SERVICE MANUAL

Winnebago LeSharo, Centauri, Utility Van
Itasca Phasar

1983 - 1986 Diesel and Gasoline Powered

TABLE OF CONTENTS

VOLUME I

SECTION A: GENERAL INFORMATION
- Subsection 1 - General/Specifications
- Subsection 2 - Maintenance and Lubrication

SECTION B: NATURALLY ASPIRATED DIESEL ENGINE
- Subsection 1 - General Information
- Subsection 2 - Engine Remove and Replace
- Subsection 3 - Overhaul and Rebuild
- Subsection 4 - Timing Belt
- Subsection 5 - Belt Tensioning Procedure
- Subsection 6 - Engine Water Pump

SECTION C: TURBOCHARGED DIESEL ENGINE
- Subsection 1 - General Information
- Subsection 2 - Engine Remove and Replace
- Subsection 3 - Overhaul and Rebuild
- Subsection 4 - Timing Belt Replacement
- Subsection 5 - Belt Tensioning Procedure
- Subsection 6 - Engine Water Pump

SECTION D: DIESEL INJECTION EQUIPMENT
- Subsection 1 - Injection Pump
- Subsection 2 - Injectors and Filters
- Subsection 3 - Checking and Troubleshooting

SECTION E: 2.2L E.F.I. GASOLINE ENGINE
- Subsection 1 - General Information
- Subsection 2 - Engine Remove & Replace
- Subsection 3 - Engine Overhaul and Rebuild
- Subsection 4 - Timing Belt
- Subsection 5 - Rocker Arm Clearance
- Subsection 6 - Final Assembly
- Subsection 7 - Belt Tensioning
- Subsection 8 - Engine Water Pump
- Subsection 9 - Oil Pressure Checking
- Subsection 10 - Engine Fuel System
- Subsection 11 - Emission Control Systems
- Subsection 12 - Ignition System

SECTION F: COOLING SYSTEM
- Subsection 1 - Special Tools
- Subsection 2 - Theory of Operation
- Subsection 3 - Theory of Operation continued
- Subsection 4 - Antifreeze/Coolant Mixture
- Subsection 5 - Cooling Circuit - Leak Checking
- Subsection 6 - Recovery Bottle Cap Calibration
- Subsection 7 - Refilling/Bleeding System
- Subsection 8 - Oil in Cooling Circuit
- Subsection 9 - Water Pump Declutching

SECTION G: ELECTRICAL
- Subsection 1 - General
- Subsection 2 - Fuel Tank Sending Unit
- Subsection 3 - Instrument Cluster
- Subsection 4 - Alternator
- Subsection 5 - Starter
- Subsection 6 - Wire Harness
- Subsection 7 - Wiring Diagrams

TABLE OF CONTENTS

VOLUME II

SECTION H: MANUAL GEARBOX
- Subsection 1 - General Information
- Subsection 2 - Removal & Reinstallation
- Subsection 3 - Rebuild
- Subsection 4 - Seal Replacement (with transaxle in vehicle)

SECTION I: CLUTCH
- Subsection 1 - Specifications
- Subsection 2 - Pressure Plate - Disc
- Subsection 3 - Flywheel
- Subsection 4 - Shaft Pilot Bearing
- Subsection 5 - Thrust Pad (Throw-Out Bearing)
- Subsection 6 - Master Cylinder
- Subsection 7 - Slave Cylinder
- Subsection 8 - Hydraulic System
- Subsection 9 - Operating Clearance

SECTION J: AUTOMATIC TRANSAXLE
- Subsection 1 - General Information
- Subsection 2 - Troubleshooting
- Subsection 3 - Components
- Subsection 4 - Transaxle - Remove and Reinstall
- Subsection 5 - Transmission - Rebuild
- Subsection 6 - Coupling Transmission to Final Drive
- Subsection 7 - Final Drive Rebuild
- Subsection 8 - External Seal Replacement

SECTION K: FRONT AXLE
- Subsection 1 - Specification
- Subsection 2 - Front Axle Geometry
- Subsection 3 - Lower Suspension Arms
- Subsection 4 - Stub Axle Carriers
- Subsection 5 - Steering Box
- Subsection 6 - Steering Wheel and Shaft
- Subsection 7 - Drive Shafts

SECTION L: REAR AXLE
- Subsection 1 - Specifications
- Subsection 2 - Standard and Medium Duty Axles
- Subsection 3 - Heavy Duty Axle
- Subsection 4 - Axle Assembly
- Subsection 5 - Axle/Spring Assembly

SECTION M: BRAKES
- Subsection 1 - Specifications
- Subsection 2 - Master Cylinder
- Subsection 3 - Brake Servo
- Subsection 4 - Front Brake Pads
- Subsection 5 - Front Brake Rotors (Discs)
- Subsection 6 - Front Brake Calipers
- Subsection 7 - Rear Brake Linings - Std. & Med. Duty Axles
- Subsection 8 - Rear Wheel Cylinders - Std. & Med. Duty Axles
- Subsection 9 - Rear Brake Linings - Heavy Duty Axle
- Subsection 10 - Rear Wheel Cylinders - Heavy Duty Axle
- Subsection 11 - Brake Limiter
- Subsection 12 - Handbrake
- Subsection 13 - Brake System Bleeding

TABLE OF CONTENTS

SECTION N: SUSPENSION
- Subsection 1 - Specifications
- Subsection 2 - Front Springs
- Subsection 3 - Front Struts
- Subsection 4 - Rear Springs
- Subsection 5 - Rear Shocks

SECTION O: HEATING/VENTILATION
- Subsection 1 - Specifications
- Subsection 2 - Dash Remove/Replace
- Subsection 3 - Dash Changing
- Subsection 4 - Dash Adjusting
- Subsection 5 - Heater/Fresh Air Adjustment
- Subsection 6 - Airflow Distributor
- Subsection 7 - Heater Valve
- Subsection 8 - Fan Motor

SECTION P: AIR CONDITIONING
- Subsection 1 - General Information & Wiring
- Subsection 2 - A/C System Operation
- Subsection 3 - Servicing the A/C System
- Subsection 4 - A/C System Diagnosis

SECTION Q: DANA® ELECTRONIC SPEED CONTROL (CRUISE)
- Q1 - Operating
- Q2 - Components
- Q8 - Electrical Check
- Q11 - Troubleshooting
- Q13 - System Testing and Wire Schematics

SECTION R: BODY
- R1 - Front End Drawings
- R4 - Paint Codes
- R5 - Sealants and Sealing
- R10 - Windshield
- R13 - Cab Door Latch
- R13 - Outside Mirrors
- R14 - Inside Trim Panel
- R15 - Cab Windows and Cranks - R&R
- R25 - Frame Dimensions
- R28 - Body Panel Repair Tips

SECTION S: FUEL TANK
- S1 - Remove and Replace
- S2 - Sending Unit - R & R
- S3 - Roll-Over Valve (Inertial Fuel Shut-Off)

CENTAURI, LE SHARO, UTILITY VAN, AND PHASAR BY WINNEBAGO INDUSTRIES

SERVICE MANUAL

This service manual describes and illustrates procedures for the removal, repair, and reinstallation of the individual components and assemblies of the Centauri, LeSharo, Utility Van, and Phasar vehicles, also known cumulatively as the "H" body.

Keep this manual available for ready reference. It will aid the technician in providing quality service and repairs to the owners of the Centauri, LeSharo, Utility Van, and Phasar vehicles.

The repair methods described in this manual are based upon the most recent information available at the time of publication. Winnebago Industries, Inc., reserves the right to make any changes without prior notice.

Winnebago Industries, Inc., reserves the right to make changes in design and to make additions to or improvements in its products without imposing any obligation upon itself to make such changes, improvements, or additions to products previously manufactured.

CAUTION

To properly reduce the chance of personnel injury and/or property damage, the following instructions must be carefully observed.

Proper service and repair are important to the safety of the service technician and the safe, reliable operation of all motor vehicles. If part replacement is necessary, the part must be replaced with one of the same part number or with an equivalent part. Do not use a replacement part of lesser quality.

The Service procedures recommended and described in this service manual are effective methods of performing service and repair. Some of these procedures require the use of tools specially designed for the purpose.

Accordingly, anyone who intends to use a replacement part, service procedure or tool, which is not recommended by the vehicle manufacturer, must first determine that neither his safety nor the safe operation of the vehicle will be jeopardized by the replacement part, service procedure, or tool selected.

It is important to note that this manual contains various 'Cautions' and 'Warnings' that must be carefully observed in order to reduce the risk of personal injury during service or repair, or the possibility that improper service or repair may damage the vehicle or render it unsafe. It is also important to understand that these 'Cautions' and 'Warnings' are not exhaustive, because it is impossible to warn of all the possible hazardous consequences that might result from failure to follow these instructions.

These vehicles contain some parts dimensioned in the metric system as well as in the domestic system. Some fasteners are metric and are very close in dimension to familiar customary fasteners in the inch system. It is important to note that, during any vehicle maintenance procedures, replacement fasteners must have the same measurements and strength as those removed, whether metric or domestic. (Numbers on the heads of metric bolts and on surfaces of metric nuts indicate their strength. Domestic bolts use radial lines for this purpose, while most domestic nuts do not have strength markings.) Mismatched or incorrect fasteners can result in vehicle damage or malfunction, or possibly personal injury. Therefore, fasteners removed from the vehicle should be saved for reuse in the same location unless otherwise indicated. Where the fasteners are not satisfactory for reuse, care should be taken to select a replacement that matches the original.

Winnebago Industries, Inc.
Forest City, Iowa 50436

TERM DEFINITIONS

Throughout this manual, you will find the following headings which are an indication of the direction given in the text:

Disassemble	Indicates that a component or assembly be completely disassembled.
Assemble	Indicates that a component or assembly be completely reassembled.
Remove or Disconnect	Indicates that a part or assembly be removed from the prescribed component.
Install or Connect	Indicates that a part or assembly be installed to the prescribed component.
Tighten	Indicates that a specific torque is required.
Adjust	Indicates that an adjustment procedure is required.
Measure	Indicates that a specific measurement procedure is required.
Clean	Indicates that all grease, oil, dirt, and foreign material must be removed from a part or assembly.
Inspect	Indicates that a part or assembly must be checked as directed.
Important	Indicates a special point of information on assembly or procedure.

CAUTION

Indicates that a failure to observe can cause damage to equipment.

WARNING

Indicates that a failure to observe can cause damage to equipment or personal injury. This symbol is used throughout the manual to alert you of precautions that involve your personal safety. Read and follow them carefully.

SECTION "A"

GENERAL INFORMATION

Subsection 1 - General

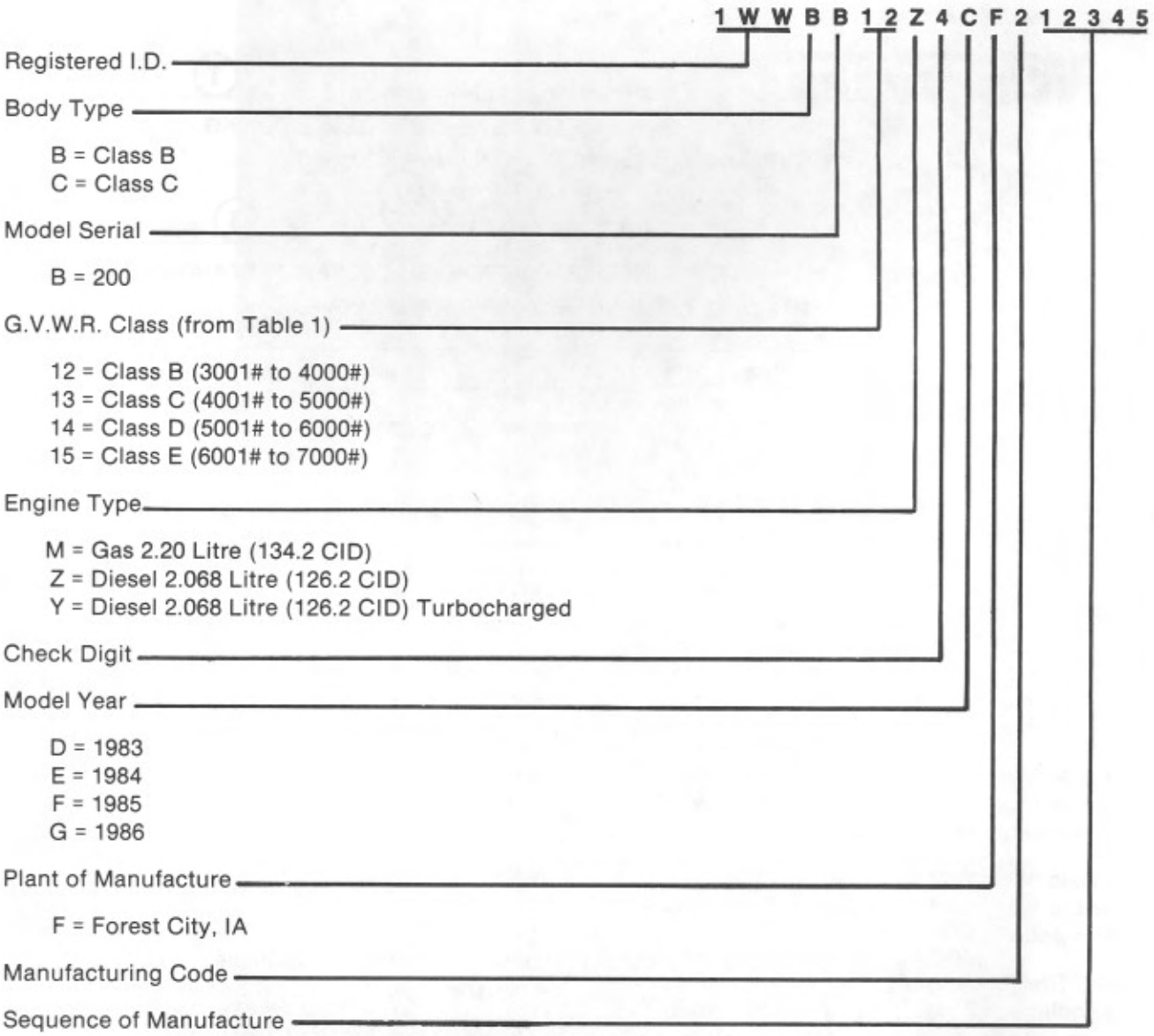
A1-5 Vehicle Identification
A1-6 Vehicle Certification
A1-7 Jacking, Hoisting and Recovery Towing
A1-9 Conversion Tables

Subsection 2 - Maintenance and Lubrication

A2-1 Capacities and Specifications
A2-3 Fluid Changing
A2-5 Service and Maintenance Schedules

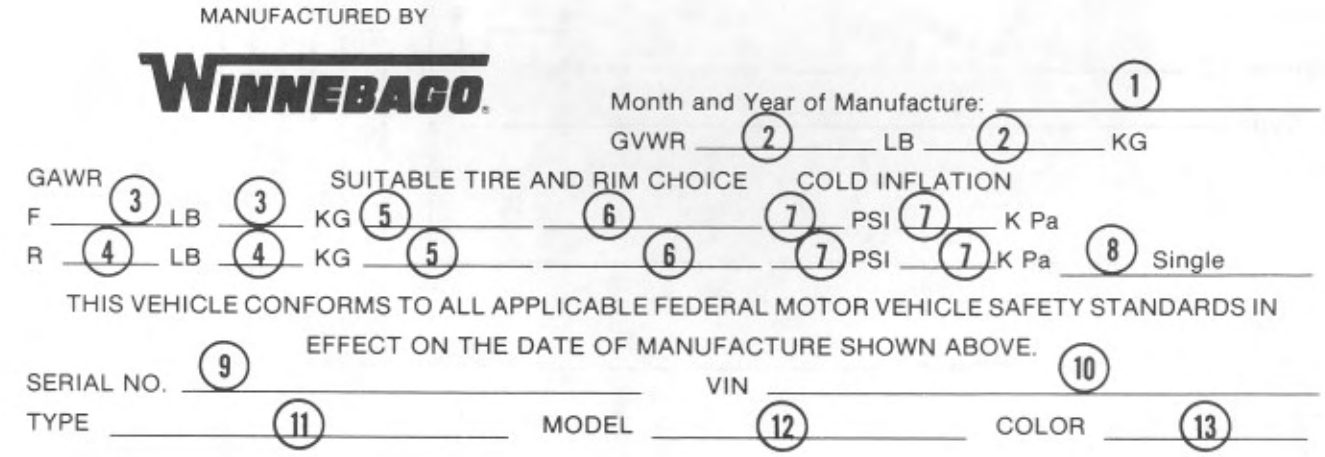
VEHICLE IDENTIFICATION SPECIFICATIONS

The V.I.N. will identify the unit as either Centauri, LeSharo, Utility Van, or Phasar. It also identifies the body type, the specific model, the G.V.W.R. classis, the engine type, the year of manufacture, the consecutive serial number, and whether any major revisions have been made in the model line during the year.



VEHICLE IDENTIFICATION SPECIFICATIONS

Vehicle Certification Label - All Centauri, LeSharo, Utility Van, and Phasar vehicles will display the vehicle certification label on the driver's door latch post or on the driver's door. This label contains important information, including manufacturing date, G.V.W.R. and G.A.W.R. limits, rim and tire size and inflation pressures, serial and model number, V.I.N. number, type of vehicle and color specifications. Never destroy or remove this label.



Explanation of Data

1. Month and year of manufacture at Winnebago Industries, Inc.
2. Gross Vehicle Weight Rating: The total permissible weight of the vehicle, including driver, passengers, and the vehicle itself with all options, and the load it is carrying, including all liquids. (Given in pounds and kilograms.)
3. Gross Axle Weight Rating - Front: The total permissible weight allowed for the front axle. (Listed in pounds and kilometers.)
4. Gross Axle Weight Rating - Rear: The total permissible weight allowed for the rear axle. (Listed in pounds and kilometers.)
5. Suitable Tire Choice: Tire recommended to meet handling and safety requirements. When replacing any tires on your vehicle, always replace with a tire that meets or exceeds these specifications.
6. Suitable Rim Choice: Front/Rear: Wheel rim recommended to meet handling and safety requirements. When replacing any rim, always replace with a rim that meets these specifications.
7. Cold Inflation Pressure: Front/Rear: Inflation pressure recommended (while cold) for the tires originally equipped on your vehicle. These pressure levels must be maintained to assure proper handling, safety and fuel economy.
8. Rear Axle Wheel Configuration: Single, Dual, etc.
9. Serial Number: This is the serial number assigned to your vehicle by Winnebago Industries.
10. Vehicle Identification Number: This number is the legal identification number of your vehicle which will be used on your vehicle's Title Certificate and Owner Registration Certificate. It is permanently attached to the front left of the dashboard bracket and can be seen through the windshield from the outside of the vehicle.
11. Type: This blank states the usuage classification to which your vehicle belongs.
12. Model: Lists the Winnebago product model number of your vehicle.
13. Color: Signifies the color code number of the decor used throughout the vehicle. This number is necessary for ordering replacement cushions, curtains, carpet, etc.

JACKING, HOISTING, AND RECOVERY TOWING

ıisting

ɔnventional hydraulic hoist may be used to lift the ɜhicle only if the hoist adaptor plates make firm ɔntact with the front lower control arms and the ɜar axle.

acking and Recovery Towing - Method 1

WARNING

No towing operation should be attempted which could jeopardize the safety of the wrecker operator, any bystanders, or other motorists.

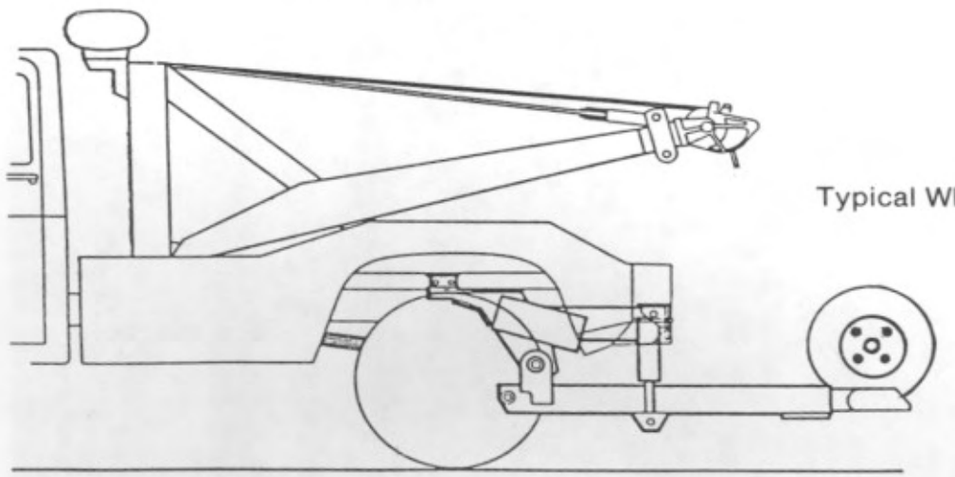
CAUTION

Do NOT tow, lift, or place force from a towing sling or similar device on the front bumper. Tow vehicle from the rear using a towing dolly under the front wheels.

A towing sling (Holmes TS-100 Universal or equivalent) is recommended when towing from the rear of the vehicle. In addition, a 4" x 4" lumber spacing material and safety chains around the rear axle assembly are required to prevent damage to the body, bumper, or other vehicle components.

Jacking and Recovery Towing - Method 2

A wheel lift wrecker attachment is also recommended (Holmes UTC 100, Sentry WL 300, Holmes DST 200, Sentry WL 600). This type of device lifts the vehicle by the front wheel and suspension and creates no danger to the front end components.



Typical Wheel Lift Attachmer

CAUTION

Jack only at the approved jacking points. Never lift or hook up chains or towing devices on the drive shafts, front suspension arms, or rear spring blades.



Jacking Points

CONVERSION TABLE

DECIMAL AND METRIC EQUIVALENTS

Fractions	Decimal In.	Metric MM	Fractions	Decimal In.	Metric MM
1/64	.015625	.39688	33/64	.515625	13.09687
1/32	.03125	.79375	17/32	.53125	13.49375
3/64	.046875	1.19062	35/64	.546875	13.89062
1/16	.0625	1.58750	9/16	.5625	14.28750
5/64	.078125	1.98437	37/64	.578125	14.68437
3/32	.09375	2.38125	19/32	.59375	15.08125
7/64	.109375	2.77812	39/64	.609375	15.47812
1/8	.125	3.1750	5/8	.625	15.87500
9/64	.140625	3.57187	41/64	.640625	16.27187
5/32	.15625	3.96875	21/32	.65625	16.66875
11/64	.171875	4.36562	43/64	.671875	17.06562
3/16	.1875	4.76250	11/16	.6875	17.46250
13/64	.203125	5.15937	45/64	.703125	17.85937
7/32	.21875	5.55625	23/32	.71875	18.25625
15/64	.234375	5.95312	47/64	.734375	18.65312
1/4	.250	6.3500	3/4	.750	19.05000
17/64	.265625	6.74687	49/64	.765625	19.44687
9/32	.28125	7.14375	25/32	.78125	19.84375
19/64	.296875	7.54062	51/64	.796875	20.24062
5/16	.3125	7.93750	13/16	.8125	20.63750
21/64	.328125	8.33437	53/64	.828125	21.03437
11/32	.34375	8.73125	27/32	.84375	21.43125
23/64	.359375	9.12812	55/64	.859375	21.82812
3/8	.375	9.52500	7/8	.875	22.22500
25/64	.390625	9.92187	57/64	.890625	22.62187
13/32	.40625	10.31875	29/32	.90625	23.01875
27/64	.421875	10.71562	59/64	.921875	23.41562
7/16	.4375	11.11250	15/16	.9375	23.81250
29/64	.453125	11.50937	61/64	.953125	24.20937
15/32	.46875	11.90625	31/32	.96875	24.60625
31/64	.484375	12.30312	63/64	.984375	25.00312
1/2	.500	12.70000	1	1.00	25.40000

CONVERSION TABLE

Multiply	By	To Get Equivalent Number of:
	LENGTH	
Inch	25.4	millimeters (mm)
Foot	0.304	meters (m)
Yard	0.914	meters
Mile	1.609	kilometers (km)
	AREA	
$Inch^2$	645.2	$millimeters^2$ (mm^2)
	6.45	$centimeters^2$ (cm^2)
$Foot^2$	0.092	$meters^2$ (m^2)
$Yard^2$	0.836	$meters^2$
	VOLUME	
$Inch^3$	16.387	mm^3
	16.387	cm^3
	0.016	litres (1)
Quart	0.946	litres
Gallon	3.785	litres
$Yard^3$	0.764	$meters^3$ (m^3)
	MASS	
Pound	0.453	kilograms (kg)
Ton	907.18	kilograms (kg)
Ton	0.907	tonne (t)
	FORCE	
Kilogram	9.807	newtons (N)
Ounce	0.278	newtons
Pound	4.448	newtons
	TEMPERATURE	
Degree Fahrenheit	(°F-32) - 1.8	degree Celsius (C)
	ACCELERATION	
$Foot/sec^2$	0.304	$meter/sec^2$ (m/s^2)
$Inch/sec^2$	0.025	$meter/sec^2$
	TORQUE	
Pound-inch	0.112	newton-meters (N-m)
Pound-foot	1.355	newton-meters
Pound-foot	.1355	deca-newton meters (daNm)
	POWER	
Horsepower	0.746	kilowatts (kW)

CONVERSION TABLE

	PRESSURE OR VACUUM	
Inches of water	.354	Bars
Pounds/sq. in.	.068	Bars
	ENERGY OR WORK	
BTU	1.055	joules (J)
Foot-pound	1.355	joules
Kilowatt-hour	3 600 000 or 3.6×10^6	joules
	LIGHT	
Foot candle	1.076	lumens/meter^2 (lm/m^2)
	FUEL PERFORMANCE	
Miles/gal	.0425	kilometers/liter (km/l)
Gal/mile	2.352	liter/kilometer (l/km)
	VELOCITY	
Miles/hour	1.609	kilometers/hr. (km/h)

CAPACITIES AND SPECIFICATIONS

Capacities - Vehicles Equipped with J8S-232 Naturally-Aspirated Diesel Engines

Fuel Tank	15.5 gallons	58.7 litres
Diesel Oil Sump (Engine)	5.3 quarts	5 litres
Diesel Oil Filter (Engine)	.52 quarts	.50 litre
Cooling System*	8.45 quarts	8 litres
Gearbox	2.64 quarts	2.5 litres
Final Drive	.84 quart	0.8 litre
Brake Circuit (Dual)	.73 quart	0.7 litre
Power Steering	1.32 quart	1.25 litre

*Without Motoraid Water Heater or Rear Heater

Diesel Engine Oil Filter	- Part #R77007-30-077
Diesel Engine Air Filters	- Part #R77006-78-752
Diesel Engine Fuel Filter	- Part #R77010-33-136
Manual Gearbox and Final Drive Oil	- API-GL5 SAE 80-90W
Brake Fluid	- SAE J 1703F DOT 3-SAE J 1703 DOT 4
Coolant	- Prestone II brand antifreeze/coolant
Power Steering Fluid	- Mobil 220 ATF Dexron II
Engine Oil Drain Plug Seal	- Part #R79030-62-003
Gearbox Drain Plug Seal	- Part #R77030-62-023

Vehicles Equipped with J8S-234 Turbocharged Diesel Engine

Fuel Tank	15.5 gallons	58.7 litres
Engine Oil (Crankcase)	5.3 quarts	5 litres
Engine Oil Filter	.52 quarts	.50 litre
Cooling System *	10.4 quarts	9.8 litres
Gearbox	2.6 quarts	2.5 litres
Final Drive	.85 quart	0.8 litre
Brake Circuit (Dual)	.74 quart	0.7 litre
Power Steering	1.22 quart	1.15 litre

* Without Motoraid Water Heater or Rear Heater

Turbo Diesel Engine Oil Filter	- Part #R77007-30-077
Turbo Diesel Engine Air Filter	- Part #R14629-85-746
Diesel Engine Fuel Filter	- part #R77010-33-136
Water Separator	- Part #R14629-85-825
Manual Gearbox and Final Drive Oil	- API-GL5 SAE 80-90W
Brake Fluid	- SAE J 1703F DOT 3-SAE J 1703 DOT 4
Coolant	- Prestone II brand antifreeze/coolant
Power Steering Fluid	- Mobil 220 ATF Dexron II
Engine Oil Drain Plug Seal	- Part #R79030-62-003
Gearbox Drain Plug Seal	- Part #R77030-62-023

CAPACITIES AND SPECIFICATIONS

Vehicles Equipped With J7T-239 Fuel Injected Gasoline Engine

Fuel Tank	15.5 gallons	58.7 litres
Engine Oil (Crankcase)	5.3 quarts	5 litres
Engine Oil Filter	.52 quart	.50 litre
Cooling System *	10.4 quarts	9.8 litres
Automatic Transmission	2.1-2.6 quarts	2.0-2.5 litres
Final Drive	.85 quart	0.8 litre
Brake Circuit (Dual)	.74 quart	0.7 litre
Power Steering	1.22 quart	1.15 litre

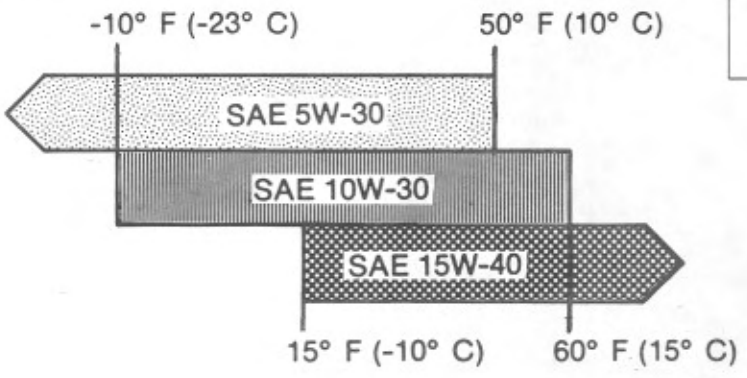
* Without Motoraid Water Heater or Rear Heater

Oil Filter	- Part #R77007-30-077
Air Filter	- Part #R14636-35-132
Fuel Filter	- Part #R14636-35-181
Final Drive Oil	- API-GL5 SAE 80-90W
Brake Fluid	- SAE J 1703F DOT 3-SAE J 1703 DOT 4
Coolant	- Prestone II brand antifreeze/coolant
Power Steering Fluid and Automatic Transmission	- Mobil 220 ATF Dexron II
Engine Oil Drain Plug Seal	- Part #R79030-62-003
Automatic Transmission Draining Plug Seals	- Part #R77030-62-023 and R79030-62-003

OIL

Engine (Diesel): Oil used must correspond to the standard MIL-L-2104C or API-SF/CD. The terms CD must appear on the container singly or in conjunction with other designations. Refer to the viscosity chart below for recommendations according to ambient temperatures. DO NOT use 5W-30 above 50° F (10° C) or 10W-30 above 60° F (15° C). NEVER use 10W-40 oils in this engine.

Engine (Gasoline): Oil used must correspond to the standard MIL-L-46152B or API-SF. The term SF must appear on the container singly or in conjunction with other designations. Refer to the viscosity chart below for recommendations according to ambient temperatures. DO NOT use 10W-30 above 60° F (15° C). NEVER use 10W-40 oils in this engine.



ENGINE OIL LEVEL CHECK

The vehicle's engine oil must be maintained at the proper level to assure proper lubrication of the engine. It is the owner's responsibility to check the oil level regularly, such as at every fuel stop. It is common for both diesel and gasoline engines to consume oil during and after the initial break-in period.

When adding oil, be sure that you use the same brand and grade of oil used during the last oil change. DO NOT overfill beyond the "max." notch on the dipstick. The level must NEVER be below the "min." mark.

CAUTION

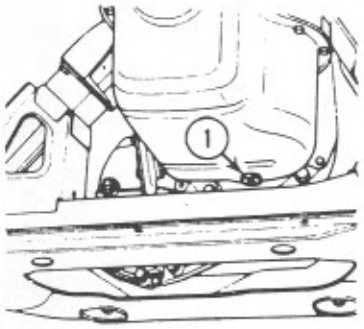
The engine must not be flushed out under any circumstances.

FLUID CHANGING
OIL DRAINING AND REFILLING

ENGINE, GEARBOX, AND FINAL DRIVE

Engine Oil Change - Diesel or Gasoline Engine

1. Remove drain plug 1. Allow time for old oil to drain.
2. Replace drain plug crush washer with new one.
3. Reinsert drain plug into drain hole.
4. Refill crankcase through filler hole on top of engine.

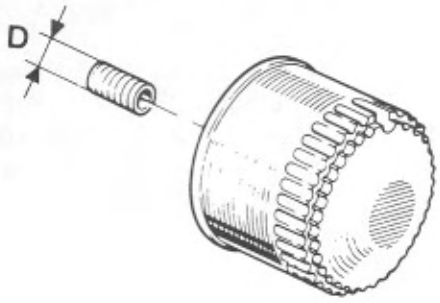


1. Engine Oil Drain Plug

NOTE: Be sure to allow for the additional capacity of the oil filter (.52 qt./.50 litre) when refilling crankcase.

Oil Filter

The oil filter is designed specifically for this engine. It has a special thread pitch and has internal flow characteristics to insure proper engine lubrication under all conditions. Use of improper filters could cause premature engine wear and possible engine failure.



TRANSMISSION, GEARBOX, AND FINAL DRIVE OIL CHANGE

To Change Final Drive Oil (Gas/Diesel):

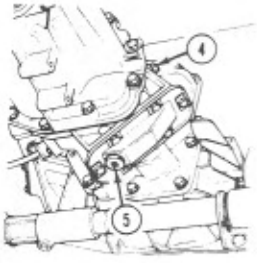
1. Remove drain plug 2. Allow adequate time for old oil to drain.
2. Reinsert plug into hole 2.
3. Refill reservoir through fill plug hole 3 until oil just starts to run out.
4. Reinsert plug into hole 3.



2. Final Drive Drain Plug
3. Final Drive Fill Plug

To Change Gearbox Oil (Diesel):

1. Remove drain plug 5. Allow adequate time for old oil to drain.
2. Replace oil drain plug washer with new one.
3. Reinsert drain plug into drain.
4. Refill reservoir through fill plug hole 4 until oil just starts to run out.
5. Reinsert plug into hole 4.

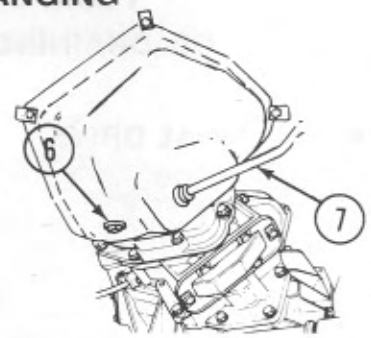


4. Gearbox Fill Plug
5. Gearbox Drain Plug

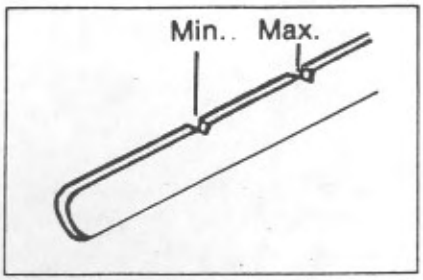
FLUID CHANGING

To Change Automatic Transmission Fluid (Gas):

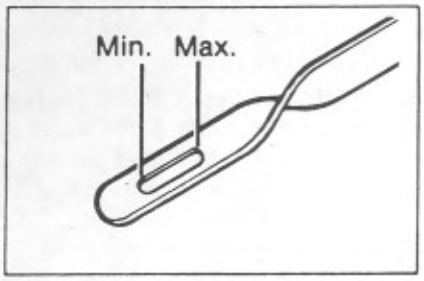
1. Remove drain plug 6. Allow adequate time for old oil to drain.
2. Replace drain plug crush washers with new ones.
3. Reinsert drain plugs into drain holes.
4. Refill reservoir with fluid through transmission dipstick tube 7.



6. Transmission Drain Plugs
7. Transmission Fill (Dipstick Tube)



Engine Oil Dipstick



Automatic Transmission Dipstick

AUTOMATIC TRANSMISSION FLUID CHECK

Check the automatic transmission fluid level after driving a sufficient distance so that the engine and transmission are at operating temperature. With the handbrake engaged and the engine idling in **Park**, pull out dipstick **3** and wipe clean. Reinsert into the tube momentarily, and pull out again to read the level. Do not allow the level to go below the "**MIN**" mark or above "**MAX**" or transmission damage may occur. If necessary, add the appropriate amount of transmission fluid through the dipstick tube using a funnel.

SERVICE AND MAINTENANCE

CHASSIS MAINTENANCE

The following pages list the required and recommended scheduled maintenance services for your Winnebago vehicle, with descriptions of the operations to be performed at each service.

Some operations listed in the maintenance schedule are required at the specified intervals to maintain emission control performance standards. Failure to have these services performed at the intervals stated may affect your warranty coverage.

NOTE: The vehicle may require additional maintenance if it is operated under extreme conditions such as non-use for long periods of time, excessive start and stop driving conditions, extreme cold or desert climates, sustained high-speed driving, frequent engine idling, heavy-duty loading, commercial use, or any other extreme operating condition.

It is the owner's responsibility to recognize the vehicle's operating conditions and to ensure that the vehicle is properly serviced according to the maintenance schedule.

The service intervals indicated on the charts are based on the odometer reading on your vehicle or the number of months since the vehicle was first used, whichever occurs first. Maintenance should be continued at the same intervals for mileage beyond that indicated on the charts.

Chart Code Explanation

The letter 'R' opposite a service indicates that a replacement is necessary. An 'A' denotes a necessary adjustment. The letter 'I' indicates that an inspection is recommended. (Inspections may lead to adjustments or other mechanical operations.) The symbol '*' beside a letter indicates that the service specified is required to maintain the vehicle's emissions. Refer to "Service Operation Descriptions" for details.

It is the owner's responsibility to keep maintenance records since it may be necessary to prove that required and recommended maintenance has been performed. These records should be left in the glove compartment and passed on to the subsequent owner when the vehicle is sold.

Also, ensure that your dealer or other servicing establishment marks the corresponding box on the chart anytime a maintenance service is performed. Remember, proper service at the proper intervals protects your investment.

NOTE: All kilometer figures listed on the charts are approximate. For comparison, one mile equals 1.609 km.

NOTE: The need for service is determined by a mileage or time interval. In most cases, the odometer mileage will indicate when service is required. However, if driven very little, the vehicle should be serviced at least every twelve months. Under severe driving conditions, more frequent maintenance is required.

CHASSIS MAINTENANCE SCHEDULE — DIESEL ENGINES

MONTHS	1	6			12				24									
MILES (Thousands)	1	3.75	7.5	11.25	15	18.75	22.5	26.25	30	33.75	37.5	40	41.25	45	48.75	52.5	56.25	60
Ref.	Operation																	
1.	Rear Wheel Bearings					I				I					I				I
2.	RoadWheel Check	I	I	I	I	I	I	I	I	I	I	I		I	I	I	I	I	I
3.	Brake Check #1	A																	
4.	Diesel Engine Oil and Filter	R	R	R	R	R	R	R	R	R	R	R		R	R	R	R	R	R
5.	Diesel Fuel Filter	I	I	I	I	I	I	I	I	I	I	I		I	I	I	I	I	I
6.	Diesel Engine Tune-up & Filter Change									AR									AR
7.	Fluid Level Check	I	I	I	I	I	I	I	I	I	I	I		I	I	I	I	I	I
8.	Battery Check	I	I	I	I	I	I	I	I	I	I	I		I	I	I	I	I	I
9.	Doors and Hood					I				I					I				I
10.	Tires	I				I				I					I				I
11.	Axle - Front and Rear	I				I				I					I				I
12.	Brake Check #2	I				I				I					I				I
13.	Fuel Line					I				I					I				I
14.	Exhaust System					I				I					I				I
15.	Clutch					A				A					A				A
16.	Drive Belts	I				I				I					I				I
17.	Equipment Check	I	I	I	I	I	I	I	I	I	I	I		I	I	I	I	I	I
18.	Coolant System							R							R				
19.	Mountings					I				I					I				I
20.	Brake Servo Filter							I							I				
21.	Final Drive Oil	R	I	I	R	I	I	R	I	I	R	I	I	R	I	I	R	I	R
22.	Gearbox Oil	R	I	I	I	I	I	R	I	I	I	I	I	R	I	I	I	I	R
23.	Rocker Shaft Oil Filter												R						
24.	Heater Plugs and Injectors												R						
25.	Timing Belt & Air Conditioner Belt																		R
26.	Idling Speed	A								A									A
	Kilometers (Approx. in thousands)	1.6	6.0	12.0	18.0	24.0	30.0	36.0	42.0	48.0	54.5	60.5	64.5	66.5	72.5	78.5	84.5	90.5	96.5

R - Replacement necessary A - Adjustment necessary I - Inspect and adjust, add or replace if necessary

SERVICE OPERATION DESCRIPTIONS — DIESEL ENGINES

Type J8S-232 and J8S-234

NOTE: Metric distance intervals are listed on the Chassis Maintenance Schedule.

1. **Repack Rear Wheel Bearings** - Repack the wheel bearings at 15,000 miles (24,135 km) and thereafter every 15,000 miles.
2. **Road Wheel Check** - Check tightness of wheel lug nuts during the 1,000-mile maintenance check at 3,750 miles and thereafter every 3,750 miles.
3. **Brake Check #1** - Adjust the handbrake and check brake operation and efficiency during the 1,000-mile maintenance check.

SERVICE OPERATION DESCRIPTIONS - DIESEL ENGINES (CONT.)

4. **Engine Oil and Filter Change** - The oil and filter must be changed during the 1,000-mile maintenance check, followed by the subsequent changes at 3,750 miles and thereafter every 3,750 miles. Change oil more often if the vehicle is subject to very hard use. Check oil at each fuel fill. See Capacities and Specifications for recommendations.
5. **Diesel Fuel Filter Water Drain** - The water must be drained from the base of the fuel filter by opening the drain screw in the filter base. This must be performed during the 1,000-mile maintenance check, followed by second draining at 3,750 miles and thereafter once every 3,750 miles.
6. **Diesel Engine Tune-Up and Filter Change** - The idling speed must be adjusted and the air and fuel filter elements must be changed every 30,000 miles or 24 months, whichever comes first.
7. **Fluid Level Check** - The fluid level check must be performed during the 1,000-mile maintenance check, followed by a second check at 3,750 miles and thereafter once every 3,750 miles. The fluid level check consists of six checks. See Capacities and Specifications for recommendations.
   A. Gearbox - Check oil level and add if necessary.
   B. Final Drive - Check oil level and add if necessary.
   C. Brake Fluid - Check lines and reservoir for leaks and check reservoir level.
   D. Clutch Fluid - Check hydraulic fluid reservoir.
   E. Coolant - Check level in the overflow bottle and check freezing temperature of coolant.
   F. Power Steering Reservoir Level - Check level on power steering reservoir.
8. **Battery Check** - Check cable connections and remove corrosion if necessary. This operation must be performed at the 1,000-mile maintenance check, followed by a second check at 3,750 miles and thereafter once every 3,750 miles or 6 months, whichever comes first.
9. **Door and Hood Lube** - Lubricate hinges of cab doors, entrance doors and hood every 15,000 miles (24,135 km) or any time a difference in operation is noticed.
10. **Tire Check** - Check tires for abnormal wear during the 1,000-mile maintenance check, followed by a second check at 15,000 miles, and thereafter every 15,000 miles. Check air pressure during the 1,000-mile maintenance check, and thereafter according to tire manufacturer's specifications and whenever any visible difference is noticed.
11. **Axle Check - Front and Rear** - Inspect condition and check for play in steering, drive shafts, and shock absorbers. Also check axle bearing nut tightness. These operations must be performed during the 1,000-mile maintenance check, at 15,000 miles and thereafter every 15,000 miles or 12 months, whichever comes first.
12. **Brake Check #2** - Check condition and routing of hoses, pad wear (disc brakes) and lining wear (drum brakes with inspection holes). Adjust brake shoes (drum brakes) and handbrake. Check brake operation and efficiency. This operation must be performed during the 1,000-mile maintenance check, every 15,000 miles or 12 months, or any time a difference in brake efficiency or operation is noticed.
13. **Fuel Line Check** - Visually check all fuel lines for ruptures, loose connections, and proper clamping every 15,000 miles or 12 months, whichever comes first.
14. **Exhaust System Check** - Check condition of complete exhaust system for rust-through, blow-out, loose connections, clamps, hangers, etc. Listen carefully for any difference in the sound of your system. Check for any type of fumes entering the interior of the vehicle. Also inspect the floor area for any holes which might allow fumes to enter the vehicle. This operation must be performed every 15,000 miles or 12 months, whichever comes first.
15. **Clutch** - Check operation clearance and bleed if necessary. This operation must be performed during the 1,000-mile maintenance check, and at 15,000 miles or 12 months, whichever comes first.
16. **Belt Check** - Check tension of air conditioner poly-vee belt and drive belts and adjust if necessary during the 1,000-mile maintenance check, at 15,000 miles and thereafter every 15,000 miles or 12 months, whichever comes first.

SERVICE OPERATION DESCRIPTIONS - DIESEL ENGINES (CONT.)

17. **Equipment Check** - Check the following items during the 1,000-mile maintenance check, at 3,750 miles, and thereafter every 3,750 miles.
    A. Headlights - Check and adjust high and low beams.
    B. Windshield Wiper Arms and Blades - Check condition of blades and sweep of arms.
    C. Direction of Indicators - Check operation.
    D. Warning Lights - Check operation.
    E. Windshield Washers - Check operation.
    F. Safety Belts - Check anchorages and belt condition.
18. **Coolant Change** - Drain and refill entire cooling system and check to make sure it will remain unfrozen to the lowest temperatures of your climate. This must be performed every 22,500 miles or 24 months, whichever comes first. See Capacities and Specifications for recommendations.
19. **Tighten Mountings** - All engine and transmission mounting bolts must be torqued to the proper specifications every 15,000 miles or 12 months, whichever comes first.
20. **Brake Servo Filter** - The brake servo filter must be cleaned or replaced every 22,5000 miles or 24 months, whichever comes first.
21. **Final Drive Oil Change** - Final drive oil must be changed during the 1,000-mile maintenance check, and at specified intervals thereafter. The drain plug crush washer must be replaced at each oil change. Be sure to check for leaks after performing this operation. See Capacities and Specifications for recommendations.
22. **Gearbox Oil Change** - Gearbox oil must be changed during the 1,000-mile maintenance check and at specified intervals thereafter. The drain plug crush washer must be replaced at each oil change. Be sure to check for leaks after performing this operation. See Capacities and Specifications for recommendations.
23. **Rocker Shaft Oil Filter Change** - Change rocker shaft oil filter and adjust rocker arm clearances every 40,000 miles.
24. **Change Heater Plugs - Recalibrate Injectors** -Heater plugs must be changed and injectors recalibrated every 40,000 miles.
25. **Toothed Timing Belt and Air Conditioner Poly-Vee Belt Change** - Toothed timing belt and air conditioner poly-vee belt must be changed every 60,000 miles.
26. **Idling Speed Adjustments** - Idling speed must be adjusted during the 1,000-mile maintenance check, at 30,000 miles, and thereafter every 30,000 miles or 12 months, whichever comes first.

CHASSIS MAINTENANCE SCHEDULE - GASOLINE ENGINE

MONTHS		1	6	12	18	24	30	36	42	48	54	60	66	72
MILES (Thousands)		1	5	10	15	20	25	30	35	40	45	50	55	60
Ref.	**Operation**													
1	Engine Oil	R	R	R	R	R	R	R	R	R	R	R	R	R
2	Oil Filter	R		R		R		R		R		R		R
3	Transmission Fluid	R	I	I	I	R	I	I	I	R	I	I	I	R
4	Final Drive Oil	R	I	R	I	R	I	R	I	R	I	R	I	R
5	Idle Speed	*A						*A						*A
6	Air Filter							*R						*R
7	Spark Plugs							*R						*R
8	Drive Belts	I			I			*A			I			*A
9	Hoses & Connections				I			*I			I			I
10	Oxygen Sensor											*I		
11	Valve Lash							*I						*I
12	PCV System											*I		
13	Fuel System				I			I			I			I
14	Exhaust System				I			I			I			I
15	Ignition System							I						I
16	Fluid Check	I	I	I	I	I	I	I	I	I	I	I	I	I
17	Cooling System							R						R
18	Evaporative System				I			I			I			I
19	Timing Belt	I			I			*A			I			*A
20	Battery	I	I	I	I	I	I	I	I	I	I	I	I	I
21	Brakes	I			I			I			I			I
22	Tires	I			I			I			I			I
23	Axles/Suspension/Steering	I			I			I			I			I
24	Wheels	I	I	I	I	I	I	I	I	I	I	I	I	I
25	Mountings				I			I			I			I
26	Lights/Electrical System	I	I	I	I	I	I	I	I	I	I	I	I	I
27	Rocke: Shaft Oil Filter									R				
28	Road Test	I	I	I	I	I	I	I	I	I	I	I	I	I
Kilometers (Approx. in thousands)		1,6	8,0	16,0	24,0	32,0	40,0	48,0	56,0	64,0	72,5	80,5	88,5	96,5

R - Replacement necessary
A - Adjustment necessary
I - Inspect and adjust add or replace if necessary
*- Required to maintain emission standards and warranty.

MONTHS		78	84	90	96	102	108	114	120	126	132	138	144
MILES (Thousands)		65	70	75	80	85	90	95	100	105	110	115	120
Ref.	**Operation**												
1	Engine Oil	R	R	R	R	R	R	R	R	R	R	R	R
2	Oil Filter		R		R		R		R		R		R
3	Transmission Fluid	I	I	I	R	I	I	I	R	I	I	I	R
4	Final Drive Oil	I	R	I	R	I	R	I	R	I	R	I	R
5	Idle Speed						*A						*A
6	Air Filter						*R						*R
7	Spark Plugs						*R						*R
8	Drive Belts			I			*A			I			*A
9	Hoses & Connections			I			*I			I			I
10	Oxygen Sensor										*I		
11	Valve Lash						*I						*I
12	PCV System										*I		
13	Fuel System			I			I			I			I
14	Exhaust System			I			I			I			I
15	Ignition System						I						I
16	Fluid Check	I	I	I	I	I	I	I	I	I	I	I	I
17	Cooling System						R						R
18	Evaporative System			I			I			I			I
19	Timing Belt			I			*A			I			*A
20	Battery	I	I	I	I	I	I	I	I	I	I	I	I
21	Brakes			I			I			I			I
22	Tires			I			I			I			I
23	Axles/Suspension/Steering			I			I			I			I
24	Wheels	I	I	I	I	I	I	I	I	I	I	I	I
25	Mountings			I			I			I			I
26	Lights/Electrical System	I	I	I	I	I	I	I	I	I	I	I	I
27	Rocker Shaft Oil Filter				R								R
28	Road Test	I	I	I	I	I	I	I	I	I	I	I	I
Kilometers (Approx. in thousands)		104,5	112,5	120,5	128,5	136,5	145,0	153,0	161,0	169,0	177,0	185,0	193,0

SERVICE OPERATION DESCRIPTIONS — GASOLINE ENGINE

NOTE: Metric distance intervals are listed on the Chassis Maintenance Schedule.

1. **Engine Oil** - Change engine oil during the 1,000-mile maintenance check, and at all required service intervals thereafter. Check oil at each fuel fill. See Capacities and Specifications for recommendations.
2. **Engine Oil Filter** - Change engine oil filter during the 1,000-mile maintenance check and, thereafter, at listed intervals. Use only Winnebago approved filters. See Capacities and Specifications for recommendations.
3. **Transmission Fluid** - Change the automatic transaxle fluid and clean filter at the 1,000-mile maintenance check and at specified intervals thereafter. See Capacities and Specifications for recommendations.
4. **Final Drive Oil** - Change final drive oil during the 1,000-mile maintenance check and, thereafter, at intervals listed. Check level at each engine oil change. See Capacities and Specifications for recommendations.
5. **Idle Speed (Qualified Technician Required)** - Check and adjust the curb/fast idle at the 1,000-mile maintenance check and at specified intervals thereafter.
6. **Air Filter** - Replace air cleaner element each 30,000 miles. Use only Winnebago approved air filter. See Capacities and Specifications for recommendations.
7. **Spark Plugs** - Replace the spark plugs at 30,000 miles. See Engine Specifications for recommended spark plugs.
8. **Drive Belts (Qualified Technician Required)** - Inspect condition and tension of belts driving the water pump, alternator, and air conditioner compressor at the 1,000-mile maintenance check and at specified intervals thereafter.
9. **Hose and Connections** - At each 15,000-mile interval, check the condition of hoses, connections, and fittings of the following systems. Tighten connections, if necessary.
   - Cooling system
   - Brake system
   - Fuel system
   - Power Steering
   - Vacuum system (emissions related)
10. **Oxygen Sensor** - At 50,000 miles, check sensor operation and replace if necessary.
11. **Valve Lash** - Adjust valve lash as required at each 30,000-mile interval.
12. **PCV System** - Check hose condition for obstructions at 50,000 miles.
13. **Fuel Systems - (Qualified Technician Required)** At each 15,000-mile maintenance interval, inspect fuel lines and tank for leakage and connections for tightness. Inspect fuel system electrical connections. Check filler cap for proper venting.
14. **Exhaust System** - At each 15,000-mile maintenance interval, inspect condition of all exhaust system components for leakage, damage, clearance, and mounting. Replace components as necessary.
15. **Ignition System (Qualified Technician Required)** - Inspect and lubricate the distribution shaft and advance mechanism at 30,000 miles. Also, inspect distributor cap, rotor and ignition wiring, and check timing.
16. **Fluid Checks** - During the 1,000-mile maintenance check, and at subsequent maintenance intervals, check the level of fluids listed and add, if necessary.
    - Transmission fluid
    - Final drive oil
    - Brake fluid
    - Power steering fluid
    - Coolant
    - Windshield washer solvent

    NOTE: Refer to Capacities and Specifications for recommended fluids.
17. **Cooling System** - Drain and replace coolant at 30,000-miles and at the beginning of each winter season thereafter. Check hoses and connections for leakage or flaws. Use only Prestone II brand antifreeze/coolant when replacing or adding.
18. **Evaporative System** - Inspect evaporative system hoses and connections for leakage or cracks at the maintenance intervals indicated.
19. **Timing Belt (Qualified Technician Required)** -Replace the toothed timing belt at 60,000 miles.
20. **Battery** - At 1,000 miles and at each 5,000-mile maintenance interval, check battery terminals (clean and tighten if necessary), voltage, battery case, and hold-downs.
21. **Brakes** - Perform the following services at 1,000 miles and at each 15,000-mile maintenance interval:
    - Check operation and performance of service brakes. Add fluid if necessary.
    - Inspect condition and thickness of front pads and rear linings. Replace if necessary.
    - Adjust handbrake.
    - Inspect brake servo filter and clean or replace as necessary.

22. **Tires** - Inspect tires (and spare) for abnormal wear or damage and adjust air inflation pressure, if necessary, at 1,000 miles and at each specified interval thereafter or whenever any visible or handling problem is apparent.
23. **Axles/Suspension** - During the 1,000-mile maintenance check and at each 15,000-mile maintenance interval, perform the following and replace as necessary:
    - Steering and suspension components - check for play and wear.
    - Drive axle boots - inspect for cracks.
    - Rear wheel bearings - inspect condition and repack.
    - Torque axle nuts to correct specifications.
24. **Wheels** - Check tightness of lug nuts and inspect condition of wheels at 1,000-miles and at each 5,000-mile service interval.
25. **Mountings** - All engine and transmission mounting bolts must be torqued to proper specifications every 15,000 miles.
26. **Lights and Electrical System** - During the 1,000-mile maintenance check and at each 5,000-mile interval, check operation of all lights, turn signals, warning lights, hazard flashes, instruments, horn, wipers, heater fan, etc. Adjust headlight alignment, if necessary, at each 15,000-mile interval.
27. **Rocker Shaft Oil Filter** - Replace rocker shaft oil filter and check valve clearances at each 40,000-mile interval.
28. **Road Test** - During the 1,000-mile maintenance check and at each 5,000-mile interval thereafter, road test the vehicle and check the following:
    - Acceleration and braking
    - Steering, suspension, and handling
    - Fluid and body leakage
    - Doors and hood (lubricate if necessary)
    - Body components
    - Accessory operation

SECTION "B"

J8S-232 NATURALLY-ASPIRATED DIESEL ENGINE

Subsection 1 - General Information

B1-1 Ghosted Views
B1-3 Engine Identification
B1-4 Special Tools
B1-10 Torques and Specifications
B1-14 General Diagnostic Procedures

Subsection 2 - Engine Removal and Replace

B2-1 Engine Removal Procedure
B2-2 Preparation for Rebuilding
B2-3 Preparation for Engine Installation
B2-3 Engine Installation Procedure
B2-4 Final Procedures After Engine Installation

Subsection 3 - Overhaul and Rebuild

B3-1 General Information
B3-2 Engine Teardown
B3-4 Cylinder Head Overhaul
B3-11 Rocker Shaft Rebuild
B3-13 Oil Pump - Overhaul
B3-16 Cylinder Block and Related Parts - Clean and Inspect
B3-19 Reassemble Cyclinder Block and Related Parts
B3-33 Reinstallation of the Cylinder Head

Subsection 4 - Timing Belt

B4-1 Timing Belt Changing/Removal
B4-2 Timing Belt Installation

Subsection 5 - Belt Tensioning Procedure

B5-1 Checking Method for All Belts

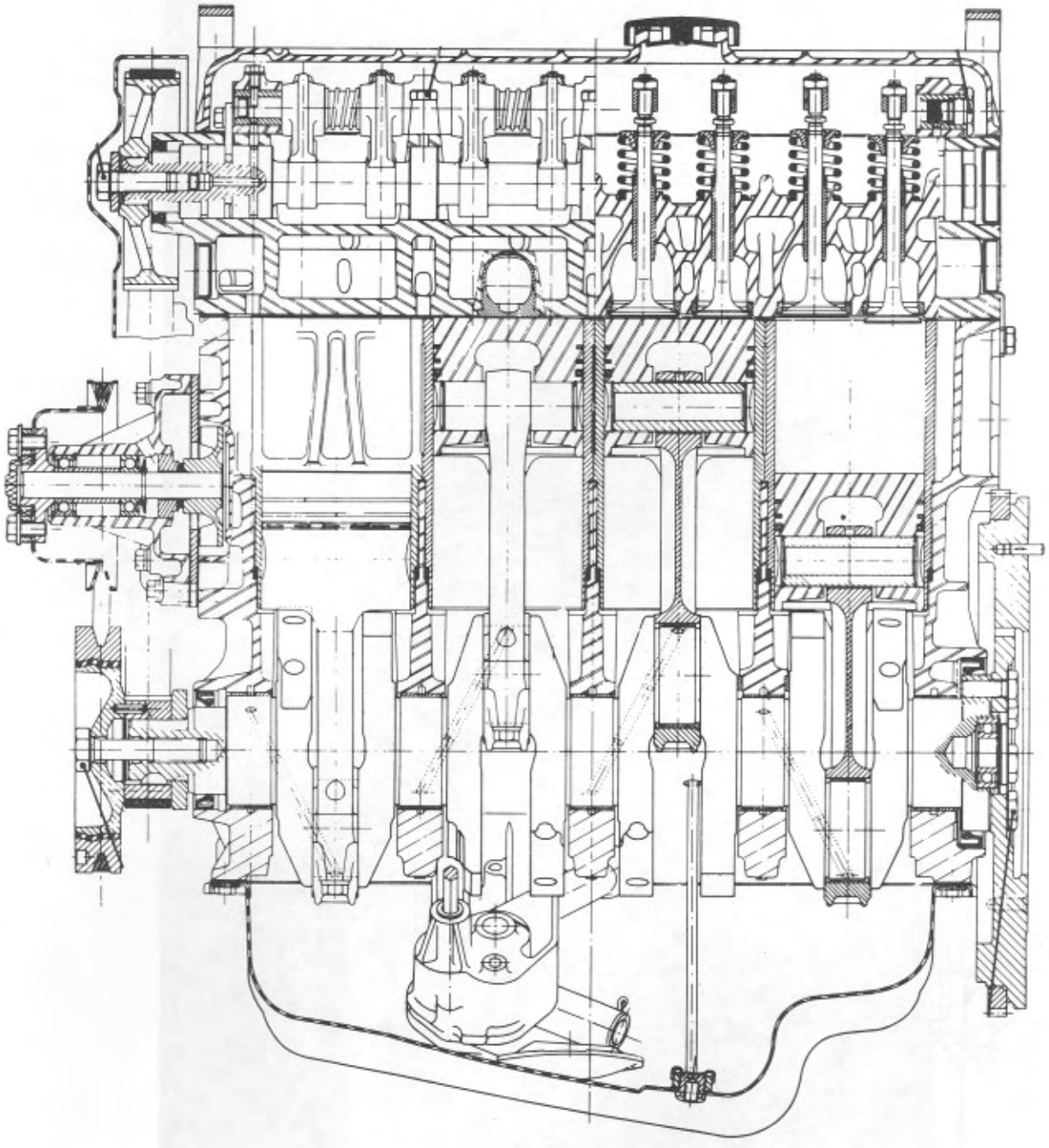
Subsection 6 - Engine Water Pump

B6-1 Removal and Replacement
B6-2 Fan/Hub Declutching Modificaton

GENERAL

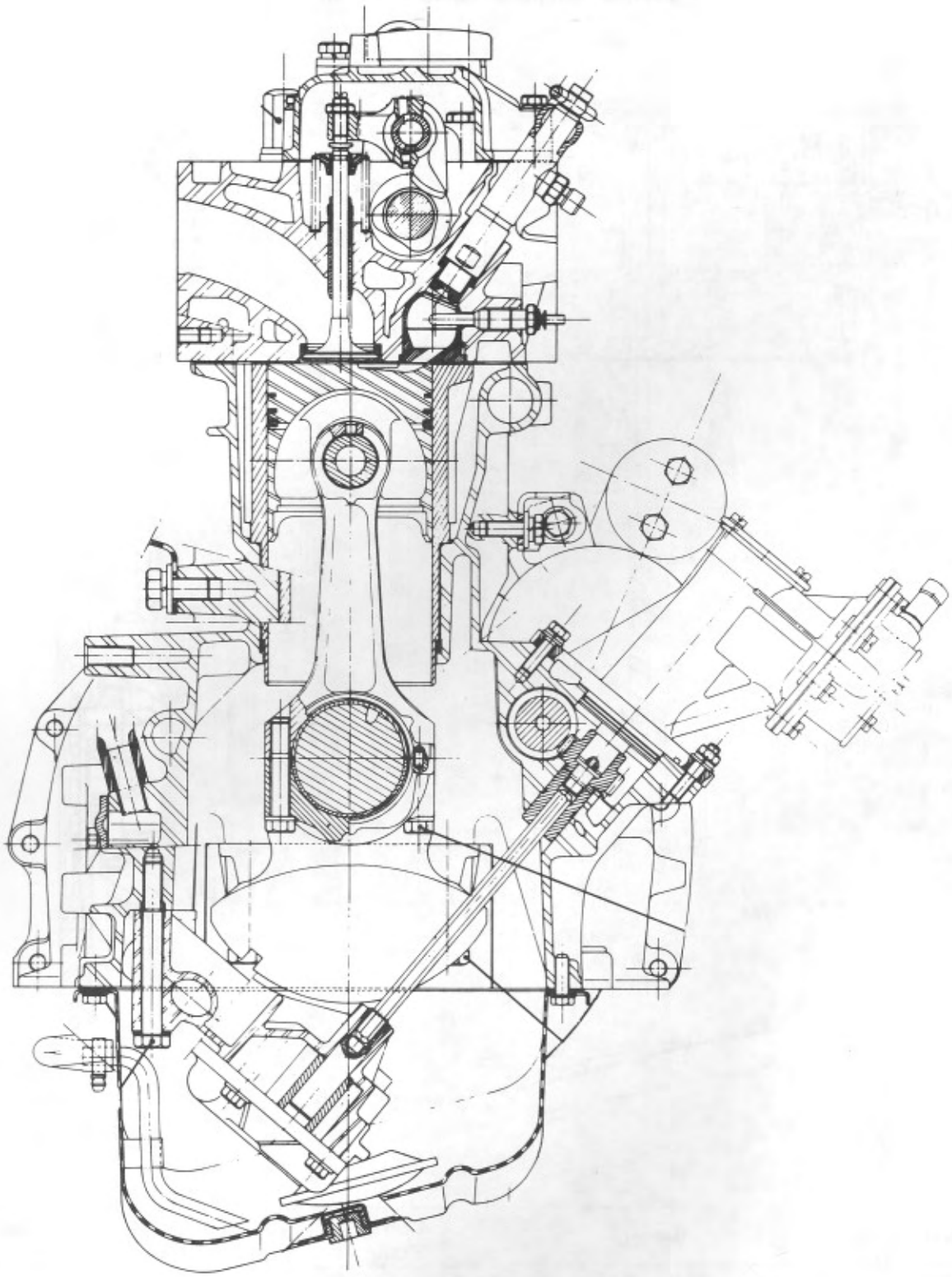
GHOSTED VIEW

J8S-232
4-Cylinder Naturally-Aspirated Diesel



Engine	Vehicle	Comp. Ratio	Stroke (mm)	Bore (mm)	Cub. Cap (mm)
J8S-232	Centauri, LeSharo, Phasar, and Utility Van	21.5	89	86	2068

GHOSTED VIEW



ENGINE IDENTIFICATION

The shape of the identification plate riveted to the cylinder block depends on the space available.

The following information is stamped on the plate:

A: — Engine Type

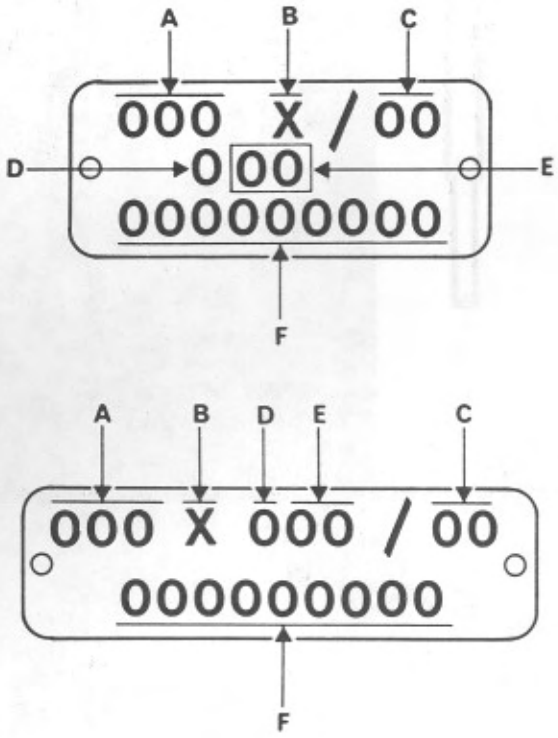
B: — Engine approval letter

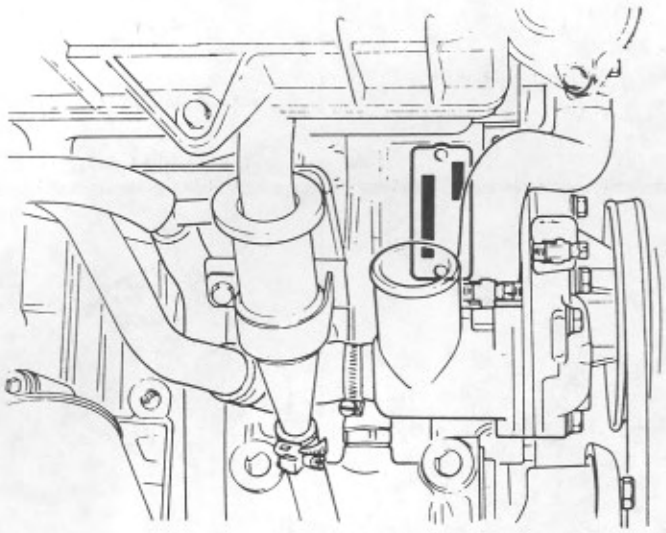
C: — Engine equipment

D: — R.N.U.R. identity

E: — Engine suffix

F: — Engine Fabrication No. (preceded by suffix).





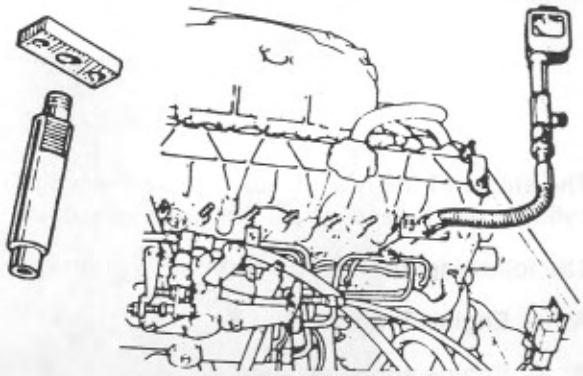
J8S-232 - Right (Passenger) Side

SPECIAL SERVICE TOOLS



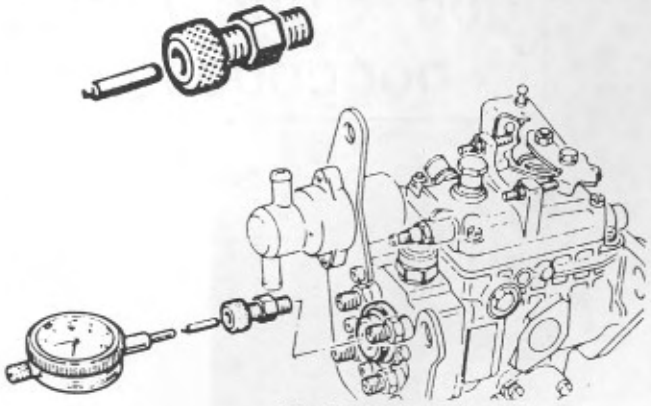
Mot. 861
TDC indicator rod

Order Tool No. 700000-86-100 EA



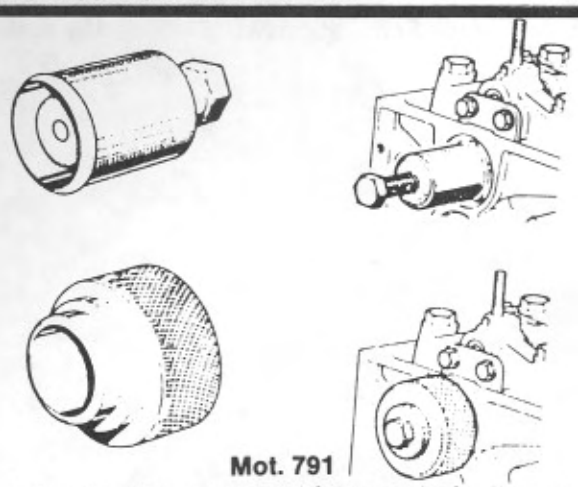
Mot. 871
Adaptor for diesel engine compression testing (to be used only with locally supplied compression gauge with scale reading at least 450 P.S.I.)

Order Tool No. 700000-87-100 EA



Mot. 856
Dial indicator adapter for timing Bosch injection pump

Order Tool No. 700000-85-600 EA



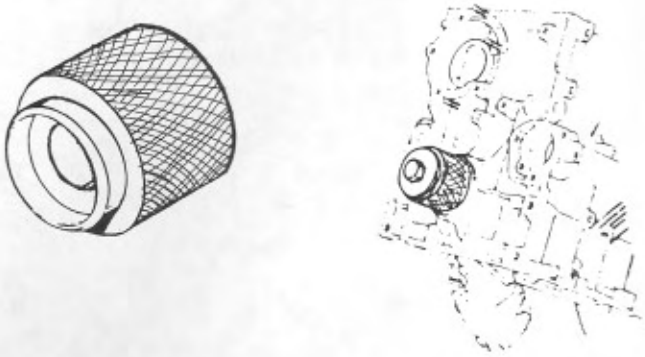
Mot. 791
Extracting/inserting tool for camshaft oil seal

Order Tool No. 700000-79-100 EA



Mot. 869
Injector holder socket use with Ele. 721

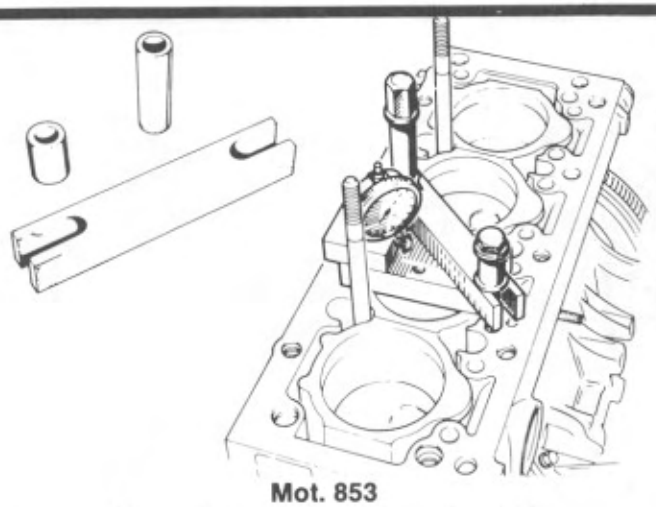
Order tool no. 700000-86-900 EA



Mot. 789
Crankshaft oil seal inserting tool (timing cover end)

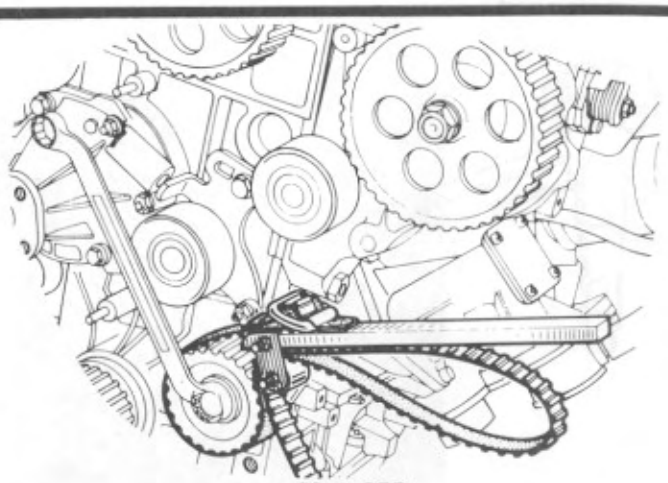
Order tool no. 700000-78-900 EA

SPECIAL SERVICE TOOLS



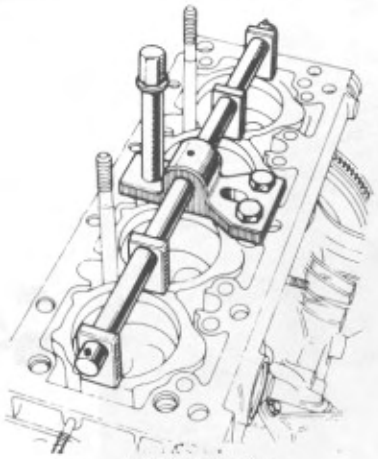
Mot. 853
Sleeve base seal compressing tool

Order Tool No. 700000-85-300 EA



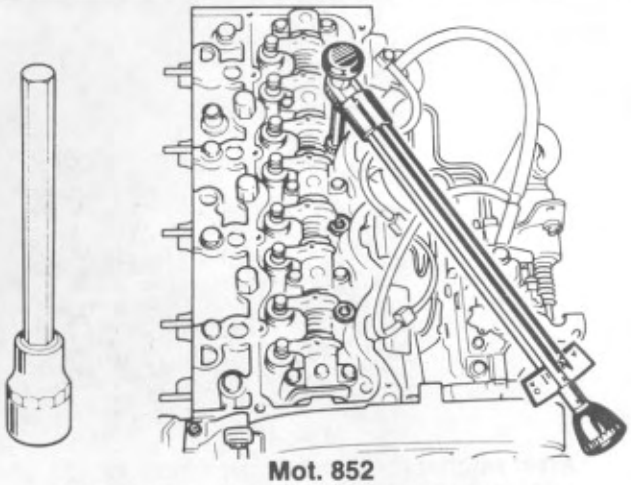
Mot. 855
Toothed belt idler sprocket locking strap

Order Tool No. 700000-85-500 EA



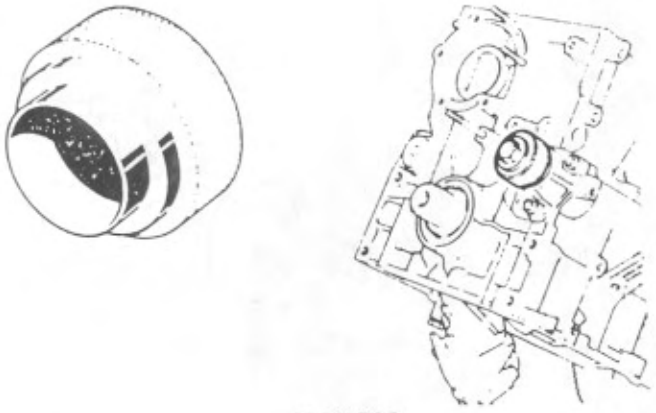
Mot. 521-01
Sleeve clamp

Order Tool No. 700000-52-101 EA



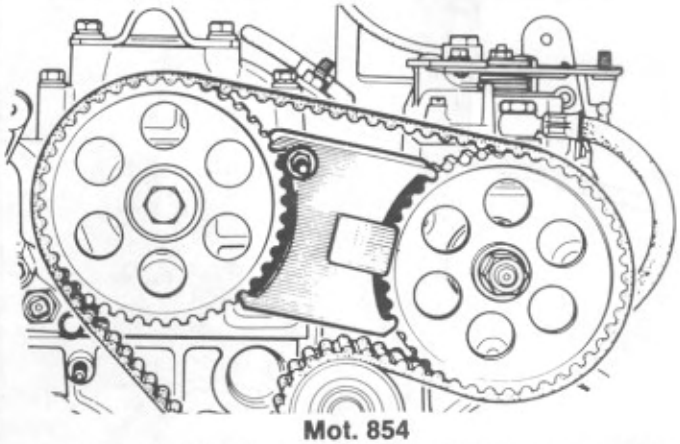
Mot. 852
Socket for cylinder head female capscrews

Order Tool No. 700000-85-200 EA



Mot. 790
Oil seal inserting and intermediate shaft bearing locating tool

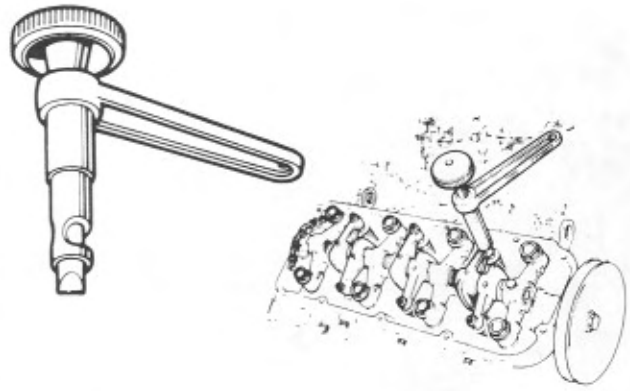
Order Tool No. 700000-79-000 EA



Mot. 854
Camshaft/injection pump sprockets locking plate

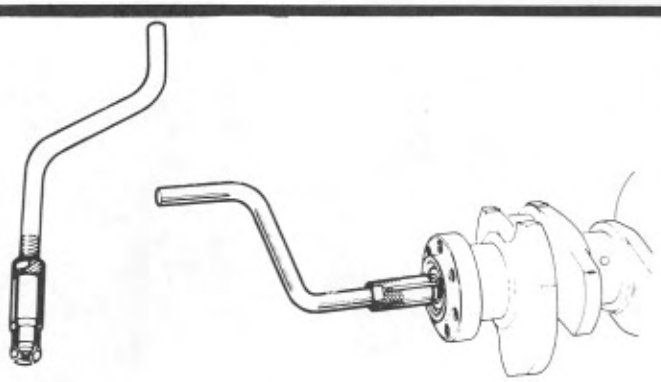
Order Tool No. 700000-85-400 EA

SPECIAL SERVICE TOOLS



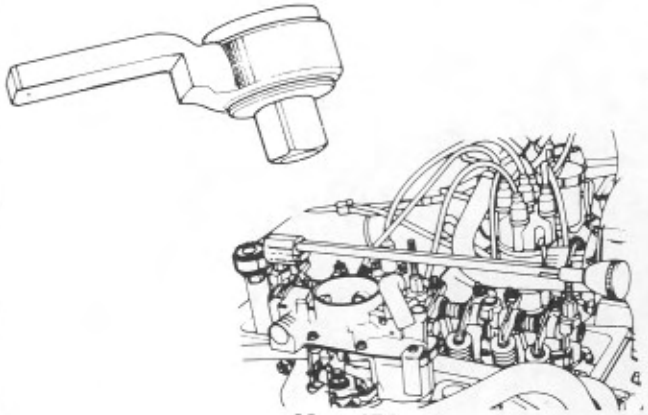
Mot. 647
Rocker arm clearance adjustment wrench

Order Tool No. 700000-64-700 EA



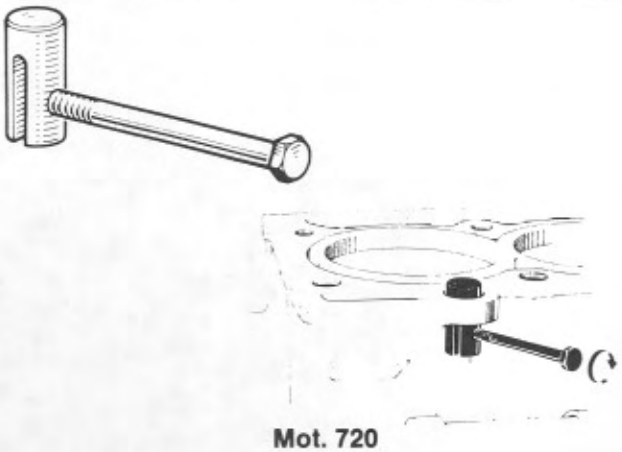
Mot. 11
Crankshaft bushing extractor

Order Tool No. 700010-72-500 EA



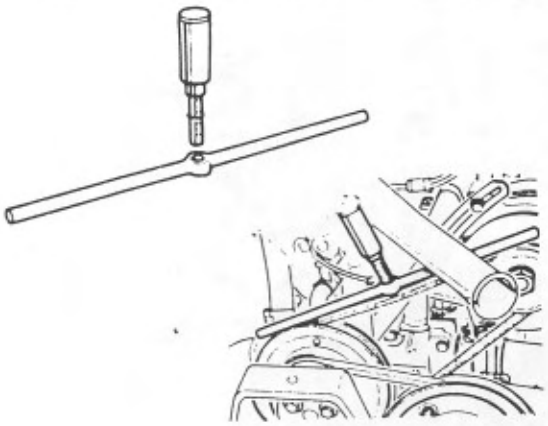
Mot. 475
Offset ratchet for tightening cylinder head bolts
use with 700009-87-700

Order Tool No. 700000-47-500 EA



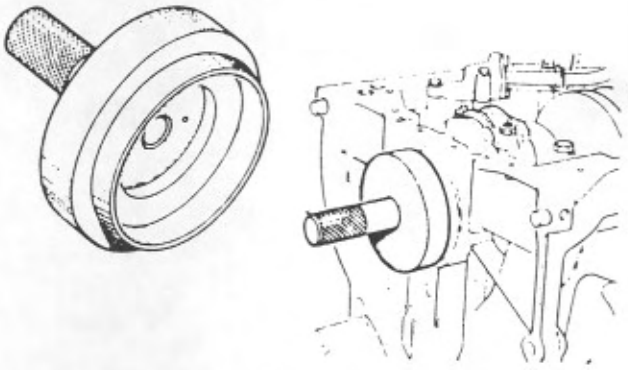
Mot. 720

Cylinder head locating tool
Order Tool No. 700000-72-000 EA



Ele. 346
Drive belt tensioning tool

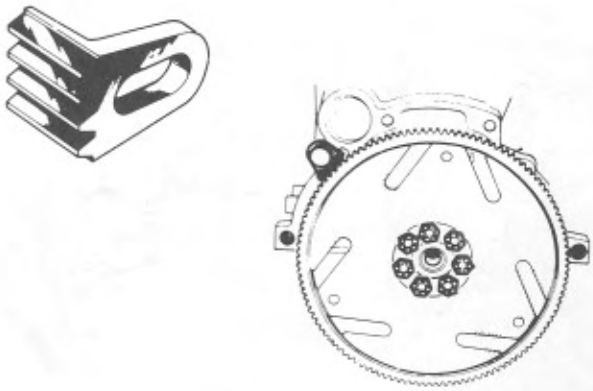
Order Tool No. 700000-34-600 EA



Mot. 788
Crankshaft oil seal inserting mandrel

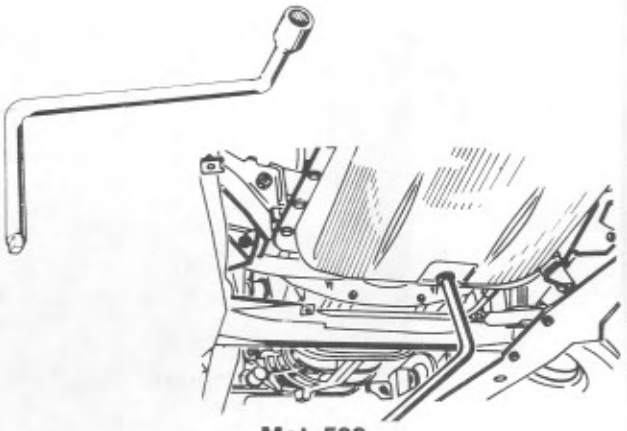
Order Tool No. 700000-78-800 EA

SPECIAL SERVICE TOOLS



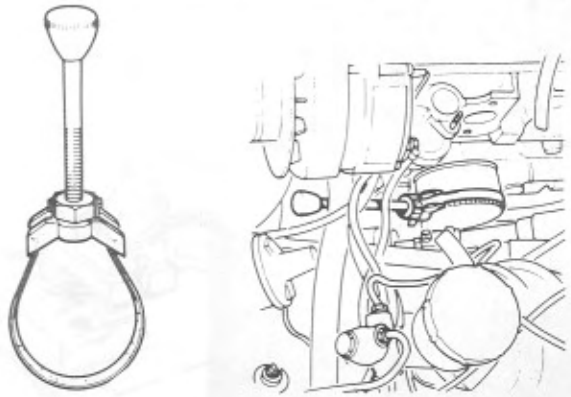
Mot. 582
Flywheel locking sector

Order Tool No. 700000-58-200 EA



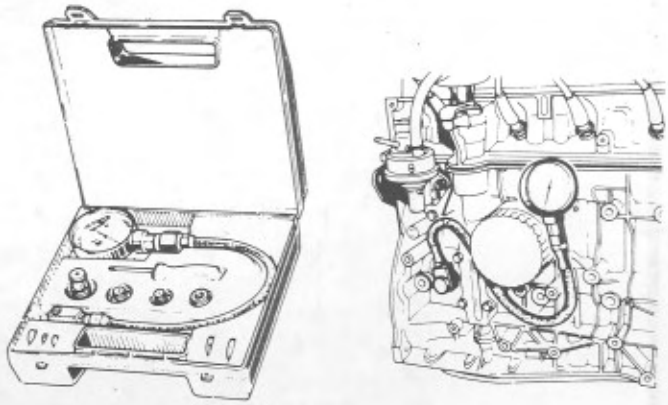
Mot. 593
Engine gearbox drain plug wrench (8 mm square)

Order Tool No. 700000-59-300 EA



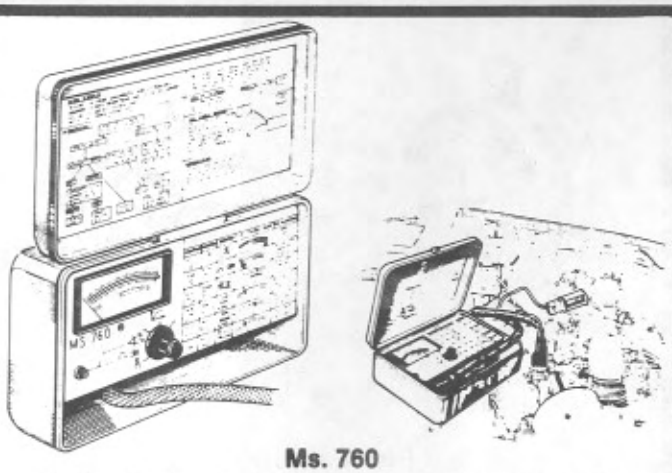
Mot. 445
Oil filter strap

Order Tool No. 700000-44-500 EA



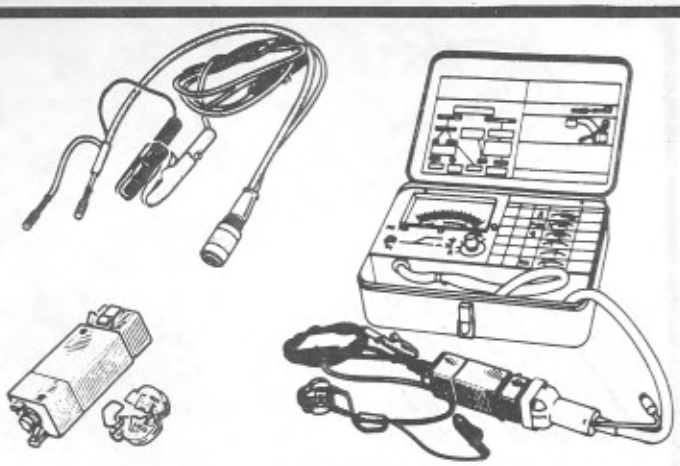
Mot. 836
Boxed oil pressure testing kit

Order Tool No. 700000-83-603 EA



Ms. 760
Engine tuning instrument, initial advance, dwell, contact points resistance with tachometer

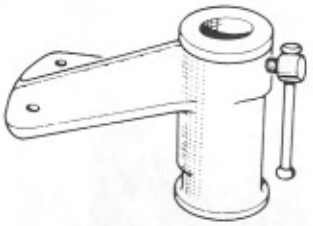
Order Tool No. 700000-76-000 EA



Ms. 881
Diesel tachometer (use with Ms. 760)

Order Tool No. 700000-88-100 EA

SPECIAL SERVICE TOOLS

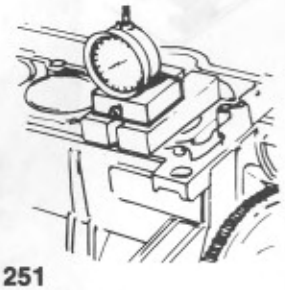


(No Number)

Bench stand for unit support

Order Tool No. 700012-39-500 EA





Mot. 251
Dial indicator support
(for checking sleeve protrusion and position)

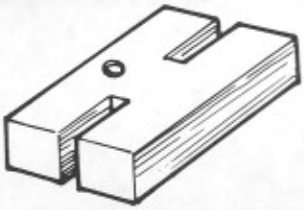
Order Tool No. 700000-25-101 EA

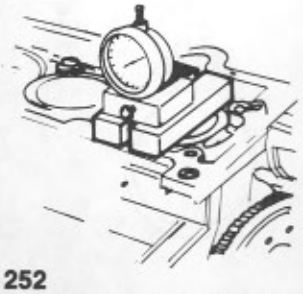


(No Number)

Fork end and swivel stand for bench stand

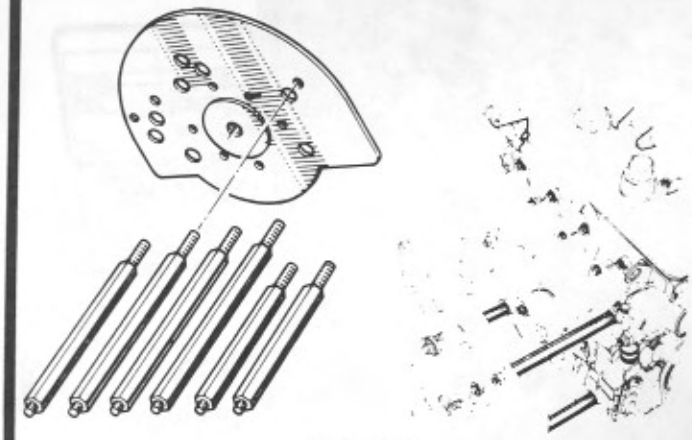
Order Tool No. 700012-09-200 EA





Mot. 252
Thrust plate (for checking sleeve protrusion)

Order Tool No. 700000-25-201 EA



Mot. 792
Engine plate for DESVIL stand

Order Tool No. 700000-79-200 EA



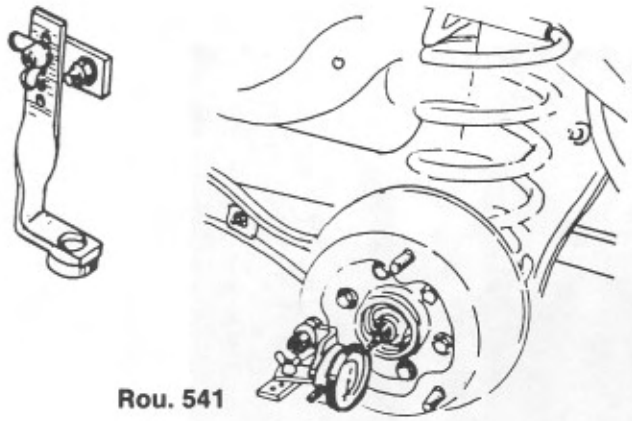


(No Number)

Dial indicator

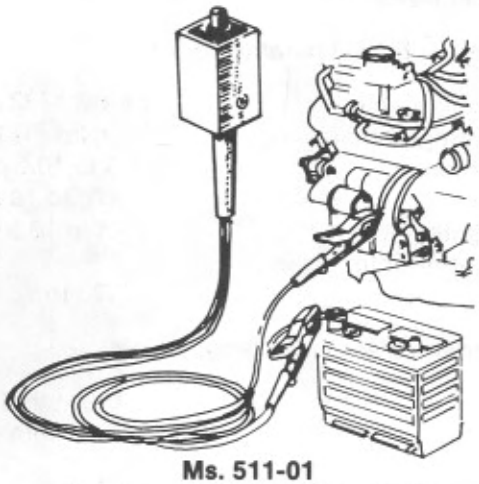
Order Tool No. 72046E-B0-000 EA

SPECIAL SERVICE TOOLS



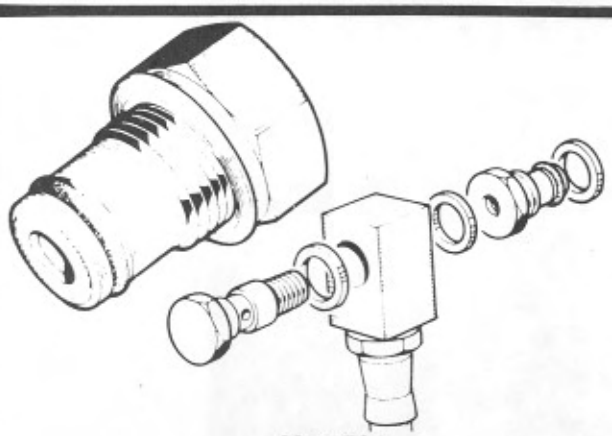
Rou. 541

Dial indicator bracket (For measuring rear hub end play and piston-to-cylinder head clearance)
Order Tool No. 700000-54-100 EA



Ms. 511-01

Remote control starter switch
Order Tool No. 700000-51-101 EA



Mot. 724

Oil pressure testing union set
(for diesel motor)
Order Tool No. 700000-83-601 EA

Cylinder Head

Tightening torque (engine cold):

1st pre-tightening	3 daNm (22 lb./ft.)
2nd pre-tightening	5 daNm (37 lb./ft.)
1st tightening	9.5 to 10.5 daNm (70 to 78 lb./ft.)
2nd tightening (without prior loosening)	9.5 to 10.5 daNm (70 to 78 lb./ft.)

Rocker arm clearances (engine cold):

inlet	0.20 mm (.008")
exhaust	0.25 mm (010")

At least 2 hours after engine has stopped.

Cylinder head height	104.5 + 0.4 mm (4.114" + .0016)
Max. bow of gasket face	0.05 mm (.002").
Pre-combustion chamber protrusion	0.01 to 0.04 mm (.0004 to .0016")

IMPORTANT
The cylinder head may not be resurfaced under any condition.

GENERAL

TIGHTENING TORQUES

Cylinder head stud insertion	1 daNm (7 1/2 lb./ft.)
Main bearing cap bolts	8.75 to 9.75 daNm (65 1/2 to 73 lb./ft.)
Connecting rod cap bolts	6.5 daNm (50 lb./ft.)
Bolts:	
Flywheel	5.5 to 6 daNm (41 to 45 lb./ft.)
Crankshaft pulley	12 to 13.5 daNm (90 to 101 lb./ft.)
Camshaft sprocket	5 daNm (37 lb./ft.)
Intermediate shaft sprocket	5 daNm (37 lb./ft.)
Injection pump sprocket	5 daNm (37 lb./ft.)
Oil pump	4 to 4.5 daNm (30 to 34 lb./ft.)
Rocker shaft	2.5 to 3 daNm (19 to 22 lb./ft.)
Glow plugs	2 to 3 daNm (15 to 22 lb./ft.)
Injector nuts	1.7 daNm (12 lb./ft.)
Rocker shaft oil way plug	2 daNm (15 lb./ft.)
Oil pan bolts	1 daNm (7.5 lb./ft.)
Intermediate shaft retaining bolt	5 daNm (37 1/2 lb./ft.)

Camshaft

Number of bearings	5
End play	0.05 to 0.13 (mm) (.002 to .005")

Valve timing:

inlet valve opens	14° B.T.D.C.
inlet valve closes	46° A.B.D.C.
exhaust valve opens	50° B.B.D.C.
exhaust valve closes	10° A.T.D.C.

with theoretical rocker arm clearances of 0.35 mm (.014").

Pistons

Fully floating wrist pins
Direction of pistons mounting:
turbulence chamber on injector side

Wrist pin length:	75 mm (2.953")
external	28 mm (1.102")
bore	16 mm (.630")

Piston rings:

top compression ring	2 mm (.079") thick
oil ring	2 mm (.079") thick
scraper ring	4 mm (.158") thick

At starter speed with engine hot, the compression pressure is 20 to 30 bars (290 to 435 psi) with a maximum spread of 50 psi per each cylinder.

Connecting Rods

Bearing shell material:	aluminum-tin
End play	0.32 to 0.58 mm (.013 to .022")

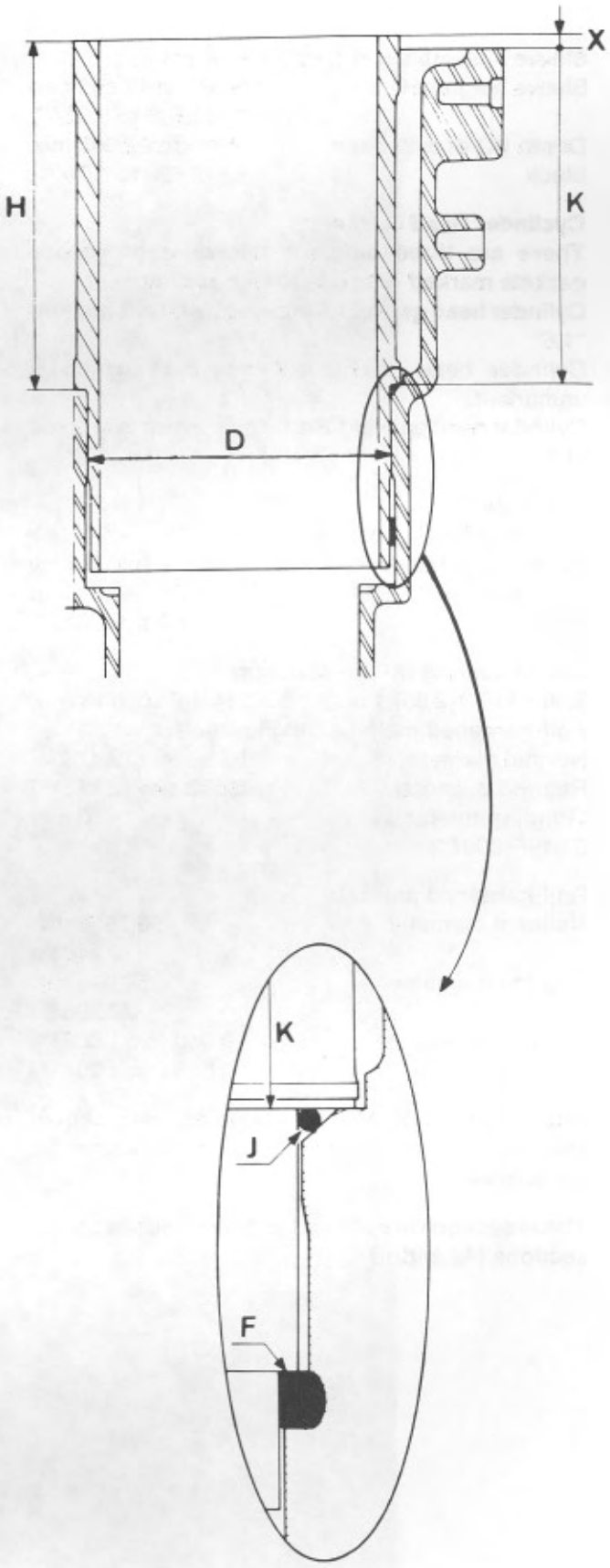
The rod end is bushed and cannot be rebushed.

The crankshaft end and top bearing shell are drilled to allow an oil jet to play on the underside of the piston.

Direction of assembly:
Crankshaft end oil jet hole on side away from turbulence chamber in piston crown.

Sleeves

Bore	86 mm (3.386")
Base locating diameter (D)	93.6 mm (3.685")
Sleeve protrusion (X) without 'O' rings	0.05 to 0.12 mm (.002 to .0047")
Base 'O' ring (J) diameter	1.15 to 1.35 mm (.045 to .053")
Large bottom plastic seal (F)	8.1 to 8.3 mm (.318 to .326")



Sleeve Assemblies in Cyclinder Block

Sleeve height (H)	93.035 to 93.065 mm (3.633 to 3.664")
Depth (K) of cylinder block	92.945 to 92.985 mm (3.699 to 3.700")

Cyclinder Head Gasket

There are three different thickness of service gaskets marked with one to three holes.
Cylinder head gasket 1.6 mm thick which is marked "1,6"
Cylinder head gasket 1.7 mm thick which is unmarked.
Cylinder head gasket 1.8 mm thick which is marked "1,8"

Crankshaft

Number of main bearings:	5
Bearing shell material	aluminum-tin
End play	0.06 to 0.25 mm (.002 to .010")

Thrust bearing thicknesses mm
2.80 (.110")-2.85(.112")-2.90(.114")-2.95(.116")
Roll-hardened main bearing journals:

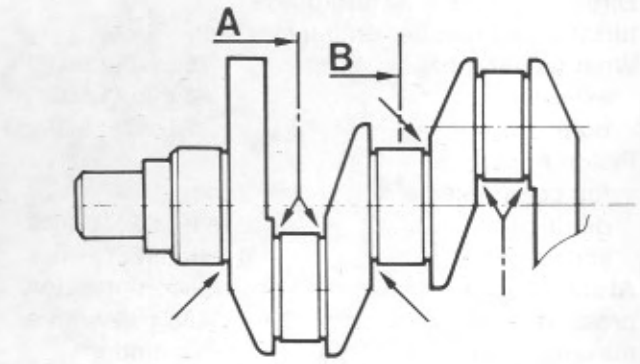
Normal diameter	62.88 mm (2.4755")
Regrind diameter	62.63 mm (2.4657")
Grinding tolerance 0.019(-.0007")	0 mm

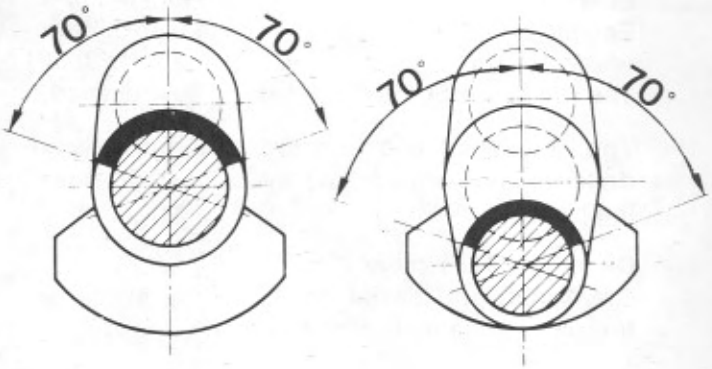
Roll-hardened journals:

National diameter	56.2956 mm (2.2163")
Regrind diameter	56.046 mm (2.2065")
Grinding tolerance	0.010 mm (.0004") 0.029 mm (.0011")

After regrinding, the roll-hardened zone should still remain intact over the 140° zones shown by the arrows.

These sections are defined in the top illustration by sections (A) and (B).

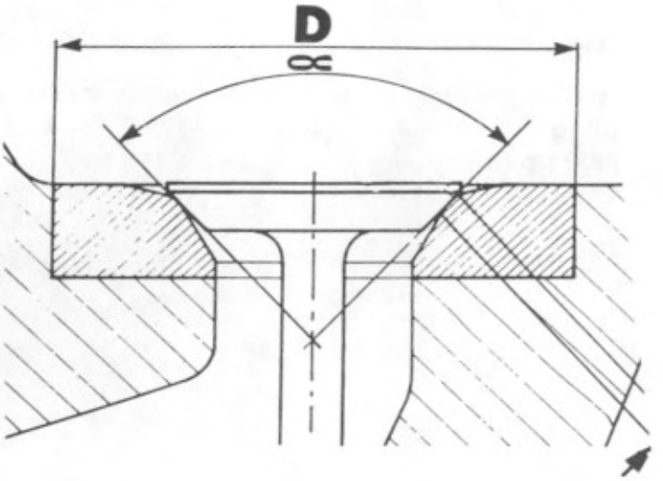




SPECIFICATIONS (CONT.)

Valve Seats

Angle (**x**)	45° each face
Seat widths :	
inlet -	1.6 to 1.9 mm (0.63 to 0.74")
exhaust - (**D**)	1.6 to 1.9 mm (.063 to .074")
External diameter (mm)	
inlet -	42 mm (1.6535")
exhaust -	34.5 mm (1.358")



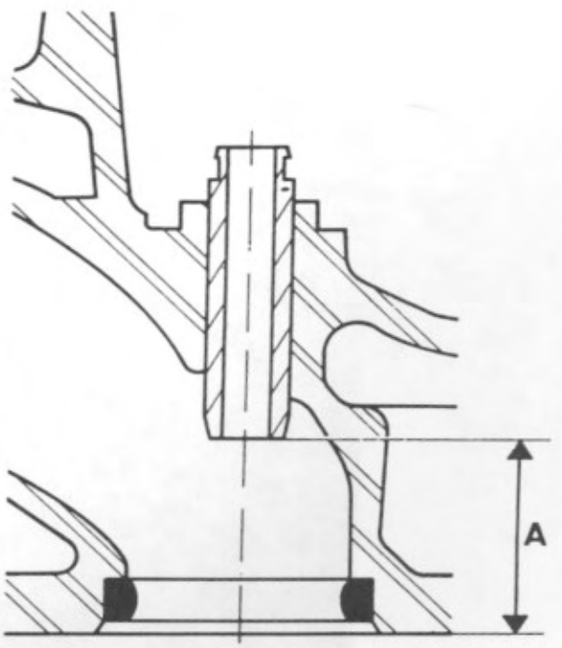
Valve Springs

The inlet and exhaust valve springs are identical.

Free length approx. 45.2 mm (1.779")	
Length under a load of:	
23 daNm (50.6 lbs)	39.3 mm (1.547")
60 daNm (132 lbs.)	29.8 mm (1.173")
with coils touching	27.2 mm (1.070")
Wire diameter	4.25 mm (.167")
Coil internal diameter	21.5 mm (.846")

Valves

Stem diameter	8 mm (.315")
Angle	45° each face
Head diameter:	
inlet -	40.2 mm (1.582")
exhaust -	33.2 mm (1.307")
Recess of valve heads in relation to joint face	0.80 to 1.15 mm (.0315 to .0452")



Valve Guides

Bore	8 mm (.315")
External diameter :	
nominal	13 mm (.515")
epair sizes with 1 groove	13.10 mm (.5157")
vith 2 grooves	13.25 mm (.521")

ll valve guides are assembled with an oil seal on e stem.

sition of inlet and exhaust valve guides in ation to joint face (mm):

32.5 mm (1.279")

rmediate Shaft

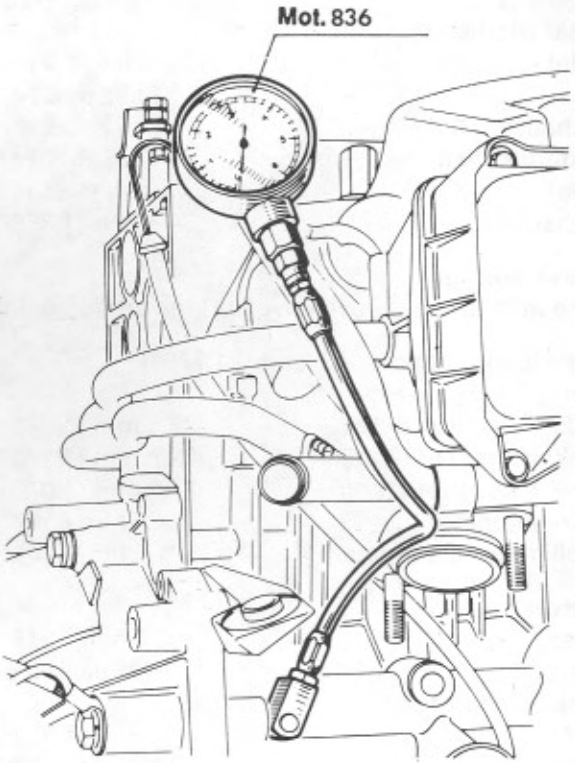
play	0.07 to 0.15 mm (.003 to .006")

Oil Pressure Checking

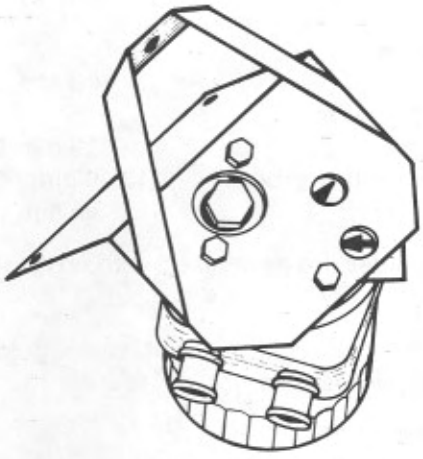
Check the oil pressure when the oil temperature reaches 80° C (176° F).

Run the engine and read off the pressure (bars):

on idling	0.8 bar (11 1/2 psi) min.
at 3,000 r.p.m.	3 bars (43 psi) min.



Alternate Location



Remote Oil Filter

Checking Oil Consumption

Diesel Engine J8S-232:

Oil Consumption Information

Oil consumption of 1 quart to 600 miles during the break-in period is to be considered reasonable. This is due to the design and manufacturing process (metal structure and surface finish) of the cylinder sleeves used in this engine. These sleeves require a lengthy break-in period, which ultimately contributes to extended service life of the engine.

The rate of oil consumption will decrease gradually after the break-in period until approximately 30,000 miles, where it will stabilize to approximately 1 quart per 2,000 miles.

During the engine break-in, oil level must be checked frequently to ensure proper lubrication during this crucial period.

If oil consumption appears to be excessive, check for signs of external leakage and correct any occurance. If no leaks are found, you may wish to conduct a test to determine accurate miles-per-quart oil consumption.

Test Procedure

Certain conditions are necessary while draining oil to ensure complete drainage of oil to ensure test accuracy:

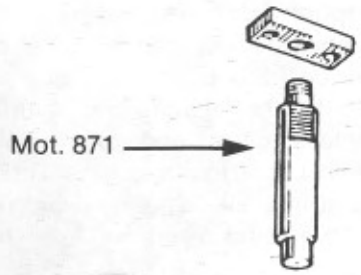
- the engine must be at normal operating temperature
- the dipstick and filler cap must both be removed

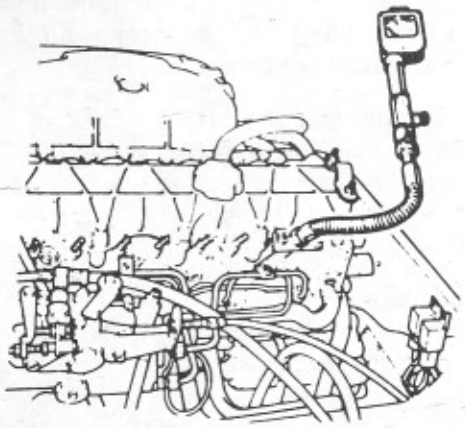
1. Drain the oil, allowing it to drain at least 15 minutes for complete drainage. Reinstall drain plug.
2. Measure the new oil in a graduated beaker and pour it into the engine. Reinstall filler cap and dipstick, making sure they are fully seated.
3. "Seal" the drain plug and filler cap with a dab of paint to check for possible tampering or loosening of plug or cap before next oil change.
4. Ask the owner to return the vehicle upon accumulation of an additional 600 miles.
5. Inspect the filler cap and drain plug for signs of tampering. If seal is broken, go back to step 1. If seals are intact, continue.
6. Drain engine oil, observing engine conditions mentioned previously, and measure drained oil in graduated beaker.
7. Calculate oil consumption by dividing amount of oil consumed into miles traveled.
   Example: 653 mi. ÷ .75 qt. = 870.6 mi./qt.

Compression Check

Adapter for diesel engine compression testing (to be used only with locally obtained compression gauge with scale range of 0-450 psi)

Specification: 290-435 P.S.I.





Using Mot. 871

ENGINE REMOVAL PROCEDURE

Remove or Disconnect

- Battery negative cable.
- Engine air intake hoses.
- Heater intake - disconnect small A/C door vacuum hose.
- All fasteners and wiring from nosepiece grill assembly - screws and bolt along upper edge and 2 bolts on each side behind headlight area on inside of fenders - access from below - unplug lighting from behind.
- Nosepiece.
- Belly pan.
- Transmission air scoop (under main cross-member).
- Upper radiator and condenser (if A/C equipped) supports.
- Four bolts and radiator guard/brace if so equipped.
- Upper fender connecting cross-member - 2 inner bolts at each end and 2 bolts at each mid-attachment point -2 bolts that attach fuel filter (do not remove filter).
- Hood cable from fender connecting cross-member - do not loose spring and plastic retainer.
- Upper and lower radiator hoses and drain antifreeze into a container.
- Front seat both high and low side service valves of air conditioning compressor.
- High side hose from A/C compressor that goes to the condenser.
- High side hose self-sealing disconnect joint.
- Condenser fan wiring if so equipped.
- Radiator and A/C condenser.
- Engine fan.
- Bolts that retain rear front bumper braces to body - leave these bolted to bumper - 2 bolts on each side.
- Bolts that retain bumper extensions to body.
- Six bolts that connect cross-member/bumper assembly to body - remove this as a complete assembly.
- Low side hose to A/C compressor.
- Air conditioner clutch wire connection.
- Exhaust pipe.
- Hoses to remote oil filter.
- Hoses to heater, rear motoraid, and surge/fill bottle.
- Ground strap on engine.
- Engine wire harness at firewall.
- Fuel supply hose to engine - remove at filter assembly - cap this hose.
- Fuel return hose at connection on L.H. frame rail - cap this hose.
- Throttle cable from injection pump.
- Cruise control cable and bracket if equipped.
- Vacuum connections at vacuum pump.
- Positive battery cable from starter.
- Supply hose from power steering reservoir to pump - drain fluid into container.
- Pressure hose from rear of power steering pump.
- Flywheel cover behind engine oil pan.
- Motor mount to transaxle mount on right side - 2 bolts rear of oil pan.
- Motor mount to transaxle mount on left side -1 long bolt and captured nut.
- Bolts that hold transaxle to engine and starter - starter to transaxle bolts have retaining nuts.
- Lock nuts that hold motor mount to cross-member assembly - one on each side - leave complete mount assemblies on engine.
- Air cleaner plastic cover and element.
- Cover open intake manifold with cardboard and tape or equivalent to prevent foreign material from falling in.
- Install engine lift fixture to engine as shown in illustration.
- Lift engine high enough for motor mount studs to clear cross-member mounts - place small 2 x 4 inch blocks under lower edges of transaxle.
- Pull engine forward and out of chassis.

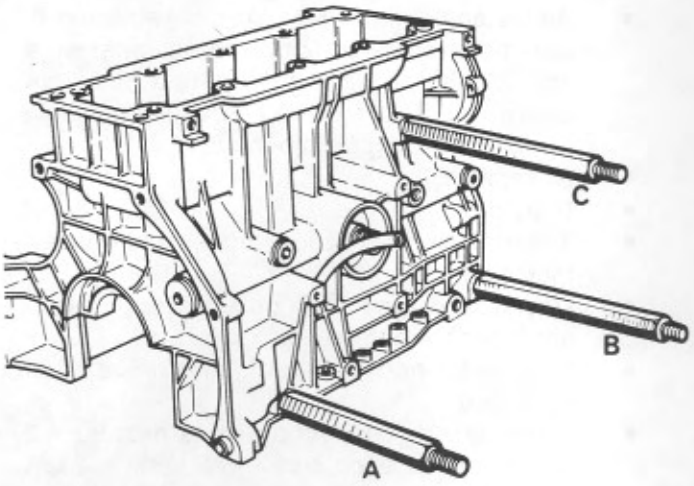
Remove or Disconnect

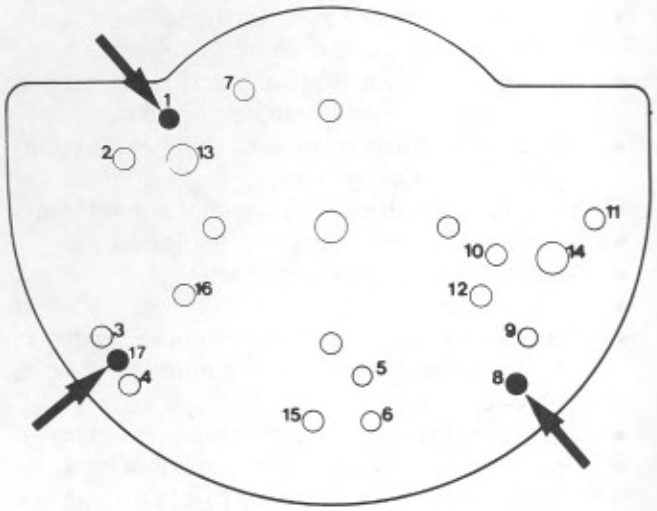
- Intake and exhaust manifolds
- Intake manifold brace
- Air conditioning compressor
- Power steering pump and A/C bracket assembly
- Alternator
- Starter
- Motor mounts
- Dipstick
- Adapter for remote oil filter hoses
- Clutch and pressure plate assembly

Mounting the Engine to the Dismantling Support (Mot. 792)

- Screw studs (A, B, and C) into their appropriate holes in the cylinder block.
- Place the engine with studs in position to the plate making use of holes (1, 8, and 17).

NOTE: These parts may be adapted to an existing engine stand.





WARNING

The fixture must be fastened to something that can safely support the weight of the engine without tipping over, which could cause personal injury or damage to the engine.

PREPARING ENGINE FOR INSTALLATION

Clean

- All accessories to be reinstalled on engine.
- Flush all cooling system parts including radiator if contaminated (see Cooling System Section for procedure).
- Chassis and underhood area.

Replace

- Engine oil cooler, if equipped (located above oil filter), if engine had any kind of metallic piece part failure or fluids in the oil.

> **CAUTION**
>
> Serious internal engine damage will occur to a new or rebuilt engine if the oil cooler is contaminated and not replaced. When in doubt ... replace.

- Engine oil filter.
- Fuel filter - make sure fuel in tank is not contaminated.
- Air filter element after engine is installed.

Inspect and Replace If Necessary

- Fan and alternator belt.
- Power steering belt.
- Surge/fill bottle cap - see Cooling System Section for procedure.
- All hoses and clamps.
- Manifolds for warpage.
- Exhaust pipe sealing surface for cracks and irregularity.
- Clutch, pressure plate, throw-out bearing, and center pilot bearing - see Clutch Section.
- Oil hoses from the engine to the remote filter base.

IMPORTANT

Make sure engine to bell housing alignment sleeves are in place in lower bolt holes on each side.

Make sure starter to bell housing alignment sleeve is in place and tightened.

Leave starter loose to be aligned and tightened after engine is installed.

Install or Connect

- All items removed in "Preparing Engine for Rebuilding" using new gaskets where called for.
- Clutch

IMPORTANT

Use clutch pilot to align clutch - see Clutch Section.

ENGINE INSTALLATION PROCEDURE

IMPORTANT

Make sure transmission is in reverse while installing engine. Turn engine over by hand with a socket and breaker bar on the crankshaft pulley bolt to help align the clutch and transmission pilot shaft. Turn in a clockwise direction only. Take transmission out of reverse after engine is in place.

Tighten

All the starter mounting bolts on the bell housing and on the side of the engine block.

Install or Connect

- Connect and install all parts and assemblies in the reverse order of that described in "Engine Removal Procedure" using new gaskets, seals, etc., where required.

FINAL PROCEDURES AFTER ENGINE INSTALLATION

IMPORTANT

All rubber shrouds and shields must be in place.
Use correct motor oil (See specifications section of vehicle operators manual.)
Use correct type and mixture of antifreeze. (See specifications section of vehicle operators manual.)
Make sure cooling system is properly bled of air and the correct level. (See Cooling System Section)

CAUTION

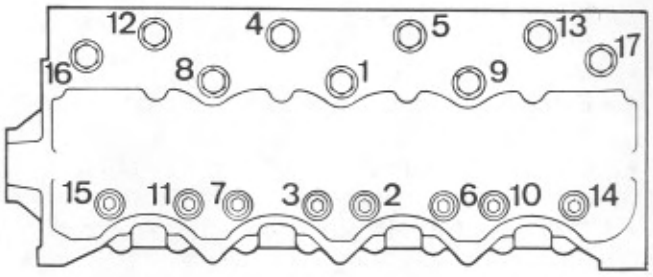
It is exteremely necessary to make sure the cooling system has all the air bled out of it and the proper level of coolant. Serious engine damage due to overheating will occur if this is not properly done.

Pressure check cooling system for leaks (See Cooling System Section).
All wiring and grounds are properly connected.
Check headlight alignment.
Air conditioning is properly charged and working correctly . (See Air Conditioning Section) Make sure that all removed body parts and bumper fit correctly and hood latch pin properly aligns with the fender connecting cross-member. Adjust hood latch pin if necessary.

When engine is reinstalled in vehicle:

- - adjust all controls
- Run engine for 20 minutes than allow it to cool down for 2 hours before torque retightening the cylinder head. (Refer to chapter "Cylinder Head - Reinstallation".)
- Recheck the rocker arm clearances.

The vehicle need not be returned to workshop for retightening the cylinder head if the above operation is carried out.



GENERAL INFORMATION

MATERIAL

COMPOUND	APPLICATION
Parts cleaner solvent	Component cleaning
Gasket seal solvent	Cleaning cylinder head joint face
Petroleum Jelly	Clutch shaft and drive shaft splines
Loctite® or equivalent	Bolts for flywheel, crankshaft pulley, intermediate shaft cover
	Inlet manifold studs
	Water pump studs and bolts
Loctite® or equivalent	Pilot bearing in crankshaft
Loctite® or equivalent	Flywheel thrust face on crankshaft side
Heatproof sealer	Exhaust pipe joints

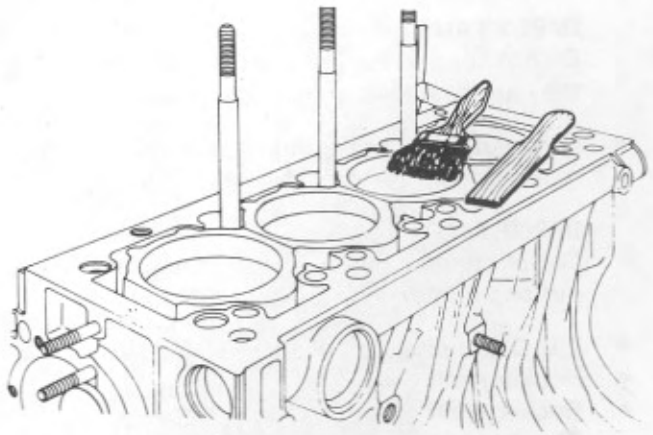
IMPORTANT

Components To Be Replaced at Each Disassembly

- Flywheel bolts
- Flywheel bolts lockplate
- Connecting rod crankshaft bolts
- Rocker shaft oil filter
- All gaskets and seals

Cleaning Engine in Place

- Protect the timing belt and alternator from water and cleaning fluid.
- Take care not to let any water enter the inlet manifold.
- Cleaning upper cylinder block surface when replacing cylinder head.
- Great care must be taken with this operation to prevent foreign matter from entering the channels for pressure-fed oil to the rocker shaft (channels in cylinder block and head) and the oil return channel.
- If the above device is disregarded, the rocker shaft filter or rocker arm oil jet holes may become choked leading to rapid cam and rocker arm finger wear.



Installing Threaded Inserts

- Threaded holes in all engine components may be restored using thread inserts such as Heli-Coil® or equivalent.

ENGINE TEARDOWN

Remove or Disconnect

- Crankcase vent hoses and attaching brackets
- Water lines to injection pump
- Supply water pipe on right side of engine from water pump to the rear
- Crankcase vent cover on right side
- Timing belt cover

IMPORTANT
Retain spacer sleeves from cover mounting studs. Also retain special spacer washers in rubber grommets in timing belt cover.

- Thermostat housing from cylinder head and by-pass hose from it to water pump.
- Thermostat from thermostat housing
- Loosen timing belt tightener
- Timing belt and discard
- Fuel return hose from injection pump and injectors

IMPORTANT
The return union to injection pump hollow connector is a restricted fitting and must not be mixed with other union connection parts. (See diesel engine injection equipment section).

- All injection lines

IMPORTANT
Do not bend or dent any of the injection lines. If they are damaged, they must be replaced.

- Complete injection pump assembly including mounting bracket from the side of the block

IMPORTANT
Cap all connections on injection pump to prevent dirt and contaminants from entering.

- T.D.C. pin plug on left side
- Rocker shaft cover
- Rocker shaft
- Plug from rear of rocker shaft - remove screen and discard

Remove or Disconnect

- Bolts and nuts retaining cylinder head

Tool Mot. 852

IMPORTANT
Do not loose washers under cylinder head bolts and nuts.

- Cyclinder head

IMPORTANT
Do not pry on or under head to remove it. Use a soft rubber or composition hammer to free the head from the head gasket.

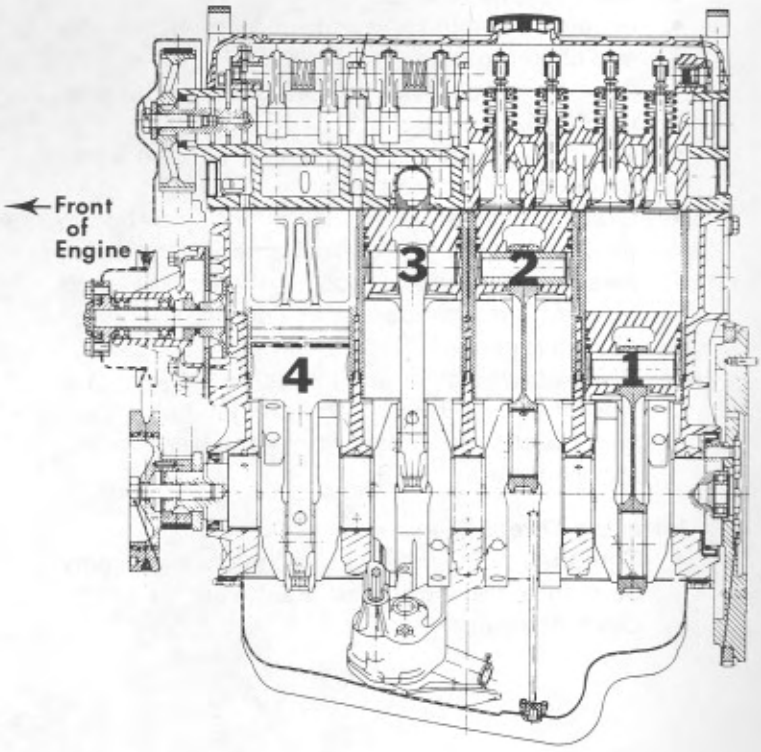
NOTE: See page B3-4 for cylinder head disassembly.

- Pulley from crankshaft

Tool Mot. 852

- Air conditioner belt and discard
- Flywheel, discard bolts - not to be reused

IMPORTANT
Hand stamp the cylinder number on the upper surface of each piston and sleeve. The pistons, sleeves, and connecting rods are not numbered. The pistons and sleeves should be reassembled in the same order that they were removed if they are to be reused. The cylinders are numbered 4 through 1 from front to back.



ENGINE TEARDOWN (CONT.)

Remove or Disconnect

- Install sleeve retaining tool

  Tool Mot. 521-01

- Sprocket from intermediate shaft

  Tool Mot. 855

  IMPORTANT
  Pry sprocket from intermediate shaft being careful not to damage or gouge block or sprocket.

- Woodruff key from intermediate shaft
- Intermediate shaft oil seal housing - remove seal from housing and discard
- Vacuum pump - remove o-ring and discard
- Angle drive gear from under vacuum pump
- Retaining fork that holds intermediate shaft in place
- Intermediate shaft
- Timing belt tightener assembly
- Water pump
- Hose (and block heater if equipped) housing from rear of water pump
- Timing sprocket and air conditioning drive pulley from crankshaft

  IMPORTANT
  Pry off sprockets from crankshaft being careful not to damage or gouge the sprockets or cylinder block surfaces.

- Woodruff key from crankshaft
- Oil pressure sender
- Oil gallery plugs from side and rear of block - 4 on side; 1 in rear
- Turn engine on stand
- Oil pan
- Oil pump and oil pump drive shaft
- Connecting rod cap bolts
- Connecting rod bearings
- Main bearing bolts

CAUTION

The rod and main bearing caps must be kept in the order they were disassembled. These items are not marked! This must be done to insure proper reassembly. Reminder: Cylinders are designated 4 to 1 from front to rear - #4 being closest to the timing belt.

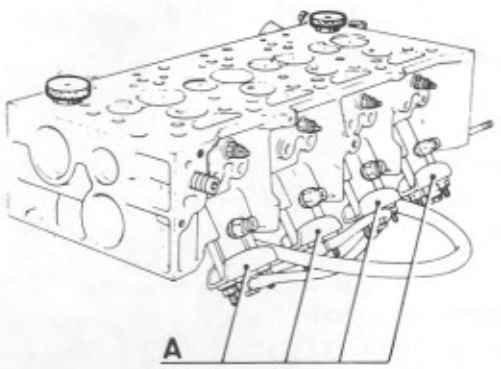
- All main bearing caps
- Crankshaft oil seals and discard
- Crankshaft
- Remove sleeve retaining Tool No. Mot. 521-01
- Sleeve and piston assemblies from upper side of block
- Piston and rod assemblies from sleeves

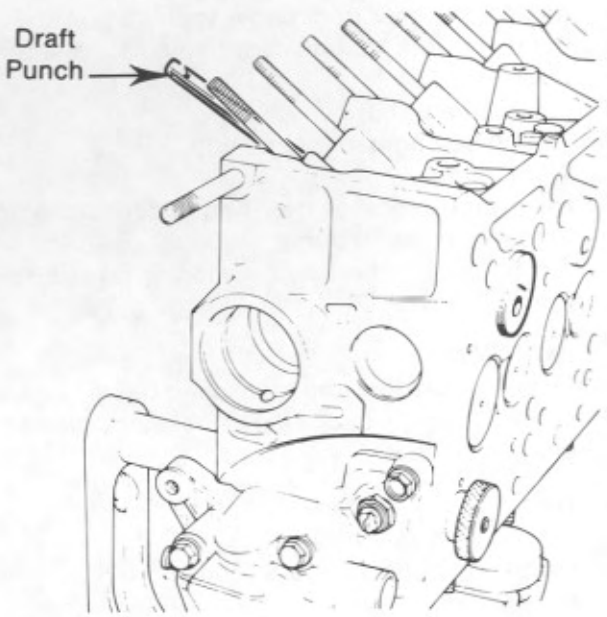
CYLINDER HEAD OVERHAUL

Dismantling

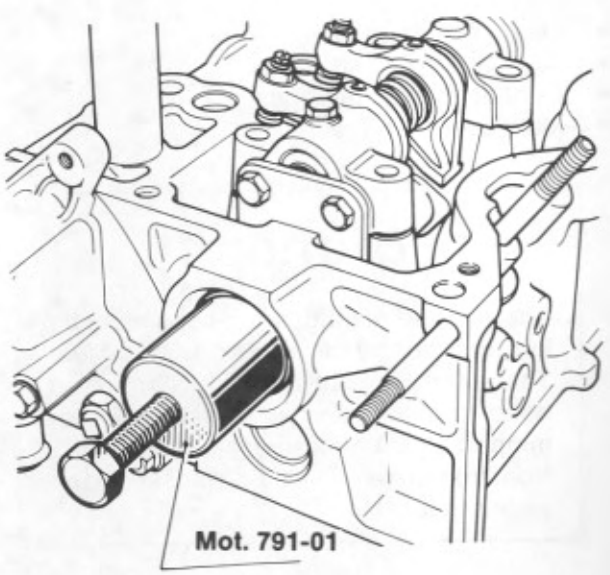
Remove or Disconnect

- Thermostat housing
- Heater plug wires
- Heater plugs
- Fuel return pipes assembly
- Injectors and holders (A) with seals
- Flame shield washers (between injectors and cylinder head)
- Pre-combustion chambers; if necessary, insert a drift through the injector hole and tap lightly to remove.
- Timing sprocket





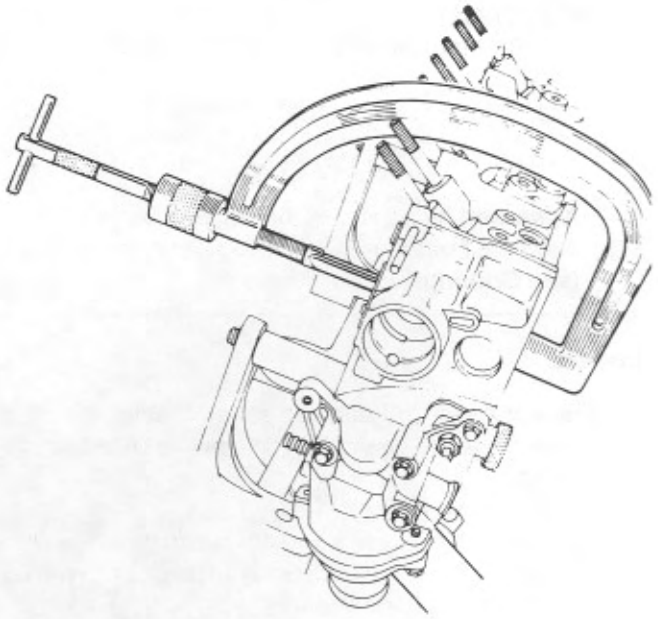
- Timing sprocket (from camshaft) using Tool Mot. 854
- Oil seal using Tool Mot. 791-01
- And camshaft



CYLINDER HEAD OVERHAUL (CONT.)

Remove or Disconnect (Cont.)

- Compress the valve springs using spring compressor
- Remove the split cotters, top cups, springs, bottom cups and valves
- Lay all the parts out in their correct order



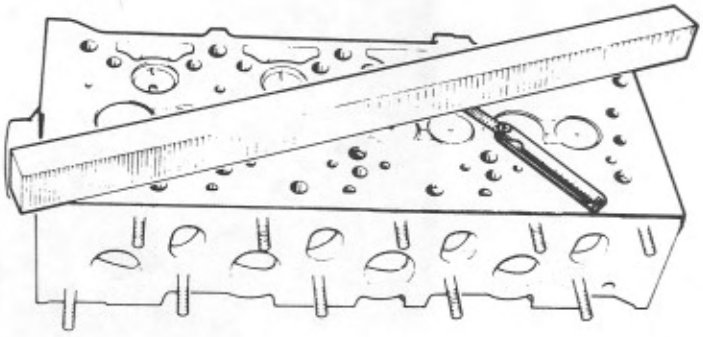
Cleaning

It is very important not to scrape gasket faces on aluminum parts.

- Use a gasket solvent to dissolve any part of the gasket still remaining stuck to the cylinder. Brush the liquid onto the area to be cleaned, wait about ten minutes, then lift the remnants off with a piece of wood. Gloves should be worn during this operation.
- The valve chambers can be cleaned with a very fine wire brush in an electric drill.
- Surfaces can also be cleaned using a soft abrasive scouring pad such as Scotchbrite® or equivalent.
- All grease, oil, carbon should be removed with a good quality cleaning solvent and thoroughly dried with compressed air.
- Thoroughly clean and flush camshaft and its oil passages - dry with compressed air.

WARNING

Always keep sparks and open flame away from commercial solvents and cleaners to prevent fire from occuring. Always follow manufacturer's instructions when using these types of products. Safety goggles should always be worn when working with compressed air.



Measure

Checking the gasket face:

- Remove the pre-combustion chambers if installed.
- Use a straight edge and a set of feeler gauges to check if any bow is present.
  Max. permissible bow: 0.05 mm (.002").

IMPORTANT
Cylinder head resurfacing is not permitted.

> **CAUTION**
>
> A warped head could be caused by an overheat condition. Check cooling system (see Cooling System Section).

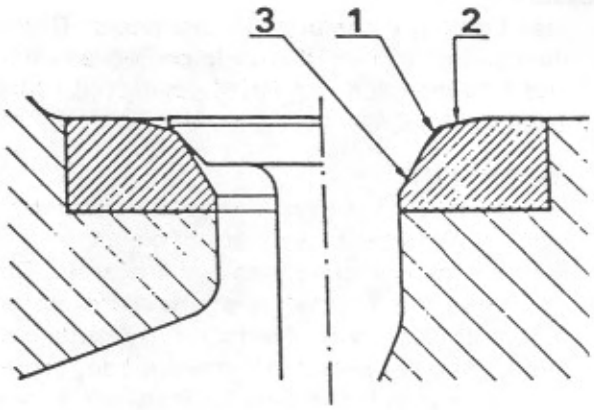
Inspect

- Inspect head for heat and stress cracks
- Inspect valve seats for excessive wear and cracks
- Inspect valve guides
- Inspect cam bearing bores for scoring and wear. If the bores are excessively scored or worn, replace the cylinder head.
- Inspect camshaft lobes and journals for excessive wear and scoring. If the lobes are excessively worn or scored, be sure to inspect the rocker arms for similar wear.

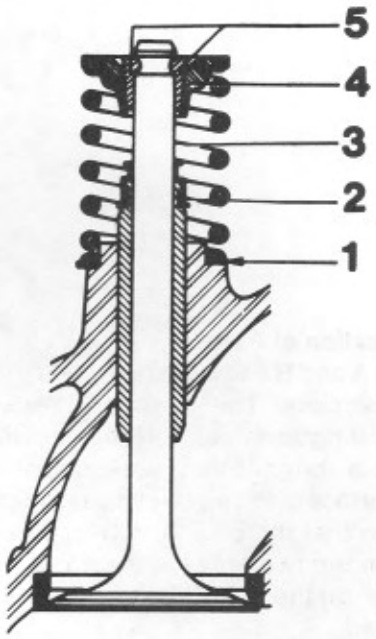
Valve and Seat Resurfacing and Measurement

IMPORTANT
The valve seats must only be reground by a very small amount otherwise the compression ratio will be reduced.

Once a satisfactory seat has been cut (1), the width is reduced with the appropriate cutter. Make a cut around (2) at first then underneath at (3) to obtain the current width (refer to Subsection B2 "General Information").

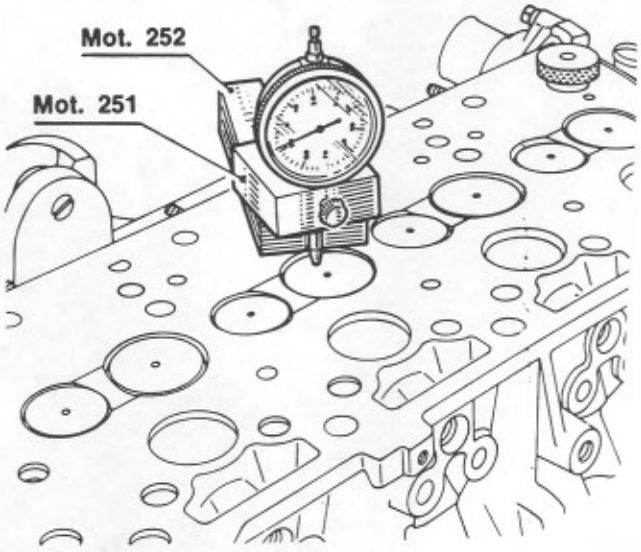


- Lightly regrind the valves to their respective seats. Clean all the components carefully and reassemble them.
- Lubricate the parts.
- Put an oil seal (2) over each valve guide
- Insert the new valves, base washers (1), and valve springs (3) (identical for inlet and exhaust) and cup washers (4).
- Use a valve spring compressor tool to compress the springs.
- Insert the split-cotters (5) (identical for inlet and exhaust).



Measure

- Check the amount of recess of each valve in relation to the cylinder head joint face using Tools Mot. 251 and Mot. 252.
- It should be between 0.80 and 1.15 mm (.0315 and .0452") in each case.



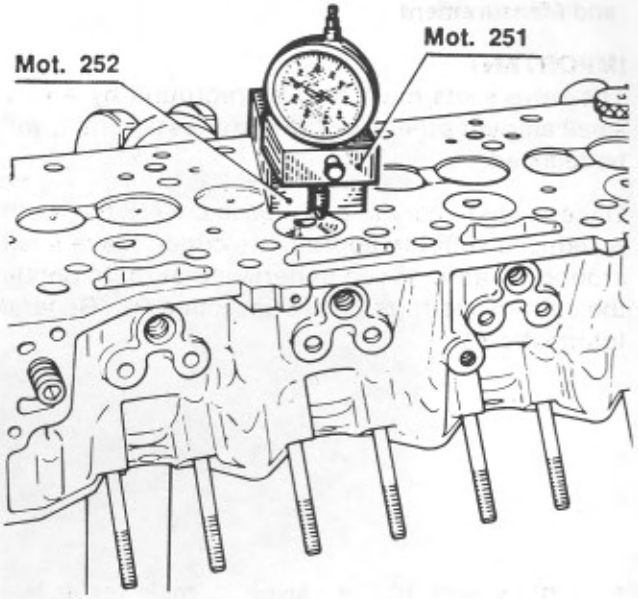
Valve and Seat Resurfacing and Measurement (Cont.)

Measure

- Insert the pre-combustion chambers. Check their protrusion which should be between 0.01 and 0.04 mm (.004 and .0016") using Tools Mot. 251 and Mot. 252.

IMPORTANT

When replacing the pre-combustion chambers in the N.A. diesel, care must be taken to ensure that the proper chambers are installed. The internal surfaces of these two parts are machined differently to achieve the required results corresponding to the method of aspiration. Therefore, if incorrect chambers are installed, engine performance may be severely impaired.



Identification of Parts

Figures A and B show the two types of pre-combustion chambers. The internal differences are not easily distinguishable. The interior of the N.A. chamber has a rough, "cast" appearance, whereas the inner surface of the turbo chamber is smoother. You will note that the only readily apparent difference between the two types is the small indentation or "dimple" on the top of the turbo diesel chamber as illustrated.



FIGURE A
Naturally Aspirated Diesel
PRECOMBUSTION CHAMBER
J8S-232

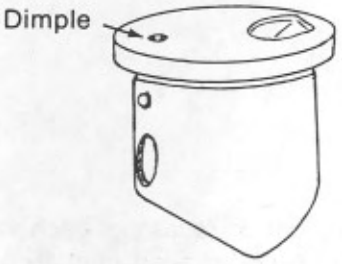


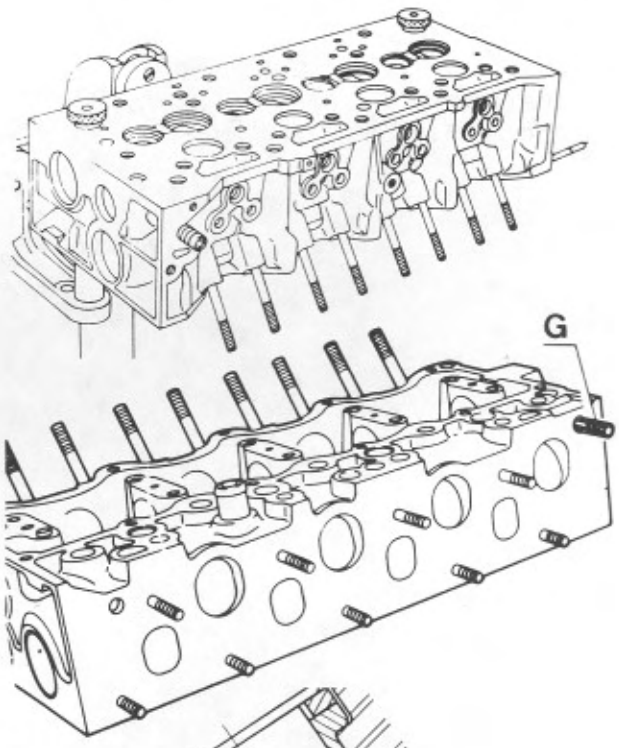
FIGURE B
Turbo Diesel
PRECOMBUSTION CHAMBER
J8S-234

Install or Connect

Reassembling

- Insert the studs for the injector holders and manifolds in the new cylinder head.

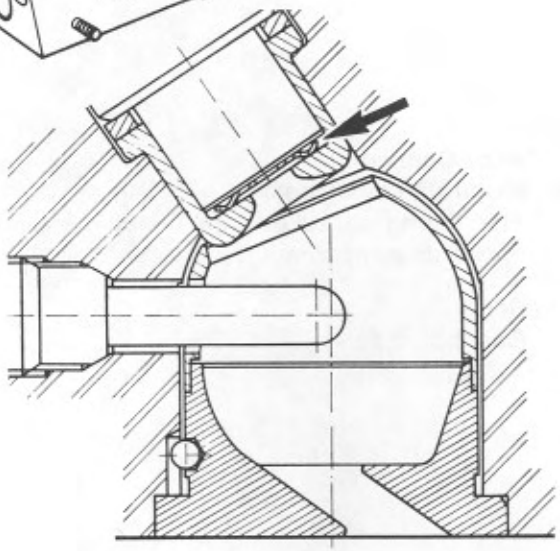
IMPORTANT
As the threaded holes for inlet air manifold stud (G) comes out into the cooling circuit, smear the threads on this stud with 1 or 2 drops of a thread locking compound such as Locktite® or equivalent.



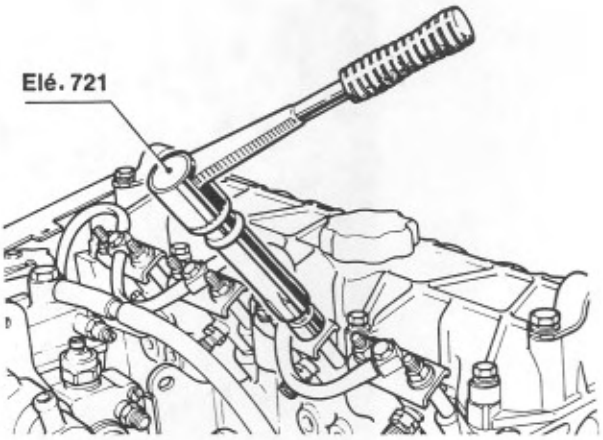
Reassemble

- The heater plugs and their wires
- The injector flame shield washers the correct way around as shown at right
- Remove glow plug before changing pre-combustion chamber.

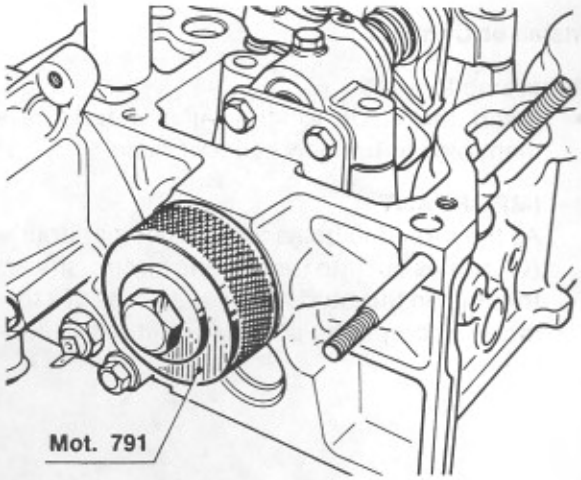
IMPORTANT
Flame shield washers must be replaced upon each injector removal.



- The injectors and injector holders with new copper washers; torque tighten the nuts using Wrench Ele. 721
- Tighten both nuts evenly
- The fuel return lines using new copper washers
- The thermostat housing using a new paper gasket.



- The camshaft
- And its oil seal using Tool Mot. 791

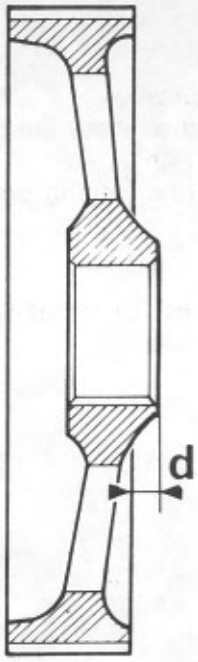


Install or Connect

- Woodruff key on cam
- The timing sprocket with offset (d) pointing outwards away from the cylinder head

Tighten

- Cam bolt 5 daNm (37 ft. lbs.)

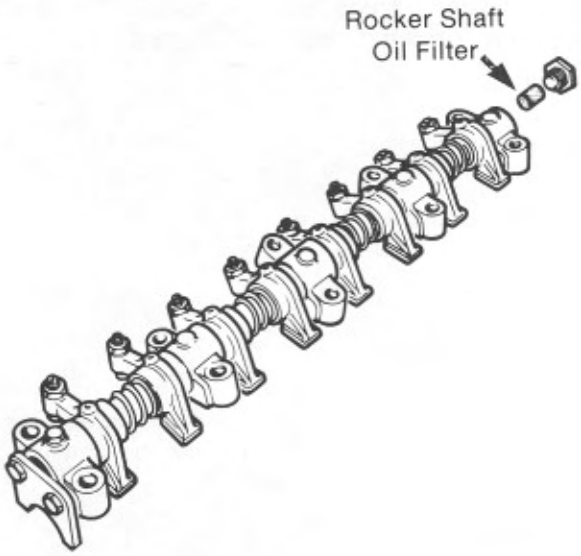


ROCKER ARM SHAFT

DISMANTLING - REASSEMBLING

IMPORTANT

The rocker shaft oil filter must be changed every 64,360 km (40,000 miles) and when every repair operations are undertaken as a result of metal particles being found in suspension in the oil. If the above incident occurs, then the engine oil and main oil filter should be changed as well. Use Clamp Tool Mot. 445 on the oil filter.



Dismantling

- Unscrew the plug on the end of the rocker shaft and remove the filter. Separate the parts and lay them out in order.

Clean

- All arms and springs with solvent and dry with compressed air
- Shaft inside and out

Inspect

- Arms for excessive wear
- Shaft for wear and grooves

IMPORTANT

Identifying Parts in the Assembly.

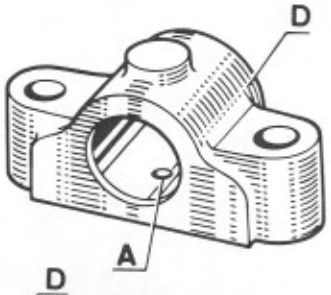
Rocker shaft bearings:

Bearing 1,2,3, and 4 are identical and they have:

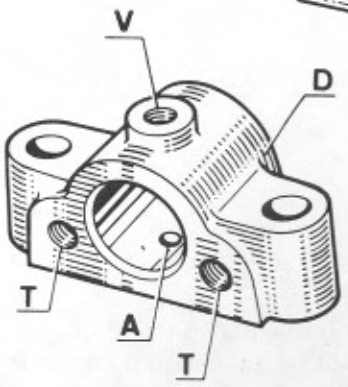
- one oil feed hole (A) for the matching camshaft bearing
- An offset (D) facing the flywheel

Bearing 5 has an addition:

- Two threaded holes (T) to hold the shim which restricts camshaft end play
- A threaded hole (V) for the set bolt which aligns the rocker shaft



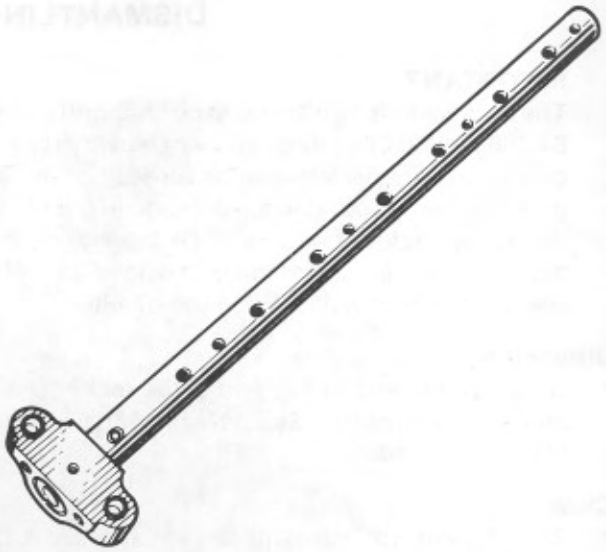
Bearing #1-4



Bearing #5

ROCKER ARM SHAFT

This set bolt aligns the rocker shaft. The camshaft bearing oil feed holes face the camshaft (the oil passes through the rocker shaft bearings).



Rocker Arms:
Inlet and exhaust rocker arms are identical. They have a calibrated hole to lubricate the camshaft cams.

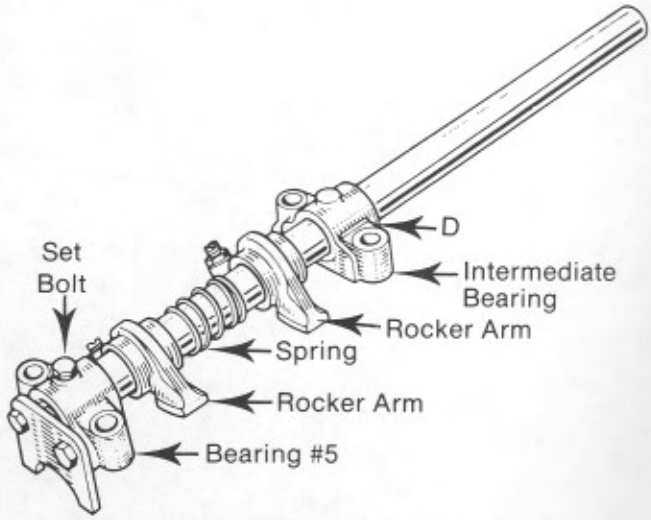
Reassembling

- Slide the following onto the rocker shaft:
  - bearing 5; insert the set bolt so that oil holes in the shaft are underneath
- Then attach:
  - an inlet rocker arm
  - a spring
  - an exhaust rocker arm

One intermediate bearing with its offset (D) facing the flywheel, and so on, terminating with the plug and filter.



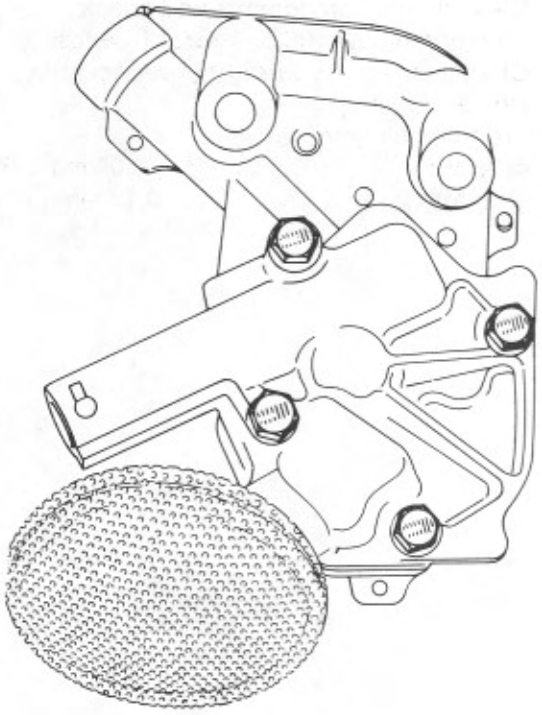
Tighten
Torque tighten the plug to 2 daNm (15 lb./ft.). This torque setting must not be exceeded because the rocker shaft is only prevented from turning by the set bolt in bearing (5).



Rocker Arm Assembly Sequence

OIL PUMP

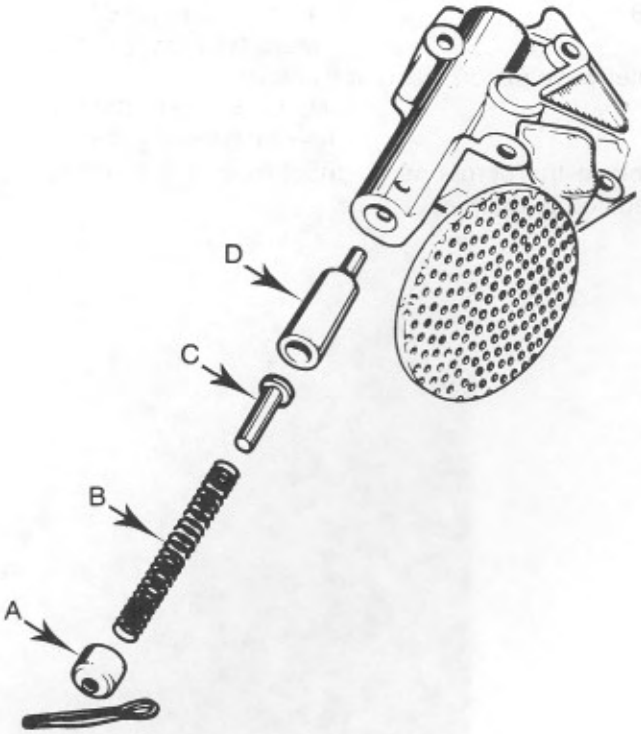
OVERHAULING



Dismantling

- Unscrew the cover bolts and remove the oil pump gears.

- Remove the relief valve cotter pin and withdraw:
  - the cup A
  - spring B
  - spring guide C
  - and piston D



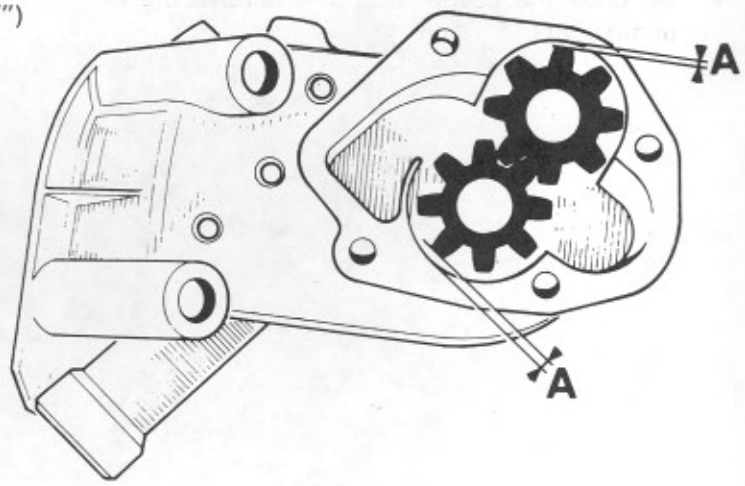
OIL PUMP

OVERHAUL (CONT.)

Inspection

- Clean all the components and check:
  - the pump cover joint face for trueness
- Change any parts worn or unserviceable.
  Check:
  - running clearances

  at A: Min.: 0.05 mm (.002")
  Max.: 0.12 mm (.0047")



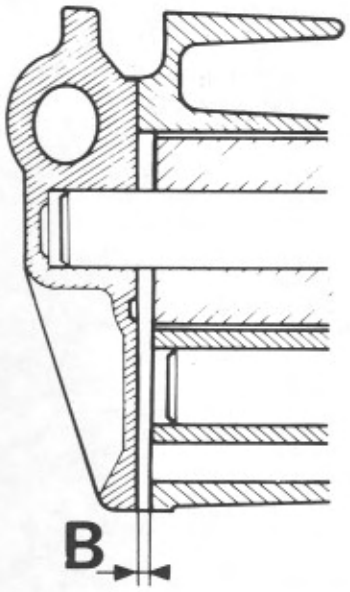
Gear End Float

at B: Min.: 0.02 mm (.001")
Max.; 0.10 mm (.004")

Relief valve piston clearance in its bore:

Min.: 0.03 mm (.0012")
Max.: 0.08 mm (.0031")

Replace the components concerned if not within specified tolerances.



Clean

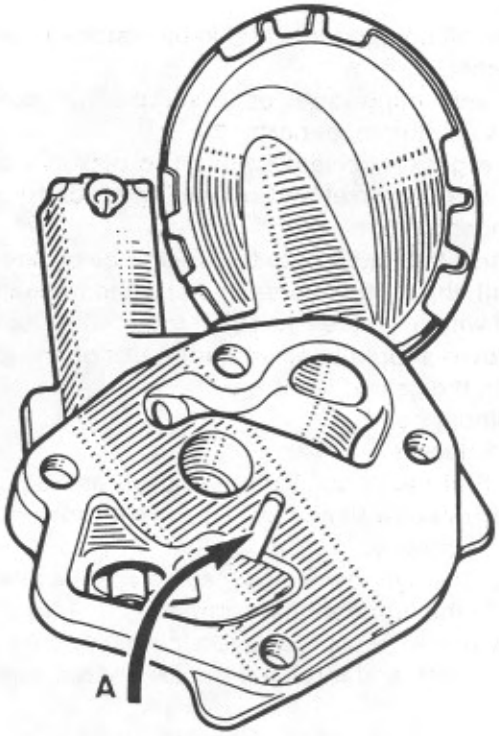
Clean all parts with a good quality cleaning solvent and dry with compressed air.

OIL PUMP

OVERHAUL (CONT.)

Reassembling

- Special points
- The oil pump cover is peculiar to this engine; note recess shape (A).
- Lubricate all components.
- The relief valve spring retaining cup is mounted over the spring.

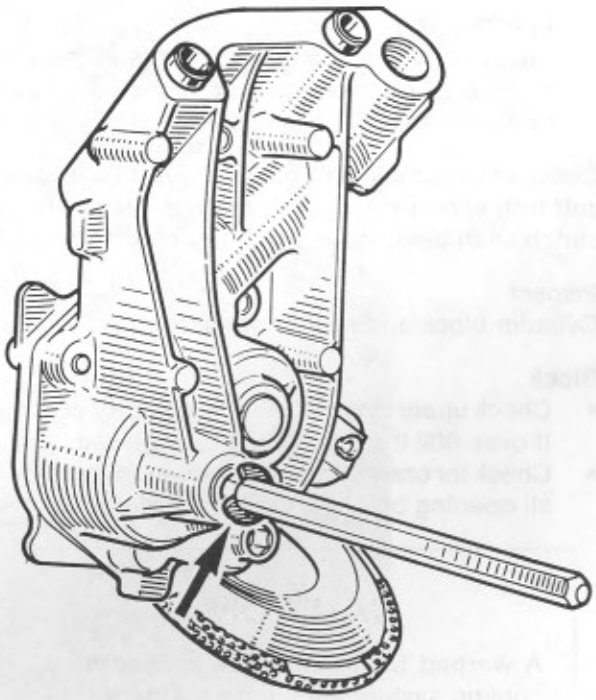


IMPORTANT

Special points concerning reassembly:

- the oil pump drive shaft has a circlip (this acts as a limit stop for the shaft in the pump)

The driveshaft must be mounted with circlip adjacent to the oil pump. Torque tighten the bolts using a torque wrench.



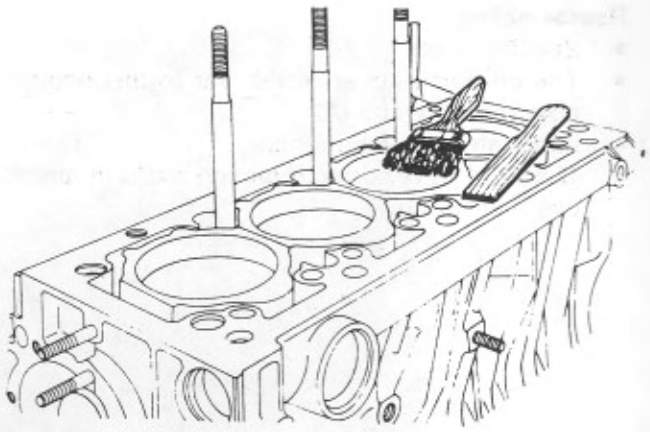
Tightening Torque

Oil pump bolts:	4 to 4.5 daNm (30 to 33 lb./ft.)

Clean and Inspect

Clean

- Clean all components and keep matched items together.
- It is very important not to scrape the gasket faces on aluminum parts.
- Use a gasket solvent solution to dissolve any part of the gasket still remaining stuck to the cylinder block.
  - Brush the liquid onto the area to be cleaned;
  - wait about 10 minutes, then lift the remnants off with a wooden scraping tool.
  - Gloves should be worn during this operation.
- Clean the gasket faces on:
  - cylinder head
  - and sleeves
- A soft abrasive scouring pad such as Scotch-brite® or equivalent may be used with solvent to clean surfaces.
- Clean the cylinder block, paying special attention to the lubrication channels.
- Blow dry with compressed air making sure all oil, solvent, and foreign particles are removed.



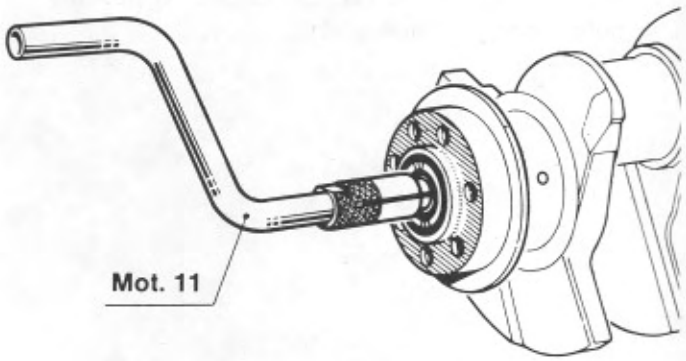
WARNING

Always wear safety eyewear when working with compressed air.

IMPORTANT

Always clean new machined parts in the same manner as reusable parts to make sure that no foreign material is on or inside.

Clean all the crankshaft oil galleys with a length of soft iron wire. Protect or extract, if necessary, the clutch shaft bearing. Use Extractor Mot. 11.



Inspect

Cylinder block and related parts inspection.

Block

- Check upper cylinder block surface for warpage. If over .002 the block must be replaced.
- Check for cracks and irregularities in and around all opening bolt holes and on surfaces.

CAUTION

A warped block could be caused by a cooling system malfunction. Check thoroughly (see Cooling System Section)

CYLINDER BLOCK AND RELATED PARTS (CONT.)

Crankshaft

- Check for: Evidence of excessive overheating. If found, replace the crankshaft since the heat treatment has probably been destroyed.

  Check for: Scoring of bearing journals.

  Check: Oil seal contact surface for roughness or grooving.

NOTE: Any imperfections of the oil seal contact surface will result in oil leakage. Slight ridges the oil seal contact area may be cleaned up with emery cloth and crocus cloth. If the grooves are too deep the crankshaft must be replaced.

- Inspect for wear of thrust washer surface area.
- Measure all journals - see specs. in "General Section."

NOTE: Slight surface imperfection can be "cleaned up" by using crocus cloth on the journals.

Main and Connecting Rod Bearings

If these are to be reused, check as follows:

Inspect

- Inspect for excessive grooving, wear through aluminum tin coating, and foreign material embedded in bearing surfaces.
- Inspect the backs of bearing shells for bright spots which indicate they have been moving in the bearing caps or bearing supports. If spots are present, discard bearings.

NOTE: Bearing failure may be the result of oil deterioration (acid formation), oil contamination, loss of oil pressure or insufficient oil level. An oil analysis may be required to determine actual cause of the failure.

CAUTION

Always discard bearings if oil has been contaminated with antifreeze or metallic particles from internal engine component failure. Always use lubricating oils that meet the recommended specifications and viscosity. See Maintenance and Lubrication Section of this manual or the Vehicle Owner's Manual.

Pistons and Sleeves

If these are to be reused, perform the following:

IMPORTANT

Failed or discarded parts should be inspected to determine cause of failure.

Clean

- Pistons and sleeves with solvent and dry them with compressed air.
- Ring grooves with a suitable tool or piece of an old compression ring that has been ground to a bevel edge.

NOTE: Only the top of the piston may be cleaned with a wire brush to remove carbon deposits. The top crown of the piston to the edge of the wrist pin may also be soaked with a multi-purpose household detergent such as Mr. Clean® or equivalent to aid in removal of carbon deposits.
DO NOT wire brush the skirts of the pistons under any circumstances.

- Inside surfaces of the piston and the oil drain holes in the ring groove area. Exercise care to avoid enlarging the holes while cleaning them.
- Cylinder liners inside and out. Remove all carbon deposits. A wire brush may be used.

WARNING

Always wear safety eyewear when working with compressed air.

Inspect

- Cylinder liner for excessive out-of-round, taper, or high spots which could cause failure of the piston.
- Sealing areas on top and around the bottom of the liner for wear, cracks, erosion, or any irregular condition.
- Pistons for score marks, cracks, damaged ring groove lands or indications of overheating. Any piston that has been severely scored or overheated must be replaced. Indications of overheating or burned spots on the piston may be the result of an obstruction in the connecting rod oil passage. Be sure to check for cracks on the inside areas of the pistons.

CAUTION

Excessively worn or scored pistons, rings and cylinder liners may be an indication of abnormal maintenance or operating conditions which should be corrected to avoid recurrance of failure.

In addition to performing proper maintenance, use of correct types of lubrication filters, fuel filters and air filters will reduce abrasive particles and other foreign materials introduced into the cylinders and oil passages, which will in turn reduce the rate of engine wear.

Always insist on and use oil filters recommended by Winnebago Industries. The wrong filter could cause serious internal engine damage due to improper oil flow characteristics and by-pass functions.

Always maintain lubricating oils and engine coolant at the proper levels to prevent engine overheating.

Extended periods of engine idling and/or use of improper lubricating oil should be avoided, since a heavy formation of carbon may result causing piston rings to stick.

A used cylinder liner must be honed to break the glaze which results after long periods of operation. This insures good "seating" between the liner wall and the new piston rings. The honed/deglazed cylinder liner must meet specifications before it can be reused. See specifications in "General Information", Subsection B.

The top of the liner must also be "ridge-reamed" to prevent ridge impact by new compression rings, which could result in ring breakage.

Connecting Rods

Clean

- Connecting rod with solvent and dry with compressed air. Blow compressed air through the oil passage in the connecting rod to be sure it is clear of obstructions.

Inspect

- Connecting rod for cracks and worn or irregular bearing areas. Replace the rods if the metal has changed colors due to overheating.

NOTE: If new connecting rods are required, stamp the cylinder number on the connecting rod and cap.

REASSEMBLE CYLINDER BLOCK AND RELATED PARTS

Install or Connect

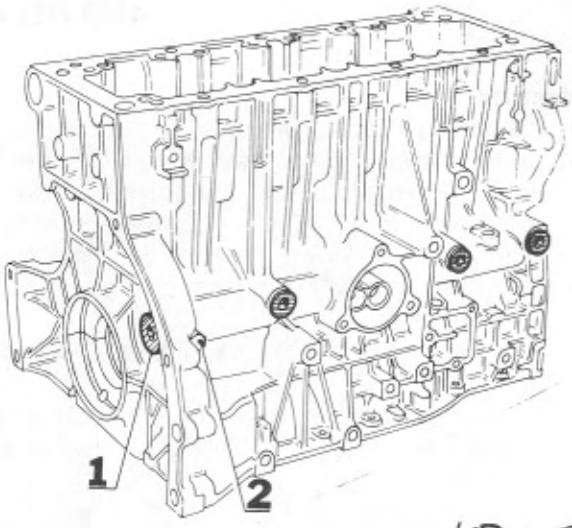
The core plugs must not be removed (frost plugs):

- Check that each cylinder head bolt may be screwed in easily.
- Screw the bolts in and out several times if required to ease the threads.

Tighten

If the oil galley plugs have been removed, refit and retorque tighten them to:

- 8 daNm (60 lb./ft.) for plugs (1)
- 2 daNm (15 lb./ft.) for plugs (2) for No. 1 main bearing
- 4 daNm (30 lb./ft.) for the other plugs



Install or Connect

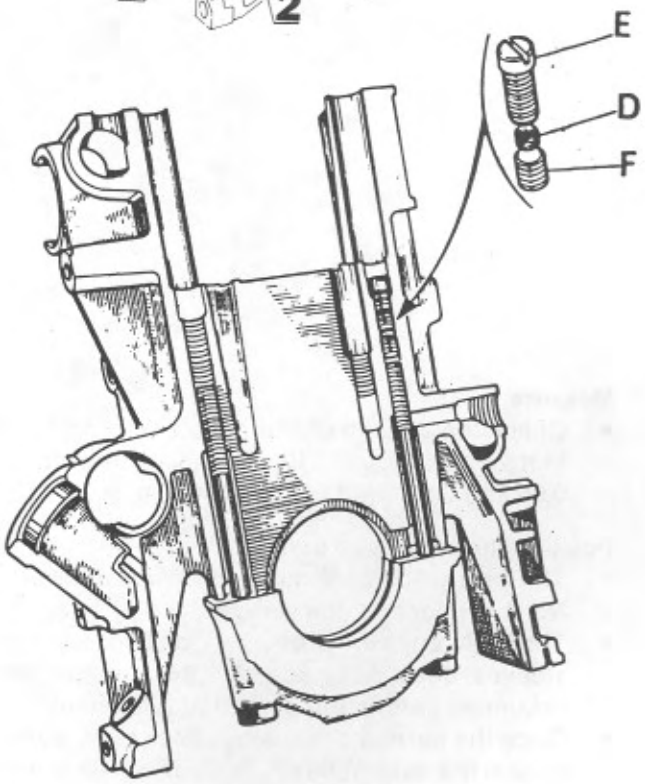
- Insert the dipstick guide tube with its flange in contact with the block.
- Rub the outside of the dipstick tube with emery cloth if necessary to make it enter easily and smear the stem with a thread locking compound such as Loctite® or equivalent.
- Attach the cylinder block to support Mot. 792.

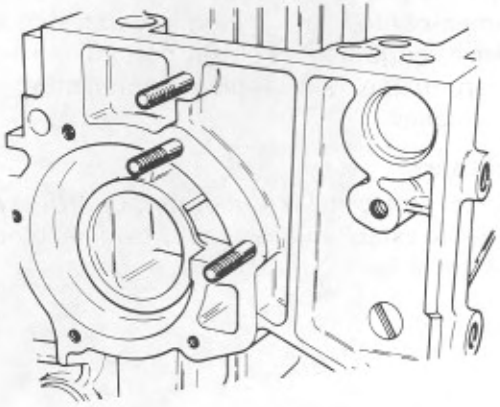
IMPORTANT:

- Make certain that seals (D) are in place between the original setscrew (E) and main bearing bolts (F) for main bearings No. 2, 3 and 4 on the same side as the oil filter.

- If the engine is not equipped with the above, insert a seal (D) and a setscrew (F), its threads smeared with a thread locking compound (Loctite® or equivalent) then tighten it fully using a 6 mm male hex. key 200 mm long.

The object of this is to prevent oil entering the cooling circuit.





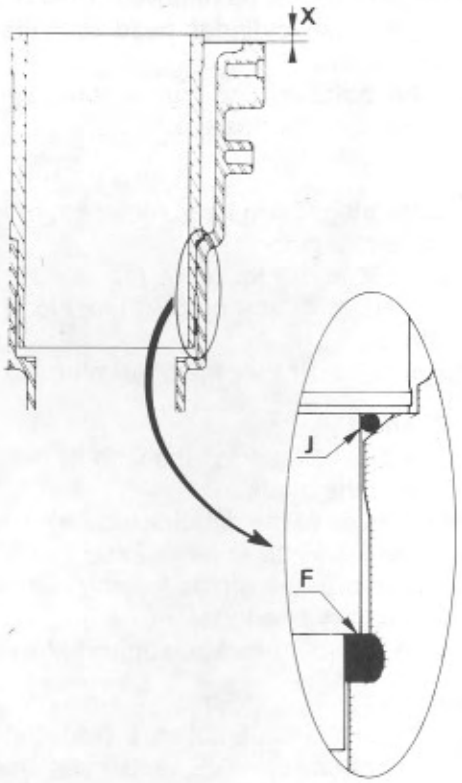
Install or Connect

- Insert the various studs. If removed, smear the threads on those for the water pump and timing belt cover with one or two drops of thread locking compound (Loctite® or equivalent) the stud holes enter the cooling circuit.

REASSEMBLE CYLINDER BLOCK AND RELATED PARTS (CONT.)

Measure

- Checking sleeve protrusion.
- In this assembly, each sleeve locates direct on the cylinder block and the correct amount of protrusion is achieved by close manufacturing tolerances of sleeves and cylinder block.
- 'O' rings (J) and large plastic rings (F) act as coolant seals only.
- Sleeve protrusion (X) should be checked as follows:
  - Insert each "sleeve-piston-connecting rod" assembly less its 'O' ring (J) and plastic bottom ring (F).

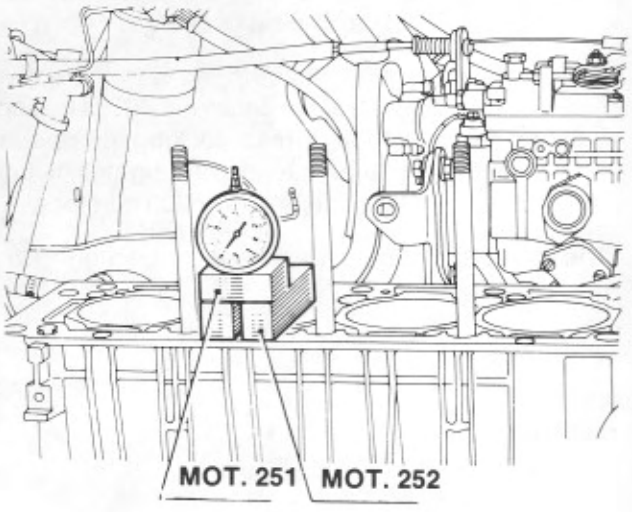


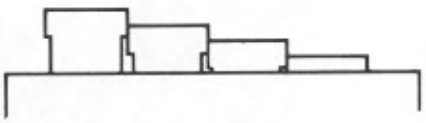
Measure

- Check the amount of protrusion (X) with Tools Mot. 251 and Mot. 252; it should measure between 0.05 and 0.12 mm (.002 and .0047").

Position the sleeves so that:

- The protrusions are stepped downwards from No. 1 cylinder or vice versa.
- The difference in protrusion of two adjacent sleeves does not exceed 0.04 mm (.0016") maximum (within the permitted tolerance).
- Once the correct protrusions have been found, reform the assemblies A, B, C, and D each with its matching sleeve, piston, and wrist pin and mark the position of each sleeve in the block.
- Remember to fit an 'O' ring free of test to each sleeve flange also the plastic bottom ring before inserting the "sleeve-piston-connecting rod" assemblies.





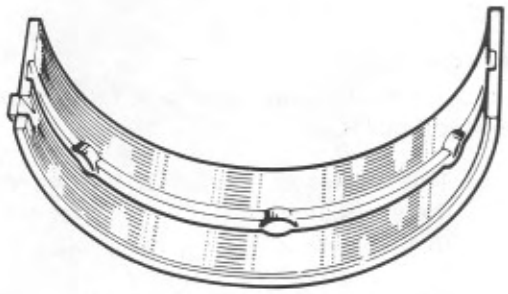
IMPORTANT

If incorrect protrusion is found, check with a new set of sleeves to establish whether the cylinder block or sleeves are at fault.

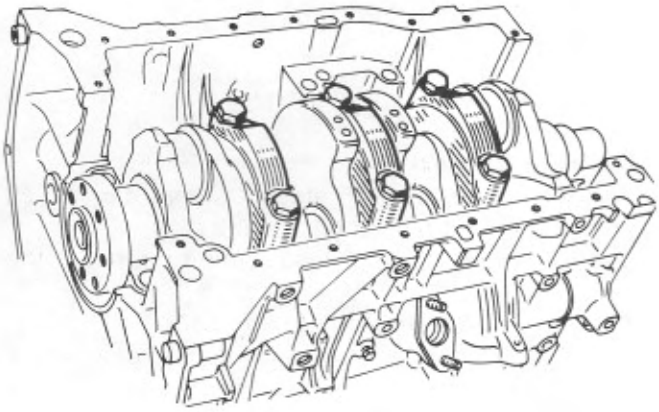
REASSEMBLE CYLINDER BLOCK AND RELATED PARTS (CONT.)

Remove or Disconnect

- Note the main bearing cap numbers in relation to the cylinder block.
- Mount the main bearing shells. They are identical; they have three oil holes and one oil groove.
- Lubricate the shells
- Lubricate the main bearing journals and lower the crankshaft in position. Put the thrust bearings with white metal face towards the crankshaft.
- Mount the shells to the main bearing caps, they are the same as those mounted to the cylinder block.
- Lubricate the shells.
- Put main bearing caps No. 2, 3, and 4 in position according to the marks on dismantling.



Measure



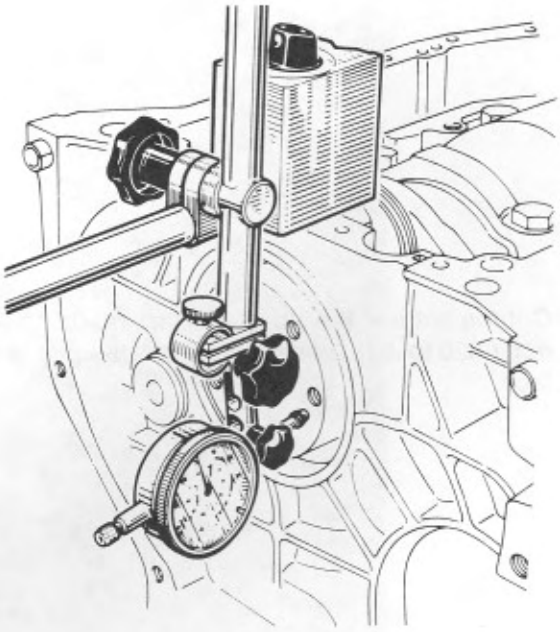
Install or Connect

- Temporarily attach main bearing caps Nos. 1 and 5 without their side seals.
- Torque tighten the main bearing cap bolts.
- **Checking crankshaft end float.**
- Put a dial indicator on the end float: 0.06 mm to 0.25 mm (.0024" to .010").
- Change the thrust bearings if end float is incorrect.
- Thrust bearings are available in different thicknesses:

2.80-2.85-2.90-2.95 mm
(.110-.112-.114-.116")

CAUTION

Be sure to mount the thrust bearings correctly. Oil grooves must face the crankshaft thrust surface. Make sure the locater pins are properly in the holes provided in the upper bearings in the upper half of the block.



FRONT AND REAR MAIN BEARING SUPPORT SIDE SEALS

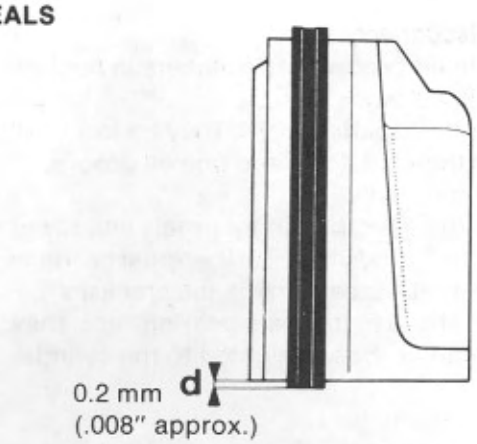
Method 1

Install or Connect

- Remove main bearing caps Nos. 1 and 5 and fit the side seals to them.

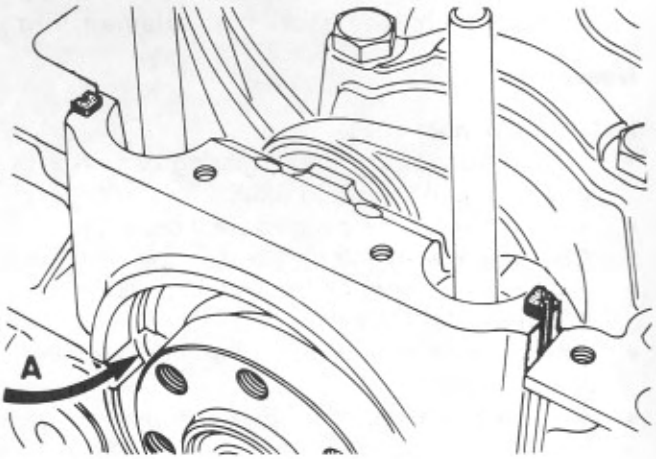
NOTE: This engine requires use of the thickest of the seals included in the gasket seal kit (5.40 mm-.212" thick-white code).

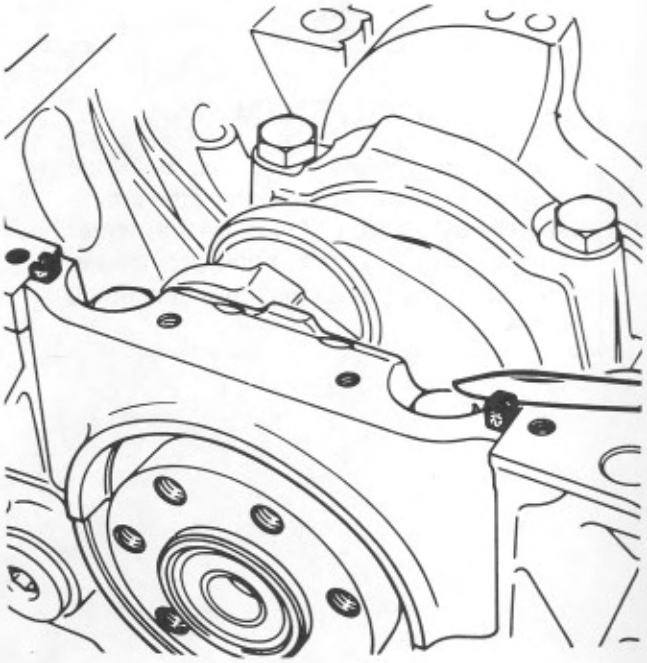
- Each seal should protrude below the surface of the bearing cap (see illustration).
- Lubricate bearing shells.
- Apply liberal amounts of petroleum jelly to seals on mating block surfaces.



Install or Connect

- Screw two locating studs (12 mm dia. x 1.50 pitch) into the cylinder block.
- Place Nos. 1 and 5 main bearing caps on the studs.
- Lower the assembly into the block
- When each bearing cap is almost home, make sure that the side seals protrude slightly by trying with a rule at (A).
- Withdraw the studs and screw in the cap bolts.





- Cut the ends of the side seals leaving 0.5 to 0.7 mm (.020 to .028") protrude above the pan joint face.

FRONT AND REAR MAIN BEARING SUPPORT SIDE SEALS (CONT.)

Method 2

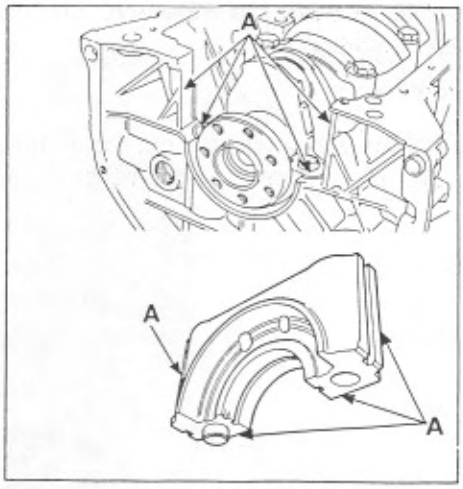
Due to machining modifications in engine production, lateral sealing of the main bearing caps cannot be ensured with the butyl seals provided in the gasket/seal kit.

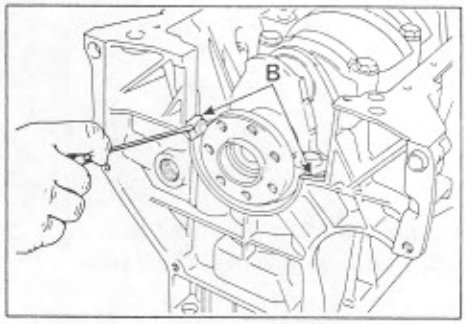
Therefore, discribed here is an alternate method of sealing main bearing caps using Thixo-Caf 4/60 Silicone (50ml tube). Thixo Silicone and an application kit are available from our Parts Sales Department. The application kit consists of:

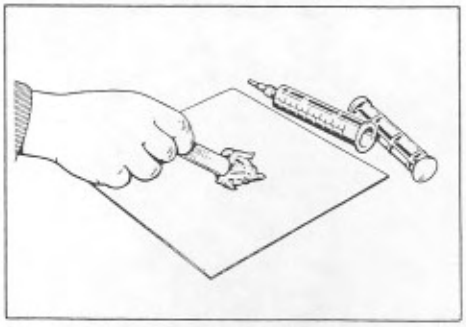
- 1 - 5ml tube of hardener
- 1 - mixing stick
- 1 - 50ml syringe
- 1 - set mixing/application instructions

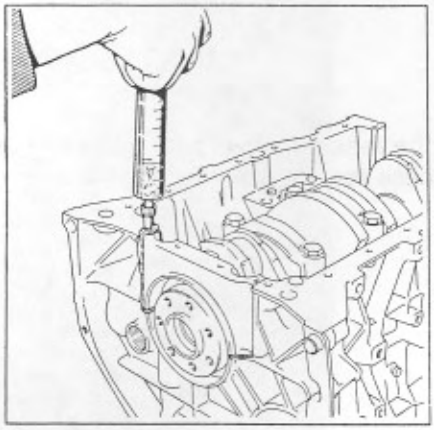
IMPORTANT
The product must be injected within approximately 5 minutes to avoid the mixture polymerizing in the syringe.

- Thoroughly clean the surfaces at (A) on the cylinder block and the main bearing cap in question, using a cloth impregnated with cleaning thinners.
- Lightly coat the lower faces of the cylinder block at (B) with CAF 4/60 THIXO but do not block the oil retention grooves.
- Fit the cap and tighten to torque.
- Mix 45 ml of CAF 4/60 THIXO with the contents of the tube of hardener using the stick to blend the mixture thoroughly.







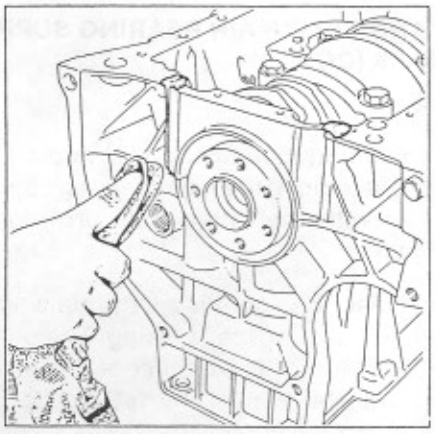


- Put the mixture in the syringe and inject it into the main bearing cap grooves.
- Allow the mixture to flow out slightly either side of the main bearing cap grooves to ensure that the injected mixture has filled the sealing groove completely.

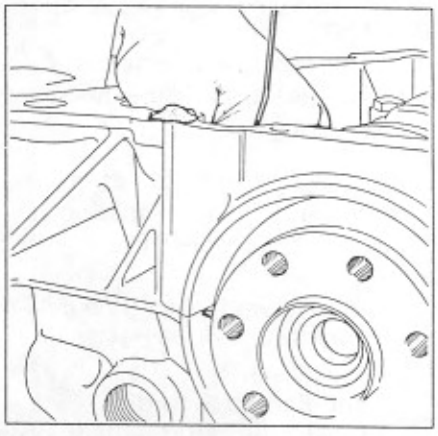
FRONT AND REAR MAIN BEARING SUPPORT SIDE SEALS (CONT.)

Method 2 (Cont.)

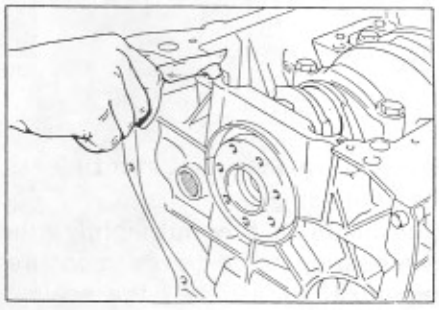
- Using a cloth, wipe away the excess mixture, both inside and outside the cylinder block.



- Pass a steel wire through the lubrication oil ways to check that they are not blocked.



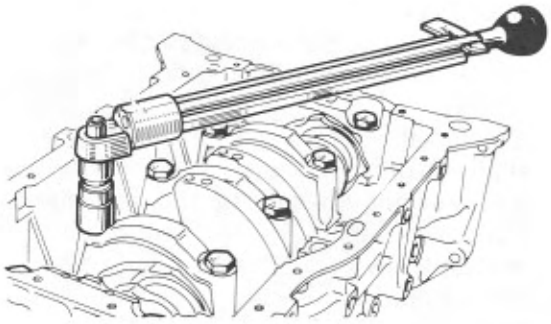
- Allow the assembly to dry for a few minutes, then cut excess sealant from the joint face.



REASSEMBLE CYLINDER BLOCK AND RELATED PARTS (CONT.)

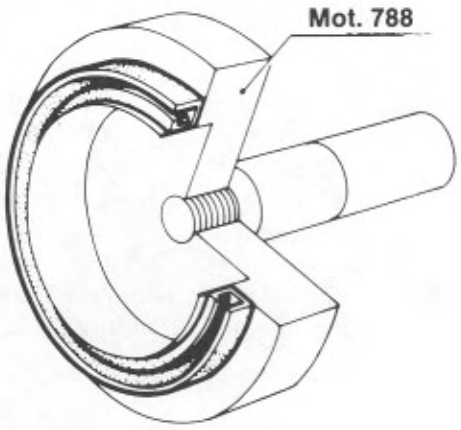
Tighten

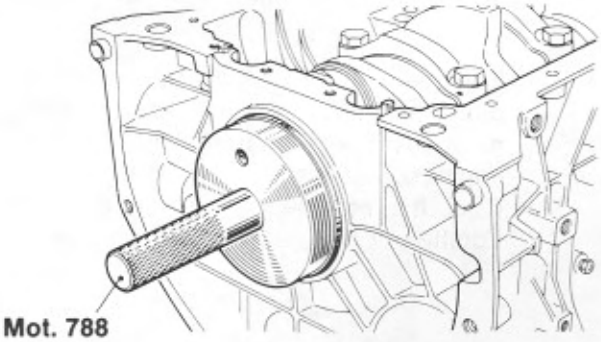
Torque tighten the main bearing cap bolts using a torque wrench. Tighten to 8.75 - 9.75 daNm (65 1/2 -73 lb./ft.) Check that the crankshaft rotates freely.



Install or Connect

- Mount the oil seals to main bearings Nos. 1 and 5.
- The lips on these oil seals are delicate; take exceptional care when mounting them. No. 1 main bearing oil seal (flywheel end).
- Place the seal on Tool Mot. 788 as shown.
- Lubricate the outside of the seal.
- Insert the seal by tapping the end of the tool lightly until the tool contacts the crankshaft.



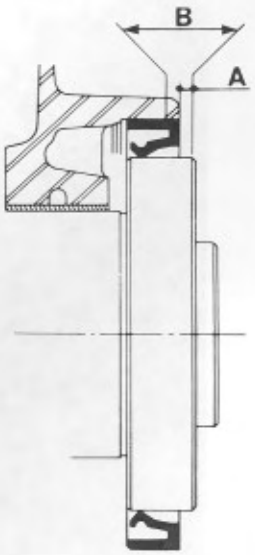


IMPORTANT

If the old oil seal lip has marked the crankshaft (flywheel end), a washer 1.5 mm (.059") thick must be inserted between the new oil seal and the tool to give the lip an unworn bearing surface when in position.

A. Normal position of oil seal using Tool Mot. 788.

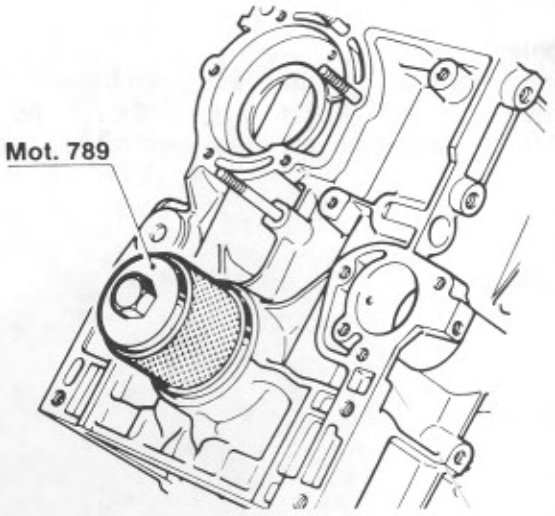
B. Position the oil seal using Tool Mot. 788 and washer (giving offset to lip on overhaul).



REASSEMBLE CYLINDER BLOCK AND RELATED PARTS (CONT.)

Install or Connect

- No. 5 main bearing oil seal (timing end). Place the seal on Tool Mot. 789 lubricate the outside of the seal.
- Position the tool/seal assembly to the crankshaft and draw it on with the pulley bolt. The seal is fully seated when the tool contacts the crankshaft.
- Woodruff key on crankshaft
- Air conditioner pulley (or spacer if not A/C equipped).
- Crankshaft belt sprocket.



IMPORTANT

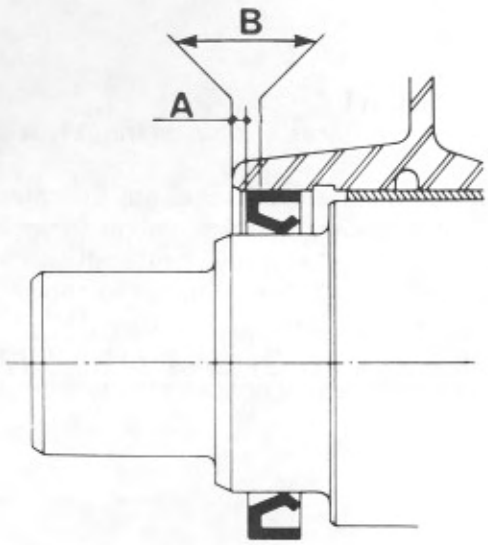
If the old oil seal lip has marked the crankshaft (timing gear end), a washer 1.5 mm (.059") thick must be inserted between the new oil seal and the tool to give the lip an unworn bearing surface when in position.

A - Normal position of oil seal using Tool 78-900.

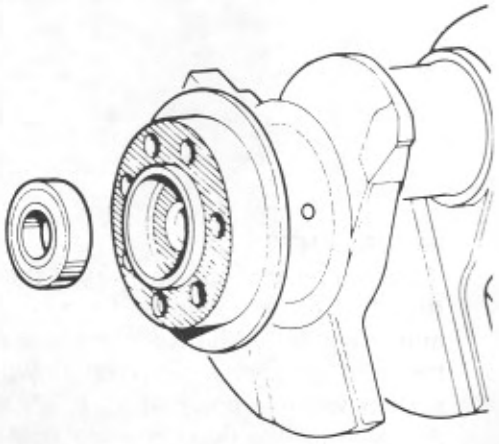
B - Position of oil seal using Tool 78-900 and a washer (giving offset to lip on overhaul).

Mount:

- the spacer
- key
- and timing sprocket, timing mark facing outwards



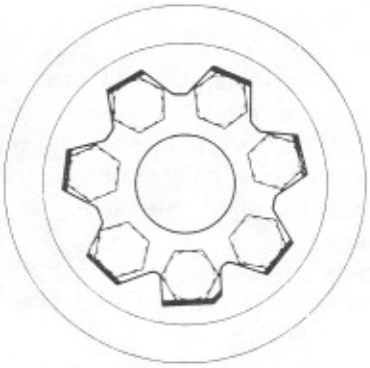
NOTE: Replacement crankshafts do not have the pilot bearing mounted, so this bearing must be mounted to the crankshaft on all engines coupled to a manual shift gearbox. Coat the outside of this bearing with Loctite® or equivalent.



REASSEMBLE CYLINDER BLOCK AND RELATED PARTS (CONT.)

Install or Connect

- Flywheel using new lock plate and bolts.



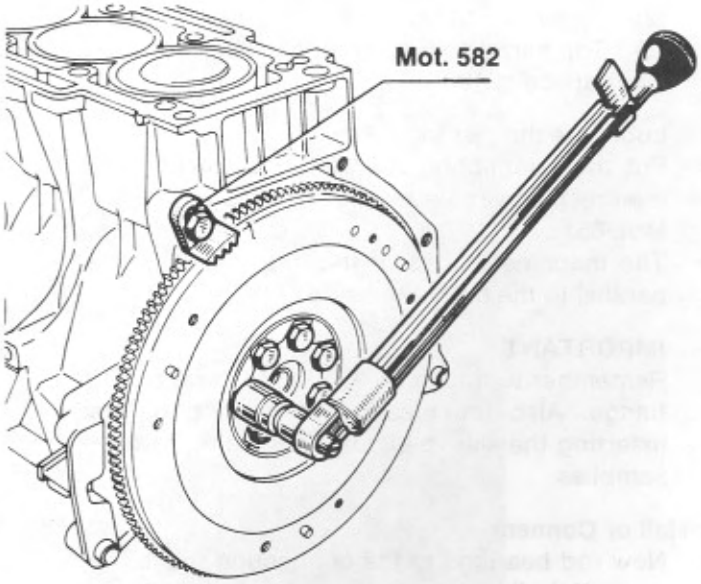
Procedure:

- Mount the clutch shaft bearing, if necessary.
- Smear the flywheel mounting face with a thread locking compound such as Loctite® or equivalent.
- Mount the flywheel using serated Locking Plate 58-200 to prevent it from turning.
- Place 1 or 2 drops of thread locking compound (Loctite® or equivalent) on the threads of the new bolts and torque tighten them using a torque wrench and Serrated Locking Plate Mot. 582.

Tighten

Torque flywheel bolts 6 daNm 45 lb./ft.

- Bend the lock plate over one flat only on each bolt.

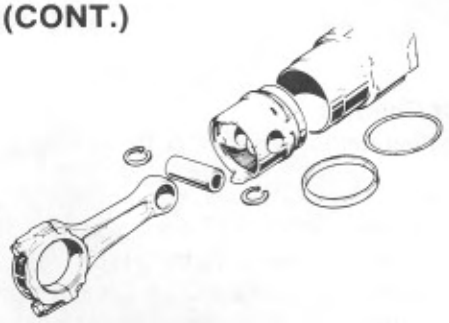


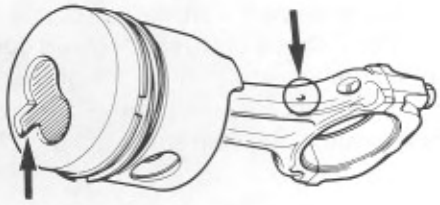
REASSEMBLE CYLINDER BLOCK AND RELATED PARTS (CONT.)

Sleeves and Pistons

Install or Connect

- Mounting wrist pins:
  Follow the instructions below to fit each piston and connecting rod assembly:
  - the turbulence chamber in the piston crown faces the intermediate shaft
  - the cap end oil jet hole faces toward the main oil galley
- Wrist pins and circlip retainers:
  - check that each wrist pin rotates freely in its new matching piston
- Lubricate the wrist pins with oil

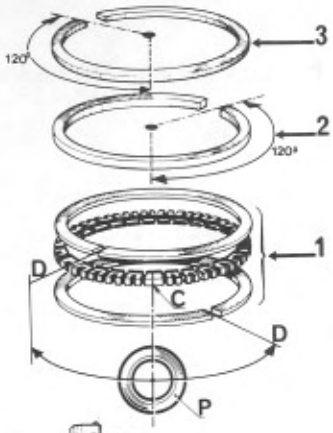




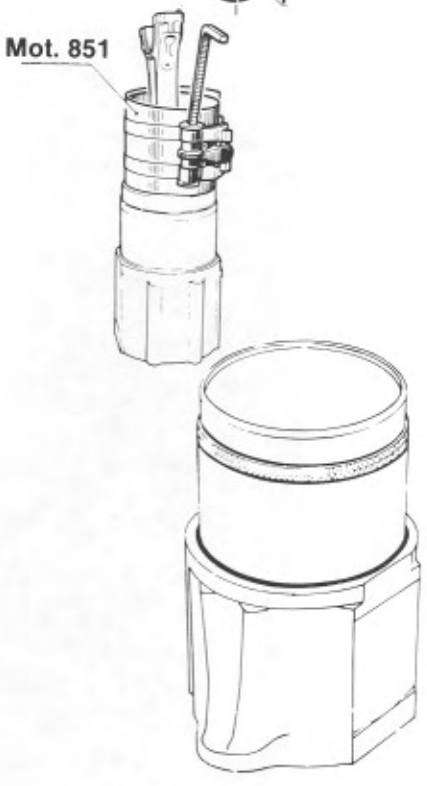
Install or Connect

Mount the piston rings:

- The pre-gapped piston rings must be free in their grooves.
- Piston rings stamped "Haut-Top" must have this mark uppermost facing the combustion chamber.
  (1) Oil scraper rim
  - expander gap (C) in line with center of wrist pin (P)
  - slots (D) in rings spaced put between 20 and 50 mm (3/4 and 2").
  (2) Taper compression ring
  (3) Top barrel shaped compression ring
- Gaps space at 120°



- Lubricate the pistons
- Put the connecting rod/piston assemblies in their respective sleeves using Ring Compressor Mot. 851.
- The machined sides of the cap end must be parallel to the flat on the side of the sleeve.



IMPORTANT

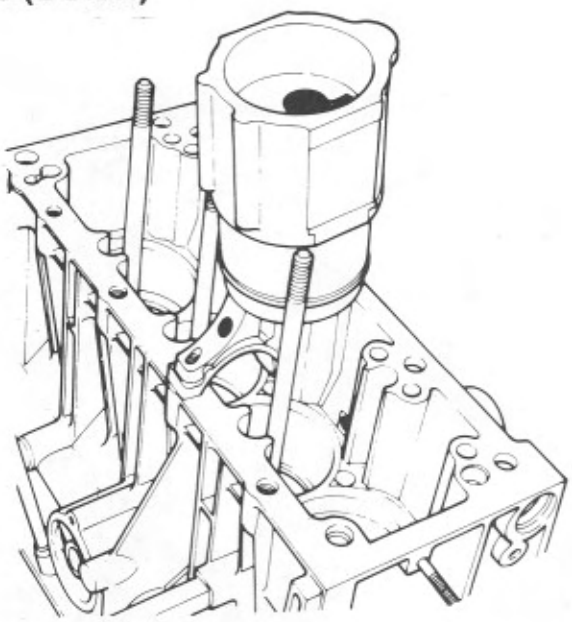
Remember to attach an 'O' ring to each sleeve flange. Also the plastic bottom ring before inserting the sleeve-piston-connecting rod assemblies.

Install or Connect

- New rod bearings to the connecting rods. The top half shells are drilled to match the oil jet hole for cooling the underside of the piston crown.
- Lubricate the bearings and crankshaft journals.

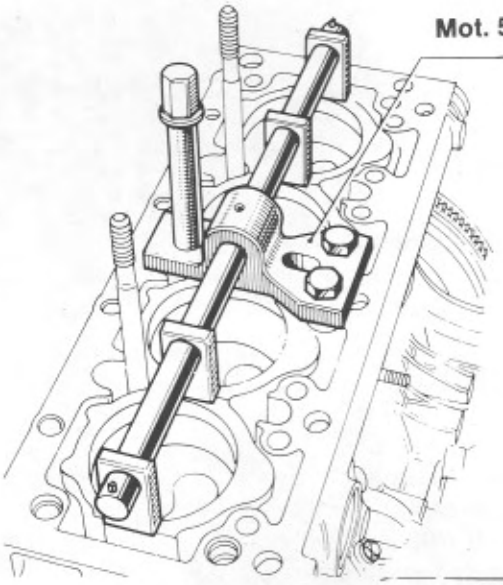
REASSEMBLE CYLINDER BLOCK AND RELATED PARTS (CONT.)

Sleeves and Pistons



Install or Connect

- Insert the sleeve/piston/connecting rod assemblies in the cylinder block and check:
  - the position of the sleeves in the block (protrusions stepped up or down-cylinders 1 to 4)
  - sleeve flats parallel
  - piston precombustion chambers facing intermediate shaft
  - connecting rod oil jet holes on side facing away from intermediate shaft.
- Put sleeve clamp Mot. 521-01 in position, tightening the bolts and nut to 5 daNm (37 lb./ft.)



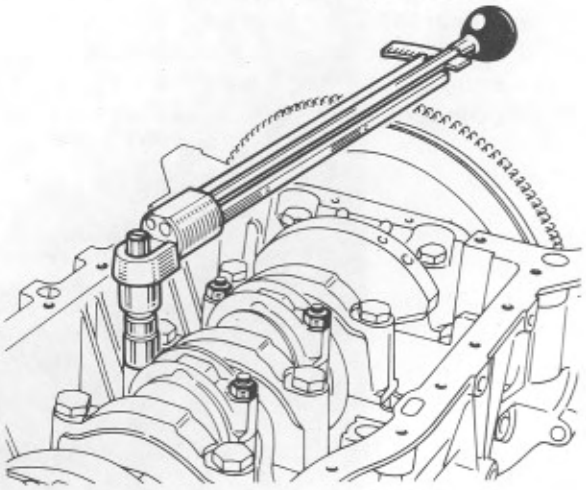
Mot. 521-01

Install or Connect

- Draw the connecting rods down onto the lubricated journals.
- Mount new bearing shells to the rod-end caps, making sure that they are correctly matched.
- Screw on and torque tighten the new rod-end cap bolts using a torque wrench.
- Check that the assembly revolves freely.

Tighten

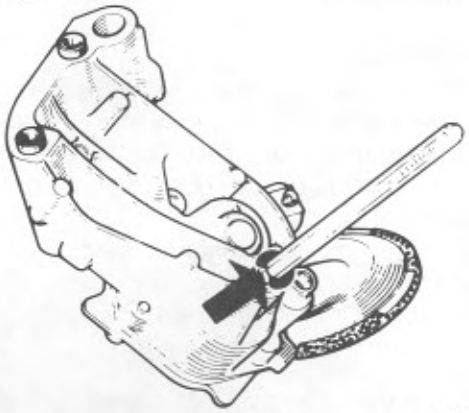
Rod bearing torque 6.5 daNm (50 lb./ft.)



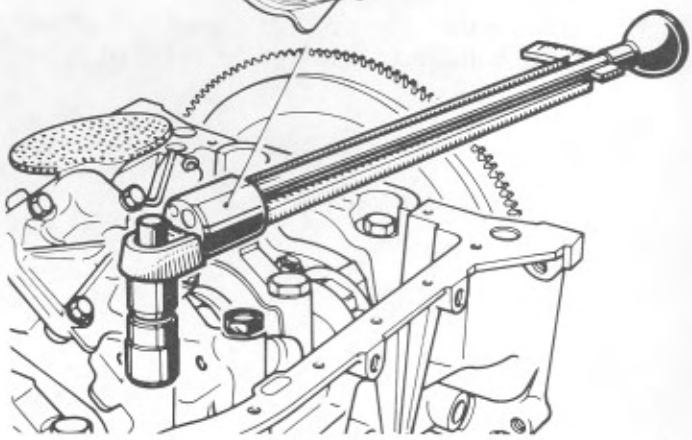
REASSEMBLE CYLINDER BLOCK AND RELATED PARTS (CONT.)

Special Points Concerning Assembly:

- Mount the oil pump complete with its drive shaft circlip at pump end and check that the locating dowels are in place.



- Relocate the oil pump; check that its locating dowels are in place. Torque tighten the bolts using a torque wrench.

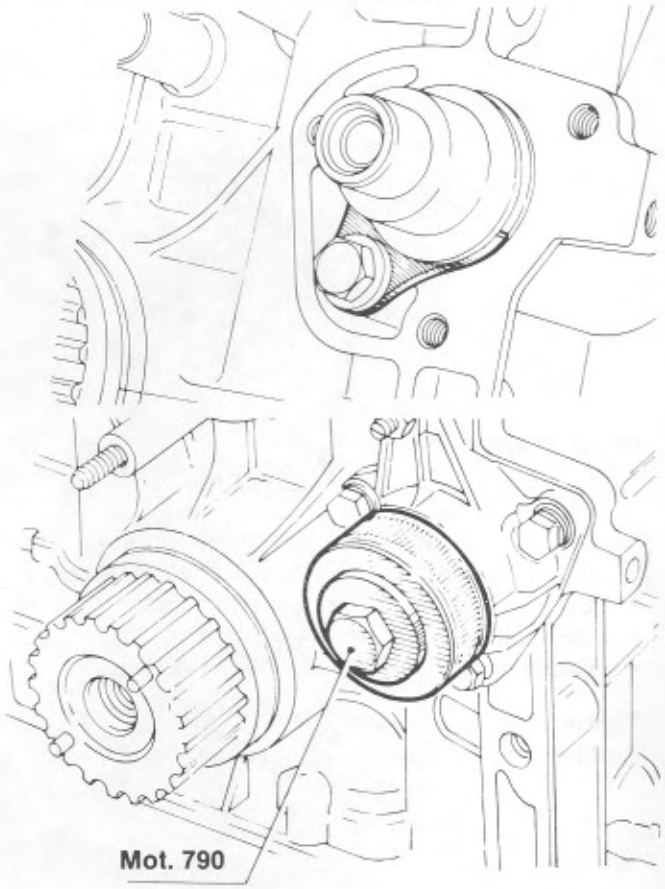


Tighten

Oil pump retaining bolt torque 4.0-4.5 daNm (30-34 lb./ft.)

Install or Connect

- Insert the intermediate shaft, secure it by its flange plate.
- Install timing belt tightener.
  - Do not tighten at this time
- Put in position:
  - The intermediate shaft cover with a new paper gasket and new oil seal. Use inserting tool Mot. 790 in order not to damage the seal lip and to assist cover location.
  - Smear the bolt threads with one or two drops of a thread locking compound (Loctite® or equivalent) as the holes pass through into the cylinder block which could lead to oil leaks.



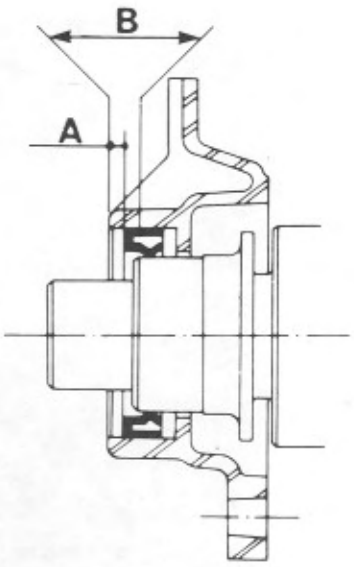
REASSEMBLE CYLINDER BLOCK AND RELATED PARTS (CONT.)

IMPORTANT

A washer 1 mm (.040") thick must be placed between the oil seal and the inserting tool so that the seal lip bears on a fresh surface if the intermediate shaft has been marked by the old oil seal.

A - Position when inserted with Tool Mot. 790.

B - Position when inserted with Mot. 790 plus the washer after overhaul.

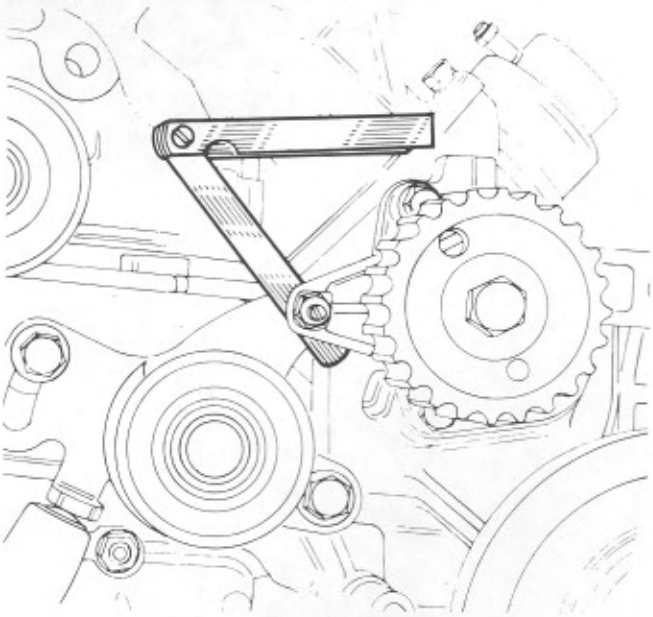


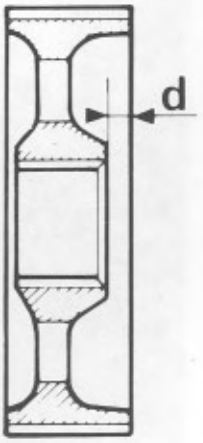
Install or Connect

- The water pump with plunger and spring for the timing belt tightener. See Cooling System Section.

Adjust

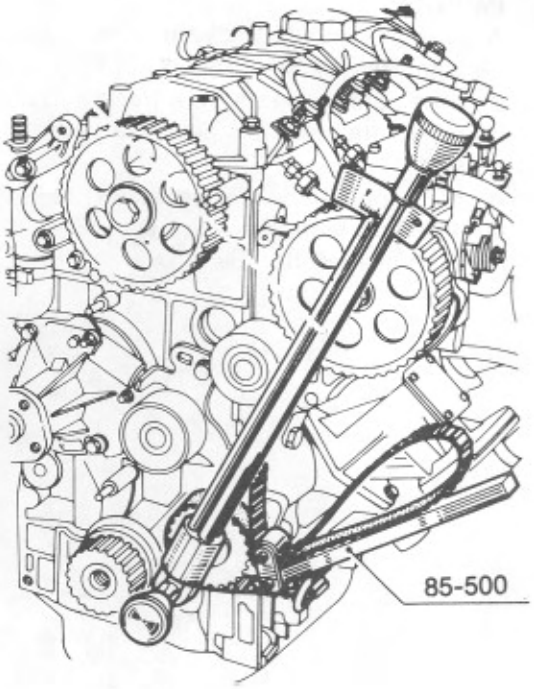
- Adjust the clearance between the tensioner and adjusting bolt to 0.1 mm (.004").





Install or Connect

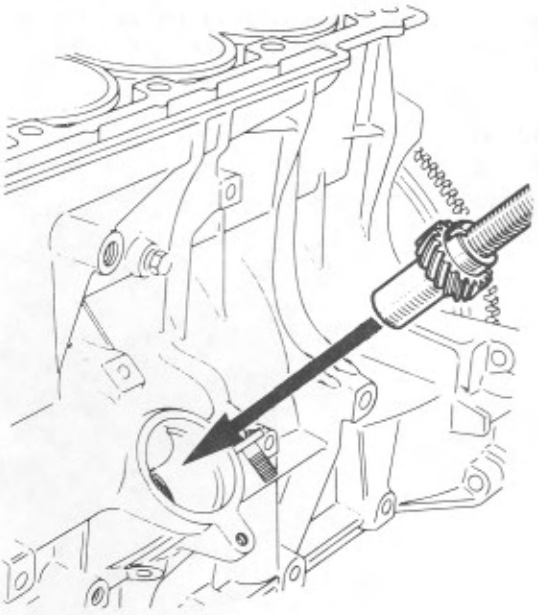
- The intermediate shaft key and the toothed sprocket, larger offset (d) facing outwards away from the cylinder block.



- Torque tighten the bolt using Strap Tool Mot. 855.

Tighten
Torque bolt to 5 daNm (37 lb./ft.)

- Install oil pump/vacuum pump angle drive. Lubricate before installing.
- Install vacuum pump with new O-ring.
- Check that the "intermediate shaft-vacuum pump-oil pump" assembly revolves freely.



REINSTALLATION OF THE CYLINDER HEAD

Measure

Install or Connect

Tighten

Step 1 - Sleeve Protrusion

Check sleeve protrusions with Tools Mot. 251 and Mot. 252.

Tool Mot. 252 will be braced by Bar Mot. 853 to ensure that the sleeve is firmly in contact with the cylinder block. Torque tighten the tool bolts gradually and alternately to 5 daNm (37 lb./ft.)

If an incorrect protrusion is found, check whether a faculty cylinder block or faulty sleeve is the cause by placing a new set of sleeves without sealing rings into the cylinder block.

Step 2 - Checking Piston Protrusion

Put Sleeve Clamp Mot. 521-01 in position and torque tighten the nuts and bolts to 5 daNm (37 lb./ft.) to ensure that the sleeves are below the pistons when the latter are on T.D.C.

Clean the piston crowns carefully and rotate crankshaft one complete revolution.

Place Tools Mot. 251 and Mot. 252 on each piston in turn with the clock gauge bracket resting on the cylinder block. Find the T.D.C. of each piston and make a note of the amount of protrusion in relation to the cylinder block on both sides of each piston. The purpose of this is to determine which of the three thicknesses of gasket will be most suitable.

Take the piston with the maximum protrusion. Add the measurements from both sides of that piston -divide by 2 to get the average. Use this as the maximum piston protrusion.

For a maximum piston protrusion:

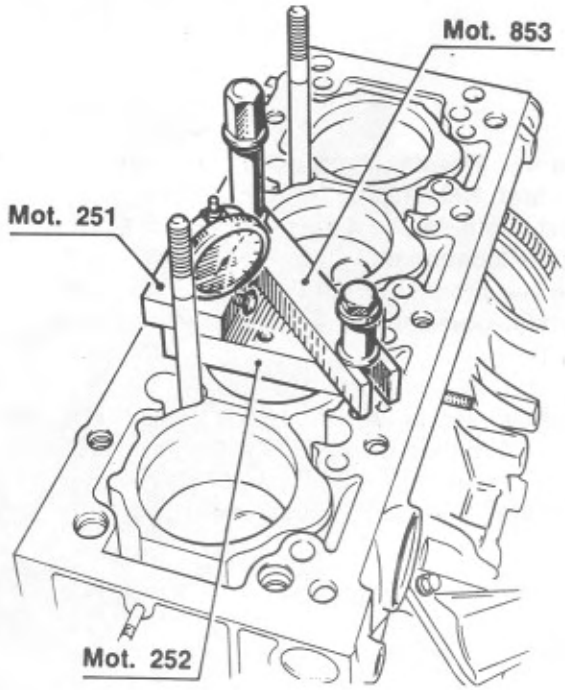
- of less than 0.96 mm, use cylinder head gasket 1.6 mm thick which is marked "1,6".
- of between 0.96 and 1.04 mm, use a cylinder head gasket 1.7 mm thick. This gasket is unmarked.
- of more than 1.04 mm use a cylinder head gasket 1.88 mm thick which is marked "1,8".

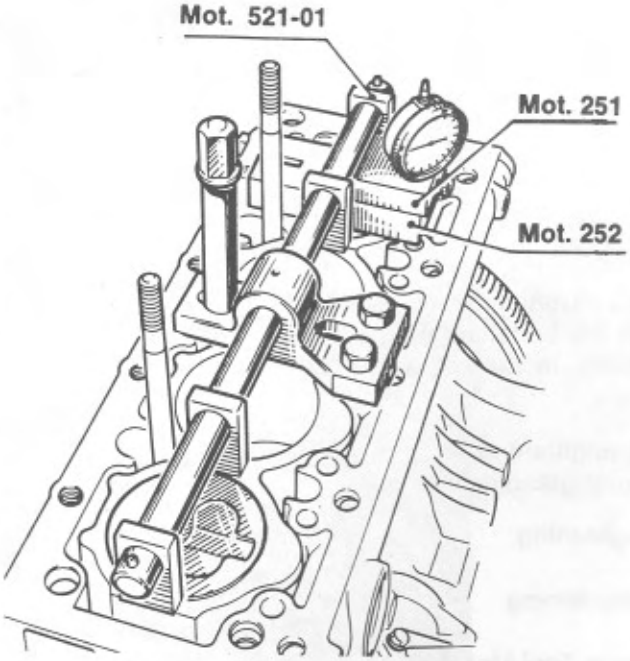
Step 3 - Measuring Valve Recesses

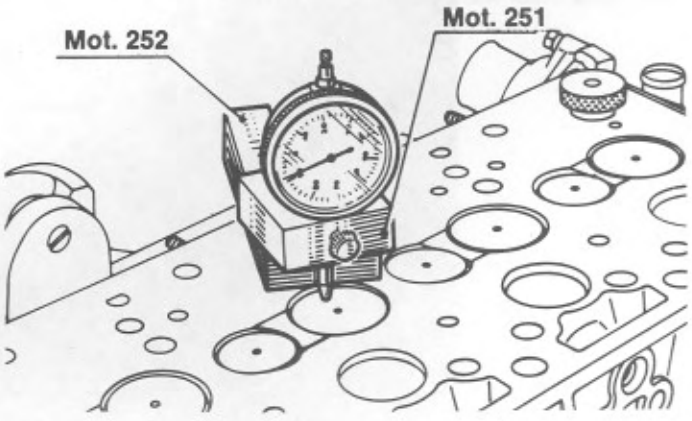
Once the piston with the highest protrusion has been found, measure the amount of recess of each valve for the cylinder concerned in relation to the cylinder head joint face (the recess value should be between 0.8 to 1.15 mm (0.315" and .0452).

To do this, clean both valve heads first then measure the distance between the cylinder head joint face and the inlet and exhaust valve heads using Tools Mot. 251 and Mot. 252.

CONSIDER ONLY THE SMALLER OF THE TWO DIMENSIONS AND MAKE NOTE OF IT.

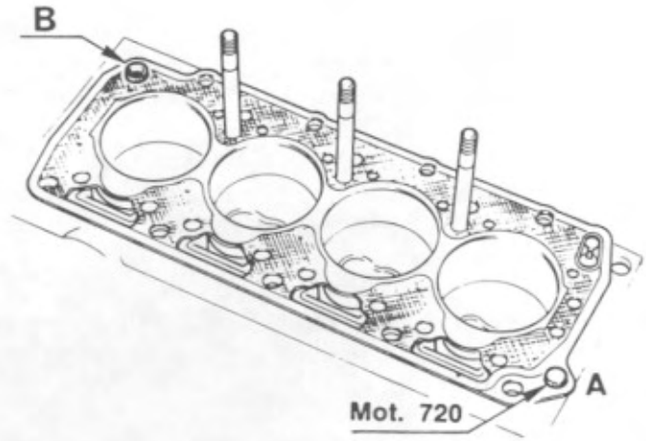


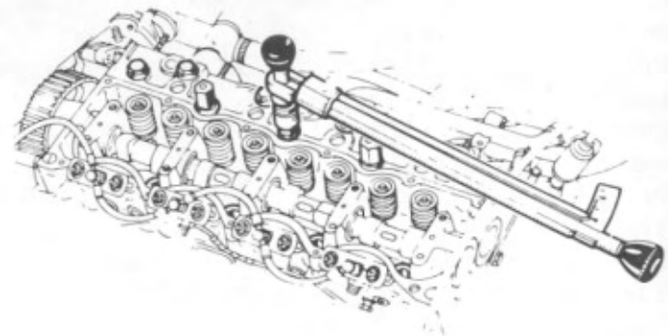




Step 4 - Positioning the Cylinder Head Gasket
Tool Mot. 720 must be used for this operation.
Insert it in hole (A) in the cylinder block and check that the locating dowel (B) is in place.
Turn the crankshaft until the pistons are halfway down the bores before removing Sleeve Clamp Mot. 521-01.
Mount:
- The cylinder head gasket, lining it up first with the studs and then with the locating dowels.

Lubricate the bolt threads and flat washers under the bolt heads with clean engine oil.

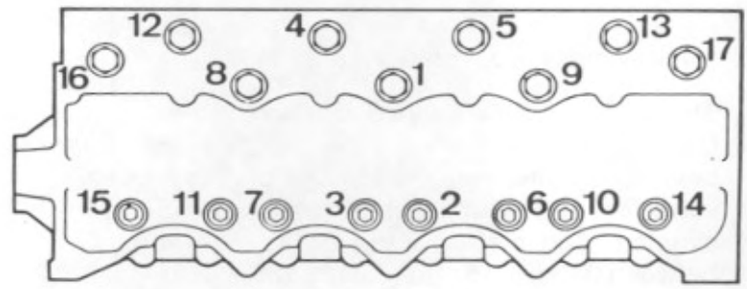




Step 5 - Tighten head
Insert the bolts and nuts and torque, tighten them gradually in the sequence shown using a torque wrench.

1st pretightening	3 daNm (22 lb./ft.)
2nd pretightening	5 daNm (37 lb./ft.)
1st tightening	9.5 to 10.5 daNm (70 to 78 lb./ft.)
2nd tightening	9.5 to 10.5 daNm (70 to 78 lb./ft.)

Remove Tool Mot. 720



Step 6 - Checking the Clearance Between Pistons and Cylinder Head

Using Bracket Rou-541 attached to a rocker shaft bearing bolt, align the dial indicator so that its stem rests on the valve selected for measurement:

- Turn the crankshaft so that the piston is on or very close to T.D.C.
- Press valve down to check that the piston is near T.D.C.
- Remove the cotters and valve spring using compressor.
- Keep the valve resting on the piston, and using the dial indicator as a guide, bring the piston up exactly on T.D.C.
- Now set the dial indicator to zero, lift the valve up by hand onto its seat and read off the distance between piston and valve.

From this value, work out amount of valve recess, which should not be less than 0.6 mm (.0236").

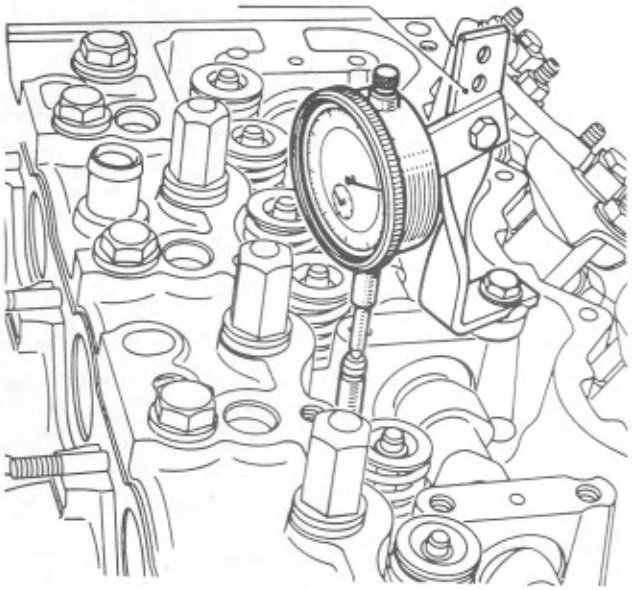
Example of these measurements:

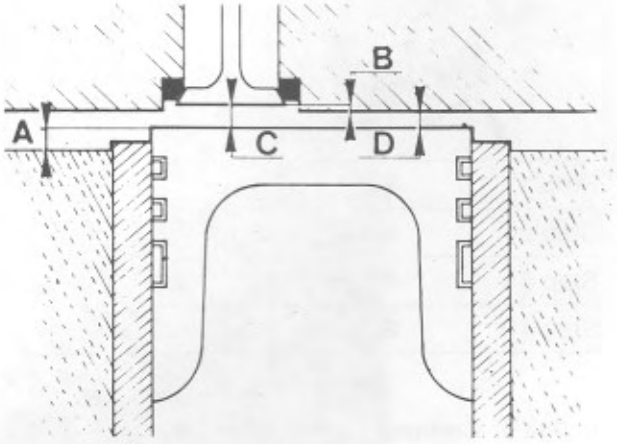
1 - Piston protrusion (measured after crankshaft has been turned one revolution in normal direction of running to take up any play).
Dimension A:
No. 1 cylinder A = 1.05 mm
No. 2 cylinder A = 1.04 mm
No. 3 cylinder A = 1.05 mm
No. 4 cylinder A = 1.07 mm
The highest protrusion, 1.07 mm, in Cylinder No. 4 will be used for the calculations. As this dimension exceeds 1.04 mm, a cylinder head gasket 1.8 mm thick must be used.

2 - Valve recess (Dimension B):
Measurement taken of No. 4 cylinder inlet and exhaust valves:
Inlet B = 0.92 mm
Exhaust B = 0.87 mm
(In both cases, the recess valve is within the tolerance of 0.80 to 1.15 mm). The lesser recess valve will be used in the calculations which is 0.87 mm for the exhaust valve.

3 - Distance between the valve and piston (Dimension C):
No. 4 cylinder exhaust valve movement as read on dial indicator was:
(Reminder: Piston on T.D.C.)
C = 1.57 mm
From which may be calculated:
PISTON-CYLINDER HEAD CLEARANCE:
D = C-B=1.57 mm - 0.87 mm = 0.7 mm
This valve being more than the minimum tolerance of 0.6 mm).

Rou. 541





REINSTALLATION OF THE CYLINDER HEAD (CONT.)

Install or Connect

- Glow plug wire harness to glow plugs
- Injection pump with mounting bracket to block
- Injection lines
- Fuel return hoses to injectors and pump
- Install timing belt (see Section Changing Timing Belt) and cover
- Mount the rocker shaft assembly (Bearing No. 1 has one locating dowel, Bearing No. 5 has two), place the thrust washer for Bearing No. 5 in its groove in the camshaft.

Tighten

Torque rocker bolts 3 daNm (22 lb./ft.)

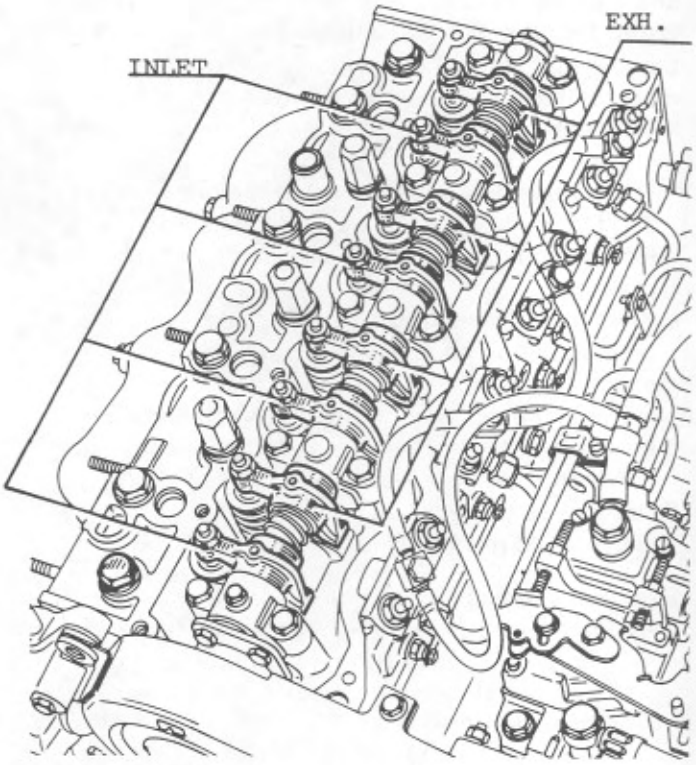
Adjust

- Adjust the rocker arm clearances using Wrench Mot. 647 (make sure that the inlet and exhaust valves are in their correct positions).

Inlet Arm	0.20 mm (.008")
Exhaust Arm	0.25 mm (.010")

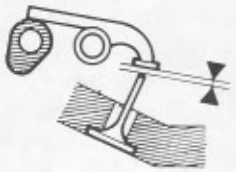
IMPORTANT

Number 4 cylinder is in the front and the Number 1 cylinder is in the rear

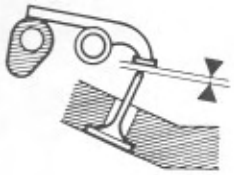




Exhaust Valve To Be Set Wide Open



Adjust Clearance On Inlet Valve



Adjust Clearance On Exhaust Valve

Step 1 -	1	3	4
Step 2 -	3	4	2
Step 3 -	4	2	1
Step 4 -	2	1	3

Install or Connect

- Rocker arm cover
- Thermostat housing, thermostat, and water temp. sender if removed
- Adjust pump timing (see Tune-Up Section)
- Install engine oil pan
- Crankcase vent hoses

TIMING BELT CHANGING

Removal

Step 1
Remove:
- Nosepiece
- Belly shield
- Fender connecting brace
- A/C condenser and fans - do not unhook A/C lines - unbolt unit and swing aside
- Radiator hoses and coolant
- Radiator
- Fan blade
- Alternator - fan belt
- Power steering belt
- Lower flywheel cover

Step 2
- Mount Locking Sector Mot. 582 and loosen the crankshaft pulley bolt.
- Remove Locking Sector Mot. 582.

Step 3
- Rotate the crankshaft until T.D.C. Rod Mot. 861 slips into position (take care not to let the rod enter one of the balancing holes in the web). Check that the crankshaft cannot turn one way or the other.

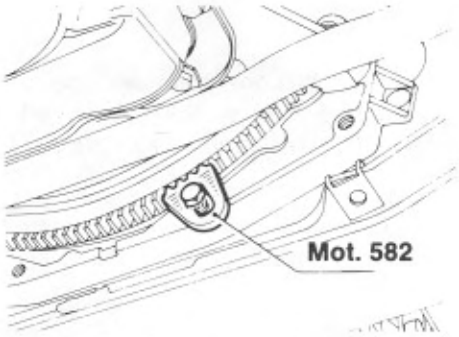
Step 4
Remove:
- The timing belt cover
- Loosen the tensioner and tilt it to slacken the timing belt. Retighten the tensioner in the slack belt position.

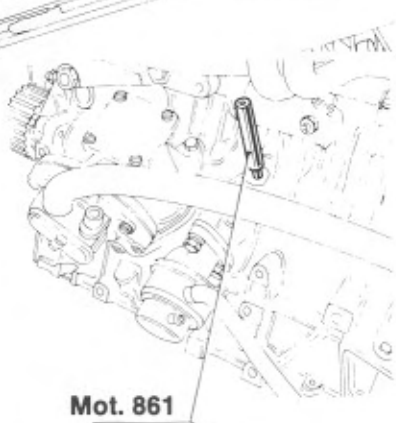
Step 5
- Put Locking Plate Mot. 854 between the camshaft and injection pump sprockets to prevent any out-of-phase movement.

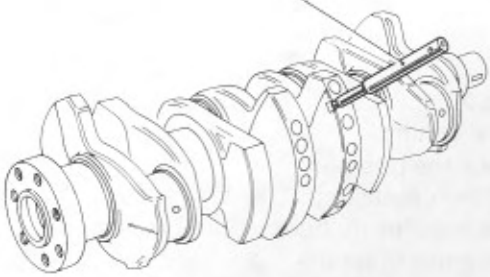
IMPORTANT
The timing belt must be changed at once if it becomes stained with oil.

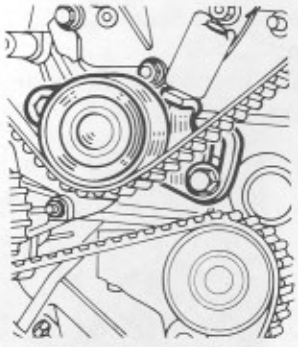
Step 6
- Mark direction of travel on the belt if it is to be reused.

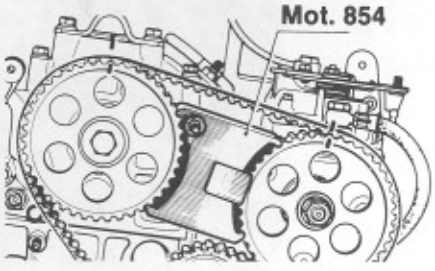
Step 7
Remove:
- The crankshaft pulley
- And timing belt







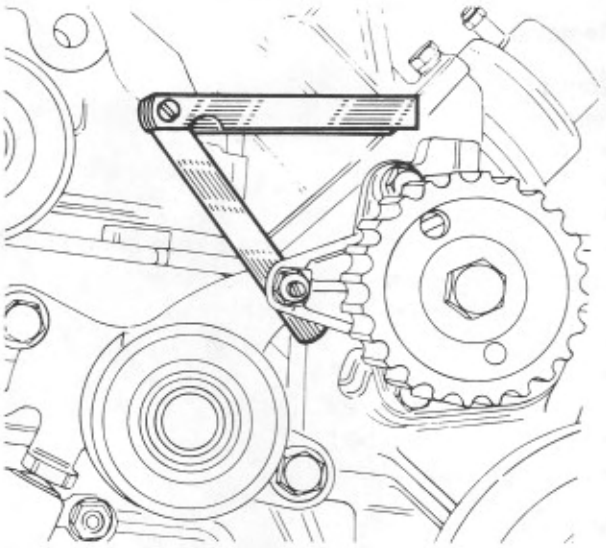




INSTALL TIMING BELT

Step 1

- Check the clearance between the tensioner pulley support and adjusting screw (A). A shim 0.1 mm (.004") thick should just bite; tighten the locknut.



Step 2

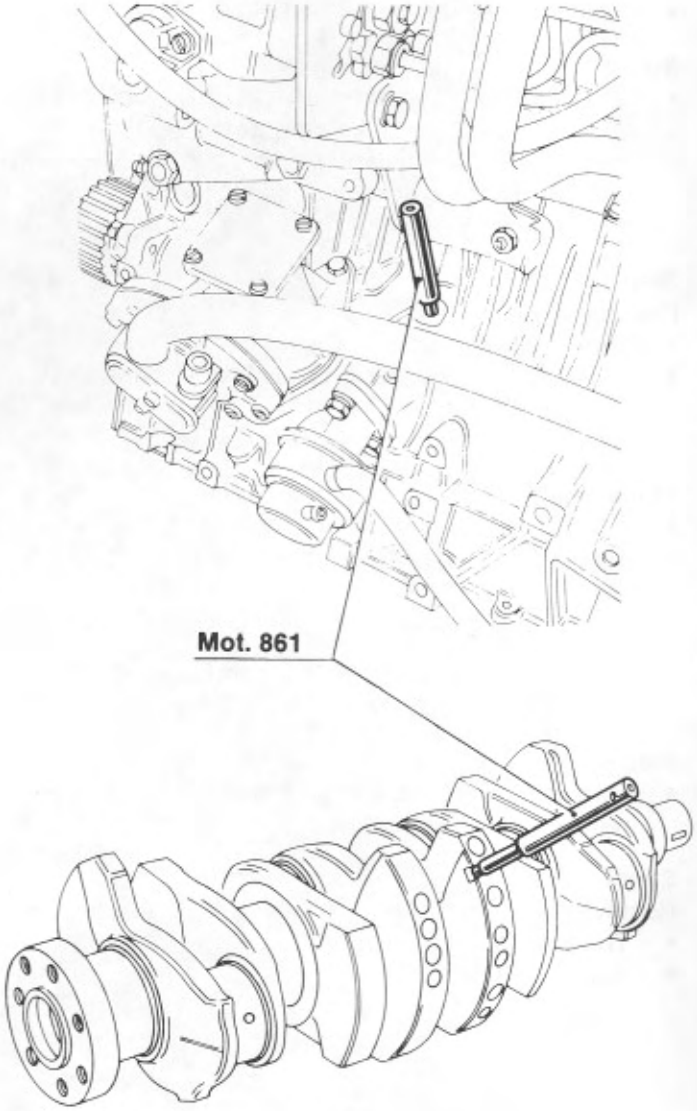
Valve Timing

Check the position:

- of the crankshaft. T.D.C. Rod Mot. 861 should be inserted in its hole in the crankshaft web (take care not to let the rod enter one of the balancing holes). Check that the crankshaft cannot turn one way or the other. Slight movement will mean that the rod has entered a balancing hole.

For information:

- balancing holes in the web are drilled 12 mm dia.
- the diameter of the T.D.C. rod is 8 mm.

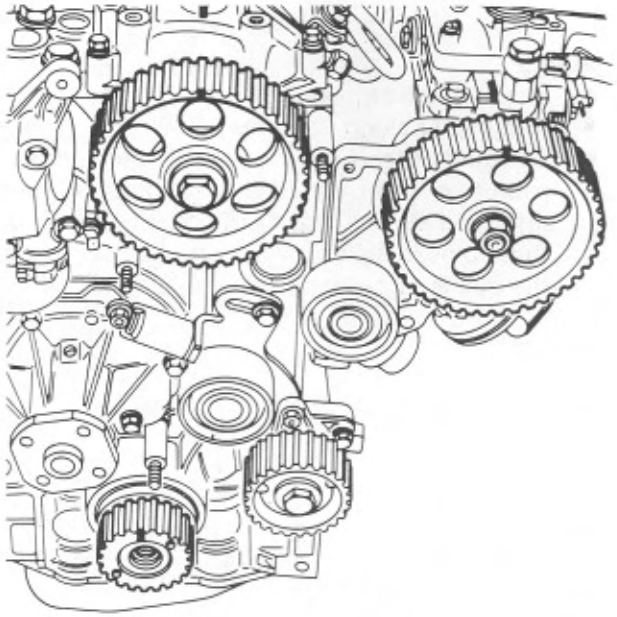


INSTALL TIMING BELT (CONT.)

Step 3

Check the position of:

- the camshaft: sprocket mark in line with the center of the boss on the rocker cover.
- the injection pump: sprocket mark in line with the web on the injection pump boss.



Step 4

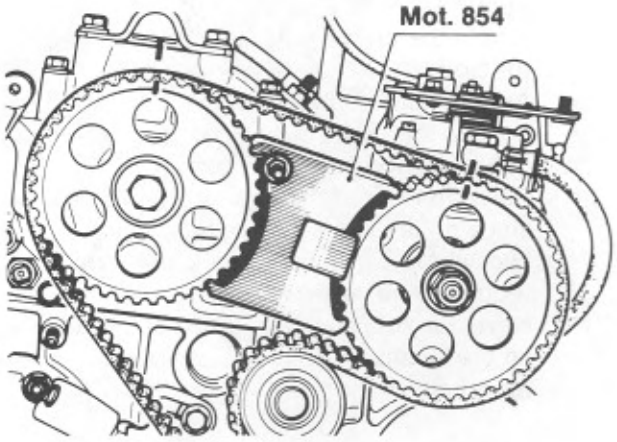
- Install air conditioning belt if equipped.

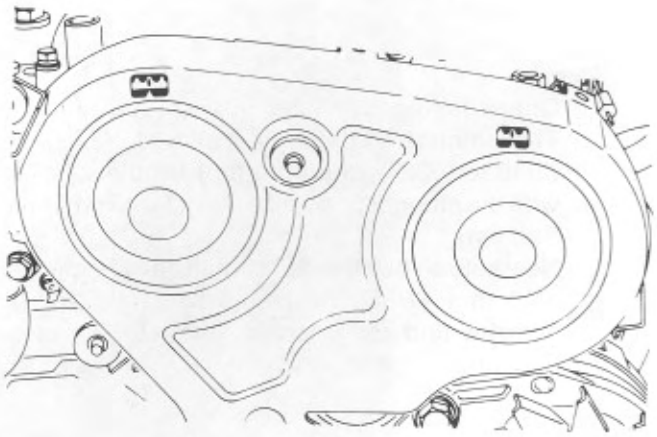
IMPORTANT

For information:

- There should be a total of 20 tooth troughs between the marked teeth on the camshaft and injection pump sprockets.
- There should be 100 tooth troughs between the marked teeth on the camshaft and crankshaft sprockets starting at the camshaft sprocket followed by the injection pump, intermediate shaft to the crankshaft.
- Put Locking Plate Mot. 854 between the camshaft and injection pump sprockets to hold them in phase.
- Always mark directions of travel before removing belt.

NOTE: It is possible to check the camshaft and injection pump sprocket positions by fitting the timing belt cover temporarily.

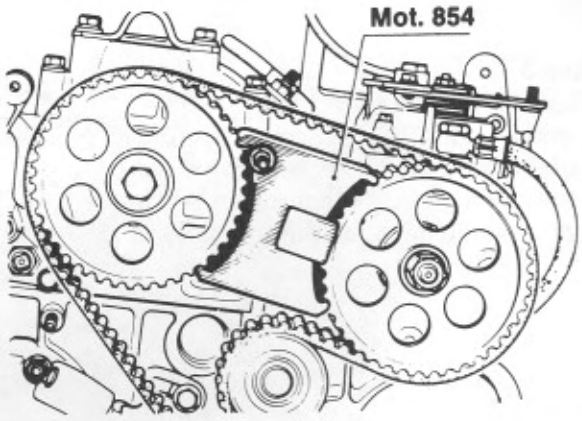




INSTALL TIMING BELT (CONT.)

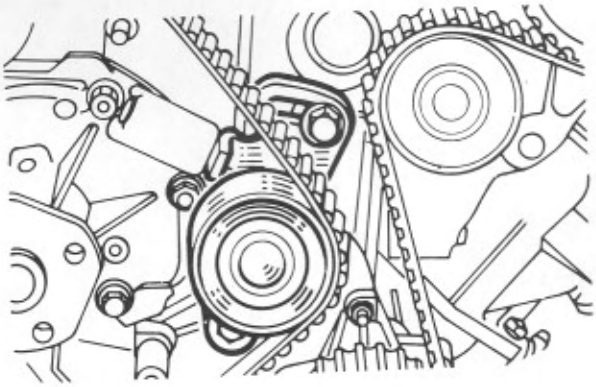
Step 5

- Mount the timing belt.
- Remove Locking Plate Mot. 854
- Check that the timing belt is well tensioned all round between the camshaft, injection pump, intermediate shaft, and crankshaft sprockets so that no possible tooth jumping can occur when the belt is tensioned by the tensioner pulley.



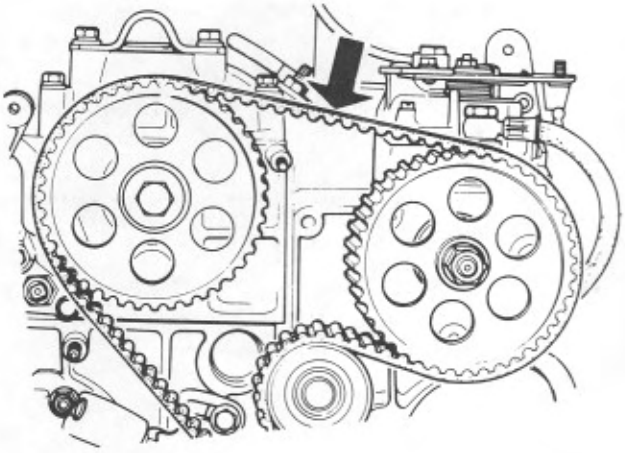
Step 6

- Loosen the tensioner mounting bolts one quarter of a turn, it will then automaticlly adopt its correct running position in contact with the belt under the effect of its spring.
- Remove T.D.C. Rod Mot. 861
- Mount the crankshaft pulley without tightening the bolt.
- Adjust timing belt tension.
- Follow the instructions below carefully when adjusting drive belt tension.
- Stand in front of the engine and turn the crankshaft pulley nut so that the engine completes two whole turns in a clockwise direction (direction of normal running).
- Never turn the engine counter-clock-wise. Loosen the tensioner bolts one quarter of a turn then retighten.



Step 7

- Check timing belt tension with Tool Ele. 346. The amount of deflection should be 5-7 mm (3/16 to 9/32") when the tool shoulder is flush with the plunger body (see Drive Belt Tensioning Section).
- New auto air belt tension should have a deflection of 3 mm (1/8"). Run approximately 15 - 20 minutes and retighten to 4mm (5/32") of deflection.



INSTALL TIMING BELT (CONT.)

IMPORTANT
It is important that the timing belt is correctly tensioned to give it a long service life and ensure correct camshaft drive:
- Too loosen a belt may lead to jumping 1 or 2 teeth with the consequent risk of the valves coming into contact with the pistons.
- Too tight a belt will increase wear rapidly and give rise to noisy operation.

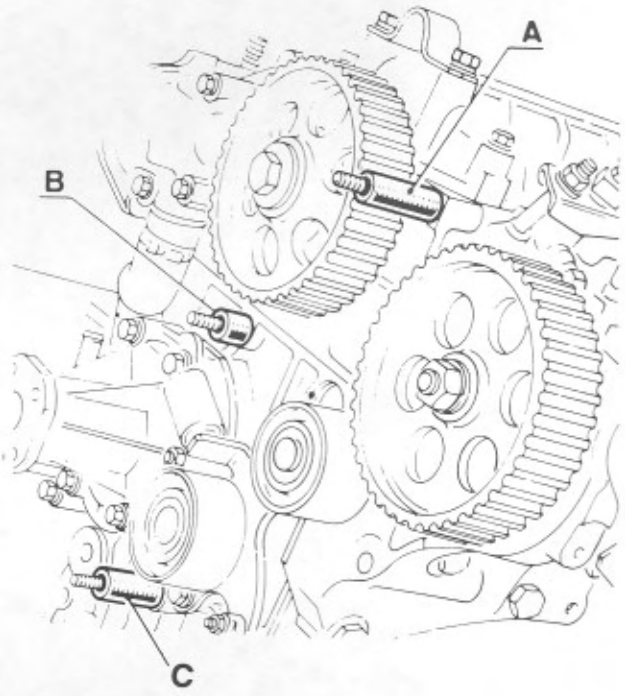
Step 8
- Mount crankshaft pulley.

Tighten

Tightening Torque:	
Crankshaft pulley bolt:	12 to 13.5 daNm
Using Tool Mot. 582	(90 to 100 lb./ft.)

Step 9
- Check injection pump timing (see Pump Timing Section)
- Put in position:
  - the timing cover distance pieces:
    - the longest at A
    - the shortest at B
    - the medium at C
- The timing belt cover

Step 10
- Reinstall the following:
- Lower flywheel cover
- Alternator - fan belt (See Belt Tensioning Procedure, B5-1)
- Power steering belt (See Belt Tensioning Procedure, B5-1)
- Fan blade
- Radiator
- Radiator coolant hoses
- Fender connecting brace
- A/C condenser and fans (if equipped)
- Belly shield
- Nosepiece
- Refill cooling system and bleed (see Cooling System Section)



BELT TENSIONING PROCEDURE

The tightener must always be slack when mounting a drive belt; this prevents strain on the pulleys and belt itself.

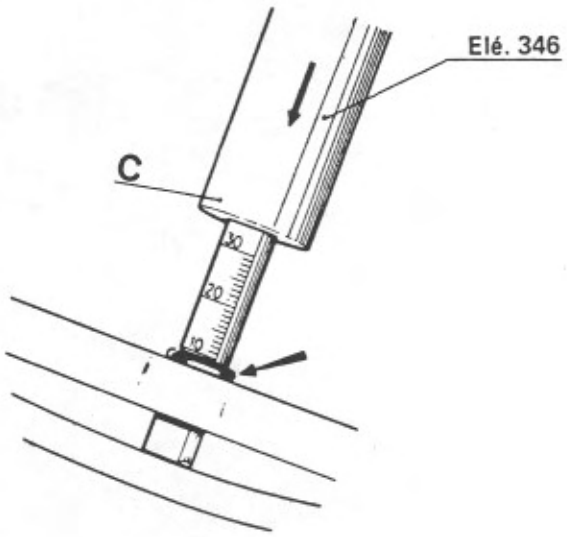
Checking Method
Check that the underside of the rubber ring is opposite the zero graduation on the plunger.
Lay the bar along the drive belt with the tool plunger an equal distance between the pulley centers.
Press the sliding portion of the plunger until shoulder (C) is flush with the plunger body.
Remove the tool and read off the value of the deflection on the underside of the rubber ring.

Timing Belt
See Section B4-4 - Timing Belt Changing

Water Pump Drive Belt (Alternator)
Measure deflection (F) on the taut side between the water pump pulley and alternator pulley.
The amount of deflection (F) on a new belt or after 10 minutes running should be 4 to 7 mm (5/32" to 9/32").

Power Steering Pump Drive Belt
Measure deflection (F) on the taut side between the crankshaft pulley and power steering pump pulley.
The amount of deflection (F) on a new belt or after 10 minutes running should be 4 to 7 mm (5/32 to 9.32")

Auto Air Drive Belt
Measure deflection (F) on the taut side between the crankshaft pulley and auto air pulley. The amount of deflection (F) on a new belt should be 3 mm (1/8").
The amount of deflection after 10 minutes of running should be 4 mm (5/32").



ENGINE WATER PUMP

IMPORTANT
The water pump cannot be repaired. Change the unit if any part is worn.

Removal
The timing belt tensioner need not be removed:

- Using a long hose clamp as shown, retain the timing belt tensioner plunger in position and prevent spring from flying out.
- Remove the water pump

Changing the gasket between the water pump and plate.

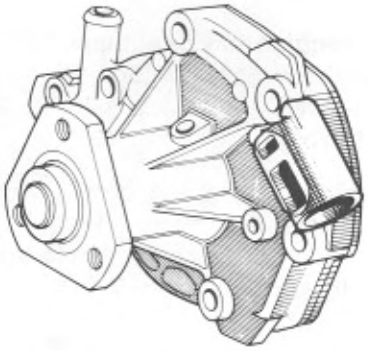
- Hold the water pump body in a vice and unstick the plate.
- Clean the joint faces by moving the plate around the pump shaft out of the way.
- Select the gasket which fits between the water pump and cylinder block and make the cut-outs shown in the sketch so that the gasket will slip between the water pump body and the plate.

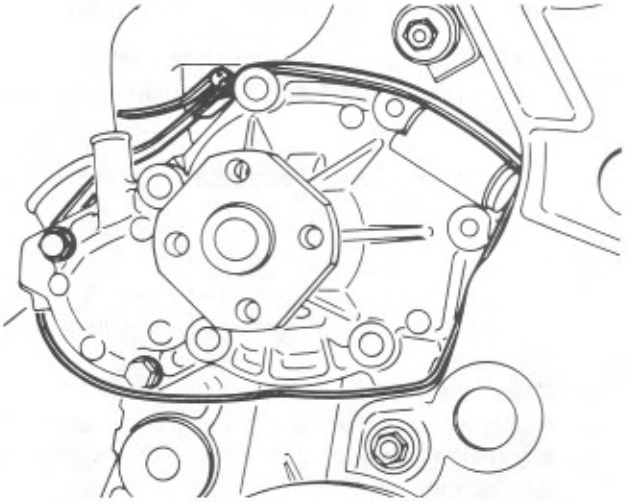
NOTE: Special points concerning refitting:

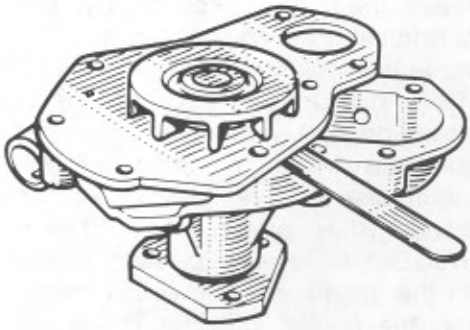
- Clean all joint faces before fitting new dry gaskets.
- Retain the timing belt tensioner plunger in position as before when refitting the pump.

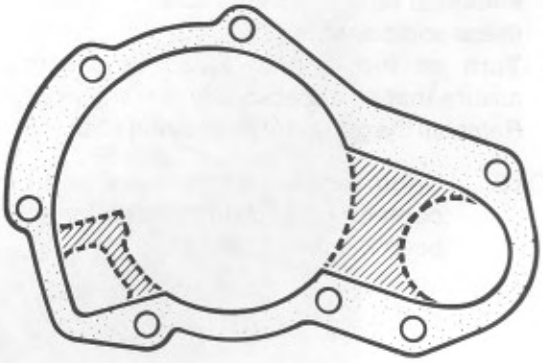
Installation

- Mount the water pump to the cylinder block followed by the coolant hoses to the pump.
- Fill and bleed the cooling circuit - see Cooling System Section.









WATER PUMP FAN/HUB DECLUTCHING MODIFICATION

This type of engine may be equipped with one of two styles of fan drive configurations:
a) "direct-drive" solid hub and b) electric de-clutching fan hub.

The type of hub equipped on the engine can be identified by counting the number of bolts at the fan hub. Four bolts fastening the fan indicates a solid hub. Six bolts (3 retaining the fan blade) indicates a clutch type fan hub.

NOTE: The clutch type fan hub will "free-wheel".

Should a "direct drive" type hub be considered more desirable to the clutch type, the following procedure may be performed.

Fan Hub Modification Procedure - (Clutch Type only)

1. Remove fan blade.
2. Remove the three (3) socket head cap screws (5mm hex) and their jamb nuts from the front of the fan.
3. Discard the three (3) hex jamb nuts.
4. Apply a thread adhesive compound (Loctite® or equivelant) to each of the three (3) socket head cap screws.
5. Reinsert the three (3) socket head cap screws into original holes and tighten.
6. Torque the socket head cap screws to 5 daNm (3.68 ft./lbs.) Do not over-torque these screws as it will break the assembly.
7. Detach the wire spring clip retaining the carbon contact assembly: remove the wire assembly, the spring, the carbon contact, and the insulated barrel. Cut the tan wire close to its connection with the main harness, near the wiper motor. Wrap the end of the clipped tan wire with electrical tape to avoid a short circuit. Discard these components.
8. Turn on the ignition switch and inspect to assure that all accessories operate properly.
9. Reinstall the grille and front panel (if so required).

NOTE: Upon removal of the wire and carbon contact, be certain that the tan wire has been insulated. See Step 7.

SECTION "C"

J8S-234 TURBOCHARGED DIESEL ENGINE

Subsection 1 - General Information

C1-1 Ghosted Views and Systems Drawings
C1-8 Engine Identification
C1-9 Special Tools
C1-15 Engine Exploded Views
C1-17 Torques and Specifications
C1-22 General Diagnostic Procedures

Subsection 2 - Engine Removal and Replace

C2-1 Engine Removal Procedure
C2-2 Preparation for Rebuilding
C2-4 Preparation for Engine Installation
C2-4 Engine Installation Procedure
C2-5 Final Procedures After Engine Installation

Subsection 3 - Overhaul and Rebuild

C3-1 General Information
C3-2 Engine Teardown
C3-4 Cylinder Head Overhaul
C3-11 Rocker Shaft Rebuild
C3-13 Oil Pump - Overhaul
C3-16 Cylinder Block and Related Parts - Clean and Inspect
C3-19 Cylinder Block and Related Parts - Reassembly
C3-37 Cylinder Head Reinstallation

Subsection 4 - Timing Belt Changing

C4-1 Removal
C4-3 Installation

Subsection 5 - Belt Tensioning Procedure

C5-1 Checking Method for All Belts

Subsection 6 - Engine Water Pump

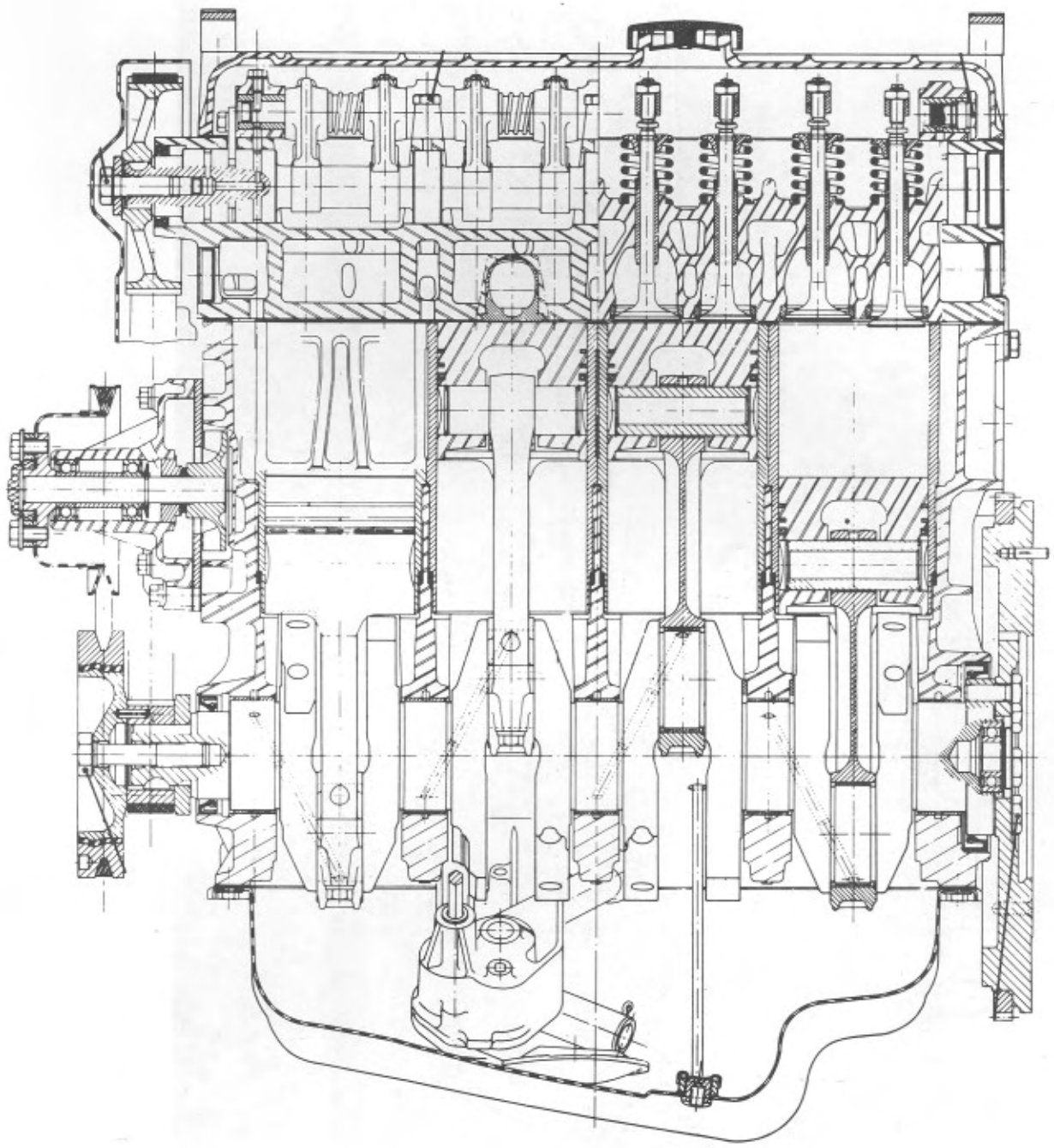
C6-1 Removal and Replacement
C6-2 Declutching Modification

GENERAL

GHOSTED VIEW

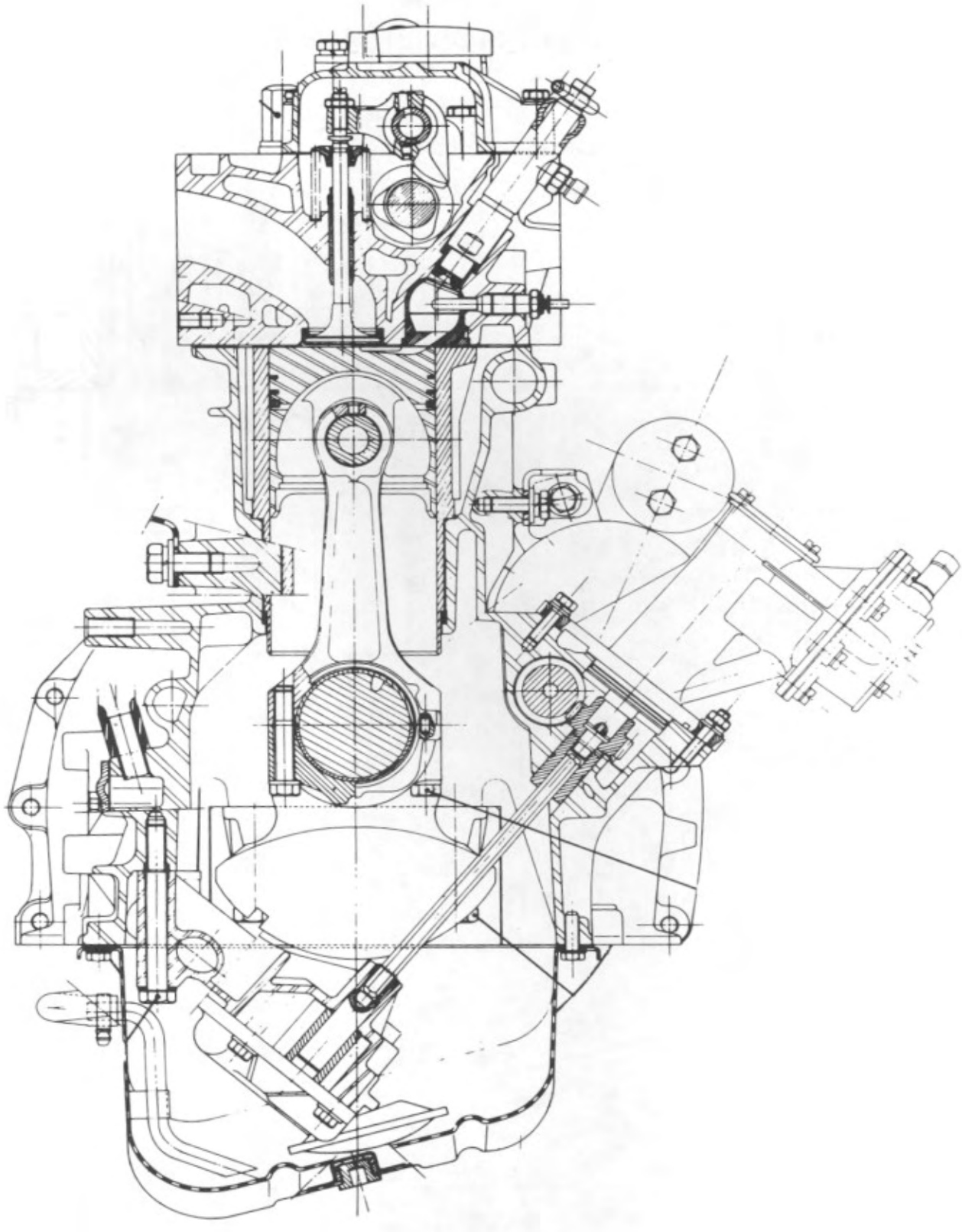
J8S-234

4-Cylinder Turbocharged Diesel

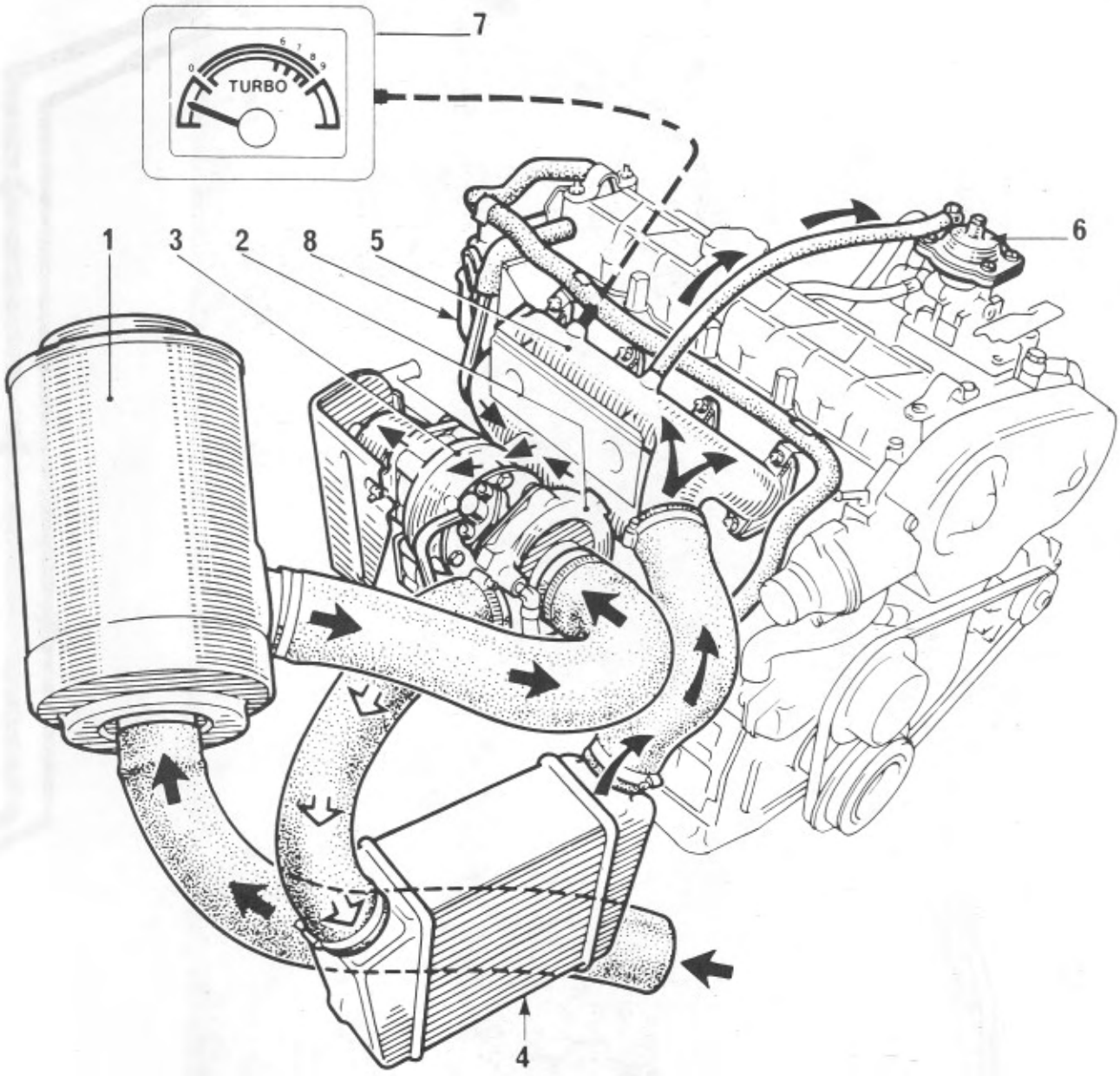


Engine	Vehicle	Comp. Ratio	Stroke (mm)	Bore (mm)	Cubic Cap. (mm)
J8S-234	Centauri, LeSharo, Phasar and Utility Van	21.5	89	86	2068

GENERAL
GHOSTED VIEW



INLET AIR EXHAUST GAS CIRCULATION



Air at atmospheric pressure

Boosted inlet air

Cooled boosted inlet air

1 - Air filter

2 - Inlet air compressor

3 - Exhaust gas driven turbine

4 - Intercooler

5 - Boosted inlet air manifold

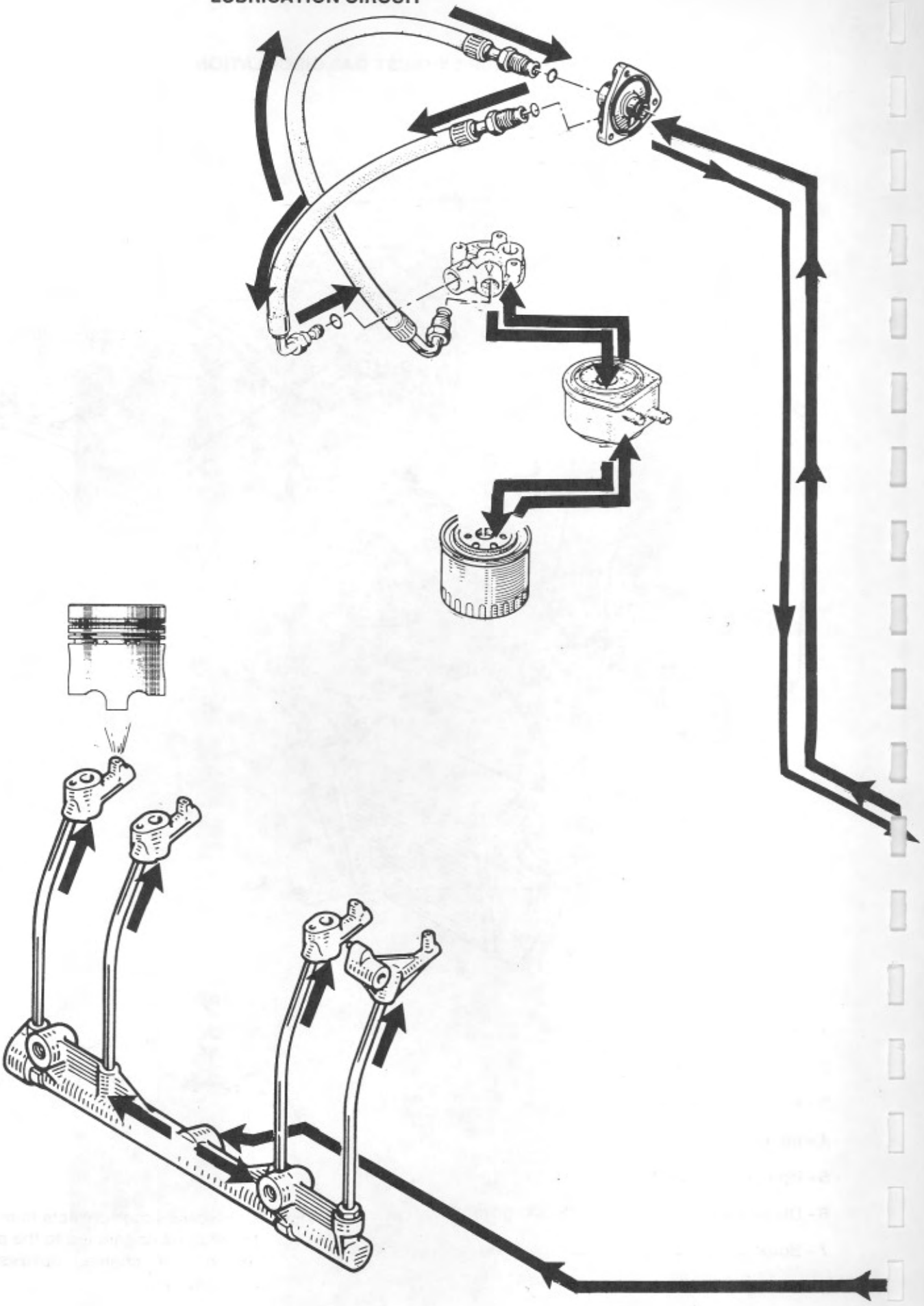
6 - Diesel injection pump with "LDA" governor

7 - Boost pressure gauge used for testing

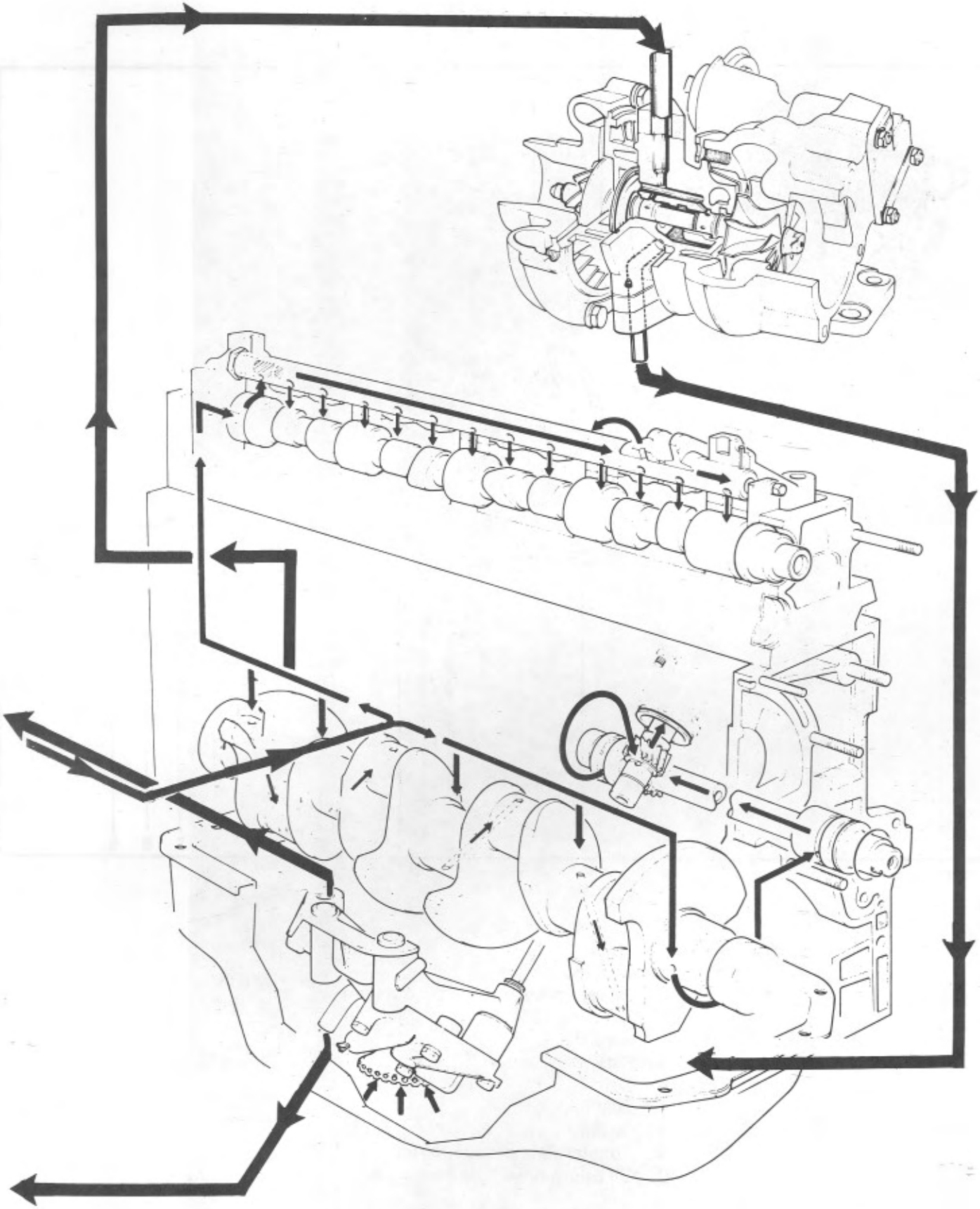
8 - Oil separator

NOTE: Crankcase vapor collects in oil separtor (8) which is connected to the pan and to the inlet air channel upstream of the turbocharger.

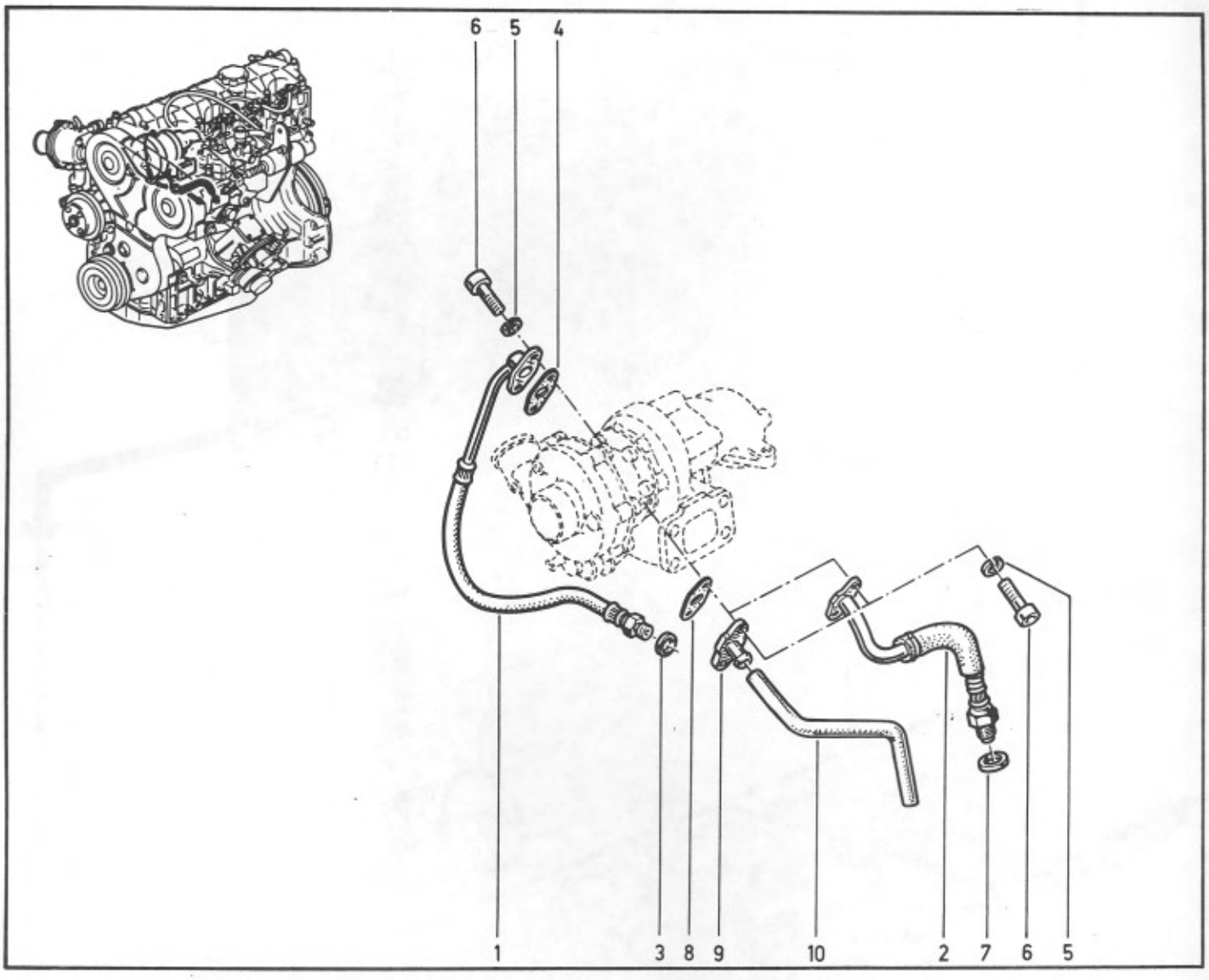
LUBRICATION CIRCUIT



LUBRICATION CIRCUIT



TURBOCHARGER LUBRICATION HOSES



1. Oil supply hose
2. Oil return hose (early production)
3. Seal ring
4. Gasket
5. Washer
6. Bolt
7. Seal ring
8. Gasket
9. Adapter (late production)
10. Oil return hose (late production)

PRECAUTIONS TO BE TAKEN WHEN STARTING A TURBOCHARGED ENGINE

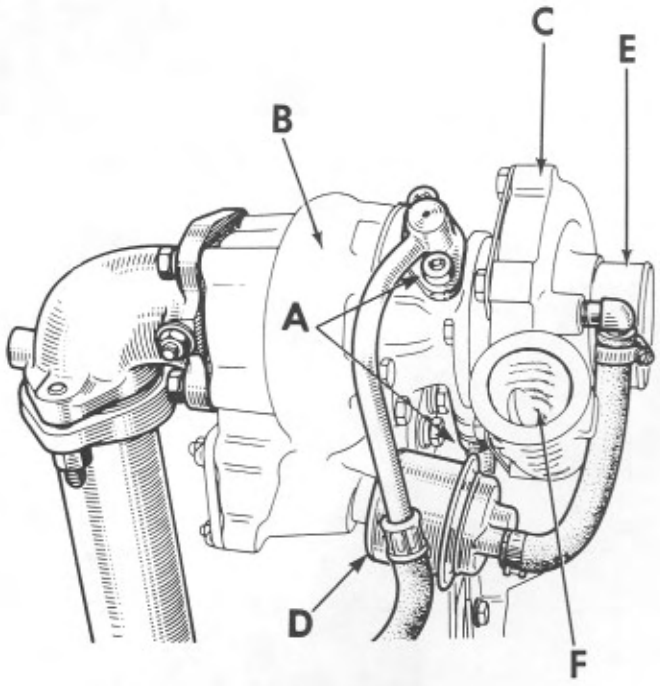
After any repair in which the oil lines have been disconnected, it is ESSENTIAL to reprime the turbocharger oil circuit as follows:

- Disconnect the oil feed pipe at the turbocharger and fill it with recommended engine oil
- Cycle the engine with the starter to reprime the turbocharger oil circuit until oil flows out of the turbocharger oil inlet pipe.
- Reconnect the turbocharger oil inlet pipe
- Start the engine and let it idle until the turbocharger oil circuit is fully reestablished.

PRECAUTIONS TO BE TAKEN WHEN SWICHING OFF A TURBOCHARGED ENGINE

Allow the engine to idle for about 30 seconds before switching off the ignition.

If the above precaution is ignored and the engine is switched off while it is being revved (turbocharger in action and ignition cut-off functioning), the turbocharger will continue to spin at very high r.p.m. due to its inertia without any oil supply (after the engine itself has stopped) and the turbine spindle may seize.



A. Oil feed (upper) and return (lower) hoses
B. Exhaust driven turbine section
C. Air compression section
D. Waste gate
E. Turbo air inlet
F. Turbo compressed air outlet

CAUTION

The wastegate setting is adjusted at the factory. It is not possible to change or adjust it and any failure means that the complete turbocharger must be replaced.

Attempting to alter the amount of turbo boost pressure can cause serious internal engine damage and void engine warranty.

ENGINE IDENTIFICATION

The shape of the identification plate riveted to the cylinder block depends on the space available.

The following information is stamped on the plate:

A - Engine type

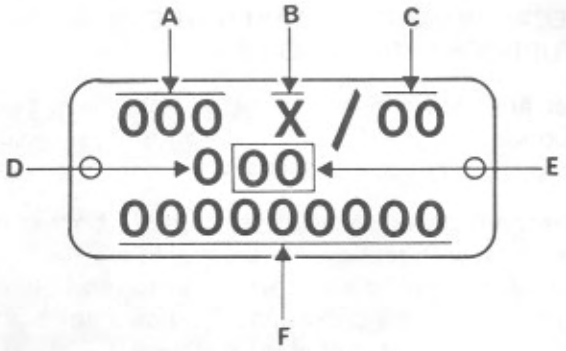
B - Engine approval letter.

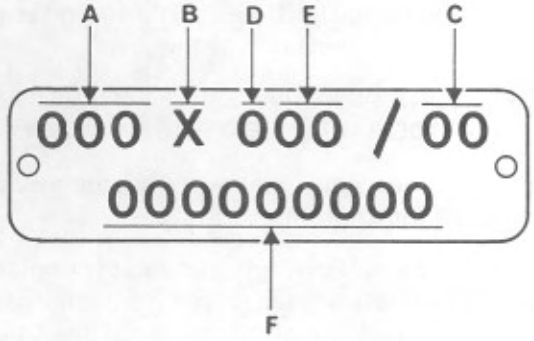
C - Engine equipment

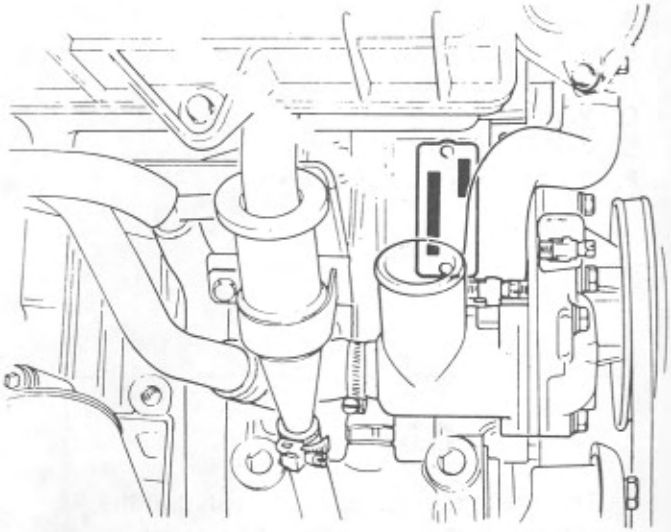
D - R.N.U.R. identity

E - Engine suffix

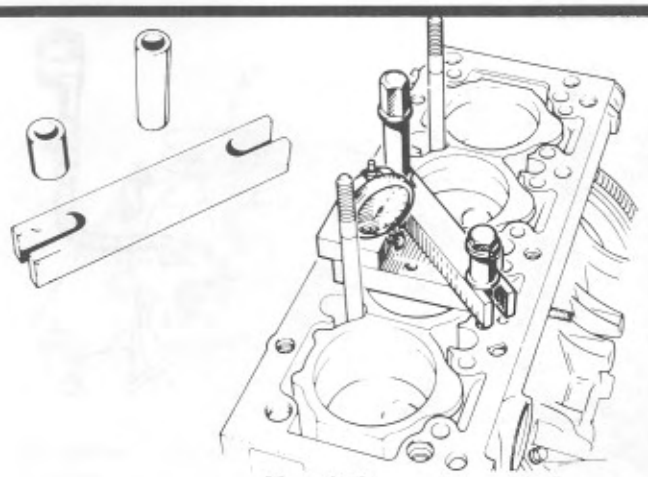
F - Engine Fabrication No. (preceded by suffix).





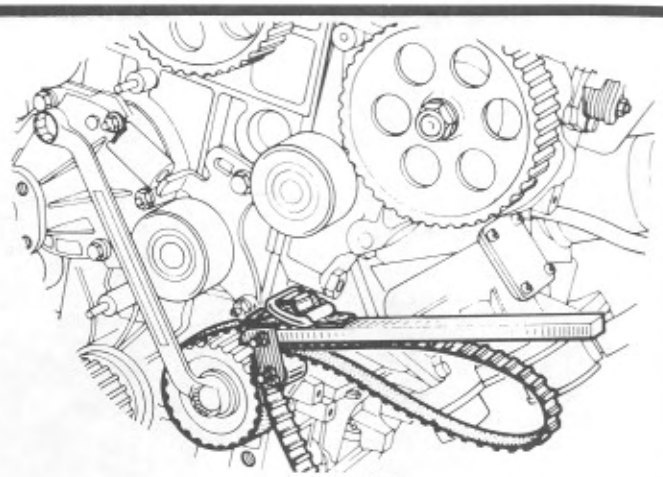


SPECIAL SERVICE TOOLS



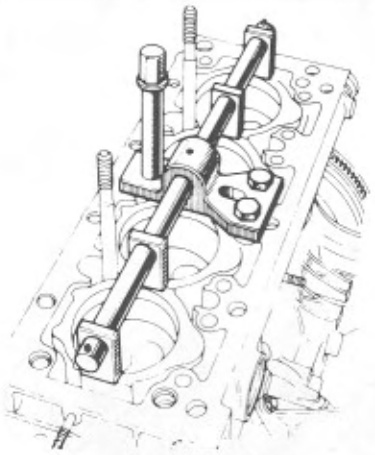
Mot. 853
Sleeve base seal compressing tool

Order Tool No. 700000-85-300 EA



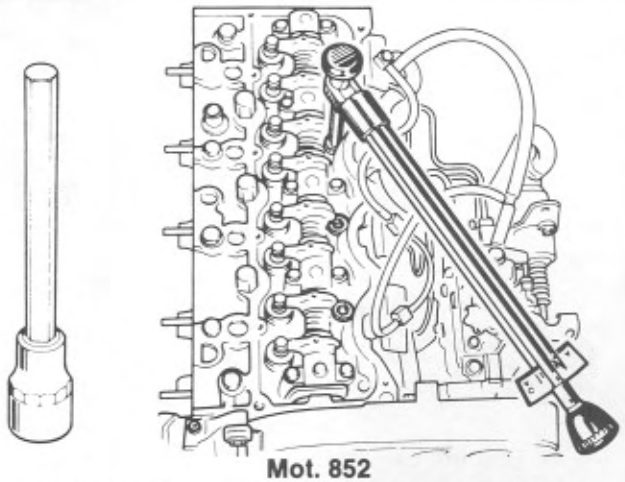
Mot. 855
Toothed belt idler sprocket locking strap

Order Tool No. 700000-85-500 EA



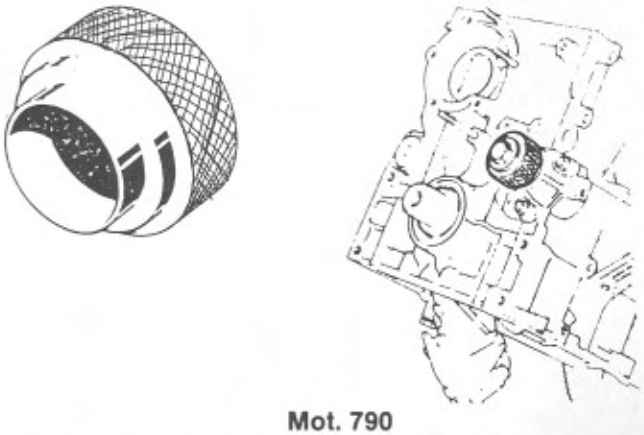
Mot. 521-01
Sleeve clamp

Order Tool No. 700000-52-101 EA



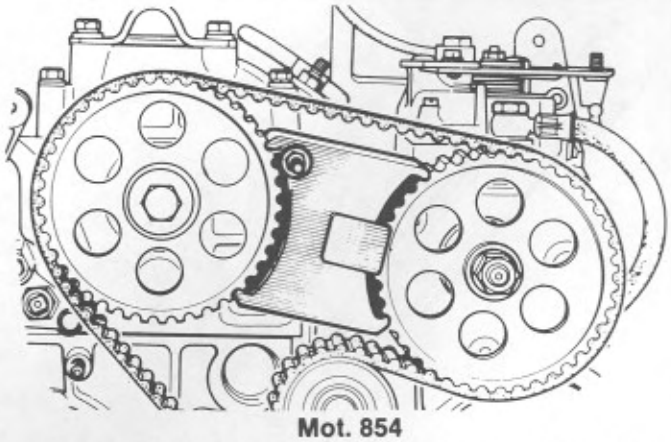
Mot. 852
Socket for cylinder head female capscrews

Order Tool No. 700000-85-200 EA



Mot. 790
Oil seal inserting and intermediate shaft bearing locating tool

Order Tool No. 700000-79-000 EA



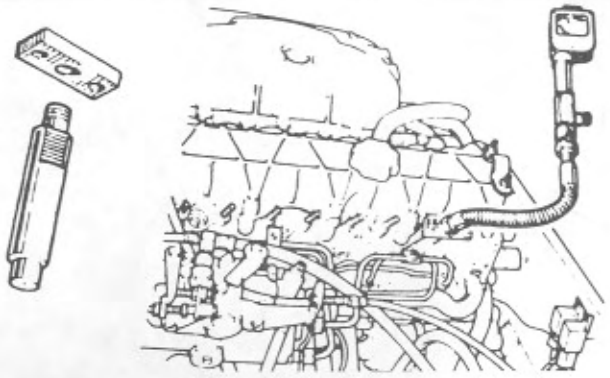
Mot. 854
Camshaft/injection pump sprockets locking plate

Order Tool No. 700000-85-400 EA



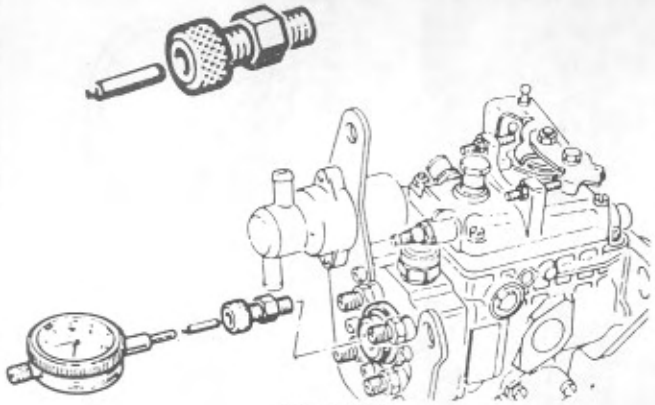
Mot. 861
TDC indicator rod

Order Tool No. 700000-86-100 EA



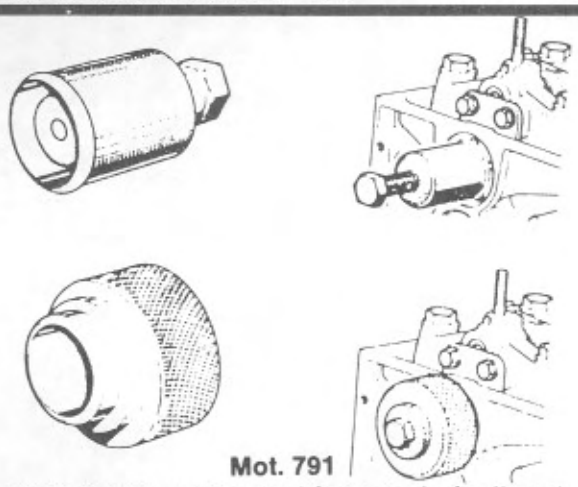
Mot. 871
Adaptor for diesel engine compression testing (to be used only with locally supplied compression gauge with scale reading at least 450 P.S.I.)

Order Tool No. 700000-87-100 EA



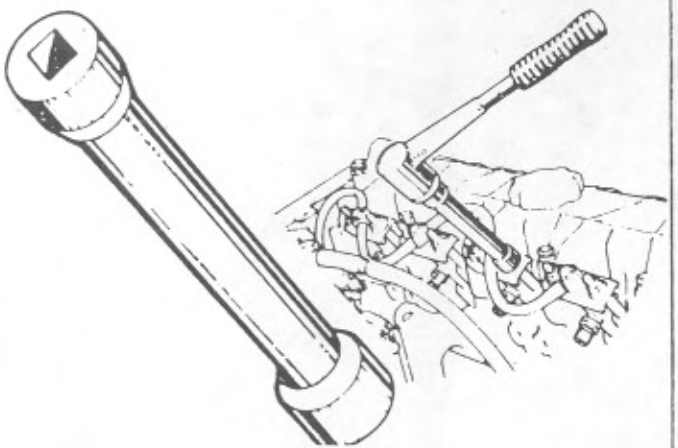
Mot. 856
Dial indicator adapter for timing Bosch injection pump

Order Tool No. 700000-85-600 EA



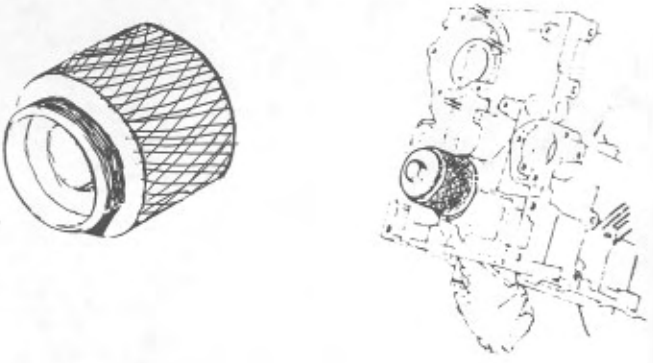
Mot. 791
Extracting/inserting tool for camshaft oil seal

Order Tool No. 700000-79-100 EA



Mot. 869
Injector holder socket use with Ele. 721

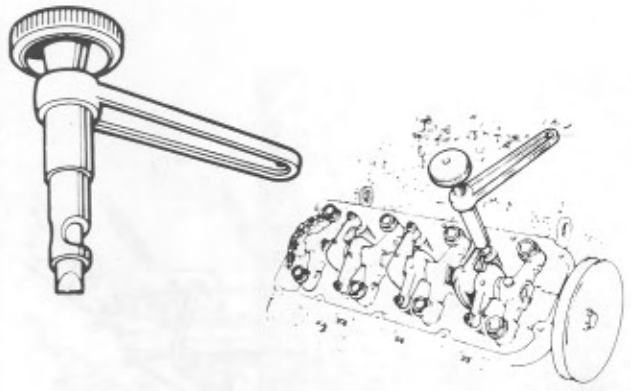
Order tool no. 700000-86-900 EA



Mot. 789
Crankshaft oil seal inserting tool (timing cover end)

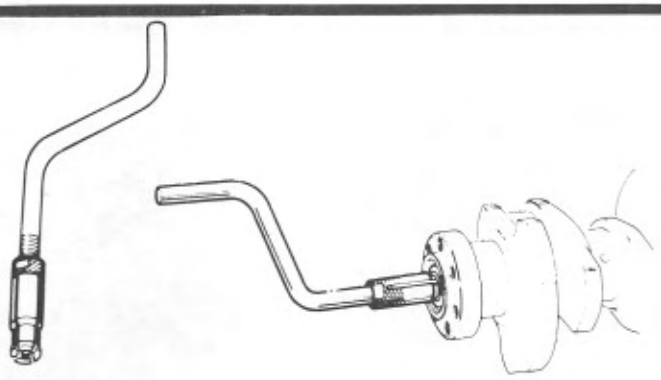
Order tool no. 700000-78-900 EA

SPECIAL SERVICE TOOLS



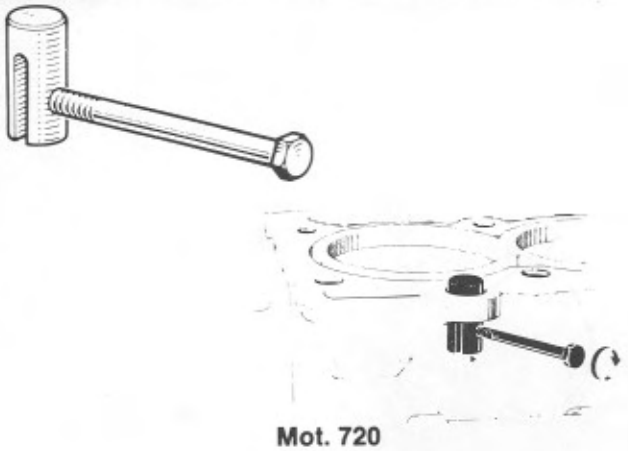
Mot. 647
Rocker arm clearance adjustment wrench

Order Tool No. 700000-64-700 EA



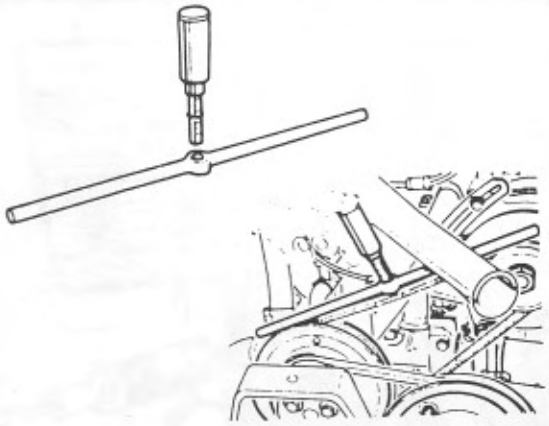
Mot. 11
Crankshaft bushing extractor

Order Tool No. 700010-72-500 EA



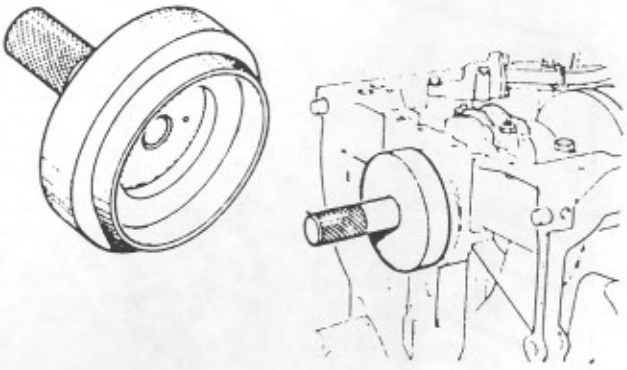
Mot. 720

Cylinder head locating tool
Order Tool No. 700000-72-000 EA



Ele. 346
Drive belt tensioning tool

Order Tool No. 700000-34-600 EA

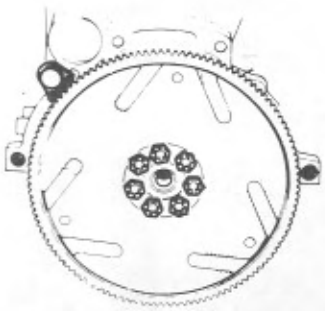


Mot. 788
Crankshaft oil seal inserting mandrel

Order Tool No. 700000-78-800 EA

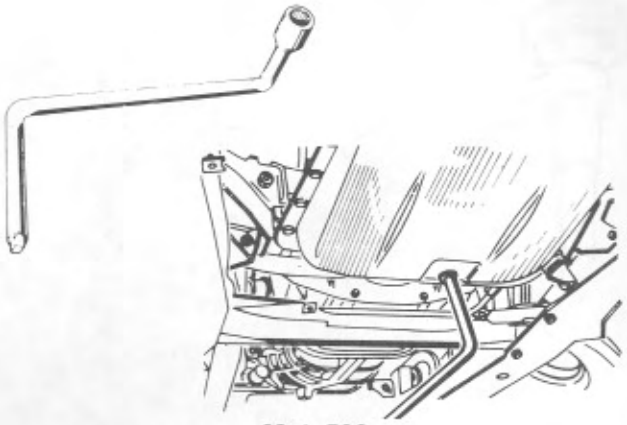
SPECIAL SERVICE TOOLS





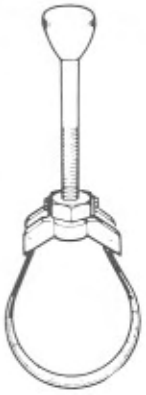
Mot. 582
Flywheel locking sector

Order Tool No. 700000-58-200 EA



Mot. 593
Engine gearbox drain plug wrench (8 mm square)

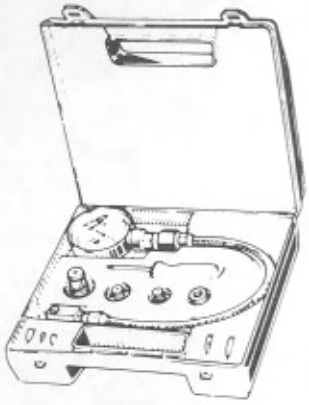
Order Tool No. 700000-59-300 EA

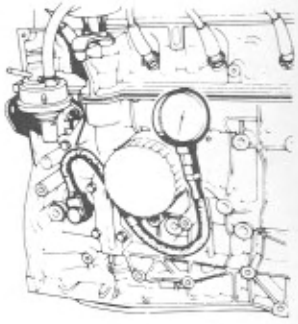




Mot. 445
Oil filter strap

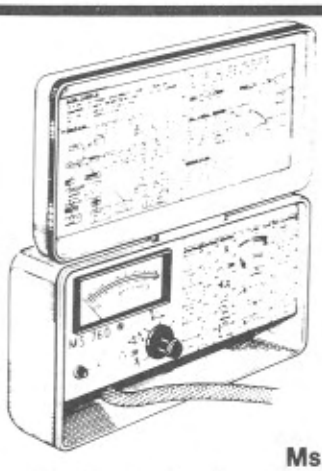
Order Tool No. 700000-44-500 EA

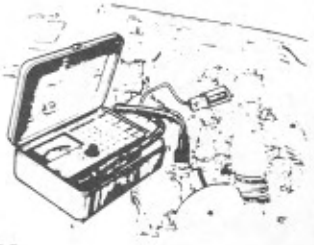




Mot. 836
Boxed oil pressure testing kit

Order Tool No. 700000-83-603 EA





Ms. 760
Engine tuning instrument, initial advance, dwell, contact points resistance with tachometer

Order Tool No. 700000-76-000 EA

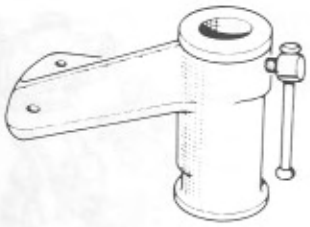




Ms. 881
Diesel tachometer (use with Ms. 760)

Order Tool No. 700000-88-100 EA

SPECIAL SERVICE TOOLS

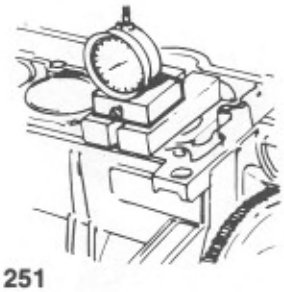


(No Number)

Bench stand for unit support

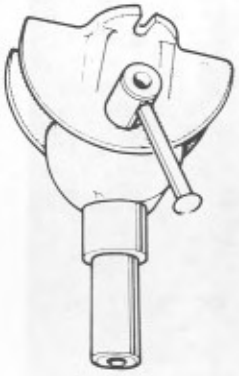
Order Tool No. 700012-39-500 EA





Mot. 251
Dial indicator support
(for checking sleeve protrusion and position)

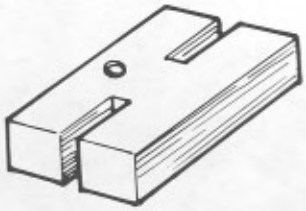
Order Tool No. 700000-25-101 EA

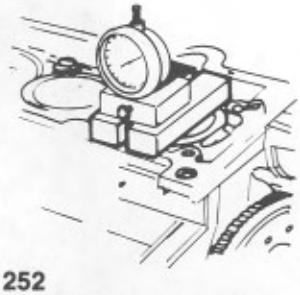


(No Number)

Fork end and swivel stand for bench stand

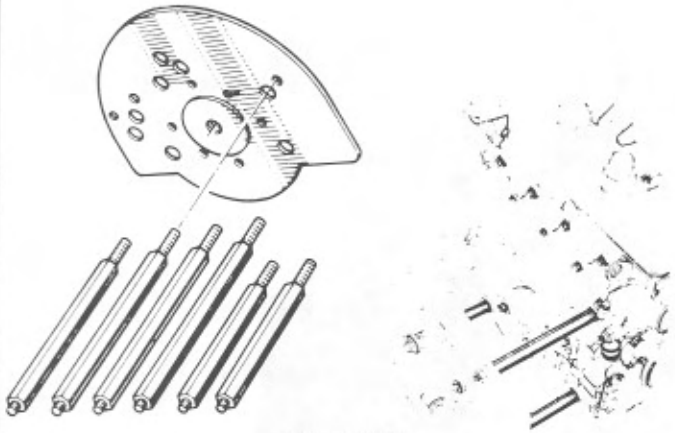
Order Tool No. 700012-09-200 EA





Mot. 252
Thrust plate (for checking sleeve protrusion)

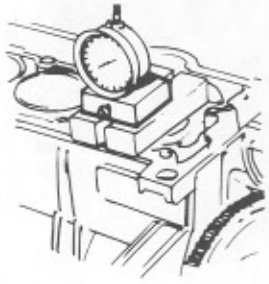
Order Tool No. 700000-25-201 EA



Mot. 792
Engine plate for DESVIL stand

Order Tool No. 700000-79-200 EA

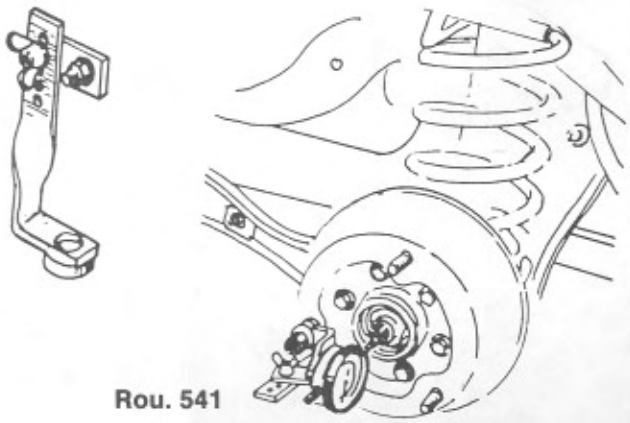




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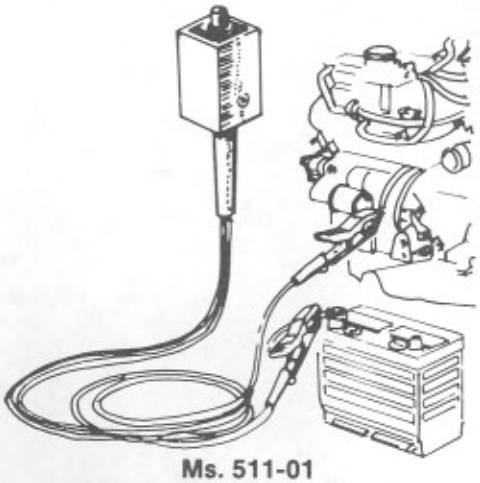
Dial indicator

Order Tool No. 72046E-B0-000 EA



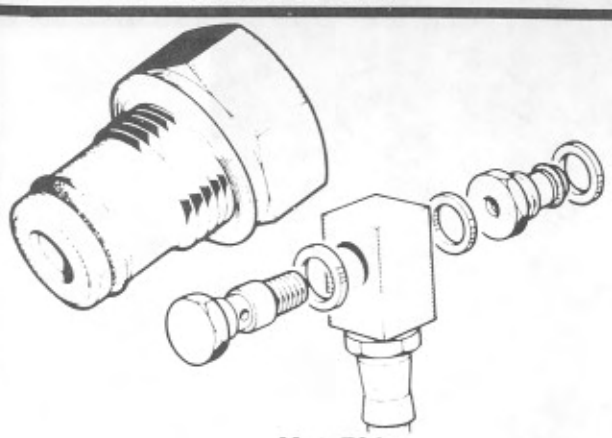
Rou. 541

Dial indicator bracket (For measuring rear hub end play and piston-to-cylinder head clearance)
Order Tool No. 700000-54-100 EA



Ms. 511-01

Remote control starter switch
Order Tool No. 700000-51-101 EA

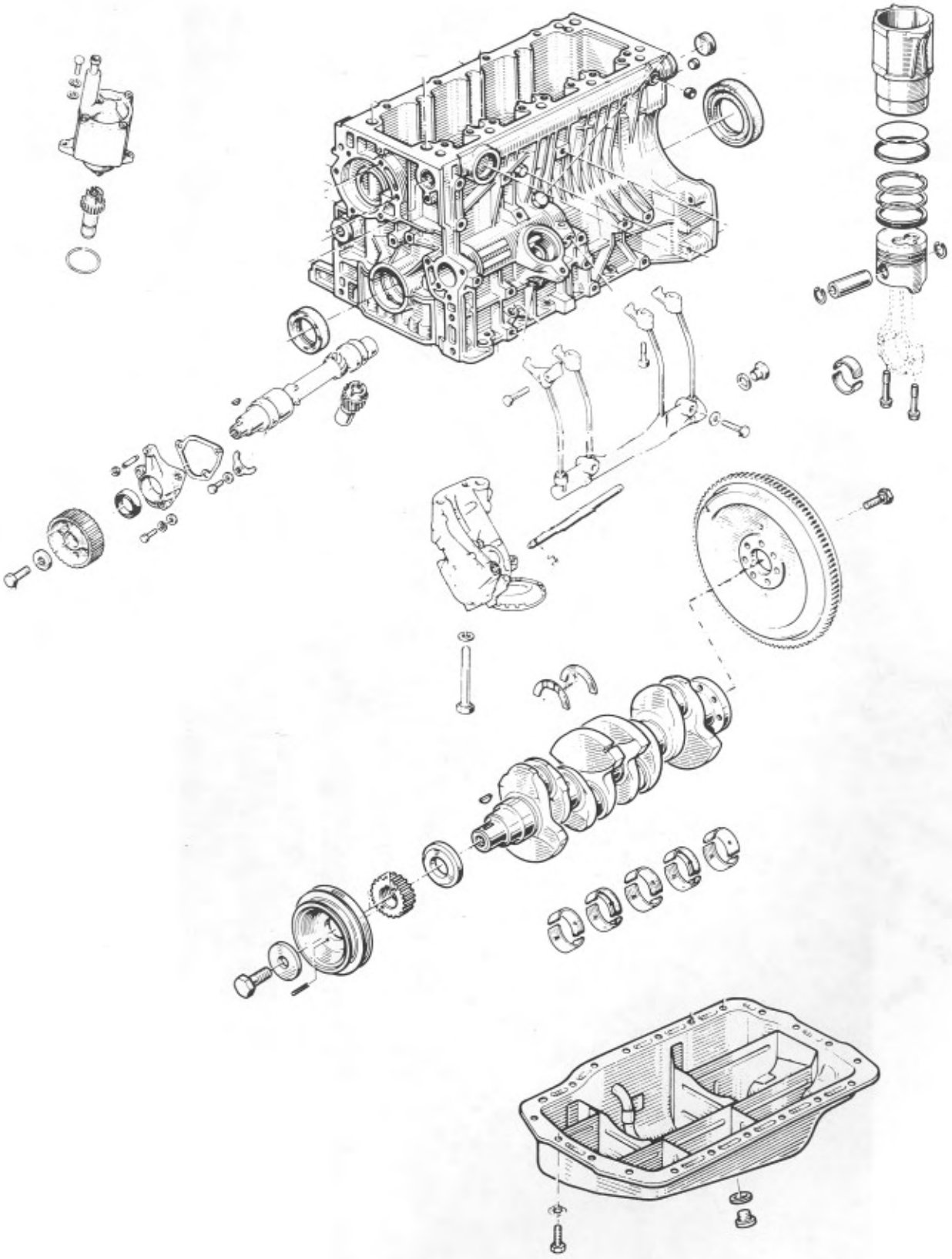


Mot. 724

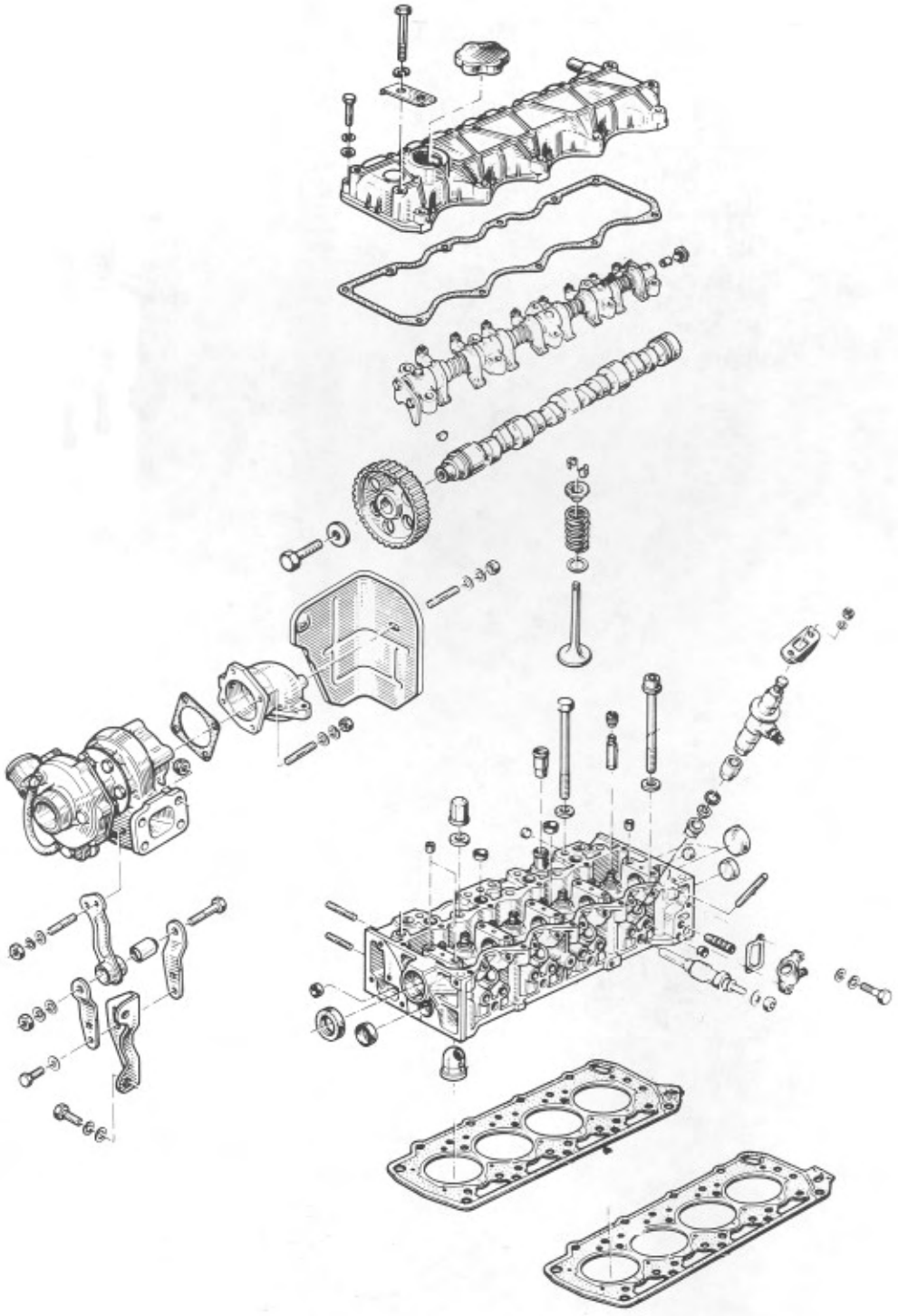
Oil pressure testing union set
(for diesel motor)
Order Tool No. 700000-83-601 EA

CYLINDER BLOCK

EXPLODED VIEW



CYLINDER HEAD



Cylinder Head

Tightening torque (engine cold)

1st pre-tightening	3 daNm (22 1/2 lb./ft.)
2nd pre-tightening	5 daNm (37 1/2 lb./ft.)
1st tightening	9.5 to 10.5 daNm (71 to 78 lb./ft.)
2nd tightening (without prior loosening)	9.5 to 10.5 daNm (71 to 78 lb./ft.)

Rocker arm clearances (engine cold)
At least 2 hours after engine has stopped.

inlet	0.20 mm (.008")
exhaust	0.25 mm (.010")

Cylinder head height	104.5 + 0.4 mm (4.114" + .0016)
Max. bow of gasket face	0.05 mm (.002")
Pre-combustion chamber protrusion	0.01 to 0.04 mm (.0004 to .0016")

IMPORTANT
The cylinder head may not be resurfaced under any condition.

GENERAL

Tightening Torques

Cylinder head stud insertion	1 daNm (7 1/2 lb./ft.)
Main bearing cap bolts	8.75 to 9.75 daNm (65 1/2 to 73 lb./ft.)
Connecting rod cap bolts	6.5 daNm (50 lb./ft.)

Bolts:

Flywheel	5.5 to 6 daNm (41 to 45 lb./ft.)
Crankshaft pulley	12 to 13.5 daNm (90 to 101 lb./ft.)
Camshaft sprocket	5 daNm (37 lb./ft.)
Intermediate shaft sprocket	5 daNm 37 lb./ft.)
Injection pump sprocket	5 daNm (37 lb./ft.)
Oil pump	4 to 4.5 daNm (30 to 34 lb./ft.)
Rocker shaft	2.5 to 3 daNm (19 to 22 lb./ft.)
Glow plugs	2 to 3 daNm (15 to 22 lb./ft.)
Injector clamps	1.7 daNm (12 1/2 lb./ft.)
Rocker shaft oil way plug	2 daNm (15 lb./ft.)
Oil pan bolts	1 daNm (7.5 lb./ft.)
Intermediate shaft retaining bolt	5 daNm (37 lb./ft.)
Piston skirt oil manifold to side of block (early turbo)	2.5 daNm (18 lb./ft.)
Jet retaining bolts for above	1 daNm (7.5 lb./ft.)

Connecting Rods

Bearing shell material: aluminum-tin

End play	0.32 to 0.58 mm (.013 to .022")

The rod end is bushed and cannot be rebushed.

The connecting rods have no oil jet hole. The top and bottom bearing shells are plain.

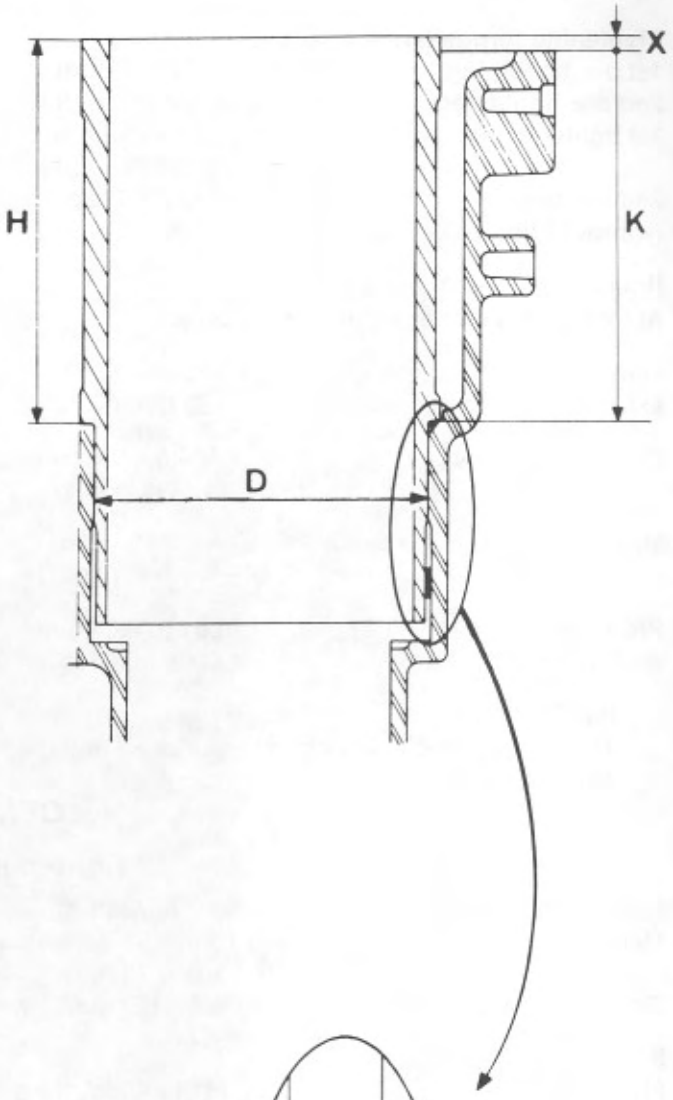
Direction of assembly:
Bearing half shell locating pegs on side away from turbulance chamber on top of piston (injector side)

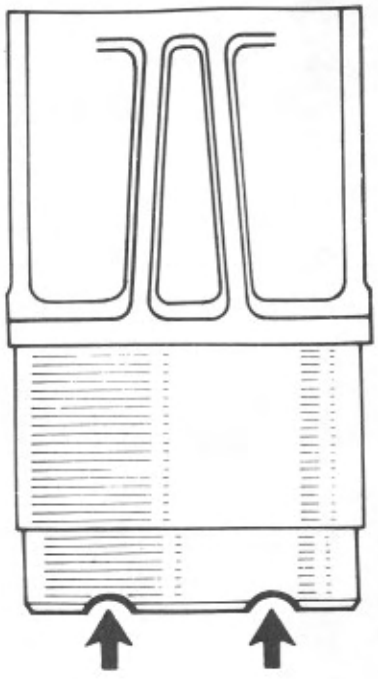
Sleeves

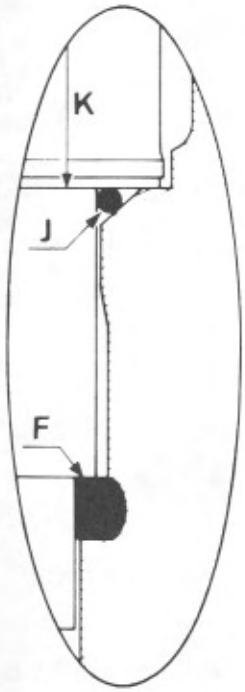
Bore	86 mm (3.386")
Base locating diameter (D)	93.6 mm (3.685")
Sleeve protrusion (X) without 'O' rings	0.05 to 0.12 mm (.002 to .0047")
Base 'O' ring (J) diameter	1.15 to 1.35 mm (.045 to .053")
Large bottom plastic seal (F)	8.1 to 8.3 mm (.318 to .326")

The basic structure of the sleeves is the same as that for the J8S-232 engine however the 2 slots in the sleeve base to clear the oil jets are unique.

The sleeves must be fitted to the cylinder block correctly otherwise the oil jets may foul the sleeves.







Camshaft

Number of bearings	5
End play	(0.05 to 0.13 mm) (.002 to .005")
Valve timing:	
inlet valve opens	14° B.T.D.C.
inlet valve closes	46° A.B.D.C.
exhaust valve opens	50° B.B.D.C.
exhaust valve closes	10° A.T.D.C.

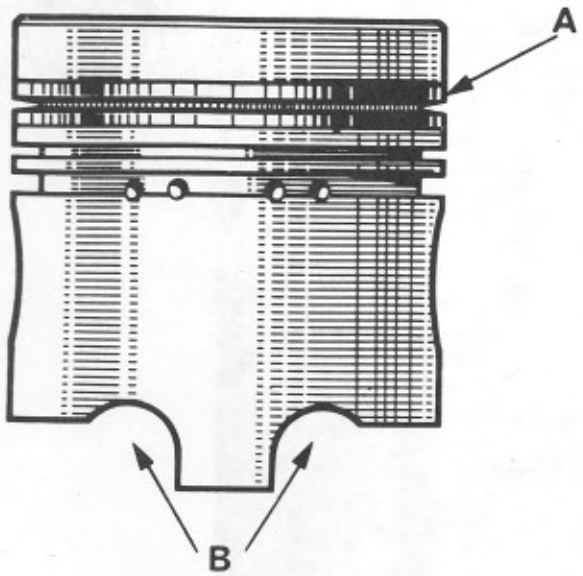
with theoretical rocker arm clearances of 0.35 mm (.014").

Pistons

Fully floating wrist pins
Direction of pistons mounting:
Precombustion chamber on injector side

Wrist pin length:	75 mm (2.953")
external	28 mm (1.102")
bore	16 mm (.630")
Piston rings:	
top compression ring	2.5 mm (.0975") thick
oil ring	2.5 mm (.0975") thick
scraper ring	4 mm (.158") thick

At starter speed with engine hot, the compression pressure is 20 to 30 bars (290 to 435 psi) with a maximum spread of 50 psi per each cylinder.



Special features:

Pistons for the above engine may be recognized by:
- an insert (A) for the top compression ring groove
- cooling fins inside the skirt
- and 2 cut-outs (B) at the bottom of the skirt to clear the oil jets.

Sleeve Assemblies in Cylinder Block

Sleeve height (H)	93.035 to 93.065 mm (3.633 to 3.664")
Depth (K) of cylinder block	92.945 to 92.985 mm (3.699 to 3.700")

(See page C1-18)

Cylinder Head Gasket

There are three different thickness of service gaskets marked with one to three holes.

Cylinder head gasket 1.6 mm thick (marked "1,6")
Cylinder head gasket 1.7 mm thick (unmarked)
Cylinder head gasket 1.8 mm thick (marked "1,8")

Crankshaft

Number of main bearings:	5
Bearing shell material:	aluminum-tin
End play	0.06 to 0.25 mm (.002 to .010")

Thrust bearing thicknesses mm
2.80 (.110")-2.85(.112")-2.90(.114")-2.95(.116")

Roll-hardened main bearing journals:

Normal diameter	62.88 mm (2.4755")
Regrind diameter	62.63 mm (2.4657")
Grinding tolerance	0 mm

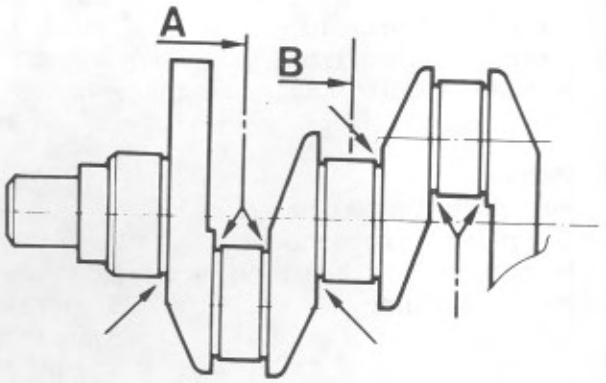
0.019 mm (-.0007")

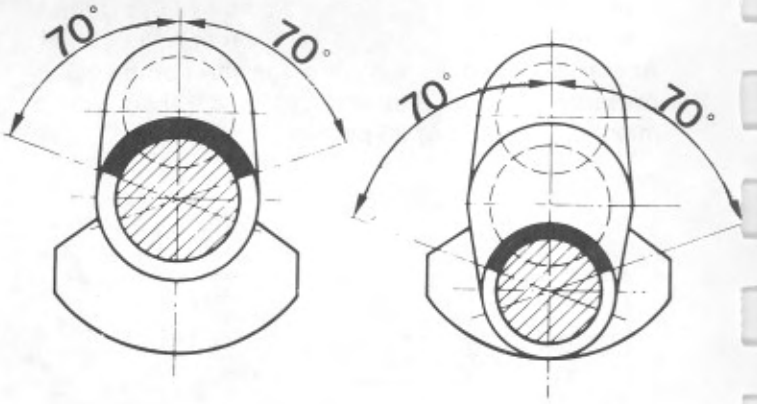
Roll-hardened journals:

National diameter	56.2956 mm (2.2163")
Regrind diameter	56.046 mm (2.2065")
Grinding tolerance	0.010 mm (.0004")
	0.029 mm (.0011")

After regrinding, the roll-hardened zone should still remain intact over the 140° zones shown by the arrows.

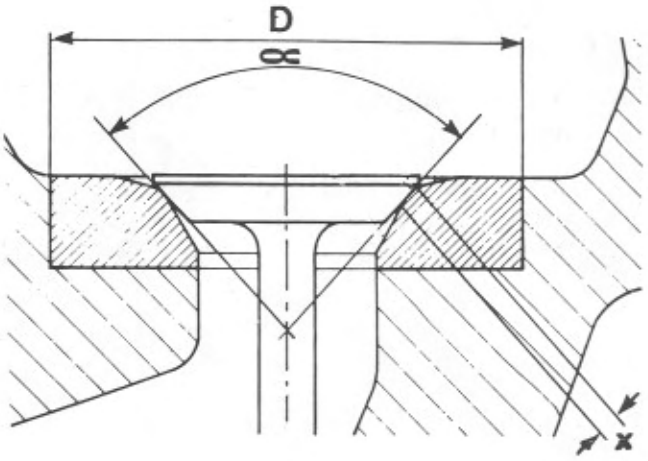
These sections are defined in the top illustration by sections (A) and (B).





Valve Seats

Angle	45° each face
Seat widths **X**	
inlet -	1.6 to 1.9 mm (0.63 to 0.74")
exhaust -	1.6 to 1.9 mm (.063 to 0.74")
External diameter **D**	
inlet -	42 mm (1.6535")
exhaust -	34.5 mm (1.358")



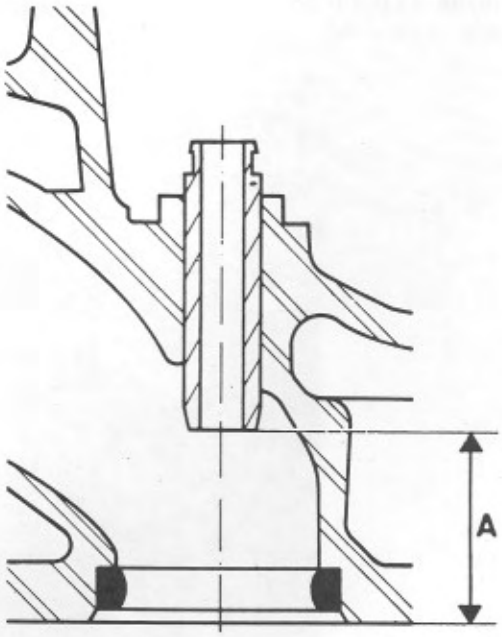
Valve Springs

The inlet and exhaust valve springs are identical.

Free length approx.	45.2 mm (1.779")
Length under a load of:	
23 daNm (50.6 lbs.)	39.3 mm (1.547")
60 daNm (132 lbs.)	29.8 mm (1.173")
With coils touching	27.2 mm (1.070")
Wire diameter	4.25 mm (.167")
Coil internal diameter	21.5 mm (.846")

Valves

Stem diameter	8 mm (.315")
Angle	45° each face
Head diameter:	
inlet	40.2 mm (1.582")
exhaust	33.2 mm (1.307")
Recess of valve heads in relation to joint face	0.80 to 1.15 mm (.0315 to 0.452")



Valve Guides

Bore	8 mm (.315")
External diameter:	
nominal	13 mm (.515")
repair sizes with 1 groove	13.10 mm (.5157")
with 2 grooves	13.25 mm (.521")

All valve guides are assembled with an oil seal on the stem.

Position the inlet and exhaust valve guides in relation to joint face.

A = 32.5 mm (1.279")

Intermediate Shaft

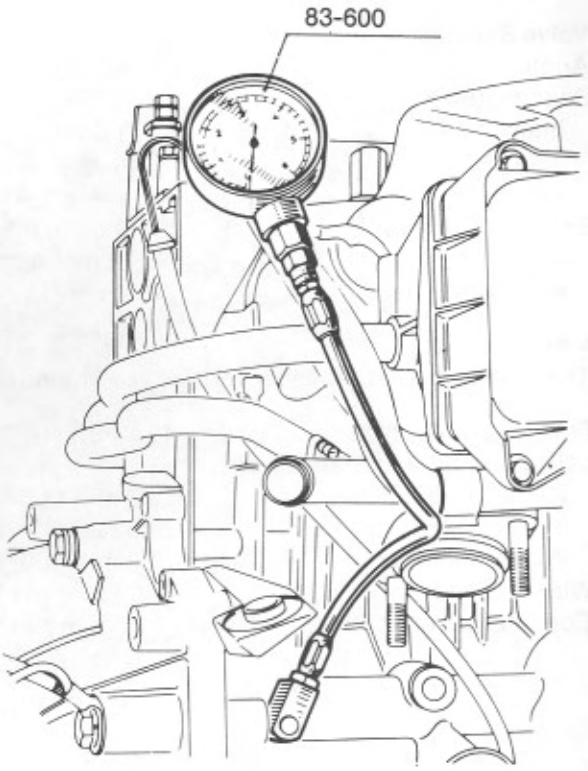
End play	0.07 to 0.15 mm (.003 to .006")

Oil Pressure Checking

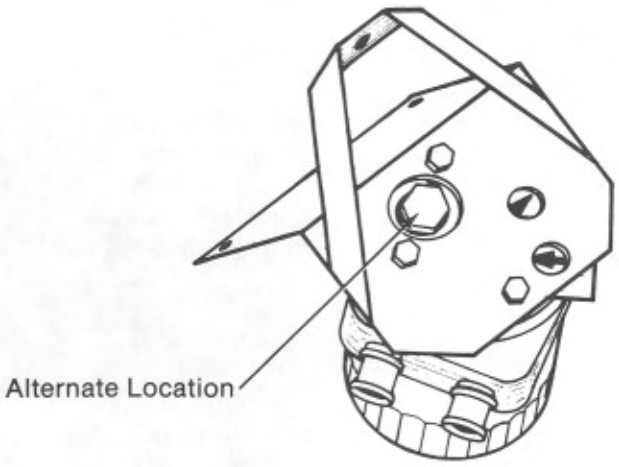
Check the oil pressure when the oil temperature reaches 80° C (176° F)

Run the engine and read off the pressure (bars):

on idling	0.8 bar (11 1/2 psi) min.
at 3,000 r.p.m.	3 bars (43 psi) min.



Alternate Location
Remote Oil Filter



Remote Oil Filter

Checking Oil Consumption

Diesel Engine J8S-234:

Oil Consumption Information

Oil consumption of 1 quart to 600 miles during the break-in period is to be considered reasonable. This is due to the design and manufacturing process (metal structure and surface finish) of the cylinder sleeves used in this engine. These sleeves require a lengthy break-in period, which ultimately contributes to extended service life of the engine.

The rate of oil consumption will decrease gradually after the break-in period until approximately 30,000 miles, where it will stabilize to approximately 1 quart per 2,000 miles.

During the engine break-in, oil level must be checked frequently to ensure proper lubrication during this crucial period.

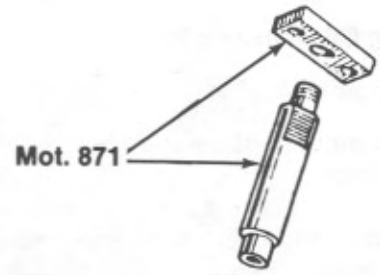
If oil consumption appears to be excessive, check for signs of external leakage and correct any occurance. If no leaks are found, you may wish to conduct a test to determine accurate miles-per-quart oil consumption.

Test Procedure

Certain conditions are necessary while draining oil to ensure complete drainage of oil to ensure test accuracy:

- the engine must be at normal operating temperature
- the dipstick and filler cap must both be removed

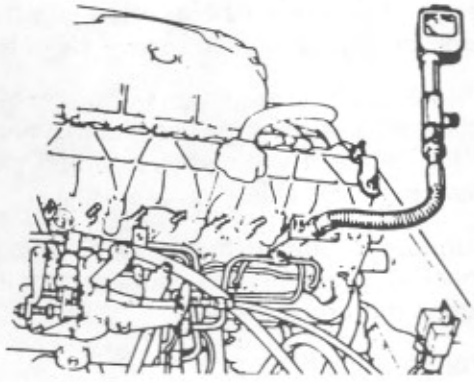
1. Drain the oil, allowing it to drain at least 15 minutes for complete drainage. Reinstall drain plug.
2. Measure the new oil in a graduated beaker and pour it into the engine. Reinstall filler cap and dipstick, making sure they are fully seated.
3. "Seal" the drain plug and filler cap with a dab of paint to check for possible tampering or loosening of plug or cap before next oil change.
4. Ask the owner to return the vehicle upon accumulation of an additional 600 miles.
5. Inspect the filler cap and drain plug for signs of tampering. If seal is broken, go back to step 1. If seals are intact, continue.
6. Drain engine oil, observing engine conditions mentioned previously, and measure drained oil in graduated beaker.
7. Calculate oil consumption by dividing amount of oil consumed into miles traveled.
   Example: 653 mi. ÷ .75 qt. = 870.6 mi./qt.



Compression Check

Adapter for diesel engine compression testing (to be used only with locally obtained compression gauge with scale range of 0 - 450 psi).

Specification 290-435 P.S.I.



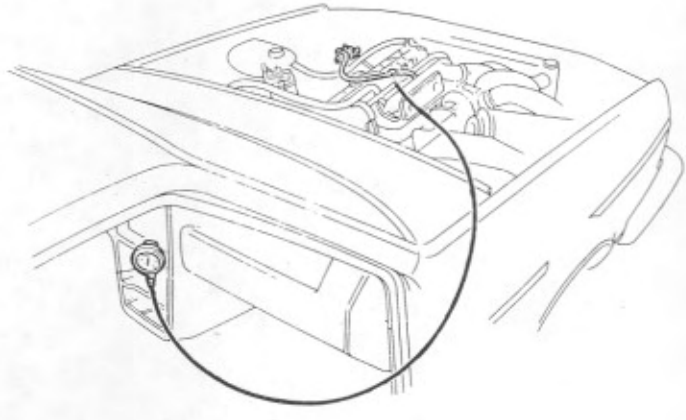
CHECKING BOOST PRESSURE

Connect one end of an extension hose to the hose between the air inlet manifold and the "LDA" governor on the diesel injection pump. Connect the other end of the hose to a pressure gauge capable of 0-10 bars or 0-15 psi.

Lay the hose around the outside of the hood (along the wing joint and secured with tape) and pass it through the front passenger's window. Make sure that there are no sharp bends. Hook the pressure gauge on the heater control panel.

Take a reading of the maximum boost pressure at 2500 r.p.m. ± 250.

- max. pressure = 0.600 bar ± 0.250
(7 1/2 to 9 psi)



TURBOCHARGER TROUBLESHOOTING

Engine lacks power	Black exhaust smoke	Excessive engine oil consumption	Blue exhaust smoke	Turbocharger noisey	Cyclic sound from turbocharger	Oil leak from compressor seal	Oil leak from turbine seal	CAUSE	REMEDY
•	•	•	•			•		Clogged air filter element	Replace element to engine manufactures recommentations
	•	•	•	•	•	•		Obstructed air intake duct to turbo compressor	Remove obstruction or replace damaged parts as required
•	•			•				Obstructed air outlet duct from compressor to intake manifold	Remove obstruction or replace damaged parts as required.
•	•			•				Obstructed intake manifold	Refer to engine manufacturers manual & remove obstructions
				•				Air leak in duct from air cleaner to compressor	Correct leak by replacing seals or tightening fasteners as required
•	•	•	•	•				Air leak in duct from compressor to intake manifold	Correct leak by replacing seals or tightening fasteners as required
•	•	•	•	•				Air leak at intake manifold to engine joint	Refer to engine manufactures manual & replace gaskets or tighten fasteners as required
•	•	•	•	•		•		Obstruction in exhaust manifold	Refer to engine manufacturers manual & remove obstruction
•	•	•	•	•	•	•	•	Obstruction in muffler or exhaust stack	Remove obstruction or replace faulty components as required
•	•			•		•		Gas leak in exhaust manifold to engine joint	Refer to engine manufacturers manual & replace gaskets or tighten fasteners as required
•	•			•		•		Gas leak in turbine inlet to exhaust manifold joint	Replace gasket or tighten fasteners as required
				•				Gas leak in ducting after the turbine outlet	Refer to engine manufacturers manual and repair leak
		•	•			•	•	Obstructed turbocharger oil drain line	Remove obstruction or replace line as required.
		•	•			•	•	Obstructed engine crankcase vent	Refer to engine manufacturers manual, clear obstruction
		•	•			•	•	Turbocharger center housing sludged or coked	Change engine oil & oil filter, overhaul or replace turbo as required
•	•							Fuel injection pump or fuel injectors incorrectly adjusted	Refer to engine manufacturers manual - replace or adjust faulty component(s) as required
•	•							Engine camshaft timing incorrect	Refer to engine manufacturers manual & replace worn parts
•	•	•	•			•	•	Worn engine piston rings or liners (blowby)	Refer to engine manufacturers manual & repair engines as required
•	•	•	•			•	•	Internal engine problem (valves, pistons)	Refer to engine manufacturers manual & repair engine as required
•	•	•	•	•	•	•	•	Dirt caked on compressor wheel and/or diffuser vanes	Clean using a Non-Caustic cleaner & soft brush. Find & correct source of unfiltered air & change engine oil & oil filter
•	•	•	•	•		•	•	Damaged turbocharger	Analyze failed turbocharger, find & correct cause of failure, or replace turbocharger as required

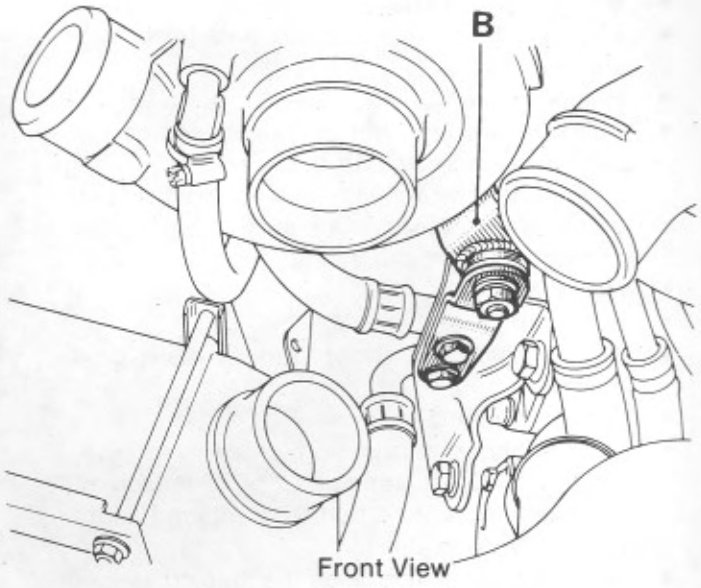
ENGINE REMOVAL PROCEDURE

Removal or Disconnect

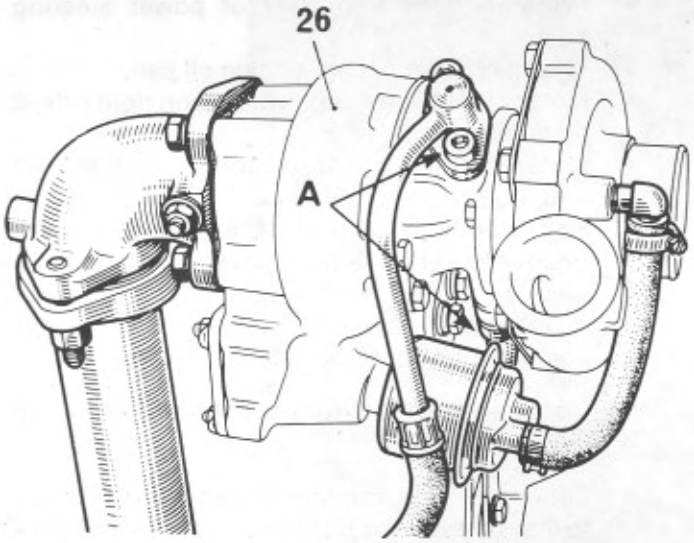
- Battery negative cable
- Engine air intake hoses to and from turbo-charger.
- Heater intake
- All fasteners and wiring from nosepiece grill assembly - screws and bolt along upper edge and 2 bolts on each side behind headlight area on inside of fenders - access from below - unplug lighting from behind.
- Nosepiece
- Belly pan.
- Transmission air scoop (under main cross-member).
- Upper radiator supports.
- Upper fender connecting cross-member - 2 inner bolts at each end and 2 bolts at each mid-attachment point - 2 bolts that attach fuel filter (do not remove filter).
- Hood cable from fender connecting cross-member - do not loose spring and plastic retainer.
- Upper and lower radiator hoses and drain anti-freeze into a container.
- Front seat both high and low side service valves of air conditioning compressor.
- High side hose from A/C compressor that goes to the condenser.
- High side hose self-sealing disconnect joint.
- Condenser fan wiring.
- Radiator and A/C condenser assembly.
- Engine fan.
- Bolts that retain rear front bumper braces to body - leave these bolted to bumper - 2 bolts on each side.
- Bolts that retain bumper extensions to body.
- Six bolts that connect cross-member/bumper assembly to body - remove this as a complete assembly.
- Low side hose to A/C compressor.
- Air conditioner clutch wire connection.
- Exhaust pipe from turbocharger.
- Hoses to remote oil filter.
- Hoses to heater, rear motoraid, and surge/fill bottle.
- Ground strap on engine.
- Engine wire harness at firewall.
- Fuel supply hose to engine - remove at filter assembly - cap this hose.
- Fuel return hose at connection on L.H. frame rail - cap this hose.
- Throttle cable from injection pump.
- Cruise control cable and bracket if equipped.
- Vacuum connections at vacuum pump.
- Positive battery cable from starter.
- Supply hose from power steering reservoir to pump - drain fluid into container.
- Pressure hose from rear of power steering pump.
- Flywheel cover behind engine oil pan.
- Motor mount to transaxle mount on right side -2 bolts rear of oil pan.
- Motor mount to transaxle mount on left side - 1 long bolt and captured nut.
- Bolts that hold transaxle to engine and starter -starter to transaxle bolts have retaining nuts.
- Lock nuts that hold motor mount to cross-member assembly - one on each side - leave complete mount assemblies on engine.
- Install engine lift fixture to engine as shown in illustration.
- Lift engine high enough for motor mount studs to clear cross-member mounts - place small 2x4 inch blocks under lower edges of transaxle.
- Pull engine forward and out of chassis.

Turbocharger Removal

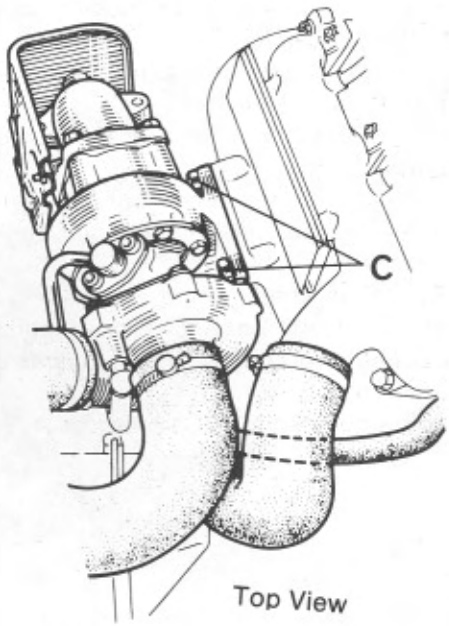
Remove or disconnect
- Oil feed and return hoses (A)
- Turbocharger mounting bolts (B) & (C).
- Remove the turbocharger (26).



Front View



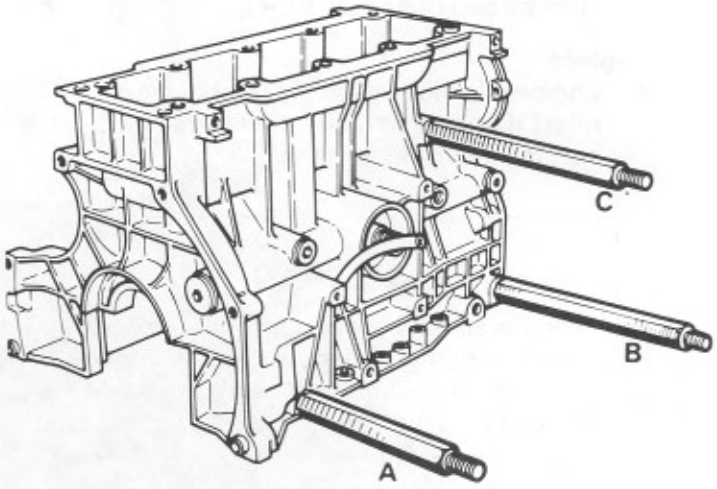
Side View



Top View

Remove or Disconnect

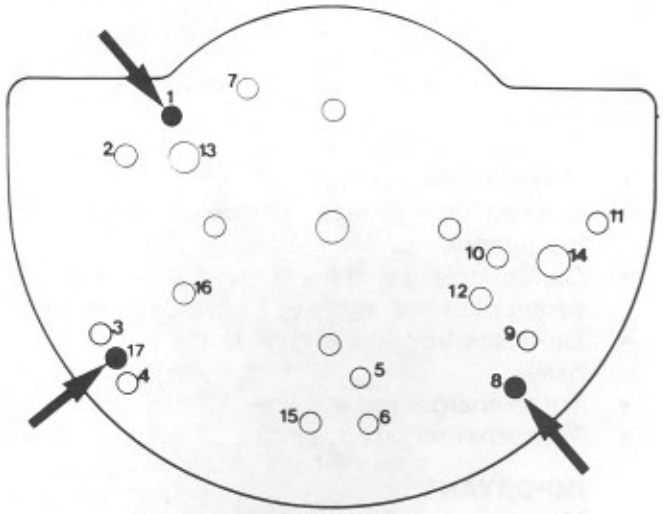
- Intake and exhaust manifolds
- Air conditioning compressor
- Power steering pump and A/C bracket assembly
- Alternator
- Starter
- Motor mounts
- Dipstick
- Adapter for remote oil filter hoses
- Clutch and pressure plate assembly.



Mounting the Engine to the Dismantling Support Mot. 792

- Screw studs (A,B, and C) into their appropriate holes in the cylinder block.
- Place the engine with studs in position to the plate making use of holes (1,8 and 17).

NOTE: These parts may be adapted to an existing engine stand.



WARNING

The fixture must be fastened to something that can safely support the weight of the engine without tipping over which could cause personal injury or damage to the engine.

PREPARING ENGINE FOR INSTALLATION

Clean

- All accessories to be reinstalled on engine.
- Flush all cooling system parts including radiator if contaminated (see Cooling System Section for procedure).
- Chassis and underhood area.

Replace

- Engine oil cooler, if equipped (located above oil filter) if engine had any kind of metallic piece part failure or fluids in the oil.

> **CAUTION**
>
> Serious internal engine damage will occur to a new or rebuilt engine if the oil cooler is contaminated and not replaced. When in doubt . . . replace.

- Engine oil filter.
- Fuel filter - make sure fuel in tank is not contaminated.
- Air filter element after engine is installed.

Inspect and Replace if Necessary

- Fan and alternator belt.
- Power steering belt.
- Surge/fill bottle cap - see Cooling System Section for procedure.
- All hoses and clamps.
- Manifolds for warpage.
- Exhaust pipe sealing surface for cracks and irregularity.
- Clutch, pressure plate, throw-out bearing, and center pilot bearing - see Clutch Section.
- Oil hoses from the engine to the remote filter base.
- Turbo charger turbine wheels and bearing
- Turbocharger oil hoses

IMPORTANT

Make sure engine to bell housing alignment sleeves are in place in lower bolt holes on each side.

Make sure starter to bell housing alignment sleeve is in place and tightened.

Leave starter loose to be aligned and tightened after engine is installed.

Install or Connect

- All items removed in "Preparing Engine for Rebuilding" using new gaskets where called for.
- Clutch

IMPORTANT

Use clutch pilot to align clutch - see Clutch Section.

Install or Connect
Turbocharger

When reassembling:

- Clean the exhaust manifold gasket faces and the turbocharger joint faces.
- Mount the turbocharger to the exhaust manifold using new nuts.
- Change the inlet gaskets and oil return seals.
- After the cylinder head gasket has been changed, take all the necessary precautions when starting the turbocharged engine (See Subsection "Special Features")

Engine Installation Procedure

IMPORTANT

Make sure transmission is in reverse while installing engine. Turn engine over by hand with a socket and breaker bar on the crankshaft pulley bolt to help align the clutch and transmission pilot shaft.

Turn in a clockwise direction only.

Take transmission out of reverse after engine is in place.

Tighten

All the starter mounting bolts on the bell housing and on the side of the engine block.

Install or Connect

- Connect and install all parts and assemblies in the reverse order of that described in "Engine Removal Procedure" using new gaskets, seals, etc., where required.

FINAL PROCEDURES AFTER ENGINE INSTALLATION

IMPORTANT

Be sure all rubber shrouds and shield are in place.

Use correct motor oil (See Specifications section of Vehicle Operator's Manual.)

Use correct type and mixture of antifreeze (See specifications section of Vehicle Operator's Manual.)

Make sure cooling system is properly bled of air and the correct level (see Cooling System Section).

> **CAUTION**
>
> It is extremely necessary to make sure the cooling system has all the air bled out of it and the proper level of coolant. Serious engine damage due to overheating will occur if this is not properly done.

Pressure check cooling system for leaks. (See Cooling System Section).

All wiring and grounds are properly connected.

Check headlight alignment.

Air conditioning is properly charged and working correctly (See Air Conditioning Section).

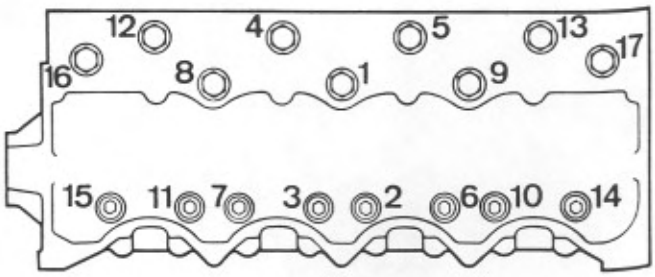
Make sure that all removed body parts and bumper fit correctly and hood latch pin properly aligns with the fender connecting cross-member. Adjust hood latch pin if necessary.

When the engine is reinstalled in vehicle:

- adjust all controls.

Run engine for 20 minutes, then allow it to cool down for 2 hours, at least, before retorque tightening the cylinder head (refer to chapter ("Cylinder Head -Reinstallation"). Recheck the rocker arm clearances.

The vehicle need not be returned to workshop for retightening the cylinder head if the above operation is carried out.



GENERAL INFORMATION

MATERIAL

Compound	Application
Parts cleaner solvent	Component cleaning
Gasket seal solvent	Cleaning cylinder head joint face
Petroleum jelly	Clutch shaft and drive shaft splines
Loctite® or equivalent	Bolts for flywheel, crankshaft pulley, intermediate shaft cover
Loctite® or equivalent	Intake manifold studs
Loctite® or equivalent	Water pump studs and bolts
Loctite® or equivalent	Pilot bearing in crankshaft
Loctite® or equivalent	Flywheel thrust face on crankshaft side
Heatproof sealer	Exhaust pipe joints

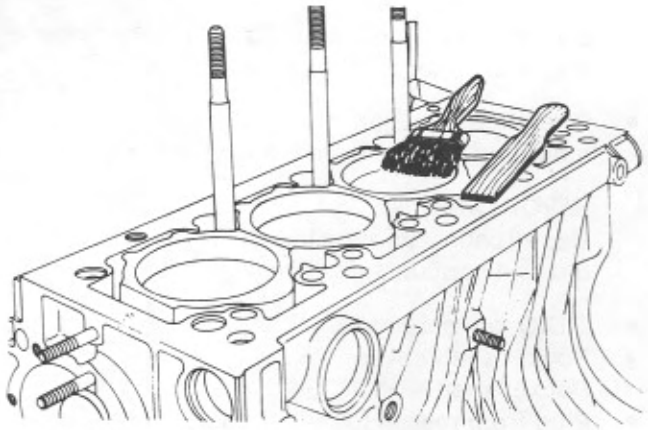
IMPORTANT

Components To Be Replaced at Each Disassembly

- Flywheel bolts
- Flywheel bolts lockplate
- Connecting rod bolts
- Rocker shaft oil filter
- All gaskets and seals

Cleaning Engine in Place

- Protect the timing belt and alternator from water and cleaning fluid.
- Take care not to let any water enter the inlet manifold.
- Cleaning upper cylinder block surface when replacing cylinder head.
- Great care must be taken with this operation to prevent foreign matter from entering the channels for pressure-fed oil to the rocker shaft (channels in cylinder block and head) and the oil return channel.
- If the above device is disregarded, the rocker shaft filter or rocker arm oil jet holes may become choked leading to rapid cam and rocker arm finger wear.



Installing Threaded Inserts

- Threaded holes in all engine components may be restored using thread inserts such as Heli-Coil® or equivalent.

ENGINE TEARDOWN

Remove or Disconnect

- Crankcase vent hoses and attaching brackets
- Water lines to injection pump
- Supply water pipe on right side of engine from water pump to the rear
- Crankcase vent cover on right side
- Timing belt cover.

IMPORTANT
Retain spacer sleeves from cover mounting studs. Also retain special spacer washers in rubber grommets in timing belt cover.

- Thermostat housing from cylinder head and by-pass hose from it to water pump
- Thermostat from thermostat housing
- Loosen timing belt tightener
- Timing belt and discard
- Fuel return hose from injection pump and injectors.

IMPORTANT
The return union to injection pump hollow connector is a restricted fitting and must not be mixed with other union connection parts (see Diesel Engine Injection Equipment Section).

- All injection lines.

IMPORTANT
Do not bend or dent any of the injection lines. If they are damaged, they must be replaced.

- Complete injection pump assembly including mounting bracket from the side of the block.

IMPORTANT
Cap all connections on injection pump to prevent dirt and contaminants from entering.

- T.D.C. pin plug on left side.
- Rocker shaft cover
- Rocker shaft
- Plug from rear of rocker shaft - remove screen and discard

Remove or Disconnect

- Bolts and nuts retaining cylinder head.

Tool Mot. 852

IMPORTANT
Do not loose washers under cylinder head bolts and nuts.

- Cylinder head

IMPORTANT
Do not pry on or under head to remove it. Use a soft rubber or composition hammer to free the head from the head gasket.

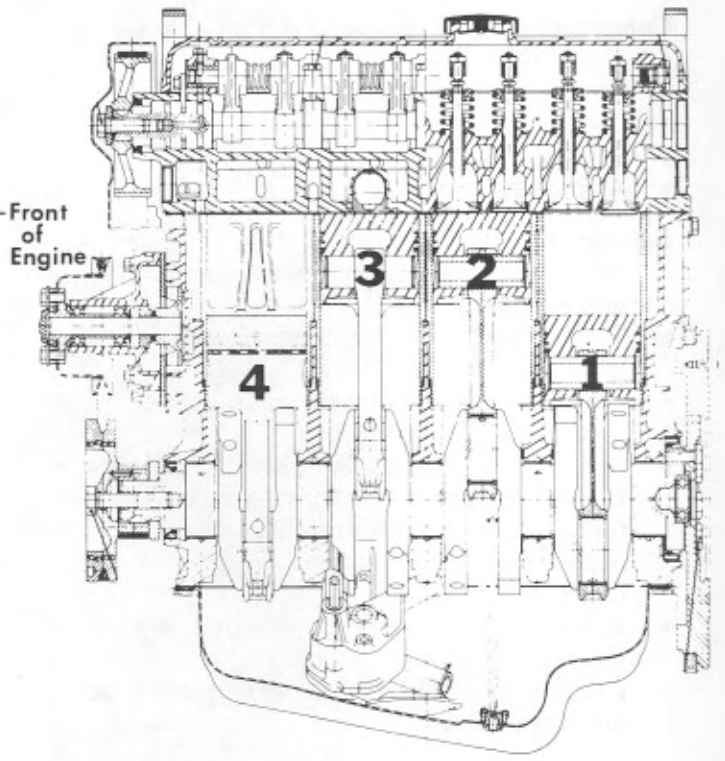
NOTE: See page B3-5 for cylinder head disassembly.

- Pulley from crankshaft

Tool Mot. 852

- Air conditioner belt and discard
- Flywheel, discard bolts - not to be reused.

IMPORTANT
Hand stamp the cylinder number on the upper surface of each piston and sleeve. The pistons, sleeves, and connecting rods are not numbered. The pistons and sleeves should be reassembled in the same order that they were removed if they are to be reused. The cylinders are numbered 4 through 1 from front to back.



Remove or Disconnect

- Install sleeve retaining tool

Tool Mot. 521-01

- Sprocket from intermediate shaft

Tool Mot. 855

ENGINE TEARDOWN

IMPORTANT
Pry sprocket from intermediate shaft being careful not to damage or gouge block or sprocket.

- Woodruff key from intermediate shaft
- Intermediate shaft oil seal housing - remove seal from housing and discard
- Vacuum pump - remove O-ring and discard
- Angle drive gear from under vacuum pump.
- Retaining fork that holds intermediate shaft in place
- Intermediate shaft
- Timing belt tightener assembly
- Water pump
- Hose (and block heater if equipped) housing from rear of water pump
- Timing sprocket and air conditioning drive pulley from crankshaft.

IMPORTANT
Pry sprockets from crankshaft being careful not to damage or gouge the sprockets or cylinder block surfaces.

- Woodruff key from crankshaft
- Oil pressure sender
- Oil gallery plugs from side and rear of block - 4 on side; 1 in rear
- Turn engine on stand
- Oil pan
- Oil pump to oil manifold connecting pipe (early production only)
- Oil pump and oil pump drive shaft
- Connecting rod cap bolts
- Connecting rod bearings
- Main bearing bolts

CAUTION

The rod and main bearing caps must be kept in the order they were disassembled. These items are not marked! This must be done to insure proper reassembly. Reminder: The cylinders are designated 4 to 1 from front to rear - #4 being the closest to the timing belt.

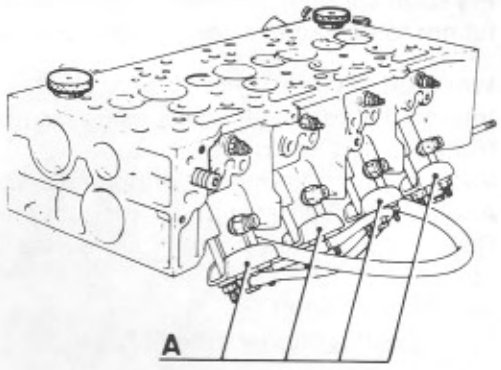
- All main bearing caps
- Crankshaft oil seals and discard
- Crankshaft
- Piston skirt cooling jets or jets with connecting manifold
- Remove sleeve retaining Tool Mot. 521-01
- Sleeve and piston assemblies from upper side of block
- Piston and rod assemblies from sleeves

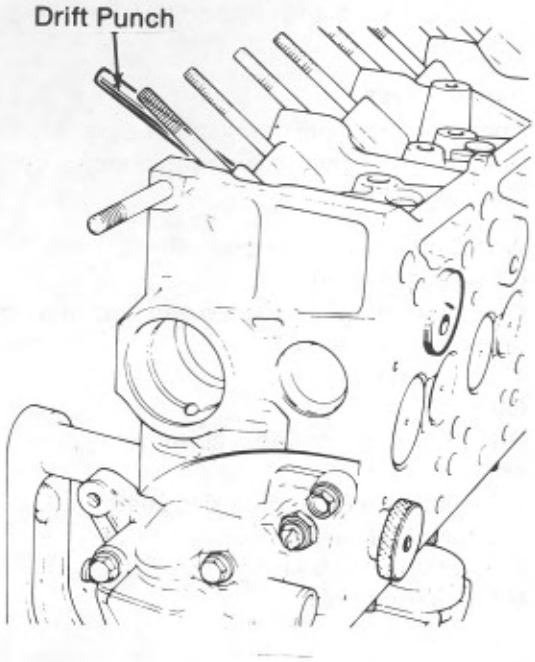
CYLINDER HEAD OVERHAUL

DISMANTLING

Remove or Disconnect

- Thermostat housing
- Heater plug wires
- Heater plugs
- Fuel return pipes assembly
- Injectors and holders (A) with seals
- Flame shield washers (between injector and cylinder head)

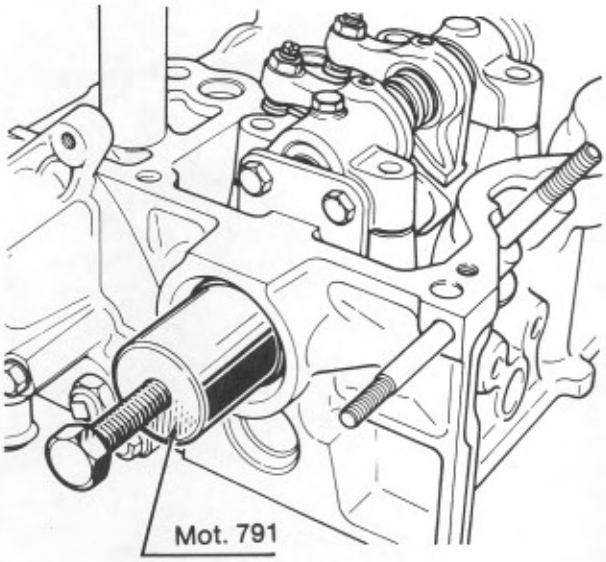




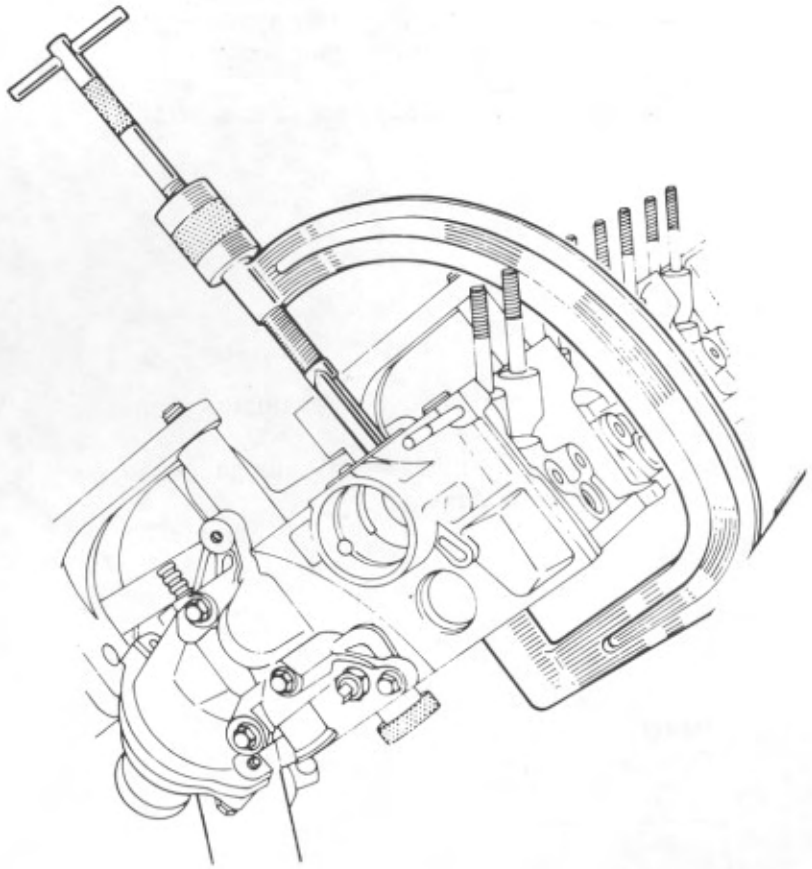
- Pre-combustion chambers, if necessary, insert a drift punch through the injector hole and tap lightly to remove

- Timing sprocket (from camshaft) using Tool Mot. 854
- Woodruff key from camshaft

- Oil seal using Tool Mot. 791
- And camshaft
- Glow plug wire harness
- Glow plugs
- Valves, springs, and keepers
- Pre-combustion chambers from head



- Compress the valve springs using spring compressor
- Remove the split cotters, top cups, springs, bottom cups and valves
- Lay all the parts out in their correct order.



Cleaning

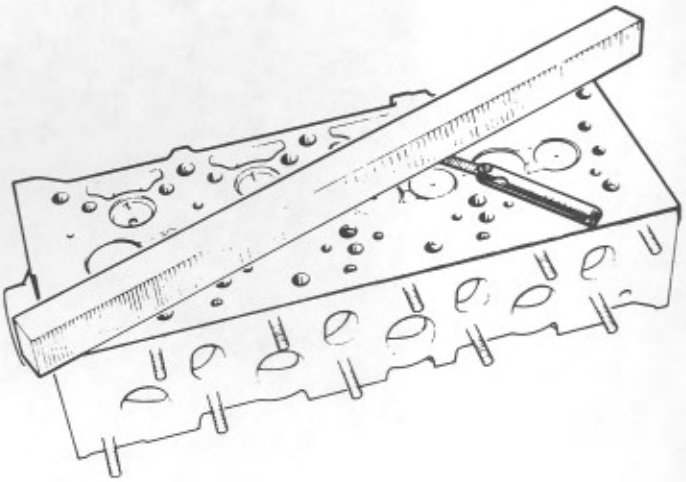
It is very important not to scrape gasket faces on aluminum parts.

- Use a gasket solvent to dissolve any part of the gasket still remaining stuck to the cylinder. Brush the liquid onto the area to be cleaned, wait about ten minutes, then lift the remnants off with a wooden scraping tool. Gloves should be worn during this operation.
- The valve chambers can be cleaned with a very fine wire brush in an electric drill.
- A soft abrasive scouring pad such as Scotch-brite® or equivalent may be used with solvent to clean surfaces.

- All grease, oil, and carbon should be removed with a good quality cleaning solvent and thoroughly dried with compressed air.
- Thoroughly clean and flush camshaft and its oil passages - dry with compressed air.

WARNING

Always keep sparks and open flame away from commercial solvents and cleaners to prevent fire from occuring. Always follow manufacturer's instructions when using these types of products. Safety eyewear should always be worn when working with compressed air.



Measure

Checking the gasket face:

- Remove the pre-combustion chambers if installed.
- Use a straight edge and a set of feeler gauges to check if any bow is present.
  Max. permissible bow: 0.05 mm (.002")

IMPORTANT
Cylinder head resurfacing is not permitted.

CAUTION

A warped head could be caused by an overheat condition. Check cooling system (see Cooling System Section).

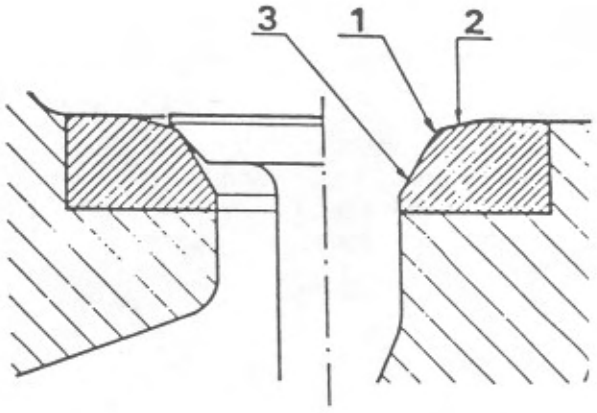
Inspect

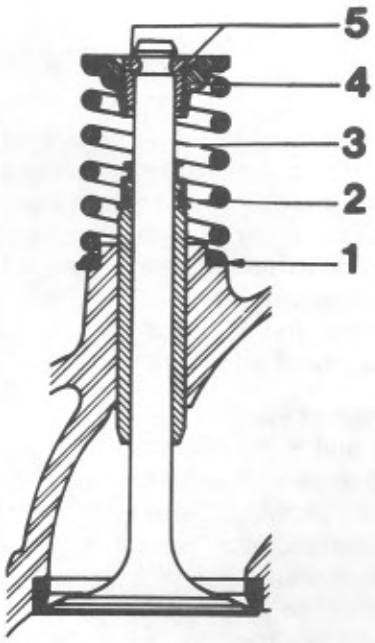
- Inspect head for heat and stress cracks.
- Inspect valve seats for excessive wear and cracks.
- Inspect valve guides.
- Inspect cam bearing bores for scoring and wear. If the bores are excessively scored or worn, replace the cylinder head.
- Inspect camshaft lobes and journals for excessive wear and scoring. If the lobes are excessively worn or scored, be sure to inspect the rocker arms for similar wear.

VALVE AND SEAT RESURFACING AND MEASUREMENTS

IMPORTANT
The valve seats must only be reground by a very small amount otherwise the compression ratio will be reduced.

Once a satisfactory seat has been cut (1), the width is reduced with the appropriate cutter. Make a cut around (2) at first then underneath at (3) to obtain the current width (refer to Subsection B2 "General Information").

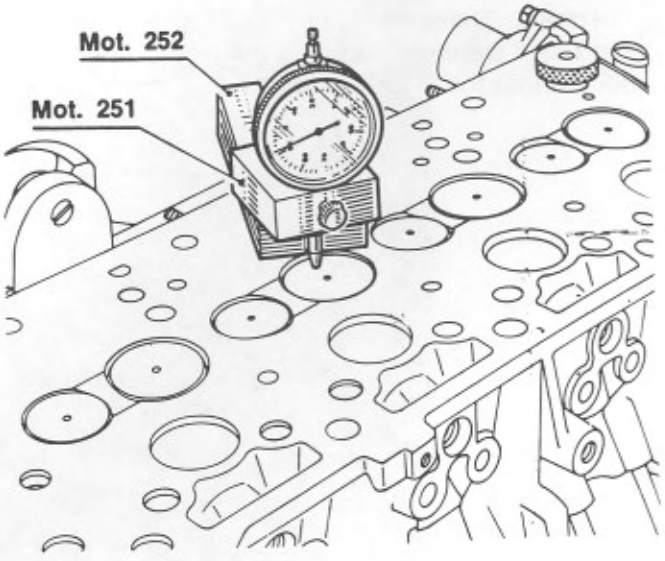




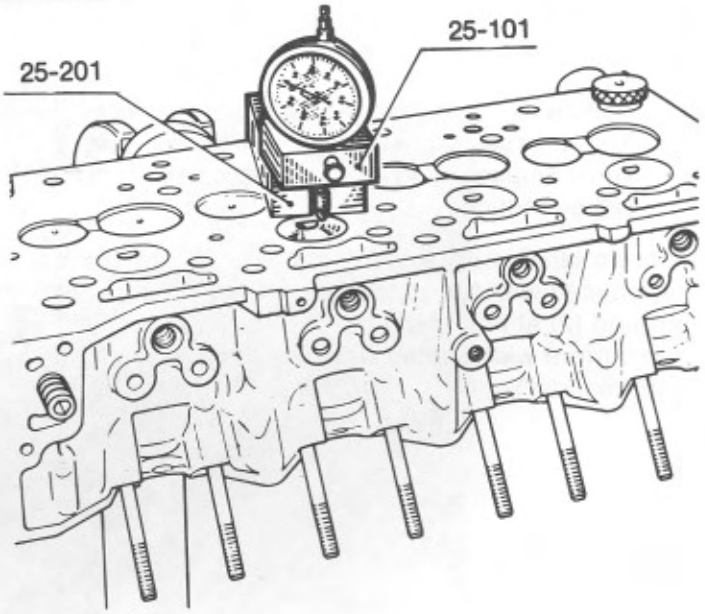
- Lightly regrind the valves to their respective seats. Clean all the components carefully and reassemble them.
- Lubricate the parts.
- Put an oil seal (2) over each valve guide.
- Insert the new valves, base washers (1), and valve springs (3) (identical for inlet and exhaust) and cup washers (4).
- Use a valve spring compressor tool to compress the springs.
- Insert the split-cotters (5) (identical for inlet and exhaust).

Measure

- Check the amount of recess of each valve in relation to the cylinder head joint face using Tools Mot. 251 and Mot. 25-252.
- It should be between 0.80 and 1.15 mm (.0315 and .0452") in each case.



VALVE AND SEAT RESURFACING AND MEASUREMENTS



Measure

- Insert the pre-combustion chambers. Check their protrusion which should be between 0.01 and 0.04 mm (.0004 and .0016") using Tools Mot. 251 and Mot. 252.

IMPORTANT

When replacing the pre-combustion chambers in the turbo diesel, care must be taken to ensure that the proper chambers are installed. The internal surfaces of these two parts are machined differently to achieve the require results for the method of aspiration. Therefore, if incorrect chambers are installed, engine performance may be severely impaired.

Identification of Parts

Figures A and B show the two types of pre-combustion chambers. The internal differences are not easily distinguishable. The interior of the N.A. chamber has a rough, "cast" appearance, whereas the inner surface of the turbo chamber is smoother. You will note that the only readily apparent difference between the two types is the small indentation or "dimple" on the top of the turbo diesel chamber as illustrated. These parts may be ordered from our Part Sales Department using the descriptions provided under the illustrations.

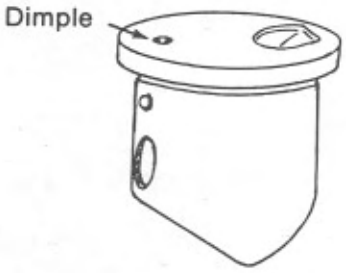
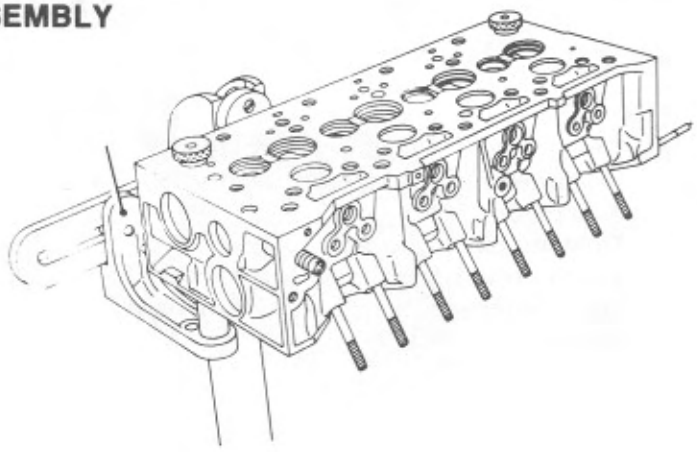


FIGURE A
Pre-Combustion Chamber
Turbo Diesel
(J8S-234)



FIGURE B
Pre-Combustion Chamber
Naturally Aspirated Diesel
(J8S-232)

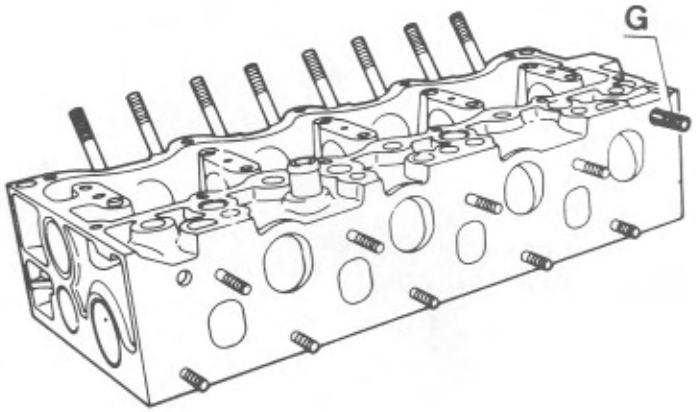
REASSEMBLY



Install or Connect

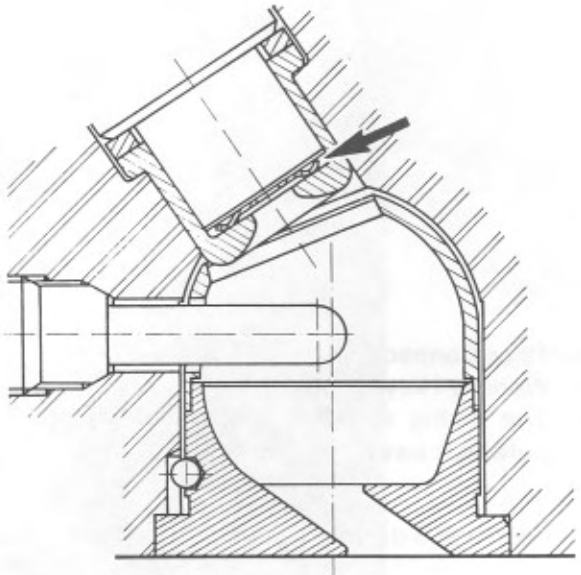
Reassembling

- Insert the studs for the injector holders and manifolds in the new cylinder head.



IMPORTANT

As the threaded hole for inlet air manifold stud (G) comes out into the cooling circuit, smear the threads on this stud with 1 or 2 drops of a thread locking compound such as Loctite® or equivalent.



Reassemble

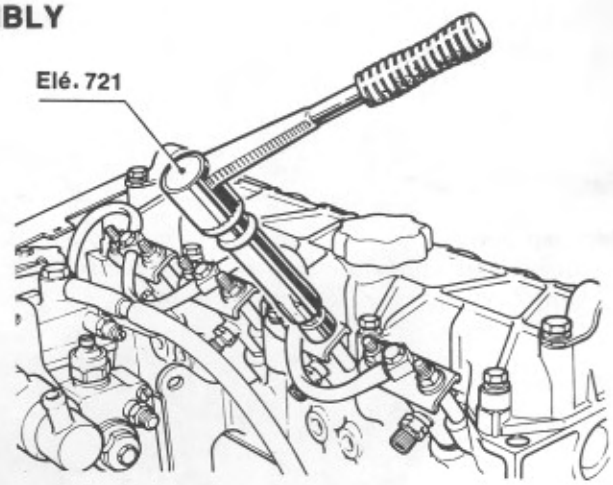
- The heater plugs and their wires
- The injector flame shield washers the correct way around as shown at right.
- Remove glow plug before changing pre-combustion chamber.

IMPORTANT

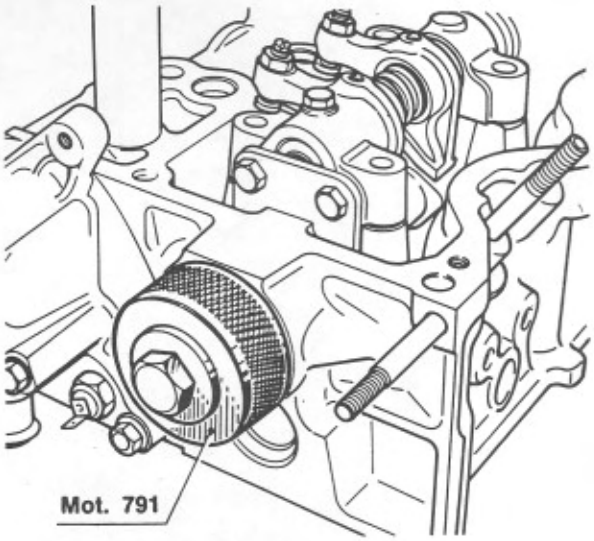
Flame shield washers must be replaced upon each injector removal.

CYLINDER HEAD OVERHALL

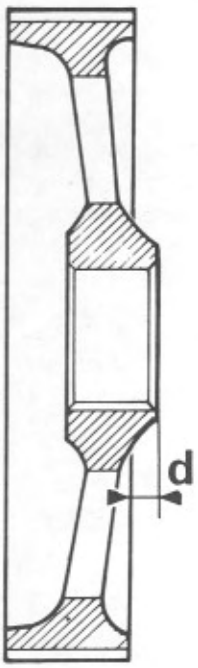
REASSEMBLY



- The injectors and injector holders with new copper washers; torque tighten the nuts using Wrench Ele. 721
- Tighten both nuts evenly.
- The fuel return lines using new copper washers.
- The thermostat housing using a new paper gasket



- The camshaft
- And its oil seal using Tool Mot. 791



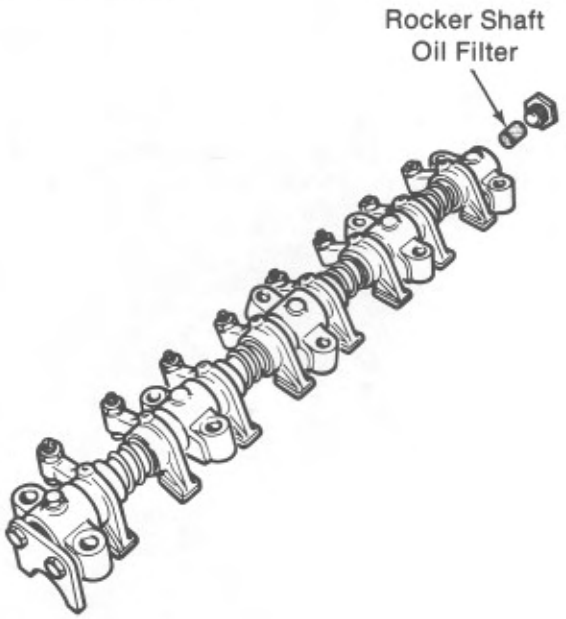
Install or Connect

- Woodruff key on cam
- The timing sprocket with offset (d) pointing outwards away from the cylinder head.

Tighten

- Cam bolt 5 daNm (37 lb./ft.)

ROCKER ARM SHAFT
DISMANTLING - REASSEMBLING

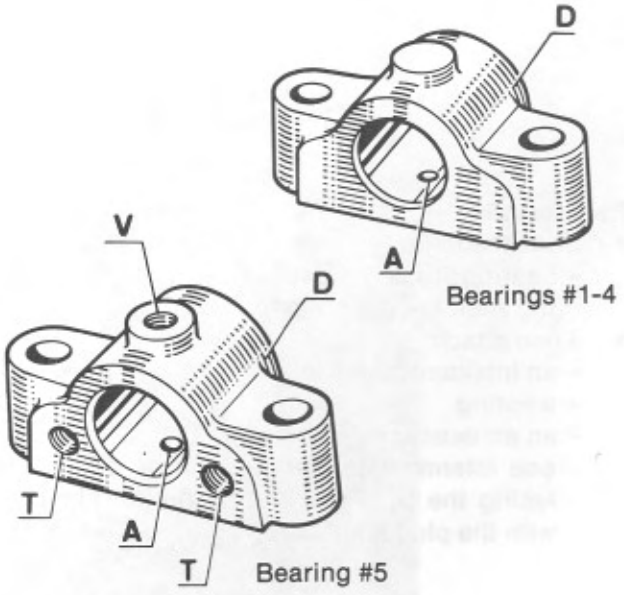


IMPORTANT
The rocker shaft oil filter must be changed every 64,360 km (40,000 miles) and when every repair operations are undertaken as a result of metal particles being found in suspension in the oil. If the above incident occurs, then the engine oil and main oil filter should be changed as well. Use Clamp Tool Mot. 445 on the oil filter.

Dismantling
- Unscrew the plug on the end of the rocker shaft and remove the filter. Separate the parts and lay them out in order.

Clean
- All arms and springs with solvent and dry with compressed air.
- Shaft inside and out

Inspect
- Arms for excessive wear
- Shaft for wear and grooves

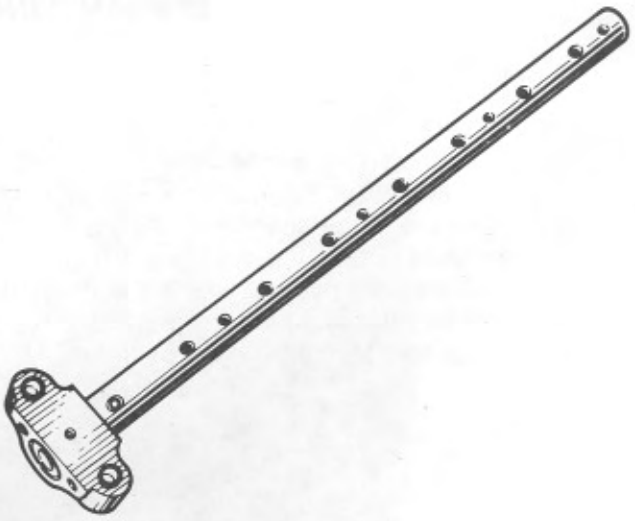


Identifying Parts in the Assembly
Rocker shaft bearings:
Bearing 1,2,3, and 4 are identical and they have:
- one oil feed hole (A) for the matching camshaft bearing
- an offset (D) facing the flywheel

Bearing 5 has an addition:
- two threaded holes (T) to hold the shim which restricts camshaft end play
- a threaded hole (V) for the set bolt which aligns the rocker shaft

ROCKER ARM SHAFT

This set bolt aligns the rocker shaft. The camshaft bearing oil feed holes face the camshaft (the oil passes through the rocker shaft bearings).

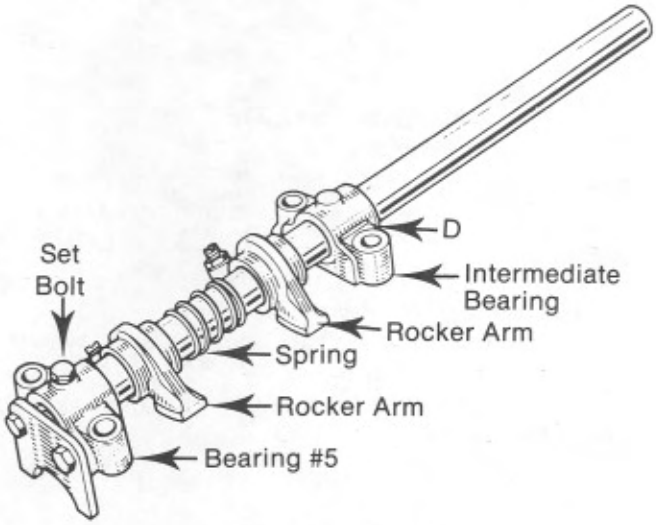


Rocker Arms:
Intake and exhaust rocker arms are identical. They have a calibrated hole to lubricate the camshaft cams.



Reassembling

- Slide the following onto the rocker shaft:
  - bearing 5; insert the set bolt so that oil holes in the shaft are underneath
- Then attach:
  - an intake rocker arm
  - a spring
  - an exhaust rocker arm
  - one intermediate bearing with its offset (D) facing the flywheel, and so on, terminating with the plug and filter.

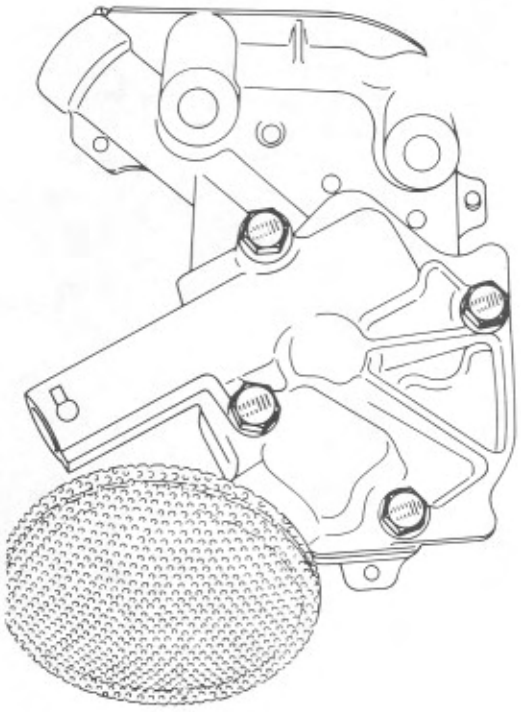


Rocker Arm Assembly Sequence

Tighten
Torque tighten the plug to 2 daNm (15 lb./ft.). This torque setting must not be exceeded because the rocker shaft is only prevented from turning by the set bolt in bearing (5).

OIL PUMP

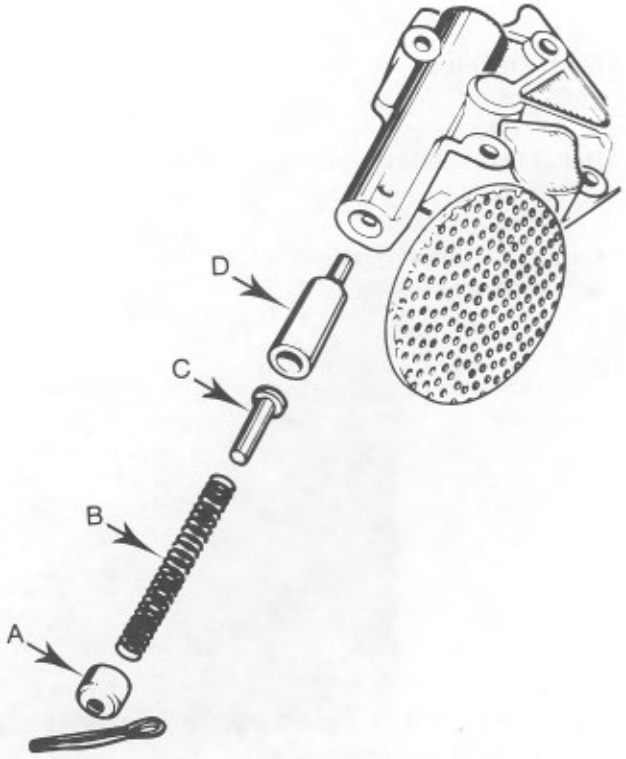
OVERHAULING



Dismantling

- Unscrew the cover bolts and remove the oil pump gears.

- Remove the relief valve cotter pin and withdraw:
  - the cup A
  - spring B
  - spring guide C
  - and piston D



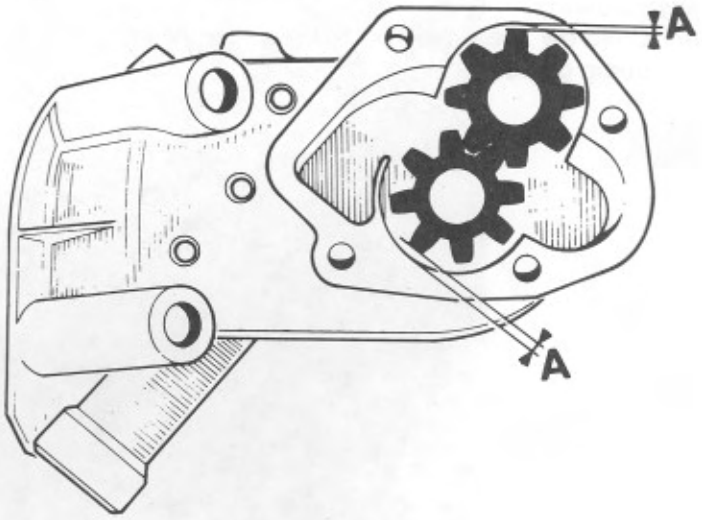
OIL PUMP

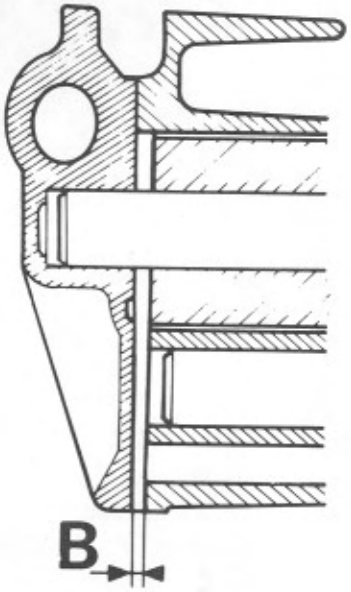
OVERHAULING (CONT.)

INSPECTION

- Clean all the components and check:
  - the pump cover joint face for trueness
- Change any parts worn or unserviceable. Check:
  - running clearances

at A: Min.: 0.05 mm (.002")
Max.: 0.12 mm (.0047")





Gear End Float
at B: Min.: 0.02 mm (.001")
Max.: 0.10 mm (.004")
Relief valve piston clearance in its bore:
Min.: 0.03 mm (.0012")
Max.: 0.08 mm (.0031")
Replace the components concerned if not within specified tolerances.

Clean

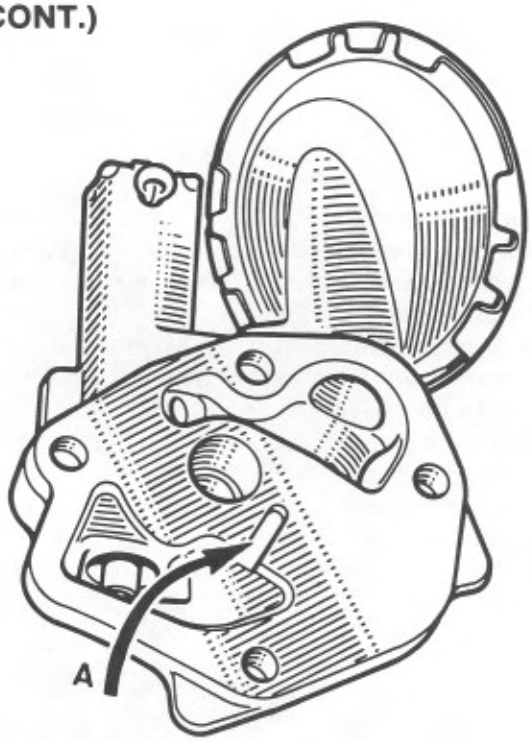
Clean all parts with a good quality cleaning solvent and dry with compressed air.

OIL PUMP

OVERHAULING (CONT.)

Reassembling

- Special points.
- The oil pump cover is peculiar to this engine; note recess shape (A).
- Lubricate all components
- The relief valve spring retaining cup is mounted over the spring.

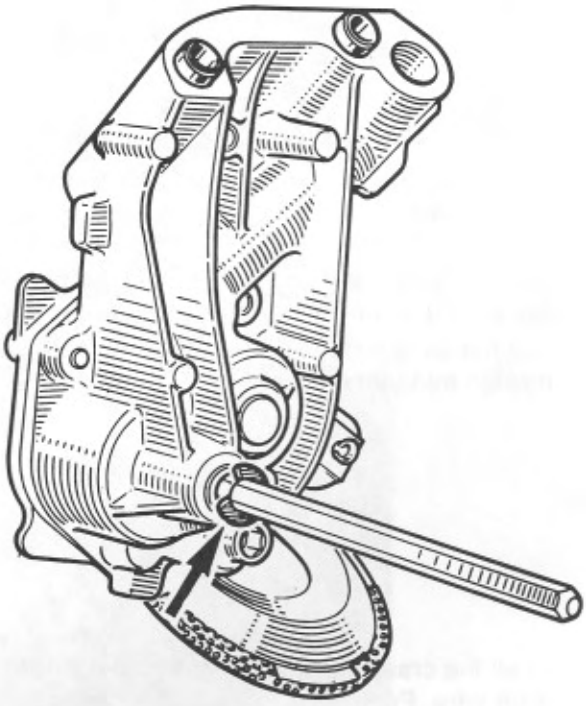


IMPORTANT

Special points concerning reassembly:

- the oil pump drive shaft has a circlip (this acts as a limit stop for the shaft in the pump)

The driveshaft must be mounted with circlip adjacent to the oil pump. Torque tighten the bolts.



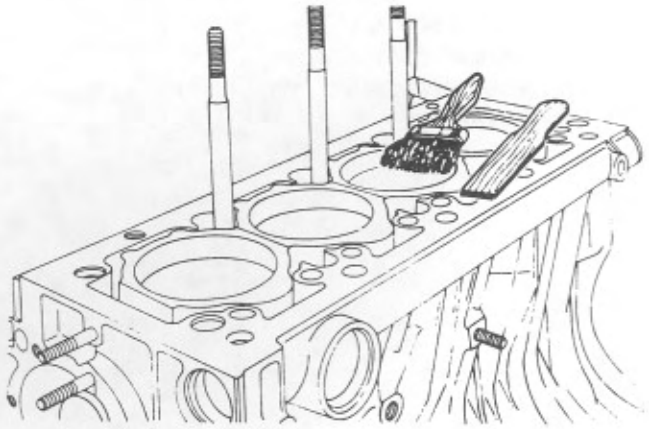
Tightening Torque

Oil pump bolts:	4 to 4.5 daNm (30 to 33 lb./ft.)

Clean and Inspect

Clean

- Clean all components and keep matched items together.
- It is very important not to scrape the gasket faces on aluminum parts.
- Use a gasket solvent solution to dissolve any part of the gasket still remaining stuck to the cylinder block.
  - Brush the liquid onto the area to be cleaned;
  - wait about 10 minutes, then lift the remnants off with a wooden scraping tool.
  - Gloves should be worn during this operation.
- Clean the gasket faces on:
  - cylinder head
  - and sleeves
- A soft abrasive scouring pad such as Scotch-brite® or equivalent may be used with solvent to clean surfaces.



- Clean the cylinder block, paying special attention to the lubrication channels.
- Blow dry with compressed air making sure all oil, solvent, and foreign particles are removed.

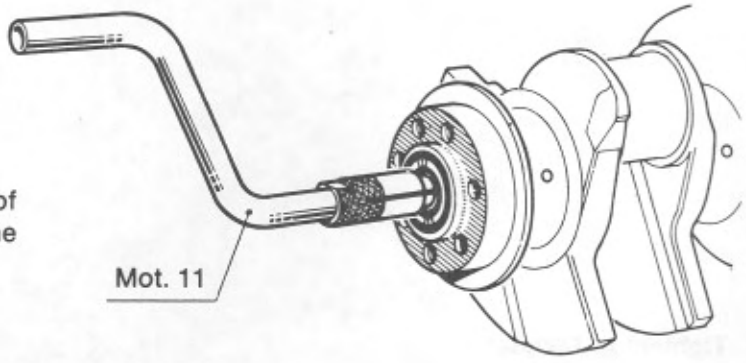
WARNING

Always wear safety eyewear when working with compressed air.

IMPORTANT

Always clean new machined parts in the same manner as reuseable parts to make sure that no foreign material is on or inside.

Clean all the crankshaft oil galleys with a length of soft iron wire. Protect or extract, if necessary, the clutch shaft bearing. Use Extractor Mot. 11.



Inspect
Cylinder Block and Related Parts Inspection

Block
- Check upper cylinder block surface for warpage. If over **.002"**, the block must be replaced.
- Check for cracks and irregularities in and around all openings, bolt holes and on surfaces.

> **CAUTION**
>
> A warped block could be caused by a cooling system malfunction. Check thoroughly (see Cooling System Section).

Crankshaft
- Check for: Evidence of excessive overheating. If found, replace crankshaft since the heat treatment has probably been destroyed.

  Check for: Scoring of bearing journals.

  Check: Oil seal contact surface for roughness or grooving.

NOTE: Any imperfections of the oil seal contact surface will result in oil leakage. Slight ridges on the oil seal contact area may be cleaned up with emery cloth or crocus cloth. If the grooves are too deep, the crankshaft must be replaced.

- Inspect for wear of thrust washer surface area.
- Measure all journals - (See specs. in "General Section.")

NOTE: Slight surface imperfection can be "cleaned up" by using crocus cloth on the journals.

Main and Connecting Rod Bearings
If these are to be reused, check as follows:

Inspect
- Inspect for excessive grooving, wear through aluminum tin coating, and foreign material embedded in bearing surfaces.
- Inspect the backs of the bearing shells for bright spots which indicate they have been moving in the bearing caps or bearing supports. If spots are present, discard bearings.

NOTE: Bearing failure may be the result of oil deterioration (acid formation) oil contamination, loss of oil pressure or insufficient oil level. An oil analysis may be required to determine actual cause of the failure.

> **CAUTION**
>
> Always discard bearings if oil has been contaminated with antifreeze or metallic particles from internal engine component failure. Always use lubricating oils that meet the recommended specifications and viscosity. See Maintenance and Lubrication Section of this manual or the Vehicle Owner's Manual.

Pistons and Sleeves
If these are to be reused, perform the following:

IMPORTANT
Failed or discarded parts should be inspected to determine cause of failure.

Clean
- Pistons and sleeves with solvent and dry them with compressed air.
- Ring grooves with a suitable tool or a piece of an old compression ring that has been ground to a bevel edge.

NOTE: Only the top of the piston may be cleaned with a wire brush to remove carbon deposits. The top crown of the piston to the edge of the wrist pin may also be soaked with a multi-purpose household detergent such as Mr. Clean® or equivalent to aid in removal of carbon deposits. DO NOT wire brush the skirts of the pistons under any circumstances.

- Inside surfaces of the piston and the oil drain holes in the ring groove area. Exercise care to avoid enlarging the holes while cleaning them.
- Cylinder liners inside and out. Remove all carbon deposits. A wire brush may be used.

> **WARNING**
>
> Always wear safety eyewear when working with compressed air.

Inspect
- Cylinder liner for excessive out-of-round, taper, or high spots which could cause failure of the pistons.
- Sealing areas on top and around the bottom of the liner for wear, cracks, erosion, or any irregular condition.

- Pistons for score marks, cracks, damaged ring groove lands or indications of overheating. Any piston that has been severely scored or overheated must be replaced. Indications of overheating or burned spots on the piston may be the result of an obstruction in the connecting rod oil passage. Be sure to check for cracks on the inside areas of the piston.

CAUTION

Excessively worn or scored pistons, rings and cylinder liners may be an indication of abnormal maintenance or operating conditions which sould be corrected to avoid recurrance of failure.

In addition to performing proper maintenance, use of correct types of lubrication filters, fuel filters and air filters will reduce abrasive particles and other foreign materials introduced into the cylinders and oil passages, which will in turn reduce the rate of engine wear.

Always insist on and use oil filters recommended by Winnebago Industries. The wrong filter could cause serious internal engine damage due to improper oil flow characteristics and by-pass functions.

Always maintain lubricating oils and engine coolant at the proper levels to prevent engine overheating.

Extended periods of engine idling and/or use of improper lubricating oil should be avoided, since a heavy formation of carbon may result causing piston rings to stick.

A used cylinder liner must be honed to break the glaze which results after long periods of operation. This insures good "seating" between the liner wall and the new piston rings. The honed/deglazed cylinder liner must meet specifications before it can be reused. See specfications in "General Information", Subsection B.

The top of the liner must also be "ridge-reamed" to prevent ridge impact by new compression rings, which could result in ring breakage.

Connecting Rods

Clean

- Connecting rod with solvent and dry with compressed air. Blow compressed air through the oil passage in the connecting rod to be sure it is clear of obstructions.

Inspect

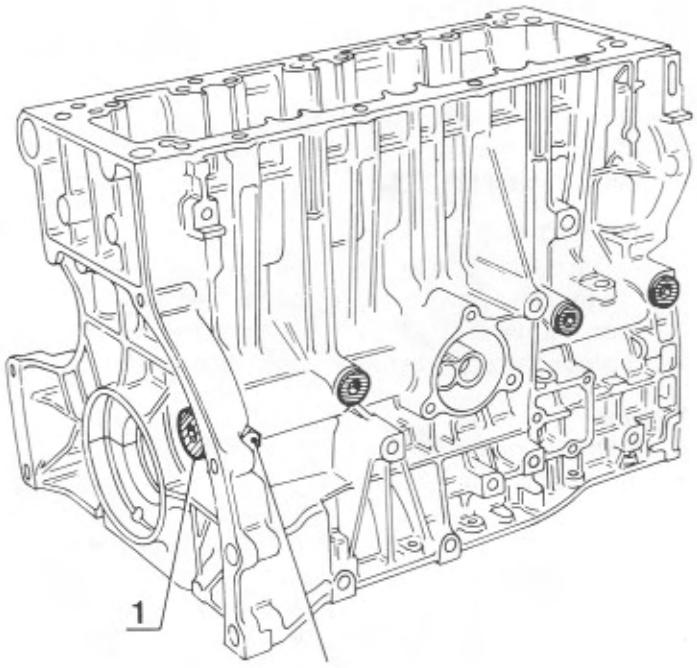
- Connecting rod for cracks and worn or irregular bearing areas. Replace the rods if the metal has changed colors due to overheating.

NOTE: If new service connecting rods are required, stamp the cylinder number on the connecting rod and cap.

Install or Connect

The core plugs must not be removed (frost plugs):

- Check that each cylinder head bolt may be screws in easily
- Screw the bolts in and out several times if required to ease the threads.



Tighten

If the oil galley plugs have been removed, refit and retorque tighten them to:

- 8 daNm (60 lb./ft.) for plugs (1)
- 2 daNm (15 lb./ft.) for plugs (2) for No. 1 main bearing
- 4 daNm (30 lb./ft.) for the other plugs

Install or Connect

- Insert the dipstick guide tube with its flange in contact with the block.
- Rub the outside of the dipstick tube with emery cloth if necessary to make it enter easily and smear the stem with a thread locking compound such as Loctite® or equivalent.
- Attach the cylinder block to support Mot. 792.

PISTON SKIRT COOLING ASSEMBLY

EARLY PRODUCTION

Install or connect

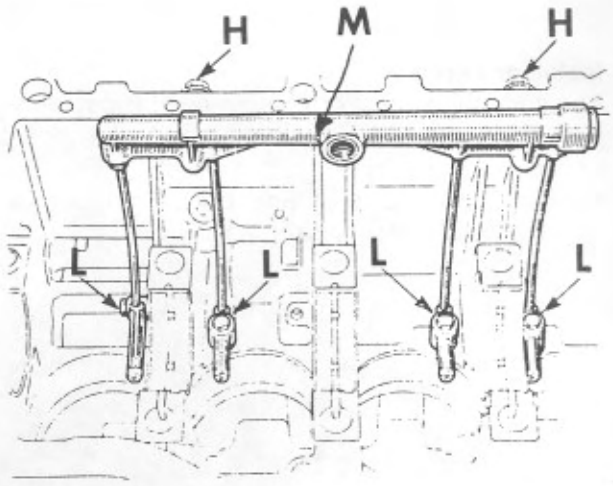
- Oil manifold assembly (M)
- Manifold retaining bolts (H)
- Jet retaining bolts (L)

IMPORTANT

- The oilway bolt threads must be smeared with one drop of thread locking compound (Loctite® or equivalent) each. Too much will tend to block the oilways around the bolts.

Tighten

- Manifold retaining bolts (H) 18.75 ft./lbs.
- Jet retaining bolts (L) 7.5 ft./lbs.)



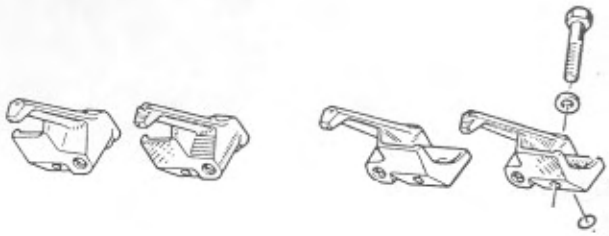
LATE PRODUCTION

Install or Connect

- Individual jets with new 'O'-Rings

Tighten

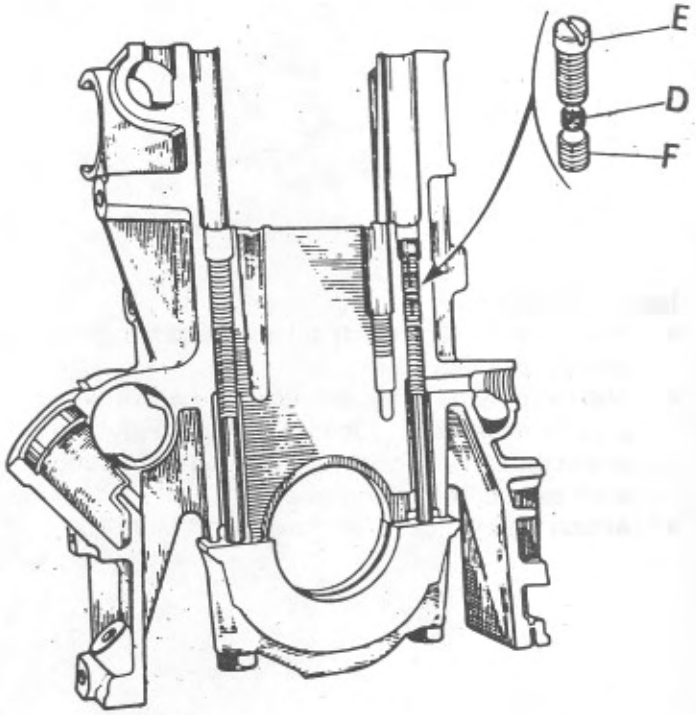
Retaining bolts 7.5 ft./lbs.



IMPORTANT

- Make certain that seals (D) are in place between the original setscrew (E) and main bearing bolts (F) for main bearings No. 2, 3 and 4 on the same side as the oil filter.
- If the engine is not equipped with the above, insert a seal (D) and a setscrew (F), its threads smeared with a thread locking compound (Loctite® or equivalent), then tighten if fully using a 6mm male hex. key 200 mm long.

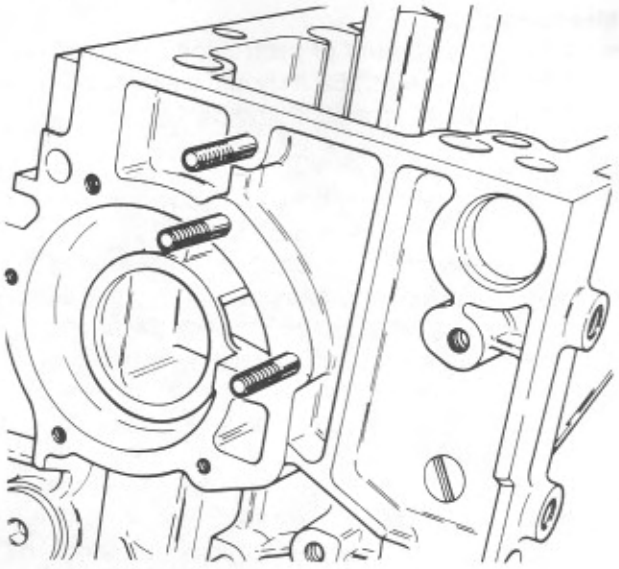
The object of this is to prevent oil entering the cooling circuit.



REASSEMBLE CYLINDER BLOCK AND RELATED PARTS (CONT.)

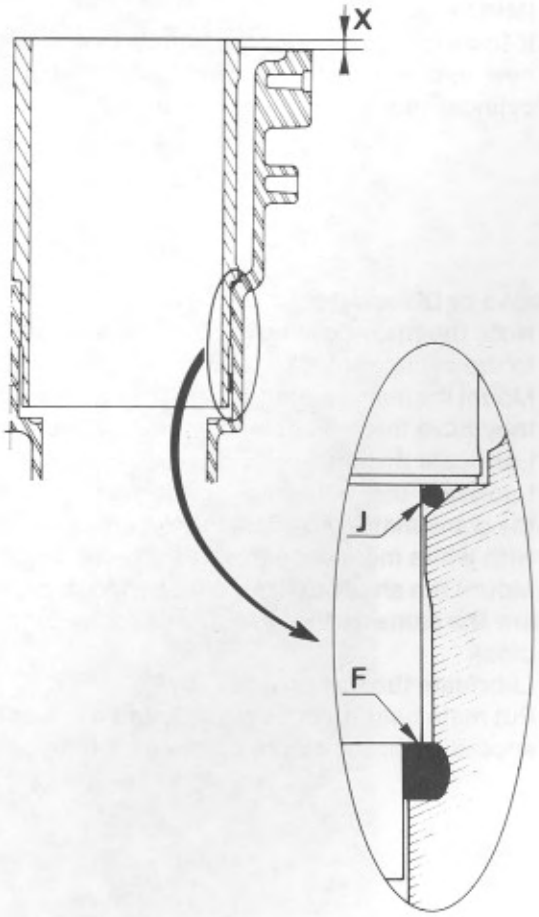
Install or Connect

- Insert the various studs. If removed, smear the threads on those for water pump and timing belt cover with one or two drops of a thread locking compound (Loctite® or equivalent) as the stud holes enter the cooling circuit.



Measure

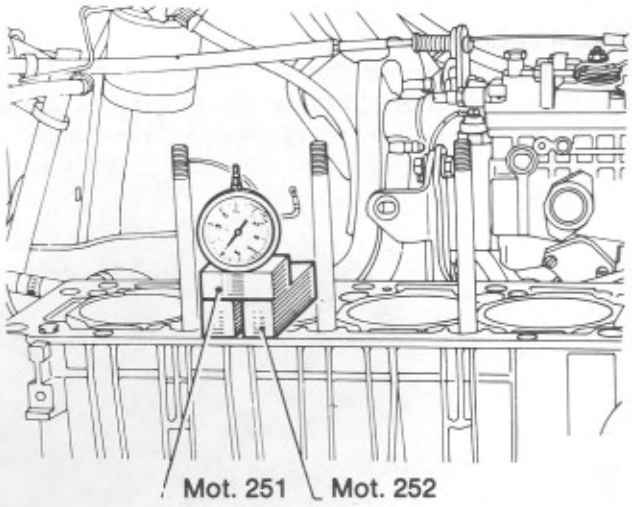
- Checking sleeve protrusion
- In this assembly, each sleeve locates direct on the cylinder block and the correct amount of protrusion is achieved by close manufacturing tolerances of sleeves and cylinder block.
- 'O' rings (J) and large plastic rings (F) act as coolant seals only.
- Sleeve protrusion (X) should be checked as follows:
  - Insert each "sleeve-piston-connecting rod" assembly less its' 'O' ring (J) and plastic bottom ring (F).



REASSEMBLE CYLINDER BLOCK AND RELATED PARTS (CONT.)

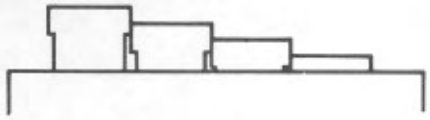
Measure

- Check the amount of protrusion (X) with Tools Mot. 251 and Mot. 252; it should measure between 0.05 and 0.12 mm (.002 and .0047").



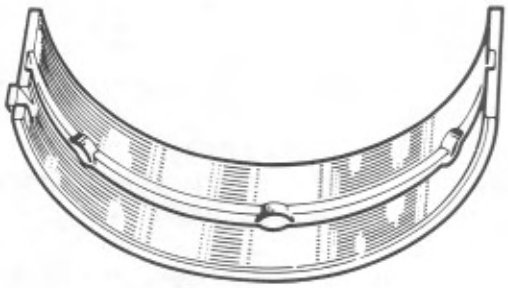
Position the sleeves so that:

- The protrusions are stepped downwards from No. 1 cylinder or vice versa.
- The difference in protrusion of two adjacent sleeves does not exceed 0.04 mm (.0016") maximum (within the permitted tolerance).
- Once the correct protrusions have been found, reform the assemblies A,B,C, and D each with its matching sleeve, piston, and wrist pin and mark the position of each sleeve in the block.
- Remember to fit an 'O' ring free of test to each sleeve flange also the plastic bottom ring before inserting the "sleeve-piston-connecting rod" assemblies.



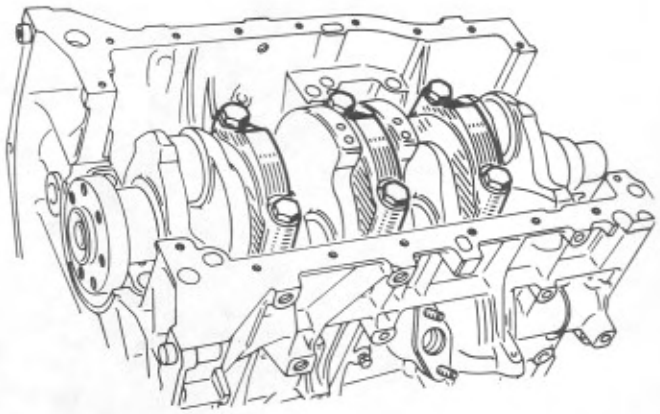
IMPORTANT

If incorrect protrusion is found, check with a new set of sleeves to establish whether the cylinder block or sleeves are at fault.



Remove or Disconnect

- Note the main bearing cap numbers in relation to the cylinder block.
- Mount the main bearing shells. They are identical; they have three oil holes and one oil groove.
- Lubricate the shells.
- Lubricate the main bearing journals and lower the crankshaft in position. Put the thrust bearings with white metal face towards the crankshaft.
- Mount the shells to the main bearing caps, they are the same as those mounted to the cylinder block.
- Lubricate the shells.
- Put main bearing caps No. 2,3, and 4 in position according to the marks on dismantling.



Measure

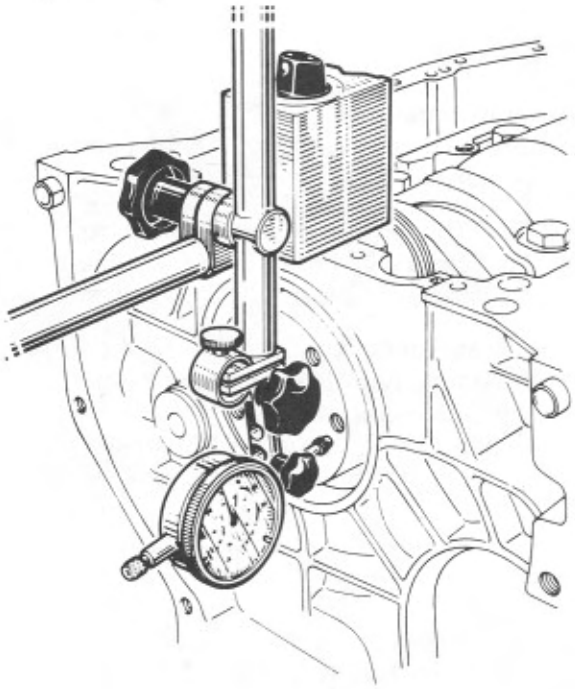
Install or Connect

- Temporarily attach main bearing caps Nos. 1 and 5 without their side seals.
- Torque tighten the main bearing cap bolts.

Checking Crankshaft End Float.

- Put a dial indicator on the end float: 0.06 mm to 0.25 mm (.0024" to .010")
- Change the thrust bearings if end float is incorrect.
- Thrust bearings are available in different thicknesses:

2.80-2.85-2.90-2.95mm
(.110-.112-.114-.116")



CAUTION

Be sure to mount the thrust bearings correctly. Oil grooves must face the crankshaft thrust surface. Make sure the locator pins are properly in the holes provided in the upper bearings in the upper half of the block.

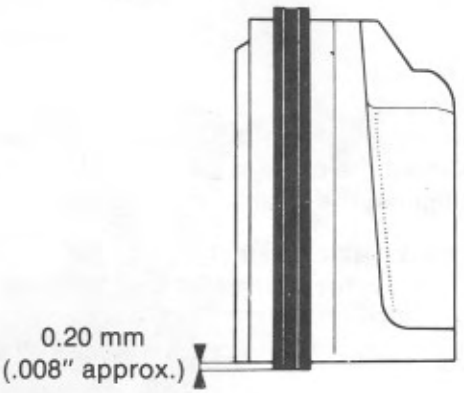
FRONT AND REAR MAIN BEARING SUPPORT SIDE SEALS

Method 1

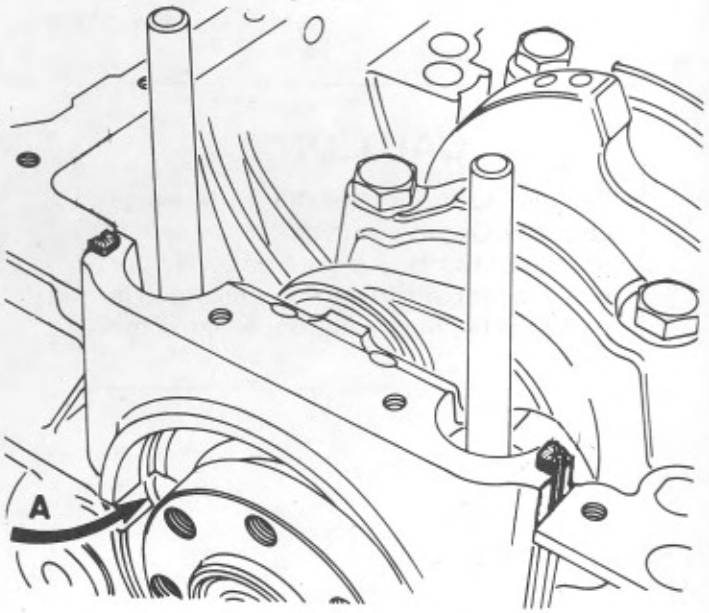
Install or Connect

- Remove main bearing caps Nos. 1 and 5 and fit the side seals to them.

NOTE: This engine requires the thickest of the seals included in the gasket seal kit to be used (5.40 mm - .212" thick-white code).

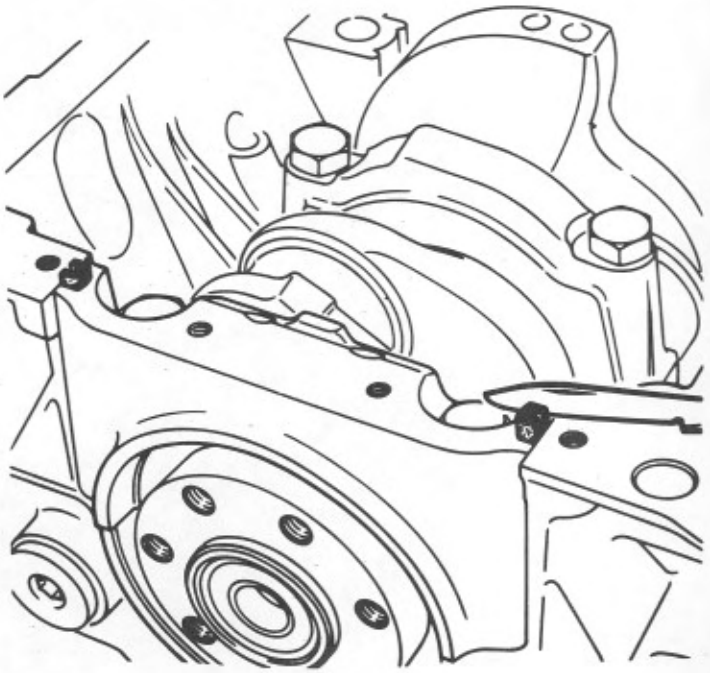


- Each seal should protrude below the surface of the bearing cap (see illustration)
- Lubricate bearing shells.
- Put liberal amounts of petroleum jelly on seals and on mating block surfaces.



Install or Connect

- Screw two locating studs (12mm dia. x 1.50 pitch) into the cylinder block.
- Place Nos. 1 and 5 main bearing caps on the studs.
- Lower the assembly into the block
- When each bearing cap is almost seated, make sure that the side seals protrude slightly by trying with a rule at (A).
- Withdraw the studs and screw in the cap bolts.



- Cut the ends of the side seals leaving 0.5 to 0.7 mm (.020 to .028") protrude above the pan joint face.

Method 2

Due to machining modifications in engine production, lateral sealing of the main bearing caps cannot be ensured with the butyl seals provided in the gasket/seal kit.

Therefore, described here is an alternate method of sealing main bearing caps using Thixo-Caf 4/60 Silicone (50 ml tube). Thixo Silicone and an application kit are available from our Parts Sales Department. The application kit consists of:

- 1 - 5ml tube of hardener
- 1 - mixing stick
- 1 - 50ml syringe
- set mixing/application instructions

IMPORTANT
The product must be injected within approximately 5 minutes to avoid the mixture polymerizing in the syringe.

- Thoroughly clean the surfaces at (A) on the cylinder block and the main bearing cap in question, using a cloth impregnated with cleaning thinners.

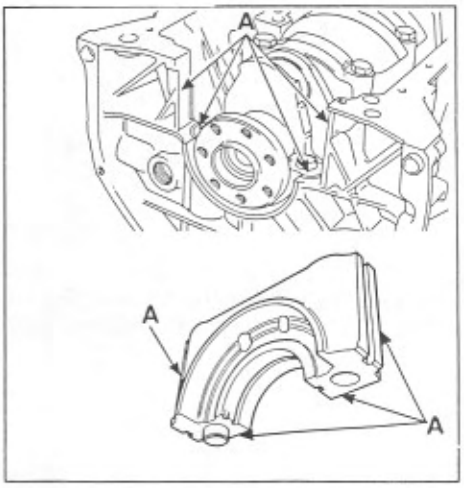
- Lightly coat the lower faces of the cylinder block at (B) with CAF 4/60 THIXO but do not block the oil retention grooves.

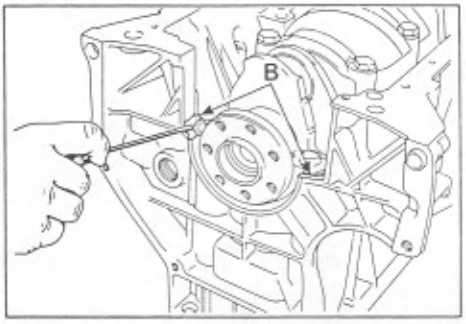
- Fit the cap and tighten to torque.

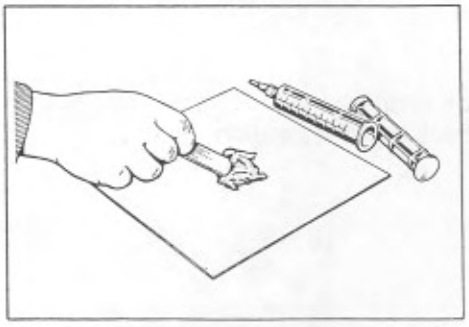
- Mix 45 ml of CAF 4/60 THIXO with the contents of the tube of hardener using the stick to blend mixture throughly.

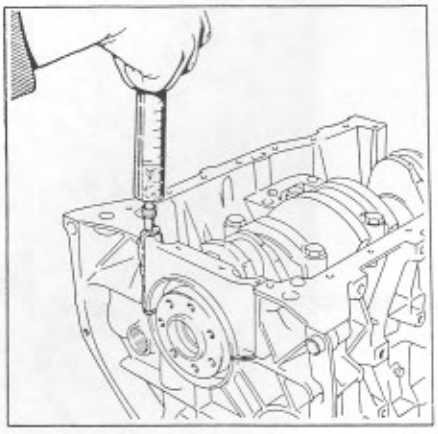
- Put the mixture in the syringe and inject it into the main bearing cap grooves.

- Allow the mixture to flow out slightly either side of the main bearing cap grooves to ensure that the injected mixture has filled the sealing groove completely.



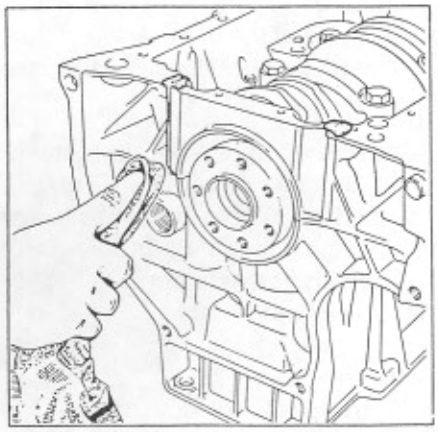




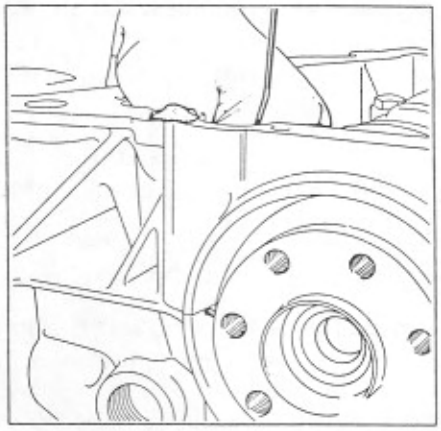


FRONT AND REAR MAIN BEARING SUPPORT SIDE SEALS

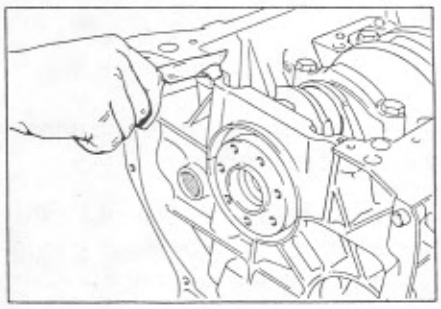
- Using a cloth, wipe away the excess mixture, both inside and outside the cylinder block.



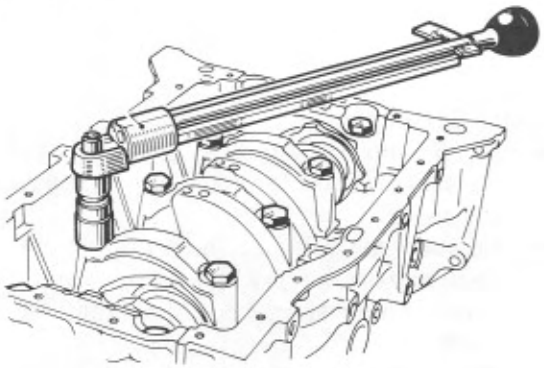
- Pass a steel wire through the lubrication oil ways to check that they are not blocked.



- Allow the assembly to dry for a few minutes, then cut excess sealant from the joint face.



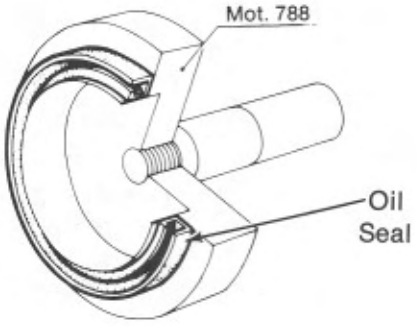
REASSEMBLE CYLINDER BLOCK AND RELATED PARTS (CONT.)



Tighten
Torque tighten the main bearing cap bolts using a torque wrench.

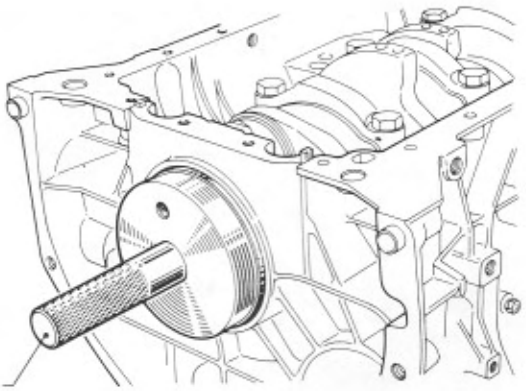
Tighten to 8.75 - 9.75 daNm (65 1/2 - 73 lb./ft.)

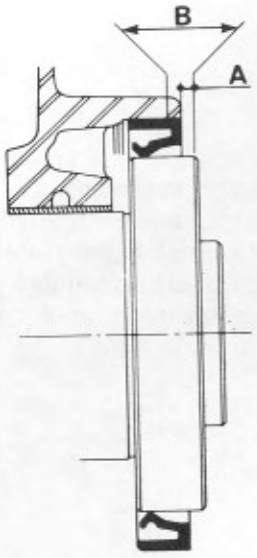
Check that the crankshaft rotates freely.



Install or Connect

- Mount the oil seals to main bearings Nos. 1 and 5.
- The lip on these oil seals is delicate; take exceptional care when mounting them. No. 1 main bearing oil seal (flywheel end).
- Place the seal on Tool Mot. 788 as shown.
- Lubricate the outside of the tool.
- Insert the seal by tapping the end of the tool lightly until the seal contacts the crankshaft.

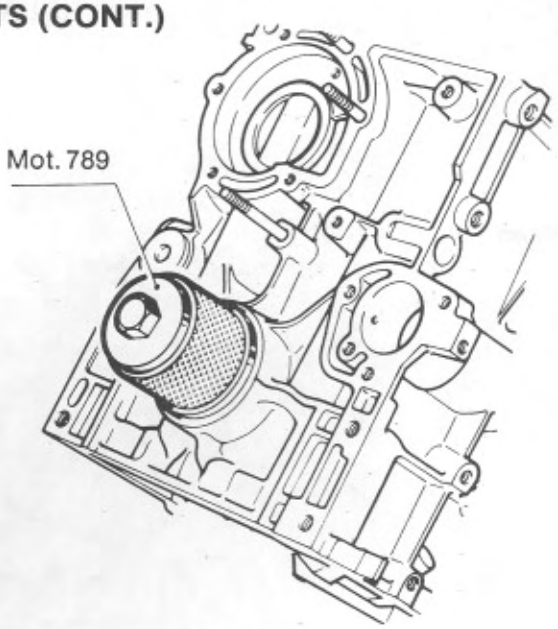




IMPORTANT
If the old oil seal lip has marked the crankshaft (flywheel end), a washer 1.5 mm (.059") thick must be inserted between the new oil seal and the tool to give the lip an unworn bearing surface when in position.

A. Normal position of oil seal using Tool Mot. 788.
B. Position the oil seal using Tool Mot. 788 and washer (giving offset to lip on overhaul).

REASSEMBLE CYLINDER BLOCK AND RELATED PARTS (CONT.)



Install or Connect

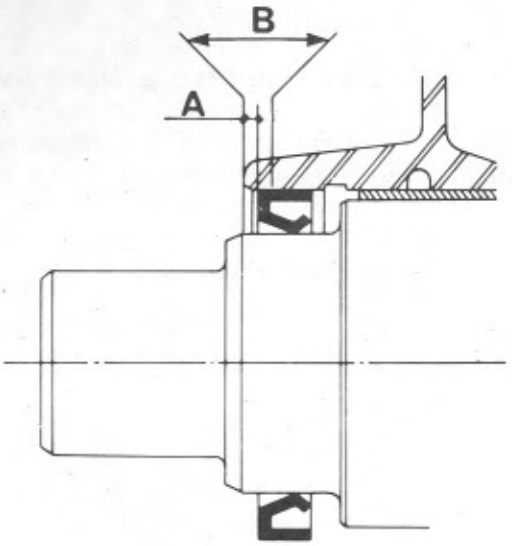
- No. 5 main bearing oil seal (timing end). Place the seal on Tool Mot. 789 lubricate the outside of the seal.
- Position the tool/seal assembly to the crankshaft and draw it on with the pulley bolt. The seal is fully home when the tool contacts the crankshaft.
- Woodruff key on crankshaft.
- Air conditioner pulley (or spacer if not A/C equipped).
- Crankshaft belt sprocket.

IMPORTANT

If the old oil seal lip has marked the crankshaft (timing gear end), a washer 1.5 mm (.059") thick must be inserted between the new oil seal and the tool to give the lip an unworn bearing surface when in position.

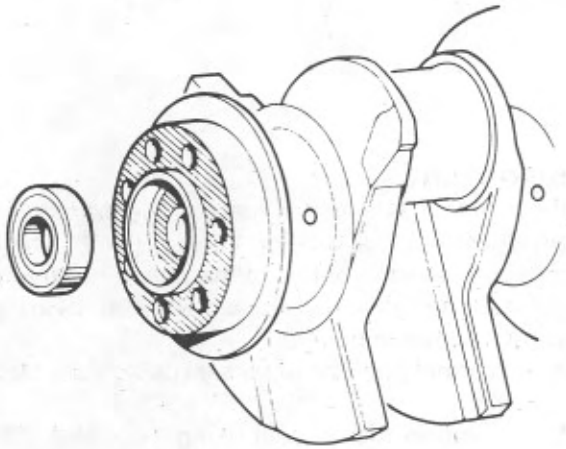
A. Normal position of oil seal using Tool Mot. 789.

B. Position of oil seal using Tool Mot. 789 and a washer (giving offset to lip on overhaul).



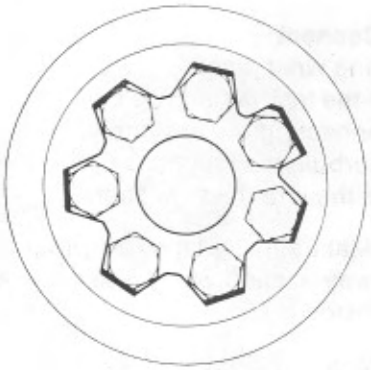
Mount:

- the spacer
- key
- and timing sprocket, timing mark facing outwards.



NOTE: Replacement crankshafts do not have the pilot bearing mounted, so this bearing must be mounted to the crankshaft on all engines coupled to a manual shift gearbox. Coat the outside of this bearing with Loctite® or equivalent.

REASSEMBLE CYLINDER BLOCK AND RELATED PARTS (CONT.)



Install or Connect

- Flywheel using new lock plate and bolts.

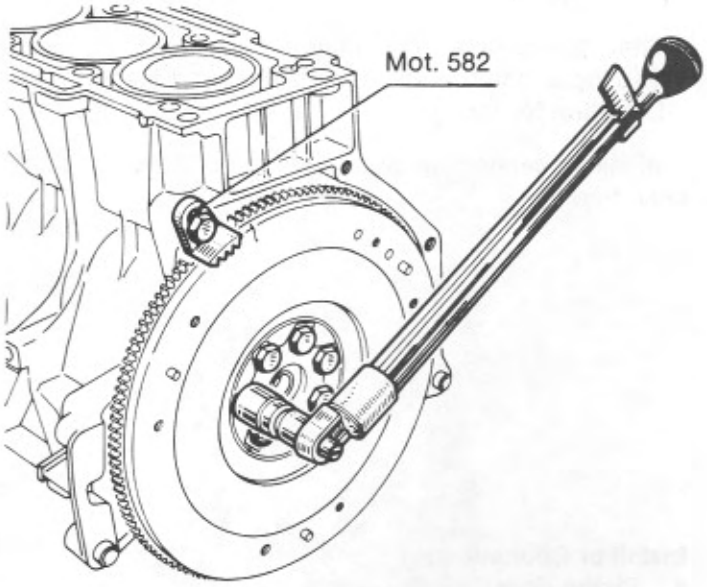
Procedure:

- Mount the clutch shaft bearing, if necessary.
- Smear the flywheel mounting face with a thread locking compound such as Loctite® or equivalent.
- Mount the flywheel using serrated Locking Plate Mot. 582 to prevent it from turning.
- Place 1 or 2 drops of a thread locking compound (Loctite® or equivalent) on the threads of the new bolts and torque tighten them using a torque wrench and Serrated Lock Plate Mot. 582.

Tighten

Torque flywheel bolts
- 6 daNm - 45 lb./ft.

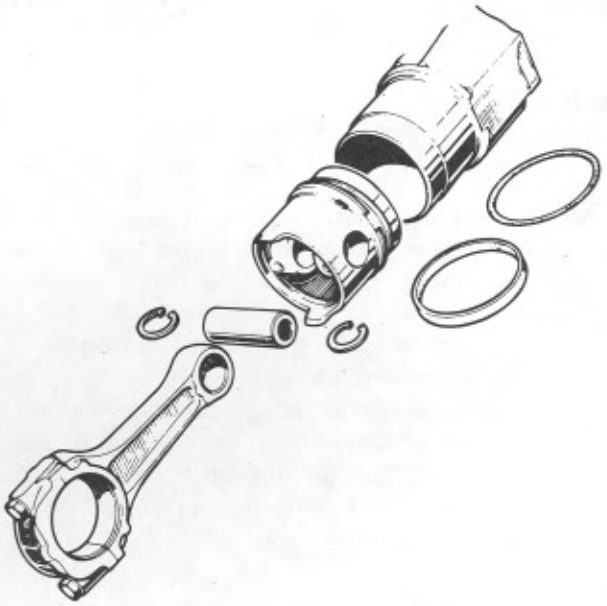
- Bend the lock plate over one flat only on each bolt.



Install or Connect

- Mounting wrist pins:
  Follow the instructions below to fit each piston and connecting rod assembly:
  - the turbulence chamber in the piston crown faces the intermediate shaft

NOTE: Make sure that they are mounted the right way around on reassembly (see arrows below).



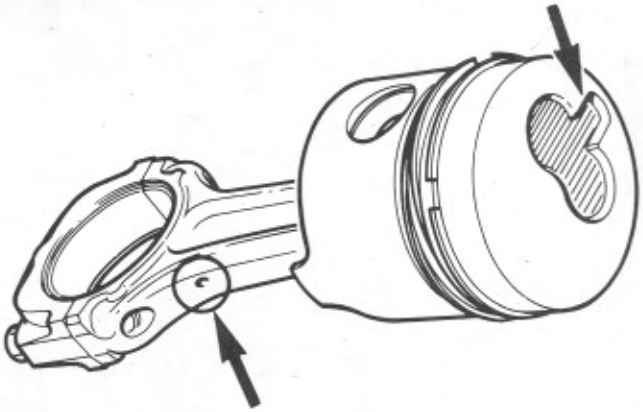
- Wrist pins and circlip retainers:
  - check that each wrist pin rotates freely in its new matching piston
- Lubricate the wrist pins with oil

J8S-234 engines.

Connecting Rods

- They do not have an oil jet hole.
- The top and bottom half-shells are not drilled.
- Direction for fitting:

Half-shell locating pegs on side away from turbulence chamber.



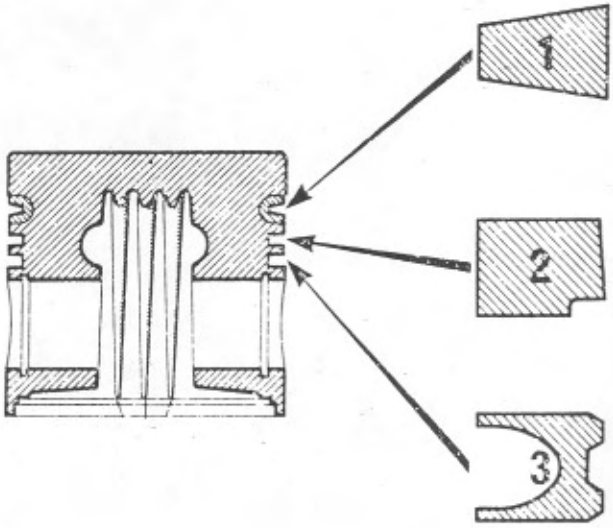
Install or Connect

- Piston rings

IMPORTANT

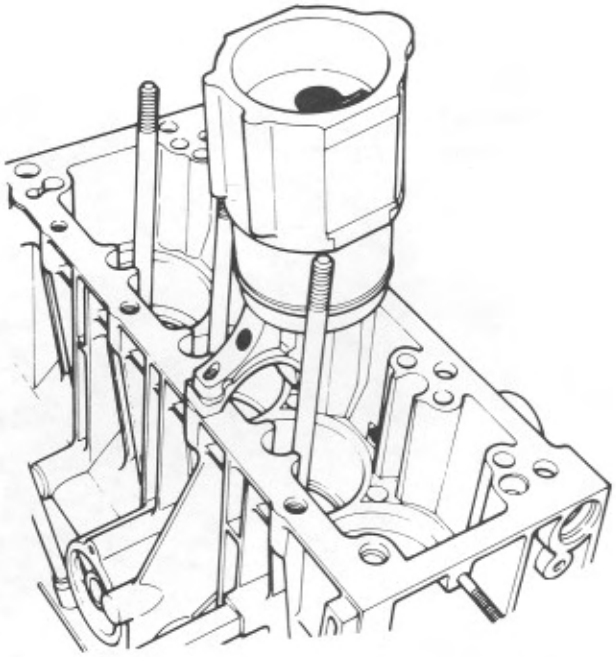
The factory pre-gapped piston rings must be free in their grooves.

- They must be installed the correct way as shown.

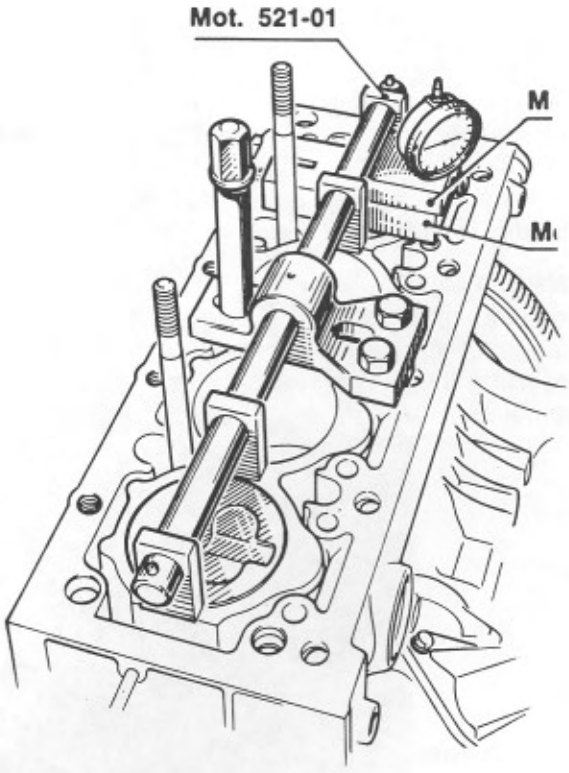


Install or Connect

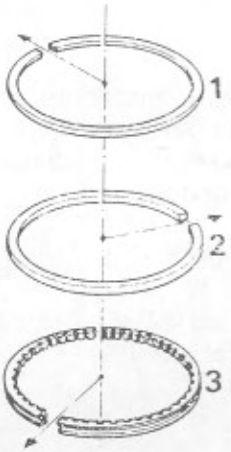
- Insert the sleeve/piston/connecting rod assemblies in the cylinder block and check:
  - the position of the sleeves in the block (protrusions stepped up or down-cylinders 1 to 4)
  - sleeve flats parallel
  - piston pre-combustion chambers facing intermediate shaft
  - connecting rod oil jet holes on side facing away from intermediate shaft.

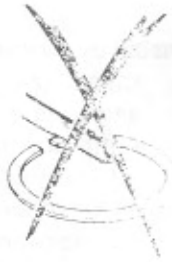


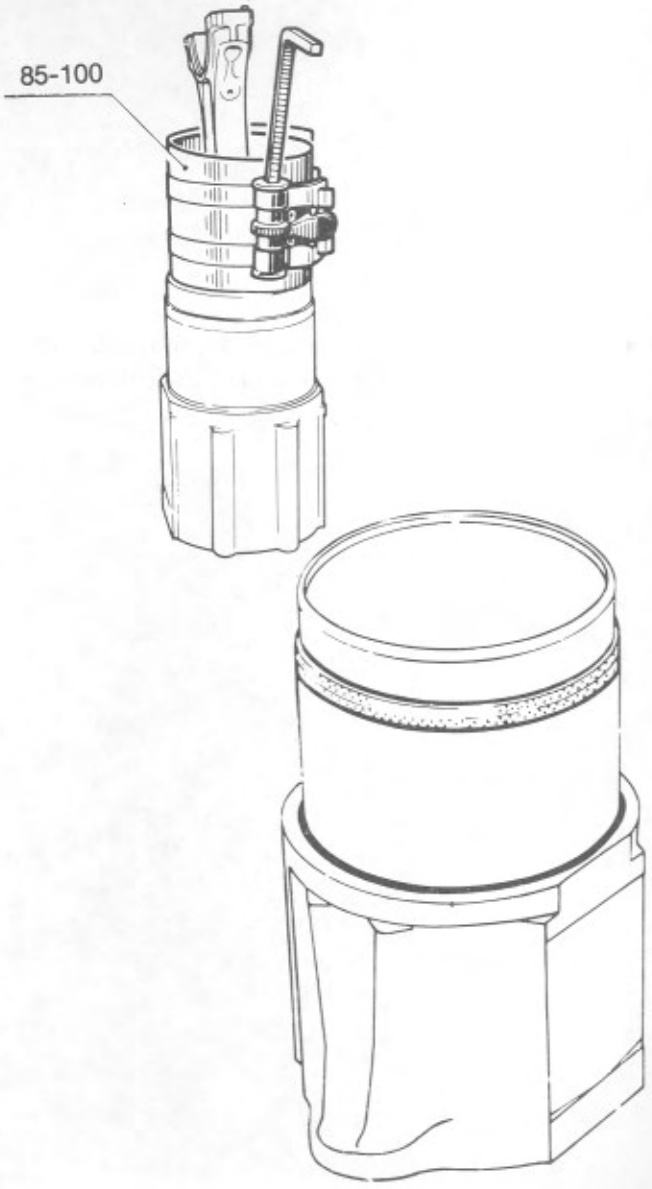
- Put sleeve clamp Mot. 521-01 in position, tightening the bolts and nut to 5 daNm (37 lb./ft.).



IMPORTANT
- Space the gaps at 120° radial intervals.







Install or Connect
- Lubricate the pistons
- Put the connecting rod/piston assemblies in their respective sleeves using Ring Compressor Mot. 851
- The machined sides of the cap end must be parallel to the flat on the side of the sleeve.

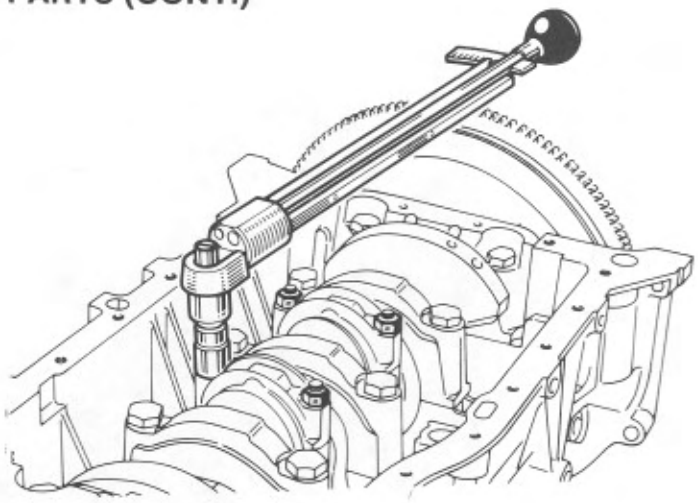
IMPORTANT
Remember to attach an 'O' ring to each sleeve flange. Also the plastic bottom ring before inserting the sleeve/piston/connecting rod assemblies.

Install or Connect
- New rod bearings to the connecting rods.
- Lubricate the bearings and crankshaft journals.

REASSEMBLE CYLINDER BLOCK AND RELATED PARTS (CONT.)

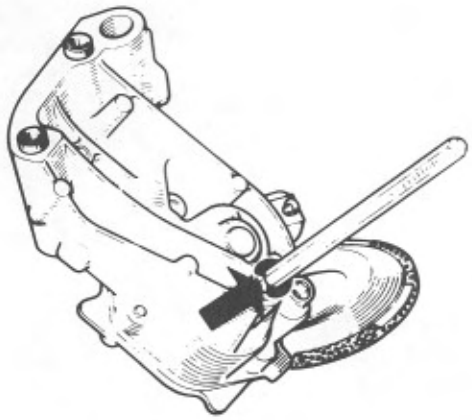
Install or Connect

- Draw the connecting rods down onto the lubricated journals.
- Mount the new bearing shells to the rod-end caps, making sure that they are correctly matched.
- Screw on and torque tighten the new rod-end cap bolts using a torque wrench.
- Check that the assembly revolves freely.



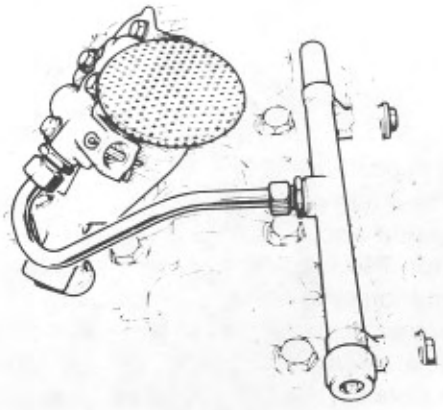
Tighten

Rod bearing torque 6.5 daNm (50 lb./ft.)

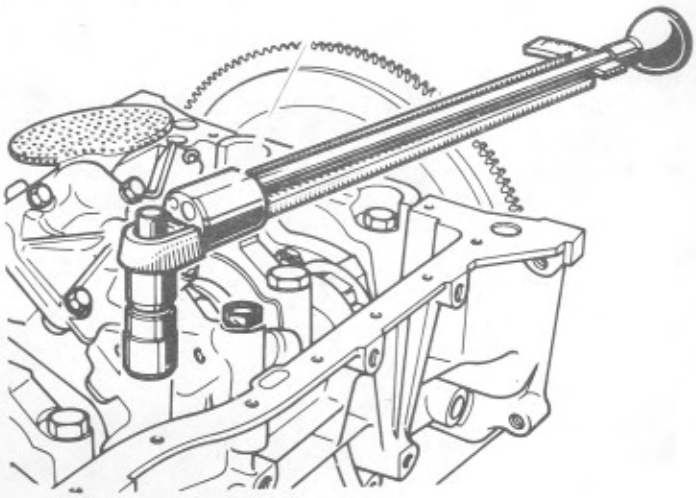


Special Points Concerning Assembly:

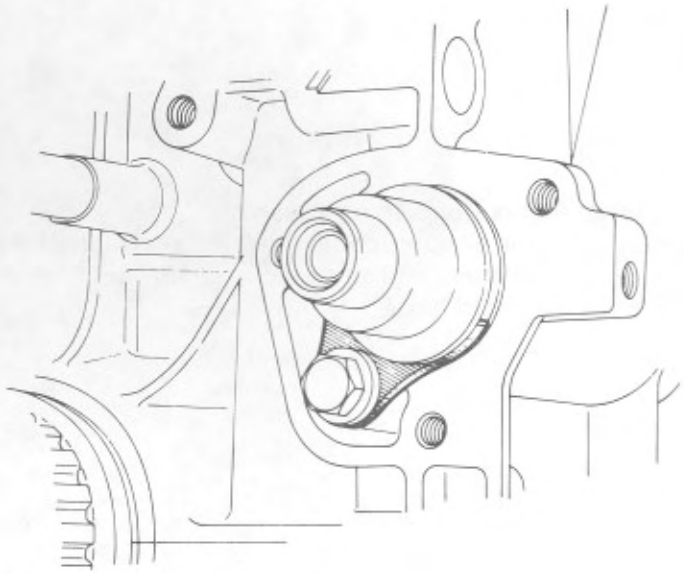
- Mount the oil pump complete with its drive shaft circlip at pump end and check that the locating dowels are in place.



- Install oil pump to oil manifold pipe (early production only.)



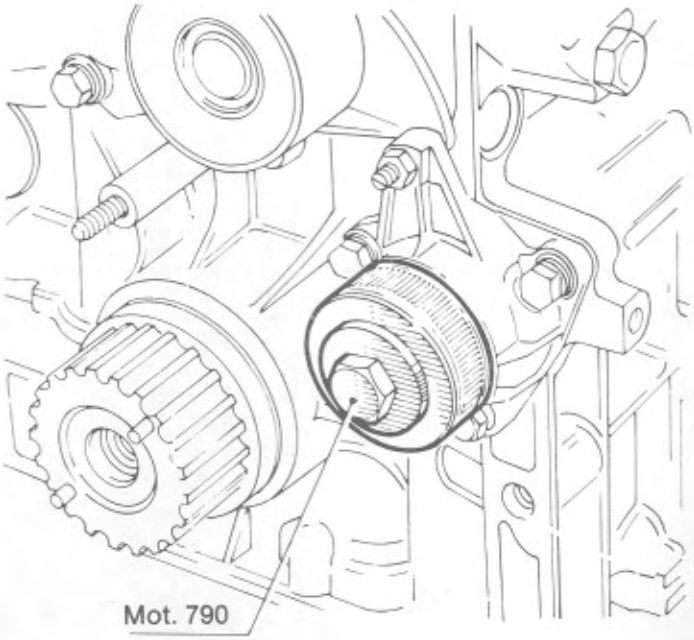
Tighten
Oil pump retaining bolt Torque 4.0 to 4.5 daNm (30-34 lb./ft.)



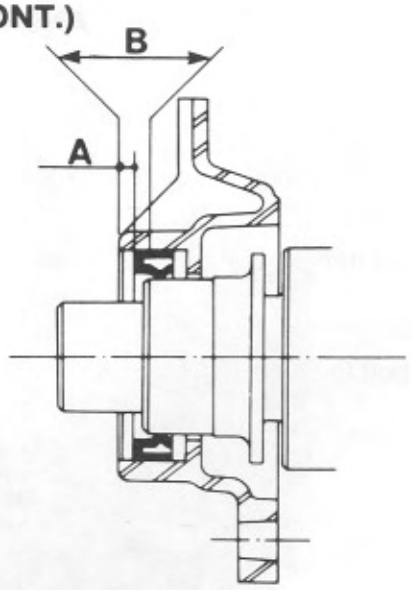
Install or Connect

- Insert the intermediate shaft, secure it by its flange plate.

- Install timing belt tightener.
  - Do not tighten at this time.



- Put in position:
  - The intermediate shaft cover with a new paper gasket and new oil seal. Use Inserting Tool Mot. 790 in order not to damage the seal lip and to assist cover location.
  - Smear the bolt threads with one or two drops of a thread locking compound (Loctite® or equivalent) as the holes pass through into the cylinder block which could lead to oil leaks.

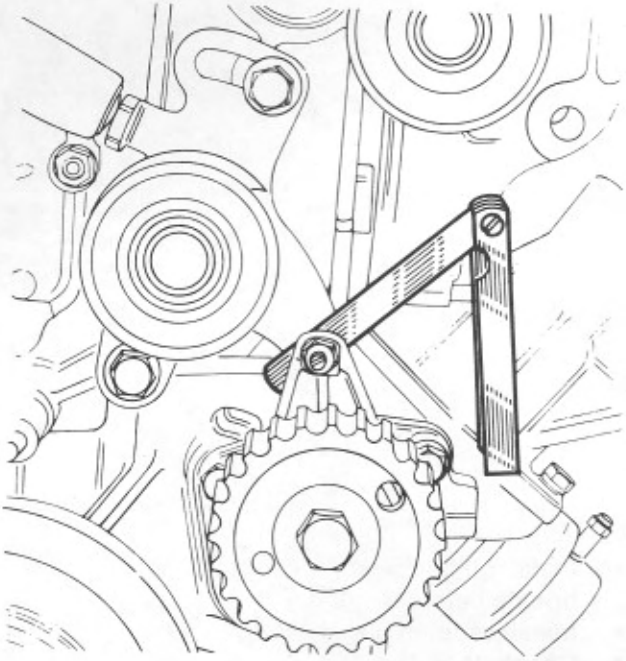


IMPORTANT

A washer 1 mm (.040") thick must be placed between the oil seal and the inserting tool so that the seal lip bears on a fresh surface if the intermediate shaft has been marked by the old oil seal.

A - Position when inserted with Tool Mot. 790

B - Position when inserted with Mot. 790 plus the washer after overhaul.

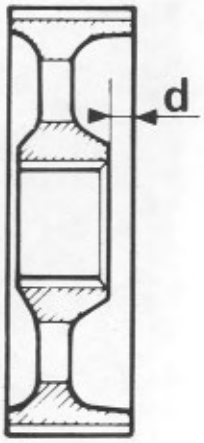


Install or Connect

- The water pump with plunger and spring for the timing belt tightener. See Cooling System Section.

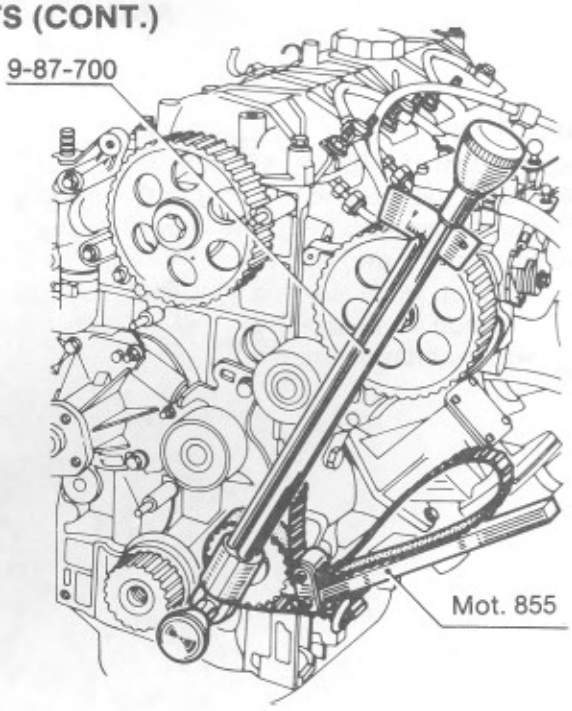
Adjust

- Adjust the clearance between the tensioner and adjusting bolt to 0.1 mm (.004")



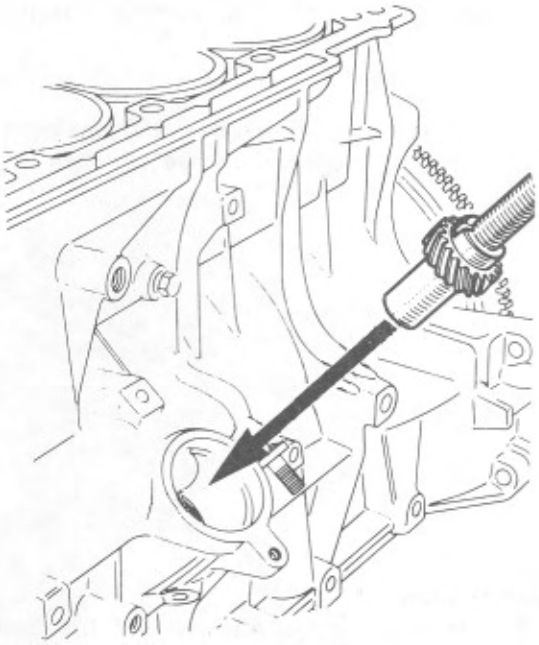
Install or Connect

- The intermediate shaft key and the toothed sprocket, larger offset (d) facing outwards away from the cylinder block.



- Torque tighten the bolt using Strap Tool Mot. 855.

Tighten
Torque bolt to 5 daNm (37 lb./ft.)



- Install oil pump/vacuum pump angle drive. Lubricate before installing.
- Install vacuum pump with new 'O'-ring.
- Check that the "intermediate shaft-vacuum pump-oil pump" assembly revolves freely.

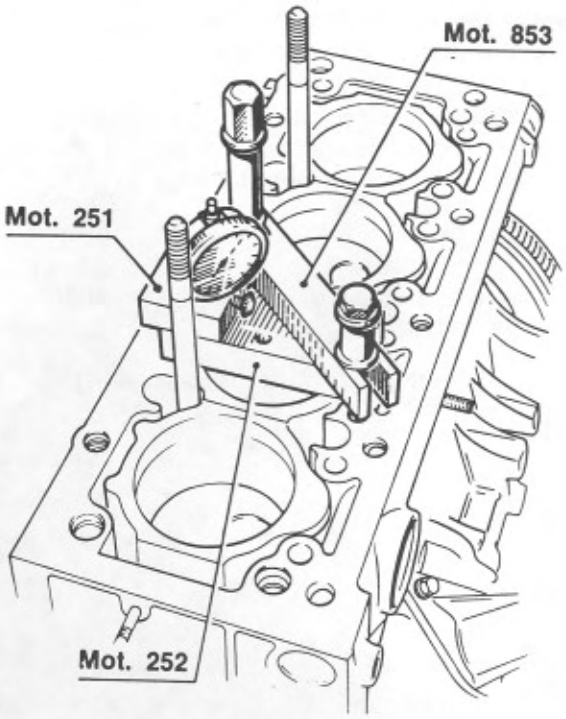
REINSTALLATION OF THE CYLINDER HEAD

Measure

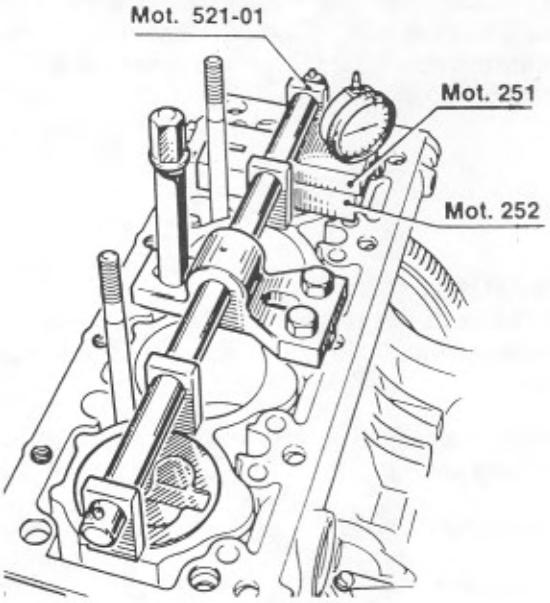
Install or Connect

Tighten

Step 1 - Sleeve Protrusion
Check sleeve protrusions with Tools Mot. 251 and Mot. 252.
Mot. 252 will be braced by bar Mot. 853 to ensure that the sleeve is firmly in contact with the cylinder block. Torque tighten the tool bolts gradually and alternately to 5 daNm (37 lb./ft.)
If an incorrect protrusion is found, check whether a faulty cylinder block or faulty sleeve is the cause by placing a new set of sleeves without sealing rings into the cylinder block.



Step 2 - Checking Piston Protrusion
Put Sleeve Clamp Mot. 521-01 in position and torque tighten the nuts and bolts to 5 daNm (37 lb./ft.) to ensure that the sleeves are below the pistons when the latter are on T.D.C.
Clean the piston crowns carefully and rotate crankshaft one complete revolution.
Place Tools Mot. 251 and Mot. 252 on each piston in turn with the clock gauge bracket resting on the cylinder block. Find the T.D.C. of each piston and make a note of the amount of protrusion in relation to the cylinder block on both sides of each piston.
The purpose of this is to determine which of the three thicknesses of gasket will be most suitable.
Take the piston with the maximum protrusion. Add the measurements from both sides of that piston - divide by 2 to get the average. Use this as the maximum piston protrusion.
For a maximum piston protrusion:
- of less than 0.96 mm, use cylinder head gasket 1.6 mm thick which is marked "1,6".
- of between 0.96 and 1.04 mm, use a cylinder head gasket 1.7 mm thick. This gasket is unmarked.
- of more than 1.04mm use a cylinder head gasket 1.88 mm thick which is marked "1,8".

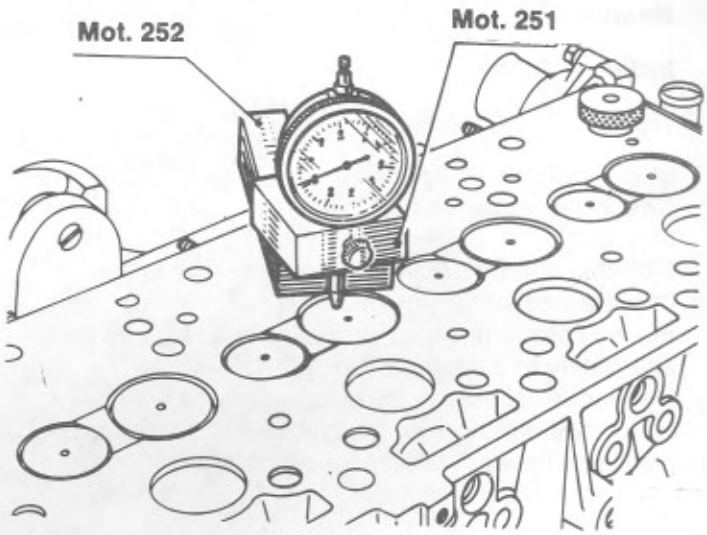


REINSTALLATION OF THE CYLINDER HEAD (CONT.)

Step 3 - Measuring Valve Recesses
Once the piston with the highest protrusion has been found, measure the amount of recess of each valve for the cylinder concerned in relation to the cylinder head joint face (the recess value should be between 0.8 to 1.15 mm (0.315" and .0452").

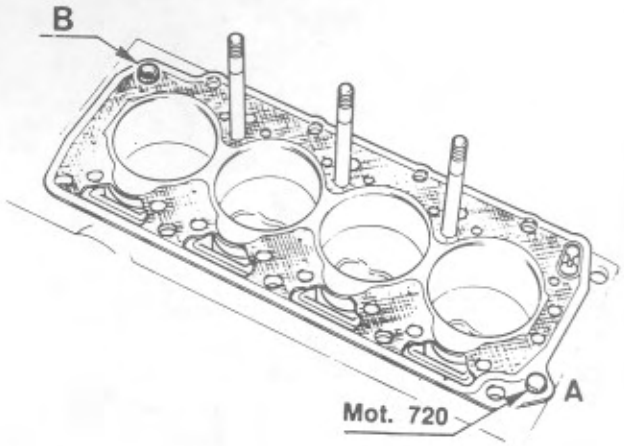
To do this, clean both valve heads first then measure the distance between the cylinder head joint face and the inlet and exhaust valve heads using Tools Mot. 251 and Mot. 252.

CONSIDER ONLY THE SMALLER OF THE TWO DIMENSIONS AND MAKE A NOTE OF IT.



Step 4 - Positioning the Cylinder Head Gasket
Tool Mot. 720 must be used for this operation.
Insert it in hole (A) in the cylinder block and check that locating dowel (B) is in place.
Turn the crankshaft until the pistons are halfway down the bores before removing Sleeve Clamp Mot. 521-01.
Mount:
- The cylinder head gasket, lining it up first with the studs and then with the locating dowels.

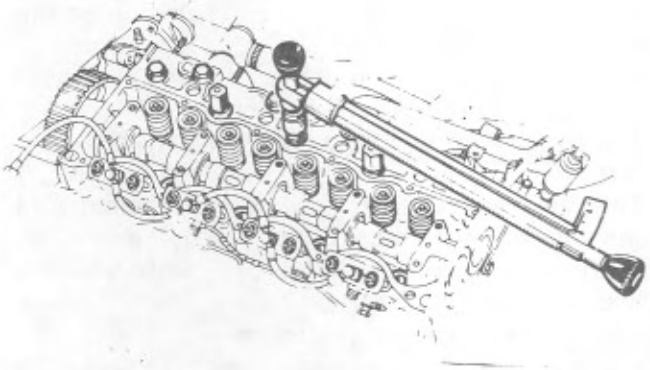
Lubricate the bolt threads and flatwashers under the bolt heads with clean engine oil.

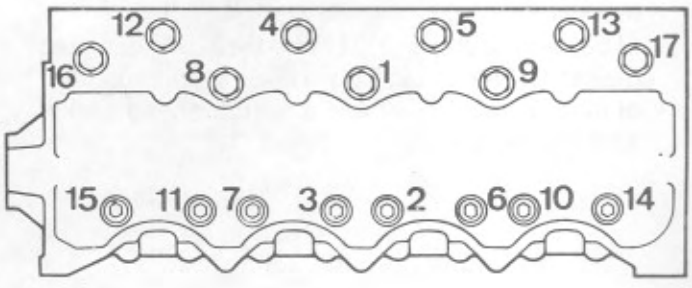


Step 5 - Tighten Head
Insert the bolts and nuts and torque, tighten them gradually in the sequence shown using a torque wrench.

1st pre-tightening	3 daNm (22 lb./ft.)
2nd pre-tightening	5 daNm (37 lb./ft.)
1st tightening	9.5 to 10.5 daNm (70 to 78 lb./ft.)
2nd tightening	9.5 to 10.5 daNm 70 to 78 lb./ft.)

Remove Tool Mot. 720





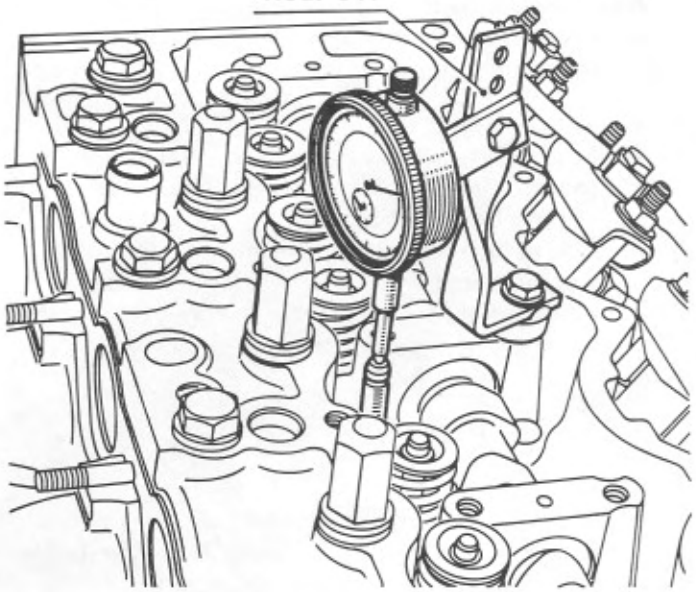
Step 6 - Checking the Clearance Between Pistons and Cylinder head

Using bracket Rou. 541 attached to a rocker shaft bearing bolt, align the dial indicator so that its stem rests on the valve selected for measurement:

- Turn the crankshaft so that the piston is on or very close to T.D.C.
- Press valve down to check that the piston is near T.D.C.
- Remove the cotters and valve spring using compressor.
- Keep the valve resting on the piston and, using the dial indicator as a guide, bring the piston up exactly on T.D.C.
- Now set the dial indicator to zero, lift the valve up by hand onto its seat and read off the distance between piston and valve.

From this value, work out amount of valve recess, which should not be less than 0.6 mm (.0236").

Rou. 541

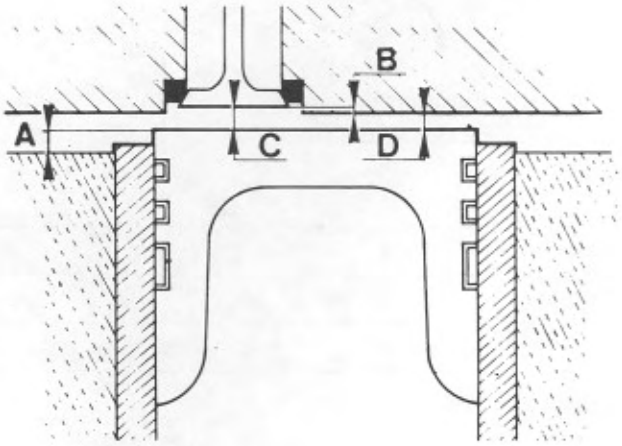


Example of these measurements:

1 - Piston protrusion (measured after crankshaft has been turned one revolution in normal direction of running to take up any play).
Dimension A:
No. 1 cylinder A = 1.05 mm
No. 2 cylinder A = 1.04 mm
No. 3 cylinder A = 1.05 mm
No. 4 cylinder A = 1.07 mm
The highest protrusion, 1.07 mm, in Cylinder No. 4 will be used for the calculations. As this dimension exceeds 1.04 mm, a cylinder head gasket 1.8 mm thick must be used.

2 - Valve recess (Dimension B):
Measurement taken of No. 4 cylinder inlet and exhaust valves:
Intake B = 0.92 mm
Exhaust B = 0.87 mm
(In both cases, the recess valve is within the tolerance of 0.80 to 1.15 mm). The lesser recess valve will be used in the calculations which is 0.87 mm for the exhaust valve.

3 - Distance between the valve and piston (Dimension C):
No. 4 cylinder exhaust valve movement as read on dial indicator was:
(Reminder: Piston on T.D.C.)
C = 1.57 mm
From which may be calculated:
PISTON-CYLINDER HEAD CLEARANCE:
D = C-B=1.57mm-0.87mm=0.7mm
This value being more than the minimum tolerance of 0.6 mm.



REINSTALLATION OF THE CYLINDER HEAD (CONT.)

Install or Connect

- Glow plug wire harness to glow plugs
- Injection pump with mounting bracket to block
- Injection lines
- Fuel return hoses to injectors and pump
- Install timing belt (see Section Changing Timing Belt) and cover
- Mount the rocker shaft assembly (Bearing No. 1 has one locating dowel, Bearing No. 5 has two), place the thrust washer for Bearing No. 5 in its groove in the camshaft.

Tighten

Torque rocker bolts 3 daNm (22 lb./ft.)

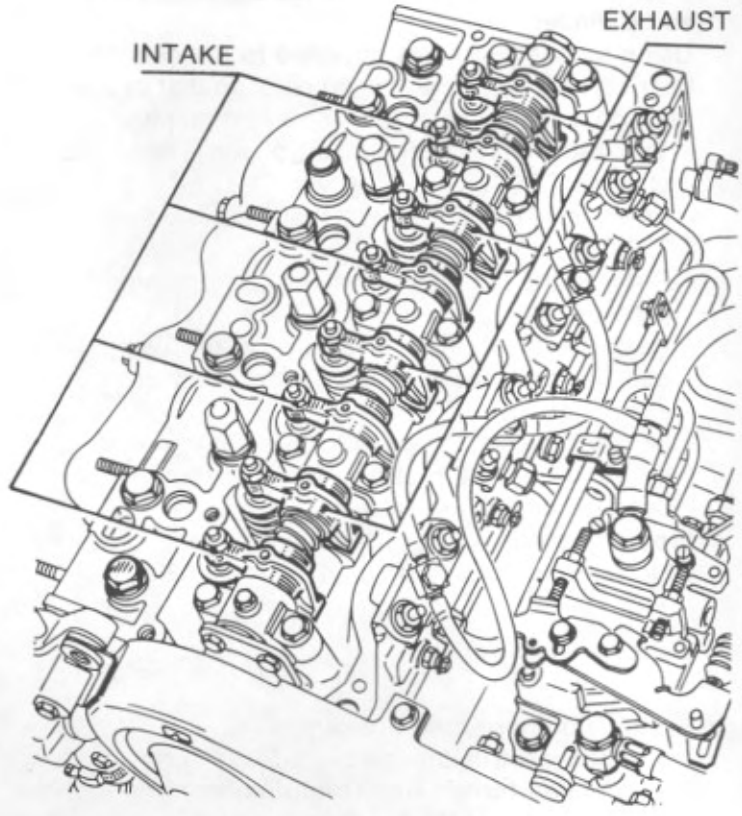
Adjust

- Adjust the rocker arm clearances using Wrench Mot. 647 (make sure that the inlet and exhaust valves are in their correct positions).

Intake arm	0.20 mm (.008")
Exhaust arm	0.25 mm (.010")

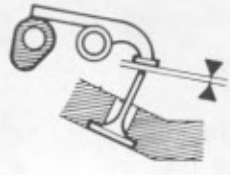
IMPORTANT

Number 4 cylinder is in the front and the Number 1 cylinder is in the rear.

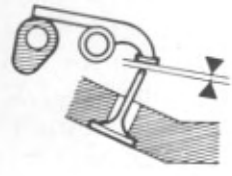




Exhaust Valve To Be Set Wide Open



Adjust Clearance On Intake Valve



Adjust Clearance On Exhaust Valve

Step 1 -	1	3	4
Step 2 -	3	4	2
Step 3 -	4	2	1
Step 4 -	2	1	3

Install or Connect

- Rocker arm cover
- Thermostat housing, thermostat, and water temp. sender if removed.
- Adjust pump timing (see Tune-up Section)
- Install engine oil pan
- Crankcase vent hoses

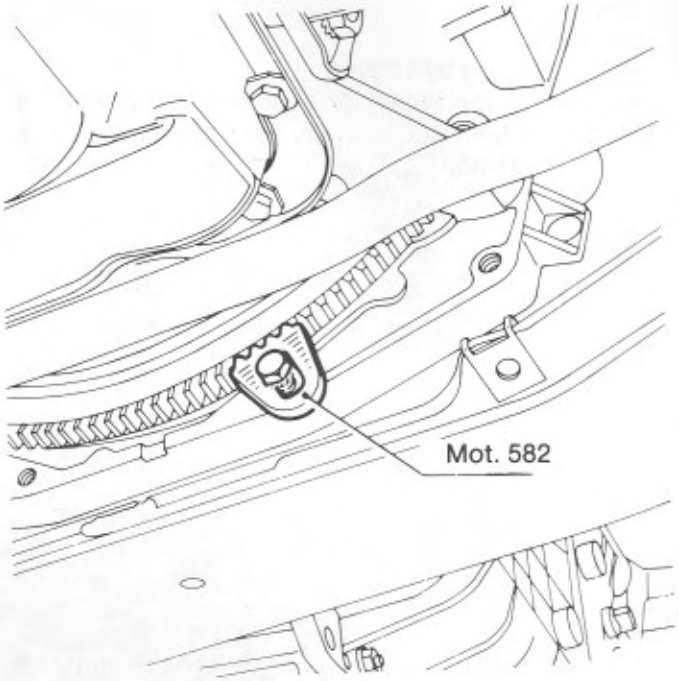
TIMING BELT CHANGING

Removal

Step 1

Remove:

- Nosepiece
- Belly shield
- Fender connecting brace
- A/C condenser and fans - do not unhook A/C lines - unbolt unit and swing aside
- Radiator hoses and coolant
- Radiator
- Fan blade
- Alternator - fan belt
- Power steering belt
- Lower flywheel cover

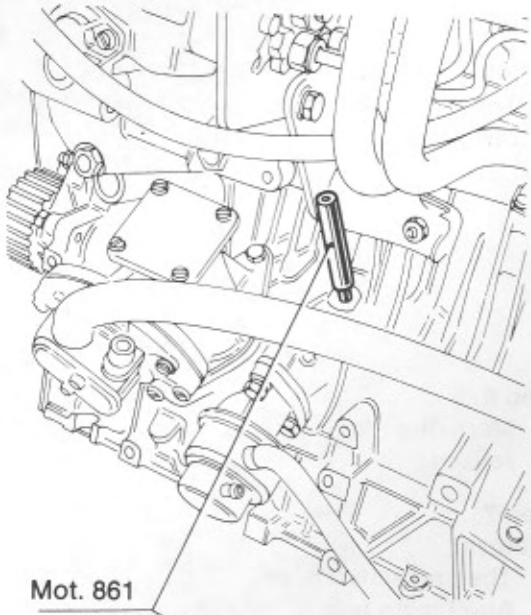


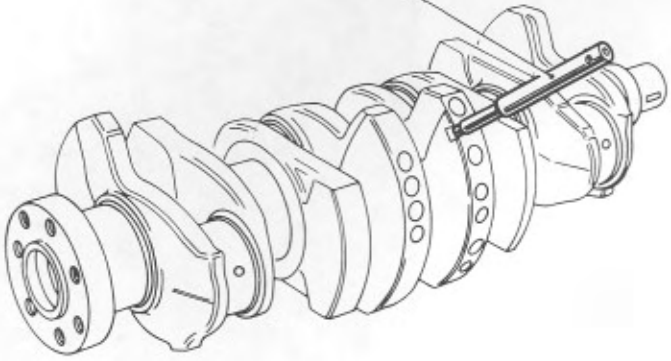
Step 2

- Mount locking Sector Mot. 582 and loosen the crankshaft pulley bolt.
- Remove Locking Sector Mot. 582.

Step 3

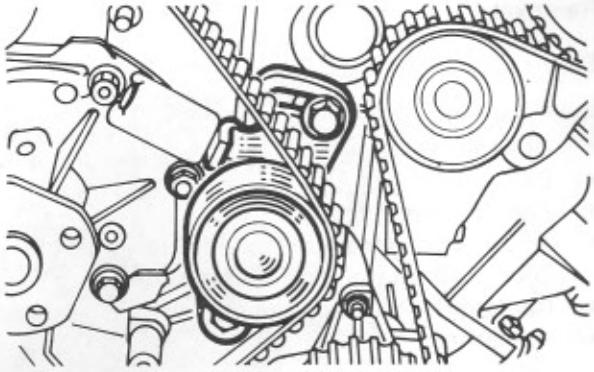
- Rotate the crankshaft until T.D.C. Rod Mot. 861 slips into position (take care not to let the rod enter one of the balancing holes in the web). Check that the crankshaft cannot turn one way or the other.





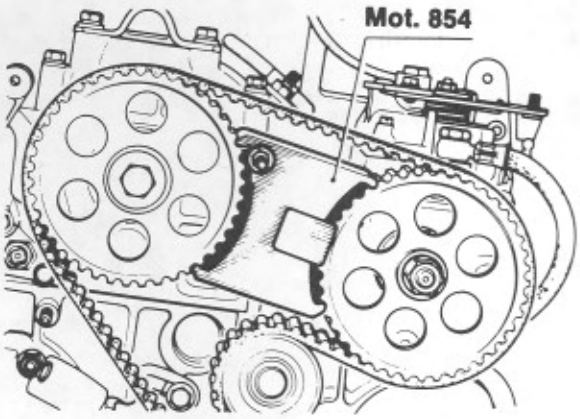
TIMING BELT CHANGING (CONT.)

Step 4
Remove:
- The timing belt cover.
- Loosen the tensioner and tilt it to slacken the timing belt. Retighten the tensioner in the slack belt position.



Step 5
- Put Locking Plate Mot. 854 between the camshaft and injection pump sprockets to prevent any out-of-phase movement.

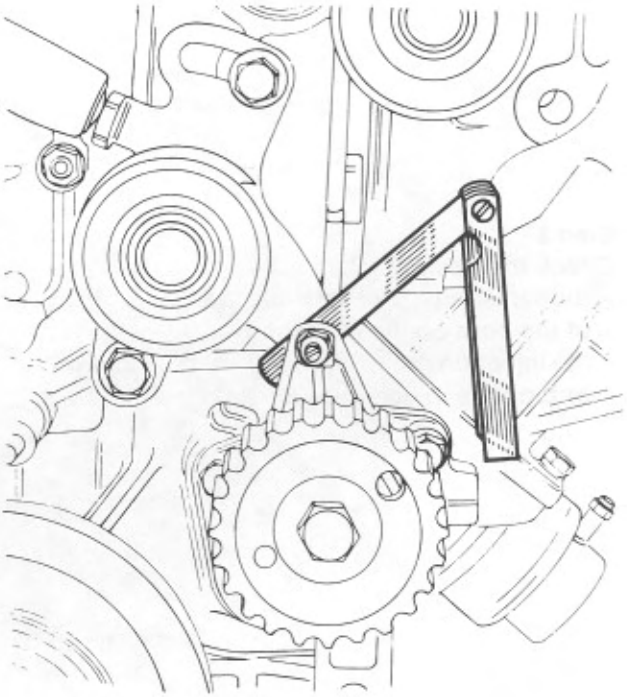
IMPORTANT
The timing belt must be changed at once if it becomes stained with oil.



Step 6
- Mark direction of travel on the belt if it is to be reused.

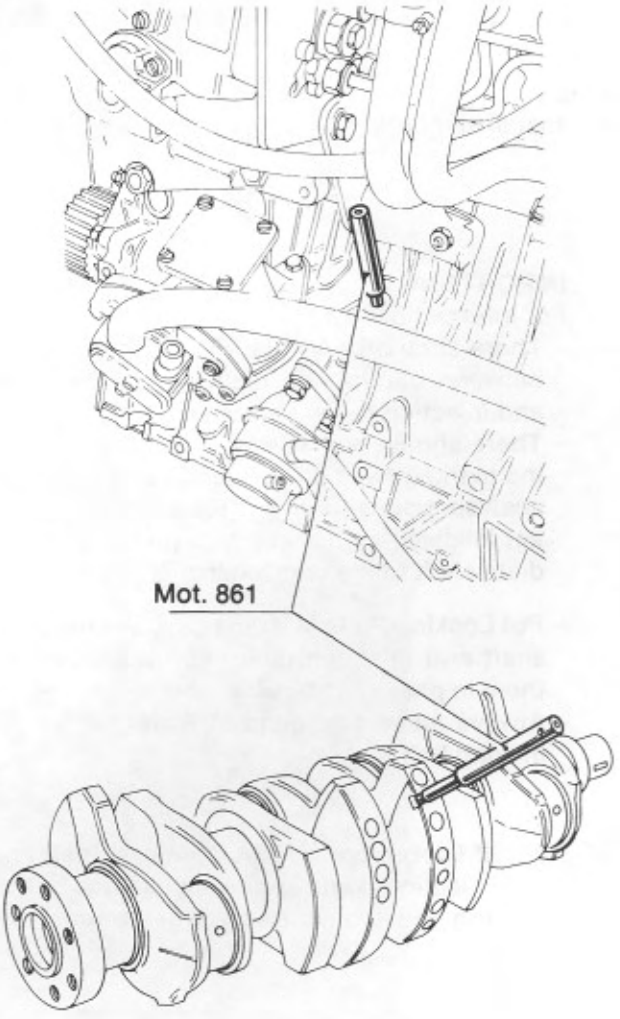
Step 7
Remove:
- The crankshaft pulley
- And timing belt.

INSTALL TIMING BELT



Step 1

- Check the clearance between the tensioner pulley support and adjusting screw (A). A shim 0.1 mm (.004") thick should just bite; tighten the locknut.



Step 2

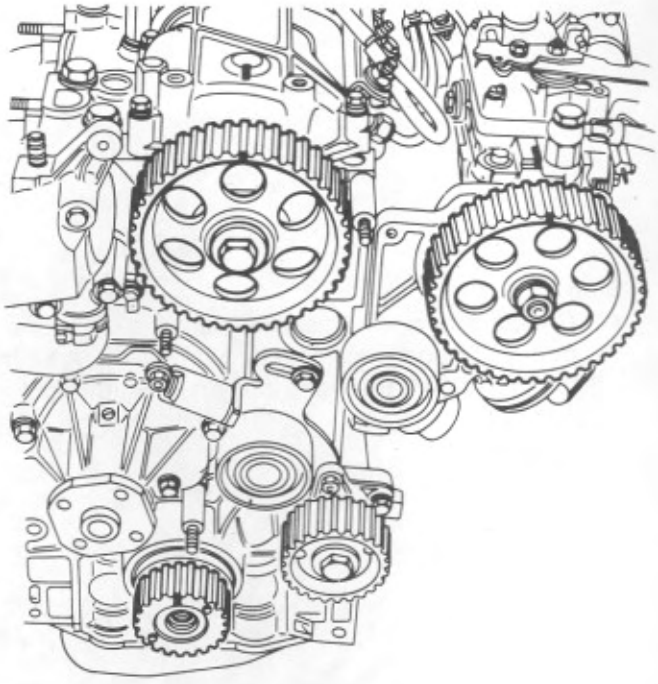
Valve Timing
Check the position:

- of the crankshaft. T.D.C. Mot. 861 should be inserted in its hole in the crankshaft web (take care not to let the rod enter one of the balancing holes). Check that the crankshaft cannot turn one way or the other. Slight movement will mean that the rod has entered a balancing hole.

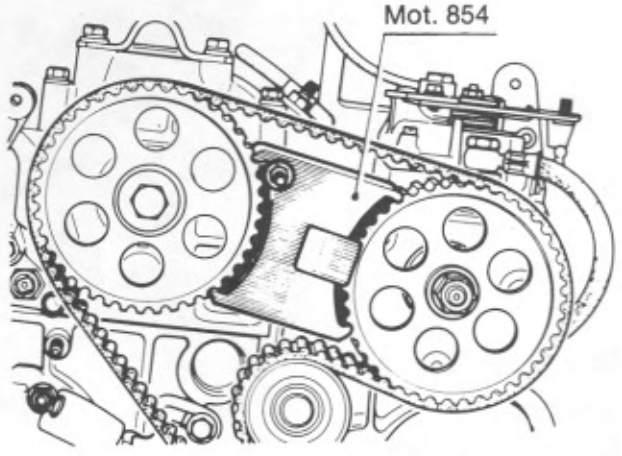
For information:

- balancing holes in the web are drilled 12 mm dia.
- the diameter of the T.D.C. rod is 8 mm.

INSTALL TIMING BELT (CONT.)

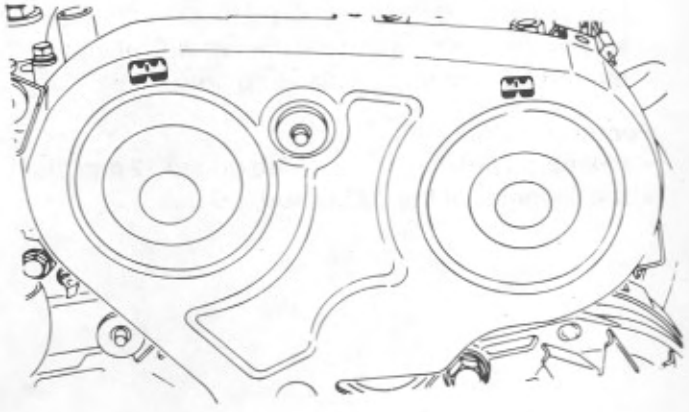


Step 3
Check the position of:
- the camshaft: sprocket mark in line with the center of the boss on the rocker cover
- the injection pump: sprocket mark in line with the web on the injection pump boss.



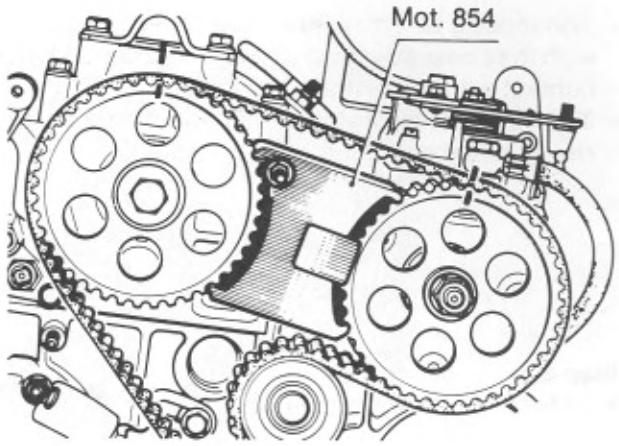
Step 4
- Install air conditioning belt if equipped.

IMPORTANT
For information:
- There should be a total of 20 tooth troughs between the marked teeth on the camshaft and injection pump sprockets.
- There should be 100 tooth troughs between the marked teeth on the camshaft and crankshaft sprockets starting at the camshaft sprocket followed by the injection pump, intermediate shaft to the crankshaft.
- Put Locking Plate Mot. 854 between the camshaft and injection pump sprockets to hold them in phase.
- Always mark directions of travel before removing belt.



NOTE: It is possible to check the camshaft and injection pump sprocket positions by fitting the timing belt cover temporarily.

INSTALL TIMING BELT (CONT.)

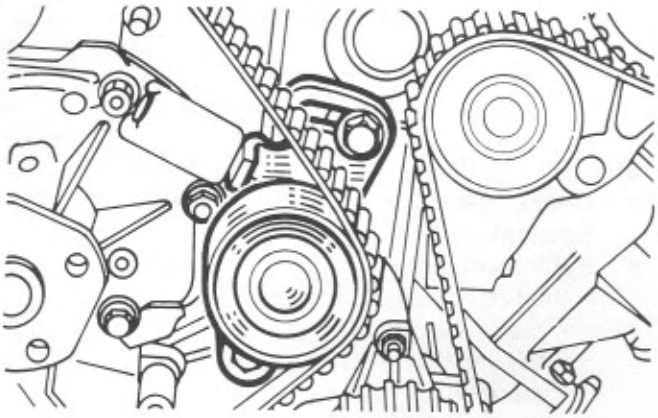


Step 5

- Mount the timing belt.
- Remove Locking Plate Mot. 854
- Check that the timing belt is well tensioned all round between the camshaft, injection pump, intermediate shaft, and crankshaft sprockets so that no possible tooth jumping can occur when the belt is tensioned by the tensioner pulley.

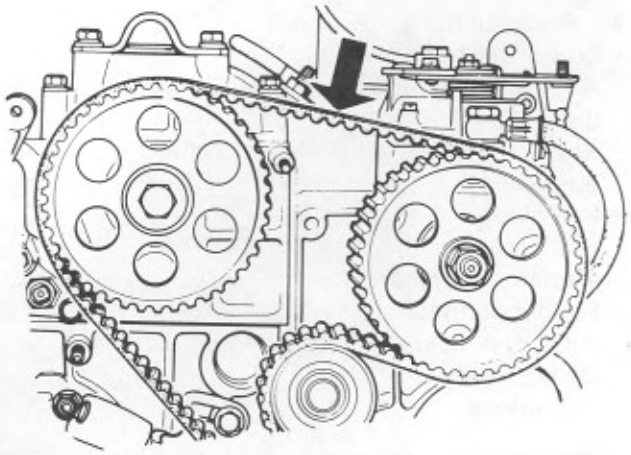
Step 6

- Loosen the tensioner mounting bolts one quarter of a turn, it will then automatically adopt is correct running position in contact with the belt under the effect of its spring.



- Remove T.D.C. Mot. 861
- Mount the crankshaft pulley without tightening the bolt.
- Adjust timing belt tension.
- Follow the instructions below carefully when adjusting drive belt tension
- Stand in front of the engine and turn the crankshaft pulley nut so that the engine completes two whole turns in a clockwise direction (direction of normal running).
- Never turn the engine counter-clock-wise. Loosen the tensioner bolts one quarter of a turn then retighten.

Step 7



- Check timing belt tension with Tool Ele. 346-02. The amount of deflection should be 5-7 mm (3/16" to 9/32") when the tool shoulder is flush with the plunger body (see Drive Belt Tensioning Section).
- New auto air belt tension should have a deflection of 3mm (1/8"). Run approximately 15-20 minutes and retighten to 4mm (5/32") of deflection.

IMPORTANT

It is important that the timing belt is correctly tensioned to give it a long service life and ensure correct camshaft drive:

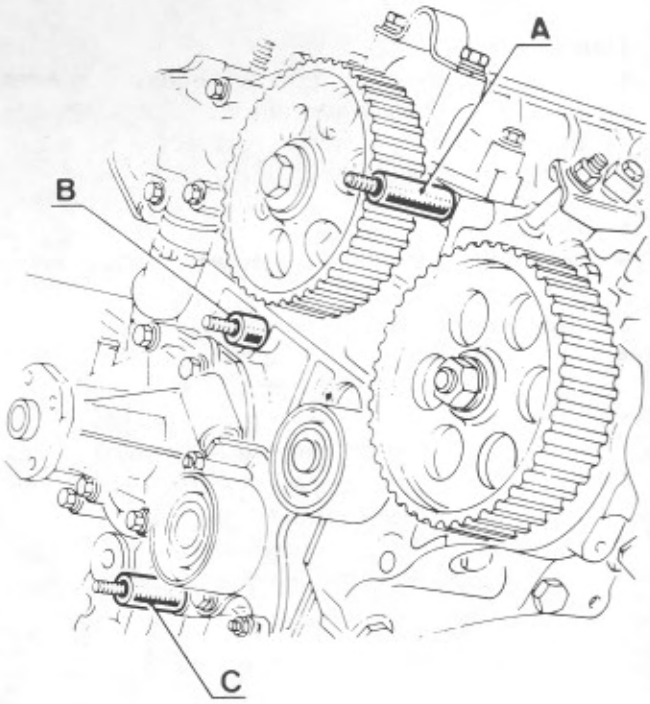
- Too loose a belt may lead to jumping 1 or 2 teeth with the consequent risk of the valves coming into contact with the pistons.
- Too tight a belt will increase wear rapidly and give rise to noisy operation.

Step 8

- Mount crankshaft pulley.

Tighten

Tightening Torque:	
Crankshaft pulley bolt:	12 to 13.5 daNm
Using Tool Mot. 582	(90 to 100 lb./ft.)



Step 9

- Check injection pump timing (see Pump Timing Section)
- Put in position:
  - the timing cover distance pieces:
    - the longest at A
    - the shortest at B
    - the medium at C
- The timing belt cover

Step 10

- Reinstall the following:

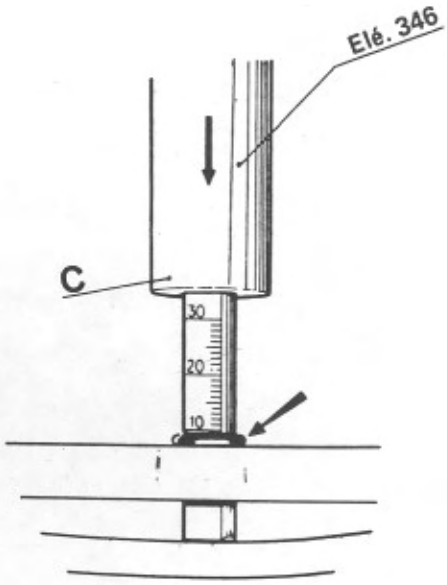
- Lower flywheel cover
- Alternator - fan belt (See Belt Tensioning Procedure - C5-1)
- Power steering belt (See Belt Tensioning Procedure C5-1)
- Fan blade
- Radiator
- Radiator coolant hoses
- Fender connecting brace
- A/C condenser and fans (if equipped)
- Belly shield
- Nosepiece

- Refill cooling system and bleed (See Cooling System Section)

BELT TENSIONING PROCEDURE

The tightener must always be slack when mounting a drive belt; this prevents strain on the pulleys and belt itself.

Checking Method
Check that the underside of the rubber ring is opposite the zero graduation on the plunger.
Lay the bar along the drive belt with the tool plunger an equal distance between the pulley centers.
Press the sliding portion of the plunger until shoulder (C) is flush with the plunger body.
Remove the tool and read off the value of the deflection on the underside of the rubber ring.



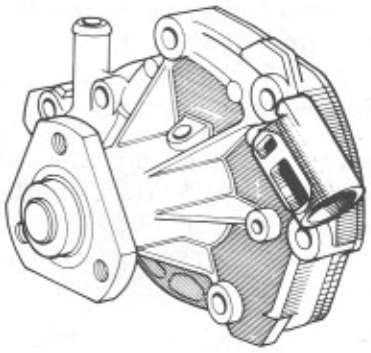
Timing Belt
See Section C4-5: Timing Belt Installation, Step 7

Water Pump Drive Belt (Alternator)
Measure deflection (F) on the taut side between the water pump pulley and alternator pulley.
The amount of deflection (F) on a new belt or after 10 minutes running should be 4 to 7 mm (5/32 to 9/32")

Power Steering Pump Drive Belt
Measure deflection (F) on the taut side between the crankshaft pulley and power steering pump pulley.
The amount of deflection (F) on a new belt or after 10 minutes running should be 4 to 7 mm (5/32 to 9/32").

Auto Air Drive Belt
Measure deflection (F) on the taut side between the crankshaft pulley and auto air pulley. The amount of deflection (F) on a new belt should be 3mm (1/8").
The amount of deflection after 10 minutes of running should be 4 mm (5/32").

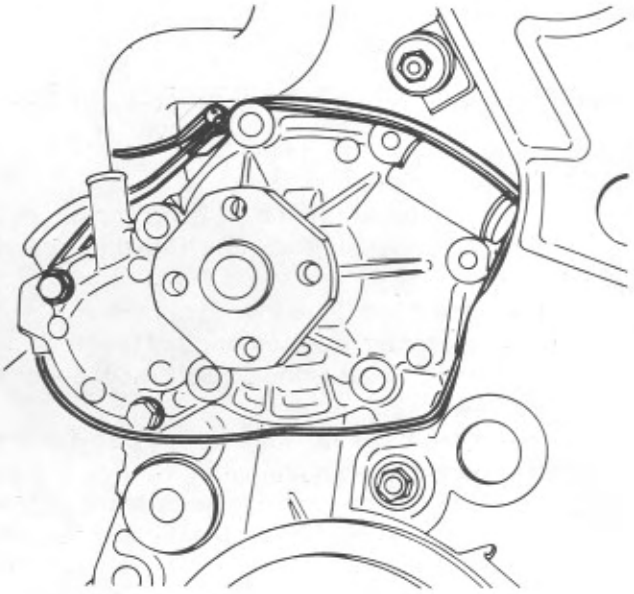
ENGINE WATER PUMP



IMPORTANT
The water pump cannot be repaired. Change the unit if any part is worn.

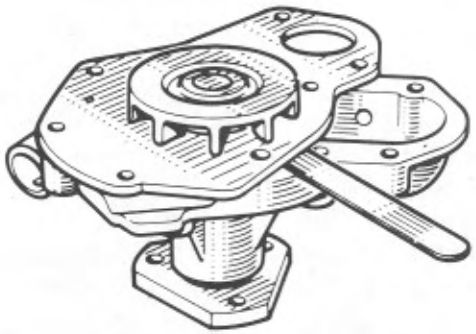
Removal
The timing belt tensioner need not be removed:

- Using a long hose clamp as shown, retain the timing belt tensioner plunger in position and prevent spring from flying out.
- Remove the water pump



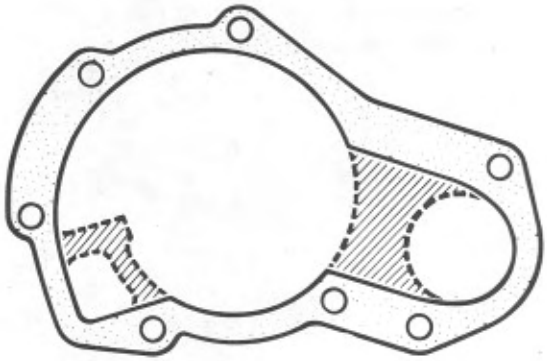
Changing the gasket between the water pump and plate.

- Hold the water pump body in a vice and unstick the plate.
- Clean the joint faces by moving the plate around the pump shaft out of the way.
- Select the gasket which fits between the water pump and cylinder block and make the cut-outs shown in the sketch so that the gasket will slip between the water pump body and the plate



NOTE: Special points concerning refitting:

- Clean all joint faces before fitting new dry gaskets.
- Retain the timing belt tensioner plunger in position as before when refitting the pump.



Installation

- Mount the water pump to the cylinder block followed by the coolant hoses to the pump.
- Fill and bleed the cooling circuit - see Cooling System Section.

WATER PUMP FAN/HUB DECLUTCHING MODIFICATION

This type of engine may be equipped with one of two styles of fan drive configurations:
a) "direct-drive" solid hub and
b) electric de-clutching fan hub.

The type of hub equipped on the engine can be identified by counting the number of bolts at the fan hub. Four bolts fastening the fan indicates a solid hub. Six bolts (3 retaining the fan blade) indicates a clutch type fan hub.

NOTE: The clutch type fan hub will "free-wheel".

Should a "direct-drive" type hub be considered more desirable to the clutch type, the following procedure may be performed.

Fan Hub Modification Procedure - (Clutch Type only)

1. Remove fan blade.
2. Remove the three (3) socket head cap screws (5mm hex) and their jamb nuts from the front of the fan.
3. Discard the three (3) hex jamb nuts.
4. Apply a thread adhesive compound (Loctite® or equivalent) to each of the three (3) socket head cap screws.
5. Reinsert the three (3) socket head cap screws into original holes and tighten.
6. Torque the socket head cap screws to 5 daNm (3.68 ft.lbs.) Do not over-torque these screws as it will break the assembly.
7. Detach the wire spring clip retaining the carbon contact assembly: remove the wire assembly, the spring, the carbon contact, and the insulated barrel. Cut the tan wire close to its connection with the main harness, near the wiper motor. Wrap the end of the clipped tan wire with electrical tape to avoid a short circuit. Discard these components.
8. Turn on the ignition switch and inspect to assure that all accessories operate properly.
9. Reinstall the grille and front panel (if so required).

NOTE: Upon removal of the wire and carbon contact, be certain that the tan wire has been insulated. See Step 7.

SECTION "D"

DIESEL ENGINE INJECTION EQUIPMENT

This section covers the injection systems on both the J8S-232 naturally aspirated and J8S-234 turbo-charged diesel engines. The systems are very similar with a few exceptions which are noted as follows:

(N/A) = J8S-232 Naturally Aspirated
(Turbo) = J8S-234 Turbo Charged

Subsection 1 - Injection Pump

D1-1 Specifications, Torques, and Special Tools
D1-4 Remove and Replace
D1-10 Injection Pump Timing
D1-12 Bleeding the Fuel Circuit
D1-13 Cold Start Device
D1-17 Solenoid Stop Valve
D1-18 Throttle Cable

Subsection 2 - Injectors and Filters

D2-1 Injectors
D2-2 Testing
D2-4 Fuel Filter

Subsection 3 - Checking and Problem Solving

D3-1 Fuel Circuit Checking
D3-2 Problem Diagnosing

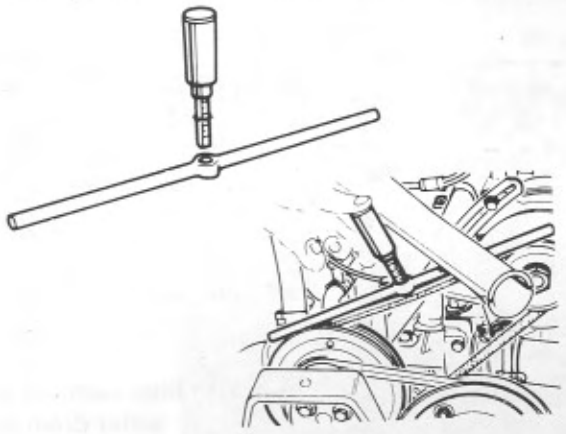
INJECTION EQUIPMENT SPECIFICATIONS

Description	Make and Type	Special Features
Injection pump	BOSCH VE 4/9F2100 R 41 (N/A) VE-R-130 (Turbo)	Single piston rotary pump, mechanical centrifugal governor, automatic hydraulic advance, automatic cold start device and solenoid stop valve.
Injector holders	BOSCH KBE 48S 5/4	
Injectors	BOSCH DNOSD 189	Calibrated at 130 bars + 8 (1850 psi) 0
Fuel filter	BOSCH	quick-fit filter element with water drain plug
H.P. Fuel Pipes		6 mm outside diameter 2 mm bore Length: 290 mm (N/A) 275 mm (Turbo)

TIGHTENING TORQUES

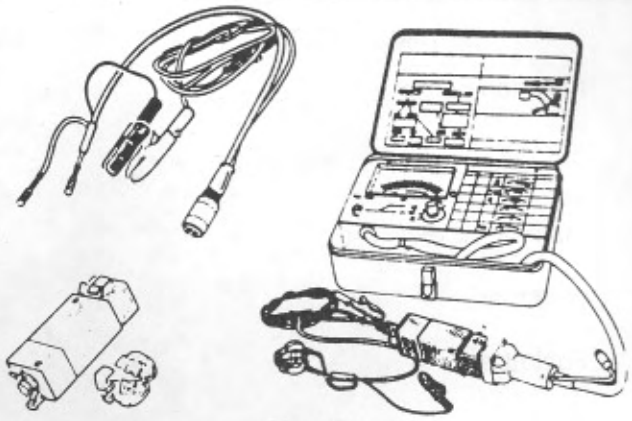
Pump sprocket nut:	5 daNm (37 lb./ft.)
Injector clamp nuts:	1.7 daNm (12 1/2 lb./ft.)
Injector nut:	6 to 9 daNm (45 to 67 lb./ft.)
Solenoid stop valve:	1.5 to 2.5 daNm (11 to 18 lb./ft.)
Access bolt for pump timing:	0.8 to 1 daNm (6 to 7 1/2 lb./ft.)
Fuel feed and return unions:	2 to 2.5 daNm (15 to 18 lb./ft.)
Fuel return pipe unions:	2 to 2.5 daNm (15 to 18 lb./ft.)

SPECIAL TOOLS



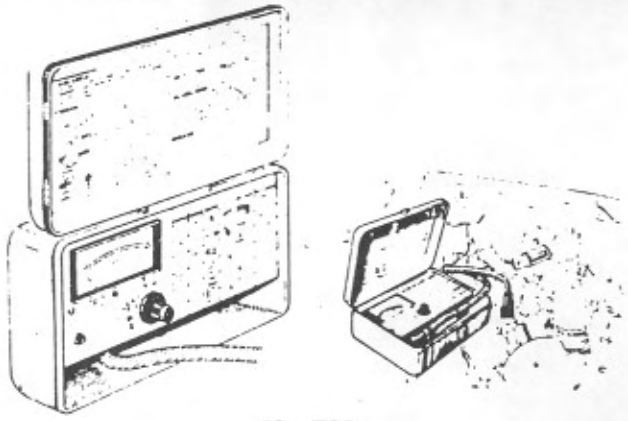
Ele. 346

Drive belt tensioning tool
Order Tool No. 700000-34-600 EA



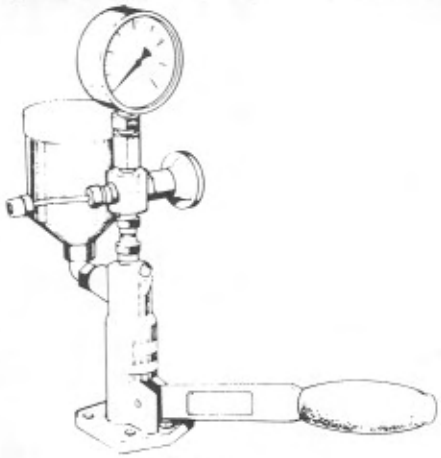
Ms. 881

Diesel tachometer
use with M5760
Order Tool No. 700000-88-100 EA



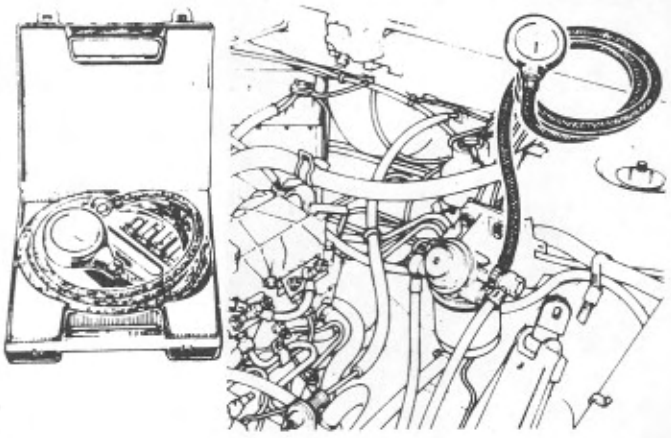
Ms. 760

Engine tuning instrument, initial advance, dwell,
contact points resistance with tachometer
Order Tool No. 700000-76-000 EA



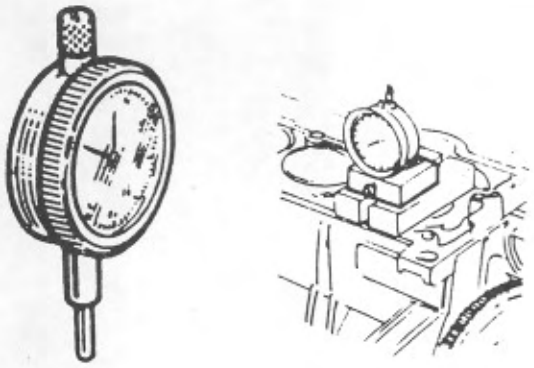
(Optional)

Injector nozzle tester (Bosch)
Order Tool No. 706812-00-502 EA



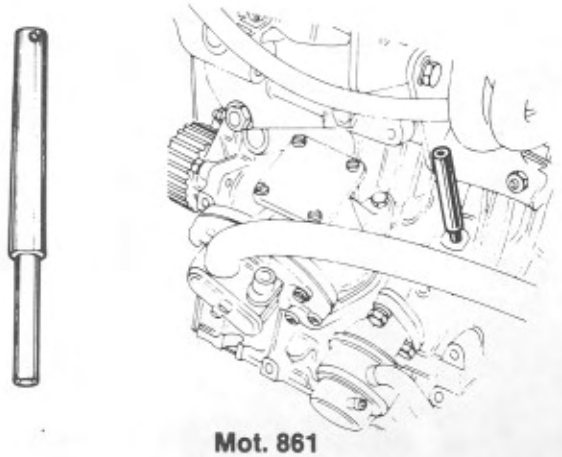
Mot. 867

Diesel fuel pressure testing kit
Order Tool No. 700000-86-700 EA



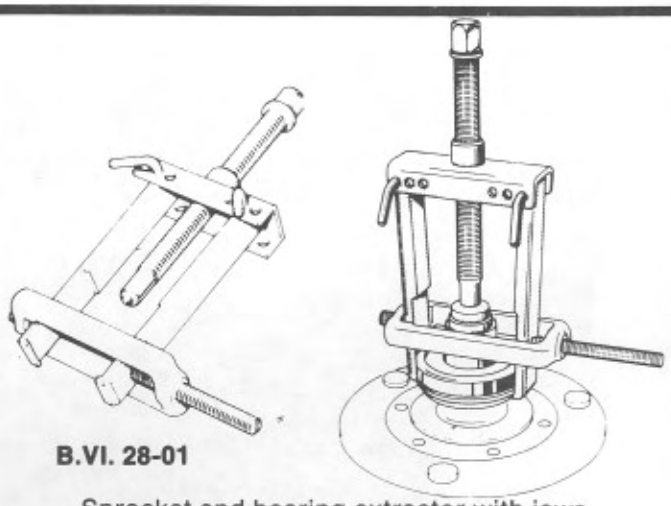
Dial indicator
Order Tool No. 72046E-B0-000 EA

SPECIAL TOOLS (CONT.)



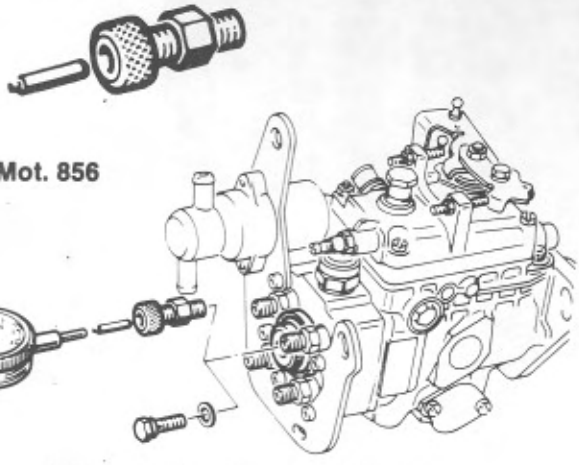
Mot. 861

TDC indicator rod
Order Tool No. 700000-86-100 EA



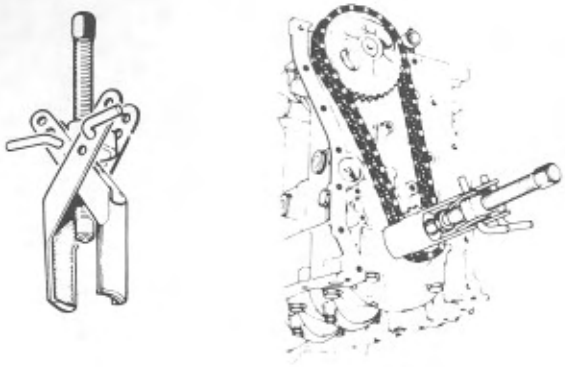
B.VI. 28-01

Sprocket and bearing extractor with jaws
146mm long
Order Tool No. 700000-27-301 EA



Mot. 856

Dial indicator adapter for timing
Bosch injection pump
Order Tool No. 700000-85-600 EA

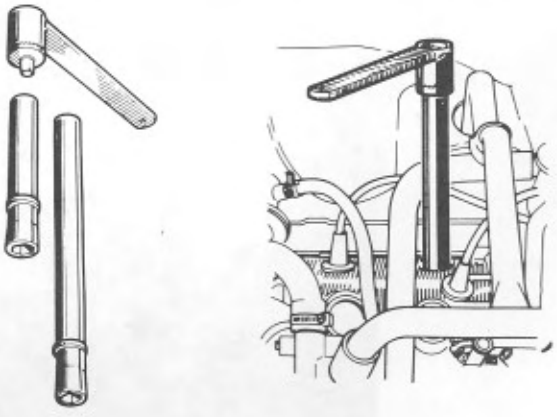


Sprocket and bearing extractor
Order Tool No. Mot. 49 EA



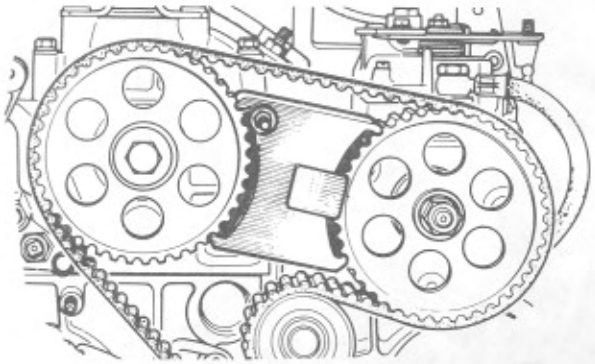
Mot. 869

Injector holder socket use with Ele. 721
Order Tool No. 700000-86-900 EA



Ele. 721

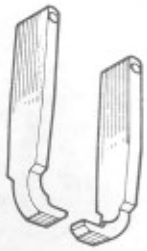
Limited torque spark plug wrench
Order Tool No. 700000-72-100 EA



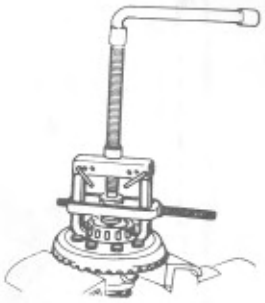
Mot. 854

Camshaft/Injection Pump Sprocket Locking Plate

Order Tool No. 700000-85-400 EA



B. VI. 48



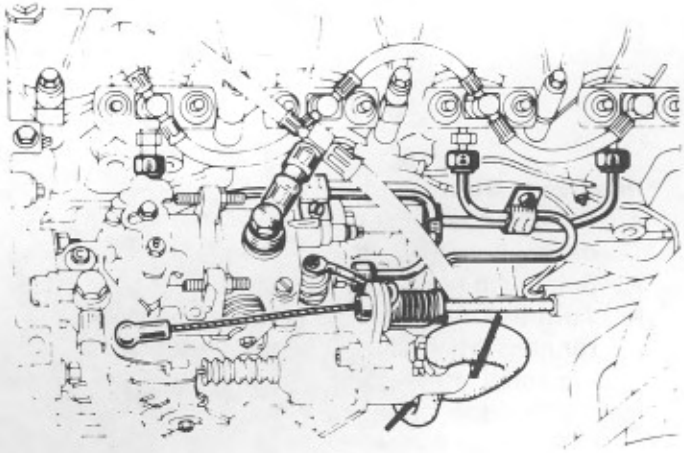
Set of two jaws with large tips for extracting sprockets. Use with Tool B.Vi. 28-01.

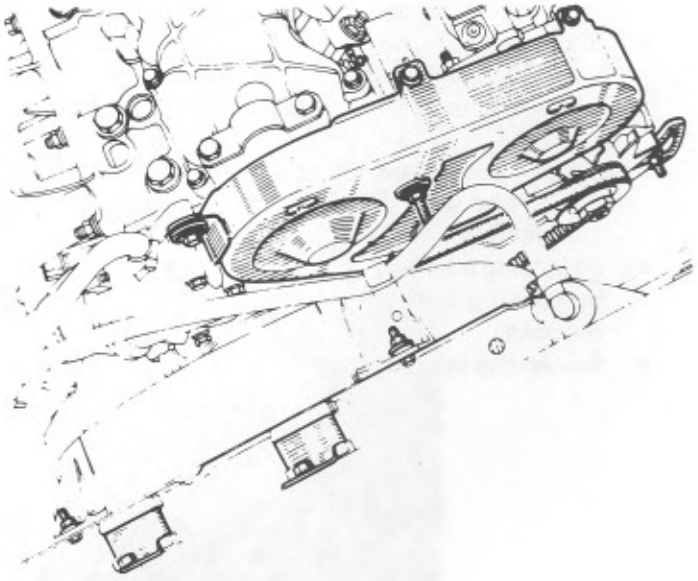
Order Tool No. 700013-30-300 Set

INJECTION PUMP R & R
REMOVE AND REPLACE

Remove or disconnect

- Removing the pump:
  - disconnect battery
  - clamp the inlet and outlet hose for the cold start thermostat using clamps Mot. 453-01 then disconnect the hoses.
- Disconnect the throttle control and stop valve wire.
- Disconnect the fuel inlet and return pipes on the pump.
- Remove the fuel return pipes.
- Loosen the alternator drive belt and remove it from the pulley.



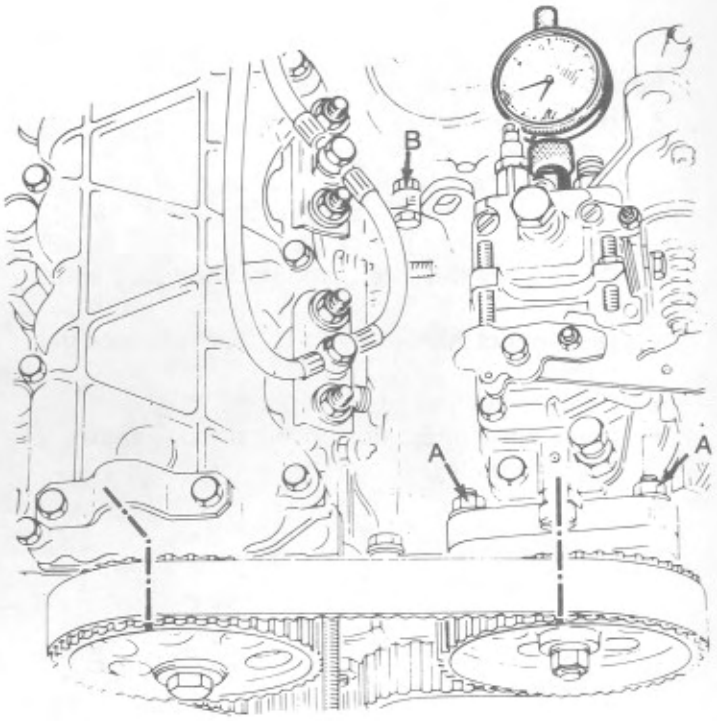


- Remove in order:
  - radiator top bolts
  - fan shroud bolts; tilt the radiator and remove the shroud (if equipped)
  - and the timing belt cover bolts.
- Remove the timing belt cover by moving the fan to allow the blades to be cleared.

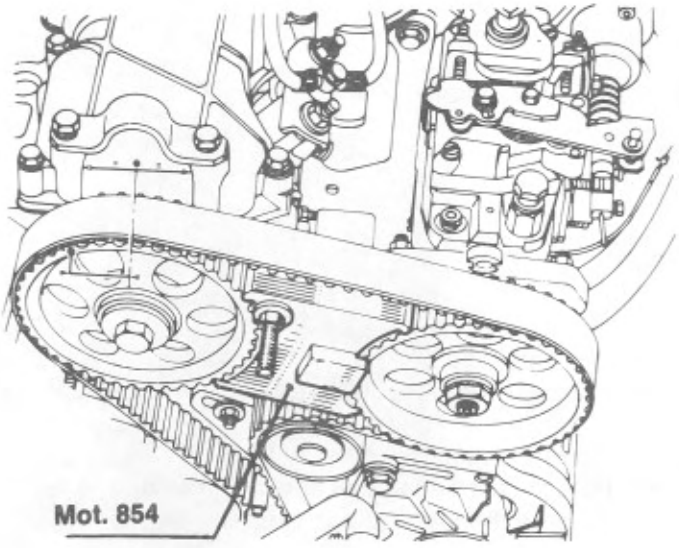
INJECTION PUMP
REMOVE AND REPLACE

Remove or Disconnect

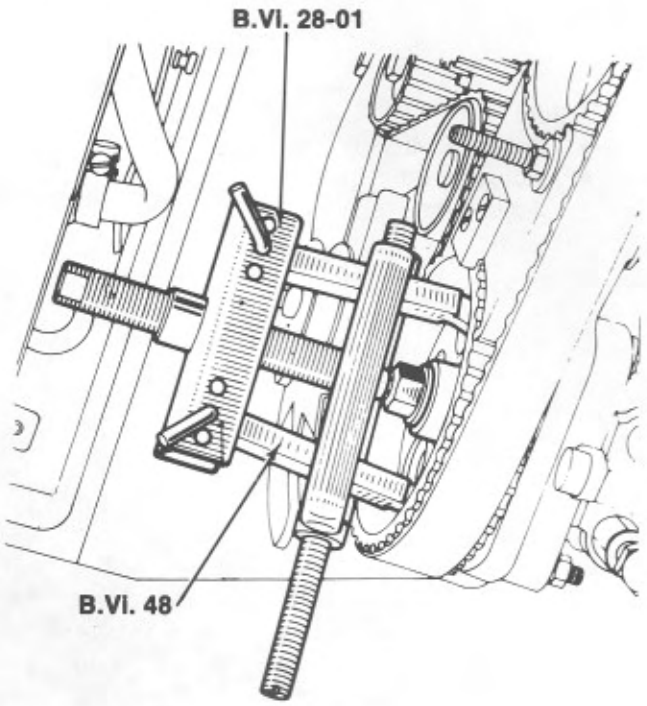
- Remove the spacer followed by the small half-casing behind the pump sprocket.
- Select 4th speed, jack up the L.H. front wheel.
- Turn the roadwheel in the normal direction of running to bring No. 1 cylinder piston on "T.D.C. - injection stroke".
- **Tighten the three front bolts at point A first followed by the two bolts at point B.**



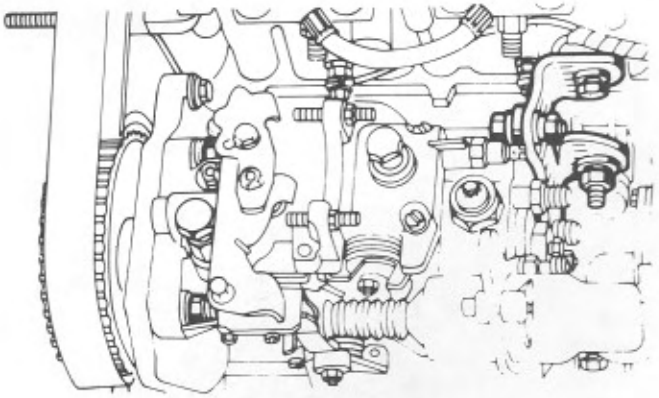
- In this position, check:
  - that the camshaft sprocket timing mark is in line with the center of the boss on the rocker cover.
  - that the injection pump sprocket timing mark is in line with the center of the boss on the injection pump.
- Fit locking plate Mot. 854 between the 2 sprockets by rocking the crankshaft slightly in both directions.
- Fasten the locking plate.



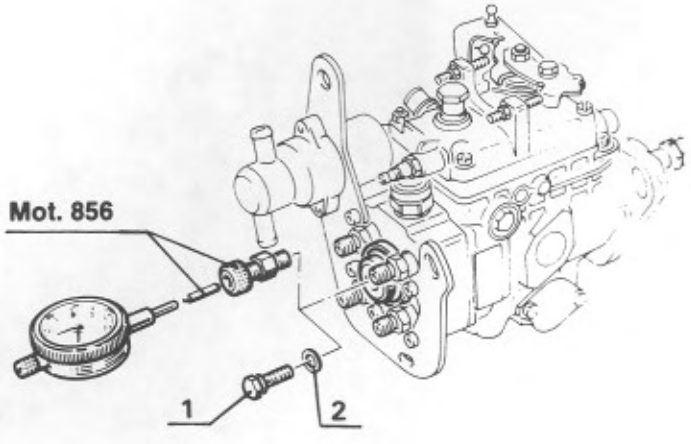
INJECTION PUMP
REMOVE AND REPLACE



- Loosen the nut on the end of the pump drive shaft ONLY as far as the end of the thread. Place sprocket extractor B.Vi. 28-01 and jaws B.Vi. 48 with short screw to the pump sprocket. Never set up the jaws over the outside of the teeth, grip behind the aperatures.
- Draw the sprocket away from the taper, remove the extractor, unscrew the nut and remove the washer.



- Remove the pump rear mounting:
- Remove the pump fixing nuts and washers.
- Lift out the injection pump and remove the key in the drive shaft taper.



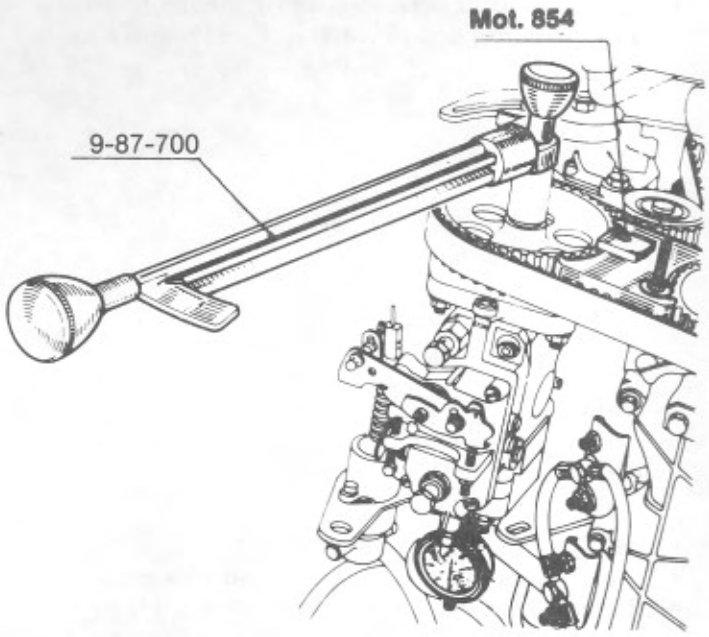
Reassembling the injection pump:

- Remove bolt (1) and washer (2) from the delivery head.
- **Screw the special dial indicator gauge holder Mot. 856 in place of the bolt and attach the dial indicator and stem to it, making sure to preload the dial indicator to read at least 3 mm.**
- Screw a locknut and nut onto the drive shaft.
- Leave some thread visible behind the locknut.
- Tighten the locknut against the nut.

INJECTION PUMP
REMOVE AND REPLACE

Adjust

- Set pump timing (see Timing Sub Section)
- Adjust cold capsule (see Cold Start Capsule Adjust, page D1-15)



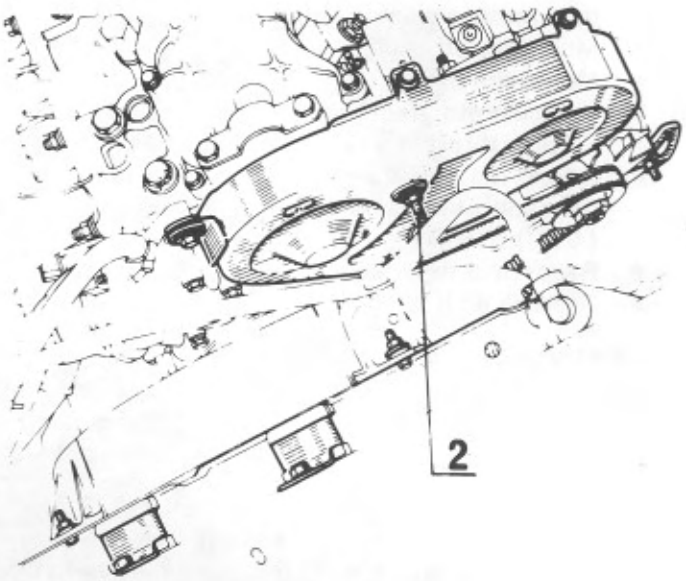
Install or Connect

- Mount the injection pump to the engine so that the key is in line with its slot in the sprocket.
- Once the pump is in position, mount the washers and nuts to the mounting flange; do not tighten the nuts at this stage.
- Mount the sprocket washer and nut and apply the recommended torque using a torque wrench.
- Remove sprocket locking plate Mot. 854.

Torque

Sprocket retaining nut 5 daNm (37 lb./ft.)

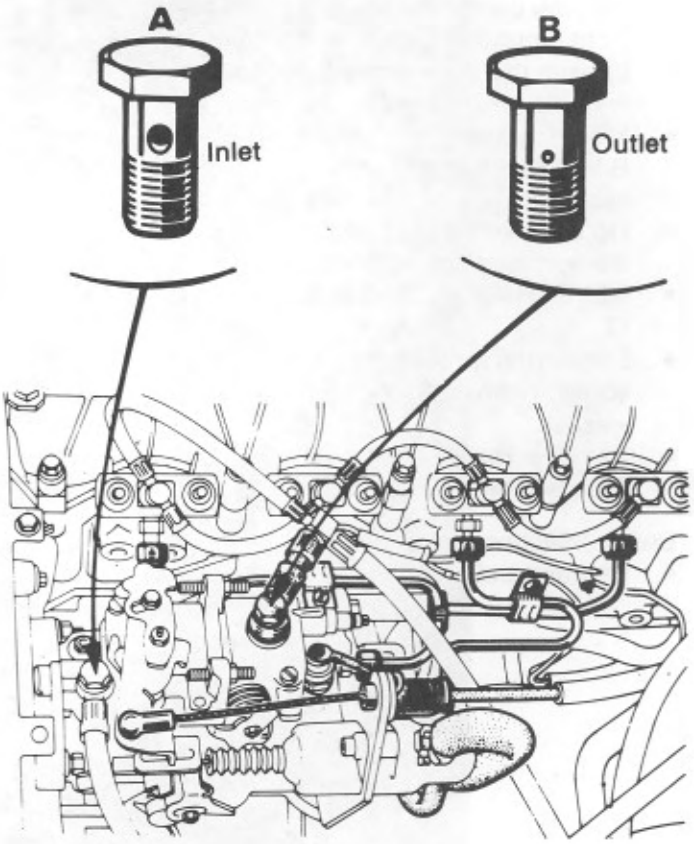
INJECTION PUMP
REMOVE AND REPLACE

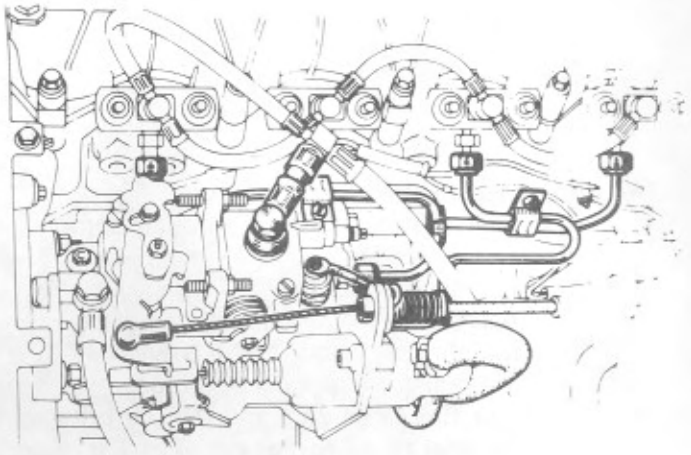


- Reassemble in the following order:
  - the small cover plate behind the pump sprocket
  - spacer for bolt (2)
  - timing belt cover; fasten it
  - alternator drive belt; tighten it
  - radiator shroud; fasten it
  - and the radiator and top mountings.
- Clean the fuel lines and operate the priming pump several times to get rid of any foreign matter.
- Reconnect the fuel inlet and fuel return pipes.

CAUTION

Do not mix the fuel inlet and return pipe unions:
A - Fuel inlet (2 x 4 mm dia. holes)
B - Fuel return to tank (1 calibrated hole + 1 filter) Reassemble the fuel return pipes but do not tighten the unions at the injector ends at this stage.



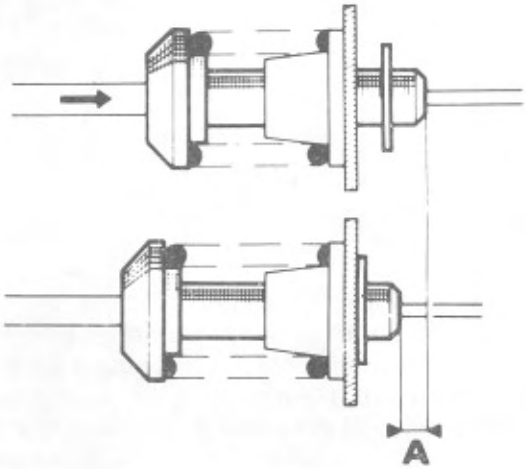


- Place the coolant hoses to the thermostat housing then remove clamps Mot. 453.
- Mount the solenoid stop valve wire.
- Mount the throttle cable and adjust it.
  - Accelerator pedal pressed to floor.
  - Pump throttle level against max. delivery stop.
- Adjust the cable sleeve stop so that the compensating spring is compressed about 2 mm (.078") (Dimension A).
- Reconnect the battery
- Then bleed the fuel circuit.

REMOVING AN INJECTION PUMP

We have found on examining returned injection pumps that some drive spindles appear to be badly marked which leads us to believe that a hammer has been used to remove the drive sprocket.

The above method which is quite unnecessary damages the inside of the pump and makes overhaul considerably more expensive.



REMINDER OF REMOVAL METHOD

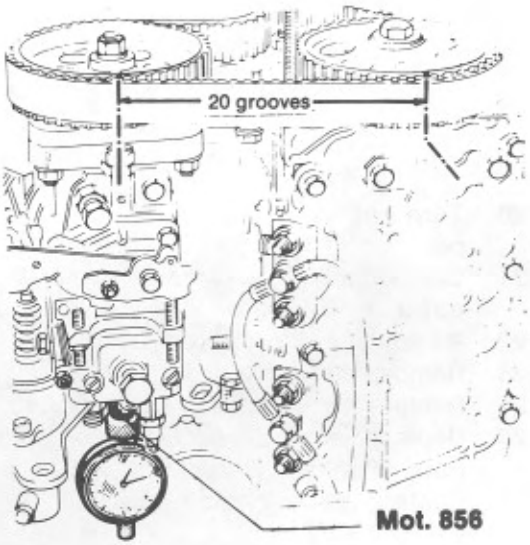
- Remove pump rear bracket (1) and unscrew the front mounting nuts by a thread or two.
- Loosen the drive spindle nut so that it is flush with the end of the spindle thread.
- Mount sprocket extractor B.Vi. 28-01 and Jaws B.Vi. 48 with short screw and jaws to the pump sprocket.
- Do not take the load on the sprocket teeth. Use the sprocket aperatures.
- NEVER HAMMER THE SPROCKET TO LOOSEN IT.
- Loosen the sprocket from the taper by tightening screw, remove the extractor, nut and sprocket washer.
- Remove the pump fixing nuts and washers. Remove the injection pump.

Bosch Injection Pump:

- Remove and retain the key in the spindle taper.

INJECTION PUMP

TIMING

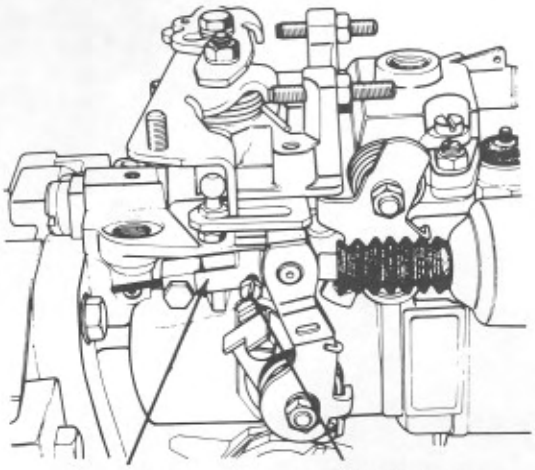


Mot. 856

IMPORTANT

- Check the timing marks when in the above position:
  - Camshaft: Sprocket timing mark in line with center of boss on rocker cover.
  - Injection Pump: Sprocket timing mark in line with center of boss on injection pump.

NOTE: Always replace belt to maintain original direction of travel.

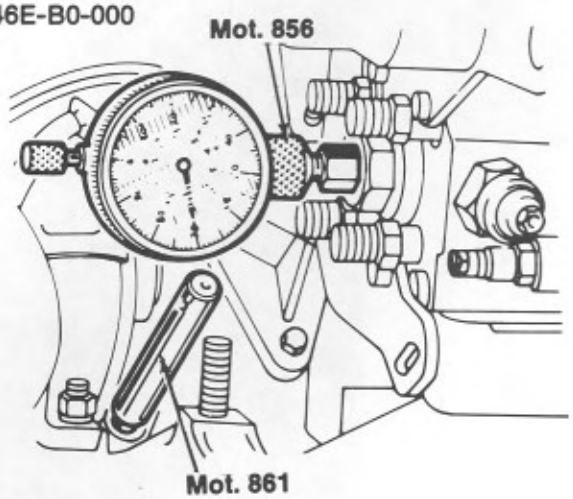

Cold Start Clevis

Tightening Screw

ADJUST

Step 1. Engine cold 2-3 hours.
Step 2. Cancel cold start clevis
Step 3. Remove fuel solenoid wire.
Step 4. Bleed pump pressure - turn engine over 4-6 seconds.
Step 5. Find TDC, install TDC pin, Mot. 861.
Step 6. Check for TDC in cover windows.
Step 7. Mark bottom of crankshaft pulley.
Step 8. Remove top two lines from rear of injection pump.
Step 9. Remove bolt and washer from rear of pump.
Step 10. Insert adapter Mot. 856 and dial indicator into pump.
Step 11. Pre-load dial at least 3 mm.
Step 12. Remove TDC pin.
Step 13. Turn engine over 1 3/4 turns to find BDC.
Step 14. "O" dial
Step 15. Turn engine 1/4 turn to TDC and insert TDC pin.
Step 16. Check for TDC in belt cover window.
Step 17. Adjust pump to:.95 mm (N.A.) - .70 mm (turbo) indicator on dial.
Step 18. Tighten pump bolts - front 3 first.
Step 19. Remove TDC pin.

72046E-B0-000



Step 20. Turn engine 2 revolutions to TDC with pin.
Step 21. Check dial for correct reading on N.A. or turbo.
Step 22. Re-adjust pump if necessary.
Step 23. Remove dial and adaptor.
Step 24. Replace pump bolt and NEW washer.
Step 25. Replace lines on rear of injection pump.
Step 26. Reposition cold start clevis.
Step 27. Replace fuel solenoid wire.
Step 28. Remove TDC pin.
Step 29. Replace TDC bolt with NEW washer.

INJECTION PUMP

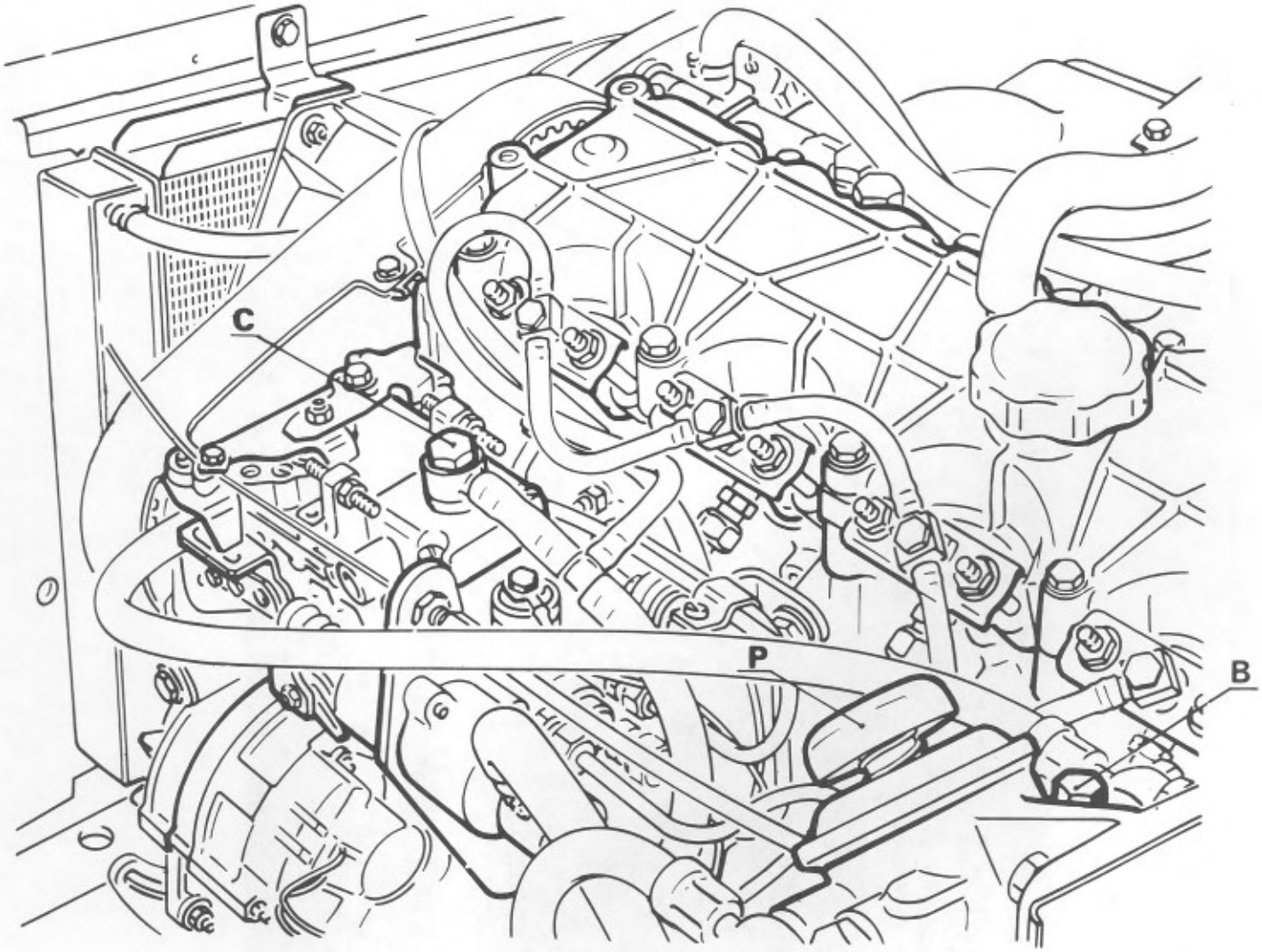
BLEEDING THE FUEL CIRCUIT

Bleeding the fuel circuit:

- Protect the alternator, which is close by, from fuel drops.
- This bleeding operation must be carried out:
  a - after any part of the fuel circuit has been disconnected (for example: after engine removal).
  b - following an air leak in the fuel pump circuit.
  c - or in the event of a breakdown following the tank running dry or after a fuel filter change when it may be necessary to bleed the air to reprime the circuits.

- Proceed as follows:
  - Loosen bleed screw (B) on the fuel filter and screw (C) on the injection pump.
  - Activate the priming pump plunger (P) on the fuel pump until fuel flows out of the screw (B) hole free of air bubbles. Retighten this screw.
  - Continue to activate priming pump plunger (P) until fuel appears from screw (C) hole free of air bubbles. Tighten this screw.
  - Stop pressing priming pump plunger when a resistance is felt.

- If the fuel return pipes have been removed (unions or injectors loose), activate the starter with throttle wide open until fuel spurts out in turn from each end of the fuel return pipes.
- Tighten the fuel return pipe unions at the injector end.
- Switch on the heater plugs and start the engine.
- Check on the heater plugs and start the engine.
- Check that all the fuel feed and return pipe unions on the injection are free from leaks.



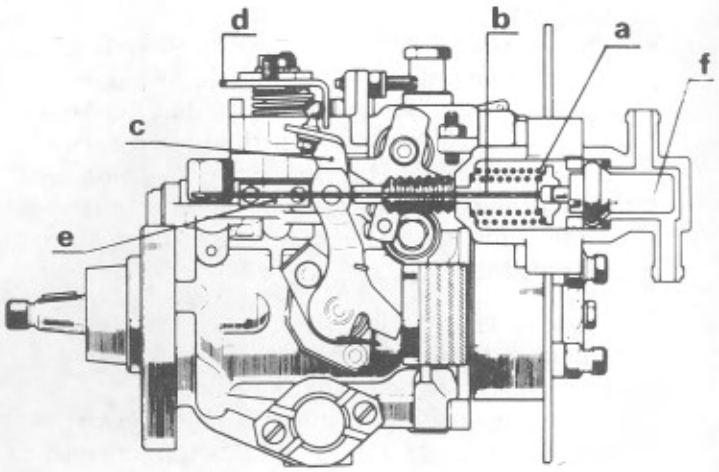
INJECTION PUMP

COLD START DEVICE

HOW THE DEVICE WORKS

Automatic cold start device:
This device fitted on the side of the injection pump is coupled direct to the roller and cam plate. It is controlled by a thermostatic capsule which is subject to engine coolant temperature.
This device is also connected to the throttle lever. When the engine is cold and stationary, springs (a) inside the thermostat body tension cable (b) which moves lever(c) to the "Advance" position as well as moving throttle lever (d) to the "fast idle" position.
As soon as the engine starts, the temperature of the coolant rises, thermostat capsule (f) expands gradually compressing springs (a), cable (b) and control lever (c) move allowing the advance plunger and throttle lever to return to their initial positions.

NOTE: A clevis (e) astride cable (b) enables the cold start device to be placed out of action while the injection pump is being timed on the engine.



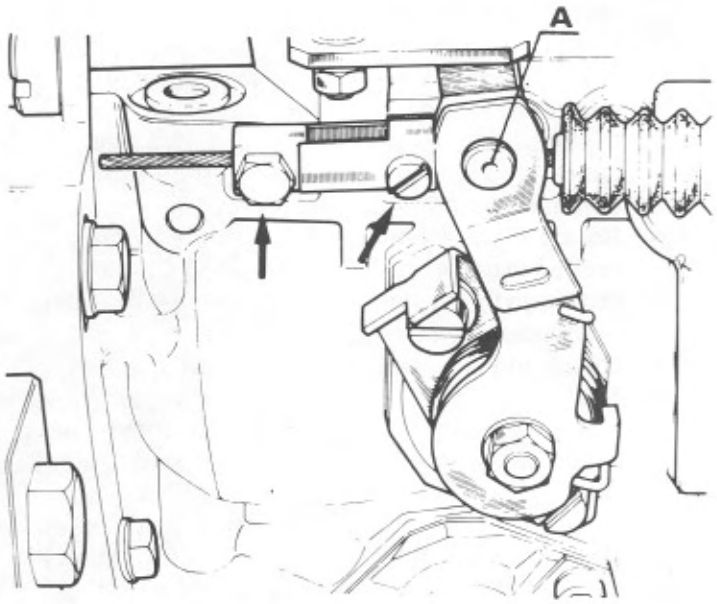
INJECTION PUMP
COLD START DEVICE

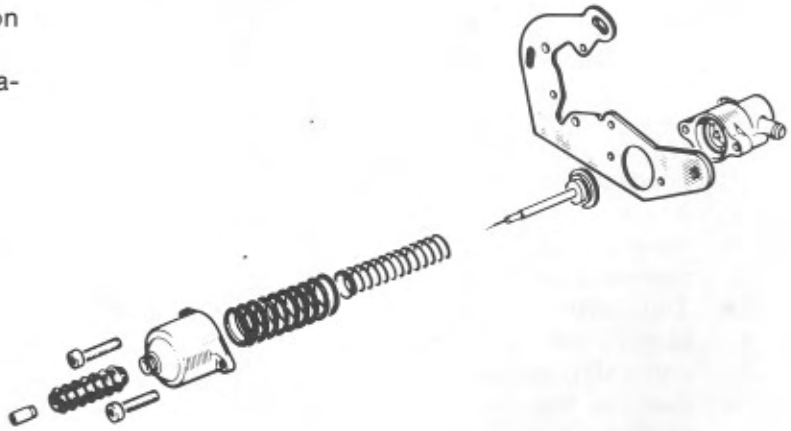
THERMOSTAT CAPSULE

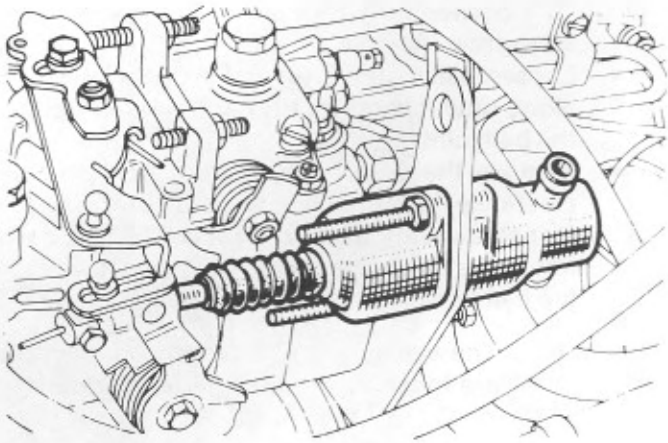
Remove and Replace

Changing the control cable:

- Loosen the screws and remove the cable stop and clevis.
- Withdraw the cable and separate the various components, i.e. springs, rubber bellows, end fitting and cup.
- When re-assembling, put the following in this order over the cable:
  - the cup
  - springs
  - cover
  - and rubber bellows with tip.
- Slip the cable through the hole in trunnion (A), refit the clevis and cable stop with screw just biting.
- Screw the 2 lengths of studding (6 mm dia. x 70 mm long) into the capsule housing.
- Mount the housing to the bracket when assemble both housings by screwing up the nuts on the studding evenly.
- Remove each piece of studding and nut separately and replace the original bolts.







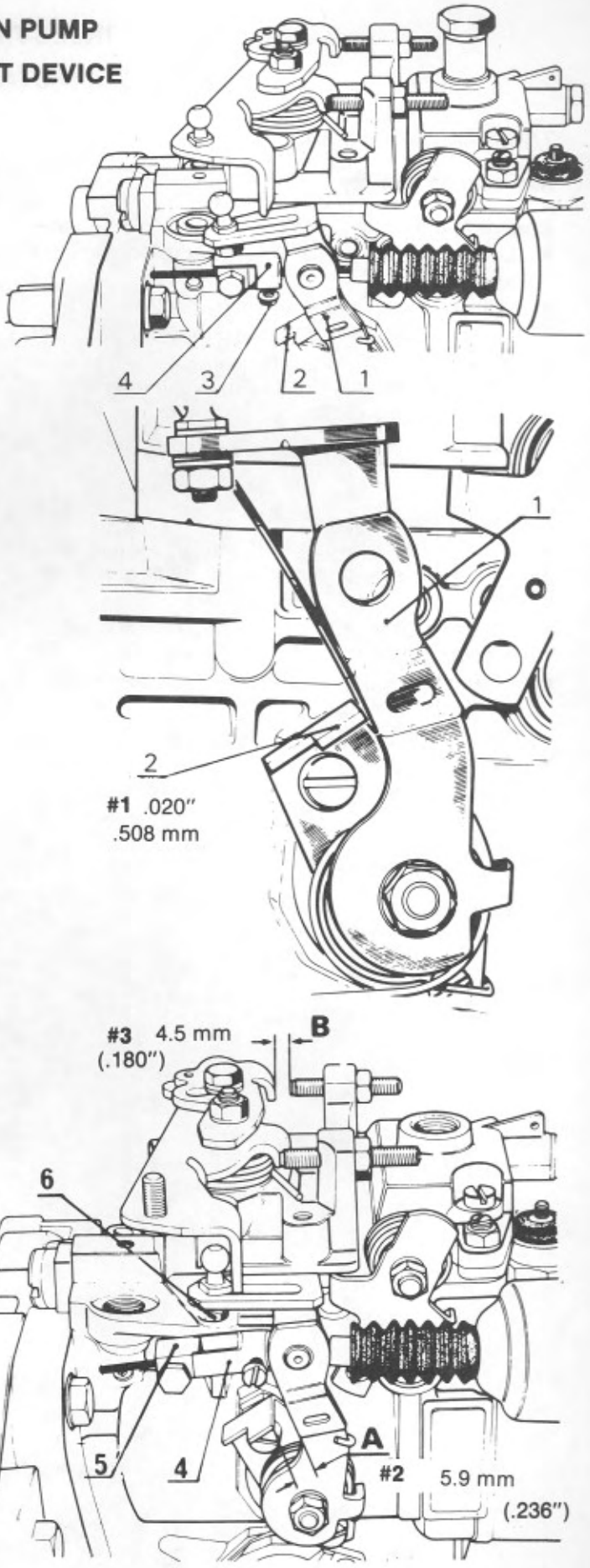
INJECTION PUMP
COLD START DEVICE

Adjust

Adjusting the thermostat capsule:

- Check that lever (1) is in contact with stop (2), if it is not, loosen screw (3) and turn clevis (4) one quarter of a turn.
- In the above position, clevis (4) slides into the cable stop allowing lever (1) to return and contact stop (2).
- Rotate crankshaft 2 complete turns in the direction of normal running, insert T.D.C. rod Mot. 861 when the engine is on T.D.C. - No. 1 cylinder - compression stroke.
- Check the clearance of lever (1) which should be .508 mm (.020") before it strikes the camplate inside the pump. Adjust so as to obtain this amount of clearance between the lever and stop (2).
- Find out the capsule temperature (capsule at ambient temperature for at least 30 minutes) and calculate the setting clearances "A" and "B" from the graph overleaf.
- Example: Setting clearance for ambient temperature of 22° C (72° F)
  Clearance "A" = 5.9 mm (.236")
  Clearance "B" = 4.5 mm (.180")
- Insert a shim 5.9 mm (.236") thick (clearance "A") between control lever (1) and stop (2) (do not take the initial clearance of 0.5 mm (.02") into account).
- Mount clevis (4) and cable stop (5) with both screws in line.
- Tension the cable and place the clevis and cable stop so that they contact lever (1); tighten the cable stop screw.
- Remove the setting shim and check that the clearance between stop (2) and lever (1) amounts to clearance "A". Correct if necessary, tighten the cable stop and clevis screws.
- Insert a shim 4.5 mm (.180") thick (clearance "B") between the throttle lever and the idling stopscrew.
- Loosen ball joint nut (6) and slide the ball joint along until it contacts the control lever; tighten the ball joint nut.
- Remove the setting shim and check that the clearance between the throttle lever and its stopscrew amounts to clearance "B". If it does not, make the necessary correction and tighten the ball joint nut.

NOTE: The values given in the above example are those for an ambient temperature of 22° C (72° F).

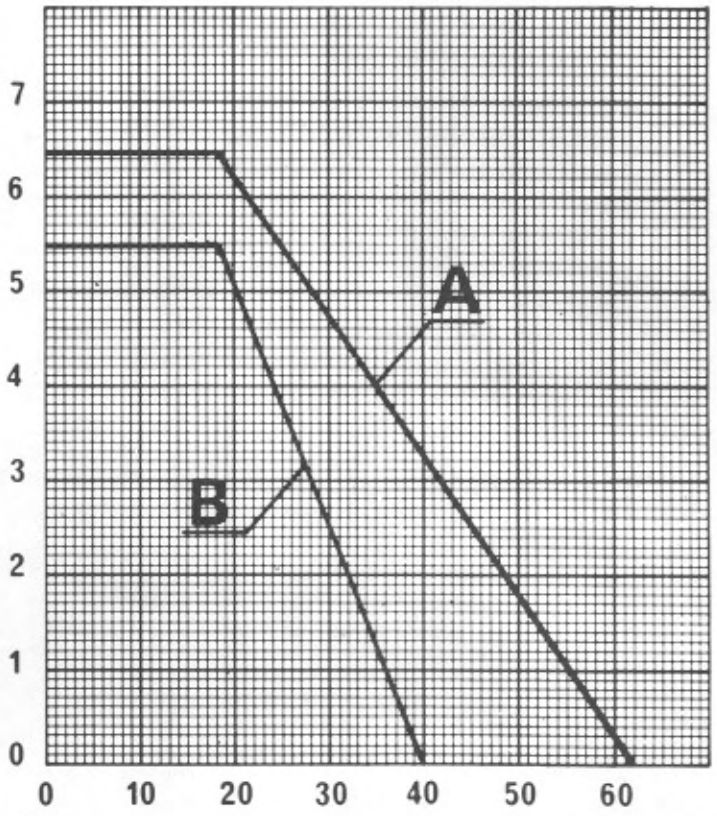


INJECTION PUMP
COLD START DEVICE

Table of fast idle setting values and automatic advance depending on thermostat capsule temperature:
Curve "A" determines dimension A (position of automatic advance lever in relation to capsule temperature).
Curve "B" determines dimension B (position of throttle lever in relation to idling stopscrew depending on capsule temperature).
Examples of shim thickness in relation to capsule temperature:

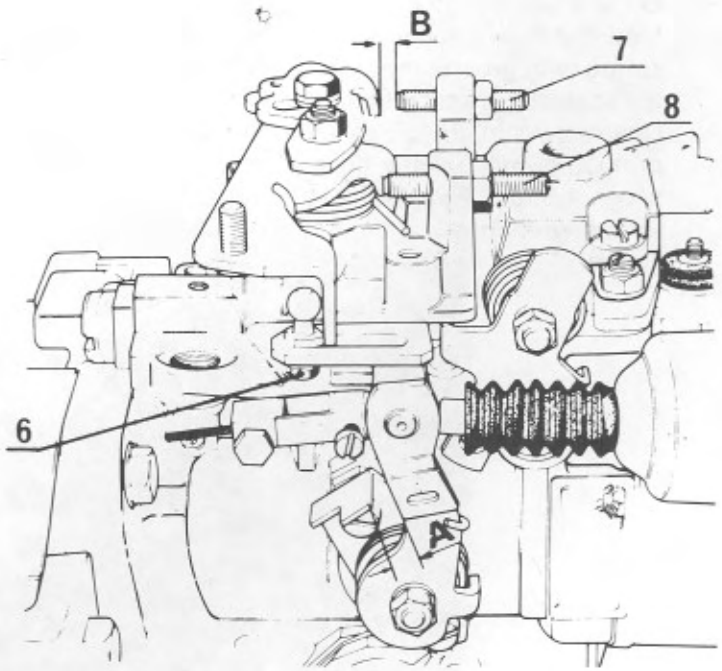
Capsule Temperature	Dim. A in mm	Dim. B in mm
less than 18° C (65° F)	6.5 (.260")	5.5 (.220")
22° C (72° F)	5.9 (.236")	4.5 (.180")
25° C (77° F)	5.5 (.220")	3.7 (.140")
30° C (86° F)	4.75 (.190")	2.5 (.100")
35° C (95° F)	4 (.160")	1.2 (.048")
40° C (104° F)	3.25 (.130")	0 (.000")

Shim valve in mm



Capsule temperature in 0°C.

- Start engine and let it attain its normal working temperature.
- Check that the throttle lever and automatic advance lever are free and resting against their stops.
- Check idling r.p.m. using an approved photo-electric cell type revolution counter.
- Turn adjusting screw (7) if an alteration is necessary.
- Recheck dimension (B) after any alteration to idling speed.
  To do this, select dimensions A and B in the table on the previous page which match the thermostat capsule temperature, for example: 18° C (65° F). Place a shim 6.5 mm (.260") thick against stop (2) (dimension A) and modify dimension B to 5.5 mm (.220") by moving ball joint (6).
- Checking maximum r.p.m.:
  Engine hot, throttle wide open, lever hard against stopscrew (8).
  The maximum should be between 4800 and 5100 r.p.m.

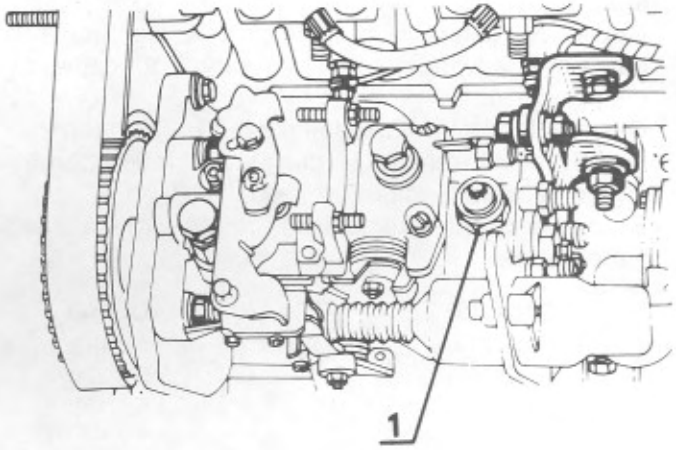


INJECTION PUMP
SOLENOID STOP VALVE

Extreme cleanliness must be exercised during this operation to avoid serious damage to the injection pump.

1. Clean all around the solenoid and blow clean with compressed air before attempting to remove it.
2. Activate the priming pump push button while unscrewing and screwing in to flush away any foreign matter which might have been dislodged in the threads.

NOTE: Cover the alternator to prevent fluids or debris from entering during this procedure.



Remove and Replace

Disconnect the solenoid stop valve wire.

Unscrew the solenoid (1) while activating the priming pump.

Take out the valve and spring.

On re-assembling:

Mount a new washer to the solenoid. Smear the spring with grease, mount it to the valve and insert the assembly into the hydraulic head.

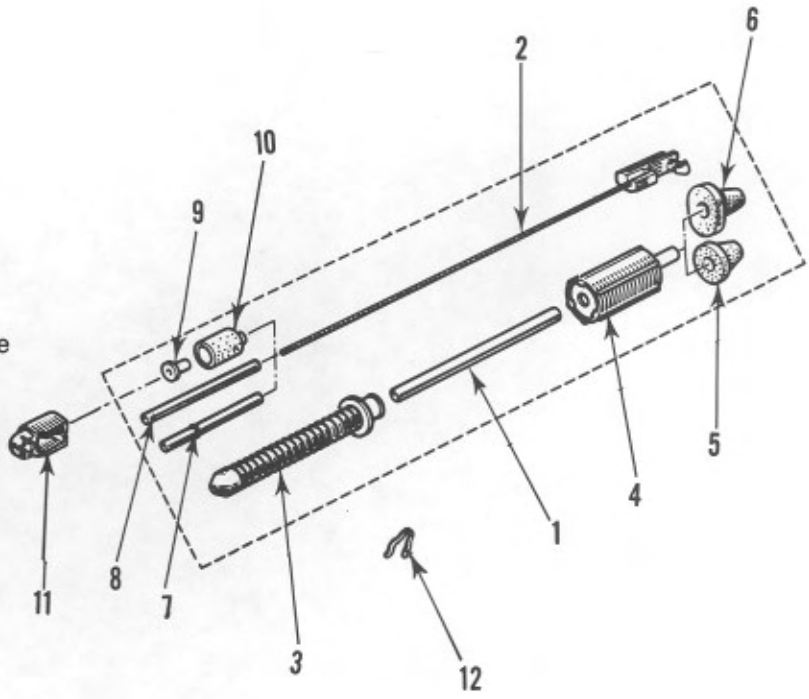
Now screw in the solenoid while activating the priming pump. Torque tighten the solenoid to between 1.5 and 2.5 daNm (20 to 34 lb./ft.) using a torque wrench and a 24 mm open end wrench to match.



THROTTLE CABLE

Replacement Kit Procedure

1. Tube
2. Cable
3. Pump end
4. Firewall end
5. Bushing
6. Not used
7. Not used
8. Not used
9. End cable stop
10. Cable stop bushing
11. Pump to cable coupling (must be ordered separately)
12. Spring clip - *not in kit* - existing clip may be used.



Step 1 Cut tube (1) to 1100 mm (43.13")

Step 2 Pass the cable (2) through items 5, 4, 1, 3, 10, and 9 in that order.

Step 3 Cut the cable (2) to a length of 1330 mm (52.15")

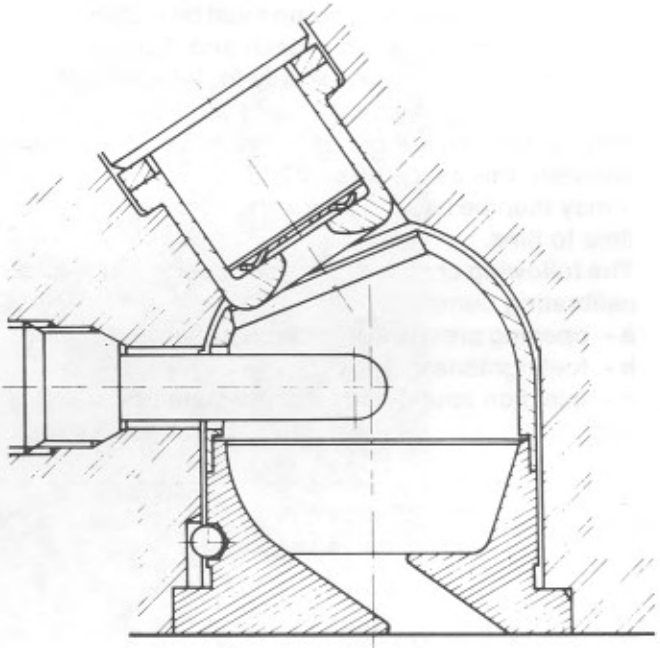
Step 4 Crimp the cable stop (9) to the cable (2) with a speedometer cable crimper or equivalent.

Step 5 Install the new pump to cable coupling over bushing and end (9 & 10)

Step 6 Install cable in vehicle.

Step 7 Check and adjust for full throttle and throttle cable height. To accomplish this, position spring clip (12) on pump end (3).

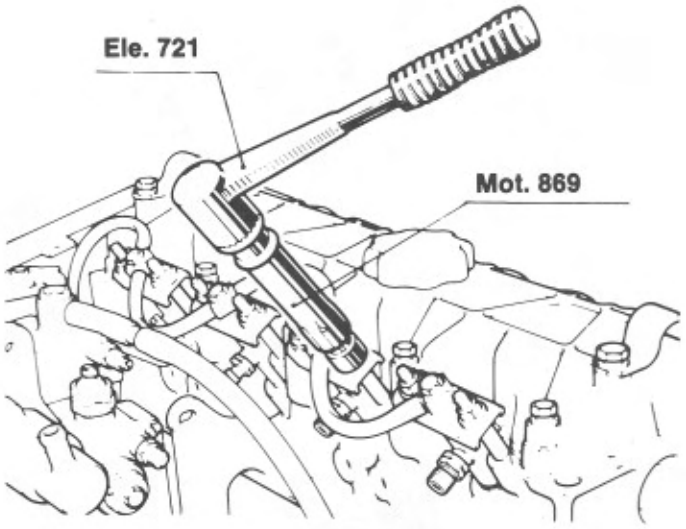
INJECTORS



Removal

Dissassembly sequence:

- the fuel return union
- union nut on the h.p. fuel pipe from the pump
- both clamp nuts
- flat washers
- clamp
- injector itself
- and seal with flame arresting washer.



Reassembly

Insert in the cylinder head:

- a new seal and a flame arresting washer (placed as shown in sketch above)
- the injector, making sure that it sits square on its seal. Screw the h.p. fuel pipe union nut on a few threads.
- mount the clamp, washers and nuts.

Tighten both nuts evenly using wrench Ele. 721 and socket Mot. 869.

Reassemble the fuel return pipe union using new washers.

TESTING INJECTORS

Checking

The injector calibrating pump must be fastened to a bench and the area kept clean and dustfree. The pump must be used exclusively for injector testing.
When installing an injector calibrating pump, test a new injector on it, note the pressure on the gauge and keep this as a master injector.
It may then be used to check the pump gauge from time to time.
The following checks are possible using an injector calibrating pump:

a - opening pressure or injector "calibrated setting"
b - fuel tighteness
c - injection sound and jet characteristics

WARNING

Keep hands clear of injector fuel jet. The jet of fuel is expelled under very high pressure and is sufficient to penetrate the skin. The effects of this can be extremely harmful.

Mount the injector to the pump.
Check that the unions are clean as the slightest amount of dust can affect injector performance.

a - Calibrating pressure

Isolate the pressure gauge and pump several times in quick succession to bleed the circuit.
Open the pressure gauge circuit and move the pump lever very slowly.
Note the pressure reading on th gauge at the instant the injector opens (calibrating pressure) this should be between 130 and 138 bars (1885 and 2,000 psi).
The opening pressure may be altered by changing the setting shim.
For information:
0.1 mm (.0039") equals a pressure change of 6-9 bars (87 to 130 psi).

b - Fuel tightness

Using the pump lever, hold the pressure 10 to 20 bars below the calibrating pressure.
Seat fuel tightness:
No fuel drip should form on the injector nose in under 10 seconds.

NOTE: A damp nose appearance is not considered to be a reason to reject an injector.
Fuel tightness of injector seat body and needle-injector body - fuel return.
No fuel should leak from the injector cap to body joint nor from the fuel return circuit:

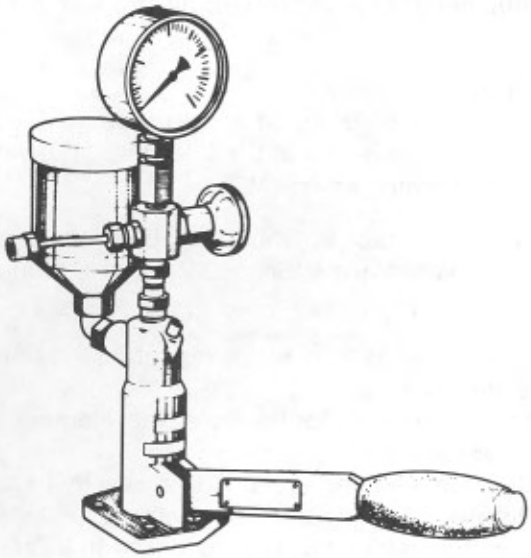
- A leak from the injector cap to body joint indicates a faulty injector spacer or seat and needle.
- A leak from the fuel return circuit indicates a faulty injector spacer, seat and needle or injector body.

TESTING

NOTE: Using a calibrated pump or test stand in good order (fuel return circuit and pump valve perfectly fueltight), a fueltightness test may be carried out by measuring the time it takes for the pressure to drop from 80 to 30 bars (1,160 to 435 psi) below the calibration pressure.

Example:
- injector calibrated at 130 bars (1885 psi). Note the time it takes for the pressure to drop from 100 to 50 bars (1,450 to 725 psi).

If the time for the pressure to drop exceeds 6 seconds, this shows that the injector is serviceable.



ATTENTION:
Bearing in mind the effect of the calibrating pump, a pressure drop time of less than 6 seconds does not necessarily mean that the injector is unserviceable.

c - Injection sound and jet shape characteristics

The injectors have a quiet sound which may be heard only when the rate is 1 or 2 injections per second.
At a higher rate this sound is replaced by whistling which may be heard when the rate is 4 to 6 injections per second.
The jet shape is crudely atomized, ragged and sometimes uneven until the whistling stage.
As injection rate increases, the shape becomes clear, finely atomized with a sharp jet angle.

NOTE: The above characteristics are obtained with a good quality injector test oil.
The sound and jet shape characteristics will change considerably if any other proprietary test liquid is used which is not equivalent.

FUEL FILTER

CHANGING THE FILTER ELEMENT

Naturally Aspirated Diesel
This element consists of a cartridge (C) screwed to the filter body (F) which has a built-in priming pump (P).

Turbo Diesel
This element consists of a cartridge (C), water separator (S) screwed to the filter body (D) with a "bolt-on" priming pump (M).

NOTE: The tool for this operation may be obtained locally (Snap-On® #A-91-C or equivalent)

- Remove wires from water sensor on the bottom of the filter.
- Mount removal tool around the element and loosen it.
- Remove the strap tool and unscrew by hand.
- Before mounting the new element, make sure that the inside seal is in position with its plastic guide.
- Screw the new element in by hand up to the filter body and tighten finally with one quarter turn using Removal Tool.
- Reinstall water-in-fuel sensor from old filter.
- Bleed filter assembly.

DRAINING WATER FROM THE FILTER BASE

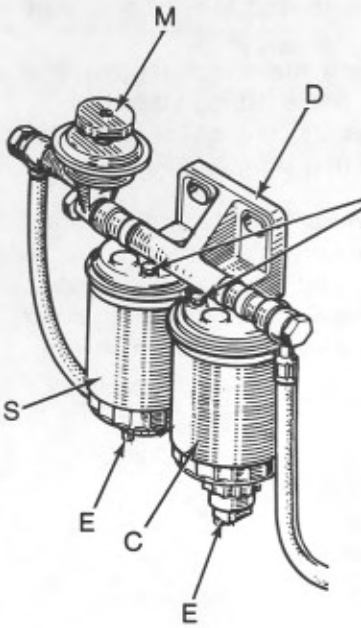
- Remove wires from water sensor.
- Place a catch tray under the filter and loosen the bleeder screw first then loosen the water drain screw (E).
- Retighten the screws once the water has been drained.
- Reinstall water-in-fuel sensor wire.
- Bleed filter assembly.

NOTE: If there is a priming pump incident, check the valve under the top before refitting the complete cover. (N/A) or priming pump (turbo).

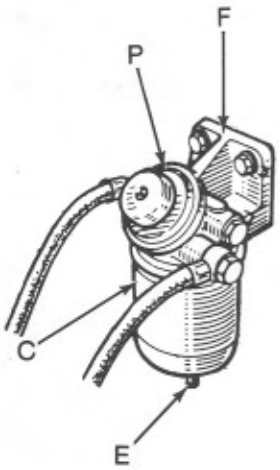
IMPORTANT
The water separator(s) (Part #R14629-85-825) for Turbo **must not be** removed and another filter installed as this creates excessive restriction in the fuel system. Drain the water separator and bleed in the same manner as a filter.

NOTE: The separator is located in the system between the filter and the fuel tank.

Turbo Diesel



N.A. Diesel



FUEL CIRCUIT

CHECKING

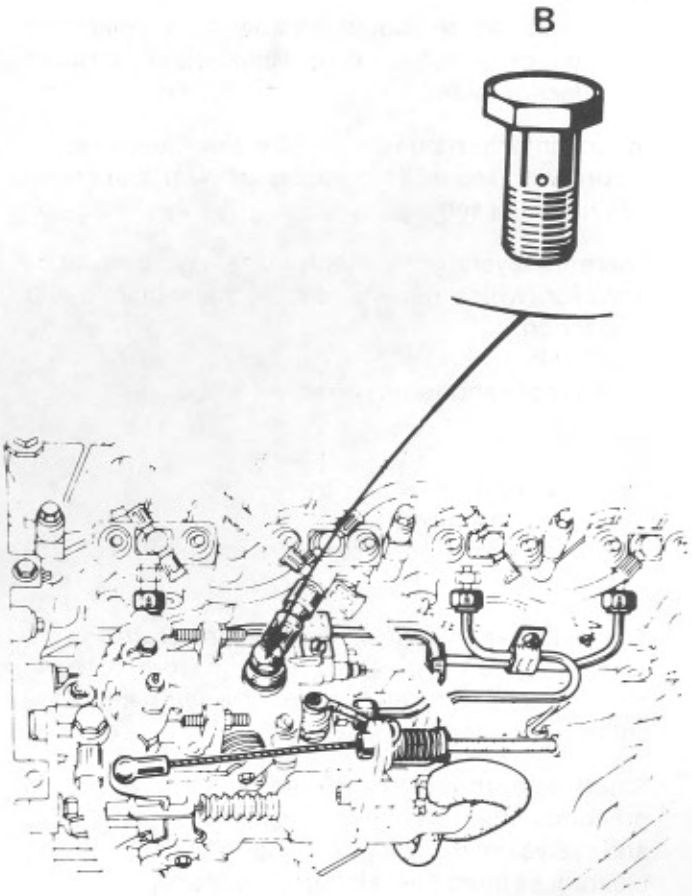
The fuel system from tank to injectors and back must always be in good condition if the engine is to perform well.

If an incident occurs, check the following before suspecting the injection pump:

- the fuel delivery and return lines which must be leak-free and undamaged.
- the fuel tank vent. The fuel filler cap must be vented.
- the return fuel flow 0.2 to 0.3 litres/minute (.42 to .63 pint/minute).

Disconnect the fuel return hose at the metal pipe union on the chassis and allow the fuel to enter a graduated beaker (in millilitres or cc). Let the engine idle for 1 minute. The amount of fuel returned should be between 0.2 and 0.3 litre (.42 and .63 pint). If the above is not obtained, check that the calibrated return union on the pump (B) is standard.

Clean the union filter and hole with compressed air.



CHECKING AND PROBLEM SOLVING

PROBLEM DIAGNOSING

GENERAL

If a diesel engine should experience an operating malfunction or failure - **do not immediately suspect the injection pump.**

In fact, injection pumps have an extremely reliable record with regard to component wear and maintaining initial settings.

There are several components in the injection system, however, which require regular maintenance and inspection:
-fuel tank
-fuel supply and return lines
-fuel filter
-injectors
-heater plugs
-solenoid stop valve.
Keep in mind the principles of diesel engine operation.

The injected fuel is ignited by intense heat inside the precombustion chamber resulting from extreme compression of the air/fuel mixture at the top of the compression stroke.

Since compression ratio has a direct effect on precombustion chamber temperature, the valves and valve seats, piston rings and rocker arm clearances must be maintained in proper condition to produce the necessary compression.

During cold starting, combustion temperature depends on the heater plugs and engine starting r.p.m., so it is very important to maintain the battery, starter, engine oil, etc. in satisfactory condition and to use engine oil with the proper viscosity.

INJECTION PUMP PRIMING LOSS DUE TO AIR LEAK

FUEL SYSTEM

Problem
After the engine has been stopped for a long period, the engine may seem to knock excessively or it may be difficult or even impossible to start.

Cause
Air may have entered the fuel system.

Solution
Check for air leaks in the fuel system as follows:
1. Close the fuel system by clamping the fuel return hose (using tool Mot. 453-01) at the inlet to the fuel tank.
2. Disconnect the fuel supply line at the tank end and attach an air hose to pressurize the system to approximately 2 bars (29 psi).
3. Inspect for leaks and repair as necessary.

CHECKING & PROBLEM SOLVING

DIAGNOSING PROBLEMS

PROBLEM	CAUSE	SOLUTION
Engine will not start and exhaust emits black smoke	Clogged air filter	Change air filter element
	Faulty injector	Check and adjust injectors
	Starter r.p.m. too low	Check battery, electrical circuit, engine oil grade
	Injection pump timing	Check pump timing
Engine will not start and exhaust emits white smoke	Preheating faulty	Check electrical circuit, change faulty components
	Cold start device not working	Adjust device and change faulty components
	Injection pump timing	Check pump timing
	Extra fuel not being injected for starting	Fuel feed or return circuits defective. Check solenoid stop valve Faulty injection pump
	Faulty cylinder head gasket	Change cylinder head gasket
Engine will not start no exhaust smoke apparent	Fuel tank empty	Fill fuel tank and bleed fuel circuit
	Clogged fuel filter	Change fuel filter element
	Faulty fuel supply	Check fuel lift pump, fuel circuits for leaks, bleed fuel circuit Check that standard vented fuel cap is fitted
	Engine stop valve solenoid faulty	Check electrical circuit and solenoid operation
	Compressions too low	Check cylinder compressions and engine condition
(If ambient temperature below 0° C (32° F)	Ice forming in low parts of fuel circuit; paraffin deposit in filter	Thaw and clean the fuel lines, change fuel filter element. Treat the fuel with an appropriate additive against low temperature
Engine starts but stops almost at once	Clogged fuel filter	Change fuel filter element
	Clogged air filter	Change air filter element
	Air in fuel circuit	Check fuel circuit for leaks and bleed it

DIAGNOSING PROBLEMS

PROBLEM	CAUSE	SOLUTION
Loss of power	Plugged fuel filter	Change fuel filter element
	Maladjusted throttle	Adjust throttle cable
	Fault in fuel circuit	Check fuel supply and return circuits and be sure that a vented cap is used
		Fuel inlet and return unions on injection pump
		Fuel lift pump
	Fuel return pipes squashed near unions	Check bore for fuel return pipes
	Injection pump timing	Check injection pump timing
	Faulty injectors	Check condition, calibration and conformity of injectors
	Injection pump out of adjustment	See Section D1 Pump adjustment and timing
Loss of power, abnormal fuel consumption and exhaust smoke	Plugged air filter	Change air filter element
	Faulty injectors	Check condition, calibration and conformity of injectors
	Incorrect rocker arm clearances	Check rocker arm clearances
	Incorrect valve timing	Adjust valve timing
	Compressions too low	Check cylinder compressions and engine condition
	Exhaust system partially clogged up	Check exhaust system
	Running temperature too low	Check cooling circuit (thermostat)
	Injection pump out of adjustment	See Section D1 Pump adjustment and timing Diesel Injection Center

DIAGNOSING PROBLEMS

PROBLEM	CAUSE	SOLUTION
Misfiring, uneven running	Idle speed too low (governor surge)	Adjust idling speed
	Leak between injection pump and injector	Check fuel return circuit
	Plugged fuel filter	Change fuel filter element
	Air in fuel circuit	Check and bleed fuel circuit
	Faulty or non-standard injector	Check condition, calibration and conformity of faulty injector
	Rocker arm clearance faulty	Check and adjust all rocker arm clearances
	Piston seizing or gummed piston rings	Check compressions, overhaul engine
Faulty injection pump		Contact nearest Bosch Service Dealer
Max r.p.m. too low	Plugged fuel filter	Change fuel filter element
	Throttle out of adjustment	Adjust throttle cable
	Injection pump out of adjustment	See Section D1 Pump adjustment
Compressed air leak	Leak from injector seal	Change faulty seal
	Leak from a heater plug	Re-tighten or change if faulty
	Leak from cylinder head gasket	Change cylinder head gasket
		Check joint faces and sleeve protrusions

DIAGNOSING PROBLEMS

PROBLEM	CAUSE	SOLUTION
Knock in engine	Injector seized	Change faulty injector
	Air in fuel circuit	Check fuel circuit
	Unsuitable fuel grade	Drain fuel tank and fill with correct diesel fuel
	Incorrect rocker arm clearances	Re-adjust rocker arm clearances
	Injector fuel returns blocked	Check injectors and fuel return circuit
	Injection pump timing	Check injection pump timing
	Valve timing	Check valve timing
	Sticking valves	Overhaul cylinder head
	Broken valve spring	Change broken spring
	Pistons seized or worn	Overhaul engine
	Crankshaft bearing wear	Overhaul engine
	Flywheel loose	Strip and refit correctly

SECTION "E"

J7T239 - 2.2 Liter Gasoline Engine

With Electronic Fuel Injection System

Subsection 1 - General Information

E1-1 Ghosted Views
E1-6 Engine Identification
E1-7 Special Tools
E1-13 Torque Specifications
E1-14 Specifications

Subsection 2 - Engine Remove and Replace

E2-1 Removal Procedure
E2-5 Preparation for Rebuild
E2-6 Preparing Engine for Installation
E2-7 Installation Procedure
E2-8 Final Procedures after Installation

Subsection 3 - Engine Overhead and Rebuild

E3-1 General Information
E3-2 Engine Disassembly
E3-9 Cylinder Head
E3-13 Rockershaft
E3-15 Oil Pump
E3-16 Cylinder Block & Related Parts - Clean and Inspect
E3-20 Piston - Sleeve Assemblies
E3-24 Reassemble Cylinder Block Assembly
E3-43 Cylinder Head Installation

Subsection 4 - Timing Belt

E4-1 Installation

Subsection 5 - Rocker Arm Clearance

E5-1 Adjustment
E5-4 Adjustment (Second Procedure)

Subsection 6 - Final Assembly

E6-1 Procedure

Subsection 7 - Belt Tensioning

E7-1 Procedure

Subsection 8 - Engine Water Pump

E8-1 Remove and Replace

Subsection 9 - Oil Pressure Checking

E9-1 Procedure

Subsection 10 - Engine Fuel System

E10-1 Fuel/L-Jetronic System Diagram)
E10-2 General
E10-4 Fuel Pump
E10-5 Pressure Regulator
E10-6 Air Flow Meter, Throttle Plate and Throttle Position Switch
E10-7 Oxygen Sensor and Cold Start Injector
E10-8 Thermo-Coolant Time Switch and Auxiliary Air Regulator
E10-9 Coolant Temperature Sensor
E10-9 Atmospheric Pressure Sensor
E10-9 Idle Speed Controls
E10-10 Tachometer Relay
E10-11 Fast Idle Diagram
E10-12 Component Testing
E10-16 Component Replacement
E10-18 Fuel System Hoses & PCV System
E10-19 Fuel System Test
E10-21 Wire Harness Connectors
E10-26 Diagnostic Plugs
E10-27 Air Flow Meter Tamper-proof Device
E10-28 Integrator Voltage
E10-30 Functional Tests (Method 1)
E10-34 Functional Tests (Method 2)
E10-38 Adjustments

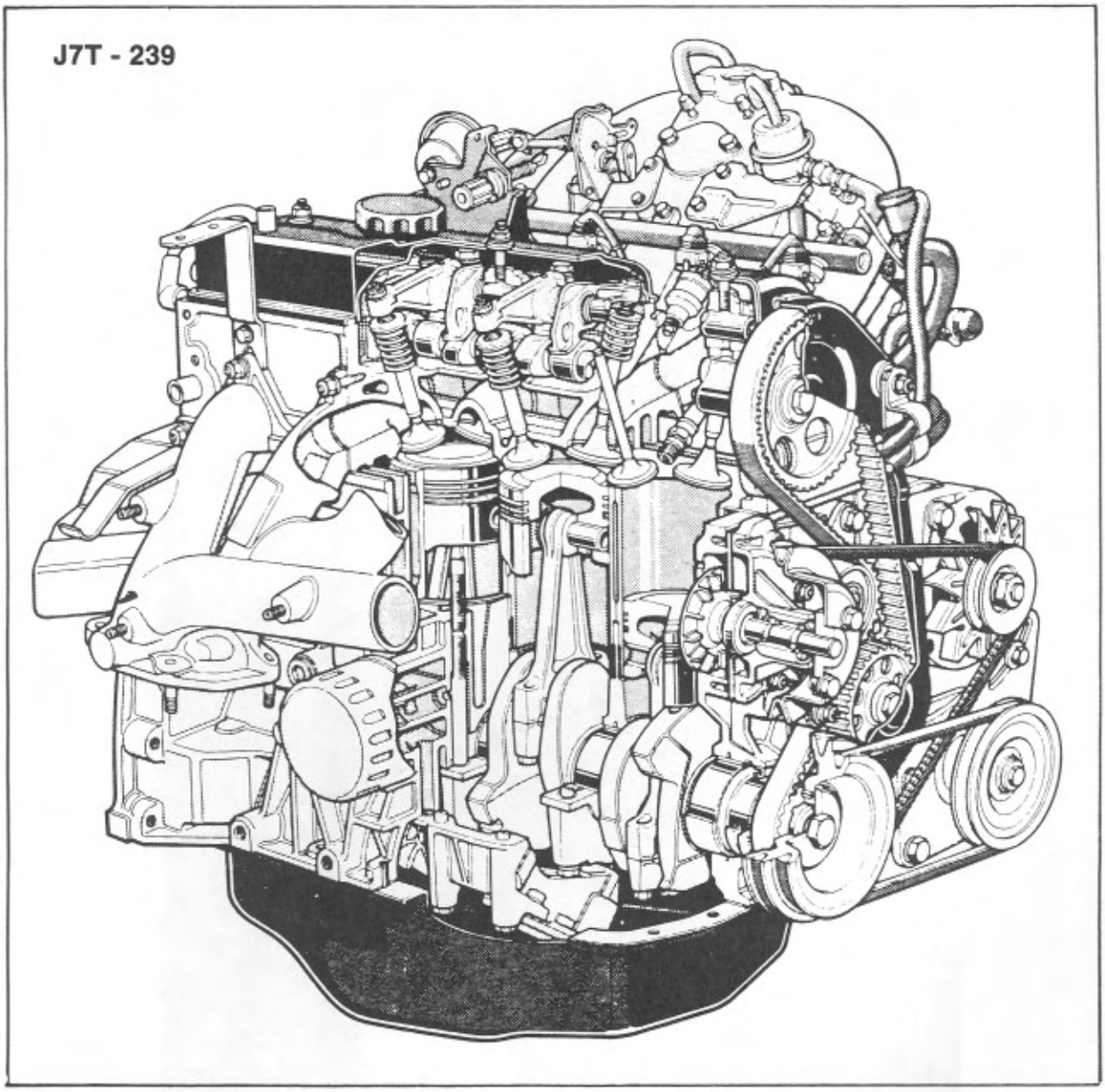
Subsection 11 - Emission Control Systems

E11-1 Emission Control System Diagram
E11-2 P.C.V. System
E11-3 E.G.R. System
E11-4 System Operation
E11-5 Emission Hose Routing

Subsection 12 - Ignition System

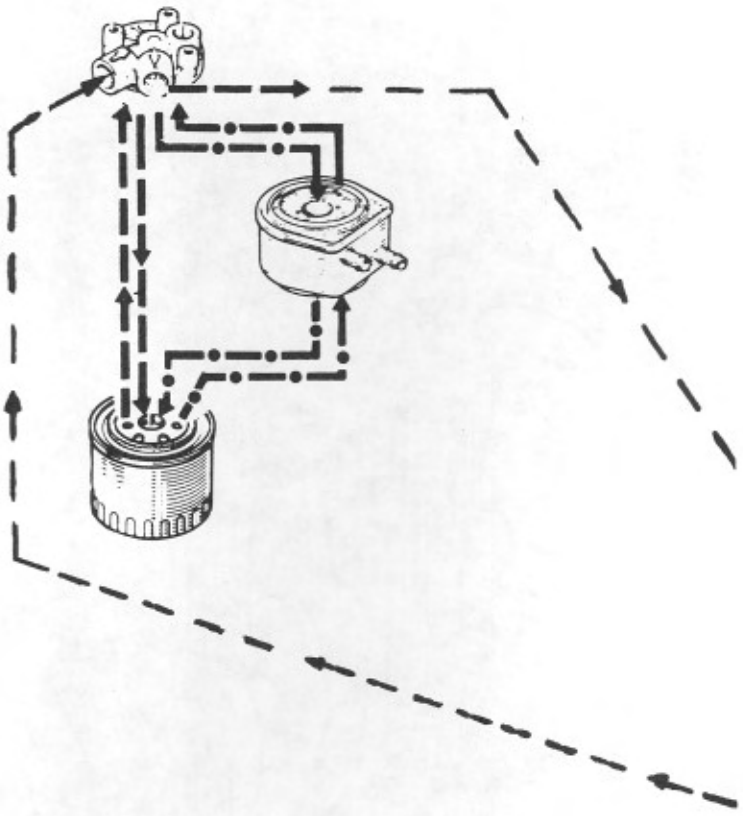
E12-1 Operating Principles
E12-3 Diagnostics

2.2L ENGINE
4-CYLINDER ALUMINUM
J7T - 239

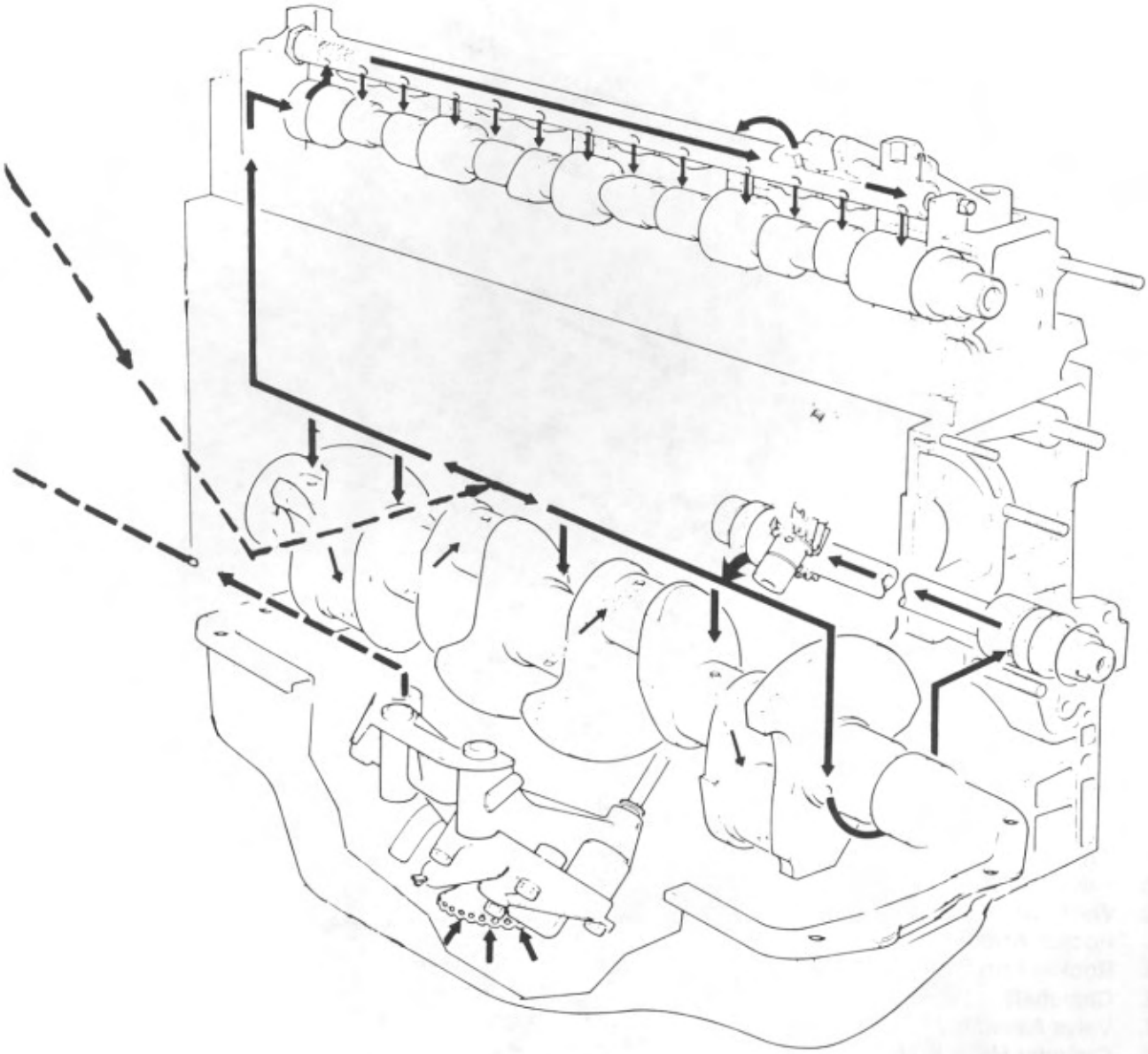


Engine Type	Suffix	Cubic Displacement	Compression Ratio	Stroke	Bore	Transmission Type
J7T	239	2165 cc (132 C.I.D.)	8.7:1	89 mm (3.50 in.)	88 mm (3,46 in.)	ML1-10 (Automatic Transmission)

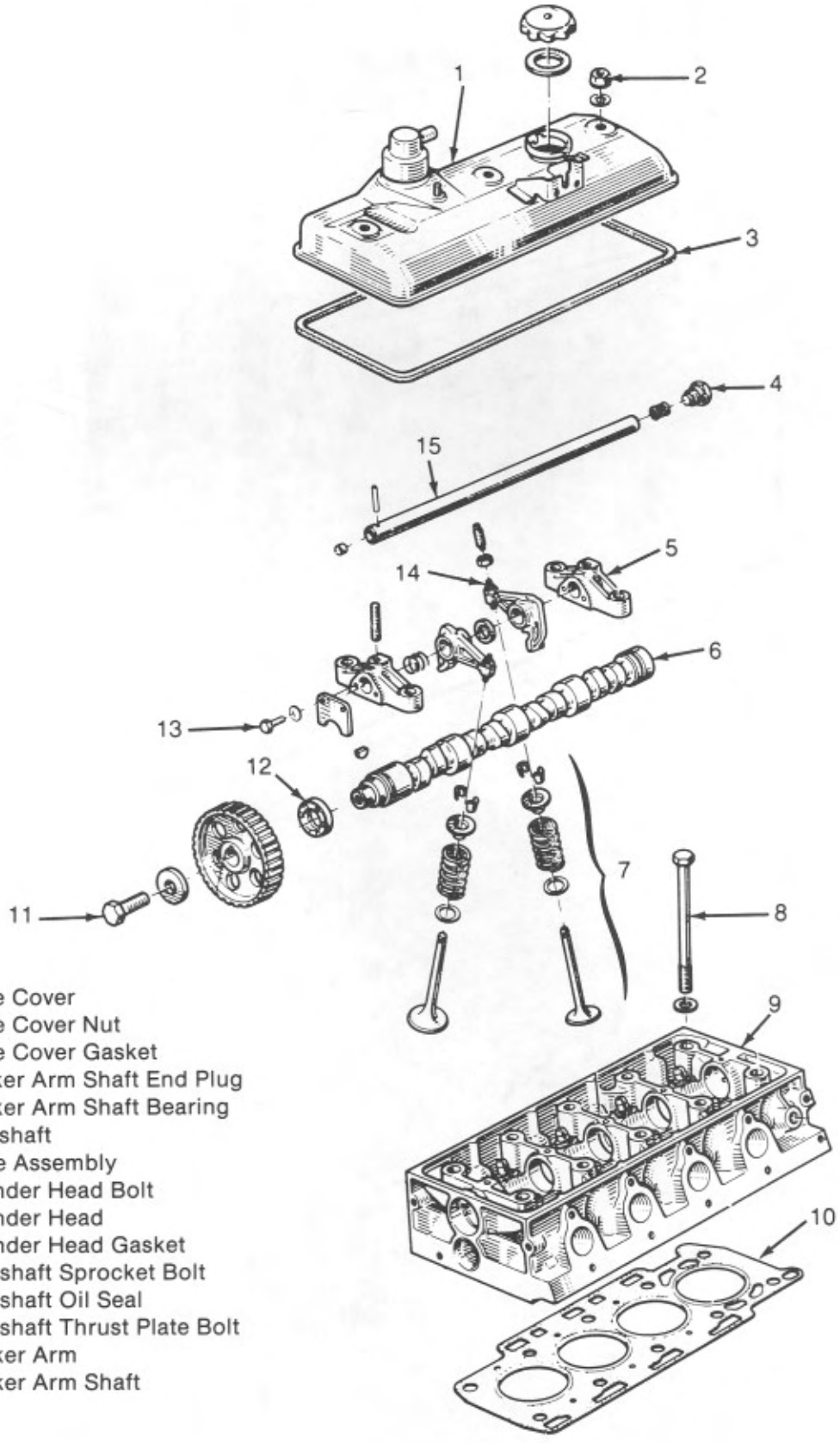
GENERAL INFORMATION
LUBRICATION CIRCUIT



GHOSTED VIEW

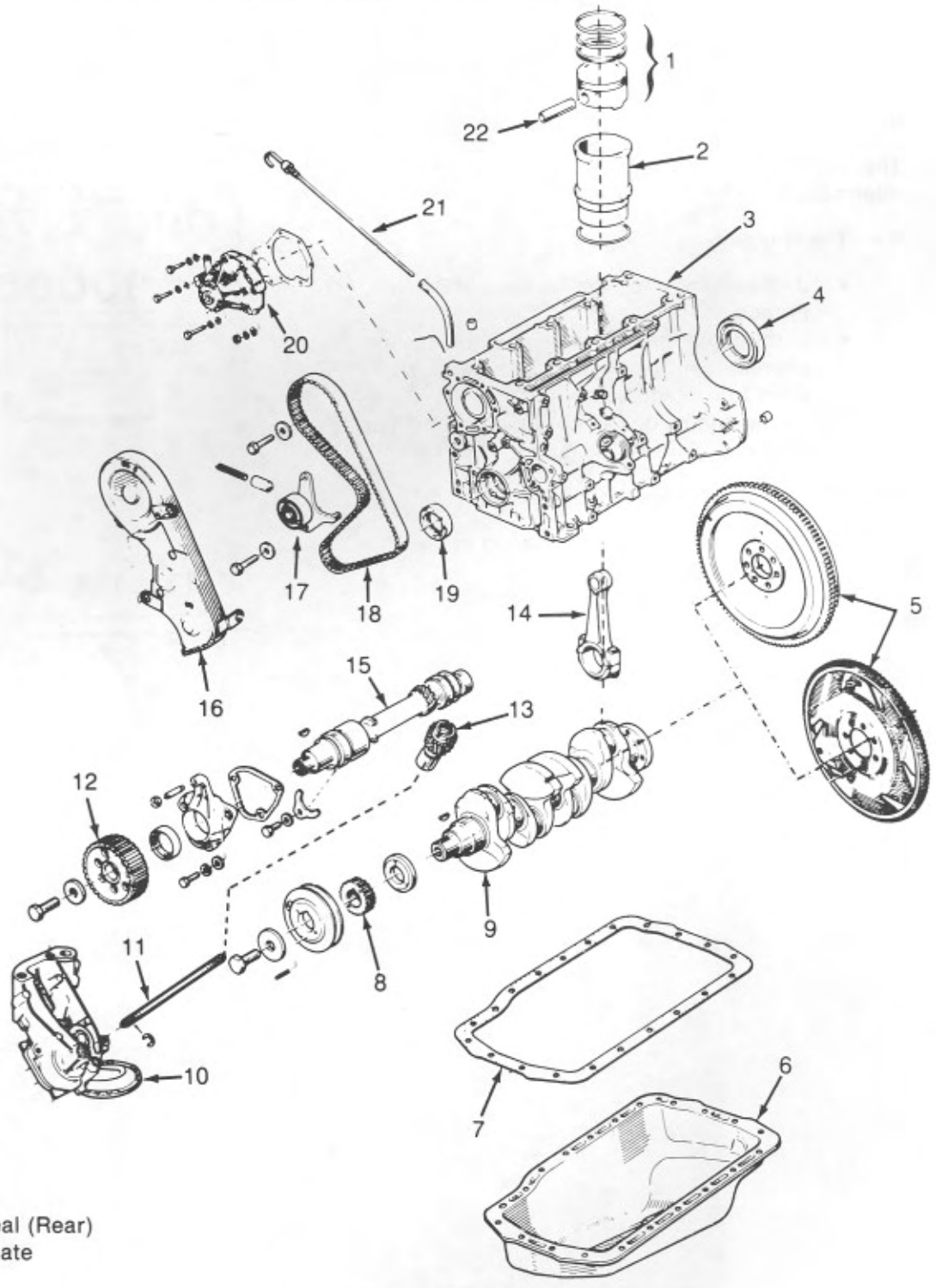


CYLINDER HEAD (EXPLODED VIEW)



1. Valve Cover
2. Valve Cover Nut
3. Valve Cover Gasket
4. Rocker Arm Shaft End Plug
5. Rocker Arm Shaft Bearing
6. Camshaft
7. Valve Assembly
8. Cylinder Head Bolt
9. Cylinder Head
10. Cylinder Head Gasket
11. Camshaft Sprocket Bolt
12. Camshaft Oil Seal
13. Camshaft Thrust Plate Bolt
14. Rocker Arm
15. Rocker Arm Shaft

CYLINDER BLOCK (EXPLODED VIEW)



1. Piston Assembly
2. Cylinder Liner
3. Cylinder Block
4. Crankshaft Oil Seal (Rear)
5. Flywheel/Drive Plate
6. Oil Pan
7. Oil Pan Gasket
8. Crankshaft Sprocket
9. Crankshaft
10. Oil Pump
11. Oil Pump Drive Shaft
12. Intermediate Shaft Sprocket
13. Oil Pump Drive Gear
14. Connecting Rod
15. Intermediate Shaft
16. Timing Belt Cover
17. Timing Belt Tensioner
18. Timing Belt
19. Crankshaft Oil Seal (Front)
20. Water Pump
21. Oil Level Dip Stick
22. Piston Pin

GENERAL INFORMATION
ENGINE IDENTIFICATION

The engine identification plate is attached to the front, right side of the cylinder block.

The plate contains the following engine coded information.

A - The engine type code:

- J - the engine was manufactured at Douvrin, France
- 7 - the engine has hemispherical combustion chambers in the cylinder head and multi-point fuel injection.
- T - the engine has a cubic displacement of 2165 cc/2.2 liters/132 cu. in.

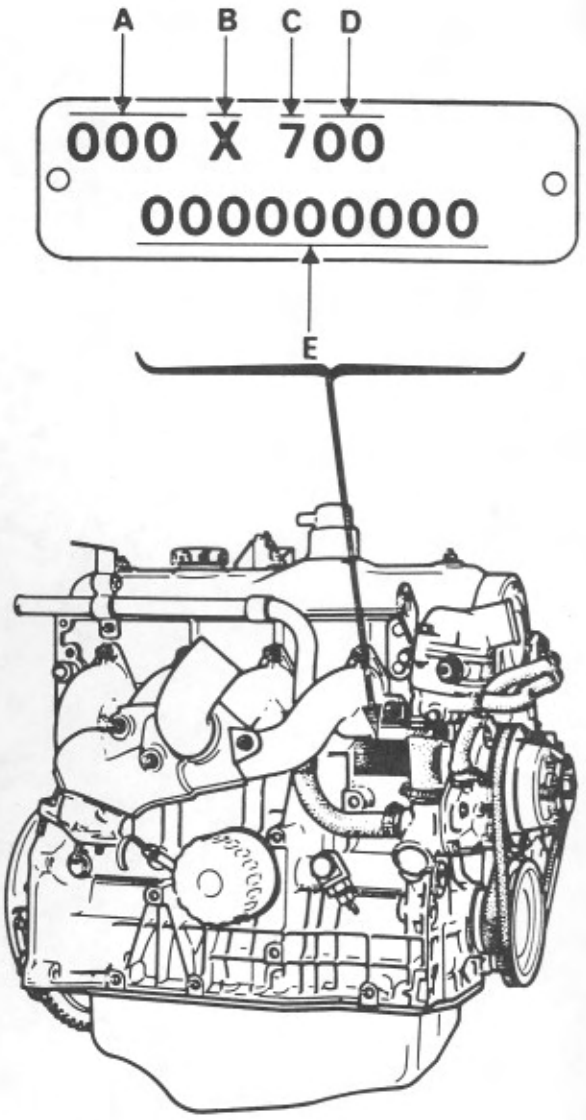
B - The engine certification code letter

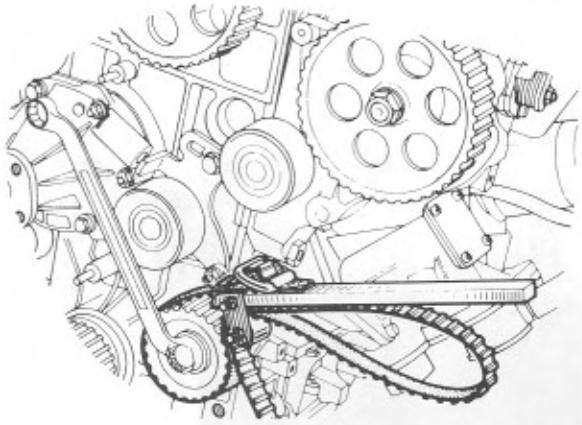
C - Engine manufacturer identification code

D - The engine identification code suffix

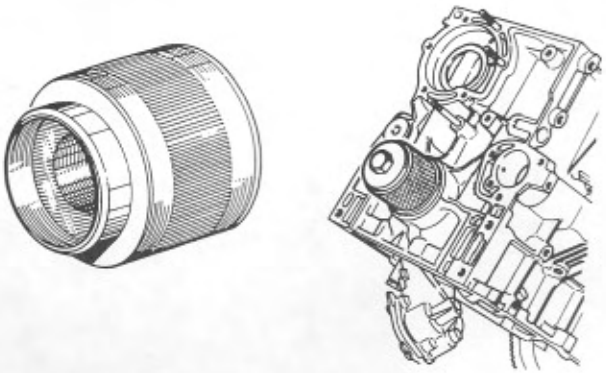
E - The engine serial number.

NOTE: The engine serial number (E) is preceded by a duplication of the engine identification code suffix (D).

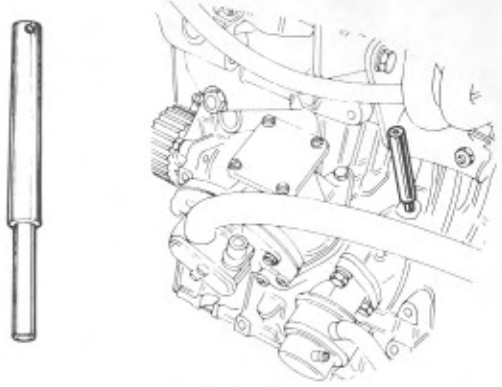




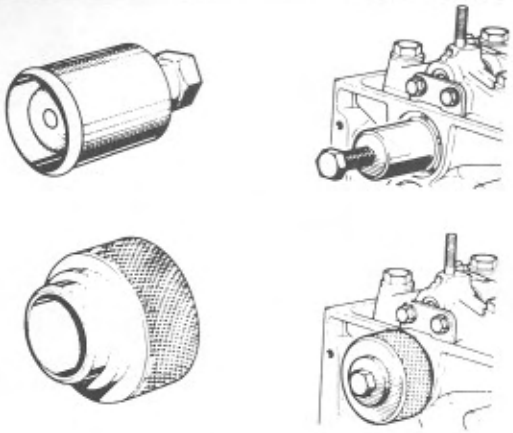
Mot. 855
Toothed belt idler sprocket locking strap
Order Tool No. 700000-85-500 EA



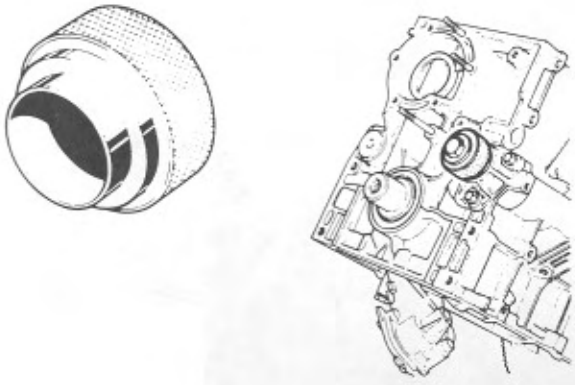
Mot. 789
Crankshaft oil seal inserting tool (timing cover end)
Order Tool No. 700000-78-900 EA



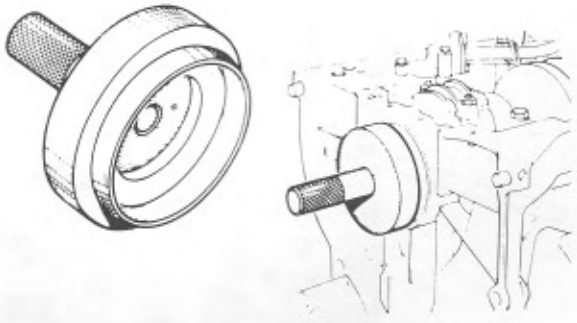
Mot. 861
TDC indicator rod
Order Tool No. 700000-86-100 EA



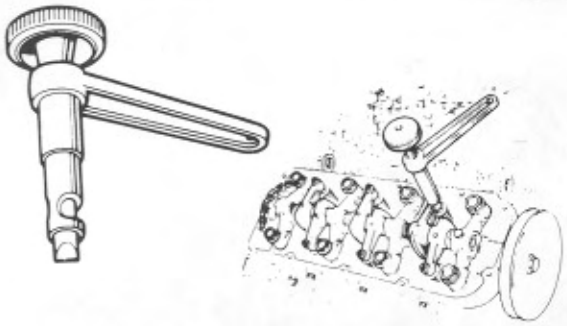
Mot. 791
Extracting/inserting tool for camshaft oil seal
Order Tool No. 700000-79-100 EA



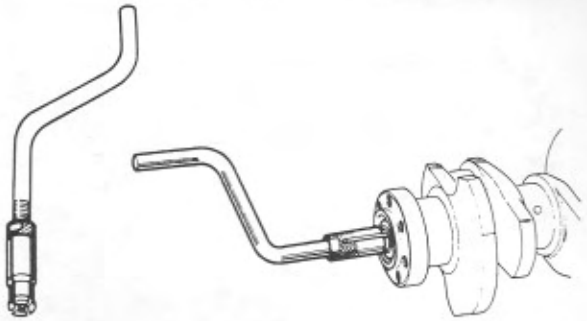
Mot. 790
Oil seal inserting and intermediate shaft bearing locating tool
Order Tool No. 700000-79-000 EA



Mot. 788
Crankshaft oil seal inserting mandrel
Order Tool No. 700000-78-800 EA



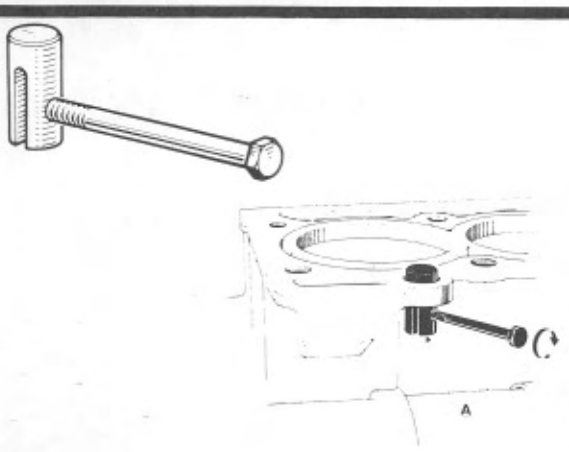
Mot. 647
Rocker arm clearance adjustment wrench
Order Tool No. 700000-64-700 **EA**



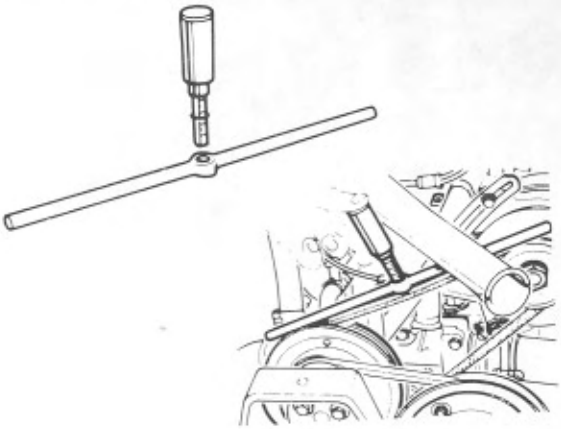
Mot. 11
Crankshaft bushing extractor
Order Tool No. 700010-72-500 EA



Mot. 851
Piston installation tool
Order Tool No. 700000-85-100 EA

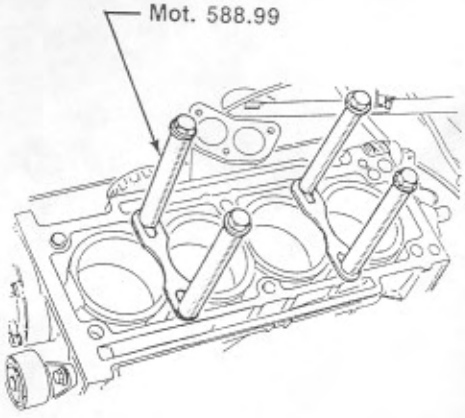


Mot. 720
Cylinder head locating tool
Order Tool No. 700000-72-000 EA



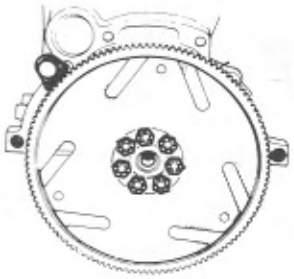
Ele. 346

Drive belt tensioning tool
Order Tool No. 700000-34-600 EA

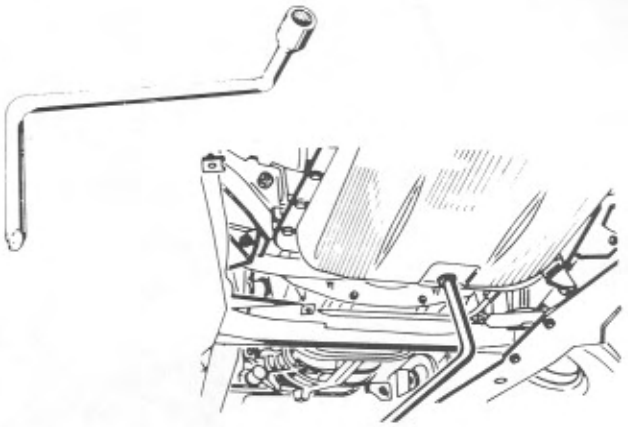


Mot. 588
Sleeve tubes
(for use with clamps Mot. 588)
Order Tool No. 700000-58-899 EA

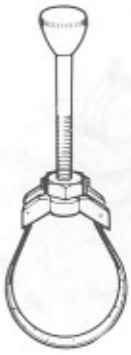




Mot. 582
Flywheel locking sector
Order Tool No. 700000-58-200 EA

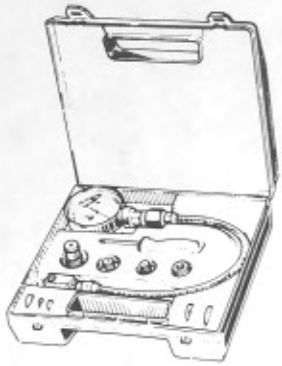


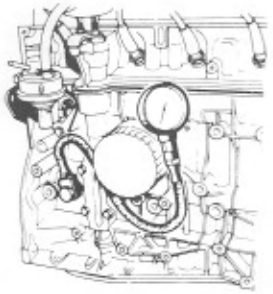
Mot. 593
Engine gearbox drain plug wrench (8 mm square)
Order Tool No. 700000-59-300 EA



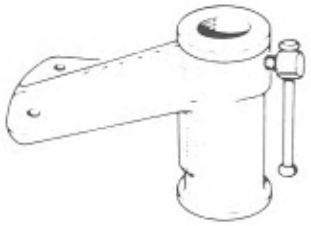


Mot. 445
Oil filter strap
Order Tool No. 700000-44-500 EA



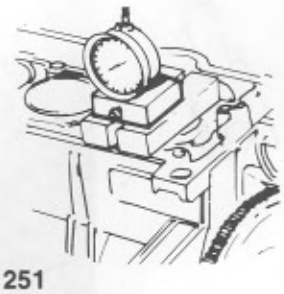


Mot. 836
Boxed oil pressure testing kit
Order Tool No. 700000-83-603 EA

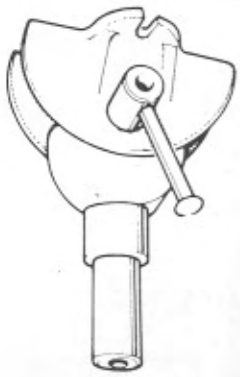


(No Number)
Bench stand for unit support
Order Tool No. 700012-39-500 EA

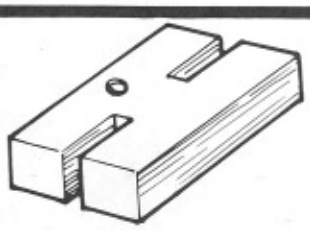


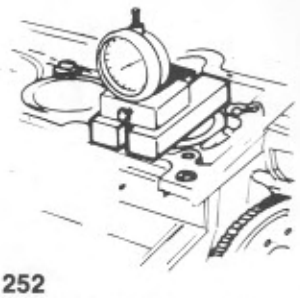


Mot. 251
Dial indicator support
(for checking sleeve protrusion and position)
Order Tool No. 700000-25-101 EA

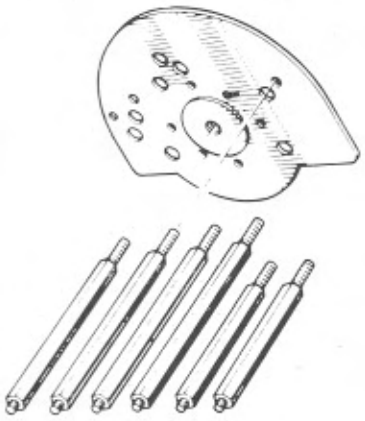


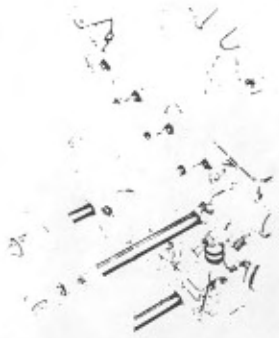
(No Number)
Fork end and swivel stand for bench stand
Order Tool No. 700012-09-200 EA





Mot. 252
Thrust plate (for checking sleeve protrusion)
Order Tool No. 700000-25-201 EA



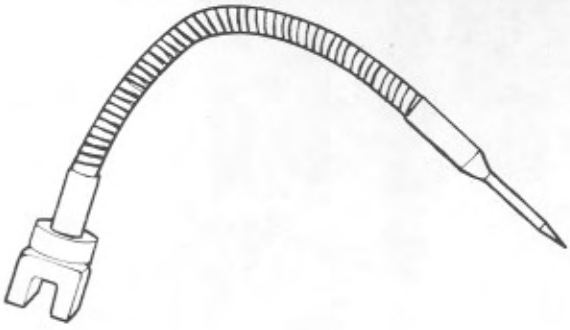


Mot. 792
Engine plate for DESVIL stand
Order Tool No. 700000-79-200 EA





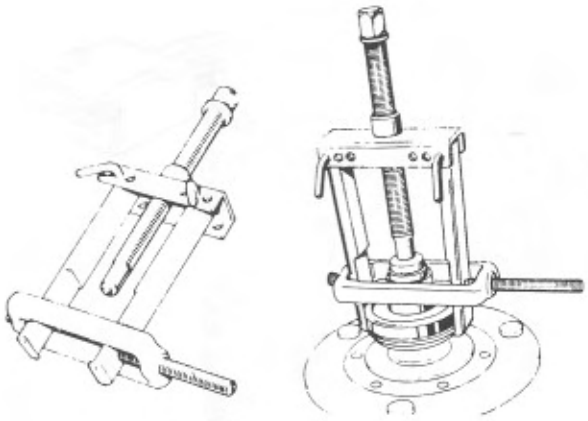
(No Number)
Dial indicator
Order Tool No. 72046E-B0-000 EA



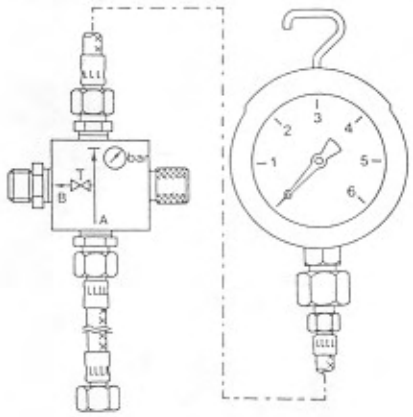
Mot. 591-02
Flexible pointer
(For valve adjustment procedure)
Order Tool No. 700000-59-102 EA



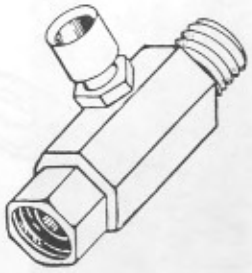
Ms. 1774
Ignition Alignment Rotor
(For valve adjustment procedure)
Order Tool No. 700001-77-400 EA



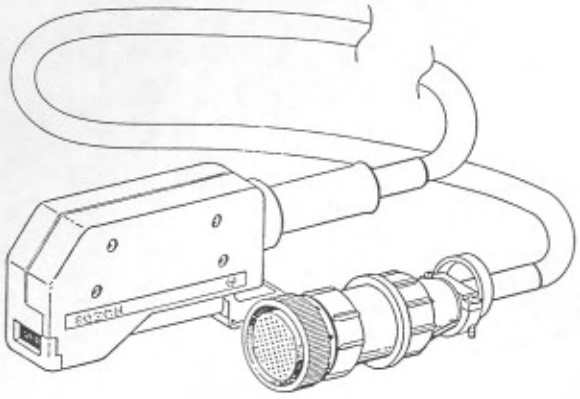
B.Vi. 28-01
Crankshaft sprocket removal tool
Order Tool No. 700012-27-301 EA



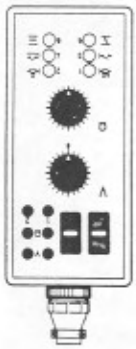
Fuel Pressure Gauge
Order Tool No. 700000-01-000 EA



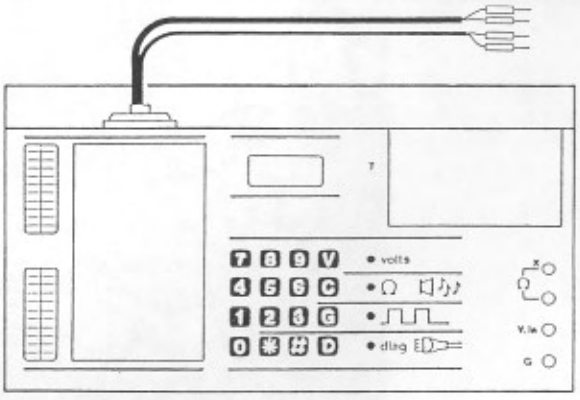
3-Way Adapter (for fuel gauge)
Order Tool No. 700000-02-700 EA



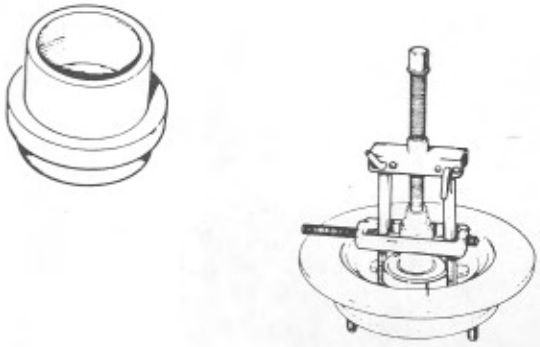
Bosch Test Harness
Order Tool No. 700000-03-000 EA



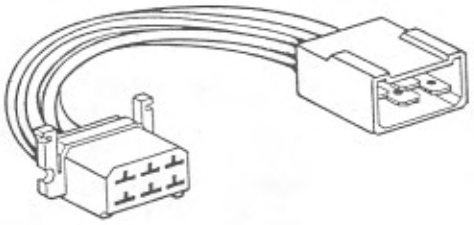
Bosch Injection Tester
Order Tool No. 700000-04-000 EA



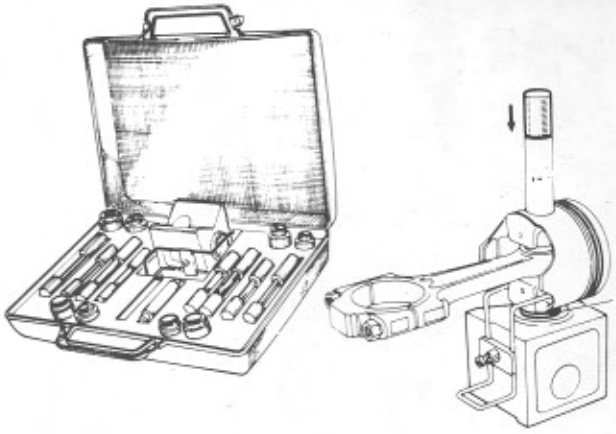
XR25 Tester
Order Tool No. 700000-00-846 EA



Rou. 15-01
Shaft end protector
Order Tool No. 700013-31-601 EA



Diagnostic Wire Harness
(for tach. relay)
Order Tool No. 700000-10-000 EA



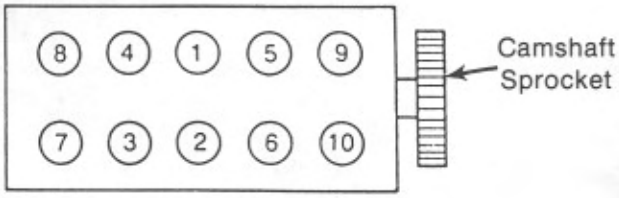
Mot. 574-07
Piston pin removal/installation tool set
Order Tool No. 700000-57-407 EA



Mot. 588
Sleeve clamp brackets
Order Tool No. 700000-58-800 EA

TORQUE SPECIFICATIONS

Component	Set-To-Torque	Service Recheck Torque
Camshaft Sprocket Bolt	5 daNm (37 lbs./ft.)	
Connecting Rod Bolts/Nuts	6.3 daNm (46 lbs./ft.)	6.0-6.5 daNm (44-48 lbs./ft.)
Converter Drive Plate Bolts	6.8 daNm (50 lbs./ft.)	6.5-7.0 daNm (48-52 lbs./ft.)
Crankshaft (Vibration Damper) Pulley Bolt	13.0 daNm (96 lbs./ft.)	12.0 - 13.5 daNm (88-100 lbs./ft.)
Cylinder Head Bolts (Tightening sequence shown below)		
First Tightening	5.0 daNm (37 lbs./ft.)	
Second Tightening	8.0 daNm (59 lbs./ft.)	
Final Tightening	9.2 daNm (69 lbs./ft.)	8.8-9.8 daNm (65-72 lbs./ft.)
Cylinder Head Cover Nuts	0.5 daNm (3.5 lbs./ft.)	0.4-0.6 daNm (3-4.5 lbs./ft.)
Flywheel Bolts	6.0 daNm (44 lbs./ft.)	
Intermediate Shaft Sprocket Bolt	5.0 daNm (36 lbs./ft.)	
Main Bearing Cap Bolts	9.2 daNm (69 lbs./ft.)	8.8-9.8 daNm (65-72 lbs./ft.)
Oil Pan Screws	0.9 daNm (6.5 lbs./ft.)	0.8-1.0 daNm (5.8-7.3 lbs./ft.)
Oil Pump Screws	4.3 daNm (33 lbs./ft.)	4.0-4.5 daNm (29-37 lbs./ft.)
Rocker Arm Shaft Plug	2.0 daNm (15 lbs./ft.)	



Cylinder Head Bolt

Tightening Sequence

SPECIFICATIONS

General Specifications

Type	In-Line, 4 Cylinder OHC
Bore	88 mm (3.46 in.)
Stroke	89 mm (3.50 in)
Displacement	2.2 Liter (132 cu. in.)
Compression Ratio	8.7:1
Firing Order	1-3-4-2
Fuel Requirement	Unleaded

Spark Plugs

Type	Champion RS9YC or AC CR42LTS
Gap	.022 to .026 in

Cylinder Block and Liners

Liner Height	148.5 mm (5.846 in)
Bore Diameter	88 mm (3.464 in.)
Base Locating Diameter	93.6 mm (3.685 in.)
Liner Protrusion (w/O-ring)	0.08 to 0.15 mm (0.003 to 0.006 in.)
Liner Height to Flange	93.065 to 93.096 mm (3.663 to 3.665 in.)
Cyl. Block Depth to Flange	92.942 to 92.985 mm (3.659 to 3.660 in.)
Cylinder Block Depth	149.25 to 149.75 mm (5.875 to 5.895 in.)

Crankshaft

Number of Main Bearings	5
Main Bearing Journal Diameter	62.892 mm (2.476 in.)
Regrind Diameter	62.842 mm (2.474 in.)
Grinding Tolerance	-0.0 to -0.019 mm (-0.0 to -0.0007 in.)
Connecting Rod Journal Diameter	56.296 mm (2.215 in.)
Regrind Diameter	0.25 mm (0.0010 in.)
Grinding Tolerance	-0.01 to -0.029 mm (-0.0004 to -0.0011 in.)
End Play	0.13 to 0.30 mm (0.005 to 0.011 in.)

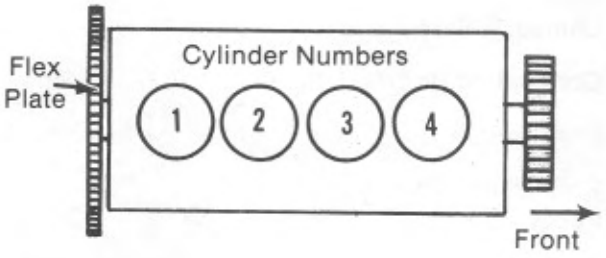
Thrust Washers with different thicknesses are available

Pistons, Connecting Rods and Piston Pins

Piston-to-Connecting Rod Fit	Press Fit
Connecting Rod End Play - Small End	0.31 to 0.57 mm (0.012 to 0.022 in.)
Piston Pin Length	75 mm (2.952 in.)
Piston Pin External Diameter	23 mm (0.905 in.)
Piston Pin Internal Diameter	14 mm (0.551 in.)

Piston Rings

Piston Ring Thickness	
Top Compression	1.75 mm (0.068 in.)
Upper Compression	2.00 mm (0.078 in.)
Oil Scraper	4.00 mm (0.157 in.)
Piston Ring Gap	Pre-Adjusted



Cylinder Head

Cylinder Head Height	111.6 mm (4.394 in.)
Combustion Chamber Volume	58.15 cc
Valve Guide Inside Diameter	8 mm (0.315 in.)
Valve Stem-to-Guide Clearance	0.1 mm (0.004 in.)
Intake Valve Seat Angle	30°
Exhaust Valve Seat Angle	45°
Intake Valve Seat Width	1.8 mm (0.07 in.)
Exhaust Valve Seat Width	1.6 mm (0.06 in.)
Cylinder Head Warpage (maximum)	0.05 mm (0.002 in.)

Rocker Arm Clearance (Cold)

Intake	0.10 to 0.15 mm (0.004 to 0.006 in.)
Exhaust	0.20 to 0.25 mm (0.008 to 0.010 in.)

Valve Train

Camshaft End Play	0.05 to 0.13 mm (0.002 to 0.005 in.)
Intake Valve Timing	
Opens	12° BTDC
Closes	52° ABDC
Exhaust Valve Timing	
Opens	52° BBDC
Closes	12° ATDC
Valve Overlap	34°

Valves

Valve Stem Diameter	Exhaust 0.313 Intake 0.314
Intake Valve Head Diameter	44 mm (1.732 in.)
Intake Valve Face Angle	30°
Exhaust Valve Head Diameter	38.5 mm (1.516 in.)
Exhaust Valve Face Angle	45°

Lubrication System

Oil Capacity
- Without Filter Change .... 5.0 liters (5.3 quarts)
- With Filter Change ..... 5.5 liters (5.8 quarts)

Operating Pressure at idle ..... 0.8 bars (12 psi)

Operating Pressure at 3,000 rpm ..... 3.0 bars (44 psi)

Oil Pump-Gear End Clearance
- Minimum ..... 0.05 mm (0.002 in.)
- Maximum ..... 0.12 mm (0.005 in.)

Oil Pump-Gear Body Clearance
- Minimum ..... 0.02 mm (0.001 in.)
- Maximum ..... 0.10 mm (0.004 in.)

CRANKSHAFT SERVICE

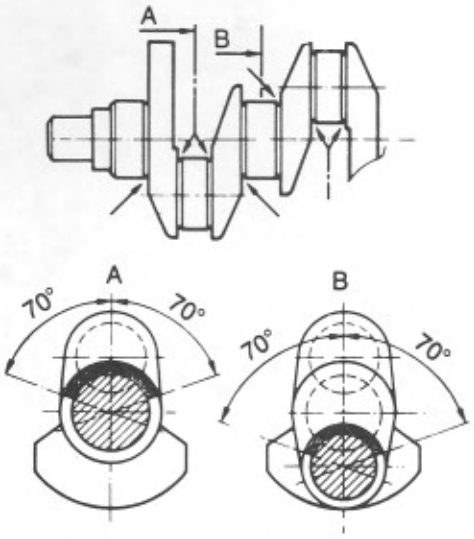
Use a micrometer to measure the main and connecting rod journals for out-of-round or taper conditions.

If the journals are not satisfactory, recondition or replace the crankshaft.

Use replacement bearings that are appropriate for the journal sizes.

RECONDITIONING

After the crankshaft has been ground, the roll-hardened areas on the journals must still remain intact over the 140° zone. The zones are illustrated below (A-rod journal, B-main journal).



ENGINE REMOVE AND REPLACE
REMOVAL PROCEDURE

REMOVE OF DISCONNECT:

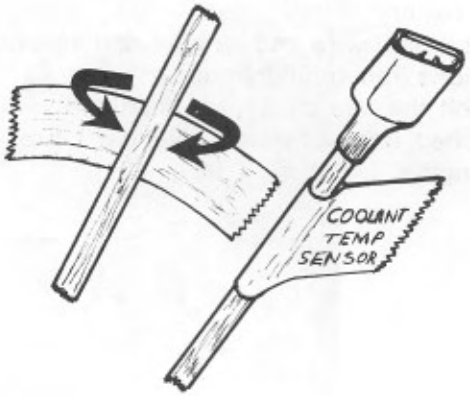
- Battery negative cable
- Heater air intake
- All fasteners and wiring from nosepiece/grill assembly - screws and bolt along upper edge and 2 bolts on each side behind headlight area on inside of fenders; access these from below - unplug lighting from behind.
- Nosepiece
- Belly pan
- Transmission belly pan
- Upper radiator retaining support
- Upper fender connecting crossmember - 2 inner bolts at each end and 2 bolts at each mid-attachment point - one bolt that attaches air flow meter bracket (do not remove air flow meter and bracket).
- Hood cable from fender connecting crossmember - do not loose spring and plastic retainer
- Upper and lower hoses from radiator and drain anti-freeze into a container.
- Vacuum hoses from thermovalve on radiator

CAUTION

It is extremely important to reconnect vacuum hoses, water hoses and electrical wiring correctly.

CAUTION

Exercise extreme care during engine removal, since even minimal flywheel flexplate damage may result in a "no-run" condition.



Hoses and wires may be labeled using an ink pen on masking tape as shown. Labeling makes reconnection simple and accurate. We also advise drawing a reference diagram of connections, since this is easier than tracing each system to verify connections.

Refer to the vehicle emissions label (located on the upper fender connection crossmember) for the emissions system schematic, or see page E11-5.

ENGINE REMOVE AND REPLACE

REMOVAL PROCEDURE

DISCONNECT:

- Front seat both high and low side service valves of air conditioning compressor
- High side hose from A/C compressor leading to condenser
- High side hose self-sealing disconnect joint at condenser
- Unplug electric fan wiring and cut wire tie connectors to fan frame
- Unplug A/C pressure switches
- Radiator and A/C condenser as a complete assembly
- Fan switch box (behind right headlight) and lay aside on left side of compartment
- Bolts that retain rear-front bumper braces to body. Leave these bolted to bumper - 2 bolts on each side.
- Bolts that retain bumper extensions to body
- Six bolts that connect cross member/bumper assembly to body. Remove this as a complete assembly
- Low side hose to A/C compressor
- Air conditioner clutch wire connection
- Hoses to heater, rear motoraid, and surge fill bottle
- Oil hoses to remote oil filter
- Unplug 0_2 sensor
- Remove exhaust lead pipe from cast iron elbow - 4 nuts w/washers
- Unplug engine harness at firewall, behind engine and at breaker plate including main feed cable at dual battery
- Unplug coil wire and all wire and vacuum connections from ignition module
- Unbolt the idle air bypass manifold with hoses attached, unplug fast idle solenoid. Lay assembly on engine.

ENGINE REMOVE AND REPLACE

REMOVAL PROCEDURE

- Supply hose from power steering reservoir to pump. Drain fluid into container.
- Pressure hose from rear of power steering pump
- Engine ground strap
- Air hoses from air flow meter to plastic elbow under intake manifold. Cover open elbow to prevent foreign material from getting into the engine.
- Vacuum hoses for E.G.R. system (behind left headlight area)
- Vacuum hose to brake booster
- Vacuum connections on top of intake manifold for cruise control and charcoal canister
- Vacuum hoses at left rear of engine to charcoal canister and automatic transaxle
- Fuel feed and return hoses at frame rail connections to metal piping. Mark connection for proper hook-up.
- Throttle and cruise cables from engine.
- Flywheel cover behind engine oil pan.
- All 3 torque converter to flexplate bolts
- Motor mount to transaxle mount on right side - 2 bolts rear of oil pan
- Motor mount to transaxle mount on left side - 1 long bolt and lock nut.
- Bolts that hold T.D.C. sensor to flywheel housing. Set sensor aside.

CAUTION

Failure to remove sensor may cause damage to the flywheel.

- Bolts that hold transaxle to engine and starter.

ENGINE REMOVE AND REPLACE

REMOVE PROCEDURE

- Lock nuts that hold motor mount to cross member assembly - one on each side - leave complete mount assemblies on engine.
- Install engine lift fixture or chain to engine.
- Lift engine high enough for motor mount studs to clear crossmember mounts. Place small 2 x 4 inch blocks under lower edges of transaxle.
- Pull engine forward and out of chassis.

CAUTION

Exercise extreme care during engine removal, since even minimal flywheel flexplate damage may result in a "no-run" condition.

ENGINE REMOVAL AND REPLACE
PREPARATION FOR REBUILDING

Remove or Disconnect
- Exhaust manifold
- Alternator
- A/C compressor, power steering pump and complete front bracket assembly.
- Motor mounts
- Dipstick
- Adapter for remote oil filter hoses
- Starter

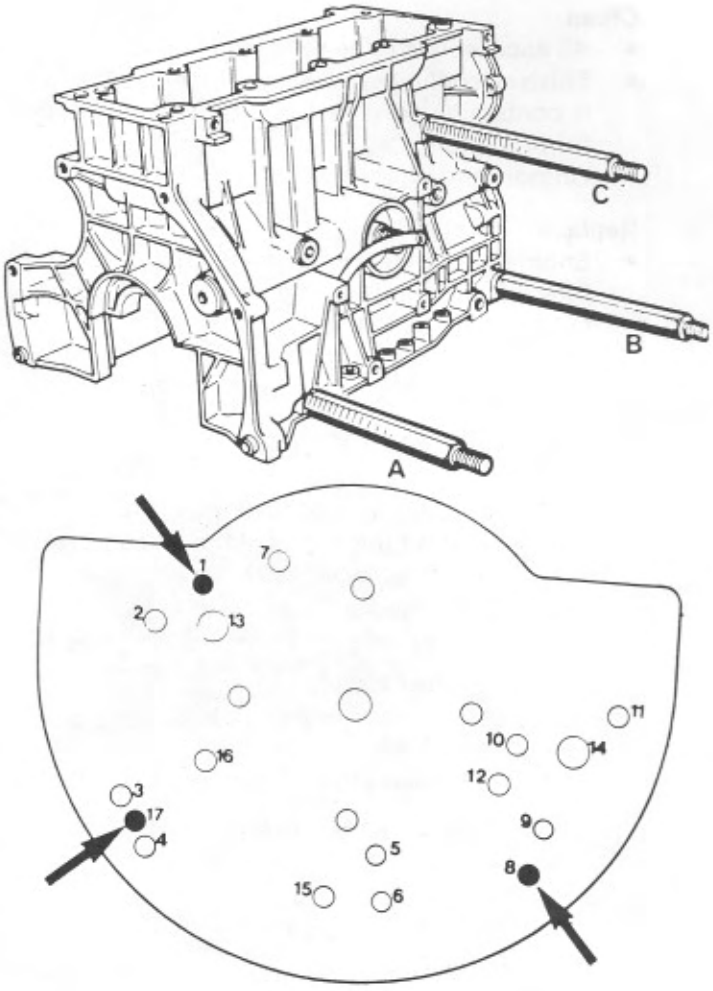
Mounting the Engine to the Dismantling Support

- Screw studs A, B, and C (tool Mot. 792) into their appropriate holes in the cylinder block.
- Place the engine with studs in position to the plate making use of holes (1,8, and 17).

IMPORTANT
This support may be adapted to an existing engine stand.

WARNING

The fixture must be fastened to something that can safely support the weight of the engine without tipping over, which could cause injury to personnel or damage to the engine.



PREPARING ENGINE FOR INSTALLATION

Clean

- All accessories to be reinstalled on engine.
- Flush all cooling system parts including radiator if contaminated (see Cooling System Section for procedure).
- Chassis and underhood area.

Replace

- Engine oil cooler, if equipped (located above oil filter), if engine had any kind of metallic part failure or fluids in the oil.

> **CAUTION**
>
> Serious internal engine damage will occur to a new or rebuilt engine if the oil cooler is contaminated and not replaced. When in doubt ... replace.

- Engine oil filter
- Fuel filter - make sure fuel in tank is not contaminated.
- Air filter element (after engine is installed).

Inspect and Replace If Necessary

- Serpentine belt.
- Power steering belt.
- Surge/fill bottle cap (See Cooling System Section for procedure)
- All hoses and clamps.
- Manifolds for warpage
- Exhaust pipe sealing surface for cracks and irregularity.
- Oil hoses from the engine to the remote filter base.
- All vacuum hoses.
- Flex plate for cracks and irregularities.

  IMPORTANT

  Make sure engine-to-bell housing alignment sleeves are in place in lower bolt holes on each side.

  Make sure starter-to-bell housing alignment sleeve is in place and tightened.

  Leave starter loose to be aligned and tightened after engine is installed.

Install or Connect

- All items removed in "Preparing Engine for Rebuilding" using new gaskets where required.

Make sure that the flywheel flexplate aligns with the torque converter bolt holes and is not damaged during reinstallation of the engine.

INSTALLATION PROCEDURE

Install or Connect

- Connect and install all parts and assemblies in the reverse order of that described in "Engine Removal Procedure" using new gaskets, seals, etc., where required.

Tighten

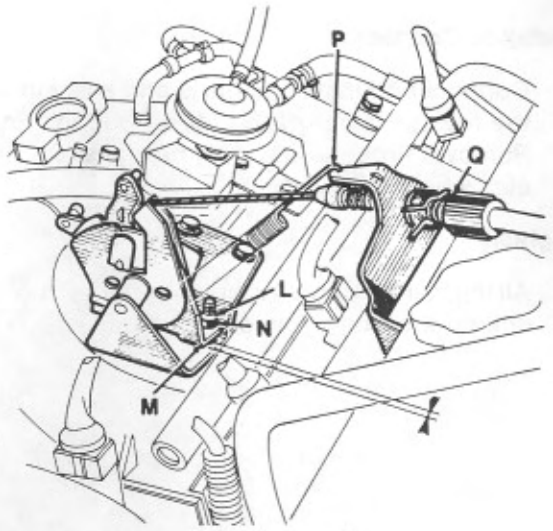
- All the starter mounting bolts on the bell housing and on the side of the engine block.

FINAL PROCEDURES AFTER INSTALLATION

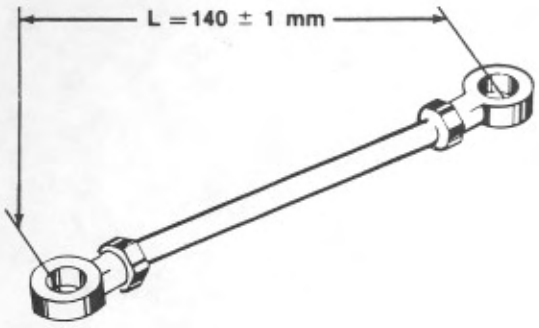
Adjust

Check the operation of the throttle cable.

- Depress the accelerator pedal to the floor two or three times.
- Hold the pedal to the floor and measure the clearance between the throttle stop screw (L) and the return support (M)
- The clearance must be approximately 0.1 mm (.004 in). If not, check the length of the throttle body connecting linkage.



- Adjust the link to 140 mm ± 1 mm (5.49 ± 0.04 in.) as shown.

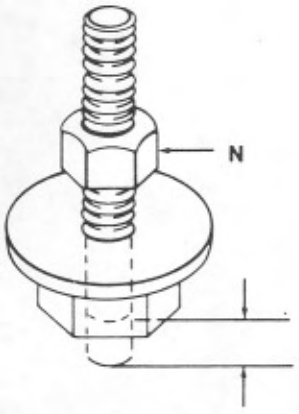


- If the position of the throttle stop screw (L) is accidently changed, it can be corrected by loosening the adjustment nut (N) and turning the screw to protrude 1 mm (0.04 in) below the weld nut.
- Depress the accelerator pedal to the floor and adjust the clearance between the trottle stop screw (L) and the support (M) for 0.1 mm (0.004 in).

NOTE: Apply a small amount of Loctite® or equivalant to the throttle stop screw before tightening the adjustment nut.

- Tighten the adjustment nut
- With the accelerator pedal depressed to the floor, the return (compensation) spring (P) must be compressed 5 mm (0.19 in). If not, change the position of the clip (Q).

NOTE: Ensure that the return spring (P) is correctly installed.



ENGINE REMOVE AND REPLACE
FINAL PROCEDURES AFTER INSTALLATION

IMPORTANT

- All rubber shrouds and shields must be in place.
- Use correct motor oil (See specifications section of vehicle operators manual)
- Use correct type and mixture of antifreeze.
- Make sure cooling system is properly bled of air and filled to proper level (See Cooling System, Section F).

> **CAUTION**
>
> It is extremely necessary to make sure the cooling system has all the air bled out of it and contains the proper level of coolant. Serious engine damage due to overheating will occur if this is not properly done.

- Pressure check cooling system for leaks (See Cooling System, Section F).
- All wiring and grounds must be properly connected.
- Check headlight alignment
- Air conditioning should be properly charged and working correctly (See Air Conditioning, Section P).
- Make sure that all reinstalled body parts and bumper fit correctly and hood latch pin properly aligns with the fender connecting crossmember. Adjust hood latch pin if necessary.

When the engine is reinstalled in the vehicle:

- Adjust all controls.
- Perform all functional checks as prescribed in subsection E10 to determine that all systems are adjusted and operating properly.
- Reset integrator voltage adjustment at air flow meter and reinstall a new tamper-proof plug.

ENGINE OVERHAUL & REBUILD
GENERAL INFORMATION

MATERIAL

TYPE	UNIT CONCERNED
Parts cleaner solvent	Component cleaning
Gasket seal solvent	Cleaning cylinder head joint face
Petroleum Jelly	Clutch shaft and drive shaft splines
Loctite® (or equivalent)	Bolts for flywheel, crankshaft pulley, intermediate shaft cover
Loctite® (or equivalent)	Inlet manifold studs
Loctite® (or equivalent)	Water pump studs and bolts
Loctite® (or equivalent)	Pilot bearing in crankshaft
Loctite® (or equivalent)	Flywheel thrust face on crankshaft side
Heatproof sealer	Exhaust pipe joints

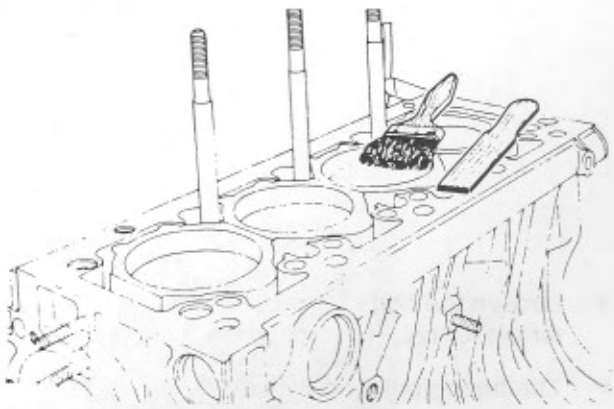
IMPORTANT

Components To Be Replaced at Each Dismantling

- Flywheel bolts
- Flywheel bolts lockplate
- Connecting rod crankshaft bolts
- Rocker shaft oil filter
- All gaskets and seals

Cleaning Engine in Place

- Protect the timing belt and alternator from water and cleaning fluid.
- Take care not to let any water enter the intake manifold.
- Clean upper cylinder block surface when replacing cylinder
- Great care must be taken with this operation to prevent foreign matter from entering the rocker shaft oil channels in the cylinder block and head.
- If the above advice is disregarded, the rocker shaft filter or rocker arm oil jet holes may become blocked leading to rapid cam and rocker arm finger wear.



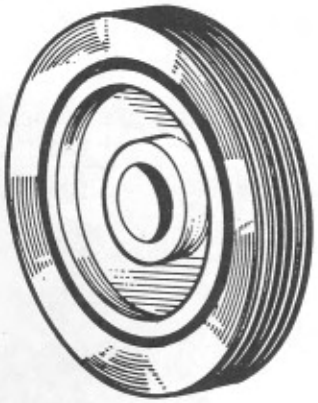
Installing Threaded Inserts

- Threaded holes in all engine components may be restored using thread inserts such as HeliCoil® or equivalent.

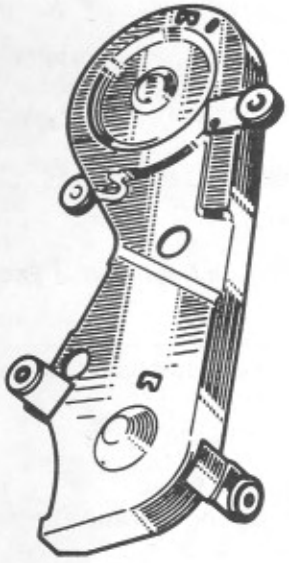
ENGINE DISASSEMBLY

REMOVE OR DISCONNECT

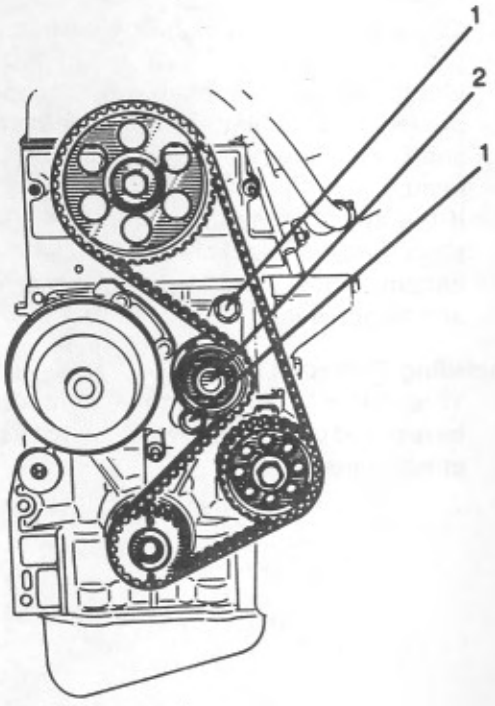
- Crankshaft (vibration damper) pulley



- The intake and exhaust manifolds, and the brackets.



- Timing belt cover

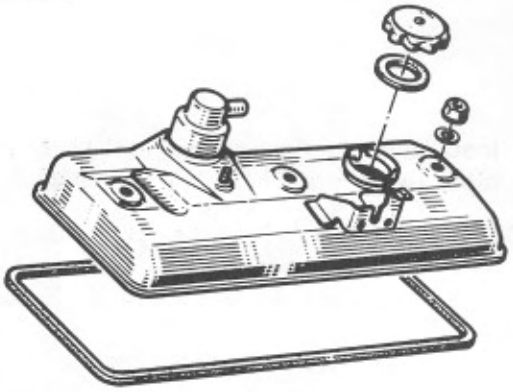


- Loosen the bolts (1) and release the timing belt tensioner (2). Then retighten bolts (1).
- The timing belt and discard.
- Belt tightener
- Water pump
- Thermostat housing

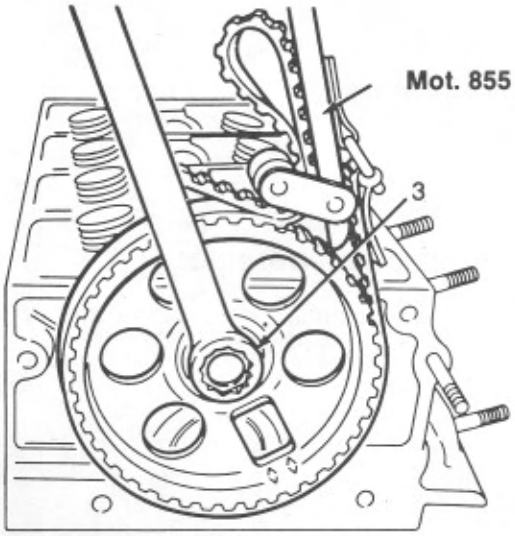
ENGINE DISASSEMBLY

REMOVE OR DISCONNECT

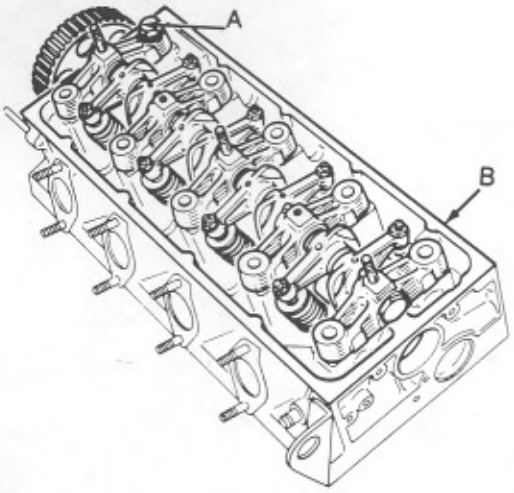
- Cylinder head cover.
- Distributor assemby.



- Camshaft sprocket retaining nut (3)
- Hold the camshaft sprocket with Sprocket Holding Tool Mot. 855.
- Camshaft sprocket
- Woodruff key

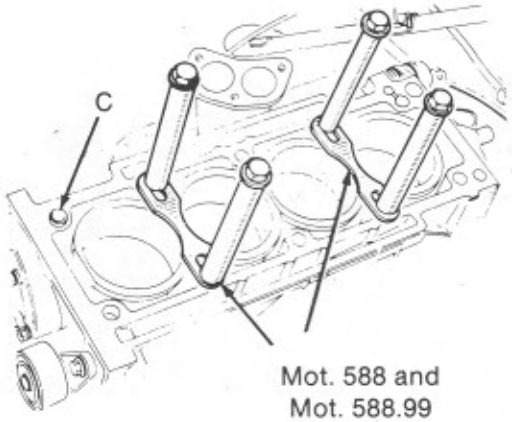


- Loosen rocker arm adjustment cap nuts.
- All cylinder head bolts except bolt (A).
- Pivot the cylinder head on bolt (A) by placing a block of wood at point (B) and tapping it with a hammer.
- Cylinder head bolt (A).
- Rocker assembly.
- Camshaft
- Cylinder head assembly



- Install cylinder liner clamps tool on the cylinder block using Mot. 588 and Mot. 588.99.

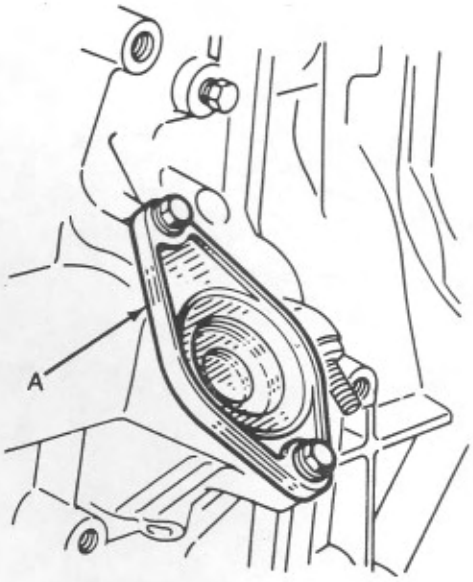
NOTE: The dowel (C) in the cylinder block is the cylinder head locator.



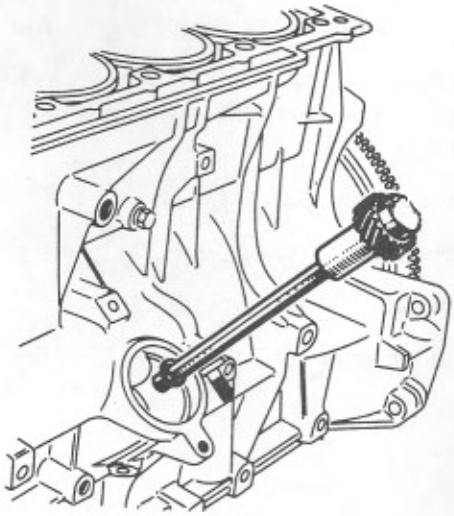
Mot. 588 and
Mot. 588.99

REMOVE OR DISCONNECT

- The cover plate (A) for access to the oil pump drive gear and shaft.



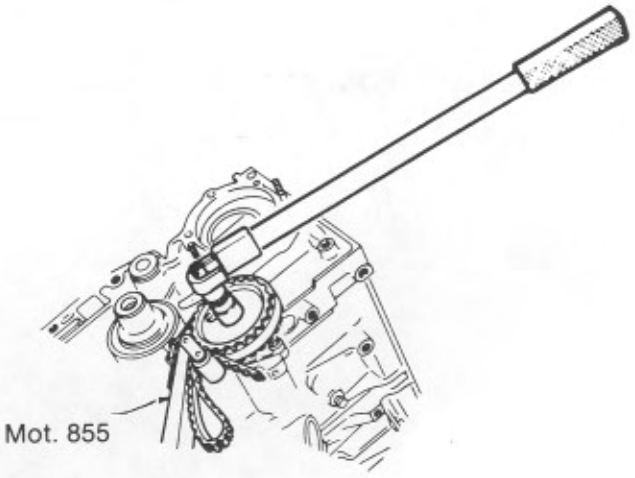
- The oil pump drive gear and shaft.

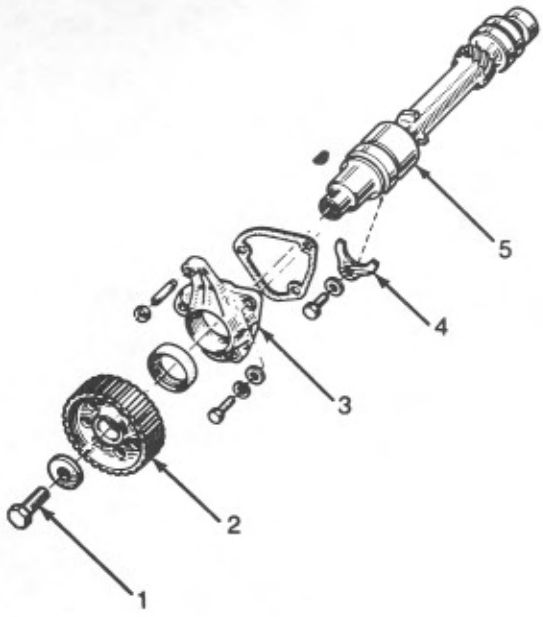


ENGINE DISASSEMBLY

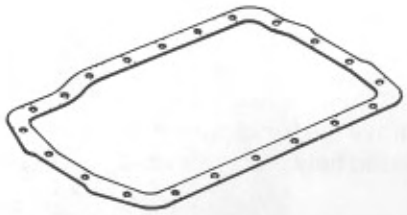
REMOVE OR DISCONNECT

- Intermediate drive shaft sprocket retaining nut (1) using the holding tool (Mot. 855) and a socket/breaker bar assembly.

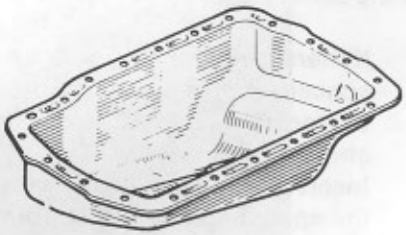




- Woodruff key from shaft
- Seal housing (3) - remove and discard used seal
- Shaft retaining fork (4)
- Intermediate shaft.

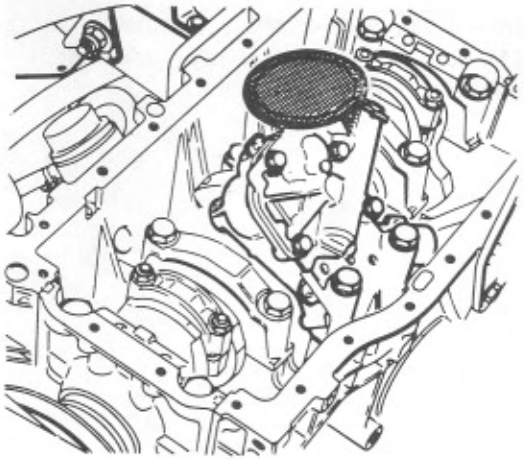


- Oil pan and gasket

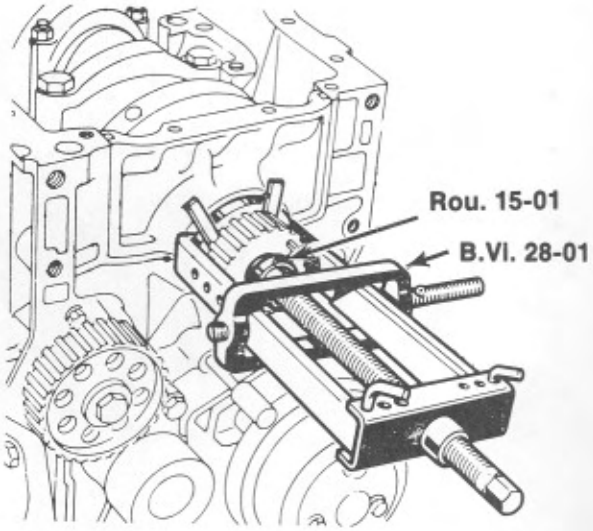


REMOVE OR DISCONNECT

- Oil pump

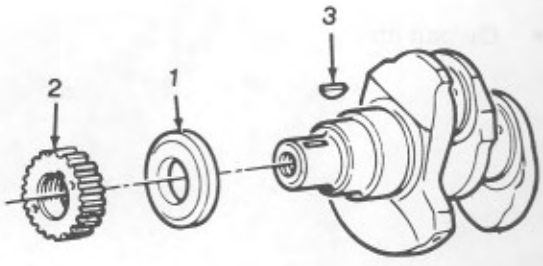


- Crankshaft timing sprocket
- Position sprocket removal tool B.Vi. 28-01 (with shaft end protector tool Rou. 15-01) with the jaws inserted behind the spacer (1).
- Pull the washer (1) and sprocket (2) forward from the crankshaft until the spacer stops at the key (3).
- Do not force the spacer beyond this position.



- Remove the tools, then install them with the jaws inserted between the washer (1) and the sprocket (2).
- Pull the sprocket (2) from the crankshaft.

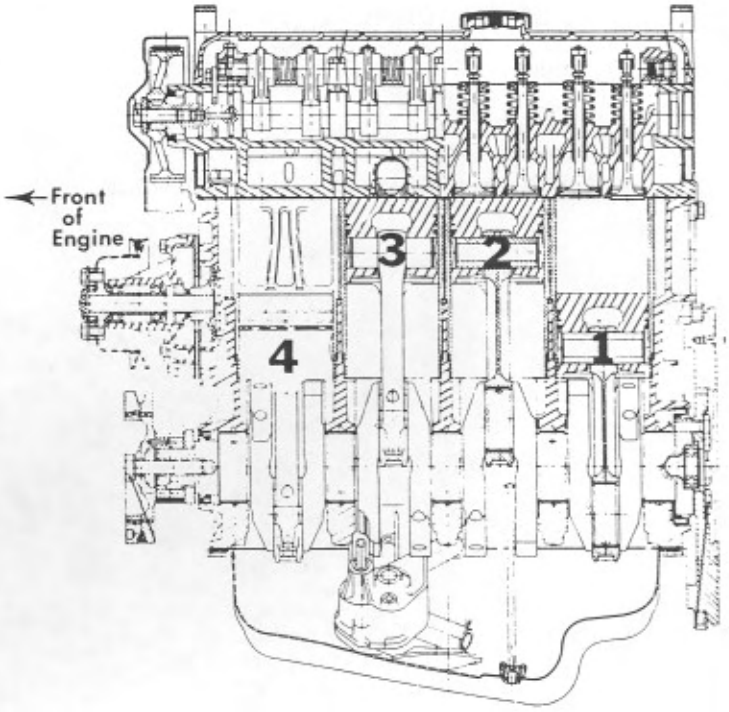
NOTE: If there is not enough space between the spacer (1) and the sprocket (2) to insert the tool jaws, insert 2 mm (0.078 in) metal strips between the washer and sprocket. Insert the jaws behind the washer and pull the spacer and sprocket from the crankshaft until the washer stops at the key.



ENGINE DISASSEMBLY

IMPORTANT

Hand stamp the cylinder number on the upper surface of each piston and sleeve. The pistons, sleeves, and connecting rods are not numbered. The pistons and sleeves should be reassembled in the same order that they were removed if they are to be reused. The cylinders are numbered 4 through 1 from front to back.

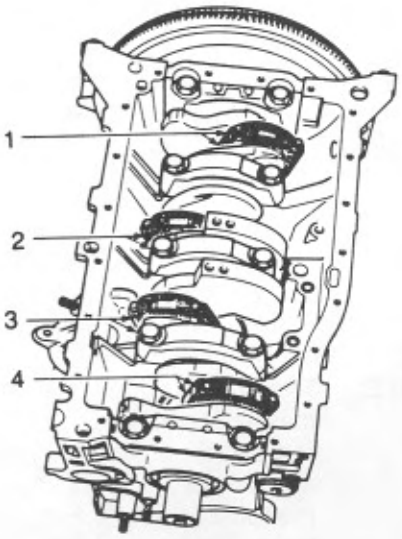


CAUTION

The rod and main bearing caps must be kept in the order they were disassembled. These items are not marked! This must be done to insure proper reassembly. Reminder: Cylinders are designated 4 to 1 from front to rear - #4 being closest to the timing belt.

REMOVE OR DISCONNECT

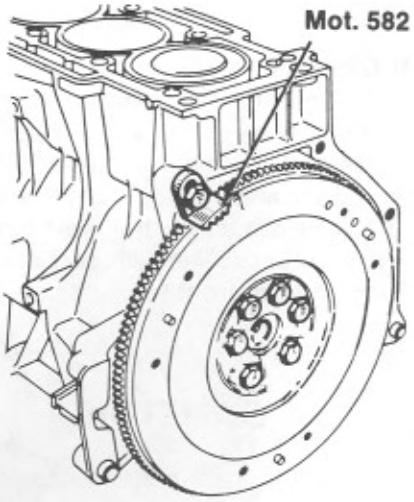
- Connecting rod bearing cap nuts and bearing inserts.
- Each connecting rod, cylinder liner and piston assembly as a unit from the cylinder block.



- Piston and connecting rod assemblies from the cylinder liners.

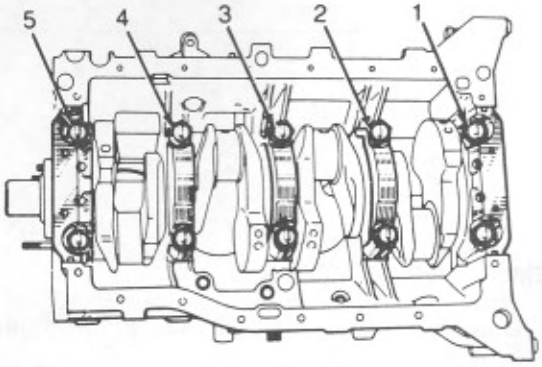
NOTE: Each piston and cylinder liner are matched as a set at the time of manufacture. Mark each piston and liner to ensure that they remain a matched set. This is especially important if the pistons and sleeves are to be reused but also applies to new assemblies.

ENGINE DISASSEMBLY



REMOVE OR DISCONNECT

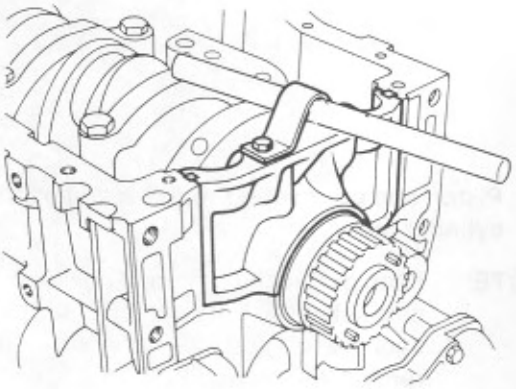
- Flywheel
  - Install flywheel holding plate to prevent the crankshaft from turning and removing the flywheel/drive plate from the crankshaft.



- Main bearing bolts and caps.

NOTE: The number one cylinder is located at the flywheel/drive plate end of the cylinder block.

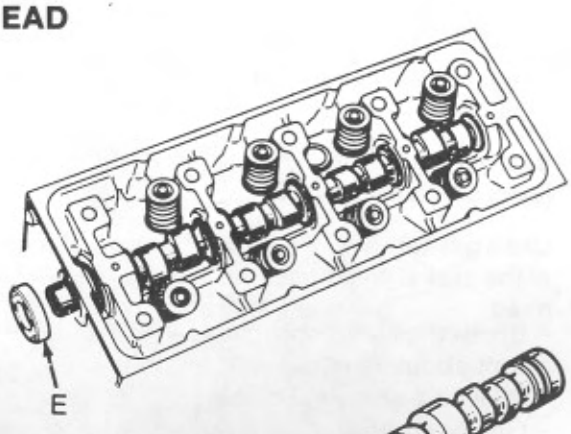
NOTE: The number one (1) and number five (5) main bearing caps may be difficult to remove. For a removal aid, fabricate a tool as illustrated using 1/8" strap iron. Attach the tool to each bearing cap and use a pry bar to remove the bearing caps. Thoroughly clean the sealant from the sides of the bearing caps.



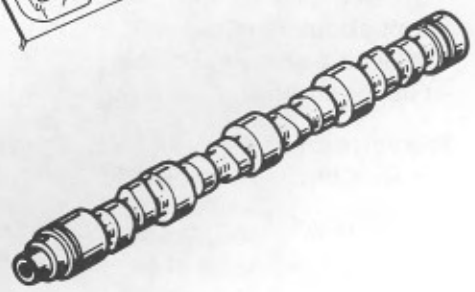
- The bearing inserts from the caps.
- The crankshaft and bearing upper inserts.

REMOVE OR DISCONNECT

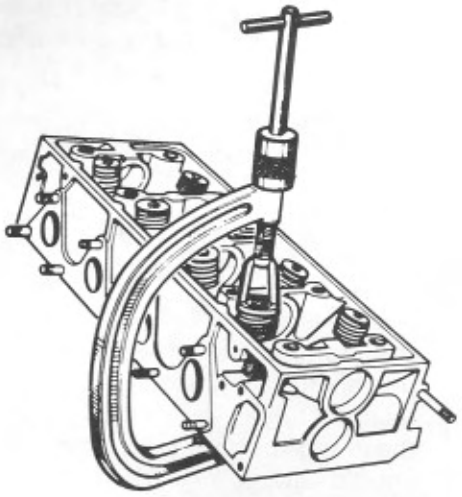
- Camshaft oil seal (E) by prying it out gently with a small pry tool.



> **CAUTION**
>
> When removing the camshaft oil seal, use care to prevent scratching the oil seal contact surface on the camshaft.

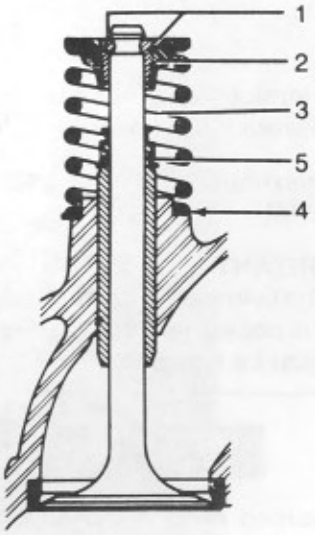


- Camshaft



- Compress each valve spring with a valve spring compressor and remove:

  valve locks (1)
  retainer (2)
  valve spring (3)
  washer (4)
  valve stem oil deflector (5)



- Remove the valves from the cylinder head.

CYLINDER HEAD

CLEANING

- Clean all components and keep matched items together.
- It is very important not to scrape the gasket faces on aluminum parts.
- Use a gasket solvent solution to disolve any part of the gasket still remaining stuck to the cylinder head.
  - Brush the liquid onto the area to be cleaned;
  - wait about 10 minutes, then lift the remnants off with a wooden scraping tool.
  - Gloves should be worn during this operation.
- The valve chambers can be cleaned with a very fine wire brush in an electric drill.
- A soft abrasive scouring pad such as Scotchbrite® or equivalent may be used with solvent to clean surfaces.
- All grease, oil, carbon should be removed with a good quality cleaning solvent and thoroughly dried with compressed air.
- Thoroughly clean and flush camshaft and its oil passages. Dry with compressed air.

WARNING

Always keep sparks and open flame away from commerical solvents and cleaners to prevent fire from occuring. Always follow manufacturer's instructions when using these types of products. Safety eyewear should always be worn when working with compressed air.

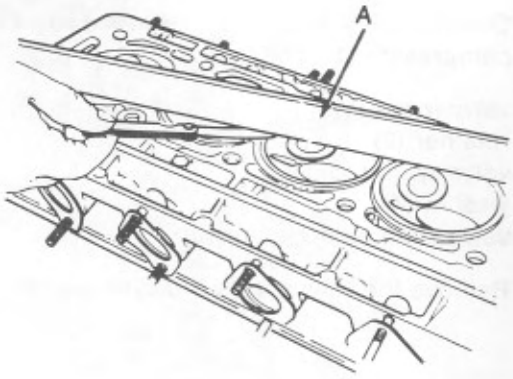
MEASURE

- Use a straightedge (A) and a set of feeler gauges to measure the cylinder head for flatness.

  The maximum allowable distortion is 0.05 mm (0.002 in)

IMPORTANT

- The cylinder head must not be resurfaced. If it is not within the distortion specification, it must be replaced.



WARNING

A warped head could be caused by an overheat condition. Check cooling system (See Section F - Cooling System).

CYLINDER HEAD

INSPECT

- Inspect head for heat and stress cracks.
- Inspect valve seats for excessive wear and cracks.
- Inspect valve guides.
- Inspect cam bearing bores for scoring and wear. If the bores are excessively scored or worn, replace the cylinder head.
- Inspect camshaft lobes and journals for excessive wear and scoring. If the lobes are excessively worn or scored, be sure to inspect the rocker arms for similar wear.
- Inspect for cracks in the combustion chambers and valve ports. Inspect for cracks in the gasket surfaces at each coolant passage.
- Inspect the valves for burned, cracked or warped heads.
- Inspect for scuffed or bent valve stems.
- Replace all damaged valves.

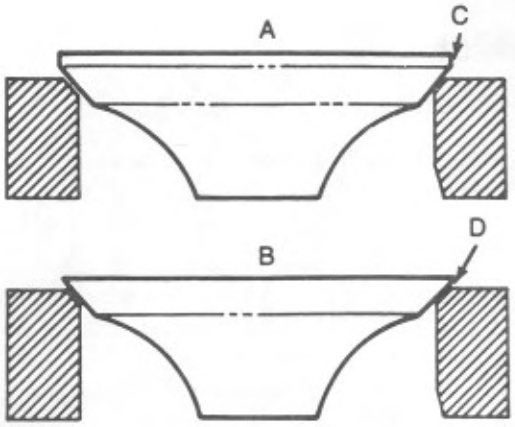
VALVE SEAT REFACING

Install the correct size pilot in each valve stem guide bore and reface each valve seat to the specified angle. Use a dressing stone that is in good condition.

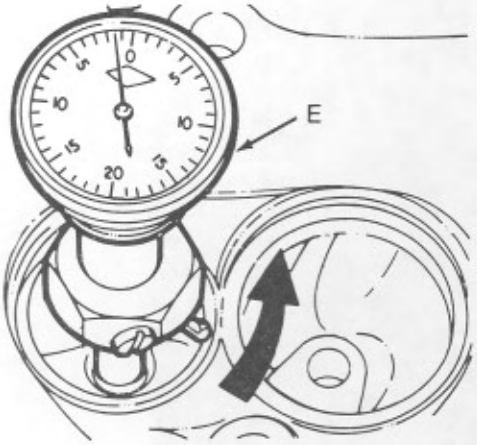
Use tapered stones to obtain the specified seat widths when necessary.

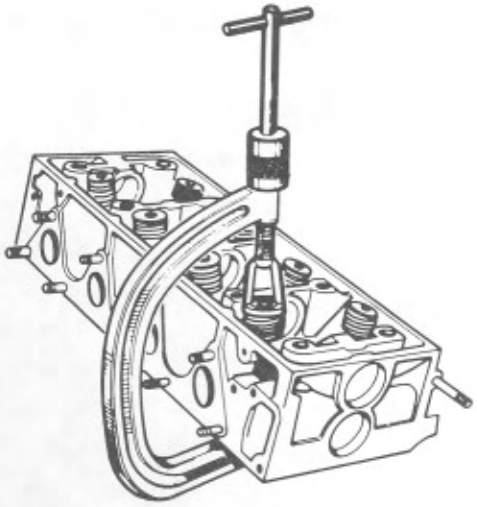
Refer to the Engine Specifications chart.

Measure the seat runout with a dial indicator (E) and control it to a maximum of 0.0635 mm (0.0025 in).



A. Correct Valve Facing
B. Incorrect Valve Facing
C. Valve Margin
D. No Valve Margin





VALVE REFACING

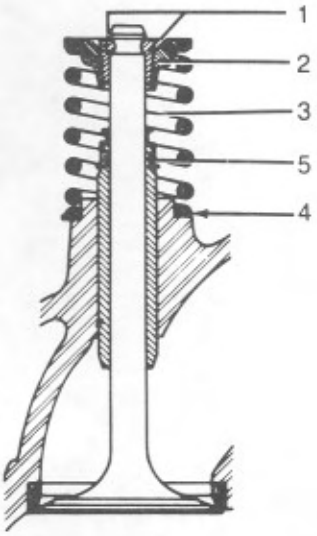
The valves cannot be refaced.

If any valve faces are excessively worn or the facing is incorrect, they must be replaced.

VALVE INSTALLATION

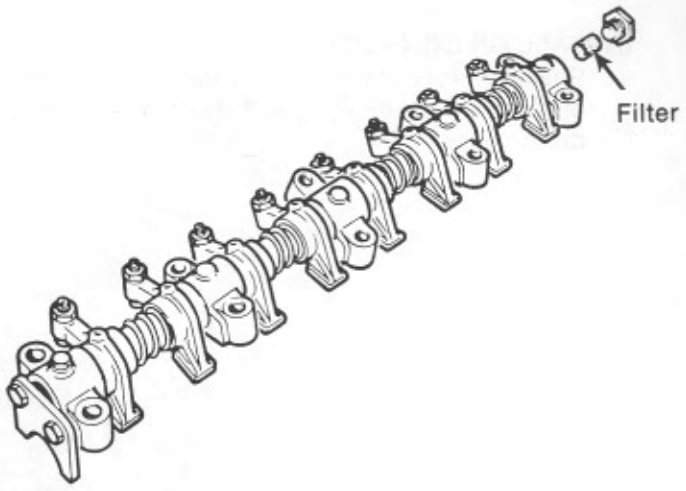
Install the valves, replacement valve stem oil deflectors (5), valve spring washers (4), valve springs (3), retainers (2) and locks (1).

Use valve spring compressor to compress the valve springs.



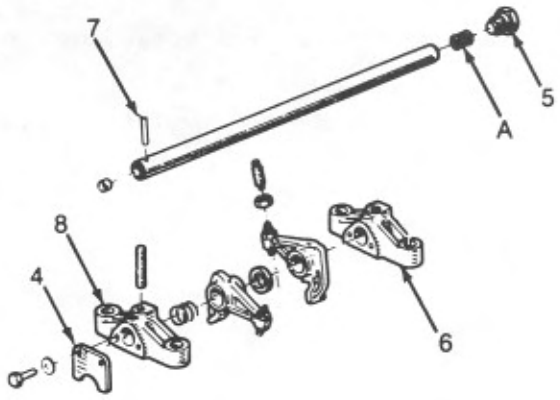
ROCKER SHAFT

IMPORTANT
The rocker shaft oil filter must be changed every 64,360 km (40,000 miles) and whenever repair operations are undertaken as a result of metal particles being found in suspension in the oil. If the above incident occurs, then the engine oil and main oil filter should be changed as well. Use Clamp Tool Mot. 445 on the oil filter.



REMOVE OR DISCONNECT

- the camshaft thrust plate (4)
- the end plug (5)
- the filter (A)
- the number one shaft bearing (6)
- the retaining pin (7)
- the number five shaft bearing (8)
- the remaining shaft bearings and rocker arms
- retain all the components in the order removed to facilitate installation at the original locations.



Clean

- All arms and springs with solvent and dry with compressed air
- Shaft inside and out

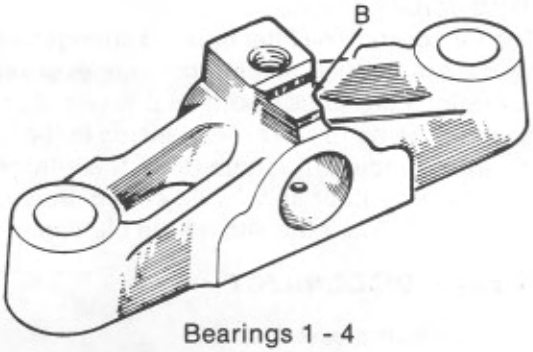
Inspect

- Arms for excessive wear
- Shaft for wear and grooves

ROCKER SHAFT

INSTALL OR CONNECT

- Reassemble rocker shaft assembly in the reverse order of disassembly. Lubricate with engine oil during assembly.

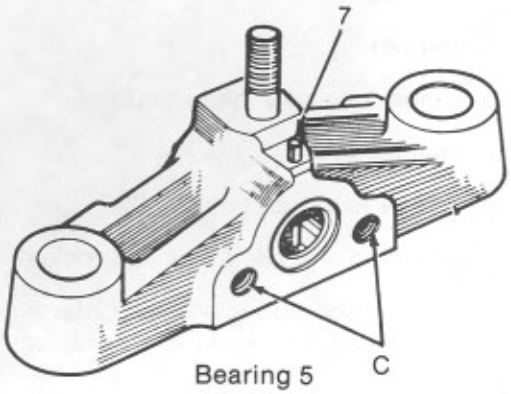


Bearings 1 - 4

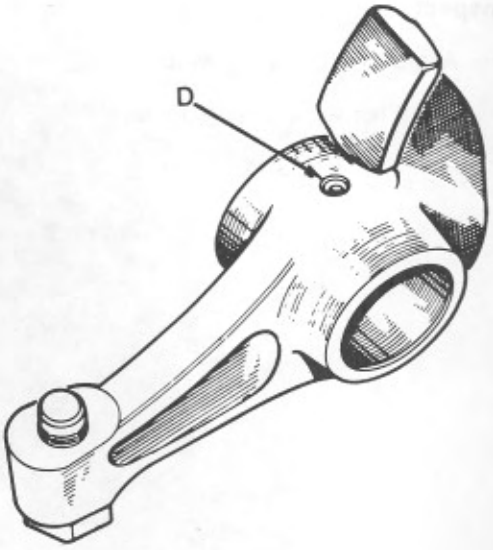
NOTE: Shaft bearings number one, two, three and four (B) are identical. Shaft bearing number five has two threaded holes (C) for retaining the camshaft thrust plate and a hole for the retaining pin (7).

The intake and exhaust valve rocker arms are identical.

The oil hole (D) in each rocker arm is for camshaft lubrication.



Bearing 5



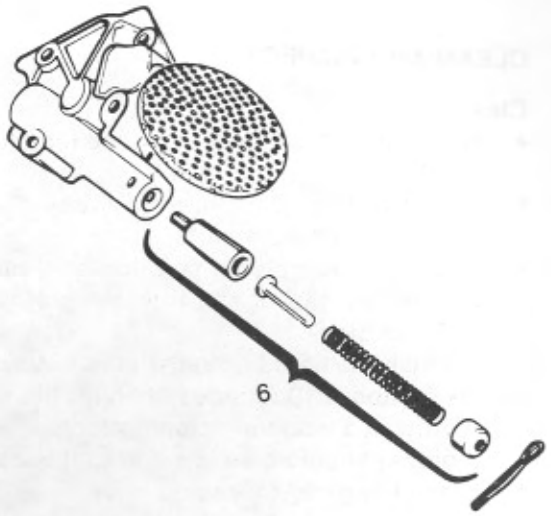
Tighten

Torque tighten the plug to 2 daNm (15 lb./ft.) This torque setting must not be exceeded because the rocker shaft is only prevented from turning by the set bolt in bearing 5.

OIL PUMP

REMOVE OR DISCONNECT

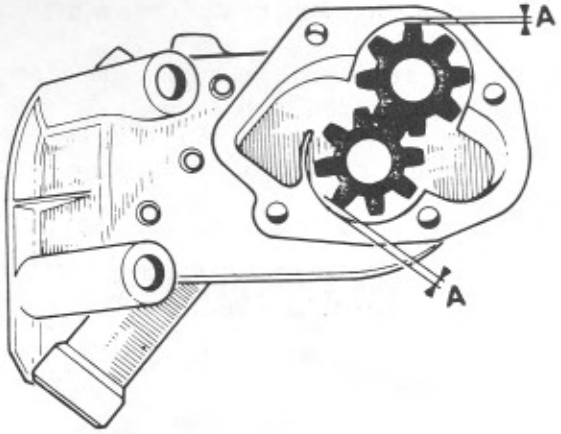
- the pressure relief valve (6) from the pump housing.
- oil pump housing cover



INSPECT

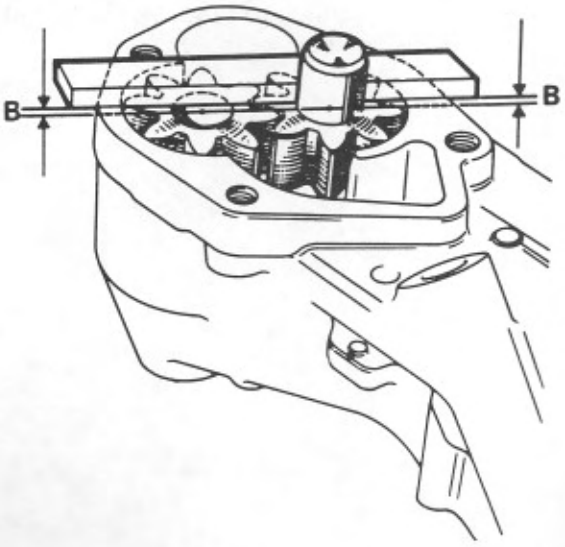
Measure the oil pump gear-to-housing clearance (A) with a feeler gauge.

- minimum clearance - 0.05 mm (0.002 in)
- maximum clearance - 0.12 mm (0.005 in)



Measure the gear end-clearance (B) with a straight-edge and feeler gauge.

- minimum clearance - 0.02 mm (0.001 in)
- maximum clearance - 0.10 mm (0.004 in)



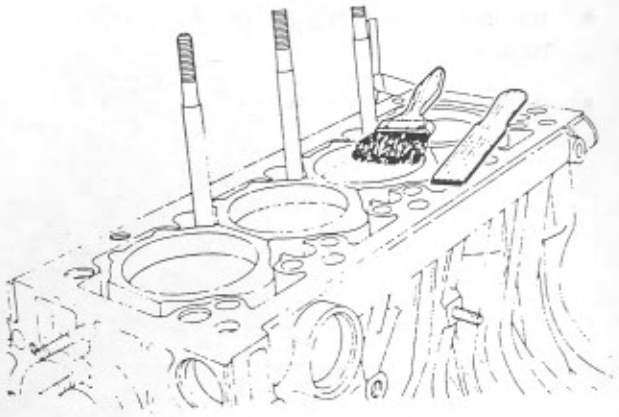
INSTALL OR CONNECT

- Oil pump housing cover

CLEAN AND INSPECT

Clean

- Clean all components and keep matched items together
- It is very important not to scrape the gasket faces on aluminum parts.
- Use a gasket solvent solution to dissolve any part of the gasket still remaining stuck to the cylinder block.
  - Brush the liquid onto the area to be cleaned;
  - wait about 10 minutes, then lift the remnants off with a wooden scraping tool
  - gloves should be worn during this operation.
- Clean the gasket faces on:
  - cylinder head
  - and sleeves
- A soft abrasive scouring pad such as Scotch-brite® or equivalent may be used with solvent to clean surfaces.
- Clean the cylinder block, paying special attention to the lubrication channels.
- Blow dry with compressed air making sure all oil, solvent, and foreign particles are removed.



WARNING

Always wear safety eyewear when working with compressed air.

IMPORTANT

Always clean new machined parts in the same manner as reusable parts to make sure that no foreign material is on or inside.

CYLINDER BLOCK & RELATED PARTS — CLEAN & INSPECT

INSPECT

Cylinder block and related parts inspection

BLOCK

- Check upper cylinder block for warpage. If over **.002"**, the block must be replaced.
- Check for cracks and irregularities in and around all openings, bolt holes and on surfaces.

> **CAUTION**
>
> A warped block could be caused by a cooling system malfunction. Check thoroughly (See Section F, Cooling System).

CRANKSHAFT

- Check for: Evidence of excessive overheating. If found, replace crankshaft since the heat treatment has probably been destroyed.

  Check for: Scoring of bearing journals.

  Check: Oil seal contact surface for roughness or grooving.

NOTE: Any imperfections of the oil seal contact surface will result in oil leakage at this point. Slight ridges on the oil seal contact area may be cleaned up with emery cloth and crocus cloth. If the grooves are too deep, the crankshaft must be replaced.

- Inspect for wear of thrust washer surface area.
- Measure all journals - see specifications in General Section.

NOTE: Slight surface imperfection can be "cleaned up" by using crocus cloth on the journals. See "General Section" for crankshaft reconditioning.

MAIN AND CONNECTING ROD BEARINGS

If these are to be reused, check as follows:

INSPECT

- Inspect for excessive grooving, wear through alumunim tin coating, and foreign material embedded in bearing surfaces.
- Inspect the backs of the bearing shells for bright spots which indicate they have been moving in the bearing caps or bearing supports. If spots are present, discard bearings.

NOTE: Bearing failure may be the result of oil deterioration (acid formation), oil contamination, loss of oil pressure or insufficient oil level. An oil analysis may be required to determine actual cause of the failure.

> **CAUTION**
>
> Alway discard bearings if oil has been contaminated with antifreeze or metallic particles from internal engine component failure. Always use lubricating oils that meet the recommended specifications and viscosity. See Maintenance and Lubrication Section of this manual or the Vehicle Owner's Manual.

CYLINDER BLOCK & RELATED PARTS — CLEAN & INSPECT

PISTONS AND SLEEVES

If these are to be reused, perform the following:

IMPORTANT
Failed or discarded parts should be inspected to determine cause of failure.

Clean

- Pistons and sleeves with solvent and dry them with compressed air.
- Ring grooves with a suitable tool or a piece of an old compression ring that has been ground to a bevel edge.

NOTE: Only the top of the piston may be cleaned with a wire brush to remove carbon deposits. The top crown of the piston to the edge of the wrist pin may also be soaked with a multi-purpose household detergent such as Mr. Clean® or equivalent to aid in removal of carbon deposits. DO NOT wire brush the skirts of the pistons under any circumstances.

- Inside surfaces of the piston and the oil drain holes in the ring groove area. Exercise care to avoid enlarging the holes while cleaning them.
- Cylinder liners inside and out. Remove all carbon deposits. A wire brush may be used.

WARNING

Always wear safety eyewear when working with compressed air.

INSPECT

- Cylinder liner for excessive out-of-round, taper, or high spots which could cause failure of the piston.
- Sealing areas on top and around the bottom of the liner for wear, cracks, erosion, or any irregular condition.
- Pistons for score marks, cracks, damaged ring groove lands or indications of overheating. Any piston that has been severely scored or overheated must be replaced. Piston sleeves must be replaced in matched sets. Single piston/sleeve replacement is not acceptable. Indications of overheating or burned spots on the piston may be the result of an obstruction in the connecting rod oil passage. Be sure to check for cracks on the inside areas of the piston.

CAUTION

Excessively worn or scored pistons, rings and cylinder liners may be an indication of abnormal maintenance or operating conditions which should be corrected to avoid recurrence of failure.

In addition to performing proper maintenance, use of correct types of lubrication filters, fuel filters and air filters will reduce abrasive particles and other foreign materials introduced into the cylinders and oil passages, which will in turn reduce the rate of engine wear.

Always insist on and use oil filters recommended by Winnebago Industries. The wrong filter could cause serious internal engine damage due to improper oil flow characteristics and by-pass functions.

Always maintain lubricating oils and engine coolant at the proper levels to prevent engine overheating.

Extended periods of engine idling and/or use of improper lubricating oil should be avoided, since a heavy formation of carbon may result causing piston rings to stick.

A used cylinder liner must be honed to break the glaze which results after long periods of operation. This insures good "seating" between the liner wall and the new piston rings. The honed/deglazed cylinder liner must meet specifications before it can be reused. See specifications in "General Information", Subsection E1.

The top of the liner must also be "ridge-reamed" to prevent ridge impact by new compression rings, which could result in ring breakage.

Connecting Rods

Clean

- Connecting rod with solvent and dry with compressed air. Blow compressed air through the oil passage in the connecting rod to be sure it is clear of obstructions.

INSPECT

- Connecting rod for cracks and worn or irregular bearing areas. Replace the rods if the metal has changed colors due to overheating.

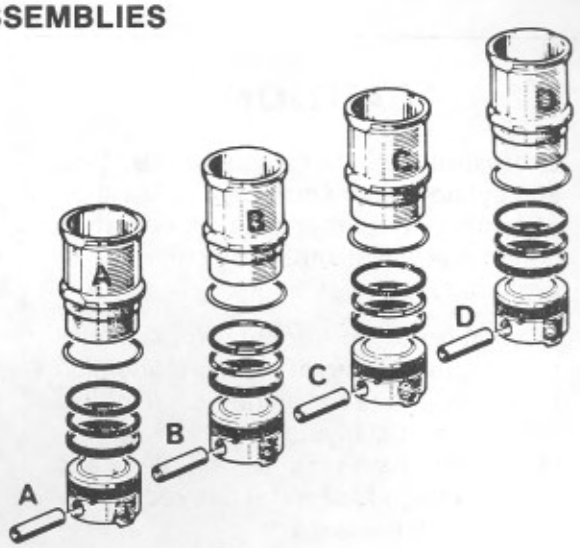
NOTE: If new connecting rods are required, stamp the cylinder number on the connecting rod and cap.

PISTON SLEEVE ASSEMBLIES

REMOVE OR DISCONNECT

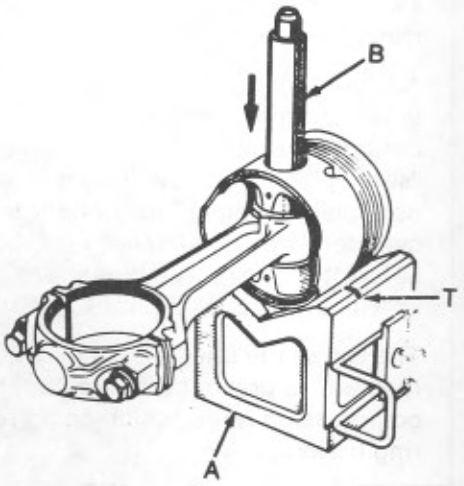
- Sleeves from piston - connecting rod assemblies.
- Rings from pistons.

IMPORTANT
The piston pins are pressed into the connecting rods and rotate freely in the piston bores. To remove and install the piston pins, use Piston Pin Removal and Installation Tool Set Mot. 574-07.



Kit Consists of:
A. Support Block
B. Extraction Mandrel
C. Guides
D. Insertion Mandrels

The block has two (2) grooves (T) for the purpose of alignment.



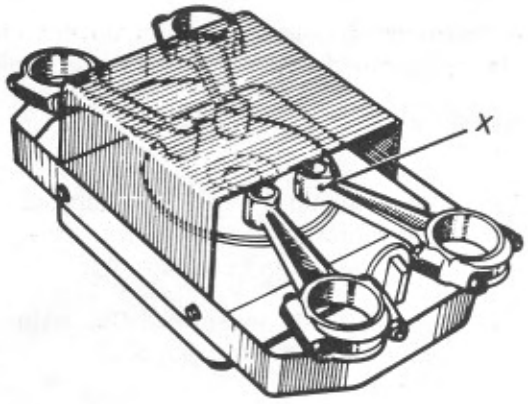
Press each piston pin out of each connecting rod with the extraction mandrel (B).

NOTE: The support block and extraction mandrel are part of the tool set.

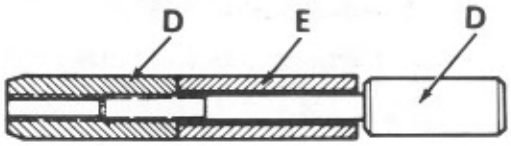
REASSEMBLY

- Place the piston pin bore end (X) of the connecting rods on a 1500 watt hotplate.
- Ensure that they lay square on the hotplate.
- Place a small piece of solder on each connecting rod end to be used as a temperature guide.

NOTE: The solder should have melting point of approximately 250° C (480° F).

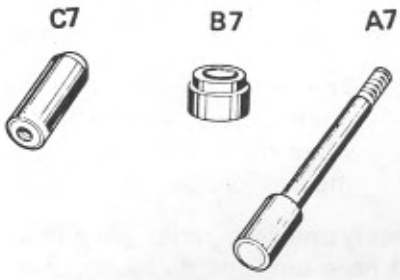


- Heat the connecting rod ends until the solder liquifies.
- Insert and ensure that each replacement piston pin rotates freely in its respective piston bore.



- Install a replacement piston pin (E) in the applicable size insertion mandrel and guide (D).
- Do not tighten. The piston pin must be free to move between the mandrel and the guide.

NOTE: The diameter is stamped on each insertion mandrel and thrust collar.



Tool Mot. 574-07

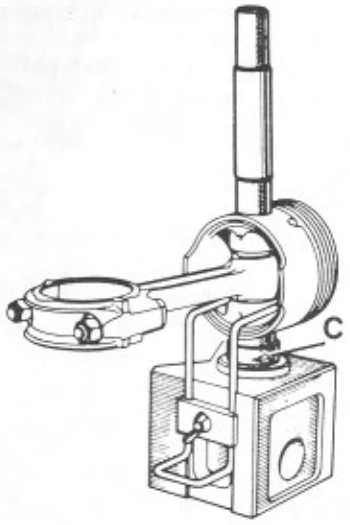
Insertion mandrels used are marked as shown:

REASSEMBLY

- Install a thrust collar (C), which corresponds to the piston pin diameter, on the support block.
- Clamp a piston to the support block with the clip.

NOTE: When installed, the arrow on the piston top must face toward the flywheel/drive plate end of the cylinder block.

- The recess on the outside of the piston bore must rest on the thrust collar (C).



- The following installation procedure must be performed quickly for each connecting rod to ensure that the heat loss is kept to a minimum.

WARNING

The connecting rods are HOT. Use protective hand wear and exercise care during installation.

When the solder liquifies and becomes a small drop:

- wipe off the solder
- insert the guide (with the piston pin and mandrel) into the piston bore.
- position a connecting rod in the applicable piston with the cylinder number mark (O) to the left and oil hole in rod to oil galley inside.

NOTE: The cylinder number mark made during removal must face the intermediate shaft when the connecting rod is installed in the cylinder block.

- quickly press the piston pin into the connecting rod bore until the guide contacts the support block.
- after a few seconds, remove the piston and connecting rod assembly from the support block
- remove the guide and mandrel assembly
- move the connecting rod from one extreme to the other and ensure that the piston pin is properly recessed from the outside perimeter of the piston at all positions.
- repeat the installation procedure for the remaining connecting rods and pistons.

PISTON PIN SPECIFICATIONS

Dimension	mm	in
Length	75	2.952
External Diameter	23	0.905
Bore	14	0.551

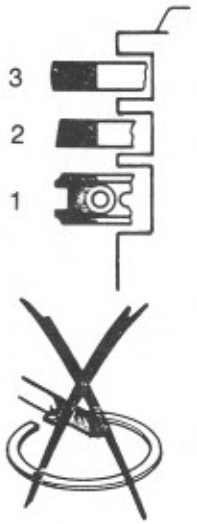
PISTON RING THICKNESS SPECIFICATIONS*

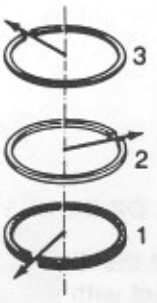
No. Description	mm	in
(1) Top Compression	1.75	0.068
(1) Taper Compression	2.00	0.078
(1) Oil Scraper	4.00	0.157

*Piston rings are pre-gapped.

Install replacement rings on each piston:

- the oil scraper ring (1)
- the taper compression ring (2) with the MARK facing UP
- the top compression ring (3)
- the piston rings are pre-gapped and the existing gaps should not be changed.
- locate the gaps on the pistons at 120° intervals.

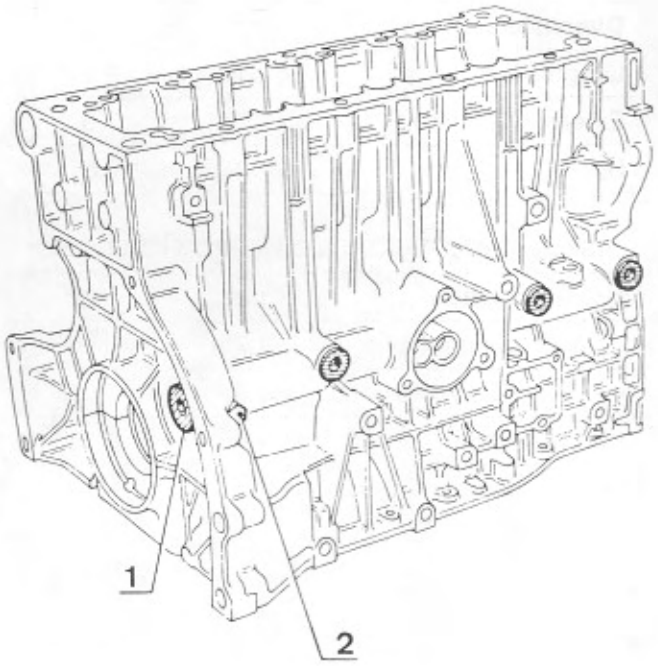




INSTALL OR CONNECT

The core plugs must not be removed (frost plugs):

- check that each cylinder head bolt screws in easily.
- screw the bolts in and out several times if required to ease the threads.



TIGHTEN

If the oil galley plugs have been removed, reinstall and tighten them to:

- Plug 1 ..... 8 daNm (60 lb./ft.)
- Plug 2 ..... 2 daNm (15 lb./ft)
- All other plugs ..... 4 daNm (30 lb./ft.)

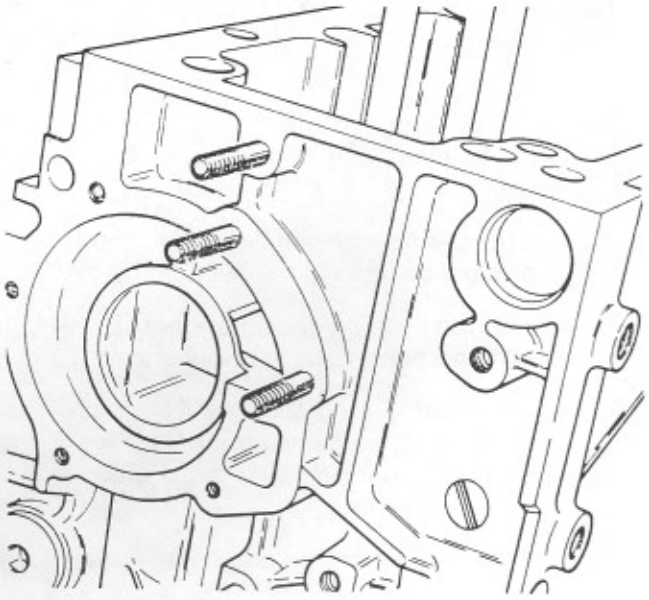
INSTALL OR CONNECT

- Insert the dipstick guide tube with its flange in contact with the block.
- Rub the outside of the dipstick tube with emery cloth if necessary to make it enter easily and coat the stem with Loctite® or equivalent.
- Attach the cylinder block to support Mot. 792.

REASSEMBLE CYLINDER BLOCK ASSEMBLY

INSTALL OR CONNECT

- Insert the various studs. If removed, coat the threads on those for the water pump and timing belt cover with one or two drops of Loctite® or equivalent since the stud holes enter the cooling circuit.

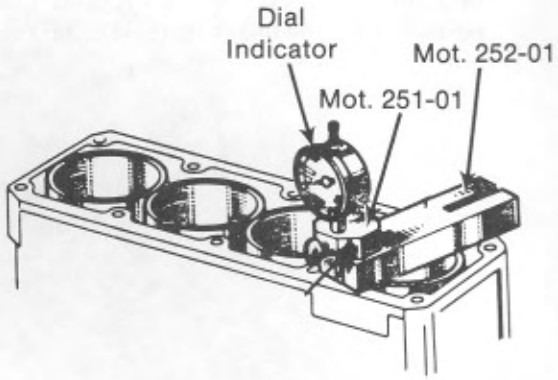


CYLINDER LINER PROTRUSION MEASUREMENT

The cylinder liners are the WET type and require an O-ring seal to provide a seal between the liner and the cylinder block.

The cylinder liner protrusion above the cylinder block can be measured according to the following procedure:

- with the O-ring seal installed, insert each liner in its original position in the cylinder block
- insert a dial indicator into support block Mot. 251-01 and tighten the screw clamp
- place thrust plate Mot. 252-01 across each cylinder liner and measure the liner protrusion above the cylinder block with the dial indicator and support block.
- the liner protrusion tolerance specification is 0.08-0.15 mm (0.003-0.006 in)



If an incorrect liner protrusion is indicated, measure the protrusion using a replacement liner to determine if the cylinder block or the liner is defective.

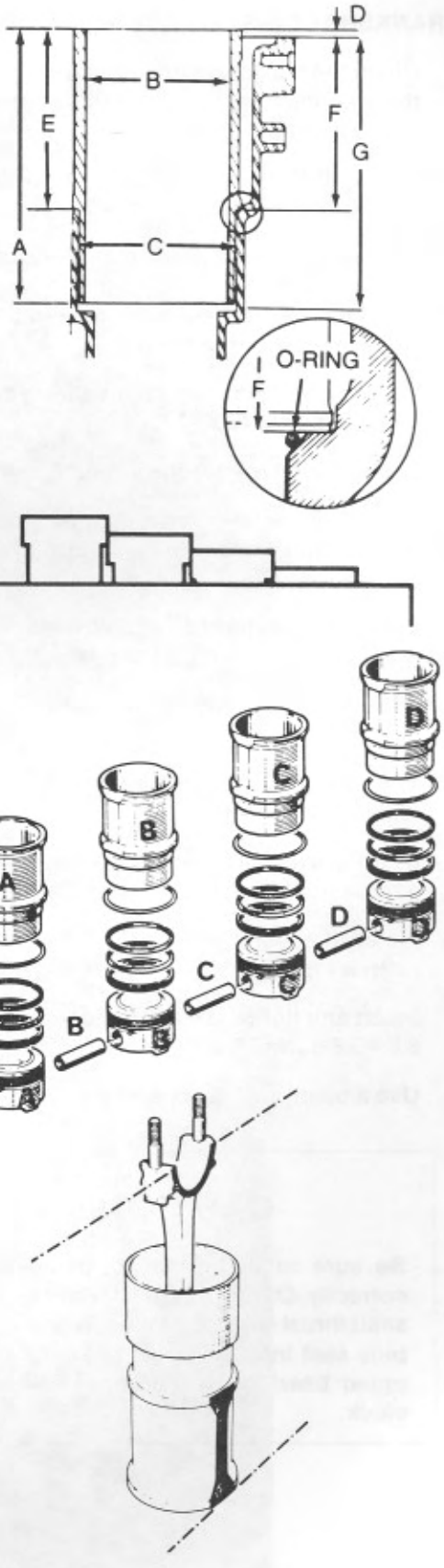
Refer to the cylinder liner and block dimensions listed in the illustrations.

Dimension	mm (in)
A Liner height	148.5 mm (5.846 in)
B Bore diameter	88 mm (3.464 in)
C Base locating diameter	93.6 mm (3.685 in)
D Liner protrusion w/o O-ring	0.08 to 0.15 mm (0.003 to 0.006)
E. Liner height to flange	(93.065 to 93.096 (3.663 to 3.665 in)
F. Cylinder block depth to flange	92.942 to 92.985 mm (3.659 to 3.660 in)
G. Cylinder block depth	149.25 to 149.75 mm (5.875 to 5.895 in)

REASSEMBLE CYLINDER BLOCK ASSEMBLY

With all the cylinder liner protrusions within tolerance, arrange them so that:

- the difference in protrusion between any two (2) adjacent liners does not exceed 0.04 mm (0.002 in)
- the protrusions are stepped down from the number one (1) cylinder to the number four (4) cylinder or from the nubmer four (4) cylinder to the number one (1) cylinder



- when the correct protrusion arrangement has been decided, match each piston and connecting rod assembly with its original liner and re-mark each according to the new position

Install the piston and connecting rod assemblies in their matched set liners with piston installation sleeve, Mot. 851.

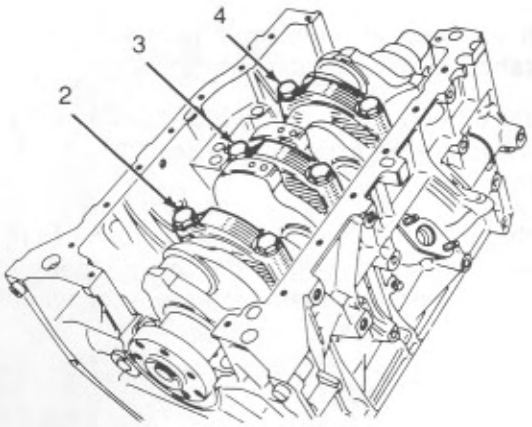
REASSEMBLE CYLINDER BLOCK ASSEMBLY

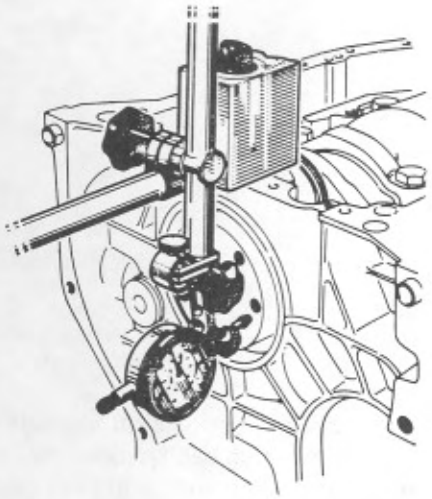
CRANKSHAFT INSTALLATION

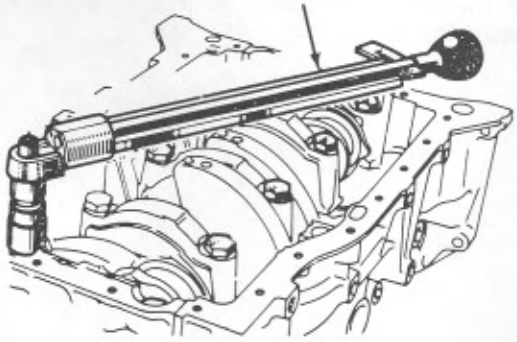
- Clean the main bearing upper insert surfaces in the cylinder block and install the replacement upper bearings.

NOTE: All the upper bearings have lubrication holes.

- Position the crankshaft in the cylinder block, lubricate and install main bearing caps numbers two (2), three (3) and four (4) with the replacement lower bearings in place.
- Insert and tighten the main bearing cap bolts to 8.8 - 9.8 daNm (65-72 lb./ft.).
- Use a beam type torque wrench.
- Install the number one (1) main bearing cap (with a replacement lower bearing) without the side seals.
- Position a dial indicator (with a magnetic base) on the number one (1) main bearing cap.
- Measure the crankshaft end-play.
- The end-play should be within 0.13-0.30 mm (0.005-0.012 in)
- If not correct, replace the thrust bearings as necessary to obtain the correct end-play.
- Install the number five (5) main bearing cap (with a replacement lower bearing).
- Insert and tighten the main bearing cap bolts to 8.8 - 9.8 daNm (65-72 lb./ft.) torque.
- Use a beam type torque wrench.







CAUTION

Be sure to mount the thrust bearings correctly. Oil grooves must face the crankshaft thrust surface. Make sure the locator pins seat into the holes provided in the upper bearings in the upper half of the block.

FRONT AND REAR MAIN BEARING SUPPORT SIDE SEALS

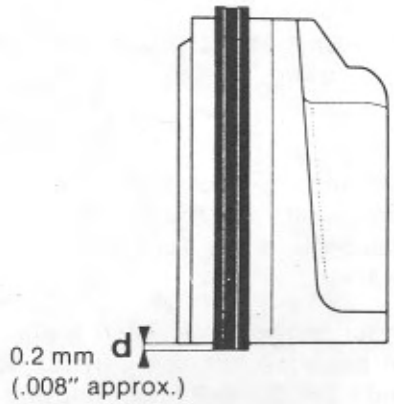
Method 1

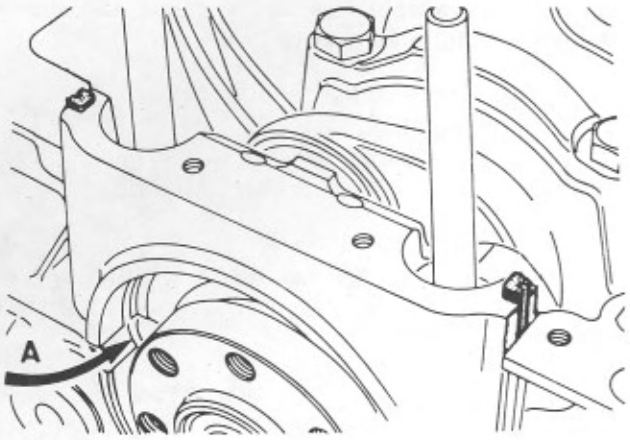
Install or Connect

- Remove main bearing caps Nos. 1 and 5 and fit the side seals to them.

NOTE: This engine requires use of the thickest of the seals included in the gasket seal kit (5.40 mm-.212" thick-white code).

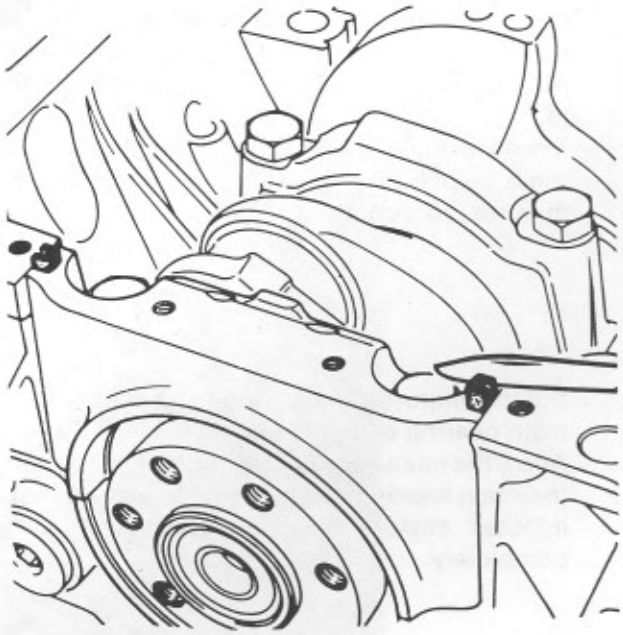
- Each seal should protrude below the surface of the bearing cap (see illustration).
- Lubricate bearing shells.
- Apply liberal amounts of petroleum jelly to seals and mating block surfaces.





Install or Connect

- Screw two locating studs (12 mm dia. x 1.50 pitch) into the cylinder block.
- Place Nos. 1 and 5 main bearing caps on the studs.
- Lower the assembly into the block.
- When each bearing cap is almost seated, make sure that the side seals still protrude slightly by measuring at (A).
- Take out the studs and screws in the cap bolts.



- Cut the ends of the side seals leaving 0.5 to 0.7 mm (.020 to .028") protrude above the pan joint face.

FRONT AND REAR MAIN BEARING SUPPORT SIDE SEALS (CONT.)

Method 2

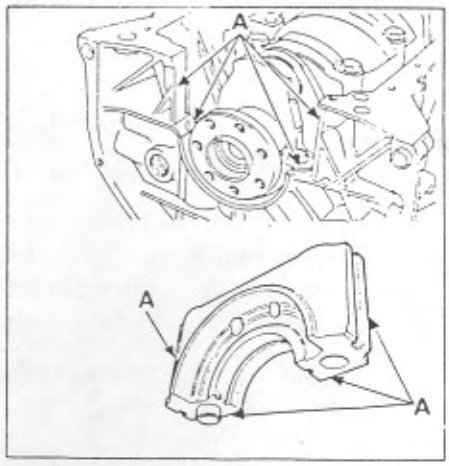
Due to machining modifications in engine production, lateral sealing of the main bearing caps cannot be ensured with the butyl seals provided in the gasket/seal kit.

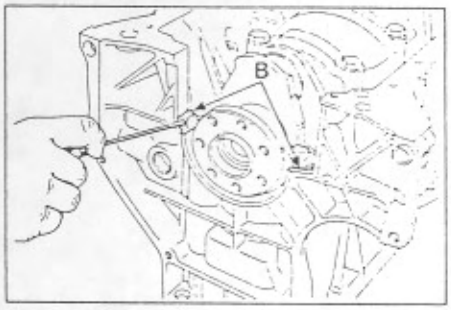
Therefore, described here is an alternate method of sealing main bearing caps using Thixo-Caf 4/60 Silicone (50 ml tube). Thixo Silicone and an application kit are available from our Parts Sales Department. The application kit consists of:

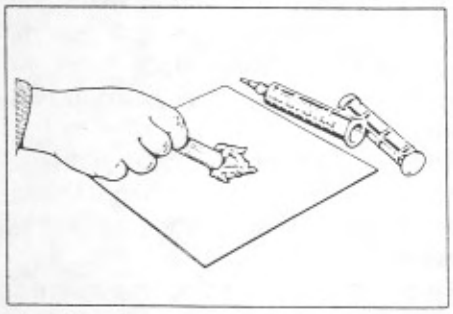
- 1 - 5 ml tube of hardener
- 1 - mixing stick
- 1 - 50 ml syringe
- 1 - set mixing/application instructions

IMPORTANT
The product must be injected within approximately 5 minutes to avoid the mixture hardening in the syringe.

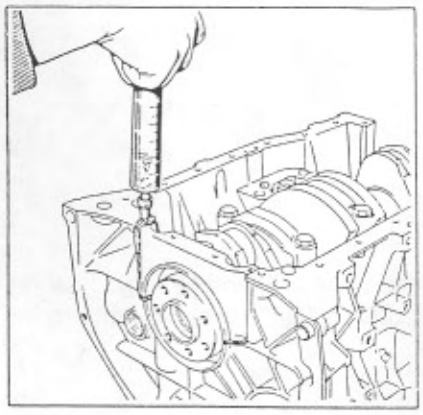
- Thoroughly clean the surfaces at (A) on the cylinder block and the main bearing cap using a cloth dampened with cleaning solvent.
- Lightly coat the lower faces of the cylinder block at (B) with CAF 4/60 THIXO but do not block the oil retention grooves.
- Attach the cap and tighten to 8.8 - 9.8 daNm (65-72 lb./ft.)
- Mix 45 ml of CAF 4/60 THIXO with the contents of the tube of hardener using the stick to blend the mixture thoroughly.







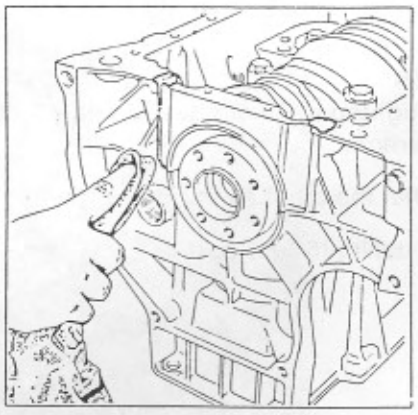
- Put the mixture in the syringe and inject it into the main bearing cap grooves.
- Allow the mixture to flow out slightly either side of the main bearing cap grooves to ensure that the injected mixture has filled the sealing groove completely.



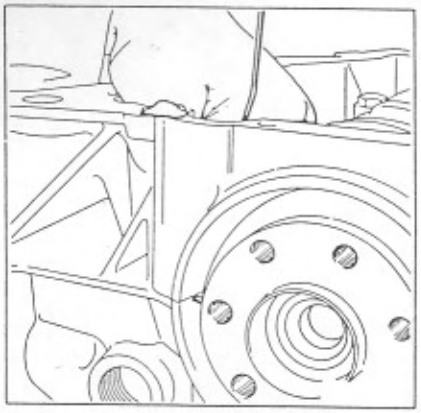
FRONT AND REAR MAIN BEARING SUPPORT SIDE SEALS (CONT.)

Method 2 (Cont.)

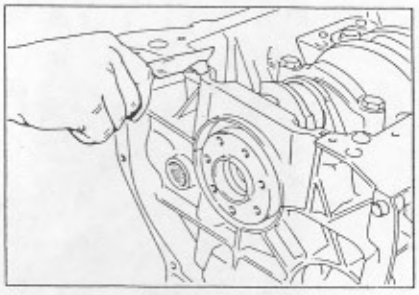
- Using a cloth, wipe away the excess mixture, both inside and outside the cylinder block.



- Pass a steel wire through the lubrication oil ways to check that they are not blocked.



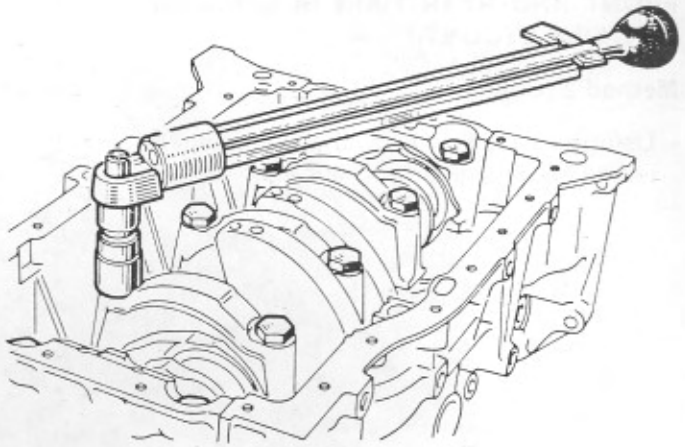
- Allow the assembly to dry for a few minutes, then cut excess sealant from the joint face.



TIGHTEN
Torque tighten the main bearing cap bolts using a torque wrench.

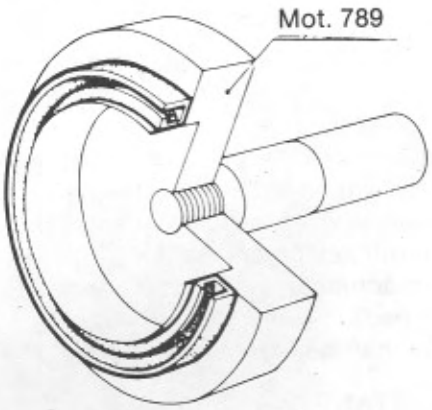
Check that the crankshaft rotates freely.

8.8 - 9.8 daNm (65-72 lb./ft.)

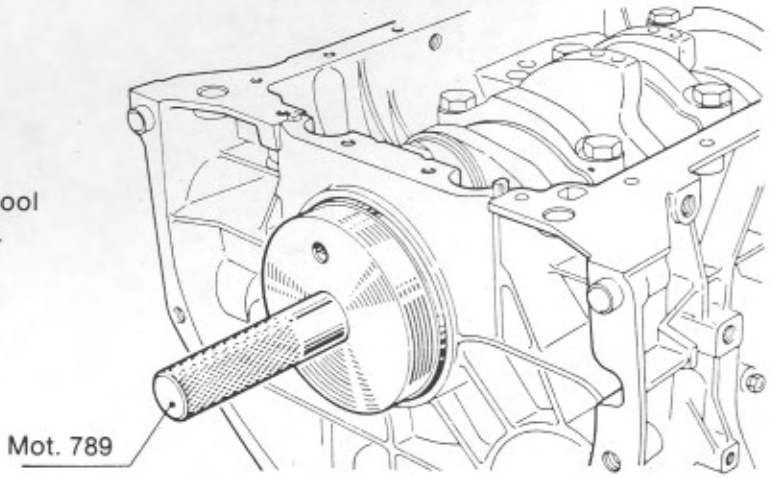


INSTALL OR CONNECT

- Mount the oil seals to main bearings Nos. 1 and 5. The lips on these oil seals are delicate; be extremely careful when mounting them.
- No. 1 main bearing oil seal (flywheel end). Place the seal on Tool Mot. 789 and lubricate the outside of the seal.



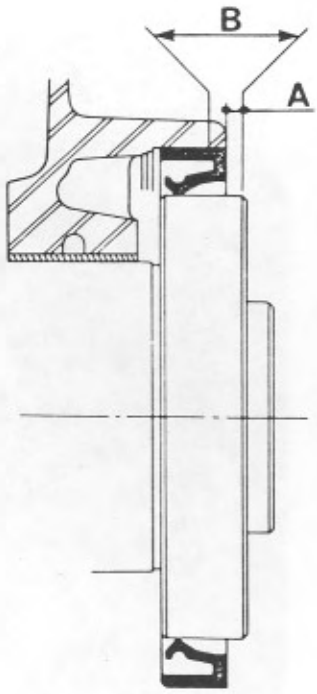
- Insert the seal by tapping the end of the tool lightly until the tool contacts the crankshaft.



IMPORTANT

If the old oil seal lip has marked the crankshaft (flywheel end), a washer 1.5 mm (.059") thick must be inserted between the new oil seal and the tool. This will push the seal in further on the shaft and give the lip an unworn bearing surface when in position.

A. Normal position of oil seal using Tool Mot. 789.
B. Position the oil seal using Tool Mot. 787 and 1.5 mm washer (giving offset to lip on overhaul).



REASSEMBLE CYLINDER BLOCK ASSEMBLY

INSTALL OR CONNECT

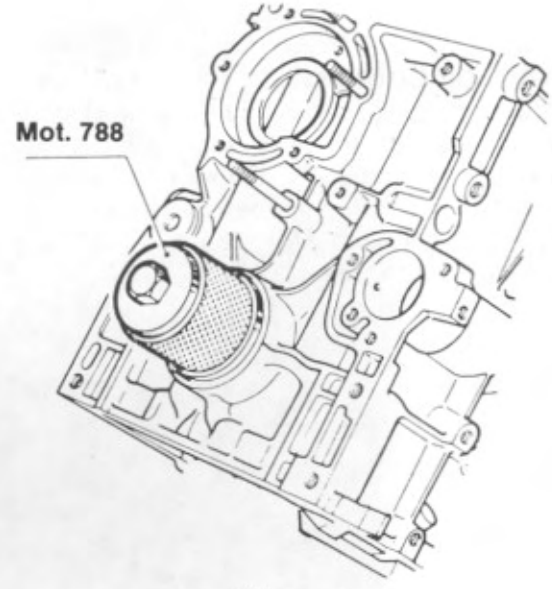
- No. 5 main bearing oil seal (timing end). Place the seal on Tool Mot. 788 and lubricate the outside of the seal.
- Position the tool-seal assembly to the crankshaft and draw it on with the pulley bolt. The seal is fully seated when the tool contacts the crankshaft.
- Woodruff key on crankshaft.
- Air conditioner pulley (or spacer if not A/C equipped).
- Crankshaft belt sprocket.

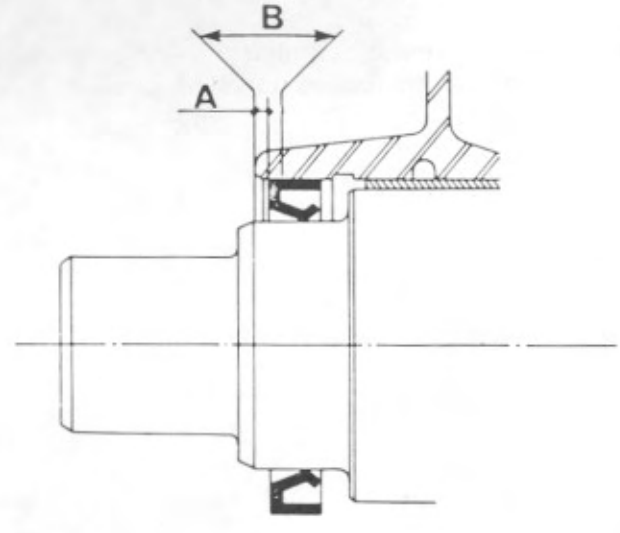
IMPORTANT

If the old oil seal lip has marked the crankshaft (timing gear end), a washer 1.5 mm (.059") thick must be inserted between the new oil seal and the tool. This will push the seal in further on the shaft and give the lip an unworn bearing surface when in position.

A. Normal position of oil seal using Tool Mot. 788.
B. Position of oil seal using Tool Mot. 788 and 1.5 mm washer (giving offset to lip on overhaul).

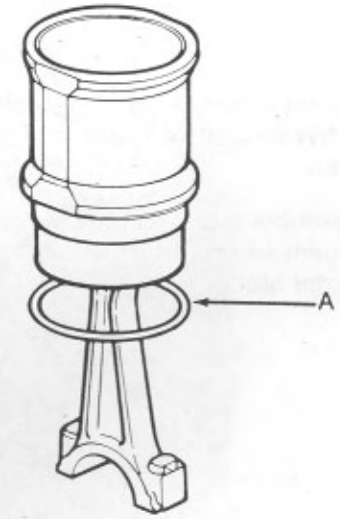
Mount:
- the spacer
- key
- and timing sprocket, timing mark facing outwards.

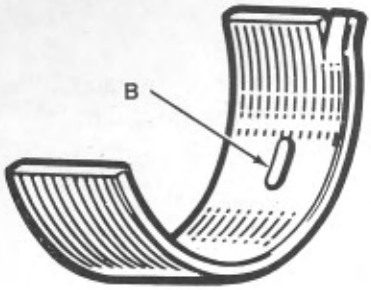




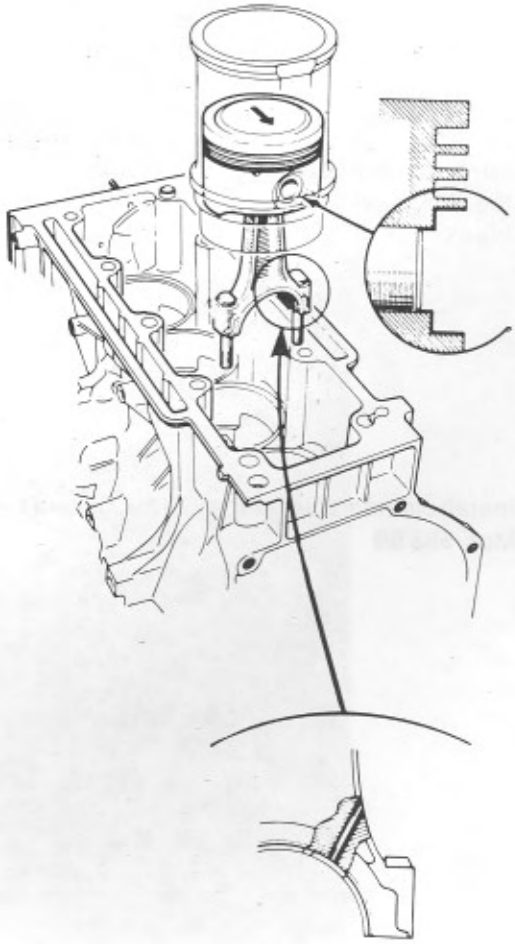
PISTON, CONNECTING ROD AND CYLINDER LINER INSTALLATION

- Install a replacement O-ring seal (A) on each cylinder liner.
- Ensure that the O-ring seal is not twisted.
- Install the appropriate size replacement upper bearings in the connecting rods.





> **CAUTION**
>
> The bearing upper bearings have lubrication holes (B); the lower bearings do not have lubrication holes. Ensure that the holes in the upper bearings are aligned with the lubrication holes in the connecting rods.

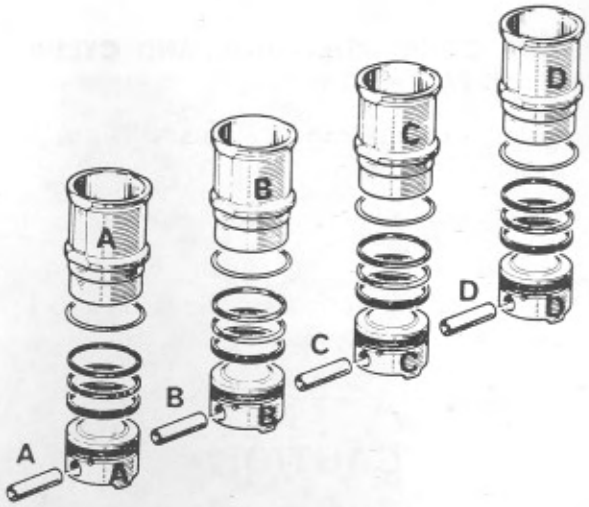


- Install the piston, connecting rod and liner assemblies in the cylinder block with the upper bearings and rods positioned on the crankshaft journals.

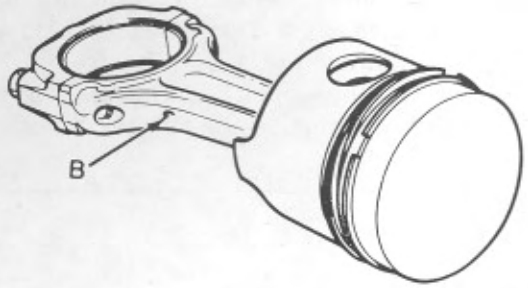
REASSEMBLE CYLINDER BLOCK ASSEMBLY

Ensure that:

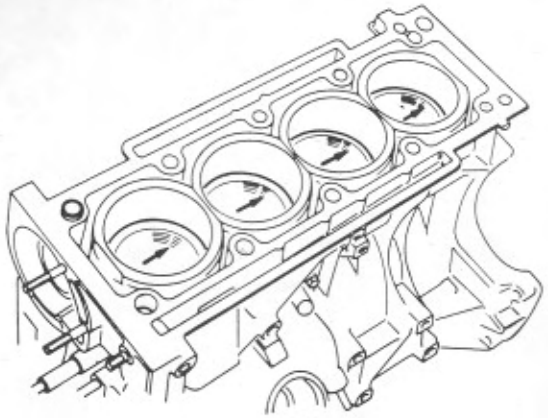
- the number one (A) liner assembly is adjacent to the flywheel/drive plate end of the cylinder block.
- the number stamped on each connecting rod is adjacent to the intermediate shaft side of the cylinder block.



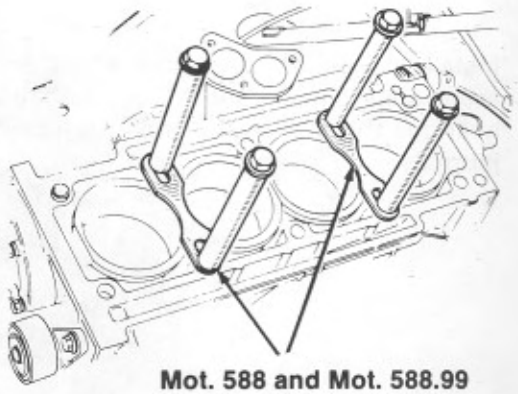
- the lubrication hole (B) in each connecting rod is adjacent to the oil filter side of the cylinder block on oil galley side.



- the arrow stamped on each piston points toward the flywheel/drive plate end of the cylinder block.

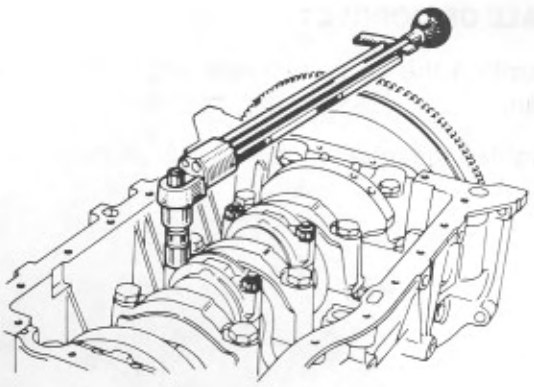


- Install cylinder liner clamps Mot. 588 and spacers Mot. 588.99



Mot. 588 and Mot. 588.99

- Install an appropriate size replacement lower bearing in each connecting rod bearing cap and lightly lubricate them with engine oil.



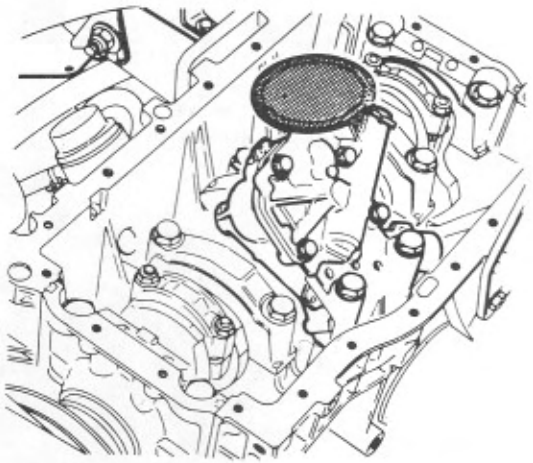
CAUTION

Ensure that each lower bearing is correctly matched with its corresponding upper bearing.

- Install each connecting rod bearing cap on its original connecting rod.

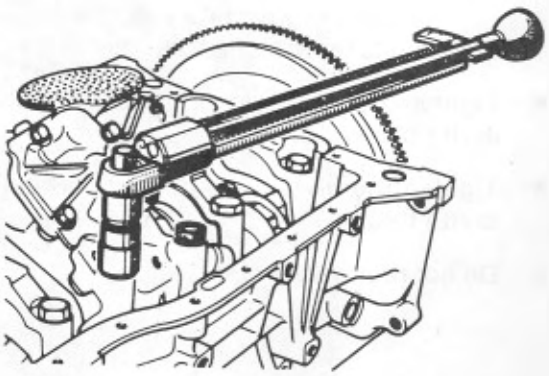
NOTE: The original connecting rod bearing cap bolts and nuts cannot be reused. Use replacement bolts and nuts when installing the connecting rods.

- Install the connecting rod bearing cap nuts and tighten with 6.0-6.5 daNm (44-48 lb./ft.) torque. Use a beam type torque wrench.
- Tap each connecting rod lightly (parallel to the crankshaft) and ensure that there is adequate clearance.
- Rotate the crankshaft and ensure that the pistons, connecting rods and the crankshaft function normally.



OIL PUMP AND OIL PAN INSTALLATION

- Install the oil pump.
- Check for locator pins.



- Tighten the oil pump bolts to 4.0-4.5 daNm (29-37 lb./ft.)

INSTALL OR CORRECT

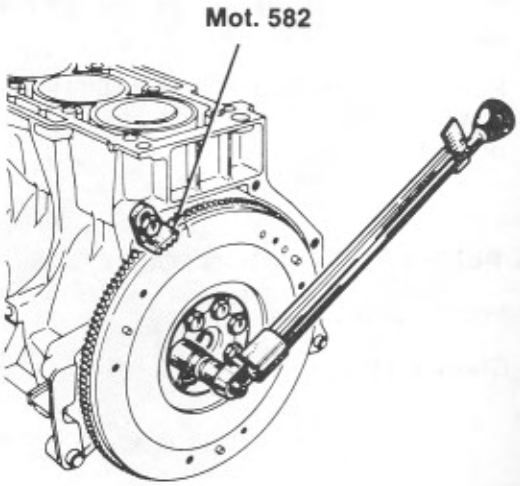
- Position the oil pan gasket and install the oil pan.
- Tighten the retaining bolts to .8-1.0 daNm (5.8-7.3 lb./ft.)



FLYWHEEL/DRIVE PLATE INSTALLATION

INSTALL OR CONNECT

- Apply Loctite® or equivalent, on the crankshaft mating surface for the flywheel/drive plate.
- Position the flywheel/drive plate on the crankshaft and install Holding Tool Mot. 582.

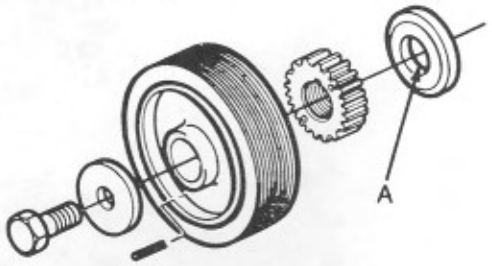


NOTE: The original flywheel/drive plate self-locking bolts are not reusable. Use replacement bolts for each installation.

- Tighten the flywheel bolts to 6.0 daNm (44 lb./ft.) torque.
- Tighten the drive plate bolts to 6.8 daNm (50 lb./ft.) torque.
- Do not remove Holding Tool.

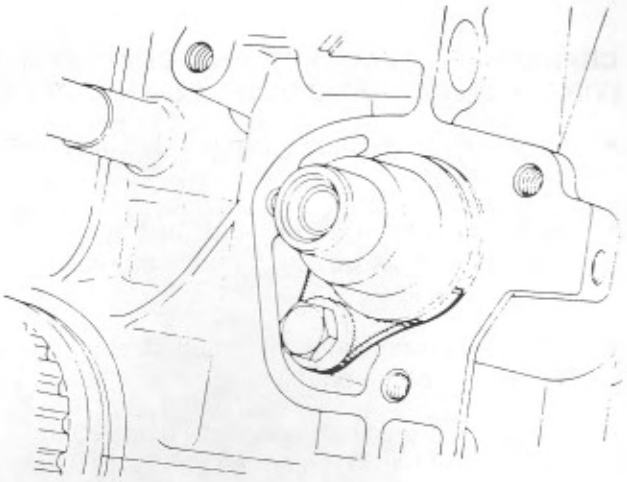
CRANKSHAFT SPROCKET AND CRANKSHAFT (VIBRATION DAMPER) PULLEY INSTALLATION

- The chamfered edge of the sprocket bore faces the washer (A).
- Apply Loctite® or equivalent, to the sprocket mating surface on the crankshaft (vibration damper) pulley.
- Position the crankshaft (vibration damper) pulley on the end of the crankshaft.
- Install the crankshaft (vibration damper) pulley washer and bolt. Tighten the bolt to 12.0 daNm (88 lb./ft.) torque.
- Remove Holding Tool from the flywheel drive plate.

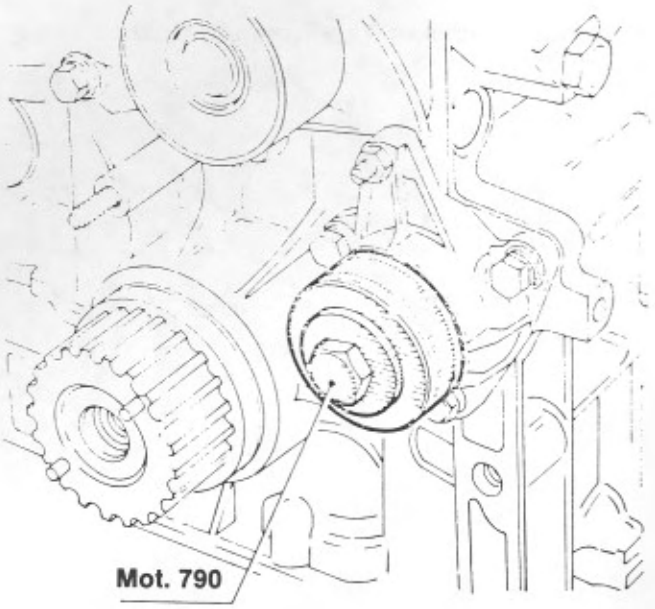


INSTALL OR CONNECT

- Insert the intermediate shaft, secure it by its flange plate.



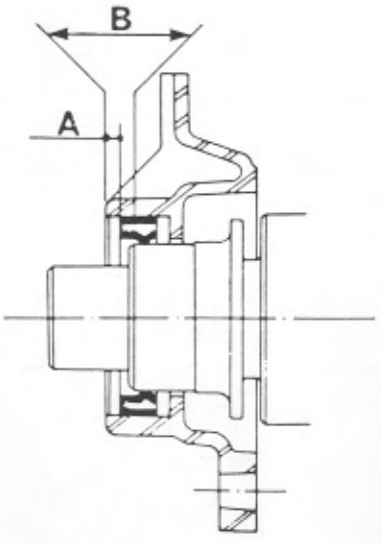
- Install timing belt tightener. Do not tighten at this time.
- Position the intermediate shaft cover with a new paper gasket and new oil seal. Use inserting tool Mot. 790 in order not to damage the seal lip and to assist cover location.
- Coat the bolt threads with one or two drops of Loctite® or equivalent, since the holes pass through into the cylinder block which could lead to oil leaks.



IMPORTANT

A washer 1 mm (.040") thick must be placed between the oil seal and the inserting tool so that the seal lip rides on a fresh surface if the intermediate shaft has been marked by the old oil seal.

A. Position when inserted with Tool Mot. 790.
B. Position when inserted with Mot. 790 plus a 1 mm washer after overhaul.

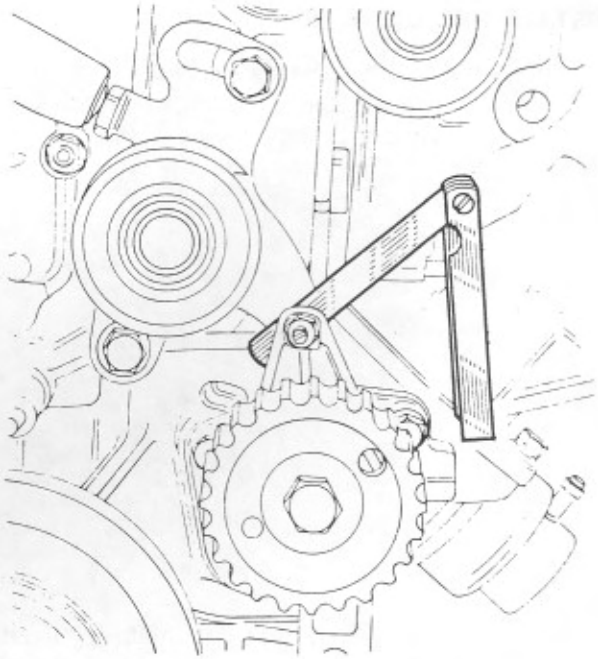


INSTALL OR CONNECT

- The water pump with plunger and spring for the timing belt tightener.

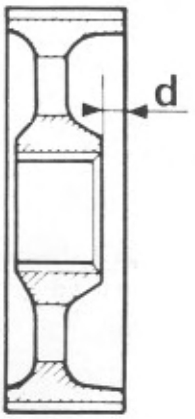
ADJUST

- Adjust the clearance between the tensioner and adjusting bolt to 0.1 mm (.004").

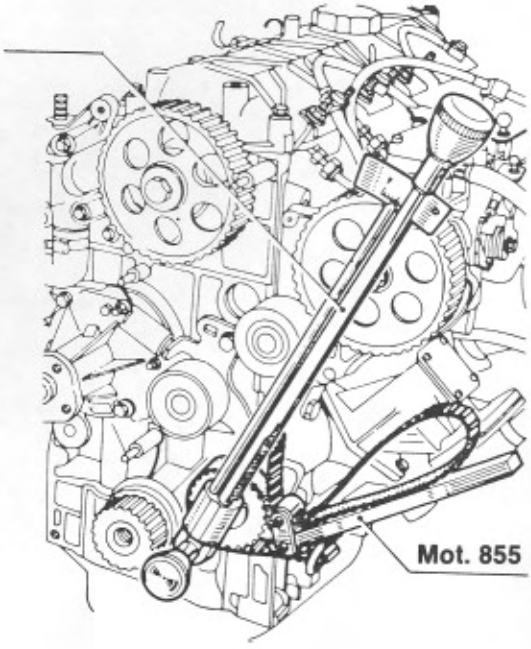


INSTALL OR CONNECT

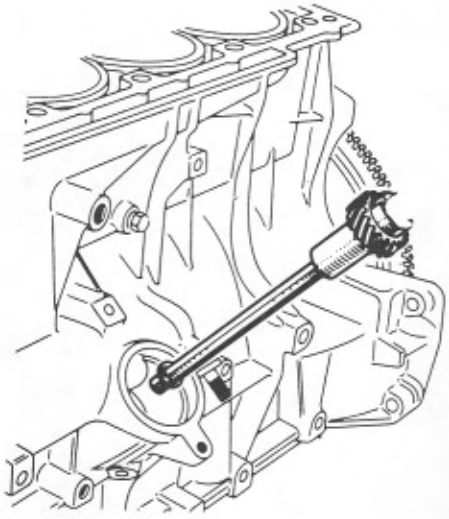
- The intermediate shaft key and the toothed sprocket, larger offset (d) facing outwards away from the cylinder block.



- Torque tighten the bolt to 5.0 daNm (37 lb./ft.) using Strap Tool Mot. 855 and a torque wrench.



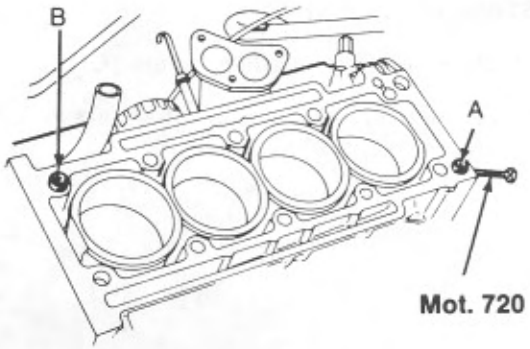
- Install oil pump/vacuum pump angle shaft. Lubricate before installing.
- Install vacuum pump with new O-ring.
- Check that the intermediate shaft/vacuum pump/oil pump assembly revolves freely.



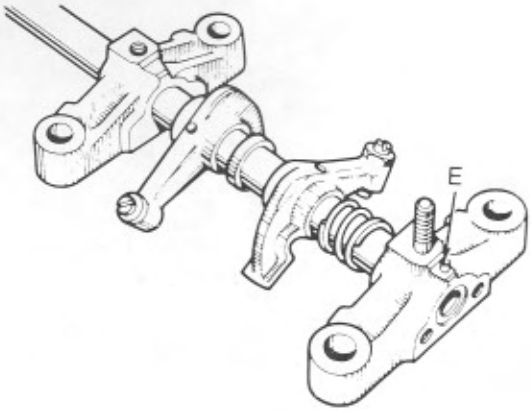
CYLINDER HEAD INSTALLATION

INSTALL CYLINDER HEAD ASSEMBLY

- Install Cylinder Head Locating Tool Mot. 720.
- Remove Cylinder Liner Clamps
- Install the cylinder head gasket.
- Use Locating Tool at (A) and the dowel (B) for alignment.



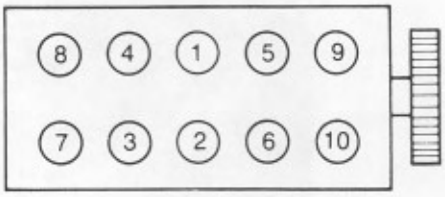
- Position the cylinder head on the cylinder block.
- Position the camshaft in the cylinder head.
- Position the rocker assembly in the cylinder head with the rocker arm adjusting screws backed off.
- When installing the rocker arm assembly components, ensure that the number five (5) bearing retainer pin (E) is correctly seated.



- Insert and tighten the cylinder head bolts.

Cylinder head bolt tightening:

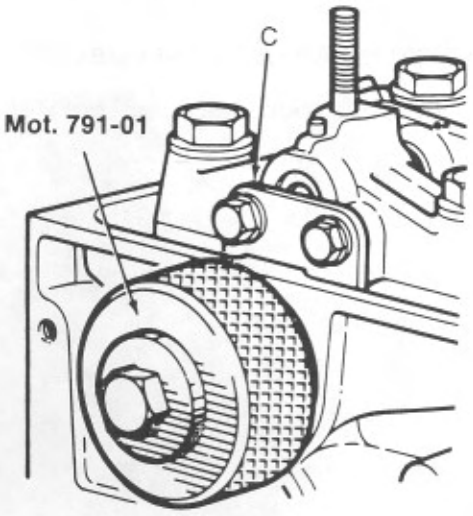
- Use the tightening sequence illustrated below.
- Initially tighten the bolts to 5.0 daNm (37 lb./ft.) torque.
- Next, tighten the bolts to 8.0 daNm (59 lb./ft.) torque.
- For the final tightening, loosen the bolts 1/2 turn and then tighten them to 8.8 - 9.8 daNm (65-72 lb./ft.) torque
- Remove Locating Tool

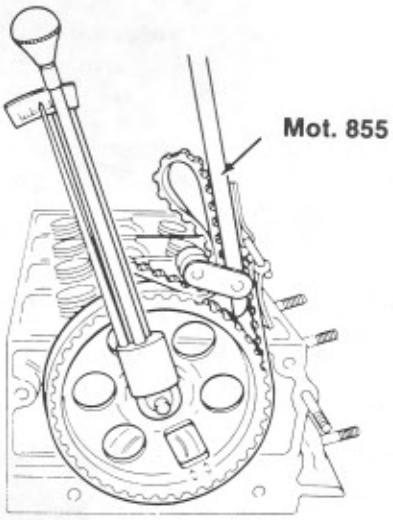


CYLINDER HEAD INSTALLATION

INSTALL OR CONNECT

- Install the camshaft thrust plate (C)
- Install the replacement camshaft oil seal with Oil Seal Installation Tool, Mot. 791-01.
- Measure the camshaft end play. Refer to the Specifications chart.

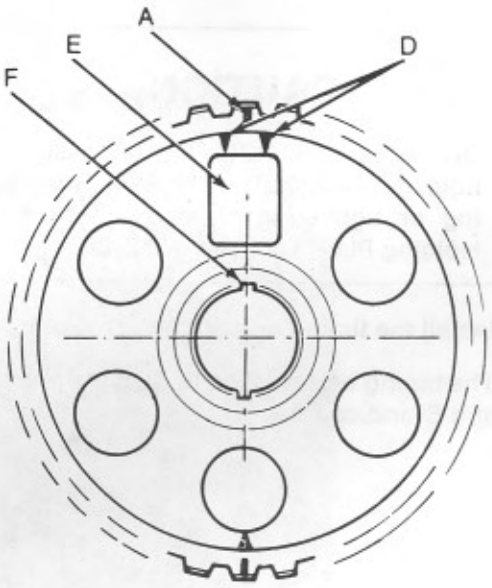




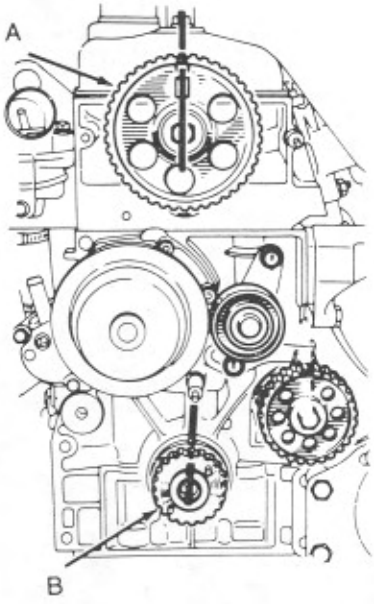
- Install the camshaft sprocket and retaining bolt on the end of the camshaft.
- Use Sprocket Holding Tool Mot. 855 and tighten the camshaft bolt to 5.8 daNm (37 lb./ft.)

TIMING BELT INSTALLATION

NOTE: The camshaft sprocket has a timing index (A), two bosses (D), a rectangular hole (E) and a key way (F) that are all used for valve adjustments.



- Position the camshaft sprocket timing index in line with the static timing mark in the timing belt cover.
- Position the crankshaft so that the number one (1) piston is at top dead center (TDC) - compression stroke.
- Remove the plug in the cylinder block and insert TDC Rod Mot. 861 into the TDC hole in the crankshaft.



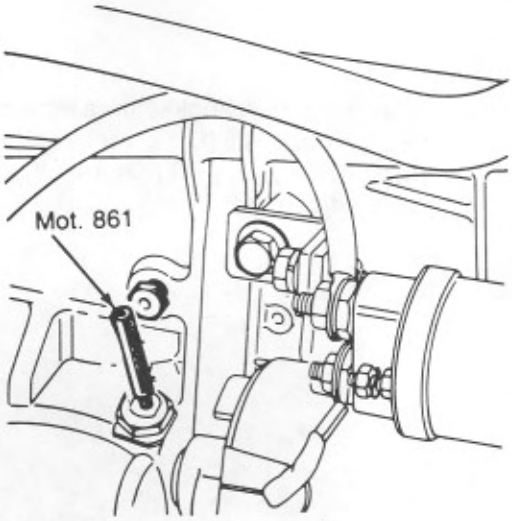
A. Camshaft Sprocket
B. Crankshaft Sprocket

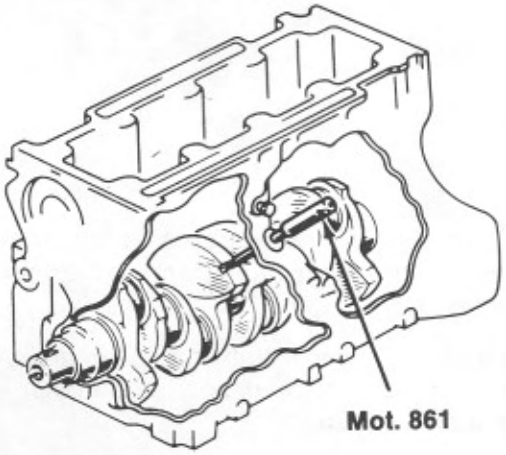
TIMING BELT INSTALLATION

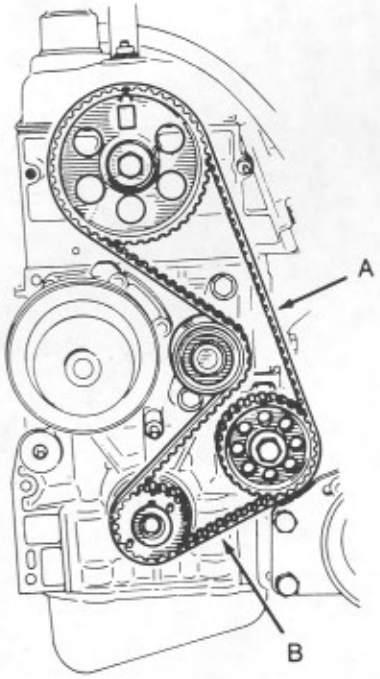
CAUTION

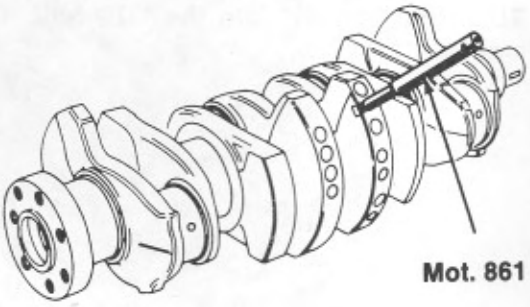
Do not use the TDC Rod (Mot. 861) to hold the crankshaft in place when loosening or tightening bolts. Use Flywheel Holding Plate Tool (Mot. 582).

- Install the timing belt on the sprockets.
- The timing belt must be tight at the positions (A and B) indicated.









TIMING BELT INSTALLATION

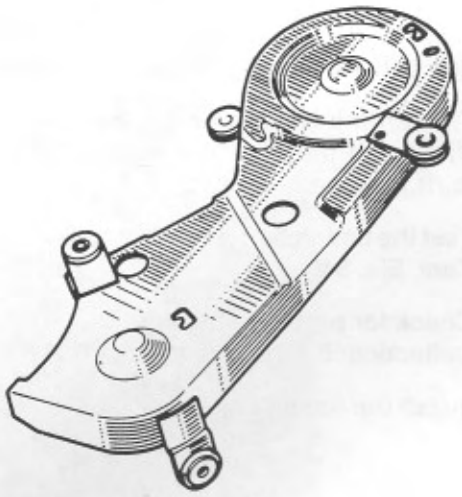
- Position the timing belt cover over the sprockets and check the camshaft timing mark with the index on the cover.

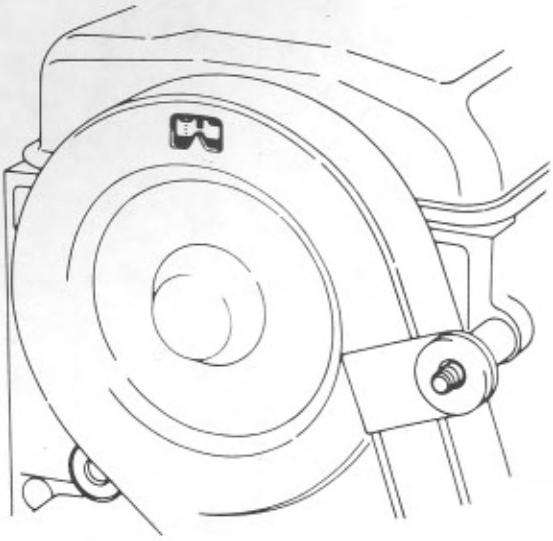
TENSION ADJUSTMENT

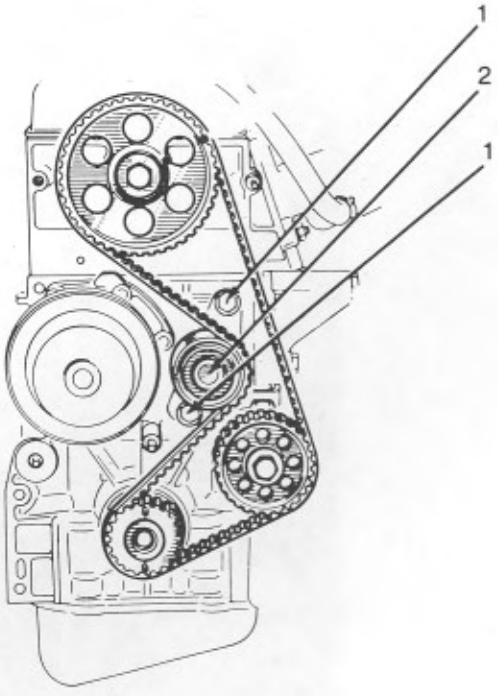
- Remove TDC Rod and install the plug in the cylinder block.
- Rotate the crankshaft clockwise (normal direction) two complete revolutions.

> **CAUTION**
>
> Never rotate the crankshaft counterclockwise when adjusting the timing belt tension.

- Remove the timing belt cover and loosen the timing belt tensioner bolts (1) 1/4 of a turn (maximum).
- The spring loaded timing belt tensioner (2), in contact with the belt, will automatically adjust to the correct position.
- Ensure that the clearance between the timing belt tensioner and the intermediate shaft cover is correct.

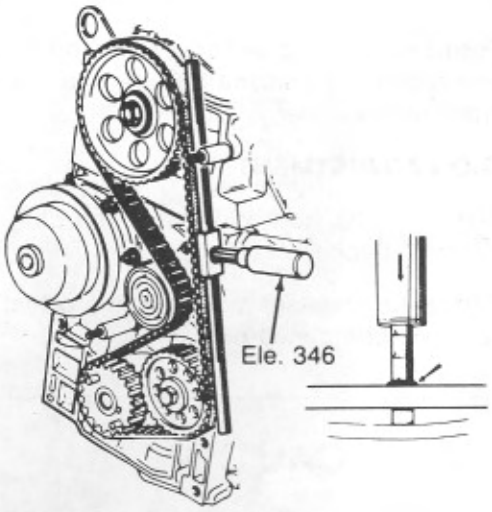






TIMING BELT INSTALLATION

- See Belt Tensioning Procedure - page E7-1.
- Tighten the bottom timing belt tensioner bolt (first) and then the top bolt to 2.5 daNm (18 lb./ft.) torque.
- Test the timing belt tension with Tension Gauge Tool, Ele. 346.
- Check for proper deflection.
  Deflection: 5.5-7.0 mm (0.216 - 0.276 in)
- Install the timing belt cover.

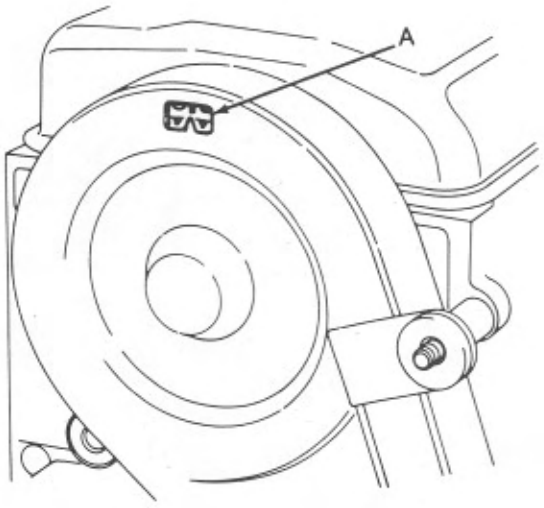


ROCKER ARM CLEARANCE ADJUSTMENT

IMPORTANT

If the engine is equipped with a timing belt cover rear window (on the back side of the timing belt cover), use the first procedure to adjust the rocker arm clearances.

If the engine is not equipped with a timing belt cover rear window, use the second procedure to adjust the rocker arm clearances.

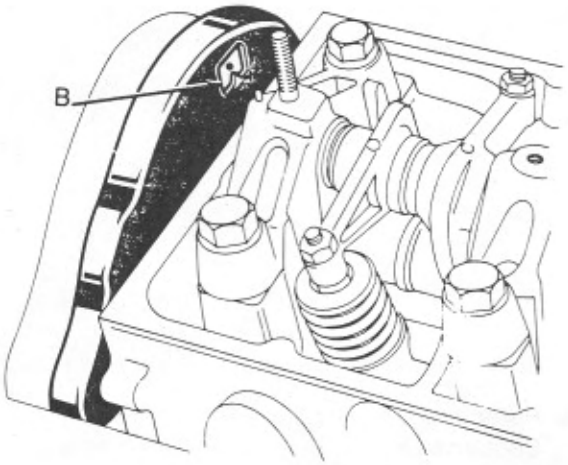


CLEARANCE ADJUSTMENT (FIRST PROCEDURE)

Rotate the crankshaft clockwise (viewed from the front of the engine) and align the number one (1) piston TDC mark on the camshaft sprocket with the index (A) in the timing belt cover front window.

NOTE: Ensure that the mark on the camshaft sprocket represents TDC for the number one (1) piston and not for the number four (4) piston. This number one (1) piston is at the flywheel/drive plate end of the cylinder block.

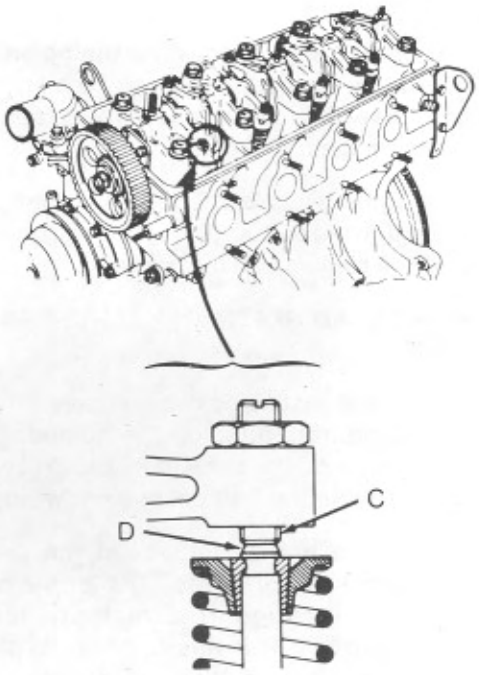
Rotate the crankshaft clockwise (viewed from the front of the engine) until the first mark (B) on the back side of the camshaft sprocket is aligned with the index in the timing belt cover rear window.



ROCKER ARM CLEARANCE ADJUSTMENT

CAUTION

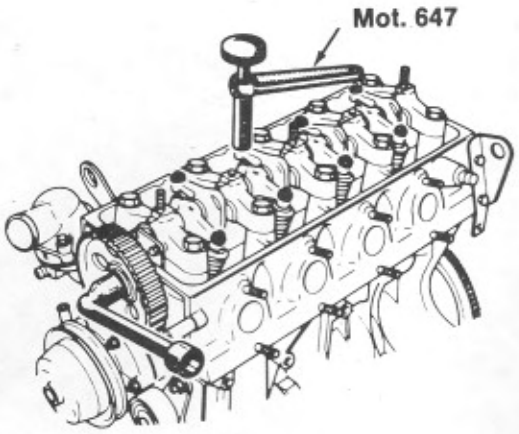
When tightening each adjustment screw (C), ensure that the bottom of the screw is aligned with the valve stem (D). If the adjustment screw is not aligned with the stem when tightened, it can cause the stem to bend.



Rocker Arm Clearances (Engine Cold)

Intake	0.10-0.15 mm (0.004-0.006 in)
Exhaust	0.20-0.25 mm (0.008-0.010 in)

- Use Tool Mot. 647 to perform the adjustments.



- Rotate the crankshaft clockwise until the second mark on the back side of the camshaft sprocket is aligned with the index in the rear window.
- Refer to the Rocker Arm Clearance Adjustment Sequence chart on page E5-3. Continue until all rocker arm clearances have been adjusted.

ROCKER ARM CLEARANCE ADJUSTMENT

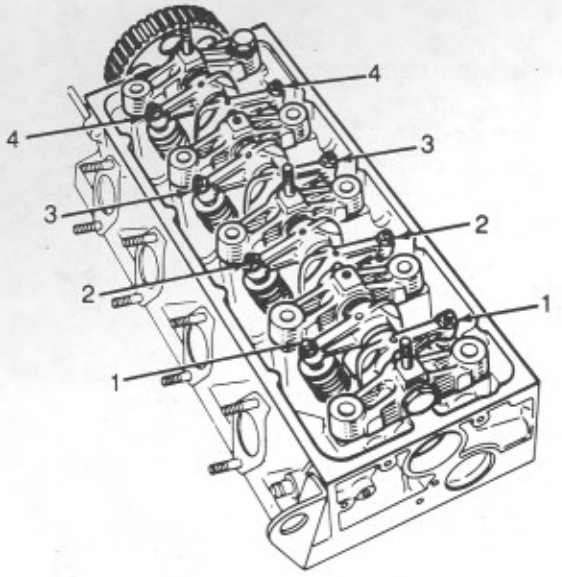
ROCKER ARM CLEARANCE ADJUSTMENT SEQUENCE

Mark on Sprocket	Intake	Exhaust
1	2	4
2	1	2
3	3	1
4	4	3

Valve Timing With Theoretical* Rocker Arm Clearance of 0.35 mm (0.014 in)

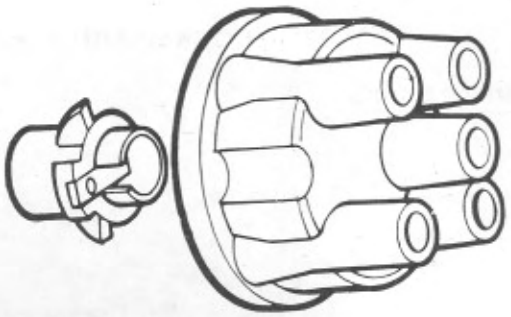
Intake Valve Opens B.T.D.C.	Intake Valve Closes A.B.D.C.	Exhaust Valve Opens B.B.D.C.	Exhaust Valve Closes A.T.D.C.
12°	52°	52°	12°

*Theoretical clearance is a reference for valve timing check only and does not indicate normal running clearances.

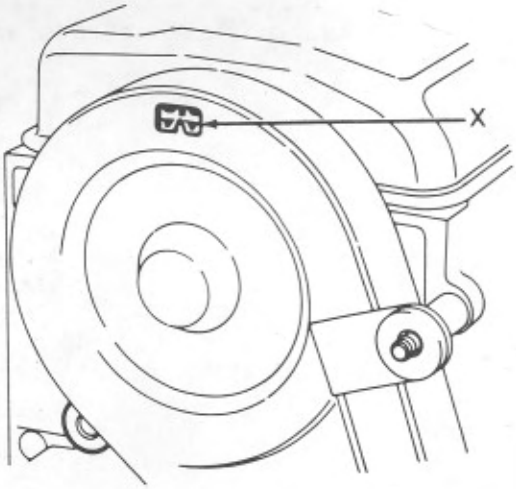


Valve Adjustment Sequence

ROCKER ARM CLEARANCE
ADJUSTMENT (SECOND PROCEDURE)

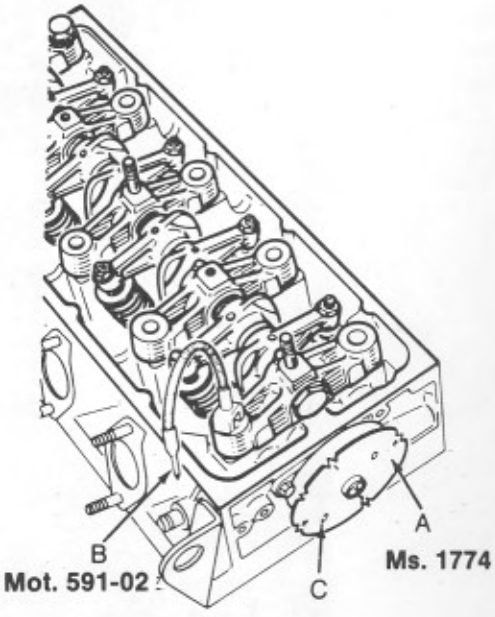


- Install the ignition distributor at the rear of the cylinder head.
- Remove the distributor cap and rotor.



- Rotate the crankshaft clockwise (viewed from the front of the engine) and align the number one (1) piston TDC mark on the camshaft sprocket with the index (X) in the timing belt cover window.

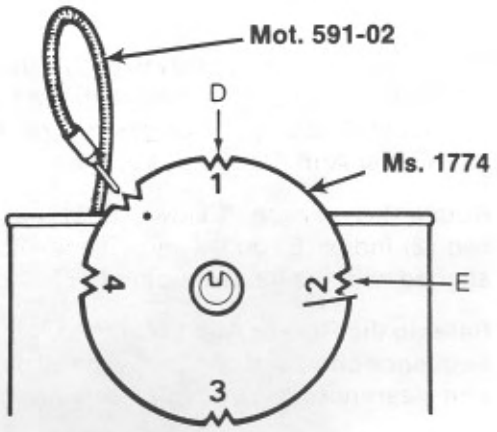
NOTE: Ensure that the mark on the camshaft sprocket represents TDC for the number one (1) piston and not for the number four (4) piston. The number one (1) piston is at the flywheel/drive plate end of the cylinder block.

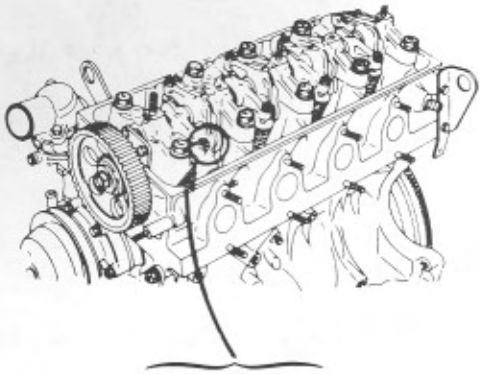


- Position Alignment Rotor Ms. 1774 (A) on the distributor shaft.
- Position Flexible Pointer Mot. 591-02 (B) on cylinder head bolt number 10 (tightening sequence number).
- Align the pointer with the TDC index (C) on the alignment rotor.

ROCKER ARM CLEARANCE
ADJUSTMENT (SECOND PROCEDURE)

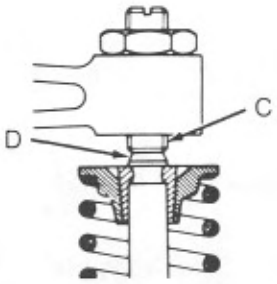
- Rotate the crankshaft clockwise (viewed from the front of the engine) two complete turns to ensure that the flexible pointer and the alignment rotor are aligned when the number one (1) piston is at TDC.
- Rotate the crankshaft clockwise slowly until the number one (1) index (D) on the alignment rotor is aligned with the flexible pointer.



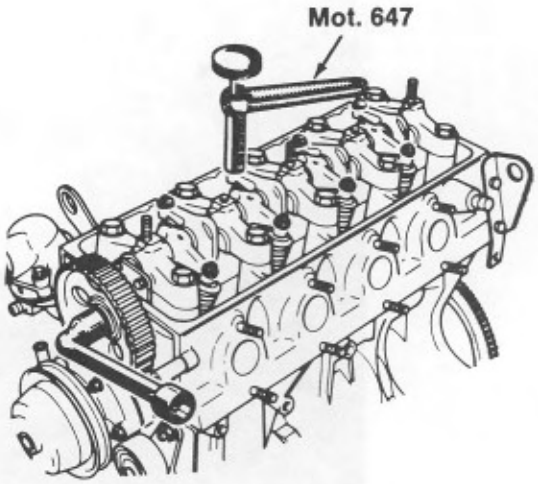


CAUTION

When tightening each adjustment screw (C), ensure that the bottom of the screw is aligned with the valve stem (D). If the adjustment screw is not aligned with the stem when tightened, is can cause the stem to bend.



- Use Tool Mot. 647 to perform adjustments.



ROCKER ARM CLEARANCE ADJUSTMENT (SECOND PROCEDURE)

- Adjust intake valve number two (2) and exhaust valve number four (4) with Adjustment Tool Mot. 647 to obtain the specified clearances. Refer to the Rocker Arm Clearances chart.
- Rotate the crankshaft slowly until the number two (2) index (E) on the alignment rotor (A) is aligned with the flexible pointer (B).
- Refer to the Rocker Arm Clearance Adjustment Sequence chart and continue until all the rocker arm clearances have been adjusted.

Intake	0.10-0.15mm (0.004-0.006 in)
Exhaust	0.20-0.25mm (0.008-0.010 in)

ROCKER ARM CLEARANCE ADJUSTMENT SEQUENCE

Mark on Alignment Rotor	Intake	Exhaust
1	2	4
2	1	2
3	3	1
4	4	3

Valve Timing with Theoretical* Rocker Arm Clearance of 0.35 mm (0.014 in.)

Intake Valve Opens B.T.D.C.	Intake Valve Closes A.B.D.C.	Exhaust Valve Opens B.B.D.C.	Exhaust Valve Closes A.T.D.C.
12°	52°	52°	12°

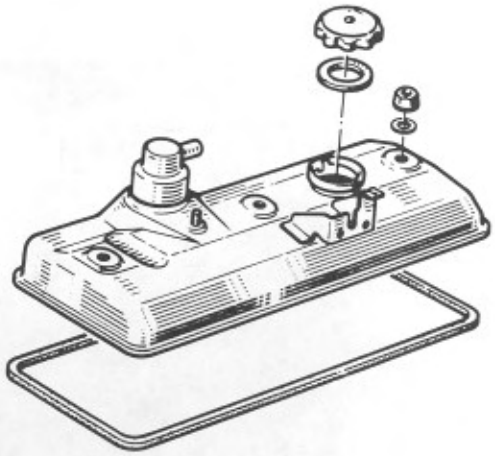
*Theoretical clearance is a reference for valve timing check only and does not indicate normal running clearances.

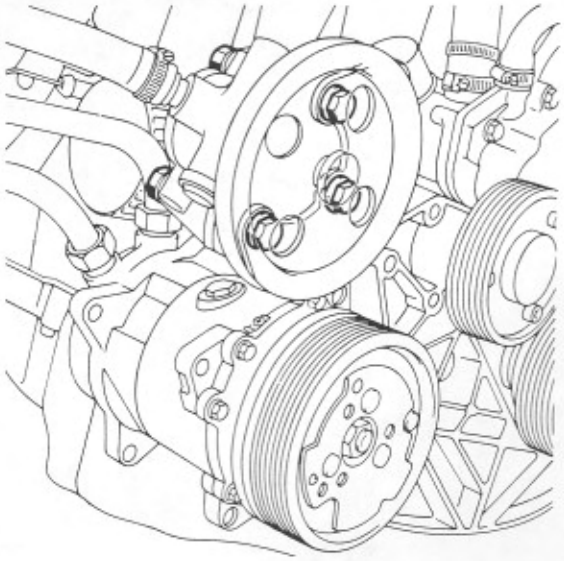
- Remove the flexible pointer from the cylinder head and the alignment rotor from the distributor.

FINAL ASSEMBLY

INSTALL OR CONNECT

- Distributor assembly
- Valve cover. Tighten nuts to 0.4-0.6 daNm (3.0-4.5 lb.ft.)
- Intake and exhaust manifolds.
- All accessory equipment
- All drive belts (See Belts & Tightening)



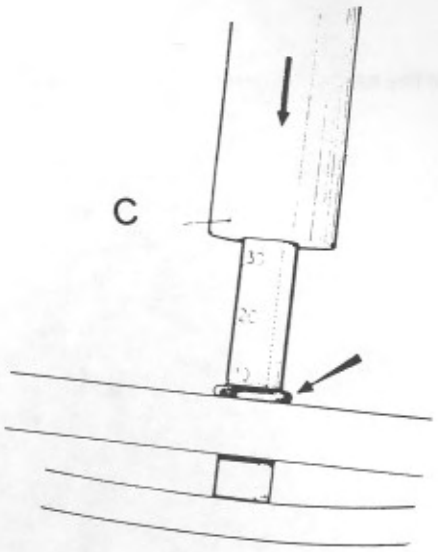


BELT TENSIONING
PROCEDURE

The tightener must always be slack when mounting a drive belt; this prevents strain on the pulleys and belt itself.

Checking Method

- Use tool Ele. 346-02
- Check that the underside of the rubber ring is opposite the zero graduation on the plunger.
- Lay the bar along the drive belt with the tool plunger an equal distance between the pulley centers.
- Press the sliding portion of the plunger until shoulder (C) is flush with the plunger body.
- Remove the tool and read the value of the deflection on the underside of the rubber ring.



Belt Tensioning Tool - Ele. 346-02

Timing Belt

See E4-4 - Timing Belt Changing Procedure

Deflection: 5.5-7.0 mm (0.216-0.276 in.)

Serpentine Drive Belt:

- Measure the tension at (F)

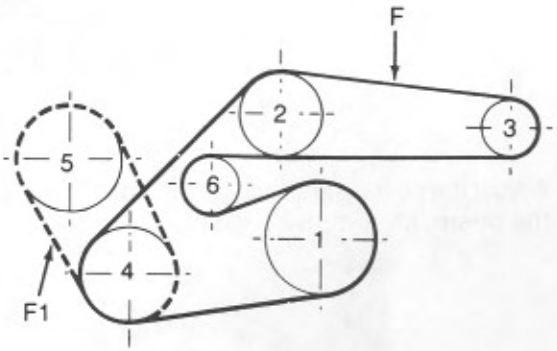
  new - 1.5 mm/800-890 N/180-200 lbs./ft.

  used - 2.5 mm/623-712 N/140-160 lbs./ft.

- Measure the tension at (F1)

  new - 3.5 mm/556-689 N/125-155 lbs./ft.

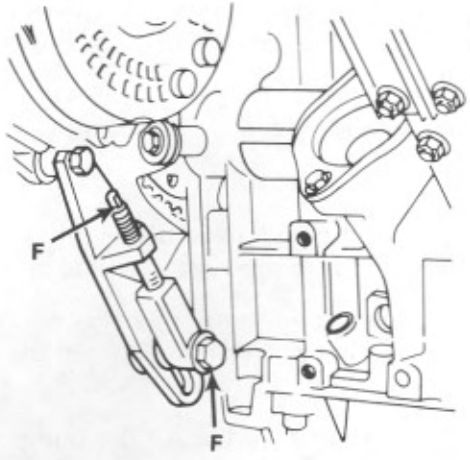
  used - 5.3 mm/400-512/90-115 lbs./ft.



1. Crankshaft
2. Water Pump
3. Alternator
4. A/C Compressor
5. Power Steering Pump
6. Idler Pulley

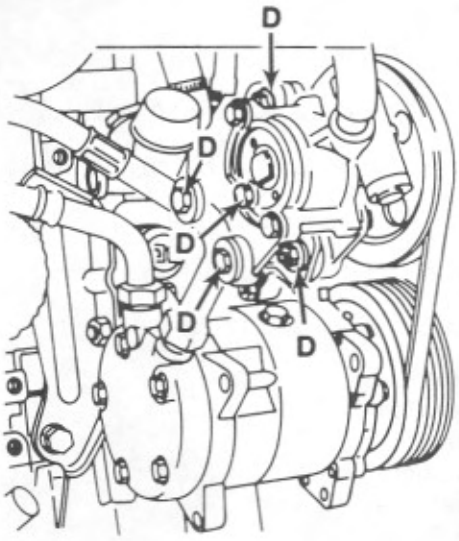
BELT TENSIONING PROCEDURE

- Adjust the serpentine belt tension at the alternator (F)



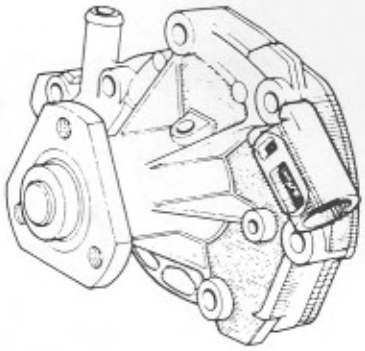
Alternator/Serpentine Belt Adjuster

- Adjust the power steering belt tension by pivoting the pump. Mounting bolts are shown at right.



Mounting Bracket Bolts (D)

ENGINE WATER PUMP
REMOVE AND REPLACE



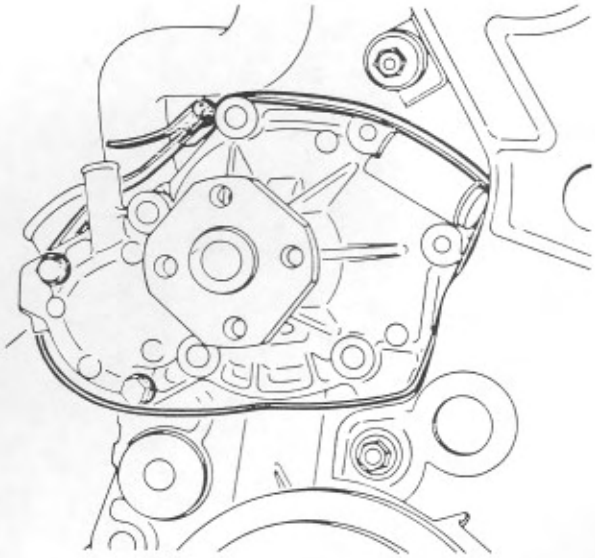
IMPORTANT
The water pump cannot be repaired. Change the component if any part is worn.

REMOVAL
The timing belt tensioner need not be removed:

- Using a long hose clamp as shown, hold the timing belt tensioner plunger in position and prevent spring from flying out.
- Remove the water pump

Changing the gasket between the water pump and plate.

- Hold the water pump body in a vice and loosen the plate.
- Clean the joint faces by moving the plate around the pump shaft out of the way.
- Select the gasket which fits between the water pump and cylinder block. Make the cut-outs shown in the illustration below to allow the gasket to slip between the water pump body and the plate.

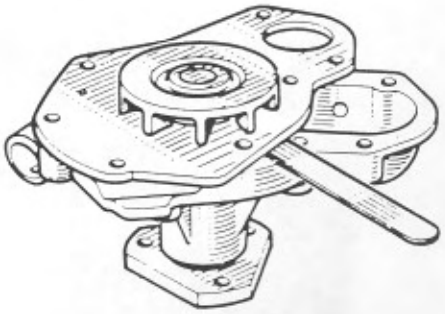


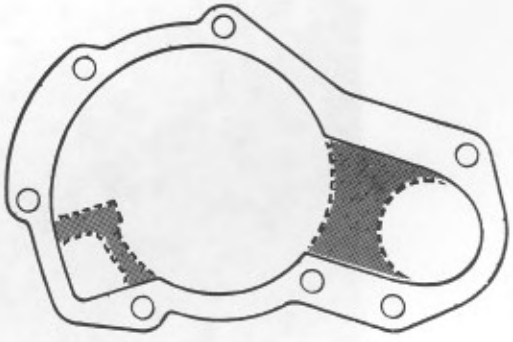
NOTE: Special points concerning refitting:

- Clean all joint faces before fitting new dry gaskets.
- Hold the timing belt tensioner plunger in position as before when refitting the pump.

INSTALLATION

- Mount the water pump to the cylinder block followed by the coolant hoes to the pump.
- Fill and bleed the cooling circuit - (See Section F - Cooling System)



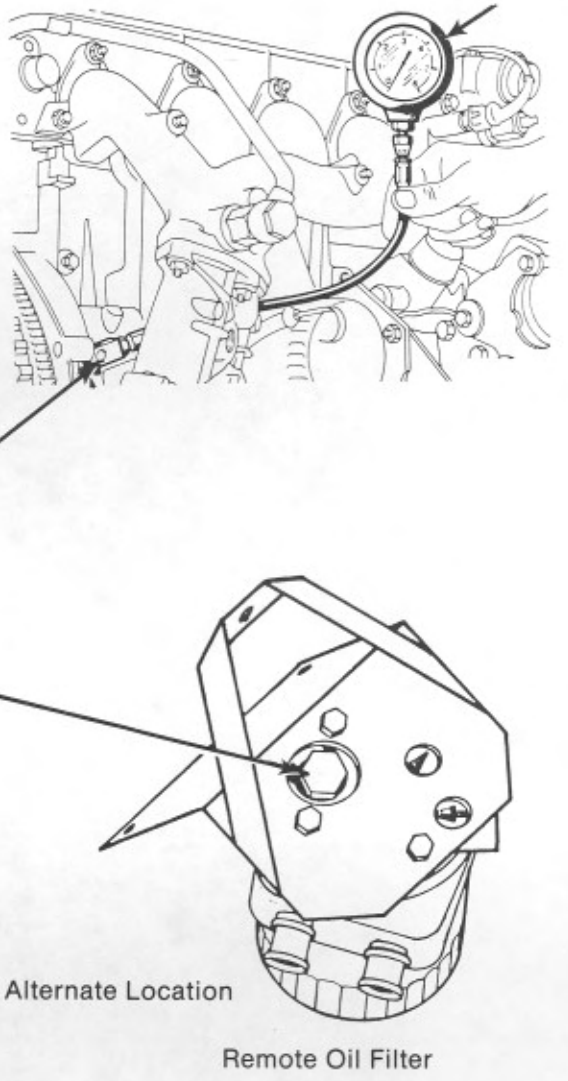


OIL PRESSURE CHECKING PROCEDURE

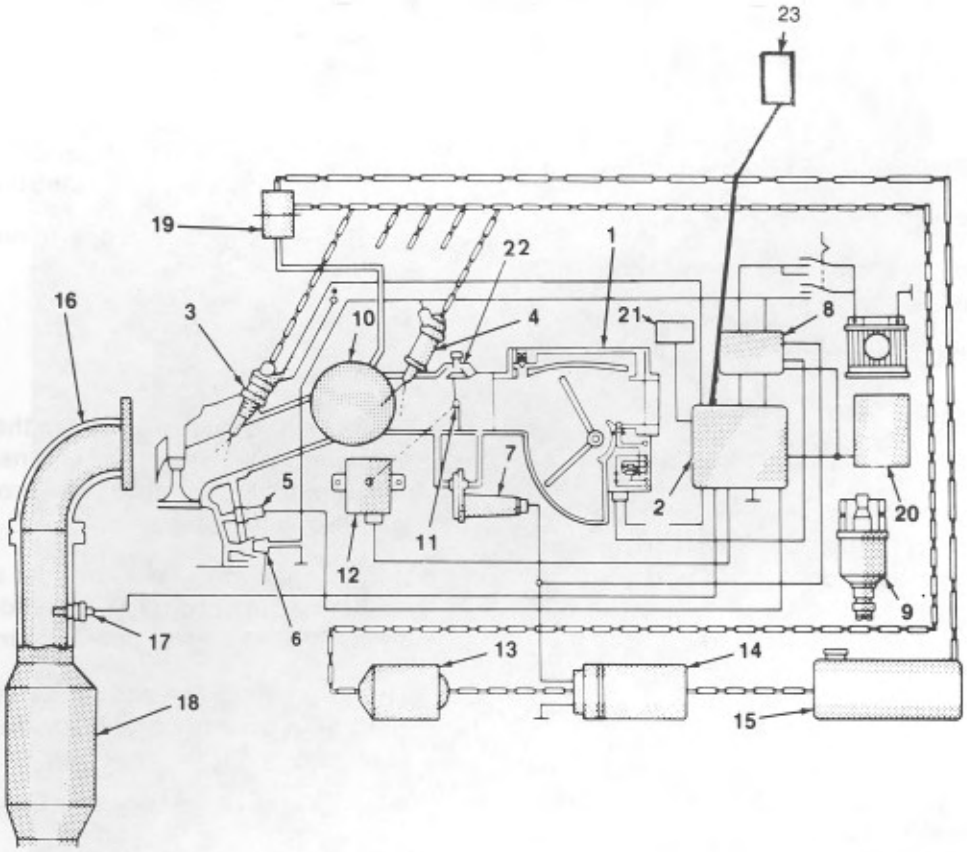
Check the oil pressure when the oil temperature reaches 80° C (176° F).

Run the engine and observe oil pressure:

at idle	0.8 bar (11 1/2 psi) minimum
at 3,000 rpm	3.0 bars (44 psi) minimum



ENGINE FUEL SYSTEM
(FUEL/L-JETRONIC SYSTEM DIAGRAM)
SYSTEM COMPONENTS



1. Airflow meter (with air temperature sensor)
2. Electronic control unit (ECU)
3. Fuel injector
4. Cold start injector
5. Coolant temp. sensor
6. Coolant temp. thermo-time switch
7. Supplementary air control valve
8. Control relay
9. Ignition distributor
10. Air intake manifold chamber
11. Throttle plate
12. Throttle position switch
13. Fuel filter
14. Electric fuel pump
15. Fuel tank
16. Exhaust manifold
17. Oxygen sensor
18. Catalytic converter
19. Fuel pressure regulator
20. Ignition control module (ICM)
21. Atmospheric Pressure Sensor
22. Idle adjustment & idle solenoid
23. Tachometric relay

ENGINE FUEL SYSTEM

GENERAL

SYSTEM DESCRIPTION

The fuel system consists of:

A. A multi-point fuel injection system with oxygen (O_2) sensor feedback for fuel and emission control.

B. Four emission control systems:

1. the fuel vapor recovery system
2. the positive crankcase ventilation (PCV) system
3. the exhaust gas recirculation (EGR) system
4. the catalytic converter system

DIAGNOSIS

The fuel injection system can be tested with Electronic Diagnostic Tester. The system is equipped with diagnostic connectors for this purpose.

SYSTEM OPERATION

The electric fuel pump delivers fuel from the fuel tank, through a filter, to the injector ramp assembly.

The pressure regulator, connected to the fuel tank return hose, maintains a pressure of 2.5-3 bars/36-43 psi in the injector ramp assembly.

The regulator is connected to the intake manifold for pressure compensation based on the intake manifold vacuum.

The injectors are controlled by the electronic control unit (ECU).

They inject fuel twice per engine cycle, which allows the use of a conventional ignition distributor, with no extra contacts for timing the injected fuel.

The electrical input to the fuel pump is controlled by the control relay.

The electronic control unit (ECU) controls the injector time interval and changes it according to input from:

- the airflow meter, which continuously measures the volume and density of the air admitted into the engine by a potentiometer (located on the end of the flap shaft) and a temperature sensor
- the ignition coil, where the primary winding tach voltage is used to determine the engine speed.
- the coolant temperature sensor (located on the thermostat housing) for fuel mixture enrichment while the engine is cold
- The throttle position switch (TPS) located on the throttle plate shaft, which is used to indicate the idle and wide-open-throttle (WOT) positions.

There are two modes of operation for the feedback system:

- open loop
- closed loop

Basically, the system will be in the open loop mode of operation whenever the engine operating conditions do not conform with the programmed criteria for closed loop operation.

During open loop operation the air/fuel mixture is maintained at a programmed ratio that is dependent on the type of engine operation involved.

The oxygen (O_2) sensor data is ignored by the electronic control unit (ECU) during this mode of operation.

The following conditions involve open loop operation:

- engine start-up
- the coolant temperature less than 17° C (63° F)
- the engine is at idle speed and the coolant temperature is between 17° C and 45° C (63° F and 113° F)
- the oxygen (O_2) sensor temperature is too low
- the engine is at wide open throttle (WOT)

NOTE: The temperatures are nominal values.

When all input data conforms with the programmed criteria for closed loop, the oxygen content output voltage from the oxygen sensor is accepted by the electronic control unit (ECU).

This results in an air/fuel mixture that will be optimal for the engine operating conditions at the time.

ENGINE FUEL SYSTEM

GENERAL

Closed loop operation occurs when:

- the coolant temperature is greater than 45° C (113° F), except when the engine is at WOT
- the engine is above idle speed and the coolant temperature is between 17° C and 45° C (63° F and 113° F)

The cold start injector is controlled by the thermo-time coolant switch.

When the starter motor is engaged, it provides the fuel enrichment necessary for cold starts.

The supplementary air regulator is controlled by a bimetallic spring that is heated by the ambient temperature of the engine and by an electric heater.

It increases the amount of air bypass to provide a faster idle speed when the engine is cold.

The control relay, located on the passenger side firewall, controls the voltage input (B+) to the fuel pump, the injectors, the electronic control unit (ECU), the supplementary air regulator and the throttle position switch.

The oxygen sensor (0_2) provides a variable voltage (millivolts) for the electronic control unit (ECU) that is proportional to the oxygen content in the exhaust gas.

A LEAN air/fuel mixture causes the exhaust gas to have a greater oxygen content.

A RICH air/fuel mixture causes the exhaust gas to have less oxygen content.

The optimum air/fuel ratio is 14.7:1

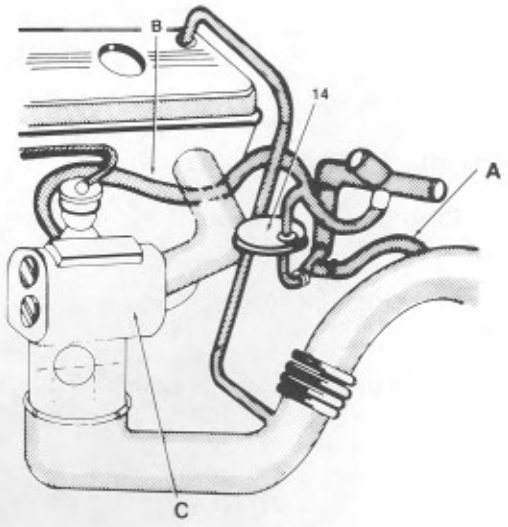
The supplementary air regulator (14) is connected by hose (A) to the air duct before the throttle plate and by a second hose (B) to the intake chamber (C).

The variable amount of supplementary air required for cold engine operation is supplied by this regulator. The air bypasses the throttle plate.

The fast idle solenoid, attached to the air bypass unit near the idle speed adjustment screw, provides and additional air circuit that compensates for the decrease in idle speed that results from A/C compressor operation.

The fast idle solenoid is also operational when the starter motor is engaged.

The timer relay energizes the fast idle solenoid for approximately 3 seconds after the starter motor is de-energized.



FUEL PUMP

The purpose of the fuel pump is to keep the injection system under operating pressure.

This pump is a roller type with a permanent magnet electric motor which is immersed in fuel. It has a check valve designed to keep the circuit under pressure after the engine has stopped.

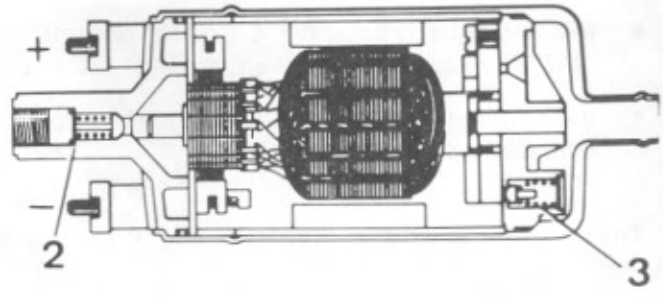
It is fed through two terminals, marked + and - to ensure that is rotates in the correct direction.

The pump is located next to the left front frame member.

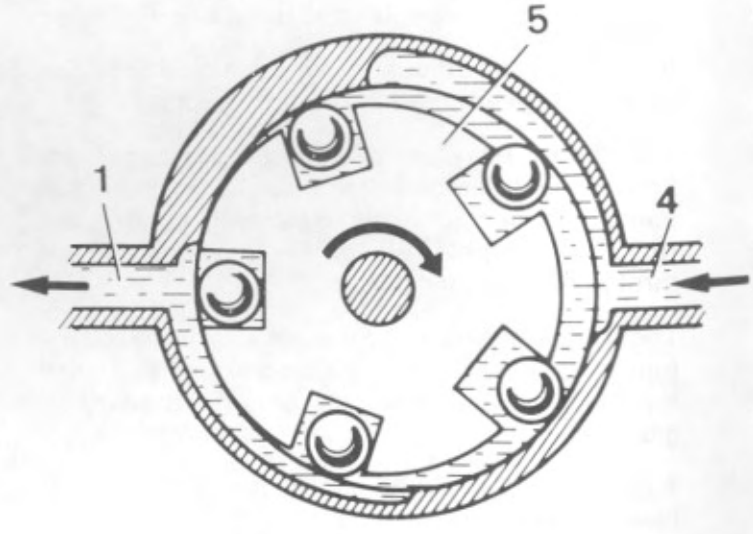
NOTE: Stopping the engine causes the pump to stop even if the ignition remains on.

J7T ENGINE - Current is routed through a control relay located near the test plugs in the engine compartment.

> **CAUTION**
>
> The sender pickup is equipped with a 50 micron filter screen for fuel pump protection. Removal or modification may result in pump failure.



2 - Check valve
3 - Safety valve



1 - Discharge side
4 - Suction side
5 - Multi-celled roller pump

ENGINE FUEL SYSTEM

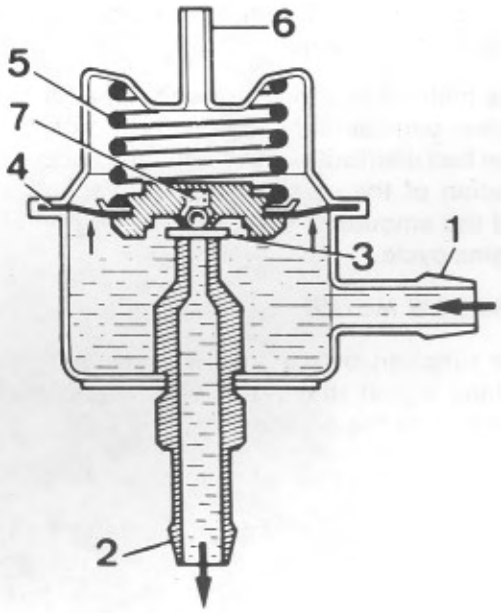
FUEL PRESSURE REGULATOR/INJECTORS

Fuel Pressure Regulator

Fuel pressure is maintained at a constant level by means of a pressure regulator. The regulator consists of a metal casing inside of which a spring-loaded diaphragm opens a discharge line whenever the pressure in the circuit exceeds the regulated pressure.

The spring chamber is connected by a tube to the intake manifold.

The difference between the manifold pressure and the fuel pressure is thereby kept constant, so that the pressure drop at the injectors is the same under all load conditions.



1 - Fuel line
2 - Fuel tank return line
3 - Valve carrier
4 - Diaphragm
5 - Spring
6 - Intake manifold connector
7 - Valve

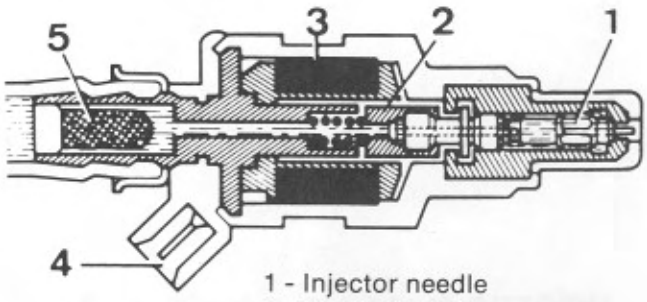
Fuel Injectors

The electromagnetically controlled injector consists, basically, of a valve body and an injector needle with a magnetic core. The moveable magnetic core is part of the needle, and the needle is compressed by a helical spring against the injector body seat. At the rear, the injector body has a magnetic winding; in front, it has a guide for the injector needle.

Signals from the control unit create a magnetic field in the winding; the core is attracted and the injector needle is pulled away from its seat. The passage for the fuel under pressure is now open. Core travel is about 0.15 mm (about 0.006 in.). Opening time is determined by the control unit depending on engine operating conditions at the time.

Each cylinder has one injector located in the intake tube, which atomizes the fuel ahead of the intake valve.

This method of injection has the advantage of not only requiring low injection pressure but also of allowing group injection, which simplifies the technicial construction of the system.



1 - Injector needle
2 - Magnetic core
3 - Magnetic winding
4 - Electrical connection
5 - Filter

AIRFLOW METER, THROTTLE PLATE & THROTTLE POSITION

In the L-Jetronic system, all injectors are controlled as one single group.

This method has the advantage of simplifying the system considerably. However, in order to ensure even fuel distribution, two injections occur for each rotation of the camshaft. Each injection contains half the amount of fuel required for one complete engine cycle.

AIR FLOW METER

The function of the airflow meter is to supply a voltage signal that varies with the amount of air drawn in by the engine.

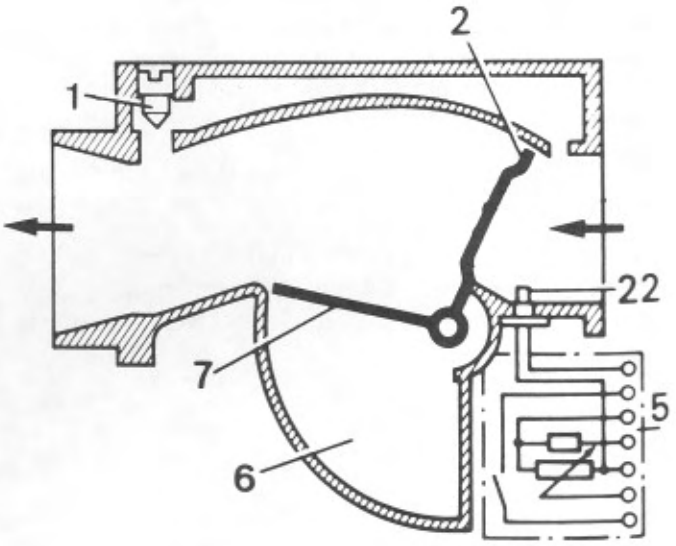
This air pushes against a movable sensor flap.

In response to the incoming airflow and the opposing action of a spring, the flap is moved into an angled position that is transmitted to a potentiometer.

A compensation flap is attached to the sensor flap. It has the same active surface area as the sensor flap, so it compensates for pulsations resulting from any possible back pressures. This keeps back pressure from affecting airflow measurement.

The sensor flap has a rubber damper to protect the sensor from any damage during back pressure peaks.

An air temperature sensor (22) is located in the air flow.

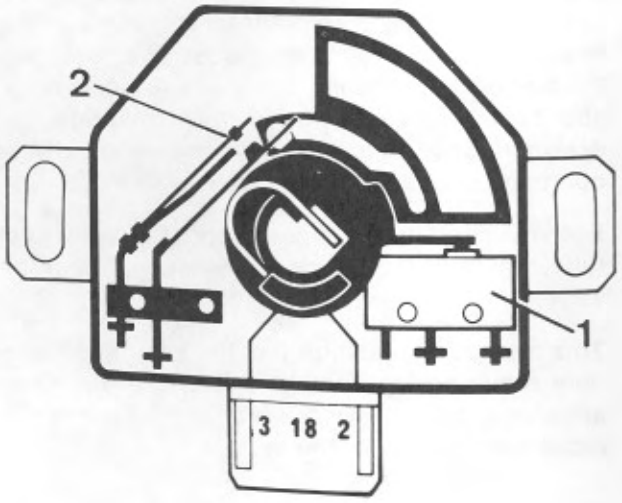


1 - Integrator voltage adjustment screw
2 - Sensor flap
5 - Electrical connections
6 - Damping chamber
7 - Compensation flap
22 - Air temperature sensor

THROTTLE PLATE AND THROTTLE POSITION SWITCH

In order to control the amount of air admitted to the engine, a double throttle plate assembly with delayed throttle plate openings is located after the airflow meter.

A switch is attached to the throttle plate shaft with one contact for idling and one contact for full throttle. The control contact closes the idling contact or the full throttle contact for a given air throttle plate position. The control unit analyzes the output signals to calculate the length of injection time.



1 - idling contact
2 - full throttle contact

OXYGEN SENSOR & COLD START INJECTOR

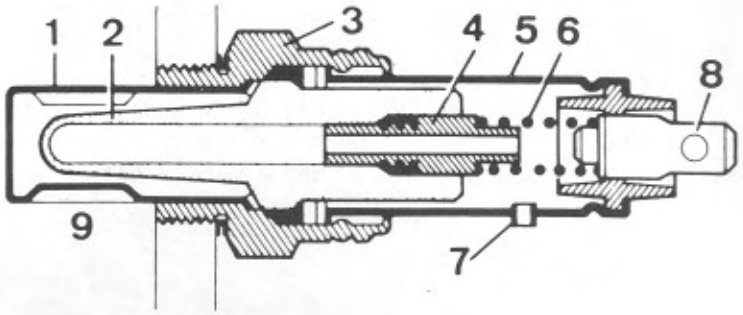
OXYGEN SENSOR

The construction of the oxygen sensor is shown in the figure at right. The ceramic detector is housed in a threaded metal base that allows it to be screwed into the exhaust and also protects it from mechanical damage. The outer surface of the ceramic body (2) is located in the exhaust gas flow, while the inner surface is in contact with the outside air by way of an air passage (7).

The ceramic material acts as a conductor for oxygen ions above a temperature of about 300° C (572° F). If the oxygen content is different on the two sides of the sensor, a voltage develops across the contact surfaces. This voltage allows measurement of the difference in oxygen content on both sides of the sensor.

CAUTION

Use of leaded fuel will result in oxygen sensor damage.



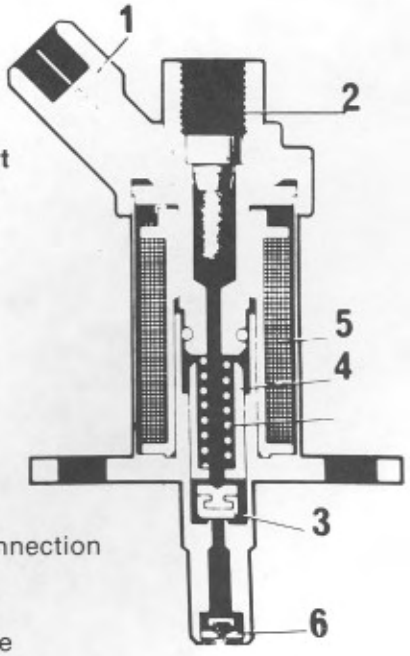
OXYGEN SENSOR

Oxygen sensor cross section:

1 - Protective sleeve
2 - Ceramic sensor
3 - Base
4 - Contact cover
5 - Protective cover
6 - Contact spring
7 - Air opening
8 - Electrical connection
9 - Exhaust gas

Cold Start Injector

Located near the air throttle plate, the cold start injector is designed to enrich the air mixture by finely atomizing the fuel in the intake manifold. It is only operative, however, when the starter is activated and when, at the same time, a thermo-time coolant switch, located in the cooling liquid, has closed the electrical circuit.



Cold Start Injector

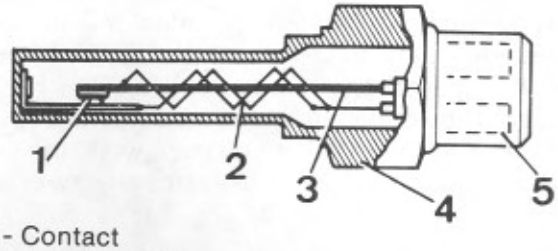
1. Electrical Connection
2. Fuel Inlet
3. Seal
4. Solenoid Core
5. Solenoid Coil
6. Rotary Nozzle

THERMO-TIME COOLANT SWITCH & AUXILIARY AIR REGULATOR

THERMO-TIME COOLANT SWITCH

The thermo-time coolant switch limits the time the cold start injector is energized. It is used for 8 seconds when starting with a coolant liquid temperature of -20° C (-4° F). The use time is zero when the coolant temperature reaches 35° C (95° F).

The time limit determined by the thermo-time switch is obtained by means of a bi-metal strip heated by an electrical resistance. This bi-metal strip breaks the circuit depending on the temperature reached after a certain heating time.



1 - Contact
2 - Heating resistances
3 - Bi-Metal Strip
4 - Housing
5 - Electrical connection

Thermo-Time Coolant Switch

AUXILIARY AIR REGULATOR

The amount of auxiliary air required when the engine is cold is supplied by a regulator that allows air to bypass the throttle plate.

The opening section of the auxiliary air regulator is automatically controlled by the temperature of the cylinder head (to which it is attached) and by a built-in electrical heater element.

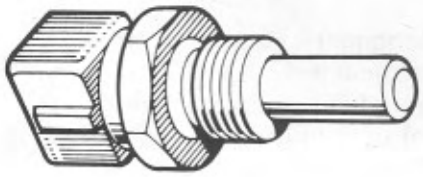


Auxiliary Air Regulator

COOLANT TEMP. SENSOR - ATMOSPHERIC PRESSURE SENSOR - FAST IDLE SOLENOID AND IDLE SPEED CONTROLS

COOLANT TEMPERATURE SENSOR (CTS)

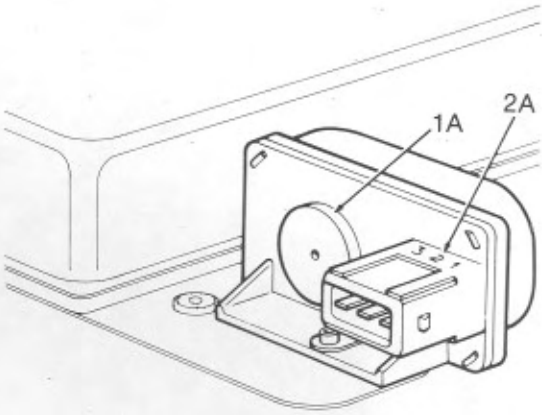
The coolant temperature sensor (threaded into the thermostat housing) provides input to the electronic control unit (ECU), which, in turn, corrects the air/fuel mixture ratio according to the engine coolant temperature.



ATMOSPHERIC PRESSURE SENSOR

The atmospheric Pressure Sensor consists of:

- an atmospheric pressure capsule (1A)
- a potentiometer (2A)



The atmospheric pressure sensor is located beneath the front passenger seat adjacent to the electronic control unit (ECU).

The potentiometer B+ voltage is provided by the fuel injection relay.

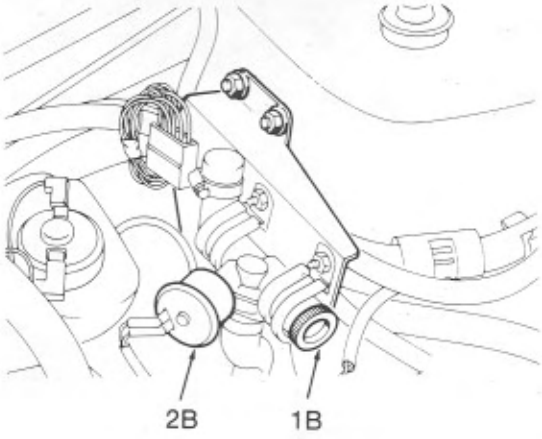
The potentiometer wiper arm position is determined by the atmospheric pressure capsule.

The atmospheric pressure sensor provides a voltage input to the electronic control unit (ECU) that represents the current ambient atmospheric pressure.

The ECU uses the input to compensate for any altitude changes.

The voltage provided to the ECU is:

- low at sea level
- high at 1,230 meters (4,000 feet) - approximately 90% of the B+ voltage.



Fast Idle Solenoid

The fast idle solenoid (2B) is attached to the idle bypass unit body.

Each time the engine is started, the fast idle solenoid is energized.

It is also energized when the air conditioner compressor is operating.

Two relays control the fast idle solenoid.

After engine start-up, the start-up time relay maintains the solenoid energized for approximately 3 seconds.

When the air conditioner compressor is turned ON, the A/C relay energizes the fast idle solenoid.

The timer relay is located near the left headlight and A/C relay behind right headlight.

IDLE SPEED CONTROLS

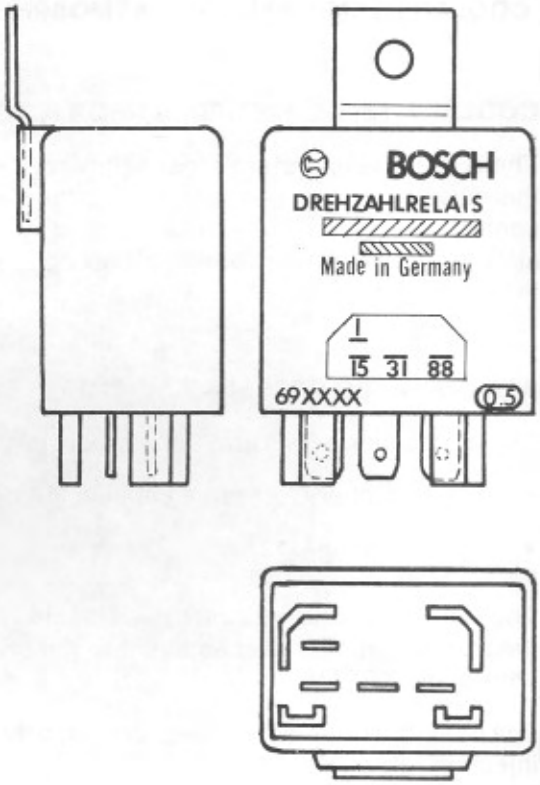
The engine idle speed is controlled by the position of the adjustment screw (1B) on the air bypass unit located on the firewall.

Engine idle speed (hot): vehicles equipped with an automatic transmission 700 ±50 rpm (D) in drive

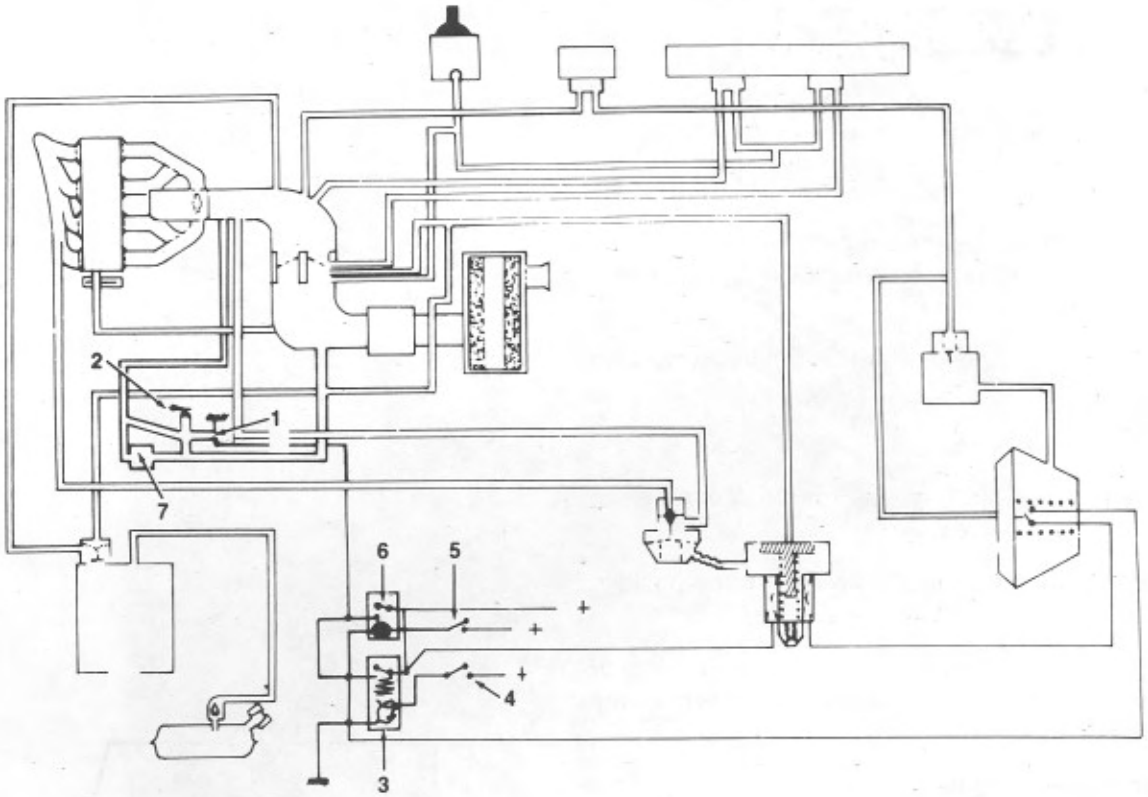
ENGINE FUEL SYSTEM

TACHOMETRIC RELAY

The Tachometric Relay is located under the passenger seat, near the ECU. The function of this relay is to prevent full fuel enrichment at WOT (wide open throttle) until the engine exceeds 4,100 rpm (± 50 rpm). This provision is required for emission control purposes.



ENGINE FUEL SYSTEM
FAST IDLE DIAGRAM



FAST IDLE DIAGRAM

1. Fast idle solenoid
2. Idle adjustment screw
3. Timer relay (located behind drivers side headlight)
4. Start/ignition switch
5. Air conditioner switch
6. A/C fast idle relay (located behind passenger side headlight)
7. Supplementary air regulator

THERMO-TIME COOLANT SWITCH TESTS

FIRST TEST PROCEDURE

WARNING

Do not loosen the coolant switch with the system hot and pressurized because serious burns from coolant can result.

Remove the thermo-time coolant switch from the cylinder head and replace it with a plug to prevent loss of coolant.

Cool the thermo-time coolant switch by immersing it in cold water.

Connect the test wires:

- connect the switch connector pin W to either of the test lamp wires
- connect the other test lamp wire to the positive (+) terminal of the battery
- connect a wire from the negative (-) terminal of the battery to the body of the thermo-time coolant switch

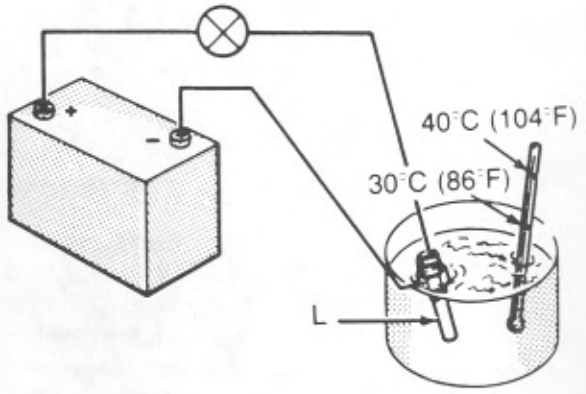
The lamp should light.

Place the thermo-time coolant switch (L) in a container of water and heat the water while monitoring its temperature.

The lamp should go out between 30° and 40° C (86° and 104° F).

The nominal values of the thermo-time coolant switch are marked on the six sides of the body.

For example: 35° C/8s (8 sec/35° C).

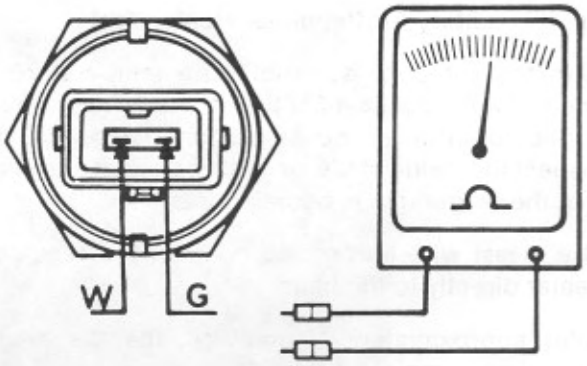


THERMO-TIME COOLANT SWITCH TESTS

Second test procedure

Test the resistance values between the thermo-time coolant switch wire connector pins (W and G) and ground for coolant temperatures lower than 30° C (86° F) and higher than 40° C (104° F).

Refer to the resistance chart.



TYPE	At a Coolant Temperature		Terminal G and Ground (Housing)	Resistance Measured Between:	
	Lower Than	Higher Than		Terminal W and Ground (Housing	Terminal G and Terminal W
35° C/85 (95° F/85)	30° C (86° F)	40° C (104° F)	25-40 ohms 50-80 ohms	0 100-160 ohms	25-40 ohms 50-80 ohms

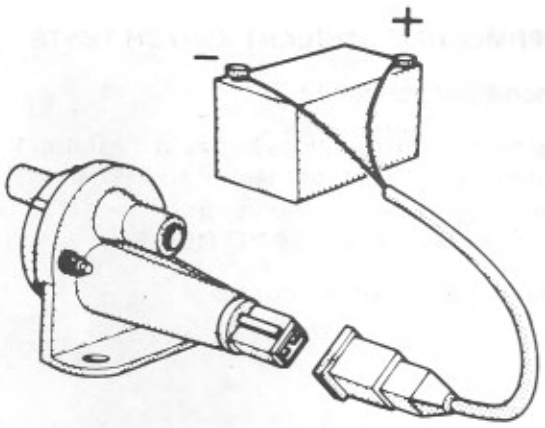
Supplementary Air Regulator Heater Test

With the complete assembly at a temperature of approxiately 20° C (68° F) and the wire harness connector and air hoses disconnected, visually inspect the inside of the air inlet and outlet to ensure that the diaghragm is partially open.

Use a test wire harness to connect the regulator heater directly to the battery.

After approximately 10 minutes, the diaphragm should be completely closed.

If it does not close, replace the air regulator.



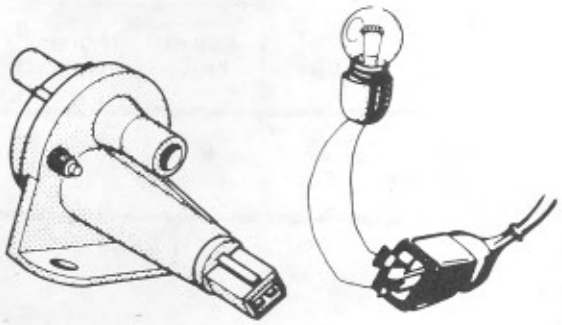
Supplementary Air Regulator Wire Harness Test

The engine should be cold.

Connect a test lamp to the wire harness connector terminals.

Start the engine.

The lamp should light.



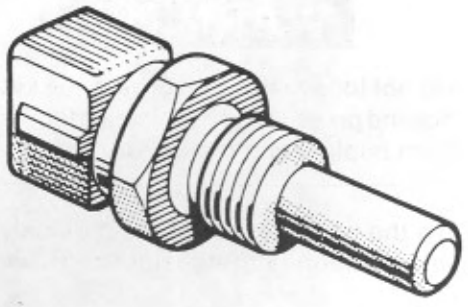
Coolant Temperature Sensor (CTS) Test

(ECU Input)

WARNING

Do not loosen the temperature sensor with the system hot and pressurized because serious burns from coolant can result.

Remove the temperature sensor and replace it with a plug to prevent loss of coolant.



Electrical Test

To facilitate electrical tests, the wire harness connector terminals and pins are assigned with reference numbers.

Measure the sensor resistance in relation to temperature with an ohmmeter after a temperature stabilization time of at least 10 minutes.

Refer to the resistance chart.

Temperature	+ 20 ± 1°C (+ 68 ± 2°F)	+ 80 ± 1°C (+ 176 ± 2°F)
Resistance	2.1k to 2.9k ohms	250 to 390 ohms

COOLANT TEMPERATURE SENSOR REPLACEMENT

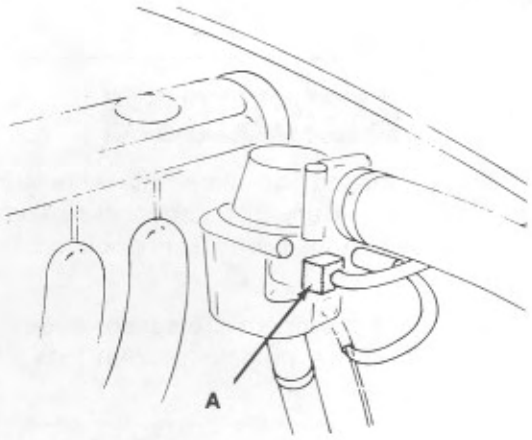
Disconnect the wire harness connector.

WARNING

Do not loosen the sensor with the system hot and pressurized because serious burns from coolant can result.

Remove the white sensor (A) and quickly plug the hole in the thermostat housing to prevent loss of coolant.

Install the replacement sensor and connect the wire harness connector.



THERMO-TIME COOLANT SWITCH REPLACEMENT

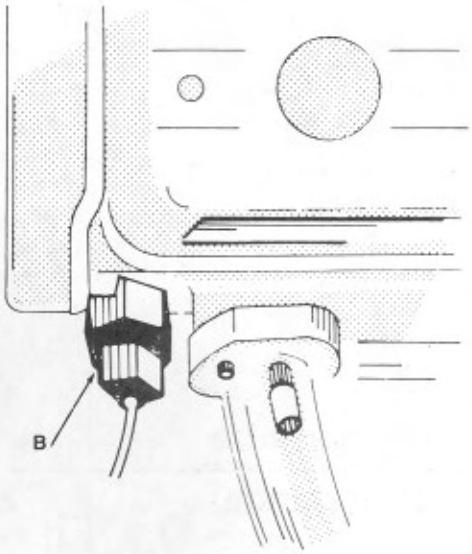
Disconnect the wire harness connector.

WARNING

Do not loosen the sensor with the system hot and pressurized because serious burns from coolant can result.

Remove the brown thermo-time coolant switch (B) and quickly plug the hole in the cylinder head to prevent loss of coolant.

Install the replacement switch and connect the wire harness connector.



OXYGEN (O_2) SENSOR REPLACEMENT

Disconnect the wire harness connector.

Remove the oxygen (O_2) sensor from the exhaust pipe with a flare head crow foot wrench (22 mm x 3/8 in drive).

When installing the replacement sensor, apply antiseize compound to the threads.

> **CAUTION**
>
> Apply antiseize compound only to the threads and not to any other part of the sensor.

Hand start the replacement sensor into the adaptor.

Tighten the sensor with 3.8 - 4.6 daNm (28-34 lb./ft.) torque with a flare head crow foot wrench (22 mm x 3/8 in drive).

ELECTRONIC CONTROL UNIT (ECU) REPLACEMENT (LOCATED UNDER PASSENGER SEAT)

Remove cover and then remove the retaining screw. Remove the ECU from the bracket. Disconnect the wire harness connector.

Connect the wire harness connector to the replacement ECU and install it in the bracket.

Tighten the screw.

CONTROL RELAY REPLACEMENT

Precautions

Never connect or disconnect a wire harness with the ignition switch on.

With the engine stopped and the ignition switch ON, the fuel pump should not be operative. Its input circuit passes through the control relay, which remains de-energized until the starter motor is engaged.

Do not attempt to charge the battery without disconnecting it.

Procedure:

Remove the relay from the right side of the firewall by first removing the bolt at the top of the relay. Remove the wire harness connector from the relay.

Connect the wire harness connector to the new replacement relay. Refasten the bolt on the top of the relay to the firewall.

AIR INTAKE SYSTEM LEAK TEST

SPECIAL PRECAUTIONS

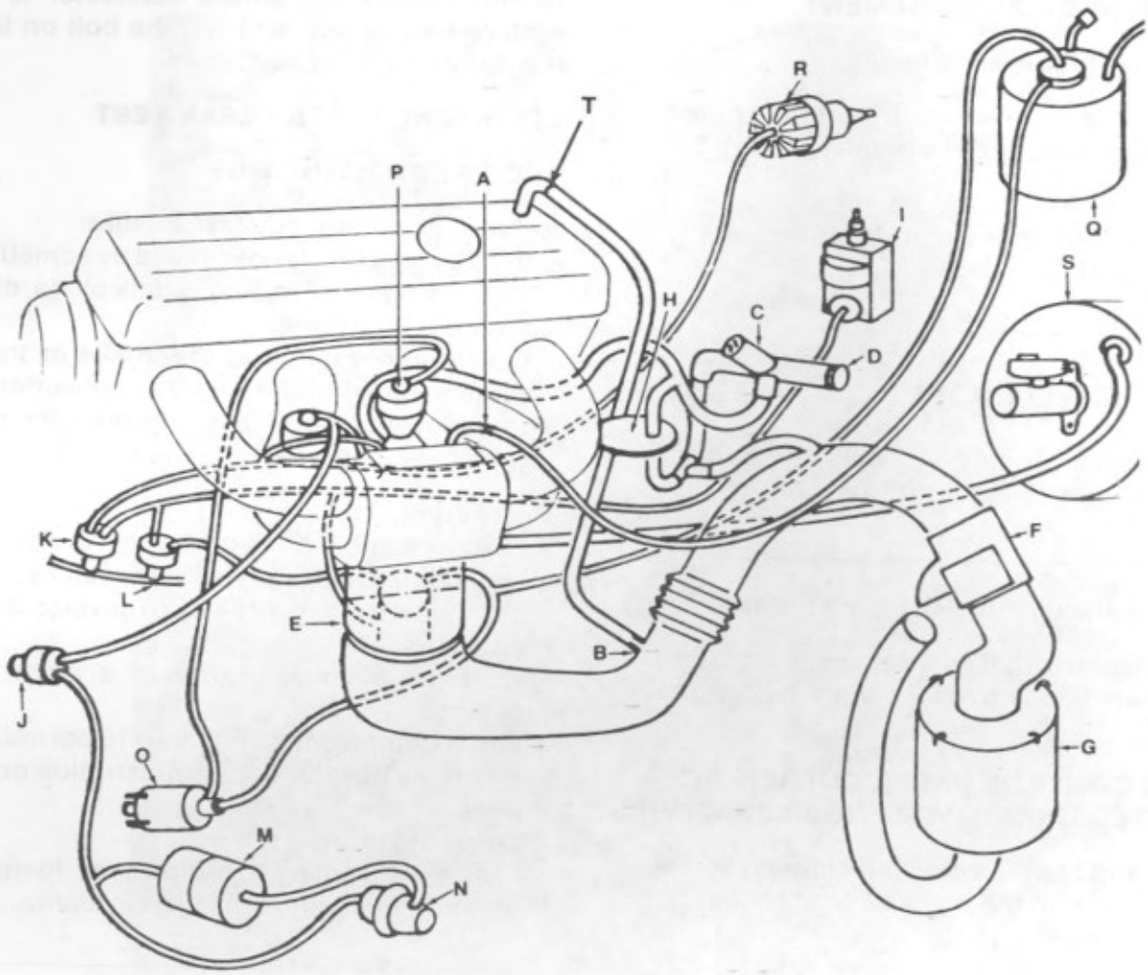
Before performing any test, ensure:
- that the problem is not caused by something other than the fuel system (e.g., spark plugs, distributor, ignition timing, etc.)
- that no air is entering the intake or the exhaust system ahead of the catalytic converter.
- that fuel is actually reaching the injectors (check the pressure in the fuel circuit)

Procedure:
- Disconnect the hose from the valve cover.
- Use a brush and apply a soapy water solution to all components that are likely to develop leaks (seals, air hoses, etc.)
- Plug the exhaust pipe with a cloth or similar object.
- Force compressed air (1 bar/15 psi max.) into the air intake hose at **T.** (See illustration on following page.)
- Open the throttle plate.
  The appearance of bubbles or foam indicates location of an air leak in the system.

> **CAUTION**
>
> If the air temperature is likely to exceed 80° C/176° F (as in a body shop paint curing oven, for example), remove the electronic control unit (ECU) from the vehicle.

ENGINE FUEL SYSTEM

FUEL SYSTEM, VACUUM HOSES AND PCV SYSTEM



A - 1.8 mm (0.070 inch) orifice
B - 5.5 mm (0.216 inch) orifice
C - Fast idle solenoid
D - Idle screw adjustment
E - Throttle body
F - Air flow meter
G - Air filter
H - Supplementary air regulator
I - Integral electronic ignition module
J - Thermo valve (open T° above 59° F)
K - Thermo valve (open T° below 59° F)
L - Thermo valve (open T° above 113° F)
M - Vacuum reservoir
N - Differential pressure switch
O - Solenoid
P - EGR valve
Q - Canister
R - Vacuum capsule
S - Brake booster
T - PCV valve

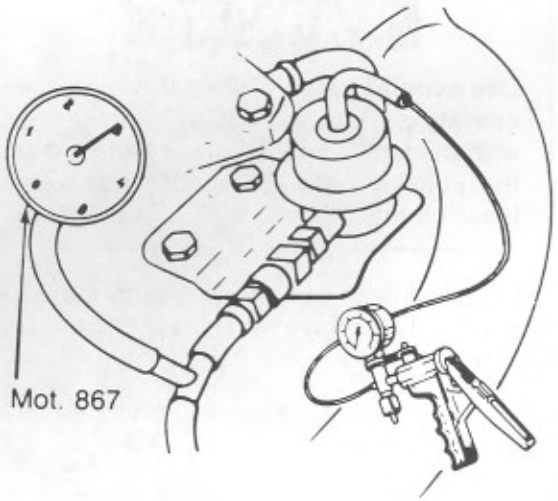
FUEL SYSTEM TEST

Fuel Pressure Test

Disconnect the hose connected between the pressure regulator and the injector ramp assembly.

Connect Fuel Pressure Test Gauge Mot. 867 with a T-fitting.

Disconnect the vacuum hose from the pressure regulator and connect a hand operated vacuum pump to the regulator.



WARNING

Use extreme caution when the engine is operating. Do not stand in a direct line with the fans. Do not put your hands near the pulleys, belts or fan. Do not wear loose clothing.

Start the engine.

Test for a pressure of 3.0 ± 0.2 bars/296 ± 20 kPa/43 ± 3 psi.

Apply a vacuum of 530 mbar/54 kPa/400 mm Hg/16 in Hg to the pressure regulator.

The fuel pressure should decrease approximately 0.5 bars/50 kPa/7 psi.

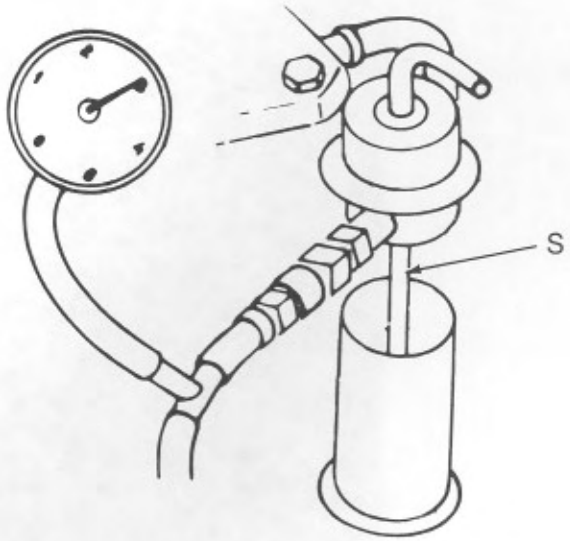
Fuel Pump Output Test

Disconnect the fuel tank return hose from the pressure regulator and connect a temporary hose (S) to the regulator.

Place the other end of the hose (S) in a 2000 cc, or 2000 ml (approx. 122 cu. in. or 2 U.S. qts.) graduated container.

Connect test terminals D1-5 and D1-6 (small diagnostic connector) with a jumper wire to activate the fuel pump.

The minimum fuel pump output should be 1000 ml (1 qt. approx.) per 30 seconds of fuel pump operation.

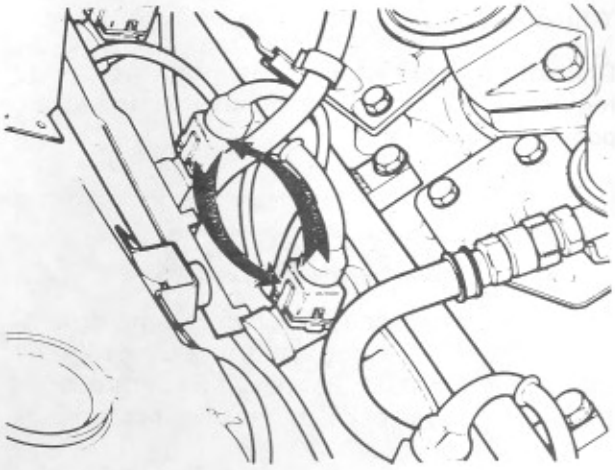


INJECTOR TEST

Test with the engine operating.

WARNING

Use extreme caution when the engine is operating. Do not stand in a direct line with the fan. Do not put your hands near the pulleys, belts or fan. Do not wear loose clothing.



Disconnect an injector wire harness connector for a moment, then reconnect it. Repeat this on each of the other injectors.

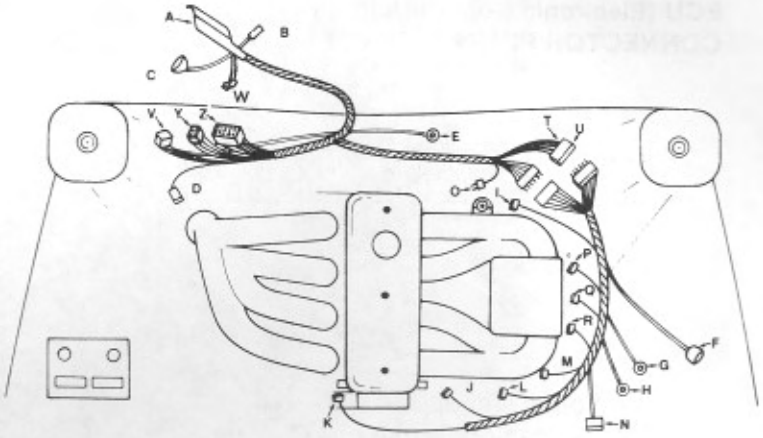
A loss of engine speed should be noticed while each injector is inoperative.

If any one cylinder is not firing because of an inoperative injector, switch the wire harness connectors between the inoperative injector and one that is working.

If the previously operational injector does not work, the wire harness is faulty.

ENGINE FUEL SYSTEM
WIRE HARNESS CONNECTIONS

A - ECU
B - +12V to fuel pump
C - Atmospheric pressure sensor
D - Oxygen sensor
E - +12V Battery
F - Airflow meter
G - Signal ground
H - Power ground
I - Supplementary air regulator
J - Thermo-time coolant switch
K - Coolant temperature sensor
L - Injector
M - Injector
N - Throttle position sensor
O - Fast idle solenoid
P - Injector
Q - Injector
R - Cold start injector
T - Tach voltage
U - Instrument panel harness
V - Control relay
W - Tach relay
Y - Diagnostic connector D1
Z - Diagnostic connector D2



ENGINE FUEL SYSTEM
WIRE HARNESS CONNECTIONS

GENERAL INFORMATION

To facilitate electrical tests, the wire harness connector terminals and pins are assigned reference numbers.

The ECU connector pin references appear on the injection system wiring diagram. They are not stamped on the connector.

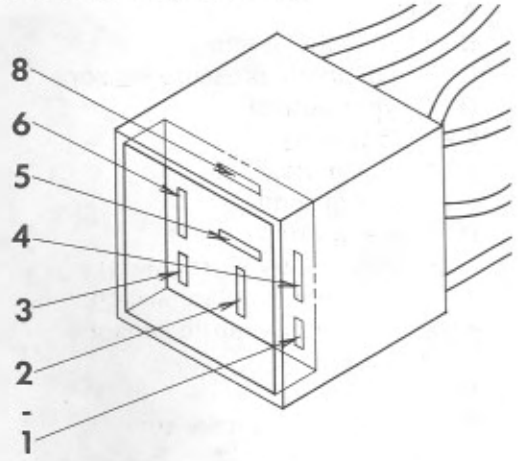
ECU (Electronic Control Unit) CONNECTOR PIN REFERENCE



PIN

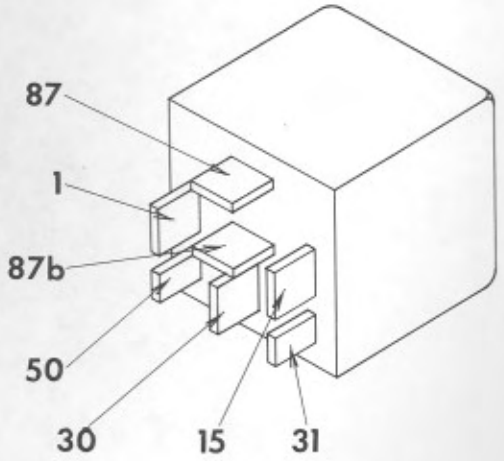
1 - Tach Voltage input
2 - Throttle Position Switch Idle Contact
3 - Throttle Position Switch WOT Contact
4 - Ignition Switch ("Hot" in Start Position)
5 - Vehicle Ground (Power Reference)
6 - Not Used
7 - Airflow Meter Potentiometer Source Voltage
8 - Airflow Meter Position Reference Voltage (Output)
9 - Battery Voltage in Start or Run Condition
10 - Coolant Temperature Sensor
11 - To Position 11 at ECU
12 - Fuel Injectors
13 - Injector Circuit Ground
14 - Not Used
15 - Not Used
16 - Not Used
17 - Not Used
18 - Not Used
19 - Not Used
20 - Oxygen (O^2) Sensor
21 - Not Used
22 - Integrator Voltage (Output to Diagnostic Connector)
23 - Not Used
24 - Not Used - Terminates at J2 connector
25 - Vehicle Gound (Power Reference)

CONTROL RELAY CONNECTOR



8 - Injection System Source Voltage
5 - Electric Fuel Pump
1 - Ignition Switch (Start) +12V
3 - Vehicle Ground
4 - Tach Voltage (Trigger)
6 - Ignition (Ignition Control Module) +12V
2 - Battery Voltage

CONTROL RELAY PIN REFERENCE

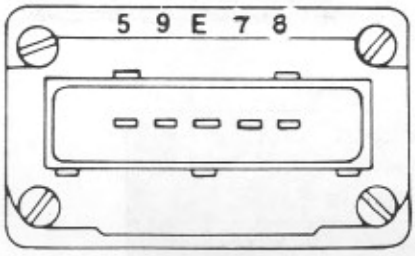


PIN

87 - Injection System Source Voltage
1 - Tach Voltage (Trigger)
87b - Electric Fuel Pump
15 - Ignition ("Hot" in ON/Running Position) +12V
50 - Energized in Ignition Start Position +12V
30 - Relay Source Voltage (12VDC)
31 - Ground

ENGINE FUEL SYSTEM
WIRE HARNESS CONNECTIONS

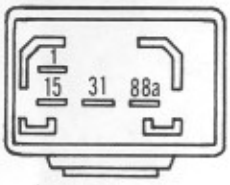
AIRFLOW METER PIN REFERENCE



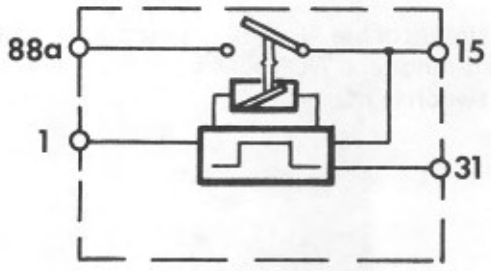
PIN
5 - Ground
9 - B+
E - Not Used
7 - Reference Voltage
8 - Wiper Arm Voltage (Output)

Tachometric Relay





Relay Schematic



1 - Tach signal voltage

15 - Full Throttle Switch

31 - Ground

88a - To pin 3 of ECU

THROTTLE POSITION SWITCH (T.P.S.) CONNECTOR

Throttle Position Switch (T.P.S.) Operational Test

3 - WOT contact
18 - B+
2 - Idle contact



Ohmmeter Leads Connected to Pins:	Resistance at Pedal Position		
	Rest/Idle	Mid Range	WOT
3 and 18	∞	∞	1-10 Ω
3 and 2	∞	∞	∞
18 and 2	1-10 Ω	∞	∞

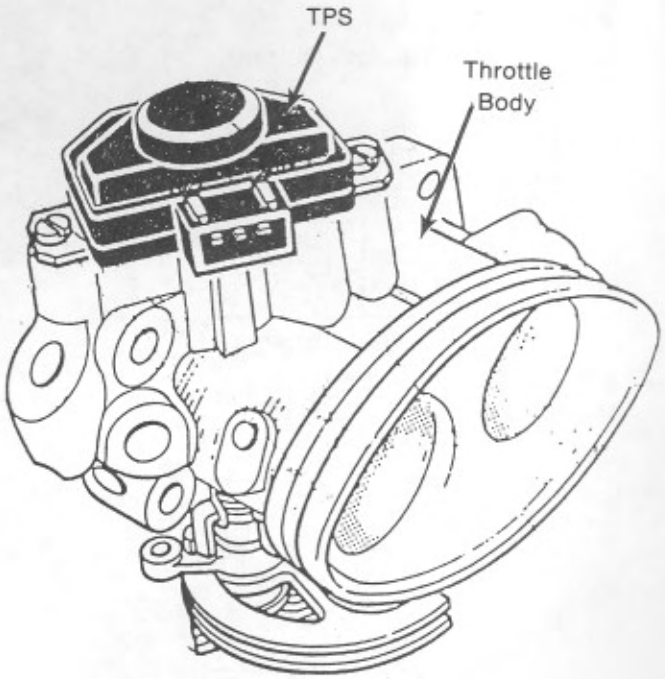
Throttle Position Switch Adjustment

With the throttle plate against its idle speed stop, slowly rotate the throttle position switch (TPS) in the direction of the throttle plate opening until the inner stop can be felt.

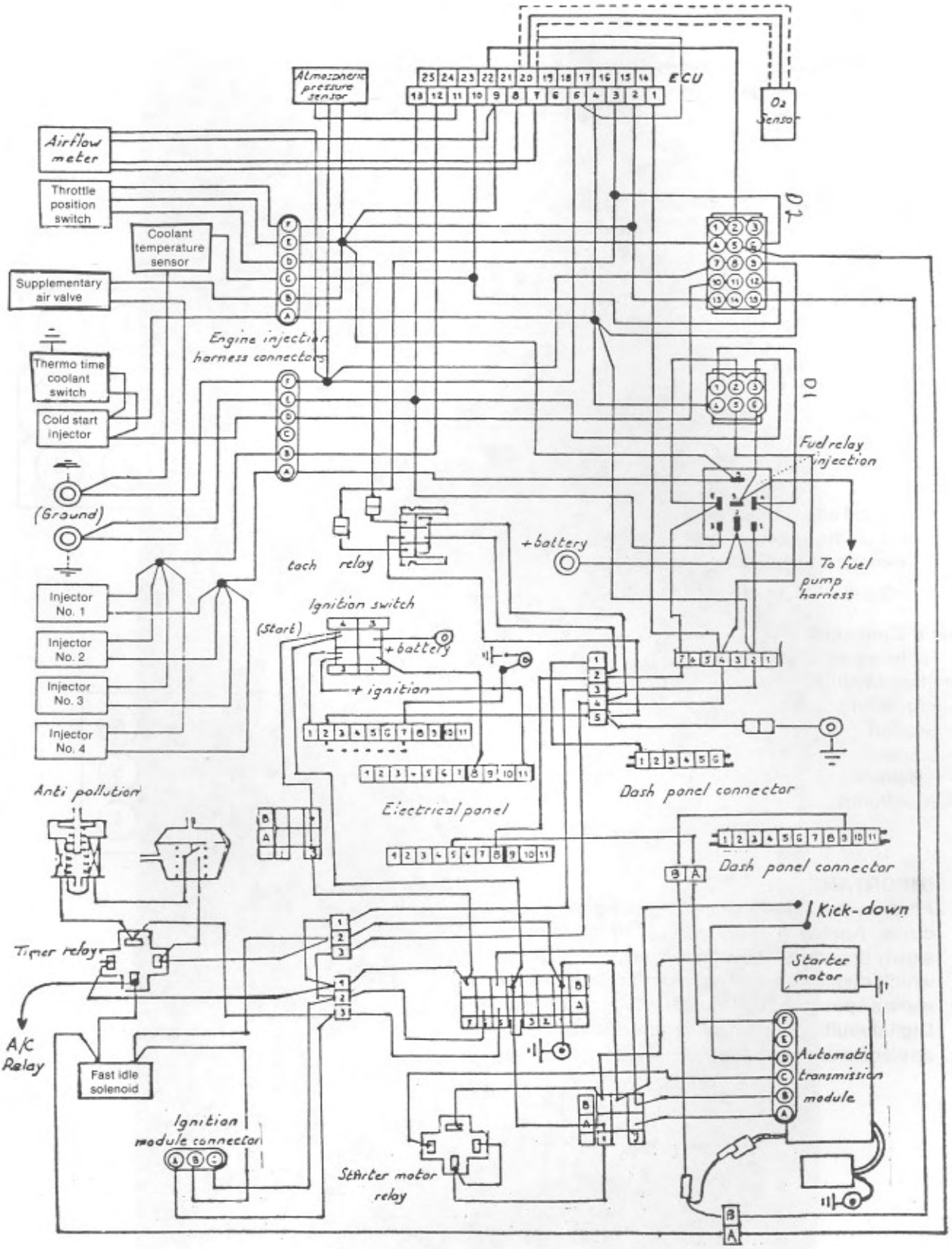
NOTE: The TPS adjustment can also be accomplished with an ohmmeter. Refer to the Functional Tests.

Tighten the two switch mounting screws.

If adjustment of the TPS will not produce the proper rest, mid-range and WOT specifications, replacement of the switch is necessary.



ENGINE FUEL SYSTEM
WIRE HARNESS CONNECTIONS



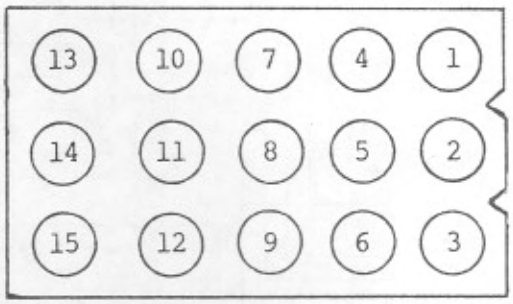
ENGINE FUEL SYSTEM
DIAGNOSTIC PLUGS

The diagnostic plugs are located near the coolant surge recovery reservoir on the passenger side of the engine compartment. They are equipped with yellow dust/debris covers.

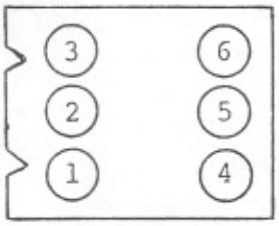
IMPORTANT
Be sure to view the plugs in the same orientation as illustrated, using the "V" notches in the plugs as a guide.

(D2) - 15 - Connector Plug
2 - Integrator Bosch air flow meter
4 - + Coil
6 - Full throttle switch
7 - Ground
9 - Cold Start Injector and Thermo-Time Coolant Switch
10 - Cold Start Injector and Thermo-Time Coolant Switch
12 - Coolant Temperature Sensor
13 - Throttle idle speed switch
15 - Automatic transmission computer

* Pins 1-3-5-8-11 & 14 are not used.



(D1) 6-Connector Plug
1 - Tachometer information (Ignition Module)
2 - + Ignition power
3 - Ground
4 - Starter
5 - + Battery
6 - Fuel Pump

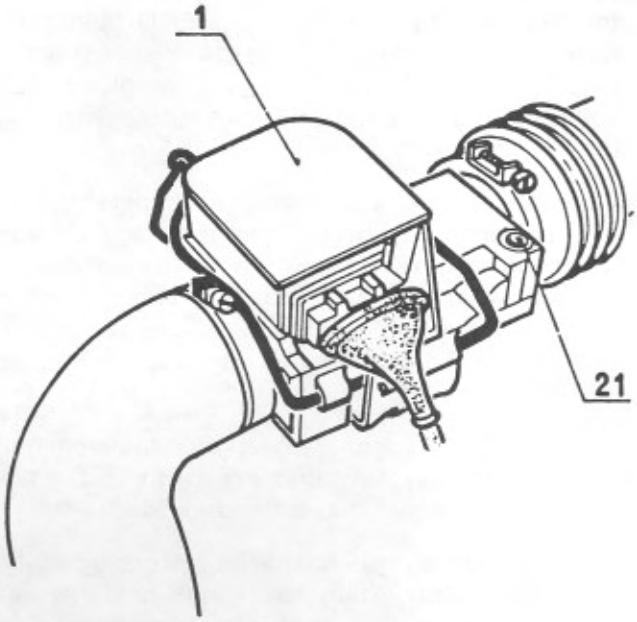


IMPORTANT
Always use a digital multi-meter for testing procedures. Analog (needle type) meters react too slowly to perform the required tests. Illustrations which display an analog meter are intended to show a specific gauge variation or position only. Digital multi-meters may be obtained locally at an electronics store or automotive supply center.

AIR FLOW METER TAMPER-PROOF DEVICE

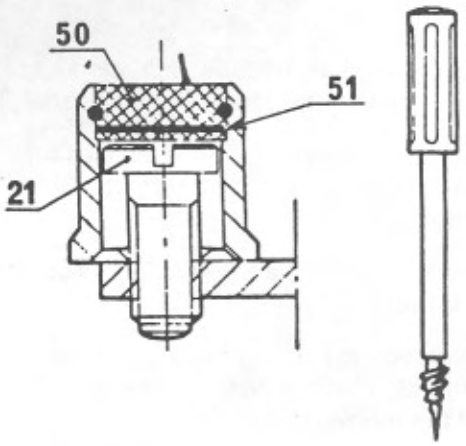
ADJUSTMENT TAMPER-PROOF DEVICE

The mixture adjustment screw (21) tamper-proof device consists of a plug (50) inserted on top of the screw (21) into the flow meter housing (1).



To pull out the plug:

- Drive the plug fully in to prevent it from rotating.
- Drill a 3 mm hole (0.119 in). A steel stopper plate (51) will stop the drill from going in too deep.
- Thread an extractor tip in and pull plug out.



FEDERAL REGULATION

Federal regulation requires that the plug be replaced after completion of adjustment operations.

Drive the replacement plug into the adjusting screw recess (21) using a hammer and proper size pin punch.

ENGINE FUEL SYSTEM

INTEGRATOR VOLTAGE

Integrator Voltage is the "language" used between the oxygen (O_2) sensor and the ECU (Electronic Control Unit). Integrator voltage is an extremely helpful tool in diagnosing engine problems. This voltage may be monitored between pins 2 and 7 of diagnostic plug D2.

When the engine is at operating temperature, the oxygen sensor tells the ECU whether the exhaust gases going past it are high or low in oxygen content, which normally indicates either a rich or lean condition. The ECU receives this information and adjusts the incoming air/fuel mixture accordingly.

NOTE: The O_2 sensor is designed to detect only the oxygen content of the exhaust gases -it cannot detect unburned fuel.

At normal operating temperature, integrator voltage fluctuates rapidly. When the engine is below operating temperature, however, a steady voltage is indicated. This steady voltage is known as **baseline voltage.**

Baseline voltage is usually indicated at a value between 6 and 7 volts under the following conditions:

- with all electrical lights and devices off,
- battery mode switch in neutral and
- radiator cooling fans off

(Baseline voltage may also be obtained by unplugging the O_2 sensor.)

If baseline voltage is significantly above or below the normal 6-7 volt range; it may indicate one or more of the following conditions:

- electrical load drawing from the battery
- dead battery
- charging system malfunction

Three very important things to remember about Integrator Voltage are:

- Normal integrator voltage should be within 1 volt above baseline voltage
- High voltage normally indicates a lean air/fuel mixture
- Low voltage normally indicates a rich air/fuel mixture.

NOTE: The integrator voltage reading is a very important tool when diagnosing engine problems.

A sampling of problems and causes are as follows:

LEAN MIXTURE:

1. Vacuum Leak (caused by one or more of the following).
   A. Vacuum hose(s) leaking or disconnected.
   B. Intake manifold gaskets, leaking or manifold cracked.
   C. E.G.R. valve not seated or open.
   D. Idle adjustment screw leaking
   E. Auxiliary air device leaking
   F. Crankcase vent hose leaking or disconnected
   G. Vacuum capsule at automatic transmission leaking
   H. Vacuum advance module on ignition module leaking or disconnected.
   I. Leaking connections at air flow meter
   J. Hoses to thermovalves (all three) disconnected or thermovalve broken)
   K. Defective brake booster, booster valve or hose.
   L. Leaking cruise control servo, dump valve, vacuum reservoir or leaking hoses.
2. Defective or misadjusted air flow meter
3. Wiring to air flow meter disconnected or bad
4. Defective oxygen sensor
5. Defective fuel pressure regulator causing low fuel pressure
6. Defective electric fuel pump
7. Insufficient fuel volume
8. Valve lash adjustment

RICH MIXTURE:

1. Defective fuel pressure regulator causing high fuel pressure.
2. Defective or leaking fuel injector or injectors
3. Leaking cold start injector
4. Electrical malfunction causing cold start injector to be on all the time.
5. Defective air flow meter
6. Defective oxygen sensor
7. Saturated evaporative emission charcoal canister.
8. Restricted exhaust system
9. Cam timing adjustment
10. Valve lash adjustment
11. EGR valve stuck shut
12. Misfiring spark plug(s)
13. Weak or defective ignition system (eg., coil, ignition module, TDC indicator, exciter ring on flywheel, distributor, spark plugs, spark plug wires, etc.

INTEGRATOR VOLTAGE

IMPORTANT
Do not overlook the charcoal canister or fuel pressure when diagnosing an over-rich condition.

The most common problem with a lean mixture is vacuum leaks. These can be traced by pinching off various vacuum hoses while observing the effect on integrator voltage.

Pinching off the lines works well in a rich condition to isolate a bad cold start injector or a saturated charcoal canister.

IMPORTANT
One cylinder not firing ("Missing"):

NOTE: When diagnosing a possible injection problem, be sure that the engine is running on all four cylinders. Also, be sure that there is **fuel, air and ignition** to all cylinders.

An ignition malfunction may seem like an over-rich condition, but integrator voltage indicates a lean condition. However, an ignition oscilloscope will reveal an ignition miss, which results in unburned fuel/air mixture being dumped into the exhaust manifold.

The O_2 sensor detects the higher oxygen content of the unburned mixture and passes this information on to the ECU. (Remember: The O_2 sensor detects oxygen content only - it cannot detect unburned fuel.)

Since the ECU is incapable of determining that a cylinder is not firing, it will try to compensate for the higher oxygen content in the exhaust by further enriching the fuel/air mixture. This causes an abnormal running condition, which results in high integrator voltage and misfiring of the remaining cylinders.

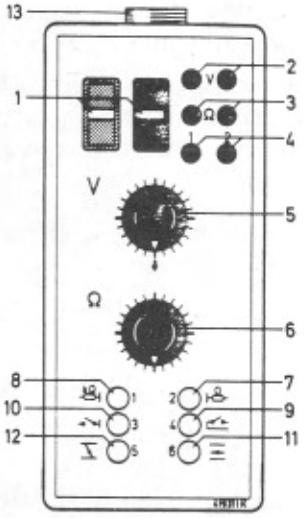
NOTE: A disconnected or inoperative fuel injector will also produce similar symptoms.

When diagnosing a fuel injection system, be very careful not to overlook ignition problems or restricted air intake or exhaust systems.

FUNCTIONAL TESTS (METHOD 1)

These tests are performed with the Bosch multi-function test box (700000-04-000) and test harness (700000-03-000).

1. Not used
2. Volt meter connections
3. Ohm meter connecting
4. Not used
5. "V" Knob 1 thru 23 and
6. Knob 1 thru 24
   NOTE: "V" knob must be on position ↓ for Ω knob functions to work.
7. Not used
8. Not used
9. Not used
10. Not used
11. Not used
12. Not used
13. Test harness connection



FUNCTIONAL TESTS (METHOD 1)

Switch Position V		Mesurement	Remarks	Test Values (display)
5	-	Voltage impulses from term. 1 of ignit. coil Control unit plug, terminal 1 to terminal 5	Put gearshift in neutral, start engine.	Observe ignition impulses on oscilloscope
6	-	Voltage from control relay, terminal 87. Control unit plug, terminal 9 to terminal 5	Put gearshift in neutral, start engine.	8 ... 15V
7	-	Voltage from starter, terminal 50 Control unit plug, terminal 4 to terminal 5	Put gearshift in neutral, start engine	8 ... 15V
8	-	Voltage from altitude sensor, terminal 11 Control unit plug, terminal 11 to terminal 5	Put gearshift in neutral, start engine Air pressure: 980 mbar (≈300 m above sea level) 615 mbar (≈ 4000 m above sea level)	 2 ... 4V 8 ... 12V
↓	11	Resistance of temperature sensor NTC I in air flow sensor, terminal 8 Control unit plug, terminal 8 to terminal 5	---	100 ... 200 Ω
↓	12	Resistance of potentiometer in air flow sensor, terminal 7. Control unit plug, terminal 7 to terminal 5	Move sensor flap to stop	60 ... 1000 Ω
↓	13	Resistance of temperature sensor NTC II terminal 10 (engine temperature) Control unit plug, terminal 10 to terminal 5	60° F/ + 15° C ... +30° C/86° F° +80° C/176° F°	1.3 ... 3.6 k Ω 250 ... 390 Ω
↓	14	Resistance, ground to output stage term. 13 Control unit plug, terminal 13 to terminal 5	---	0 ... 10 Ω
↓	16	Resistance of idle contact in throttle valve switch, terminal 2. Control unit plug, terminal 2 to terminal 9	Accelerator in rest position Accelerator slightly depressed	0 ... 10 Ω ∞ Ω
↓	17	Resistance of full-load contact in throttle valve switch, terminal 3 Control unit plug, terminal 3 to terminal 9	Accelerator completely depressed Accelerator slightly depressed	0 ... 10 Ω ∞ Ω
↓	18	Resistance of all 4 parallel solenoid-operated injection vlaves, terminal 12 Control unit plug, terminal 12 to terminal 9	---	68° F/+20° C: 7.0 ... 9.5 176° F/+80° C:

ENGINE FUEL SYSTEM

FUNCTIONAL TESTS (METHOD 1)

The following tests are to be preformed using Diagnostic plugs D1 and D2 and a digital VOM (Volt-Ohm-Milliammeter).

NOTE: The voltage and resistance values listed are nominal. The actual value will vary slightly from one vehicle to the next.

Conditions	Test	Test Points	Correct Result
1. Ignition on 2. Engine off 3. Engine coolant temp. less than 25° C (77° F)	1. Control Relay Ground and ECU Ground	Ohmmeter test probes between D1-3 and D2-7	0 ohms
	2. Battery Voltage	Voltmeter test probes between D1-5 (+) and D1-3 (-)	12 volts (approx.)
	3. Ignition Voltage	Voltmeter test probes between D1-2 (+) and D1-3 (-)	12 volts (approx.)
4. ECU Disconnected	4. Coolant Temperature Sensor	Ohmmeter test probes between D2-12 and D2-7	2.5K ohms R 2000 at 20° C (68° C (68° F) 320 ohms R 250 at 80° C (176° F)
5. ECU Connected	4a. Coolant Temperature Sensor		1.5K ohms R 1500 at 20° C (68° F)
	5. Injectors	Ohmmeter test probes between pins A and B of injector wire harness connector.	16 ohms (approx.)
	6. Fuel Pump	Apply 12 volts with jumper wire between D1-5 and D1-6	Listen for fuel pump noise.

ENGINE FUEL SYSTEM

FUNCTIONAL TEST (METHOD 1)

Conditions	Test	Test Points	Correct Result
6. ECU Disconnected	7. Throttle Position Switch	Ohmmeter test probes between D2-13 and D2-6	Infinite ohms
		Ohmmeter test probes between D2-8 and D2-13 (Throttle at idle position).	0 ohms - 10 ohms
		Ohmmeter test probes between D2-8 and D2-6 (WOT)	0 ohms - 10 ohms
	8. Thermo-time Coolant Switch and Cold Start Injector	Voltmeter test probes between D2-9 (+) and D2-10 (-)	8 - 12 volts After a few seconds, 0 volts time will vary with the temperature.
1. Starter motor Engaged 2. Engine Coolant Temp. less than 25° C (77° F)	9. Start Voltage (Signal)	Voltmeter test D1-4 (+) and D1-3 (-)	8-12 volts
	10. Tack Voltage	Voltmeter test probes between D1-1 (+) and D1-3 (-)	Oscillating voltage (Pulses)
1. Engine operating 2. Coolant Temp. less than 25° C (77° F) 3. Oxygen (O_2) sensor temp. less than 250° C (480° F)	11. Integrator Voltage (open loop)	Voltmeter test probes between D2-2 (+) and D2-7 (-)	6.8 volts (approx.) Note voltage For test 12 and Test 13
1. Engine operating at 800 + 50 rpm 2. Coolant temp. greater than 40° C (104° F) 3. Oxygen (O_2) Sensor temp. greater than 250° C (480° F)	12. Integrator Voltage (closed loop)	Voltmeter test probes between D2-2 (+) and D2-7 (-)	Voltage obtained with this test varying + 1 volt (e.g. 6.8-7.8 volts)
1. Increase engine speed to 3500 rpm and rapidly close throttle plate (idle position)	13. Fuel cut-off (during deceleration)	Voltmeter test probes between D2-2 (+) and D2-7 (-)	Voltage obtained with above test. (i.e. approx. 6.8 volts)

ENGINE FUEL SYSTEM
FUNCTIONAL TESTS (METHOD 2)

Functional tests may also be performed by just using diagnostic plug D2 and a digital VOM. The following pages contain guide charts for these procedures. They explain component tests, engine conditions, test points and desired results.

These pages may be photocopied to accompany you as a worksheet while testing a vehicle. Record test results carefully to assist you in making a more efficient diagnosis.

NOTE TO DEALERSHIPS: Worksheet values are required when contacting Winnebago Technical Service for assistance.

FUNCTIONAL TEST FOR WINNEBAGO/ITASCA H-BODY
EQUIPPED WITH GAS ENGINE AND AUTOMATIC TRANSMISSION

Date_____ Unit_____ Serial No. _____ Technician _____ Engine Serial No. _____

SECTION I Before Starting Engine

Component	Check	Engine Parameters	Normal Result	Actual Result & Notes
A) Coolant temperature sensor	Resistance between pins 12 and 7	Coolant temperature between 50° & 86°F	R 2000	
B) Throttle position switch				
1) Idle switch	Resistance between pins 13 and 7	Closed throttle	R ≃ 0 Ω	
		Slightly open throttle	R ≈ 2000 Ω	
2) Full load switch	Resistance between pins 6 and 7	Wide open throttle	R ≈ 0 Ω	
	Without tach. relay (electrical modification)	Closed throttle	R ≃ ∞	
C) Electronic ignition thermovalves	Vacuum pump: Δp on common hose	Coolant temperature between 66° and 95°F	Δp must remain at the same value	

SECTION II When Starting Engine or Just After Engine Start

Component	Check	Engine Parameters	Normal Result	Actual Result & Notes
A) Cold start injector	Voltage between pins 9 and 10	Engine cranking	8-12 volts. After a few seconds must be 0 volts.	
B) Fast idle solenoid	Voltage between pins of solenoid wire harness connector	Engine cranking and just after	8-12 volts during 3 seconds after crank operation.	
C) EGR	Visual check with engine RPM increase	Coolant temperature <59°F, engine running	Valve must remain closed	

SECTION III Engine Running and Warm

Component	Check	Engine Parameters	Normal Result	Actual Result & Notes
A) Idle speed	Engine RPM by adjusting air by pass screw	Engine warm & fan off. Transmission in drive.	700 ± 50	
B.) Idle mixture* See page E10-38 for details on this operation. * Tamper proof plug on air flow meter must be removed for this operation.	Voltage between pins 2 and 7 Voltage between pins 2 & 7. Adjust w/idle mixture screw on flowmeter.	Oxygen sensor disconnected Oxygen sensor connected	6 to 7 volts and record actual as X Set at X + 1 volt - 0 volt	

SECTION IV Engine Running and Warm

Component	Check	Engine Parameters	Normal Result	Actual Result & Notes
A) Atmospheric pressure sensor	Integrator voltage between pins 2 and 7	Altitude <330 ft. engine at idle.	Integrator voltage must remain the same with sensor connected or disconnected	
B) Tachometer relay	Voltage between pins 6 & 7 (w/check harness)	Increase RPM slowly to over 4100 Decrease RPM slowly to less than 4100	RPM = 4100 ± 50 when voltage changes from ≂0 to ≂12 RPM = 4050 ± 50 when voltage changes from ≂12 to ≂0	
C) Fast idle solenoid	Engine RPM	Air cond. "on" transmission in "drive"	RPM must remain between 650 & 850	
D) EGR	Visual	Coolant temperature >86°F Increase engine RPM to over 3000	Valve opens & must close when acceleration stops	
E) Fuel injection computer loom	Visual Wire 107, yellow/black disconnected & conector removed & wire taped	————	————	

SECTION IV (Cont'd)

Component	Check	Engine Parameters	Normal Result	Actual Result & Notes
F) Electronic ignition thermovalves 1) 59° F	Engine RPM	Connect thermovalve hoses together	RPM should increase ≈50	
2) 113° F	Vacuum between thermovalve and AM capsule	Engine RPM >2500	Vacuum ≥2.95 inches of mercury	

SECTION V Engine Off and Hot

Component	Check	Engine Parameters	Normal Result	Actual Result & Notes
A) Coolant temperature sensor	Resistance between pins 12 and 7	Coolant temperature >176° F	R ≤ 300 Ω	
B) Cold start injector	Voltage between pins 9 and 10	Engine cranking	No voltage	

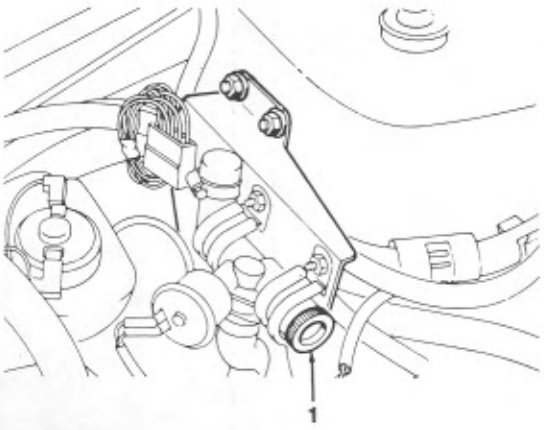
NOTES: _____

ENGINE FUEL SYSTEM

ADJUSTMENTS

IDLE SPEED ADJUSTMENT

The idle speed adjustment screw is located at the air bypass unit on the firewall.



WARNING

Use extreme caution when the engine is operating. Do not stand in direct line with the fan. Do not put your hands near the pulleys, belts or fan. Do not wear loose clothing.

Start and allow the engine to reach normal operating temperature.

Use test box Ms. 760.

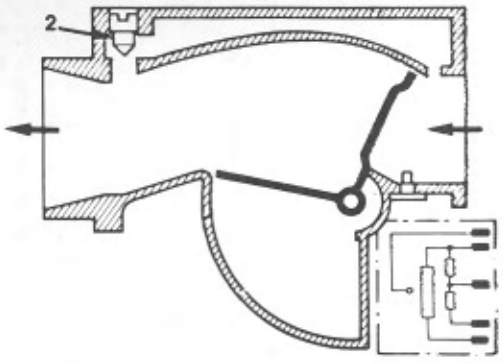
Turn all accessories off.

Wait for the cooling fan to cycle ON then OFF.

Adjust the idle speed (adjustment screw 1) to 700 + 50 rpm in DRIVE. with automatic transmission.

AIRFLOW METER BYPASS ADJUSTMENT

In the event of major engine overhaul or airflow meter replacement, the bypass adjustment screw (2) must be adjusted to obtain the correct air/fuel mixture ratio.



WARNING

Use extreme caution when the engine is operating. Do not stand in a direct line with the fan. Do not put your hands near the pulleys, belts or fan. Do not wear loose clothing.

CAUTION

Do not remove the cap and readjust the airflow meter bypass screw unless involved in a major engine overhaul, airflow meter replacement or the presence of high idle CO has been determined by a competent authority.

ADJUSTMENTS

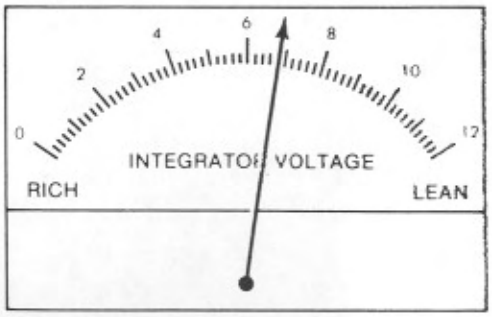
Remove the tamper-resistant cap for access to the screw (2).

Disconnect the oxygen (O_2) sensor wire harness connector.

Connect a **digital voltmeter** to diagnostic connector terminals D2-2 and D2-7.

NOTE: Battery must have a full charge with all switches and fans off to ensure no drain or draw on battery.

Record the voltage. It should be approximately 6-7 volts.



Allow the engine to reach operating temperature -when the cooling fans cycle on, then off. The cooling fans must be off while testing.

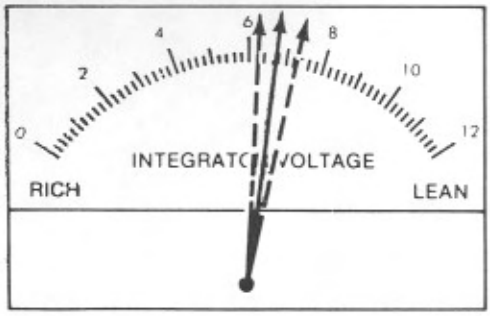
Connect the oxygen (O_2) sensor wire harness connector.

Observe the digital voltmeter and adjust the bypass screw to obtain the voltage recorded above plus + 1 volt.

NOTE: A misadjusted bypass screw can cause a voltage variance of ±3 volts.

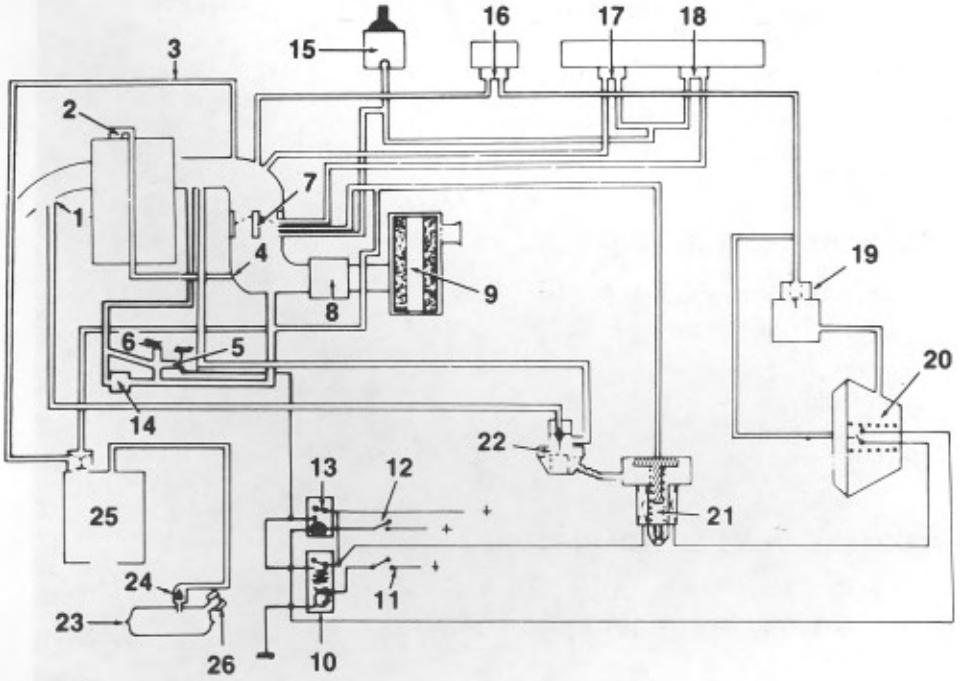
After the bypass adjustment, check the idle speed and adjust, if necessary.

Install the tamper-resistant cap.



EMISSION CONTROL SYSTEMS

EMISSION CONTROL SYSTEMS DIAGRAM



1. 4 mm (0.57 inch) orifice
2. Positive crankcase ventilation (PCV) valve
3. 1.8 mm (0.070 inch) orifice
4. 5.5 mm (0.216 inch) orifice
5. Fast idle solenoid
6. Idle speed adjustment screw
7. Throttle body
8. Airflow meter
9. Air filter
10. Timer relay
11. Start ignition switch
12. Air conditioner switch
13. Fast idle relay (A/C)
14. Supplementary air regulator
15. Integral electronic ignition module
16. Thermo valve (open T° above 59° F)
17. Thermo valve (open T° below 59° F)
18. Thermo valve (open T° above 113° F)
19. Vacuum reservoir
20. Differential pressure switch
21. EGR valve solenoid
22. EGR valve
23. Fuel tank
24. Roll-over valve
25. Vapor Canister (charcoal)
26. Vacuum filler cap

EMISSION CONTROL SYSTEMS

P.C.V. SYSTEM

GENERAL INFORMATION

The emission control systems are:

- the fuel vapor recovery system
- the positive crankcase ventilation (PCV) system
- the exhaust gas recirculation (EGR) system
- the catalytic converter system

FUEL VAPOR RECOVERY SYSTEM

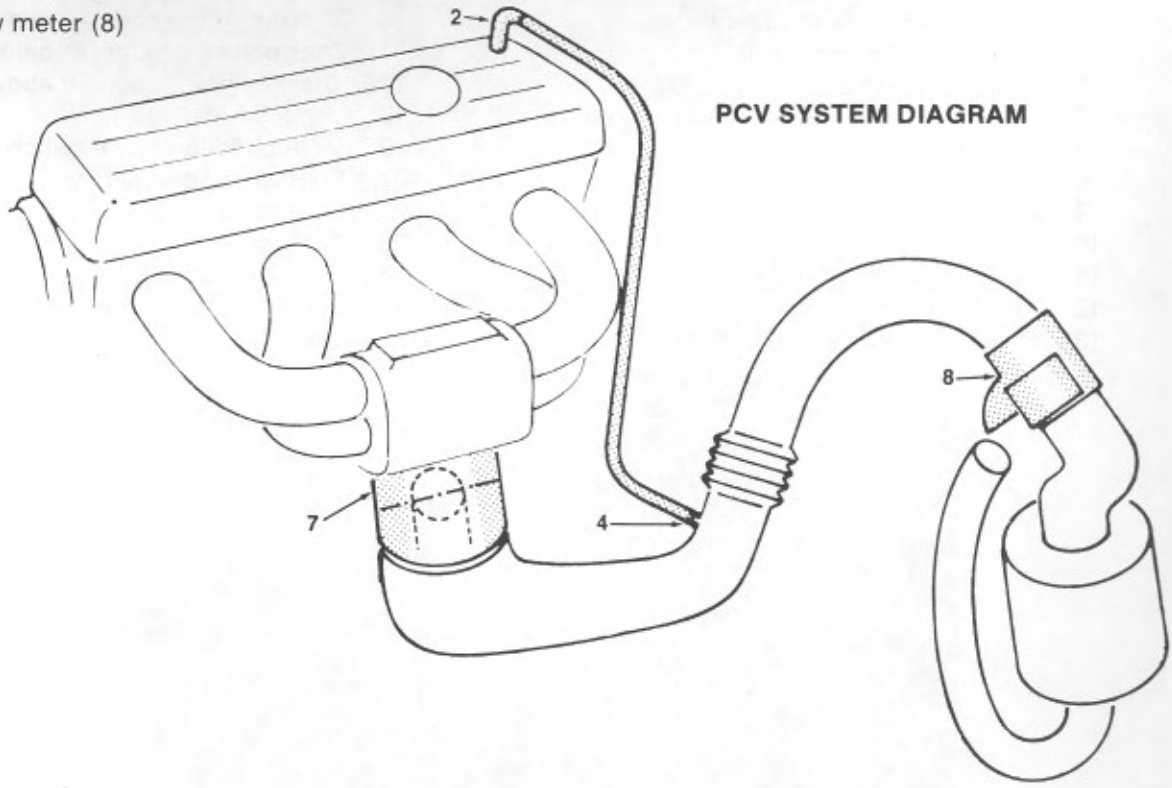
The fuel vapor recovery system includes:

- a rollover valve (24)
- a charcoal canister (25)
- a fuel filler cap (26)

POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM

The pcsitive crankcase ventilation (PCV) system includes:

- a valve cover crankcase vent connection (2)
- a 5.5 mm orifice (4)
- a throttle body (7)
- an airflow meter (8)

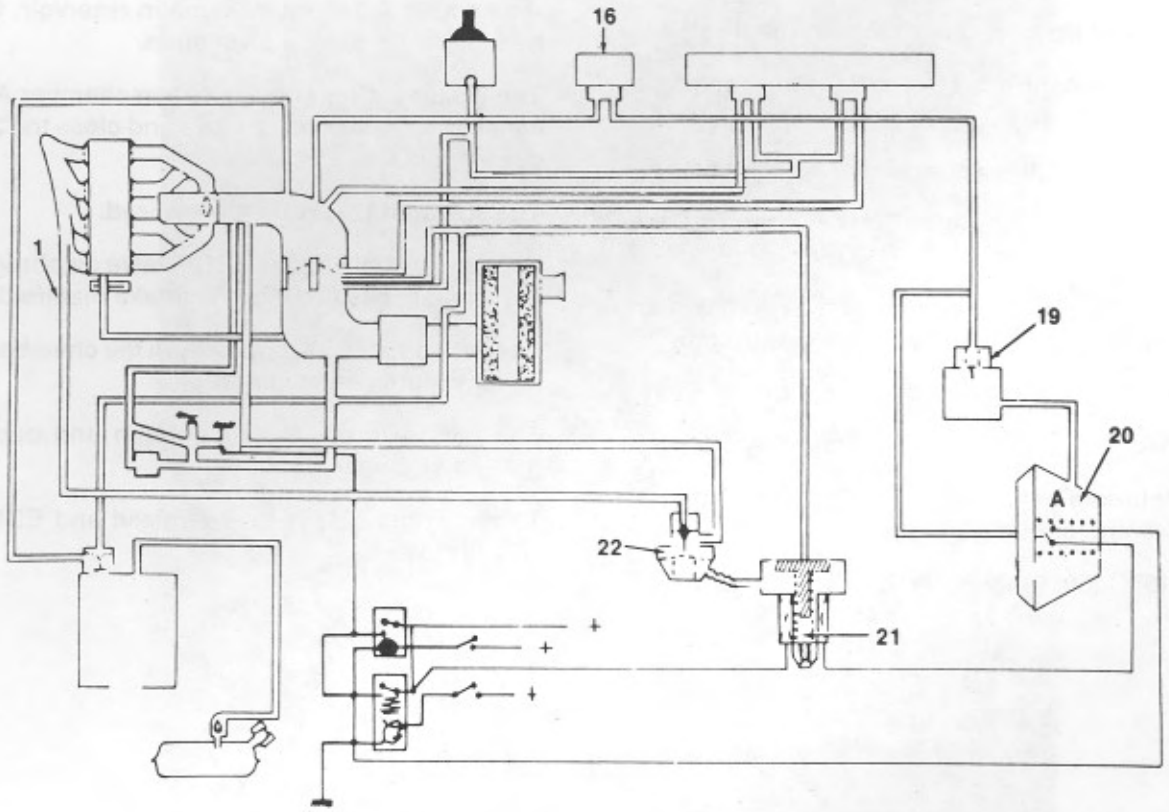


PCV SYSTEM DIAGRAM

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

The EGR system includes:

- a 4 mm orifice (1)
- a thermo valve (16)
- a vacuum reservoir (19)
- a differential pressure switch (20)
- an EGR valve solenoid (21)
- an EGR valve (22)



EGR SYSTEM DIAGRAM

1. 4 mm (0.157 inch) orifice
16. Thermo valve (open T° above 59° F)
19. Vacuum reservoir
20. Differential pressure switch
21. EGR valve solenoid
22. EGR valve

SYSTEM OPERATION

The thermo valve (16) is connected to the radiator.

Below 15° C (59° F), the thermo valve is closed.

Above 15° C (59° F), the thermo valve opens the vacuum circuit from the intake manifold to the differential pressure switch (20) and to the vacuum reservoir (19).

The EGR valve (22) opens or closes the passage from the exhaust manifold to intake manifold.

The amount of exhaust gas allowed to pass is controlled by the orifice (1) located in the exhaust manifold.

Vacuum causes the EGR diaphragm to open the valve.

The source of the vacuum is close to the throttle.

The vacuum is controlled by the EGR valve solenoid (21).

The solenoid (21) has voltage applied at all times.

The differential pressure switch (20) controls the ground circuit for the solenoid (21).

The differential pressure switch (20) has two chambers (A and B) separated by a diaphragm.

There is a calibrated hole located in the diaphragm.

One side of the diaphragm is controlled by a spring.

The diaphragm either opens or closes the internal ground circuit contact.

Above 15° C (59° F) the thermo valve (16) is open.

Chamber B of the differential pressure switch is connected to the intake manifold via the thermo valve.

Chamber A of the differential pressure switch is also connected to the intake manifold, but via the vacuum reservoir (19).

When the engine is operating at a stabilized RPM, the pressure is equal on both sides of the diaphragm.

The ground circuit contact is open, the solenoid (21) is de-energized and the EGR valve (22) is closed.

If the throttle is opened, the vacuum in chamber B decreases immediately.

In chamber A and in the vacuum reservoir, there is no immediate pressure variation.

The vacuum differential between chamber A and B cause the diaphragm to move and close the ground circuit contact.

The solenoid (21) is then energized.

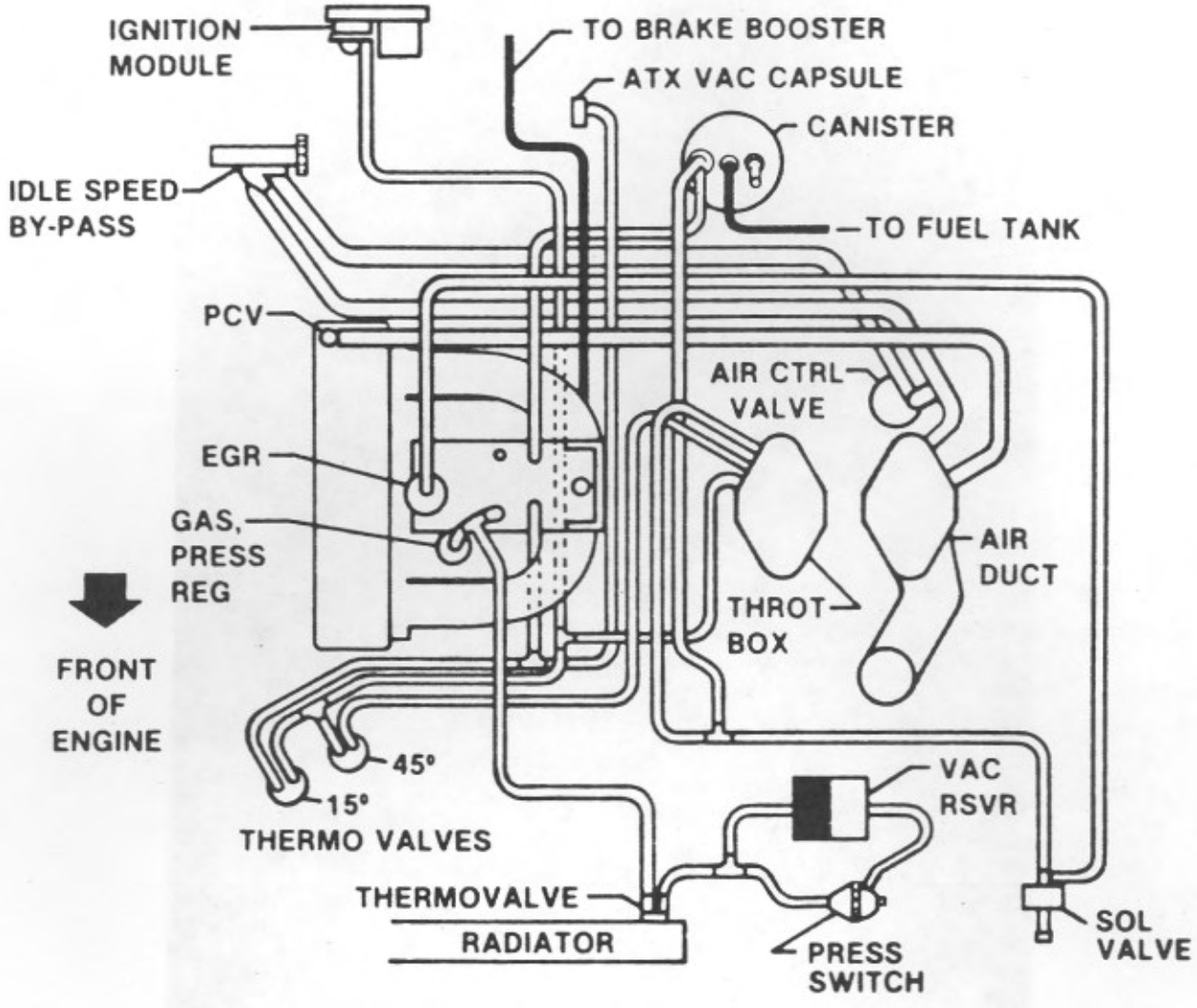
Vacuum is applied to the EGR valve diaphragm and the exhaust gas flows to the intake manifold.

The vacuum decreases slowly in the chamber A and in the vacuum reservoir (19).

The spring forces the diaphragm and opens the ground circuit contact.

The solenoid (21) is de-energized and EGR valve (22) is closed.

EMISSION CONTROL SYSTEMS
EMISSION HOSE ROUTING



IGNITION SYSTEM

OPERATING PRINCIPLES

The ignition module is fed by two sources of information:

a. The magnetic position sensor (P).

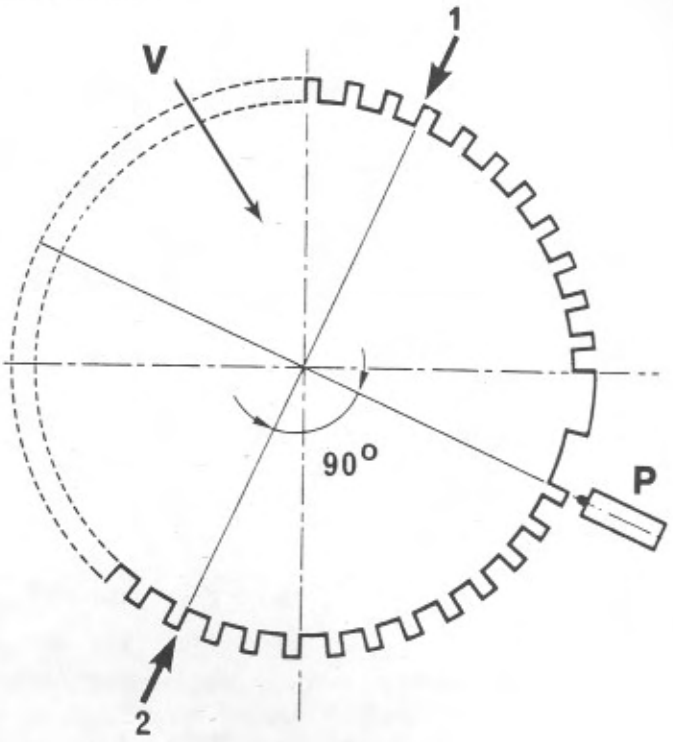
b. The vacuum sensor (C) which cannot be disassembled.

According to the information received from both sensors, the module sets the ignition advance ratio and regulates primary voltage which is then transformed into high voltage current through the coil.

The distributor cap sends this high tension current to the four spark plugs, in the correct firing order.

FLYWHEEL (V)

There are 44 evenly spaced tooth positions around the fly wheel circumference. Two teeth have been eliminated for each half-revolution in order to obtain a timing mark located at an absolute 90° angle from top and bottom dead center positions. (There are actually only 40 teeth on the flywheel.)

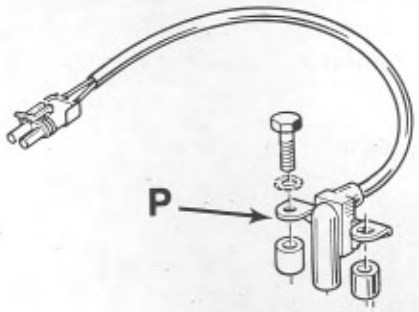


MAGNETIC POSITION SENSOR (P)

(T.D.C. Sensor)

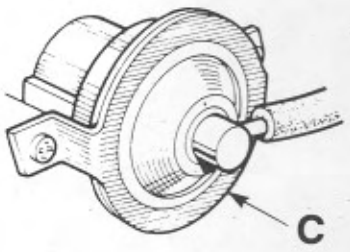
It indicates:

- the position of the top dead center (T.D.C.) (1) and the position of the bottom dead center (B.D.C.) (2),
- the engine RPM.



This sensor cannot be adjusted — it is preset on its support bracket.

It must be mounted on the clutch bell-housing with cap bolts.



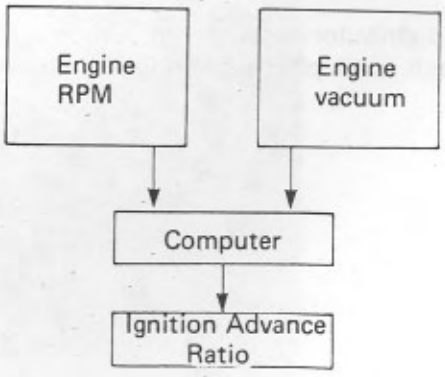
VACUUM SENSOR (C)

Although this sensor appears to be identical to the vacuum diaphragm found in a conventional ignition system, its internal design is quite different.

Do not remove this sensor. It is permanently connected to the ignition module by a small gauge wire which will break if any attempt is made to remove the sensor unit.

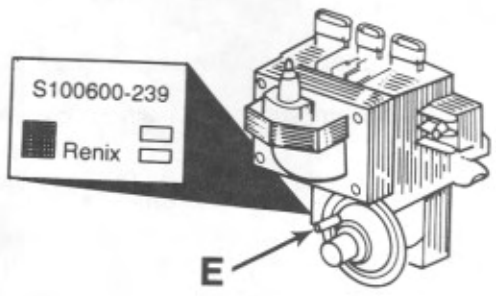
IGNITION MODULE (E)

The ignition module is an electronic device (microprocessor) that calculates the ignition timing advance ratio according to engine RPM and engine vacuum.



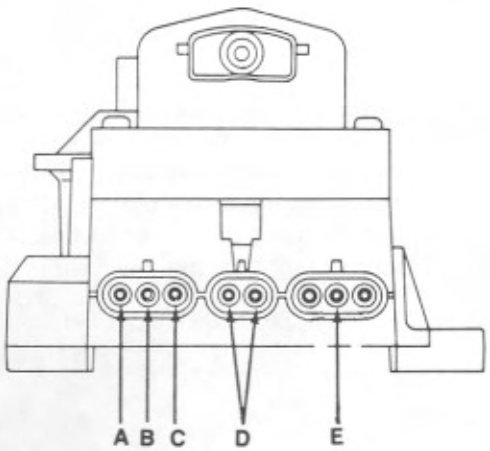
IGNITION SYSTEM
OPERATING PRINCIPLES

The ignition module identification label is affixed to the lower side as shown.



CONNECTOR IDENTIFICATION

A - Tachometer
B - Positive Lead (+)
C - Ground (-)
D - TDC Sensor
E - Center Terminal hooks to ground for timing modification of -2°



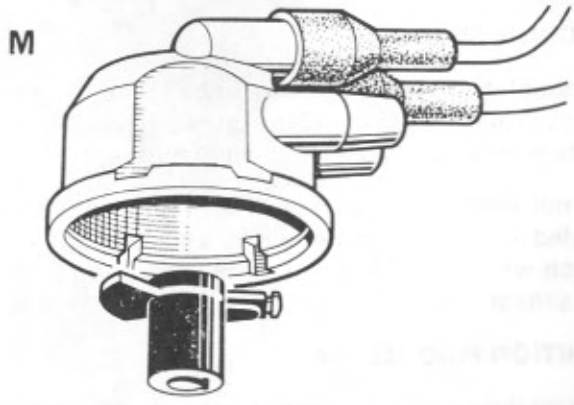
IGNITION TIMING

Ignition timing adjustment is not possible and should not be attempted.

The timing advance range is programmed into the ignition module, which responds to vacuum signal (indicating engine load) and TDC sensor signal (indicating engine flywheel position and rpm). Timing is then adjusted automatically to correspond with those conditions. (Refer back to IGNITION MODULE.)

If timing is incorrect, check:

- vacuum lines
- TDC sensor
- ignition module

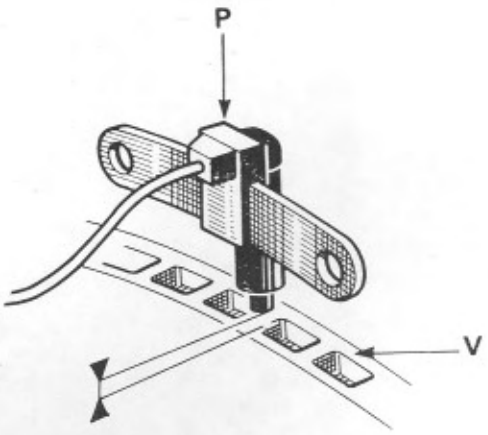


DISTRIBUTOR (M)

The distributor cap and rotor arm feed high voltage to each spark plug according to their firing order.

MAGNETIC POSITION SENSOR (P)
(T.D.C. Sensor)

For correct operation the sensor must be at a distance (A) of between 0.5 and 1 mm (0.020 and 0.039 in) from the flywheel.



The sensor can be tested using an ohm meter. The reading taken between the wire connector pins should be 150 ohms + 50 ohms.

IMPORTANT
Absolutely no interference between the flywheel and the magnetic position (TDC) sensor can be tolerated. A warped, bent, or damaged flyweel can cause an interruption in the signal sent to the ignition module, resulting in either complete or intermittent ignition loss. An ignition analyzer oscilliscope is extremely useful in diagnosing ignition problems. Do not rule out the possibility of bad spark plugs, plug wires, distributor cap and rotor in the case of an ignition interruption. Eliminate these possibilities before condemning the ignition module.

WARNING

Do not short out the high tension lead (coil wire) on the ignition module body. This can cause permanent damage to internal circuitry of the module.

SPECIFICATIONS:

Firing Order : 1-3-4-2
Spark plug gap : .022 in - .026 in
Plug type - Champion RS9YC or
AC CR42LTS

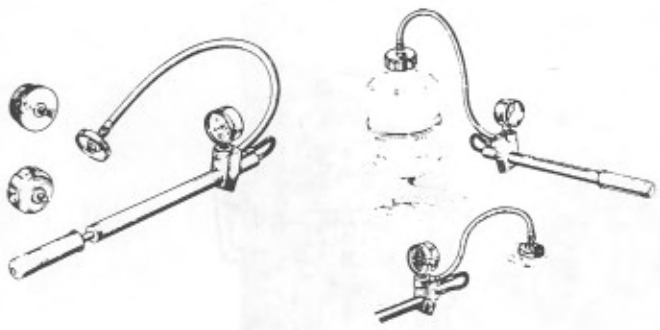
SECTION "F"

COOLING SYSTEM

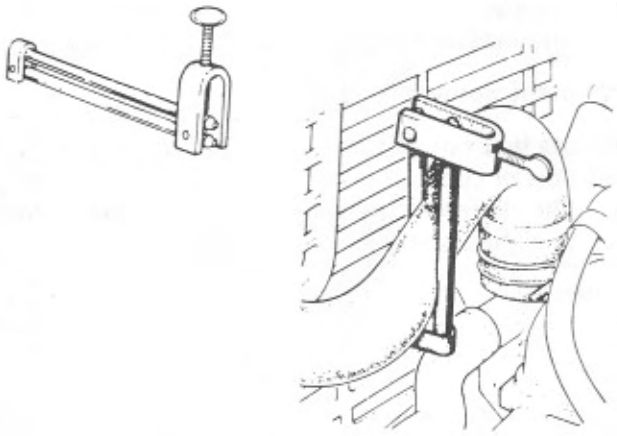
F-1 Special Tools
F-2 Theory of Operation
F-3 Anti-freeze Mixture Strength
F-4 Cooling Circuit - Checking for Leaks
F-5 Checking Coolant Bottle Cap Calibration
F-6 Cooling System - Refilling and Bleeding
F-7 Oil in Cooling Circuit
F-8 Water Pump Declutching

See specific Engine Section for:

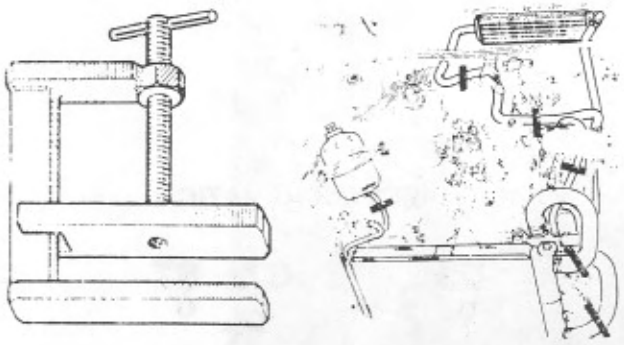
Radiator R & R - See Engine Remove and Replace
Water Pump R & R
Belt Tightening Information



Ms. 554-03
Cooling circuit pressurizing apparatus
Order Tool No. 700000-55-403 EA



Ms. 583
Hose clamp (maxi dia 50mm)
Order Tool No. 700000-58-300 EA



Mot. 453-01
Hose clamp (maximum dia. 25 mm)
Order Tool No. 700000-45-301 EA

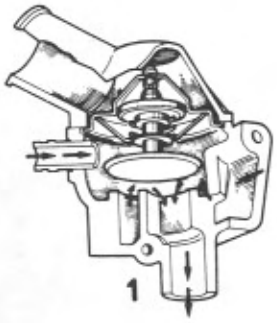
Thermostat
The thermostat has two operating conditions.

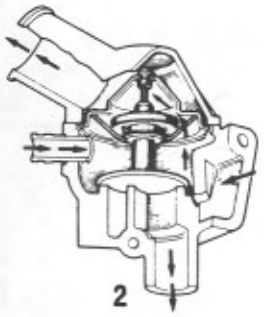
When the coolant is cold (1):

- the thermostat valve is closed and prevents the flow of coolant from the engine to the radiator
- The thermostat bypass is open and allows coolant to circulate within the engine.

When the coolant is hot (2):

- the thermostat valve is open and allows coolant to flow from the engine to the radiator
- the thermostat bypass is closed





WARNING

Do not loosen the coolant bottle cap or remove the cylinder block drainplugs with system hot and pressurized because serious burns from coolant can result.

Electric Cooling Fan Operation
Naturally Aspirated Diesels with Air Conditioning
All Turbo Diesels
All Gas

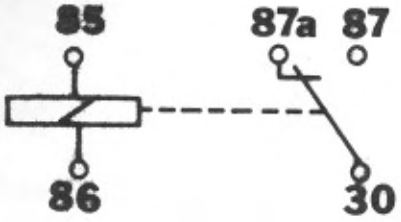
The electric fans are powered via a relay for each individual fan and a thermo-switch mounted in the **bottom right** (passenger) side of the radiator. When the coolant in the radiator reaches the specified temperature, the thermo-switch closes completing the circuit to the relays, which in turn switches the 12-volt current to each fan.

Relay Locations:
Diesels - Right front corner of engine compartment
Gas - Black relay and diode box behind right headlight.

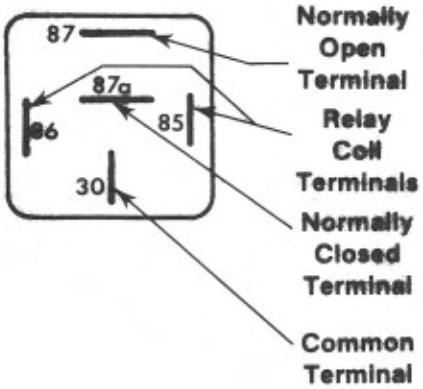
NOTE: The diesel engines also employ an engine driven fan while the gas units do not.

See Electrical and/or Air Conditioning Section for specific wiring information.

RELAY SCHEMATIC



5-Pin Relay (Typical)



ANTI-FREEZE MIXTURE STRENGTH

CHECKING

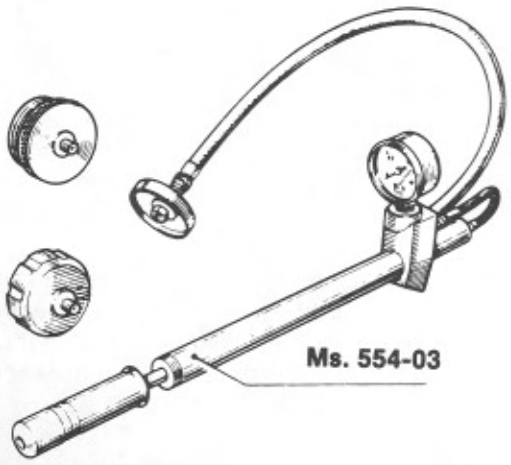
- The coolant mixture must be changed every 3 years or after 38,616 km (24,000 miles) (whichever comes first).
- A suitable anti-freeze or anti-freeze mixture must be used in the cooling system that is compatible with aluminum components.
- The use of borax based anti-freeze is forbidden.
- The use of a Prestone II® anti-freeze/coolant meets the specification.
- In this type of cooling system, the coolant circulates continually through the expansion bottle to aid removal of air in suspension.
- Run the engine until the coolant in the expansion bottle reaches a temperature of approximately 40° C (140° F).
- Then remove the expansion bottle cap.

Test anti-freeze with a locally obtained anti-freeze tester.

COOLING CIRCUIT
CHECKING FOR LEAKS

Install the cap from pressure apparatus Ms. 554-03 in place of the coolant bottle cap.

- Connect pressure apparatus Ms. 554-03 to this cap.
  Open the heater valve.
- Run the engine to warm it up then switch off.
  Pump up to pressurize the circuit.
- Stop pumping when the gauge indicates 1.6 bar (23 psi) (red zone limit) which is 0.4 bar (6 psi) over the calibration of the valve.
- The pressure should remain steady; if it does not, locate and repair the leak.
- Decompress the cooling circuit by unscrewing the union gradually on pressure apparatus then remove the cap adapter and replace the expansion bottle, cap after checking its release value as described on the following page.

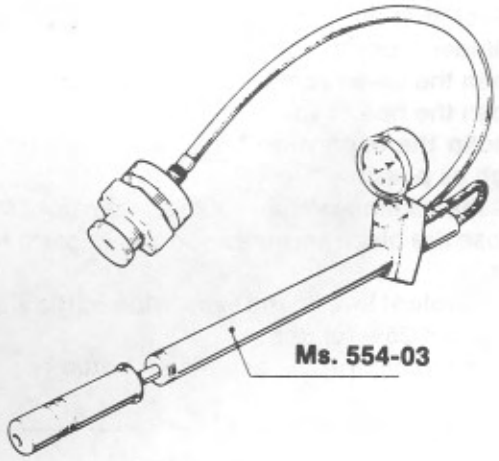


COOLING CIRCUIT
CHECKING COOLANT BOTTLE
CAP CALIBRATION

IMPORTANT
The cap must be changed if coolant has passed through it.

- Mount adaptor to pressure appartus Ms. 554-03 and mount the cap to the adaptor.
- Operate the pump and note the pressure on the gauge. It should maintain the calibrated value.
- Calibrated value of cap:
  - hold value 1.1 to 1.2 bar (16 to 17 1/2 psi)
  - release pressure 1.2 bars (17 1/2 psi)

IMPORTANT
If the cap does not meet specifications it **must** be replaced.



COOLING SYSTEM
REFILLING - BLEEDING

ALL VEHICLES

- Prepare a 50/50 mixture of anti-freeze and water prior to filling.
- Check that the hoses and the drain plug in the cylinder block are tight.
- Open the bleed screw on the heater core.
- Open the heater valve.
- Unclip the expansion bottle and support it as high as possible.
- Fill the cooling system via the expansion bottle.
- Close the bleed screw as soon as coolant flows out.
- The coolant level in the expansion bottle should be about 25% full (cold).
- Place the cap on the expansion bottle.

WARNING

Be careful to keep hot coolant from contacting the eyes or skin. Always wear protective eyewear and clothing.

Bleeding

- Run the engine until the thermostat opens and let it continue to run a few minutes.
- Open the bleed screw on the heater core and close it when coolant flows out without any trace of air.
- Mount the expansion bottle.
- Recheck that the coolant level in the expansion bottle is correct after the engine has cooled down completely.

Coolant level in expansion bottle.
Cold - 25% full
Hot - 50% full

Vehicles Equipped with Rear Automotive Heater and/or Motorald Water Heater

The air bleeding procedure is identical to the previous directions, however extreme care must be exercised to insure that all air has been purged from the rear system. The rear heater valve must be opened for at least 50% of the time during the air bleeding procedure to insure that all lines are bled. Elevating the front of the vehicle and shutting off the dash heater will assist air bleeding.

WARNING

The coolant level must be repeatedly checked and filled as necessary after bleeding the system to ensure that all air has been purged. Failure to do this may cause an overheat condition which could result in serious engine damage.

OIL IN COOLING CIRCUIT

The following must be carried out if oil is found contaminating the cooling system:

Find the source of the oil leakage
Check for:
- Defective oil cooler (above oil filter) if equipped.
- Cracked cylinder block (See Engine Section)
- Cracked or warped cylinder head (See Engine Section)
- Grubscrew seals under main bearing bolts leaking (See Engine Section diesels only)
- Automatic transmission cooler leak (if the contaminant is transmission fluid)

Cleaning An Oil Contaminated Cooling System (After source of leakage is repaired)
This may be accomplished using a solution of water and a **grease emulsifying** liquid dishwashing detergent such as Dawn®. The procedure for cleaning is as follows:

1. Drain and refill the system with clean water (no antifreeze) allowing space to add 8-12 oz. of Dawn® liquid dishwashing soap or an equivalent grease emulsifying liquid dish soap.
2. Run the engine for approximately 5 minutes **at operating temperature** to thoroughly circulate the solution.
3. Drain the system and allow the engine to cool.
4. Refill the system with clean water only and rinse by running the engine at operating temperature for 5 minutes. Then drain the system.
5. Repeat steps 1 - 4 until all traces of oil are eliminated.
6. Perform an additional rinse to ensure removal of soap residue.
7. Fill system with a 50/50 mixture of water and antifreeze/coolant.
8. Bleed air from the system and recheck level. (Refer to "Bleeding" - pg. F-7.)

WATER PUMP FAN/HUB DECLUTCHING
(DIESEL ONLY)

This type of engine may be equipped with one of two styles of fan drive configurations:
a) "direct-drive" solid hub
b) electric de-clutching fan hub.

It has been determined that the following procedure may be performed on vehicle with an electric de-clutching fan hub. This type of hub can be identified by looking at the number of bolts at the fan hub. 4 bolts retaining the fan indicates that this is a solid hub and needs no modification. 6 bolts (3 retain the fan blade) indicates a fan clutch type hub.

NOTE: The clutch type fan hub will "free-wheel".

Should a "direct-drive" type hub be considered more desirable to the clutch type, the following procedure may be performed.

Fan Hub Modification Procedure - (Clutch Type only)

1. Remove fan blade.
2. Remove the three (3) socket head cap screws 5 mm hex and their jamb nuts from the front of the fan.
3. Discard the three (3) hex jamb nuts.
4. Apply a thread adhesive compound (Locktite® or equivalent) to each of the three (3) socket head cap screws.
5. Reinsert the three (3) socket head cap screws into original holes and tighten.
6. Torque the socket head cap screws to 5 Nm (3.68 ft./lbs.). Do not over-torque these screws as it will break the assembly.
7. Detach the wire spring clip retaining the carbon contact assembly; remove the wire assembly, the spring, the carbon contact and the insulated barrel. Cut the tan wire close to its connection with the main harness, near the wiper motor. Wrap the end of the clipped tan wire with electrical tape to avoid a short circuit. Discard these components.
8. Turn on the ignition switch and inspect to assure that all accessories operate properly.
9. Reinstall the grille and front panel (if so required).

NOTE: Upon removal of the wire and carbon contact, be certain that the tan wire has been insulated. See Step 7.

SECTION "G"

ELECTRICAL

Subsection 1 General

G1-1 Special Tools
G1-2 Fuses and Breakers
G1-3 Auxiliary Battery
G1-4 Engine Coolant Temperature Switch
G1-5 Engine Oil Pressure Switch
G1-6 Steering Column Switches
G1-7 Windshield Wipers
G1-8 Diesel Tachometer
G1-9 Bosch 5-Prong Relay

Subsection 2 Fuel Tank Sending Unit

G2-1 Testing

Subsection 3 Instrument Cluster

G3-1 Lay-out
G3-2 Remove and Replace
G3-3 Printed Circuit Board

Subsection 4 Alternator

G4-1 Exploded View
G4-2 Operation and Diagnosis
G4-3 Remove and Replace
G4-4 Repair

Subsection 5 Starter

G5-1 Remove and Replace
G5-2 Paris - Rhone D11E172
G5-4 Paris - Rhone D9R
G5-7 Paris - Rhone D10E88

Subsection 6 Wire Harness

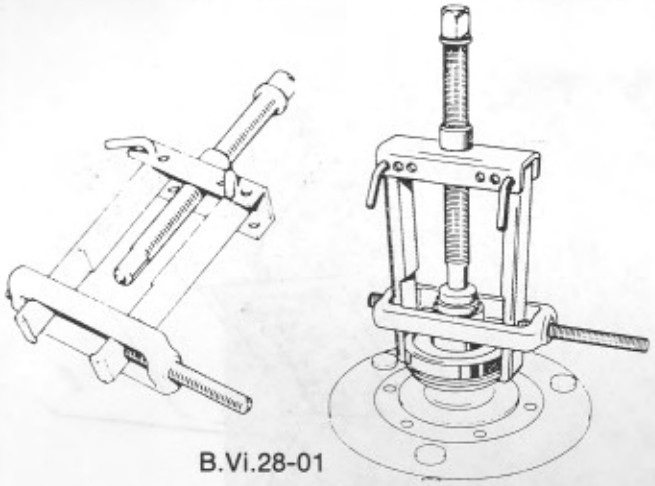
G6-1 Rear Wiring Harness Routing
G6-2 Engine and Front Harness Routing

Subsection 7 Wiring Diagrams

G7-1 Wiring Diagram Index

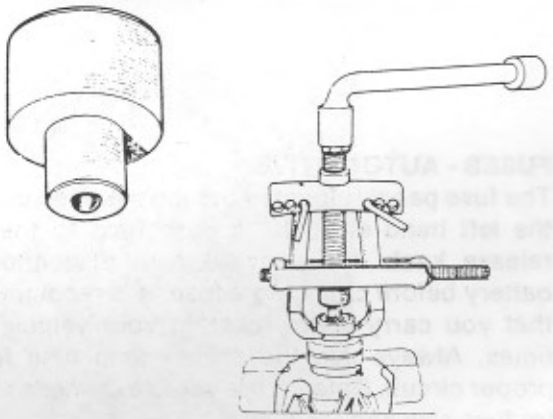
See Section P "Air Conditioning" for additional diagrams.

SPECIAL TOOLS



B.Vi.28-01

Bearing extractor with jaws 146 mm long
Order Tool No. 700012-27-301 EA



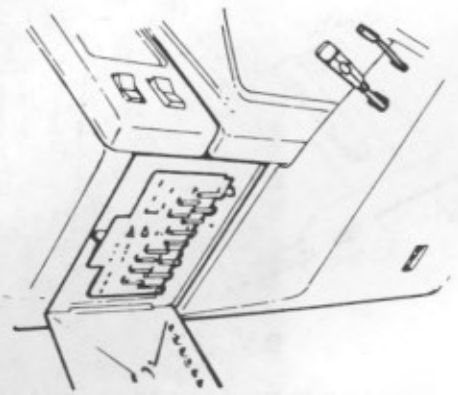
Ele.22-01

End fitting for extracting alternator bearing
Order Tool No. 700013-31-001 EA

FUSES AND BREAKERS

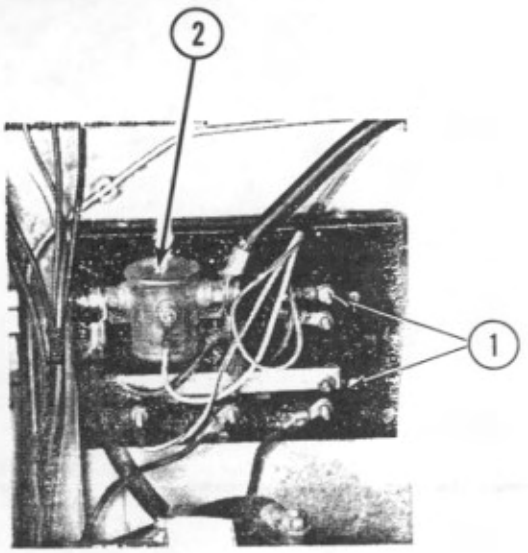
FUSES - AUTOMOTIVE

The fuse panel is located behind a hinged cover on the left hand side of the dash next to the hood release knob. It is advisable to disconnect the battery before changing a fuse. It is recommended that you carry spare fuses in your vehicle at all times. Always use the proper amp fuse for the proper circuit. Refer to the Vehicle Owner's Manual for fuse size and locations.



CIRCUIT BREAKER

The circuit breaker panel is located in the engine compartment. It is a wise precaution to disconnect the battery before changing a circuit breaker. Always use the proper amp circuit breaker for the proper circuit.



1. Breakers
2. Dual Battery Solenoid

AUXILIARY BATTERY

12-VOLT DC SYSTEM

The 12-volt DC system consists of the automative battery and the auxiliary battery. The automotive battery is used solely to operate the engine starter and all automotive accessories and controls found on the instrument panel. This includes the horn, cruise control, all exterior lights, radio, windshield wipers, heater fans, etc.

Auxiliary Battery

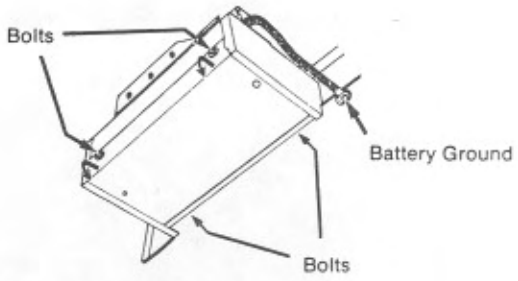
The auxiliary battery operates all 12-volt equipment located in the living area of the motor home. This includes the interior lights, furnace fan, water pump, water level and holding tank gauges, and the refrigerator. In addition, the auxiliary battery may be used to start the engine if for some reason the automotive battery is discharged.

Location

The auxiliary battery is located in a compartment (battery box) beneath the driver's seat (passenger seat on diesel) on the underside of the vehicle. The battery should be removed from the compartment for periodic inspection or maintenance.

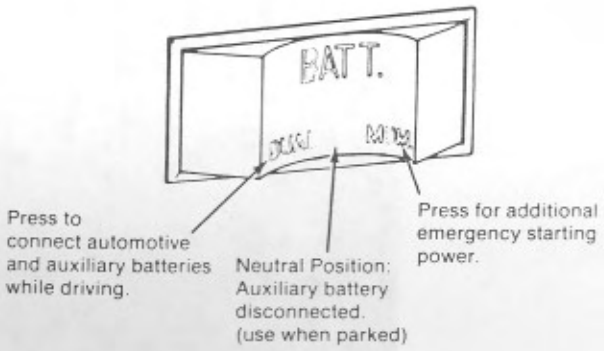
Aux. Battery Access:

1. Remove the ground cable from the vehicle frame to avoid sparks by accidental contact of the positive terminal with other metal parts of the vehicle.
2. Support the battery tray from beneath, using a jack or blocks, etc., then remove the 4 bolts that fasten the battery tray to the compartment frame.
3. Slide the battery toward the driver stepwell and carefully lower to the ground. (If the vehicle is on a ramp or hoist, the battery cables are not long enough to reach the ground, so a support platform must be used.
4. Reverse the above steps to return the battery to the compartment.



DUAL BATTERY SWITCH

The dual battery switch is located on the dash, next to the hazard warning switch. The DUAL position connects the coach to the automotive electrical system, permitting the battery to be charged by the engine alternator while driving. Should the automotive battery fail, the engine may be started by holding the battery switch in the momentary (MOM) position to gain additional starting power from the coach battery.



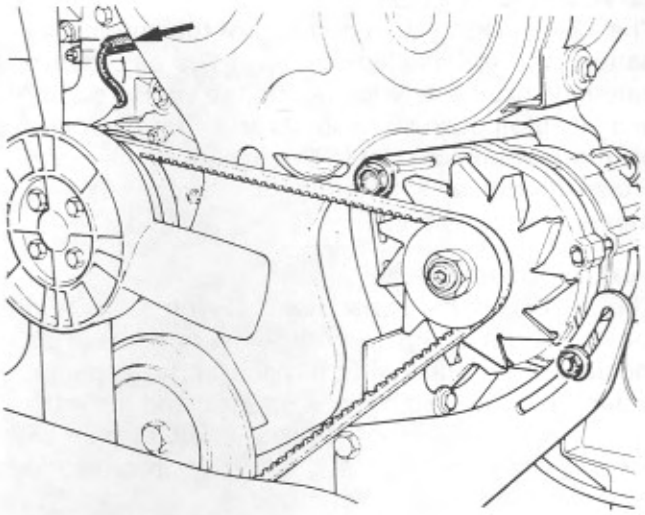
ENGINE COOLANT TEMPERATURE SWITCH

Max. tightening torque : 4 daNm (30 lb./ft.)

LOCATION ON ENGINE

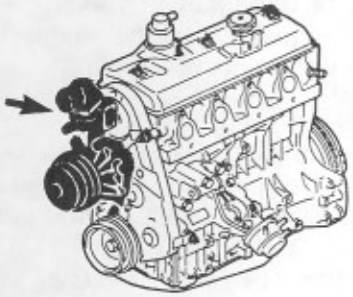
DIESEL ENGINES

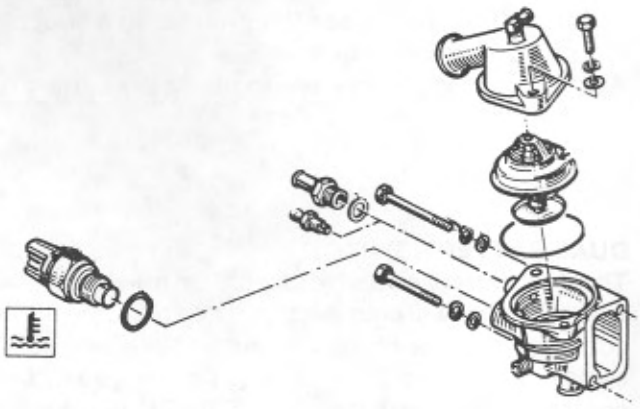
The coolant temperature switch is on a hose at the front of the engine.



GASOLINE ENGINES

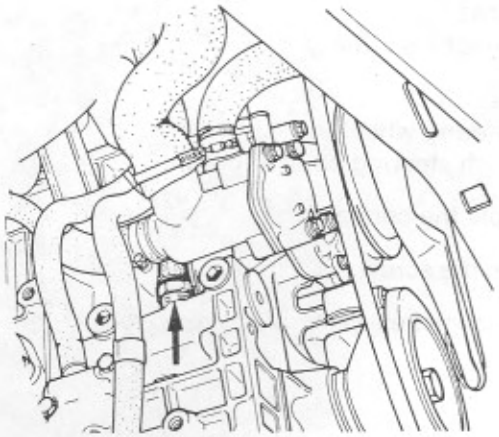
The coolant temperature switch is located in the thermostat housing on the right side of the engine.





ENGINE OIL PRESSURE SWITCH

Tightening torque : 2 daNm (15 lb./ft.)



LOCATION ON ENGINE

All engines
The oil pressure switch is on the R.H. (passenger) side of the engine behind the water pump.

CHECKING

- There should be electrical contact between the switch terminal and the switch body when the engine is not running.
- As soon as the oil pressure exceeds 0.36 bar (5.1 psi), electrical contact should be broken.

STEERING COLUMN SWITCHES

REMOVAL

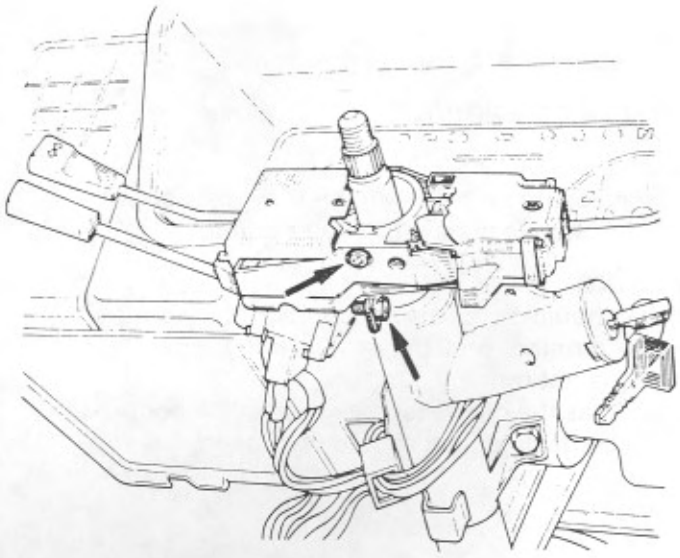
Disconnect the battery.

Remove:
- the steering wheel
- and both steering column covers

Uncouple the connectors.

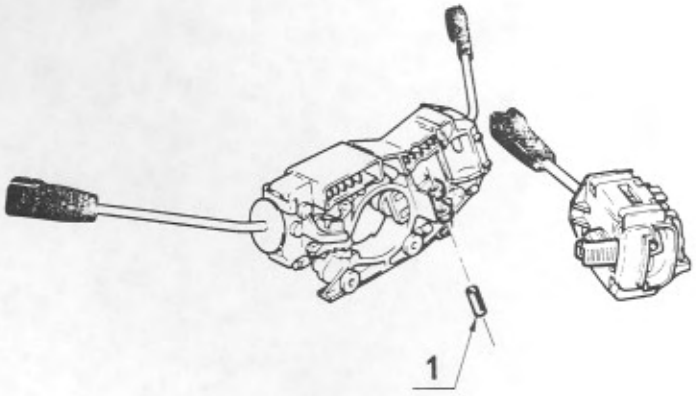
Remove the screw.

Pull the switches assembly to remove.



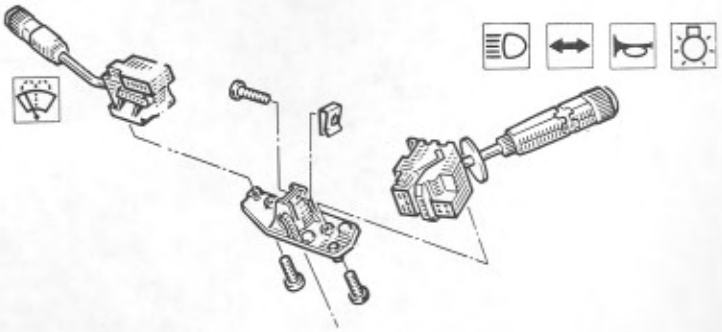
1983-1985

NOTE: The combination lighting switch may be separated from the assembly by taking out pin (1).

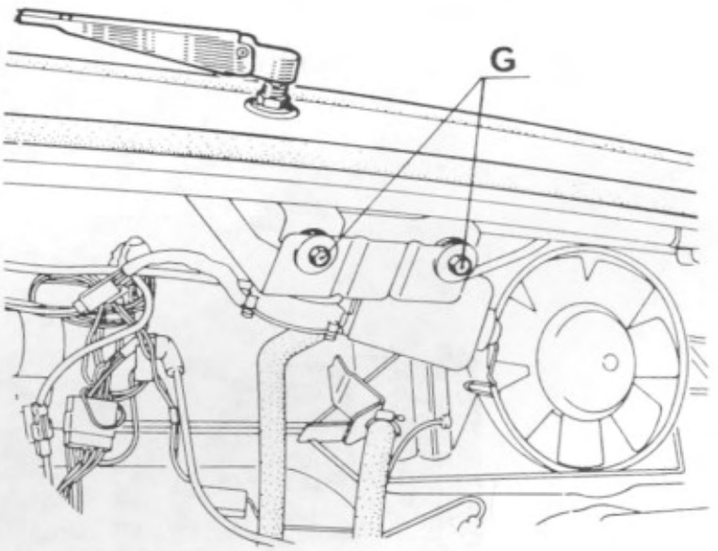


1986

Both switches may be removed and replaced separately.



WINDSHIELD WIPERS



CHANISM REMOVAL

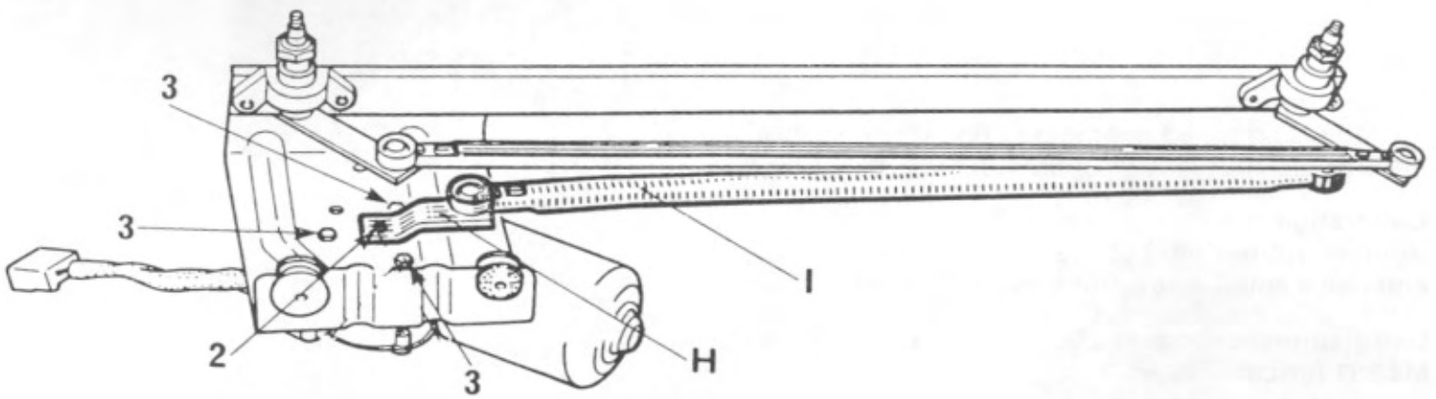
Disconnect the battery.
Remove the air inlet elbow.
Remove:
- the windshield wiper arms
- windshield wiper arm spindle nuts
- connector
- and 2 bolts (G).

emove the windshield wiper assembly.

PECIAL POINT CONCERNING REASSEMBLY

Vith the motor in the "Stop" position, make sure hat crank (H) and link (I) are in line.

Remove and replace the motor (Mechanism removed).



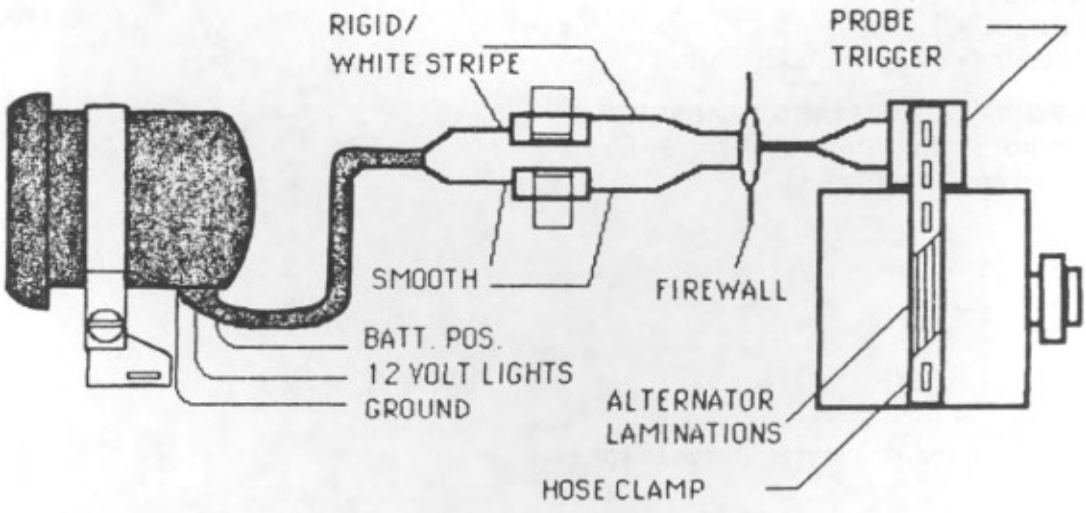
REMOVAL

- Unscrew nut (2) holding the crank.
- Unscrew screws (3).

SPECIAL POINTS CONCERNING REASSEMBLY

- Set the motor in the "Stop" position.
- Attach the motor to its plate, tighten crank (H) when it is in line with link (I).

ALTERNATOR DRIVEN TACHOMETER - DIESEL



Meter
- Mounted on the upper left side of dash.

Probe Trigger
- Probe is strapped over lamination on alternator
- Wires are routed through the firewall to the tach.

Calibration
Remove rubber plug at the rear of the tachometer and use a small screwdriver to adjust the tach.

Use diagnostic meter Ms.760 and diesel tachometer Ms.881 for calibration.

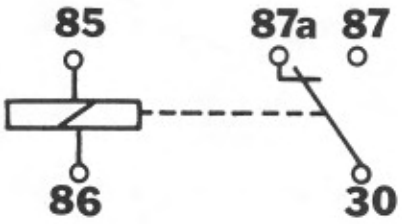
GENERAL

BOSCH 5-PRONG RELAY

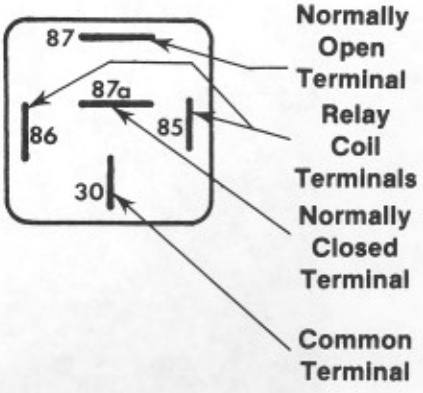
Various electrical systems throughout the coach employ the use of a Bosch 5 prong relay (or equivalient by another manufacturer). The relay schematic is shown here.



RELAY SCHEMATIC



5-Pin Relay (Typical)



FUEL TANK SENDING UNIT

TESTING

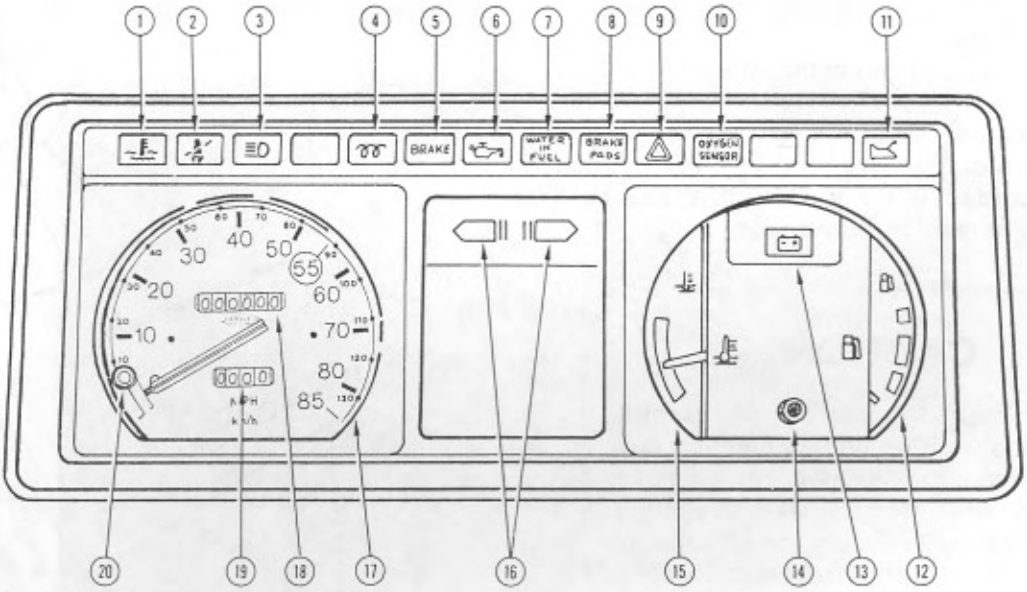
Fuel tank must be removed for this operation. See Fuel Tank Section "S".

- Connect an ohmmeter between the feed wire terminal and the tank gauge unit body or mount plate.
- Raise the float the desired level and note the resistance reading.

Fuel Level	Resistance Range (Ohms)
Full	2 to 12
3/4	46 to 60
1/2	86 to 108
1/4	150 to 180
Empty	280 to 320

INSTRUMENT CLUSTER

LAY-OUT



INSTRUMENT PANEL

1. Coolant Temp. Warning - Lights up when an engine overheating condition exists, (if equipped).
2. Seat Belt Reminder - Light comes on and tone sounds for 4-8 seconds after ignition is switched on as a reminder to fasten safety belts.
3. High Beam Indicator - Illuminated while headlight high beams are in use.
4. Heater Plugs Indicator (Diesel only) - Lights up when the ignition is switched on to indicate that the engine heater plugs ("glow plugs") are activated. Wait until the light goes out before attempting to start the engine.
5. Brake Warning - Lights while handbrake is applied to any degree. Also lights if brake fluid level is low or if a brake circuit malfunction exists. If the light is on, be sure that the handbrake is fully released. If the light remains lit, stop the engine and check the brake fluid level.
6. Oil Pressure Warning - Illuminates when the ignition is switched on. It should go out as engine starts. If the light comes on while driving, stop the engine immediately and check oil.
7. "Water in Fuel" Indicator (Diesel only) - Illuminates if any water is present in the diesel fuel. If the light comes on, have the water drained from the system as soon as possible. If the light comes on right after refueling, this means that a large amount of water has been pumped into the tank. Stop the engine immediately and have the water purged from the system.
8. Brake Pad Wear Indicator - If equipped, light comes on when either of the brake pads is worn to a pre-determined level as a warning that brake service is needed.
9. Hazard Warning Indicator - Flashes while the hazard warning flashers are engaged.
10. Not used.
11. Automatic Transmission System Monitor (Gas only) - Lights up when the vehicle is started to verify that all systems are functional. It should go out as soon as the vehicle is driven forward at a speed of 1 1/2 to 3 mph. If the light comes on while driving, pull over, set the handbrake, place transmission in Park and check the transmission fluid level with the engine idling.
12. Fuel Gauge
13. Battery Charge Indicator - Light should go out as soon as the engine starts. If it illuminates while driving, stop the engine immediately and check drive belts. Tighten or replace as necessary. If drive belts are satisfactory, a malfunction of the charging system may exist.

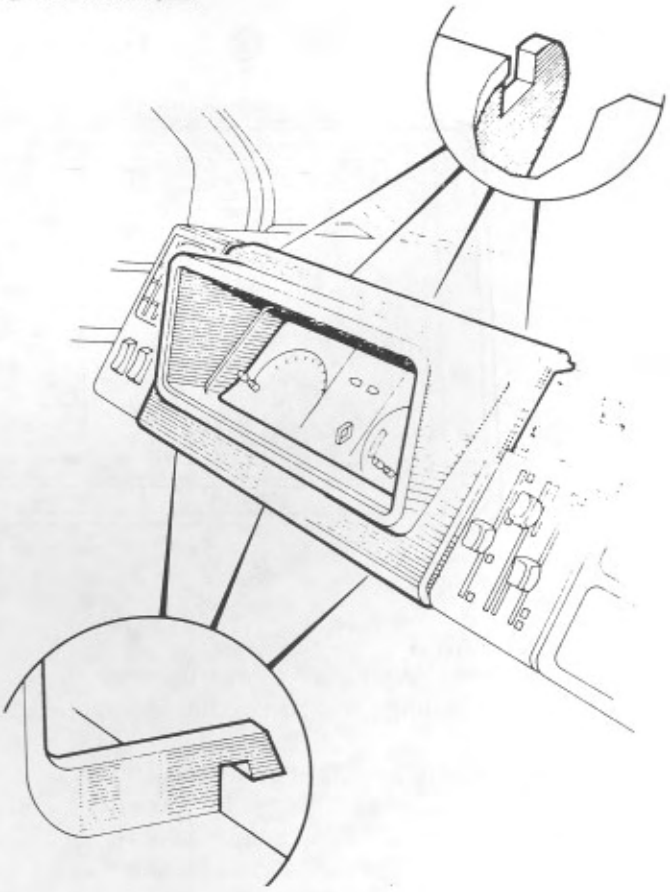
WARNING

Be sure to shut off the engine before attempting to check belts.

14. Panel Lighting Dimmer Knob - Controls the intensity of the instrument panel lighting.
15. Coolant Temp. Gauge - If the needle moves into the red zone, stop at once.
16. Turn Indicator Lights - **Both arrows flash in unison** while signaling either direction and during use of hazard flashers.

INSTRUMENT CLUSTER
REMOVE AND REPLACE

17. Speedometer
18. Odometer - Records accumulated mileage on vehicle.
19. Trip Recorder - Records mileage on trips or between fuel fills.
20. Trip Recorder Reset Knob - Push in and turn to the right to reset display back to "O".

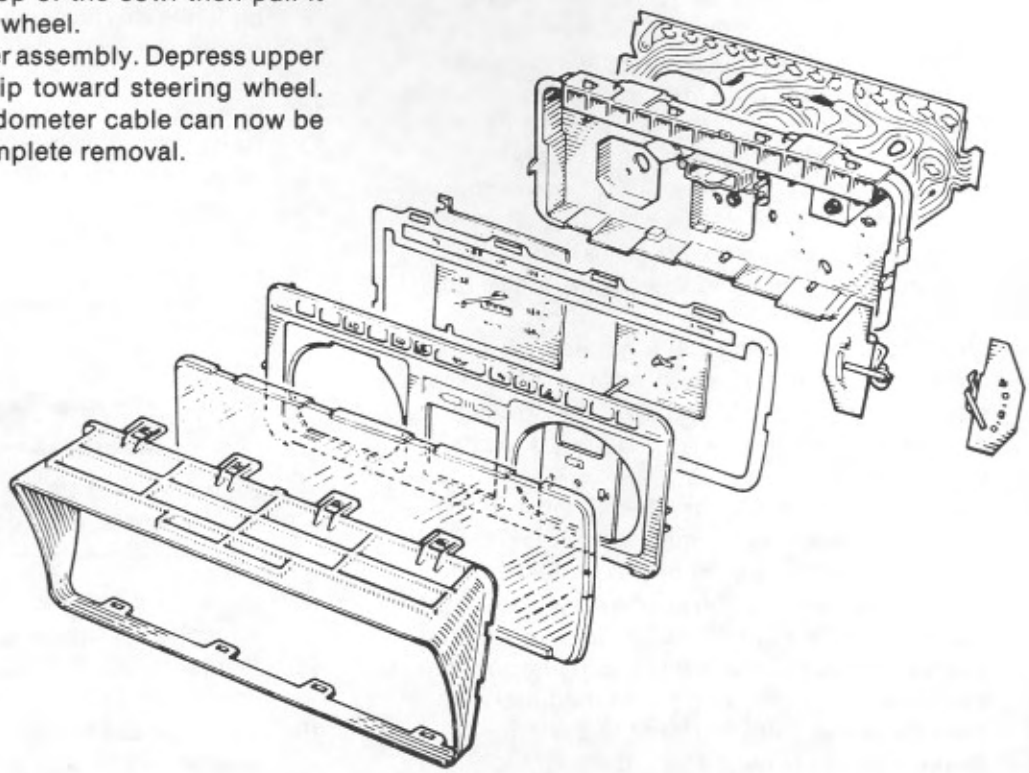


CAUTION

Stop vehicle and shut off engine at once if any of the warning lights come on, any gauge enters the "danger" zone, smoke or steam emits from beneath the hood, engine suddenly loses power, or any sudden change in engine operation occurs. Failure to do so may result in severe engine damage.

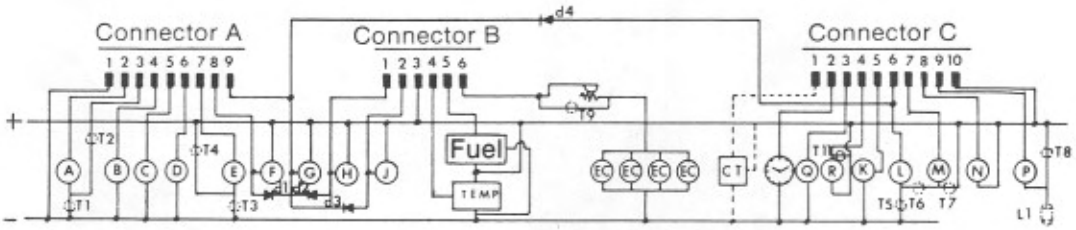
REMOVAL
Disconnect battery.

- Remove the instrument panel cowl
- Press down on the top of the cowl then pull it towards the steering wheel.
- Remove gauge cluster assembly. Depress upper retaining clips and tip toward steering wheel. Harnesses and speedometer cable can now be disconnected for complete removal.



INSTRUMENT CLUSTER
PRINTED CIRCUIT BOARD

PRINTED CIRCUIT BOARD CONNECTOR DIAGRAM
CONNECTOR IDENTIFICATION

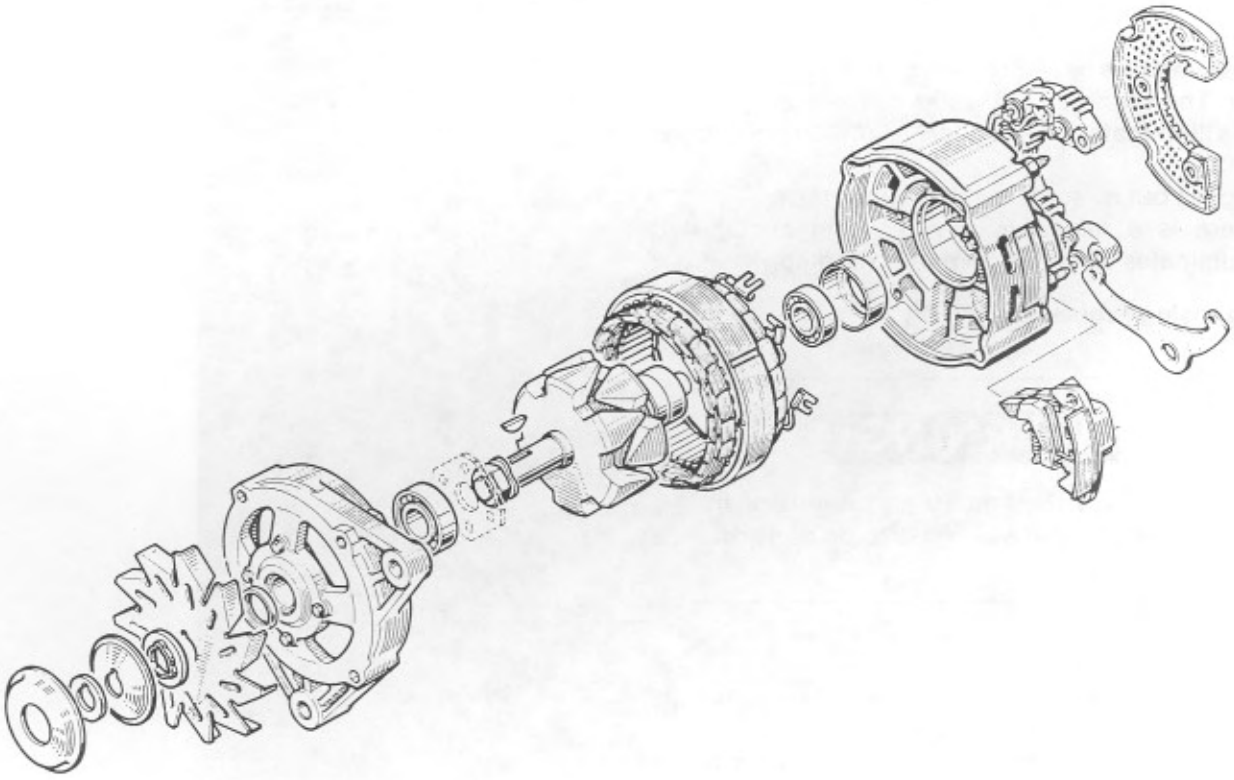


CONNECTOR IDENTIFICATION

	A	Polarity	Identification		B	Polarity	Identification		C	Polarity	Identification
1	Ground	—		1	Water in Fuel*		H	1			
2	Coolant Temp. Warning Light		A	2	Brake Pads	—	J	2			
3	—			3	Ignition On	+		3	Turn Indicator	+	Q
4	Seat Belt Warning	+	B	4	Temperature Gauge			4	Battery Charge		R
5	High Beam Indicator	+	C	5	Fuel Gauge			5	Hazard Lights	+	K
6				6	Dash Lighting	+		6			
7	Glow Plug Indicator*		E					7			
8	Brake	—	F								
9	Oil Light	—	G					9	Transmission Warning Light	—	P
								10	Ignition On	+	

* Diesel Only

ALTERNATOR
EXPLODED VIEW



NOTE: There were 3 different size alternators used between 1983 and 1986. Each alternator has an identifying label on the center of the rear case. Use these numbers when ordering parts or replacement.

Diesel - 70 amp.
90 amp.
105 amp.

Gas - 105 amp. only

ALTERNATOR

OPERATION - DIAGNOSIS

ALTERNATOR WITH BUILT-IN REGULATOR

These vehicles have alternators with a built-in regulator. The warning light works as follows:
- it is illuminated as soon as the ignition is switched on,
- it goes out as soon as the engine starts
- there is a failure in the charging circuit if it illuminates while the engine is running.

Diagnosing Problems

> **WARNING**
>
> Disconnect the battery and regulator if any electric arc welding is to be done on the vehicle.

Checking the current:
- Connect a voltmeter across the battery terminals and read off the battery current
- Start the engine and increase the revs. until the voltmeter needle remains steady on the regulated current figure. This should be between 13.5 and 15v.
- Switch on as many accessories as possible; the controlled current should remain steady between 13.5 and 15v.

- If the warning light does not illuminate when the ignition is switched on, check for:
  - broken alternator drive belt,
  - broken charging wire,
  - internal alternator failure (rotor, starter, diodes or brushes),
  - faulty regulator.

If the customer complains of a charging failure although the warning light functions correctly:
- check the regulator if the regulated current is less than 13.5v. The problem may be due to:
  - a faulty diode,
  - a severed phase,
  - or carboned-up tracks.

The regulator should be replaced only after the first 3 possibilities have been checked and found correct.

ALTERNATOR
REMOVE AND REPLACE

Do not use a screwdriver or similiar tool to force the belt off or onto a pulley as the synthetic fibers will be damaged and the belt will fail prematurely.

REMOVAL — DIESEL ENGINES
- Remove fresh air inlet
- Remove the air inlet elbow. (J8S-232 Natural Asp. Diesel)
- Remove Fuel Filter Assembly

Disconnect:
- the battery
- and wires

Remove:
- the bellyshield
- tightening bolt
- mounting bolt

and withdraw the alternator from above.

SPECIAL POINT CONCERNING REASSEMBLY
Tighten the belt after reassembling the alternator (refer to Section "B" or "C" Engine - Diesel)

REMOVAL - GAS ENGINE
Disconnect the negative battery cable.

Remove the splash shield.

Loosen the tensioner bolt (1).

Remove the mounting bolt (2) and swing the tensioner to the side.

Remove the serpentine belt.

Remove the mounting bolt (3) and lower the alternator.

Disconnect the wire harness from the alternator.

INSTALLATION
Connect the wire harness to the alternator.

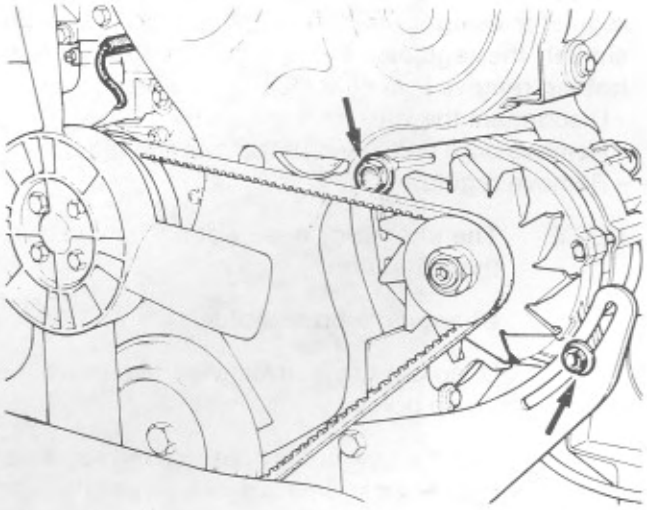
Position the alternator at the mounting bracket and install the attaching bolt (3).

Install the serpentine belt.

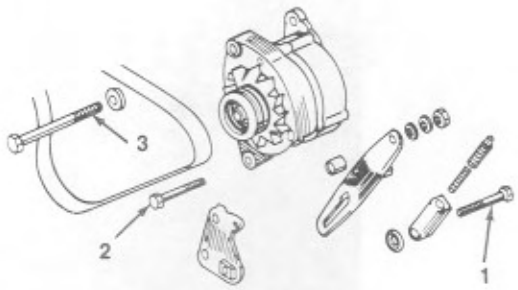
Position the tensioner and install the mounting bolt (2).

Adjust the belt tension. Refer to Section: E-"J7T Gas Engine" for the adjustment procedure.

Diesel Engines



Gas Engines



REMOVING REGULATOR

These alternators are similar to others of rear mount regulator design; the disassembly procedures are similar, the regulator being mounted to the brush holder; remove in similar fashion to a brush holder:

- Disconnect the wire from the diode bridge
- Remove both hex. head bolts from the regulator
- Remove regulator.

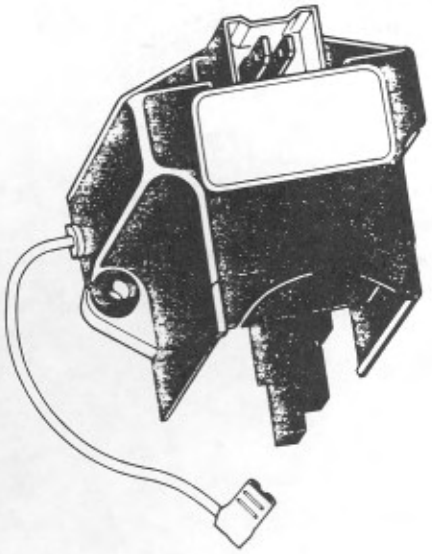
NOTE: The alternator need not be removed for this operation.

Changing a brush holder.

Unsolder the 3 terminals and remove the brush holder.

Bolt the new brush holder to the regulator to prevent straining it when mounting it to the alternator and possible damage to the regulator printed circuit.

Resolder the 3 terminals taking care not to melt the plastic.



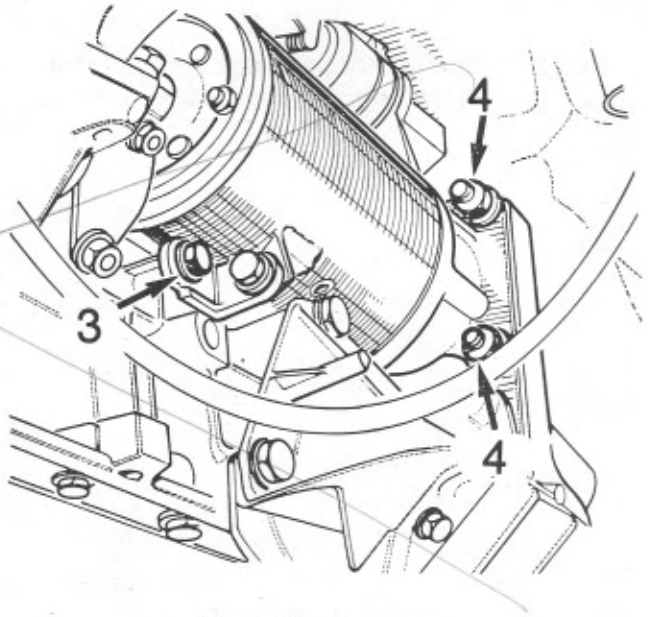
STARTER

REMOVE AND REPLACE

NOTE: The starter is removed from below.

REMOVAL

- Disconnect the negative battery cable.
- Disconnect the intake manifold support brackets (1) at the base plate (2) and remove the base plate from the engine block (gas engine vehicles only).
- Remove the three starter motor-to-bellhousing mounting bolts (4)
- Remove the starter mounting bracket bolts (3).
- Lower the starter and disconnect the wire harness to the starter solenoid.



Diesel Engine Starter

INSTALLATION

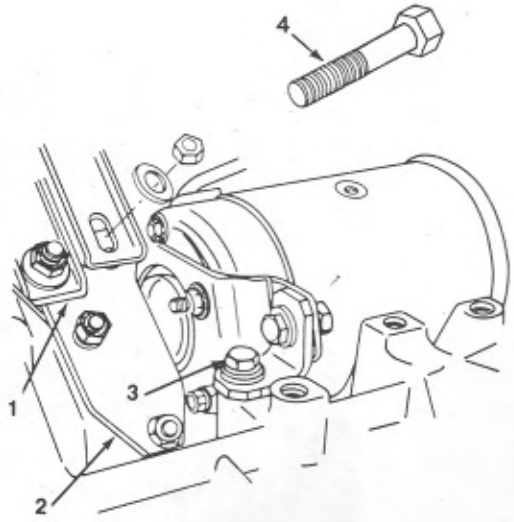
- Connect the wire harness to the starter solenoid.

IMPORTANT
Make sure alignment dowel is mounted in the starter or bell housing. Mounting the starter without the dowel will result in starter drive-to-flywheel misalignment.

- Position the starter in the bellhousing and install the three mounting bolts (4).

NOTE: Tighten these bolts before proceeding to the next step.

- Install the starter mounting bracket attaching bolts (3).
- Install the base plate (2) on the engine block and the brackets (1) on the base plate.
- Connect the negative battery cable.



Gas Engine Starter

Diesel Engine Starter

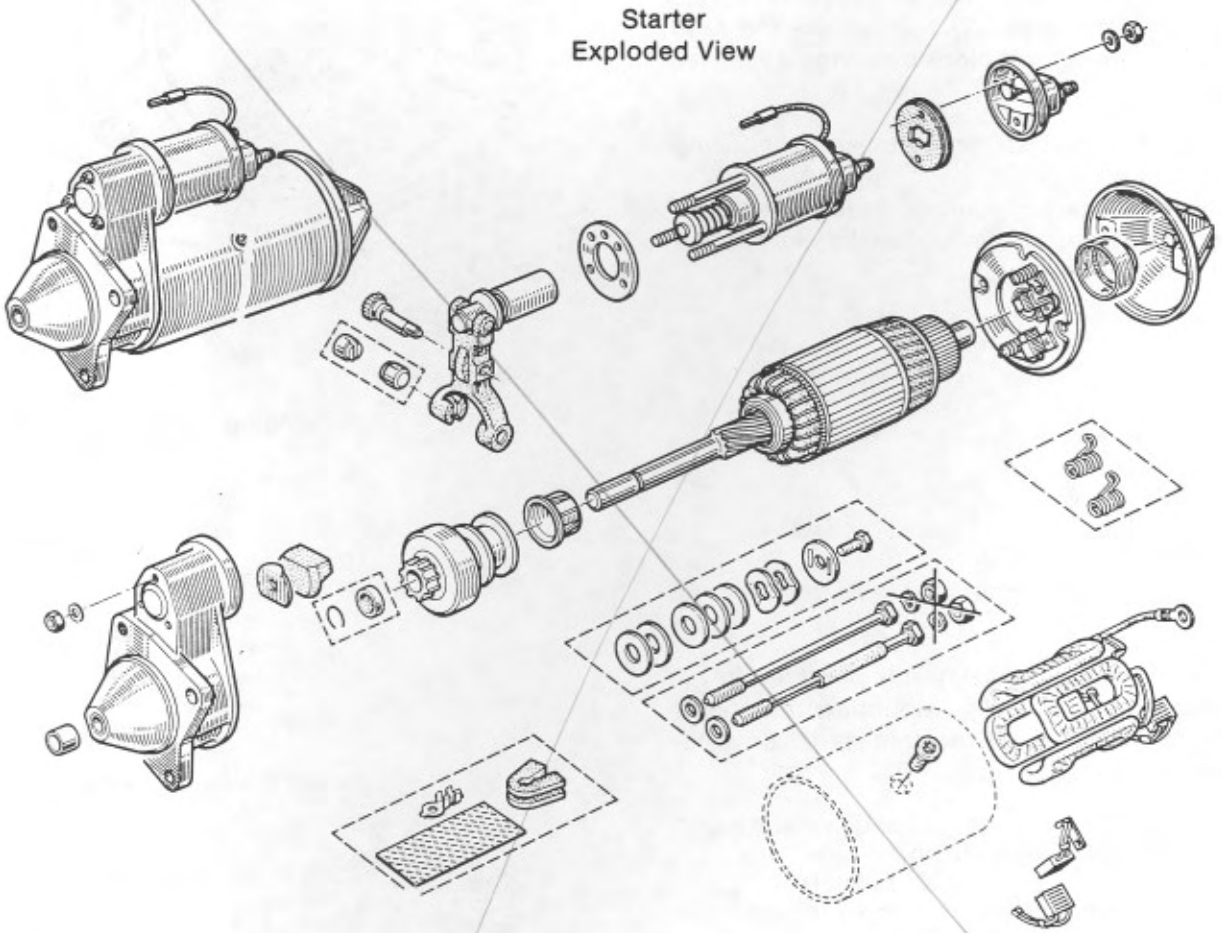
Gasoline Engine Vehicle Starter

STARTER

PARIS-RHONE D11E172

NOTE: This starter was original equipment on all diesel engines from 1983 to mid 1986.

Starter
Exploded View

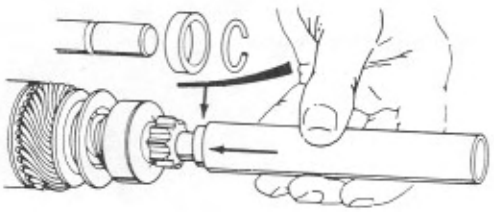


COMPONENT REPLACEMENT

STARTING DRIVE MECHANISM

After removing the armature, tap the stop collar with a drift to disengage the retaining clip.

When installing the starter drive mechanism, put the clip back in place and push the stop collar over the clip.



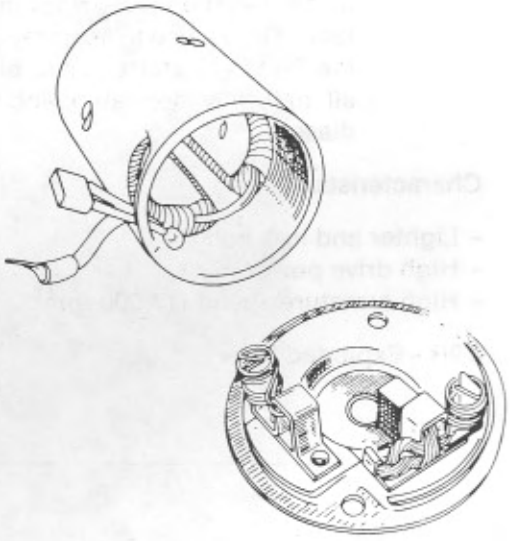
STARTER

PARIS-RHONE D11E172

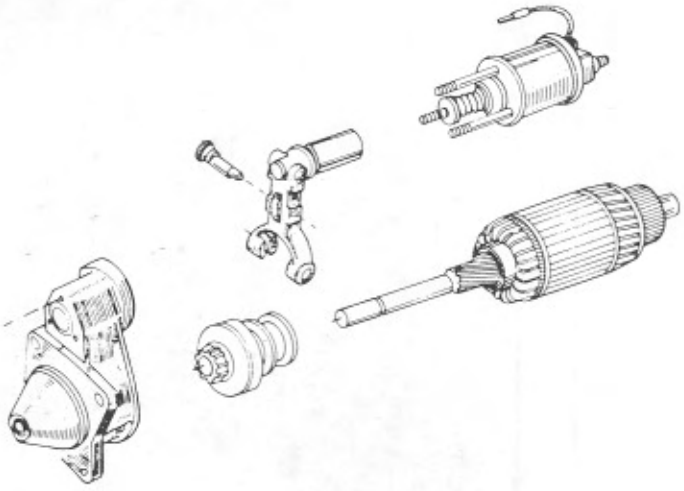
BRUSH REPLACEMENT

Remove:

- the starter
- the case



- Unsolder the brushes to be replaced
- Solder on the replacement brushes
- Check the armature and reinstall the starter.



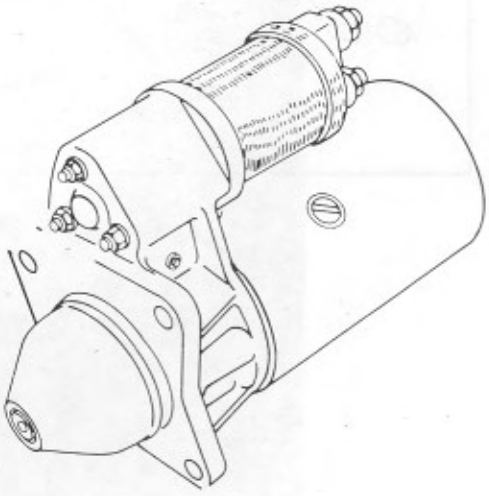
SOLENOID REPLACEMENT

Unscrew:

- the electrical connection
- the mounting nuts

Remove the solenoid.

During installation, put the spring in place and check the seal.



STARTER

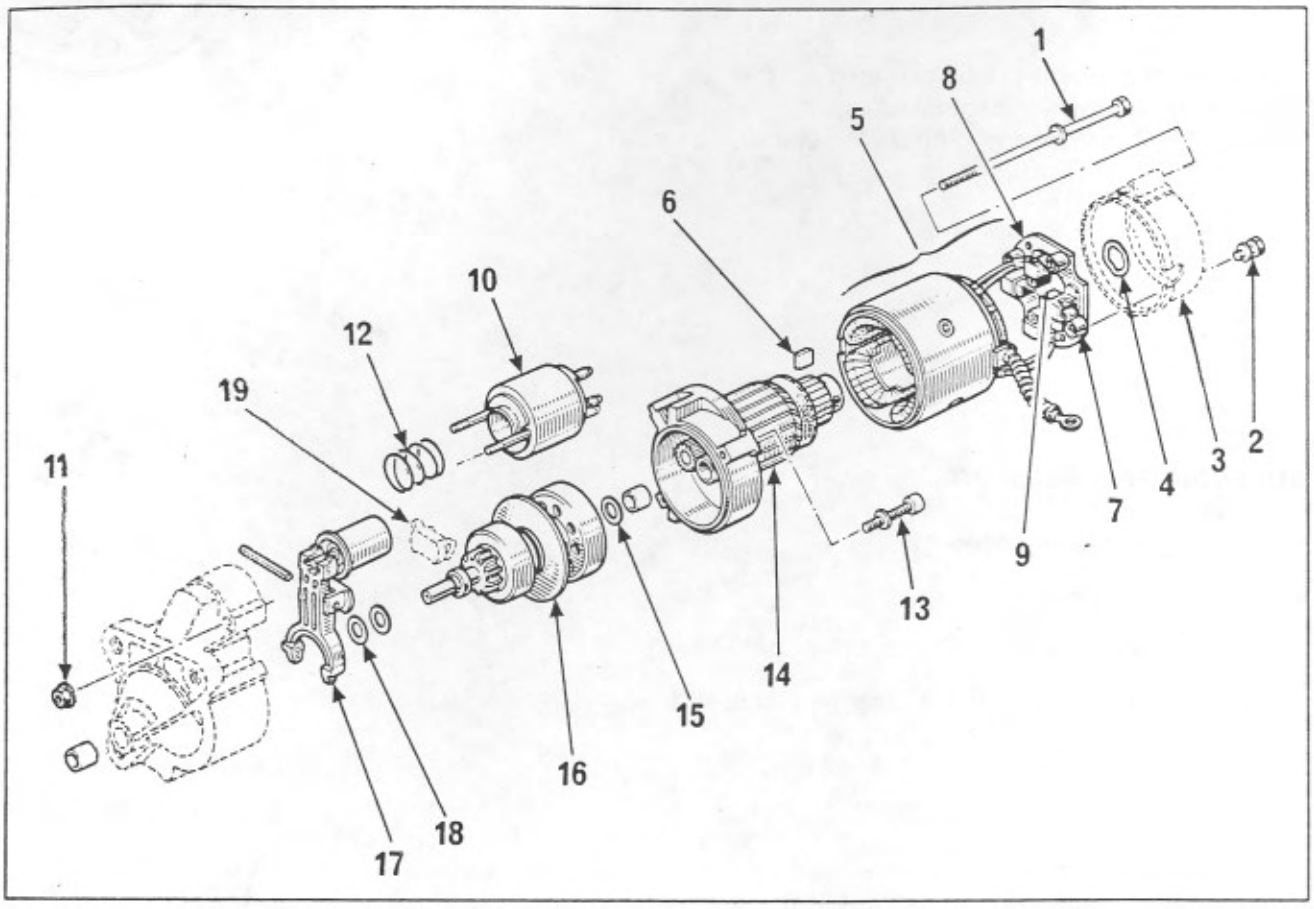
PARIS-RHONE D9R

NOTE: This starter was original equipment on turbo diesel engines from mid-1986 and later. This is also a direct replacement for the D11E172 starter used previously on all naturally aspirated and most turbo diesels.

Characteristics:

- Lighter and less bulky.
- High drive power.
- High armature speed (17,000 rpm)

D9R - Exploded View



DISMANTLING THE REAR SECTION OF THE STARTER

REMOVE:
- bolts (1) from the assembly,
- nuts (2) securing the brush holder;
- the cover (3);
- washer (4);
- field coil/brush holder assembly (5)

Remove locating piece (6)

ATTENTION

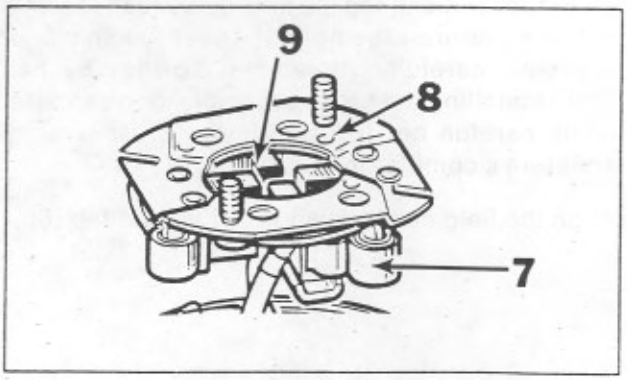
Springs (7) **must not be** removed from the brushes. This type of starter has high pressure brushes (applied force 5.5 daNm - 40 lb./ft.) which is produced by springs (7). There is a risk of serious injury if these springs are dismantled.

REPLACING THE BRUSHES

It is not possible to change brushes (9) only.

Since the operating temperature around the brushes is high, soft solder must not be applied to the brushes.

Because of this, the brushes are sold pre-assembled on their plates (8) attached to the field coils.



DISMANTLING THE DRIVE

Remove:
- switch (10) and its spring (12) by removing nuts (11),
- bolt (13) holding the reduction gear unit,
- armature (14),
- washer (15),
- seal (19),
- drive (16) and control lever (17),
- shims (18).

SPECIAL POINTS
The armature/reduction gear assembly cannot be dismantled (the pinion is attached to the armature).

The drive/toothed wheel assembly cannot be dismantled (toothed wheel is crimped on the shaft).

REASSEMBLING THE DRIVE
Install the shims taken off during dismantling.

Grease the drive.

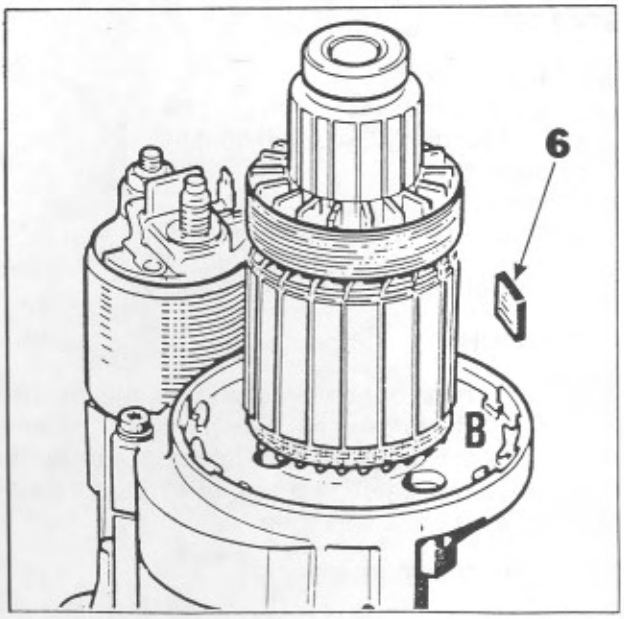
Reassemble in the order of removal.

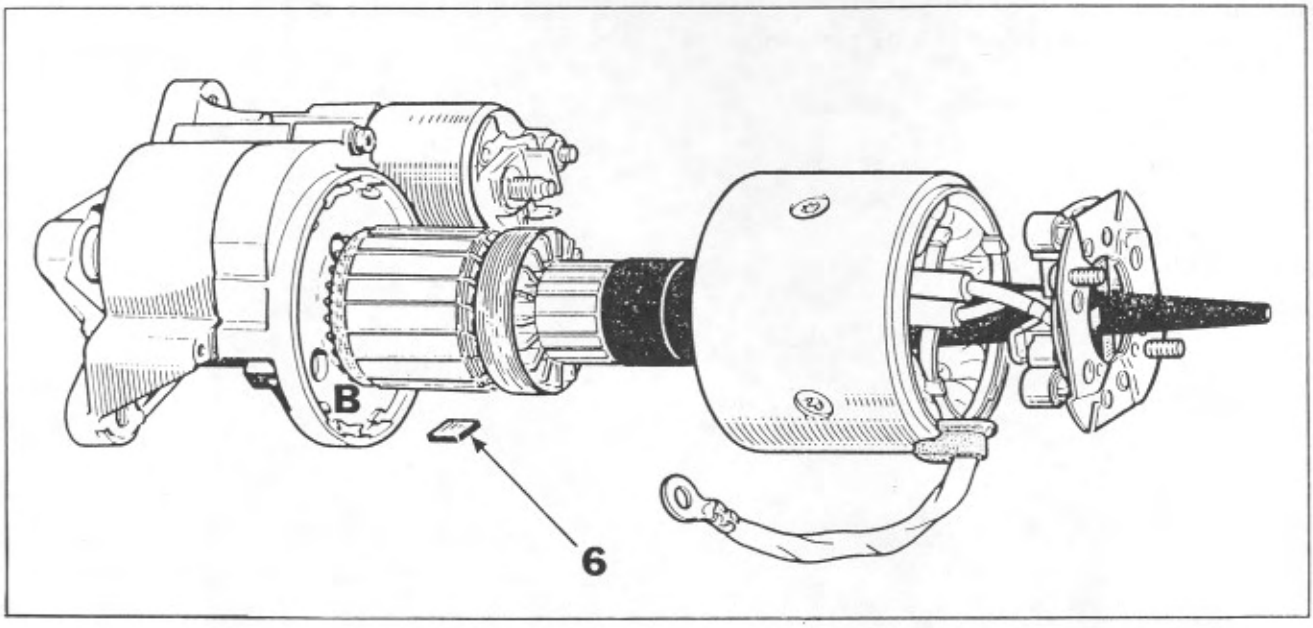
SPECIAL POINTS
Reassembling the field coil and brushes:

Install locating piece (6) on B.

Place a brush spreading tool over the end of the armature for installing the field coil/brush assembly to the armature assembly. If a tool like this is not available, carefully spread the brushes by hand when installing the brush assembly to the armature being carefull not to damage the brushes or the armature's comutator.

Align the field coil in relation to locating tab (6).



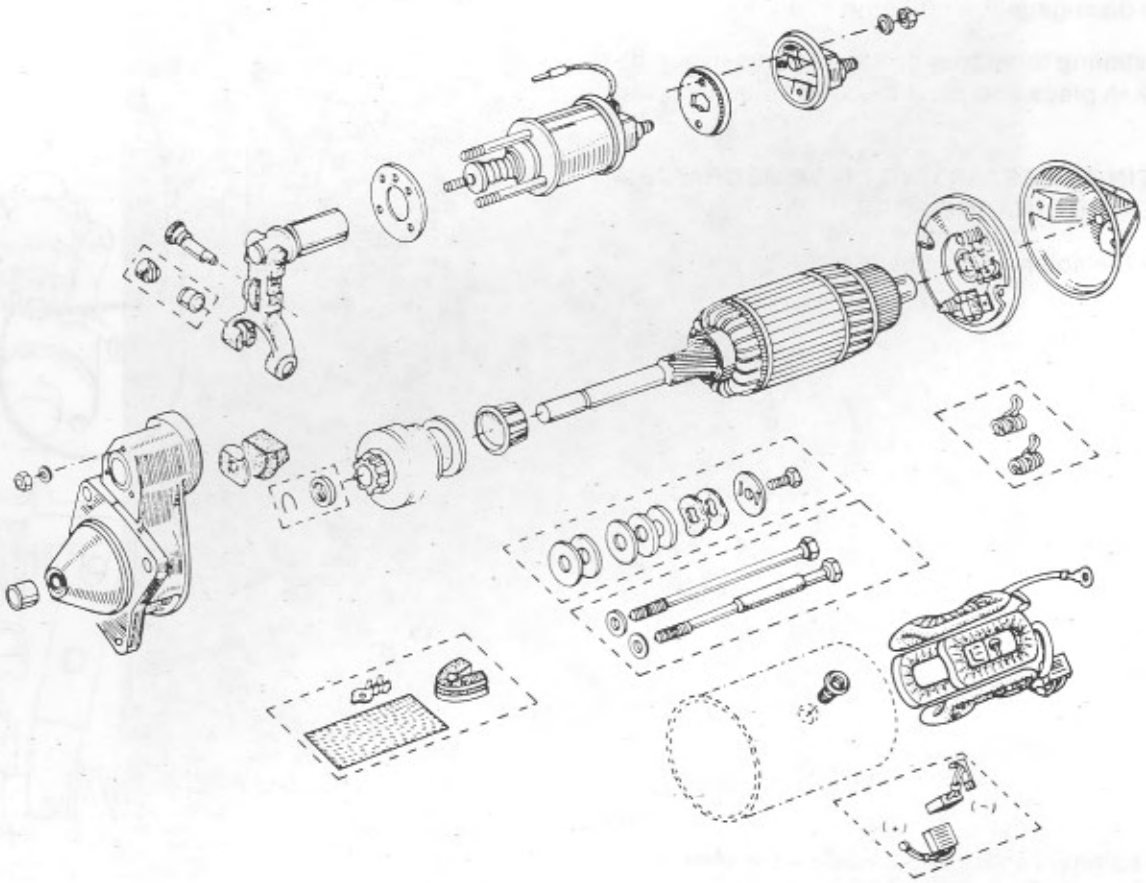


STARTER

PARIS-RHONE D10E 88

NOTE: This starter was original equipment on all gasoline engine vehicles.

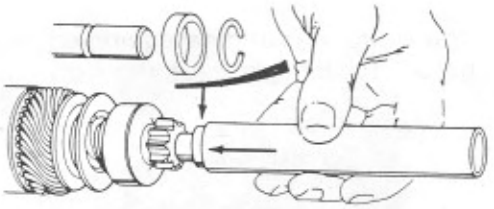
PARIS-RHONE TYPE D10 E
Exploded View



COMPONENT REPLACEMENT

STARTING DRIVE MECHANISM

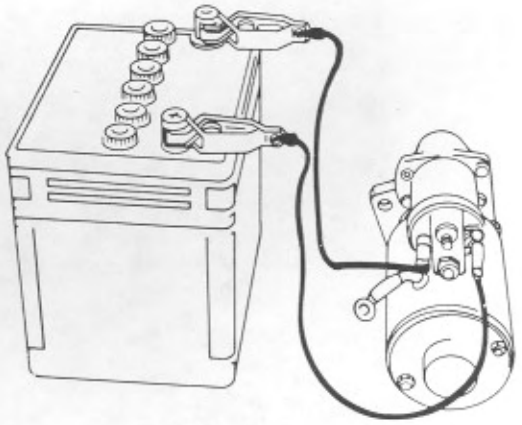
After removing the armature, tap the stop collar with a drift to disengage the retaining clip.



When installing the starter drive mechanism, put the clip back in place and push the stop collar over the clip.

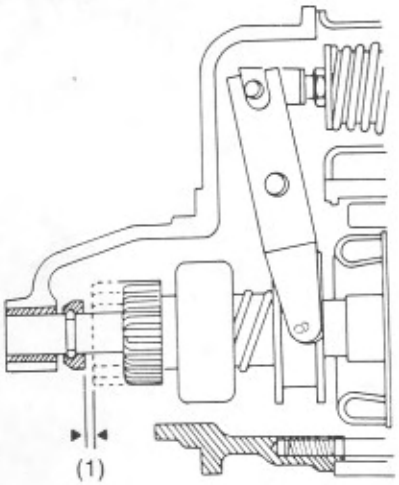
ADJUSTING THE STARTING DRIVE MECHANISM — SOLENOID LINKAGE FORK

Connect the solenoid to a battery.

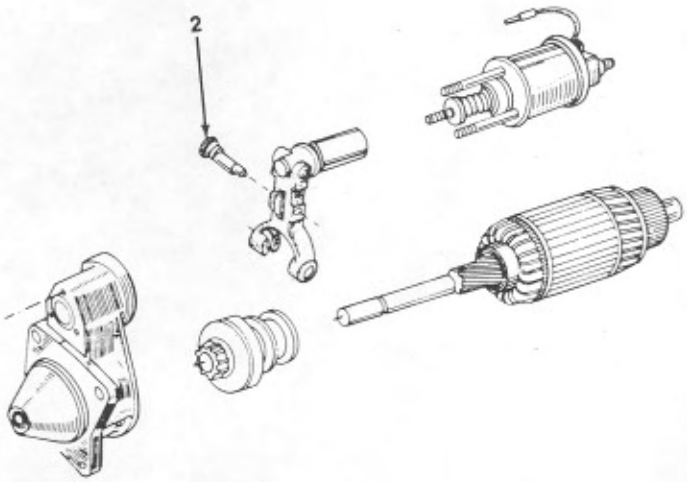


With the solenoid energized, measure the clearance (1) between the drive pinion and the stop.

NOTE: Clearance = 1.5 mm (0.059 in)



If the clearance is not correct, adjust it with an eccentric pin (2) in the fork.



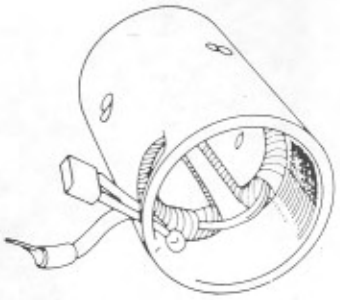
STARTER

PARIS-RHONE D10E88

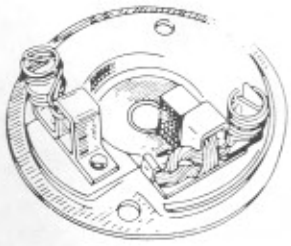
BRUSH REPLACEMENT

Remove:

- the starter
- the case



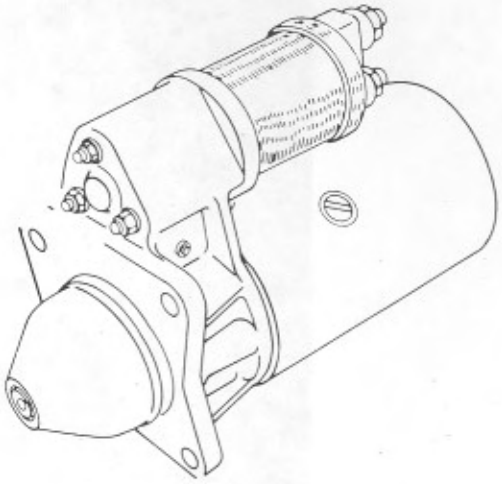
- Unsolder the brushes to be replaced.
- Solder on the replacement brushes.
- Check the armature and reinstall the starter.



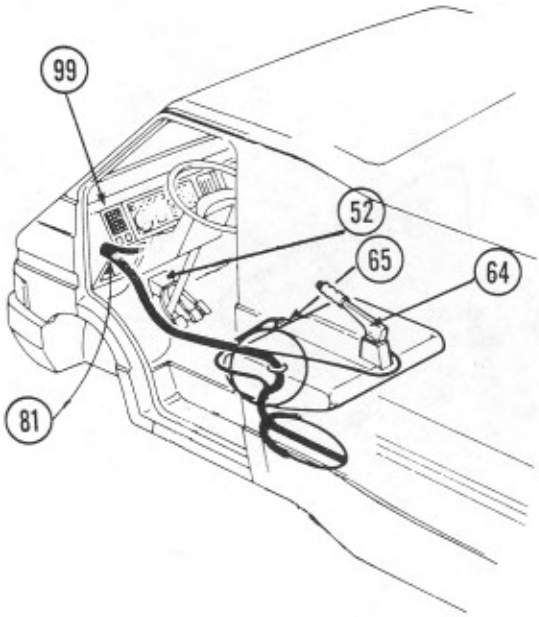
SOLENOID REPLACEMENT

Unscrew:

- the electrical connection
- the mounting nuts
- Remove the solenoid
- During installation, put the spring in place and check the seal.

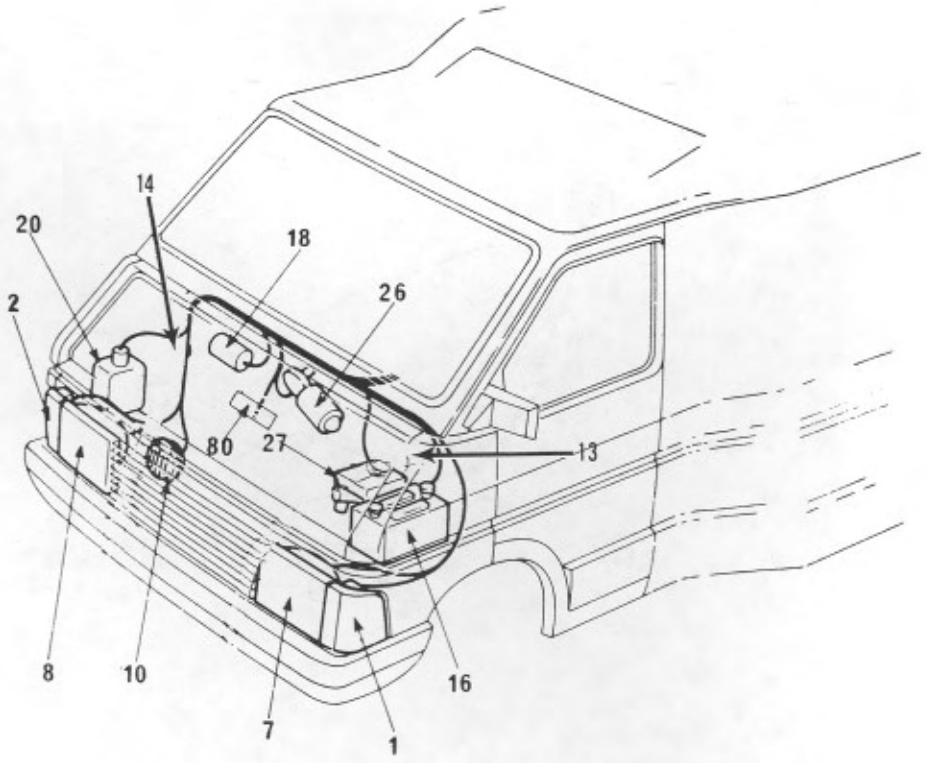


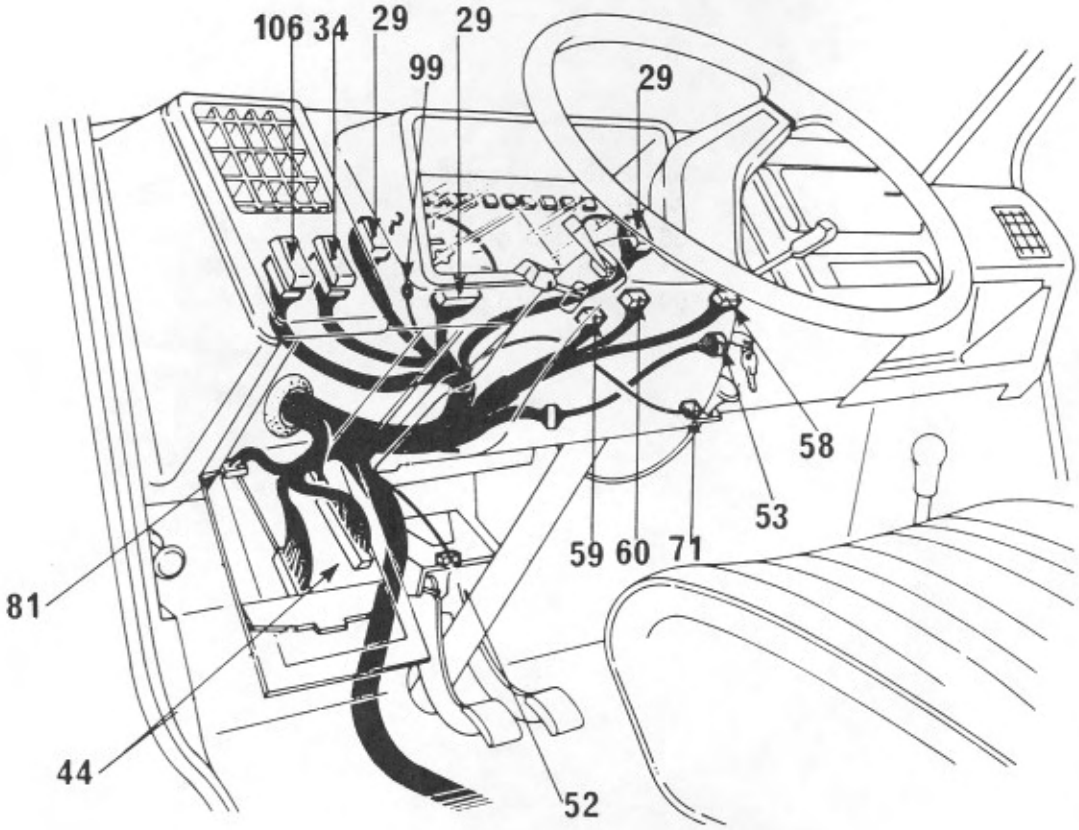
WIRE HARNESS
REAR WIRING HARNESS
ROUTING



52 - Brakelights switch
64 - Handbrake
65 - Fuel tank gauge unit
81 - Front harness junction block
99 - Dashboard ground

WIRE HARNESS
ENGINE AND FRONT HARNESS
ROUTING





WIRE HARNESS

ENGINE AND FRONT HARNESS ROUTING

1 - L.H. sidelight and turn signal
2 - R.H. sidelight and turn signal
7 - L.H. headlight
8 - R.H. headlight
10 - R.H. horn
13 - L.H. ground
14 - R.H. ground
16 - Battery
18 - Ignition coil
20 - Windshield washer pump
26 - Windshield wiper motor plate
27 - Brake master cylinder

29 - Instrument panel junction blocks
34 - "Hazard" warning lights switch
44 - Accessories plate
52 - Brake light switch
53 - Ignition - starter - anti-theft switch
58 - Windshield wiper-washer switch
59 - Combination lighting switch
60 - Turn signal switch
80 - Connector - front and engine harnesses
81 - Connector - front and rear harnesses
99 - Dashboard ground
106 - Dual battery switch

WIRING DIAGRAMS

The following pages contain wiring diagrams pertaining to both diesel and gas versions.

Wiring Diagram Index:

Wiring Assembly Identification Guide (1985-1986) ..... G7-2 to G7-4

1986 Model Year Production
Component Locations, Harness and Wire Codes G7-5, G7-6
Wiring Diagrams ..... G7-7 to G7-18

Mid-Year 1985 Production
Component Locations, Harness and Wire Codes G7-19, G7-20
Wiring Diagrams ..... G7-21 to G7-32

Early 1985 Production
Component Locations, Harness and Wire Codes G7-33, G7-34
Wiring Diagrams ..... G7-35 to G7-46

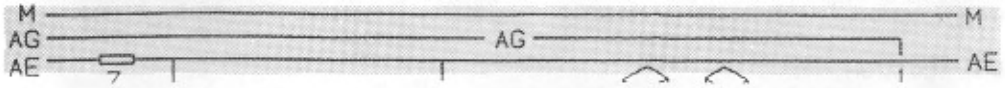
1983-1984 Production
Diesel Wiring Diagram ..... G7-47 to G7-51

WIRE ASSEMBLY IDENTIFICATION

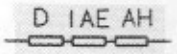
The Harness Code tables at the beginning of each set of diagrams list the letter codes and descriptions of wire assemblies in that set of diagrams.

Figure 1 on the following page illustrates the symbols used to identify wire assemblies and splices within wire assemblies as described below.

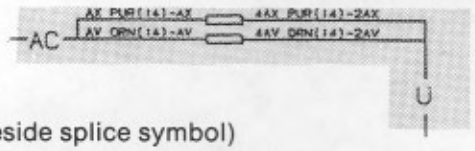
1. A wire assembly is coded with one or two letters in configuration like this:



2. An internal splice within a given wire assembly looks like these examples:



3. A splice that connects two separate wire assemblies or a wire assembly to a component will look like this:



(Note absence of letter code beside splice symbol)

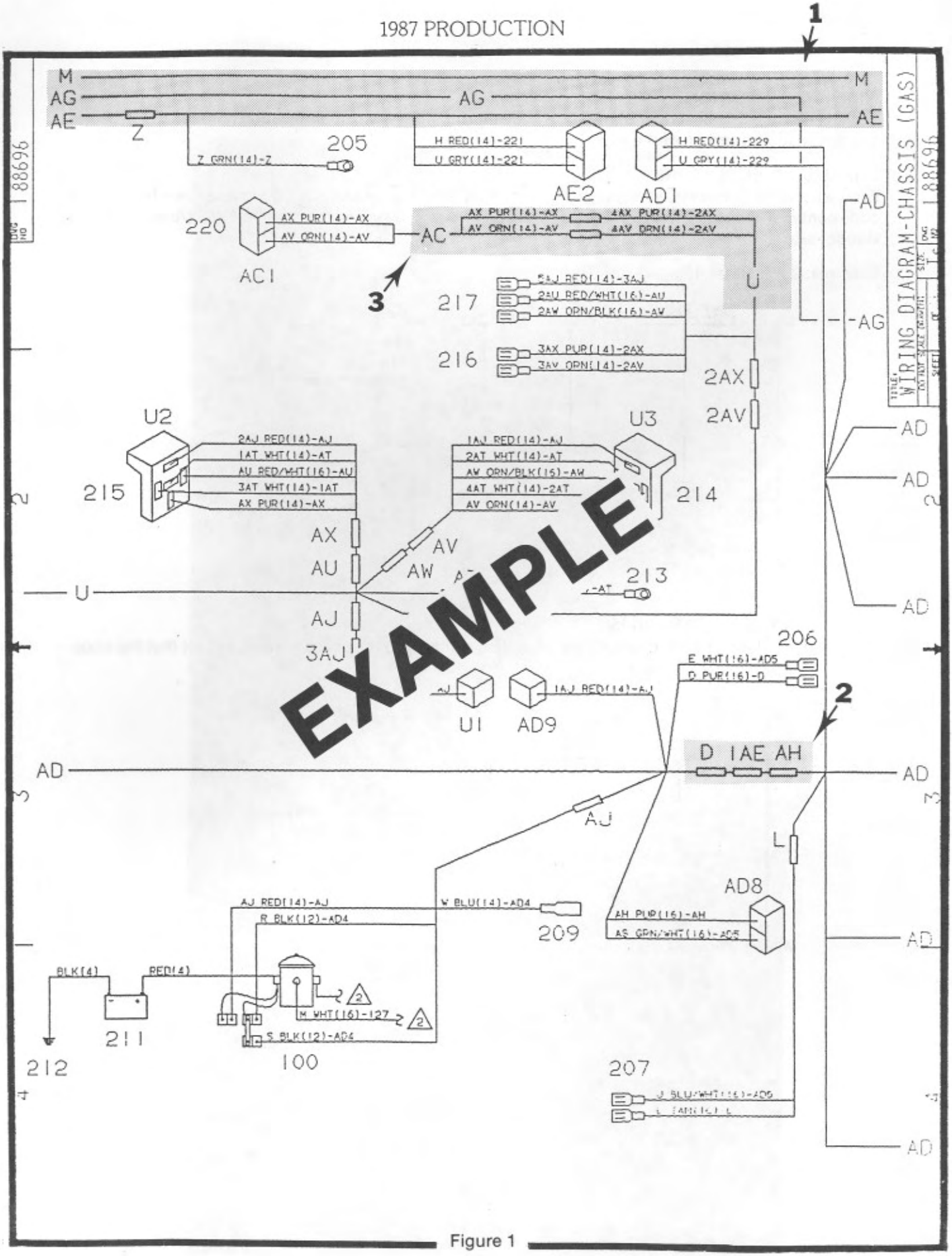
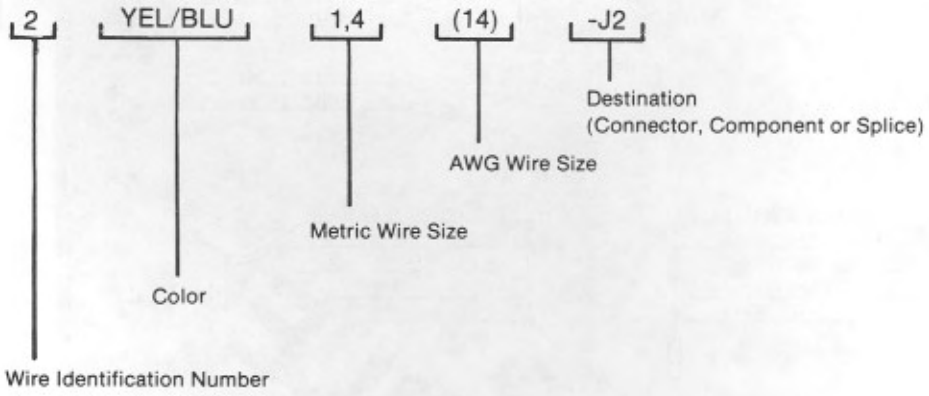

1
M
AG
AE
Z
205
Z GRN(14)-Z
H RED(14)-221
U GRY(14)-221
AE2
AD1
H RED(14)-229
U GRY(14)-229
AD
AG
AE
220
AX PUR(14)-AX
AV ORN(14)-AV
AC1
AC
AX PUR(14)-AX
AV ORN(14)-AV
4AX PUR(14)-2AX
4AV ORN(14)-2AV
3
217
2AJ RED(14)-3AJ
2AU RED/WHT(16)-AU
2AW ORN/BLK(16)-AV
216
3AX PUR(14)-2AX
3AV ORN(14)-2AV
U
2AX
2AV
WIRING DIAGRAM-CHASSIS (GAS)
188696
U2
215
2AJ RED(14)-AJ
1AT WHT(14)-AT
AU RED/WHT(16)-AU
3AT WHT(14)-1AT
AX PUR(14)-AX
U3
214
1AJ RED(14)-AJ
2AT WHT(14)-AT
AW ORN/BLK(16)-AW
4AT WHT(14)-2AT
AV ORN(14)-AV
AX
AU
AV
AW
AT
213
U
AJ
3AJ
206
E WHT(16)-AD5
D PUR(16)-D
2
U1
AD9
1AJ RED(14)-AJ
D 1AE AH
AD
AJ
L
AD8
AJ RED(14)-AJ
R BLK(12)-AD4
W BLU(14)-AD4
209
AH PUR(16)-AH
AS GRN/WHT(16)-AD5
BLK(4)
RED(4)
M WHT(16)-127
S BLK(12)-AD4
211
212
100
207
J BLU/WHT(16)-AD5
EXAMPLE

Figure 1

WIRE IDENTIFICATION
Each wire in the diagram is identified with a code that includes a wire identification number, color, gauge and destination or origin of the wire.

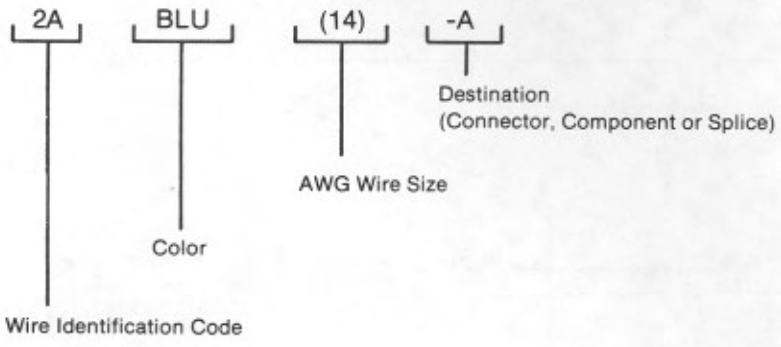
CHASSIS ASSEMBLY WIRES
Each wire within a chassis wire assembly is identified on a diagram with a code as shown below. The code contains two wire gauge sizes - one in Metric wire thickness and the other in AWG (American Wire Gauge) size.

Example: 2YEL/BLU1,4(14)-J2



WINNEBAGO ASSEMBLY WIRES
Wires in a Winnebago wire assembly are identified similarly to the chassis wires, except that the code does not include a Metric wire size.

Example: 2A BLU(14)-A



DWG NO 83273

COMPONENT LOCATIONS

NO.	NAME	SHT. NO.
16	WINDSHIELD WASHER FLUID RESERVOIR	9
27	COOLING FANS	8
29	SENSOR-RADIATOR COOLANT TEMP.,LOWER	9
30	A/C COMPRESSOR	9
31	PRESSURE SWITCH-P/S.A/C	9
32	PRESSURE SWITCH-COOLING FANS	9
33	PRESSURE SWITCH-A/C.LOW	9
34	PRESSURE SWITCH-A/C.HIGH	9
35	SENSOR-RADIATOR COOLANT TEMP.,UPPER	9
36	A/C TEMP CONTROL SWITCH	8
37	RELAY	8
38	RELAY	8
39	RELAY	8
40	CIRCUIT BREAKER	8
41	CIRCUIT BREAKER	8
42	DIODE	9
43	DIODE	9
44	DIODE	9
45	SOLENOID VALVE	8
46	PRESSURE SWITCH	8
48	RELAY	8
49	AUTOMATIC TRANSMISSION COMPUTER	9
50	HEADLAMP,RIGHT	7
51	HEADLAMP,LEFT	7
52	HORN	7
53	AIR BY-PASS VALVE	9
55	IGNITION MODULE	9
57	RELAY-NEUTRAL START	10
58	ACCELERATOR CABLE OR CRUISE CONTROL	10
60	CRUISE CONTROL	13
64	OVERFLOW BOTTLE	10
65	BRAKE FLUID RESERVOIR	9
67	STARTER	9
70	AIRFLOW METER	8
72	TURN AND PARK LAMP,RIGHT FRONT	7
73	SIDEMARKER,RIGHT FRONT	7
74	TURN AND PARK LAMP,LEFT FRONT	7
75	SIDEMARKER,LEFT FRONT	7
78	RELAY-RPM	12
79	LAMBDA SENSOR	12
85	BAROMETRIC PRESSURE SENSOR	16
86	FUEL PUMP	17
87	INJECTION COMPUTER	17
92	RELAY-TACHYMETRIQUE	16
97	HEATER FAN	10
98	WINDSHIELD WIPER MOTOR	10
100	BREAKER PLATE	11
102	HAZARD FLASHER	13
110	CONNECTOR-FRONT RISER WIRE ASM	13
112	FUSE PANEL	13
113	BRAKE LIGHT SWITCH	13
114	IGNITION SWITCH	14
119	HEATER CONTROL SWITCH	14
120	INSTRUMENT CLUSTER	14
125	HEATER CONTROL LIGHTS	14
127	BATTERY CHANGEOVER SWITCH	13
128	WATER TEMPERATURE FLASHER	15
130	TAILLIGHT ADAPTER ASSEMBLY	16
131	RELAY	16
133	RELAY	16
134	DIODE	15
135	CAB DOOR SWITCH,LEFT	15
137	PARK BRAKE	16
138	PARK BRAKE LIGHT	16
139	SEAT BELT	16
140	FUEL TANK SENDING UNIT	17
141	SPLICE	17
142	ASHTRAY LIGHT,LEFT	17
144	FRONT CLEARANCE LIGHT	17
145	FRONT CLEARANCE LIGHT	17
146	FRONT CLEARANCE LIGHT	17
147	FRONT CLEARANCE LIGHT	17
148	DOME LIGHT	17
149	ASHTRAY LIGHT,RIGHT	17
150	FOOT LIGHT,RIGHT	17
151	VISOR LIGHT	17
152	REAR CLEARANCE LIGHT	18
153	REAR CLEARANCE LIGHT	18
154	REAR CLEARANCE LIGHT	18
155	REAR CLEARANCE LIGHT	18
156	REAR CLEARANCE LIGHT	18
157	SIDE MARKER,RIGHT REAR	18
158	TAIL LIGHT,RIGHT	18
159	SIDE MARKER,LEFT REAR	18
160	TAIL LIGHT,LEFT	18
161	LICENSE PLATE LIGHT	18
163	GROUND	18
164	INTERNAL SPLICE	11
165	INTERNAL SPLICE	11
166	AIR BYPASS SOLENOID	11
167	INJECTOR-CYLINDER #1	11
168	INJECTOR-CYLINDER #2	11
169	INJECTOR-CYLINDER #3	11
170	INJECTOR-COLD START	11
171	GROUND	11
172	THROTTLE POSITION SWITCH	11
173	INJECTOR-CYLINDER #4	11
174	WATER TEMPERATURE SWITCH	11
175	WATER TEMPERATURE SENSOR	11
176	CAB DOOR SWITCH,RIGHT	15
177	TURN SIGNAL/HEADLAMP/WASHER MECHANISM	15
178	FRONT LEFT CLEARANCE LIGHT	18
179	CIRCUIT BREAKER	14
180	RELAY-DOOR LOCK	14
181	RELAY-DOOR LOCK	14
182	ELECTRIC DOOR LOCK SWITCH,RH	15
183	ELECTRIC DOOR LOCK MOTOR,RH	15
184	ELECTRIC DOOR LOCK SWITCH,RH	16
185	ELECTRIC DOOR LOCK MOTOR,RH	16
187	CONNECTOR	13
188	CONNECTOR-UNUSED	14

TITLE WIRING DIAGRAM-CHASSIS (GAS)
DO NOT SCALE DRAWING | SIZE C | DWG NO 83273 | SHEET OF

HARNESS CODES

WIRE ASM	DESCRIPTION
A	WIRE ASM-AUTO.FRONT
C	WIRE ASM-PUMP,W/S WASHER
D	WIRE ASM-BRAKE PAD WEAR
E	WIRE ASM-INJECTION,ELECT
F	WIRE ASM-TRANS.AUTO
G	WIRE ASM-ENGINE
H	WIRE ASM-OVERFLOW BOTTLE LIGHT
J	WIRE ASM-INJECTION SYSTEM
K	WIRE ASM-EMISSION CONTROL
L	WIRE ASM-COOLING FANS
M	WIRE ASM-EXTERIOR LIGHTING
N	WIRE ASM-PARK BRAKE
P	WIRE ASM-SHIFT LEVER LIGHT
R	WIRE ASM-FUEL TANK SENDER
S	WIRE ASM-BACKWALL
T	WIRE ASM-INJECTION,ENGINE
U	WIRE ASM-LOCK
W	WIRE ASM-CHIME

WIRE COLOR CODES

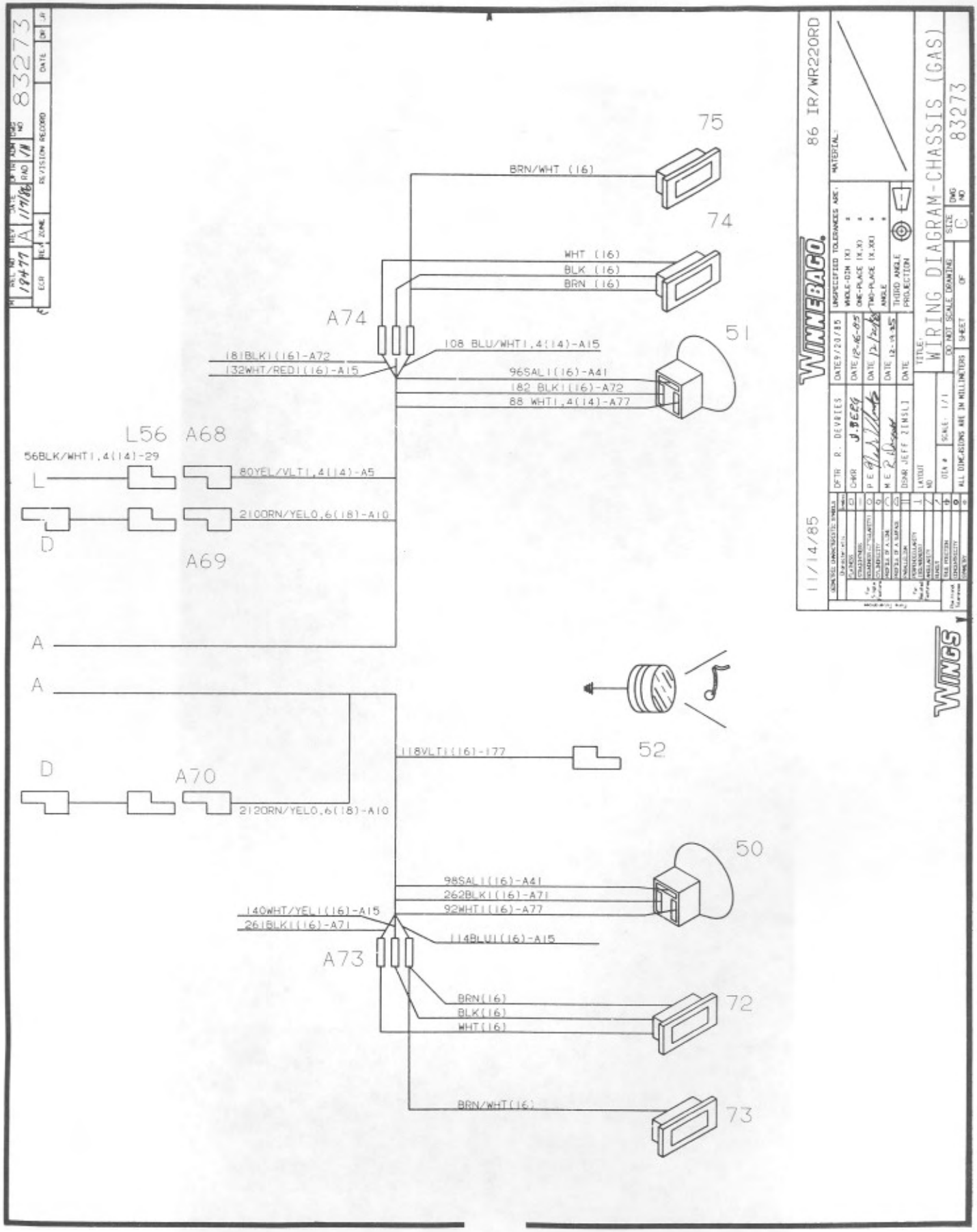
CODE	COLOR	CODE	COLOR
BLK	BLACK	PNK	PINK
BLU	BLUE	RED	RED
BRN	BROWN	VLT	VIOLET
GRN	GREEN	WHT	WHITE
GRY	GRAY	YEL	YELLOW
ORN	ORANGE	BGE	BEIGE
MAR	MAROON	PUR	PURPLE
SAL	SALMON		

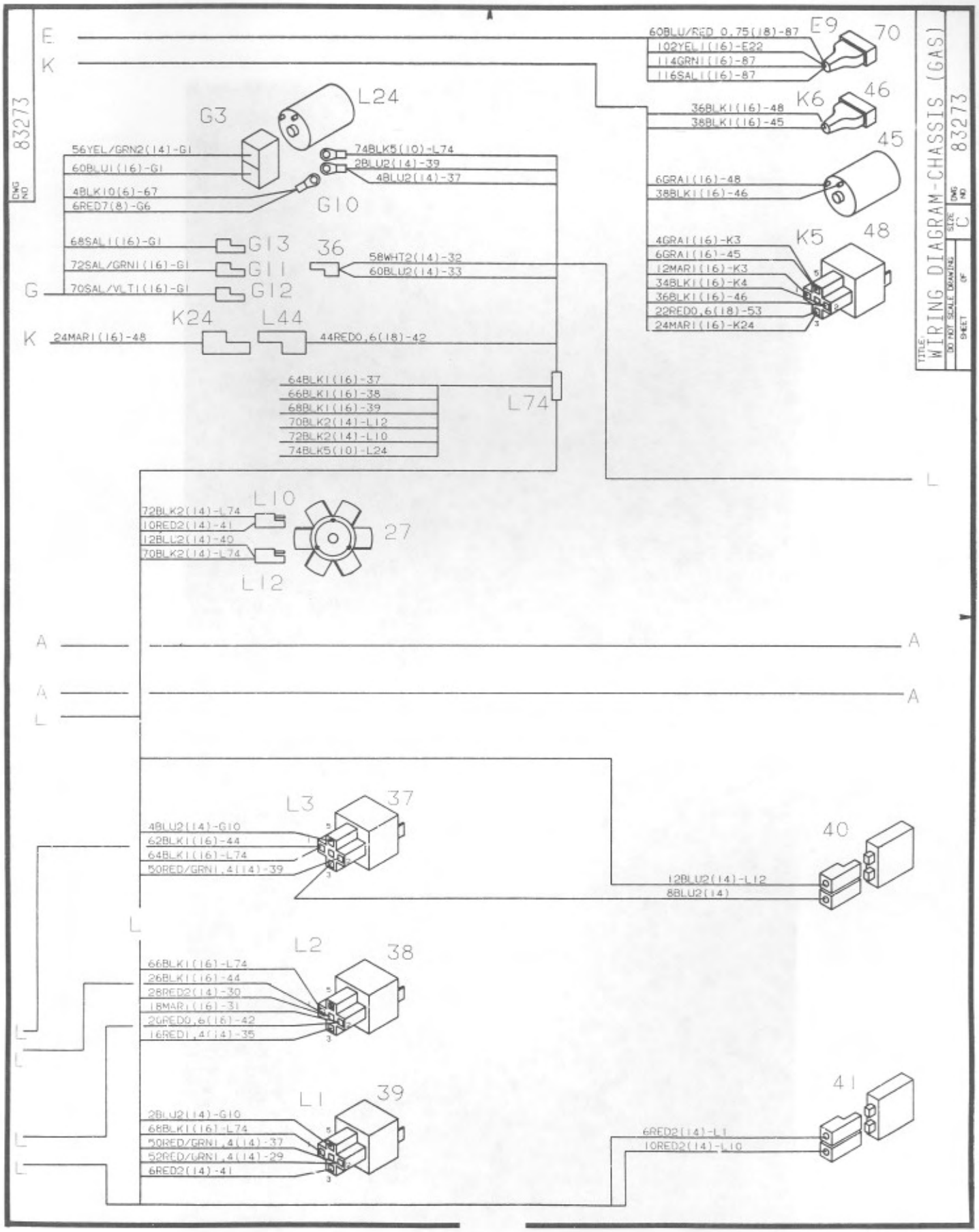
DWG NO 87273

CONNECTOR LOCATIONS

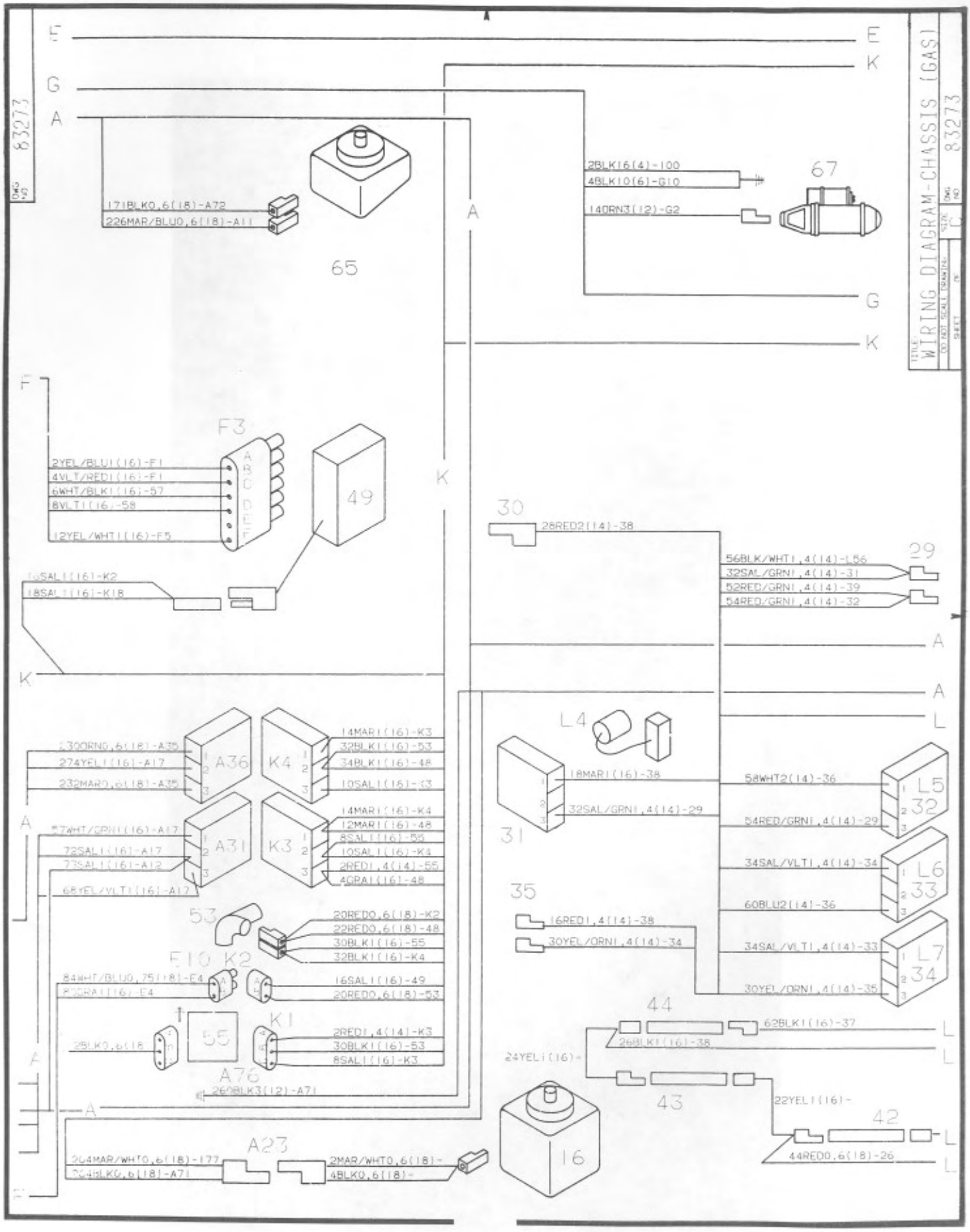
NO.	NAME	SHT. NO.
A01	CONNECTOR-FUSE PANEL (WHITE)	13
A02	CONNECTOR-FUSE PANEL (YELLOW)	13
A03	CONNECTOR-FUSE PANEL (BROWN)	13
A04	CONNECTOR-FUSE PANEL (GREEN)	13
A05	CONNECTOR-FUSE PANEL (RED)	13
A06	CONNECTOR	14
A07	CONNECTOR-TURN SIGNAL SWITCH	15
A08	CONNECTOR-WINDSHIELD WIPER SWITCH	15
A09	CONNECTOR-LIGHT SWITCH	15
A10	CONNECTOR	14
A11	CONNECTOR	14
A12	CONNECTOR	14
A13	CONNECTOR	13
A14	CONNECTOR	10
A15	CONNECTOR	12
A16	CONNECTOR	15
A17	CONNECTOR	10
A19	CONNECTOR	14
A20	CONNECTOR	14
A21	CONNECTOR	10
A22	CONNECTOR-UNUSED	10
A23	CONNECTOR	9
A26	CONNECTOR	13
A27	CONNECTOR	13
A31	CONNECTOR	9
A35	CONNECTOR	14
A36	CONNECTOR	9
A38	CONNECTOR	12
A39	CONNECTOR	15
A40	CONNECTOR	10
A41	CONNECTOR	15
A46	CONNECTOR	13
A61	CONNECTOR	10
A62	GROUND-FIREWALL	10
A67	CONNECTOR-UNUSED	14
A68	CONNECTOR	7
A69	CONNECTOR	7
A70	CONNECTOR	7
A71	INTERNAL SPLICE	11
A72	INTERNAL SPLICE	12
A73	SPLICE	7
A74	SPLICE	7
A76	GROUND-FIREWALL	9
A77	INTERNAL SPLICE	11
A78	INTERNAL SPLICE	12
E01	CONNECTOR	17
E02	CONNECTOR	16
E03	CONNECTOR	15
E04	DIAGNOSTIC PLUG	12
E05	CONNECTOR	12
E06	CONNECTOR	11
E07	DIAGNOSTIC PLUG	12
E08	CONNECTOR	11
E09	CONNECTOR	8
E10	CONNECTOR	9
E11	CONNECTOR	16
E12	CONNECTOR	16
E21	INTERNAL SPLICE	16
E22	INTERNAL SPLICE	17
E23	INTERNAL SPLICE	16
E24	INTERNAL SPLICE	16
E25	INTERNAL SPLICE	15
E26	INTERNAL SPLICE	15
E28	INTERNAL SPLICE	16
F01	CONNECTOR	10
F03	CONNECTOR	9
F04	CONNECTOR	10
F05	CONNECTOR	10
F11	CONNECTOR	10
G01	CONNECTOR	10
G02	CONNECTOR	10
G03	CONNECTOR	8
G04	CONNECTOR	10
G06	CONNECTOR	10
G10	TERMINAL-ALTERNATOR, POSITIVE	8
G11	WATER TEMPERATURE SENSOR (LIGHT)	8
G12	WATER TEMPERATURE SENSOR (GUAGE)	8
G13	OIL PRESSURE SENSOR	8
J01	CONNECTOR	14
J02	CONNECTOR	15
J03	CONNECTOR	16
J04	CONNECTOR	16
J05	CONNECTOR	16
K01	CONNECTOR	9
K02	CONNECTOR	9
K03	CONNECTOR	9
K04	CONNECTOR	9
K05	CONNECTOR	8
K06	CONNECTOR	8
K18	CONNECTOR	10
K24	CONNECTOR	8
L01	CONNECTOR	8
L02	CONNECTOR	8
L03	CONNECTOR	8
L04	CONNECTOR	9
L05	CONNECTOR	9
L06	CONNECTOR	9
L07	CONNECTOR	9
L10	CONNECTOR	8
L12	CONNECTOR	8
L24	TERMINAL-ALTERNATOR, NEGATIVE	8
L44	CONNECTOR	8
L56	CONNECTOR	7
L74	INTERNAL SPLICE	8
M01	CONNECTOR	12
M02	CONNECTOR	12
M03	CONNECTOR	15
M04	CONNECTOR	16
M05	CONNECTOR	16
M06	CONNECTOR	16
M09	CONNECTOR	16
M18	CONNECTOR	16
M20	CONNECTOR	16
M50	CONNECTOR	18
M51	CONNECTOR	18
M65	CONNECTOR	17
S01	CONNECTOR	18
S02	CONNECTOR	18
T01	CONNECTOR	11
T02	CONNECTOR	11
T03	CONNECTOR	11
T04	CONNECTOR	11
T05	CONNECTOR	11
T06	CONNECTOR	11
T07	CONNECTOR	11
T08	CONNECTOR	11
T09	CONNECTOR	11
T10	CONNECTOR	11
T11	CONNECTOR	11

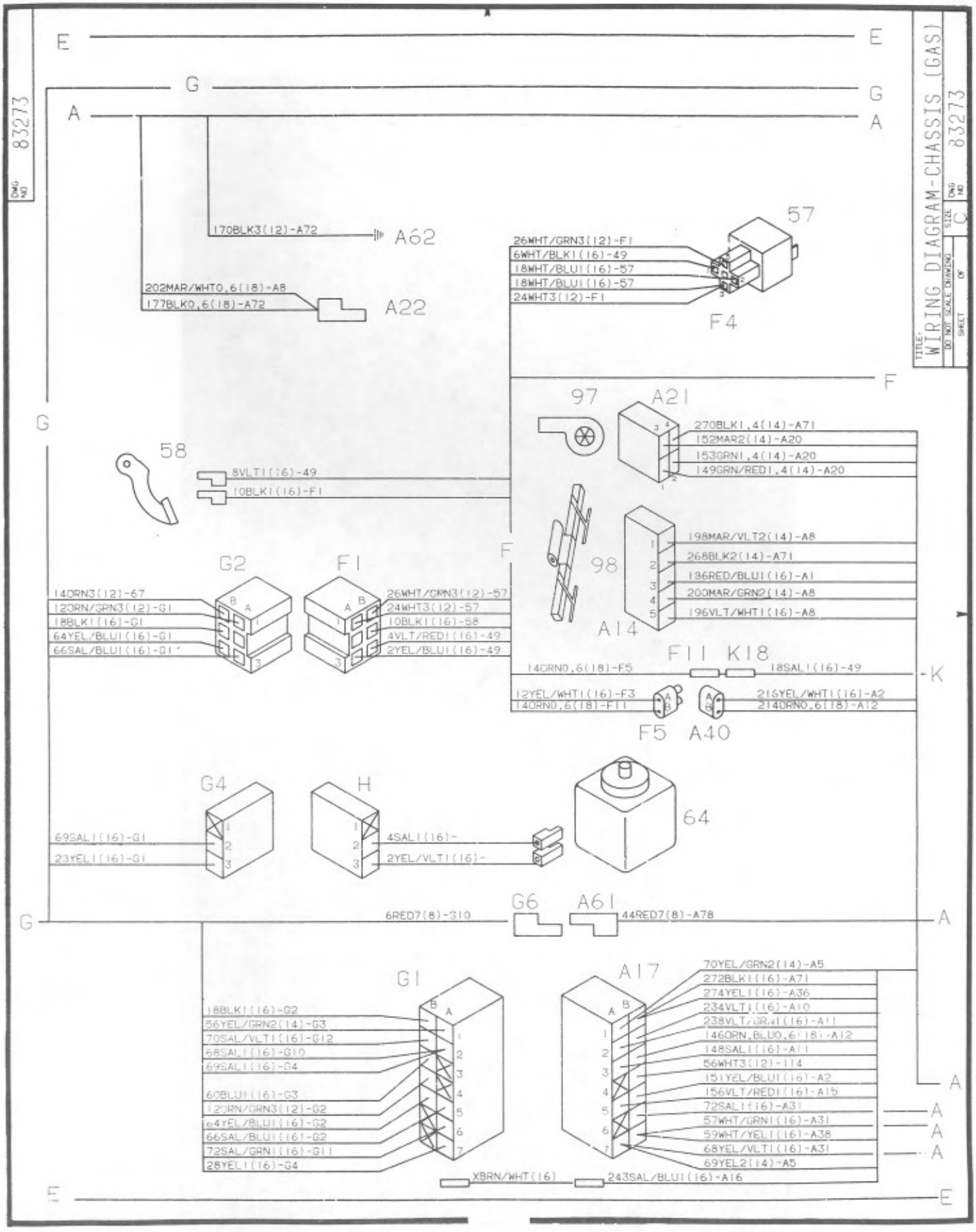
TITLE: WIRING DIAGRAM-CHASSIS (GAS)
DO NOT SCALE DRAWING | SIZE C | DWG NO 83273
SHEET OF

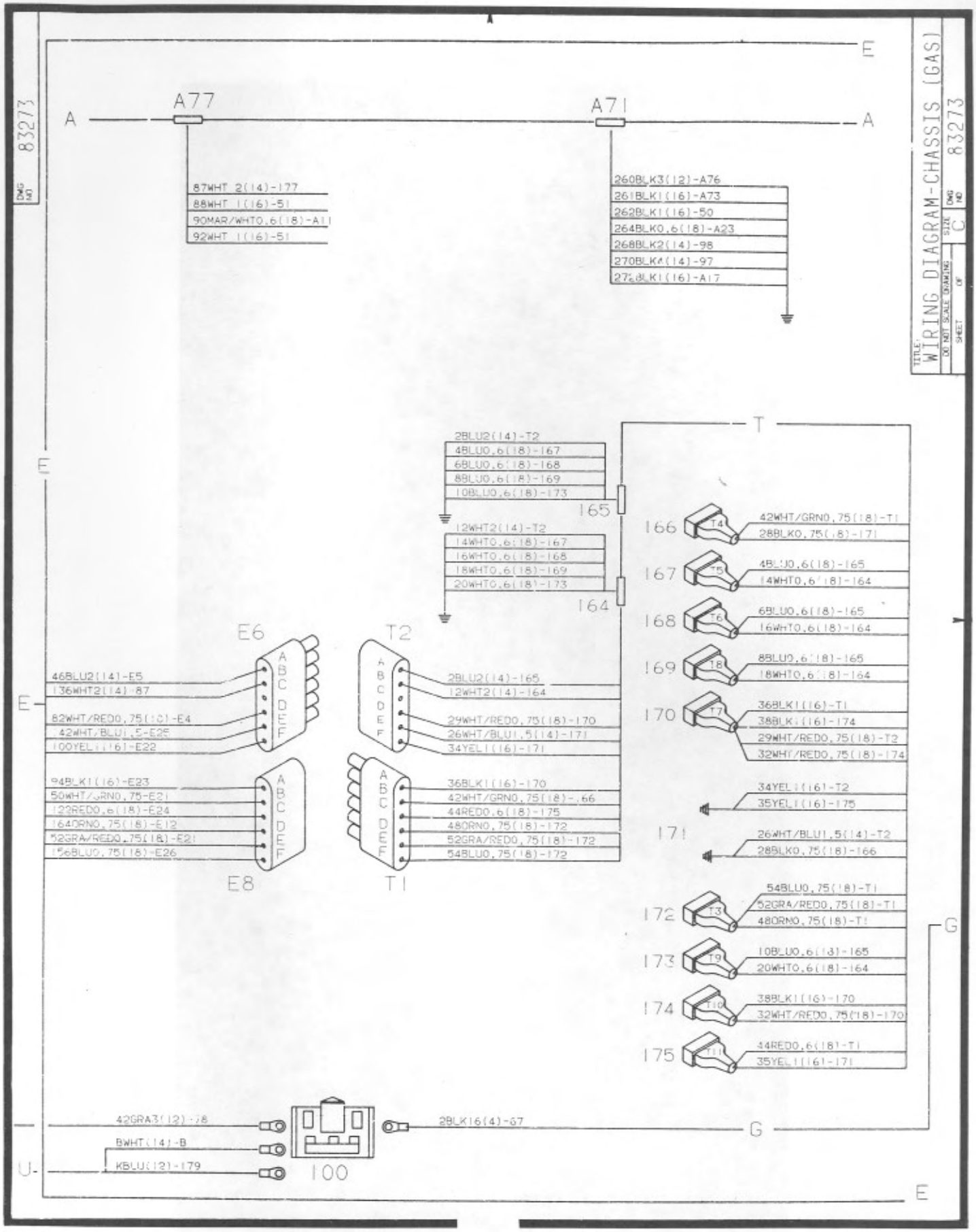

75
BRN/WHT (16)
74
WHT (16)
BLK (16)
BRN (16)
A74
51
108 BLU/WHT1,4(14)-A15
181BLK1(16)-A72
132WHT/RED1(16)-A15
96SAL1(16)-A41
182 BLK1(16)-A72
88 WHT1,4(14)-A77
L56 A68
56BLK/WHT1,4(14)-29
L
80YEL/VLT1,4(14)-A5
210ORN/YEL0,6(18)-A10
D
A69
A
A
52
118VLT1(16)-177
D
A70
210ORN/YEL0,6(18)-A10
50
98SAL1(16)-A41
262BLK1(16)-A71
92WHT1(16)-A77
140WHT/YEL1(16)-A15
261BLK1(16)-A71
114BLU1(16)-A15
A73
BRN(16)
BLK(16)
WHT(16)
72
BRN/WHT(16)
73
86 IR/WR220RD
WINNEBAGO
11/14/85
WIRING DIAGRAM-CHASSIS (GAS)
83273
WINGS

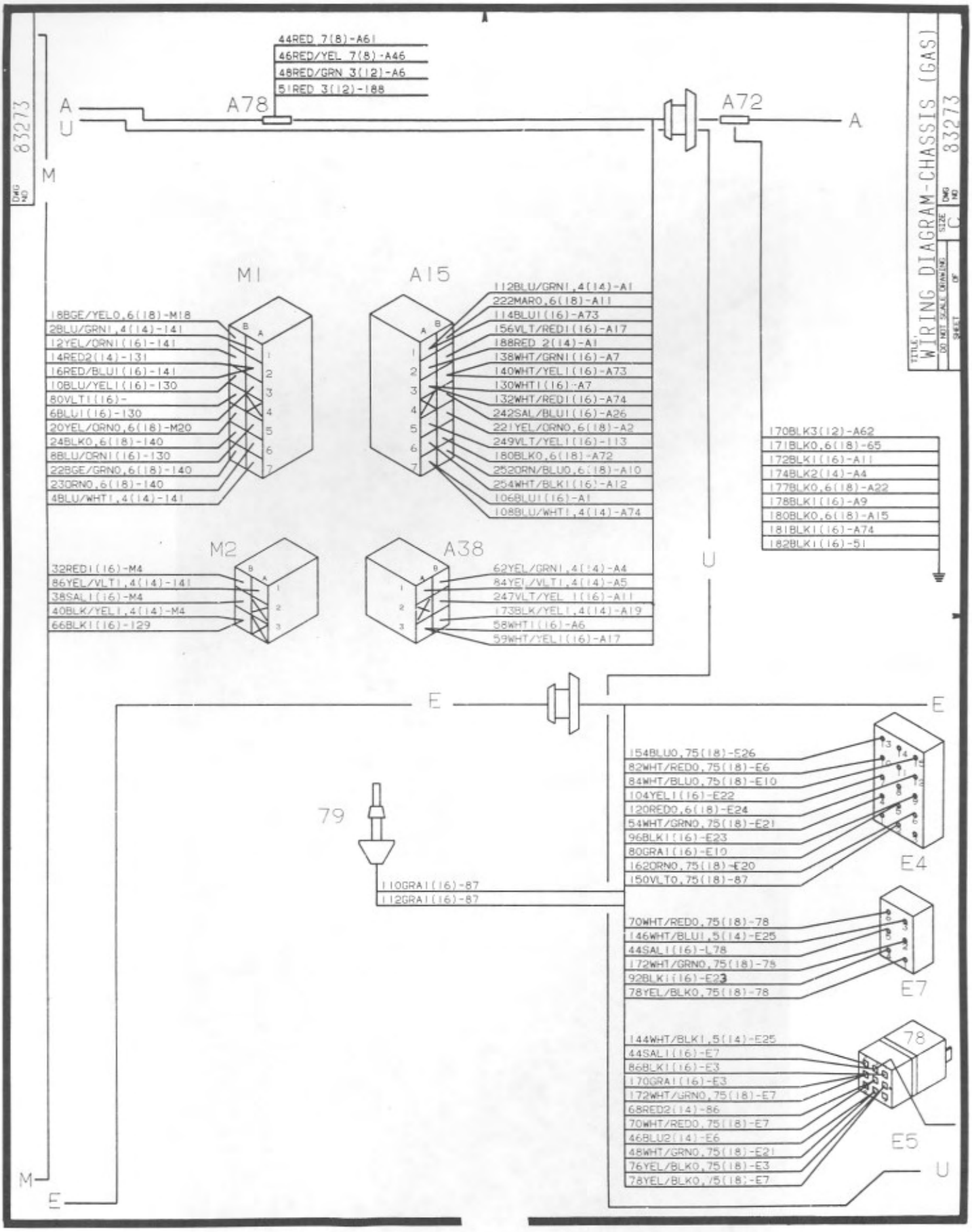

WIRING DIAGRAM-CHASSIS (GAS)
83273
E
K
G
L
A
60BLU/RED 0.75(18)-87
102YEL(16)-E22
114GRN(16)-87
116SAL(16)-87
E9
70
36BLK(16)-48
38BLK(16)-45
K6
46
6GRA(16)-48
38BLK(16)-46
45
4GRA(16)-K3
6GRA(16)-45
12MAR(16)-K3
34BLK(16)-K4
36BLK(16)-46
22RED0.6(18)-53
24MAR(16)-K24
K5
48
G3
L24
56YEL/GRN2(14)-G1
60BLU(16)-G1
4BLK10(6)-67
6RED7(8)-G6
74BLK5(10)-L74
2BLU2(14)-39
4BLU2(14)-37
G10
68SAL(16)-G1
72SAL/GRN(16)-G1
70SAL/VLT(16)-G1
G13
G11
G12
36
58WHT2(14)-32
60BLU2(14)-33
K24
L44
24MAR(16)-48
44RED0.6(18)-42
64BLK(16)-37
66BLK(16)-38
68BLK(16)-39
70BLK2(14)-L12
72BLK2(14)-L10
74BLK5(10)-L24
L74
L10
72BLK2(14)-L74
10RED2(14)-41
12BLU2(14)-40
70BLK2(14)-L74
27
L12
L3
37
4BLU2(14)-G10
62BLK(16)-44
64BLK(16)-L74
50RED/GRN1.4(14)-39
40
12BLU2(14)-L12
8BLU2(14)
L2
38
66BLK(16)-L74
26BLK(16)-44
28RED2(14)-30
18MAR(16)-31
20RED0.6(16)-42
16RED1.4(14)-35
L1
39
2BLU2(14)-G10
68BLK(16)-L74
50RED/GRN1.4(14)-37
52RED/GRN1.4(14)-29
6RED2(14)-41
41
6RED2(14)-L1
10RED2(14)-L10

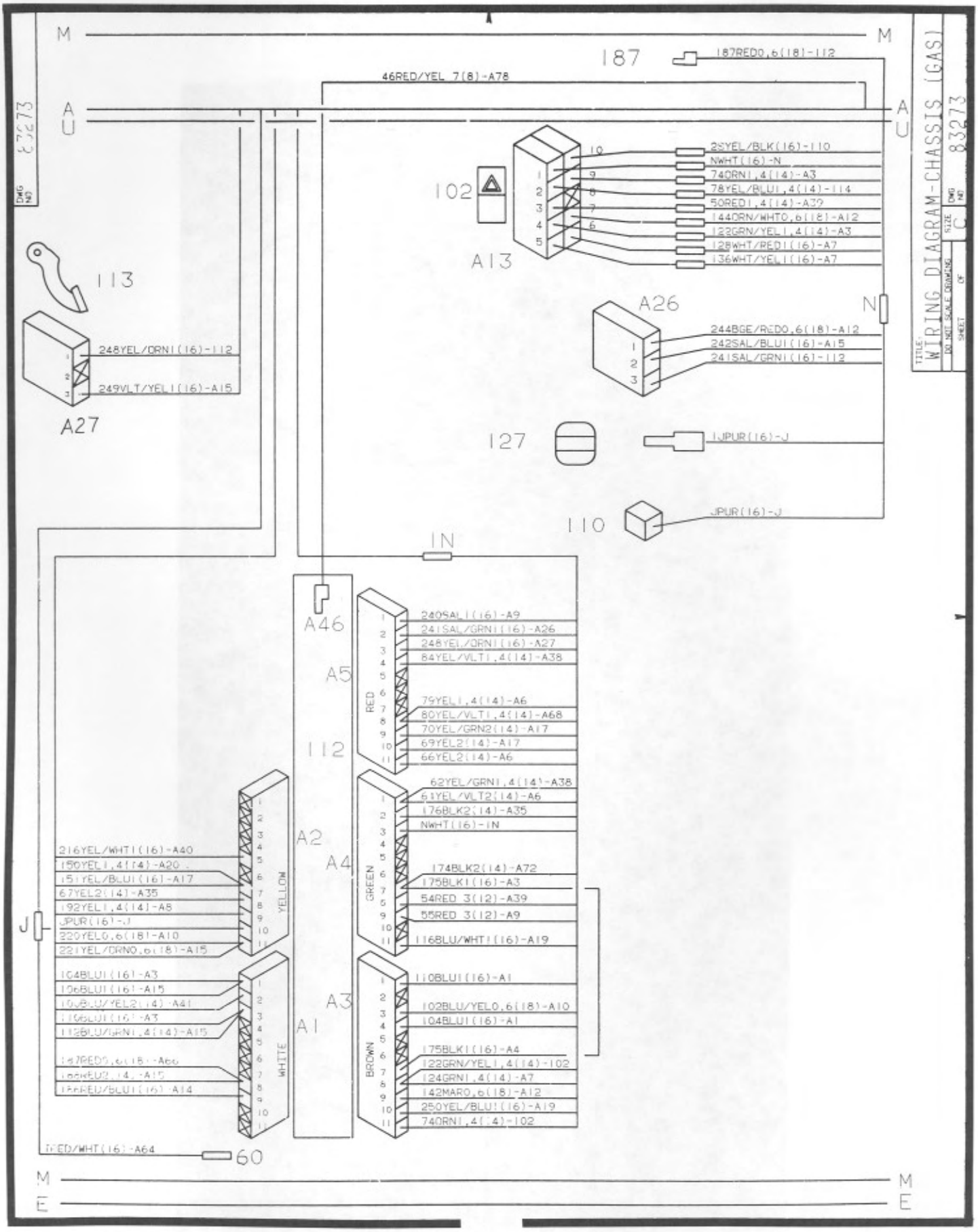
1986 PRODUCTION

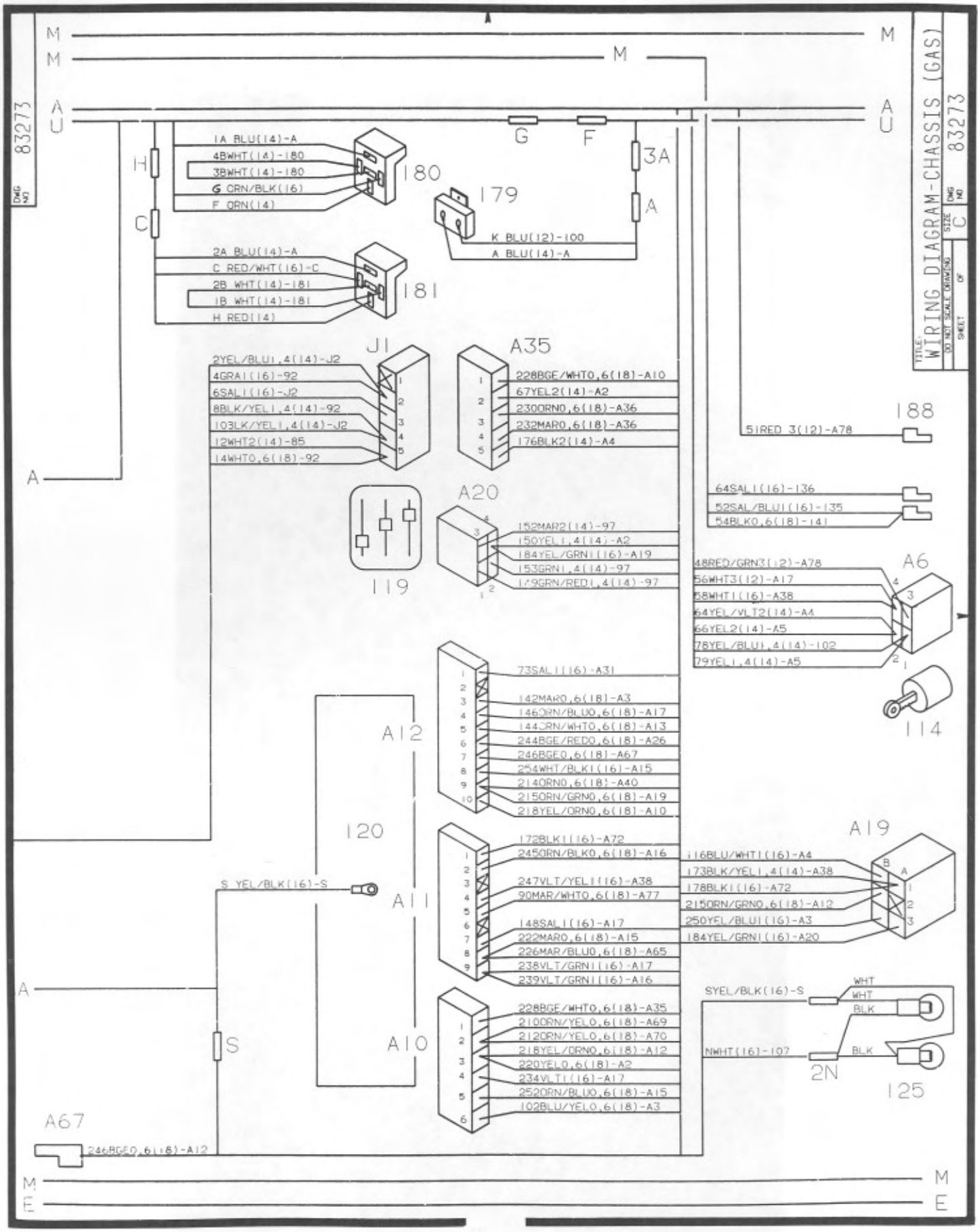


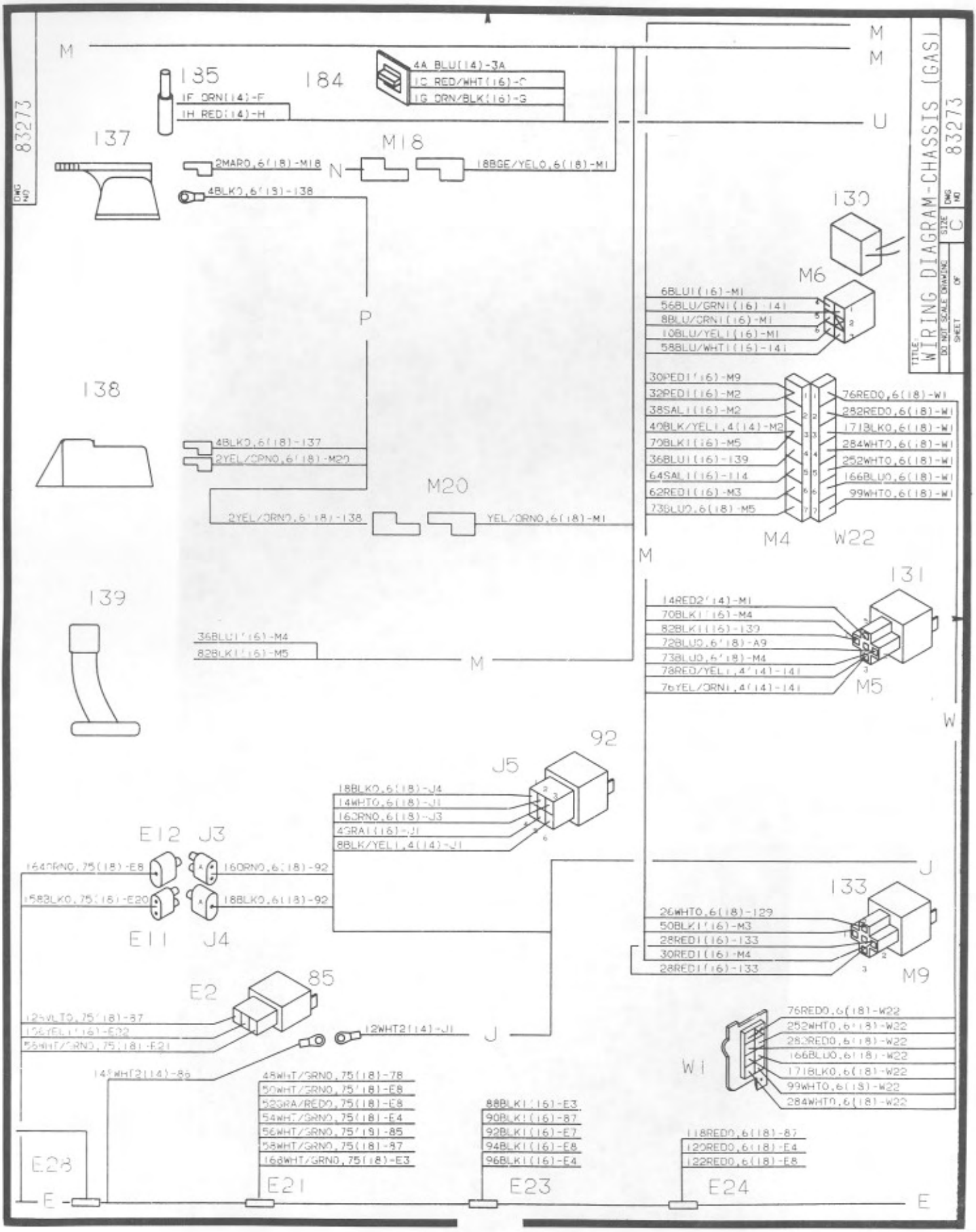

DWG NO 83273
TITLE: WIRING DIAGRAM-CHASSIS (GAS)
DWG NO 83273
SIZE C
SHEET OF
DO NOT SCALE DRAWING
E
G
A
F
170BLK3(12)-A72
A62
202MAR/WHT0,6(18)-A8
177BLK0,6(18)-A72
A22
57
26WHT/GRN3(12)-F1
6WHT/BLK1(16)-49
18WHT/BLU1(16)-57
18WHT/BLU1(16)-57
24WHT3(12)-F1
F4
97
A21
270BLK1,4(14)-A71
152MAR2(14)-A20
153GRN1,4(14)-A20
149GRN/RED1,4(14)-A20
58
8VLT1(16)-49
10BLK1(16)-F1
98
198MAR/VLT2(14)-A8
268BLK2(14)-A71
136RED/BLU1(16)-A1
200MAR/GRN2(14)-A8
196VLT/WHT1(16)-A8
A14
G2
F1
140RN3(12)-67
120RN/GRN3(12)-G1
18BLK1(16)-G1
64YEL/BLU1(16)-G1
66SAL/BLU1(16)-G1
26WHT/GRN3(12)-57
24WHT3(12)-57
10BLK1(16)-58
4VLT/RED1(16)-49
2YEL/BLU1(16)-49
F11 K18
140RN0,6(18)-F5
18SAL1(16)-49
K
12YEL/WHT1(16)-F3
140RN0,6(18)-F11
215YEL/WHT1(16)-A2
214ORN0,6(18)-A12
F5 A40
G4
H
64
69SAL1(16)-G1
23YEL1(16)-G1
4SAL1(16)-
2YEL/VLT1(16)-
6RED7(8)-310
G6
A61
44RED7(8)-A78
G1
A17
18BLK1(16)-G2
56YEL/GRN2(14)-G3
70SAL/VLT1(16)-G12
68SAL1(16)-G10
69SAL1(16)-G4
60BLU1(16)-G3
120RN/GRN3(12)-G2
64YEL/BLU1(16)-G2
66SAL/BLU1(16)-G2
72SAL/GRN1(16)-G11
28YEL1(16)-G4
70YEL/GRN2(14)-A5
272BLK1(16)-A71
274YEL1(16)-A36
234VLT1(16)-A10
238VLT/GRN1(16)-A11
146ORN,BLU0,6(18)-A12
148SAL1(16)-A11
56WHT3(12)-114
151YEL/BLU1(16)-A2
156VLT/RED1(16)-A15
72SAL1(16)-A31
57WHT/GRN1(16)-A31
59WHT/YEL1(16)-A38
68YEL/VLT1(16)-A31
69YEL2(14)-A5
XBRN/WHT(16)
243SAL/BLU1(16)-A16

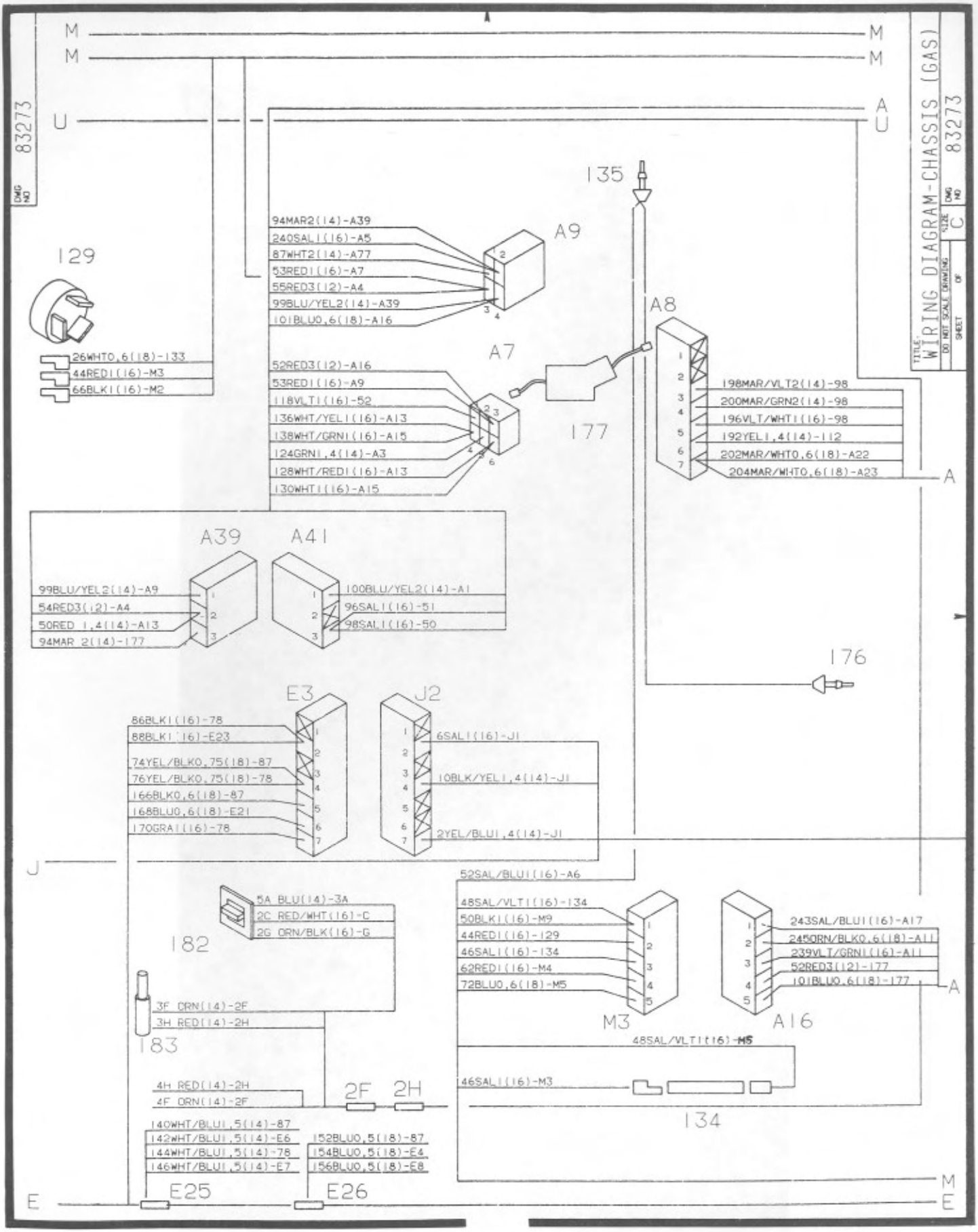

TITLE: WIRING DIAGRAM-CHASSIS (GAS)
DO NOT SCALE DRAWING
SHEET OF
SIZE C
DWG NO 83273
DWG NO 83273
A77
A71
87WHT 2(14)-177
88WHT 1(16)-51
90MAR/WHT0.6(18)-A11
92WHT 1(16)-51
260BLK3(12)-A76
261BLK1(16)-A73
262BLK1(16)-50
264BLK0.6(18)-A23
268BLK2(14)-98
270BLK4(14)-97
272BLK1(16)-A17
2BLU2(14)-T2
4BLU0.6(18)-167
6BLU0.6(18)-168
8BLU0.6(18)-169
10BLU0.6(18)-173
165
12WHT2(14)-T2
14WHT0.6(18)-167
16WHT0.6(18)-168
18WHT0.6(18)-169
20WHT0.6(18)-173
164
166 42WHT/GRN0.75(18)-T1
28BLK0.75(18)-171
167 4BLU0.6(18)-165
14WHT0.6(18)-164
168 6BLU0.6(18)-165
16WHT0.6(18)-164
169 8BLU0.6(18)-165
18WHT0.6(18)-164
170 36BLK1(16)-T1
38BLK1(16)-174
29WHT/RED0.75(18)-T2
32WHT/RED0.75(18)-174
34YEL1(16)-T2
35YEL1(16)-175
171
26WHT/BLU1.5(14)-T2
28BLK0.75(18)-166
54BLU0.75(18)-T1
172 52GRA/RED0.75(18)-T1
480RN0.75(18)-T1
173 10BLU0.6(18)-165
20WHT0.6(18)-164
174 38BLK1(16)-170
32WHT/RED0.75(18)-170
175 44RED0.6(18)-T1
35YEL1(16)-171
E6
46BLU2(14)-E5
136WHT2(14)-87
82WHT/RED0.75(18)-E4
142WHT/BLU1.5-E25
100YEL1(16)-E22
94BLK1(16)-E23
50WHT/GRN0.75-E21
123RED0.6(18)-E24
164ORN0.75(18)-E12
52GRA/RED0.75(18)-E21
156BLU0.75(18)-E26
E8
T2
2BLU2(14)-165
12WHT2(14)-164
29WHT/RED0.75(18)-170
26WHT/BLU1.5(14)-171
34YEL1(16)-171
36BLK1(16)-170
42WHT/GRN0.75(18)-166
44RED0.6(18)-175
480RN0.75(18)-172
52GRA/RED0.75(18)-172
54BLU0.75(18)-172
T1
42GRA3(12)-78
BWHT(14)-B
KBLU(12)-179
100
2BLK16(4)-G7
A
E
T
G
U

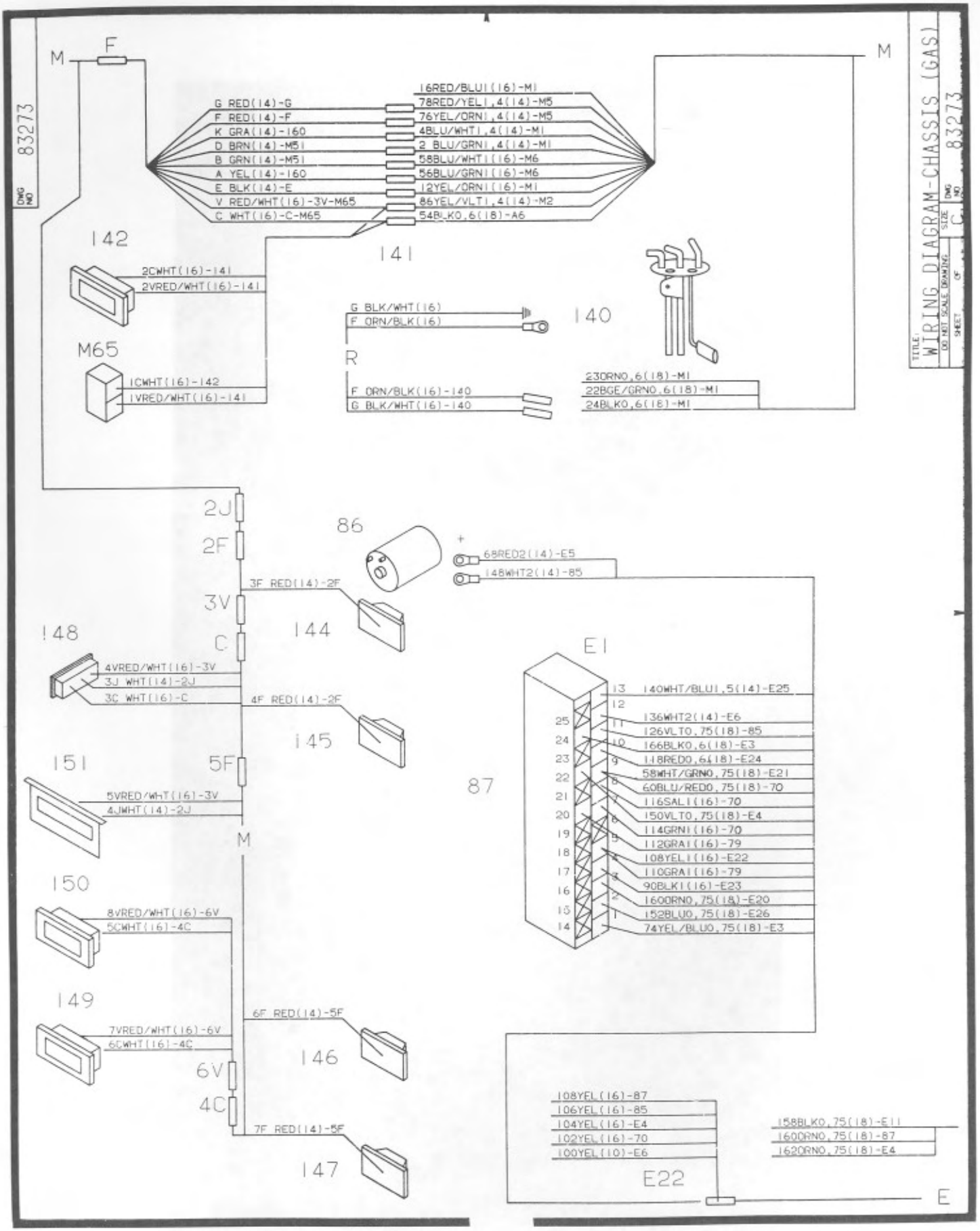

44RED 7(8)-A61
46RED/YEL 7(8)-A46
48RED/GRN 3(12)-A6
51RED 3(12)-188
A78
A72
A
A
U
M
DWG NO 83273
TITLE: WIRING DIAGRAM-CHASSIS (GAS)
SIZE C
DWG NO 83273
DO NOT SCALE DRAWING
SHEET OF
M1
18BGE/YEL0,6(18)-M18
2BLU/GRN1,4(14)-141
12YEL/ORN1(16)-141
14RED2(14)-131
16RED/BLU1(16)-141
10BLU/YEL1(16)-130
80VLT1(16)-
6BLU1(16)-130
20YEL/ORN0,6(18)-M20
24BLK0,6(18)-140
8BLU/ORN1(16)-130
22BGE/GRN0,6(18)-140
23ORN0,6(18)-140
4BLU/WHT1,4(14)-141
A15
112BLU/GRN1,4(14)-A1
222MAR0,6(18)-A11
114BLU1(16)-A73
156VLT/RED1(16)-A17
188RED 2(14)-A1
138WHT/GRN1(16)-A7
140WHT/YEL1(16)-A73
130WHT1(16)-A7
132WHT/RED1(16)-A74
242SAL/BLU1(16)-A26
221YEL/ORN0,6(18)-A2
249VLT/YEL1(16)-113
180BLK0,6(18)-A72
252ORN/BLU0,6(18)-A10
254WHT/BLK1(16)-A12
106BLU1(16)-A1
108BLU/WHT1,4(14)-A74
170BLK3(12)-A62
171BLK0,6(18)-65
172BLK1(16)-A11
174BLK2(14)-A4
177BLK0,6(18)-A22
178BLK1(16)-A9
180BLK0,6(18)-A15
181BLK1(16)-A74
182BLK1(16)-51
M2
32RED1(16)-M4
86YEL/VLT1,4(14)-141
38SAL1(16)-M4
40BLK/YEL1,4(14)-M4
66BLK1(16)-129
A38
62YEL/GRN1,4(14)-A4
84YEL/VLT1,4(14)-A5
247VLT/YEL 1(16)-A11
173BLK/YEL1,4(14)-A19
58WHT1(16)-A6
59WHT/YEL1(16)-A17
U
E
E
79
110GRA1(16)-87
112GRA1(16)-87
154BLU0,75(18)-E26
82WHT/RED0,75(18)-E6
84WHT/BLU0,75(18)-E10
104YEL1(16)-E22
120RED0,6(18)-E24
54WHT/GRN0,75(18)-E21
96BLK1(16)-E23
80GRA1(16)-E10
162ORN0,75(18)-E20
150VLT0,75(18)-87
E4
70WHT/RED0,75(18)-78
146WHT/BLU1,5(14)-E25
44SAL1(16)-L78
172WHT/GRN0,75(18)-78
92BLK1(16)-E23
78YEL/BLK0,75(18)-78
E7
144WHT/BLK1,5(14)-E25
44SAL1(16)-E7
86BLK1(16)-E3
170GRA1(16)-E3
172WHT/GRN0,75(18)-E7
68RED2(14)-86
70WHT/RED0,75(18)-E7
46BLU2(14)-E6
48WHT/GRN0,75(18)-E21
76YEL/BLK0,75(18)-E3
78YEL/BLK0,75(18)-E7
78
E5
M
E
U

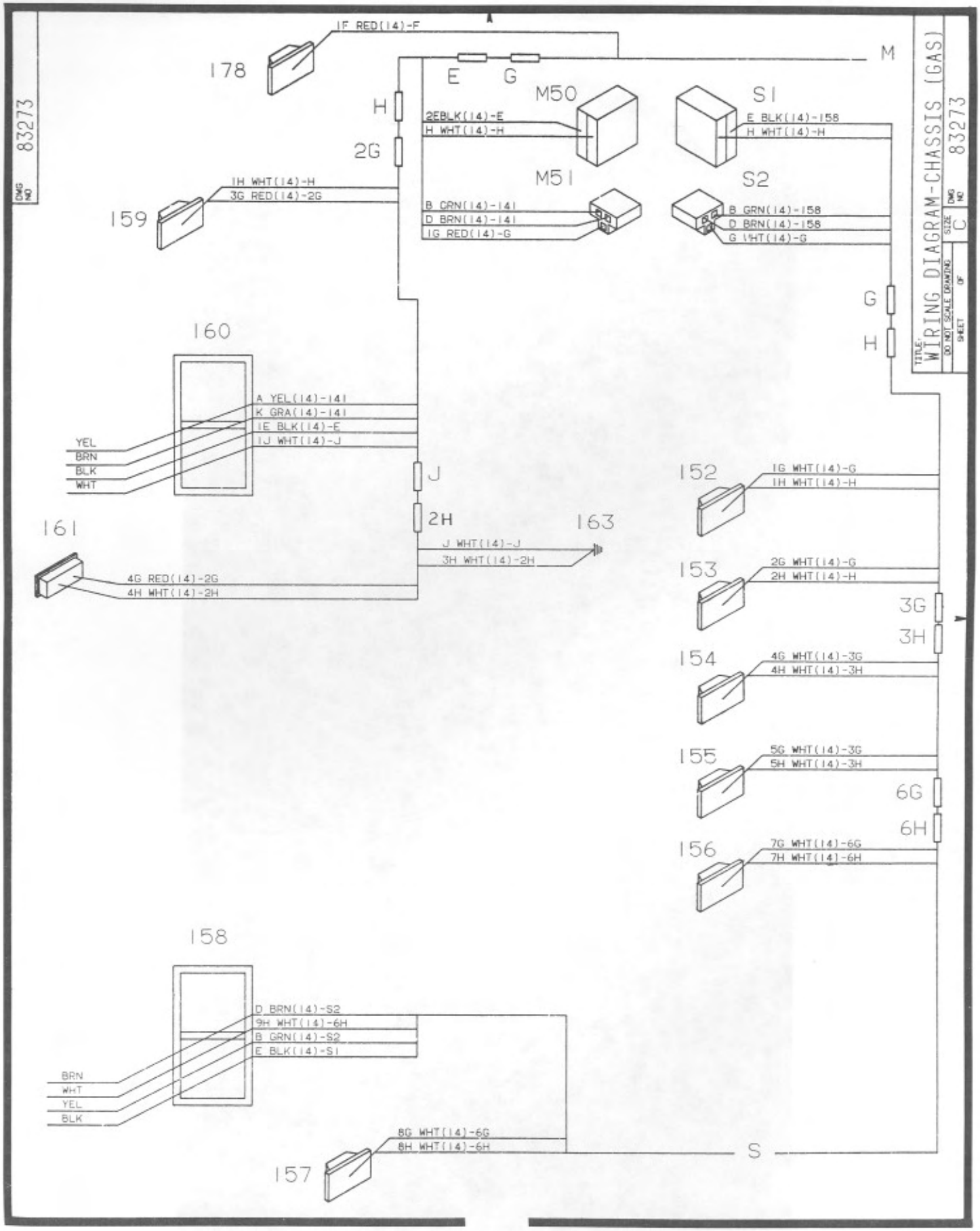

WIRING DIAGRAM-CHASSIS (GAS)
83273
M
M
A
U
A
U
187
187RED0,6(18)-112
46RED/YEL 7(8)-A78
102
A13
2SYEL/BLK(16)-110
NWHT(16)-N
740RN1,4(14)-A3
78YEL/BLU1,4(14)-114
50RED1,4(14)-A39
144ORN/WHT0,6(18)-A12
122GRN/YEL1,4(14)-A3
128WHT/RED1(16)-A7
136WHT/YEL1(16)-A7
113
248YEL/ORN1(16)-112
249VLT/YEL1(16)-A15
A27
A26
N
244BGE/RED0,6(18)-A12
242SAL/BLU1(16)-A15
241SAL/GRN1(16)-112
127
1JPUR(16)-J
110
JPUR(16)-J
IN
A46
A5
112
240SAL1(16)-A9
241SAL/GRN1(16)-A26
248YEL/ORN1(16)-A27
84YEL/VLT1,4(14)-A38
79YEL1,4(14)-A6
80YEL/VLT1,4(14)-A68
70YEL/GRN2(14)-A17
69YEL2(14)-A17
66YEL2(14)-A6
RED
A2
A4
62YEL/GRN1,4(14)-A38
61YEL/VLT2(14)-A6
176BLK2(14)-A35
NWHT(16)-IN
174BLK2(14)-A72
175BLK1(16)-A3
54RED 3(12)-A39
55RED 3(12)-A9
1168LU/WHT1(16)-A19
GREEN
A3
A1
110BLU1(16)-A1
102BLU/YEL0,6(18)-A10
104BLU1(16)-A1
175BLK1(16)-A4
122GRN/YEL1,4(14)-102
124GRN1,4(14)-A7
142MARO,6(18)-A12
250YEL/BLU1(16)-A19
740RN1,4(14)-102
BROWN
J
216YEL/WHT1(16)-A40
150YEL1,4(14)-A20
151YEL/BLU1(16)-A17
67YEL2(14)-A35
192YEL1,4(14)-A8
JPUR(16)-J
220YEL0,6(18)-A10
221YEL/ORN0,6(18)-A15
YELLOW
104BLU1(16)-A3
106BLU1(16)-A15
109BLU/YEL2(14)-A41
1106LU1(16)-A3
112BLU/GRN1,4(14)-A15
147RED0,6(18)-A66
150RED2,14,-A15
156RED/BLU1(16)-A14
WHITE
TRED/WHT(16)-A64
60
M
E
M
E


TITLE: WIRING DIAGRAM-CHASSIS (GAS)
DWG NO 83273
SIZE C
SHEET OF
DO NOT SCALE DRAWING
M
A
C
G
F
3A
H
1A BLU(14)-A
4BWHT(14)-180
3BWHT(14)-180
G ORN/BLK(16)
F ORN(14)
180
179
K BLU(12)-100
A BLU(14)-A
2A BLU(14)-A
C RED/WHT(16)-C
2B WHT(14)-181
1B WHT(14)-181
H RED(14)
181
J1
2YEL/BLU1,4(14)-J2
4GRA1(16)-92
6SAL1(16)-J2
8BLK/YEL1,4(14)-92
103BLK/YEL1,4(14)-J2
12WHT2(14)-85
14WHT0,6(18)-92
A35
228BGE/WHT0,6(18)-A10
67YEL2(14)-A2
230ORN0,6(18)-A36
232MAR0,6(18)-A36
176BLK2(14)-A4
188
51RED 3(12)-A78
64SAL1(16)-136
52SAL/BLU1(16)-135
54BLK0,6(18)-141
A20
152MAR2(14)-97
150YEL1,4(14)-A2
184YEL/GRN1(16)-A19
153GRN1,4(14)-97
179GRN/RED1,4(14)-97
119
A6
48RED/GRN3(12)-A78
56WHT3(12)-A17
58WHT1(16)-A38
64YEL/VLT2(14)-A4
66YEL2(14)-A5
78YEL/BLU1,4(14)-102
79YEL1,4(14)-A5
114
A12
120
A11
A10
73SAL1(16)-A31
142MAR0,6(18)-A3
146ORN/BLU0,6(18)-A17
144ORN/WHT0,6(18)-A13
244BGE/RED0,6(18)-A26
246BGE0,6(18)-A67
254WHT/BLK1(16)-A15
214ORN0,6(18)-A40
215ORN/GRN0,6(18)-A19
218YEL/ORN0,6(18)-A10
172BLK1(16)-A72
245ORN/BLK0,6(18)-A16
247VLT/YEL1(16)-A38
90MAR/WHT0,6(18)-A77
148SAL1(16)-A17
222MAR0,6(18)-A15
226MAR/BLU0,6(18)-A65
238VLT/GRN1(16)-A17
239VLT/GRN1(16)-A16
228BGE/WHT0,6(18)-A35
210ORN/YEL0,6(18)-A69
212ORN/YEL0,6(18)-A70
218YEL/ORN0,6(18)-A12
220YEL0,6(18)-A2
234VLT1(16)-A17
252ORN/BLU0,6(18)-A15
102BLU/YEL0,6(18)-A3
A19
116BLU/WHT1(16)-A4
173BLK/YEL1,4(14)-A38
178BLK1(16)-A72
215ORN/GRN0,6(18)-A12
250YEL/BLU1(16)-A3
184YEL/GRN1(16)-A20
S YEL/BLK(16)-S
S
A67
246BGE0,6(18)-A12
SYEL/BLK(16)-S
WHT
WHT
BLK
NWHT(16)-107
BLK
2N
125
M
E


WIRING DIAGRAM-CHASSIS (GAS)
83273
135
184
137
M18
138
139
130
M6
131
M5
M4
W22
133
M9
W1
92
J5
E12
J3
E11
J4
E2
85
E28
E21
E23
E24
4A BLU(14)-3A
1C RED/WHT(16)-C
1G ORN/BLK(16)-G
1F ORN(14)-F
1H RED(14)-H
2MARO,6(18)-M18
18BGE/YELO,6(18)-M1
4BLKO,6(18)-138
2YEL/ORNO,6(18)-M20
2YEL/ORNO,6(18)-138
YEL/ORNO,6(18)-M1
36BLU1(16)-M4
82BLK1(16)-M5
6BLU1(16)-M1
568LU/GRN1(16)-14
8BLU/ORN1(16)-M1
106LU/YEL1(16)-M1
588LU/WHT1(16)-14
30PED1(16)-M9
32PED1(16)-M2
38SAL1(16)-M2
40BLK/YEL1,4(14)-M2
70BLK1(16)-M5
36BLU1(16)-139
64SAL1(16)-114
62RED1(16)-M3
73BLUO,6(18)-M5
76REDO,6(18)-W1
282REDO,6(18)-M1
171BLKO,6(18)-M1
284WHTO,6(18)-M1
252WHTO,6(18)-M1
166BLUO,6(18)-M1
99WHTO,6(18)-M1
14RED2(14)-M1
70BLK1(16)-M4
82BLK1(16)-139
72BLUO,6(18)-A9
73BLUO,6(18)-M4
78RED/YEL1,4(14)-141
76YEL/ORN1,4(14)-141
18BLKO,6(18)-J4
14WHTO,6(18)-J1
16ORNO,6(18)-J3
4GRA1(16)-J1
8BLK/YEL1,4(14)-J1
160RNO,6(18)-92
18BLKO,6(18)-92
26WHTO,6(18)-129
50BLK1(16)-M3
28RED1(16)-133
30RED1(16)-M4
28RED1(16)-133
76REDO,6(18)-W22
252WHTO,6(18)-W22
282REDO,6(18)-W22
166BLUO,6(18)-W22
171BLKO,6(18)-W22
99WHTO,6(18)-W22
284WHTO,6(18)-W22
12WHT2(14)-J1
45WHT/GRNO,75(18)-78
50WHT/GRNO,75(18)-E8
52GRA/REDO,75(18)-E8
54WHT/GRNO,75(18)-E4
56WHT/GRNO,75(18)-85
58WHT/GRNO,75(18)-87
166WHT/GRNO,75(18)-E3
88BLK1(16)-E3
90BLK1(16)-87
92BLK1(16)-E7
94BLK1(16)-E8
96BLK1(16)-E4
118REDO,6(18)-87
120REDO,6(18)-E4
122REDO,6(18)-E8


M
M
U
A
DWG NO 83273
TITLE: WIRING DIAGRAM-CHASSIS (GAS)
DO NOT SCALE DRAWING
SIZE C
DWG NO 83273
SHEET OF
135
A9
94MAR2(14)-A39
240SAL1(16)-A5
87WHT2(14)-A77
53RED1(16)-A7
55RED3(12)-A4
998LU/YEL2(14)-A39
101BLU0,6(18)-A16
129
26WHT0,6(18)-133
44RED1(16)-M3
66BLK1(16)-M2
A8
A7
52RED3(12)-A16
53RED1(16)-A9
118VLT1(16)-52
136WHT/YEL1(16)-A13
138WHT/GRN1(16)-A15
124GRN1,4(14)-A3
128WHT/RED1(16)-A13
130WHT1(16)-A15
177
198MAR/VLT2(14)-98
200MAR/GRN2(14)-98
196VLT/WHT1(16)-98
192YEL1,4(14)-112
202MAR/WHT0,6(18)-A22
204MAR/WHT0,6(18)-A23
A39
A41
99BLU/YEL2(14)-A9
54RED3(12)-A4
50RED 1,4(14)-A13
94MAR 2(14)-177
100BLU/YEL2(14)-A1
96SAL1(16)-51
98SAL1(16)-50
176
E3
J2
86BLK1(16)-78
88BLK1(16)-E23
74YEL/BLK0,75(18)-87
76YEL/BLK0,75(18)-78
166BLK0,6(18)-87
168BLU0,6(18)-E21
170GRA1(16)-78
6SAL1(16)-J1
10BLK/YEL1,4(14)-J1
2YEL/BLU1,4(14)-J1
J
52SAL/BLU1(16)-A6
48SAL/VLT1(16)-134
50BLK1(16)-M9
44RED1(16)-129
46SAL1(16)-134
62RED1(16)-M4
72BLU0,6(18)-M5
M3
243SAL/BLU1(16)-A17
245ORN/BLK0,6(18)-A11
239VLT/GRN1(16)-A11
52RED3(12)-177
101BLU0,6(18)-177
A16
5A BLU(14)-3A
2C RED/WHT(16)-C
2G ORN/BLK(16)-G
182
3F ORN(14)-2F
3H RED(14)-2H
183
48SAL/VLT1(16)-M5
4H RED(14)-2H
4F ORN(14)-2F
2F
2H
46SAL1(16)-M3
134
140WHT/BLU1,5(14)-87
142WHT/BLU1,5(14)-E6
144WHT/BLU1,5(14)-78
146WHT/BLU1,5(14)-E7
152BLU0,5(18)-87
154BLU0,5(18)-E4
156BLU0,5(18)-E8
E25
E26
E


TITLE: WIRING DIAGRAM-CHASSIS (GAS)
DO NOT SCALE DRAWING
SIZE C
DWG NO 83273
SHEET OF
DWG NO 83273
M
F
M
G RED(14)-G
F RED(14)-F
K GRA(14)-160
D BRN(14)-M51
B GRN(14)-M51
A YEL(14)-160
E BLK(14)-E
V RED/WHT(16)-3V-M65
C WHT(16)-C-M65
16RED/BLU1(16)-M1
78RED/YEL1,4(14)-M5
76YEL/ORN1,4(14)-M5
4BLU/WHT1,4(14)-M1
2 BLU/GRN1,4(14)-M1
58BLU/WHT1(16)-M6
56BLU/GRN1(16)-M6
12YEL/ORN1(16)-M1
86YEL/VLT1,4(14)-M2
54BLK0,6(18)-A6
142
2CWHT(16)-141
2VRED/WHT(16)-141
M65
1CWHT(16)-142
1VRED/WHT(16)-141
141
G BLK/WHT(16)
F ORN/BLK(16)
R
F ORN/BLK(16)-140
G BLK/WHT(16)-140
140
23ORN0,6(18)-M1
22BGE/GRN0,6(18)-M1
24BLK0,6(18)-M1
2J
2F
3V
C
3F RED(14)-2F
144
86
+
68RED2(14)-E5
148WHT2(14)-85
148
4VRED/WHT(16)-3V
3J WHT(14)-2J
3C WHT(16)-C
4F RED(14)-2F
145
151
5F
5VRED/WHT(16)-3V
4JWHT(14)-2J
M
150
8VRED/WHT(16)-6V
5CWHT(16)-4C
149
7VRED/WHT(16)-6V
6CWHT(16)-4C
6V
4C
6F RED(14)-5F
146
7F RED(14)-5F
147
E1
87
13 140WHT/BLU1,5(14)-E25
12
11 136WHT2(14)-E6
10 126VLT0,75(18)-85
9 166BLK0,6(18)-E3
8 118RED0,6(18)-E24
7 58WHT/GRN0,75(18)-E21
6 60BLU/RED0,75(18)-70
5 116SAL1(16)-70
4 150VLT0,75(18)-E4
3 114GRN1(16)-70
2 112GRA1(16)-79
1 108YEL1(16)-E22
25 110GRA1(16)-79
24 90BLK1(16)-E23
23 160ORN0,75(18)-E20
22 152BLU0,75(18)-E26
21 74YEL/BLU0,75(18)-E3
20
19
18
17
16
15
14
108YEL(16)-87
106YEL(16)-85
104YEL(16)-E4
102YEL(16)-70
100YEL(10)-E6
E22
158BLK0,75(18)-E11
160ORN0,75(18)-87
162ORN0,75(18)-E4
E


DWG NO 83273
178
1F RED(14)-F
M
E
G
H
2G
M50
2EBLK(14)-E
H WHT(14)-H
M51
S1
E BLK(14)-158
H WHT(14)-H
S2
B GRN(14)-158
D BRN(14)-158
G WHT(14)-G
159
1H WHT(14)-H
3G RED(14)-2G
B GRN(14)-141
D BRN(14)-141
1G RED(14)-G
G
H
TITLE: WIRING DIAGRAM-CHASSIS (GAS)
DO NOT SCALE DRAWING
SHEET OF
SIZE C
DWG NO 83273
160
A YEL(14)-141
K GRA(14)-141
1E BLK(14)-E
1J WHT(14)-J
YEL
BRN
BLK
WHT
J
2H
161
4G RED(14)-2G
4H WHT(14)-2H
163
J WHT(14)-J
3H WHT(14)-2H
152
1G WHT(14)-G
1H WHT(14)-H
153
2G WHT(14)-G
2H WHT(14)-H
3G
3H
154
4G WHT(14)-3G
4H WHT(14)-3H
155
5G WHT(14)-3G
5H WHT(14)-3H
6G
6H
156
7G WHT(14)-6G
7H WHT(14)-6H
158
D BRN(14)-S2
9H WHT(14)-6H
B GRN(14)-S2
E BLK(14)-S1
BRN
WHT
YEL
BLK
8G WHT(14)-6G
8H WHT(14)-6H
157
S

DWG NO. 80148

COMPONENT LOCATIONS

NO.	NAME	SHT.NO.
16	WINDSHIELD WASHER FLUID RESERVOIR	23
27	COOLING FANS	22
29	SENSOR-RADIATOR COOLANT TEMP,LOWER	23
30	A/C COMPRESSOR	23
31	PRESSURE SWITCH-P/S,A/C	23
32	PRESSURE SWITCH-COOLING FANS	23
33	PRESSURE SWITCH-A/C,LOW	23
34	PRESSURE SWITCH-A/C,HIGH	23
35	SENSOR-RADIATOR COOLANT TEMP,UPPER	23
36	A/C TEMP CONTROL SWITCH	22
37	RELAY	22
38	RELAY	22
39	RELAY	22
40	CIRCUIT BREAKER	22
41	CIRCUIT BREAKER	22
42	DIODE	23
43	DIODE	23
44	DIODE	23
45	SOLENOID VALVE	22
46	PRESSURE SWITCH	22
48	RELAY	22
49	AUTOMATIC TRANSMISSION COMPUTER	23
50	HEADLAMP,RIGHT	21
51	HEADLAMP,LEFT	21
52	HORN	21
53	AIR BY-PASS VALVE	23
55	IGNITION MODULE	23
57	RELAY-NEUTRAL START	24
58	ACCELERATOR CABLE OR CRUISE CONTROL	24
60	CRUISE CONTROL	27
64	OVERFLOW BOTTLE	24
65	BRAKE FLUID RESERVOIR	23
67	STARTER	23
70	AIRFLOW METER	22
72	TURN AND PARK LAMP,RIGHT FRONT	21
73	SIDEMARKER,RIGHT FRONT	21
74	TURN AND PARK LAMP,LEFT FRONT	21
75	SIDEMARKER,LEFT FRONT	21
78	RELAY-RPM	26
79	LAMBDA SENSOR	26
85	BAROMETRIC PRESSURE SENSOR	30
86	FUEL PUMP	31
87	INJECTION COMPUTER	31
92	RELAY-TACHYMETRIQUE	30
97	HEATER FAN	24
98	WINDSHIELD WIPER MOTOR	24
100	BREAKER PLATE	25
102	HAZARD FLASHER	27
110	CONNECTOR-FRONT RISER WIRE ASM	27
112	FUSE PANEL	27
113	BRAKE LIGHT SWITCH	27
114	IGNITION SWITCH	28
119	HEATER CONTROL SWITCH	28
120	INSTRUMENT CLUSTER	28
125	HEATER CONTROL LIGHTS	28
127	BATTERY CHANGEOVER SWITCH	27
129	WATER TEMPERATURE FLASHER	29
130	TAILLIGHT ADAPTER ASSEMBLY	30
131	RELAY	30
132	RELAY	30
133	RELAY	30
134	DIODE	29
135	CAB DOOR SWITCH,LEFT	29
136	IGNITION SWITCH BUZZER	30
137	PARK BRAKE	30
138	PARK BRAKE LIGHT	30
139	SEAT BELT	30
140	FUEL TANK SENDING UNIT	31
141	SPLICE	31
142	ASHTRAY LIGHT,LEFT	31
144	FRONT CLEARANCE LIGHT	31
145	FRONT CLEARANCE LIGHT	31
146	FRONT CLEARANCE LIGHT	31
147	FRONT CLEARANCE LIGHT	31
148	DOME LIGHT	31
149	ASHTRAY LIGHT,RIGHT	31
150	FOOT LIGHT,RIGHT	31
151	VISOR LIGHT	31
152	REAR CLEARANCE LIGHT	32
153	REAR CLEARANCE LIGHT	32
154	REAR CLEARANCE LIGHT	32
155	REAR CLEARANCE LIGHT	32
156	REAR CLEARANCE LIGHT	32
157	SIDE MARKER,RIGHT REAR	32
158	TAIL LIGHT,RIGHT	32
159	SIDE MARKER,LEFT REAR	32
160	TAIL LIGHT,LEFT	32
161	LICENSE PLATE LIGHT	32
163	GROUND	32
164	INTERNAL SPLICE	25
165	INTERNAL SPLICE	25
166	AIR BYPASS SOLENOID	25
167	INJECTOR-CYLINDER #1	25
168	INJECTOR-CYLINDER #2	25
169	INJECTOR-CYLINDER #3	25
170	INJECTOR-COLD START	25
171	GROUND	25
172	THROTTLE POSITION SWITCH	25
173	INJECTOR-CYLINDER #4	25
174	WATER TEMPERATURE SWITCH	25
175	WATER TEMPERATURE SENSOR	25
176	CAB DOOR SWITCH,RIGHT	29
177	TURN SIGNAL/HEADLAMP/WASHER MECHANISM	29
178	FRONT LEFT CLEARANCE LIGHT	32
179	CIRCUIT BREAKER	28
180	RELAY	28
181	RELAY	28
182	ELECTRIC DOOR LOCK SWITCH,RH	29
183	ELECTRIC DOOR LOCK MOTOR,RH	29
184	ELECTRIC DOOR LOCK SWITCH,RH	30
185	ELECTRIC DOOR LOCK MOTOR,RH	30

TITLE: WIRING DIAGRAM-CHASSIS (GAS)
DO NOT SCALE DRAWING | SIZE C | DWG NO. 80148 | SHEET OF

HARNESS CODES

WIRE ASM	DESCRIPTION
A	WIRE ASM-AUTO,FRONT
C	WIRE ASM-PUMP,W/S WASHER
D	WIRE ASM-BRAKE PAD WEAR
E	WIRE ASM-INJECTION,ELECT
F	WIRE ASM-TRANS,AUTO
G	WIRE ASM-ENGINE
H	WIRE ASM-OVERFLOW BOTTLE LIGHT
J	WIRE ASM-INJECTION SYSTEM
K	WIRE ASM-EMISSION CONTROL
L	WIRE ASM-COOLING FANS
M	WIRE ASM-EXTERIOR LIGHTING
N	WIRE ASM-PARK BRAKE
P	WIRE ASM-SHIFT LEVER LIGHT
R	WIRE ASM-FUEL TANK SENDER
S	WIRE ASM-BACKWALL
T	WIRE ASM-INJECTION,ENGINE
U	WIRE ASM-LOCK

WIRE COLOR CODES

CODE	COLOR	CODE	COLOR
BLK	BLACK	PNK	PINK
BLU	BLUE	RED	RED
BRN	BROWN	VLT	VIOLET
GRN	GREEN	WHT	WHITE
GRY	GRAY	YEL	YELLOW
ORN	ORANGE	BGE	BEIGE
MAR	MAROON	PUR	PURPLE
SAL	SALMON		

DWG NO. 80148

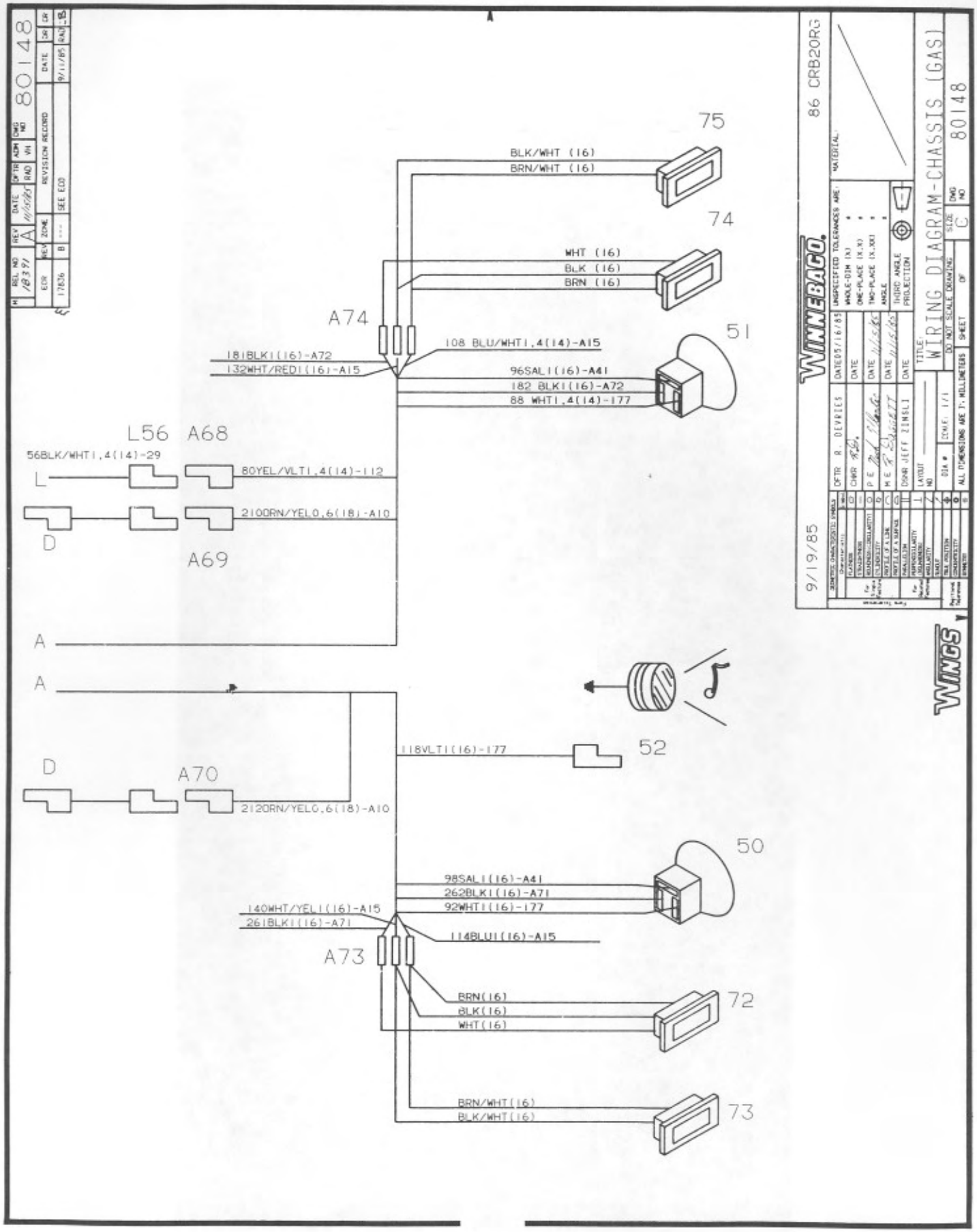
CONNECTOR LOCATIONS

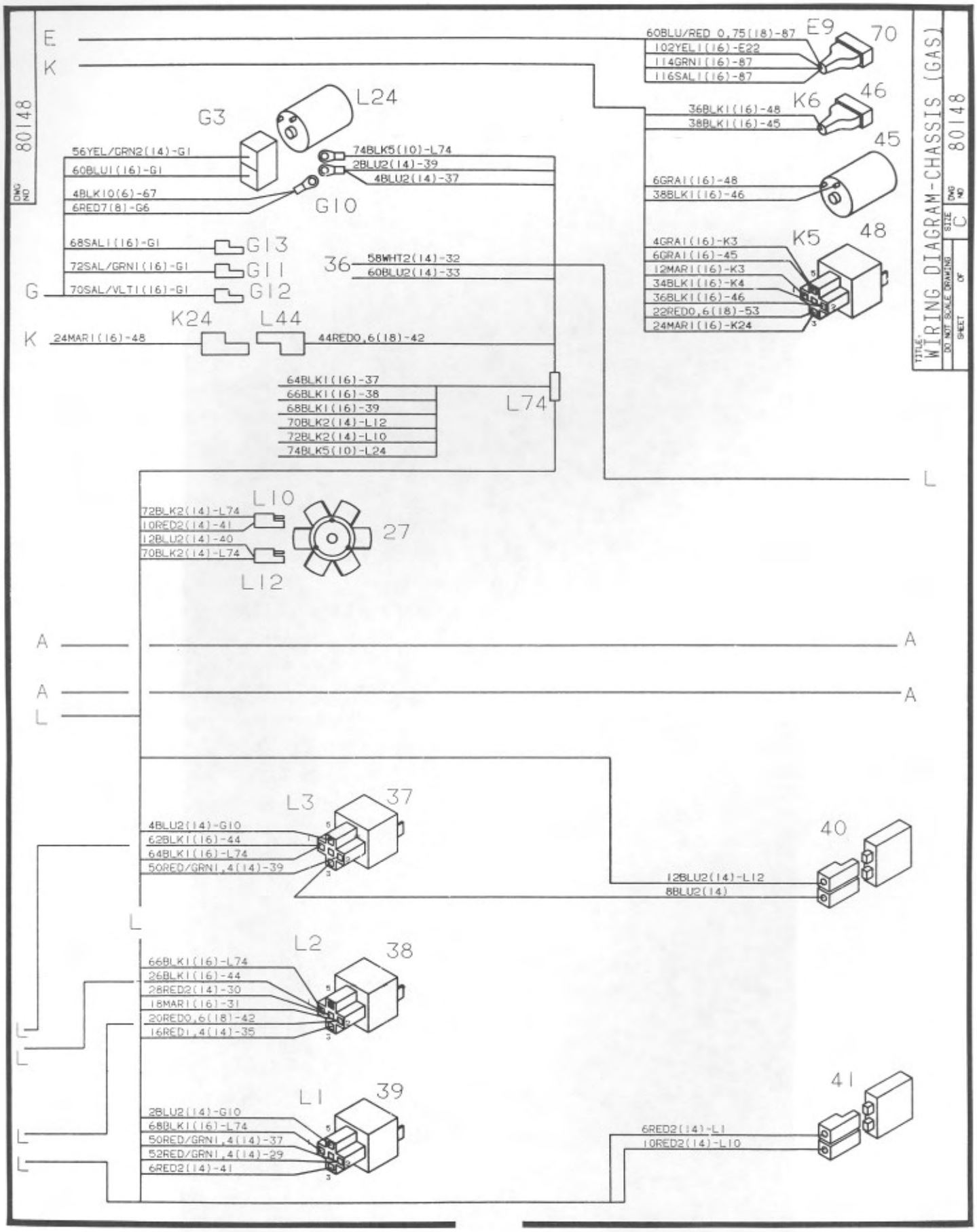
NO.	NAME	SHT.NO.
A01	CONNECTOR-FUSE PANEL (WHITE)	27
A02	CONNECTOR-FUSE PANEL (YELLOW)	27
A03	CONNECTOR-FUSE PANEL (BROWN)	27
A04	CONNECTOR-FUSE PANEL (GREEN)	27
A05	CONNECTOR-FUSE PANEL (RED)	27
A06	CONNECTOR	28
A07	CONNECTOR-TURN SIGNAL SWITCH	29
A08	CONNECTOR-WINDSHIELD WIPER SWITCH	29
A09	CONNECTOR-LIGHT SWITCH	29
A10	CONNECTOR	28
A11	CONNECTOR	28
A12	CONNECTOR	28
A13	CONNECTOR	27
A14	CONNECTOR	24
A15	CONNECTOR	28
A16	CONNECTOR	29
A17	CONNECTOR	24
A19	CONNECTOR	28
A20	CONNECTOR	28
A21	CONNECTOR	24
A22	CONNECTOR-UNUSED	24
A23	CONNECTOR	23
A26	CONNECTOR	27
A31	CONNECTOR	23
A35	CONNECTOR	28
A36	CONNECTOR	23
A38	CONNECTOR	28
A39	CONNECTOR	29
A40	CONNECTOR	24
A41	CONNECTOR	29
A46	CONNECTOR	27
A61	CONNECTOR	24
A62	GROUND-FIREWALL	24
A67	CONNECTOR-UNUSED	28
A68	CONNECTOR	21
A69	CONNECTOR	21
A70	CONNECTOR	21
A71	INTERNAL SPLICE	25
A72	INTERNAL SPLICE	28
A73	SPLICE	21
A74	SPLICE	21
A76	GROUND-FIREWALL	23
E01	CONNECTOR	31
E02	CONNECTOR	30
E03	CONNECTOR	29
E04	DIAGNOSTIC PLUG	26
E05	CONNECTOR	25
E06	CONNECTOR	25
E07	DIAGNOSTIC PLUG	26
E08	CONNECTOR	25
E09	CONNECTOR	22
E10	CONNECTOR	23
E11	CONNECTOR	30
E12	CONNECTOR	30
E21	INTERNAL SPLICE	30
E22	INTERNAL SPLICE	31
E23	INTERNAL SPLICE	30
E24	INTERNAL SPLICE	30
E25	INTERNAL SPLICE	29
E26	INTERNAL SPLICE	29
E28	INTERNAL SPLICE	30
F01	CONNECTOR	24
F03	CONNECTOR	23
F04	CONNECTOR	24
F05	CONNECTOR	24
F11	CONNECTOR	24
G01	CONNECTOR	24
G02	CONNECTOR	24
G03	CONNECTOR	22
G04	CONNECTOR	24
G06	CONNECTOR	24
G10	TERMINAL-ALTERNATOR,POSITIVE	22
G11	WATER TEMPERATURE SENSOR (LIGHT)	22
G12	WATER TEMPERATURE SENSOR (GUAGE)	22
G13	OIL PRESSURE SENSOR	22
J01	CONNECTOR	28
J02	CONNECTOR	29
J03	CONNECTOR	30
J04	CONNECTOR	30
J05	CONNECTOR	30
K01	CONNECTOR	23
K02	CONNECTOR	23
K03	CONNECTOR	23
K04	CONNECTOR	23
K05	CONNECTOR	22
K06	CONNECTOR	22
K18	CONNECTOR	24
K24	CONNECTOR	22
L01	CONNECTOR	22
L02	CONNECTOR	22
L03	CONNECTOR	22
L04	CONNECTOR	23
L05	CONNECTOR	23
L06	CONNECTOR	23
L07	CONNECTOR	23
L10	CONNECTOR	22
L12	CONNECTOR	22
L24	TERMINAL-ALTERNATOR,NEGATIVE	22
L44	CONNECTOR	22
L56	CONNECTOR	21
L74	INTERNAL SPLICE	22
M01	CONNECTOR	26
M02	CONNECTOR	26
M03	CONNECTOR	29
M04	CONNECTOR	30
M05	CONNECTOR	30
M06	CONNECTOR	30
M09	CONNECTOR	30
M18	CONNECTOR	30
M20	CONNECTOR	30
M50	CONNECTOR	32
M51	CONNECTOR	32
M62	CONNECTOR	30
M64	CONNECTOR	30
M65	CONNECTOR	31
S01	CONNECTOR	32
S02	CONNECTOR	32
T01	CONNECTOR	25
T02	CONNECTOR	25
T03	CONNECTOR	25
T04	CONNECTOR	25
T05	CONNECTOR	25
T06	CONNECTOR	25
T07	CONNECTOR	25
T08	CONNECTOR	25
T09	CONNECTOR	25
T10	CONNECTOR	25
T11	CONNECTOR	25

TITLE: WIRING DIAGRAM-CHASSIS (GAS)

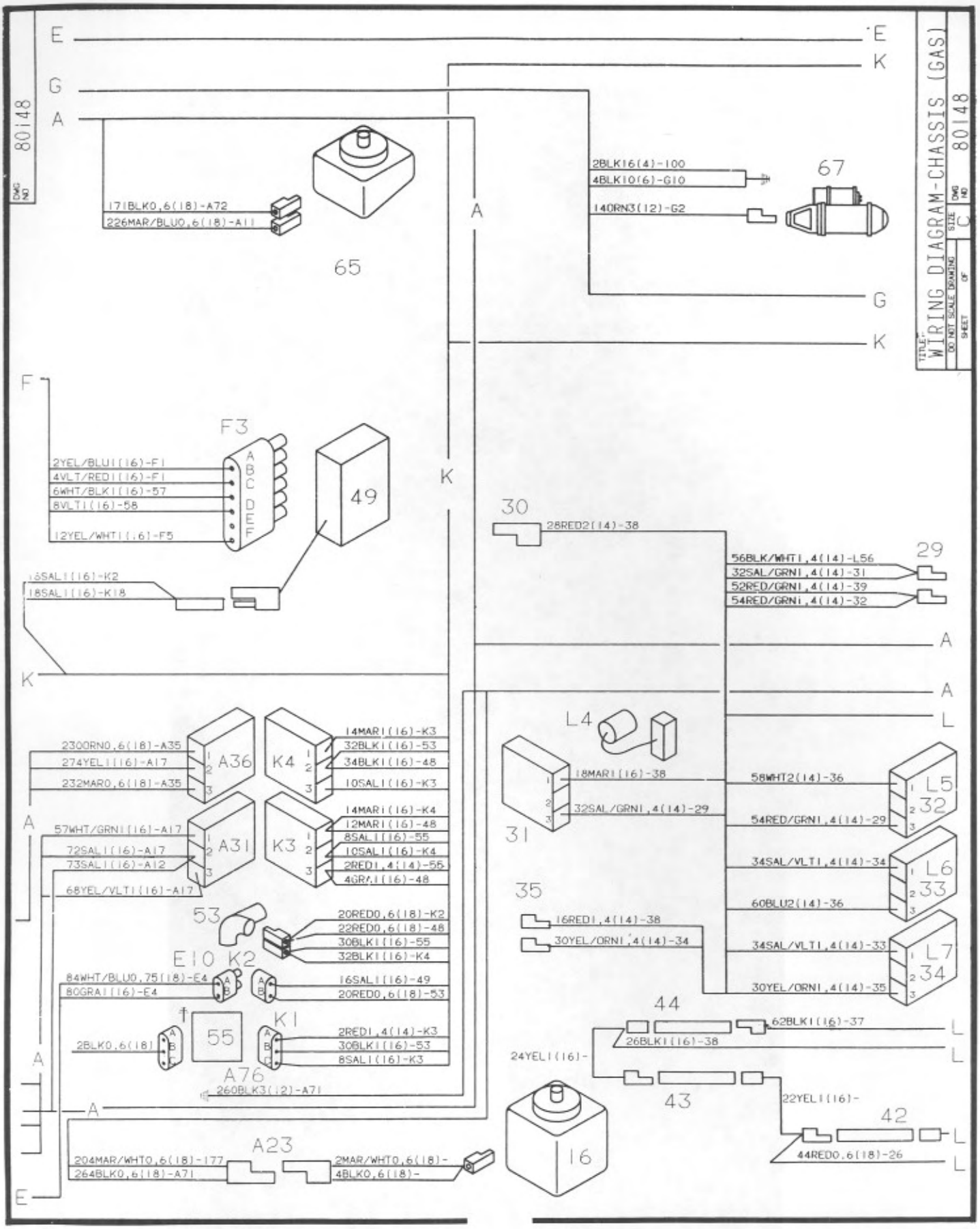
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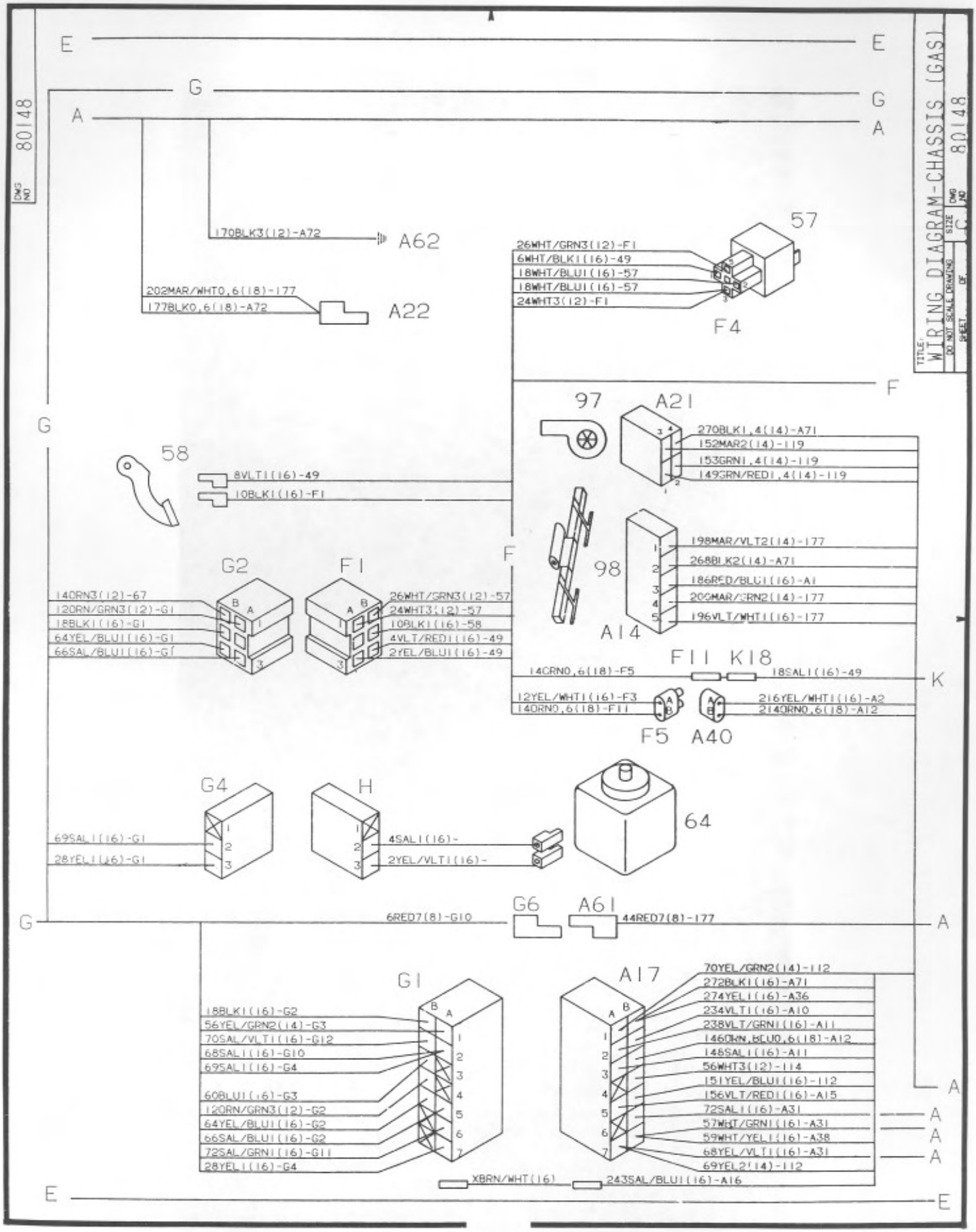
1985 MID-YEAR PRODUCTION

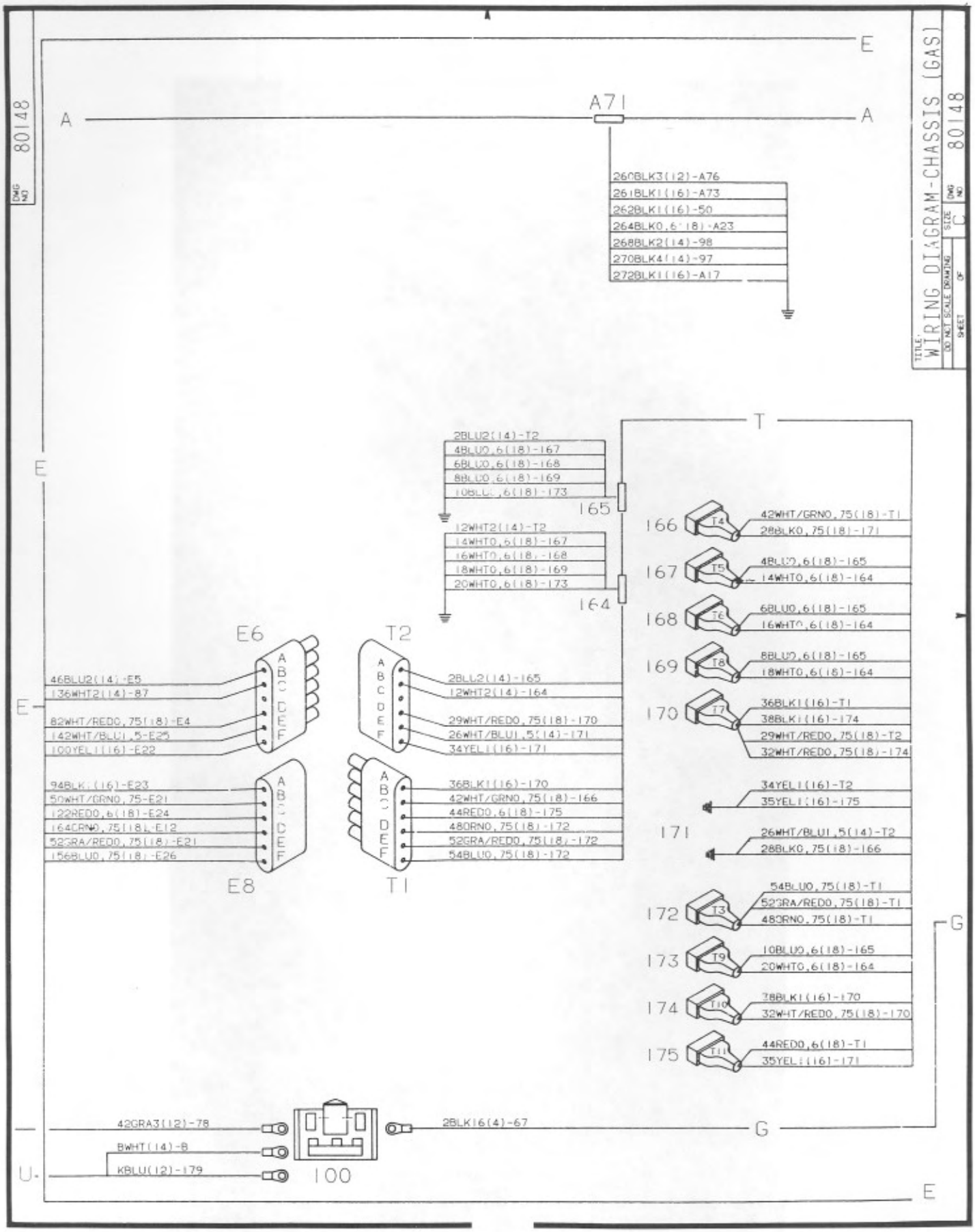


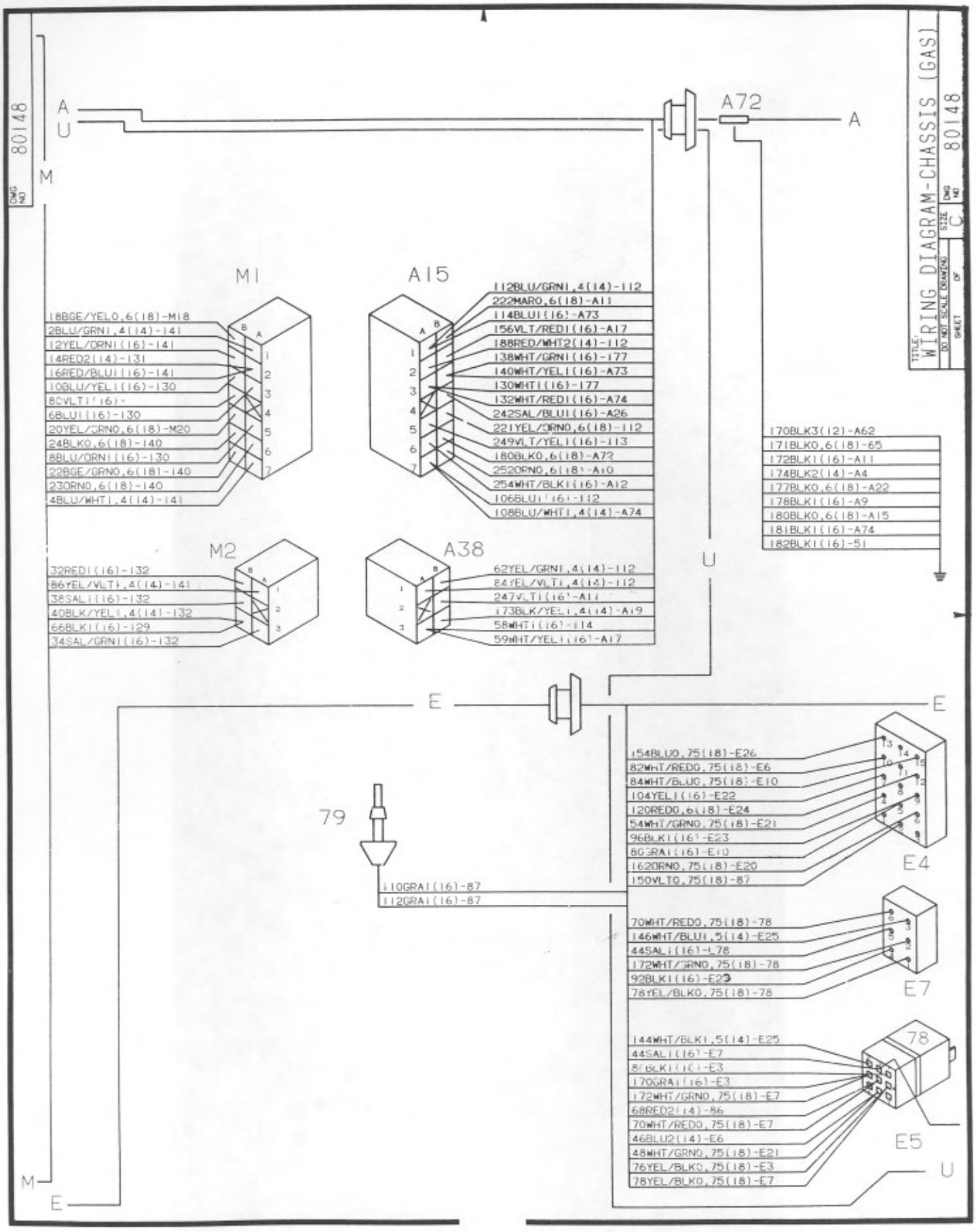

TITLE: WIRING DIAGRAM-CHASSIS (GAS)
DWG NO 80148
SIZE C
SHEET OF
DO NOT SCALE DRAWING
E
K
60BLU/RED 0.75(18)-87
102YEL1(16)-E22
114GRN1(16)-87
116SAL1(16)-87
E9
70
36BLK1(16)-48
38BLK1(16)-45
K6
46
6GRA1(16)-48
38BLK1(16)-46
45
4GRA1(16)-K3
6GRA1(16)-45
12MAR1(16)-K3
34BLK1(16)-K4
36BLK1(16)-46
22RED0.6(18)-53
24MAR1(16)-K24
K5
48
G3
L24
56YEL/GRN2(14)-G1
60BLU1(16)-G1
4BLK10(6)-67
6RED7(8)-G6
74BLK5(10)-L74
2BLU2(14)-39
4BLU2(14)-37
G10
68SAL1(16)-G1
G13
72SAL/GRN1(16)-G1
G11
70SAL/VLT1(16)-G1
G12
G
36
58WHT2(14)-32
60BLU2(14)-33
K24
L44
K
24MAR1(16)-48
44RED0.6(18)-42
64BLK1(16)-37
66BLK1(16)-38
68BLK1(16)-39
70BLK2(14)-L12
72BLK2(14)-L10
74BLK5(10)-L24
L74
L
L10
72BLK2(14)-L74
10RED2(14)-41
12BLU2(14)-40
70BLK2(14)-L74
L12
27
A
A
A
A
L
L3
37
4BLU2(14)-G10
62BLK1(16)-44
64BLK1(16)-L74
50RED/GRN1.4(14)-39
40
12BLU2(14)-L12
8BLU2(14)
L
L2
38
66BLK1(16)-L74
26BLK1(16)-44
28RED2(14)-30
18MAR1(16)-31
20RED0.6(18)-42
16RED1.4(14)-35
L1
39
2BLU2(14)-G10
68BLK1(16)-L74
50RED/GRN1.4(14)-37
52RED/GRN1.4(14)-29
6RED2(14)-41
41
6RED2(14)-L1
10RED2(14)-L10

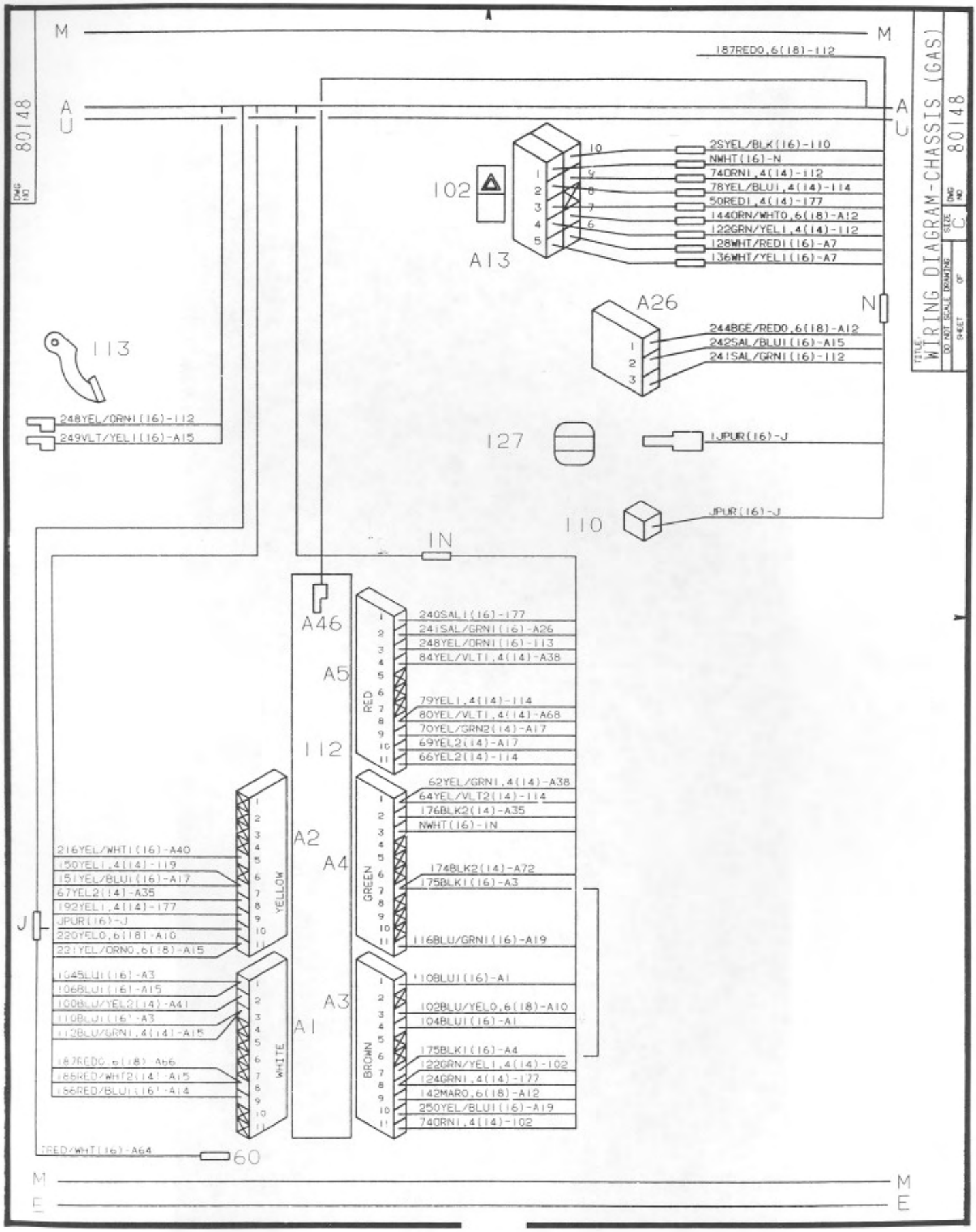
1985 MID-YEAR PRODUCTION



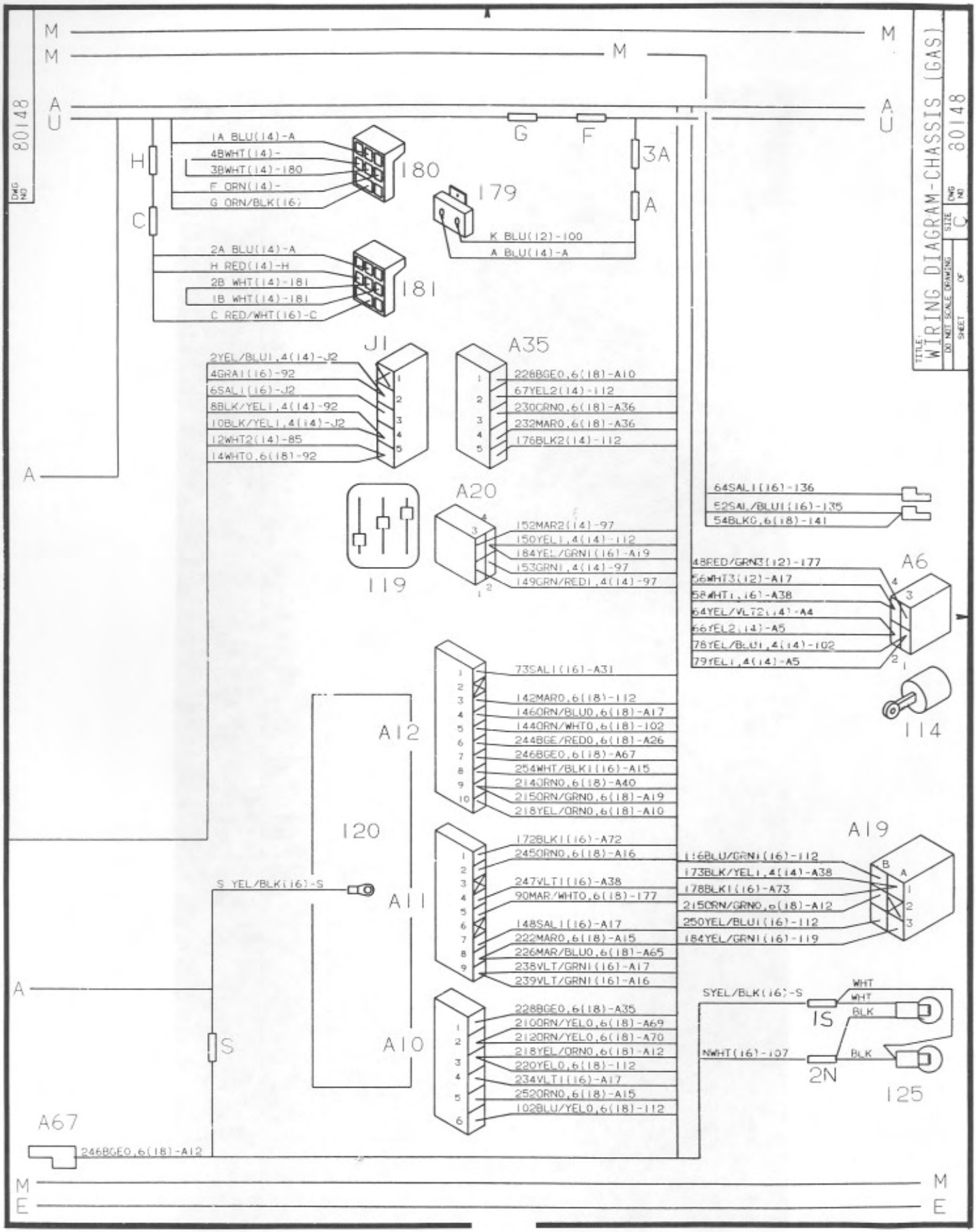

DWG 80148
TITLE WIRING DIAGRAM-CHASSIS (GAS)
DWG 80148
SIZE C
DO NOT SCALE DRAWING
SHEET OF
E
G
A
170BLK3(12)-A72
A62
202MAR/WHT0,6(18)-177
177BLK0,6(18)-A72
A22
57
26WHT/GRN3(12)-F1
6WHT/BLK1(16)-49
18WHT/BLU1(16)-57
18WHT/BLU1(16)-57
24WHT3(12)-F1
F4
F
97
A21
270BLK1,4(14)-A71
152MAR2(14)-119
153GRN1,4(14)-119
149GRN/RED1,4(14)-119
58
8VLT1(16)-49
10BLK1(16)-F1
98
198MAR/VLT2(14)-177
268BLK2(14)-A71
186RED/BLU1(16)-A1
200MAR/GRN2(14)-177
196VLT/WHT1(16)-177
A14
G2
F1
140RN3(12)-67
120RN/GRN3(12)-G1
18BLK1(16)-G1
64YEL/BLU1(16)-G1
66SAL/BLU1(16)-G1
26WHT/GRN3(12)-57
24WHT3(12)-57
10BLK1(16)-58
4VLT/RED1(16)-49
2YEL/BLU1(16)-49
F11 K18
14GRN0,6(18)-F5
18SAL1(16)-49
K
12YEL/WHT1(16)-F3
140RN0,6(18)-F11
216YEL/WHT1(16)-A2
214ORN0,6(18)-A12
F5 A40
G4
H
64
69SAL1(16)-G1
28YEL1(16)-G1
4SAL1(16)-
2YEL/VLT1(16)-
6RED7(8)-G10
G6
A61
44RED7(8)-177
G1
A17
18BLK1(16)-G2
56YEL/GRN2(14)-G3
70SAL/VLT1(16)-G12
68SAL1(16)-G10
69SAL1(16)-G4
60BLU1(16)-G3
120RN/GRN3(12)-G2
64YEL/BLU1(16)-G2
66SAL/BLU1(16)-G2
72SAL/GRN1(16)-G11
28YEL1(16)-G4
70YEL/GRN2(14)-112
272BLK1(16)-A71
274YEL1(16)-A36
234VLT1(16)-A10
238VLT/GRN1(16)-A11
1460RN,BLUO,6(18)-A12
148SAL1(16)-A11
56WHT3(12)-114
151YEL/BLU1(16)-112
156VLT/RED1(16)-A15
72SAL1(16)-A31
57WHT/GRN1(16)-A31
59WHT/YEL1(16)-A38
68YEL/VLT1(16)-A31
69YEL2(14)-112
XBRN/WHT(16)
243SAL/BLU1(16)-A16


DWG NO 80148
TITLE: WIRING DIAGRAM-CHASSIS (GAS)
DO NOT SCALE DRAWING
SIZE C
DWG NO 80148
SHEET OF
A71
260BLK3(12)-A76
261BLK1(16)-A73
262BLK1(16)-50
264BLK0,6(18)-A23
268BLK2(14)-98
270BLK4(14)-97
272BLK1(16)-A17
2BLU2(14)-T2
4BLU0,6(18)-167
6BLU0,6(18)-168
8BLU0,6(18)-169
10BLU0,6(18)-173
165
12WHT2(14)-T2
14WHT0,6(18)-167
16WHT0,6(18)-168
18WHT0,6(18)-169
20WHT0,6(18)-173
164
166
42WHT/GRN0,75(18)-T1
28BLK0,75(18)-171
167
4BLU0,6(18)-165
14WHT0,6(18)-164
168
6BLU0,6(18)-165
16WHT0,6(18)-164
169
8BLU0,6(18)-165
18WHT0,6(18)-164
170
36BLK1(16)-T1
38BLK1(16)-174
29WHT/RED0,75(18)-T2
32WHT/RED0,75(18)-174
34YEL1(16)-T2
35YEL1(16)-175
171
26WHT/BLU1,5(14)-T2
28BLK0,75(18)-166
172
54BLU0,75(18)-T1
523RA/RED0,75(18)-T1
480RN0,75(18)-T1
173
10BLU0,6(18)-165
20WHT0,6(18)-164
174
38BLK1(16)-170
32WHT/RED0,75(18)-170
175
44RED0,6(18)-T1
35YEL1(16)-171
E6
46BLU2(14)-E5
136WHT2(14)-87
82WHT/RED0,75(18)-E4
142WHT/BLU1,5-E25
100YEL1(16)-E22
E8
94BLK1(16)-E23
50WHT/GRN0,75-E21
122RED0,6(18)-E24
164GRN0,75(18)-E12
523RA/RED0,75(18)-E21
156BLU0,75(18)-E26
T2
2BLU2(14)-165
12WHT2(14)-164
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26WHT/BLU1,5(14)-171
34YEL1(16)-171
T1
36BLK1(16)-170
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44RED0,6(18)-175
480RN0,75(18)-172
52GRA/RED0,75(18)-172
54BLU0,75(18)-172
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BWHT(14)-8
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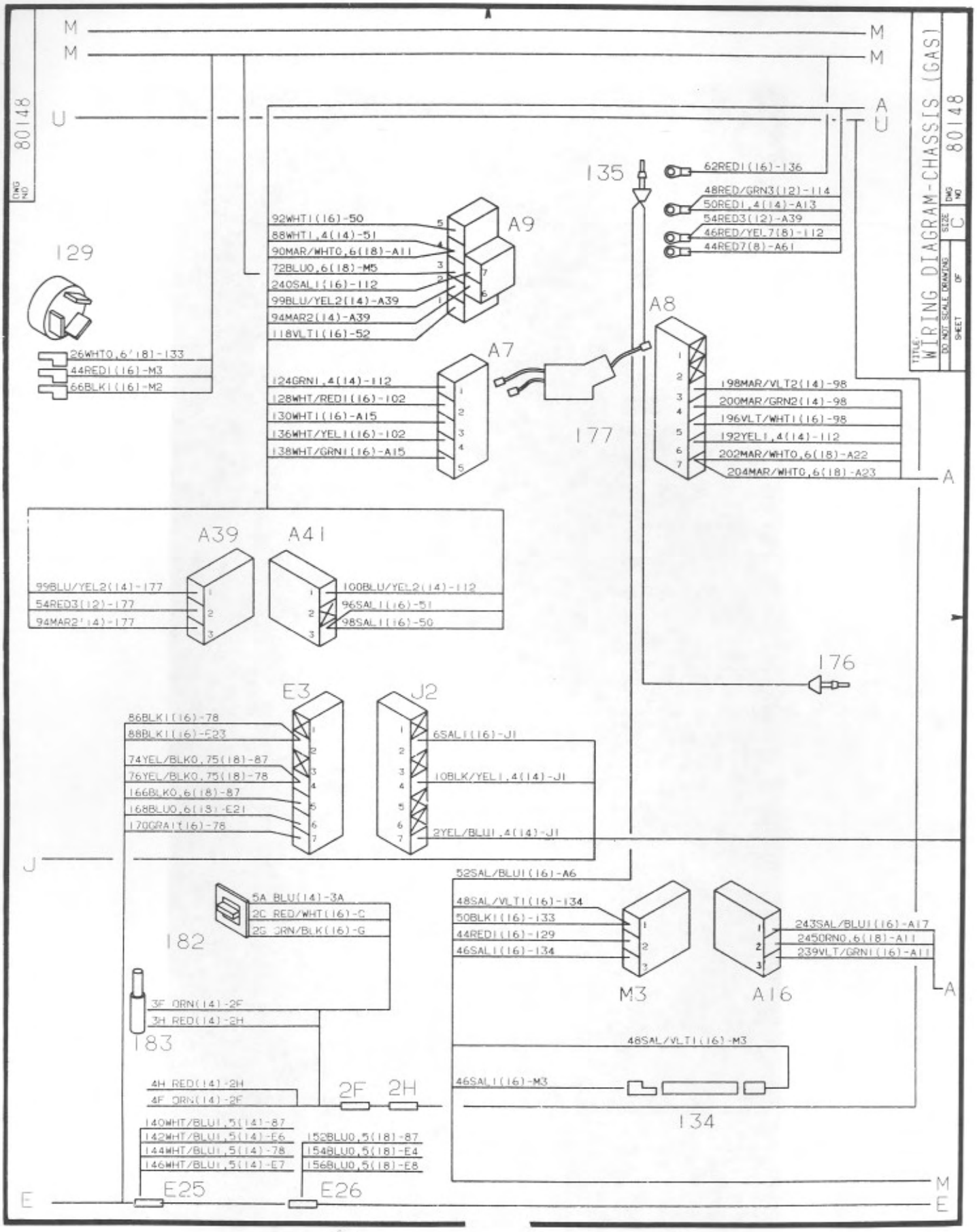

TITLE: WIRING DIAGRAM-CHASSIS (GAS)
DO NOT SCALE DRAWING
SHEET OF
SIZE C
DWG NO 80148
DWG NO 80148
A
U
M
A72
A
M1
18BGE/YEL0,6(18)-M18
2BLU/GRN1,4(14)-141
12YEL/ORN1(16)-141
14RED2(14)-131
16RED/BLU1(16)-141
10BLU/YEL1(16)-130
8VLT1(16)-
6BLU1(16)-130
20YEL/GRN0,6(18)-M20
24BLK0,6(18)-140
8BLU/ORN1(16)-130
22BGE/GRN0,6(18)-140
23ORN0,6(18)-140
4BLU/WHT1,4(14)-141
A15
112BLU/GRN1,4(14)-112
222MAR0,6(18)-A11
114BLU1(16)-A73
156VLT/RED1(16)-A17
188RED/WHT2(14)-112
138WHT/GRN1(16)-177
140WHT/YEL1(16)-A73
130WHT1(16)-177
132WHT/RED1(16)-A74
242SAL/BLU1(16)-A26
221YEL/ORN0,6(18)-112
249VLT/YEL1(16)-113
180BLK0,6(18)-A72
252ORN0,6(18)-A10
254WHT/BLK1(16)-A12
106BLU1(16)-112
108BLU/WHT1,4(14)-A74
170BLK3(12)-A62
171BLK0,6(18)-65
172BLK1(16)-A11
174BLK2(14)-A4
177BLK0,6(18)-A22
178BLK1(16)-A9
180BLK0,6(18)-A15
181BLK1(16)-A74
182BLK1(16)-51
M2
32RED1(16)-132
86YEL/VLT1,4(14)-141
38SAL1(16)-132
40BLK/YEL1,4(14)-132
66BLK1(16)-129
34SAL/GRN1(16)-132
A38
62YEL/GRN1,4(14)-112
84YEL/VLT1,4(14)-112
247VLT1(16)-A11
173BLK/YEL1,4(14)-A19
58WHT1(16)-114
59WHT/YEL1(16)-A17
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E
E
79
110GRA1(16)-87
112GRA1(16)-87
154BLU0,75(18)-E26
82WHT/RED0,75(18)-E6
84WHT/BLU0,75(18)-E10
104YEL1(16)-E22
120RED0,6(18)-E24
54WHT/GRN0,75(18)-E21
96BLK1(16)-E23
80GRA1(16)-E10
162ORN0,75(18)-E20
150VLT0,75(18)-87
E4
70WHT/RED0,75(18)-78
146WHT/BLU1,5(14)-E25
44SAL1(16)-L78
172WHT/GRN0,75(18)-78
92BLK1(16)-E23
78YEL/BLK0,75(18)-78
E7
144WHT/BLK1,5(14)-E25
44SAL1(16)-E7
8?BLK1(1?)-E3
170GRA1(16)-E3
172WHT/GRN0,75(18)-E7
68RED2(14)-86
70WHT/RED0,75(18)-E7
46BLU2(14)-E6
48WHT/GRN0,75(18)-E21
76YEL/BLK0,75(18)-E3
78YEL/BLK0,75(18)-E7
78
E5
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M
M
187RED0,6(18)-112
A
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80148
DWG NO
102
A13
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4
5
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NWHT(16)-N
740RN1,4(14)-112
78YEL/BLU1,4(14)-114
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1440RN/WHT0,6(18)-A12
122GRN/YEL1,4(14)-112
128WHT/RED1(16)-A7
136WHT/YEL1(16)-A7
TITLE
WIRING DIAGRAM-CHASSIS (GAS)
DO NOT SCALE DRAWING
SIZE
C
DWG NO
80148
SHEET
OF
A26
N
1
2
3
244BGE/RED0,6(18)-A12
242SAL/BLU1(16)-A15
241SAL/GRN1(16)-112
113
248YEL/ORN1(16)-112
249VLT/YEL1(16)-A15
127
1JPUR(16)-J
110
JPUR(16)-J
IN
A46
A5
112
A2
A4
A3
A1
J
60
RED
GREEN
BROWN
YELLOW
WHITE
240SAL1(16)-177
241SAL/GRN1(16)-A26
248YEL/ORN1(16)-113
84YEL/VLT1,4(14)-A38
79YEL1,4(14)-114
80YEL/VLT1,4(14)-A68
70YEL/GRN2(14)-A17
69YEL2(14)-A17
66YEL2(14)-114
62YEL/GRN1,4(14)-A38
64YEL/VLT2(14)-114
176BLK2(14)-A35
NWHT(16)-1N
174BLK2(14)-A72
175BLK1(16)-A3
116BLU/GRN1(16)-A19
1108LU1(16)-A1
102BLU/YEL0,6(18)-A10
104BLU1(16)-A1
175BLK1(16)-A4
122GRN/YEL1,4(14)-102
124GRN1,4(14)-177
142MAR0,6(18)-A12
250YEL/BLU1(16)-A19
740RN1,4(14)-102
216YEL/WHT1(16)-A40
150YEL1,4(14)-119
151YEL/BLU1(16)-A17
67YEL2(14)-A35
192YEL1,4(14)-177
JPUR(16)-J
220YEL0,6(18)-A10
221YEL/ORN0,6(18)-A15
1045LU1(16)-A3
106BLU1(16)-A15
100BLU/YEL2(14)-A41
110BLU1(16)-A3
112BLU/GRN1,4(14)-A15
187RED0,6(18)-A66
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186RED/BLU1(16)-A14
DRED/WHT(16)-A64
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E
M
E

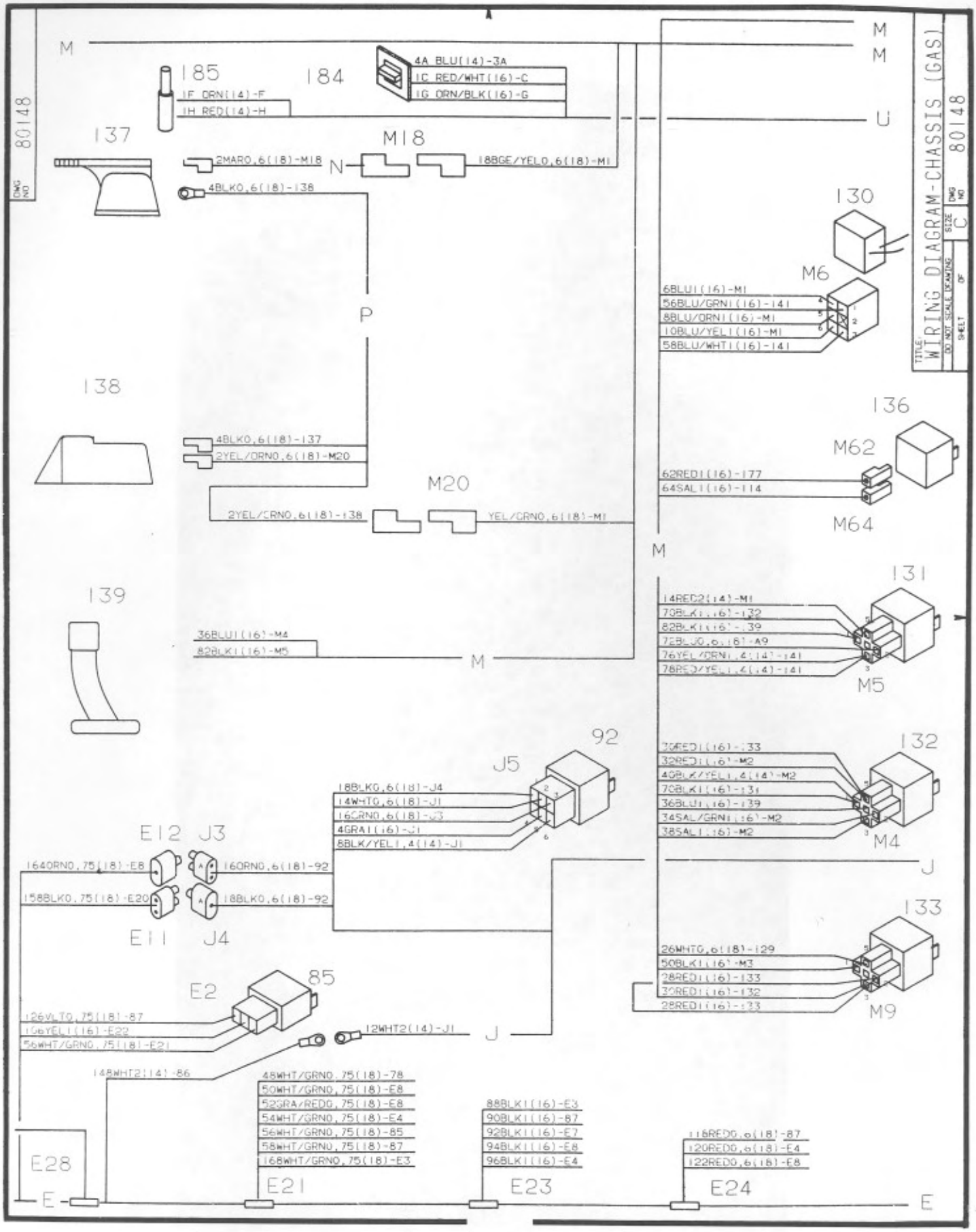
1985 MID-YEAR PRODUCTION

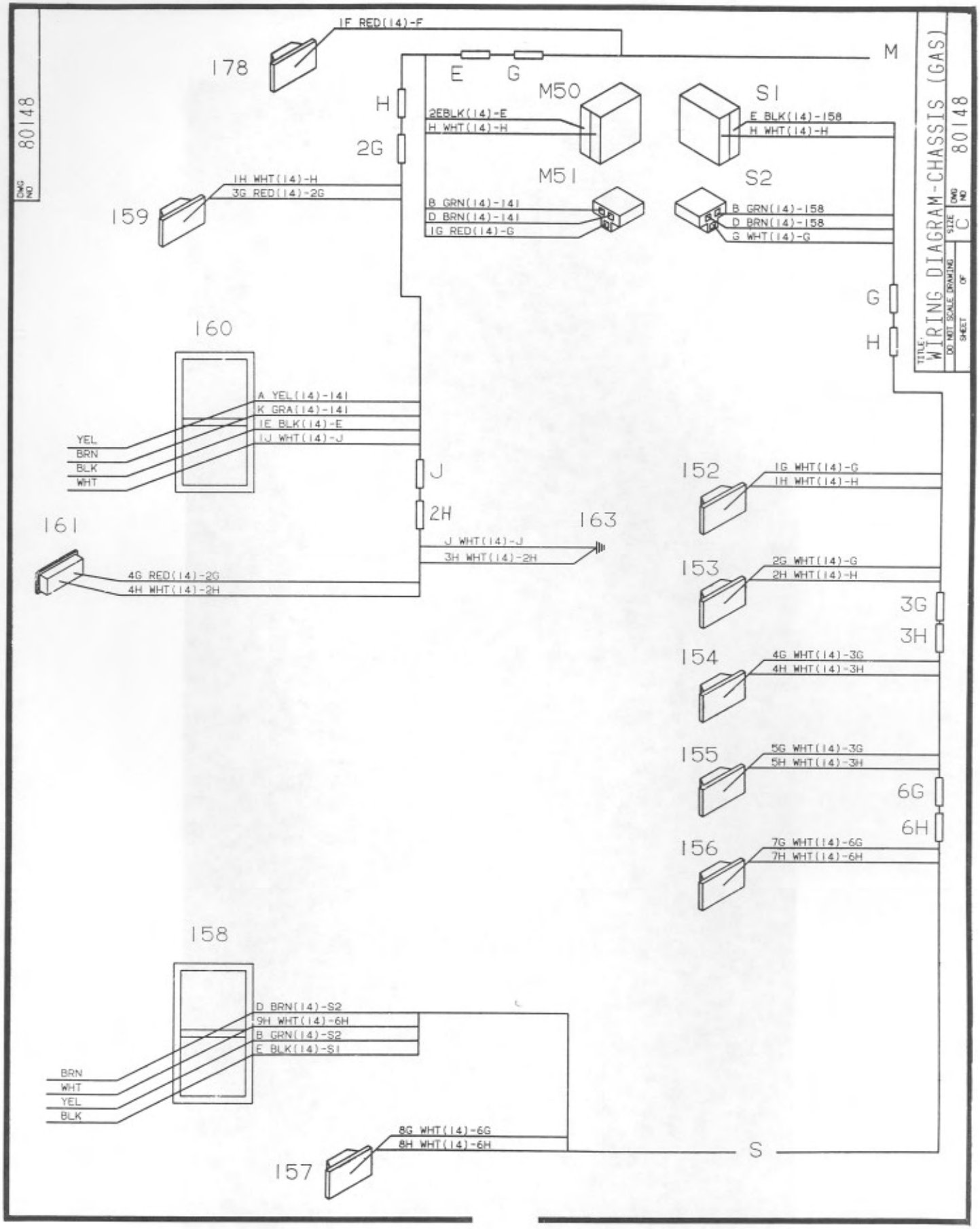


1985 MID-YEAR PRODUCTION

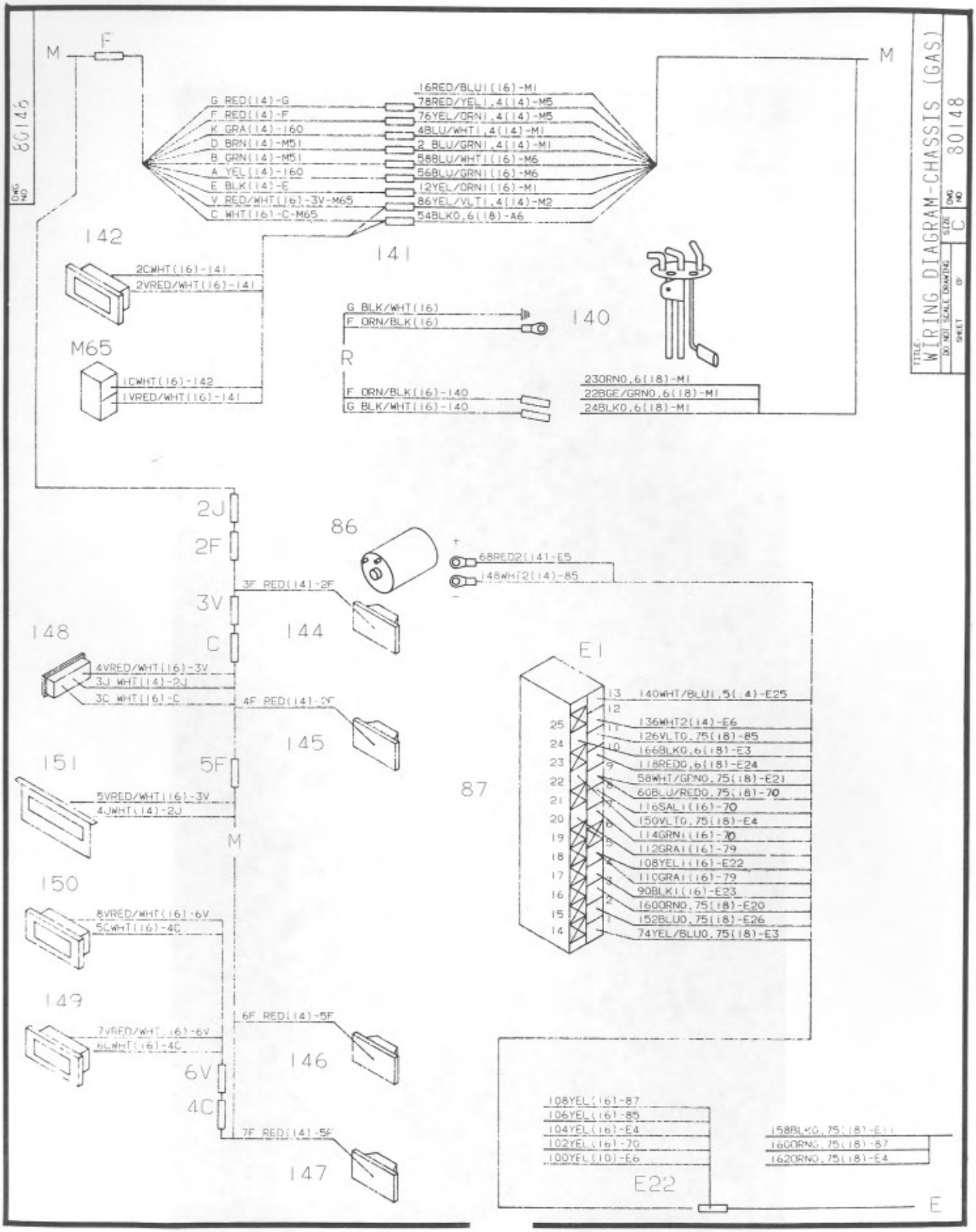


1985 MID-YEAR PRODUCTION




DWG NO 80148
178
1F RED(14)-F
M
E
G
H
2G
M50
2EBLK(14)-E
H WHT(14)-H
M51
B GRN(14)-141
D BRN(14)-141
1G RED(14)-G
S1
E BLK(14)-158
H WHT(14)-H
S2
B GRN(14)-158
D BRN(14)-158
G WHT(14)-G
G
H
TITLE: WIRING DIAGRAM-CHASSIS (GAS)
DO NOT SCALE DRAWING
SIZE C
DWG NO 80148
SHEET OF
159
1H WHT(14)-H
3G RED(14)-2G
160
A YEL(14)-141
K GRA(14)-141
1E BLK(14)-E
1J WHT(14)-J
YEL
BRN
BLK
WHT
J
2H
161
4G RED(14)-2G
4H WHT(14)-2H
163
J WHT(14)-J
3H WHT(14)-2H
152
1G WHT(14)-G
1H WHT(14)-H
153
2G WHT(14)-G
2H WHT(14)-H
3G
3H
154
4G WHT(14)-3G
4H WHT(14)-3H
155
5G WHT(14)-3G
5H WHT(14)-3H
6G
6H
156
7G WHT(14)-6G
7H WHT(14)-6H
158
D BRN(14)-S2
9H WHT(14)-6H
B GRN(14)-S2
E BLK(14)-S1
BRN
WHT
YEL
BLK
157
8G WHT(14)-6G
8H WHT(14)-6H
S

1985 MID-YEAR PRODUCTION



80148

COMPONENT LOCATIONS

NO.	NAME	SHT.NO.
16	WINDSHIELD WASHER FLUID RESERVOIR	37
27	COOLING FANS	36
29	SENSOR-RADIATOR COOLANT TEMP,LOWER	37
30	A/C COMPRESSOR	37
31	PRESSURE SWITCH-P/S,A/C	37
32	PRESSURE SWITCH-COOLING FANS	37
33	PRESSURE SWITCH-A/C,LOW	37
34	PRESSURE SWITCH-A/C,HIGH	37
35	SENSOR-RADIATOR COOLANT TEMP,UPPER	37
36	A/C TEMP CONTROL SWITCH	36
37	RELAY	36
38	RELAY	36
39	RELAY	36
40	CIRCUIT BREAKER	36
41	CIRCUIT BREAKER	36
42	DIODE	37
43	DIODE	37
44	DIODE	37
45	SOLENOID VALVE	36
46	PRESSURE SWITCH	36
48	RELAY	36
49	AUTOMATIC TRANSMISSION COMPUTER	37
50	HEADLAMP,RIGHT	35
51	HEADLAMP,LEFT	35
52	HORN	35
53	AIR BY-PASS VALVE	37
55	IGNITION MODULE	37
57	RELAY-NEUTRAL START	38
58	ACCELERATOR CABLE OR CRUISE CONTROL	38
60	CRUISE CONTROL	41
64	OVERFLOW BOTTLE	38
65	BRAKE FLUID RESERVOIR	37
67	STARTER	37
70	AIRFLOW METER	36
72	TURN AND PARK LAMP,RIGHT FRONT	35
73	SIDEMARKER,RIGHT FRONT	35
74	TURN AND PARK LAMP,LEFT FRONT	35
75	SIDEMARKER,LEFT FRONT	35
78	RELAY-RPM	40
79	LAMBDA SENSOR	40
85	BAROMETRIC PRESSURE SENSOR	44
86	FUEL PUMP	45
87	INJECTION COMPUTER	45
92	RELAY-TACHYMETRIQUE	44
97	HEATER FAN	38
98	WINDSHIELD WIPER MOTOR	38
100	BREAKER PLATE	39
102	HAZARD FLASHER	41
110	CONNECTOR-FRONT RISER WIRE ASM	41
112	FUSE PANEL	41
113	BRAKE LIGHT SWITCH	41
114	IGNITION SWITCH	42
119	HEATER CONTROL SWITCH	42
120	INSTRUMENT CLUSTER	42
125	HEATER CONTROL LIGHTS	42
127	BATTERY CHANGEOVER SWITCH	41
129	WATER TEMPERATURE FLASHER	43
130	TAILLIGHT ADAPTER ASSEMBLY	44
131	RELAY	44
132	RELAY	44
133	RELAY	44
134	DIODE	43
135	CAB DOOR SWITCH,LEFT	43
136	IGNITION SWITCH BUZZER	44
137	PARK BRAKE	44
138	PARK BRAKE LIGHT	44
139	SEAT BELT	44
140	FUEL TANK SENDING UNIT	45
141	SPLICE	45
142	ASHTRAY LIGHT,LEFT	45
144	FRONT CLEARANCE LIGHT	45
145	FRONT CLEARANCE LIGHT	45
146	FRONT CLEARANCE LIGHT	45
147	FRONT CLEARANCE LIGHT	45
148	DOME LIGHT	45
149	ASHTRAY LIGHT,RIGHT	45
150	FOOT LIGHT,RIGHT	45
151	VISOR LIGHT	45
152	REAR CLEARANCE LIGHT	46
153	REAR CLEARANCE LIGHT	46
154	REAR CLEARANCE LIGHT	46
155	REAR CLEARANCE LIGHT	46
156	REAR CLEARANCE LIGHT	46
157	SIDE MARKER,RIGHT REAR	46
158	TAIL LIGHT,RIGHT	46
159	SIDE MARKER,LEFT REAR	46
160	TAIL LIGHT,LEFT	46
161	LICENSE PLATE LIGHT	46
162	TRAILER TOWING PIGTAIL	46
163	GROUND	46
164	INTERNAL SPLICE	39
165	INTERNAL SPLICE	39
166	AIR BYPASS SOLENOID	39
167	INJECTOR-CYLINDER #1	39
168	INJECTOR-CYLINDER #2	39
169	INJECTOR-CYLINDER #3	39
170	INJECTOR-COLD START	39
171	GROUND	39
172	THROTTLE POSITION SWITCH	39
173	INJECTOR-CYLINDER #4	39
174	WATER TEMPERATURE SWITCH	39
175	WATER TEMPERATURE SENSOR	39
176	CAB DOOR SWITCH,RIGHT	43
177	TURN SIGNAL/HEADLAMP/WASHER MECHANISM	43

WIRING DIAGRAM-CHASSIS (GAS) 80148

XX XX 13/14

HARNESS CODES

WIRE ASM	DESCRIPTION
A	WIRE ASM-AUTO,FRONT
B	WIRE ASM-JUMPER
C	WIRE ASM-PUMP,W/S WASHER
D	WIRE ASM-BRAKE PAD WEAR
E	WIRE ASM-INJECTION,ELECT
F	WIRE ASM-TRANS,AUTO
G	WIRE ASM-ENGINE
H	WIRE ASM-OVERFLOW BOTTLE LIGHT
J	WIRE ASM-INJECTION SYSTEM
K	WIRE ASM-EMISSION CONTROL
L	WIRE ASM-COOLING FANS
M	WIRE ASM-EXTERIOR LIGHTING
N	WIRE ASM-PARK BRAKE
P	WIRE ASM-SHIFT LEVER LIGHT
R	WIRE ASM-FUEL TANK SENDER
S	WIRE ASM-BACKWALL
T	WIRE ASM-INJECTION,ENGINE

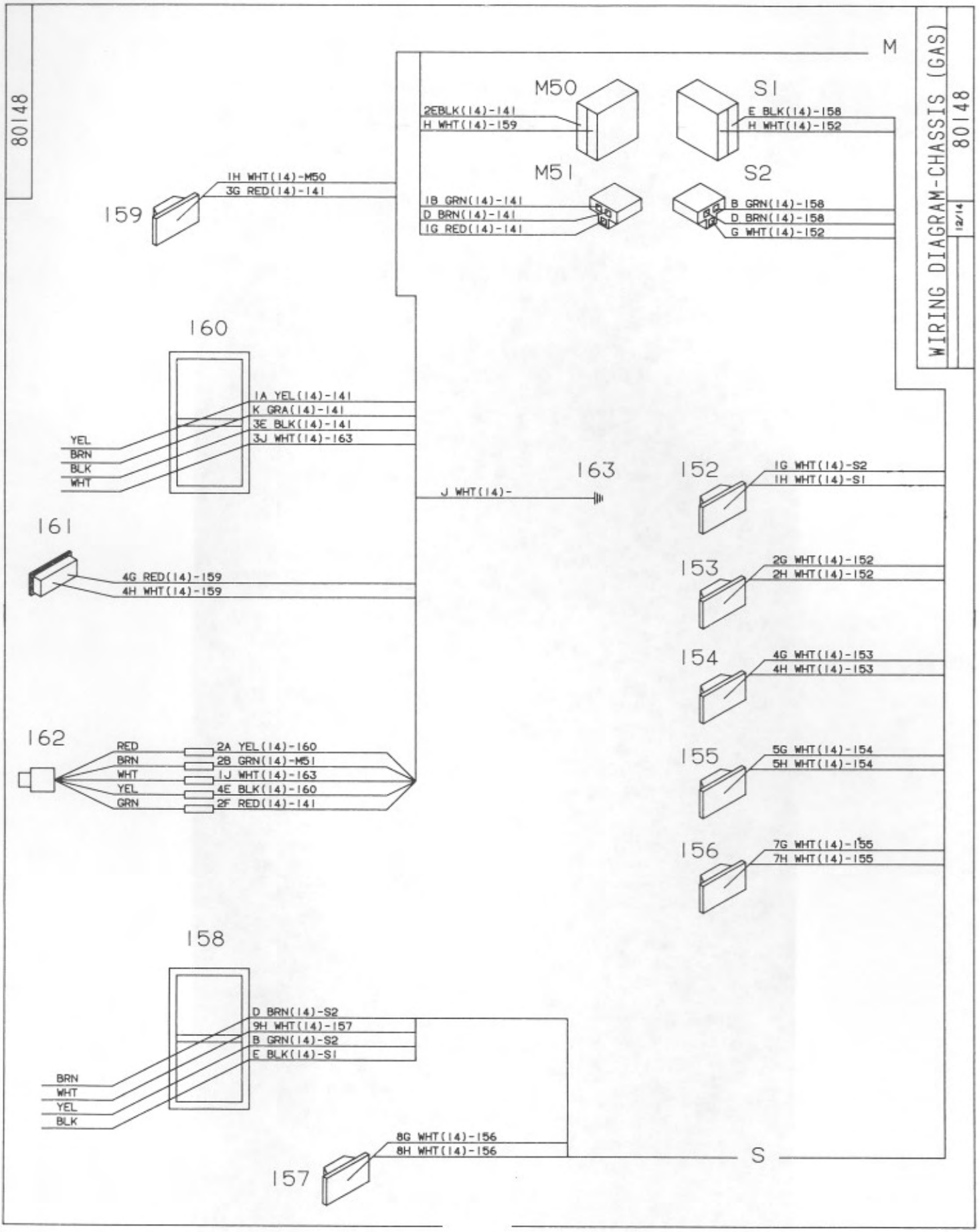
WIRE COLOR CODES

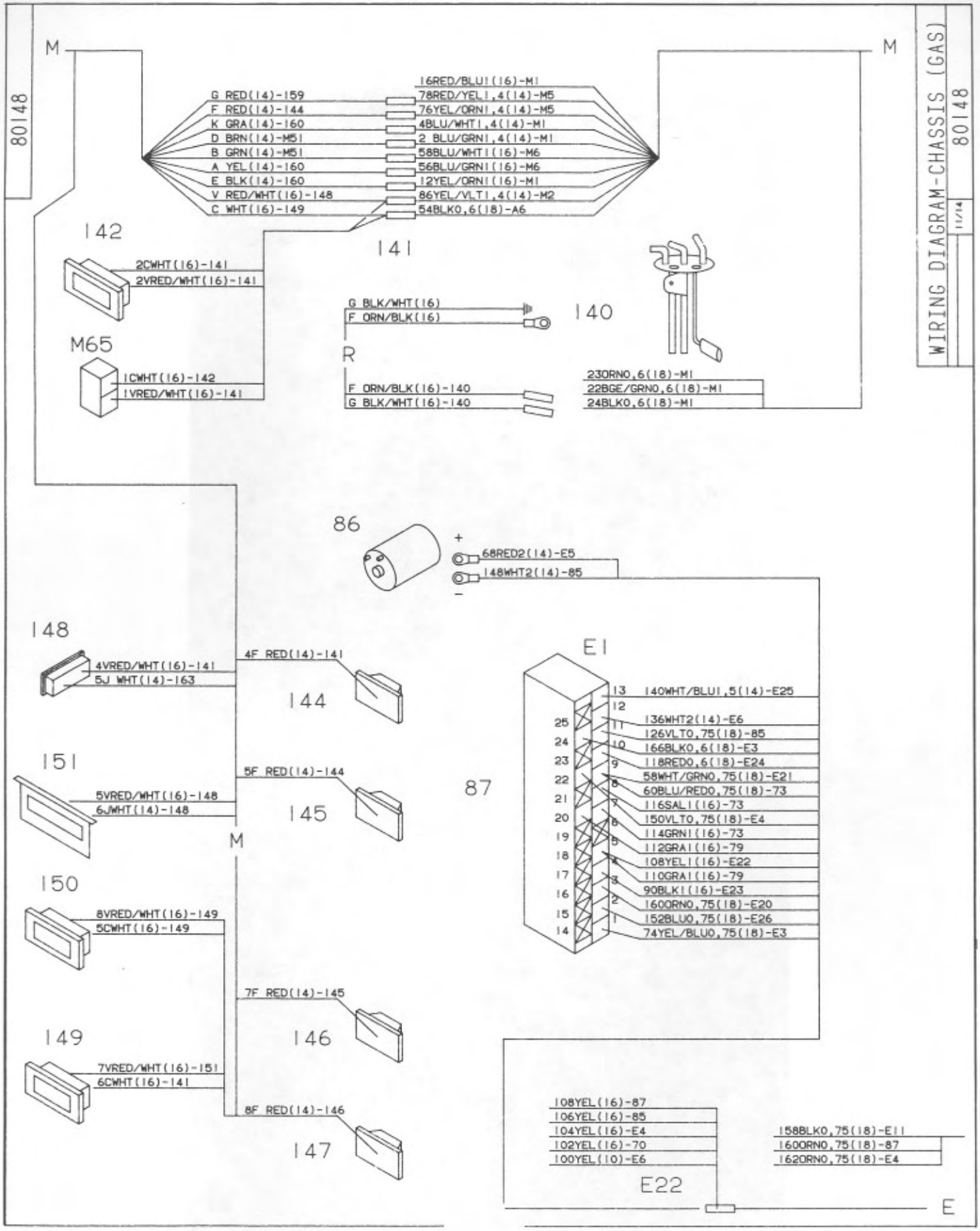
CODE	COLOR	CODE	COLOR
BLK	BLACK	PNK	PINK
BLU	BLUE	RED	RED
BRN	BROWN	VLT	VIOLET
GRN	GREEN	WHT	WHITE
GRY	GRAY	YEL	YELLOW
ORN	ORANGE	BGE	BEIGE
MAR	MAROON	PUR	PURPLE
SAL	SALMON		

CONNECTOR LOCATIONS

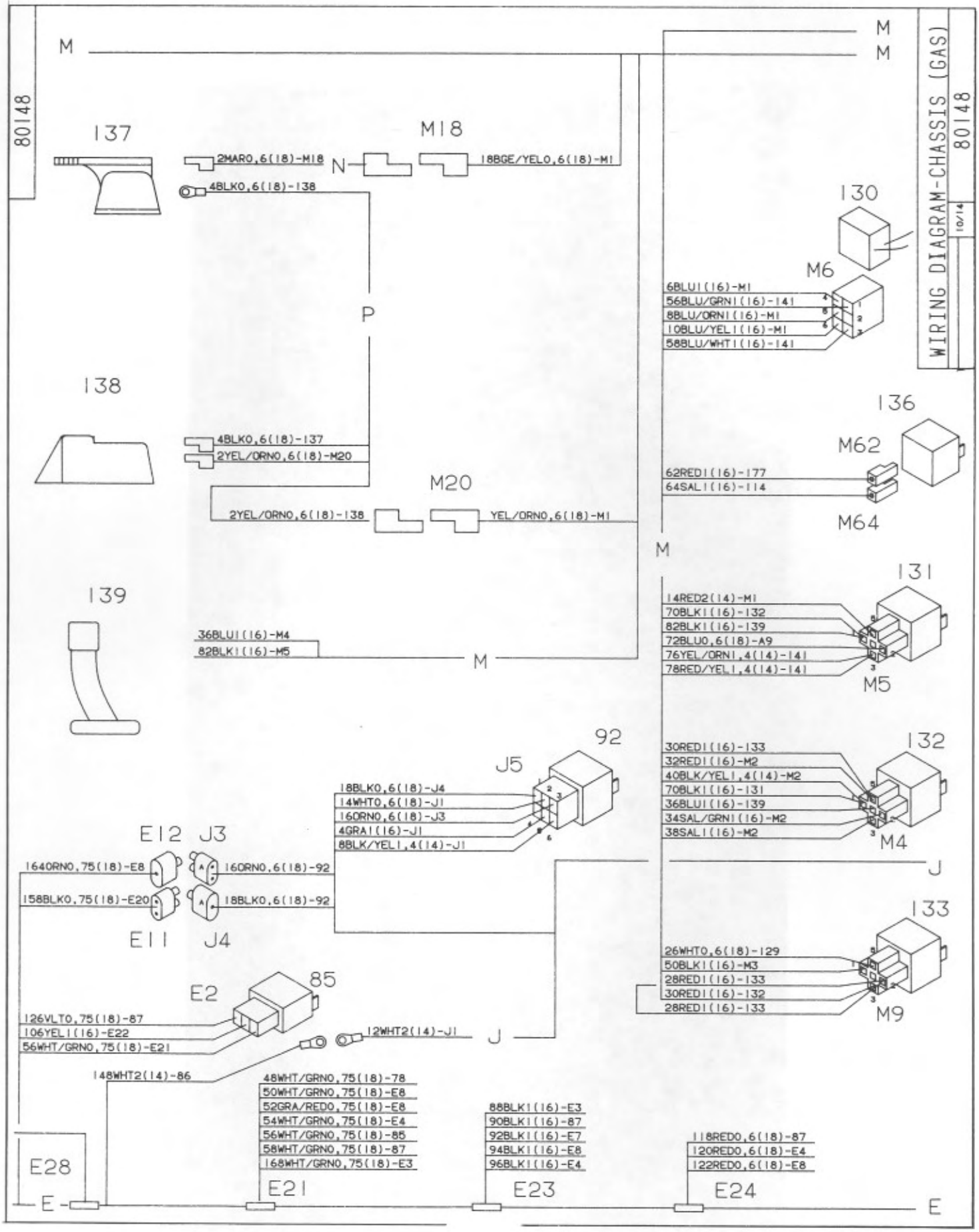
NO.	NAME	SHT.NO.
A01	CONNECTOR-FUSE PANEL (WHITE)	41
A02	CONNECTOR-FUSE PANEL (YELLOW)	41
A03	CONNECTOR-FUSE PANEL (BROWN)	41
A04	CONNECTOR-FUSE PANEL (GREEN)	41
A05	CONNECTOR-FUSE PANEL (RED)	41
A06	CONNECTOR	42
A07	CONNECTOR-TURN SIGNAL SWITCH	43
A08	CONNECTOR-WINDSHIELD WIPER SWITCH	43
A09	CONNECTOR-LIGHT SWITCH	43
A10	CONNECTOR	42
A11	CONNECTOR	42
A12	CONNECTOR	42
A13	CONNECTOR	41
A14	CONNECTOR	38
A15	CONNECTOR	40
A16	CONNECTOR	43
A17	CONNECTOR	38
A19	CONNECTOR	42
A20	CONNECTOR	42
A21	CONNECTOR	38
A22	CONNECTOR-UNUSED	38
A23	CONNECTOR	37
A26	CONNECTOR	41
A31	CONNECTOR	37
A35	CONNECTOR	42
A36	CONNECTOR	37
A38	CONNECTOR	40
A39	CONNECTOR	43
A40	CONNECTOR	38
A41	CONNECTOR	43
A46	CONNECTOR	41
A61	CONNECTOR	38
A62	GROUND-FIREWALL	38
A64	SPLICE	41
A66	SPLICE	41
A67	CONNECTOR-UNUSED	42
A68	CONNECTOR	35
A69	CONNECTOR	35
A70	CONNECTOR	35
A71	INTERNAL SPLICE	39
A72	INTERNAL SPLICE	40
A73	SPLICE	35
A74	SPLICE	35
A76	GROUND-FIREWALL	37
A79	CONNECTOR	39
B01	CONNECTOR	39
E01	CONNECTOR	45
E02	CONNECTOR	44
E03	CONNECTOR	43
E04	DIAGNOSTIC PLUG	40
E05	CONNECTOR	40
E06	CONNECTOR	39
E07	DIAGNOSTIC PLUG	40
E08	CONNECTOR	39
E09	CONNECTOR	38
E10	CONNECTOR	37
E11	CONNECTOR	44
E12	CONNECTOR	44
E21	INTERNAL SPLICE	44
E22	INTERNAL SPLICE	45
E23	INTERNAL SPLICE	44
E24	INTERNAL SPLICE	44
E25	INTERNAL SPLICE	43
E26	INTERNAL SPLICE	43
E28	INTERNAL SPLICE	44
F01	CONNECTOR	38
F03	CONNECTOR	37
F04	CONNECTOR	38
F05	CONNECTOR	38
F11	CONNECTOR	38
G01	CONNECTOR	38
G02	CONNECTOR	38
G03	CONNECTOR	36
G04	CONNECTOR	38
G06	CONNECTOR	38
G10	TERMINAL-ALTERNATOR,POSITIVE	36
G11	WATER TEMPERATURE SENSOR (LIGHT)	36
G12	WATER TEMPERATURE SENSOR (GUAGE)	36
G13	OIL PRESSURE SENSOR	36
J01	CONNECTOR	42
J02	CONNECTOR	43
J03	CONNECTOR	44
J04	CONNECTOR	44
J05	CONNECTOR	44
K01	CONNECTOR	37
K02	CONNECTOR	37
K03	CONNECTOR	37
K04	CONNECTOR	37
K05	CONNECTOR	36
K06	CONNECTOR	36
K18	CONNECTOR	38
K24	CONNECTOR	36
L01	CONNECTOR	36
L02	CONNECTOR	36
L03	CONNECTOR	36
L04	CONNECTOR	37
L05	CONNECTOR	37
L06	CONNECTOR	37
L07	CONNECTOR	37
L10	CONNECTOR	36
L12	CONNECTOR	36
L24	TERMINAL-ALTERNATOR,NEGATIVE	36
L44	CONNECTOR	36
L56	CONNECTOR	35
L74	INTERNAL SPLICE	36
M01	CONNECTOR	40
M02	CONNECTOR	40
M03	CONNECTOR	43
M04	CONNECTOR	44
M05	CONNECTOR	44
M06	CONNECTOR	44
M09	CONNECTOR	44
M18	CONNECTOR	44
M20	CONNECTOR	44
M50	CONNECTOR	46
M51	CONNECTOR	46
M62	CONNECTOR	44
M64	CONNECTOR	44
M65	CONNECTOR	45
S01	CONNECTOR	46
S02	CONNECTOR	46
T01	CONNECTOR	39
T02	CONNECTOR	39
T03	CONNECTOR	39
T04	CONNECTOR	39
T05	CONNECTOR	39
T06	CONNECTOR	39
T07	CONNECTOR	39
T08	CONNECTOR	39
T09	CONNECTOR	39
T10	CONNECTOR	39
T11	CONNECTOR	39

EARLY 1985 PRODUCTION

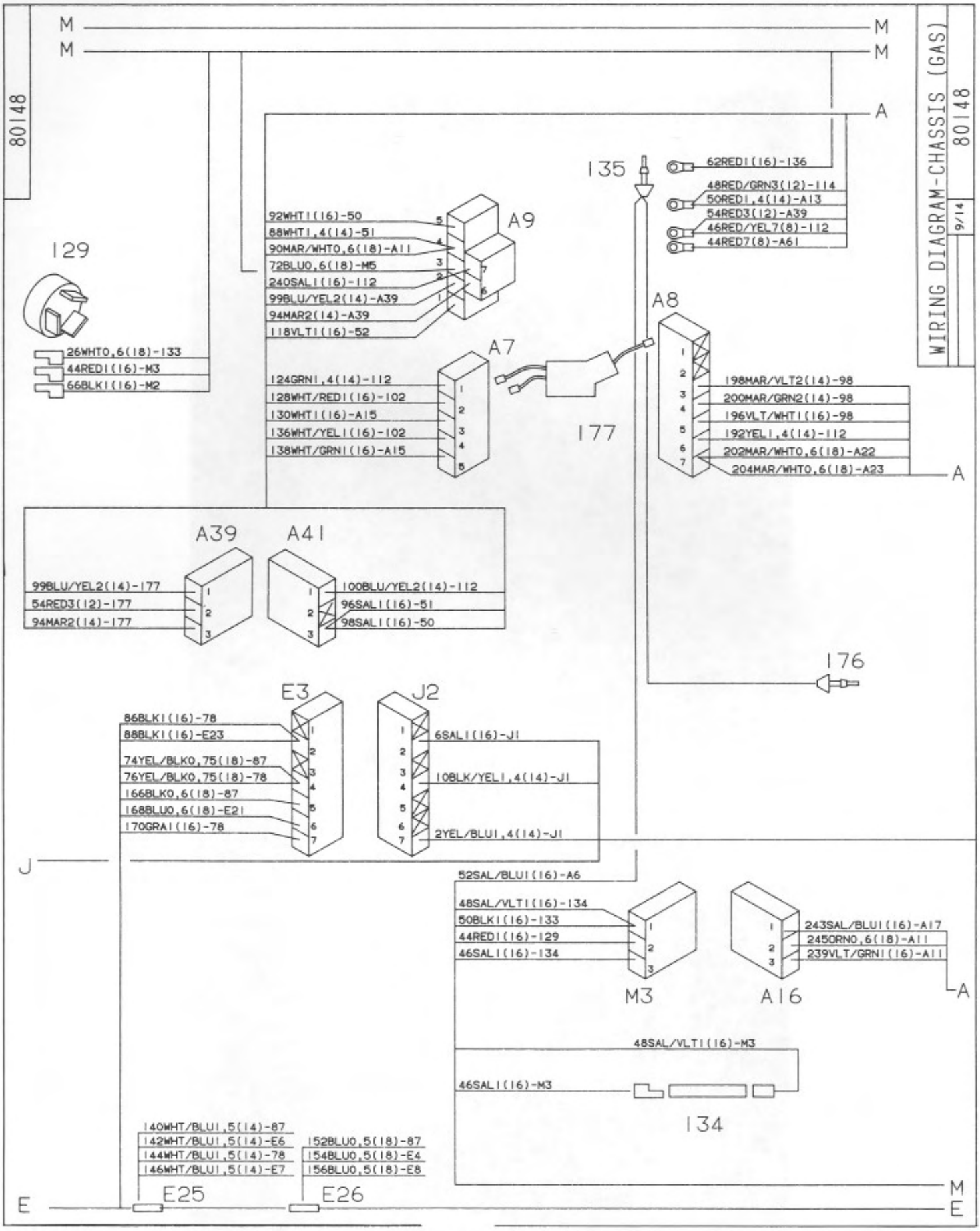



80148
M
M
WIRING DIAGRAM-CHASSIS (GAS)
80148
11/14
G RED(14)-159
F RED(14)-144
K GRA(14)-160
D BRN(14)-M51
B GRN(14)-M51
A YEL(14)-160
E BLK(14)-160
V RED/WHT(16)-148
C WHT(16)-149
16RED/BLU1(16)-M1
78RED/YEL1,4(14)-M5
76YEL/ORN1,4(14)-M5
4BLU/WHT1,4(14)-M1
2 BLU/GRN1,4(14)-M1
58BLU/WHT1(16)-M6
56BLU/GRN1(16)-M6
12YEL/ORN1(16)-M1
86YEL/VLT1,4(14)-M2
54BLK0,6(18)-A6
142
2CWHT(16)-141
2VRED/WHT(16)-141
141
G BLK/WHT(16)
F ORN/BLK(16)
R
F ORN/BLK(16)-140
G BLK/WHT(16)-140
140
230RN0,6(18)-M1
22BGE/GRN0,6(18)-M1
24BLK0,6(18)-M1
M65
1CWHT(16)-142
1VRED/WHT(16)-141
86
+
68RED2(14)-E5
148WHT2(14)-85
-
148
4VRED/WHT(16)-141
5J WHT(14)-163
4F RED(14)-141
144
151
5VRED/WHT(16)-148
6J/WHT(14)-148
5F RED(14)-144
145
M
150
8VRED/WHT(16)-149
5CWHT(16)-149
7F RED(14)-145
146
149
7VRED/WHT(16)-151
6CWHT(16)-141
8F RED(14)-146
147
E1
87
13 140WHT/BLU1,5(14)-E25
12
25 11 136WHT2(14)-E6
24 10 126VLT0,75(18)-85
23 9 166BLK0,6(18)-E3
22 8 118RED0,6(18)-E24
21 7 58WHT/GRN0,75(18)-E21
20 6 60BLU/RED0,75(18)-73
19 5 116SAL1(16)-73
18 4 150VLT0,75(18)-E4
17 3 114GRN1(16)-73
16 2 112GRA1(16)-79
15 1 108YEL1(16)-E22
14 110GRA1(16)-79
90BLK1(16)-E23
160ORN0,75(18)-E20
152BLU0,75(18)-E26
74YEL/BLU0,75(18)-E3
108YEL(16)-87
106YEL(16)-85
104YEL(16)-E4
102YEL(16)-70
100YEL(10)-E6
E22
158BLK0,75(18)-E11
160ORN0,75(18)-87
162ORN0,75(18)-E4
E

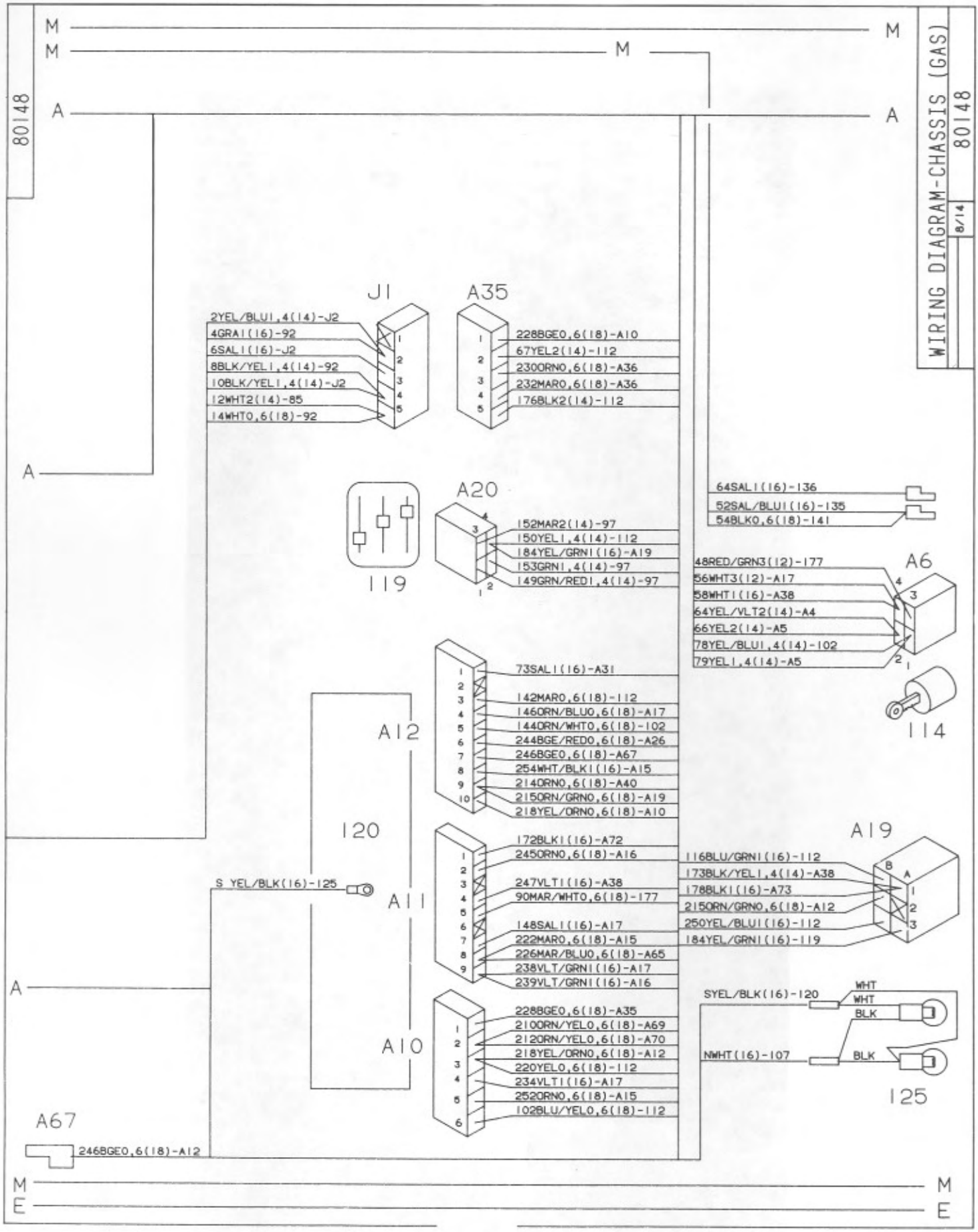
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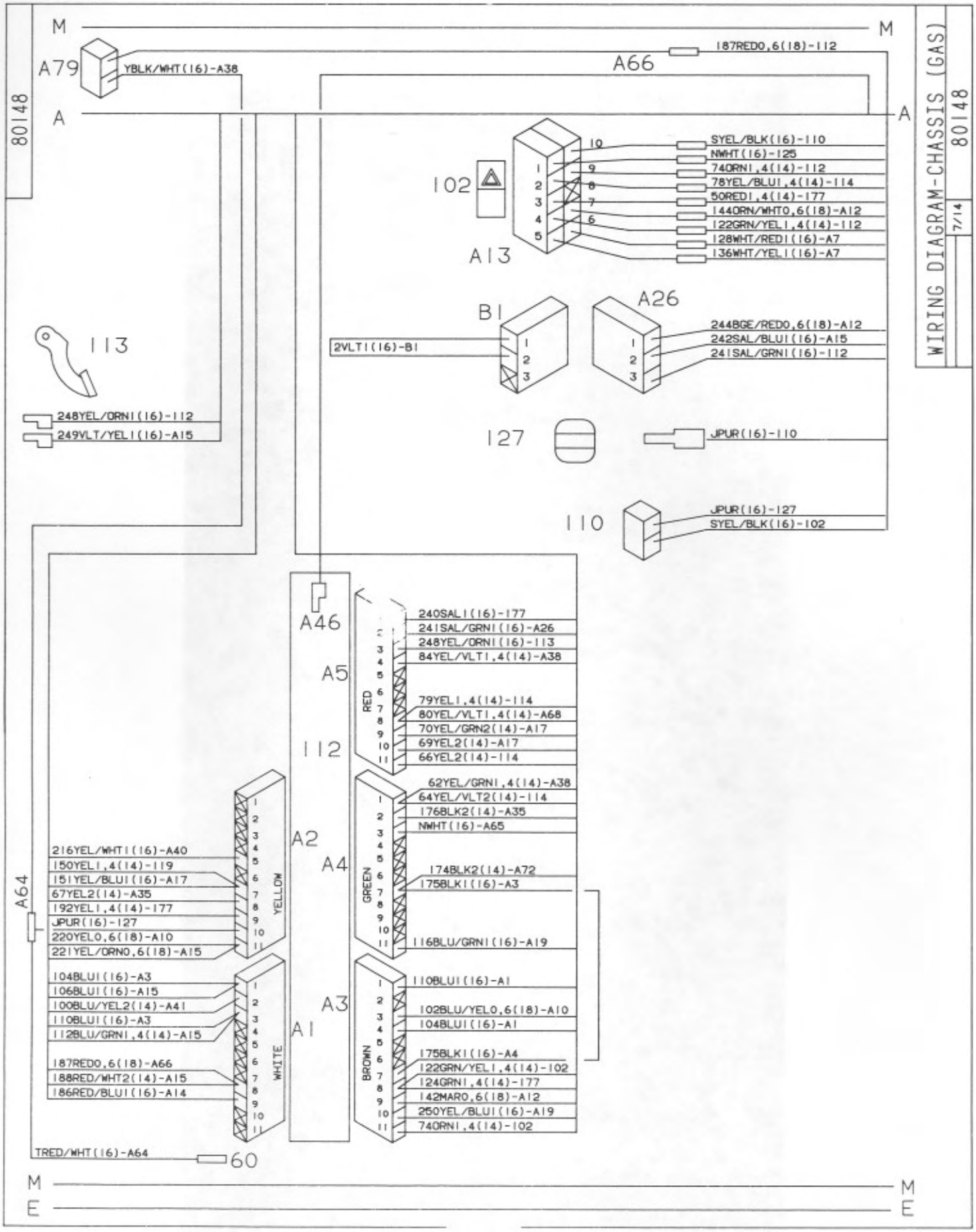
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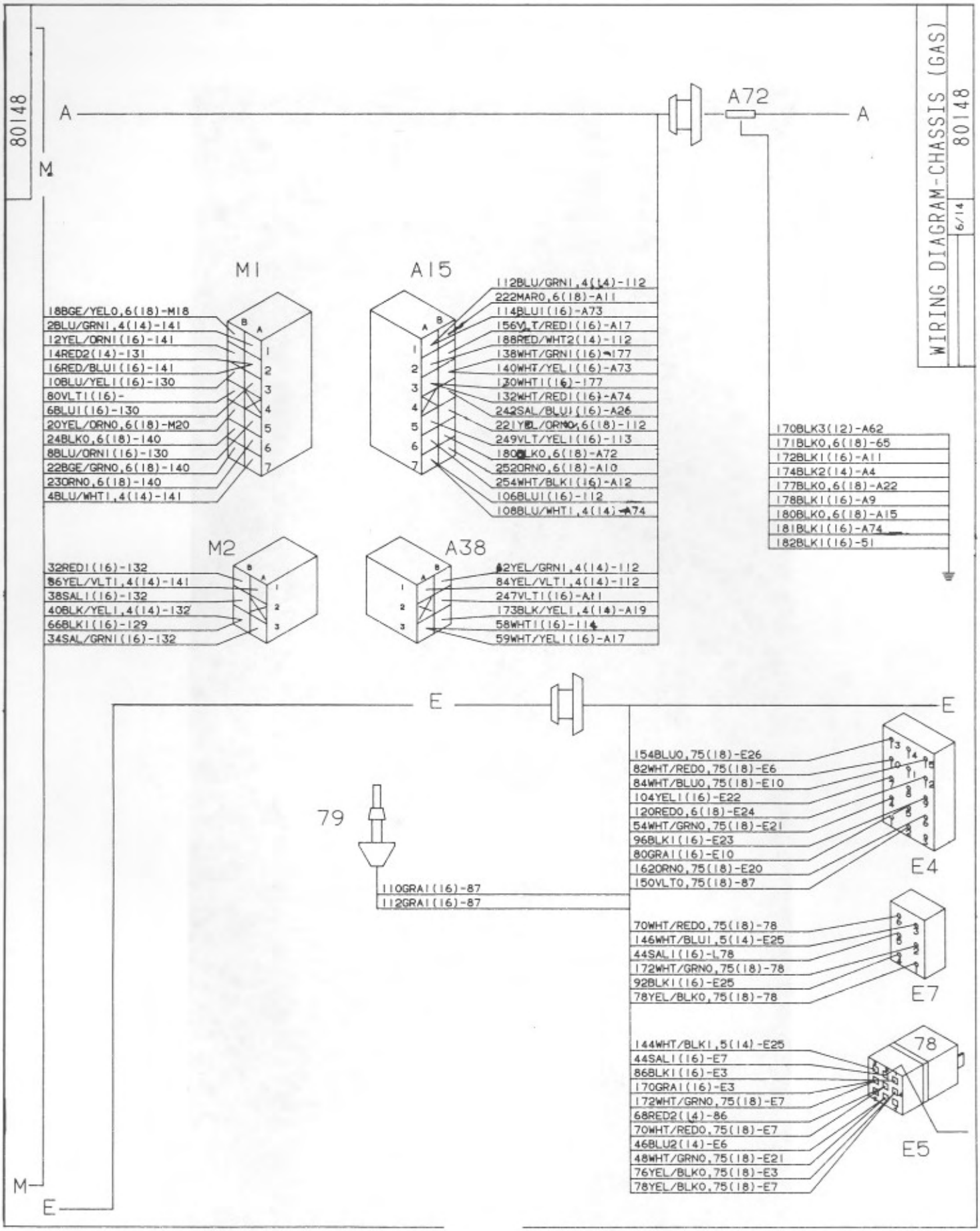
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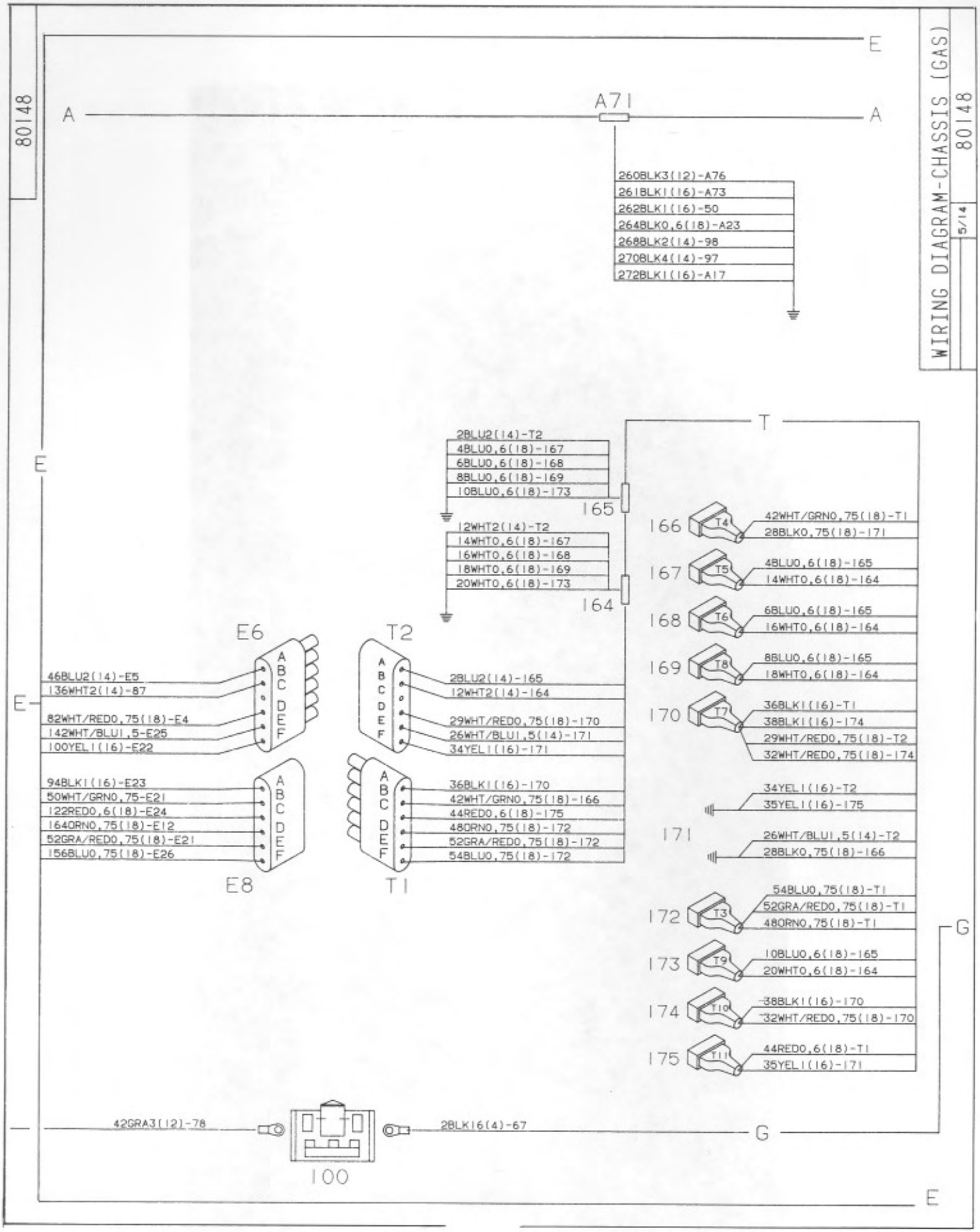


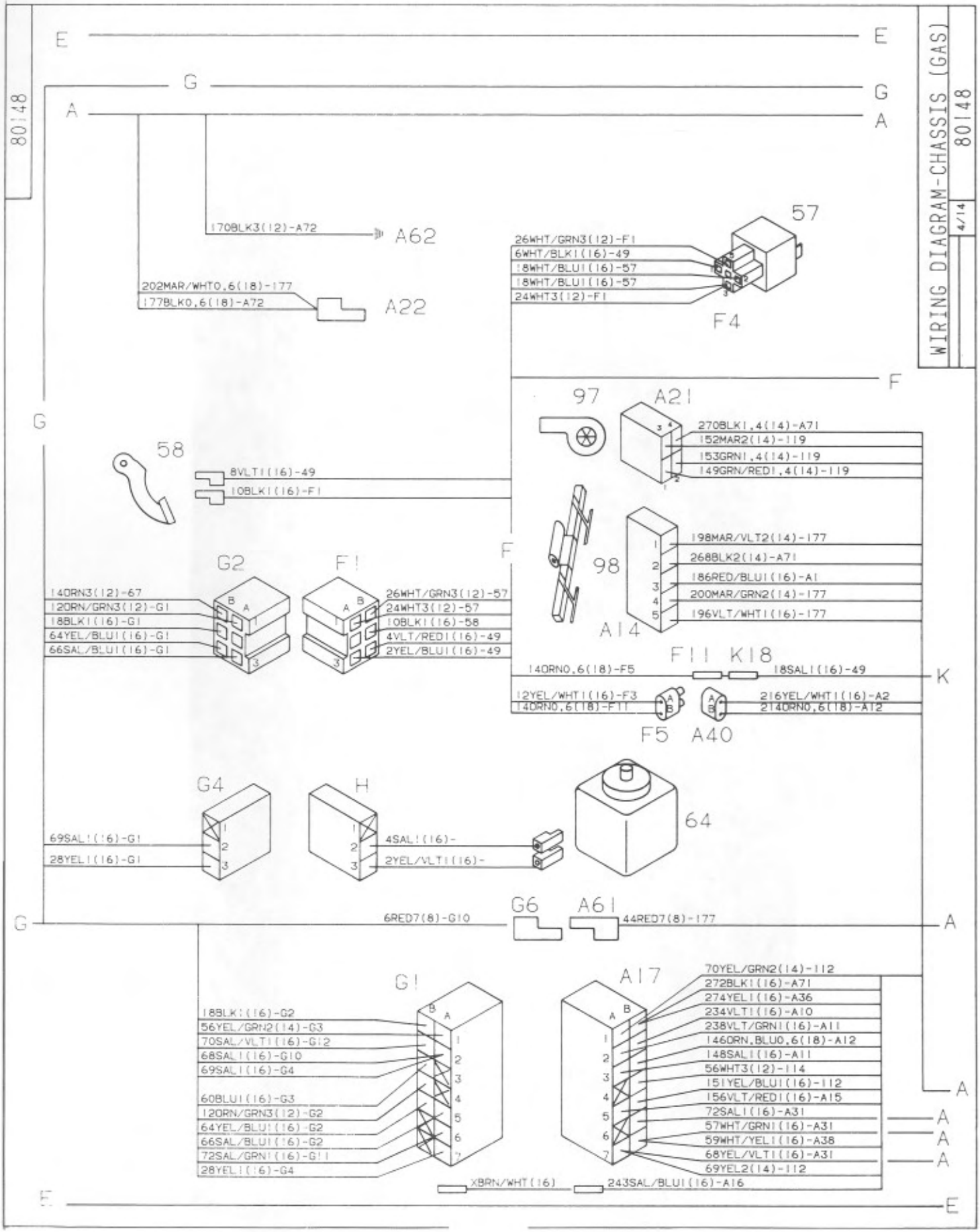
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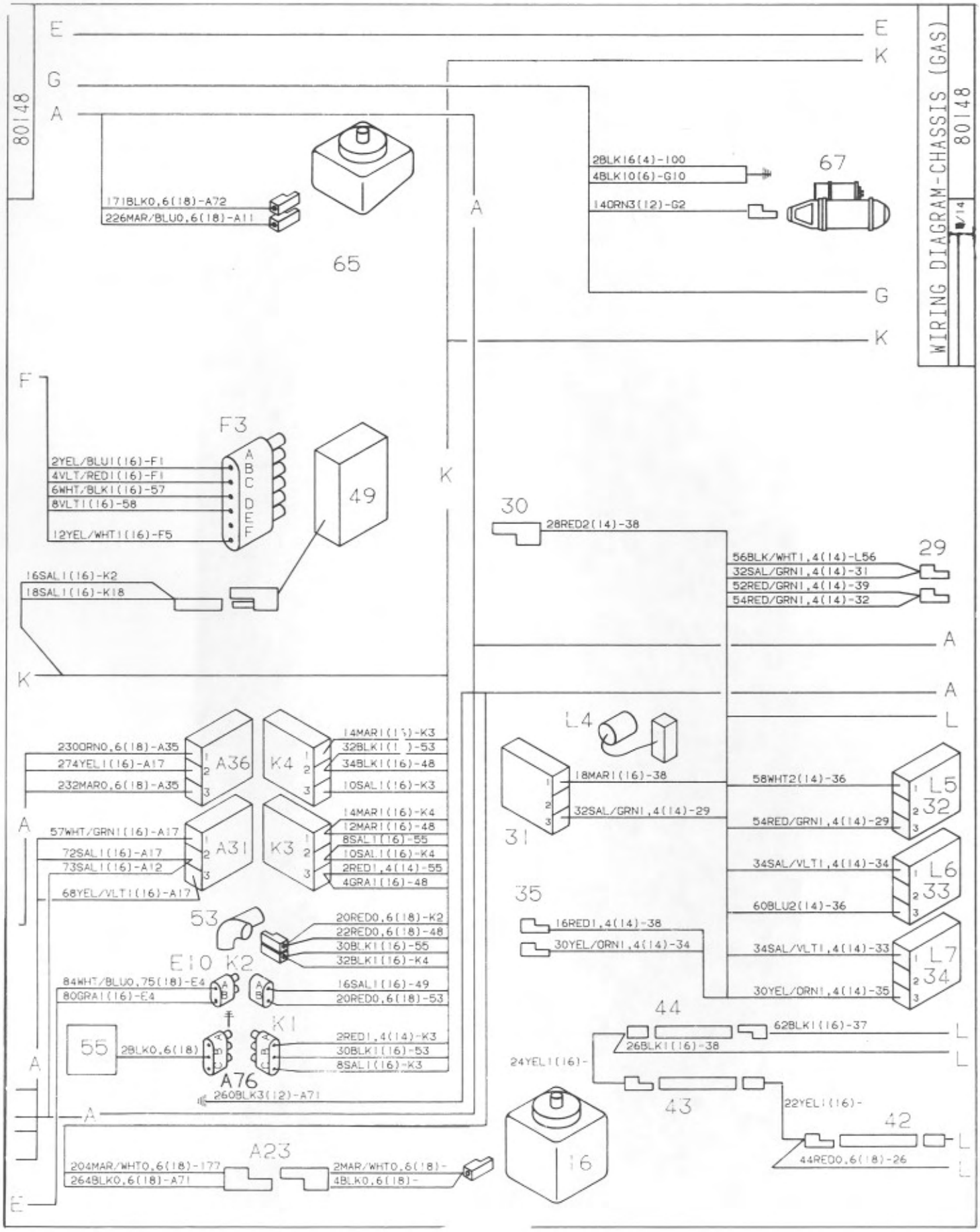
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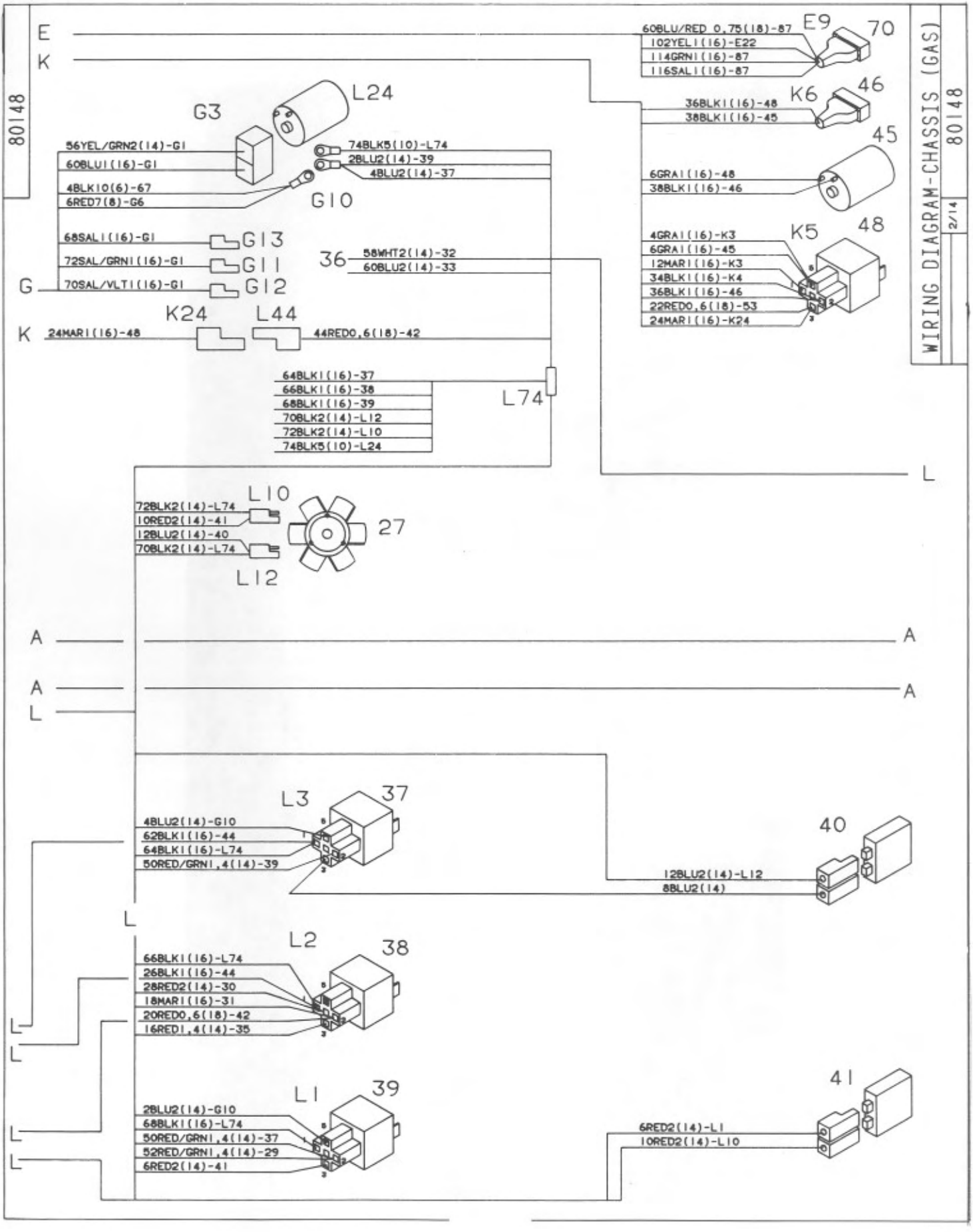

80148
WIRING DIAGRAM-CHASSIS (GAS)
80148
5/14
E
A
A71
A
260BLK3(12)-A76
261BLK1(16)-A73
262BLK1(16)-50
264BLK0,6(18)-A23
268BLK2(14)-98
270BLK4(14)-97
272BLK1(16)-A17
T
2BLU2(14)-T2
4BLU0,6(18)-167
6BLU0,6(18)-168
8BLU0,6(18)-169
10BLU0,6(18)-173
165
12WHT2(14)-T2
14WHT0,6(18)-167
16WHT0,6(18)-168
18WHT0,6(18)-169
20WHT0,6(18)-173
164
166 T4 42WHT/GRN0,75(18)-T1
28BLK0,75(18)-171
167 T5 4BLU0,6(18)-165
14WHT0,6(18)-164
168 T6 6BLU0,6(18)-165
16WHT0,6(18)-164
169 T8 8BLU0,6(18)-165
18WHT0,6(18)-164
170 T7 36BLK1(16)-T1
38BLK1(16)-174
29WHT/RED0,75(18)-T2
32WHT/RED0,75(18)-174
34YEL1(16)-T2
35YEL1(16)-175
171
26WHT/BLU1,5(14)-T2
28BLK0,75(18)-166
172 T3 54BLU0,75(18)-T1
52GRA/RED0,75(18)-T1
48ORN0,75(18)-T1
173 T9 10BLU0,6(18)-165
20WHT0,6(18)-164
174 T10 38BLK1(16)-170
32WHT/RED0,75(18)-170
175 T11 44RED0,6(18)-T1
35YEL1(16)-171
E
E6
46BLU2(14)-E5
136WHT2(14)-87
82WHT/RED0,75(18)-E4
142WHT/BLU1,5-E25
100YEL1(16)-E22
E8
94BLK1(16)-E23
50WHT/GRN0,75-E21
122RED0,6(18)-E24
164ORN0,75(18)-E12
52GRA/RED0,75(18)-E21
156BLU0,75(18)-E26
T2
28LU2(14)-165
12WHT2(14)-164
29WHT/RED0,75(18)-170
26WHT/BLU1,5(14)-171
34YEL1(16)-171
T1
36BLK1(16)-170
42WHT/GRN0,75(18)-166
44RED0,6(18)-175
48ORN0,75(18)-172
52GRA/RED0,75(18)-172
54BLU0,75(18)-172
G
42GRA3(12)-78
28LK16(4)-67
G
100
E


WIRING DIAGRAM-CHASSIS (GAS)
80148
4/14
80148
E
G
A
170BLK3(12)-A72
A62
202MAR/WHTO,6(18)-177
177BLKO,6(18)-A72
A22
57
26WHT/GRN3(12)-F1
6WHT/BLK1(16)-49
18WHT/BLU1(16)-57
18WHT/BLU1(16)-57
24WHT3(12)-F1
F4
F
97
A21
270BLK1,4(14)-A71
152MAR2(14)-119
153GRN1,4(14)-119
149GRN/RED1,4(14)-119
58
8VLT1(16)-49
10BLK1(16)-F1
98
198MAR/VLT2(14)-177
268BLK2(14)-A71
186RED/BLU1(16)-A1
200MAR/GRN2(14)-177
196VLT/WHT1(16)-177
A14
G2
F1
140RN3(12)-67
120RN/GRN3(12)-G1
18BLK1(16)-G1
64YEL/BLU1(16)-G1
66SAL/BLU1(16)-G1
26WHT/GRN3(12)-57
24WHT3(12)-57
10BLK1(16)-58
4VLT/RED1(16)-49
2YEL/BLU1(16)-49
F11 K18
140RNO,6(18)-F5
18SAL1(16)-49
K
12YEL/WHT1(16)-F3
140RNO,6(18)-F11
216YEL/WHT1(16)-A2
214ORNO,6(18)-A12
F5 A40
G4
H
64
69SAL1(16)-G1
28YEL1(16)-G1
4SAL1(16)-
2YEL/VLT1(16)-
6RED7(8)-G10
G6
A61
44RED7(8)-177
A
G1
A17
18BLK1(16)-G2
56YEL/GRN2(14)-G3
70SAL/VLT1(16)-G12
68SAL1(16)-G10
69SAL1(16)-G4
60BLU1(16)-G3
120RN/GRN3(12)-G2
64YEL/BLU1(16)-G2
66SAL/BLU1(16)-G2
72SAL/GRN1(16)-G11
28YEL1(16)-G4
70YEL/GRN2(14)-112
272BLK1(16)-A71
274YEL1(16)-A36
234VLT1(16)-A10
238VLT/GRN1(16)-A11
146ORN,BLUO,6(18)-A12
148SAL1(16)-A11
56WHT3(12)-114
151YEL/BLU1(16)-112
156VLT/RED1(16)-A15
72SAL1(16)-A31
57WHT/GRN1(16)-A31
59WHT/YEL1(16)-A38
68YEL/VLT1(16)-A31
69YEL2(14)-112
XBRN/WHT(16)
243SAL/BLU1(16)-A16
A
A
A
A
E

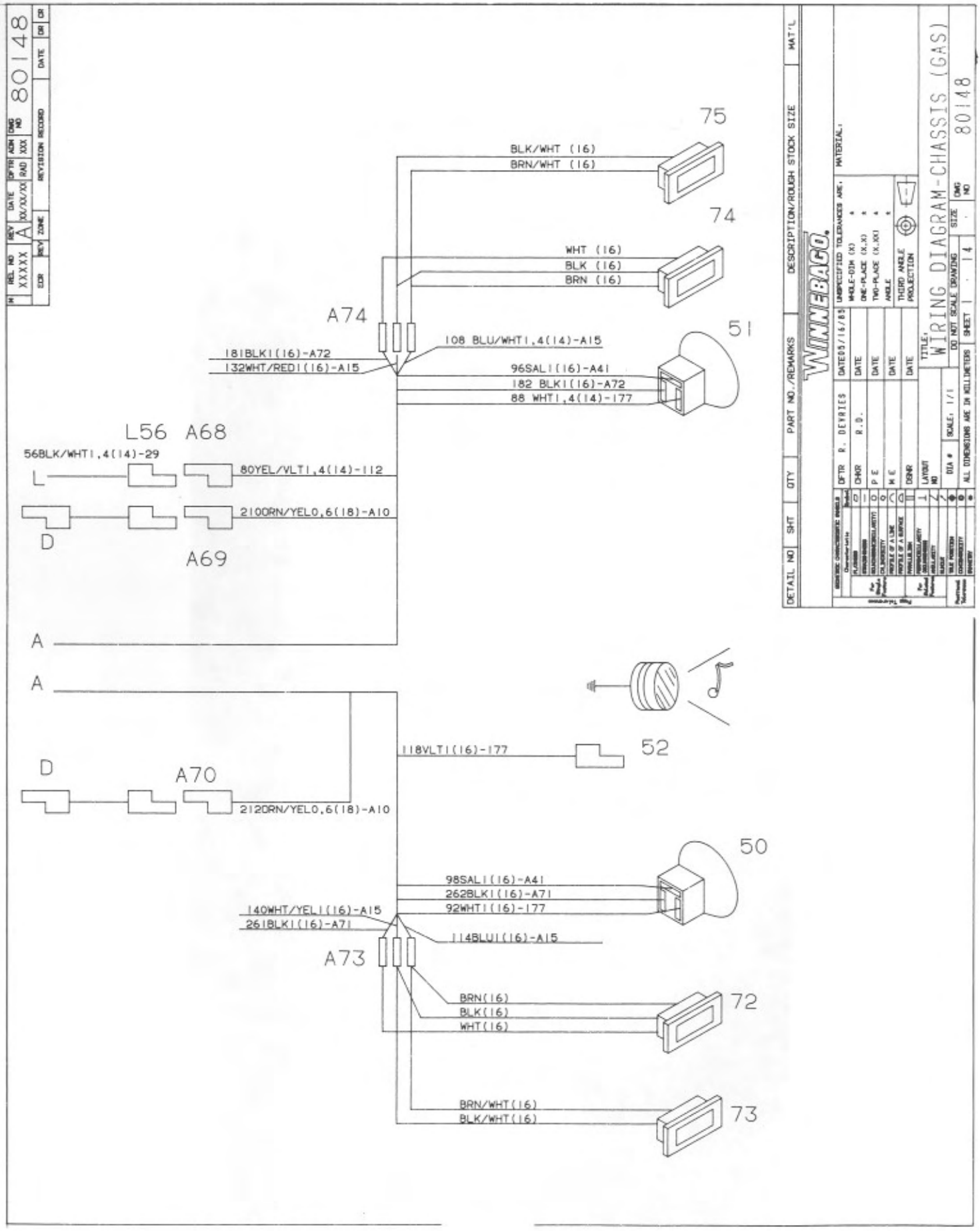
EARLY 1985 PRODUCTION



EARLY 1985 PRODUCTION



EARLY 1985 PRODUCTION



DIESEL CHASSIS WIRING
1983 Centauri Van
(Serial #30001 to 30357 only) See last 5 digits of Winnebago Serial No.

DRAWING NO.	MODEL DESIGNATION/SERIAL NO.	SHT
74880 -01	83CRZ20VC / 30001 TO 30357	1&3
74880 -02	83CRZ20VC / 30358 AND OVER	2&3
74880 -03	83W/RZ20RD/ 30358 AND OVER	2&4
74880 -04	83 5RZ20RS	2&5

COLOR CODE	
BLK	BLACK
BRN	BROWN
BLU	BLUE
GRN	GREEN
ORN	ORANGE
RED	RED
PUR	PURPLE
GRY	GRAY
WHT	WHITE
YEL	YELLOW

LEGEND

⏚ GROUND

WIRE GUAGE CODE – NO. IN FRONT OF COLOR INDICATES WIRE GUAGE

⟶ ELECTRICAL CONNECTION

⟶ ELECTRICAL SPLICE

* WIRE DESIGNATION WITH A "T" ARE SAE WIRE GUAGE ALL OTHERS ARE MM²

REV	ZONE	REVISION RECORD	DATE	DR	CK
4942	B	F-5 SHT 2 REMOVE RESISTOR	5-9-83	SP	JB
5526	C	ADD -04/SHTS/3&5 ADD A/C DIODE	9-6-83	SP	JB

WINNEBAGO.

ALL DIMENSIONS ARE IN MILLIMETERS

TITLE: WIRING DIAGRAM – BODY / CHASSIS

DO NOT SCALE DRAWING — SHEET 1 OF 5 — SIZE E — DWG NO. 74880

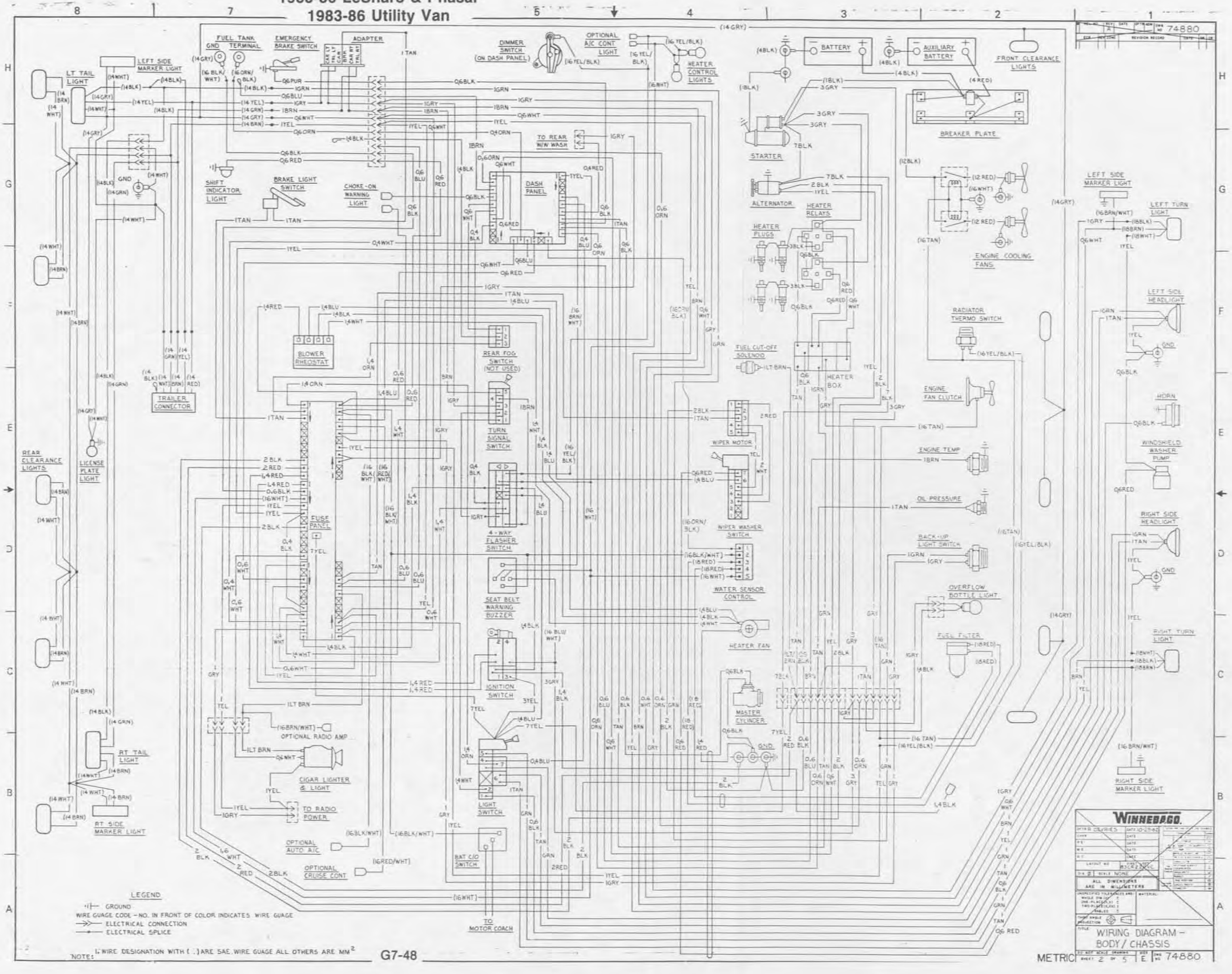
METRIC

DIESEL CHASSIS WIRING

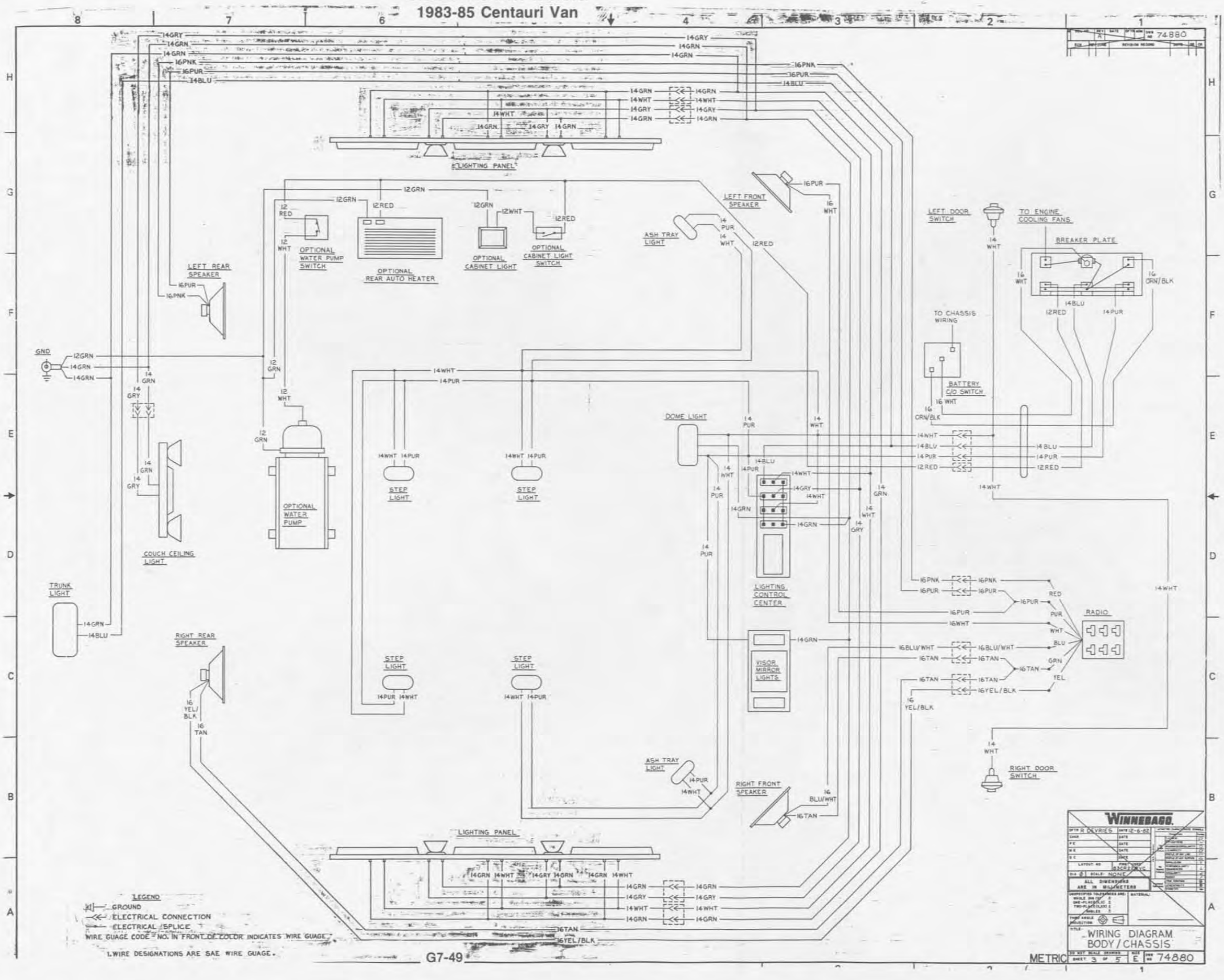
1983-86 Centauri Van (Serial #30358 and up) See last 5 digits of Winnebago Serial No.

1983-86 LeSharo & Phasar

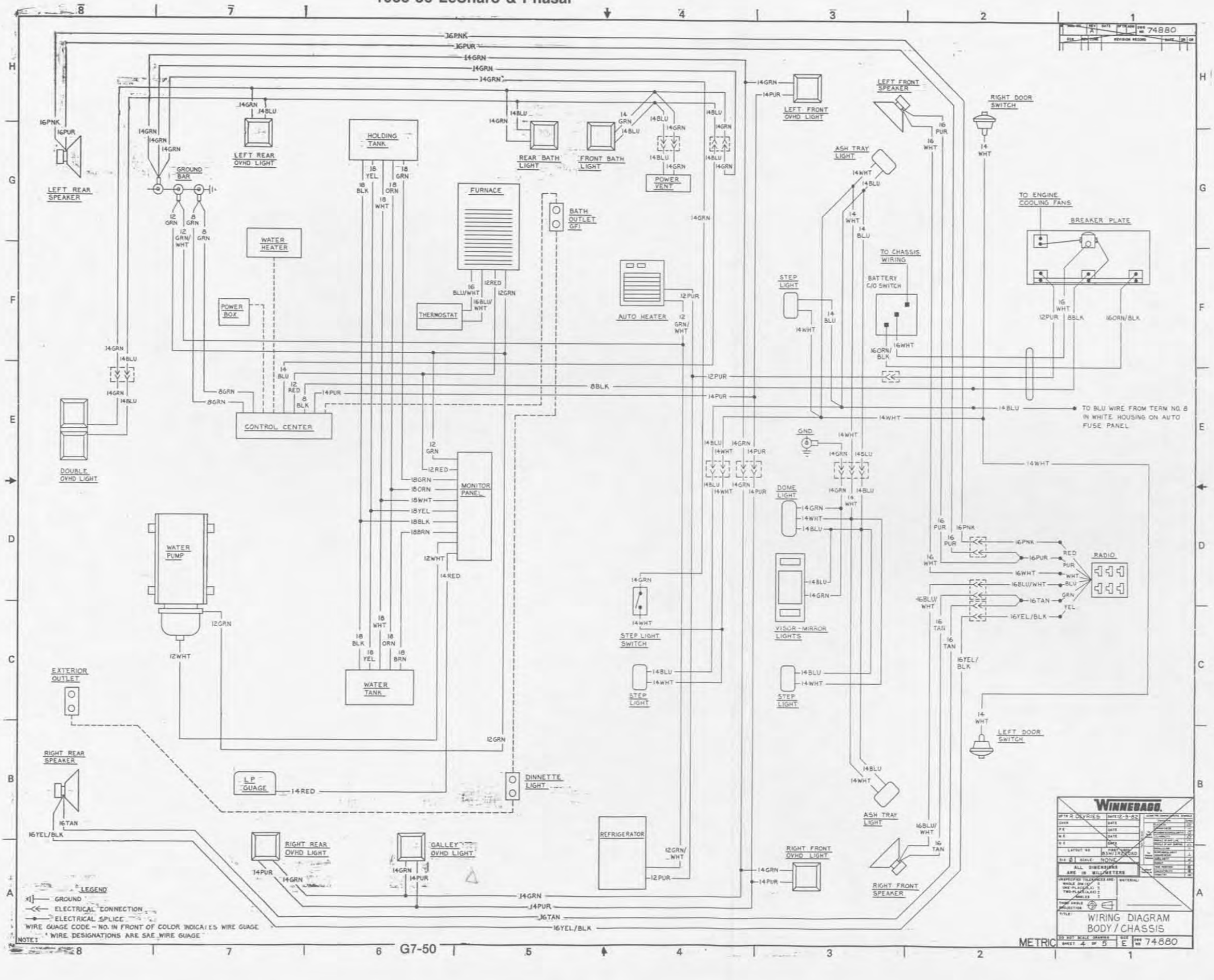
1983-86 Utility Van



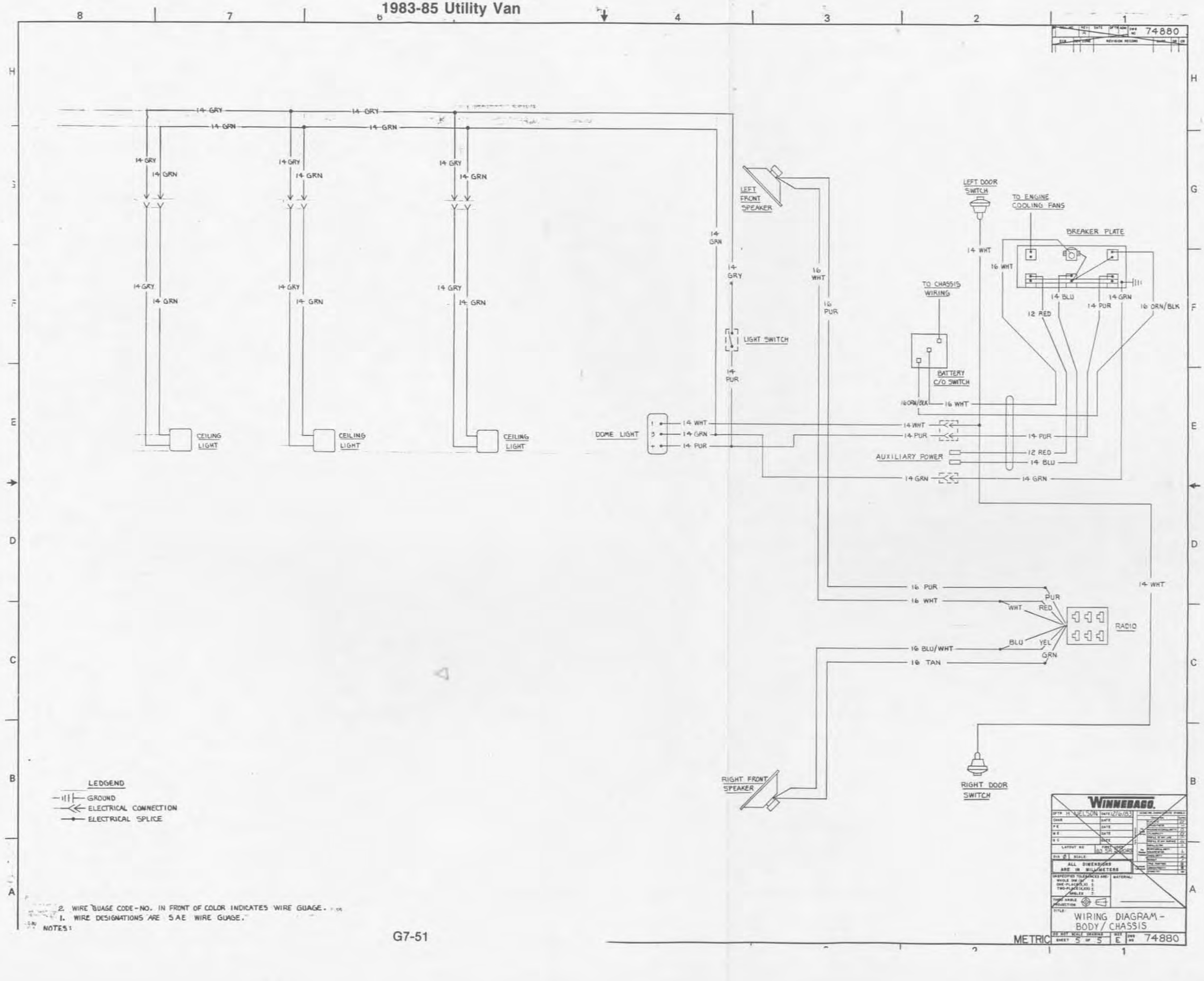
DIESEL COACH WIRING
1983-85 Centauri Van



DIESEL COACH WIRING
1983-86 LeSharo & Phasar



DIESEL COACH WIRING
1983-85 Utility Van



LEDGEND

- GROUND
- ELECTRICAL CONNECTION
- ELECTRICAL SPLICE

NOTES:

1. WIRE DESIGNATIONS ARE SAE WIRE GUAGE.
2. WIRE GUAGE CODE-NO. IN FRONT OF COLOR INDICATES WIRE GUAGE.

SECTION "H"

MANUAL GEARBOX (TRANSAXLE)

Subsection 1 **General Information**

H1-1 Specifications
H1-3 Exploded Views
H1-10 Special Tools
H1-14 Special Features Information

Subsection 2 **Removal and Installation**

H2-1 R & R Procedure

Subsection 3 **Rebuild**

H3-1 Disassembly
H3-9 Clean and Inspect
H3-10 Final Drive Assembly
H3-19 Primary Shaft Assembly
H3-23 Secondary Shaft Assembly
H3-31 Final Assembly

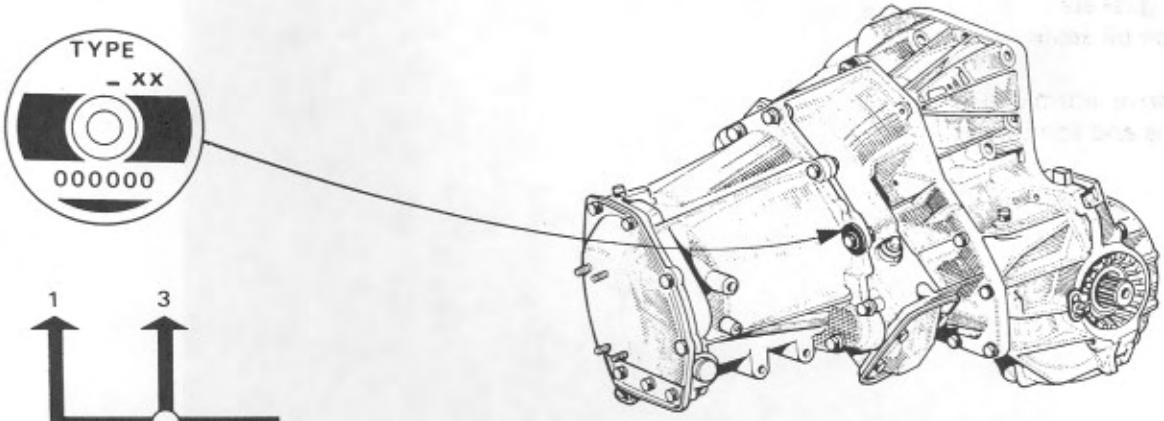
Subsection 4 **Seal Replacement (Transaxle in Vehicle)**

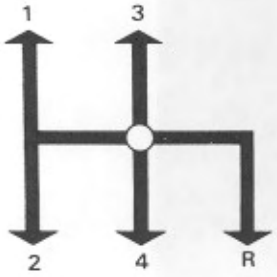
H4-1 Differential Seal and Nut
H4-2 Speedometer Shaft Seal

GENERAL INFORMATION

SPECIFICATIONS

The type, suffix and fabrication number are stamped on a plate secured by a casing bolt. (See below) Always use this when ordering replacement parts.





4 forward synchronized speeds:

1st - 2nd Renault synchro.
3rd - 4th Borg-Warner synchro.

Gearbox Model Numbers
NL2- 12
NL2- 50
NL2- 96
NL2-102

OIL

Type	API-GL 5 or MIL-L-2105 B or C
Viscosity	Above 32° F (-10° C): SAE80W-90 Below 32° F (-10° C): SAE75W
Capacity	Gearbox: 2.6 qts. (2.5 liter) Final Drive: .85 qt. (0.8 liter)

- The clutch shaft oil seal can only be removed after the gearbox has been removed and opened.
- The hubs are free-turning on the secondary shaft and limited in sliding movement by snap rings.
- The pinion protrusion cannot be adjusted.
- Adjustment of the ring gear and pinion backlash and differential bearing pre-load are unique to this type of gearbox. (Reference H3-18).

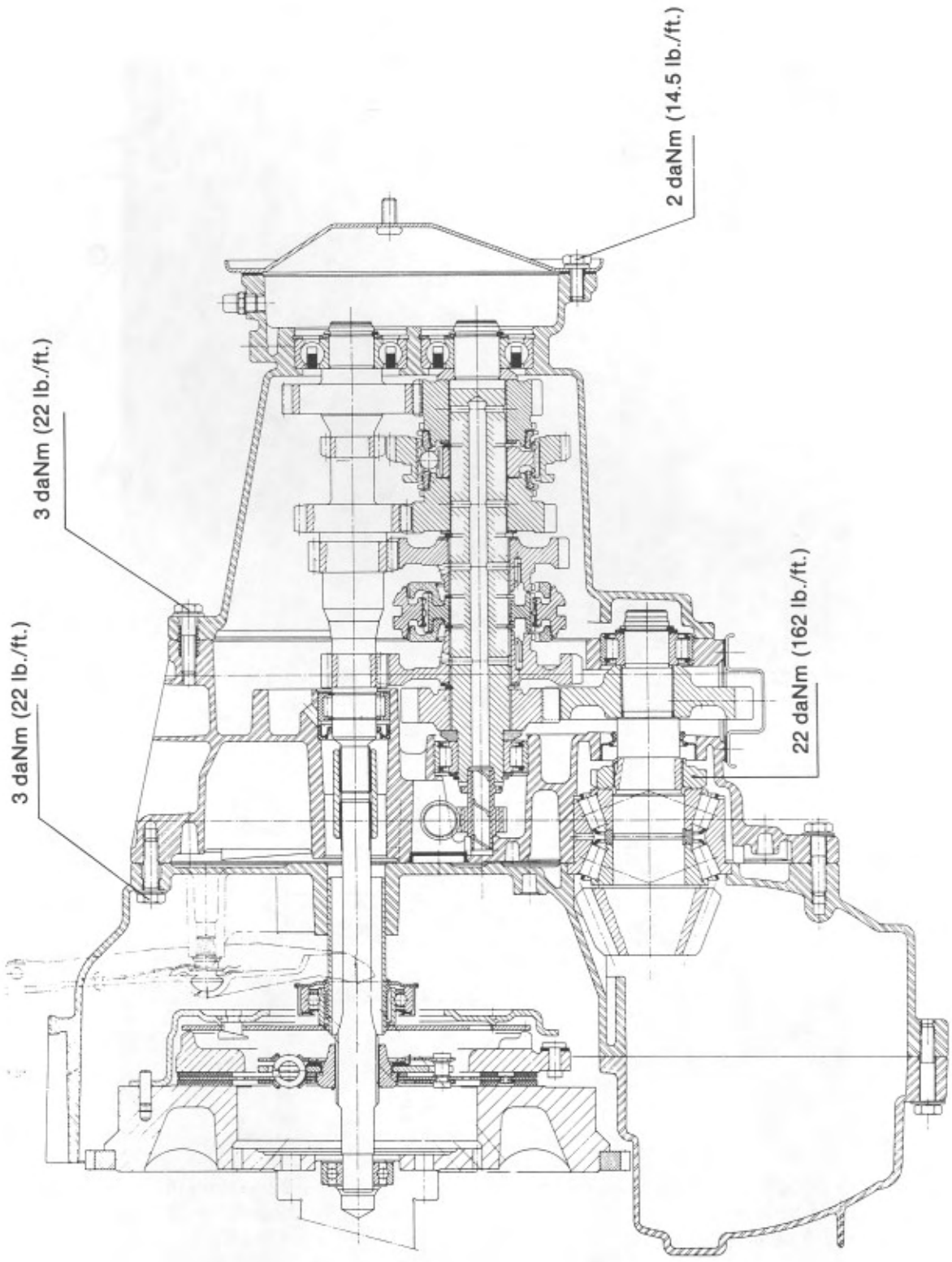
SPECIFICATIONS

IMPORTANT

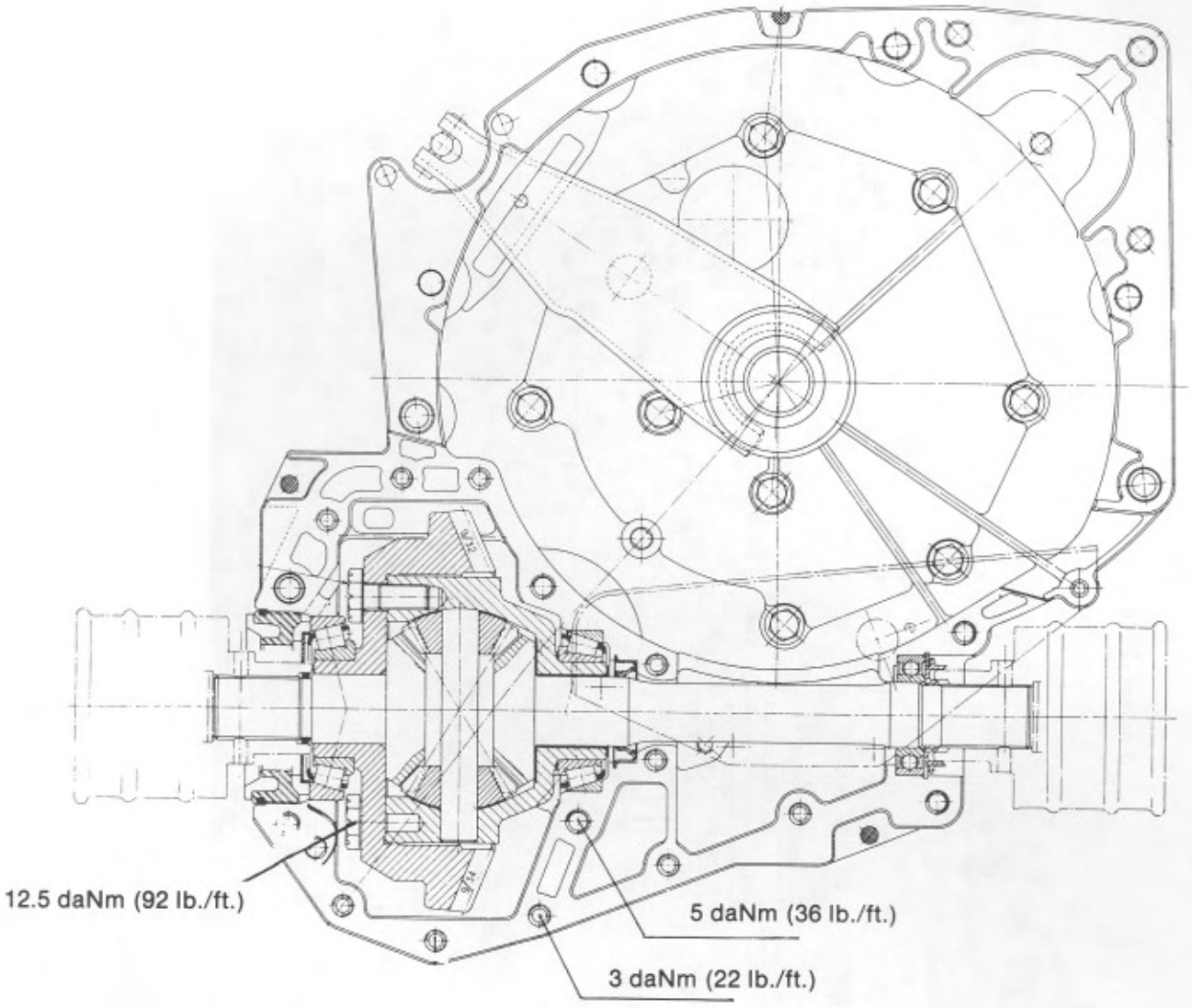
The following parts must be changed routinely whenever a gearbox is overhauled:

- all paper gaskets
- all lip-type oil seals
- rollpins
- speedo drive worm gear
- all circlips and snap rings.

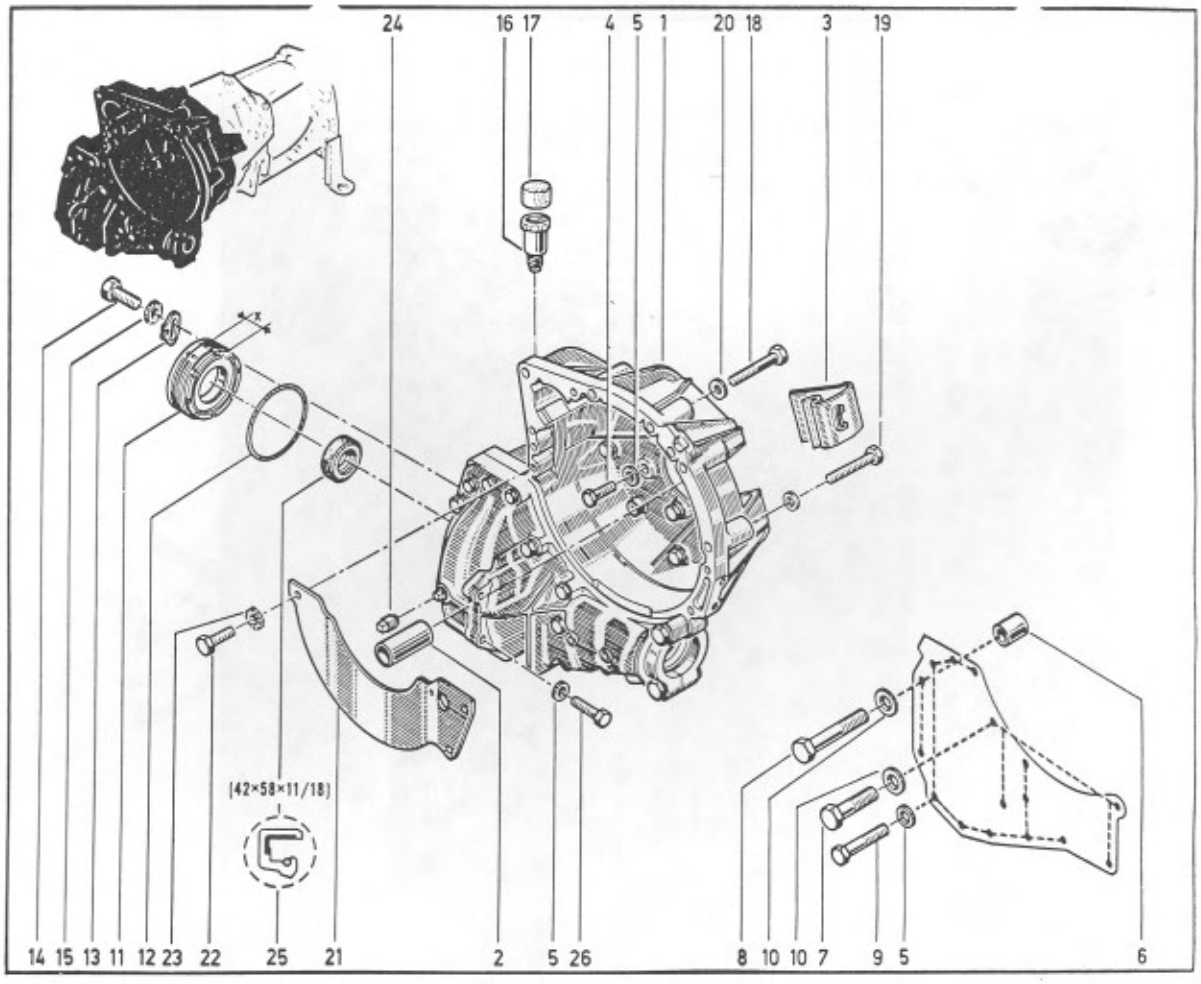
EXPLODED VIEWS



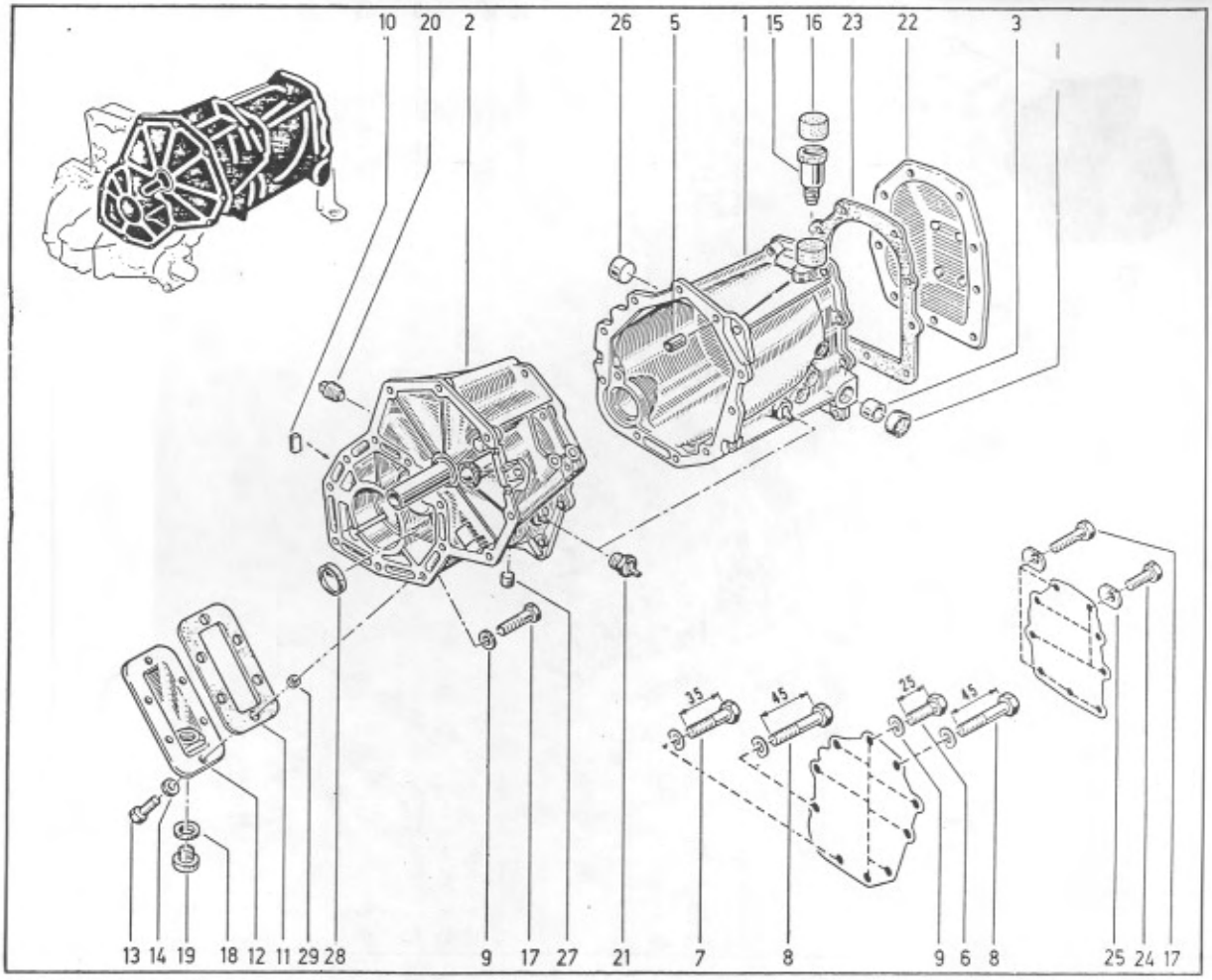
EXPLODED VIEWS



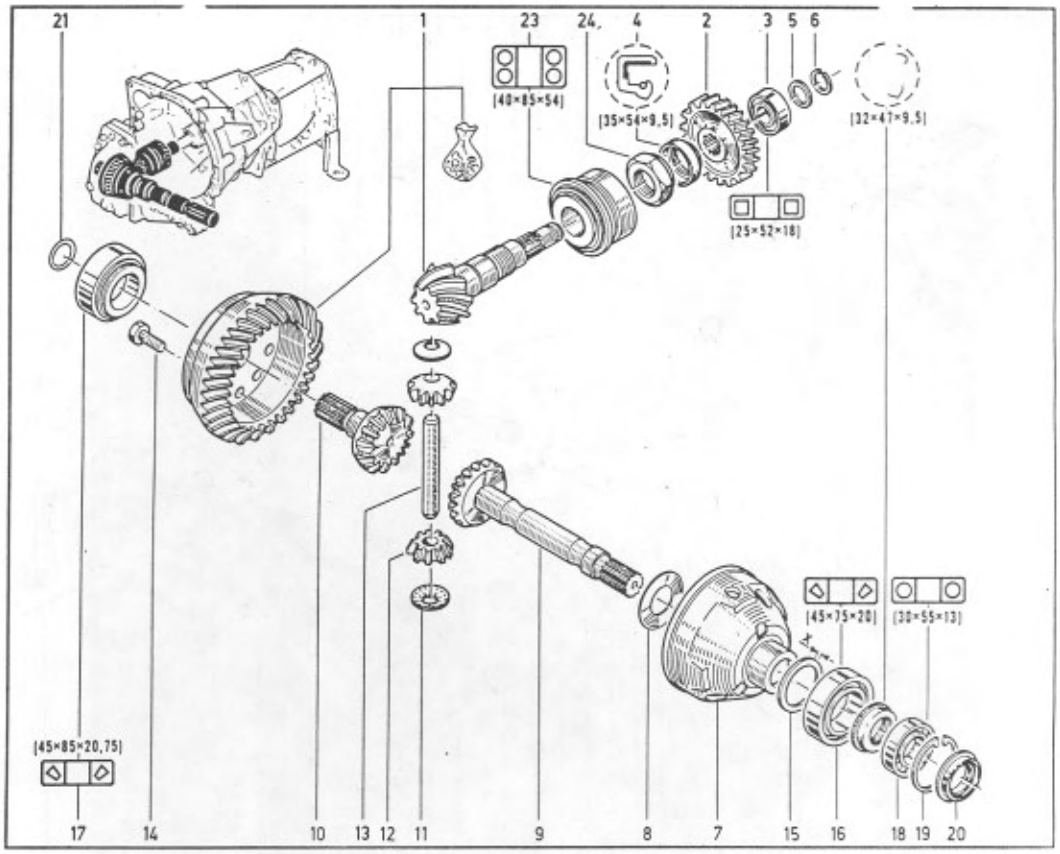
Bearing nut on final drive pinion	22 daNm (162 lb./ft.)
Ring gear bolts	12.5 daNm (92 lb./ft.)
Half housing bolts : 8 mm	3 daNm (22 lb./ft.)
: 10 mm	5 daNm (36 lb./ft.)
Bolts securing clutch housing to step down housing	3 daNm (22 lb./ft.)
Step down housing cover bolts	1.5 daNm (11 lb./ft.)



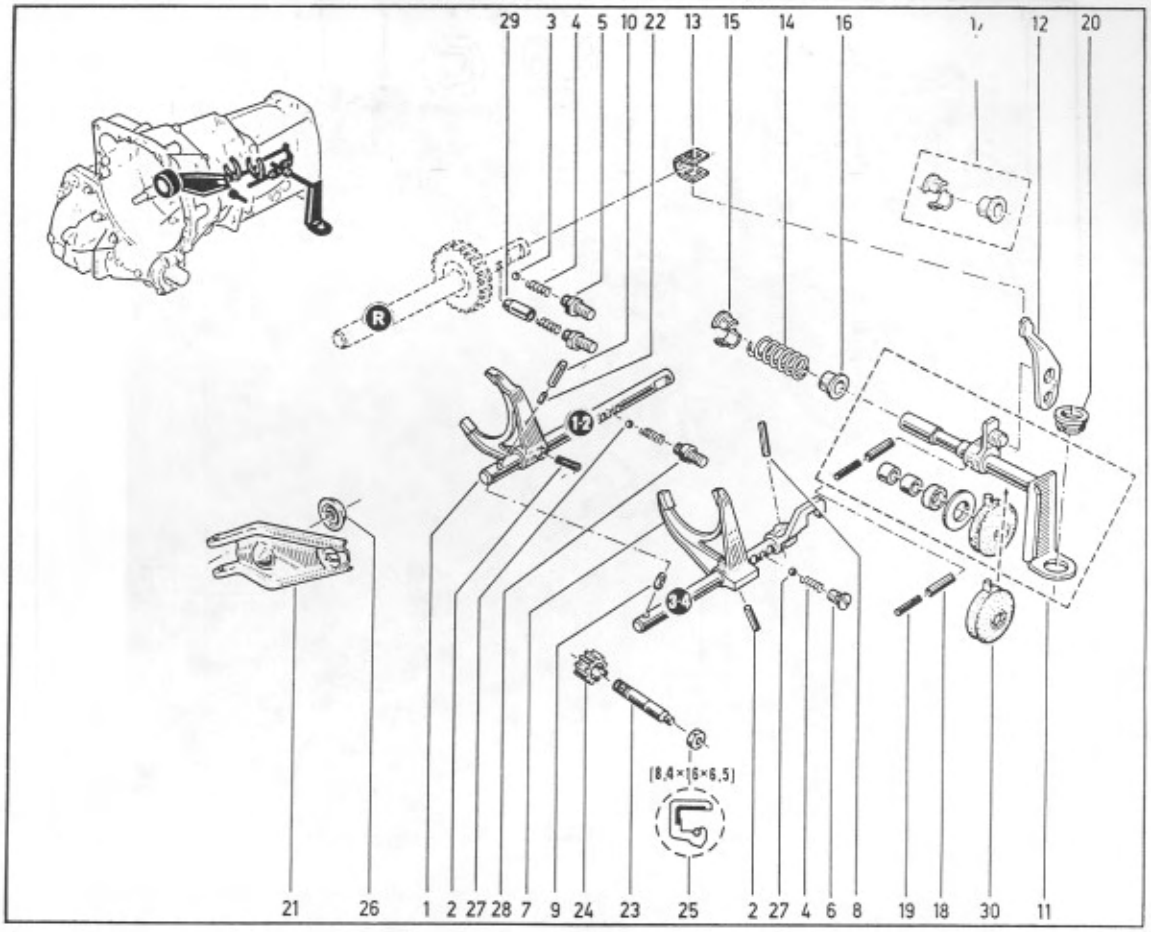
1. Final drive housing
2. Sleeve
3. Boot
4. Bolt
5. Washer
6. Alignment dowel
7. Bolt
8. Bolt
9. Bolt
10. Washer
11. O-Ring
12. Washer
13. Clip
14. Bolt
15. Washer
16. Vent
17. Cover
18. Bolt
19. Bolt
20. Washer
21. Cover
22. Bolt
23. Washer
24. Fill or drain plug
25. Seal
26. Bolt



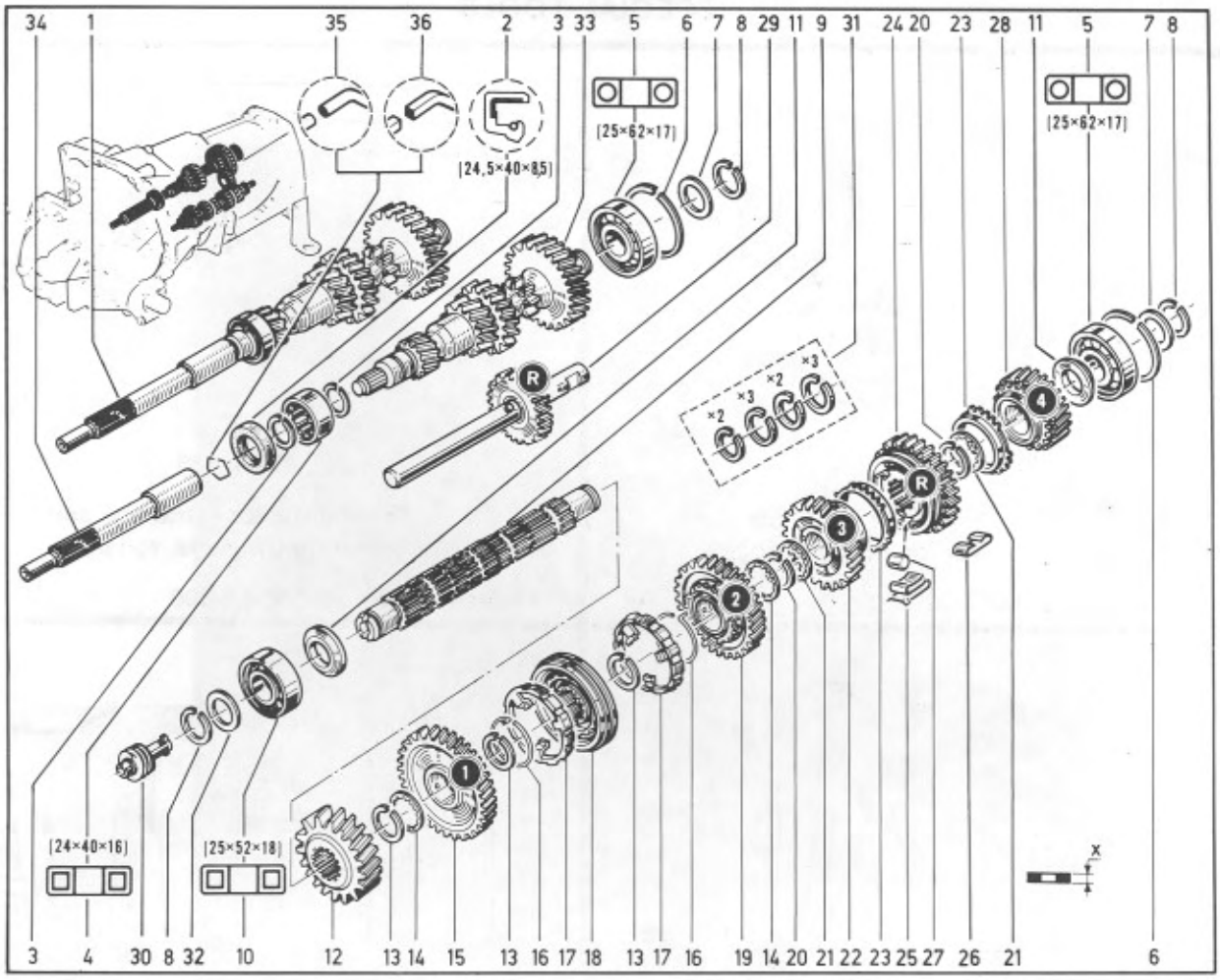
1. Transmission housing
2. Center housing
3. Bushing
4. Seal
5. Alignment dowel
6. Bolt
7. Bolt
8. Bolt
9. Washer
10. Magnet
11. Gasket
12. Cover
13. Bolt
14. Washer
15. Vent
16. Cover
17. Bolt
18. Seal Ring
19. Drain plug
20. Fill plug
21. Plug
22. Cover
23. Gasket
24. Bolt
25. Washer
26. Plug
27. Plug
28. Plug
29. Alignment dowel



1. Ring and pinion set
2. Step-down gear
3. Bearing
4. Seal
5. Washer
6. Snap ring
7. Differential housing
8. Washer
9. Sun gear
10. Short sun gear
11. Cup
12. Planet gear
13. Planet gear shaft
14. Bolt
15. Selective backlash adjusting shim
16. Bearing
17. Bearing
18. Bearing
19. Snap ring
20. Seal
21. O-Ring
22. Seal
23. Bearing
24. Nut

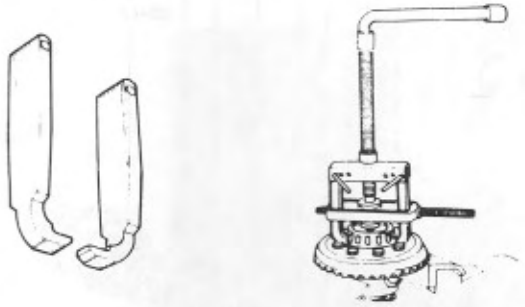


1. 1st/2nd Speed fork shaft
2. Roll pin
3. Ball
4. Spring
5. Plug
6. Plug
7. 3rd/4th speed shift fork
8. Roll pin
9. Interlock
10. Plunger between 1st/2nd and Reverse shafts
11. Shifter kit
12. Reverse lever
13. Reverse lever-shaft clip
14. Shift shaft spring
15. Spring retainer half-shells
16. Plastic ring
17. Plastic ring and half-shell kit
18. Roll pin
19. Roll pin
20. Shift lever bushing
21. Clutch release arm
22. 1st/2nd speed plunger shaft
23. Speedometer drive shaft
24. Speedometer drive gear
25. Seal
26. Rubber seal
27. Ball
28. Plug
29. Detent plunger
30. Seal



1. Primary shaft
2. Seal
3. Snap ring
4. Bearing
5. Bearing
6. Snap ring
7. Washer
8. Snap ring
9. Secondary shaft
10. Bearing
11. Shouldered washer
12. Step-down gear
13. Snap ring
14. Spline washer
15. 1st speed gear
16. Synchronizer spring
17. Synchronizer ring
18. 1st/2nd hub sliding gear
19. 2nd speed gear
20. Snap ring
21. Spline washer
22. 3rd speed gear
23. Synchronizer ring
24. Reverse gear
25. Synchronizer roller spring - early type
26. Synchronizer roller spring - later type
27. Synchronizer roller
28. 4th speed gear
29. Reverse idler shaft
30. Speedometer drive gear
31. Snap ring set
32. Washer
33. Primary shaft - later design
34. Clutch shaft - later design
35. Primary shaft retaining ring - round type - early design
36. Primary shaft retaining ring - square type - late design

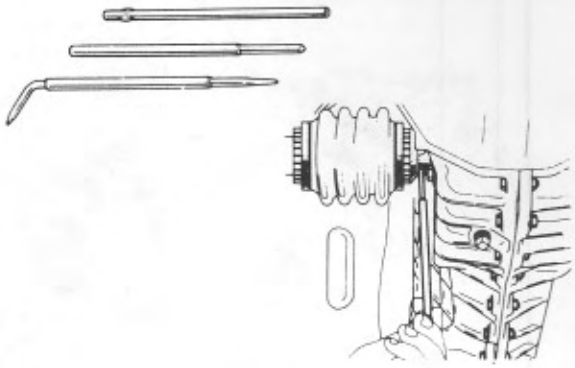
SPECIAL TOOLS



B.VI. 48

Set of two jaws with large tips
for extracting differential bearings

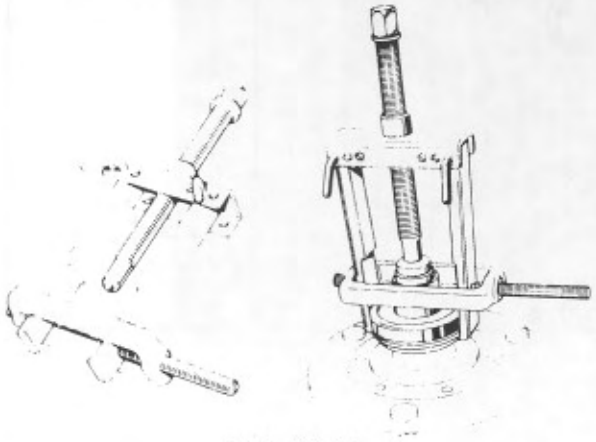
Order Tool No. 700013-30-300 Set



B.VI. 606

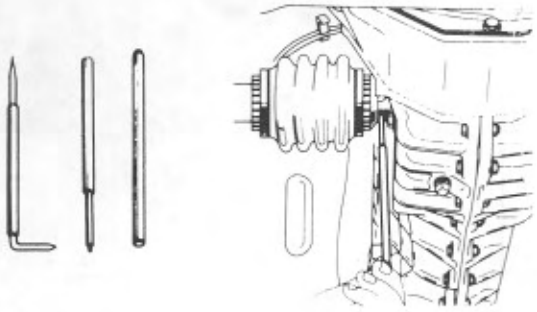
Set of drifts for extracting and
inserting 6 mm dia. roll pins

Order Tool No. 700000-60-600 Set



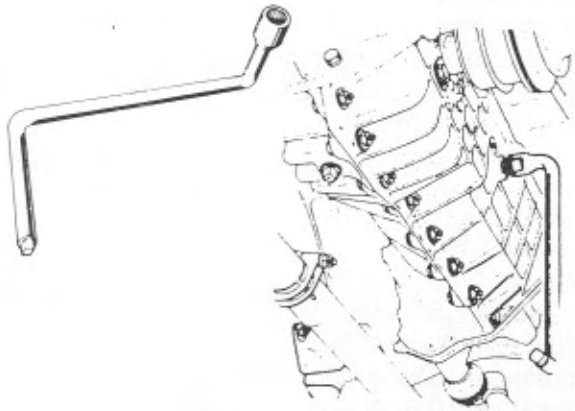
B.VI. 28-01

Bearing extractor with jaws 146 mm long
Order Tool No. 700012-27-301 EA



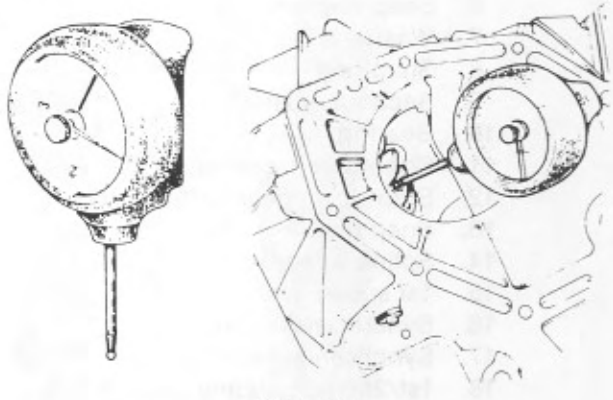
B.VI 31-01

Set of three drifts for 5 mm dia. roll pins
Order Tool No. 700012-59-401 Set



Mot. 593

Engine/Gearbox drainplug wrench
Order Tool No. 700000-59-300 EA

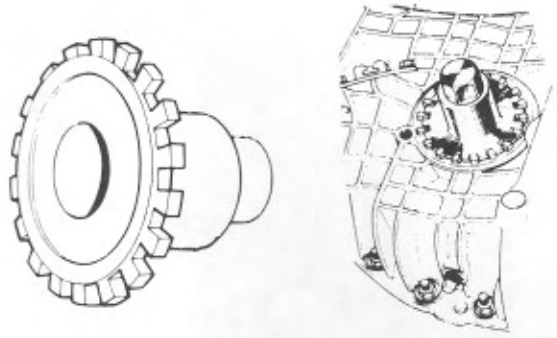


B.VI. 906

Torque meter for measuring
differential bearing preload

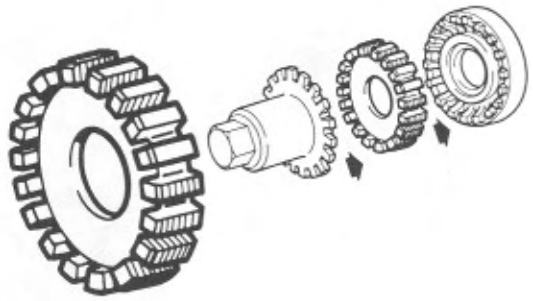
Order Tool No. 700000-90-600 EA

SPECIAL TOOLS



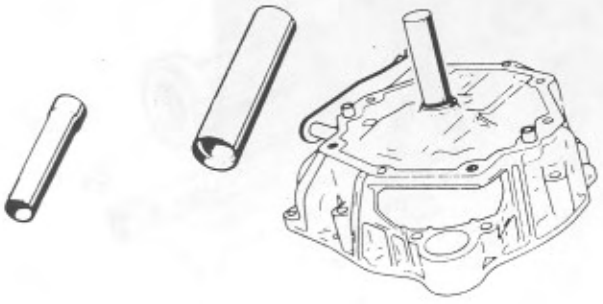
B.VI. 645

Castellated differential nut wrench
Order Tool No. 700000-64-500 EA



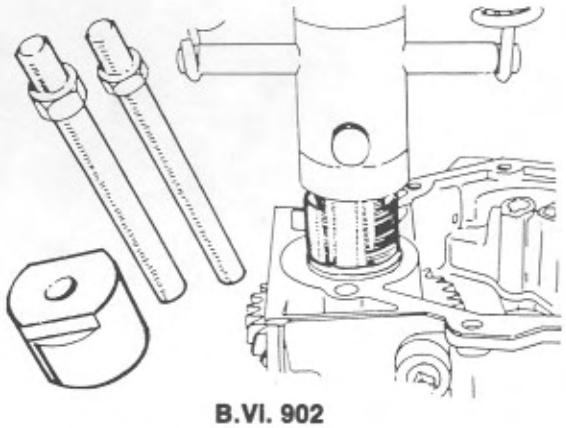
B.VI. 805

Differential nut wrench adapter
(For 3-lip seal nut)
Order Tool No. 700000-80-500 EA



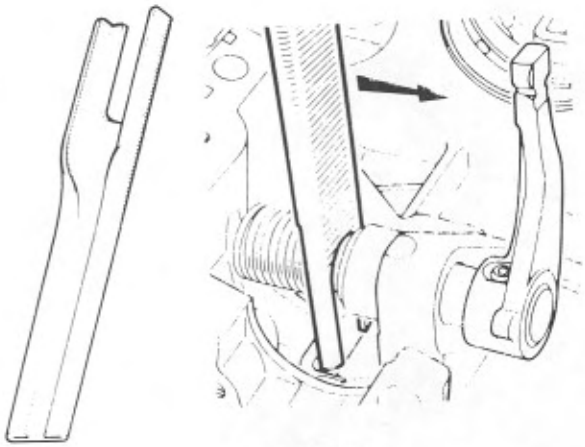
B.VI. 526

Clutch shaft oil seal inserting and protecting tool
Order Tool No. 700000-52-600 EA



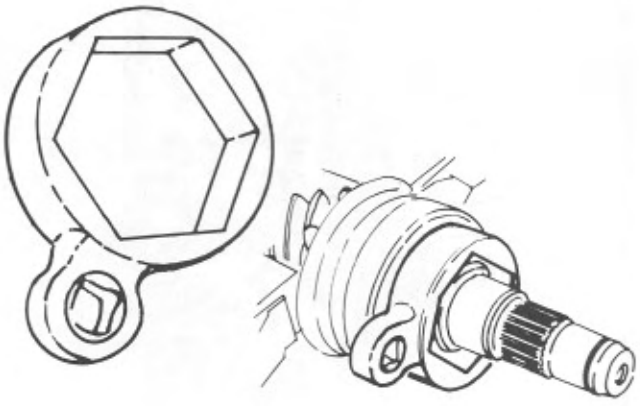
B.VI. 902

Extracting and inserting tool for input shaft
and output shaft circlip
Order Tool No. 700000-90-201 EA



B.VI. 747

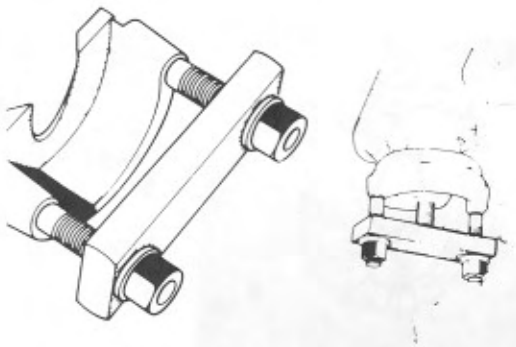
Selector spring dismantling and re-assembly tool
Order Tool No. 700000-74-700 EA



B.VI. 903

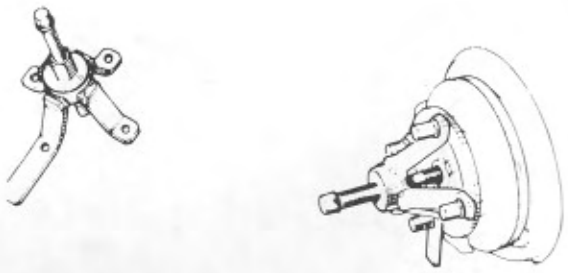
Wrench 58 mm for driving pinion nut
Order Tool No. 700000-90-300 EA

SPECIAL TOOLS



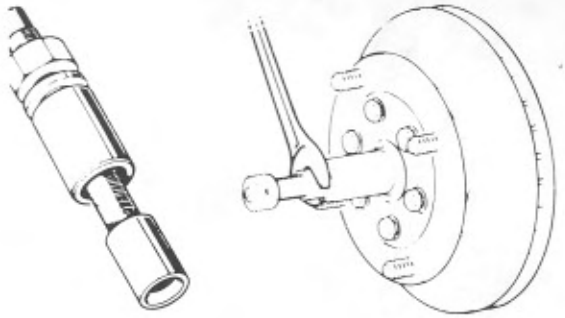
T.Av. 476

Tool for extracting ball joint
Order Tool No. 700000-47-600 EA



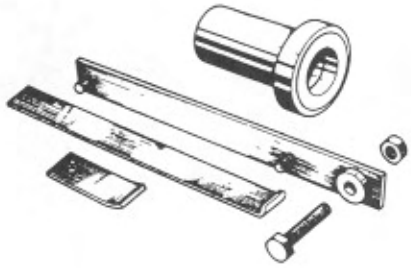
T.Av. 601

Tool for extracting drive shaft and hub
Order Tool No. 700000-60-100 EA



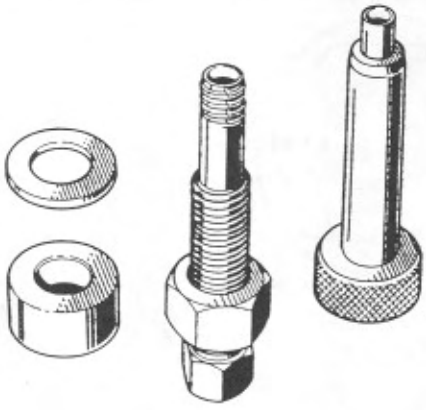
T.Av. 602

Drive shaft inserting tool
Order Tool No. 700000-60-200 EA



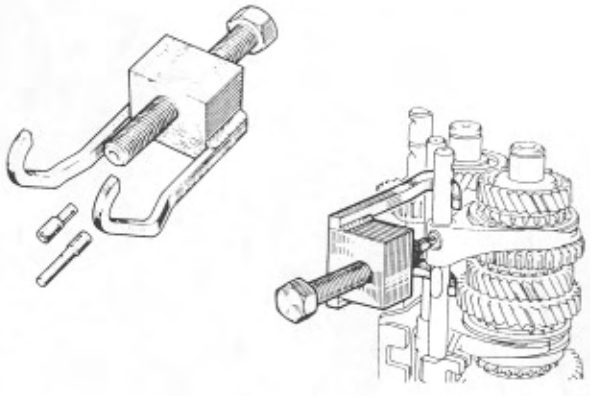
B.Vi. 465

Torque converter seal R&R tool
Order Tool No. 700000-46-500 EA



B.Vi. 905-02

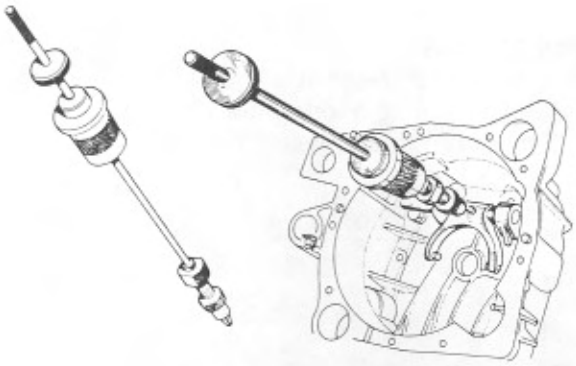
Tools for replacing the speedometer drive shaft seal
Order Tool No. 700000-90-502 EA



B.Vi. 949

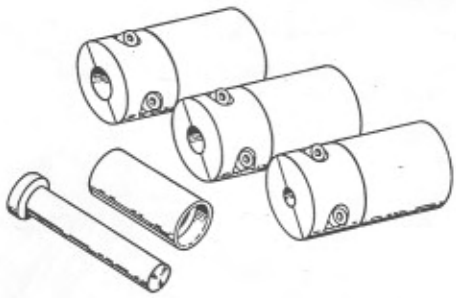
Tool for removing and refitting the shift fork shaft spring pins
Order Tool No. 700000-94-900 EA

SPECIAL TOOLS



Emb. 880

Extractor (slide hammer)
Order Tool No. 700000-88-000 EA

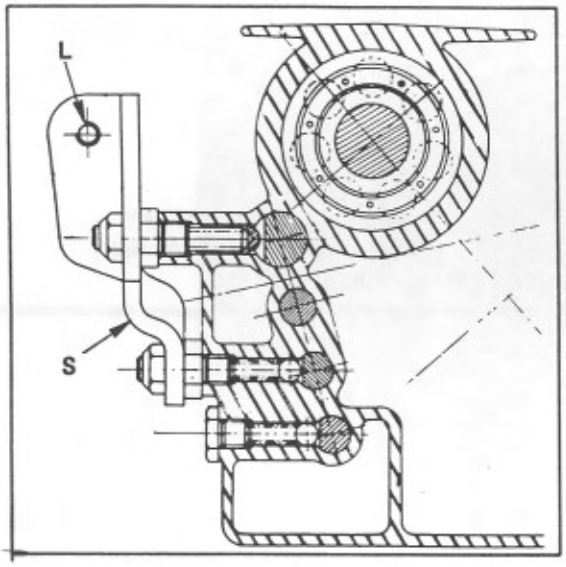


Emb. 1075

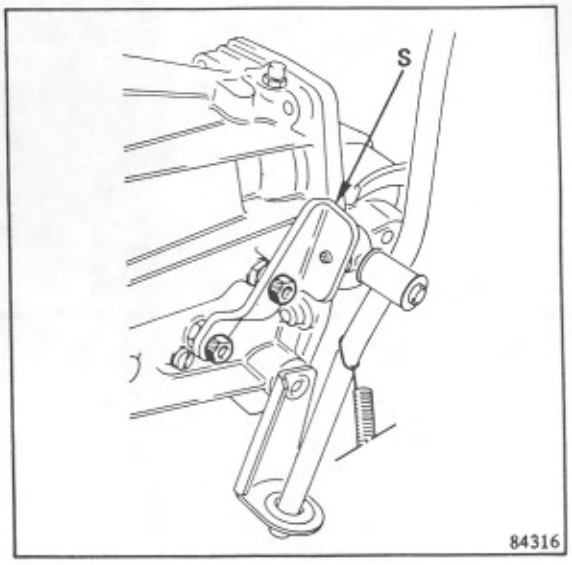
Input shaft extractor kit
(For use with tool Emb. 880)
Order Tool No. 700001-07-500 EA

SPECIAL FEATURES

1st DESIGN:
The shift lever bracket (**S**) has a hole (**L**) tapped into it for the lever attachment bolt. Length of bolt: 35 mm (1.40")



2nd DESIGN:
The hole (**L**) in the shift lever bracket is untapped. A bolt 50 mm (1.96") long plus a spring washer and a nut must be used to fasten the lever.



Starter Mount/Clutch Housing Cracks

CAUTION

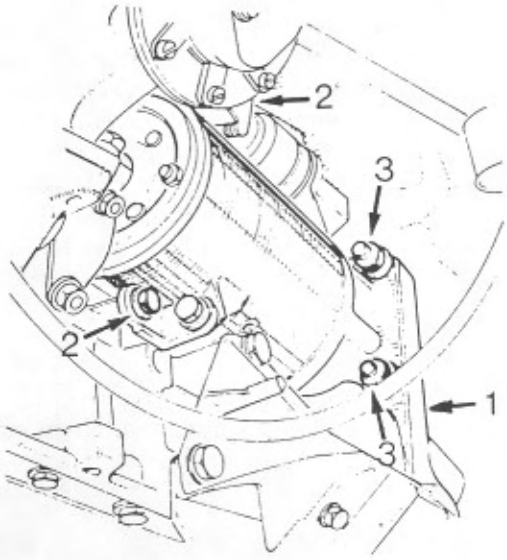
Incorrect mounting of the starter can cause cracks to develop in the clutch housing near the starter mounting plate.

The starter must be completely removed from the unit any time the engine or gearbox are removed. NEVER leave the starter attached by the two (2) rear mounting bolts. This may cause the bolts to bend and become distorted.

A starter with distorted or improperly positioned rear mounting bolts may cause the clutch housing to crack due to vibration at high engine R.P.M.'s.

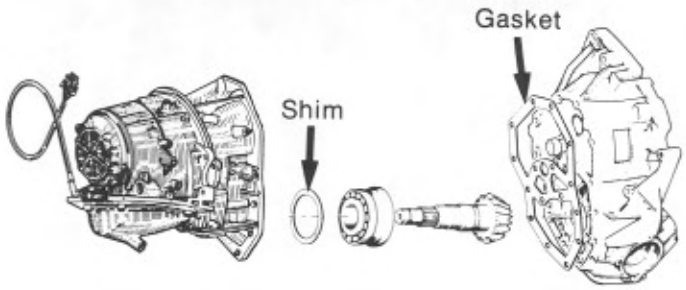
When remounting a starter, ALWAYS tighten the rear mounting bolts before the front mounting bolts. (See illustration.).

1. Area of possible crack
2. Starter mounting bolts - Front
3. Starter mounting bolts - Rear



Differential/Intermediate Case Gasket
(Late model NL-102 transmissions)
The gasket between the differential bell housing and the intermediate gear case **must be replaced** each time the transmission is disassembled. The metal shim(s) between the pinion bearing collar and the intermediate gear case must also be replaced at that time, since the shims are matched to the gasket thickness. (Refer to illustration.) Our Part Sales Department has a parts package available which contains 1 gasket and a quantity of shims. Order part number **R77014-64-332.**

NOTE: The quantity of shims provided with each gasket will vary according to the thickness of the gasket. **Always use all shims included in the package.**

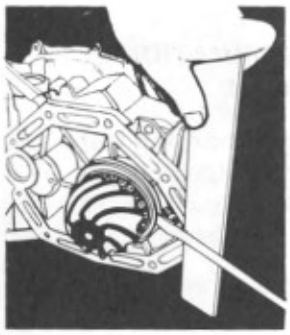


This gasket/shim kit is also compatible with older model transmissions and may be retrofitted, if desired, while performing necessary transmission repairs. If installing the gasket, **do not use** the anaerobic silicone compound. And remember that the shim(s) **must be installed** between the pinion bearing and intermediate case to compensate for the gasket thickness.

Repair Procedure
This procedure allows you to replace the shim(s) without totally diassembling the intermediate section of the transmission. **If total disassembly of the transmission is to be performed anyway, this procedure does not apply.**

The following steps assume that you have already removed the transmission from the vehicle, separated the differential bell housing from the intermediate case, and that the intermediate case is on the bench.

1. Insert a pry tool or large screwdriver into the rectangular opening on the pinion bearing collar and pry the pinion bearing forward approximately 1/4". Use a wooden slat between the screwdriver and the case to protect the case from damage.



2. Make a cut int he shim(s) using a sharp scissors as shown. It is important that you use **scissors only** not "tin snips".



3. Insert the shim(s) between the pinion bearing and the case in the same manner as installing rings on a piston.

NOTE: Use all shims provided in the package.

4. Press the pinion gear and bearing back into the case using the heel of your hand or tap lightly with a rubber mallet if necessary.

5. Install the new gasket between the intermediate gear case and the differential bell housing and reassemble the transmission.

GENERAL INFORMATION
Anaerobic Sealant

Assembly of gearbox and transmission cases may require use of a special type of silicone sealant known as **anaerobic sealer.** This compound is used as a gasket material in specified applications.

In each application which specifies anaerobic sealant, we recommend using Loctite® "518" or "515" or NAPA/Balkamp® Part No. 765-1189 or an equivalent anaerobic sealant.

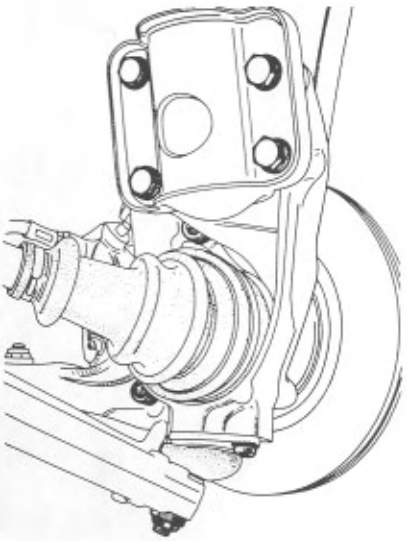
> **CAUTION**
>
> Do not substitute anaerobic sealer with RTV silicone sealant or other adhesive gasket materials. These do not possess the heat-resistant properties required to affect a durable seal.
>
> Improper sealing could allow fluid leakage, resulting in serious mechanical damage.

REMOVAL AND INSTALLATION

The gearbox must be removed from below using a floor jack or transmission jack.

Tightening Torques

Wheel Nuts:	12 daNm (90 lb./ft.)
Shock Absorber Bottom Bolts:	8 daNm (60 lb./ft.)
Steering Arm Ball Joint Nut:	3.5 daNm (26 lb./ft.)



REMOVAL

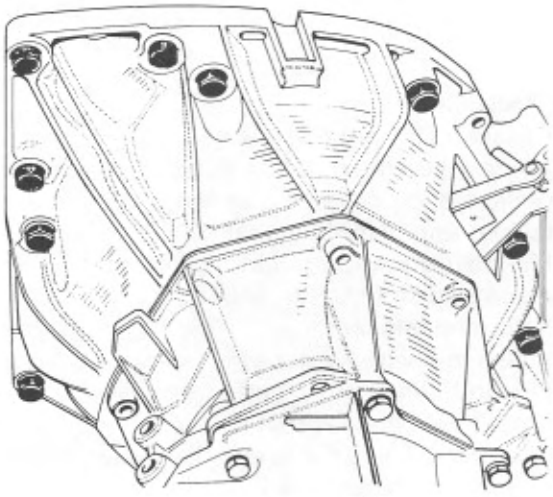
Support vehicle under engine supporting crossmember so the road wheels are off the ground and front suspension at the relaxed end of its travel.

Remove or Disconnect

- Battery
- Transmission and final drive fluids (drain)
- Front wheels
- Bottom 4 front strut bolts
- Steering rack connections to stub axle carriers
- Steering rack (mark the location)
- Drive shaft roll pins (using drift B.Vi. 606)

Tilt stub axle carriers outward while removing drive axles from final drive and position out of the way.

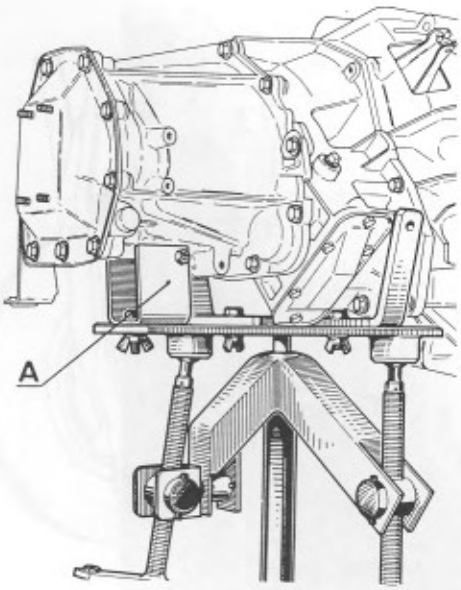
- Back-up light wires
- Speedometer cable (by squeezing the plastic end together and pulling)
- Shift lever - prop aside
- Clutch slave cylinder - do not disconnect line, support line as necessary
- Long rear mount bolt
- Rear mount holders on crossmember behind rear mount
- Rear mount from transmission - set cable aside
- Lower air scoop
- Lower flywheel cover behind engine oil pan



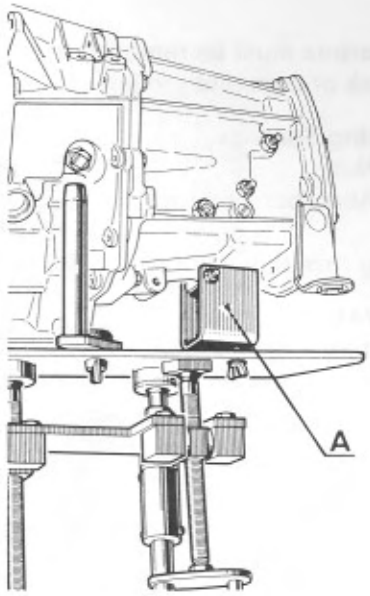
Place transmission jack in position and secure. (Make certain the assembly is evenly balanced)

- Gearbox Engine support stay-bolts (1 long bolt through bell housing on left and 2 small bolts on right ahead of final drive housing)
- Clutch housing bolts (shown at right)
- Starter (3 bolts)

REMOVAL AND REINSTALLATION

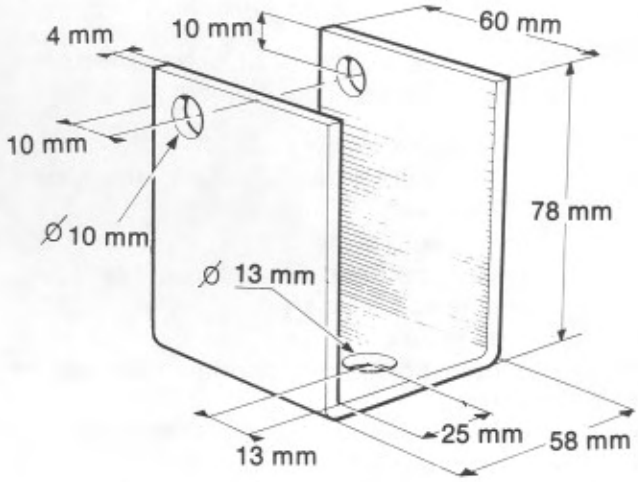


Typical Jacking Arrangements



Remove and lower the gearbox.

NOTE: Fabricate a "U" bracket (A) to the dimensions shown at right to support the rear of the gearbox.

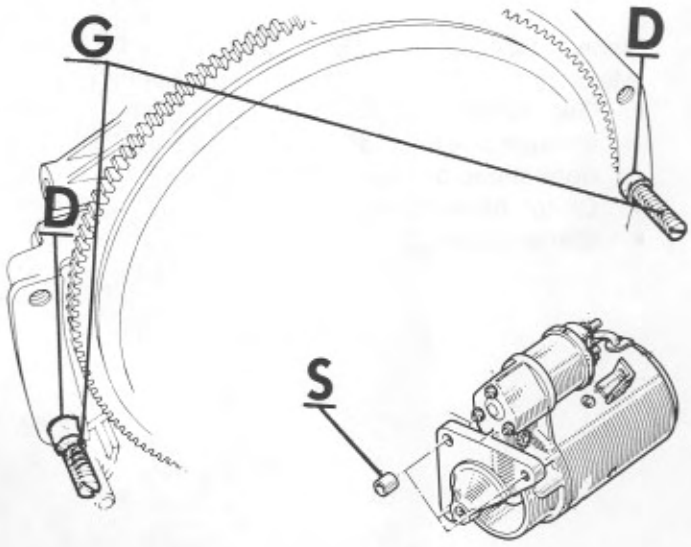


REASSEMBLY

- Reassembly can be made easier by using 2 studs (G) to guide the gearbox into position.
- Grease should be smeared on the clutch shaft splines and planetary gear splines.
- Make sure that the alignment dowels (D) are in place and the starter dowel (S) is also in place before reinstallation
- Install in reverse order of removal
- Fill both final drive and transmission with the proper type and level of oil
- Check front wheel and steering wheel alignment
- Check clutch operation

IMPORTANT

Make sure safety cable is installed properly and is not rubbing on power steering lines. Tie up if needed.



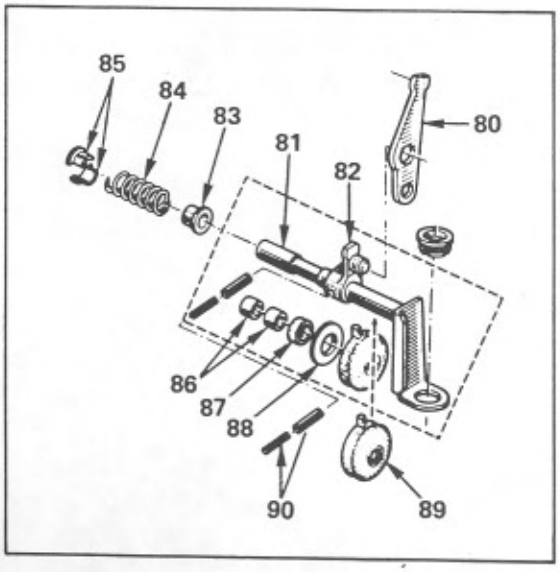
REBUILD

DISASSEMBLY

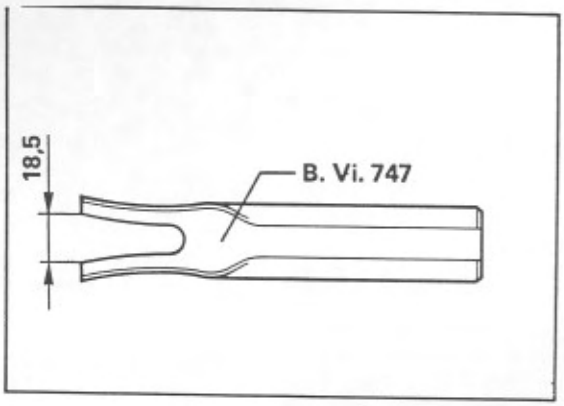
REMOVE OR DISCONNECT

Rear Transmission Cover

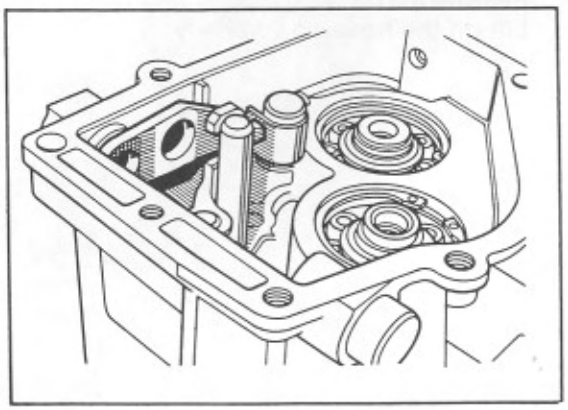
- Remove the two half-shells (85)
- Pull the shaft outwards and retrieve the spring (84), the bushing (83) and the selector lever (82).



- The two pins (90) from the selector lever (82) using punch B.Vi. 606.
- Place a cloth under the control shaft spring to prevent the parts from falling into the box housing.
- Compress the spring (84) with tool B.Vi. 747, modified as shown in the drawing at right.



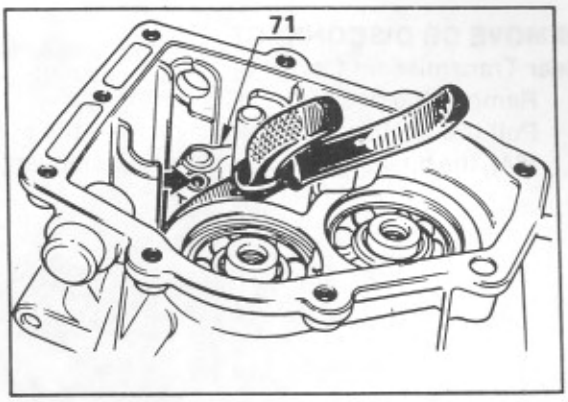
- Remove the reverse stirrup and disconnect the selector lever from the reverse shaft.



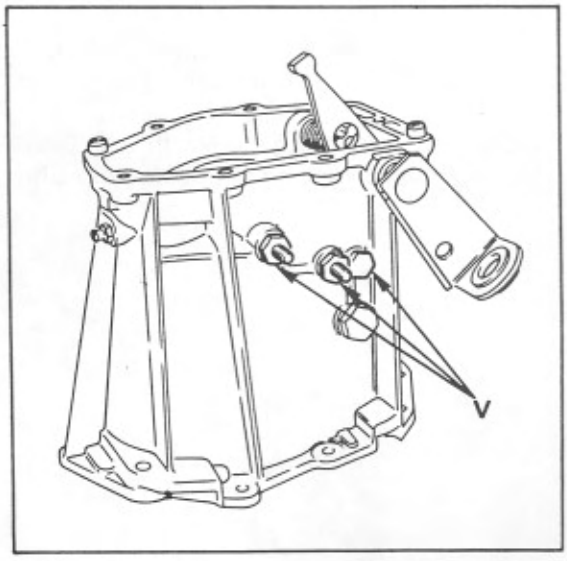
REBUILD

DISASSEMBLY

- Remove the pin connecting the dog (71) to the 3rd/4th shaft with punch B.Vi. 31-01.



- The locking assemblies (V).
- The three springs are identical.

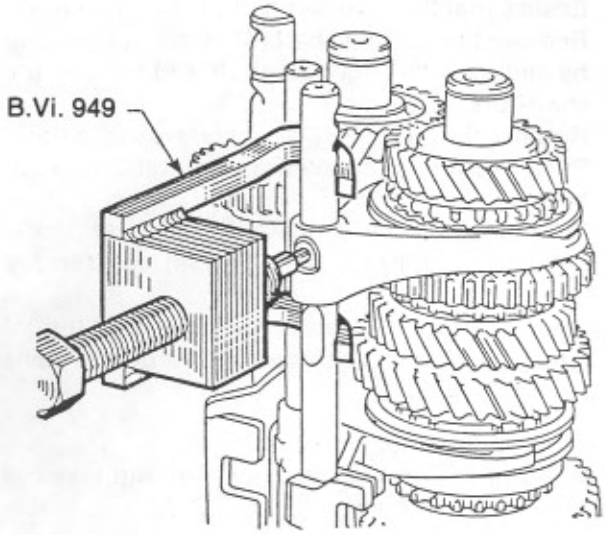


- Remove the bolts from the main gearbox housing. Lift off the housing vertically.

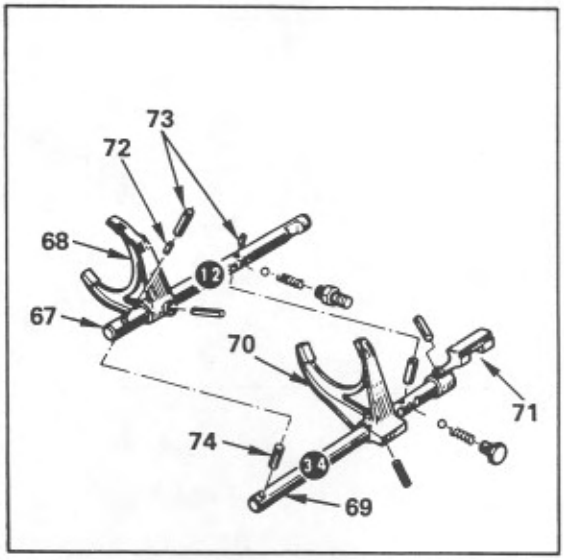
REBUILD

DISASSEMBLY

- Remove the pin from the 3rd-4th speed fork (70) with tool B.Vi. 949.



- Place the 1st/2nd fork shaft (67) in the neutral position, followed by the reverse shaft (positioning it if necessary).
- Take out the 3rd/4th shaft (69) from the bore in the housing, by sliding it through the fork and remove the 3rd/4th shaft fork assembly.



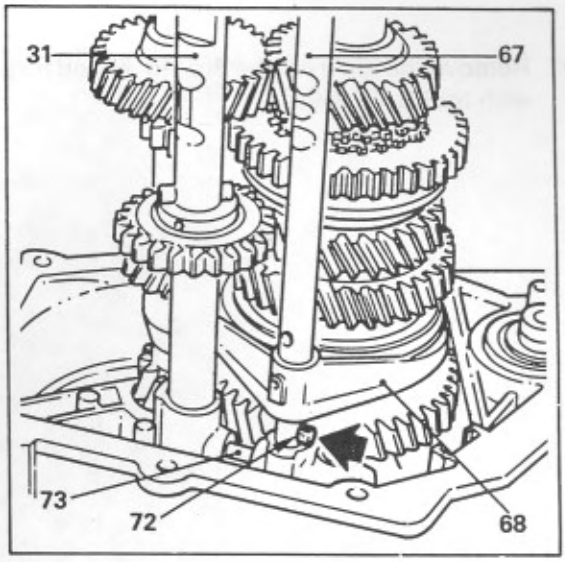
REBUILD

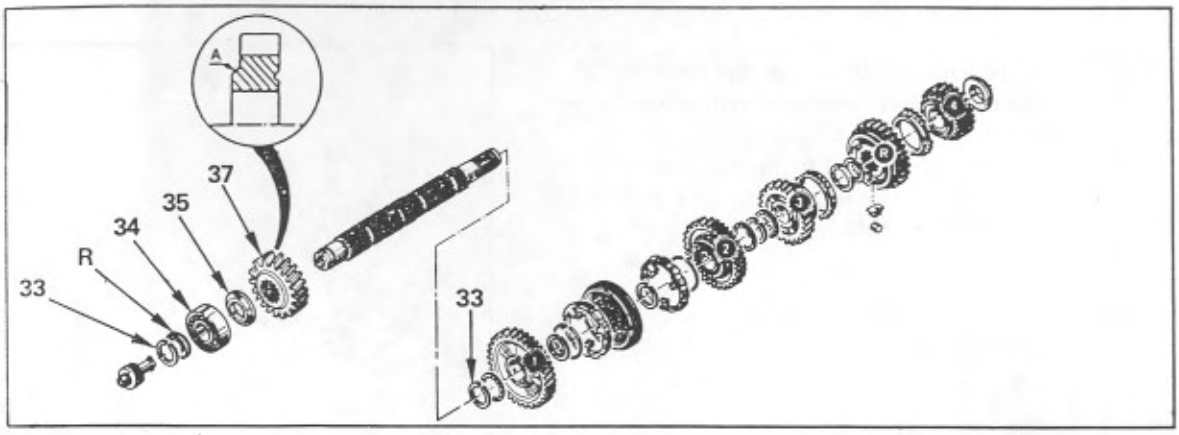
DISASSEMBLY

- Ensure that the reverse shaft (31) is in neutral.
- Remove the 1st/2nd shaft (67) from the housing by sliding it through the shaft and remove the shaft-fork assembly.
- Retrieve the plungers (72) which are in the shaft.
- Push plunger (73) towards the 1st/2nd shaft bore
- Pull simultaneously on the three gear shafts (primary, secondary and reverse) and remove them.
- Hold the secondary shaft vertically, with the 1st speed downwards to prevent the gear wheels from falling off.

From inside the housing:

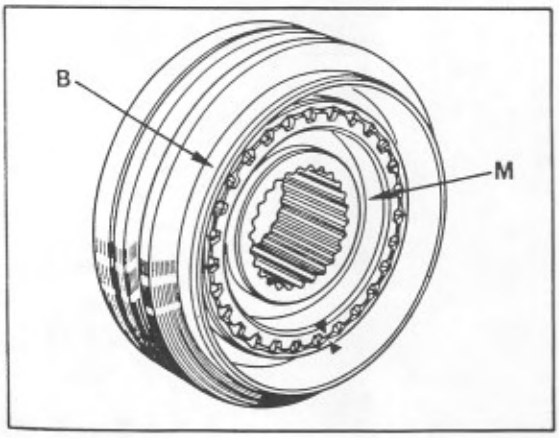
- Retrieve the locking plunger (74) and take out the magnet and clean it. See H3-3.





Dismantling the gear assembly:

- Grip the secondary shaft in a vice, equipped with soft jaws, across the step down gear (37) and remove all the gear wheels.
- Mark the positions of the hubs (M) with reference to the sliding gears (B).
- Remove the secondary shaft from the vice and take off the circlip (33), the bearing (34), the washer (35) and the step down gear (37).

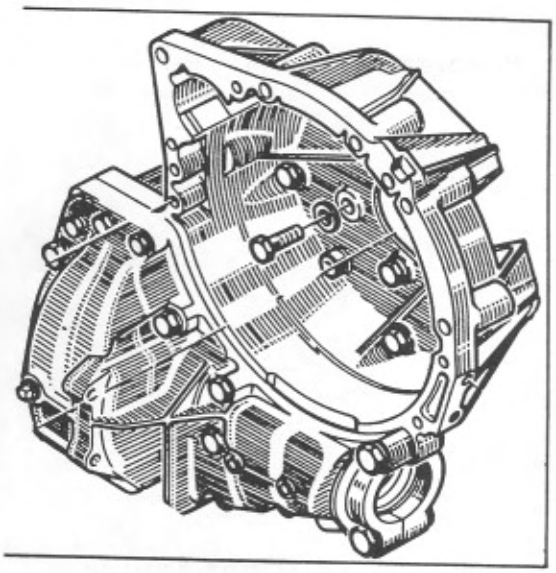


REBUILD

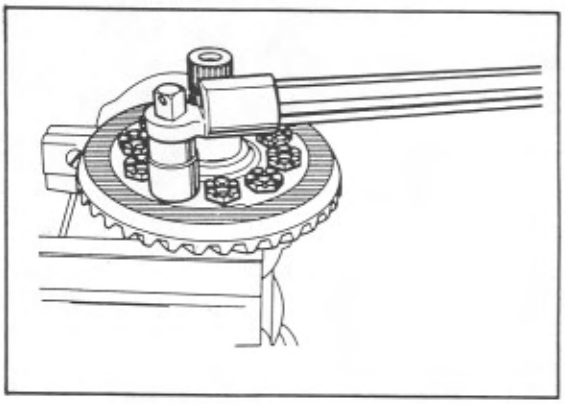
DISASSEMBLY

Dismantling:

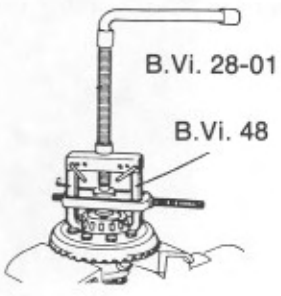
- Free the clutch-final drive housing from the step down housing.
- Mark the position of the differential nut. Remove the final drive half housing.



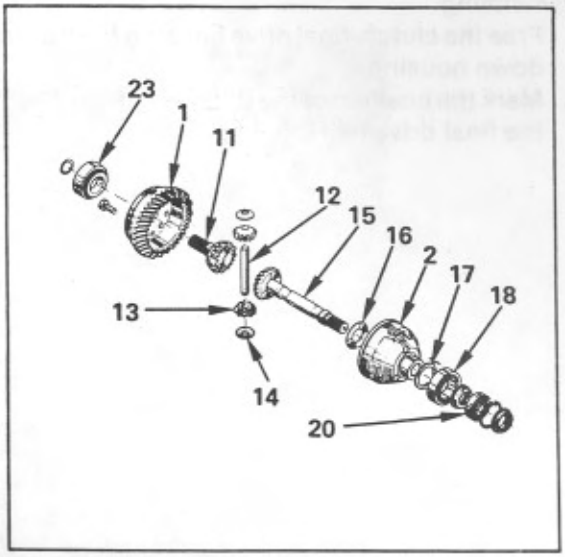
- Take out the differential.
- Remove the ring gear fastening bolts (they are self-locking bolts that cannot be re-used). Leave two in place, diametrically opposite to one another.



- Extract the three bearings using special tools B.Vi. 28-01 and B.Vi. 48.



- Remove parts 11 to 16.

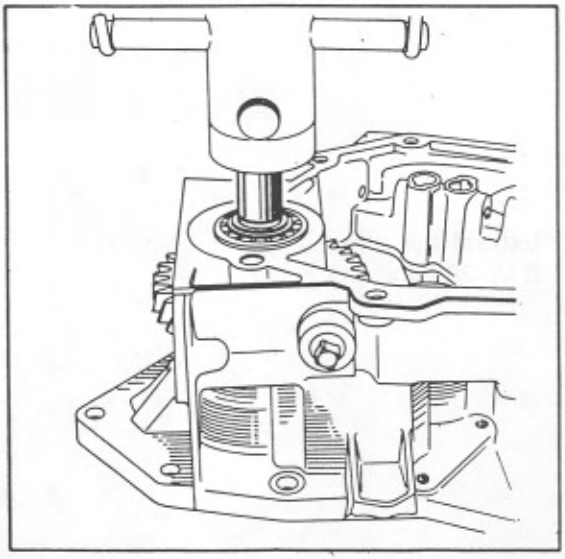


REMOVING THE FINAL DRIVE PINION
Remove:

- circlip (10),
- pressed steel cover (T).



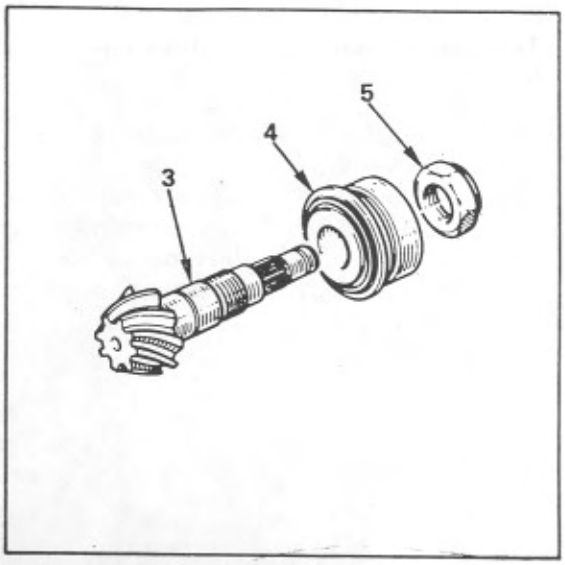
- Push out the pinion on the press.



REBUILD

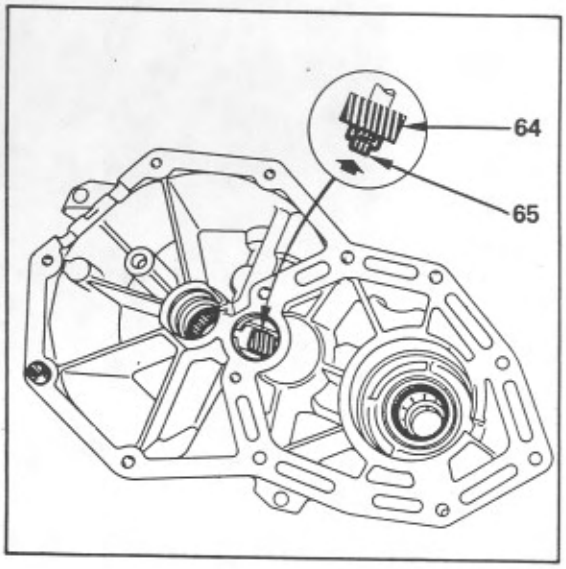
DISASSEMBLY

- Unlock the nut (5) and remove it with tool B.Vi. 903.
- Using Tools B.Vi. 28-01 and B.Vi. 48, extract the pinion bearing (4).

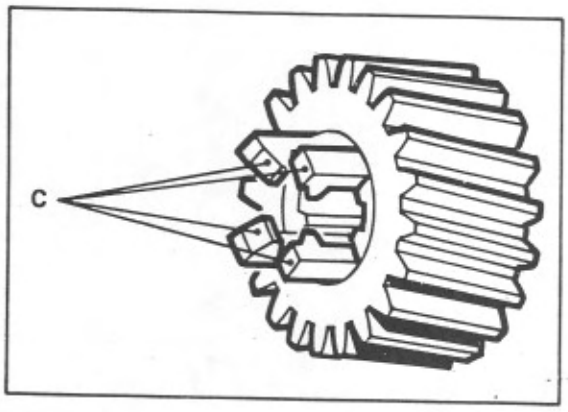


REMOVE:

- The speedometer drive pinion (64) and its shaft (65).
- Spread the lugs (C) that secure the pinion to the shaft.



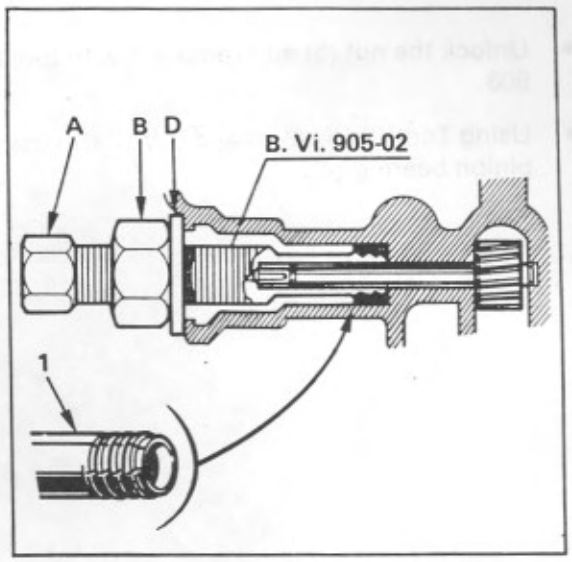
- Remove the shaft.
- The pinion must be replaced with a new one each time it is removed.



REBUILD

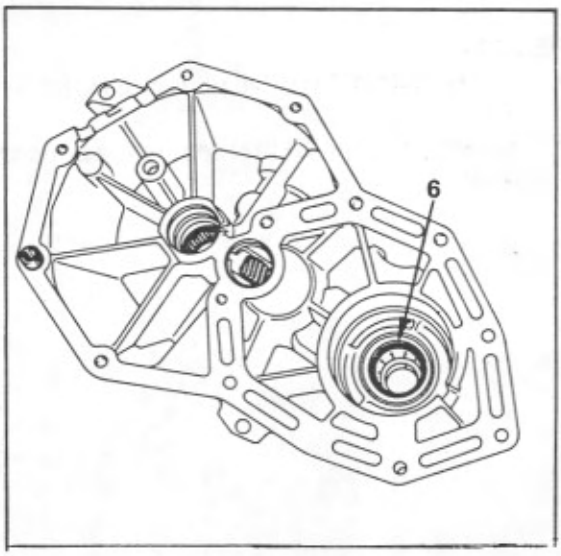
DISASSEMBLY

- Take out the speedometer drive seal using tool B.Vi. 905-02.
- Fit the extractor tool (A) equipped with the nut (B) and the spacer (D).
- Screw in the tool (A) by approximately three to four turns after it has made contact with the seal so that the thread (1) enters the rubber.
- Extract the seal by turning the nut (B) while holding the tool (A).



REMOVE:

- The lip seal (6) using tool B.Vi. 465.



REBUILD

CLEAN AND INSPECT

CLEAN

- All parts with a good grade of cleaning solvent and dry with compressed air.

> **WARNING**
>
> Alway wear safety goggles when working with compressed air to prevent eye injuries.

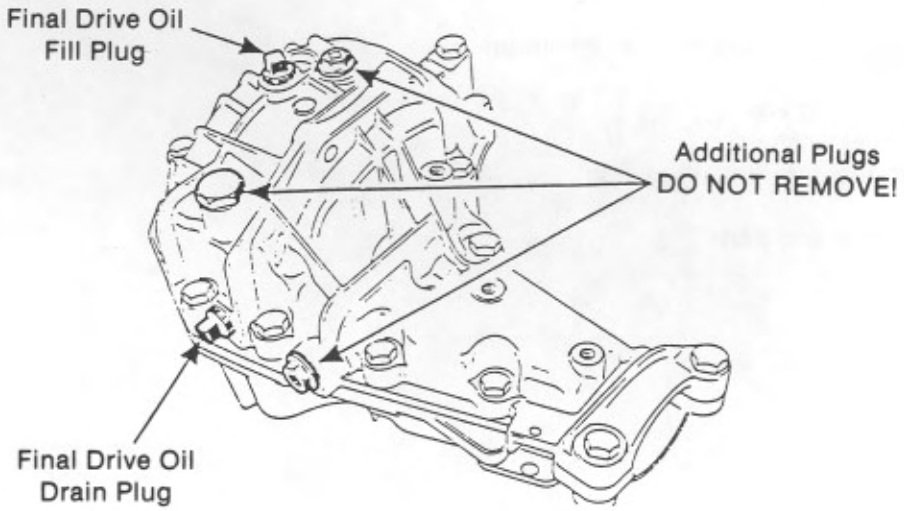
INSPECT:

Check that the following are in good condition:

- the gear teeth,
- the bearing locating areas,
- the planet wheel washers,
- the splines in the differential housing
- the shift forks
- syncronizer teeth and parts

MODIFICATION TO DIFFERENTIAL COVER

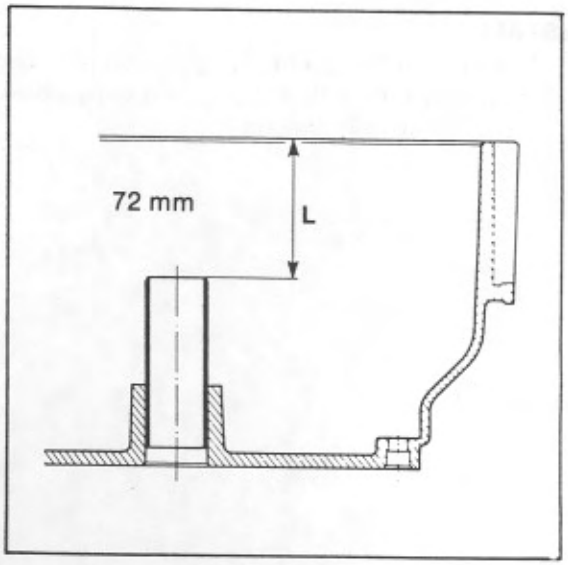
To allow some vehicles to be fitted with a final drive oil cooling system, the differential cover for "NL" gearboxes has been redesigned and now has three additional threaded bosses fitted with hex-head plugs.



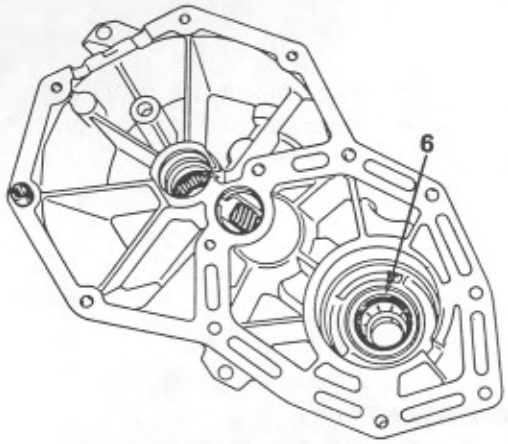
DO NOT USE these additional hex-headed plugs for draining, refilling or topping up the final drive oil. Doing so could result in differential oil seal damage caused by overfilling. It could also result in oil leakage caused by reduced effectiveness of the plug seal washers.

Use only the tapered, square-headed drain and fill plugs provided for these purposes.

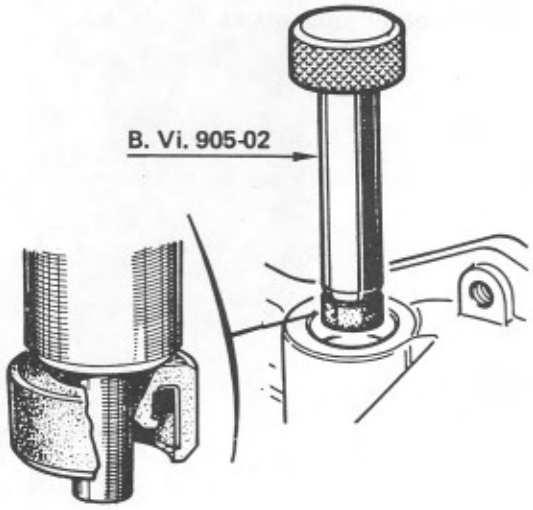
CLUTCH HOUSING THRUST BEARING TUBE
Place the unhardened section of the tube (white) into the housing and push it in to obtain the dimension (L) shown at right.



INSTALL:
- Oil the lip seal (6) and install it with tool B.Vi. 465.

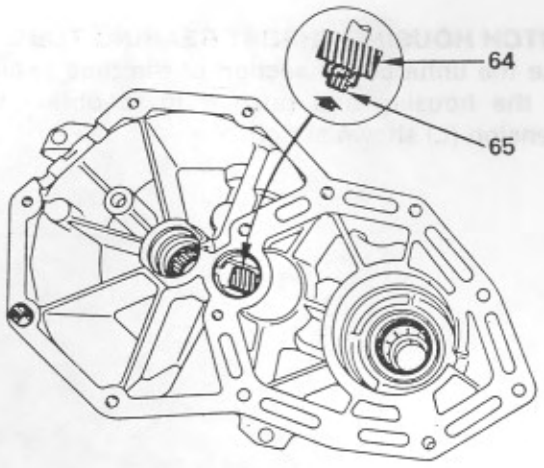


REFIT:
- The speedometer pinion seal ensuring that it is facing the correct direction.
- Use tool B.Vi. 905-02.



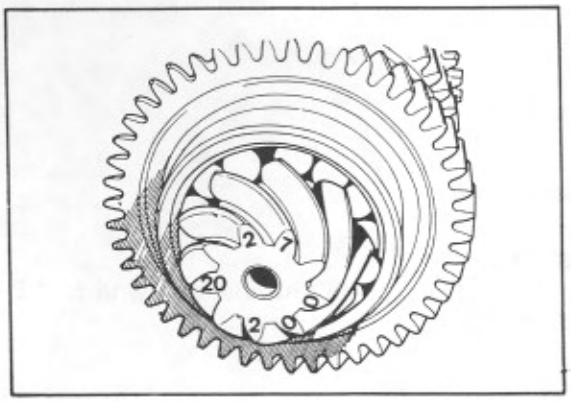
INSTALL:

- The new speedometer drive pinion (64) and its shaft (65) check that the pinion clips correctly into its groove in the shaft.



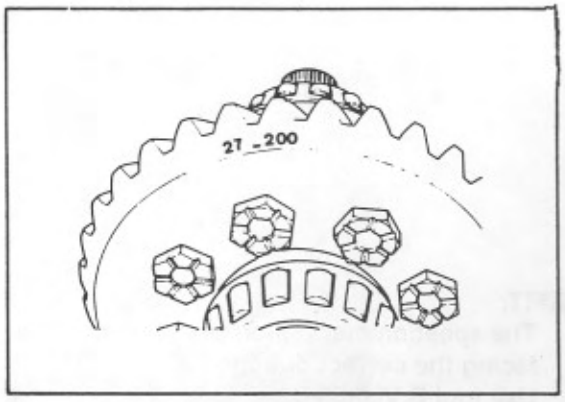
NOTE:

- The ring gear and pinion are matched.
- The same references are marked on both the ring gear and pinion.

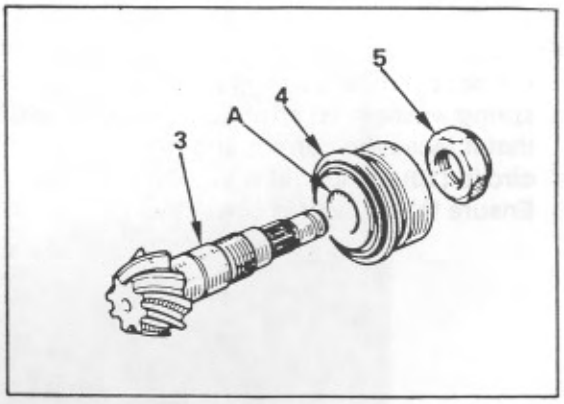


IMPORTANT

- If one of these parts requires replacing, the other must also be replaced.

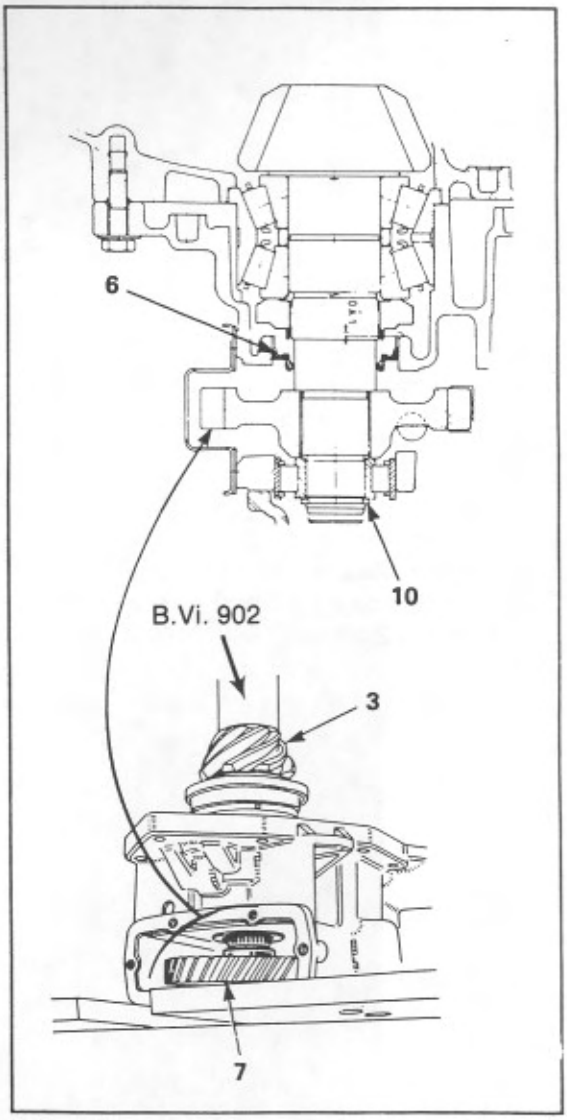


- Fit the bearing (4) on the press with the reference mark (A) towards the final drive pinion.
- Apply 3 drops of Loctite® threadlocker to the threads in the nut.
- Hold the pinion vertically, spin the nut up (5) and tighten it to a torque of 4 daNm (30 lb./ft.) using tool B.Vi. 903.
- Turn the bearing by hand then tighten the nut to a torque of 22 daNm (162 lb./ft.)



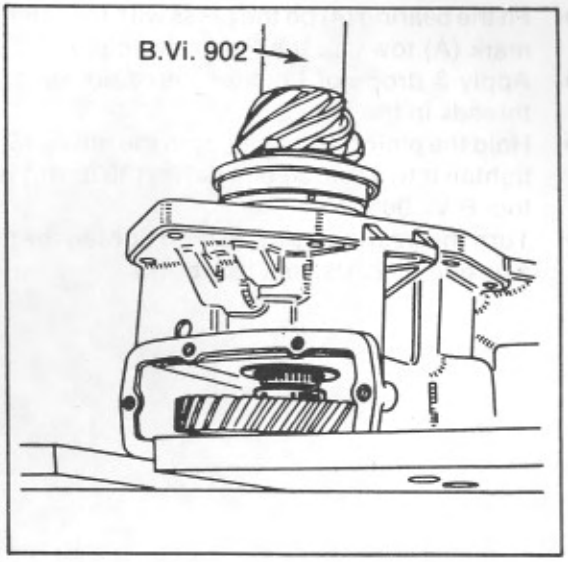
REFITTING THE FINAL DRIVE PINION:

- Fit the pinion assembly into the center housing first if the gasket/shim set is being used between the case housings (Refer to "Differential/Intermediate Case Gasket" in Subsection H1.)
- Install the gear (7) with its offset towards the cylindrical roller bearing.
- Fit the final drive pinion (3) on the press.



REFIT:

- cylindrical roller bearings,
- spring washer (1st arrangement only), ensuring that it faces the correct direction,
- circlip (10) using tool B.Vi. 902,
- Ensure that it locates correctly.

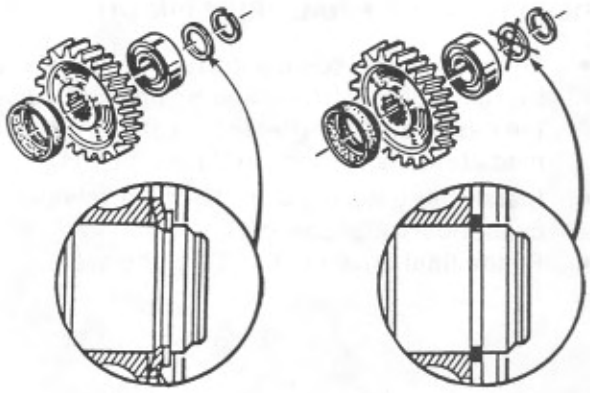


1st Type

- Circlip thickness = 1.5 mm
- Assembly includes spring washer.

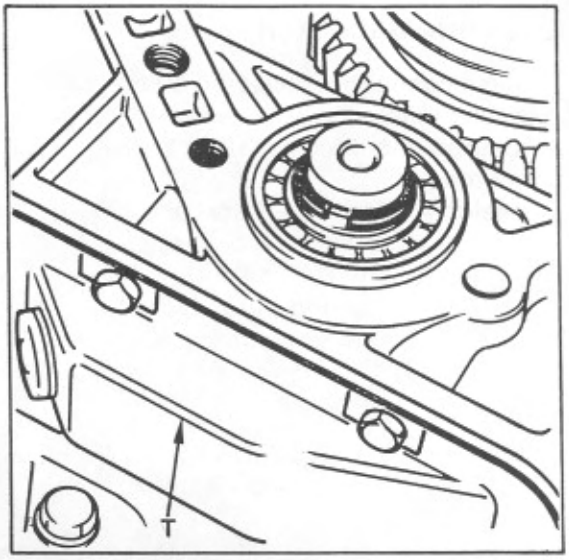
2nd Type

- Circlip thickness = 2.0 mm
- NO spring washer used.
- Pinion tail shaft is 2 mm shorter
- Groove is located 1.6 mm further ahead and is widened to 2.5 mm.

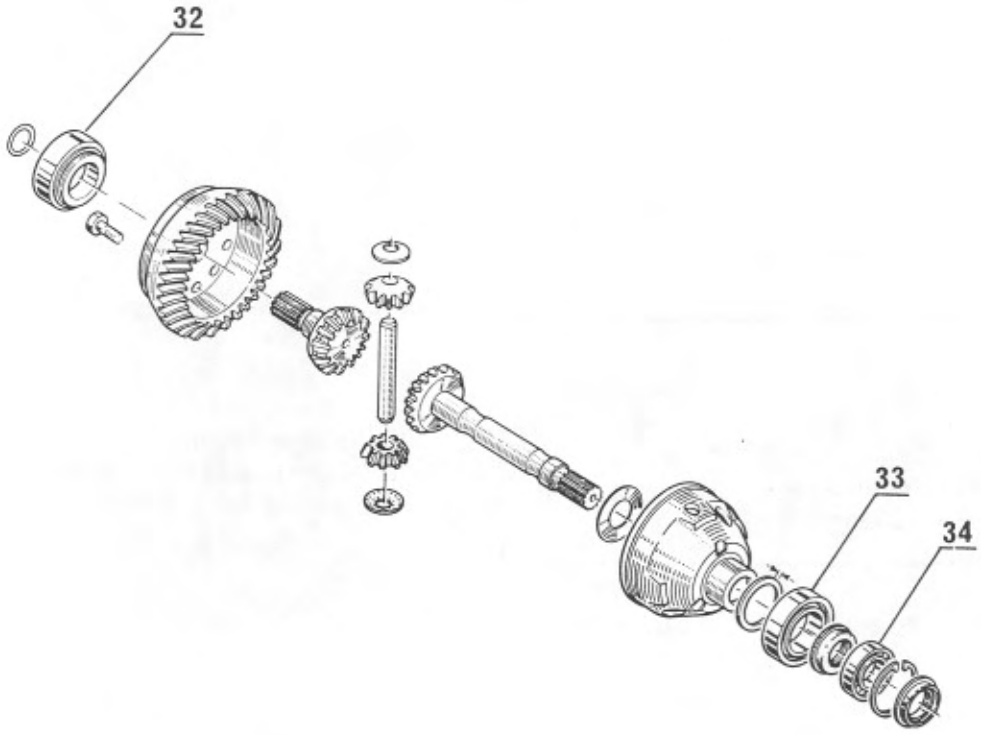


1st Type 2nd Type

- Fit the pressed steel cover (T) with the drain plug on the opposite side to the filler plug (coat the gasket with gasket seal compound).
- Tighten the bolts to a torque of 1.5 daNm (11 lb./ft.)
- Install the drain plug with a new sealing ring.



DIFFERENTIAL



ADJUSTING BACKLASH

Backlash cannot be measured after the gearbox is assembled; it must be adjusted when the differential bearings are mounted by taking the following measurements:

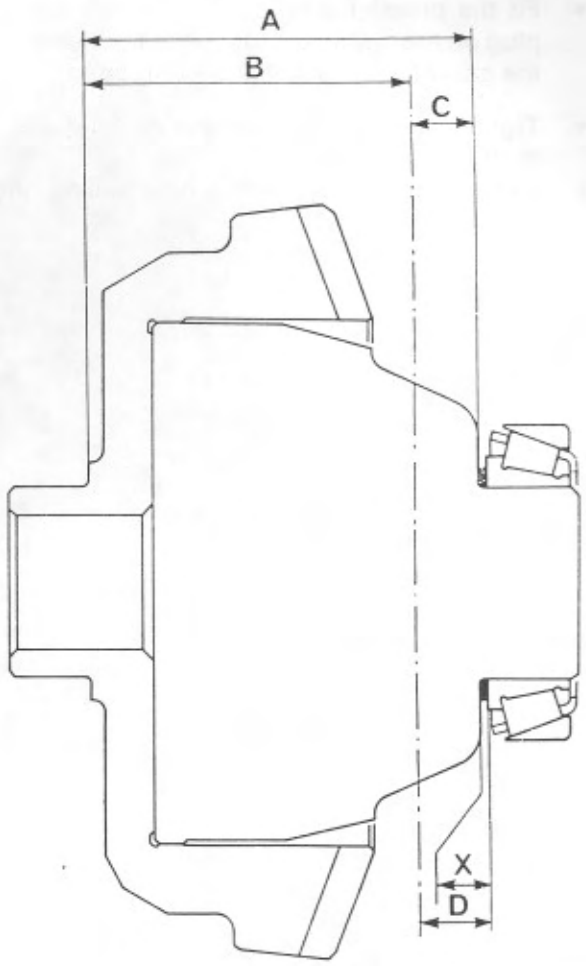
Dimension A: Distance between thrust faces for differential bearings.

Dimension B: Theoretical dimension between bearing thrust face at ring gear end and final drive pinion centerline. This dimension is produced by machining.

Dimension C: Determined by subtracting dimension B from dimension A.

Dimension D: Theoretical dimension between bearing thrust face at differential housing end and the final drive pinion centerline. This dimension is produced by machining.

Shim X: Adjusting shim to be inserted between the bearing and differential housing.



METHOD

- Assemble the differential housing and ring gear using 3 bolts.
- Measure dimension A.
- Since dimension B is known to be 86 mm for all differentials, calculate dimension C.:

C = A - 86 mm

- Dimension D is 7.93 mm for all differentials. Insert a shim X of thickness D-C between the bearing and the differential housing.

> Example:
> A = 93 mm
> A - B = C
> 93 - 86 = 7 mm
> Setting shim thickness X
> 7.93 - 7 = 0.93 mm

In the above example, you would use a shim 1 mm thick (the one as close as possible to the calculated value) to correct the backlash.

3 thicknesses of adjusting shims are available:
0.8 mm, 1 mm, 1.2 mm.

Mount the differential bearings (the larger) (32) being at the ring gear end). See page H1-7.

Mount the ring gear to the differential housing using new bolts.

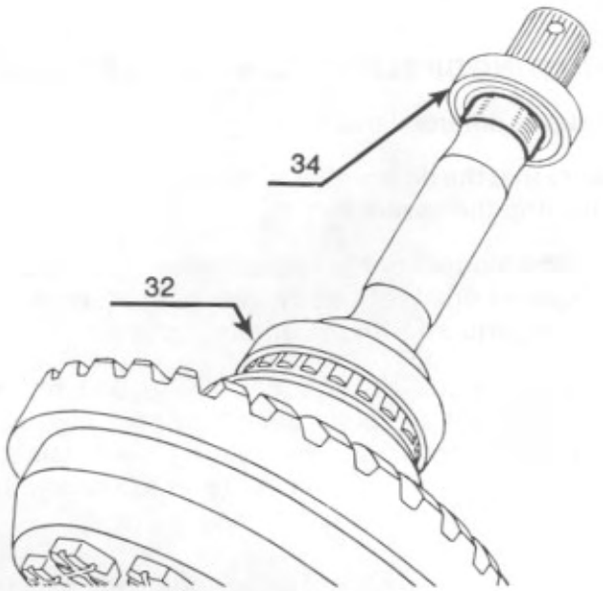
Torque tighten the ring gear bolts (See H1-4)

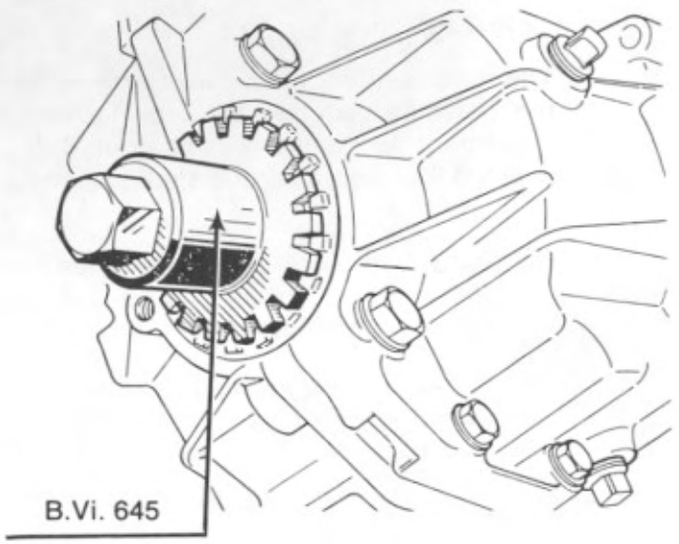
Press the ball bearing onto the shaft (34) a few millimeters at the planetary gear end to center it.

Lift up the assembly to the differential housing (bearing (34) not being in its working position).

Coat the half-casing joint faces with anaerobic sealer), fit the other half-casing and assemble them with several bolts.

Hand tighten these bolts only at this stage.





Mount the differential ring nut (with its seal and its threads coated with gasket sealer) using castellated wrench B.Vi. 645.

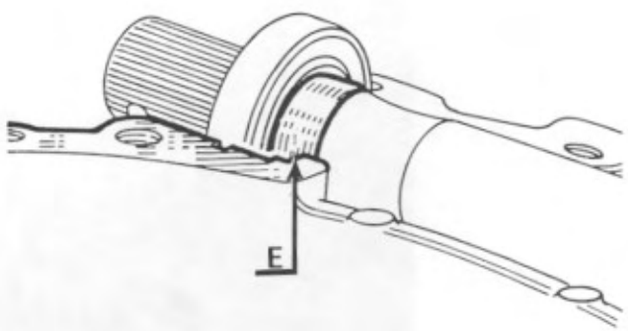
Tighten the ring nut until it contacts the differential bearing outer track ring.

Complete the assembling of ball bearing (34) driving it on until it touches shoulder (E) in the casing.

Unscrew the differential ring nut one half-turn.

Torque tighten the casing bolts (See H1-4)

Place the following at the planetary gear end:
- circlip
- plastic bushing.



ADJUSTING DIFFERENTIAL BEARING PRE-LOAD

Rotate the differential assembly to settle the bearings.

Ensure that the differential bearings locate correctly by turning the assembly.

Place the plunger on the torque measuring tool B.Vi. 906 against one tooth of the ring gear at its largest diameter, square with the differential shaft.

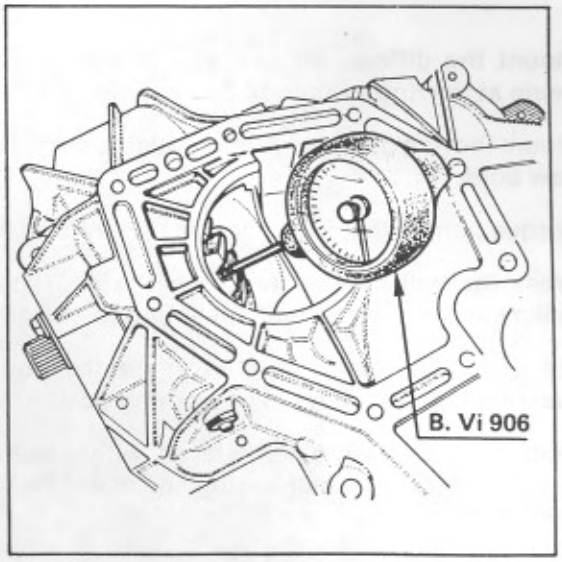
Using the torque measuring tool B.Vi. 906, press a ring gear tooth to rotate the differential slightly **in the same direction** as the bearing was installed. (Bearing roller-to-cage play will give a false reading if rotated in the opposite direction.)

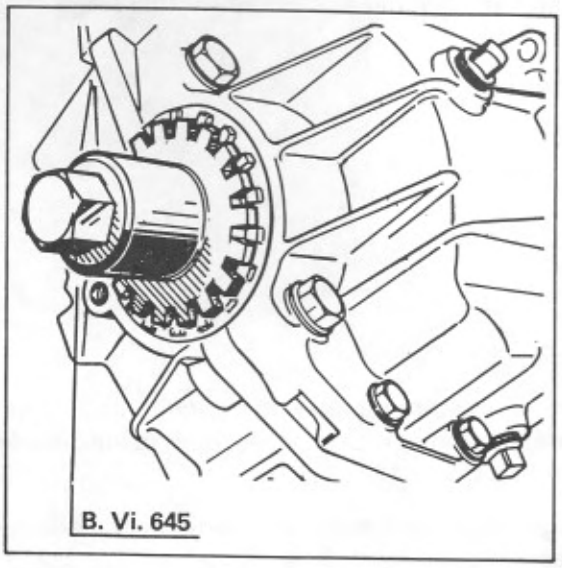
Release the torque measuring tool and read the torque shown by the follow-up pointer (Red).

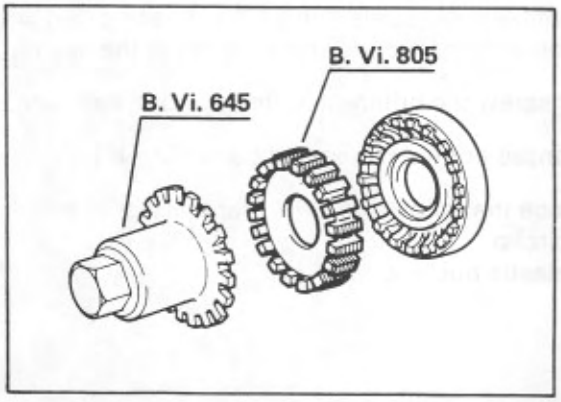
Screw the differential ring nut in or out to obtain a reading of: 2 to 2.5 daNm.

NOTE: The specification 2 to 2.5 daNm represents the pressure required for crown wheel movement as measured with tool B.Vi. 906; NOT the actual torque applied at tool B.Vi. 645.

- Adapter B.Vi. 805 must be used with wrench B.Vi. 645 when removing or replacing a 3-lip seal nut to avoid damaging the outer lip.
- When the correct adjustment has been obtained, lock the nut with its locking washer.



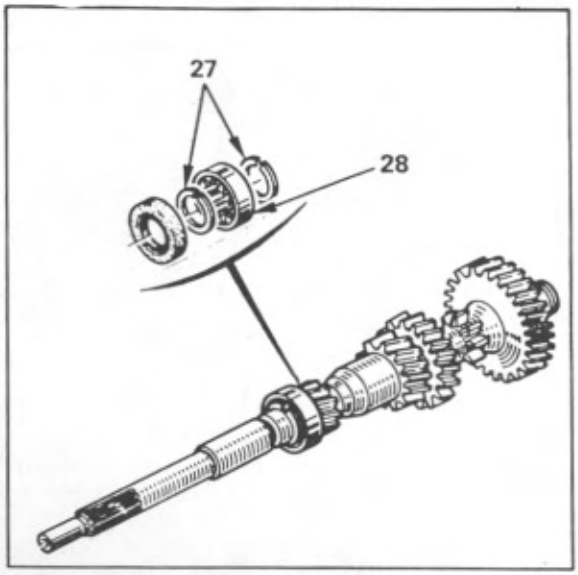




Replace the circlips (27) with new ones each time they are removed.

NOTE: The bearing (28) has no inner race. The rollers may possibly fall out when removing.

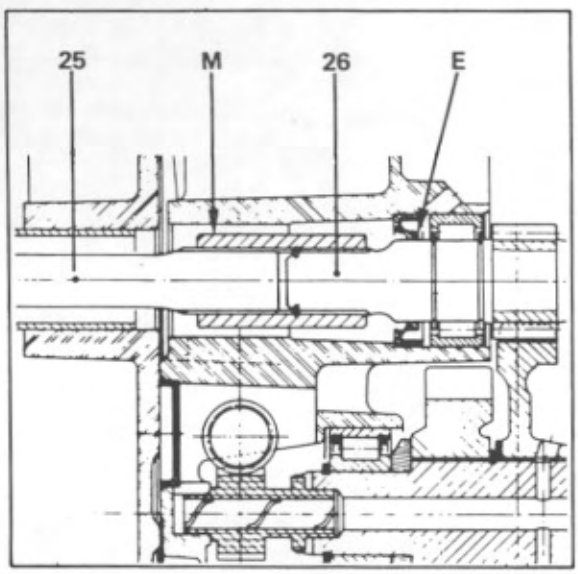
Since the lip seal and the bearing rollers run directly on the shaft, check the condition of their bearing area. If it is scored or appears defective, repalce the primary shaft.



Type 1:
- The clutch shaft and primary shaft are one piece.

Type 2:
- The connecting sleeve (M) is press fit onto the clutch shaft (25) and is circlipped to the primary shaft (26) using a round-wire, pentagonal circlip as shown at right.
- Damage to seal (E) can be avoided by installing the primary shaft before attaching the clutch shaft.
- The clutch housing must be removed to replace the clutch shaft.

Type 3:
- The primary shaft and clutch shaft are designed to use a square-wire, pentagonal circlip as shown at right, rather than a round-wire type.





Type 2 Circlip
(Round-wire)



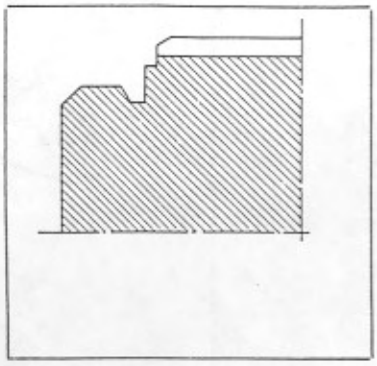
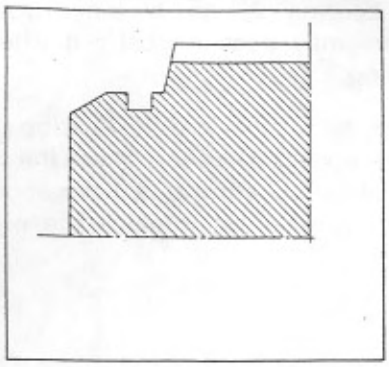
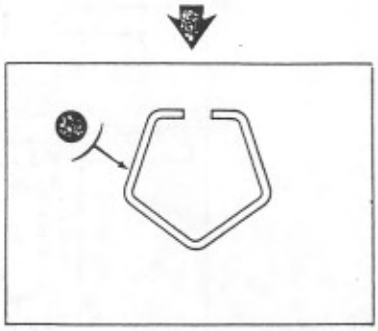
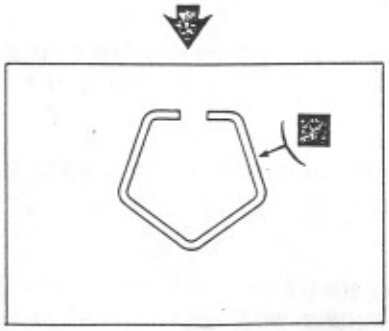
Type 3 Circlip
(Square-wire)

CAUTION

Parts from types 1, 2 and 3 are not interchangeable.

REBUILD

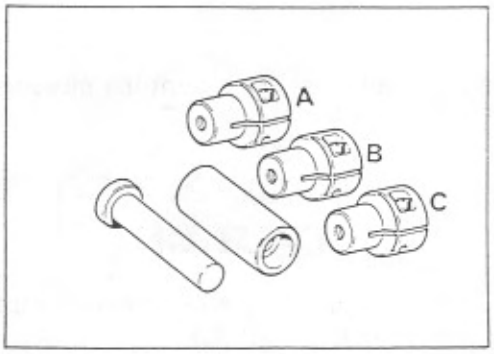
PRIMARY SHAFT ASSEMBLY

	2nd type of assembly	3rd type of assembly
Profile of clip groove for primary shaft		
Outer Ø of sleeve	x = 27.5 mm  x = 28.5 mm	
Special points	These parts can only be fitted with the circlip with the round cross-section. 	The modified parts can only be fitted with a circlip having a square cross-section.  NOTE: The circlip with a square cross-section must be replaced systematically each time it is removed.

REBUILD

PRIMARY SHAFT ASSEMBLY

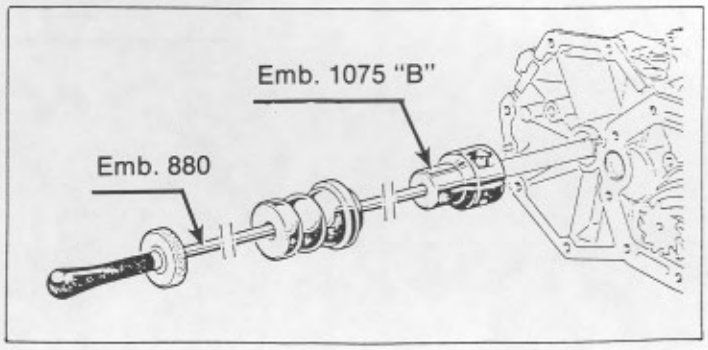
The clutch shaft is removed and the pentagonal circlip fitted in the sleeve using tools Emb. 880 and part "B" of tool Emb. 1075.



REMOVAL

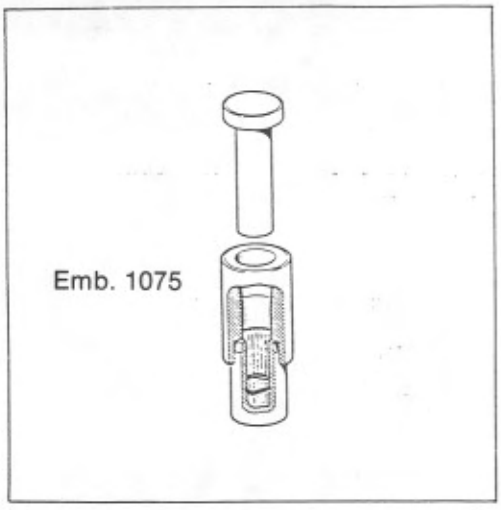
Fit part "B" of Tool Emb. 1075, which matches the shaft diameter, and tighten it on the splines.

Screw tool Emb. 880 onto this tool and remove the shaft.



The pentagonal circlip with a square cross-section must be replaced with a new one after each dismantling operation.

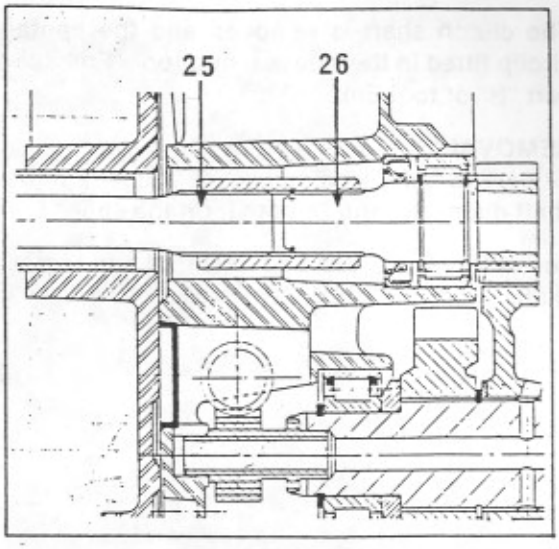
Using a small screwdriver and pliers, take the circlip out of the sleeve.



REFITTING

Fit the pentagonal circlip in the sleeve using tool Emb. 1075.

Using a small hammer, mount the clutch shaft on the primary shaft.



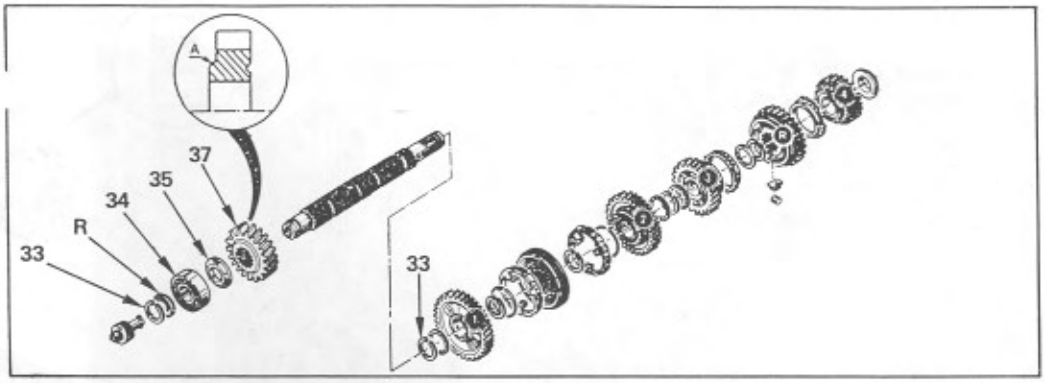
CAUTION

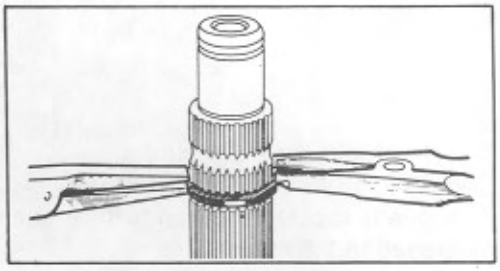
Use the hammer gently. A heavy impact could break the circlip.

If there is a slight axial clearance, this indicates that the circlip is clipped correctly in place in the primary shaft groove.

REBUILD

SECONDARY SHAFT ASSEMBLY





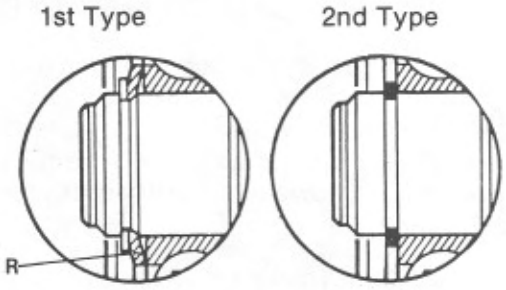
REASSEMBLY :
All the circlips must be replaced with new ones.

When refitting the circlips, use a pair of circlip pliers to open the ends and a pair of flat nosed pliers on the opposite side to prevent the circlip from twisting.

There are two types of bearing assembly at the step down gear end :

1st Type:
- Circlip thickness = 1.5 mm
- Assembly includes spring washer (R).

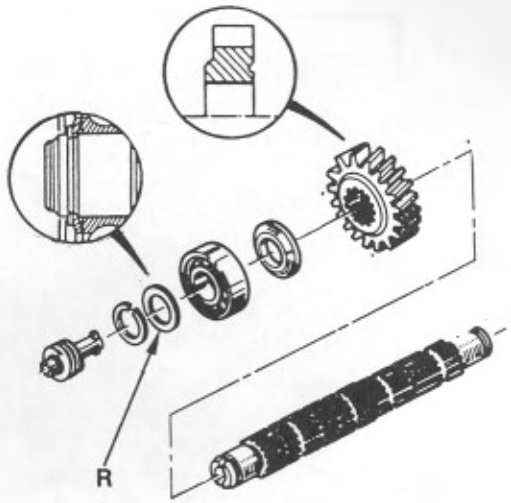
2nd Type:
- Circlip thickness = 2.0 mm
- Spring washer (R) is NOT used.
- Groove is located 1.5 mm further ahead and is widened to 2.5 mm.



SECONDARY SHAFT ASSEMBLY

Different arrangements of the bearing on the step down gear side and the 4th speed side.

1st Type:
- Circlip thickness = 1.5 mm
- Assembly includes spring washer (R).



2nd Type:
- Circlip thickness = 2.0 mm
- Does NOT use spring washer (R).
- Groove is located 1.5 mm further ahead and is widened to 2.5 mm

This modification has been accompanied by the widening of the groove and the bearing retaining circlip on the 4th speed side (thickness 2 mm). The spring washer has been replaced by a flat washer.

Installing the Step-Down Gear onto the Secondary Shaft
The original step-down gear may have been bonded to the shaft with Loctite® adhesive. The replacement step-down gear, however, is designed to be press fit onto the shaft.

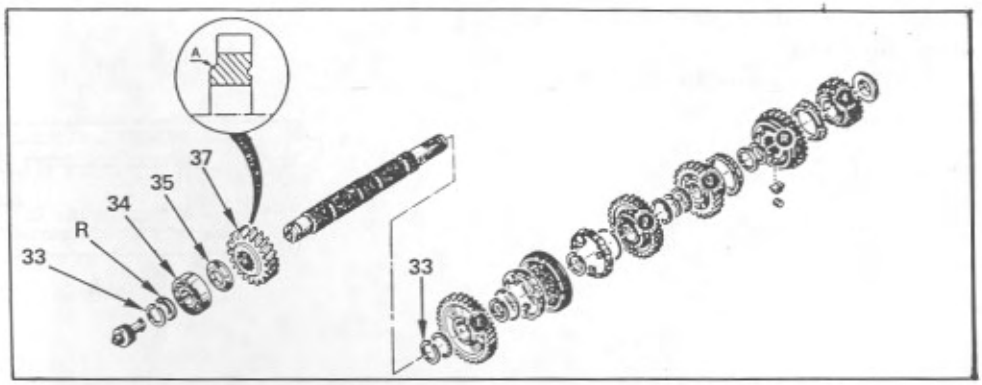
Step-Down Gear Thickness
The standard step-down gear thickness is 22.9 mm.

A limited number of NL gearboxes were produced with a 21.4 mm gear and a spline washer between the gear and the circlip.

Replacing a 21.4 mm Step-Down Gear
Should it be necessary to replace a 21.4 mm step-down gear, remove the spline washer and replace the gear with a standard 22.9 mm gear.

REBUILD

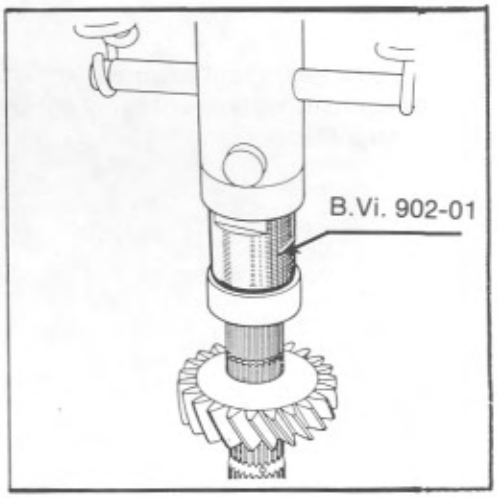
SECONDARY SHAFT ASSEMBLY



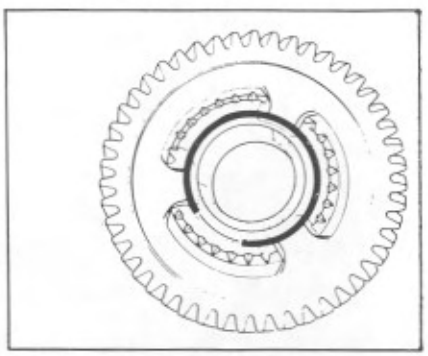
REASSEMBLY:

Install or Connect:

- The circlip (33).
- The step down gear (37), ensuring that the shoulder (A) is on the correct side.
- The washer (35) with the large bearing face on the step down gear side.
- The bearing (and the spring washer, in those cases where one is fitted).
- The circlip (33) using tool B.Vi. 902-01 if necessary.



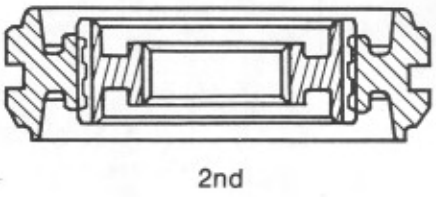
- Ensure that the circlip is correctly located in its groove in the secondary shaft.
- Refit the gear wheels by performing the removal sequence in reverse and oiling the gear wheels and synchronizer rings.
- Fit the synchronizer springs to the 1st and 2nd gear wheels with their ends folded into the apertures in the gears.



REBUILD

SECONDARY SHAFT ASSEMBLY

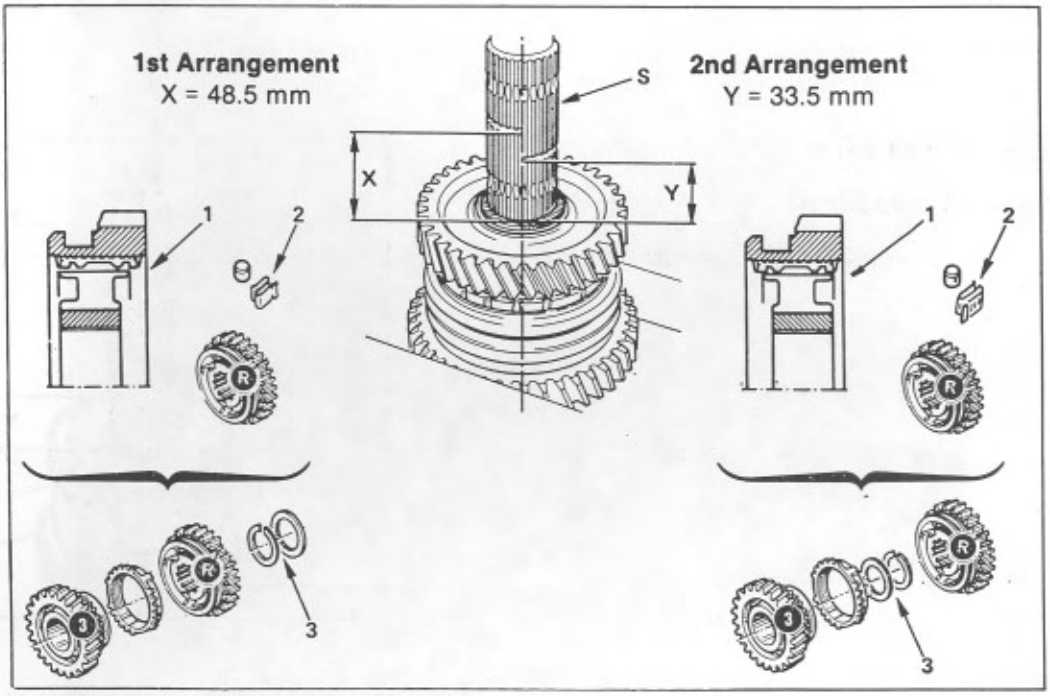
- Ensure that the hub-sliding gear assemblies face the correct direction.
- 1st - 2nd : sliding gear chamfer towards 2nd.



3rd - 4th : Reverse gear teeth towards 4th.
: There are three types of synchronizer hub arrangements

SECONDARY SHAFT

3rd/4th Synchronizer Hub Installation



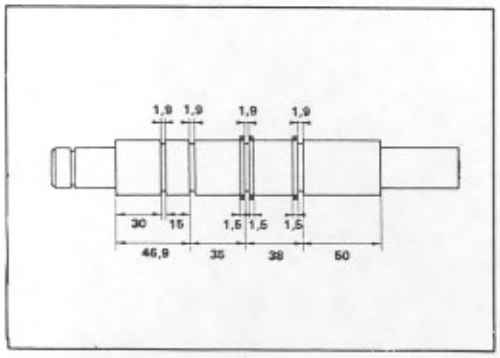
The synchronizer assembly parts are identical except for two different versions of the secondary shaft (S). On the 1st type, the groove is located 48.5 mm from the gear as indicated by dimension X. On the 2nd type, the groove is closer to the gear (33.5 mm) as indicated by dimension Y. This variation results in two different assembly arrangements as shown.

Note the position of the synchronizer roller and spring (2) in the relation to the hub (1) and the location of the circlip and washer (3) in relation to the reverse gear (R).

Only the 1st speed gear from the "2nd arrangement" can be used regardless of the original arrangement. There can be an axial clearance of approximately 2 mm in the case of a secondary shaft of the "1st arrangement" type.

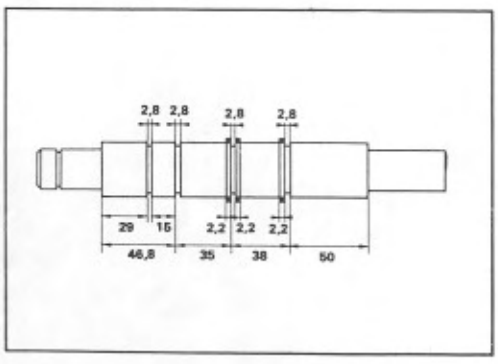
1st Arrangement

Circlip:	1.9 mm
Splined washer:	1.5 mm



2nd Arrangement

Circlip:	2.8 mm
Splined washer:	2.2 mm



REBUILD
SECONDARY SHAFT ASSEMBLY

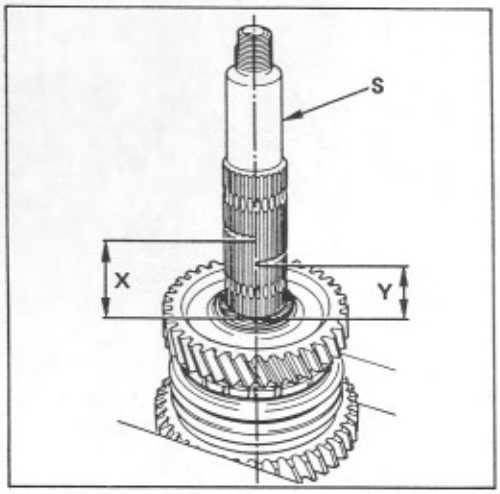
REASSEMBLY :

Special Features:
All the parts are identical except for dimensions X and Y on the secondary shaft.

1st arrangement **X = 48.5 mm**

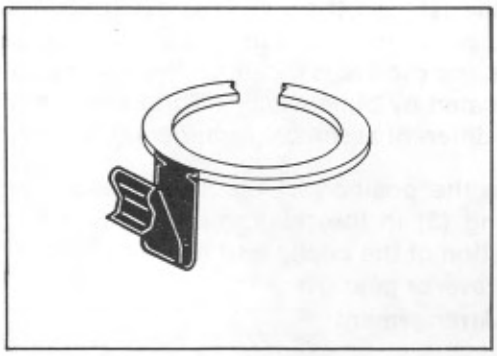
2nd arrangement **Y = 33.5 mm**

Ensure that the synchronizer roller springs face the correct direction.



The locking tabs must be on the same side as the circlip.

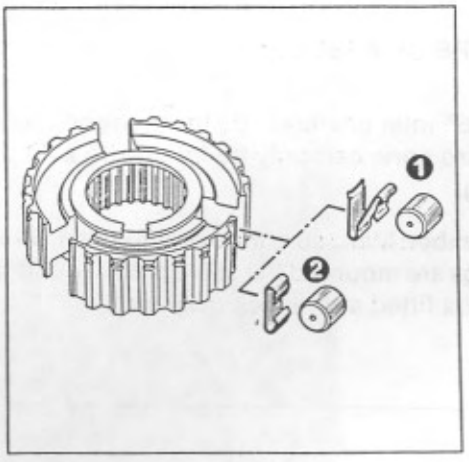
The washer must be installed with the large bearing face towards the 4th speed gear.



REBUILD

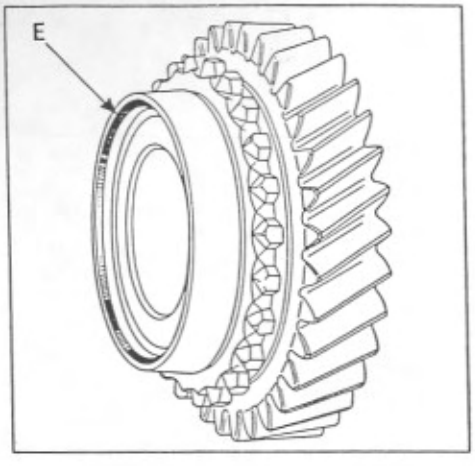
SECONDARY SHAFT ASSEMBLY

NOTE: In all NL gearboxes, the "Z-shaped" BORG-WARNER (3rd/4th speed) synchro roller springs used to date have now been replaced in production by "heart-shaped" springs.



1 : 1st type of assembly ("Z" shape)
2 : 2nd type of assembly (heart-shaped)

The inlet recess chamfer (E) of 3rd and 4th speed idler synchro cones has been redesigned to accommodate the new shape roller spring. The new springs can only be used with the new design idler gears. They will not work with old design idler gears.



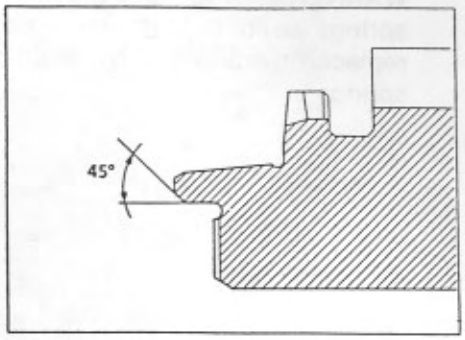
REBUILD

SECONDARY SHAFT ASSEMBLY

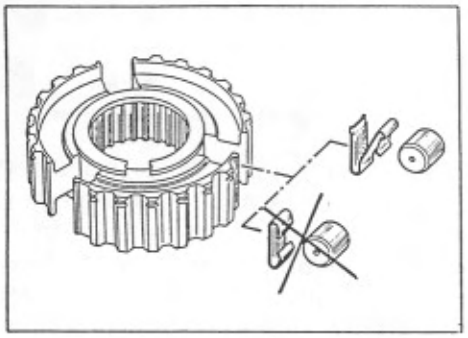
1st TYPE OF ASSEMBLY

The 45° inlet chamfer "E" for the recess under the synchro cone can only be fitted with a "Z-shaped" spring.

Remember: Make sure the synchro roller "Z-shaped" springs are mounted the correct way round : locking the tabs fitted at the lock ring end.



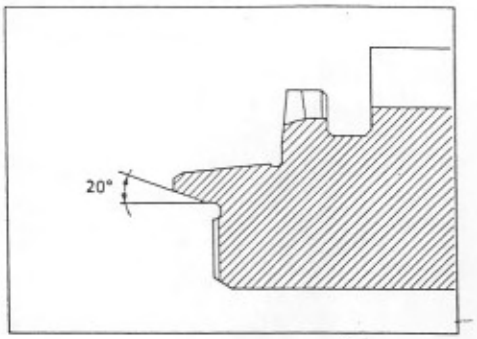


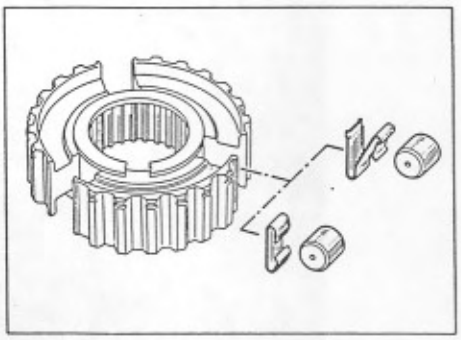


2nd TYPE OF ASSEMBLY

Special Point: idler gears with a 20° inlet chamfer "E" can be fitted either with "heart-shaped" or "Z-shaped" springs. However, different shaped springs **must not** be used on the same synchro assembly.

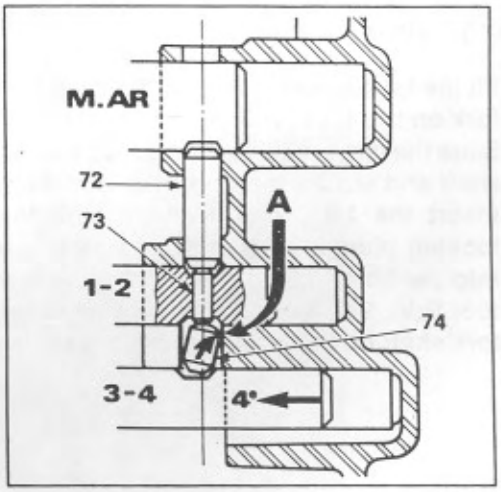
Make sure the "heart-shaped" springs are fitted correctly with the flat section fitted at the synchro hub end.





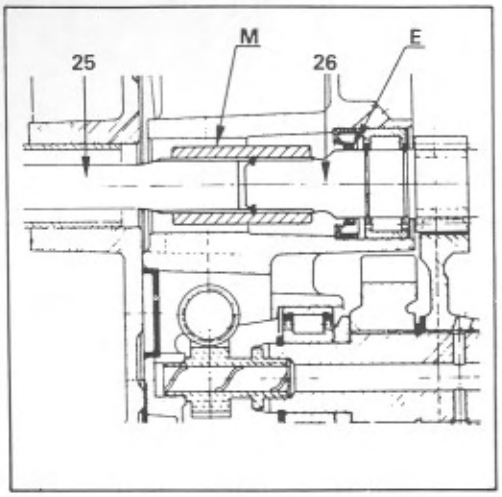
Reassembly:

- Place the locking balls in the housing :
- Between the reverse shaft and 1st/2nd shaft bores (73).
- Between the 1st/2nd and 3rd/4th shaft bores (74).



- Ensure that they slide correctly.
- Refit the shafts to the step down housing.

- Precautions : To avoid damaging the lip on the primary shaft seal, carefully guide the clutch shaft to prevent its splines or sleeve from making contact with the lip on the seal.



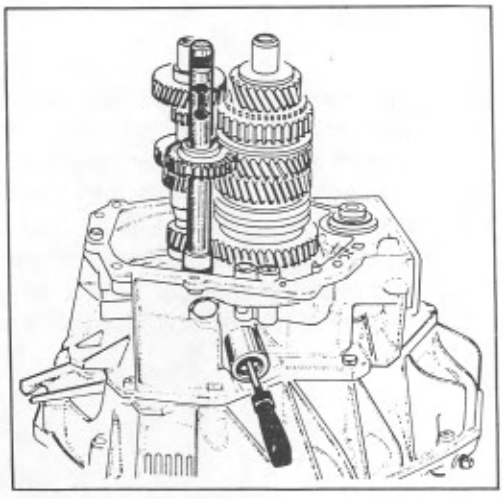
1st arrangement:

- The clutch shaft is integral with the primary shaft.

2nd arrangement:

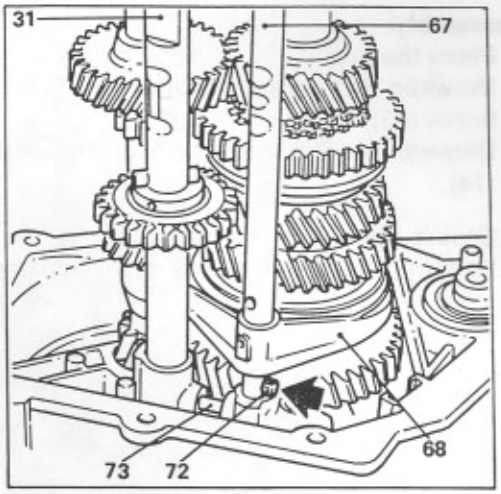
- A coupling flange (M) is press fitted to the clutch shaft (25) and is clipped to the primary shaft (26).
- The two shafts are assembled after fitting the primary shaft to avoid damaging the lip seal (E). See page **H3-22**.

- Fit the speedometer worm to the secondary shaft.
- Connect the primary shaft to the secondary shaft. Take both the shafts and position them in their housings simultaneously.
- Fit the reverse shaft with locking recesses opposite the shafts.
- Turn the speedometer pinion and tap the three shafts with a plastic mallet until they align into their correct positions.
- Place a cloth under the step down gears to prevent any parts from falling into the housing.



REASSEMBLY :

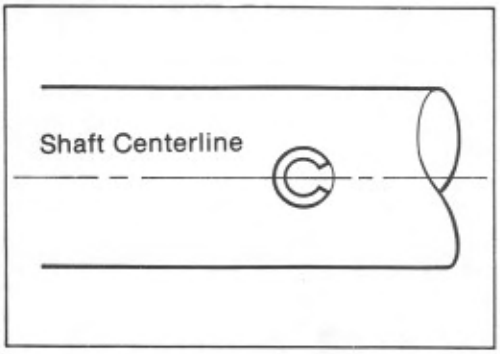
- Fit the 1st/2nd shift fork (with the flat face of the fork on the 1st speed side).
- Slide the large locking plunger up to the reverse shaft and ensure that the shaft is locked.
- Insert the 1st/2nd fork shaft, with the small locking plunger (72) into the fork and lower it into the bore in the housing. Pin the fork using tool B.Vi. 949 with the locking recesses in the fork shaft opposite the secondary shaft.



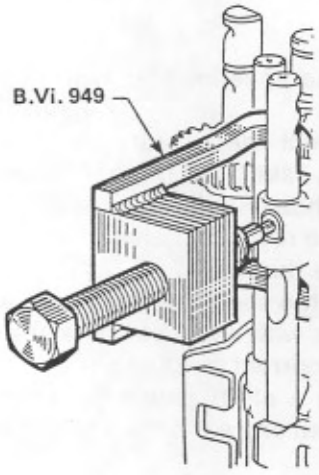
NOTE:

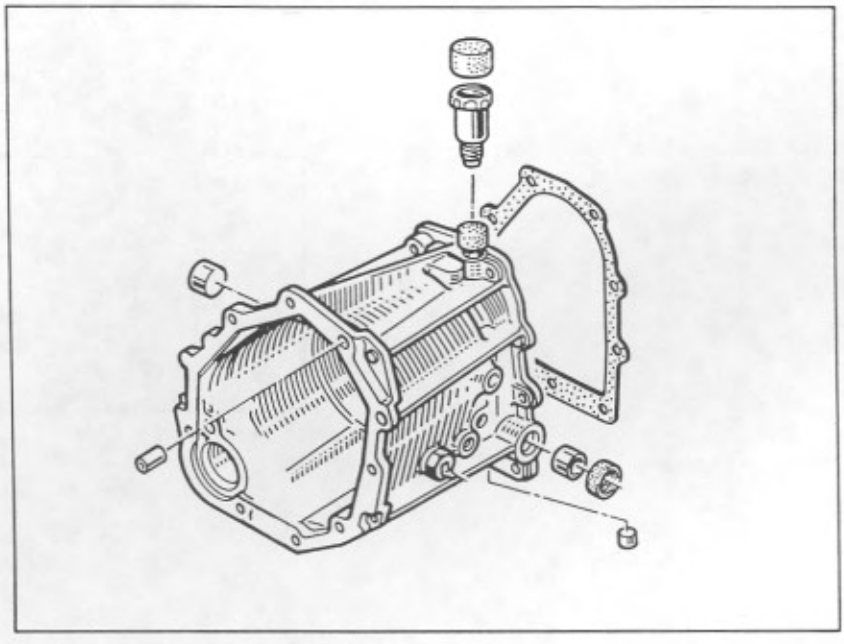
1 - The seams in the pins must line up with the shaft centerline.

2 - These pins must be replaced with new ones each time they are removed.

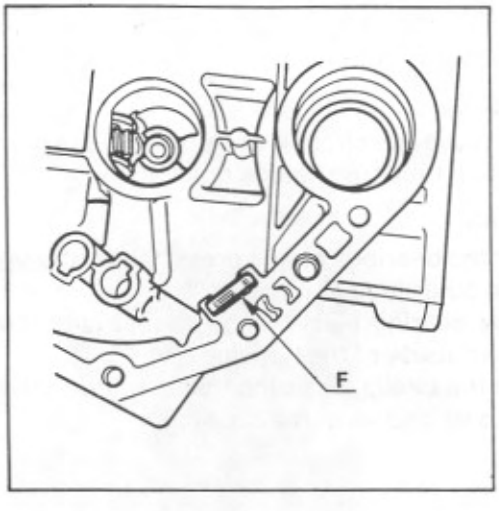


- Fit the 3rd/4th speed fork (flat face towards 4th speed) on the sliding gear. Ensure that the reverse shaft and 1st/2nd fork shaft are locked. Slide the 3rd/4th fork shaft into the fork and lower it into the housing. Ensure that the bore recesses on the shaft are opposite the secondary shaft and that the plunger (74) is in position. (See H3-31) Pin the fork in place using tool B.Vi. 949.





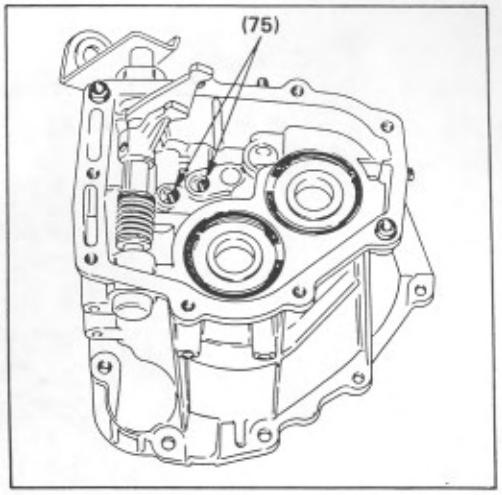
- Ensure that the shouldered washer (item 11, page H1-9) is correctly positioned on the secondary shaft. That the magnet (F) is in its location. That the 2 locating dowels are in the housing.



In the main housing :

- Fit the two interlocks (75) between the fork shaft bores:

  - 1/2 and 3/4



Replacing the bearings

1st arrangement : thickness : 17 mm
2nd arrangement : thickness : 17.5 mm

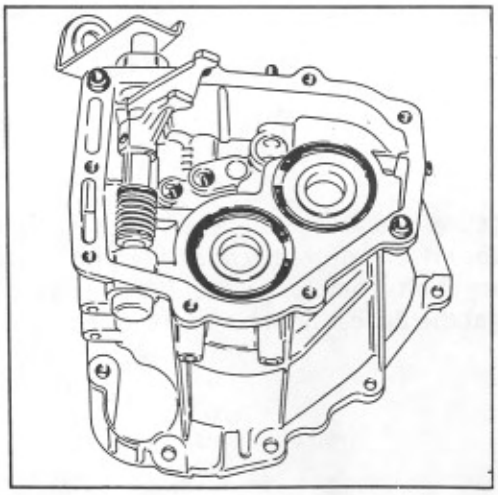
When replacing a bearing, it must be identical to the one removed.

Removing:

- Remove the circlips and push out the bearings with a tube from inside the housing.

Refitting:

- Fit the bearings on the press, taking the load on the outer race (Ø.61 mm).
- The bearing plastic cage should face towards the outside of the housing.
- Fit the circlip, ensuring that it enters, correctly, into its groove in the housing.

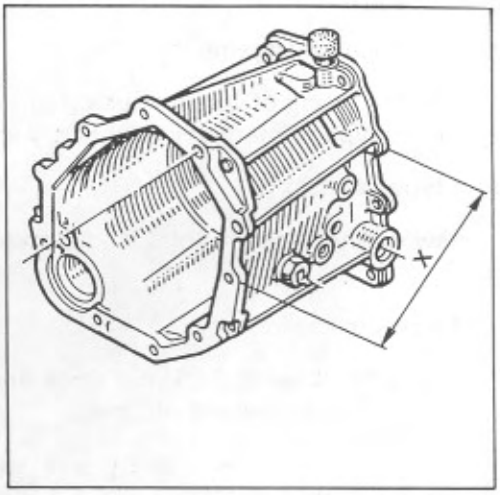


1st arrangement : without a gasket

Coat the joint face between the main and step-down housing with anaerobic sealant. Refer to "Anaerobic Sealants" in subsection H1 for recommendations.

2nd arrangement : Fit a gasket (dry).

To check whether the arrangement is of the gasket or no gasket type, simply measure dimension X on the main housing or the thickness of the bearings fitted to it.



1st case:

Dimension X : 205 mm, bearing thickness 17 mm.

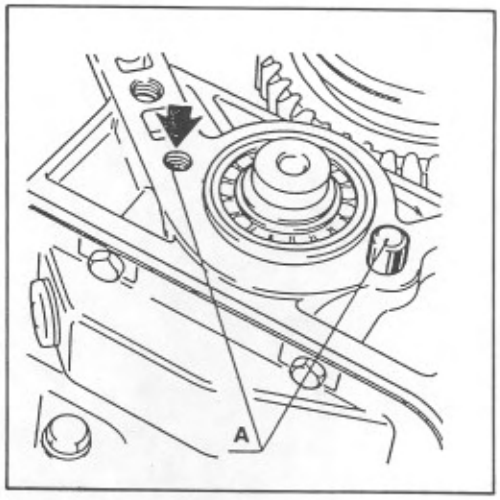
- arrangement without gaskets

Coat the joint face between the main and step down housings with an anaerobic sealant. Refer to "Anaerobic Sealants" in subsection H1 for recommendations.

2nd case:

Dimension X : 204.2 mm with bearings 17.5 mm thick.

Arrangement with gaskets
(do not use jointing compound).



CAUTION

1st arrangement without a gasket **cannot** be fitted with a gasket.

- The two bolts fitted at (A) must be coated with anaerobic sealant.
- Fit the main housing and tighten the bolts to a torque of 3 daNm (22 lb./ft.)

Different repair arrangements:

1st case: The fitting of a new housing to a gearbox with the old type primary and secondary shafts.

a) first type gearbox :

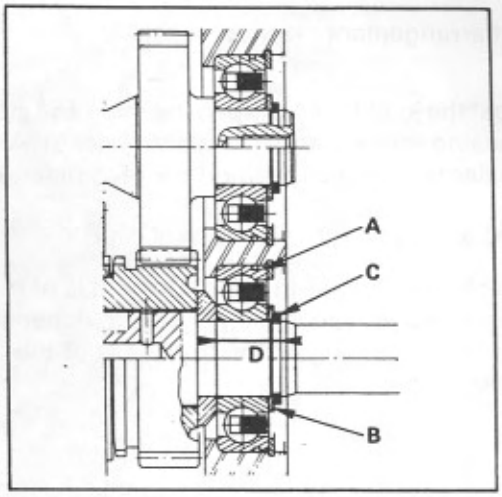
Fit a new washer 1.5 mm thick and circlip 1.5 mm thick.

b) 2nd type gearbox :

Fit the original washer 2.05 mm thick and a new circlip 1.5 mm thick instead of 2 mm.

2nd case: - Fitting new primary and secondary shafts to an old type gearbox.

Fit the washer 2.05 mm thick with a circlip 2.4 mm thick.

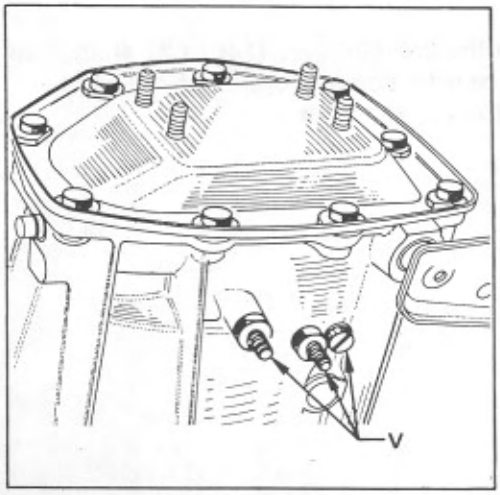


	Thicknesses in mm			
	Bearings A	Washer B	Circlip : C	Dimension D
First Arrange.	17	2,05	1,5	20,65
Second Arrange.	17	2,05	2	21,15
Third Arrange.	17,5	2,05	2	21,65

- Refit the locking assemblies (V).

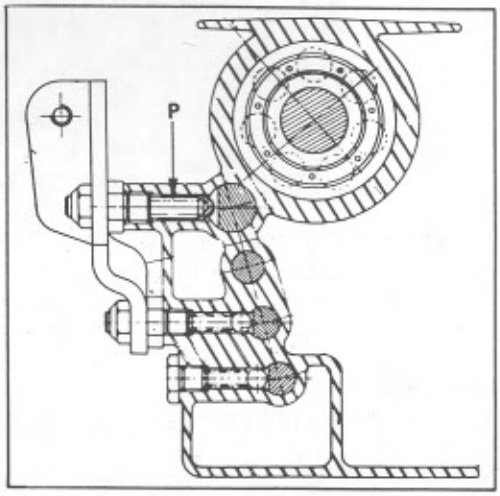
1st arrangement:

The 3 balls and 3 springs are identical.

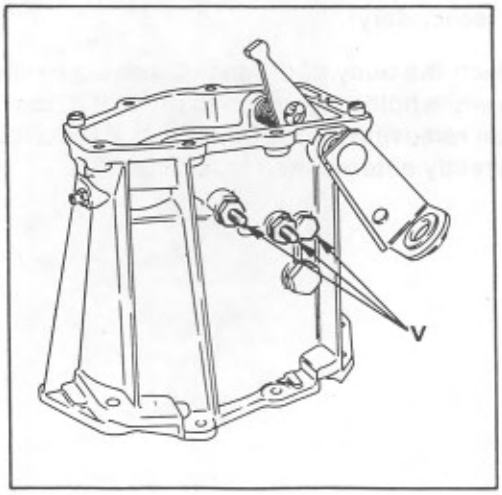


2nd arrangement:

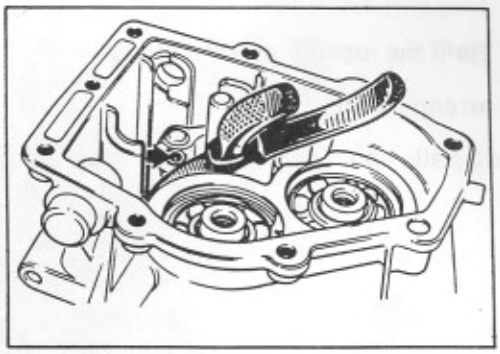
- The 2 locking balls for the 1st/2nd and 3/4th shafts are identical
- Reverse is locked by a plunger (P).
- The 3 springs are identical.



- Coat the plugs with anaerobic sealer and tighten them to a torque of 1.7 daNm (12.5 lb./ft.)



Pin the 3rd/4th lever (14) to its shaft, holding it in place with a pair of long bent-nosed pliers, with the 3rd/4th shaft in 4th.

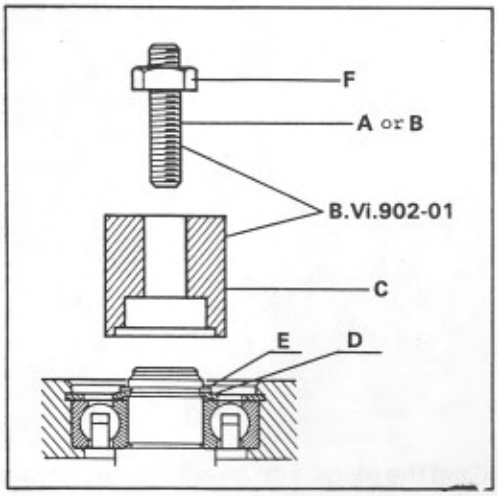


- Fit the spring washers to the primary and secondary shafts ensuring that they face the correct direction.
- Attach the circlip using tool B.Vi. 902-01.

Primary shaft:
- Use the (10 x 150) threaded rod.

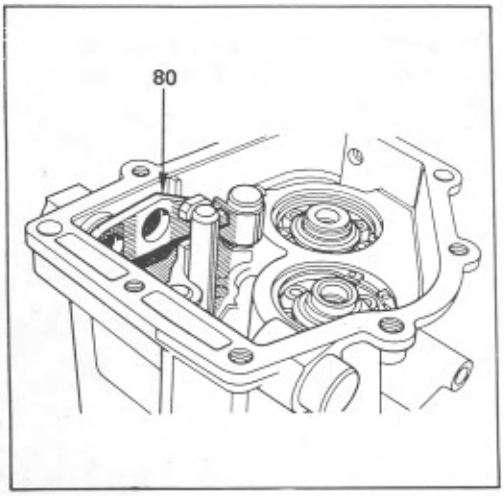
Secondary shaft:
- Use the (12 x 150) threaded rod.
- Screw the rod (A) into the shaft (primary or secondary).

Attach the body of the tool C and screw on the nut (F) while holding tool (C) to prevent it from turning. After removing the tool, ensure that the circlips have correctly entered their locations.



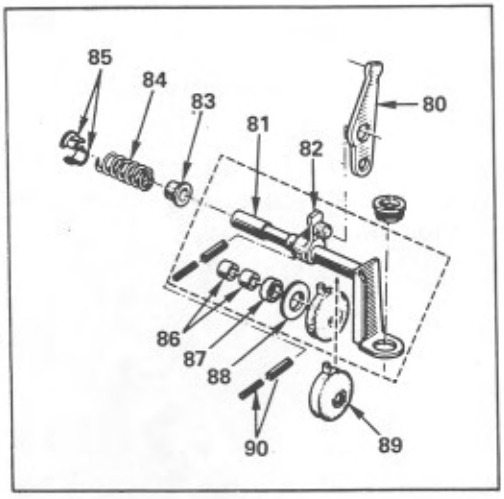
NOTE: The lip seal must be replaced each time the shift shaft is removed, since it is unavoidably damaged as the shaft is taken out.

- Fit the lip seal (oiled).
- Ensure that there are no burrs on the shaft to avoid damaging the lip on the seal.
- Refit the ring (if there is one).
- Place the reverse lever (80) in position with its boss towards the outside and clip it to the shaft.
- Oil the shaft and fit it together with its boot (when applicable).

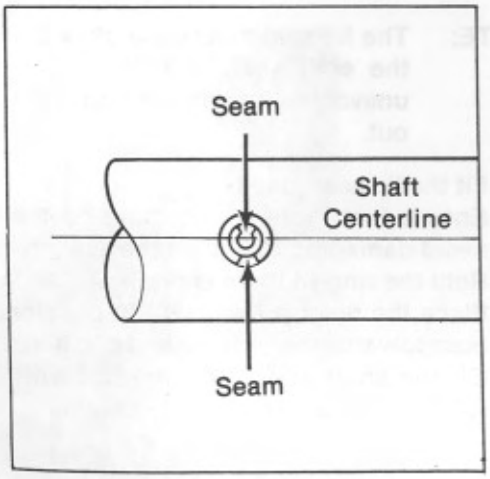


Assemble:

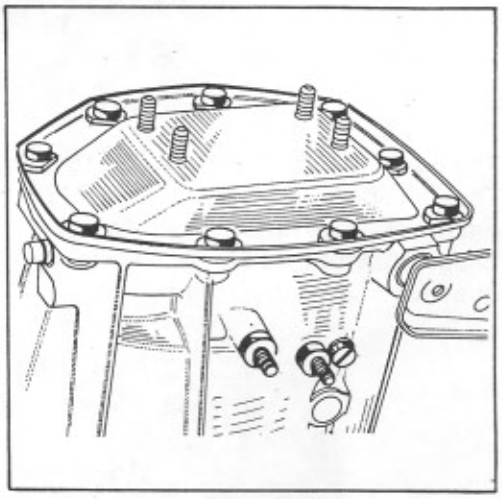
- The selector lever (82).
- The bushing (83) and the spring (84).
- The half shells (85) using tool B.Vi. 747
- Pin the selector lever (82) in place.
- Ensure that the pins are installed facing the right direction.



- The seams of the pins must be perpendicular to the shaft center line and on opposite sides to one another.
- Check that the control slides freely and that there is no play.



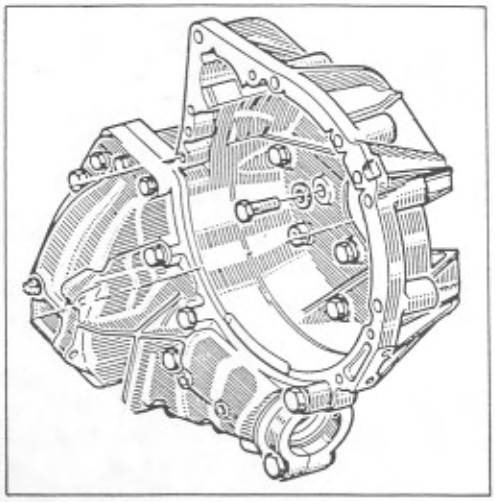
- Check that all the gears engage.
- Attach the rear cover after coating its gasket with jointing compound.

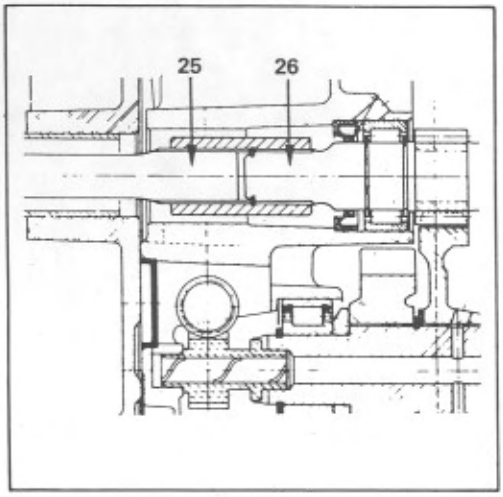


REBUILD

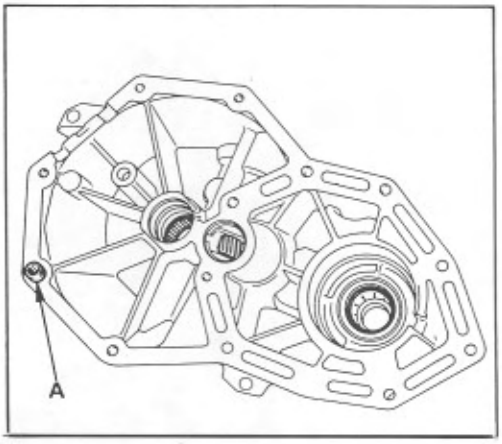
FINAL ASSEMBLY

Before connecting the clutch housing-final drive assembly to the step down and main housings:





- Assemble the clutch shaft (25) (2nd arrangement) by clipping it to the primary shaft (26). See page H3-22.

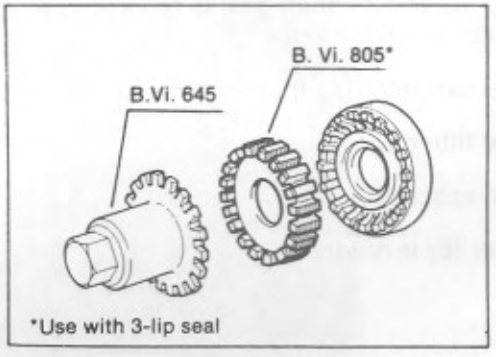


- Check that the locating dowel A is in position and coat the assembly faces of the housings with anaerobic sealer or use the gasket shim described on page H1-16. Refer to "Anaerobic Sealants" in subsection H1 for recommendations.
- Assemble the housings and tighten the bolts to a torque of 3 daNm (22 lb./ft.)

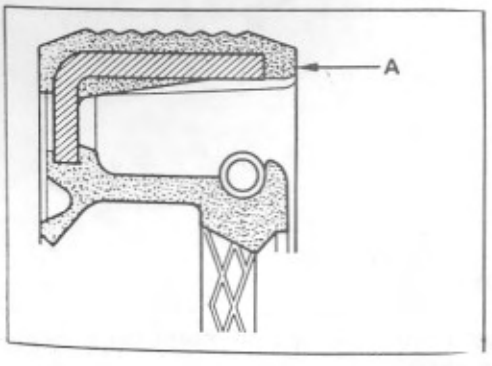
DIFFERENTIAL SEAL AND NUT
REMOVE AND REPLACE

REMOVING:

- Drain the final drive case.
- Disconnect the transmission shaft at the final drive end.
- Mark the position of the adjusting nut in relation to the case.
- Remove the locking washer.
- Unscrew the nut, counting the number for turns. Use tool B.Vi. 645.

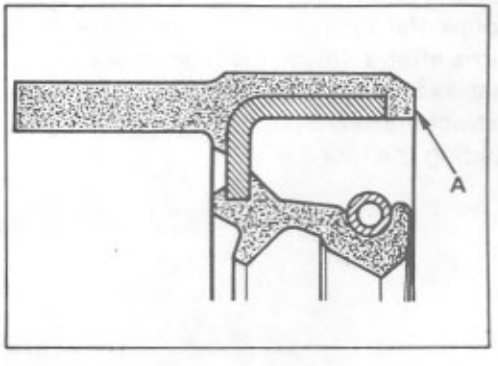


1st Type: Seal with 2 lips.



2nd Type: Seal with 3 lips.

- Adapter B.Vi. 805 must be used with wrench B.Vi. 645 when removing or replacing a 3-lip seal nut to avoid damaging the outer lip.

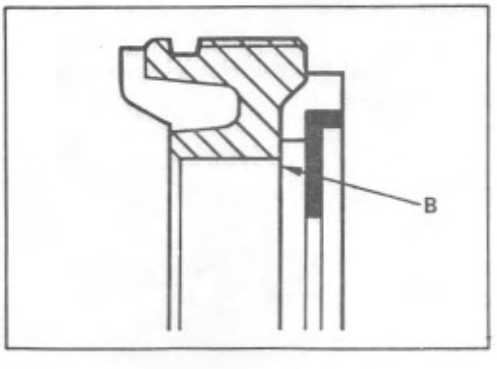


Face A must be flush with the inner face of the nut B regardless of the type of seal.

Refitting:

- Refit the nut, equipped with a new, oiled O-ring, screwing in by the same number of turns and aligning it with the marks made during dismantling.
- Refit the locking washer.
- Reconnect the transmission shaft.
- Fill the final drive case.

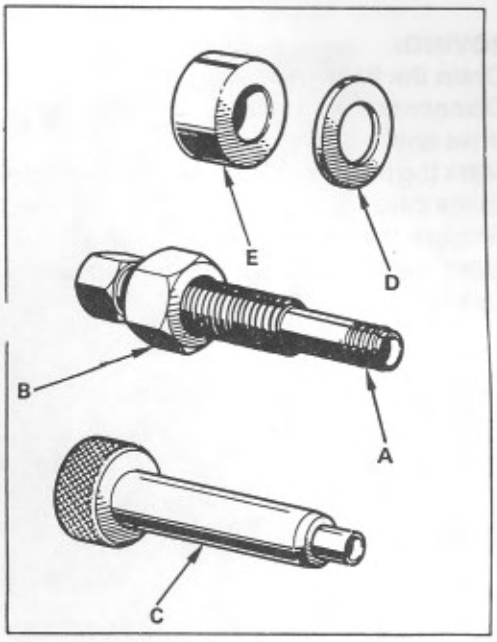
NOTE: The 3 lip seal can be installed as a replacement for the 2 lip seal.



SPEEDOMETER SHAFT SEAL
REMOVE AND REPLACE

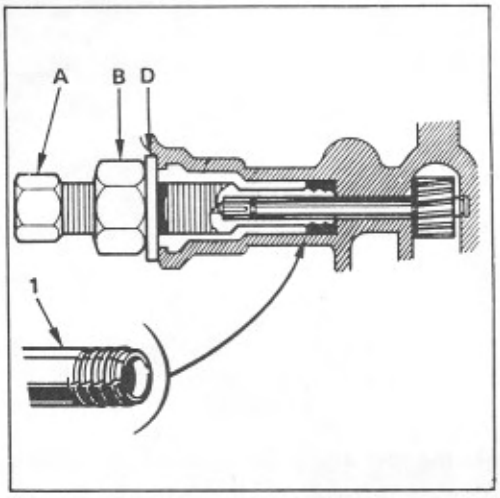
The speedometer shaft seal is replaced using tool B.Vi. 905 which includes:

- a seal extractor (A) fitted with a nut (B).
- a seal fitting tool (C),
- a thin spacer (D),
- spacer (E) is not used.



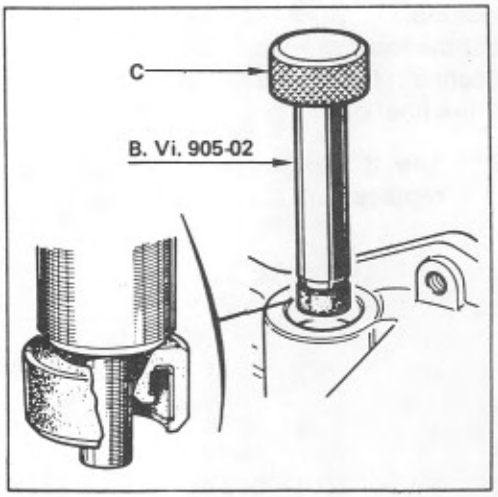
REMOVING

- Disconnect the speedometer drive cable from the gearbox.
- Attach the extractor tool (A) equipped with nut (B) and spacer (D).
- Screw the tool (A) in by approximately three turns after it has made contact with the seal so that its thread (1) penetrates the rubber.
- Extract the seal by screwing in the nut (B) while holding the tool (A).



REFITTING

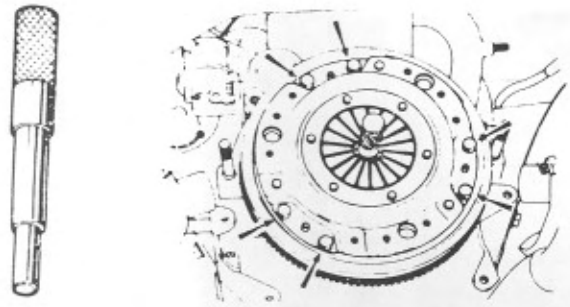
- Place the seal on tool (C) as shown and hit the end of the tool.



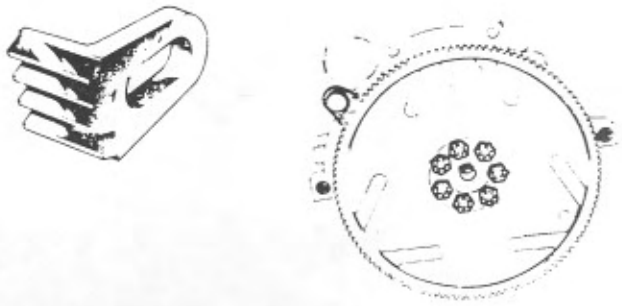
SECTION "I"

CLUTCH

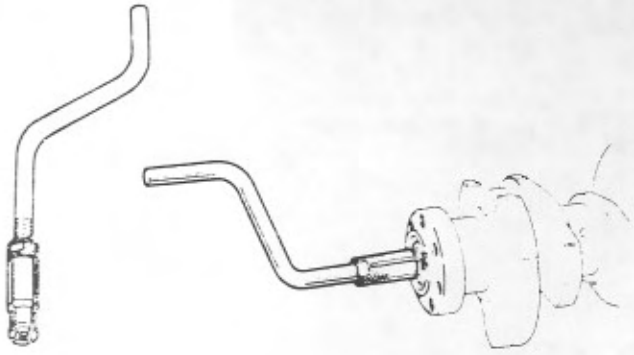
Subsection 1	**Specifications**
I1-1	Special Tools
I1-2	General Information
Subsection 2	**Pressure Plate - Disc**
I2-1	Changing
Subsection 3	**Flywheel**
I3-1	Remove and Replace
Subsection 4	**Clutch Shaft Pilot Bearing**
I4-1	Changing
Subsection 5	**Thrust Pad (Throw-out Bearing)**
I5-1	Changing
Subsection 6	**Clutch Master Cylinder**
I6-1	Remove and Replace
Subsection 7	**Clutch Slave Cylinder**
I7-1	Remove and Replace
Subsection 8	**Clutch Hydraulic System**
I8-1	Bleeding
Subsection 9	**Operating Clearance**
I9-1	Adjusting



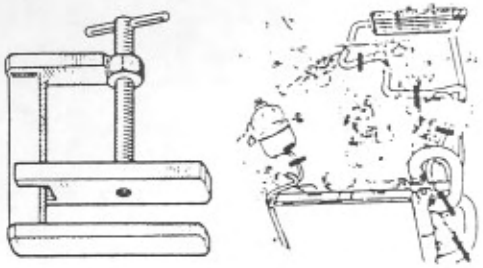
Emb. 786.01
Mandrel for locating clutch disc
Order Tool No. 700000-78-601 EA



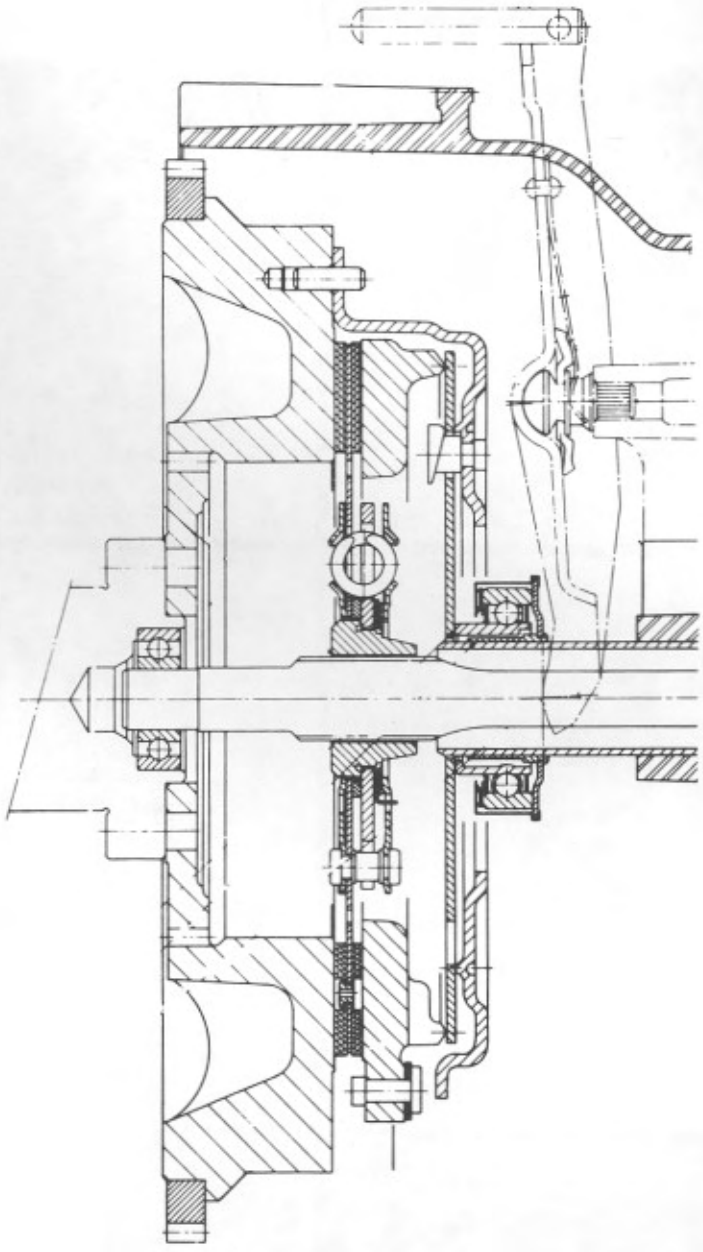
Mot. 582
Flywheel locking sector
Order Tool No. 700000-58-200 EA



Mot. 11
Crankshaft bushing extractor
Order Tool No. 700000-72-500 EA



Mot. 453-01
Hose clamp (25 mm dia. max.)
Order Tool No. 700000-45-301 EA



Centauri, LeSharo, Phasar and Utility Van

- Single dry plate hydraulically operated clutch.
- Diaphragm spring pressure plate
- Clutch disc with cushioned hub.
- Self-centering guided ball thrust pad.

The brake fluid reservoir supplies the clutch hydraulic circuit.

PRESSURE PLATE - DISC
CHANGING

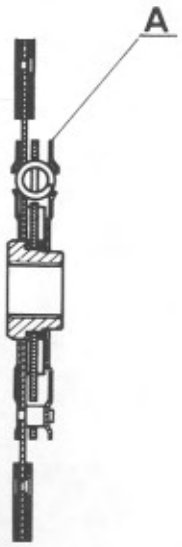
The gearbox must be removed for this operation

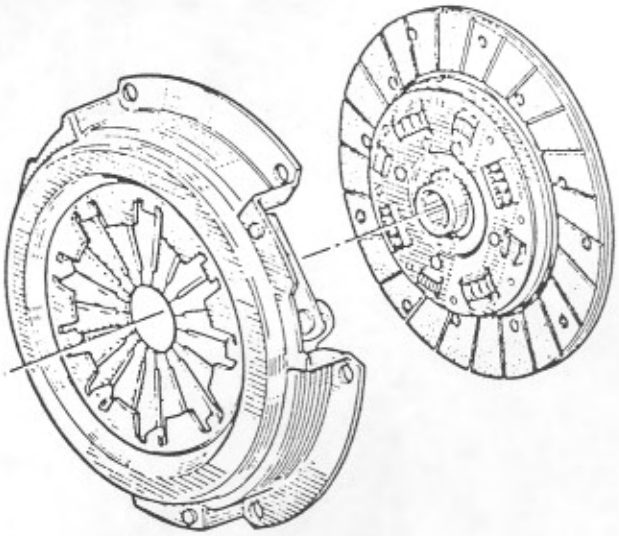
Removal

- Unscrew the ring of pressure plate bolts and remove it and the disc.
- Inspect all components and change any if worn or faulty.

REASSEMBLY

- Clean the flywheel friction face.
- Mount the disc (hub offset A facing gearbox) using:
  - mandrel Emb. 786.01
- Tighten the pressure plate ring of bolts gradually and in rotation before final tightening, 2 daNm (22 lb./ft.)
- Lightly grease the bearing surface for the thrust pad.





FLYWHEEL
REMOVE AND REPLACE

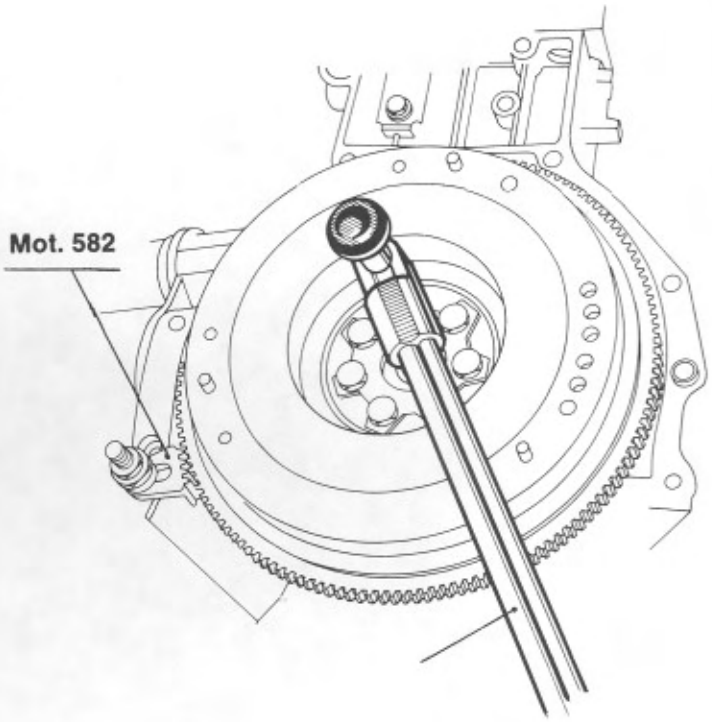
The gearbox and clutch must be removed for this operation.

TIGHTENING TORQUES
Flywheel bolts: 6 daNm (45 lb./ft.)

Removal
- Mount locking sector Mot. 582
  Unlock (if applicable) and unscrew the flywheel bolts.
- These are self-locking bolts which cannot be reused.
- Remove the flywheel

IMPORTANT
- The flywheel friction face cannot be resurfaced.
- The flywheel must be changed if unservicable.

REASSEMBLY
- Use a dry cloth to clean the threaded holes in the crankshaft.
- Degrease the flywheel locating face on the crankshaft.
- Apply Loctite® or equivalent to the mating faces.
- Mount the flywheel, coat the bolt threads with 1 or 2 drops of Loctite® and insert new self-locking bolts through new lockplate.
- Torque tighten the bolts using a torque wrench.
- Bend the lockplate tabs onto one hexagon only on each bolt.



CLUTCH SHAFT PILOT BEARING
CHANGING

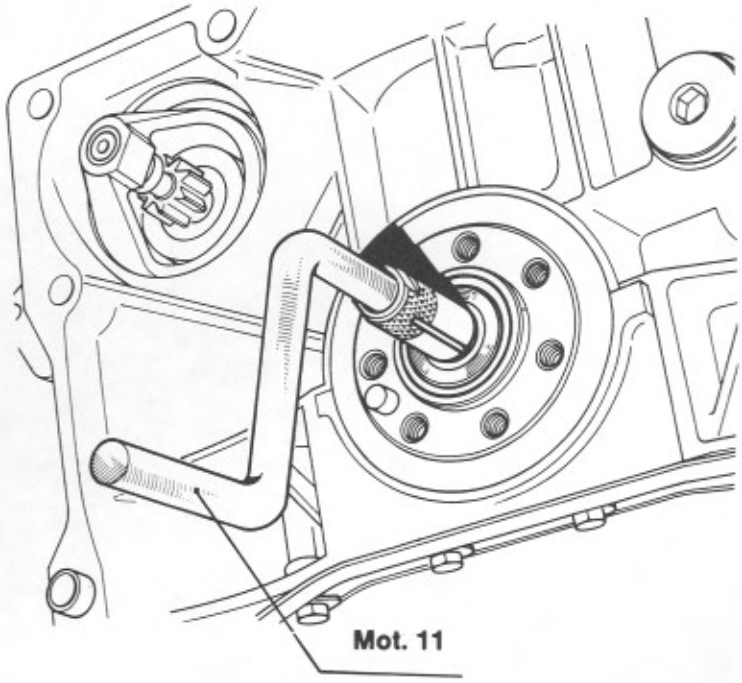
The gearbox, clutch and flywheel must be removed for this operation.

REMOVAL

- Extract the bearing using extractor Mot. 11.

REASSEMBLY

- Coat the outside of the bearing with Loctite® or equivalent.
- Insert the new bearing. Clean the outside only since it is pre-greased.



THROW-OUT BEARING

CHANGING

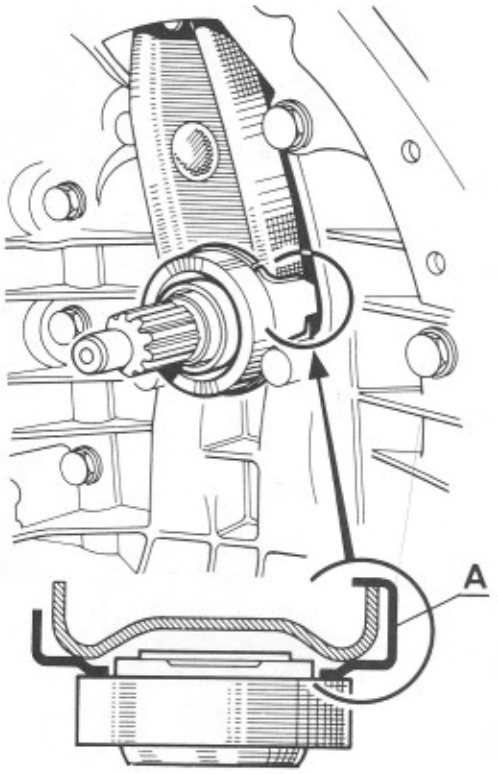
The gearbox must be removed for this operation.

REMOVAL

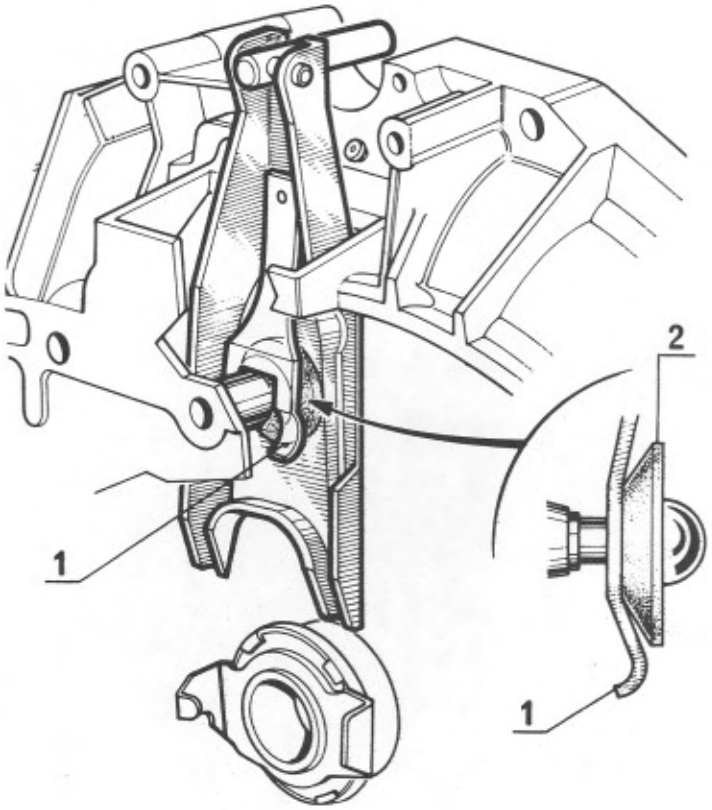
- Remove the thrust pad.

REASSEMBLY

- Lightly grease the diaphragm spring bearing surface.
- Coat the fork pivot pin with graphite grease.
- Attach the thrust pad to the guide tube correctly as shown at (A).



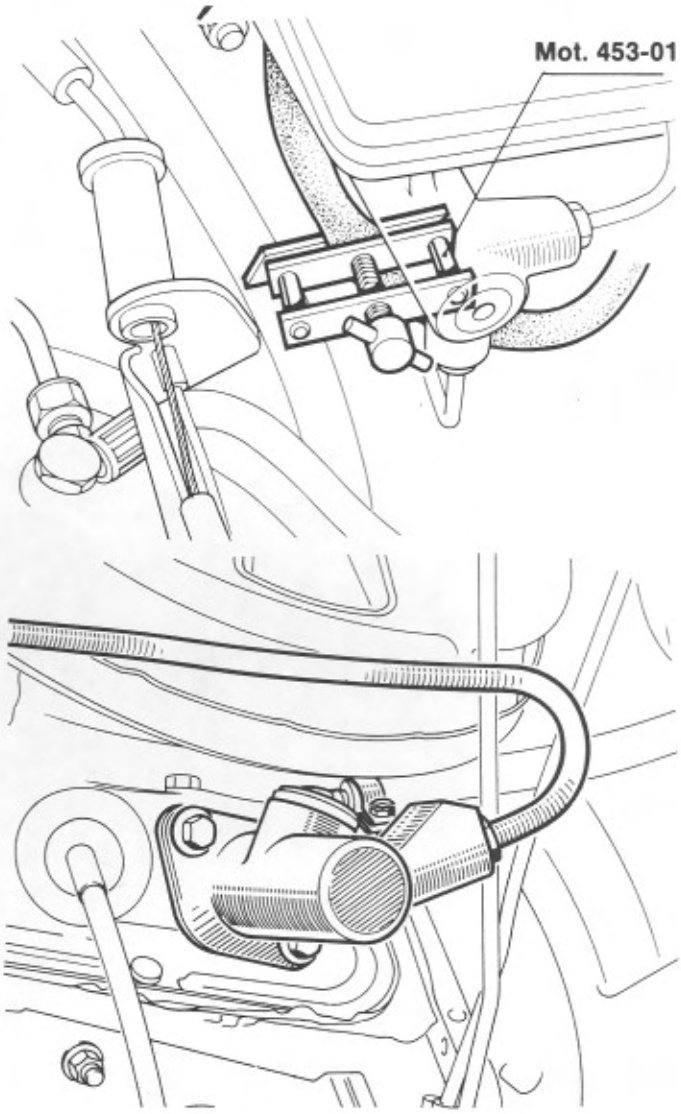
- Lift up the fork, placing retainer (1) behind seal (2).



CLUTCH MASTER CYLINDER
REMOVE AND REPLACE

REMOVAL

- Clamp the hose from the fluid reservoir with clamp Mot. 453-01 and disconnect the master cylinder.
- Unscrew both master cylinder bolts and remove it.



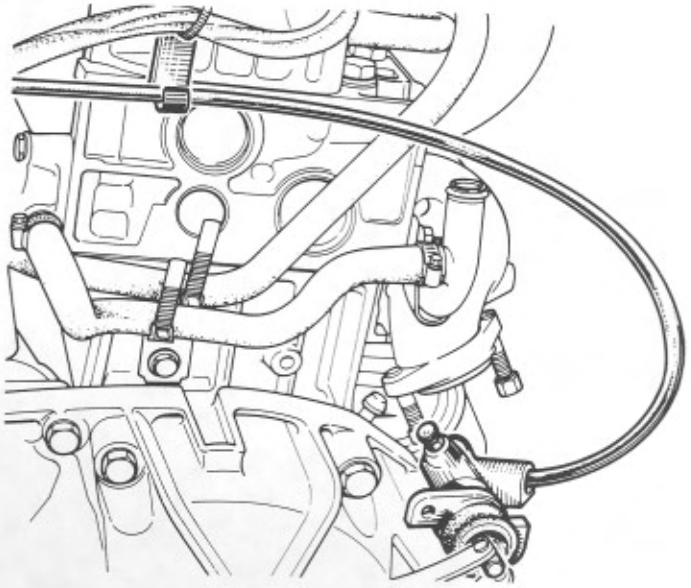
REASSEMBLY

- Bolt the master cylinder in position and adjust the operating clearance. See Section I9-1.
- Pressure bleed the circuit. See Section I8-1.

SLAVE CYLINDER
REMOVE AND REPLACE

REMOVING

- Partially drain the brake fluid reservoir.
- Disconnect the slave cylinder pipe.
- Unscrew the two slave cylinder bolts and remove the cylinder.



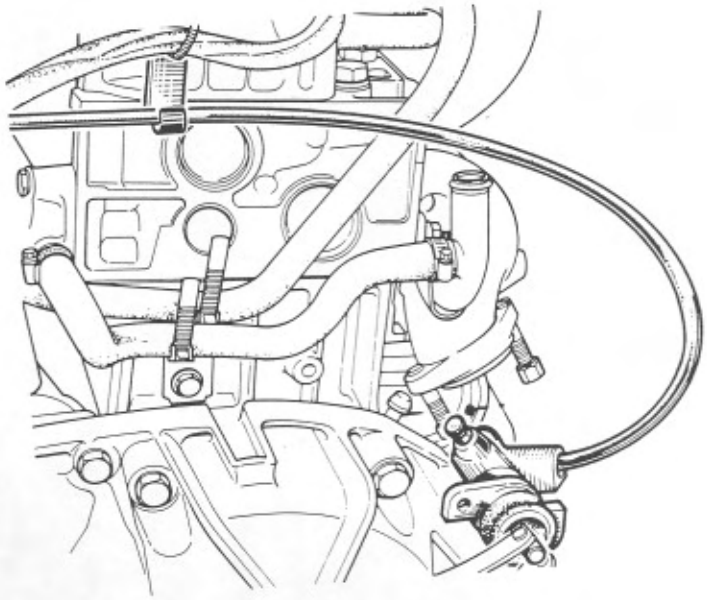
REASSEMBLY

- Hook up the slave cylinder and reconnect the pipe.
- Check and adjust the operating clearance, if necessary. See Section I9-1.
- Pressure bleed the circuit.

CLUTCH HYDRAULIC SYSTEM

BLEEDING

IMPORTANT
The brake/clutch fluid reservoir must be full before, during and after bleeding.



WARNING

Brake fluid is a skin irritant. Wash off any fluid that gets on your skin. Care should also be taken not to get fluid in the eyes. Use protective eyewear.

Pressure Bleeding
This operation can be performed with a commercial power bleeder or with the cooling system pressurizer Ms. 554-03 with the coolant bottle adapter installed.

- Pressurize reservoir

CAUTION

Do not pressurize over 1 bar. Exceeding this could cause the reservoir to "blow-off" of the brake booster possibly causing paint damage to the vehicle. If this happens, immediately wash all surfaces with a soap and water solution and rinse thoroughly.

WARNING

Over pressurizing could cause personal injury.

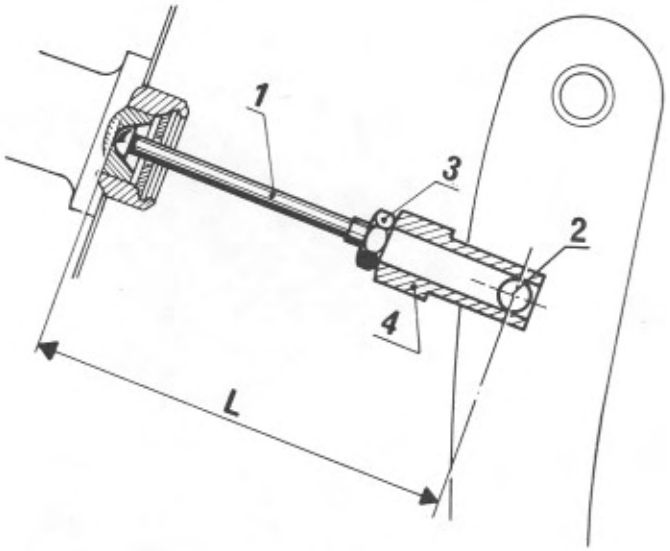
- Open bleed screw until all traces of air and foam are expelled.
- Close bleed screw.
- Remove bleeding aparatus.
- Check fluid level in reservoir.
- Check clutch operation.

OPERATING CLEARANCE

ADJUSTING

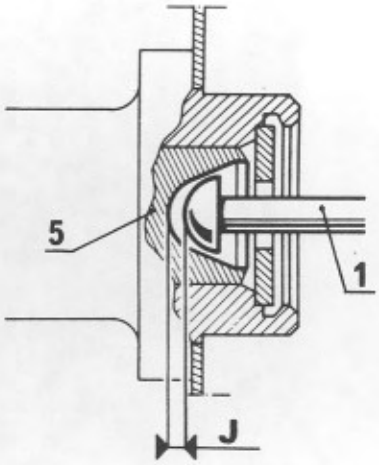
PRE-ADJUSTMENT

- Remove pushrod (1) by pulling out pin (2).
- Unlock locknut (3) holding clevis (4).
- Turn pushrod (1) to obtain dimension (L): L = 148 mm (5-13/16").

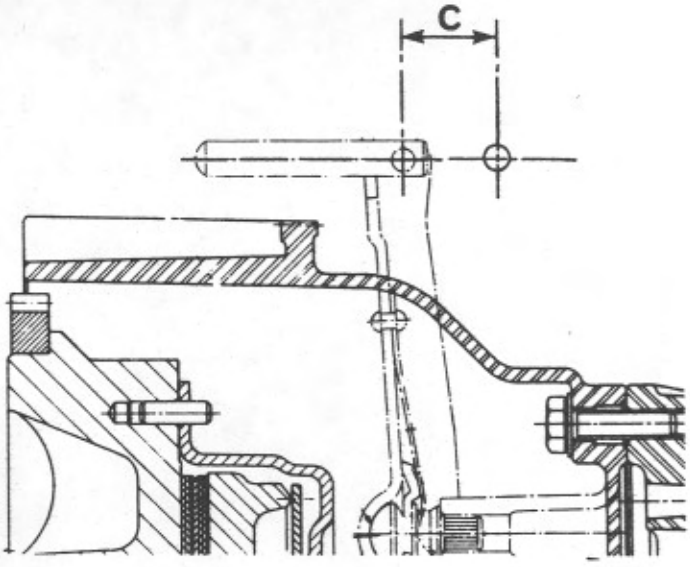


ADJUSTING

- Check that a clearance (J) of 0.5 mm (.020") exists between pushrod (1) and master cylinder piston (5).



- Check the slave cylinder rod travel, (C) It should be 12 mm (15/32").



SECTION "J"
AUTOMATIC TRANSAXLE

Subsection 1 - General Information

J1-1 Special Tools

J1-4 Specifications
J1-7 Exchange Units
J1-8 Anaerobic Sealer
J1-9 Exploded Views and Tightening Torques
J1-12 Principles of Operation
J1-18 Component Descriptions

Subsection 2 - Diagnostic

J2-1 Procedure
J2-3 Fault - Correction Chart
J2-15 XR25 Tester
J2-26 Checking the Connections
J2-33 Accelerator Cable Kick-Down Switch
J2-34 Transmission Fluid Pressure
J2-35 Vacuum Capsule

Subsection 3 - Components

J3-1 Transmission Fluid Filter
J3-2 Computer, Remove and Replace
J3-5 Multi-Purpose Switch, Replace
J3-7 Speed Sensor, Replacement
J3-8 Hydraulic Control Unit (Valve Body)
J3-12 Solenoid Pilot Valves, Remove and Replace
J3-13 Torque Converter
J3-16 Torque Converter Seal

Subsection 4 - Transaxle Remove and Reinstall

J4-1 Procedure

Subsection 5 - Transmission Rebuild

J5-1 Exploded Views
J5-4 Disassembly
J5-9 Clean and Inspect
J5-14 Reassembly

Subsection 6 - Coupling Transmission To Final Drive

J6-1 Adjusting the End Float
J6-4 Final Reassembly Procedure

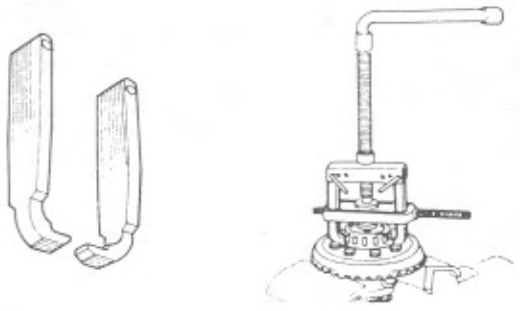
Subsection 7 - Final Drive Rebuild

J7-1 General Information
J7-5 Disassembly
J7-11 Clean and Inspect
J7-12 Reassembly

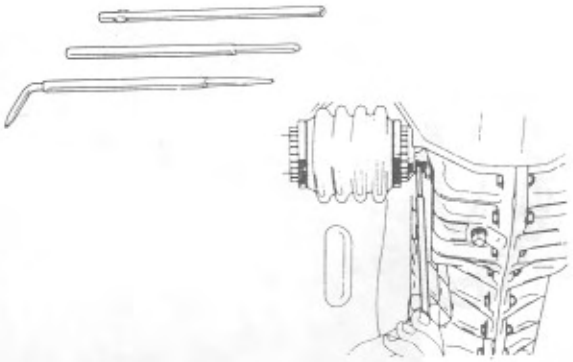
Subsection 8 - External Seal Replacement

J8-1 Differential Seal
J8-3 Speedometer Shaft Seal

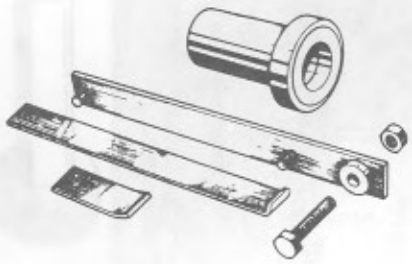
SPECIAL TOOLS



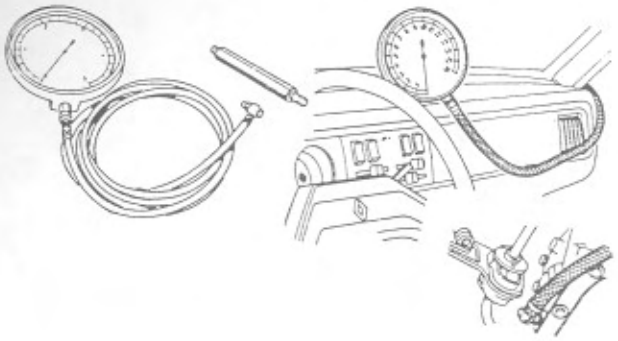
B.VI. 48
Set of two jaws with large tips
for extracting differential bearings
(Use with tool B.Vi. 28-01.)
Order Tool No. 700013-30-300 Set



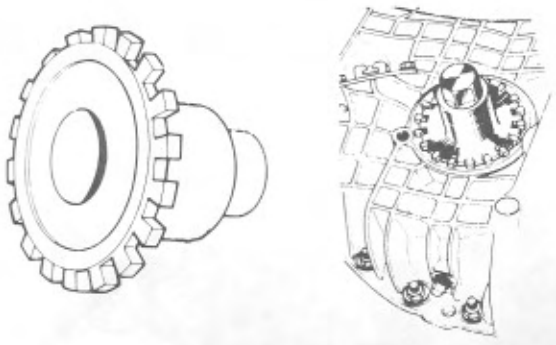
B.VI. 31-01
Set of 3 drifts for fitting 5 mm dia. rollpins.
Order Tool No. 700012-59-401 EA



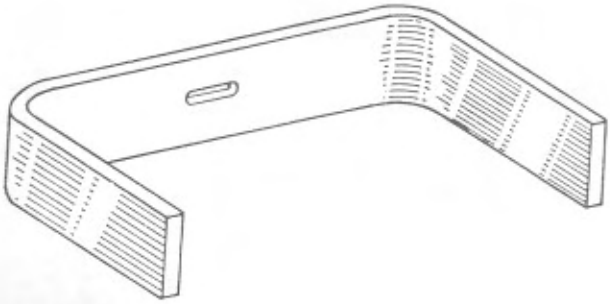
B.VI. 465
Converter seal replacing tool.
Converter holding lug
Order Tool No. 700000-46-500 EA



B.VI. 466-04
Oil pressure gauge
Order Tool No. 700000-46-604 EA

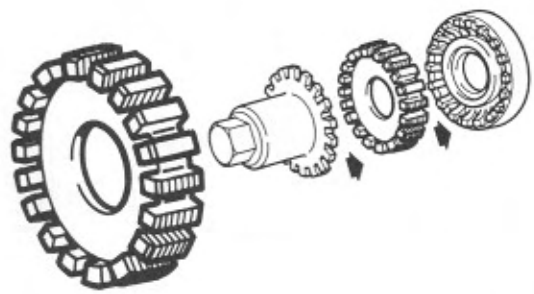


B.VI. 645
Castellated wrench for adjusting differential play
Order Tool No. 700000-64-500 EA

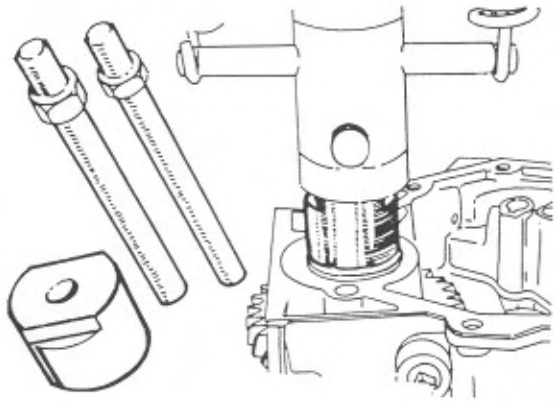


B.VI. 715
Tool from kit B.Vi. 710
Order Tool No. 700000-71-000 EA

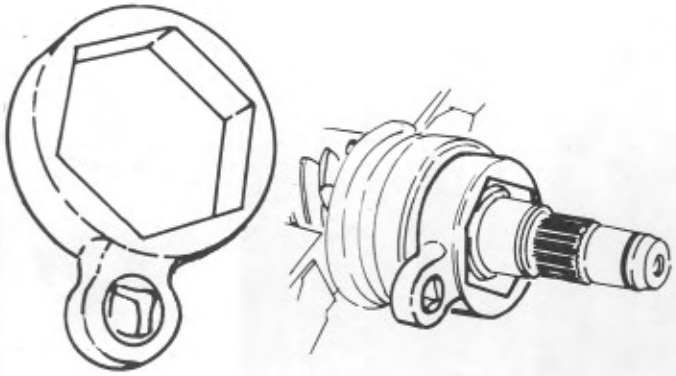
SPECIAL TOOLS



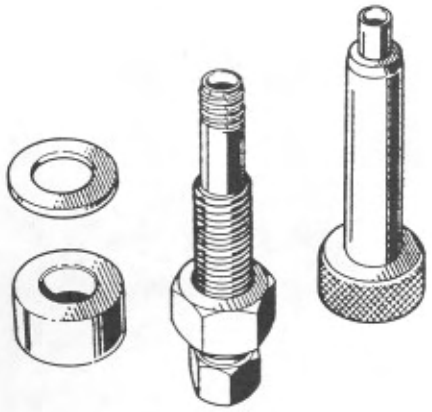
B.VI. 805
Differential nut wrench
Order Tool No. 700000-80-500 EA



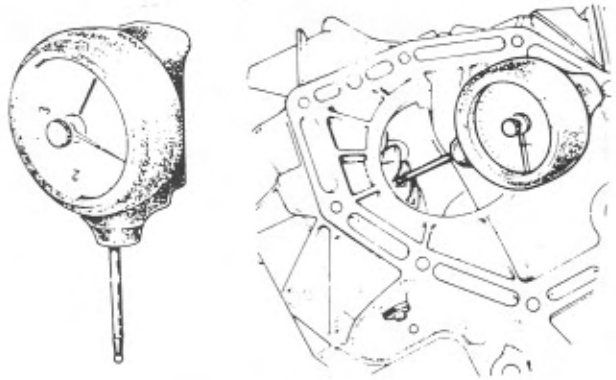
B.VI. 902-01
Circlip fitting tool
Order Tool No. 700000-90-201 EA



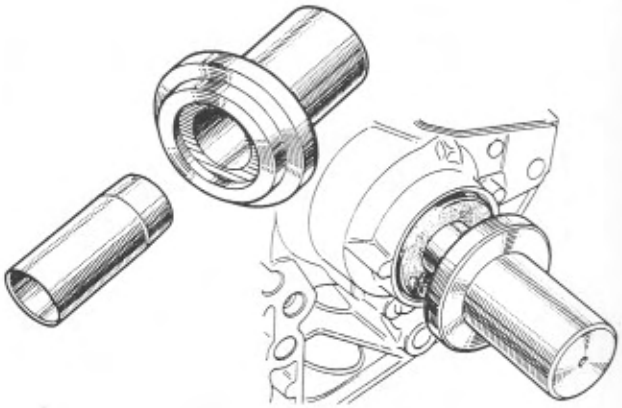
B.VI. 903
Ring spanner for final drive pinion nut
Order Tool No. 700000-90-300 EA



B.VI. 905-02
Speedometer drive shaft seal replacing tool (kit)
Order Tool No. 700000-90-502 EA

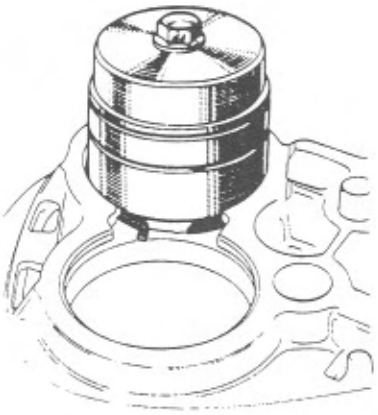


B.VI. 906
Torque-measuring device
Order Tool No. 700000-90-600 EA



B.VI 945
Sun wheel seal installation tool
Order Tool No. 700000-94-500 EA

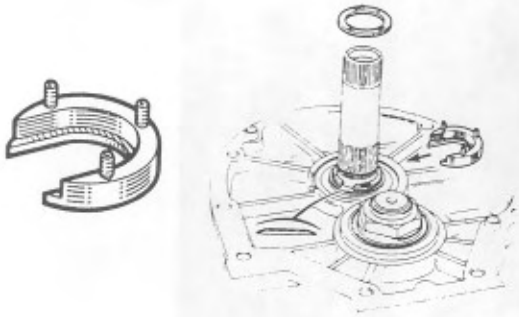
SPECIAL TOOLS



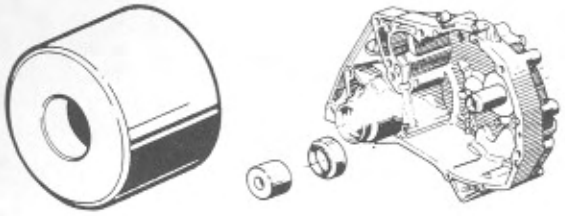
B.VI. 947
Tool for installing bearings in separator housing
Order Tool No. 700000-94-700 EA



B.VI. 952
Feed hub centering tools and tool for removing F2 piston
Order Tool No. 700000-95-200 EA



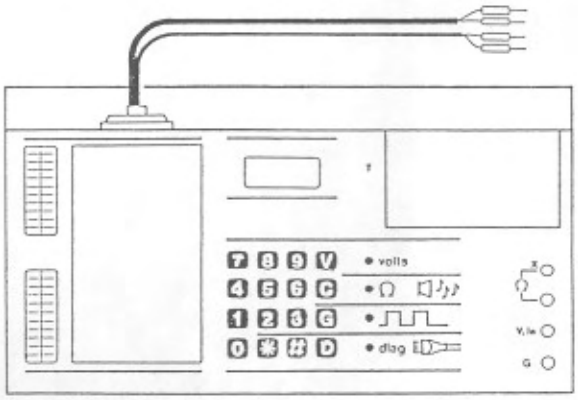
B.VI. 959
Tool for attaching circlip to output shaft
Order Tool No. 700000-95-900 EA



B.VI. 962
Tool for installing converter seal
Order Tool No. 700000-96-200 EA



Rou. 15-01
Shaft-protecting tool with 16 mm bore
Order Tool No. 700013-31-601 EA



M.S. 1019
XR25 box for testing microprocessor systems
Order Tool No. 700000-00-876 EA

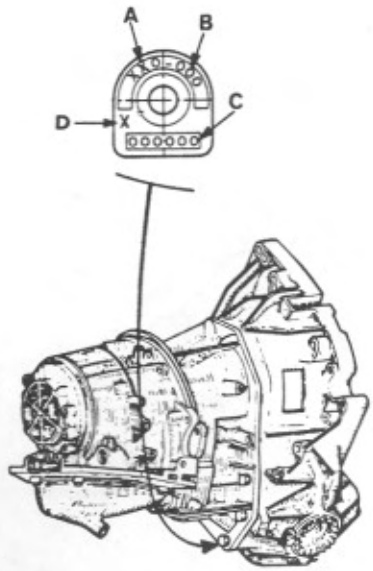
GENERAL INFORMATION

SPECIFICATIONS

The type, suffix and fabrication number are stamped on a plate secured by a casing bolt. (See right) Always refer to this number when ordering replacement parts.

The identification plate indicates:
A - type of automatic transmission
B - type suffix
C - fabrication number
D - manufacturing factory

ML 1-01



SPECIFICATIONS

TRANSMISSION FLUID:

The same type of fluid is used throughout the entire transmission (torque converter, and mechanisms).

Mobil ATF 220 (Dexron® II type)

APPROXIMATE CAPACITIES:

If converter is empty	5 litres
Fluid change	2.5 litres

FINAL DRIVE OIL:

Temperate climates API-GL5 SAE 80W-90

Capacity	0.8 litre (0.85 qt.)

OIL CHANGE INTERVALS:

See Section "A" General for specific intervals and servicing procedures.

TRANSMISSION FLUID CHANGE PROCEDURE

Draining

Fluid should be drained while hot.

Procedure:

- take out the dipstick
- unscrew the drain plug
- allow the fluid to drain for as long as possible,
- refit the plug, using a new seal.

Refilling

The transmission is refilled through the dipstick tube.

Use a funnel equipped with a 15/100 strainer to avoid dirt entering the reservoir.

After draining out the old fluid refill using Mobil ATF 220 (Dexron® II Type).

Checking the Fluid Level after Refill

Park the vehicle on a level surface.

Place the selector lever in the "Park" (P) position.

Start the engine and wait for one or two minutes to allow the torque converter and cooler to fill with fluid.

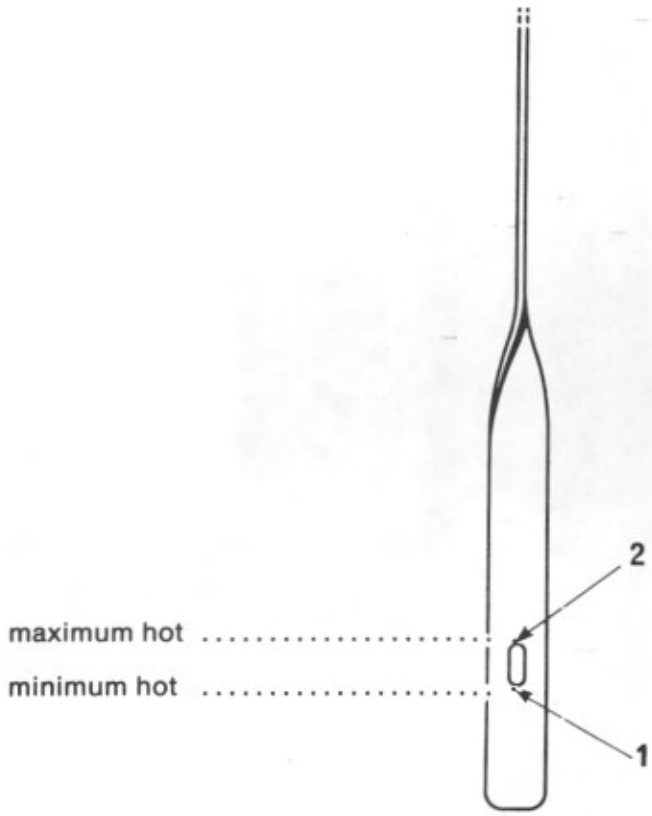
Move the shifter through the entire shift selection range.

CAUTION

Be careful to keep service brake and parking brake applied throughout shift selection range.

Check Fluid Level at Operating Temperature

Never allow the fluid level to be **above the "Maximum"** mark or **below the "Minimum"** mark. This could cause damage to the clutch/brake assembly due to overheating or leakage



GENERAL INFORMATION

EXCHANGE UNITS

Standard service exchange units are available in two forms.

Complete Automatic Transmission.

Clutch/Brake Assembly. Only.

Whenever replacing a unit following damage to a clutch or brake, where the fluid is black or full of suspended particles, the torque converter must also be replaced since it acts as a centrifugal fluid filter.

Check the fluid pressure and adjust it if necessary. (See page J2-34.)

Clean out the differential casing.
Check and adjust the end play.
Check and adjust the fluid pressure (See page J2-34.)

Anerobic Sealant
Assembly of gearbox and transmission cases may require use of a special type of silicone sealant known as **anaerobic sealer.** This compound is used as a gasket material in specified applications.

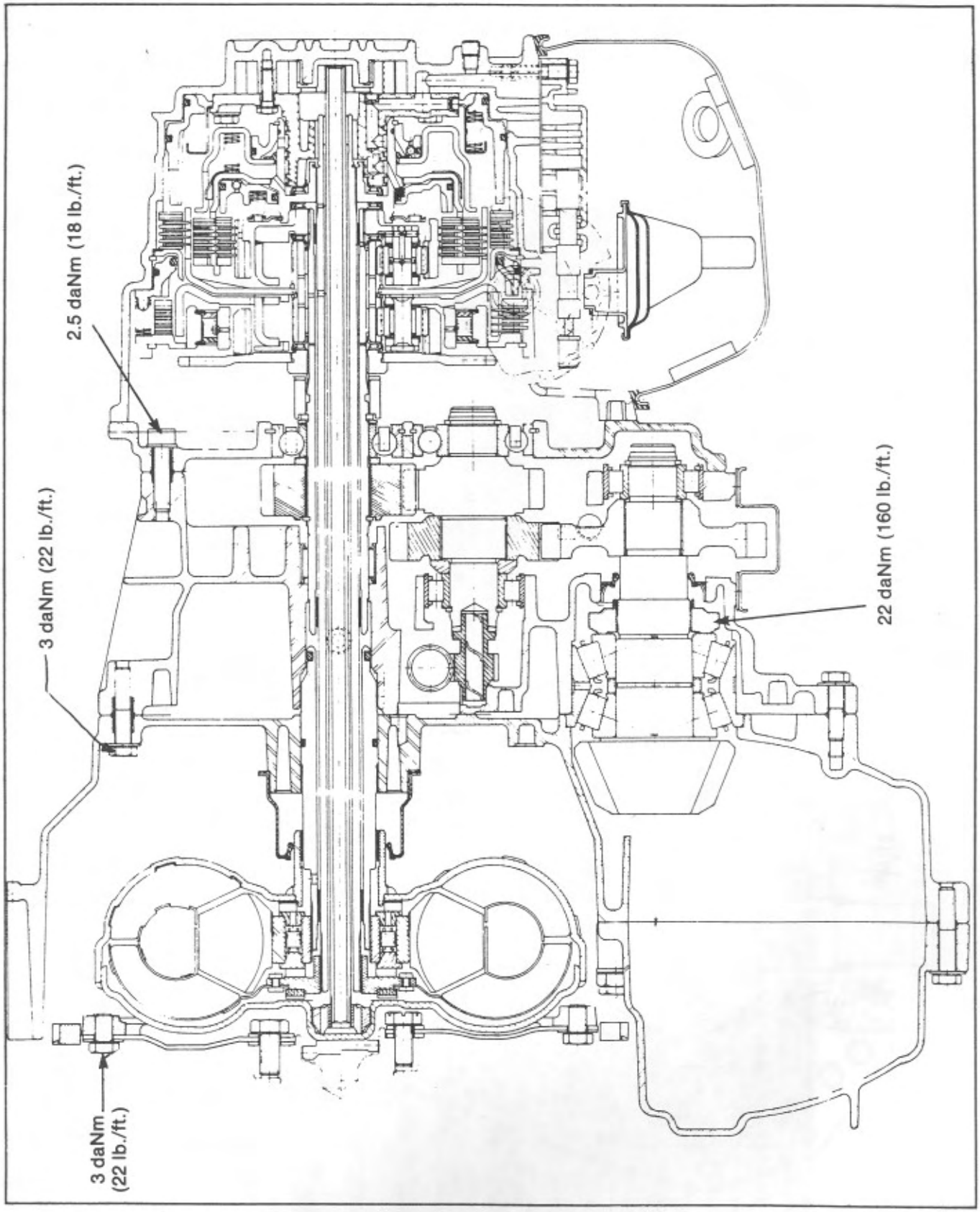
In each application which specifies anaerobic sealant, we recommend using Loctite® "518" or "515" or NAPA/Balkamp® Part No. 765-1189 or an equivalent anaerobic sealant.

CAUTION

Do not substitute anaerobic sealer with RTV silicone sealant or other adhesive gasket materials. These do not possess the characteristics required to produce a durable seal.

Improper sealing could allow fluid leakage, resulting in serious mechanical damage.

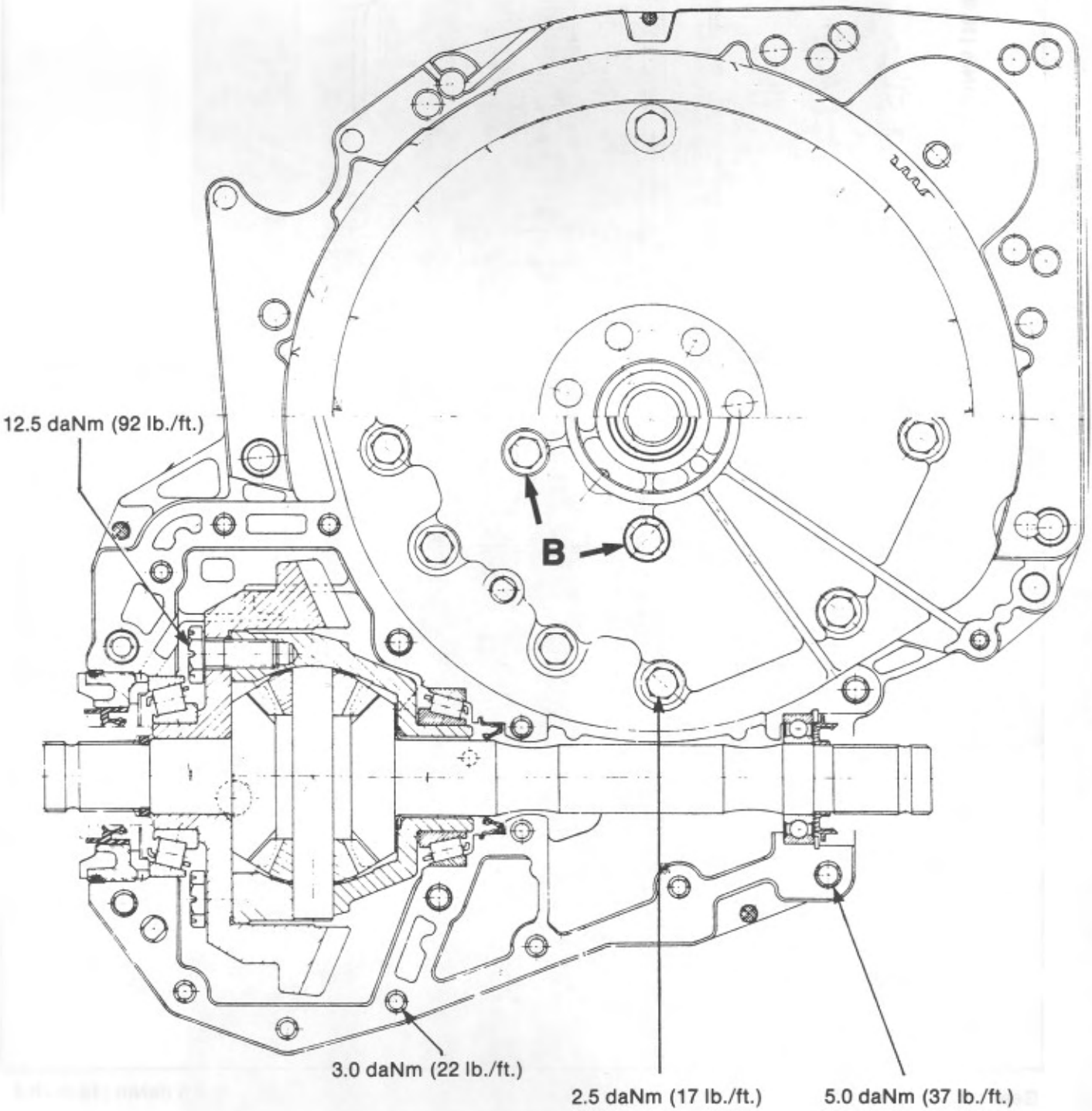
SECTIONAL VIEWS AND TIGHTENING TORQUES



Gear section to separator casing bolts ..... 2.5 daNm (18 lb./ft.)

SECTIONAL VIEWS AND TIGHTENING TORQUES

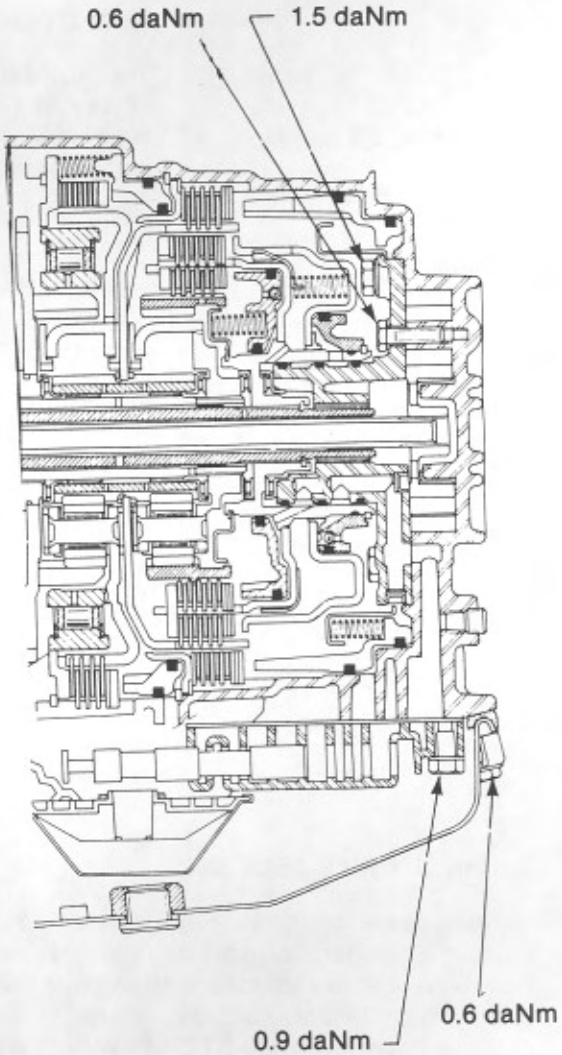
* The converter case bolts (B) must be coated with silicone sealant before reassembly (See pg. J7-22).



SECTIONAL VIEWS AND TIGHTENING TORQUES

TIGHTENING TORQUES

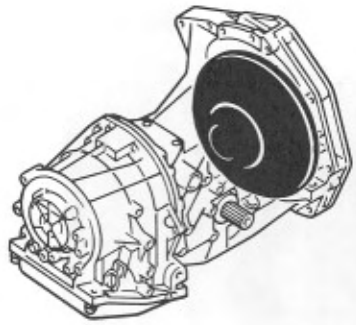
Sump mounting bolts	0.60 daNm (4.5 lb./ft.)
Hydraulic control unit mounting bolts (see tightening order, page J3-9)	0.9 daNm (6.5 lb./ft.)
Fluid pump hub mounting bolts	1.5 daNm (11 lb./ft.)
	0.6 daNm (4.5 lb./ft.)

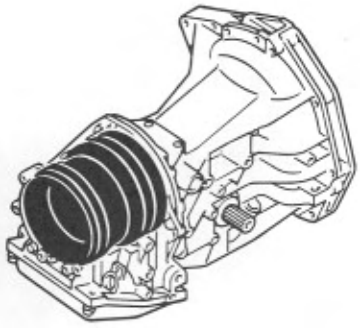


GENERAL INFORMATION

PRINCIPLES OF OPERATION

The automatic transmission consists of 3 main sections.





1. TORQUE CONVERTER

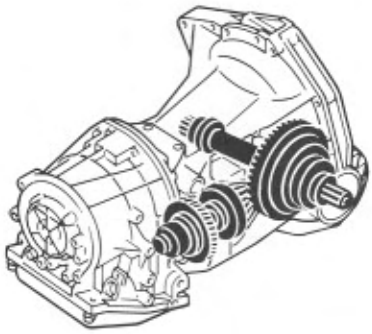
This ensures a FLEXIBLE and AUTOMATIC connection between the ENGINE and the CLUTCH/-BRAKE ASSEMBLY: it is an AUTOMATIC CLUTCH.

In addition, it multiplies the torque delivered by the engine when the vehicle starts.

2. CLUTCH/BRAKE ASSEMBLY

This provides one reverse gear and 3 forward gears by way of two EPICYCLIC GEAR TRAINS. Gear changes are AUTOMATIC and WITHOUT INTERRUPTION in torque transfer. Three types of unit control the epicyclic gear trains to obtain these results:

- the MECHANICAL units,
- the HYDRAULIC units,
- the ELECTRICAL and ELECTRONIC units.



3. FINAL DRIVE SECTION

Its purpose and component parts are similar to those in a mechanical gearbox-final drive assembly. However, it also includes a change in the line of drive which is achieved by means of a pair of external gears known as STEP-DOWN gears. These step-down gears play a part in the overall drive reduction.

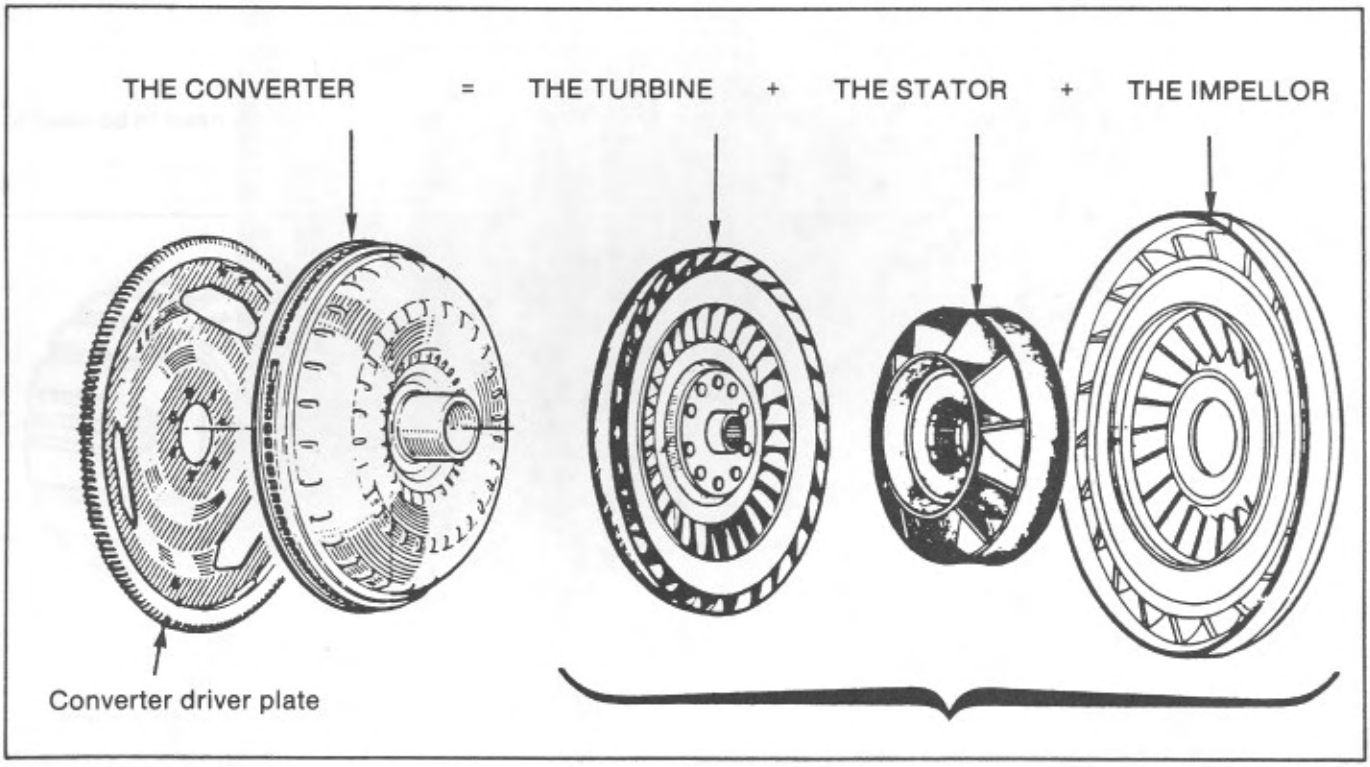
GENERAL INFORMATION

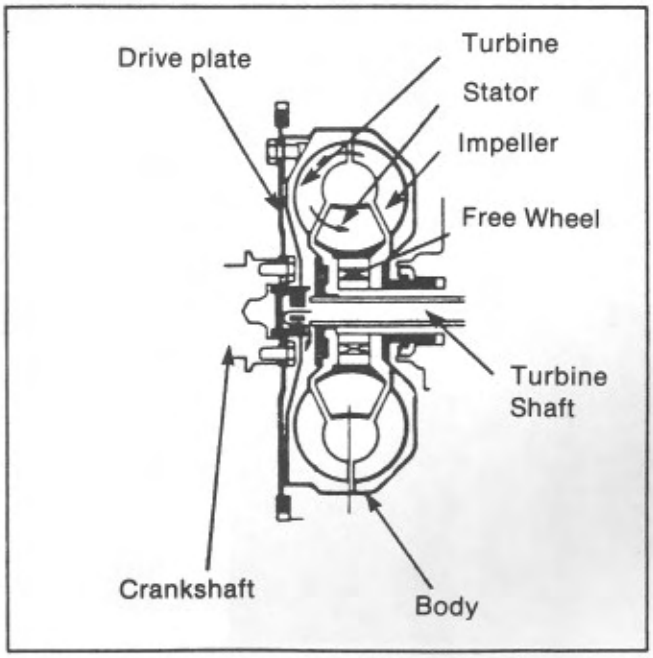
PRINCIPLES OF OPERATION

The torque converter is a hydraulic clutch system which provides a flexible, automatic link between the engine and the automatic transmission mechanism. Its method of operation can be divided into 2 stages.

WHEN STARTING	AT HIGH SPEED
It multiplies the engine torque. THIS IS THE CONVERTER FUNCTION	It transmits the engine torque. THIS IS THE COUPLING FUNCTION

The CONVERTER body contains 3 wheels with vanes.





- The converter BODY consists of 2 half-shells welded together. It is coupled to the engine CRANKSHAFT by the DRIVE PLATE. In operation it is full of fluid.
- The IMPELLER is integral with the converter body and hence with the engine.
- The TURBINE is linked with the CLUTCH/BRAKE UNIT of the automatic transmission by the TURBINE SHAFT.
- The STATOR is located between the impeller and the turbine.
- The STATOR rests on the free wheel.

PRINCIPLES OF OPERATION

THE EPICYCLIC GEAR TRAINS

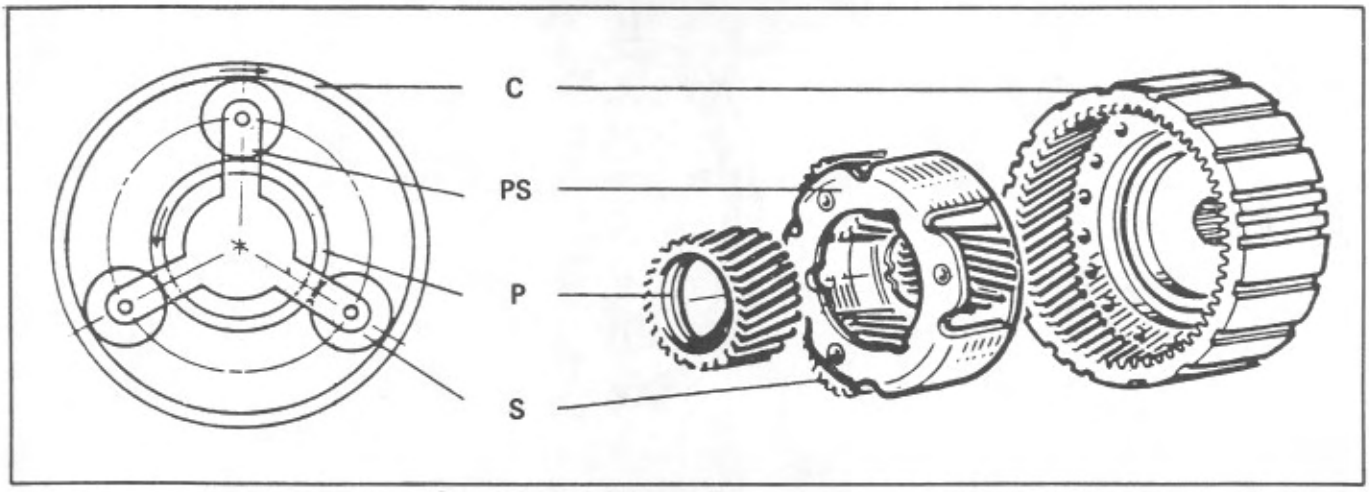
1 - DEFINITION

This is a set of internal and external helically cut gears. They can provide different reduction ratios depending on the manner in which they are activated. The gears are always in mesh.

2 - DESCRIPTION

A "SINGLE" EPICYCLIC GEAR TRAIN contains:
- a SUNWHEEL P with external teeth
- a number of planet wheels S (generally 3)
- a planet wheel carrier PS
- a ring C, with internal teeth.

This type of gear train can provide a number of ratios. Only TWO of the gear components need to be used to obtain each reduction.



The Mechanical Control Units

To activate TWO untis in the EPICYCLIC GEAR TRAIN, multi-disc oil bath type hydraulic receivers are used.
- The movement input component is driven by a Clutch "E"
- the reactive component is locked by a Brake "E".

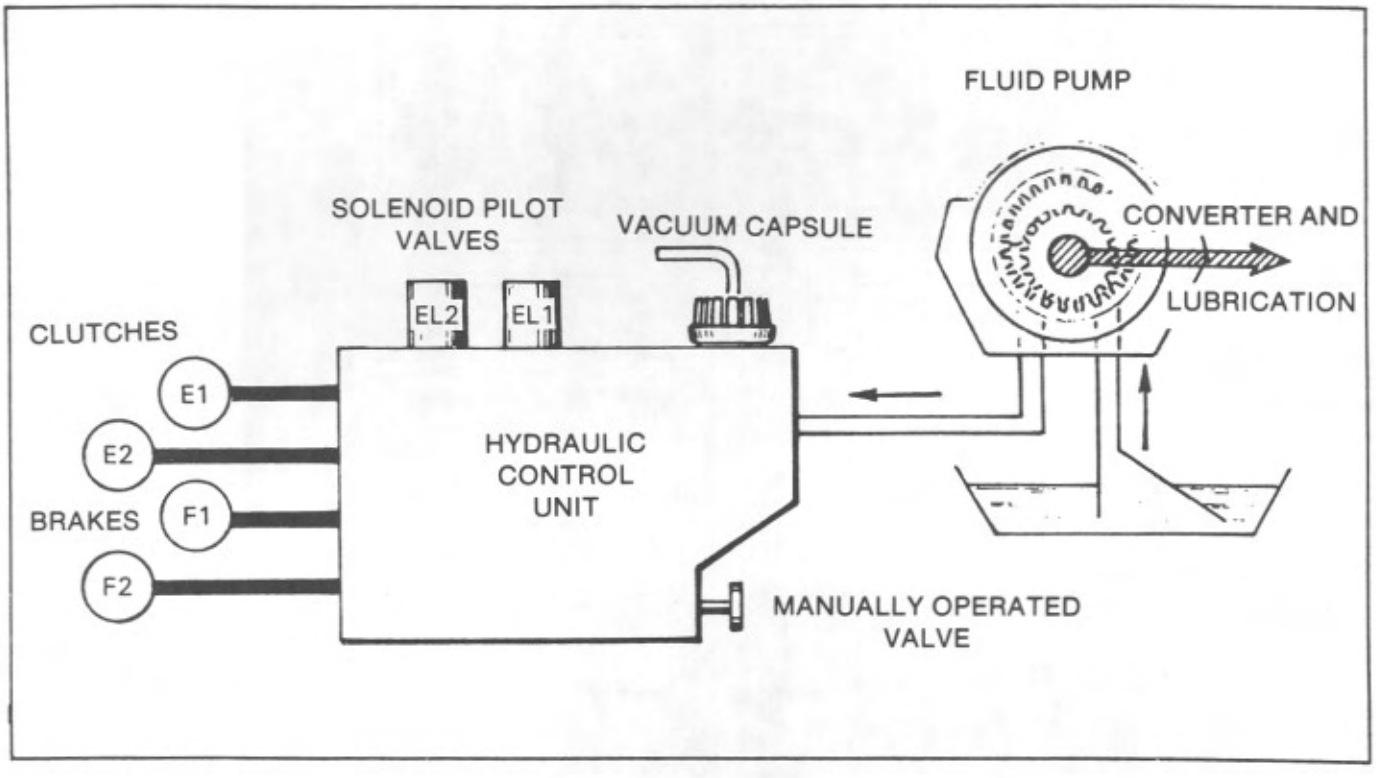
They are controlled by the HYDRAULIC CONTROL UNITS.

NOTE: Epicyclic gear trains were invented in the second half of the nineteeth century. Willys made a mathematical study of them in order to calculate the reduction ratios. There are also "double gear trains" or "Ravigneaux gear trains" containing 2 sunwheels and 2 sets of planet wheels instead of only one.

THE HYDRAULIC CONTROL UNITS

- the Fluid Pump: lubricates and feeds the converter and ensures operation of brakes and clutches (line pressure)

- the Hydraulic Distributor: supplies the components in question depending on the engine conditions (load, speed) by means of valves whose positions are controlled hydraulically by solenoid valves known as solenoid pilot valves.

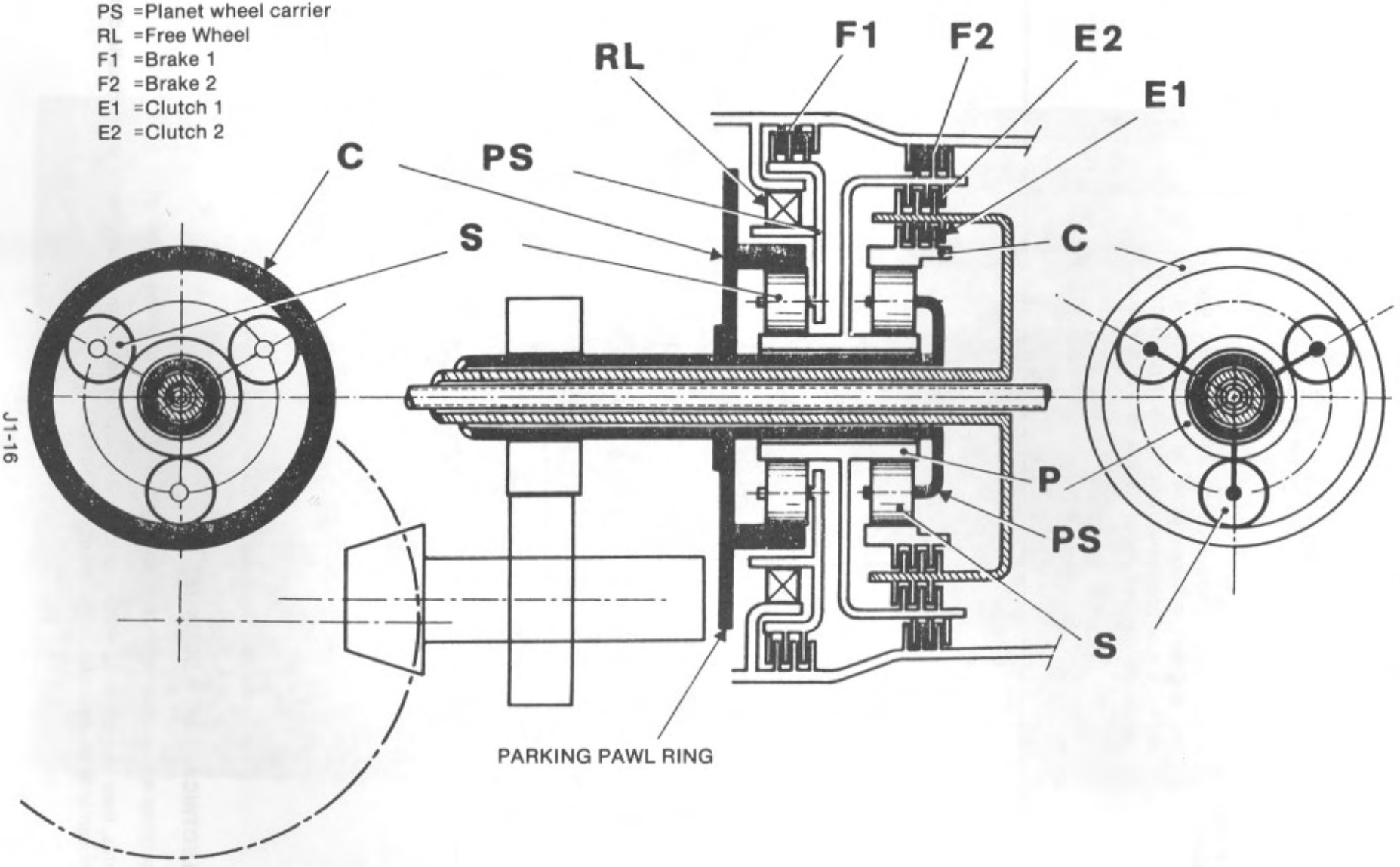


THE ELECTRICAL CONTROL UNITS

Their purpose is to decide when to change gear and to control the gear change.

To do this, they trigger the activation of the solenoid pilot valves and thus control the hydraulic distributor valve movements which result in the changes in speed.

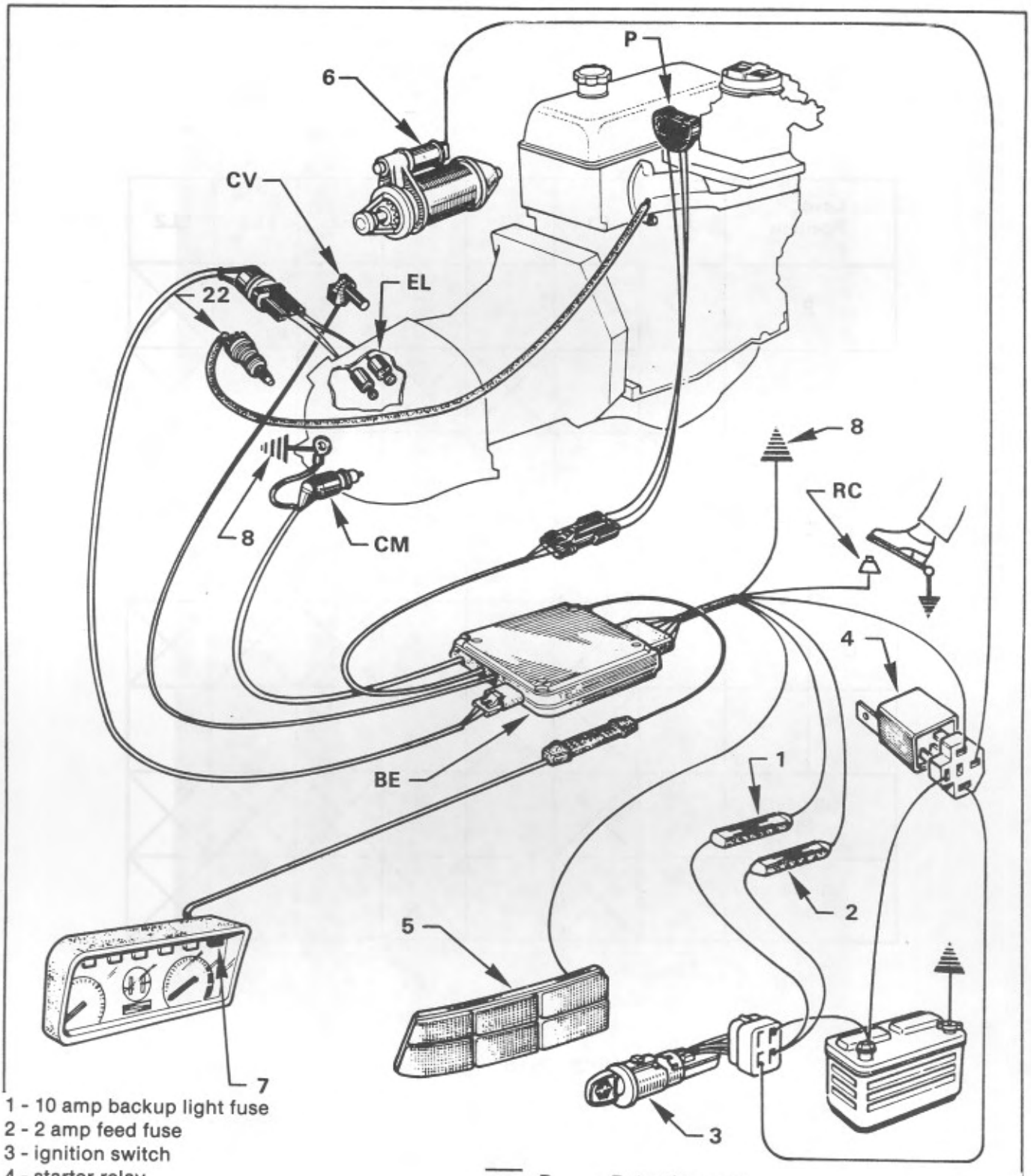
C =Ring Gear (Internal Tooth)
S =Planet wheel(s)
P =SunWheel
PS =Planet wheel carrier
RL =Free Wheel
F1 =Brake 1
F2 =Brake 2
E1 =Clutch 1
E2 =Clutch 2



Lever Position		RL	E1	E2	F1	F2	EL1	EL2
P								X
R				X	X			X
N								X
D	1	X	X					X
	2		X			X	X	X
	3		X	X				
2nd gear "Hold"			X			X	X	X
1st gear "Hold"			X		X			X

☐ = **COMPONENTS OPERATING**

RL = Free Wheel
E1 = Clutch 1
E2 = Clutch 2
F1 = Brake 1
F2 = Brake 2
EL1 = Solenoid pilot valve 1
EL2 = Solenoid pilot valve 2



1 - 10 amp backup light fuse
2 - 2 amp feed fuse
3 - ignition switch
4 - starter relay
5 - back-up lights
6 - starter
7 - instrument panel (warning light)
8 - automatic transmission ground on computer connector (BE) or on multi-purpose switch connected to automatic transmission

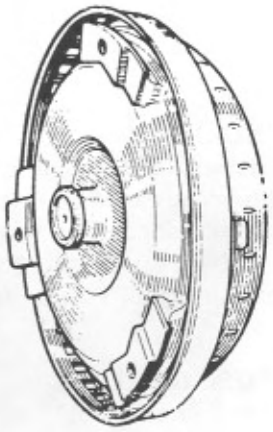
P - Potentiometer
CM - Multipurpose switch
EL - Solenoid pilot valves
RC - Kickdown switch
CV - Speed sensor
22 - Vacuum capsule
BE - Computer

The automatic transmission selects through the three forward drive ratios, without disconnecting the drive.

It consists of three main units:

- the torque converter,

- the differential section,
- the clutch/brake unit.



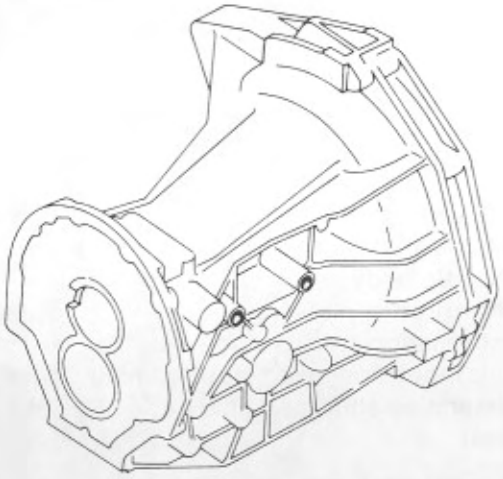
The Torque Converter

- provides a flexible drive from the engine through to the mechanical section.
- acts as an automatic clutch,
- increases the torque output during the starting phase.

The Differential

This carries the drive from the transmission mechanism through to the wheels.

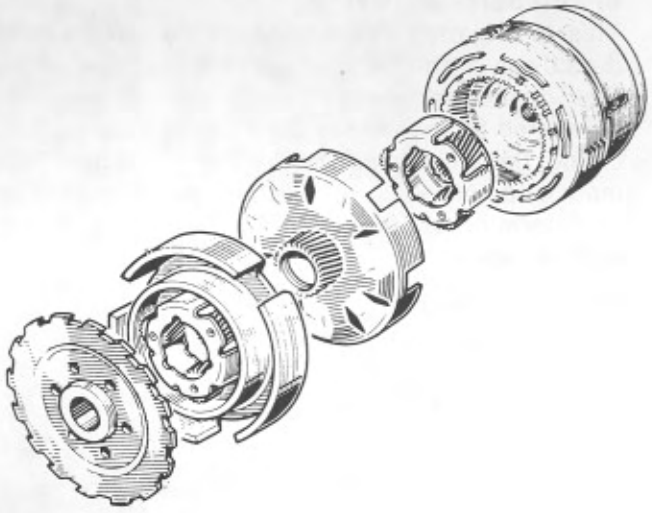
It consists of:
- the output train that lowers the drive centerline.
- the ring gear and pinion set that drives the differential housing.



The Clutch/Brake Unit

This provides three reduction ratios in forward drive and one in reverse.

It contains:
- planetary gear train
- the units that control this train which can be separated into three categories:
- mechanical units
- hydraulic units
- electrical units.



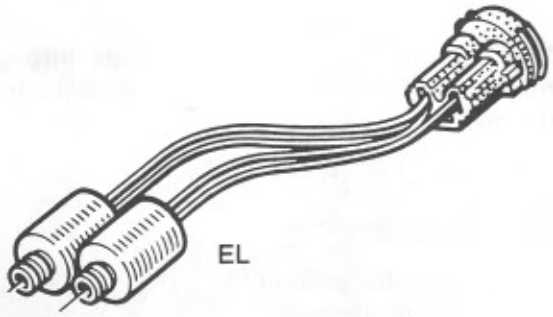
Planetary Gear Train

This is a set of helical cut gears that provide the various ratios (3 forward ratios and 1 reverse ratio) depending on the way in which the control units (E1 - E2- F1 - F2) are selected.

COMPONENT DESCRIPTIONS

KICK-DOWN SWITCH (RC)

This switch is integrated into the accelerator cable and is non-adjustable and non-serviceable. The switch is closed at full throttle position of the accelerator pedal travel, signalling the computer to down-shift.



PILOT SOLENOID VALVES (EL)

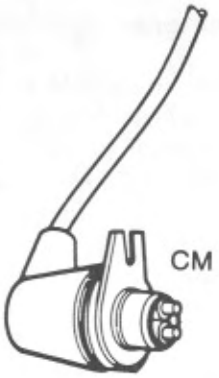
These are ball type solenoid valves that are controlled by the computer. They are mounted to the hydraulic valve body. Their function is to seal off or allow by-pass of high pressure fluid, which controls movement of the spool valves, resulting in gear changes.

MULTI-PURPOSE SWITCH (CM)

This switch is mounted on the rear of the transmission. It is operated by a cam (with a series of lobes) actuated by the shift selector cable. The cam lobes open and close the pins on the switch in various combinations to tell the computer which gear position has been selected.

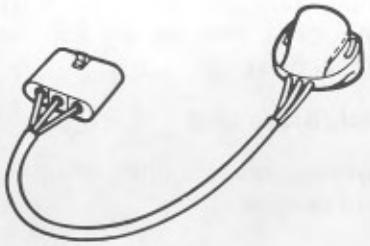
The multi-purpose switch controls:

- the starter circuit (current is supplied only while in N or P)
- back-up light circuit (position R)
- solenoid valves (EL 1 & EL 2)



LOAD POTENTIOMETER (P)

This is a variable resistor mounted to the rear of the throttle body assembly. It monitors the position of the throttle plate (butterfly) to feed engine load information to the computer. The computer uses this input along with input from the speed sensor to determine shift thresholds. (See Speed Sensor below).



SPEED SENSOR (CV)

This is mounted to the side of the transmission directly over the park wheel. The rotation of the teeth on the park wheel interrupts the magnetic field generated by the sensor. This sends a signal indicating transmission RPM to the computer. This input is combined with that of the load potentiometer to determine shift thresholds. (See Load Potentiometer above.)

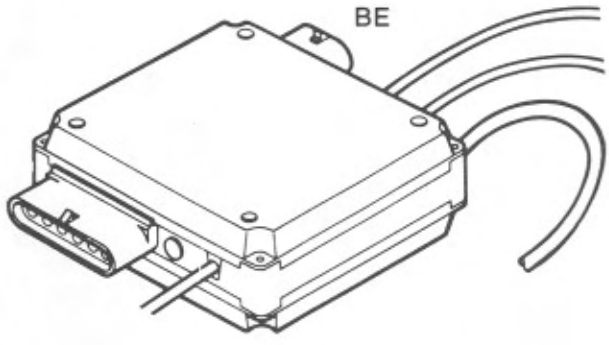


COMPUTER MODULE/RENIX® BOX (BE)

The computer module is mounted to the driver side firewall. It receives input from:

- the kick-down switch
- the multi-purpose switch
- the load potentiometer
- the speed sensor

The computer then interprets these signals and sends a control signal to the pilot solenoid valves to initiate gear changes.



THE FLUID PUMP

The fluid pump is an internal gear type, driven directly by the engine through the torque converter flange plate. It provides the pressurized fluid required:

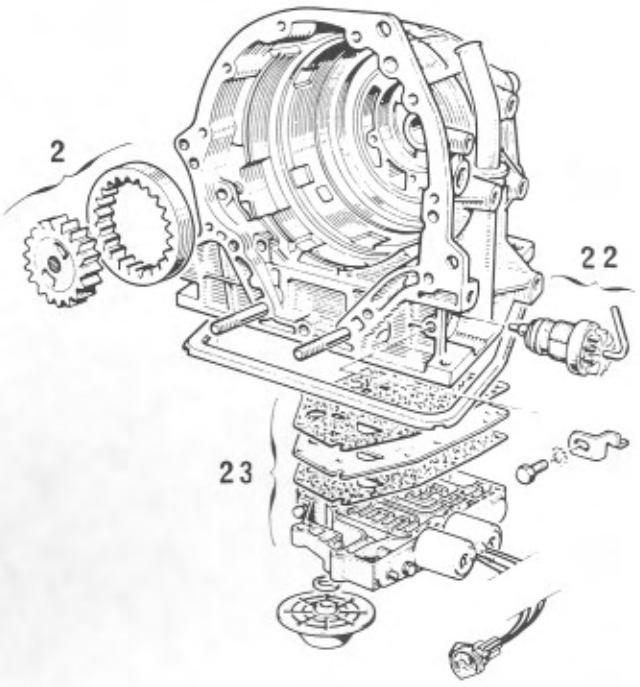
- to feed the converter,
- to lubricate the gears,
- to control the brakes and clutches.

VACUUM CAPSULE (22)

The vacuum capsule is located on the side of the transmission case. Its function is to regulate transmission fluid pressure according to engine load, which is indicated by engine manifold vacuum.

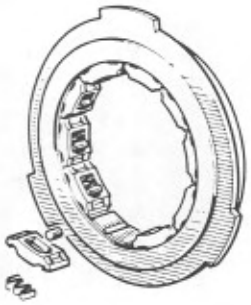
HYDRAULIC CONTROL UNIT OF VALVE BODY (23)

The valve body is an integral part of the transmission assembly and is located between the main case and the fluid pan. The valve body distributes hydraulic fluid to the proper clutches and brakes to provide gear selection according to the positions of the pilot valves.



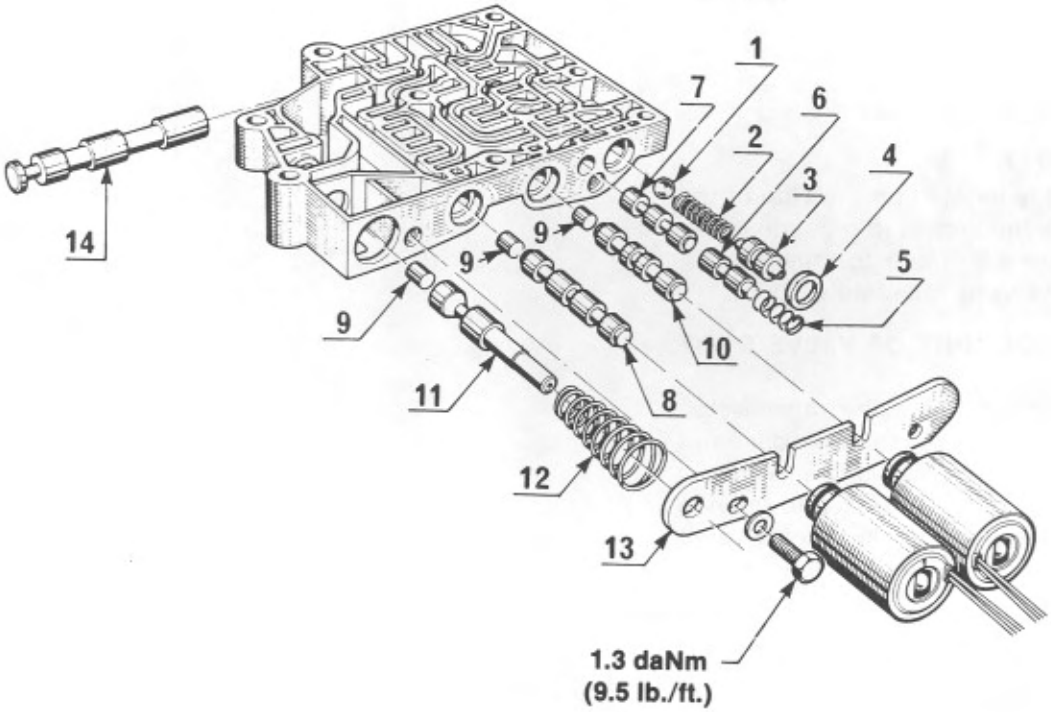
FREE WHEEL

The free wheel permits torque to be transferred to the drive wheels while under engine load but allows a free-wheel or "coasting" effect under no-load conditions. The exception is that, in 1st gear, the free wheel locks to provide engine braking during deceleration.



CLUTCHES (E1 & E2) AND BRAKES (F1 & F2)

The clutches and brakes are multi-disc, oil-bath type. The different gears are determined by application of clutches and brakes in various combinations according to fluid distribution from the valve body.



HYDRAULIC CONTROL UNIT

1 - PLV ball
2 - PLV spring (medium size)
3 - Pressure limiting valve (PLV)
4 - PLV seal
5 - SV spring (small)
6 - Sequence valve (SV)
7 - Sequence valve (SV)
8 - No. 1 selector valve (SV1)
9 - Plungers
10 - No. 2 selector valve (SV2)
11 - Pressure regulating valve (PRV)
12 - PRV spring (large)
13 - Cover plate
14 - Manually selected valve (MV)

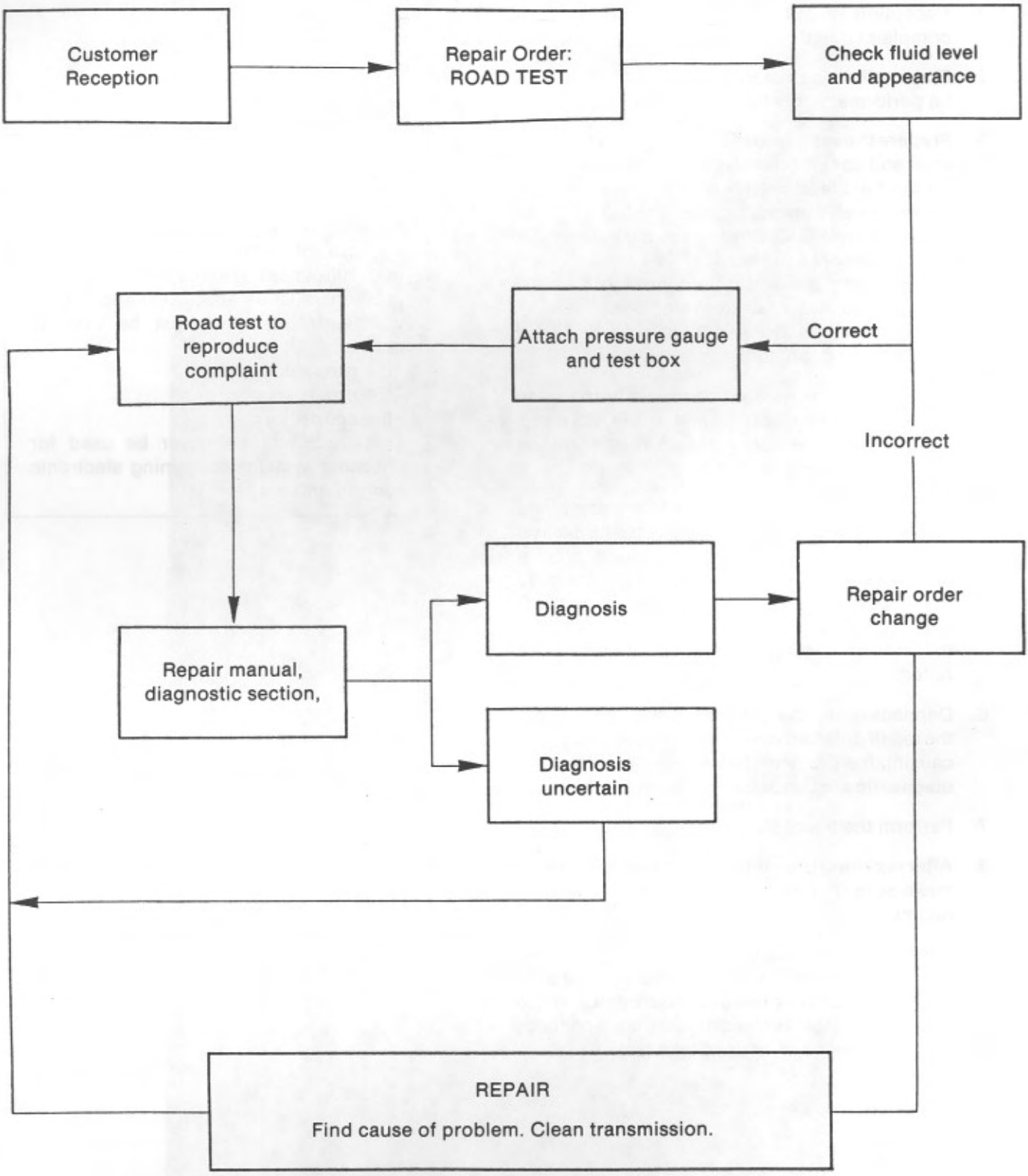
The plungers (9) are identical on valves 8 & 10. The PRV plunger is different - 5.5 mm in diameter.

Valves (3-7-8-10) are symmetrical.

Valve (6) is not symmetrical.

DIAGNOSTIC PROCEDURE

What to do when you receive a defective automatic transmission.



DIAGNOSTIC PROCEDURE

What to do when you receive a defective automatic transmission.

1. Reception of vehicle - ask customer about complaint noted.
2. Prepare the repair order but do not enter work to be performed; only the vehicle road test.
3. Prepare the vehicle for a road test and check the level and condition of the transmission fluid:
   - if the fluid level is OK and fluid does not look dark or smell burned, proceed to step 5.
   - if fluid level is OK but looks dark or smells burned, proceed to step 4.
   - if fluid level is low but fluid looks and smells OK, fill fluid and proceed to step 5.
   - if fluid level is low and fluid looks dark and smells burned, proceed to step 4.
4. If the fluid appears dark or smells burned, the problem is mechanical. Connect the XR25 tester and attach oil pressure gauge B.Vi. 466-07 then proceed to road test, step 5.
5. Test the vehicle on the road until the complaint recurs. At the end of the road test, the person performing the test must prepare a precise diagnosis of the failure using the necessary documents (repair manual, diagnostic section) and according to the information supplied by the various testing means and observations noted.
6. Depending on the diagnosis made, complete the repair order indicating the vehicle component causing the problem. **Never begin repairs if the diagnostic sequence has not been performed.**
7. Perform the necessary repairs.
8. After repairing the vehicle, perform a road test to make sure that all complaints have been corrected.

Remember: The transmission warning light comes on only if there is an electrical problem or there is interference in the engine compartment (faulty connections or high voltage leaks).

CAUTION

All electronic systems operate at very low voltages and current intensities (millivolts and milli-amps). The supply voltages and grounds must be absolutely accurate. A voltmeter/ohmmeter must be used to check:
- the grounds -
- the power supply +
- the connectors

Test bulbs should never be used for checking systems containing electronic components.

DIAGNOSTIC

FAULT - CORRECTION CHART

CHART INDEX

Engine stalls, uneven idling and grabs on changing speeds J2-4

Grabs on starting J2-4

Jerks when changing from 2nd speed to 3rd with light throttle J2-4

Grabs when changing gear J2-5

Creep in "N" J2-5

Excessive creep in "D" J2-5

Slip when starting in "D-2-1-R" J2-6

Slip when starting in "D" or "2nd" (more sensitive when changing from 3rd speed to 1st at full throttle J2-6

Slip when cold J2-6

Continually or intermittently difficult to start and normal operation above 13 to 18 mph (20 to 30 km/h) (also noticeable on slopes) J2-6

Slip when changing speeds J2-7

Speed-changing thresholds incorrect but warning light does not come on J2-7

Fixed speed-changing thresholds with or without warning light coming on (depending on vehicle) J2-8

No drive regardless of gear selection J2-8

No forward drive J2-9

No reverse drive and no engine braking in 1st gear "Hold" J2-9

No drive in 1st automatic but drive in 1st gear "Hold" J2-9

No drive in 2nd speed but warning light does not come on J2-10

No 3rd speed J2-10

No 3rd gear or reverse J2-10

No 1st gear "Hold" or 2nd gear "Hold" J2-11

No 3rd speed in "D" but normal operation for changing from 1st to 2nd with warning light on J2-11

Stays in 1st with warning light on J2-11

Stays in 3rd with warning light on J2-11

Stays in 3rd or gears changing at random without warning light coming on J2-12

No park function in "P" J2-12

Starter not working in "N" or "P" J2-12

Starter operates in all lever positions J2-13

Back-up lights do not work in "R" J2-13

Noise from hydraulic control unit in "P" or "N" when cold J2-13

Rumbling noise between 37.5 and 50 mph (69 and 80 km/h) J2-14

DIAGNOSTIC

FAULT - CORRECTION CHART

ENGINE STALLS, UNEVEN IDLING AND GRABS WHEN CHANGING GEAR

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Engine not tuned properly	Tune the engine
2. Vacuum capsule hose punctured, cut or disconnected	Check the condition and routing of the hose and of the connection of the inlet manifold.
3. Punctured vacuum capsule	Check the capsule (see subsection on "Vacuum capsule")

GRABS ON STARTING

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Lack of fluid in clutch/brake section	Check the fluid level and fill if necessary. Check to see if fluid is leaking.
2. Improperly adjusted engine idling speed	Adjust the engine idling speed.

Jerk when changing from 2nd-3rd with light throttle

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Light throttle fluid pressure incorrect	Check fluid pressure at light throttle when hot : vehicle travelling at 37 mph (60 km/h), foot off accelerator, fluid pressure must be 3.5 bars + 0.1. Otherwise change hydraulic distributor, its plate and seals (see "Hydraulic Control Unit" subsection).
2. Defective hydraulic distributor plate	Change plate and its seals.

DIAGNOSTIC
FAULT - CORRECTION CHART

GRABS WHEN CHANGING GEAR

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Engine not tuned properly	Tune the engine
2. Lack of fluid in gear section	Check the fluid level. Check for leaks.
3. Capsule vacuum hose kinked or capsule damaged	Check condition and routing of hose and capsule.
4. Incorrect fluid pressure	Check fluid pressure and adjust (J2-34)
5. Incorrect assembly or operation of hydraulic control unit	- Check that the hydraulic control unit is tightened properly - Check position and condition of its seals - Check hydraulic distributor (see "Hydraulic Control Unit" Subsection)

CREEP IN "N"

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Fluid appearance	- Check appearance of the fluid (if it is dirty and smells burnt, see point 3)
2. Adjustment of gear selector lever incorrect	- Adjust selector lever
3. E1 - E2 clutch damaged	Change damaged components

Excessive creep in "D"

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Engine idling speed not adjusted	Adjust engine idling speed
2. Damaged converter (metallic noise)	Change the converter

DIAGNOSTIC

FAULT - CORRECTION CHART

Slippage while starting off in "D-2-1-R"

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Level and appearance of fluid	Check fluid level and appearance
2. Clogged filter screen	Clean or replace filter screen as necessary
3. Damaged vacuum capsule or trapped pipe	Check the capsule and pipe routing.
4. Incorrect fluid pressure	Check the fluid pressure
5. Incorrect fitting or operation of hydraulic control unit	- Check that the hydraulic control unit is properly tightened - Check the condition and position of its seals - Check the hydraulic control unit (see "Hydraulic Control Unit" Subsection)
6. Stuck or damaged feed hub rings	Check the feed hub rings of E1 - E2 (condition and free rotation)

Slippage while starting off in "D" and "2" (More sensitive when passing from 3rd to 1st at full throttle)

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Automatic transmission freewheel not engaging	Change the freewheel

Slippage while starting off when cold

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Fluid level	Check the fluid level and fill if necessary

Continually or intermittently difficult to start moving but operates normally above 15 mph to 20 mph (20 to 30 km/h) (Also noticeable on slopes)

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Faulty converter	- Change the converter (be sure the stator shaft is installed correctly)

DIAGNOSTIC

FAULT - CORRECTION CHART

Slippage during gear changing

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Lack of fluid in gear section	Fill if necessary, and check the appearance of the fluid (if it is dirty and smells burnt, see point 6). Check to see whether oil is leaking.
2. Incorrect fluid pressure	Check the fluid pressure
3. Damaged vacuum capsule or trapped pipe	Check the capsule and pipe routing
4. Incorrect fitting or operation of hydraulic control unit	- Check that the hydraulic control unit properly tightened - Check the condition and position of its seals - Check the hydraulic control unit (sequence valve) (See subsection "Hydraulic Control Unit)
5. Stuck or damaged feed hub rings	Check the feed hub rings of E1 - E2 (freely rotating and their condition)
6. Worn or burnt out brakes and clutches	Change the damaged components
7. Cut seals on F2	Check seals and F2 brake and change as necessary

Threshold values for gear changing incorrect and warning light not illuminating

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Kick-down wire or kick down devices defective	Check the routing and condition of the kick-down wire and the kick-down devices
2. Clogged air filter (at full throttle the engine remains at an idling speed which does not allow you to change to higher gear)	Change the air filter
3. Load potentiometer	Incorrect adjustment of the potentiometer : driving lug not engaging, is broken or seized.
4. Incorrect operation of hydraulic control unit (passage valve rings)	- Check that the hydraulic control unit is tightened properly - Check the hydraulic control unit (passage valve) (See subsection "Hydraulic Control Unit" and solenoid pilot valves)

DIAGNOSTIC

FAULT - CORRECTION CHART

Fixed gear changing speeds with or without warning light illuminating

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Load potentiometer not adjusted properly, disconnected or defective	Using tool RX25 check and adjust the load potentiometer Check the connection.

No drive regardless of gear selected

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Level and appearance of fluid	Check the fluid level and fill if necessary. Check the appearance of the fluid (if it is dirty and smells burnt, see point 8)
2. Selector lever and cable	Check the selector control adjustment. Check the displacement of the manual controlled spool valve
3. Clogged filter screen	Clean or replace filter screen as needed.
4. Damaged fluid pump or shaft	- Withdraw the dipstick with engine stopped - Withdraw the dipstick with engine running. If the fluid level does not alter, the pump shaft is no longer driving the pump. Change the damaged components depending on the extent of the damage
5. Incorrect fluid pressure	Check the fluid pressure
6. Broken drive plate or screws (metallic noise)	Change the drive plate (check that the centering dowels are present and the condition of the converter centering device and the crankshaft.)
7. Incorrect fitting or operation of hydraulic control unit	- Check that the hydraulic control unit is tightened properly - Check the condition and position of its seals - Check the hydraulic control unit (see Hydraulic Control Unit subsection)
8. Burnt-out mechanism or broken bearing	Change the damaged parts depending on the extent of damage
9. Defective impeller shaft	Change the impeller shaft
10. Damaged converter	Change the converter

DIAGNOSTIC

FAULT - CORRECTION CHART

No forward drive

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Check the appearance of the fluid	If it is dirty and smells burnt, see point 2
2. Defective E1 clutch or E1 piston seal	Change E1-E2 assembly (see point 3)
3. Stuck or damaged feed hub rings	Check the feed hub rings of E1-E2 (condition and free rotation)
4. Incorrect fitting or operation of hydraulic control unit	- Check that the hydraulic control unit is tightened properly - Check the condition and position of its seals - Check the hydraulic control unit (See subsection "Hydraulic Control Unit")

No reverse and no engine braking in 1st gear "Hold"

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Appearance of fluid	If it is dirty or smells burnt, see point 4
2. Missing F1 or F2 circlips	Check the condition of the circlip grooves, change the circlips
3. F1 piston seals	Check and change the piston seals
4. Worn F1 brake	Change F1 brake

No drive in 1st Automatic but drive in 1st gear "Hold"

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Freewheel	Change freewheel

DIAGNOSTIC

FAULT - CORRECTION CHART

No drive in 2nd speed and warning light does not illuminate

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Appearance of fluid.	If dirty and smells burnt, see point 4
2. EL1 solenoid valve (stuck ball)	Check the correct displacement of the ball and that the EL1 solenoid valve hose is clean
3. F2 piston seals	Check and change the F2 piston seals
4. Worn F2 brake	Change the F2 brake

No 3rd

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Faulty multipurpose switch	Use XR25 tester to check that the multipurpose switch is operating
2. Solenoid valve (ball stuck)	Check that the balls are moving correctly and that the solenoid valve hose is clean
3. Defective computer	Change the computer

No 3rd and no reverse

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Appearance of fluid	If dirty and smells burnt, see point 2
2. Defective E2 piston or E2 clutch seals	Change the E1 - E2 assembly (see points 3 and 4)
3. Stuck or damaged feed hub rings	Check the feed hub rings of E1 - E2 (their condition and free rotation)
4. Incorrect fitting or operation of hydraulic control unit	- Check that the hydraulic control unit tightened properly - Check the condition and position of its seals - Check the hydraulic control unit (sequence valve) (See "Hydraulic Control Unit")

DIAGNOSTIC
FAULT - CORRECTION CHART

No 1st gear "Hold" or 2nd gear "Hold"

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Control adjustment	- Check selector control adjustment
2. Defective multipurpose switch	- Use XR25 tester to check that the multipurpose switch is operating correctly

No 3rd in "D" but operates normally when changing from 1st to 2nd, and warning light illuminates (remove the fuse and the vehicle should stay in 3rd)

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Ground connection in computer melted	Change computer

Remains in 1st with warning light illuminated

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Speed sensor	After a road test, if the light stays illuminated, connect XR25 tester. Change the speed sensor if faulty.

Stays in 3rd with light illuminated

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. "+" feed to computer faulty	Connect XR25 Tester. (See XR25 tester section) Check: - the fuse and condition of fuse holder - the computer feed connectors
2. Faulty solenoid pilot valves	Connect XR25 Tester. (See XR25 tester section) Check: - the valve and sealed connector
3. Faulty computer	Change the computer

DIAGNOSTIC
FAULT - CORRECTION CHART

Stays in 3rd or gears change at random and warning light does not illuminate

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Lack of ground or poor "-" ground of computer	Check grounding at the multipurpose switch. Check the vehicle wiring harness
2. Kick-down switch wire poorly connected or damaged wire affecting ground.	Check routing and condition of kick-down switch wire

No park function in "P"

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Badly adjusted selector lever	Adjust selector lever
2. Ratchet arm and its spring and internal control device defective	Check the various parts

Starter inoperative in "N" or "P"

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Battery and its terminal	Check the battery charge and the condition of its terminals to ensure that they are clean
2. Badly adjusted selector lever	Adjust the selector lever
3. Defective multipurpose switch	Check that the multipurpose switch is operating correctly. Perform test using XR25
4. 6-way connector wire of computer from starter relay cut or disconnected	Check the voltage at the 6-way connector at computer with the starter activated - The ground wire at the multi-purpose switch.
5. Defective starter relay	Check the starter relay
6. Defective switch	Check the key switch
7. Starter inoperative	Check the starter

DIAGNOSTIC
FAULT - CORRECTION CHART

Starter operates in all lever positions

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Start relay defective (located on the firewall near the transmission computer	Replace defective relay

Back-up lights inoperative in "R"

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Badly adjusted selector lever	Adjust the selector lever
2. Defective light bulbs	Check the bulbs
3. Defective multipurpose switch	Check that the multipurpose switch is working properly using the XR25 tester.
4. Feed and return to reversing lights on 6-way connector cut, disconnected, etc.	Check the voltage at the 6-way connector.
5. No "+" voltage to the multi-purpose switch	Check 10 amp. fuse

Noise from hydraulic distributor (valve body) in "P" or "N" when cold

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Noisy pressure regulating valve	Change the hydraulic distributor plate and gaskets

DIAGNOSTIC

FAULT - CORRECTION CHART

Rumbling noise between 40 and 50 mph (60 and 80 km/h)

FAULT - PROBABLE CAUSE	CHECKS - CORRECTIVE ACTION
1. Tires	Check the balance and inflation pressure of the tires
2. Noisy final drive gears	Change Final Drive gears (See Subsection "Final Drive Assembly"

SPECIAL POINTS

If the warning light illuminates, it is important to check that all the computer cables (speed sensor, kick-down switch, load potentiometer, feed) are at least 15 cm away from the high voltage ignition wires and that the computer is correctly supplied with current (+ 6-way connector, fuse, vehicle harness).

DIAGNOSTIC
XR25 TESTER

XR25 INSTRUCTIONS FOR USE

The XR25 tester is used to analyze the diagnostic codes emitted by the Renix electronic control.

An interchangeable memory module contains the information necessary to diagnose the electrical system.

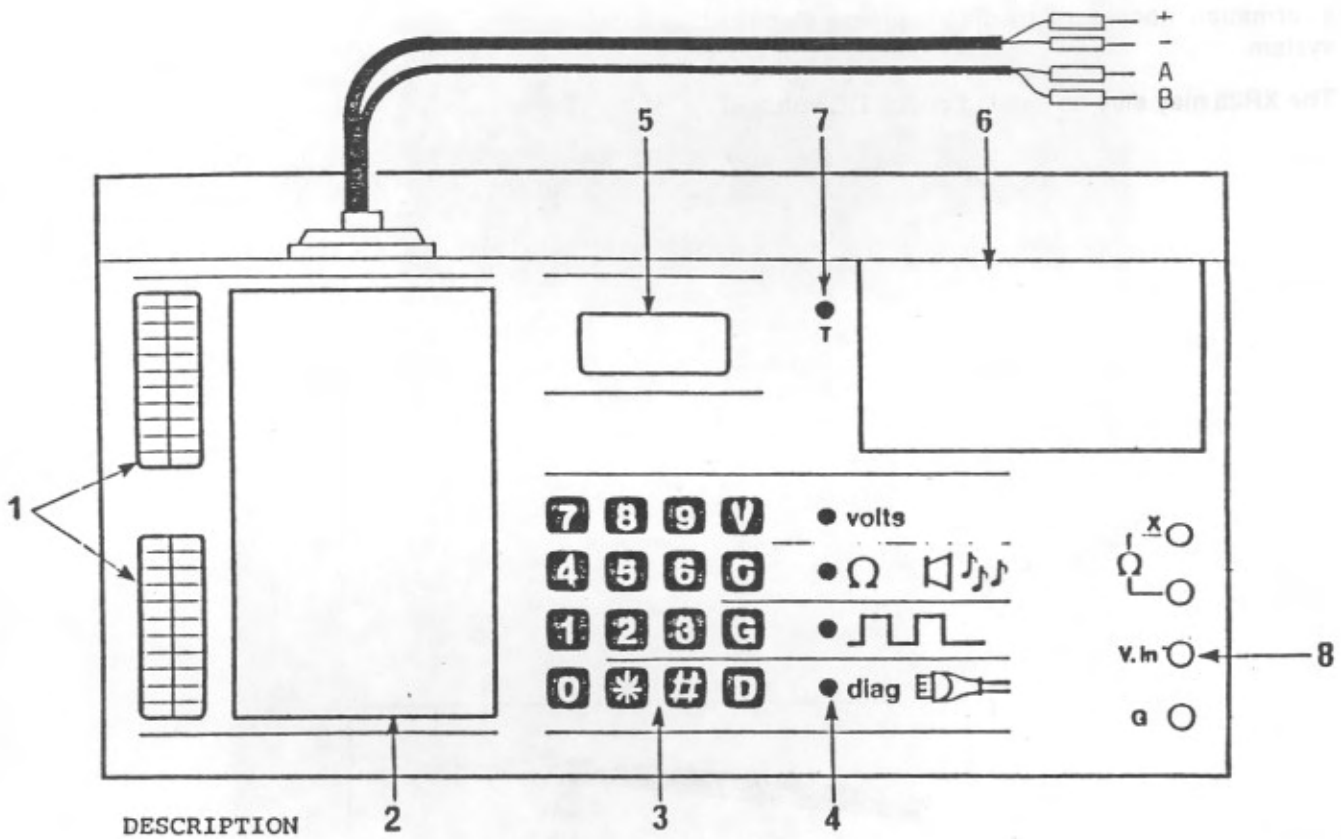
The XR25 may also be used to check DC voltage.



DIAGNOSTIC

XR25 TESTER

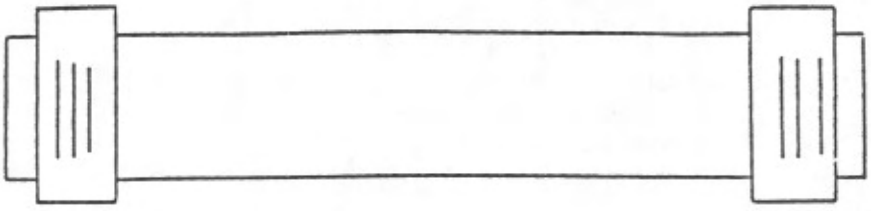
GENERAL DISPLAY & FUNCTION IDENTIFICATION



1 - "Go or No Go" results display (bargraphs).
2 - Analytical test card
3 - Data entering keyboard
4 - Lights reminding check selected
5 - Display of numbered data (voltage, etc.)
6 - Interchangeable memory module
7 - Memory module "connected" indicator
8 - Voltmeter/Impulse detector input

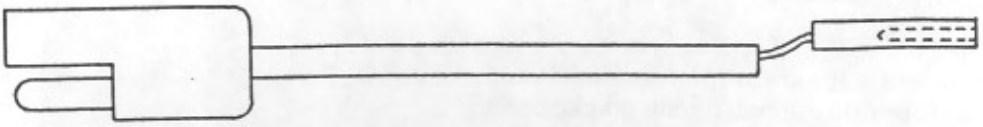
IB - DESCRIPTION OF CABLES

T



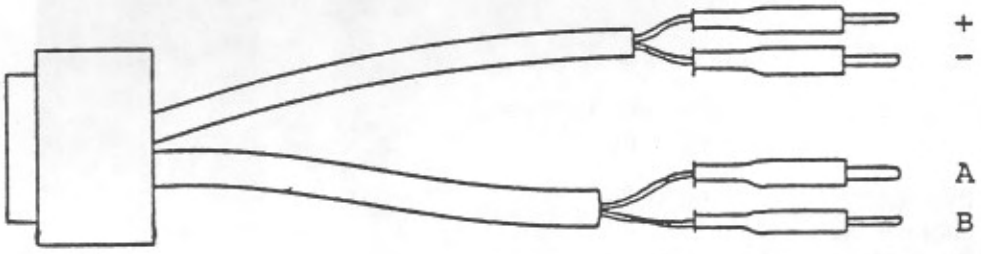
- Extender

X

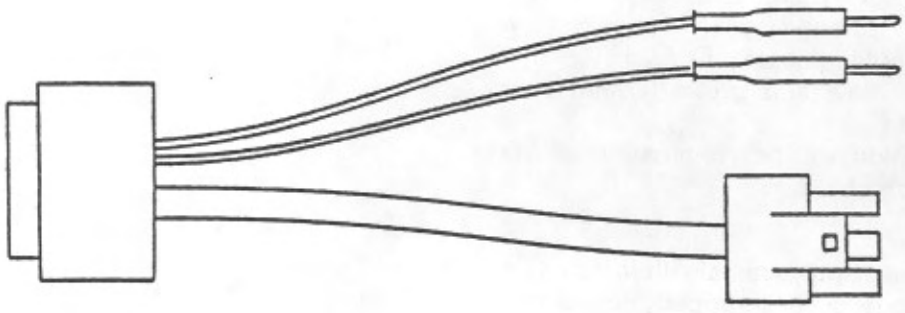


- Adaptor

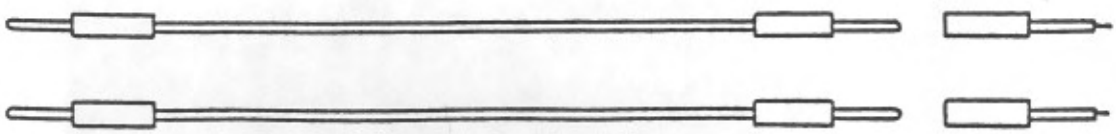
V



W



- Adaptor for potentiometer adjustment



CONNECTING THE XR25

The XR25 comes with all the electrical cables necessary for each test. Each cable is identified on page J2-17 with a letter designation.

Cable "T" is an extension cable and can be either the round or ribbor variety. Cable "T" connects the XR25 to either cable "V" or "W". Included also are two alligator clips to connect to the battery as a power source for the XR25 tester.

NOTE: If the power leads are reversed the XR25 will not operate, but it will not be damaged either. Each test schematic will indicate proper connection.

IMPORTANT
As soon as power leads are properly connected, the XR25 will perform internal circuit diagnosis. Monitor each indication display in sequence, followed by very brief tone and all zeros on the display (5).

Checking Connections and Input Circuits:

This check is necessary if internal circuit diagnosis is correct but display indicates no reading.

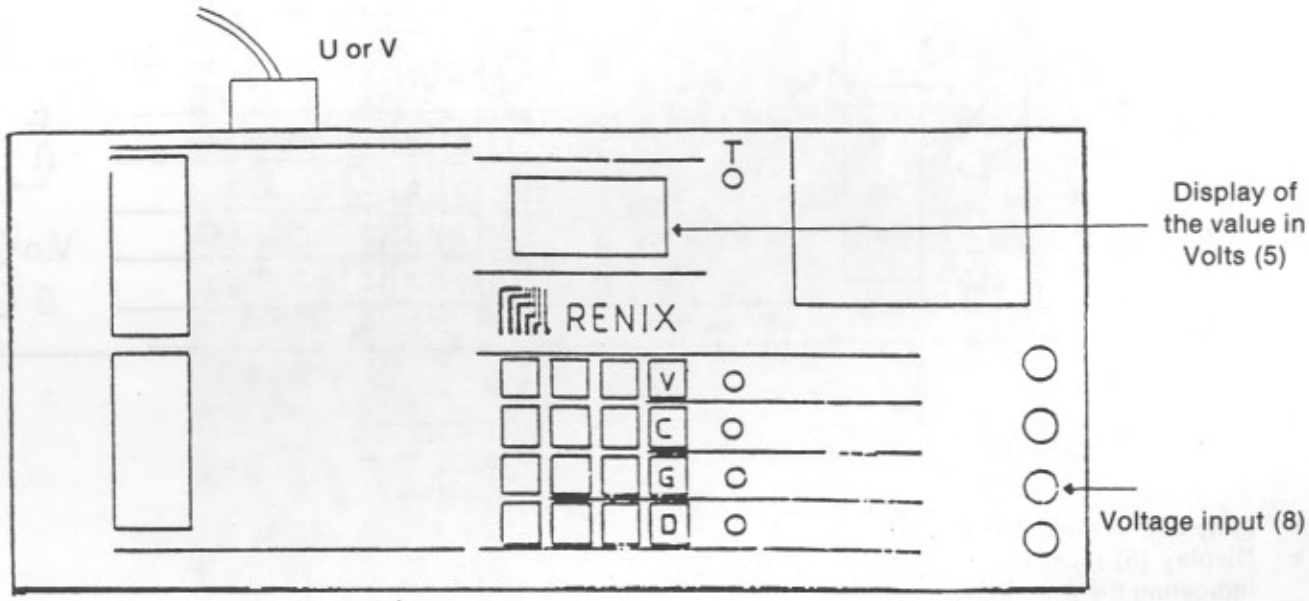
- Connect the extension "T" to the XR25
- Connect cable "V" to extension "T"
- Connect the red terminal to battery +
- Connect the black terminal to battery -
- Depress key "D", then key ✱
- The display should indicate : C O P
- Connect the yellow and green terminals to vehicle ground.
- Correct indication will be illumination of the right side bar graphs.
  1-2-3-4-5-6-7-8

Should one or more displays remain illuminated on the left, the extension is cut or improperly connected.

USE WITH GENERAL REPAIRS

VOLTMETER

- Connect cable V
- Push key V

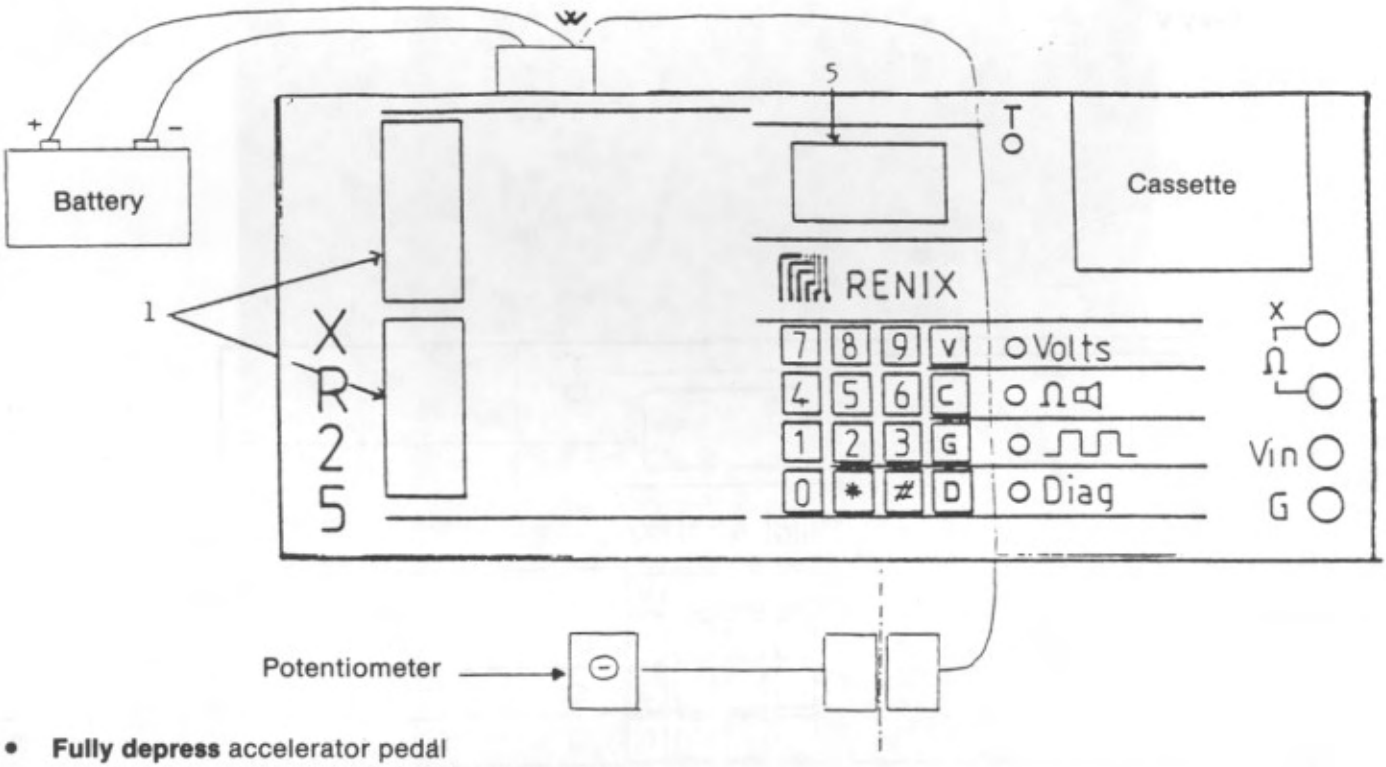


Display characteristics in voltage mode

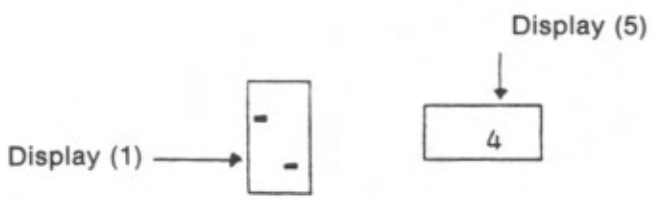
- Scale : 0 to 25 Volts continuous
- Precision : ± 4%
- Protection : 400 Volts max.

POTENTIOMETER (LOAD SENSOR)

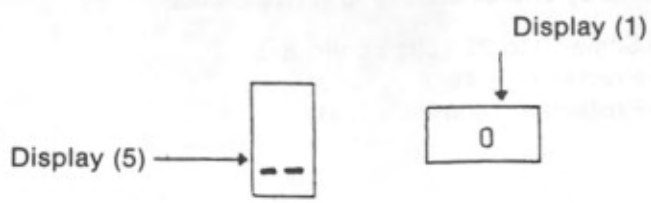
- Connect cable "W"
- Depress key V, then key 1



- **Fully depress** accelerator pedal
- Display (5) must indicate between 0 and 3, 0 indicating the optimum adjustment.
- The bar display must also be aligned



Potentiometer needs adjusting



Potentiometer adjusted

If the potentiometer is not within the range specified, it must be adjusted.

POTENTIOMETER (LOAD SENSOR) ADJUSTMENT

To adjust the potentiometer, locate the two holes in the throttle control assembly. Potentiometer adjustment can be made only in the W.O.T. (wide open throttle) position. Using a 3 mm hex wrench, loosen the securing screws and rotate the potentiometer. To maintain a proper setting, it is necessary to apply screw tension evenly (tighten both screws equally). Failure to tighten evenly will result in improper adjustment after tightening.

If correct potentiometer adjustment is not possible, the potentiometer is defective and must be replaced, then adjusted.

> **CAUTION**
>
> Be sure that the floor mat does not interfere with full travel of the accelerator pedal.

FAULT INDICATION DIAGNOSIS

The Renix control unit is designed to send a coded signal. The Renix control unit is located on the left side of the firewall and is equipped with a diagnostic lead (lower right corner). The diagnostic lead extends approximately 6" and connects to the warning light in the top right corner of the instrument panel.

When an electrical fault is indicated by the warning light, the XR25 should be connected to the system.

IMPORTANT

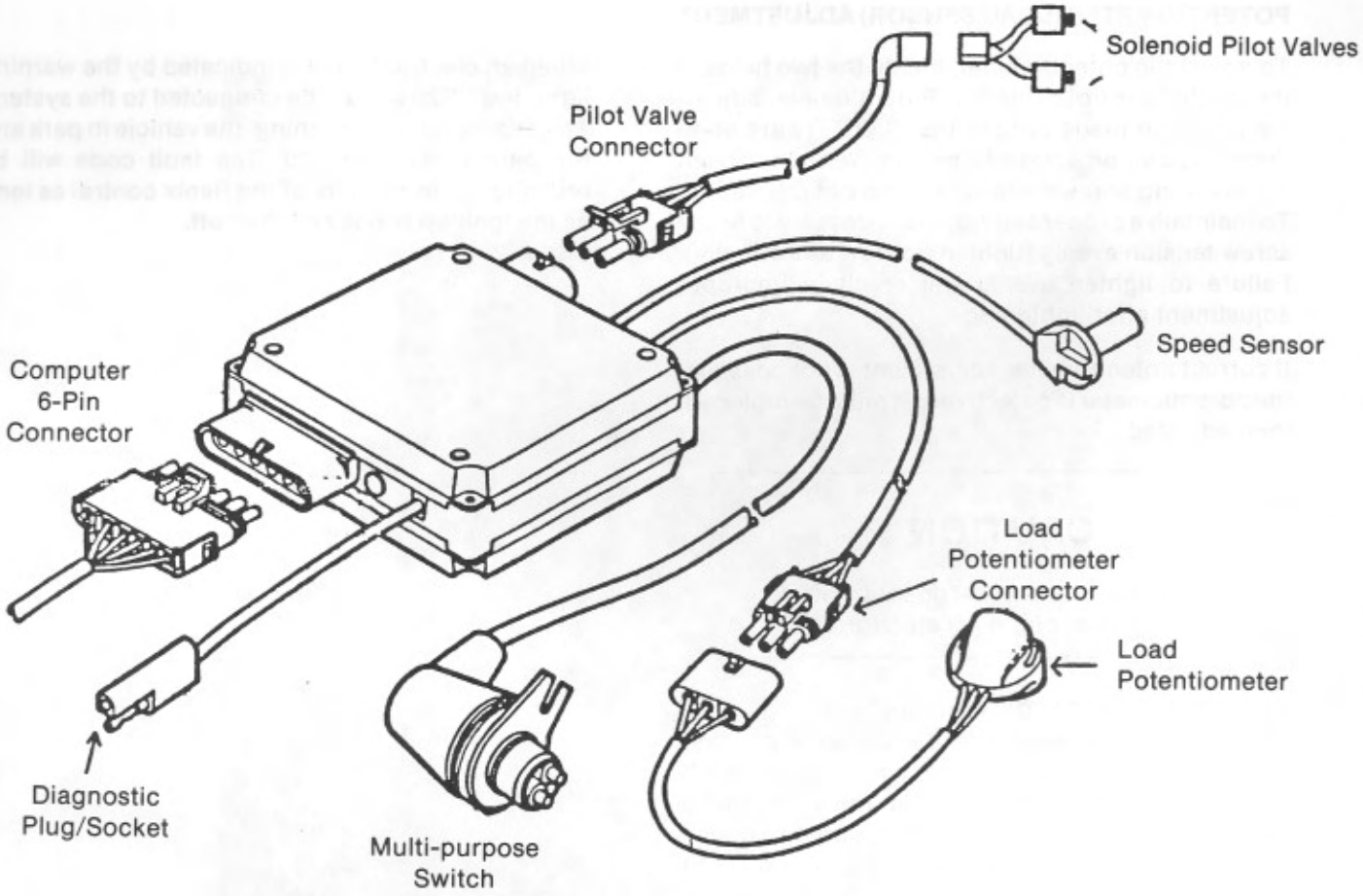
There are 2 (two) variations of Renix control operation. This text will distinguish the variations as "Type 1" and "Type 2".

On "Type 1", the Renix control requires an input signal from the road speed sensor before the warning light is extinguished. This means that the vehicle must be moving at approximately 2 m.p.h. before the light will go off. If the light remains on, there is an electrical problem.

"Type 2" is designed so that the warning light comes on when the ignition is switched on and goes out, when the engine starts and other test lights are extinguished. If the light stays on, an electrical problem is indicated.

- On "Type 1" and "Type 2" this diagnosis monitors:
  - the solenoid valves and circuits
  - the road speed sensor and circuit
- On **"Type 2" only** this diagnosis also monitors:
  - continuity through the potentiometer circuit

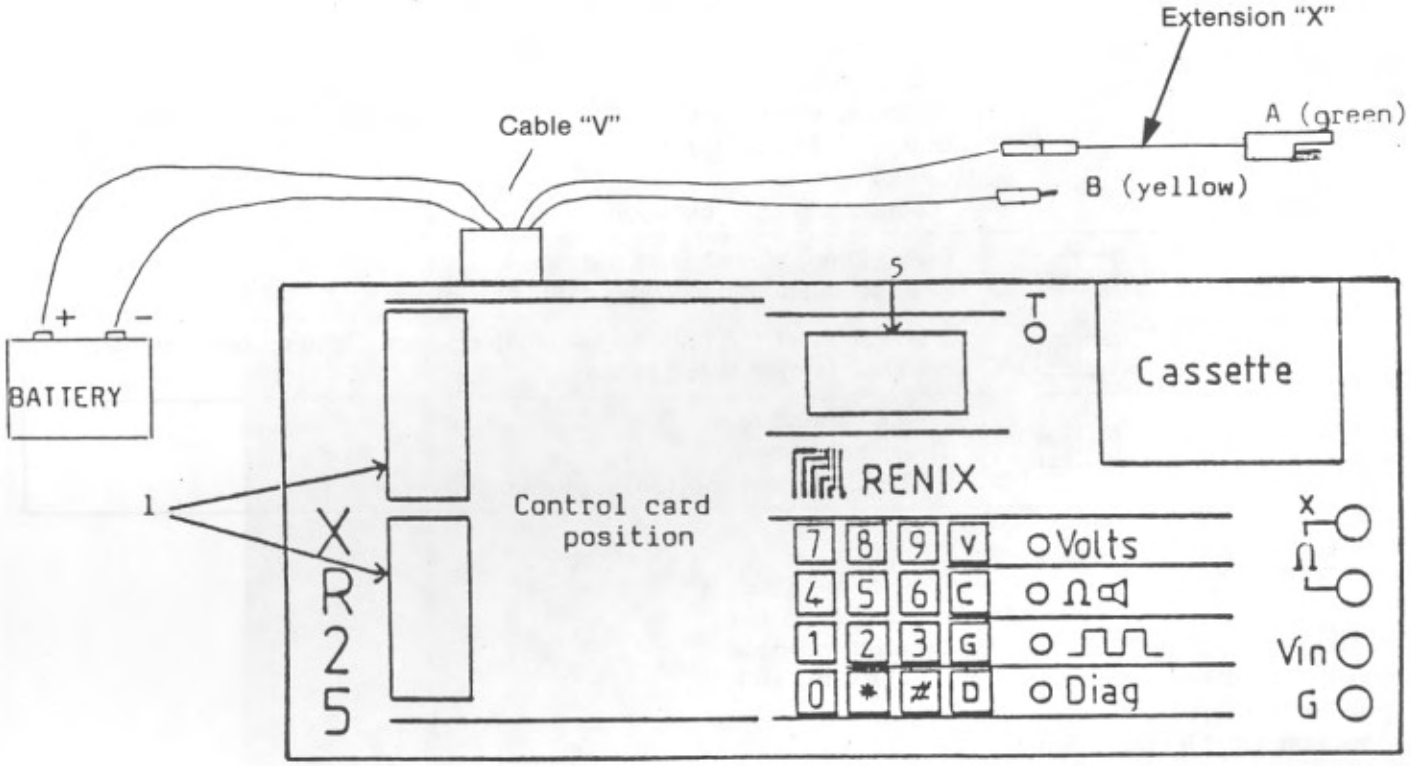
When an electrical fault is indicated by the warning light, the XR25 should be connected to the system. The engine must be running, the vehicle in park and the park brake engaged. The fault code will be retained in the memory of the Renix control **as long as the ignition is not switched off.**



Connecting the XR25 for Fault Indication Diagnosis

- Connect cable "V"
- Observe internal checks
- Depress key "D"
- Depress key "O"
- Depress key "1"
- Position the magnetic display card (supplied with the XR25) next to the display windows on the left side of the face of the XR25.

- Connect adaptor "X" to the green lead on cable "V"
- Connect the yellow lead on cable "V" to the instrument warning light connector.



Test 1 - Cable "V" - Reading the display
This test is performed after a road test, **before the ignition is switched off.** The bar display in the top window of the XR25 is divided into four sections. The top bar indicates that the XR25 is properly connected.

If a bar does not appear in the first section, check all connections for good contact. If a bar appears in one of the other three sections, a fault is indicated. On "Type 1" and "Type 2", this test monitors solenoid valve and road speed sensor circuits. On **"Type 2" only**, continuity through the potentiometer circuit is also checked.

N° code	0	**If bargraph extinguished** Check feed to control (12V) Chassis ground Diagnostic plug/socket connection
	1	Check solenoid ball valve wiring Change solenoid ball valves EL1 - EL2
	2	After road test, if it remains illuminated without ignition being switched off, change road speed sensor
	3	Check continuity Check adjustment NOTE: Late 1986 and 1987 models only.

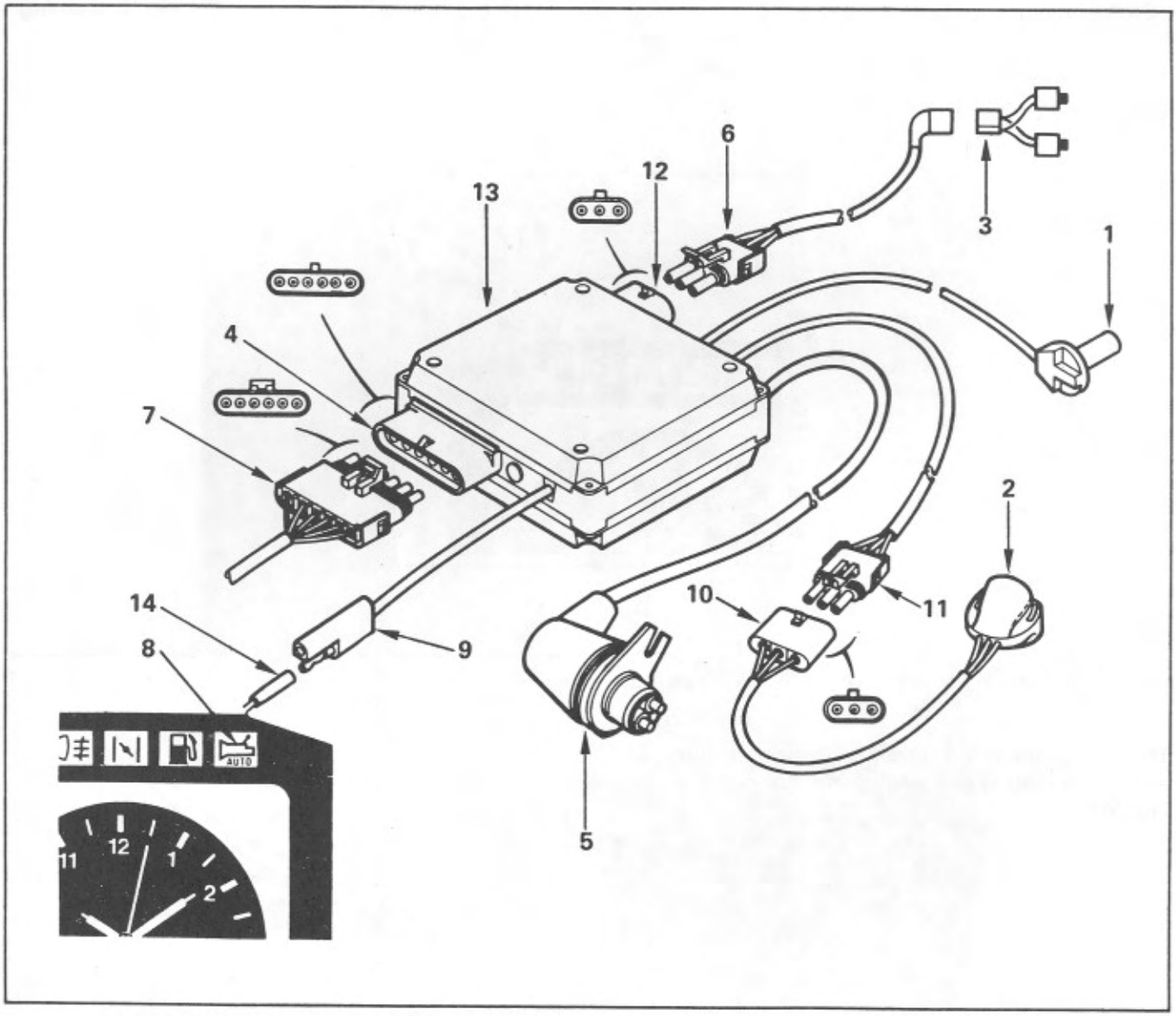
Test 2 - Cable "V" - Reading the display
This test appears in the lower window of the XR25. For this, the engine should be stopped and the ignition switched on. This checks the multi-purpose switch and the kickdown circuit. With the shift selector in the first gear hold position, the bars in section 4 and 5 of the display should appear. Move the selector to the second gear hold position and only 4 should appear. When the selector lever is moved to drive, neutral, reverse or park, no bars should appear.

Check the kickdown switch by pressing the accelerator pedal to the floor. A bar must appear in section 6; if not, the switch is defective and must be replaced. Be certain the floor mat does not interfere with accelerator travel.

Move selector lever	4	1st 4 Correct	2nd 4 Correct	P.R.N.D. 4 Correct	**IF INCORRECT: Check selector adjustment, wiring, multi-function switch**
	5	5	5	5	
	6	6	Completely depress accelerator pedal.		

DIAGNOSTIC
INTERPRETING THE AUTOMATIC TRANSMISSION WARNING LIGHT

The computer (13) incorporates a system for self-testing the electrical components. A defect warning light (8) on the instrument panel lights up to indicate that this system is operational. Warning light (8) should come on when the vehicle's ignition is switched on and go out either when the vehicle is moving at more than 1.9 mph (3 km/h) or after three seconds have elapsed (depending on version).

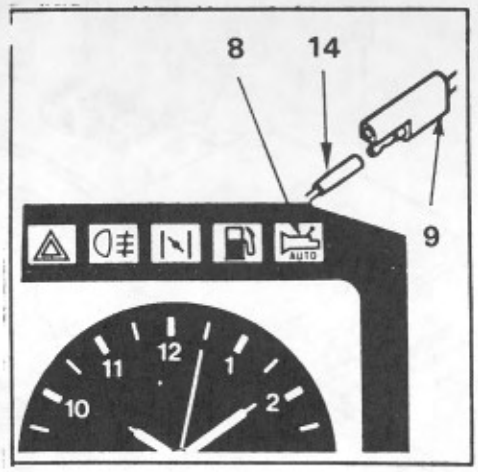


1 - Speed sensor
2 - Load potentiometer
3 - Solenoid pilot valves
4 and 7 - 6-way socket/plug
5 - Multi-purpose switch
6 and 12 - Pilot valve sealed connector - socket
8 - Incident warning light
9 and 14 - Diagnostic plug/socket
10 and 11 - Load potentiometer plug and socket
13 - Computer

- Checking the Instrument Panel Warning Light

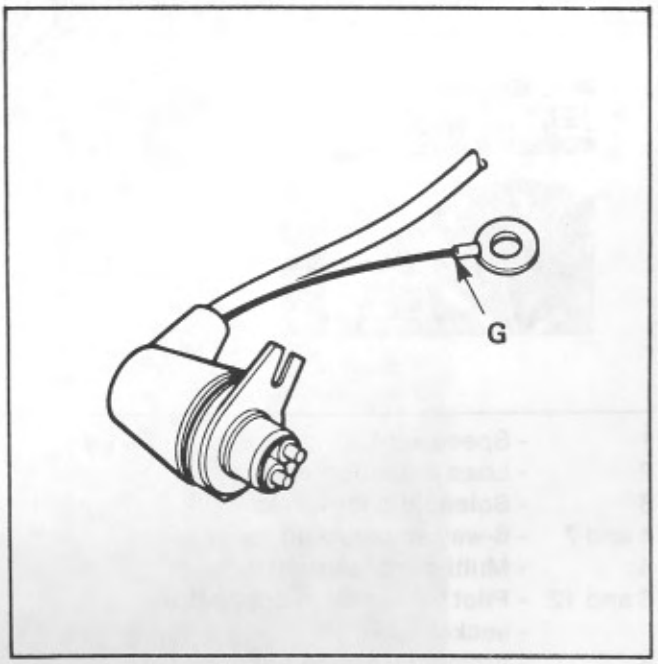
Disconnect connector 9.

Action to be taken on the vehicle	Points for taking readings	Diagnosis
Switch the ignition on	Ground connector (14) at the wiring harness end. The warning light (8) on the instrument panel should turn on	Check the supply fuse, the warning light bulb and the wiring

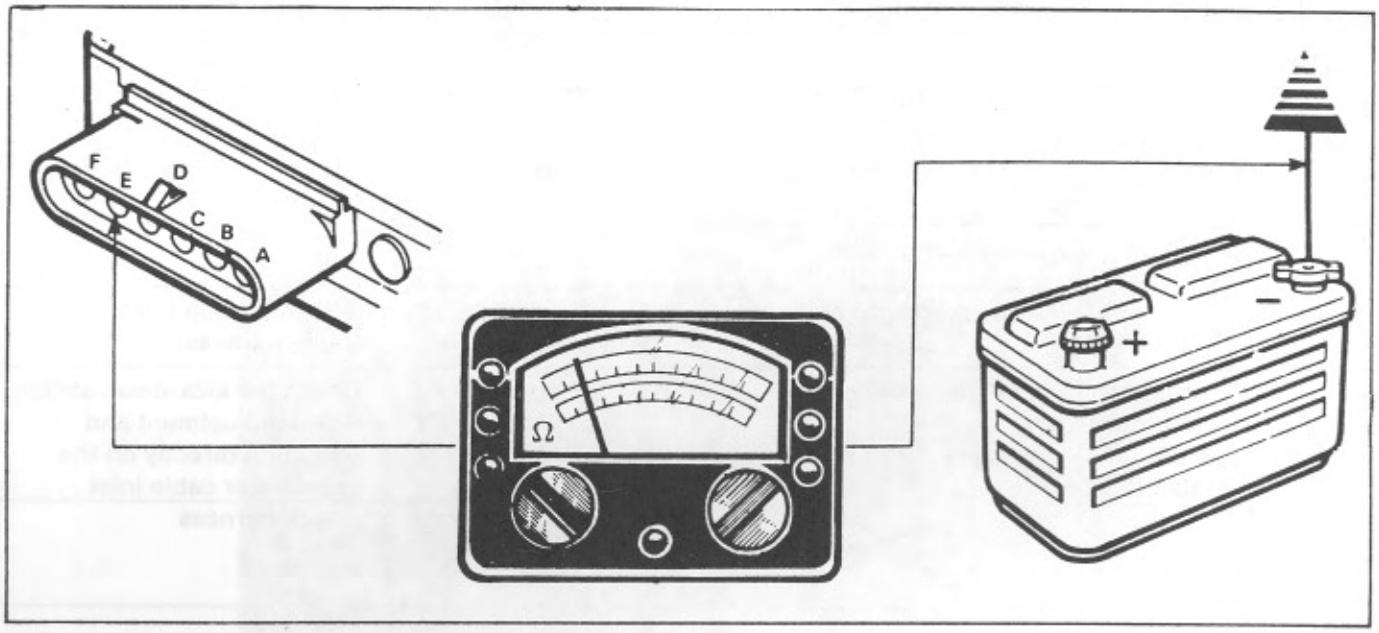


FAULT : COMPUTER INCORRECTLY GROUNDED

Step 1
The computer is grounded at the multi-purpose switch via lead G secured to the automatic transmission.



Step 2
Disconnect the 6-way connector at the computer and make the following measurement using an ohmmeter.



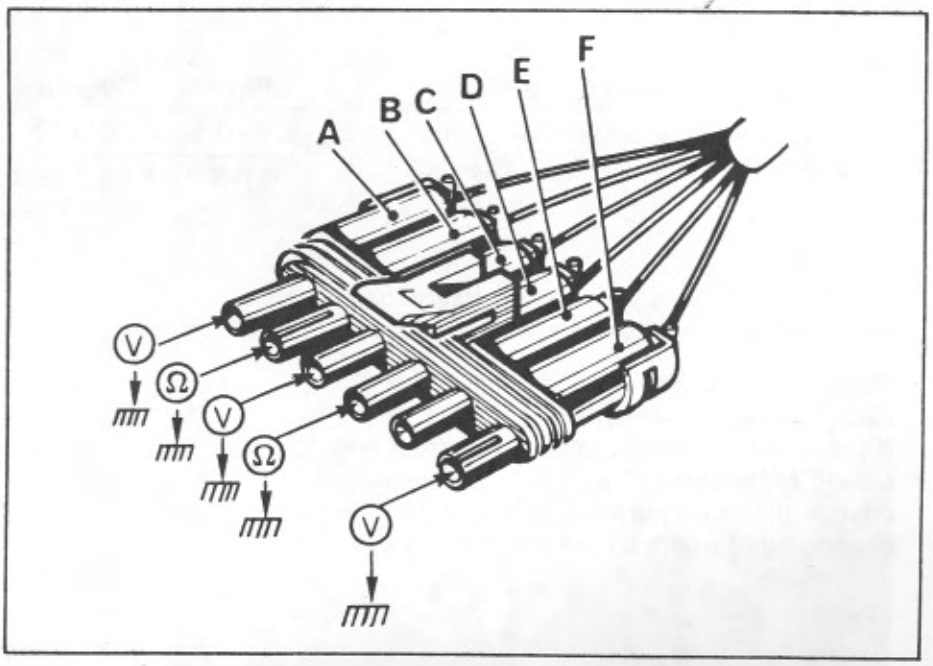
Measuring points	Result	Diagnosis
Between the battery - (- on terminal) and point E on computer connector	0 - 0.5	GOOD
	OTHER	INCORRECT See 1 - 2 - 0

1. Check connection and condition of terminal (G) ground lead on automatic transmission housing.
2. Check continuity of ground lead (using ohmmeter) placed between terminal (G) and point (E) on connector on computer. Correct result should be between 0 and 0.5 . If incorrect, change the multi-purpose switch or computer depending of where the lead is damaged.

DIAGNOSTIC

CHECKING THE SIXWAY CONNECTOR AT THE COMPUTER

CHECKING WITH AN OHMETER - VOLTMETER			
Measuring Conditions	**Component checked**	**Measuring point and values**	**Operations to be performed if values incorrect**
Ignition on	Computer feed	F and Ground : 12 ± 2 V	Check fuse and harness
	Backup light feed	A and Ground 12 ± 2 V	Check feed (fuse, harness)
Starter activated	Starter activation feed	C and Ground	Check starter relay and harness
Ignition off	Computer ground		
	To backup light bulb	B and ground : 4 ± 3 Ω	Check backup lights (bulb, harness)
Depress accelerator pedal completely	Kick-down switch	D and Ground: 0 to 0.5 Ω	Check the kick-down switch. Check adjustment and operation directly on the accelerator cable inlet.
Foot off accelerator pedal		D and Ground ∞ Ω	Check harness

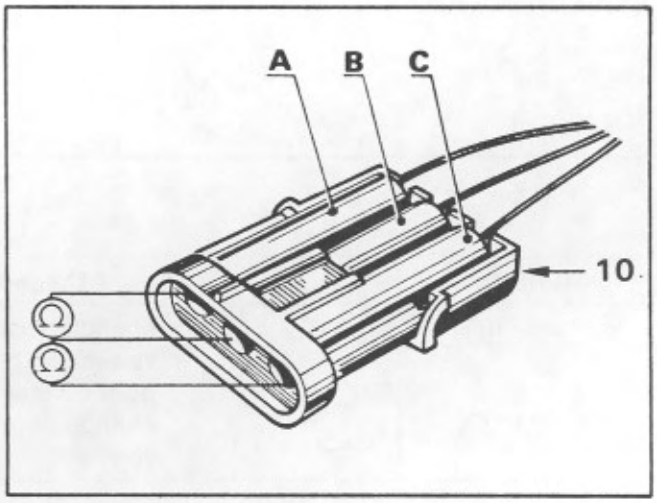


DIAGNOSTIC

CHECKING THE LOAD POTENTIOMETER (Using an ohmmeter)

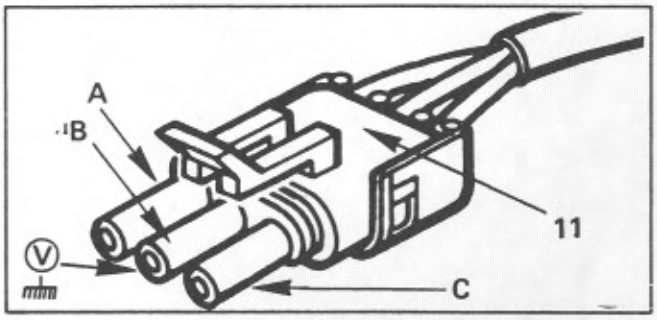
Disconnect connector (10) from (11) and check the following using an ohmmeter:

Measuring points	Correct Value	Diagnosis
C - B	4 k Ω ± 1	If the measurements are different, the potentiometer is faulty or badly adjusted. (See adjustment procedure J2-21)
A - B	2,5 k Ω ± 1	
A - B	Open throttle slowly; the ohmmeter should **never** indicate infinite resistance	



CHECKING 3-WAY CONNECTOR (11) FEEDING THE POTENTIOMETER (using a voltmeter)

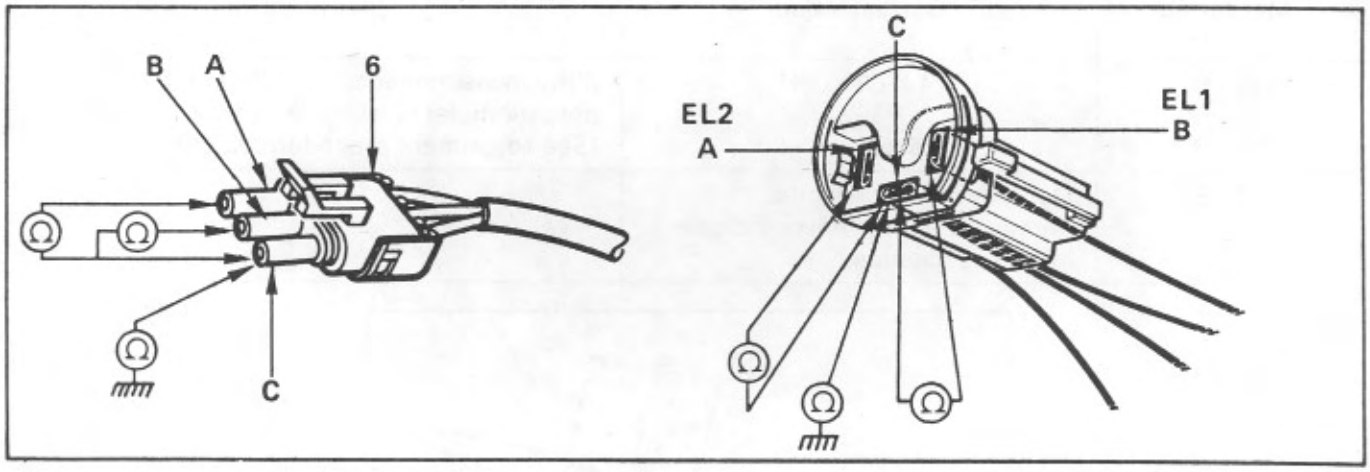
Conditions	Measuring points	Correct valve	Diagnosis
Ignition on	B ground	4.3 V ± 0.5	If incorrect, check the 6-way connector (see page J2-28).



A = Potentiometer data
B = Potentiometer feed
C = Ground

SEALED CONNECTOR AND SOLENOID PILOT VALVES

CHECKING THE SOLENOID PILOT VALVE SEALED CONNECTOR AND SOLENOID PILOT VALVES ONLY



Measuring Point	Result	Diagnosis	
Between B and C	30 Ω ± 10 Ω	If 0 Ω	change harness or solenoid pilot valves
		60 Ω ± 20 Ω	poor connection
Between A and C	30 Ω ± 10 Ω	∞ Ω	change harness or solenoid pilot valves
Between C and Ground	∞ Ω	If different from ∞ Ω	short circuit between ground and solenoid pilot valve coil (change harness or solenoid pilot valves)

Solenoid valve balls sticking (Reference Subsection "Components" Hydraulic Control Unit, J3-8.)

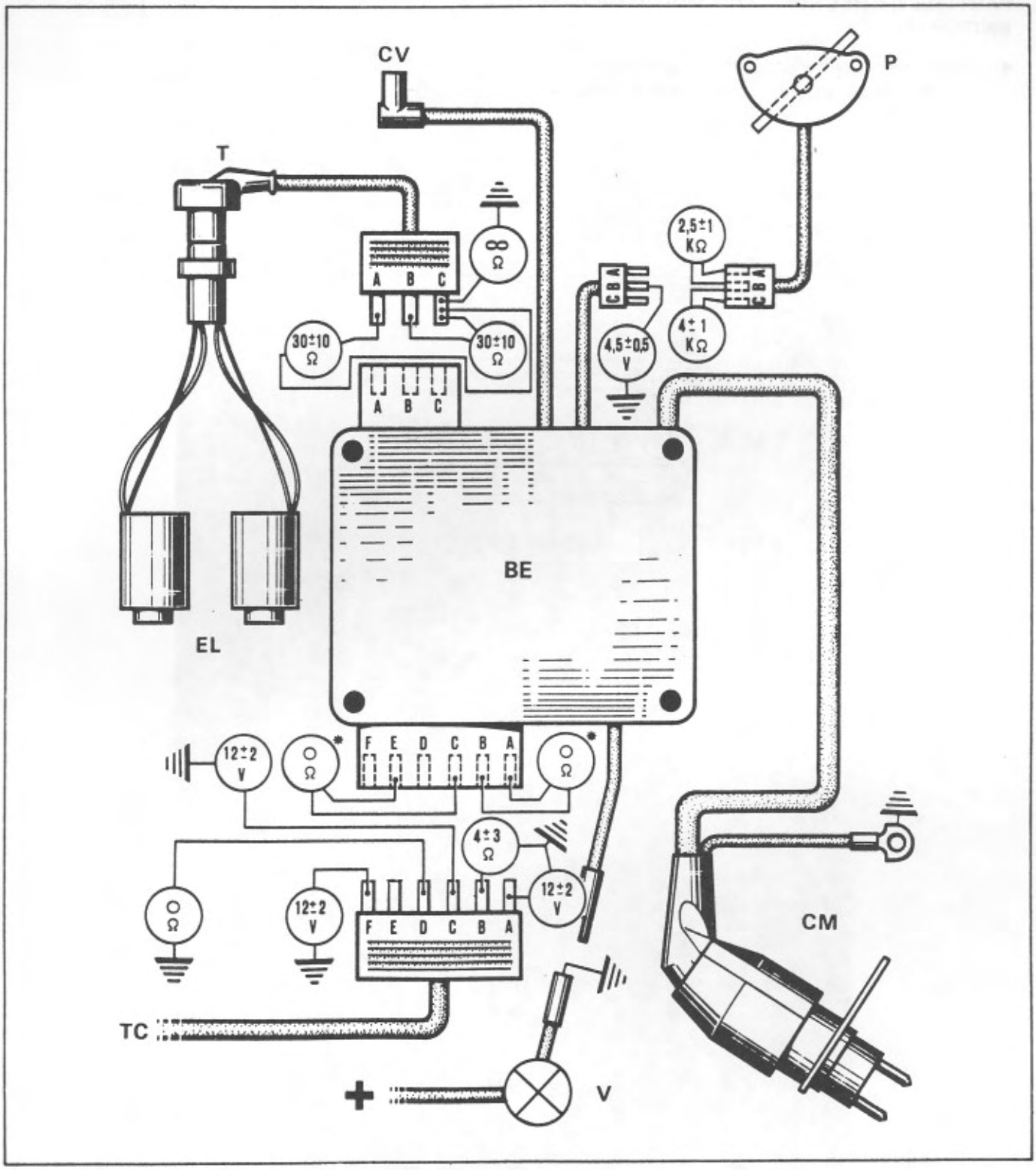
Transmission operating in 2nd speed only, in "D" EL1 remains closed.

No 2nd speed in "D" operating 1 ↗ 3 EL1 remains open.
No 3rd speed in "D" operating 1 ↗ 2 ↘ 1 EL2 remains closed.

No 1st speed in "D" operating 3 ↘ 2 ↗ 3 EL2 remains open.

Operating 2 ↘ 1 ↗ 3 solenoid valves incorrect way round.

CHECKING THE CONNECTORS FOR REFERENCE



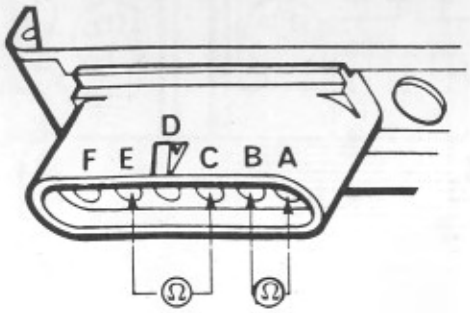
* Depending on shift lever position

P —Potentiometer
CM —Multipurpose switch
EL —Solenoid pilot valves
TC —Connection to vehicle harness
CV —Speed sensor
BE —Computer
T —Sealed bulkhead connector

PARTIALLY CHECKING THE MULTIPURPOSE SWITCH (5)

- Disconnect the six pin connector (7) and carry out the check on the base (4) of the computer housing.

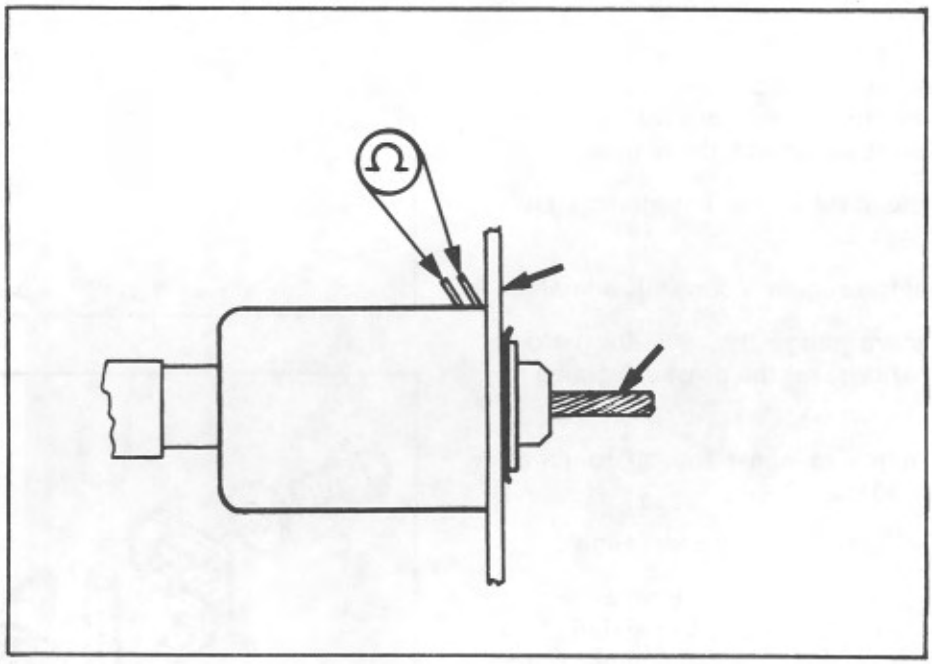
Points for taking readings	Diagnosis
A - B = O Ω (selector in R) E - C = O Ω (selector in P or N)	Replace the multipurpose switch.



4

CHECKING THE ACCELERATOR CABLE KICK-DOWN SWITCH.

The kickdown switch is located on the accelerator cable on the engine side of the firewall connector.



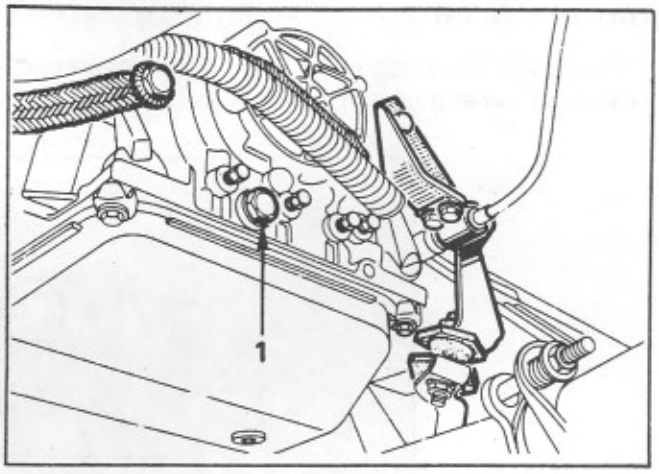
- Disconnect the leads from the kickdown switch and connect an ohmmeter.
- Depress the accelerator pedal **completely**. The resistance should be approximately O Ω If not, adjust the cable at the stop clip on top of the valve cover.
- Retest and check to make sure cable returns properly to the idling stop.

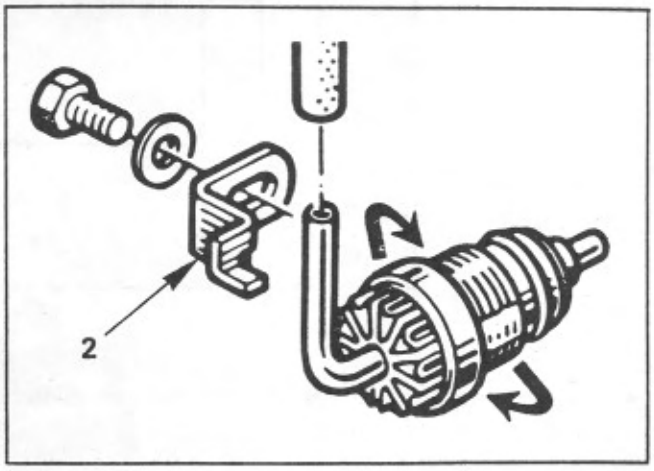
DIAGNOSTIC

TRANSMISSION FLUID PRESSURE

The quality of gear changing and the useful life of the clutch/brake section of the automatic transmission depend on correct fluid pressure adjustment.

Special Tool B.Vi. 466-07 must be used for this function.





CHECKING

- The fluid pressure must be checked with the transmission hot (80° C) during a road test only (the fluid pressure varies with the temperature).
- Check the fluid level in the automatic transmission.
- Make sure that the engine is correctly adjusted.
- Connect pressure gauge B.Vi. 466-07 (before using the apparatus, set the pressure gauge to zero).
- Drive a few miles to allow the oil to reach approximately 80° C.
- Move the selector level to 2nd gear "Hold".
- Depress the accelerator pedal completely and brake at the same time to stabilize speed at 50 mph (80 km/h) and read off the value on the pressure gauge.
- The correct value should be 4.6 bars.

ADJUSTING

- Remove lock plate (2) and turn the capsule. The pressure is increased by turning the capsule clockwise.

NOTE:

2 notches = approximately 0.1 bars.

DIAGNOSTIC
VACUUM CAPSULE

The vacuum capsule varies the fluid pressure to suit the engine load.

CHECKING THE VACUUM CAPSULE

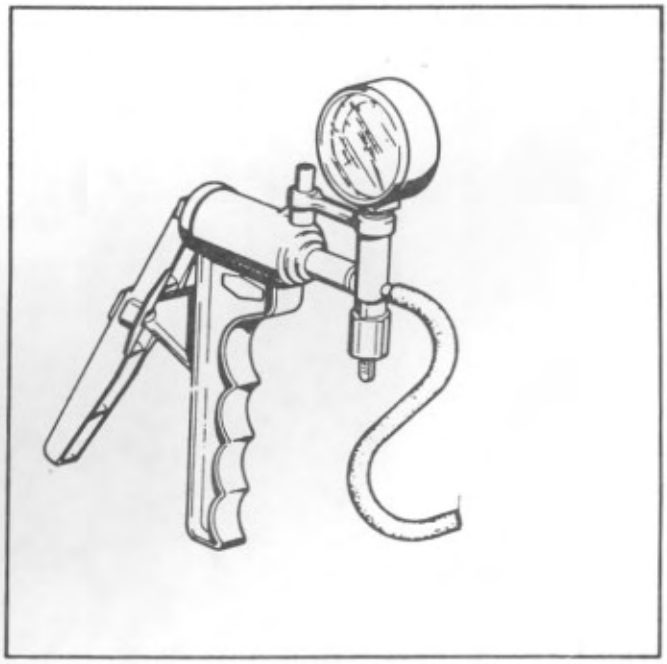
- Engine stopped
- Check the routing of the vacuum hose.
- Connect a manual vacuum pump to the vacuum hose disconnected from the intake manifold.
- If the reading is incorrect, perform the test again directly on the capsule. If the result is good, change the hose, if it is not, change the capsule.
- Also make sure that the connection on the intake manifold is in good condition.

REMOVAL

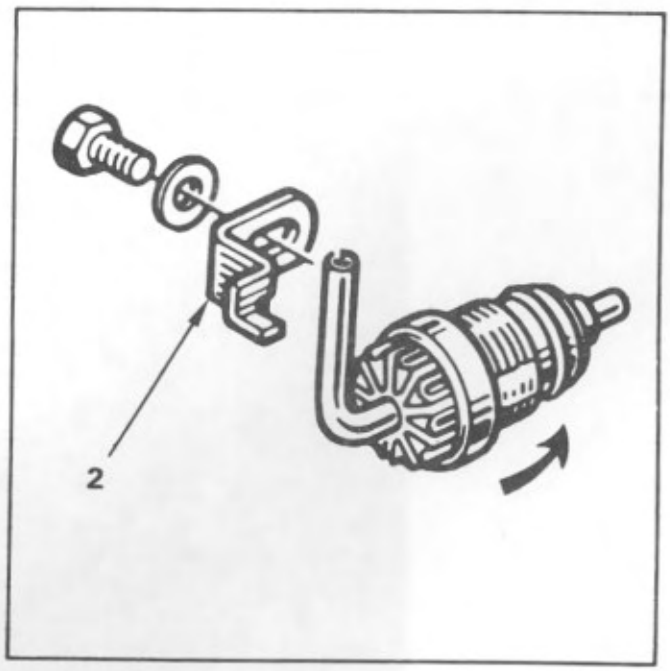
- Disconnect the hose, remove stop plate (2) and unscrew the capsule.

REFITTING

- Oil the capsule (black rubber).
- Screw the capsule in 2 1/2 to 3 turns and attach lock plate (2).
- TOP UP THE FLUID AND ADJUST THE FLUID PRESSURE (See "FLUID PRESSURE" on previous page).



Vacuum to be applied	NEEDLE	
	STABLE	DROPS
525 mbar or 400 mmHg (16 in. Hg)	GOOD	INCORRECT



COMPONENTS

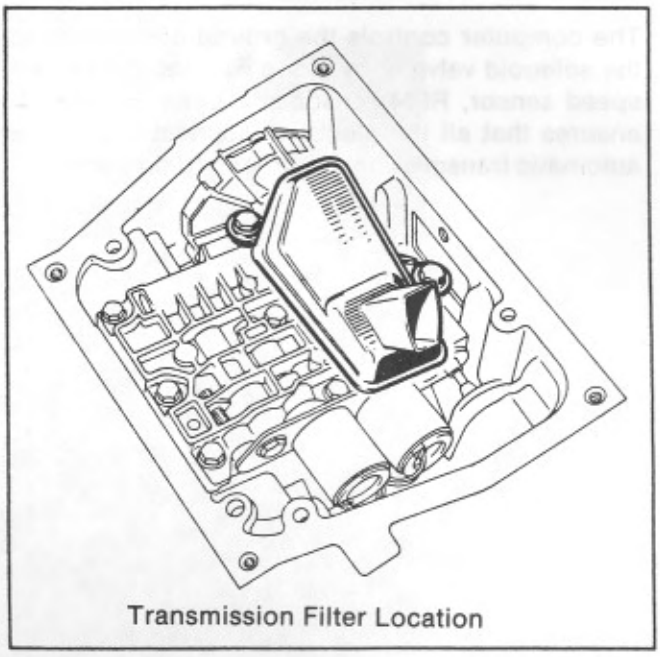
TRANSMISSION FLUID FILTER

The screen filters the fluid and ensures that the automatic transmission is operating correctly.

TIGHTENING TORQUES (In daNm)

Distributor ..... (Filter mounting bolts)	0.9 daNm (6.5 lb./ft.)
Pan bolts	0.6 daNm (4.5 lb./ft.)

The filter screen must be cleaned or replaced at regular intervals and whenever major work is performed on the gear section.



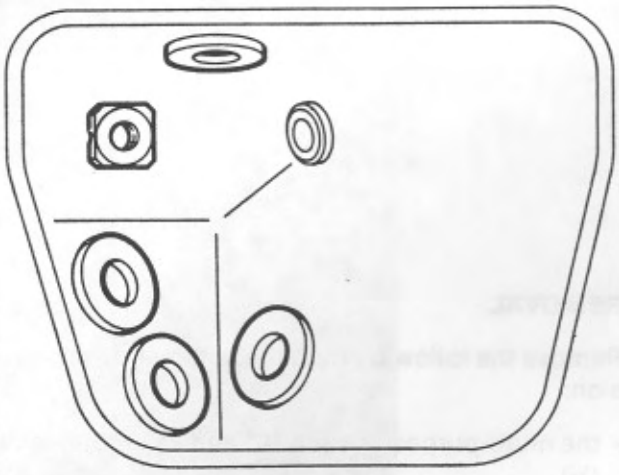
Transmission Filter Location

REMOVAL

Drain the fluid and remove:

- the pan
- the filter screens and its seal. Before refitting, clean the pan and its magnets and replace them as shown.

Magnet Placement



Attach magnets with ribbed side against pan.

REINSTALLATION

Mount the fluid filter as shown in the illustration at right. Torque tighten mounting bolts to 0.9 daNm (6.5 lb./ft.)

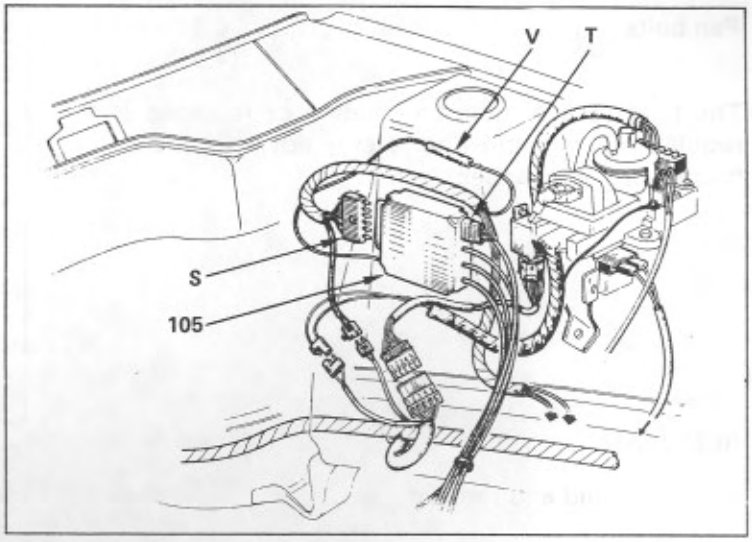
Mount the pan and refill with fluid.

> **CAUTION**
>
> Failure to place magnets as shown may result in interference with the filter screen assembly, causing an air leak at the filter base mount.

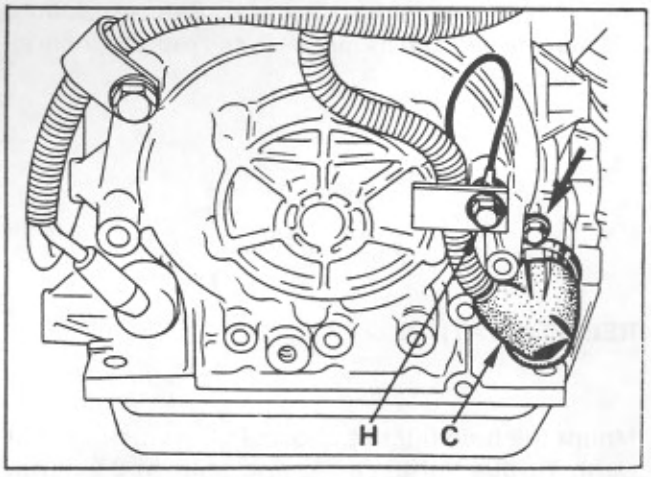
COMPONENTS

COMPUTER - REMOVE AND REPLACE

The computer controls the ground connection to the solenoid valve body along with input from the speed sensor, RPM sensor and potentiometer. It ensures that all the electrical connections of the automatic transmission are operating properly.



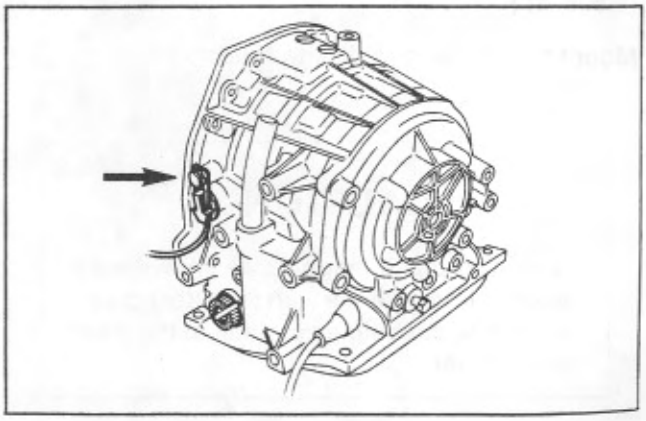
Before removing the computer (105) with its speed sensor and multi-purpose switch, mark the harness routing accurately and disconnect the battery.



REMOVAL

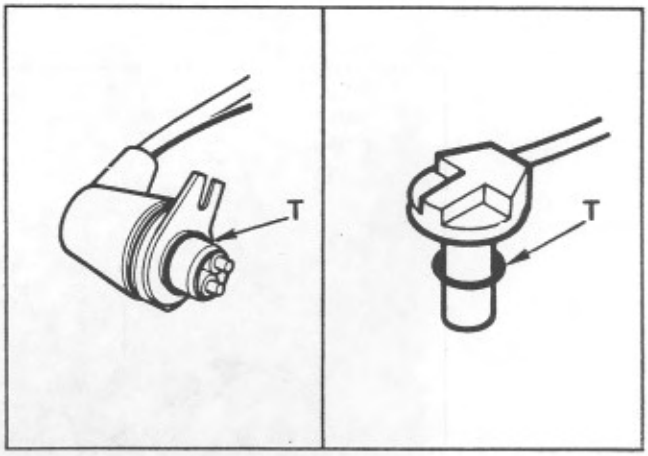
Remove the following from the automatic transmission:

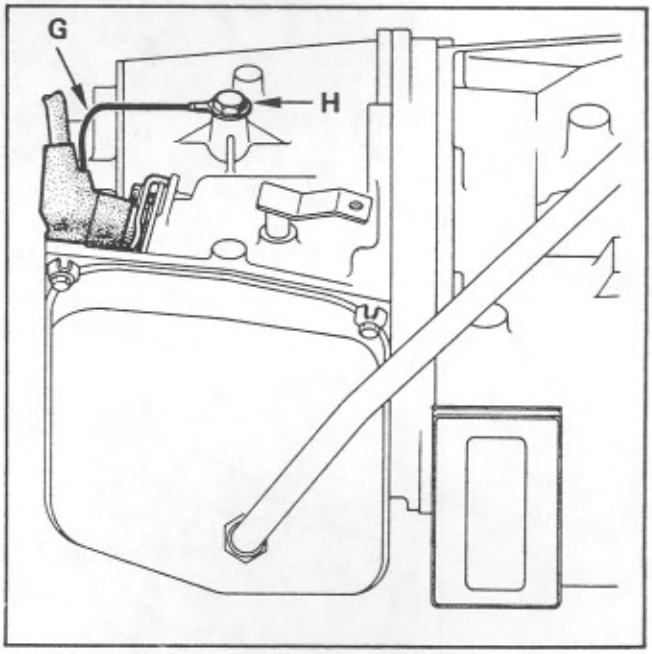
- the multi-purpose switch (C) and its ground lead. (H).
- the speed sensor and its seal. Disconnect connectors (S), (T), (V) and the load potentiometer connector.
- Remove the computer.



REINSTALLATION

Check that O-ring seals (T) are present on the speed sensor and multi-purpose switch.





Refit:
- the speed sensor
- the multi-purpose switch and ground lead (G) at (H), to the automatic transmission.

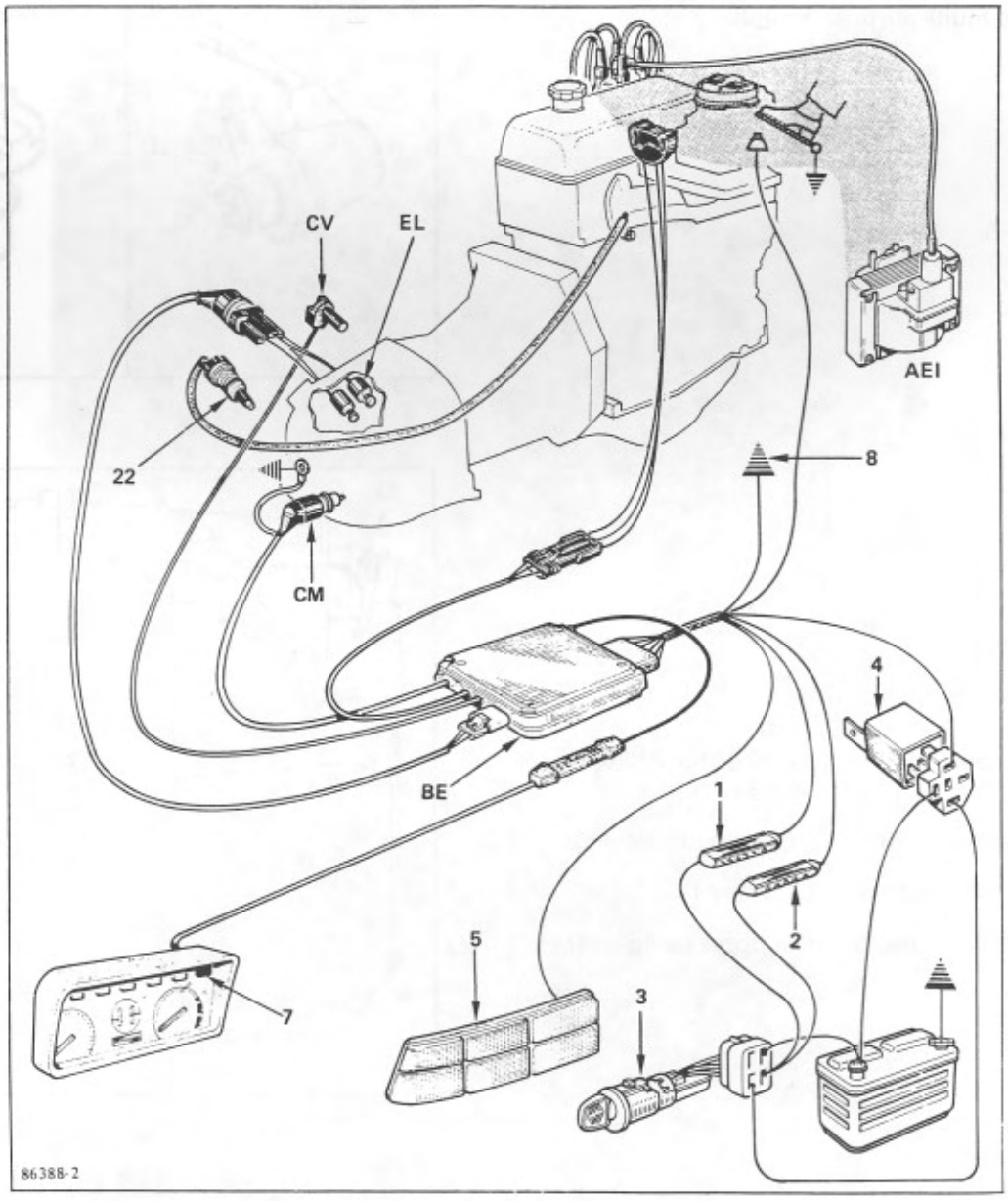
Replace the harnesses in their ribbed sleeving.

Reconnect connectors (S), (T) and (V).

Secure the computer on its support using a strap.

COMPONENTS

COMPUTER - REMOVE AND REPLACE



CHECK:

- That the harnesses of the kickdown switch, load potentiometer and computer feed are at least 15 cm (6") away from the ignition high tension lead (area shaded gray). Otherwise there is a risk of interference which could cause the warning light to come on intermittently and the automatic transmission to function irregularly.
- That the high tension harness leads are in perfect condition.

COMPONENTS

MULTI—PURPOSE SWITCH - REPLACEMENT

This operation consists of cutting the wire connecting the electronic module to the multi-purpose switch and replacing the switch with a new one.

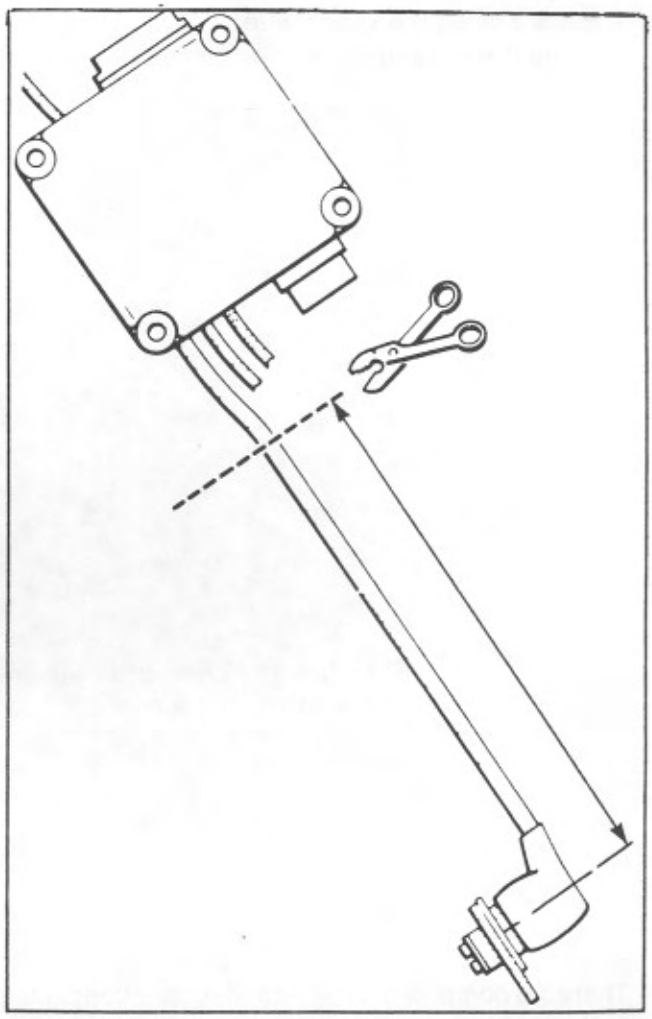
Before cutting the wire, check the multi-purpose switch.

Contents of replacement kit.

- 1 multi-purpose switch together with a ground lead male connector and cable,
- 1 female connector,
- 6 male pins
- 6 seals.

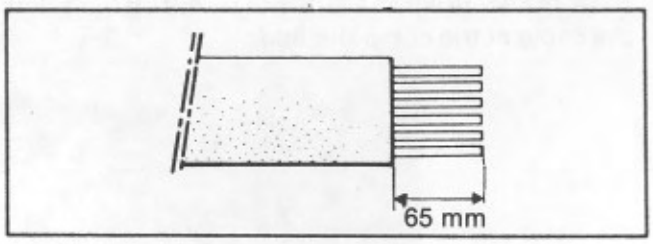
PROCEDURE

Remove the multi-purpose switch from the automatic transmission and cut off the wiring to the same length as the wiring on the replacement part.



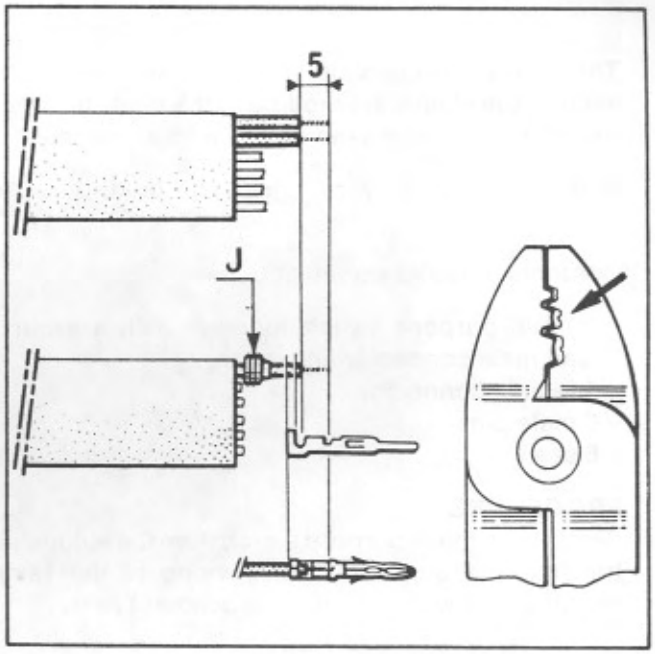
At the electronic module end:

- remove the protective sleeve back 65 mm. (2.5 in)



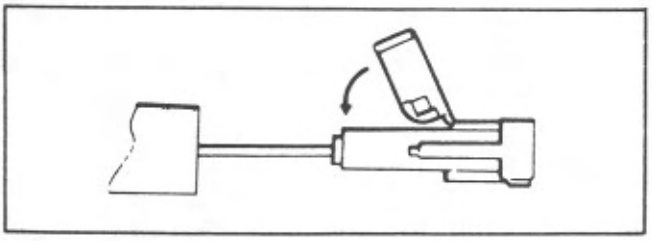
MULTI-PURPOSE SWITCH - REPLACEMENT

- Strip the wires back 5 mm (.20 in)
- Place a seal (J) on each wire,
- crimp the end terminals in place.

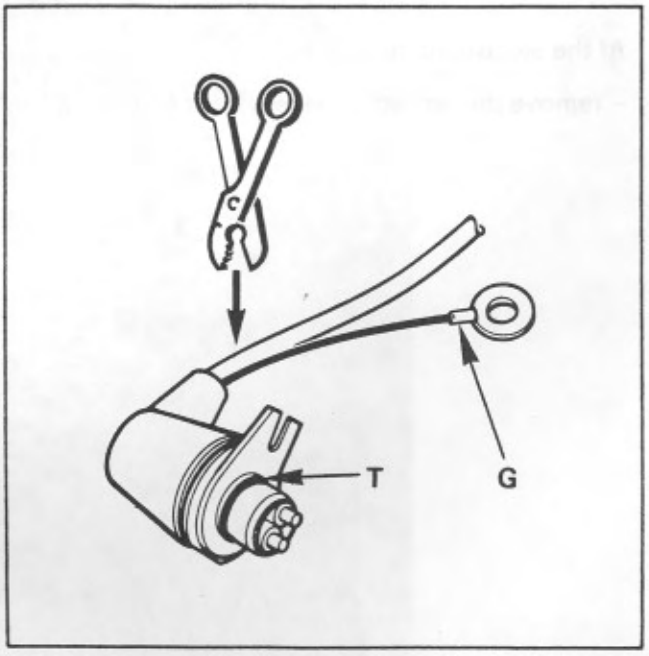


When fitting the wires into the connector, ensure that the color codes are correctly aligned.

Fold down the locking tab on the connector.



There are computers in service which are connected to the multi-purpose switch via seven wires. In this case, the white wire sheath is to be cut off flush with the cable at the computer end.



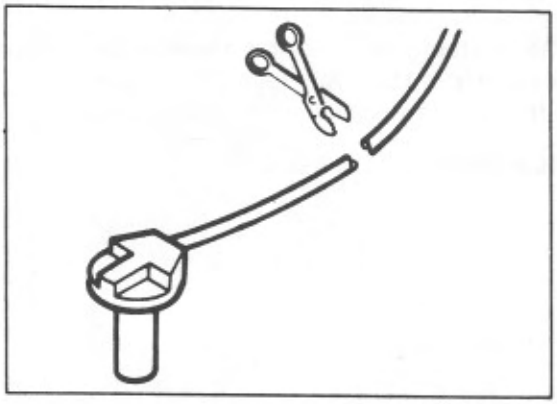
Check that O-ring (T) is in place and attach the multi-purpose switch to the automatic transmission.

IMPORTANT
REMEMBER TO RECONNECT THE GROUND LEAD TO THE AUTOMATIC TRANSMISSION CASE.

COMPONENTS

SPEED SENSOR - REPLACEMENT

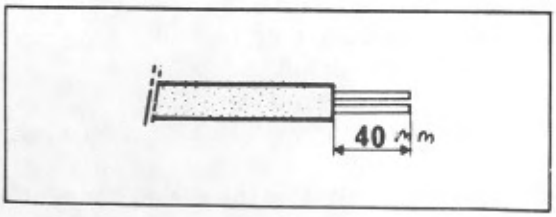
This operation consists of cutting off the wire connecting the electronic module to the speed sensor and replacing the sensor with a new one.



Check the speed sensor before cutting the wire.

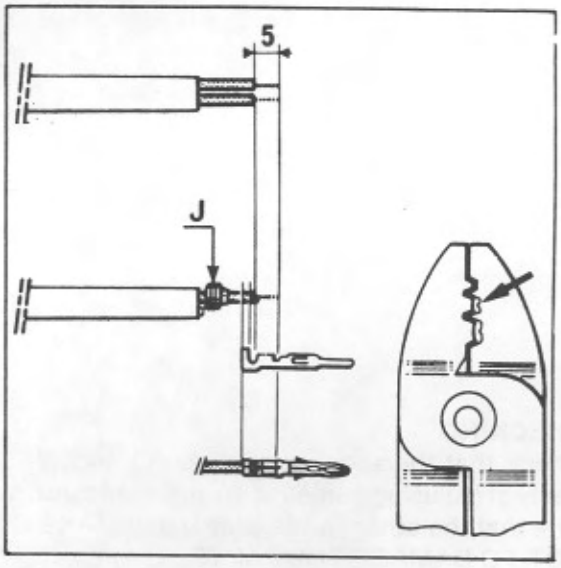
Contents of replacement sensor kit:
- 1 speed sensor equipped with a wire and a male connector,
- 1 female connector,
- 2 male pins,
- 2 seals.

Procedure:
Remove the automatic transmission speed sensor and cut off the cable to the same length as the cable on the replacement unit.



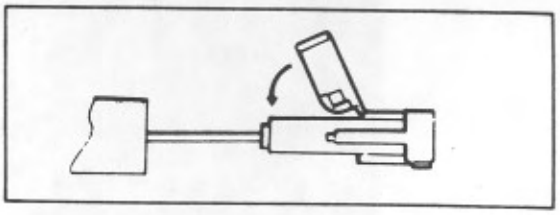
At the electronic module end :

- remove the protective sleeve and the shielding back 40 mm (1.5 in)

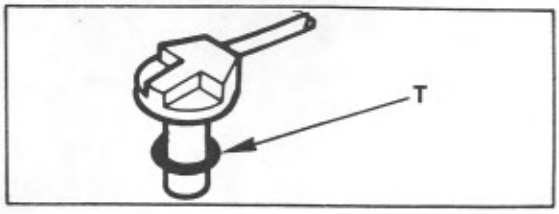


- strip the two wires back 5 mm (.20 in).
- place a seal on each of the wires,
- crimp the terminals in place.

When fitting the wires to the connector, follow the wiring code by placing the same code colors opposite one another.



Fold down the locking tab on the connectors.



Check that O-ring (T) is in place before reassembly.

COMPONENTS

HYDRAULIC CONTROL UNIT (VALVE BODY)

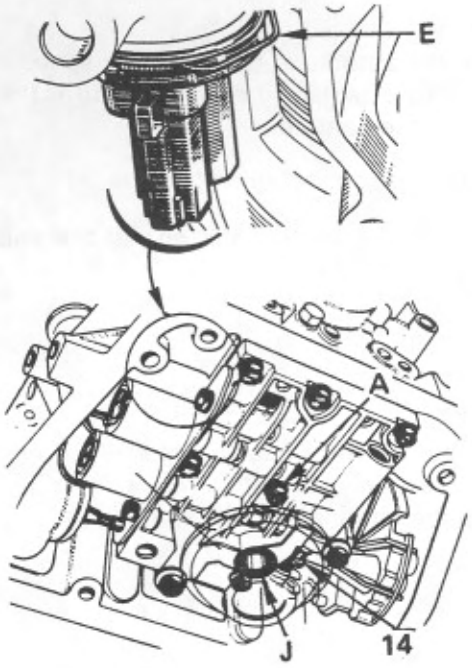
The hydraulic control unit delivers (or discharges) oil to (or from) the clutches and brakes in accordance with the solenoid pilot valve feed.

TIGHTENING TORQUES

Distributor bolts ..... 0.9 daNm (6.5 lb./ft.)
Pan bolts ..... 0.6 daNm (4.5 lb./ft.)
Cover plate bolts ..... 1.3 daNm (9.5 lb./ft.)

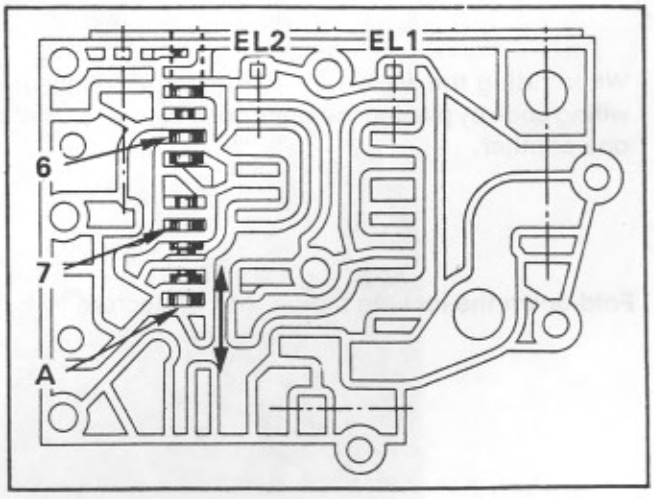
REMOVAL

- Drain the fluid and remove:
  - the pan
  - the filter screen (reuse seal J)
  - all the control unit bolts except for bolt A.
- When removing bolt (A) take care that the following do not fall:
  - manually operated valve (14)
  - the plate and two seals located under the control unit
- Remove clip (E) from the sealed connector and remove the control unit/solenoid pilot valve assembly.



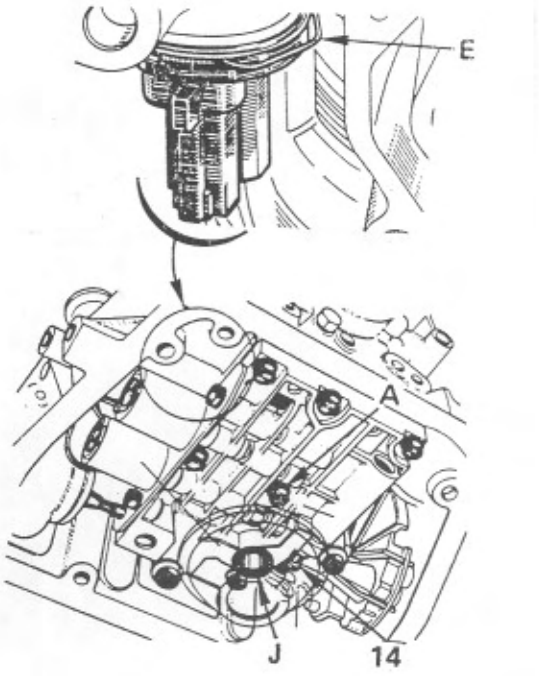
CHECKING

Check that the sequence valves (6) and (7) slide freely at (A) using a small screwdriver and also make sure that the other valves slide freely. TAKE CARE NOT TO DAMAGE THE PARTS.

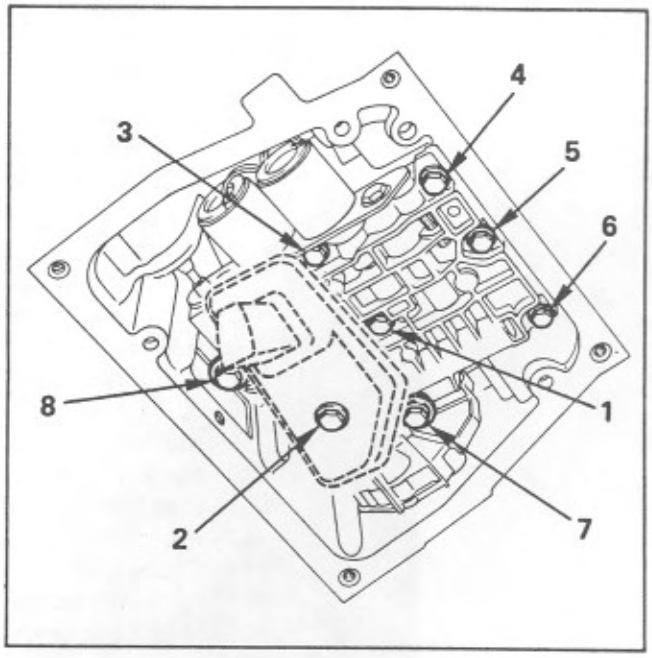


REFITTING

- Attach clip (E) to the sealed connector socket and reconnect socket.
- Fit manually operated valve (14) in the center line of the toothed quadrant.
- Place the vacuum capsule on the pressure regulating valve (11).
- Screw in bolts (2) and (6) on the control unit as far as they will go since they determine the position of the control unit when all the bolts have been tightened.

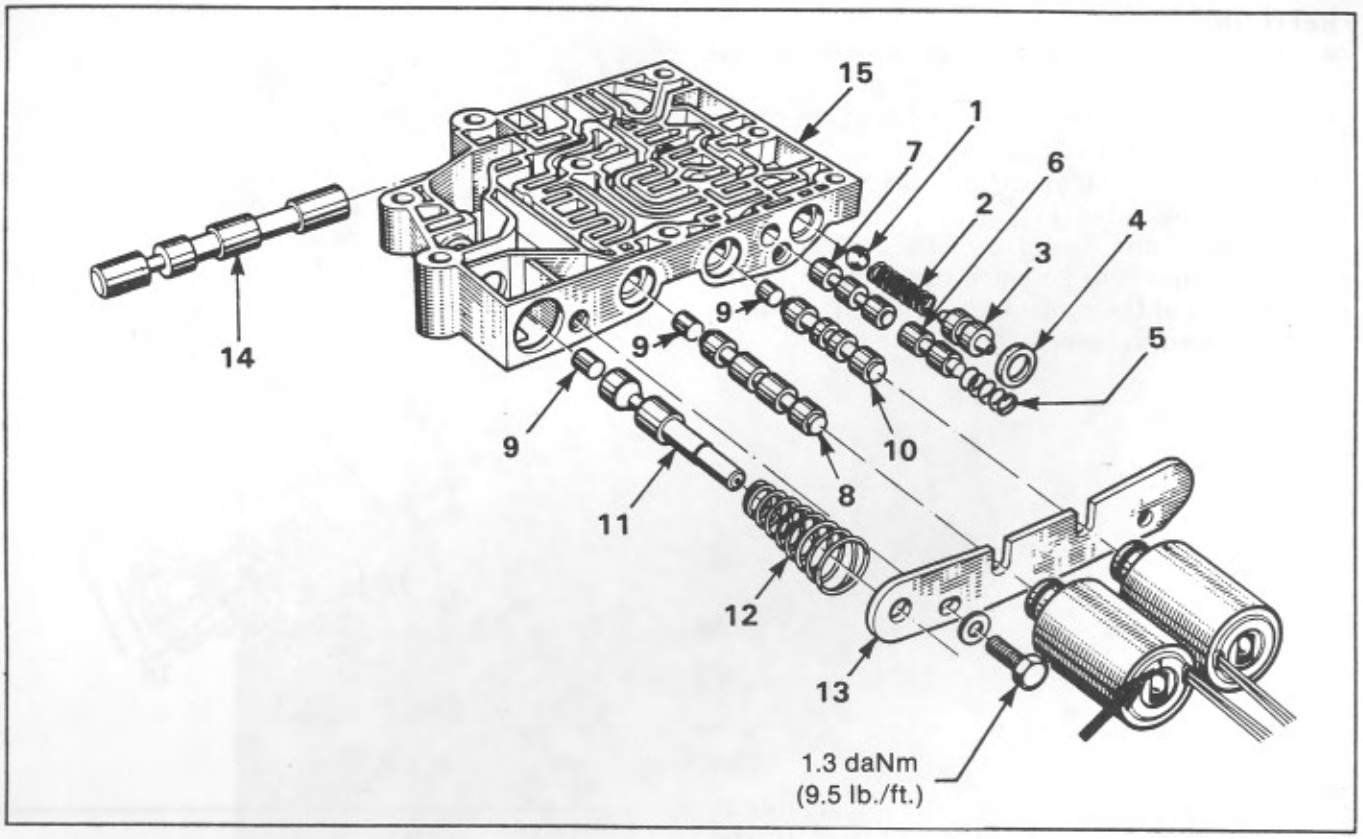


- Using a torque wrench, tighten the hydraulic control unit bolts to 0.9 daNm (6.5 lb./ft.) in the order shown.
- After tightening bolts (1) to (6), install the new filter screen and seal as shown in the illustration.
- After installing, check that the manually operated valve moves correctly.
- Attach the pan equipped with a new gasket.
- Fill with fluid and adjust the fluid pressure.



COMPONENTS

HYDRAULIC CONTROL UNIT (VALVE BODY) REPAIR



1 - Pressure limiting valve ball (PLV)
2 - Pressure limiting valve spring (medium size)
3 - Pressure limiting valve (PLV)
4 - Pressure limiting valve seal
5 - Sequence valve (SV) spring (small)
6 - Sequence valve (SV)
7 - Sequence valve (SV)
8 - No. 1 selector valve (SV1)
9 - Plungers
10 - No. 2 selector valve (SV2)
11 - Pressure regulating valve (PRV)
12 - Pressure regulating valve (PRV) spring (large)
13 - Cover plate
14 - Manually operated valve (VM)
15 - Hydraulic unit

Plungers (9) are identical.

Valves (3, 7, 8, 10) are symmetrical.

Valve (6) is not symmetrical.

COMPONENTS

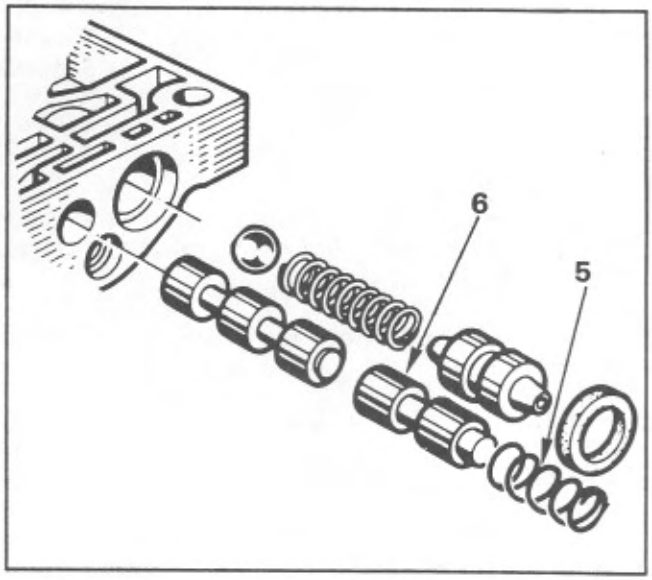
HYDRAULIC CONTROL UNIT (VALVE BODY) REPAIR

Disassembly must be performed in a clean, dust-free location.

DISASSEMBLY

Remove in succession the 2 bolts securing cover plate (13) TAKING CARE NOT TO LOSE SPRING (12).

Remove the other components, turning over the unit and manual valve (14).



CLEANING

Use:
- clean solvent
- lint-free shop towels for wiping down,
- compressed air, blowing strongly into all ducts.

> **WARNING**
>
> Always wear eye protection when working with compressed air.

CHECKS

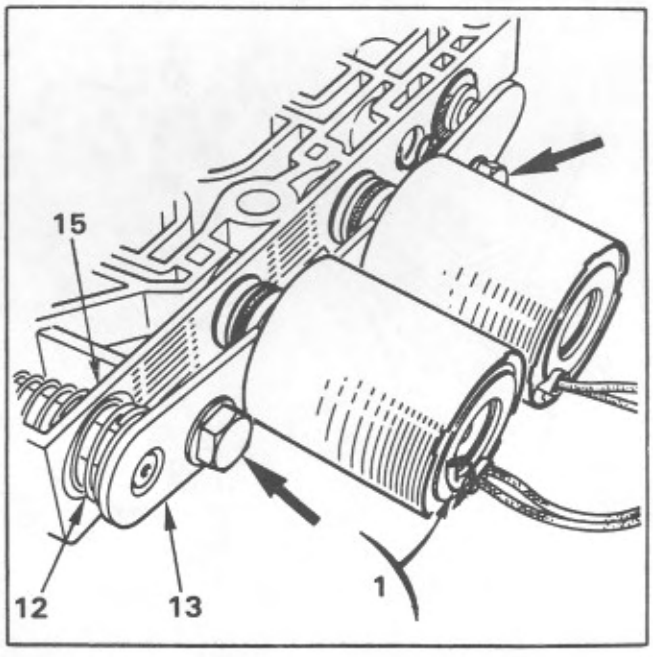
If there are any scoring or wear marks on any of the spool valves the entire hydraulic control unit must be changed.

All the spool valves should move freely and should not stick at any point.

Seal (4) and the seals on the solenoid pilot valves must be in perfect condition.

REASSEMBLY

Lubricate all the parts with Mobil® 220 Dexron® II and reassemble them as shown in the exploded view, page J3-9.



> **CAUTION**
>
> The largest spigot on valve (6) must face towards small spring (5).

Secure plate (13) by its 2 bolts and mount solenoid pilot valve with mark 1 at the same end as the pressure regulator valve.

Tighten the cover plate bolts (13) progressively so that the last coil of spring (12) is not jammed between plate (13) and unit (15) and torque tighten to 1.3 daNm (9.5 lb./ft.).

Check that all the valves move freely.

COMPONENTS

SOLENOID PILOT VALVES - REMOVE & REPLACE

Depending on whether or not they are supplied with power, the solenoid pilot valves control the movement of the passage selector valves of the hydraulic control unit which in turn determine the gear changes.

TIGHTENING TORQUES

Control unit mounting bolts	0.9 daNm (6.5 lb./ft.)
Pan mounting bolts	0.6 daNm (4.5 lb./ft.)
Cover plate mounting bolt (retains solenoid pilot valves)	1.3 daNm (9.5 lb./ft.)

REMOVAL

The hydraulic control unit must be removed in order to remove the solenoid pilot valves (see HYDRAULIC CONTROL UNIT chapter).

Loosen the two bolts until the solenoid pilot valves can be released.

TAKE CARE NOT TO LOSE SPRING (12).

Before reassembling, check:
- that seal (J) is in perfect condition
- that O-ring seals (T) on the solenoid pilot valves and the sealed connector are in perfect condition
- that the ball-bearings move properly and that the solenoid pilot valves are clean.

REASSEMBLY

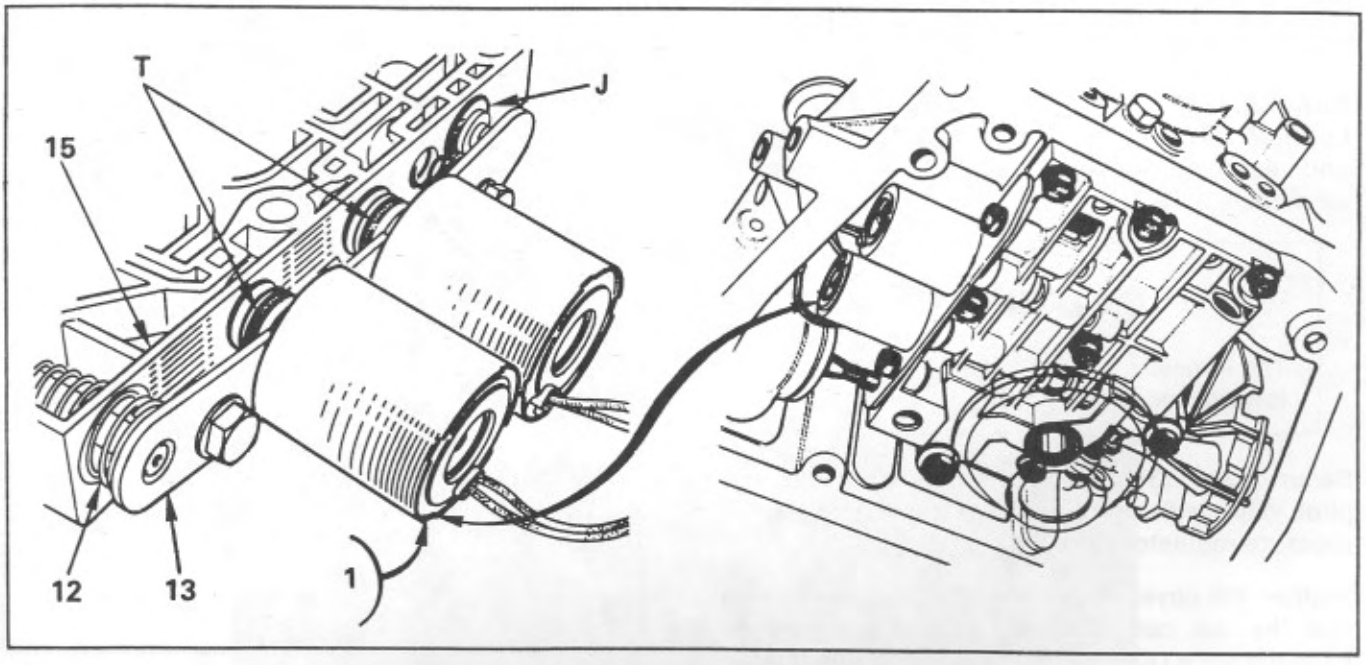
Lubricate the solenoid pilot valves and mount solenoid pilot valve marked (1) at the regulating valve end (see diagram).

Tighten the plate mounting bolts (13) progressively so that the final coil of spring (12) is not jammed between plate (13) and unit (15) and torque tighten to 1.3 daNm. (9.5 lb./ft.)

Insert the clip in the socket of the sealed connector and reconnect it.

Remount the hydraulic control unit (see page J3-9)

Fill the fluid and adjust the fluid pressure.



ATTENTION: If the solenoid valves are not mounted on the correct sides, 1st gear will not operate.

COMPONENTS

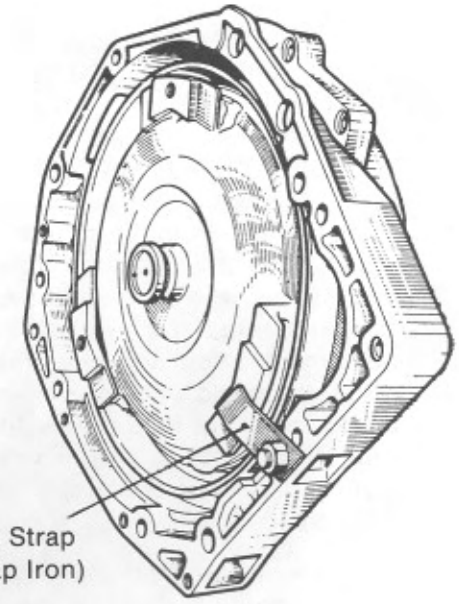
TORQUE CONVERTER

The torque converter ensures a flexible and automatic connection between the engine and the gear section. It multiplies the torque delivered by the engine when the vehicle starts.

REMOVAL:

- Remove the converter retaining strap. (See illustration).

Pull the converter towards you to remove it.

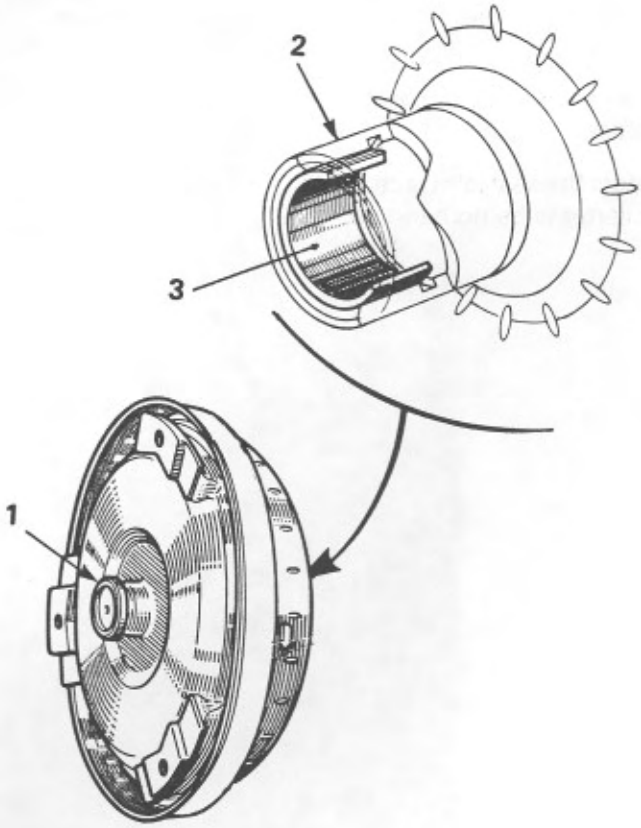


Converter Retaining Strap
(Fabricate from Strap Iron)

CHECKING

Check the condition of:

- the converter centering device 1 (at crankshaft and converter end) 40 mm dia.
- sealing area (2)
- converter "white metal" bushing (3)
- the three securing points.



NOTE:

1. ONLY THE RECOMMENDED FLUID (MOBIL 220 - DEXRON® II) MUST BE USED IN THE TORQUE CONVERTER.
2. If the fluid contains particles from damaged clutches or brakes (the fluid will be black and smell burnt), follow the instructions below for discharging the fluid from the converter:
   - allow the fluid to drain from the converter
   - fill the converter with clean fluid (Mobil 220-Dexron® II). Using a turbine shaft, rotate the turbine to mix the fluid and let it drain.
   - When the automatic transmission has been reattached, top up the fluid and run the engine (selector in Park) for several minutes. Drain the automatic transmission and clean or replace the filter screen.

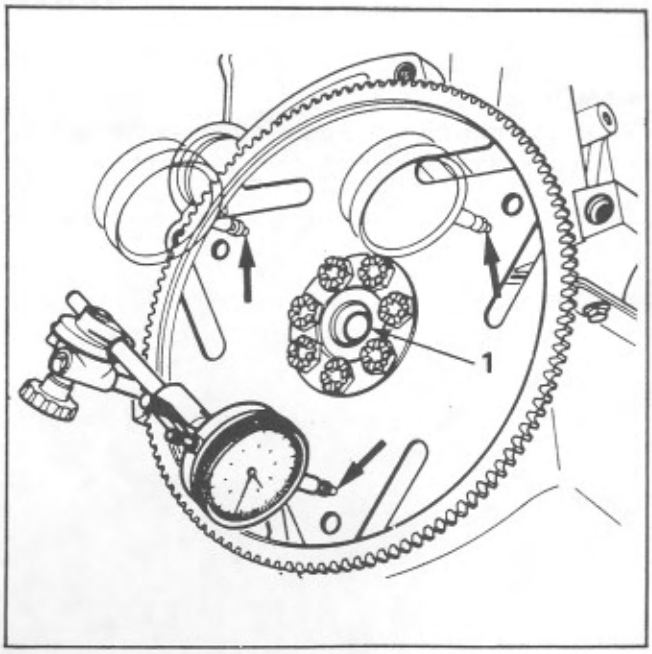
NOTE: If heavy metallic contamination is present, replacement of the torque converter will be necessary. Cleaning is unacceptable.

REFITTING

- Rotate the fluid pump shaft and turbine shaft by hand to check that they turn freely.
- Lubricate the "white metal" bushing and the seal joint face with transmission fluid or petroleum jelly.

Install the torque converter and the retaining strap in place.

Protect the seal joint face with a plastic cap while the converter is being handled.



CHECKING

Place a support, with a dial indicator attached on one of the cylinder block securing holes.

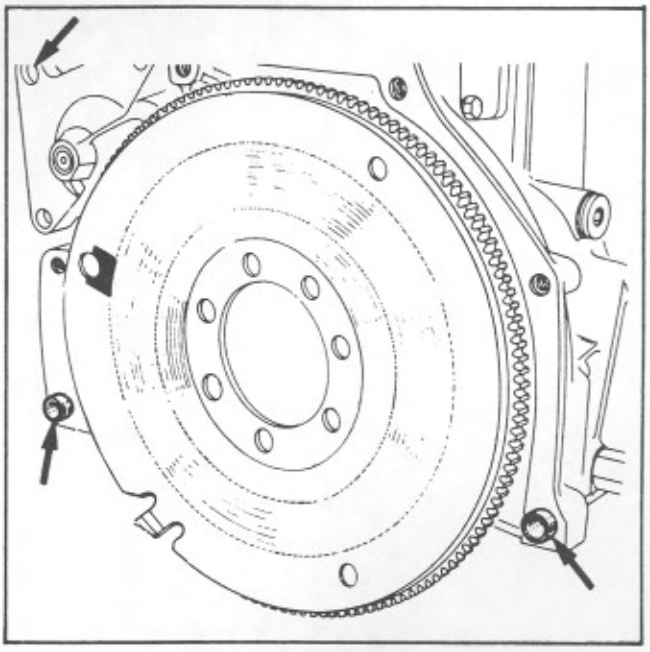
Take a reading at each converter mounting hole.

Compare the readings: the permissible run-out is 0.3 mm (.011 in).

If the readings are above this figure the flex plate must be replaced.

Before reinstalling the automatic transmission check:

- the condition of locating hole (1) in the crankshaft



- That the locating dowels are present on the engine and starter.

CAUTION

Failure to reinsert locating dowels may cause additional mechanical damage.

COMPONENTS

CONVERTER SEAL

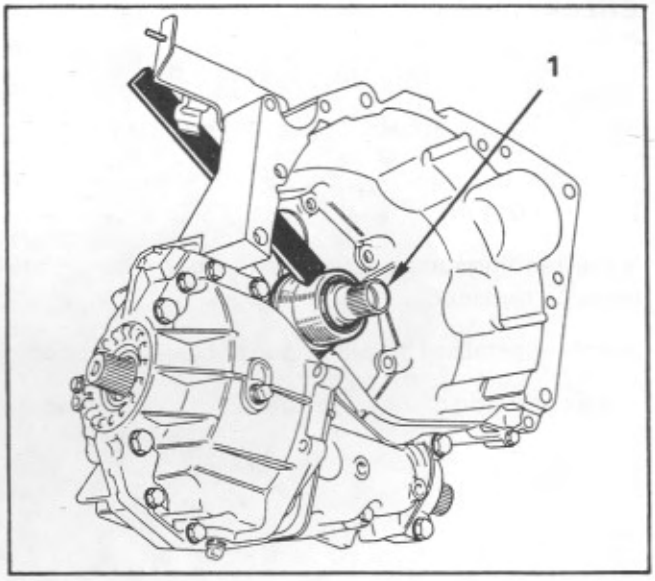
REMOVAL

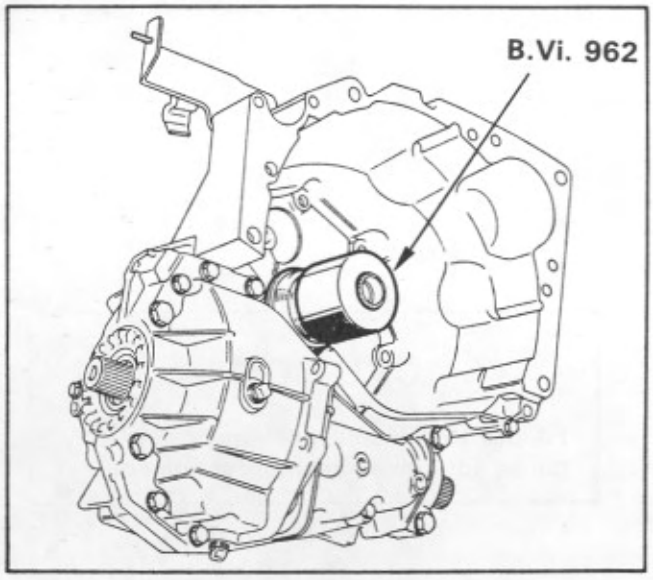
When the converter has been removed, remove the seal using a chiesel or a seal extracting tool.

Check the condition of the smooth part of the stator shaft (1).

REASSEMBLY

- Lubricate the seal and push it on using tool B.Vi. 962.
- Refit the converter after lubricating the joint face.





COMPONENTS

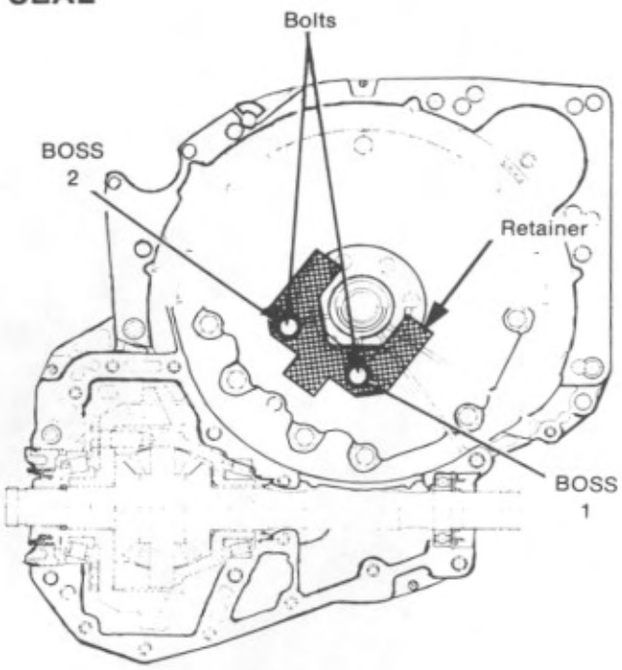
CONVERTER SEAL

A torque converter seal retainer (currently used in ML1-011 automatic transmissions) may be retrofitted to model ML1-010 transmissions.

Three type of bell housings exist on model ML1-010 transmissions. Each type is explained in separate installation procedures below.

ML1-010 Automatic Transmissions - Type 1
With Final Drive Cooling Ports (See pg. J7-4)

1. Remove and discard the two existing bolts at bosses 1 and 2. See Figure 1.
2. Install retainer over seal as shown using new, longer bolts.
3. Coat new retainer bolts with silicone sealant before inserting.
4. Torque tighten retainer bolts to 2.5 daNm (18 lb./ft.)



TYPE 1

Figure 1 - Bosses Equal Height (No shims required)

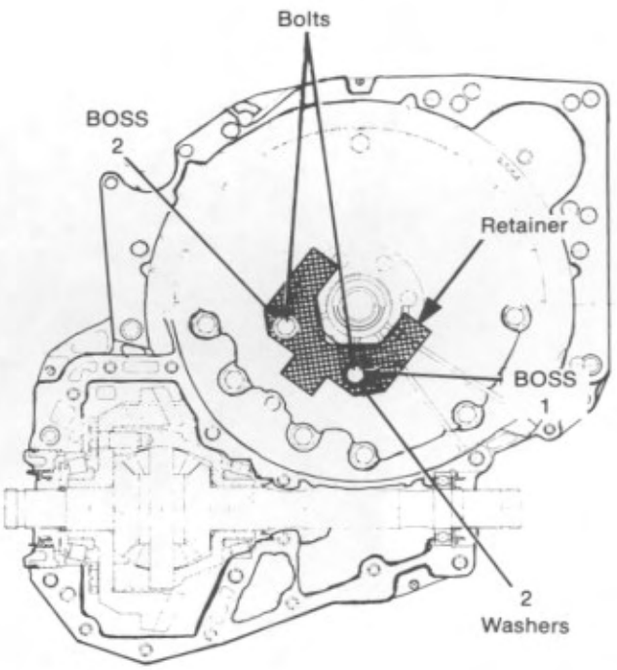
ML1-010 Automatic Transmissions - Type 2
Without Final Drive Cooling Ports

1. Remove and discard the two existing bolts at bosses 1 and 2.
2. Add 5 mm spacer (2 washers 2.5 mm thick) between boss 1 and retainer to compensate for curvature of case and permit retainer to exert equal pressure on seal.
3. Install retainer over seal as shown using new, longer bolts.
4. Coat new retainer bolts with silicone sealant before inserting.
5. Torque tighten retainer bolts to 2.5 daNm (18 lb./ft.)

ML1-010 Automatic Transmissions - Type 3
Early 1985 Models Only

Certain early 1985 model transmission bell housings do not have mounting bolt holes in the bosses. If this condition is encountered, the retainer cannot be installed and the information in this bulletin does not apply.

If holes are present in the bosses, follow procedures for Type 2.

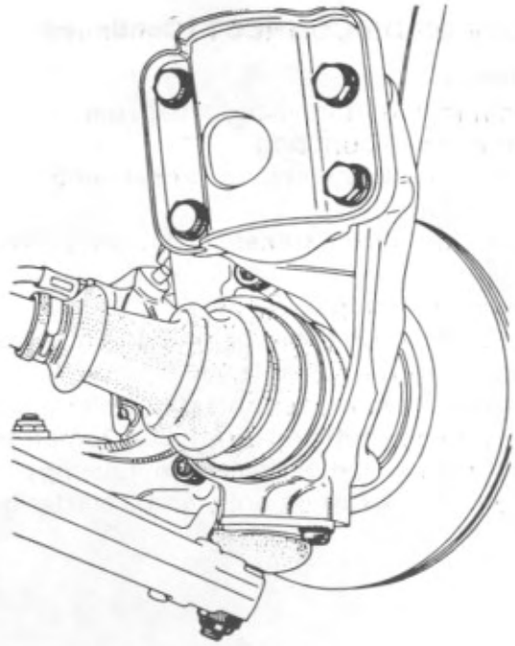


TYPE 2

Figure 2 - Bosses Unequal Height (2 Washers at Boss 1)

REMOVE AND REINSTALL PROCEDURE

The transaxle must be removed from below using a floor or transmission jack. The transmission section cannot be removed from the final drive assembly (differential) while installed in the vehicle. They must be removed as one assembly.



TIGHTENING TORQUES

Wheel nuts:	12 daNm (90 lb./ft.)
Shock absorber bottom bolts:	8 daNm (60 lb./ft.)
Steering arm ball joint nut:	3.5 daNm (26 lb./ft.)

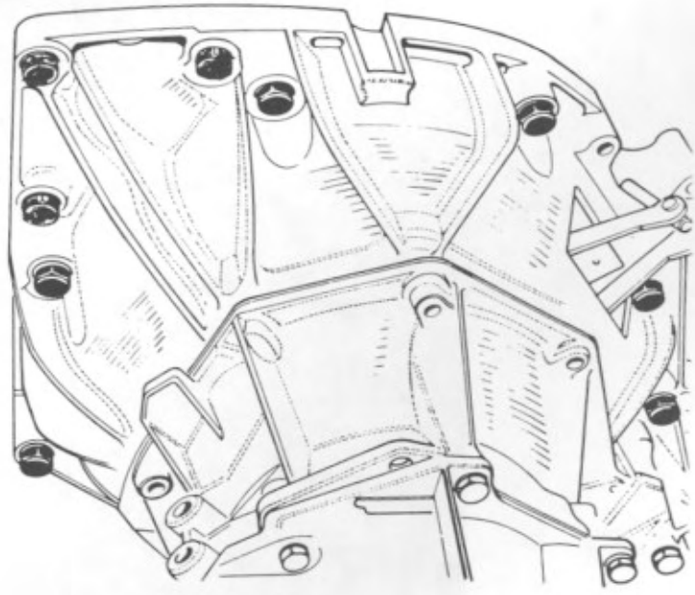
REMOVAL: Support vehicle under engine supporting crossmember so the front wheels are off the ground and front suspension at the relaxed end of its travel.

REMOVE OR DISCONNECT

- Drain transmission and final drive
- Front wheels
- Bottom 4 shock absorber bolts
- Steering box connections to the stub axle carriers
- Steering box
- Drive shaft roll pins using drifts B.Vi. 606.

(Tilt stub axle carriers outward while removing drive axles from final drive and position out of the way.)

- Transmission computer and harness from firewall (Tie to transmission)
- Speedometer cable by pinching the plastic end
- Shift cable (prop aside)
- Transmission cooling lines
- Speed sensor on bell housing



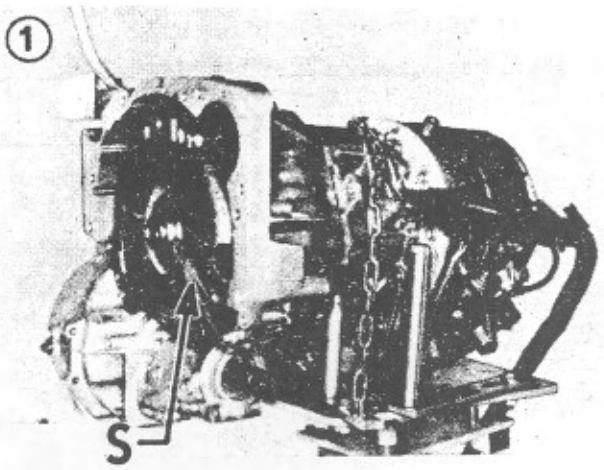
CAUTION

Exercise extreme care during transmission removal and installation process. Even minimal flexplate (flywheel) damage may result in a no-run condition.

REMOVE OR DISCONNECT (Continued)

- Dipstick
- Vacuum line from vacuum capsule
- Large rear mount bolt
- Rear mount holders on crossmember behind rear mount
- Rear mount from transmission (set safety cable aside)
- Lower air scoop
- Lower flywheel cover behind engine oil pan
- Torque converter bolts
- Gearbox - engine support stay-bolts (1 long bolt through bell housing on left and 2 small bolts on right side ahead of final drive housing)
- The ring of gearbox bolts and 3 starter bolts
- Starter

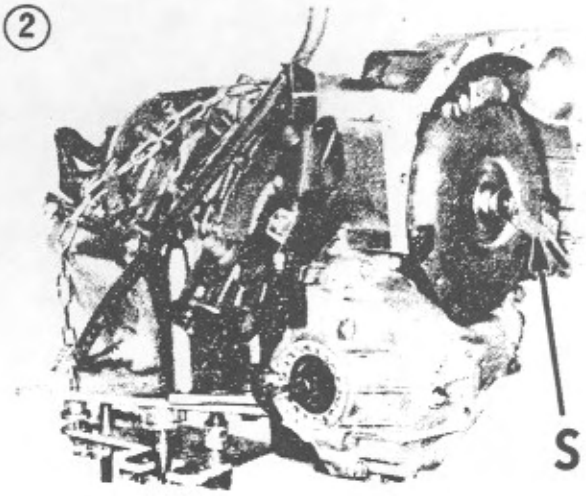
REMOVE AND REPLACE
PROCEDURE



S - Converter retaining strap used after removal from vehicle. Fabricate from strap iron.

CAUTION

If a jack is used, take care that the assembly is evenly balanced.



REASSEMBLY

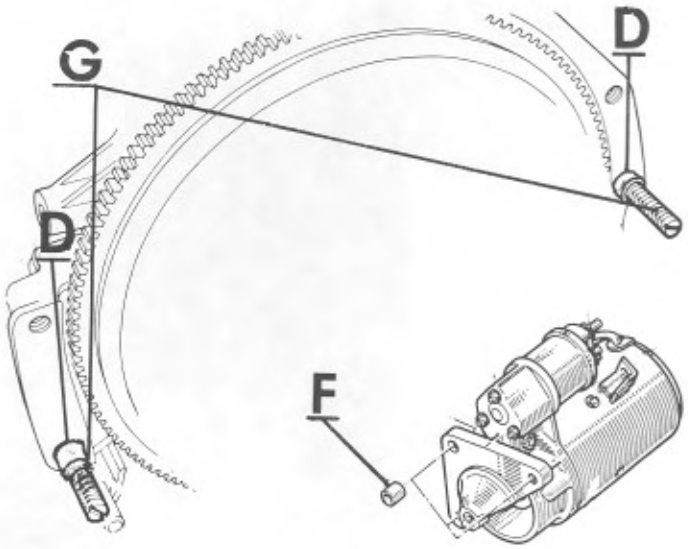
Reassembly is straightforward.

Note however:

- Reassembly will be made easier by using 2 studs (G) to guide the gearbox into position.
- See following page for cooler line and dipstick installation
- Silicone should be used to plug the rollpins holes in the drive shaft.
- Be sure the alignment dowels (D) are in place and the starter dowel (F) is also in place before reinstallation.
- Install in reverse order of removal.
- Fill both final drive and transmission with the proper type and level of fluids:
  - Differential: 80W-90 Gear Lube
  - Transmission: Mobil 220 ATF Dexron® II
- Check front wheel and steering wheel alignment
- Check shifter operation.

IMPORTANT

Make sure safety cable is installed properly and is not rubbing on power steering lines. Tie up if needed.

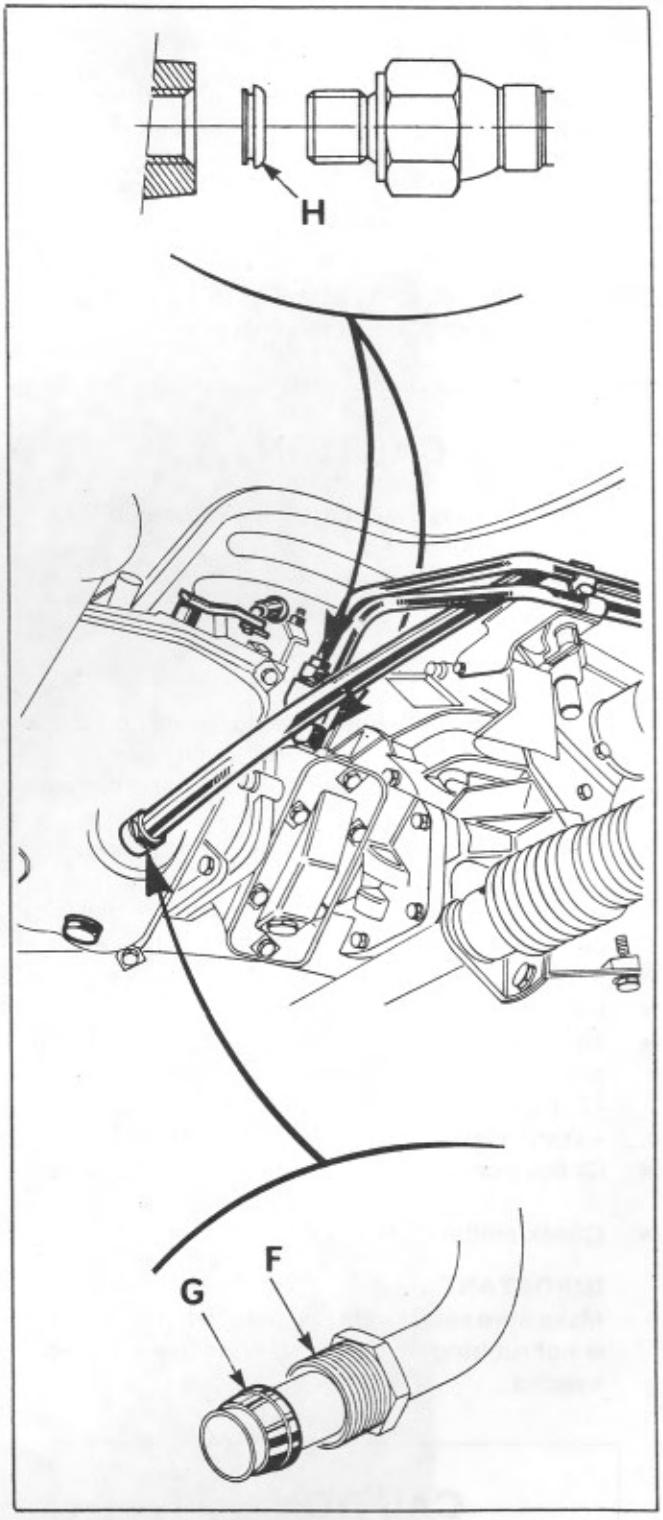


CAUTION

Be sure to fill the final drive with 80W-90 gear lube! Do not fill with ATF since it will not sufficiently lubricate internal parts of the final drive.

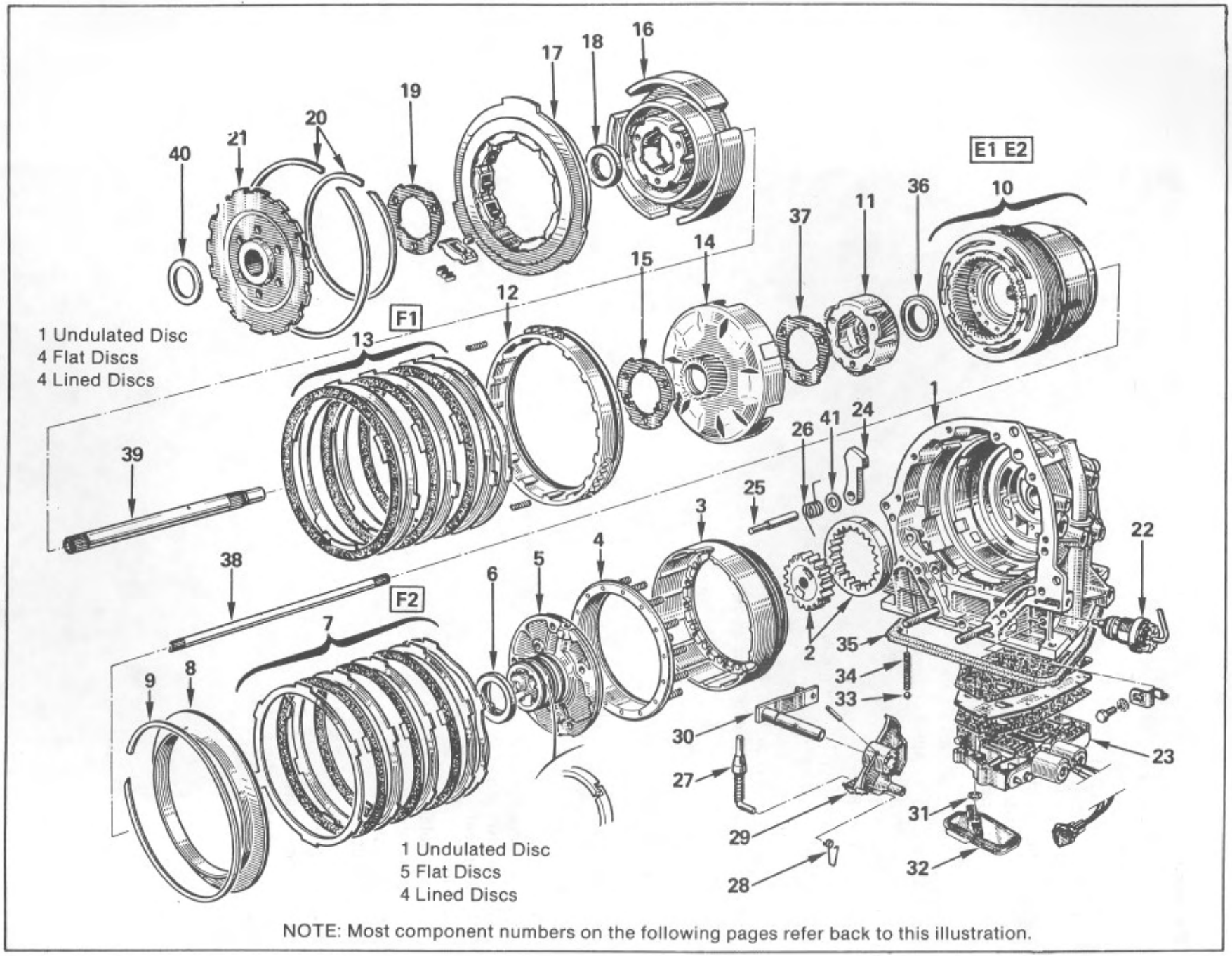
REMOVE AND REPLACE
PROCEDURE

Reconnect the oil cooler lines using new washers (H); torque tighten to 2 daNm (15 lb./ft.)



Check the condition of ferrule (G) on the dipstick tube before reattaching.

If the dipstick tube ferrule is worn or damaged, the complete dipstick tube with ferrule and nut must be changed. The nut (F) and ferrule (G) should be installed onto the dipstick tube as shown.



NOTE: Most component numbers on the following pages refer back to this illustration.

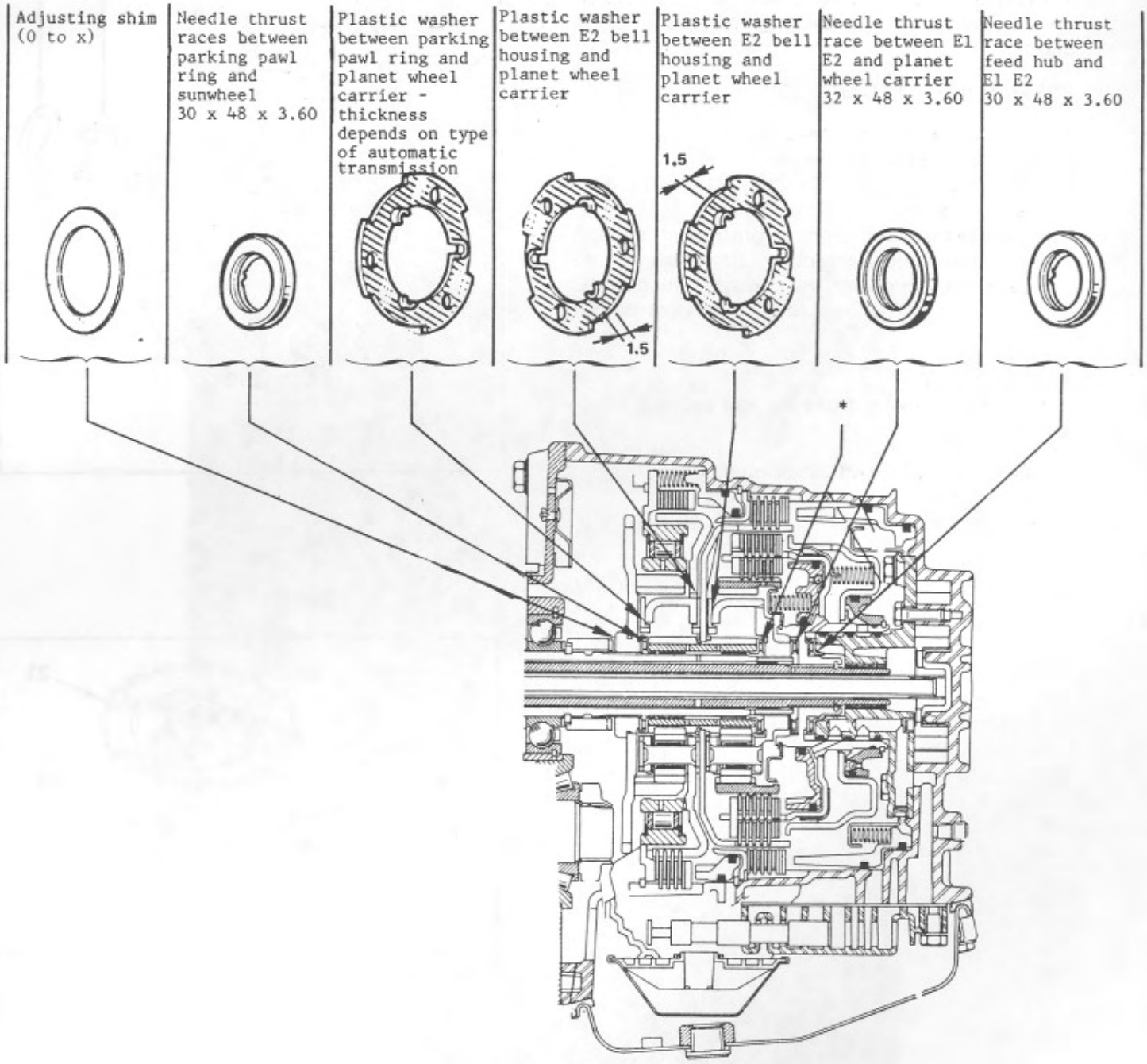
TRANSMISSION REBUILD
EXPLODED VIEW

Descriptions

1 : clutch/brake case
2 : pump
3 : F2 brake piston
4 : F2 brake cup
5 : feed hub
6 : needle thrust race
7 : F2 brake discs
8 : F1 clutch piston support
9 : circlip
10 : clutches E1 and E2
11 : forward drive train
12 : F1 clutch piston
13 : F1 clutch discs
14 : E2 clutch-housing
15 : friction washer (1.5 mm thick)
16 : reverse drive train
17 : free wheel
18 : needle thrust race
19 : friction washer (thickness to be determined)
20 : circlip
21 : parking pawl ring
22 : vacuum capsule
23 : valve body
24 : parking pawl
25 : parking pawl pivot pin
26 : parking pawl spring
27 : parking pawl link
28 : clip
29 : gear selector cam
30 : cam pivot pin
31 : filter seal
32 : filter
33 : cam detent ball
34 : cam detent spring
35 : pan gasket
36 : needle thrust race
37 : friction washer (1.5 mm thick)
38 : pump shaft
39 : turbine shaft
40 : end play adjusting shim
41 : washer

TRASMISSION REBUILD

EXPLODED VIEW



* Cannot be dismantled

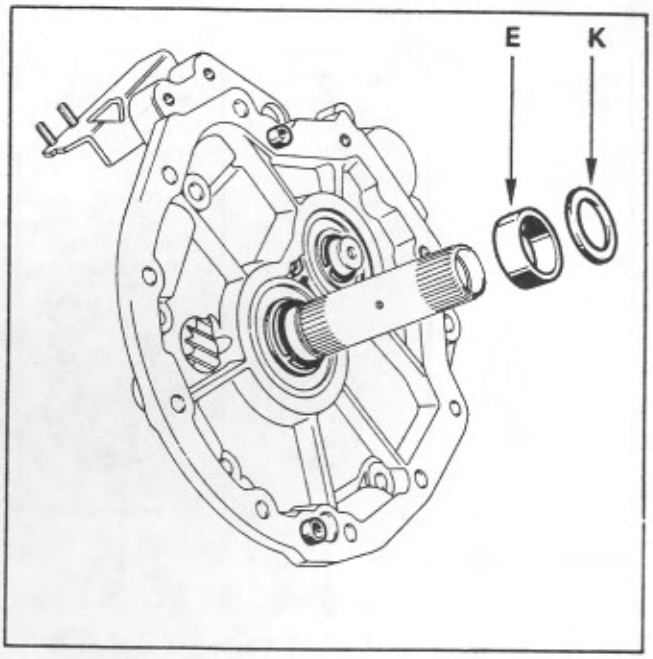
TRANSMISSION REBUILD

DISASSEMBLY

The components must be disassembled and handled on a bench with a padded top (rubber or thick plastic).

SEPARATING THE CASINGS

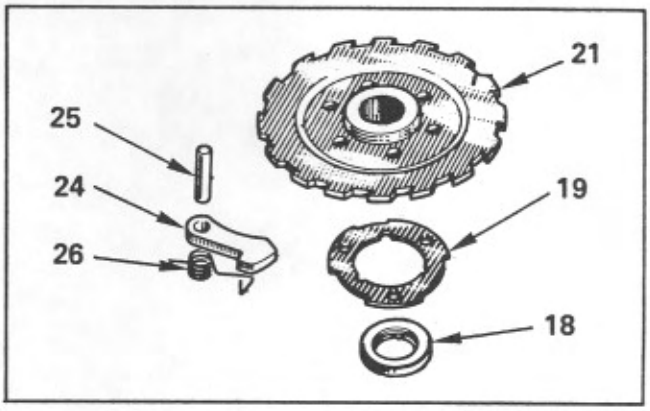
- Remove the torque converter.
- Remove the pump drive shaft.
- Separate the final drive casing from the gear section casing.
- Remove the external bolts from the gear section casing and the 2 internal bolts which can be reached by removing the pan and filter screen.
- Leave spacer (E) and shim (K) on the output shaft.



DISASSEMBLY

Remove the following from the gear section:

- parking pawl ring (21),
- parking pawl (24) and its spring (26)
- plastic washer (19)
- needle thrust race (18).

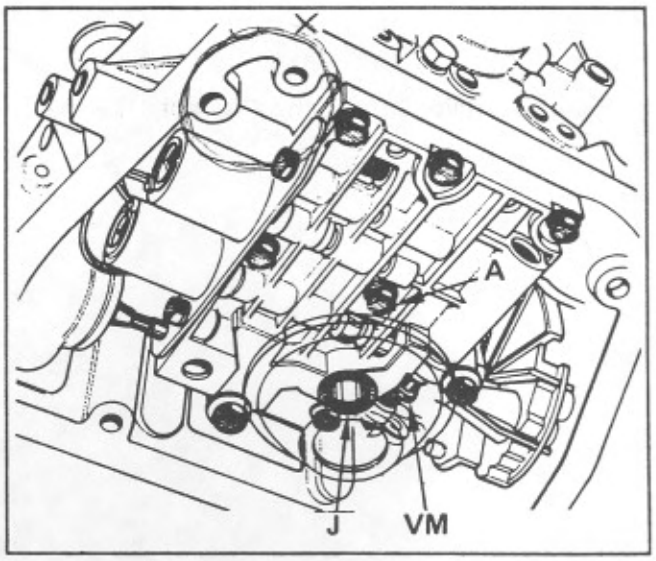


TRANSMISSION REBUILD

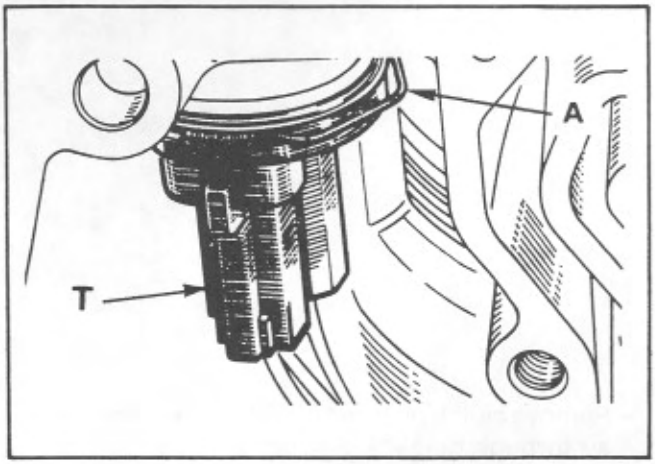
DISASSEMBLY

When taking out bolt (A), take care not to drop the manually operated valve (VM) or the plate and two seals under the control unit.

NOTE: See the chapter "Hydraulic Control Unit" for complete instructions on dismantling the valve body.



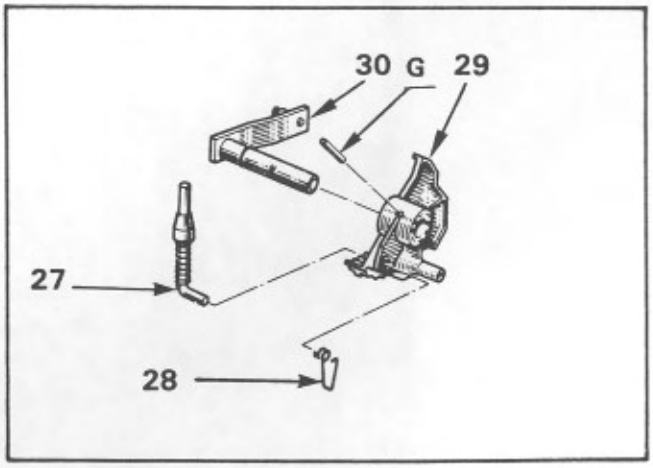
Remove clip (A) and disconnect solenoid pilot valve connector (T).



REMOVE:
- the parking pawl plunger (27)
- spring (28)

NOTE: To remove lever (30), place it in 1st gear "Hold" (opposite the "Park" position) and extract rollpin (G).

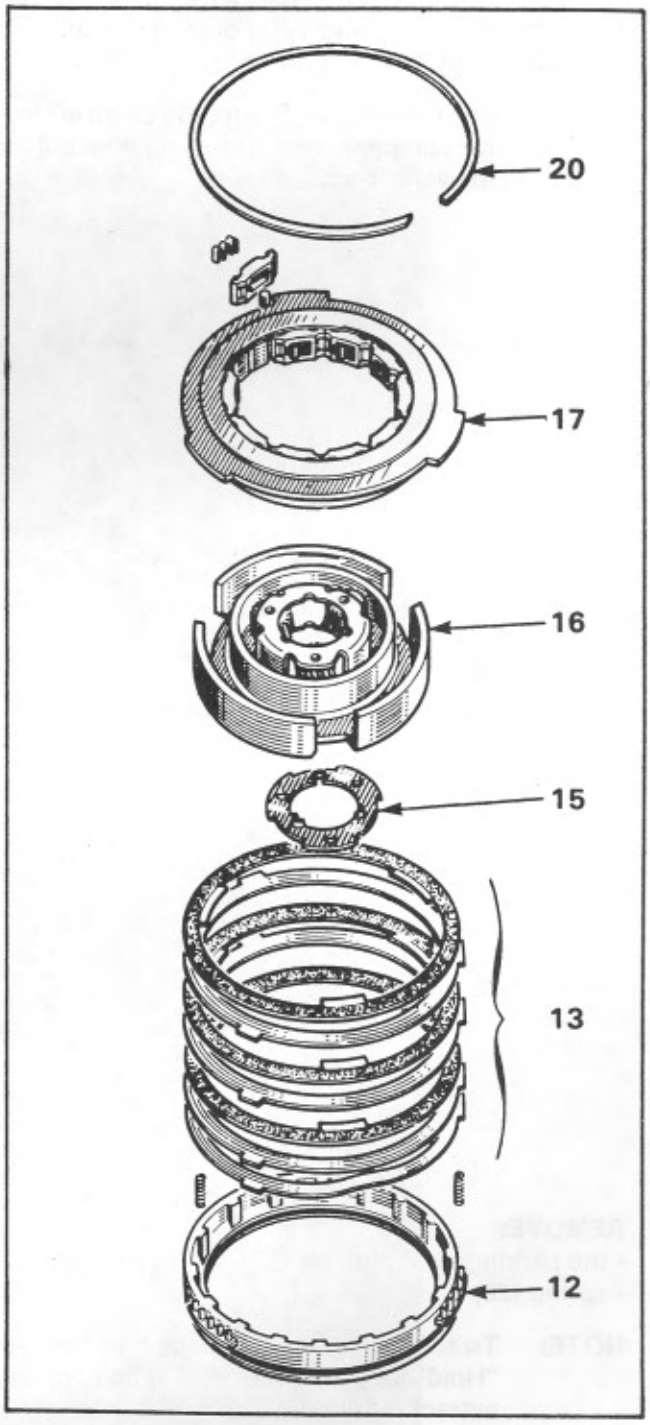
TAKE CARE NOT TO LOSE THE QUADRANT BALL AND SPRING.



TRANSMISSION REBUILD

DISASSEMBLY

- Remove circlip (20) and the assembly 17 - 16 - 15 -13

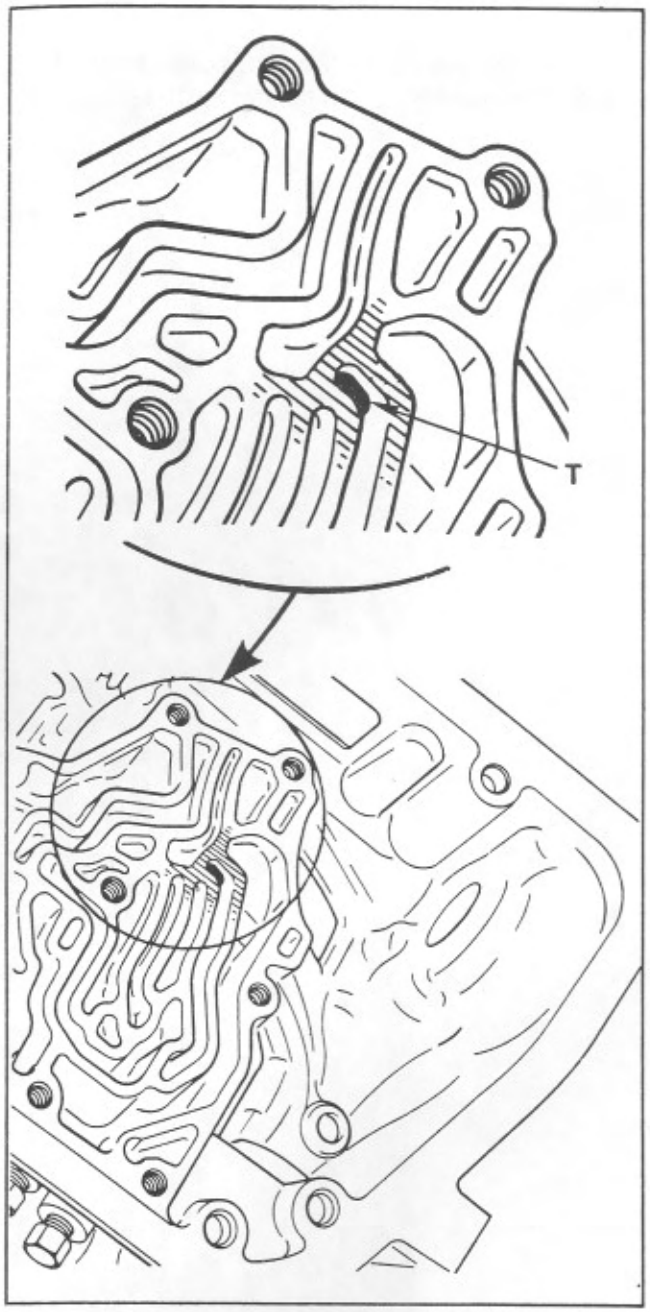


- Remove clutch piston (12) by blowing compressed air through hole (T). See pg. J5-7.

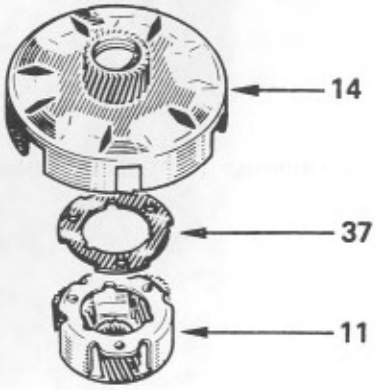
DISASSEMBLY

"T" denotes port in worm channels for removal of clutch piston with compressed air.

(Insert a small piece of tubing in hole (T) and apply compressed air.) DO NOT USE TOOLS TO RELEASE (12).

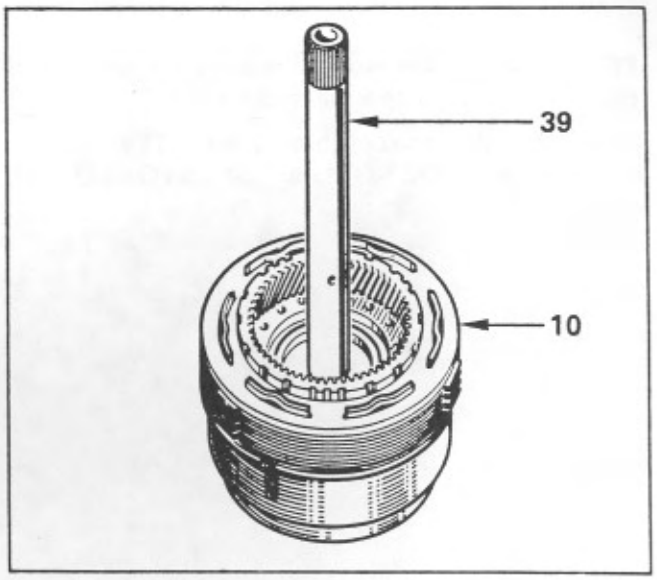


Remove E2 clutch housing (14) and 37-11.

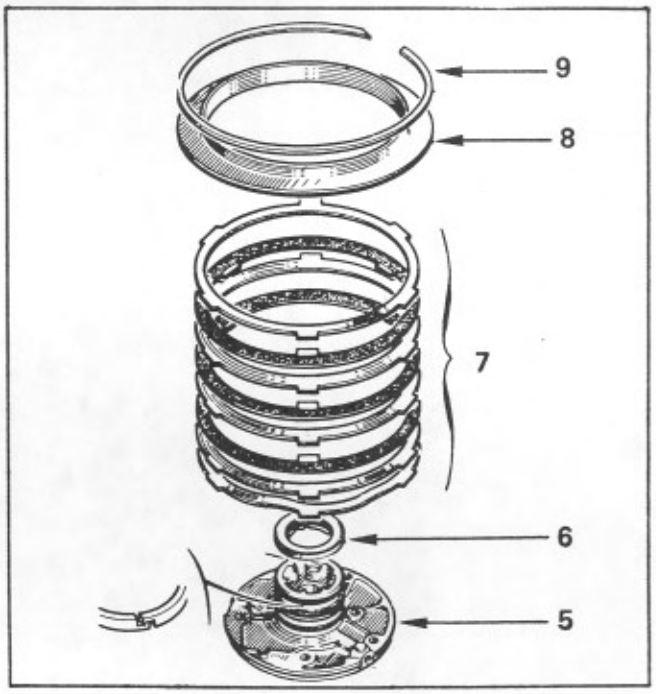


DISASSEMBLY

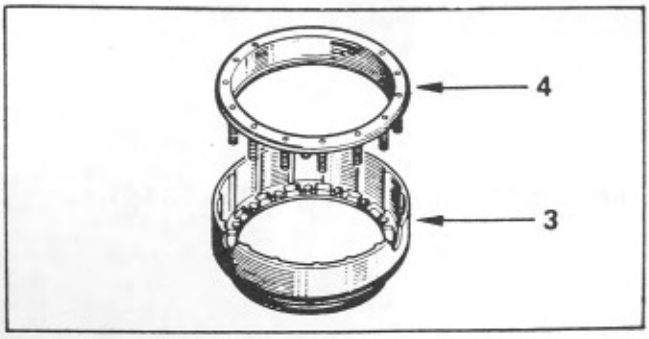
Remove assembly E1/E2 (10) using the turbine shaft (39) (assembly (10) cannot be disassembled):



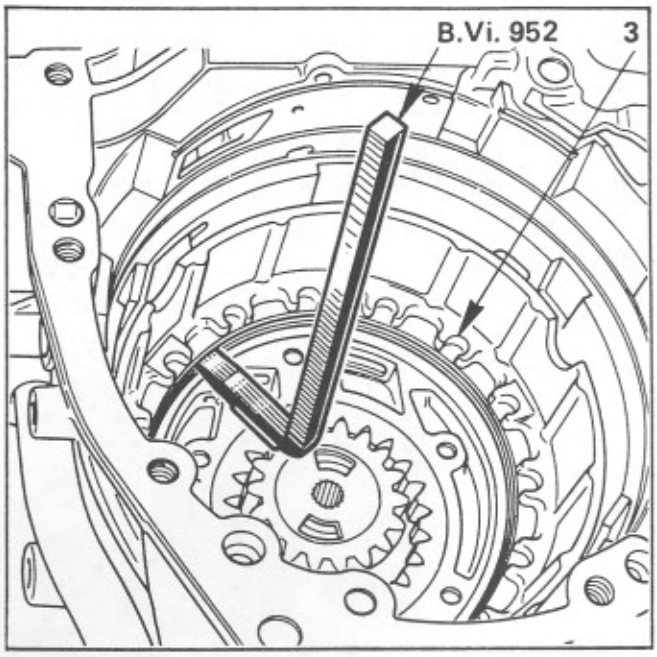
- circlip (9) and parts (8) to (5)



- cup (4) and piston (3) using tool B.Vi. 952.



MARK THE FACE OF THE PUMP OUTER PINION and remove (2).



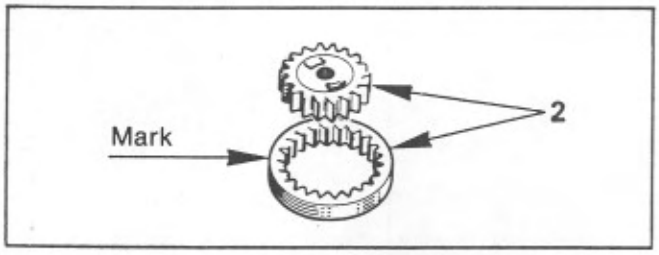
CLEANING

Do not use trichloroethylene as this may splash on the seals and cause damage.

Do not use shop towels which could leave lint particles in the system.

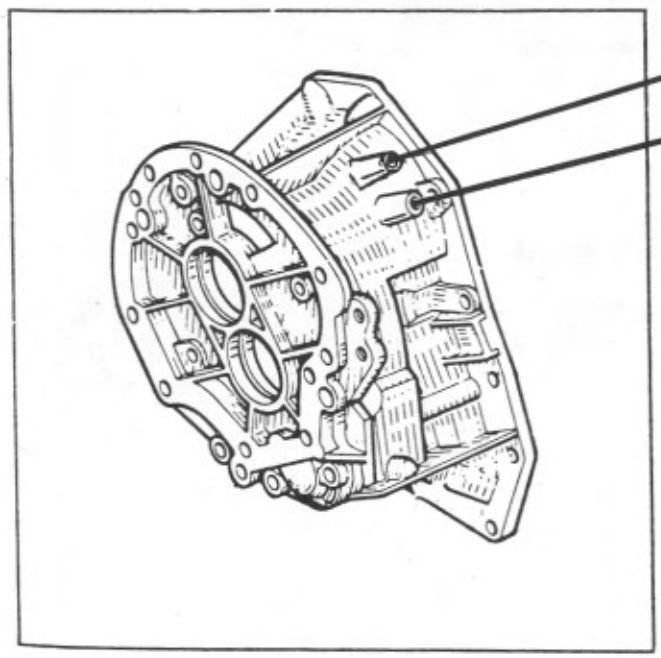
Use:
- solvent or degreasing fluid, (except on the seals) and lint-free towels for wiping off.
- compressed air, blowing hard in all holes, feed ways and oilways on:

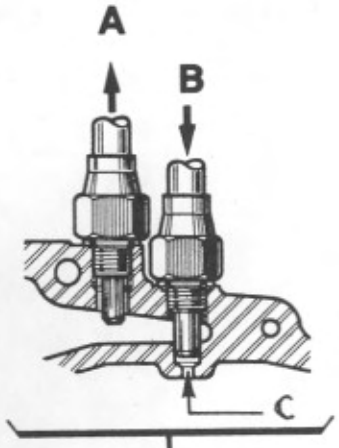
- the gear section casing (1)
- the free wheel (17)
- the forward gear train (11)
- the reverse gear train (16)
- the E2 clutch housing (14)
- pistons (12-3)
- feed hub (5)
- pump (2)
- pump shaft (38)
- turbine shaft (39)



Blow compressed air into the fluid cooler inlet and return pipes (A and B).

After cleaning, lubricate the parts immediately with Mobil 220 - Dexron® II automatic transmission fluid.

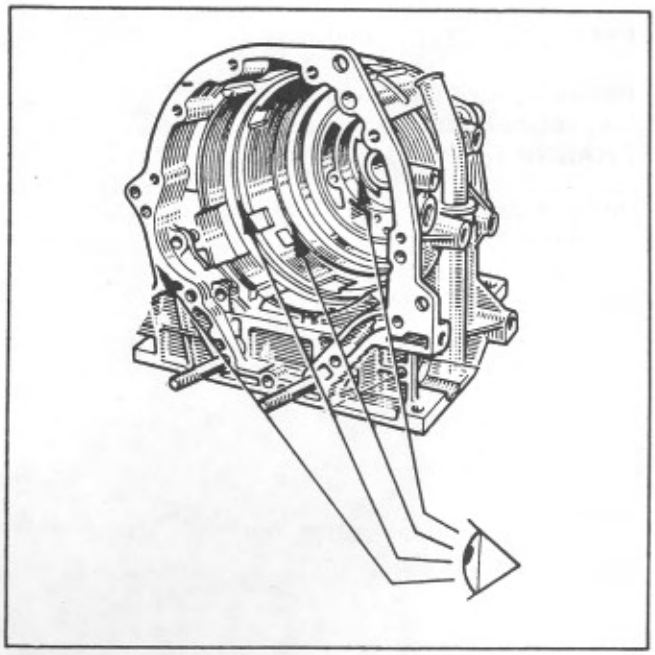




GEAR SECTION CASING (1)

Check that the following are in good condition:

- the pump location (see FLUID PUMP)
- the circlip grooves
- the joint faces on pistons F1 and F2
- the face of the valve body casing
- the coupling faces
- the joint faces of the sealed connector and input shaft.

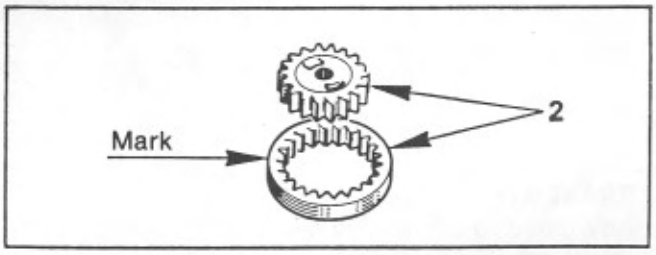


FLUID PUMP (2)

Check that the pump pinions are in good condition.

Gear section casing/pinion/wheel assembly is matched.

If one part has to be changed, then the entire assembly must be changed.

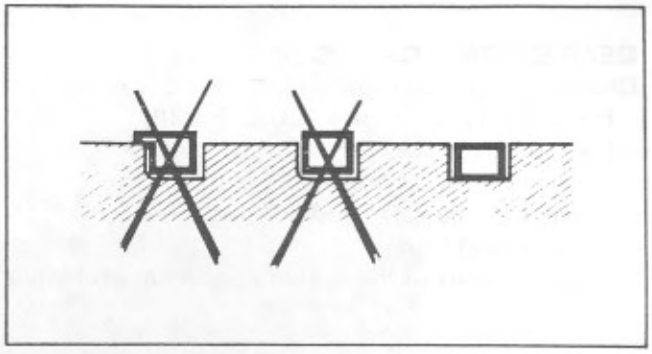


FEED HUB - SEALING RiNGS (5)

Before removing the rings from the hub check that they rotate freely on the hub. If any rings are stuck CHANGE THE HUB-RING ASSEMBLY.

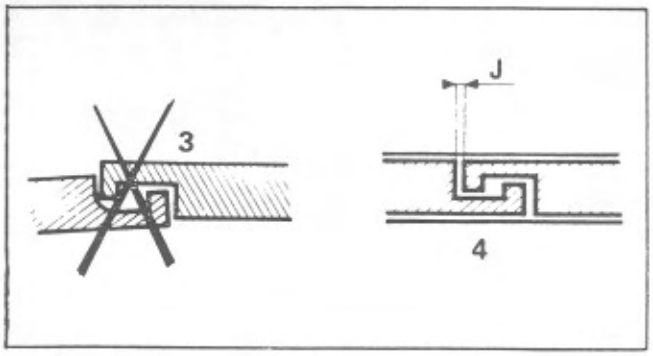
Remove the rings and check the condition of the following on the hub:

- the bottom of the three grooves in which the rings fit,



- the white metal faced bushing,
- the face at the pump end.

On the rings check:
- the ring gap ends (3) - they should fit together exactly (4).
- the clearance at section (J) : it should be between 0.05 and 0.35 mm (.002 - .010 in)



BRAKES (7) (13)

Any lined discs showing sings of overheating (blackening of lining), on which the finish is poor or which are worn must be replaced.

Scrap all steel discs that show signs of picking-up or seizing.

CLUTCHES E1, E2 (10)

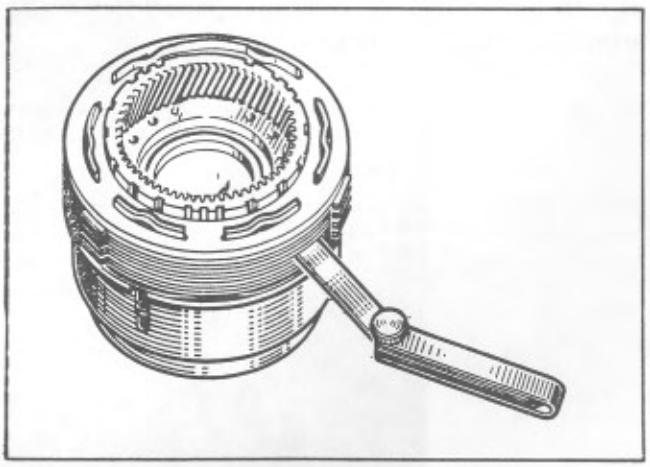
Clutches E1 and E2 cannot be disassembled.

Clutch 2 has visible discs.

Check the clearance of clutch E2 using a set of shims.

Maximum permissible clearance: 4.1 mm (.16 in)

If clearance is not correct replace E1-E2.



Clutch E1 is not visible but the clearance can be checked by moving crown wheel (C).

If the clearance is not correct change E1 - E2 and the hydraulic control unit.

On E1 - E2 check the condition of:

- the turbine shaft retaining seal.
- the inside of the bore accommodating the E2 Clutch Housing feed hub (14).

Check that:
- the pinion,
- the two white metal faced bushings are in good condition.

CUP WITH CRIMPED SPRING (4)

Check that the springs and their crimped areas are in good condition.

SEAL (All seals removed must be routinely replaced).

Tightening the seals.

0.2 to 0.7 mm (.008 to .027 in) over the diameter.

Replace any seals which do not meet the given tolerances.

VALVE BODY (23)

The valve body assembly can be dismantled (see chapter "Hydraulic Control Unit" in Subsection J3).

If an E1 clutch is burnt out, change the valve body.

PLANETARY GEAR TRAINS (11) (16) - check the condition of the teeth on all the gears.

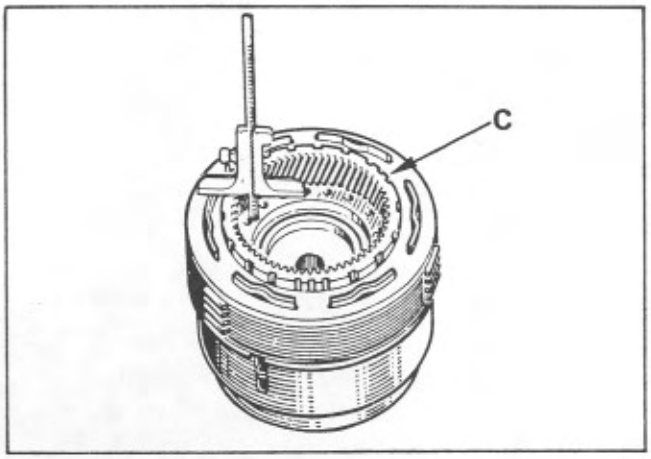
Make sure that all the gears in the forward and reverse gear trains turn freely and without excessive play on their shafts.

FREE WHEEL (17)

Check the condition of:

- the components of the free wheel (spring, roller, body)
- the surface of the free wheel track on (16)

If any components are defective the entire free wheel and the reverse gear train (16) must be changed.



Allowable play: 3.5 mm (0.137 in.)

REASSEMBLY

STEP 1

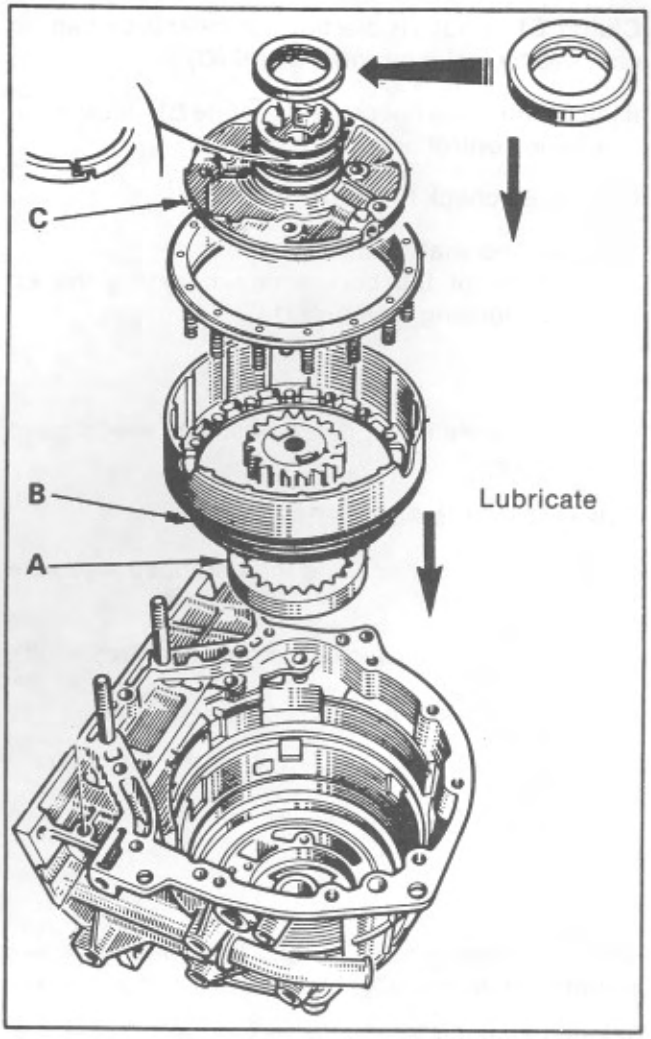
A - Outer pinion according to mark made on dismantling.

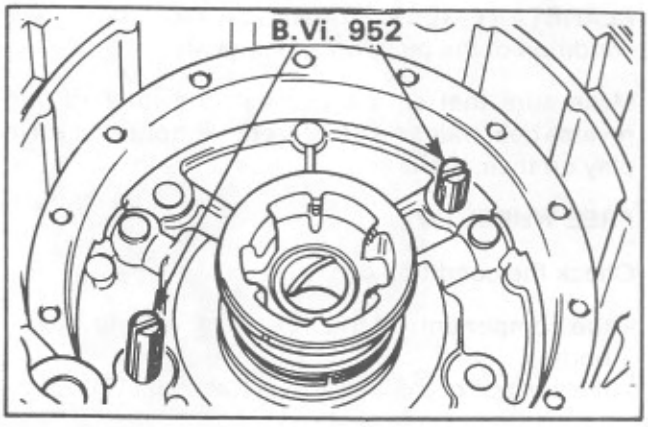
Check that it turns freely in the housing.

B - Lubricate the seals

C - Center using tool B.Vi. 952 and progressively torque tighten the bolts:

Tighten 7 mm dia. bolts to 1.5 daNm (11 lb./ft.)
6 mm dia. bolts to 0.6 daNm (4.5 lb./ft.)



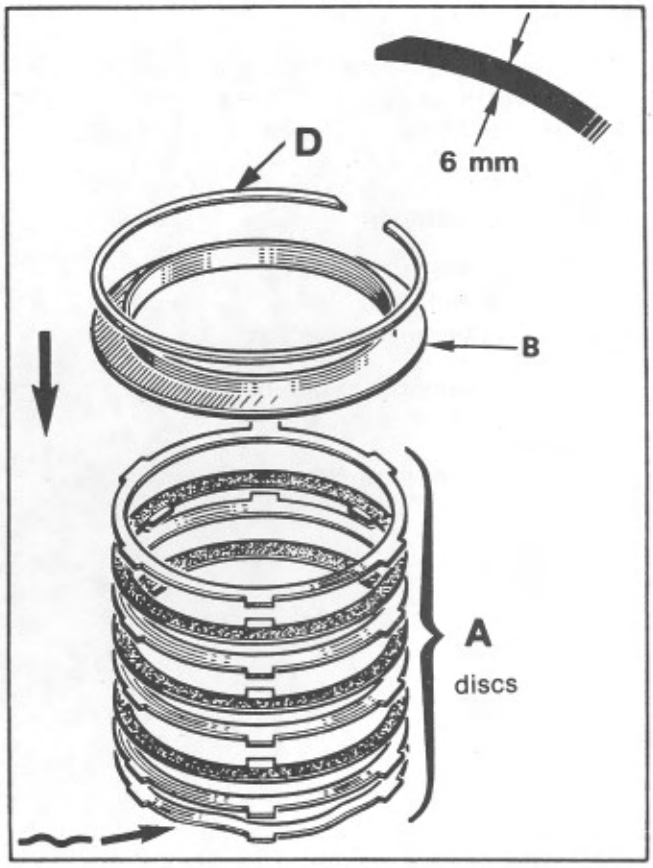


BRAKE F2

STEP 2

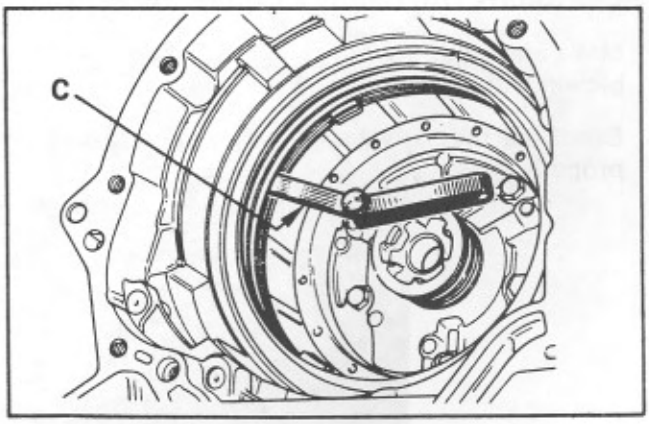
ATTENTION:

Attach the proper circlip (D) as shown in the illustration.



A - one undulating disc, one flat disc and one lined disc alternately.
B - Lubricated F1 piston support

C - Operating clearance should be 1.5 to 2.1 mm



ADJUSTING F2 PISTON

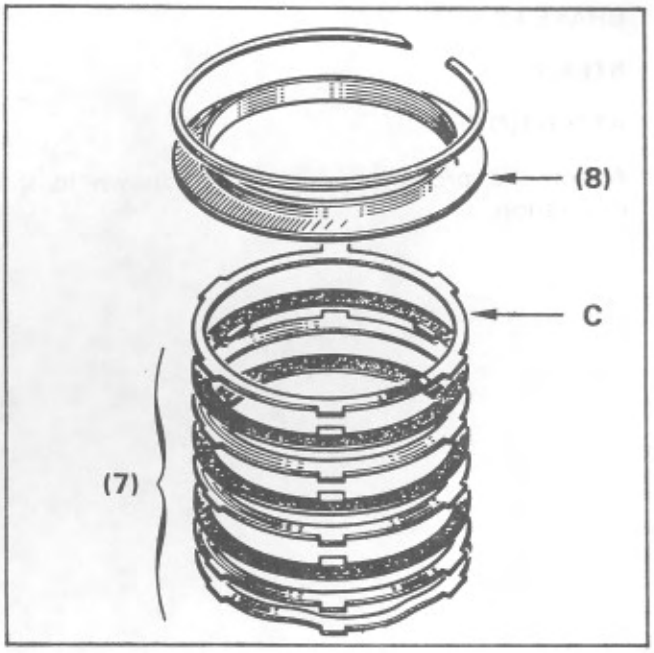
This is adjusted using a spacer shim (C) which is available in three sizes (0.5, 1 and 2 mm). It is placed between the F1 piston support (8) and the F2 brake discs (7).

Calculation example

Clearance measured: 3.6 mm
Select the 2 mm shim
Clearance after adjustment: 3.6 - 2 = 1.6

When the assembly has been reassembled with the shim, check the clearance again.

Do not use more than two shims.



CHECKING THE OPERATION OF THE PISTON

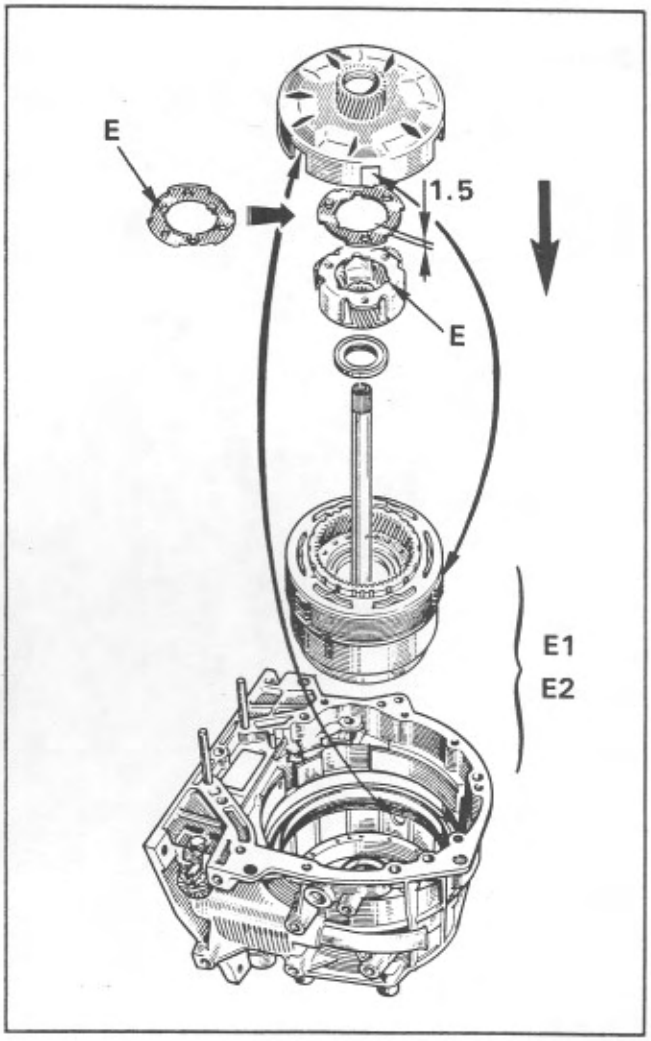
Make sure that the piston is working properly by blowing compressed air through hole (T).

Check that the piston moves backwards and forwards properly.



STEP 3

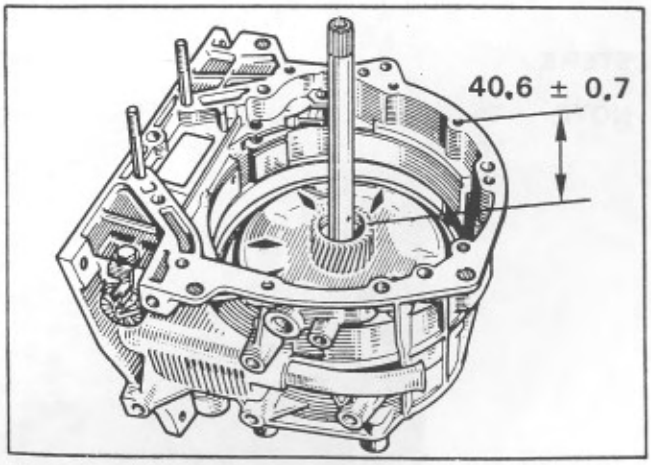
Clip the turbine shaft in the E1 - E2 clutch assembly and fit:



IMPORTANT
TAKE CARE NOT TO MIX THE F2 and E2 DISCS.

CHECK THAT THE ASSEMBLY IS CORRECT
The dimension between the end of sunwheel (P) and the joint face must be:

40.6 ± 0.7 mm (1.60 ± .027 in)

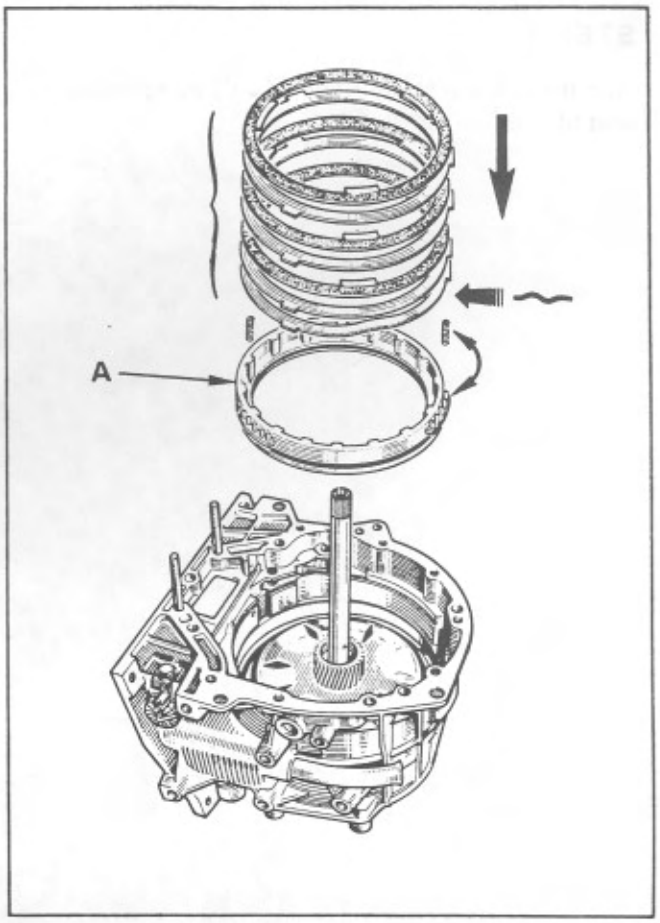


BRAKE F1

STEP 4

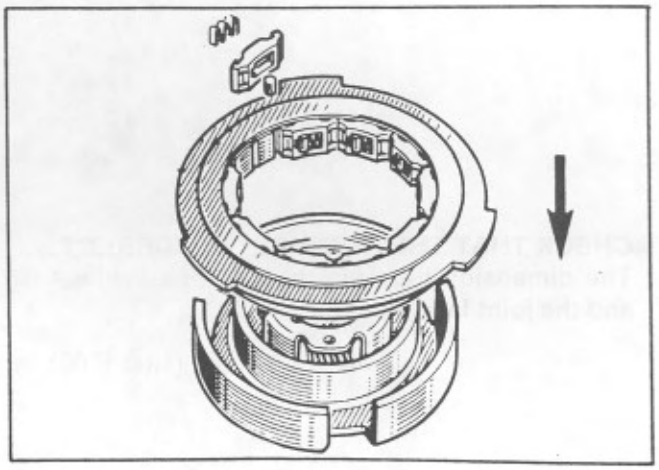
A - Lubricate the seals and assemble them progressively onto the piston.
B - One undulated disc, one flat disc and one lined disc should be fitted alternately.

PRE-ASSEMBLY OF FREE WHEEL AND REVERSE GEAR TRAIN



STEP 5

NOTE: The components of the free wheel should not be disassembled unless absolutely necessary.

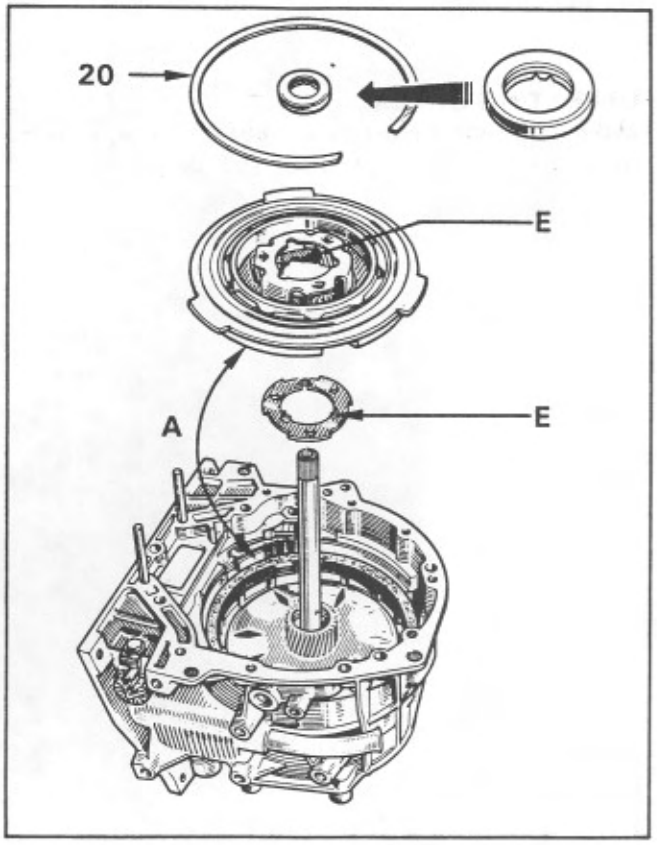


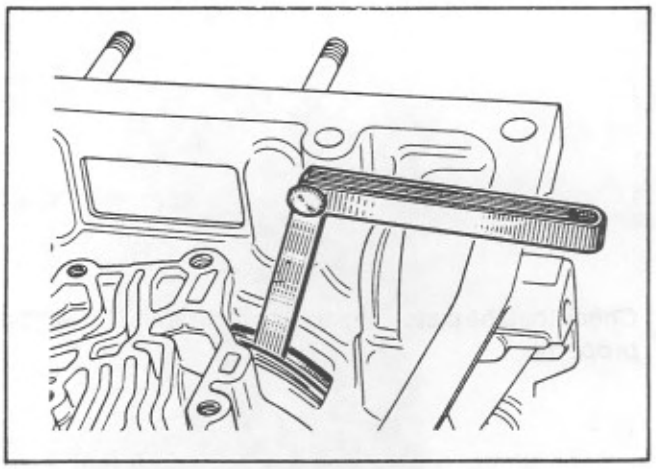
ATTENTION:

STEP 6

Circlip (20) must be the correct size. (See item D, page J5-15.)

A - Mount the assembly and rotate the reverse gear train so that the brake notches are in line with their locations.

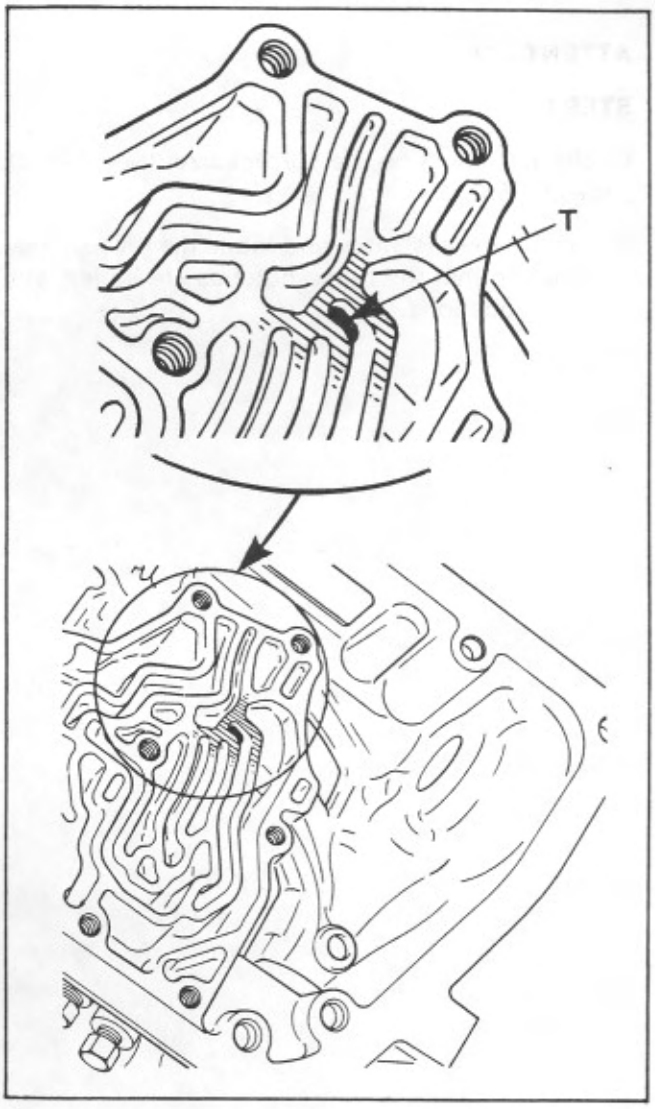




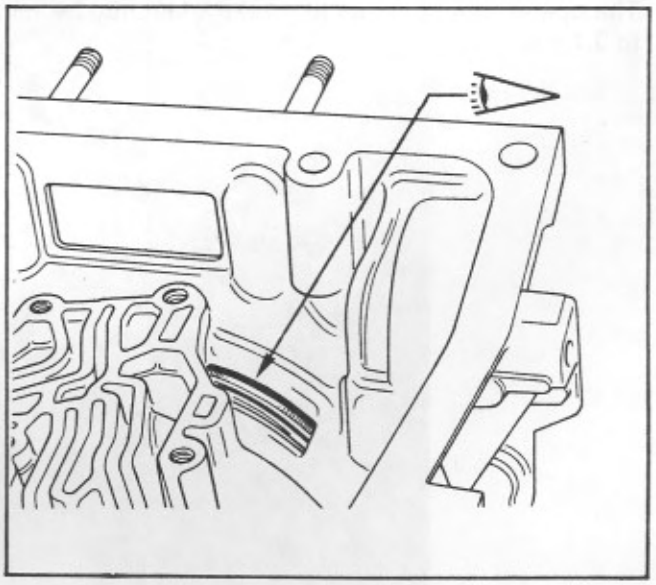
The operating clearance for brake F1 should be 1.1 to 3.1 mm.

OPERATING CHECK

Make sure that the piston is operating correctly by blowing compressed air through hole (T).



Check that the piston moves backwards and forwards properly.



ADJUSTING THE REVERSE GEAR TRAIN

The object of the adjustment is to restrict the displacement of the reverse gear train by determining the thickness of plastic shim (19).

THE AVERAGE CLEARANCE MUST BE 0.4 mm.

The adjustment is made in two stages:

1. At gear section end

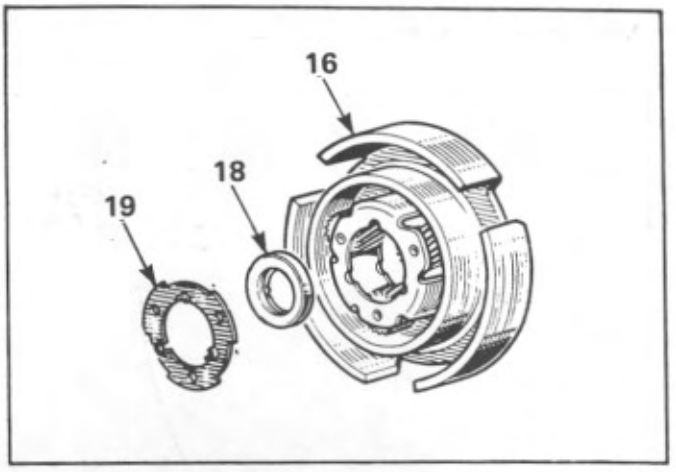
Check that stop (18) is on the sunwheel and that there is no plastic shim (19).

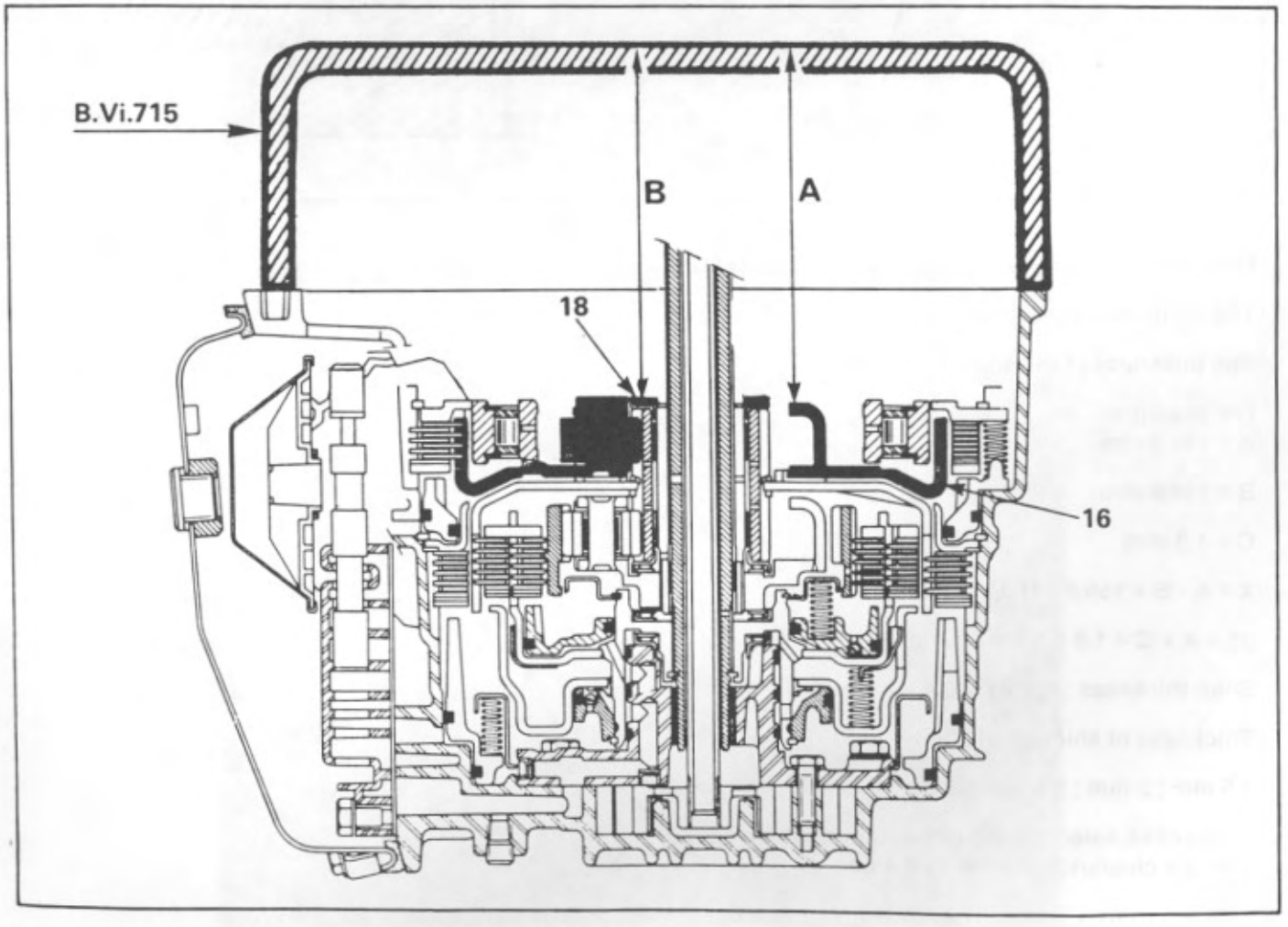
Fit tool B.Vi. 715 and measure:

- dimension A between the tool and the planet wheel carrier (16).
- dimension B between stop (18) and the tool.

Calculate dimension X

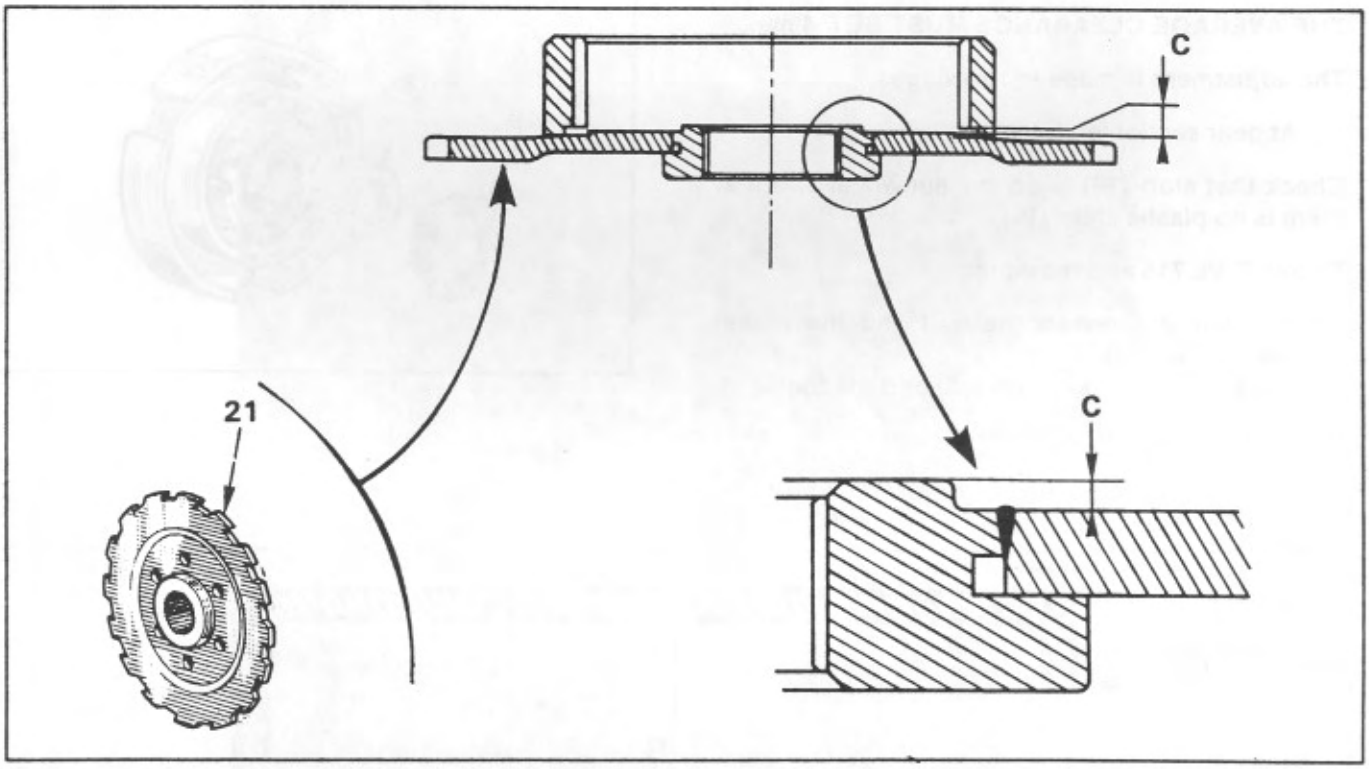
X = A — B





2. On the parking pawl ring (21).

Measure dimension C.



Calculate the thickness E (See J5-23) of shim (19).

The total clearance is: JT = X + C.

The thickness of the shim is : E = JT - 0.4

For example:
A = 158.2 mm

B = 156.9 mm

C = 1.3 mm

X = A - B = 158.2 - 156.9 = 1.3 mm

JT = X + C = 1.3 + 1.3 = 2.6 mm

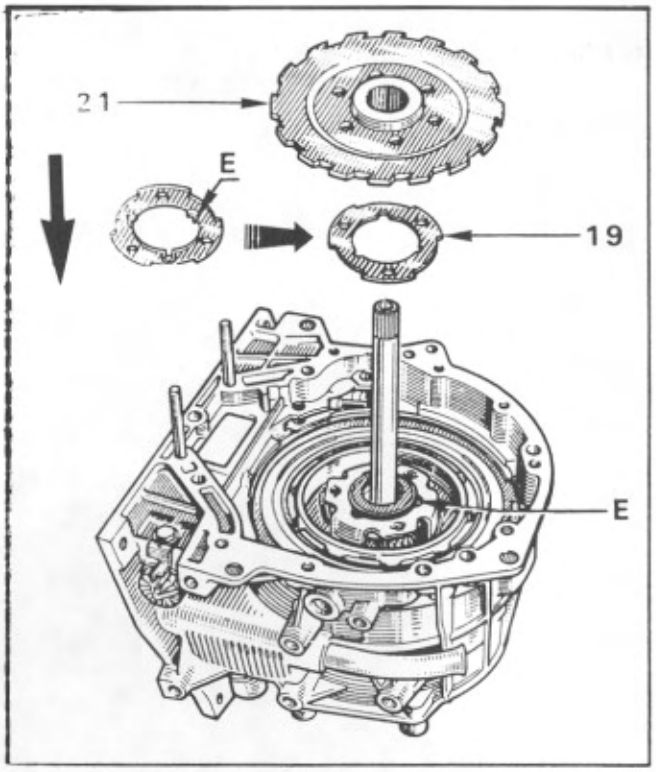
Shim thickness : E = 2.6 - 0.4 = 2.2 mm

Thickness of shims available:

1.5 mm ; 2 mm ; 2.6 mm ; 3.2 mm

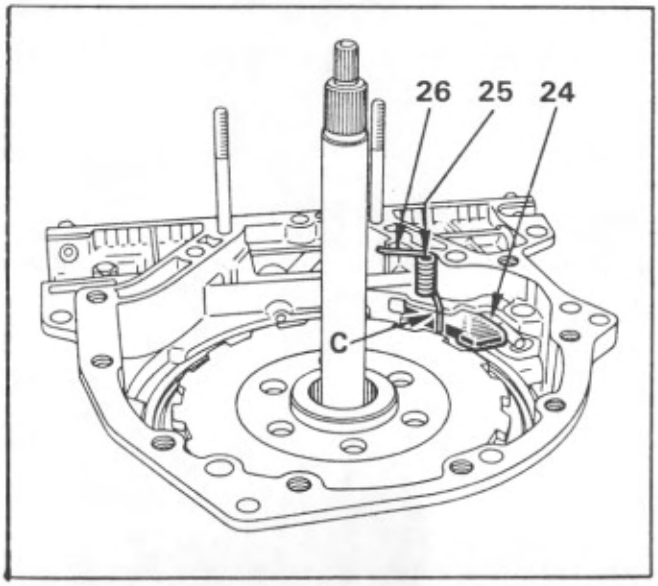
In this case, select the 2 mm thick shim, which would give the clearance closest to 0.4 mm.

Fit plastic shim (19), whose thickness has already been determined, and parking pawl ring (21).



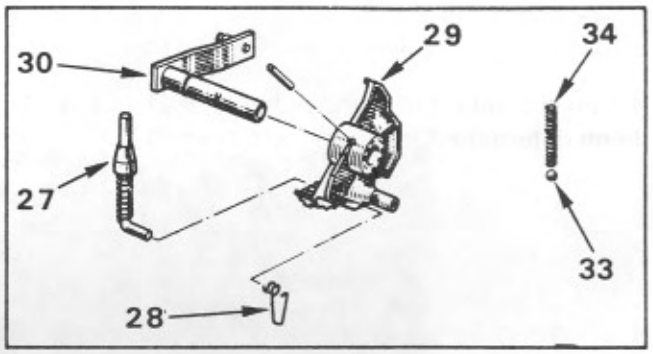
Fit parking pawl (24) and its spring (26) on shaft (25).

NOTE: To limit the movement of parking pawl (24), a shim is placed between the parking pawl and the gear section at (C).

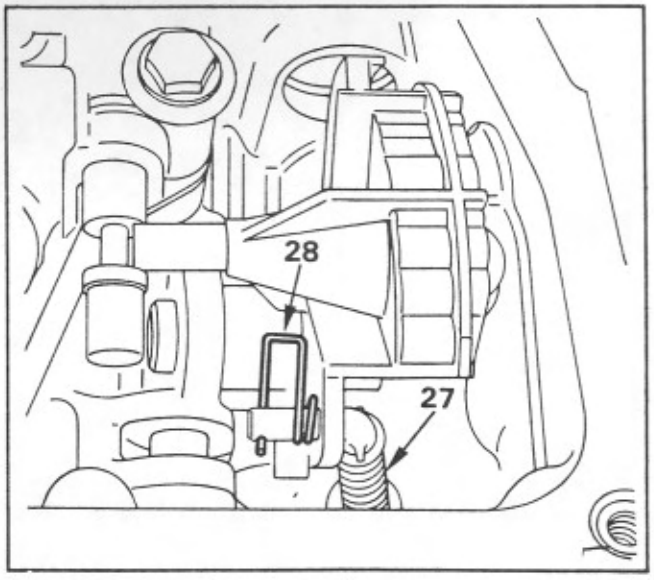


REASSEMBLE:

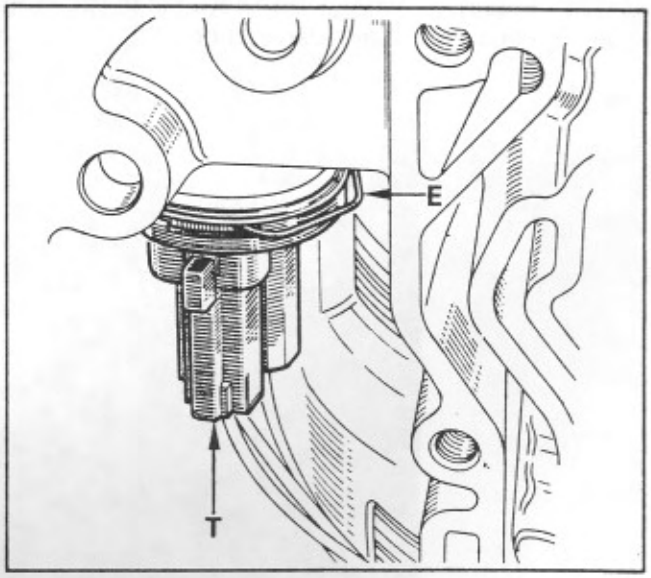
- 34 - 33 - 29 - 30 simultaneously, with a new seal and rollpin,



- 27 and 28



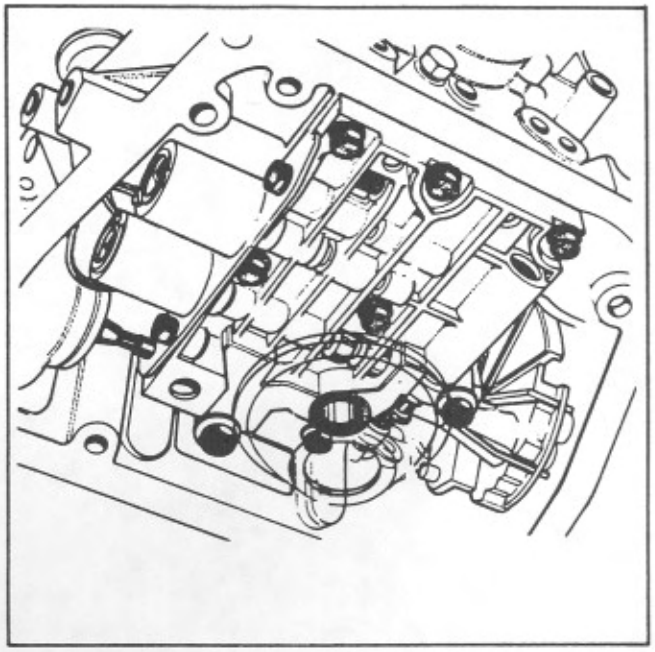
Attach clip (E) to sealed connector (T) and connect it.



REASSEMBLE:

- the valve body with its two seals and plate;
- torque tighten the valve body bolts in the order indicated (see chapter on "Hydraulic Control Unit").

Install the transmission filter screen.

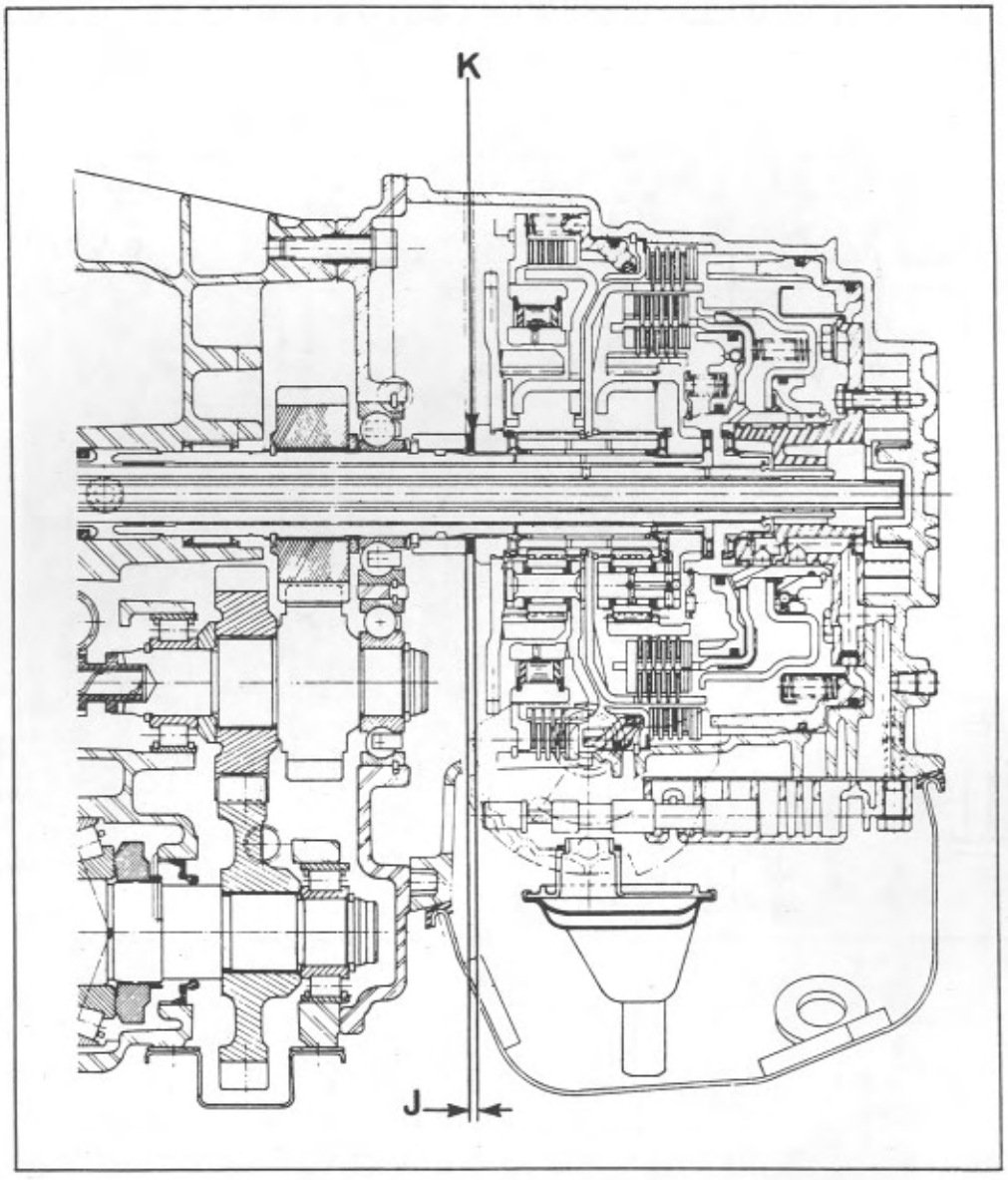


COUPLING TRANSMISSION TO FINAL DRIVE

ADJUSTING THE END FLOAT

The end float is the operating clearance of the gear section of the automatic transmission.

THE AVERAGE CLEARANCE (J) MUST BE 0.8 mm. The end float is adjusted by shim (K) which is a ground shim.



End float (J) is 0.65 mm - 1.0 mm. It is adjusted by thickness of shim (K).

IMPORTANT

The end float must be adjusted when a service exchange transmission section is installed as well as during a transmission or final drive rebuild.

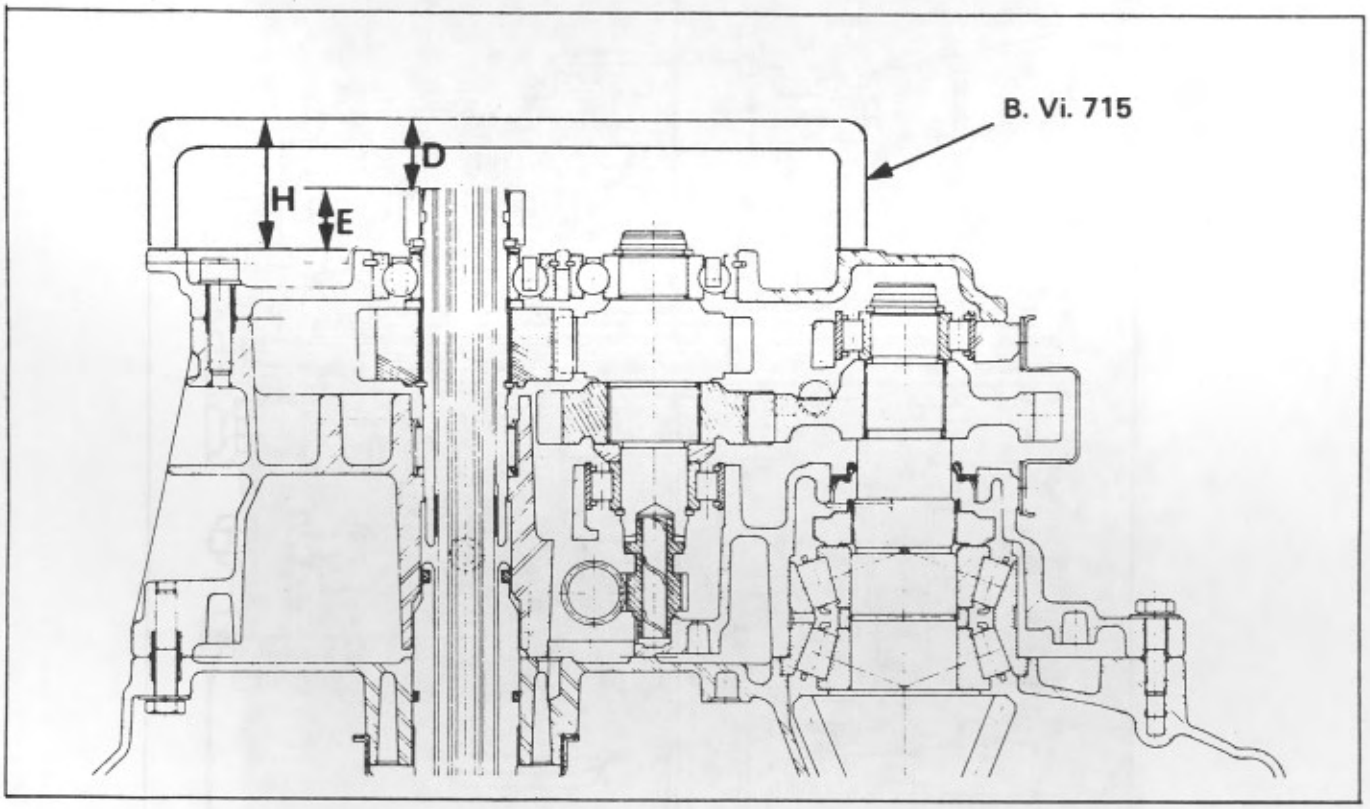
COUPLING TRANSMISSION TO FINAL DRIVE
ADJUSTING THE END FLOAT

The adjustment is made in 2 stages.

1. Final drive end (shim K removed).

Measure dimensions H and D, with a depth gauge, and deduct dimension E.

E = H - D



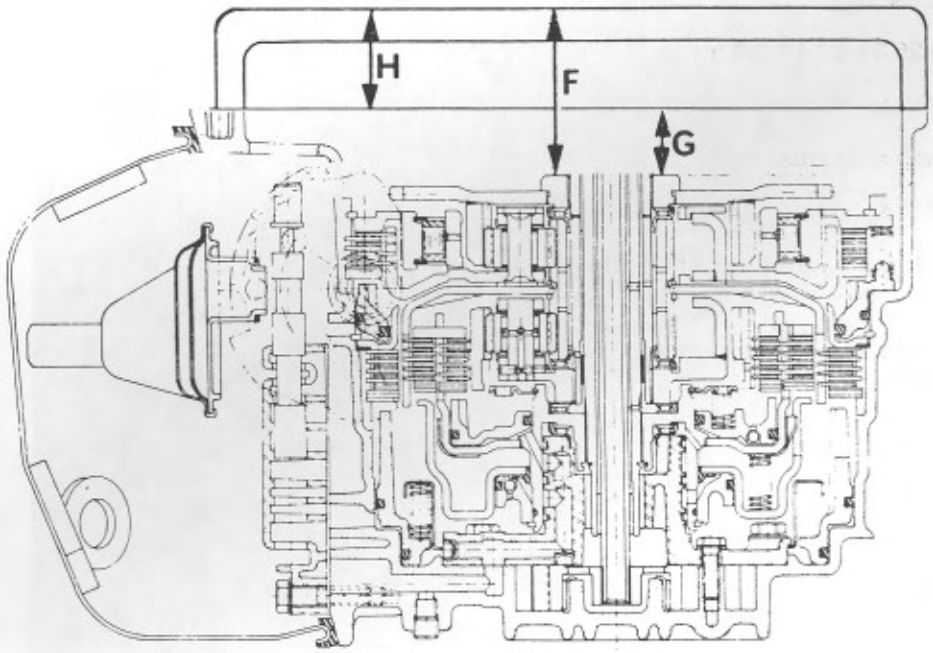
COUPLING TRANSMISSION TO FINAL DRIVE
ADJUSTING THE END FLOAT

2. Transfer case end (Paper gasket in position).

The reverse train clearance must be correct (see J5-21) and the parking pawl wheel correctly installed.

Measure dimension F and deduct dimension G.

G = F - H



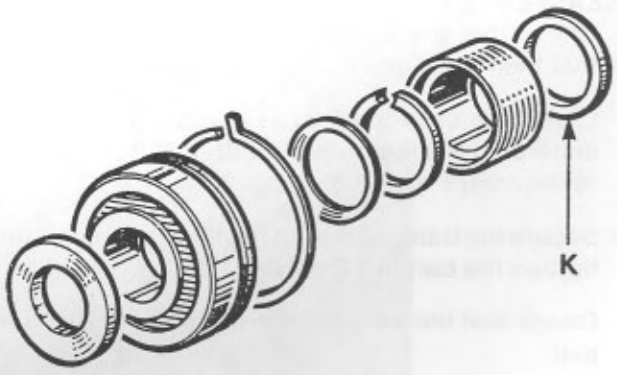
The float (L) is therefore: L = G - E

From this we can calculate the thickness of the shim K that will provide an end play (J) of between 0.65 and 1 mm.

L = J + K

Thickness of shims available:

0.25 0.7 1.1 1.7 & 2.3 mm



COUPLING TRANSMISSION TO FINAL DRIVE
ADJUSTING THE END FLOAT

For example:

H = 120 mm

F = 145.3 mm

D = 97.6 mm

G = 145.3 - 120 = 25.3 mm

E = 120 - 97.6 = 22.4 mm

Total end float = 25.3 - 22.4 = 2.9 mm

K = 2.9 - 0.8 = 2.1 mm

Thickness of shims available:

0.25 0.7 1.1 1.7 & 2.3 mm

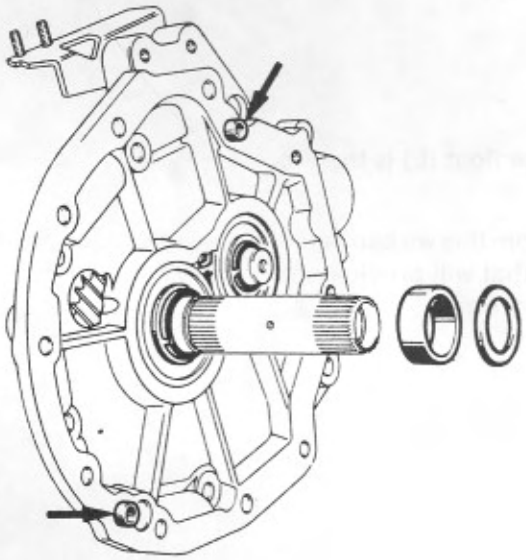
In this case select a 2.3 mm thick shim which will give the clearance closest to 0.8 mm.

Once the adjustment has been made, set the mechanism in the "Park" position.

FINAL REASSEMBLY PROCEDURE

REASSEMBLY

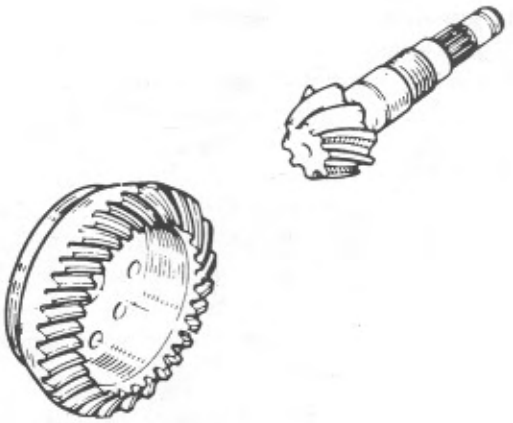
- Check that the 2 dowel bushings are fitted and that their locations are in good condition.
- Clean the case joint faces and coat them with anaerobic sealant compound and fit a "special replacement" paper gasket.
- Secure the transfer case to the final drive case and tighten the bolt to 2.0 daNm (15 lb./ft.)
- Check that the 4 magnets are in place in the fluid pan.
- Mount the pan and torque tighten the bolts to 0.6 daNm (4.5 lb./ft.)



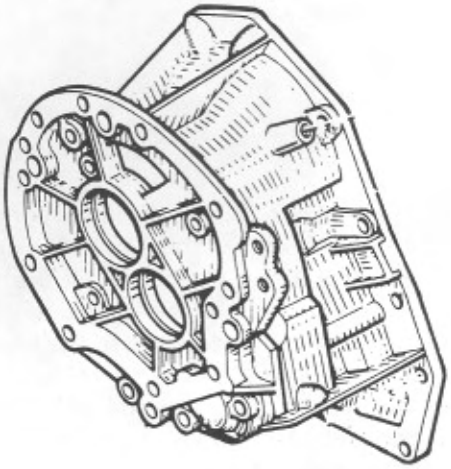
FINAL DRIVE REBUILD
GENERAL INFORMATION

Matching parts

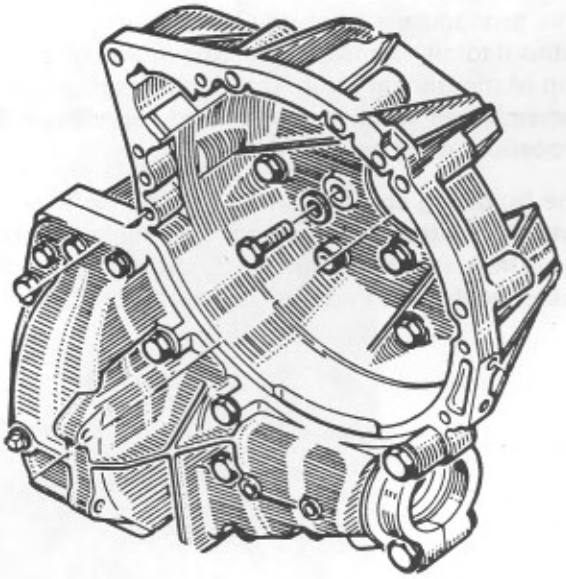
The final drive pinion and ring gear.



The separator case and the step-down case.



The final drive casing and the converter casing.



TIGHTENING TORQUES

Bearing nut on final drive pinion ..... 22 daNm (160 lb./ft.)

Bolt securing separator casing to step-down casing 2.5 daNm (18 lb./ft.)

Bolt securing step-down casing to converter casing 2.5 daNm (18 lb./ft.)

Differential/Intermediate Case Gasket
The gasket between the differential bell housing and the intermediate gear case must be replaced each time the transmission is disassembled. The metal shim(s) between the pinion bearing collar and the intermediate gear case must also be replaced at that time, since the shims are matched to the gasket thickness. (Refer to figure 1). Winnebago Part Sales Department has a parts package available which contains 1 gasket and a quantity of shims. Order part number **R77014-64-332** for all transmissions.

NOTE: The quantity of shims provided with each gasket will vary according to the thickness of the gasket. **Always use all shims included in the package.**

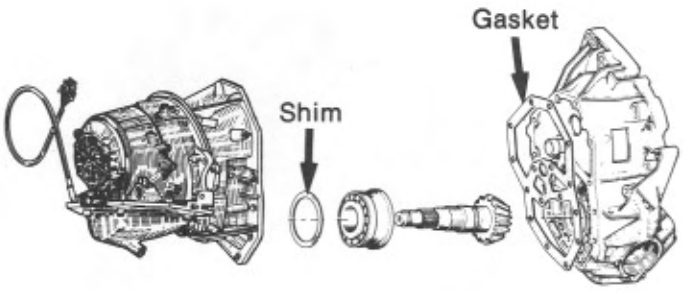


Figure 1

NOTE: This gasket/shim kit is also compatible with older model transmissions and may be retrofitted, if desired, while performing necessary transmission repairs. If installing the gasket, **do not use** the anaerobic silicone compound. And remember that the shim(s) **must be installed** between the pinion bearing and intermediate case to compensate for the gasket thickness.

REPAIR PROCEDURE
This procedure allows you to replace the shim(s) without totally disassembling the intermediate section of the transmission. **If total disassembly of the transmission is to be performed regardless, this procedure does not apply.**

The following steps assume that you have already removed the transmission from the vehicle, separated the differential bell housing from the intermediate case, and that the intermediate case is on the bench.

Differential/Intermediate Case Gasket

1. Insert a pry tool or large screwdriver into the rectangular opening on the pinion bearing collar and pry the pinion bearing forward approximately 1/4". Use a wooden slat between the screwdriver and the case to protect the case from damage. (See figure 2).

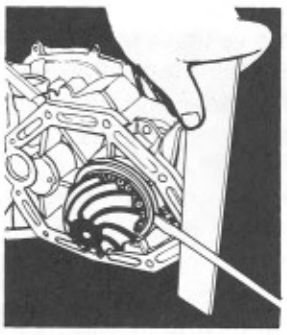


Figure 2

2. Make a cut in the shim(s) using a sharp scissors as shown, (See figure 3). It is important that you use **scissors only** - not "tin snips".



Figure 3

3. Insert the shim(s) between the pinion bearing and the case in the same manner as installing rings on a piston.

NOTE: Use all shims provided in the package.

4. Press the pinion gear and bearing back into the case using the heel of your hand or tap lightly with a rubber mallet if necessary.

5. Install the new gasket between the intermediate gear case and the differential bell housing (See figure 1) and reassemble the transmission.

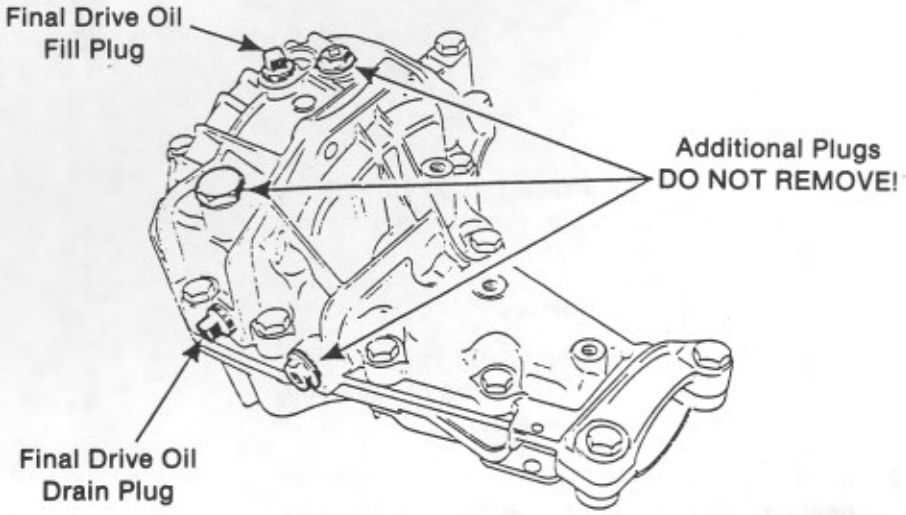
FINAL DRIVE REBUILD
GENERAL INFORMATION

MODIFICATION TO DIFFERENTIAL COVER

To allow some vehicles to be fitted with a final drive oil cooling system, the differential cover for "ML" gearboxes has been modified and now has three additional threaded bosses. This cover is interchangeable on all type NL & ML transmissions. Therefore, you may encounter vehicles, which have had transmission repair, with this modified final drive case installed.

DO NOT USE these additional hex-headed plugs for draining, refilling or topping up the final drive oil. Doing so could result in differential oil seal damage caused by overfilling. It could also result in oil leakage caused by reduced effectiveness of the plug seal washers.

Use only the tapered, square-headed drain and fill plugs provided for these purposes.

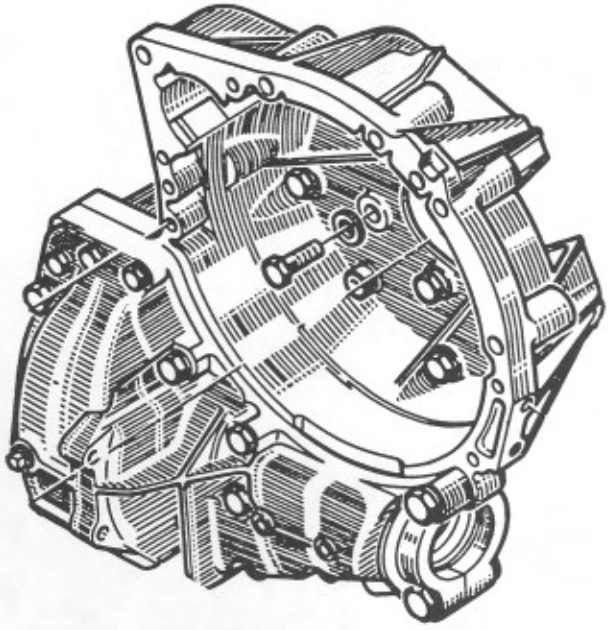


FINAL DRIVE REBUILD

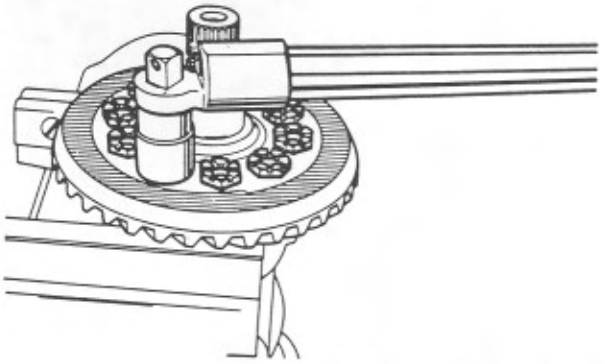
DISASSEMBLY

Dismantling:

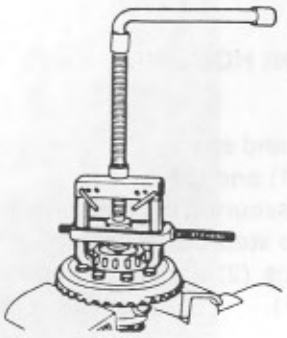
- Separate the converter - final drive housing from the step down housing.
- Mark the position of the differential nut. Remove the final drive half housing.



- Take out the differential.
- Remove the ring gear mounting bolts (they are self-locking bolts that cannot be re-used). Leave two in place, diametrically opposite one another.



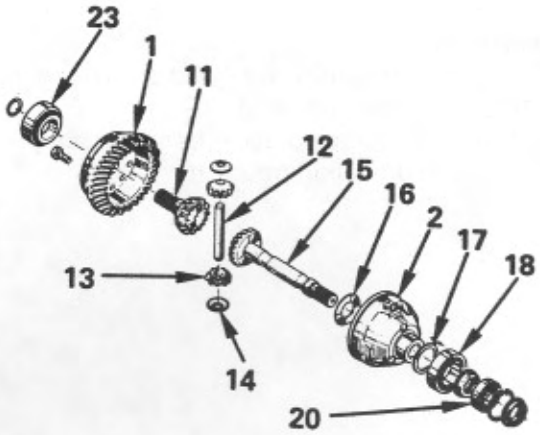
- Extract the three bearings using special tools B.Vi. 28-01 and B.Vi. 48.



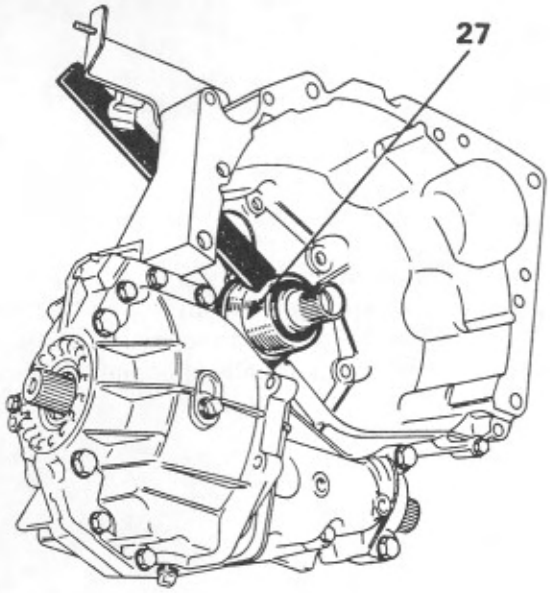
FINAL DRIVE REBUILD

DISASSEMBLY

- Remove parts 11 to 16

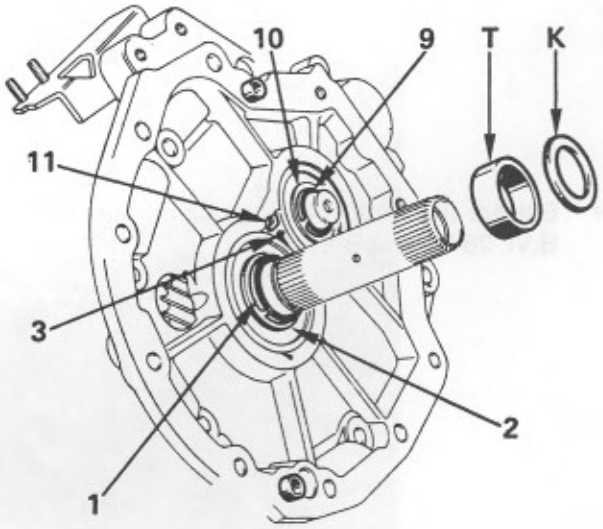


Remove the converter seal (27) using a chisel or a seal removal tool.



SEPARATOR HOUSING
REMOVE:

- Shim (K) and spacer (T)
- Circlips (1) and (9)
- The bolts securing the separator housing; separate it from the step-down casing.
- Bearings (2) and (10), separating circlips (3) and (11).

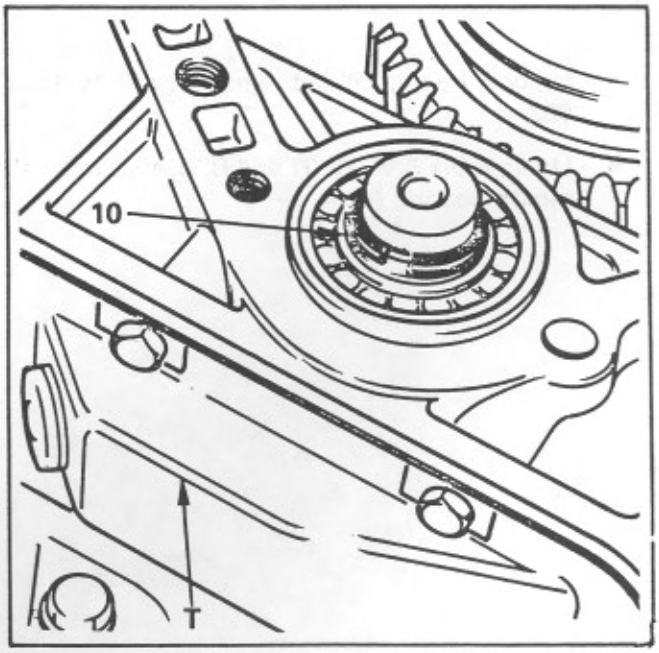


FINAL DRIVE REBUILD

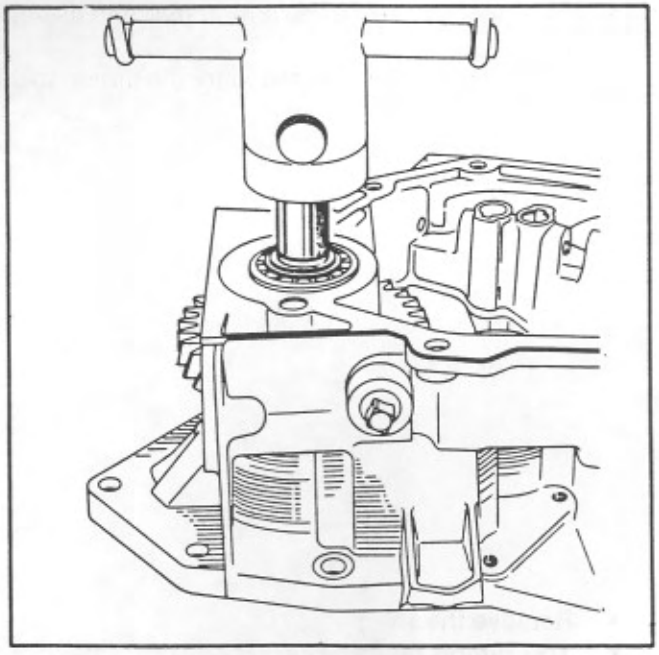
DISASSEMBLY

REMOVING THE FINAL DRIVE PINION
REMOVE:

- the circlip (10),
- the pressed steel cover (T)



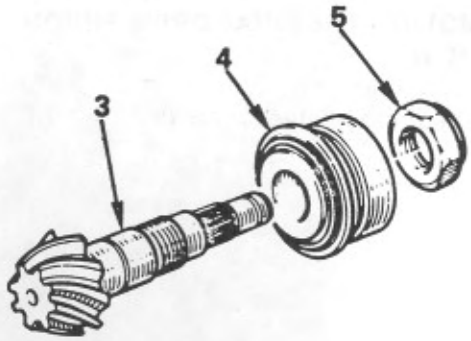
- Push out the pinion on the press.



FINAL DRIVE REBUILD

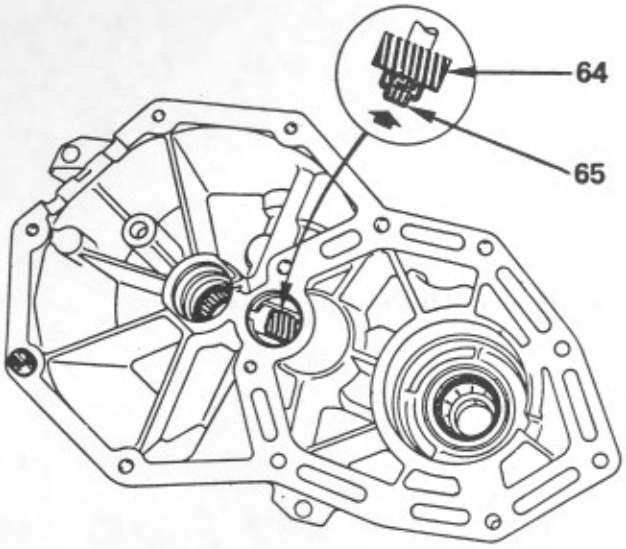
DISASSEMBLY

- Unlock the nut (5) and remove it with tool B.Vi. 903.
- Using tools B.Vi. 28-01 and B.Vi. 48, extract the pinion bearing (4).

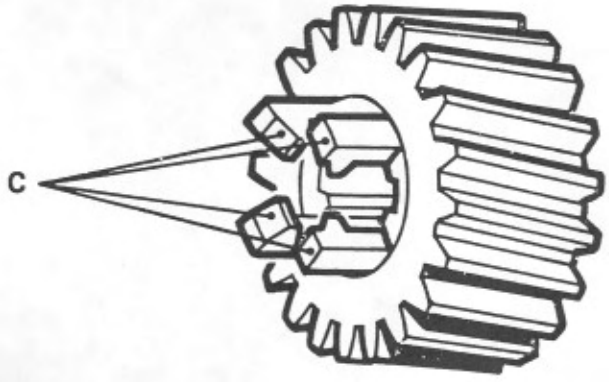


REMOVE:

- The speedometer drive pinion (64) and its shaft (65).
- Spread the lugs (C) that secure the pinion to the shaft.



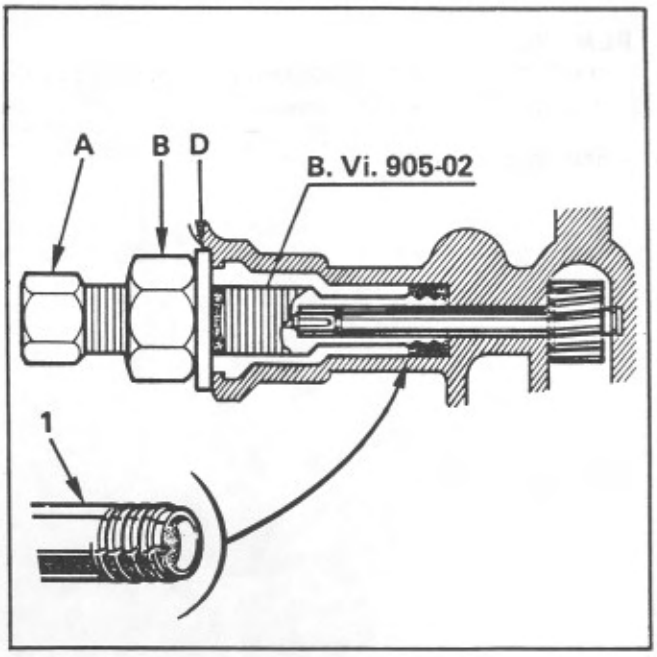
- Remove the shaft
- The pinion must be replaced with a new one each time it is removed.



FINAL DRIVE REBUILD

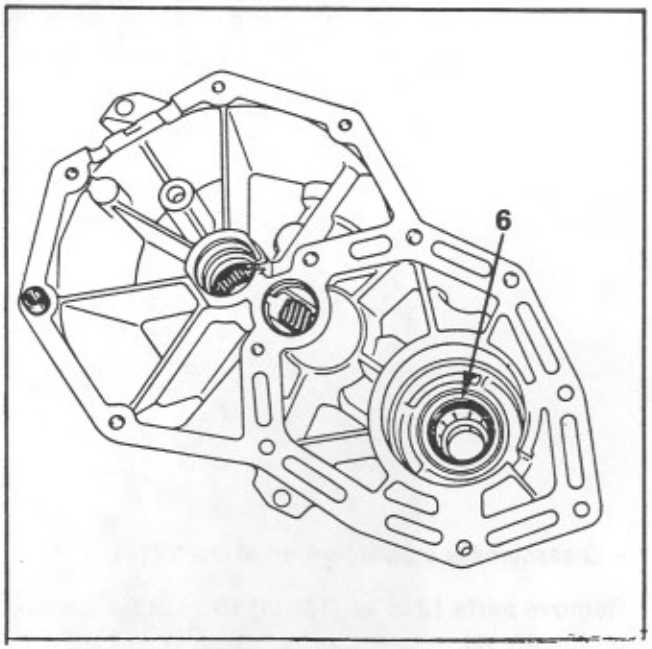
DISASSEMBLY

- Remove the speedometer drive seal using tool B.Vi. 905-02.
- Attach the extractor tool (A) equipped with the nut (B) and the spacer (D).
- Screw in the tool (A) approximately three to four turns after it has made contact with the seal so that the thread (1) enters the rubber.
- Extract the seal by turning the nut (B) while holding the tool (A).



REMOVE:

- The lip seal (6) using tool B.Vi. 465.

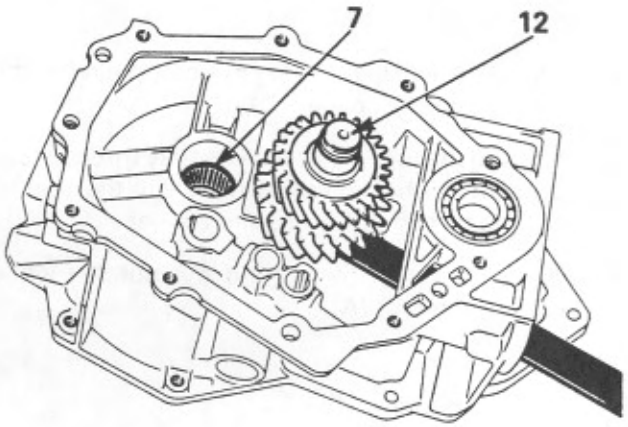


FINAL DRIVE REBUILD

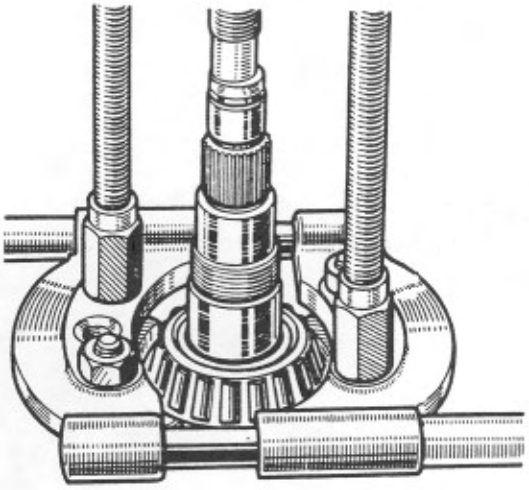
DISASSEMBLY

REMOVE:

- step-down driveshaft (12) using a tool through the inspection cover for leverage.
- needle bearing (7)

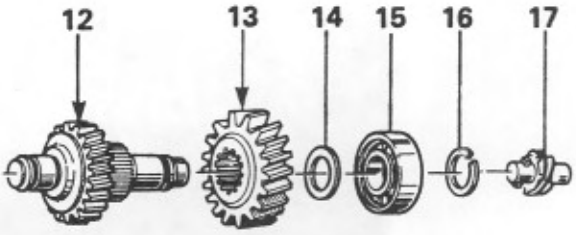


- extract the bearing



- Disassemble step-down drive shaft (12).

Remove parts 12 to 17 (13 and 15 must be removed on the press).



CLEAN

- All parts with a good grade of cleaning solvent and dry with compressed air.

> **WARNING**
>
> Always wear safety goggles when working with compressed air to prevent eye injuries.

INSPECT

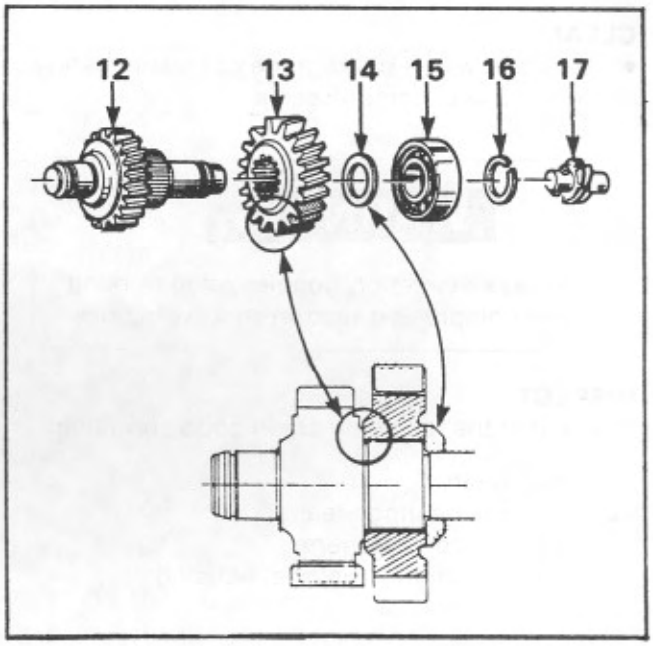
Check that the following are in good condition:

- the gear teeth,
- the bearing locating areas
- the planet wheel washers
- the splines in the differential housing.

REASSEMBLY

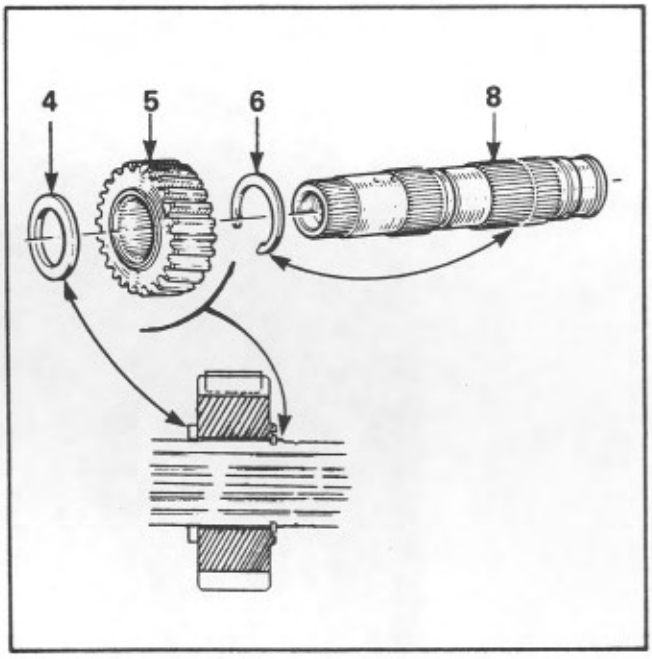
Step-Down drive shaft (12).

Refit:
- parts 12 to 17 (parts 15 and 13 must be installed on the press). Make sure pinion (13) is facing the correct direction.



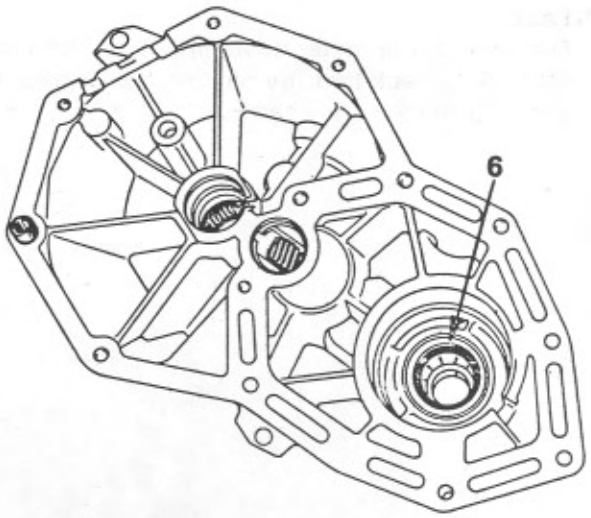
Output shaft (8)

Mount parts 4 to 6 on part 8. Make sure that pinion (5) is facing the correct direction.



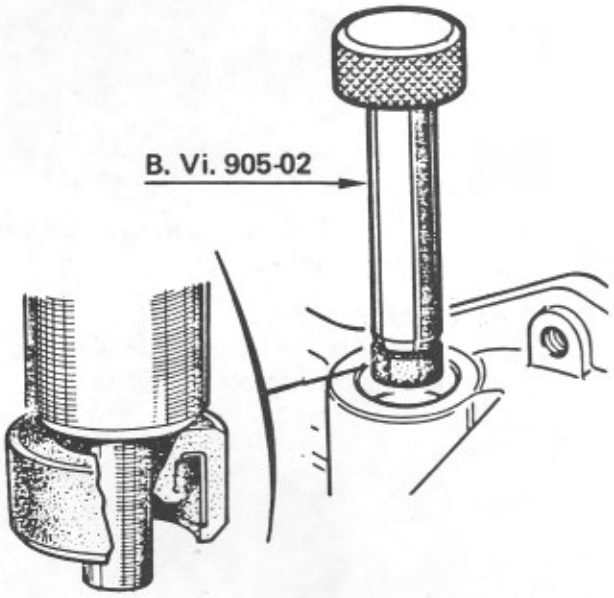
INSTALL:

- Oil the lip seal (6) and install with tool B.Vi. 465.



Insert:

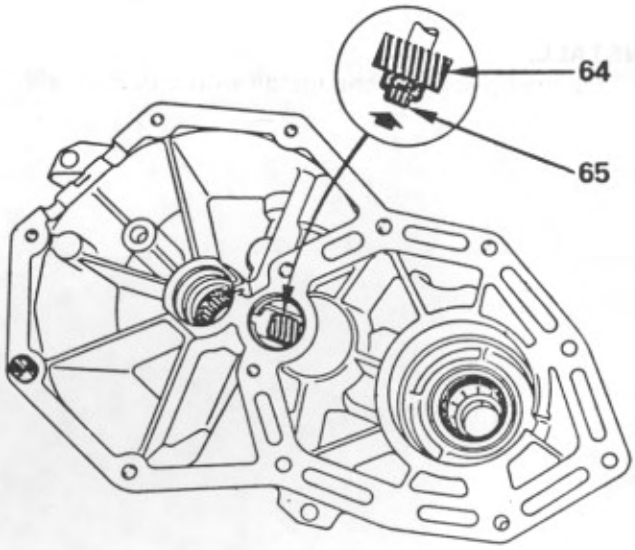
- The speedometer pinion seal ensuring that it is facing the correct direction.
- Use tool B.Vi. 905-02.



REASSEMBLY

INSTALL:

- The new speedometer drive pinion (64) and its shaft (65) check that the pinion clips correctly into its groove in the shaft).

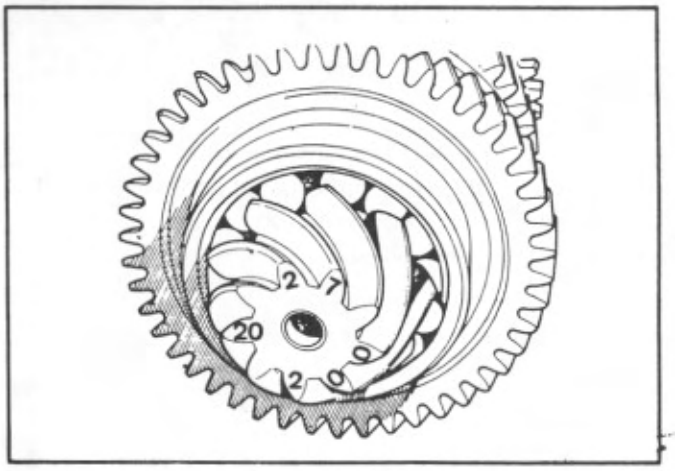


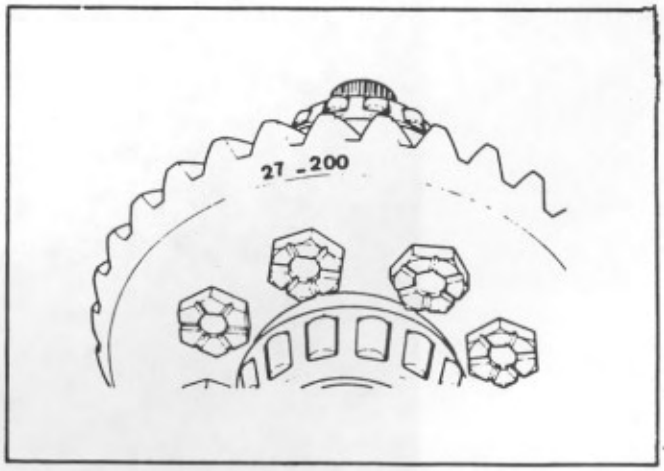
NOTE:

- The ring gear and pinion are matched.
- The same references are marked on both the crown wheel and pinion.

IMPORTANT

- If one of these parts requires replacement, the other must also be replaced.



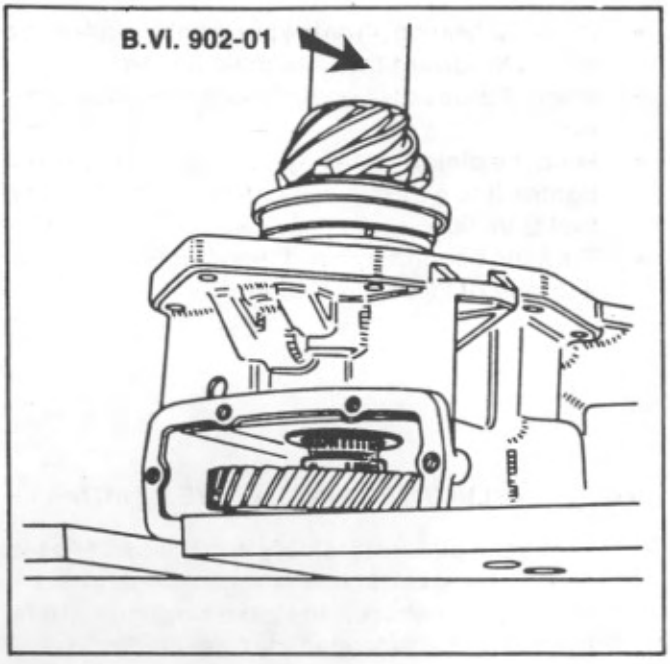


FINAL DRIVE REBUILD

REASSEMBLY

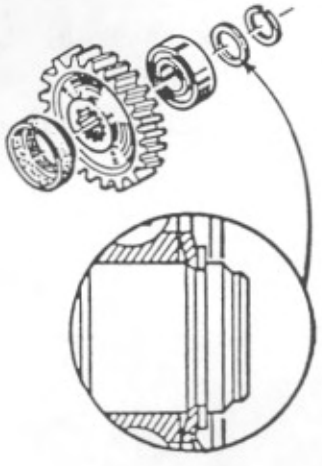
Assemble:

- the cylindrical roller bearings,
- the spring washer (1st type only), ensuring that it is the correct way round.
- the circlip (10) using tool B.Vi. 902-01.
- ensure that it located correctly.



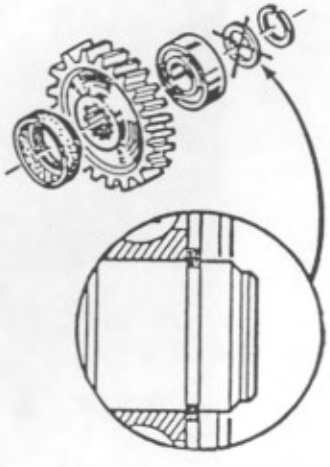
1st Type:

- Circlip thickness = 1.5 mm
- Assembly includes spring washer



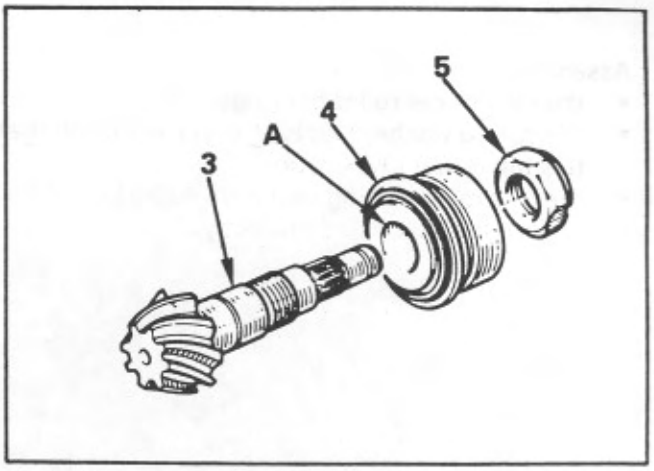
2nd Type:

- Circlip thickness = 2.0 mm
- Does NOT use spring washer
- Pinion tail shaft is 2 mm shorter
- Groove is located 1.6 mm further ahead and is widened to 2.5 mm



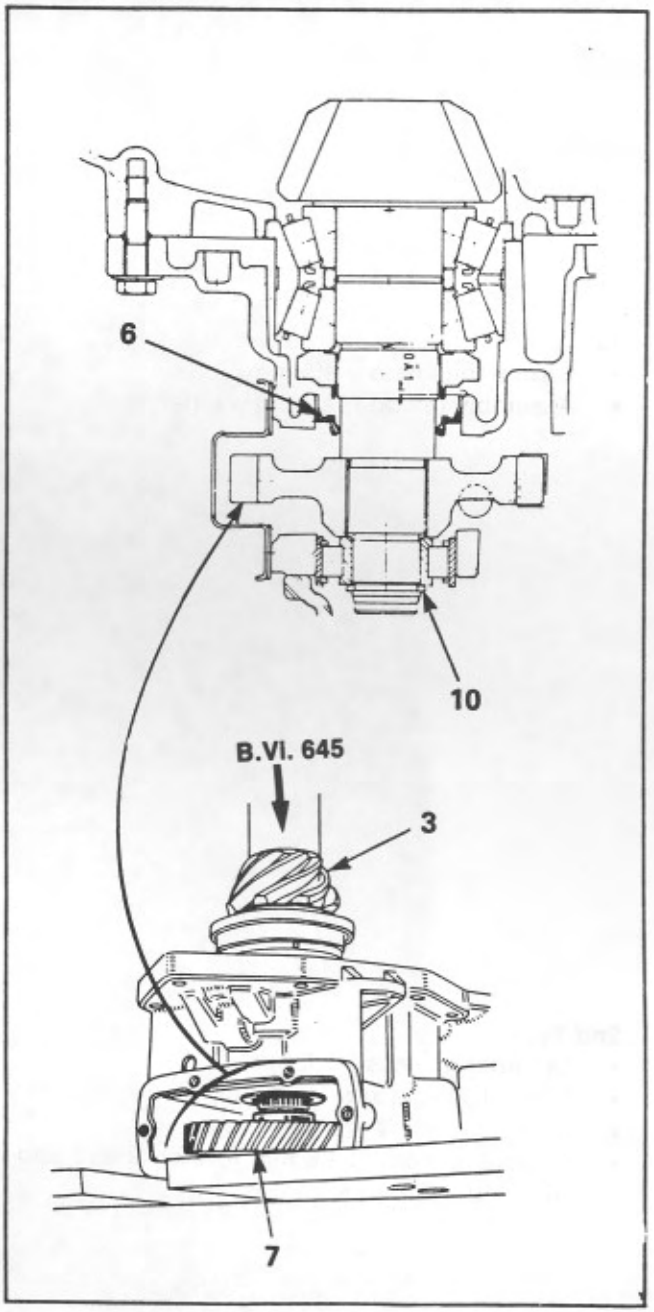
REASSEMBLY

- Install the bearing (4) on the press with the reference mark (A) toward the final drive pinion.
- Apply 3 drops of "Loctite®" to the threads in the nut.
- Hold the pinion vertically, run up the nut (5) and tighten it to a torque of 4 daNm (30 lb./ft.) using tool B.Vi. 903.
- Turn the bearing by hand then tighten the nut to a torque of 22 daNm (160 lb./ft.)



REASSEMBLING THE FINAL DRIVE PINION:

- Install the pinion assembly into the center case. Install the shim first if the gasket/shim set is being used between the case housings. (Refer to "Differential/Intermediate Case Gasket", pages J7-2 and J7-3.)
- Mount the gear (7) with its offset toward the cylindrical roller bearing.
- Install the final drive pinion (3) on the press.

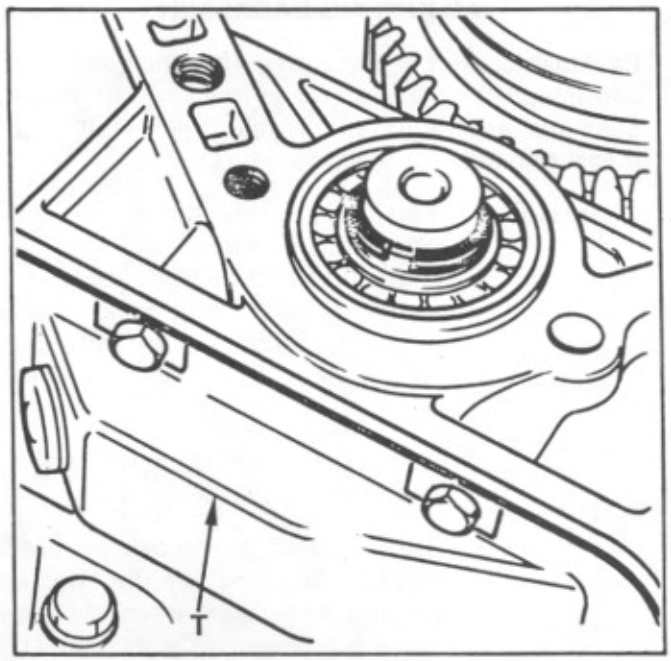


REASSEMBLY

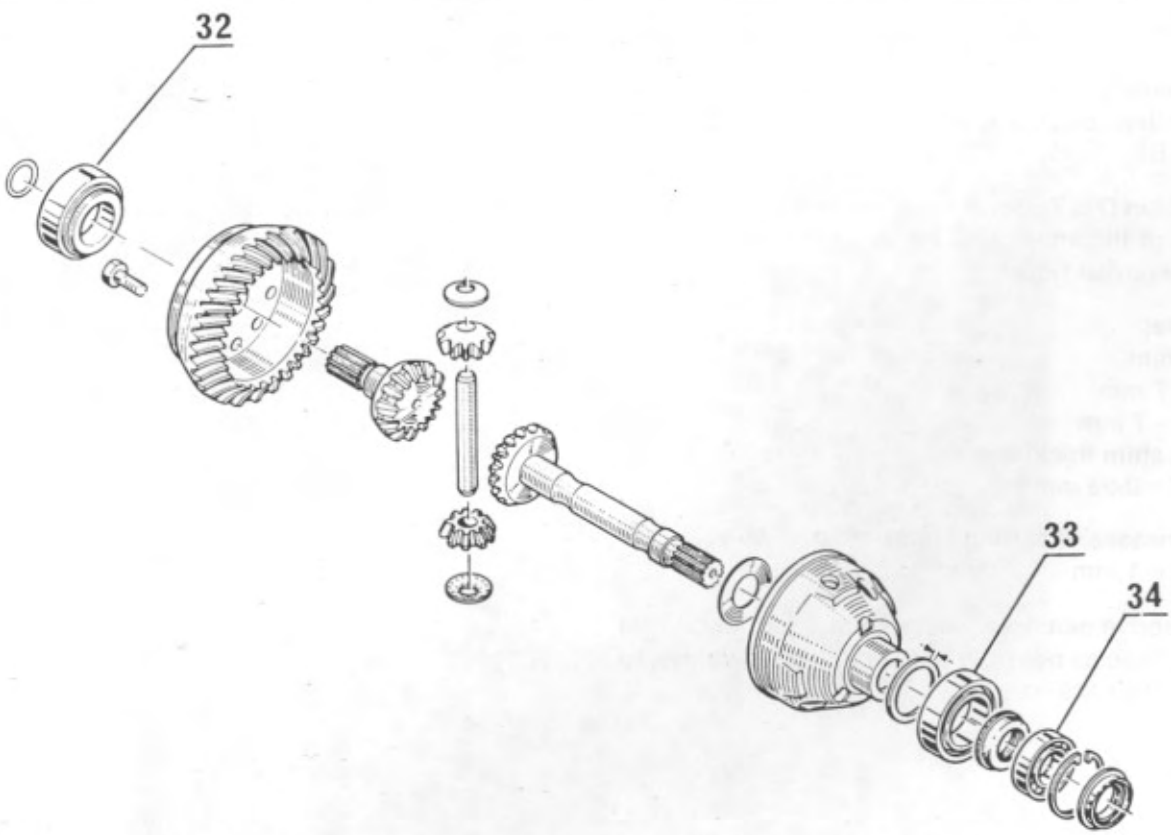
- Attach the pressed steel cover (T) with the drain plug on the opposite side to the filter plug (coat the gasket with gasket seal compound).

Tighten the bolts to a torque of 1.5 daNm (11 lb./ft.)

- Install the drain plug with a new sealing ring when applicable.



DIFFERENTIAL



REASSEMBLY

ADJUSTING BACKLASH

Backlash cannot be measured after the gearbox is assembled. It must be adjusted when the differential bearings are mounted by taking the following measurements:

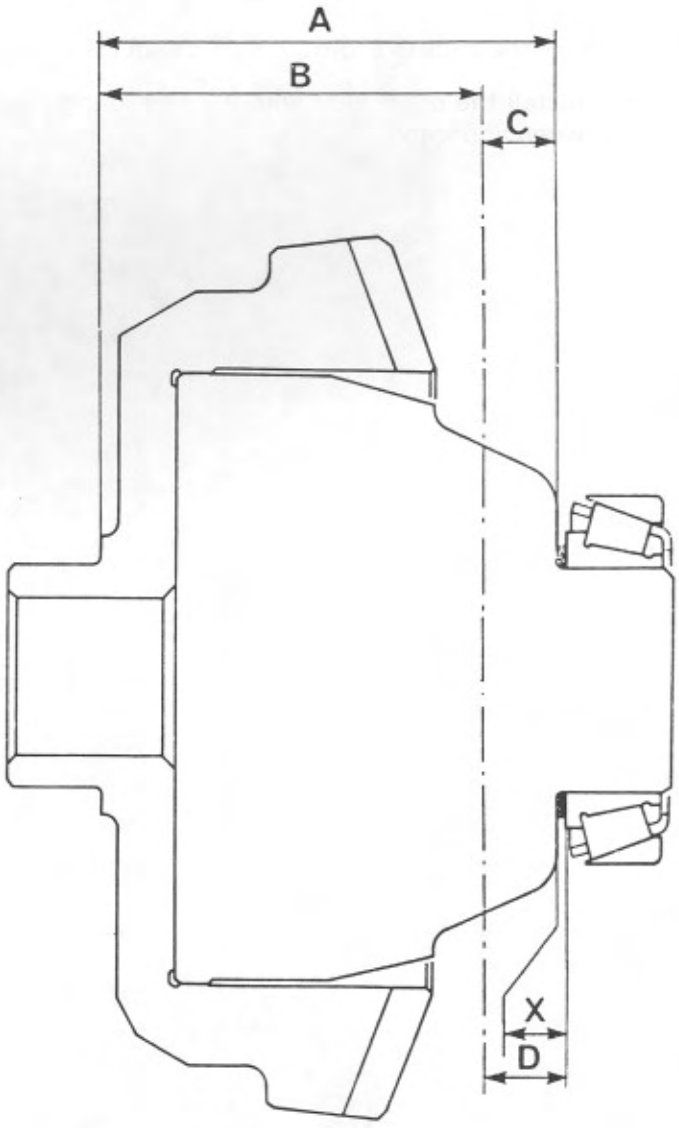
Dimension A: Distance between thrust faces for differential bearings.

Dimension B: Theoretical dimension between bearing thrust face at crown wheel end and final drive pinion centerline. This dimension is produced by machining.

Dimension C: Determined by subtracting dimension B from dimension A.

Dimension D: Theoretical dimension between bearing thrust face at differential housing end and the final drive pinion center line. This dimension is produced by machining.

Dimension X: Adjusting shim to be inserted between the bearing and differential housing.



PROCEDURE

Assemble the differential housing and ring gear using 3 bolts.

Measure dimension A.

As dimension B is known to be 86 mm for all differentials, calculate dimension C:
C = A - B

Dimension D is 7.93 mm for all differentials. Insert a shim X of thickness D-C between the bearing and the differential housing.

Example:
A = 93 mm
A - B = 7 mm
93 - 86 = 7 mm
Setting shim thickness X
7.93 - 7 = 0.93 mm

3 thicknesses of setting shims are available:
0.8 mm 1 mm 1.2 mm

In the above example, use a shim 1 mm thick (the one as close as possible to the calculated value), to correct the backlash.

REASSEMBLY

Mount the differential bearings (the larger (32) being at the ring gear). See upper illustration on page J7-6.

Mount the ring gear to the differential housing using new bolts.

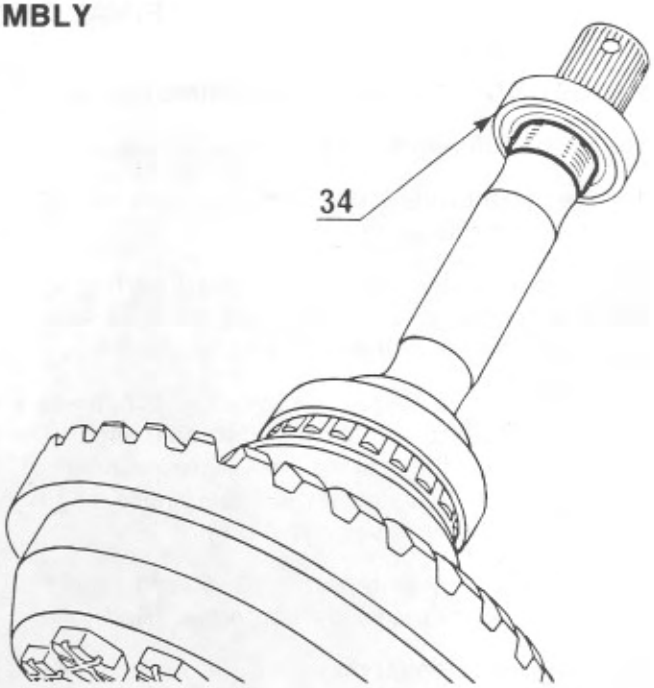
Torque tighten the ring gear bolts.

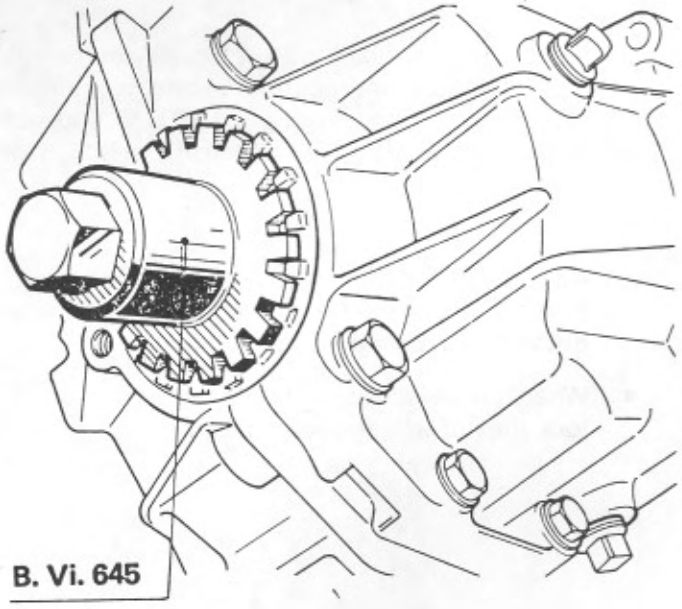
Press the ball bearing on the shaft (34) a few millimeters at the planetary gear end to center it.

Lift up the assembly to the differential housing (bearing (34) not being in its working position.)

Coat the half-casing joint faces with an anaerobic sealer, fit the other half-casing and assemble them with several bolts.

Hand tighten these bolts only at this stage.





Mount the differential ring nut with its seals and its threads coated with gasket sealer using castellated wrench B.Vi. 645.

Tighten the ring nut until it contacts the differential bearing outer race.

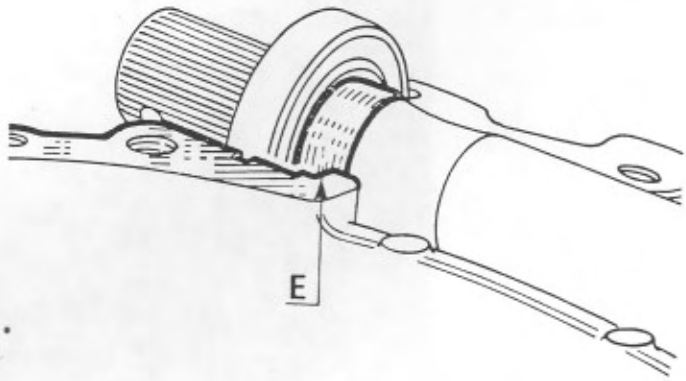
Complete the assembling of ball bearing (34) driving it on until it touches shoulder (E) in the casing.

Unscrew the differential ring nut one half-turn.

Torque tighten the casing bolts.

Place the following at the planetary gear end:

- the circlip
- and the plastic bushing



ADJUSTING DIFFERENTIAL BEARING PRE-LOAD

Rotate the differential assembly to seat the bearings.

Ensure that the differential bearings locate correctly by turning the assembly.

Place the plunger on the torque measuring tool B.Vi. 906 against one tooth of the ring gear, at its largest diameter, square with the differential shaft.

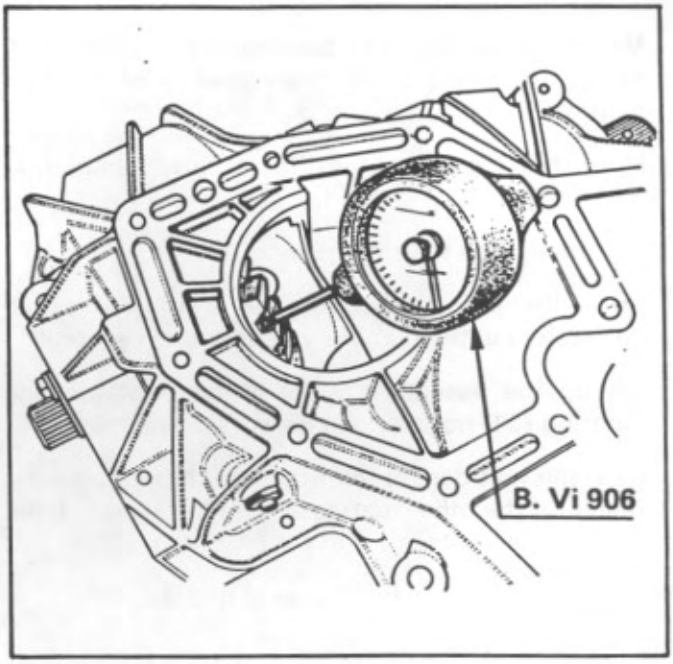
Using the torque measuring tool B.Vi. 906, press a ring gear tooth to rotate the differential slightly **in the same direction** as the bearing was installed. (Bearing roller-to-cage play will give a false reading if rotated in the opposite direction.)

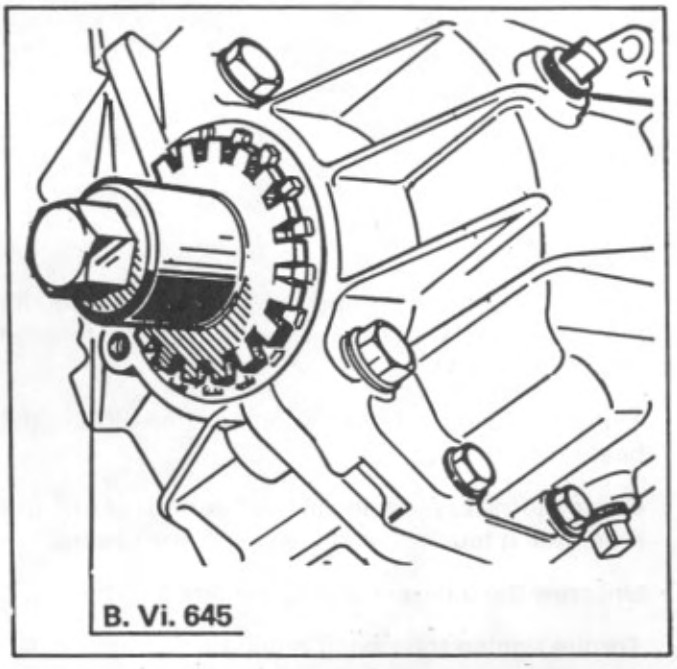
Release the torque measuring tool and read the torque shown by the follow up pointer (Red).

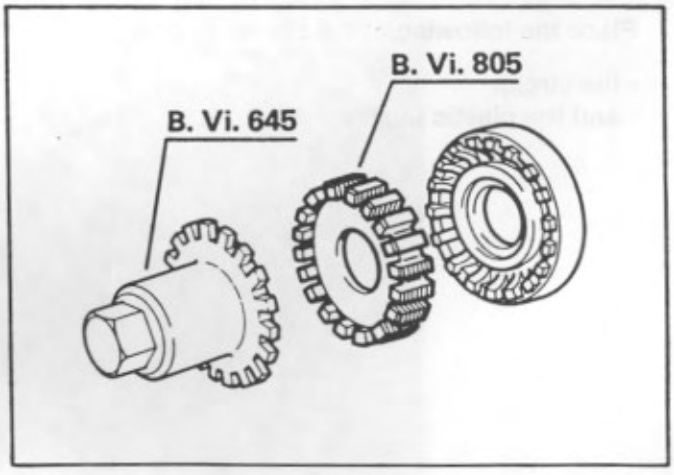
Screw the differential ring nut in or out to obtain a reading of: 2 to 2.5 daNm

NOTE: The specification 2 to 2.5 daNm represents the pressure required for ring gear movement as measured with tool B.Vi. 906, not the actual torque applied at tool B.Vi. 645.

- Adapter B.Vi. 805 must be used with wrench B.Vi. 645 when removing or replacing a 3-lip seal nut to avoid damaging the outer lip.
- When the correct adjustment has been obtained, lock the nut with its locking washer.





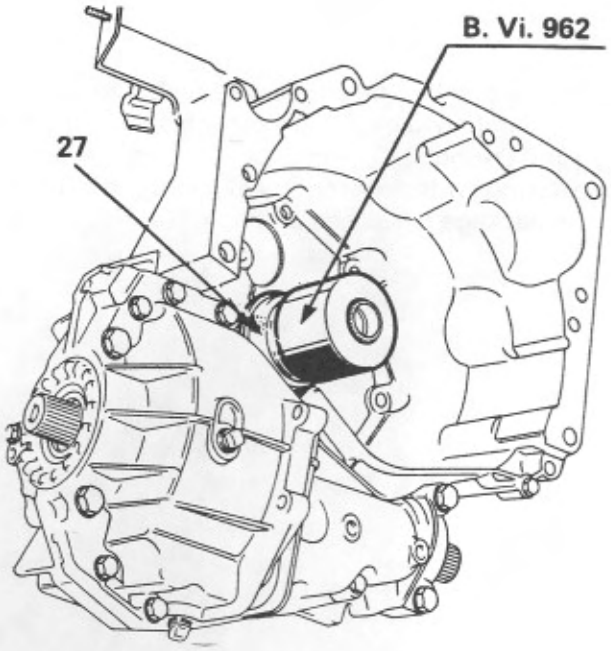


FINAL DRIVE REBUILD

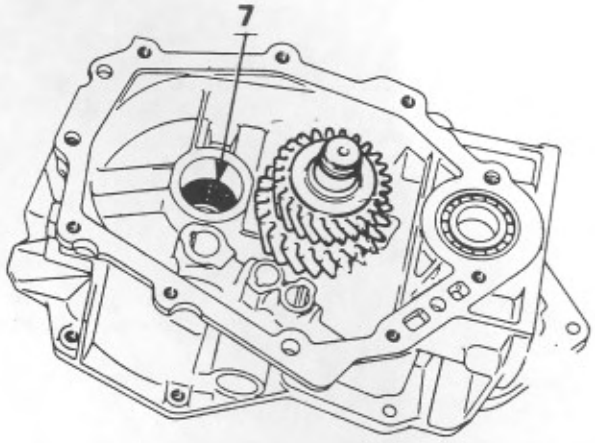
REASSEMBLY

INSTALL:

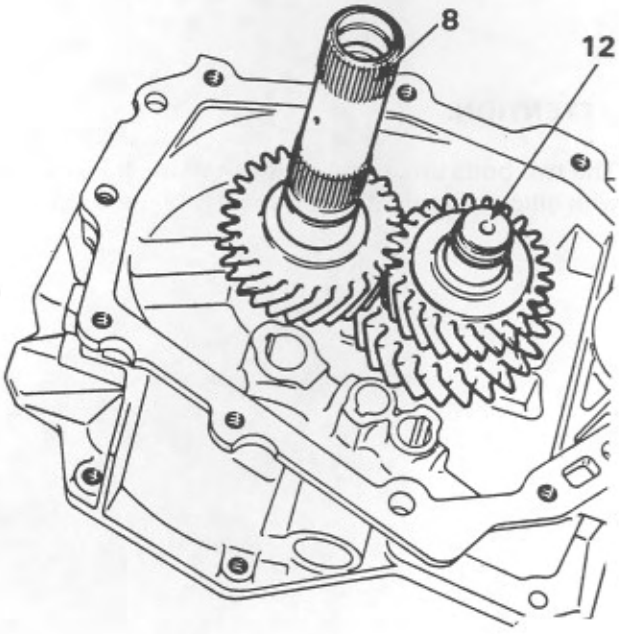
- Torque converter seal (27). Use tool B.Vi. 962 -see page J8-1 for procedure.



- Press the needle bearing as indicated (7) and recess to a dimension of 37 mm. (1.45 in).



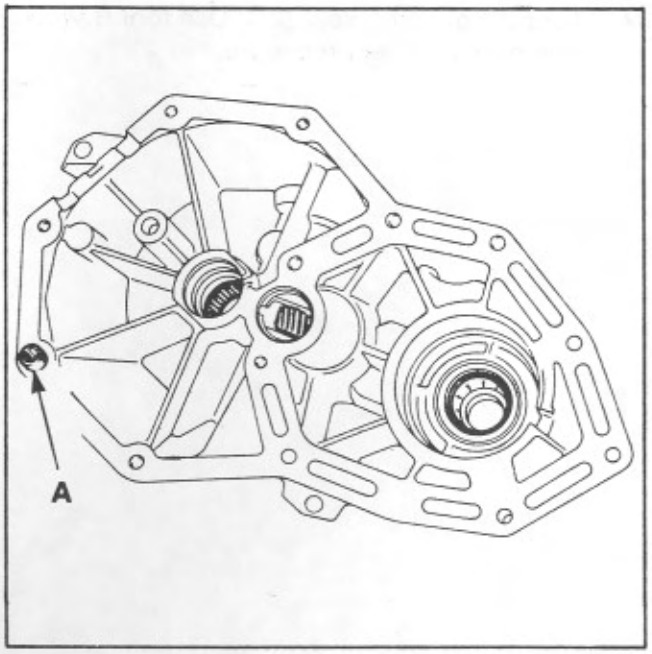
- step down drive shaft (12),
- output shaft (8).



FINAL DRIVE REBUILD

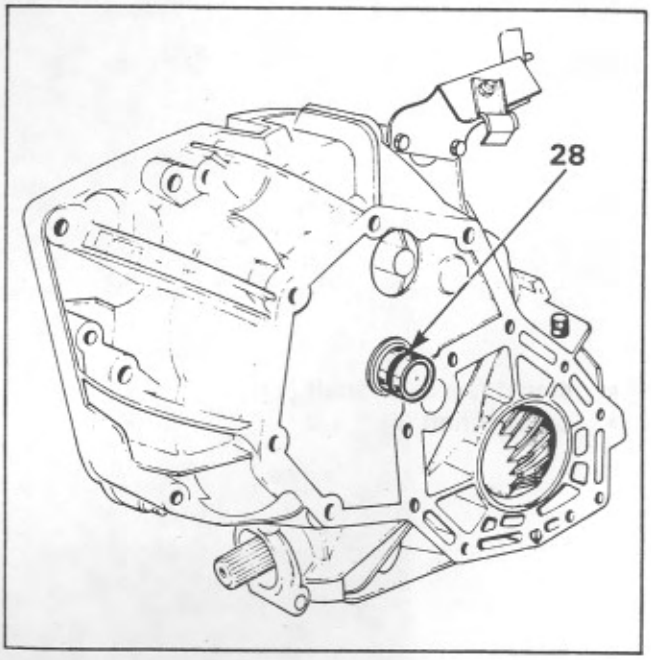
REASSEMBLY

Before attaching the step-down casing to the converter/final drive casing, check that locating dowel (A) and O-ring (28) are in position. Coat the faces of the casings with anaerobic sealer or use the gasket-shim package described on page J7-2.



ATTENTION:

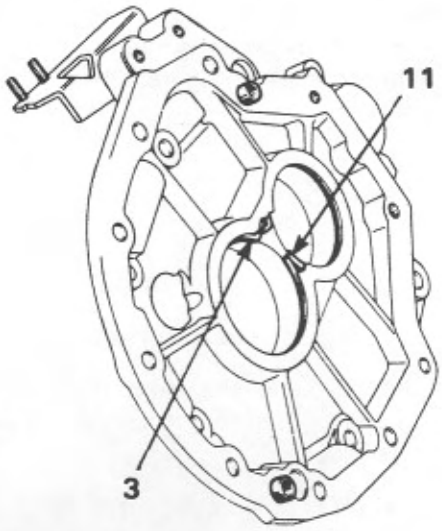
The two bolts under the stator shaft must be coated with silicone sealant (see page J1-10, item B).

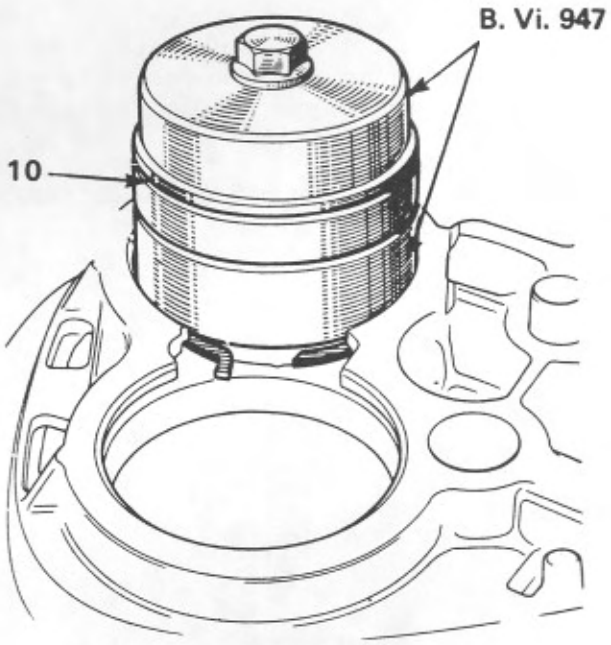


REASSEMBLING THE SEPARATOR HOUSING

INSTALL:

- circlips (3) and (11) with the notches on the same side.

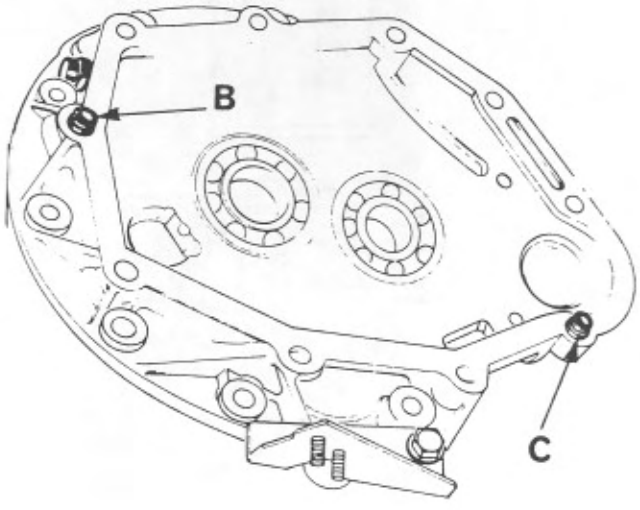




- bearing (10) using tool B.Vi. 947
- bearing (2), inserting a piece of strap iron to keep the circlip open.

Make sure that the circlips are correctly positioned in the bearing grooves.

Before attaching the separator housing to the step-down casing, check that the 2 locating dowels (B) and (C) are present and install the paper seal (it must be installed dry).



REASSEMBLY

IMPORTANT
All the separator housing bolts must be coated with anaerobic sealer before being installed.

INSTALL:
- washer (28),
- circlip (1) (bringing it under groove (G) to output shaft (8).

Use tool B.Vi. 959 to position circlip (1) in its groove:

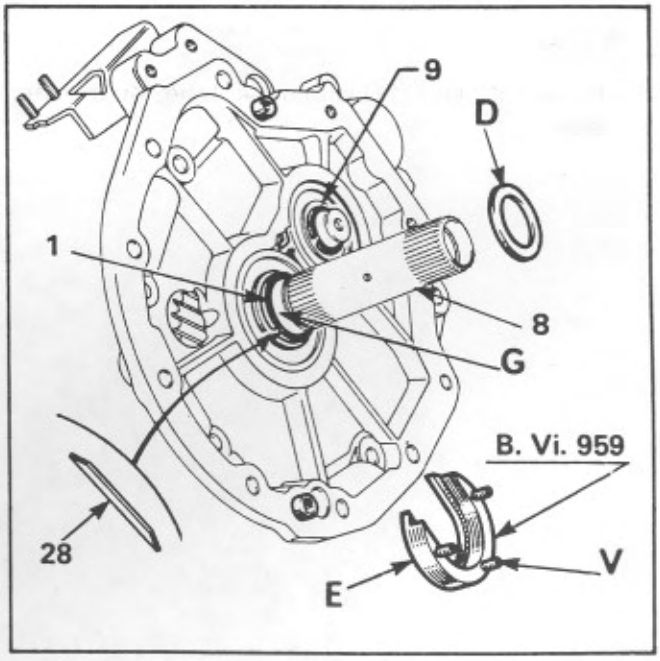
- fit washer (D) from the tool on the circlip,

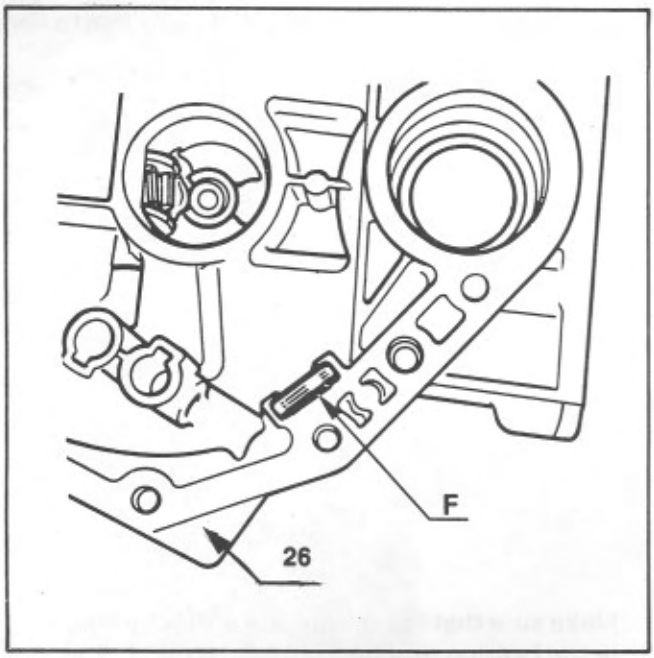
- place crescent piece (E) from the tooling in groove (G) and tighten the three bolts (V) circlip (1) enters its groove.

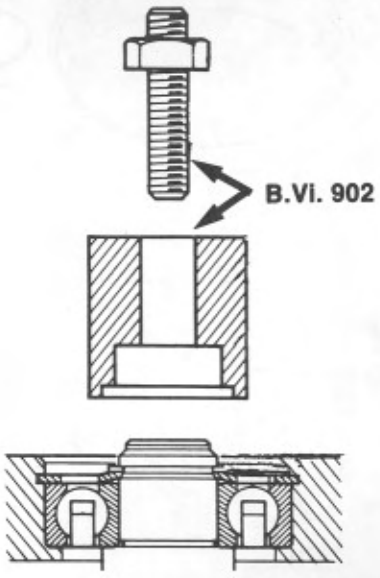
Make sure that (1) is positioned correctly.

Refit:
- circlip (9) using tool B.Vi. 902-01 (keep the output shaft in position through the inspection cover);
- center housing (26) equipped with its seal (cap towards the bottom) and its magnet (F).

See Subsection 6 for assembling the gear section casing to the separator casing.



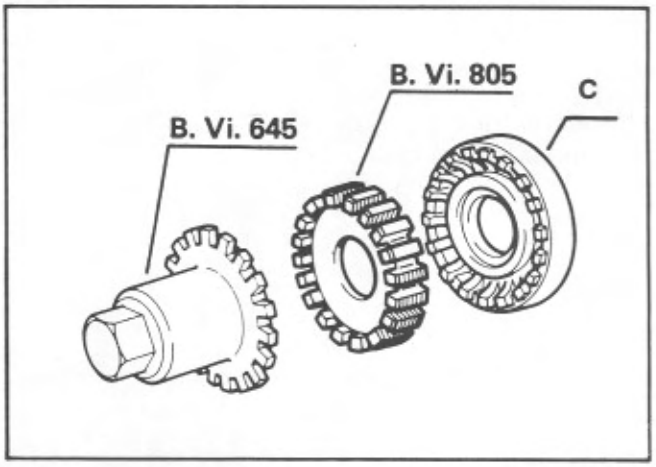




EXTERNAL SEAL REPLACEMENT

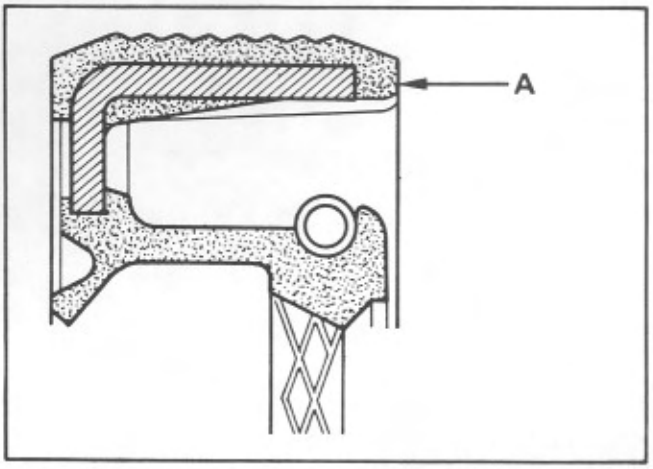
DIFFERENTIAL SEAL

REMOVAL:
Drain the final drive case.
Disconnect the transmission shaft at the final drive end.
Mark the position of the adjusting nut (C) in relation to the housing.
Remove the locking washer.
Unscrew the nut, counting the number of turns : tools B.Vi. 805 and B.Vi. 645.

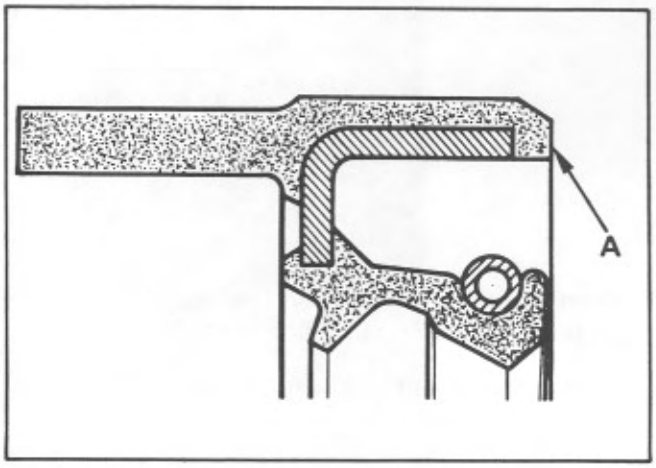


Replace either the seal only or the nut/seal assembly.

1st ARRANGEMENT: Seal with 2 lips



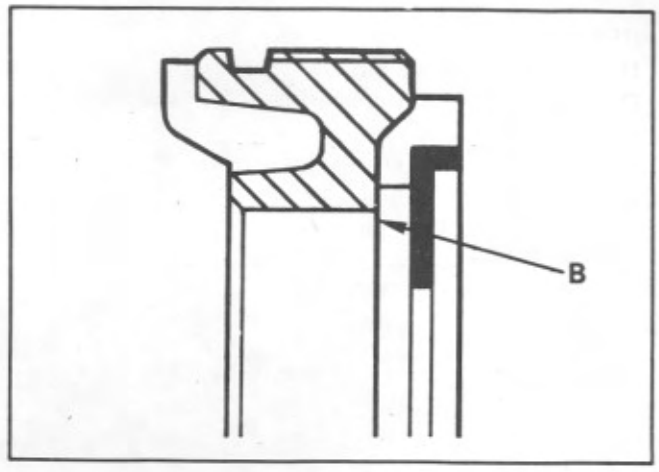
2nd ARRANGEMENT: Seal with 3 lips



EXTERNAL SEAL REPLACEMENT
DIFFERENTIAL SEAL

It is essential to use tool B.Vi. 805 in addition to B.Vi. 645 to remove or refit the nut when the seal is of the 2nd type in order not to damage the outer lip.

Whatever the type of seal, face A must be flush with the inner face of the nut B.



NOTE: the 3 lip seal can be fitted as a replacement for the 2 lip seal.

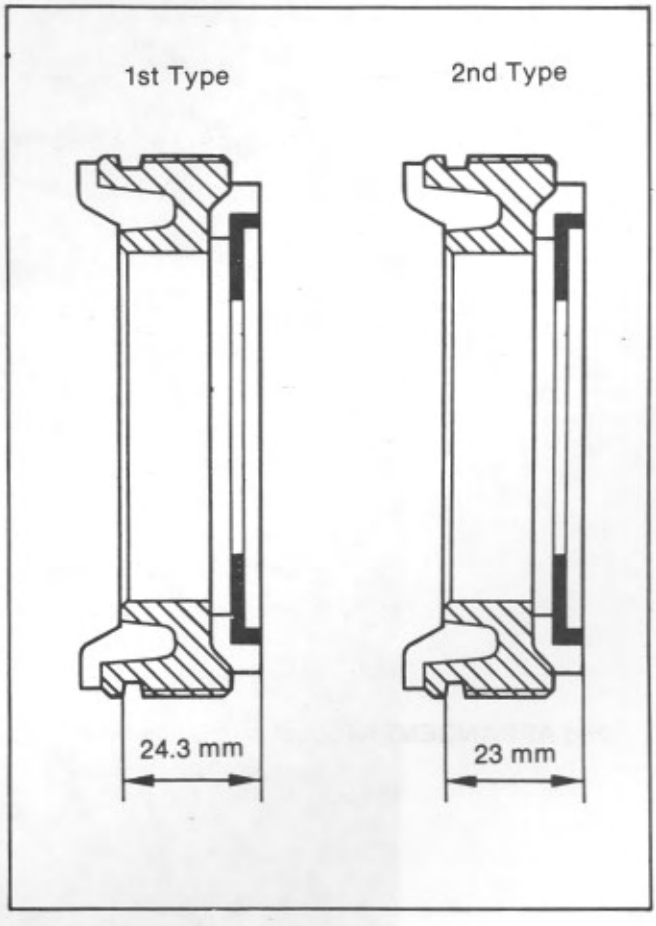
REFITTING:
Refit the nut, equipped with a new, oiled O ring, screwing in by the number of turns and aligning it with the marks made during dismantling.

Refit the locking washer.

Reconnect the transmission shaft.

Fill the final drive housing.

NOTE: There are two types of differential nut. The O-ring groove is offset.



When replacing a nut, use the same type of arrangement which was originally fitted.

When replacing the housing, a nut of the second type must be used.

EXTERNAL SEAL REPLACEMENT
SPEEDOMETER SHAFT SEAL

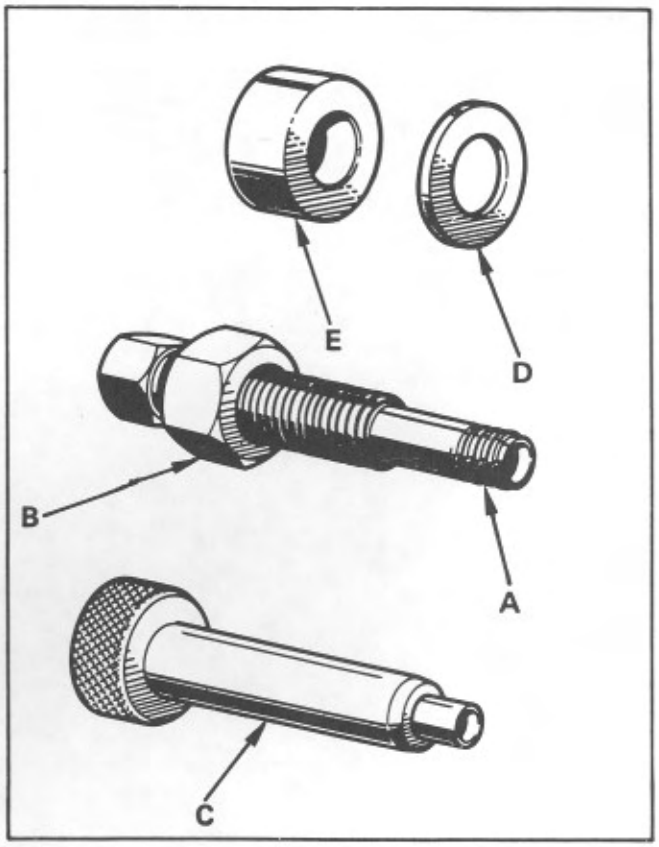
The speedometer shaft seal is replaced using tool B.Vi. 905 which comprises:

a seal extractor (A) fitted with a nut (B)

a seal fitting tool (C),

a thin spacer (D),

spacer (E) is not used.



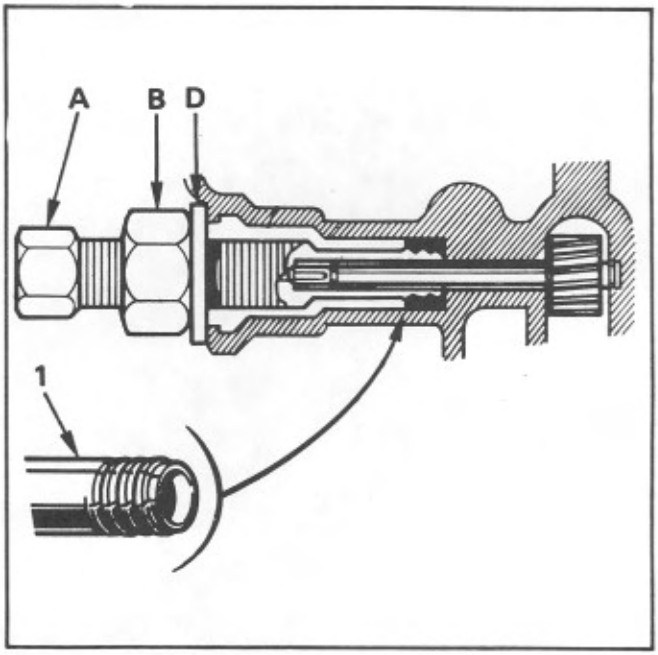
REMOVING

Disconnect the speedometer drive cable from the gearbox.

Fit the extractor tool (A) equipped with nut (B) and spacer (D).

Screw the tool (A) in by approximately three turns after it has made contact with the seal so that its thread (1) penetrates the rubber.

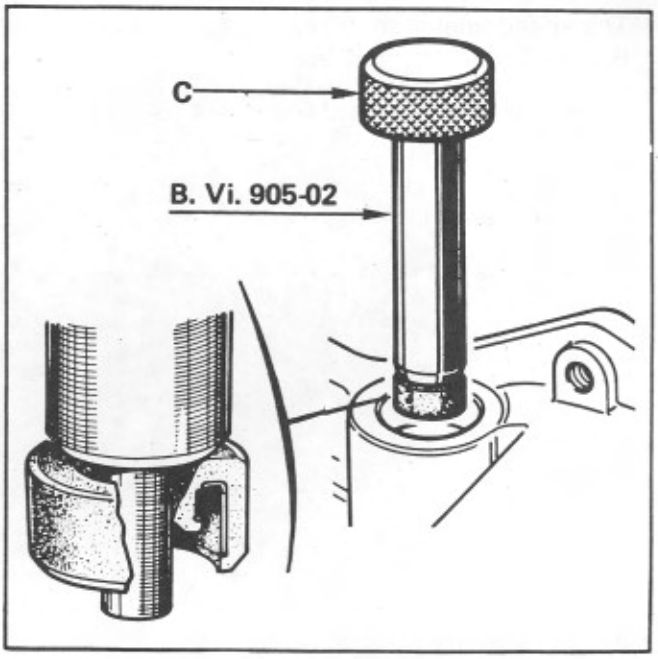
Extract the seal by screwing in the nut (B) while holding the tool (A).



EXTERNAL SEAL REPLACEMENT
SPEEDOMETER SHAFT SEAL

REFITTING

Place the seal on tool (C), ensuring that the seal is facing the correct way, and tap the end of the tool.



SECTION "K"

FRONT AXLE

Subsection 1 **Specifications**

K1-1 Special Tools
K1-4 Features
K1-5 Tightening Torques
K1-6 Front Axle Geometry
K1-7 Measuring Points
K1-7 Greases

Subsection 2 **Front Axle Geometry**

K2-1 Checking - Adjusting
K2-2 Steering Box Height Setting
K2-10 Centering the Steering Wheel
K2-10 Parallelism

Subsection 3 **Lower Suspension Arms**

K3-1 Removing - Reassembling
K3-2 Changing the Rubber Bushings
K3-3 Changing a Ball Joint

Subsection 4 **Stub Axle Carriers**

K4-1 Changing the Bearings
K4-4 Removing - Reassembling a Stub Axle Carrier

Subsection 5 **Steering Box**

K5-1 Removing - Reassembling
K5-2 Changing a Steering Arm
K5-4 Steering Arm Axial Ball Joint
K5-5 Adjusting the Plunger

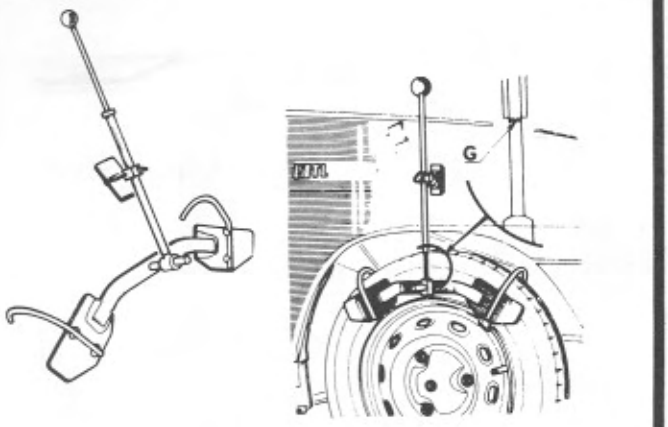
Subsection 6 **Steering Wheel and Shaft**

K6-1 Removing - Reassembling the Steering Wheel
K6-1 Removing - Reassembling Steering Wheel Shaft
K6-5 Changing the Bushing

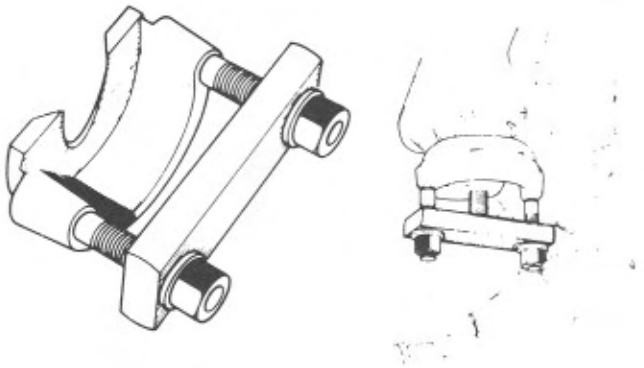
Subsection 7 **Drive Shafts**

K7-1 Removing - Reassembling
K7-3 Overhauling the Constant Velocity Joint

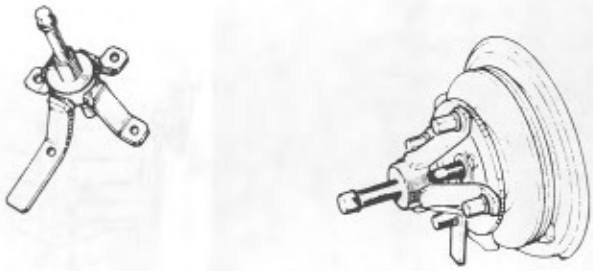
SPECIAL TOOLS



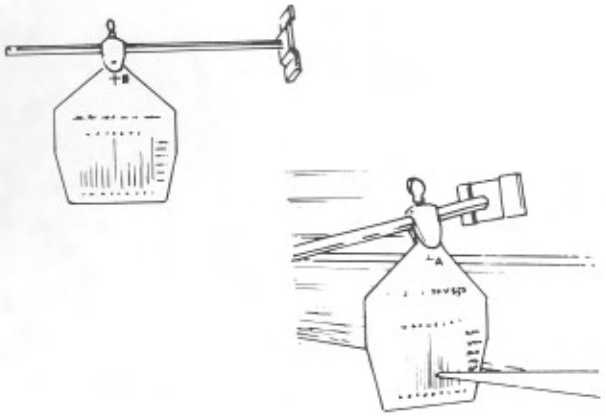
T.Av. 549
Front axle alignment measuring tool
Order Tool No. 700000-54-900 EA



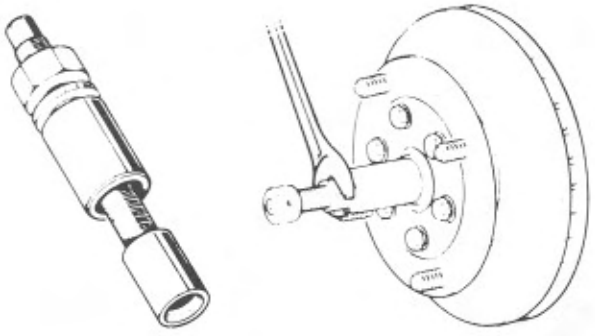
T.Av. 476
Tool for extracting ball joint
Order Tool No. 700000-47-600 EA



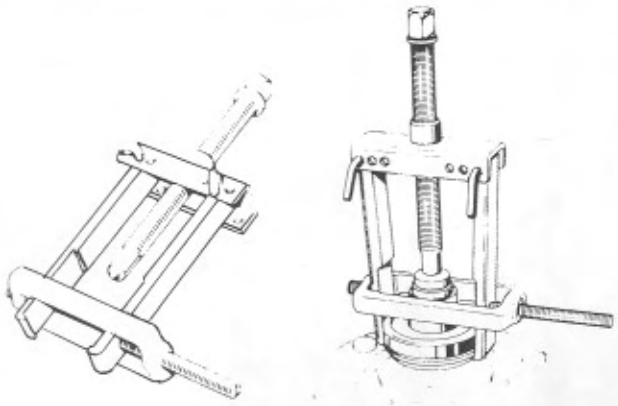
T.Av. 601
Tool for extracting drive shaft and hub
Order Tool No. 700000-60-100 EA



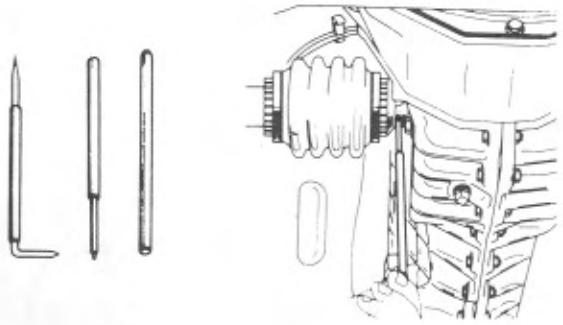
T.Av. 552
Scaleboard for steering box height setting
Order Tool No. 700000-55-200 EA



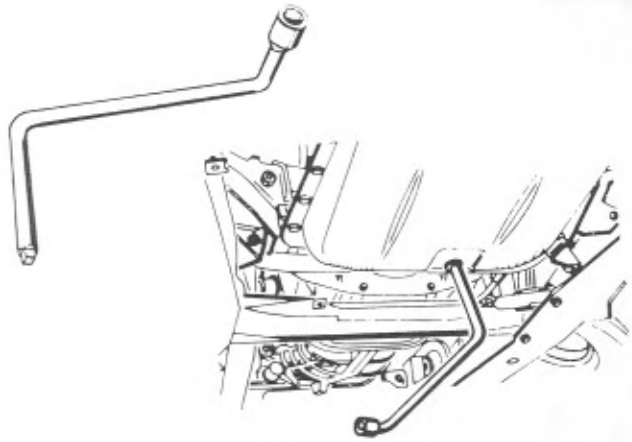
T.Av. 602
Drive shaft inserting tool
Order Tool No. 700000-60-200 EA



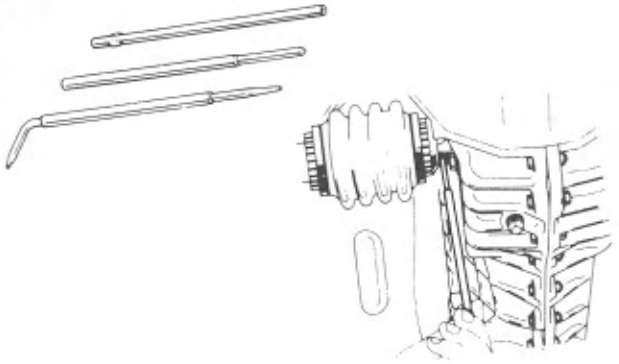
B.Vi. 28-01
Bearing extractor with jaws 146mm long
Order Tool No. 700012-27-301 EA



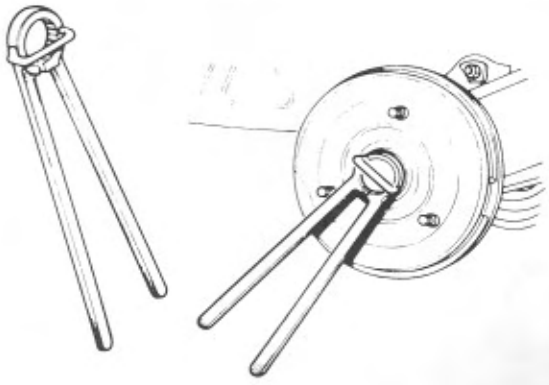
B.Vi. 31-01
Set of drifts for 5 mm dia. roll pins
Order Tool No. 700012-59-401 SET



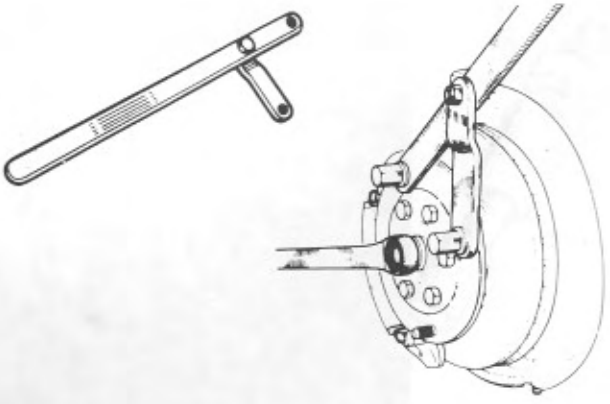
Mot. 593
Engine gearbox drainplug wrench
Order Tool No. 700000-38-100 EA



B.Vi. 606
Set of drifts for extracting and
inserting 6 mm dia. roll pins
Order Tool No. 700000-60-600 SET



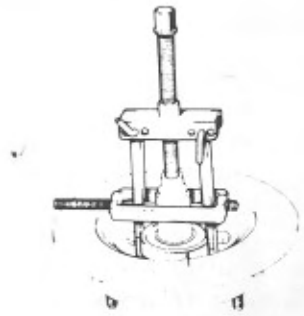
Rou. 441
Pliers for removing-refitting 49 mm dia. grease cup
Order Tool No. 700000-44-100 EA



Rou. 604
Hub locking tool
Order Tool No. 700000-60-401 EA

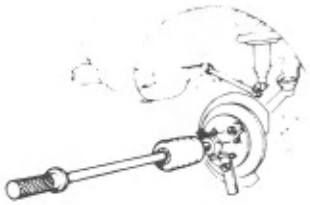
SPECIAL TOOLS



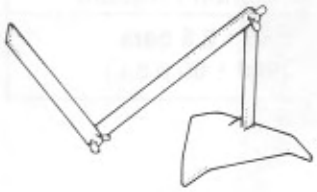


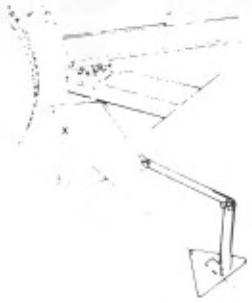
Rou. 15-01
Protective end cup with 16 mm dia. bore for shaft
Order Tool No. 700013-31-601 EA



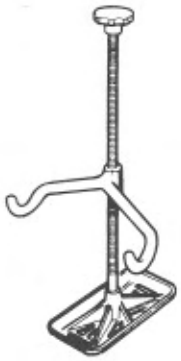


Ms. 580
Slide Hammer for hub removal.
Use with T.Av. 601
Order Tool No. 700000-58-000 EA





T.Av. 605-04
Height gauge
Order Tool No. 700000-60-504 EA





Ms. 504-01
Steering wheel lock
Order Tool No. 700000-50-401 EA

SPECIFICATIONS

Features
Independently sprung wheels and MacPherson® front suspension.

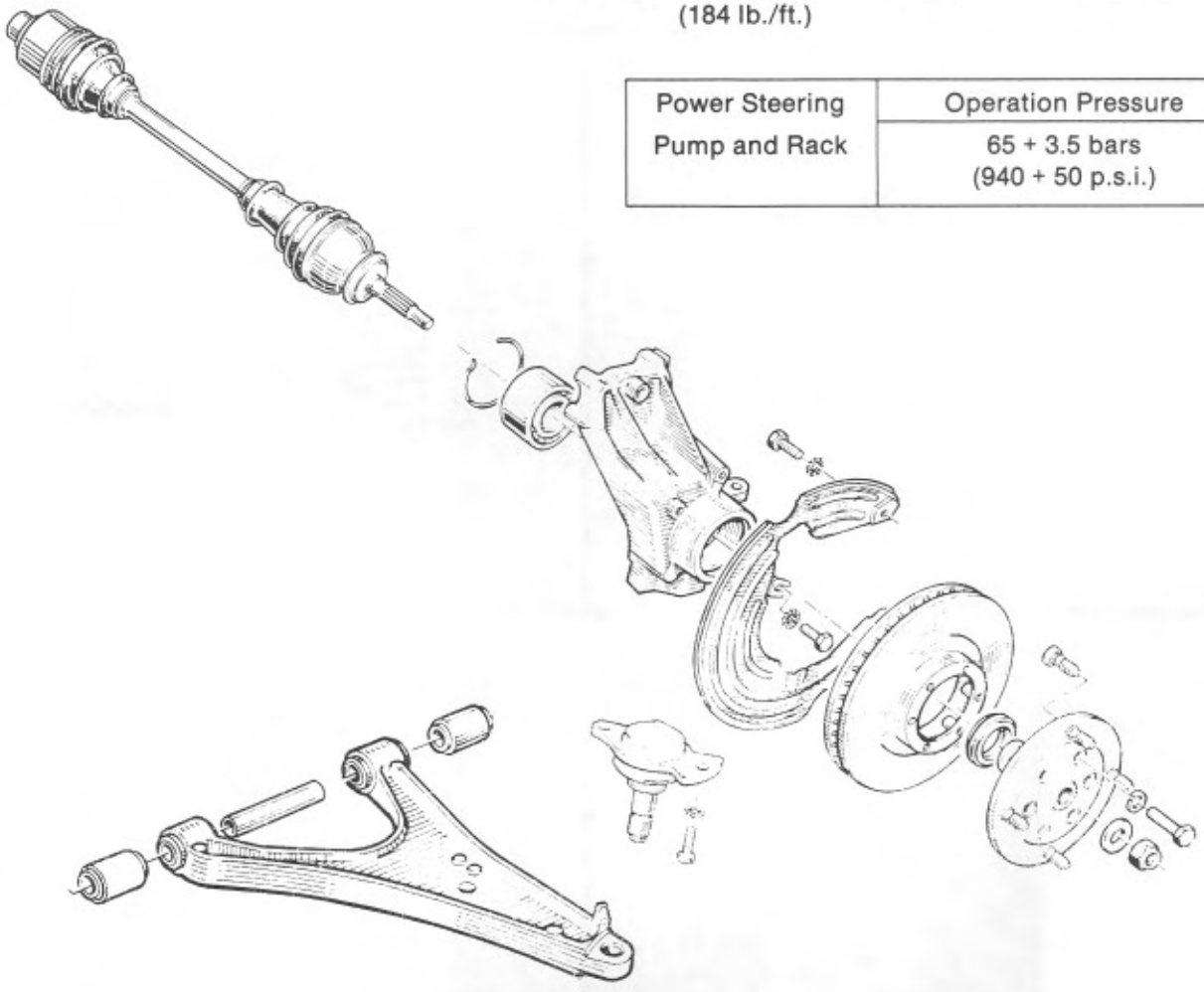
Suspension pivot point:
- at chassis end: rubber bushes in lower arm and at top of strut.
- at wheel end: sealed ball joint at bottom of strut.

MacPherson® struts pivot at top in sleeve and sealed needle thrust bearing:
- Rack and pinion steering box
- Front wheel drive (FWD) via drive shafts with constant velocity joint
- Hubs fitted with dual-row ball bearings.

If it becomes necessary to replace a front axle bearing on a straight splined driveshaft, the following procedures MUST be followed during reinstallation to ensure the proper performance and longevity of the replacement bearings.

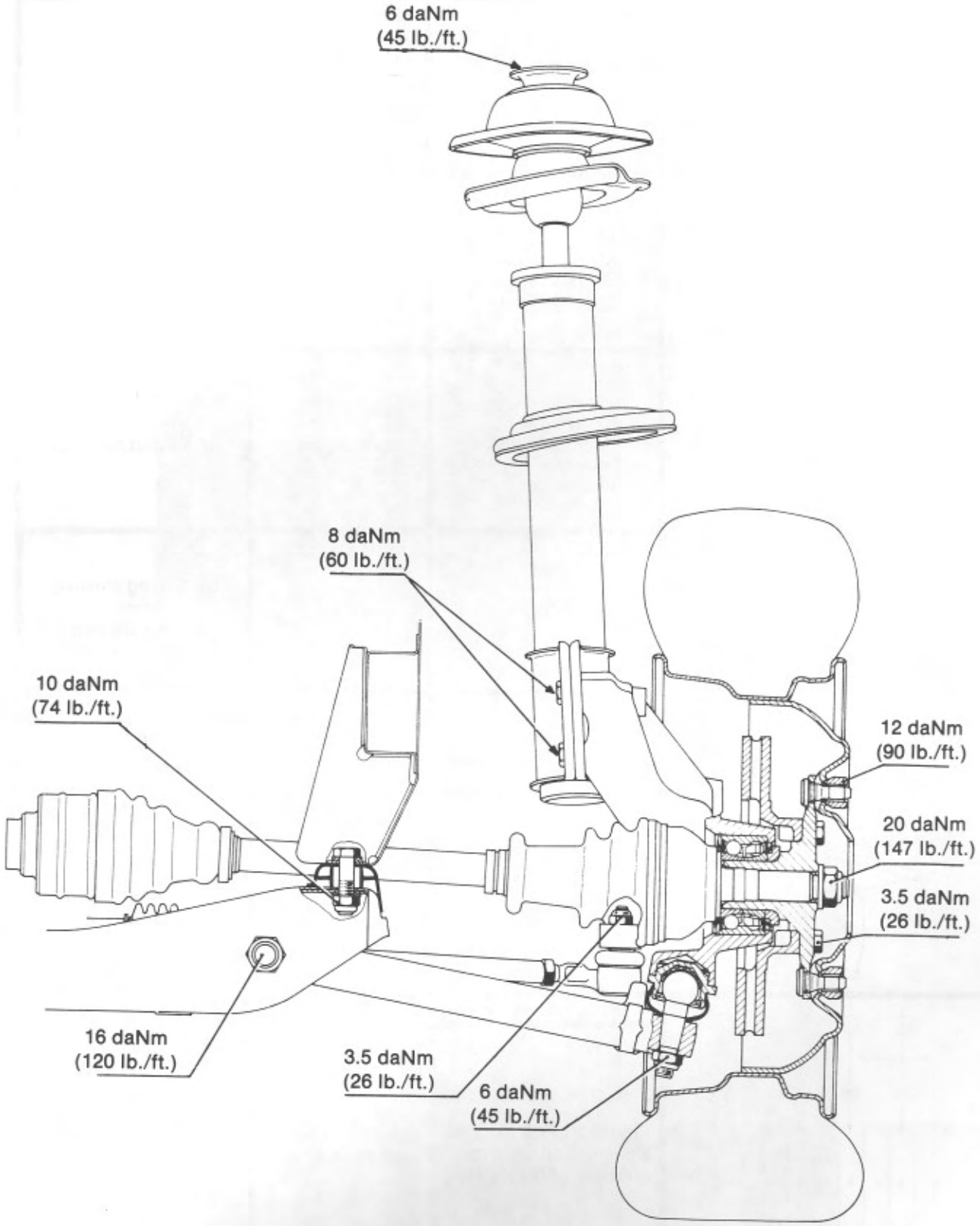
1. Apply shaft sealer (Loctite® 680 High Strength®) (Winnebago part number 076062-01-700), see section K4-5. **Do not use any other form of Loctite® for this operation,** as it will not meet the required specifications. Be careful not to apply shaft sealer onto the surrounding parts.
2. When reinstalling the assembly, always replace the driveshaft washer (Winnebago part number R79030-53-143) and the driveshaft nut (Included in Front Bearing Kit - Left or Right - Winnebago part number R77014-62-021).
3. Torque tighten the driveshaft nut to 25 daNm (184 lb./ft.)

Power Steering	Operation Pressure
Pump and Rack	65 + 3.5 bars (940 + 50 p.s.i.)



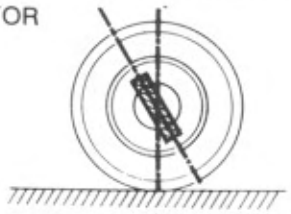
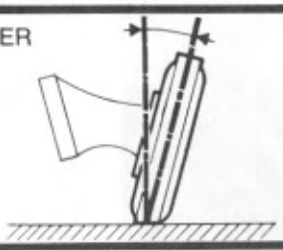
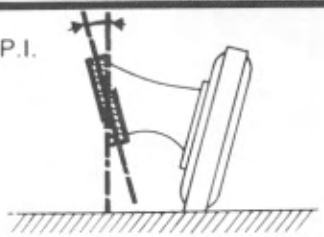
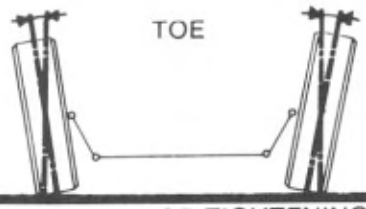
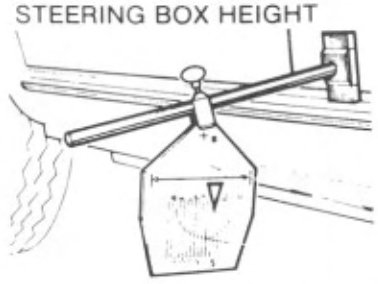
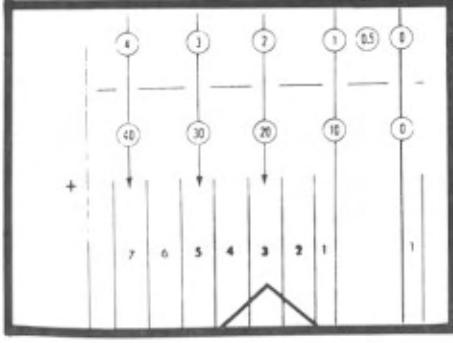
SPECIFICATIONS

TIGHTENING TORQUES



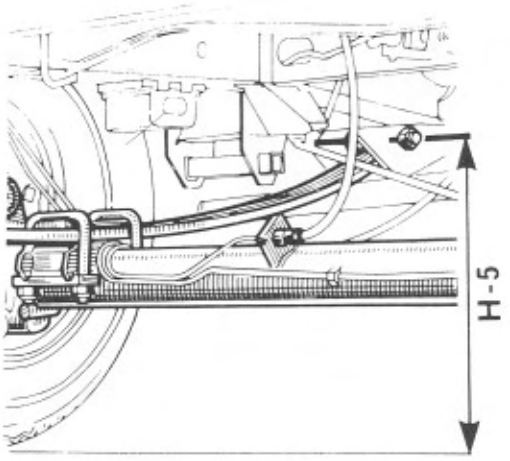
SPECIFICATIONS

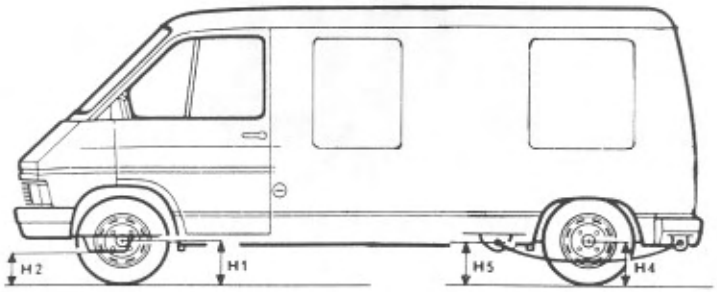
FRONT AXLE GEOMETRY

Angles	Values	Checking position	Adjustment
CASTOR 	1°30') 1°) 0°30') ± 30' 0°) Max. difference between R.H. and L.H. sides 1°	Short Long 90 90 H^5-H^2 110 110 H^5-H^2 130 135 H^5-H^2 150 160 H^5-H^2	NON-ADJUSTABLE
CAMBER 	1° ± 30' Max. difference between R.H. and L.H. sides 1°	UNLADEN	NON-ADJUSTABLE
K.P.I. 	9° ±30' Max. difference between R.H. and L.H. sides 1°	UNLADEN	NON-ADJUSTABLE
TOE 	Toe-out 0°10' ±10' (1 mm ± 1)	UNLADEN	By turning steering arms: 1 complete turn= 30' (3 mm)
POSITION FOR TIGHTENING RUBBER BUSHES		$H_1 - H_2 = 100$ mm	In this position tighten the lower arm pivot pin
STEERING BOX HEIGHT 	Method with compression		BY SLOTS
	8 to 10 On 55-200. scaleboards	Low position H^1 - H^2 = 130 mm	
	Method without compression		
	Zone 3 on setting scale From 1.5 to 2.5 mm (per wheel) variation in the direction of the toe-in.	Low position unladen High position unladen + 40 mm	

SPECIFICATIONS

MEASURING POINTS





GREASES

Component	Amount
Oil seal lips	5 g (.175 oz.)
Hub bearings	10 g (.35 oz.)
Drive Shaft Splines	coating
Wheel Stud Threads	coating
MacPherson® Strut (Top Thrust Bearing)	coating
Lower arm pivot pins	coating
Steering Shaft Splines	coating
Steering Shaft Bushings	coating
Steering Arm Pins	coating
Steering Box (Manual only)	20 g (.7 oz.)
Gearbox/Driveshaft Splines	coating
Wheel/Driveshaft Coupling	140 g (5 oz.)
Gearbox/Driveshaft Coupling	160 g (5.65 oz.)

FRONT AXLE GEOMETRY
CHECKING - ADJUSTING

Preliminary Checks

Examine the following and correct if necessary before checking and adjusting the front axle geometry:

- Uniformity of front tires (size, inflation pressure and wear)
- Pivot points
- Condition of rubber bushings
- Play: in ball joints and in bearings
- Wheel end play : not to exceed 1 mm (compensate for this with measuring instruments)
- Underbody height symmetry (condition of suspension).

Sequence of Operations

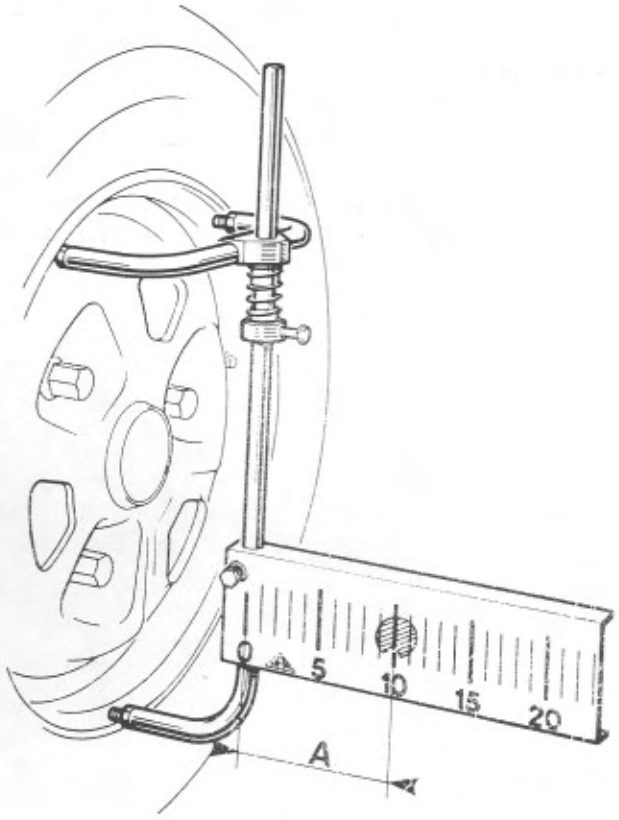
The design of the front axle geometry is such that should one of the angles be altered (caster, camber, KPI, toe and variation) there will be a greater or lesser change in the values of the other angles. (The caster angle exerts the greatest influence).

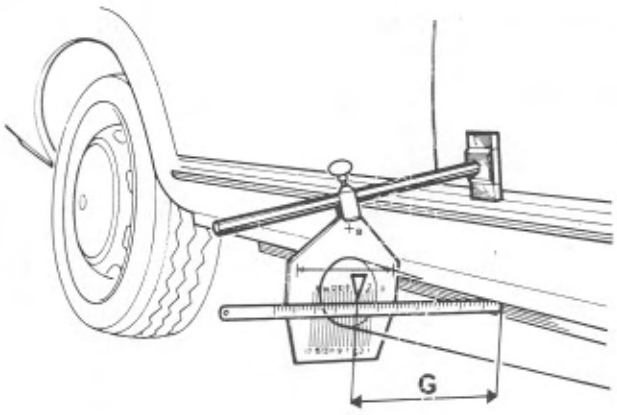
So it is absolutely necessary to follow this sequence:

1. Attach the measuring instrument to the vehicle according to the manufacturer's instructions
2. Jack up the vehicle under the body
3. Neutralize any wheel end play
4. Lower the vehicle onto the turntables
5. Attach the brake pedal press
6. Settle the suspension so that it adopts its normal position
7. Align the front wheels in relation to the rear wheels or in relation to the body on each side by turning the steering wheel so as to obtain values A and G which are identical on the R.H. and L.H. sides
8. Set the turntables to zero in this position

Check the following in the order shown and adjust:

1. Castor
2. K.P.I.
3. Camber
4. Steering box height setting
5. Toe and its distribution



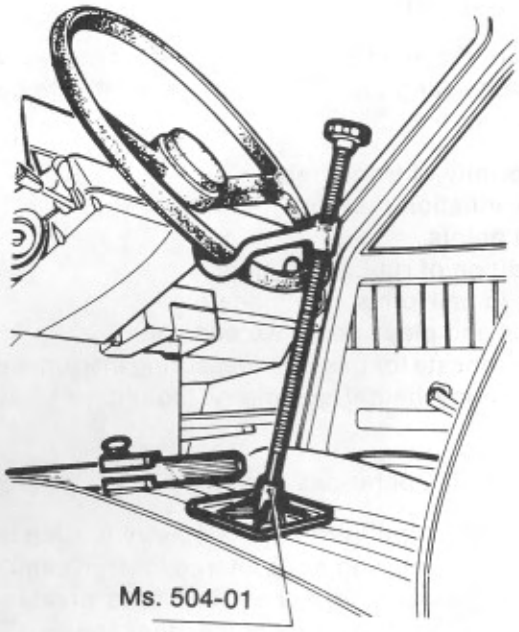


FRONT AXLE GEOMETRY
STEERING HEIGHT SETTING

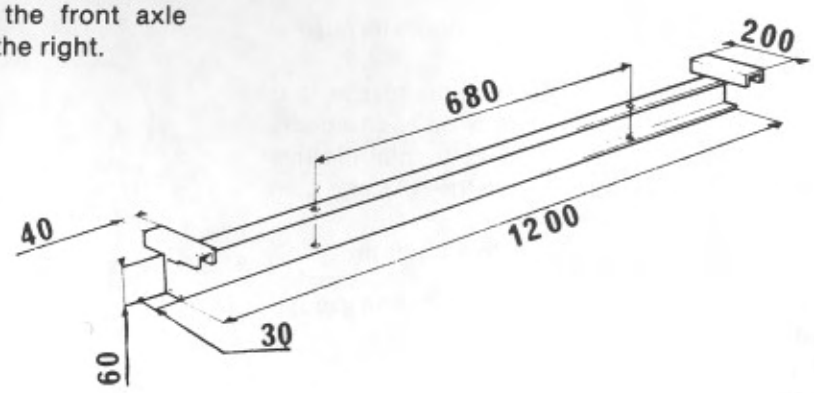
METHOD WITH COMPRESSION

CHECKING

- Place the vehicle on a hoist
- Place the front wheels on turntables and attach the brake pedal press.
- Set the steering to center point then prevent it from turning with steering wheel lock Ms. 504-01.



Fabricate a compressing bar for the front axle locally to the dimensions shown at the right.

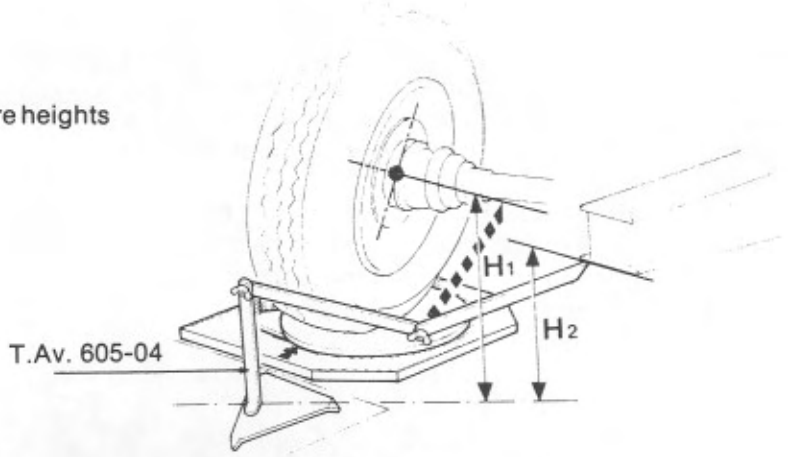


FRONT AXLE GEOMETRY

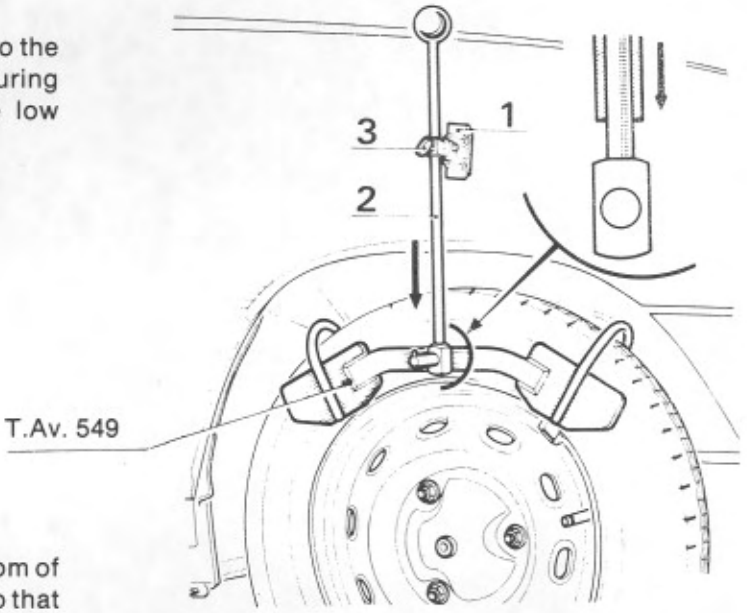
STEERING BOX HEIGHT SETTING

Method with compression

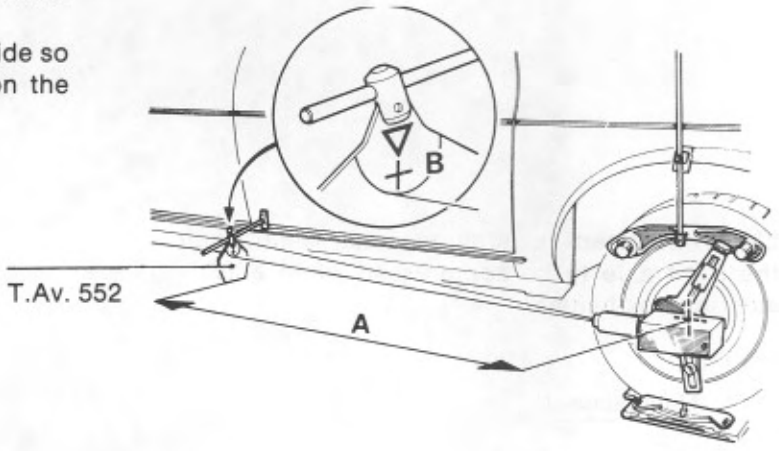
- Use height gauge T.Vi. 605-04 to measure heights H1 and H2.



- Compress the front axle.
- Place tool T.Av. 549 on the tire and hold it to the wing with magnetic base (1). Adjust measuring rod (2) so that it is vertical and in the low position.
- Tighten screw (3)



- Attach a scaleboard (T.Av. 552) to the bottom of each door by means of its magnetic base so that A = 1.30 m (51 5/32") from the front wheel center.
- Mount a measuring instrument on each side so that the beam lines up with cross (B) on the scaleboard.

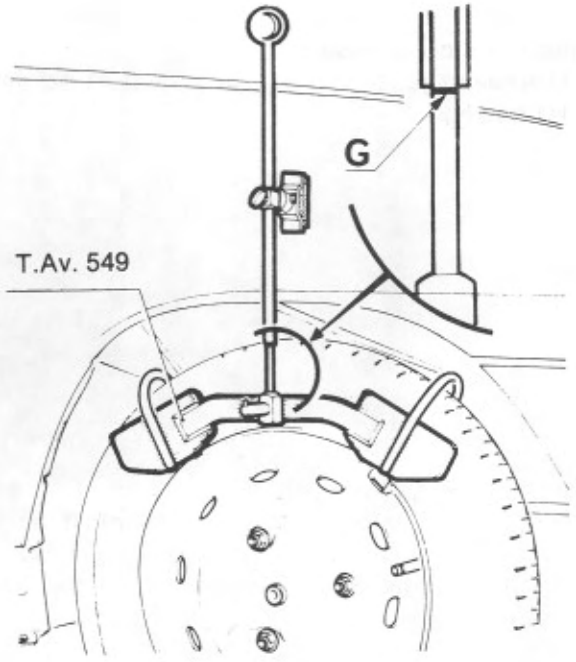


FRONT AXLE GEOMETRY

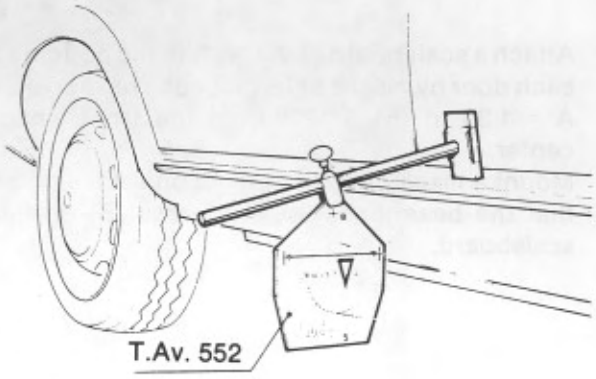
STEERING BOX HEIGHT SETTING

Method with compression

- Jack up the front of the vehicle slowly until red line (G) on T.Av. 549 becomes visible. This corresponds to a front axle height variation of 80 mm (3 5/32").
- In this position, read off the figure nearest the beam tip on the scaleboards on each side.
- Compare the values as read with those given in the chapter "Specifications".



If the beam tip is outside this zone, the steering box height must be increased or reduced to reach the correct value.



List of equipment currently available which requires the front axle to be compressed when adjusting steering box height.

Manufacturer	Type
Facom	U 70
Muller	665

FRONT AXLE GEOMETRY

STEERING BOX HEIGHT SETTING

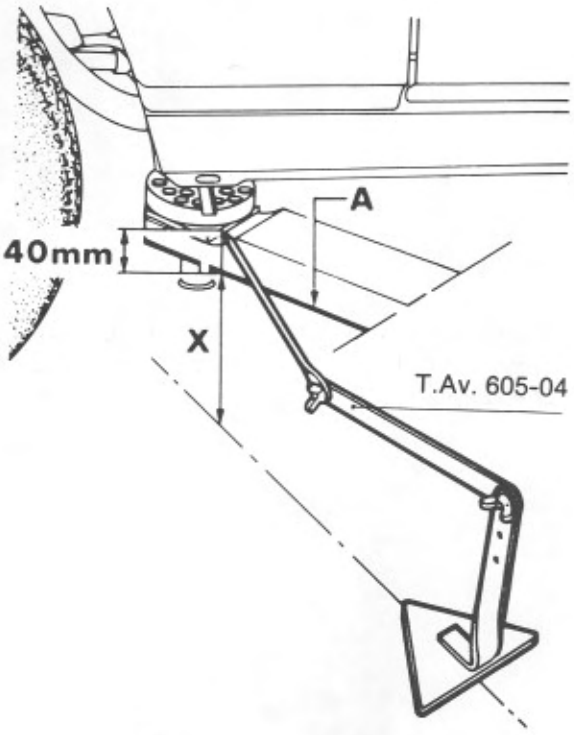
METHOD WITHOUT COMPRESSION

This method is only possible by the back projection method using front axle measuring instruments which read off the toe direct.

CHECKING

- Place the vehicle on a lift.
- It should be empty and in its normal position. Place the front wheel on turntables and fit the brake pedal press.
- Place the lift swing arms under the body front jacking points so that the pads make contact.

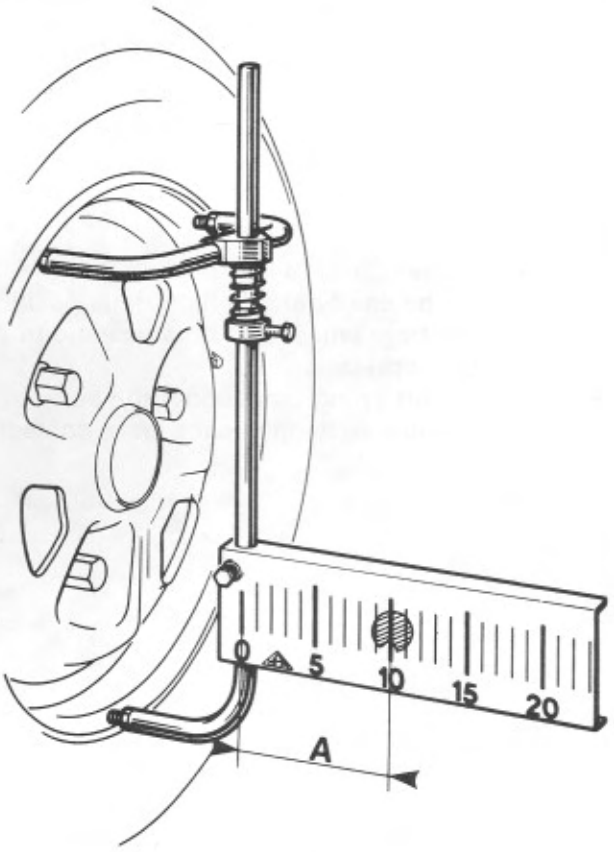
- Measure dimension (X) between the lift floor (or ground) and underside (A) of the swing arm (or under bodyshell).
- Set the tip of height gauge T.Av. 605-04 to dimension X + 40 mm (1 9/16").



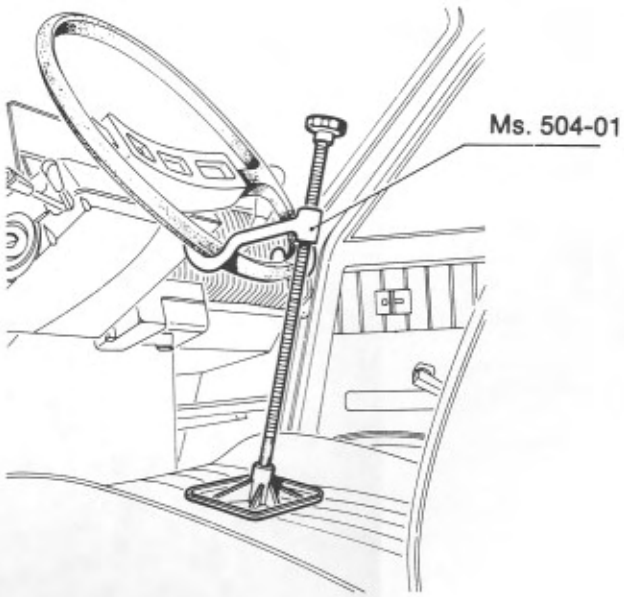
FRONT AXLE GEOMETRY

STEERING BOX HEIGHT SETTING

- Align the front wheels to the rear wheels so that each beam image gives an identical value (A) on the aligning rule (or divide the amount of toe equally).



- Lock the steering wheel with tool Ms. 504-01.
- Read off the toe value of each wheel and note the values.

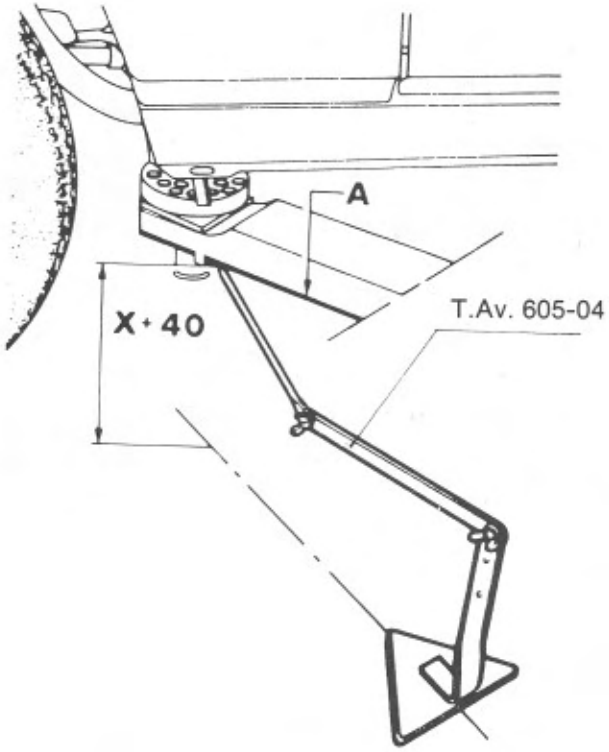


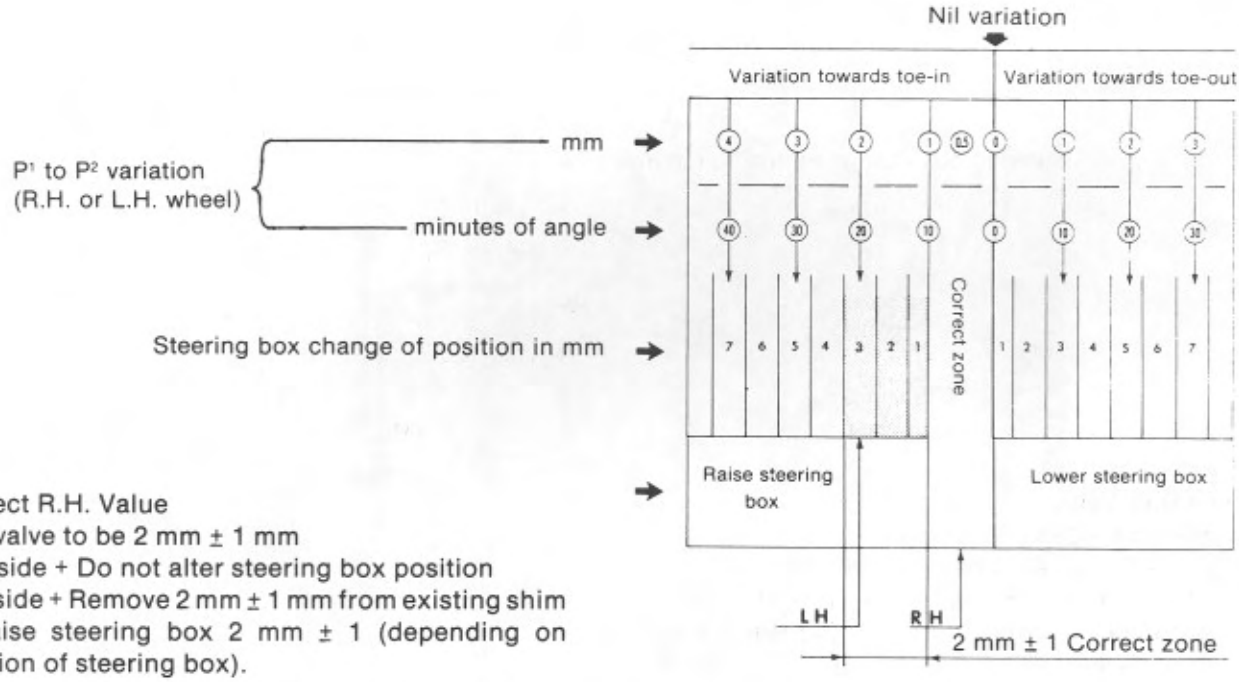
FRONT AXLE GEOMETRY
STEERING BOX HEIGHT SETTING

METHOD WITHOUT COMPRESSION

Identification:
- P^1D is the R.H. front wheel reading
- P^1G is the L.H. front wheel reading

- Now raise the front of the vehicle until the underside of the lift swing arm (or underside of the bodyshell) is level with the tip of gauge T.Av. 605-04.
- Read off and note the new toe values, which are:
  - P^2D for the R.H. front wheel reading
  - P^2G for the L.H. front wheel reading
- Therefore a variation in toe exists of:
  - P^1D to P^2D for the R.H. front wheel
  - P^1G to P^2G for the L.H. front wheel
- This variation may be :
  - towards toe-in
  - towards toe-out
  - or nil (if $P^1 = P^2$)
- Refer the values obtained to the table below and read off the corrections to be made to the existing shims on each side on the vehicle.





Correct R.H. Value
L.H. valve to be 2 mm ± 1 mm
R.H. side + Do not alter steering box position
L.H. side + Remove 2 mm ± 1 mm from existing shim or raise steering box 2 mm ± 1 (depending on position of steering box).

- After adjusting the steering box height, recheck, then adjust the parallelism to keep the steering wheel centered.

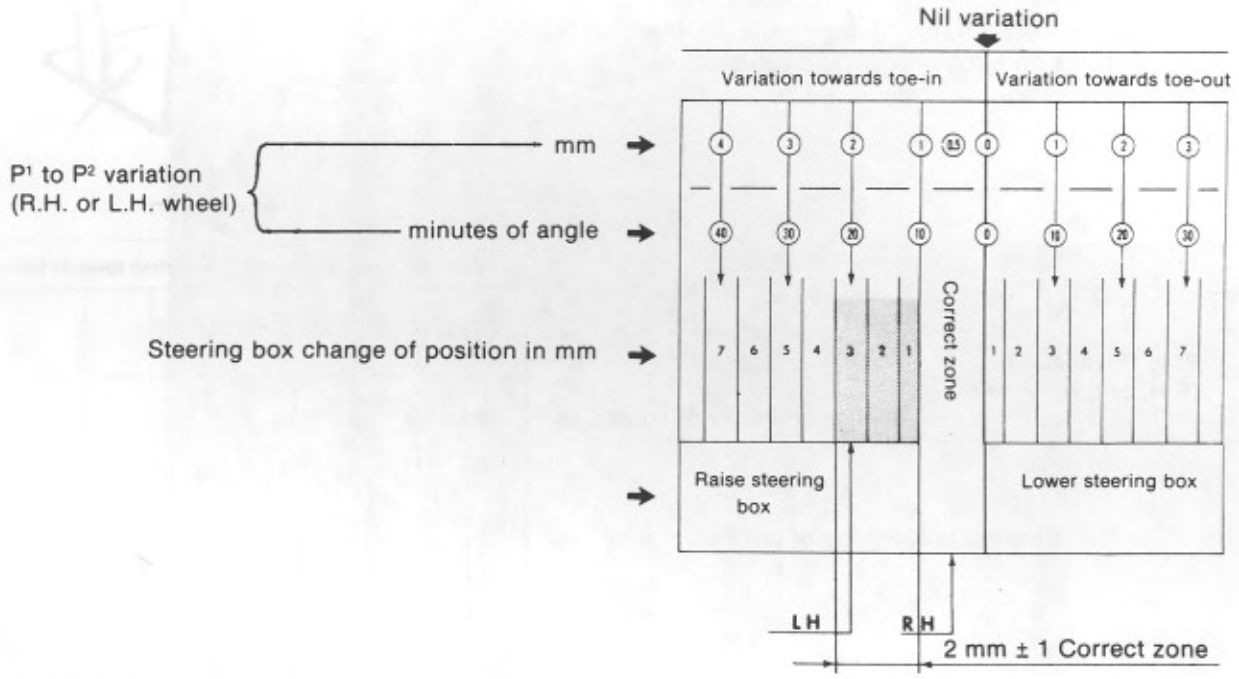
FRONT AXLE GEOMETRY
STEERING BOX HEIGHT SETTING

Example:

Supposing: P^1D = 2 mm (20') toe-out
P^1G = 1 mm (10') toe-out
and P^2D = 1.5 mm (15') toe-out
Supposing: P^2G = 1 mm (10') toe-out

Then:
- the variation between P^1D and P^2D = 2 mm (20') to 1.5 mm (15') of toe-out
  = a variation towards toe-in of 0.5 mm (5')
- the variation between P^1G and P^2G = 1 mm (10') toe-out to 1 mm (10') toe-in
  = a variation towards toe-in of 2 mm (20')

Now refer the above values to the table on the previous page:



Correct R.H. Value
L.H. valve to be 2 mm ± 1 mm
R.H. side = Do not alter steering box position
L.H. side = Remove 2 mm ± 1 mm from existing shim or raise steering box 2 mm ± 1 (depending on position of steering box).

- After adjusting the steering box height, recheck then adjust the parallelism to keep the steering wheel center.

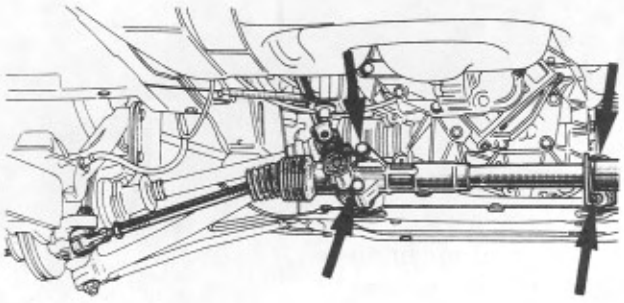
FRONT AXLE GEOMETRY

STEERING BOX HEIGHT SETTING

ADJUSTING

Always begin the operation with the side which is the furthest from the correct zone.

- Loosen the four steering box mounting bolts and move the box by hand to:
  - bring the beam tips onto the correct zones on the T.Av. 552 scaleboards (method with compression)
  - carry out the corrections given in the table (method without compression).
- Retighten the four bolts gradually and check the setting.
- Check the toe and adjust if necessary.



List of apparatus currently available in the U.S. giving a direct parallelism reading wheel by wheel:

Manufacturer	Type
Lowener	Uniflex
John Bean	Optoe Liner
Hunter	Autron-a-Line
Muller	666

FRONT AXLE GEOMETRY

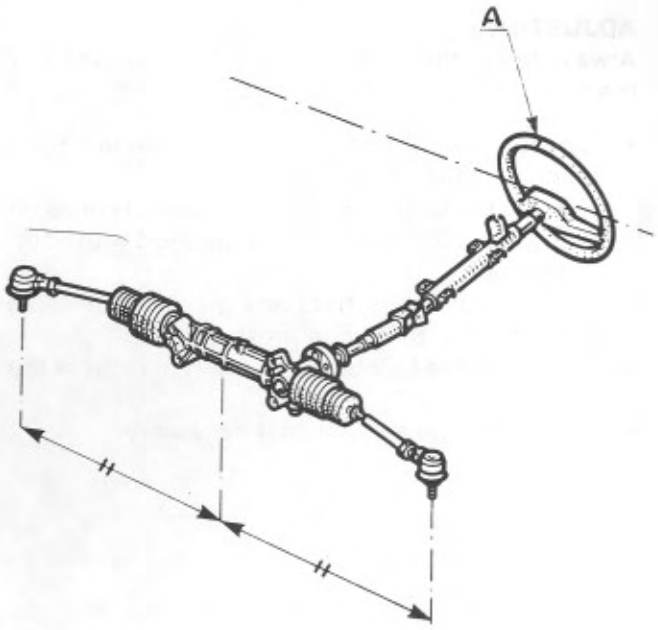
CENTERING THE STEERING WHEEL

With this operation it is not necessary to remove the bellows to measure the steering center point:

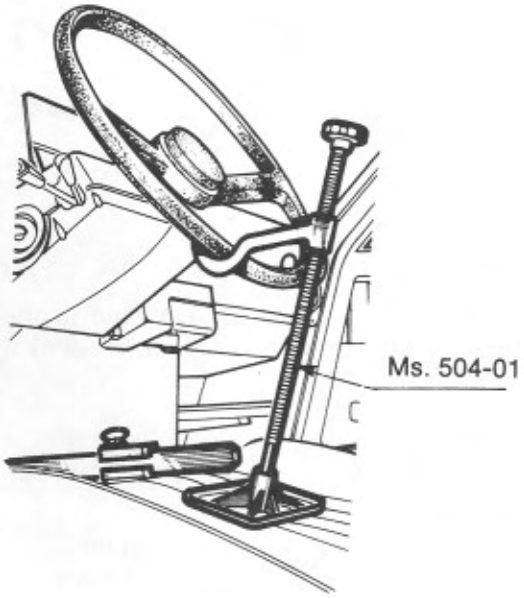
- turn the steering wheel full lock in one direction
- mark the top center of the rim at (A)
- now turn the steering wheel on full opposite lock, counting the number of complete turns and fractions of a turn while doing so.
- turn the steering wheel back half the number of complete turns and half the fractions of a turn noted. This is the steering center point.

Remove the steering wheel without moving the setting and mount it to the splines with the spokes as near horizontal as possible.

This is the "Steering straight ahead position".



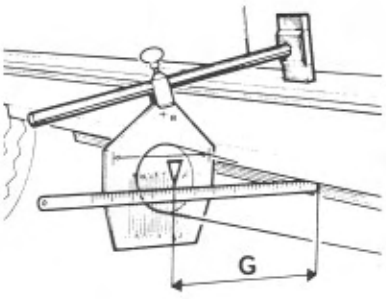
Check that the steering wheel is centered and bring it in the "straight ahead" position with spokes horizontal (see above paragraph).
Prevent the steering wheel from turning using lock Ms. 504-01.

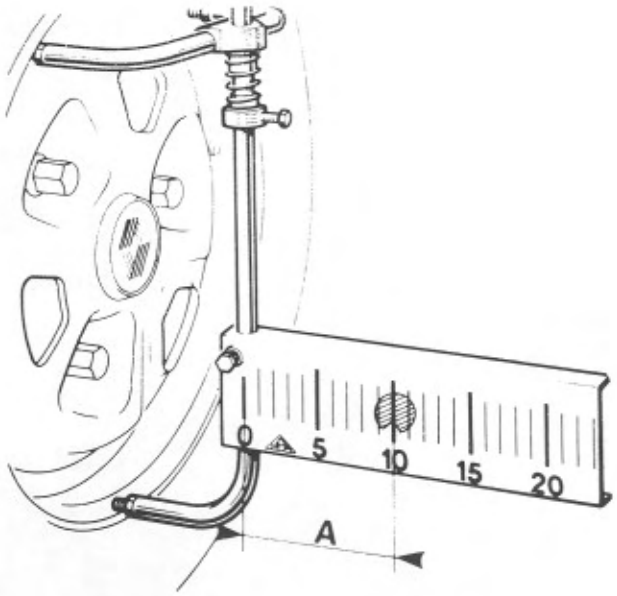


FRONT AXLE GEOMETRY

PARALLELISM

Measure the toe and then how it is divided between the two sides either in relation to the rear wheels (dimension A) or in relation to the body sides (dimension G).

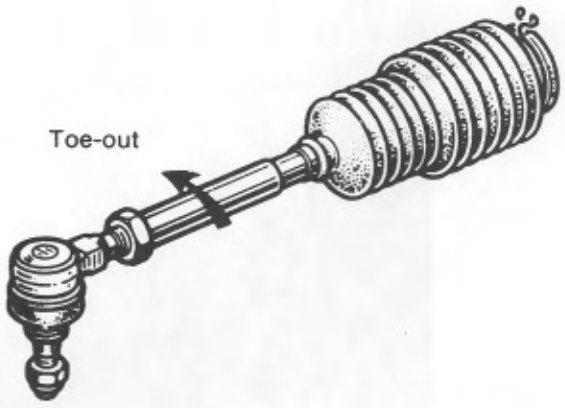




ADJUSTING

There are several possibilities:

Toe-In	Toe-Out	Correction to be made
CORRECT	INCORRECT	Turn each steering arm rod (or end fitting) an equal number of turns but in opposite directions to obtain values A and G which are equal both sides.
INCORRECT	CORRECT	Adjust the toe-in on both sides to the same value making sure that values (A and G) remain the same.
INCORRECT	INCORRECT	Adjust the toe-in first to the correct value, then adjust the toe-out.

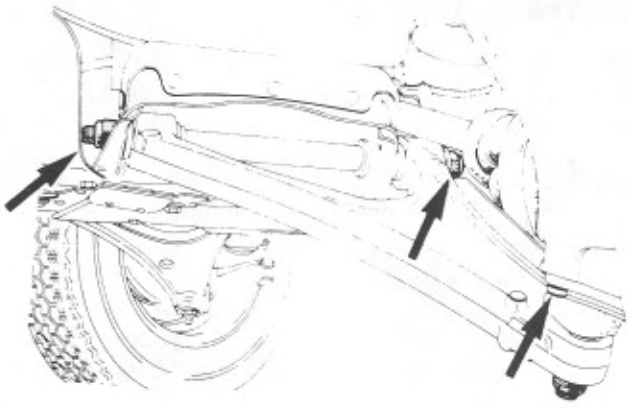


1 complete turn = 30' (3 mm) of toe-in or toe-out.

LOWER SUSPENSION ARMS
REMOVING - REASSEMBLING

TIGHTENING TORQUES

Lower arm pivot pin	16 daNm (120 lb./ft.)
Ball joint mounting screw	2.5 daNm (19 lb./ft.)
Wheel nuts	12 daNm (90 lb./ft.)

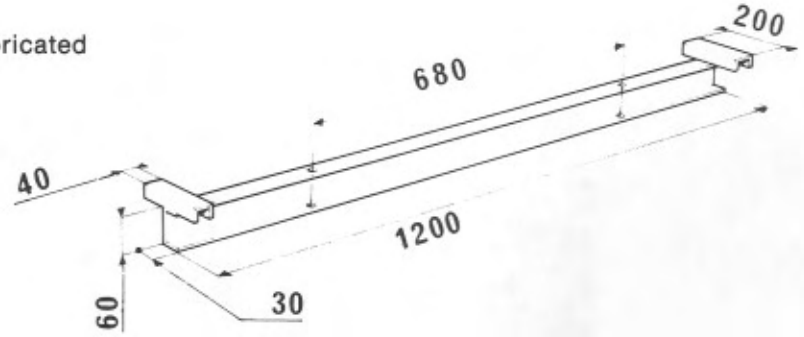


REMOVING

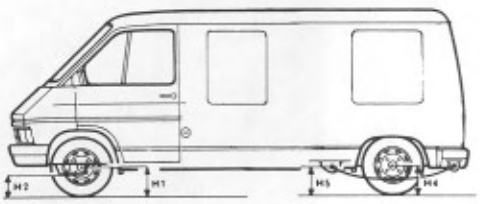
- Place the side concerned on stands and remove the tire.
- Remove the two ball joint mounting screws from the stub axle carrier using a male angle wrench with TORX® T40 tip.
- Withdraw the pivot pin and remove the lower arm.

REASSEMBLING

- Coat the lower arm pivot pin with grease and lift up the arm to the engine crossmember. Degrease the pivot pin threads and screw the nut up. Do not tighten it yet.
- Attach the other end of the arm with its ball joint to the stub axle carrier.
- Lower the vehicle onto its wheels.
- Compress the front axle using a bar fabricated to the dimensions shown at right.



- Compress the front axle so that $H^1 - H^2 = 100$ mm (4").
- Torque tighten the pivot pin nut.



LOWER SUSPENSION ARMS
CHANGING A BALL JOINT

TIGHTENING TORQUES

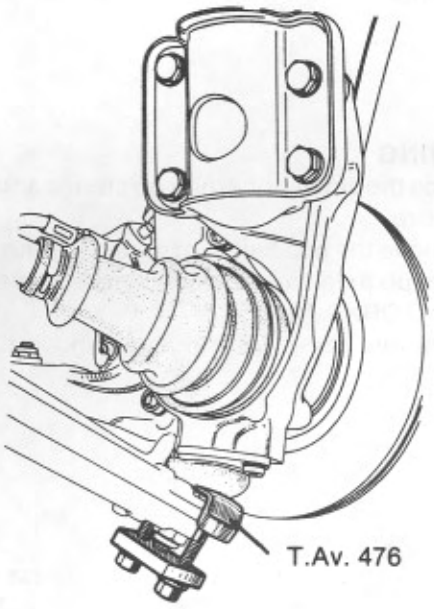
Ball joint nut	6 daNm (45 lb./ft.)
Ball joint mounting screws	2.5 daNm (19 lb./ft.)
Wheel nuts	12 daNm (90 lb./ft.)

REMOVING

- Place the side concerned on stands and remove the tire.
- Unscrew the ball joint nut and remove the lower arm from the taper using extractor T.Av. 476.
- Remove the two ball joint mounting screws from the stub axle carrier using an allen wrench with TORX® T40 tip.

REASSEMBLY

- Mount the ball joint to the stub axle carrier.
- Insert the ball joint taper into the lower arm and screw on the nut.
- Place a jack under the lower arm to prevent the taper from turning in its seat while the nut is torque tightened.

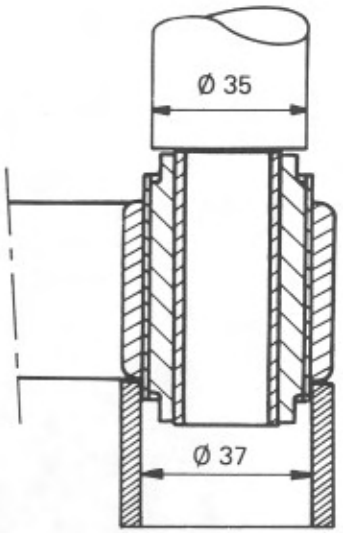


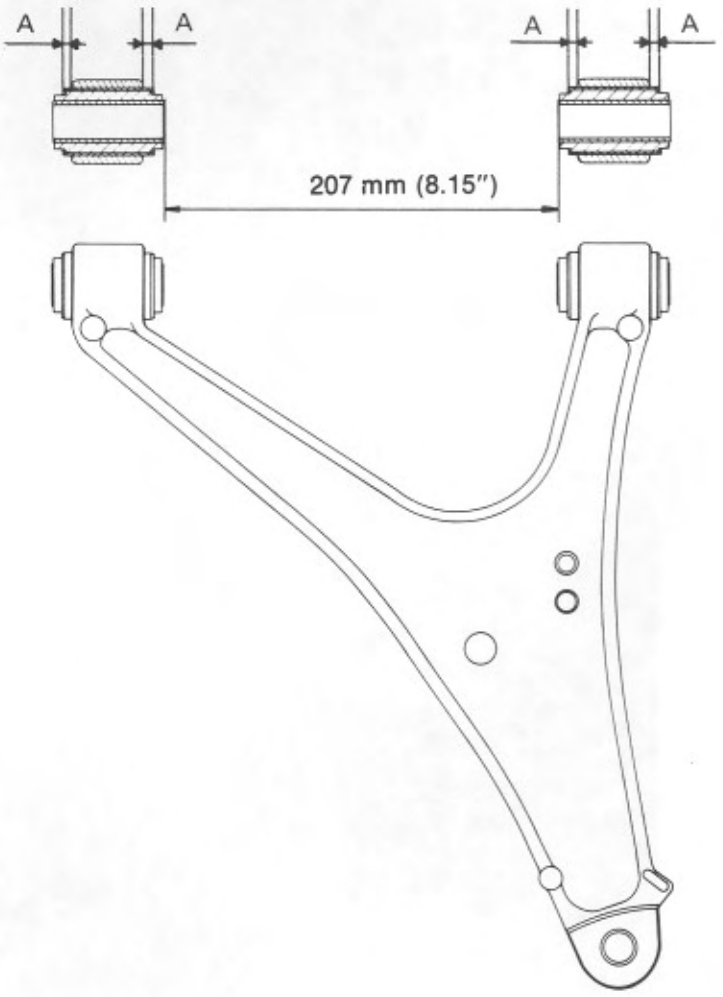
LOWER SUSPENSION ARMS
CHANGING THE RUBBER BUSHINGS

A press is required for this operation after the arm has been removed from the vehicle.

Use a piece of tube 37 mm bore (1.45") under the arm on the press and a 35 mm (1.37") dia. mandrel to push out the bushings.

When pressing in new bushings, they must be symmetrical in relation to the mounting (shown by dimension A) and there must be a distance of 207 mm (8.15") between them as shown below.





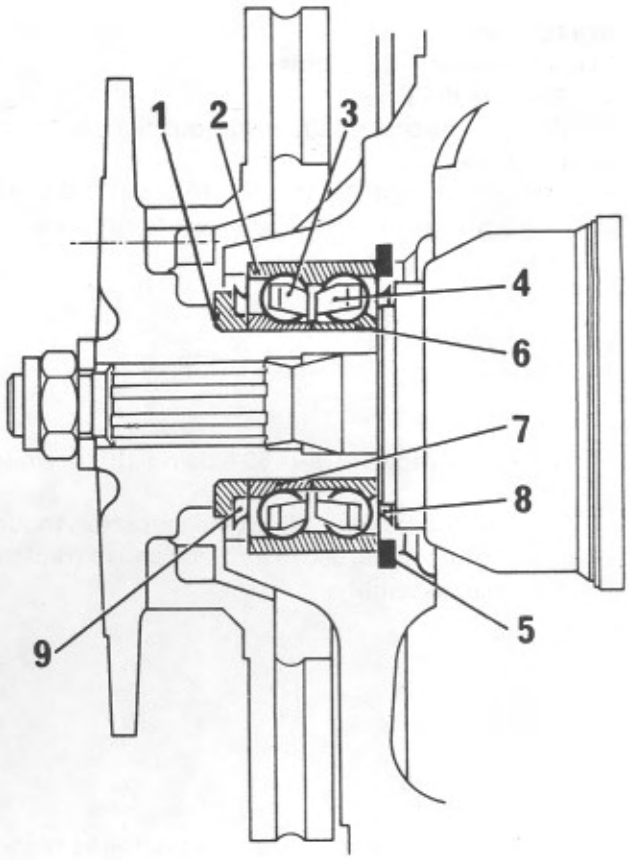
STUB AXLE CARRIERS
CHANGING THE BEARINGS

TIGHTENING TORQUES

Shock absorber bolts	8 daNm (60 lb./ft.)
Ball joint mounting screws in stub axle carrier	2.5 daNm (19 lb./ft.)
Steering arm nut	3.5 daNm (26 lb./ft.)
Drive shaft nut	20 daNm (147 lb./ft.)
Wheel nuts	12 daNm (90 lb./ft.)

Front hub bearings contain:
- 2 rows of balls
- 2 inner races
- 1 outer race
- and 2 lip-type oil seals

1. Inner race thrust washer
2. Outer race
3. Outer ball cage
4. Inner ball cage
5. Circlip
6. Inside inner race
7. Outside inner race
8. Inside oil slinger
9. Outside oil seal

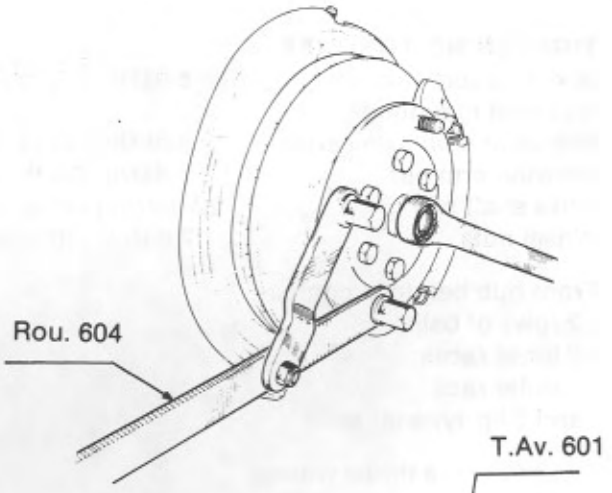


STUB AXLE CARRIERS
CHANGING THE BEARINGS

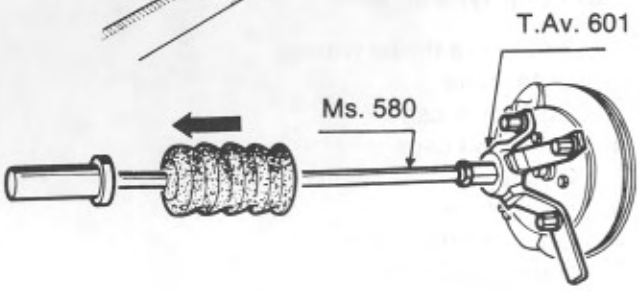
REMOVING

Place the vehicle on stands.

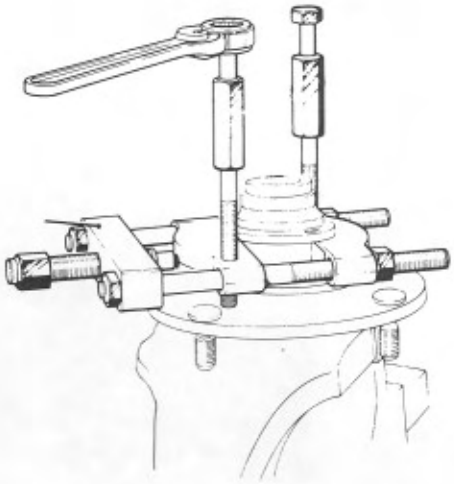
- Remove the wheel.
- Remove the brake caliper without disconnecting the hose.
- Mount locking tool Rou. 604 to prevent the hub from turn turning and unscrew the drive shaft nut.



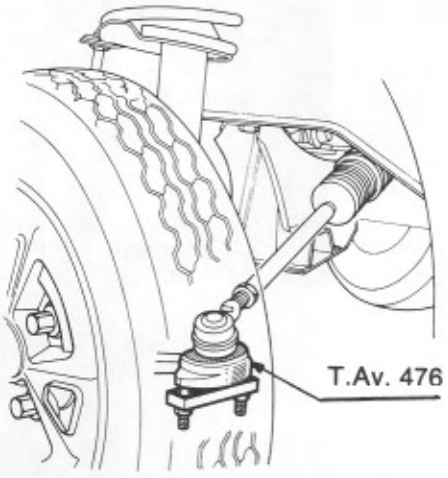
- Mount extractor T.Av. 601 using the 4 wheel nuts.
- Remove the long bolt from the extractor, mount slide hammer Ms. 580 in its place and extract the hub-disc assembly.



- Use an axle bearing splitter/extractor as shown to remove the inner race remaining on the hub. Obtain tool from local tool vendor. Jaw range 0 -100 mm (4").
- Retain the thrust washer.



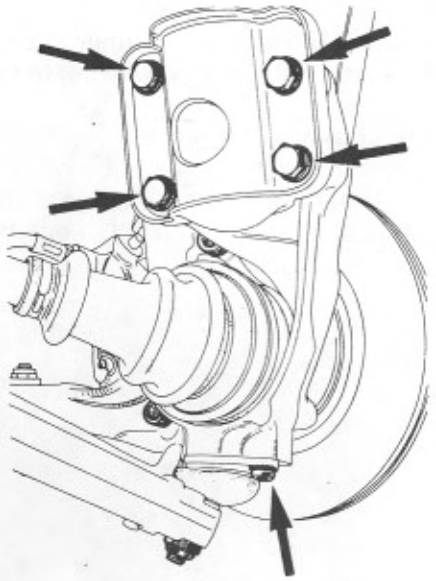
- Extract the steering arm ball joint from the stub axle carrier using extractor T.Av. 476



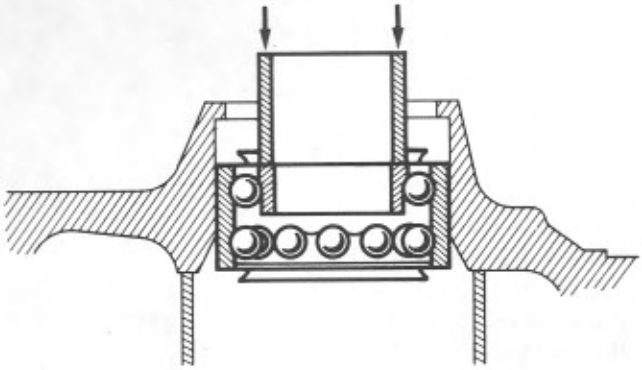
STUB AXLE CARRIERS
CHANGING THE BEARINGS

Remove:

- The Torx@ head bolts from the lower ball joint mount.
- The shock absorber bottom bolts (4).

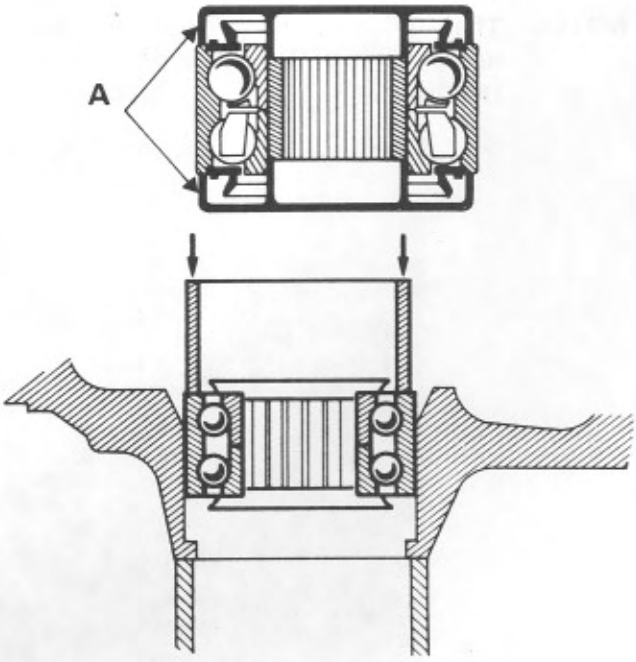


- The circlip from the hub.
- The outer race using a press and one of the old inner races, leaving the ball cages and seals in position.



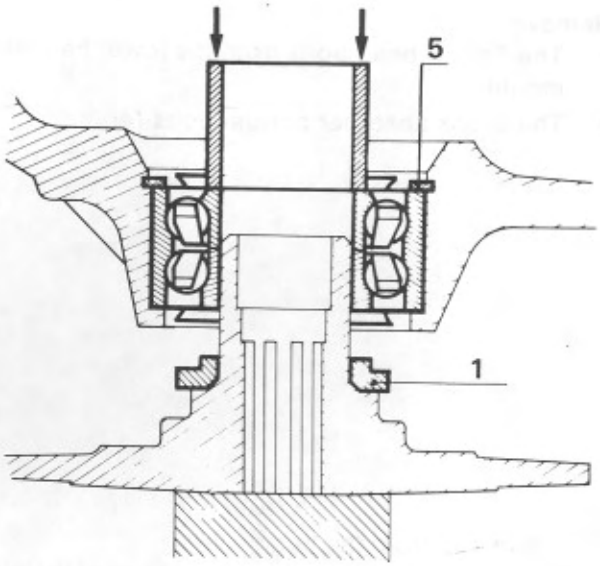
REASSEMBLY

- Remove the two plastic covers (A) from the oil seals on the new bearing.
- Press in the complete new bearing with its plastic ring. Hold the 2 inner races using a piece of tube 83 mm (3.26") OD x 76 mm (3.00") ID. Apply pressure to the outer race only.
- Do not press on the inner race since this could damage the bearing.



STUB AXLE CARRIERS
CHANGING THE BEARINGS

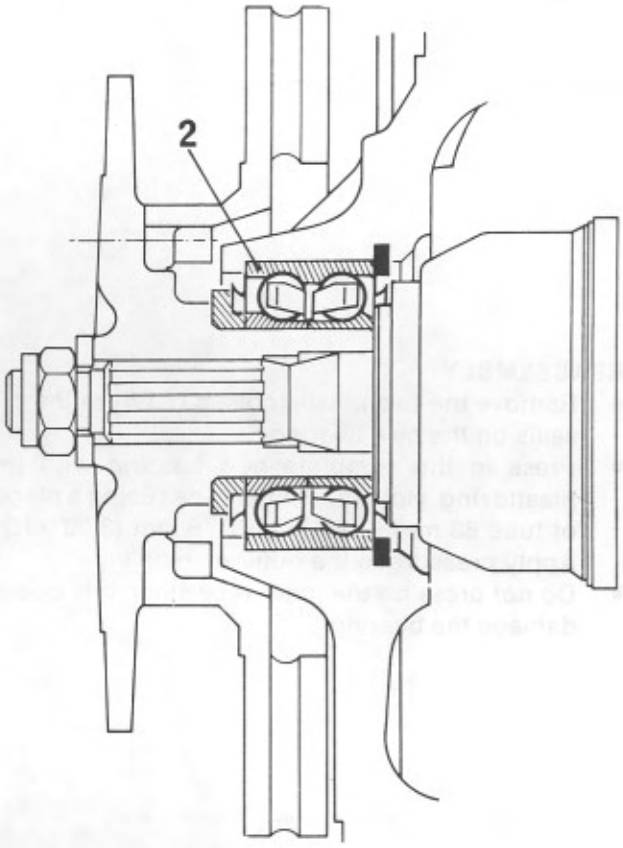
- Insert circlip (5) so that it rests against the outer race. Make certain that it is fully seated in the groove.
- Coat each lip seal with grease.
- Slip thrust washer (1) on the hub and press in the hub-disc assembly using a piece of tube 53 mm (2.08") OD x 43 mm (1.70") ID, applying the load to the inner race.



Stub Axle Carrier
Removal & Reassembly

The bearing replacement steps described above must be performed first in order to gain access to the carrier assembly.

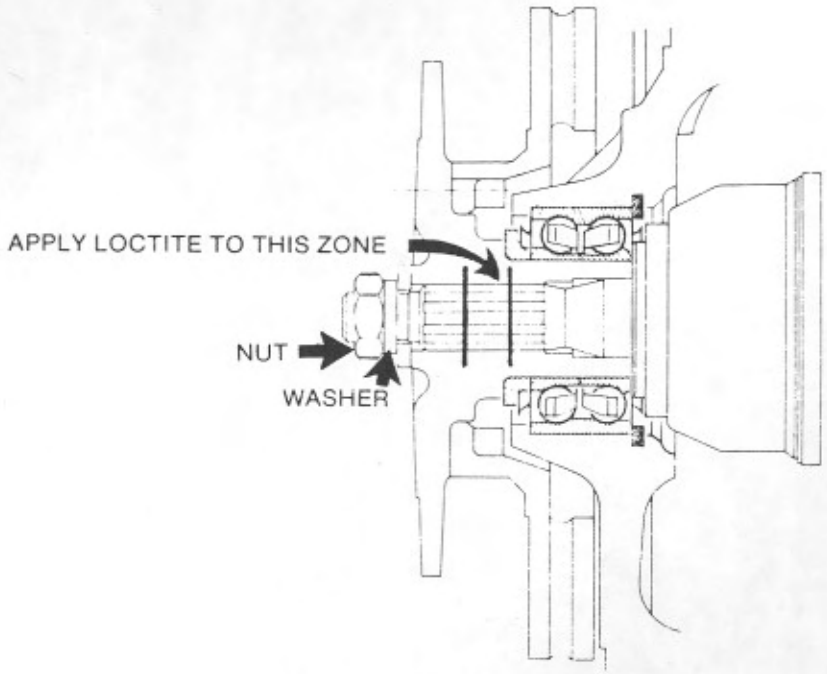
NOTE: The bearing assembly is non-serviceable and must be replaced whenever it is removed.



STUB AXLE CARRIERS
CHANGING THE BEARINGS

If it becomes necessary to replace a front axle bearing or change a driveshaft, the following procedures MUST be followed during reinstallation to ensure the proper performance and longevity of the replacement bearings.

1. Apply shaft sealer (Loctite® 680 High Strength) (Winnebago Part number 076062-01-700), per manufacturer's instructions, onto the center 1/3 of the inside hub grooves (See Diagram). **Do not use any other form of Loctite® for this operation,** as it will not meet the required specifications. Be careful not to apply shaft sealer onto the surrounding parts.
2. When reinstalling the assembly, always replace the driveshaft washer (Winnebago Part Number R79030-53-143) and the driveshaft nut (Included in Front Bearing Kit - Left or Right - Winnebago Part Number R77014-62-021).
3. Torque tighten the driveshaft nut to 20 daNm (147 lb./ft.)



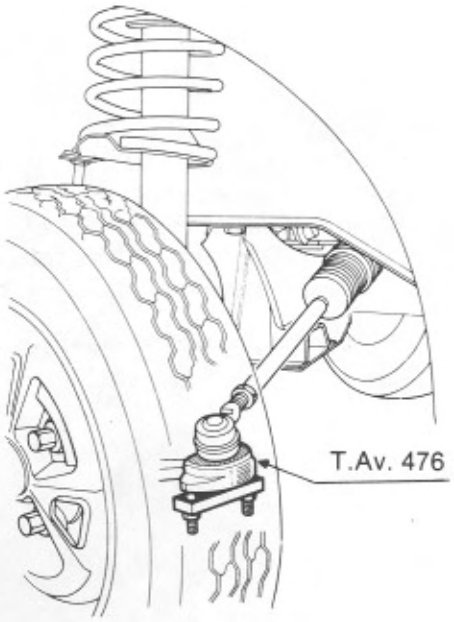
STEERING BOX
REMOVING - REASSEMBLING

TIGHTENING TORQUES

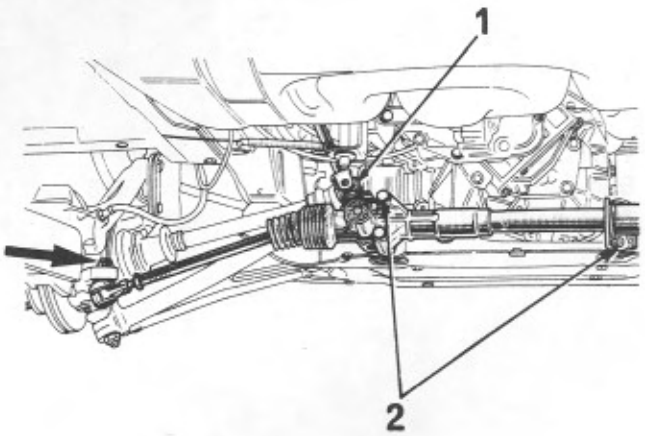
Ball joint nut	3.5 daNm (26 lb./ft)

REMOVING

- Place the front of the vehicle on stands and unscrew the ball joint nuts.
- Use extractor T.Av. 476 to separate the ball joint from the stub axle carrier taper.



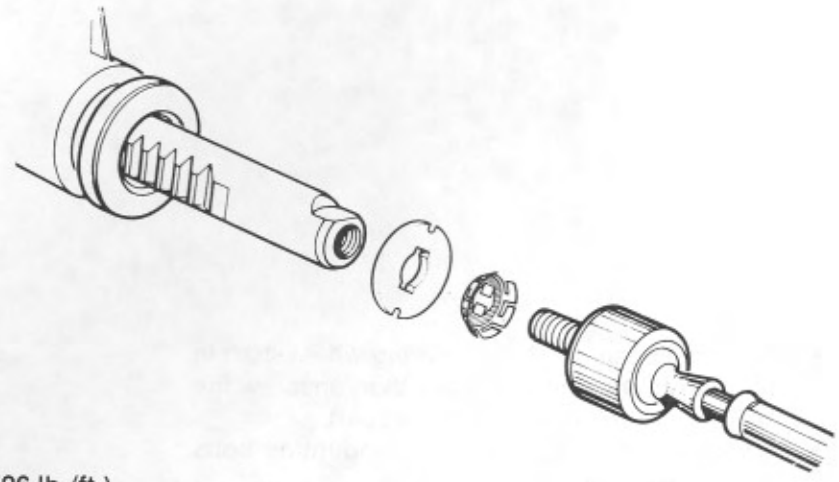
- Mark the position of the steering wheel shaft in relation to the pinion splines than unscrew the key bolt(1) and disconnect the shaft.
- Unscrew the four steering box mounting bolts on the crossmember.
- Remove the steering box complete with its arms.
- NEVER unscrew the rack axial ball joints unless they are to be changed. New lockplates must always be used in this instance.



STEERING BOX
REMOVING - REASSEMBLING

REASSEMBLY

- Mount the axial ball joint components to the rack in the sequence shown.
- Mount the steering box assembly, with arms, to the vehicle. Align the U-joint onto the steering shaft using the mark made before disassembly.
- Check and adjust the steering box height and toe-in.



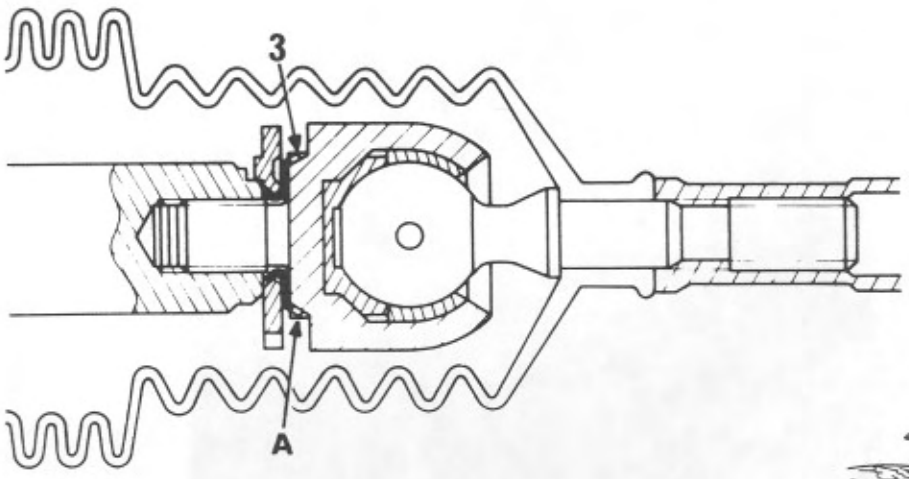
Changing a Steering Arm

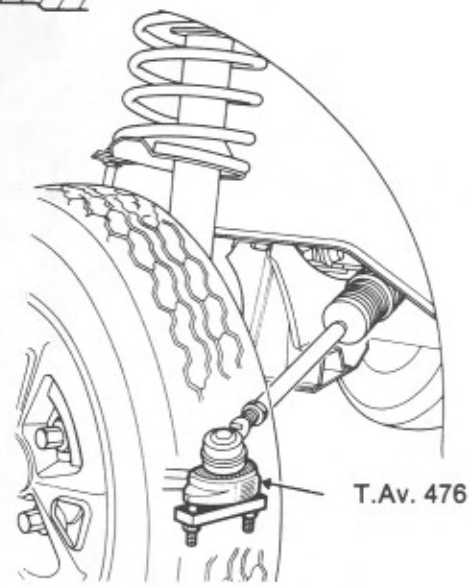
TIGHTENING TORQUES

Ball joint nut	3.5 daNm (26 lb./ft.)
Axial ball joint	4 daNm (30 lb./ft.)

STEERING BOX

CHANGING THE STEERING ARM





STEERING ARMS FITTED WITH AN AXIAL BALL JOINT AND THIS TYPE OF LOCKPLATE CANNOT BE RE-USED ONCE THEY HAVE BEEN REMOVED.

This is because lockwasher (3) damages the notched area (A) on the ball joint body when the assembly is removed and a good mechanical joint is no longer possible on re-assembly.

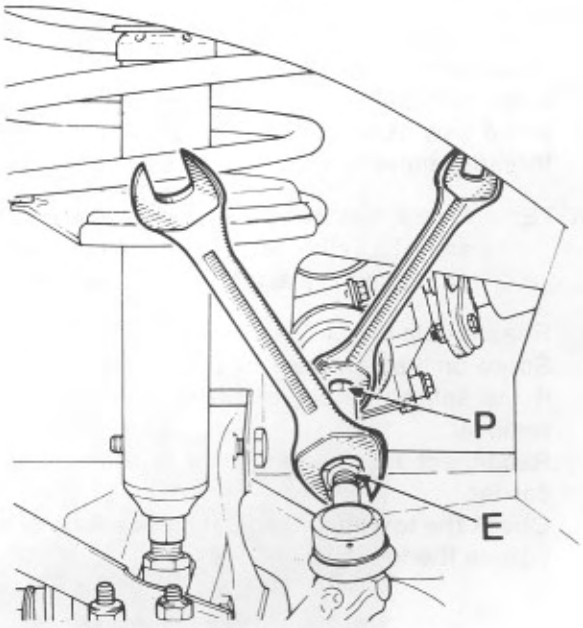
For this reason, the steering arm assembly and lockwasher must be changed routinely after each disassembly.

REMOVING

- Place the side concerned on a stand.
- Disconnect the steering arm ball joints using extractor T.Av. 476

Remove the steering arm ball joint and axial ball joint; to do this:

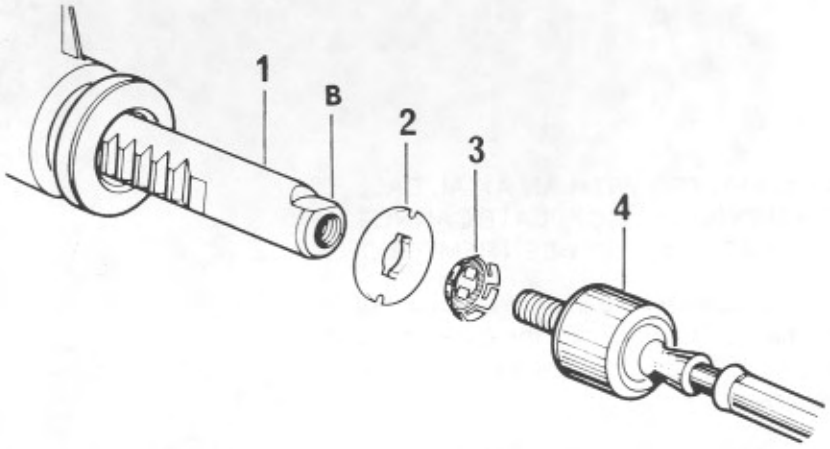
- Hold axial ball joint at (P) with an open end wrench and loosen locknut (E)
- Unscrew the steering arm ball joint, counting the number of turns required to clear the threads so that an approximate toe-in setting may be obtained immediately on mounting the new arm.



STEERING BOX

STEERING ARM AXIAL BALL JOINT

- Remove the rack bellows.
- Unlock the axial ball joint from inside the inner wing panel.



REASSEMBLY

Mount the following to rack (1):

- thrust washer (2)
- a new lockplate (3)
- and a new axial ball joint (4) having coated its threads beforehand with Loctite® or equivalent.

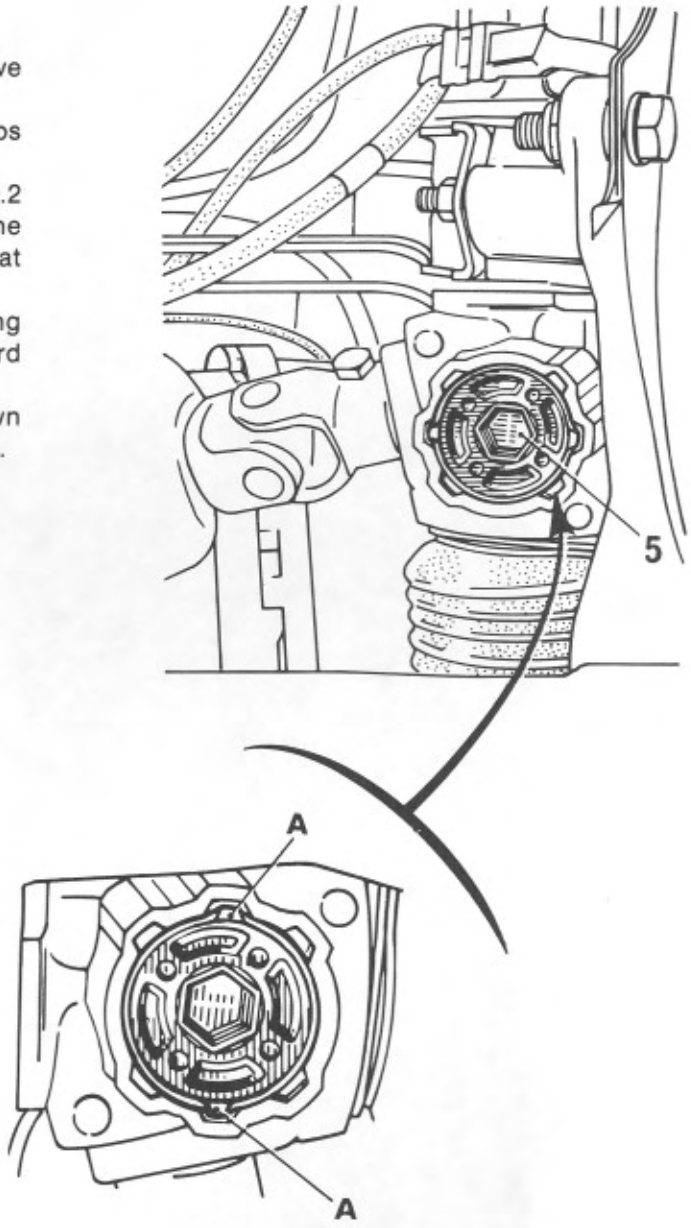
NOTE: Check that the two lugs on lockwasher (3) are in line with flats (B) on the rack before tightening the axial ball joint assembly.

- Reassemble the bellows and its clip.
- Screw on the new steering arm ball joint turning it the same number of turns counted during removal.
- Reconnect the steering arm to the stub axle carrier.
- Check the tow-in and adjust if necessary. Then tighten the locknut.

STEERING BOX

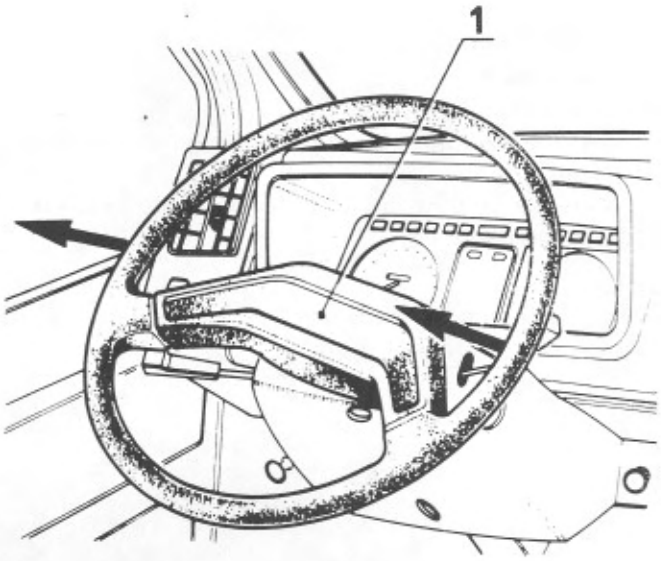
ADJUSTING THE PLUNGER

- Place the vehicle on a frame hoise and remove the front wheels.
- Unlock adjusting nut (5) by raising locking tabs (A).
- Torque tighten the adjusting nut to 1 daNm ± 0.2 (7 1/2 lb./ft.) using a 10 mm allen wrench. The steering wheel should be fairly hard to turn at this point.
- Next, back off the nut 1/4 turn. The steering should now be free turning without any hard spots.
- Lock the nut by bending the nut flange down into two opposite notches in the steering box.



STEERING WHEEL AND SHAFT

REMOVING - REASSEMBLING THE STEERING WHEEL



TIGHTENING TORQUES

Steering wheel nut 4.5 daNm (34 lb./ft.)

REMOVAL

- Remove plastic spoke cover (1)
- Unscrew the shaft nut several turns
- Pull the steering wheel upwards by hand easing it to right and left to free it from the splines.
- Mark its position in relation to the shaft
- Remove the nut and the steering wheel

REASSEMBLY

- Lift up the steering wheel with the marks made on dismantling in line, otherwise recentralize the steering wheel (see corresponding paragraph).

Removing - Reassembling the steering wheel shaft

REMOVING

- Place the front of the vehicle on stands.

From underneath, remove:
- keybolt (1) and disconnect the shaft,
- disconnect the intermediate bearing (2) (2 bolts) and remove it,
- remove 4 nuts (3) holding the shaft column to the firewall.

From inside, remove:
- the steering wheel,
- column covers,
- combination lighting switch,
- anti-theft lock,
- steering column bolts (4) under the dashboard.

Pull out the steering column and shaft assembly from inside.

STEERING WHEEL SHAFT
REMOVING - REASSEMBLING

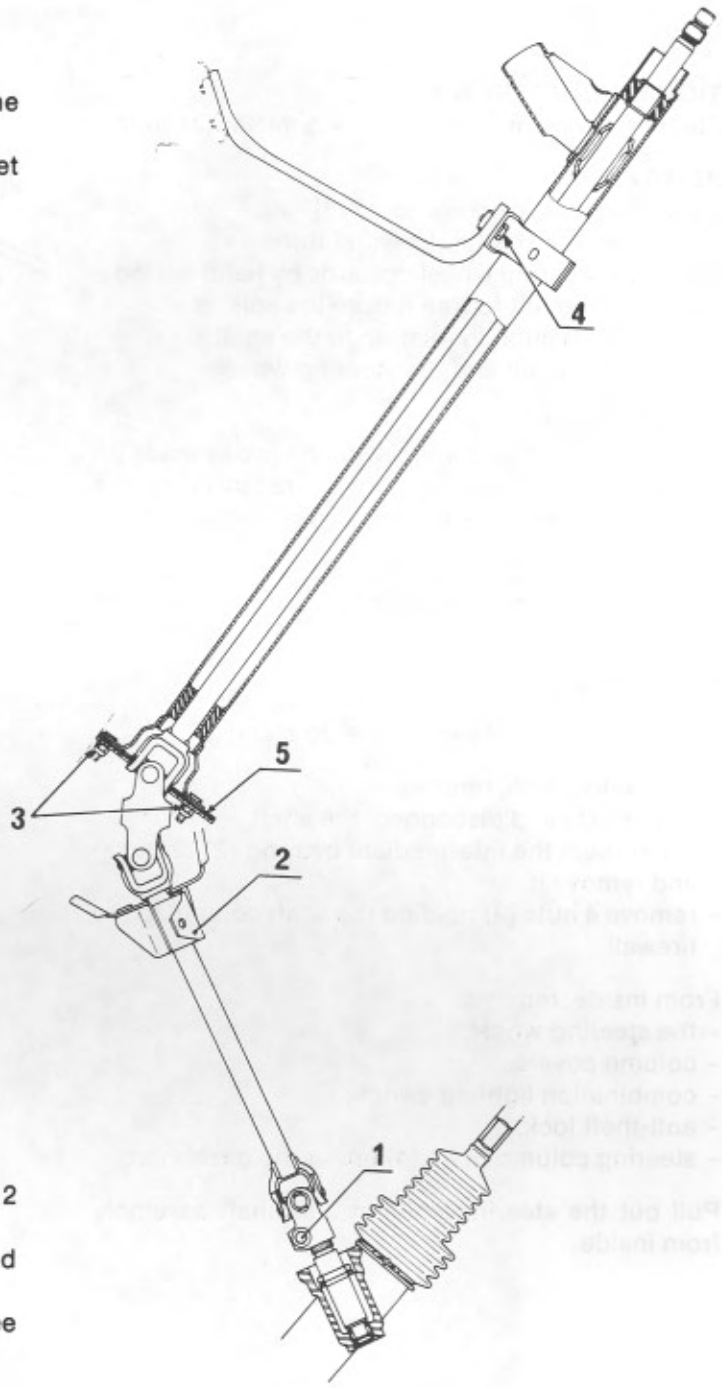
REASSEMBLY

Inside the vehicle

- Insert the steering column assembly through the firewall
- fasten the column by 2 bolts (4) to the bracket under the dashboard.

Reassemble:

- the anti-theft lock
- combination lighting switch
- column covers
- and steering wheel



Underneath the vehicle

- attach the steering column and its plate (5) by 2 bolts
- slide the universal joint over the pinion splines and secure it with keybolts (1) (See section K6-4)
- re-center the steering wheel if necessary (See Section K6-4)

INCORRECT STEERING CENTERING

PROBLEM:
The steering wheel does not return to center position after either a right or left turn - the driver must manually turn the steering wheel back to straighten out.

ORIGIN OF PROBLEM:
1 - Sticking steering.
2 - Hard spot in steering column

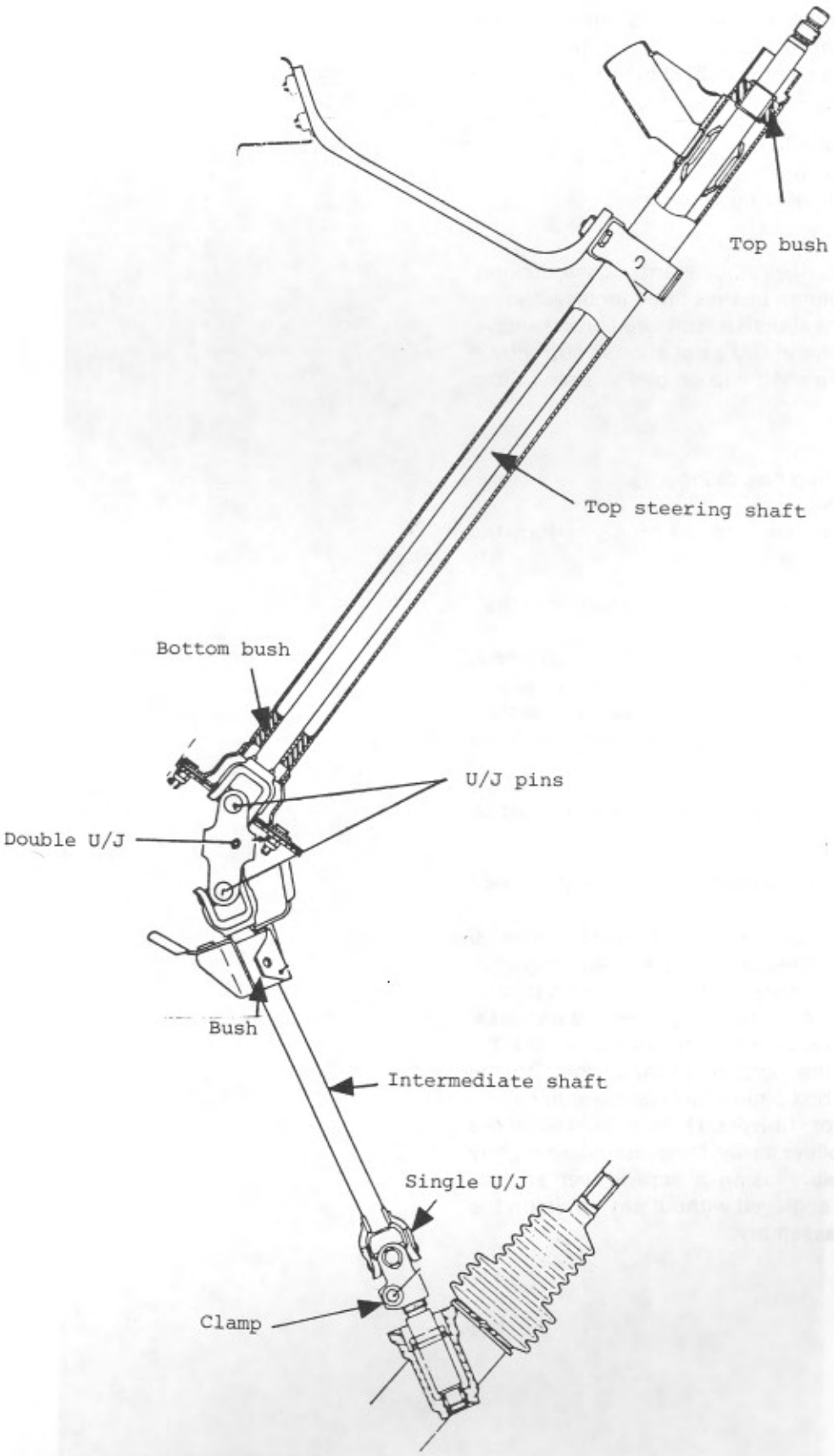
CAUSES:
1 - Incorrect plunger adjustment causes sticking.
2 - Steering column bushes fitted incorrectly.
Steering wheel shaft not greased on assembly.
Steering column U/J's not aligned correctly.
Intermediate shaft clip on pinion shank fitted incorrectly.

SOLUTION:
1 - Adjust steering box plunger
(Refer to K5-5)
2 - If the steering box is not the cause, perform the following operations:

- Disconnect the intermediate shaft from the steering box
- Make sure that the assembly (steering wheel, top shaft and intermediate shaft) turn easily.
- It may be necessary to withdraw the assembly to lubricate or change the bushings. (See K6-5)

In all cases the double universal joint must be aligned as follows:

- Set the front wheels in the straight ahead position.
- Turn the shafts so that the double universal joint pins (see drawing) are at right angles to the intermediate shaft and top shaft plane. This position is reached when the universal joint pins are virtually parallel to the scuttle.
- Now fit the bottom universal joint to the steering box pinion (grease the splines) The bottom universal joint should enter the pinion splines easily. Open the clamp slightly if necessary using a screwdriver so that fitting is achieved without any strain on the column assembly.


Top bush
Top steering shaft
Bottom bush
U/J pins
Double U/J
Bush
Intermediate shaft
Single U/J
Clamp

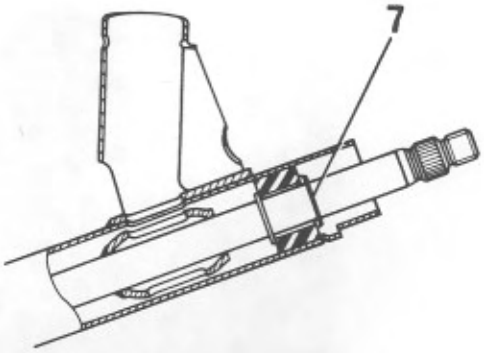
STEERING WHEEL SHAFT
CHANGING THE BUSHES

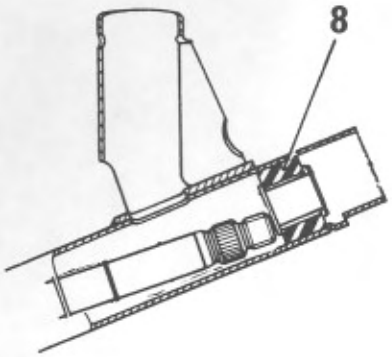
TIGHTENING TORQUE

Steering wheel nut	4.5 daNm (34 lb./ft.)

REMOVING

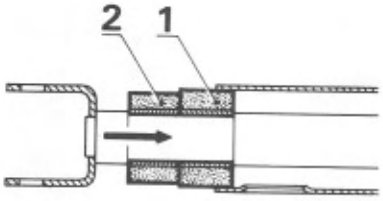
- Remove the steering column assembly (see previous paragraph) but leave the anti-theft lock in position.
- Remove circlip (7) and extract the shaft from the bottom of the column withdrawing the bottom bushing at the same time.
- Now use the top of the steering wheel shaft at an angle to push out top bushing (8).

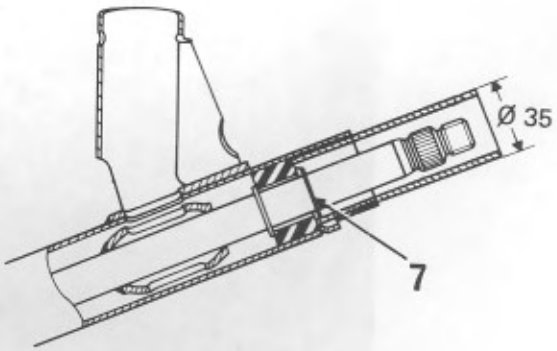




REASSEMBLY

- Coat the inside of the new bushing with grease and the outside with rubber lubricant or soapy water solution.
- Lift up the new bottom split bushing (1) to the shaft with an old bush (2) reduced 2 mm (0.08") in diameter underneath it.
- Insert the shaft with its new bottom bush into the bottom of the steering column and push in until the bushing is between the indents.
- Withdraw the shaft and remove the old bushings (2).
- Tap the top bushing into the top of the column using a piece of tube 35 mm (1.38") diameter.
- Attach the circlip
- Reassemble the steering column assembly to the vehicle (see previous chapter).

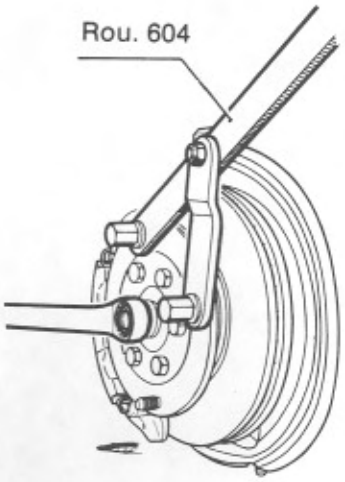




DRIVE SHAFTS
REMOVING - REASSEMBLING

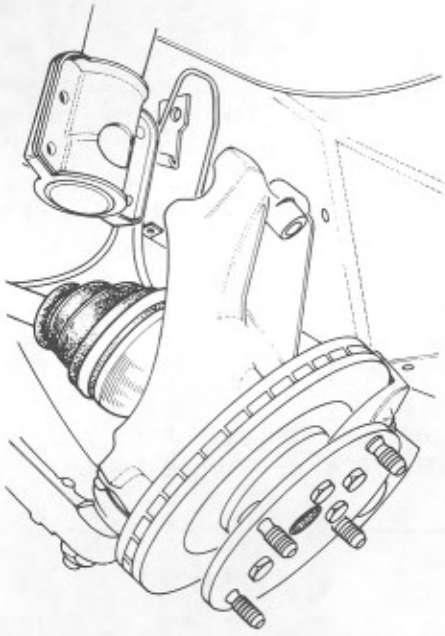
TIGHTENING TORQUES

Shock absorber base bolts	8 daNm (60 lb./ft.)
Steering arm nut	3.5 daNm (26 lb./ft.)
Drive shaft nuts	20 daNm (147 lb./ft.)
Wheel nuts	12 daNm (90 lb./ft.)



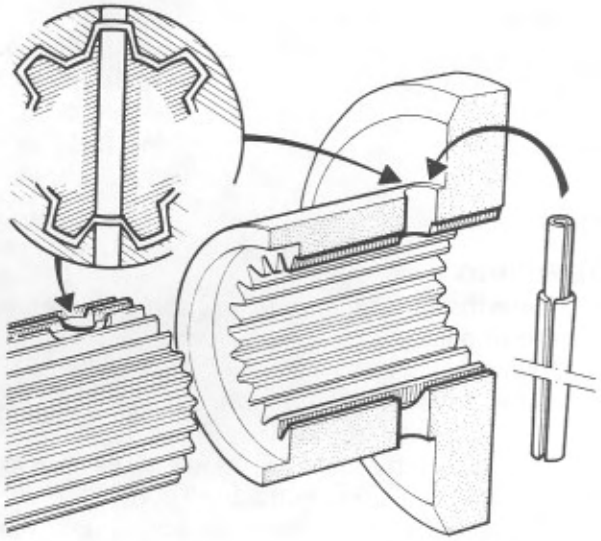
REMOVING

- Place the side concerned on a stand and remove the wheel.
- Remove:
  - the drive shaft nut; prevent the hub from turning with locking tool Rou. 604.
  - the steering arm ball joint nut at the stub axle carrier end using extractor T.Av. 476.
- Remove the 4 shock absorber bottom mounting bolts on the MacPherson® strut.
- Tilt the stub axle carrier and release the drive shaft at the wheel end.



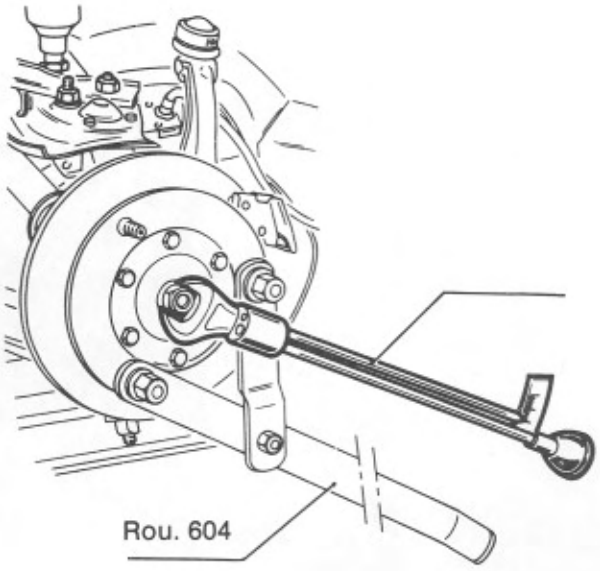
DRIVE SHAFTS
REMOVING - REASSEMBLING

- Punch out the drive shaft rollpins at the gearbox end using drift B.Vi 606.
- Place a receptacle to catch the oil and withdraw the drive shaft from the planetary gear.



REASSEBLY

- Coat the drive shaft splines with grease and insert the shaft into the planetary gear splines.
- Insert 2 new rollpins using drift B.VI 606 smear grease on the inside oil slinger.
- Coat the drive shaft splines at the stub axle end with Loctite 680® and insert it in the hub. (See page K4-5)
- Re-attach the stub axle carrier to the shock absorber (4 bolts).
- Reconnect the steering arm ball joint to the stub axle carrier.
- Torque tighten the drive shaft nut using locking tool Rou. 604 and a torque wrench.



CAUTION

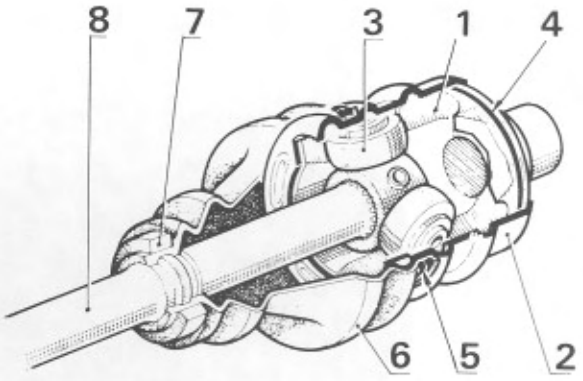
Inside oil slinger must be installed at drive axle replacement. See page K4-1, item 8.

DRIVE SHAFTS

OVERHAULING (SPIDER G182 COUPLING)

These operations may be carried out on this type of coupling:
- bellows change
- spider gear change
- and a yoke change

The disassembly method is the same for all three operations. The method of reassembly differs for the yoke as the sheet metal cover must be crimped in place.



1. Yoke
2. Cover
3. Spider gear
4. Seal
5. Retaining clip
6. Rubber bellows
7. Retaining ring
8. Drive shaft



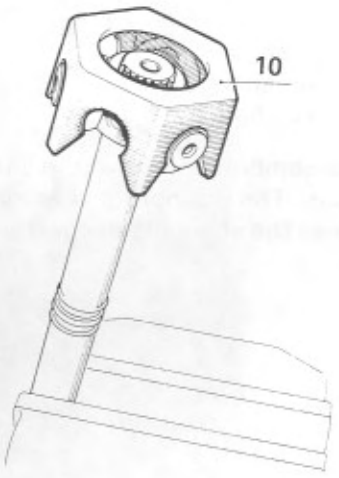
DISMANTLING

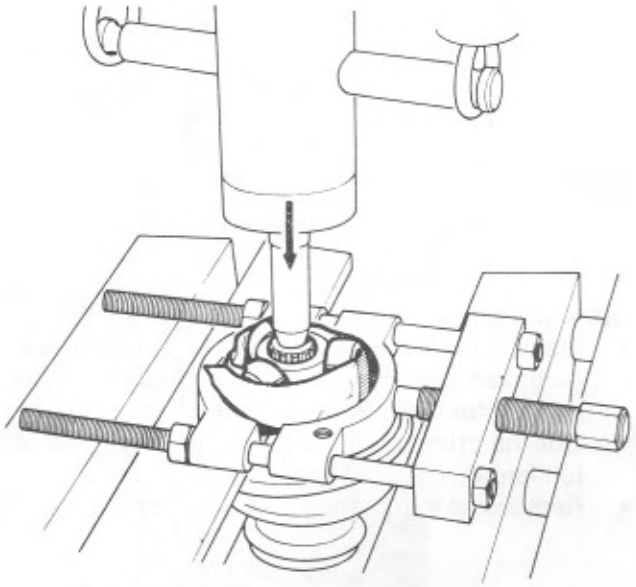
- Place some adhesive tape or the protective cap (supplied with new drive shaft) on the bearing surface for the differential nut oil seal.
- Cut the crimped clip and the bellows along its full length.
- Remove as much grease as possible.

DRIVE SHAFTS

OVERHAULING (SPIDER G182 COUPLING)

- Remove the yoke.
- Do not remove the roller cages from their respective trunnions. The cages and rollers are matched and must never be mixed.
- Attach plastic retainer (10) supplied with new spider gears, or adhesive tape around the spider gear to make sure of this.
- Never use any sort of thinners for cleaning the component parts.





- Extract the spider gear in a press.

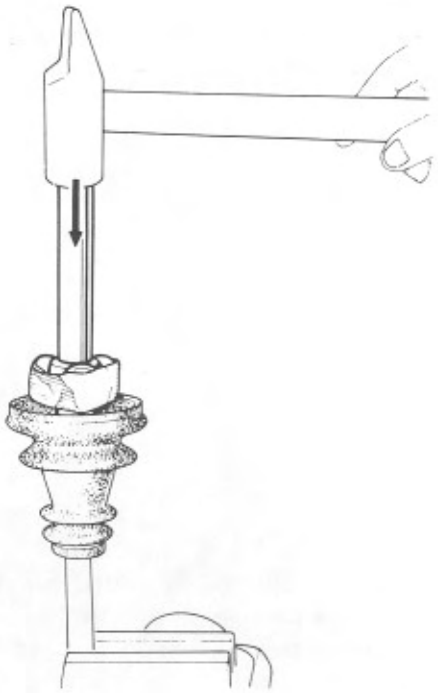
DRIVE SHAFTS

OVERHAULING (SPIDER G182 COUPLING)

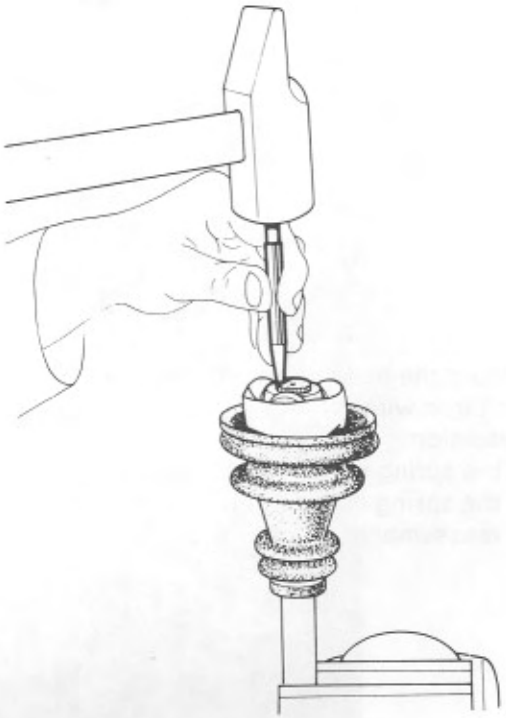
REASSEMBLING

When replacing the spider gear or bellows:

- Lubricate the drive shaft and slide on the new retaining clip and bellows.
- Mount the spider gear onto the splined shaft.



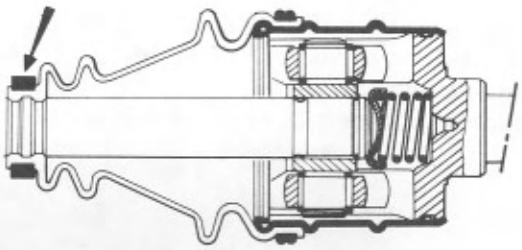
- Crimp at 3 points 120° apart by peening the metal on the splines over onto the drive shaft.
- Remove the plastic retainer or adhesive tape.
- Mount the spider gear onto the yoke.

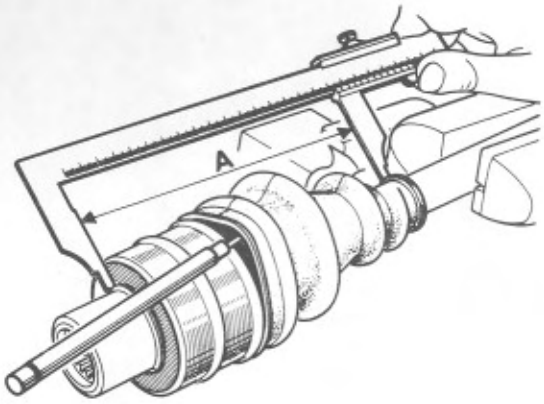


DRIVE SHAFTS

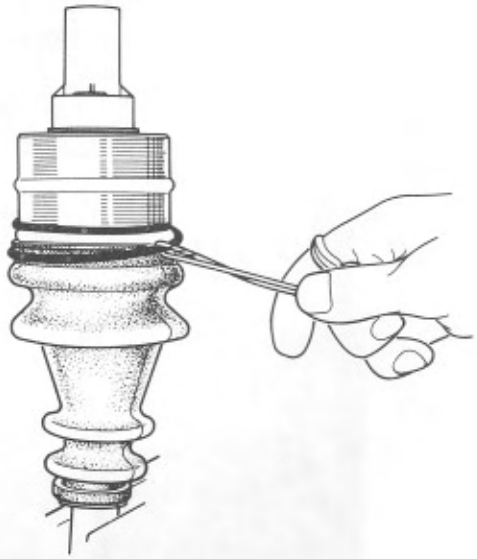
OVERHAULING (SPIDER G182 COUPLING)

- Spread the grease equally between the bellows and the yoke (150 gr.).
- Locate the bellows lip in the grooves on the drive shaft and on the cover.
- Mount the retaining ring over the bellows.





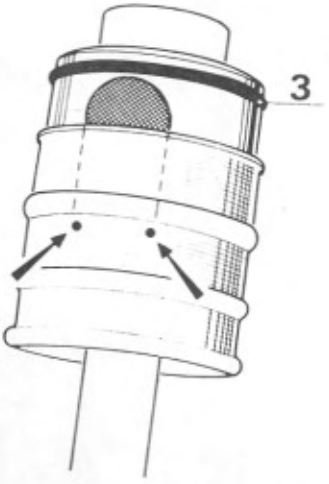
- Insert a smooth round-ended piece of rod between the bellows and yoke to restrict the amount of air trapped inside the coupling.
- Lengthen or shorten the coupling to obtain dimension A = 162 mm (6 3/8") (dimension taken between the bellows and face and the largest diameter machined face on the yoke).
- Remove the rod when in this position.



- Mount the bellows retaining clip with a piece of soft iron wire.
  Attention:
  - the spring must not be stretched
  - the spring coils should still be touching after reassembly.

DRIVE SHAFTS

OVERHAULING (SPIDER G182 COUPLING)

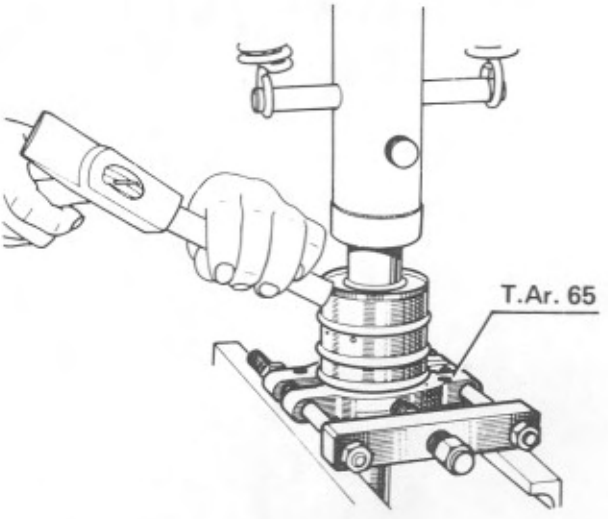


REASSEMBLING

When changing a yoke:

- Lubricate the drive shaft and slide on the new retaining clip and bellows.
- Slide the yoke cover over the shaft and spider gear onto the drive shaft splines.
- Crimp at 3 points 120° apart by peening the spline metal over onto the drive shaft.

- Align the 2 raised dots on the cover with a yoke cut-out (the yoke being fitted with a new 'O' ring (3)) and slide the yoke into the cover.



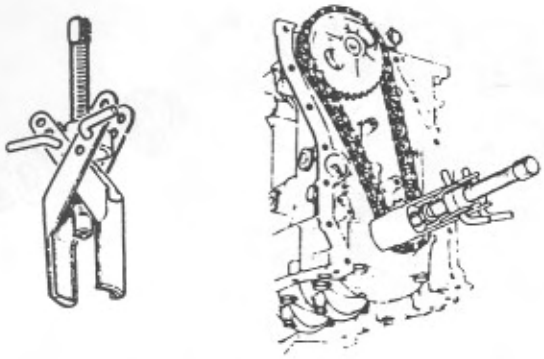
- Use a press to crimp the cover over the yoke.
- Make sure the yoke is fully seated.
  DO NOT ALLOW THE PRESSURE TO IN-CREASE.
- Crimp the cover to the yoke in this position then complete the operation in the same manner as for a bellows change.

SECTION "L"

REAR AXLE

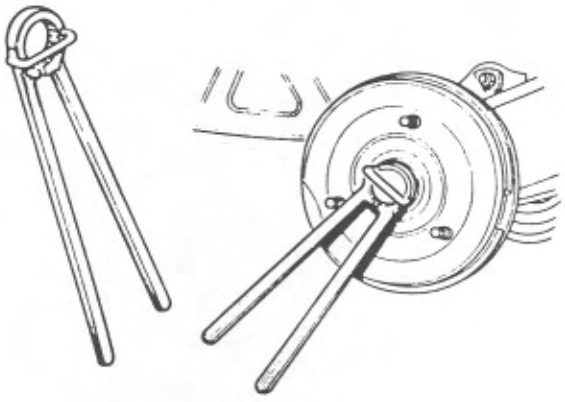
Subsection 1	Specifications
L1-1	Special Tools
L1-3	Identification & Special Features
L1-5	Tightening Torques
L1-7	Geometry
L1-8	Lubrication
Subsection 2	Standard and Medium Duty Rear Axle
L2-1	Changing the Bearing
Subsection 3	Heavy Duty Rear Axle
L3-1	Changing the Bearings
Subsection 4	Rear Axle Assembly
L4-1	Remove and Replace
Subsection 5	Rear Axle and Spring Assembly
L5-1	Remove and Replace

SPECIAL TOOLS



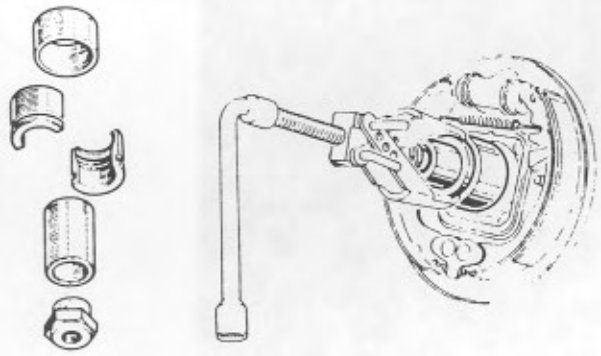
Mot. 49

Sprocket and bearing extractor
Order Tool No. 700010-75-600 EA



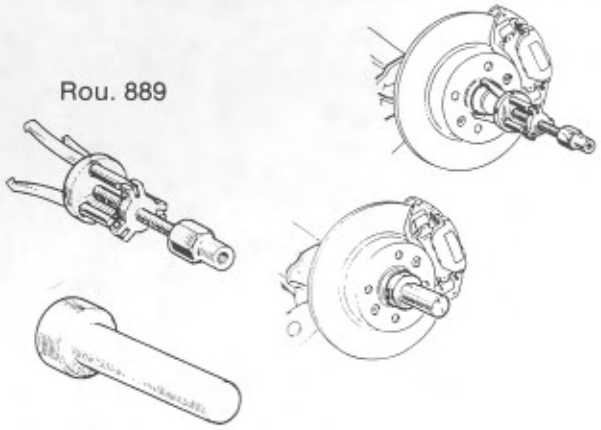
Rou. 441

Pliers for removing-refitting hub grease cup
Standard and medium duty axles
Order Tool No. 700000-44-100 EA



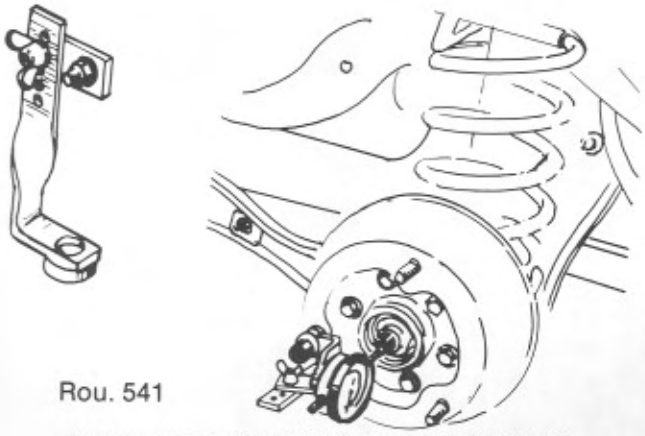
Tool for extracting inserting rear hub inner bearing

		Order Tool No.
Rou. 801	Standard Axle	700000-80-100
Rou. 1080	Medium Axle	700001-08-000
Rou. 898	Heavy Duty Axle	700000-89-800



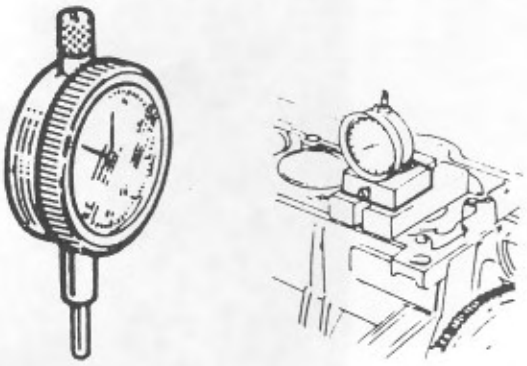
Rou. 889

Tools for removing/installing hub grease cup -
heavy duty axle
Order Tool No. 700000-94-300 EA



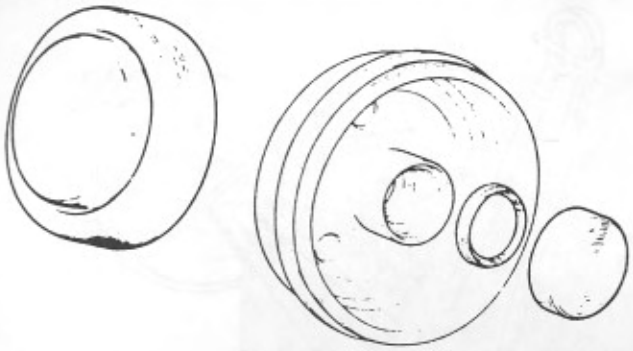
Rou. 541

Dial indicator bracket for measuring rear
hub end play
Dial indicator
Order Tool No. 700000-54-100 EA



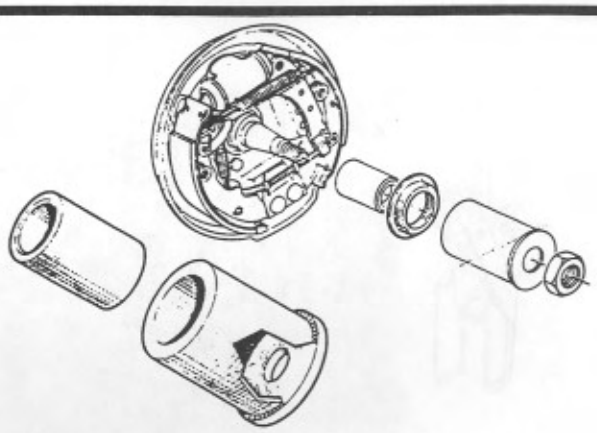
Dial indicator
Order Tool No. 72046E-B0-000 EA

SPECIAL TOOLS



Hub seal inserting tool

		Order Tool No.
Rou. 907	Standard Axle	700000-90-700
Rou. 896	Heavy Axle	700000-89-600



Hub grease seal deflector inserting tool

		Order Tool No.
Rou. 908	Standard Axle	700000-90-800

SPECIFICATIONS

IDENTIFICATIONS AND SPECIAL FEATURES

Standard Duty Axle

All Naturally Aspirated Diesel
Turbo Diesel Units V.I.N. # 1WWBBXXXXXXXX0001 to 6299
Gasoline Engine Units V.I.N. # 1WWBBXXXXXXXX0001 to 0050

Medium Duty Axle

Turbo Diesel Units V.I.N. # 1WWBBXXXXXXXX6300 and up

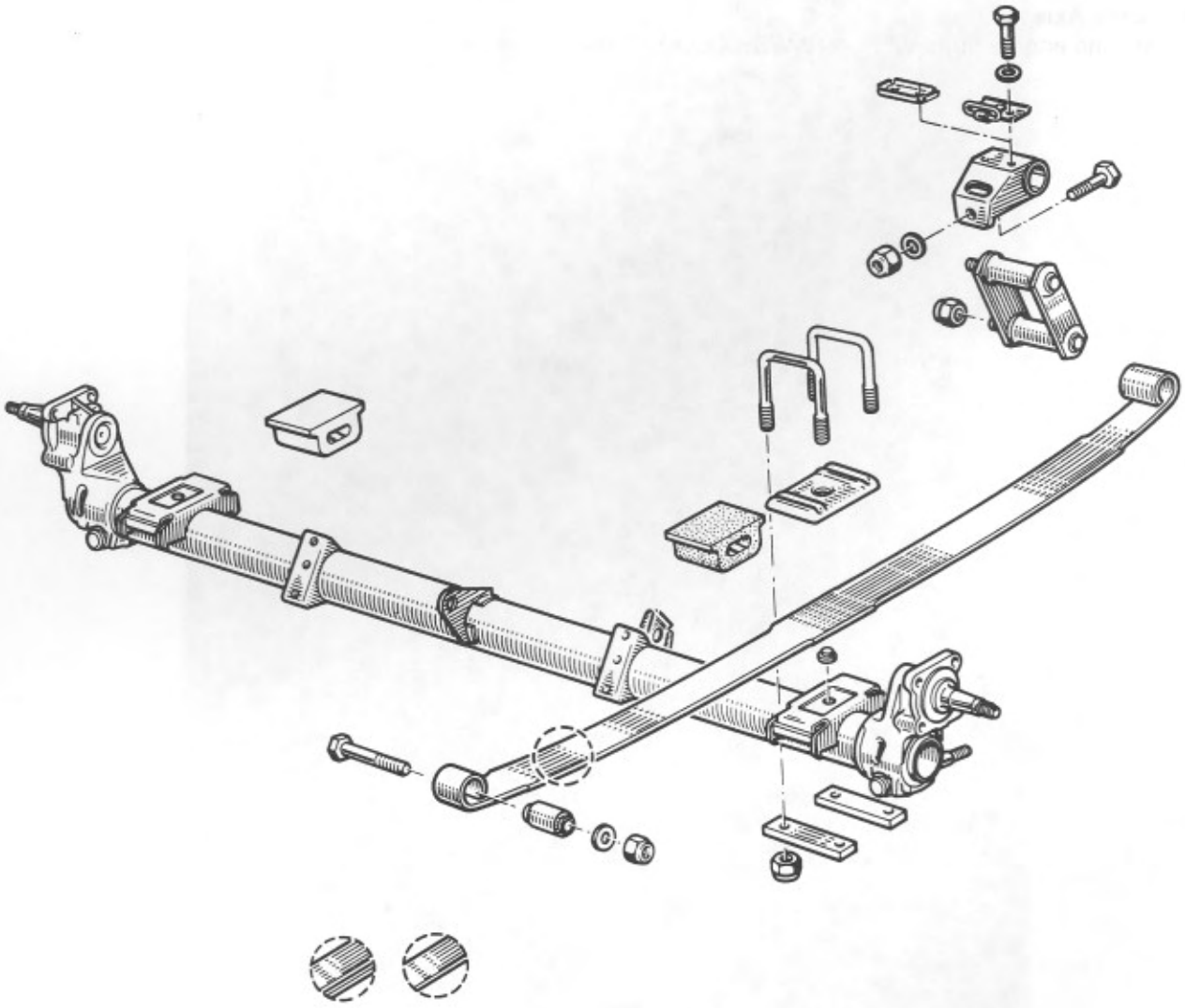
Heavy Duty Axle

Gasoline engine units V.I.N. # 1WWBBXXXXXXXX0051 and up

SPECIFICATIONS

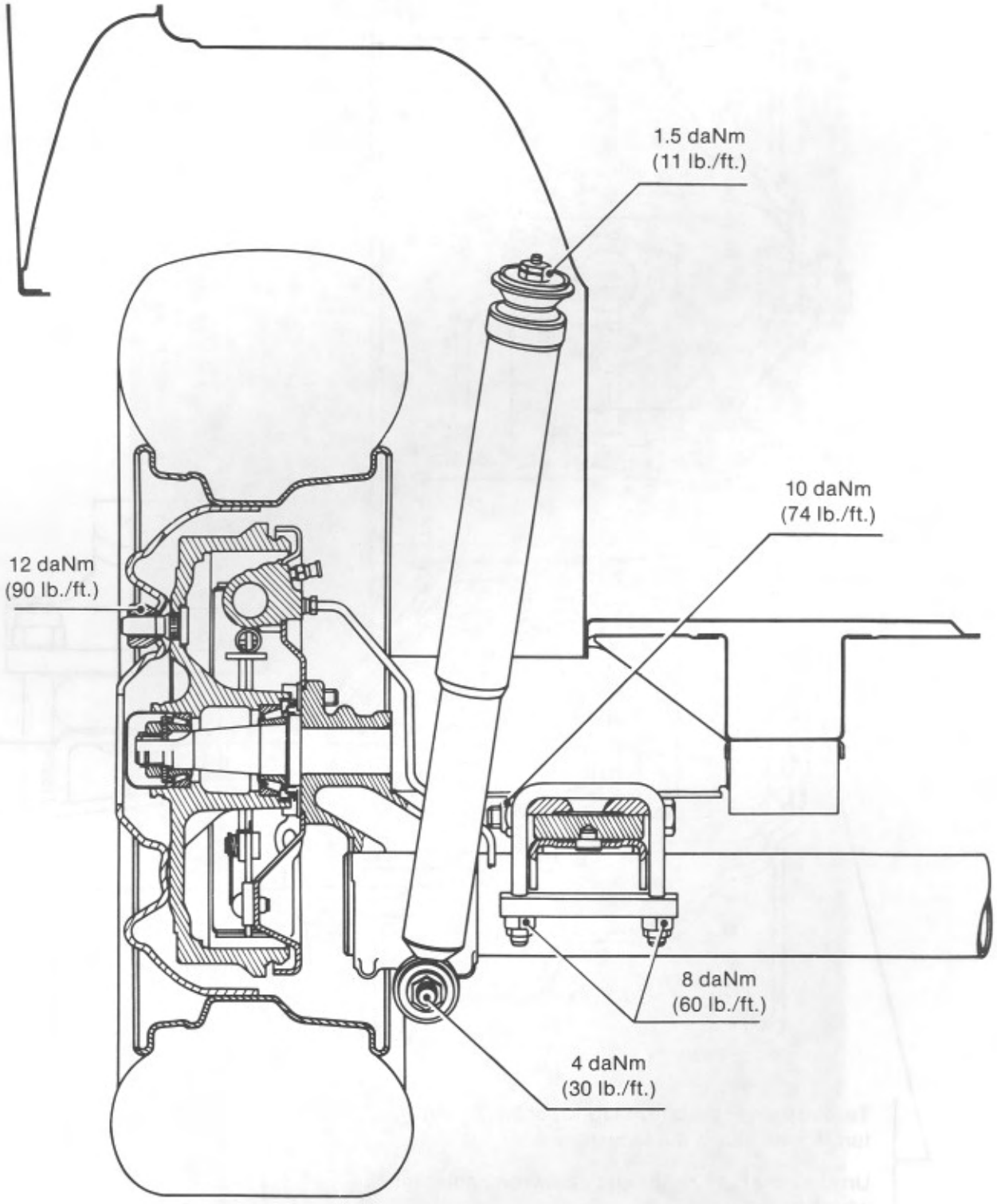
IDENTIFICATIONS AND SPECIAL FEATURES

- One-piece tubular axle beam secured to the chassis by means of a double leaf spring and rear swinging link on each side.
- Rubber bushed pivot points
- Hub-drum assemblies mounted on taper roller bearings



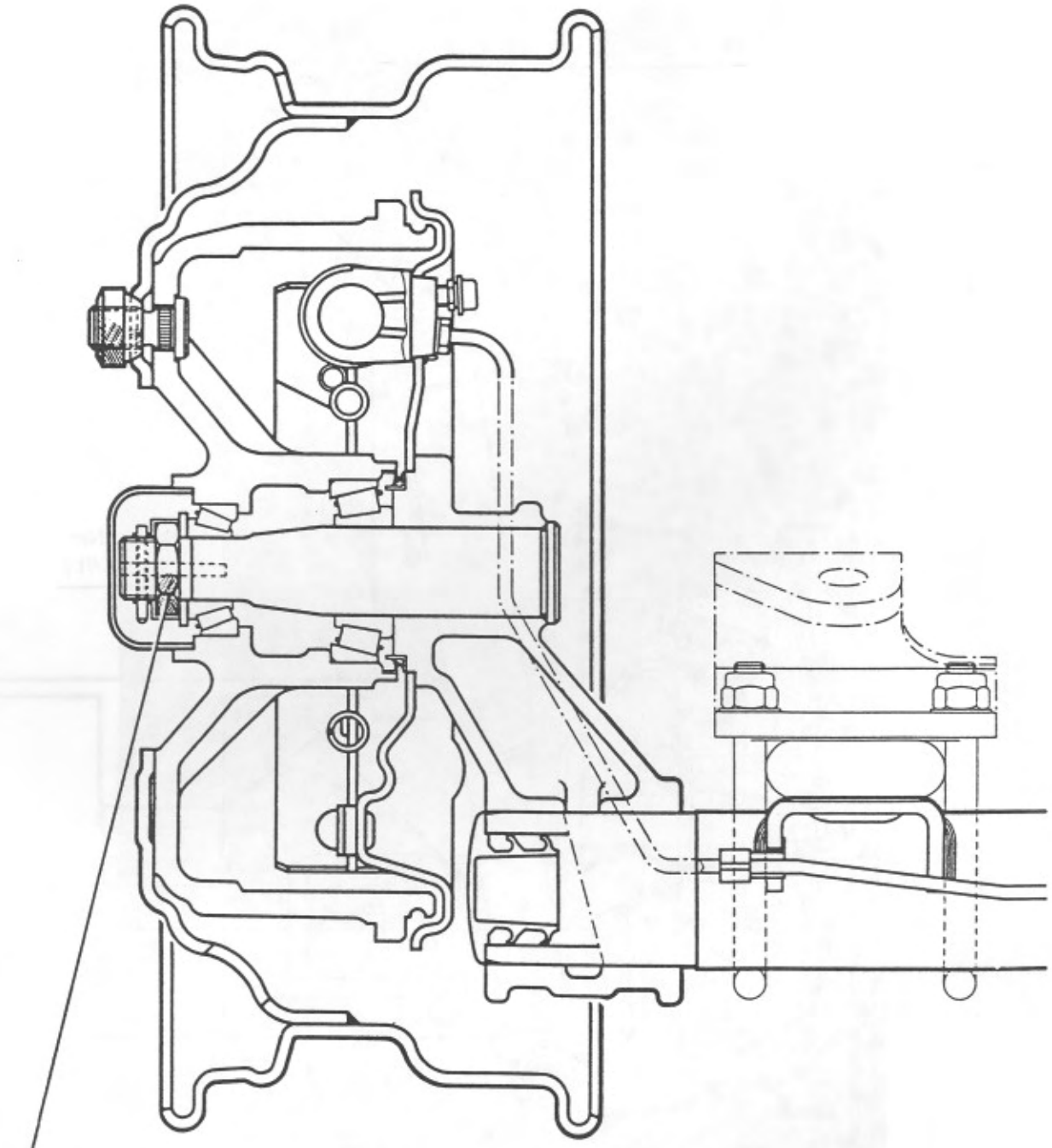
SPECIFICATIONS

TIGHTENING TORQUES - STANDARD AND MEDIUM DUTY AXLE



SPECIFICATIONS

TIGHTENING TORQUES - HEAVY DUTY AXLE



Torque tighten the hub nut to 10 daNm (74 lb./ft.), turning the hub at the same time.

Unscrew the nut 72° (the angle between 2 adjacent wheel studs).

REAR AXLE GEOMETRY

Diagnosis

Preliminary checks

Examine the following and check if necessary before proceeding with the geometry check:
- tire symmetry on the same axle:
- dimensions
- inflation pressures
- tread wear
- pivot points
- condition of rubber bushes
- bearing play
- wheel end play
- not to exceed 1 mm (.040") (to be compensated for with measuring instrument)
- underbody height symmetry (condition of suspension)

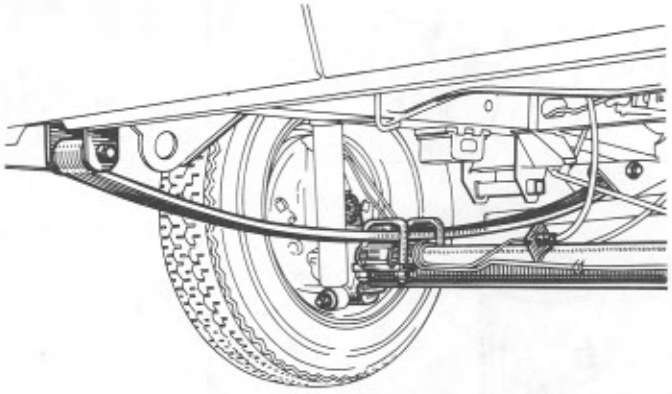
CHECKING AND ADJUSTING

The vehicle must be unladen and ready for the road.

Place the rear wheels on turntables.

Check:
- toe-in
- toe-out
- and camber

in this position.

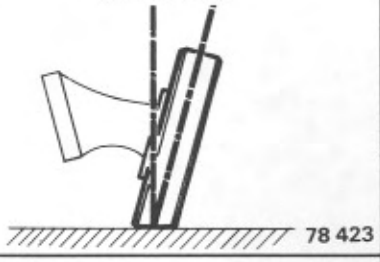
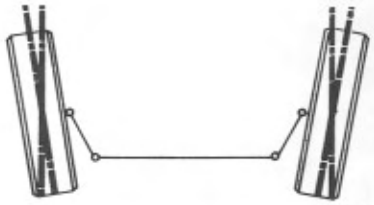
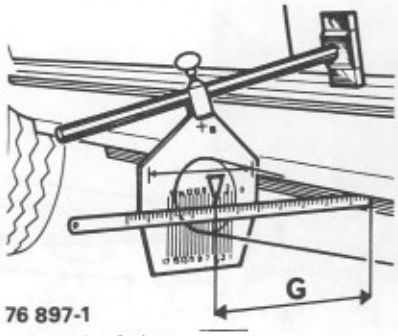
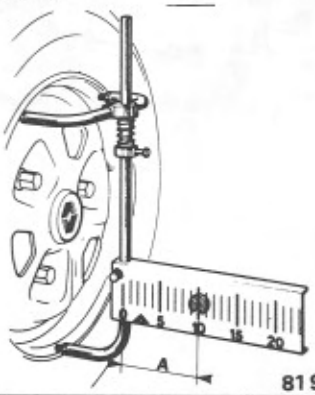


If necessary, adjust the toe-in distribution (or axle alignment) by loosening off the "U" bolts. Retighten the "U" bolts after adjustment.

NOTE: Check that any correction made is in the right direction or on the right side so as to avoid excessive displacement of the axle in relation to the spring blade longitudinal center.

SPECIFICATIONS

GEOMETRY

	Value	Position	Adjustment
CAMBER  78 423	0° to 0°30'	UNLADEN*	Non-adjustable
TOE-IN  78423	0° to - 0°30' (0 to - 3 mm) (0 to - 1/8")	UNLADEN*	Non-adjustable
TOE-OUT (or axle alignment)  76 897-1  81940-F	Max. difference between R.H. and L.H. sides: G = 10 mm (3/8") A = 20 mm (25/32")	UNLADEN*	By moving axle on spring blades

* The "UNLADEN" position means that the vehicle is in running order ready for the road (fuel tank full and tire inflation pressures correct).

LUBRICATION

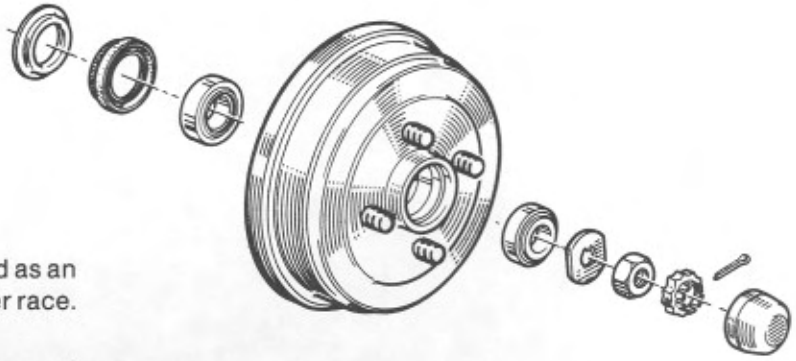
GREASE

Units to be greased	Quantity
Drum bore	20 g
Hub grease cup	10 g
Taper rollers	Smear
Wheel studs	Smear

STANDARD AND MEDIUM DUTY REAR AXLE
CHANGING THE BEARINGS

TIGHTENING TORQUES

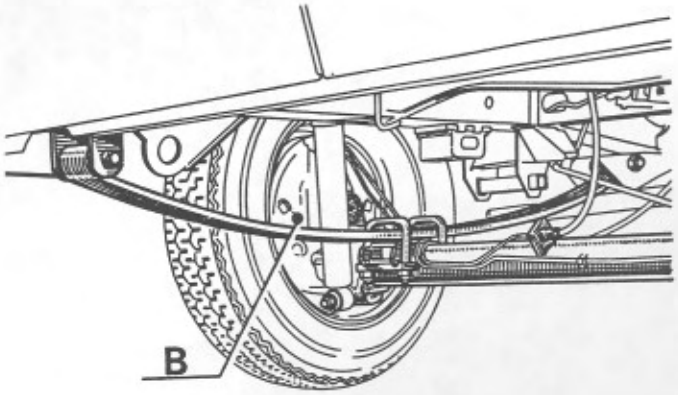
Hub nut pre-torque	3 daNm (22 lb./ft.)
Wheel nuts	12 daNm (90 lb./ft.)



Taper roller bearings must always be changed as an assembly, that is: outer race, bearing and inner race.

The grease seal and deflector should also be changed at the same time.

Lock nut may be a castellated nut with cotter key or one that the nut has to be locked on the key-way with a hammer blow.

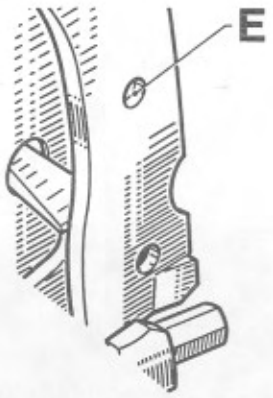


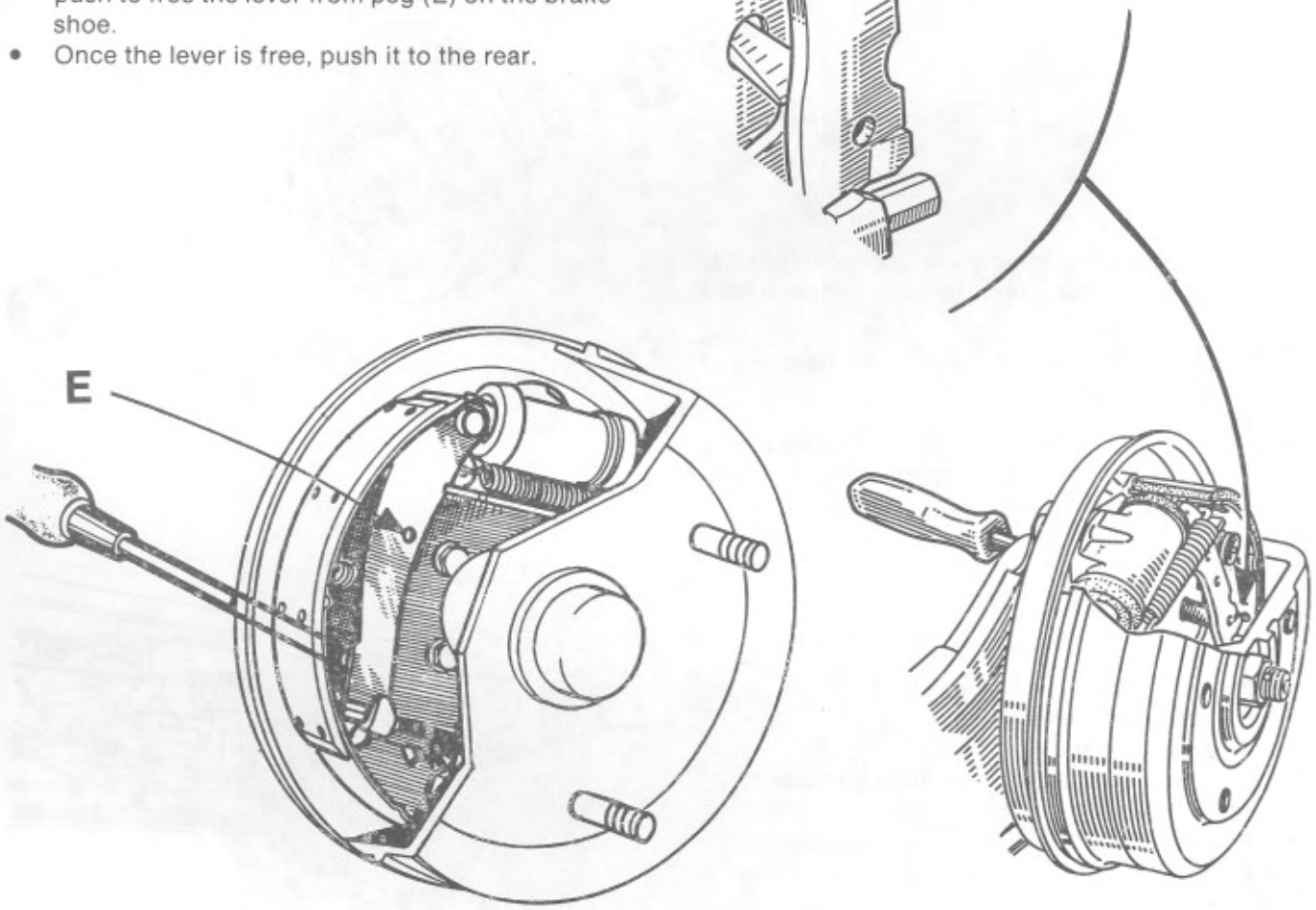
REMOVAL

- Place the rear of the vehicle on stands.
- Remove the brake drum
- Release the handbrake
- Loosen the secondary handbrake cables to let the lever return
- Remove plastic plug (B) in the backplate to zero the self-adjusting mechanism.

STANDARD AND MEDIUM DUTY REAR AXLE
CHANGING THE BEARINGS

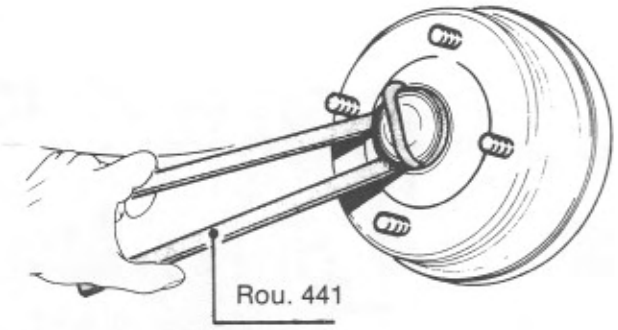
- Insert a screwdriver in the hole in the backplate (the brake shoe has a hole in it so that the handbrake lever behind may be reached) and push to free the lever from peg (E) on the brake shoe.
- Once the lever is free, push it to the rear.

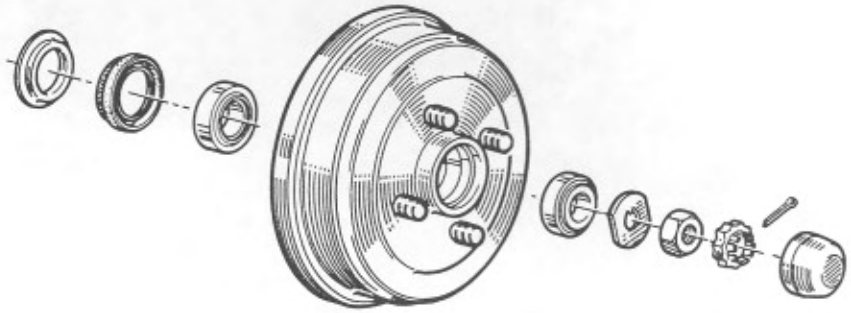




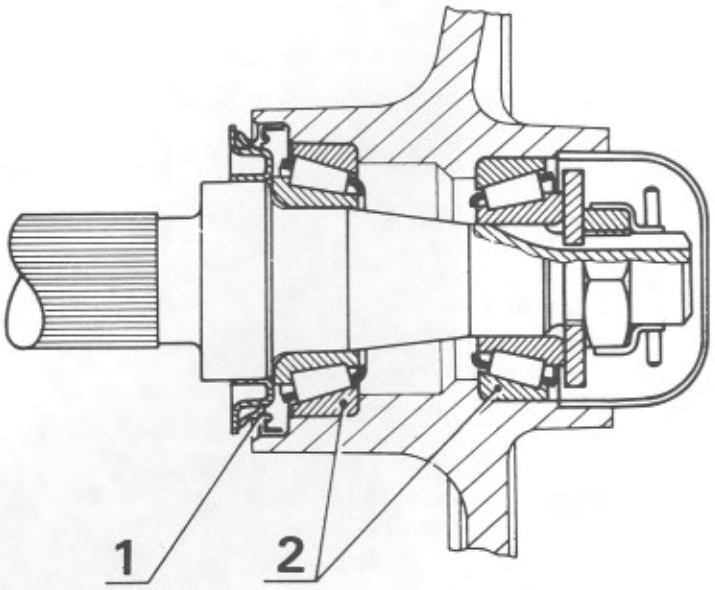
STANDARD AND MEDIUM DUTY REAR AXLE
CHANGING THE BEARINGS

- Remove:
  - the grease cup using pliers Rou. 441
  - cotter pin
  - lock nut
  - and nut and washer
- Remove the brake drum
- Catch the outer bearing





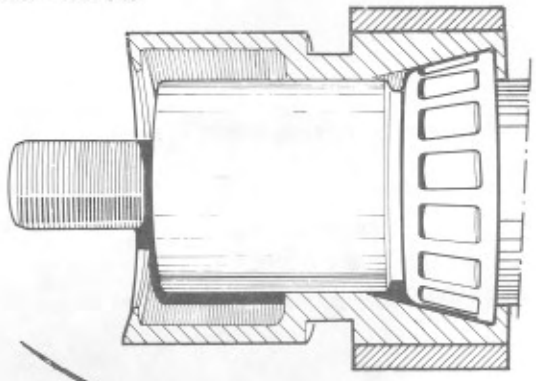
- Extract the following from the brake drum:
  - grease seal (1)
  - and bearing outer race (2).

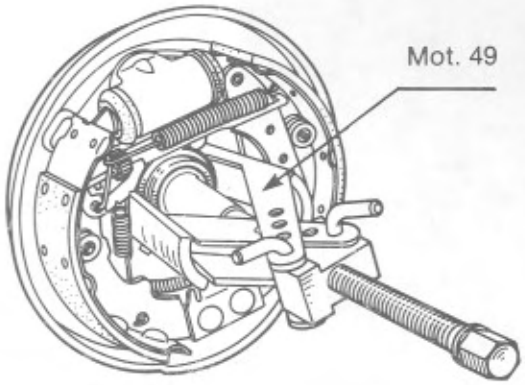


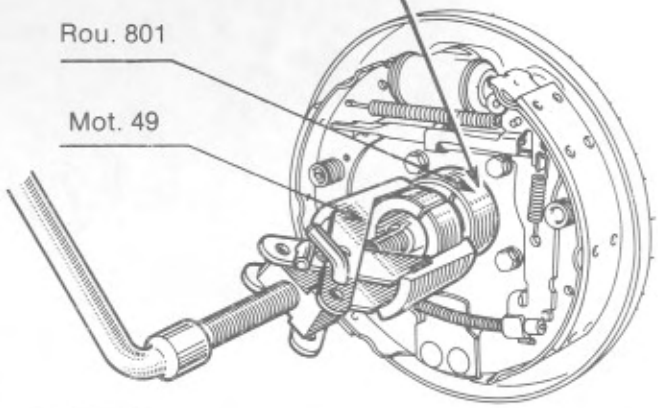
STANDARD AND MEDIUM DUTY REAR AXLE

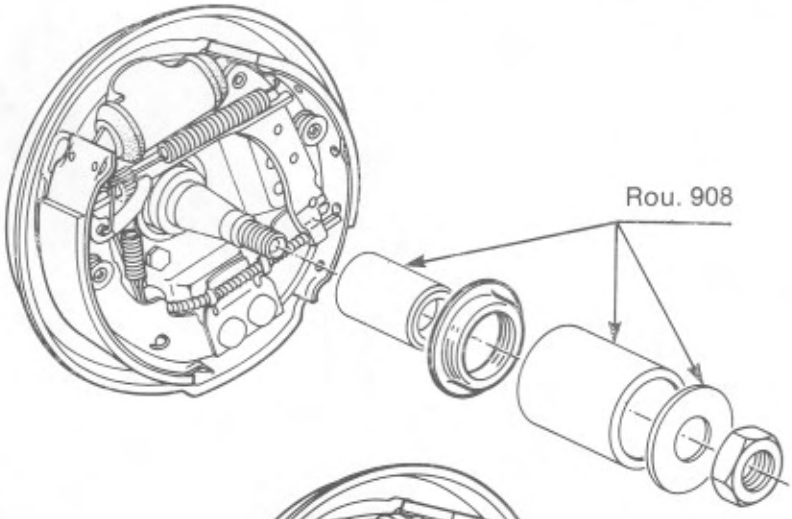
CHANGING THE BEARINGS

- Extract the inner bearing using sleeve Rou. 801 and extractor Mot. 49, then remove the grease seal deflector.
- Check stub axle condition. The complete rear axle beam must be changed if there is any trace of seizure or wear.



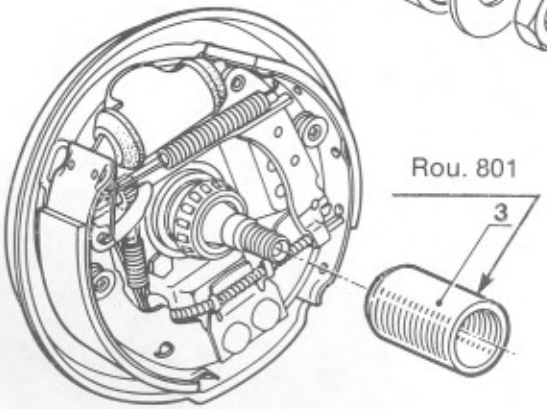






REASSEMBLY

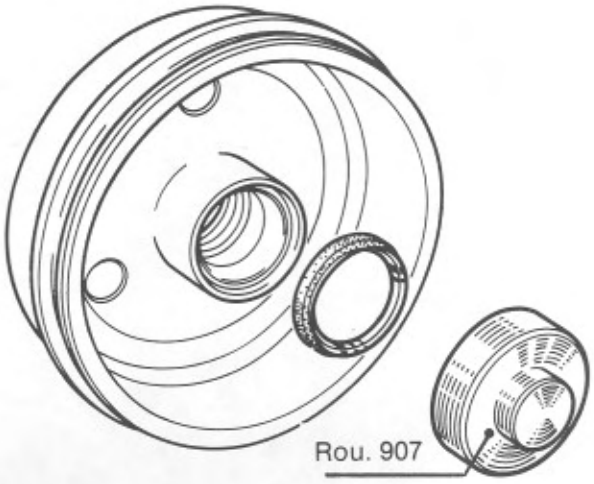
- Attach the new deflector to the stub axle the correct way around using inserting tool Rou. 908 to draw it into position.
- Insert the inner bearing using sleeve (3) from tool Rou. 801 and the stub axle nut.
- Use the following inserting mandrels to attach the bearing outer races.
  - 46 mm dia. for the inner bearing
  - 57 mm dia. for the outer bearing

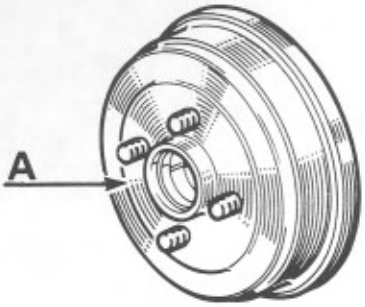


STANDARD AND MEDIUM DUTY REAR AXLE

CHANGING THE BEARINGS

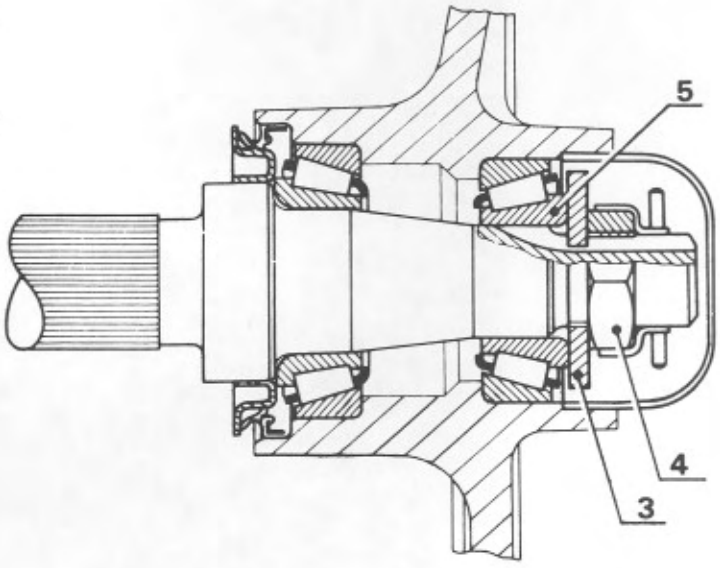
- Insert into the hub:
  - the bearing outer races using pieces of tube of suitable diameter
  - a new grease seal:
    standard - use tool Rou. 907
    medium - use old seal as tool
- Spread about 20 grams (6.7 oz.) of grease inside the hub and around the bearing.
- Mount the following into the stub axle:
  - the hub
  - outer bearing
  - and washer and nut.
- Then adjust the bearing end play.





ADJUSTING

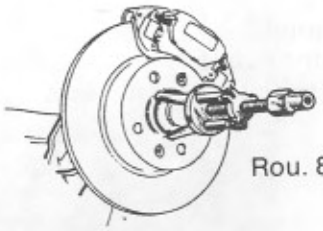
- Torque tighten the stub axle nut to 3 daNm (22 lb./ft.) turning the drum at the same time
- Settle the bearings by tapping zone (A) on the drum lightly with a soft hammer.
- Unscrew the stub axle nut (1/6th of a turn) so that washer (3) turns without play between nut (4) and outer bearing face (5).
- Mount the nut lock and cotter pin.
- Mount the grease cup with 10 grams (.35 oz.) of grease.
- Adjust the brake shoes by repeated application of the brake pedal.
- Adjust the handbrake
- Remember to attach a new plastic plug in the backplate.

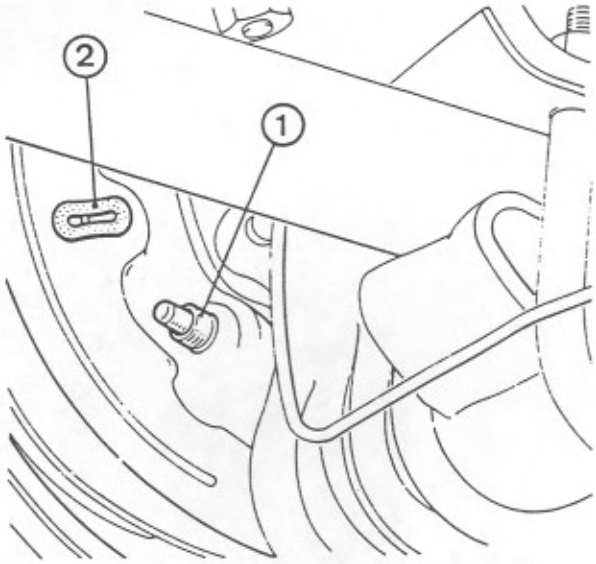


HEAVY DUTY REAR AXLE
Changing the Bearings

REMOVAL

- Use pullers Rou. 889 to remove the hub grease cup.
- Loosen the wheel nuts only and place the rear of the vehicle on stands.
- Remove the wheel nuts and wheel concerned.
- Release the handbrake and slacken the secondary cables to allow the lever to return.
- Remove backplate plug (2) and visually check for sufficient clearance between brake linings and enable the drum to be removed.
- If the clearance is insufficient on account of the position of the self-adjusting system, pull the brake lever stop (1) with a pair of pliers to allow the shoes to back off further.

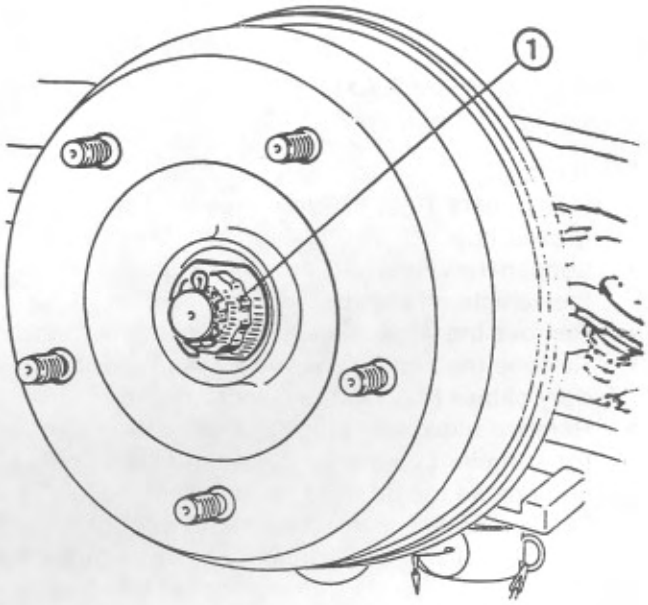

Rou. 889



HEAVY DUTY REAR AXLE

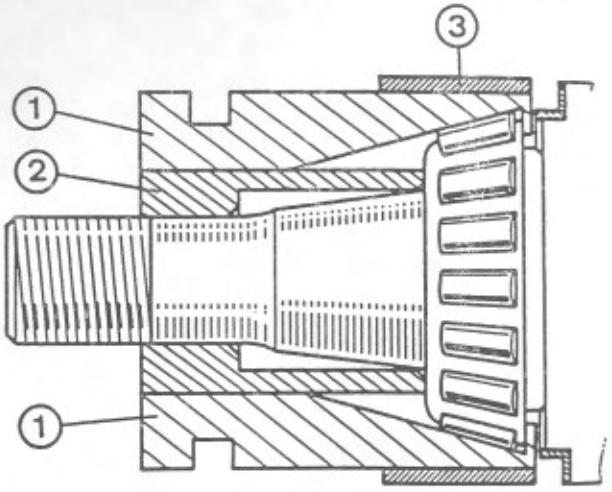
CHANGING THE BEARINGS

- Remove the cotter pin and nutlock (1)
- Unscrew the nut, remove the thrust washer and outer bearing.
- Remove the hub-drum, extract the worn grease seal and the bearing outer race.

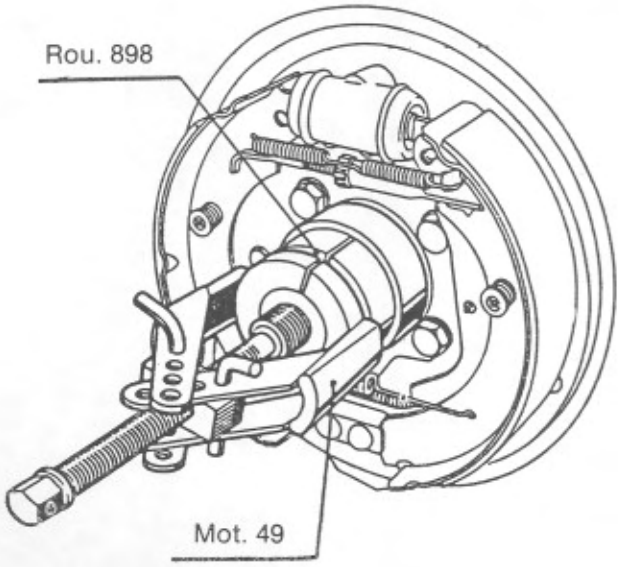


Fitting extractor Rou. 898

- Fit locating sleeve (2) over the stub axle
- Slip over the 2 half-shells (1).
- Hold the complete assembly with sleeve (3).



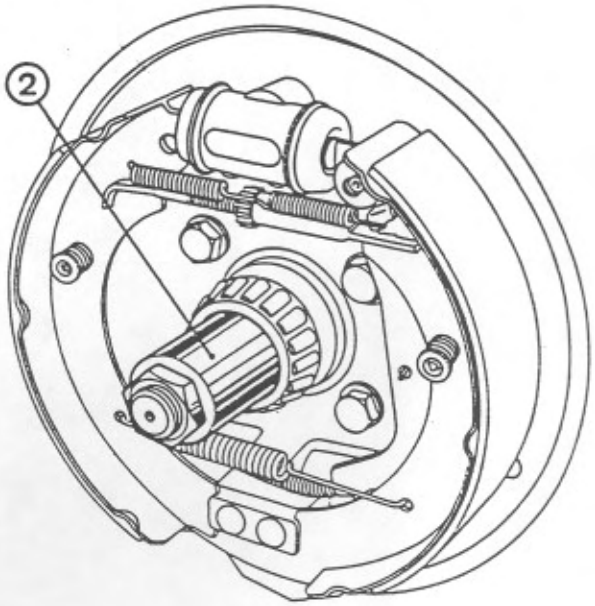
- Use tool Rou. 898 and extractor Mot. 49 to extract the inner bearing.
- Use a screwdriver to extract the deflector, if necessary.



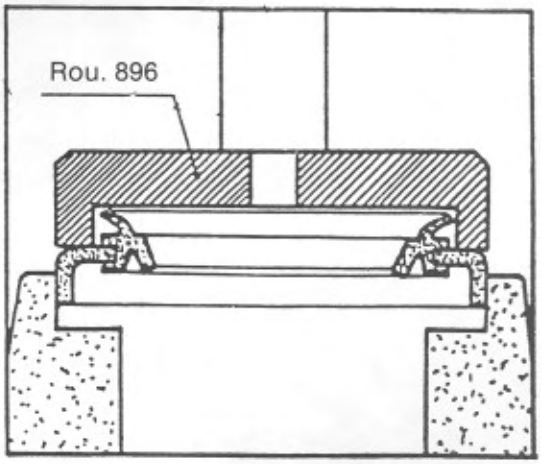
HEAVY DUTY REAR AXLE
CHANGING THE BEARINGS

REASSEMBLY

- If the old deflector has been removed, install a new one using a piece of tube with 68,5 mm (2.69") bore.
- Mount the bearing to the stub axle and push it on the first 10 mm (.39") using a piece of 36 mm bore tube.
- Complete the operation by drawing it on with sleeve (2) from tool Rou. .898 and the stub axle nut.



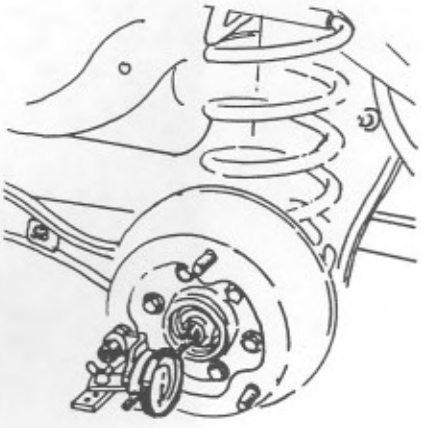
- Fit the following to the hub:
  - The bearing outer race using tubes of suitable diameter
  - A new grease seal using tool Rou. 896.
  - Fill the inside of the hub with 65 g. (2.5 oz) of multi-purpose grease and smear the rollers and grease seal lip as well.
- Fit the following to the stub axle:
  - the hub
  - the outer bearing
  - and the thrust washer and nut



- Torque tighten the stub axle nut to 10 daNm (74 lb./ft.) turning the hub-drum at the same time.
- Loosen the nut 72° (the angle between 2 adjacent studs).
- Mount dial indicator bracket Rou. 541 and dial indicator to the drum face and set the plunger on the end of the stub axle.
- Check the endplay, which should be between 0,02 and 0,08 mm (.001 and .003"). Adjust by turning the nut.
- Fit the nut lock, cotter pin and grease cup filled with multi-purpose grease.
- Adjust the handbrake
- Fit the wheel and torque tighten the nuts.



Rou. 541

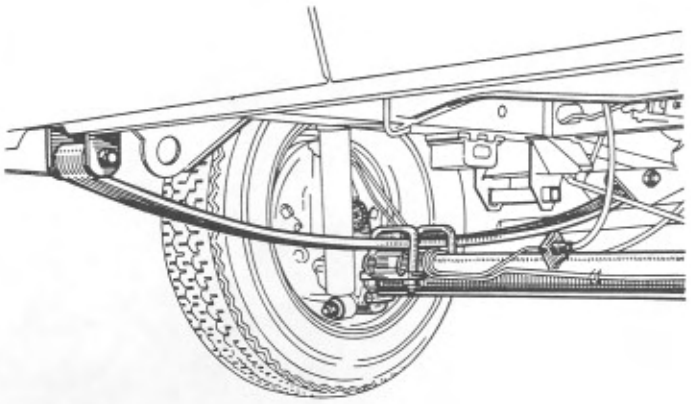


72046E-B0-000

REAR AXLE ASSEMBLY
REMOVE AND REPLACE

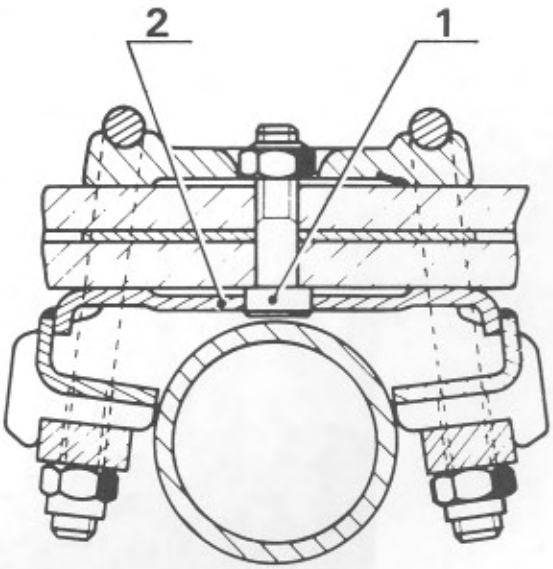
TIGHTENING TORQUES

"U" bolt nuts	8 daNm (60 lb./ft.)
Shock absorber bottom Mounting nuts	4 daNm (30 lb./ft.)
Wheel nuts	12 daNm (90 lb./ft.)



REMOVAL

- Place the rear of the vehicle on stands
- Remove the following (refer to appropriate sections):
  - wheels
  - brake drums
  - bearings
  - hub grease seal deflectors
  - brake backplates
  - brake pipelines
  - shock absorbers (at bottom fixings only)
  - and the "U" bolts



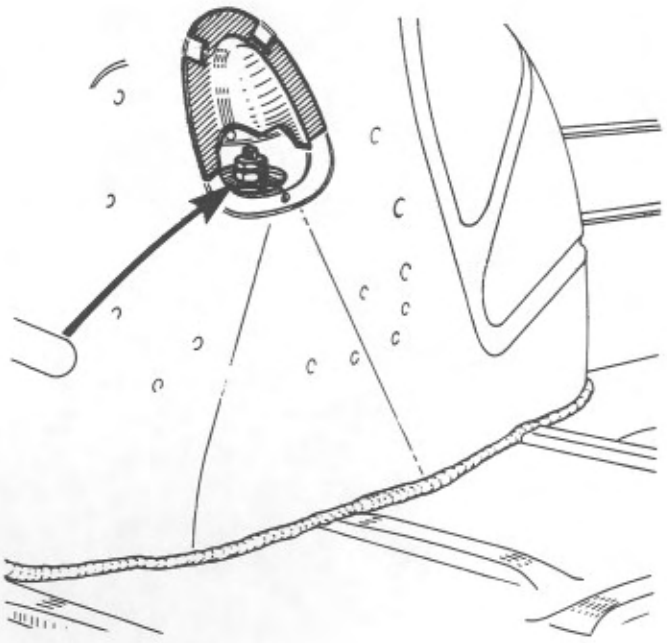
REASSEMBLY

- Align the axle beam under its spring blades so that locating dowels (1) fit into their holes (2) in the beam.
- Bleed the brake circuit on completion of the operation.
- Check rear axle alignment and adjust if necessary.
- Torque tighten the "U" bolts.

REAR AXLE AND SPRING ASSEMBLY
REMOVE AND REPLACE

TIGHTENING TORQUES

Spring front and rear trunnion bolts
(10 daNm 74 lb./ft.)
Shock absorber top mounting nuts
1.5 daNm (11 lb./ft.)



REMOVAL

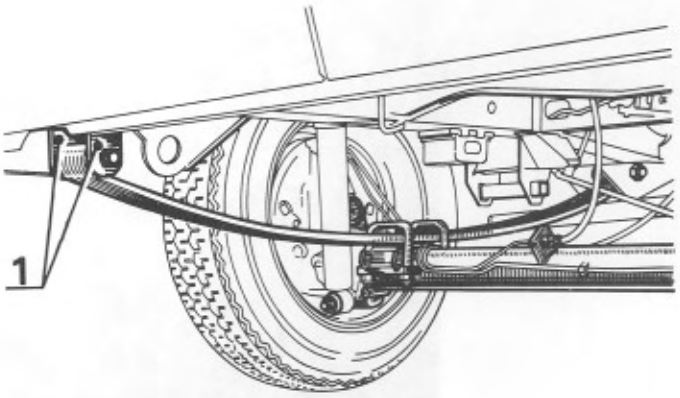
- Place the rear of the vehicle on stands. From inside the vehicle, remove the shock absorber top mounting nuts.
- Remove the rear spring trunnion mounting pin nuts and the shock absorber bottom mounting nuts.
- Disconnect the brake hose and handbrake secondary cables.
- Using a jack under the axle beam, take its weight so that the front trunnion bolts may be removed. Lower the jack and free the limiter control.
- Remove rear blade clips (1)
- Withdraw the complete assembly.

REASSEMBLY

- With the rear of the vehicle on stands, lift up the rear axle assembly and insert the trunnion bolts at the front of the rear springs. Remember to mount the limiter control in its bearing.
- Using a jack under the axle beam, take its weight and mount the rear trunnion bolts.

Reconnect:

- the handbrake cables
- brake hose
- shock absorbers at their top mountings
- lower the vehicle onto its wheels and fasten the shock absorber bottom mountings
- torque tighten all the trunnion bolt nuts and bleed the brake circuit.



SECTION "M"

BRAKES

Subsection 1 **Specifications**

M1-1 Special Tools
M1-3 Brake Layout
M1-4 Identification & Special Features
M1-6 Tightening Torques

Subsection 2 **Master Cyclinder**

M2-1 Remove and Replace

Subsection 3 **Brake Servo**

M3-1 Checking for Loss of Vacuum Pressure (Diesel)
M3-2 Remove and Replace
M3-3 Changing the Air Filter
M3-3 Changing the Check Valve

Subsection 4 **Front Brake Pads**

M4-1 Remove and Replace

Subsection 5 **Front Brake Rotors (Discs)**

M5-1 Remove and Replace

Subsection 6 **Front Brake Calipers**

M6-1 Remove and Replace
M6-3 Overhaul

Subsection 7 **Rear Brake Linings - Standard and Medium Duty Axles**

M7-1 Remove and Replace
M7-5 Automatic Adjusting System

Subsection 8 **Rear Wheel Cylinders - Standard and Medium Duty Axles**

M8-1 Remove and Replace
M8-1 Overhaul

Subsection 9 **Rear Brake Shoes - Heavy Duty Axle**

M9-1 Remove and Replace

Subsection 10 **Rear Wheel Cyclinders**

M10-1 Remove and Replace

Subsection 11 **Brake Limiter**

M11-1 Adjustment
M11-2 Checking Brake Pressure

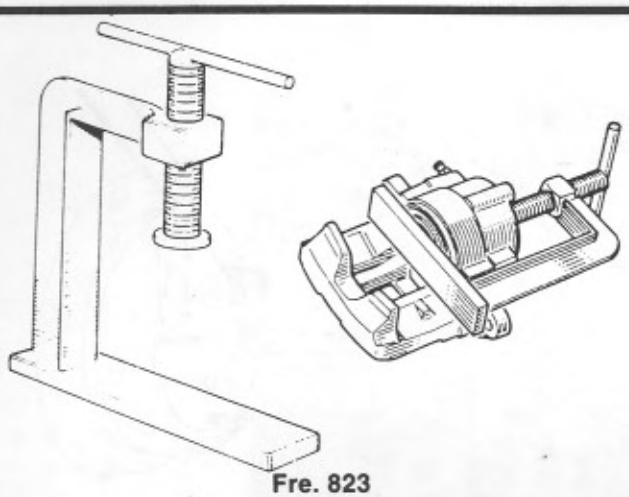
Subsection 12 **Handbrake**

M12-1 Layout
M12-2 Adjustment
M12-3 Secondary Cable Remove and Replace

Subsection 13 **Brake System Bleeding**

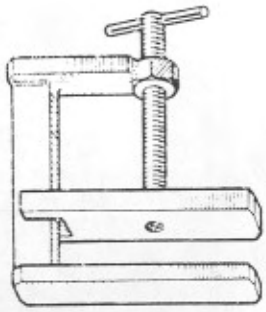
M13-1 Procedure

SPECIAL TOOLS



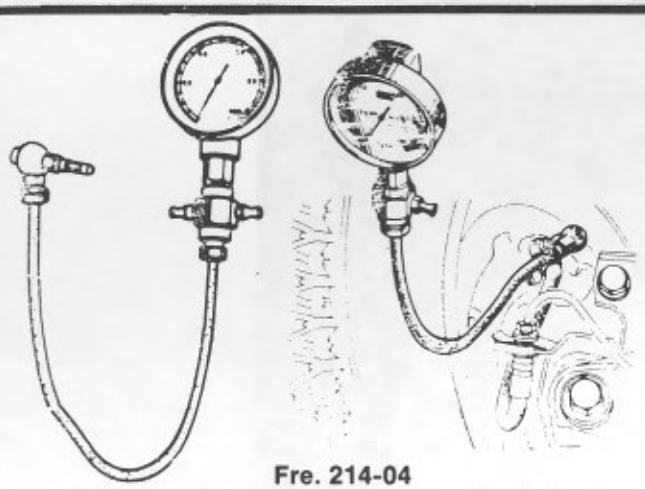
Fre. 823

Piston entering tool
Order Tool No. 700000-82-300 EA

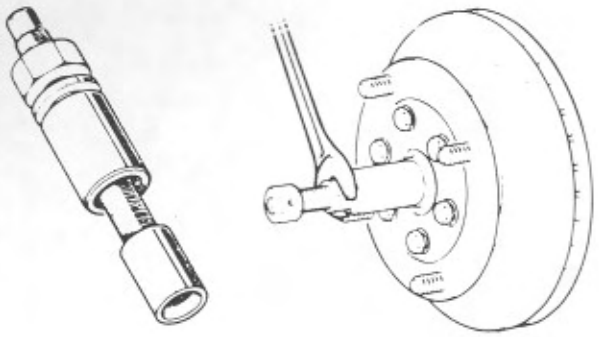


Mot. 453-01

Hose clamp (maximum dia. 25 mm)
Order Tool No. 700000-45-301 EA

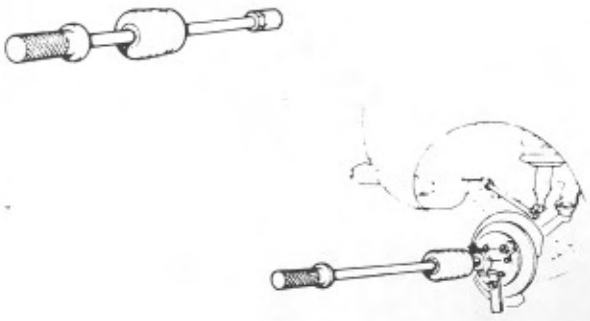


Fre. 214-04
Pressure checking gauge for brake limiter
(range 0 to 100 bars)
Order Tool No. 700000-21-404 EA



T.Av. 602

Drive shaft inserting tool
Order Tool No. 700000-60-200 EA



Ms. 580

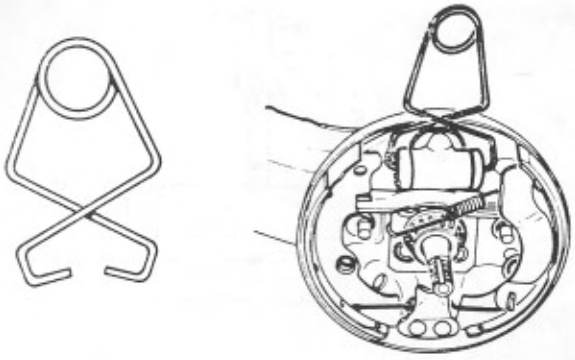
Slide hammer for hub removal
Order Tool No. 700000-58-000 EA



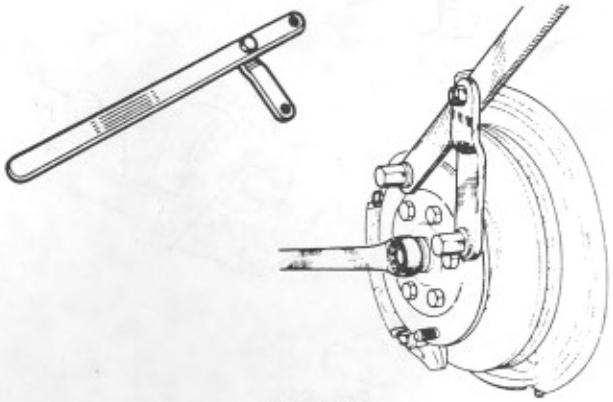
T.Av. 601

Tool for extracting drive shaft and hub
Order Tool No. 700000-60-100 EA

SPECIAL TOOLS



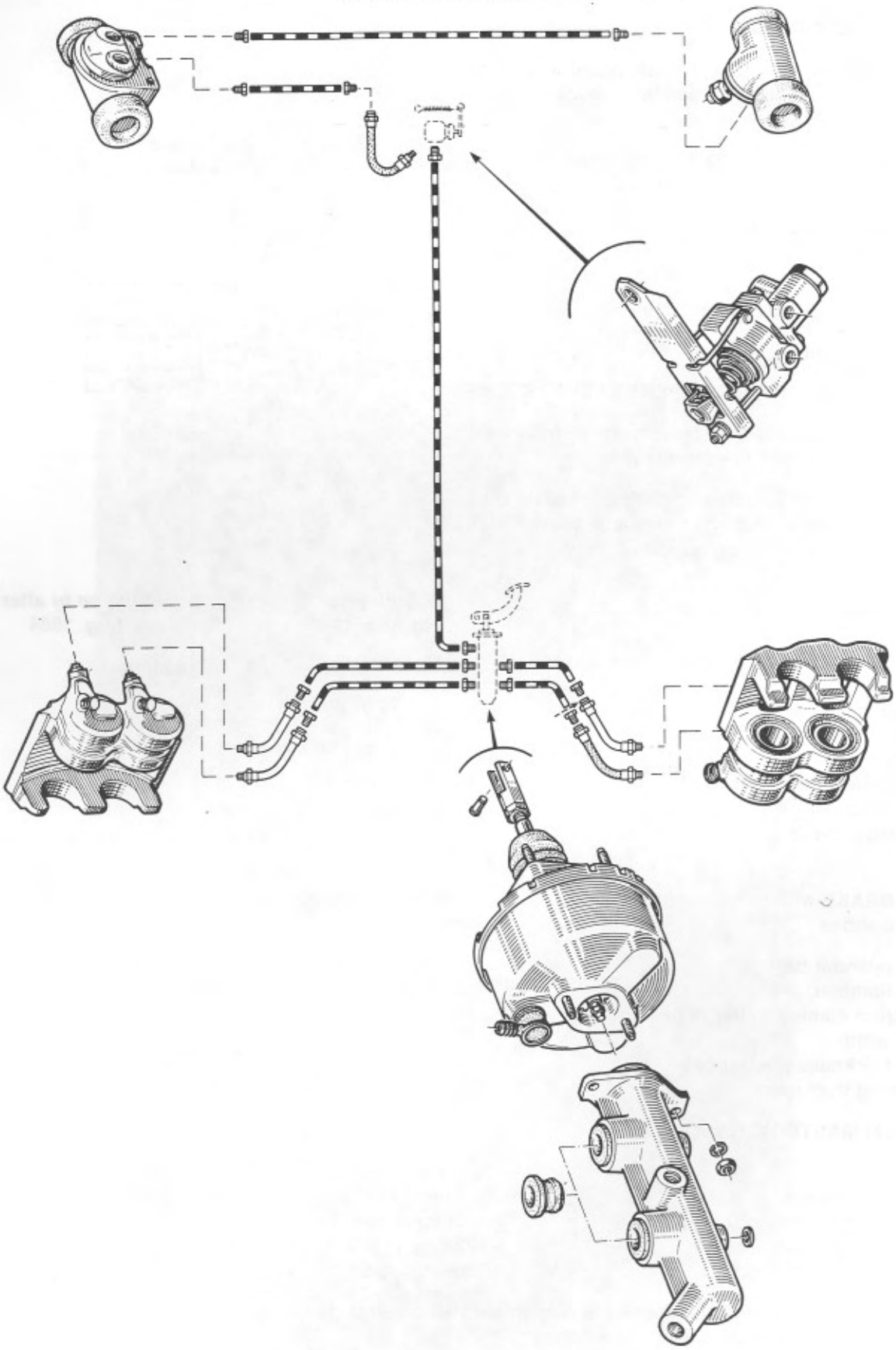
Fre. 05
Set of two wheel cylinder clips
Order Tool No. 700009-99-400 Set



Rou. 604
Hub locking tool
Order Tool No. 700000-60-401 EA

SPECIFICATIONS

BRAKE LAYOUT



SPECIFICATIONS

IDENTIFICATION AND SPECIAL FEATURES

HYDRAULIC CIRCUIT

Metric threads are used for all pipeline unions connecting the master cylinder, front calipers, limiter and rear wheel cylinders.

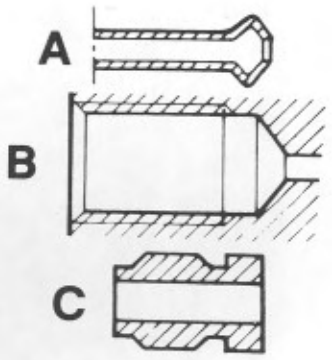
Use only replacement parts listed in the Centauri, LeSharo and Phasar Service Parts Catalog.

Component identification (Shape):

A - Pipe Ends

B - Threaded Bores in wheel cylinders

C - Pipe Unions



METHOD OF LOCKING CALIPER BRACKET BOLTS

The front caliper bracket bolts have their threads coated with Loctite® or equivalent.

If these bolts are unscrewed during a repair, they must be cleaned and their threads coated with Loctite® or equivalent on reassembly.

FRONT BRAKES	**Built prior to Aug. 1984**	**Built on or after Aug. 1984**
Caliper cylinder bore	42 mm	45 mm
Disc diameter	252 mm (9.921")	
Disc thickness	24 mm (.945")	
Min. disc thickness	22 mm (.866")	
Pad thickness (incl. backing)	18.5 mm (.728")	
Min. pad thickness (incl. backing)	9 mm (.354")	
Max. disc run-out	0.07 mm (.003") on 242 mm (9.528") dia.	
REAR BRAKE with self-adjusting brake shoes	**Standard and Medium Duty Axles**	Heavy Duty Axles
Wheel cylinder bore	25.4 mm (1.0")	25.4 mm (1.0)
Drum diameter	254 mm (10.0")	254 mm (10.0")
Max. drum diameter after regrinding	255 mm (10.04")	254,75 mm (10.04")
Lining width	45 mm (1.77")	57 mm (2.24")
Lining thickness (incl. shoe)	7 mm (.276")	7 mm (.276")
Min. lining thickness	0.5 mm (.020") above shoe	.5 mm (.020")
TANDEM MASTER CYLINDER		
Bore	23.8 mm (.937")	23.8 mm (.937")
Stroke with Servo	22 mm (.866")	22 mm (.866")
Pressure Drop Indicator	not equipped	not equipped
Servo cylinder bore	22.8 mm (.897")	
Residual pressure valve	not equipped	not equipped

HANDBRAKE: Mechanically applied at rear wheel via floor-mounted lever.
Maximum travel : 12 notches

BRAKE FLUID: Conforms to SAE J 1703 F and DOT3 or DOT4 Standards.

SPECIFICATIONS

INDENTIFICATION AND SPECIAL FEATURES

FRONT BRAKES

1. Standard Front Disc Brakes:
   All Naturally Aspirated Diesel Units
   Turbo Diesel Units Built prior to Aug. 1984

2. Heavy Duty Front Disc Brakes:
   Turbo Diesel units built Aug. 1984 and after.
   All gasoline engine units.

REAR BRAKES

1. Standard - Duty Axle:
   All naturally aspirated diesel units.
   Turbo diesel units V.I.N. #1WWBBXXXXXXXXOOO1 to 6299
   Gasoline engine units V.I.N. #1WWBBXXXXXXXXOOO1 to 0050

2. Medium Duty Axle:
   All turbo diesel units from VIN # 1WWBBXXXXXXXX6300 and up

3. Heavy Duty Axle:
   Gasoline engine units from VIN # 1WWBBXXXXXXXX0051 and up

SPECIFICATIONS

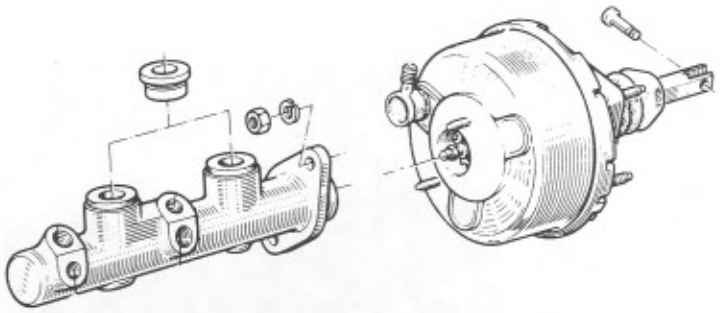
TIGHTENING TORQUES

Wheel Nuts	12 daNm (90 lb./ft.)
Caliper bracket bolts	9 daNm (66 lb./ft.)
Stub axle nut	20 daNm (147 lb./ft.)
Bleed screws	0.7 daNm (5 lb./ft.)
Hose at caliper end	2 daNm (15 lb./ft.)
Metal pipe union on hose	2 daNm (15 lb./ft.)
Wheel cylinder mounting bolts	0.7 daNm (5 lb./ft.)

MASTER CYLINDER
REMOVE AND REPLACE

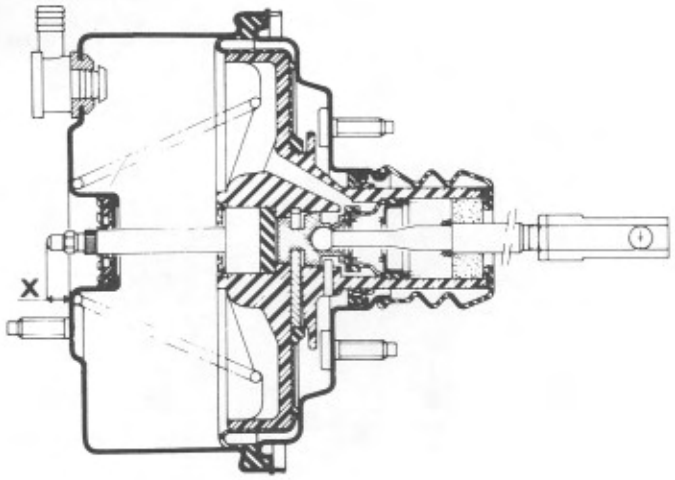
REMOVAL

- Drain the brake fluid reservoir with a syringe and remove the rubber rings
- Unscrew:
  - the metal pipe unions on the master cylinder
  - and the 2 servo nuts
- Remove the master cylinder



REINSTALLATION

- Check the master cylinder operating clearance which is length (X) of the pushrod proud of the servo face:
  X = 0.5 mm (.020")
- Attach the master cylinder to the brake servo
- Reconnect the brake pipes to their correct unions on the master cylinder.
- Reassemble the fluid reservoir with its rubber rings.
- Fill the reservoir
- Bleed the system

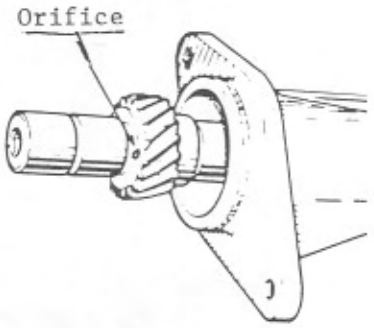


BRAKE SERVO

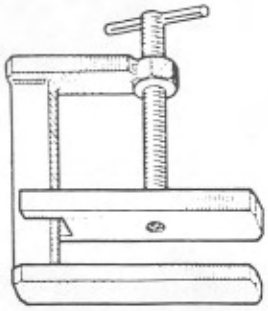
Checking for Loss of Vacuum Pressure (Diesel Powered Units Only)

The check for loss of vacuum pressure in the brake servo unit must be carried out with the hydraulic circuit functioning normally.

- Connect a vacuum gauge to the line between the brake servo and vacuum source (inlet manifold) using a "T" piece union and as short a length of flexible pipe as possible.
- Run the engine at idling speed for 1 minute.
- Clamp the pipe between the "T" piece union and vacuum source using clamp Mot. 453-01.
- Switch off the engine
- If the vacuum drops 33 m/bar (1" Hg) within 15 seconds, a leak is present which may be in either:
  - the check valve (change it)
  - or in the pushrod diaphragm (if in the latter, change the complete servo)



Lubrication to the vacuum pump is provided by a small orifice through the gear for oil to spray through. Hard braking would indicate that the pump is not being lubricated as a result of this orifice being plugged. The pump should be removed and the orifice should be cleaned from the pump side using an air blow gun.



Tool Mot.453-01

CAUTION

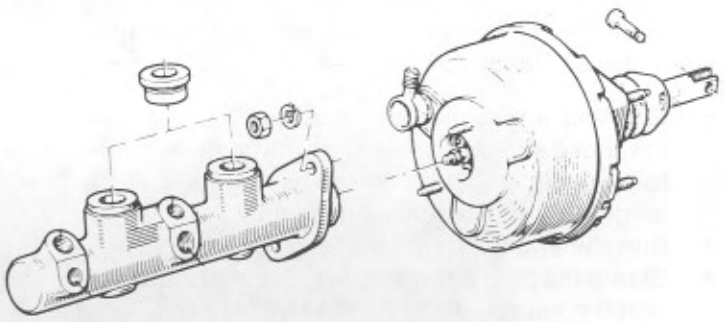
When removing the vacuum pump gear shaft, care should be taken that the oil pump shaft does not stick and fall back into the oil pan.

BRAKE SERVO

REMOVE AND REPLACE

REMOVAL

- Remove the master cylinder from the vehicle.



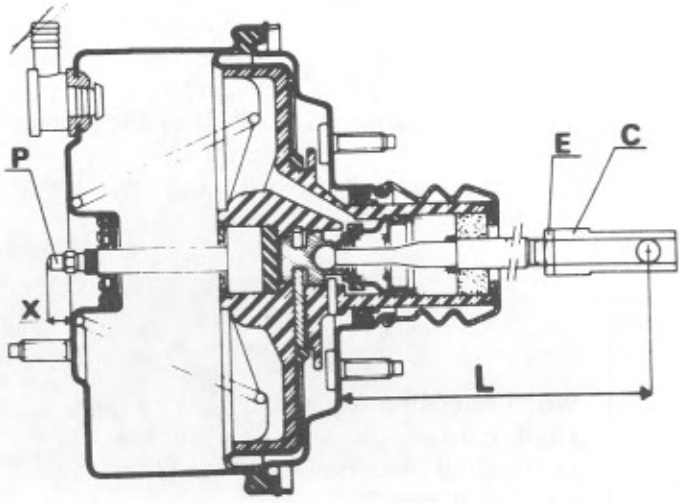
- Remove:
  - the brake pedal clevis pin
  - the nuts securing the master cylinder to the firewall
  - and the servo

REINSTALLATION

- Before reinstalling the brake servo, check:
  - the master cylinder operating clearance which is obtained by turning pushrod nut (P) to give:

    X = 0.5 mm (.020") between the end of the pushrod and the master cylinder mounting face.

  - the adjustment of clevis (C) at the brake pedal end is obtained by unscrewing locknut (E) and turning the clevis to obtain dimensions : L = 138 mm (5.43") diesel, L = 116 mm (4.56") Gas

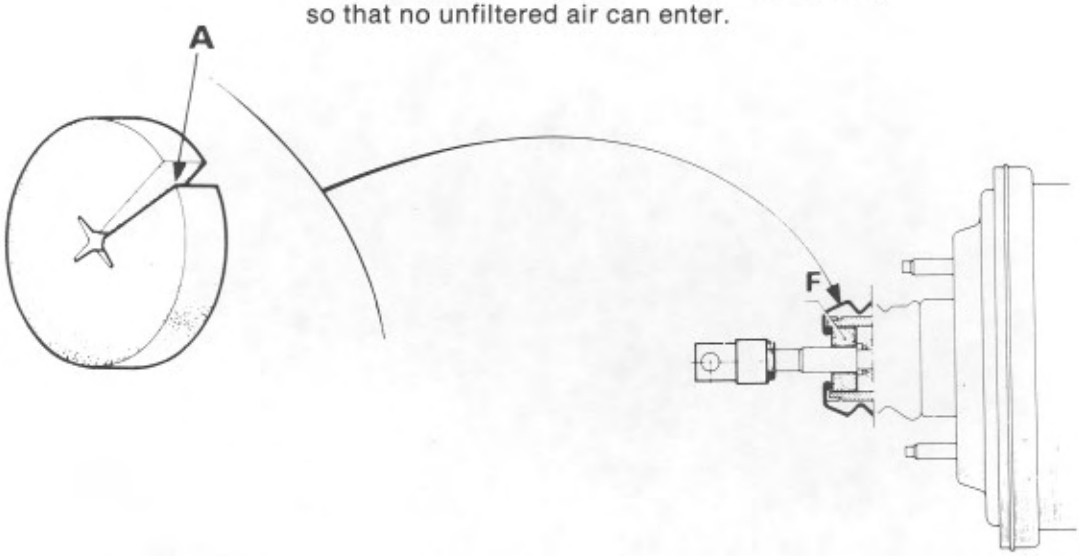


- Mount the following to the servo:
  - the master cylinder
  - and spacer plate (taken from the old servo if latter is to be changed).
- Lift up:
  - the assembly to the firewall and secure it,
  - insert the brake pedal clevis pin
- Reconnect:
  - the servo vacuum hose,
  - and the master cylinder pipes to their correct unions
- Fill and bleed the brake system.

BRAKE SERVO

CHANGING THE AIR FILTER

- The servo need not be removed to change air filter (F).
- Remove the old filter (F) under the pedal assembly with a screwdriver or scriber.
- Make a cut (A) in the new filter (see insert), slip it over the pushrod and push it fully home evenly so that no unfiltered air can enter.



Changing the check valve

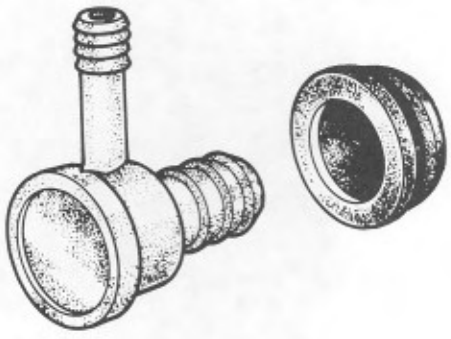
- This operation may be carried out in place.

REMOVAL

- Disconnect the vacuum hose at the servo end.
- Pull and turn the check valve to free it from the rubber sealing washer.

REINSTALLATION

- Check the condition of the sealing washer and check valve.
- Replace all faulty parts.
- Mount the assembly.



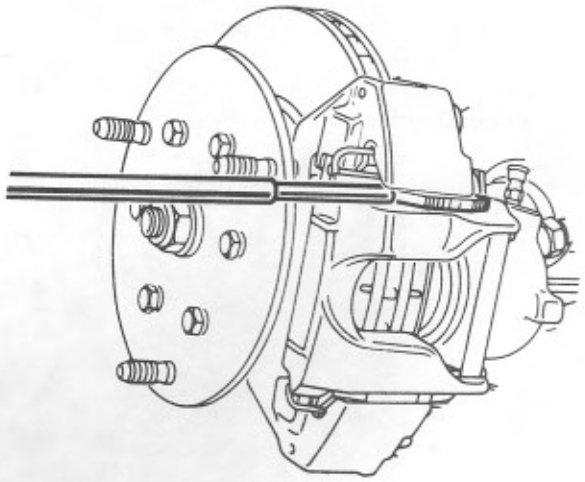
FRONT BRAKE PADS
REMOVE AND REPLACE

TIGHTENING TORQUES

Wheel nuts	12 daNm (90 lb./ft.)

IMPORTANT
Brake pads must be changed in complete axle sets and each pad must be located correctly.

This is essential to ensure even pad wear, efficient braking and an even spread of braking effort.



REMOVAL

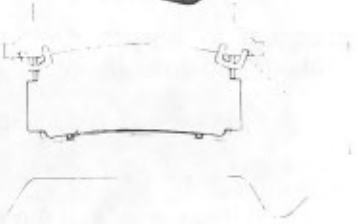
- Remove both clips.
- Tap out one retaining key with a pin punch.
- Slide out the second retaining key.

FRONT BRAKE PADS
REMOVE AND REPLACE

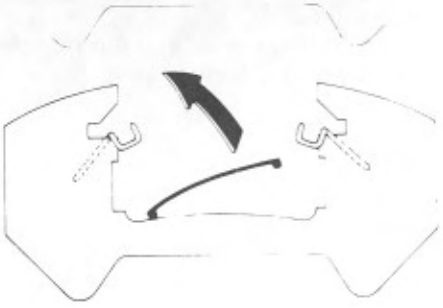
- Remove the caliper

IMPORTANT
Do not touch the brake pedal from this point until completion of this operation.



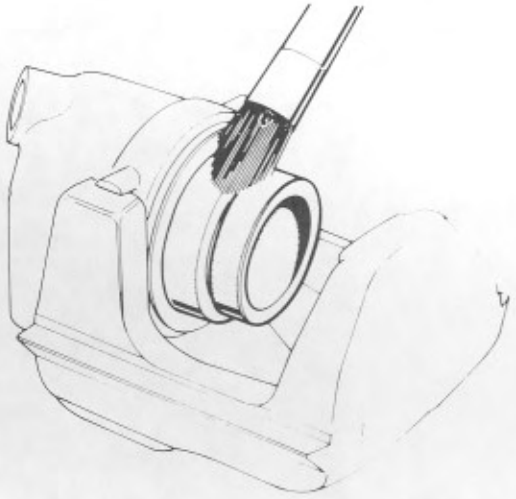


- Remove the brake pads.
- Lift out the springs under the pads.

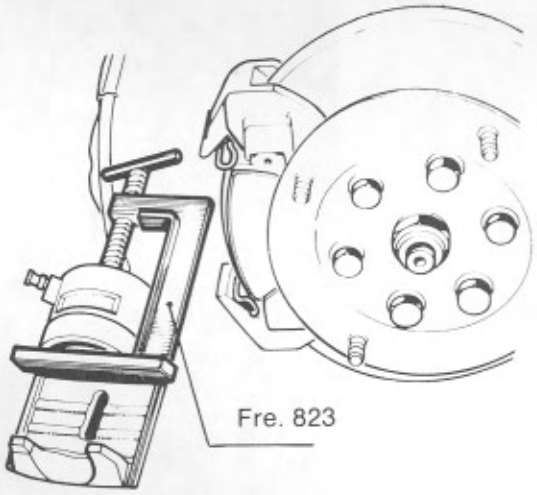


REASSEMBLY

- Remove the dust covers from their grooves and clean them and the ends of the pistons with methylated spirit.
- Lubricate the piston skirts all around with graphite grease.

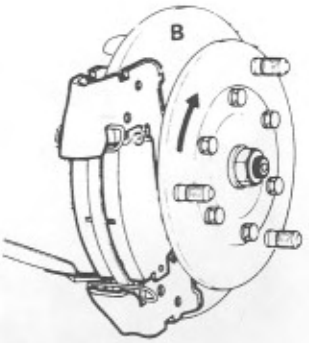


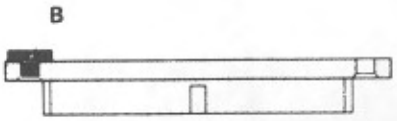
- Mount the dust cover.
- Push the piston back into its bore with tool Fre.823
- Remount the springs under the pads.



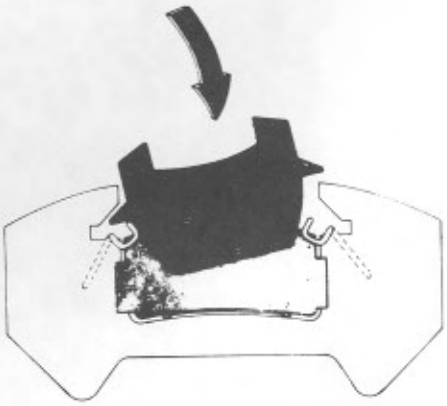
FRONT BRAKE PADS
REMOVE AND REPLACE

- Mount the pads in position (they must be free to slide).
- The retaining peg (B) on replacement service pads must be at the front (direction of wheel rotation).

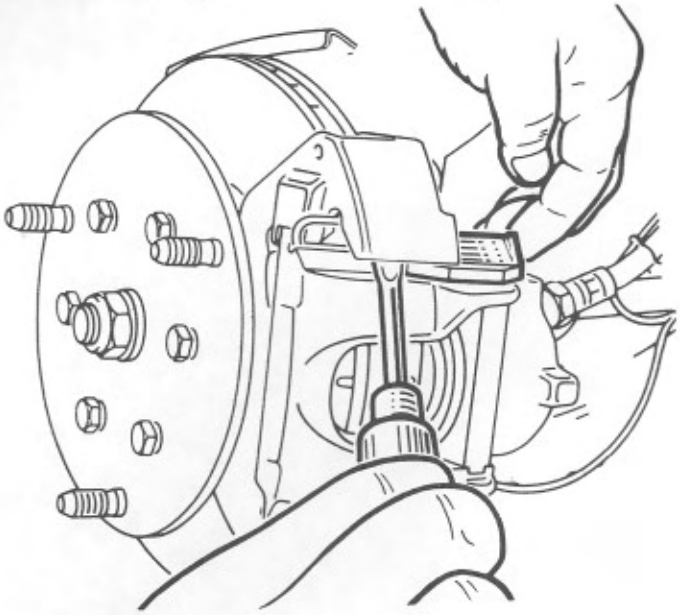




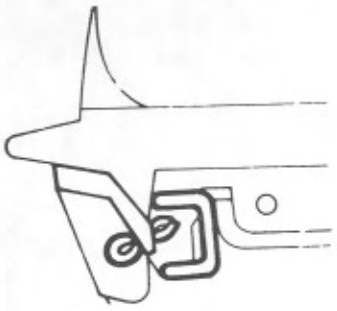
- Slip one end of the caliper between the spring clip and the key location on the caliper bracket.



- Insert the other end by compressing both springs.
- Mount the first key, insert a screwdriver in the slot for the second key, press on the screwdriver and push the second key in.



- Remove the screwdriver and tap the key until fully seated with a pin punch.
- Mount two new key retaining pins.
- Press the brake pedal several times to push the pistons up into contact with the back of the pad.

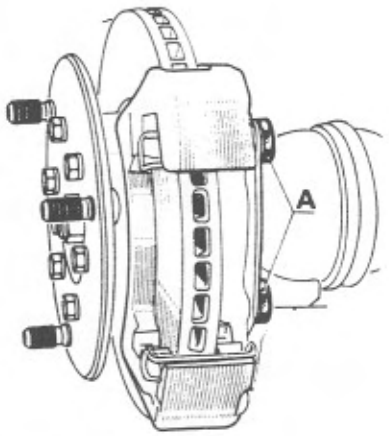


FRONT BRAKE ROTORS
REMOVE AND REPLACE

IMPORTANT
Brake rotors (discs) cannot be resurfaced. A rotor must be changed if excessive or uneven wear is present.

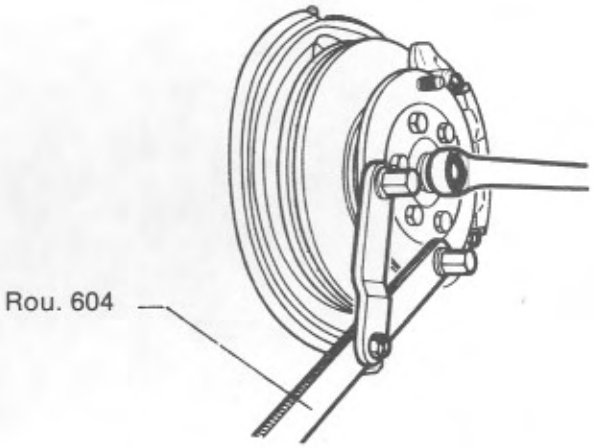
Disc thickness:
Brake disc wear is acceptable up to a minimum disc thickness of 22 mm (.866")

Disc run-out:
0.07 mm (.003") maximum measured 5 mm from the outer edge with a dial indicator.

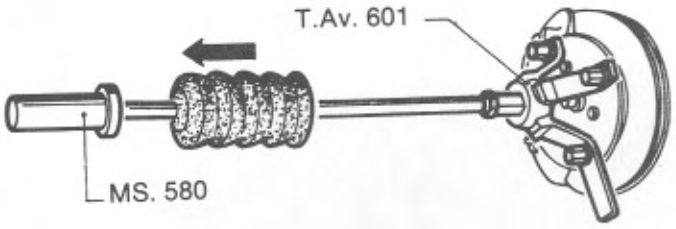


REMOVAL

- Remove the brake assembly : pads, caliper and caliper bracket (bolts A).
- Attach locking tool Rou. 604 over 2 wheel studs and unscrew the stub axle nut.



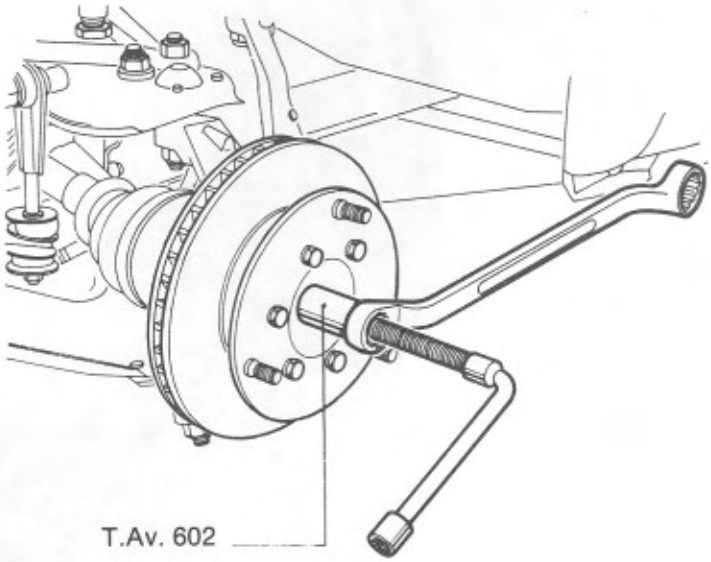
- Remove the screw from tool T.Av.601 and place impact tool Ms. 580 in its place.
- Attach the assembly to the wheel studs.
- Remove the hub-rotor assembly.
- Separate the rotor from the hub.



REASSEMBLY

- Remove the protective coating from the rotor and fasten the rotor to the hub.
- Coat the bearing with grease.
- Apply loctite® 680 to driveshaft splines.
- Mount the rotor-outer bearing-spacer assembly to the stub axle splines.
- Screw tool T.Av. 602 onto the stub axle; align the assembly with the stub axle carrier then screw in the tool to draw the drive shaft into the hub.
- Mount the washer and a new stub axle nut and torque tighten; 20 daNm (147 lb./ft.)
- Reassemble
  - the caliper bracket (coat the bolt threads with Loctite® or equivalent).
  - pads
  - and caliper bracket
- Press the brake pedal several times to take up the play.

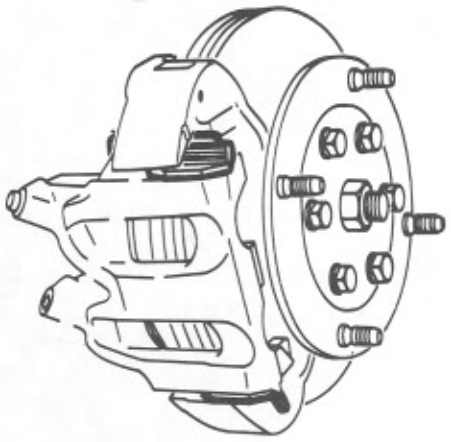
NOTE: See Section K for detailed information on axle tightening procedure.



FRONT BRAKE CALIPERS
REMOVE AND REPLACE

TIGHTENING TORQUES

Bleed screws	0.7 daNm (5 lb./ft.)
Hose at caliper end	2 daNm (15 lb./ft.)
Metal pipe union on hose	2 daNm (15 lb./ft.)
Wheel nuts	12 daNm (90 lb./ft.)
Caliper bracket bolts	9.0 daNm (66 lb./ft.)



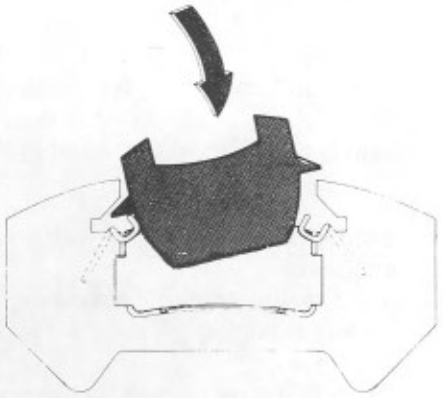
REMOVAL

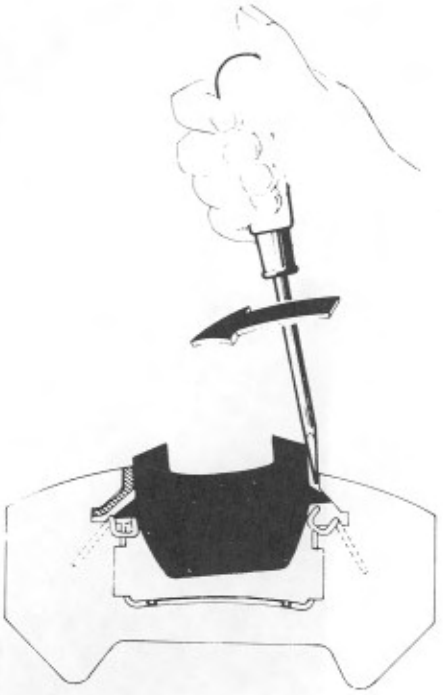
- Isolate the clutch master cylinder with clamp Mot. 453-01 if applicable.
- Drain the fluid reservoir with a syringe.
- Remove the key retaining pins.
- Slide out the keys.
- Unscrew the metal pipe unions on the hoses.
- Remove the hose clips from the brackets and release the caliper.
- Unscrew the hoses from the caliper and check them.
- Check the condition of the pads.

FRONT BRAKE CALIPERS
REMOVE AND REPLACE

REASSEMBLY

- Mount the brake pads
- Slip one end of the caliper between the spring clip and the key locating face on the bracket.
- The first key should slide in easily; use a screwdriver to insert the second key by prying between the caliper and bracket.
- Remove the screwdriver and tap the second key fully home with a pin punch.
- Mount new key retaining clips.
- Bleed the clutch hydraulic circuit (if applicable) followed by the brake circuit.





- Press the brake pedal several times to push the pistons up into contact with the pad.

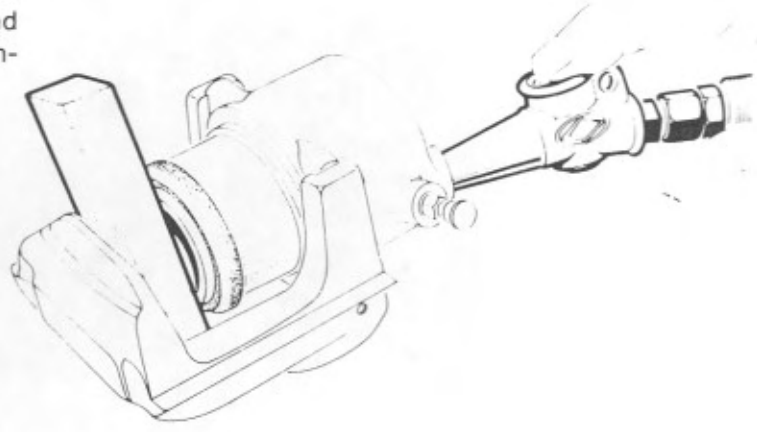
FRONT BRAKE CALIPERS

OVERHAUL

- The caliper must be removed for this operation.
- The complete caliper assembly must be changed if the bore shows any signs of scoring.

DISMANTLING

- Remove rubber dust cover.
- Push out the piston with compressed air, inserting a block of wood between the caliper and piston to prevent the piston from being damaged. The piston must not be re-used if the skirt is scored.
- Use a flexible strip of steel with smooth round edges (like a feeler gauge) to extract the rectangular section seal from the caliper groove.
- Change all worn parts and reassemble.

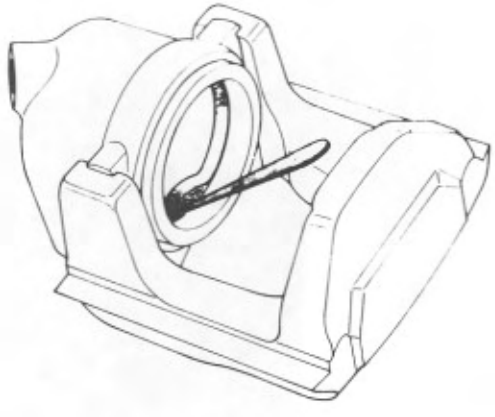


REASSEMBLING

- The piston must never be hammered or forced in as this would damage the seal.
- Lubricate the caliper bore, groove and the new seal with clean brake fluid.
- Mount the new seal and the piston, pushing the piston in by hand.
- Coat the piston skirt and the space between it and the bore with grease.
- Mount a new dust cover.
- Fill the caliper with brake fluid through the bleed screw aperture to make the bleeding operation easier.

  Remove the bleed screw, tilt the caliper from side to side during filling to release any air, then remount the bleed screw.

  Attach the hose to the caliper using a new copper washer.



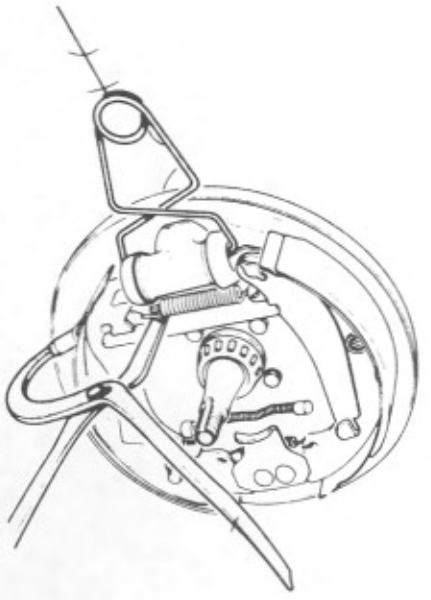
REAR BRAKE LININGS - STANDARD & MEDIUM DUTY AXLES

REMOVE AND REPLACE

TIGHTENING TORQUE
WHEEL NUTS 12 daNm (90 lb./ft.)
REMOVAL

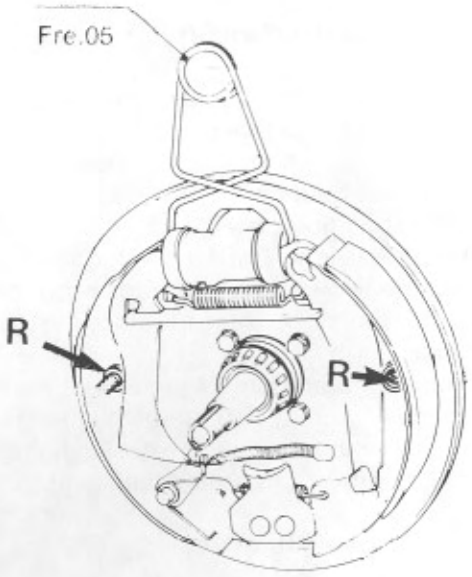
- Place the rear of the vehicle on stands and remove the tires, and brake drums.
- Rear Brake Drums must be removed for this operation - see Section L, Rear Axle.
- Check the condition of:
  - both brake drums. Their diameter should be exactly the same. If one requires regrinding, the other must be reground to the same diameter.
  - The maximum amount of metal that may be removed is 1 mm (.040") on the diameter.
- Attach clip Fre.05 astride the wheel cylinder.
- Remove the top return spring with brake shoe pliers.
- Disconnect the handbrake cable.

Fre. 05

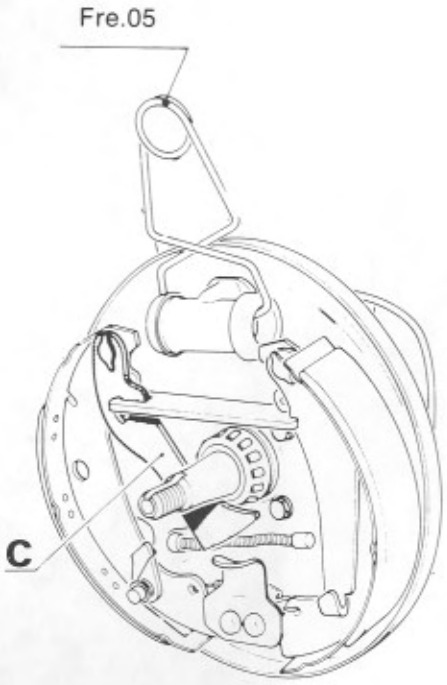


REAR BRAKE LININGS - STANDARD AND MEDIUM DUTY AXLES
REMOVE & REPLACE

- Release the 2 brake shoe retaining springs (R) by pressing in the bottom of the spring.



- Tilt toothed lever (C) as far as possible in towards the stub axle.
- Pull the brake shoes outwards at the top.

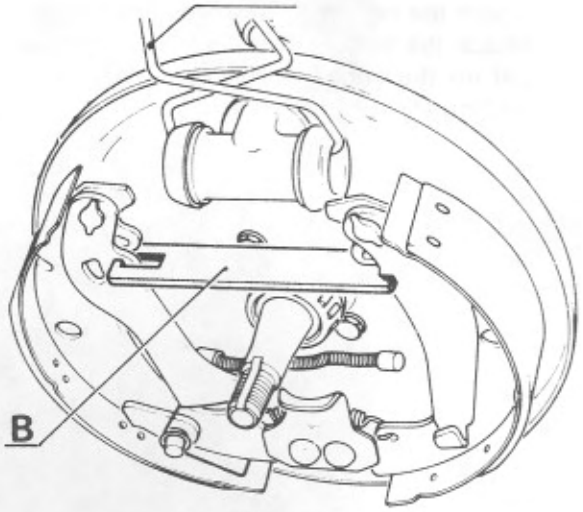


REAR BRAKE LININGS - STANDARD AND MEDIUM DUTY AXLES

REMOVE AND REPLACE

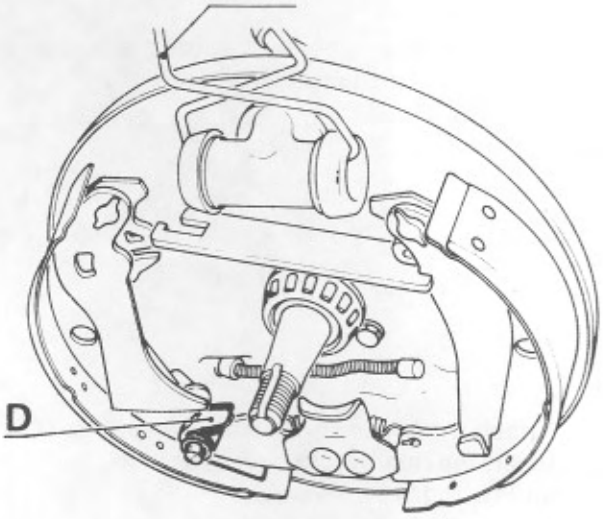
- Pull link (B) outwards and free it from the leading brake shoe.

Fre.05



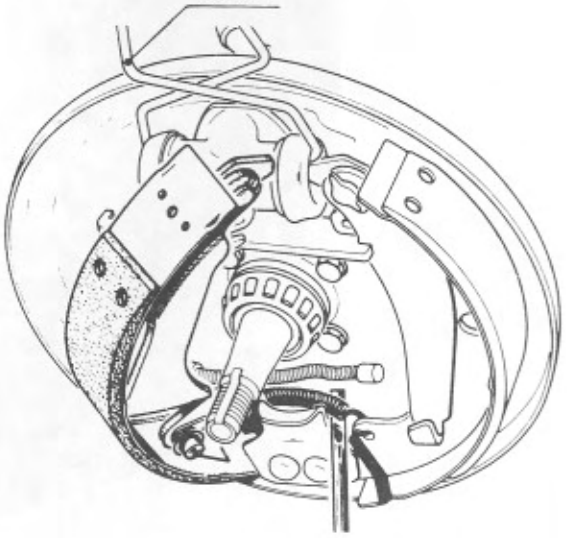
Fre.05

- Move toothed sector (D) to its initial position.



Fre.05

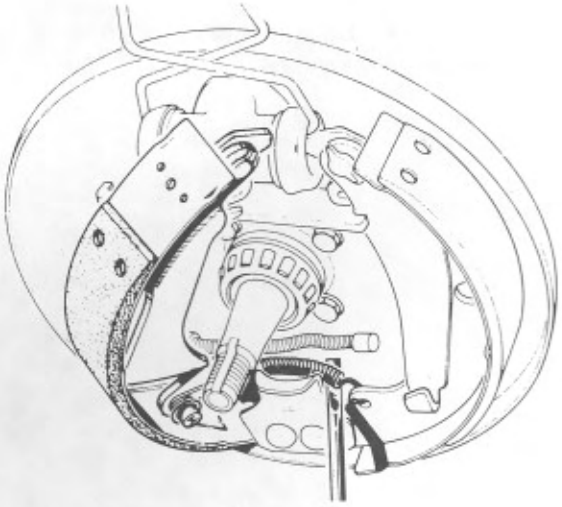
- Tilt the leading shoe 90° outwards.
- Ease out the bottom return spring with a screw-driver.
- Free the leading shoe.
- Remove the trailing shoe.



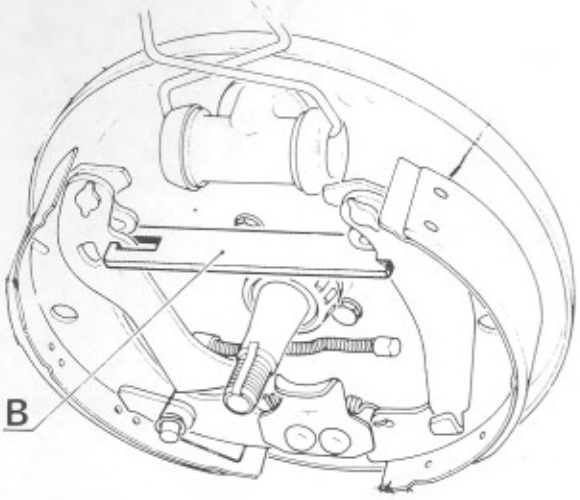
REAR BRAKE LININGS — STANDARD AND MEDIUM DUTY AXLES
REMOVE AND REPLACE

REASSEMBLY

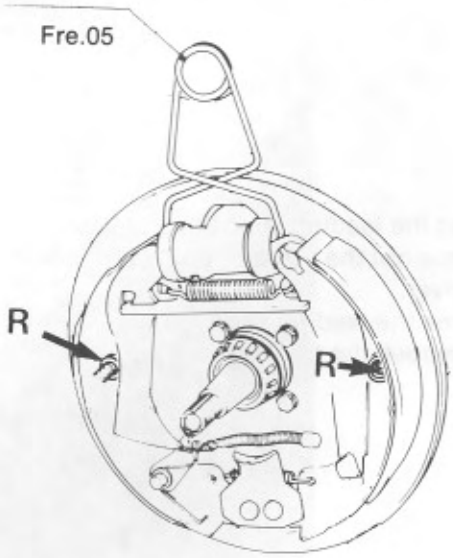
- Check the condition of the drums and hoses.
- Attach the bottom return spring to both shoes.
- Lift up the shoes to the backplate, tilting the leading shoe 90° outwards.



- Tilt the toothed lever in towards the stub axle as far as it will go and insert link (B).



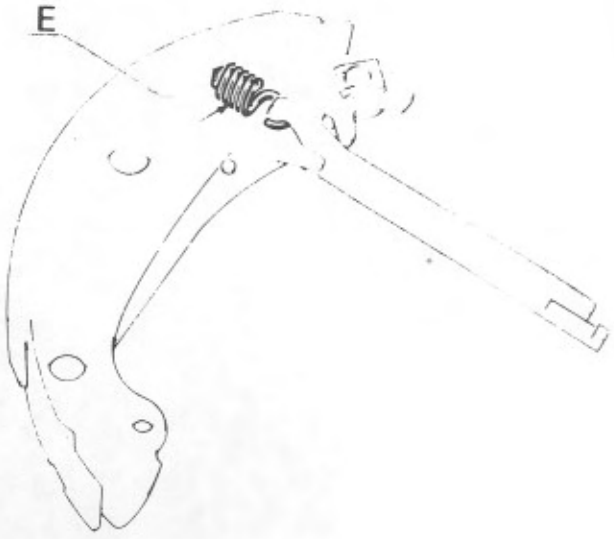
- Attach the brake shoe retaining springs (R).
- Insert the retaining spring clips in the backplate and twist 1/4 turn to fasten.
- Attach the handbrake cable.



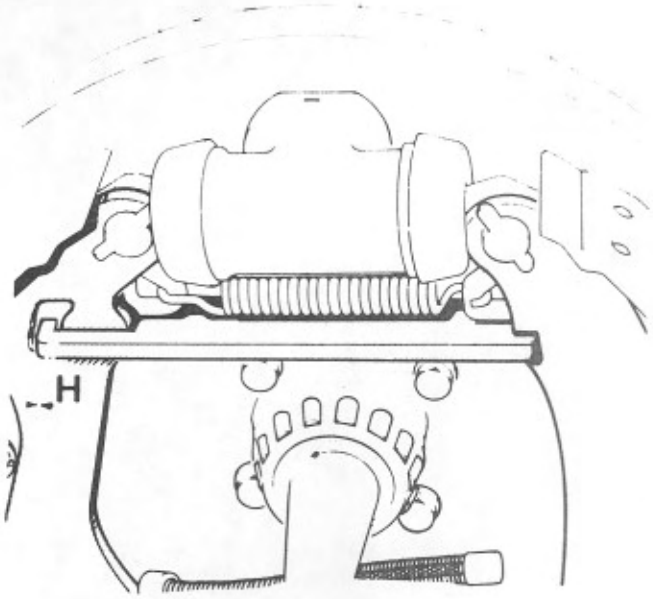
- Primary brake shoe is the front shoe.

REAR BRAKE LININGS — STANDARD AND MEDIUM DUTY AXLES
PRE-SETTING THE AUTOMATIC ADJUSTING SYSTEM

- Satisfactory adjustment depends on the tension of spring (E) hooked between the link and the trailing shoe.



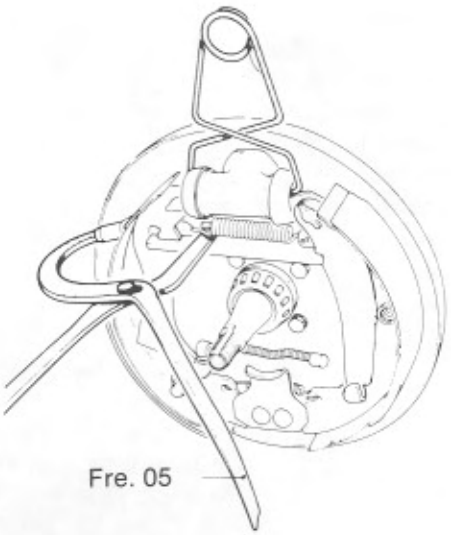
- Adjustment consists of measuring dimension H = 1 mm (.040") approximately between the link and the leading shoe as shown in the sketch (the brake operating lever must be resting against the shoe).
- If dimension (H) is incorrect then the link spring and both the brake shoe return springs must be replaced.
- Reassemble the drum and adjust the bearing endplay.
- Press the brake pedal to center the shoes in the drum and take up the initial play.
- Adjust the handbrake.
- Remember to insert a new plug in the backplate hole.



REAR WHEEL CYLINDERS — STANDARD AND MEDIUM DUTY AXLES
REMOVE AND REPLACE

TIGHTENING TORQUES

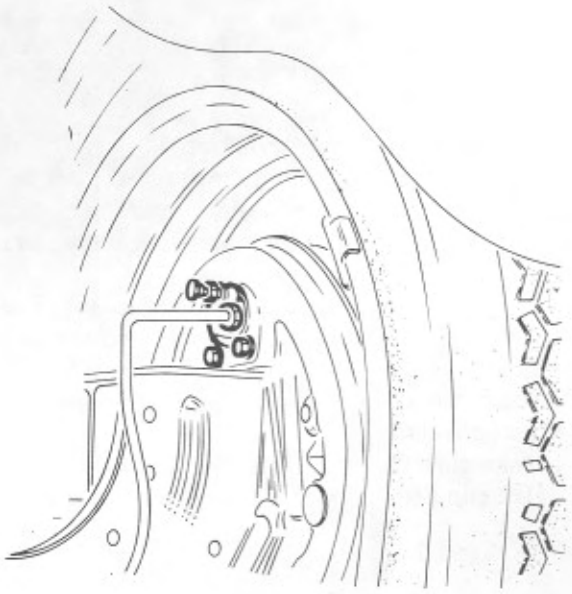
Bleed screws	0.7 daNm (5 lb./ft.)
Metal pipe unions	2 daNm (15 lb./ft.)
Wheel nuts	12 daNm (90 lb./ft.)



Fre. 05

REMOVAL

- Place the rear of the vehicle on stands and remove:
  - the tire
  - brake drum
  - and top return spring
- Pull the brake shoes apart.
- Unscrew:
  - the metal pipe union on the wheel cylinder
  - both bolts on the backplate
- Remove the wheel cylinder.



REAR WHEEL CYLINDERS — STANDARD AND MEDIUM DUTY AXLES

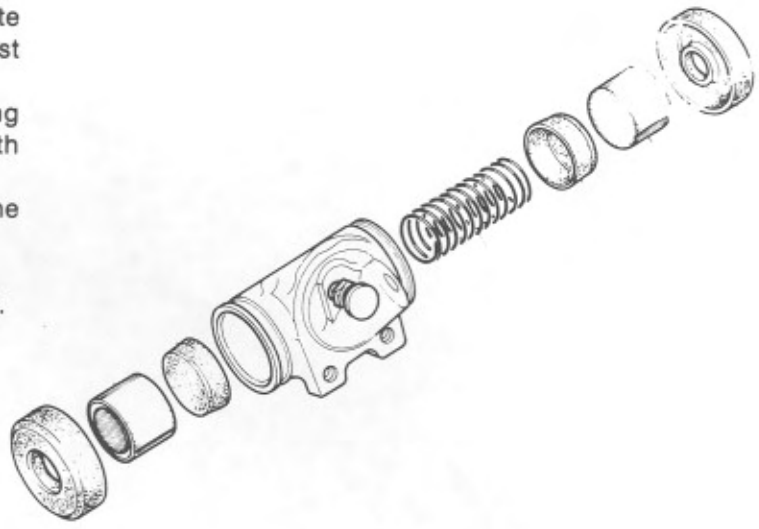
REMOVE AND REPLACE

REASSEMBLY

- Check the condition of the brake shoes; replace them if oil or grease is present on the linings.
- Mount the wheel cylinder and fasten it with the two bolts to the backplate.
- Reconnect the metal pipe.
- Attach the top return spring using brake shoe pliers.
- Reassemble the brake drum.
- Adjust the bearing endplay.
- Bleed the brake circuit.
- Adjust the brakes by several applications of the pedal.
- Adjust the handbrake.
- Remember to insert a new plastic plug in the backplate.

OVERHAULING

- Dismantle the wheel cylinder.
- Check that the wheel cylinder and pistons are serviceable before reassembling. The complete wheel cylinder must be replaced if scores or rust are present.
- If the cylinder is serviceable, dip the sliding parts in brake fluid, mount the bleed screw with its dust cap.
- Insert the spring, cups, pistons and mount the dust covers.
- Make sure that the parts slide freely.
- Use clip Fre.05 to hold the assembly together.



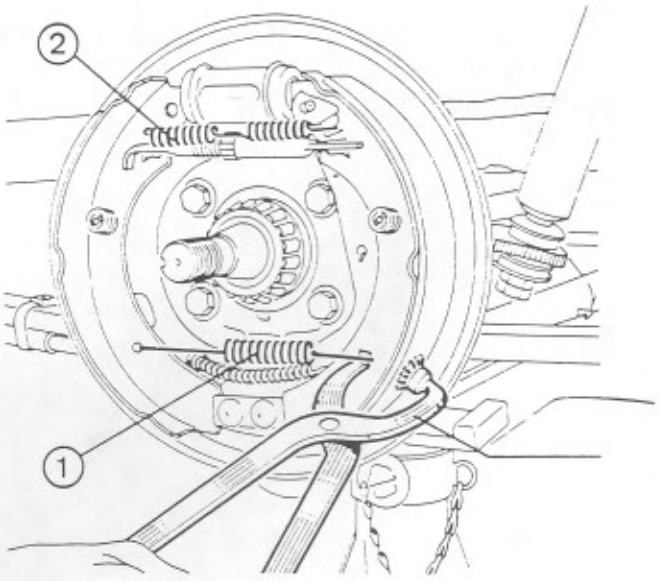
REAR BRAKE SHOES — HEAVY DUTY AXLE

REMOVE AND REPLACE

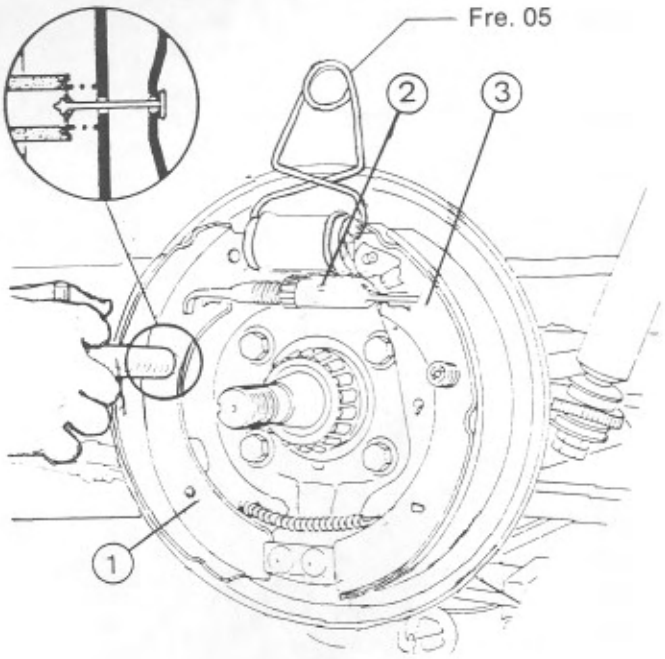
Rear Brake Drums Must Be Removed For This Operation. See Rear Axle Section.

REMOVAL

- Unhook bottom return spring (1) followed by top return spring (2).

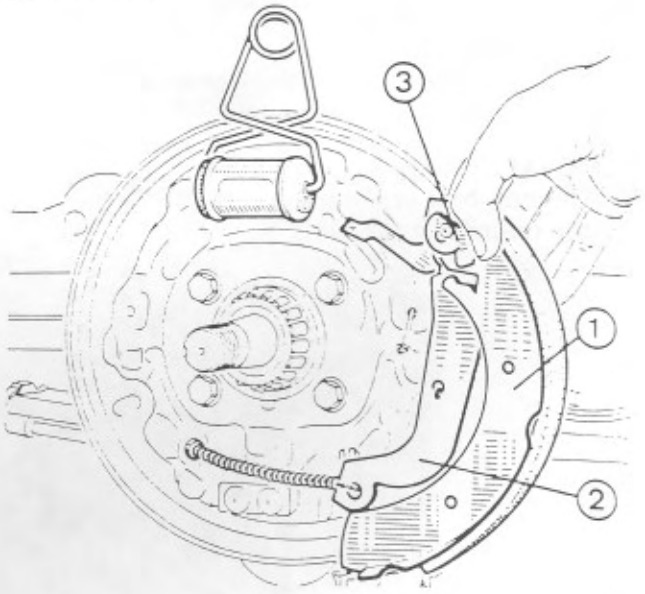


- Fit wheel cylinder clip Fre.05 astride the cylinder.
- Using the same shoe locator tool or a piece of tube, remove the spring retaining cup locating brake shoe (1) by pressing it in and turning.
- Remove the cup and spring followed by brake shoe (1) and threaded body (2).
- Disconnect the handbrake cables at the swivel (where the cables meet).
- Remove the spring retaining cup and spring locating brake shoe (3).

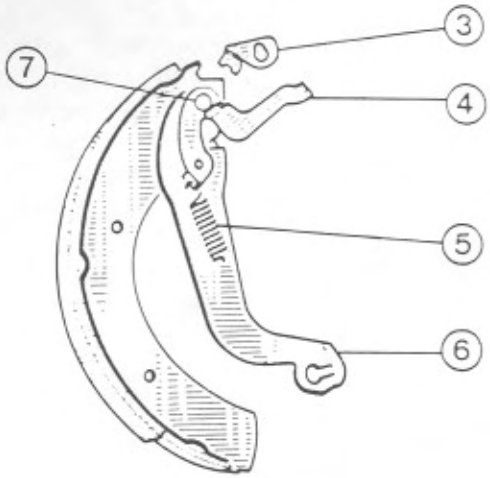


REAR BRAKE SHOES — HEAVY DUTY AXLE
REMOVE AND REPLACE

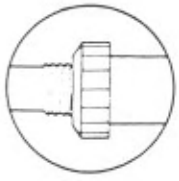
- Remove brake shoe (1) and disconnect the cable from lever (2).
- Keep stop plate (3) on its pin during this operation.

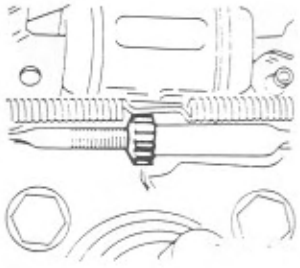


- Remove stop plate (3).
- Disconnect lever (6) from the brake shoe followed by ratchet arm (4) and its spring (5).
- Check all the components. Replace any part which appears worn.
- When reassembling : lubricate pin (7) lightly.
- Check the adjuster body and rod assembly. The rod should screw in freely along the entire length of the threads.
- When reassembling : lubricate the threads.

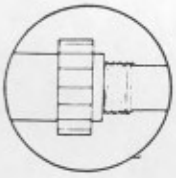


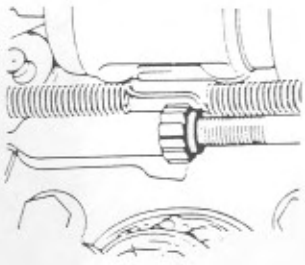
- Identifying the L.H. and R.H. adjuster assembly:
  - L.H. rear brake : this has a R.H. thread and the ratchet is chamfered.





  - R.H. rear brake : this has a L.H. thread and the ratchet is shouldered.

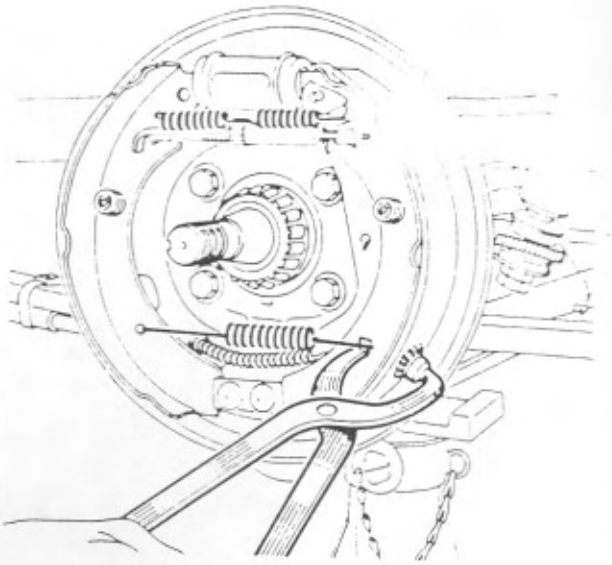




REAR BRAKE SHOES — HEAVY DUTY AXLE
REMOVE AND REPLACE

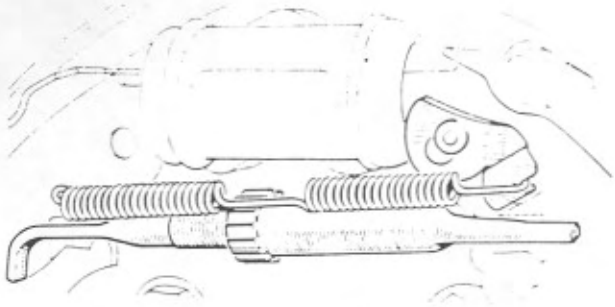
RE-INSTALLATION

- Lightly grease the areas on the backplate where the brake shoes rub.
- Insert the end of the handbrake cable into the lever.
- Mount the brake shoe, reattach the side locating spring and cup using the special tool or a piece of tube.
- Screw the threaded rod into the adjuster body so that it is of minimum length, position this assembly and brake shoe.
- Attach the shoe side retaining spring and secure its cup with the special tool or a piece of tube.
- Remove wheel cylinder clip Fre.05.
- Hook on the top return spring using pliers followed by bottom spring.



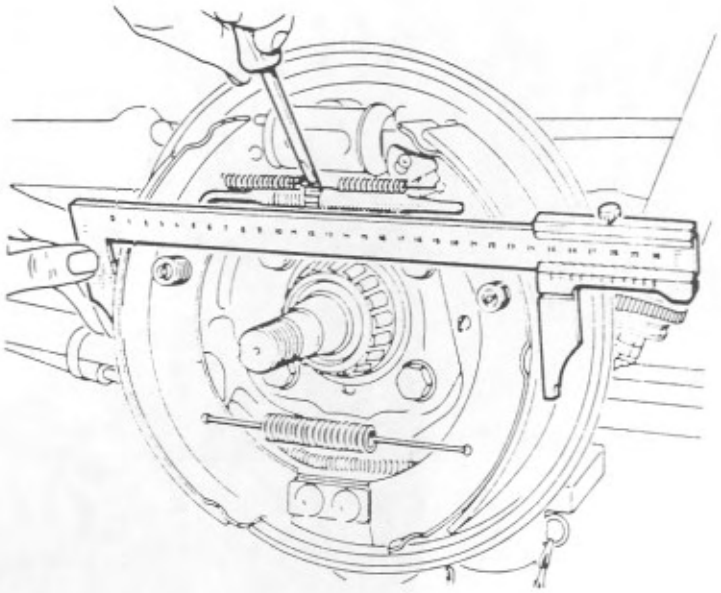
WARNING

The longer hook end of the spring must be attached to the handbrake lever end.



- Make sure that stop plate is mounted correctly when reassembling.

- Unscrew the ratchet by turning the teeth with a screwdriver until a presetting diameter across the brake shoes of 252,5 (9.94") to 253 (9.96") mm is obtained.
- Do the same on the other side.
- Refit the brake drum, bleed the brakes, press the brake pedal several times to obtain the normal operating clearance between drum and shoes then adjust the handbrake cables.

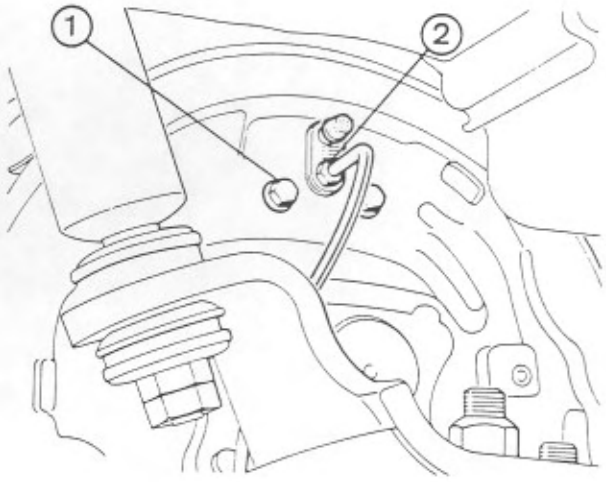


REAR WHEEL CYLINDERS — HEAVY DUTY AXLE
REMOVE AND REPLACE

TIGHTENING TORQUES

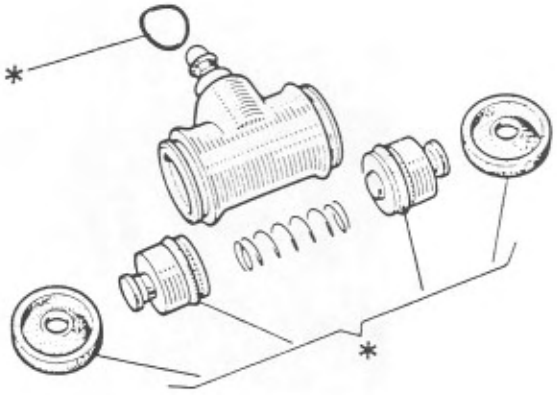
Bleed screw	0.7 daNm (5 lb./ft.)
Metal pipe union on wheel cylinder	2 daNm (15 lb./ft.)
Wheel cylinder mounting bolts	0.7 daNm (5 lb./ft.)

- Remove the brake drum and brake shoes then check the wheel cylinders. The wheel cylinders must show no signs of external leakage and the pistons must slide easily with finger pressure.
- This check must be carried out:
  - every 60,000 km (40,000 miles) or once every 3 years (whichever occurs first).
  - each time the brake linings or shoes are changed.
- If a defect is found then both wheel on the same axle must be changed. Wheel cylinders may be overhauled if the bores and pistons are completely free of scratches and oxidation.



REMOVAL
- Unscrew metal pipe union (2) and mounting bolts (1).
- Remove the wheel cylinder and its seal.

RE-INSTALLATION
- Stick the seal to the back of the wheel cylinder with a dab of grease.
- Mount the cylinder and secure bolts (1).
- Torque tighten metal pipe union (2) followed by bolts (1).
- Refit the brake shoes and drums then bleed the circuit.
- Press the brake pedal several times to restore the correct operating clearance between linings and drum.



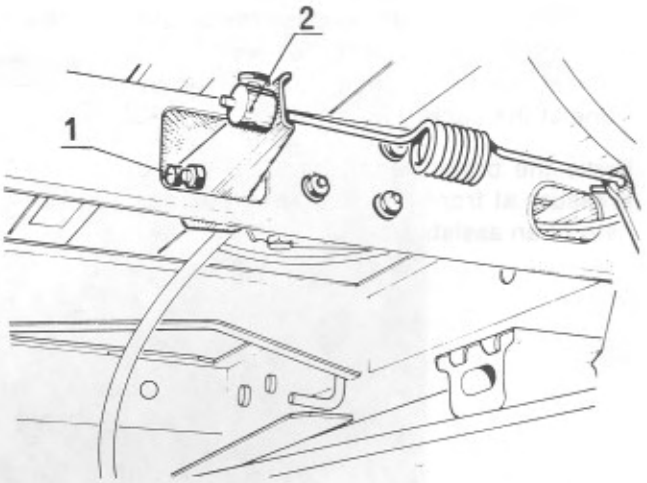
OVERHAULING
- Change all the components marked (*) routinely.
- Check the pistons and bore. The complete wheel cylinder must be changes if any traces of scratches are present.
- If the pistons and cylinder are serviceable, install new cupwashers.
- Dip all moving parts in new clean brake fluid. Assemble the pistons, spring and dust covers. Check that the assembly slides freely. Mount clip Fre. 05 astride the wheel cylinder to hold the assembly together.

BRAKE LIMITER
ADJUSTMENT

TIGHTENING TORQUES

Bleed screws	0.7 daNm (5 lb./ft.)

IMPORTANT
The brake limited must be checked and adjusted with the wheels on the ground, vehicle unladen and driver on board.



CHECKS

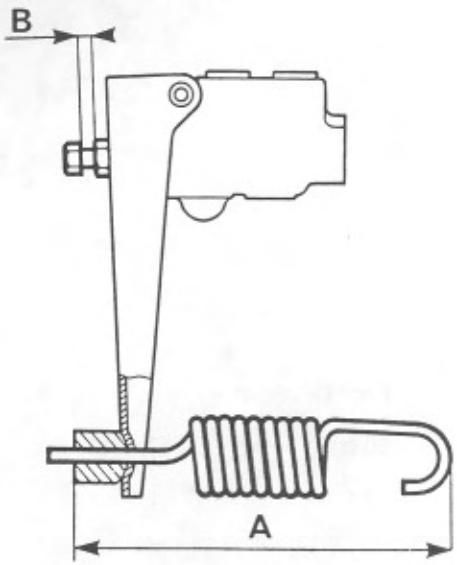
- There are 2 preliminary checks to be made before proceeding with the pressure check:

1 - setting of the spring length (A) by altering the position of collar (2).

A = 200 mm (7 7/8")

2 - protrusion of bolt (1)

B = 5 mm + 0.5 (.197")

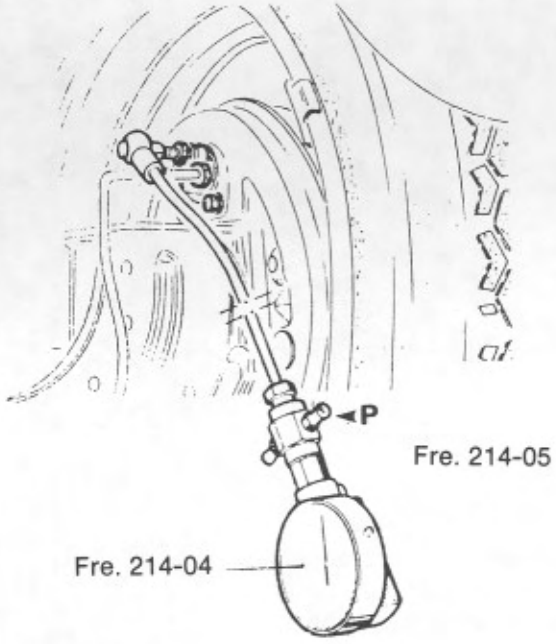


BRAKE LIMITER

CHECKING THE PRESSURE

Once the preliminary checks are complete, connect the 2 pressure gauges: Fre.214-04
- one at the front, with a standard union
- one at the back, with a union Fre.214-05.

Press the brake pedal gradually and observe the pressure at front and rear simultaneously with the help of an assistant.



LESHARO/PHASAR

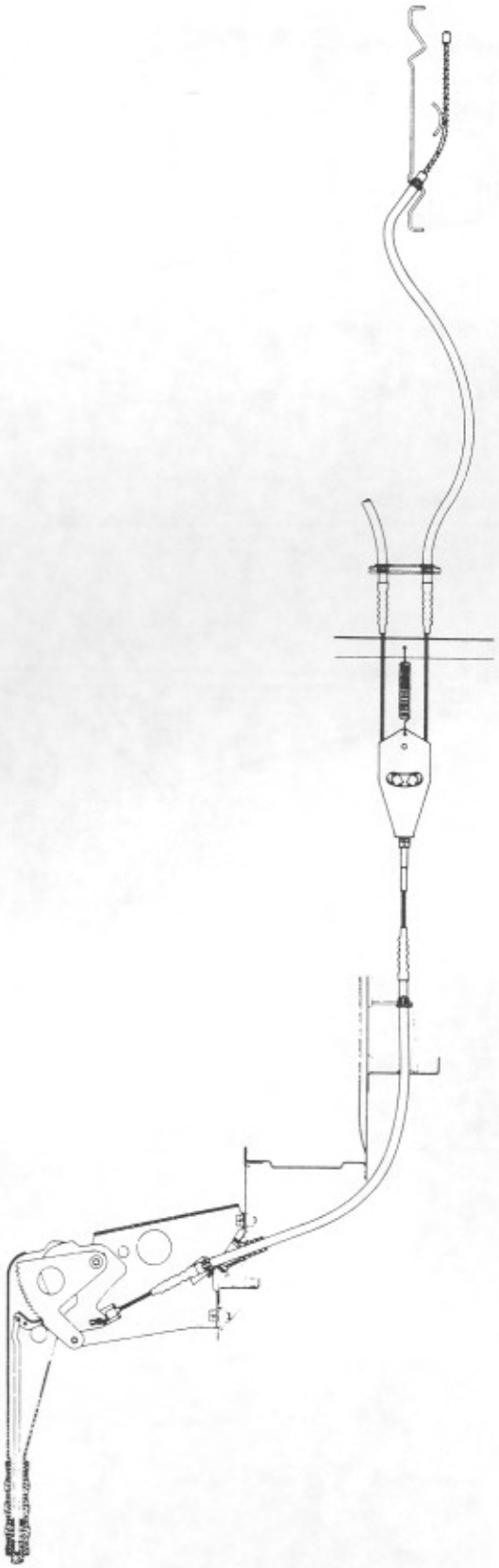
Front Pressure:	Rear Pressure:
50 bars + 1 (725 PSI + 14)	50 bars +0 -4 (725 PSI +0 -58)
75 bars + 1 (1087 PSI + 14)	54 bars +0 -4 (783 PSI +0 -58)
100 bars +1 (1450 PSI + 14)	58.5 bars +0 -4 (848 PSI +0 -58)

CENTAURI/UTILITY VAN

Front Pressure:	Rear Pressure:
40 bars +1 (580 PSI +14)	40 bars +0 -4 (580 PSI +0 -58)
70 bars +1 (1015 PSI +14)	46 bars +0 -4 (667 PSI +0 -58)
100 bars +1 (1450 PSI +14)	52 bars +0 -4 (754 PSI +0 -58)

NOTE: Wheel nut tightening torque: 12 daNm (90 lb./ft.). All models.

HANDBRAKE
LAYOUT



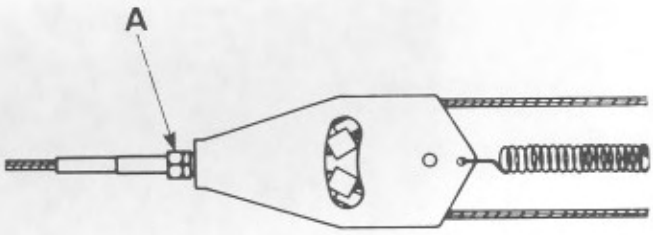
HANDBRAKE

ADJUSTMENT



In order to allow the self-adjusting mechanism to function normally, the cable should be tensioned so that the handbrake lever will travel 6 notches on the ratchet quadrant to apply the rear brakes when new; 10 notches after break-in.

An adjustment with a travel of more than 12 notches will unmesh lever (L) and upset the self-adjusting mechanism.

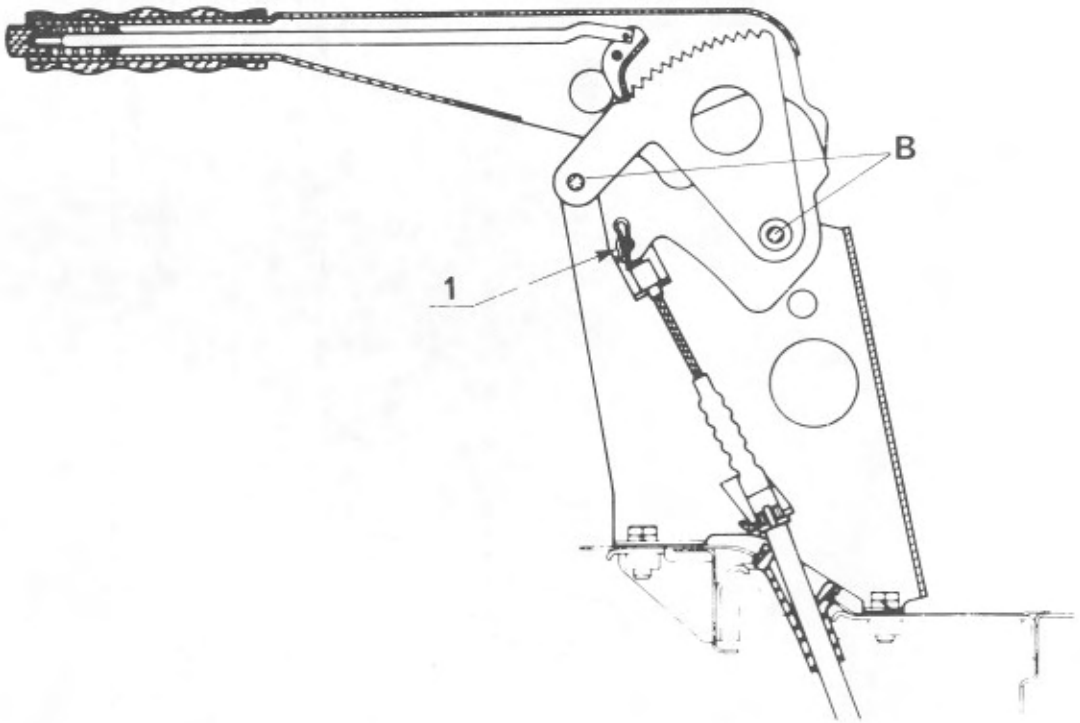


ADJUSTING

- Place the vehicle on a hoist and release the handbrake (safety blocks in position).
- Unscrew locknut (A) and turn the main nut to adjust cable tension.

Removing - Reassembling the handbrake lever

- Remove pins (B) holding the quadrant and primary cable clevis pin (1).



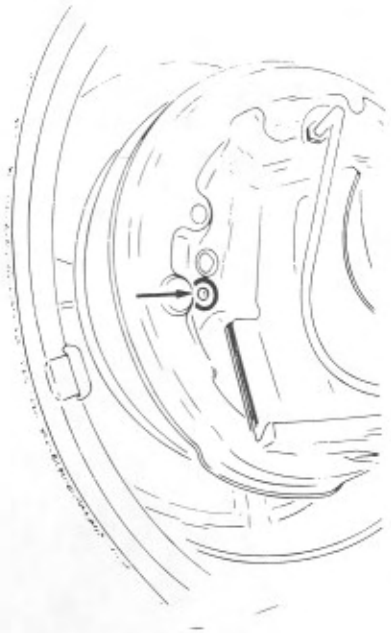
HANDBRAKE SECONDARY CABLE
REMOVE AND REPLACE

TIGHTENING TORQUE

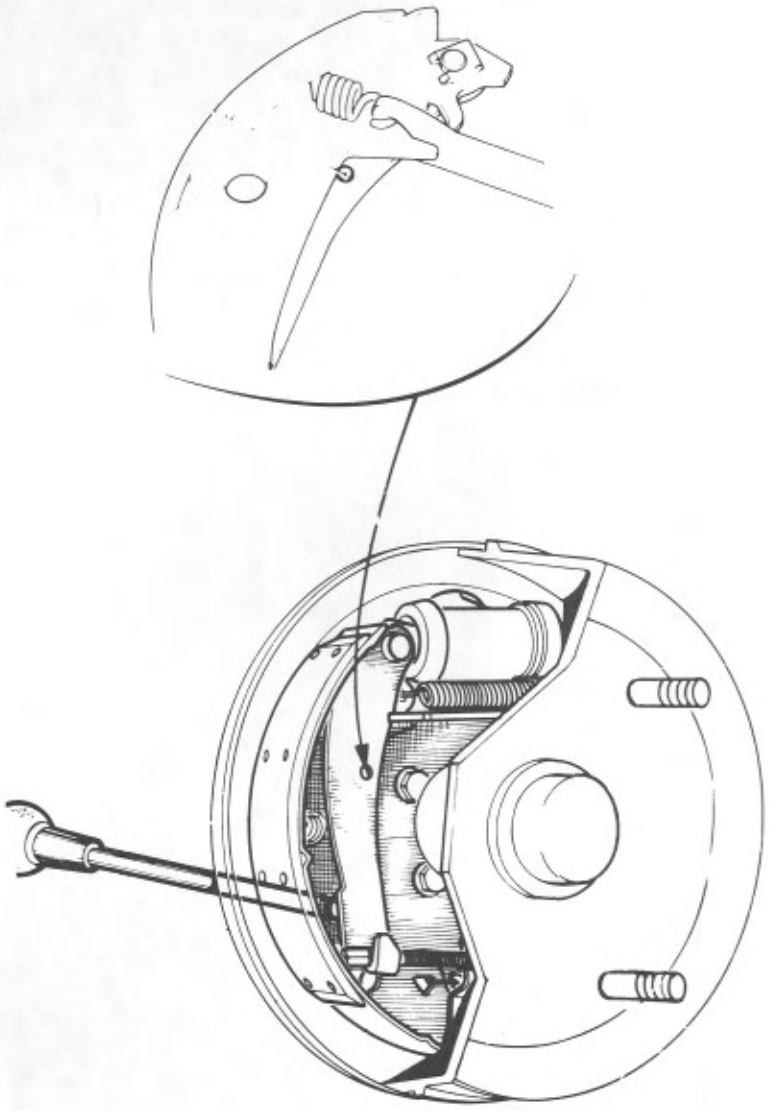
Wheel nuts	12 daNm (90 lb./ft.)

REMOVAL

- Release the handbrake
- Loosen the secondary cables to allow the operating lever to return.
- Remove the plastic plug in the backplate and zero the self-adjusting mechanism.

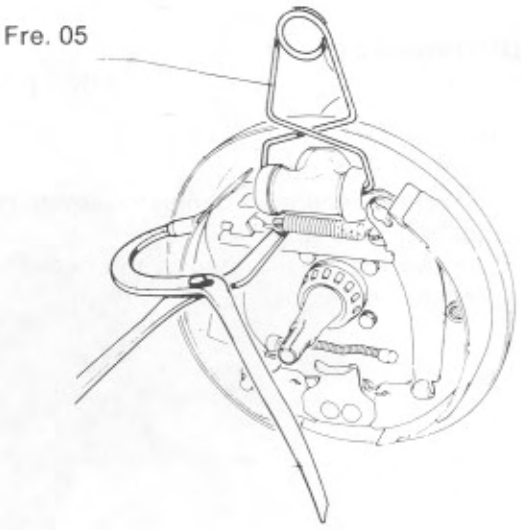


- Push the operating lever inwards with a screwdriver (access holes are provided in the backplate and brake shoe) to free peg (E) from the brake shoe.
- When the peg is free, push the lever to the rear.



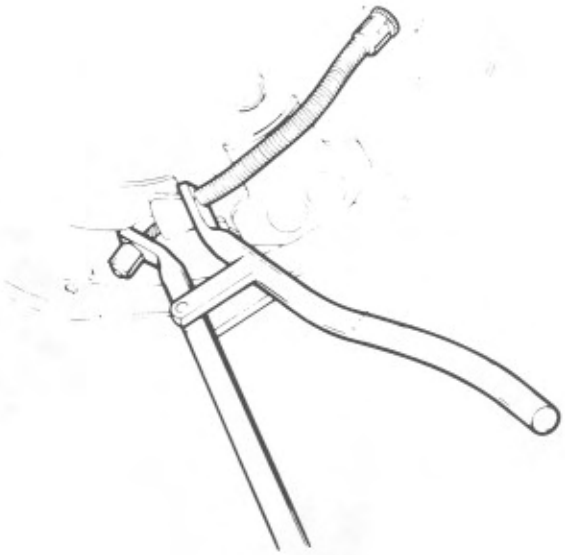
HANDBRAKE SECONDARY CABLE
REMOVE AND REPLACE

- Remove the brake drum (see previous sections)
- Mount clip Fre.05 astride the wheel cylinder.
- Unhook the top return spring.
- Disconnect the handbrake cable.
- Remove the cable stop in the backplate.
- Disconnect the cable under the floor.



REASSEMBLE

- Reconnect the cable under the floor, attach the cable stop to the backplate.
- Connect the handbrake cable.
- Hook the top return spring.
- Remove wheel cylinder clip Fre.05
- Mount the brake drum and adjust the bearing endplay.
- Insert fresh grease in the cup and reasemble.
- Reassemble the rear wheel and torque tighten the nuts with a torque wrench.
- Adjust the cable tension.
- Mount a new plastic plug to the backplate.
- Remount the brake drum and tire.



BRAKE SYSTEM BLEEDING

Procedure

This vehicle is equipped with a brake servo. It is important that the servo is not applied during the bleeding operation, regardless of the procedure used.

BLEEDING WITH PRESSURE BLEEDING APPARATUS

PREPARING THE APPARATUS

- Fill apparatus with brake fluid and pressurize. Do not exceed the pressure recommended by the equipment manufacturer.
- The compressed air must be humidity-free. Before connecting the air hose check that no water droplets are present in the line.
- Let the apparatus stand pressurized for a while to prevent possible emulsification.

BLEEDING

Do not exceed a pressure of 1.2 to 2 bars (17 to 29 psi) to prevent emulsion forming.

- Attach a bleed tube to each bleed screw and route each one into a clean container.
- Fill the fluid reservoir to the brim with new fluid.
- Screw the special cap onto the reservoirs and connect the apparatus to the cap.
- Adjust the pressure to between 1.2 and 2 bars (17 to 29 psi), and gradually open the control valve on the apparatus to pressurize the hydraulic circuit on the vehicle.
- Close all the bleed screws when fluid begins to flow from them.
- Remove the special cap.
- Check the fluid level in the reservoir and perform a brake test.

SECTION "N"

SUSPENSION

Subsection 1 **Specifications**

N1-1 Special Tools
N1-2 Identification & Tightening Torques

Subsection 2 **Front Struts**

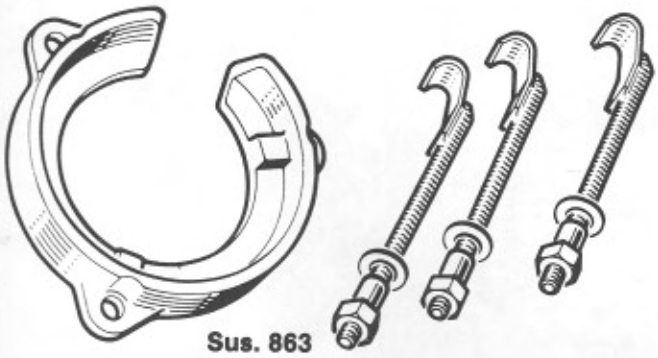
N2-1 Changing

Subsection 3 **Rear Spring Blades**

N3-1 Changing

Subsection 4 **Rear Shock Absorbers**

N4-1 Remove and Replace



Sus. 863

Front Spring Compressor (3-point)
(when changing front struts)

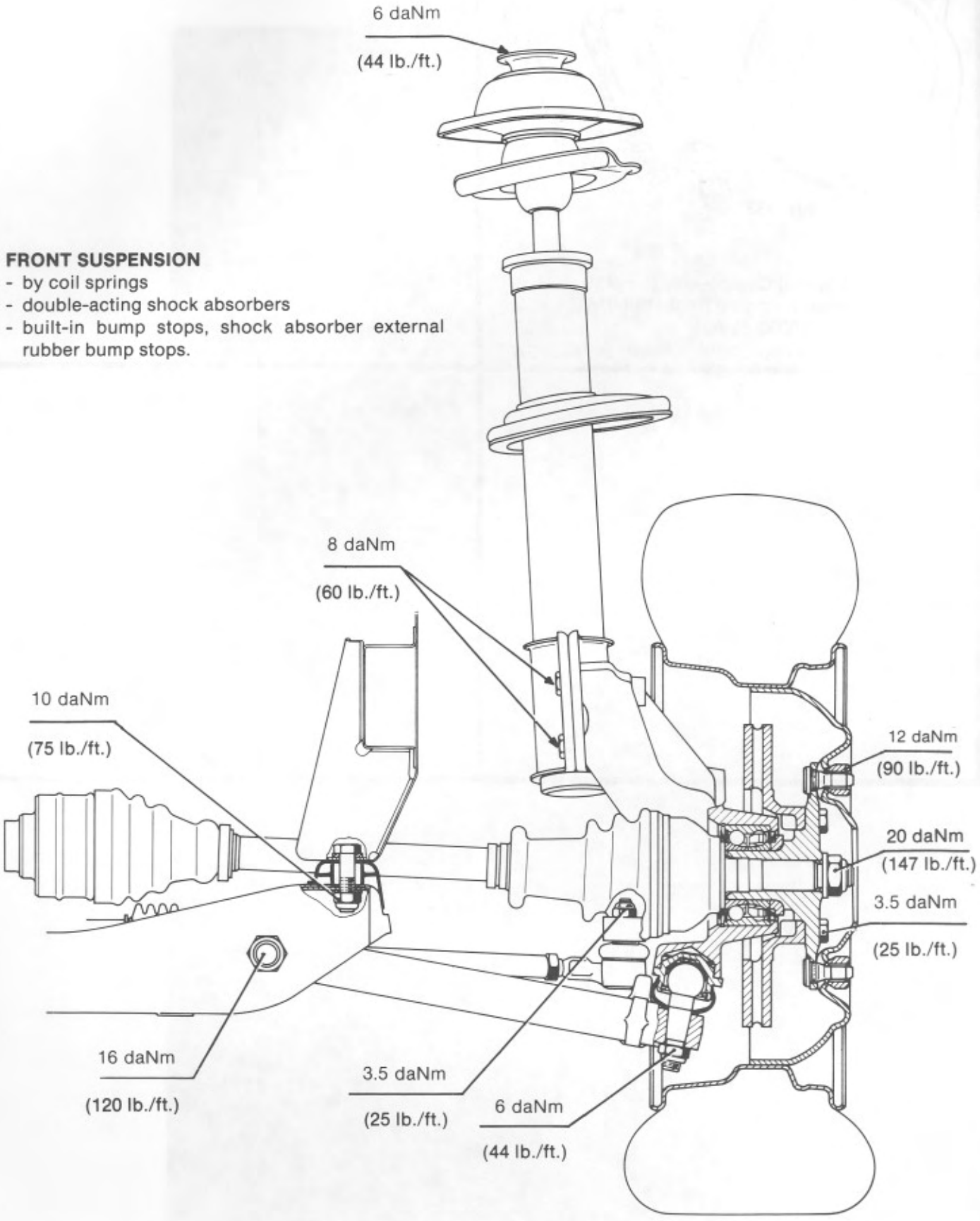
Order Part No. 700000-59-601 EA

Order Part No. 700000-86-300 EA

SPECIFICATIONS

TIGHTENING TORQUES

FRONT SUSPENSION
- by coil springs
- double-acting shock absorbers
- built-in bump stops, shock absorber external rubber bump stops.

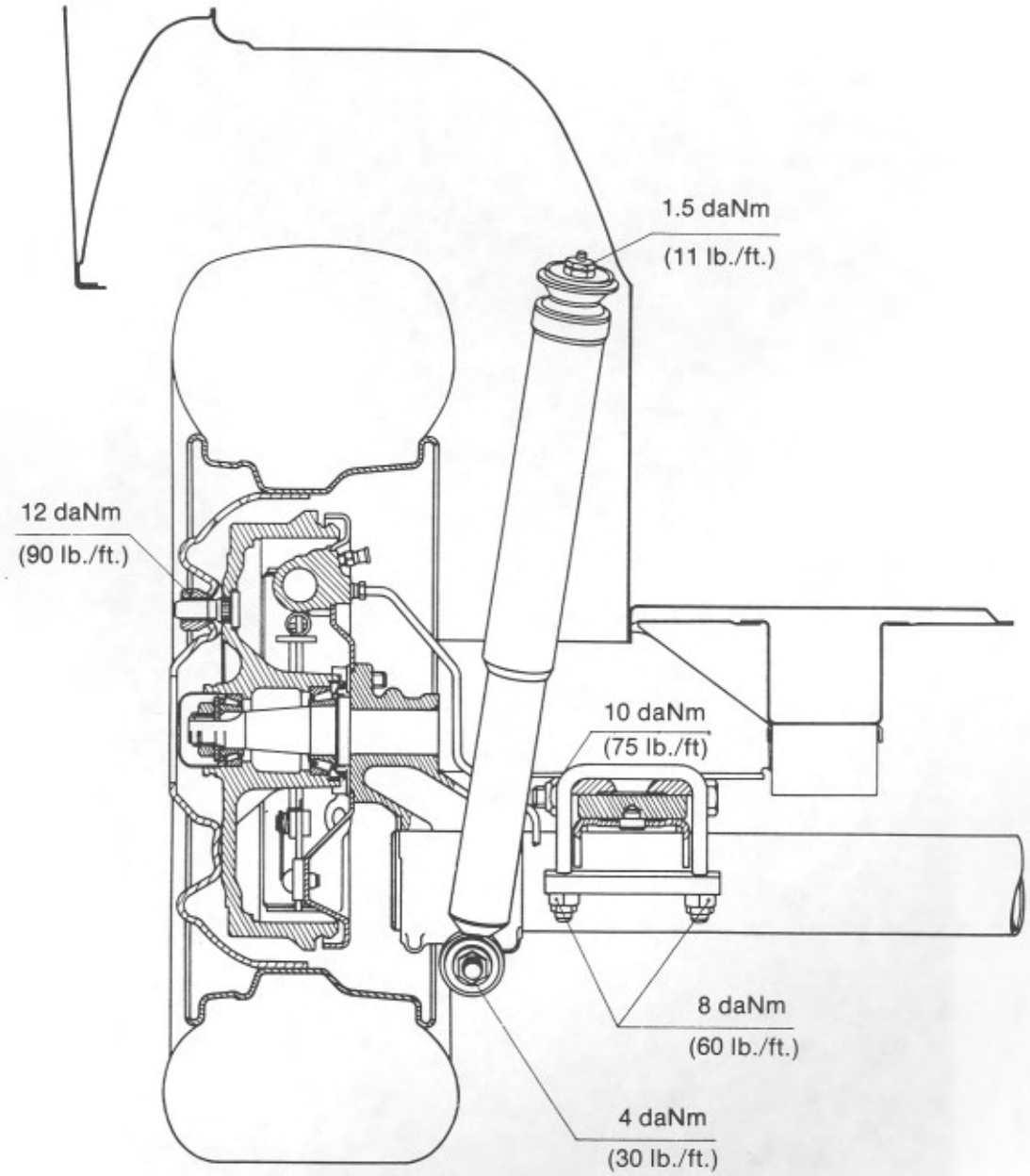


SPECIFICATIONS

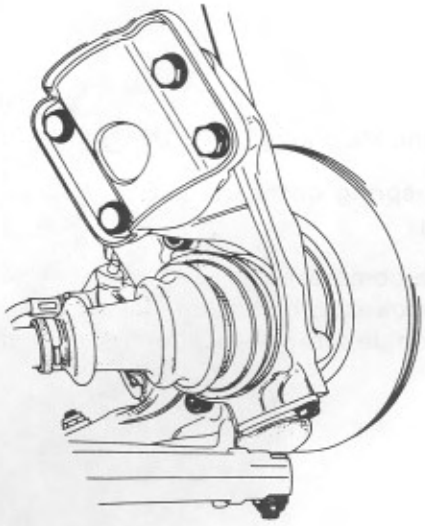
IDENTIFICATION - TIGHTENING TORQUES

REAR SUSPENSION

- by double leaf spring with rear double trunnions
- double-acting hydraulic shock absorbers with built-in bump stop
- rubber snubbers on sidemembers



FRONT STRUTS
CHANGING



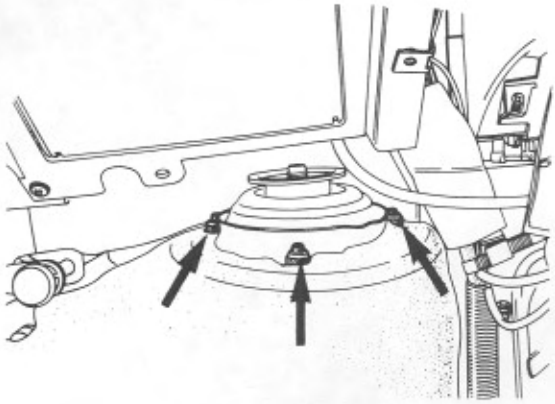
TIGHTENING TORQUES

Shock absorber bottom mounting bolts
8 daNm (60./ft.)
Wheel nuts
12 daNm (90 lb./ft.)

REMOVING

Place the side concerned on a stand.

Unscrew only 3 shock absorber bolts on the stub axle carrier. The 4th bolt will remain in position to hold the shock absorber-spring assembly while the top mounting is unfastened.



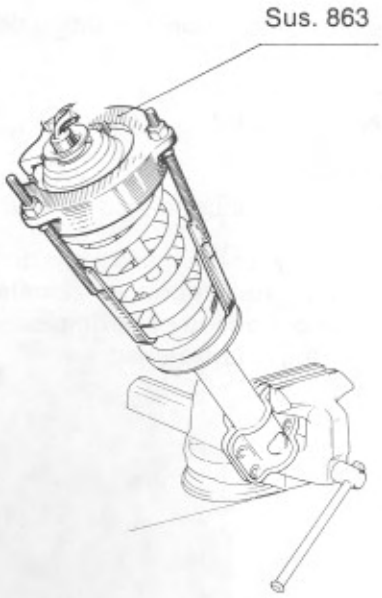
- Place a jack under the lower suspension arm to support the half-axle.
- From inside the passenger compartment remove the 3 nuts holding the top mounting.
- Remove the MacPherson® strut assembly by undoing the 4th bolt on the stub axle carrier.

FRONT STRUTS
CHANGING

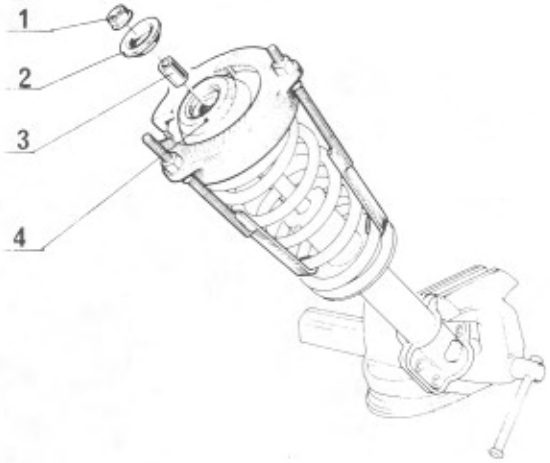
Hold the MacPherson® strut assembly in a vice.

Place spring compressor Sus. 863 over the coil spring.

Before compressing the spring, unlock the nut on the shock absorber piston rod using a wrench and a right-angle screwdriver after first removing the socket.



Compress the spring until the tool assembly and spring turn free on the shock absorber.

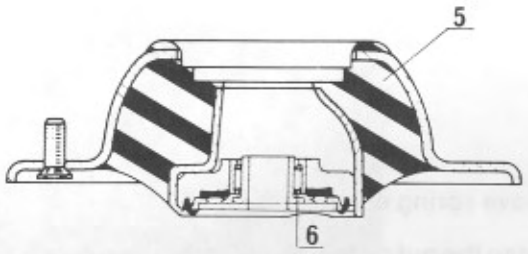


Remove:
- rod nut (1)
- cupwasher (2)
- distance piece (3)
- and washer (4)

FRONT STRUTS

CHANGING

NOTE: Rubber mounting pad (5) and needle roller bearing (6) cannot be separated and if one or other is unserviceable, the assembly must be changed.



Release the spring tension gradually until it reaches its free length then remove it.

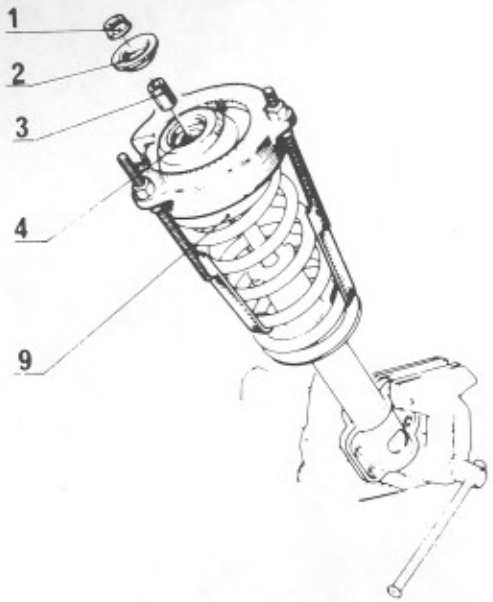
REASSEMBLY

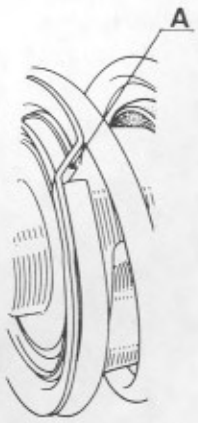
Compress the spring.

Place the shock absorber in a vice and place the spring-tool assembly over it.

Place the following on the shock absorber piston rod:

- washer (4)
- distance piece (3)
- cupwasher (2)
- and nut (1)





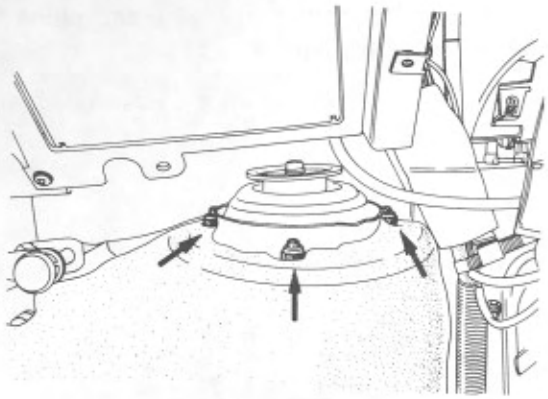
Check that the end of the last spring coil butts up against the cupwasher at (A).

FRONT STRUTS
CHANGING

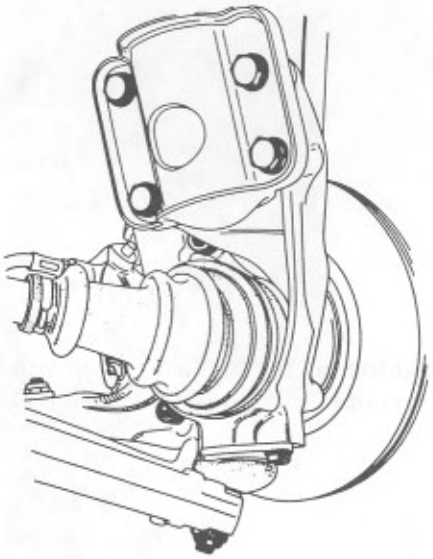


Remove spring compressor Sus. 863.

Tighten the nut on top of the rod with a wrench and a right-angled screwed.



Reassemble the MacPherson® strut to the vehicle securing it at the top first (3 nuts) then at the bottom (4 bolts).



FRONT STRUTS
CHANGING

TIGHTENING TORQUES

Stub axle carrier bolts	8 daNm (60 lb./ft.)
Wheel nuts	12 daNm (90 lb./ft.)

The MacPherson® strut has no serviceable parts and cannot be rebuilt.

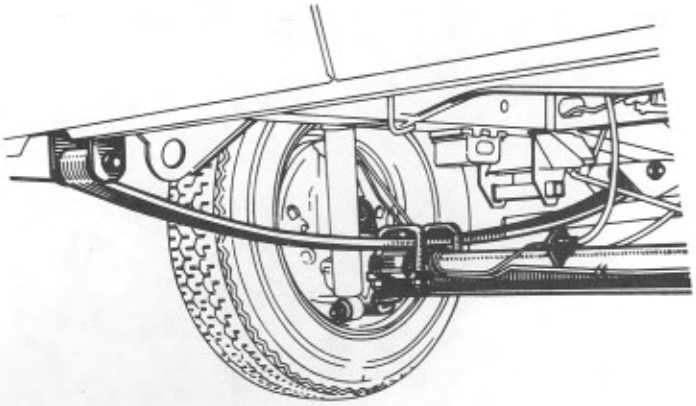
REAR SPRING BLADES
CHANGING

TIGHTENING TORQUES

Spring trunnion bolts	10 daNm (75 lb./ft.)
"U" bolt nuts	8 daNm (60 lb./ft.)

REMOVING

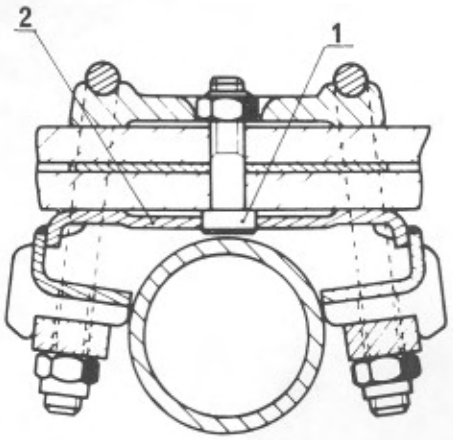
- Place the rear of the vehicle on stands and remove the nuts from spring trunnion bolts.
- Using a jack, take the weight of the axle and remove the "U" bolts. Remove the front and rear trunnion bolts and remove the spring blade(s).



REASSEMBLY

With the rear of the vehicle on stands, coat the trunnion bolts with grease. Fasten the spring blade(s) at the trunnion end first then attach the "U" bolts. Make sure that locating dowel (1) is in its recess (2) in the axle beam.

Check the rear axle alignment and adjust if necessary.



REAR SHOCK ABSORBERS

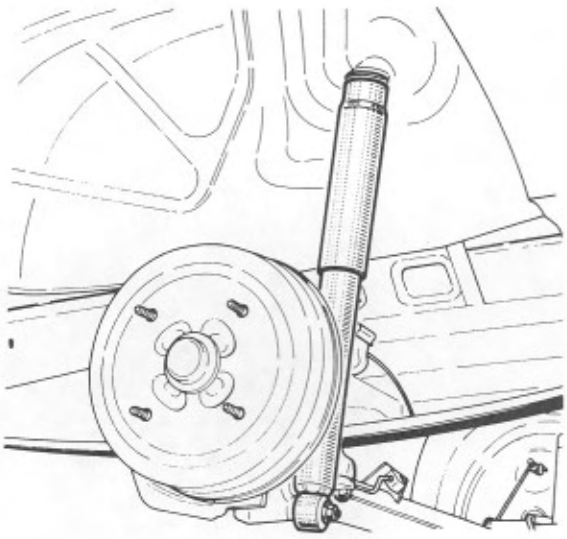


TIGHTENING TORQUES

Piston rod nut (as a guide)	1.5 daNm (11 lb./ft.)
Bottom mounting nut	4 daNm (30 lb./ft.)

REMOVING

- Unscrew the top locknut and main nut.
- Place the rear of the vehicle on a stand on the side concerned.
- Unscrew the bottom mounting nut.
- Mark the way in which the cupwashers are stacked.
- Remove the shock absorber



REASSEMBLY

Shock absorbers are usually stowed horizontally in Parts Stores.

In time, they may lose prime in this position, as they are designed to function vertically.

So, before installing them on a vehicle, they should be pumped manually in a vertical position several times.

With the vehicle on stands, mount the shock absorber to its top mounting first with its cupwashers in their correct order (as marked on dismantling).

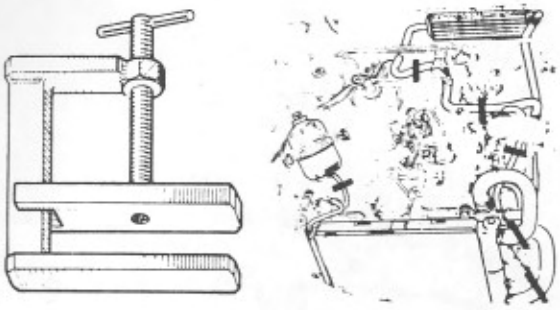
Lower the vehicle to the ground, coat the bottom bolt with grease, insert it and torque tighten the nut.

SECTION "O"

HEATING - VENTILATING

Subsection 1	**Specifications**
O1-1	Special Tools
O1-2	General Information
O1-3	Operation
Subsection 2	**Dashboard**
O2-1	Remove and Replace
Subsection 3	**Heater Control Panel**
O3-1	Changing
Subsection 4	**Air Flow Distribution Cable**
O4-1	Adjustment
Subsection 5	**Heater Valve and Fresh Air Door Cable**
O5-1	Adjustment
Subsection 6	**Airflow Distributor**
O6-1	Remove and Replace
Subsection 7	**Heater Valve**
O7-1	Changing
Subsection 8	**Fan Motor**
O8-1	Remove and Replace

SPECIAL TOOLS



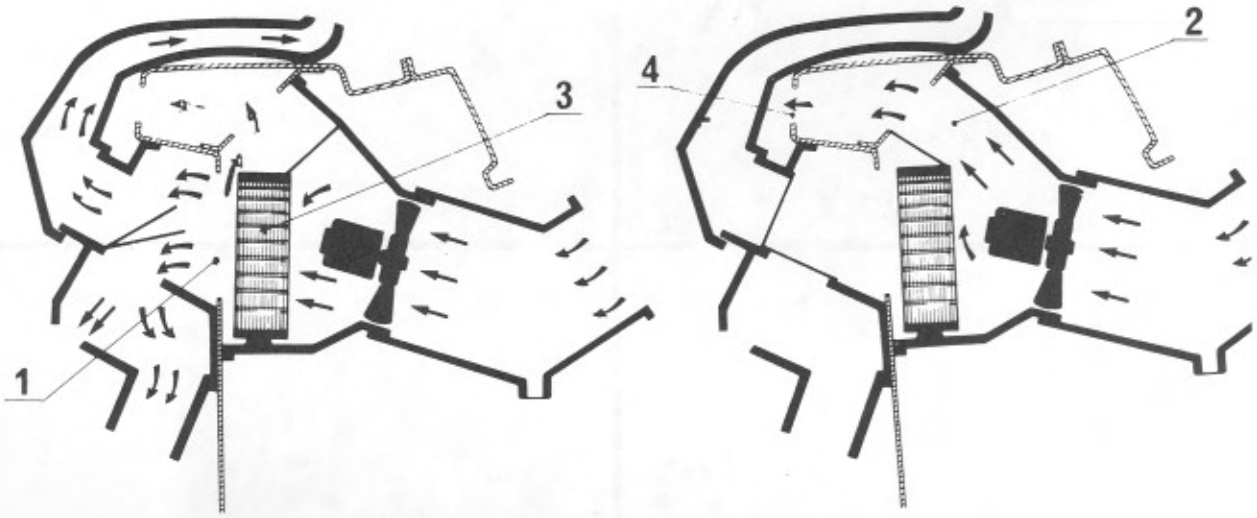
MOT. 453-01

Hose Clamp (maximum dia. 25 mm)
Order Part No. 700000-45-301 EA

GENERAL

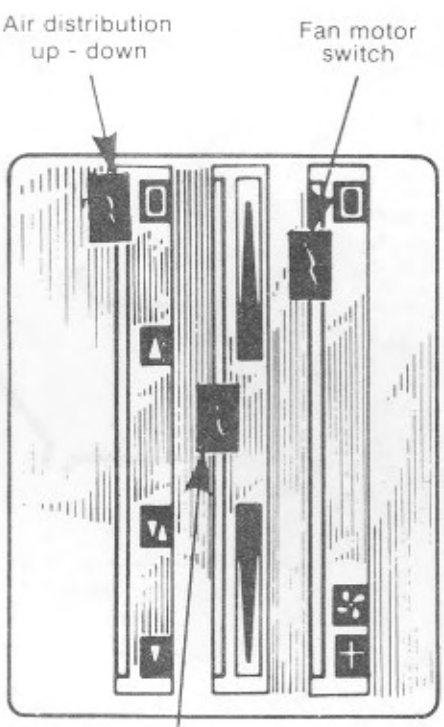
Heating, defrosting and ventilating functions are provided by air taken from outside the vehicle and channelled through the warm air blower.

Two air distribution circuits leave the warm air blower housing.

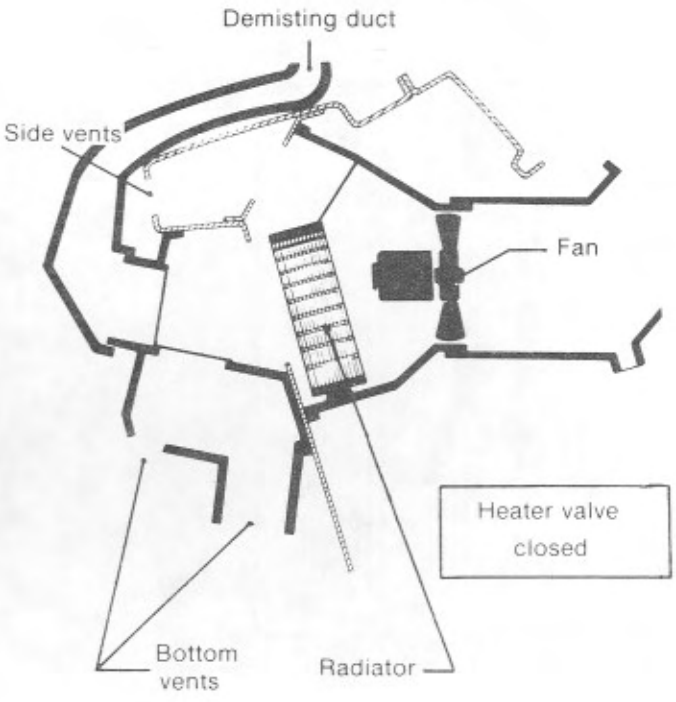


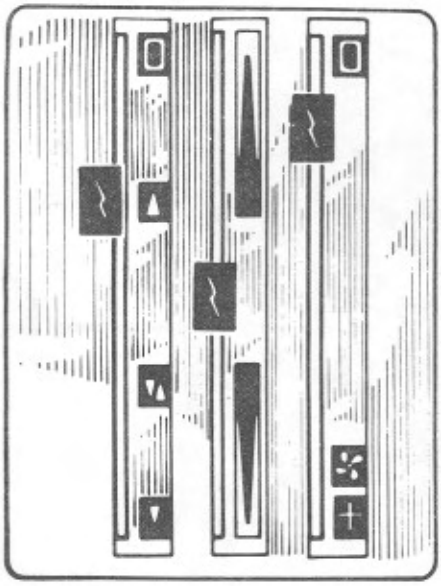
- Circuit (1) passes through the heater matrix (X). This circuit provides:
  - windshield defrosting and heating when the heater valve is open
  - fresh air when the heater valve is closed.
- Circuit (2) is a direct fresh air supply for side ventilators (4) on the dashboard.

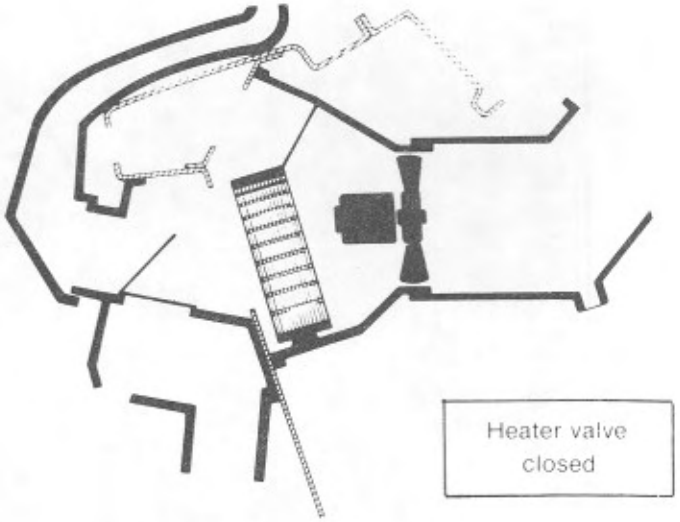
Control panel



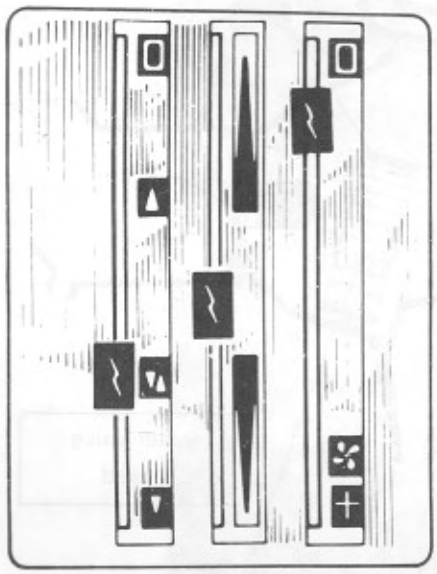
Air distribution circuits



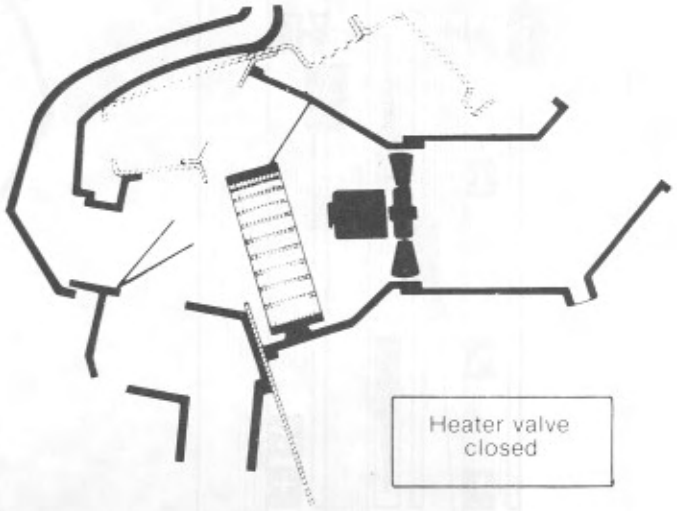


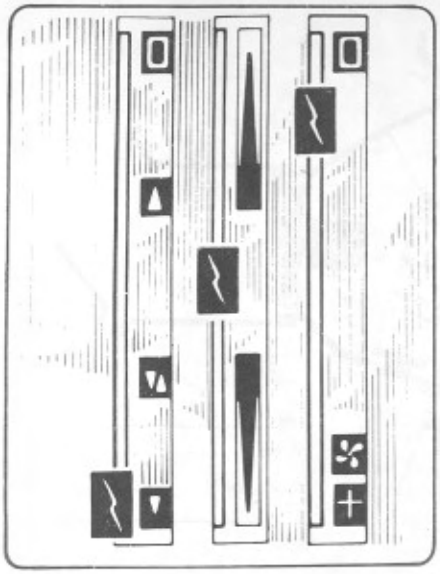


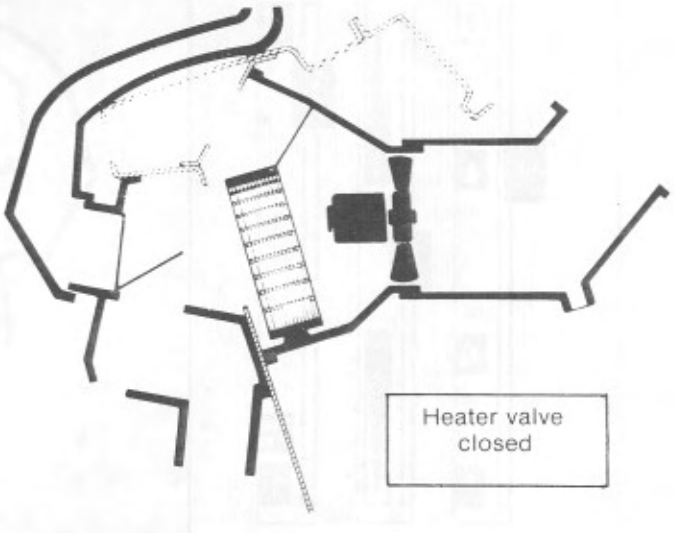
Control panel



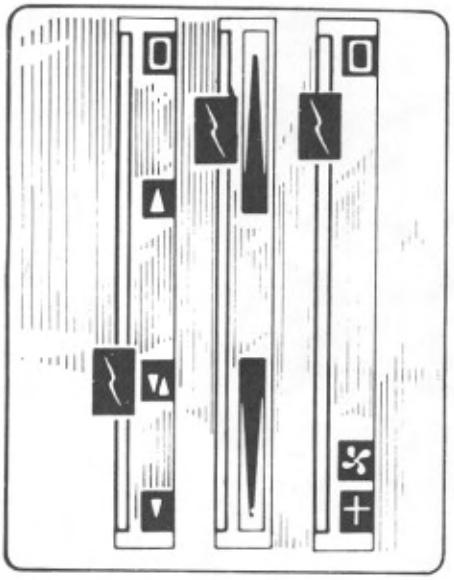
Air distribution circuits



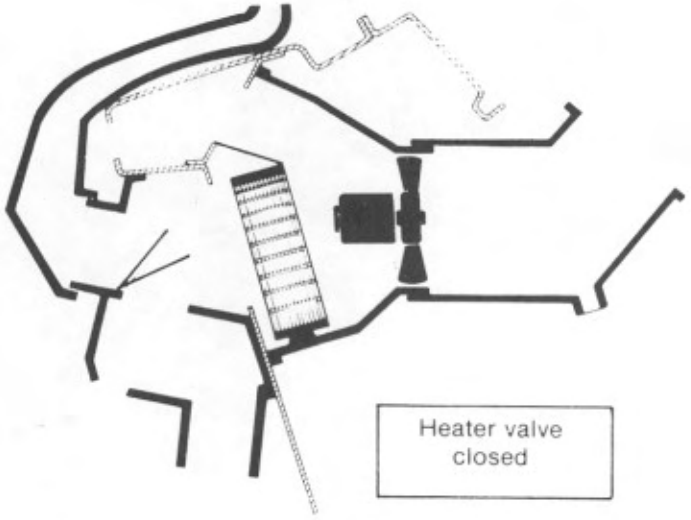


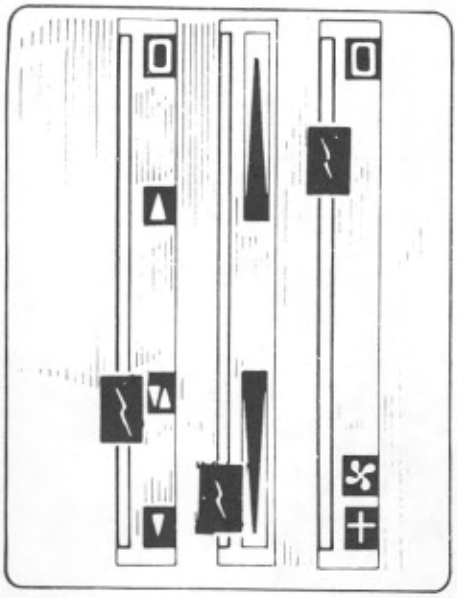


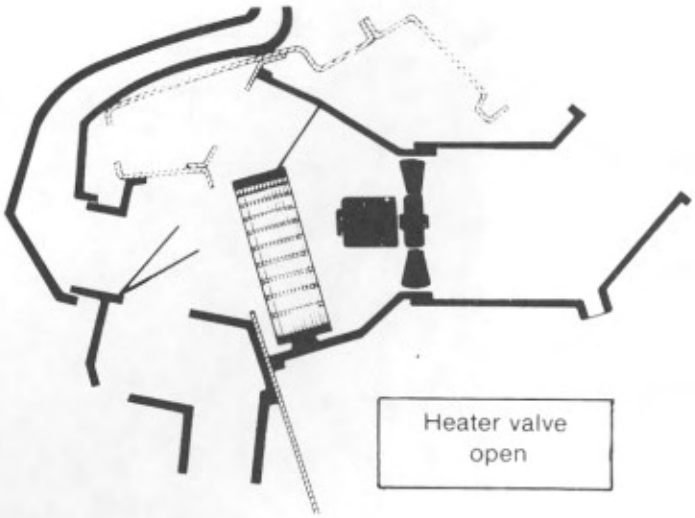
Control panel



Air distribution circuits

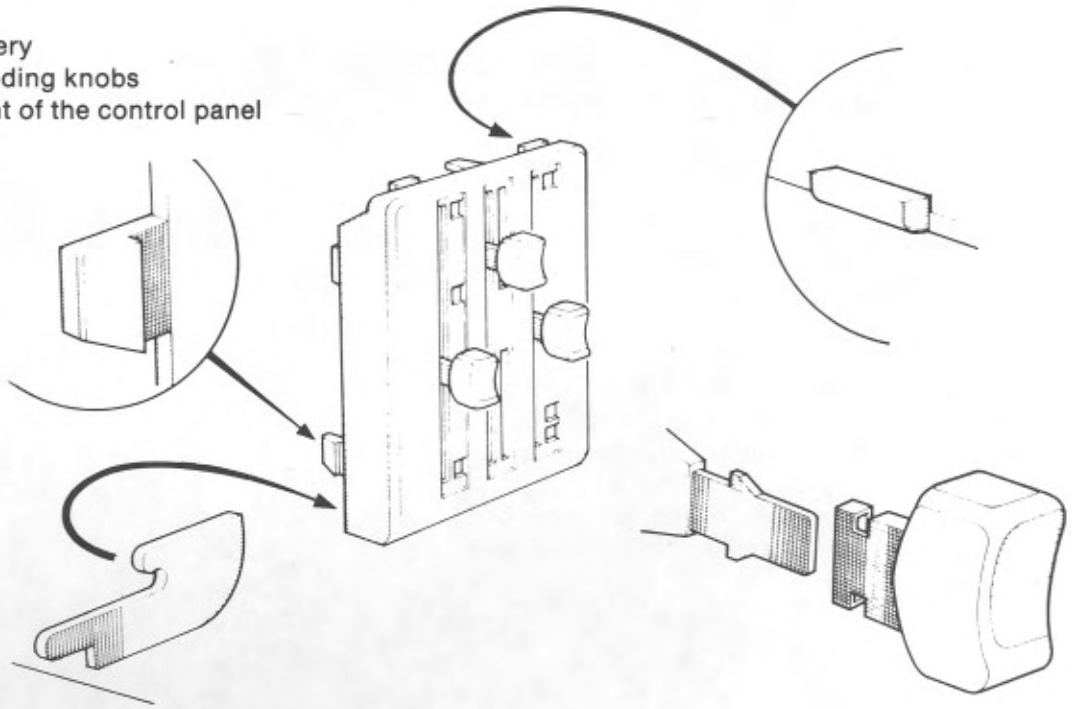




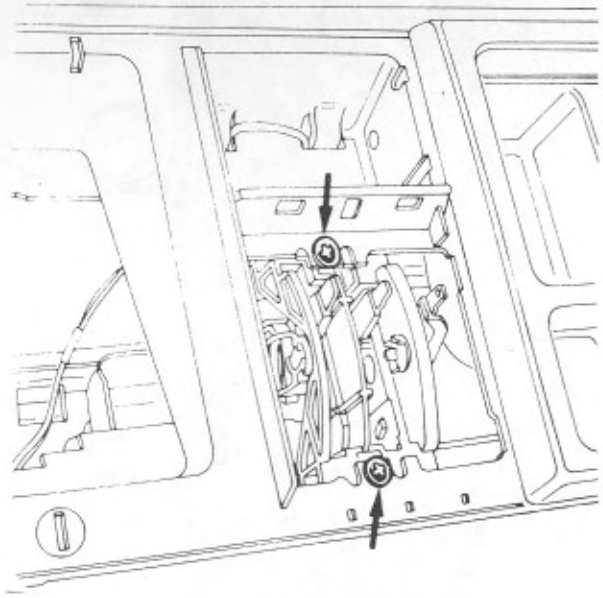


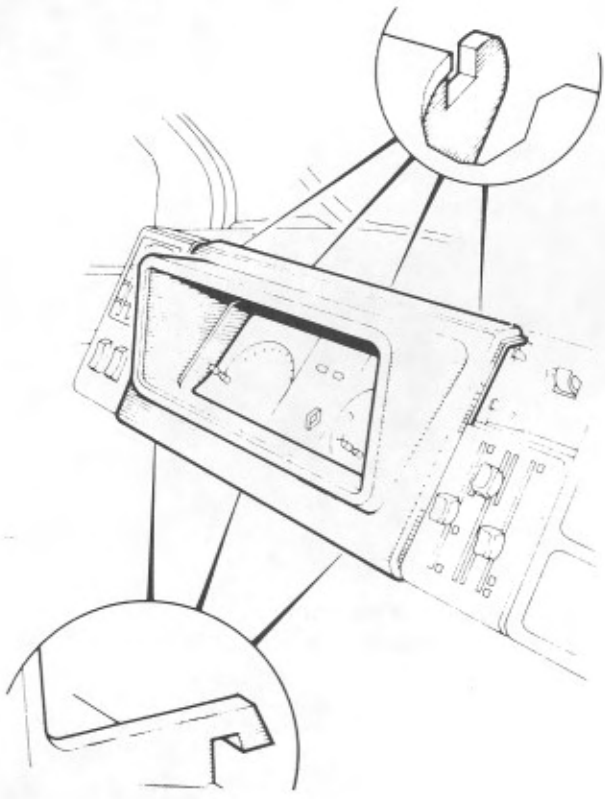
DASHBOARD
REMOVE AND REPLACE

- Disconnect battery
- Remove the 3 sliding knobs
- Remove the front of the control panel



- Remove the 2 screws holding the control panel

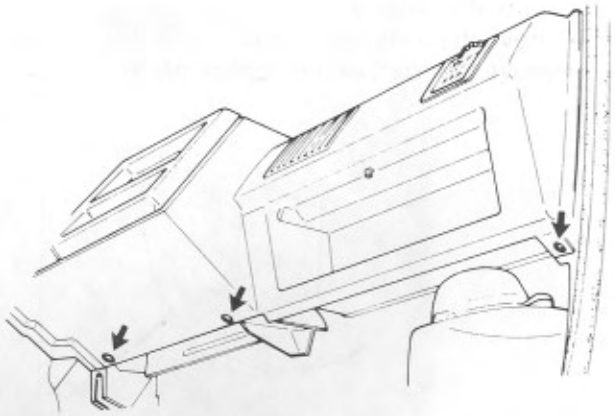


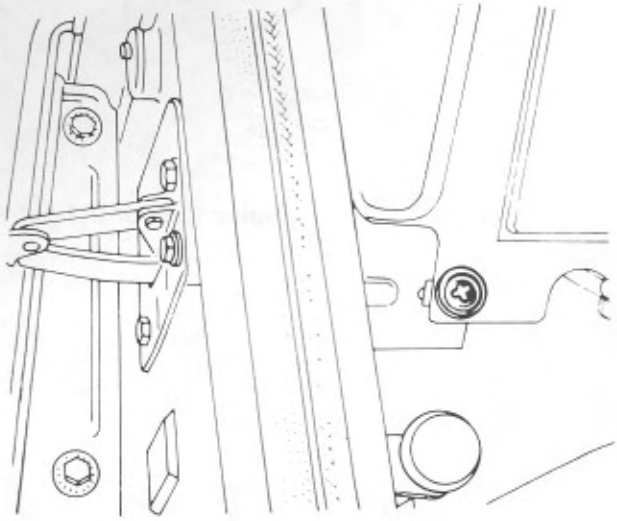


- Remove the instrument panel cowl
- Press down on the top of the cowl then pull it towards the steering wheel.
- Remove gauge cluster assembly. Depress upper retaining clips and tip toward steering wheel. Harnesses and speedometer cable can now be disconnected for complete removal.

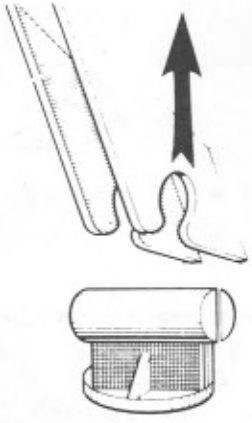
DASHBOARD
REMOVE AND REPLACE

- Remove steering wheel
- Remove the top and bottom covers from steering column.
- Remove the accessories plate on the left, label and remove wiring.
- Remove ash tray.
- Disconnect heater control lights and lay aside.
- Remove radio
- Remove beverage tray
- Open fuse panel door
- Pull out fuse panel - turn sideways - push back through hole and out of the way
- Disconnect dash mounted tachometer (if equipped)
- Disconnect battery condition gauge (if equipped)
- Remove the lower dashboard retaining screws





- Lift the dashboard to remove it
- Top side is retained by snap-clips illustrated at right
- Remove through passenger side door

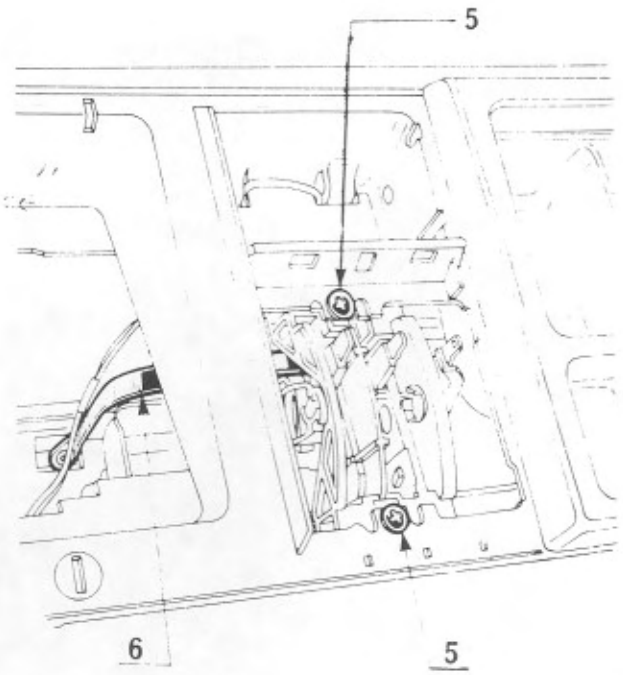


HEATER CONTROL PANEL

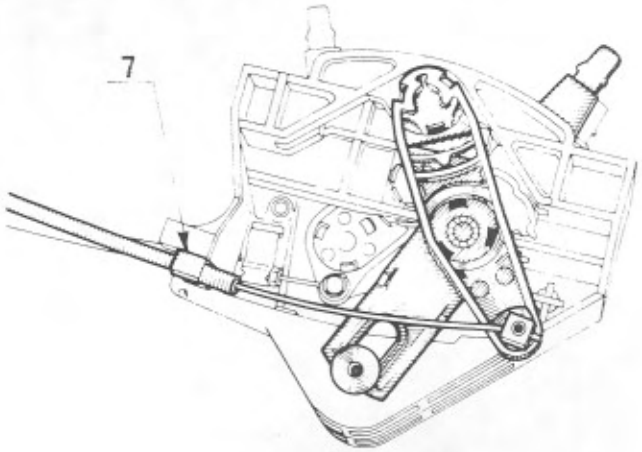
CHANGING

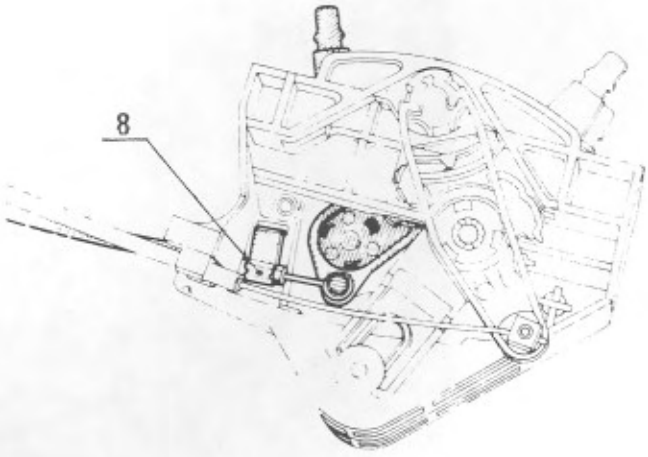
REMOVING

- Disconnect the battery
- Remove:
  - the front of the control panel
  - instrument panel cowl
  - instrument panel
  (refer to chapter "Dashboard remove & replace")
- Remove the two control panel screws (5).
- The control panel is fastened by 2 metal brackets (6) in production. These may be cut to assist removal.



- Disconnect cables (7) and (8).
- Disconnect the feed wires.





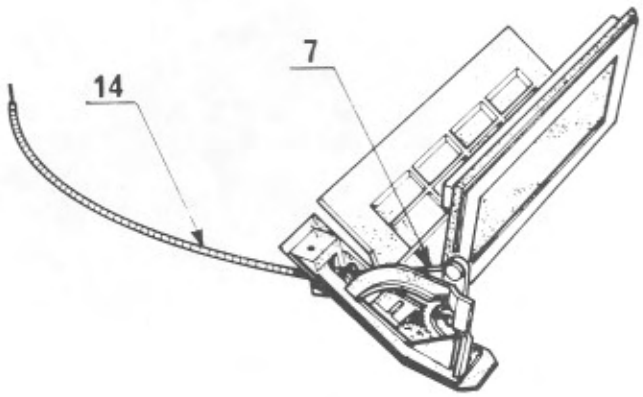
REASSEMBLY

- Perform the removal operations in reverse order.

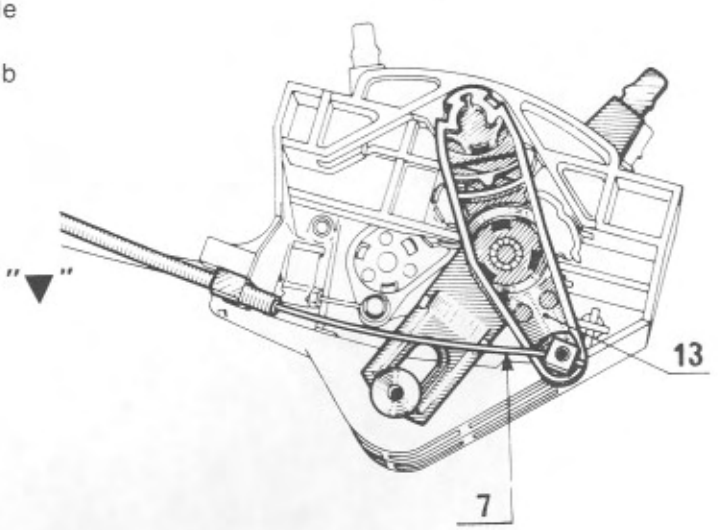
AIRFLOW DISTRIBUTION CABLE
ADJUSTING

Position of sliding knob	Top door	Bottom door
○	Closed	Closed
▲	Open	Closed
▲▼	Open	Open
▼	Closed	Open

This cable controls both distribution flaps (top and bottom)



- Push outer sleeve (12) against the stop
- Clip the outer sleeve
- Attach outer sleeve (14) to the panel
- Door positions:
  - bottom: open
  - top: closed.
- Slide control knob to position:
- Tighten the cable
- Replace the cable in the panel if the cable cannot be tightend in the above position.
- Check the operation by sliding the control knob and observing that the doors open and close.



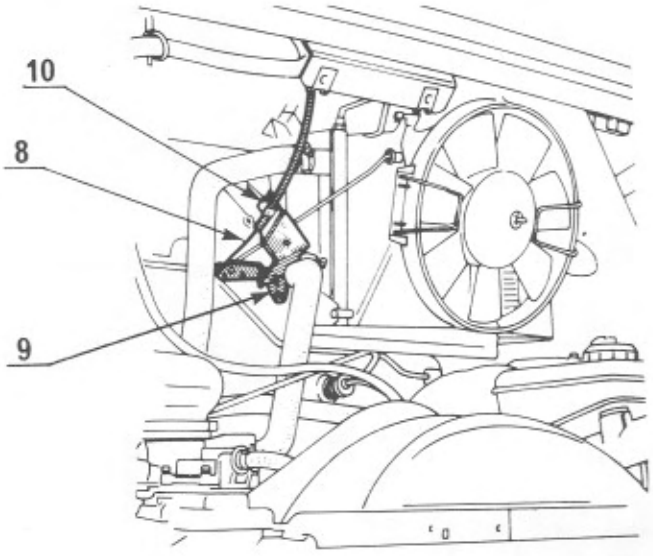
HEATER VALVE AND FRESH AIR DOOR CABLE

ADJUSTING

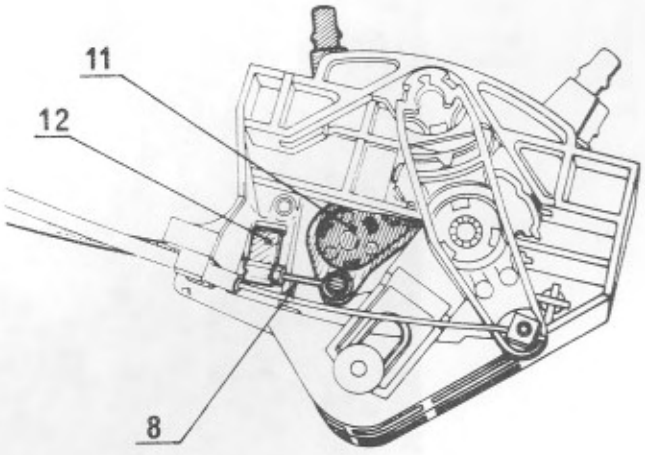
This cable controls the heater valve and fresh air door.

Position sliding knob	Fresh air door	Heater valve
MAX. COLD	Open	Closed
INTERMEDIATE	Closed	Closed
MAX. HOT	Closed	Open

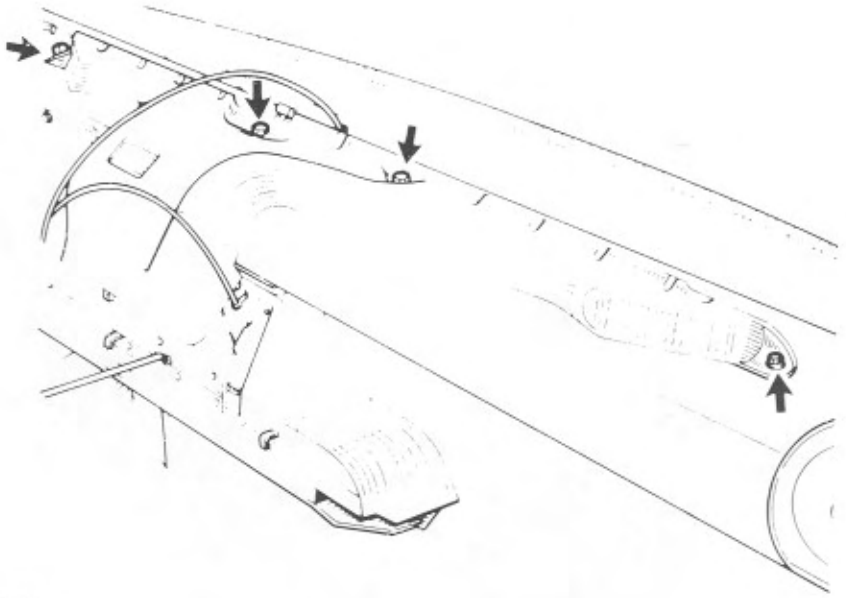
- Attach cable (8) to heater valve (9).
- Clip outer sleeve (10).



- Attach cable (8) to sliding knob (11).
- Set the heater valve in the "Off" position.
- Set sliding knob (11) to "Max. Cold" position.
- Clip outer sleeve (12).
  - If the cable cannot be clipped in this position, reset it at the heater valve end.
  - Check the operation by sliding the control knob and observing that both the heater valve and the fresh air door open and close correctly.

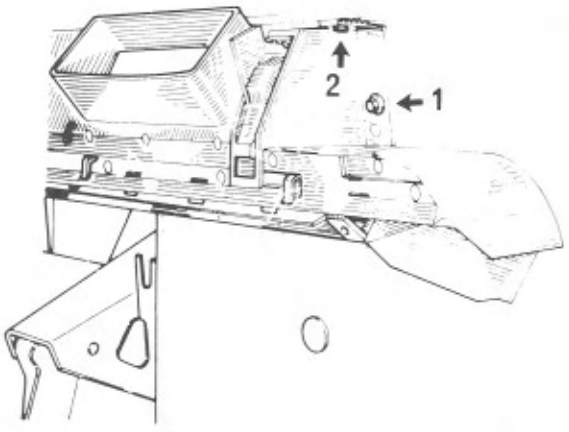


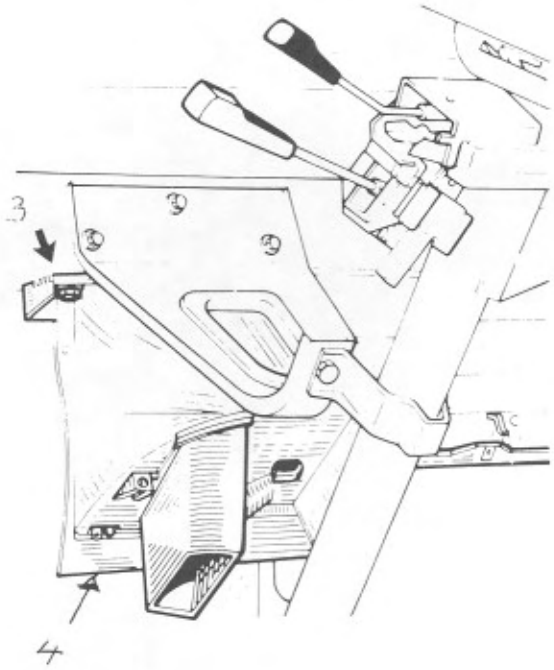
AIRFLOW DISTRIBUTOR
REMOVE AND REPLACE



REMOVING

- Disconnect the battery
- Remove the dashboard
- Remove the windshield defrosting duct
- Remove the heater control panel. Do not disconnect the heater valve cable.
- Remove screws (1), (2), and (3)
- Remove the airflow distributor
- Make sure that the foam gasket is in its right position between firewall and airflow distributor on reassembly.
- Make sure that lip (4) is behind the metal retaining lip on the firewall.



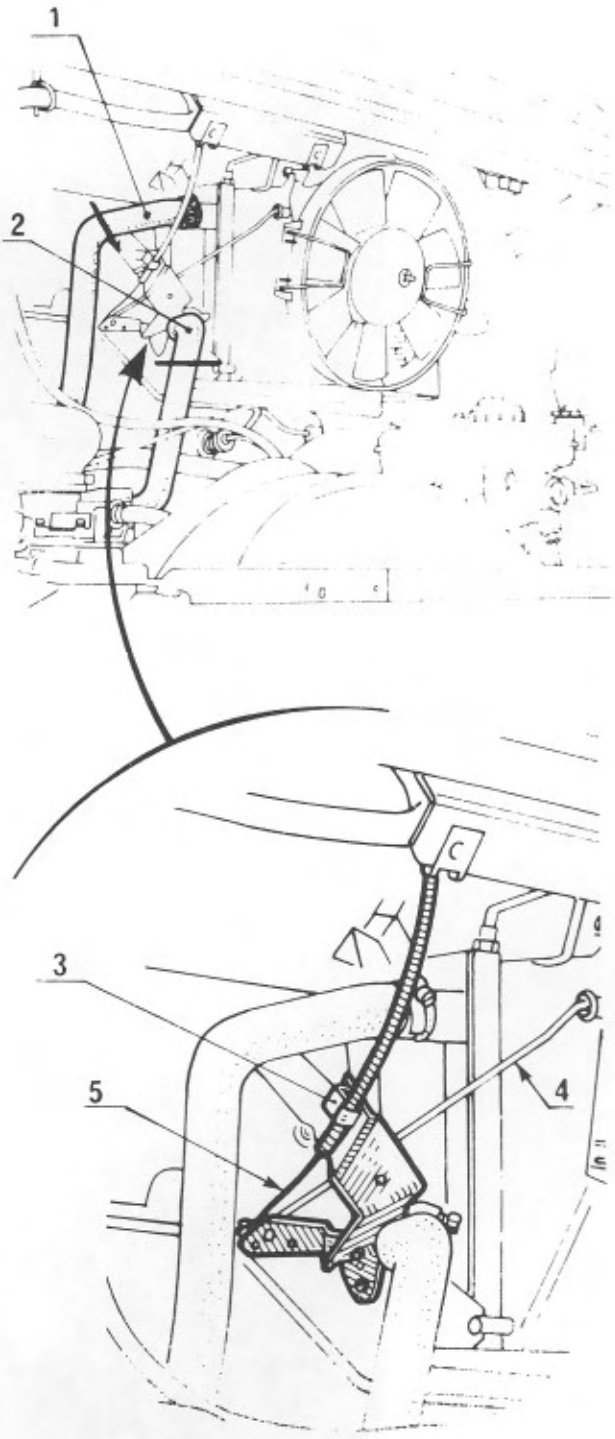


HEATER VALVE

CHANGING

REMOVING

- Clamp hoses (1) and (2) using clamp Mot. 453-01.
- Disconnect hoses (1) and (2)
- Remove cable clip (3)
- Disconnect cable (5) at the heater valve end
- Remove fresh air door rod (4)
- Remove the screws holding the heater valve
- Remove the valve



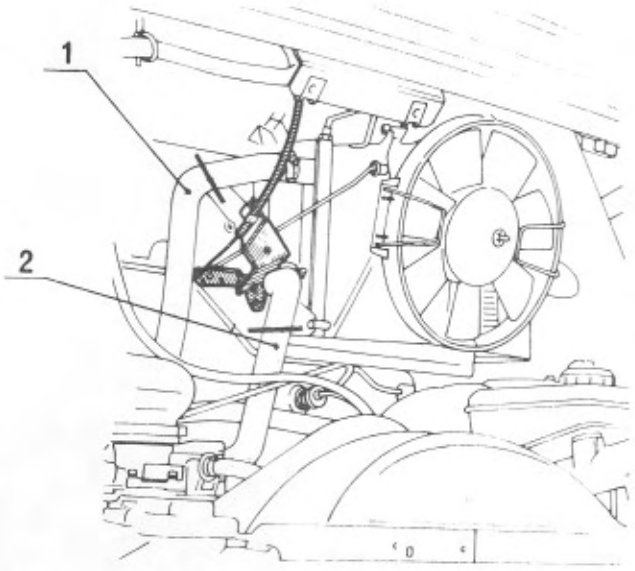
REASSEMBLY

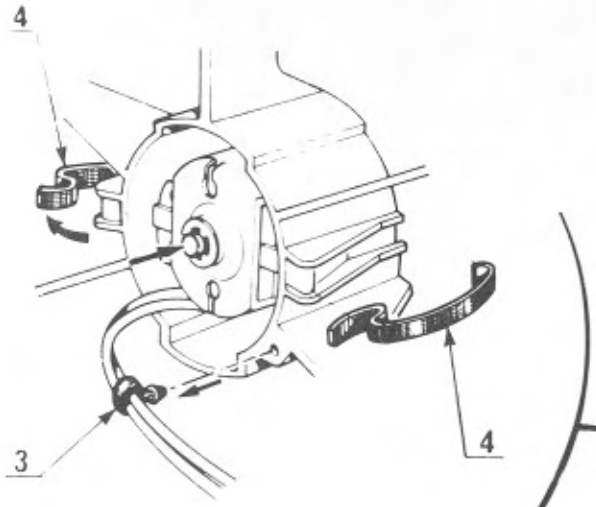
- Lift up the new heater valve
- Attach the heater valve cable
- Attach the fresh air door rod
- Attach hoses (1) and (2)
- Bleed the cooling system after the operation is complete.

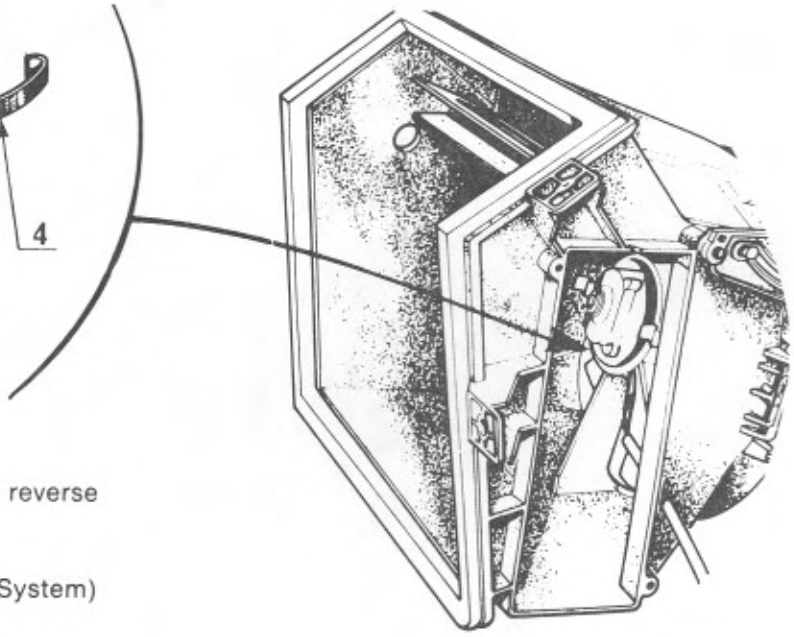
HEATING - VENTILATING FAN MOTOR
REMOVE AND REPLACE

REMOVING

- Disconnec the battery
- Clamp hoses (1) and (2) with clamp Mot. 453-01.
- Disconnect hoses (1) and (2)
- Remove the fan assembly
- Remove the heater matrix
- Remove clip (3) holding the fan motor feed wire
- Release clips (4) holding the fan motor
- Withdraw the motor







REASSEMBLY

- Carry out the removing operations in reverse order.
- Adjust the heater valve control cable.
- Bleed the cooling system (see Cooling System)

CAUTION

Serious internal engine damage could result due to low coolant level if the cooling system is not bled after this operation.

SECTION "P"

AIR CONDITIONING

Subsection 1 **General Information and Wiring**

P1-1 System View - Dash A/C
P1-2 Evaporator - Dash A/C
P1-3 Condensor - Early Dash A/C
P1-4 Condensor - Late Dash A/C
P1-5 Wire Diagram - Dash A/C
P1-6 Switch & Fan Wiring 1983 - early 1984
P1-7 Overhead A/C - 1983 - 1986
P1-8 Overhead A/C - Exploded
P1-13 Receiver Dryer Access Mid 1985 and Up Diesel and Gas
P1-14 Compressor - Condensor Assembly - 1983 - 1986 with Turbo Diesel
P1-15 Compressor Condensor Assembly - 1985-1986 with E. F.I. Gas
P1-16 Condensor Assembly - Turbo Diesel Mid 1985 and up and All E.F.I. Gas
P1-17 Switch and Fan Wiring - Early Turbo Diesel
P1-18 Switch and Fan Wiring - Late Turbo Diesel
P1-19 Evaporator Wiring - Turbo Diesel and E.F.I.Gas Units
P1-20 Underhood Wiring - E.F.I. Gas

Subsection 2 **A/C System Operation**

P2-1 Basic System Description

Subsection 3 **Servicing the A/C/ System**

P3-1 Stabilizing the System
P3-1 Adding Refrigerant
P3-3 Receiver - Dryer Replacement Intervals and Moisture Contamination
P3-5 Evacuating the System
P3-7 Charge the System

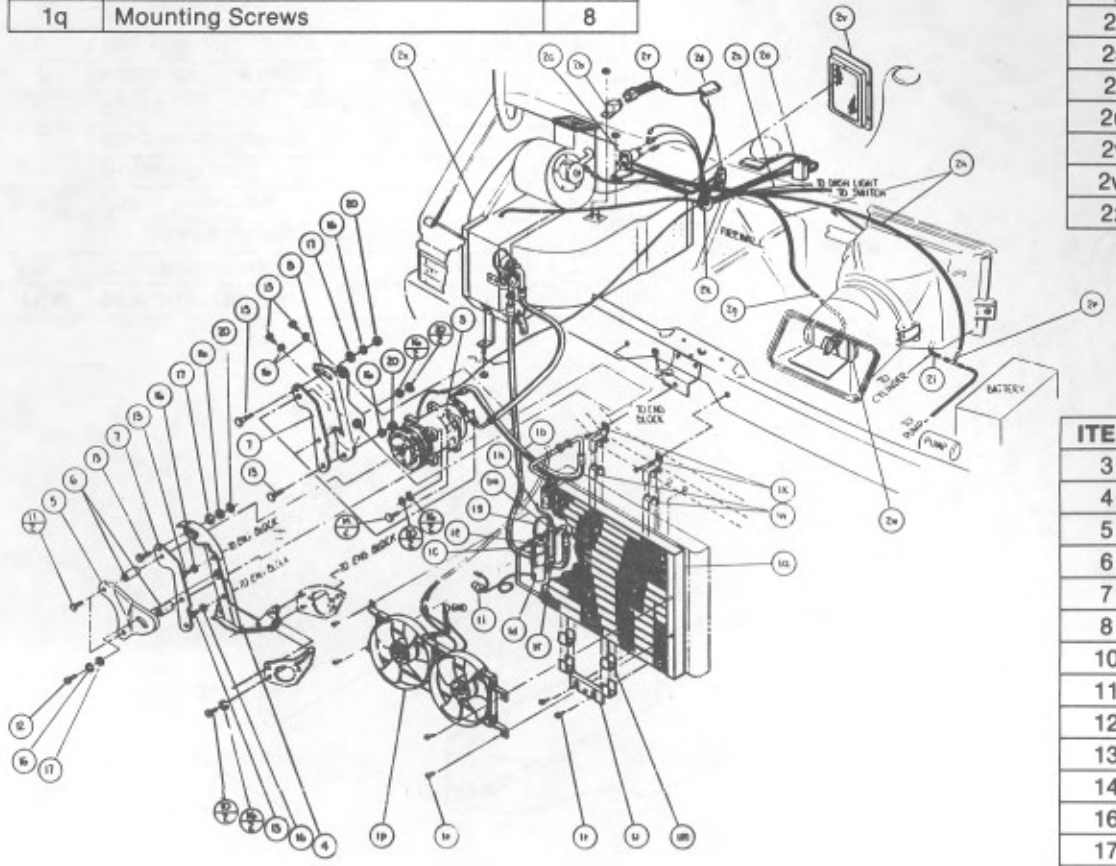
Subsection 4 **A/C System Diagnosis**

P4-1 Diagnosis Procedure
P4-3 Pressure Temperature Charts
P4-4 Test Condition Solutions

DASH A/C SYSTEM

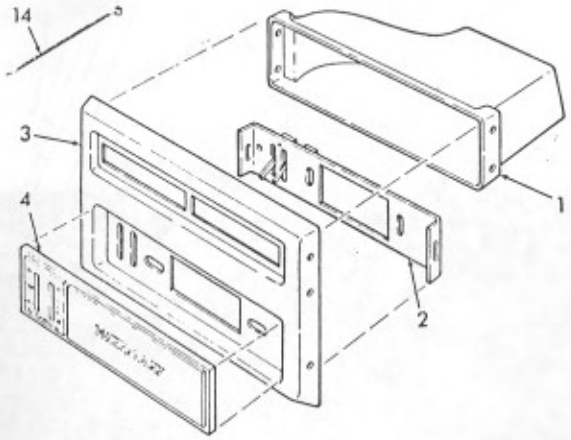
(used with J8S-232 N/A Diesel Engine 1983-1984)

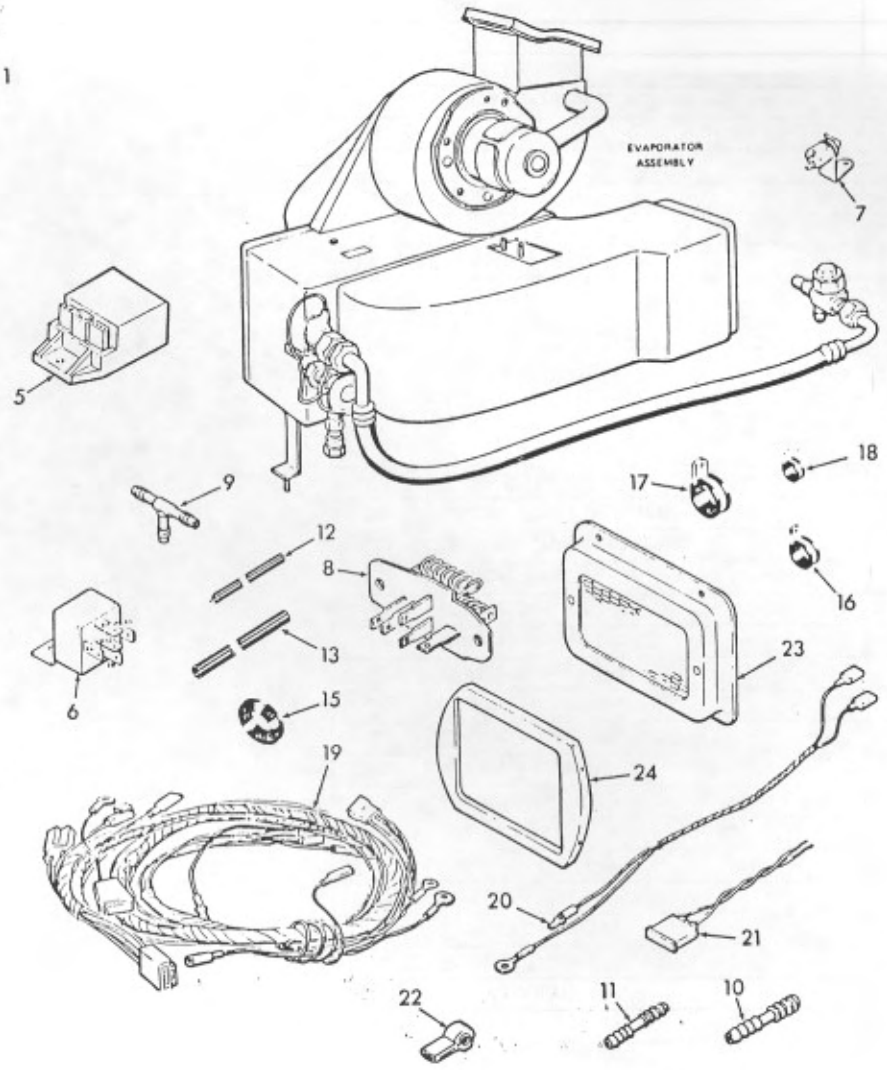
ITEM	DESCRIPTION	QTY
1a	Condenser Coil	1
1b	Discharge Hose	1
1c	Liquid Hose	1
1d	Receiver-Drier	1
1e	Pressure Tap Tee	1
1f	High Pressure Cut Out	1
1g	Jumper Wire	1
1h	Jumper Wire	1
1i	Engine Heat Switch	1
1j	Bottom Condensor Bracket	1
1k	Top Condensor Bracket	2
1m	Low Pressure Switch	1
1n	Rubber Insert	4
1p	Dual Fan Assembly	1
1q	Mounting Screws	8



ITEM	DESCRIPTION	QTY
2a	Electronic Control Module	1
2b	Relay	1
2c	Vacuum Solenoid	1
2d	Resistor	1
2e	"T" Vacuum	1
2f	Splicer 1/8 x 1/4	1
2g	Splicer 1/8 x 1/8	1
2h	Vacuum Hose 48"	2
2i	Vacuum Hose 3"	1
2j	Tie Wraps	3
2k	Grommet	1
2m	Clamp Hose #6	1
2n	Clamp Hose #8	1
2p	Clamp Hose #4	1
2r	Wire Harness Main	1
2s	Wire Harness Light	1
2t	Indicator Light	1
2u	Splicer Tee	1
2v	Grill Air Inlet Assembly	1
2w	Heater Door Assembly	1
2x	Case Assembly	1

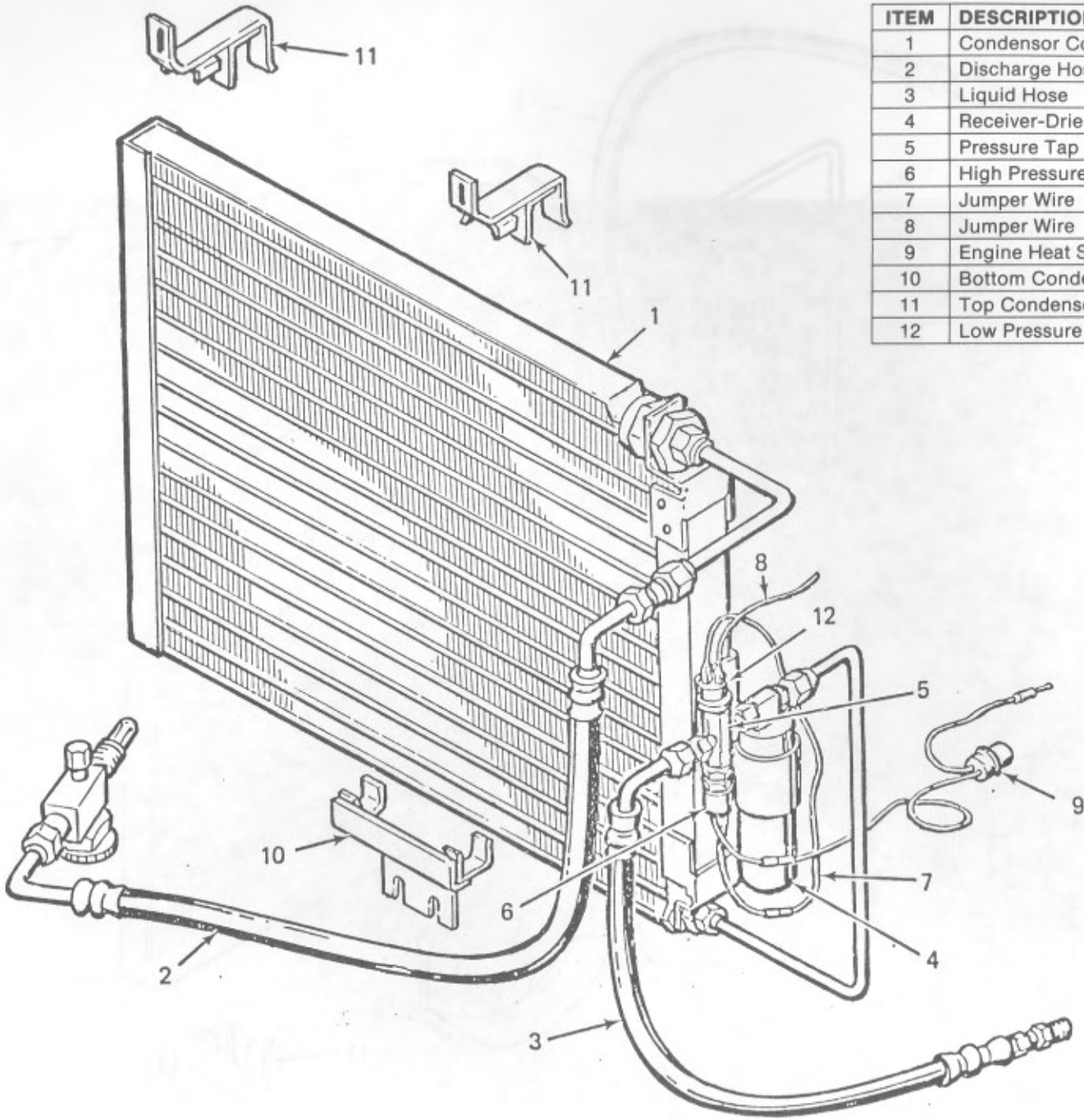
ITEM	DESCRIPTION	QTY
3	Compressor	1
4	Crossmember	1
5	Stiffener	1
6	Spacer	2
7	Crossmember Bracket	2
8	Rear Bracket	1
10	Bolt	2
11	Bolt	2
12	Bolt	1
13	Bolt	7
14	Bolt	2
16	Washer	14
17	Washer	3
20	Nut	7





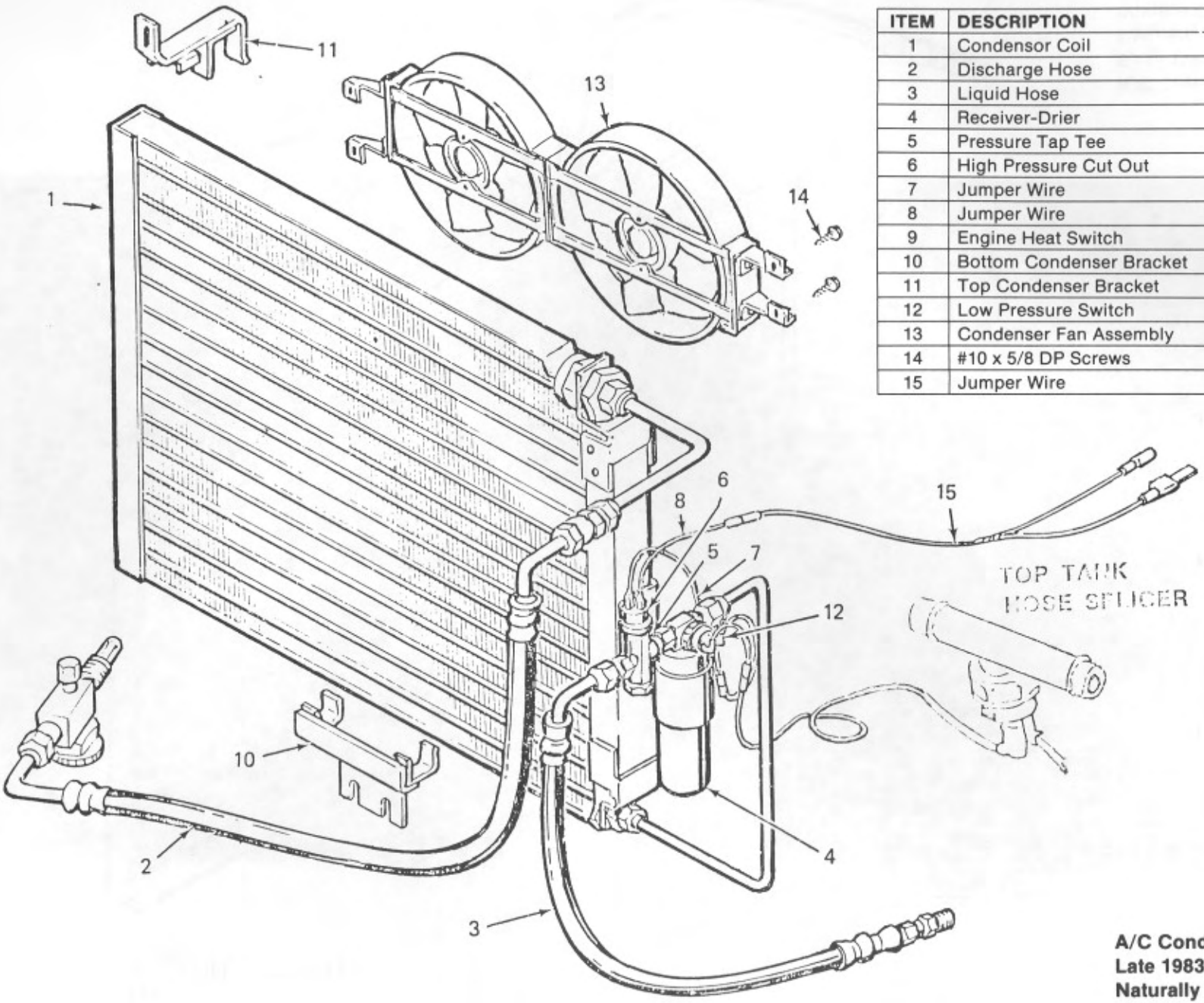
ITEM	DESCRIPTION	QTY
1	Duct Assembly A/C	1
2	Control Panel Assembly	1
3	Bezel Assembly	1
4	Switch Plate	1
5	Electronic Control Module	1
6	Relay	1
7	Vacuum Solenoid	1
8	Resistor	1
9	"T" Vac 3/8 x 3/8 x 1/4	1
10	Splicer 1/8 x 1/4	1
11	Splicer 1/8 x 1/8	1
12	Vacuum Hose 7/64 x 48"	2
13	Vacuum Hose 1/4 x 3"	1
14	Tie Wraps	3
15	Grommet	1
16	Clamp Hose #6	1
17	Clamp Hose #8	1
18	Clamp Hose #4	1
19	Wire Harness Main	1
20	Wire Harness, Light	1
21	Indicator Light	1
22	Splicer Tee 3 m	1
23	Grill Air Inlet Assembly	1
24	Heater Door Assembly	1

ITEM	DESCRIPTION	QTY
1	Condensor Coil	1
2	Discharge Hose	1
3	Liquid Hose	1
4	Receiver-Drier	1
5	Pressure Tap Tee	1
6	High Pressure Cut Out	1
7	Jumper Wire	1
8	Jumper Wire	1
9	Engine Heat Switch	1
10	Bottom Condenser Bracket	1
11	Top Condenser Bracket	2
12	Low Pressure Switch	1

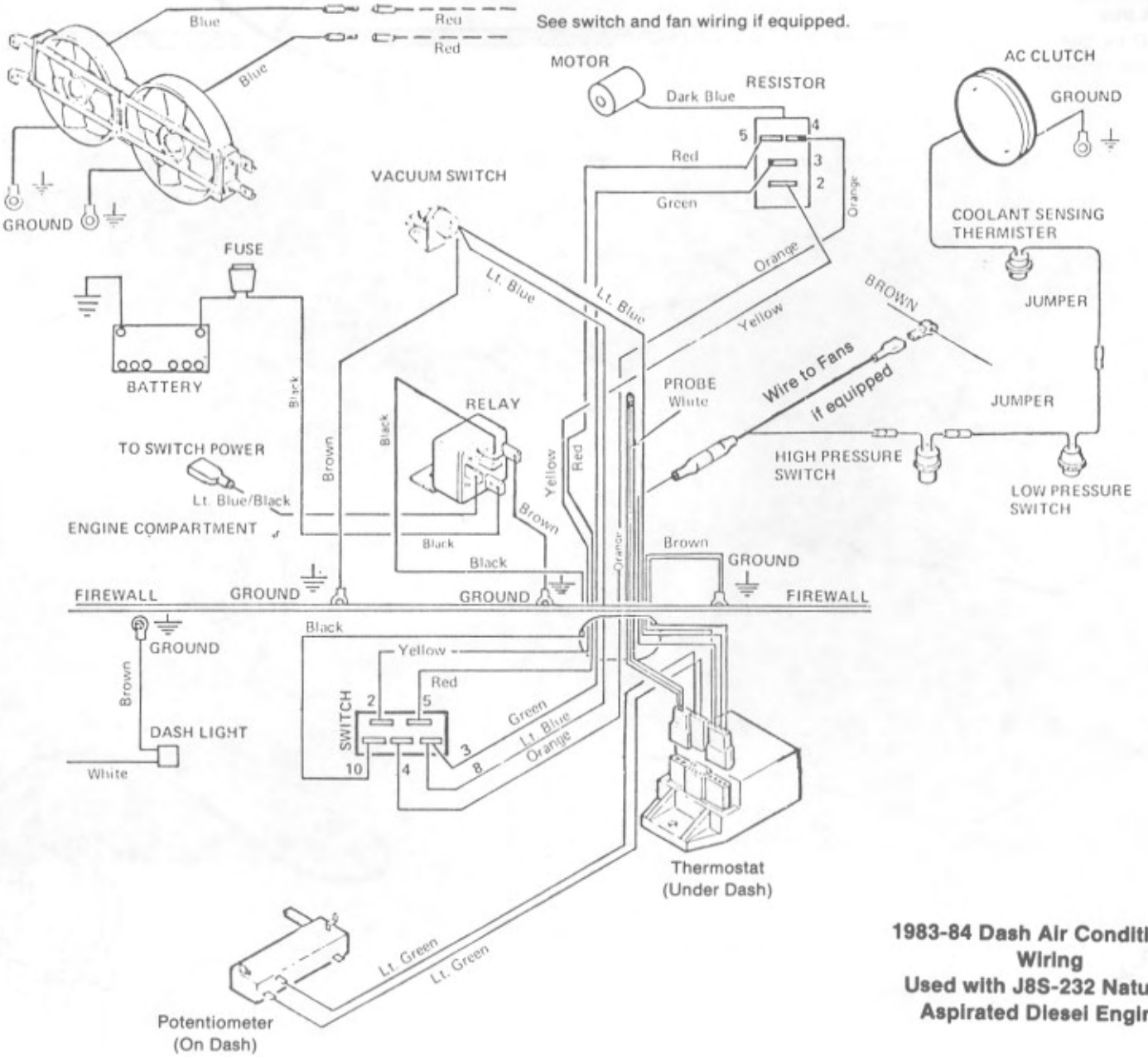


A/C Condensor Assembly
Early 1983
Naturally Aspirated Diesel
Without Condenser Fans

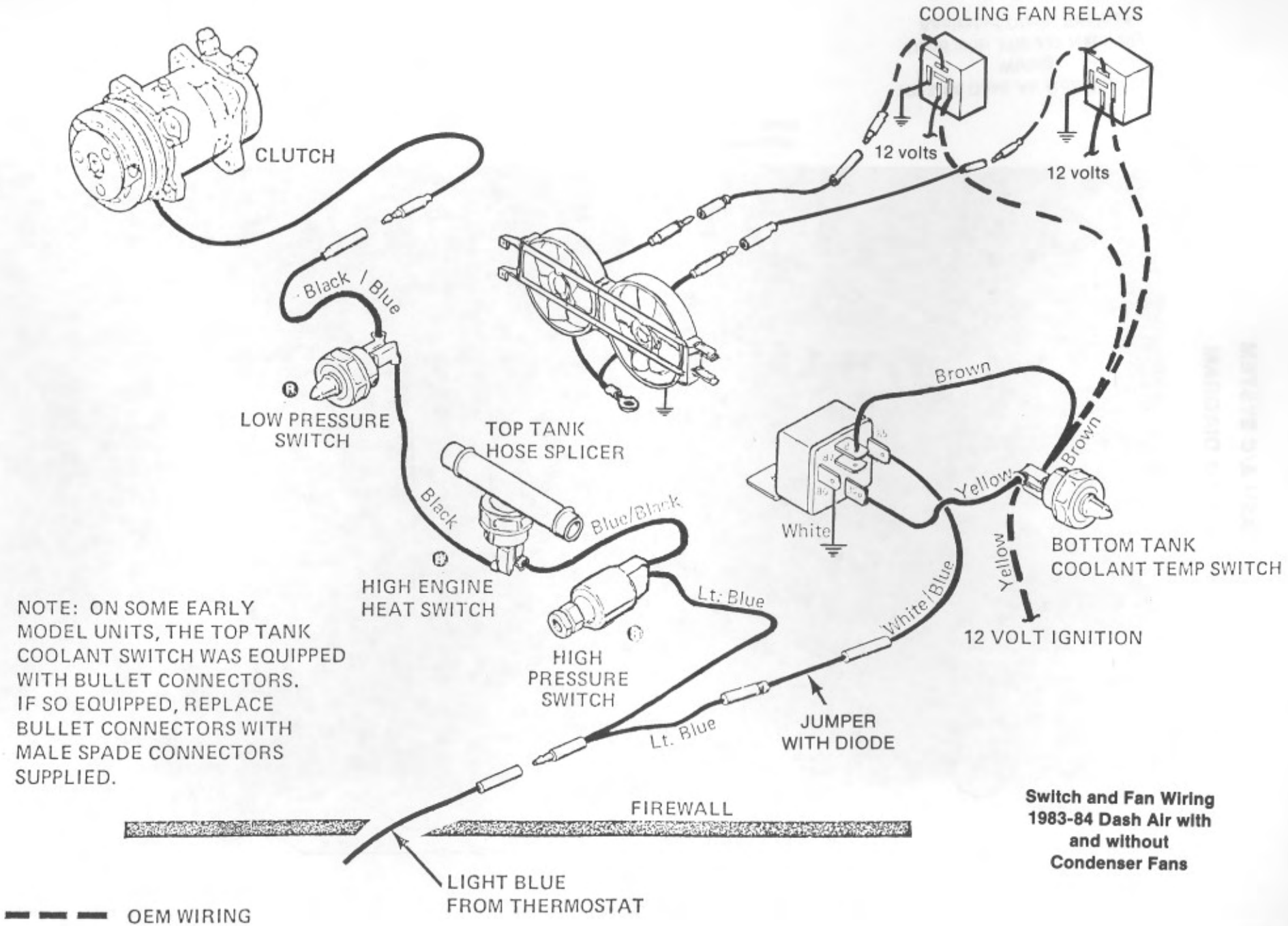
ITEM	DESCRIPTION	QTY
1	Condensor Coil	1
2	Discharge Hose	1
3	Liquid Hose	1
4	Receiver-Drier	1
5	Pressure Tap Tee	1
6	High Pressure Cut Out	1
7	Jumper Wire	1
8	Jumper Wire	1
9	Engine Heat Switch	1
10	Bottom Condenser Bracket	1
11	Top Condenser Bracket	2
12	Low Pressure Switch	1
13	Condenser Fan Assembly	1
14	#10 x 5/8 DP Screws	4
15	Jumper Wire	1



**A/C Condenser Assembly
Late 1983 and 1984
Naturally Aspirated Diesel
With Condenser Fans**



1983-84 Dash Air Conditioning Wiring
Used with J8S-232 Naturally Aspirated Diesel Engines



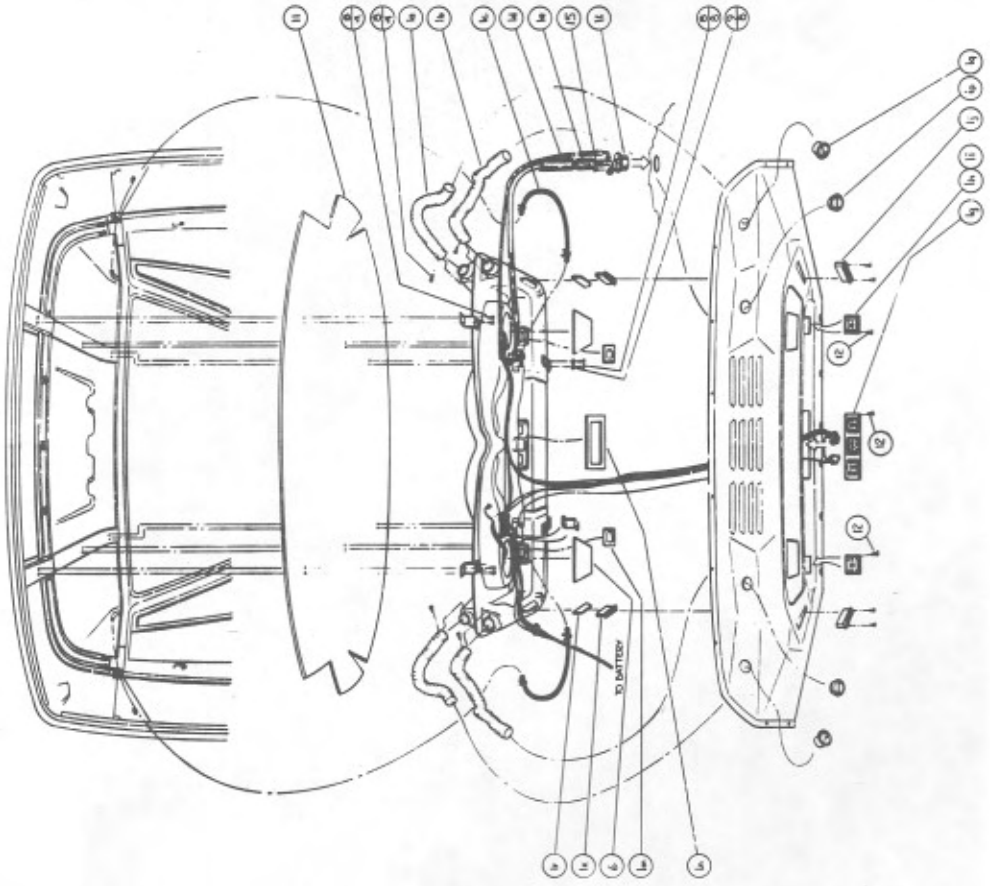
Switch and Fan Wiring 1983-84 Dash Air with and without Condenser Fans

TYPICAL OVERHEAD AIR CONDITIONING

1983 - 1986

TURBO DIESEL & EFI GAS ENGINES

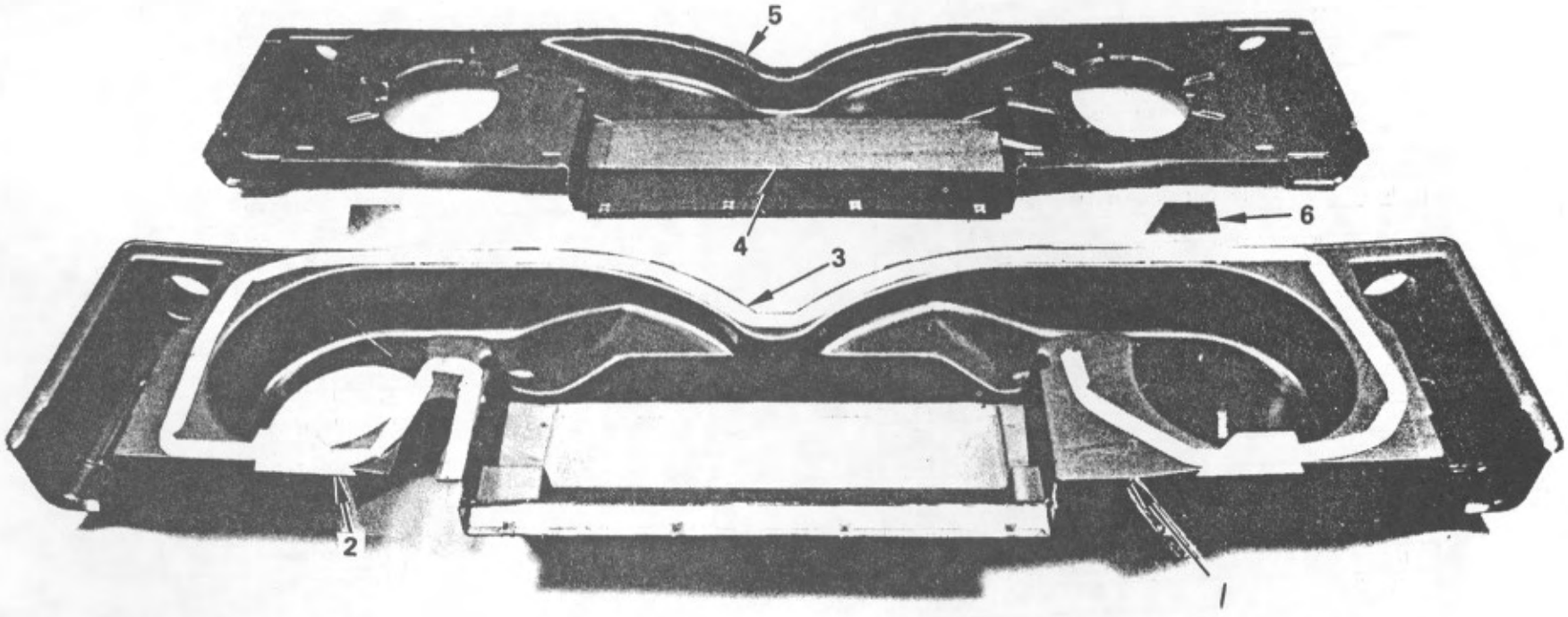
ITEM	DESCRIPTION	QTY
1a	Wire Hose - 2 x 32	2
1b	Wire Hose - 2 1/2 x 18	2
1c	Drain Tube	1
1d	Liquid Hose	1
1e	Suction Hose	1
1f	Floorboard Grommet	1
1g	Louver Escutch/Switch Panel	1
1h	Louver Escutcheon	2
1i	Louver	4
1j	Side Vent Assembly	2
1k	Side Vent Adapter	2
1m	Seal - Plenum to Louver	2
1n	Seal - Center Plenum	1
1p	Louver Assembly - 3"	2
1q	Louver Assembly - 2"	2
1r	Extension	2
6	Insulation	2
8	Screw	12
9	Washer	12
11	Roof Insulation Pad	1
12	Screw	14
15	Screw	3



TYPICAL OVERHEAD AIR CONDITIONING SYSTEM
EVAPORATOR ASSEMBLY
TURBO DIESEL 1983 - MID 1985

ITEM	DESCRIPTION	QTY
1	Case bottom sub assembly	1
2	Bracket forward evaporator mounting	2
3	Gaska tape seal 1/8 x 3/4 x 106"	1
4	Insulation, top	1
5	Case, top	1
6	Bracket, rear evaporator mounting	2
7	Evaporator coil	1

TYPICAL OVERHEAD EVAPORATOR ASSEMBLY



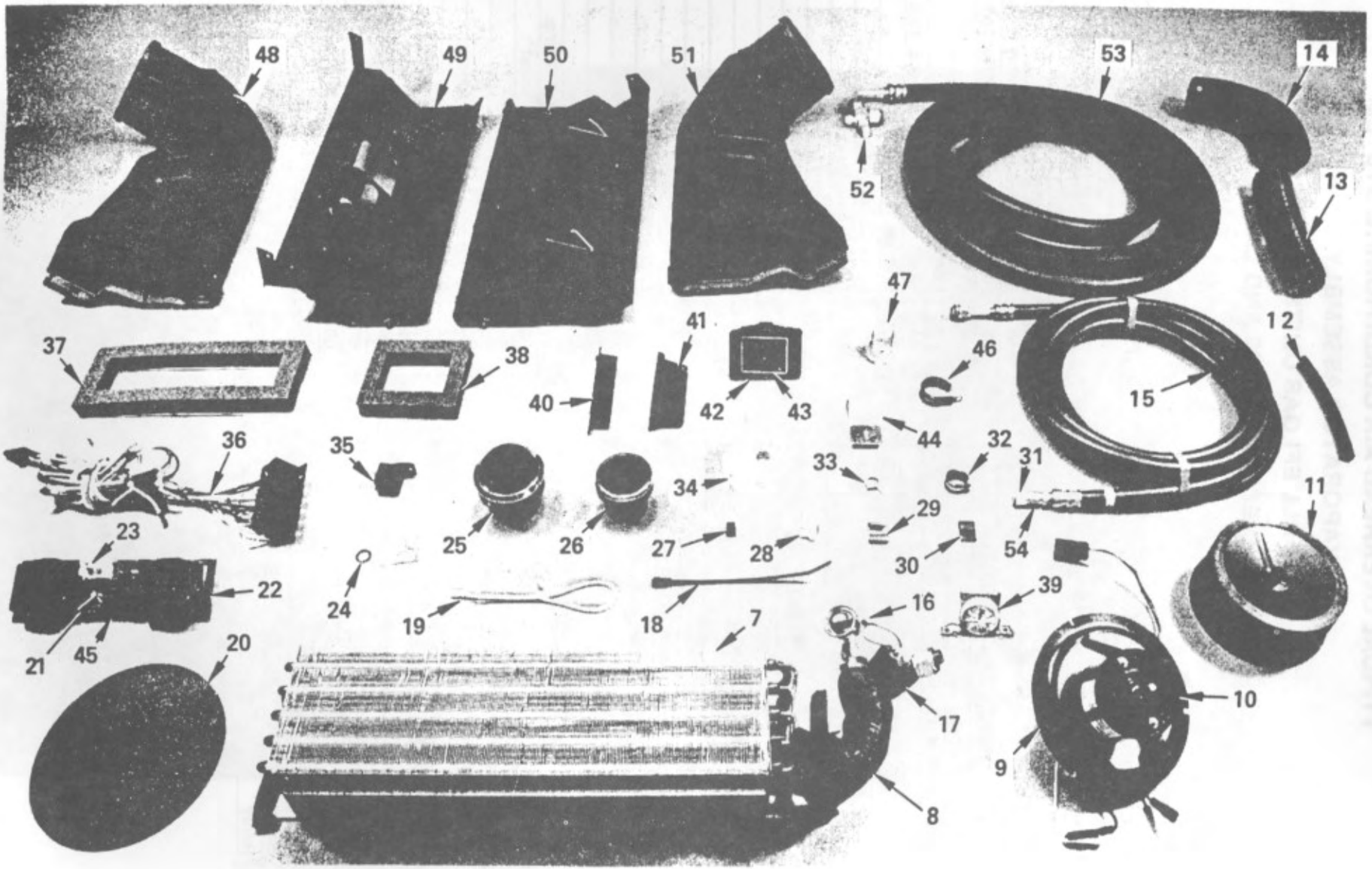
TYPICAL OVERHEAD AIR CONDITIONING SYSTEM
EVAPORATOR ASSEMBLY
TURBO DIESEL 1983 - MID 1985

ITEM	DESCRIPTION	QTY
8	Armorflex 3/4 ID x 6"	1
9	Motor mount	2
10	Motor, blower CCW Rotation: Blue to red, Yellow to Ground CW Rotation: Blue to yellow Red to Ground	2
11	Wheel blower CCW rotation	1
NS	Wheel blower CW rotation	1
12	Drain tube 1/2 x 30"	2
13	Hose wire form 2 x 32"	2
14	Hose wire form 2-1/2 x 18"	2
15	Hose liquid #6	1
16	Expansion valve	1
17	Armorflex 7/8 ID x 6"	1
18	Tiewrap w/mounting hole	12
19	Tiewrap 15"	6
20	Motor cover	2
21	Bracket, fan switch	1
22	Excutcheon louver and switch panel	1
23	Switch, fan	1
24	"O"-ring, #10	1
25	Louver assembly 3"	2
26	Louver assembly 2"	2
27	Knobs	2
28	Blower wheel retainer	2

ITEM	DESCRIPTION	QTY
29	Bulb clamp	1
30	"U" Clip	12
31	Fitting, Aeroquip	1
32	Hose clamp #6	6
33	Clamp hose drain 1/2"	4
34	Floorboard grommet	1
35	Relay	3
36	Wire harness	1
37	Seal, center plenum to louver	1
38	Seal, plenum to louver	2
39	Thermostat	1
40	Escutcheon vane assembly side vent	2
41	Side vent adapter	2
42	Escutcheon louver	2
43	Louver	4
44	Bracket, front plenum mounting	2
45	Bracket, thermostat	1
46	Hose clamp #10	6
47	Adapter fitting, compressor	1
48	Plenum, right side	1
49	Plenum, bottom	1
50	Plenum, top	1
51	Plenum, left side	1
52	Service valve	1
53	Suction hose #12	1
54	"O-ring", Aeroquip fitting	1
NS	Coupling flexible	2
NS	Retainer	8
NS	Tiewrap 7 3/4" Black	1

N/S - Not Shown

TYPICAL OVERHEAD
EVAPORATOR ASSEMBLY

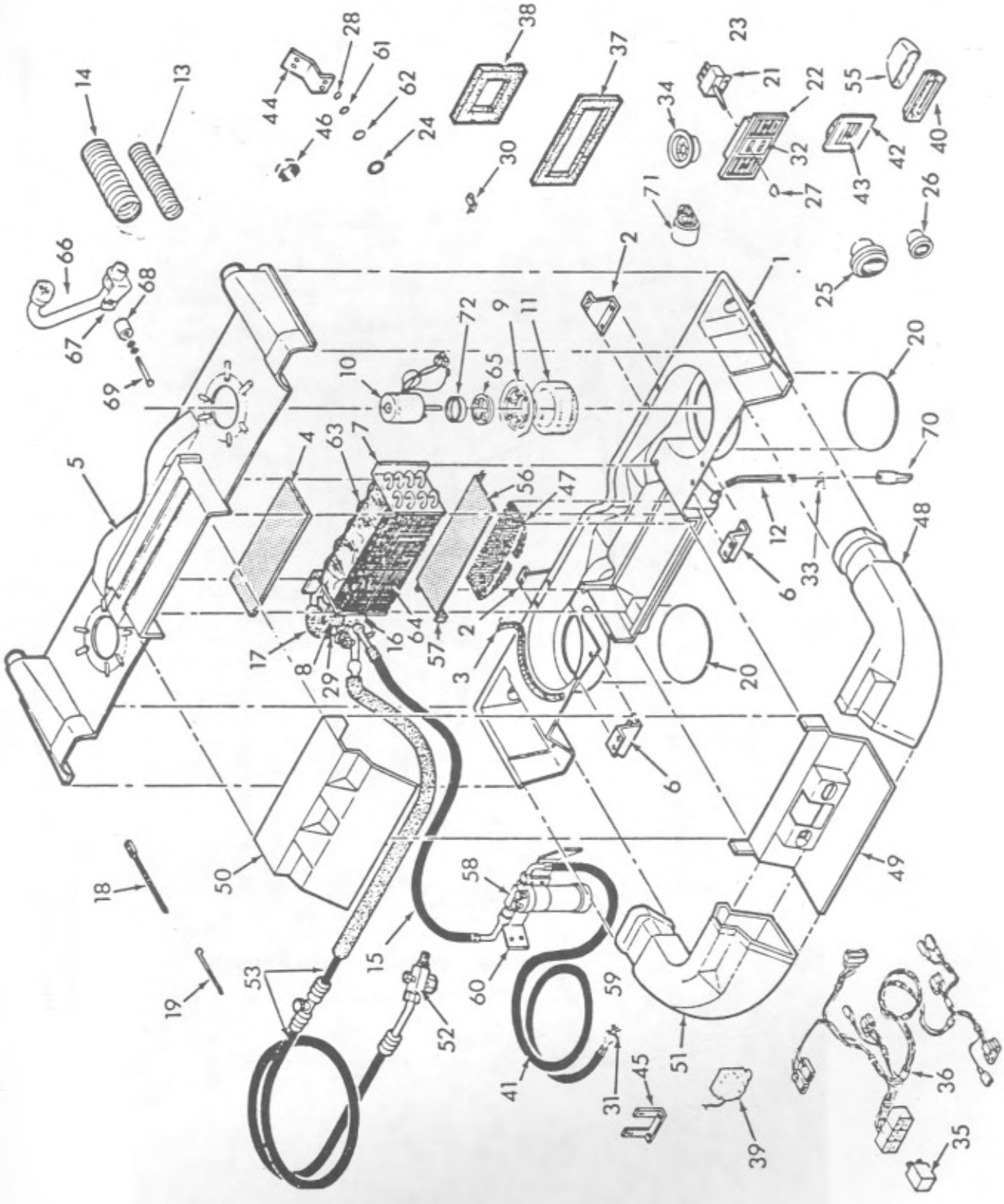


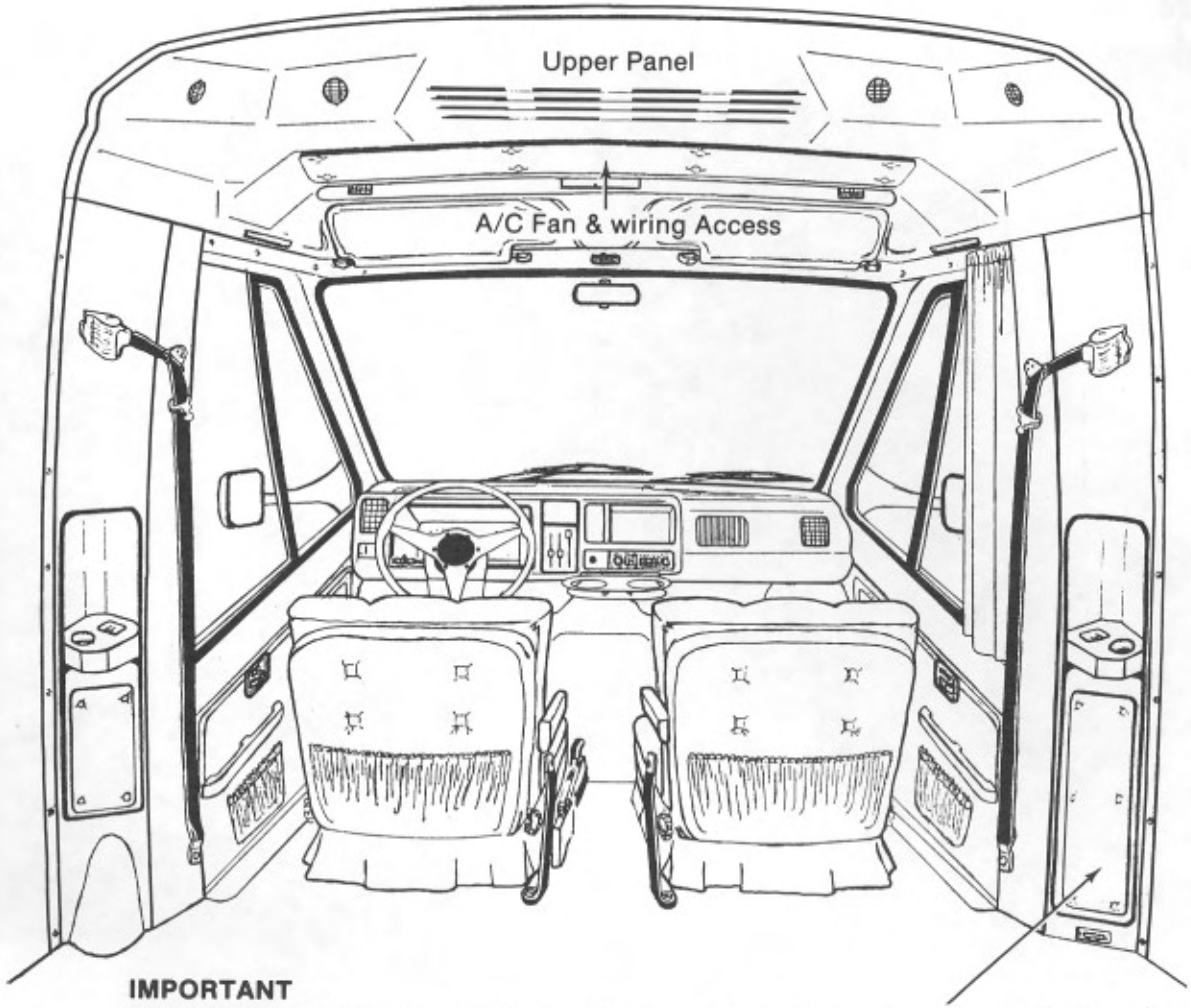
TYPICAL OVERHEAD AIR CONDITIONING SYSTEM
EVAPORATOR ASSEMBLY
ALL EFI GAS UNITS
TURBO DIESEL MID 1985 AND LATER

ITEM	DESCRIPTION
1	Case, Bottom Sub Assembly
2	Bracket, Forward - Evaporator Mounting
3	Gasket Tape Seal 1/8 x 3/4 x 106"
4	Insulation, Top
5	Case, Top
6	Bracket Rear Evaporator Mounting
7	Evaporator Coil
8	Armorflex, 3/4 ID x 6"
9	Motor Mount
10	Blower Motor
11	Wheel, Blower CCW Rotation
NS	Wheel, Blower CW Rotation
12	Drain Tube 1/2" x 30"
13	Hose, Wireform 2 x 32"
14	Hose, Wireform 2 1/2 x 20"
15	Hose, Liquid #6 TXV/Receiver
16	Expansion Valve
17	Armorflex 7/8 ID x 6"
18	Tiewrap w/Mounting Hole
19	Tiewrap, 15"
20	Motor Cover
21	Fan Switch Bracket
22	Escutcheon, Louver and Switch Panel
23	Fan Switch
24	"O" Ring, #10
25	Louver Assembly, 3"
26	Louver Assembly, 2"
27	Knobs
28	"O" Ring Cap Tube
29	Bulb Clamp
30	"V" Clip
31	Fitting, Aeroquip
32	Hose, Clamp #6
33	Clamp, Hose Drain 1/2"
34	Floorboard Grommet
35	Relay

ITEM	DESCRIPTION
36	Wire, Harness
37	Seal, Center Plenum to Louver
38	Seal, Plenum to Louver
39	Thermostat
40	Escutcheon Vane Assembly Side Vent
41	Hose, Liquid Condenser Receiver (In)
42	Escutcheon Louver
43	Louver
44	Bracket, Front Plenum Mounting
45	Bracket, Thermostat
46	Hose Clamp, #10
47	Lint Screen, Mesh
48	Plenum, Right Side
49	Plenum, Bottom
50	Plenum, Top
51	Plenum, Left Side
52	Service Valve
53	Suction Hose #10
54	"O" Ring, Aeroquip Fitting
55	Coupling, Flexible
56	Insulation, Baffle Plate
57	Plate, Baffle
58	Receiver/Drier
59	Bracket, Rec/Drier, Mtg Clamp
60	Receiver/Drier Mtg Bracket
61	"O" Ring #6
62	"O" Ring #8
63	Scott Foam 20 x 12"
64	Aluminum Screen Wire
65	Vibration Eliminator
66	Compressor Suction Adapter Assembly
67	Nut, Speed 1/4 - 12"
68	Steel Spacer 3/4" x 21/64" x 5/8"
69	Bolt, 1/4 - 20 x 3/4"

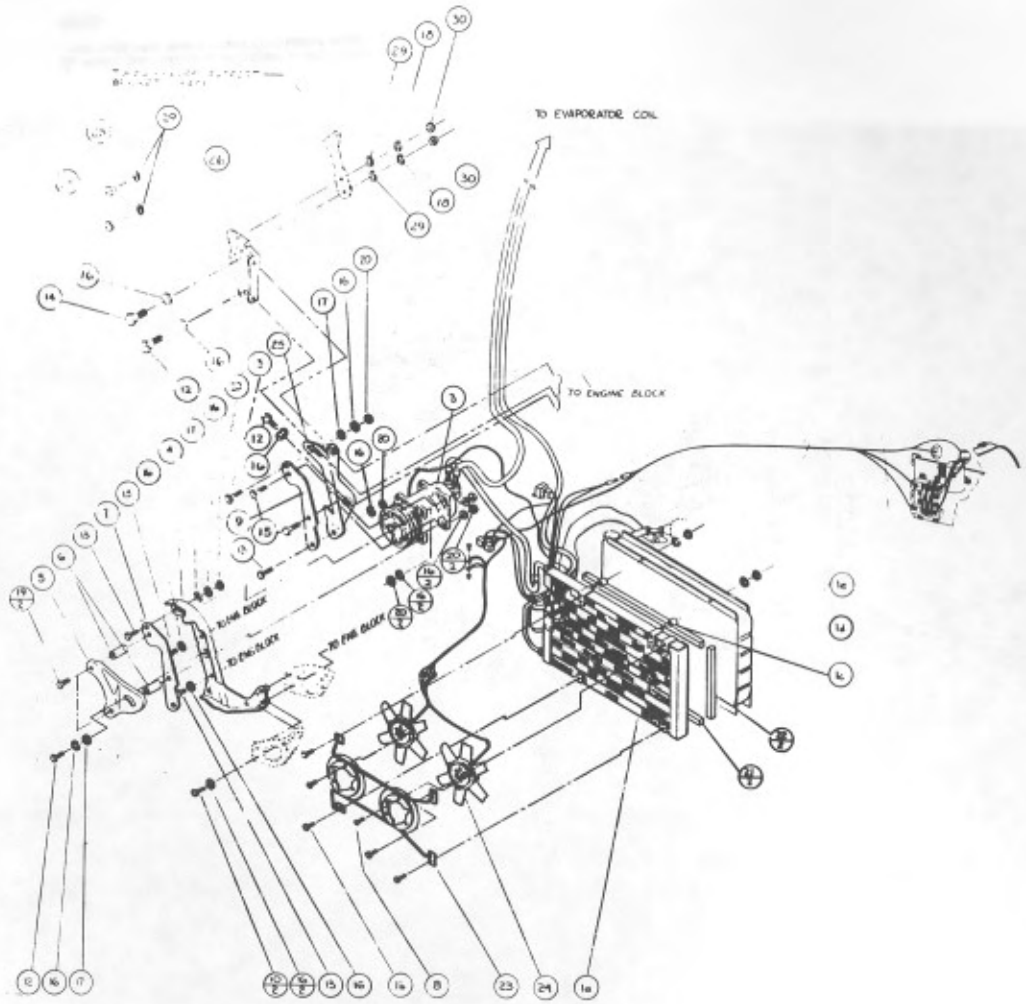
TYPICAL EVAPORATOR ASSEMBLY
ALL E.F.I. GAS UNITS
TURBO-DIESEL MID 1985 AND LATER





IMPORTANT
This Trim Pad provides access to the Receiver-Drier on all gas units and mid-'85 and later diesel models.

A/C COMPRESSOR - CONDENSER ASSEMBLY
1983-1986 TURBO DIESEL ENGINE

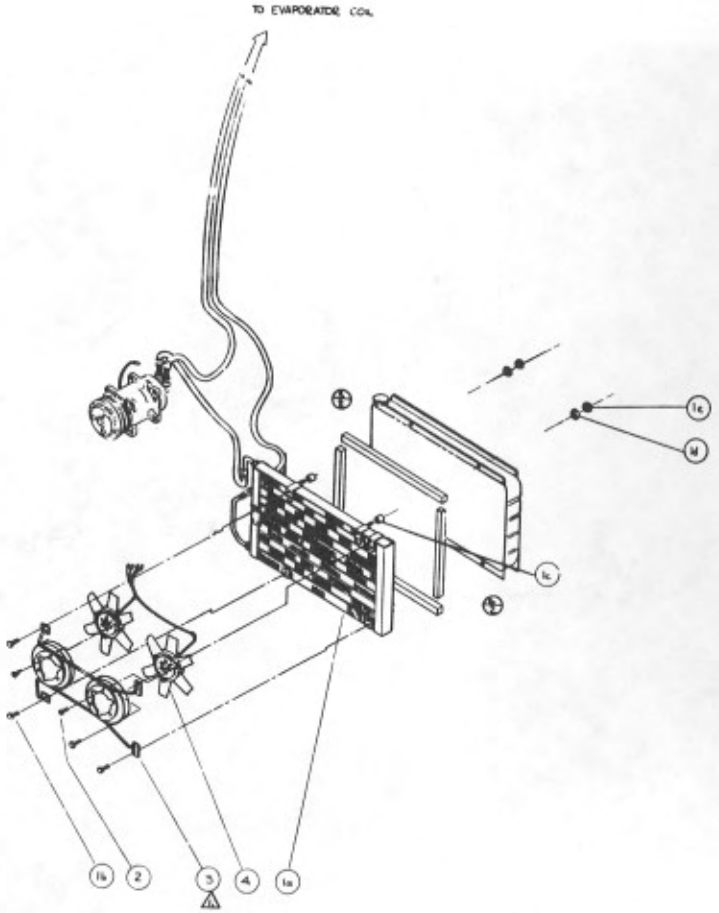


NOTES:

ITEM	DESCRIPTION	QTY
1a	Condenser Coil	1
1b	Bolt	4
1c	Spacer	4
1d	Washer	4
1e	Nut	4
3	Compressor	1
4	Crossmember	1
5	Stiffener	1
6	Spacer	2
7	Crossmember Bracket	1
8	Bolt	4
9	Crossmember Bracket	1
10	Bolt	2
11	Bolt	2
12	Bolt	3
13	Bolt	5
14	Bolt	2
15	Bolt	2
16	Washer	13
17	Washer	3
18	Washer	2
19	Bolt	2
20	Nut	7
21	Radiator Gasket	2
22	Radiator Gasket	2
23	Fan Bracket	1
24	Fan	2
25	Compressor Bracket	1
26	Support Bracket	1
28	Bolt	2
29	Washer	4
30	Nut	2

A/C COMPRESSOR — CONDENSER ASSEMBLY

1985 - 1986 E.F.I. GAS ENGINE



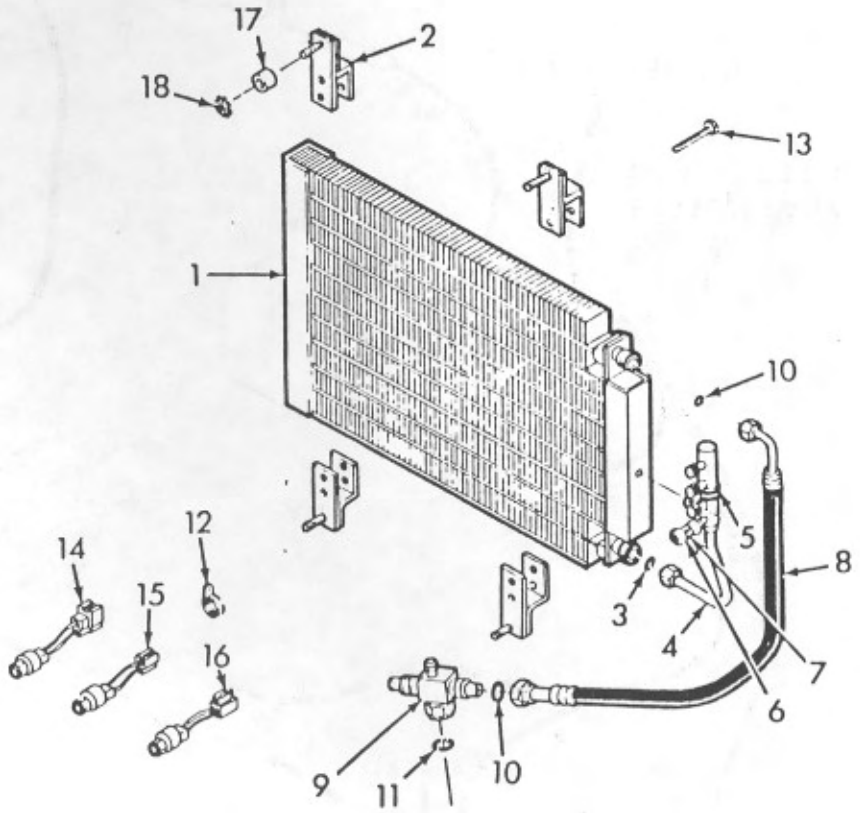
ITEM	DESCRIPTION	QTY
1a	Condensor coil	1
1b	Bolt	4
1c	Spacer	4
1d	Washer	4
1e	Nut	4

ITEM	DESCRIPTION	QTY
2	Bolt	4
3	Fan Bracket	1
4	Fan	2
5	Radiator Gasket	2
6	Radiator Gasket	2

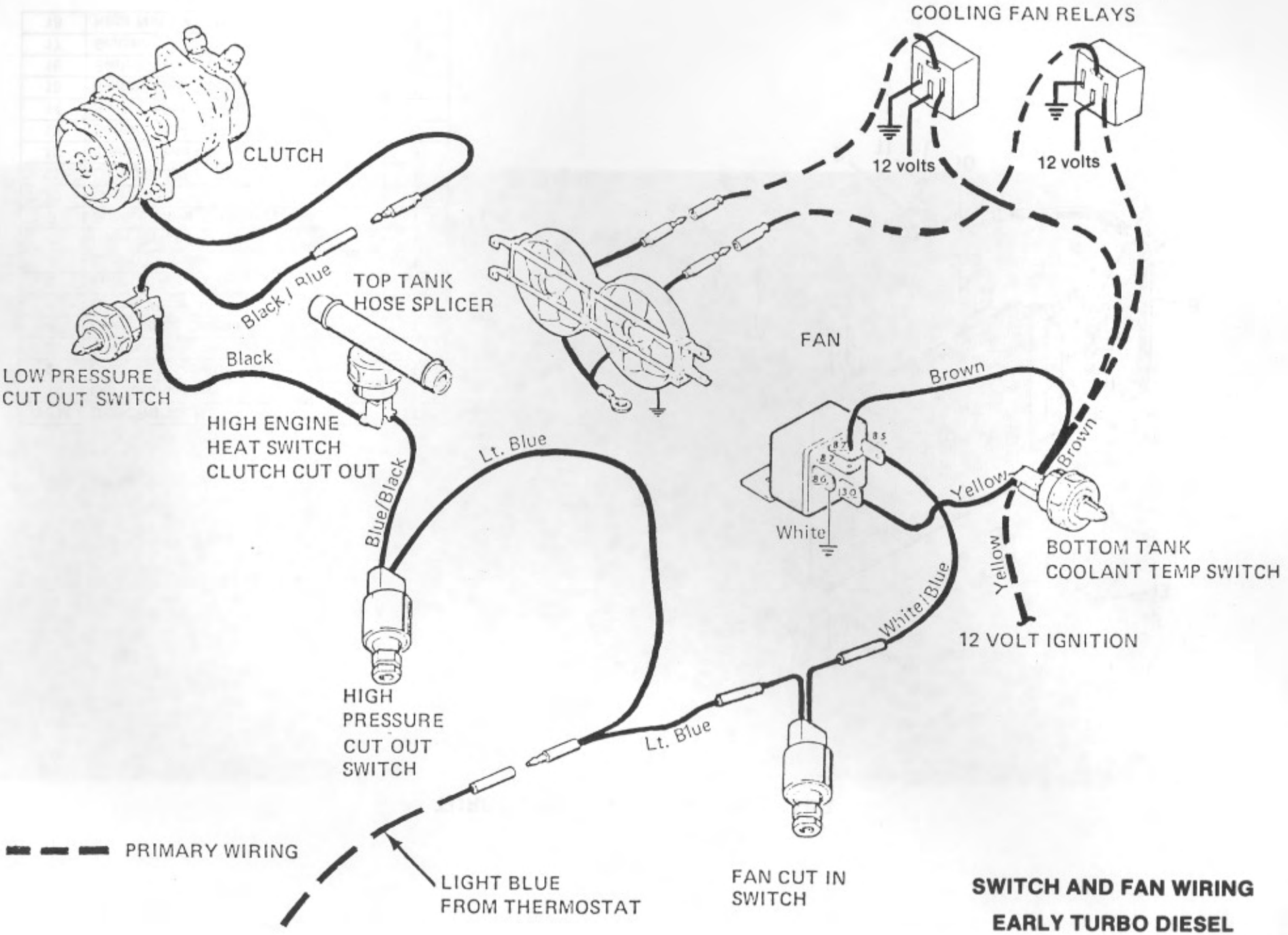
⚠ INSTALL SEAL [illegible] MUST CLOSE SPACE BRACKET [illegible]

NOTES:

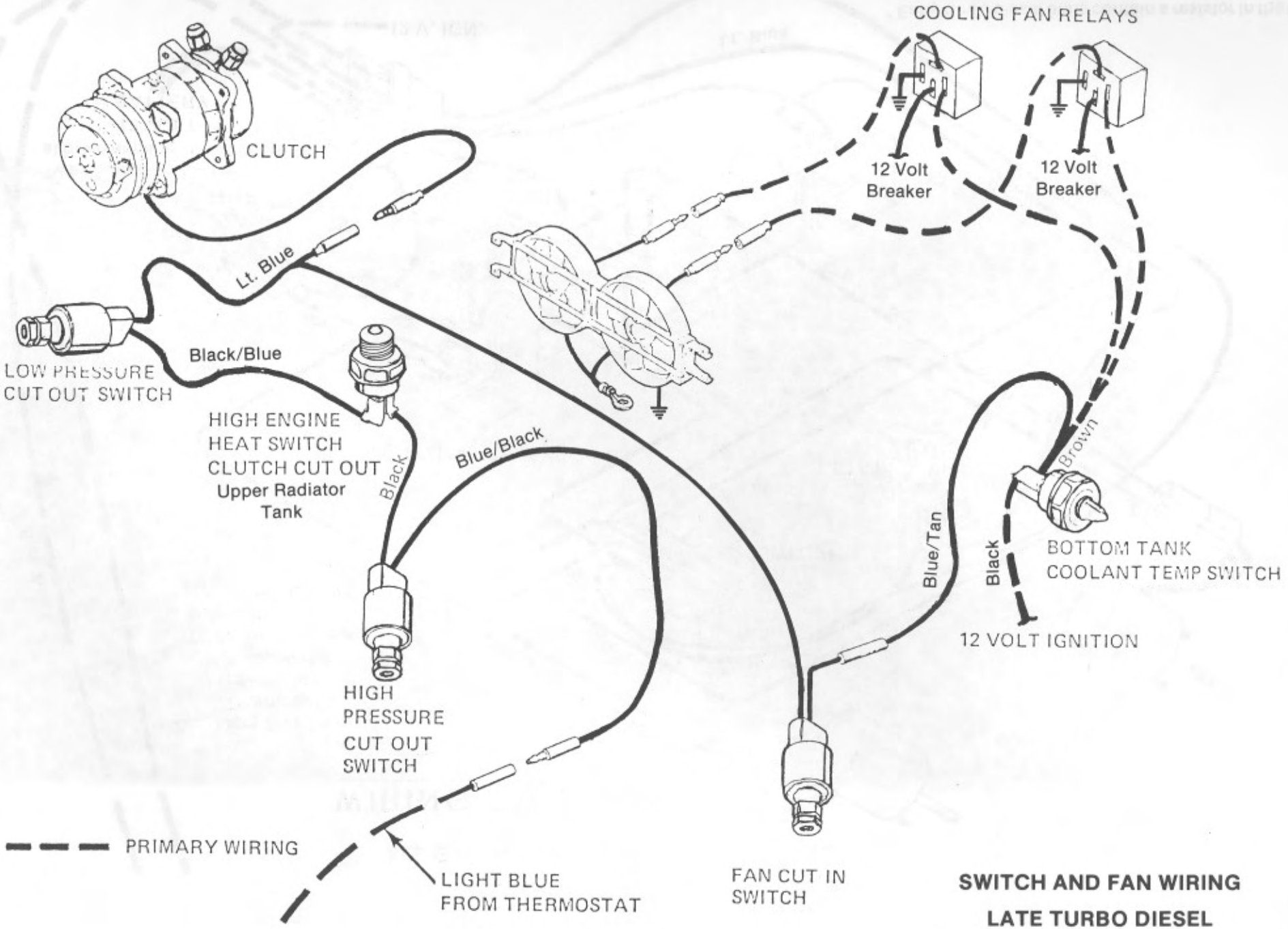
CONDENSER ASSEMBLY
WINNEBAGO 'H' BODY
ALL E.F.I. GAS UNITS
TURBO DIESEL MID 1985 AND LATER



ITEM	DESCRIPTION	QTY
1	Coil, Condenser	1
2	Bracket, Condenser Mounting	4
3	O ring #6	
4	Line, Liquid Condenser	1
5	Clamp, Hose	1
6	Fittings, Aeroquip	1
7	O-ring	1
8	Hose, Discharge #8	1
9	Service Valve, Discharge	1
10	O ring #8	2
11	O ring #10	1
12	Clamp, Hose #4	2
13	Screw, 10 24 x 1 1/2 PPH	8
14	Switch, High Pressure	1
15	Switch, Low Pressure (Fan)	1
16	Switch, Low Pressure Cut Out	1
17	Spacer	4
18	Keps Nut 1/4 - 20	4



SWITCH AND FAN WIRING
EARLY TURBO DIESEL



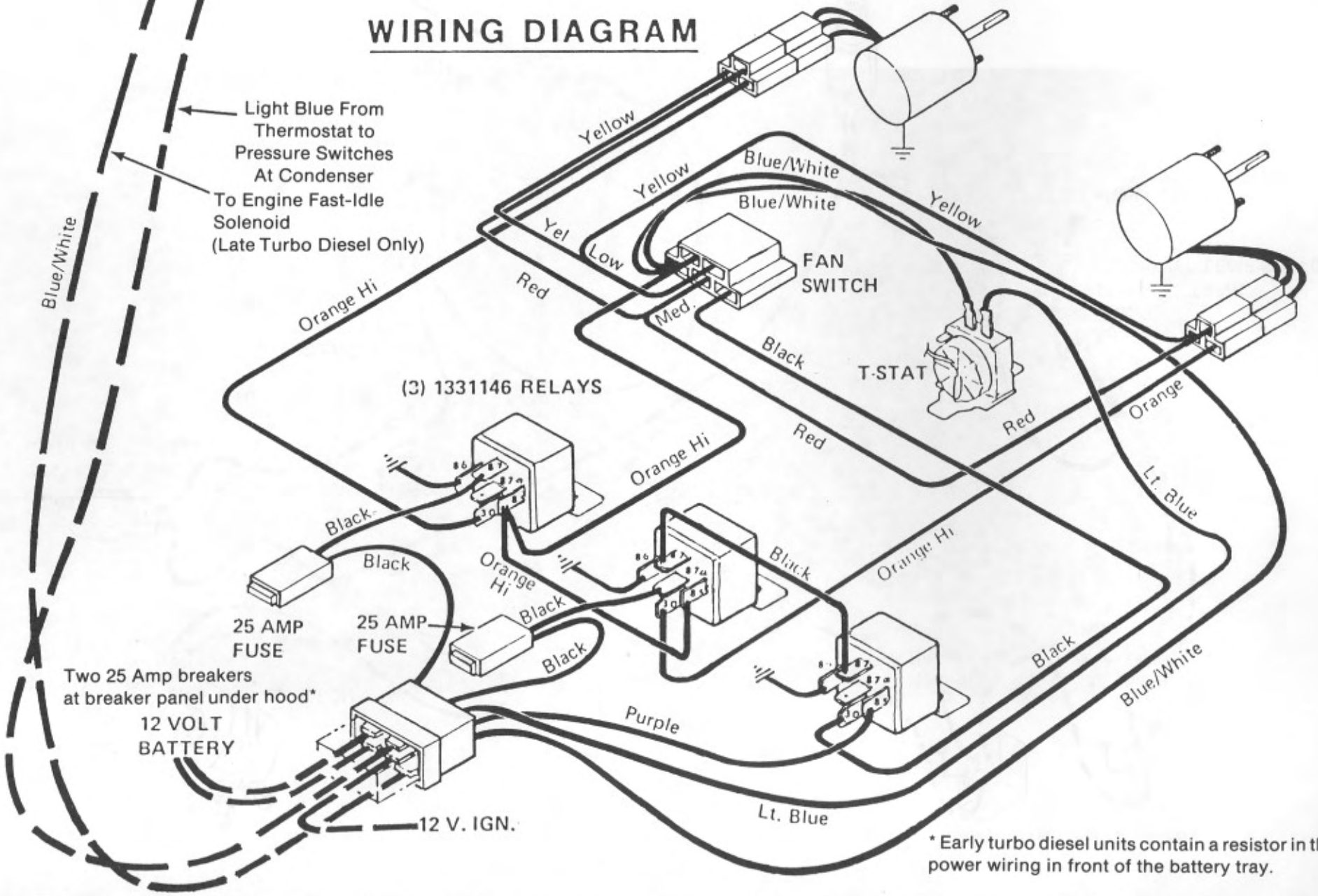
SWITCH AND FAN WIRING
LATE TURBO DIESEL

TYPICAL WINNEBAGO H-BODY

EVAPORATOR WIRING

ALL E.F.I. GAS AND TURBO DIESEL UNITS

WIRING DIAGRAM



* Early turbo diesel units contain a resistor in the fan power wiring in front of the battery tray.

1985 - 1986 E.F.I. GAS ENGINE
EQUIPPED WITH OVERHEAD A/C

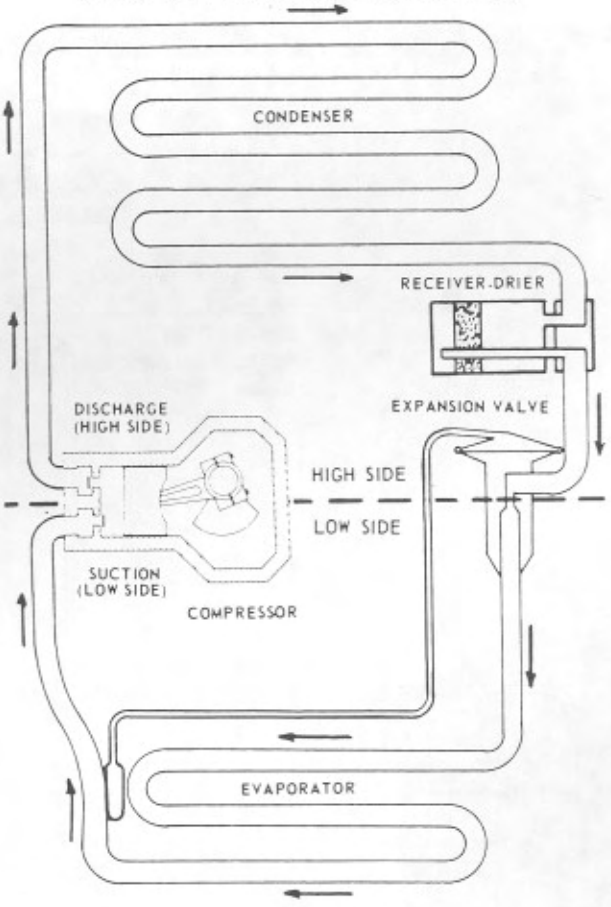
See Section G (Electrical) of this manual for wiring from firewall to compressor.

A/C SYSTEM OPERATION

Basic Operation

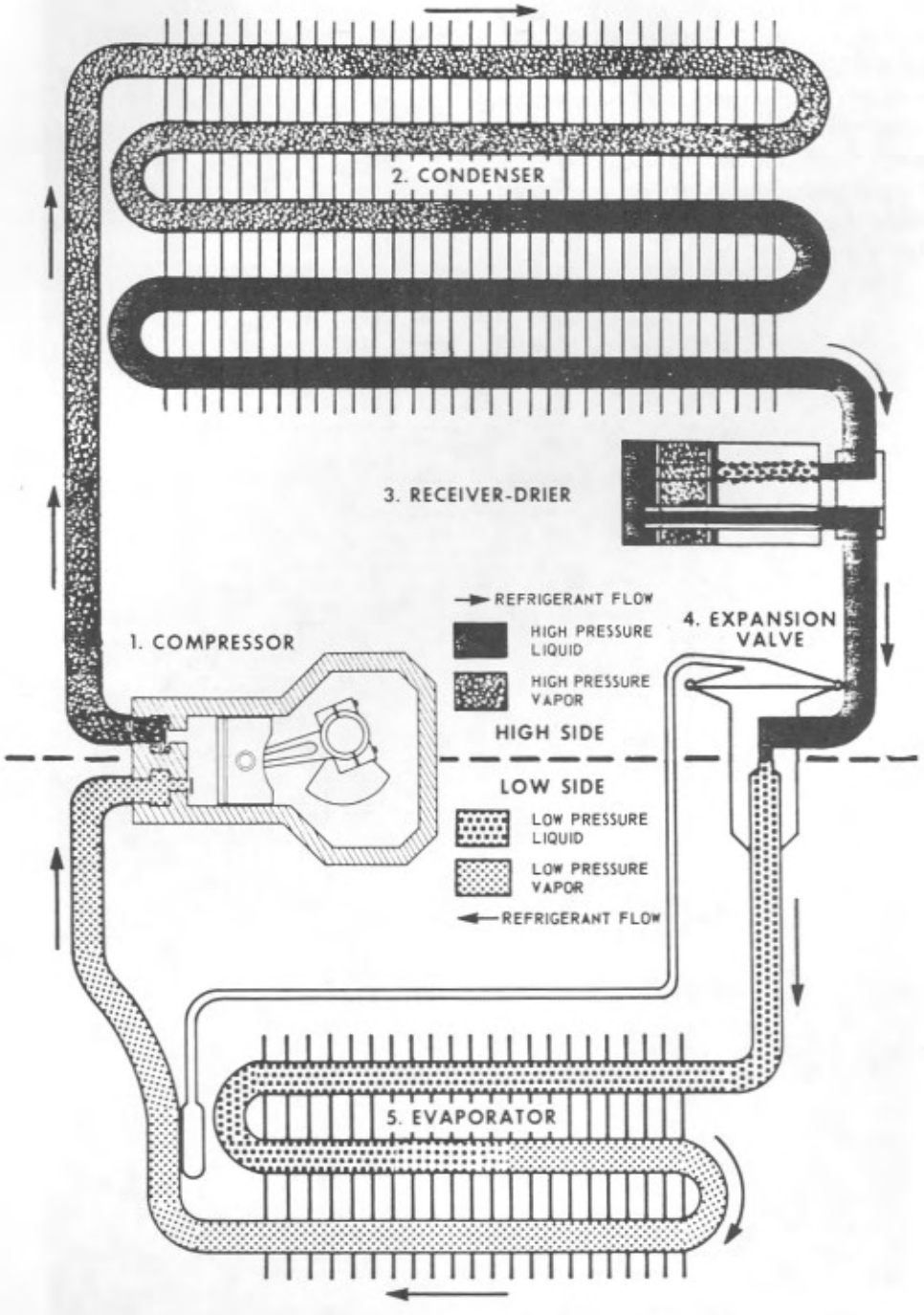
The automotive air conditioning system is a simple mechanical device designed to move heat from within the vehicle to the outside air. It uses all of the principles of heat transfer discussed in the previous chapter and is divided into a HIGH PRESSURE SIDE and a LOW PRESSURE SIDE as indicated by the line drawn through the center of the Compressor and Expansion Valve as shown in the accompanying diagram. All components above this line are on the high side and operate under high pressure; all components below the line are on the low side and operate under low pressure.

BASIC AIR CONDITIONING SYSTEM



A/C SYSTEM OPERATION

BASIC AIR CONDITIONING SYSTEM
REFRIGERANT FLOW CYCLE



LOW SIDE CONTAINS:

1. Suction side of the Compressor and its Low Side Service Fitting.
2. Evaporator.
3. Outlet half of Expansion Valve
4. Connecting hoses to all parts described above.

HIGH SIDE CONTAINS:

1. Discharge side of Compressor and its High Side Service Fitting.
2. Condenser
3. Receiver-Drier
4. Inlet half of expansion valve.
5. Connecting hoses to all parts described above.

SERVICING THE A/C SYSTEM

STABILIZING THE SYSTEM

With Manifold Gauge Set connected into system, air and moisture purged from high and low side test hoses, and both manifold hand valves closed, the air conditioner is ready for testing. The system must be operated for a few minutes to allow all components to attain operating stability and the system must be checked for a full refrigerant charge before tests can be made. Stabilize the system as follows:

System must be properly stabilized.

System Stabilizing Procedure

1. Start engine and adjust engine to normal fast idle speed.
2. Turn air conditioner on and set for maximum cooling with blower fan on high speed.
3. Open doors or windows.
4. Operate air conditioner for 5-10 minutes to stabilize system.
5. Check system for full refrigerant charge by noting sight glass indication. See page P3-2 for sight glass data. On systems where sight glass is not used, note gauge readings. See P4-4 for normal gauge readings. An insufficient charge will be indicated by high and low gauges registering lower than normal.

System must have full charge.

If an insufficient refrigerant charge is indicated by the test gauge readings and sight glass indication, the system must first be fully charged before accurate tests can be performed to determine the cause of system failure. The stabilizing period is an ideal time to add refrigerant to bring the system to a full charge. Refer to ADDING REFRIGERANT.

Some refrigerant loss is normal.

Some refrigerant loss will occur from one season to the next and is accepted as normal. Vibration, hose porosity, and the general construction of components mounted on a moving vehicle make the leak-free system an exception. Replacing this refrigerant loss between seasons will constitute much of the quick-service required on air conditioning equipment.

ADDING REFRIGERANT

System must contain full refrigerant charge.

The air conditioner must contain a full refrigerant charge before an accurate system check can be made. An insufficient charge is indicated by both the high and low side gauge readings registering lower than normal. Also the sight glass will show a stream of bubbles or foam. Refer to the accompanying illustration and proceed as follows with the system still in operation.

Adding Refrigerant Procedure

1. If can of refrigerant-12 not already connected to manifold gauge set center hose, connect can as follows: Install can valve on can of R-12 and connect can valve to center hose.
2. Loosen center hose connection at gauge manifold, open can valve for several seconds to purge air from the center hose, then tighten hose connection and close can valve.
3. **Start engine and operate air conditioner.** With system operating, slowly open low side manifold hand valve to allow refrigerant to enter the system.

NOTE: The low side of the system is the SUCTION side and the Compressor will pull refrigerant from the can into the system.

Add charge on Low Side Only.

CAUTION

High side hand valve must never be opened while system is operating. This would result in refrigerant being pumped into the can and causing it to burst. NOTE: The high side of the system is the DISCHARGE side and compressor would push refrigerant out of the system (unless safety can valve used).

4. With refrigerant container in **upright** vapor-position, add refrigerant until sight glass clears or gauge readings are normal.

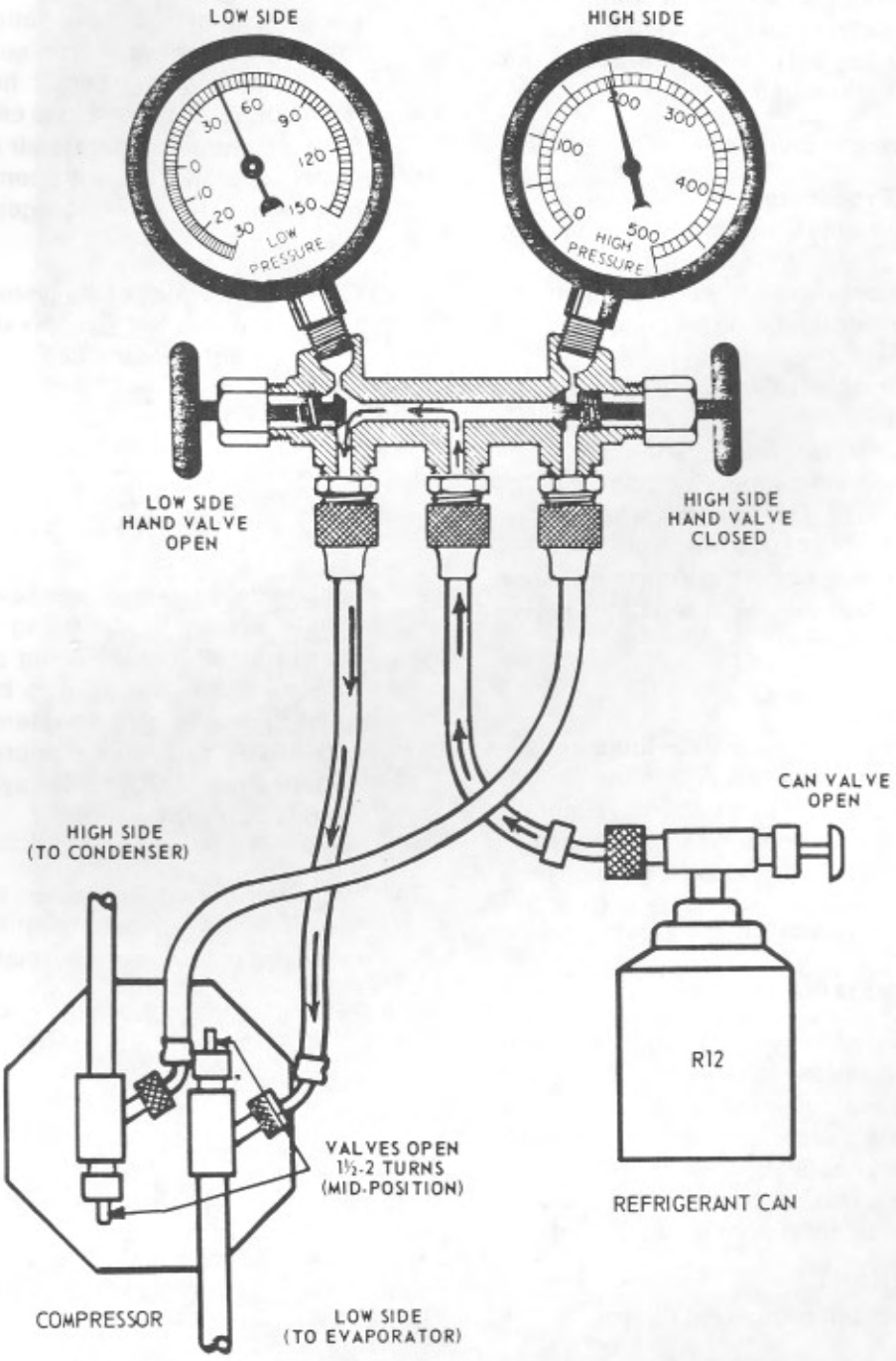
NOTE: Refrigerant can may be rocked from side to side to increase flow of refrigerant into system.

CAUTION

Never turn can into a position where liquid refrigerant will flow into system.

5. Close low side manifold hand valve and refrigerant can valve.
6. Continue to stabilize system and check for normal refrigerant charge.

ADDING REFRIGERANT TO SYSTEM
(SYSTEM OPERATING)



RECEIVER-DRIER REPLACEMENT INTERVALS

The receiver-drier cannot be serviced and should be replaced whenever there is reason to believe the desiccant has become saturated with moisture or if there is an doubt as to its correct functioning.

A quick check of the receiver-drier can be made by feeling the receiver-drier and the inlet and outlet hoses or refrigerant lines with the system operating. These should be HOT to the touch. A cool receiver-drier or lines indicates a malfunction.

Receiver-Drier must be replaced at certain intervals.

In regular operation, the following replacement schedule should be used:

Normal Conditions - Replace receiver-drier every third time the system is opened for repair or servicing.

Special Conditions - Replace receiver-drier **each time** the system is opened when operated under the following conditions.

1. In a high humidity area (high moisture content in the air).
2. If the system has been open for a long period as when an existing leak (broken hoses, loose connections, etc) has allowed air and moisture to enter the system.
3. Whenever thermostatic expansion valve is replaced (usually because of corrosion caused by moisture in system).
4. Whenever receiver-drier and inlet and outlet hoses or lines cool to the touch with system operating.
5. When cloudiness noted in sight glass.

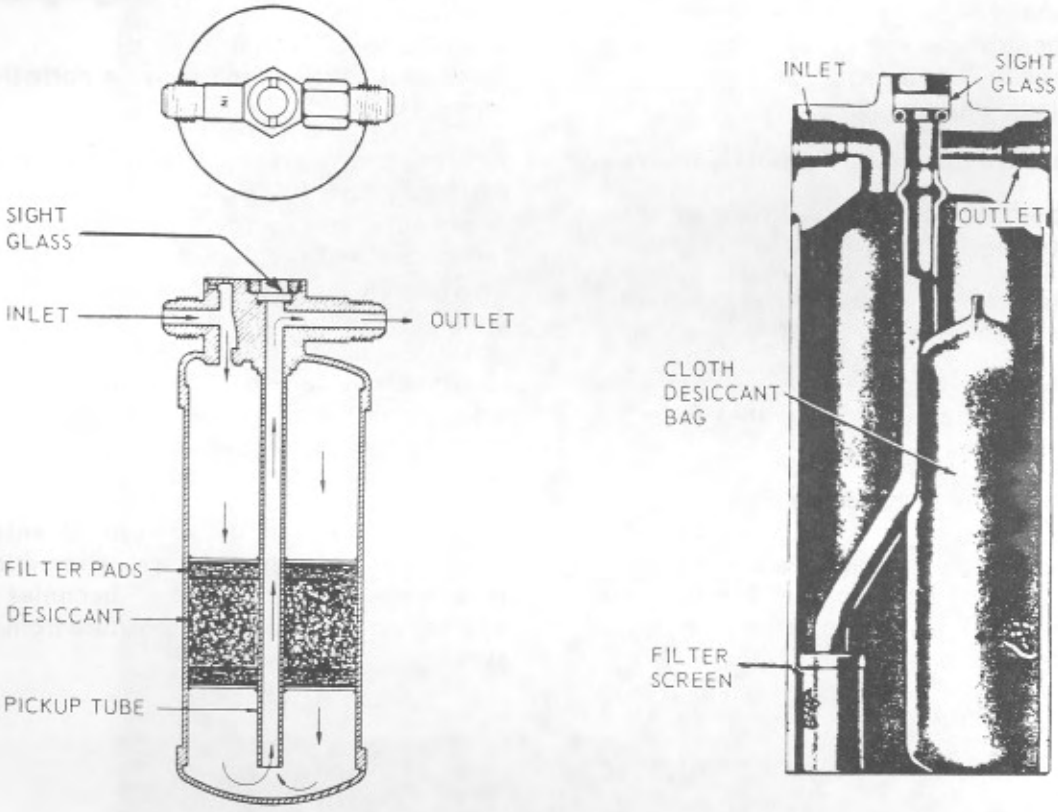
MOISTURE CONTAMINATION

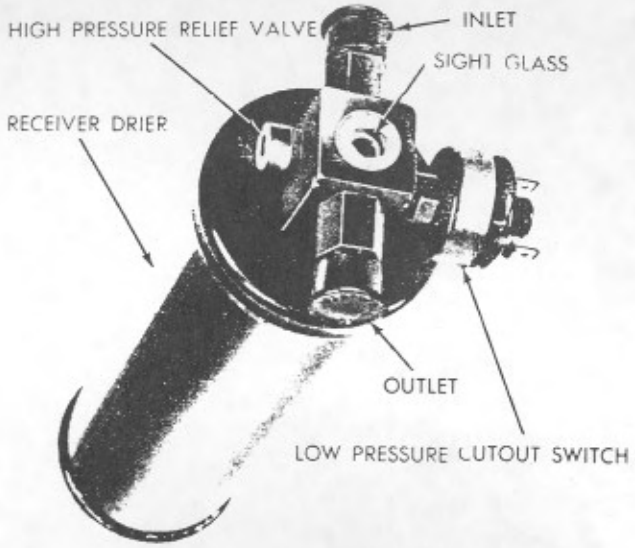
Moisture in system will cause a corrosive acid to form.

Any moisture in the air conditioning system is extremely harmful. Moisture not absorbed by the desiccant in the receiver-drier will circulate with the refrigerant and droplets may collect and freeze in the Thermostatic Expansion Valve orifice. This would block the refrigerant flow and stop the cooling action. Also, moisture will react with Refrigerant-12 to form a hydrochloric acid which will cause corrosion of the metal parts in the system. Corrosion particles may become detached and block the small passages and orifices in the system.

Moisture must not be allowed to enter the air conditioning system and the receiver-drier must be replaced when the desiccant becomes saturated and can no longer remove moisture from within the system.

RECEIVER-DRIER ASSEMBLIES (TYPICAL)





EVACUATING THE SYSTEM

A system that has had the refrigerant removed to perform repairs, or is excessively low on refrigerant, must be evacuated with a vacuum pump before new refrigerant is installed.

System must be evacuated to remove air and moisture

MOISTURE in any quantity (even a few drops of water) is extremely harmful to the air conditioning system and if not retained by the desiccant in the receiver-drier will circulate with the refrigerant. Moisture may collect and freeze in the Thermostatic Expansion Valve orifice which would block refrigerant flow and stop the cooling action. Moisture will also react with Refrigerant-12 to form hydrochloric acid which will cause corrosion of the metal parts of the system. Corrosion particles may become detached and block the small passages and orifices in the system. The desiccant in the receiver-drier can absorb only a limited amount of moisture before it becomes saturated and it is extremely important to prevent moisture entering the system, and to remove moisture which may have entered the system through a leak or open connection.

Vacuum pump must be used for evacuation.

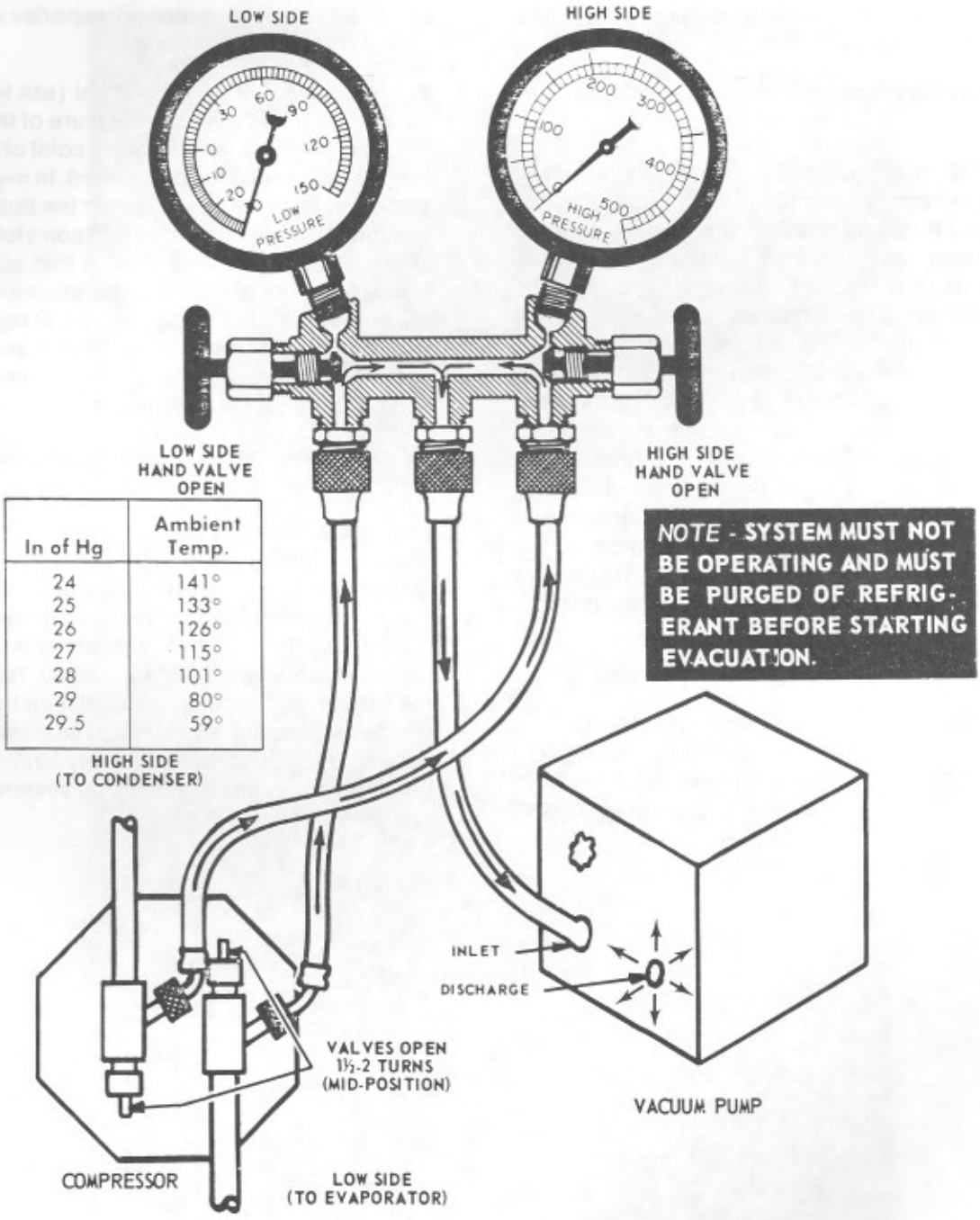
Unwanted air and moisture are removed from the system by controlling the pressure: however, instead of adding pressure, we remove pressure or **evacuate** the system. A vacuum pump is the only piece of equipment designed to lower the pressure sufficiently so that the moisture boiling temperature is reduced to a point where the water will vaporize and can then be evacuated from the system.

Water boils at 212° F, at 14.7 psi (sea level). As the vacuum pump lowers the pressure of the closed air conditioning system, the boiling point of the moisture in the system will also be lowered. In evacuating the system, it is necessary to lower the boiling point of any moisture in the system to a point lower than the ambient temperature to ensure that all moisture is boiled off. At an ambient temperature of 75° F., when the desired vacuum of 29.5 inches of Hg. is reached, water will boil at approximately 72° F. and a complete boiling off of all moisture in the system is assured when this vacuum reading has been reached.

Altitude affects vacuum gauge readings.

At altitudes higher than sea level, it will not be possible to obtain a vacuum reading of 29.5 inches of Hg. on the low side compound gauge. For each 1000 feet of altitude, the vacuum gauge must be corrected by 1 inch of Hg. to compensate for a change in atmospheric pressure. For example, at altitudes between 950 and 1,050 feet, a gauge reading of 28.5 inches of Hg. will be the same as a gauge reading of 29.5" of Hg. at sea level. When this vacuum is reached, approximately 30 minutes should be allowed in evacuating the system to ensure complete moisture removal.

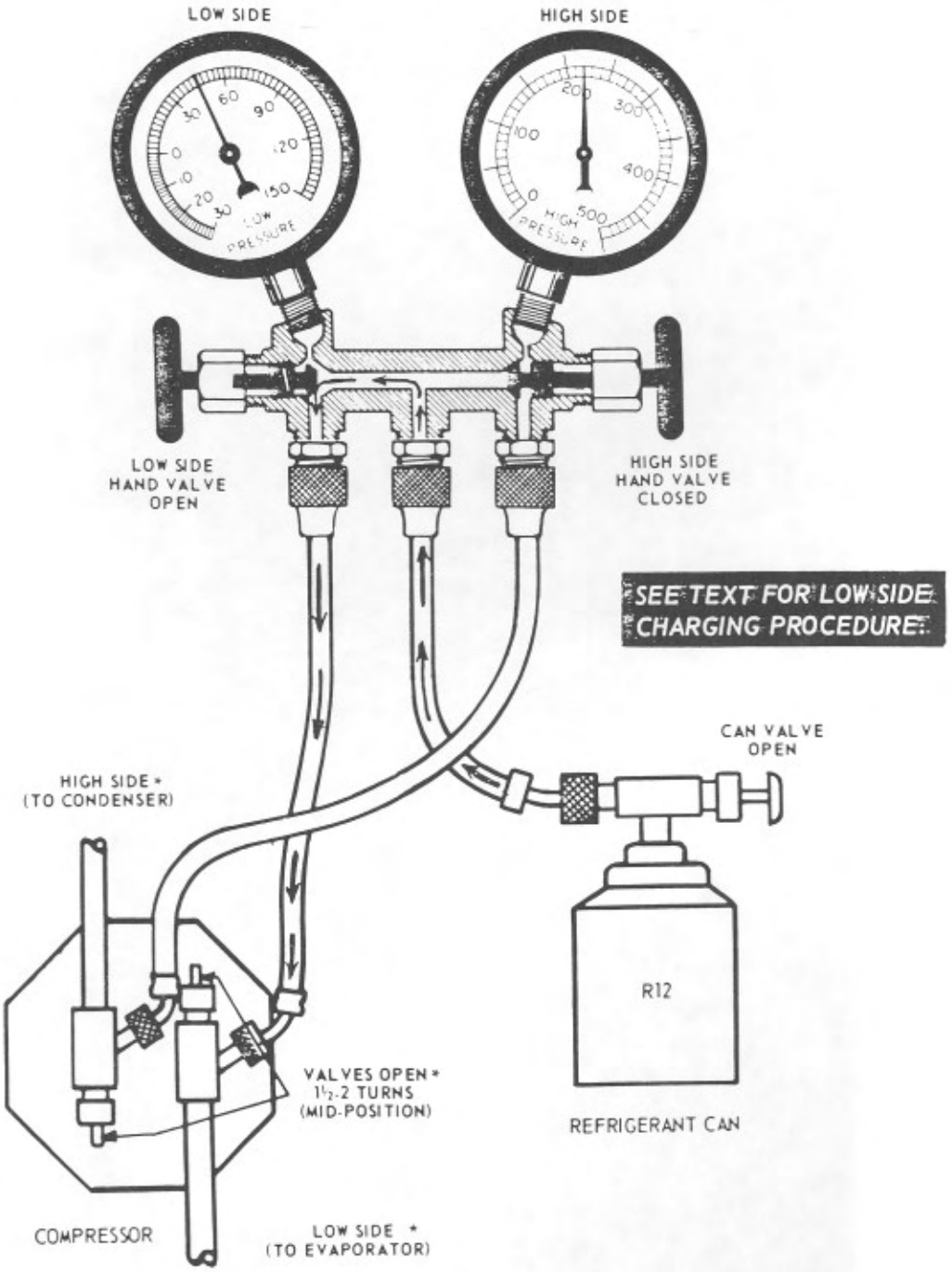
EVACUATING THE SYSTEM



In of Hg	Ambient Temp.
24	141°
25	133°
26	126°
27	115°
28	101°
29	80°
29.5	59°

NOTE - SYSTEM MUST NOT BE OPERATING AND MUST BE PURGED OF REFRIGERANT BEFORE STARTING EVACUATION.

CHARGING THE SYSTEM (COMPLETE CHARGE)



*Or make these connections at drier and low side connections at the right hand transition panel on some models.

DIAGNOSIS OF A/C SYSTEM

In most instances, when a vehicle is brought in for air conditioning service work, the complaint will be "Lack of Cooling" or "Insufficient Cooling". The first problem will be to determine why the air conditioner is not operating at normal efficiency.

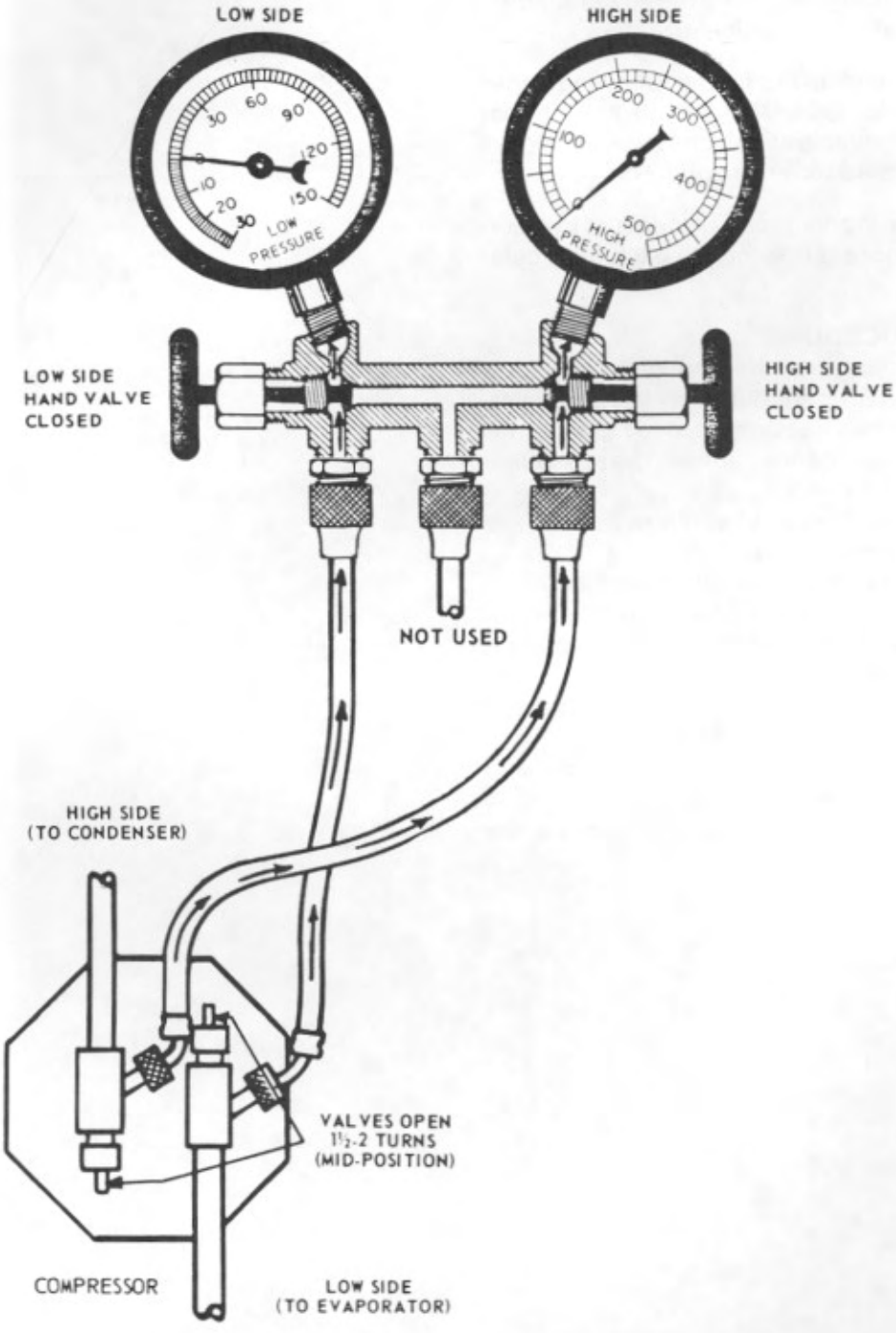
The conditions summarized on the following pages cover the common causes of the air conditioner failure to cool the vehicle satisfactorily. A corrective procedure is detailed for each condition.

Perform the following diagnostic procedure to determine the conditions applying to each particular case.

DIAGNOSIS PROCEDURE

1. Connect the gauge manifold set to the system at compressor. (On mid-1985 and later vehicles, the gauge set may be connected to the receiver-drier and low side connections in the passenger side transition panel.)
2. Operate air conditioner to stabilize system and perform an operating test.
3. Note gauge readings and other indications as listed under "Conditions". Refer to "Pressure-Temperature Relationship" chart if ambient temperature is not the same as that listed. NOTE: "Shaded" section of chart indicates normal operating range (see page P4-3)
4. Note trouble as listed under complaint and make any additional tests indicated.
5. Perform all corrective procedures indicated under "Correction".

GAUGE SET CONNECTIONS FOR TESTING



GAUGE SET CONNECTIONS FOR TESTING

NOTE: On mid-1985 and later vehicles, the gauge manifold set may be connected to the receiver-drier and low side connections in the passenger side transition panel.

PRESSURE-TEMPERATURE RELATIONSHIP

NOTE: Pressures shown are subject to specific conditions (see Test Conditions below), and are not necessarily true for every vehicle checked.

Ambient Temperature is given as the temperature of the air surrounding the condenser, and is taken 2" in front of the condenser.

LOW PRESSURE GAUGE READING	EVAPORATOR TEMPERATURE F°
10	2
12	6
14	10
16	14
18	18
20	20
22	22
24	24
26	27
28	29
30	32
35	36
40	42
45	48
50	53
55	58
60	62
65	66
70	70

AMBIENT TEMPERATURE °F	HIGH PRESSURE GAUGE READING
60	95-115
65	105-125
70	115-135
75	130-150
80	150-170
85	165-185
90	175-195
95	185-205
100	210-230
105	230-250
110	250-270
115	265-285
120	280-310

TEST CONDITIONS:

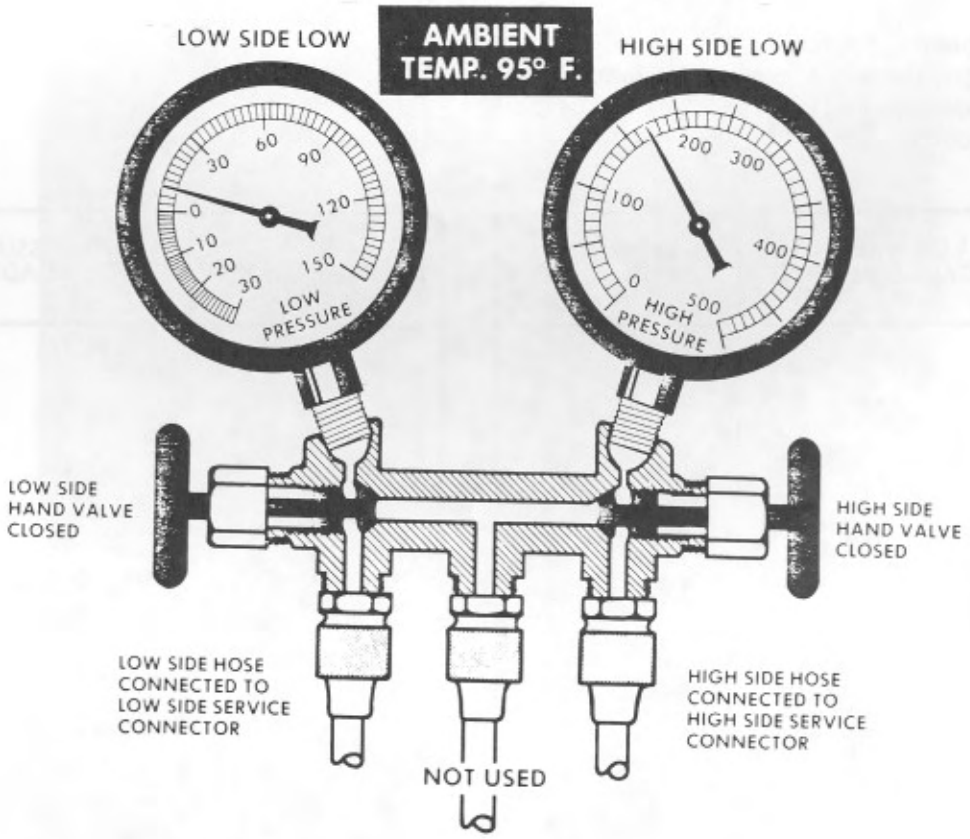
1. Use large fan to subsitute normal ram air flow through condenser.
2. Engine adjusted to normal fast idle speed.
3. System fully charged.
4. All conditions equivalent to vehicle operation at 30 MPH.

Normal operating ranges shown by shaded areas.

DIAGNOSIS OF A/C SYSTEM

CONDITION 1

REFRIGERANT SLIGHTLY LOW



Complaint

Little or no cooling.

Condition

1. Low side gauge reading too low. Should be 15-30 psi.
2. High side gauge reading too low. Should be 185-205 psi at ambient temperature of 95° F. See Chart for pressures at other ambient temperatures.
3. Stream of bubbles visible in sight glass.
4. Discharge air from evaporator only slightly cool.

Diagnosis

System low on refrigerant. May be caused by small leak.

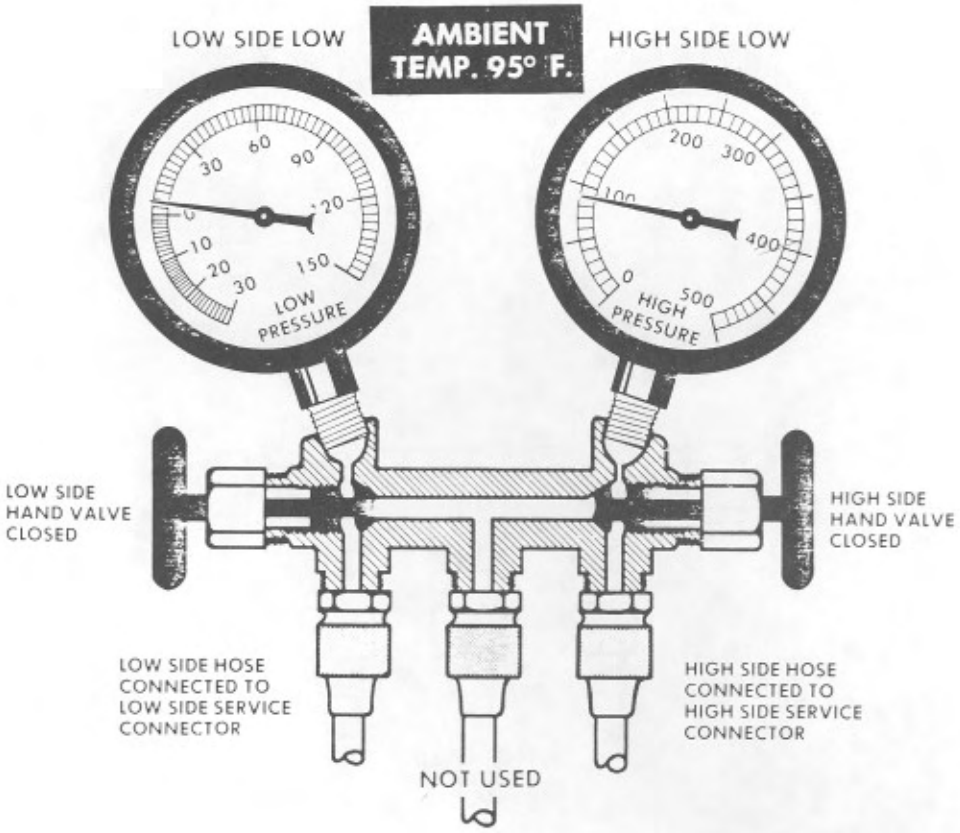
Correction

1. Leak test system.
2. Discharge refrigerant from system if necessary to replace units or lines.
3. Repair leaks.
4. Check compressor oil level. System may have lost oil due to leakage.
5. Evacuate system using vacuum pump.
6. Charge system with NEW Refrigerant-12.
7. Operate system and check performance.

DIAGNOSIS OF A/C SYSTEM

CONDITION 2

REFRIGERANT EXCESSIVELY LOW



Complaint

Cooling is not adequate

Condition

1. Low side gauge reading very low. Should be 15-30 psi.
2. High side gauge reading very low. Should be 185-205 psi at ambient temperature of 95° F. See chart for pressures at other ambient temperature.
3. No liquid and no bubbles visible in sight glass.
4. Discharge air from evaporator is warm.

Diagnosis

System excessively low on refrigerant. Serious leak indicated.

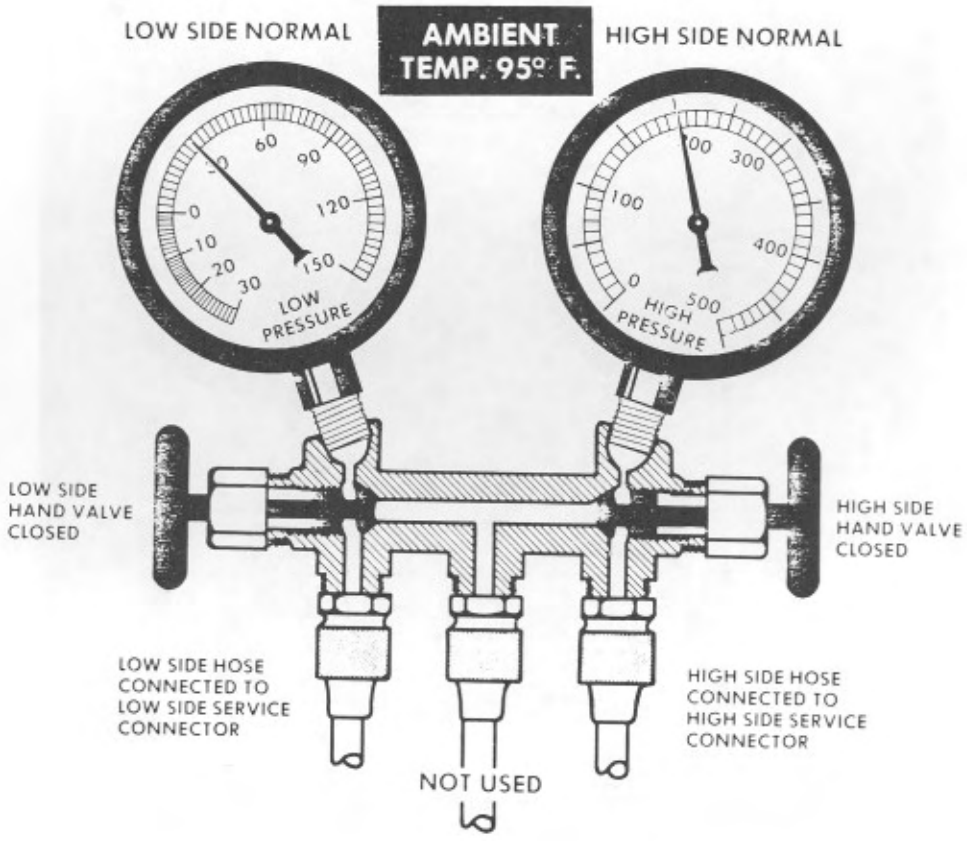
Correction

1. Leak test system.
   NOTE: Add partial refrigerant charge before leak testing to ensure a leak test indication. a). Leak test compressor seal area very carefully. b). On cars with suction throttling valve, valve diaphragm may be leaking.
2. Discharge refrigerant from system.
3. Repair leaks.
4. Check compressor oil level. System may have lost oil due to leakage.
5. Evacuate system using vacuum pump.
6. Charge system with NEW Refrigerant-12.
7. Operate system and check performance.

DIAGNOSIS OF A/C SYSTEM

CONDITION 3

AIR IN SYSTEM



Complaint

Cooling is not adequate

Condition

1. Low side gauge reading is constant and does not drop. Pressure should drop until compressor cycles (thermostat control) or should indicate modulation (suction control).
2. High side gauge reading slightly high (or slightly lower especially if large fan used to substitute ram air). High side gauge reading should be 185-205 psi at ambient temperature of 95° F. See chart for pressures at other ambient temperatures.
3. Sight glass free of bubbles or shows only occasional bubble.
4. Discharge air from evaporator only slightly cool.

Diagnosis

Non-condensables present in system. Air or moisture present instead of full refrigerant charge.

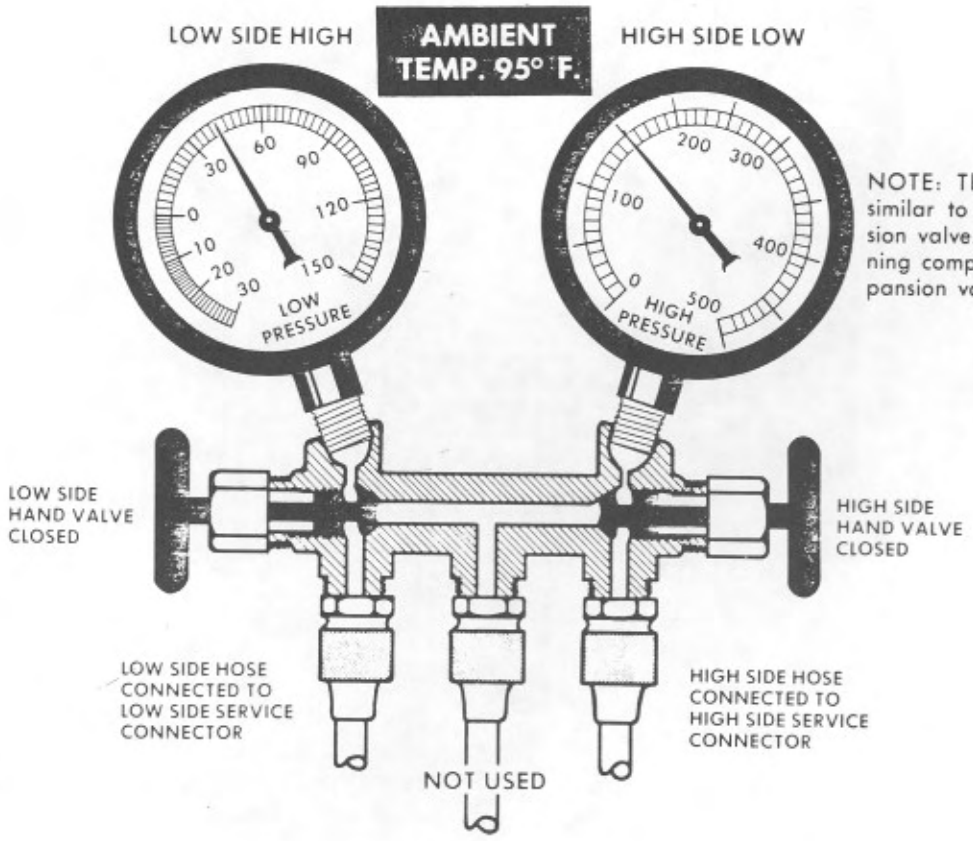
Correction

1. Leak test system.
   a.) Leak test compressor seal area very carefully.
2. Discharge refrigerant from system.
3. Repair leaks as located.
4. Replace Receiver-Drier. Drier probably saturated with moisture.
5. Check compressor oil level.
6. Evacuate system using a vacuum pump, with particular attention to moisture removal from system.
7. Charge system with NEW Refrigerant-12.
8. Operate system and check performance.

DIAGNOSIS OF A/C SYSTEM

CONDITION 4

COMPRESSOR MALFUNCTION



Complaint

Cooling is not adequate.

Condition

1. Low side gauge reading too high. Should be 15-30 psi.
2. High side gauge reading too low. Should be 185-205 psi at temperature of 95° F. See Chart for pressures at other ambient temperatures.
3. Sight glass free of bubbles (system is fully charged).
4. Discharge air from evaporator not sufficiently cool.

Diagnosis

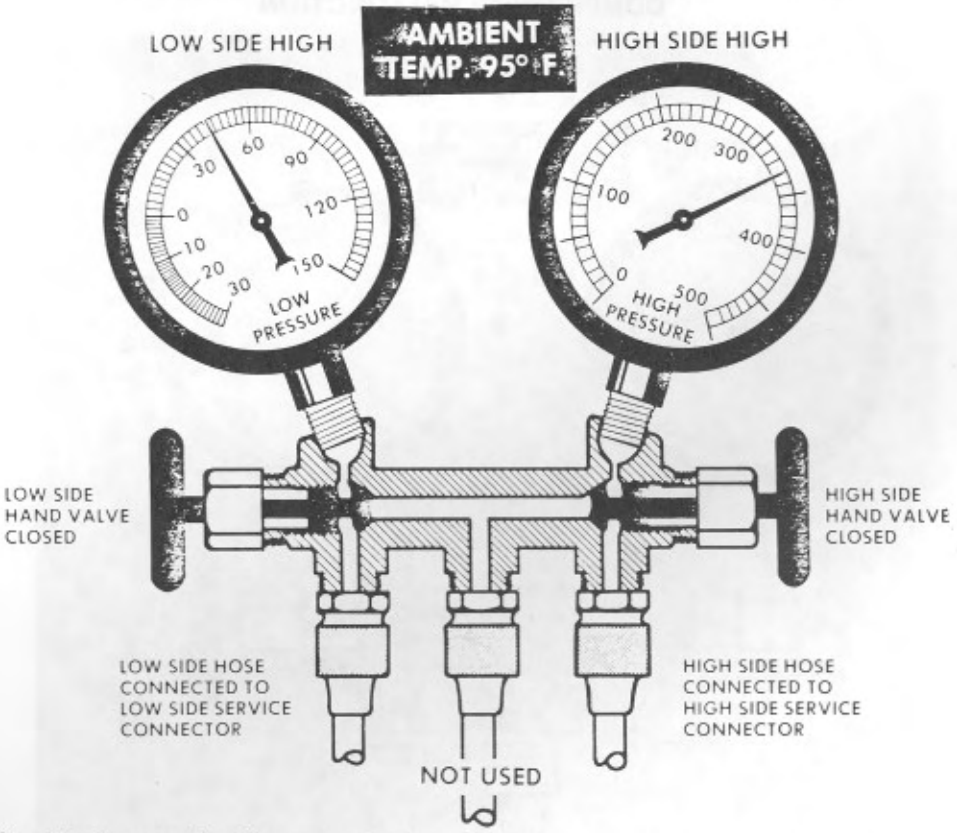
Internal leak in compressor. Reed valves or head gasket leaking. Compressor pistons, rings, or cylinders excessively worn or scored.

Correction

1. Isolate compressor (systems with high and low side service valves) **or** discharge system (systems without service valves).
2. Remove compressor cylinder head and inspect compressor.
   a). replace reed valve plate assembly if necessary.
   b). install cylinder head using NEW gasket.
3. Check compressor oil level.
4. Replace Receiver-Drier if:
   a.) System previously opened.
   b.) System operated two or more seasons with present unit.
   c.) Compressor inspection reveals desiccant particles (very fine golden or brown particles).
5. Evacuate compressor **or** evacuate system (if completely discharged) using vacuum pump.
6. Charge system with NEW Refrigerant-12.
7. Operate system and check performance.

DIAGNOSIS OF A/C SYSTEM

CONDITION 5
CONDENSER MALFUNCTION OR SYSTEM OVERCHARGE



Complaint

Little or no cooling. Engine overheating may also be noted.

Condition

1. Low side gauge reading excessively high. Should be 15-30 psi.
2. High side gauge reading excessively high. Should be 185-205 psi at 95° F. See chart for pressures at other ambient temperatures.
3. Bubbles may appear occasionally in sight glass. Liquid line very hot.
4. Discharge air from evaporator is warm.

Diagnosis

Improper condenser operation with lack of cooling caused by excessive high side pressure. System may have either normal charge or overcharge of refrigerant.

Correction

1. Check for loose or worn drive belts causing excessive compressor head pressures.
2. Inspect condenser for clogged air passages, bug screen, or other obstructions preventing air flow through condenser.
3. Inspect condenser mounting for proper radiator clearance.
4. Inspect clutch type fan for proper operation.
5. Inspect radiator pressure cap for correct type and proper operation.

After making above corrections:

1. Operate system and check performance.

If condition not corrected:

1. Inspect system for overcharge of refrigerant and correct as follows:
   a.) Discharge refrigerant until stream of bubbles appears in sight glass and both high and low gauge readings drop below normal.
   b.) Add new Referigerant-12 until bubbles disappear and pressures are normal, then add 1/4 -1/2 lb. more refrigerant.
2. Operate system and check performance.

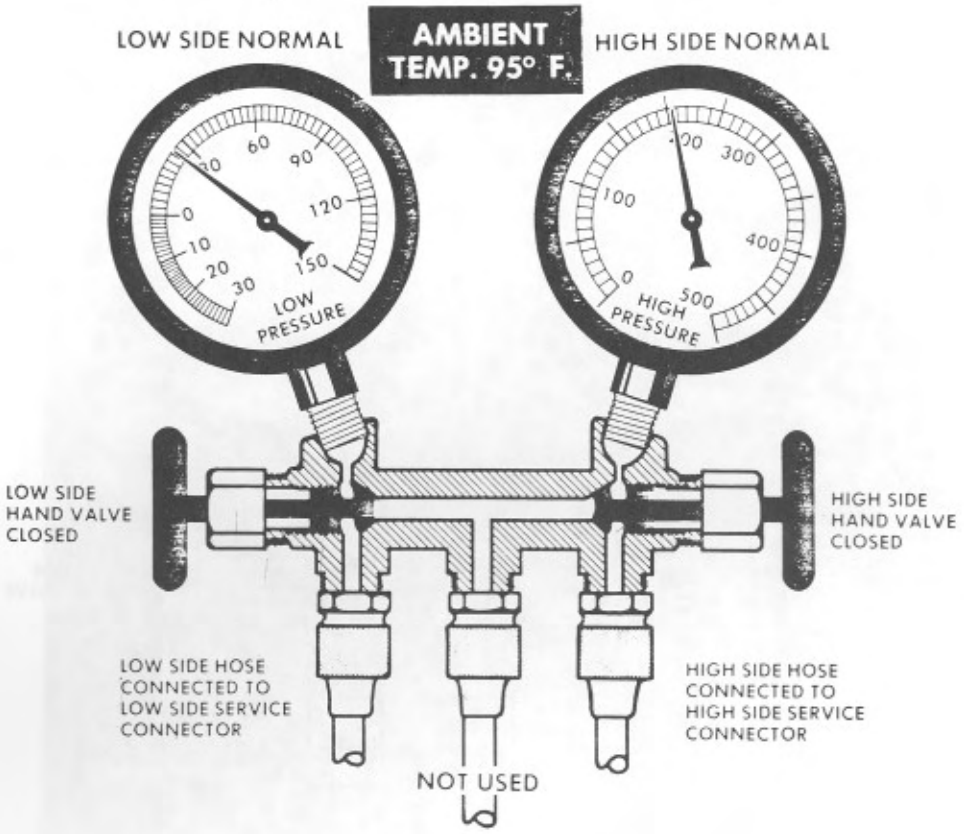
If gauge readings still too high:

1. Discharge system.
2. Remove and inspect condenser for oil clogging. Clean and flush condenser to ensure free passage of refrigerant or replace condenser.
3. Replace Receiver-Drier.
4. Evacuate system using vacuum pump.
5. Charge system with NEW Refrigerant-12.
6. Operate system and check performance.

DIAGNOSIS OF A/C SYSTEM

CONDITION 6

MOISTURE IN SYSTEM



Complaint

Cooling is not adequate during hot part of day.

NOTE: Cooling may be satisfactory during early morning or late evening hours but is not adequate during hot part of the day.

Condition

1. Low side gauge reading normal (15-30 psi) but may drop into vacuum during testing.
2. High side gauge reading normal (205 psi at 95° F) but will drop when low side gauge reading drops into vacuum. See chart for high side gauge reading at other ambient temperatures.
3. Sight glass may show tiny bubbles.
4. Discharge air from evaporator is sharp and cold but becomes warm when low side gauge reading drops into a vacuum.

Diagnosis

Excessive moisture in system. Desiccant agent saturated with moisture which is released during high ambient temperatures. Moisture collects and freezes in expansion valve and stops refrigerant flow.

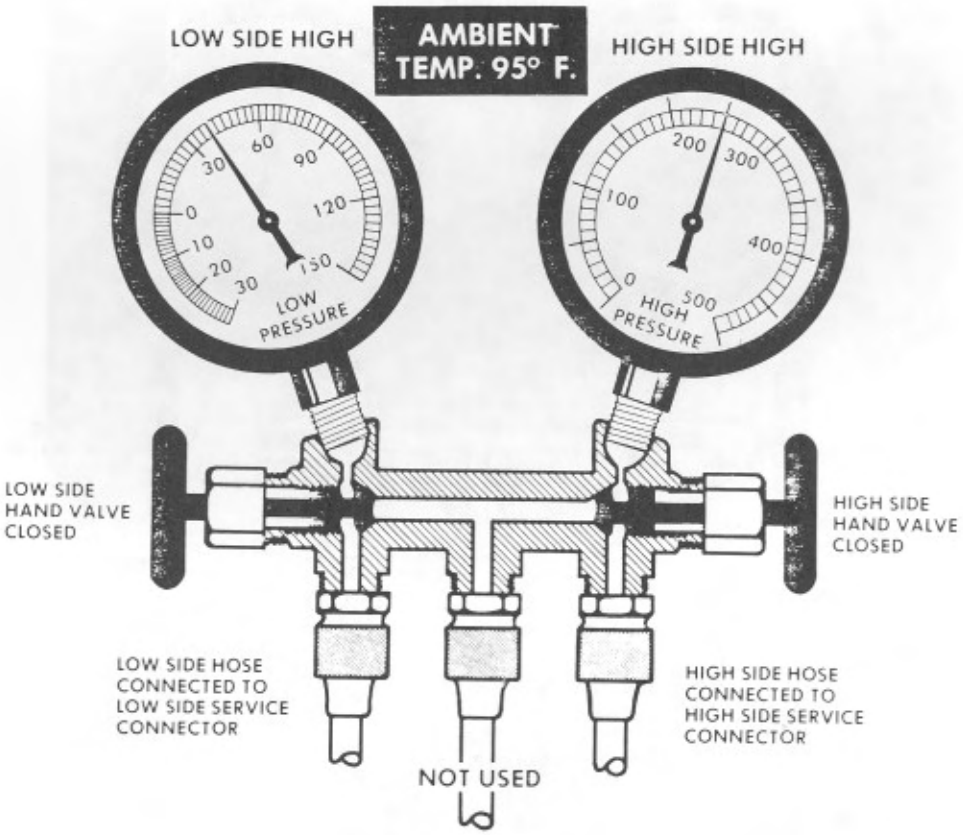
Correction

1. Discharge refrigerant from system.
2. Replace Receiver-Drier.
3. Evacuate system with vacuum pump.
4. Charge system with NEW Refrigerant-12.
5. Operate system and check performance.

DIAGNOSIS OF A/C SYSTEM

CONDITION 7

LARGE AMOUNT OF AIR IN SYSTEM



Complaint

Little or no cooling.

Condition

1. Low side gauge reading too high. Should be 15-30 psi.
2. High side gauge reading too high. Should be 185-205 psi at ambient temperature of 95° F. See chart for pressures at other ambient temperatures.
3. Occasional bubbles evident in sight glass.
4. Discharge air from evaporator is not cool.

Diagnosis

Air in system. Refrigerant contaminated by non-condensables (air and/or moisture).

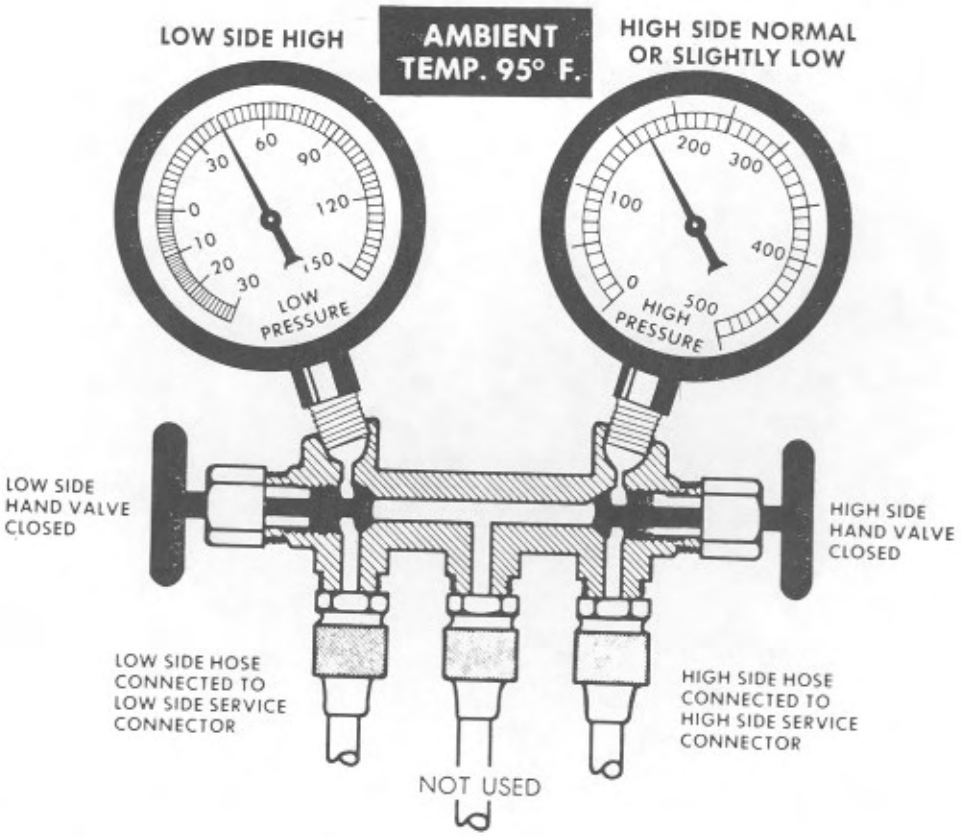
Correction

1. Discharge refrigerant from system.
2. Replace Receiver-Drier which may be saturated with moisture.
3. Evacuate system using vacuum pump.
4. Charge system with NEW Refrigerant-12.
5. Operate system and check performance.

DIAGNOSIS OF A/C SYSTEM

CONDITION 8

THERMOSTATIC EXPANSION VALVE MALFUNCTION (VALVE STUCK OPEN)



Complaint

Little or no cooling.

Condition

1. Low side gauge reading too high. Should be 15-30 psi.
2. High side gauge reading normal or slightly low. Should be 185-205 psi at an ambient temperature of 95° F. See chart for pressures at other ambient temperatures.
3. Discharge air from evaporator warm.
4. Suction hose and evaporator show heavy sweating.

Diagnosis

Expansion valve allowing excessive flow of refrigerant through evaporator causing flooding of evaporator coils.

Testing

1. Check for expansion valve stuck open or incorrect mounting of temperature sensing bulb as follows:
   a.) Set air conditioner for maximum cooling and operate the system.
   b.) Spray liquid Refrigerant-12 on head of valve or capillary bulb; note low side gauge reading. Low side gauge should drop into a vacuum.
   c.) If low side vacuum reading obtained, warm expansion valve diaphragm chamber with hand, then repeat test (Step "b").

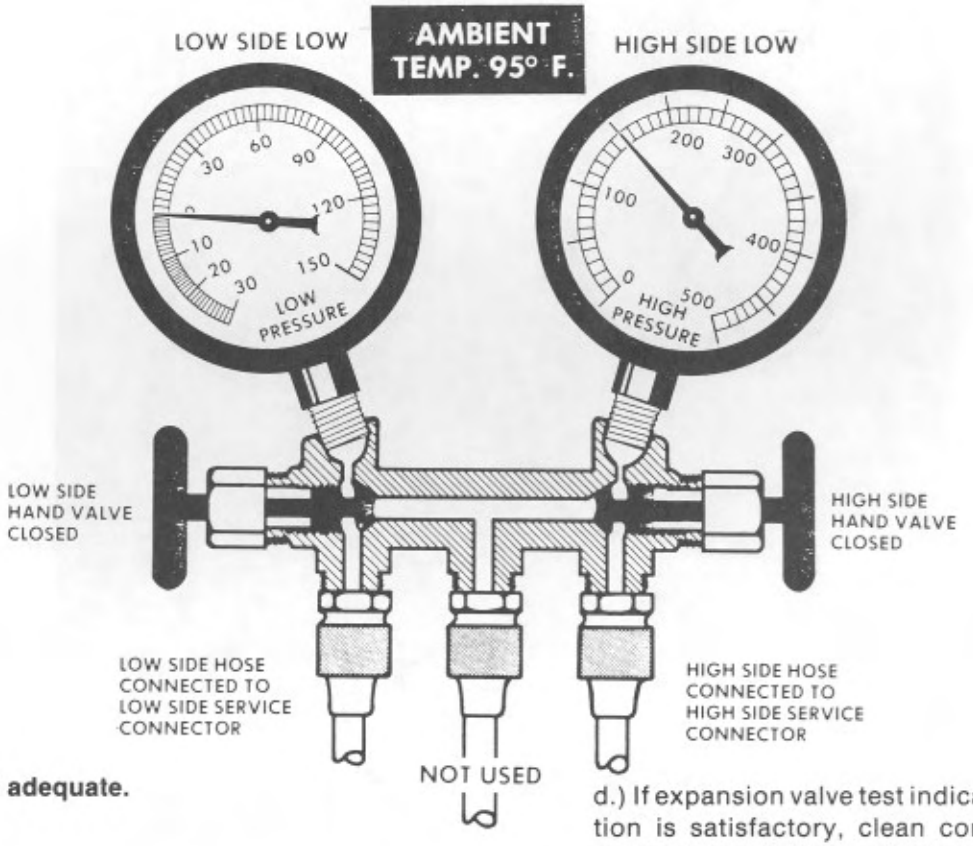
Correction

1. If expansion valve test indicates valve operation is satisfactory, proceed as follows:
   a.) Clean contact surface of evaporator outlet pipe and temperature sensing bulb, clamp bulb securely in contact with pipe.
   b.) Operate system and check performance.
2. If expansion valve test indicates valve is defective, proceed as follows:
   a). Discharge system.
   b). Replace expansion valve.
   c). Evacuate system using vaccum pump.
   d). Charge system with NEW Refrigerant-12.
   e). Operate system and check performance.

DIAGNOSIS OF A/C SYSTEM

CONDITION 9

THERMOSTATIC EXPANSION VALVE MALFUNCTION (VALVE STUCK CLOSED)



Complaint

Cooling is not adequate.

Condition

1. Low side gauge reading too low (0 psi or a vacuum). Should be 15-30 psi.
2. High side gauge reading too low. Should be 185-205 psi at ambient temperature of 95° F. See chart for pressures at other ambient temperatures.
3. Discharge air from evaporator only slightly cool.
4. Expansion valve inlet may shown heavy sweating or frost.

Diagnosis

Expansion valve restricting refrigerant flow due to clogged screen, stuck valve, or temperature sensing bulb having lost its charge.

Testing

1. If expansion valve inlet is cool to touch, proceed as follows:
   a.) Set air conditioner for maximum cooling and operate the system.
   b.) Spray liquid Refrigerant-12 on head of valve or capillary bulb, note low side gauge reading. Low side gauge should drop into a vacuum.
   c.) If low side vacuum reading obtained, warm expansion valve diaphragm chamber with hand, then repeat test (Step "b").
   d.) If expansion valve test indicates valve operation is satisfactory, clean contact surface of evaporator outlet pipe and temperature sensing bulb, clamp bulb securely in contact with pipe. Proceed with correction procedure (below).
2. If expansion valve inlet shows sweating or frost proceed as follows:
   a.) Discharge system.
   b.) Disconnect inlet line at expansion valve, remove and inspect screen.
   c.) Clean and replace screen, reconnect inlet line.
   d.) Proceed with correction procedure (below).
3. If expansion valve test (step "1" preceding) indicates valve is defective, proceed as follows:
   a.) Discharge system.
   b.) Replace expansion valve, then proceed with correction procedure (below).

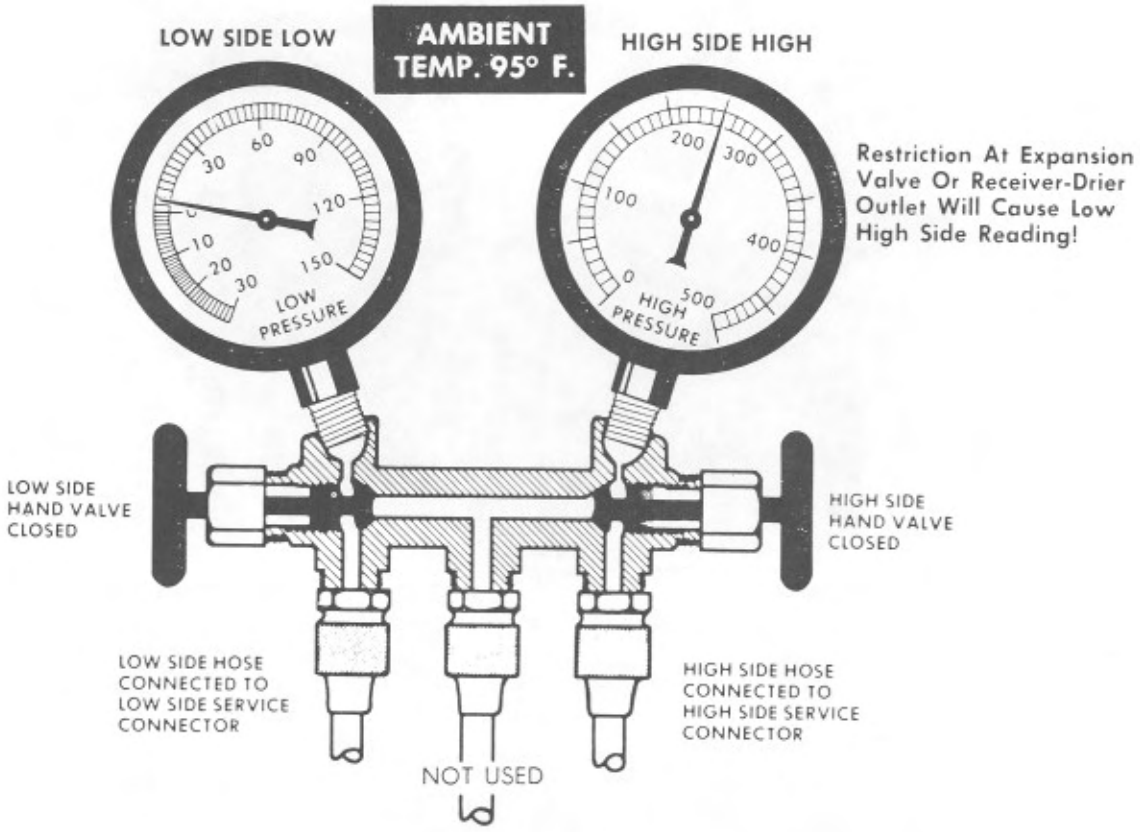
Correction

1. After cleaning expansion valve screen, or replacing expansion valve if necessary, and properly mounting temperature sensing bulb on evaporator outlet pipe, proceed as follows:
   a.) Evacuate system using vacuum pump.
   b.) Charge system with NEW Refrigerant-12.
   c.) Operate system and check performance.

DIAGNOSIS OF A/C SYSTEM

CONDITION 10

RESTRICTION IN HIGH SIDE



Complaint

Cooling is not adequate

Condition

1. Low side gauge reading too low. Should be 15-30 psi.
2. High side gauge reading will build excessively high. Should be 185-205 psi at an ambient temperature of 95° F. See chart for pressures at other ambient temperatures.
   NOTE: An overcharged system, or a Condenser or Receiver-Drier that is too small, will cause high side gauge reading to be normal or excessively high.
3. Discharge air from evaporator only slightly cool.
4. Liquid line cool to the touch; line or Receiver-Drier may show heavy sweating or frost.

Diagnosis

Restriction in Receiver-Drier or liquid line with compressor removing refrigerant from evaporator faster than it can enter resulting in a "starved" evaporator.

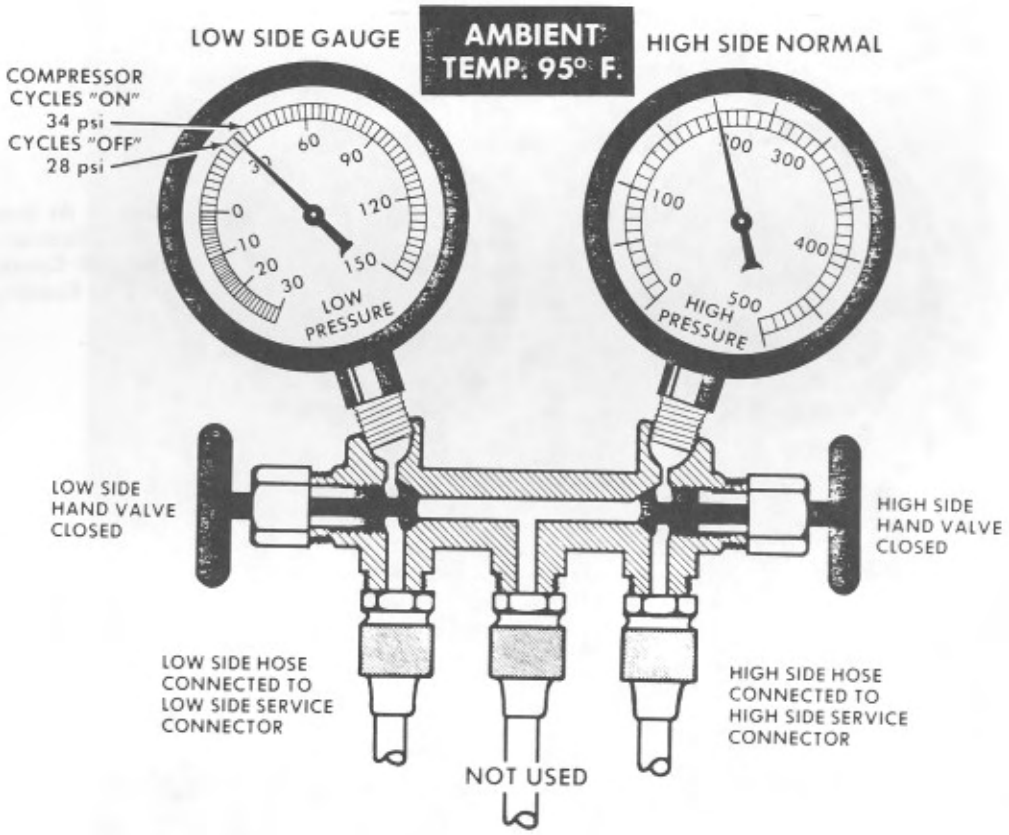
Correction

1. Discharge system.
2. Remove and replace Receiver-Drier, liquid lines, or other defective parts.
3. Evacuate system using vacuum pump.
4. Charge system with NEW Refrigerant 12.
5. Operate system and check performance.

DIAGNOSIS OF A/C SYSTEM

CONDITION 11

DEFECTIVE THERMOSTATIC SWITCH



Complaint

Compressor cycles (cuts in and out) too rapidly.

Condition

1. Low side pressure cycle too high with insufficient range between OFF and ON. Cycle should be:

   Cycle "Off" - 12-15 psi
   Cycle "On" - 36-39 psi.
   Cycle Range - 24-28 psi.

2. High side gauge reading Normal (200 psi). Should be 185-205 psi at ambient temperature of 95° F. See chart for pressures at other ambient temperatures.

Diagnosis

Thermostatic switch defective.

Correction

1. Stop engine and turn air conditioner OFF.
2. Remove and discard old thermostatic switch, install new switch of same type.
3. When installing new Thermostatic Switch, make certain that capillary tube is installed in same position and to same depth in evaporator core as old switch tube.

> **CAUTION**
>
> Do not kink or bend capillary tube sharply (tube is gas filled).

4. Operate system and check performance of new thermostatic switch.

SECTION "Q"

DANA'S ELECTRONIC SPEED CONTROL

Q-1 Operating Instructions
Q-2 Components
Q-8 Electrical Check
Q-11 Troubleshooting
Q-13 Speed Control System Tester & Wire Schematic

OPERATING INSTRUCTIONS

The regulator box of your Speed Control is a safety switch which will not let the system operate until your vehicle is moving above a pre-selected low speed. At the factory this "low speed switch" is set to close between 27 and 33 mph; it should, however, be checked during the Road Test.

The **Control Switch** is the switch you use to operate all features of the system described in the following paragraphs. It is installed near the turn signal lever.

Set Speed - On the control switch, move the slide button to the ON position and drive at any speed above 32 mph at which you want automatic control. Hold that speed with your foot while you press and release the SET/COAST button. One second after release, take your foor off the accelerator pedal.

You can increase speed at any time with the accelerator pedal. When you release the pedal, you will return to the set speed.

Acceleration - Hold the slide button in the RESUME/ACCEL position and your vehicle will accelerate until you release it, then your vehicle will slow to your set speed and again control there.

If you want to make the higher speed your new set speed, release the slide button when you reach the speed you want, and as you do, quickly press and release the SET/COAST button. Remember, you set speed as you release the button - Not when you press it.

Coast - When you press and hold the SET/COAST button, you erase the set speed from the regulator's memory and allow the vehicle to coast. Just before you reach the lower speed you want, release the button and it will control there, providing it is above the low speed setting.

Disengagement - Depress the brake pedal about an inch and you again are in control of the vehicle speed. You can also disengage the Speed Control by pushing the slide button to OFF, but this erases the set speed from the regulator's memory.

Resume - When you disengage the system with the brake, you do not erase the set speed from the regulator's memory, even if you come to a complete stop. To return to your chosen speed, drive to a speed above 32 mph, then move the slide button to the RESUME/ACCEL position and release it. The Speed Control will take you back to your set speed and control there.

If the rate of acceleration is faster or slower than you like, drive with the accelerator to a speed close to the set speed, then slide the button to the RESUME/ACCEL position and release it.

Unusual Conditions - When the regulator is adjusted right, your selected speed should be held within plus or minus 4 mph so long as grades do not exceed 7% (most interstate highways). Since the Speed Control is vacuum operated, this speed range will widen as you drive at higher altitudes.

When you are pulling an extra heavy load, climbing a very steep hill, or bucking a severe head wind, a much wider than normal (throttle) opening is called for.

The way to handle these occasional problems is to bring the vehicle up to speed with the accelerator pedal - then let the Speed Control take over again.

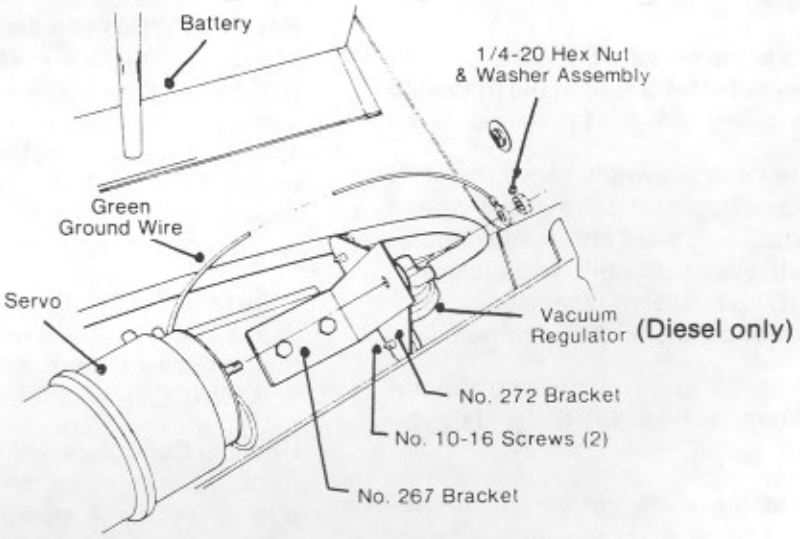
There is no drain on the battery when the ignition switch is off - even if the control switch is left on.

WARNING

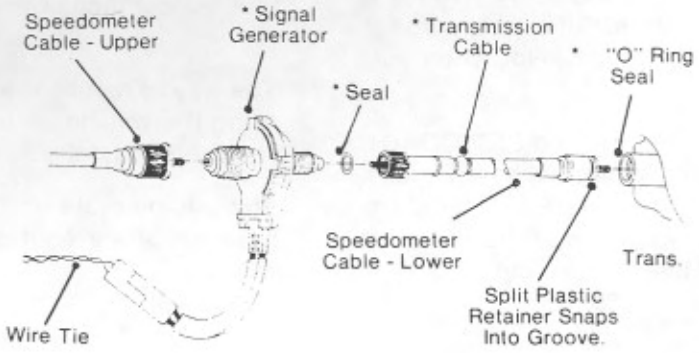
Do not use your Speed Control on slippery roads, nor in heavy traffic.

COMPONENTS

SERVO and VACUUM REGULATOR MOUNTING



SIGNAL GENERATOR



CAUTION

Be **SURE** all square driving members and speedometer cables are properly engaged with their mating counterparts and all cable nuts are tight. "Snap in" type ends must be completely engaged.

COMPONENTS

VACUUM HOSE INSTALLATION

Diesel

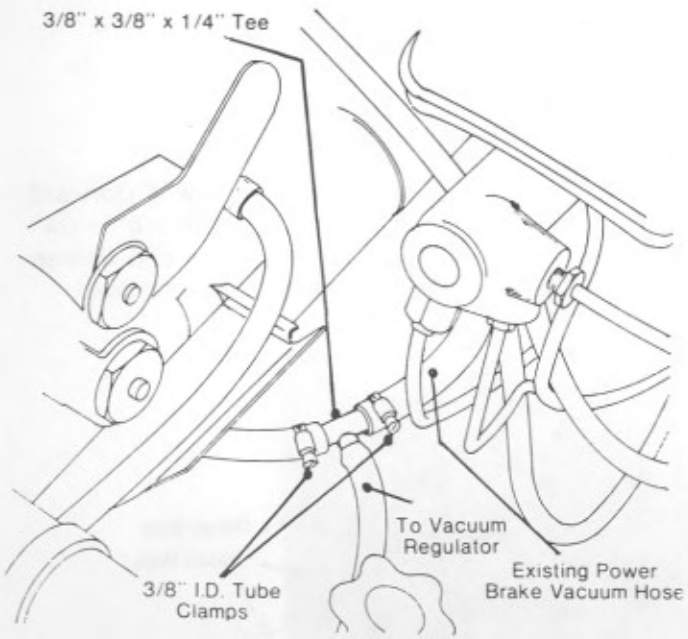
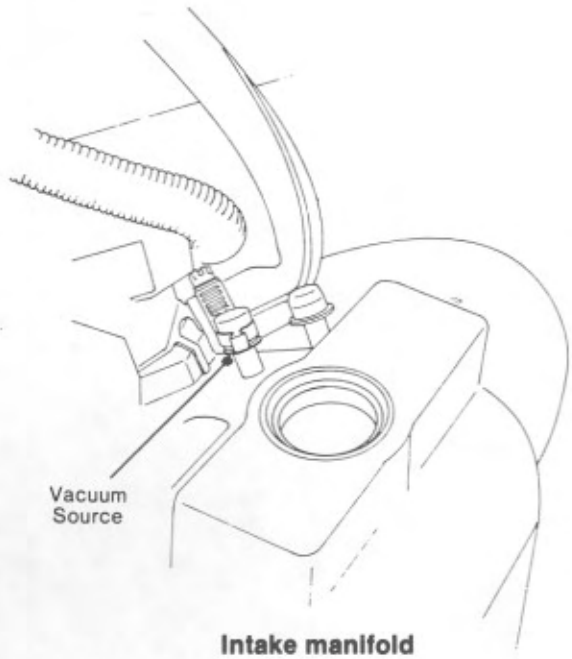


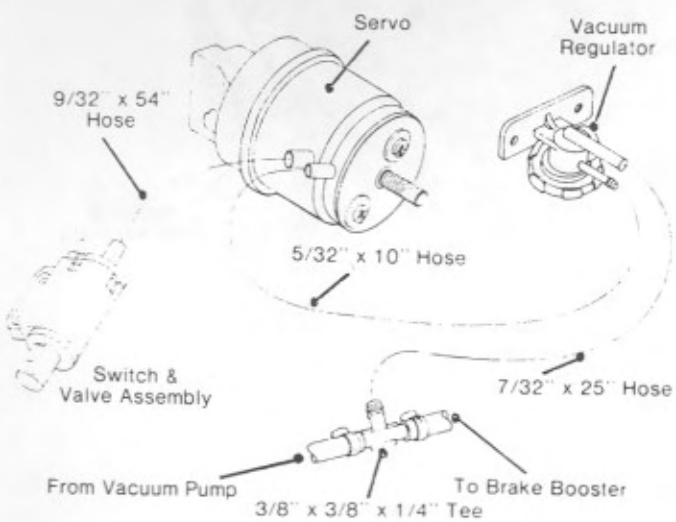
FIGURE 6

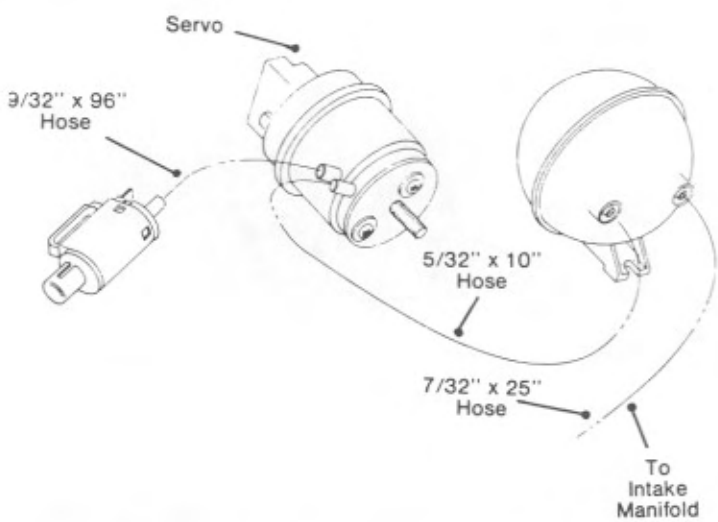
Gas



Intake manifold

5/32" I.D. x 60"large attaches to intake manifold. Locate nipple on top of intake manifold (left hand side of engine).





VACUUM RESERVOIR MOUNTING

The vacuum reservoir is mounted beneath battery bracket. May require removing battery and bracket to locate reservoir.

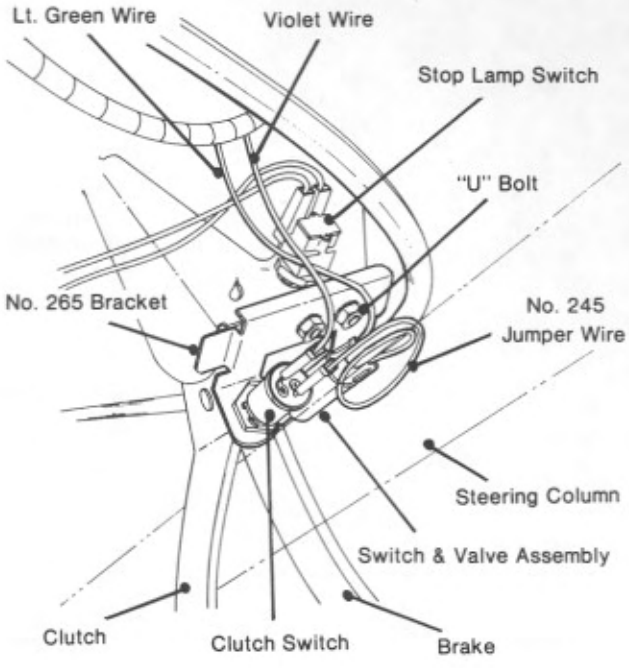
COMPONENTS

DISENGAGE SWITCH AND VALVE ASSEMBLY ADJUSTMENTS

Diesel

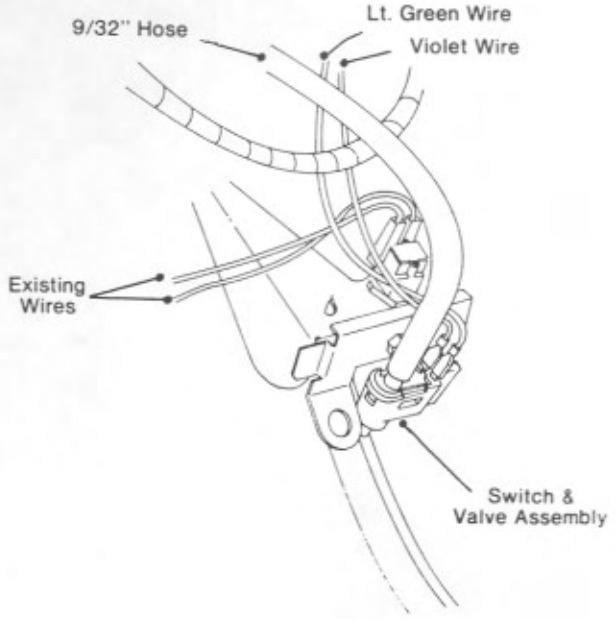
Loosen No. 10 screw in slot and slide switch forward against brake arm until plunger extends 3/8" to 1/4" from switch body. Hold switch there and tighten screw. Switch and vacuum port must be closed.

Adjust clutch switch until plunger extends 1/8" to 1/4" from switch body. Tighten 5/8-18 stamped nuts (Fig. 9).



Gas

Loosen No. 10 screw in slot and slide switch forward against brake arm until plunger extends 3/8" to 1/4" from switch body. Hold switch there and tighten screw. Switch and vacuum port must be closed.

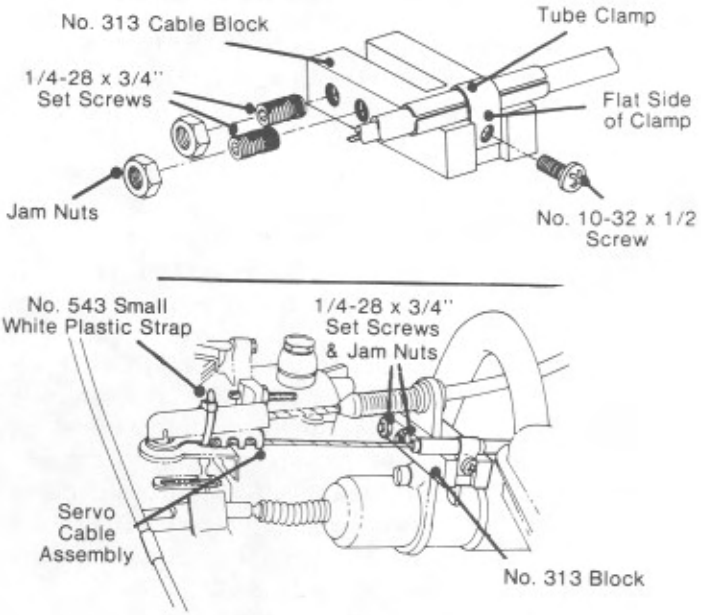


COMPONENTS

SERVO CONNECTION TO THROTTLE ON DIESEL ENGINES

Adjust servo cable so its travel will correspond to travel of throttle cable as follows:

1. Use jumper wires to apply 12 volts from battery to maroon wire and white wire terminals at 4 pin connector of servo harness. Also jump orange wire to vehicle ground.
2. Use blue plastic shipping cap to seal larger vacuum nipple on servo.
3. With hand vacuum pump, apply vacuum to smaller servo nipple until servo reaches its full stroke. Hold vacuum there while you complete Step 4.
4. At block No. 313, pull servo cable through tube clamp until ball stud is at wide open throttle position. While in that position, move split metal sleeve on servo cable so it is centered in tube clamp, then tighten clamp screw.
5. Remove jumper wires, pump and plastic cap.
6. Use small white plastic tie strap to bind end fitting of servo cable to ball socket of throttle cable as shown in Figure 5. Cinch tight and cut off excess.



ADJUSTING AUXILIARY TRANSMISSION KICK-DOWN SWITCH ON GASOLINE ENGINE:

1. Use jumper wires to apply 12 volts from battery to maroon wire and white wire terminals at 4-pin connector of servo harness. Also jump orange wire to vehicle ground.
2. Use blue plastic shipping cap to seal larger vacuum nipple on servo.
3. With hand vacuum pump, apply vacuum to smaller servo nipple until servo reaches its full stroke. Hold vacuum there while you complete Step 4.
   Explanation of Auxiliary Switch: When the Cruise Control is pulling on the throttle, the vehicle's existing trans. kick-down switch cannot be activated because the vehicle's throttle cable is at rest. The switch is activated when cruise cable moves to nearly full end of its travel. The round end of clevis strikes switch lever and closes the contacts of switch to activate kick-down.
4. Switch closure is adjusted by bending the lever of auxiliary trans. kick-down switch. You may have to move servo back and forth a few times to get lever bent. DO NOT ADJUST SO THAT SERVO CABLE CLEVIS KEEPS pushing on switch lever after switch activated to close contacts and overtravel of switch is used up. The servo travel must come to a stop before switch lever bottoms out.
5. Remove jumper wires, pump and plastic cap.
6. Using Harness Assembly P/N 59B-02494, connect auxiliary switch to existing trans. kick-down switch (located at firewall, it is part of the vehicle accelerator cable assembly.) Unplug vehicle's existing harness and insert Harness Assembly 59B-02494 as shown, Fig. 5.

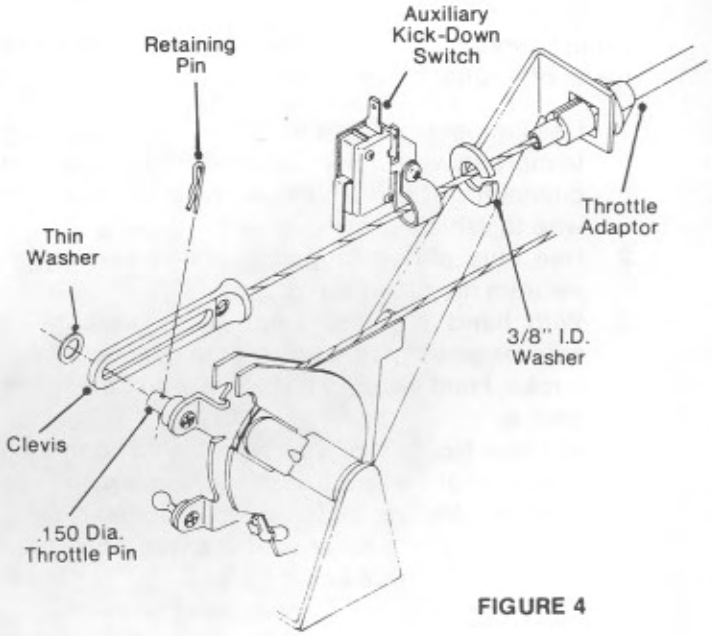


FIGURE 4

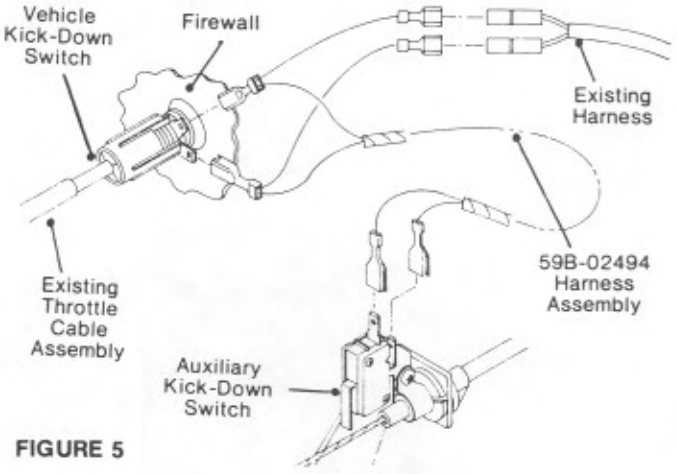
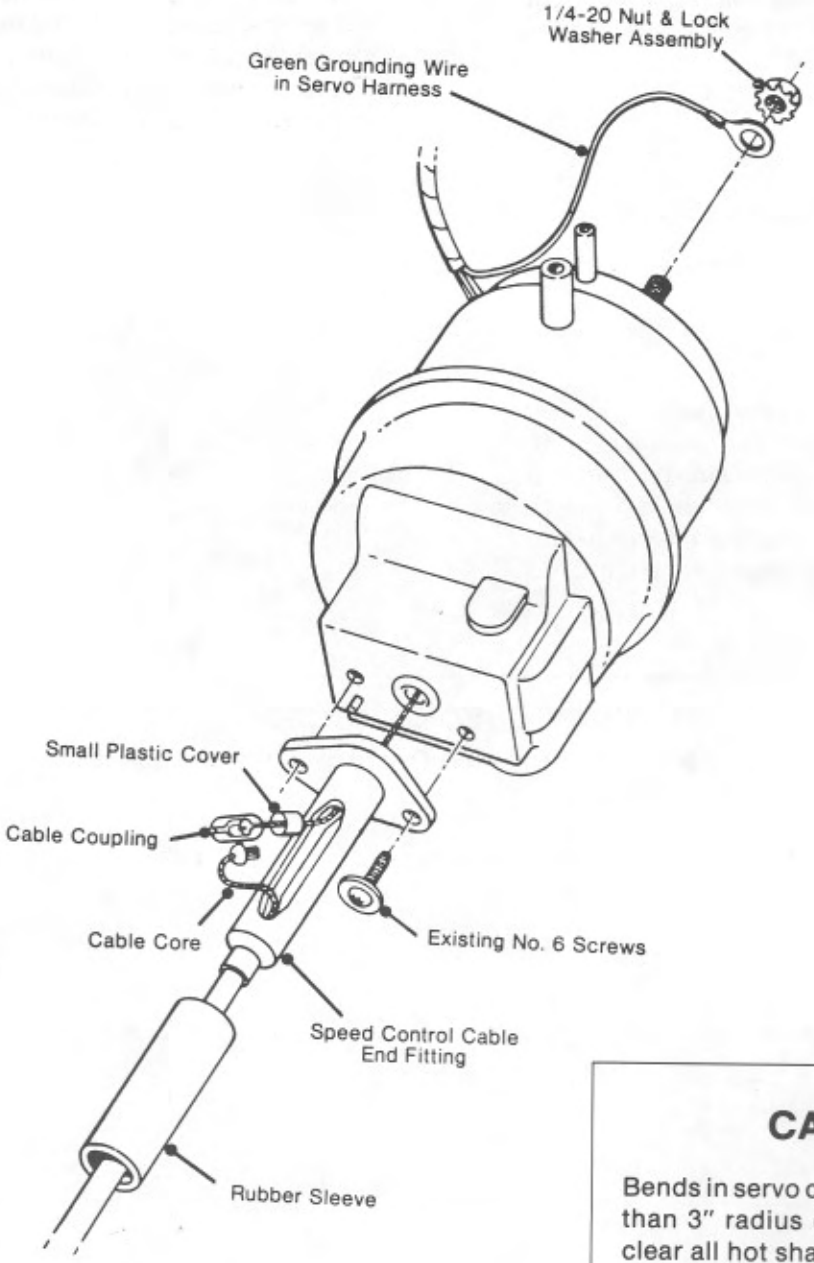


FIGURE 5

COMPONENTS

SHOULD IT BECOME NECESSARY TO REPLACE SPEED CONTROL CABLE, USE THIS PROCEDURE



CAUTION

Bends in servo cable should be no smaller than 3" radius (6" dia.), and cable must clear all hot sharp, or moving parts.

A. To remove old cable, slide rubber sleeve off cable end fitting so slots are exposed.

B. Slide small plastic cover off coupling and onto servo coupling cable. Use side cutter pliers or small screwdriver to spread coupling. Remove core end of old cable from coupling.

C. Remove and retain two No. 6 screw and washer assemblies attaching cable end fitting to servo.

D. Thread servo coupling cable into end fitting of new Speed Control cable and out through slot. Attach cable to servo with two screws retained.

E. Put core end of cable in coupling and squeese it closed with pliers. Slide small plastic sleeve back onto coupling.

F. From other end of cable, pull all slack from cable core and slide rubber sleeve back into place over end fitting slots.

ELECTRICAL CHECK

A. A test light or volt-ohmeter is needed to perform these checks. If you have neither, a test light can be made as shown in Fig. 10.

HOMEMADE TEST LIGHT

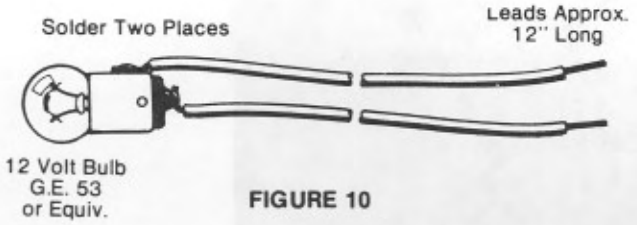
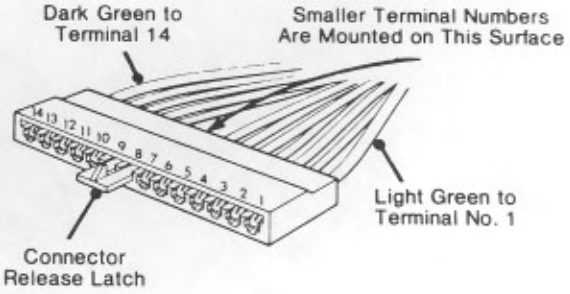


FIGURE 10

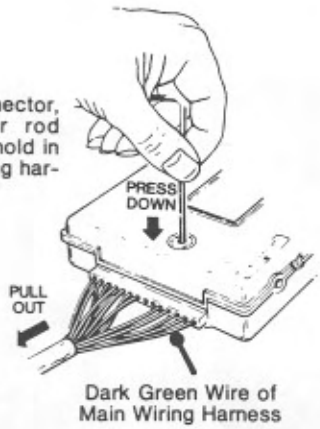
B. There is available from your dealer, a Speed Control System Tester which will quickly indicate any problem area. The Dana part number is 56L-08X29-B. More information is given on pages Q10 to Q14. If attaching the connector to the tester, the dark green wire and Light No. 1 are at the same end.

C. To make this check, the 14-pin connector must be disconnected from the electronic regulator. If it has already been connected Figure 11 shows how to unplug it. The terminal numbers are very small and are molded on the wire side of the connector. Wire colors for the system are shown on page Q13 and Q14.



ELECTRICAL CHECK PROCEDURE
Use a 12-volt Test Light To Perform These Checks

CONDITION	POSSIBLE CAUSE	REMEDY
Ignition Switch OFF. Control Switch ON. Ground one lead of test light, touch other lead to each terminal of connector individually.	Light OFF, all terminals	None, system O.K.
	Test light ON at terminals 5, 7, and 14	Red fused wire connected to wrong power source. Use a "switched" power source at fuse block. Test light should be "ON" when ignition switch is "ON" and "OFF" when ignition switch is "OFF".
Ignition Switch On. Control Switch ON. Ground one test light lead. Touch other lead to each terminal of connector individually.	Test light ON at terminals 5, 7, and 14 only	None, system O.K.
	No light on any terminal	Replace fuse, if blown. Connect red wire to ignition switched power source.
Ignition Switch ON. Control Switch ON. Ground one test light lead. Press and hold SET SPEED button and touch other test lead to terminal 14.	Test light OFF at terminal 14.	None, system O.K.
	Test light ON at terminal 14.	See Trouble Shooting Guide - Control Switch.
Ignition Switch ON. Control Switch ON. Ground one test light lead. Press and hold. Slide switch to RESUME while touching other lead to terminal 10 and 14 individually.	Test light ON at terminal 10 and 14.	None, system O.K.
	No light at terminal 10 and/or 14.	See Trouble Shooting Guide - Control Switch.
Ignition Switch ON. Control Switch ON. Touch one test light lead to terminal No. 5 and other lead to terminal No. 13.	Test light ON; push brake and test light goes OFF.	None, system O.K.
	Test light OFF.	Adjust disengagement switch. Plunger travel to get test light ON; OFF when brake or clutch pedal is pushed. Ground green servo wire with eyelet terminal. Check light green wire connections.



To unplug 14-terminal connector, press small screwdriver or rod through TERMINAL-RELEASE hold in regulator while pulling on wiring harness connector.

FIGURE 11

NOTE: Electronic Regulator is located behind the dash gauge cluster assembly.

D. When electrical check is done, turn ignition Off. To connect 14-terminal connector, hold electronic regulator with RELEASE hole up. Hold connector so dark green wire is to your right. Start one end in first with release latch under circuit board in regulator, then push firmly into place. Let electronic regulator hang down for now because it must be adjusted during road test.

PRELIMINARY OPERATIONAL CHECK

Electonic Regulator Check

A. Set parking brake hard, put shift lever in "park" and start engine.

B. Keep one hand on ignition key and with other hand push slide button on control switch to ON position.

C. Press and hold SET/COAST button for two or three seconds, then release it. The system should NOT engage. If it does (indicated by engine racing faster than cold idle), turn off ignition switch immediately. If system passed electrical check above, and in this check, engine did not race until SET/COAST button was pressed, electronic regulator must be replaced.

Vacuum Check

D. Run engine at idle, unplug hose from small servo fitting, and put your finger over end. You should feel a strong suction. If you do, put hose back on servo fitting. If not, check hose and/or replace vacuum regulator.

ROAD TEST

For Electrical Regulator Adjustments

NOTE: The adjustments on the Electronic Regulator (Low Speed Switch, Centering, and Sensitivity) are set nearly correct at the factory. However, the electronic regulator can be adjusted if necessary. Full adjustment range is 3/4 of a turn. DO NOT force beyond stops. A small screwdriver may be inserted through the appropriate hole to engage the adjusting slot.

WARNING

To insure driving safety, a passenger should accompany the driver to make adjustments.

A. Low Speed Switch Adjustment

1. Start vehicle and make ready for the road.
2. Move slide button to ON position. Drive at about 45 mph. Press and release SET/-COAST button to activate the system. Apply brake and reduce speed to about 18 mph.
3. Move slide button to RESUME/ACCEL position and hold it. Accelerate slowly, noting speed at which accelerator pulls away from your foot. This is the LOW SPEED switch setting. It should be within the range of 27-33 mph. If it is not, adjust the "Low Speed SW ADJ" on the electronic regulator.
4. Turn clockwise to increase the setting, or counterclockwise to decrease setting.

B. Centering Adjustment

1. Move slide button to ON position.
2. On a level road drive at about 45 mph then push and release the SET/COAST button. The system should engage, and the speed should be within 2 mph of your selected speed. If it is not, adjust the "CENTERING ADJ" on the electronic regulator.
3. Turn clockwise if the speed decreased, or counterclockwise if the speed increased. Make these adjustments in small steps.

C. SENSITIVITY ADJUSTMENT

The "SENSITIVITY ADJ" is set at the factory. No further adjustment is required. It should be set to full clockwise position.

D. Final Test

After adjustments have been made, use all the features of the system - Set Speed, Coast, Resume, Accelerate - and move slide button to "Off". If everything checks satisfactorily, you are done with the road test. If it does not, see the Troubleshooting Guide.

TROUBLE SHOOTING GUIDE

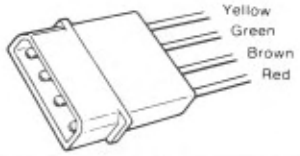
CONDITION	POSSIBLE CAUSE	REMEDY
Does not operate "ON-OFF" switch "ON" **NOTE:** System will not engage if vehicle is not moving faster than the **low speed setting.**	No voltage at either brown wire of 14 pin connector, main wiring harness.	Check for correct power source, blown fuse, broken red wire, broken brown wire(s) or loose connections. Replace, repair, or tighten.
	Poor electrical ground connection at servo and/or servo bracket.	Check light green wire & its eyelet terminal. Tighten "servo-to-bracket" nut. Tighten "bracket-to-body" screws (this is part of electrical ground return circuit).
	Disengagement Switch, Valve Assembly and Electrical Switch improperly adjusted. Switch **"open"** valve **"open".**	Adjust switch. Must be **"closed"** when brake pedal is released.
	Restricted vacuum or no vacuum	Check for pinched or disconnected vacuum hoses.
	Leaking vacuum regulator. (Check vacuum at small fitting).	Replace vacuum regulator.
	Electrical	**See "Electrical Check",**
	In-line **fuse blown,** red wire	Check for short(s). Replace fuse (5 amp max.)
	Control Switch faulty.	Replace Control Switch. For Control Switch check, see end of "Trouble Shooting", "Control Switch".
	Signal Generator faulty. No continuity between blue wire & grey wire.	Replace Signal Generator. See "Signal Generator".
	At **regulator,** electrical terminals in 14-pin connector of main wiring harness **not** making good contact with printed circuit board in regulator.	Bend contacts up slightly with small sharp probe. Must be **above** small plastic separators of main wiring harness 14-pin connector body.
	Low speed switch set too high.	Turn **"low speed switch adj"** c'clockwise. See "Road Test".
	Servo cable not connected.	Check cable connections at servo and at throttle.
	Electronic regulator faulty.	Replace electronic regulator.
Engine accelerates when started	No clearance at carburetor end of servo cable	Adjust slack at fuel rack lever.
	Servo faulty.	Replace servo
Vehicle continues to accelerate after depressing and releasing **"SET/COAST"** button	Servo faulty.	Replace Servo
	Electronic regulator faulty.	Replace electronic regulator.
"RESUME/ACCEL" inoperative	Poor electrical ground connection at servo and/or servo bracket.	Check light green wire & its eyelet terminal. Tighten "servo-to-bracket" nut. Tighten "bracket-to-body" screws. (This is part of electrical ground return circuit.)
	Control Switch faulty.	Replace Control Switch. For Control Switch Check, see end of "Trouble Shooting". "Control Switch".
Does **NOT** disengage when brake pedal is depressed.	**Disengagement Switch, Valve Assembly** and **Electrical Switch** improperly adjusted; switch **"CLOSED"**, valve **"CLOSED"** when brake pedal or clutch is depressed.	Adjust switch. Must be "OPEN" when brake pedal is depressed.
	Servo cable kinked or binding.	Replace servo cable.
	Servo faulty.	Replace servo
System in use, brake pedal depressed, system disengages. Then release brake pedal and system re-engages.	Disengagement switch and Valve Assembly or Electrical Switch faulty **(electrical portion only).**	Replace switch and valve assembly.
	Electronic regulator faulty.	Replace electronic regulator.

TROUBLE SHOOTING GUIDE (Cont.)

CONDITION	POSSIBLE CAUSE	REMEDY
"Resume" does **not** cancel when ignition switch is turned off.	Wrong power source. Power supply is always on.	Select 12 volt power source for fused red wire which is "hot" when ignition switch is **"ON"** and **"COLD"** (no voltage) when ignition switch is **"OFF".**
Fuel rack does not return to normal idle.	No clearance at fuel rack end of servo cable.	Adjust slack at fuel rack lever.
	Improper vehicle accelerator linkage adjustment.	Adjust vehicle accelerator linkage.
	Weak or disconnected vehicle throttle return spring(s).	Replace or connect vehicle throttle return spring(s).
Vehicle speed increases or decreases more than 2 miles per hour when setting speed with "SET/COAST" button.	**"Centering Adj."** improperly set.	Adjust **"Centering Adj."** at electronic regulator.
Erratic operation or surging of Speed Control	Loose speedometer cable nut and/or loose double hexagon adaptor at **Signal Generator.**	Tighten cable nut and/or adaptor. See "Signal Generator".
	Bent drive tip(s), kinked or worn (relaxed) speedometer cable core.	Replace Speedometer cable. See "Signal Generator".
	Servo faulty.	Replace Servo.
	Electronic regulator faulty.	Replace Electronic Regulator.
System disengages on level road without depressing brake pedal.	Loose wiring connections.	Tighten connections, especially at all plastic connector bodies of wiring harness(s).
	Loose or leaky vacuum connections.	Tighten connections.
	Disengagement Switch, Valve Assembly or **Electrical Switch** not adjusted correctly.	Adjust switch. Must be **"Closed"** when brake pedal is released.
	Vacuum leak at **valve** of disengagement switch & valve assembly, or leak(s) in large hose.	Adjust or replace switch. Must be **"Closed"** when brake pedal is released. Repair or replace hose.
System engages but loses speed; then slowly returns to **"SET SPEED"** selected.	Poor electrical ground connection at servo and/or servo bracket.	Check light green wire & its eyelet terminal. Tighten "servo-to-bracket" nut. Tighten "bracket-to-body" screws. (This is part of electrical ground return circuit).
After system has been used and working for some time, **Speed Control** operation ceases. **Speedometer** may be inoperative.	Square adaptor key broken.	Replace square adaptor key. See Signal Generator.

CONTROL SWITCH

Use 12 volt test light and jumper wire. Disconnect **Control Switch** at flat, 4-wire harness connector. Connect jumper wire from 12 volt power source to red wire terminal of **Control Switch.**

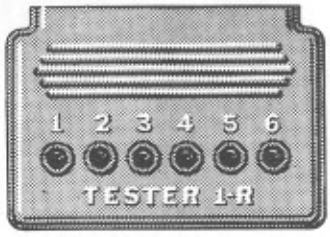


TEST CONDITION	WIRE COLOR	LIGHT SWITCH O.K.	LIGHT REPLACE SWITCH
Slide switch **OFF,** ground one test light lead, touch other test lead in turn, to terminal of:	Brown	OFF	ON
	Green	OFF	ON
	Yellow	OFF	ON
Slide switch **ON,** ground one test light lead, touch other test lead in turn, to terminal of:	Brown	ON	OFF
	Yellow	ON	OFF
	Yellow	OFF	ON
Slide switch **ON**, hold **"SET/COAST"** button in. Ground one test light lead, touch other test lead in turn, to terminal of:	Brown	ON	OFF
	Green	OFF	ON
	Yellow	ON	OFF
Press and hold **"RESUME/ACCEL"** slide Ground one test light lead, touch other test lead in turn, to terminal of:	Brown	ON	OFF
	Green	ON	OFF
	Yellow	ON	OFF

THIS PROCEDURE FOR TESTING DIESEL UNIT SYSTEMS WITH GREY OR BROWN BOX REGULATOR

SPEED CONTROL SYSTEM TESTER

EACH LIGHT CHECKS THE FOLLOWING



LIGHT 1

Power Source, Fuse and Ground, "On-Off" and "Set/Coast" Position of Control Switch, and Associated Wiring Terminals and Connectors.

LIGHT 2

Signal Generator and Associated Wiring Harness Terminals and Connectors.

LIGHT 3

Disengagement Switch Adjustment and Associated Wiring Harness Terminals and Connectors.

LIGHT 4

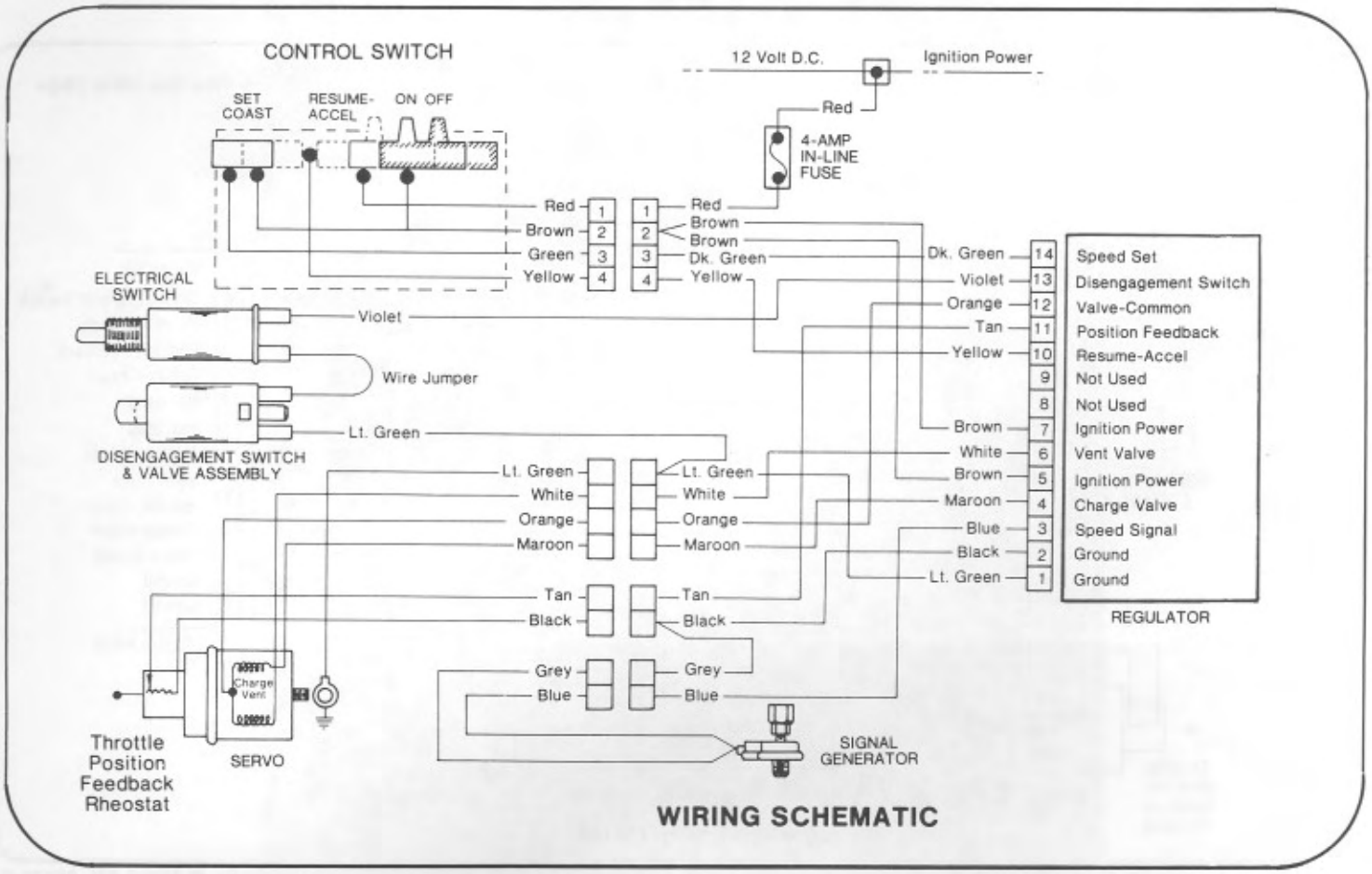
Throttle Position Feedback and Associated Wiring Harness Terminals and Connectors

LIGHT 5

Servo Vent Valve, "Resume" Contacts in the Control Switch and Associated Wiring Harness Terminals and Connectors.

LIGHT 6

Servo Charge Valve "Resume/Accel" Contact of the Control Switch and Associated Wiring Harness Terminals and Connectors.



WIRING SCHEMATIC

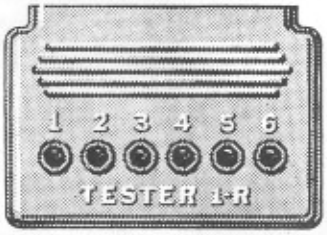
THE TESTER IS AVAILABLE THROUGH YOUR DEALER

DANA PART NUMBER 56L-08X29-B

THIS PROCEDURE FOR TESTING E.F.I. GAS UNIT SYSTEMS WITH GREY OR BROWN BOX REGULATOR

SPEED CONTROL SYSTEM TESTER

EACH LIGHT CHECKS THE FOLLOWING



LIGHT 1

Power Source, Fuse and Ground, "On-Off" and "Set/Coast" Position of Control Switch, and Associated Wiring Terminals and Connectors.

LIGHT 2

Signal Generator and Associated Wiring Harness Terminals and Connectors.

LIGHT 3

Disengagement Switch Adjustment and Associated Wiring Harness Terminals and Connectors.

LIGHT 6

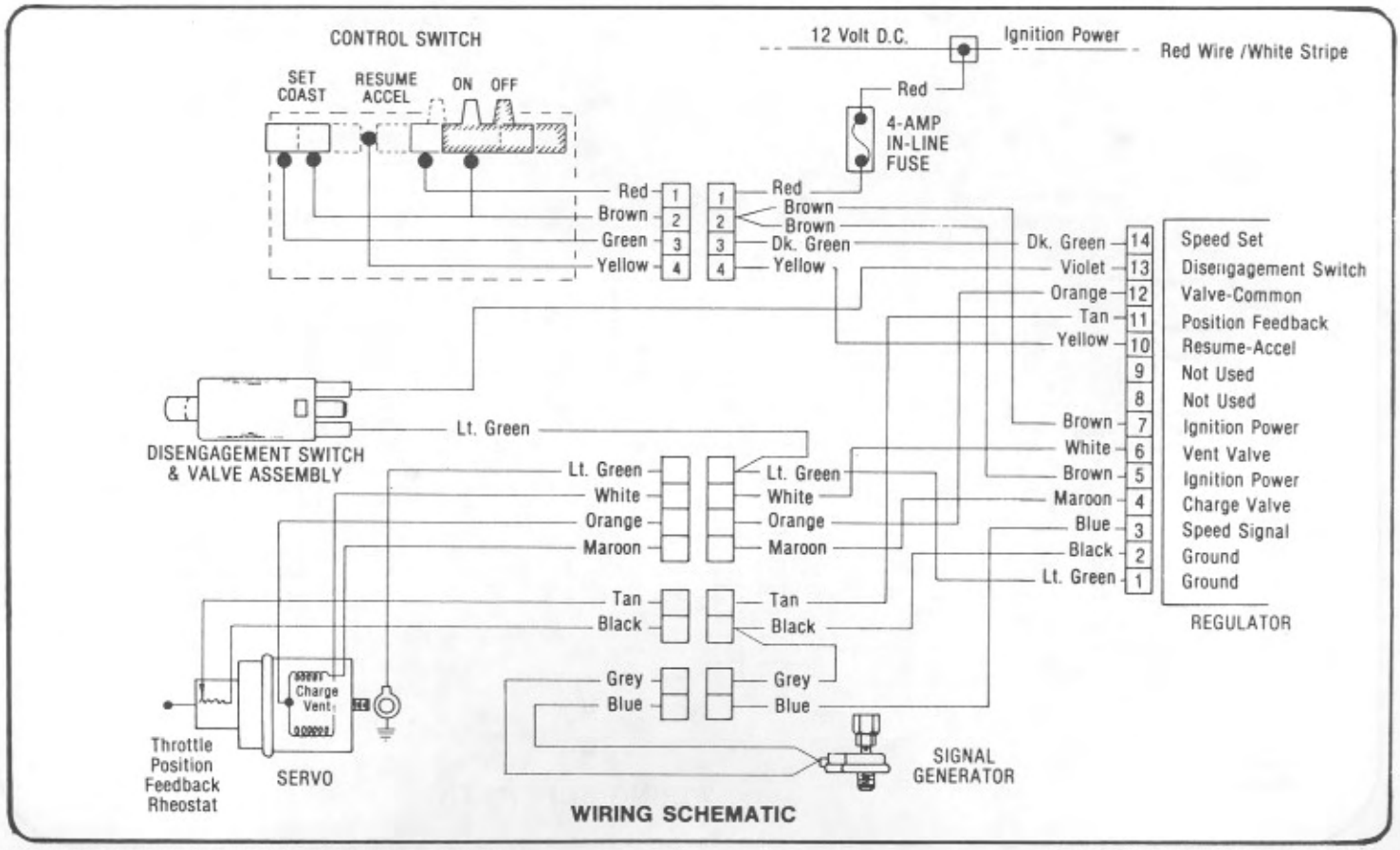
Servo Charge Valve "Resume/Accel" Contact of the Control Switch and Associated Wiring Harness Terminals and Connectors.

LIGHT 5

Servo Vent Valve, "Resume" Contacts in the Control Switch and Associated Wiring Harness Terminals and Connectors.

LIGHT 4

Throttle Position Feedback and Associated Wiring Harness Terminals and Connectors



WIRING SCHEMATIC

THE TESTER IS AVAILABLE THROUGH YOUR DEALER

DANA PART NUMBER 56L-08X29-B

To Test, Disconnect Harness From Regulator and Connect To Tester

Test No. and Condition	Correct Response	Trouble Shooting For Incorrect Response
1. *Correct Power Source:* Ignition Switch "Off" Control Switch "On"	***ALL LIGHTS OFF***	***ANY LIGHT ON DURING TEST NO. 1*** Red Wire Connected Directly To Constant Power Source
2. *System's Electrical Continuity:* Ignition Switch "On" Control Switch "On"	***LIGHTS*** ON — OFF 1,2,3,&4 — 5&6	***These Are Checks To Make For Incorrect Lights in Tests 2 Thru 5. Replace Components if Necessary.*** ***ALL LIGHTS OFF*** - Check Red Wire Fuse. Check Light Green Wire Ground. ***LIGHT 1 OFF*** - Check Red, Brown and Green Wires, and Terminal at Control Switch Connectors. Check Dark Green Wire (No. 14) at 14-Pin Connector. Check all Light Green Connections between 14-Pin Connector and Servo. ***LIGHT 2 OFF*** - Check Continuity between Blue and Grey Wires of Signal Generator Harness. Check Light Green Wire Connections between 14-Pin Connector and Servo, and Connections of Black, Blue, Brown (No. 5) and Grey Wires in Main Wiring Harness. ***LIGHT 3 OFF*** - Check Disengagement Switch Adjustment. Check No. 7 Brown Wire at 14-Pin Connector. Check both Violet Wire Connections and All Light Green Wire Connections between Disengagement Switch and Servo. ***LIGHT 4 OFF*** - Check Continuity between Black and Tan Wires of Servo Harness. Check Light Green Wire Connections between 14-Pin Connector and Servo. Check Connections of Black and Tan Wires in Main Wiring Harness. ***LIGHT 5 OFF*** - Check Continuity between Orange and White Wires in Servo Harness. Check All Connections of White, Yellow and Orange Wires in Main Wiring Harness. ***LIGHT 6 OFF*** - Check Continuity between Orange and Maroon Wires in Servo Harness. Check All Connections of Maroon, Yellow and Orange Wires in Main Wiring Harness. ***ALL LIGHTS OFF*** - After Pushing "SET/COAST" or "RESUME/ACCEL" in Tests 4, 5, or 6; Blown Fuse, Maroon or White Wires Shorted; Bad Servo.
3. *Disengagement Switch Continuity:* Ignition Switch "On" Control Switch "On" Push and Hold Brake Pedal	***LIGHTS*** ON — OFF 1,2,&4 — 3,5,&6 Release Brake Pedal and Light 3 Will Go "On"	
4. *Servo Continuity:* Ignition Switch "On" Control Switch "On" Push and Hold Set/Coast Button	***LIGHTS*** ON — OFF 2,3,4,5&6 — 1	
5. *Control Switch Contact Check:* Ignition Switch "On" Control Switch "On" Slide and Hold ON-OFF Switch to "Resume/Accel"	***ALL LIGHTS - ON***	
6. *Start Engine* Momentarily Hold SET/COAST Button In and **Release It When Engine Starts to Race**	Engine Should Run in a Normal Manner Rack Will Open Quickly and Light 4 Will Dim	***IF THROTTLE DOES NOT OPEN,*** Check Connection of Servo Cable to Servo and Servo Cable to Fuel Rack Lever, Check Adjustment of Disengagement Switch; Check Attachment at Both Ends of Vacuum Hoses.
7 With Engine Still Running, Hold Slide Button to RESUME/ACCEL Position and **As Engine Starts to Race, Apply and Hold Brakes**	When Brakes Are Applied, Throttle Will Close, Light 3 Will Go "Off", and Light 4 Will Brighten. ***TURN IGNITION OFF***	***IF THROTTLE DOES NOT CLOSE.*** Check Large Vacuum Hose for Kinks or Blockage, Check Valve Portion of Disengagement Switch and Valve Assembly - Replace Assembly if Necessary.

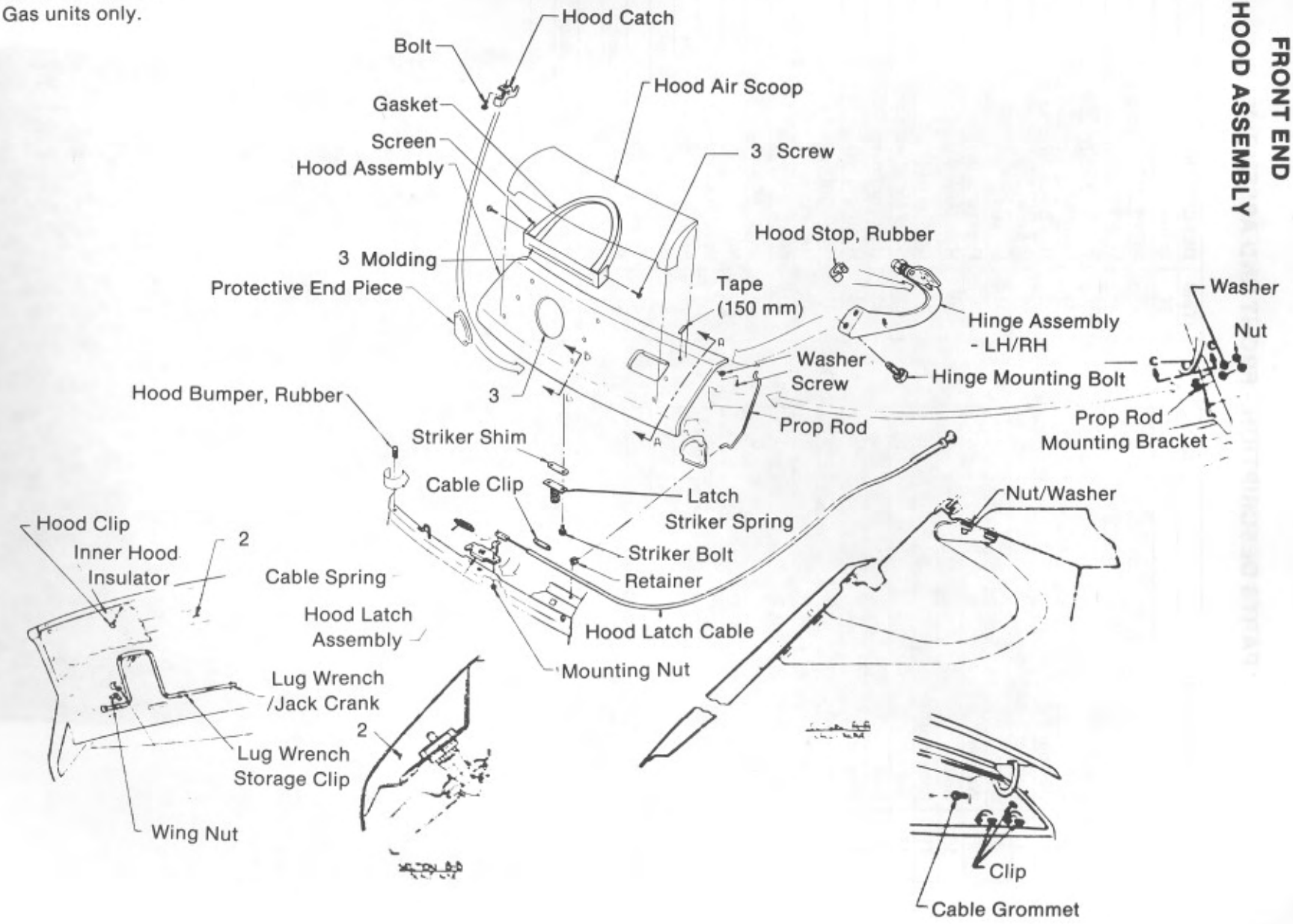
TESTER CANNOT BE USED TO ROAD TEST SPEED CONTROL

SECTION "R"

BODY

R-1	Front End Drawings
R-4	Paint Codes
R-5	Sealants & Sealing
R-10	Windshield
R-13	Cab Door Latch Mechanism
R-13	Outside Mirrors
R-14	Inside Trim Panel
R-15	Cab Window and Cranks - Remove & Replace
R-25	Frame Dimensions
R-28	Body Panel Repair Hints

1. Use shims as required to align hood
2. Inject expandable urethane foam into cavity before installing hood onto vehicle to prevent flexing of inner panel.
3. EFI Gas units only.



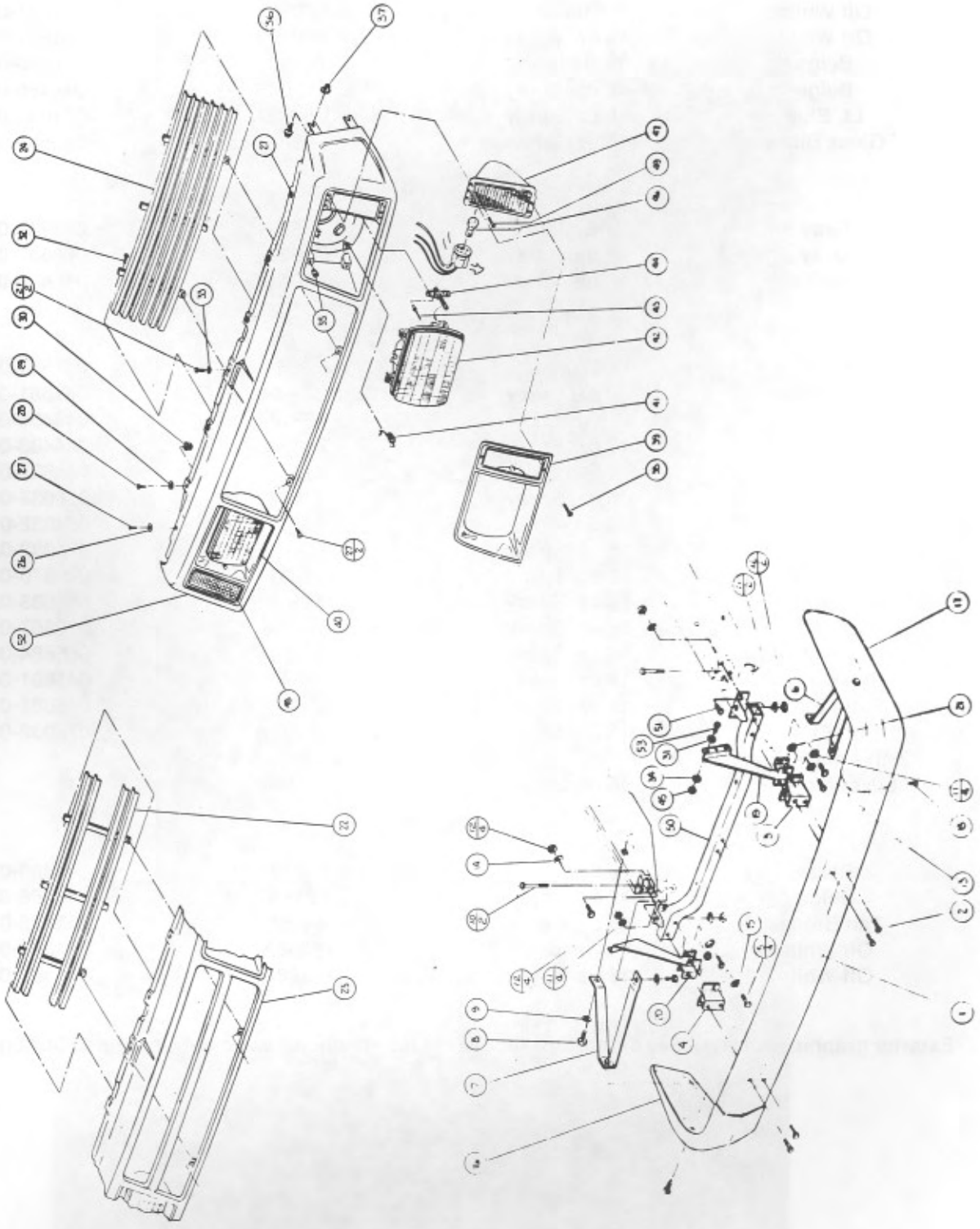
PARTS DESCRIPTION - FRONT END ASSEMBLY

ITEM	DESCRIPTION	QTY
1	Bumper	1
2	Machine Screw	6
3	Bumper Bracket - LH	1
4	Bumper Bracket - RH	1
5	Bolt	4
6	Bumper Side Support - LH	1
7	Bumper Side Support - RH	1
8	Bolt	4
9	Washer	4
10	Bolt	2
11	Lock Washer	10
12	Nut	10
13	Bolt	4
14	Washer	4
15	Washer	4
16	Bumper End Cap - LH	1
17	Bumper End Cap - RH	1
18	Screw	2
19	Bumper Support - LH	1
20	Bumper Support - RH	1
21	Nut	4
22	Grille Assembly - LeSharo	1
23	Grille Panel - LeSharo	1
24	Grille Panel - Phasar/Centauri	1
26	Washer	6

ITEM	DESCRIPTION	QTY
27	Screw	4
28	Screw	4
29	Washer	4
30	Screw Fastener Clip	4
31	Washer	6
32	Hex Bolt w/Washer	4
33	Washer	1
34	Washer	6
35	Brass Insert	12
36	Hex Screw	4
37	Captive Nut	4
38	Bezel Mounting Screw	6
39	Headlight Bezel - LH	1
40	Headlight Bezel - RH	1
41	Headlight Spring	2
42	Headlamp	2
43	Rivet	8
44	Beam Adjustment Assembly	4
45	Nut	6
46	Park/Turn Bulb - #1157	2
47	Park/Turn Light Assy. - LH	1
48	Park/Turn Light Assy. - RH	1
49	Screw	6
50	Front Crossmember Assembly	1
51	Bolt	4
52	Grille Assy. - Phasar/Centauri	1
53	Bolt	6

FRONT END

GRILLE/BUMPER ASSEMBLY



PAINT CODES

Listed below are paint colors and part numbers (DuPont and Winnebago) for all units manufactured by Winnebago Industries, Inc. All colors are available in 16 ounce aerosol can. Main body colors are also available in one (1) gallon containers.

COLOR	UNIT OF MEASURE	DUPONT NUMBER	WINNEBAGO NUMBER
		Utility Van	
Off White	Gallon	45396A	041561-01-000
Off White	16 oz. Spray	45396A	041561-03-000
Beige	Gallon	7633A	044486-01-000
Beige	16 oz. Spray	7633A	044486-03-000
Lt. Blue	16 oz. Spray	G-8672A	074032-03-000
Gloss Black	16 oz. Spray	99A	045681-03-000
		Phasar	
Gray	Gallon	71537	058637-01-000
Gray	16 oz. Spray	71537	058637-03-000
Gloss Black	16 oz. Spray	99A	045681-03-000
		Centauri	
Off White	Gallon	45396A	041561-01-000
Off White	16 oz. Spray	45396A	041561-03-000
Beige	Gallon	7633A	044486-01-000
Beige	16 oz. Spray	7633A	044486-03-000
Gray	Gallon	71537	058637-01-000
Gray	16 oz. Spray	71537	058637-05-000
Blue	Gallon	—	074032-01-000
Blue	16 oz. Spray	—	074032-03-000
Burgundy Metallic	16 oz. Spray	45761	072870-03-000
Tan Bronze	16 oz. Spray	44161	055683-03-000
Slate Blue	16 oz. Spray	C-8056	072867-03-000
Gray Metallic	16 oz. Spray	44783	055684-03-000
Gloss Black	16 oz. Spray	99A	045681-03-000
Satin Black	16 oz. Spray	—	045681-01-000
Lt. Blue	16 oz. Spray	G-8672A	074032-03-000
25th Anniversary Silver Metallic	16 oz. Spray	B-8140	
		LeSharo	
Beige	Gallon	7633A	044486-01-000
Beige	16 oz. Spray	7633A	044486-03-000
Tan Bronze	16 oz. Spray	44161	055683-03-000
Off White	Gallon	45396A	041561-01-000
Off White	16 oz. Spray	45396A	041561-03-000

Exterior graphics not shown as paint colors above are tape or decals and must be ordered through Part Sales.

SEALANT PART NUMBERS

Ref. Code	Winnebago Part Number (WPN)	Unit of Measure (U/M)	Description (Vendor, P/N, Size)	Packaging Qty.
none	002328-02-000	EA	W/S spacer blocks, rubber, .98 x .062 x .50	EA
FT1	076322-02-000	FT	3M Y-4950 Double-coat Foam Tape, .045 x 1.0	108 ft. roll
FT2	076322-01-000	FT	3M Y-4930 Double-coat Foam Tape, .025 x 1.0	216 ft. roll
FT3	063642-01-000	FT	3M Y-9473 Adhesive Tape, .10 mil x 1.5	180 ft. roll
BT1	038886-01-000	FT	PTI Butyl Tape, Black	148 in. roll
UR1	072889-01-000	EA	Essex 552.2 Urethane Adhesive, Black	Tube
UR2	072889-03-000	EA	Essex 553.02 Urethane, Black	Tube
PR1	072890-01-000	QT	Essex 435.34 Pinchweld Primer, Black	1 qt. can
PR2	072891-01-000	QT	Essex 435.18 Glass Primer, Clear	1 qt. can
PR3	072892-01-000	QT	Essex 435.20 Glass Primer, Black	1 qt. can
PR4	035023-01-000	GL	Tremco 263-44Y, Pinchweld Primer, Black	5 gal. can
PR5	035024-01-000	EA	PTI CP110C, Glass Primer, Clear	12 oz. can
SC1	053752-01-000	EA	Schnee 5504 Roof Sealer, Alum.	Tube
SC2	053766-06-000	EA	Schnee 5522 Bedding Compound, Clear	Tube
SC2	053766-02-000	EA	Schnee 5522 Bedding Compound, White	Tube
SC2	053766-07-000	EA	Schnee 5522 Bedding Compound, Beige	Tube
SC2	053766-08-000	EA	Schnee 5522 Bedding Compound, Gray	Tube
SC3	053766-05-000	EA	Schnee 5525WB Bedding Compound, Gray	Tube
SC4	077967-01-000	EA	Schnee 8200 Acrylic Sealant, White	Tube
SC5	040545-01-000	GL	3M 606 Weatherban Weld-Through Seam Sealer, Wht.	5 gal. can
SC6	069637-01-000	EA	3M 404 Weatherban Sealer, White	Tube
ST1	069640-06-000	FT	Schnee 5603 Isocryl Tape, 5/16" Bead, Gray	15 ft. roll
ST2	069640-02-000	FT	Schnee 5603 Isocryl Tape, 1/2" x 1/8", Gray	30 ft. roll
ST3	069640-03-000	FT	Schnee 5603 Isocryl Tape, 3/4" x 1/8", Gray	30 ft. roll
ST4	069640-05-000	FT	Schnee 5603 Isocryl Tape, 2 1/2" x 3/32", Gray	50 ft. roll
ST5	069640-07-000	FT	Schnee 5603 Isocryl Tape, 2" x 3/32", Gray	30 ft. roll
ST6	069640-01-000	FT	Schnee 5603 Isocryl Tape, 1/4" Bead, Gray	20 ft. roll

NOTE: Throughout this section, sealants are designated by Reference Codes listed above in Column 1. Winnebago part numbers are prefixed by the letters WPN.

SEALANT SPECIFICATIONS

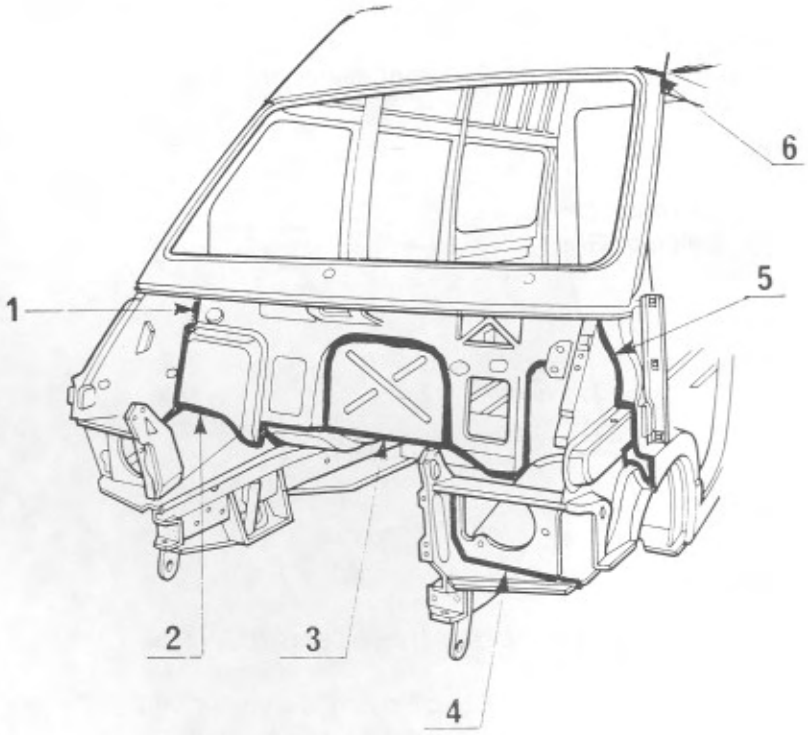
Product	Workable Temp. Range	Cure Time Workable (Max.)	Shelf Life	Storage Precautions
(SC1) Schnee 5504	40° F - 100° F+	1 hr. (90%/24 hr.)	1 yr. (min) at 80° F max.	Avoid extreme heat
(SC2) Schnee 5522	40° F - 100° F+	1 hr. (90%/24 hr.)	1 yr. (min) at 80° F max.	Avoid extreme heat
(SC3) Schnee 5525	40° F - 100° F+	1 hr. (90%/24 hr.)	1 yr. (min) at 80° F max.	Avoid extreme heat
(SC4) Schnee 8200	40° F - 100° F+	1 hr. (90%/24 hr.)	1 yr. (min) at 80° F max.	Avoid extreme heat & freezing
(ST1 thru ST6) Schnee 5603	40° F - 100° F+	non-curing	1 yr. (min) at 80° F max.	Avoid extreme heat
(FT2) 3M Y-4950	70° F - 100° F+	non-curing	12 mo. at 70° F/50% RH	Avoid heat and humidity
(FT1) 3M Y-4950	70° F - 100° F+	non-curing	12 mo. at 70° F/50% RH	Avoid heat and humidity
(FT3) 3M Y-9473	70° F - 100° F+	non-curing	12 mo. at 70° F/50% RH	Avoid heat and humidity
(SC5) 3M 404 weatherban	50° F - 100° F+	1 hr. (24 hr)	10 mo. at 80° F max.	Avoid heat
(SC6) 3M 606 weatherban	50° F - 100° F+	30 min (36 hr)	12 mo. at 80° F max.	Avoid extreme heat & freezing
(PR2) Essex 435.18	40° F - 100° F+	20 min (30 min)	90 days (warranty)	Avoid heat and humidity
(PR3) Essex 435.20	40° F - 100° F+	5 min (15 min)	90 days (warranty)	Avoid heat and humidity
(PR1) Essex 435.34	40° F - 100° F+	20 min (30 min)	90 days (warranty)	Avoid heat and humidity
(UR1) Essex 552.2	40° F - 100° F+	2-4 hr (7 days)	90 days (warranty)	Avoid heat and humidity
(UR2) Essex 553.02	40° F - 100° F+	2-4 hr (7 days)	90 days (warranty)	Avoid heat and humidity

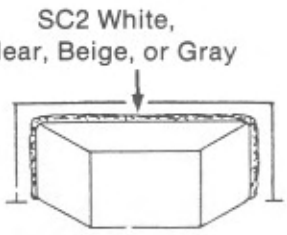
GENERAL BODY SEALING

Cab Front Section

1 - Pillar lining - inner wing panel
2 - Scuttle side section - inner wing panel
3 - Scuttle - front floor
4 - Headlight panel - inner wing panel
5 - Pillar lining - front pillar
6 - Windshield frame pillar - roof pillar

Seal all seams with SC4.



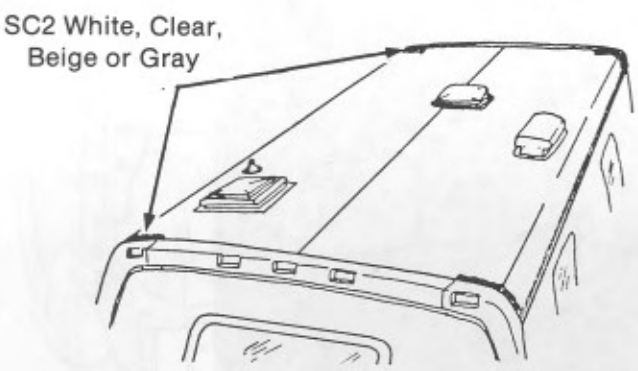


CLEARANCE LIGHTS
Cap seal top and side edges of base with SC2 clear as shown.



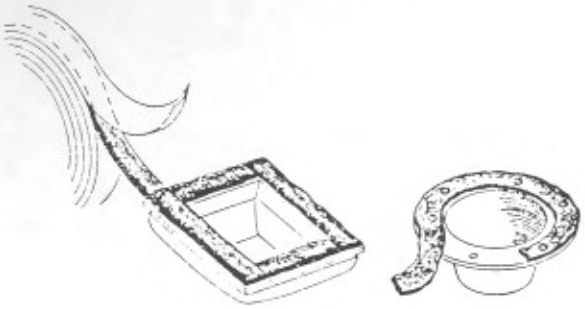
GENERAL BODY SEALING

ROOF SEAMS
Seal roof seams with SC1 roof sealer and SC2 in locations shown.



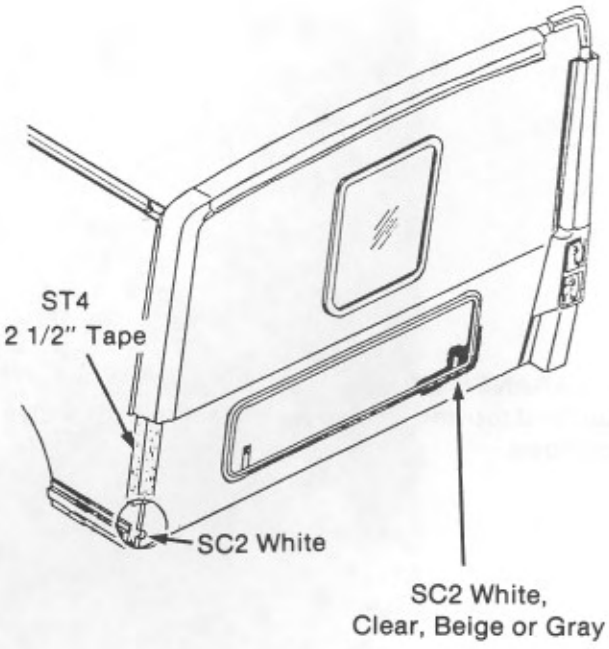


ROOF MOUNTED COMPONENTS (A/C, Vents, Soil Pipe, Etc.)
Apply 1/2 inch tape, ST2, to bottom of all mounting flanges before fastening. Screws must penetrate sealant.



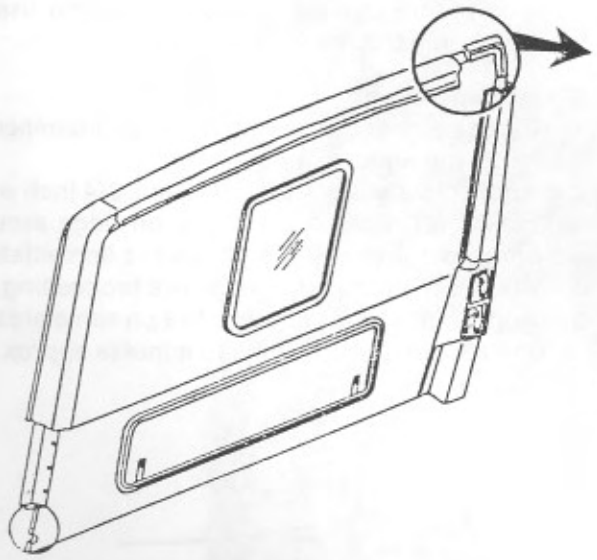
BACKWALL/SIDEWALL JOINT
Apply 2 1/2 inch tape along outside corner of joint. Apply SC2 white over wire holes after wires are through. Install contour moldings.

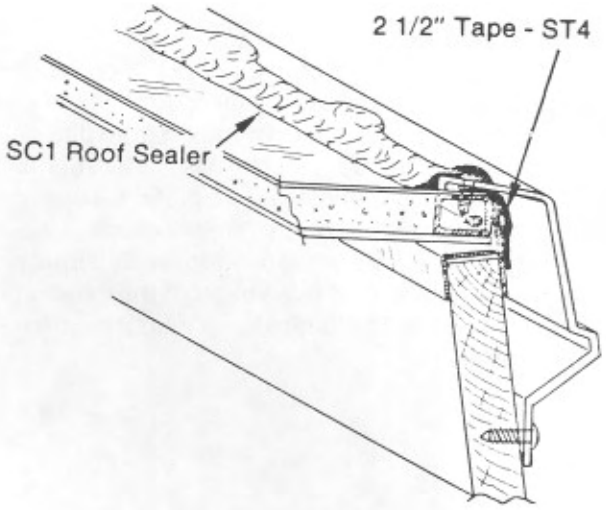
TRUNK DOOR (Centauri Van)
Apply 5/16 inch tape, ST1, to rear of door jamb and install door in opening. Seal perimeter of inside and outside frame edges and around locks with SC2 white, beige, gray or clear.



BACKWALL/ROOF JOINT

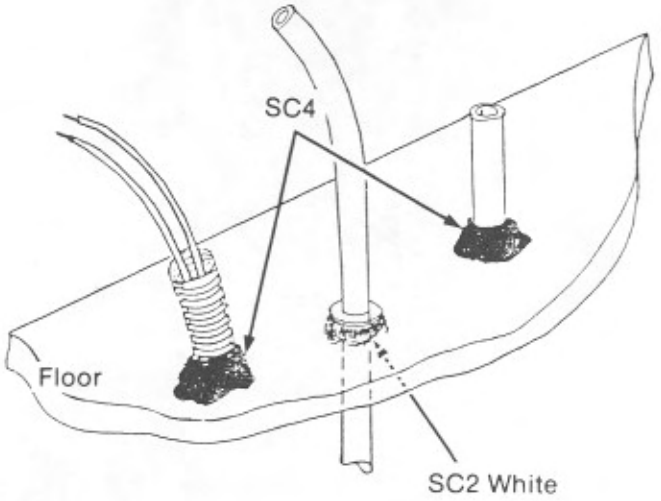
Apply a bead of SC2 white to top rail of backwall. Place 2 1/2 inch sealant tape along outside edge of joint as shown and install contour molding. Cap seal top edge of molding and screw heads with SC1 roof sealer.





HOLES IN FLOOR

Seal on top side with SC4 and on bottom side with SC2 white.



WINDSHIELD

The windshield glass is retained to the body by urethane adhesive. Glass rests on a rubber support molding placed around the perimeter of the pinchweld. Urethane is pumped into the cavity between the body and glass and capped by reveal moldings.

Removal Procedure

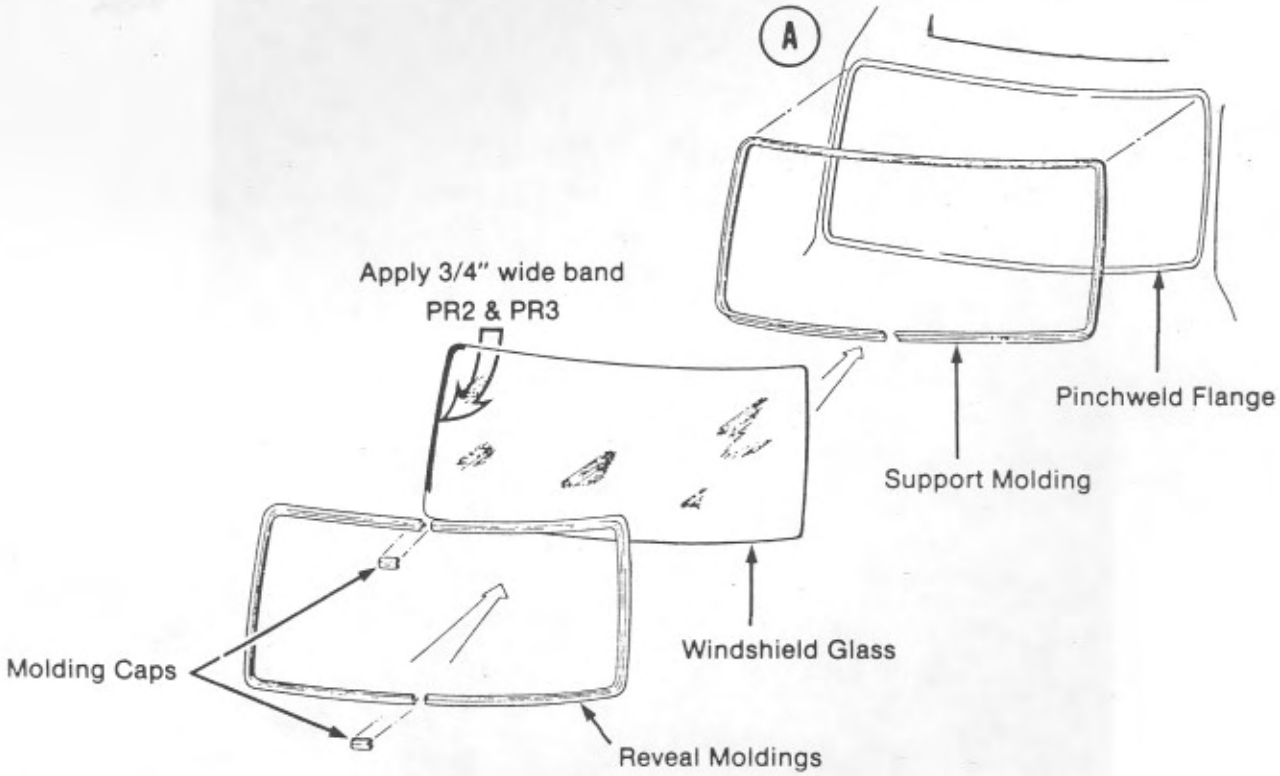
Reveal and support moldings must be pulled off in order to remove glass. Pull reveal moldings away from urethane. Remove support molding from pinchweld flange from inside vehicle. Use a urethane cutting knife to cut adhesive completely around perimeter of gass and carefully remove glass. (Urethane knife is available at your auto body supply dealer.) Make sure that an even bead of the existing urethane remains on the flange to serve as a base for replacement glass.

IMPORTANT

If body repair or painting requires that existing urethane be totally removed, pinchweld must be thoroughly cleaned with alcohol and primed with PR1 pinchweld primer before proceeding with installation. (Allow 30 minutes set time). Do not use a petroleum base solvent (kerosene, gasoline, etc) to clean metal or glass as any presence of oil will prevent adhesion of urethane. Primers must be agitated before use and frequently during use to keep carbon particles in suspension.

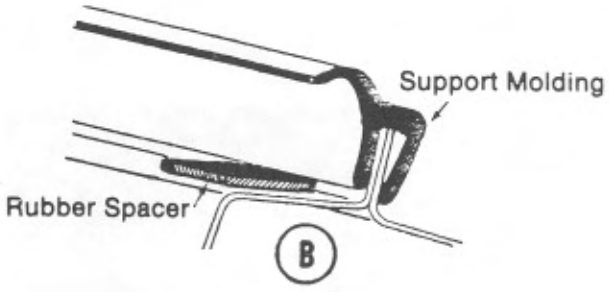
Glass Preparation

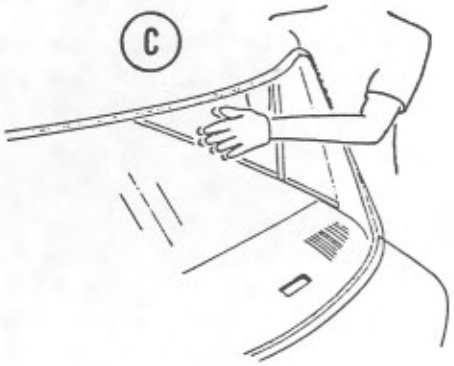
1. Clean inside edge of glass with alcohol dampened cloth and allow to air dry.
2. Apply clear glass primer PR2 in a 3/4 inch wide band on inside of glass and on edge around entire perimeter. Wipe off excess immediately. Allow 5 minutes set time before proceeding.
3. Apply black glass primer, PR3 on same area as Step 3. Let dry to touch (10 minutes approx.)



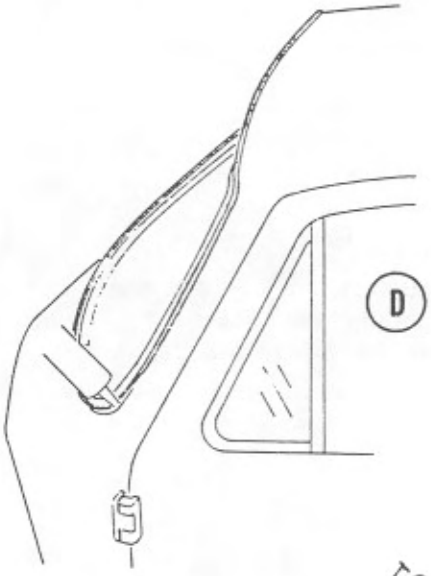
Installation Procedure

1. Install support molding onto pinchweld flange with joint located at bottom center of opening. Trim to ensure a flush fit at joint. Refer to Fig. A.
2. Place rubber spacers (1/16" x 1/2" x 1") on windshield glass supports at bottom of opening. (Refer to Figure B). Glass should not be allowed to contact metal at any point to avoid breakage from road vibration.

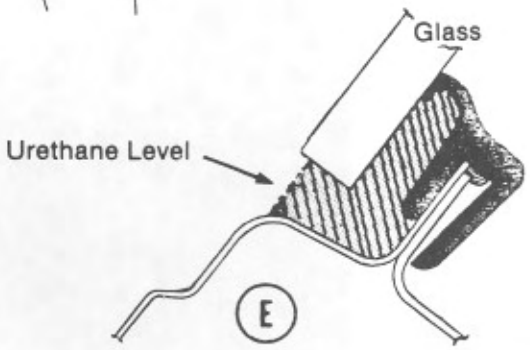




3. With aid of an assistant, carry glass with one hand on outside and other on inside. Do not touch primed edges. Set glass onto opening in an upright position. While helper holds glass, reach one arm around pillar and hold glass while he does likewise. (Fig. C).
4. Lower glass onto support molding, centering it side to side and resting on rubber support spacers.



5. Cut tip of urethane tube, UR1, to an opening of 3/16 inch and fill in completely around glass spacer supports.
6. Apply a smooth continuous bead of urethane around perimeter of glass. Direct flow down into cavity to fill space between glass edge and original urethane base or primed metal. Fill approximately to level indicated. This allows for displacement by reveal molding.

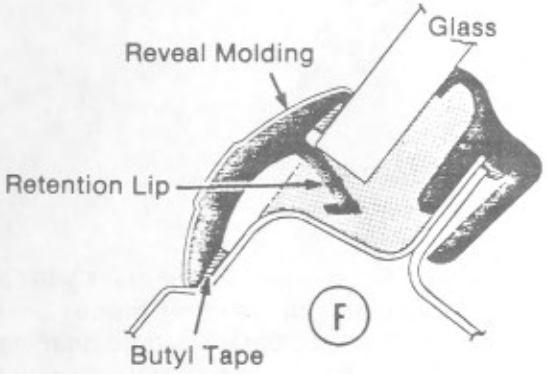


7. Spray a mist of water onto urethane and dry off areas where molding will contact body and glass. Urethane is a moisture curing compound, so this step will assist the curing process.

IMPORTANT
Reveal moldings must be installed into urethane adhesive **within 10 minutes** after application.

8. Slide molding caps onto both ends of one of the reveal moldings and peel backing from butyl strips on rear edges of moldings. If original moldings are reusable, remove any excessive butyl or urethane from rear edges.
9. Install reveal moldings by pressing retention lip into urethane using glass edge as a guide (See cross section, Fig. F).

IMPORTANT
Make sure molding is seated at corners and that butyl tape contacts body and glass as shown. (Fig. F). Use hand roller if necessary to obtain best fit to body and glass. Use duct tape to hold molding down in correct position until adhesive cures.



WARNING

Vehicles should be allowed to remain at room temperature for **six hours** before being driven to allow proper curing of adhesive.

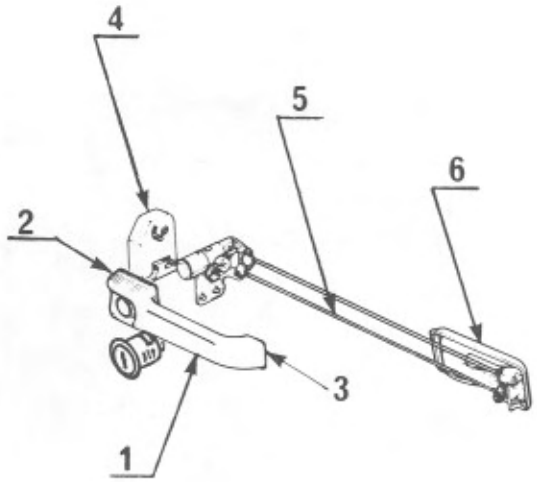
CLEAN-UP
A solvent such as naptha is suggested for cleaning tools and equipment. For hand cleaning, use a lanolin base, waterless hand cleaner.

CAB DOOR LOCK MECHANISM

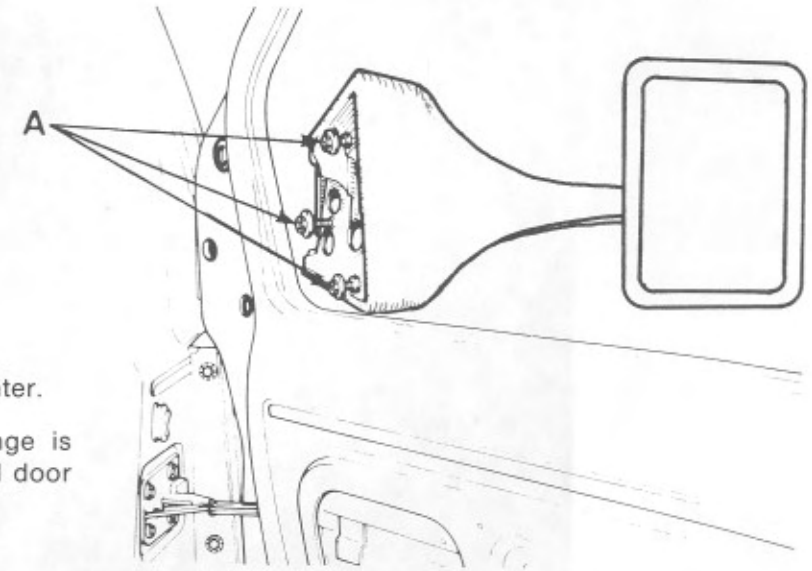
REMOVING:

- Raise the window to its full extent.
  Remove the inside trim panel.
- Remove the plastic sheet.

Remove:
- outer handle (1) held by screw and nut (3)
- the 3 screws holding plate (4)
- unhook remote control rods (5) from the inside handle (6)
- remove the lock mechanism by pivoting it around the window channel



OUTSIDE MIRRORS



REMOVE:

- the 3 plugs on the inside of the door frame,
- and 3 bolts (A), the longer bolt is in the center.

The rubber which protects the mirror hinge is locked in position between the bracket and door outer panel.

INNER DOOR PANEL

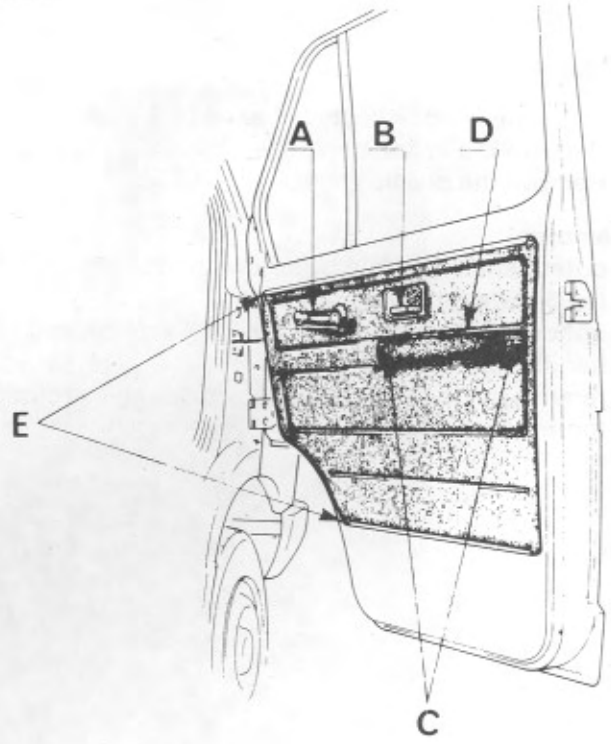
REMOVAL

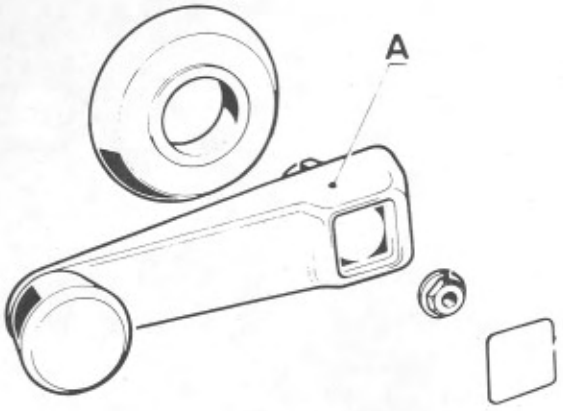
Remove:
- window crank handle (A)
- remote control lever (B)
- and the 2 screws holding door pull (C).

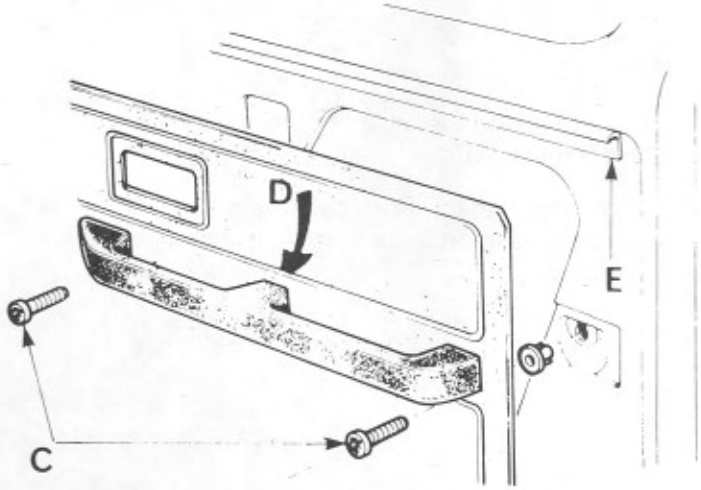
The door pull remains attached to the panel by rivet (D).

Unclip the panel and ease it out of channels (E).

Remove the plastic sheet.



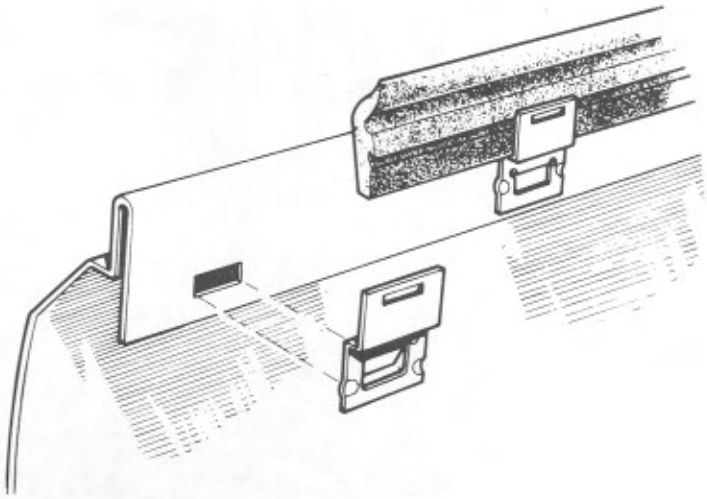




CAB WINDOWS AND CRANKS
REMOVE AND REPLACE

REMOVAL

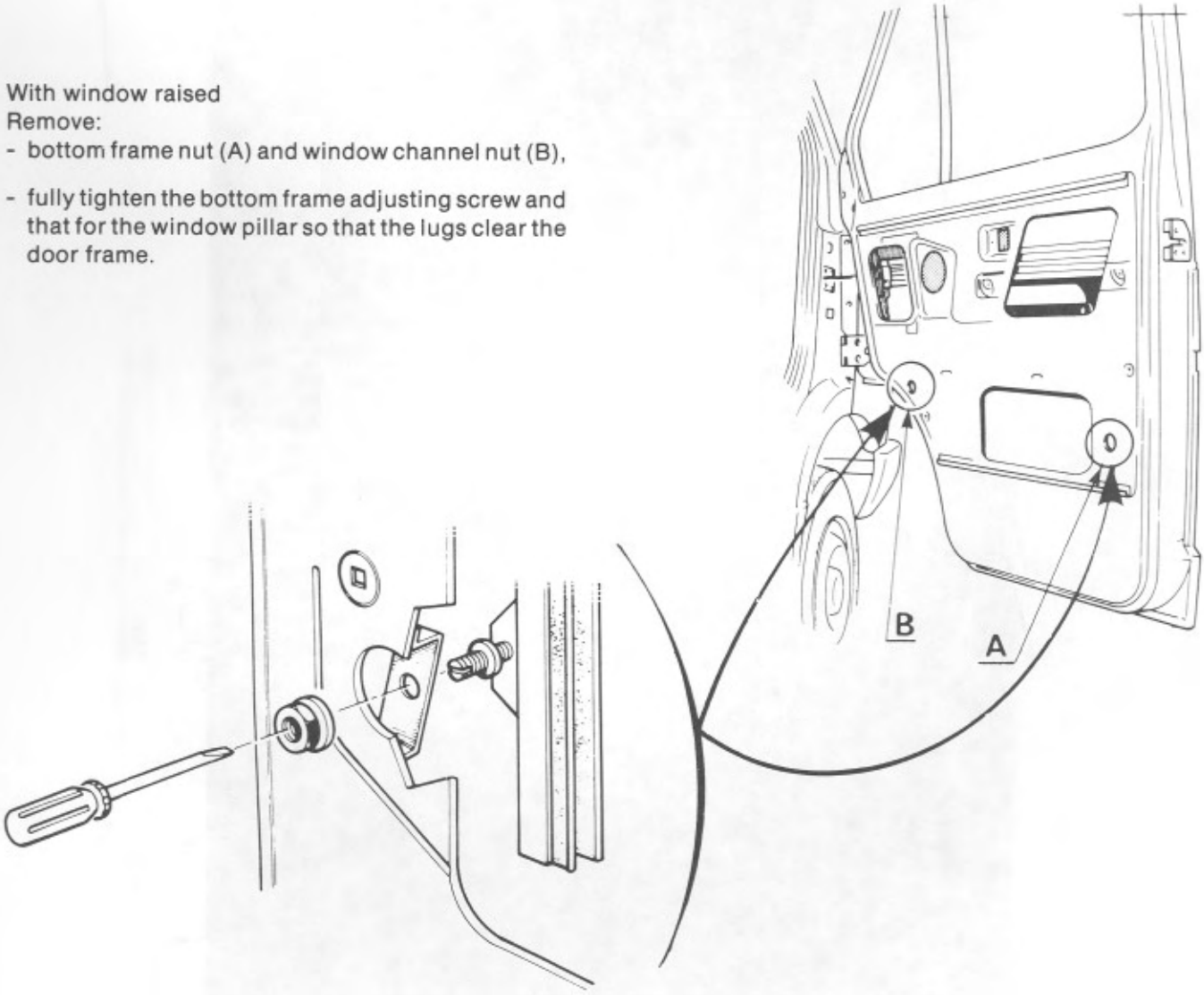
With window lowered, remove the inner and outer wiper strips and clips.



With window raised

Remove:

- bottom frame nut (A) and window channel nut (B),
- fully tighten the bottom frame adjusting screw and that for the window pillar so that the lugs clear the door frame.

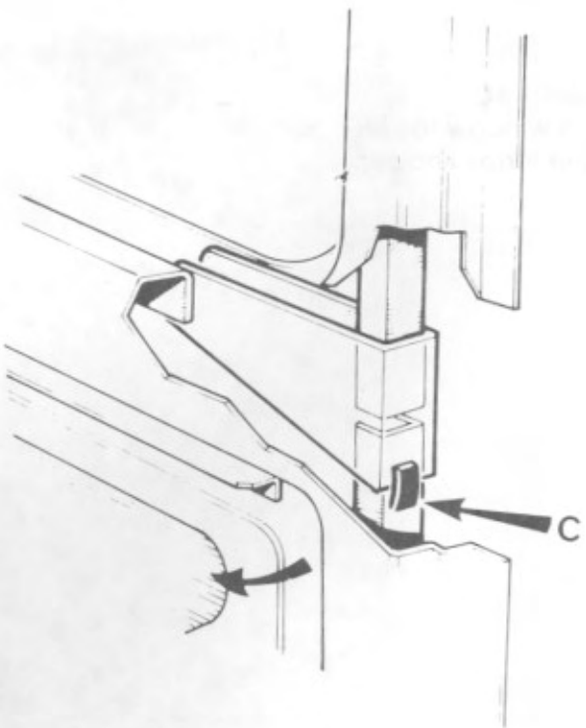


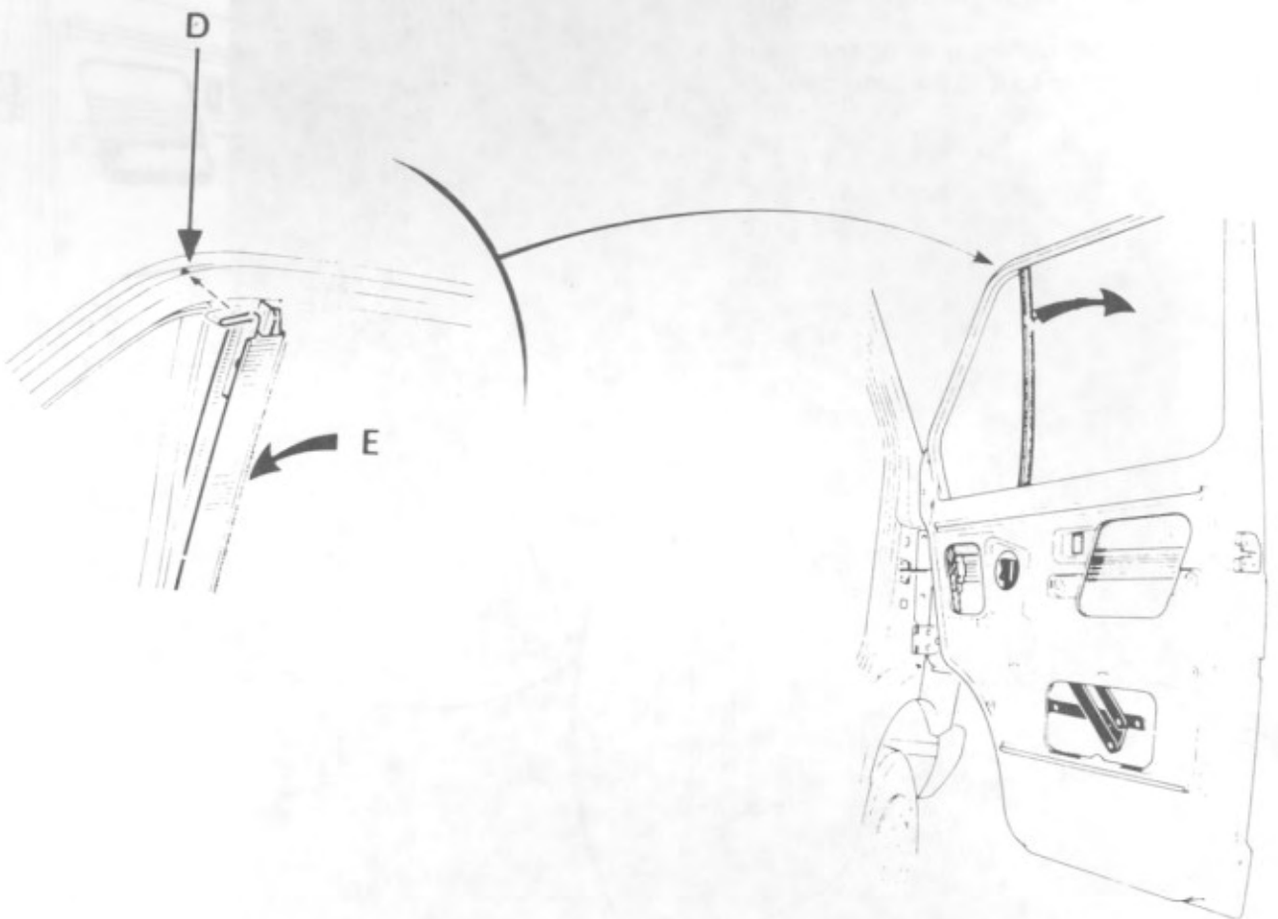
CAB WINDOWS AND CRANKS
REMOVE AND REPLACE

Remove lower frame (C) by pivoting it.

With window lowered

Remove:
- fixed window pillar top screw (D), channel (E),
- and tilt the fixed window pillar.

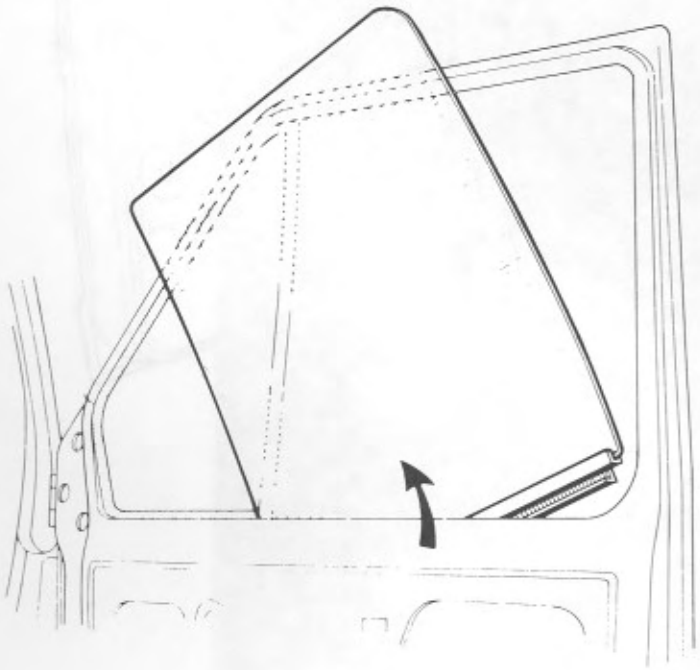


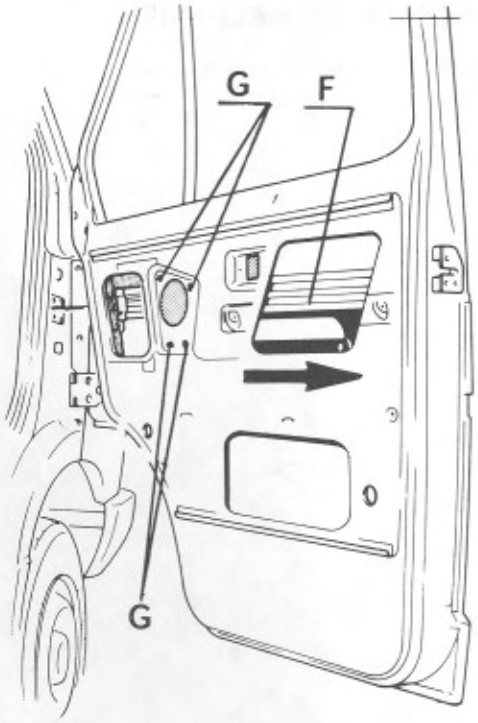


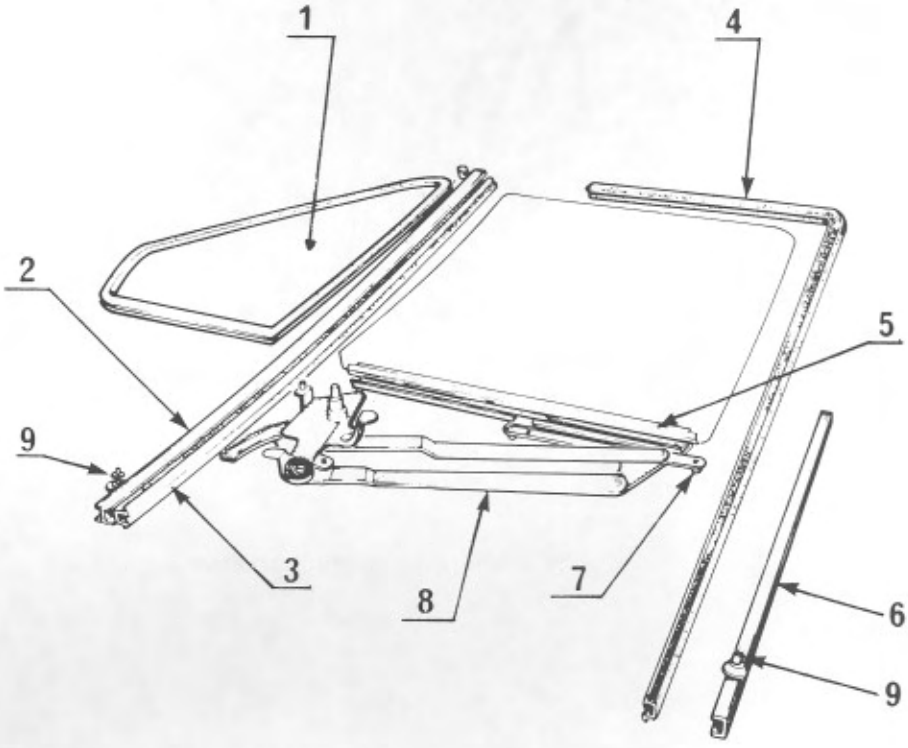
CAB WINDOWS AND CRANKS
REMOVE AND REPLACE

REMOVING THE WINDOW CRANK MECHANISM

- Raise the mechanism level with door panel stiffener (F),
- Unscrew the 4 mechanism nuts (G),
- Slide the mechanism to the rear to clear the rollers at the bottom
- Remove the window.





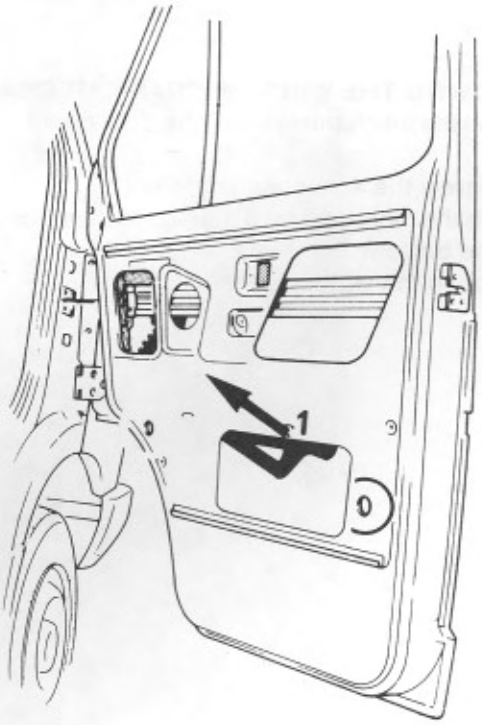


1. Fixed window
2. Fixed window pillar
3. Fixed window pillar channel
4. Channel
5. Bottom channel
6. Bottom frame
7. Mechanism rollers
8. Window crank mechanism
9. Window pillar adjusting screws

CAB WINDOWS AND CRANKS
REMOVE AND REPLACE

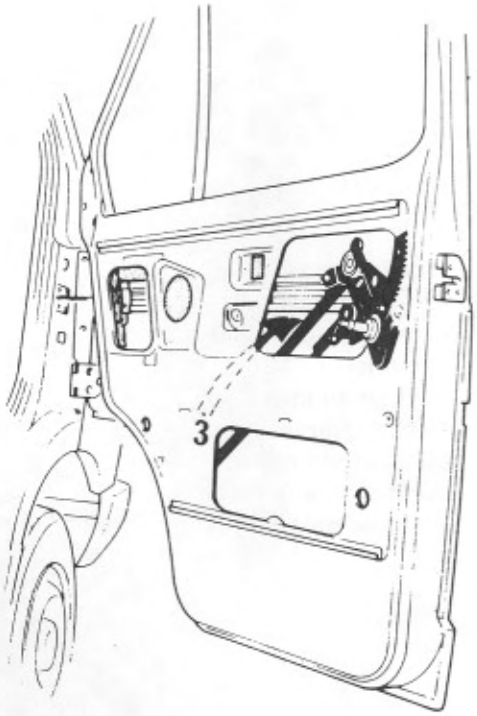
TO REMOVE THE MECHANISM

1 - Push the mechanism forward.



2 - Tilt it downwards





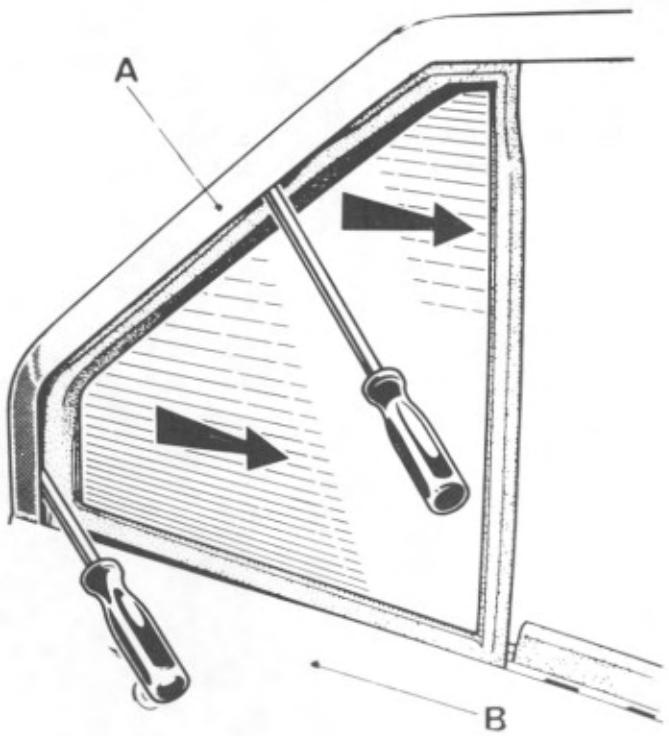
3 - Withdraw it through the top cut-out.

CAB WINDOWS AND CRANK
REMOVE AND REPLACE

REMOVING — REPLACING

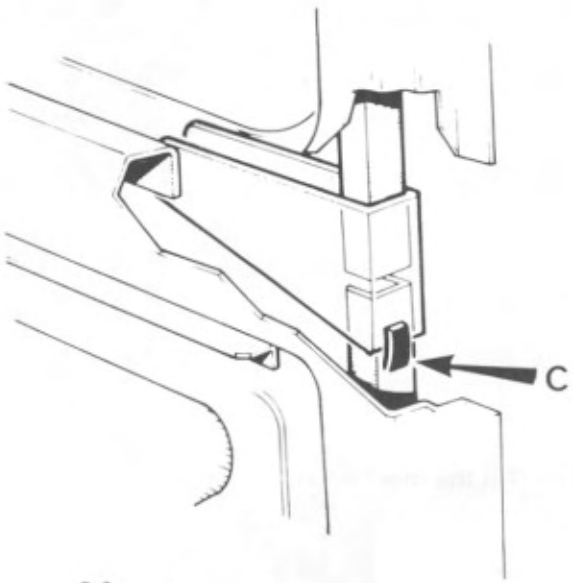
The fixed window is held firm by its rubber seal in frame (A) and between door frame (B) and the outer panel.

Use soapy water to insert the window to make the operation easier.

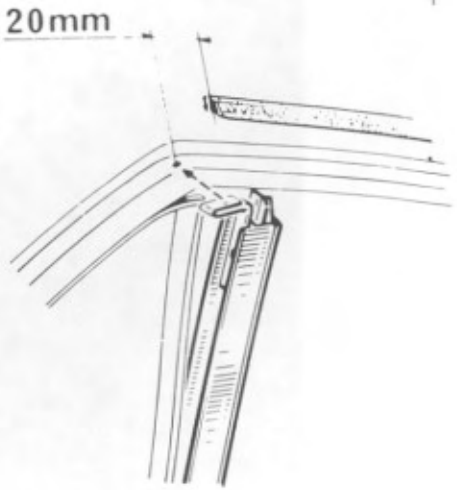


REASSEMBLING THE WINDOW CRANK MECHANISM

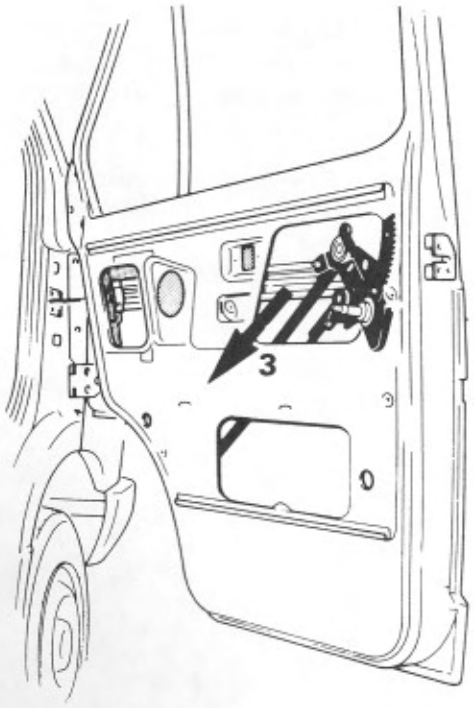
1 - Insert lower frame (C).



2 - Position the channel in the window frame, the front part of the channel 20 mm from the fixed window pillar fixing hole.



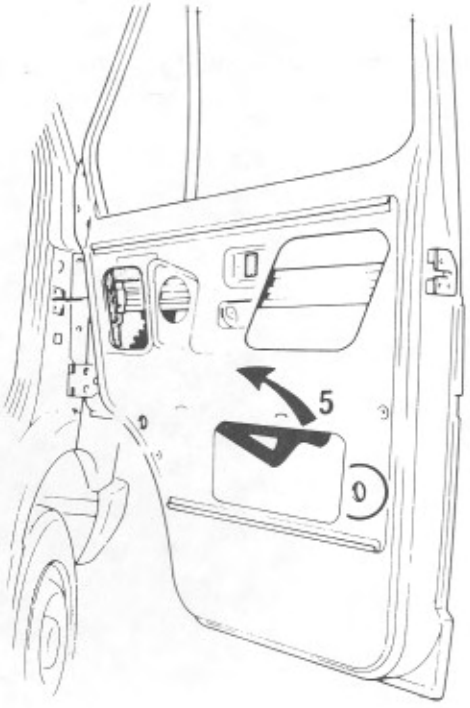
3 - Insert the window crank mechanism in the door frame via the cut-out at the top.



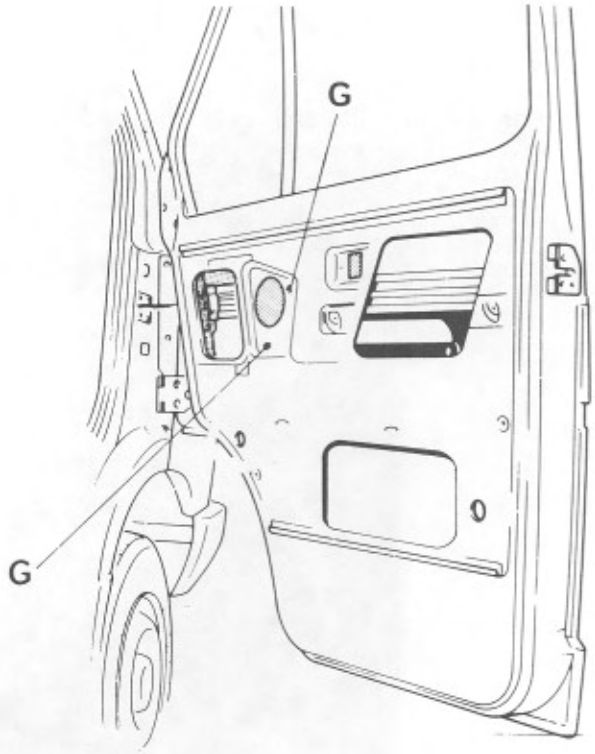
4 - Tilt the mechanism down.



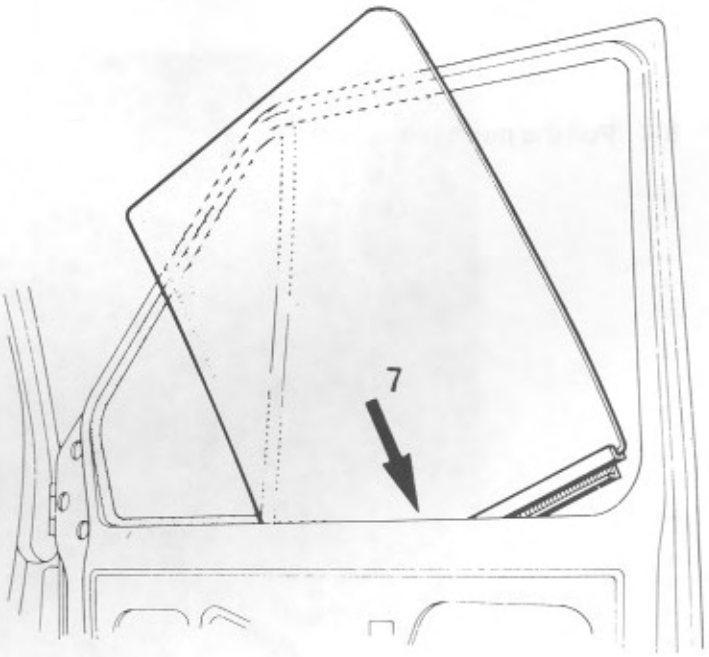
5 - Pull the mechanism back



6 - Hold it temporarily with 2 nuts (G)

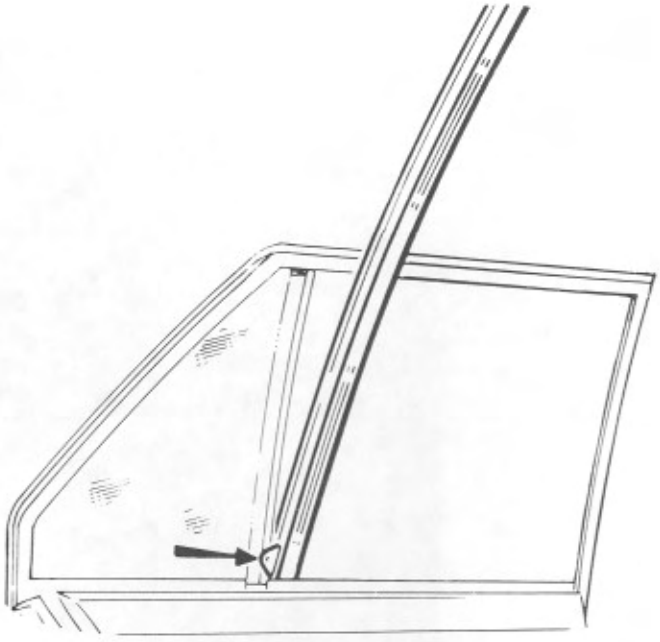


7 - Insert the window into the bottom of the door frame

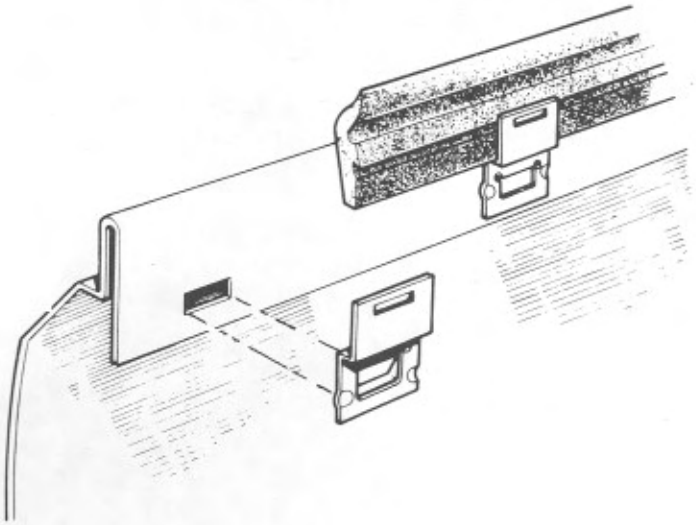


8 - Attach the fixed window pillar to the door frame. On the way down, insert the pillar angle adjusting screw.

9 - Position the pillar and fasten it at each end.

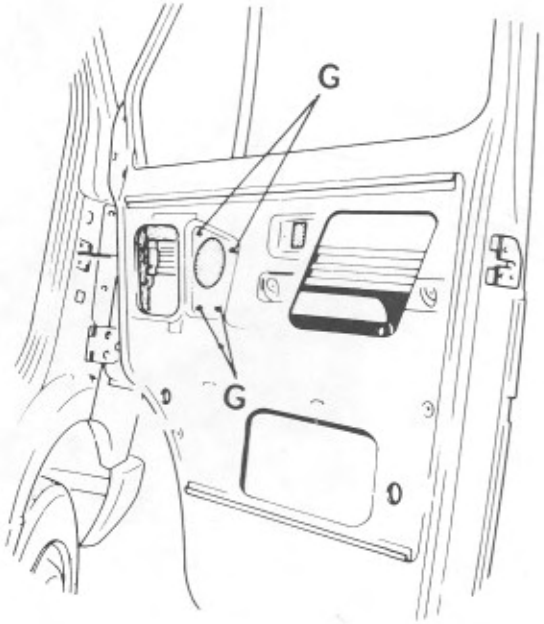


10 - Insert the inside and outside wiper strip clips.



11 - Wind the window up level with the panel stiffener, remove the 2 screws holding the mechanism temporarily. Slide the mechanism rollers into the bottom channel.

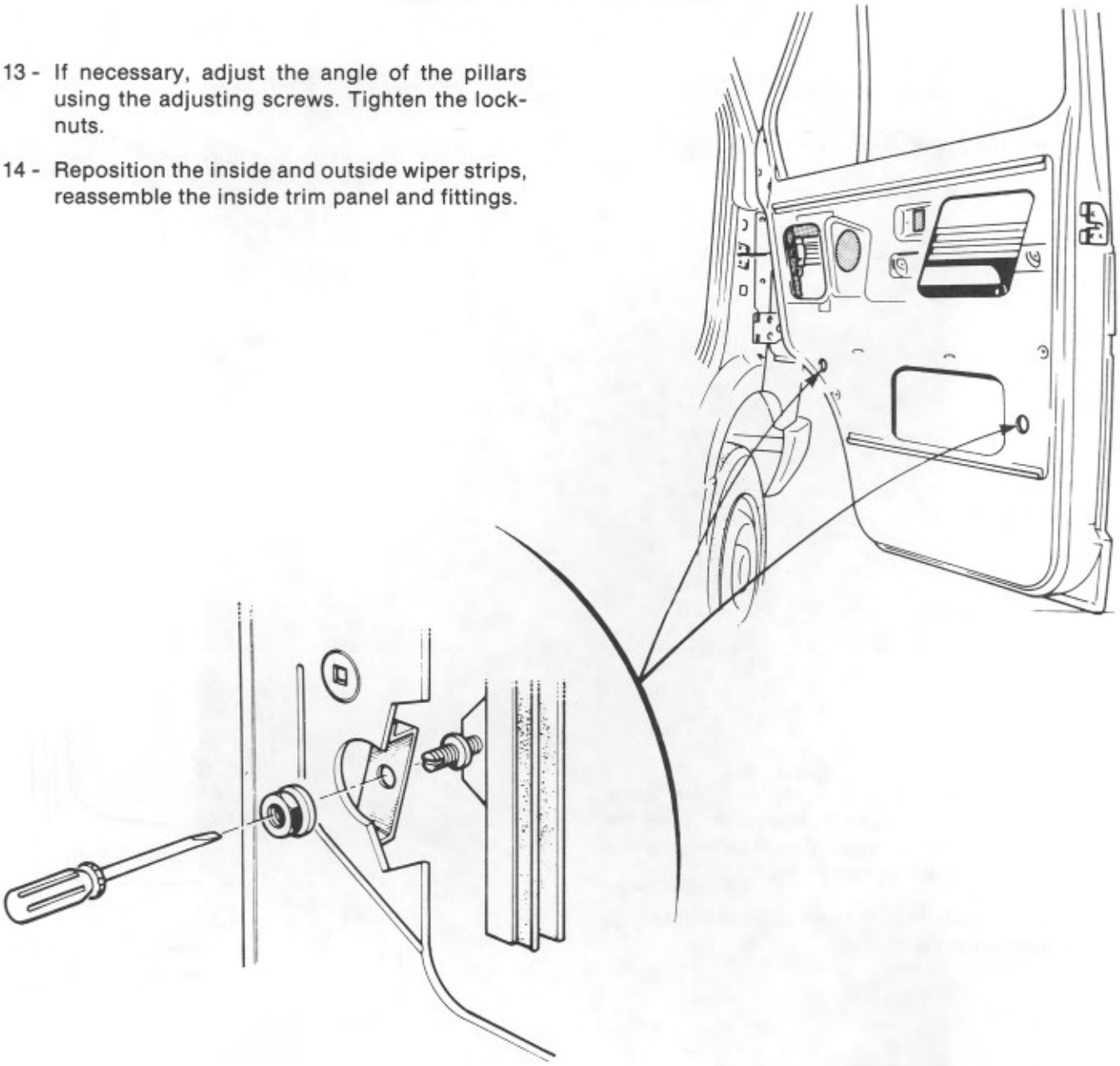
12 - Crank the window up to the top and tighten the 4 mechanism nuts (G).



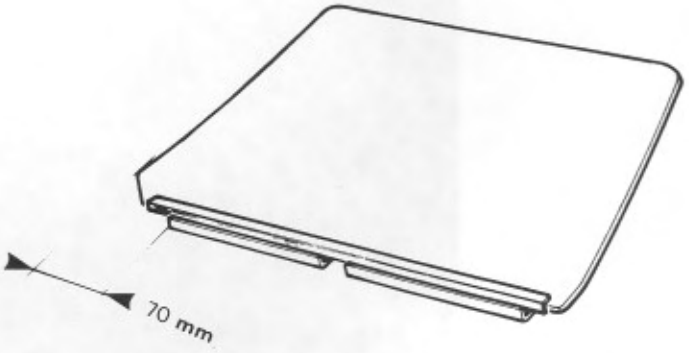
CAB WINDOWS AND CRANKS
REMOVE AND REPLACE

13 - If necessary, adjust the angle of the pillars using the adjusting screws. Tighten the locknuts.

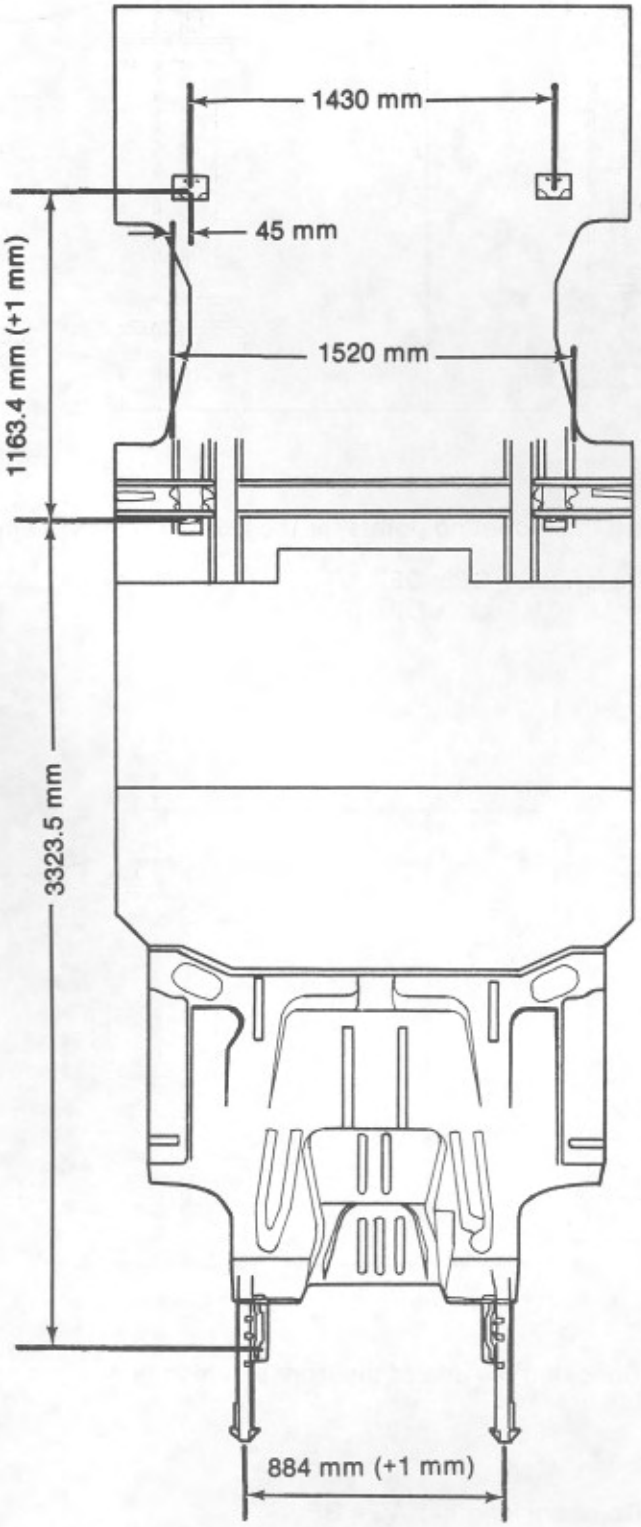
14 - Reposition the inside and outside wiper strips, reassemble the inside trim panel and fittings.



The edge of the glass should be 2 3/4" (70 mm) from the bottom channel as shown.

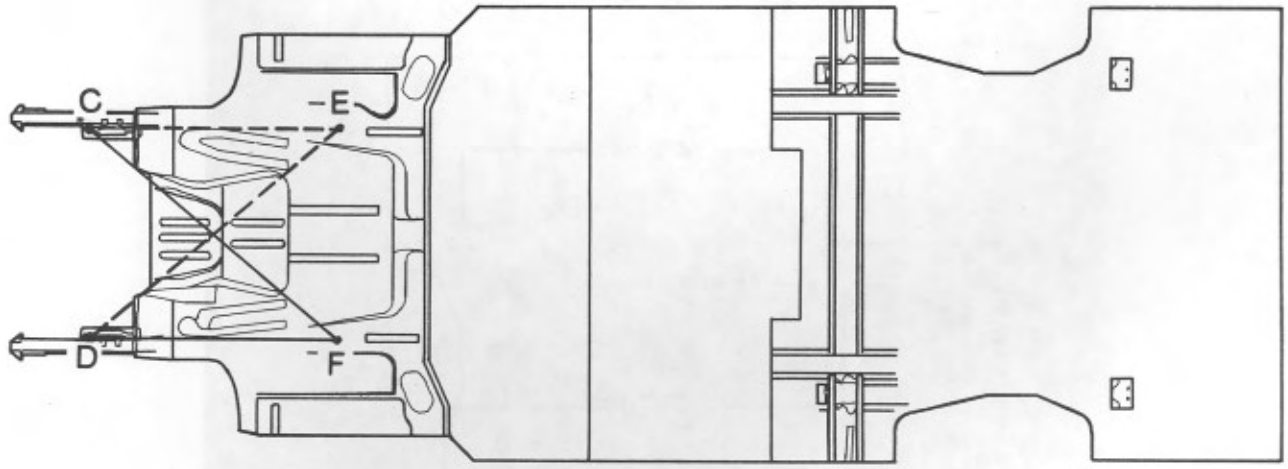


FRAME DIMENSIONS
(METRIC ONLY)



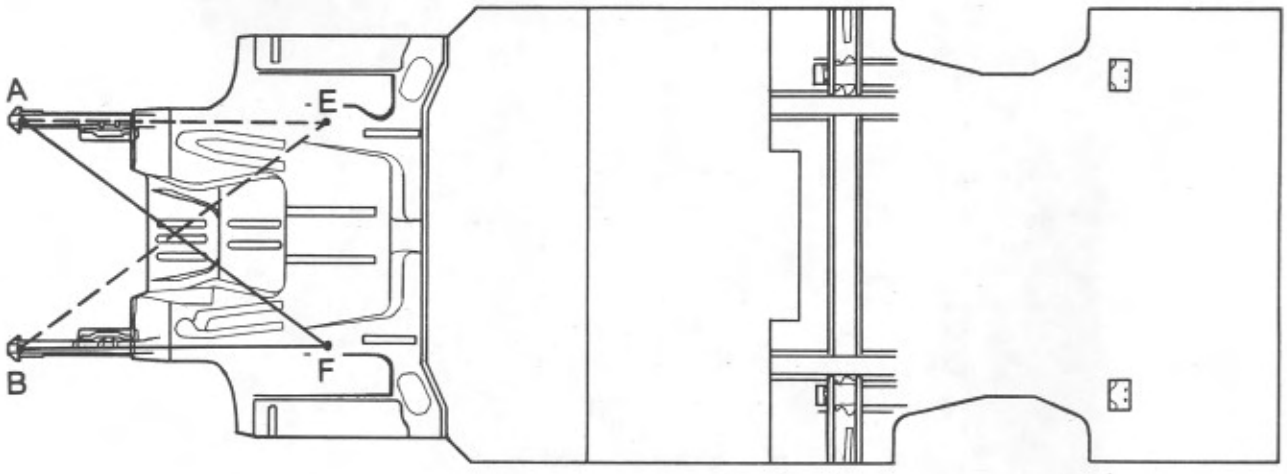
FRAME DIMENSIONS

Checking with the trammel gauge (or equivalent)



Checking the mounting points for the front axle crossmember.

Compare lengths: CE = DF
CF = DE

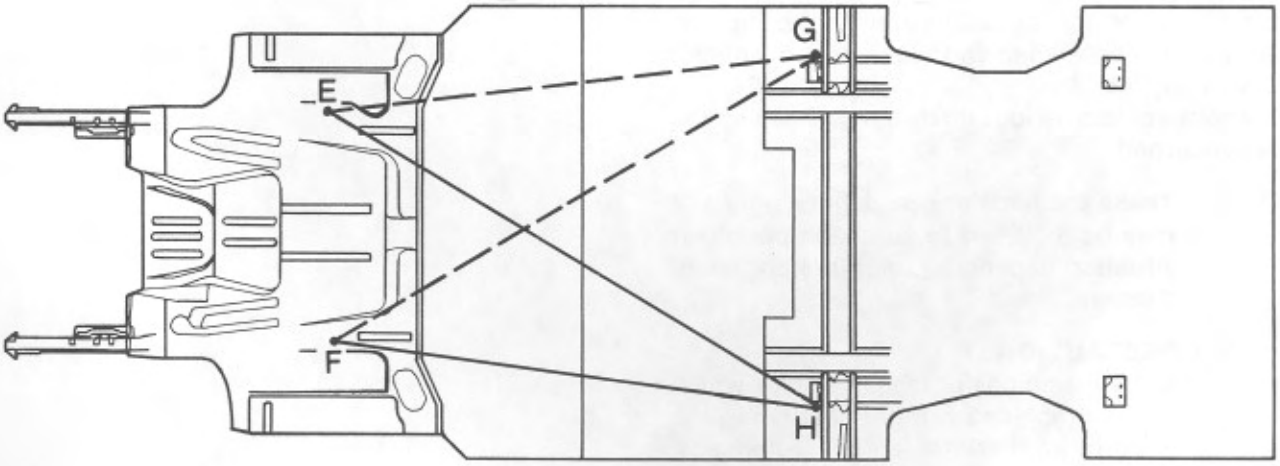


Checking the end of the front sidemember.

Compare lengths: AE = BF
AF = BE

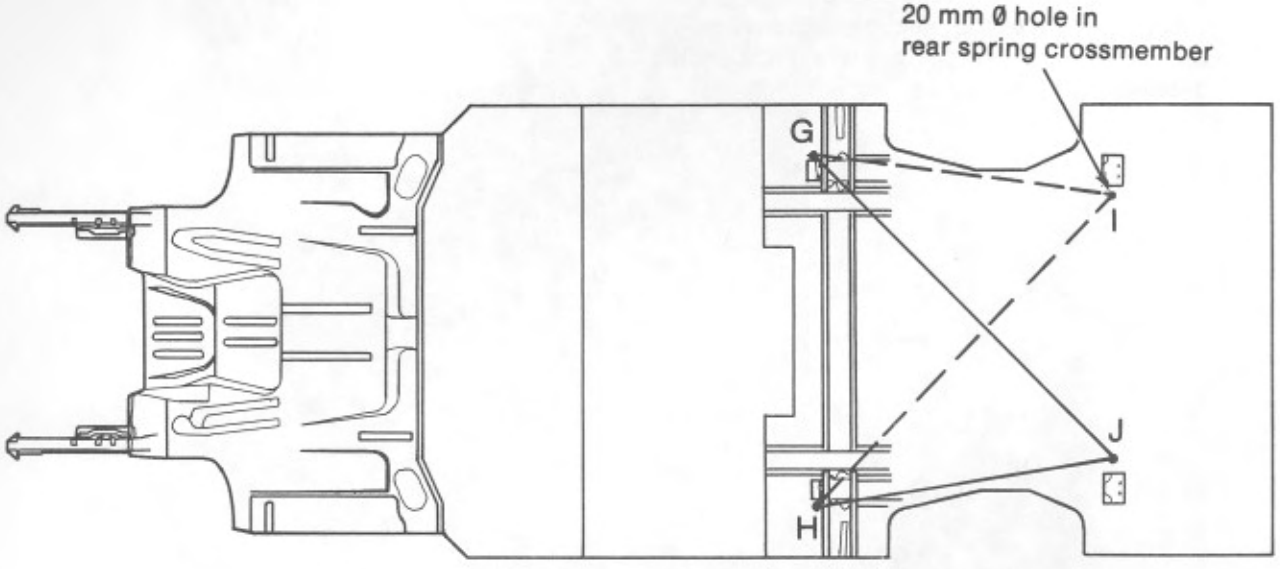
FRAME DIMENSIONS

Checking with the trammel gauge (or equivalent)



Checking spring blade mounting gusset.

Compare lengths: EG = FH
EH = FG



Checking the rear crossmember.

Compare lengths: GI = HJ
HI = GJ

BODY PANEL REPAIR GUIDE

The procedures in this section describing how to change welded components are given purely as a guide. They depend on:

- how the panels are cut,
- the degree of accessibility inside for positioning the panel to be welded and the tools available for planishing, etc.
- the zones of less serious distortion where welding is concerned.

NOTE: These methods are guidelines only and may be modified to suit each particular situation depending upon the degree of damage.

SPECIAL PRECAUTIONS

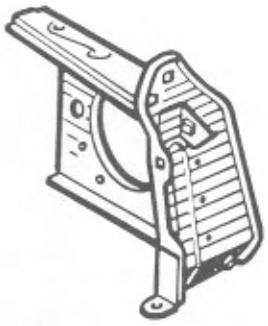
There are certain sections of these vehicles which **cannot** be cut or replaced without sacrificing the structural integrity and initial safety characteristics. Details on these sections are listed below.

IMPORTANT

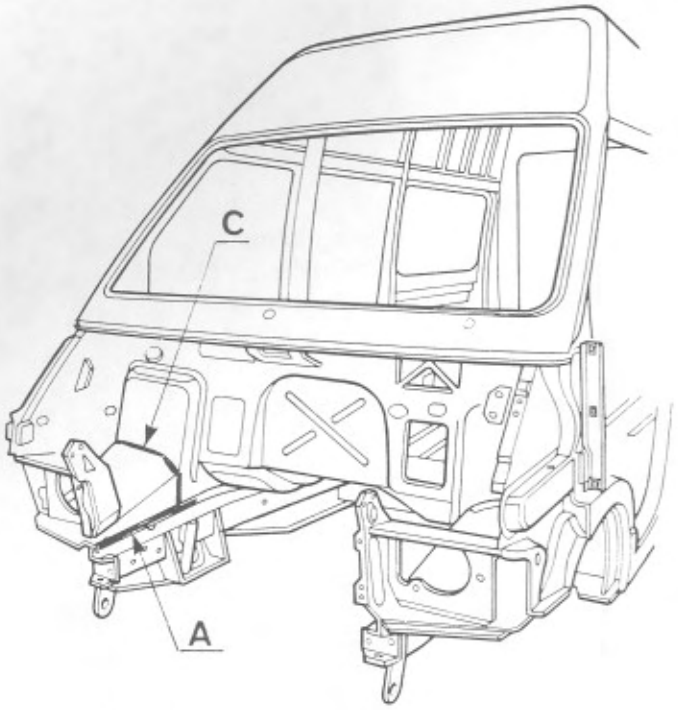
Never:

- partially change a front sidemember
- heat up a frame sidemember for straightening
- change a component or section which supports a mechanical component without the use of a jig bench.
- submit a vehicle positioned on a jig bench to hydraulic force (pull or push) without first correctly anchoring the vehicle.
- change a front or rear section without using all the special supports on a jig bench designed for the vehicle.

CHANGING THE FRONT SECTION



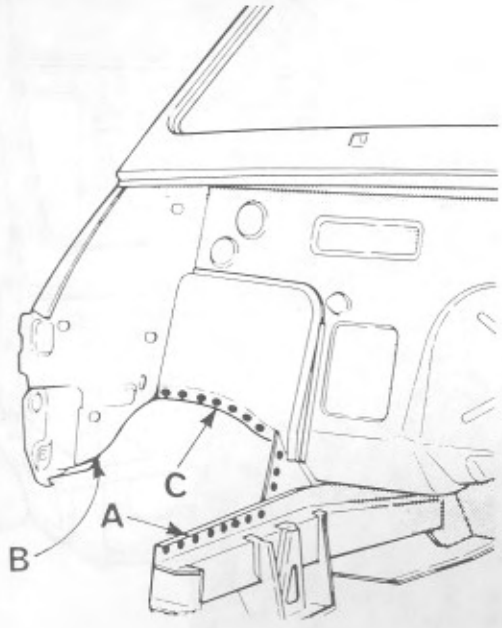


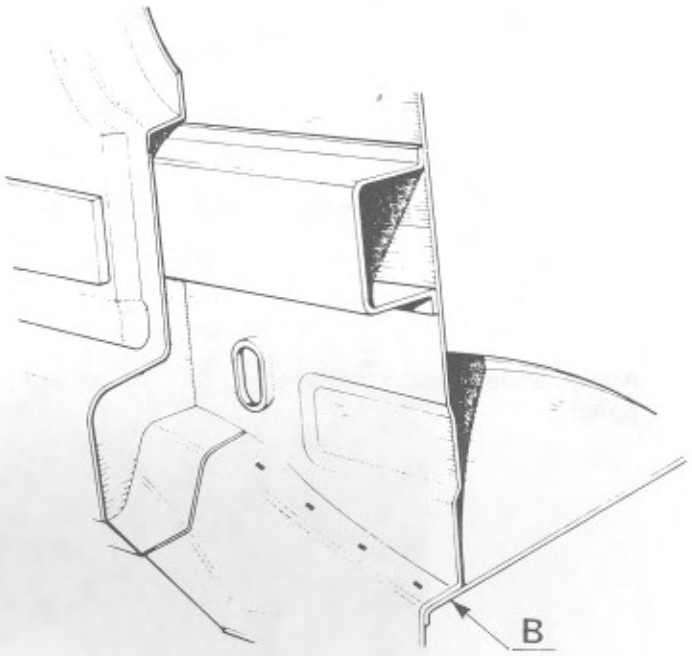


REMOVING:
Chisel cut the inner wing panel at the following joints:

A: Inner wing panel - sidemember,
B: Inner wing panel - pillar lining,
C: Inner wing panel - scuttle.

Then separate the spotwelds at these joints.





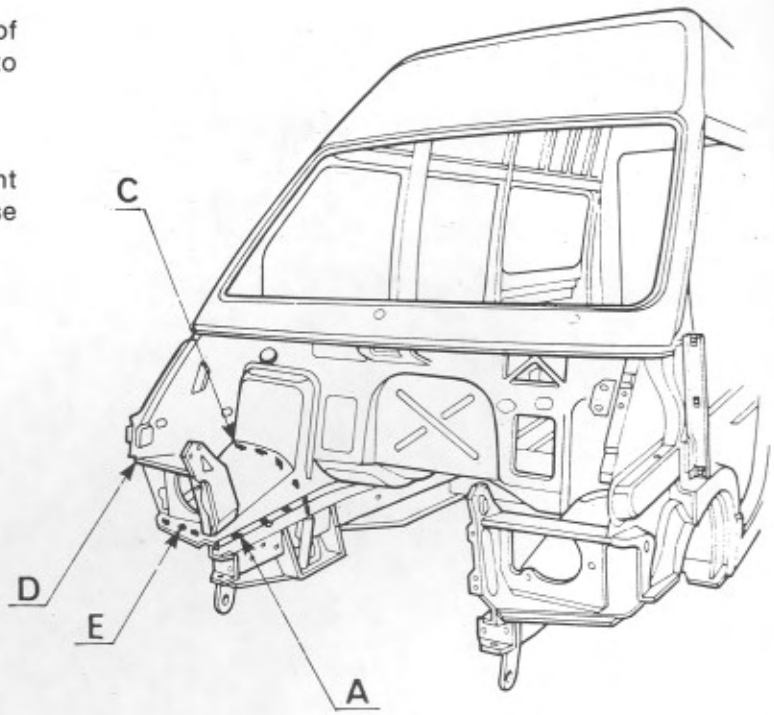
CHANGING THE FRONT SECTION

PREPARATION

After grinding the joints smooth, apply a coat of plastic filler or zinc-based paint to the new panel to prevent rust forming.

REFITTING

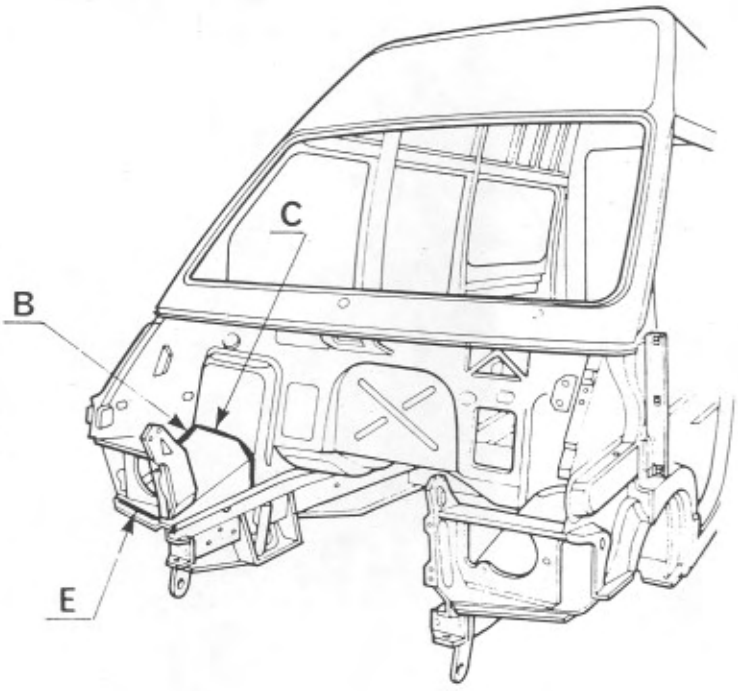
Mount and align the new inner wing panel front section followed by the headlight panel. Hold these panels with vice-grips.



Spotweld the following joints:
- A : Sidemember - inner wing panel
- B : Inner wing panel - pillar lining
- D : Headlight panel - pillar lining
- E : Headlight panel - pillar lining

Seam braze:

- C : Inner wing panel - scuttle.

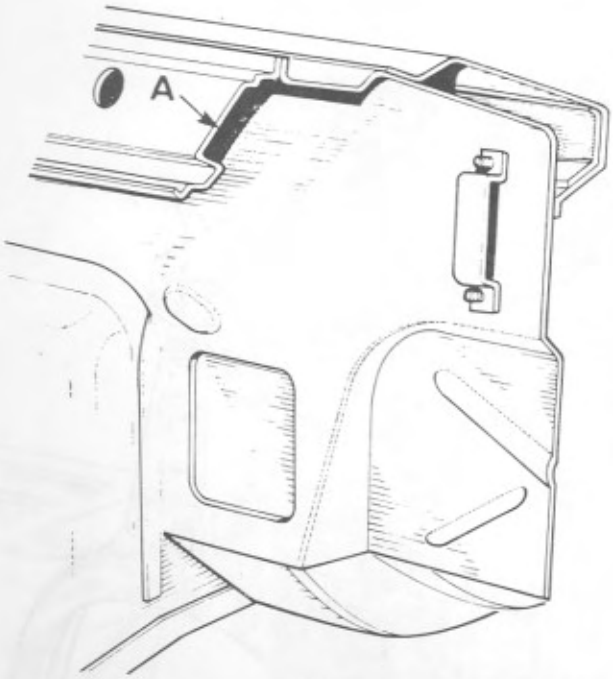


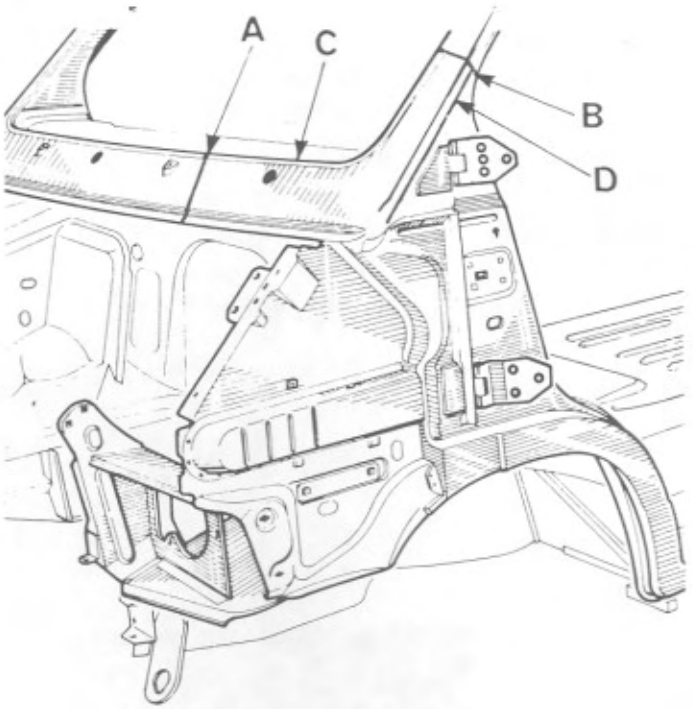
Apply strips of SC4 sealer to the following joints:

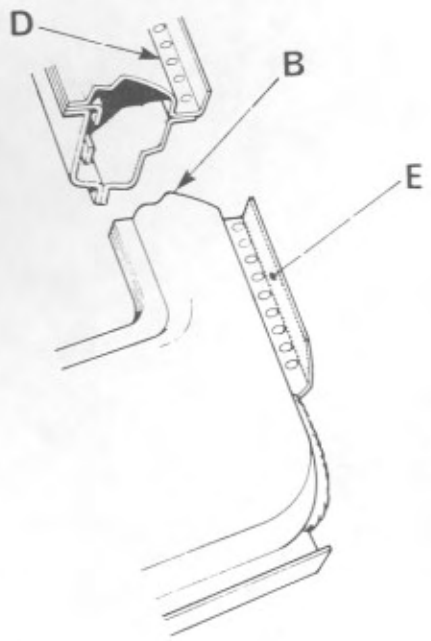
- B : Pillar lining - inner wing panel
- C : Inner wing panel - scuttle side section
- E : Headlight panel - inner wing panel.

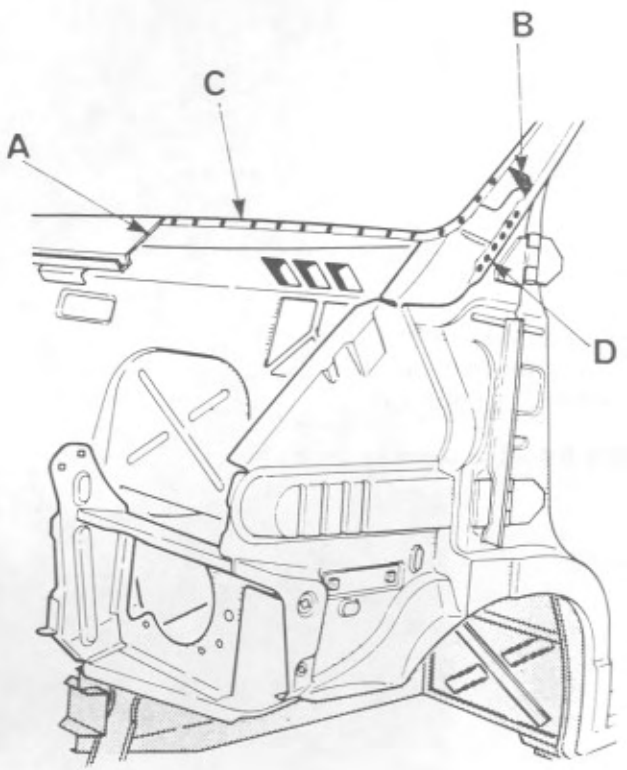
Apply undercoating material to the inner wing panel.

PART REPLACEMENT
SCUTTLE PANEL









REMOVING:
Saw cut the scuttle panel (A) and the pillar at (B).

Chisel cut the scuttle panel at the following joints:

C: scuttle panel - scuttle top section,
D: scuttle panel - front pillar.

Snip off the rain channel flange (E) leaving the welded seam in position.

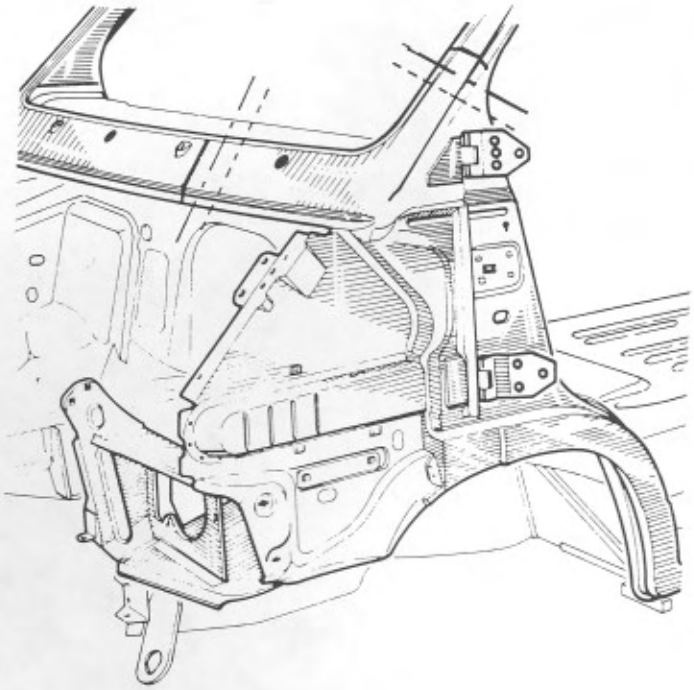
Because of the large number of spotwelds in this area, the lining will tend to distort.

PART REPLACEMENT
SCUTTLE PANEL

PREPARATION

Cut a section out of a new scuttle panel which is larger than the section it is to replace.

After grinding the joint smooth, apply a coat of plastic filler or zinc based paint to the new panel to prevent rust forming.

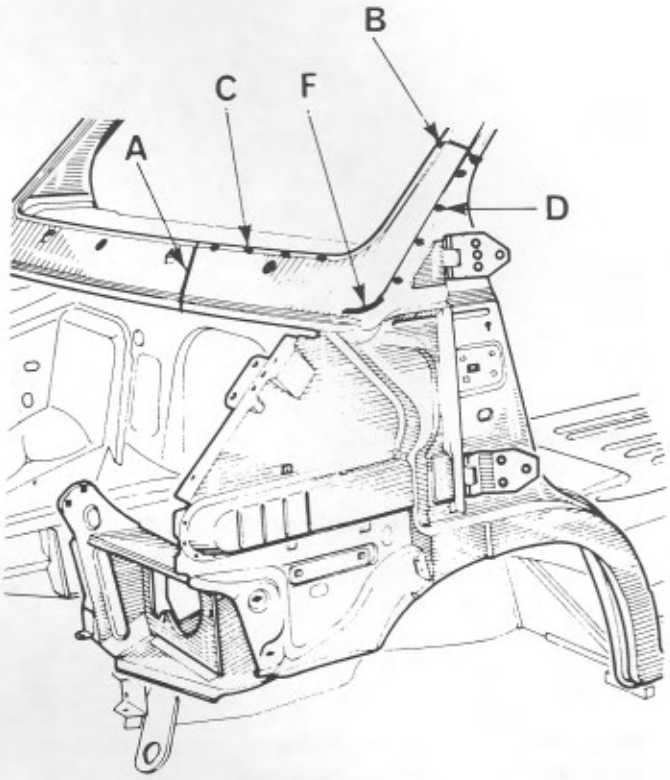


REFITTING

Mount and align the new panel so that it overlaps the section remaining in place.

Sawcut both sections to obtain a butt joint.

_____ *New section*
..... Old section
— — — — — — — — — — — — — — Overlapped section

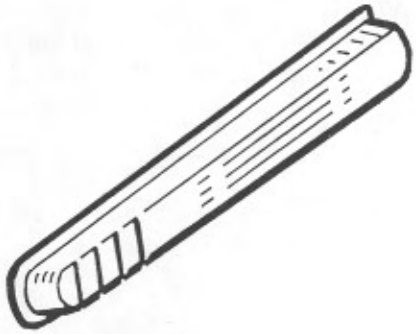


Spotweld the following joints:
- C : scuttle panel - scuttle top section.
- D : scuttle panel - front pillar

Oxy-acetylene or MIG butt weld:
- both panel sections (A) and pillar (B).
- corner (F) where it joins the pillar.

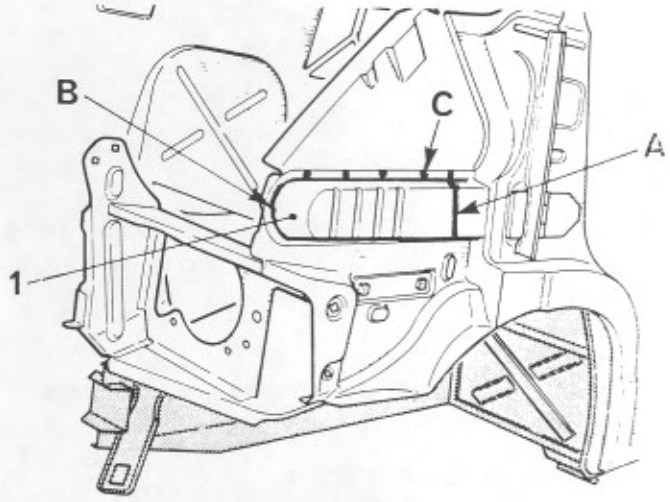
Apply a coat of body solder to the pillar seam.

PART REPLACEMENT
PILLAR LINING STIFFENER



Stiffener (1) is welded to the pillar lining below the pillar and along its full length.

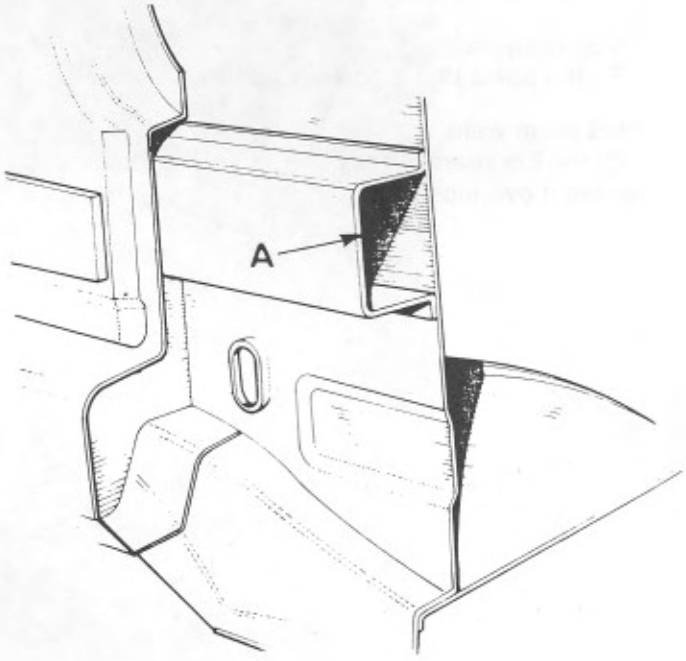
This stiffener may be partly replaced if the impact was at the front.



REMOVING
Saw cut the stiffener at (A).

Chisel cut the stiffener flush with the pillar lining welded seam at (B).

Then separate the spotwelds on the remaining section at (C).



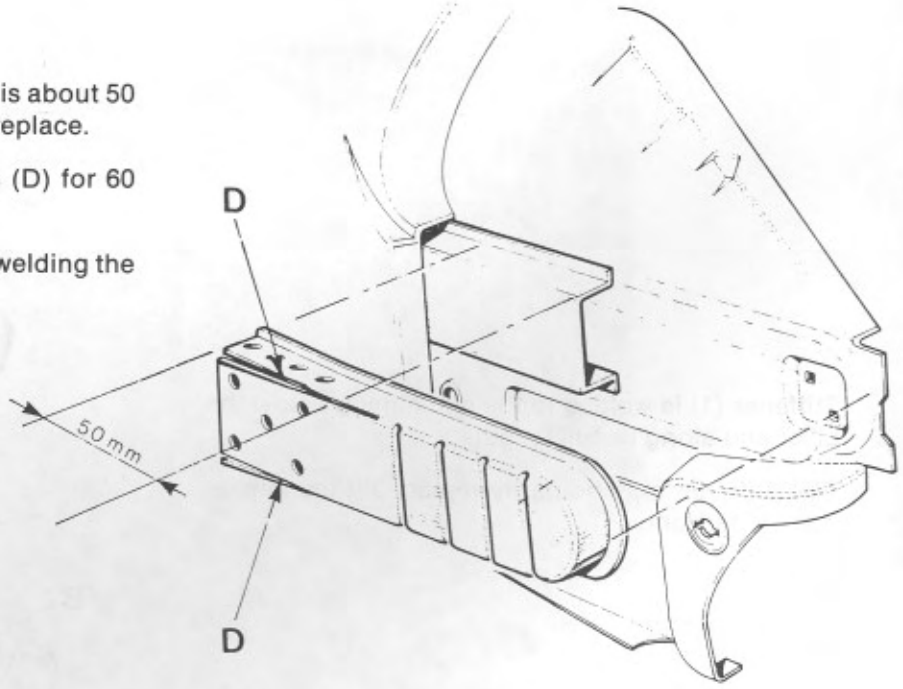
PART REPLACEMENT
PILLAR LINING STIFFENER

PREPARATION

Cut a section out of new stiffener which is about 50 mm (2") longer than the section it is to replace.

Saw cut the new section along corners (D) for 60 mm (2 1/2") so that it overlaps.

Drill a series of 6 mm dia. holes for plug welding the overlapping section.



REFITTING

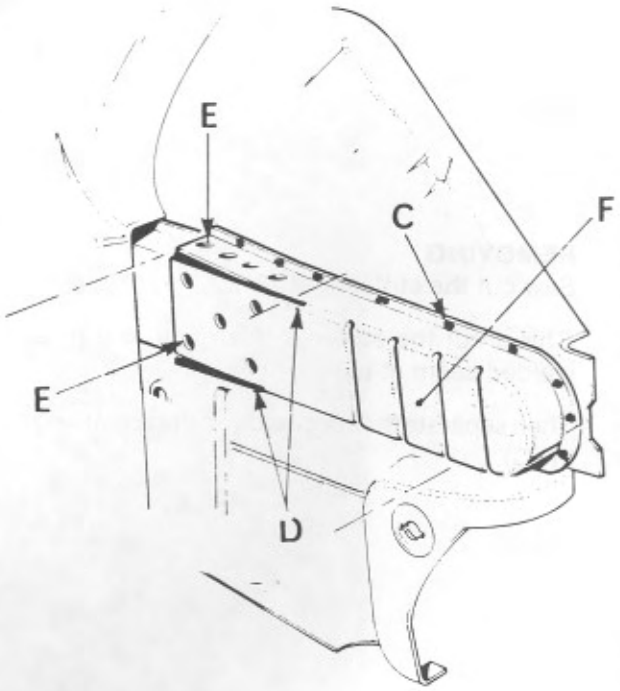
Mount and align the new stiffener section so that it overlaps the section remaining in place.

Spotweld the following joints:

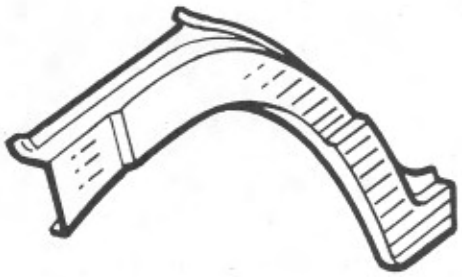
- C : stiffener and pillar lining.

MIG plugweld:
- E : the holes in the new section

MIG seam weld:
- D : the 2 corners (D) and the end of the new section where it overlaps.



COMPLETE REPLACEMENT
FRONT PILLAR BOTTOM



REMOVING

Remove the spotwelds using a cutter at the following joints:

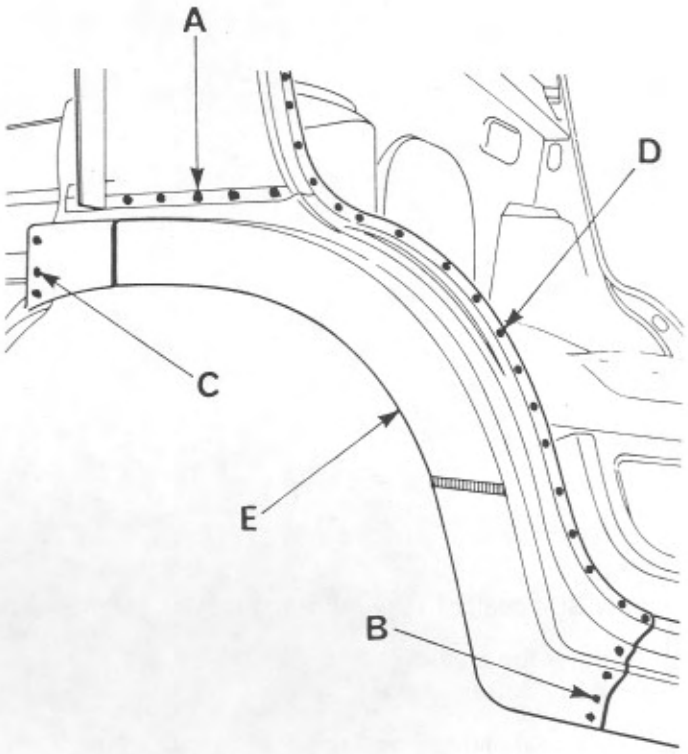
- A : top section
- B : bottom panel

Chisel cut the front pillar bottom section as close as possible to the following joints:

- C : pillar lining
- D : front pillar closure panel

Grind away the front pillar bottom edge (E).

Separate those spotwelds which remain after chisel cutting.



PREPARATION

After grinding the joints smooth, apply a coat of plastic filler or zinc-based paint to the new panel to prevent rust forming.

COMPLETE REPLACEMENT
FRONT PILLAR BOTTOM

REFITTING:
Mount the new bottom section and insert it below the pillar top section.

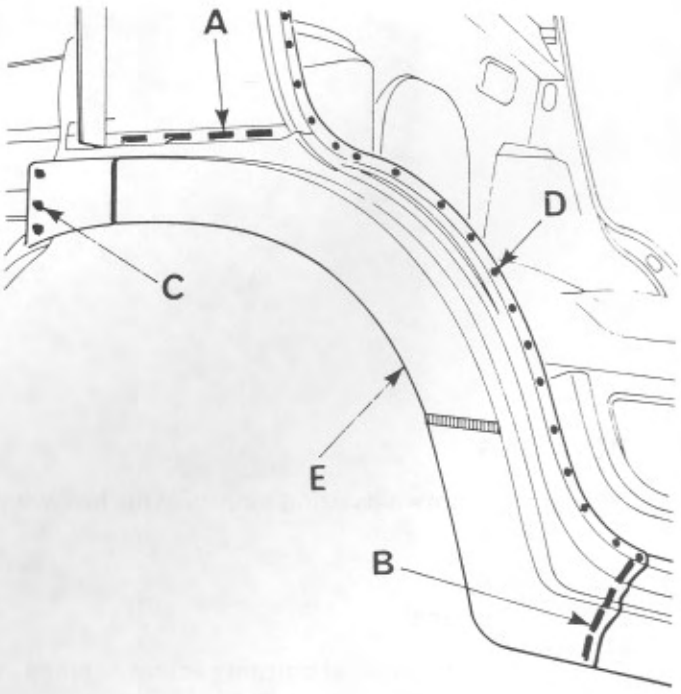
Line it up with the door and wing.

Spotweld the following joints:

- C : pillar lining
- D : front pillar closure panel

Chain weld the following joints:

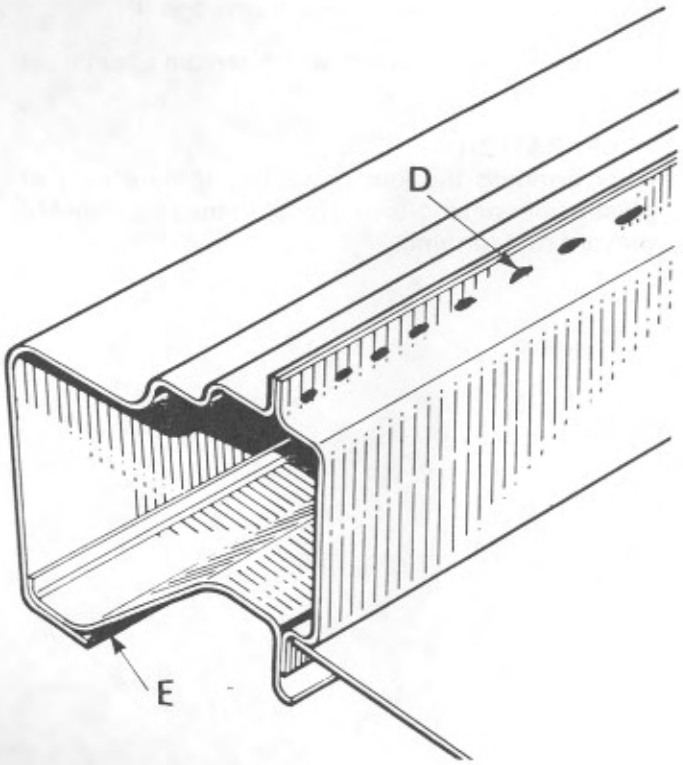
- A : top section
- B : body bottom panel
- E : bottom section lining



Apply SC4 sealer to the following joints:

- A : pillar top section
- B : body bottom panel

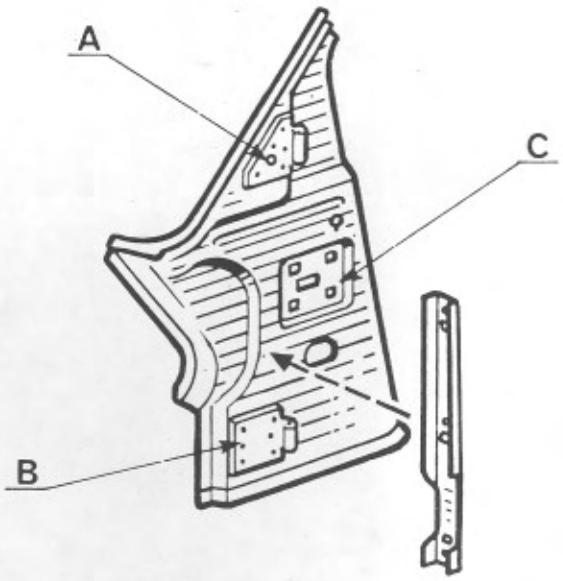
Apply a coat of underbody protective to underneath the front pillar bottom section lining (E).



COMPLETE REPLACEMENT
FRONT PILLAR TOP

Because of the position of the various stiffeners it is not advisable to change only part of the front pillar top section.

- top hinge (A),
- bottom hinge (B),
- door pull (C).



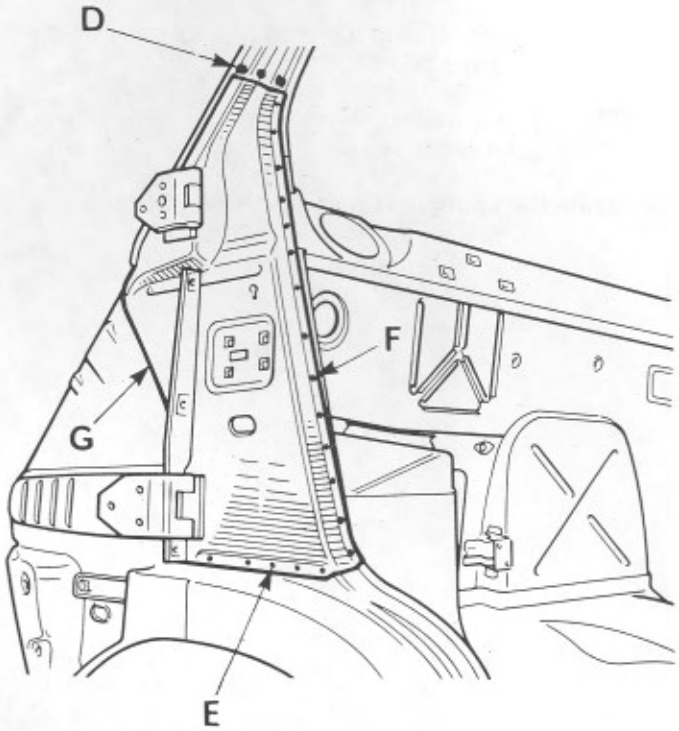
REMOVING

Separate the spotwelds at the following joints using a cutter:

- D : top of body,
- E : front pillar bottom section

Chisel cut the front pillar top section as near as possible to the following joints:

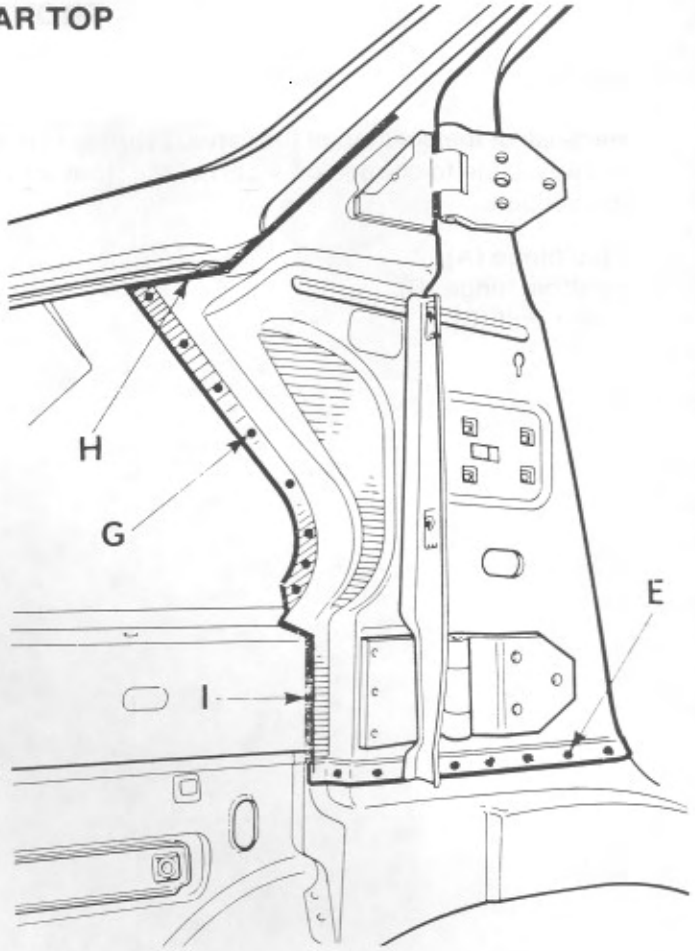
- F and G : pillar lining.



COMPLETE REPLACEMENT

FRONT PILLAR TOP

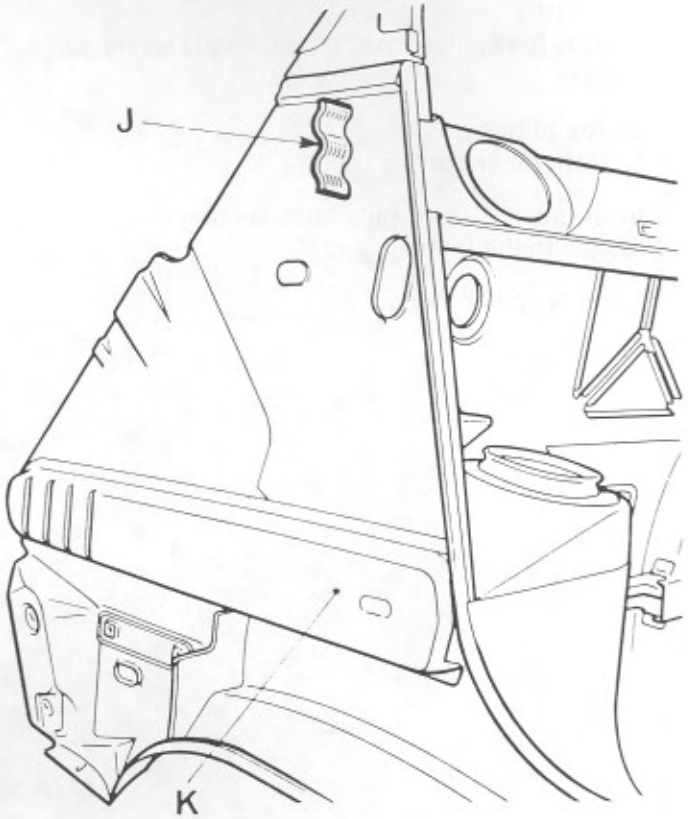
- H : scuttle panel,
- I : front pillar lining stiffener



Cut joint gusset (J) with a pneumatic saw, inserting the blade between the front pillar and lining.

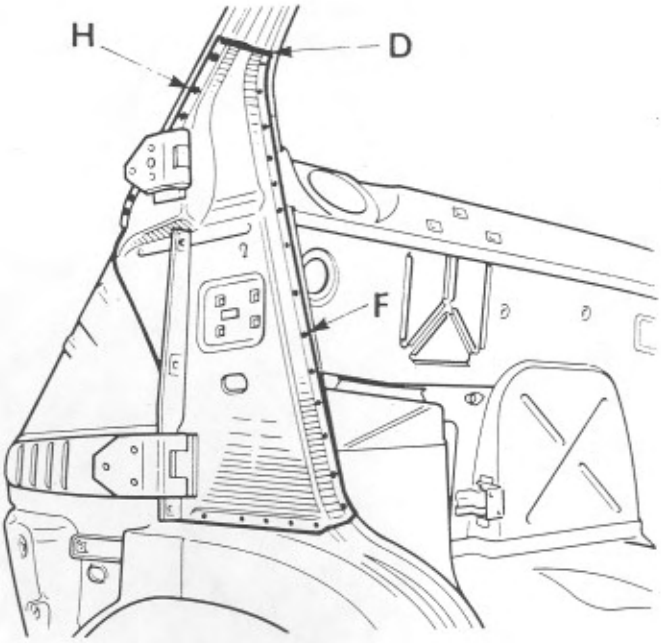
NOTE: Front pillar lining stiffener (K) is not spotwelded to the front pillar top section.

Separate the spotwelds remaining after cutting.



COMPLETE REPLACEMENT
FRONT PILLAR TOP SECTION

PREPARATION
After grinding the joints smooth, apply a coat of plastic filler or zinc-based paint to the new panel to prevent rust forming.



REFITTING
Mount the new section and align it with the door and wing.

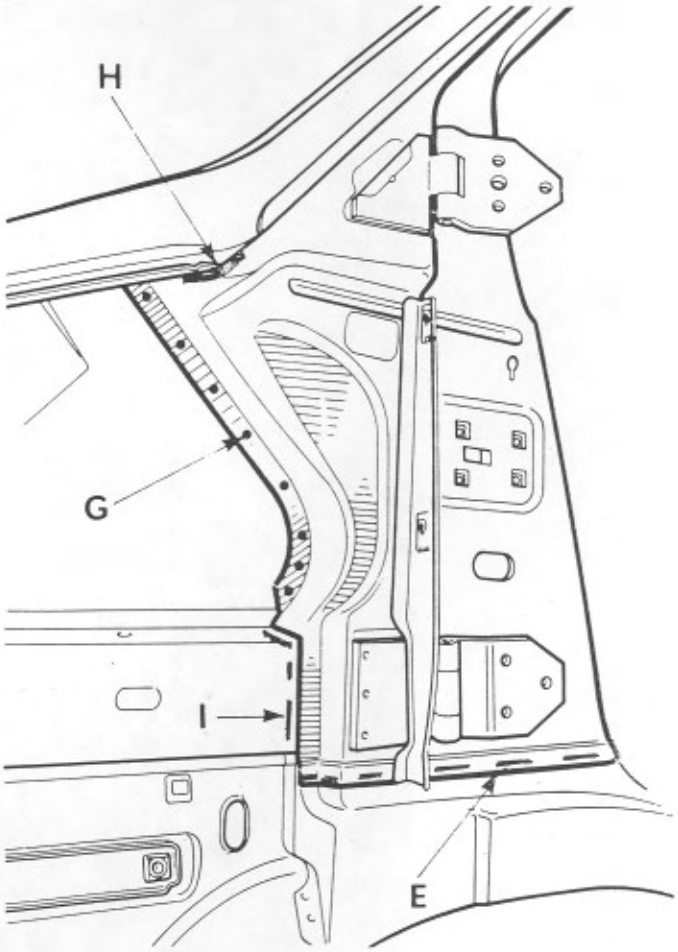
Spotweld the following joints:
- H : scuttle panel
- F and G : pillar lining.

Chain weld the following:

- E : front pillar bottom section
- I : pillar lining stiffener.

Braze seam weld:
- D : Body top.

Oxy-acetylene butt-weld:
- H : scuttle panel.



Apply strips of SC4 sealer to the following joints:

G: pillar lining.
E: front pillar bottom section.
I: pillar lining stiffener.
D: body top

SECTION "S"

FUEL TANK

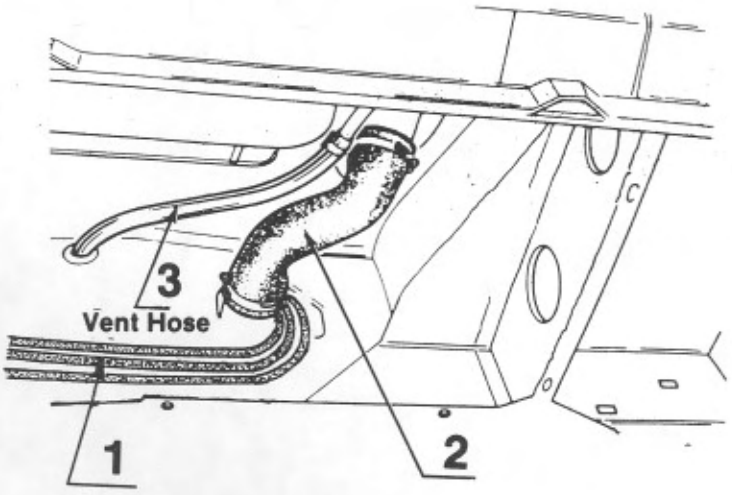
Subsection 1	Specifications
S-1	Remove and Replace
S-2	Sending Unit Remove and Replace*
S-3	Roll Over Valve

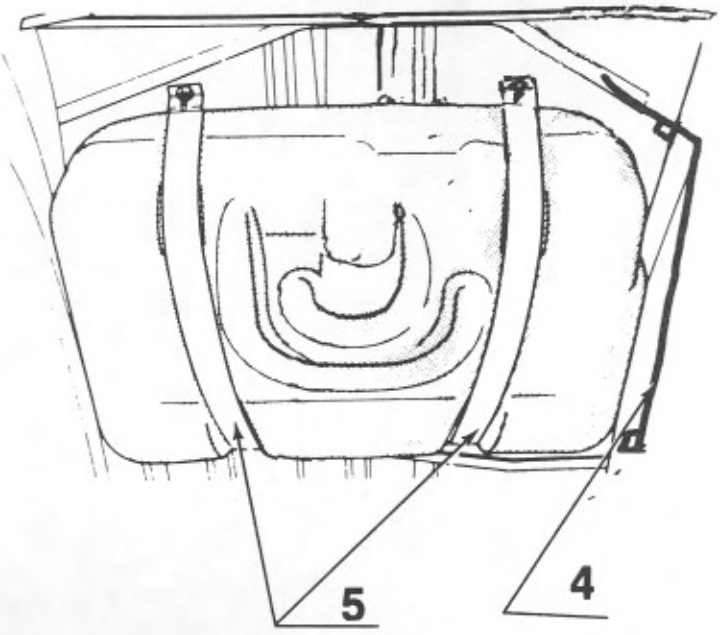
* Fuel gauge sending unit testing - See Electrical Section G2-1

FUEL TANK GAUGE SENDING UNIT
REMOVE AND REPLACE FUEL TANK

Remove Fuel Tank

- Start with a near empty fuel tank or siphon by removing the hose at the frame rail(1) that goes to the injection pump (electrical fuel pump on gasoline units). Create a negative pressure on this hose to start a siphon. Remove the fuel fill cap to allow air for fuel displacement. Fuel must be drained into approved fuel container.
- Disconnect fuel hoses from metal fuel neck (2) and metal lines (3) on the frame rail. Remove vent hose from external roll over valve on the front side of vehicle (when equipped w/external valve).
- Remove exhaust shield on right side of tank (4).
- Disconnect parking brake cable from rod - push rod rearward so it does not interfere with tank removal (Do not misplace or bend the spring at the rear end of the rod.
- Remove fuel tank retaining straps (5).
- Lower the right side of the fuel tank enough to disconnect the fuel sending wires (black wire, ground - orange wire, hot).
- Lower the right side of the tank far enough to pull it out to the right side letting the hoses come with the tank through the holes in the frame rail.

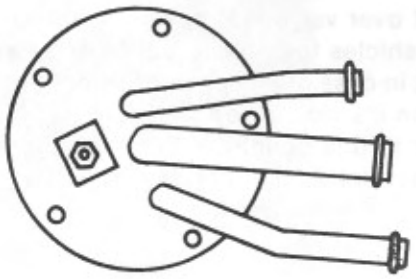




REINSTALL FUEL TANK

- Install in the reverse order of removal being careful not to pinch or crimp any hoses.
- Reconnect parking brake cable and rod making sure rear tension spring is installed
- Check parking brake adjustment.

FUEL TANK GAUGE SENDING UNIT
REMOVE AND REPLACE



SENDING UNIT REMOVAL

- Remove retaining screws
- Pull sender up and out being careful not to bend or alter any of its components.

SENDING UNIT INSTALLATION

- Install new gasket on tank

NOTE: Fuel sender mounting screw holes and gasket have an un-even pattern and can only be installed one way. This is to insure that the sender is always mounted correctly. Make sure the gasket holes align with the sender mount holes.

- Install sender being careful not to bend or alter any of its components.
- Install 4 of the 5 mounting screws - the fifth is for the ground wire when reinstalling the tank assembly in the vehicle.

FUEL TANK GAUGE SENDING UNIT
ROLL OVER VALVE

PURPOSE AND OPERATION OF THE VALVE

The roll over valve is a device installed in all "H-body" vehicles to prevent fuel from escaping from the tank in case of an accident where the vehicle is tipped on it's side or top. A ball in the valve closes the vent in this condition to prevent fuel spillage. Under normal driving conditions, the valve simply functions as a tank vent.



Externally Mounted Valve
Diesel 1983 to Mid-1984

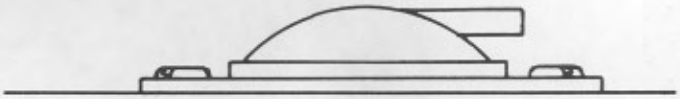
NOTE: The roll over valve will not prevent the tank from being overfilled and is not intended for this purpose. See the vehicle's owner's manual for fuel tank filling procedure.



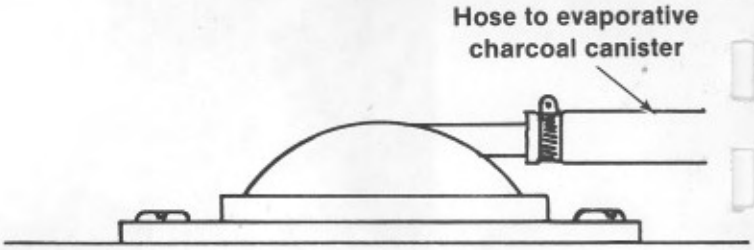
Tank Mounted Valve
Diesel Mid-1984 to Late 1985

WARNING

Do not alter the valve or eliminate it from the system. This is a safety feature and must not be tampered with.



Tank Mounted Valve
Diesel Late 1985 to 1986



Tank Mounted Valve
All Gasoline Vehicles