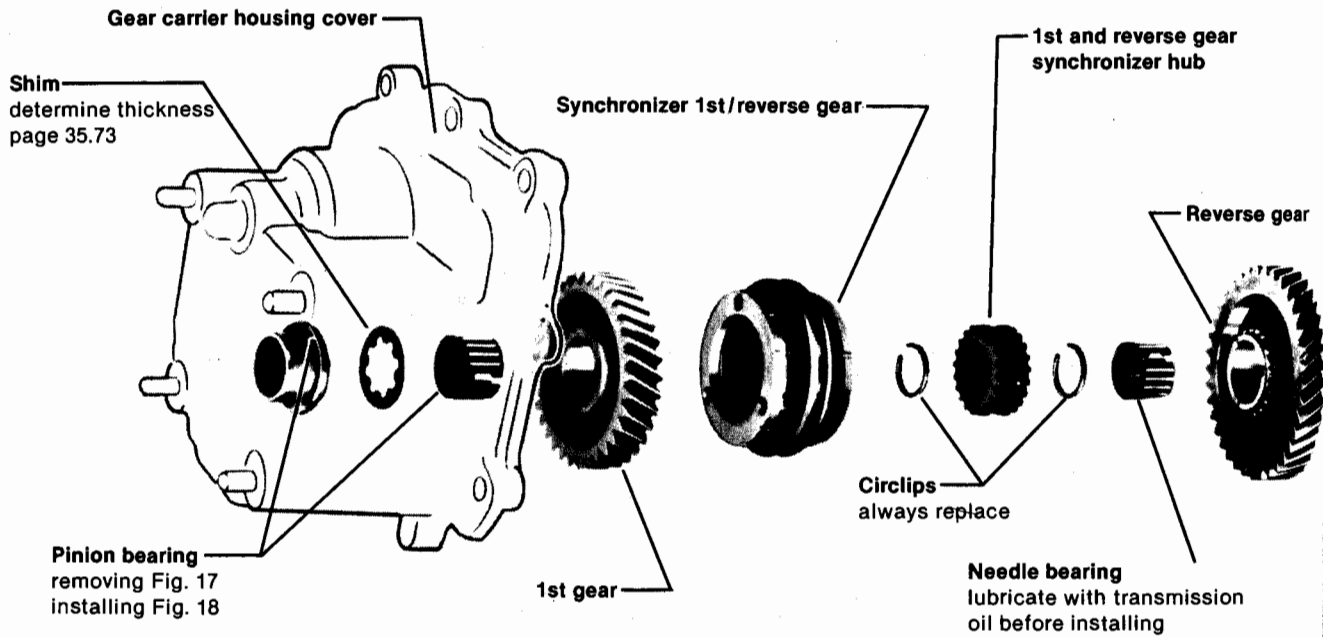


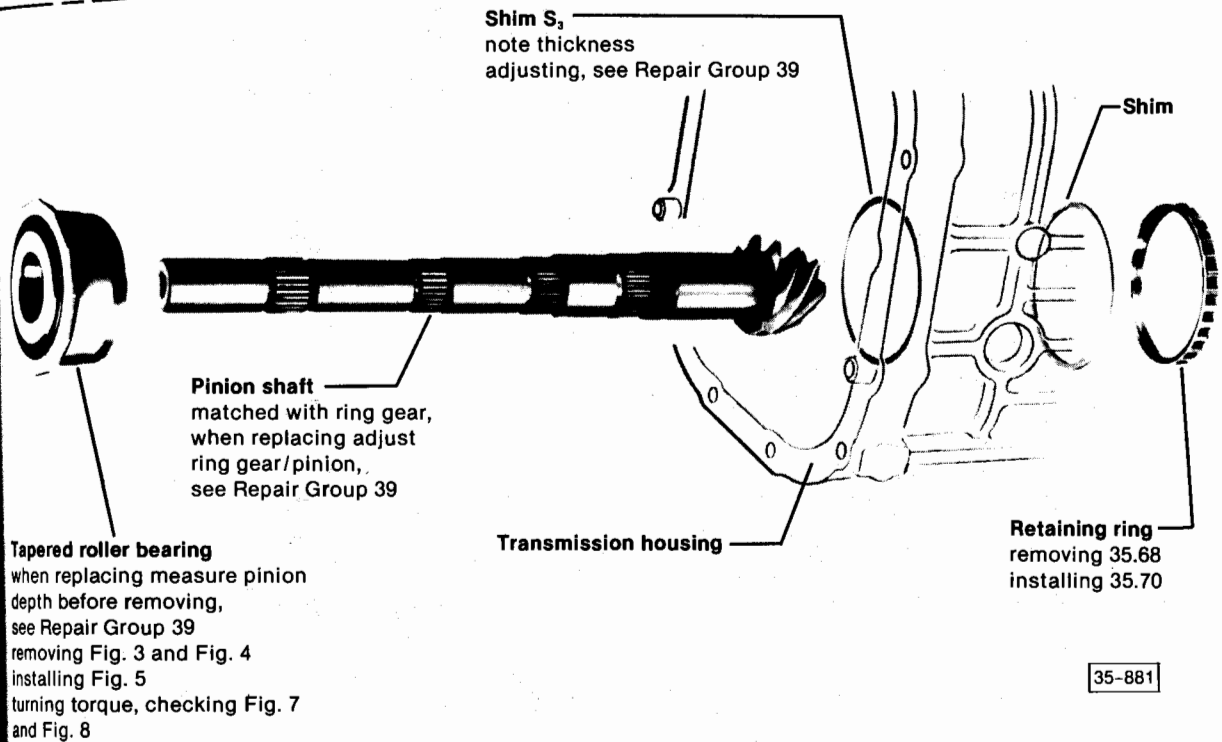
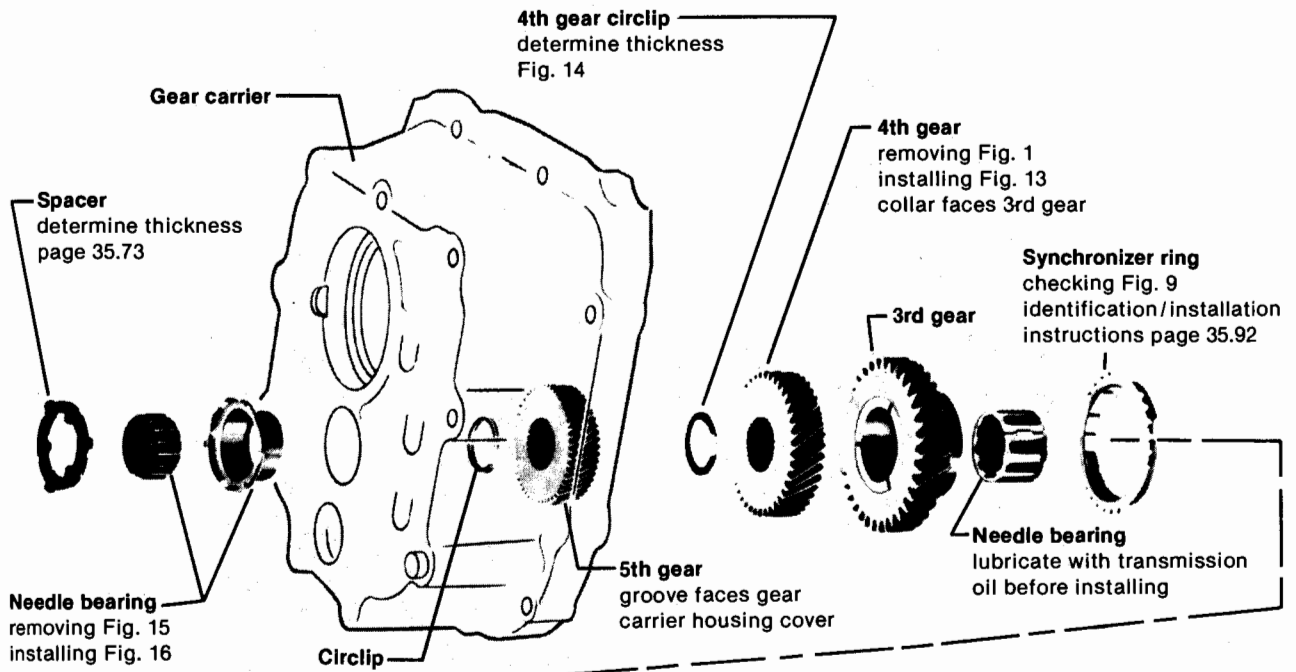
circlip  
No. 091 311 38



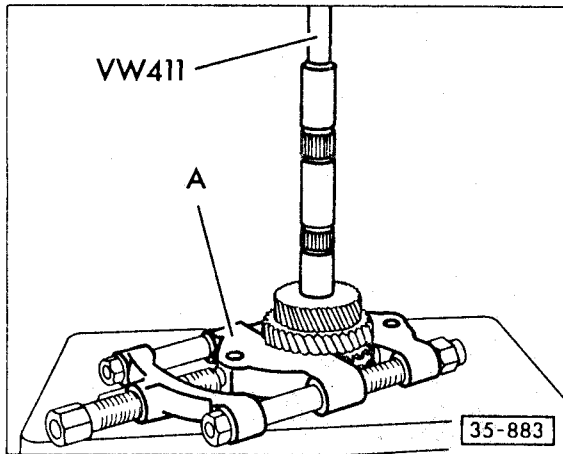
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# 35 Manual Transmission-Case, Gears, Shafts

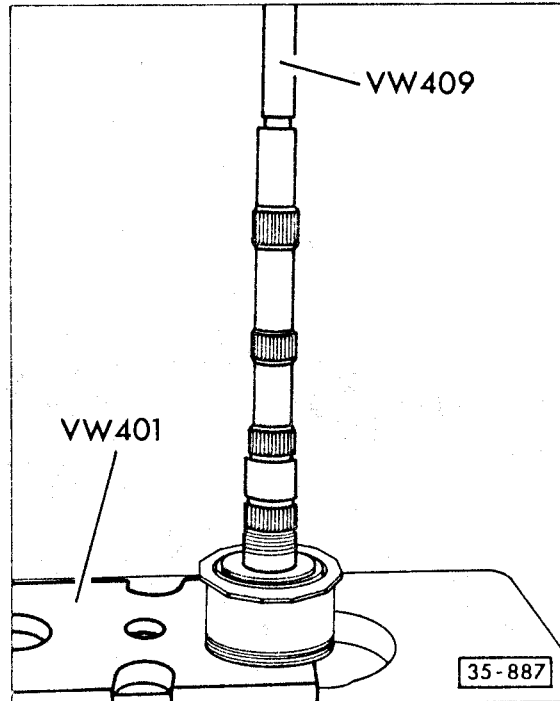




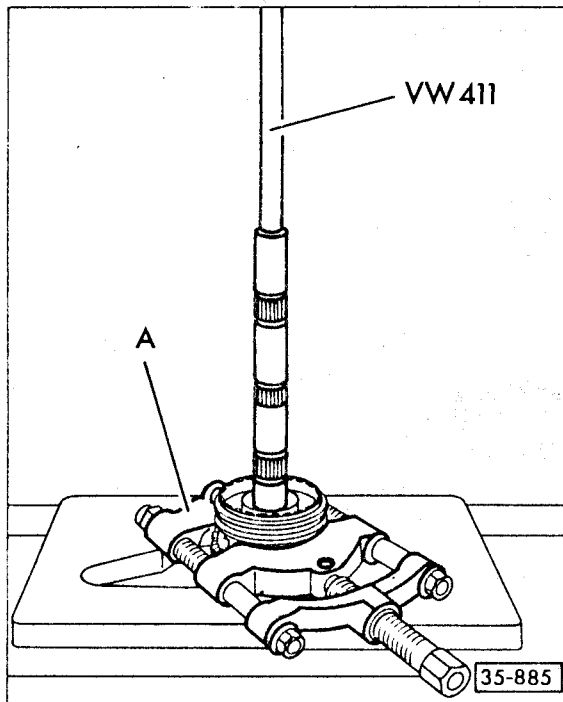
35-881



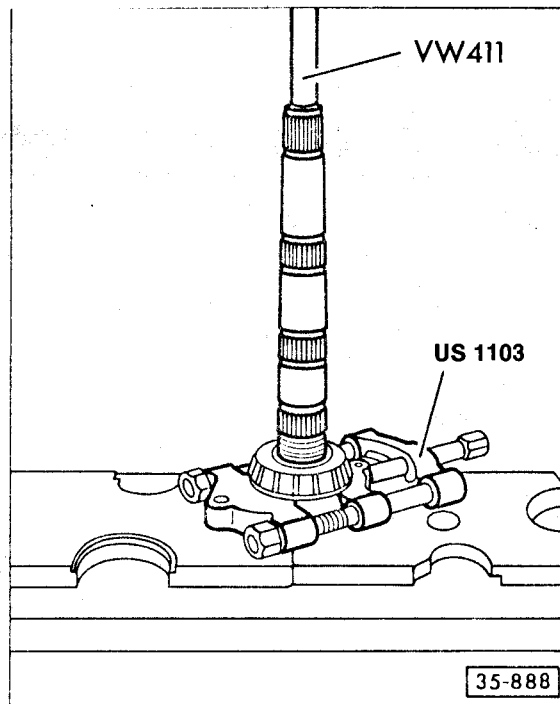
**Fig. 1 3rd and 4th gear, removing**  
A—US 1103



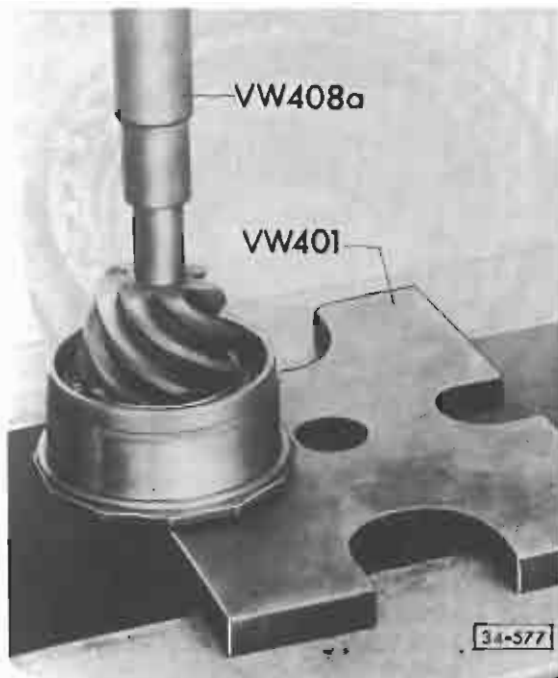
**Fig. 3 Tapered roller bearing, removing**  
—remove retaining ring first



**Fig. 2 Synchronizer and 2nd gear, removing**  
A—US 1103

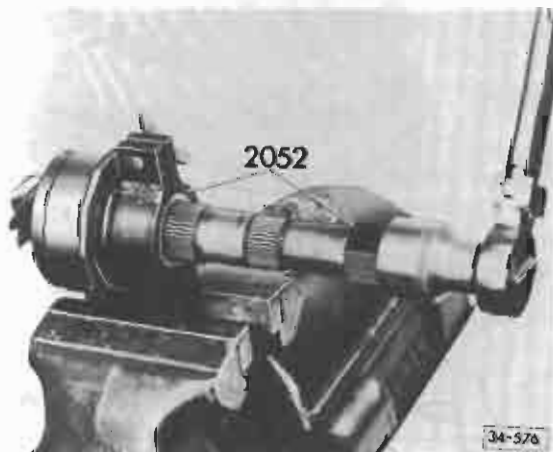


**Fig. 4 Tapered roller bearing inner race, removing**



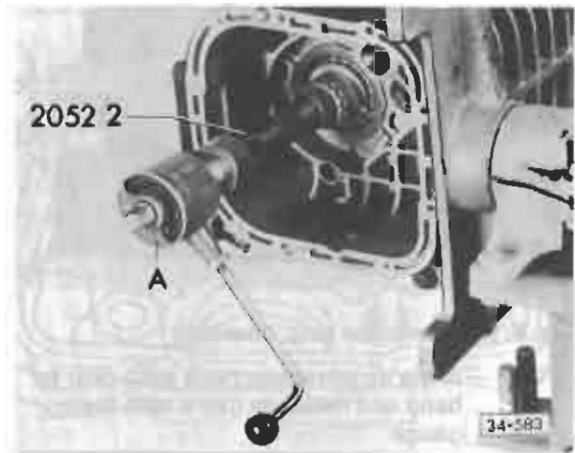
**Fig. 5 Tapered roller bearing, installing**

- heat inner race to about 100°C (212°F) and press on
- before tightening needle bearing inner race, let tapered roller bearing cool to room temperature



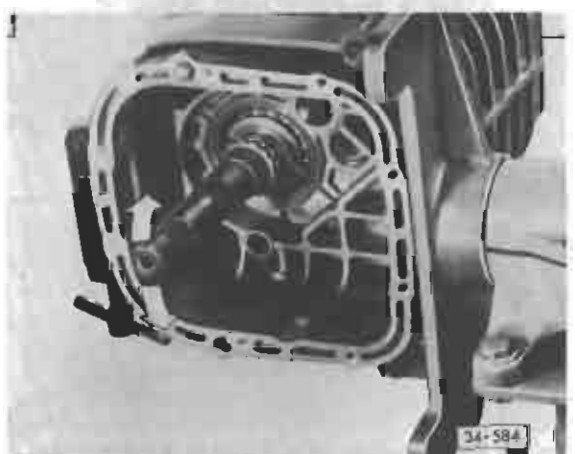
**Fig. 6 Needle bearing, loosening/tightening**

- heat inner race to about 60°C (140°F) and screw on as far as possible by hand
- place pinion shaft in tool 2052 and tighten wing nut lightly
- tighten inner race to 210 Nm (152 ft lb)



**Fig. 7 Tapered roller bearing, checking turning torque**

- lubricate bearings with transmission oil and tighten retaining ring,
- turn pinion shaft in both directions about 15–20 times
- turn further and read turning torque
  - new bearings: up to 210 Ncm (180 in. lb)
  - used bearings\*: up to 70 Ncm (61 in. lb) (\*after running at least 30 miles)
  - if no turning torque can be measured, see Fig. 8

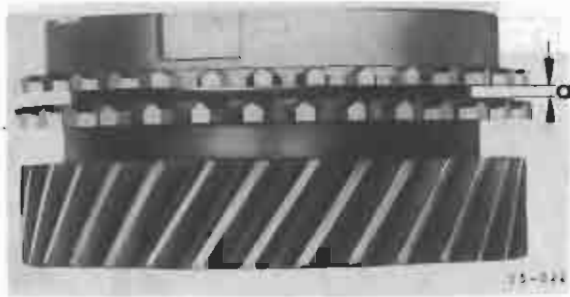


**Fig. 8 Bearing condition, checking**

- check for rock at end of pinion. There must not be any detectable movement if YES, replace tapered roller bearing



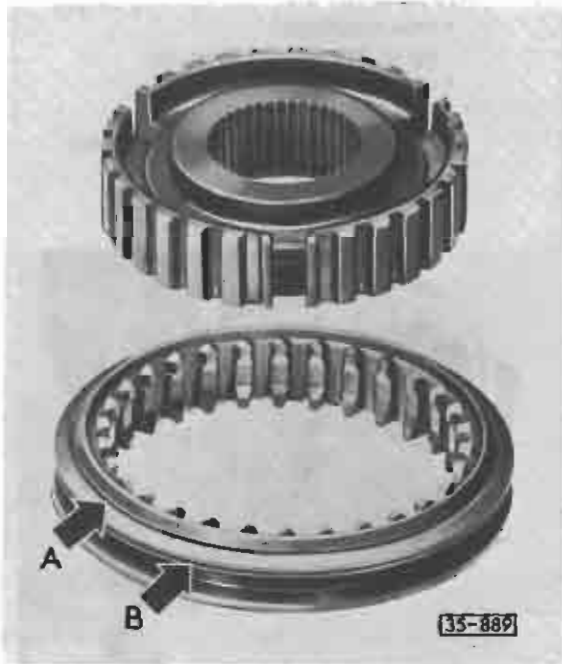
# 35 Manual Transmission-Case, Gears, Shafts



**Fig. 9 Synchronizer ring, checking**

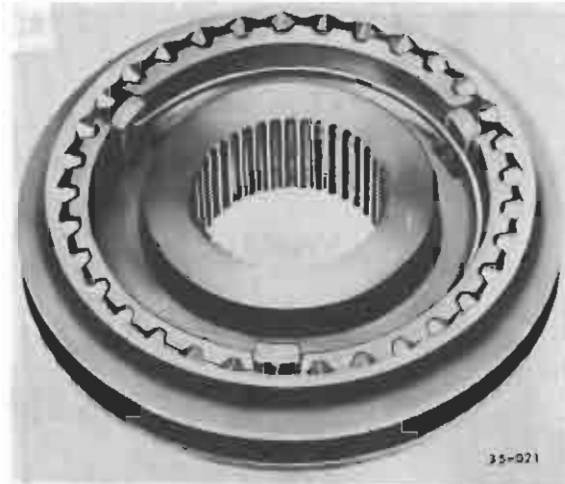
- press synchronizer rings onto gear by hand and measure gap *a* with feeler gauge

	New Part mm (in.)	Wear limit mm (in.)
Gap <i>a</i>	1.3-1.9 (0.051-0.075)	0.5 (0.020)



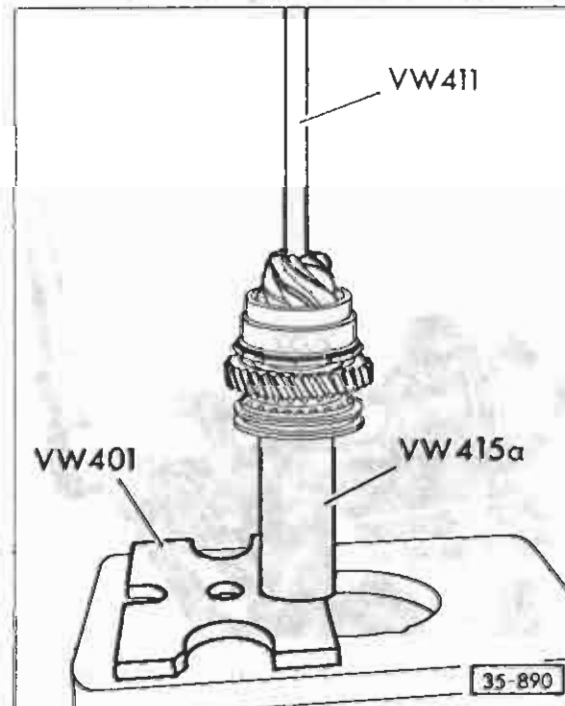
**Fig. 10 Synchronizer 2nd/3rd gear, assembling**

- groove (arrow A) must face 3rd gear
- collar on hub must face 2nd gear
- grooves (arrow B) are for identification:
  - 2nd gear & 3rd gear = 1 groove
  - 4th gear & 5th gear = 2 grooves



**Fig. 11 Synchronizer, assembling**

- slide sleeve over synchronizer hub. Matched position is not necessary
- insert keys and install springs with ends offset 120°. Angled ends of springs must fit into keys



**Fig. 12 Synchronizer, installing**

- turn synchronizer ring until grooves are in line with keys (installation position, see Fig. 10)

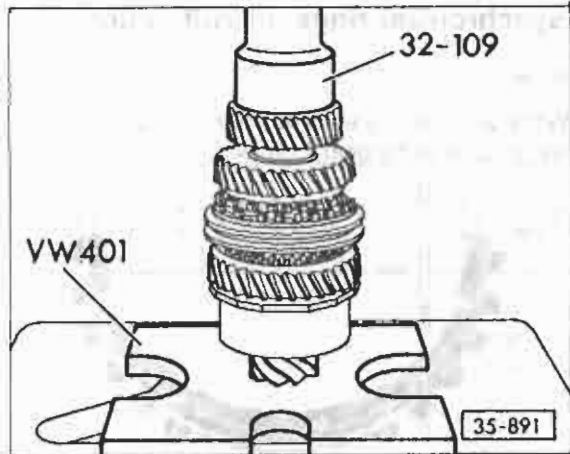


Fig. 13 4th gear, installing

—collar must face 3rd gear

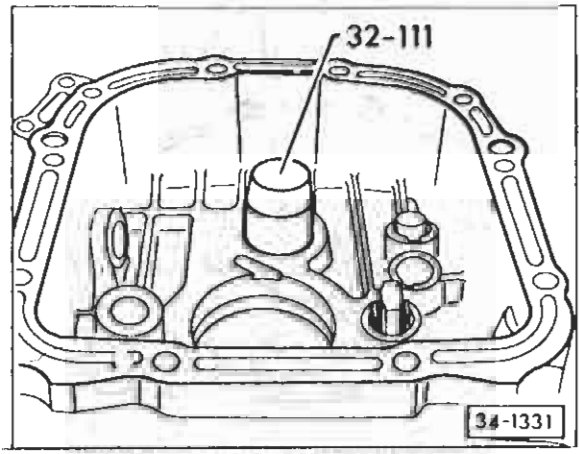


Fig. 15 Pinion needle bearing in gear carrier housing, removing



Fig. 14 4th gear end play, adjusting

- measure end play with feeler gauge
- adjust by selecting suitable circlip
  - play should be 0.05 mm–0.20 mm (try to keep lower limit)

Circlips available:

Thickness mm	Color	Part No.
1.60	black	113 311 382
1.75	blue	113 311 383
1.90	brown	113 311 384
2.05	gray	113 311 385
2.20	copper	113 311 386
2.30	brass	113 311 387
2.40	silver	113 311 388

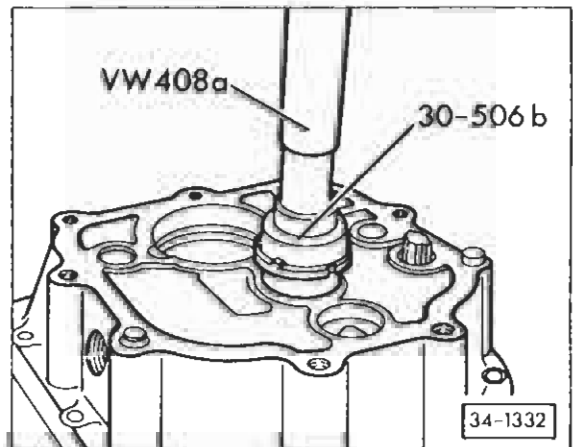


Fig. 16 Pinion needle bearing in gear carrier housing, installing

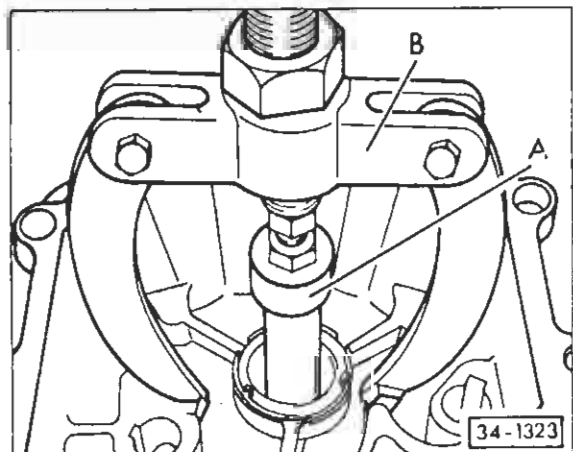


Fig. 17 Pinion bearing outer race in gear carrier housing cover, removing

A—extractor US 1088  
B—puller US 1039

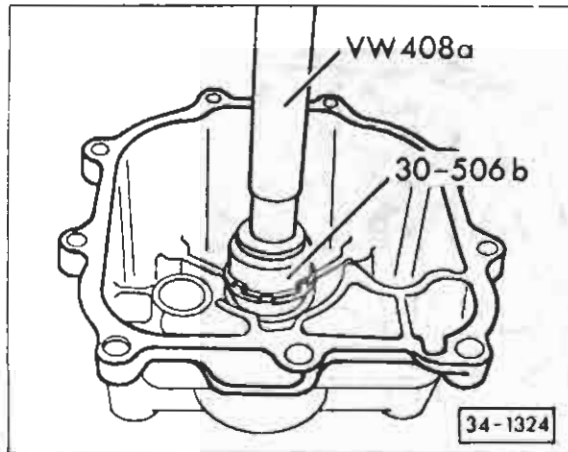
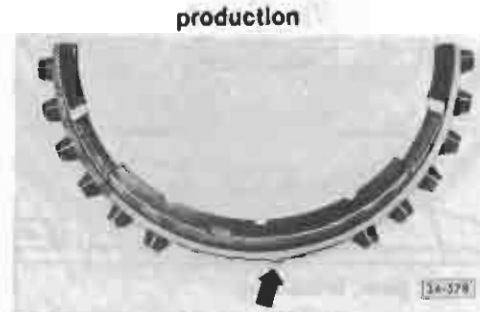


Fig. 18 Pinion bearing in gear carrier housing cover, installing

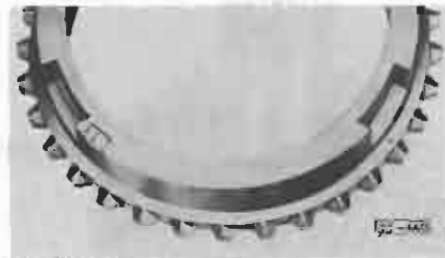
## Synchronizer rings, Identification

### Note

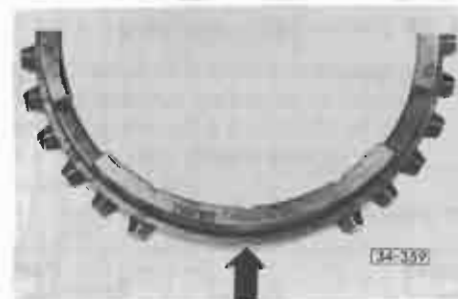
When assembling transmission, install synchronizer ring to same gear from which it was removed



2nd gear:  
special brass ring  
molybdenum coated  
3 x 6 teeth  
with 3 lips (arrow)



3rd and 4th gear:  
special brass ring  
molybdenum coated  
teeth all around circumference



5th gear:  
brass ring  
3 x 8 teeth  
with 3 notches (arrow)

### spare part

For all gears install ring (3rd and 4th gear) which is supplied under Spare Part No: 091 311 295 A

## 4-Speed 091/1 Manual Transmission Case, Gears, Shafts

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  - installing 35.35
  - marking/removing 35.34
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#### 4-Speed 091

- See page 35.1

#### 5-Speed 094

- See page 35.61

#### 094-4WD Syncro

- See page 35.93

# 35 Manual Transmission—Case, Gears, Shafts

**Transmission/Final drive lubricant:**

Hypoid oil API/GL-4; MIL-L2105

SAE 80W, SAE 80W/90

**Capacities:**

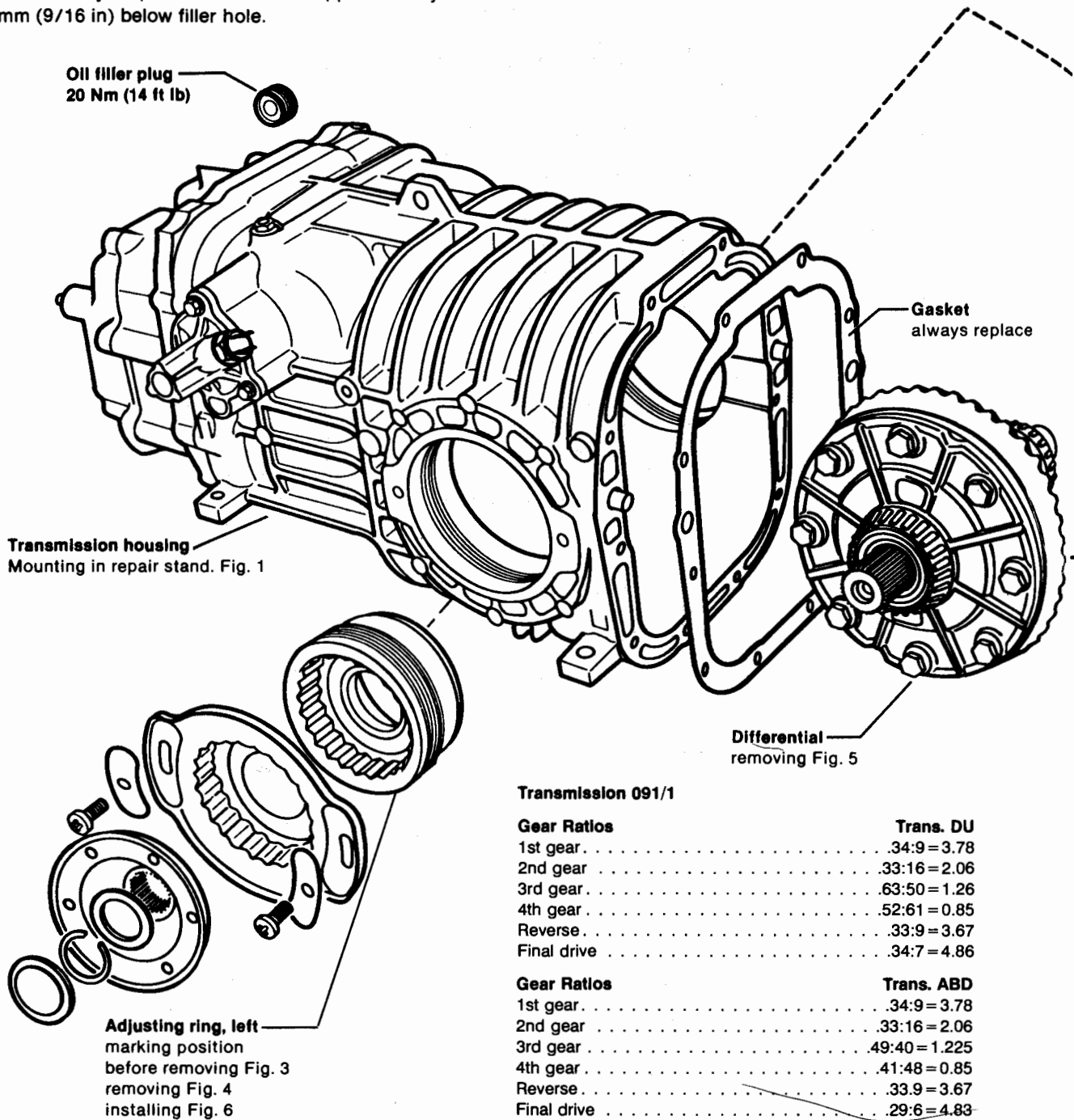
Vehicles with gasoline engines 3.0 L (3.2 US qt)

Vehicles with Diesel engines 4.0 L (4.2 US qt)

**Note**

To reduce shifting effort, transmission oil capacity has been reduced. For production reasons, the oil filler hole remains at the same location

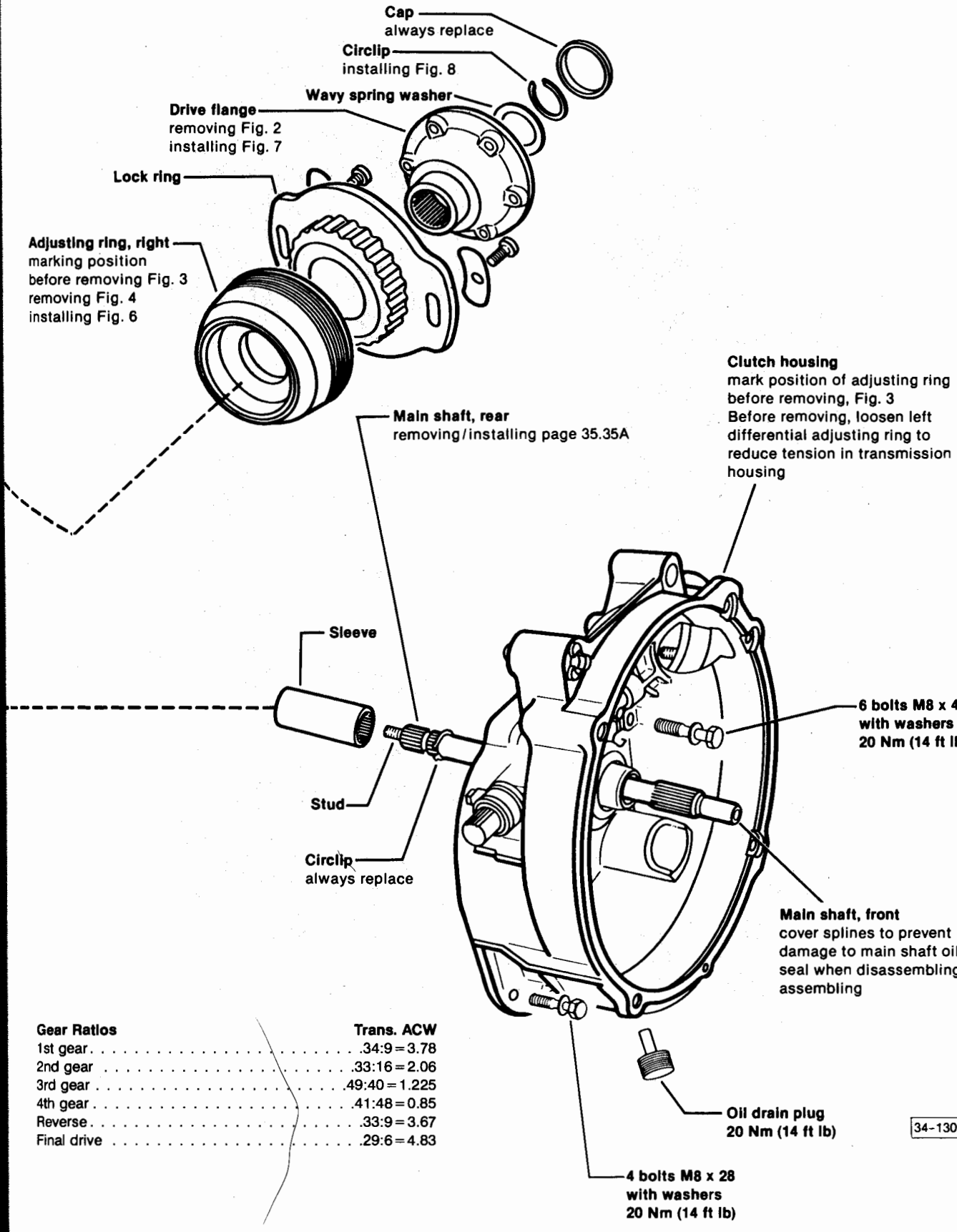
Oil should only be poured into a level approximately 15 mm (9/16 in) below filler hole.



**Transmission 091/1**

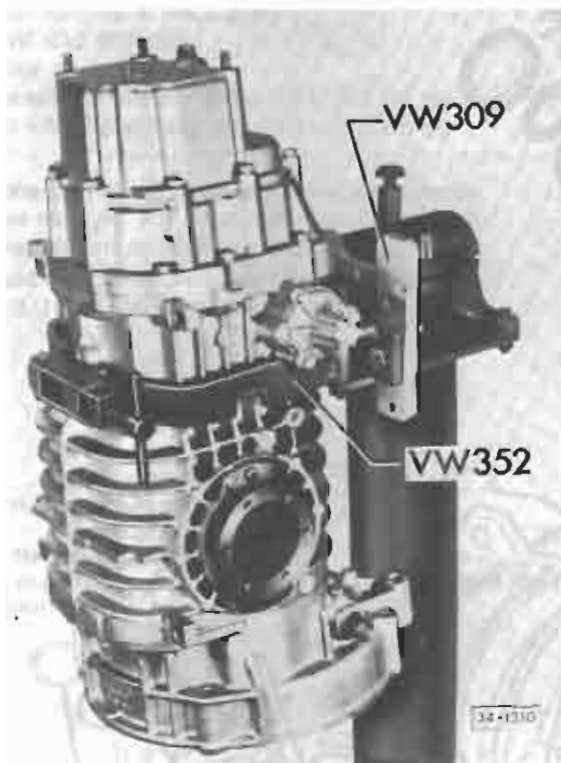
Gear Ratios	Trans. DU
1st gear . . . . .	.34:9 = 3.78
2nd gear . . . . .	.33:16 = 2.06
3rd gear . . . . .	.63:50 = 1.26
4th gear . . . . .	.52:61 = 0.85
Reverse . . . . .	.33:9 = 3.67
Final drive . . . . .	.34:7 = 4.86

Gear Ratios	Trans. ABD
1st gear . . . . .	.34:9 = 3.78
2nd gear . . . . .	.33:16 = 2.06
3rd gear . . . . .	.49:40 = 1.225
4th gear . . . . .	.41:48 = 0.85
Reverse . . . . .	.33:9 = 3.67
Final drive . . . . .	.29:6 = 4.83



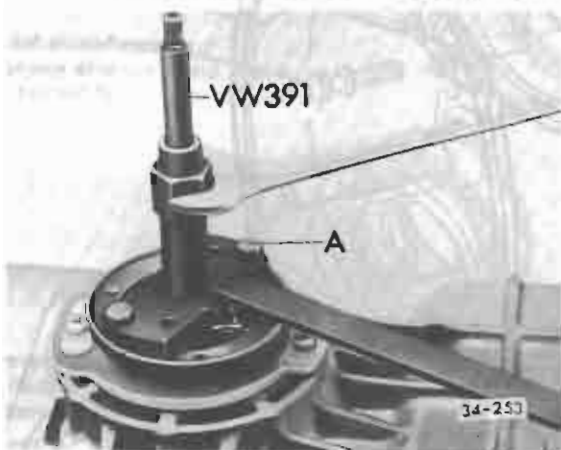
Gear Ratios	Trans. ACW
1st gear . . . . .	.34:9 = 3.78
2nd gear . . . . .	.33:16 = 2.06
3rd gear . . . . .	.49:40 = 1.225
4th gear . . . . .	.41:48 = 0.85
Reverse . . . . .	.33:9 = 3.67
Final drive . . . . .	.29:6 = 4.83

34-1309



**Fig. 1** Transmission assembly, mounting in repair stand

- drain transmission oil
- mount transmission in repair stand



**Fig. 2** Drive flange, removing

- remove circlip and wavy spring washer
- attach VW391 to flange with 2 bolts
  - A = M8 x 30 bolts
- pull drive flange out



**Fig. 3** Adjusting ring, marking position

**Note**

Before starting repair work (which does not require final drive to be adjusted) mark position of adjusting rings on transmission housing. Measure depth to which they are installed with VW 382/7 and write down readings

- scribe left side (ring gear side) with one mark (arrow)
- scribe right side with two marks

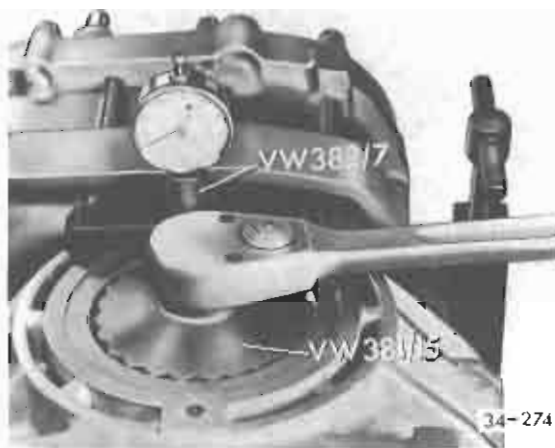


**Fig. 4** Adjusting rings, removing



**Fig. 5 Differential, removing**

- remove adjusting rings and rear main shaft
- lift out differential



**Fig. 6 Adjusting rings, installing**

- install left and right adjusting rings and align marks at depth previously measured
- lubricate threads with MoS<sub>2</sub> grease

**CAUTION**

Do not tighten left side adjusting ring until clutch housing has been installed and bolts torqued



**Fig. 7 Drive flange, installing**



**Fig. 8 Circlip for drive flange, installing**

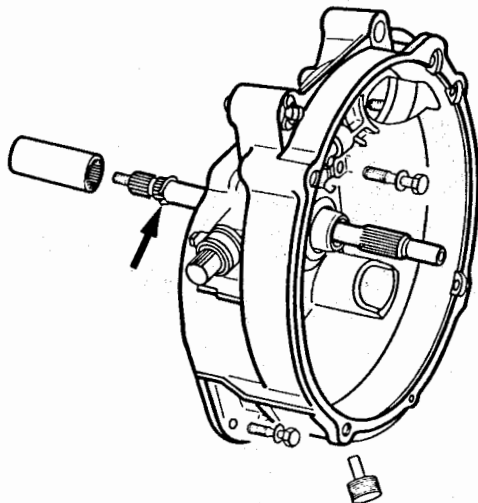
- insert wavy spring washer and circlip
- press circlip into groove with VW 244b and at same time check that washer is centered



# 35 Manual Transmission-Case, Gears, Shafts

## Rear main shaft, removing/installing

### Work sequence



34-1309 A

### Removing

- remove circlip (arrow)
- push sleeve backward and screw out main shaft

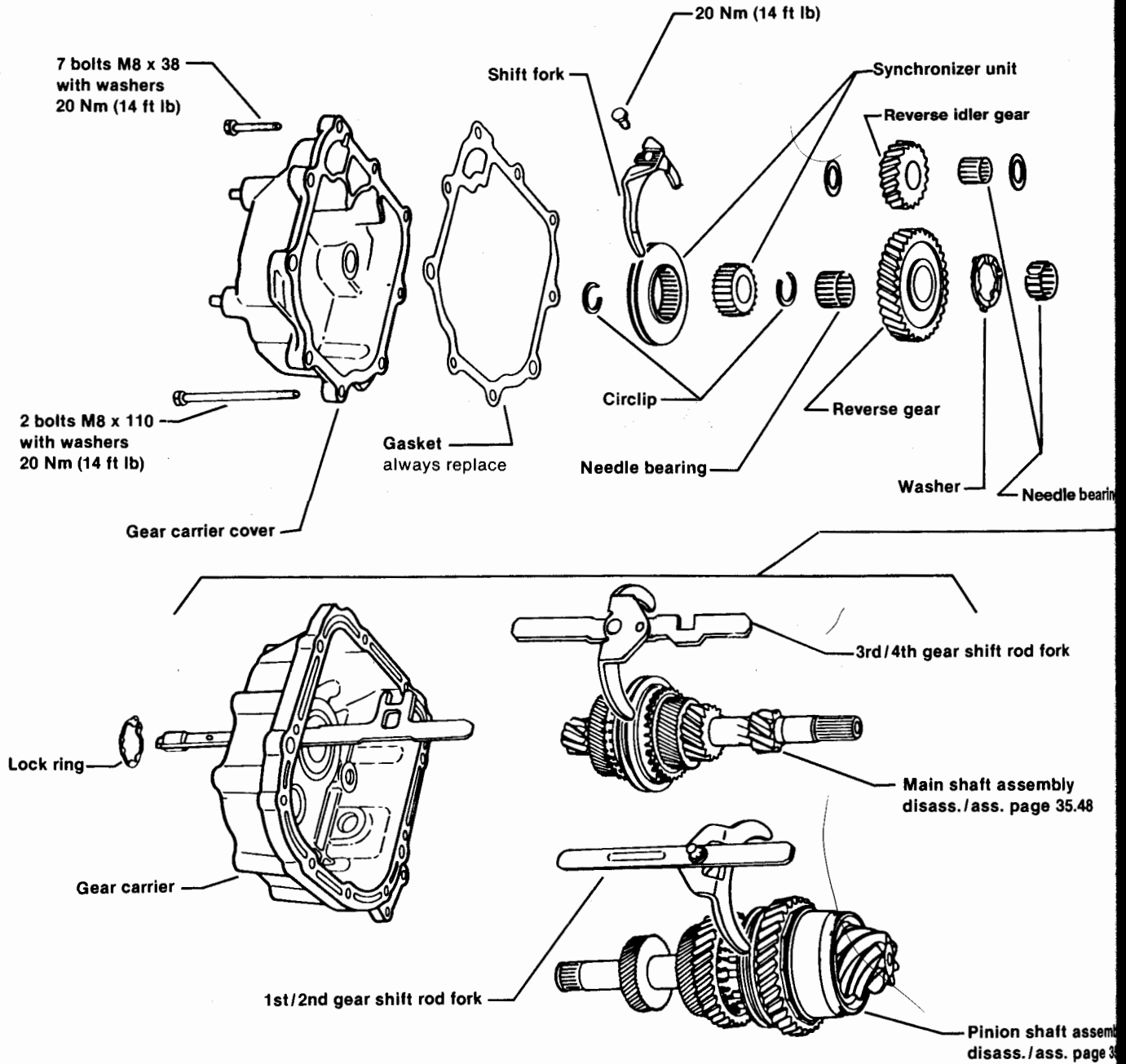
### Installing

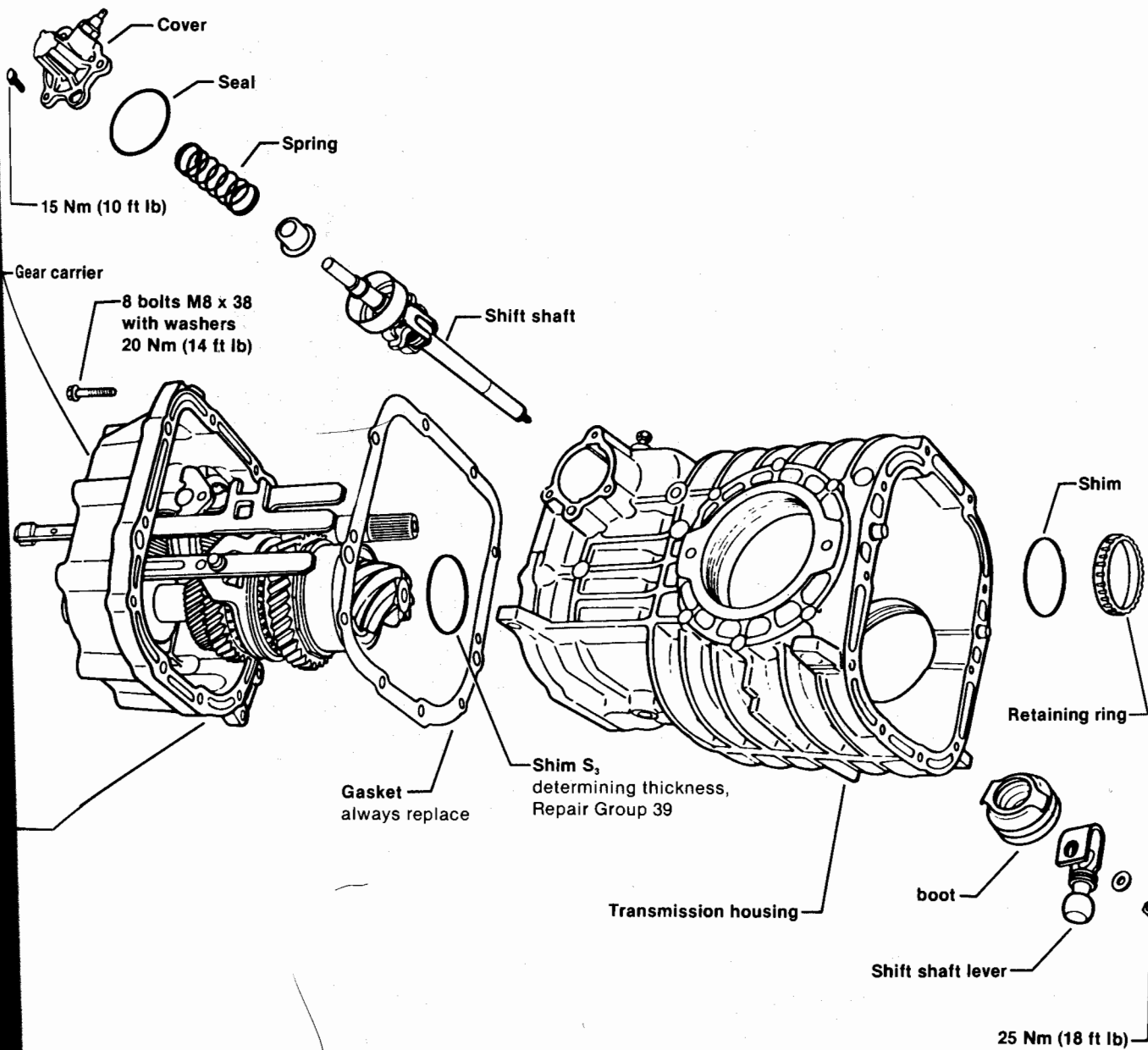
- screw front and rear main shafts together, then back off one spline
- push sleeve on and install new circlip

# 35 Manual Transmission-Case, Gears, Shaft

## Note

Differential must be removed before gear carrier can be removed, see page 35.35





34-1312

4-speed 091/1

Gear carrier, assembly  
Transmission, assembly

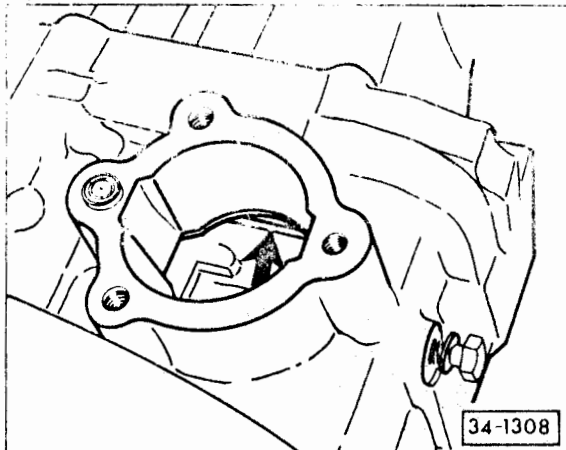
35.37

# 35 Manual Transmission—Case, Gears, Shafts

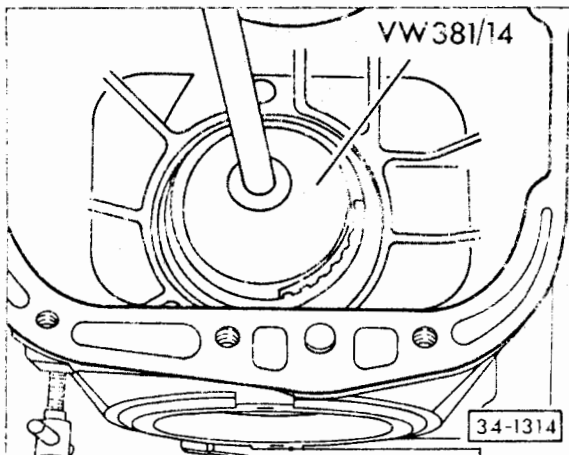
## Transmission Disassembling

### Work sequence

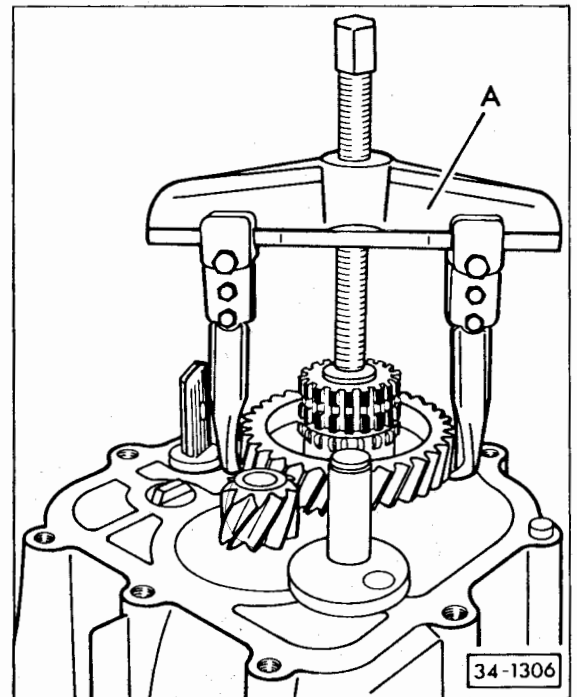
- remove coverplate
- remove shift shaft



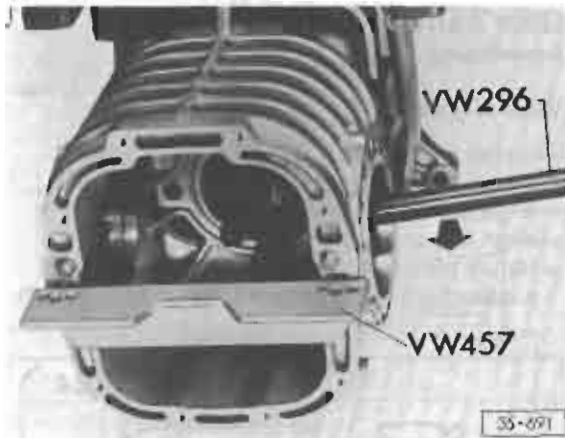
- loosen bolt until relay lever (arrow) can be pulled against housing
- tighten bolt to lock lever in that position



- remove retaining ring
- remove gear shift housing
- remove reverse gear shift fork and hub
- remove outer circlip



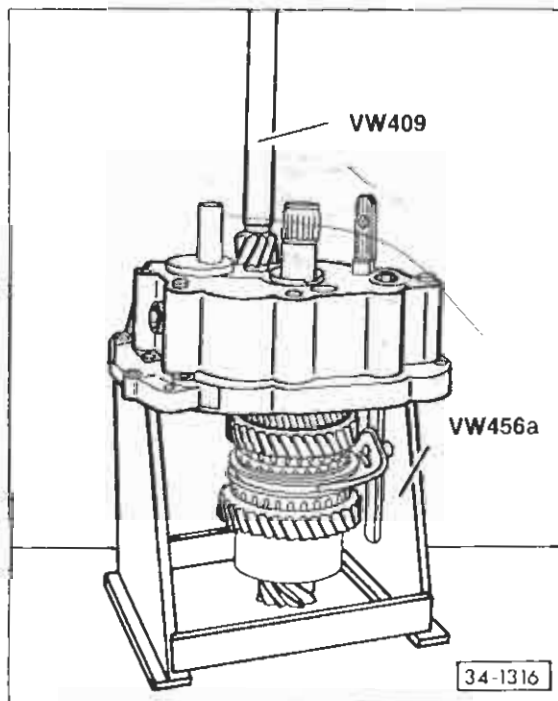
- pull off synchronizer hub and reverse gear  
A—Puller US 1078
- remove inner circlip, washer and needle bearing
- remove reverse gear together with needle bearing and washer
- remove gear carrier housing bolts



- to remove gear carrier attach VW 457 with two M8 x 20 bolts
- press gear carrier out with VW 296
- remove shim  $S_3$  and note thickness

**Note**

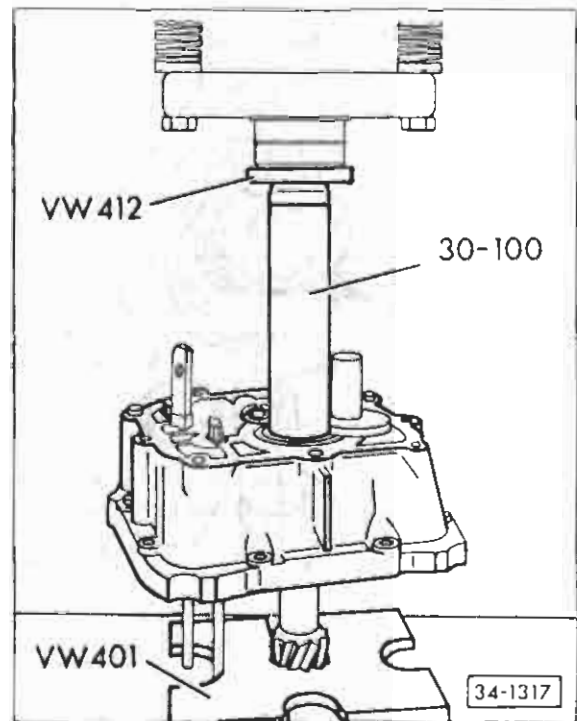
If bearing and/or transmission housing are replaced, and dimension  $r$  is not marked on ring gear, pinion depth must be measured and noted **before** gear carrier is removed. This is dimension  $r$ . See Repair Group 39. When assembling, parts must be installed in same position. See Ring gear/pinion, adjusting, Repair Group 39



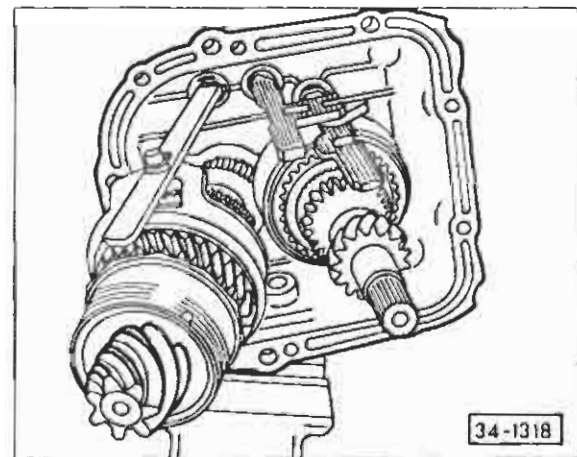
- press pinion shaft with main shaft and shift rod out of gear carrier

**Assembling**

**Work sequence**

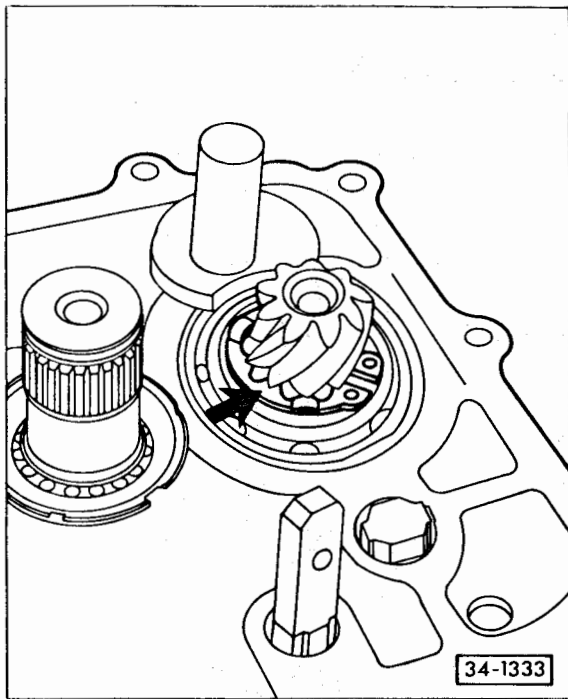


- press main shaft with shift rod into gear carrier



- install pinion shaft with shift rod
  - shift into 3rd gear
- shift into neutral
- install pinion shaft needle bearing

# 35 Manual Transmission-Case, Gears, Shafts

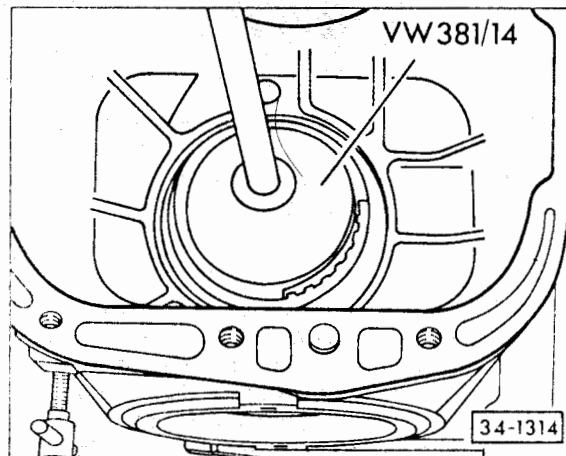


- install circlip
- make sure lugs of circlip are below teeth of pinion head (arrow)

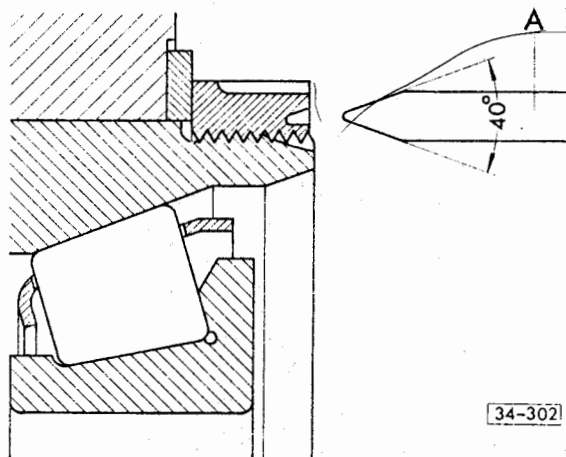
## Gear carrier Assembling

### Work sequence

- install shim  $S_3$
- install new gasket
- align shift rod
- align flat on piston with recess in housing
- tap on pinion with plastic hammer to install
  - make sure teeth of gears match properly

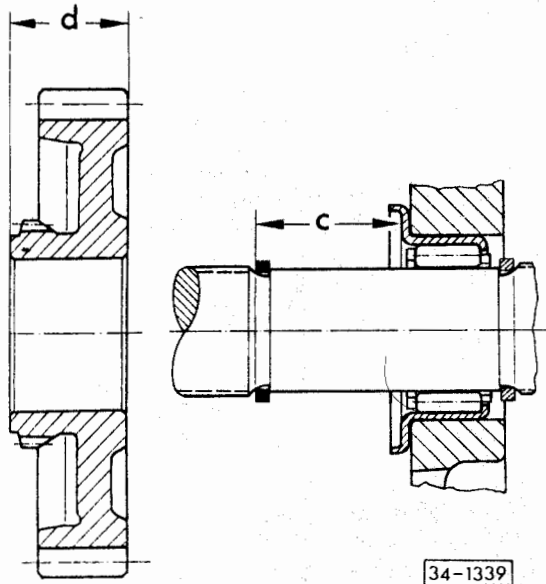


- install retaining ring and tighten to 225 Nm (162 ft lb), then loosen and retighten to 225 Nm (162 ft lb)



- peen retaining ring twice with suitable tool A (local manufacture)
- attach gear carrier to transmission housing and tighten bolts to 20 Nm (14 ft lb)

## determining thickness of spacer for reverse gear



- install circlip
- measure distance C

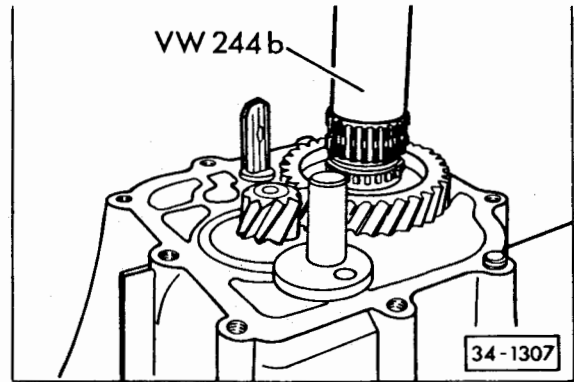
### Example

measurement c	29.1 mm
measurement d	— 24.7 mm
thickness of spacer	4.4 mm

### thickness of spacers available

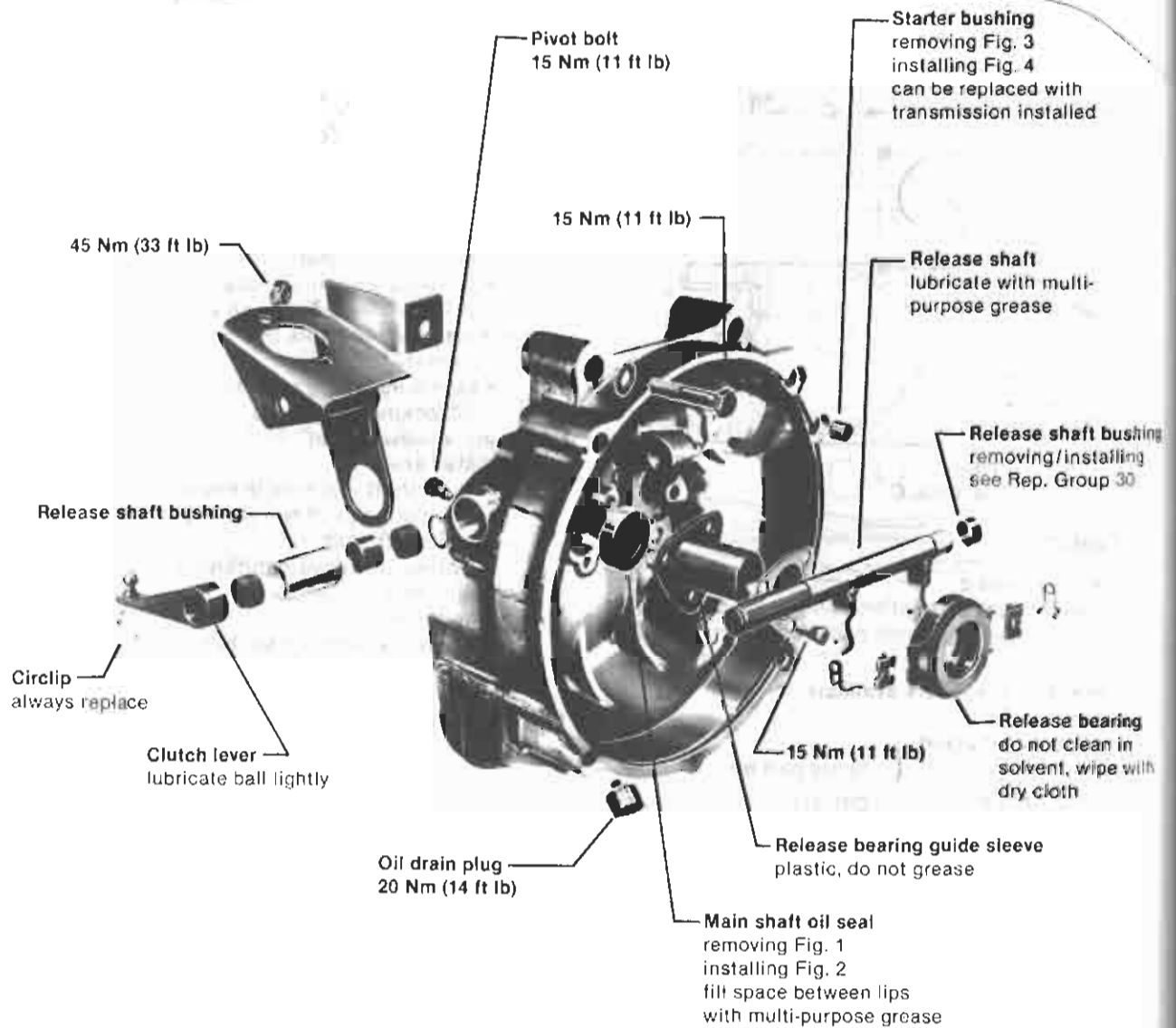
gap to be adjusted (mm)	Spare part no.	color
3.97-4.19	091 311 379	white
4.20-4.39	091 311 379 A	black
4.40-4.59	091 311 379 B	green
4.60-4.90	091 311 379 C	red

- install selected spacer, reverse gear, needle bearing and circlip



- install synchronizer
- install circlip
- install reverse gear
  - groove in gear must face cover
- install needle bearing and washers
- install shift rod/fork bolt and tighten to 20 Nm (14 ft lb)
  - before installing coat thread of bolt with D6-locking compound
- install new gasket
- install cover
  - align shaft and bore in cover
- tighten bolts to 20 Nm (14 ft lb)
- install shift shaft
  - slotted side toward differential housing
- install new gasket
- install spring
- install cover and tighten bolts to 15 Nm (10 ft lb)
- install back-up light switch
- install shift shaft lever

# 35 Manual Transmission-Case, Gears, Shafts



35-697



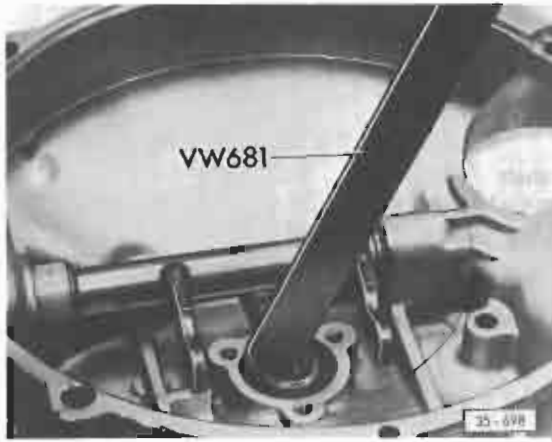


Fig. 1 Main shaft oil seal, removing



Fig. 4 Starter bushing, installing  
—lubricate bushing and drive in flush

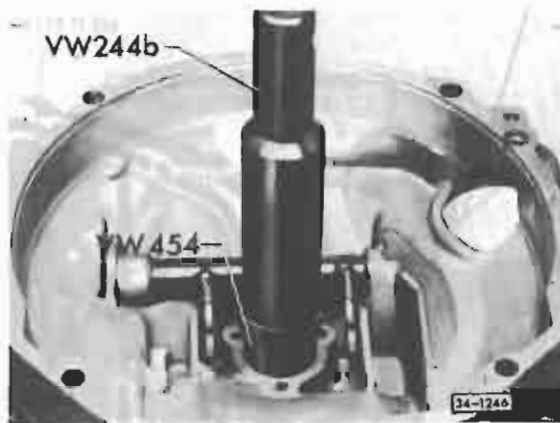


Fig. 2 Main shaft oil seal, installing

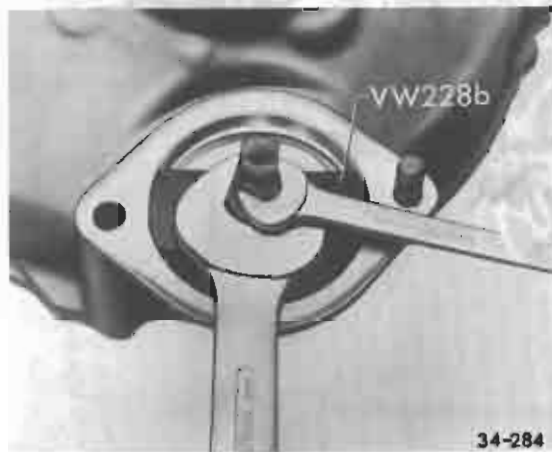


Fig. 3 Starter bushing, removing  
(transmission installed)

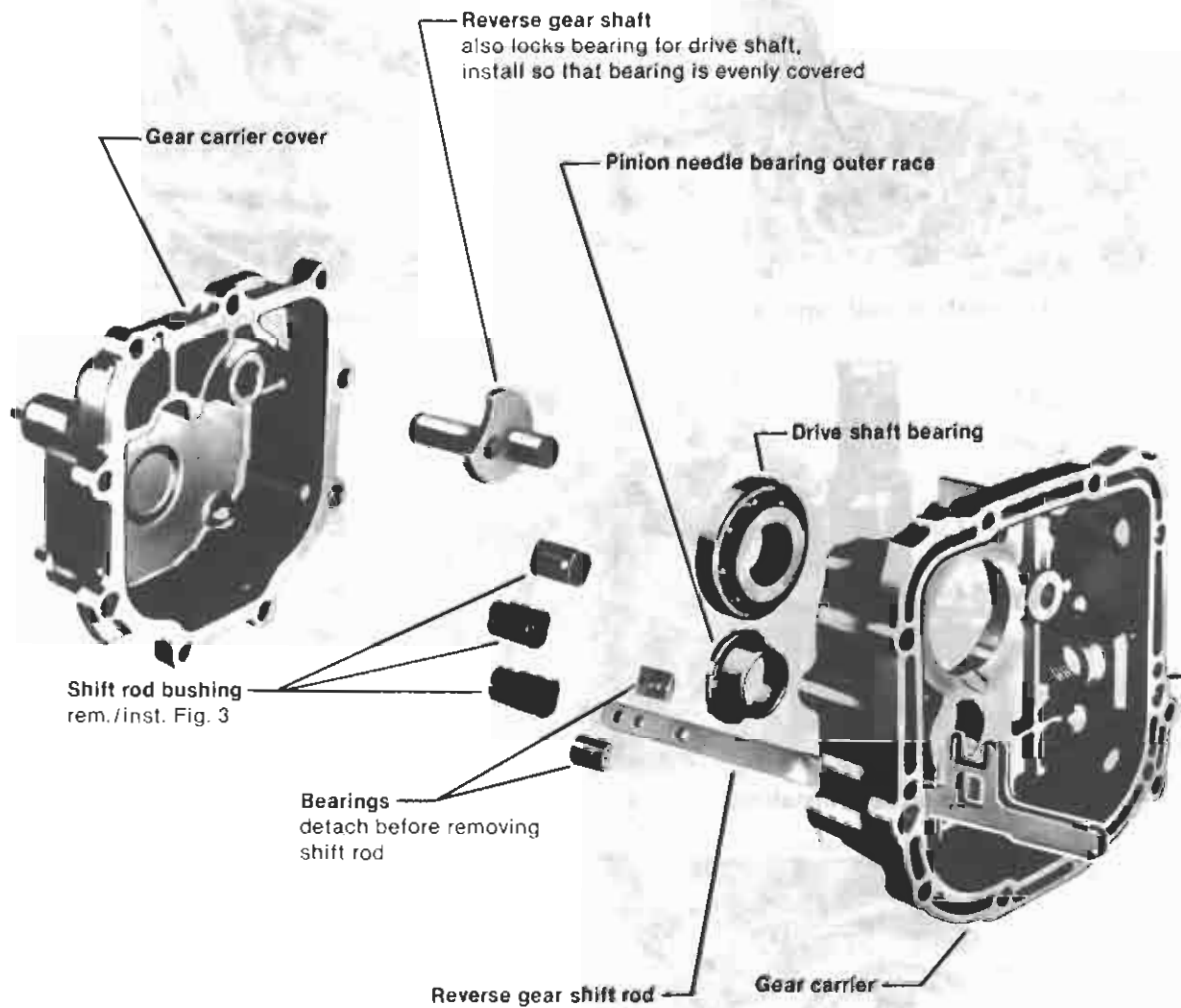
- when transmission is removed, use drift VW 222a

bushing  
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37

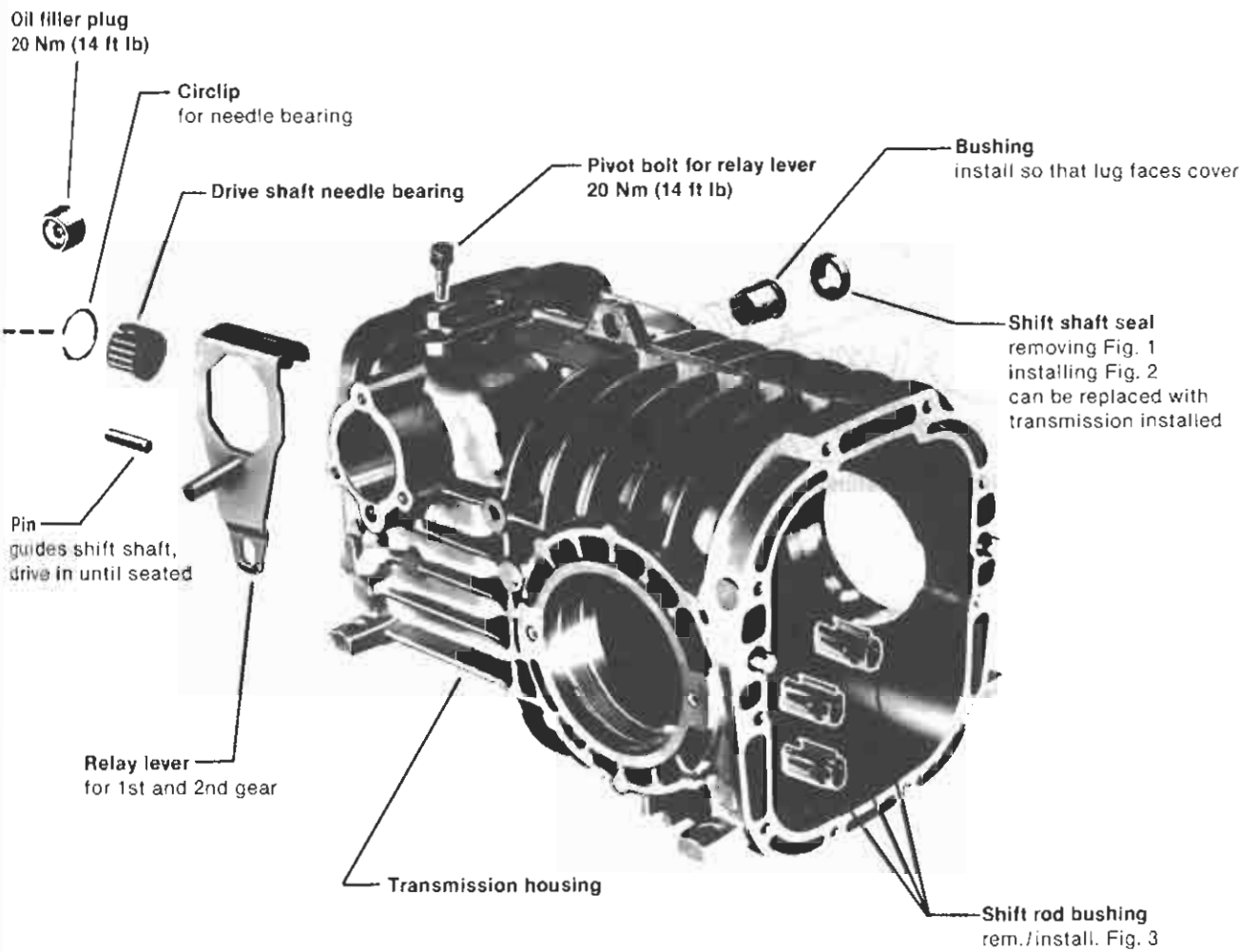
# 35 Manual Transmission-Case, Gears, Shafts



**35.44**

Gear carrier housing  
Gear carrier housing cover

4-speed 091/1



34-1319

4-speed 091/1

Transmission housing

35.45

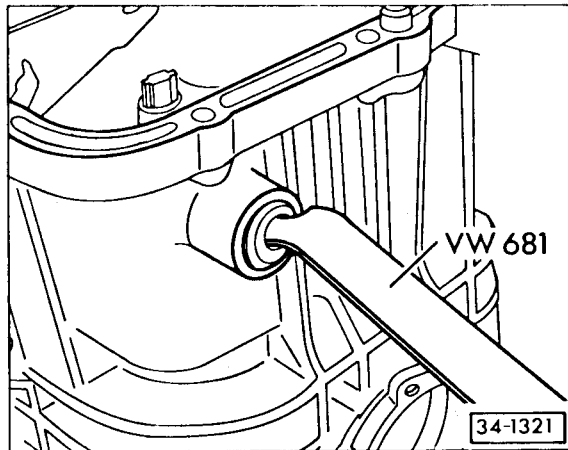


Fig. 1 Shift shaft oil seal, removing

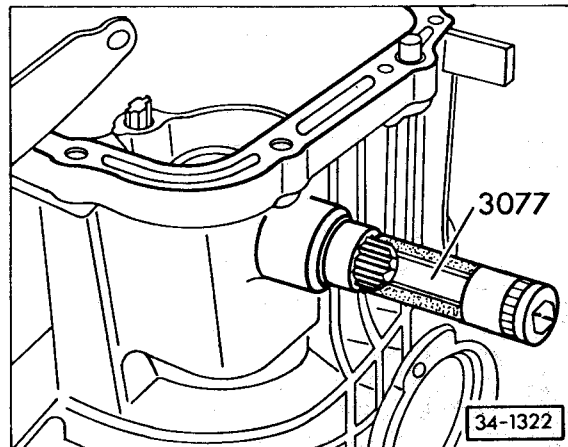


Fig. 2 Shift shaft oil seal, installing

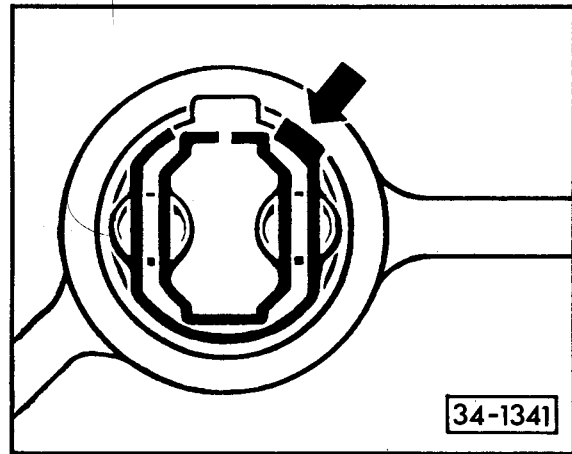
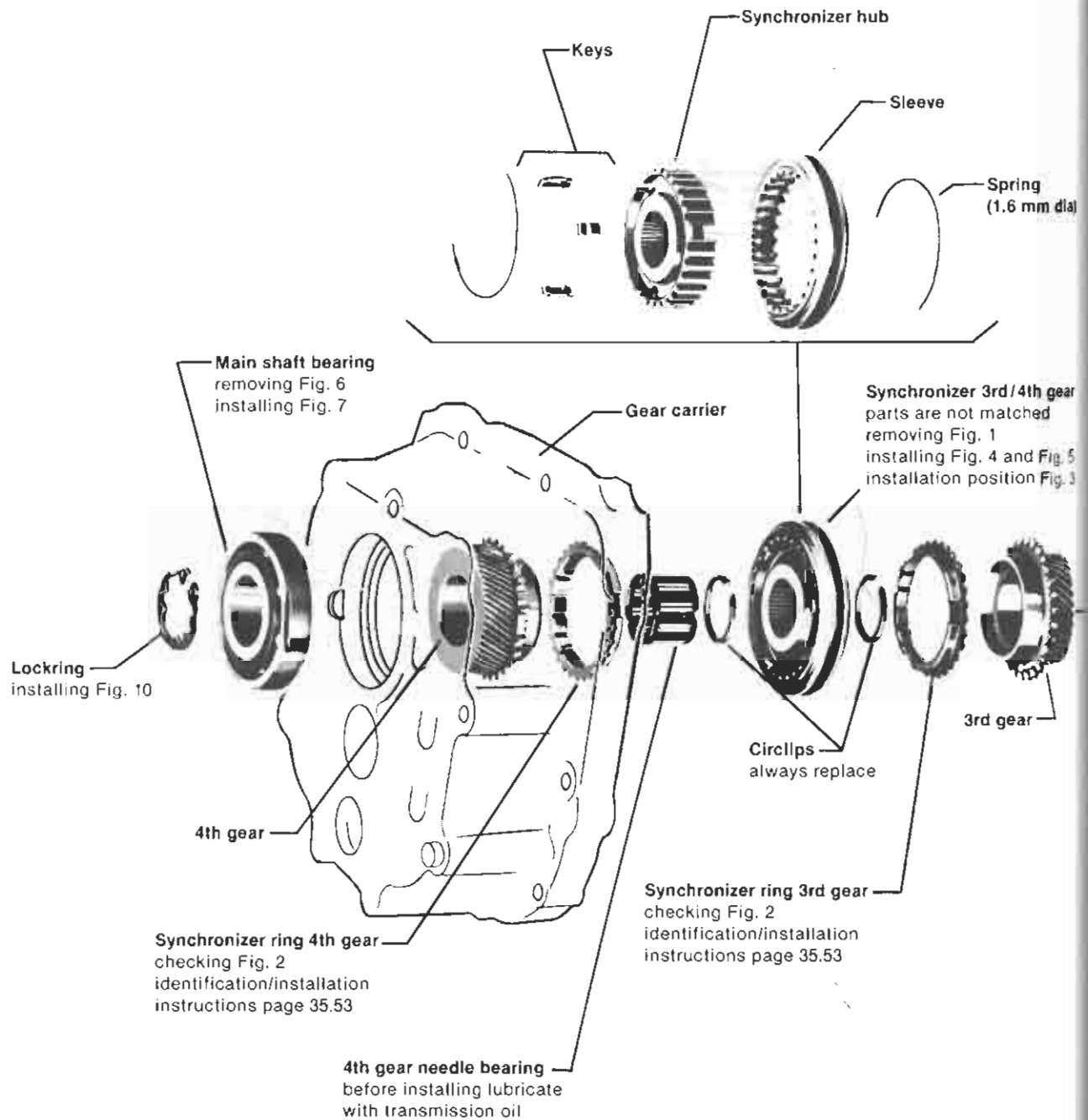


Fig. 3 Shift rod bushing

- removing
  - turn bushing so that lug (arrow) is in recess of housing and press out
- installing
  - align bushing and rod

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# 35 Manual Transmission-Case, Gears, Shafts

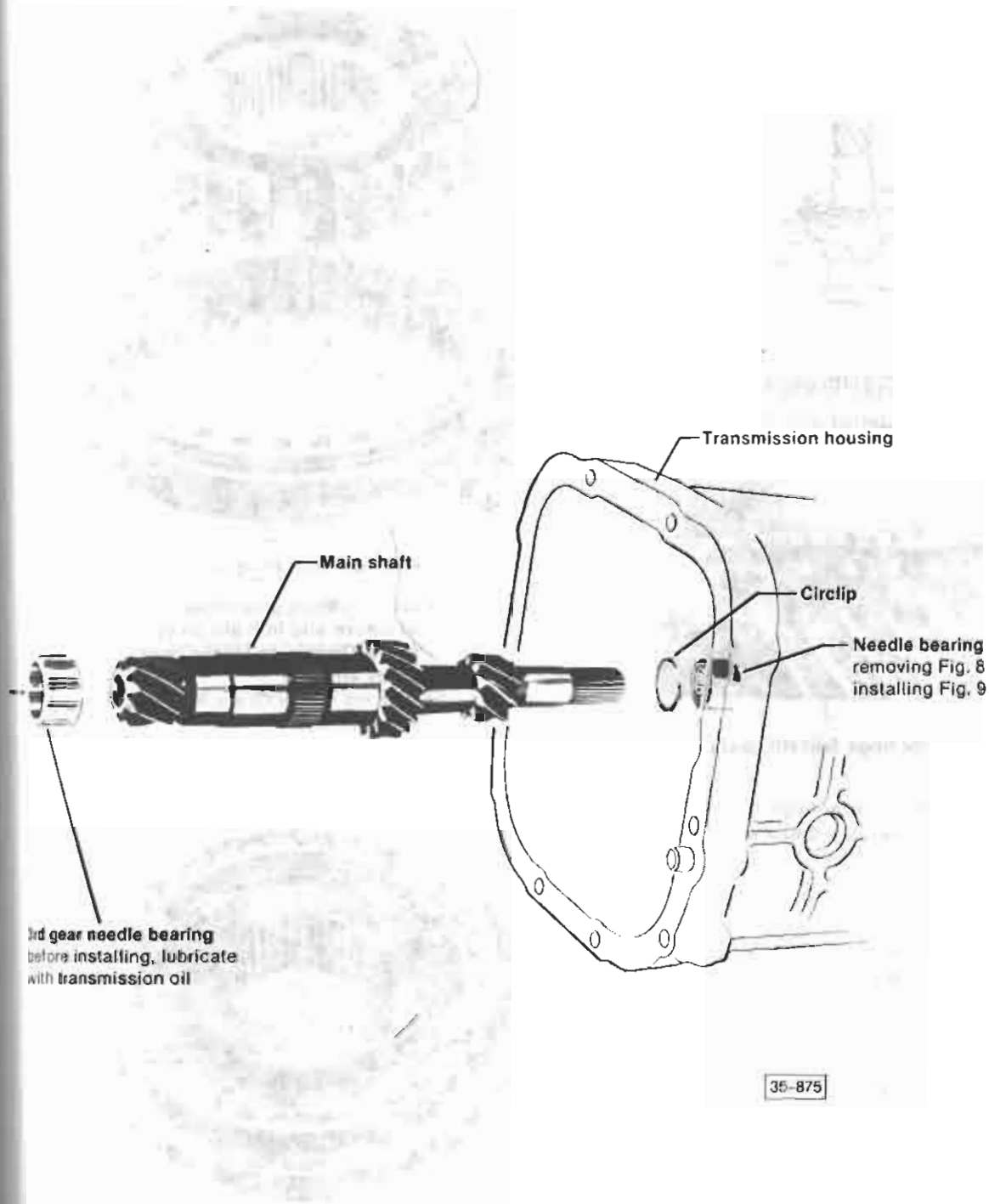


ing  
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4th gear  
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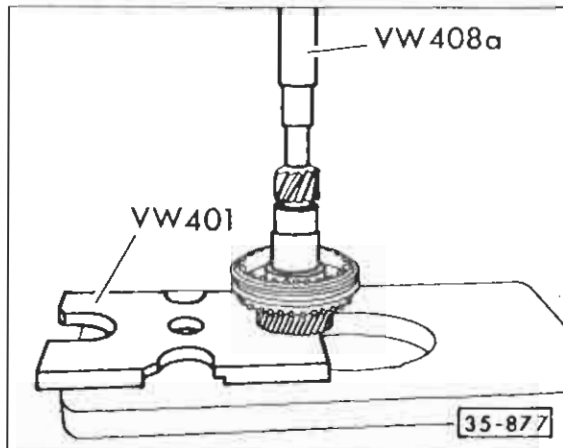
ear  
ear



4-speed 091/1

Main shaft

35.49



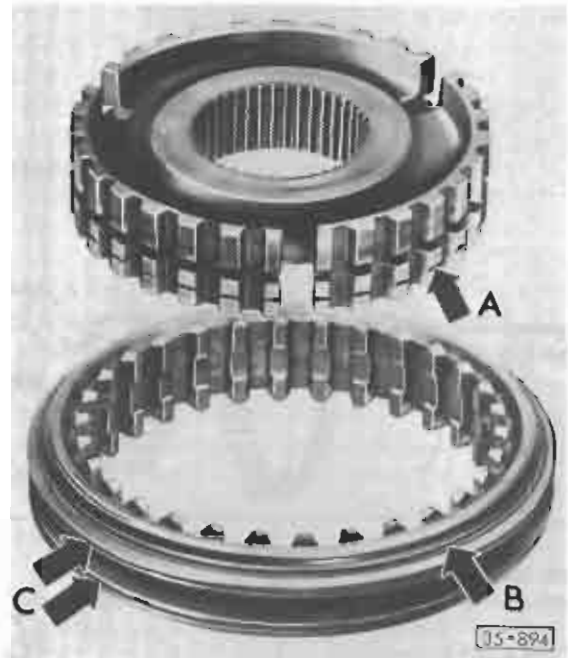
**Fig. 1 Synchronizer 3rd/4th gears, removing**  
—press off together with 3rd gear



**Fig. 2 Synchronizer rings 3rd/4th gears, checking**  
—press synchronizer rings onto gear by hand and measure gap a with feeler gauge

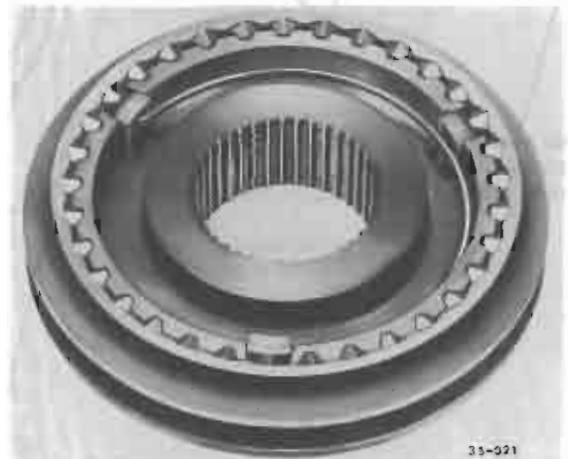
**Gap a**

Gear	New Part mm (in.)	Wear limit mm (in.)
3rd	1.25–1.95 (0.049–0.077)	0.5 (0.020)
4th	1.0–1.7 (0.039–0.067)	0.5 (0.020)



**Fig. 3 Synchronizer 3rd/4th gear, assembling**

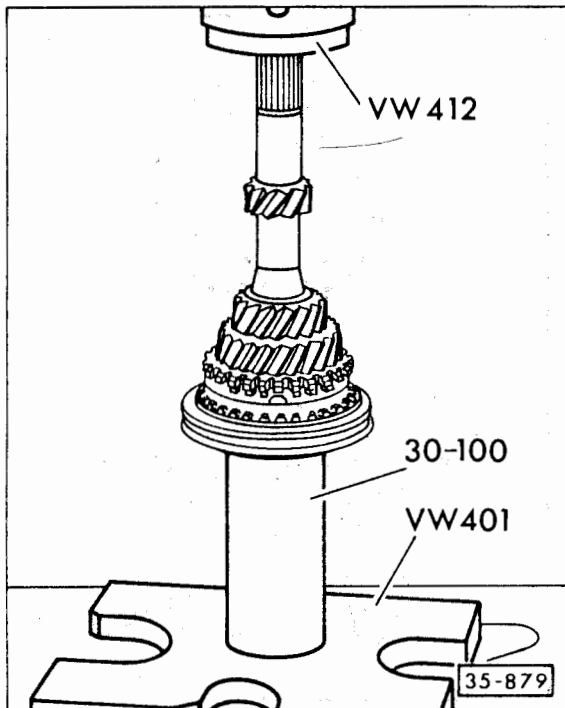
- identification grooves (arrows A & B of sleeve and hub are on opposite sides. Groove on sleeve (arrow B) faces 4th gear
- grooves (arrow C) are for identification;  
1st & 2nd gear = 1 groove  
3rd & 4th gear = 2 grooves



**Fig. 4 Synchronizer 3rd/4th gear, assembling**

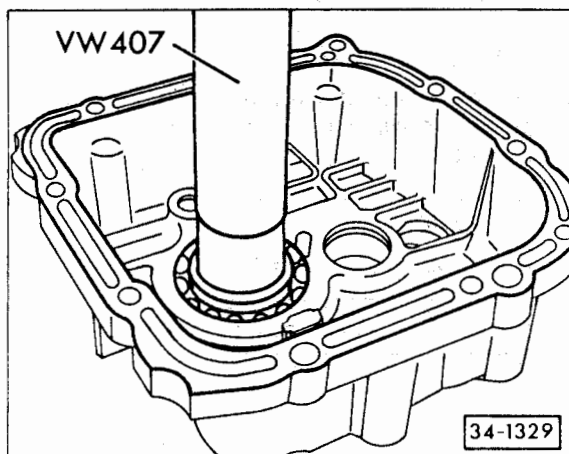
- slide sleeve over synchronizer hub. Matched position is not necessary
- insert keys and install springs with ends offset 120°. Angled ends of springs must fit into keys



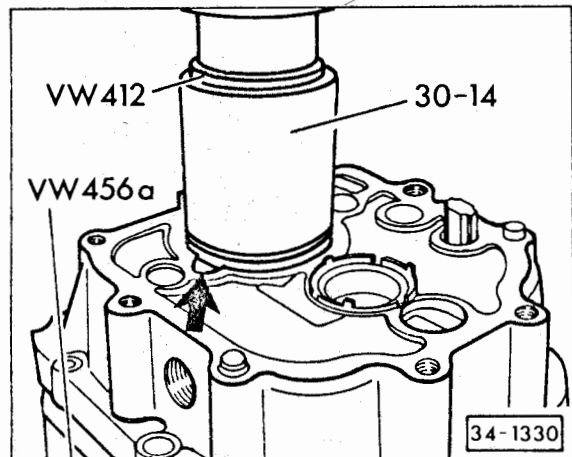


**Fig. 5 Synchronizer 3rd/4th gear, installing**

- turn synchronizer ring until grooves are in line with keys
- identification groove on sleeve (Fig. 3, arrow B) faces 4th gear

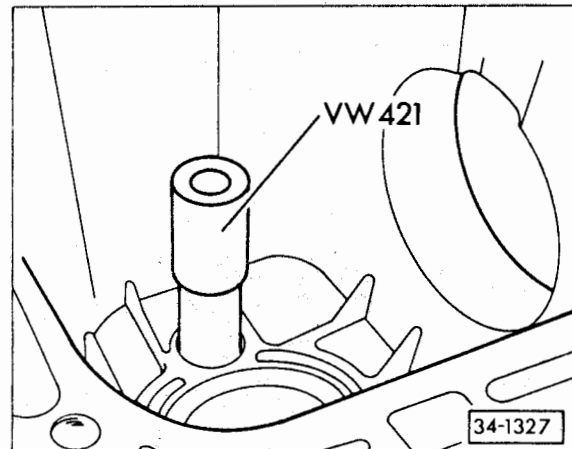


**Fig. 6 Main shaft ball bearing, removing**

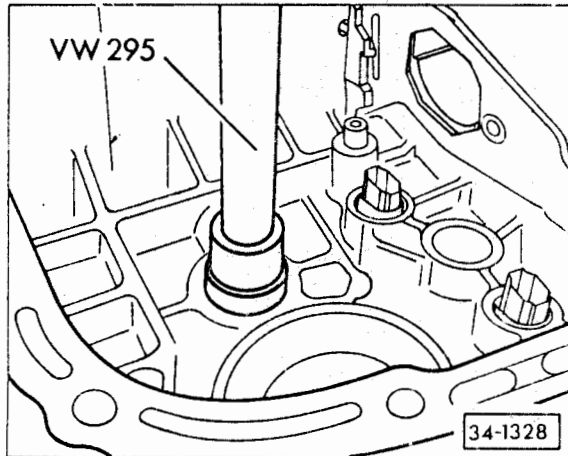


**Fig. 7 Main shaft ball bearing, installing**

- press in so that recess in bearing is aligned with recess (arrow) in housing

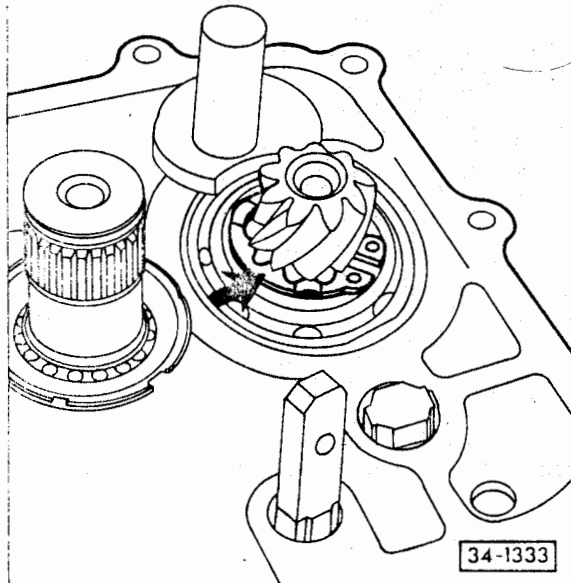


**Fig. 8 Needle bearing in housing, removing**



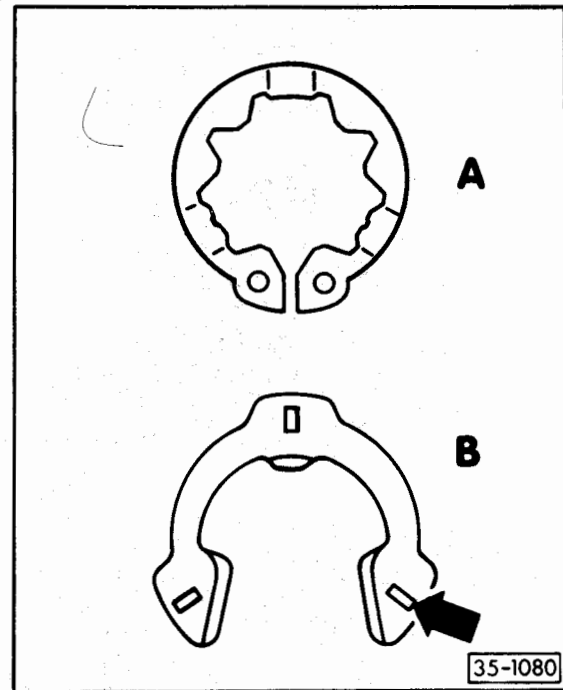
**Fig. 9 Needle bearing in housing, installing**

- lettered side of bearing (thicker material) must face installing tool



**Fig. 10 Circlip, installing**

- make sure ring is seated correctly (arrow)



**Fig. 11 Circlip, two types**

A = previous circlip  
Part No. 091 311 381

B = new circlip  
Part No. 091 311 381 A

**Note**

Use either type of circlip during repairs. The previous circlip will be discontinued when stock is used up.

**CAUTION**

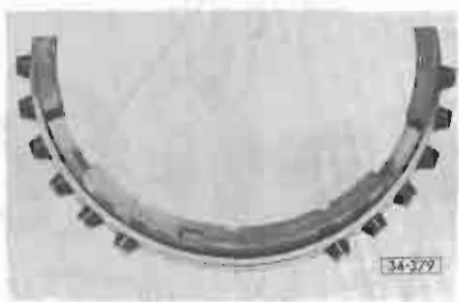
Always replace the circlip during repairs. Identifying marks on a new circlip (arrow) must face reverse gear splines.

## Synchronizer rings, identification

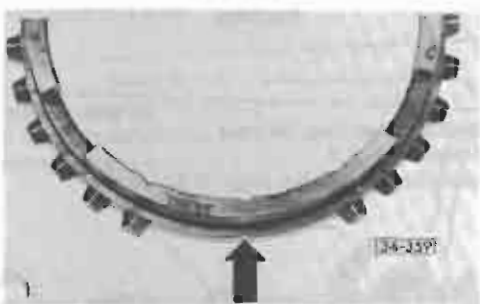
### Note

When assembling transmission, install synchronizer ring to same gear from which it was removed

### production

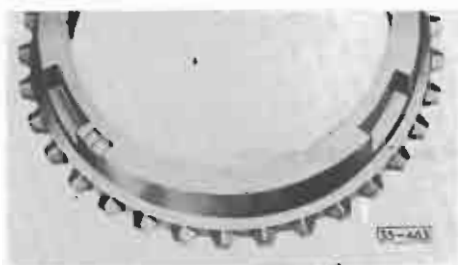


1st gear: brass ring,  
molybdenum coated,  
3 x 6 teeth,  
without notches



2nd gear: brass ring,  
molybdenum coated,  
3 x 8 teeth,  
with 3 notches (arrow)

4th gear: brass ring,  
3 x 8 teeth,  
with 3 notches (arrow)

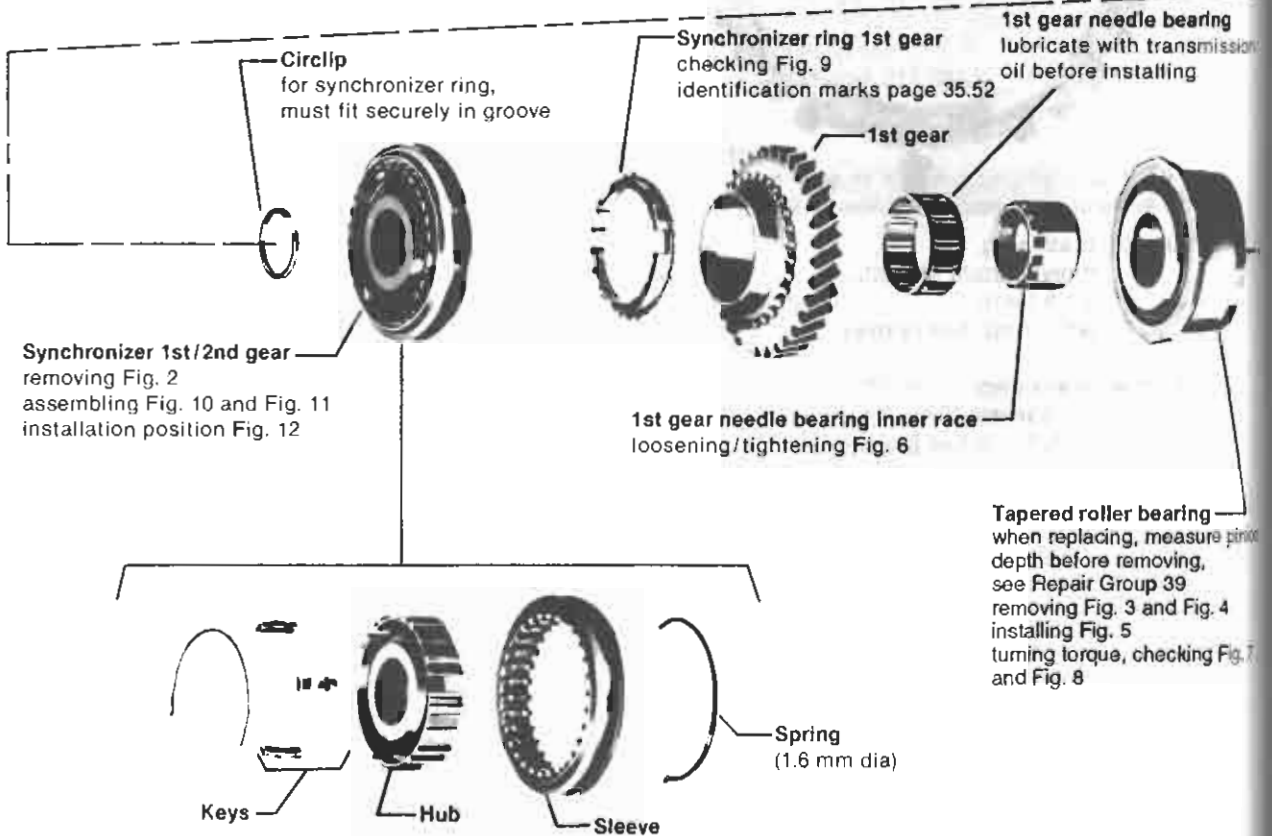
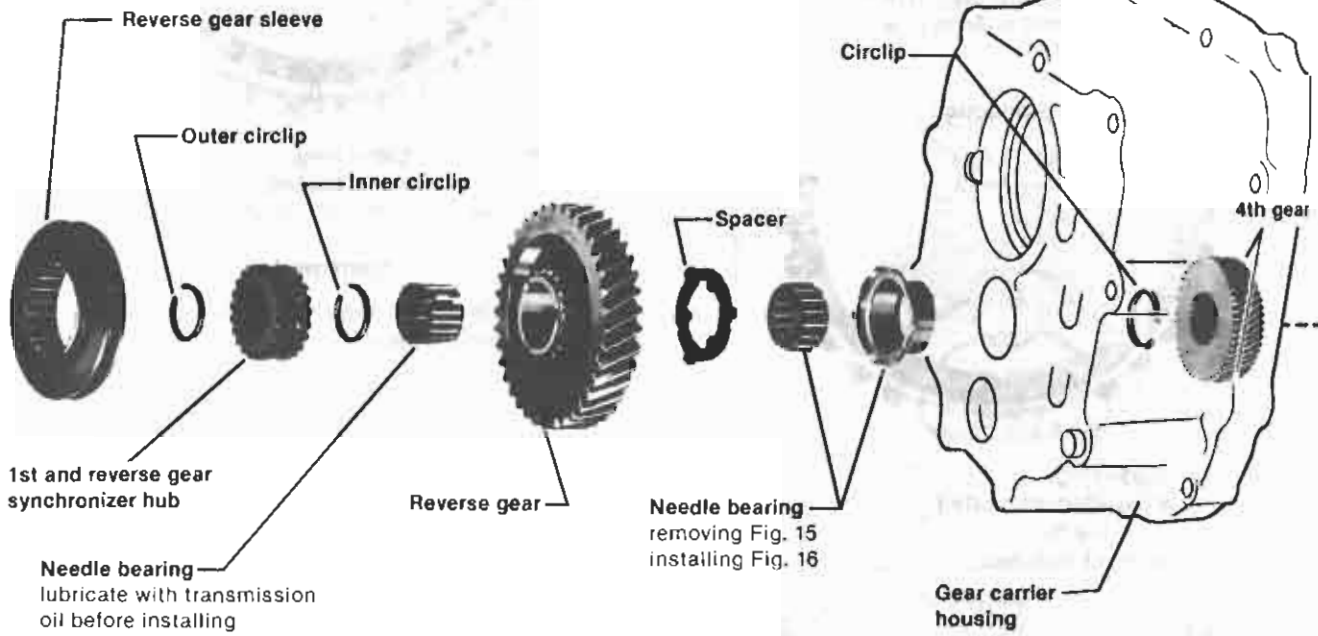


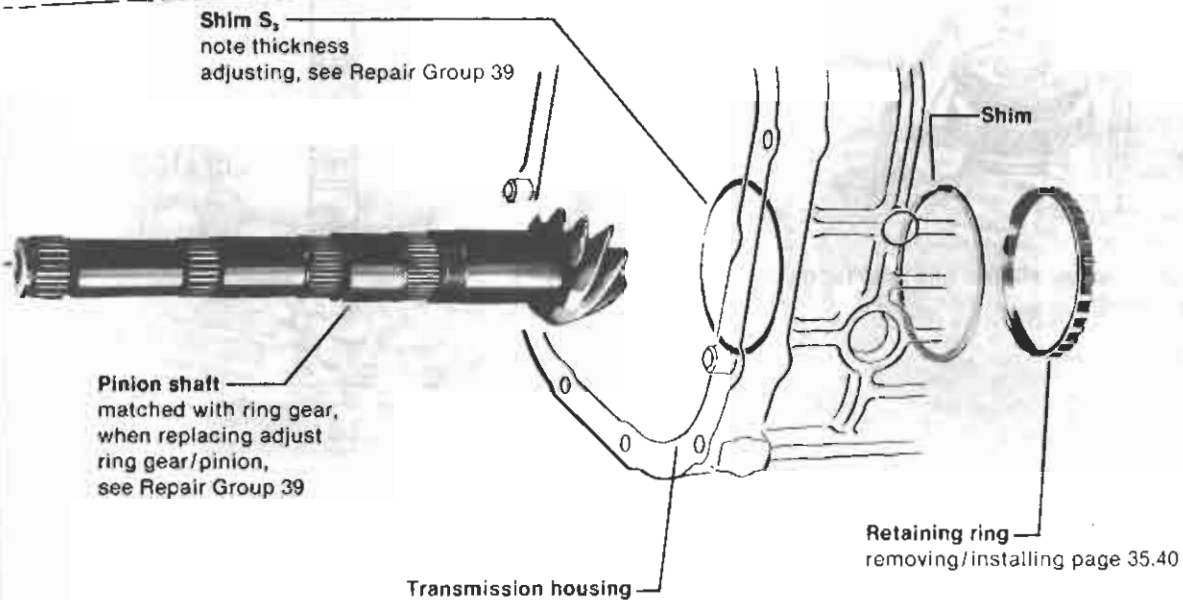
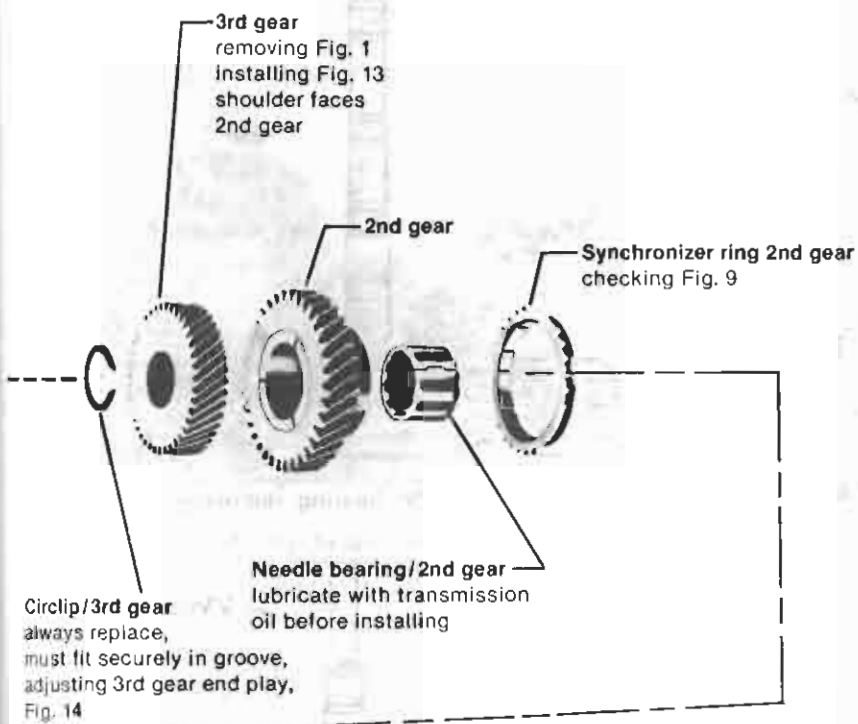
3rd gear: special brass ring,  
molybdenum coated,  
teeth all around circumference

### spare part

For all gears install ring off 3rd gear which is  
supplied under Spare Part No.: 091 311 295 A

# 35 Manual Transmission-Case, Gears, Shafts





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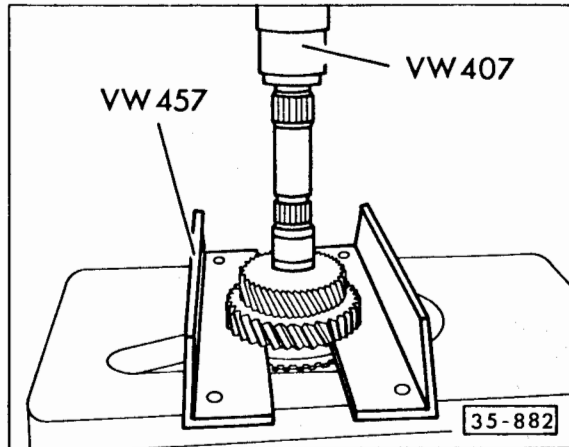


Fig. 1 3rd and 2nd gears, removing

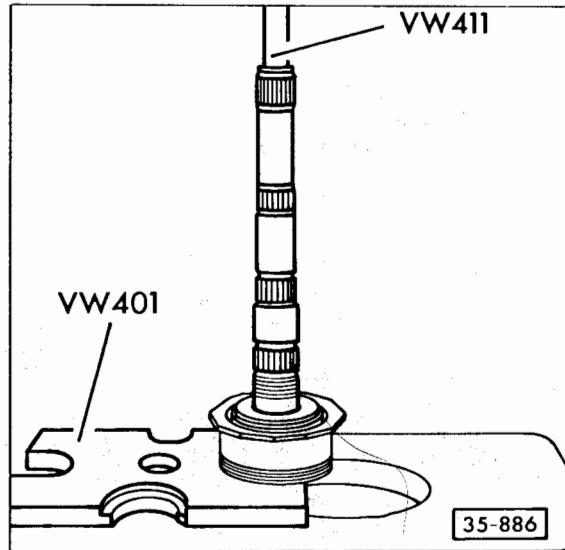


Fig. 3 Tapered roller bearing, removing

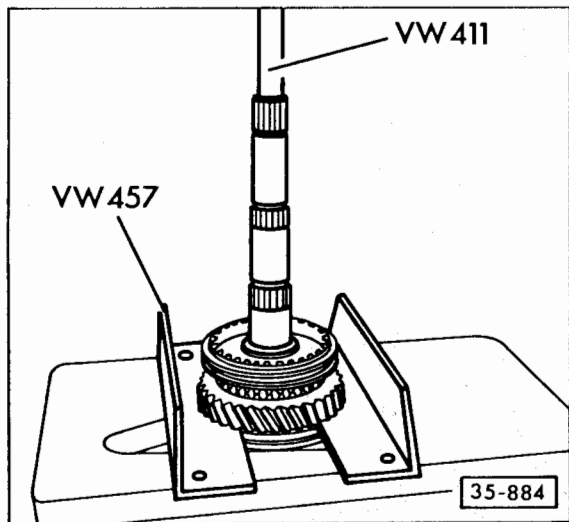


Fig. 2 Synchronizer sleeve/hub and 1st gear, removing

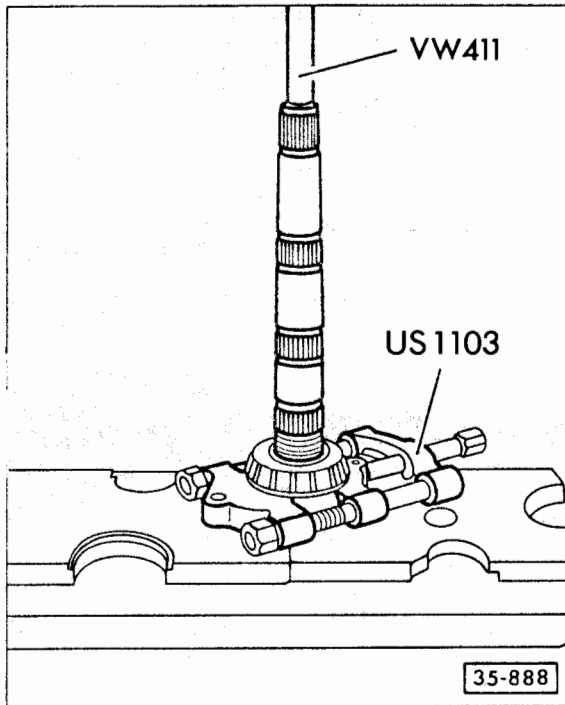
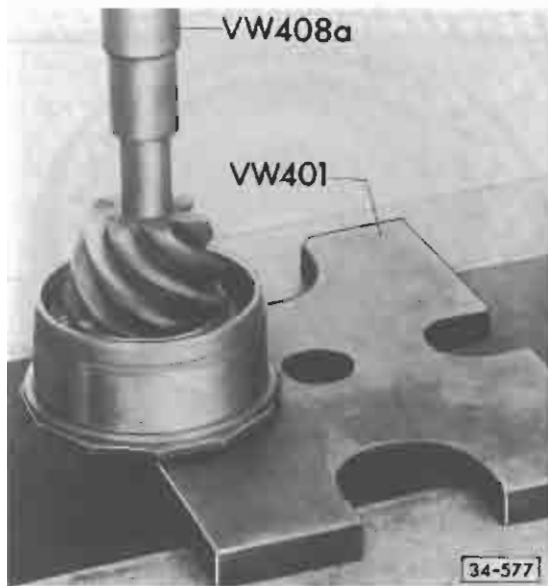
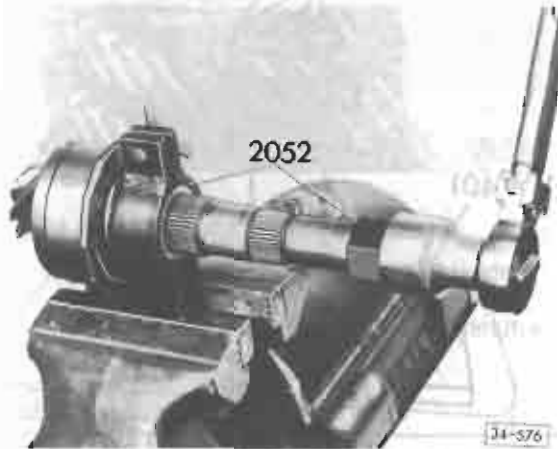


Fig. 4 Tapered roller bearing inner race, removing



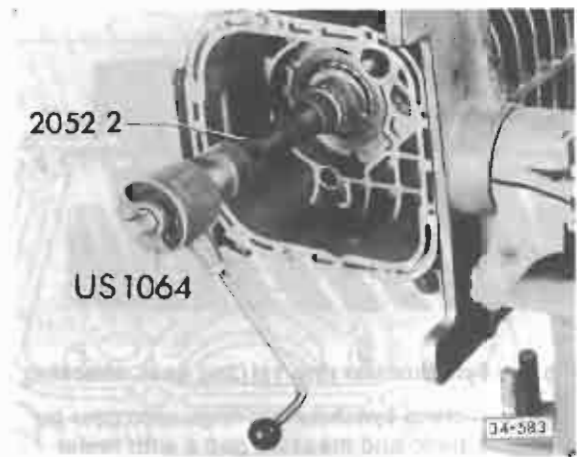
**Fig. 5 Tapered roller bearing, installing**

- heat inner race to about 100°C (212°F) and press on
- before tightening needle bearing inner race, let tapered roller bearing cool to room temperature



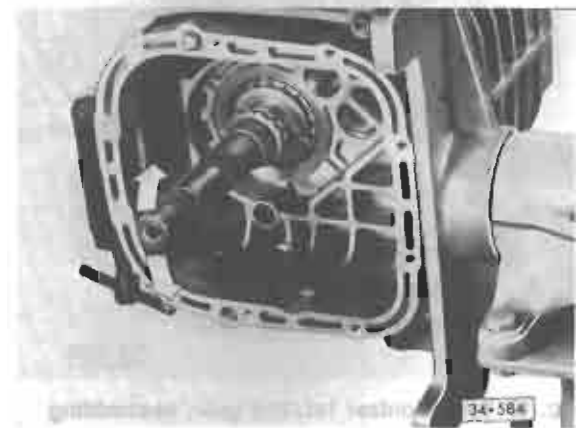
**Fig. 6 Needle bearing, loosening/tightening**

- heat inner race to about 60°C (140°F) and screw on as far as possible by hand
- place pinion shaft in tool 2052 and tighten wing nut lightly
- tighten inner race to 210 Nm (152 ft lb)
- check turning torque of tapered roller bearing, see Fig. 7



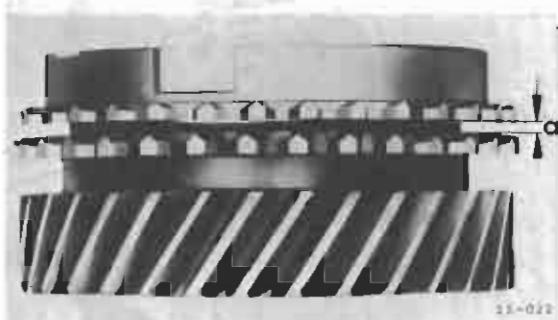
**Fig. 7 Tapered roller bearing, checking turning torque**

- lubricate bearings with transmission oil and tighten retaining ring
- turn pinion shaft in both directions about 15-20 times
- turn further and read turning torque
  - new bearings: up to 210 Ncm (180 in. lb)
  - used bearings\*: up to 70 Ncm (61 in. lb) (\*after running at least 30 miles)
  - if no turning torque can be measured, see Fig. 8



**Fig. 8 Bearing condition, checking**

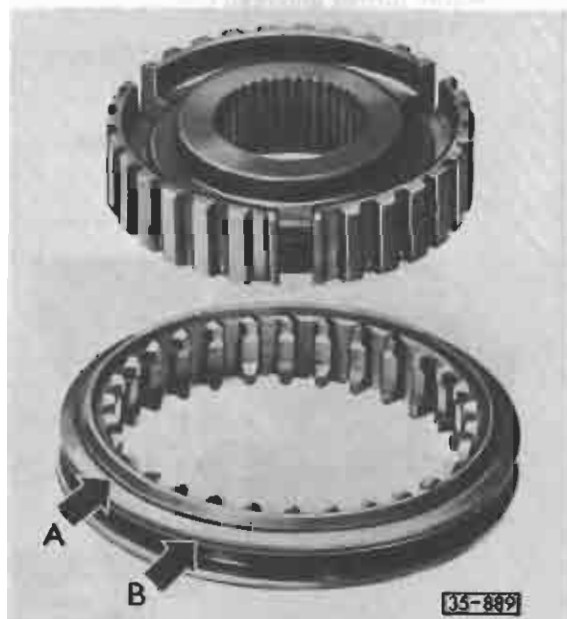
- check for rock at end of pinion. There must not be any detectable movement if YES, replace tapered roller bearing



**Fig. 9 Synchronizer ring 1st/2nd gear, checking**

—press synchronizer rings onto gear by hand and measure gap *a* with feeler gauge

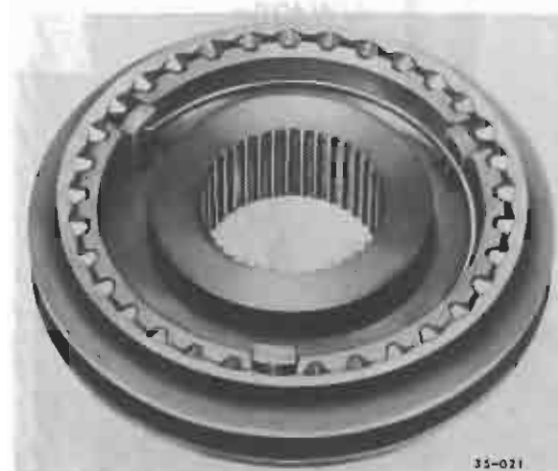
	New Part mm (In.)	Wear limit mm (In.)
Gap <i>a</i>	1.3-1.9 (0.051-0.075)	0.5 (0.020)



**Fig. 10 Synchronizer 1st/2nd gear, assembling**

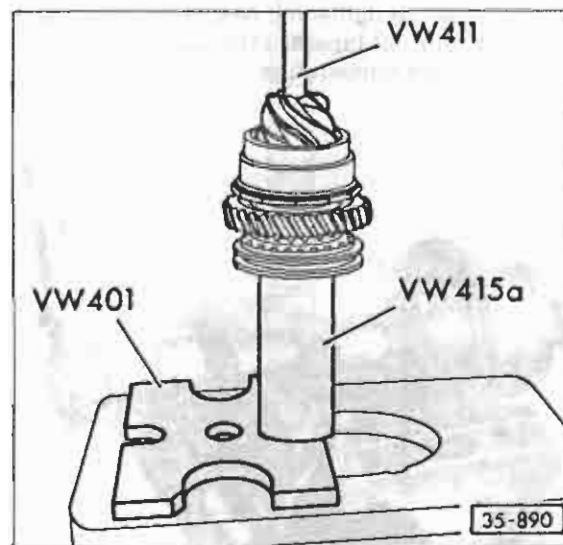
—groove (arrow A) must face 2nd gear  
 —collar on hub must face 1st gear  
 —grooves (arrow B) are for identification:

- 1st gear & 2nd gear = 1 groove
- 3rd gear & 4th gear = 2 grooves



**Fig. 11 Synchronizer 1st/2nd gear, assembling**

—slide sleeve over synchronizer hub. Matched position is not necessary  
 —insert keys and install springs with ends offset 120°. Angled ends of springs must fit into keys



**Fig. 12 Synchronizer 1st/2nd gear, installing**

—turn synchronizer ring until grooves are in line with keys (installation position, see Fig. 10)



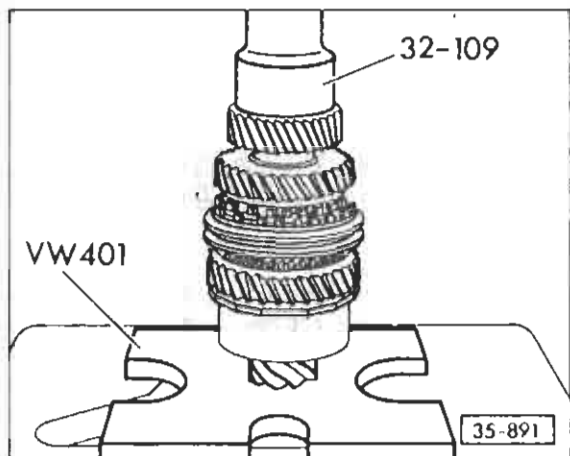


Fig. 13 3rd gear, installing

—collar must face 2nd gear

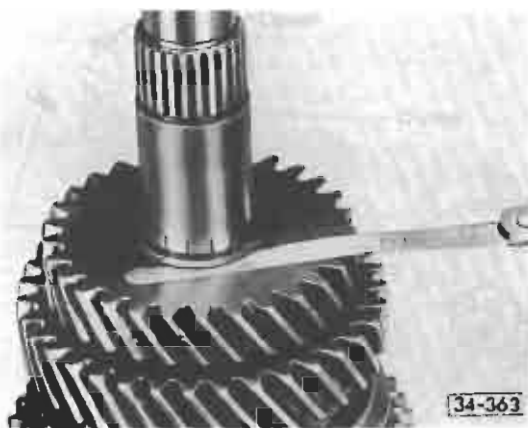


Fig. 14 3rd gear end play, adjusting

- measure end play with feeler gauge
- adjust by selecting suitable circlip
  - play should be 0.05 mm-0.20 mm (try to keep lower limit)

Circlips available:

Thickness mm	Color	Part No.
1.60	black	113 311 382
1.75	blue	113 311 383
1.90	brown	113 311 384
2.05	gray	113 311 385
2.20	copper	113 311 386
2.30	brass	113 311 387
2.40	silver	113 311 388

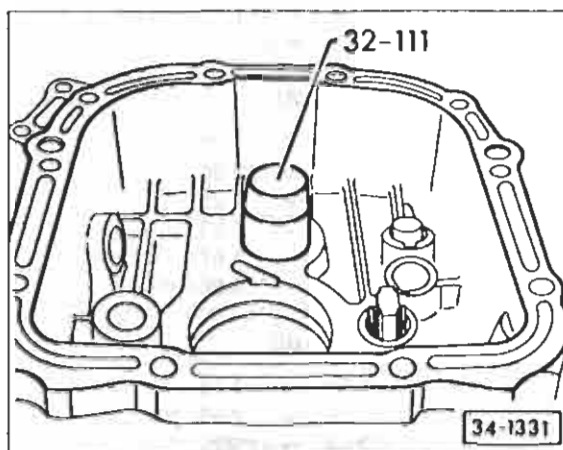


Fig. 15 Pinion needle bearing in gear carrier housing, removing

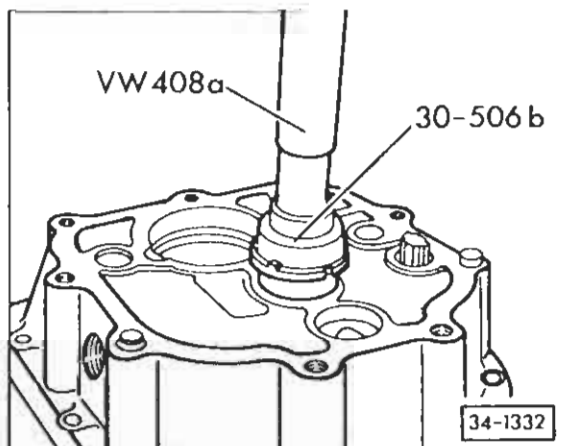


Fig. 16 Pinion needle bearing in gear carrier housing, installing

# 35 Manual Transmission-Case, Gears, Shafts

Listed below are gear ratios and lubricant specifications for 1985 MY Vanagons equipped with 4-speed manual transmission 091/1:

Gear Ratios	Trans. DU	
1st gear	34:9	= 3.78
2nd gear	33:16	= 2.06
3rd gear	63:50	= 1.26
4th gear	52:61	= 0.85
Reverse	33:9	= 3.67
Final drive	34:7	= 4.86

Gear Ratios	Trans. ABD	
1st gear	34:9	= 3.78
2nd gear	33:16	= 2.06
3rd gear	49:40	= 1.225
4th gear	41:48	= 0.85
Reverse	33:9	= 3.67
Final drive	29:6	= 4.83

lubricant capacity (incl. differential)  
091/1 ..... 3.0 l (3.2 US qt)  
viscosity ... SAE 80W, SAE 80W/90  
type ... hypoid, MIL-L-2105; API/GL-4

To reduce shifting effort, transmission oil capacity has been reduced.

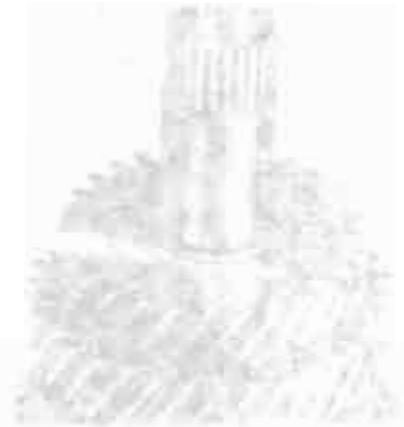
For production reasons, the oil filler hole remains at the same location.

Oil should only be poured in to a level approximately 15 mm (9/16 in.) below the filler hole.

Transmission filling capacities:

Vehicles with gasoline engines 3.0 liters (3.2 qt)

Vehicles with Diesel engines 4.0 liters (4.2 qt)



Transmissions installed in vehicles produced before May, 1984 are subject to refinements currently used in production. Transmissions needing repair should be inspected and repaired as necessary according to following procedures with parts required according to transmission date of manufacture (see transmission housing code).

### Note

Only latest version parts will be supplied as spare parts.

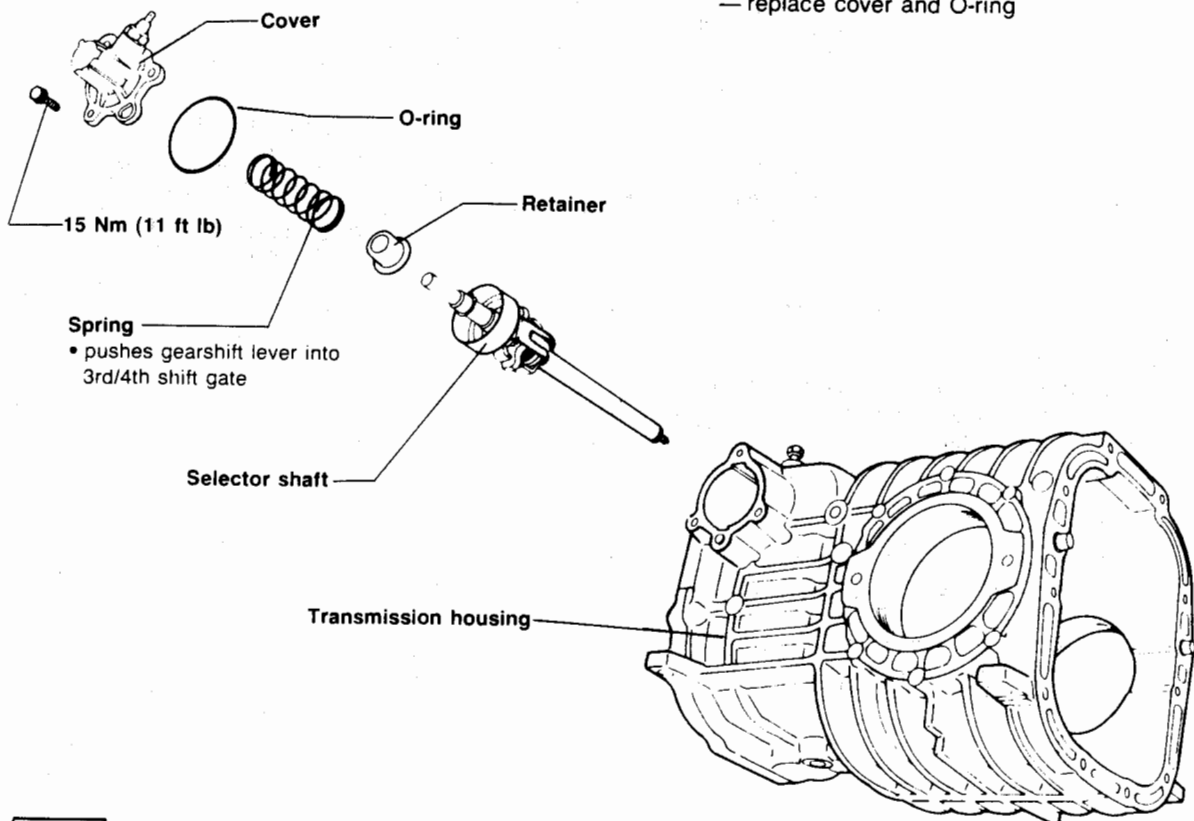
### CAUTION

Part numbers are for reference only. Always check with your Parts Department for latest parts information.

### Selector shaft, modifications

- external repairs performed with transmission installed

- A — Selector shaft
  - replace complete shaft with new version
- B — Selector shaft cover
  - provided with shoulder for spring to maintain proper position when assembling
  - replace cover and O-ring

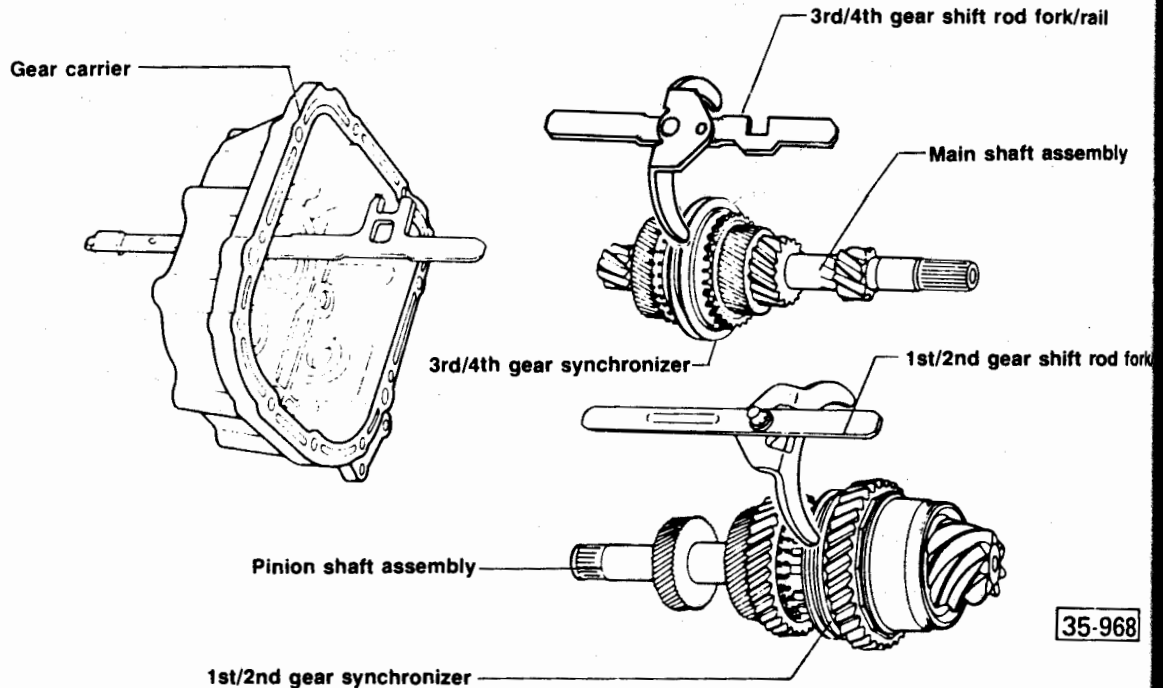


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# 35 Manual Transmission-Case, Gears, Shafts

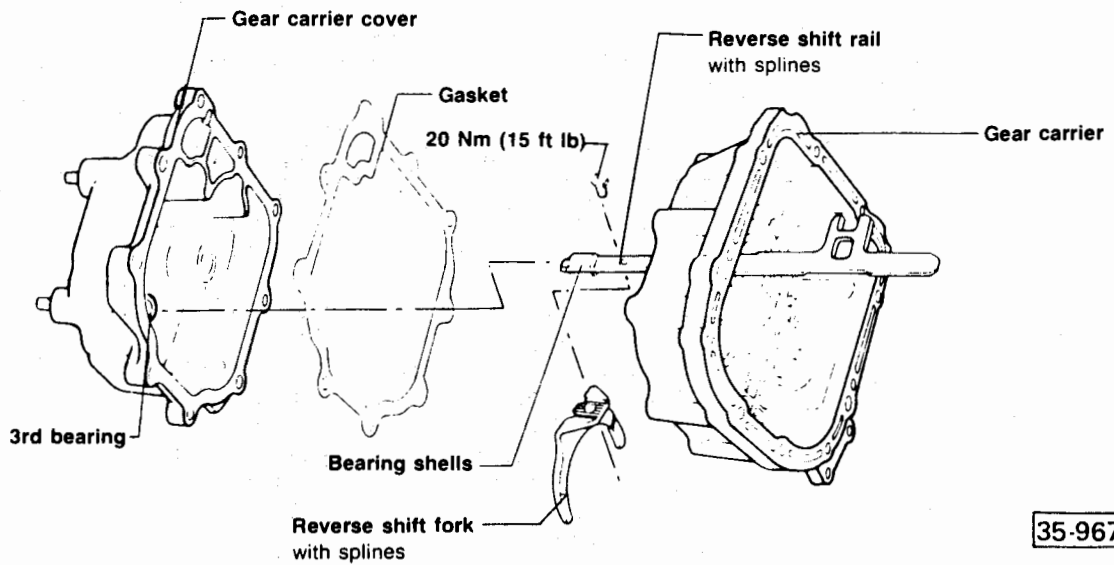
## Internal repairs (requiring disassembly of transmission)

### Shift forks/synchronizers, modifications



- C — Shift forks/rails
- 1st/2nd and 3rd/4th gear shift forks/rails are riveted and welded to maintain proper alignment to each other
  - replace with new shift forks/rails
- D — Synchronizers
- 1st/2nd and 3rd/4th gear synchronizers have been changed to prevent jumping out of gear
  - changes cannot be detected visually
  - replace with new version synchronizers

## Reverse shift fork/rail, modifications

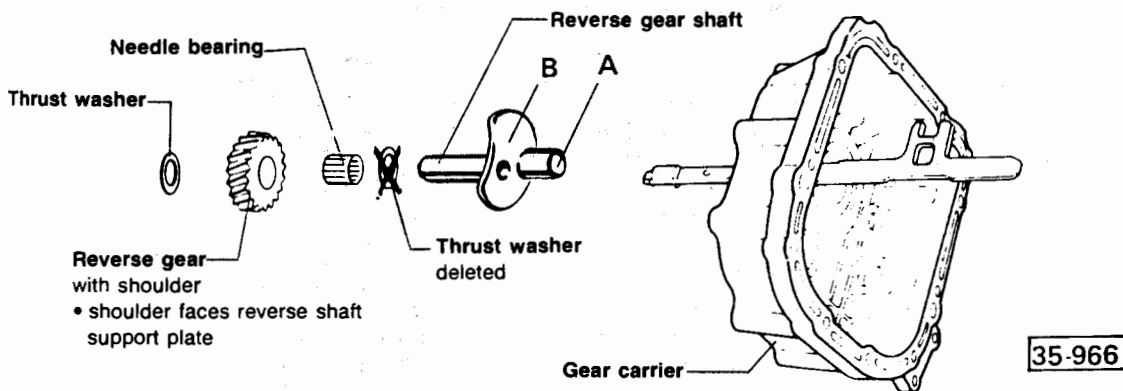


### E — Reverse shift fork/rail

- mating surfaces of fork/rail have splines to properly align to each other
- reverse shift rail is lengthened

and has two bearing shells which ride in 3rd bearing which is housed in boss provided in gear carrier cover  
— replace with all new version parts

## Reverse gear/shaft, modifications



### F — Reverse gear/shaft

- diameter of reverse gear shaft bearing pin **A** increased from 12 to 18 mm
- bearing carrier hole increased to fit
- thickness of support plate **B** increased from 5 to 6 mm and thrust washer between plate and reverse gear is deleted
- reverse gear provided with shoulder

— replace with all new version parts only if reverse shaft pin **A** is loose in bearing carrier

#### Note

Thrust washer between support plate and reverse gear must be removed if new version reverse shaft is installed.

# 35 Manual Transmission-Case, Gears, Shafts

## Parts requirements (based on transmission date of manufacture)

### Note

Previous version parts are not available and must be replaced by latest version listed below

### CAUTION

Part numbers are for reference only. Always consult your Parts Department for latest parts information

Transmission date of manufacture	Parts Required	
	Description	Part number (Quantity)
Prior to 09 08 2	Selector shaft**	091-311-534B**
	Selector shaft cover	091-301-232A
	Selector shaft cover O-ring	091-301-278A
	Shift fork (1/2)	091-311-549A
	Shift fork (3/4)	091-311-559A
	Synchronizer (1/2)	091-311-241B
	Synchronizer (3/4)	091-311-301B
	Reverse shift fork	091-311-571A
	Reverse shift rail	091-311-577C
	Reverse shift rail bearing shells	091-301-146(2)
	Bearing carrier cover	091-301-205E
	Reverse gear shaft*	091-311-514A
	Bearing carrier*	091-301-173C
	Reverse gear*	091-311-507A
*Only to be replaced if reverse shaft is loose in bearing carrier		
from 10 08 2 to 25 08 2	Selector shaft**	091-311-534B**
	Selector shaft cover	091-301-232A
	Selector shaft cover O-ring	091-301-278A
	Shift fork (1/2)	091-311-549A
	Shift fork (3/4)	091-311-559A
	Synchronizer (1/2)	091-311-241B
	Synchronizer (3/4)	091-311-301B
	Reverse shift fork	091-311-571A
	Reverse shift fork rail	091-311-577C
	Reverse shift rail bearing shells	091-301-146(2)
Bearing carrier cover	091-301-205E	
from 26 08 2 to 18 11 2	Selector shaft**	091-311-534B**
	Selector shaft cover	091-301-232A
	Selector shaft cover O-ring	091-301-278A
	Shift fork (1/2)	091-311-549A
	Shift fork (3/4)	091-311-559A
	Synchronizer (1/2)	091-311-241B
Synchronizer (3/4)	091-311-301B	
from 19 11 2 to 24 11 2	Selector shaft**	091-311-534B**
	Selector shaft cover	091-301-232A
	Selector shaft cover O-ring	091-301-278A
	Shift fork (1/2)	091-311-549A
Shift fork (3/4)	091-311-559A	
from 25 11 2 to 02 12 2	Selector shaft**	091-311-534B**
	Selector shaft cover	091-301-232A
	Selector Shaft cover O-ring	091-301-278A
from 03 12 2 to vehicles produced up to May, 1984	Selector shaft**	091-311-534B**

\*\* See page 35.60a

# Appendix

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# VEHICLE CARE

## FUEL SUPPLY

**Your vehicle is equipped with a catalytic converter and requires unleaded fuel.**

For maximum engine performance, unleaded fuel with an octane rating of 91 RON, which corresponds to an anti-knock index (AKI) of 87, is recommended.

**Do not use leaded gasolines.**

Deposits from leaded gasolines deactivate the catalytic converter and thus defeat its purpose to control exhaust emissions.

**Unleaded fuels may not be available outside the continental USA and Canada. Therefore, we recommend you do not take your vehicle to areas or countries where unleaded fuel may not be available.**

### Octane rating

Octane rating indicates a gasoline's ability to resist detonation. Therefore, buying the correct octane gas is important to prevent engine "knock", which reduces performance and may cause engine damage.

Under high load operating conditions, unleaded premium gasoline may be used.

The 91 RON octane rating which you will find above the filler neck is based on the research method. The AKI octane rating usually displayed on USA gasoline pumps is calculated as follows: Research octane number plus motor octane number, divided by 2.

Regular fuels have an octane rating ranging from 91 to 95 **RON** (Research Octane Number) or 87 to 91 AKI.

**Do not use any fuel with octane ratings lower than 91 RON or 87 AKI.**

### Gasolines containing alcohol

Gasoline containing alcohol is available at gas stations in some areas. The gas pump may not be labeled to identify that alcohol is present in the gasoline. If it is labeled, it may not identify what amount and type(s) of alcohol are used. We recommend you use quality gasoline that is **NOT** blended with alcohol. The use of fuel containing alcohol can cause loss of fuel economy and driveability and performance problems. If these problems are experienced, we recommend you switch to another brand of gasoline.

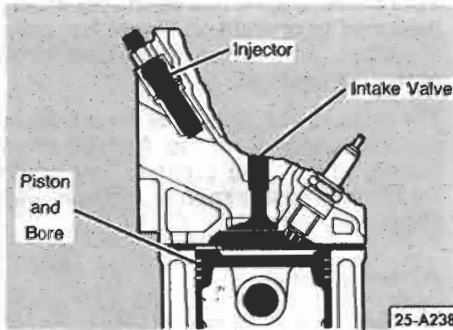
### Seasonally adjusted gasoline

Many gasolines are blended to perform especially well for winter or summer driving. During seasonal change-over, we suggest that you fill up at busy gas stations where the seasonal adjustment is more likely to be made in time.

### Gasoline additives

A major concern among many auto manufacturers is carbon deposit build-up caused by the type of gasoline you use.

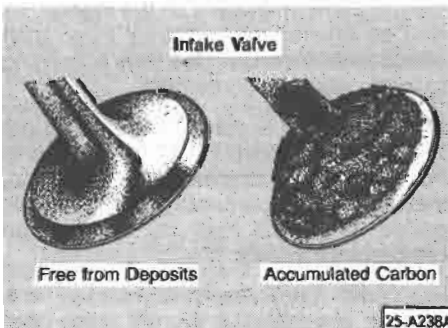
Although gasolines differ from one manufacturer to another, there is a common thread. All gasolines contain properties that can cause deposits to collect on essential engine components, specifically fuel injectors and intake valves. Although most gasoline brands include additives to keep engine and fuel systems clean, they are not equally effective.



After an extended period of using inadequate fuels, built-up carbon deposits can rob your engine of peak performance. And carbon deposits like those in the illustration can lead to other engine performance problems such as:

- unstable idling
- surging
- misfiring
- power loss
- engine run-on
- engine pinging or knocking

If these problems continue over a long period of time, engine damage can be a result.

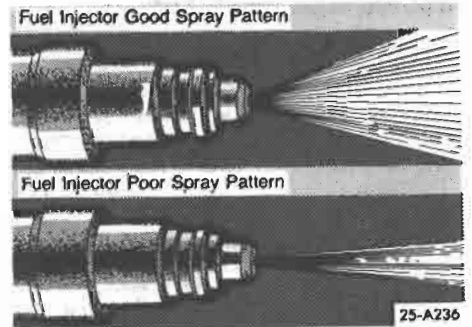


Damage or malfunction due to poor fuel quality is not covered by the Volkswagen New Vehicle Limited Warranty.

### Recent fuel developments

Over the past few years, more manufacturers have been advertising detergent additives in their gasoline. These additives are primarily intended to keep fuel injectors clean.

However, they are not all equally effective in reducing carbon deposit build-up on intake valves. We are aware that, as of the time of printing, some manufacturers



advertise and sell gasoline that contains the proper deposit control additives that will keep intake valves and injectors clean.

To assure the long term performance of your car's engine, you should use gasoline brands that include these deposit control additives.

If gasolines with additives are not available, contact your Volkswagen dealer about proper fuel additives.



## If wrong fuel was put into your tank

### Premium gasoline instead of regular

Your engine runs equally well on premium gasoline, however neither fuel consumption nor engine output are likely to be affected.

### Regular gasoline with RON/AKI rating (lower than 91 RON or 87 AKI)

Your engine will run but avoid full power as engine can be damaged. Fill up with correct fuel as soon as possible.

### Diesel fuel instead of gasoline

Your gasoline engine must not be started with Diesel fuel in the tank. In such case the fuel tank must be drained while observing all environmental and fire hazard precautions.

### Leaded instead of unleaded gasoline

Do not drive your car. Have your fuel tank drained immediately as otherwise the emission control system will be damaged.

The fuel system must be drained while observing all environmental regulations, it is best to have this performed by your Volkswagen dealer.

## Diesel engine: Diesel Fuel No. 2

Service stations offering Diesel fuel are generally located on truck routes of major highways. Directories of Diesel fuel stations are usually sold at Diesel fuel stations.

Some U.S. states require permits to purchase Diesel fuel. Check with your State Motor Vehicle Department.

Diesel fuel may not be available outside the continental U.S. and Canada, we recommend you do not take your vehicle to countries where Diesel fuel may not be obtainable.

**Your Diesel engine has been specifically designed to operate on Diesel fuel only. Therefore, do not use home heating oil or regular gasoline.**

**The properties of these fuels may cause serious damage to the fuel injection system and to the engine. This could lead to additional expense and may also affect your warranty.**

### Winter operation

At temperatures below 20° F (-7° C), Diesel Fuel No. 2 loses its fluidity due to wax separation, which may clog the fuel filter or tank strainer and keep the engine from running.

If you expect temperatures below 20° F (-7° C):

- Use Diesel Fuel No. 1, if available in your area.

- If Diesel Fuel No. 1 is not available, ask your fuel dealer whether his Diesel Fuel No. 2 is sufficiently winterized for the prevailing temperatures.

- As a measure of precaution, add a commercially available Diesel Fuel flow improver (pour point depressant) to your Diesel Fuel. Because of the many different flow improvers on the market, as well as differences in Diesel Fuel, their effectiveness varies. Use only according to instructions on containers.

- If winterized Diesel Fuel No. 2 is not available, mix Diesel Fuel No. 2 with up to 50% Kerosene. Engine power may drop, therefore keep percentage of kerosene added to Diesel Fuel as low as the temperature allows.

Temperature	Diesel Fuel No. 2	Kerosene
20° to 14° F (-7° C to -10° C)	75 %	25 %
below 14° F (-10° C)	50 %	50 %

- Only if neither Diesel Fuel No. 1, winterized Diesel Fuel No. 2, nor Kerosene are available, use up to 30% leaded or unleaded gasoline.

- **Do not use Premium gasoline.**

- **Mixing Diesel Fuel No. 2 with Kerosene (or gasoline) must be done before wax starts to separate. Later mixing may be effective in the fuel tank but not in the rest of the fuel system.**

- **Always add the correct amount of Kerosene (or gasoline) to the fuel tank first, and then fill up with Diesel Fuel No. 2.**

- **Do not use "starting assist fluids", they will cause engine damage.**

- **Do not use fuel line anti-freeze offered for gasoline engines.**

It is normal that the engine noise level (dieseling) is louder during the warm-up period in winter. It is also normal that whitish-blue smoke may be emitted from the exhaust after starting and during warm-up. The amount of smoke depends on the outside temperature.

Do not let your Diesel engine idle unnecessarily after a cold start-up. Driving off slowly will shorten the warm-up period.

### WARNING

- **Do not use "starting assist fluids". They may be potentially explosive or cause a "run-away" engine condition. This could result in serious engine damage and personal injury.**

- **Any amount of gasoline added to Diesel fuel makes the mixture as flammable as pure gasoline.**

- **Handle all fuels in well ventilated areas. Do not smoke or have anything in the area that can ignite fuel.**

- **Never carry additional fuel containers in your vehicle. Such containers, full or empty, may leak, cause an explosion, or result in fire in case of a collision.**

# VEHICLE CARE

## CLEANING PRODUCTS

Any automobile is subjected to abuse from industrial fumes, corrosive road salt, abandoned lollipops, muddy dog feet, etc.; to name just a few. A well cared for Volkswagen can look like new many years later. Regular and correct care will contribute to maintaining the beauty and the value of your Volkswagen.

Your Volkswagen dealer has a number of car-care products and can advise you which ones to use for cleaning the exterior and interior of your vehicle.

Whether you use Volkswagen recommended products or other, commercially available cleaning agents, make sure first of their correct application.

### WARNING

■ **Cleaning agents may be poisonous. Keep them out of the reach of children.**

■ **Observe all caution labels.**

■ **Always read directions on the container before using any product.**

■ **Most chemical cleaners are concentrates which require dilution.**

■ **Only use spot removing fluids in well ventilated areas.**

■ **Do not use gasoline, kerosene, naphtha, nail polish remover or other volatile cleaning fluids. They may be toxic, flammable or hazardous in other ways.**

## EXTERIOR

### Washing and waxing

The paint on your Volkswagen is very durable but must be protected from losing its luster due to outside influences. Therefore, wash and wax your Volkswagen often. The longer the dirt is left on the paint, the greater the risk of damaging the glossy finish, either by scratching if the dirt is rubbed into the paint, or simply by the chemical effect dirt particles have on the paint surface.

**Do not wash or wax in direct sunlight, or when the sheet metal is hot. Do not use hot water. Lukewarm to cool water is kinder to the paint.**

### WARNING

■ **Do not wash, wax or dry the vehicle with the engine running.**

■ **Do not clean the underside of chassis, fenders, wheel covers, etc., without protecting your hands and arms. You may cut yourself on sharp-edged metal parts.**

■ **Moisture, ice and road salt on brakes may affect braking efficiency. Test the brakes carefully after each vehicle wash.**

Do not aim the water jet directly at door, hatch or rear lid locks. Tape the key holes to prevent water from seeping into the lock cylinders. Water in lock cylinders should be removed with compressed air. To prevent locks from freezing in the winter, squirt glycerine or lock de-icer into the lock cylinders. **Do not use any solution that can damage the body paint.**

Use plenty of water, a car-wash and wax solution and a soft sponge or hose brush. Begin by spraying water over the dry surface to remove all loose dirt before applying the car-wash and wax solution. Use plenty of water to rinse the vehicle off. Wipe everything dry with a chamois to avoid water spots.

When having your vehicle washed at an automatic car wash, be sure to observe all the precautions suggested by the establishment.

The underside of the vehicle picks up dirt and road salt. To guard against corrosion, it is important to remove mud, debris and road salt from the underside with a powerful jet of water. Be sure to include the wheel housings, bumpers, muffler, tailpipe and brackets. This should be done twice a year and is best accomplished after the vehicle has been driven through a heavy rain. Let engine and exhaust cool down before washing.

Waxing is not really needed when you have used a car-wash and wax solution. If you do not use a car-wash liquid with wax, apply wax to preserve the natural shine of the body paint. To obtain a long lasting finish, apply hard wax. Wax again when water remains on the surface in large patches instead of forming beads and rolling off.

This will make dirt easier to remove and will prevent the paint from being damaged from industrial dust, tree sap or bird droppings.

Use a polish when it becomes evident that waxing no longer accomplishes the job. If the polish you are using does not contain wax, apply hard wax after polishing.

### Tar or oil

Do not allow tar or oil to remain on the paint. Remove as soon as possible with a cloth soaked with a special paint cleaner. If you do not have a tar or oil remover, you may substitute with turpentine. After applying a cleaning fluid, always wash with a lukewarm soap water solution and apply a new wax coat.

### Insects

Remove as soon as possible with a lukewarm soap water solution or insect remover.

### Tree sap

Do not allow tree sap or bird droppings to harden on the paint. Remove with a lukewarm soap water solution.

### Windows

Clean all windows regularly to remove road film and car-wash wax buildup. Use a lukewarm soap water solution or an alcohol base commercial window cleaning agent. If a chamois is used for polishing the glass, it should exclusively be used for that purpose.

Also, be sure to clean all windows regularly on the inside.

Use a plastic scraper to remove snow and ice from windows and mirrors. To prevent dirt from scratching the window, always scrape in a forward direction — never back and forth.

### Wiper blades

Always loosen frozen wiper blades from glass otherwise they may tear.

Clean wiper blades regularly with an alcohol base solution. If necessary, use a sponge or a brush to remove accumulated road film. To assure good visibility, replace wiper blades at least once a year, or more often when wiping becomes streaky.

## Weatherstrips

**Keep silicone sprays off the windshield to avoid wiper smear in rain.**

To seal properly, weatherstrips around hood, hatch, windows, doors, etc., must be pliable. Spray with silicone or coat with talcum powder or glycerine to retain flexibility of the rubber and to protect against freezing in the winter.

## Sliding roof guide rails

To assure that the sliding roof\* function properly, clean the guide rails and lubricate with silicone spray at least once a year. See your Volkswagen dealer for correct procedures and lubricant.

## Touch-up paint

Your Volkswagen dealer has touch-up paint for minor scratches and stone chips. Scratches should be touched up soon after they occur to prevent corrosion. If corrosion formation becomes visible, however, a simple touch-up job will not suffice.

The affected surface must be smoothed with sand paper and covered with an anti-rust primer, before restoring the painted finish.

The number for the original vehicle paint can be found on the vehicle identification label.

## Dull finishes and plastics

Plastic parts, such as light bulb lenses, decorative stripes, panels, bumpers, etc., will come clean with regular washing. Should additional cleaning or spot removal be necessary, use a soft brush or cloth soaked with a mild detergent solution. Then rinse thoroughly and immediately with clear water.

**Do not use anything which could mar the plastic or dull finished surface, such as wax, polish, abrasive detergents or chemical cleaning solvents.**

## Steel wheels

Always include the hub caps and wheel rims when washing your vehicle to remove road dirt, salt sprays and brake dust. If necessary, use a commercial wheel cleaner to remove accumulated brake dust. Paint scratches should be touched up to prevent corrosion.

## Light alloy wheels

To preserve the decorative appearance of the light aluminium cast, some special care is necessary. In addition to road dirt and salt sprays, brake metal dust is also corrosive. If left on too long, brake metal dust can cause pitting. Wash the wheels with a sponge or hose brush every other week. Road salt should be removed weekly with an acid free cleaning solution. Every three months (after regular cleaning) the wheels should be coated with petroleum jelly or car wax. Rub it in firmly with a soft cloth. Never use abrasive or metal polishing cleaning agents.

**Remember that moisture, ice and road salt on brakes may affect braking efficiency. Test the brakes carefully after each washing.**

## Sliding door

The sliding door mounting points, the guide tracks and the roller guides should be lubricated regularly and as often as necessary.

## Bright metal trim

Bright or black anodized trim will come clean with regular washing. To protect metal trim, use car wax. Remove spots or dirt from chrome and stainless steel with a chrome cleaner. Apply a chrome polish for continued luster and protection.

## INTERIOR

### Glass

Use the same cleaning agents as for exterior and polish dry.

### Fabric

Use a vacuum cleaner or a soft bristle brush to remove dust and loose dirt from carpeting, upholstery, headliner and other trim. Dirt stains can usually be removed with a lukewarm soap water or all purpose cleaner solution, or a dry foam cleaner. For greasy, oily and other stubborn stains, use a spot remover. Do not pour the liquid on the fabric. Dampen a clean cloth and rub carefully, starting at the edge and working inward.

### Plastic, vinyl and leather/leatherette

Use a clean, damp cloth or sponge to keep this trim free from dust. For other soilage, use a lukewarm solvent free all purpose cleaning solution or a mild saddle soap for vinyl and leather trim. Remove water spots and soap traces with a clean, damp cloth or sponge. Use a clean, soft cloth to rub dry.

Grease, tar or oil stains can be removed with a clean cloth or sponge soaked with all purpose cleaner or with a solvent type vinyl or leather cleaning agent.

Occasionally apply a colorless vinyl or leather preservative to retain the material's luster and pliability.

### Safety belts

**Keep belts clean. Dirty belts may not retract properly. Do not remove belts from the vehicle. Do not use chemical cleaning agents, bleach or dyes. They contain corrosive properties which will weaken the webbing. Do not allow inertia reel safety belts to retract before they are completely dry.**

For cleaning, use a mild soap water solution. Let belts dry out thoroughly and away from direct sun light.

**Use the opportunity to inspect the belts for damage. If you discover damage, see your dealer.**

where applicable

## CORROSION PROTECTION

The transmission, front and rear axle assembly surfaces have been treated at the factory with a wax based coating for protection against corrosion. However, we recommend to have the and the underside inspected twice a year for any damage to the protective coating preferably before and after the winter season. Have necessary repairs done as soon as possible. See your dealer for correct procedures and materials.

### WARNING

**Do not apply additional undercoating or rustproofing on or near the exhaust manifold, exhaust pipes, catalytic converter or heat shields. During driving, the substance used for undercoating could overheat and cause a fire.**

### Engine Compartment

When washing the engine compartment, only use commercially available grease cutting solvents made especially for this purpose. Carefully follow directions printed on the container by the manufacturer.

### WARNING

**Never use gasoline, Diesel fuel or solvents which could damage rubber parts or painted surfaces and could cause a fire.**

### Chassis

The lower body shell of your Volkswagen is thoroughly protected against corrosion. However, it is recommended to have the underside inspected twice a year. Any detected damage to the undercoating, due to road hazards, should be repaired promptly. Oil based protective sprays must not be applied. Only tar or wax based anticorrosion protectors are compatible with the factory applied undercoating. Before application, road dirt, salt spray deposits and oily substances must be removed.

Whenever the lower body shell, axle, transmission or engines assemblies have been repaired, the lost anti-corrosion coating of the affected surfaces should be reapplied.

Your Volkswagen dealer has the appropriate materials, the necessary equipment and is familiar with the application procedure. Therefore, any additional corrosion protection work should be performed by a Volkswagen dealer.

### Body cavity sealing

All body cavities which could be affected by corrosion have been given a thorough protection at the factory.

This sealing does not require any inspection or additional treatments. If any wax should seep out of the cavity when the ambient temperature is high, it can be removed with a plastic scraper and a suitable solvent. Be sure to observe all safety and environmental regulations.

## MAINTENANCE

Your vehicle has been designed to help keep maintenance requirements to a minimum. However, a certain amount of regular maintenance is still necessary to assure your vehicle's safety, economy and reliability.

**Maintenance Service is required every 12 months or every 15,000 miles (24,000 kilometers), whichever occurs first.**

In addition, it is necessary to perform an oil change 6 months after each Maintenance Service, or after each 7,500 miles (12,000 kilometers) whichever occurs first.

The first oil change must be performed 6 months after the delivery of the vehicle or after 7,500 miles (12,000 kilometers).

**Under difficult operating conditions**, for example at extreme low outside temperatures or in very dusty regions, etc., some service work should be performed between the intervals specified.

This applies particularly to:

- oil changes, and
- cleaning or replacing the air filter.

The maintenance work should be performed by Volkswagen dealers because they have the expertise, the workshop facilities and the special tools required. It is important that this work is performed according to the manufacturer's instructions.

Proof of servicing in accordance with the maintenance schedule may be a condition for upholding a possible warranty claim made within the warranty period.

**Safety and environmental** concerns place very strict limits on the nature of repairs and adjustment on engine and transmission parts which an owner can perform. **Tampering with safety-related parts can endanger you as well as other motorists.**

Always observe environmental regulations when disposing of old engine oil, used brake fluid, dirty engine coolant, spent batteries or worn out tires.

# VEHICLE CARE

## LUBRICANTS

### Engine

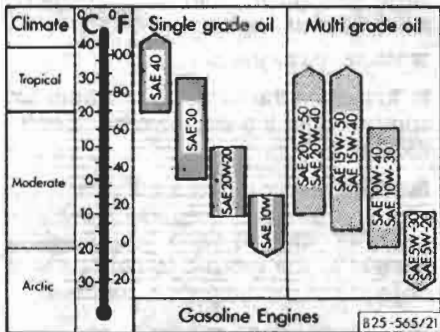
Your engine was factory filled with an all-season high quality engine oil. If you need to add oil between oil changes use any high quality petroleum or synthetic based oil with correct specifications.

The following term must appear on the oil container singly or in combination with other designations: "API Service SF or SG" (Gasoline engine) or "API Service CD" (Diesel engine).

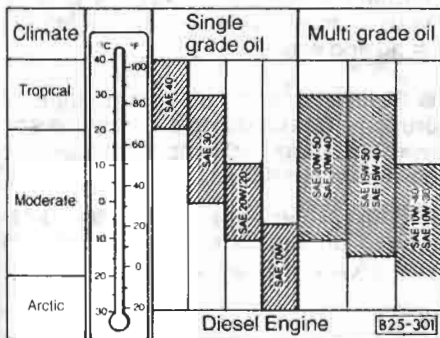
Engine oils are graded according to their viscosity. The proper grade to be used in your engine depends on existing climatic or seasonal conditions.

Refer to the temperature chart when selecting engine oil. As temperature ranges of the different oil grades overlap, brief variations in outside temperatures are no cause for alarm. It is also permissible to mix oil of different viscosities if you find it necessary to add oil.

### Gasoline engine:



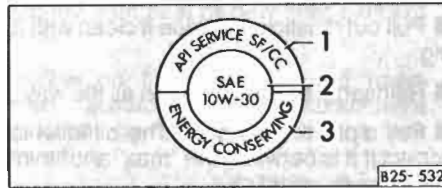
### Diesel engine:



When using SAE 10 W or SAE 5 W-20 or SAE 5 W-30 engine oil, avoid high speed long distance driving if outside temperature rises above the indicated limits.

### Engine Oil Identification Symbol

Select an oil for your vehicle which conforms to the standards of the American Petroleum Institute (API). A symbol has been added to the top of some oil containers to help in selecting the correct oil.



- (1) The top portion indicates the oil quality by API designations.
- (2) The center portion shows the SAE oil viscosity grade.
- (3) The lower portion indicates that the oil has fuel saving capabilities.

### Transmission

Manual transmission:

Hypoid oil SAE 80 (Mil-L-2105 or API/GL 4).

Automatic transmission:

ATF Dexron® or Dexron II® for torque converter and hypoid oil SAE 90 (Mil-L-2105 B or API/GL 5) for final drive.

### Front axle differential (Synchro only)

Hypoid oil SAE 80 (Mil-L 2105 B or API/GL 4) or synthetic transmission oil G 50, SAE 75 W-90.

The lubricant used does not have to be changed.

Should the need arise to add oil, it should only be done with the necessary workshop equipment.

### Power steering

ATF Dexron®

### Lubricant additives

Volkswagen does not recommend the use of oil additives. It may adversely affect your warranty.

## ENGINE OIL

### Engine oil consumption

It is normal for your engine to consume oil. The rate of oil consumption depends on the quality and viscosity of oil, the speed at which the engine is operated, the climate, road conditions as well as the amount of dilution and oxidation of the lubricant.

Because of these variables, no standard rate of oil consumption can be established, but drivers should expect an increased oil consumption at high speeds and when the engine is new.

■ The engine in your vehicle depends on oil to lubricate and cool all of its moving parts. Therefore the engine oil should be checked regularly and kept at the required level.

■ Make it a habit to have the engine oil level checked with every fuel filling.

■ Lack of sufficient engine oil may lead to severe engine damage.

■ The oil pressure warning light is not an oil level indicator.

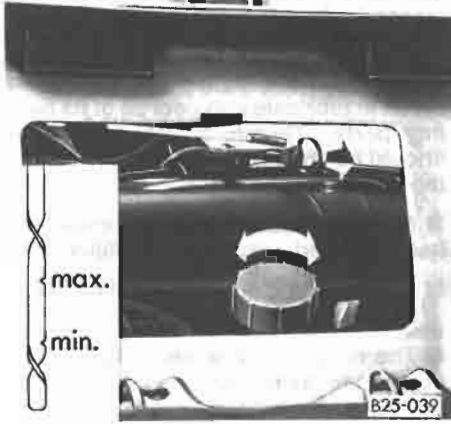
Always heed WARNINGS on page 6.

## Checking the engine oil level

The best time to check the engine oil level is when the oil is warm.

The engine oil dipstick and the oil filler neck are located behind the license plate lid.

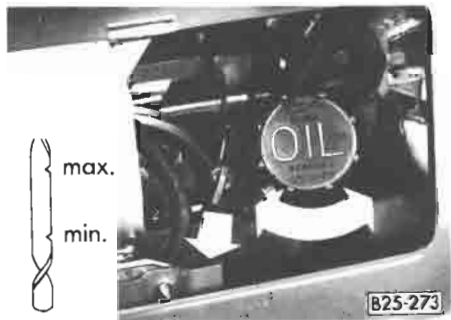
### Air-cooled engine:



### Diesel engine:



### Water-cooled engine:



- Turn off the engine.
- To get a true reading, the vehicle should be on level ground. After turning off the engine, wait a few minutes for the oil to return to the crankcase.
- Flip license plate down.
- Pull out dipstick and wipe it clean with a rag.
- Reinsert dipstick; push it in all the way.
- Pull dipstick out again. The oil level is correct if it is between the "max" and "min" marks on the dipstick.
- If oil level is below "min" mark, or not showing on dipstick, add oil immediately.
- Make sure that the dipstick is completely in.

### Adding engine oil

- Unscrew cap from oil filler neck.
- Pull extension tube out of filler neck as far as it will go.
- Only add the amount of oil needed. The difference between the "min" and "max" marks on the dipstick is about 1 U.S. quart or 1 liter. Always select a quality oil with the correct specification. See "Lubricants" on page 7.

### Do not exceed the MAX marking.

Otherwise, the excess oil may be drawn in through the crankcase breather into the exhaust system. The oil would then burn in the catalytic converter and cause damage.

- Push in the extension tube, replace filler cap and hand tighten securely.

### WARNING

**The oil filler cap must be secure to avoid oil spill causing fire hazard.**

## Changing the engine oil

Have your engine oil changed regularly, but at least twice a year (see Maintenance booklet).

This is very important because the lubricating properties of oil diminish gradually during normal operation of the vehicle.

If you drive mostly short distances, or if you operate the vehicle in dusty areas, or under predominantly stop-and-go traffic conditions, or when temperatures remain below freezing for extended periods, the engine oil should be changed more frequently.

Due to the detergent additives in the oil, the fresh oil will look dark after the engine has been running for a short time. This is normal and there is no reason to change the oil more often than recommended by the manufacturer.

### WARNING

■ Drain the oil into a container that is designed for this purpose, one that is large enough to hold at least the oil filling of your engine.

■ Wear eye protection.

■ To reduce the risk of burns from hot engine oil let the engine cool down to the touch.

■ When removing the oil drain plug with your fingers, keep as far away as possible. Always keep your forearm parallel to the ground to help prevent hot oil from running down your arm.

■ Engine oil is poisonous. Keep it well out of the reach of children. Continuous contact with used engine oil is harmful to your skin. Always protect your skin by washing thoroughly with soap and water.

■ Always dispose of used engine oil properly. Do not dump it on garden soil, wooded areas, into open streams or down sewage drains.

■ Recycle used engine oil by taking it to a used engine oil collection facility in your area, or contact a service station.

■ Turn off the engine.

■ Remove the oil drain plug (arrow) when the engine is still warm and allow the oil to drain.

■ Always use a new gasket when reinstalling the plug. Do not overtighten.

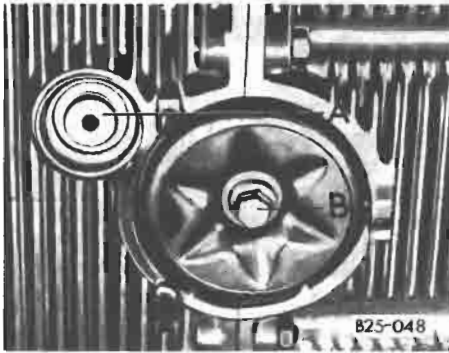
■ Fill the engine with oil. Do not overfill. Always check engine oil level with dipstick as described on previous page.

**Always heed WARNINGS on page 6.**



## ENGINE OIL FILTER

### Air-cooled engine:



Remove the drain plug **A** first. After the oil is drained, take out the oil strainer by removing the center nut **B** and clean it. Use new washers and gaskets.

#### Important

The center nut **B** for the oil strainer should be tightened with a torque wrench. The correct torque is 7-9 ft lb (1.0-1.3 mkg).

### Diesel engine:



### Water-cooled engine:



### Changing the oil filter

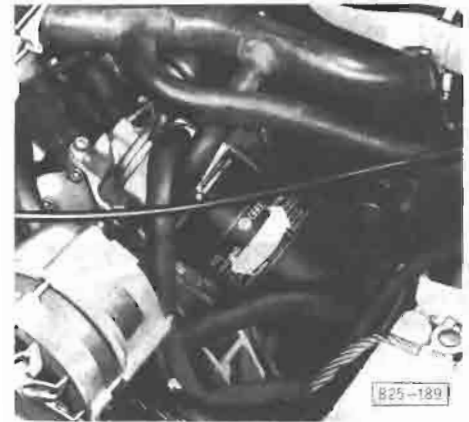
The oil filter should be changed at the intervals listed in your Maintenance booklet.

- Remove old oil filter element and discard.
- Lightly coat seal of new filter element with oil.
- Screw on filter element and hand-tighten according to manufacturer's instructions on the carton or on the filter element.
- Fill engine with appropriate amount of engine oil.
- Run engine at various speeds for three to five minutes and check for leaks.
- Check dipstick for correct oil level, top up if necessary.

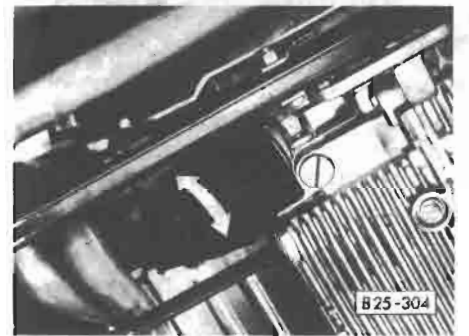
### Air-cooled engine:



### Diesel engine:



### Water-cooled engine:



Always heed WARNINGS on page 6.

## VEHICLE CARE

### FUEL FILTER

Fuel filter replacements should be performed by your VW dealer or a qualified mechanic.

On Diesel engine equipped vehicles, accumulated water should be drained regularly.

Fuel filter replacement and water drainage intervals are specified in your Warranty & Maintenance booklet.

Should it become necessary to drain the fuel filter of water between scheduled maintenance intervals, proceed as follows.

#### To drain water from Diesel fuel filter

#### WARNING

- Turn the engine off and let it cool down. Hot components can burn skin on contact and ignite fuel.
- Do not smoke or have anything in the area that can ignite fuel.
- Handle fuel only in well ventilated areas.
- Disconnect ground strap from battery to prevent sparking.



- Open vent screw at top of fuel filter.
- Loosen drain plug underneath filter and, using a container, drain about half a cup or until drained fuel is pure.
- Tighten drain plug and vent screw.
- Do not let Diesel fuel spill on rubber hoses. Such connecting hoses may develop leaks and cause serious engine damage.
- Do not dump Diesel fuel from the old canister on the ground, into open streams or down sewage drains. Should the discarding of Diesel fuel present a problem, we suggest you have filter changes performed by your VW dealer or at a service station.

### AIR CLEANER

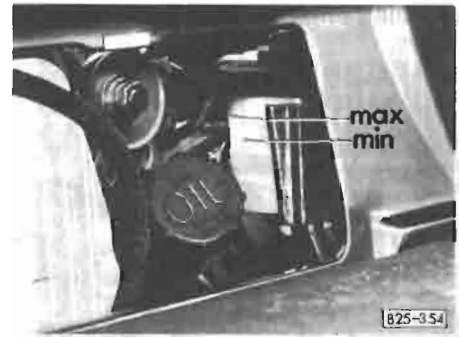
A dirty filter element reduces engine output and increases fuel consumption and can cause premature engine wear.

Normally, it is not required to service the air cleaner more often than recommended in the Maintenance booklet. If the vehicle is driven on very dusty roads, the air cleaner must be serviced more frequently, even daily. We recommend that you have the air cleaner serviced by your Volkswagen dealer or a qualified workshop.

**If your air filter must be changed more frequently, we recommend that you have your Volkswagen dealer show you the procedure before you attempt doing it yourself.**

**The paper filter element must never be cleaned or soaked with gasoline, cleaning solvents or oil.**

### POWER STEERING\*



The fluid reservoir is located behind the licence plate lid.

The power steering is filled with ATF Dexron®.

A correct fluid level in the reservoir is important for the proper functioning of power steering.

With the engine running, the fluid level in the power steering system must be checked at regular intervals. The fluid level should always be between the "max" and "min" markings. If the level should go below the "min" marking, have the power steering system inspected by your Volkswagen dealer. It is not sufficient to just add hydraulic fluid.

#### WARNING

- Be sure not to confuse brake fluid and hydraulic fluid. If the wrong fluid is used, the systems may fail.
- If the power steering system should fail, or if the engine is not running (for example while being towed), you will still be able to steer the vehicle, however, more effort will be required.

#### Note

Since the hydraulic fluid also functions as a lubricant, serious damage to the pump and to other components of the system could result if there is insufficient hydraulic fluid in the system.

Always heed WARNINGS on page 6.

\*where applicable



# VEHICLE CARE

## COOLING SYSTEM

The cooling system is sealed and generally requires little attention.

The cooling system has been filled at the factory with a permanent coolant which does not need to be changed. The coolant consists of a mixture of water and the manufacturer's coolant additive G 11 – antifreeze on glycol basis with anticorrosion additives (40% for USA models; 50% for Canadian models). This mixture assures the necessary frost protection and protects the entire cooling system against corrosion and scaling, and raises the boiling point of the coolant.

Do not reduce the concentration of the coolant in the summer by adding plain water. **The coolant additive proportion must be at least 40% but not more than 60%**, to maintain the antifreeze protection and the cooling efficiency.

For year round driving, antifreeze is added at the factory for temperatures down to:

- 13° F/-25° C (USA)
- 40° F/-40° C (Canada)

Only use quality phosphate-free antifreeze containing ethylene glycol. Such antifreeze is available at your Volkswagen dealer.

### WARNING

**Antifreeze is poisonous. Always store antifreeze in its original container and well out of the reach of children. If you drain the coolant, it must be caught and safely stored. Drained coolant should normally not be reused. Always dispose of used coolant observing all environmental regulations.**

### Coolant losses

Coolant losses may indicate a leak in the cooling system. In this case, the cooling system should be inspected immediately by your Volkswagen dealer. It is not sufficient merely to add coolant.

In a sealed system, losses can only occur if the boiling point of the coolant is exceeded as a result of overheating.

Overheating can occur if:

- the flow of air to the radiator is obstructed by leaves, dust, insects or by additional lights installed in front of the radiator grille;
- the boiling point of the coolant has been reduced due to an incorrect mixture of coolant and water;
- the radiator fan is not working – see "Radiator fan", or;
- the vehicle is being driven up a long hill in a low gear with engine speed very high and at very high ambient temperature – see "Radiator fan".

If the cause for the overheating cannot be determined and corrected, contact your Volkswagen dealer immediately, otherwise serious engine damage could result.

### Checking the coolant level

The coolant level should be checked from time to time, and always before going on a longer trip.

### WARNING

**To reduce the risk of being burned, never open the hood if you see or hear steam or coolant escaping from the engine compartment. Wait until no steam or coolant can be seen or heard before carefully opening the hood.**

The refill tank and the expansion tank are in the engine compartment.

On the refill and the expansion tank, the cap need not be taken off, since the tanks are transparent.

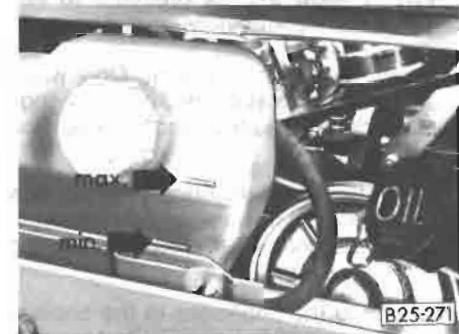
The coolant level is normally checked only in the refill tank (behind the license plate lid).

On the refill tank, the coolant level must be between the min. and max. marks when engine is cold and not running. When engine is warm, coolant level may be slightly above max. mark.

### Diesel engine:



### Water-cooled engine:

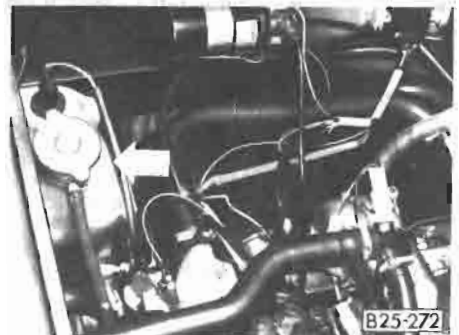


The expansion tank needs checking only if a large amount of coolant is lost or if the warning light in the water temperature gauge lights up.

### Diesel engine:



### Water-cooled engine:



**Always heed WARNINGS on page 6.**

## Adding coolant

Turn off the engine and allow it to cool down.

### WARNING

Reduce the risk of scalding from hot coolant by following these steps.

■ If the cap from the expansion tank must be removed wait until the engine has cooled down. The cooling system is under pressure.

■ Protect face, hands and arms by covering the cap with a large, thick rag to protect against escaping fluid and steam.

■ Carefully and slowly turn cap one turn to allow excess pressure to escape before completely removing cap.

Top up coolant in refill tank. Only when cooling system was drained or a lot of coolant needs to be added, also fill expansion tank.

To maintain the anti-corrosion properties of the coolant, the antifreeze concentration should not be reduced, even during the warm season.

Increasing the antifreeze in the coolant to more than 60% is not only uneconomical, it is also detrimental to engine cooling.

Only use quality phosphate-free anti-freeze containing ethylene glycol. Such antifreeze is available at your Volkswagen dealer.

Antifreeze, other than specified by Volkswagen, may cause corrosion of the cooling system, leading to engine overheating and damage.

Only for topping-up coolant, a small amount of antifreeze containing ethylene glycol and phosphates may be used, if recommended antifreeze is not available.

■ After adding coolant, run the engine at idle speed for a few seconds.

■ Wait for the radiator fan to switch on and off again.

■ Check coolant level. Add more coolant if necessary.

Do not overfill the system.

Excess coolant will be forced out through the pressure relief valve in the reservoir when the engine becomes hot.

Screw cap on again tightly.

## Radiator fan

The electric radiator fan (located in front of the car behind grille) is controlled by thermostats from the coolant and engine compartment temperature.

After turning off the engine, the radiator fan can continue to run (up to 10 minutes). It may also suddenly start to run again even with the ignition switched off.

### Notes

■ If the radiator fan does not come on when the coolant temperature is very high, check the fuse and replace it if necessary

■ The speed of the radiator fan does not depend on the engine speed, therefore cooling effect cannot be increased by downshifting. As long as the engine runs smoothly and driving an uphill road does not considerably reduce speed, there is no need to downshift.

## V-BELT

### Tension checking

Correct V-belt tension is important for overall vehicle performance.

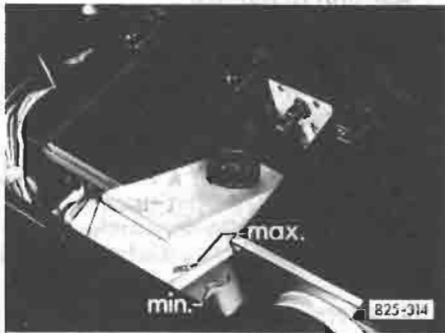
Tensioning and replacing of vehicle V-belts should be performed by your Volkswagen dealer or a qualified workshop.

### WARNING

To prevent personal injury stay well clear of the V-belt when the engine is running. Before checking V-belt tension turn the engine off and let it cool down. Hot components can burn skin on contact.

Always heed WARNINGS on page 6.

## BRAKE FLUID



### Brake fluid reservoir

The brake fluid reservoir is located under the instrument cluster in the dashboard panel.

To gain access to the reservoir, grasp the two recesses provided on back of the frame cover and pull up.

When replacing the cover, insert the front edge first, then press the cover down firmly. Make sure it is correctly seated.

### Checking fluid level

The correct fluid level is important for the proper functioning of the brake system. The fluid level in the brake fluid reservoir should always be between the MAX and MIN markings. Your brake fluid level is automatically monitored by the brake warning light.

The fluid level may drop slightly after some time due to the automatic adjustment of the brake pads. This is no cause for alarm.

If the brake fluid level falls considerably below the mark "MIN", the brake warning light will come on. Do not continue to operate the vehicle. The complete brake system should be thoroughly checked by your Volkswagen dealer and the cause corrected.

### WARNING

■ Brake fluid is poisonous. Brake fluid is also harmful to the paint of your vehicle.

When adding or replacing brake fluid, make certain to avoid spilling. Brake fluid will damage fabric, paint, plastics and metal. Cover the areas surrounding the reservoir before removing the filler cap.

■ If brake fluid must be added to the reservoir, use only new and unused DOT 4 brake fluid that meets SAE specification J 1703 and conforms to Federal Motor Vehicle Safety Standard 116.

■ Do not use any other brake fluid, or brake fluid that has absorbed moisture from the open air, or brake fluid that is dirty. It may cause premature wear or unreliable braking action.

■ Do not add or mix DOT 5 silicone type brake fluid with the brake fluid in your vehicle as severe component corrosion may result. Such corrosion could lead to brake system failure.

### Changing brake fluid

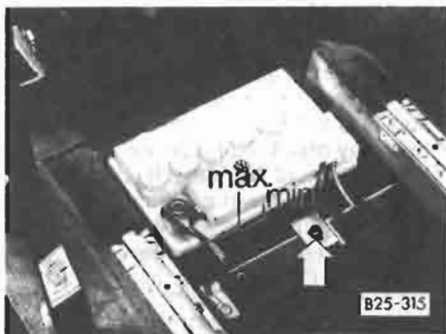
Brake fluid absorbs moisture from the atmosphere. If the water content in the brake fluid is too high, corrosion in the brake system may result after a period of time. The boiling point of the brake fluid will also decrease considerably. If the brakes are under constant and extreme use, a vapor lock may result impairing the effectiveness of the brakes and the vehicle safety.

### WARNING

The brake fluid must be replaced every 2 years. Your Volkswagen dealer will perform this service for you.

Always heed WARNINGS on page 6.

## BATTERY



The battery is located under the front passenger seat. To check the battery, move the seat all the way forward.

On vehicles with swivel seats, turn the seat 180° (half circle) and then push forward.

### Diesel:

The battery is in the engine compartment on the right.

### Auxiliary battery\*

The auxiliary battery is located under the left seat. Push the seat all the way forward to gain access to the battery.

The auxiliary battery supplies power when the vehicle is stationary. A special relay between the vehicle battery and the auxiliary battery prevents the vehicle battery from discharging. This way, you still have power to start your vehicle. While driving, both the vehicle battery and the auxiliary battery are charged.

### Battery acid level

Under normal operating conditions, the battery in your Volkswagen is maintenance-free.

At high outside temperatures it is advisable, however, to check the fluid level at regular intervals through the transparent battery housing. The fluid level should always be between the "min" and "max" marks in each cell.

If the fluid level is below the "min" mark, let your Volkswagen dealer correct the condition.

#### WARNING

■ Always shield your eyes and avoid leaning over the battery whenever possible.

■ Do not let battery acid come in contact with skin, eyes, fabric, or painted surface.

■ If you get battery acid in your eyes or on your skin, immediately rinse with cold water for several minutes and call a doctor.

■ Do not expose the battery to an open flame or electric spark. Hydrogen gas generated by the battery can explode and cause personal injury.

### Winter operation

During the winter months, battery capacity tends to decrease as temperatures drop. Additionally, more power is consumed while starting, and the headlights, heater, rear window defogger, etc., are used more frequently. Curtail unnecessary power consumption, particularly in city traffic or when travelling short distances only. Let your Volkswagen dealer test the battery's capacity before winter sets in. A well charged battery will not only prevent starting problems but will also live longer.

If your vehicle is left standing for several weeks at extremely low temperatures, the battery should be removed and stored where it will not freeze. This will prevent it from being damaged.

When removing the battery, first disconnect both cables (see Charging of Battery), then unscrew the battery mounting.

#### WARNING

Always keep the battery well out of the reach of children.

### Charging of battery

#### WARNING

■ Always shield your eyes and avoid leaning over the battery whenever possible.

■ Charge battery in a well ventilated area. Keep away from open flame or electrical spark. Do not smoke. Hydrogen gas generated by the battery is explosive.

■ Battery acid that may spill during charging should be washed off with a solution of warm water and baking soda to neutralize the acid.

■ If you get battery acid in your eyes or on your skin, immediately rinse with cold water for several minutes and call a doctor.

■ Never charge a frozen battery. It may explode because of gas trapped in the ice. Allow a frozen battery to thaw out first.

■ Never use a fast charger as a booster to start the engine. This will seriously damage sensitive electronic components, such as relays, radio, etc., as well as the battery charger.

■ Fast charging a battery is dangerous and should only be attempted by a competent mechanic with the proper equipment.

\*where applicable

Always heed WARNINGS on page 6.

## Slow battery charging

### WARNING

■ **Heed all WARNINGS and follow instructions that come with your battery charger.**

■ It is not necessary to remove the battery from the engine compartment, and it is also not necessary to disconnect the cables.

■ Make sure the electrolyte level in each cell is between the "min" and "max" marks. If the fluid level is below the "min" mark, let your Volkswagen dealer correct the condition.

■ Connect charger cables.

**Charger cables must be connected POSITIVE (+) to POSITIVE (+) and NEGATIVE (-) to NEGATIVE (-).**

Do not connect or disconnect charger cables while charger is operating to reduce the danger of exploding.

■ Switch on charger.

■ **Charging rate not over 6 Amp.**

Normally, a battery should be charged at no more than 10 percent of its rated capacity.

For example, a charging current of 4.5 Amp. would be used on a battery having 45 Ah. Rated capacity of the battery in your vehicle is listed on the battery housing.

■ After charging, turn off charger and disconnect charger cables.

## To remove battery from vehicle

- Disconnect negative ground cable.
- Disconnect positive cable.
- Unscrew bolt of holding plate with open end wrench.

## To reinstall battery in vehicle

- Place battery in vehicle and tighten bolt of holding plate.
- Reconnect positive cable.
- Reconnect negative ground cable.

### WARNING

**Do not reverse polarity.**

## Cleaning terminals and connections

### WARNING

■ **Before work is done on the electrical system, disconnect the negative ground cable.**

■ **When working on the battery, be sure not to short circuit the terminals with tools or other metal objects. This would cause the battery to heat up very quickly, which could lead to damage or explosion and personal injury.**

The terminals and connections should be kept clean and greased with silicone spray or petroleum jelly. Make sure the ground connection to the body is tight and free of corrosion.

**With a disconnected battery the engine must not run because the electrical system will be damaged.**

## Replacing battery

A replacement battery must have the same specifications and dimensions as the original equipment battery. Specifications are listed on the battery housing. Make sure the replacement battery is installed correctly and securely. See "Removing and reinstalling battery".

**Always heed WARNINGS on page 6.**

## WINDSHIELD / REAR WINDOW WASHER CONTAINER\*



The filler cap is located at the left side of the driver's footwell.

Vehicles with rear window wiper and washer have an additional container on the right in the luggage compartment.

The capacities of the containers are:  
Windshield washer container . . . . . 4.3 qt/4.2 liters  
Rear window washer container . . . . . 1.1 qt/1.0 liters

### Filling the containers

To fill the container, unsnap cover and unscrew the filler cap. After filling the container, screw the cap on tightly and close cover.



Since clear water is usually not adequate for cleaning the glass, add a cleaning solution to the water.

Use winterized washer solvent during the cold season. It helps to keep your windshield and rear window clean and prevents the fluid from freezing in the winter.

**Do not use engine coolant antifreeze or any other solution that can damage the vehicle paint.**

Follow the directions on the can for the correct amount to be used.

After filling the container press the cap onto the filler neck.

\* where applicable



### Adjusting washer jets

When vehicle is stationary, the water should hit the windshield as illustrated.

The washer jet for the rear window should be adjusted so that the fluid hits the glass in the center of the wiped area.

The jets can be adjusted with a needle.

The jets for the **headlight washer system\*** can only be adjusted with a special tool. If necessary contact your Volkswagen dealer.



## REPLACING WIPER BLADES

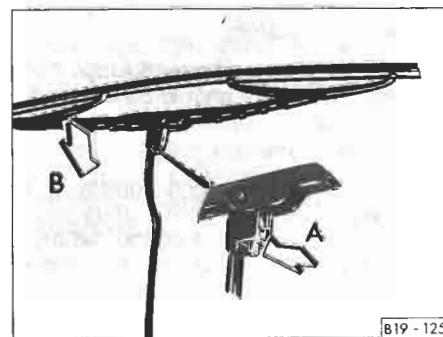
Wiper blades must be in good condition to provide clear vision.

Clean your wiper blades regularly with a windshield washer solution to prevent streaking. If the blades are very dirty, for example with insects, carefully clean the blades with a sponge or a soft brush.

Replace your wiper blades once or twice a year. See your Volkswagen dealer for replacement blades.

### Notes

- Commercial hot waxes applied by automatic car washes have been known to affect the cleanability of the windshield.
- To prevent damage to wiper blades, do not use gasoline, kerosene, paint thinner, or other solvents on or near the wiper blades.
- To prevent damage to the wiper arms or other components, do not attempt to move the wipers manually.



### Removing wiper blades

- Raise the wiper arm and hold wiper blade horizontally.
- Depress locking spring (A) and remove blade by pulling it towards the glass (B).

### Installing new wiper blades

- The locking spring must click into place on the wiper arm.



# VEHICLE CARE

## TIRES/WHEELS

### New tires

New tires do not possess maximum traction and should be driven at moderate speeds and with caution for the first 100 miles (160 kilometers).

### Tire traction

#### WARNING

**When driving on wet or slushy roads, a wedge of water may build up between the tires and the road. This phenomenon is known as aquaplaning or hydroplaning and may cause partial or complete loss of traction, vehicle control or stopping ability. Always reduce speed on wet roads.**

### Tire service life

The service life of your tires depends for the most part on the following factors:

### Tire pressures

#### WARNING

**Incorrect tire pressures cause increased tire wear and adversely affect road holding of the vehicle, leading to loss of control and personal injury.**

**Incorrect tire pressures can also lead to sudden deflation, resulting in an accident and personal injury.**

Check your tire pressures twice a month, and especially before taking a long trip. Be sure not to forget to check the spare tire. Always check tire pressures when the tires are cold. When the tires are warm, the pressure will be higher. Do not reduce the pressure of warm tires.

Use an accurate tire pressure gauge when checking inflation pressures. Do not exceed the maximum tire inflation pressure listed on the tire sidewall. Cold tire inflation pressure means: when a vehicle has been standing for at least 3 hours or driven for less than 1 mile.

Always include the spare tire during a pressure check.

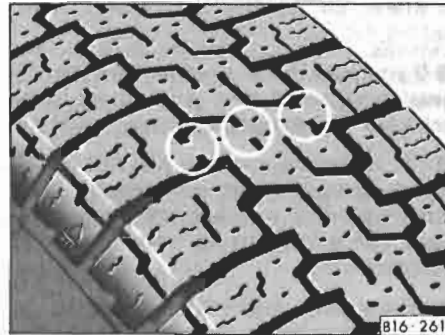
### Driving habits

Fast cornering, heavy acceleration and hard braking all increase tire wear.

### Wheel balancing

The front wheels on new vehicles are balanced. When driving, however, various conditions can cause a wheel to become unbalanced. This may be noticed as vibrations in the steering.

Since tire imbalance can cause wear on the steering, suspension and tires, you should have your wheels rebalanced. A wheel should always be balanced if a new tire has been mounted or a tire was repaired.



### Tire wear

The original tires on your vehicle have built-in wear indicators. They are molded into the bottom of the tread grooves and will appear as approximately 1/2 inch (12mm) bands when the tire tread depth wears down to 1/16 inches (1.6 mm). Depending on the tire manufacturer, there are six to eight wear indicators evenly spaced around the circumference of the tire. Markings on the sides of the tires (e.g. the letters "TWI" or a triangle) show the locations of the wear indicators.

When the indicators appear in two or more adjacent grooves, it is time to replace the tires. We recommend, however, that you do not let the tires wear down to this extent. Worn tires cannot grip the road surface properly, and are even less effective on wet roads.

#### WARNING

**Do not drive with worn tires or tires showing cuts, bruises or other damage because they may lead to sudden deflation causing loss of vehicle control and personal injury.**

**Since worn tires do not grip the road surface properly when driving on wet roads, the vehicle may tend to aquaplane sooner. We strongly urge you to replace your tires when the remaining tread depth is .12 inches (3 mm).**

### Incorrect wheel alignment

Incorrect wheel alignment causes excessive and uneven tire wear impairing the safety of the vehicle. If you notice excessive tire wear, contact your Volkswagen dealer.

### Tire care

Inspect your tires at least every 2,000 miles (3,000 km) for wear and damage.

#### WARNING

**Avoid damaging tires and wheel rims. If you must drive over a curb or other obstacle, drive slowly and at an angle. Frequently check tires for uneven wear and damage.**

**Remove imbedded material.**

**Replace worn or damaged tires immediately.**

**Replace missing valve dust caps.**

**Keep oil, fuel, brake fluid, etc. away from tires.**

**Keep tires inflated correctly.**

**Mark tires before removing them. Remount tires on the same vehicle side because the rotation direction should stay the same.**

**Store removed tires in a cool, dry and preferably dark place. Tires which are not on wheels should be stored standing up.**

Tires age even if they are not being used. Tires which are older than 6 years should only be used cautiously in an emergency.

## Wheels and tire replacement

Wheels and tires approved by the manufacturer have been specially matched to your vehicle and contribute largely to the road-holding and driving characteristics of the vehicle.

■ Fitting and repairing tires requires expert knowledge and special tools. This work should only be performed by a specialist.

■ For safety reasons, tires should be replaced in pairs and not individually. The tires with the deepest tread should always be mounted on the front wheels.

■ In the interest of maximum safety and best all-around vehicle handling, always buy replacement radial tires that have the same specifications with regard to tire size, design, load carrying capacity, tread pattern, tread depth etc. This also applies to Volkswagen recommended alternate replacement tires.

■ Never mount used tires if you are not sure of their previous history.

■ Whenever replacing a tubeless tire, always install a new valve stem. Tire repair should only be performed by a specialist.

### WARNING

■ **Never mix tires of different design such as steel belted radials with radial bias belted or bias ply tires etc. Mixing tire types will adversely affect road holding and can lead to loss of vehicle control and personal injury.**

■ **New tires do not possess maximum traction. They tend to be slippery. Break new tires in by driving cautiously at moderate speed for the first 100 miles (160 kilometers).**

### Applies additionally to the Syncro:

All four wheels on the vehicle must always have tires of the same size, construction and tread type so that the viscous coupling does not abnormally activate the front wheel drive. Different tires on the front or rear wheels exert additional stress on the drive train components, causing increased tire wear and impair vehicle control.

## General notes

The original equipment tires and wheel rims on your vehicle comply with all applicable Federal Motor Vehicle Safety Standards.

If you wish to equip your vehicle with tires or wheels other than those installed at the factory, please note the following:

■ **If you plan to install other than the original equipment tires and wheel rims, ask your Volkswagen dealer.**

■ **For technical reasons it is not possible in every case to use wheels from other vehicles – under certain conditions not even wheels from the same vehicle model.**

■ **Wheel rims and wheel bolts or lug nuts are matched to fit your Volkswagen.**

■ **When installing different wheels (for example, wheels with winter tires), the correct wheel bolts or lug nuts with the proper length and conical shape must be used. The secure fit of the wheels and the proper functioning of the brake system are dependent upon this.**

■ **Using tires and/or wheels which have not been approved by the manufacturer for your vehicle type can be detrimental to vehicle safety.**

■ If wheel trim discs or a front spoiler are installed, make sure the air flow for cooling the brakes is not obstructed.

■ **Before you plan on exchanging steel wheels, light alloy wheels, or snow tires already mounted on wheel rims, consult your Volkswagen dealer. He has the technical information necessary to advise you which wheel rims and wheel bolts or lug nuts are compatible with the original factory installations.**

### WARNING

■ **The use of the wheel rims and wheel bolts or lug nuts that do not meet specifications of the original factory installed equipment will affect the safe operation of your vehicle and may cause an accident and personal injury.**

## Tire specifications

Tire specifications are imprinted on the sidewall of the tires. If in doubt, check with your Volkswagen dealer.

**All passenger car and some light trucks tires must conform to Federal Safety Requirements in addition to these grades.**

### Treadwear

The treadwear grade is a comparative rating based on the wear rate of the tire when tested on a government test course. For example, a tire graded 150 would wear one and a half (1½) times as well as a tire graded 100. The relative performance of tires depends on actual conditions of use, however, and may depart significantly from the norm due to variations in driving habits, service practices and differences in road characteristics and climate.

### Traction A, B, C

The traction grades, from highest to lowest, are A, B and C and represent the tire's ability to stop on wet pavement as measured on government test surfaces of asphalt and concrete. A tire marked C may have poor traction performance.

### WARNING

**The traction grade is based on braking (straightahead) traction tests and does not include cornering (turning) traction.**

### Temperature A, B, C

The temperature grades A (the highest), B and C, represent the tire's resistance to the generation of heat. Sustained high temperatures can reduce tire life, and lead to sudden tire failure. Grade C corresponds to a performance which all passenger car tires must meet under the Federal Motor Vehicle Safety Standard No. 109. Grades B and A represent higher levels than the minimum required by law.

### WARNING

**The temperature grade for this tire is established for a tire that is properly inflated and not overloaded. Excessive speed, underinflation, or excessive loading, either separately or in combination, can cause heat buildup, possible tire failure, loss of control and personal injury.**



## VEHICLE CARE

### Snow tires

The tires for your vehicle were selected for optimal performance under normal driving conditions.

For winter driving, the roadability of your vehicle can be improved by installing all season tires or radial snow tires (M + S with or without studs<sup>1</sup>).

That applies also to the Syncro

When installing snow tires, please note the following:

- Only radial ply snow tires must be installed. Ask your Volkswagen dealer for the recommended tire size.
- Snow tires should be mounted on all four wheels.
- The tire pressures for snow tires are the same as for summer tires. However, do not exceed the maximum tire pressure listed on the sidewall.
- Snow tires should have the same load capacity as original equipment tires and should be mounted on all four wheels.
- Snow tires do not fulfill their purpose, if the tread depth is less than  $\frac{5}{32}$  in (4 mm).

#### WARNING

- Tires with badly worn treads and studs are very dangerous. Make sure they are replaced immediately.
- Never mix tires of different design such as steel belted radials with radial bias belted or bias ply tires etc. Mixing tire types will adversely affect road holding and can lead to loss of vehicle control and personal injury.

- Snow tires with studs should be run at moderate speeds when new in order to give the studs time to settle.

Do not drive a vehicle equipped with snow tires at prolonged high speed. Snow tires do not have the same degree of traction on dry, wet or snowfree roads as a normal tire. Furthermore, snow tires wear rapidly under these conditions.

- Where snow tires are compulsory on certain roads, this also applies to vehicles with all-wheel-drive.

### Snow chains

**Snow chains can be used on the rear wheels only.**

Only use chains with fine pitch links protruding no more than  $\frac{1}{2}$  in/15 mm from tire tread and side walls, including tensioner. Wheels must rotate freely in all steering positions with chains mounted to prevent damage to body, axle or brake components. **Drive slowly and follow the chain manufacturer's instructions.**

Remove chains when roads are free of snow. Otherwise, they can be damaged and impair vehicle handling.

#### Syncro models only

Conventional snow chains may not be used with 205/70 x 14 tires on  $5\frac{1}{2}$  J x 14 wheels which are mounted on your vehicle. The use of conventional snow chains is only possible on smaller tires (e.g. 185 R 14C). Ask your VW dealer.

Where possible, snow chains should be fitted to all four wheels. If only two chains are available, these must be fitted to the rear wheels.

Cable type chains may also be fitted on all standard tires and wheels (including 205/70 x 14 tires on  $5\frac{1}{2}$  J x 14 wheels), however, they should only be used when road conditions require them. Always remove snow chains when road conditions improve. Be sure to follow all state and local regulations pertaining to the use of snow chains.

#### WARNING

**To prevent personal injury, wear protective gloves when fitting cable chains on your wheels. Always follow the instructions of the manufacturer.**

## WINTER DRIVING

Remember the following points when driving in the winter:

- Winter weather is particularly hard on the battery. We recommend having the battery checked, preferably by a Volkswagen dealer, before the cold weather starts

If the vehicle is left standing for several weeks at extremely low temperatures, the battery should be removed

- Have the antifreeze concentration in the cooling system checked before the cold weather starts

- The engine oil must have the correct viscosity grade for the outside temperatures to be expected

- The best way to protect the bodywork is to wash and wax it frequently, especially in winter

- Always use a windshield washer fluid with antifreeze for the windshield and rear window washer system in winter

- Use a scraper to remove snow and ice from the windows

- On winter roads the use of winter tires or all-weather tires will improve handling; this also applies to vehicles with all-wheel drive

- When driving in the mountains in winter it is best to take along a set of snow chains. Snow chains may be compulsory for some mountain roads, and this restriction also applies to vehicles with all-wheel drive

<sup>1</sup>) Check with your local Motor Vehicle Bureau for possible restrictions.